



Instruction Manual

230 SERIES

Bench Top High Voltage Power Supply

**SPELLMAN
HIGH VOLTAGE ELECTRONICS
CORPORATION**
One Commerce Park
Valhalla, New York, 10595

+1(914) 686-3600 * FAX: +1(914) 686-2870
E-mail: sales@spellmanhv.com
Website: <http://www.spellmanhv.com>

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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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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SECTION 2 OPERATION

1.1 PURPOSE OF THE EQUIPMENT

The Series 230 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 Series 230 is a family of compact bench top power supplies with output voltages up to 30 kV. The units consist of a DC power supply that converts the AC line power to a low DC voltage and a DC to DC converter that generates the high DC output voltage. Low voltage electronic solid-state circuitry is mounted on the PCB100, and the high voltage assembly is fully encapsulated for reliable, arc-free, operation.

These stable, low noise high voltage power supplies feature front panel digital voltage and current metering, and calibrated direct-reading front panel controls. The high voltage output is also obtainable from the front panel. The rear panel features a connector for remote analog programming and output voltage and output current monitoring, line power plug, fuse, and AC voltage selection switch. All units have arc and short circuit protection for safe, reliable, and arc-free operation. Although primarily designed for rack mounting, the unit may also be used in benchtop applications.

1.3 OPTIONS

Isolated Floating Output

Units can be provided with the output capable of floating up to ± 2 kV from ground. All controls, programming and monitoring functions operate normally, referenced to ground. The high voltage output polarity, with respect to the floating input terminal is reversible.

1.4 SAFETY TERMS

The **WARNING** used in this manual explains dangers that could result in personal injury or death.

The **CAUTION** used in this manual explains hazards that could damage the instrument.

2.1 INSTALLATION

WARNING! *This unit produces hazardous voltage. Do not apply line voltage input unless adequate ground is connected to the unit and the high voltage output has been properly connected.*

2.2 FRONT PANEL CONTROLS AND DISPLAYS

Output Connector:

The HV output connector on the 1kV through 5kV models mate with a shielded mating connector supplied with each unit. Refer to the specifications on page 12 to identify the mating connector. Assembly procedures for mating connectors are given at the end of this manual. On 10kV through 30kV models, an unshielded, preassembled high voltage cable connected to the appropriate connector is provided with each unit. Only the proper mating connector should be used with the indicated power supply and the power supply should NEVER be energized without a mating connector and suitable load connected.

Power Switch:

A rocker switch turns the line power on or off to the entire instrument. The display panel will be lit when line power is applied to the unit.

Output Meter:

The digital output meter can display the output current or the output voltage. A switch below the meter allows the operator to select which output parameter to monitor. The accuracy of the meter is given in the specification (see page 12).

Polarity Indicator:

An LED on the front panel display indicates the polarity of the output. The appropriate LED is lit as soon as line power is applied regardless of whether high voltage output is enabled or disabled. To change the polarity setting, see paragraph 2.4.

Voltage Control:

A continuous multi-turn digital dial is used to adjust the high voltage output. The resolution 0.2% of maximum.

2.3 REAR PANEL CONTROLS, CONNECTORS, AND TERMINALS

Gnd:

Ground is connected to the case of the Series 230.

Fuse:

The fuse is the ac line power fuse. It is rated for 1A, 250Vac for 105Vac-125Vac operation and 0.5A, and 250Vac for 210Vac-250Vac operation. Should a fuse ever need replacement, only these values should be used unless otherwise advised by a qualified BERTAN service technician.

Line Voltage Selector:

The line voltage selector selects the appropriate line voltage 105Vac-125Vac or 210Vac-250Vac at 50-60 Hz. By default, power supplies are shipped from the factory in the 105-125V position. Before energizing your power supply, verify that the line voltage selector switch is in the proper position for your mains input.

AC Line Plug:

The IEC 320 line plug receptacle accepts a three-wire female line plug for ac line power.

WARNING! *This unit is equipped with a three-wire grounded line cord. This must be used with a three-wire receptacle where the "third wire" is connected to earth ground; otherwise personal injury or death may occur.*

2.4 POLARITY REVERSING:

WARNING! *Before attempting to reverse the power supply's polarity, the power supply must be turned off and the output fully discharged. Failure to follow these procedures may result in damage to the power supply, associated test equipment and/or personnel.*

For 1kV to 5kV output models, a screwdriver-adjustable POLARITY SELECTOR SWITCH is accessible at the rear panel of the unit, next to the HV output connector. For 10kV to 50kV output models, the polarity of the HV output is reversible by means of an internal switching

mechanism that is easily accessible upon removal of the top cover. The polarity reversal module is a clear plastic assembly identified by the exiting silicone high voltage cables. It is a two-part assembly. To change the polarity, turn off power supply, remove all cover screws holding the top cover on and:

- a. Remove the two diagonally opposed screws fastening the top portion of the module assembly to the bottom portion. NOTE: DO NOT DESOLDER WIRES OR PINS.
- b. Carefully separate the module by pulling the top portion from the bottom portion. The module portions are fitted very snugly and removal may be eased by slightly rocking the assembly.
- c. Rotate the top portion of the module assembly 180°, taking care not to unduly stress the high voltage cables.
- d. Rejoin the 2 portions of the module assembly. Make sure that the top portion is entirely seated to the bottom portion. NOTE: An interlock automatically insures that the high voltage cannot be applied until the portions of the module are properly mated.
- e. Resecure the top portion to the bottom portion of the Polarity Reversal Module Assembly.
- f. Re-cover the power supply.

2.5 PREPARATION FOR USE

WARNING! *Before energizing your power supply, thoroughly review and follow these procedures. Failure to do so may result in damage to equipment and injury or death to personnel.*

To prepare the Series 230 for use, use the following procedure:

Set the Series 230 for the appropriate line voltage as specified in Section 2.3.

Connect a ground strap from case ground (on the rear panel) to a system common.

Select the appropriate HV output polarity for the application.

Set the front panel controls to:

- a. Power Switch - OFF
- b. Output Voltage Switch(s) – 0 (205B only).
- c. Multi Turn Digital Dial - 000 (fully counterclockwise)

Set the LOCAL/REMOTE (ANALOG/DIGITAL) rear panel switches (205B only) to:

- a. LOCAL for local front panel operation.
- b. REMOTE/ANALOG for remote analog operation. Note: Selecting the REMOTE control will override all local front panel controls of the output.
- c. REMOTE/DIGITAL for Computer Programming if equipped with a CBNY option. Reference Section 2.7.

Plug the line cord into the power line with a three-wire IEC receptacle to maintain proper case ground.

WARNING! This unit is equipped with a three-wire grounded line cord. This must be used with a three-wire receptacle where the "third wire" is connected to earth ground; otherwise personal injury or death may occur.

Connect the output of the Series 230 to the circuit. Use a properly rated shielded cable with the supplied HV output connector to insure good circuit connections and safe operation. Refer to Section 2.10.

WARNING! Prior to connecting or removing any equipment from the High Voltage power supply, always return the Output Voltage Control(s) to 0V prior to applying or removing power. External circuits may retain voltage after controls are set to zero. Discharge any residual voltage before connecting or removing any equipment.

2.6 LOCAL OPERATION

Turn POWER - ON to the instrument. Slowly increase the output voltage using the appropriate Voltage Control(s) until the desired output level

is reached. Apply power to the load by switching the High Voltage - ON. The output will quickly reach the value set by the controls. Full stability will be achieved after approximately 30 minutes.

2.7 REMOTE OPERATION

PROGRAM CONTROL SWITCH:

Before the Series 230 can be remotely programmed, the instrument must be configured by setting the rear panel PROGRAM CONTROL SWITCH (S102) to the REMOTE ANALOG position (206B is only programmable through the rear panel and therefore S101 is omitted). All monitoring and enable functions are active, independent of the S102 switch, as are the front panel meters. When in remote mode the front panel controls are inactive.

REMOTE PROGRAMMING:

The high voltage output can be remotely programmed from either an external voltage source or with an external potentiometer using the internal reference voltage source (Pin 4). A 0 to +5Vdc programming voltage applied to Pin 6 of J107 (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 4 (+5Vdc), Pin 7 (GND) and with the wiper connected to Pin 6 (PRGM INPUT). The potentiometer should be a low temperature coefficient wirewound or cermet type, 5k Ω to 20k Ω resistance values. The power supply output will be proportional to the programming input. The programming input impedance is greater than 1M Ω . TABLE 2.1 below lists the PROGRAMMING / MONITOR connector pin designations. The accuracy of the remote programming is detailed in the specifications.

TABLE 2.1 - J107 PIN DESIGNATIONS

PIN #	FUNCTION
1	Output voltage monitor, buffered, 0 to +5Vdc (output impedance 10k Ω)
2	No connection

3	Enable/Disable. Input logic zero <u>disables</u> high voltage generation. Open circuit or input logic one <u>enables</u> high voltage generation.
4	Precision +5Vdc reference output referenced to analog ground.
5	Output current monitor, buffered, 0 to +5Vdc (output impedance 10k Ω)
6	Remote analog voltage programming input, 0 to +5Vdc
7	Analog Ground
8	Digital Ground
9	Polarity Indicator

REMOTE ANALOG MONITORING:

Buffered, analog output monitors, 0 to + 5Vdc, linearly proportional to the power supply's voltage and current output are provided. To monitor the output voltage, connect a high impedance meter to pin 1 and pin 7 (ground). To monitor the output current, connect a high impedance meter to pin 5 and pin 7 (ground). The accuracy of the voltage and current monitors is given in the specifications (see page 12). The monitor output impedance is approximately 10k Ω .

ENABLE/DISABLE:

A TTL level logic TRIP input signal can be used to enable or disable the power supply output remotely. Input logic zero or grounding pin 3 disables high voltage generation. Open circuit or input logic one on pin 3 enables high voltage generation.

+5Vdc REFERENCE OUTPUT:

A precision +5Vdc reference output is provided on pin 4 for the user's convenience. This fixed output can be used for remote resistance programming (see REMOTE PROGRAMMING, above) or various control functions. This output is referenced to analog ground (pin 7).

POLARITY INDICATOR:

A TTL polarity indicator output signal is available at pin 9. An NPN open collector connection with respect to digital ground indicates the high voltage output polarity. NPN saturation denotes positive polarity.

2.8 COMPUTER PROGRAMMING (Optional)

GENERAL:

All Series 230 instruments can be provided with a factory-installed option for remote digital programming of the high voltage output. The programming inputs are TTL compatible and the data is positive logic (all data bits low yield 0 high voltage output). The addition of this option allows the unit to be easily interfaced to any computer or microprocessor utilizing one of its three user selectable modes of operation.

16 Bit Transparent: The 16 bit data is passed from the inputs directly to the DAC. This is the default mode (is 100% compatible with all previous CBNY digital programming boards).

16 Bit Register: The 16 bit data is latched into an internal 16-bit register in one write cycle.

8 Bit Register: Two 8-bit bytes (Most Significant Byte and Least Significant Byte) are latched into two 8-bit registers. The MSB and LSB registers are individually addressed and written. This allows an 8 bit data bus system to provide 16 bit programming in two write cycles.

The register modes utilize standard Chip Select and Write Enable protocol allowing the CBNY to act as a memory mapped register or an I/O port attached directly to an 8 or 16 bit microprocessor system bus. In addition, any standard unit in the Series 230 can be computer programmed and monitored using the Bertan B-HiVE minicomputer controlled enclosure with the appropriate interface module. Remote TTY or RS-232C control at selectable 110 to 9600-baud rate is possible. A separate IEEE-488 interface is also available for use with the Series 205B high voltage power supplies. See the Model 200-C488 data sheet for complete information.

FUNCTIONAL DESCRIPTION:

Connector J3 (Amphenol 57-40240) accepts the remote binary coded inputs and is located on the rear panel. When the REMOTE/LOCAL switch is in the REMOTE DIGITAL position, control of the unit is dependent upon the digital signals present at Pin 2 through Pin 17 of J3. Pin 2 is for the most significant bit, with increasing pin numbers having lower significant bits. Pin 17 is the least significant bit input. Positive logic is

used, with logic 0 on all 16 data lines needed for 0 volts output.

The incremental resolution is a function of the power supply's maximum output. The resolution for different models in the Series is listed in TABLE 2.2 below.

TABLE 2.2 – SERIES 230 DIGITAL PROGRAMMING RESOLUTION

-01R	0.02V
-03R	0.05V
-05R	0.08V
-10R	0.16V
-20R	0.31V
-30R	0.50V
-50R	0.80V

OPERATION:

In addition to the 16 data lines, J3 contains ground and +5Vdc output on Pins 21 and 22 respectively, and five control lines described below. The +5Vdc and ground allow remote control via an external digitally coded switch.

The digital data at the input can continuously control the power supply output high voltage. The detailed functions of the control inputs are described below.

Pin 01: 16/8. If strapped to "1" or left open the device operates as a 16 bit parallel input. If strapped to "0" the device operates as an 8 bit parallel bus with the BS input selecting the byte being written.

Pin 18: CS-Chip Select (device select). When "0" the data on the bus may be written into the latches by the WR signal.

Pin 19: WR-Write. When "0" with CS, "0" the input to the DAC the data on the bus. When the first CS or WR is returned to "1" the data present on the bus is latched into the DAC.

Pin 20: BS-Byte Select. If the 16/8 input is strapped to "0", a "1" on the BS selects the least significant byte to write data to. If BS is "0" data is written to the most significant byte. If 16/8 input is "1" or open the BS lead has no effect.

Pin 23: Enable. If strapped to "0" or open the output of the latch (input of the DAC) is at high impedance and the input of the DAC set to zero. If strapped to "1" the output of the latch is enabled and the data at the input of the DAC is dependant on the CS WR and F/L.

Pin 24: F/L-Latch/Follow. If strapped to "0" the device operates in a latching mode where data on the data bus is latched into^o on board latches by a write pulse. If strapped to "1" or left open, the data at the input to the D to A follows the data on the data bus regardless of the levels on CS, WR or BS. The 16/8 must be open or strapped to "1" when in the follow mode or the most significant byte to the DAC will be identical to the least significant byte input.

Byte select must be valid at least 25ns before WR goes low and remain valid at least 40ns after the first of CS or WR to go high.

All timing is from the latter of CS or WR going low and from earlier of CS or WR going high.

The minimum common low time of WR and CS is 40ns. Data must be valid at least 125ns before the earlier of CS or WR goes high and remain valid at least 20ns after that time.

2.9 INPUT POWER

Input AC line voltage required is 115Vac/230Vac ±10%, 50-60Hz, single phase. The recessed LINE VOLTAGE selector switch on the rear panel selects either 115 Vac or 230 Vac operation. By default, power supplies are shipped from the factory in the 115Vac position. Before energizing your power supply, verify that this switch is in the proper position for your mains input.

2.10 CURRENT LIMITING

The Series 230 includes a current limiting circuit that drops the output voltage to a safe level when the rated output current is exceeded by approximately 5%. (See specification on Current Capability when operating the unit at reduced output voltages or when operating in a current limit mode for capacitor charging).

2.11 HIGH VOLTAGE OUTPUT

The high voltage output connector is located on the rear panel. An appropriate shielded mating connector is supplied with each unit. These connectors are as listed in Table 2.3. Refer to pages 13-16 for the mating connector assembly instructions. Only the proper mating connector should be used with the indicated power supply and the power supply should never be energized without a mating connector and suitable load connected.

TABLE 2.3: SERIES 230 HIGH VOLTAGE CONNECTORS

MODEL	OUTPUT	MATING
-01R	JDK	PDB
-03R	JDK	PDB
-05R	JDK	PDB
-10R	JJA	405787
-20R	JJA	405787
-30R	JJA	405787
-50R	JJB	405786

SECTION 3 THEORY OF OPERATION

3.1 FUNCTIONAL DESCRIPTION

The circuit uses a DC to DC converter that 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 oscillator 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 that 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 high voltage output.

3.2 CIRCUIT DESCRIPTION

The input AC line is converted to the B+ (36Vdc) supply and regulated +12Vdc 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 (+12Vdc) consists of a rectifier circuit located on T1 and output regulators located on the PCB 100.

The output of the oscillator circuit is amplified in the AGC amplifier. The gain of the AGC 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 circuit 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 signal from the output voltage sense circuit. Any difference causes a correction in the gain control of the AGC 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 +5Vdc 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.

3.3 CURRENT CAPABILITY

The maximum current rating for each model, as shown in the table to the left, is applicable when the unit is operated at maximum output voltage. When operated at reduced output voltage levels, or when operating in a current limit mode for charging capacitors, the output current must be limited to reduced levels. This is required to protect against excessive power dissipation of the driver transistors.

The maximum output current must be linearly derated from maximum output voltage to 30% of

maximum current at zero output voltage. Maximum output current available at any desired voltage can be calculated by applying the following formula:

$$I_{max} = V_{set}(.7I_{rated}/V_{rated})+.3I_{rated}$$

When operating the power supply as a capacitor charger (i.e., a capacitor is being continuously discharged then recharged from zero voltage by the power supply) use a charging resistor in series with the power supply output. The resistance should be equal to the power supply's maximum rated output voltage divided by the maximum rated output current.

The above derating factors are safe for all conditions and all models. Consult BERTAN for special cases before exceeding these factors.

SECTION 4 MAINTENANCE

4.1 GENERAL

The Series 230 instrument should not require any maintenance. It is designed for reliable, trouble free operation. If any question should arise, contact the Bertan Customer Service Department for assistance or return authorization. It is suggested that the unit be returned to the factory if service should become necessary.

4.2 CLEANING

Cleaning of the power supply should *only* be performed with the supply disconnected from the ac power source. A soft cloth moistened with conventional ammonia-based cleaning agents will suffice for all exposed surfaces. The metal shell of the HV connector should be cleaned with isopropyl alcohol.

If the supply is operated in a dusty environment, an accumulation of dust/debris may build-up inside the unit which may cause noisy operation (i.e., "ticking" or minor crackling) in the area of the HV cabling on the -10R through -50R. The safest way to remove such debris is with compressed air. Ensure that no dust/debris is left behind in the insulative medium of the HV output connector after this cleaning operation. Such dust may be removed with a cotton swab moistened with isopropyl alcohol.

4.3 CALIBRATION SERVICES

Your BERTAN high voltage power supply is designed to provide many years of reliable service. For a nominal charge it can be returned to the factory for calibration and certification 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 (NIST). Calibration is guaranteed from 1 year of issuance. Contact the factory at (516) 433-3110 or your local sales representative for additional details.

To obtain information on Spellman's product warranty please visit our website at:

<http://www.spellmanhv.com/en/About/Warranty.aspx>

