

Instruction Manual

uX SERIES

High Voltage Power Supply

MODEL :
SERIAL# :
DATE :

**SPELLMAN
HIGH VOLTAGE ELECTRONICS
CORPORATION**

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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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Chapter 1

INTRODUCTION

1.1 Description of the uX Series

The uX 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 uX 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 uX 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 75W models. Custom designed units for single use or OEM applications are available.

A video showing the functionality of the uX/uXHP graphical user interface (GUI) can be seen here:

<https://www.youtube.com/watch?v=1BX333Gu1rE&feature=youtu.be>

1.2 Standard Features

The uX 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. Prior to closing the Interlock the filament operates at a user determined preheat current level. Preheat levels are selected for the desired X-ray tube to minimize mA overshoot.

INDICATOR LEDS: HIGH VOLTAGE ON and POWER ON indicators. The green POWER ON indicator will flash whenever any fault occurs. Use of the uX/uXHP GUI is recommended to investigate any faults generated.

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.

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 (J4).

1.2.1 Remote Operating Features

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

EXTERNAL INTERLOCK: Interlock connections are provided on the Analog Interface connector on the front of the chassis 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 12V lamp rated for 0.5W to 0.8W and a safety switch. This configuration provides fail safe interlocking. During high voltage operation, opening the safety switch or failure of the 12V lamp will cause the High Voltage to shut OFF. This option should be used for safety interlock circuits.

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

1.4 Options

CODE DESCRIPTION	
• XCC	XRM Compatible HV Cable (50kV only)
• 5VPM	0 to 5 Volt Programming and Monitor Scaling
• GB	Grid Bias Option.
• K5302	Mammoflex HV cable for uX
• K2001	Mammoflex HV cable for uX w/XCC option

Table 1.1 uX Options

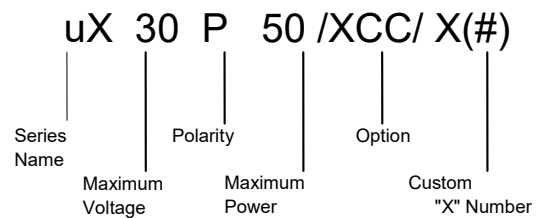
The options available are listed in Table 1.1. See Section 5 for more information on these options along with operating and set-up instructions. With few exceptions, these options and modifications can be retrofitted to your power supply at the factory in a short time. For price and retrofit arrangements,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

1.4 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 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.

Standard Spellman uX 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

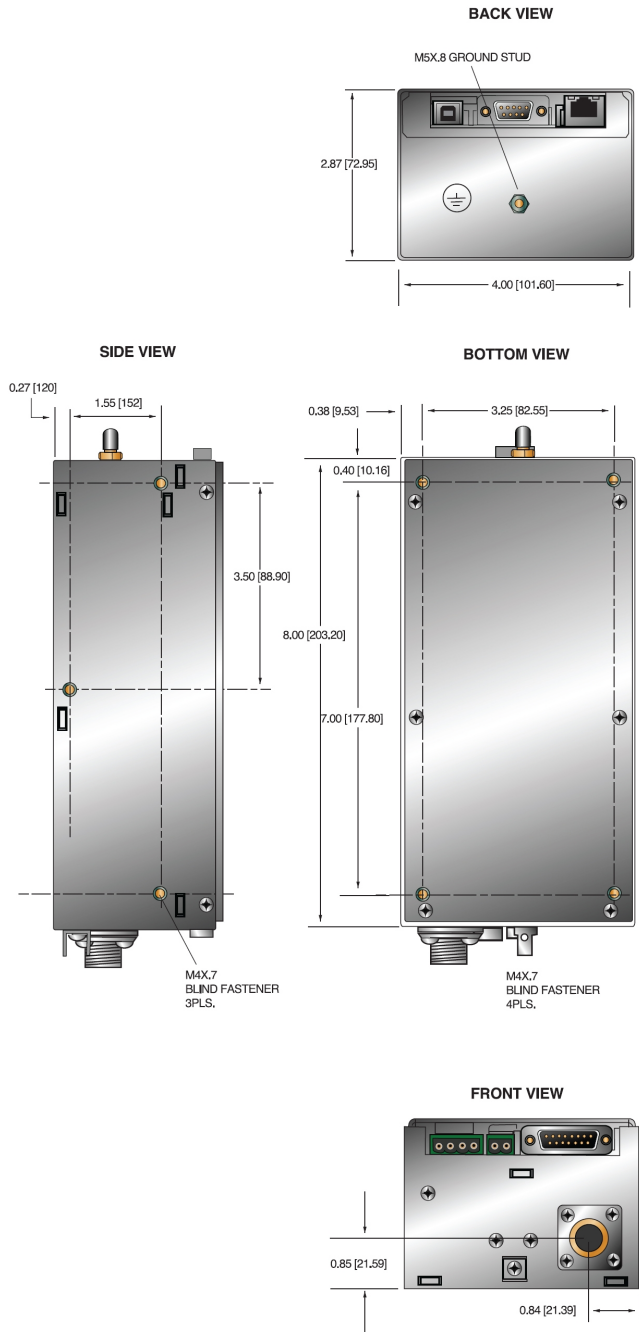
The uX Series of modular X-ray generators are designed for installation into existing or newly developed OEM equipment. The X-ray generator can also easily fit into bench top applications or test set requirements. Standard unit dimensions are shown in Figure 2.1.

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

DIMENSIONS: in.[mm]

50KV



50KV WITH XCC OPTION

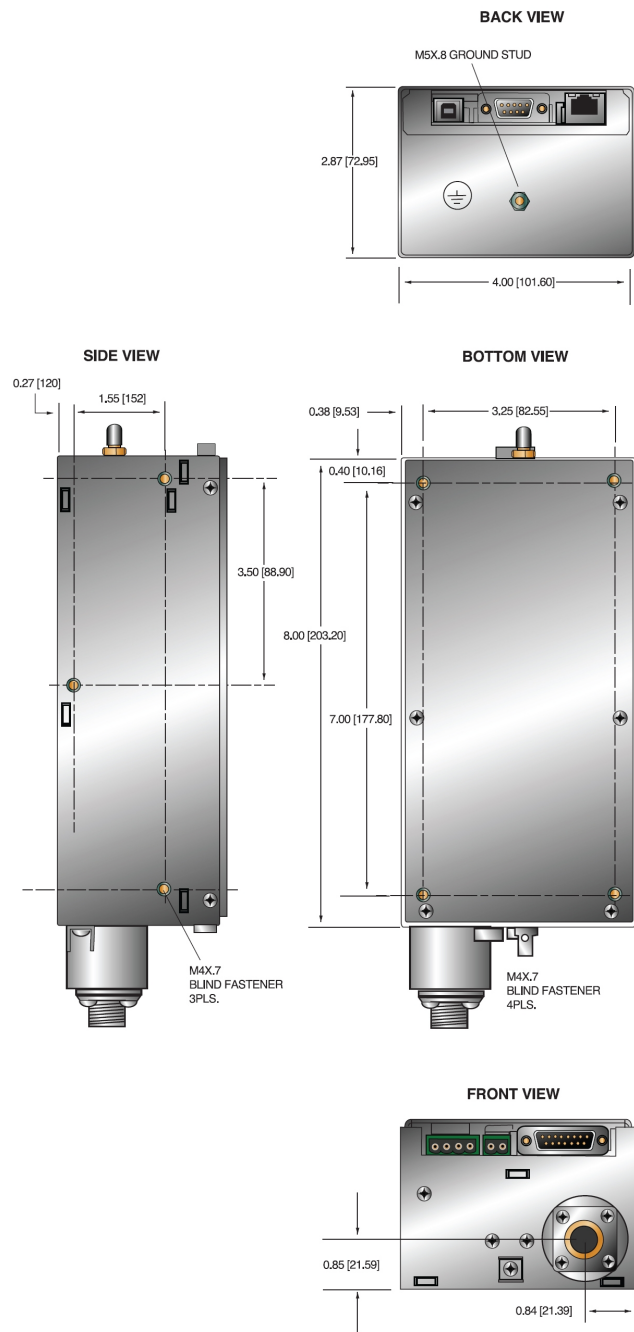


Figure 2.1 50kV uX DIMENSIONS

DIMENSIONS: in.[mm]

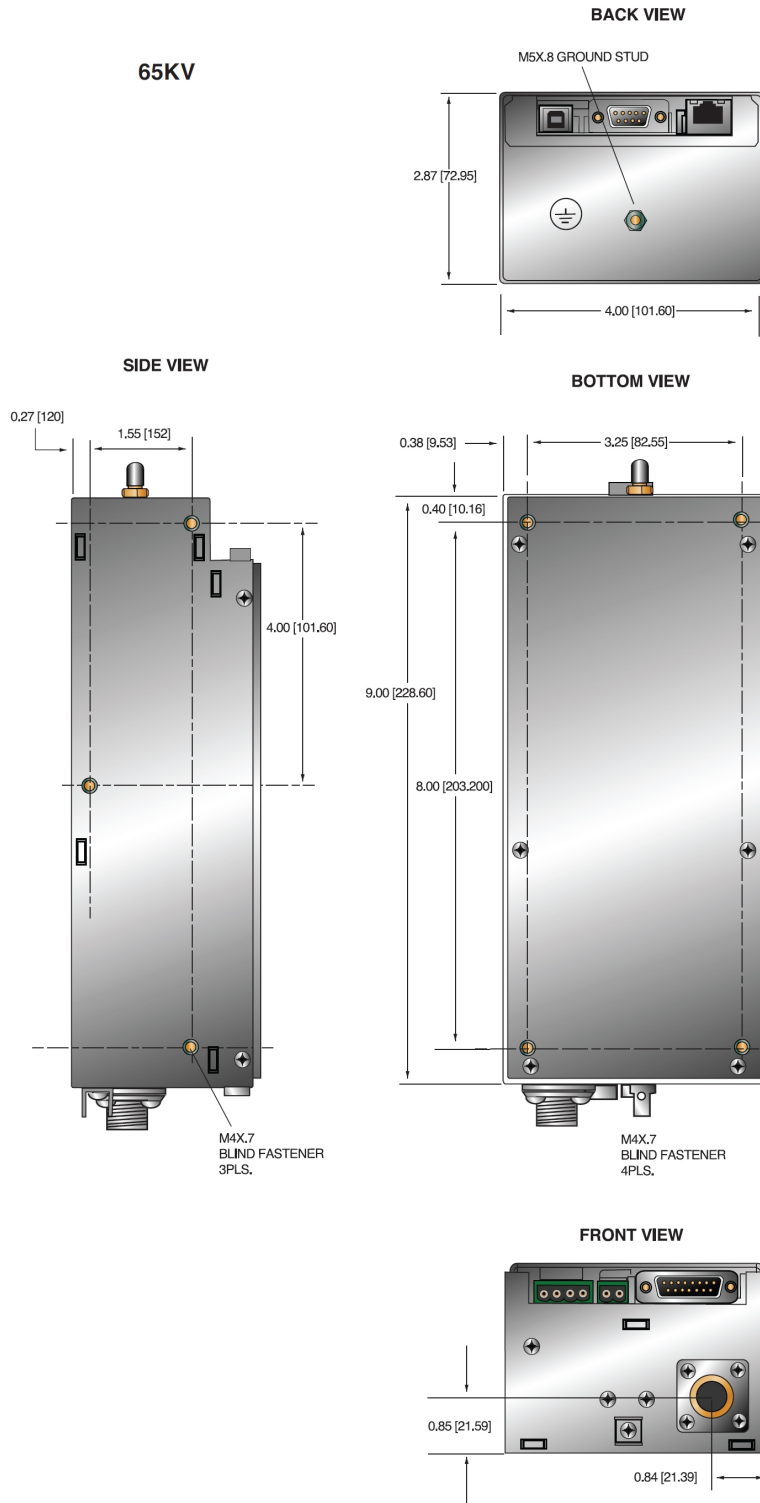


Figure 2.2 65kVuX DIMENSIONS

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 to the X-ray generator 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 uX 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, 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 uX 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 design. 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 operator. 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 volts (zero output) to 10 volts (full 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 to 10 volts equals 0-100% of output on standard units. 0 to 5 volts equals 0-100% of output on units with 5VPM option. Test points have an output impedance of 1K ohms. 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 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.

FILAMENT LIMIT: The maximum current that the filament power supply can operate is user adjustable from 1.0A 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, uX power supplies are shipped with the Filament Limit set for minimum. The operator must set filament limit at the time of installation in accordance with the X-ray tube manufacturers recommendations.

FILAMENT PREHEAT: uX 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 .8A to 2.5A.

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 = 1ADC. See Figure 3.3 for the recommended interface circuit.

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

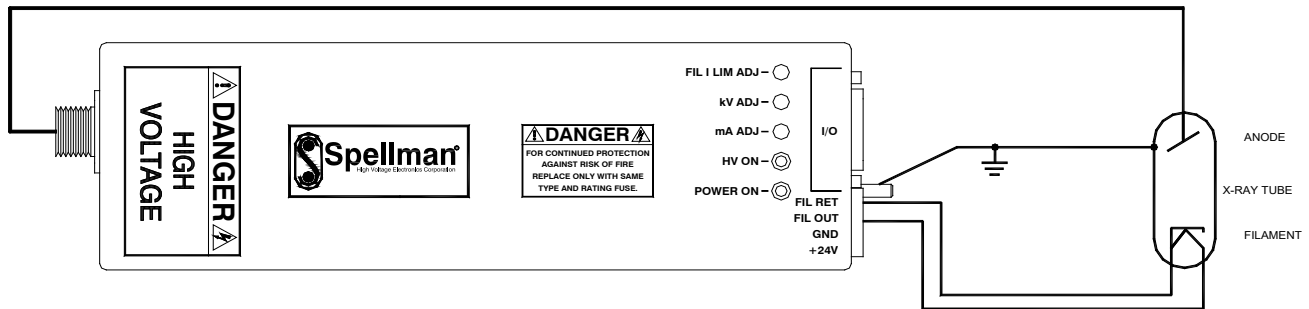
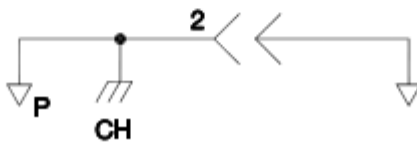
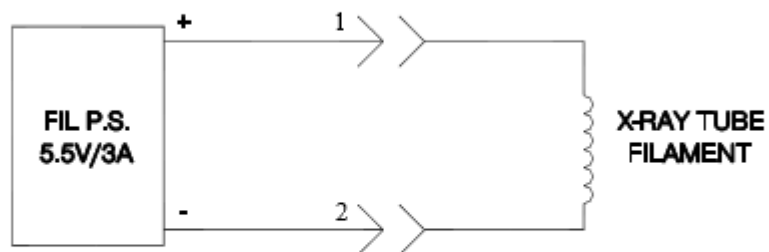


Figure 3.1 Typical Operating Setup uX



**24V INPUT CONNECTIONS
(BLACK CONNECTOR)**



**FILAMENT CONNECTIONS
(GREEN CONNECTOR)**

Table 3.2 DC Input & Filament Connections

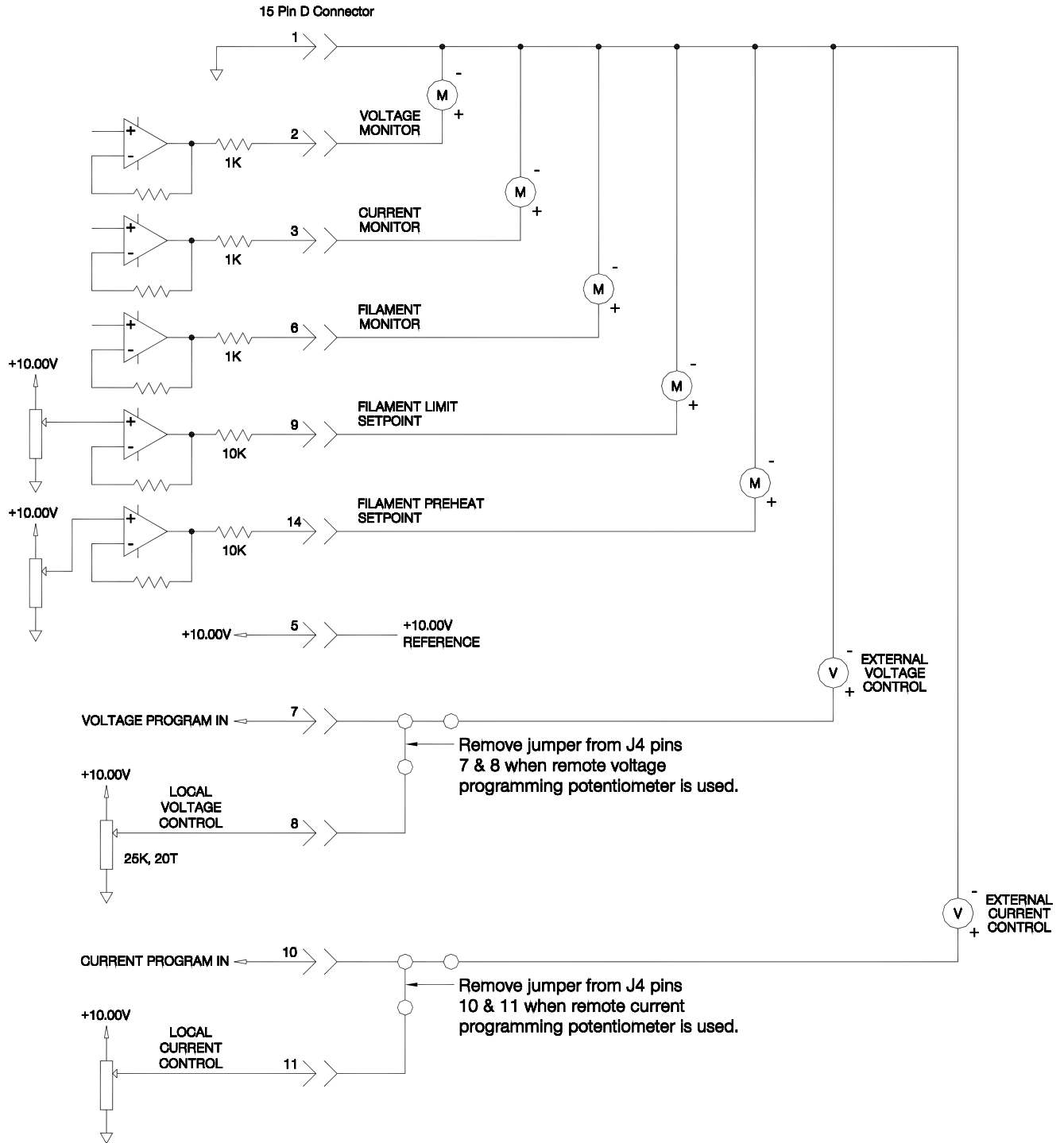
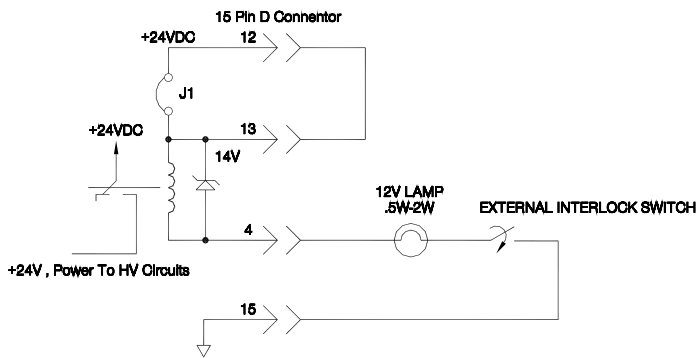
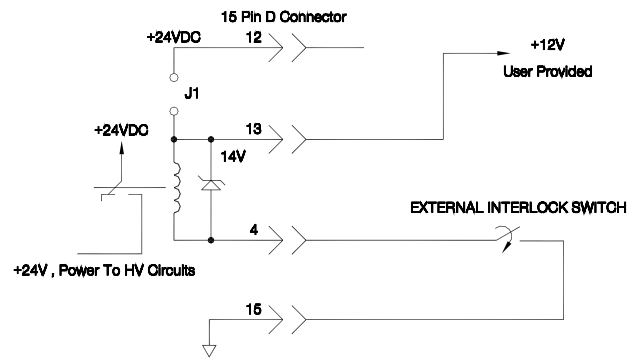


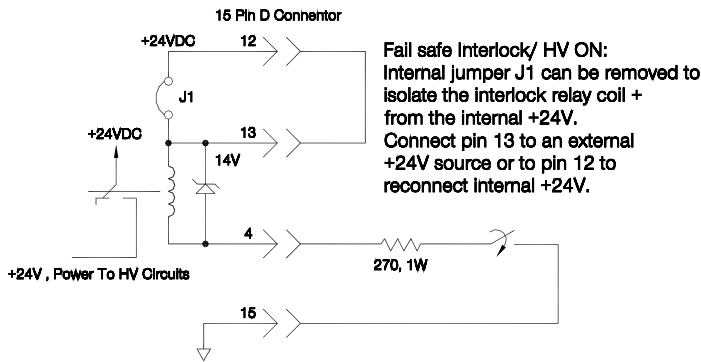
Figure 3.3 Monitors & Voltage/Current Control Connections



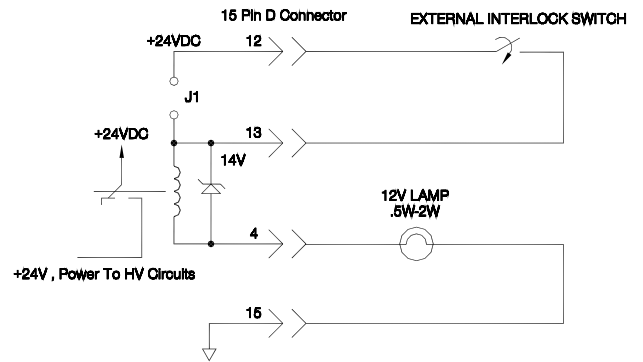
**Recommended Interlock Configuration
With Fail Safe Lamp Installed**



**Alternate Interlock Configuration 2
Customer Provided +12V For HV ON Relay
Internal Jumper, J1, Removed
Relay Return Grounded**



**Alternate Interlock Configuration 1
Fail Safe Lamp Replaced With A Resistor**



**Alternate Interlock Configuration 3
Interlock Switch Installed In The High Side Of Relay Coil.
Relay Return Is Thru Lamp or 270 ohm Resistor.
This Configuration Is Required When SIC Option Is Installed.**

Figure 3.4 Recommended Interlock/HV on Configurations

Chapter 4

Principles of Operation

The uX 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 uX power supply. For details on a specific circuit, consult Spellman's Engineering Department.

The uX 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 uX is a compact, high efficiency, X-ray generator. The power supply can supply up to 75 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 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 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. 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 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 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. 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 uX 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 uX 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 uX 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 0-5V = 0-full rated output.

5.3 Grid Bias Option GB

Plug-n-play compatibility for Oxfords Apogee X-ray tubes that utilize grid bias control.

5.4 Mammoflex HV Cable K5302

Mammoflex HV cable for uX.

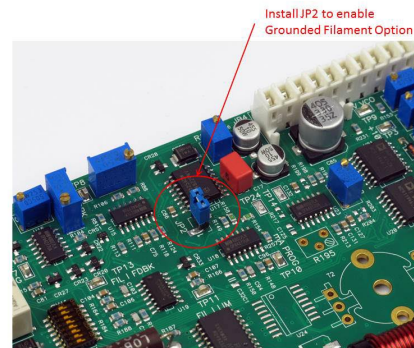
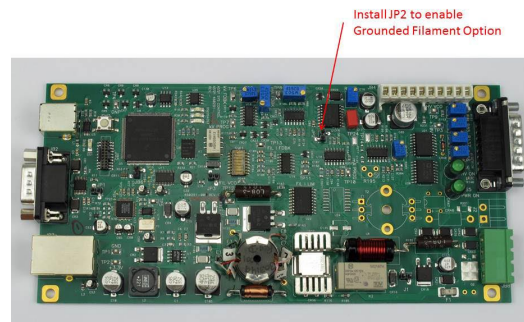
5.5 Mammoflex HV Cable K2001

Mammoflex HV cable for uX with XCC option.

5.6 Grounded Filament GF

The grounded filament option allow the uX to operate with X-ray tubes where the filament is ground referenced.

Remove the cover to expose Control board. Follow photos as shown.



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, a 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.

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
<http://www.spellmanhv.com>

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

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





uX/HP Interface Control Digital Interface:

Serial – RS-232
Ethernet
Universal Serial Bus - USB



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Revision Table

Revision Release Date	Revision Number	Changes Made To Document
November 8, 2013	-----	Initial Release
2/18/14	1	Added Sections for Ethernet and USB
10/09/14	2	Added section 8.3 for uX80P100
02/13/15	3	Included HP model
07/02/18	4	Added Filament Ramp Time commands, fixed various typos

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1 Scope

This document applies to the communications interface on the uX (Micro-X) Interface Control Board , assembly 460291-XXX.

2.0 Functional Description

The communications interface provides:

- RS-232.
- Ethernet (10/100-Base-T)
- USB

Data acquisition and control capabilities are provided by:

- 6 channels of 12-bit analog-to-digital converters.
- 2 additional analog channels that monitor the house-keeping 24V power supply and ambient board temperature
- 4 channels of 12-bit digital-to-analog converters.
- 1 digital output bit
- 3 digital inputs bits
- 1 relay/interlock

3.0 Getting Started – Hardware Setup

The digital hardware includes a 120MIPS micro control unit processor (MCU).

The uX can operate in manual (analog) control mode or remote (digital control via the selected interface). The selection is done using DIP Switches located on the control board.

3.1 DIP Switches

The DIP switch (SW1) settings determine if the unit is running in local mode (analog control) or remote mode (digital control via serial / Ethernet / USB).

Switch Settings for Local or Remote Mode

ID	Local Mode	Description	Switch Position
SW1-1	Local	Disable processor KV setting control.	OFF
SW1-2	Local	Bypass processor KV enable relay	ON
SW1-3	Local	Disable processor mA control	OFF
SW1-4	Local	Disable processor filament preheat control.	OFF
SW1-5	Local	Disable processor filament current limit control.	OFF
SW1-6	Local	Enable filament preheat adjustment pot R156.	ON
SW1-7	Local	Enable filament current limit adjustment pot R152.	ON
SW1-8	Local	Spare Not Used.	ON
ID	Remote Mode	Description	Switch Position
SW1-1	Remote	Enable processor KV setting control.	ON
SW1-2	Remote	Enable processor KV enable relay	OFF
SW1-3	Remote	Enable processor mA control	ON
SW1-4	Remote	Enable processor filament preheat control.	ON
SW1-5	Remote	Enable processor filament current limit control.	ON

SW1-6	Remote	Disable filament preheat adjustment pot R156.	OFF
SW1-7	Remote	Disable filament current limit adjustment pot R152.	OFF
SW1-8	Remote	Spare Not Used.	ON

3.2 RS232 Interface

The RS232C interface has the following attributes:

- 115.2K bits per second (factory default)
- No Parity
- 8 Data Bits
- 1 Stop Bit
- No handshaking
- DB-9 connector as shown

Figure 1 below shows the pin location and definition.

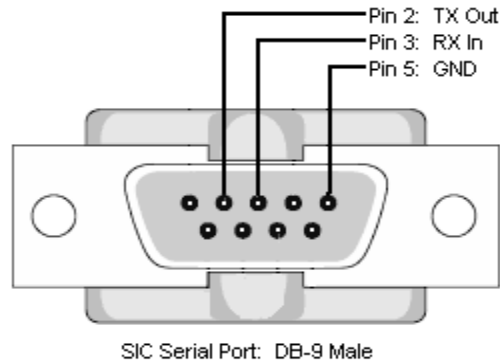


Figure 1 – JB2, RS-232 DB-9M pinout (front view)

Pin Definition

PIN	DESCRIPTION
1	-
2	Tx Out
3	Rx In
4	-
5	Ground
6	-
7	-
8	-
9	-

3.3 Ethernet Interface

The Ethernet interface has the following attributes:

- 10/100-Base-T
- IP address can be set by the system integrator
- Network Mask can be set by the system integrator
- TCP Port Number can be set by the system integrator
- RJ-45 connector
- Network attachment via Crossover and Standard Ethernet cables.

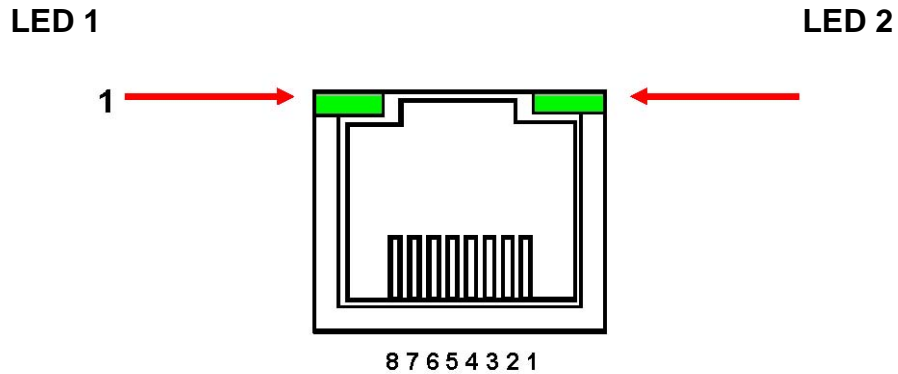


Figure 5 – JB3, Ethernet RJ45 Jack (front view)

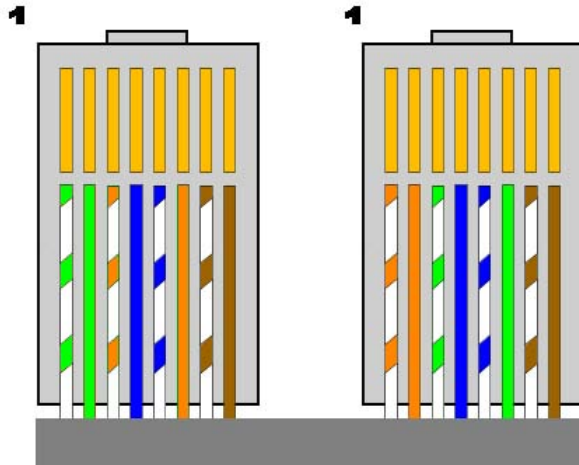
PIN	DESCRIPTION
1	TX+
2	TX-
3	RX+
4	-
5	-
6	RX-
7	-
8	-

The Ethernet RJ-45 has two LED indicators, as shown in Figure 5. The left LED, LED1 indicates that the network processor has a valid network link. The right LED, LED2 indicates network activity.

3.3.1 Ethernet Cabling

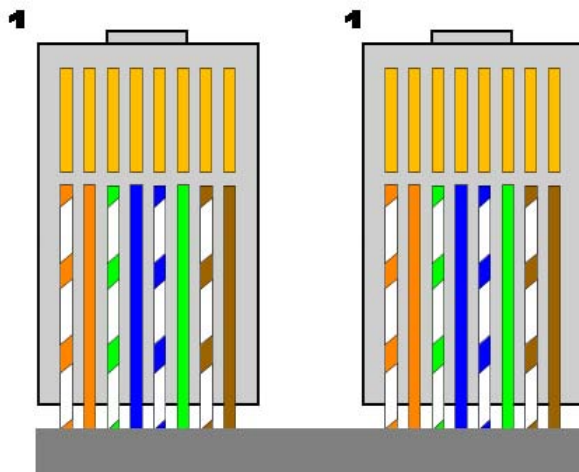
Category 5 (CAT5) Ethernet patch cables are used to connect the uX to the host computer. There are two ways to connect to the uX via Ethernet: the first is to directly cable between the host and the uX, and the second is through the use of a switch, hub, or network.

A direct connection requires a non-standard cable where the wires are not run straight through. Please refer to the two cable ends shown below in.



Crossover Cable for Direct Connection

A standard connection through a hub, switch, or network uses a standard CAT5 patch cable. Please refer to the two cable ends shown below in figure 8.



Standard Straight Through Cable – Standard CAT5 Patch

3.4 USB – Universal Serial Bus Interface

The USB interface has the following attributes:

- Compliant with USB 1.1 and USB 2.0 specifications
- Type B male connector
- Included driver can be communicated with via standard Windows serial communications methods

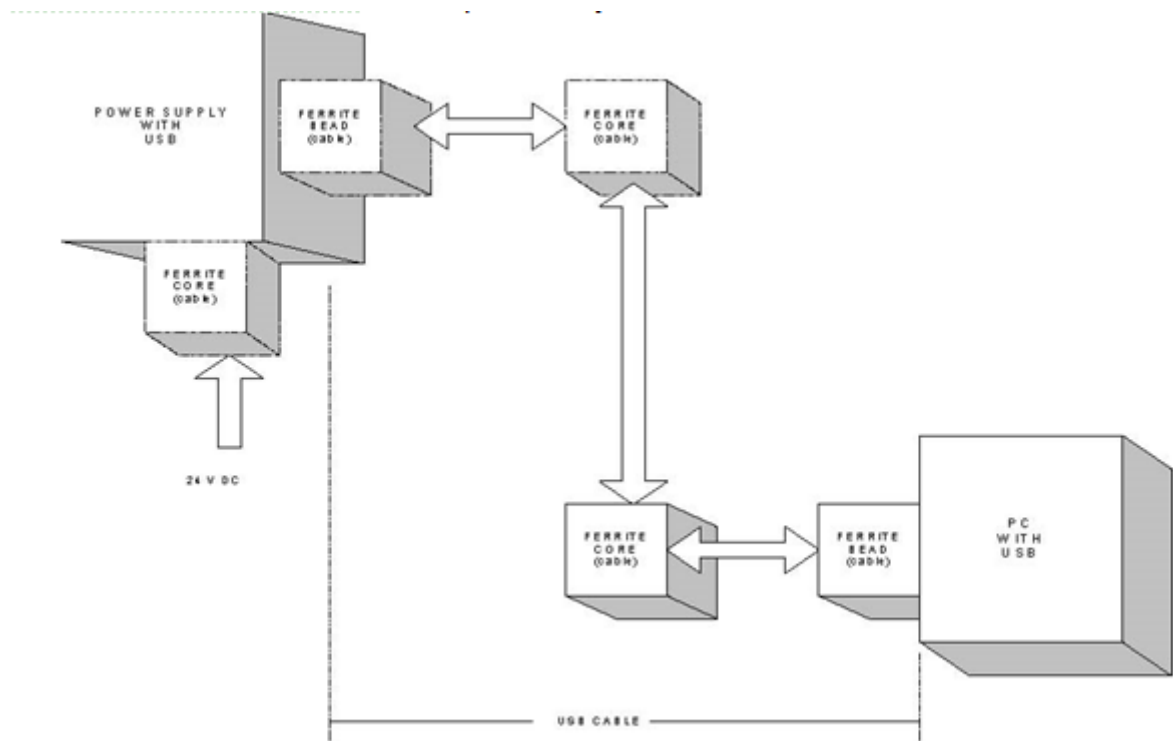


Figure 6 – JB4, USB Type B (front view)

PIN	DESCRIPTION
1	Vbus +5V
2	D-
3	D+
4	Ground

3.5 USB Cabling In High EMI Environments

If the uX USB interface is being used in a high-EMI environment, ferrites should be added to the USB cable. The figure below illustrates the possible combinations of ferrites that can be used to achieve acceptable operation under these conditions.



Block Diagram of USB Cable Utilizing Ferrites

Ferrite beads should be attached to the USB cable next to the connectors – both sides should be installed. In extreme cases ferrite cores may be added where the cable is looped 3 or 4 times around the core as shown in figure 11. Cores of 1.5 to 2 inches should be used at both ends of the cable. In addition, a ferrite core may be required on the 24VDC input.

4.0 Getting Started – Software

The following sections detail how to create software to interface to the uX communications interfaces.

4.1 RS-232

The RS-232 interface makes use of a standard ‘command/response’ communications protocol. See section 5.0 for the syntax of the serial interface protocol.

The baud rate for the RS232 is adjustable using a serial control command (see the change baud rate command). The factory default is 115200 baud. Supported baud rates are 115200, 57600, 38400, 19200, 9600, and 4800. All software that addresses the RS-232 interface must adhere to the following parameters:

- No Parity
- 8 Data Bits
- 1 Stop Bit
- No handshaking

4.1.1 Enabling Communications in C# for RS-232

Communications in Microsoft Visual C# are started with the COM port initialized and then the port opened. Then a routine would be created to send commands out the COM port, and another routine to receive responses from the port.

- Initialization Routine:

For example:

```
CommResult Connect(string comPort, int baudRate, Parity parity =  
Parity.None)
```

- Send Routine:

For example:

```
void SendCommand(Command cmd, string[] parameters, ref byte[]  
buf)
```

- Receive Routine: That is polled or interrupt called.

For example:

```
void ReceiveCommand(ref byte[] buf)
```

4.1.2 Configuring Communications in C# for RS-232

In order to configure the COM port object, first you must initialize it in the COM port properties:

Settings	115200,n,8,1
Handshaking	0 – None

The following could be an example C# Code routine to initialize the COM Port.

```
port = new SerialPort(comPort, baudRate);  
port.Parity = parity;  
try  
{  
    port.Open();  
}  
catch  
{  
    Console.WriteLine("Error opening " + comPort);  
}
```

The application can be set to either default to a specific COM Port or the End User can be allowed to choose one for the particular PC.

After initial configuration the following could be an example C# code routine to set up a transmit array, to build and send out a message to the COM port.

```
Void SendCommand(Command cmd, string[] parameters, ref byte[] buf)
{
    Array.Clear(buf, 0, 128); // Clear a transmit buffer.
    len = BuildCommand(cmd, parameters, buf); // Build Message.
    port.Write(buf, 0, len); // Send buffer to COMM Port.
    lastResult = CommResult.CmdGood;
}
```

For the receive routine, the reply routine would be polled when the receive buffer is filled with messages. Then a user routine would be needed to parse the reply messages.

```
void ReceiveCommand(ref byte[] buf)
{
    // Wait for response
    Array.Clear(buf, 0, buf.Length); // Clear Receive Port

    port.ReadTimeout = 50;
    port.Read(buf, 0, 128); // Read COM port char. By char. Into
    // buffer.
    DecodeResponse(buf); // Decode message in buffer.
}
```

4.2 Ethernet

4.2.1 Configuring the uX For a Local Area Network (LAN)

If you have chosen to place the uX onto your local area network you will need:

A CAT5 network patch cable to physically connect the uX to the LAN

A static IP address to assign to the uX.

Remember that even if the IP address you have selected is in general a valid IP address it needs to be valid for your LAN (local area network). Otherwise the device will not be accessible from an Internet browser or Ping.

4.2.2 Configuring Ethernet communications in C#

A complete description of the use of sockets in C# for Ethernet communication is beyond the scope of this document, however a brief introduction is given here.

First a socket must be created and initialized to the correct IP address and port number. In the following code snippet, address has the IP address assigned to the uX and IPPort the port number.

```
public CommResult Connect(byte[] address, int IPPort)
{
    lastResult = CommResult.CmdErr;
    socket = new Socket(AddressFamily.InterNetwork, SocketType.Stream,
        ProtocolType.IP);
    socket.NoDelay = true;
    try
    {
        socket.Connect(new IPAddress(address), IPPort);
    }
    catch (SocketException sockEx)
    {
        Logger.Write(Logger.ErrLog, "ERROR: Socket terminated on
            connect with: " + sockEx.Message);
    }

    if (socket.Connected)
    {
        lastResult = CommResult.CmdGood;
    }
    return lastResult;
}
```

Now this open socket can be used to communicate with the uX. In the following code snippet the socket is passed in the argument "sock" and the string "cmd" has the command to be sent. The code waits for a response and then stores it back in the "cmd" string.

```

private static int ethernetCommand(Socket sock, string cmd)
{
    int idx = 0;
    int timer = 0;
    int counter = 0;
    byte[] buf = new byte[256];

    foreach (char c in cmd.ToCharArray()) // copy characters from cmd string
    {                                     // into buf for sending to uX
        buf[idx++] = (byte)c;
    }

    sock.Send(buf, idx, SocketFlags.None); // Send the command via the socket
    Array.Clear(buf, 0, buf.Length);     // Clear the buffer, response is put here
    counter = 0;                          // Counts the number of bytes received

    // Response loop, keep reading socket until timer expires (timeout) or
    // the STX char is found in the buffer
    while (timer < 6000 && (!(IList<byte>)buf).Contains(ETX))
    {
        counter += sock.Receive(buf, 128, SocketFlags.None);
        Thread.Sleep(5);
        timer++;
    }

    cmd = System.Text.Encoding.ASCII.GetString(buf);

    return counter;
}

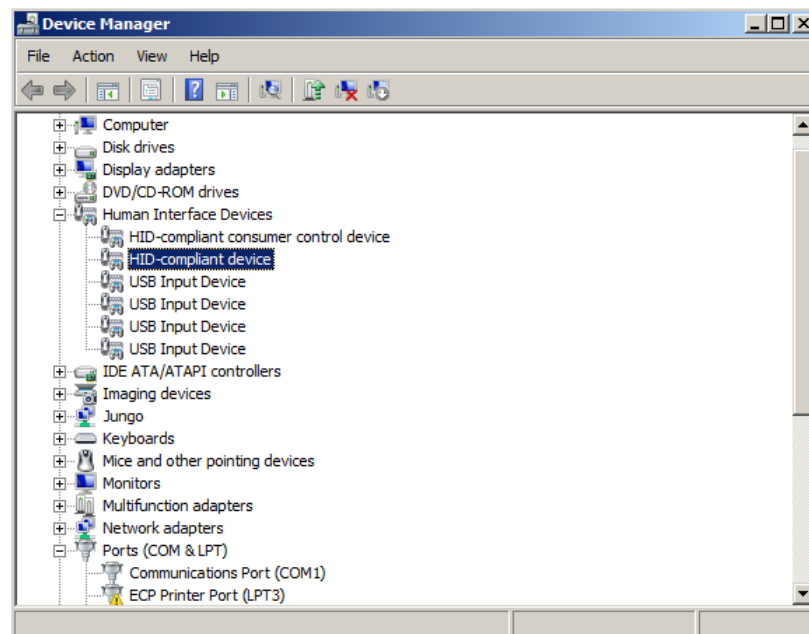
```


4.3 USB

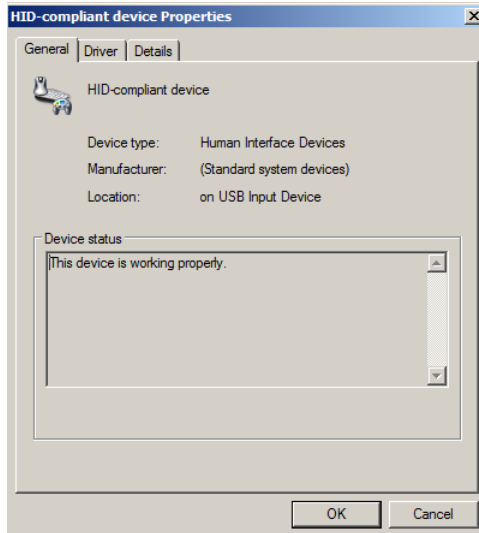
The uX presents itself to the Host computer as a Human Interface Device (HID). In HID devices, the attached device instructs the host computer what the report format looks like via a “Report Descriptor”. The uX defines only a single write and a single read report type. The uX Write (commands to the uX) and Read (responses from the uX) reports are both 64 bytes. The USB report acts as a data transport. No data formatting is done at the USB layer, data must be correctly formatted as described in section 5.3 prior to being placed in the report buffer. Note that for long messages the total message can span multiple buffers, and it is possible that multiple messages can be present in a single buffer. Unused bytes in write reports should be filled with zeros. Unused bytes in read reports will be filled with zeros.

4.3.1 USB Driver Installation

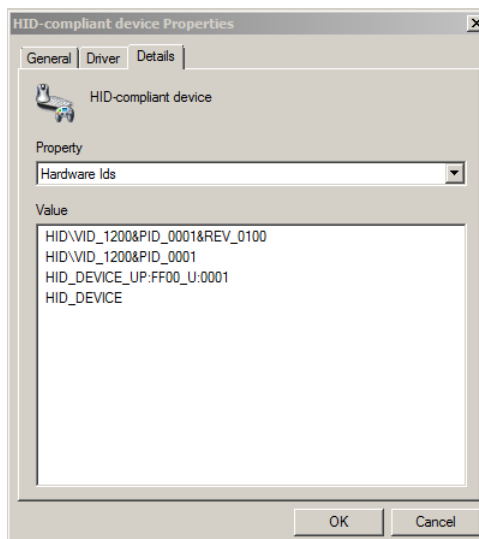
The Windows USB Human Interface Device (HID) driver is included with the windows operating system. The driver should automatically install itself when the uX is first connected to host computer. It should appear in the device list (in device manager) as a Human Interface Device. The exact nomenclature may vary depending on the version of Windows used. For Windows 7 it appears as a HID-Compliant device as show below. (Note that the uX must be attached to the USB and powered up to appear in the device list).



It can be verified that this is the uX by right clicking on the device, and choosing properties.



Click on the details tab, and choose the Hardware Ids property from the drop down list.



Note the VID (Vendor ID) of VID_1200. This is Spellman's assigned VID.

4.3.2 The Spellman HID communication DLL (USB_DLL.dll)

Spellman provides a .dll (dynamic link library) to help communicate with the uX via the Windows driver. This file is named "USB_DLL.dll" and is included on the CD that comes with the uX unit. This library contains 3 functions:

- FindTheHid() – Finds the connection with the correct VID & PID.
- WriteReport(str) – Writes a string to the connected device
- ReadReport() – Reads a string from the connected device.

4.3.3 USB Example Code

The following code snippet of C# code declares a USB port, calls FindTheHid() and if it is found writes out a report. The code then waits 50ms for a response. If a response is received the variable count is assigned the number of bytes received.

```
int len; // Length of message in buf
byte buf[] = new byte[128]; // holds message to be sent
usbPort = new usbDll();
string tmp = "";
string rptstr = "";
int c, count;

if (usbPort.FindTheHid()) // Search the list if HID devices and find
{ // the Spellman HID & PID
    // Figure out how many buffers required to send report
    int blocksToSend = len / 64;
    if (len > blocksToSend * usbconst.rpt_size) blocksToSend++;

    for (int iBlk = 0; iBlk < blocksToSend; iBlk++) // for each report
    {
        for (int i = 0; i < len; i++) // format byte buffer as string
        {
            str = str + System.Convert.ToChar(buf[i]);
        }
        usbPort.WriteReport(str); // write report to uX
    }
    // Wait for report back from uX
    while (timeout_cnt < 50) // Response timeout counter loop
    {
        rptstr = usbPort.ReadReport(); // Read report (if any from uX)
        tmp = tmp + rptstr; // concatenate chars
        c = rptstr.Length; // get length of string
        if (rptstr.Contains((char)0x03)) // Check for STX terminating char
        { // If found, save char count
            count = tmp.Length; // and exit loop
            break;
        }
        if (c > 0)
        {
            count += c;
            timeout_cnt = 0;
        }
        Else // if no buffer from uX increment timeout counter
        {
            timeout_cnt++;
        }
        Thread.Sleep(1);
    }
}
```

5.0 Command Format

5.1 Serial Interface Protocol - RS232

Serial communications will use the following protocol:

<STX><CMD><,>ARG><,><CSUM><ETX>

Where:

<STX> = 1 ASCII 0x02 Start of Text character
<CMD> = 2 ASCII characters representing the command ID
<,> = 1 ASCII 0x2C character
<ARG> = Command Argument
<,> = 1 ASCII 0x2C character
<CSUM> = Checksum (see section 5.1.2 for details)
<ETX> = 1 ASCII 0x03 End of Text character

5.1.1 Command arguments

The format of the numbers is a variable length string. To represent the number 42, the string '42', '042', or '0042' can be used. This being the case, commands and responses that carry data are variable in length.

5.1.2 Checksums

The checksum is computed as follows:

- Add the <CMD>, <,>, <ARG>, <,> bytes into a 16 bit (or larger) word. The bytes are added as unsigned integers.
- Take the 2's compliment (1's compliment plus 1).
- Truncate the result down to the eight least significant bits.
- Clear the most significant bit (bit 7) of the resultant byte, (bitwise AND with 0x7F).
- Set the next most significant bit (bit 6) of the resultant byte (bitwise OR with 0x40).

Using this method, the checksum is always a number between 0x40 and 0x7F. The checksum can never be confused with the <STX> or <ETX> control characters, since these have non-overlapping ASCII values.

If the MCU detects a checksum error, the received message is ignored – no acknowledge or data is sent back to the host. A timeout will act as an implied NACK.

The following is sample code, written in C#, for the generation of checksums:

```
for (int n = begin; n < end; n++)
{
    checksum += buf[n];
}

if (Config.includeEndCharInChecksum)
{
    checksum += buf[end];
}
checksum = (((0x100 - checksum) & 0x7F) | 0x40);
```

Here is an example of an actual Checksum calculation for command 10 (Program kV setpoint)

The original message with a placeholder for the checksum is
<STX>10,4095,<CSUM><ETX>

- First, you add up all the characters starting with the '1' in the command number, to the comma before the checksum with their ASCII values (in hexadecimal):

$$0x31 + 0x30 + 0x2C + 0x34 + 0x30 + 0x39 + 0x35 + 0x2C = 0x18B$$

- Next, you then take the two's complement of that number by negating it, by subtracting it from 0x100 (decimal 256), and only retain the lowest 7 bits by bitwise AND the results with 0x7F.

NOTE: This combines the steps of getting the twos complement, truncating the result to 8 bits and clearing the 8th bit.

$$(0x100 - 0x18B) \& 0x7F = 0x75$$

- Finally, bitwise OR the result with 0x40:

$$0x75 | 0x40 = 0x75$$

The checksum byte is 0x75 (Decimal 117, ASCII: u)

Here is another example, this time for command 22 (Request Status) which has no arguments.

The original message with a placeholder for checksum is:

<STX>22,<CSUM><ETX>

- First, you add up all the characters starting with the '2' in the command number to the comma before the checksum with their ASCII values (in hexadecimal):

$$0x32 + 0x32 + 0x2C = 0x90$$

- Next, you then take the two's complement of that number by negating it, by subtracting it from 0x100 (decimal 256), and only retain the lowest 7 bits by bitwise AND the results with 0x7F.

NOTE: This combines the steps of getting the twos complement, truncating the result to 8 bits and clearing the 8th bit.

$$(0x100 - 0x90) \& 0x7F = 0x70$$

- Finally, bitwise OR the result with 0x40:

$$0x70 | 0x40 = 0x70$$

The checksum byte is 0x70 (Decimal 112, ASCII: p)

5.2 Ethernet Interface

Each Ethernet command will consist of a TCP/IP header followed by the required data bytes as specified in section 5.2.1. The following figure summarizes the TCP/IP header configuration. Please note that this functionality is provided by the software implementation of the Open Systems Interconnection (OSI) TCP/IP protocol stack, specifically the upper 4 layers

Byte																				
0	Protocol Version	Header Length	Type Of Service		Total Length															
4	Packet ID				Flags	Fragmentation Offset														
8	Time To Live		Protocol		Header checksum															
12	Source Address																			
16	Destination Address																			
20	Source Port				Destination Port															
24	Sequence Number																			
28	Acknowledgement Number																			
32	Data Offset	Reserved	Code Bits		Window															
36	Checksum				Urgent Pointer															
40	Data Byte 1		Data Byte 2		Data Byte 3		Data Byte N													

Network TCP/IP datagram header

5.2.1 Ethernet Command Format

<STX><CMD><,>ARG><,><ETX>

Where:

<STX>	= 1 ASCII 0x02 Start of Text character
<CMD>	= 2 ASCII characters representing the command ID
<,>	= 1 ASCII 0x2C character
<ARG>	= Command Argument
<,>	= 1 ASCII 0x2C character
<ETX>	= 1 ASCII 0x03 End of Text character

This is similar to the RS232 serial commands as defined in section 5.1.1, except the checksum is omitted. The Ethernet interface acts as a transport for the serial uX commands. The command formats, responses, and examples as shown in section 5.4 apply to both RS232 and Ethernet communication, except that when using Ethernet communication, there is no checksum byte.

5.2.2 Ethernet Default IP Address

The default factory settings for the Ethernet interface are:

- IP Address – 192.168.1.4
- Port Number - 50001

5.2.3 Ethernet Web Server

The uX has resident an applet that can be accessed using a Web Browser such as Internet Explorer. This can be used to change the Ethernet settings.

To access this applet, open your web browser and in the address bar type “http://” followed by the IP address, for the factory default settings this would be “http://192.168.1.4”. The log-on web page should appear in your browser. If you can’t connect to the uX, verify the cable is attached, the unit is powered and your network card is set properly (it must be on the same subnet as the uX).



Login

System Login

User Name:

Password:

Login

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Log On Screen

The factory default user name is “admin”, and the default password is “shv”. Enter these in the form, and click the login button in the lower left corner. You will now get the network settings page.



Login Network Settings About

Configure Network Settings

IP Address:

Subnet Address:

Gateway Address:

Port:

Mac Address:

Device Id:

Save Refresh

Settings Screen

You can change the IP address, subnet mask, gateway address and port number. Remember to record these values, because at the next power up they will be used to access the Ethernet. Type the values in their respective fields. Internet address is

entered using the standard nomenclature of 4 decimal numeric values separated by periods, for example “192.168.1.5”.

If the Ethernet settings are lost, forgotten or an error is made when entering, and you lose access to the uX Ethernet connection, you may restore the above default settings using the “Reset IP Address” switch on the uX unit. To do this, power down the uX unit. Push the “Reset IP Address” switch and hold it down, and then power up the unit while continuing to hold down the switch. Wait 5 seconds while holding the switch down. Release the switch, power cycle the unit. You should now be able to access the unit at the default 192.168.1.4 address.

The applet also has an “About” page. This page contains some revision information related to uX firmware. The information on this page is read only.

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Login Network Settings **About**

System Information

Model:	MicroX
MCU Part Number:	SWM0632-001
MCU Revision:	13740
Hardware Revision:	001

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About Screen

5.3 Universal Serial Bus

USB communications will use the following protocol:

<STX><CMD><,>ARG><,><CSUM><ETX>

Where:

<STX>	= 1 ASCII 0x02 Start of Text character
<CMD>	= 2 ASCII characters representing the command ID
<,>	= 1 ASCII 0x2C character
<ARG>	= Command Argument
<,>	= 1 ASCII 0x2C character
<CSUM>	= Checksum (see section 5.1.2 for details)
<ETX>	= 1 ASCII 0x03 End of Text character

This is identical to the Serial RS232 protocol as described in section 5.1. Note that the checksum is used for USB communication.

5.4 Control Command Overview

The following table summarizes the control commands for the uX unit.

Command Name	<CMD>	<ARG>	RANGE
Change Baud Rate	7	1 ASCII	0-5
Program DAC Channel A	10	1-4 ASCII	0-4095
Program DAC Channel B	11	1-4 ASCII	0-4095
Program DAC Channel D	12	1-4 ASCII	0-4095
Program DAC Channel C	13	1-4 ASCII	0-4095
Request DAC A Setpoint	14	None	-
Request DAC B Setpoint	15	None	-
Request DAC D Setpoint	16	None	-
Request DAC C Setpoint	17	None	-
Request Analog Readbacks Channels 7 – 15	19	None	-
Request Analog Readbacks Channels 0 – 6	20	None	-
Request HV On Hours Counter	21	None	-
Request Status	22	None	-
Request Software Version	23	None	-
Request Hardware Version	24	None	-
Request Model Number	26	None	-
Reset HV On Hours Counter	30	None	-
Request Expanded Status	32	None	-
Program Filament Ramp Time	47	2 ASCII	0-10000
Request Filament Ramp Time	48	None	-
Reset Faults	52	None	-
Request Aux KV Feedback	65	None	-
Request SVN Revision	66	None	-
Program High Voltage Status	99	1 ASCII	0 or 1

5.5 Response Overview

The command responses will follow the same format as outlined above in section 6.1. This list is comprised of Commands with complex responses only. Commands using a simple response will use the <\$> character (ASCII 0x24) as a “Success” response or a single character error code. These responses will be eight ASCII characters in length.

Response Name	<CMD>	Response
Request DAC A Setpoint	14	11 ASCII
Request DAC B Setpoint	15	11 ASCII
Request DAC D Setpoint	16	11 ASCII
Request DAC C Setpoint	17	11 ASCII
Request Analog Readbacks Ch 7-15	19	24-51 ASCII
Request Analog Readbacks Ch 0-6	20	20-41 ASCII
Request Total Hours High Voltage On	21	14 ASCII
Request Status	22	12 ASCII
Request MCU Software Version	23	18 ASCII
Request Hardware Version	24	10 ASCII
Request Web Server Version	25	18 ASCII
Request Model number	26	12 ASCII
Request Expanded Status	32	20 ASCII
Request Filamet Ramp	47	4-8 ASCII
Read Interlock Status	55	12 ASCII
Read Aux KV Feedback	65	8-11 ASCII
Read SVN Revision	66	8-11 ASCII

6.0 Command descriptions

This section gives descriptions of all available uX commands. Note that the examples given in this section include the checksum byte. The checksum byte is used for serial RS232 and USB communication, but not for Ethernet. If you are using Ethernet omit the checksum "<CSUM>" byte in your commands and response. For example, if you are using RS232 communication. the "Set kV" command (command 10) would be sent as:

<STX>10,4095,<CSUM><ETX>

For Ethernet the same command would be sent as:

<STX>10,4095,< ETX>

6.1 Change Baud Rate

Description:

The host requests that the firmware change the baud rate of the RS232 serial communications port. The factory default is 115200. The newly programmed baud rate will be saved in non-volatile memory and will become the new default (power-up) baud rate.

Direction:

Host to supply

Syntax:

<STX><7><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 5 in ASCII format. See the following table

uX Baud Rate Table	
<ARG>	Selected Baud Rate
0	4800
1	9600
2	19200
3	38400
4	57600
5	115200

Example: To set a baud rate of 38400 the command is:

<STX>7,3,<CSUM><ETX>

Responses:

Success : <STX><7><,><\$><,><CSUM><ETX>

Error : <STX><7><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes 1=out of range

Note: When this command is sent via the serial port the actual baud rate change does not occur until a delay time of 200ms has expired. This is to allow time for the response to be sent at the old baud rate. The host must wait for a minimum period of 200ms before sending new commands at the new baud rate.

6.2 Program kV Setpoint

Description:

The host requests that the firmware change the kV output setpoint. The kV/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><10><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example:

<STX>10,4095,<CSUM><ETX>

Response:

Success: <STX><10><,><\$><,><CSUM><ETX>

Error : <STX><10><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes, 1=out of range

6.3 Program mA Setpoint

Description:

The host requests that the firmware change the mA output. The mA/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><11><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example:

<STX>11,4095,<CSUM><ETX>

Response:

Success: <STX><11><,><\$><,><CSUM><ETX>

Error: <STX><11><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1=out of range

6.4 Program Filament Preheat

Description:

The host requests that the firmware change the filament preheat setpoint. The A/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><12><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example:

<STX>12,4095,<CSUM><ETX>

Response:

Success: <STX><12><,><\$><,><CSUM><ETX>

Error: <STX><12><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

6.5 Program Filament Current Limit

Description:

The host requests that the firmware change the filament current limit setpoint. This is the maximum filament current that will be allowed by the hardware. The A/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><13><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example:

<STX>13,4095,<CSUM><ETX>

Response:

Success: <STX><13><,><\$><,><CSUM><ETX>

Error: <STX><13><,><ARG><,><CSUM><ETX>

where <ARG> = error code

Error Codes TBD, 1 = out of range

6.6 Request kV Setpoint

Description:

The host requests that the firmware report the kV output setpoint. The kV/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><14><,><CSUM><ETX>

Response:

<STX><14><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example Response:

<STX>14,4095,<CSUM><ETX>

6.7 Request mA Output Setpoint

Description:

The host requests that the firmware report the current mA output setpoint. The mA/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><15><,><CSUM><ETX>

Response:

<STX><15><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example Response:

<STX>15,4095,<CSUM><ETX>

6.8 Request Filament Preheat

Description:

The host requests that the firmware report the current filament preheat setpoint. The A/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><16><,><CSUM><ETX>

Response:

<STX><16><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example Response

<STX>16,4095,<CSUM><ETX>

6.9 Request Filament Current Limit

Description:

The host requests that the firmware report the filament current limit setpoint. The A/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><17><,><CSUM><ETX>

Response:

<STX><17><,><ARG><,><CSUM><ETX>

Where:

<ARG> = 0 - 4095 in ASCII format

Example:

<STX>17,4095,<CSUM><ETX>

6.10 Request Analog Monitor Readbacks

Description:

The host requests that the firmware transmit the present values of the system analog monitor inputs. Bit scaling in model dependent versions, see the tables in section 7.0.

Direction:

Host to supply

Syntax:

<STX><20><,><CSUM><ETX>

Example:

<STX>20,<CSUM><ETX>

Response:

<STX><20><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,>
<ARG5><,><ARG6><,><ARG7>,<CSUM><ETX>

Where:

<ARG1> = Control Board Temperature Sensor Reading, range 0-4095

<ARG2> = Low Voltage Supply Monitor, range 0-4095

<ARG3> = kV Feedback Reading, range 0-4095

<ARG4> = mA Feedback Reading, range 0-4095

<ARG5> = Filament Current Reading, range 0-4095

<ARG6> = Filament Voltage Reading, range 0-4095

<ARG7> = High Voltage Board Temperature Sensor, range 0-4095

Example:

<STX>20,500,2048,4095,4095,4095,4095,4095,650,
<CSUM><ETX>

6.11 Request Total Hours High Voltage On

Description:

The host requests that the firmware sends the present value of the Total Hours High Voltage On.

Direction:

Host to supply

Syntax:

<STX><21><,><CSUM><ETX>

Example:

<STX>21,<CSUM><ETX>

Response:

<STX><21><,><ARG1><,><CSUM><ETX>

Where:

<ARG1> is the "HV On" time as a decimal string "X.Y" and

X = hours on.

. = The ASCII Period Character

Y = Tenths of hours.

Example Response: for 1234.9 hours

<STX>21,1234.9,<CSUM><ETX>

6.12 Request Status

Description:

The host requests that the firmware sends the power supply status.

Direction:

Host to supply

Syntax:

<STX><22><,><CSUM><ETX>

Example:

<STX>22,<CSUM><ETX>

Response:

<STX><22><,><ARG1><,><ARG2><,><ARG3><,><CSUM><ETX>

Where:

<ARG1> 1 = HvOn, 0 = HvOff

<ARG2> 1 = Interlock Open, 0 = Interlock Closed

<ARG3> 1 = Fault Condition, 0 = No Fault

Example:

<STX>22,1,1,1,<CSUM><ETX>

Notes:

The fault indicator indicates 1 of 3 possible faults.

- Interlock Fault, Interlock Opened while High Voltage was On
- Over-Voltage Fault, Output Voltage exceeds 106% of unit maximum.
- Configuration Fault, Unit Configuration stored in NV memory is invalid.

This response will also be sent in an unsolicited manner when either the interlock is opened while High Voltage is On (interlock fault), or an Overvoltage fault occurs. This unsolicited message is sent once when the fault occurs, with the fault argument set to 1. Thereafter, the fault will again read as 0. To get detailed fault status use the Request Expanded Status Command.

6.13 Request Expanded Status

Description:

The host requests that the firmware send an expanded version of the power supply status.

Direction:

Host to supply

Syntax:

<STX><32><,><CSUM><ETX>

Example:

<STX>32,<CSUM><ETX>

Response:

<STX><32><,><ARG1><,><ARG2><,><ARG3><,><ARG4><,><ARG5><,><ARG6><,><ARG7><,><CSUM><ETX>

Where:

<ARG1> 1 = Hv On, 0 = Hv Off

<ARG2> 1 = Interlock 1 Open, 0 = Interlock 1 Closed

<ARG3> 1 = Interlock Fault, 0 = No Interlock Fault

<ARG4> 1 = Over-voltage Fault, 0 = No Over-voltage Fault

<ARG5> 1 = Configuration Fault, 0 = No Configuration Fault

<ARG6> 1 = Overpower Fault, 0 = No Overpower Fault

<ARG7> 1 = 24V Undervoltage Fault, 0 = No Undervoltage Fault

Example Response for HV on, interlock closed, no faults:

<STX>32,1,0,0,0,0,<CSUM><ETX>

Note:

For this command the Interlock, and Over-voltage fault indicators persist until they are cleared. The Interlock fault (interlock opened while HV was on) is automatically cleared when the interlock is closed. The Over-Voltage fault (High Voltage > 106% of unit maximum) is automatically cleared when High Voltage is again turned on. In addition the "Clear Faults" command can be sent to manually clear both of these faults.

A configuration fault indicates an error during power up configuration of the unit. This can be caused by non-volatile memory corruption or a hardware failure. This fault cannot be cleared using the reset faults command, and the unit will not allow high voltage to be turned on until the problem is rectified. Contact Spellman High Voltage.

6.14 Request MCU Software Part Number/Version

Description:

The host requests that the firmware sends the MCU firmware version.

Direction:

Host to supply

Syntax:

<STX><23><,><CSUM><ETX>

Example:

<STX>23,<CSUM><STX>

Response:

<STX><23><,>< ARG><,><CSUM><ETX>

Where:

<ARG> consists of eleven ASCII characters representing the current firmware part number/version. The format is SWMxxxx-yyy where xxxx is a 4 numeric character software identification number and yyy a 3 numeric character version number.

Example Response:

<STX>23,SWM9999-999,<CSUM><ETX>

6.15 Request Hardware Version

Description:

The host requests that the firmware sends the hardware version.

Direction:

Host to supply

Syntax:

<STX><24><,><CSUM><ETX>

Example:

<STX>24,<CSUM><ETX>

Response:

<STX><24><,>< ARG><,><CSUM><ETX>

Where:

<ARG> consists of 3 ASCII characters representing the hardware version.
The format is NNN, where N is a numeric character

Example:

<STX>24,001,<CSUM><ETX>

6.16 Request Model Number

Description:

The host requests that the firmware sends the unit model number

Direction:

Host to supply

Syntax:

<STX><26><,><CSUM><ETX>

Example:

<STX>26,<CSUM><ETX>

Response:

<STX><26><,><ARG><,><CSUM><ETX>

Where:

<ARG> consists of five ASCII characters representing the model number.
The format is XNNNN, where N is a numeric character.

Example:

<STX>26,X9999,<CSUM><ETX>

6.17 Reset Run Hours

Description:

The host requests that the firmware resets the run hour counter.

Direction:

Host to supply

Syntax:

<STX><30><,><CSUM><ETX>

Example:

<STX>30,<CSUM><ETX>

Response:

<STX><30><,><\$><,><CSUM><ETX>

6.18 Program Filament Ramp Time

Description:

This command is used to enable the filament / mA ramping function and to set the ramp time. When the ramping function is enabled the filament current and mA set point value are ramped up from zero to their set values starting when the high voltage is turned on. When the ramping function is disabled the filament preheat current and mA setpoint go immediately to their set values. There are 2 arguments sent with the command. The first argument determines if the ramping function is enabled or disabled. The second is the ramp time in milliseconds. The maximum allowed ramp time is 10000 ms (10 seconds).

Direction:

Host to supply

Syntax:

<STX><47><,><ARG1><,><ARG2><,><CSUM><ETX>

Where:

<ARG1> = 0 or 1 in ASCII format. "0" disables the ramping function, "1" enables it.

<ARG2> = 0 – 10000 in ASCII format. This is the ramp time in milliseconds. Note that if <ARG1> is set to 0, the ramp time <ARG2> must also be set to 0. If <ARG1> is set to 1, then the ramp time <ARG2> must be set to be greater than 0. The ramp can not be enabled with ramp time set to 0.

Examples:

Ramp Off: <STX>47,0,0,<CSUM><ETX>

Ramp On, Ramp Time 2000ms: <STX>47,1,2000,<CSUM><ETX>

Response:

<STX><47><,><\$><,><CSUM><ETX>

Error Codes, 1 = One (or possibly both) of the arguments is out of range.

6.19 Request Filament Ramp Time

Description:

This command is used to read the filament ramp enabled / disabled status and the currently set ramp time. (See also section 6.18).

Direction:

Host to supply

Syntax:

<STX><48><,><CSUM><ETX>

Example:

<STX>48,<CSUM><ETX>

Response:

<STX><48><,>< ARG1><,><ARG2><,><CSUM><ETX>

Where:

<ARG1> is ASCII 1 or 0, with 1 = Ramping Enabled, 0 = Ramping Disabled.

<ARG2> is the Ramp Time in milliseconds, Range 0 - 10000

Example Responses:

Ramp is Off <STX>48,0,0,<CSUM><ETX>

Ramp On, Ramp Time = 500ms: <STX>48,1,500,<CSUM><ETX>

Reset Faults

Description:

The host requests that the firmware resets all Fault messages and indicators.

Direction:

Host to supply

Syntax:

<STX><52><,><CSUM><ETX>

Example:

<STX>52,<CSUM><ETX>

Response:

<STX><52><,><\$><,><CSUM><ETX>

Note:

This command does not clear a configuration fault. The configuration problem must be corrected to clear that fault.

6.19 Request Auxiliary KV Feedback

Description:

The host requests that the firmware report the value of the Auxiliary KV Feedback. This is similar to kV feedback but is scaled differently to allow a higher full scale value. The kV/bit scaling for the argument is model dependent. See the tables in section 8 of this document.

Direction:

Host to supply

Syntax:

<STX><65><,><CSUM><ETX>

Example:

<STX>65,<CSUM><ETX>

Response:

<STX><65><,><ARG><,><CSUM><ETX>

Where:

ARG = 0 - 4095

Example:

<STX>65,4095, <CSUM><ETX>

6.20 Request SVN Revision

Description:

The host requests that the firmware report the value of the SVN Revision. This is a Spellman HV version control number that specifically identifies the firmware build.

Direction:

Host to supply

Syntax:

<STX><66><,><CSUM><ETX>

Example:

<STX>66,<CSUM><ETX>

Response:

<STX><66><,><ARG><,><CSUM><ETX>

Where:

<ARG> consists of ASCII characters representing the SVN firmware revision number. The length is variable, but will be a maximum of 6 characters.

Example:

<STX>66,12345,<CSUM><ETX>

6.21 Program High Voltage On/Off

Description:

The host requests that the firmware to turn on or off High Voltage.

Direction:

Host to supply

Syntax:

<STX><99><,><ARG><,><CSUM><ETX>

Where:

<ARG> 1 = On, 0 = Off in ASCII format

Example: Turn High Voltage On

<STX>99,1,<CSUM><ETX>

Response:

Success: <STX><99><,><\$><,><CSUM><ETX>

Error: <STX><99><,><ARG><,><CSUM><ETX>

Where <ARG> = error code

Error Codes:

1 = out of range (<ARG> must be 0 or 1)

2 = Interlock 1 open, High Voltage Disabled

7.0 Command Handling

7.1 Command Time Out

The host computer should set a serial time out at approximately 100mS. This allows the MCU to process the incoming message, and transmit a response. The MCU will typically initiate a reply to incoming messages in approximately 1-2mS, with a worst case of 5mS.

7.2 Buffer Flushing

The MCU will flush the incoming serial data buffer every time an STX is received. This provides a mechanism to clear the receive buffer of partial or corrupt messages.

7.3 Handshaking

The only handshaking implemented on the host interface, is built in to the implementation of this protocol. That is, the host must initiate all communications. If the supply receives a program command, an acknowledge message is sent back to the host via the "\$" message. If the host does not receive an acknowledge within the time out window, the host should consider the message lost or the device off-line.

Similarly, if the supply receives a request command, the requested data is sent back to the host. If the host does not receive the requested data within the time out window, the host should consider the message lost or the device off-line.

This essentially uses the full-duplex channel in a half-duplex communication mode.

8.0 Product Specific Usage

The tables below indicate the scaling of setpoint controls and feedback monitors for the various versions.

8.1 uX50P50

Tabular information applies to the 50kV Model.

Digital to Analog Converter Scaling (Setpoints)

Setpoint	Full Scale (= 4095)	Scaling (LSB Multiplier)	Project Signal Name
kV Setpoint	50.0kV	12.21 V/Bit	KV_PROG
mA SetPoint	2.0 mA	0.4884 uA/Bit	MA_PROG
Filament Preheat	10.0 A	2.442 mA /Bit	FIL_LIMIT_PROG
Filament Limit	10.0 A	2.442 mA /Bit	FIL_PREHEAT

Analog to Digital Converter Scaling (Feedbacks, Monitors and Temperatures)

Analog Signal	Full Scale (= 4095)	Scaling (LSB Multiplier)	Notes:
kV Feedback	50.0kV	12.21 Volts/Bit	High Voltage output Monitor
kV Feedback 2	55.0kV	13.43 Volts/Bit	Auxiliary High Voltage output Monitor
mA Feedback	2.4 mA	0.58608 uA/Bit	Output Current Monitor
Filament Current	3.6 A	0.87912 mA/Bit	Filament Current Monitor
Filament Voltage	5.5 V	0.001343 V/Bit	Filament Voltage Monitor
Control Board Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C
High Voltage Bd Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C max
Low Voltage Supply Monitor	42.9V	0.10476 V/Bit	24V supply monitor

Product Specific Command	Generic Command	Comments
Program Voltage Setpoint	Program DAC Channel A	LSB = 12.21v
Program Emission Current Setpoint	Program DAC Channel B	LSB = 488 uA
Program Filament Pre-heat Setpoint	Program DAC Channel D	LSB = 2.442 mA (Vref=10v)
Program Filament Current Limit	Program DAC Channel C	LSB = 2.442 mA (Vref=10v)
Request Voltage Setpoint	Request DAC A Setpoint	LSB = 12.21 v
Request Emission Current Setpoint	Request DAC B Setpoint	LSB = 488 uA
Request Filament Pre-heat Setpoint	Request DAC D Setpoint	LSB = 2.442 mA (Vref=10v)
Request Filament Current Limit	Request DAC C Setpoint	LSB = 2.442 mA (Vref=10v)
Request Analog Readbacks	Request Analog Channels	Ch 2: LSB = 12.21 V Ch 3: LSB = 586.1 uA Ch 4: LSB = 879 uA Ch 5: LSB = 1.343mV Ch 6: LSB = 0.0732°

8.2 uX65P65

Tabular information applies to the 65kV Model.

Digital to Analog Converter Scaling (Setpoints)

Setpoint	Full Scale (4095 Digital Counts)	Scaling (LSB Multiplier)	Project Signal Name
kV Setpoint	65.0kV	15.87 V/Bit	KV_PROG
mA SetPoint	2.0 mA	0.4884 uA/Bit	MA_PROG
Filament Preheat	10.0 A	2.442 mA /Bit	FIL_LIMIT_PROG
Filament Limit	10.0 A	2.442 mA /Bit	FIL_PREHEAT

Analog to Digital Converter Scaling (Feedbacks, Monitors and Temperatures)

Analog Signal	Full Scale (4095 Digital Counts)	Scaling (LSB Multiplier)	Notes:
kV Feedback	65.0	15.87 V/Bit	High Voltage output Monitor
kV Feedback 2	71.5kV	17.46 V/Bit	Auxiliary High Voltage output Monitor
mA Feedback	2.4 mA	0.58608 uA/Bit	Output Current Monitor
Filament Current	3.6 A	0.87912 mA/Bit	Filament Current Monitor
Filament Voltage	5.5 V	0.001343 V/Bit	Filament Voltage Monitor
Control Board Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C
High Voltage Bd Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C max
Low Voltage Supply Monitor	42.9V	0.010476 V/Bit	24V supply monitor

Product Specific Command	Generic Command	Comments
Program Voltage Setpoint	Program DAC Channel A	LSB = 12.21v
Program Emission Current Setpoint	Program DAC Channel B	LSB = 488 uA
Program Filament Pre-heat Setpoint	Program DAC Channel D	LSB = 2.442 mA (Vref=10v)
Program Filament Current Limit	Program DAC Channel C	LSB = 2.442 mA (Vref=10v)
Request Voltage Setpoint	Request DAC A Setpoint	LSB = 12.21 v
Request Emission Current Setpoint	Request DAC B Setpoint	LSB = 488 uA
Request Filament Pre-heat Setpoint	Request DAC D Setpoint	LSB = 2.442 mA (Vref=10v)
Request Filament Current Limit	Request DAC C Setpoint	LSB = 2.442 mA (Vref=10v)
Request Analog Readbacks	Request Analog Channels	Ch 2: LSB = 12.21 V Ch 3: LSB = 586.1 uA Ch 4: LSB = 879 uA Ch 5: LSB = 1.343mV Ch 6: LSB = 0.0732°

8.3 uXHP80P100

Tabular information applies to the uXHP 80kV Model.

Digital to Analog Converter Scaling (Setpoints)

Setpoint	Full Scale (= 4095)	Scaling (LSB Multiplier)	Project Signal Name
kV Setpoint	80.0kV	19.536 V/Bit	KV_PROG
mA SetPoint	5.0 mA	1.221 uA/Bit	MA_PROG
Filament Preheat	10.0 A	2.442 mA /Bit	FIL_LIMIT_PROG
Filament Limit	10.0 A	2.442 mA /Bit	FIL_PREHEAT

Analog to Digital Converter Scaling (Feedbacks, Monitors and Temperatures)

Analog Signal	Full Scale (= 4095)	Scaling (LSB Multiplier)	Notes:
kV Feedback	80.0kV	19.536 Volts/Bit	High Voltage output Monitor
kV Feedback 2	88.0kV	21.49 Volts/Bit	Auxiliary High Voltage output Monitor
mA Feedback	6 mA	1.4652 uA/Bit	Output Current Monitor
Filament Current	3.6 A	0.87912 mA/Bit	Filament Current Monitor
Filament Voltage	5.5 V	0.001343 V/Bit	Filament Voltage Monitor
Control Board Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C
High Voltage Bd Temperature	300 deg C	0.07326 C/Bit	Temperature Sensor: 10 mV/ Degree C max
Low Voltage Supply Monitor	42.9V	0.10476 V/Bit	24V supply monitor

Product Specific Command	Generic Command	Comments
Program Voltage Setpoint	Program DAC Channel A	LSB = 19.536v
Program Emission Current Setpoint	Program DAC Channel B	LSB = 1.221 uA
Program Filament Pre-heat Setpoint	Program DAC Channel D	LSB = 2.442 mA (Vref=10v)
Program Filament Current Limit	Program DAC Channel C	LSB = 2.442 mA (Vref=10v)
Request Voltage Setpoint	Request DAC A Setpoint	LSB = 19.536 v
Request Emission Current Setpoint	Request DAC B Setpoint	LSB = 1.221 uA
Request Filament Pre-heat Setpoint	Request DAC D Setpoint	LSB = 2.442 mA (Vref=10v)
Request Filament Current Limit	Request DAC C Setpoint	LSB = 2.442 mA (Vref=10v)
Request Analog Readbacks	Request Analog Channels	Ch 2: LSB = 19.536 V Ch 3: LSB = 1.4652 uA Ch 4: LSB = 879 uA Ch 5: LSB = 1.343mV Ch 6: LSB = 0.0732°