

# Instruction Manual

## CZE 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 CZE Series

The CZE 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 these modules, 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. High operating frequency 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 CZE series operates from 24VAC  $\pm 10\%$ . (User should specify the input voltage at the time of ordering). The CZE series operates at 9W continuous. The series does not require 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 CZE series.

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

### 1.2 CZE 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 1mA etc.).
- **Input**  
Voltage: 24Vdc  $\pm 10\%$ . Consult the factory for other input voltages.
- **Voltage Regulation:**  
**Load Regulation:** 0.01% of full voltage for a no load to full load change.  
**Line Regulation:**  $\pm 0.01\%$  of full voltage over the specified input voltage range.

- **Current Regulation:**  
**Load Regulation:** 0.05%  $\pm 25\mu\text{A}$  from 0 voltage to full voltage.  
**Line Regulation:**  $\pm 0.01\%$  of full current over the specified input voltage range.
- **Ripple:**  
0.1% p-p of output voltage.
- **Polarity:**  
Reversible via TTL Signal in Polarity Control Signal Pin.
- **Stability:**  
0.01% per hour after 1/2 hour warm up.
- **Temperature Coefficient:**  
100 ppm per  $^{\circ}\text{C}$ .
- **Temperature:**  
Operating:  $0^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$   
Storage:  $-40^{\circ}\text{C}$  to  $+80^{\circ}$
- **Monitoring:**  
0 to 10VDC corresponding to 0 to 100% of output voltage  
0 to 10VDC corresponding to 0 to 100% of output current.  
0 to 10VDC corresponding to 0 to 100% of load return current input.  
Ground Fault Indication (GFI):  $+15\text{V} = \text{Fault}$ ;  
Output Impedance:  $= 4.7\text{k}\Omega$ .  
(Other scale factors available).
- **Control:**  
Control signal for high voltage enable/disable.

### IMPORTANT

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



## 1.3 Standard Features

The CZE 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 the Spellman's Sales Department for information on slow start options. (The slow start time will be a function of set point, input voltage and load conditions).

**Polarity Control:** A TTL compatible input controls the polarity of the high voltage output. A logic level HIGH will give a Positive, a LOW a Negative. If left open, the unit will default to Positive.

**G.F.I.:** The Ground Fault Interrupt will give an indication if there is more than approximately a 10% difference between the return current test point and the delivered current test point.

**Polarity Indicator:** Two outputs indicate whether positive or negative polarity has been selected.

**Mode Indicators:** The two mode outputs indicate which control loop is in control, the voltage or the current regulation circuits.

### 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.

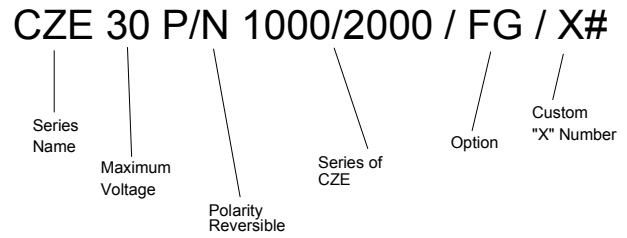
CODE DISCRIPTION	
• <b>FG</b>	Floating Ground
•	Alternate Test Point Scaling
•	Test Point Polarity Reversal
• <b>NSS</b>	No Slow Start
• <b>SS(X)</b>	Non-Standard Slow Start
• <b>LL(X)</b>	Extra Length Output Cable
•	Non-Standard Output Connector

**Table 1.1 Options**

## 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) P/N indicated reversibility.
- (3) The Series of CZE 1000 or 2000
- (4) The option code for all options that are included.
- (5) Custom "X" number representing details listed in a separate specification control drawing.



Maximum Ratings		Model Number
kV	mA	
5	2	CZE5PN1000/2000
10	1	CZE10PN1000/2000
15	0.67	CZE15PN1000/2000
20	0.50	CZE20PN1000/2000
30	0.3	CZE30PN1000/2000

# Chapter 2

## Inspection and Installation

**I**nitial inspection and preliminary check-out 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 CZE 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 CZE 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 CZE series utilizes solid encapsulations for corona free operation. No periodic maintenance is required. Due to conservative voltage spacing design, periodic maintenance is not required

PIN	FUNCTION
1	Chassis Ground & 24Vdc Return
2	+24Vdc Input
3	High Voltage Enable/Inhibit
4	Voltage Test Point: $10V \pm 2\% = 0$ to Rated Output
5	Current Test Point: $10V \pm 2\% = 0$ to Rated Output
6	Remote Voltage Control (0 to 10V)
7	Remote Current Control (0 to 10V)
8	+10.24Vdc Reference
9	Test Point & Remote Programming Return
10	Polarity Control Signal
11	Positive Polarity Indicator
12	Negative Polarity Indicator
13	Current Mode Indicator
14	Voltage Mode Indicator
15	Return Current Test Point
16	Load Return
17	Ground Fault Indication
18	Spare (Shield Ground Option)

Note: If Enable/Inhibit is not used, connect Pin 3 to Pin 8.

### Remote Programming:

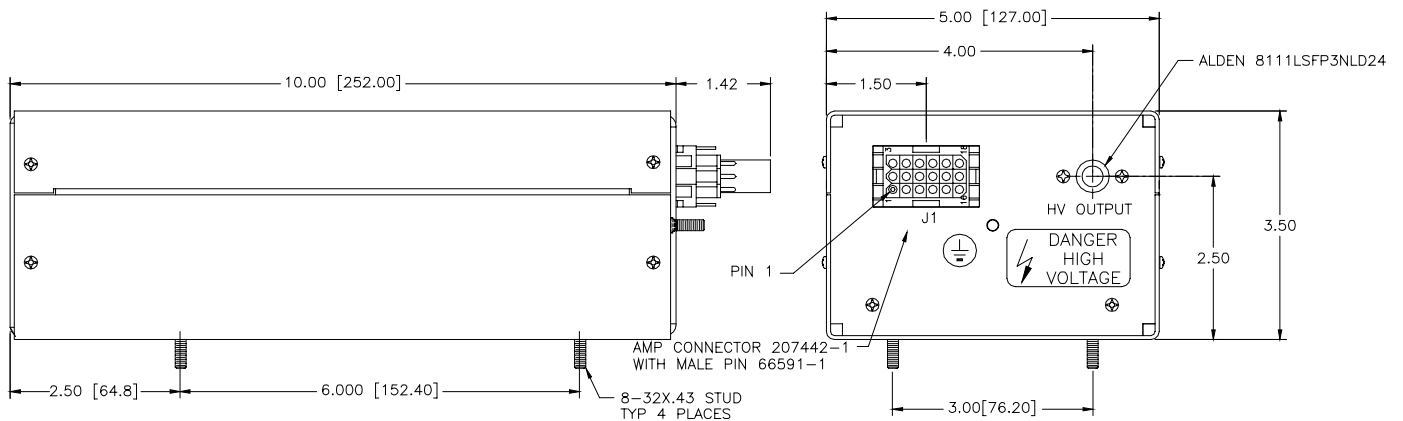
Permits remote adjustment of the output voltage and current via an external voltage source. By adjusting the voltage source from 0V to 10V the desired output may be selected.

### Remote Monitor:

Test points, pins 4 and 5 of the input connector, monitor voltage and current outputs. The output polarity is positive from 0V to 10V equal to 0 to 100% of the output  $\pm 0.5\%$ . Output impedance is 10k Ohms.

### High Voltage Enable/Inhibit:

The external TTL signal allows the user to inhibit the power supply output without switching the HIGH VOLTAGE OFF.



**Figure 2.1 CZE1000 Dimensions & Connector Interface**

PIN	FUNCTION
1,2,3	Chassis Ground & 24Vdc Return
4	High Voltage Enable/Inhibit
5	Voltage Test Point: $10V \pm 2\% = 0$ to Rated Output
6	Output Current Test Point: $10V \pm 2\% = 0$ to Rated Output
7	Chassis Ground
8	Remote Voltage Control
9	Remote Current Control
10	+10.24Vdc Reference
11	Test Point and Remote Programming Return
12	Polarity Control Signal
13	Positive Polarity Indicator
14, 15	+24Vdc Input
16	Chassis Ground
17	Negative Polarity Indicator
18	I – Mode Indicator
19	V- Mode Indicator
20	Current Return Test Point
21	Load Return
22	Ground Fault Indication
23,24,25	Spares

Note: If Enable/Inhibit is not used, connect Pin 4 to Pin 10.

### Remote Programming:

Permits remote adjustment of the output voltage and current via an external voltage source. By adjusting the voltage source from 0V to 10V the desired output may be selected.

### Remote Monitor:

Test points, pins 5 and 6 of the input connector, monitor voltage and current outputs. The output polarity is positive from 0V to 10V equal to 0 to 100% of the output  $\pm 0.5\%$ . Output impedance is 10k Ohms.

### High Voltage Enable/Inhibit:

The external TTL signal allows the user to inhibit the power supply output without switching the HIGH VOLTAGE OFF.

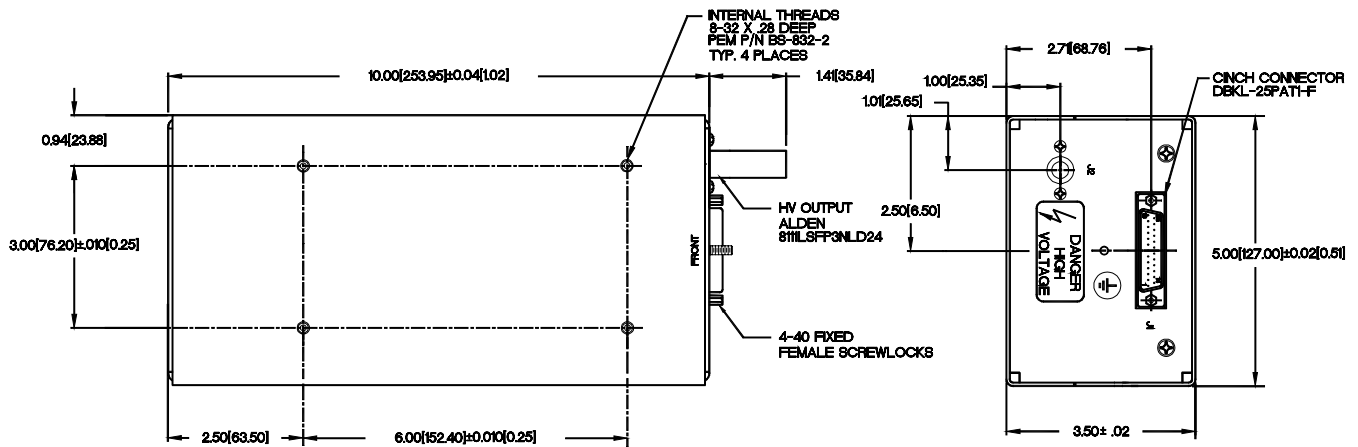


Figure 2.2 CZE2000 Dimensions & Connector Interface

# Chapter 3

## Operating Instructions

### 3.1 Operation

#### WARNING

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

#### WARNUNG

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

#### IMPORTANT

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

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

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

#### ACHTUNG

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

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

A) 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. CZE series modules operate on 28Vdc unless ordered with a different input voltage option. External fusing is recommended for the DC input power. For the CZE series a 2 AMPERE SLO-BLO type fuse must be used.

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 and 3.2 for a typical operating setup. The return line from the load should be connected to the power supply chassis or to Load Return pin.

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 Input 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 by grounding the Enable line. Set the desired polarity.

G) The DC input power may now be connected.

H) Enable the power supply via the enable/disable logic signal.

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 the DC INPUT source.

### WARNING

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

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

### WARNUNG

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

### WARNING

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

### WARNUNG

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

### CAUTION

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

### CAUTION

**Betreiben Sie das Hochspannungsnetzteil ausschließlich mit geschlossenem Gehäuse. Versuchen Sie nicht die internen Schaltkreise zu**

**berühren oder zu reparieren, da lebensgefährliche Hochspannungen in Innern erzeugt werden.**

## 3.2 Standard Features

A note on remote interface circuitry and remote signal grounding: whenever possible, electrical isolation should be provided when interfacing with any high voltage power supply. For enable/disable signal connections, an isolated relay or 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

**REMOTE PROGRAMMING:** Allows remote adjustment of the output voltage and current via an external voltage source. A 0 to 10VDC signal is supplied to Pin 6/8 of the control input connector for voltage programming. A 0 to 10 VDC signal is supplied to Pin 7/9 of the control input connector for current programming. Programming signals should be referenced to Pin 9/11 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 the output. See Figure 3.4 for test point wiring.

## 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.**

## WARNUNG

**Es ist sehr gefährlich diese Schaltung zum abschalten der Spannung für Reparatur oder Service Zwecke zu benutzen.**

**Reverse Polarity Control Signal:** This input signal is intended to be driven from TTL logic and will cause the output to switch polarity. The unit will automatically sequence all internal functions to switch output polarity with minimal stress. Greater than 3.4V (or open) on pin 10 yields Positive High Voltage. Less than 1V on pin 10 yields Negative High Voltage.

Operation is as follows: upon reverse command, the inverter is instantaneously disabled and the output begins to decay from its set point to zero. At no load, this time constant is 0.1 seconds. At approximately 10% output, the logic circuitry will switch the primary and secondary relays and enable the inverter. The output then slows up to its set value time constant. Obviously, the time to complete the switch operation is a function of output voltage setting and load current. The maximum switch time for set points above 3kV occurs at no load and 30kV. Under this condition, that time is a constant 100 milliseconds, regardless of output voltage or current setting.

**Polarity Indicator:** +24V on pin 11/13 indicates positive polarity selected, +24V on pin 12/17 indicates negative polarity selected. Output impedance is 100 ohms. This is intended to drive an incandescent lamp. Internally, a relay contact switches the 100ohm resistor to the +24V. Therefore, the indicator bulb should be connected between the output and ground. Please note that the power supply input current will increase by the amount of

current drawn by the incandescent bulb (maximum current is 50mA). If it is desired to drive an LED instead of an incandescent bulb, simply add a 3.3k 1/4W resistor in series with the output and the LED.

**Voltage and Current Mode Signals:** +15V is provided through a 3.3K resistor to drive an LED. +15V on pin 19 indicates that the voltage regulator mode is selected. +15V on pin 18 indicates that the current regulation mode is selected. The internal control circuitry employs automatic crossover between voltage and current modes. In the voltage mode, the current level is set and the voltage programming is used to control the output. If the load current is increased to the point where it exceeds the preset level, the unit will cross over automatically into current mode. In current mode operation, the voltage programming is preset and current control controls the output. If the load current is reduced to the point that the voltage exceeds the preset level, then the output will automatically cross over to voltage mode. When the unit crosses over from either current to voltage mode or voltage to current mode, the mode signal will switch with it.

**Control Current Test Point:** +10V on pin 8/10 = Full Scale Current  $\pm 2\%$ . The return current circuitry allows a separate path to measure actual load current. The load is returned to the load return, pin 16/21 of the connector and a buffer test point is provided on pin 15/20. The standard current test point provided on pin 5/6 measures the current delivered to the load while the return current test point measures the current returned to the power supply by the load. By comparing these two signals, any differences between them must be going into leakage. Therefore, if this leakage exceeds some level, the unit could be shut down.

**Ground Fault Indication:** +15 V on pin 17/22 = Fault. Output impedance = 4.7K. This feature compares the return load current to the delivered load current and provides a fault signal if the difference between these signals (leakage current) exceeds 20uA. This fault signal can be used to shut down the whole system or through appropriate circuitry to shut down the power supply either by using the remote enable or by removing the +24V input power. The output circuit for this fault indication is an open collector with a 4.7K pull up resistor



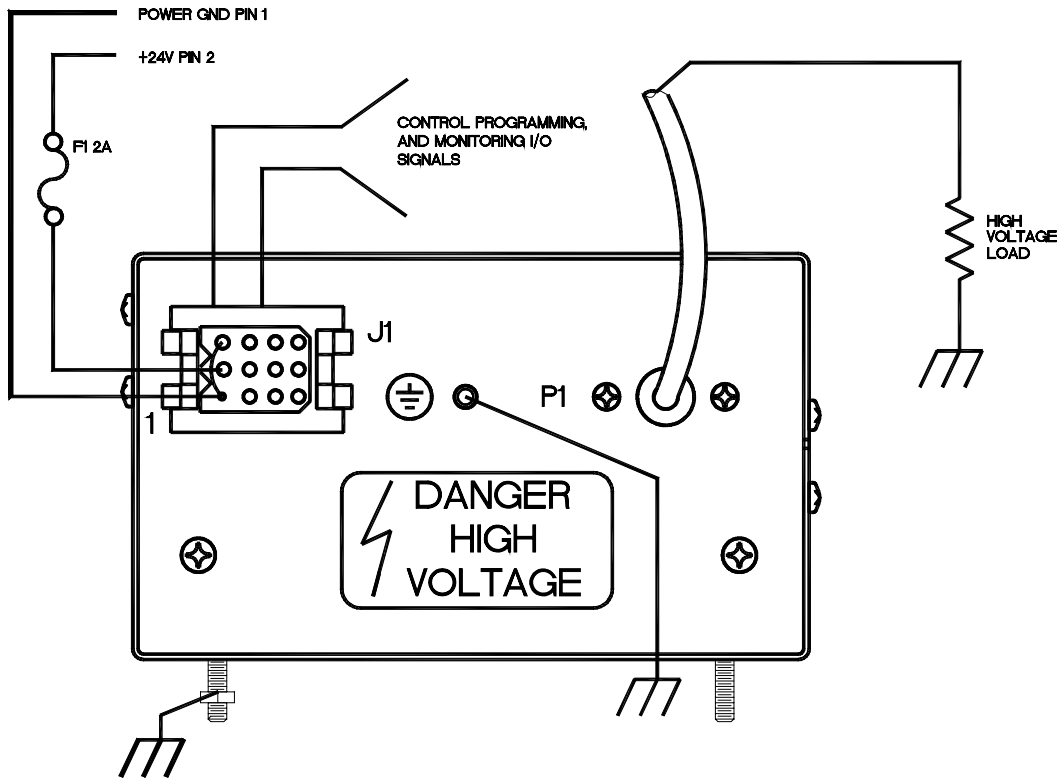


Figure 3.1 CZE1000 Typical Operating Set Up

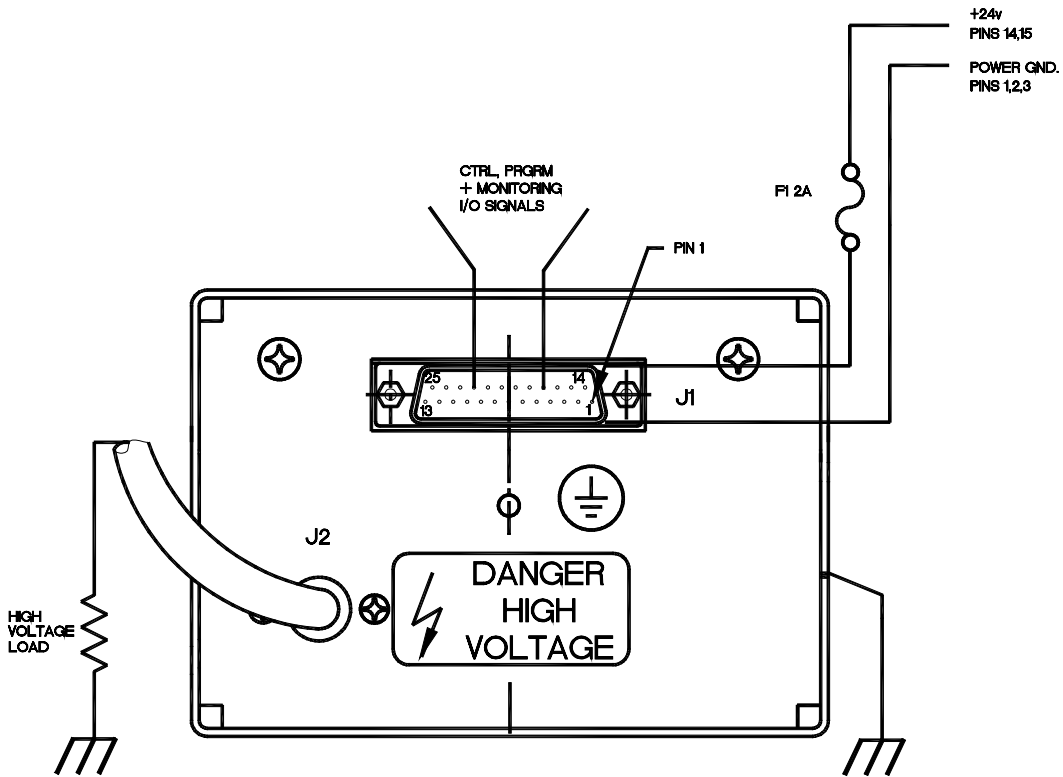
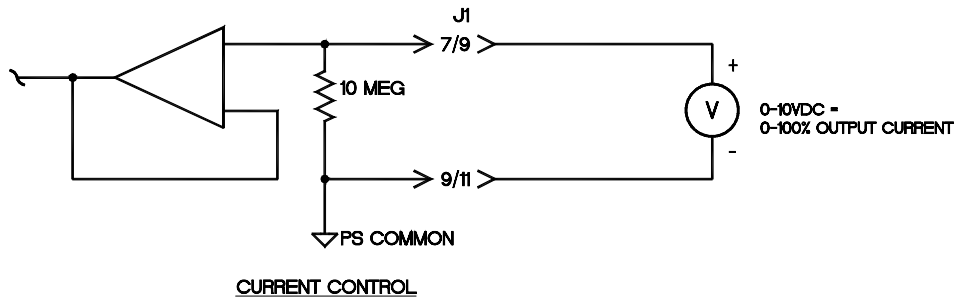
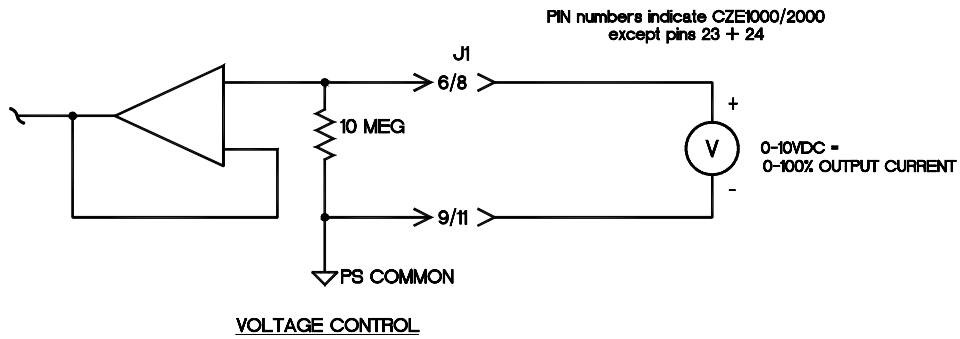
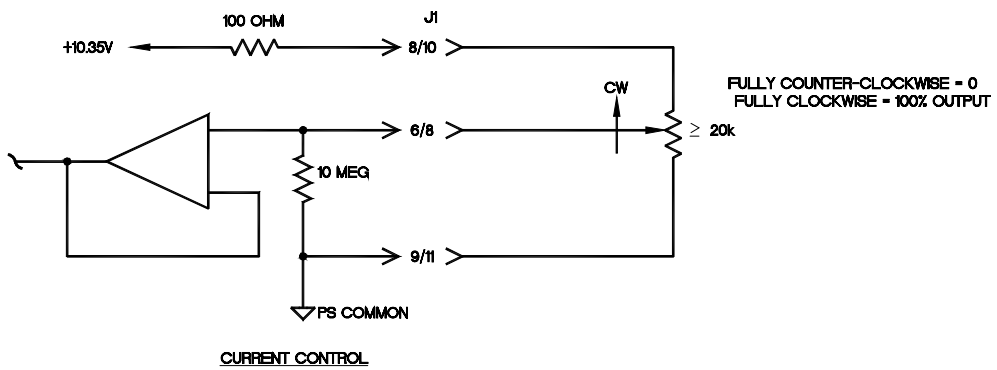
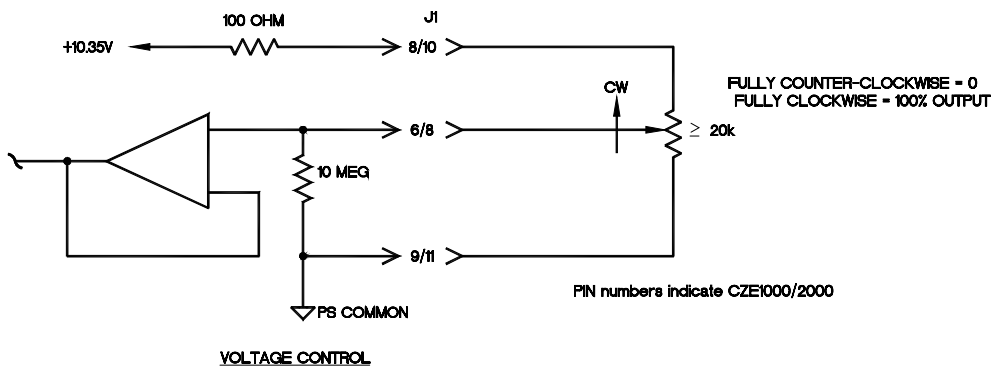


Figure 3.2 CZE2000 Typical Operating Set up



**Figure 3.3A CZE Remote Programming Via Voltage Source**



**Figure 3.3B CZE Remote Programming Via External Resistance**

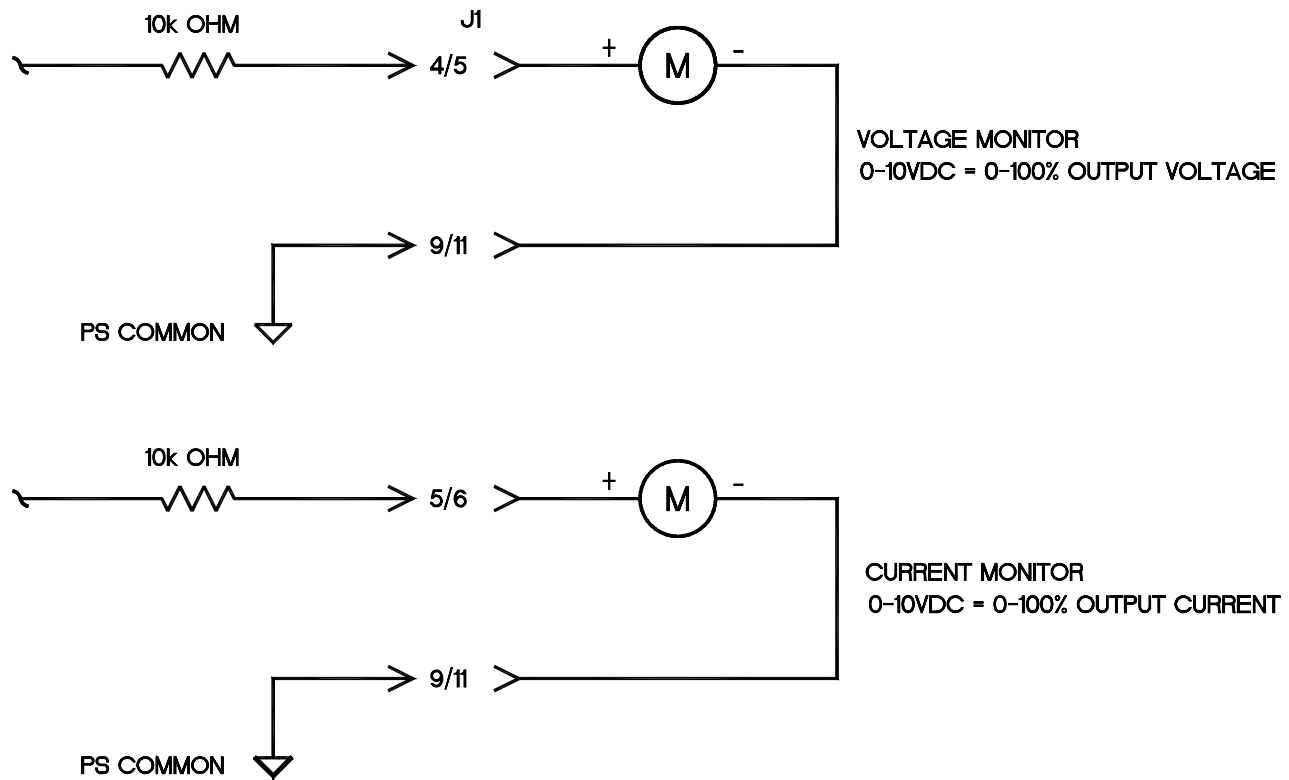


Figure 3.4 CZE Remote Monitoring

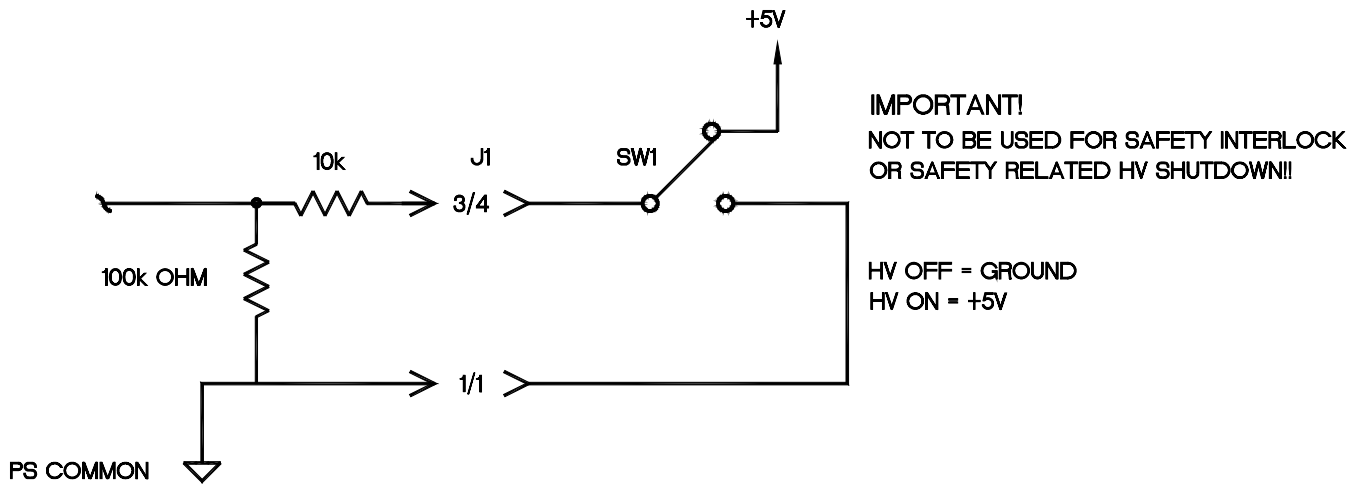
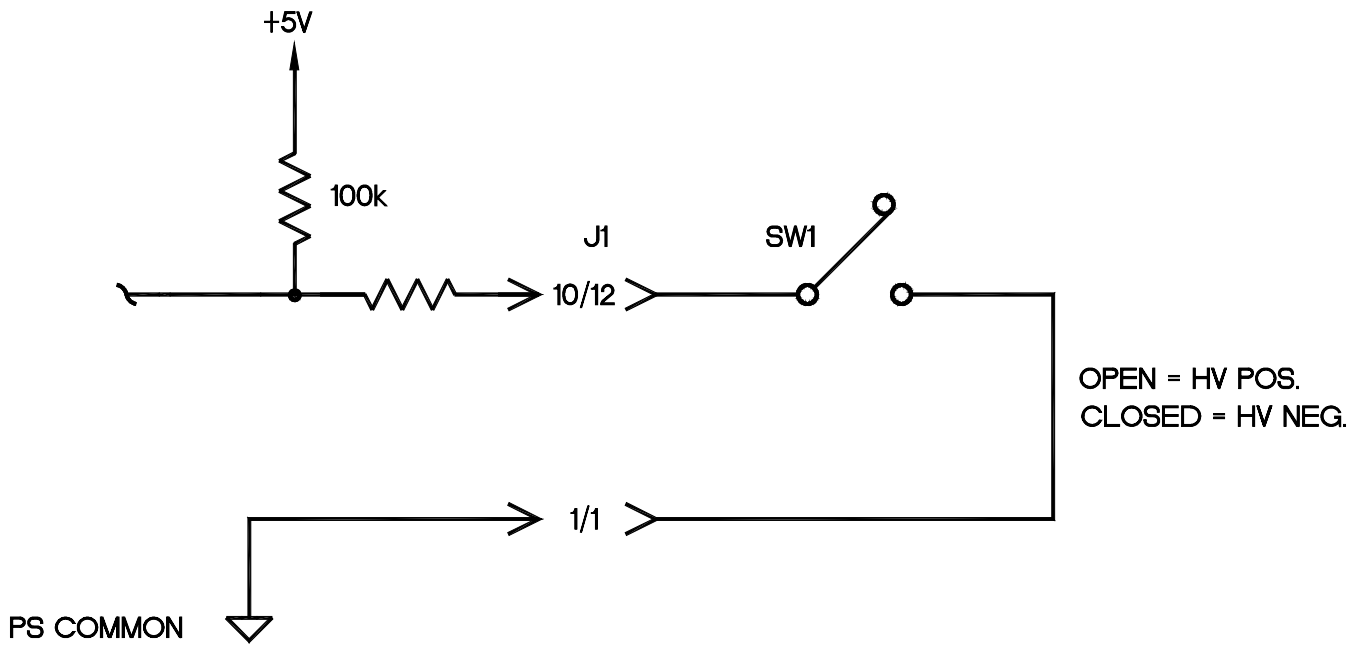
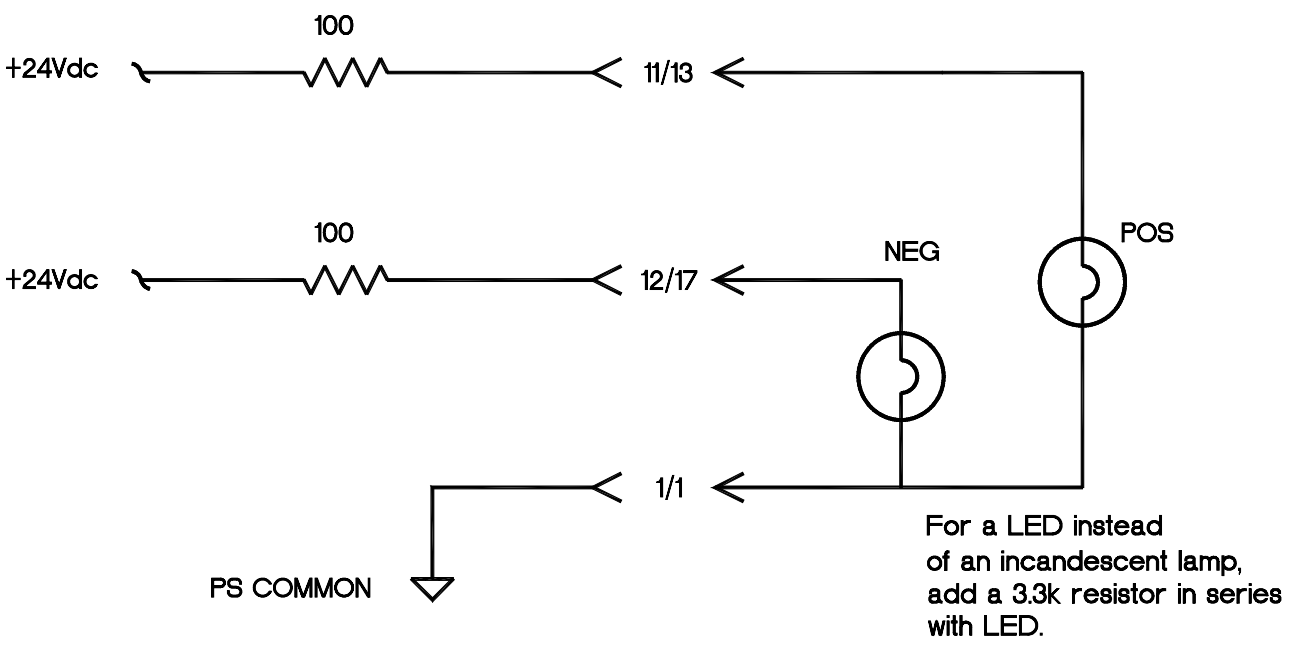


Figure 3.5 CZE HV ON/OFF Control



**Figure 3.6 CZE Polarity Control**



**Figure 3.7 CZE Polarity Indicators**

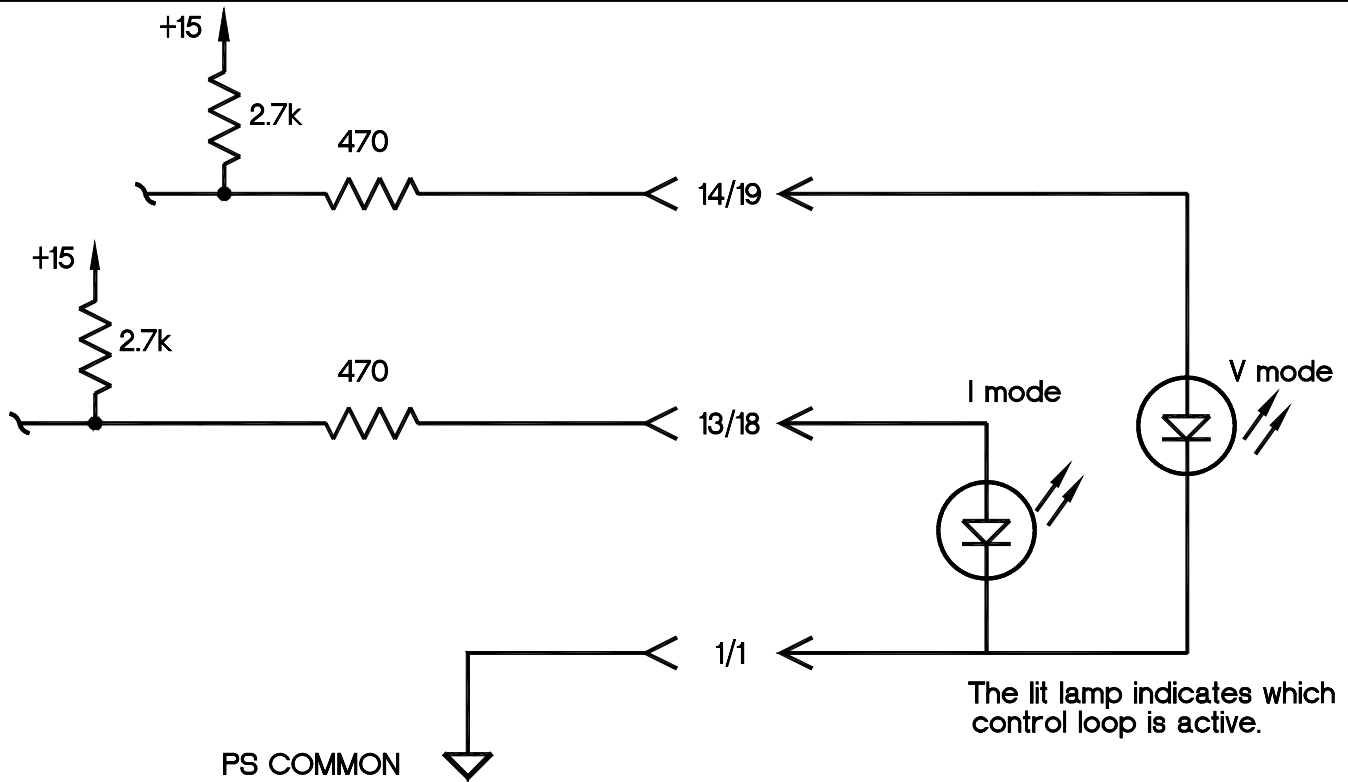


Figure 3.8 CZE Mode Indicators

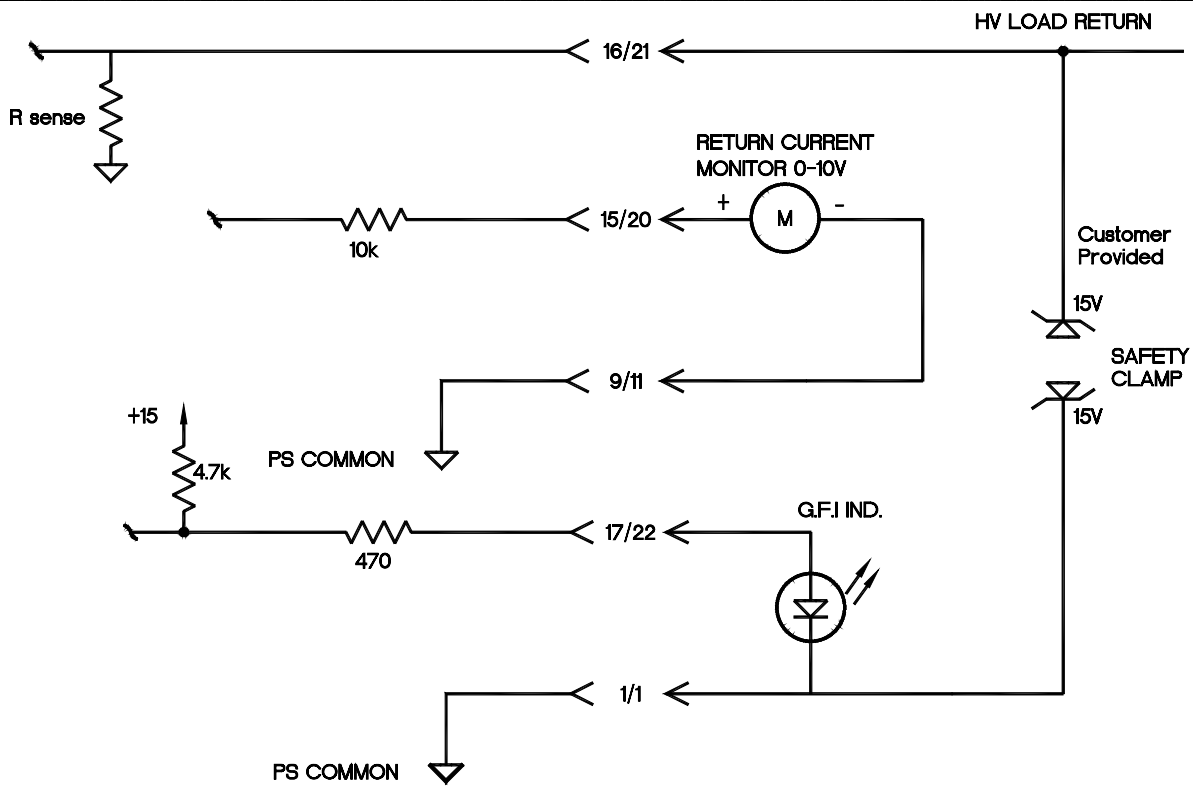


Figure 3.9 GFI and Load Return

# Chapter 4

## PRINCIPLES OF OPERATION

The CZE Series of high voltage power supplies utilizes sophisticated power conversion technology. Advanced analog and power conversion techniques are used in the CZE series. The intention of the Principles of Operation is to introduce the basic function blocks of the CZE series power supply. For details on a specific circuit, consult Spellman's Engineering Department.

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

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

### 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.

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

## 4.2 High Frequency Inverter

The CZE series uses a resonant converter operating in a zero current switching, resonant flyback and forward converter topology. MOSFET transistors switch DC voltage to the resonant circuit. Typical operating frequency is in the range of 20-35KHz depending on model. Control of the resonant circuit output is done by the low voltage control circuits. The resonant circuitry consists of a resonant inductor and step-up 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.

In the SMS series, an auxiliary voltage sense signal is generated by the overvoltage protection feedback resistor. This is used to provide overvoltage protection.

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 occurring. 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.

### 4.5 Polarity Reversal Circuits

The CZE1000 and CZE2000 polarity reversal circuits operate as follows: A polarity reversal command is given; at this point the output begins to decay. At a safe level a high voltage relay switches to the opposite polarity output section and ramps to its preset level.

### 4.6 Options

Due to the variations of models and options provided in the CZE 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 CZE 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 Input Voltage IV

CZE power supplies with different input voltage options will operate from the input voltage specified plus or minus a tolerance, typically  $\pm 10\%$ .

### 5.3 No Slow Start NSS

The no slow start option causes the output voltage of the power supply to rise (within approximately 500 msec) to the rated voltage upon Power Up.

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

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

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

Standard output cable is 18" long. Other lengths may be specified.

### 5.6 Auxiliary Outputs AO

The specific AUXILIARY 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.

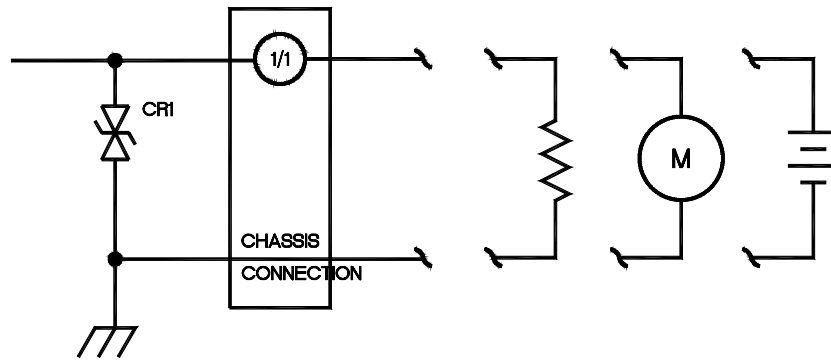
Spellman welcomes the opportunity to tailor its units to fit your requirements or to develop new products for your applications. Contact the Spellman Sales Department with your needs.



Possible FG termination circuits

To internal high voltage return circuits.

Pin 2 internally connected to power supply chassis.



Clamp Voltage is +15V standard.  
Up to 50V is available.  
Consult factory.

**IMPORTANT:** Power dissipation in CR1 should not exceed 1W. This can be accomplished by keeping chassis and power ground voltage below Zener voltage. CR1 is for safety and transient protection only, and is not designed for continuous clamping.

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.**

### WARNUNG

**DIESES HOCHSPANNUNGSNETZTEIL ERZEUGT LEBENSGEFÄHRLICHE HOCHSPANNUNG!**

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

### 6.1 Periodic Servicing

The CZE series does not require periodic maintenance or servicing.

### 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

**S**Pellman provides parts and assemblies 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 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 the Spellman 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](mailto: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>

