Instruction Manual

uXHP SERIES

High Voltage Power Supply

MODEL :
SERIAL# :
DATE :

SPELLMAN
HIGH VOLTAGE ELECTRONICS CORPORATION
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Hauppauge, New York, 11788

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The uXHP Series is the result of Spellman’s exceptional high voltage packaging and surface mount fabrication techniques coupled with proprietary encapsulation technology producing this ultra-compact X-Ray generator module. The uXHP powers grounded cathode X-Ray tubes from a variety of well-known manufacturers, featuring a 0 to 50kV/65kV/80kV high voltage output @ 5mA limited to 100W. The uXHP uses closed loop filament control circuitry providing highly regulated beam current. The low noise dc filament supply operates between 0.3 and 3.5A. Offering tight regulation, high stability and low ripple, the uXHP provides users local and remote analog control to set beam voltage, emission current and filament current limit. USB, RS-232 and Ethernet interface is standard.

TYPICAL APPLICATIONS
Powering grounded cathode X-Ray tubes from Varian, Kevex, Oxford, RTW, Superior and Trufocus.

SPECIFICATIONS
Input: +24Vdc ±1V; 7.75A maximum
Efficiency: 75%, typical
Output: See model selection table on page 2
Voltage Control:
Local: Internal multi-turn potentiometer to set voltage from 0 to full output voltage.
Remote: 0 to 10Vdc = 0 to 100% rated output voltage.
Accuracy: ±1%, Z_{in} = 10Mohm.
Emission Control:
Local: Internal potentiometer to set beam current from 0 to full output current.
Remote: 0 to 10Vdc = 0 to 100% rated output current.
Accuracy: ±1%, Z_{in} = 10Mohm. Filament limit and filament preheat control capability is also provided.
Voltage and Current Monitors:
0 to 10Vdc = 0 to 100% rated output
Accuracy: ±1%, Z_{in} = 1kohm

Redundant Voltage Monitor:
A redundant high voltage feedback divider where 0 to 10Vdc = 0 to 100% rated output is monitored via firmware. The analog monitor signal can be provided by special order.

Stability: 0.005% per 8 hours after 1/2 hour warm-up.

Digital Interface:
RS-232, Ethernet and USB is standard

DC Filament Supply:
Ground isolated filament power supply allows actual tube current feedback signal for monitoring accurate low X-Ray tube current performance.
Current: 0-3.5A, adjustable limit
Voltage: 5.0V, maximum compliance

Environmental:
Operational: 0° C to +50° C
Storage: -40° C to +85° C
Humidity: 0% to 90%, non-condensing

Dimensions:
50/65kV Unit: 7.00"H x 3.07"W x 9.50"D
(177.80mm x 78.00mm x 228.60mm)
80kV Unit: 7.00"H x 3.07"W x 10.50"D
(177.80mm x 78.00mm x 266.70mm)

Weight:
50/65kV Unit: 8.5 lbs. (3.85kg)
80kV Unit: 10.0 lbs. (4.53kg)

Cooling:
User provided forced air cooling is required

Regulatory Approvals:
Compliant to 2004/108/EC, the EMC Directive and 2006/95/EC, the Low Voltage Directive (approval pending). Compliant to 2002/95/EC, RoHS.
ANALOG INTERFACE CONNECTOR
MALE 15 PIN MINI “D”

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Monitor Return</td>
<td>Signal Ground</td>
</tr>
<tr>
<td>2</td>
<td>Voltage Monitor</td>
<td>0-10V = 0 to full scale, Zout=1KΩ</td>
</tr>
<tr>
<td>3</td>
<td>Current Monitor</td>
<td>0-10V = 0 to full scale, Zout=1KΩ</td>
</tr>
<tr>
<td>4</td>
<td>Interlock Output</td>
<td>Connect 12V HVON bulb to pin 15 to enable</td>
</tr>
<tr>
<td>5</td>
<td>+10V Reference</td>
<td>+10V at 1mA, maximum</td>
</tr>
<tr>
<td>6</td>
<td>Filament Monitor</td>
<td>1V = 1A, Zout=1KΩ</td>
</tr>
<tr>
<td>7</td>
<td>Voltage Program Input</td>
<td>0-10V = 0 to full scale, Zin=10MΩ</td>
</tr>
<tr>
<td>8</td>
<td>Local Voltage Program*</td>
<td>0-10V, screwdriver adjust</td>
</tr>
<tr>
<td>9</td>
<td>Filament Limit Setpoint*</td>
<td>1V = 1A, screwdriver adjust</td>
</tr>
<tr>
<td>10</td>
<td>Current Program Input</td>
<td>0-10V = 0 to full scale, Zin=10MΩ</td>
</tr>
<tr>
<td>11</td>
<td>Local Current Program*</td>
<td>10 turn pot, screwdriver adjust</td>
</tr>
<tr>
<td>12</td>
<td>Not used (+24V Out for Interlock)</td>
<td>(Optional Interlock configuration)</td>
</tr>
<tr>
<td>13</td>
<td>Not used (Interlock Coil)</td>
<td>(Optional Interlock configuration)</td>
</tr>
<tr>
<td>14</td>
<td>Filament Preheat Setpoint*</td>
<td>1V = 1A, screwdriver adjust</td>
</tr>
<tr>
<td>15</td>
<td>Interlock Return</td>
<td>Interlock Ground</td>
</tr>
</tbody>
</table>

*Denotes 10 turn potentiometer accessible through holes in cover

CONTROL POWER/FILAMENT CONNECTOR
4 PIN PHOENIX CONTACT

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24V Control Power</td>
<td>+24V @ 1A max</td>
</tr>
<tr>
<td>2</td>
<td>+24V Control Power Return</td>
<td>Power Ground</td>
</tr>
<tr>
<td>3</td>
<td>Filament Output</td>
<td>0.3A to 3.5A @ 5V, max</td>
</tr>
<tr>
<td>4</td>
<td>Filament Return</td>
<td>Filament Return</td>
</tr>
</tbody>
</table>

Note: The filament return wire cannot be grounded as this would short circuit the tube return current monitoring to the uXHP. If grounding of the filament is required, please consult the factory.

HIGH VOLTAGE POWER INPUT CONNECTOR
2 PIN PHOENIX CONTACT

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>PARAMETER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+24V High Voltage Power Input</td>
<td>+24V @ 7.75A max</td>
</tr>
<tr>
<td>2</td>
<td>+24V High Voltage Power Return</td>
<td>Power Ground</td>
</tr>
</tbody>
</table>

HIGH VOLTAGE OUTPUT CONNECTOR
Spellman drywell type detachable connector.

- **50/65kV**: A one meter (39.4”) long polyethylene mating high voltage cable with banana plug termination is provided.
- **80kV**: A one meter (39.4”) long polyethylene mating high voltage cable with corona ball termination is provided.

HV Cable Options:
- **K5302**: (50kV/65kV units only) A one meter (39.4”) long Mammoflex mating high voltage cable is provided, SHV p/n 201946-007
- **K2001**: (50kV/65kV units only) A one meter (39.4”) long Mammoflex mating high voltage cable is provided, compatible with the XCC Option SHV p/n 201946-002

USB DIGITAL INTERFACE— 
4 PIN USB “B” CONNECTOR

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>SIGNAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VBUS</td>
<td>+5Vdc</td>
</tr>
<tr>
<td>2</td>
<td>D-</td>
<td>Data -</td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
<td>Data +</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Ground</td>
</tr>
</tbody>
</table>

ETHERNET DIGITAL INTERFACE— 
8 PIN RJ45 CONNECTOR

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>SIGNAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TX+</td>
<td>Transmit Data +</td>
</tr>
<tr>
<td>2</td>
<td>TX-</td>
<td>Transmit Data -</td>
</tr>
<tr>
<td>3</td>
<td>RX+</td>
<td>Receive Data +</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>6</td>
<td>RX-</td>
<td>Receive Data -</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>No Connection</td>
</tr>
</tbody>
</table>

RS-232 DIGITAL INTERFACE— 
9 PIN FEMALE D CONNECTOR

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>SIGNAL PARAMETERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>2</td>
<td>TX out</td>
<td>Transmit Data</td>
</tr>
<tr>
<td>3</td>
<td>RX in</td>
<td>Receive Data</td>
</tr>
<tr>
<td>4</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>5</td>
<td>SGND</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>No Connection</td>
</tr>
<tr>
<td>8</td>
<td>Voltage Monitor 2</td>
<td>0-10V = 0 to full scale, Zout = 1KΩ</td>
</tr>
<tr>
<td>9</td>
<td>Power Supply OK</td>
<td>+15V = OK, 0V = Fault, Sink/Source 3mA max</td>
</tr>
</tbody>
</table>
Digital Interface

The uXHP features a standard USB, RS-232 and Ethernet digital interface. Utilizing these standard digital interfaces can dramatically simplify power supply interfacing requirements saving the user both time and money, while enhancing functionality and overall capability. Spellman provides a GUI with the uXHP that allows the customer to both customize operational features of the uXHP while also providing basic power supply operational features. Details of the uXHP's digital interface are described in detail in the uXHP manual.
# IMPORTANT SAFETY PRECAUTIONS

## SAFETY

This power supply generates voltages that are dangerous and may be fatal. Observe extreme caution when working with this equipment.

<table>
<thead>
<tr>
<th>High voltage power supplies must always be grounded.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not touch connections unless the equipment is off and the capacitance of both the load and power supply is discharged.</td>
</tr>
<tr>
<td>Allow five minutes for discharge of internal capacitance of the power supply.</td>
</tr>
<tr>
<td>Do not ground yourself or work under wet or damp conditions.</td>
</tr>
</tbody>
</table>

## 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.
### 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.
### CONSIGNES DE SÉCURITÉ

_Cette alimentation génère des tensions qui sont dangereuses 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**

<table>
<thead>
<tr>
<th>SICUREZZA</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUESTO ALIMENTATORE GENERA TENSIONI CHE SONO PERICOLOSE E POTREBBERO ESSERE MORTALI. PONI ESTREMA CAUTELA QUANDO OPERI CON QUESO APPARECCHIO.</td>
</tr>
</tbody>
</table>

**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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Chapter 1

INTRODUCTION

1.1 Description of the uXHP Series

The uXHP 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 driving various low power, cathode grounded X-ray tubes. Extremely stable output voltage and current result in significant performance improvements over previously available technology. Low output ripple provides higher intensity levels, without increasing tube loading.

All these technical advancements are possible only by Spellman’s long history of innovation in X-ray power supply systems. The uXHP utilizes extremely advanced resonant conversion techniques, along with sophisticated digital technology.

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

The X-ray tube voltage and emission current are all continuously adjustable over their entire range. With the maximum output current being rated at 5mA and power limited to 100 watt the uXHP can provide operational parameters not previously available via other X-ray generator modules.

These modular X-ray generators operate from +24Vdc and are cooled via customer provided forced air. Custom designed units for OEM applications are available.

A unique filament design senses the actual X-ray tube emission current. This allows the uXHP to operate down to very low emission current levels. For this circuit to function the filament return of the X-ray tube cannot be externally grounded. Doing so will short out the emission sensing circuitry. The X-ray tube filament return must be connected back to the FIL RETURN pin on the 4 pin Phoenix Contact connector. If an externally grounded filament is required please speak to a Spellman sales individual.

The uXHP also uses higher precision digital control circuitry for the USB, RS-232 and Ethernet connectivity. This means the uXHP can be operated at finer programming resolution when compared the Spellman’s legacy MNX X-ray generator.

The uXHP uses the same type of high voltage connector for the 50kV and 65kV versions as what has been used in Spellman’s MNX X-ray generator, making the uXHP backwards compatible. The 80kV version uses a longer high voltage connector with a corona ball termination for reliable operation at this increased output voltage.
1.2 Standard Features

The uXHP 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 high voltage and filament shock to the X-ray tube. The kV ramp rate is approximately 4 seconds. The filament current is slowly increased over 4 seconds until the desired mA level is achieved. These ramp conditions are started at the initial INTERLOCK CLOSED control signal. Prior to closing the Interlock the filament operates at a user determined preheat current level. Preheat levels are user selected for the desired X-ray tube to minimize mA overshoot.

**INDICATOR LEDS:** POWER ON (Control +24Vdc), HV ON (Interlocks Closed) and +24V (Inverter +24Vdc and Interlocks Closed) indicators. The POWER ON LED will flash when the unit shuts down due to fault conditions; cycle the power to reset the X-Ray generator.

**OUTPUT CABLE:** Standard units are provided with a 1 meter shielded high voltage output cable. The HV cable can be easily removed from the mating receptacle located on the front panel of the power supply. 50kV and 65kV units use a banana plug connector while the 80kV uses a corona ball type high voltage connector. For non-standard units, see applicable Specification Control Drawing.

**LOCAL AND REMOTE PROGRAMMING:** Potentiometers accessible through the top cover are provided for controlling tube voltage, tube emission current, tube filament limit set point and tube filament preheat set point.

Tube voltage and tube emission current can also be controlled remotely via the Analog Interface connector.

1.2.1 Remote Operating Features

**REMOTE MONITOR:** Allows remote monitoring of the tube voltage, emission current, filament current, filament limit set point and filament preheat set point via the Analog Interface connector.

**EXTERNAL INTERLOCK:** Interlock connections are provided on the Analog Interface connector for connection to a safety switch. The unit will not operate unless the interlock circuit is closed. The recommended configuration is to close the interlock circuit through a 12Vdc lamp (rated for 0.5 – 2.0 watts) and a safety switch. This configuration provides fail safe interlocking. During high voltage operation, opening the safety switch or failure of the 12Vdc lamp will cause the High Voltage to shut OFF. It is strongly recommended to use this arrangement for safety interlock circuits.

If fail-safe interlocking of the X-ray On is not required the lamp can be replaced with a 270Ω, 1 watt resistor. Provisions are provided for isolating the interlock relay coil from the internal +24Vdc, allowing the user to connect the coil to an external +12Vdc source. This eliminates the need for either the lamp or the 270Ω, 1 Watt resistor allowing pin 4 to be grounded for HIGH VOLTAGE ON control. See Figure 3.4 for alternate Interlock Configurations.

1.4 Options

<table>
<thead>
<tr>
<th>CODE DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• XCC XRM Compatible HV Cable (50kV only)</td>
</tr>
<tr>
<td>• 5VPM 0 to 5 Volt Programming and Monitor Scaling</td>
</tr>
<tr>
<td>• K5302 Mammoflex HV cable for uXHP(50/65kV)</td>
</tr>
<tr>
<td>• K2001 Mammoflex HV cable for uXHP w/XCC option (50/65kV)</td>
</tr>
</tbody>
</table>

Table 1.1 uXHP 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 can be retrofitted to your power supply at the factory. For price and retrofit arrangements, contact Spellman’s Sales Department.

1.4 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 output polarity
3. the maximum output power (in watts)
4. 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 chassis for visible damage.

Standard Spellman uXHP X-ray generators 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

The uXHP Series of modular X-ray generators are designed for installation into existing or newly developed OEM equipment. The X-ray generator can also easily fit into bench top applications or test set requirements. Standard unit dimensions are shown in Figure 2.1.

For custom mounting requirements or specific package size requirements consult Spellman’s Sales Department. Spellman has many package designs available, or can design a specific enclosure for your requirements.

The uXHP Series utilizes solid encapsulation for corona free operation. No periodic maintenance is required.

All units required customer provided forced air cooling for maximum X-ray generator lifetime and trouble free operation and reliability. Generally speaking the more forced air cooling that is provided the better.

2.3 High Voltage Cable/Connector

The uXHP utilizes an air insulated “dry well” styled high voltage cable/connector arrangement. This allows easy connection of the uXHP to the subject X-Ray tube. 50kV and 65kV versions use a banana plug termination while the 80kV version uses a corona ball termination. The connectors have been designed to have ample high voltage standoff distance to operate safely and reliably at maximum rated output voltage using air as the primary insulator. The following precautions should be taken into account to assure reliable fault free operation:

a) Both the insertion portion of the high voltage cable and drywell connector itself should be kept clean and free of contamination of any kind.

b) Use only OEM provided high voltage cables, aftermarket or self-made high voltage cables can cause high voltage breakdown issues, damaging both the high voltage cable and power supply drywell connector.

c) The uXHP is designed to be used in laboratory/office environments of 10 to 90% non-condensing humidity, free of contaminants. Higher humidity exposure or condensing humidity will potentially cause problematic issues wherever air is being used as a primary insulator, i.e. the high voltage drywell connector, relay/switch contacts, etc.
Figure 2.1 50kV, 65kV and 80kV uXHP 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.

IMPORTANT

Before connecting the power supply to the AC line, follow this step-by-step procedure.

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 uXHP units operate on 24Vdc unless ordered with a different input voltage.

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

Failure to follow these procedures may void the warranty.

ACHTUNG

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

SCHLIESSEN SIE DAS HOCHSPANNUNGSMODULE 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.

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 setup changes.

F) For initial turn-on, set the programming voltage to the zero voltage position.

G) The input power cable may now be connected and power applied. The POWER ON LED should light up. No high voltage will be generated at this time.

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

NOTE: The uXHP 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 and the filament operates at the Preheat level.

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 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 suggestions. All interface cables should be properly shielded. All power supply signals should be referenced to the power supplies signal ground.

LOCAL AND REMOTE PROGRAMMING: Allows the operator to select local or remote adjustment of the output voltage and current. Adjustments are made using the screwdriver adjustable potentiometers accessible through the top cover of the power supply or via an external voltage source provided by the user. In local control jumpers are installed on the 15 pin interface connector between pin 7 and pin 8 for voltage control and between pin 10 and pin 11 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 signal ground. By adjusting the voltage source from 0 to 10 volts = 0 to 100% rated output, the desired output can be selected. 0 to 5 volts equals 0-100% of output on units with 5VPM option. 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 on the 15 pin D connector for monitoring the voltage, current and filament outputs and for reading the filament current limit and preheat set points. The test points are always positive regardless of the output polarity, where 0-10 volts equals 0-100% of output on standard units. 0-5 volts equals 0-100% of output on units with 5VPM option. Test points have an output impedance of 1kΩ. See Figure 3.3 for test point designation.

EXTERNAL INTERLOCK: Interlock connections are provided on the 15 pin D connector for connection to a safety switch. The unit will not make high voltage 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.
FILAMENT LIMIT: The maximum current that the filament power supply can provide is user adjustable from 0.3A to 3.5A. The Limit adjustment is made when the power supply is in the high voltage OFF mode (Interlock Open) via the screwdriver adjustable potentiometer labeled “FIL I LIM ADJ” that is accessible through the top cover.

A test point is provided on pin 9 on the 15 pin D connector for monitoring the Filament Limit set point. The test point scaling is 1Vdc=1amp. See Figure 3.3 for the recommended interface circuit.

Due to the wide variety of X-ray tubes available, uXHP power supplies are shipped with the Filament Limit set for minimum. The operator must set the filament limit at the time of installation in accordance with the X-ray tube manufacturer’s recommendations.

FILAMENT PREHEAT: uXHP filament power supplies operate at a user selectable preheat current level whenever the +24Vdc input power is applied to the unit and the Interlock is Open (High Voltage OFF). The Preheat Level is adjustable from between 0.8 to 2.5 amps. Selecting the correct preheat current level can greatly reduce or eliminate the overshoot that typically occurs on the output emission current when operating into a “cold filament”.

The Preheat adjustment is made when the power supply is in the high voltage OFF mode (Interlock Open) via the screwdriver adjustable potentiometer labeled “PH ADJ” that is accessible through the top cover.

A test point is provided on pin 14 on the 15 pin D connector for monitoring the Filament Preheat set point. The test point scaling is 1Vdc = 1amp. See Figure 3.3 for the recommended interface circuit.

Due to the wide variety of X-ray tubes available, uXHP X-ray generators are shipped with the Filament Preheat set for minimum. The operator must set Filament Preheat at the time of installation.

REDUNDANT HV MONITOR:
A redundant high voltage feedback divider where 0-10Vdc = 0-100% rated output is monitored by firmware. Customer adjustable overvoltage protection (via GUI) is provided. The analog monitor signal is provided on pin 8 of the 9 pin “D” connector for the RS-232 interface.

Note: The filament return wires cannot be grounded as this would short circuit the tube return current monitoring of the uXHP. If grounding of the filament is required, please consult the factory.

Figure 3.1 Typical Operating Setup uXHP
Note: The filament return wires cannot be grounded as this would short circuit the tube return current monitoring of the uXHP. If grounding of the filament is required, please consult the factory.

Table 3.2 DC Input & Filament Connections
Figure 3.3 Monitors & Voltage/Current Control Connections
Figure 3.4 Recommended Interlock/HV ON Configurations
Chapter 4

Principles of Operation

The uXHP series of modular X-ray generators 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 uXHP power supply. For details on a specific circuit, consult Spellman’s Engineering Department.

The uXHP 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 Case

The uXHP is a compact, high efficiency, X-Ray generator. The power supply can supply 100 watts of power. Output voltages of up to 80kV can be generated. The sheet metal case is electrically connected to the power and signal ground of the X-Ray generator.

**WARNING**

The energy levels 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**


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 15μ seconds.
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 – 10kV 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 voltage doubler circuits. Output filtering is typically provided by an R-C type filter. A high bandwidth resistive/capacitive divider provides voltage feedback for regulation and monitoring. Current feedback for regulation and monitoring is provided by a sense resistor connected at the low voltage end of the Filament Power Supply.

4.5 Control PWB
The majority of control circuits for power supply controls are located on the CONTROL/POWER PWB. +15Vdc, -15Vdc, +10Vdc, +3.3Vdc and +3.0Vdc are generated on the CONTROL/POWER PWB. High Voltage On/Off control is accomplished by K2, and its associated circuitry. Interlock control is provided by K2. Voltage feedback from a high voltage divider, located on the High Voltage Assembly, is sent to U16. Gain adjustment is provided by R98. The KV feedback signal is sent to the 15 pin D connector for remote monitoring. Program voltages are typically ramped up to set level by the slow start circuits of U16.

Current feedback from the high voltage rectifier is sent to sense resistors located on the High Voltage Assembly. Feedback is then sent to U15. The resonant control circuitry consists of a voltage to pulse width converter. U17 generates all pulse width control signals.

4.6 Filament Supply
The filament inverter provides the power for the X-ray tube filament. The filament inverter is a high frequency inverter providing regulated current to the primary of the filament transformer. The filament transformer secondary is then connected to a rectifier and filter circuit, the output and return is then provided on pin 3 and 4 respectively of the 4 pin Control Power/Filament Output connector.

Note: The filament return wire cannot be externally grounded as this would short circuit the tube return current monitoring of the uXHP. If grounding of the filament is required, please consult the factory.

4.7 Options
Due to the many variations of models and options provided in the uXHP 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 uXHP 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 XRM Compatible Cable   XCC
The XCC option allows the uXHP power supply to except the same high voltage output cable that is used on the XRM series power supply.

5.2 5 Volt Programming and Monitor   5VPM
5VPM changes the voltage and current programming inputs and monitors to 0-5Vdc = 0-100% rated output.

5.4 Mammoflex HV Cable   K5302
Mammoflex HV cable for uXHP. (50/65kV only)

5.5 Mammoflex HV Cable   K2001
Mammoflex HV cable for uXHP with XCC option. (50/65kV only)

5.6 Custom Designed Models
X(#)
Units built to customer specifications are assigned an X number by the factory. If this unit is an X model, a specification control drawing 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. Please contact the 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.

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.

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 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.

Click here for HVD information.
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.
Chapter 8

Factory Service

8.1 Warranty Repairs

During the Warranty period, Spellman will repair all units free of charge. The Warranty is void if the unit is worked on by other than Spellman personnel. See the Warranty in the rear of this manual for more information. Follow the return procedures described in Section 8.2. The customer shall pay for shipping to and from Spellman.

8.2 Factory Service Procedures

Spellman has a well-equipped factory repair department. If a unit is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached.

For all units returned for repair, please obtain an authorization to ship from the Customer Service Department, either by phone or mail prior to shipping. When you call, please state the model and serial numbers, which are on the plate on the rear of the power supply, and the purchase order number for the repair. A Return Material Authorization Code Number (RMA Number) is needed for all returns. This RMA Number should be marked clearly on the outside of the shipping container. Packages received without an RMA Number will be returned to the customer. The Customer shall pay for shipping to and from Spellman.

A preliminary estimate for repairs will be given by phone by Customer Service. A purchase order for this amount is requested upon issuance of the RMA Number. A more detailed estimate will be made when the power supply is received at the Spellman Repair Center. In the event that repair work is extensive, Spellman will call to seek additional authorization from your company before completing the repairs.

8.3 Ordering Options and Modifications

Many of the options listed in Chapter 5 can be retrofitted into Spellman power supplies by our factory. For prices and arrangements, contact our Sales Department.

8.4 Shipping Instructions

All power supplies returned to Spellman must be sent shipping prepaid. Pack the units carefully and securely in a suitable container, preferably in the original container, if available. The power supply should be surrounded by at least four inches of shock absorbing material. Please return all associated materials, i.e. high voltage output cables, interconnection cables, etc., so that we can examine and test the entire system.

All correspondence and phone calls should be directed to:

Spellman High Voltage Electronics Corp.
475 Wireless Boulevard
Hauppauge, New York 11788
TEL: (631) 630-3000 FAX: (631) 435-1620
E-Mail: sales@Spellmanhv.com
www.spellmanhv.com
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;
- subject 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