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XKW 8-350
XKW 10-300
XKW 12-150
XKW 20-150
XKW 40-75
XKW 55-55
XKW 60-50
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Operating Manual

XKW 3000 Watt Series Programmable DC Power Supply

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Operating Manual for

XKW 3000 Watt Series
Programmable DC Power Supply

Limited Warranty

What does this warranty cover and how long does it last?

This Limited Warranty is provided by Xantrex Technology, Inc. ("Xantrex") and covers defects in workmanship and materials in your **XKW 2500 Watt Series DC Power Supply**. This warranty lasts for a Warranty Period of **5 years** from the date of purchase at point of sale to you, the original end user customer.

What will Xantrex do?

Xantrex will, at its option, repair or replace the defective product free of charge, provided that you notify Xantrex of the product defect within the Warranty Period, and provided that Xantrex through inspection establishes the existence of such a defect and that it is covered by this Limited Warranty.

Xantrex will, at its option, use new and/or reconditioned parts in performing warranty repair and building replacement products. Xantrex reserves the right to use parts or products of original or improved design in the repair or replacement. If Xantrex repairs or replaces a product, its warranty continues for the remaining portion of the original Warranty Period or 90 days from the date of the return shipment to the customer, whichever is greater. All replaced products and all parts removed from repaired products become the property of Xantrex.

Xantrex covers both parts and labor necessary to repair the product, and return shipment to the customer via a Xantrex-selected non-expedited surface freight within the contiguous United States and Canada. Alaska and Hawaii are excluded. Contact Xantrex Customer Service for details on freight policy for return shipments outside of the contiguous United States and Canada.

How do you get service?

If your product requires troubleshooting or warranty service, contact your merchant. If you are unable to contact your merchant, or the merchant is unable to provide service, contact Xantrex directly at:

Telephone:	1 800 670 0707 (toll free North America) 1 360 925 5097 (direct)
Fax:	1 800 994 7828 (toll free North America) 1 360 925 5143 (direct)
Email:	customerservice@xantrex.com
Web:	www.xantrex.com

Direct returns may be performed according to the Xantrex Return Material Authorization Policy described in your product manual. For some products, Xantrex maintains a network of regional Authorized Service Centers. Call Xantrex or check our website to see if your product can be repaired at one of these facilities.

In any warranty claim, dated proof of purchase must accompany the product and the product must not have been disassembled or modified without prior written authorization by Xantrex.

Proof of purchase may be in any one of the following forms:

- The dated purchase receipt from the original purchase of the product at point of sale to the end user, or
- The dated dealer invoice or purchase receipt showing original equipment manufacturer (OEM) status, or
- The dated invoice or purchase receipt showing the product exchanged under warranty

What does this warranty not cover?

This Limited Warranty does not cover normal wear and tear of the product or costs related to the removal, installation, or troubleshooting of the customer's electrical systems. This warranty does not apply to and Xantrex will not be responsible for any defect in or damage to:

a. the product if it has been misused, neglected, improperly installed, physically damaged or altered, either internally or externally, or damaged from improper use or use in an unsuitable environment;

b. the product if it has been subjected to fire, water, generalized corrosion, biological infestations, and high input voltage from lightning strikes;

c. the product if repairs have been done to it other than by Xantrex or its authorized service centers (hereafter "ASCs");

d. the product if it is used as a component part of a product expressly warranted by another manufacturer;

e. the product if its original identification (trade-mark, serial number) markings have been defaced, altered, or removed.

Disclaimer

Product

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY XANTREX IN CONNECTION WITH YOUR XANTREX PRODUCT AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, PRINCIPLES OF MANUFACTURER'S LIABILITY, OPERATION OF LAW, CONDUCT, STATEMENT OR OTHERWISE), INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE TO THE EXTENT REQUIRED UNDER APPLICABLE LAW TO APPLY TO THE PRODUCT SHALL BE LIMITED IN DURATION TO THE PERIOD STIPULATED UNDER THIS LIMITED WARRANTY.

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Exclusions

If this product is a consumer product, federal law does not allow an exclusion of implied warranties. To the extent you are entitled to implied warranties under federal law, to the extent permitted by applicable law they are limited to the duration of this Limited Warranty. Some states and provinces do not allow limitations or exclusions on implied warranties or on the duration of an implied warranty or on the limitation or exclusion of incidental or consequential damages, so the above limitation(s) or exclusion(s) may not apply to you. This Limited Warranty gives you specific legal rights. You may have other rights which may vary from state to state or province to province.

Information

WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, UNLESS SPECIFICALLY AGREED TO BY IT IN WRITING, XANTREX

a. MAKES NO WARRANTY AS TO THE ACCURACY, SUFFICIENCY OR SUITABILITY OF ANY TECHNICAL OR OTHER INFORMATION PROVIDED IN MANUALS OR OTHER DOCUMENTATION PROVIDED BY IT IN CONNECTION WITH THE PRODUCT; AND

b. ASSUMES NO RESPONSIBILITY OR LIABILITY FOR LOSSES, DAMAGES, COSTS OR EXPENSES, WHETHER SPECIAL, DIRECT, INDIRECT, CONSEQUENTIAL OR INCIDENTAL, WHICH MIGHT ARISE OUT OF THE USE OF SUCH INFORMATION.

THE USE OF ANY SUCH INFORMATION WILL BE ENTIRELY AT THE USER'S RISK.

WARNING: Limitations on Use

Please refer to your product user manual for limitations on uses of the product. Specifically, please note that this power supply is not intended for use in connection with life support systems and Xantrex makes no warranty or representation in connection with any use of the product for such purposes.

Xantrex Technology, Inc.
8999 Nelson Way
Burnaby, British Columbia
Canada V5A 4B5

Information About Your Power Supply

Please record the following information when you first open your Power Supply package:

Model Number _____

Serial Number _____

Purchased From _____

Purchase Date _____

Release

Revision A (2003-12)

Printed in Canada

Warnings and Cautions

Warnings and cautions are defined and formatted in this manual as shown below.

WARNING
Describes a potential hazard which could result in injury or death, or, a procedure which, if not performed correctly, could result in injury or death.

CAUTION
Describes a procedure which, if not performed correctly, could result in damage to data, equipment, or systems.

Power Supply Safety

WARNING—High Energy and High Voltage
Exercise caution when using and calibrating a power supply. High energy levels can be stored at the output voltage terminals on a power supply in normal operation. In addition, potentially lethal voltages exist in the power circuit and on the output and sense connectors of a power supply with a rated output greater than 40 V. Filter capacitors store potentially dangerous energy for some time after power is removed.

CAUTION
Operate the power supply in an environment free of flammable gases or fumes. To ensure that the power supply's safety features are not compromised, use the power supply as specified in this manual and do not substitute parts or make any unauthorized modifications. Contact the service technician for service and repair help. Repairs must be made by experienced service technicians only.

CAUTION
For Use as a Battery Charger
When you are using any of these power supplies for battery charging applications, it is essential to provide an appropriately sized fuse or circuit breaker in series between the power supply output and the battery.
Installation of a protector (fuse or DC circuit breaker) rated for about 115% of the maximum current rating of the power supply and designed specifically to interrupt the DC voltage of the battery, will provide adequate reverse polarity current protection. Where several power supplies are in parallel, it is best to fuse each one, rather than one large fuse for all.

About This Manual

This Operating Manual contains user information for the XKW Series of variable DC output power supplies, available in several voltage models at 3000 Watts. It provides information about features and specifications, installation procedures, and basic functions testing, as well as operating procedures for using both front panel control and remote analog programming functions.

Who Should Use This Manual

This manual is designed for the user who is familiar with basic electrical laws especially as they apply to the operation of power supplies. This implies a recognition of Constant Voltage and Constant Current operating modes and the control of input and output power, as well as the observance of safe techniques while making supply or pin connections and any changes in switch settings.

Main Sections

Section 1 Features and Specifications Describes the power supply and lists its features and specifications.

Section 2 Installation Goes through basic setup procedures. Describes inspection, cleaning, shipping, and storage procedures. Includes AC input connection, basic functions testing, and load and sense lines connections.

Section 3 Operation Provides procedures for local (front panel) operation. Includes procedures for using over voltage protection, shutdown function, multiple supplies, and over temperature protection.

Section 4 Calibration Includes calibration for programming and readback accuracy.

Manual Revisions

The current release of this manual is listed below. Updates may be issued as an addendum.

Revision A (2003-12)

Power Supply Safety Markings


Alternating Current


Earth (Ground) Terminal


Protective Conductor Terminal

On (Supply)


Off (Supply)


Caution (Hot Surface)


Caution (Check manual for additional information.)

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Section 1. Features and Specifications

Description

This series of power supplies provides highly stable, variable DC output voltage and current at 3000 Watts of output power. You can select from several remote control choices: standard analog programming, optional isolated programming or readback, and optional GPIB programming or RS-232 control. It is designed for a broad range of development, system and burn-in applications and uses high frequency switching regulator technology to achieve high power density in a small package size. See Table 1.1. for the list of available models.

Table 1.1 Available Voltage and Current Ranges

Model	Voltage Range	Current Range
8-350	0-8 V	0-350 A
10-300	0-10 V	0-300 A
12-250	0-12 V	0-250 A
20-150	0-20 V	0-150 A
40-75	0-40 V	0-75 A
55-55	0-55 V	0-55 A
60-50	0-60 V	0-50 A
80-37	0-80 V	0-37 A
150-20	0-150 V	0-20 A
300-10	0-300 V	0-10 A

Features and Options

- Simultaneous digital display of both voltage and current.
- Ten-turn front panel voltage and current controls for high resolution setting of the output voltage and current from zero to the rated output.
- Automatic mode crossover into current or voltage mode.
- Optional 190-250 Vac input voltage, Delta configuration three phase, 47–63 Hz, or 200-250 Vac input voltage, single phase, 47–63 Hz.
- High frequency switching technology allows high power density, providing increased power output in a small, light package.
- Multiple units can be connected in parallel or in series to provide increased current or voltage and operated in master/slave mode.
- Remote sensing to compensate for losses in power leads up to 1 V per lead.
- Adjustable Over Voltage Protection (OVP).
- External TTL, AC, or DC shutdown.
- Remote voltage, current limit and OVP programming with selectable programming ranges.
- External indicator signals for remote monitoring of OVP status, local/remote programming status, thermal shutdown and output voltage and current.
- Isolated analog remote programming control of the output voltage or current with the optional ISOL Interface.
- Optional internal GPIB control for remote digital programming and readback from a computer.
- Front panel push button control of Output Standby Mode, OVP reset, Remote/Local Programming Mode selection and preview of voltage, current and OVP setpoints.
- Optional bus bar cover may be purchased as there may be a high voltage issue for benchtop units operating above 42 Vdc.

Front Panel Controls

See Figure 1.1 to review the controls, LEDs, and meters located on the power supply's front panel. Check the following sections for additional descriptions of front panel controls and functions.

- "Mechanical Specifications" on page 25
- "Functional Tests" on page 35
- Section 3, "Operation"

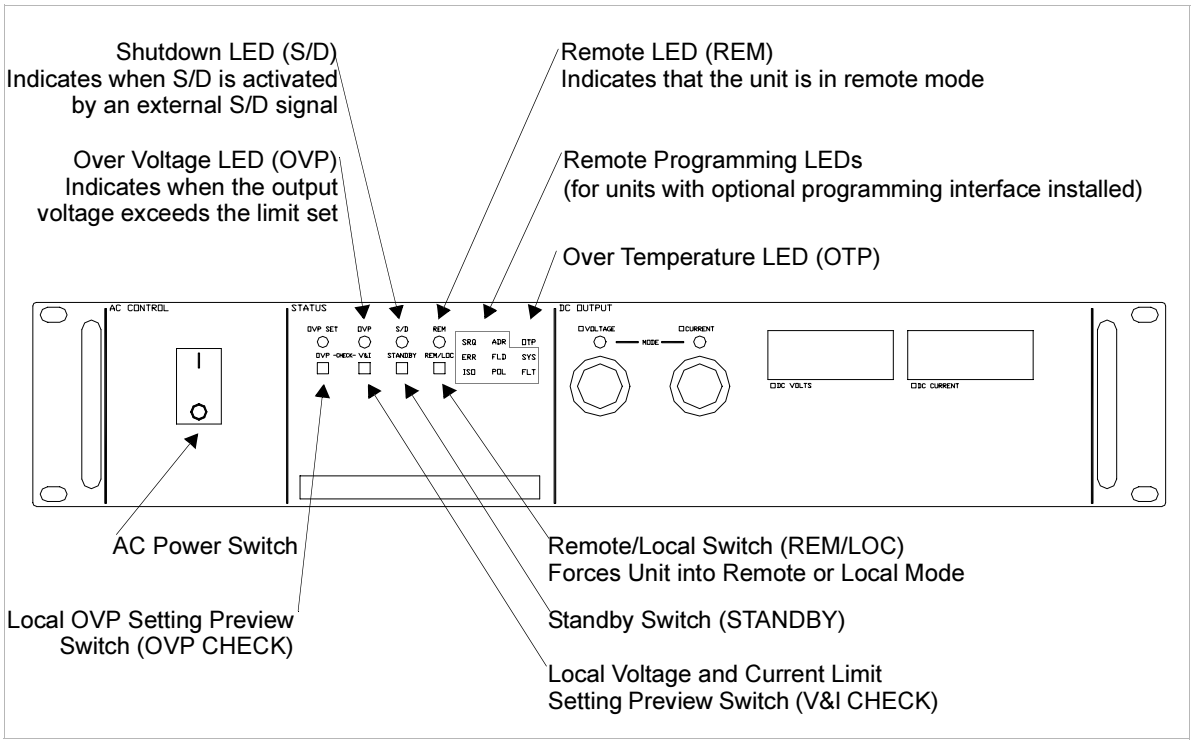

Figure 1.1 Power Supply Front Panel

Rear Panel Connectors and Switch

The input AC power, output DC power, as well as the remote program sense and monitor connector are located on the rear panel. The program and monitor function selector switch (SW1) is located internally on the main PCB. See Figure 1.2, on page 20 for locations. Refer to Section 2, “Installation” for detail on procedures for connections and settings.

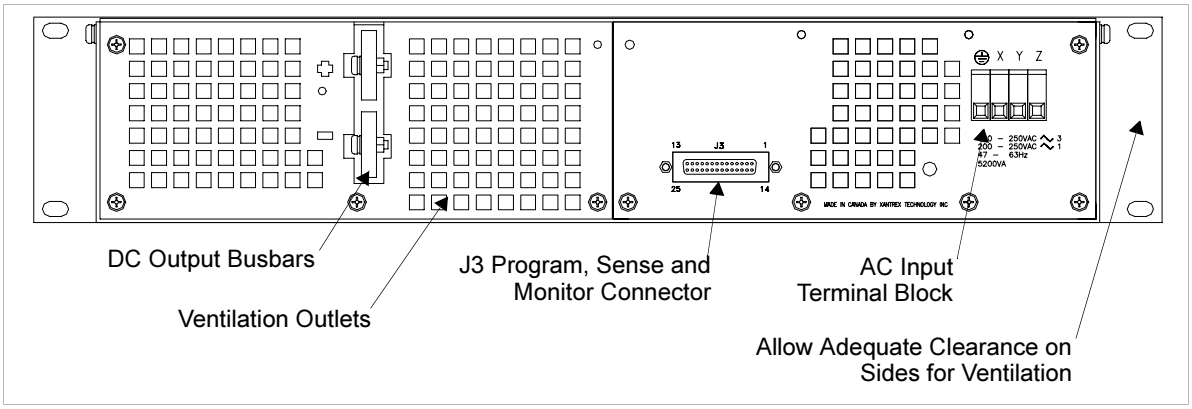

Figure 1.2 Power Supply Rear Panel

Specifications

Electrical Specifications

These specifications are warranted over a temperature range of 0 °C to 50 °C.

Specifications are subject to change without notice.

Table 1.2 Electrical Specifications for 8 V to 40 V Models

Models	8-350	10-300	12-250	20-150	40-75
Output Ratings:					
Output Voltage	0-8 V	0-10 V	0-12 V	0-20 V	0-40 V
Output Current	0-350 A	0-300 A	0-250 A	0-150 A	0-75 A
Output Power	2800 W	3000 W	3000 W	3000 W	3000 W
Line Regulation: [1]					
Voltage	8 mV	10 mV	12 mV	20 mV	40 mV
Current	350 mA	300 mA	250 mA	150 mA	75 mA
Load Regulation: [2]					
Voltage	8 mV	10 mV	12 mV	20 mV	40 mV
Current	350 mA	300 mA	250 mA	150 mA	75 mA
Meter Accuracy:					
Voltage	0.09 V	0.11 V	0.13 V	0.2 V	0.5 V
Current	4.5 A	4.0 A	3.5 A	1.6 A	0.85 A
OVP Adjustment Range:	0.4-8.8 V	0.5-11 V	0.6-13.2 V	1-22 V	2-44 V
Output Noise and Ripple: (20 Hz - 20 MHz)					
Voltage (p-p)	100 mV	100 mV	100 mV	100 mV	150 mV
Voltage (rms)	12 mV	15 mV	15 mV	15 mV	20 mV
Analog Programming Accuracy					
Voltage (1% of Vmax)	80 mV	100 mV	120 mV	200 mV	400 mV
Current (1% of Imax)	3500 mA	3000 mA	2500 mA	1500 mA	750 mA
Drift:[3]					
Voltage	4 mV	5 mV	6 mV	10 mV	20 mV
Current	175 mA	150 mA	125 mA	75 mA	37.5 mA
Temperature Coefficient: [4]					
Voltage	1.6 mV	2 mV	2.4 mV	4 mV	8 mV
Current	105 mA	90 mA	75 mA	45 mA	22.5 mA

1. For input voltage variation over the AC input voltage range, with constant rated load.
2. For 0-100% load variation, with constant nominal line voltage.
3. Maximum drift over 8 hours with constant line, load and temperature, after 90 minute warm-up.
4. Change in output per °C change in ambient temperature, with constant line and load.

Table 1.3 Electrical Specifications for 55 V to 300 V Models

Models	55-55	60-50	80-37	150-20	300-10
Output Ratings:					
Output Voltage	0-55 V	0-60 V	0-80 V	0-150 V	0-300 V
Output Current	0-55 A	0-50 A	0-37 A	0-20 A	0-10 A
Output Power	3025 W	3000 W	2960 W	3000 W	3000 W
Line Regulation: [1]					
Voltage	55 mV	60 mV	80 mV	150 mV	300 mV
Current	55 mA	50 mA	37 mA	20 mA	10 mA
Load Regulation: [2]					
Voltage	55 mV	60 mV	80 mV	150 mV	300 mV
Current	55 mA	50 mA	37 mA	20 mA	10 mA
Meter Accuracy:					
Voltage	0.65 V	0.7 V	0.9 V	1.6 V	3.1 V
Current	0.65 A	0.6 A	0.47 A	0.30 A	0.20 A
OVP Adjustment Range:	2.75-60.5 V	3-66 V	4-88 V	7.5-165 V	15-330 V
Output Noise and Ripple: (20 Hz - 20 MHz)					
Voltage (p-p)	150 mV	150 mV	150 mV	200 mV	300 mV
Voltage (rms)	20 mV	20 mV	20 mV	30 mV	30 mV
Analog Programming Accuracy					
Voltage (1% of Vmax)	550 mV	600 mV	800 mV	1.5 V	3.0 V
Current (1% of Imax)	550 mA	500 mA	370 mA	200 mA	100 mA
Drift:[3]					
Voltage	27.5 mV	30 mV	40 mV	75 mV	150 mV
Current	27.5 mA	25 mA	18.5 mA	10 mA	5 mA
Temperature Coefficient: [4]					
Voltage	11 mV	12 mV	16 mV	30 mV	60 mV
Current	16.5 mA	15 mA	11.1 mA	6.0 mA	3.0 mA

1. For input voltage variation over the AC input voltage range, with constant rated load.
2. For 0-100% load variation, with constant nominal line voltage.
3. Maximum drift over 8 hours with constant line, load and temperature, after 90 minute warm-up.
4. Change in output per °C change in ambient temperature, with constant line and load.

Additional Specifications

Rise Time (No Load, Full Load): [1]	~ 30 ms
Fall Time (No Load): [1]	~ 1 s
Fall Time (Full Load): [1]	~ 50 ms
Voltage Mode Transient Response:[2]	1 ms
Time Delay from power on until output stable	5 s maximum

1. Measured with stepped 0-10 V analog programming source and a resistive load.
2. Time for the output voltage to recover within 1% band for 30% step load change from 70% to 100% or 100% to 70%.

Input Conditions

Rated AC Input Voltage with Maximum Input Current	200-250 Vac at 26 Arms, single phase or 190-250 Vac at 14 Arms, three phase
Maximum AC Input Power	3800 W
Operational AC Input Voltage	200-250 Vac or 190-250 Vac
Input Frequency Range	47-63 Hz
Power Factor	0.65 or better

Additional Features

Switching Frequency	Nominal 30 kHz, 60 kHz output ripple
Maximum Voltage Differential from either output to safety ground	±400 Vdc

Remote Programming and Monitoring

Remote Start/Stop and Interlock	TTL compatible input. Contact Closure, 12-250 Vac or 12-130 Vdc
Remote Analog Programming	Voltage and current programming: 0-5k resistances; 0-5V, 0-10V sources; 0-1mA sources OVP programming: 0-5V, 0-10V sources
Maximum Remote Sense Line Drop Compensation	1 V max.

Environmental Specification

Operating Temperature Range	0-50 °C. From 50-70 °C, derate output 2% per °C
Storage Temperature Range	-55 °C to +85 °C
Humidity Range	Up to 80% non-condensing
Operating Altitude	Derate maximum operating temperature by 1°C per 1,000 feet (30 m) for operation between 5,000 feet and (1,500 m) and 15,000 feet (4,500 m)
Storage Altitude	Up to 50,000 feet (15,000 m)
Installation Category	II
Pollution Degree	2

Mechanical Specifications

Front Panel V and I Control	10-turn voltage and current potentiometers
Front Panel Voltage Control Resolution	0.02% of V max
Front Panel Voltage and Current Meters	3 or 4 digit LED readouts for each. See Table 1.2 and Table 1.3 for accuracy.
AC Input Connector Type	IEC
Output Connector	Nickel-plated copper busbars
Sense Connector	Part of J3
Analog Programming Connector	Part of J3
Cooling	Fan cooled. Air exhausts to rear. Over temperature shutdown: automatic restart.
Mounting	Integral rack mount ears on front panel
Dimensions	3.45 in. (87.6 mm) H x 19 in. (482.6 mm) W x 20 in. (508 mm) D
Weight	Approximately 35 lb. (16 kg)
Approvals	CSA Certified to CSA Bulletin 556B FCC Part 15B and Industry Canada Class A CE Marked for Low Voltage Directive and EMC Directive (Class A emissions)

Section 2. Installation

Introduction

This section provides recommendations and procedures for inspecting, installing, and testing the power supply.

Basic Setup Procedure

See Table 2.1 for a summary of the basic setup procedure and an overall view of the subsections in Section 2. Use the procedure as a quick reference if you are familiar with the installation requirements for the power supply. If you want more information, each step in the procedure refers to subsequent sections which contain more details. Execute each step in the sequence given.

Table 2.1 Basic Setup Procedure

Step #	Description	Action	Reference
1	Safety	Read and follow safety recommendations	"Inspection, Cleaning, and Packaging" on page 28
2	Inspection	Perform an initial physical inspection of the supply.	"Inspection, Cleaning, and Packaging" on page 28
3	Installation	Install the supply (bench or rack mount), ensuring adequate ventilation.	"Location, Mounting and Ventilation" on page 31
4	Input Power	Connect AC input power.	"AC Input Power" on page 32
5	Test	Perform functional tests for voltage mode operation, current mode operation, and front panel controls.	"Functional Tests" on page 35
6	Load	Connect the load.	"Load Connection" on page 37
7	Sensing	Connect sensing lines.	"Local and Remote Sensing" on page 43

See Section 3, "Operation" for instructions about front panel operation, OVP, OTP, shutdown, and using multiple supplies. You will also find remote programming and monitoring described in the same section.

Inspection, Cleaning, and Packaging

Initial Inspection

When you first receive your unit:

1. Inspect the unit for scratches and cracks, and for broken switches, connectors, and displays.
2. Have the service technician check the printed circuit board and its components if you suspect internal damage.

If the unit is damaged, save all packing materials and notify the carrier immediately. See packing instructions on page 29.

Periodic Cleaning

No routine servicing of the power supply is required except for periodic cleaning. Whenever a unit is removed from operation, clean metal surfaces with naphtha or an equivalent solvent and the front panel with a weak solution of soap and water. Use low-pressure compressed air to blow dust from in and around components on the printed circuit boards.

Returning Power Supplies to the Manufacturer

Return Material Authorization Policy

Before returning a product directly to Xantrex you must obtain a Return Material Authorization (RMA) number and the correct factory "Ship To" address. Products must also be shipped prepaid. Product shipments will be refused and returned at your expense if they are unauthorized, returned without an RMA number clearly marked on the outside of the shipping box, if they are shipped collect, or if they are shipped to the wrong location.

When you contact Xantrex to obtain service, please have your operating manual ready for reference and be prepared to supply:

- The serial number of your product
- Information about the installation and use of the unit
- Information about the failure and/or reason for the return
- A copy of your dated proof of purchase

When you ship:

1. Package the unit safely following the procedures on page 30, preferably using the original box and packing materials. Please ensure that your product is shipped fully insured in the original packaging or equivalent. This warranty will not apply where the product is damaged due to improper packaging.
2. Include the following:
   - The RMA number supplied by Xantrex Technology Inc clearly marked on the outside of the box.
   - A return address where the unit can be shipped. Post office boxes are not acceptable.
   - A contact telephone number where you can be reached during work hours
   - A brief description of the problem

Ship the unit prepaid to the address provided by your Xantrex customer service representative.

If you are returning a product from outside of the USA or Canada:

In addition to the above, you MUST include return freight funds and are fully responsible for all documents, duties, tariffs, and deposits.

If you are returning a product to a Xantrex Authorized Service Center (ASC):

A Xantrex return material authorization (RMA) number is not required. However, you must contact the ASC prior to returning the product or presenting the unit to verify any return procedures that may apply to that particular facility.

Packaging for Shipping or Storage

Follow these instructions to prepare the unit for shipping or storage.

1. When returning the unit or sending it to the service center, attach a tag to the unit stating its model number (available from the front panel label) and its serial number (available from the rear panel label). Give the date of purchase and an invoice number, if you have it, as well as a brief description of the problem.
2. For storage or shipping, repack the power supply in its original container. If the original container is not available, seal the unit in a plastic bag and then pack it in a 200 lb. (90 kg) test, corrugated cardboard carton large enough to allow 2 inches (5 cm) of cushioning material to surround the unit. Use a material such as foam slabs or chips.
3. Label the carton as shown in Figure 2.1.
4. If shipping, mark the address of the service center and your return address on the carton.
5. If storing, stack no more than eight cartons high. Check the storage temperature range and storage altitude specification in "Environmental Specification" on page 24.

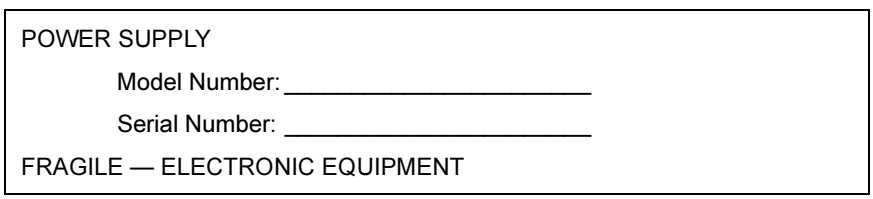

Figure 2.1 Shipping or Storage Carton Label

Location, Mounting and Ventilation

Ventilation Requirements

The power supply may be used in rack mounted or benchtop applications. In either case, sufficient space must be allowed for cooling air to reach the ventilation inlets in the top and on each side of the unit and for the fan exhaust air to exit from the rear of the unit.

Rack Mounting

The power supply is designed to fit in a standard 19 in. equipment rack. Bolt holes in the chassis sides are provided for rack mount slides such as the ZERO #C300S18 slides. When installing the unit in a rack, be sure to provide adequate support for the rear of the unit while not obstructing the ventilation inlets on the sides of the unit.

Bus Bar Cover

An optional busbar cover is available for bench-top power supplies. This will guard against injury from the exposed bus-bars at voltages above 42 Vdc. Rack mounted supplies are already protected.

AC Input Power

WARNING
There is a potential shock hazard if the power supply chassis and cover are not connected to an electrical ground via the safety ground in the AC input connector. Ensure that the power supply is connected to a grounded AC outlet with the recommended AC input connector configured for the available voltage as described in this section.

WARNING
Disconnect AC power from the unit before removing the cover. Even with the front panel power switch in the OFF position, live line voltages are exposed when the cover is removed. Repairs must be made by experienced service technicians only.

CAUTION
When the power switch is turned ON, output voltage or current previously set will be applied to loads.

AC Input Connector and Voltage Selection

The AC input connector is a 4-terminal wire clamp located on the power supply's rear panel. Operate the power supply with either a single phase or three phase AC power source. Check the specifications in the table below for input voltage, current, and frequency.

AC Voltage Range	Maximum Input Current	Frequency
200-250 Vac, 1 ϕ	26 Arms	47-63 Hz
190-250 Vac, 3 ϕ	14 Rms	47-63 Hz

AC Input Cord

WARNING
The AC input cord is the disconnect device for the power supply. The plug must be readily identifiable by and accessible to the operator. The input cord must be no longer that 9.84 feet (3 m).

The AC input cord we recommend is specified in the table below. Add a non-locking plug suitable for use in the country in which you are operating. If you require a special cord, please contact the manufacturer.

Wire Size	Ratings	Cable Outside Diameter
3 x 12 AWG stranded copper (1 ϕ)	60 °C minimum, 300 V	0.545-0.708 in. (13.63-17.7 mm)
4 x 12 AWG stranded copper (3 ϕ)	60 °C minimum, 300 V	0.545-0.708 in. (13.63-17.7 mm)

AC Input Wire Connection

WARNING
Wear protective gloves and use caution when removing the circular knockout from the cover as described below. The exposed metal edges of the knockout may be sharp.

The power supply is shipped with a protective cover for the AC input connector. As long as the screw-holes on the AC input cover and the standoffs on the unit align, the cover may be installed at any orientation. To prepare and connect the AC input wiring, follow these steps:

1. Use a gloved finger or a blunt tool to push in the circular knockout on the cover that is preferred for your system setup. After you push in the knockout, twist it until it detaches from the cover, and throw it away.
2. Strip the outside insulation on the AC cable approximately 2 in. (5 cm). Strip 0.25 in. (6 mm) at the end of each of the wires. See Figure 2.2, on page 34 for details.
3. Unscrew the base of the strain relief from the helix-shaped body. Insert the base through the outside opening in the AC input cover and, from the inside, screw the locknut securely onto the base.
4. Slide the helix-shaped body onto the AC cable. Insert the stripped wires through the strain relief base until the outer cable jacket is flush with the edge of the base. Tighten the body to the base while holding the cable in place. The cable is now securely fastened inside the strain relief.
5. Route the AC wires to the input connector terminals as required. For input connector terminal locations, see the label on the rear panel of the unit and Table 2.2, on page 34. To connect the wiring, loosen the terminal screw, insert the stripped wire into the terminal, and tighten the screw securely.

6. Route the wires inside the cover to prevent pinching. Fasten the AC input cover to the standoffs on the unit using the 6-32 x 2 in. (2) screws, flat washers, and lock washers provided.

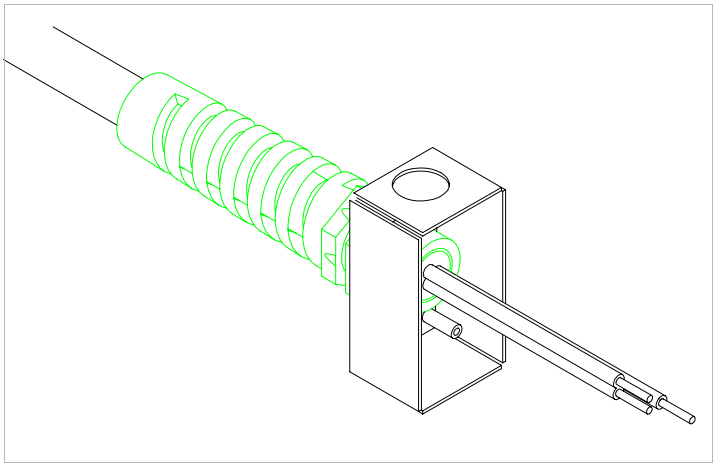

Figure 2.2 Stripped Wire Installed in Strain Relief

Table 2.2 AC Connections for Single and Three Phase Input

Phase	Ground	X Terminal	Y Terminal	Z Terminal
Single phase	E	L		N
Three phase	E	L	L	L

Input Line Impedance

The maximum input line impedance for operation at full rated output is 1 ohm. Higher source impedances can be tolerated by raising the input line voltage or by reducing the output voltage and/or current.

Functional Tests

Before connecting the unit to an AC outlet, make sure that the power switch is in the OFF position and that the voltage and current controls are turned fully counter clockwise. Check that the J3 mating connector on the rear of the unit is in place with jumpers connected for local operation as shown below. (This is the default configuration as shipped from the factory). Connect the unit to a 230 Vac grounded outlet and switch the unit on. After a short power on delay the front panel meters should light up with both displays reading zero.

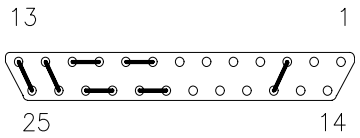

Figure 2.3 Connector J3 Configuration for Local Operation

Voltage Mode Operation

To check voltage mode operation, proceed as follows:

1. Connect a DVM, rated better than 0.5% accuracy, to the rear output terminals, observing correct polarity.
2. Rotate the CURRENT control 1/2 turn clockwise. Slowly rotate the VOLTAGE control clockwise and observe both the internal and external meters. Minimum control range should be from zero to the maximum rated output. Compare the test meter reading with the front panel voltmeter reading. Check that the green voltage mode indicator led is ON.
3. Set the POWER switch to OFF.

Current Mode Operation

To check current mode operation, proceed as follows:

1. Rotate the VOLTAGE and CURRENT controls fully counterclockwise.
2. Rotate the VOLTAGE control 1/2 turn clockwise.
3. Connect a high current DC ammeter[1] across the rear output terminals, observing correct polarity. Select leads of sufficient current carrying capacity and an ammeter range compatible with the unit's rated current output. The ammeter should have an accuracy of better than 0.5%.
4. Set the POWER switch to ON.
5. Rotate the CURRENT control slowly clockwise. The control range should be from zero to the maximum rated output. Compare the test meter reading with the reading on the front panel ammeter. Check that the red current mode indicator led is ON.
6. Set the POWER switch to OFF.

Front Panel Function Checks

1. Press OVP CHECK switch and check that the voltmeter displays approximately the model-rated output voltage plus 10%.
2. Turn OVP SET potentiometer counter-clockwise and check that the voltmeter reading decreases. Continued turning (up to 20 turns) will see the reading decrease to approximately 5% of the model-rated voltage output. Turn the potentiometer clockwise until the voltmeter once again displays approximately the model-rated output voltage plus 10%.
3. With voltage and current controls turned all the way in a clockwise direction, press the V & I CHECK switch and check that the voltmeter and ammeter display a minimum of the power supply model output ratings.
4. With voltage and current controls turned all the way in a clockwise direction, push the STANDBY switch to its IN position and check that the voltmeter reading falls to zero and the S/D (Shutdown) LED illuminates. Push the STANDBY switch once again to reset it to its OUT position. The S/D LED will turn off.
5. Push REM/LOC switch to IN position and check that the REM LED illuminates and the voltmeter reading falls to zero. Reset the REM/LOC switch to its OUT position for local (default) operation.

---

1. Either a direct reading meter or calibrated meter and shunt combination.

Controls, Connectors, and Indicators

CAUTION
All remote programming input and monitoring lines are internally referenced to the supply's negative output. Do not reference remote programming or monitor lines to the supply's positive output. J3 pin 6 (ground) is directly connected to the supply's negative output. Do not connect this pin to the positive output or to the chassis.

Please refer to Figure 1.1, "Power Supply Front Panel" on page 19 for front panel controls and indicators, Figure 1.2, "Power Supply Rear Panel" on page 20 for rear panel connectors and switch details, and to Figure 3.1, "J3 Program, Sense, and Monitor Connector Description" on page 49 for a description of the J3 Program, Sense, and Monitor Connector.

Note: J3 pins 1, 2, and 14 form an isolated control function and may be biased relative to the supply output

Load Connection

Reliable performance of the power supply can be obtained if certain basic precautions are taken when connecting it for use on the lab bench or installing it in a system.

To obtain a stable, low noise output, careful attention should be paid to factors such as conductor ratings, system grounding techniques and the way in which the load and remote sensing connections are made.

Load Conductor Ratings

As a minimum, load wiring must have a current capacity greater than the output current rating of the power supply. This ensures that the wiring will not be damaged even if the load is shorted. Table 2.3 shows the maximum current rating, based on 450 A/cm^2, for various gauges of wire rated for 105 °C operation. Operating at the maximum current rating results in an approximately 30 °C temperature rise for a wire operating in free air. Where load wiring must operate in areas with elevated ambient temperatures or bundled with other wiring, use larger gauges or wiring rated for higher temperatures.

Table 2.3 Current Carrying Capacity for Load Wiring

Wire Size (AWG)	Maximum Current (A)	Wire Size (AWG)	Maximum Current (A)
20	2.5	6	61
18	4	4	97
16	6	2	155
14	10	1	192
12	16	1/0	247
10	21	2/0	303
8	36		

Load Wiring Length for Operation with Sense Lines

For applications using remote sensing, the voltage drop across each load line must be limited to 1V or less. Figure 2.4, shows the maximum allowable wire length that may be used for a given load current and wire size to ensure that this limit is not exceeded.

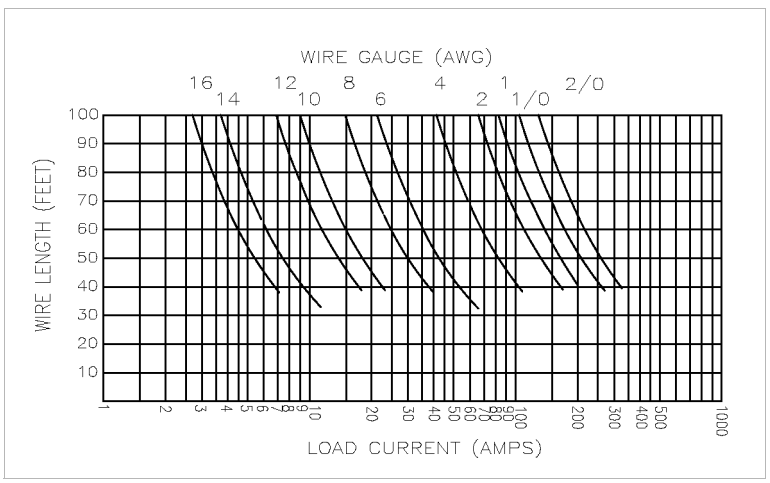

Figure 2.4 Maximum Load Wire Length

Noise and Impedance Effects

To minimize noise pickup or radiation, use shielded-twisted pair wiring of as short a length as possible for load wires. Connect the shield to the chassis via a rear panel mounting screw. Where shielding is impossible or impractical, simply twisting the wires together will offer some noise immunity. When using local sense connections, use the largest practical wire size to minimize the effects of load line impedance on the regulation of the supply.

Making the Connections

CAUTION
When making connections to the bus bars, ensure each terminal's mounting hardware and wiring assembly is placed to avoid touching the other terminal and shorting the power supply output. Heavy connecting cables must have some form of strain relief to avoid loosening the connections or bending the bus bars.

Make load connections to the power supply at the positive and negative output terminals (or bus bars) at the rear of the power supply. See Figure 1.2, “Power Supply Rear Panel” on page 20. The power supply provides three load wiring mounting holes on each bus bar terminal as specified in the following table.

Load Wiring Mounting Holes	Diameter	Hardware Size
One (1) per terminal	0.332 in.	1/4 in. (5/16 in. for 8V + 12V models)
Two (2) per terminal	0.190 in. on 0.5 in. centers	#10

Connecting Single Loads

Figure 2.5 and Figure 2.6 show recommended load and sensing connections for single loads. Local sense lines shown are default J3 connections. Refer to “Connecting Remote Sensing Lines” on page 44 for more information about the sense line shield.

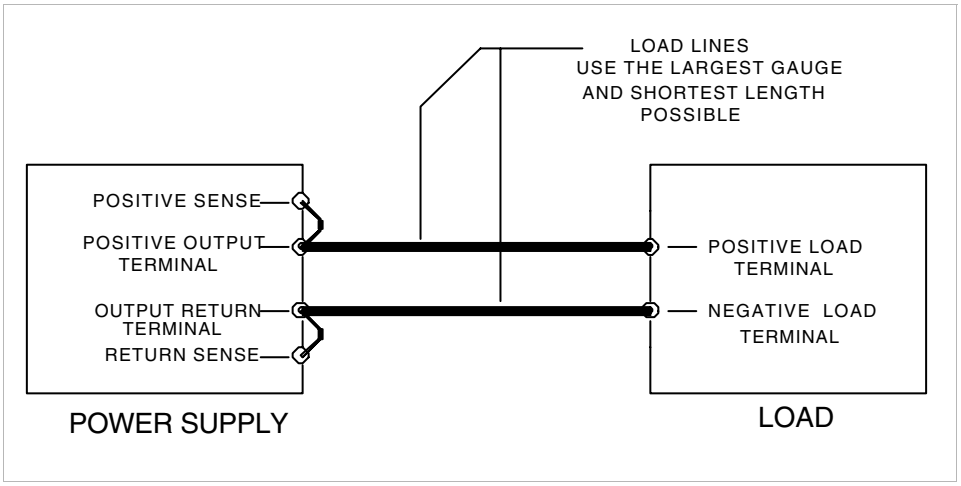

Figure 2.5 Single Load with Local Sensing (Default)

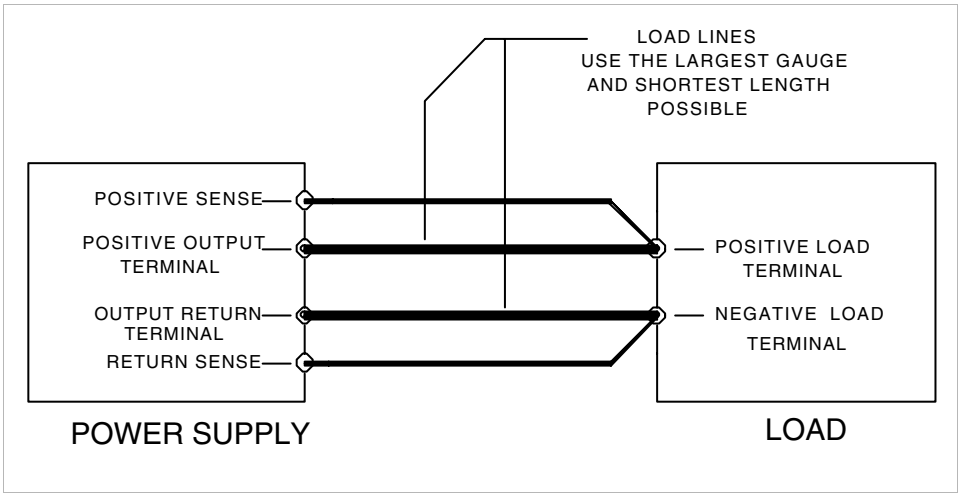

Figure 2.6 Single Load with Remote Sensing

Load Connection and Grounding

WARNING
Exercise caution when using and servicing power supplies. High energy levels can be stored at the output voltage terminals on all power supplies in normal operation. In addition, potentially lethal voltages exist in the power circuit and the output connector of power supplies which are rated at 40V and over. Filter capacitors store potentially dangerous energy for some time after power is removed.

Proper connection of distributed loads is an important aspect of power supply application. A common mistake is to connect leads from the power supply to one load, from that load to the next load, and so on for each load in the system. In this **parallel power distribution** method, the voltage at each load depends on the current drawn by the other loads and DC ground loops are developed. Except for low current applications, this method should not be used.

The preferred way to distribute power is by the **radial distribution** method in which power is connected to each load individually from a single pair of terminals designated as the positive and negative distribution terminals. The pair of terminals may be the power supply output terminals, the terminals of one of the loads or a distinct set of terminals especially established for distribution. Connecting the sense leads to these terminals will compensate for losses and minimize the effect of one load upon another.

Inductive Loads To prevent damage to the power supply from inductive kickback, connect a diode (rated at greater than the supply's output voltage and with a current surge rating greater than or equal to the supply's output current rating) across the output. Connect the cathode to the positive output and the anode to return. Where positive load transients such as back EMF from a motor may occur, connect a transorb or a varistor (with a breakdown voltage approximately 10% higher than the rated supply output) across the output to protect the power supply.

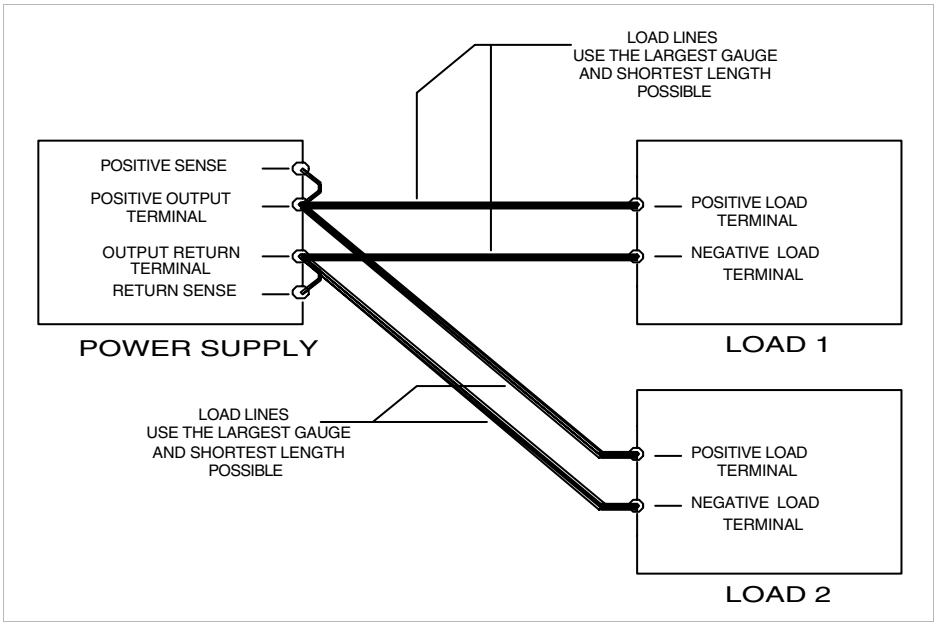

Figure 2.7 Multiple Loads with Local Sensing

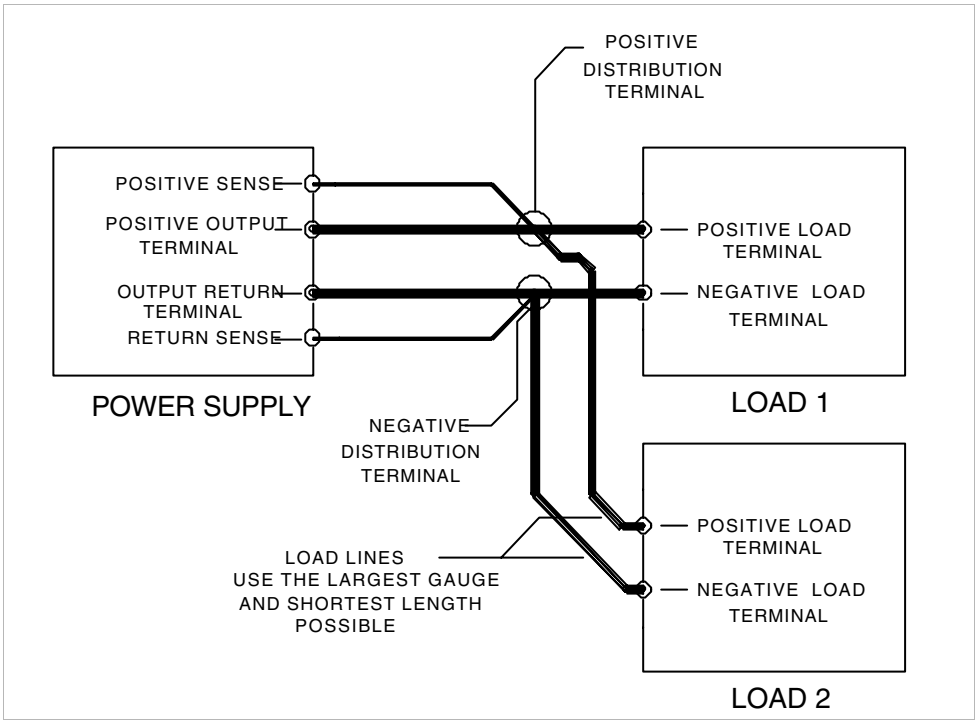

Figure 2.8 Multiple Loads with Remote Sensing

Local and Remote Sensing

Local Programming Mode Operation

Units are shipped from the factory configured for local programming mode operation.

- Output voltage and current limit settings are adjusted with the front panel controls.
- The sense point of the supply is at the output terminals.
- The front panel OVP potentiometer determines the OVP set point. See "Using Over Voltage Protection (OVP)" on page 62 for the adjustment procedure.

Local Mode Default Configuration

Figure 2.9 shows the default factory settings for the internal jumpers JMP1 and JMP2, for switch SW1, and for rear panel connector J3. These controls are used to select among the various options for programming, sensing, and monitoring. See "Configuring for Remote Programming, Sensing, and Monitoring" on page 48.

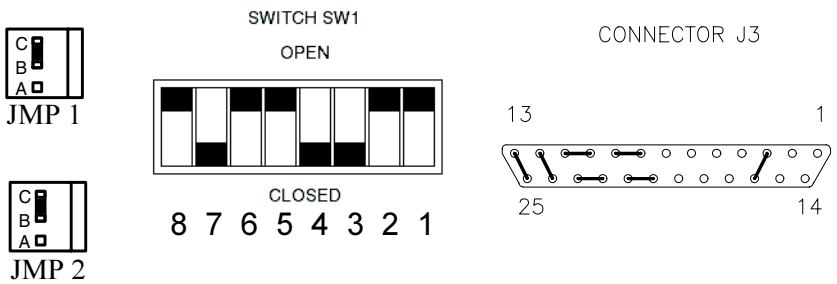

Figure 2.9 Local Mode Default Configuration

Setting Output Voltage and Current Limit

After installing the power supply and connecting the load, set the required output voltage and current limit according to the following front panel procedure:

1. Turn both the voltage and current controls fully counter-clockwise.
2. Turn the AC power ON.
3. Press the STANDBY switch to its IN position to disable the power supply output.
4. Press and hold the V & I CHECK button to display the voltage and current control settings on the voltmeter and ammeter displays.
5. Adjust the voltage control to the required voltage (the compliance voltage for applications using current mode operation).
6. Adjust the current control to the required current limit setting.
7. Release the V & I CHECK button.

8. Press the STANDBY switch to its OUT position to apply power to the load.

Using Remote Sensing

CAUTION
Do not use remote sensing with multiple supplies connected in series or in parallel.

Remote sensing is used during voltage mode operation to shift the power supply's regulation point from its output terminals (default sense point) to the load or distribution terminals by using a separate pair of wires to monitor the load voltage. Remote sensing allows the power supply to compensate for voltage losses in the load lines (up to 1V per line) which will otherwise degrade the regulation of the supply. The sense line connection points are located on the rear panel J3 connector. "Configuring for Remote Programming, Sensing, and Monitoring" on page 48 has more information about making J3 connector changes.

Connecting Remote Sensing Lines

Sense wires can be any size (24 AWG or larger) but in high noise environments or when the lowest possible power supply ripple is required, sense wires must be twisted and/or shielded.

To connect remote sense lines, refer to Figure 2.10 and to the following procedure:

1. Ensure the power supply is turned OFF. Allow five (5) minutes to elapse to dissipate stored energy before altering J3 connector pin connections.
2. Remove the local sense jumpers connecting J3 pins 13 to 25 (positive sense) and pins 12 to 24 (negative sense or return sense).
3. Connect the positive sense lead to pin 13 and the negative lead to pin 12. Use shielded-twisted pair wiring of 24 AWG or larger for sense lines.
4. Ground the sense line shield, at one point only, to the power supply's return output connection at the load, or, to the power supply's return output at its output terminal, or to the power supply's chassis.
5. The optimal point for the shield ground must be determined by experiment, but the most common connection point is at the power supply's return output connection at the load.
6. Turn the power supply ON.

Notes:

- If the power supply is operated with remote sense lines connected and with either of the positive or negative load lines **not** connected, the power supply shutdown circuit will be activated, causing the output voltage and current to fall to zero.

- If the power supply is operated **without** remote sense lines **or** local sense jumpers in place, the supply will continue to work, but supply regulation will be degraded and/or erratic.

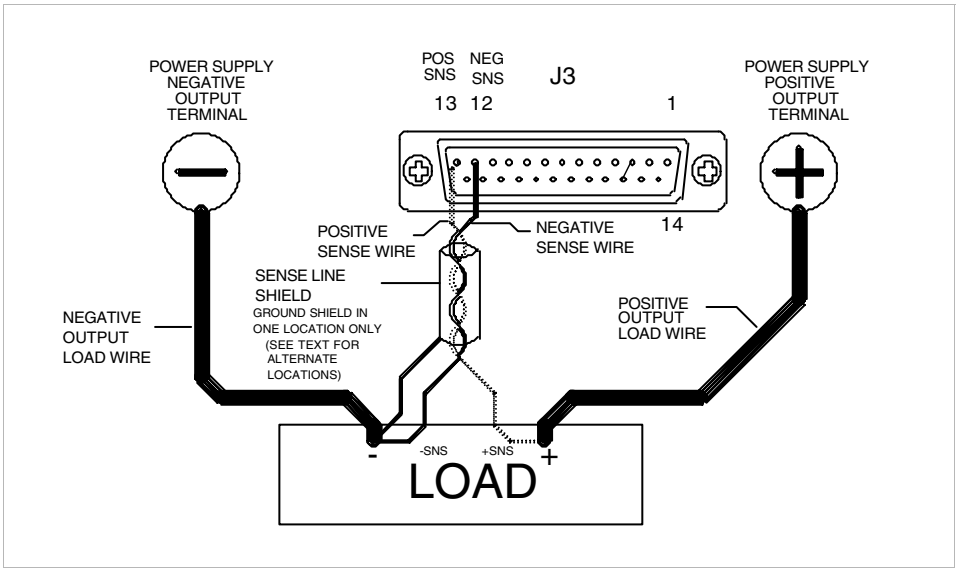

Figure 2.10 Connecting Remote Sense Lines

Section 3. Operation

Introduction

All power supplies in this series offer the following features as part of their standard configuration.

Feature	Reference
Remote Programming of Output Voltage and Current Limit with 0-5V, 0-10V, 0-1mA, and 0-5k ohms	page 54
Overvoltage Protection (OVP) with front panel controls or 0-5V and 0-10V programming	page 62
Programmable Shutdown with AC, DC, or TTL compatible signals and contact closure	page 65
Remote Monitoring of Status Indicators for thermal shutdown, OVP status, remote/local programming mode, and voltage/current mode operation	page 72
Calibrated Readback Signals for output voltage and output current with selectable 0-5V or 0-10V scales	page 72
Multiple Supply Configurations such as series, parallel, and split supplies	page 73

Accessing Advanced Features

Accessing these features may require that you use one or more of the following procedures:

- Using the front panel REM/LOC (Remote/Local Programming) switch.
- Reconfiguring the rear panel J3 connector.
- Making connections to the J3 connector.
- Resetting internal jumpers JMP1 and JMP2.
- Resetting internal switch SW1.

"Configuring for Remote Programming, Sensing, and Monitoring" on page 48 provides a reference to the function and location of these controls, and procedures for making any required changes.

Configuring for Remote Programming, Sensing, and Monitoring

This section lists switch, connector, and jumper functions for the power supply. Subsequently, it provides a location diagram, gives procedures for resetting the internal jumpers and switches, and covers reconfiguring or making connections to the J3 connector.

You will find remote programming procedures and diagrams covered in more detail in "Remote Programming of Output Voltage and Current Limit" on page 54, remote sensing in "Local and Remote Sensing" on page 43, and remote monitoring of readback signals and status indicators in "Remote Monitoring of Readback Signals and Status Indicators" on page 72.

Programming, Monitoring, and Control Functions

Front Panel REM/LOC Switch You can use the REM/LOC (Remote/Local Programming) switch for remote programming. When set to REM (Remote Programming), control of BOTH output voltage AND current limit is passed to external voltage and/or current sources which are connected to the J3 connector. Resetting the switch to LOC returns the supply to local (front panel) control. See "Remote Programming of Output Voltage and Current Limit" on page 54 for more information about using this switch.

External J3 Connector

The external J3 connector provides user access to the following functions:

- Remote programming of output voltage OR current limit, and for OVP
- Remote monitoring of the following readback signals and status indicators

Readback Signals	Status Indicators
• Calibrated output voltage • Calibrated output current	• Thermal shutdown • OVP circuit • Remote/local programming mode

- Remote programming of the shutdown function using AC, DC, or TTL compatible signals
- Remote sensing of output voltage

See Figure 3.1.

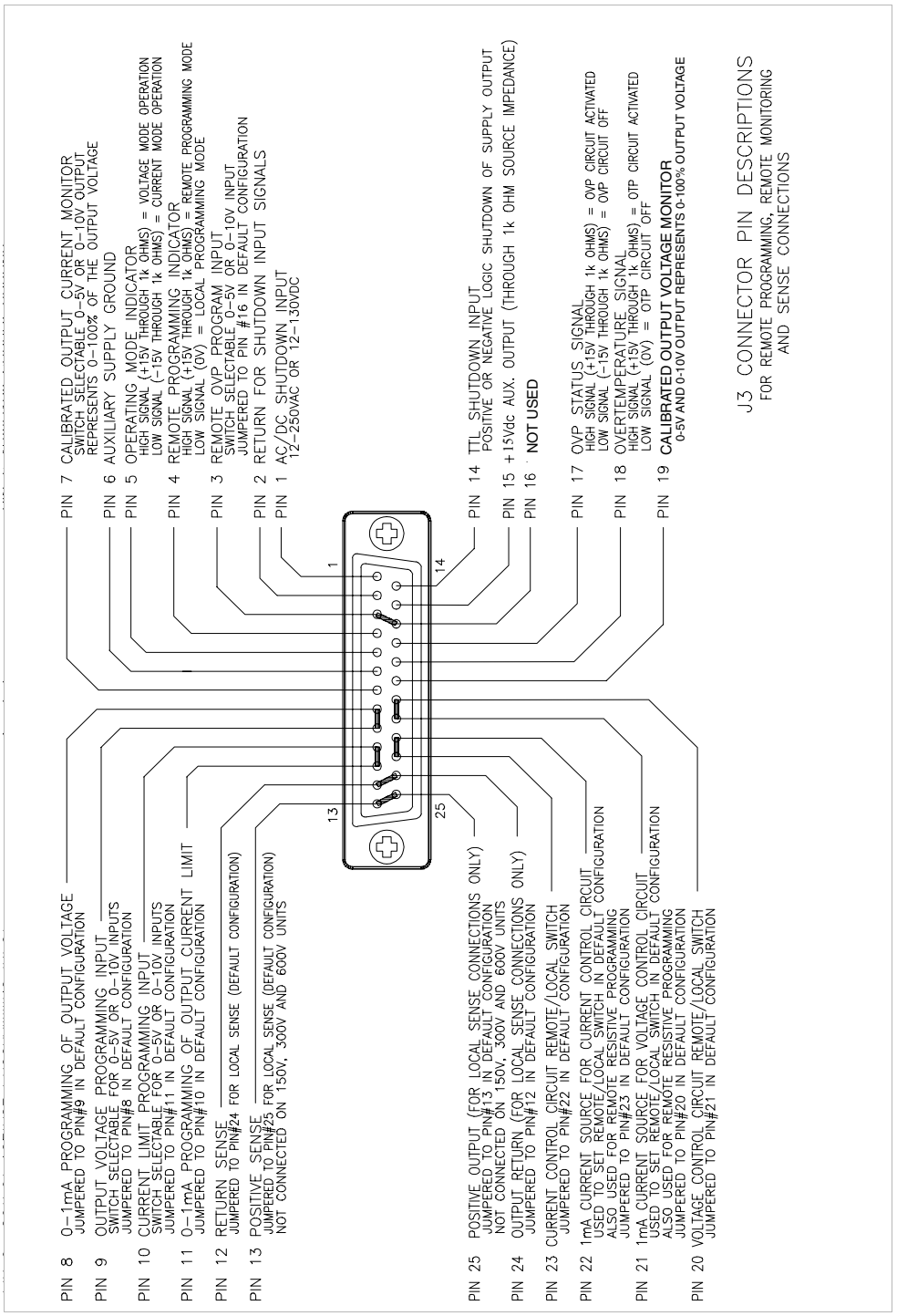

Figure 3.1 J3 Program, Sense, and Monitor Connector Description

Internal Switch and Jumpers If you should need to change any of the standard configurations of the supply, internal jumpers JMP1 and JMP2, and switch SW1 enable you to select:

- Voltage and Current Programming Scale Factor
- Over Voltage Protection (OVP) Programming Mode and Scale
- Voltage and Current Monitor Range
- Shutdown Circuit Logic

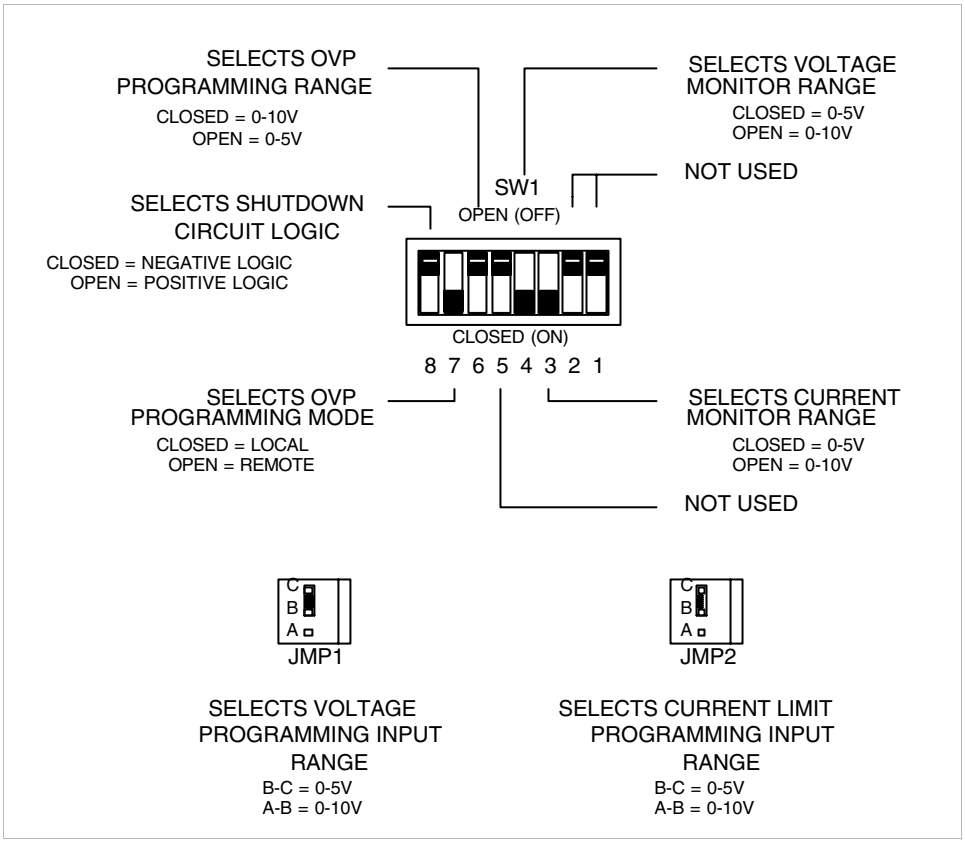

Figure 3.2 Internal Jumpers and Switch (Default Settings Shown)

Locating Jumpers, Switch, and Connector

Switch SW1 and jumpers JMP1 and JMP2 are located on the main printed circuit board (A2) inside the power supply. "Resetting Jumpers and Switch" on page 51 provides a procedure for removing the power supply cover and changing jumper and switch settings. The J3 connector is located on the unit's rear panel. "Making J3 Connections" on page 53 provides a procedure for changing connections to the J3 connector.

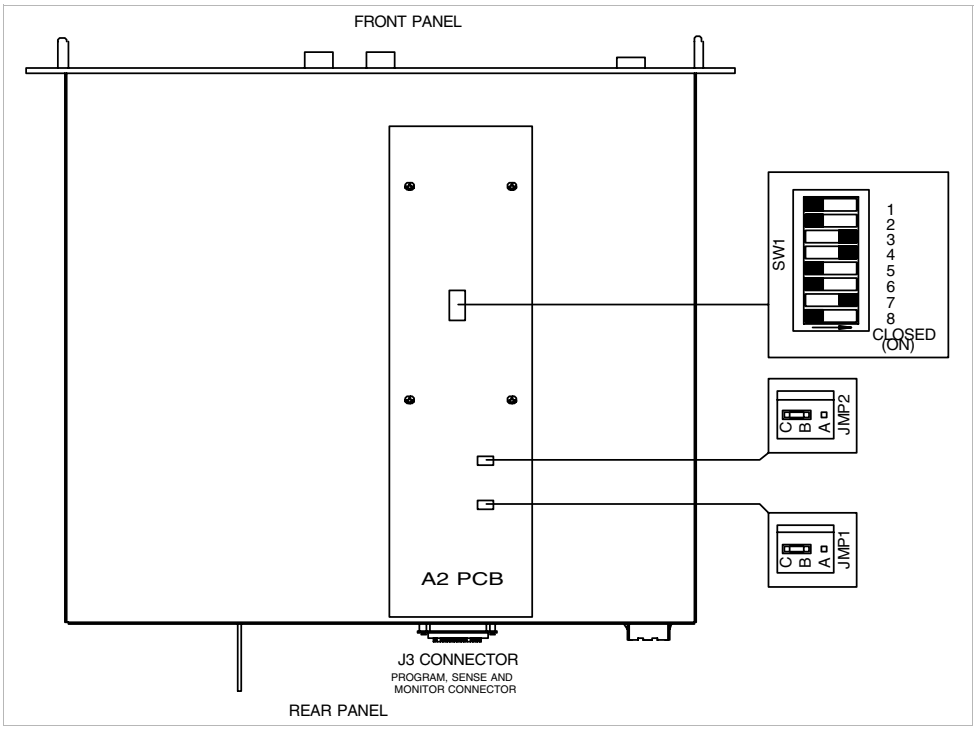

Figure 3.3 Locating Jumpers, Switch, and Connector

Resetting Jumpers and Switch

Most applications will use the default factory settings of the internal jumpers, JMP1 and JMP2, or of the internal 8-position DIP switch, SW1. If the jumpers and switch should require resetting, follow the procedures in this section.

The steps to follow are:

- Dissipating stored energy
- Removing the cover
- Removing the option board (when required)
- Resetting JMP1, JMP2 and SW1
- Replacing the option board
- Replacing the cover
- Powering up

Dissipating Stored Energy

1. Ensure the power supply is turned OFF. Disconnect the AC input connector. Allow five (5) minutes to elapse to dissipate stored energy before removing the cover.

Removing the Cover

CAUTION
If you should remove the unit's cover, use proper static control techniques to avoid damage to static-sensitive digital components on the printed circuit board.

2. Unscrew and remove the eight (8) flathead Philips screws from the top of the cover: two (2) are located near the front panel, six (6) near the rear panel. Use a #1 Philips screwdriver.
3. Loosen but do not remove the six (6) Philips screws located three (3) to a side in the slots along each side of the power supply.
4. Lift cover off and set aside.

Removing the Option Board (when required) The power supply may have either of two option circuit boards installed over the A2 circuit board where the jumpers and switches are located. The option board must be removed to allow access to them.

5. Unplug any external mating connector and attached wiring.
6. Use a nutdriver to remove the jack screws which fasten the option board to the rear panel.
7. Unscrew the mounting screws which fasten the option board down.
8. Unplug any attached cables.
9. Lift out the option board and set aside.

Resetting JMP1, JMP2, and SW1

10. Lift the appropriate jumper from its pin header and replace it as the programming requires. The default location is B-C for both JMP1 and JMP2. Alternate locations are A-B in each case.
11. Push the dual position SW1 switches closed (ON) or open (OFF) as required by the application.
12. Place the option board into its original location over the A2 circuit board.
13. Reinstall the mounting screws into the standoffs. Reattach any cables.

14. Reinstall the jack screws with the nut driver.
15. Reconnect any external cables and connector.

Replacing the Cover

16. Place the cover in its original location.
17. Reinstall the eight (8) flathead Philips screws on the top of the cover, then tighten the six (6) Philips screws in the side slots.

Powering Up

18. Reconnect the AC input connector. Turn the power supply ON.

Making J3 Connections

Some applications will use only the default factory connections on the J3 connector located on the rear panel. Other applications will require replacing pin-to-pin connections or making connections to external devices such as voltage sources, current sources, or resistance. Follow the procedures in this section whenever the rear panel connector, J3, is to be reconfigured.

The steps to follow are:

- Dissipating stored energy
- Making the connections
- Powering up

Refer to the "Dissipating Stored Energy" on page 52 and "Powering Up" on page 53.

Making the Connection

To make pin-to-pin connections:

1. Unsolder any pin-to-pin jumpers as required by the application.
2. Solder new connections using any appropriate single bus wire such as AWG 20 to 24.

To connect external source leads, resistance leads, or monitoring or sense lines:

3. Unsolder any jumpers as required by the application.
4. Solder leads to the specified pin using the recommended wiring and/or grounding point for the application. Pin, wiring, and grounding specifications for particular applications can be found in this section, except for remote sensing specifications which are in "Using Remote Sensing" on page 44.

Remote Programming of Output Voltage and Current Limit

CAUTION
The remote programming input is internally referenced to the supply's negative output. Do not connect remote programming input lines (J3 pins 9 and 10) to the supply's positive output.

Remote programming allows control of the power supply's output voltage and/or current limit to shift from local operation at the front panel voltage and current controls to external analog input sources. As a programming source is varied, the power supply's output varies proportionally over its output range.

The analog programming signals are connected to the rear panel J3 connector. To provide the lowest noise performance, use shielded-twisted pair wiring for making connections from external circuits to the J3 connector. Use the shortest leads possible. Ground the shield to pin 6 on the J3 connector or to the chassis via one of the J3 connector screws.

Remote Programming Options

The following table summarizes access options for programming output voltage and current limit with the input scales supported for the power supply. Refer to "Programming Output Voltage and Current Limit with the REM/LOC Switch" on page 55 for a procedure and a connection diagram for programming output voltage and current limit using the REM/LOC switch. Subsequent sections provide short procedures and diagram the J3 connector configurations and connections required for remote programming of output voltage and/or current limit without using the REM/LOC switch.

Table 3.1 Remote Programming Options

Remote Programming Options	Control of...	Programming Scales [1]
Programming with the REM/LOC Switch	Output Voltage and Current Limit	0-5V 0-1mA 0-10V (see Notes below)
Programming without the REM/LOC Switch	Output Voltage and/or Current Limit	0-5V 0-1mA 0-5k Local control 0-10V (see Notes below)

1. These scales may be used in any combination.

Notes for Programming with a 0-10V Source:

WARNING
Exercise caution when resetting internal jumpers. Follow the procedures for removing the cover and resetting jumpers in "Resetting Jumpers and Switch" on page 51

1. Programming with a 0-10V external voltage source requires that you reset internal jumpers JMP1 and/or JMP2 in addition to performing any external operations.
2. Resetting internal jumpers may require a recalibration of the programming circuit to maintain programming accuracy. See "Calibrating for Programming Accuracy" on page 82.

"Configuring for Remote Programming, Sensing, and Monitoring" on page 48 explains how to use the front panel REM/LOC switch, how to reconfigure or make connections to the external J3 connector, and how to access internal jumpers JMP1 and JMP2 to change their settings.

Programming Output Voltage and Current Limit with the REM/LOC Switch

The front panel REM/LOC (Remote/Local Programming) switch will allow you to switch back and forth between remote and local operation when programming output voltage and current limit with external voltage and/or current sources.

For programming output voltage and current limit using the REM/LOC switch:

1. Connect the programming source between pins 9 (voltage programming input/positive) and 12 (return).
2. Connect the programming source between pins 10 (current limit programming input/positive) and 12 (return).
3. Set the front panel REM/LOC switch to REM.

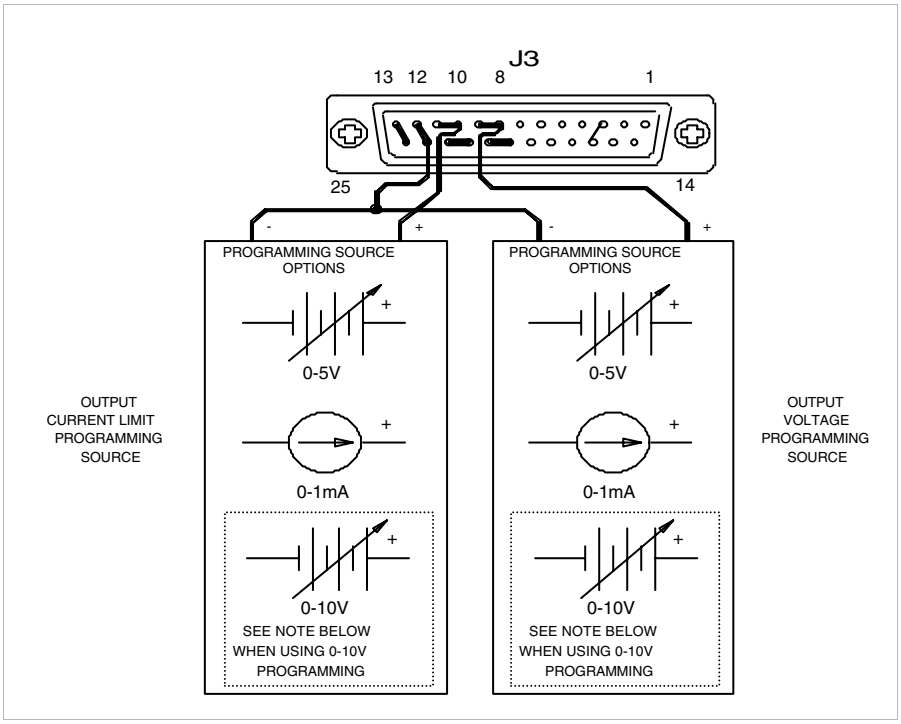

Figure 3.4 Programming Output Voltage and Current Limit (with the REM/LOC Switch)

Notes:

1. If you are programming both output voltage and current limit with a 0-10V source and using the REM/LOC switch, set internal jumpers JMP1 and JMP2 to their A-B locations before connecting the voltage and current limit programming inputs.
2. Resetting internal jumpers may require a recalibration of the programming circuit to maintain programming accuracy. See "Calibrating for Programming Accuracy" on page 82 for the procedures.

Programming Output Voltage

Programming Output Voltage with a 0-5Vdc Source

1. Remove the jumpers connecting pins 8 to 9 and 20 to 21 on connector J3.
2. Connect the external programming source between pins 9 (voltage programming input/positive) and 12 (return).

Varying the programming voltage from 0 to 5Vdc will cause the output to vary from 0 to 100% of the model rating. The output current limit may be programmed using another source or set locally by adjusting the front panel current limit control.

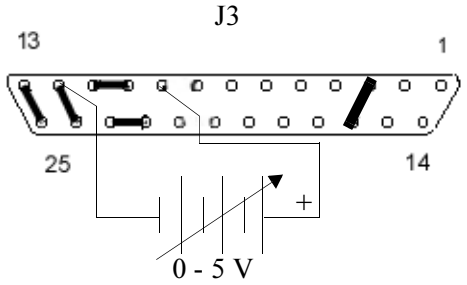

Figure 3.5 Programming Output Voltage with a 0-5Vdc Source

Programming Output Voltage with a 0-10V Source

WARNING
Exercise caution when resetting internal jumpers. Follow the procedures for removing the cover and resetting jumpers in "Configuring for Remote Programming, Sensing, and Monitoring" on page 48.

1. Set internal jumper JMP1 to its A-B location.
2. Remove the jumpers connecting pins 8 to 9 and 20 to 21 on connector J3.
3. Connect the external voltage programming source between pins 9 (voltage programming input/positive) and 12 (return).

Varying the programming voltage from 0 to 10Vdc will cause the output voltage to vary from 0 to 100% of the model rating. The output current limit may be programmed using another source or set locally by adjusting the front panel current control.

Note:
Resetting internal jumpers may require a recalibration of the programming circuit to maintain programming accuracy. See "Calibrating for Programming Accuracy" on page 82.

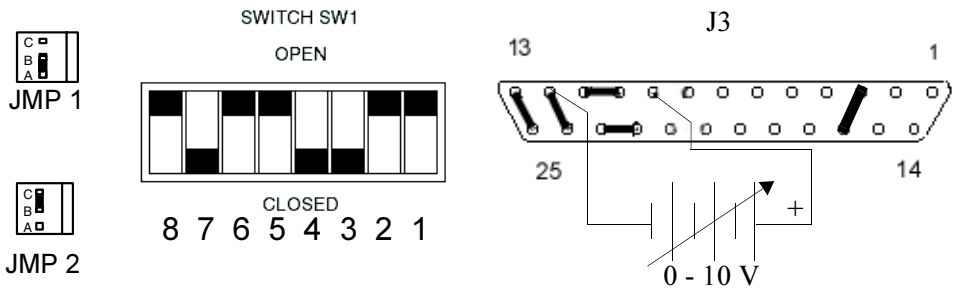

Figure 3.6 Programming Output Voltage with a 0-10Vdc Source

Programming Output Voltage with a 0-1mA Source

1. Remove the jumper between pins 20 and 21 of connector J3.
2. Connect the external programming source between pin 9 (voltage programming input/positive) and pin 12 (return) of connector J3.

Varying the current source from 0 to 1mA will vary the output voltage from 0 to 100% of the model rating. The output current limit is set by adjusting the front panel current limit control.

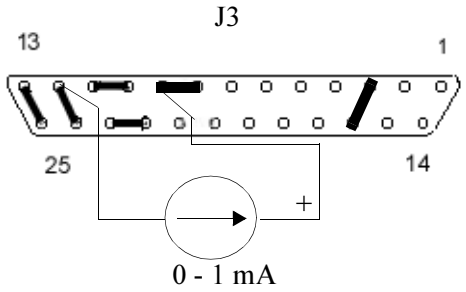

Figure 3.7 Programming Output Voltage with a 0-1mA Source

Programming Output Voltage with a 0-5k Resistance

1. Remove the jumpers connecting pins 8 to 9 and pins 20 to 21 on connector J3.
2. Connect pins 9 (voltage programming input/positive) and 21 (1 mA current source for voltage control) to the counter-clockwise end of the 5 k potentiometer and connect the tap and clockwise end of the potentiometer to pin 12 (return).

Adjusting the resistance from 0 to 5k will vary the output voltage from 0 to 100% of the model rating. The output current limit is set locally by adjusting the front panel current limit control.

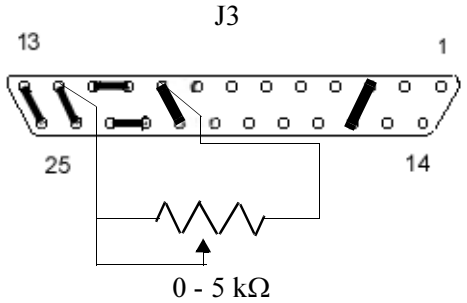

Figure 3.8 Programming Output Voltage with a 5k ohm Resistance

Programming Output Current Limit

Programming Output Current Limit with a 0-5Vdc Source

1. Remove the jumpers connecting pins 10 to 11 and 22 to 23 on connector J3.
2. Connect the external programming source between pins 10 (current limit programming input/positive) and 12 (return).

Varying the programming voltage from 0 to 5Vdc will cause the current limit to vary from 0 to 100% of the model rating. The output voltage is set locally by adjusting the front panel voltage control.

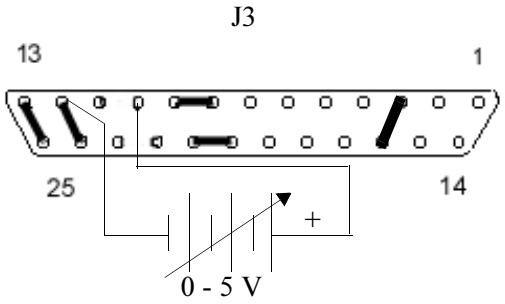

Figure 3.9 Programming Output Current Limit with a 0-5Vdc Source

Programming Output Current Limit with a 0-10Vdc Source

WARNING
Exercise caution when resetting internal jumpers. Follow the procedures for removing the cover and resetting jumpers in "Configuring for Remote Programming, Sensing, and Monitoring" on page 48.

1. Set jumper JMP2 to its A-B location.
2. Remove the jumpers connecting pins 10 to 11 and 22 to 23 on connector J3.
3. Connect the external current programming source between pins 10 (current limit programming input/positive) and 12 (return).

Varying the programming voltage from 0 to 10Vdc will cause the output current limit to vary from 0 to 100% of the model rating. The output voltage is set locally by adjusting the front panel voltage control.

Note:
Resetting internal jumpers may require a recalibration of the programming circuit to maintain programming accuracy. See "Calibrating for Programming Accuracy" on page 82.

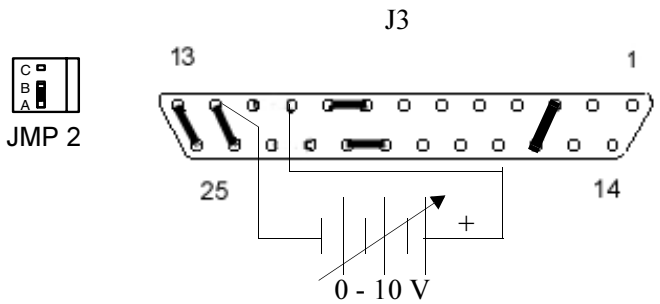

Figure 3.10 Programming Output Current Limit with a 0-10Vdc Source

Programming Output Current Limit with a 0-1mA Source

1. Remove the jumper between pins 22 and 23 of connector J3.
2. Connect the external programming source between pin 10 (current limit programming input/positive) and pin 12 (return) of connector J3.

Varying the current source from 0 to 1mA will vary the current limit from 0 to 100% of the model rating. The output voltage is set by adjusting the front panel voltage control.

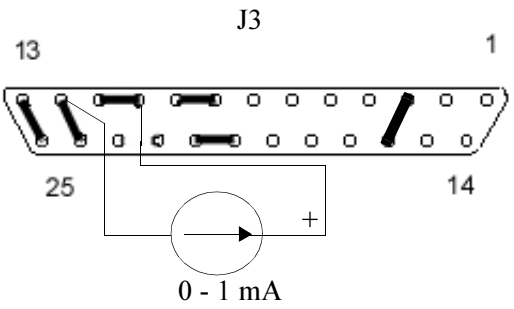

Figure 3.11 Programming Output Current Limit with a 0-1mA Source

Programming Output Current Limit with a 0-5k Resistance

1. Remove the jumpers connecting pins 10 to 11 and pins 22 to 23 on connector J3.
2. Connect pins 10 (current limit programming input/positive) and 22 (1mA current source for current control) to the counterclockwise end of the 5k potentiometer and connect the tap and clockwise end of the potentiometer to pin 12 (return).

Adjusting the resistance from 0 to 5k will vary the current limit from 0 to 100% of the model rating. The output voltage is set by adjusting the front panel voltage control.

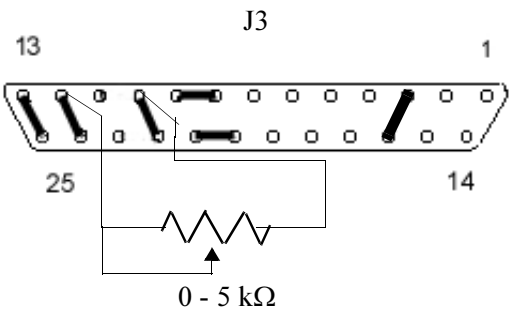

Figure 3.12 Programming Output Current Limit with a 5k ohm Resistance

Using Over Voltage Protection (OVP)

The OVP circuit allows for protection of the load in the event of a remote programming error, an incorrect voltage control adjustment, or a power supply failure. The protection circuit monitors the output voltage and will reduce the output current and voltage to zero whenever a preset voltage limit is exceeded. The preset voltage limit, also called the set point or trip level, can be set either in local programming mode from the front panel or by remote programming through the J3 connector on the rear panel.

The red OVP LED on the front panel will light up when the OVP circuit has been activated.

Front Panel OVP Operation

In local programming mode, the OVP set point can be checked at any time by pressing the OVP CHECK switch: the OVP set point is the value displayed on the digital voltmeter.

To set the trip level from the front panel:

1. Adjust the power supply output to zero volts.
2. Press the OVP CHECK switch to observe the OVP set point on the voltmeter display.
3. Turn the OVP SET potentiometer until the desired set point is reached. Release the OVP CHECK switch.
4. Increase the power supply output voltage to check that the power supply shuts off the output at the selected set point.

Resetting the OVP Circuit

To reset the OVP circuit after it has been activated:

1. Reduce the power supply's output voltage setting to below the OVP set point.
2. Press the STANDBY switch IN. The Shutdown (S/D) LED on the front panel will light up.
3. Press the STANDBY switch again to return power to the load and resume normal operation.

OR

1. Reduce the power supply's output voltage setting to below the OVP set point.
2. Turn the power supply OFF using the AC power switch, then turn it back ON again.

Programming OVP with an External Voltage Source

To set the OVP trip level with a 0-5Vdc or a 0-10Vdc external voltage source:

1. Ensure the power supply is turned OFF and that both the AC power source and the load are disconnected. Allow five (5) minutes to elapse to dissipate stored energy before resetting switches or making connections. Refer to "Configuring for Remote Programming, Sensing, and Monitoring" on page 48 for instructions for removing the cover and resetting switches or making J3 connections.
2. Set the power supply's internal switch SW1-7 OPEN. Ensure switch SW1-6 is set to OPEN for 0-5Vdc OVP programming (factory default setting) or set it to CLOSED for 0-10Vdc OVP programming. See Figure 3.13 and Figure 3.14.
3. Connect the external voltage source between pin 3 (positive) and pin 12 (return) on the J3 connector on the rear panel. See Figure 3.13 and Figure 3.14. The use of shielded-twisted pair wiring is recommended. Ground the shield to J3 connector pin 6 or to the chassis using one of the J3 connector screws.
4. Set the external programming source voltage to maximum (5 Vdc or 10 Vdc).
5. Turn the power supply ON and turn the front panel voltage control clockwise until the voltmeter shows the desired trip voltage.
6. Slowly reduce the external programming voltage until the red OVP LED lights and the power supply shuts down.

Note: When OVP is programmed by an external voltage source, the OVP set point can be approximated using the following formula:

$$\text{OVP Set Point} \pm 2\% = (V_O / PGM_{SCALE})V_{PGM}$$

where: V_O is the power supply model-rated voltage

PGM_{SCALE} is the external voltage source maximum voltage (5 or 10)

V_{PGM} is the remote OVP program voltage setting (0 to 5Vdc or 0 to 10Vdc)

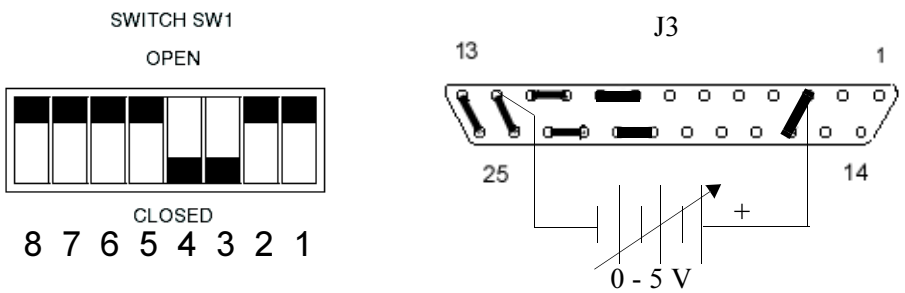

Figure 3.13 Remote Programming of OVP
(with a 0-5Vdc External Voltage Source)

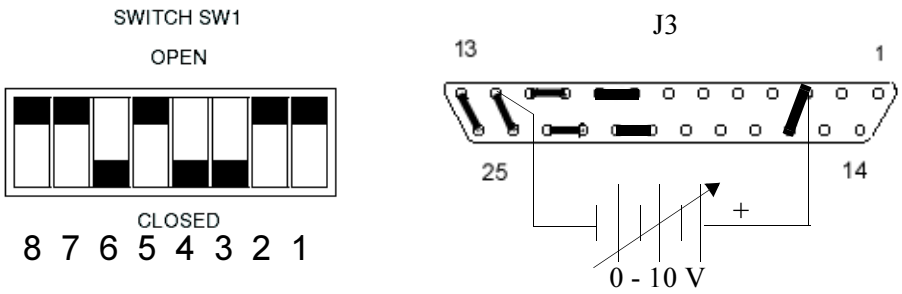

Figure 3.14 Remote Programming of OVP
(with a 0-10Vdc External Voltage Source)

Using Over Temperature Protection (OTP)

The OTP circuit protects the power supply in the event of excessive temperature. The protection circuit monitors the temperature of a supply heatsink using a temperature sensor, and will activate the internal shutdown circuit whenever the maximum temperature is exceeded.

The red OTP LED on the front panel lights up when an OTP shutdown occurs.

Resetting the OTP circuit

To reset the OTP after it activates:

1. The supply recovers to normal operation when the over temperature condition no longer exists.

OR

1. Turn the AC power switch OFF.
2. Correct the situation causing the over temperature condition.
3. Turn the AC power switch ON.

Using the Shutdown Function

The Shutdown function is used to disable or enable the supply's output voltage and current. It can be used to allow adjustments to be made to either the load or the power supply without shutting off the entire supply. This function may be activated from the front panel at any time by using the STANDBY switch. It can also be activated via remote programming, using positive or negative logic, with a TTL compatible input or with an AC or DC signal.

STANDBY Switch

The STANDBY switch is a press ON/press OFF switch located on the power supply's front panel. See the front panel diagram, Figure 1.1, on page 19. When pushed IN, or depressed, the Shutdown circuit is activated, the output voltage and current fall to zero and the S/D (Shutdown) LED on the front panel is illuminated. Pushing the switch once more resets it to its OUT position and normal power supply operation is resumed.

Programming the Shutdown Function

CAUTION
The external voltage applied to J3 connector pins 1 and 2 (Shutdown input and return) cannot exceed 250V rms with respect to the supply's negative output or the supply may be damaged.

The Shutdown circuit uses either a TTL compatible signal, or a 12-250Vac or 12-130Vdc input, to disable or enable the power supply output. Connections for either TTL, AC, or DC input signals are made at connector J3. Internal switch SW1-8 settings determine whether positive or negative logic for the signal is used. The input lines for the Shutdown circuit are optically isolated and can therefore be used by input sources with a voltage differential of up to 400Vdc.

External Wiring Use 20 to 24 AWG wiring when making connections to the J3 connector. Keep wiring as short as possible.

TTL Shutdown To activate the Shutdown function using a TTL compatible input:

1. Turn off the power supply and disconnect the AC power source. Allow five (5) minutes to elapse to dissipate stored energy before making connections or resetting switches.
2. Connect the TTL signal source to pin 14 (TTL Shutdown Input/positive) and pin 2 (Return for Shutdown Input) on the J3 connector on the rear panel. See Figure 3.15 and Figure 3.16.

3. Set internal switch SW1-8 to select the desired circuit logic as set out in the following table.

Table 3.2 Switch Settings for TTL Shutdown Circuit Logic

Switch SW1-8 Setting	TTL Signal Level	Output Condition
OPEN (Positive logic)	HIGH LOW	OFF ON
CLOSED (Negative logic)	HIGH LOW	ON OFF

The red S/D (Shutdown) LED on the front panel lights up when the Shutdown circuit is activated.

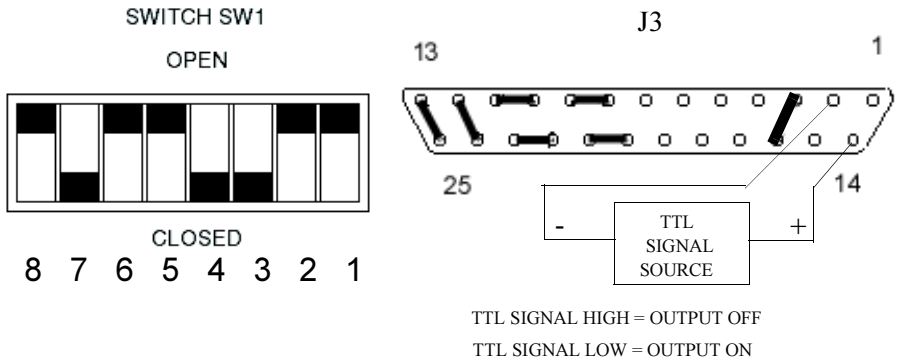

Figure 3.15 Using Shutdown with a TTL Compatible (Positive Logic)

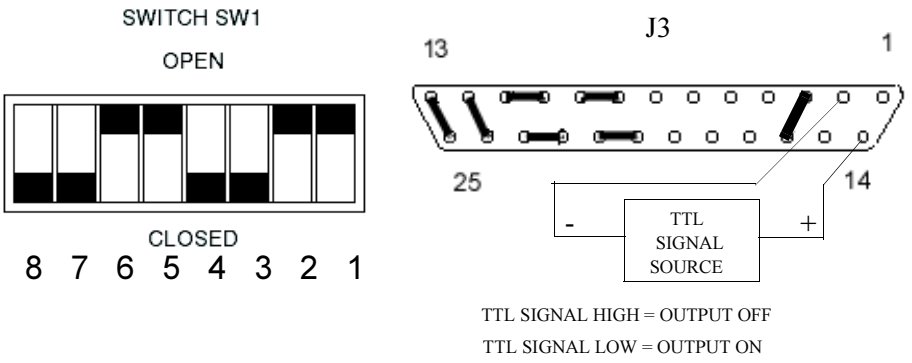

Figure 3.16 Using Shutdown with a TTL Compatible (Negative Logic)

AC/DC Shutdown

CAUTION
The external voltage applied to J3 connector pins 1 and 2 (Shutdown input and return) cannot exceed 250V rms with respect to the supply's negative output or the supply may be damaged.

To activate the Shutdown function using a 12-250Vac input or a 12-130Vdc input:

1. Turn off the power supply and disconnect the AC power source. Allow five (5) minutes to elapse to dissipate stored energy before making connections or resetting switches.
2. Connect the AC or DC source to pin 1 (positive) and pin 2 (return) on the J3 connector on the rear panel. See Figure 3.17 and Figure 3.18.
3. Set internal switch SW1-8 to select the desired circuit logic as set out in Table 3.3.

Table 3.3 Switch Settings for AC/DC Shutdown Circuit Logic

Switch SW1-8 Setting	AC/DC Signal Level	Output Condition
OPEN (Positive)	ON OFF	OFF ON
CLOSED (Negative)	ON OFF	ON OFF

The red SD (shutdown) LED on the front panel lights up with the Shutdown circuit is activated.

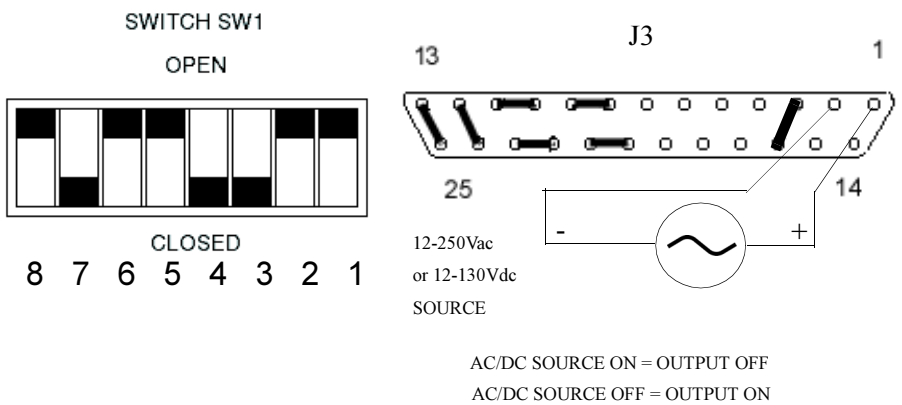

Figure 3.17 Using Shutdown with an AC or DC Input (Positive Logic)

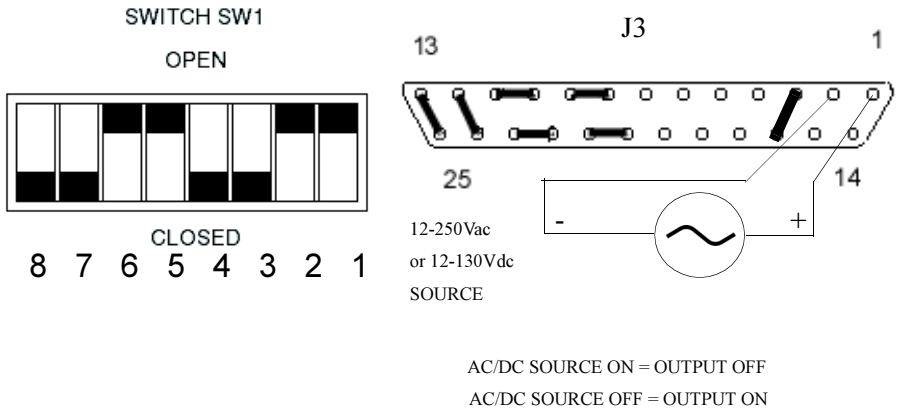

Figure 3.18 Using Shutdown with an AC or DC Input (Negative Logic)

Shutdown Application Contact Closure

An external relay, whether normally open or normally closed, may be used to activate the Shutdown circuit. Either positive or negative logic may be used.

To activate the Shutdown function using an external relay:

1. Turn off the power supply and disconnect the AC power source. Allow five (5) minutes to elapse to dissipate stored energy before making connections or resetting switches. Refer to "Configuring for Remote Programming, Sensing, and Monitoring" on page 48 for instructions for resetting switches or making J3 connections.
2. Connect one side of the external relay to pin 15 (+15Vdc Auxiliary Output) on connector J3. Connect the other side of the relay to pin 14 (TTL Shutdown Input). Also connect pin 2 (Shutdown Return) to pin 6 (Auxiliary Supply Ground). See Figure 3.19 through Figure 3.22.
3. Set internal switch SW1-8 to select the desired circuit logic as set out in Table 3.4.

Table 3.4 Relay and Switch Settings for Contact Closure

Relay	Switch SW1-8 Setting	Relay Coil State	Output
Normally Open Relay	OPEN (Positive Logic)	Energized	OFF
		De-energized	ON
	CLOSED (Negative Logic)	Energized	ON
		De-energized	OFF
Normally Closed Relay	OPEN (Positive Logic)	Energized	ON
		De-energized	OFF
	CLOSED (Negative Logic)	Energized	OFF
		De-energized	ON

The red S/D (Shutdown) LED on the front panel lights up when the Shutdown circuit is activated.

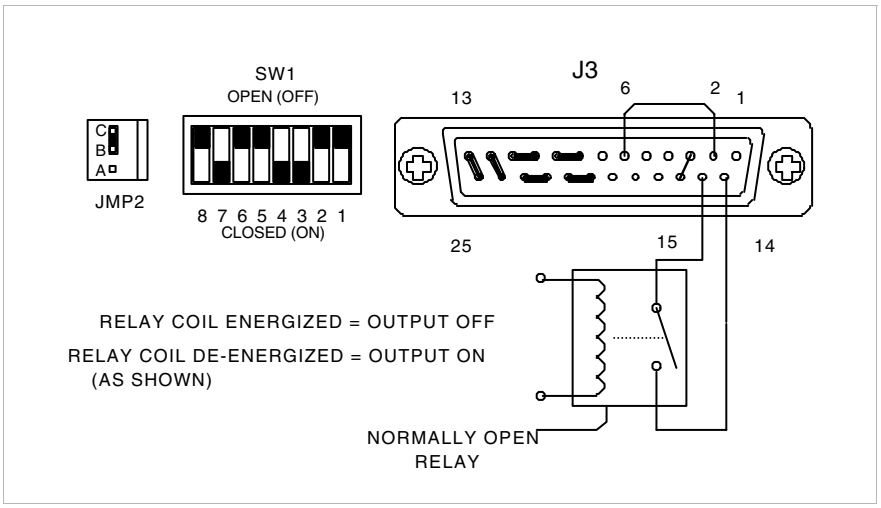

Figure 3.19 Using Shutdown with Contact Closure of a Normally OPEN Relay (Positive Logic)

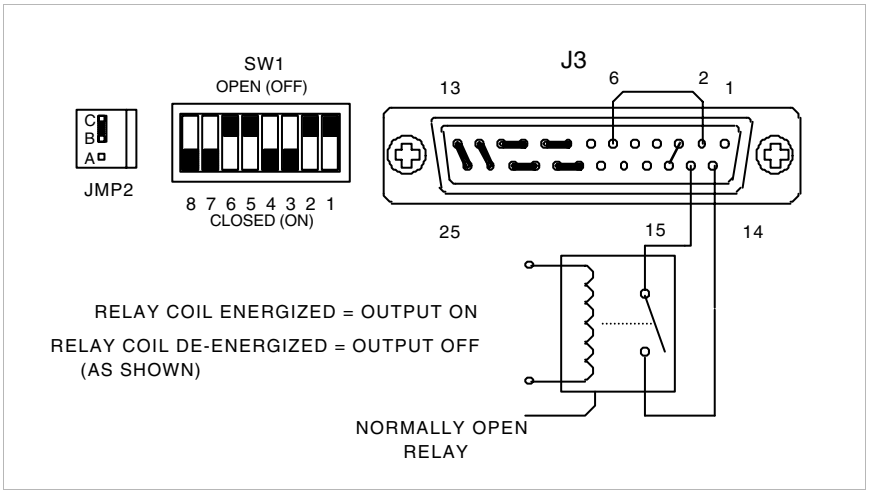

Figure 3.20 Using Shutdown with Contact Closure of an OPEN Relay (Negative Logic)

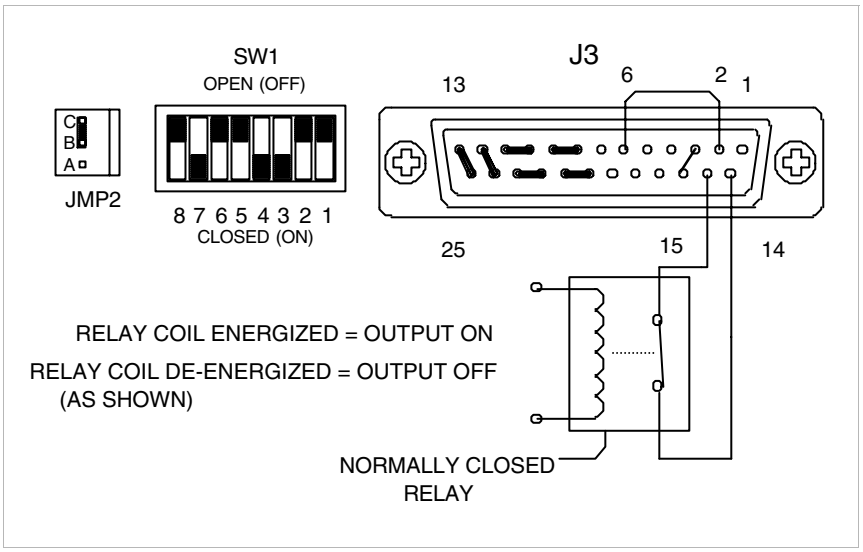

Figure 3.21 Using Shutdown with Contact Closure of a CLOSED Relay (Positive Logic)

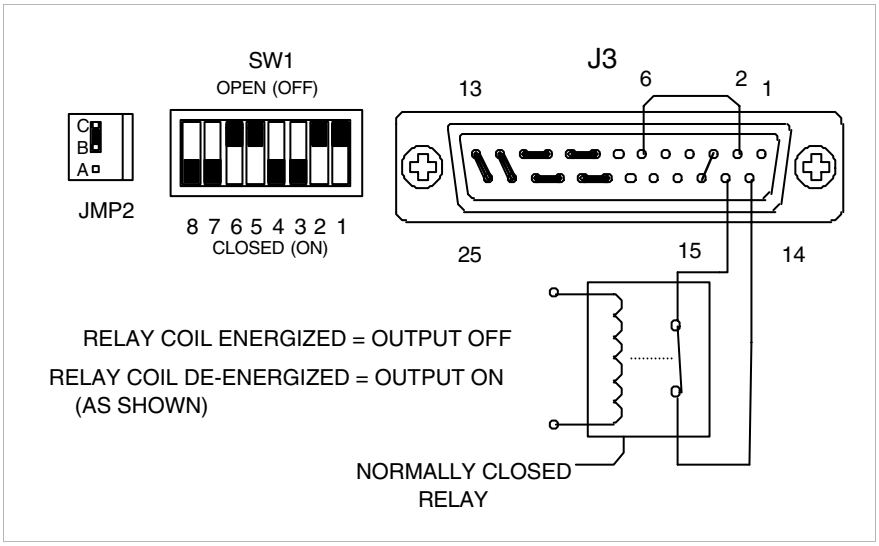

Figure 3.22 Using Shutdown with Contact Closure of a CLOSED Relay (Negative Logic)

Remote Monitoring of Readback Signals and Status Indicators

Readback Signals

Calibrated readback signals for remote monitoring of the output voltage and current are available via connections at the J3 connector on the rear panel. Internal switch SW1 settings allow you to select either a 0-5Vdc or a 0-10Vdc range for the output. See "Configuring for Remote Programming, Sensing, and Monitoring" on page 48 for more information about making these connections.

Table 3.5 shows the required pin connections and switch settings for remote monitoring of readback signals with 0-5Vdc or 0-10Vdc outputs. Use shielded-twisted pair wiring (20 to 24 AWG) and ground the shield to J3 connector pin 6 or to the chassis via one of the J3 connector screws.

Table 3.5 Supply Settings for Remote Monitoring of Readback Signals

Readback Signal	J3 Connections:		Switch SW1 Settings:		Output Signal Range
	Signal (+)	Return (-)	Switch #	Setting	
Output Voltage	Pin 19	Pin 12	SW1-4	CLOSED OPEN	0-5Vdc 0-10Vdc
Output Current	Pin 7	Pin 12	SW1-3	CLOSED OPEN	0-5Vdc 0-10Vdc

The readback signal represents 0 to 100% of the model-rated output.

Status Indicators

Status indicators for thermal shutdown, OVP circuit, programming mode, and operating mode are available via connections on the J3 connector on the rear panel.

Table 3.6 shows the indicator signals, the J3 connector pin at which they are available, an approximation of the signal magnitude, and the source impedance through which the signal is fed. Use 20 to 24 AWG wiring.

Table 3.6 Power Supply Settings for Status Indicator Signals

Indicator Signal/Alternate State	J3 Connections:		Signal Voltage	Source Impedance
	Signal (+)	Return (-)		
Thermal Shutdown/ Normal Operation	Pin 18 Pin 18	Pin 6 Pin 6	+13V 0V	1k ohms 1k ohms
OVP Circuit Activated/ OVP Circuit Not Activated	Pin 17 Pin 17	Pin 6 Pin 6	+13V -13V	1k ohms 1k ohms
Remote Programming Mode/ Local Programming Mode	Pin 4 Pin 4	Pin 6 Pin 6	+13V 0V	1k ohms 1k ohm
Voltage Mode Operation/ Current Mode Operation	Pin 5 Pin 5	Pin 6 Pin 6	+13V -13V	1k ohms 1k ohms

Using Multiple Supplies

Power supplies of the SAME MODEL in this series may be operated with outputs in series or in parallel to obtain increased load voltage or increased current. Split supply operation allows two positive or a positive and a negative output to be obtained.

Configuring Multiple Supplies for Series Operation

CAUTION
Do not use remote sensing during series operation.

CAUTION
The remote programming input is internally referenced to the supply's negative output. Do not connect remote programming input lines (J3 pins 9 and 10) to the supply's positive output.

Series operation is used to obtain a higher voltage from a single output using two or more supplies. Connect the negative (-) output terminal of one supply to the positive (+) output terminal of the next supply. See Figure 3.23. The total voltage available is the sum of the maximum voltages of each supply (add voltmeter readings). The maximum allowable current for a series string of power supplies is the model-rated output current of a single supply in the string.

Note: The maximum allowable sum of the output voltages is 600Vdc. This is limited by the voltage rating of certain internal components.

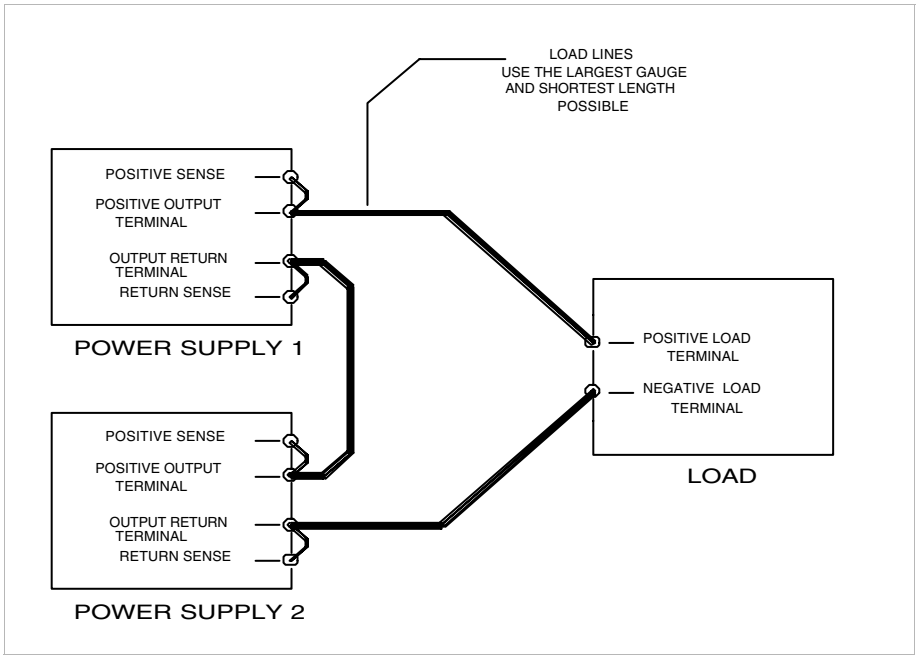

Figure 3.23 Series Operation of Multiple Supplies
(Local sense lines shown are default J3 connections.)

Configuring Multiple Supplies for Parallel Operation

Parallel operation is used to obtain a higher current through a single output using two or more supplies. Set all of the outputs to the same voltage before connecting the positive (+) output terminals and negative (-) output terminals in parallel. See Figure 3.23. The total current available is the sum of the maximum currents of each supply.

Notes:

1. Set the OVP trip level to the same point for all of the paralleled supplies.
2. When operating multiple supplies in parallel, the operating mode of each supply will depend on the load current being drawn. For example, with two 60V-50A output power supplies operating in parallel with a 75A load, one supply will operate in constant current mode supplying 50A and the other supply will operate in voltage mode supplying the remaining 25A.

Sensing for Parallel Operation Use default local sensing to enhance power sharing between units, as the impedance of the load lines will tend to correct for current imbalance. If you use remote sensing at the load for better voltage regulation, one supply always operates in current limit mode and supplies most of the power.

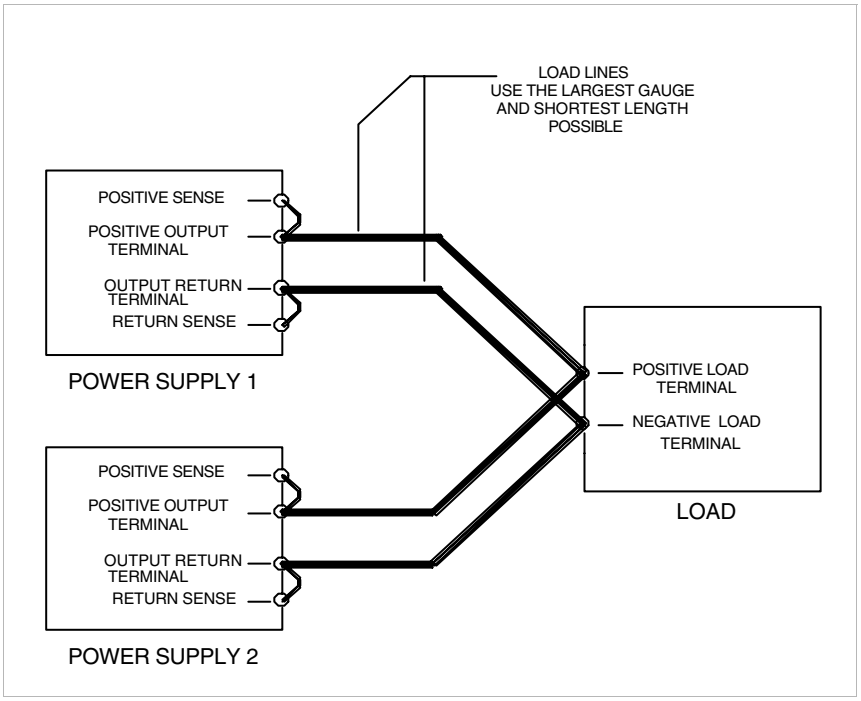

Figure 3.24 Parallel Operation of Multiple Supplies
(Local sense lines shown are default J3 connections.)

Configuring Multiple Supplies for Split Supply Operation

CAUTION
To prevent possible damage to the supply, do not connect the remote program return line of the negative supply to the common connection.

Split supply operation uses two power supplies to obtain two positive voltages with a common ground, or to obtain a positive-negative supply.

To obtain **two positive voltages**, connect the negative output terminals of both supplies together. The positive output terminals will provide the required voltages with respect to the common connection. See Figure 3.25. To obtain a **positive-negative supply**, connect the negative output terminal of one supply to the positive output terminal of the second supply. The positive output terminal of the first supply then provides a positive voltage relative to the common connection while the negative output terminal of the second supply provides a negative voltage. The current limits can be set independently. The maximum current available in split supply operation is equal to the model-rated output of the supplies used. See Figure 3.26.

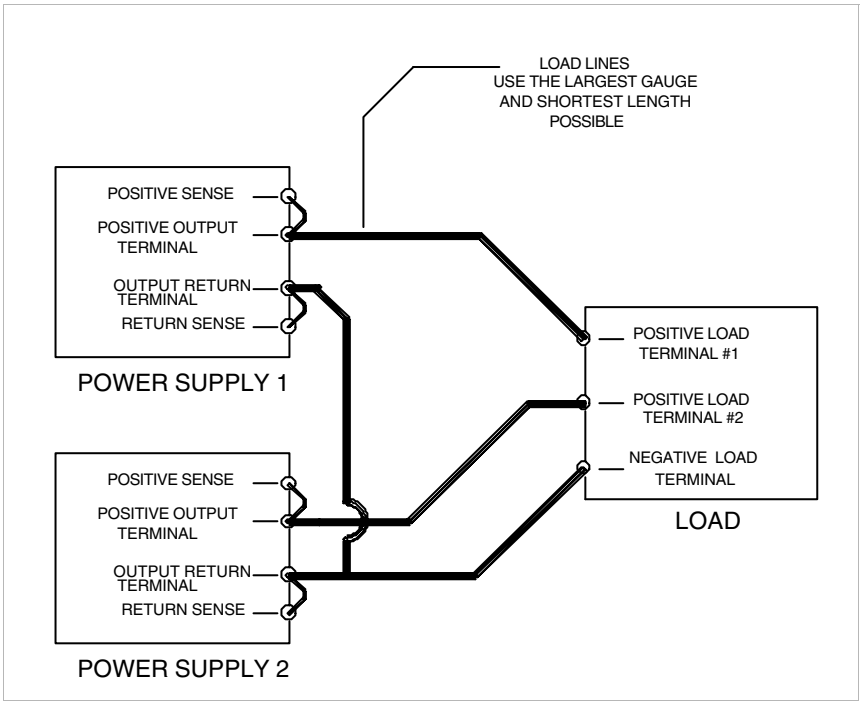

Figure 3.25 Split Supply Operation of Multiple Supplies
(Two Positive Voltages)
(Local sense lines shown are default J3 connections)

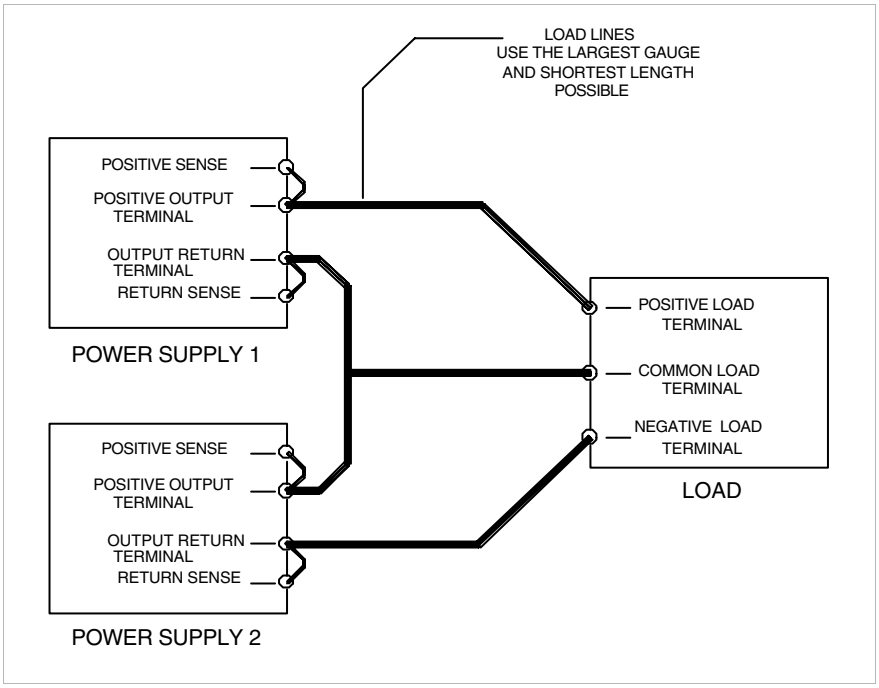

Figure 3.26 Split Supply Operation of Multiple Supplies
(Positive-negative Supply)
(Local sense lines shown are default J3 connections.)

Section 4. Calibration

Introduction

WARNING
Exercise caution when using and calibrating a power supply. High energy levels can be stored at the output voltage terminals on a power supply in normal operation. In addition, potentially lethal voltages exist in the power circuit and on the output and sense connectors of a power supply with a rated output greater than 40 V. Filter capacitors store potentially dangerous energy for some time after power is removed.

Adjustments to programming and readback accuracy for the power supply are made using cover-off procedures which must be performed by a service technician.

Calibration Setup

Service Environment and Precautions

- Follow established antistatic procedures.
- Work at a bench with adequate room and support for the unit under test and for all equipment required.
- To reduce shock hazard, use only an insulated, straight-blade screwdriver when calibrating trim potentiometers.
- NEVER calibrate these units alone. Ensure that someone is present who can help should an accident occur.

Accessing Calibration Potentiometers

WARNING
Disconnect AC power from the unit before removing the cover. Even when the front panel power switch is in the OFF position, live line voltages are exposed when the cover is removed. Repairs and adjustments must be made by experienced service technicians only.

WARNING
Use a non-conducting, straight-blade screwdriver to adjust the trim pots.

CAUTION
Follow established antistatic procedures. There are static-sensitive parts on the printed circuit boards.

Removing the Cover

1. Unscrew and remove the eight (8) flathead Philips screws from the top of the cover: two (2) are located near the front panel, six (6) near the rear panel. Use a #1 Philips screwdriver.
2. Loosen but do not remove the six (6) Philips screws located three (3) to a side in the slots along each side of the power supply.
3. Lift cover off and set aside.

Removing the Option Board (when required)

The power supply may have either of two option circuit boards installed over the A2 circuit board where the jumpers and switches are located. The option board must be removed to allow access to them.

1. Unplug any external mating connector and attached wiring.
2. Use a nutdriver to remove the jack screws which fasten the option board to the rear panel.
3. Unscrew the mounting screws which fasten the option board down.
4. Unplug any attached cables.

Lift out the option board and set aside.

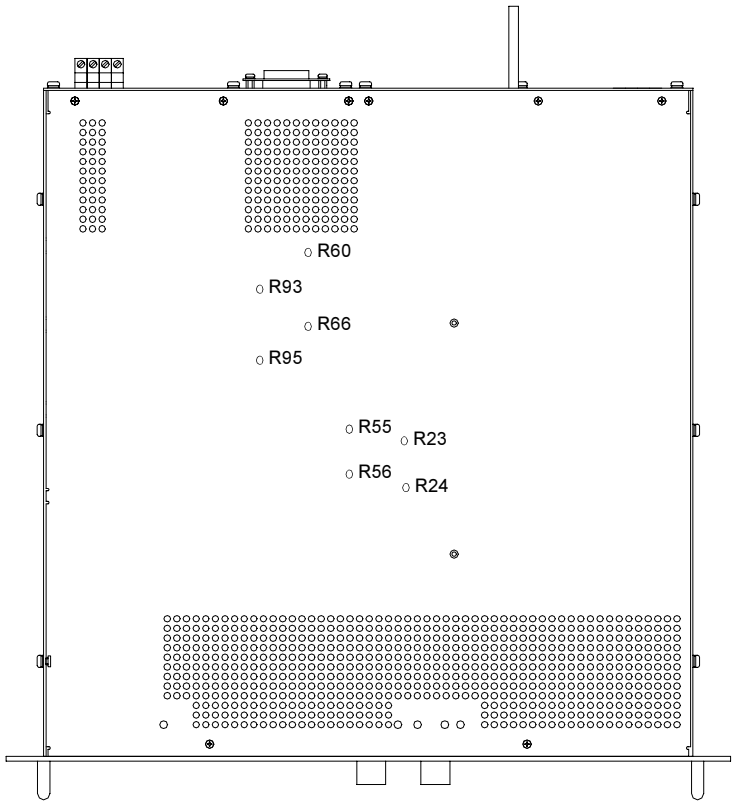

Figure 4.1 Calibration Adjustment Locations

Calibrating for Programming Accuracy

The offset and range of the voltage and current programming circuits are calibrated for default 0-5Vdc programming signals at the factory. Recalibration may be necessary when you use custom 0-10Vdc programming or when you switch back to 0-5Vdc programming after previously calibrating for 0-10Vdc programming.

Voltage Programming Circuit Calibration

Table 4.1 Voltage Programming Calibration Procedures

Function & designation of multiturn trim pots	Step	Action
Voltage Program Offset (R93)	1	Disconnect any load. Connect a DVM rated at better than 0.5% accuracy to the power supply output.
	2	Apply 1% of program voltage. Example: 0.1 for 0-10Vdc or 0.05 for 0-5Vdc programming source
	3	Adjust R93 until the DVM reads 1% of the rated output voltage. Example: 0.4Vdc for 40V Model
Voltage Program Scale (R60)	1	Disconnect any load. Connect a DVM rated at better than 0.5% accuracy to the power supply output.
	2	Apply 100% of program voltage. Example: 10V for 0-10Vdc or 5V for 0-5Vdc programming source
	3	Adjust R60 until the DVM reads 100% of the rated output voltage. Example: 40Vdc for 40V Model

Repeat this procedure until the voltage programming is adjusted to the desired accuracy.

Current Programming Circuit Calibration

Table 4.2 Current Programming Calibration Procedures

Function & designation of multiturn trim pots	Step	Action
Current Program Offset (R95)	1	Connect a shunt and DVM to the power supply output. See Note 1.
	2	Apply 1% of program voltage. Example: 0.1 for 0-10Vdc or 0.05 for 0-5Vdc programming source
	3	Adjust R95 until the DVM indicates 1% of the rated output current. Example: 0.75A for 40V Model. See Note 2.
Current Program Scale (R66)	1	Connect a shunt and DVM to the power supply output. See Note 1.
	2	Apply 100% of program voltage. Example: 10V for 0-10Vdc or 5V for 0-5Vdc programming source
	3	Adjust R66 until the DVM indicates 100% of the rated output current. Example: 75A for 40V Model. See Note 2.

Repeat this procedure until the current programming is adjusted to the desired accuracy.

Notes:

1. The DC shunt-DVM combination must be rated better than 0.5% accuracy. The recommended current ratings for the DC shunt and connecting wire must be at least 10% greater than the power supply's output current rating.
2. The required DVM reading is calculated using V=I x R where V is the DVM reading, I is the current, and R is the DC shunt resistance.

Voltage Readback Calibration

The factory calibrates the offset and range of the output voltage and current monitor circuits to within 1% for the default 0-5Vdc scales. Should you need to recalibrate, make adjustments to multiturn potentiometers on the A2 Assembly PCB which you access by removing the cover of the power supply.

Table 4.3 Voltage Readback Calibration

Function & Designation of multiturn trim pots	Step	Action
Output Voltage Monitor Offset (R55)	1	Disconnect any load. Connect two DVMs; one to the power supply output and the second to the voltage monitor terminals on the rear panel J3 connector [J3-19 (Positive) and J3-6 (Negative)]. See Note.
	2	Set the power supply output to 1% of its rated output voltage.
	3	Adjust R55 until the monitor DVM reads 1% of the readback scale. Example: 0.4Vdc for 40V Model.
Output Voltage Monitor Range (R56)	1	Set the power supply output to 100% of its rated voltage.
	2	Adjust R56 until the monitor DVM reads 100% of the readback scale. Example: 40Vdc for 40V Model.

Repeat this procedure until the monitor signal is adjusted to the desired accuracy.

Note:

1. The recommended accuracy rating for the DVMs is four times better than your desired readback accuracy.

Current Readback Calibration

Table 4.4 Current Readback Calibration

Function & Designation of multiturn trim pots	Step	Action
Output Current Monitor Offset (R23)	1	Disconnect any load. Connect a shunt and DVM across the power supply output to read the output current. Connect a second DVM to the rear panel J3 output current monitor terminals. [J3-7 (Pos.) and J3-12 (Neg.)]. See Note 1.
	2	Set the supply output current to 1% of its rated output current. See Note 2.
	3	Adjust R23 until the monitor DVM indicates 1% of the readback scale. Example: 0.75A for 40V Model.
Output Current Monitor Range (R24)	1	Set the supply output current to 100% of its rated value.
	2	Adjust R24 until the monitor DVM indicates 100% of the readback scale. Example: 75A for 40V Model.

Repeat this procedure until the monitor scale is adjusted to the desired accuracy.

Notes:

1. The recommended accuracy of the DVM and DC shunt-DVM combination is four times better than your desired readback accuracy. The recommended current ratings for the DC shunt and connecting wire is at least 10% greater than the power supply's output current rating.

Calculate the required DVM reading using V=I x R where V is the DVM reading, I is the current, and R is the DC shunt resistance.

Battery Charging

When using this power supply to charge a battery, take the following precautions to prevent damage to the supply and/or the battery **in case the overvoltage protection (OVP) circuit is activated**.

1. Select a diode rated to handle the required charging current and voltage. Use the following table as a reference.

Peak Charging Current	Maximum Voltage	Diode Type
250-350A	40V	Two (2) parallel MBR30045CT
60-249A	40V	One (1) MBR30045CT
25-59A	100V	One (1) MUR7015
10-24A	300V	One (1) MUR3040PT
5-9A	500V	One (1) MUR1560
<5A	600V	One (1) MUR758

2. Connect the diode in series with either supply output to prevent the battery from discharging through the internal OVP crowbar transistor. The diode must be mounted on a suitably-rated heatsink to prevent its case temperature from exceeding the manufacturer's maximum limits.

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