Instruction Manual

CCM1KW 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.

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 EXTRÊMENT 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 entrainer 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 QUESO 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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1 INTRODUCTION

1.1 DESCRIPTION OF THE CCM1KW SERIES

This series of high voltage power supplies represents an advanced approach to capacitor charging power requirements. These power supplies incorporate a resonant output circuit topology, and a power factor correction input circuit to achieve a fast charging rate and high efficiency power conversion while generating minimal line voltage harmonics.

These achievements are made possible by Spellman's long history in high power conversion systems. This series of power supplies utilizes an interleaving Continuous Conduction Mode PFC topology that reduces ripple components on both the input AC and output DC rails. The result is reduced emi and DC ripple current in the rail filter capacitor. The power factor of the supply is maintained at approximately 0.99, thus reducing the AC mains current requirement for maximum rectifier circuit efficiency and minimum power line harmonics.

The High Voltage power conversion circuit is a high power inverter utilizing MOSFET devices in a resonant topology which lowers the switching losses, and boosts efficiency. MOSFETs drive a step up transformer and output bridge rectifier circuit. Innovations such as this allow the power supply to be configured with a high degree of physical efficiency, resulting in a relatively small package size.

In addition to the main high voltage output, the CCM1KW supply provides a 15VDC auxiliary output capable of supplying 100 miliamperes continuous current to a ground referenced load.

1.2 STANDARD FEATURES

The CCM1KW series incorporates several standard features designed to optimize user control and safety.

INRUSH CONTROL: This feature limits the AC input current required to charge the rail capacitors when power is applied to avoid blowing line fuses or tripping external circuit breakers. This feature is designed to limit AC mains inrush current to less than 60 amps peak for one half cycle of the AC line power.

INVERTER DELAY: The high voltage inverter circuit is inhibited for approximately one second following the inrush control cycle to allow the power factor control pre-regulator to stabilize the rail power before high voltage is generated. Internal housekeeping supplies are also allowed to turn on and stabilize during this time so that reference voltages, etc. reach their correct operating levels.

OVERVOLTAGE FAULT SENSING: The CCM1KW series monitors High Voltage output and compares it to an internal reference. If this circuit detects an output level greater than the reference level, a latching fault is generated, which inhibits the HV inverter circuit so that no HV output is present. The internal reference is set to produce a fault condition if output voltage exceeds 107%. Removing AC power for approximately 30 seconds resets the fault latch.

OVERTEMP FAULT SENSING: A thermostat switch attached to the CCM1KW unit heat sink will cause the HV Inverter circuit to be inhibited if the heat sink temperature exceeds 60deg C. When the heat sink cools down, the inverter inhibit will automatically be removed, and normal operation will resume if the enable signal is present.

INHIBIT: The high voltage inverter is inhibited by +5V to +15V on the inhibit pin of the I/O connector. A 0V signal or ground will enable the HV inverter. If the inhibit input is not connected (open circuit), the inverter will be inhibited. The inhibit signal only affects the inverter circuit, and does not affect the power factor control. DC rails are maintained at 400VDC as long as AC power is applied to the unit.

1.2.1 SYSTEM STATUS AND FAULT DIAGNOSTIC DISPLAY

LED indicators are provided to give the user indication of system operation and fault conditions. These can be viewed through access holes on the front panel of the unit. If a fault occurs, the power supply inverter will shut down.
POWER ON: Indicates the ±12VDC internal auxiliary power supply is operating.

HV ON: Indicates the INHIBIT input is in the HV ENABLE mode.

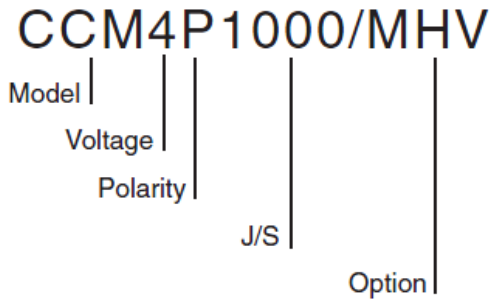
GEN FAULT: Indicates the RAIL SENSE, OVER CURRENT, OVER VOLTAGE, or OVER TEMP protection circuitry has caused the power supply to turn off.

1.3 OPTIONS:

The options available are listed in Table 1.1. See Section 6 for more information on these options. 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.

1.4 INTERPRETING THE MODEL NUMBER

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



OPTION CODE	OPTION
MHV	MHV U36931/U HV connector
L	Legacy interface signals

Table 1.1 Options

2 INSPECTION & INSTALLATION

Initial inspection and preliminary checkout procedures are recommended. For safe operation, please follow the step-by-step procedures described in Section 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 this shipment.

After unpacking, inspect the panel and chassis for visible damage.
Fill out and mail the Warranty Registration card accompanying the unit. Standard Spellman CCM1KW 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 SYMBOLS

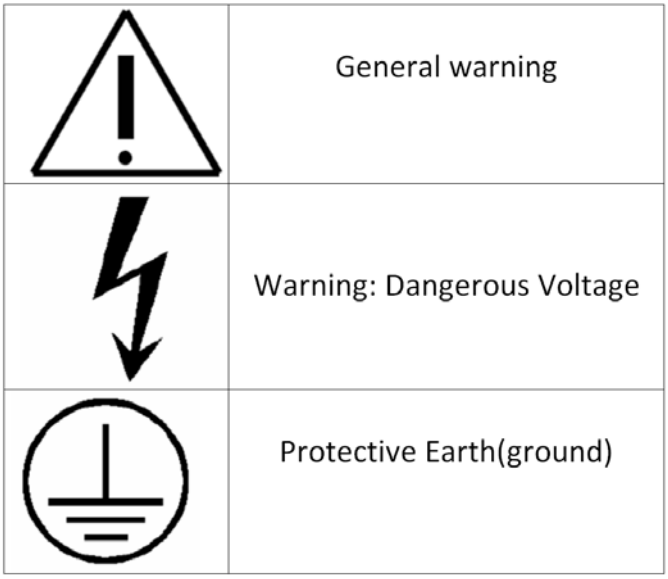


Figure 2.1 Symbols

2.3 MECHANICAL INSTALLATION

When installing allow access on front side for cable connections and allow at least 2 inches at front and rear of unit for cooling air intake and venting. Units are fully enclosed and are suitable for bench or tabletop operation. Standard unit dimensions are shown in Figure 2.2.

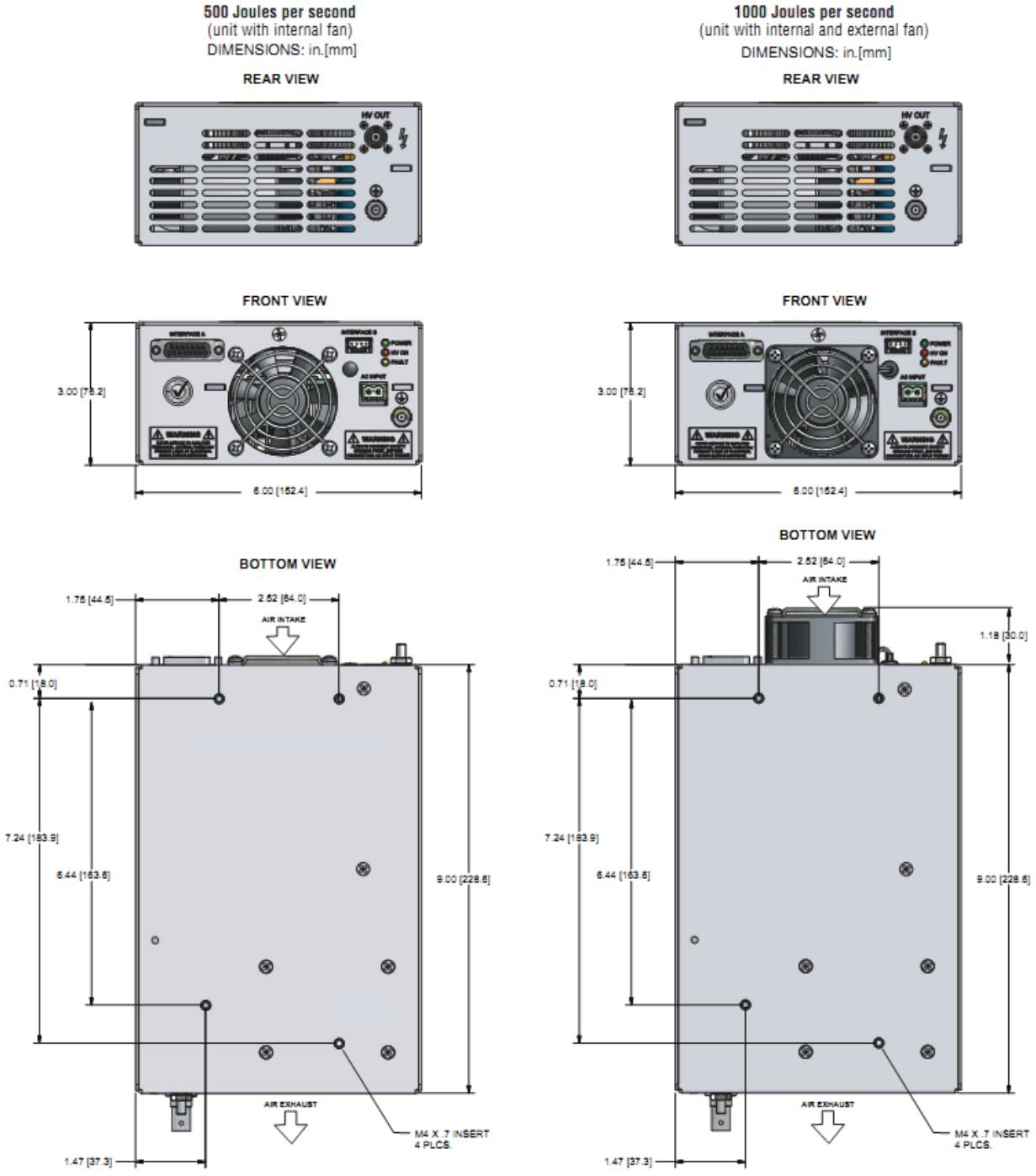


Figure 2.2 Unit dimensions

2.4 SYSTEM CONNECTION

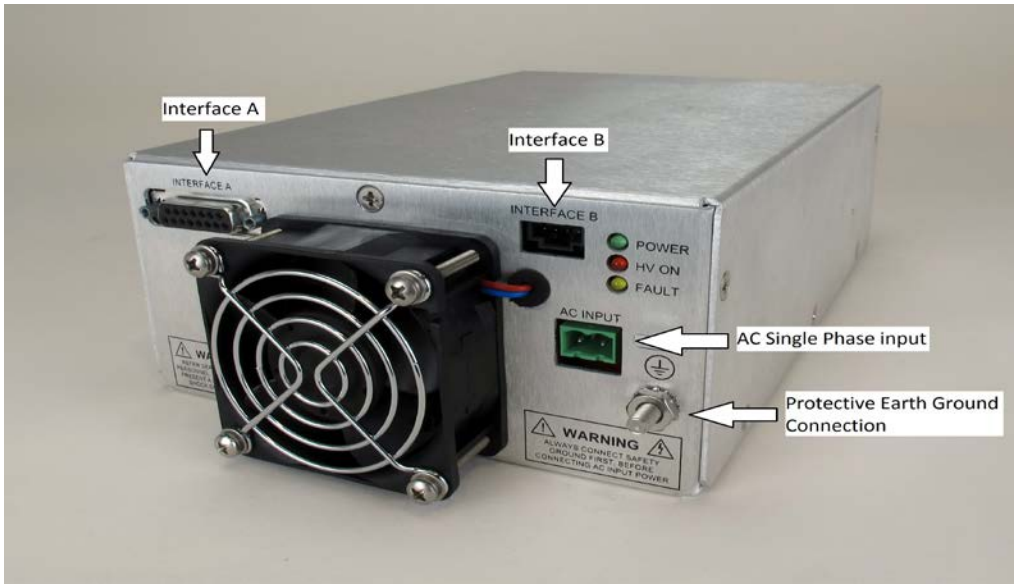


Figure 2.3 **CCM1KW Connections (1)**

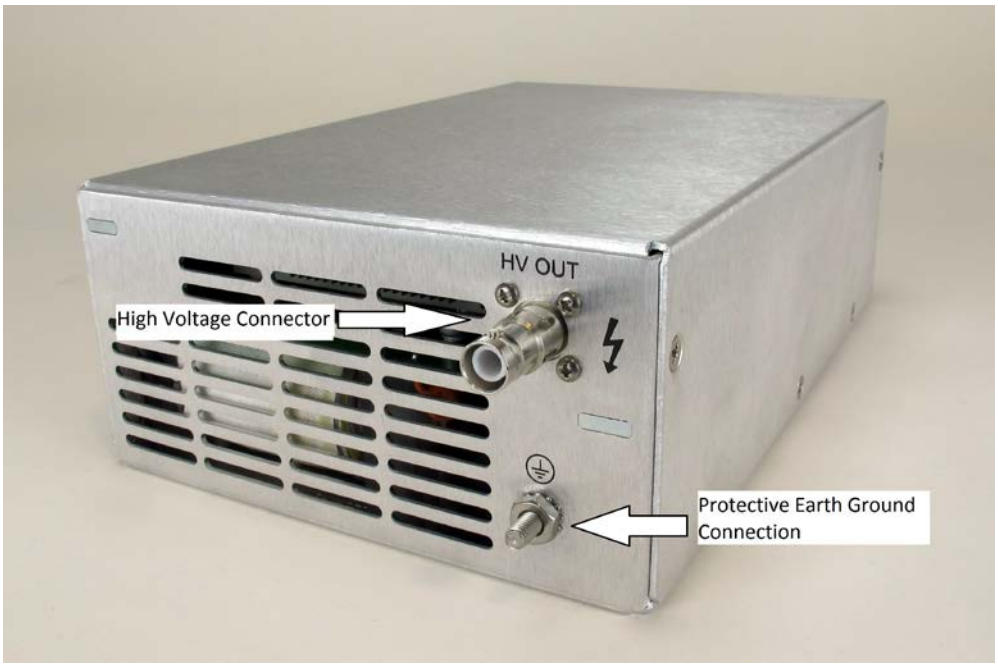


Figure 2.4 **CCM1KW Connections (2)**

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 E is reached.

Failure to follow these procedures may void the warranty.

A) Check the input voltage rating on the nameplate of the supply and make certain that this is the rating of the power source to be connected. Units operate on 90- 264VAC single phase, unless ordered with a different input voltage.

B) Proper Grounding Technique: The chassis of the high voltage power supply must be grounded to the local earth ground.

C) Connect the HV cable to the output load capacitor, and to HV connector J1on the CCM1KW supply. The HV output should be terminated into a capacitor of at least 0.25uf for 4KV unit, 1uF for 2KV unit, or 4uF for 1KV unit to maintain the .2% pulse to pulse repeatability.

D) For initial turn on, set the program control voltage to the zero position.

E) The input power cable may now be connected to the AC power source.

F) Depending on input voltage requirement, the line current requirements will vary. Typically, a 25Amp service is advised. If unsure of service requirements, consult Spellman's Engineering Department.

G) AC power can now remain in the ON position and HV can be turned ON and OFF via the INHIBIT signal on the I/O connector. With AC power applied, the "POWER" led at the front panel should be illuminated.

H) The magnitude of HV output is controlled by the application of program voltage input. Program voltage of 0 to +10VDC will result in HV output from 0 to full output. The program voltage should be set for desired HV output before enabling output by applying 0V to the INHIBIT input.

I) If the HV inhibit signal is +5VDC to +15vDC (or open circuit), the HV ON led (center led) will be OFF, and the HV inverter will be disabled.

If the HV INHIBIT signal is 0v, the HV ON led will illuminate, indicating that the HV inverter is enabled.

J) OVERVOLTAGE fault will occur if the output voltage is increased 107% above the rated output. This is a latching type fault, and is reset by Removing AC power for approximately 30 seconds.

K) OVERTEMP fault will occur if the internal heat sink temperature exceeds 60 degrees centigrade. This is a latching type fault, and normal operation will resume after the heat sink temperature returns below approximately 40 degrees centigrade, and enable signal is present.

WARNING

AFTER TURN OFF, DO NOT UNPLUG THE OUTPUT CABLE UNTIL THE INTERNAL CAPACITANCE IS DISCHARGED (APPROXIMATELY 10 SECONDS).

WARNING

THE OUTPUT MONITORING SIGNALS AT THE POWER SUPPLY I/O CONNECTOR DO NOT READ THE OUTPUT VOLTAGE WHEN THE AC POWER IS TURNED OFF, EVEN IF A CHARGE STILL EXISTS ON THE LOAD.

CAUTION

ALWAYS OPERATE THE UNIT WITH THE COVER ON. A FAN MAINTAINS SAFE OPERATING TEMPERATURE IN THE POWER SUPPLY BY DRAWING AIR OVER CRITICAL COMPONENTS. THE COVER MUST BE ON IN ORDER TO DIRECT THE AIRFLOW OVER THE AREAS THAT NEED COOLING.

Important

In operation, the unit must be placed so that the air intake and the fan exhaust are clear of any obstruction that might impede the flow of air.

3.2 STANDARD FEATURES:

3.2.1 PROGRAMMING:

Table 3-1, and table 3-2 list all connections available at the user I/O connector. The programming signal allows remote adjustment of the output voltage via external voltage source. Input impedance is 1 megOhm. For remote program, a positive voltage source from 0 to 10VDC = 0-100%, is applied to the appropriate terminals on the 15 pin I/O connector. By adjusting the voltage source from 0 volts (zero output) to 10 volts (full rated output) the desired output can be selected.

3.2.2 MONITOR:

Test points are made available at the 15 pin I/O connector for monitoring instantaneous and peak output voltage.0 to 10VDC = 0-100% of output. Accuracy is within ±1%. All test points have output impedance of 1kOhm.

3.2.3 CONTROL:

There are two control signals for the CCM1KW supply. These are the INHIBIT and the PROGRAM signals. The INHIBIT signal disables the HV inverter circuit when it is +5VDC to 15VDC, and enables the inverter when it is 0v. This signal is used as a HV ON / OFF control. The PROGRAM signal is an analog input used to control the magnitude of the HV output (see par. 3.2.1).

3.2.4 STATUS:

Status signals are provided at the I/O connector for OVERTEMP fault, and over voltage fault. A fault condition is indicated when any of these signals is 0V, while a normal condition is +15VDC with 4.99kOhm source impedance. Additionally, a signal is provided that indicates “end of charge” (EOC), when the external load capacitor is fully charged to the program value. Full charge is 0v, while “charge in progress” is +15VDC with 10kOhm source impedance.

3.2.5 Parallel Operation:

The CCM1KW series can be operated in parallel to provide additional power if required. The units to be connected in parallel need to be the same polarity, output voltage and output power rating. A few interface signals located on the 15 pin D connector must be connected in parallel (Voltage Program, Inhibit, Over Voltage and Over Temperature). The End of Charge signals from each unit need to be “ored” together to create a new End of Charge signal for the paralleled units. Finally the respective high voltage output cables need to be connected to the load. Multiple units can be connected in parallel and that they need not be using the same AC phase. Please see Figure 3.2 for more details.

TABLE 3.1 I/O CONNECTOR INTERFACE A

PIN	SIGNAL	SIGNAL PARAMETERS
1	Inhibit/Fault Reset	+5VDC to +15VDC = inhibit HV, 0V = HV Enable
2	N/C	N/C
3	OverTemp Fault	Fault = 0V, NO Fault = +15VDC through 4.99kOhm
4	Signal Ground	Signal Ground (optional)*
5	Voltage Program	0 to 10VDC = 0 to 100% rated output voltage
6	Overvoltage Status	Fault = 0v, NO Fault = +15VDC through 4.99kOhm
7	Vout Peak Hold	Peak output voltage displayed, 0 to 10VDC = 0 to 100% rated output voltage with a 5 second time constant
8	Voltage Monitor	0 to 10VDC = 0 to 100% rated output voltage
9	+15VDC	+15VDC @ 150mA, maximum
10	N/C	N/C
11	+15VDC	+15VDC @ 150mA, maximum (optional)*
12	Signal Ground	Signal Ground (optional)*
13	End of Charge	End of charge = 0v, Charging +15VDC through 4.99kOhm
14	Signal Ground	Signal Ground
15	Signal Ground	Signal Ground

TABLE 3.2 I/O CONNECTOR INTERFACE B

PIN	SIGNAL	SIGNAL PARAMETERS
1	Inhibit/Fault Reset	+5VDC to +15VDC = inhibit HV, 0V = HV Enable
2	Signal Ground	Signal Ground
3	Voltage Program	0 to 10VDC = 0 to 100% rated output voltage
4	+15VDC	+15VDC @ 150mA, maximum (optional)*

*Optional interface signals can be provided to be compatible with other pre-existing legacy interfaces. On standard units these signals are N/C.

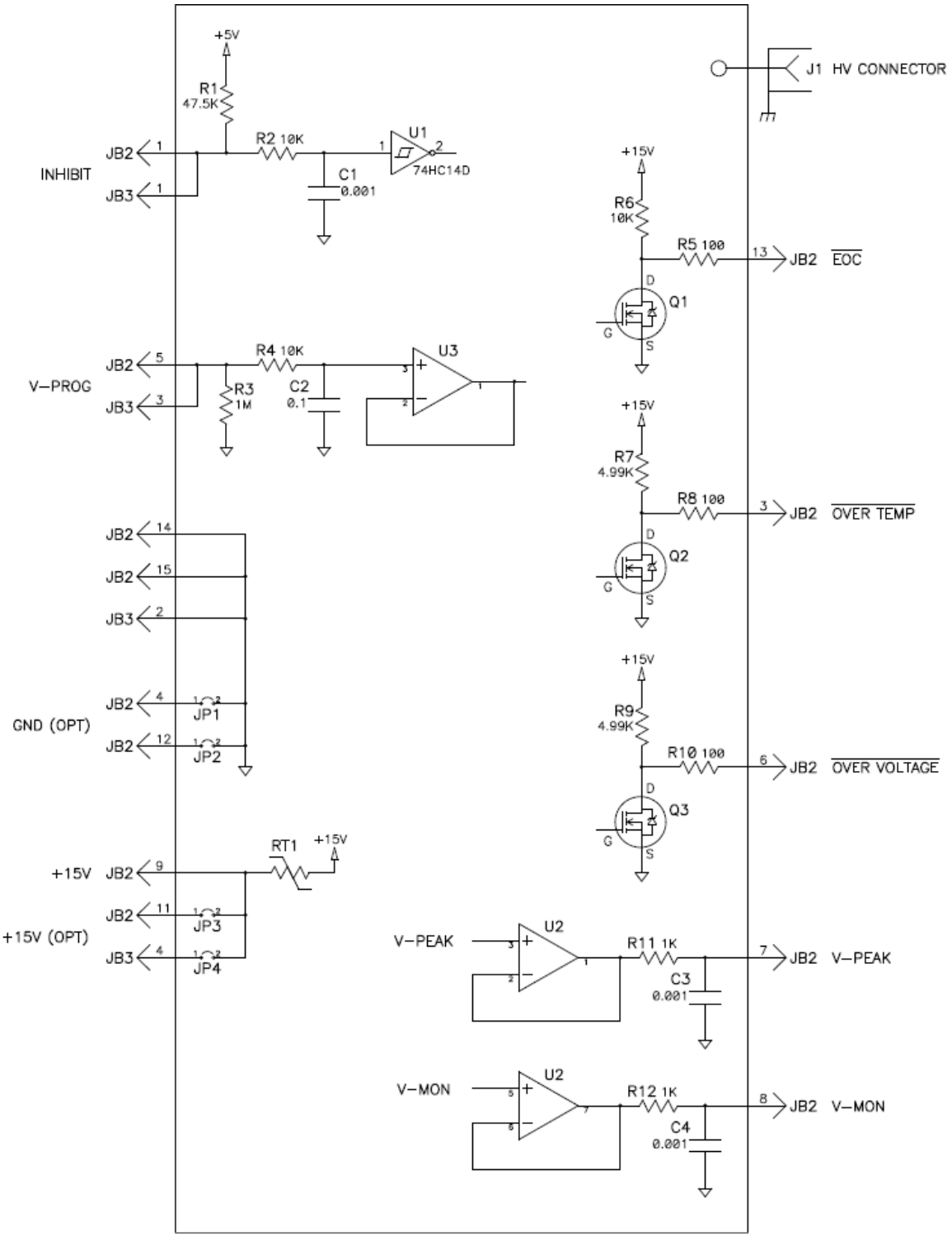


Figure 3.1 Unit interface

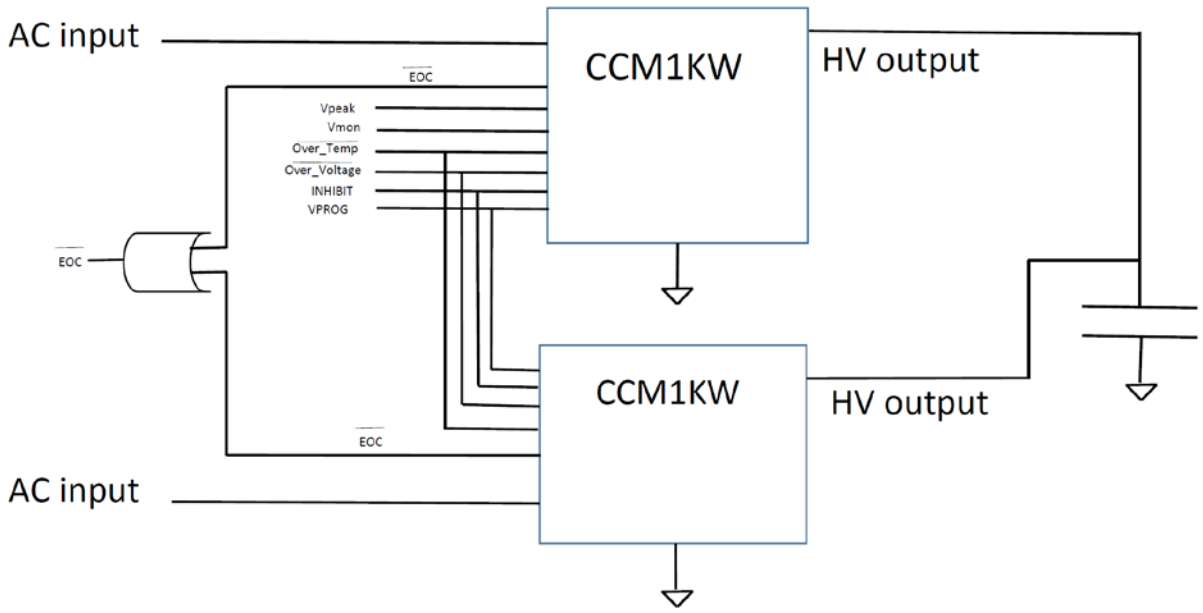


Figure 3.2 Parallel Operation

4 PRINCIPLES OF OPERATION

The CCM1KW series of high voltage power supplies utilize 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 CCM1KW power supply. For details on a specific circuit, consult Spellman's Engineering Department.

The CCM1KW 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. By reviewing the sub-assemblies, a basic understanding of the process can be gained.

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.

4.1 LINE RECTIFICATION AND FILTERING

AC line voltage of 115VAC to 220 VAC at 50 – 60 Hz is converted to DC voltage by means of an active power factor correction circuit to produce 400VDC rail voltage for operation of subsequent circuits in the CCM1KW supply. Circuit protection must be provided by external slo-blow fuses or circuit breaker on each side of the line. EMI filter reduces conducted HF noise from the CCM1KW to the mains. Output of the EMI filter is connected to a boost choke, which is part of the power factor correction circuit described in a later paragraph. The power factor circuit creates a PWM drive signal, which is applied to the boost choke to increase the AC input voltage to 400V peak, and subsequently rectifies the resultant output to produce the 400VDC rail voltage. The 400VDC rail voltage is then applied to capacitors on the power board assembly to provide filtered, low impedance, DC rail voltage for the HV inverter circuit.

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.

The filter caps are initially charged through inrush limiting circuitry located on the Power PWB. An inductor on the output of the PFC circuit helps to prevent high frequency inverter circuit noise from being applied to the electrolytic filter capacitors.

4.2 POWER FACTOR CORRECTION

Conversion of the AC input power to DC rail voltage 400V is accomplished by means of an active power factor correction circuit. The CCM1KW supply employs a unique topology for the PFC circuit, employing an interleaving Continuous Conduction Mode PFC controller. This results in increased conversion efficiency, reduced emi, and a reduced requirement for rail filtering capacitance due to reduced ripple

When the charge on the rail capacitors reaches 100VDC, the auxiliary supply on the Power PCB begins to generate the aux voltages, which causes the inrush limiter resistor to be bypassed by a relay, allows circuits on the Control Circuits PCB assembly to begin operating, and starting PFC circuit to generate 400V rail.

4.3 HV INVERTER CIRCUITS

The High Voltage Inverter circuits are comprised of MOSFETs connected in a half-bridge configuration with isolated gate drivers. Control board PWM controller oscillates at approximately 20 to 120kHz, and produces a square wave output to power board MOSFETSs which drive a steering circuit before application to isolated gate drive. This steering circuit provides a lock-out function that ensures that noise pulses, etc. can not cause false gating signals to the inverter MOSFETs that might result in “shoot thru” current in the half bridge. A Current transformer provides a sample of the current through the HV transformer resonant circuit to PWM controller on the Control PCB, where circuits detect zero current crossing of the resonant waveform, and subsequently generates the gate drive waveforms so that inverter switching occurs at zero current crossings to minimize switching losses. Zero current switching also reduces overshoots and emi in the inverter circuit.

4.4 HIGH VOLTAGE CIRCUITS

High voltage circuits consist of the HV transformer and components located on the control PCB assembly. The output rectifier is a classic bridge configuration, with a small capacitance for nominal output filtering and transient reduction. feedback resistors divide the high voltage to a low voltage proportional sample compatible with the regulator circuits on the CONROL PCB.

4.5 CONTROL CIRCUITS

The Control circuits PCB contains the circuits required for regulation of the HV output, and monitoring of the output voltage for OVERVOLTAGE, OVERTEMP, and OVERCURRENT conditions. The control circuits operate on +/-12VDC power derived from the auxiliary supply on the Power PCB board. Green led on the control board indicates presence of the ±12VDC aux power input to the control circuits (viewable through a front panel access hole).

Inrush limiter and inverter delay. When AC power is initially applied to the unit, all circuits remain dormant as the RAIL capacitors charge through a current limiter resistor to approximately 100VDC. At approximately 100VDC, the AUX supply starts up, and +/-12VDC supplies begin to power all control circuits. Relay K1 is initially de-energized, allowing current flow through the current limiter resistor, but when the charge on the rail capacitor reaches the threshold, a control circuit energize a relay K1, bypassing the current limiter resistor and allowing normal

operation of the unit. In order to allow some time for the Power factor control circuit to reach full output capability the 400VDC RAIL voltage is sensed by a differential voltage divider and differential amplifier. The output of the differential amp is applied to HI/LO comparator resulting in a signal to partially enable the HV inverter circuit if the rail voltage is between 372VDC and 428VDC.

HV enable. The HV inverter is inhibited by +5VDC to +15VDC applied through I/O connector JB2-1or JB3-1. An open circuit on this pin will result in a default +15VDC inhibit. HV enable is achieved by applying 0V to JB2-1or JB3-1, which generate the inverter enable, reset faults, and illuminate the red led (HV ON). When the output voltage reaches the programmed preset level, the PWM is switched OFF, allowing the output capacitor to remain charged until an external circuit causes a discharge (in conjunction with an INHIBIT signal).

Program and feedback. Program voltage for the CCM1KW is 0 to +10VDC, and is applied through I/O connector JB2-5 or JB3-3. The program voltage is applied to end of charge (EOC) comparator as the reference signal for comparison to the high voltage output feedback sample, so that the PWM is partially enabled. When the charge on the external capacitor reaches the program voltage level, the (EOC) comparator output switches to 0v, pulling the program reference down by approximately .2%, so that feedback must decrease by .2% before (EOC) comparator will switch back to +15VDC to re-charge the external capacitor to full program value.

Monitoring. Compensated feedback is buffered by an op-amp and I/O connector JB2-8 through series 1K resistor for user monitoring of the HV output by means of the compensated sample (0 to +10V = 0 to full output). In normal use, the external output capacitor is repetitively charged, discharged, and re-charged, making measurement of the output voltage difficult. For this reason, a **peak hold** circuit is provided to deliver a steady output signal, which can be monitored with a DVM, which correlates to the peak value of the output waveform. The peak hold signal is buffered and connected to I/O connector JB2-7 through series 1K resistor.

Fault monitoring. HV output is continuously monitored for OVERVOLTAGE, OVERTEMP, and OVERCURRENT conditions. Overvoltage is a latching fault requires removing AC power for approximately 30 seconds. Overtemp is initiated by a thermal switch on the heat sink assembly, and inhibits the HV inverter until the temperature drops approximately 20 degrees C, at which time the HV inverter is re-enabled.

Overvoltage is detected when output voltage exceeds 107% of rated output. The overvoltage latch is set by a flip-flop, and causes the yellow led to illuminate, while inhibiting the HV inverter.

Overtemp is detected if the heat sink temperature exceeds 60 degrees C. by means of a temperature switch with normally closed contacts. The thermal switch has a mechanical hysteresis of approximately 20 degrees C. If sink temperature exceeds 60 degrees, contacts will open and the yellow led will be illuminated, while the HV inverter is inhibited. In addition, a transistor will be biased on to provide a logic low at I/O connector JB2-3 for user monitoring. When the heat sink temperature cools down by approximately 20 degrees, the switch contacts will re-close, and normal operation will resume if enable signal is

present. Normal condition for this signal is +15VDC through 4.99kOhm

Overcurrent is sensed by monitoring the HV transformer primary current through a current transformer, and control board circuits. If the primary current becomes excessive, a signal will be generated to disable the HV PWM and illuminate the yellow fault LED. This is not a latched fault, so normal operation will return if the over current condition is removed.

5 ENVIROMENTAL & CLASSIFICATION

5.1 ENVIROMENTAL CONDITIONS

5.1.1 TEMPERATURE

Operating: 0°C TO 40°C
Storage: -40°C TO 85°C

5.1.2 HUMIDITY

10% to 90% non-condensing

5.2 OVER VOLTAGE CATEGORY

The CCM1KW is classified as overvoltage category II.

5.3 POLLUTION DEGREE

The CCM1KW is classified as pollution degree 2.

5.4 EQUIPMENT CLASSIFICATION

This equipment is classified as class 1, permanently connected equipment.

6 EMC COMPLIANCE

Note: Portable and mobile RF communications equipment can affect MEDICAL ELECTRICAL EQUIPMENT.

Warning: ME EQUIPMENT or ME SYSTEM should not be used adjacent to or stacked with other equipment and that if adjacent or stacked use is necessary, the ME EQUIPMENT or ME SYSTEM should be observed to verify normal operation in the configuration in which it will be used.

Warning: This equipment is intended for use by healthcare professionals only. This equipment may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or shielding the location. This equipment complies with conducted emissions requirements of CASPER 11 Class A as built. Compliance with CASPER 11, Class B may be achieved by adding an external 1uF capacitor and a common mode 1mH inductor in series with the input line.

6.1 CISPR 11: Group 1, Class B, criteria for conducted and radiated emissions.

6.2 IEC 61000-4-2: Electrostatic Discharge (ESD) 6kV contact, 8kV air.

6.3 IEC 61000-4-3: Radiated RF immunity, 3 V/m.

6.4 IEC 61000-4-4: Electrical Fast Transient, 2kV power lines.

6.5 IEC 61000-4-5: Surge, 1kV line to line, 2kV line to earth.

6.6 IEC 61000-4-6: Conducted RF immunity, 3Vrms.

6.7 IEC 61000-4-11: Voltage dips, interruptions, and variations, on input power lines.

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Table 6.1 – Guidance and MANUFACTURER'S declaration – ELECTROMAGNETIC EMISSIONS – for all ME EQUIPMENT and ME SYSTEMS

Guidance and manufacturer's declaration – electromagnetic emissions		
The CCM is intended for use in the electromagnetic environment specified below. The customer or the user of the CCM should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment – guidance**
RF emissions CISPR 11	Group 1	The CCM uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class B *	The CCM is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

*

For Class B compliance you have to connect a 1uF capacitor and a 1mH common mode choke (not supplied) in series with the input line. See figure 6.1

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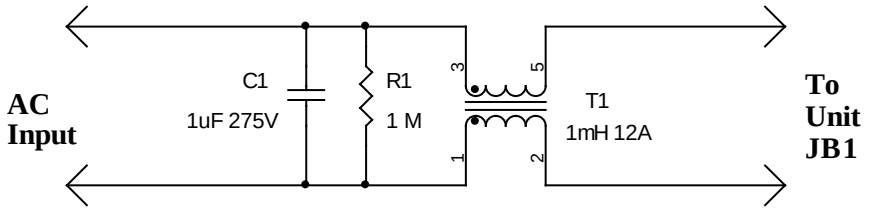

Figure 6.1 Class B Conducted Emission Input Filter Circuit.
Input filter consist of 1uF capacitor and a 1mH common mode choke with discharging resistor R1 across C1.

Table 6.2 – Guidance and MANUFACTURER'S declaration – ELECTROMAGNETIC EMISSIONS – for all ME EQUIPMENT and ME SYSTEMS

Guidance and manufacturer's declaration – electromagnetic immunity			
The CCM is intended for use in the electromagnetic environment specified below. The customer or the user of the CCM should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment – guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	± 1 kV line(s) to line(s) ± 2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	<5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles <5 % U_T (>95 % dip in U_T) for 5 s	Mains power quality should be that of a typical commercial or hospital environment. If the user of the CCM requires continued operation during power mains interruptions, it is recommended that the CCM be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Table 6.4 – Guidance and MANUFACTURER'S declaration – electromagnetic IMMUNITY – for ME EQUIPMENT and ME SYSTEMS that are not LIFE-SUPPORING

Guidance and manufacturer's declaration – electromagnetic immunity

The CCM is intended for use in the electromagnetic environment specified below. The customer or the user of the CCM should assure that it is used in such an environment.

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment – guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the CCM, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.17 \sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.17 \sqrt{P}$ 80 MHz to 800 MHz $d = 2.33 \sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

a Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the CCM is used exceeds the applicable RF compliance level above, the CCM should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the CCM.

b Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 6.6 – Recommended separation distances between portable and mobile RF communications equipment and the ME EQUIPMENT or ME SYSTEM – for ME EQUIPMENT and ME SYSTEMS that are not LIFE-SUPPORTING

Recommended separation distances between portable and mobile RF communications equipment and the CCM

The CCM is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the CCM can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the CCM as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter m		
	150 kHz to 80 MHz $d = 1.17 \sqrt{P}$	**80 MHz to 800 MHz** $d = 1.17 \sqrt{P}$	**800 MHz to 2,5 GHz** $d = 2.33 \sqrt{P}$
0.01	0.117	0.117	0.233
0.1	0.370	0.370	0.737
1	1.17	1.17	2.33
10	3.70	3.70	7.37
100	11.7	11.7	23.3

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

7 OPTIONS

The options available for the power supply are described in this section.

7.1 L OPTION- LEGACY INTERFACE

The Legacy Interface provides form, fit and function replacement for presently available commercially made units. See table 3-1, and table 3-2.

7.2 MVH option

In a standard unit the voltage connector is SHV1707-1. The MHV option provides MVH U6G-31/U high voltage connector instead.

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

8 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.

8.1 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. Be sure that the fans are not obstructed and spin freely. The fans have sealed bearings and do not need lubrication. Be sure to replace the top cover before operating for proper cooling.

8.2 PERFORMANCE TEST

WARNING:

HIGH VOLTAGE IS DANGEROUS. Only qualified personnel should perform these tests.

High voltage test procedures are described in Spellman 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 is needed for performance tests. All test components must be rated for operating voltage.

8.3 HIGH VOLTAGE DIVIDERS

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

9 FACTORY SERVICE

9.1 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.

9.2 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 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 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.

9.3 Ordering Options and Modifications

Many of the options listed in chapter 5 can be retrofitted into Spellman's power supplies by our factory. For prices and arrangements contact the Spellman sales department.

9.4 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) 435-1600
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