

Instruction Manual

PCM SERIES

High Voltage Power Supply

MODEL :
SERIAL# :
DATE :

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- **OUTPUT VOLTAGE FROM 1KV TO 70KV**
- **UNIVERSAL INPUT, POWER FACTOR CORRECTED**
- **TEST POINTS FOR OUTPUT CURRENT AND VOLTAGE**
- **POWER ON, INTERLOCK CLOSED AND FAULT INDICATORS**

www.spellmanhv.com/manuals/PCM

Spellman's PCM Series of high voltage power supplies are well regulated with output voltages from 1kV to 70kV. These supplies feature universal AC input (85-265Vac) and power factor correction. They are designed with a resonant circuit that provides high efficiency and high pulse current capability up to 400W peak. The PCM Series incorporates local and remote programming, monitoring and fault indicators with safety interlock, and short-circuit and overload protection.

TYPICAL APPLICATIONS

- Electrophoresis
- Detector Arrays
- X-ray Inspection
- Capacitor Charging

SPECIFICATIONS

Input:

85-265Vac, 47-63Hz, power factor corrected.
UL® rated for 85-250Vac input for 1kV to 5kV models.

Power Factor (Typical):

FL: 0.99
NL: 0.98

Output:

11 models from 1kV to 70kV. Positive or negative polarity outputs.

Voltage Regulation:

Load: 0.01% of output voltage, no load to full load.
Line: ±0.01% for ±10% change in input voltage.

Current Regulation:

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

Ripple:

0.1% p-p of maximum output voltage.

Voltage Stability:

0.02% per 8 hours.

Voltage Temperature Coefficient:

100ppm per °C, voltage or current regulated.

Dimensions:

1kV to 50kV: 3.65"H x 5"W x 9"D
(9.27cm x 12.7cm x 22.9cm).
60, 70kV: 3.65"H x 5"W x 11"D
(9.27cm x 12.7cm x 27.9cm).

Connectors:

AC Input: IEC320 with mating cable.
Signal: 15pin D connector.

HV Output Cable:

Spellman Delrin type connector with 36"
(91.4cm) shielded cable.

Regulatory Approvals:

Compliant to 2004/108/EC, the EMC Directive and 2006/95/EC, the Low Voltage Directive.
UL/CUL recognized, File E148969 (up to 60kV only).

PCM SELECTION TABLE

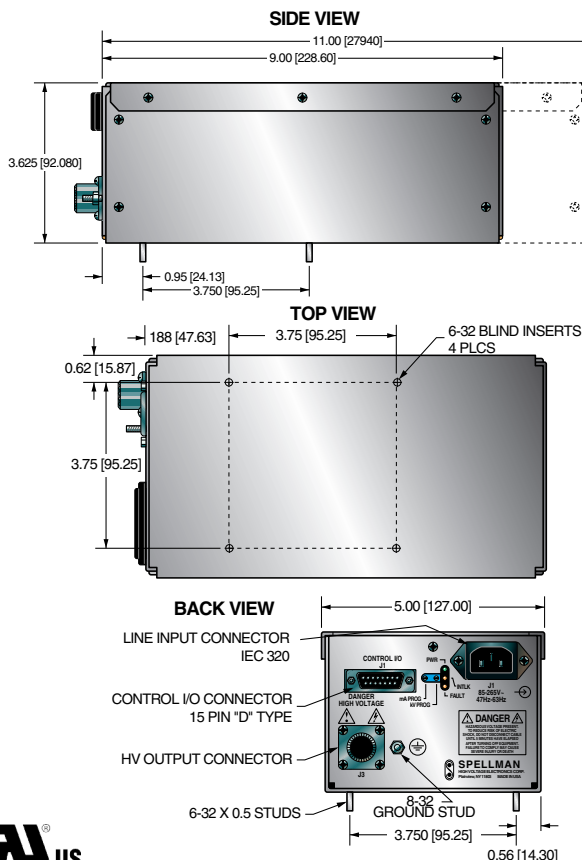
Maximum Rating kV	Maximum Rating mA	Model Number	Maximum Rating kV	Maximum Rating mA	Model Number
1	120	PCM 1*120	30	4	PCM 30*120
3	40	PCM 3*120	40	3	PCM 40*120
5	24	PCM 5*120	50	2.4	PCM 50*120
10	12	PCM 10*120	60	2	PCM 60*120
15	8	PCM 15*120	70	1.7	PCM 70*120
20	6	PCM 20*120			

*Specify "P" for positive polarity or "N" for negative polarity.

PCM D CONNECTOR 15 PIN

J1	SIGNAL	J1	SIGNAL
1	Remote mA Program	9	Power Supply Fault
2	Remote kV Program	10	+10V Reference
3	Enable (L)/Disable(H)	11	Signal Return
4	mA Monitor	12	Spare
5	Interlock Return	13	Spare
6	Interlock	14	Spare
7	kV Monitor	15	Local mA Program
8	Local kV Program		

DIMENSIONS: in.[mm]



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Spellman High Voltage is an ISO 9001:2000 and ISO 14001:2004 registered company

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 PCM Series

The PCM series of high voltage power supplies provides very well regulated, low ripple high voltage in a highly efficient, compact design. The dramatically reduced size of the PCM Module, compared to traditional high voltage modules, is obtained by a state of the art off-line resonant converter. The resonant converter utilizes a unique control scheme, which allows constant frequency operation while maintaining high efficiency. The high efficiency is obtained by zero current switching (ZCS) resonant control. High operating frequency, typically 50KHz, allows for very low ripple and excellent dynamic response capabilities.

The DC output voltage and current are controllable over the full range of operation. Monitoring and control signals are provided for simple, yet flexible control of the power supply. The PCM series operates from 85 - 265VAC, at 50/60 Hz single phase. The input power factor corrected, no reconfiguring is required. The PCM series operates at 120W continuous without the need for forced air cooling. The ambient temperature must be kept below the maximum rating as specified in 1.2. Consult Spellman Sales Department for higher power capabilities of the PTV series (up to 400W peak).

The standard warranty applies to the PCM modules. Consult factory about the warranty for custom PCM modules.

1.2 PCM Specifications

- **Output Control:** Voltage and current are externally programmable over the entire range from zero to maximum rating via 0-10VDC reference or potentiometer. (Other scale factors for control and monitoring can be provided i.e. 1 volt per 10KV, 1 volt per 10mA etc.).
- **Input Voltage:**
85-265VAC, 47-63Hz, power factor corrected
UL® rated for 85-250VAC input for 1kV to 5kV models.
- **Power Factor:**
FL: 0.99, NL: 0.98
- **Regulation:**
 - **Load Regulation:** 0.01% of full voltage for a no load to full load change.
 - **Line Regulation:** +/-0.005% of full voltage over the specified input voltage range.
- **Current Regulation:**
 - **Load Regulation:** 0.01% from 0 voltage to full voltage.
 - **Line Regulation:** ±0.01% of full current over the specified input voltage range.
- **Ripple:** 0.1% p-p of output voltage.
- **Polarity:** Positive or Negative polarity with respect to ground. (Specify at time of ordering).
- **Stability:** 0.02% per 8 hours after 1/2 hour warm up.
- **Temperature Coefficient:** 100 ppm per °C.
- **Temperature:**
 - Operating: 0°C to -45°C
 - Storage: -20°C to +85°
- **Monitoring:**
 - 0-10 VDC corresponding to 0-100% of output voltage
 - 1-10VDC corresponding to 0-100% of output current.(Other scale factors available).

IMPORTANT

This control signal is not a safety interlock and should not be used for protection from high voltage generation for safety purposes.

- **Control:**
Logic level control for high voltage enable/disable.
- **Interlock:**
Open interlock will shut down unit..

1.3 Standard Features

The PCM series incorporates several standard features designed to optimize user operation.

Slow Start: Provides a gradual increase in high voltage output until the maximum set point is reached. Various slow start times can be accommodated. Consult Spellman’s Sales Department for information on slow start options.

Overvoltage Protection: An overvoltage protection circuit monitors the output for excessive voltage generation. Overvoltage conditions can be caused by excessive input program signal. If an overvoltage condition is detected, the power supply is latched off until input power is reset.

PS Fault Indication: A PS Fault Indicator and a PS Fault Output on J1, indicate an OVP or a regulation error.

Power Factor and Universal Input: The input voltage of the PCM can operate within the range from 85VAC to 265VAC. The power factor is actively corrected across this entire range and is better than 0.99 at full load.

Internal EMI Filter and Fuse Protection: An internal EMI filter and fuse provide protection against line voltage surges and power supply faults.

1.3.1 Remote Operating Features

Remote Programming: Allows remote adjustment of the output voltage and current via an external voltage source.

Remote Monitor: Allows remote monitoring of the Output voltage and current.

High Voltage Enable/Disable: Allows remote ON/OFF control of the high voltage.

+10VDC Reference: A +10VDC reference is provided for remote programming via a potentiometer or resistive divider.

1.4 Options

The options available are listed in Table 1.1. See section 5 for more information on the options along with

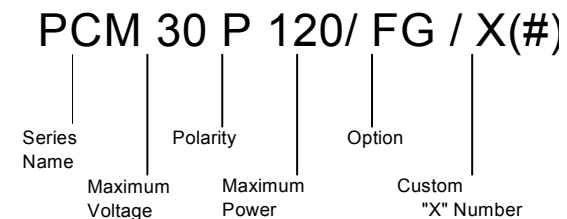
operating and set-up instructions. With few exceptions, these options can be retrofitted to your power supply at the factory in a short time. For price and retrofit arrangements, contact the Spellman Sales Department.

CODE DISCRPTION	
•	NSS No Slow Start
•	SS(X) Non-Standard Slow Start
•	LL(X) Extra Length Output Cable
•	FG
•	Output Connector
•	Focus Outputs
•	Grid Outputs
•	Filament Output

1.5 Interpreting the Model Number:

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

- (1) The maximum voltage in kilovolts.
- (2) The polarity of the output – positive (P), or negative (N).
- (3) The maximum output in watts.
- (4) The option code for all options that are included.
- (5) Custom “X” number representing details listed in a separate specification control drawing.



Chapter 2

Inspection and Installation

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

2.1 Initial Inspection

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

Fill out and mail the Warranty Registration card accompanying the unit. Standard PCM120 high voltage power supplies and components are covered by warranty. Custom and special order models (with an X suffix in the model number) are also covered by warranty.

2.2 Mechanical Installation

The PCM series module power supplies are designed for installation into existing or newly developed OEM equipment. The power supply 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 PCM series utilizes solid encapsulations for corona free operation. No periodic maintenance is required. Lower voltage units (under 6KV) utilizes air insulation. Due to conservative voltage spacing design, periodic maintenance is not required.

SIGNAL CONNECTOR J1	
PIN	FUNCTION
1	Remote mA Program
2	Remote kV Program
3	Enable (L)/Disable (H)
4	mA Monitor
5	Interlock Return
6	Interlock
7	kV Monitor
8	Local kV Program
9	Power Supply Fault
10	+10V Reference
11	Signal Return
12	Spare
13	Spare
14	Spare
15	Local mA Program

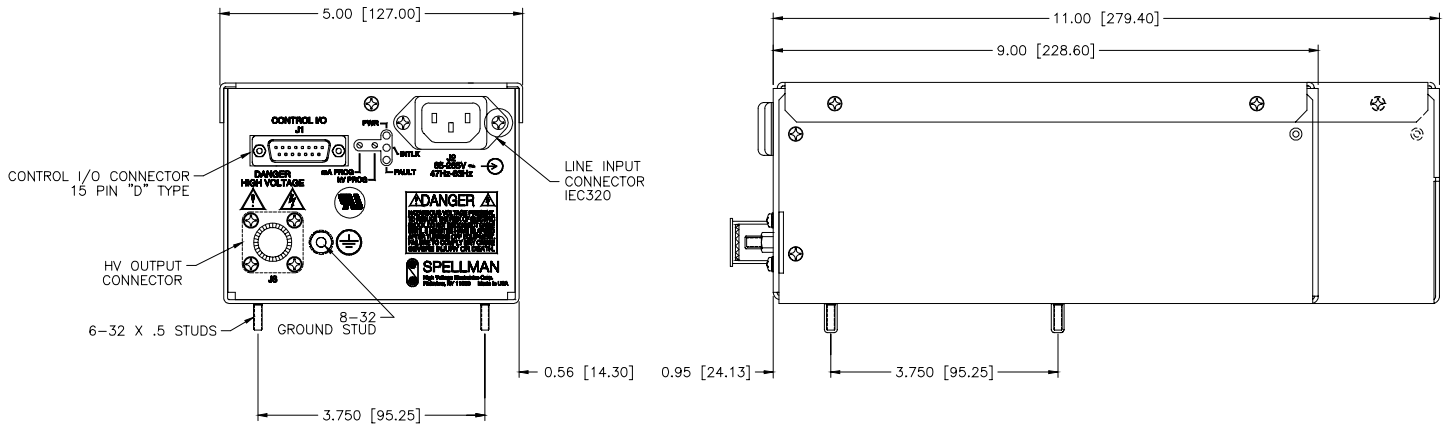
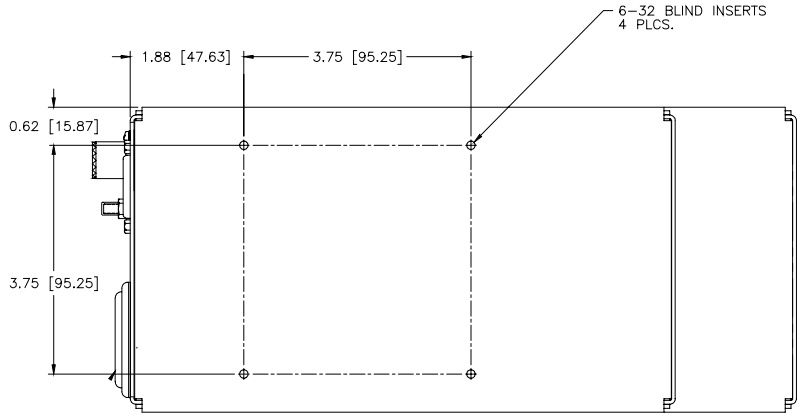


Figure 2.1 Unit Dimensions

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.

Do not connect the power supply to the AC line until Step G is reached.

Failure to follow these procedures may void the warranty.

- A) Insure that the high voltage cable is properly terminated to the load. Insure that all circuits connected to the high voltage output are safely interlocked against accidental contact. Insure external load is discharged.
- B) Check the input voltage rating on the serial nameplate of the supply and make certain that this is the rating of the available power source
- C) **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. See Figure 3.1 for a typical operating setup. The return line from the load should be connected to the power supply chassis. Using a separate external ground at the load is not recommended. An IEC 320 connector is provided for connection to the line voltage source. A standard three prong line cord is also provided.
- D) **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.
- E) **Hook-up:** Connect control and monitoring connections as described in this manual.
- F) For initial turn-on, program the voltage and current for zero output. Connect the enable/disable signal to disable, open the interlock.
- G) The input power cable may now be connected to the AC power line.
- H) Enable the power supply via the enable/disable logic signal, close the interlock.
- I) Slowly program the output voltage and current to desired level. Monitor the output voltage and current via the monitoring test points. Note equipment operation is normal, i.e. Load is behaving as predicted.
- J) To turn high voltage off, use the enable/disable signal. If equipment is to be kept off for extended periods, disconnect power supply from line voltage source.

Note: If an over voltage condition occurs, the power supply will latch off. To reset the power supply, remove the line voltage and reconnect, or toggle the enable/disable signal.

WARNING

**AFTER TURNOFF, DO NOT HANDLE THE LOAD UNTIL THE CAPACITANCE HAS BEEN DISCHARGED!
LOAD CAPACITANCE MAY BE DISCHARGED BY SHORTING TO GROUND.**

WARNING

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

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.

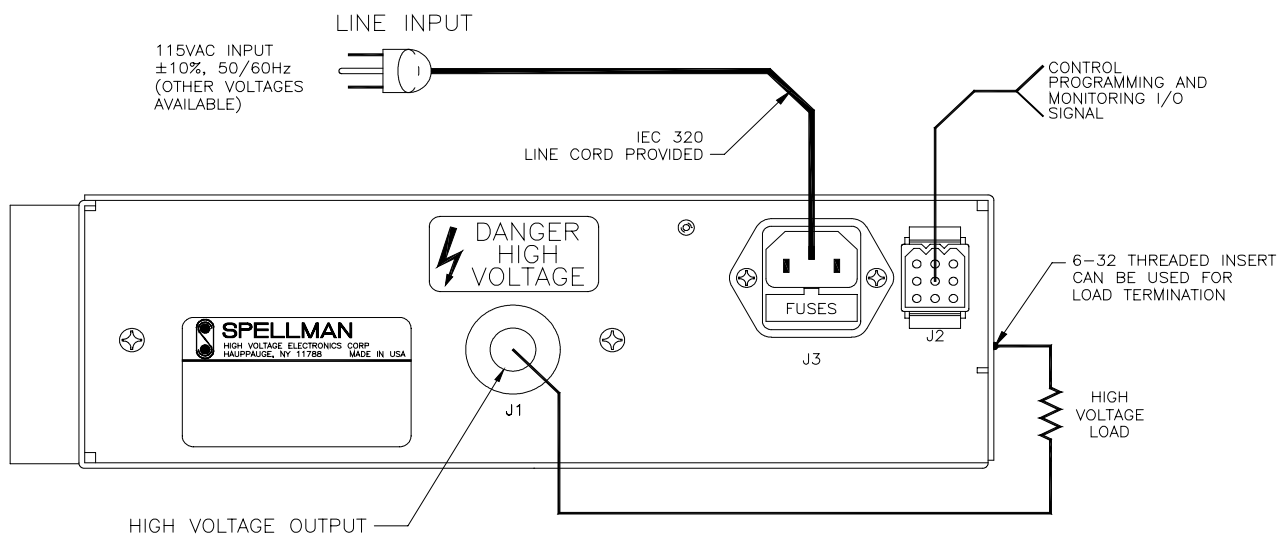


Figure 3.1 Typical Operating Set Up

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 enable/disable signal connections, an isolated relay or optocoupler should be used. For PS Fault indication an optocoupler 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 or power supply chassis ground

Local Programming: The mA and KV controls on the front panel can be used to control the output of the PCM. For local KV control, jump J1-2 to J1-8. For local mA control, jump J1-1 to J1-15. See Figure 3.2.

REMOTE PROGRAMMING: Allows remote adjustment of the output voltage and current via an external voltage source. 0-10VDC signal is supplied to Pin 2 of the control input connector for voltage programming and 0-10 VDC signal is supplied to Pin 1 of the control input connector for current programming. Programming signals should be referenced to Pin 11 of the control input connector signal ground. By adjusting the voltage source from 0 volts (zero output) to 10 volts (full rated output) the desired output can be selected. See Figure 3-3A 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. See Figure 3.3B for wiring diagram.

Remote Monitoring: Test points are made available for monitoring the voltage and current output. The test points are always positive regardless of the output polarity, where zero (0) to 10 (10) volts equals 0-100% of output. See Figure 3.4 for test point wiring.

Enable/Disable Control: Remote control of the high voltage on and high voltage off can be done via the enable/disable logic control. See Figure 3.5 for recommended interface circuits.

WARNING

It is extremely dangerous to use this circuit to inhibit high voltage generation for the purpose of servicing or approaching any area of load considered unsafe during normal use.

Interlock: A safety interlock is provided on pins J1-5 and J1-6. When the interlock is open, the PCM is incapable of producing high voltage. See Figure 3.6.

PS Fault: A logic signal is provided which can be used to determine if the OVP or Reg. Error Shutdown is active. See Figure 3.7

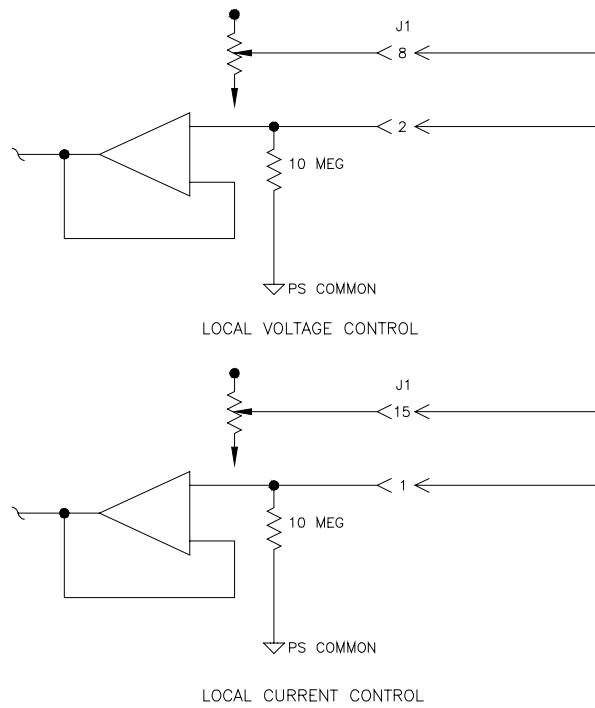


Figure 3.2 Local Programming Via Voltage Source

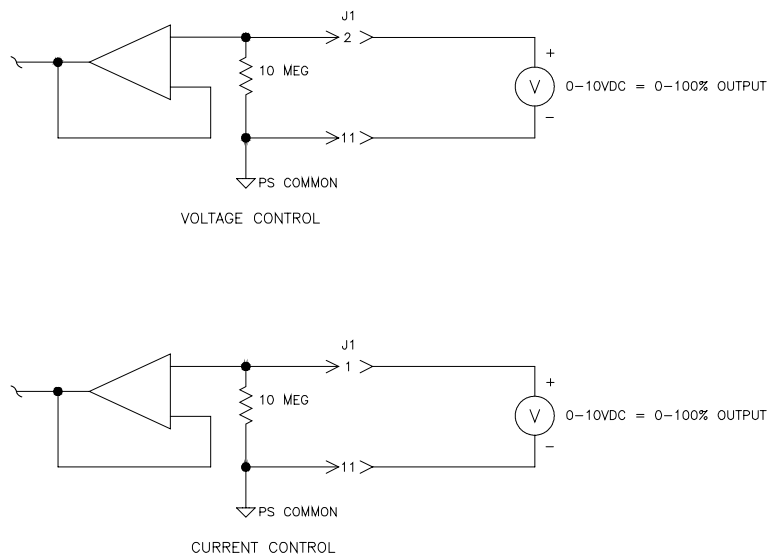


Figure 3.3A Remote Programming Via Voltage Source

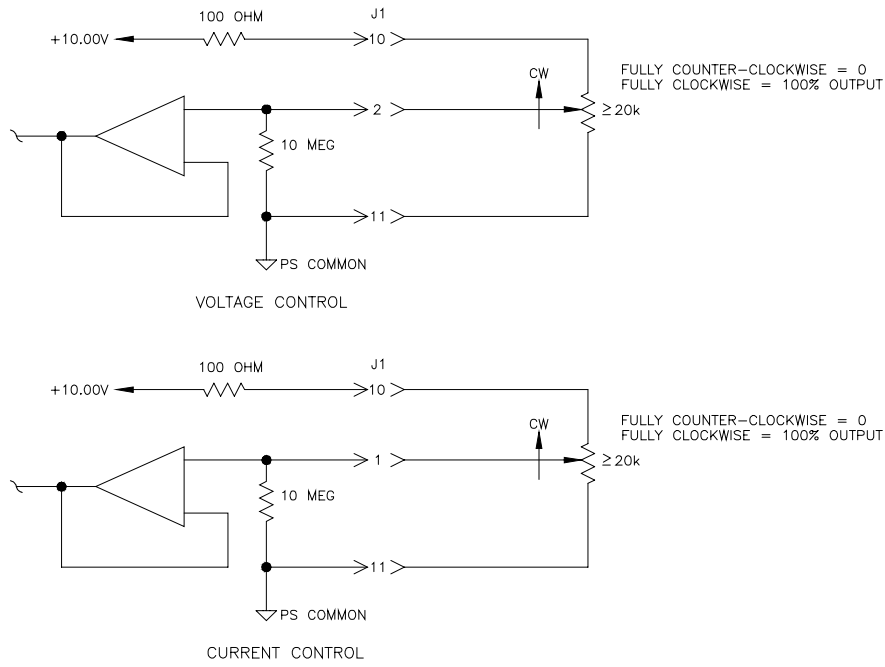


Figure 3.3B Remote Programming Via External Resistance

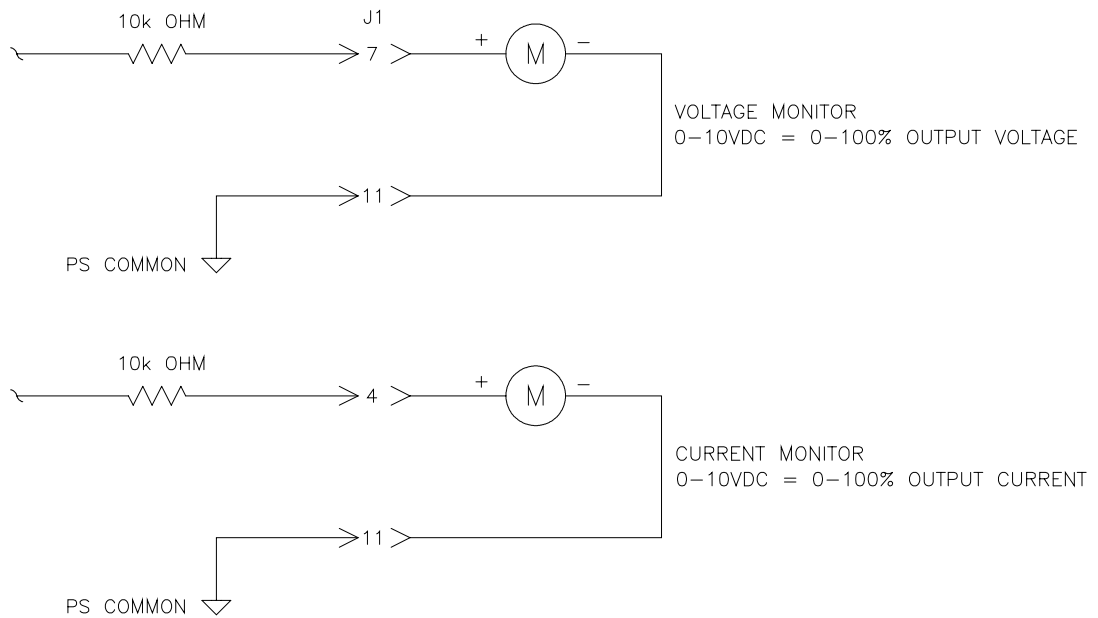


Figure 3.4 Remote Monitoring

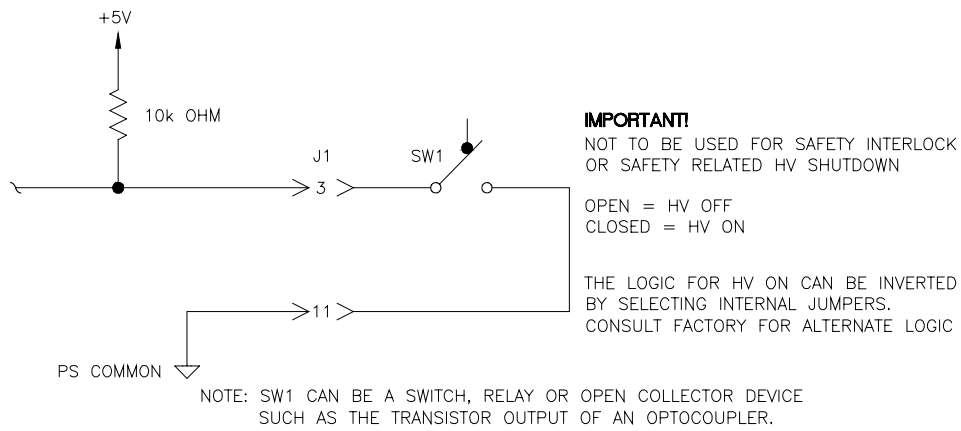


Figure 3.5 Enable/Disable Control

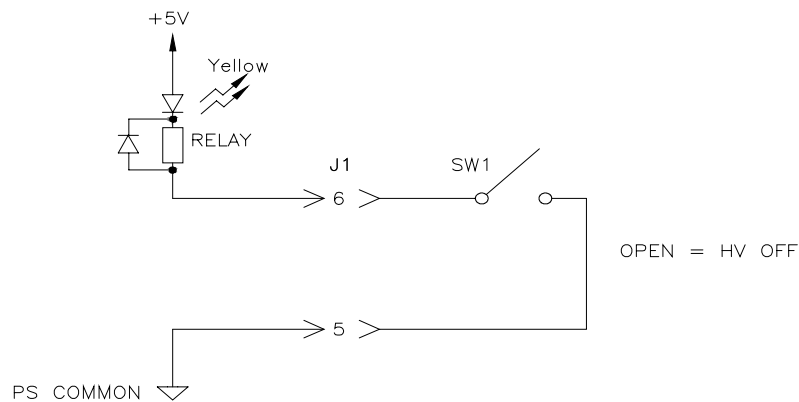


Figure 3.6 Safety Interlock

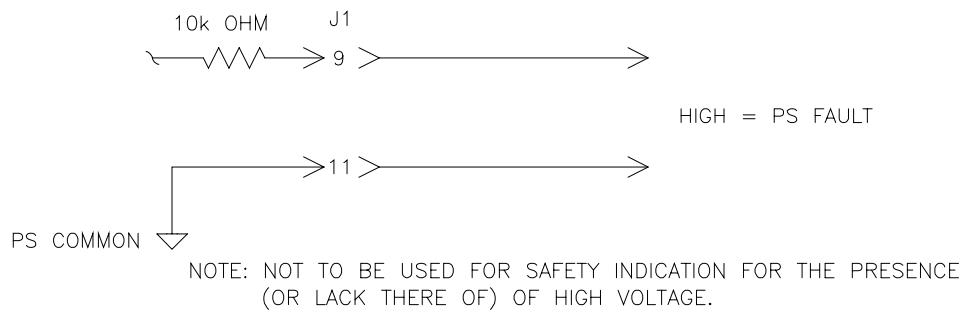


Figure 3.7 Power Supply Fault Indicator

Chapter 4

PRINCIPLES OF OPERATION

The PCM Series of high voltage power supplies utilizes sophisticated power conversion technology.

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

The PCM power supply is basically an AC to DC power converter. Within the power supply, conversions of AC to DC then to high frequency AC, then to high voltage DC take place.

Typical PCM power supplies comprise a few basic building blocks. These are: 1) AC to DC rectifier, 2) High frequency quasi-resonant inverter, 3) High voltage transformer and rectifier circuits, and 4) Control and monitoring circuits. The following is a brief description of each building block.

4.1 Power Factor and Associated Circuits

The PTV series can operate from 85VAC to 265Vac. The 1kV model are UL® rated for 85V to 250Vac input range.

The input voltage is connected via a typical IEC 320 type input connector. An internal EMI filter and fuse housing is an integral part of the IEC input module. The input circuits actively correct the power factor.

The input line voltage is applied to a current limit device to reduce the initial inrush current. The input line voltage is converted to a 400VDC voltage via an active PFC Converter.

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.

4.2 High Frequency Inverter

The PCM is a resonant converter operating in a zero current switching, series resonant, parallel loaded topology. MOSFET transistors switch the 400 VDC voltage to the resonant tank circuit. Typical operating frequency is in the range of 35-65KHz depending on model. Control of the resonant circuit output is done by the low voltage control circuits, and are isolated by an isolated pulse transformer. The output of the resonant circuit is applied to the primary of the high voltage transformer.

4.3 High Voltage Circuits

The high voltage transformer is a step-up type. The secondary of the high voltage transformer is connected to the high voltage rectifier circuit. The rectifier circuit will vary depending upon the rated output voltage. For lower output voltage, a full bridge or doubler circuit is used. For higher voltages, a half wave Cockcroft-Walton multiplier is used. A feedback signal is generated by the high voltage resistor divider. This feedback signal is sent to control circuits to provide voltage regulation and monitoring. A current sense resistor is connected at the low voltage end of the rectifier circuit. The circuit sense signal is sent to the control circuits to provide current regulation and monitoring.

The high voltage rectifier output is connected to an R-C type filter to reduce high frequency ripple components. The filter is then connected to the output limiting resistors. These resistors limit the peak surge current in the event an arc or discharge occurs. The limiting resistor output is connected to the output cable or connector provided.

4.4 Control Circuits

Control circuits are used for regulation, monitoring, pulse-width, control, slow-start and inhibit control. Feedback signals are calibrated and buffered via general purpose OP-AMPS. Pulse width control is accomplished by a typical PWM type control I.C. Logic enable/disable is provided by a logic gate I.C. Regulators generate +/- 15V and 10VDC.

WARNING

**LINE VOLTAGE IS PRESENT
WHENEVER THE POWER SUPPLY IS
CONNECTED TO EXTERNAL LINE
VOLTAGES. BE SURE TO DISCONNECT
THE LINE CORD BEFORE OPENING THE
UNIT. ALLOW 5 MINUTES FOR
INTERNAL CAPACITANCE TO**

**DISCHARGE BEFORE REMOVING ANY
COVER.**

4.5 Options

Due to the variations of models and options provided in the PCM 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 PCM 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 1.4.

5.1 Floating Ground **FG**

The floating ground option allows isolation of the power supply common from chassis ground. A typical application for FG is for connection of an external meter or circuit into the FG signal point. This circuit can monitor actual current flow at a low voltage level. See Figure 5.1 for typical connection to the floating ground terminal.

IMPORTANT

The power supply common must be connected to chassis ground through a low impedance circuit. The power supply common is clamped to chassis ground using a power zener diode. This diode is not intended to clamp under continuous operation. On higher current units the power dissipation within the zener diode can be excessive if allowed to clamp.

5.2 No Slow Start **NSS**

The no slow start option causes the output voltage of the power supply to rise (within 50 msec) to the rated voltage upon Power Up.

5.3 Non-Standard Slow Start **SS(x)**

The non-standard slow start option allows the gradual rise time of the output voltage to be different from the standard of six seconds. To order the option, place the time desired in seconds after the suffix letter; i.e. SS(10) denotes a 10 second rise time.

5.4 Extra Length Output Cable **LL(ft)**

Standard output cable is 1 Meter long. Other lengths may be specified.

5.5 Focus Outputs

Focus outputs for CRT type applications can be provided. Generally, the focus output range is 6kV – 12kV, <1mA. Specific focus output requirements should be discussed with Spellman's sales department. Multiple focus, dynamis focus and variable focus control can also be provided.

5.6 Grid Outputs

Grid outputs for CRT type applications can be provided. Grid outputs can either be fixed or adjustable. Generally, grid outputs are in the ranges of a few hundred volts to 1800V, @ 1mA. Specific grid output requirements should be discussed with Spellman's sales department.

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

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

5.8 Filament Outputs

Filament outputs with an emission control loop are available for use with X-Ray tubes. Generally, filament outputs are in the range of 3V – 12V, at currents up to 5A. Both AC and DC filaments are available.

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

Note: Before operating this system, refer to operating instructions in Chapter 3.

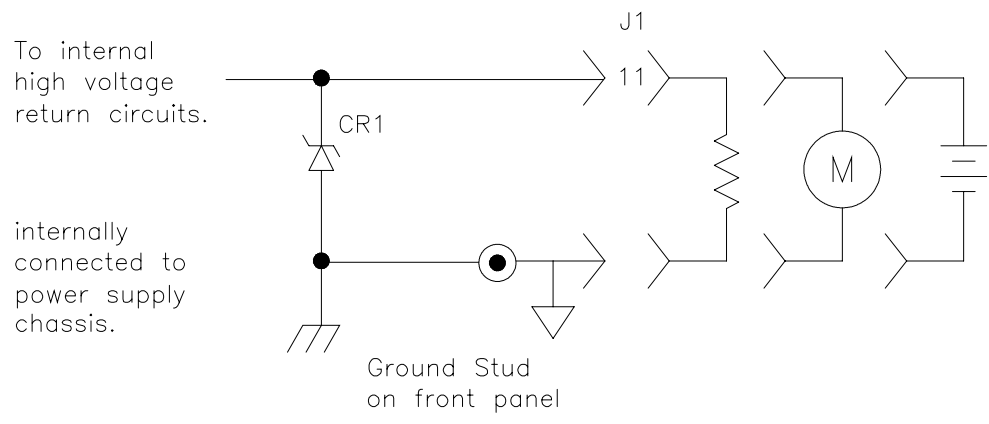


Figure 5.1 Floating Ground Interface Circuit

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

Approximately once a year (more often in high dust environments), disconnect the power to the unit and remove the top cover. Use compressed air to blow dust out of the inside of the unit. Avoid touching or handling the high voltage assembly.

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 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

FACTORY SERVICE

7.1 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.

7.2 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.

7.3 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.

7.4 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>

SPELLMAN HIGH VOLTAGE ELECTRONICS

WARRANTY

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

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

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

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

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

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

Factory Service Procedures

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

Factory Service Warranty

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

Spellman Worldwide Service Centers

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

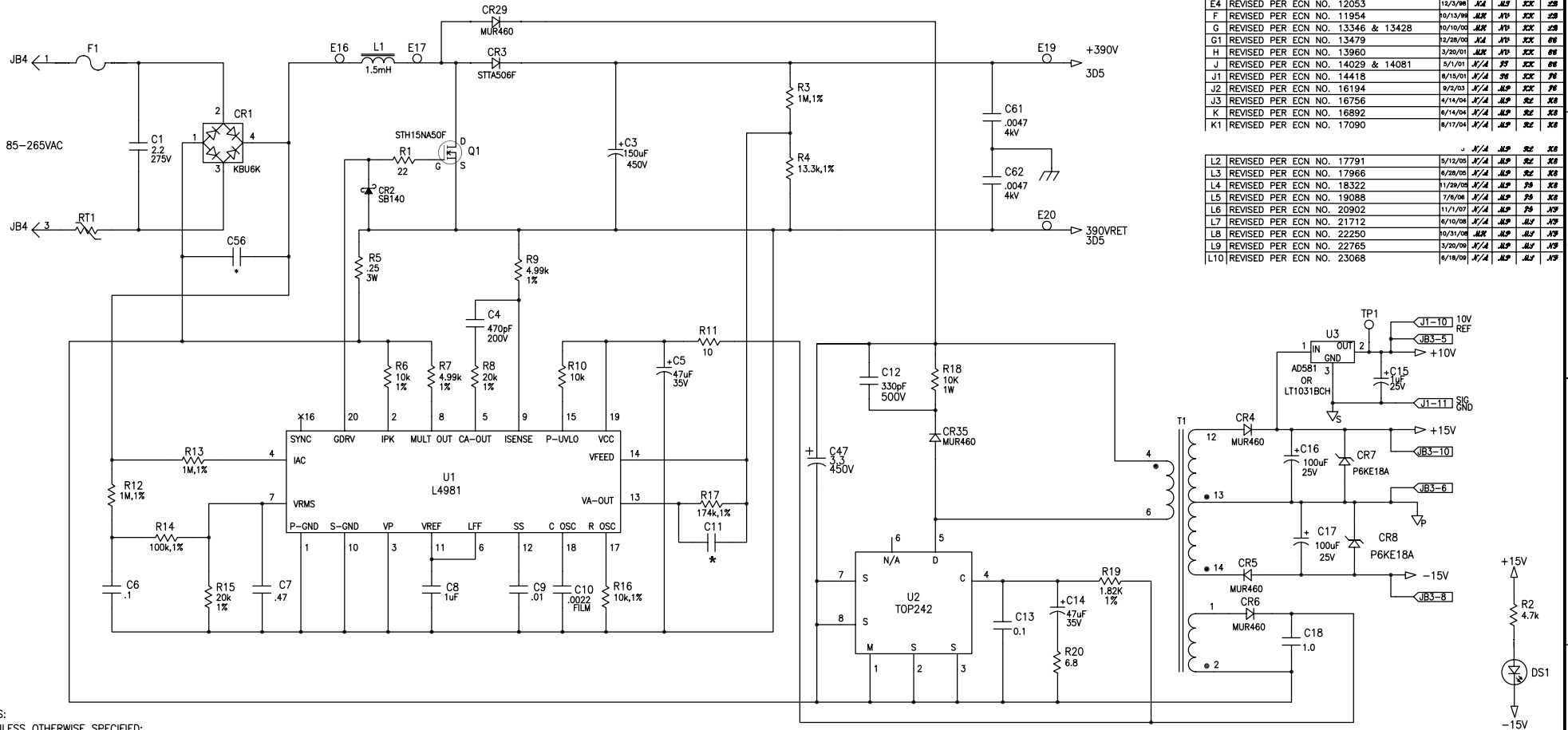
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DESCRIPTION OF HOLES

NOTE: DIMENSIONS APPLY TO INSTALLATION SIZE OF HARDWARE, IF APPLICABLE

SYM	DESCRIPTION	QTY
-----	-------------	-----

REVISIONS		DATE	DESIGN	APP'D	QUALITY	REV
D1	REVISED PER ECN NO. 9752	7/16/96	J/A	P/M	J/C	5/1
D2	REVISED PER ECN NO. 10392	4/21/97	J/A	P/M	J/C	5/1
D3	REVISED PER ECN NO. 10592	6/23/97	J/A	P/M	J/C	5/1
D4	REVISED PER ECN NO. 11157	1/9/98	J/A	P/M	J/C	5/1
E	REVISED PER ECN NO. 11166	2/9/98	J/P	J/D	J/C	2/8
E1	REVISED PER ECN NO. 11733	7/28/98	J/A	J/S	J/C	2/8
E2	REVISED PER ECN NO. 11886	9/24/98	J/A	J/A	J/C	2/8
E3	REVISED PER ECN NO. 11924	10/8/98	J/A	J/S	J/C	2/8
E4	REVISED PER ECN NO. 12053	12/3/98	J/A	J/S	J/C	2/8
F	REVISED PER ECN NO. 11954	10/13/98	J/A	J/D	J/C	2/8
G	REVISED PER ECN NO. 13346 & 13428	10/10/00	J/A	J/D	J/C	2/8
G1	REVISED PER ECN NO. 13479	12/28/00	J/A	J/D	J/C	8/8
H	REVISED PER ECN NO. 13960	3/20/01	J/A	J/D	J/C	8/8
J	REVISED PER ECN NO. 14029 & 14081	5/1/01	J/A	J/D	J/C	8/8
J1	REVISED PER ECN NO. 14418	8/15/01	J/A	J/D	J/C	8/8
J2	REVISED PER ECN NO. 16194	9/2/03	J/A	J/P	J/C	8/8
J3	REVISED PER ECN NO. 16756	4/14/04	J/A	J/D	J/C	8/8
K	REVISED PER ECN NO. 16892	6/14/04	J/A	J/D	J/C	8/8
K1	REVISED PER ECN NO. 17090	8/17/04	J/A	J/P	J/C	8/8
L2	REVISED PER ECN NO. 17791	5/12/05	J/A	J/P	J/C	8/8
L3	REVISED PER ECN NO. 17966	6/28/05	J/A	J/P	J/C	8/8
L4	REVISED PER ECN NO. 18322	11/29/05	J/A	J/P	J/C	8/8
L5	REVISED PER ECN NO. 19088	7/6/06	J/A	J/P	J/C	8/8
L6	REVISED PER ECN NO. 20902	11/1/07	J/A	J/P	J/C	8/8
L7	REVISED PER ECN NO. 21712	6/10/08	J/A	J/P	J/C	8/8
L8	REVISED PER ECN NO. 22250	10/31/08	J/A	J/P	J/C	8/8
L9	REVISED PER ECN NO. 22765	3/20/09	J/A	J/P	J/C	8/8
L10	REVISED PER ECN NO. 23068	6/18/09	J/A	J/P	J/C	8/8



- NOTES:
- UNLESS OTHERWISE SPECIFIED: RESISTORS ARE N OHMS, 1/4W. 1/8W RESISTORS ARE RN, 1%. 1/10W RESISTORS ARE RN, 0.1%. CAPACITORS ARE IN MICROFARADS.
 - ALL DIODES ARE FDH333 UNLESS OTHERWISE STATED.
 - ALL CAPS CK05 STYLE UNLESS OTHERWISE STATED.
 - * DENOTES SEE TABLE 1 ON SHEET 4 FOR TABULATED COMPONENTS.
 - COMPONENTS BORDERED BY DASH LINES ARE ARC INDICATOR CIRCUITRY PARTS.

APPROVALS		DATE	
DRAWN	J. Sullivan	5/5/94	
CHECKED	J/A	4/4	
MECH. DESIGN	E. Korman	6/2/95	
PROJ. ENG.	P. J. Smith	6/2/95	
Q.A.	K. Koo		
MFG. ENG.			

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES [mm] AND TOLERANCES ARE:
 DIMENSIONS: .005" ± .001" (0.127mm ± .0254mm)
 ANGLES: 45°

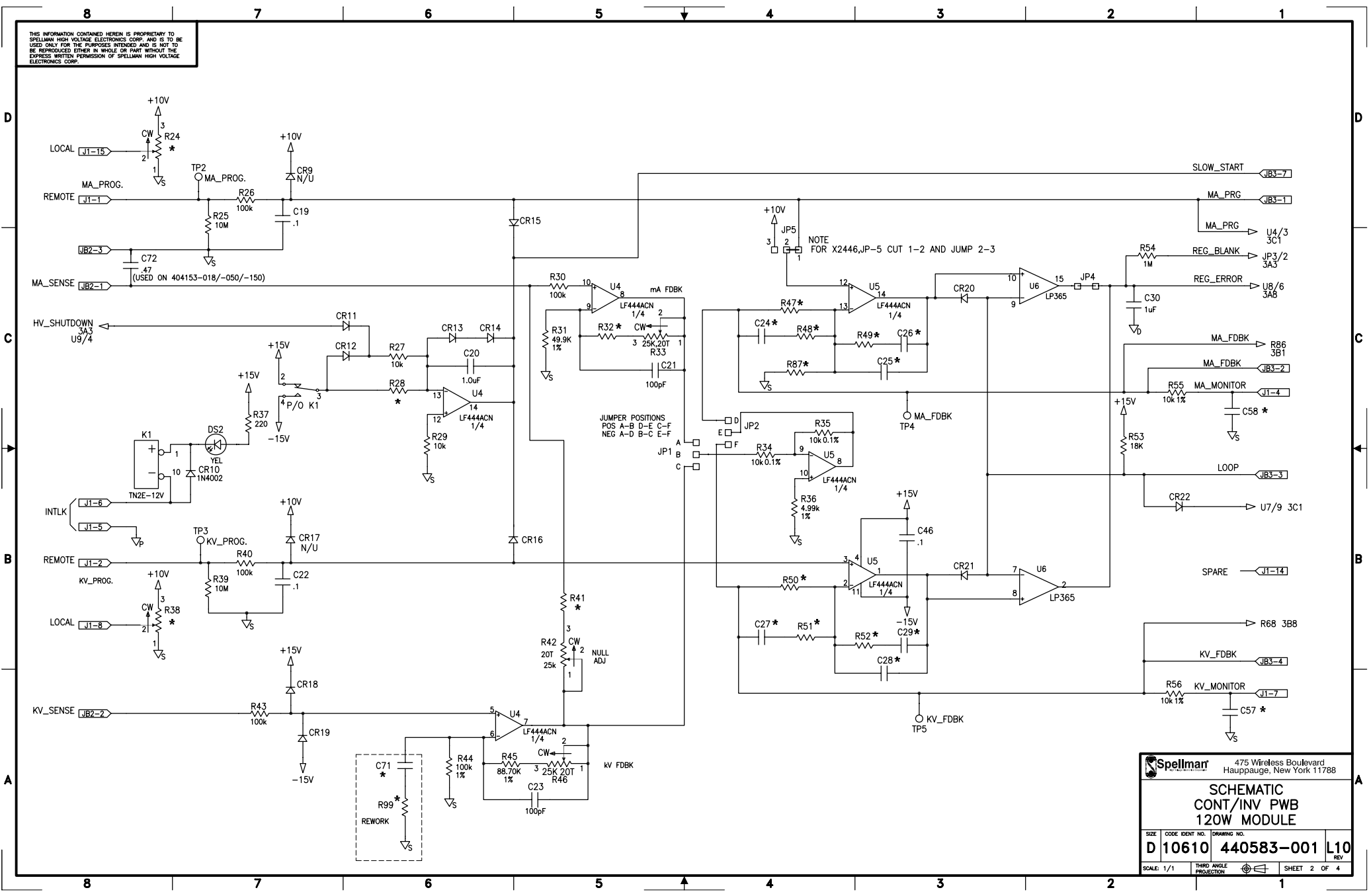
Spellman 475 Wireless Boulevard
Hauppauge, New York 11788

**SCHEMATIC
CONT/INV PWB
120W MODULE**

SIZE: D 10610 CODE IDENT NO.: 440583-001 DRAWING NO.: L10
 REV: 1

DO NOT SCALE DRAWING BREAK ALL SHARP EDGES & CORNERS SCALE: 1/1 THIRD ANGLE PROJECTION SHEET 1 OF 4

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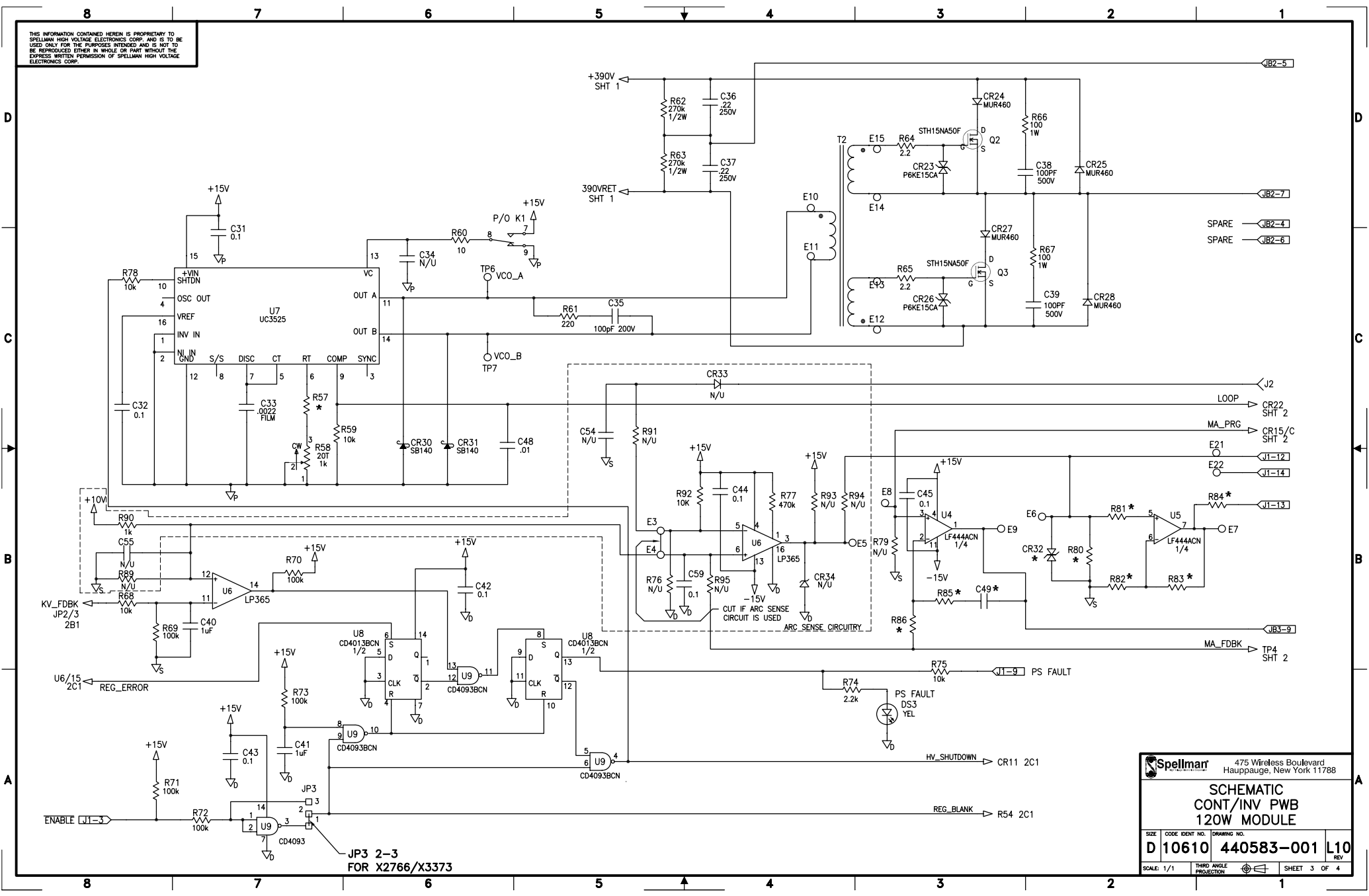
Spellman 475 Wireless Boulevard
 Hauppauge, New York 11788

**SCHEMATIC
 CONT/INV PWB
 120W MODULE**

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	10610	440583-001	L10

SCALE: 1/1 THIRD ANGLE PROJECTION SHEET 2 OF 4

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Spellman 475 Wireless Boulevard
Hauppauge, New York 11788

**SCHEMATIC
CONT/INV PWB
120W MODULE**

SIZE	CODE IDENT NO.	DRAWING NO.
D	10610	440583-001
REV	L10	

SCALE: 1/1 THIRD ANGLE PROJECTION SHEET 3 OF 4

JP3 2-3
FOR X2766/X3373

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TABLE I

REF. DESIGNATORS	1kV	3kV	5kV	10kV	15kV	20kV	30kV	40kV POS	40kV NEG	50kV	60kV	70kV	X2345	X2232	X2446	X2766	X3373	X2514	X2824
C11	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	.047	—	—
C24	—	—	—	—	.33	.47	—	—	—	.47	—	—	—	—	—	—	.47,50V	—	—
C25	.001	.001	.001	.001	.001	.01	—	.001	.001	.001	.001	.001	—	—	—	.001	.001,200V	.001	.001
C26	.1	.1	.1	.1	.1	.1	—	.1	.1	.047	.1	.1	.1	—	—	.1	.047,50V	.1	.1
C27	—	—	—	0.1	0.1	—	.001	.001	.001	.001	0.1	0.1	0.1	0.1	0.1	0.1	.001, 200V	—	—
C28	100pf	100pf	100pf	100pf	100pf	100pf	.001	.001	.001	.01	100pf	100pf	—	—	—	100pF	.001,200V	100pF	100pF
C29	.01	.01	.01	.01	.01	.01	—	.0056	.0056	.01	.01	.01	—	—	—	.01	.01,100V	.01	.01
C49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
C52	—	—	—	—	—	—	—	—	—	—	—	—	—	.0047,250V	—	—	—	—	.0047,250V
C53	—	—	—	—	—	—	—	—	—	—	—	—	—	.0047,250V	—	—	—	—	.0047,250V
C56	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.0022,1000V	.10	.0022,1000V	—	—
C57	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.1	.1	—	—
C58	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	.1	.1	—	—
C71	—	—	—	—	0.1	.22	.1	.1	.1	—	—	—	—	—	—	—	.1	—	—
CR32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R28	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	1M	10M	1M	1M	—	—
R32	95.3K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%	37.4K,1%
R41	—	665K,1%	402K,1%	402K,1%	280K,1%	280K,1%	324K,1%	280K,1%	280K,1%	274K,1%	249K,1%	237K,1%	255K,1%	2.21K,1%	255K,1%	274K,1%	274K,1%	665K,1%	280K,1%
R47	10K	22K	22K	22K	22K	22K	22K	22K	4.12K	22K	22K	22K	—	—	—	22K	22K,5%	22K	22K
R48	—	—	—	—	3.3K	2.7K	—	—	20K	—	—	—	—	—	—	—	20K,1%	—	—
R49	4.7K	4.7K	4.7K	4.7K	4.7K	4.7K	—	4.7K	4.7K	4.7K	4.7K	4.7K	—	—	—	4.7K	4.7K,5%	4.7K	4.7K
R50	22K	22K	22K	22K	12K	39K	22K	7.5K,1%	7.5K,1%	7.5K,1%	22K	22K	—	—	—	22K	7.5K,1%	22K	22K
R51	—	—	—	2.2K,1%	2.2K,1%	—	6.19K	22K,1%	4.12K	2.2K,1%	2.2K,1%	2.2K,1%	2.2K,1%	2.2K,1%	2.2K,1%	2.20K	2.20K	—	—
R52	22K	22K	22K	22K	22K	22K	22K	19.1K,1%	19.1K,1%	22K	22K	22K	—	—	—	22K	22K,5%	22K	22K
R57	6.19K,1%	6.19K,1%	6.19K,1%	6.19K,1%	6.19K,1%	5.36K,1%	5.36K,1%	4.12K,1%	4.12K,1%	6.19K,1%	6.19K,1%	4.99K,1%	6.19K,1%	6.19K,1%	6.19K,1%	4.42K,1%	4.42K,1%	6.19K	—
R80	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω
R81	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω
R82	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R83	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω	0Ω
R84	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R85	—	—	—	—	—	—	—	—	—	—	—	—	0Ω	0Ω	100K	0Ω	0Ω	—	0Ω
R86	—	—	—	—	—	—	—	—	—	—	—	—	—	—	100K	—	—	—	—
R87	—	—	—	—	—	—	—	—	—	—	—	—	—	—	220K,5%	—	—	—	—
R88	—	—	—	—	—	—	—	—	—	—	—	—	—	1M,1/2W	—	—	—	—	1M, 1/2W
R99	—	—	—	—	—	4.53K,1%	4.12K,1%	20K	20K	20K	—	—	—	—	—	—	20K,1%	—	—
R24	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	—
R38	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	25T	—

Spellman 475 Wireless Boulevard
Hauppauge, New York 11788

**SCHEMATIC
CONT/INV PWB
120W MODULE**

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D	10610	440583-001	L10

SHEET 4 OF 4