Filament Power Supply

Version 2.3

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1.0 Packing List

1.1 Packing List for Filament Power Supply

The Filament Power Supply is shipped with the following items:

Table 1. Filament Power Supply

Quantity	Part Number	Description
1	PDS1_FILS_100W_01	Filament Power Supply
1	CABL_OPTX_7B3_10FT_01	Filament Cable
1	CABL_POW_110AC_10FT	Universal AC power cable for US use, 10 feet long
1	PDS1_FILS_100W_01_MAN	Filament Power Supply Operators Manual

2.0 Product Identification

In all communication with Ardara Technologies, please specify the Ardara Technologies part number for the power supply from your original purchase order.

3.0 Scope of Manual

This manual applies to the Ardara Technologies Filament Power Supplies identified with “Ardara” in the upper left hand corner and “Filament Power Supply” in the lower right hand corner of the box’s front panel.

This document is valid as of the date of publication. We reserve the right to make technical changes to the design. As this design of the Filament Power Supply is customizable, please refer to configuration document.

4.0 Intended Use

The Ardara Technologies Filament Power Supply was designed to provide stable emission-regulated electron current from a heated filament for use with electron impact ionizers such as Ardara Technologies’ Axial Molecular Beam Ionizer and Cross Beam Ionizer.

5.0 Safety

This Filament Power Supply is capable of generating lethal voltages. Care must be taken to ensure safety in use

5.1 Input Power

This Filament power supply is equipped with a universal input AC power connection, which requires that the power cord ground connection be connected to earth ground through a properly wired AC outlet to ensure safe operation. The use of a 'ground isolator' or similar device is prohibited for safe operation.

The AC power input is compatible with worldwide AC power, from 100 to 240 VAC, 50-60 Hz and 600 Watts.

5.2 Custom Output Connections

Use only approved high voltage cables and connectors, which are rated to the voltages in use.

It is often the case that this Filament power supply is used to replace another in an existing application. Be sure to review the voltage ratings of the cables and vacuum feedthrus in use to verify compatibility with high voltages possible from this Filament supply.

5.3 Vacuum Pressure Considerations

The Ardara Filament Power Supply is often used to power pressurized ionizers. One challenge to operating pressurized high voltage devices is the impact of gas pressure on the voltage discharge limit.

At high vacuum (10^{-5} torr and below) and at atmospheric pressure and above, devices can tolerate quite high voltage gradients with very small electrode gaps.

However, for intermediate pressures (10^{-2} torr to 1 torr), the tolerance to high voltage gradients is dramatically reduced, resulting in discharges (i.e. glow discharge) which can damage the device as well as damage the power supplies driving it. This phenomenon is described in the literature using the Paschen Curve.

In addition, for the safety of the Ion Source, it is important to allow the filament to cool before returning it to atmospheric pressure. At pressures of 10^{-4} torr and higher the rapid exposure of a hot filament to air will oxidize the filament wire, reducing the life of the filament and increasing the likelihood of breaking the fine filament wire.

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6.0 Liability and Warranty

Ardara Technologies assumes no liability and the warranty becomes null and void if the end user or third parties:

- Disregard the information in this manual
- Use the product in a non-conforming manner
- Make any kind of changes (modifications, alterations, etc.) to the Filament Power Supply.
- Use the product with accessories not listed in the corresponding product documentation

7.0 Product Overview

7.1 Summary

The Ardara Technologies Filament Power Supply was designed to provide stable emission-regulated electron current from a heated filament for use with electron impact ionizers such as Ardara Technologies' Axial Molecular Beam Ionizer and Cross Beam Ionizer.

Ardara's Filament power supply is conveniently designed to install into a standard 19-inch (48.25 cm) instrument rack, allowing for adequate ventilation.

The power supply has a Universal AC input of 100-240 VAC, 50-60 Hz.

The system is rated up to 100-Watt output with up to ten amperes filament current with up to ten volts across the filament. Filament current limit is adjustable through the front panel potentiometer.

The Ion Region power supply can be adjusted from –200V to +200V via the front panel potentiometer. The Ion Region power supply is also the main reference for all other supplies in the device. By floating the filament and focusing supplies on the Ion Region, all of the power supplies are referenced individually to the same common point. Since all the supplies are reference to the Ion Region, the ion energy can be found by simply monitoring the Ion Region potential. Additionally, this allows broad adjustments of the Ion Region to be made without the need to adjust other focusing potentials.

The main reference can be switched via the back panel switch labeled Electron Energy Reference. The electron energy can have a reference point of either ground or the ion region voltage. The front panel will not show the difference, only the output will reflect the reference point.

The Filament power supply Electron Energy can be adjusted from -200V to +200V electron energy relative to the ion region potential via front panel controls.

Emission current controls are accessible on the front panel potentiometer to 5 mA. Emission current is regulated as electron current leaving the filament circuit traveling to the ion region circuit.

Front Panel Display shows the readings of the internal Voltmeter. Selector switch adjusts display readout between actual Ion Region potential, relative Electron Energy, and Emission Current.

Front panel filament On/Off switch enables the emission current; when emission is off the electron energy supply is still enabled.

LED's indicate if the filament is enabled and filament failure states.

External command inputs can be implemented through the use of the DB25 connector on the back panel. Toggling the front panel switch from Manual to Computer enables the external control, via the back panel connection, of the Ion Region Potential, Electron Energy, Emission Current, and Emission Enable.

- Ion Region Potential is varied by a command voltage of +/- 10 V and yields +/- 200 V output.
- Electron Energy is varied by a command voltage of +/- 10 V and yields +/- 200 V output.
- Emission Current command voltage ranges from 0 V to +10 V, and yields 0 mA to 5 mA emission current.
- The Emission Enable command is switched On/Off via TTL where the Lo is Off.
- The Front Panel Meter is also controlled via the Readback Bits (TTL). With all at their Lo state (ground) the meter will read the Ion Region voltage. With bit 0 at the Hi state and the rest at Lo, the meter will read the Electron Energy. With bit 1 at the Hi state and the rest at Lo, the meter will read the Emission Current.

7.2 Front Panel Display

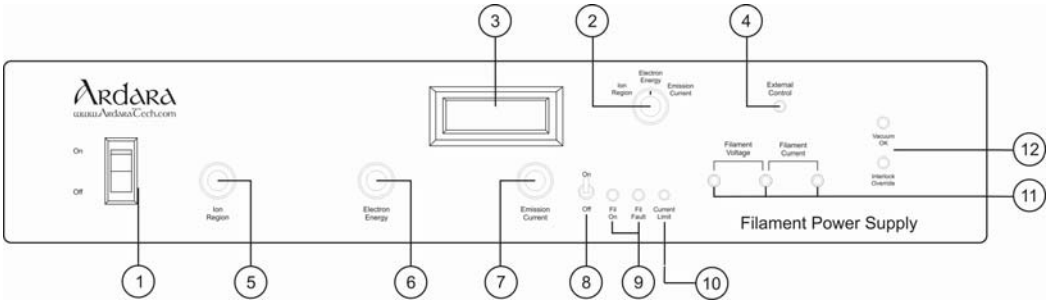

Figure 1. Front Panel Controls for Filament Power Supply

Table 1. Filament Power Supply Front Panel Controls

Balloon Number	Function	Description
1	On / Off Power Switch	Lighted power switch that enables AC power for the Optics power supply and also serves as a circuit breaker.
2	Voltmeter Selector Switch	Selects between actual Ion Region Potential, Electron Energy, and Emission Current to be displayed on the Voltage Display.
3	Voltage Display	Displays actual output voltage of the selected output.
4	Computer Mode LED	LED lights when system is in Computer Mode.
5	Ion Region Adjustment	Commands Ion Region, via front panel potentiometer, from –100V to +100V.
6	Electron Energy Adjustment	Commands Electron Energy, via front panel potentiometer, from 15 eV to 100 eV.
7	Emission Current Adjustment	Commands Emission Current, via front panel potentiometer, from 0 mA to 5 mA. Emission current is regulated as the electron current leaving the filament circuit and traveling to the Ion Region circuit.
8	Filament Switch	Enables emission current through the filament.
9	Filament Status LEDs	Lit LED's indicate filament enabled and filament failure states.
10	Current Limit Adjustment	Adjust the maximum allowable current through the filament
11	Filament Read Backs	Test port, which allows easy access of the filament voltage and current reading by Multimeter.
12	Vacuum Interlock LEDs	Lit LEDs indicate if Vacuum OK has a contact closure through the Vacuum Interlock DB9 and if the Vacuum Interlock switch is set to Interlock Override.

7.3 Rear Panel Display

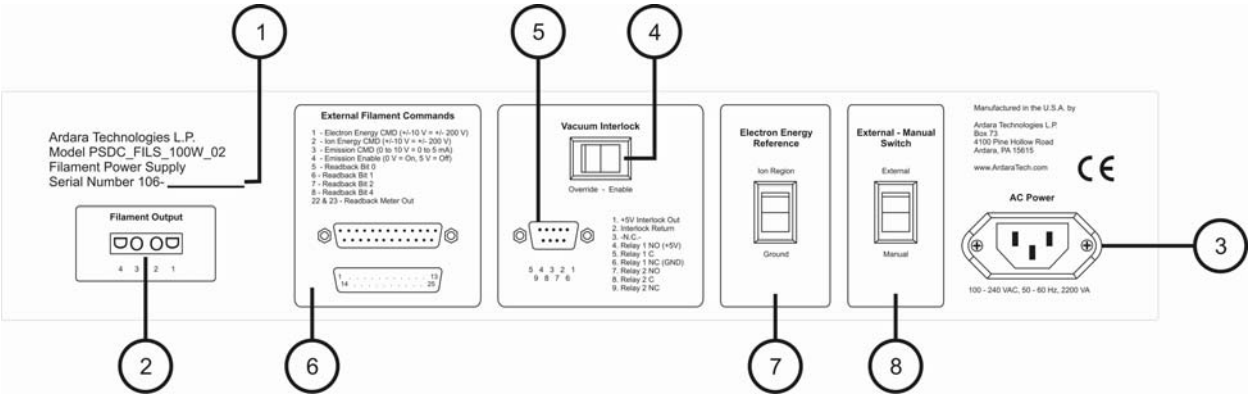

Figure 2. Rear Panel Controls for Filament Power Supply

Table 4. Filament Power Supply Front Panel Controls

Balloon Number	Function	Description
1	Serial Number	Ardara Technologies serial number of Optics Power Supply
2	Optics Output	4 pin AMP connector Pin 1 is the output for Filament (+). Pin 3 is the output for Filament (-). Pin 4 is the output for Ion Region.
3	Universal AC Power Input	100 to 240 VAC, 60 Hz universal power input.
4	Vacuum Interlock Enable	Controls whether the vacuum interlock feature is enabled. When set to 'Override', the high voltage output is always enabled when AC power is turned on. When set to 'Enable', the high voltage output is enabled only when +5 interlock voltage is presented to pin 2 of the Vacuum Interlock Connector via contact closure on an ion gauge.

5	Vacuum Interlock Connector	Female DB9 input that allows external enabling and disabling of the high voltage output. Enables or disables the high voltage output depending on whether there is +5 volts presented to pin 2 from an outside source. For convenience, a +5 volt source is provided on pin 1, suitable for use with an ion gauge controller which has a contact closure output when a suitable pressure is established. A +5V signal present at pin 2 energizes two relays (#1, and #2) The Optics supply utilizes relay #1 internally, with pins 4, 5, and 6 available for diagnostics purposes. Relay #2 is available to echo the contact closure status, allowing the unit to daisy chain the vacuum interlock contact closure to other devices. The vacuum interlock relays used in this device support DC operation to 24 volts.
6	External Control Input	Female DB25 input that allows the control and readback of filament voltages. Pin 1 commands Electron Energy (+/-10 V = +/- 200 V). Pin 2 commands Ion Energy (+/-10 V = +/- 200 V). Pin 3 commands Emission Current (0 to 10 V = 0 to 5 mA). Pin 4 commands Emission Enable (0 V = On, 5 V = Off). Pin 5 provides Readback Bit 0. Pin 6 provides Readback Bit 1. Pin 7 provides Readback Bit 2. Pin 8 provides Readback Bit 4. Pins 22 and 23 provide the readback for the Meter Input
7	Electron Energy Reference	Switch that allows the electron energy to be either referenced to ground or the ion region voltage. Only the output will reflect the selection.
8	External – Manual Switch	Switch that allows the power supply to be either manually controlled (front panel potentiometers) or externally controlled through the Extrenal Control Input. While in External Control all commands must be controlled.

8.0 Installation

8.1 Installing the Filament Power Supply

Installation of the Filament Power Supply onto an Ionization system requires the following:

- Do not obstruct the airflow around the Filament Power Supply.
- Do not operate the Filament Power Supply in an environment that is subject to dust, high humidity, or mechanical vibrations.
- The Filament power supply is designed to be mounting onto a 19-inch instrument rack, with adequate ventilation to the rear. The chassis of the controller must be properly connected to the mains ground, through mechanical fasteners.

8.2 Electrical Connections

8.2.1 AC Power Input

The Filament power supply box is connected to ground via the ground connection in the three-pronged AC power cable.

- It is not safe to operate the Filament power supply using a 'ground isolator' or three-prong to two-prong converter.
- Use only approved high voltage cables and connectors, which are rated to the maximum output voltage of the Filament power supply.
- Make all filament connections with the Filament Power Supply turned off

8.2.2 External Filament Output

The Filament Power Supply output is rated up to 100 Watts, with a max of 10 Amps of filament current and up to 10 V across the filament.

Ion Region power supply is full adjustable from –100V to +100V.

Electron Energy is factory configured to range from 15 to 100 eV, with Emission current control from 0 mA to 5 mA.

8.2.3 External Control Input

The Filament (both positive and negative) and Ion Region can be controlled via the DB-15 connector, labeled J1, on the back panel. When the "Computer" mode is selected by toggling the front panel switch, all operating parameters must be supplied by computer control.

8.2.4 Vacuum Interlock

The vacuum interlock feature needs a contact closure between pin 1 and 2 of the back panel female DB9 vacuum interlock connector. The contact closure from an ionization gauge controller would provide an ideal mechanism for the feature.

9.0 Commissioning

9.1 Initial Operation

- Set the filament switch to off, turn the Voltage Display to Electron Energy, and rotate all controller knobs to full counterclockwise.
- Attach the AC power cable to the connector on the back panel.
- Turn on the main power to the Filament Power Supply. The Voltage Display should display –15 VDC +/- 1.0 VDC. The red "Fil Fault" LED should be lit.
- Rotate the Electron Energy control to full clockwise. The Voltage Display should move smoothly to –100 VDC +/- 5 VDC.
- Set the Voltage Display to Ion Region. With the Ion Region Control at full counterclockwise, the display should read –100 VDC.
- Adjust the Ion Region to full clockwise position, the display will read +100VDC.
- Toggle the Computer Mode Switch to "Computer". The red LED will light to the left of the switch. The Voltage Display will read 0 +/- 15 VDC. The meter value will float at a given value, if no computer command is received.
- Return the Computer Mode Switch to "Manual" and power down. The Filament Power Supply can now be connected to the Ion Source.

9.2 Connecting to the Ion Source

- First insure that all Ion Source Connections are free from inter element and system common shorts.
- Attach the connections for the outputs in the rear panel to the connectors on the Ion Source. As an added safety precaution the Filament Power Supply can operate as a ground-based device. To enable this option, connect a wire jumper between the J2 and J3 terminals.
- Once all connections are made, power on the Filament Power Supply. Adjust the Election Energy to –70 VDC and the Ion Region to +10 VDC. (This is a general tuning parameter that will allow the immediate formation and extraction of ions. Once it is determined that ions are being emitted, the tuning parameters can be adjusted to suit the users individual needs.)
- Adjust the "Emission Energy" control clockwise. When the emission current begins to flow the "Fil Fault" LED will pulse once, this indicates the circuit is beginning to regulate the emission current.
- Turn the "Emission Energy" control to full clockwise position. The Voltage Meter should smoothly increase to 5 mA.

10.0 Maintenance and Care

Under normal operating conditions, the Filament power supply does not require maintenance.

10.1 External Cleaning

Use a slightly moist cloth to clean the outside of the Filament power supply. Aggressive scouring or cleaning agents might damage the painted surfaces.

10.2 Internal Cleaning

Under normal operating conditions, there should be no need to clean the inside of the Filament power supply.

11.0 Dimensions

Table 5. PB_6511A Dimensions

Description	Dimension
Box dimensions (WxHxD)	Rack mount front panel 19 x 3.5 x 14 inches
Power Cable length	10 feet (removable)
Filament Cable	10 feet (removable)
Weight (with cables)	13 lbs.
Shipping Weight	15lbs.

Appendix A: Ardara Technologies' Ionizers

Slim-Line Ionizer

The Ardara Technologies Slime-Line Ionizer was designed to provide maxium sensitivity with the shortest possible profile. The ion source mounting hardware has been recessed into the filament shield, minimizing potential mechanical interferences with other vacuum components, allowing a shorter path from a molecular beam source to the electron emitting filaments.

The use of interlocking lens assemblies allows for tight coupling of the ion region to the extraction lens, and the upper and lower filament plates while allowing for simple radial electrical connections using M2 hardware. The use of high tolerance aluminum oxide washers and high tolerance counter bores yields the assembly precision of ruby balls and reamed holes, without chasing tiny ruby balls across the floor.

The Slim-Line ionizer is the basic building block for the other molecular beam ionizers in the Ardara Technologies ionizer family.

Axial Molecular Beam Ionizer

This high performance ionizer provides excellent sensitivity and long focal lengths for optimal abundance sensitivity. The Axial Molecular Beam Ionizer is constructed from out standard Slim-Line Ionizer components mounted to a thick-lens Einzel lens set.

The Axial Molecular Beam Ionizer is the standard choice for general-purpose molecular beam ionizer, which is also optimized for residual gas analysis work.

Cross Beam Ionizer

When performing analysis of molecular beam consisting of corrosive, reactive or condensable material, it is generally best not to flow the molecular beam through the mass analyzer and the detector, rather one should sample the molecular beam orthogonally to the analyzer axis, and extract the ions from the molecular beam, deflecting them ninety degrees to the analyzer.

By mounting a Slim-Line ionizer to a Quadruple Deflector Energy Filter, one can unite a high-sensitivity molecular beam ionizer with a high transmission energy filter. The bandpass of the energy filter can be tuned to a wide energy range, especially useful for use with supersonic molecular beams, where convectional cross beam ionizers have been known to show mass discrimination effects.