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.
- Front panel push-button control of output standby mode and preview of voltage, current, or OVP setpoints. Front panel light emitting diode (LED) indicators for voltage and current mode operation, OVP, remote programming mode, and shutdown. Front panel control of OVP.
- Multiple units can be connected in parallel or in series to provide increased current or voltage.
- Thermal shutdown, latching or auto reset.
- Remote analog voltage and current limit programming with selectable programming ranges.
- External monitor signals for output voltage and current.
- Isolated analog remote programming control of the output voltage or current and isolated readback of output voltage and current with the optional ISOL Interface.
- Optional internal GPIB or RS-232 control for remote digital programming and readback from a computer.

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 A–11
- "Functional Tests" on page 2–10
- Chapter 3, "Local Operation"

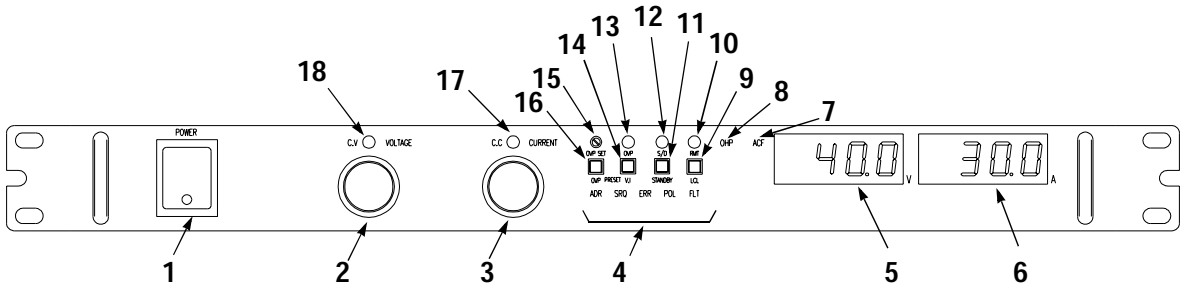

Figure 1-1 Power Supply Front Panel

Item	Description
1	AC Power Switch
2	Output Voltage Control Knob
3	Output Current Control Knob
4	Remote Programming LEDs. (For units with digital programming interface installed.)
5	Voltage Meter
6	Current Meter
7	AC Fail LED (ACF)
8	Over Temperature Protection LED (OTP)
9	Return to Local Programming (LOCAL) (For units with digital programming interface installed.)
10	Remote Programming LED (REM)
11	Standby Switch (STANDBY) (See page 3–9 for more information)
12	Shutdown LED (S/D)
13	OVP Shutdown LED (OVP)
14	Local Voltage and Current Limit Setting Preview Switch (V-I PRESET) (See page 2–10 for more information.)
15	OVP Adjust Potentiometer (OVP SET) (See page 3–7 for more information.)
16	OVP Setting Preview Switch (OVP CHECK) (See page 3–7 for more information.)
17	Current Mode LED
18	Voltage Mode LED

Rear Panel Connectors and Switch

Use the rear panel SW1 Programming, Monitoring, and Shutdown Select switch and the rear panel J2 Programming and Monitoring connector to choose among several remote programming and monitoring options. See Figure 1-2 for the switches and connectors available at the rear panel. See "Rear Panel SW1 Switch" on page 1–7 and "Rear Panel J2 Connector" on page 1–9 for a list of switches and connector functions, and procedures for using them.

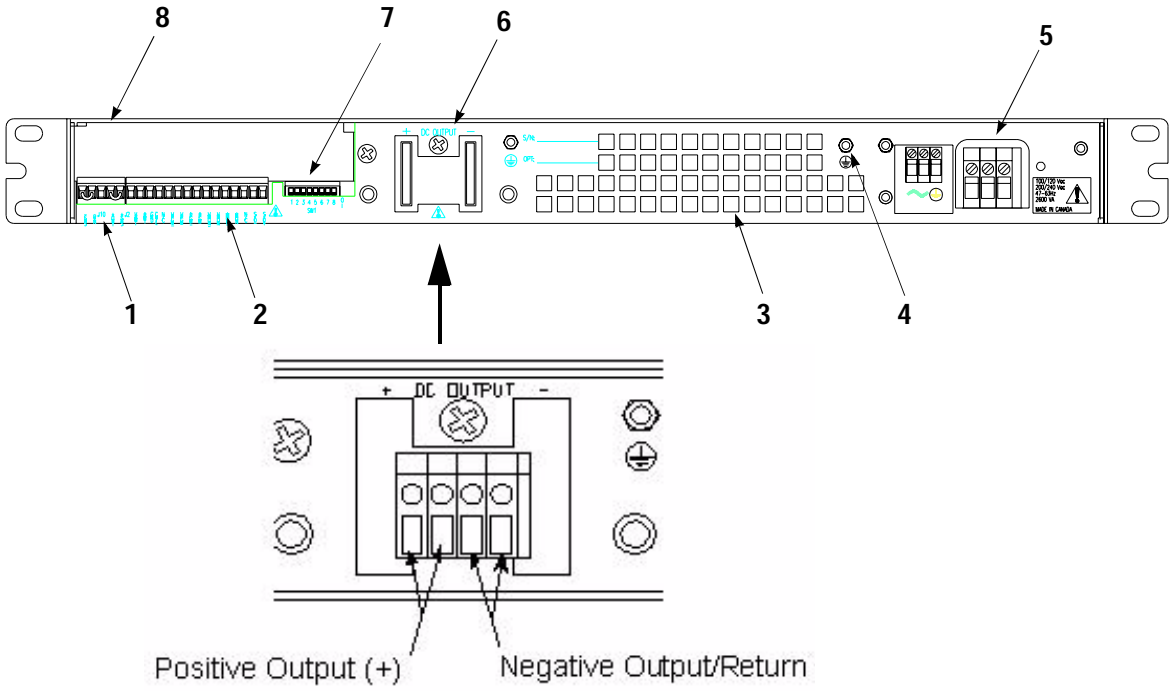

Figure 1-2 Power Supply Rear Panel

Item	Description
1	J10 Sense Connector (See page 2–23 for more information.) J10-1 Return Sense J10-2 Negative Output (Return) J10-3 No connection (N/C) J10-4 Positive Output J10-5 Positive Sense
2	J2 Programming and Monitoring Connector (See page 1–9 for more information.)
3	Fan Exhaust Vents (Do not block.)
4	Chassis Ground Screw
5	AC Input Connector (See page 2–6 for more information)
6	DC Output for Bus Bar Models (See inset in Figure 1-2 and page 2–13 for more information.)
7	SW1 Switch (See page 1–7 for more information.)
8	Blank Subplate (Replaced if digital programming interface installed.

Rear Panel SW1 Switch

The SW1 Programming, Monitoring, and Shutdown Select switch is an 8-position piano DIP switch located on the power supply's rear panel. See Figure 1-3. The SW1 switch enables you to choose:

- Resistive programming of output voltage or current limit
- Output voltage and current limit programming scales
- Output voltage and current monitor scales
- Remote shutdown circuit logic
- Over temperature shutdown mode

1 Resistive Programming of Output Voltage
2 Resistive Programming of Output Current
3 Selects Output Voltage Programming Source Range
4 Selects Output Current Limit Programming Source Range
5 Selects Output Voltage Monitor Range
6 Selects Output Current Monitor Range
7 Selects Remote Shutdown Logic
8 Selects Over Temperature Shutdown Reset Mode

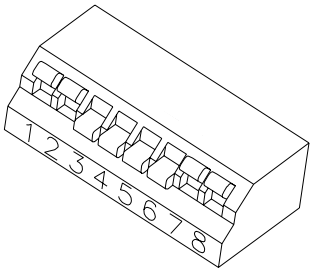

Figure 1-3 Programming and Monitoring SW1 Switch
(Switch is shown in factory default configuration)

Table 1-2 shows the functions assigned to each SW1 switch. Factory defaults are underlined.

Table 1-2 Rear Panel SW1 Switch Assignments

Switch	Function	Open	Closed
SW1-1	1 mA current source for resistive programming of output voltage	Voltage source programming	Resistive programming (0-5 k, 0-10 k)
SW1-2	1 mA current source for resistive programming of output current limit	Voltage source programming	Resistive programming (0-5 k, 0-10 k)
SW1-3	Output voltage programming source range select	0-5 V (0-5 k)	0-10 V (0-10 k)
SW1-4	Output current limit programming source range select	0-5 V (0-5 k)	0-10 V (0-10 k)
SW1-5	Output voltage monitor range select	0-5 V	0-10 V
SW1-6	Output current monitor range select	0-5 V	0-10 V
SW1-7	Remote shutdown logic select	HIGH=OFF	HIGH=ON
SW1-8	Over temperature shutdown reset mode select	Auto reset	Latch OFF

Resetting the Switches

Before making any changes to the switch settings, disable the power supply output by pushing the front panel STANDBY switch to its IN position. This temporarily shuts down the power supply. The front panel S/D LED turns on. Then use any small, flat-bladed screwdriver to change the switch settings.

Any of the eight switches on SW1 is OFF (OPEN) when it has been flipped up to break contact, ON (CLOSED) when flipped down to close contact.

Rear Panel J2 Connector

The J2 Programming and Monitoring connector is a 15-terminal wire clamp connector located on the power supply's rear panel. See Figure 1-4. The J2 connector provides access to the following functions:

- Remote programming of output voltage AND/OR current limit
- Remote monitoring of calibrated readback signals for output voltage and output current
- Remote control of the shutdown function using a 2.5 V to 15 V signal

1 Remote Output Voltage Programming Select
2 Remote Output Current Limit Programming Select
3 Control Ground
4 N/C
5 Voltage Program Signal Return
6 Output Voltage Programming Input
7 Current Program Signal Return
8 Output Current Limit Programming Input
9 Voltage Monitor Signal Return
10 Output Voltage Monitor
11 Current Monitor Signal Return
12 Output Current Monitor
13 N/C
14 Shutdown (S/D) Signal Return (–)
15 S/D Input (+)

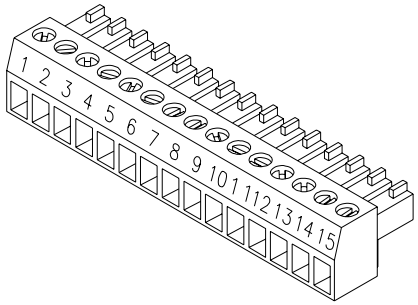

Figure 1-4 Programming and Monitoring J2 Connector

See Table 1-3 for the list of the J2 connector terminal numbers, their references, and corresponding functions.

Table 1-3 Rear Panel J2 Connector Terminals and Functions

Connector	Reference	Name	Function
J2-1	VRMT	Remote Output Voltage Programming Select	Selects remote output voltage programming when jumpered to pin 3.
J2-2	IRMT	Remote Output Current Limit Programming Select	Selects remote output current limit programming when jumpered to pin 3.
J2-3	CNTL GND	Control ground.	Control ground.
J2-4	N/C	No connection	None
J2-5	VPGM–	Voltage Program Signal Return	Return for voltage program signal.
J2-6	VPGM	Output Voltage Programming Input	Input for voltage programming signals from an analog device.
J2-7	IPGM–	Current Program Signal Return	Return for current program signal.
J2-8	IPGM	Output Current Limit Programming Input	Input for current limit programming signals from an analog device.
J2-9	VMON–	Voltage Monitor Signal Return	Return for voltage monitor signal.
J2-10	VMON	Output Voltage Monitor	Output for output voltage monitor signal.
J2-11	IMON–	Current Monitor Signal Return	Return for current monitor signal.
J2-12	IMON	Output Current Monitor	Output for output current monitor signal.
J2-13	N/C	No connection	None.
J2-14	S/D–	Shutdown Signal Return (–)	Return for shutdown signal.
J2-15	S/D+	S/D Input (+)	Input for shutdown signal.

Connecting Single Loads

Figure 2-7 and Figure 2-8 show recommended load and sensing connections for single loads. Local sense lines shown are default connections at the rear panel J10 sense connector.

You do not need remote sensing for basic operation of your supply. However, if you wish to correct any small drops in your load lines, then use the remote sensing feature. See "Local and Remote Sensing" on page 2–23 for more information.

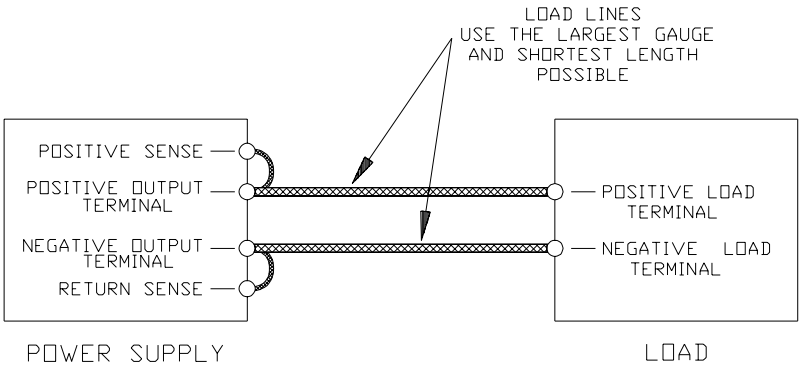

Figure 2-7 Single Load with Local Sensing (Default)

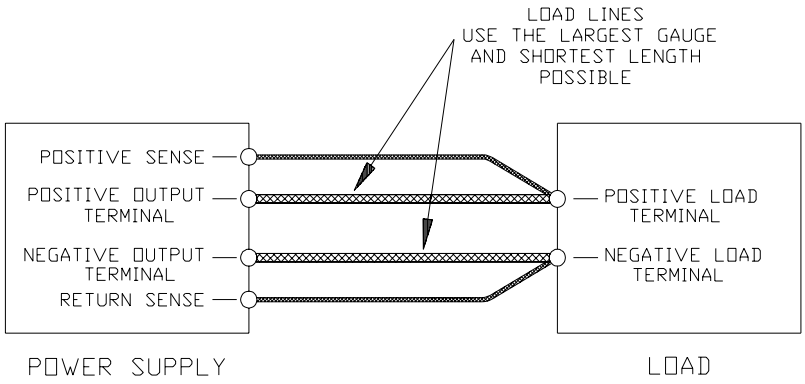

Figure 2-8 Single Load with Remote Sensing

Connecting Multiple Loads

Proper connection of distributed loads is an important aspect of power supply use. Two common methods of connection are the parallel power distribution method and the radial power distribution method.

Parallel Power Distribution

This distribution method involves connecting leads from the power supply to one load, from that load to the next load, and so on for each load in the system. This method results in the voltage at each load depending on the current drawn by the other loads and allows DC ground loops to develop. Except for low current applications, we do not recommend using this method.

Radial Power Distribution Method

To connect distributed loads, we recommend that you use radial power distribution. With this method, you connect power to each load individually from a single pair of terminals designated as the positive and negative distribution terminals. These 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 use. Connect the sense leads to these terminals to compensate for losses and minimize the effect of one load upon another.

Figure 2-9 and Figure 2-10 show recommended load and sensing connections for multiple loads. Local sense lines shown are default J10 sense connections. See “Local and Remote Sensing” on page 2–23 for more information about using remote sensing, and about grounding the sense line shield.

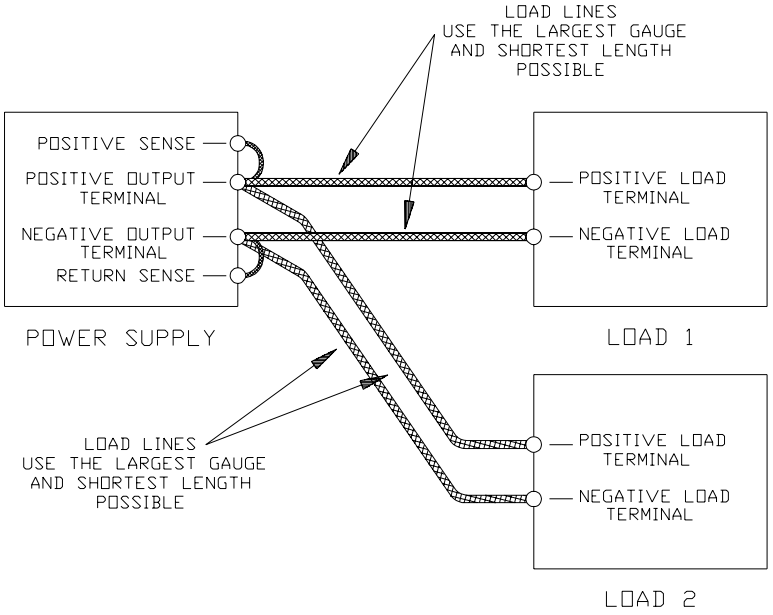

Figure 2-9 Multiple Loads with Local Sensing

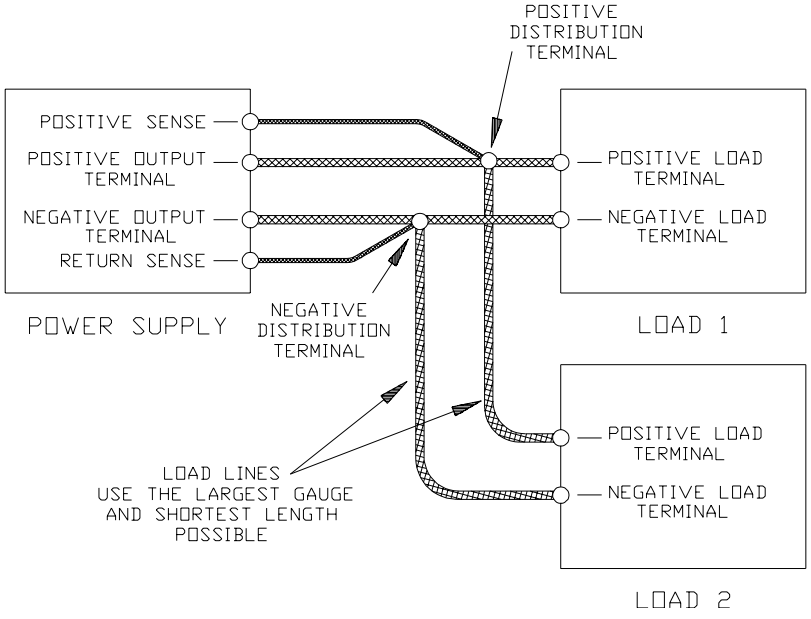

Figure 2-10 Multiple Loads with Remote Sensing

Local and Remote Sensing

Use connections at the rear panel J10 sense connector to configure the power supply for local or remote sensing of output voltage. See Figure 2-11 for a drawing of the sense connector.

Sense Wiring

WARNING

There is a potential shock hazard at the sense connector when using a power supply with a rated output greater than 40 V. Select wiring with a minimum insulation rating equivalent to the maximum output voltage of the power supply for use as local sense jumpers or for remote sense wires. For example, select TEW-105, 105 °C, 600 V wiring for use with a 600 V, 2 A model power supply. Ensure that connections at the load end are shielded to prevent contact with hazardous voltages.

For lowest noise performance, use shielded pair wiring of 16 to 24 AWG for remote sense lines. Strip wires 0.26 in. (6.5 mm), insert and tighten the wire clamp.

Local Sensing

We ship the power supply with the rear panel J10 sense connector jumpered for local sensing of the output voltage. See Table 2-5 for the list of connector functions and a description of local sense connections. With local sensing, the output voltage is regulated at the output terminals (or bus bars). This method does not compensate for voltage losses in the load lines, so it is recommended only for low current applications or applications for which load regulation is not essential.

Important: When using local sense connections, use the largest practical load wire size to minimize the effects of line impedance on the regulation of the supply.

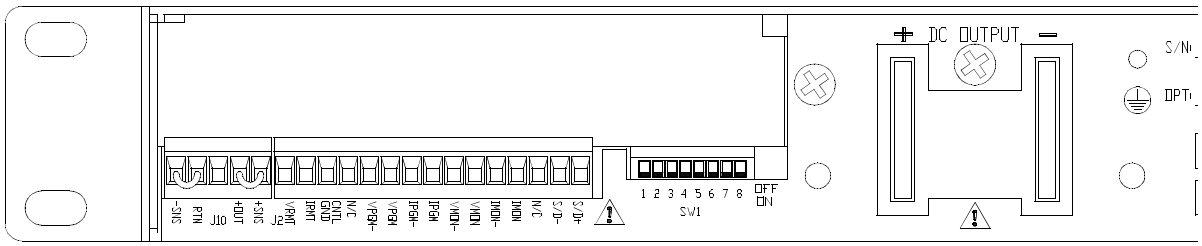

Figure 2-11 J10 Sense Connector
(Shown with local sense jumpers connected)

Table 2-5 Rear Panel J10 Sense Connector Terminals and Functions

Terminal	Name	Function
J10-1	Return Sense (–SNS)	Remote negative sense connection. Default connection to terminal 2.
J10-2	Negative Output (Return or RTN)	Connected internally to negative output.
J10-3	N/C	No connection.
J10-4	Positive Output (+OUT)	Connected internally to positive output.
J10-5	Positive Sense (+SNS)	Remote positive sense connection. Default connection to terminal 4.

Using Remote Sensing

WARNING

There is a potential shock hazard at the sense points when using a power supply with a rated output greater than 40 V. Ensure that connections at the load end are shielded to prevent contact with hazardous voltages.

CAUTION

Ground the sense line shield in one place only. Locations include: the power supply's return output connection at the load, the power supply's return output at its negative output terminal, or at the power supply's chassis.

CAUTION

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

Use remote sensing during voltage mode operation to shift the power supply's regulation point from its default position at the rear panel output terminals to the load or distribution terminals by using a separate pair of wires to allow the control circuitry to monitor the load voltage. This allows the power supply to compensate for voltage losses in the load lines which will otherwise degrade the regulation of the supply. Line drop is subtracted from the total voltage available at the output.

To connect remote sense lines:

1. Turn OFF the power supply.
2. Remove the local sense jumpers connecting J10 mating connector terminal 5 (positive sense) to terminal 4 (positive output) and terminal 1 (return sense) to terminal 2 (power supply return).
3. Connect the positive remote sense lead to J10 mating connector terminal 5 (positive sense) and the negative lead to terminal 1 (return sense). Ensure the mating connector is plugged securely into the rear panel sense connector. Connect the other ends of the sense wires to the corresponding sense points at the load.
4. To prevent ground loops, ground the sense line shield, at one point only, to the power supply's return output connection at the load, to the power supply's return output at its negative output terminal, or to the power supply's chassis.

5. Turn ON the power supply.

Important: If you operate the power supply with remote sense lines connected to the load and with either of the positive or negative load lines not connected, the shutdown circuit will activate, causing the output voltage and current to fall to zero
If you operate the power supply 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; or, the OVP circuit may activate.

Figure 2-12 shows a sample setup for using remote sensing.

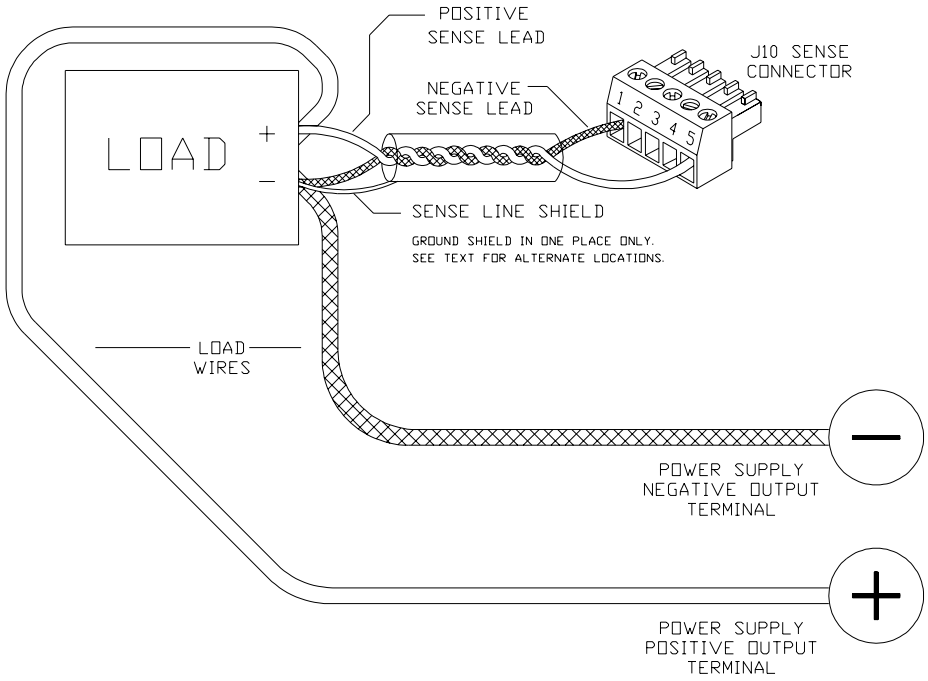

Figure 2-12 Connecting Remote Sense Lines

Introduction

The rear panel switches and connector on the power supply allow you to program the supply with an analog device or to output readback signals. This section covers the following topics:

- See "Remote Analog Programming of Output Voltage and Current Limit" on page 4–3 for procedures covering remote analog programming of output voltage and current limit with 0-5 V and 0-10 V voltage sources and 0-5 k and 0-10 k resistances.
- See "Remote Monitoring of Output Voltage and Current" on page 4–7 for more about the connector and switch settings for using calibrated readback signals for output voltage and output current with selectable 0-5 V or 0-10 V scales.

Isolated Programming The 4-channel Isolated (ISOL) Programming Interface is an internal card which can be ordered as an option. It allows remote programming and readback of the power supply's output voltage and current limit with 0-5 V analog signals at a different voltage potential relative to the power supply's output. Contact the manufacturer to order the ISOL Interface.

Remote Digital Programming You can operate the power supply from a computer if you have had the GPIB or RS-232 Interface card installed as an option. Refer to the separate interface manual for all setup and operation instructions for remote digital programming.

Remote Analog Programming of Output Voltage and Current Limit

Remote analog 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 sources. As you vary the external programming source, the power supply's output varies proportionally over its output range.

Using remote analog programming requires that you reset switch SW1 and make connections to the J2 connector on the power supply's rear panel. See "Rear Panel Connectors and Switch" on page 1–5.

Remote Programming Options

See Table 4-1 for a summary of the options available to you for programming output voltage and current limit using an analog source.

Table 4-1 Remote Programming Options

Control of...	Programming Scales [a]
Output Voltage and/or	0-5 V and 0-10 V voltage sources
Current Limit	0-5 k and 0-10 k resistances

a. These scales may be used in any combination.

Remote Analog Programming Procedure

CAUTION

To maintain the isolation of the power supply output and prevent ground loops, use an isolated (ungrounded) programming source when operating the power supply via remote analog control at the J2 connector.

CAUTION

The remote programming inputs are internally referenced to the supply's negative output. Do not connect control ground (J2 terminals 3, 5, or 7) to the supply's positive output.

To set up remote analog programming:

1. Turn the power supply OFF.
2. Set switches SW1-1, SW1-2, SW1-3, and SW1-4 according to the programming sources that you are using, as indicated in Table 4-2. See Notes at the end of this procedure for more information about switch settings.
3. Install any required J2 connector jumpers as indicated in Table 4-2.
4. Connect the programming source(s) to the mating J2 connector as shown in Figure 4-1 and observe the correct polarity for voltage sources. Ensure that the mating connector is plugged securely into the rear panel connector.
5. Set the programming sources to the desired levels and turn the power supply ON. The REM LED turns on. Adjust the external programming source to change the power supply's output.

Please remember:

- Any of the eight switches on SW1 is OFF (OPEN) when it has been flipped up to break contact, ON (CLOSED) when flipped down to close contact.
- Resetting switches SW1-3 or SW1-4, the programming scale selection switches, may require that you recalibrate the programming circuit to maintain programming accuracy. See "Calibration and Troubleshooting".
- Switches SW1-5, SW1-6, SW1-7, and SW1-8 are not required for remote programming. They remain at the settings you have selected for your application.
- Switches SW-1 to SW-4 can be set to their defaults (1 and 2 open, 3 and 4 closed) unless otherwise specified in Table 4-2. See "Rear Panel SW1 Switch" on page 1–7 for default settings.
- The control circuits have been designed to allow you to set output voltage and current up to 5% over the model-rated maximum values. The power supply will operate within these extended ranges, but we cannot guarantee full performance to specification.

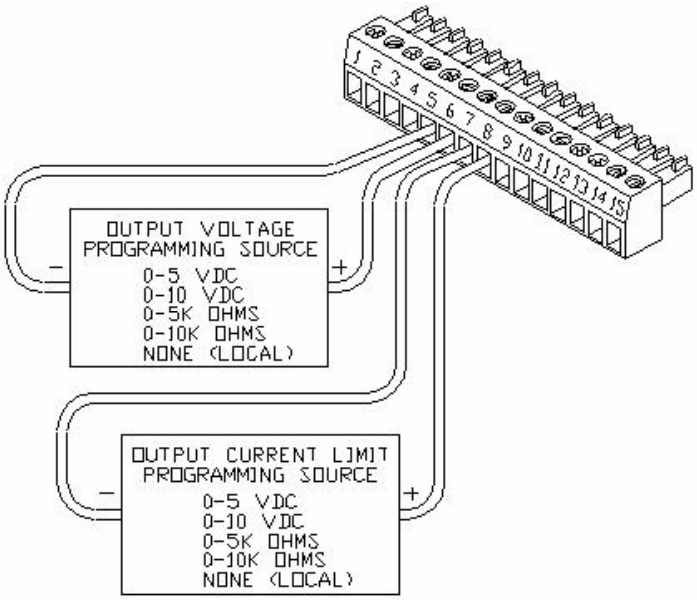

Figure 4-1 Connecting Programming Sources to J2 Connector

Table 4-2 Power Supply Settings for Different Programming Sources

Output Voltage Programming Source	Output Current Limit Programming Source				
	0-5 Vdc	**0-10 Vdc**	**0-5 k Resistor**	**0-10 k Resistor**	**None (Front Panel Control)**
0-5 Vdc	SW1: set 3 and 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 3 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 2 closed, 3 and 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 2 closed, 3 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 3 open. J2: jumper 1 to 3.
0-10 Vdc	SW1: set 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: default settings. J2: jumper 1 to 3 and 2 to 3.	SW1: set 2 closed, 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 2 closed. J2: jumper 1 to 3 and 2 to 3.	SW1: default settings. J2: jumper 1 to 3.
0-5 k Resistor	SW1: set 1 closed, 3 and 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 closed, 3 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 and 2 closed, 3 and 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 and 2 closed, 3 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 3 open, 1 closed. J2: jumper 1 to 3.
0-10 k Resistor	SW1: set 1 closed, 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 closed. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 and 2 closed, 4 open. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 and 2 closed. J2: jumper 1 to 3 and 2 to 3.	SW1: set 1 closed. J2: jumper 1 to 3.
None (Front Panel Control)	SW1: set 4 open. J2: jumper 2 to 3.	SW1: default settings. J2: jumper 2 to 3.	SW1: set 2 closed, 4 open. J2: jumper 2 to 3.	SW1: set 2 closed. J2: jumper 2 to 3.	SW1: default settings. J2: no jumper

Remote Monitoring of Output Voltage and Current

Readback Signals

The J2 connector on the rear panel provides access to calibrated readback signals for remote monitoring of the output voltage and current. Rear panel switches SW1-5 and SW1-6 allow you to select either a 0-5 Vdc or a 0-10 Vdc range for the output. The readback signal represents 0 to 100% of the power supply's output.

See Table 4-3 for the required J2 connections and switch settings for remote monitoring of readback signals with 0-5 Vdc or 0-10 Vdc outputs. Use shielded pair wiring (20 to 24 AWG) and ground the shield to J10 sense connector terminal 1 (return sense) or to the chassis.

Table 4-3 Settings for Remote Monitoring of Readback Signals

Readback Signal	J2 Connection Signal (+)	J2 Connection Return (–)	Switch SW1 Setting
Output Voltage (0-5 Vdc)	J2-10	J2-9	SW1-5 OFF (OPEN)
Output Voltage (0-10 Vdc)	J2-10	J2-9	SW1-5 ON (CLOSED)
Output Current (0-5 Vdc)	J2-12	J2-11	SW1-6 OFF (OPEN)
Output Current (0-10 Vdc)	J2-12	J2-11	SW1-6 ON (CLOSED)

Important: Check the readback accuracy any time you reset switches SW1-5 and SW1-6. See “Calibration and Troubleshooting”.