



INSTRUCTION MANUAL

LPS-800-2 SERIES SAMPLE POWER SUPPLIES
(FOR RESISTIVE HEATERS)

Version 1.2

SERIAL # _____

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WARNING

POWER SUPPLIES FOR SAMPLE HEATING MAY EMPLOY LETHAL VOLTAGES.

PLEASE READ THE MANUAL AND UNDERSTAND IT. DO NOT HESITATE TO CALL US AND ASK QUESTIONS ABOUT THE DEVICE AND PROCEDURES IF REQUIRED.

THIS DEVICE SHOULD BE INSTALLED AND OPERATED ONLY BY PROPERLY QUALIFIED PERSONNEL.

We at Thermionics want you alive and well, using our equipment to achieve your goals. With appropriate care this unit will operate safely and effectively. There is no risk that is worth your life.

WARNING

THIS POWER SUPPLY MAY GENERATE AMPLE VOLTAGE AND CURRENT TO KILL.

ALL PERSONNEL INVOLVED IN ITS INSTALLATION AND OPERATION MUST BE QUALIFIED TO WORK ON AND WITH SUCH EQUIPMENT. ANY USER MUST FIRST BE FAMILIAR WITH THIS MANUAL, IT'S SAFETY WARNINGS, AND HIGH VOLTAGE PROCEDURES IN GENERAL.

DO NOT TAKE SHORT CUTS. PLEASE DO NOT BE IN A HURRY.

EACH and EVERY item in the following list must be strictly followed.

1. The LPS series power supplies do supply high voltage to the heater and/or sample stage. It is imperative the customer establish a good ground between the LPS supply and the chamber housing the heater assembly.
2. Attach a grounding cable (strap) supplied, to the rear of the power supply chassis. This should be hard wired to the chamber which will house the heater. This connection must be made prior to connecting the electrical connector to the vacuum feedthrough. Verify the ground connection with a VOM.
3. INTERLOCK: The rear panel of the power supply has a two conductor, twist lock connector. This interlock enables the heater power to be turned on. This should be connected to a SPST set of contacts that close when the chamber containing the heater is under vacuum. Depending on application, this may be a diaphragm switch, a filament relay on a controller for a hot cathode ion gauge, or other suitable contacts. The contacts must stay open unless vacuum is established in the chamber, and thus preclude human entry and/or oxidation (burning out) of the heater.
4. If most exposed resistive heaters (tungsten filament) are operated at pressures $>10^{-5}$ Torr, the heater will be damaged and the possibility of inadvertent human contact is possible. ****DO NOT ALLOW THIS TO OCCUR****
5. Unplug this supply from the wall and wait at least 1 minute prior to working on the sample area of the manipulator.
6. The power supply operates on 230 VAC, 50/60 Hz. using a 3 prong plug (grounding type). This must be connected to a correctly wired receptacle. IF one is not available, one must be installed.
7. Protect the electrical output cable and connector from moisture. Bag and tape the connector when not in use.
8. Care is especially important around liquid nitrogen. Condensation due to LN2 boil-off can cause corrosion. Thoroughly insulate LN2 lines when they are near the cable or at the connector at the base of the manipulator or at the chamber wall. Do not run the cable on the floor. Mechanical damage or freezing by LN2 may cause failure of the insulation and thus produce a severe safety hazard.
9. Replace any equipment showing damage or misuse.

10. The heater power lines may be exposed in the vacuum chamber. BE CERTAIN to constrain all conductors in the chamber in such a manner as to not allow them to reach other power lines under any condition. IF the TC lines contact the power, significant electrical damage would result to equipment as well as create a PERSONNEL SAFETY HAZARD.
11. IF there is any doubt, verify electrical path to ground with a VOM.
12. Replace any items that may be damaged or worn.
13. Do not open the LPS chassis. There are no user-serviceable components inside. Lethal voltage is exposed inside this chassis. This chassis should only be opened by qualified electronics personnel under proper conditions.
14. Limits of Travel: understand the limits of travel of your device and calibrate the range of operation. Do not do this by feel. Visually watch the operation through a view-port. Forcing the system beyond its capabilities will cause mechanical and electrical damage and may endanger the operator's life. Do not change the position of the heater assembly while the power is on.

Preface

Congratulations! You have purchased a quality vacuum product from Thermionics. This unit is capable of many years of use with minimal care and maintenance. This manual is a tool to aid you in obtaining this service.

We at Thermionics encourage your comments and suggestions on this manual.

Product Description

The LPS series substrate power supplies are a line of power control units especially designed to give the researcher exceptional operational control of the sample temperature while maximizing the life of the heater filament. Depending on the options selected, this is accomplished by providing:

- PID microprocessor based controller
- True proportional output
- Adjustable peak power output control
- Adjustable minimum power output

This model LPS-800-2 supply provides up to 10 amps DC current, at up to 100 VDC. Do not operate this supply at higher parameters.

Unpacking

All LPS models are shipped with custom foam-in-place packing. We have found this the only system to provide adequate protection for shipment. The foam is separated approximately halfway inside the box with thin blue plastic. We recommend the packing box with packing be saved for possible future shipment or equipment storage.

Mounting

Due to the weight, LPS series power supplies require full support from under the chassis. When rack mounting, utilize shelves or support angles that fully support the sides of the chassis from underneath.

Controls, Fuses, Meters and Adjustments

The following is a list of controls found on some or all the LPS supply.

FRONT PANEL:

AC POWER SWITCH: Rocker type. Controls all power to the chassis. The on/off switch includes an integral dual circuit breaker with a 10 amp capacity.

OUTPUT SWITCH, ILLUMINATED:

Disconnects all power to the output transformer.

TEMPERATURE CONTROLLER:

Refer to controller manual. This power supply may be provided with various brands and models of controllers depending upon the requirements of the

customer. We find the best and most accurate source of instructions for each controller is to check the website of the controller manufacturer and refer to the specific model's information.

MODE SWITCH (MANUAL/AUTOMATIC), (GUARDED):

Determines if the supply output is adjusted manually or is controlled by the PID controller. In manual mode, the PID controller does not have any influence on the power being supplied to the heater. In automatic mode, the PID controller controls the power level being supplied to the heater. In all cases, the Maximum Output knob limits the power the supply will deliver to the heater.

MANUAL OUTPUT ADJUSTMENT KNOB, 10 TURN

Controls the output manually when in manual mode. This knob setting has no influence when in "automatic" mode.

MAXIMUM OUTPUT ADJUSTMENT KNOB, 10 TURN:

Adjusts maximum power output, whether in manual or automatic operation mode. This must be set correctly as not to burn out filament assembly or overdrive components.

DIGITAL METERS (WITH ANALOG DISPLAY)

Voltage

Indicates the voltage being supplied to the heater. The meter face will turn red when 100 VDC is exceeded.

Current

Indicates the current being supplied to the heater. The meter face will turn red if the capacity of the supply is exceeded (10 amps maximum). The output circuit low (negative) side is connected to chassis ground.

NOTE:

The current is measured via a shunt on the return (negative) line from the heater, as required by the metering system. Because of this, an internal short inside the chamber between the heater or return conductor and ground will cause the current meter to read incorrectly and thus not indicate the short condition. If 10 amps is exceeded the rear panel fuse will blow.

Do not operate this supply with > 100 volts or >10 amps of current indicated.

AUX. THERMOCOUPLE READOUT

Provided to allow monitoring of secondary or reference temperature.

BACK PANEL

FUSE

Fuses the current to the sample heater. Provided with a 10 amp fuse.

VALUBLE NOTE:

Operational human errors can happen and even quality electronic components can fail. Once the maximum safe power (and thus current) setting is established for your heater, and the Maximum Output knob is adjusted and locked, we recommend you replace this 10 amp fuse. Choose a current value under 10 amps and just above the required current for your full operation. By doing this, if there is a operational failure, your heater will be protected.

AC INPUT:

230VAC 50/60 Hz required. This unit can be operated at 208 VAC but reduced capacity may be noted.

THERMOCOUPLE INPUTS:

Type "K" thermocouple connection to PID controllers
Aux thermocouple input (type "K") for operator reference

RS232 INPUT:

To PID controller

Pin 2 = PID controller HE
Pin 3 = PID controller HF
Pin 7 = PID controller HD

INTERLOCK:

Required for operation (see warnings, page 2 and page 9).

OUTPUT:

The output cable fitted with Thermionics standard FHV.5-133-2/con connector to fit Thermionics FHV.5-133-2/S high vacuum electrical feedthrough. The positive conductor is fused at the rear of the chassis and negative conductor is grounded through a current shunt.

GROUND STUD:

¼-20 thread
Ground to chamber

Connections

The following connections are made on the back panel, and must be attached to the appropriate circuits prior to operation. Be sure the main AC power switch is off before connecting the power cord to the 230 VAC supply outlet.

GROUNDING CABLE/STRAP:

Attach a grounding cable (strap) supplied, to the rear of the power supply chassis. This must be hard wired to the chamber which will house the heater. This connection must be made prior to connecting the electrical connectors to the vacuum feedthroughs. Verify the ground connection with a VOM.

AC INPUT:

Power cord supplied without end connector for export applications. Customer must fit correct grounding connector for their application.

OUTPUT:

15 ft. Output cable included. This cable is terminated with a Thermionics standard FHV.5-133-2/con connector to fit Thermionics FHV.5-133-2/S high vacuum electrical feedthrough. Do not route this cable on the floor.

THERMOCOUPLE 1: (to PID controller) Type “K” thermocouple input; 15 ft. Type “K” thermocouple cable included.

THERMOCOUPLE 2: (Auxiliary thermocouple meter) Type “K” thermocouple input; 15 ft. Type “K” thermocouple cable included.

INTERLOCK:

The rear panel of the power supply has a two conductor , twist lock connector. This interlock enables the heater power to be turned on. This should be connected to a SPST set of contacts that close when the chamber containing the heater is under vacuum. Depending on application, this may be a diaphragm switch, a filament relay on a controller for a hot cathode ion gauge, or other suitable contacts. The contacts must stay open unless vacuum is established in the chamber, and thus preclude human entry and/or burning out the heater.

NOTE:

During operation, if the interlock circuit is interrupted, the output power will shut down, but a few volts of power may continue to the heater, depending on the operational settings. This is caused by a small leakage current through the SSR when turned off and is normal. chamber

Operation

MAKE CONNECTIONS:

1. Connect the ground strap from the chassis to the chamber.
2. Connect the thermocouple cable to the reference thermocouple on your sample or near your heater.
3. Connect the aux thermocouple readout as desired.
4. Connect the output power cable to the heater feedthrough on your chamber. Do not run any cables on the floor.
5. Connect the interlock connection to protect from powering the heater without vacuum in the chamber (see warnings, page 2)
6. DO not connect the power cable to the power source at this time.

Before turning on the AC switch, high vacuum ($<10^{-5}$ Torr) should be established in the chamber and the controls should be set as follows:

AC switch: Off

Output switch: Off

Manual Output: set to minimum (counter-clockwise)

Maximum Output: set to minimum (counter-clockwise)

Manual/Automatic switch: switch to manual

Now, Plug in the AC power cable to the power source.

TASK 1: Set maximum power output for your application.

1. Turn on AC switch. The controller should light and indicate the sample temperature.
2. Turn on output switch. No current or voltage should indicate.
3. Turn Manual output knob clockwise to maximum. No current or voltage should indicate.
4. Slowly turn the maximum knob clockwise. Current and voltage will indicate on the meters and the temperature will increase and be displayed on the PID controller.
5. Continue to increase the maximum output knob until the maximum current or temperature you wish to operate is achieved. Lock this knob. At this point, consider turning off the supply and changing the value of the output fuse as outlined on page 7.
6. Turn down the Manual Knob to lower temperature.

TASK 2: Operate heater in automatic mode

WARNING: MAXIMUM OUTPUT MUST BE CORRECTLY SET BEFORE ATTEMPTING AUTOMATIC OPERATION!

NOTE:

First, read the controller manual for its proper operation. The controller is a true proportional type and a number of tuning values should be set for best operation. These values are dependent upon on your operating temperature and the thermal properties of your heater and assembly.

We supply different types of temperature controllers depending upon the parameters requested by the user. Most are supplied with an "auto-tune" self-tuning capacity. Refer to the controller manual for proper "auto- tune" operation.

If you are manually tuning the temperature controller, we suggest the following settings for initial operation:

Proportional Band ("Pb"): 20
Integral Time ("ti"): 10
Derivative Time ("td"): 5

1. Set the controller to a desired temperature higher than the current indicated temperature. The output indicator "OPT" should illuminate.
2. Switch the Automatic/Manual switch to Automatic.
3. The PID will apply power to achieve the requested temperature. Temperature overshoot and oscillation should be expected until the controller is tuned (see " auto-tune" function of the PID controller in the controller manual)

Proceed to operate.

We at Thermionics have a large stake in your new equipment operating up to your expectations. If you experience difficulty with this unit, or any other aspect of your endeavor where our experience might be of value, we want to hear from you. We want to be part of your success.

Included reference:

“Red Lion” thermocouple meter manual