

# Instruction Manual

## XRM SERIES

### High Voltage Power Supply

MODEL :  
SERIAL# :  
DATE :

**SPELLMAN  
HIGH VOLTAGE ELECTRONICS  
CORPORATION**

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- **OUTPUT VOLTAGES FROM 25KV TO 65KV**
- **ADJUSTABLE INTEGRATED FILAMENT SUPPLY**
- **OVERVOLTAGE & SHORT CIRCUIT PROTECTION**
- **VOLTAGE & CURRENT PROGRAMMING**
- **LOCAL AND REMOTE EMISSION CONTROL**
- **SAFETY INTERLOCK**
- **OEM CUSTOMIZATION AVAILABLE**

Spellman's XRM Series of regulated X-ray power supplies offer output voltages to 65kV and incorporate a filament supply which provides regulated dc current adjustable between 0.3A and 3.5A at 5.5V. High voltage and filament current can be linearly ramped up. The XRM incorporates local and remote programming, monitoring, safety interlock, short-circuit and overload protection.

### TYPICAL APPLICATIONS

Powering grounded cathode X-ray tubes from KeveX, Oxford, RTW, Superior, Varian and Trufocus.

### OPTIONS

- AC** AC Filament
- CPC** Constant Power
- BIAS** Bias Supply
- TP(x)** Alternate Test Point Scaling

### SPECIFICATIONS

#### Input:

+24Vdc $\pm$ 10%, 4.25A maximum.

#### Output:

4 models with positive output polarity and adjustable voltages from zero to maximum voltage and current.

#### Voltage Control:

Local: Internal multi-turn potentiometer to set voltage from 0 to full output voltage.

Remote: 0 to +10Vdc proportional from 0 to full output voltage. Accuracy:  $\pm$ 1%.  $Z_{IN}$ : 10Mohm.

#### Emission Control:

Local: Internal potentiometer to set beam current between 0 and full output.

Remote: 0 to +10Vdc proportional from 0 to full output current. Accuracy :  $\pm$ 1%.  $Z_{IN}$ : 10Mohm.

#### DC Filament Supply:

Current: 3.5A, adjustable  
Voltage: 5.5V

#### Voltage Regulation:

Load: 0.01% of output voltage no load to full load.  
Line:  $\pm$ 0.01% for  $\pm$ 10% change in input voltage.

#### Current Regulation:

Load: 0.01% of output current from 0 to rated voltage.  
Line: 0.01% of rated current over specified input range.

#### Ripple:

0.25% p-p of output voltage.

#### Temperature Range:

0°C to +50°C operational

#### Temperature Coefficient:

0.01% per °C, voltage or current regulated.

#### Stability:

0.05% per 8 hours after 1/2 hour warm-up.

#### Voltage and Current Monitors:

0 to +10Vdc proportional from 0 to rated output.  
Accuracy  $\pm$ 1%.

#### Dimensions:

6.3"H x 3.937"W x 10"D (16cm x 10cm x 25.4cm).

#### Connectors:

HV Output Connector: Delrin type connector, recessed.  
Cable assembly with mating connector 39.4in (1m).  
I/O Connectors: 9 pin mini D-type Phoenix connector for power, filament and monitor connections.

#### Remote Programming:

(P/O 9 pin "D" analog control interface) Permits remote adjustment of the output voltage and current via an external potentiometer and the internal +10V reference. By adjusting the potentiometer from minimum to maximum, the desired output may be selected.

#### Remote Monitor:

Test points are made available at J4 for monitoring voltage and current outputs. The output polarity is positive from 0 to 10V equal to 0 to 100% of the output.

### XRM SELECTION TABLE

Maximum Rating		Model Number
kV	mA	
25	2.0	XRM25P50
30	1.67	XRM30P50
50	1.00	XRM50P50
65	0.77	XRM65P50

### XRM MONITOR CONNECTOR 4 PIN

J4	SIGNAL		
1	Monitor Return	3	mA Monitor
2	kV Monitor	4	Intlk Enable

### CONTROL INTERFACE MINI-D CONNECTOR 9 PIN

J5	SIGNAL		
1	+10Vdc Reference	6	mA Program Input
2	Spare	7	Remote/Local mA Program
3	kV Program Input	8	Spare
4	Remote/Local kV Program	9	Ground
5	Spare		

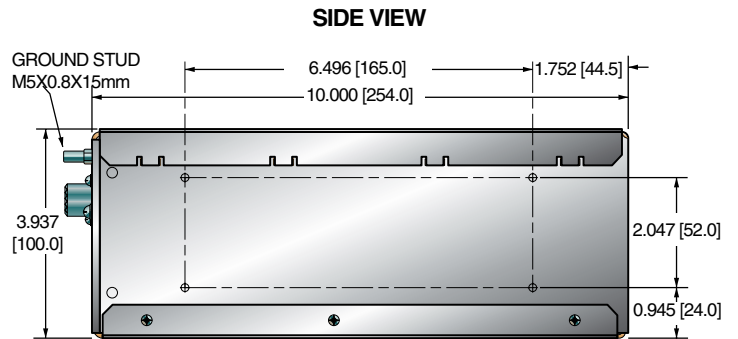
### XRM FILAMENT CONNECTOR 3 PIN

J3	SIGNAL	J3	SIGNAL
1	Filament Out	3	Spare
2	Filament Return		

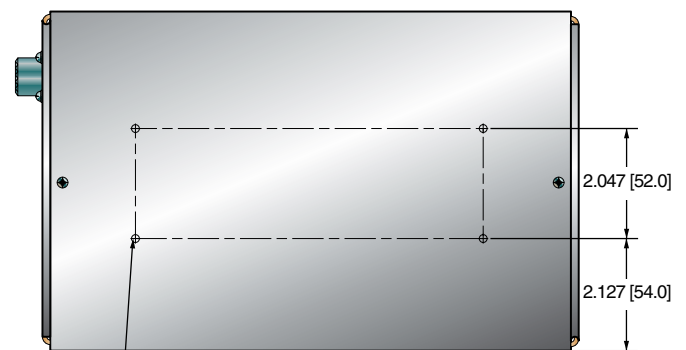
### XRM POWER CONNECTOR 2 PIN

J2	SIGNAL
1	+24V Input
2	24V Return (Gnd.)

DIMENSIONS: in.[mm]

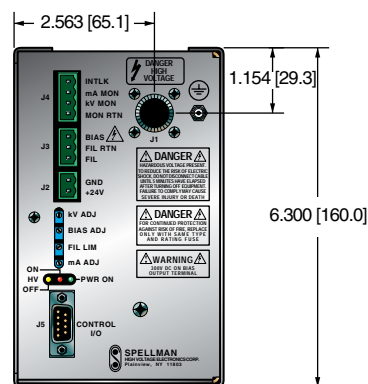


### TOP VIEW



M4X0.7 BLIND INSERTS TYPICAL

### 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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# 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.

## **SICHERHEIT**

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Das Hochspannungsnetzteil muß inner 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.

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## **SERVICE SICHERHEIT**

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

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# Chapter 1

## INTRODUCTION

### 1.1 Description Of The XRM Series

The XRM series of high voltage power supplies represent an advanced approach to X-ray generator power requirements. These power supplies provide all the power, control, and support functions required for practically all X-ray applications. The XRM series provide high voltage, high current outputs with very low ripple. Extremely stable voltage and current outputs result in significant performance improvements over previously available technology. Low output ripple provides higher intensity levels, with no increase in tube loading.

All these advancements are possible only by Spellman's long history in X-ray power systems. This series of power supplies utilize extremely advanced resonant conversion techniques, along with sophisticated digital technology.

The XRM series is specifically designed for X-ray tube application where the high voltage is a positive polarity, and the filament circuits are referenced to the cathode ground potential, (grounded filament).

The X-ray tube voltage and tube emission current are all continuously adjustable.

The power supplies operate from +24Vdc and are convection cooled for 0 to 50W models. Custom designed units for single use or OEM applications are available.

### 1.2 XRM Specifications

- **Output Control:**  
Voltage and current are continuously adjustable over the entire range from zero to maximum rating via a twenty-turn potentiometer.
- **Input Voltage:** 24Vdc  $\pm$  10%
- **Voltage Regulation:**  
Load regulation: 0.01% of full voltage for a no load to full load charge.  
  
Line regulation: 0.01% of full voltage over specified input voltage range.
- **Current Regulation:**  
Load regulation: 0.01% of full current from 0 to rated voltage.  
  
Line regulation:  $\pm$ 0.01% of full current over specified voltage range.
- **Ripple:** 0.25% p-p of maximum output voltage.
- **Filament:** 3.5A, 5.5V
- **Stability:** 0.05% per 8 hours after ½ hour warm up.
- **Temperature Coefficient:** 0.01% per °C. Higher stability available on special order.
- **Ambient Temperature:**  
0°C to 50°C operating.  
-20°C to 85°C storage.
- **Weight:** 10.5 lbs. (4.8kg).
- **Size:** 3.937"H x 6.3"W x 10.0"D.  
(10 x 16 x 25.4cm).

## 1.3 Standard Features

The XRM series incorporates several standard features designed to optimize user satisfaction and safety.

**KV AND MA/FILAMENT CURRENT RAMP CIRCUITS:** This feature provides for a gradual rise for kV, mA and filament current. This feature is designed to limit voltage shock and filament shock to the X-ray tube. The kV ramp rate is approximately 4 seconds. The filament current is slowly increased until the desired mA level is achieved. This time is typically 4 seconds for full mA output. These ramp conditions are started at the initial INTERLOCK CLOSED control signal.

**INDICATOR LEDS:** HIGH VOLTAGE OFF, HIGH VOLTAGE ON and POWER ON indicators.

**OUTPUT CABLE:** Standard units are provided with a 1 meter shielded high voltage output cable. The cables are designed with a plug arrangement so that they can be easily removed from the mating receptacle located on the front of the chassis. For non-standard units, see Spec. Control drawing.

### 1.3.1 Remote Operating Features

**REMOTE MONITOR:** Allows remote monitoring of the tube voltage and tube emission current

**EXTERNAL INTERLOCK:** Interlock connections are provided on J4-4 on the front of the chassis for connection to a safety switch. The unit will not operate unless the interlock circuit is closed through a 12V lamp rated for 0.5W to 0.8W. During high voltage operation, opening the interlock circuit will cause the High Voltage to shut off. This option should be used for safety interlock circuits. The lamp can be replaced with a 270 Ohm, 1 W resistor if fail-safe interlocking of the X-ray On is not required.

## 1.4 Options

CODE DISCRPTION	
• AC	AC Filament
• SS(X)	Non-Standard Slow Start
• NSS	No Slow Start
• BIAS	Bias Supply
• CPC	Constant Power
• ATP	Alternate Test Point Scaling
• LL(x)	Extra Length Output Cable (in meters)

**Table 1.1 XRM Options**

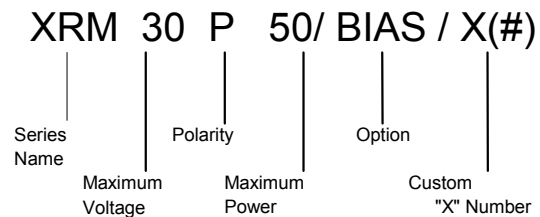
The options available are listed in Table 1.1. See Section 5 for more information on these options along with operating and set-up instructions. With few exceptions, these options and modifications can be retrofitted to your power supply at the factory in a short time. For price and retrofit arrangements, contact Spellman's Sales Department.

## 1.5 Interpreting the Model Number:

The model number of the power supply describes its capabilities. After the series name is:

- (1) the maximum voltage (in kV)
- (2) the maximum output (in watts)
- (3) the option codes for all options that are included.

Custom units have an X number after the option codes.



# Chapter 2

## Inspection and Installation

Initial inspection and preliminary checkout procedures are recommended. For safe operation, please follow the step-by-step procedures described in Chapter 3, Operating Instructions.

### 2.1 Initial Inspection

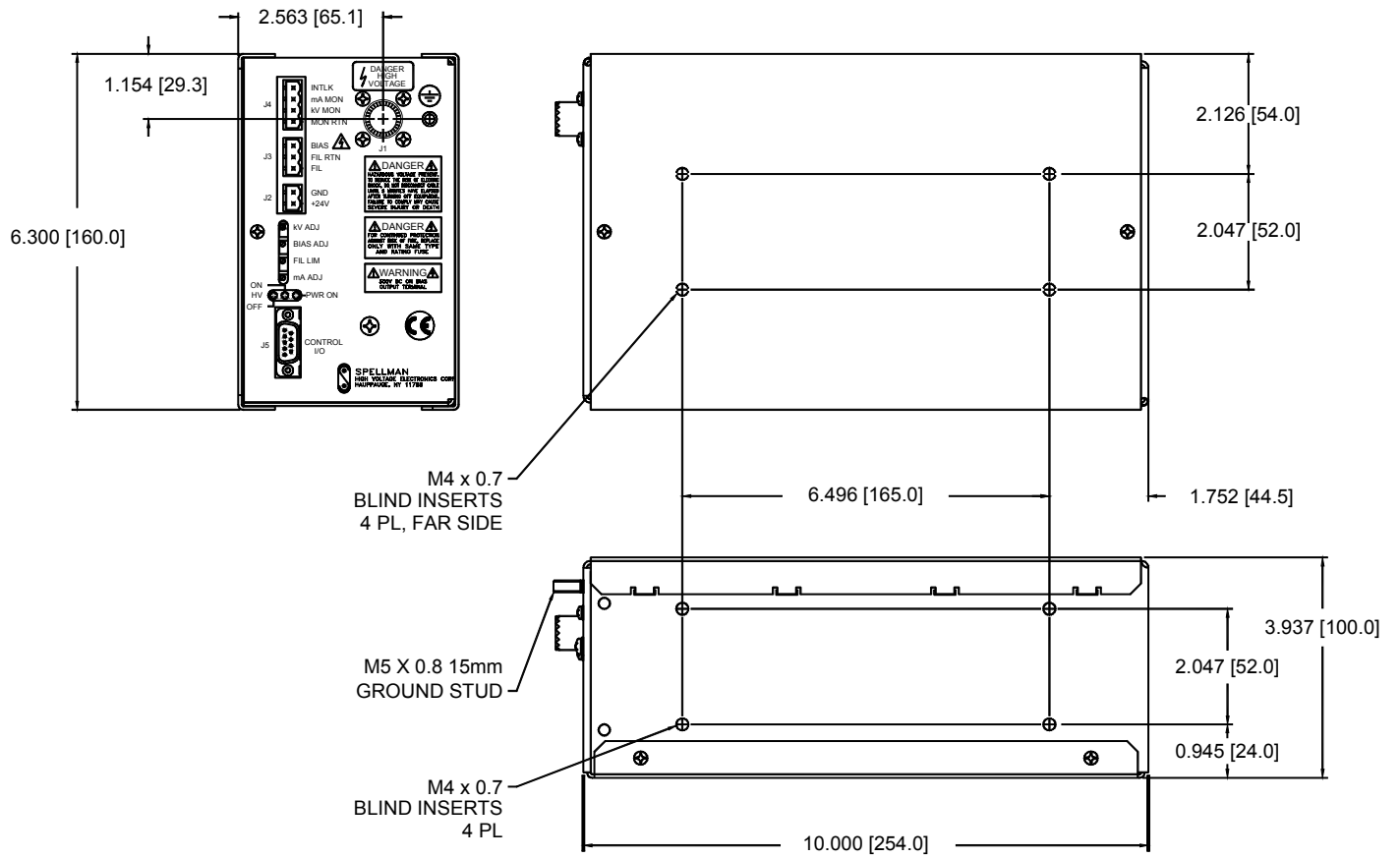
Inspect the package exterior for evidence of damage due to handling in transit. Notify the carrier and Spellman immediately if damage is evident. Do not destroy or remove any of the packing material used in a damaged shipment.

After unpacking, inspect the panel and chassis for visible damage.

Fill out and mail the Warranty Registration card accompanying the unit. Standard Spellman XRM high voltage power supplies and components are covered by warranty. Custom and special order models (with an X suffix in the model number) are also covered by warranty.

### 2.2 Mechanical Installation

Units in the XRM series have front panel holes for standard EIA rack mounting. The rack must allow rear access for cable connections. Units are fully enclosed and are suitable for bench or tabletop operation. Standard unit dimensions are shown in Figure 2.1.



**Figure 2.1 XRM DIMENSIONS**

# Chapter 3

## Operating Instructions

### 3.1 Operation

#### WARNING

**THIS EQUIPMENT GENERATES DANGEROUS VOLTAGES THAT MAY BE FATAL. PROPER GROUNDING OF ALL HIGH VOLTAGE EQUIPMENT IS ESSENTIAL.**

#### WARNUNG

**DIESES GERÄT ERZEUGT LEBENSGEFÄHRLICHE HOCHSPANNUNG. ALLE HOCHSPANNUNGSGERÄTE MÜSSEN ÜBER EINE GEEIGNETE ERDUNG VERFÜGEN.**

#### IMPORTANT

**Before connecting the power supply to the AC line, follow this step-by-step procedure. Do not connect the power supply to the AC line until Step G is reached.**

**Failure to follow these procedures may void the warranty.**

#### ACHTUNG

**BEVOR SIE DAS HOCHSPANNUNGSNETZEIL AN DIE STROMVERSORGUNG ANSCHLIESSEN, MÜSSEN FOLGENDE PUNKTE GEPRÜFT WERDEN.**

**SCHLIESSEN SIE DAS HOCHSPANNUNGSNETZEIL NICHT AN DIE SPANNUNGSVERSORGUNG BEVOR PUNKT G ERREICHT IST. EVENTUELLE AUFTRETENDE BESCHÄDIGUNG DES GERÄTES DURCH NICHT BEFOLGEN DIESER ANWEISEN KANN ZUM VERLUST DES GARANTIEANSPRUCHES FÜHREN.**

A) Check the input voltage rating on the nameplate of the supply and make certain that this is the rating of the available power source. Spellman XRM units operate on 24Vdc unless ordered with a different input voltage.

B) **PROPER GROUNDING TECHNIQUE:** The chassis of high voltage power supplies must be grounded, preferably to a water system ground using copper pipe or other earth ground using the connection terminal at the rear of the unit. See Figure 3.1, for a typical operating setup.

The return line from the load should be connected to the terminal on the rear of the power supply. Using a separate external ground at the load is not recommended.

C) Attach the output cable to the load.

D) Plug the high voltage output cable into the front of the supply and hand tighten the knurled collar.

E) **Options Note:** See section 5 for hook up and operating instructions for the options on your unit. Custom models may also require set up changes.

F) For initial turn-on, rotate the KILOVOLT control fully counter-clockwise to the zero voltage position.

G) The input power cable may now be connected.

H) Close the INTERLOCK. The LED inside should light up and the output will slow start to the preset level output voltage and/or output current.

NOTE: The XRM series is equipped with a slow start circuit that ramps the output up to its maximum setting in approximately 4 seconds after the INTERLOCK is closed.

I) To terminate the generation of output power, open the INTERLOCK. In the HIGH VOLTAGE OFF mode the power supply's fault and interface circuits are still active.

J) To turn off the power supply, disconnect the power.



### WARNING

**AFTER TURNOFF, DO NOT HANDLE THE LOAD UNTIL THE CAPACITANCE HAS BEEN DISCHARGED!**

**LOAD CAPACITANCE MAY BE DISCHARGED BY SHORTING TO GROUND.**

### WARNUNG

**Nach dem Ausschalten des Gerätes die Last erst berühren wenn diese vollständig entladen ist. Die elektrische Kapazität der Last kann durch einen Kurzschluß zur Erde entladen werden.**

### WARNING

**THE VOLTAGE MONITOR ON THE POWER SUPPLY FRONT PANEL DOES NOT READ THE OUTPUT VOLTAGE WHEN THE POWER IS TURNED OFF, EVEN IF A CHARGE STILL EXISTS ON THE LOAD.**

### WARNUNG

**Der Spannungsmonitor arbeitet nicht bei abgeschalteter Versorgungsspannung, auch nicht wenn die Last noch aufgeladen ist.**

### CAUTION

**ALWAYS OPERATE THE UNIT WITH THE COVER ON. DO NOT ATTEMPT TO ACCESS OR REPAIR ANY INTERNAL CIRCUITS. DANGEROUS AND LETHAL VOLTAGES ARE GENERATED INSIDE THE MODULE.**

### CAUTION

**Betreiben Sie das Hochspannungsnetzteil ausschließlich mit geschlossenem Gehäuse. Versuchen Sie nicht die internen Schaltkreise zu berühren oder zu reparieren, da lebensgefährliche Hochspannungen in Innern erzeugt werden.**

## 3.2 Standard Features

A note on remote interface circuitry and remote signal grounding. Whenever possible, electrical isolation should be provided when interfacing with any high voltage power supply. For power control signals such as EXTERNAL INTERLOCK, HIGH VOLTAGE OFF and HIGH VOLTAGE ON isolated relay contacts should be used. If possible, analog programming and monitoring signals should be isolated via analog isolation amplifiers. Spellman application engineers are available to assist in interface circuitry design. All interface cables should be properly shielded. All power supply signals should be referenced to the power supplies signal ground on J4-1 or J5-9.

**REMOTE PROGRAMMING:** Allows remote adjustment of the output voltage and current via an external voltage source. In local control jumpers are installed on connector J5 in the front of the chassis between J5-3 and J5-4 for voltage control and between J5-6 and J5-7 for current control.

For remote programming, the jumpers are removed and a positive voltage source, from 0 to 10 volts, is applied to the appropriate terminals. Programming signals should be referenced to J5-9 signal ground. By adjusting the voltage source from 0 volts (zero output) to 10 volts (full rated output) the desired output can be selected. See Figure 3.4 for wiring diagram and specifications.

An alternate method of controlling the output remotely is by using external resistance such as a potentiometer or a resistor network. For remote control the jumpers are removed and the desired resistor configuration is installed. See Figure 3.4 for wiring diagram.

**REMOTE MONITOR:** Test points are made available at J4 on the front of the chassis for monitoring the voltage and current output. The test points are always positive regardless of the output polarity, where zero 0 to 10 volts equals 0-100% of output. Test points have an output impedance of <10 ohms. See Figure 3.3 for test point designation.

**EXTERNAL INTERLOCK:** Interlock connections are provided on J4-4 on the front of the chassis for connection to a safety switch. The unit will not operate unless the interlock circuit is closed. During high voltage operation, opening the interlock circuit will cause the unit to revert to the HIGH VOLTAGE OFF mode. See Figure 3.3 for the recommended interface circuit.

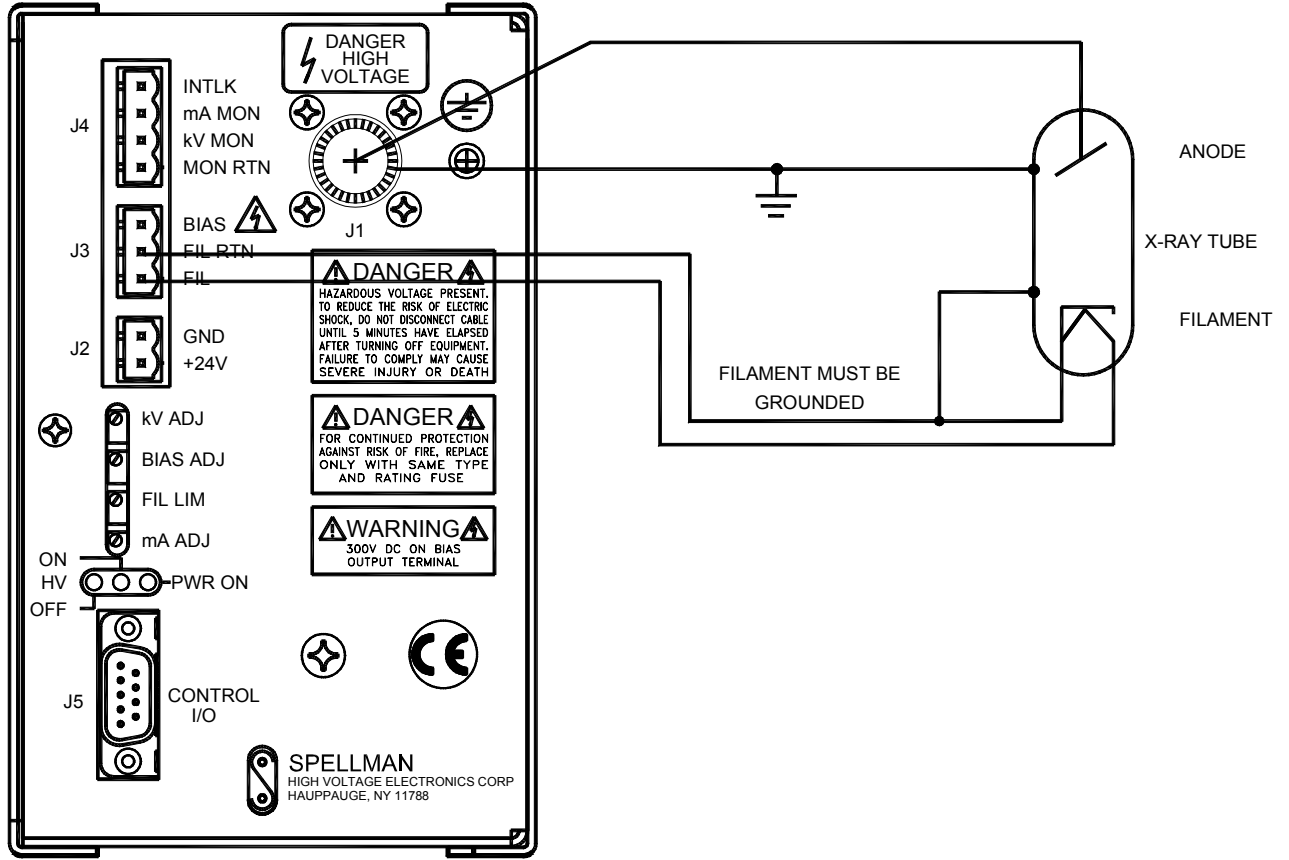
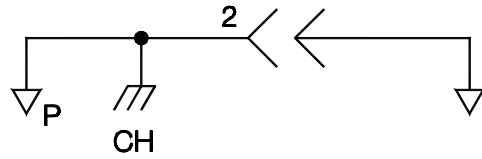
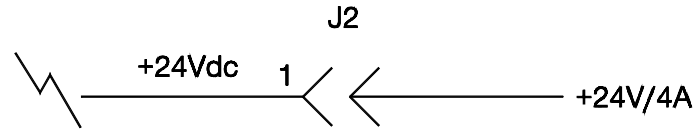
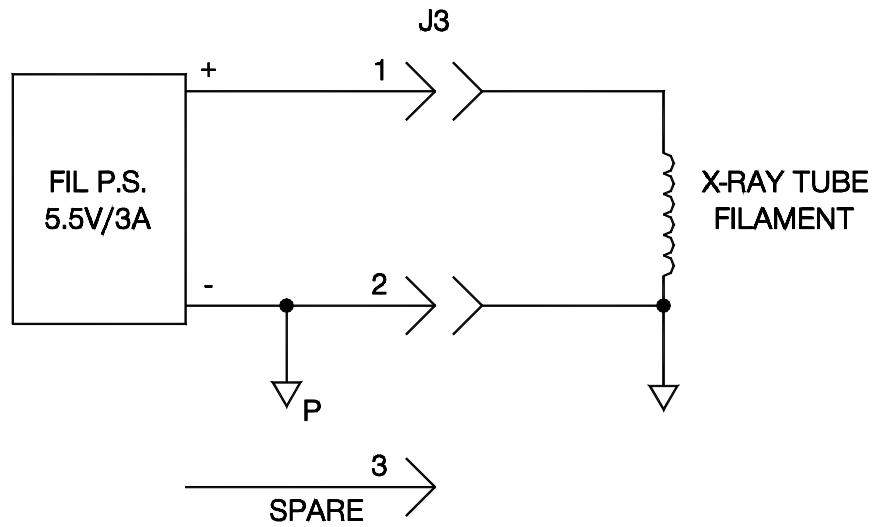


Figure 3.1 Typical Operating Setup XRM

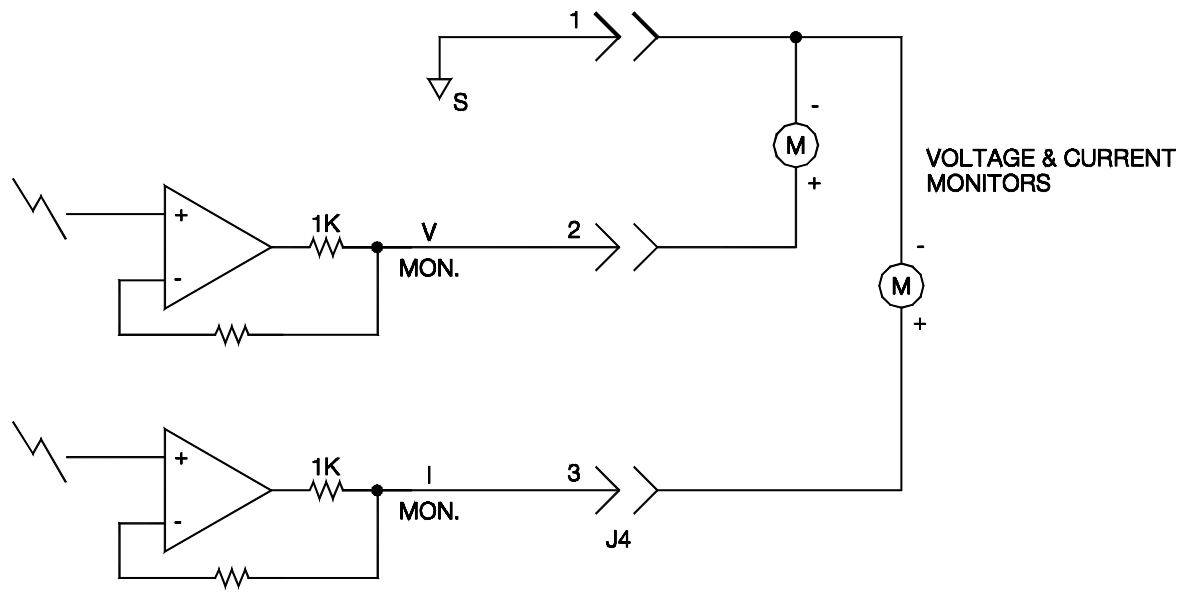


24V INPUT CONNECTIONS

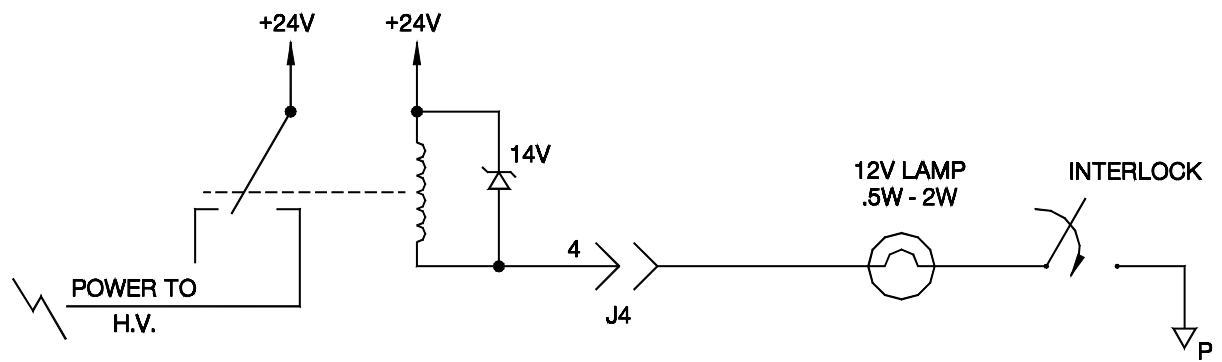


FILAMENT CONNECTIONS

Table 3.2 DC Input & Filament Connections



VOLTAGE & CURRENT MONITORS



EXTERNAL INTERLOCK INTERFACE

Figure 3.3 Monitors & Interlock Connections

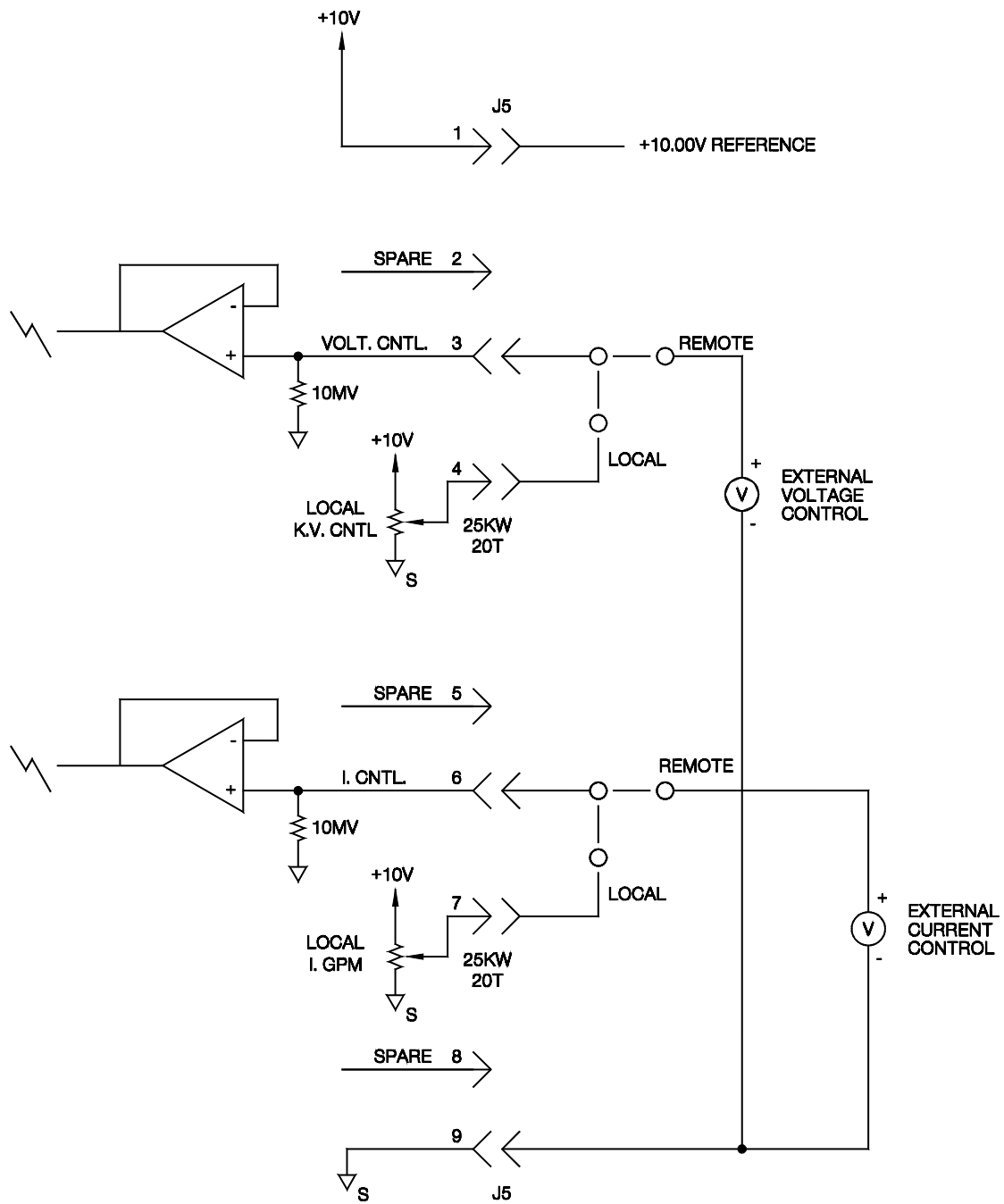


Figure 3.4 Local/Remote Control

# Chapter 4

## Principles of Operation

The XRM series of high voltage power supplies utilizes sophisticated power conversion technology.

A variety of analog, digital and power conversion techniques are used throughout. The intention of the Principles of Operation is to introduce the basic function blocks that comprise the XRM power supply. For details on a specific circuit, consult Spellman's Engineering Department.

\*Due to the many variations within the XRM series, drawing numbers may differ from unit to unit.

The XRM power supply is basically a DC to DC converter. Within the power supply, conversions of DC to high frequency AC, then to high voltage DC takes place.. By reviewing further the sub-assemblies, a basic understanding of the process can be gained.

### WARNING

To reduce the risk of fire, replace fuse with same type and rating.

### WARNING

Um die Brandgefahr zu verringern, muss die Sicherung durch eine neue gleichen Typs ersetzt werden.

### 4.1 Chassis

The XRM is a compact, high efficiency, high voltage power supply. The power supply can supply up to 50 watts of DC power. (Output power capability may be higher or lower depending upon model ordered). Output voltages of up to 65kV can be generated.

### WARNING

**The energy levels used and generated by the power supply can be lethal! Do not attempt to operate the power supply unless the user has a sufficient knowledge of the dangers and hazards of working with high voltage. Do not attempt to approach or touch any internal or external circuits or components that are connected or have been connected to the power supply. Be certain to discharge any stored energy that may be present before and after the power supply is used. Consult IEEE recommended practices for safety in high voltage testing #510-1983.**

### WARNUNG

Die verwendete und erzeugte Energie des Hochspannungsnetztes kann tödlich sein! Betreiben Sie das Hochspannungsnetzteil nur wenn Sie ausreichendes Kenntnis über mögliche Gefahren beim Umgang mit der Hochspannung haben. Versuchen Sie nicht interne Schaltkreise oder elektrische Bauelemente, die an das Hochspannungsnetzteil angeschlossen sind, zu berühren. Vergewissern Sie sich, daß alle Restladungen, die vor oder nach dem Betrieb des Hochspannungsnetztes vorhanden sind, entladen werden. Weitere Informationen finden Sie der IEEE-Vorschrift Nr. 510-1983.

### 4.2 Inverter

The inverter is a series resonant, parallel loaded topology. A PWM scheme is used for regulating the power generated from the inverter. Q1 is a high speed MOSFET. This device provides high frequency switching to control the resonant current flow. The typical resonant operating period is approximately 15µseconds.

### **4.3 High Voltage Transformer**

The output of the High Frequency Resonant Inverter is connected to the primary of the High Voltage Transformer. The High Voltage Transformer is a step-up type. Typically secondary voltages are in the range of 5kV depending upon output voltage ratings.

### **4.4 High Voltage Assembly**

The High Voltage Assembly will vary depending upon the model ordered. The circuitry typically consists of series arrangements of a half wave voltage multiplier. The higher voltage ranges utilize various series arrangements of a voltage doubler.

Output filtering is typically provided by an R-C type filter. Voltage feedback for regulation and monitoring is provided by a high bandwidth resistive/capacitive divider. Current feedback for regulation and monitoring is provided by a sense resistor connected at the low voltage end of the High Voltage Rectifier/Multiplier Circuit.

### **4.5 Control PWB**

The majority of control circuits for power supply controls are located on the CONTROL/POWER PWB.

+15VDC, -15VDC, and +10VDC is generated on the CONTROL/POWER PWB. High Voltage On/Off control is accomplished by K1, and its associated circuitry. Interlock control is provided by K1.

Voltage feedback from the high voltage divider is sent to U6. Gain adjustment is provided by R10. The KV feedback signal is sent to J4 for remote monitoring.

Program voltages are typically ramped up to set level by the slow start circuits of U7.

Current feedback from the high voltage rectifier is sent to sense resistors located on the High Voltage Assembly. Feedback is then sent to U5.

The resonant control circuitry consists of a voltage to pulse width converter. U1 generates all pulse width control signals.

### **4.6 Filament Supply**

The power for the X-ray tube filament is provided by the filament inverter. The filament inverter is a high frequency inverter. The inverter provides regulated current to the primary of the filament transformer. The filament isolation transformer secondary is then connected to the output connector.

### **4.7 Options**

Due to the many variations of models and options provided in the XRM series, details of actual circuits used may differ slightly from above descriptions. Consult Spellman's Engineering Department for questions regarding the principles of operations for the XRM series.

# Chapter 5

## OPTIONS

The options available for this power supply are described in this section. Interface diagrams are shown where required. Options are specified by including the option code in the model number as described in Section 1.5.

### 5.1 AC Filament **ACF**

An ac filament supply is available; however, the current and voltage limit circuits will not protect the X-ray tube.

### 5.2 Bias Supply **BIAS**

A Bias Supply is available on J3-3 with an output voltage up to negative 300Vdc at currents up to 1mA.

### 5.3 Constant Power Operation **GS**

Constant power operation is possible from 20kV to 65kV up to 40 Watts of output power.

### 5.4 Non-Standard Slow Start **SS(x)**

The non-standard slow start option allows the gradual rise time of the output voltage to be different from the standard of six seconds. To order the option, place the

time desired in seconds after the suffix letter; i.e. SS(10) denotes a 10 second rise time.

### 5.5 Extra Length Output Cable **LL(ft.)**

Standard output cable is 1 meter of shielded high voltage cable. Other lengths may be specified.

### 5.6 Alternate Test Point Scaling **ATP**

Alternate test point scaling is available upon request. For example: 1V per 10kV or 1V per 100 $\mu$ A.

### 5.7 Custom Designed Models **X(#)**

Units built to customer specifications are assigned an X number by the factory. If this unit is an X model, specification control sheet is added at the end of this instruction manual.

Spellman welcomes the opportunity to tailor units to fit your requirements or to develop new products for your applications. Contact Spellman Sales Department with your needs.



# Chapter 6

## MAINTENANCE

This section describes periodic servicing and performance testing procedures.

### WARNING

**THIS POWER SUPPLY GENERATES VOLTAGES THAT ARE DANGEROUS AND MAY BE FATAL.**

**OBSERVE EXTREME CAUTION WHEN WORKING WITH HIGH VOLTAGE.**

### WARNUNG

**DIESES HOCHSPANNUNGSNETZTEIL ERZEUGT LEBENSGEFÄHRLICHE HOCHSPANNUNG!**

**SEIEN SIE SEHR VORSICHTIG BEIM ARBEITEN MIT HOCHSPANNUNG!**

### 6.1 Periodic Servicing

No periodic servicing is required on this module.

### 6.2 Performance Test

### WARNING

**HIGH VOLTAGE IS DANGEROUS. ONLY QUALIFIED PERSONNEL SHOULD PERFORM THESE TESTS.**

### WARNING

**HOCHSPANNUNG IST GEFÄHRLICH!**

**NUR QUALIFIZIERTES PERSONAL DARF DIESE PRÜFUNGEN DURCHFÜHREN.**

High voltage test procedures are described in Bulletin STP-783, Standard Test Procedures for High Voltage Power Supplies. Copies can be obtained from the Spellman Customer Service Department. Test equipment, including an oscilloscope, a high impedance voltmeter, and a high voltage divider such as the Spellman HVD-100 or HVD-200, is needed for performance tests. All test components must be rated for operating voltage.

### 6.3 High Voltage Dividers

High voltage dividers for precise measurements of output voltage with an accuracy up to 0.1% are available from Spellman. The HVD-100 is used for voltages up to 100KV. The HVD-200 measures up to 200KV. The Spellman divider is designed for use with differential voltmeters or high impedance digital voltmeters. The high input impedance is ideal for measuring high voltage low current sources, which would be overloaded by traditional lower impedance dividers.

# Chapter 7

## REPLACEMENT PARTS

### 7.1 Replacement Parts

Contact the Spellman Customer Service Department for parts lists for specific models.

Spellman provides parts and subassemblies for its high voltage power supplies but recommends that only qualified personnel perform the repair. High voltage is dangerous; even minor mistakes in repairs can have serious consequences.

When requesting parts please give the model number and serial number of the power supply

### 7.2 Correspondence And Ordering Spare Parts

Each Spellman power supply has an identification label on the rear of the chassis that bears its model and serial number.

When requesting engineering or applications information, please state the model and serial number of the power supply. If specific components or circuit sections are involved in the inquiry, it is helpful to indicate the component symbol number(s) shown on the applicable schematic diagram.

When ordering spare parts, please specify the part's description, the part's reference designation or part number, and the model and serial number of the unit.

# 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>