



DC MAGNETRON

POWER SUPPLY

INSTALLATION AND OPERATION MANUAL

DOCUMENT 9007-004

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The Kurt J. Lesker Company assumes no liability for damages to customer facilities or personnel resulting from misuse or misapplication of the unit.

Original instructions are written in English.

Kurt J. Lesker Company®
~ Version C ~
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WARRANTY

EQUIPMENT WARRANTY AND REMEDY: COMPANY warrants that the Equipment fabricated and furnished by COMPANY hereunder shall be free from material defects in workmanship and materials. If any of the Equipment fabricated and furnished by COMPANY materially fails to conform to the warranty set forth in the preceding sentence, CUSTOMER's remedy shall be limited, at COMPANY's option, to either (i) repair or replacement of the non-conforming Equipment, F.O.B. point of repair or replacement, with shipping charges prepaid by CUSTOMER; or (ii) repayment of the portion of the contract price paid by CUSTOMER attributable to such non-conforming Equipment. Dismantling and reinstalling work is excluded from this Equipment Warranty and Remedy.

SERVICES WARRANTY AND REMEDY: COMPANY warrants that any engineering, design or software development and programming services furnished under COMPANY's proposal or quotation will conform to standards of practice generally accepted in the profession and/or industry for services of a similar nature. If the services provided by COMPANY materially fail to conform to the warranty set forth in the preceding sentence, CUSTOMER's remedy shall be limited to revision, replacement or reperformance, at COMPANY's expense, of those services which COMPANY reasonably determines fails to so conform.

SOFTWARE WARRANTY AND REMEDY: COMPANY warrants that any Equipment furnished hereunder which is comprised of software, when used with COMPANY-specified hardware, shall conform to the specifications set forth in COMPANY's proposal or quotation or, in the case of standard software, with published specifications prepared, approved and issued by COMPANY's headquarters in Clairton, Pennsylvania. If any software furnished by COMPANY hereunder materially fails to conform to the warranty set forth in section 3, CUSTOMER's remedy shall be limited to correction of the non-conformance by COMPANY, without charge to CUSTOMER. COMPANY makes no representation or warranty, express or implied, that the operation of the software will be uninterrupted or error free, or that the functions contained therein will meet or satisfy CUSTOMER's intended use or requirements.

WARRANTY PERIOD: The warranties set forth in sections 1 and 3 above shall be effective for a period of twelve (12) months from the date of shipment of the Equipment from COMPANY's plant. The warranty set forth in section 2 above shall be effective for a period ending twelve (12) months from the date of performance of the services.

WARRANTY CONDITIONS AND LIMITATIONS: CUSTOMER's right to enforce the foregoing warranties is expressly conditioned upon CUSTOMER notifying COMPANY in writing during the Warranty Period of any alleged non-conformity or defect, stating specifically the nature of the alleged non-conformity or defect. COMPANY shall have the right, upon such notification, to review, inspect and/or examine the Equipment indicated by CUSTOMER, and CUSTOMER shall make the Equipment available to COMPANY for such purposes.

The foregoing warranties shall not apply if COMPANY's review, inspection or examination discloses that the Equipment (i) has not been installed, maintained or operated in accordance with COMPANY's instructions; (ii) has been used by CUSTOMER in a manner or for applications not recommended by COMPANY; (iii) has been repaired, altered or modified by CUSTOMER; (iv) has been subjected to other than normal use, storage, handling, installation, operation or maintenance; or (v) has been damaged by fire, act of God, any cause covered by CUSTOMER's insurance or any other event or occurrence not caused by COMPANY.

The foregoing warranties shall not apply to Equipment, or parts or components thereof, which are not manufactured or processed by COMPANY, or which are purchased by COMPANY from another party or parties. The manufacturer's warranty for such Equipment, parts or components, if any, shall be assigned to CUSTOMER without recourse to COMPANY.

The foregoing warranties shall not apply to designs, materials or specifications furnished or specified by CUSTOMER and incorporated into the Equipment.

THE EXPRESS WARRANTIES AND REMEDIES SET FORTH IN THIS SECTION ARE EXCLUSIVE AND ARE CONDITIONED UPON TIMELY NOTIFICATION BY CUSTOMER. THEY ARE GIVEN BY COMPANY AND ACCEPTED BY CUSTOMER IN LIEU OF ANY AND ALL OTHER REMEDIES, WARRANTIES, AND GUARANTEES, EXPLICIT OR IMPLIED, AND IN LIEU OF ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ALL OF WHICH ARE HEREBY SPECIFICALLY EXCLUDED AND DISCLAIMED.

COMPANY neither assumes, nor authorizes any representative or other person to assume for it, any obligation or liability other than such as is expressly set forth in this section. Any change, modification, extension or addition to the foregoing warranties, remedies or limitations shall not be binding upon COMPANY unless in writing and duly executed by an authorized officer of COMPANY

GLOBAL SERVICE AND SUPPORT

Prior to contacting Process Equipment Division (PED) Global Service, review this Operations Manual, component manuals or the KJLC website for troubleshooting and service support.

When additional support is required, contact PED Global Service:

NORTH AMERICA	EUROPE	ASIA
Phone: (412) 387-9200 systemscustomerservice@lesker.com	Phone: (+44) 1424-458100 EMEIASystemservice@lesker.com	Phone: (+86) 21-50115900 systemscustomerservicecn@lesker.com

For all other regions, contact North America customer service.



ABOUT US

As a leading global provider of high quality vacuum products and systems, along with an established tradition of service and attention to detail, the Kurt J. Lesker Company® has built a reputation for “Enabling Technology for a Better World”.

The common attribute across the entire company is the relentless and tireless pursuit of quality and customer satisfaction, both in the vacuum products and the services we provide worldwide. KJLC takes this responsibility seriously, working at all levels to ensure high quality performance in all our products.

Drawing from our comprehensive list of products and services, KJLC has long believed and behaved in ways that set industry standards and demonstrate responsibility and responsiveness to its customers. Every phone call is answered by an actual person. Every product issue gets immediate and complete attention until it is resolved. Experienced employees continually make themselves available to those seeking information and guidance. KJLC sees every customer interaction as an opportunity to deepen valued relationships.

Founded in 1954, KJLC has grown from a regional manufacturer and distributor of vacuum components into today's worldwide marketplace, offering a full range of vacuum parts, products, systems, design technologies, innovative thinking, and responsive customer service. Working with an attentive eye toward quality, environmental stewardship of resources, and customer satisfaction, KJLC serves the research and development market at both the academic and commercial levels, as well as providing vacuum products and services to industry on a global scale. Following our successful expansions into Europe and Asia, KJLC continues to reach out for a greater global presence with the newest location in Hong Kong.

FOUR FOCUSED DIVISIONS

As a manufacturer and distributor of all things vacuum, being focused is crucial. KJLC has developed the following divisions to better focus on the unique challenges each application provides:



Quality, backed by years of experience - that's what sets our manufacturing division apart. Providing not only standard and custom vacuum chambers to the industry for over six decades, but also ensuring the quality that comes with the KJLC brand is infused throughout the organization. World class manufacturing equals top quality products for all of our business segments



We provide customers with advanced single chamber and cluster chamber, computer controlled, and thin film deposition systems designed and built to meet the high demands of a growing and increasingly adventurous research and production client base. Utilizing our clean room assembly and test facilities in the U.S. and the U.K., KJLC is ready to help meet all of your capital equipment needs.



Customers have access to the full range of approximately 14,000 basic vacuum components, such as flanges, fittings, pumps, fluids, valves, feedthroughs, and traps. Some would refer to these as the building blocks for every application in the marketplace; to that end we have the largest inventory of in-stock, ready to ship products in the industry. Dependable delivery and superior customer service keep the Vacuum Mart™ division the go-to source for customers all around the world.



Customers can select from an extensive list of pure elements, compounds, alloys, advanced metal oxide ceramic materials, and mixtures for thin film deposition, each stocked for rapid delivery. In addition to our expansive materials offering and technical expertise, this division also provides a vast array of crucibles, boats, filaments and wires available in all shapes and sizes, so you get the exact fit for your process. In-house bonding facilities and precious metal reclaim services highlight one of the most complete and quality driven material lines in the industry.

INTRODUCTION

FEATURES

- Superior Arc Detection & Suppression - < 100 nsecs (.1 μ secs)
- 500 watt, 1000 watt and 1500 watt Output Power Versions
- Adjustable Arc Detection Delay & Off Time Before Restarting
- Voltage, Current and Power Regulation Modes
- Adjustable Power Ramping
- Adjustable Run Timer
- Stored Target Parameters for Up to 7 Separate Targets
- kWh Counting & Time Limit
- RS-232 & Analog Communication Capability
- Wide 0-1000 Volt Range – Full Rated
- Power can be Applied Under Nearly all Conditions
- Stable Operation Down to 20 watts for Non-Reactive Processes
- Suitable for Use as a Substrate Bias Power Supply
- No Transformer Tap Changes Are Necessary to Operate Across Entire Range



The front panel control allows the user to manually set the output parameters, protection levels and to preview the settings. Output voltage, current and power are alternatively displayed on the LED display by briefly pressing the “Select” button on the front panel. Doing so will toggle only between these three settings. Pressing and holding the “Select” button while twisting the “Adjust” rotary encoder switch will allow quick selection of and setting the values of any desired function (“Arc Off Time”, “Watts”, “Volts” and “Amps”, etc..). Actual values for any selected function are displayed when the power supply is running.

Power supply local parameters are stored and remembered when the AC power switch is turned off. These values are restored when the power supply is turned back on.

The rear panel includes the necessary connectors to automatically control and monitor the power supply by remote analog signals or by the RS-232 serial communication.

SAFETY

SAFETY SYMBOLS

The following safety notations will be used throughout this manual:



This notation indicates a potentially hazardous situation, which, if not avoided, will result in death or severe injury.



This notation indicates a potentially hazardous situation that may result in injury if not avoided. It is also used to alert against unsafe practices that may result in damage to the equipment.



This notation is used to highlight any technical requirements, operations, procedures, or conditions that should be emphasized.

The following are American National Standards Institute (ANSI) and the International Organization for Standardization (IOS) symbols that will be used within this manual:



SAFETY NOTICE



This manual must be thoroughly read and understood prior to installation of the power supply. Failure to comply with the specifications, safety instructions, directives and warnings in this manual will void all warranties and can result in permanent injury or death. [Private Labeling] is not liable for the users' failure to read the manual and to comply with the stated requirements.

Only technically qualified personnel should install, maintain and troubleshoot the equipment described herein.



Lethal voltages and currents can be developed within the power supply, therefore the power supply chassis should not be opened.

**CAUTION**

REMOVAL OF THE POWER SUPPLY COVER WILL VOID ALL WARRANTIES.

Disconnect the input power cord from the back of the power supply prior to making any modifications to the power supply inputs and output.

Do not remove identifying and warning labels from the power supply.

GROUNDING

For safety reasons, all conductive parts must be grounded to prevent voltage buildup and potentially lethal discharges.



The power supplies are Safety Class 1 instruments. To minimize shock hazard, the power supply chassis **MUST** be connected to a true earth electrical ground through the three-wire AC power supply cable. Any interruption of the protective ground conductor or disconnection of the protective earth terminal on the chassis will cause a potential shock hazard that can result in injury or death.

POWER SUPPLY REPAIRS AND MODIFICATIONS

Parts replacement and modifications may be done only by authorized [Private Labeling] service personnel. For repairs or modifications, the power supply must be returned to an authorized [Private Labeling] service facility.

FCC COMPLIANCE NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their expense.

INSTALLATION

SCOPE OF DELIVERY

Included with the DC Magnetron Power Supply are:

QUANTITY	DESCRIPTION
1	Input power cord with pigtail termination (user to supply appropriate wall plug for voltage and location)
1	RS-232 cable
1	Chassis ground cable
1	Ferrite radiation suppressors for communications cables.
1	Electronic copy of the documentation.

SPECIFICATIONS

DESCRIPTION	VALUE
Input Frequency	50 - 60 Hz
Input Phase	1 phase
Input Voltage	85 - 275 VAC (lower VAC may limit power output)
Input Current	13.7 amps maximum
Power Factor	> 0.98
Input Power Consumption	1.75 kW
Output Power	1500 watts
Output Power @ 1000 volts	1500 watts
Output Power @ 500 volts	1500 watts
Output Power @ 200 volts	800 watts
Output Voltage (steady state)	-1000 volts maximum
Output Voltage (strike)	-1000 volts maximum
Output Current (maximum)	4 A (1500 watts)
Arc Detection Time	< 100 nsecs (.1 μ secs)
Arc Energy	< 1 mJ
Arc Detect Delay Time	0.1 to 6500 μ secs (adjustable)
Arc Out/Off Time	0 (no arc handling) or 32 to 65000 μ secs (adjustable)
Arc Rate Counter	Yes
Arc Recovery Time	Set points will be re-established < 200 μ secs after arc off time
Line Regulation	<1% of full scale *See Note
Load Regulation	<1% of full scale *See Note
Power Ramping	0.001 to 65 seconds (adjustable)
Run Timer	0.1 to 6553 seconds (adjustable)

DESCRIPTION	VALUE
kWh Counting	Yes
kWh Limit	0 (limit shutdown disabled) or 0.01 to 655 kWh's
LED Display Accuracy	+/- 1% of full scale
Display Resolution	0.1 watt, 1 volt, 0.001 amp (1 milliamp)
Stored Target Information	Stores parameter sets for targets that can be re-installed after exchange. Saves P/V/I, ramp time, run time, arc detect delay, arc off time, kWh's for 7 separate targets
Interlocks	1 each
Temperature Monitoring Protection	Yes. "Fan on Demand" cooling with thermal shutdown protection.
Dimensions	48.3 cm/19" x 50.32 cm/19.81" x 4.44 cm/1.75" (1 U Rack Height)
Weight	8.2 kG/18 pounds
RS-232/Analog Interfaces	Yes
DC Bias Operation	Basic open circuit operation between 1000 volts to < 100 volts
Output Power Connector	HN Female Connector
Regulatory	CE Conformity

* **NOTE:** Assumes output power is not limited by input current when running at low input voltages.

VERIFY INPUT POWER REQUIREMENTS

Verify that the AC input power meets the requirements in the above Specification Chart, that unit is properly grounded, and all cables are correctly installed before applying AC power.

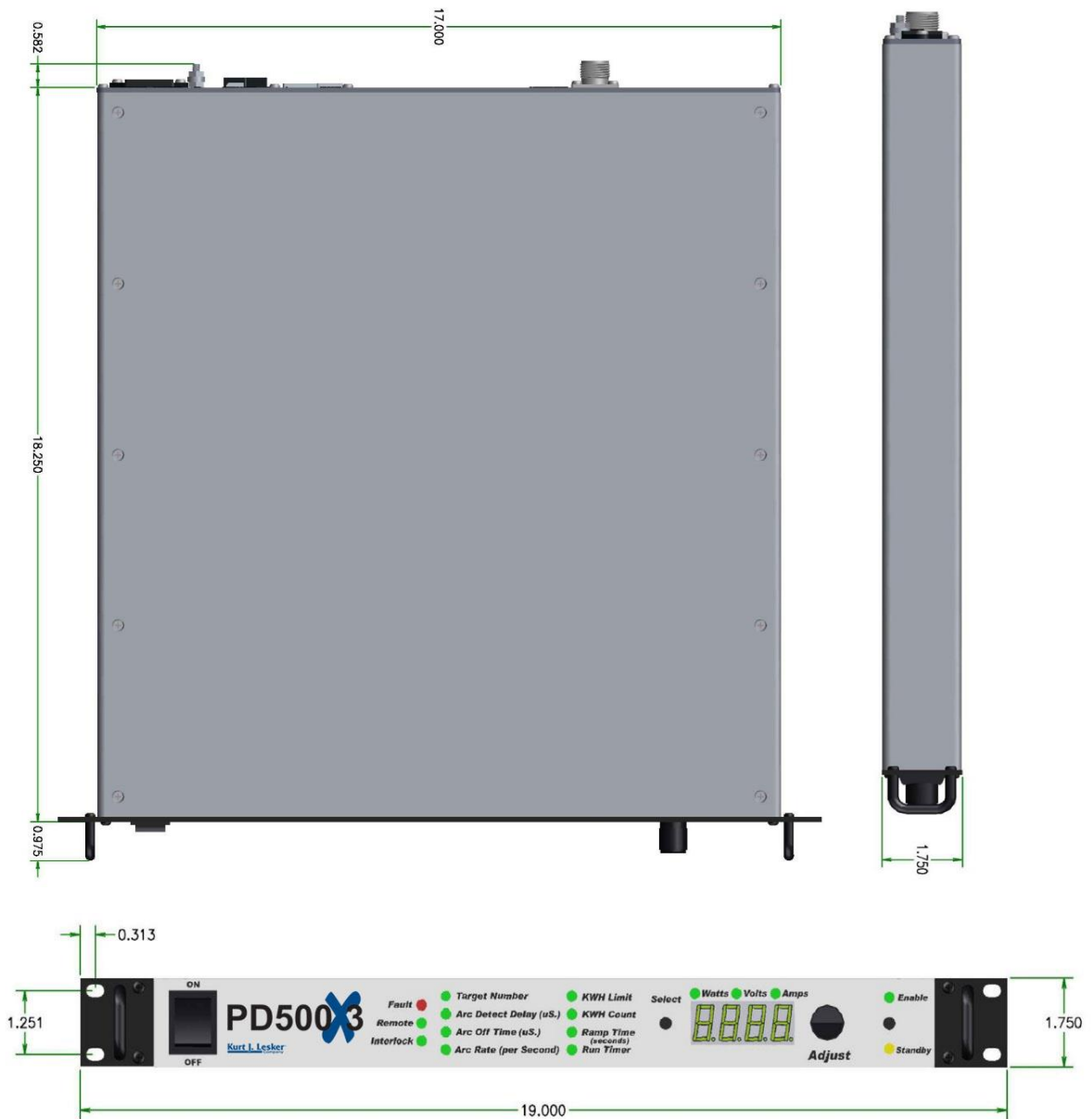
MOUNTING

The DC Power Supply is designed to be mounted in a standard, ventilated 19 inch (483mm) rack mount cabinet connected to a true earth ground (not a water pipe or similar connection). Install the power supply in the cabinet prior to making any electrical or power connections. Allow additional 4" at rear for clearance of input/output connectors, cables and plugs. Support rails must be used to support the DC Power Supply.



CAUTION DO NOT attempt to use the front panel mounting holes to suspend the power supply in the cabinet. This will bend the front panel and damage the power supply.

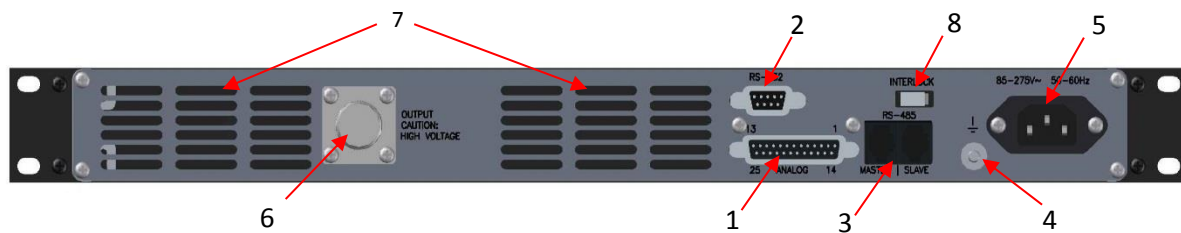
DIMENSIONS



COOLING AND VENTILATION

The DC Power Supply is forced air cooled with airflow entering and exiting through the back of the chassis. Ensure that there are no obstructions in the rack mount cabinet that will restrict the airflow. Allow at least 4" (10cm) between the back of the chassis and the cabinet. The cabinet itself should be positively (forced) air-cooled with a 110 CFM fan with a warm air exhaust to prevent heat build-up within the cabinet. Maximum 90% relative humidity and 104° F (40° C) ambient temperature.

REAR PANEL CONNECTIONS



REAR PANEL DESCRIPTIONS

Number	ITEM	DESCRIPTION
1	Analog Remote Connector	DB25 Female for remote analog interface
2	RS-232 Connector	DB9 Female
3	RS-485	RJ-12 type. Not Enabled. For Future Implementation
4	Ground Terminal	10-32 Screw & Nut for chassis ground connection
5	AC Input Connector	3 Prong Male IEC (C14)
6	DC Output	HN Female Connector (Coaxial)
7	Air Vents	
8	Interlock Connector	2 Pin Molex

ANALOG REMOTE CONNECTION

The analog connector is a DB-25 subminiature connector. The DB-25 cable should be a quality-shielded cable with proper terminations such as L-COM Premium series CS2N25MF-6.

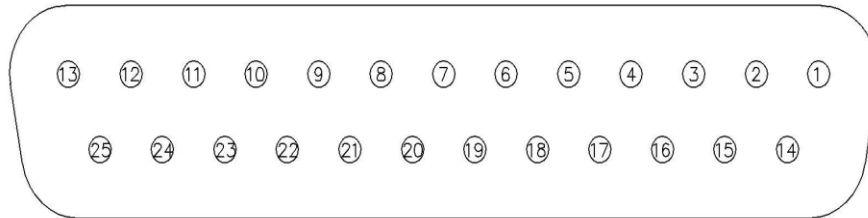
Turn the AC On/Off switch to the OFF position and wait until the front panel display has turned OFF before making any connection.



CAUTION

The analog I/O provides differential set point inputs and isolated outputs to prevent ground loops and to maintain the isolation of the power supply when programming from the Analog Input. This isolation has a maximum common mode voltage range (voltage difference between grounds) of 20 volts. Setpoint accuracy beyond this limit will be seriously impaired.

The power supply can be remotely controlled using a 0-5 volt DC analog interface. The analog remote uses 0-5 volt signals for controlling and monitoring the power supply. A 25 pin DB-25 subminiature connector labeled “Analog” is provided for this purpose. The pin-out descriptions for the interface are provided on the following table.



DB-25 PIN IDENTIFIER

DB-25 PIN CONNECTION DESCRIPTIONS

PIN	SIGNAL NAME	FUNCTION	REFERENCE
1	ENABLE +	Connect to ISO +5V to enable the output. Requires pin 2 Remote Select to be enabled, connected to ISO +5V. Same function as pin 14 except opposite polarity (tie high vs low to enable). Either pin 1 or 14 can be used for enable.	Input
2	REMOTE SELECT	Connect to ISO-+5V to activate. Required for analog remote control only. This is not required for RS-232 control.	Input
3	ISO-GND	DB25 Port Isolated ground reference	Common
4	REMOTE INDICATOR	Open Collector Opto output with 2k Pull-up Active low when unit is in remote (pin 14 is active or RS232 control mode is enabled with S01 cmd.)	Output
5	N.C.		
6	ISO-GND	DB25 Port Isolated ground reference	Common
7	CURRENT READBACK	0-5 volts equals 0-Supply maximum Setup Current.	Output
8	POWER READBACK	0-5 volts equals 0-Supply maximum Setup Power.	Output
9	POWER SETPOINT	0-5 volts equals 0-Supply maximum Setup Power.	Input
10	CURRENT SETPOINT	0-5V equals 0 - Supply maximum Setup Current	Input
11	ISO-GND	DB25 Port Isolated ground reference	Common
12	ISO-GND	DB25 Port Isolated ground reference	Common
13	ISO-+5V	+5 Volts with respect to ISO-GND (20 mA maximum combined load on all pins)	Reference
14	ENABLE -	Connect to ISO-GND to enable the output. Requires pin 2 Remote Select to be enabled also. Same function as pin 1 except opposite polarity (tie low vs high). Either pin 14 or 1 can be used for enable.	Input
15	ISO-+5V	+5 Volts with respect to ISO-GND (20mA maximum combined load on all pins)	Reference

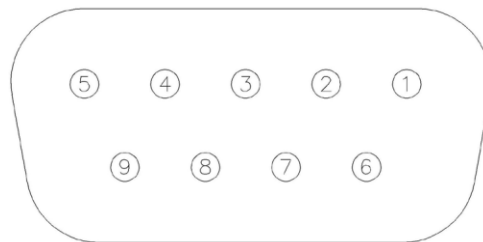
PIN	SIGNAL NAME	FUNCTION	REFERENCE
16	ISO-GND	DB25 Port Isolated ground reference	Common
17	ISO-GND	DB25 Port Isolated ground reference	Common
18	FAULT	Open Collector Opto output with 2k Pull-up Active low when unit is in a Fault condition	Output
19	VOLTAGE READBACK	0-5 volts equals 0-Supply maximum Setup Voltage.	Output
20	N.C.	Tied to PIN 4	
21	ISO-GND	DB25 Port Isolated ground reference	Common
22	N.C.	Tied to PIN 10	
23	N.C.		
24	ISO-GND	DB25 Port Isolated ground reference	Common
25	ISO-+5V	+5 Volts with respect to ISO-GND (20 mA maximum combined load on all pins)	Reference



Analog input pins are level sensitive not edge sensitive. If pin 14 enable is tied to ISO-GND for example when AC power is applied the output will turn on.

RS-2323 REMOTE CONNECTION

The ferrite suppressors are provided to protect the signal cables, RS-232 and analog, from false electromagnetic interference and to meet FCC and CE requirements for radiated emissions. The use of shielded cables is recommended.



DB-9 PIN IDENTIFIER

DB-9 PIN CONNECTION DESCRIPTIONS

PIN	SIGNAL NAME	FUNCTION	REFERENCE
1	N.C.		
2	RS232 TXD	RS232 Transmit to PC	Output
3	RS232 RXD	RS232 Receive from PC	Input
4	N.C.		
5	GND	Chassis Ground	Common
6	N.C.		
7	N.C.		
8	N.C.		
9	N.C.		

RS-232 PROTOCOL DEFINITION

This document defines the communication protocol between a PC and the DC Power Supply. The hardware layer is standard RS232 with no hardware handshaking and is accessed via a rear panel DB9 female connector. Communication is direct with no addressing. This protocol uses a simple command and query rule set. Control through a simple PC ASCII terminal program is sufficient. Baud rate is factory defaulted to 9600 but any baud rate from 1200 to 115200 can be accommodated. The baud rate can be changed in the setup.

Data bits = 8 Parity = None Stop Bits = 1

DEFAULT MODE

A serial exchange is always initiated by the PC or PLC. A command or query (defined below) is sent followed by a carriage return (0x0D) to terminate the command. The unit will then respond with ASCII data followed by a carriage return (0x0D) and line feed (0x0A).

ECHO MODE

This mode can be enabled using cmd S98. In this mode the cmd sent to the unit is echoed back followed by a carriage return and line feed then the cmd response.

REPEAT MODE

This mode requires the ECHO mode to also be enabled. To enable this mode requires sending cmd S96 after sending cmd S98. This mode will respond with an ECHO of the cmd sent for the PC to verify. If the string matches then the PC must repeat the string back to the Supply. The Supply will also compare the repeated message with the first sent string. If the repeat does not match, the Supply will return the ASCII string "Error 10". If the string does match, but isn't a valid command or query, the supply will return ASCII string "Error 11". Two consecutive carriage returns will reset the string sequence and start a new one.



The supply incorporates a "Heart Beat" timer to ensure the serial connection is intact. A valid command or query must happen within this time window or the supply will revert to standby. This only applies when RS232 control mode is selected. The unit may be run in analog mode and still be "queried" via the RS232 with no interruption via Heart Beat timeout. Setting the Heartbeat time to zero disables this feature. The default value is zero.

RS-232 COMMAND SET

“H” (HELP) COMMANDS

All Help commands start with ASCII character “H” followed by a 2 digit decimal number. The command must be terminated with a carriage return (0x0D).

H00	Returns formatted text string of all Set commands
H01	Returns formatted text string of all Query commands

“S” (SET) COMMANDS

All Set commands start with the ASCII character "S" followed by the 2 digit decimal number of the command. If the command requires a data value then a single space needs to delimit the command from the data. Data is limited to 6 digits plus decimal point. The length can be less than 6 digits and the decimal point is optional. Out of range entries will return "Error 15". The command must be terminated with a carriage return (0x0D). Once a command is accepted as a valid command the unit will respond with the ASCII string “OK” followed by a carriage return (0x0D) and line feed (0x0A).

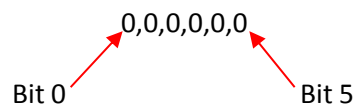
S00	Return supply to analog control
S01	Place unit into RS232 control mode
S02	Enable Output (Heart Beat Timer applies)
S03	Disable Output
S04 #	Set Active Target Number (1-7)
S09 ##.###	Set Heartbeat Timeout time in seconds (0.000-65.535)
S10 #####.#	Set Active Target Power Setpoint in Watts
S11 #.###	Set Active Target Current Setpoint in Amps
S12 #####.#	Set Active Target Voltage Setpoint in Volts
S13 #####.#	Set Active Target Arc Detect Delay Time in uSeconds (0.0 - 999.9)
S14 #####	Set Active Target Arc Off Time in uSeconds (0 or 32 - 65535) "0" Disables Arc Handling
S15 ###.##	Set Active Target Kilowatt-Hour Limit in KWH (0.0 - 655.35) "0" Disables kWh Limiting
S16	Clear Active Target Kilowatt-Hour Count Resets kWh Count to Zero
S17 ##.###	Set Active Target Ramp Time in Seconds (0.000-65.535)
S18 #####.#	Set Active Target Run Time in Seconds (0.0 - 6553.5) "0" Disables Run Timer

- S67 Reset Factory Defaults, sets the following parameters back to the factory defaults. Requires AC power cycle after sending. Responds with OK.
- Power Only Regulation
 - Resets maximum watts, volts, and amps to default max values
 - Arc E = 1500
 - Arc Threshold = 100V
 - Rchl = 1 (power only)
 - Baud rate = 9600
 - Current Target # = 1
 - Arc Detect delay = 10us
 - Arc off = 32us
 - kWh limit = 0
 - kWh count = 0
 - Ramp time = 0
 - Run timer = 0
 - Front panel local power setpoint = 0
- S96 Enables the "Repeat" mode. Command must be sent twice.
- Requires that "ECHO" mode is enabled cmd 98
- S97 Disable the "Repeat" mode. (default)
- S98 Enables the "ECHO" requirement
- S99 Disables the "ECHO" mode. (default)

"Q" (QUERY) COMMANDS

All query commands start with the ASCII character "Q" followed by the 2 digit decimal number of the query. The query is then terminated with a carriage return. The requested data will then be returned followed by either a carriage return (0x0D) and line feed (0x0A) or a space plus descriptor and a carriage return and line feed.

- Q00 Read Fault Bits
- This command returns a 6 bit comma separated string indicating the fault status.
- Bit 0 = Interlock Open
- Bit 1 = Bus Fault
- Bit 2 = AC Line Current Limit Bit 3 = Thermal Sensor Fault Bit 4 = Overtemp Fault
- Bit 5 = Heartbeat Timeout Fault



1 = true or fault conditions exist. 0 = false or fault conditions do not exist.

EXAMPLE 1

Q00 state of 0,0,0,0,0,0

Means that there is no active fault conditions

EXAMPLE 2

Q00 state of 1,0,0,0,0,0

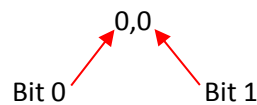
Means that there is an interlock fault

Q01 Read Status Bits

This command returns a 2 bit comma separated string indicating the status of various features. Values are either 0 or 1.

Bit 0 = Output Enabled

Bit 1 = RS-232 Control Active



1 = true or active. 0 = false or inactive.

EXAMPLE

Q01 return of 1,0

Means the output is enabled, RS-232 Control is not active.

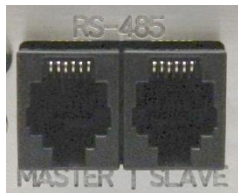
- Q00 Read Fault Bits
- Q01 Read Status Bits
- Q02 Read Hard Arc Count
- Q03 Read Micro Arc Count
- Q04 Read Active Target Number
- Q05 Read Actual Power (Watts)
- Q06 Read Actual Current (Amps)
- Q07 Read Actual Voltage (Volts)
- Q08 Read Arc Rate (Arcs/second)
- Q09 Read Heartbeat Timeout (seconds)
- Q10 Read Active Target Power Setpoint (Watts)
- Q11 Read Active Target Current Setpoint (Amps)
- Q12 Read Active Target Voltage Setpoint (Volts)
- Q13 Read Active Target Arc Detect Delay Time (µs)
- Q14 Read Active Target Arc Off Time (µs)
- Q15 Read Active Target Kilowatt-Hour Limit (kWh)
- Q16 Read Active Target Kilowatt-Hour Count (kWh)
- Q17 Read Active Target Ramp Time (s)
- Q18 Read Active Target Run Time (s)
- Q19 Report all output and arc parameters, comma delimited
(power, current, voltage, arc rate, hard arc count, micro arc count)

RS-232 ERROR MESSAGES

The RS232 error message definition can be retrieved by sending carriage return (0x0D) only to retrieve list of error codes.

- Error 10 Invalid Match (Repeat is active, use S97 to disable)
- Error 11 Data Invalid
- Error 12 Command Invalid
- Error 13 Needs to be in standby for this command
- Error 14 Needs to be in RS232 control for this command
- Error 15 Data out of range (Check supply min-max settings)

RS-485



Currently not enabled. Available for future expansion.

INTERLOCKS



INTERLOCK CONNECTIONS

PIN NUMBER	DESCRIPTION
1	Active Low Interlock – Connect to common (Interlock pin 2) to enable the power supply
2	Interlock Return - Common

⚠️ WARNING

Interlocks are provided as a method to disable the supply but are not intended to meet or satisfy safety requirements and should not be used for operator protection.

AC INPUT POWER REQUIREMENTS



Connect the power supply to an 85 - 275 VAC (lower VAC may limit output), single phase, 14A maximum power source.

The AC input connector is an IEC C14 250V/10A, 110V/15A socket. The mating connector for the power cord should be an IEC C13 style.

The input power cable should be a 3 conductor at least 16 awg, rated to 60°C minimum, and rated for the input voltage being used. A non-locking plug approved by the national safety standards of the country of usage must be used.

Make a true earth connection between the stud provided on the power supply chassis and an appropriate ground connection within the instrument rack or other true earth ground.

DC POWER OUTPUT LIMITATIONS



WARNING

Only qualified, experienced persons should perform these connections.



Remove the AC power cord to completely disconnect power to the power supply before making the output power or other connections or attempting to service the unit.

A potential shock hazard exists if the power supply chassis (with cover in place) is not connected to an electrical safety ground via the safety ground in the AC input connector.

The maximum current input draw is controlled to approximately 12.5A. This is to protect and accommodate a common 15A circuit breaker.

INSTALLATION DETAILS



When using 100-120 VAC input voltage, the power output may be limited to a value of less than 1500W.

For example, at a nominal input voltage of 120V and maximum input current of 12.5, then a theoretical (100% conversion) output power would be 1500 W. However, considering actual power supply performance, the introduction of the power factor and efficiency need to be included. With power factor of 0.98 and typical efficiency of 90%, then the maximum power output is reduced:

$$120V \times 12.5A \times 0.98 \times .9 = 1323W$$

Therefore, when full 1500W output power is required, then the input line voltage should be 208-240V.

For example, using the same power factor and efficiency from above example and a nominal voltage of 208V, then the input current draw is well below the 12.5A maximum.

$$1500W / (208 \times 0.98 \times .9) = 8.18A$$

DC OUTPUT POWER CONNECTION



The following are the specifications for the output cable.

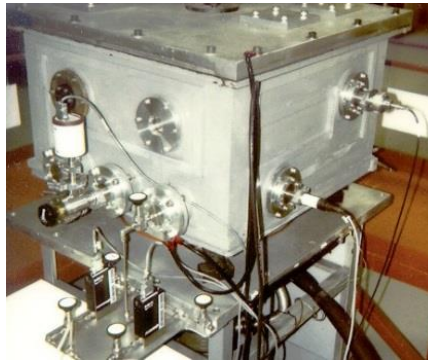
- HN coax connector, center conductor should be rated for 1000V continuous operation, 4A, and at least 75C.
- The cable should be a quality double shielded braid over foil cable with a proper 360 shield termination.

GROUNDING

It is **absolutely essential** that the 10-32 screw on power supply chassis be connected to a true earth ground. It is equally essential that there is a reliable ground return circuit between the sputtering source and the power supply itself. Use the ground cable provided with the power supply or equivalent solid conductor (not stranded) wire/strap. Single conductor bare .094" diameter copper wire is recommended (12-10 AWG).

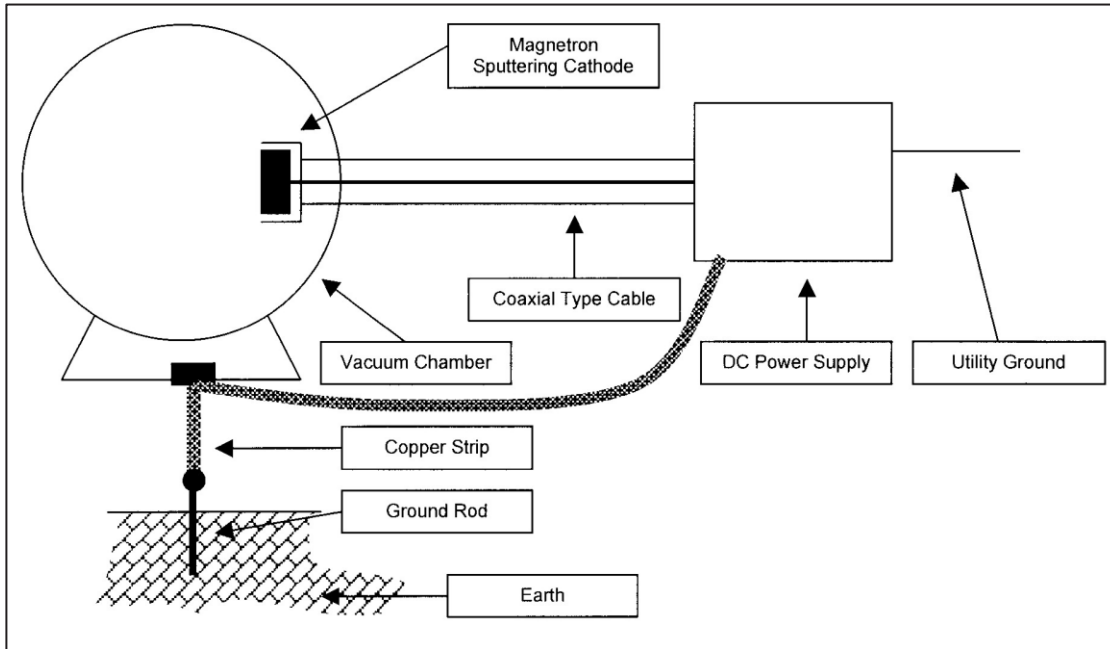


DO NOT use a stranded wire. A flat copper ground strap is preferred.



VIEW OF TYPICAL VACUUM CHAMBER SHOWING TOP PLATE, CHAMBER AND FLANGE(S) GROUNDED (BLACK CABLES) TO TRUE EARTH GROUND

The importance of true earth grounding for basic safety and equipment protection reasons cannot be overstated. If the system does not have it, make certain this situation is immediately rectified. Do not confuse signal ground with true earth ground. Signal ground does not ensure safety. For safety reasons, all conductive parts must be grounded to prevent voltage buildup and potentially lethal discharges



DC PASS/RF BLOCKING FILTER

If the DC Power supply is used with an RF bias or RF cathode then an RF filter should be put on the output of the supply to protect the supply. 13.56MHz for example will cause serious problems with running simultaneously with the power supply. Contact the manufacturer regarding what should be used for a filter.



Adding a filter between the DC output and the load will adversely affect the stored energy in the system and may interfere with the arc handling capability of the power supply.

OPERATION

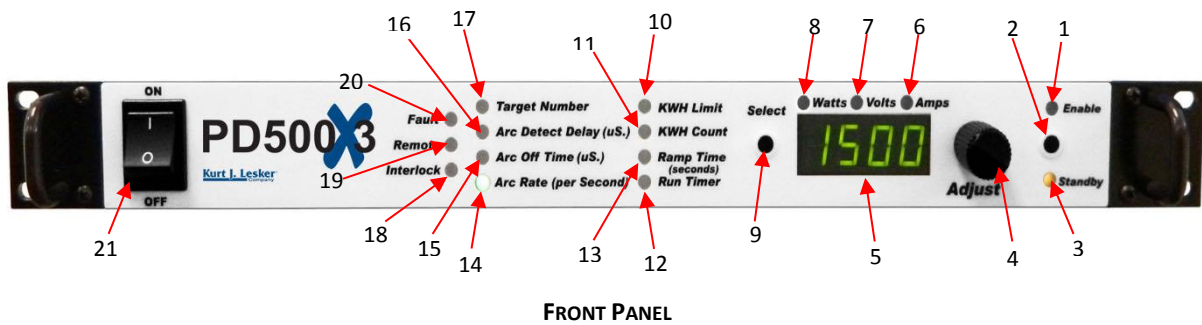
FRONT PANEL INTERFACE

This chapter describes the operating modes that are not involved in programming, monitoring and operating the power supply via its serial communication port (RS-232) or by remote analog signals. Ensure that the “Remote” LED on the front panel is “Off”.

The front panel display and LED indicators are active in both Standby and Enable modes.








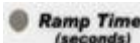
FRONT PANEL OPERATION (LOCAL)

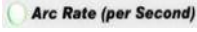

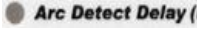

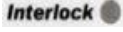
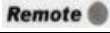


This section describes the operating modes that are not involved in programming and monitoring the power supply via its serial communications port (RS-232) or by remote analog signals.



FRONT PANEL INDICATORS AND CONTROLS

NUMBER	CONTROL / INDICATOR	DESCRIPTION
1	Enable 	Illuminates green when the DC output is turned on.
2	Black or White Button 	Turns power supply DC output on or off
3	Standby 	Yellow LED indicates power supply is turned on, but DC output is turned off.
4	Adjust 	Pressing and holding the “Select” button while twisting the “Adjust” rotary dial will allow quick selection of and setting the values of any desired function (“Arc Off Time”, “Watts”, “Volts” and “Amps” etc.). NOTE: The slower or faster the knob is turned, the slower or faster the display numbers change.
5	LED Display 	4 digit 7 segment LED display. Displays programmed values corresponding to selected function indicated by illuminating LED. Shows actual values when power supply output is on (enabled).

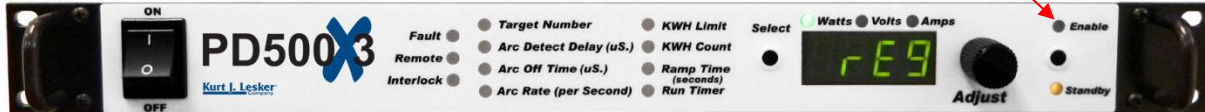
NUMBER	CONTROL / INDICATOR	DESCRIPTION
6	Amps 	The load (conditions within the sputtering chamber) determines the actual operating value independent of the voltage, current and power settings. Setting a current value does not mean that the power supply will regulate on current and force voltage and power to follow. Setting the current limit to less than the 4A maximum output potentially limits the power and voltage that can be achieved during operation. The value displayed on the LED display when the DC output is enabled is the actual operating value.
7	Volts 	The load (conditions within the sputtering chamber) determines the actual operating value independent of the voltage, current and power settings. Setting a voltage does not mean that the power supply will regulate on voltage and force current and power to follow. Setting the voltage to less than the 1000V maximum output potentially limits the power and current. The value displayed on the LED display when the DC output is enabled is the actual operating value.
8	Watts 	The load (conditions within the sputtering chamber) determines the actual operating value independent of the voltage, current and power settings. The power supply may be at either the current or voltage limit if the display shows a lower power value than the setting while the power supply is operating. Current and voltage settings when set at lower than maximum values can be used to intentionally limit the total power output.
9	Select 	Black or White Button. The green Watts, Volts or Amps LED indicators are alternatively lit and values displayed on the LED display by briefly pressing the "Select" button on the front panel. Doing so will toggle only between these three settings. Pressing and holding the "Select" button while twisting the "Adjust" rotary switch will allow quick selection of and setting the values of any desired function ("Arc Off Time", "Watts", "Volts" and "Amps" etc.).
10	kWh Limit 	Sets active target kWh limit (0.00 to 655.35). Allows the user to set target lifetime limits to prevent sputtering target burn-through. Setting the value to 0 disables kWh limiting. When the limit is reached the unit will shut off and display "CHEC". Press and hold both "Select" and "Enable" buttons to reset.
11	kWh Count 	Stores actual kWh used per specific target number (0.00 to 655.35). The supply continuously accumulates the Kilowatt Hours delivered to the target. Press and hold the Select button while this parameter is selected to clear the count.
12	Run Timer 	Sets the target run time in seconds (0.0 to 6553.5). Allows the user to "automate" the run based upon time. Setting the value to 0 disables the run timer. When the run time is reached the unit will shut off. Press the enable button if in Local control or remove the any remote enable if in remote control to reset.
13	Ramp Time 	Sets the target ramp time to full preselected power in seconds (0.000 to 65.535).

NUMBER	CONTROL / INDICATOR	DESCRIPTION
14	Arc Rate 	Reads arcs per second as measured in rolling forward 10 second intervals in real time. Measurements are not made in sequential “snapshots” of 10 seconds each, but reflect the immediate prior 10 seconds. “0.2” on the display means 2 arcs in the last 10 seconds. Once an arc event is 10 seconds old it is no longer counted. NOTE: If the run time is less than the 10 second window then the arc rate reported will be incorrect. To calculate the actual rate for short run times use the following formula: Actual rate = reported arc rate *10/actual run time (sec).
15	Arc Time Off 	Sets the off time (32 to 65535 µsecs) before the power supply output turns back on after a “handled” arc has shut off the power supply output. Starting with a value of 32 is recommended. Setting the value to 0 disables arc handling. A flashing light means “observe mode.” The Arc Rate (per Second) light will come on and Arc Rate will be displayed.
16	Arc Detect Delay 	Sets the time before active arc handling is activated (0.0 to 6553.5 µsecs). Allows as close to 100% duty cycle as possible by allowing small, low energy microarcs of no consequence to clear themselves before the power supply reacts. Any value less than 10µsecs begins to react to extremely small microarcs that likely will not affect most processes. A flashing light means “observe mode.” The Arc Rate (per Second) light will come on and Arc Rate will be displayed.
17	Target Number 	Sets the active target number from 1 to 7. The kWh count, kWh limit and all other values that can be set from the front panel are stored for each target until cleared by the user. This allows up to 7 different targets to be interchanged on the same sputtering source in research systems and the target usage to be remembered. Rotate the adjust dial to select the desired target number. Then step to any of the parameters you wish to associate with the selected target (ramp time, etc.), make the desired setting and push and hold the “Select” button. Repeat until operation for the indicated target is complete. Press and hold both “Select” and “Enable” buttons to clear.
18	Interlock 	Interlock requirement is satisfied when green LED is lit. If the sputtering system is not interlocked to the power supply, then the interlock must be jumpered as shown in the Interlocks Section.
19	Remote 	Illuminates green when the unit is in Remote mode. Remote/Local operation can be selected on the rear DB25 connector.
20	Fault 	Any active fault will trigger this LED. Unit will display an error code on the front display or toggle a bit in the Q00 status byte indicating the problem.
21	AC Power Switch 	Turns power supply On/Off

SET UP

HOW TO ENTER SET UP MODE

To enter set up mode, press and hold the “Enable” button while powering up the unit until the display reads “reg”.



SETTING THE REGULATION MODE

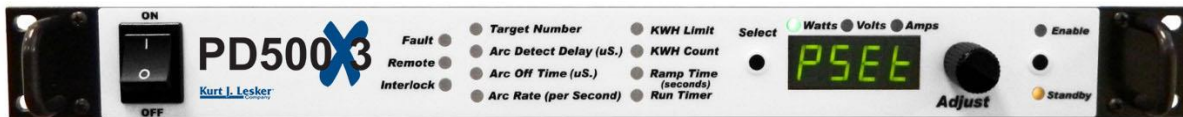
This step sets the regulation modes used by the power supply. The regulation mode can be set to Watts, Volts, Amps, or all three by turning the knob. The Watts, Volts, and Amps LED will indicate the selected regulation mode. The default setting for this product is power only regulation. The regulation mode can only be changed by entering this setup screen. It cannot be changed remotely. Once the value is set press the “Select” button to advance.



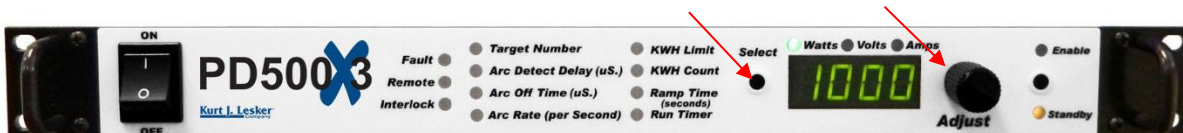
If power, voltage, or current only modes are selected then the setup will skip the other regulation modes in the setup and will automatically set them to the supply maximum values. For example if power regulation only is selected then voltage and current setup will be skipped and be set to the maximum values for those parameters.

SETTING THE MAXIMUM WATTS

This step sets the maximum possible watts. The analog 0-5 volts power reference is scaled to this maximum also. Display shows “PSEt” (Power Select).

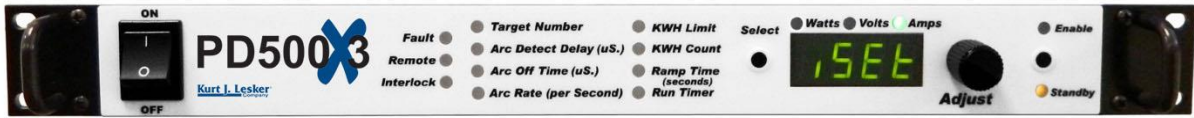


Use the Adjust dial to change the value, then press Select button to advance.



SETTING THE MAXIMUM AMPS

This step sets the maximum possible current. The analog 0-5 volts current reference is scaled to this maximum also. Display shows “iSEt” (Current Select).



Use the Adjust dial to change the value, then press Select button to advance.



SETTING MAXIMUM VOLTS

This step sets the maximum possible volts. The analog 0-5 volts Voltage reference is scaled to this maximum also. Display shows “vSEt” (Voltage Select).



Use the Adjust dial to change the value, then press Select button to advance.



“ARCE” ARC RATE TRIP

This is the number of arcs per second before the unit will fault out.

Use the Adjust dial to change the value, then press Select button to advance.



“ARCT” ARC THRESHOLD VOLTAGE

This sets the voltage threshold level which is used to determine an arc. The value is in volts. For example if it is set to 100 then any arcs which cause the output to drop below 100v will be considered an arc event.

Use the Adjust dial to change the value, then press Select button to advance.



SETTING “RCHL” REMOTE CHANNELS

This step sets the DB25 analog channels that will be used in remote control mode. The Power and Voltage setpoints are available for remote input through the DB25 connector on their respective pins according to the DB-25 Pin Connection Chart. Select the appropriate value for your desired operation.

0 = None, remote setpoint inputs are disabled

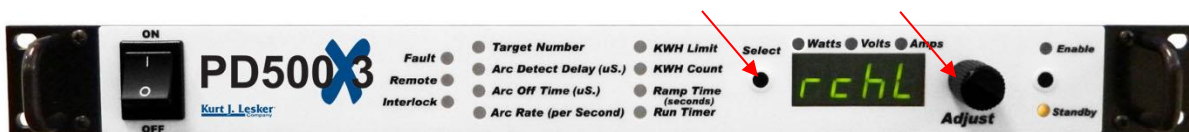
1 = Power only

2 = Current only. Requires unit to be in Current only regulation mode. See Setting the Regulation Mode above.

3 = Power and Current. Requires unit to be in power, voltage, and current regulation mode.

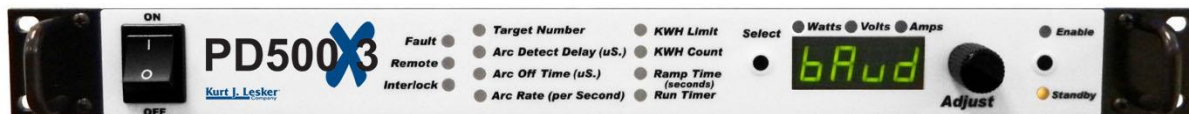
See Setting the Regulation Mode above.

Use the Adjust dial to change the value, then press Select button to advance.



SETTING RS232 BAUD RATE

This step sets the RS232 Baud rate. The display will toggle between “bAud” and a number. The default factory pre-set value is 9600 Baud.



Use the Adjust dial to change the value using the following options then press Select button to advance.

115.2 = 115200

57.6 = 57600

38.4 = 38400

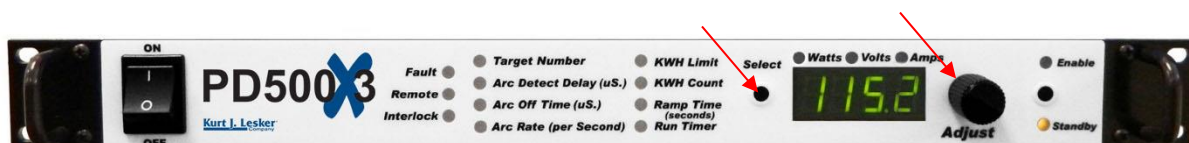
19.2 = 19200

9.6 = 9600

4.8 = 4800

2.4 = 2400

1.2 = 1200



SETTING LED BRIGHTNESS

This step sets LED brightness. The display will toggle between “LEd” and a number. 64 is the maximum brightness value.

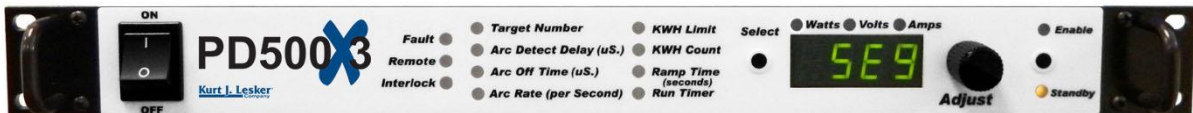


Use the Adjust dial to change the value, then press Select button to advance.



SETTING DISPLAY BRIGHTNESS

This step sets the 7 segment LED Display brightness. The display will toggle between “SEg” and a number. 64 is the maximum brightness value.



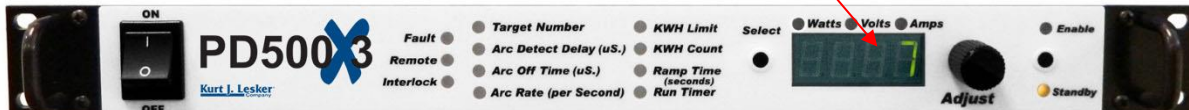
Press the “Select” Button to Exit Setup and return to normal operational mode.

IDENTIFYING SOFTWARE REVISION DATE CODE

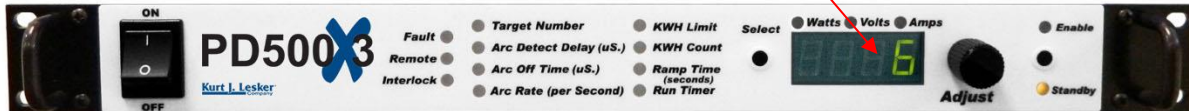
Press and hold the Select button while powering up the unit to view the Software Revision Date Code. This value cannot be changed by the user



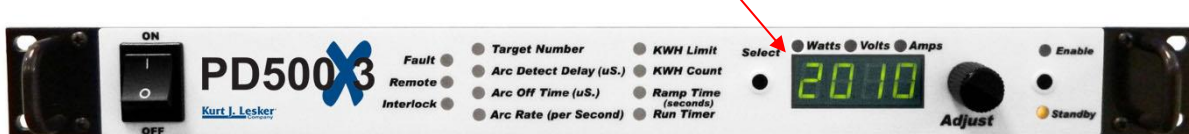
The Month is displayed. Press "Select button to advance to the day software was released.



This step shows the Day the software was released. Press Select button to advance to the year the software was released.



This step shows the Year the software was released.



Press the Select button to Exit to the operating mode.

FRONT PANEL ERROR MESSAGES

ERROR MESSAGE	DESCRIPTION	POSSIBLE CAUSE OF FAILURE	CLEAR METHOD
Err1	Primary Current Latch Fault	This is caused by an internal failure of the supply and will require the unit to be returned to the manufacturer for repair.	Cycle AC power to clear
Err2	Line Limit	The AC input voltage is too low. Shutdown the power supply and verify the AC Voltage.	Restore AC input voltage to the correct value.
Errt.	Heartbeat Timeout	An RS-232 command/query was not received within the heartbeat timeout window.	Send output disable to clear. Front panel mode - press enable. Analog remote - open pin 14 or tie to ISO-+5V. RS-232 remote - send cmd S03 to disable.
hot	Overtemp Fault	The power supply temperature is too high. Verify the air vents are not blocked, that there is at least 4" of clearance behind the unit, and that the rack or cabinet ambient temperature is being maintained below 40°C.	Fault will clear once the ambient temperature is returned below 40C
tFLt	Bad or Faulty Thermistor	Thermistor failed open or short	Internal supply failure, must be returned to manufacturer for repair.
int-Loc	Open Interlock	Verify pins D-E are shorted together on the output connector	Restore connection between pins D-E on output connector.
CHEC	kWh Limit	The kWh limit has been reached.	Cycle AC power or press the Enable and Select buttons simultaneously on the front panel to clear.
Arce	Arc Rate per Second Limit was Exceeded	Water leaks, air leaks or other conditions that result in an arc rate of 1500 arcs/sec for 3-4 seconds will result in the error message "Arce" on the LED display. The power supply will be disabled until it is reset. The high rates of arcing may occur during target conditioning of a new target with an oxide layer on its' surface or a contaminated target. If this is the case, reduce the power applied to the target until arcing stops, then increase the power level incrementally until the target surface is "clean" and arcing stops. Additionally, cooling water leaks, shorts from debris and film buildup may cause this situation to occur in a well-built system.	Send output disable to clear. Front panel mode - press enable Analog remote - open pin 14 or tie to ISO-+5V RS-232 remote - send cmd S03 to disable.

ARC HANDLING

OPERATION

The arc handling feature uses a voltage threshold (Arct) for detection. When the output voltage drops below the threshold an arc is detected.

The arc detect delay value is then used to determine whether an arc is acted upon or not. If the arc extinguishes (voltage rises above the threshold + 18v) before the arc delay is reached then it is counted as a micro arc and is not acted upon, therefore the output is not shutoff.

If the arc is sustained longer than the arc delay time then the arc is counted as a hard arc and is acted upon by shutting off the output for the arc off time. After the arc off time has expired the output is re-enabled. If the arc still exists then the arc off time is increased to 500 μ s and will stay at this value until the arc is extinguished, Arc Rate limit is tripped, or the unit is shut off by the user. The 500 μ s off time value is to protect the supply and limits the arc rate and output re-enable rate to 2000 arcs per second. The unit has an ArcE (Arc Rate Fault) which shuts off the output if the ArcE set value is exceeded. This value is defaulted to 1500.

The arc counters are cleared on an output enable so they are able to be queried after the run is complete. The arc detection also includes an arc rate counter (arcs/second) which is the total number of arcs detected occurring over a 10 second sliding window divided by 10. If the run time is shorter than 10 seconds then the arc rate value will be incorrect. The following formula must be used to calculate the actual arc rate for run times less than 10 seconds. Actual Arc Rate = reported arc rate * 10/ actual run time (seconds)

There is an exclusion for ignitions so they are not counted as arcs, but are included in the arc rate counter so the arc rate and arc counters may not match. The difference is the number of ignitions.

ARC PARAMETERS

The following parameters are used by the Arc Handling feature of the product.

ARC ERROR VALUE "ARCE" (ARCS/SECOND LIMIT)

- Sets max number of arcs/second before unit faults out shutting off the output.
- Set in setup, front panel only. See Setup Section.
- Default value = 1500, max value = 1500

ARC THRESHOLD "ARCT" (VOLTS)

- Output voltage threshold value used for determining an arc
- Set in setup, front panel only. See Setup Section
- Default value = 100

ARC DETECT DELAY (μ s)

- Time after an arc is detected until it is acted upon by shutting off the output
- Used to determine micro arc vs hard arc and whether an arc shuts off the output.
- Set by front panel only. See Front Panel Indicators and Controls Chart.
- Default value = 10, Range = 0 – 6553.5

ARC OFF TIME (μ s)

- Amount of time output is shut off after arc delay has expired on the 1st attempt to quench an arc. Automatically increased to 500 μ s on subsequent tries.
- Set by front panel only. See Front Panel Indicators and Controls Chart.
- Default value = 32, Range = 32 – 65535, 0 = arc handling is disabled.

ARC RATE (ARCS/SECOND)

- Report only, Q08 cmd or front panel
Number of arcs/second calculated over a rolling 10 second window. Includes ignitions in count.
- For run times < 10 seconds the arc rate will be incorrect. The following formula can be used to calculate the actual arc rate for short run times, but the user must know the actual run time.

$$\text{Actual Arc Rate} = \text{reported arc rate} * 10 / \text{actual run time.}$$

- Cleared on output enable.

HARD ARC COUNTS

- Report only, Q02 cmd
- All arcs lasting > arc detect delay value. Does not include ignitions.
- Cleared on output enable.

MICRO ARC COUNTS

- Report only, Q03 cmd
- All arcs lasting < arc detect delay value. Does not include ignitions.
- Cleared on output enable

RECOVERY TIMER

- Hard coded, not settable by the user.
- Varies depending on state, typically 50 μ s – 500 μ s
- Used to allow output to recover above the threshold after an arc and limit the max number of arcs per second to protect the product

TROUBLESHOOTING

⚠️ WARNING

Only technically qualified personnel should install, maintain, and troubleshoot the power supply.



Troubleshooting and maintenance should be carried out only after grounding the components to be worked on and assuring that power cannot be applied to those components while working on them. Ensure all cables are properly connected before connecting AC power. Verify input line voltage and current capacity are within the specifications.

TROUBLESHOOTING CHART

SYMPTOM	ACTION
No output. All front panel displays and indicators are blank	Verify AC switch is turned on. Verify AC input voltage is within the specifications
No output, front display is on	Verify interlock is satisfied. Verify output power, current, and voltage settings are correct. Disconnect AC power and check the output cable for continuity.
Output voltage does not reach setpoint	Verify unit has voltage selected as a regulation mode in the setup process. See Setup Section. Verify unit is not hitting the power or current limits causing the voltage to fold back.
Output power does not reach setpoint	Verify unit has voltage selected as a regulation mode in the setup process. See Setup Section. Verify unit is not hitting voltage or current limits causing power to fold back.
Output current does not reach setpoint	Verify unit has voltage selected as a regulation mode in the setup process. See Setup Section. Verify unit is not hitting power or voltage limits causing current to fold back.
Err1 message on front panel	Err1 is a current latch and is likely an internal failure of the product.
Err2 message on front panel	Low input voltage. Turn off unit and verify the AC input voltage is correct.
hot message on front panel	Power supply internal temperature has exceeded maximum temperature. Verify ambient temperature in cabinet is <40C and that there is adequate ventilation.
tFLt message on front panel	Internal temperature sensor has failed. Return to manufacturer for repair
int Loc message on front panel	Open interlock
CHEC message on front panel	kWh limit has been reached. See Front Panel Indicators and Controls Chart.

WILL NOT START

Verify:

- All power supply/system interlocks (water/pressure/flow) are satisfied
- Argon gas pressure in chamber is sufficient (high enough gas flow). If type of gas being used has changed (ie from Argon to Oxygen), it may be necessary to increase the gas flow. Lighter molecular weight gases ionize less efficiently than heavier gases.
- Power supplies are properly connected to the cathode and anode
- Chamber pressure is not too high or low
- Water leaks are not causing shorting
- No shorts between cathode and anode caused by whisker growth, flaking and debris
- Insulator surfaces are not coated or conductive
- Magnet module has not been overheated or weakened
- Anode is not coated by an insulating layer. Backscattered material can coat the anode surface with a thin layer of insulating material (might be transparent). This is known as the “disappearing anode” effect.
- Excessively thick targets are not being used
- Target material is electrically conductive when using a DC power supply

PLASMA TROUBLESHOOTING

PLASMA DISCHARGE EXTINGUISHES, IS INTERMITTENT OR ARCING OCCURS

- Insufficient pressure – check gas mass flow controllers, throttle valve and gas supply.
- Whisker growth or debris between anode and cathode

WEAK DISCHARGE - LOW DEPOSITION RATES

- Check for electrical leakage across insulators
- Power is being transmitted through cooling water lines - check for proper resistivity
- Weak magnet - verify against supplied profile(s) - are magnets being sufficiently cooled?
- Poor or no ground connection
- Suspect a weakened magnet module when target utilization degrades over time for the same thickness and type of target material used in an unchanged process environment. The erosion groove profile usually begins to become more pinched and wobbly in this circumstance. This will correlate to the fact that the power supply voltage must be increased to maintain the same power output. A sure indication that the magnet module must be replaced is when new targets cannot sustain the desired applied power level.

POWER SUPPLY CANNOT DELIVER FULL RATED POWER

- Low water resistivity - check for proper resistivity
- Additives in proprietary solutions used in closed loop water recirculators or house water are inappropriate
- Deionized water is being used - Immediately eliminate its use

- Materials other than copper, brass, stainless steel, PTFE and appropriate plastics are contained in closed loop or house water system - Immediately eliminate their use.
- Source is operating at low pressure (typically less than 5×10^{-4} Torr)
- High atomic weight materials like Au (gold) require several hundred volts more output from the power supply at equivalent pressures and operating conditions compared to most other commonly sputtered materials. In practice, this often means that the total power that can be applied to the target is limited by the upper voltage limit of the power supply.

SOLUTION SUGGESTIONS TO ALLEVIATE FULL POWER ISSUE

- Make sure that the maximum operating voltage of the power supply is enabled.
- Raise the operating pressure to suppress the voltage required. Be aware that increasing the pressure to too high a level can actually reduce the effective sputtering rate due to gas scattering. This pressure will vary by circumstance and system, but will occur in the region of 10 mTorr.
- Change the sputtering gas from argon to krypton, xenon or an argon/krypton argon/krypton gas mixture. It's desirable to match the atomic weight of the material being sputtered as closely as possible to that of the sputtering gas to achieve the best sputter yield/rate. The atomic weight of argon is nominally 40, compared to nominal 84 for krypton and 131 for xenon. The atomic weight of gold is nominally 196.
- Consider running at higher pressures than you would normally.

Here is a summary of the sputter yields for various gases @ 600 eV ion energy:

Ne - 1.15	Kr - 3.40
Ar - 2.75	Xe - 3.40

TARGET OVERHEATING

Dramatic, immediate increases in voltage and/or current are indications of target overheating.

Check for:

- Inadequate water flow
- Inlet water temperature not per specification
- Poor target bonding or target clamping
- Higher than permissible power density per duty cycle

Most commercially available small sputtering sources only allow for the use of clamped targets. Bonded or directly water-cooled targets are preferred due to the much superior target cooling these methods provide. Clamped targets should be used with caution and only at low power levels during short runs, otherwise damage may occur as shown below.





Clamped aluminum target run at 1500 watts for 3 minutes without thermal transfer foil or paste. Note target cracking, melting, shifting of plasma discharge area due to overheating.

POWER SUPPLY SHUTS DOWN

Water leaks, air leaks or other conditions that result in an arc rate of 1500 arcs/sec for 3-4 seconds will result in the error message “Arce” on the LED display. The power supply will be disabled until it is reset after the cause of the problem has been identified and eliminated.

Check for:

- Shorts caused by debris and particulates between anode and cathode surfaces – remove anode shielding and clean them. Use dry, unlubricated compressed air or dry nitrogen to blow out dark space region.
- Flakes or backscattered material across insulators. Disassemble and clean.
- Water leaks at the cooling water fittings. Validate that correct water line material is being used (hard shore required). Check for improperly tightened ferrules where compression fittings are being used. Make certain the bend radius of the tubing does not exceed its rating.
- Condensation on the utility fitting caused by cooling water temperature being too cold. Warm the cooling water and make sure the dew point is not reached.
- Water leak across target backing plate o-ring. Replace o-ring and check for debris in the o-ring groove, scratches in the sealing surfaces in the groove and across the backing plate sealing surface.
- Severely contaminated or highly oxidized target surface. Remove target and clean it. Targets with thick oxide layers can take many hours to clean. Start at low powers where the arcing level does not exceed 1500 arcs/sec for 3-4 seconds. Increase the power once the arc rate is reduced to near zero. Repeat this process until the target surface is clean and the desired power level can be applied to the target without arcing during process runs.
- Leaking flanges and ports in the process chamber. Use an RGA or helium leak detector to identify and remedy the problem.

MAINTENANCE

No routine maintenance of the power supply is required except for periodic cleaning. To clean, disconnect the unit from the AC supply and allow 30 seconds for discharging internal voltage. The front panel and the metal surfaces should be cleaned using mild solution of detergent water. The solution should be applied onto a soft cloth, and not directly to the surface of the unit. Do not use aromatic hydrocarbons or chlorinated solvents for cleaning. Use low pressure compressed air to blow dust from the unit.