

Instruction Manual

210 SERIES

Rack-Mount High Voltage Power Supply

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Spellman's Bertan brand of 210 Series of 125 to 225 watt high voltage power supplies provide regulated high voltage outputs from 1 to 50kV. The low noise, linear topology employed results in extremely low output ripple specifications. Units are inherently reversible by design, providing either positive or negative output polarity. The 210 is fully arc and short circuit protected. Excellent regulation specifications are featured along with outstanding stability performance.

TYPICAL APPLICATIONS

HiPot Testing
CRT Testing
Electrostatics
E Beam Systems
General Laboratory Usage

SPECIFICATIONS

Input Voltage:

115Vac, $\pm 10\%$, 50/60 Hertz @ 5 amps
230Vac, $\pm 10\%$, 50/60 Hertz @ 2.5 amps
Input voltage is switch selectable

Output Voltage:

See "model selection" table

Output Polarity:

1kV to 50kV units are inherently reversible by design

Output Current:

See "model selection" table

Voltage Regulation:

Line: $\leq 0.001\%$ of rated output voltage over specified input voltage range
Load: $\leq 0.005\%$ of rated output voltage for a full load change

Current Regulation:

Internally set to limit at 105% of rated current at full output voltage. Maximum output current at any other voltage setting must be derated linearly down to 30% of maximum at zero output voltage

Ripple:

See "model selection" table

- **STANDARD RACK MOUNTED DESIGN**
- **LOW RIPPLE AND NOISE**
- **REVERSIBLE OUTPUT POLARITY**

www.spellmanhv.com/manuals/210

Temperature Coefficient:

$\leq 50\text{ppm}/^\circ\text{C}$

Stability:

$\leq 0.01\%$ /hour, 0.02% per 8 hours after a 1/2 hour warm up

Accuracy:

Voltage Monitor: $\pm(0.25\%$ of reading + 0.25% of maximum)
Current Monitor: $\pm(0.5\%$ of reading + 0.25% of maximum)
Remote Programming; $\pm(0.25\%$ of setting + 0.05% of maximum) for 1kV to 30kV $\pm(0.5\%$ of setting + 0.25% of maximum) for 50kV
Front Panel Control: $\pm(0.25\%$ of setting + 0.05% of maximum) for 1kV to 30kV $\pm(0.5\%$ of setting + 0.25% of maximum) for 50kV
Front Panel Meter: $\pm 2\%$ of full scale

Operating Temperature

0°C to +50°C

Storage Temperature:

-40°C to +85°C

Humidity:

20% to 85% RH, non-condensing

Input Line Connector:

A captive 3 conductor line cord and NEMA plug is provided

Interface Connector:

7 pin Amphenol 126-198, mating connector and pins provided

Output Connector:

A detachable 10 foot (3 meter) long HV cable is provided

Cooling:

Internal fan, forced-air cooling

Dimensions

1-5kV: 19.0" W X 5.25" H X 11.0" D
(483mm X 133mm X 279mm)
10-50kV: 19.0" W X 5.25" H X 16.0" D
(483mm X 133mm X 406mm)

Weight:

≤ 40 pounds (18.1kg) up to and including 30kV units
 ≤ 50 pounds (22.7kg) for 50kV unit

Regulatory Approvals:

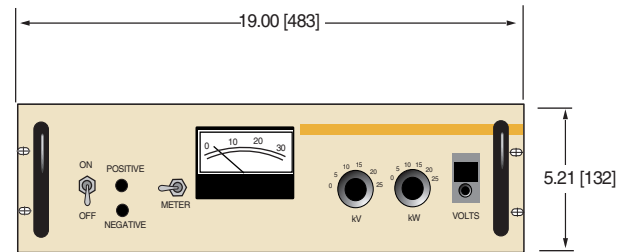
Compliant to 2004/108/EC, the EMC Directive and 2006/95/EC, the Low Voltage Directive.

MODEL SELECTION TABLE

210 Series	Voltage	Current	Ripple
210-01R	0 to 1kV	0 to 225mA	50mV
210-1.5R	0 to 1.5kV	0 to 130mA	100mV
210-02R	0 to 2kV	0 to 100mA	100mV
210-03R	0 to 3kV	0 to 75mA	100mV
210-05R	0 to 5kV	0 to 40mA	200mV
210-10R	0 to 10kV	0 to 15mA	500mV
210-20R	0 to 20kV	0 to 7mA	1 volt
210-30R	0 to 30kV	0 to 4.5mA	1.5 volts
210-50R	0 to 50kV	0 to 2.5mA	5 volts

DIMENSIONS: in.[mm]

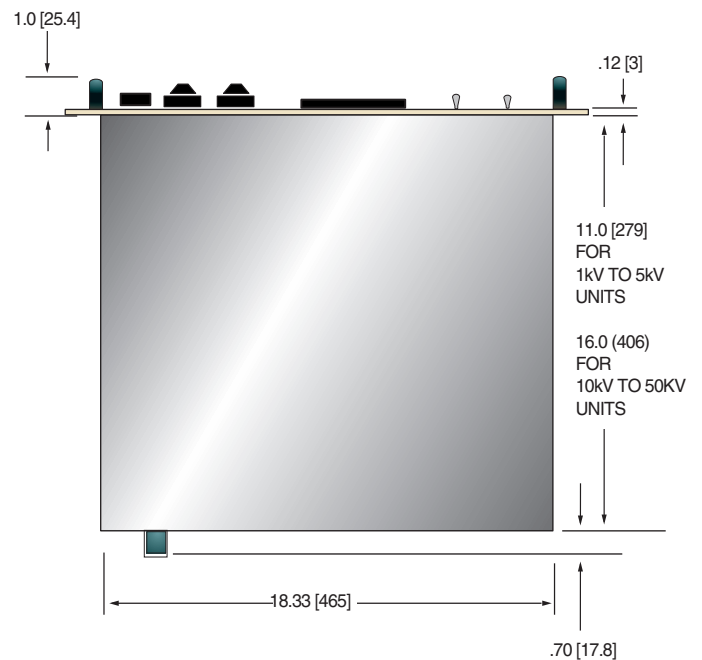
FRONT VIEW



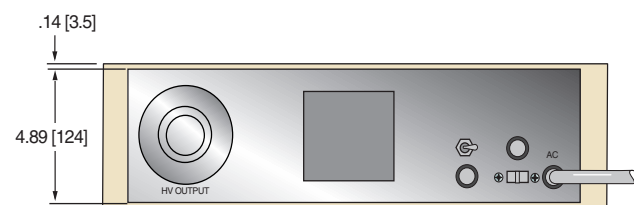
INTERFACE CONNECTOR

PIN	SIGNAL	PARAMETERS
A	-5Vdc Reference	-5.0Vdc @ 5mA, maximum
B	Voltage Program Input	0 to -5Vdc = 0 to 100% rated voltage, Zout = 10KΩ
C	Analog Ground	Ground
D	Current Monitor	0 to 5Vdc = 0 to 100% rated current, Zout = 10KΩ
E	Voltage Monitor	0 to 5Vdc = 0 to 100% rated voltage, Zout = 10KΩ
F	Polarity Indicator	Open collector output, ON = Positive Polarity
G	n/c	none

TOP VIEW



BACK VIEW



IMPORTANT SAFETY PRECAUTIONS

SAFETY

THIS POWER SUPPLY GENERATES VOLTAGES THAT ARE DANGEROUS AND MAY BE FATAL.
OBSERVE EXTREME CAUTION WHEN WORKING WITH THIS EQUIPMENT.

High voltage power supplies must always be grounded.

Do not touch connections unless the equipment is off and the Capacitance of both the load and power supply is discharged.

Allow five minutes for discharge of internal capacitance of the power supply.

Do not ground yourself or work under wet or damp conditions.

SERVICING SAFETY

Maintenance may require removing the instrument cover with the power on.

Servicing should be done by qualified personnel aware of the electrical hazards.

WARNING note in the text call attention to hazards in operation of these units that could lead to possible injury or death.

CAUTION notes in the text indicate procedures to be followed to avoid possible damage to equipment.

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This information contained in this publication is derived in part from proprietary and patent data. This information has been prepared for the express purpose of assisting operating and maintenance personnel in the efficient use of the model described herein, and publication of this information does not convey any right to reproduce it or to use it for any purpose other than in connection with installation, operation, and maintenance of the equipment described.

WICHTIGE SICHERHEITSHINWEISE

SICHERHEIT

DIESES HOCHSPANNUNGSNETZTEIL ERZEUGT LEBENSGEFÄHRLICHE HOCHSPANNUNG.
SEIN SIE SEHR VORSICHTIG BEI DER ARBEIT MIT DIESEM GERÄT.

Das Hochspannungsnetzteil muß immer geerdet sein.

Berühren Sie die Stecker des Netzteiles nur, wenn das Gerät ausgeschaltet ist und die elektrischen Kapazitäten des Netzteiles und der angeschlossenen Last entladen sind.

Die internen Kapazitäten des Hochspannungsnetzteiles benötigen ca. 5 Minuten, um sich zu entladen.

Erden Sie sich nicht, und arbeiten Sie nicht in feuchter oder nasser Umgebung.

SERVICESICHERHEIT

Notwendige Reparaturen können es erforderlich machen, den Gehäusedeckel während des Betriebes zu entfernen.

Reparaturen dürfen nur von qualifiziertem, eingewiesenem Personal ausgeführt werden.

“WARNING” im folgenden Text weist auf gefährliche Operationen hin, die zu Verletzungen oder zum Tod führen können.

“CAUTION” im folgenden Text weist auf Prozeduren hin, die genauestens befolgt werden müssen, um eventuelle Beschädigungen des Gerätes zu vermeiden.

PRECAUTIONS IMPORTANTES POUR VOTRE SECURITE

CONSIGNES DE SÉCURITÉ

CETTE ALIMENTATION GÉNÈRE DES TENSIONS QUI SONT DANGEUREUSES ET PEUVENT ÊTRE FATALES.
SOYEZ EXTRÊMEMENT VIGILANTS LORSQUE VOUS UTILISEZ CET ÉQUIPEMENT.

Les alimentations haute tension doivent toujours être mises à la masse.

Ne touchez pas les connectiques sans que l'équipement soit éteint et que la capacité à la fois de la charge et de l'alimentation soient déchargées.

Prévoyez 5 minutes pour la décharge de la capacité interne de l'alimentation.

Ne vous mettez pas à la masse, ou ne travaillez pas sous conditions mouillées ou humides.

CONSIGNES DE SÉCURITÉ EN CAS DE REPARATION

La maintenance peut nécessiter l'enlèvement du couvercle lorsque l'alimentation est encore allumée.

Les réparations doivent être effectuées par une personne qualifiée et connaissant les risques électriques.

Dans le manuel, les notes marquées « **WARNING** » attire l'attention sur les risques lors de la manipulation de ces équipements, qui peuvent entraîner de possibles blessures voire la mort.

Dans le manuel, les notes marquées « **CAUTION** » indiquent les procédures qui doivent être suivies afin d'éviter d'éventuels dommages sur l'équipement.

IMPORTANTI PRECAUZIONI DI SICUREZZA

SICUREZZA

QUESTO ALIMENTATORE GENERA TENSIONI CHE SONO PERICOLOSE E POTREBBERO ESSERE MORTALI.
PONI ESTREMA CAUTELA QUANDO OPERI CON QUESTO APPARECCHIO.

- Gli alimentatori ad alta tensione devono sempre essere collegati ad un impianto di terra.
- Non toccare le connessioni a meno che l'apparecchio sia stato spento e la capacità interna del carico e dell'alimentatore stesso siano scariche.
- Attendere cinque minuti per permettere la scarica della capacità interna dell'alimentatore ad alta tensione.
- Non mettere a terra il proprio corpo oppure operare in ambienti bagnati o saturi d'umidità.

SICUREZZA NELLA MANUTENZIONE.

- Manutenzione potrebbe essere richiesta, rimuovendo la copertura con apparecchio acceso.
- La manutenzione deve essere svolta da personale qualificato, coscio dei rischi elettrici.
- Attenzione alle **AVVERTENZE** contenute nel manuale, che richiamano all'attenzione ai rischi quando si opera con tali unità e che potrebbero causare possibili ferite o morte.
- Le note di **CAUTELA** contenute nel manuale, indicano le procedure da seguire per evitare possibili danni all'apparecchio.

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THIS UNIT CONTROLS HAZARDOUS VOLTAGES. DO NOT APPLY INPUT POWER UNLESS ADEQUATE GROUNDING IS PROVIDED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN PROPERLY CONNECTED.

THE DATA CONTAINED IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE. WRITTEN PERMISSION FROM SPELLMAN HIGH VOLTAGE IS REQUIRED PRIOR TO THE REPRODUCTION OF ANY TECHNICAL DATA CONTAINED IN THIS MANUAL.

WARNING

THIS UNIT CONTROLS HAZARDOUS VOLTAGES. DO NOT APPLY INPUT POWER UNLESS ADEQUATE GROUNDING IS PROVIDED TO THE POWER SUPPLY AND THE HIGH VOLTAGE OUTPUT HAS BEEN PROPERLY CONNECTED.

1.0 SCOPE OF MANUAL

This manual is provided to assist the user in the installation and operation of the Spellman Series 210 high voltage power supplies. Statements will apply to all models in all the Series unless reference is made to specific models. For the protection of personnel and equipment, it is essential that this manual be thoroughly read prior to the installation and application of power.

1.1 PURPOSE OF EQUIPMENT

The series 210 is a family of regulated precision laboratory high voltage power supplies. They provide exceptional performance in critical applications such as nuclear and electro-optical instrumentation, precision CRT and electron beam applications.

1.2 DESCRIPTION

The units are fully enclosed and designed to mount in a standard 19" rack. A wide range of stable output voltages, up to 50kV are available. The output voltage is controlled by the calibrated front panel controls or from a remote voltage or

resistance programming, or the Spellman Model 200-C488 (IEEE-488 interface) can provide intelligent remote IEEE-488 programming and monitoring of any Series 210 power supply.

The units are reversible polarity. Polarity reversal is achieved on 1kV through 5kV units by means of a polarity switch on the rear panel. On 10kV through 50kV units, polarity reversal is via an internal polarity reversing assembly. Optional floating outputs, Suffix RF are also available.

The Series 210 units consist of a DC power supply which converts the AC line power to a low DC voltage and a DC to DC converter which generates the high DC voltage. Low voltage electronics solid state circuits are mounted on a single plug-in printed circuit board and the high voltage assembly is fully encapsulated in silicone rubber for reliable, arc-free, stable operation.

1.3 MECHANICAL SPECIFICATIONS

Physical dimensions and weight of all models are specified as listed in TABLE 1.1 (NOTE: The depth given in the chart below is depth of the chassis behind the front panel and does not include allowance for the rear panel high voltage or remote connectors).

TABLE 1.1

MODEL	SIZE	WEIGHT
	ALL UNITS ARE 19" WIDE HIGH " X DEEP (mm)	Lbs (kgms)
210-01R	5.25 X 11 (133 X 279)	34 (15.3)
210-01.5R	5.25 X 11 (133 X 279)	34 (15.3)
210-02R	5.25 X 11 (133 X 279)	34 (15.3)
210-03R	5.25 X 11 (133 X 279)	34 (15.3)
210-05R	5.25 X 11 (133 X 279)	34 (15.3)
210-10R	5.25 X 16 (133 X 406)	34 (15.3)
210-20R	5.25 X 16 (133 X 406)	37 (16.8)
210-30R	5.25 X 16 (133 X 406)	39 (17.7)
210-50R	5.25 X 16 (133 X 406)	46 (20.9)

SECTION II OPERATION

CAUTION – THIS UNIT CAN STORE HAZARDOUS VOLTAGE. COMPLETELY DISCHARGE HIGH VOLTAGE AT REAR PANEL GROUND TERMINAL BEFORE ATTEMPTING REMOVAL OF THE HIGH VOLTAGE CABLE.

2.1 INSTALLATION

The series 210 high voltage power supplies mount in a standard 19" wide rack.

2.2 INPUT POWER

Input AC line voltage required is 115/230 Vac + 10%, 50 – 60 Hz single phase. The recessed LINE VOLTAGE selector switch on the rear panel selects either 115 Vac or 230 Vac operation.

The toggle switch on the front panel is used to turn the unit on. A led indicator light is illuminated when the unit is under power.

2.3 VOLTAGE CONTROL

The standard Series 210 power supply has three modes of controlling the high voltage output, available to the user. Set the LOCAL /REMOTE switch on the rear panel to LOCAL if front panel control is desired. If remote operation is required, set the switch to REMOTE. The high voltage output can be remotely programmed from either an external voltage source or with an external potentiometer. When in the REMOTE position the front panel controls have no effect on the output voltage and therefore need not to be turned to zero. When in the LOCAL position, the front panel controls determine the high voltage output independent of any programming input.

2.3.1 LOCAL CONTROL

The output voltage can be set by the controls on the front panel. A continuous 10 turn digital dial directly reads from 0 to 1000v with a resolution of 0.2 V on all models, except those with an output greater than 30kV.

A 1kV selector switch, with up to 10 positions as appropriate is used on all 3kV to 30kV models.

A 5kV selector switch, with up to 6 positions as appropriate is used on all 20kV and 30kV models.

The output voltage is the sum of the dial settings as described above.

The 50kV model employ a continuous multi- turn digital dial to control the high voltage output, resolution and resetability of this potentiometer is 20.0V.

2.3.2 REMOTE CONTROL

The high voltage output can be remotely programmed from either an external voltage source or with an external potentiometer from the internal reference voltage source. A 0 to –5V programming voltage applied to Pin B of J2 (PROGRAMMING/MONITOR) connector jack on the rear panel will remotely program the high voltage output from zero to maximum OUTPUT. Programming can also be accomplished using a potentiometer connected between Pin a (-5V), Pin

C (GND) and with the wiper connected to Pin B (PRGM INPUT). The potentiometer should be a low temperature coefficient wire wound or cermet type, 5kΩ to 20kΩ resistance value. The output is proportional to the programming input. TABLE 2.1 below lists the PROGRAMMING/MONITOR connector pin designations.

TABLE 2.1

PIN #	FUNCTION
A	-5 volt reference output
B	Remote program input
C	Ground
D	Remote current monitor output
E	Remote voltage monitor output
F	Polarity ident (gnd+/-open -)
G	No connection

CAUTION – LINE INPUT POWER MUST BE TURNED OFF AND THE HIGH VOLTAGE SHOULD BE DISCHARGED FULLY BEFORE PROCEEDING TO REVERSE THE POLARITY.

2.3.3 MODELS 1kV TO 5kV OUTPUT

The screwdriver operated POLARITY SELECTION switch is accessible at the rear panel of the instrument.

2.3.4 MODELS 10kV to 50kV OUTPUT

The polarity is reversible by means of an internal switching mechanism which is easily accessible upon removal of the top cover.

The polarity is reversed by removing the bracket containing the high voltage connectors, rotating the bracket 180 and then re-inserting it. An interlock automatically assures that the high voltage cannot be turned on until this bracket is installed in either position.

A remote polarity indication is provided at J2 (PROGRAMMING/MONITOR) connector jack located on the rear of the unit. Pins F and H of J2 are shorted when the polarity is set for positive output and are open when the terminals are set for negative output. These terminals are both isolated, (see TABLE 2.1).

2.4 REMOTE MONITORING

Remote current and voltage monitoring signals are available at Pins D and E respectively of the PROGRAMMING/MONITOR connector. A 0 to 5V voltmeter or a 0 to 100µA current meter may be used to monitor both current (Pin D) and voltage (Pin E) for the full output range. Both outputs are positive polarity regardless of the actual polarity of the output voltage.

Remote output voltage monitor; 0 to +5 volts (49.9K series impedance) for 0 to max rated output voltage.

Remote output current monitor; 0 to +5 volts (49.9K series impedance) for 0 to max rated output current except as shown for the models listed below in TABLE 2.2 below.

TABLE 2.2

MODEL	mA MONITOR (FULL SCALE)
210-01R	0 to +5 volts via 49.9kΩ for 0 to 225mA
210-01.5R	0 to +5 volts via 49.9kΩ for 0 to 130mA
210-02R	0 to +5 volts via 49.9kΩ for 0 to 100mA
210-03R	0 to +5 volts via 49.9kΩ for 0 to 75mA
210-05R	0 to +5 volts via 49.9kΩ for 0 to 40mA
210-10R	0 to +5 volts via 49.9kΩ for 0 to 15mA
210-20R	0 to +5 volts via 49.9kΩ for 0 to 7mA
210-30R	0 to +5 volts via 49.9kΩ for 0 to 4.5mA
210-50R	0 to +5 volts via 49.9kΩ for 0 to 2.5mA

2.5 CURRENT LIMITING

The series 210 includes a current limiting circuit that drops the output voltage to a safe level when the rated output current is exceeded by approximately 20%. (See specification on Maximum Current when operating the unit at reduced output voltages or when operating in a current limit mode for capacitor charging).

2.6 HIGH VOLTAGE OUTPUT

The high voltage output connector is located on the rear panel. An appropriate shielded mating connector is supplied with each unit.

TABLE 2.3

MODEL	HIGH VOLTAGE CONNECTOR	
	OUTPUT	MATING
210-01R	JAC	PAE
210-01.5R	JAC	PAE
210-02R	JAC	PAE
210-03R	JAC	PAE
210-05R	JJA	405787
210-10R	JJA	405787
210-20R	JJA	405787
210-30R	JJB	405786
210-50R	JJB	405786

SECTION III = THEORY

3.1 FUNCTIONAL DESCRIPTION

The Series 210 utilizes a DC to DC converter circuit which converts low voltage DC power to a high voltage Dc output. This output voltage is highly regulated and filtered and can be varied either by

the front panel controls or through the REMOTE PROGRAM input on the rear panel. The input to the DC to DC converter is obtained from internal low voltage power supplies powered by the AC line input.

An oscillation determines the frequency (approximately 20kHz) at which all amplification, high voltage transformation, rectification and filtering occurs. The amplification is a function of a control voltage which performs the function of control and regulation. A sample of the output voltage is compared against a reference voltage in the sensing circuit. The sensing circuit generates the control voltage to set and maintain a fixed voltage output.

3.2 CIRCUIT DESCRIPTION

The input AC line is converted to the B+ (36Vdc) supply and regulated ± 12 Vdc low voltage power supplies. The B+ supply is a filtered full wave rectifier circuit located on the chassis. The regulated low voltage power supply circuit (± 12 Vdc) consists of a rectifier circuit located on the T1 and output regulators located of the PCB 100.

The output of the oscillator circuit is amplified in the AGC amplifier. The gain of the ACG amplifier is a function of the control voltage developed at the output of the error amplifier.

The encapsulated high voltage assembly includes a high voltage power transformer, rectifier or multiplier circuits, ripple filter and sensing circuits. These are all critical custom designed and encapsulated components.

A sample of the high voltage Dc output is fed to the output voltage sensing circuits and is compared to a command voltage. Output voltage control is obtained by varying the command voltage fed to the error amplifier. The error amplifier compares the command voltage and the correction in the gain control of the ACG amplifier. The command voltage is controlled by the front panel controls when the rear panel program switch is in the LOCAL position.

The reference and reference control and buffer provide a stable -5 Vdc to the front panel output voltage controls.

The current sensing circuit monitors the output current. The buffered output of this circuit is employed for both internal and remote current monitoring.

SECTION IV MAINTENANCE

4.1 GENERAL

The high voltage power supply should not require any maintenance or calibration. It is designed for reliable, trouble free operation. If any question should arise, contact the Spellman Customer Service Department for assistance or return authorization. Although adequate information is provided in the schematics provided with this manual, it is suggested that the unit be returned to the factory if service should become necessary.

CALIBRATION SERVICES

Your Spellman high voltage power supply is designed to provide years of reliable service. For a nominal charge it can be returned to the factory for annual calibration to its original specification. For traceability, a certificate will be issued, identifying the serial number of the unit calibrated and all test equipment used to perform the calibration. All measurements are traceable to the National Institute of Standards and Technology (N.I.S.T.). Contact the factory at (914) 686-3600 for additional details.

SPELLMAN HIGH VOLTAGE ELECTRONICS

WARRANTY

Spellman High Voltage Electronics ("**Spellman**") warrants that all power supplies it manufactures will be free from defects in materials and factory workmanship, and agrees to repair or replace, without charge, any power supply that under normal use, operating conditions and maintenance reveals during the warranty period a defect in materials or factory workmanship. The warranty period is twelve (12) months from the date of shipment of the power supply. With respect to standard SL power supplies (not customized) the warranty period is thirty-six (36) months from the date of shipment of the power supply.

This warranty does not apply to any power supply that has been:

- Disassembled, altered, tampered, repaired or worked on by persons unauthorized by **Spellman**;
- subjected to misuse, negligent handling, or accident not caused by the power supply;
- installed, connected, adjusted, or used other than in accordance with the original intended application and/or instructions furnished by **Spellman**.

THE FOREGOING WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THOSE OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

The buyer's sole remedy for a claimed breach of this warranty, and **Spellman's** sole liability is limited, at **Spellman's** discretion, to a refund of the purchase price or the repair or replacement of the power supply at **Spellman's** cost. The buyer will be responsible for shipping charges to and from **Spellman's** plant. The buyer will not be entitled to make claim for, or recover, any anticipatory profits, or incidental, special or consequential damages resulting from, or in any way relating to, an alleged breach of this warranty.

No modification, amendment, supplement, addition, or other variation of this warranty will be binding unless it is set forth in a written instrument signed by an authorized officer of **Spellman**.

Factory Service Procedures

For an authorization to ship contact **Spellman's** Customer Service Department. Please state the model and serial numbers, which are on the plate on the rear panel of the power supply and the reason for return. A Return Material Authorization Code Number (RMA number) is needed from **Spellman** for all returns. The RMA number should be marked clearly on the outside of the shipping container. Packages received without an RMA Number may delay return of the product. The buyer shall pay shipping costs to and from **Spellman**. Customer Service will provide the Standard Cost for out-of-warranty repairs. A purchase order for this amount is requested upon issuance of the RMA Number (in-warranty returns must also be accompanied by a "zero-value" purchase order). A more detailed estimate may be made when the power supply is received at **Spellman**. In the event that the cost of the actual repair exceeds the estimate, **Spellman** will contact the customer to authorize the repair.

Factory Service Warranty

Spellman will warrant for three (3) months or balance of product warranty, whichever is longer, the repaired assembly/part/unit. If the same problem shall occur within this warranty period **Spellman** shall undertake all the work to rectify the problem with no charge and/or cost to the buyer. Should the cause of the problem be proven to have a source different from the one that has caused the previous problem and/or negligence of the buyer, **Spellman** will be entitled to be paid for the repair.

Spellman Worldwide Service Centers

For a complete listing of **Spellman's** Global Service facilities please go to:
<http://www.spellmanhv.com/customerservice/service.asp>