SEL-9310

Power Supply/Battery Charger Instruction Manual

Features and Benefits

The SEL-9310 Power Supply/Battery Charger provides auxiliary 48 Vdc power for SEL relays, circuit breakers, or similar loads. The SEL-9310 charges lead-acid batteries as large as 12 Ah. Upon ac input power interruption, it automatically powers the load from the battery. Monitoring circuits give alarms for loss of ac input or battery power.

The SEL-9310 is available with a 120 Vac input (Model 93104) or 240 Vac input (Model 93106).

- Supply 48 Vdc power from the ac input or from the battery for relay operation and circuit breaker tripping.
- Charge a lead-acid battery as large as 12 Ah (nominal rating).
- Eliminate relay power interruptions when replacing batteries.
- Avoid battery damage with charge limiting and temperature compensation.
- Maintain battery readiness with automatic constant-voltage float charging.

Application

Apply the SEL-9310 to provide control power for protective relays and circuit breakers. *Figure 1* shows the typical SEL-9310 application.

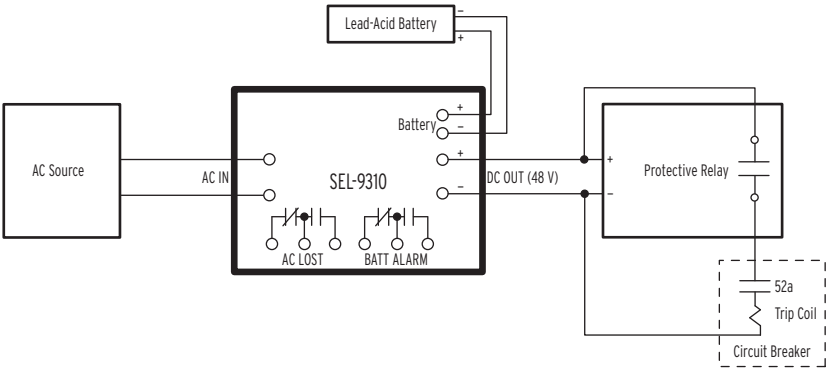

Figure 1 Application Diagram

While ac input power is present, the SEL-9310 can drive a 0.6 A, 48 Vdc load indefinitely and maintain the storage batteries at 100 percent capacity. When ac input power is not present, the SEL-9310 supplies power to the load from the battery. The SEL-9310 supplies as much as 30 A for circuit breaker tripping.

The SEL-9310 provides temperature-compensated battery charging using a regulated taper-charge method. Upon reaching full charge, the SEL-9310 automatically provides a constant-voltage float charge.

When the batteries discharge to less than 40 V, the SEL-9310 automatically isolates the load to prevent deep battery discharge and possible permanent battery damage.

Temperature Compensation

Temperature affects battery charging. The SEL-9310 controls the temperature-compensated charging process for safe and accurate charging over the entire specified temperature range. This avoids undercharging, overcharging, and battery venting. For accurate temperature compensation, the battery must be mounted in the same environment as the SEL-9310. *Figure 2* shows the temperature compensation curve.

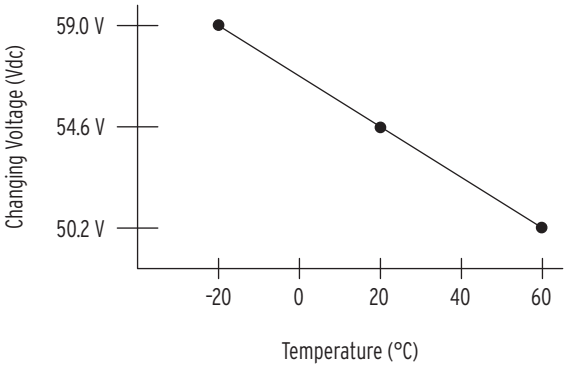

Figure 2 Temperature-Compensated Charging Voltage

Installing the SEL-9310

Refer to the panel cutout and dimension drawings (*Figure 3*), the front-panel drawing (*Figure 4*), and the rear-panel drawing (*Figure 5*) to complete the following installation instructions:

Step 1. Mount the SEL-9310 in a switchboard panel. Four #10-32 nuts are included for mounting.

CAUTION: Leave a one-inch space directly below and to the left and right of the SEL-9310 to allow for adequate ventilation and cooling.

Because the SEL-9310 has venting holes, it must be installed indoors or in a weatherproof enclosure.

Step 2. Mount the battery (not supplied with the SEL-9310) in the same temperature environment as the SEL-9310; this assures that the charging process is properly temperature compensated.

Step 3. Connect a 12 Ah or smaller capacity lead-acid battery to the rear terminals marked BATTERY, observing proper polarity (see *Figure 5*).

Step 4. Connect ac power to the terminals marked AC IN on the terminal strip on the back of the SEL-9310. A ground lug is located below the terminal strip. Connect the lug to the equipment ground bus.

Step 5. Connect the served load (protective relay, circuit breaker trip coil, radio, and similar devices), observing proper polarity.

Step 6. Connect the alarm contacts.

The SEL-9310 signals failure conditions via Form C (normally open and normally closed) relay output contacts on the main rear-panel terminal block. *Table 1* describes the alarm contact conditions.

Table 1 SEL-9310 Alarm Contacts

Alarm Contact	Description
BATT ALARM	Indicates that the battery fuse is open while the battery is connected. In addition, the BATT ALARM contacts change state when the dc output voltage drops below approximately 30 Vdc. Note that the BATT ALARM contacts do not provide any indication of battery availability when ac power is present.
AC LOST	Alerts operators that ac input power is not present.

Mechanical Diagrams

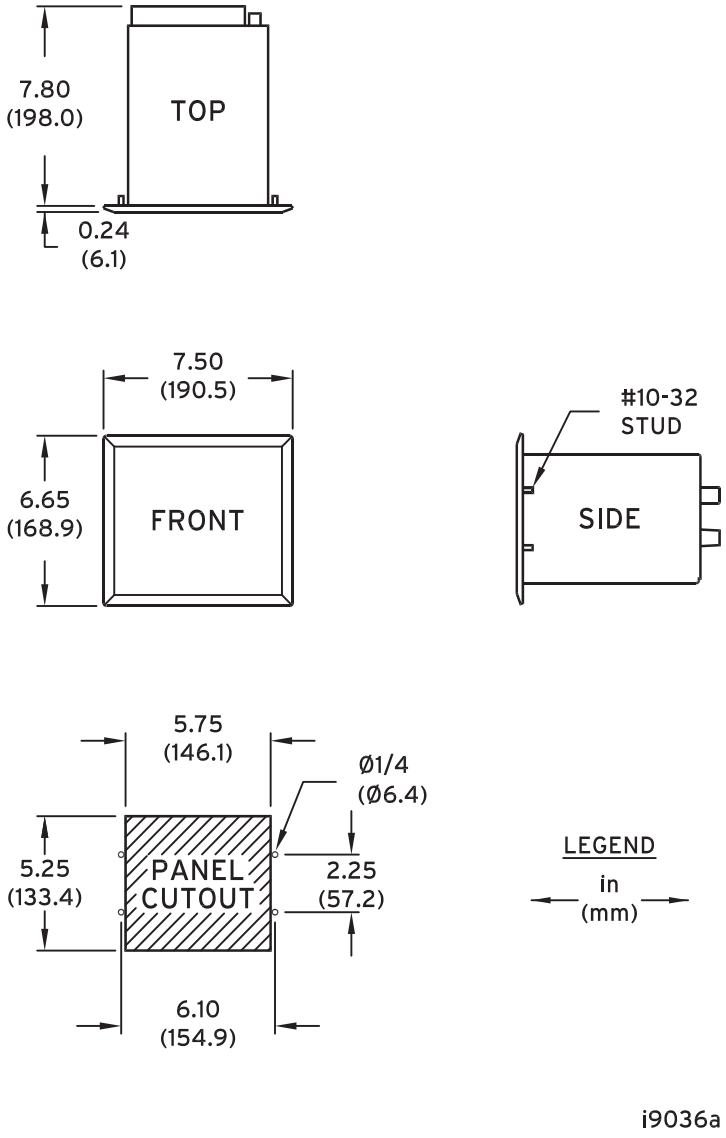

Figure 3 SEL-9310 Dimensions and Panel-Mount Cutout

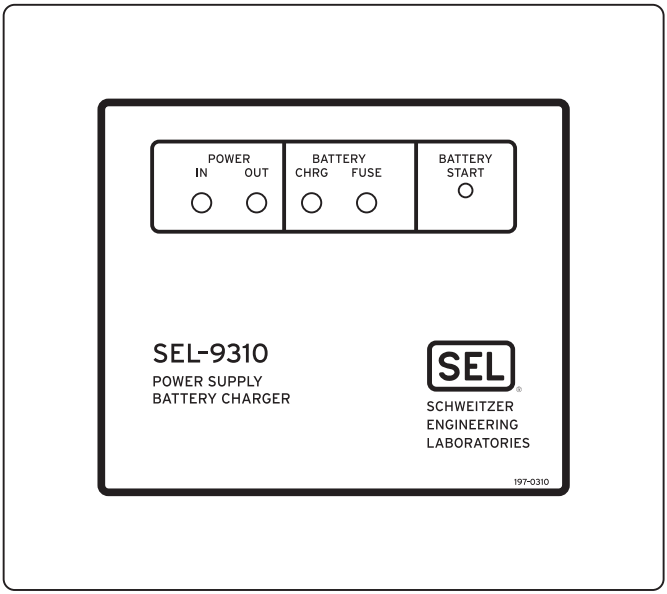

Figure 4 SEL-9310 Front Panel

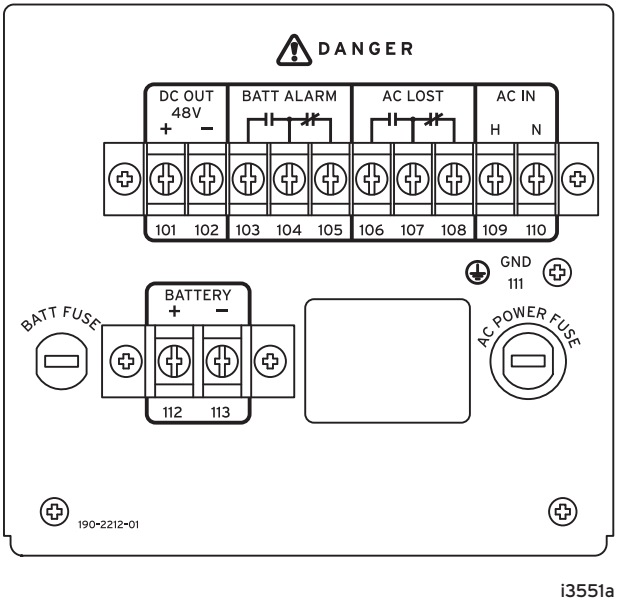

Figure 5 SEL-9310 Rear Panel

Front-Panel LEDs and Controls

The SEL-9310 front panel indicates SEL-9310 operation. In addition, the front panel contains one inset control pushbutton.

LEDs

Table 2 SEL-9310 Front-Panel LEDs

LED	Description
POWER IN	Illuminates when ac input power is present.
POWER OUT	Illuminates when the SEL-9310 is supplying power to the load. Removing ac input power does not extinguish the LED because the SEL-9310 automatically switches battery power to the load.
BATTERY CHRG	Indicates that the SEL-9310 has sensed a low-battery condition and is charging the battery.
BATTERY FUSE	Illuminates when the battery fuse is open while ac power and battery inputs are applied. The battery fuse is labeled BATT FUSE on the rear panel (see *Figure 5*).

Controls

BATTERY START Switch

To manually connect a battery to the load with no ac power present, press the BATTERY START switch. Note that the switch is inset in the front panel. Use a small screwdriver or similar tool to press the BATTERY START switch.

You can use the BATTERY START switch to enable protection before a line is energized or to retrieve information from the protection device following an extended outage.

Testing the SEL-9310

Functional Testing

SEL performs a complete functional check and calibration of each SEL-9310 before shipment so that your SEL-9310 operates correctly and accurately. You can test the SEL-9310 before or after installation is complete to verify proper operation and connections.

Prior to Installation

Perform the following steps to test the unit before installation:

Step 1. Connect a fully-charged battery; see *Installing the SEL-9310*.

Step 2. Connect a suitable load, such as any 48 V SEL relay, to the DC OUT terminals, noting the polarity markings on the SEL-9310 and on the load.

Step 3. Press the BATTERY START switch or apply and then remove ac power.

Step 4. Verify that the following occurs:

- ➢ the POWER OUT LED illuminates.
- ➢ the BATT ALARM output relay activates.
- ➢ the SEL-9310 supplies current to the load.

Step 5. To end the test, disconnect the battery assembly. Verify that the LED for POWER OUT turns off.

In Service

Perform the following steps to test the unit after installation:

Step 1. Verify that the LEDs for POWER IN and POWER OUT illuminate, and the LED for BATTERY FUSE is off. The LED for BATTERY CHRG illuminates if the batteries have less than a full charge.

Step 2. Confirm that the SEL-9310 is supplying load current:

a. Remove the ac power fuse located on the rear panel.

b. After the ac power fuse is removed, verify that the LED for POWER OUT is illuminated and the SEL-9310 still supplies load current.

Step 3. To end the test, replace the ac power fuse.

Dielectric Strength Testing

To perform high potential (2500 Vdc) testing, connect any or all terminal groups together and test them with respect to any other group or with respect to the chassis.

Combine the DC OUT and BATTERY terminals as one test group when performing these tests. The SEL-9310 has the following terminal groups:

- DC OUT–BATTERY
- BATT ALARM
- AC LOST
- AC IN

Maintaining the SEL-9310

Battery Fuse

The battery fuse is located on the rear panel. If the fuse is blown or removed while ac input power and the battery are connected, then the BATT ALARM activates and the LED for BATTERY FUSE illuminates. The fuse protects the SEL-9310 from short-circuit current. Replace only with a 5 x 20 mm, 8 A slow blow fuse (see *Specifications*). The battery fuse can degrade after more than 2000 surge current operations (e.g., circuit breaker tripping) and should be replaced accordingly.

AC Power Fuse

The ac power fuse is located on the rear panel. If the fuse is blown or removed, the AC LOST alarm activates and the LED for POWER IN turns off. Replace only with a 5 x 20 mm slow blow fuse (see *Specifications*). The ac power fuse can degrade after more than 2000 surge current operations (e.g., circuit breaker tripping) and should be replaced accordingly.

Troubleshooting

Troubleshooting procedures for common problems are listed in *Table 3*. The table lists each symptom, possible causes, and corresponding diagnoses/solutions. If you have difficulty assessing or correcting a problem with the SEL-9310, contact your Technical Service Center or the SEL factory (see *Factory Assistance*).

Table 3 SEL-9310 Troubleshooting Procedures

Condition	Diagnosis/Solution
POWER IN LED is not illuminated.	Verify that ac input is present.
POWER OUT LED is not illuminated.	Check ac input. Check AC POWER FUSE; replace if blown.
BATTERY FUSE LED is always on.	Replace BATT FUSE.

Factory Assistance

We appreciate your interest in SEL products and services. If you have questions or comments, please contact us at:

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Specifications

Input

Model 93104:	100 to 140 Vac, 120 Vac 50/60 Hz nominal, fuse protected
Model 93106:	200 to 265 Vac, 240 Vac 50/60 Hz nominal, fuse protected

Fuses

AC line	
Model 93104:	5 x 20 mm, 2 A slow blow
Model 93106:	5 x 20 mm, 1 A slow blow
Battery:	5 x 20 mm, 8 A slow blow

Rated Output Current

0.6 A at 48 Vdc indefinitely while ac power is present

Nominal Voltage Output

54.6 Vdc ±0.5 Vdc with unloaded output and charged batteries connected

Battery Charger

Charge method:	Taper
Float method:	Constant voltage
Battery type:	Lead acid
Battery voltage:	48 Vdc
Battery capacity (nominal):	12 Ah

Batteries

External lead acid batteries are available. Contact SEL for details.

Output Contact Current Ratings

30 A make per IEEE C37.90
6 A carry continuously

ALARM Contacts

AC LOST alarm (Form C):	AC power lost
BATT ALARM (Form C):	DC output off or battery fuse blown

LED Indicators

POWER IN (Green):	AC power input is present
POWER OUT (Green):	DC power output is available
BATTERY CHRG (Yellow):	Battery is charging
BATTERY FUSE (Red):	Battery fuse is blown

Control

BATTERY START switch

Operating Temperature Range

Discharge:	–40° to 60°C (–40° to 140°F)
Charge:	–18° to 49°C (0° to 120°F)

Battery parameters limit charge temperature range; see *Figure 2*.

Unit Weight

4 kg (9 lb.)

Dimensions

See *Figure 3*.

Routine Dielectric Strength Tests

AC current inputs, optoisolated inputs, and output contacts:	2500 Vac for 10 s
Power supply:	3100 Vdc for 10 s

Type Tests

Electromagnetic Compatibility

Electrostatic Discharge:	IEC 60255-22-2: 1996 IEC 61000-4-2: 1995 Levels 1, 2, 3, 4 IEEE C37.90.3: 2001 2, 4, and 8 kV contact; 4, 8 and 15 kV air
Fast Transient Burst:	IEC 61000-4-4: 1995 IEC 60255-22-4: 1992 4 kV at 2.5 kHz and 5 kHz

Radiated Radio Frequency:	ENV 50140: 1993 IEC 60255-2-3: 2000 EN 61000-4-3: 1996 IEC 61000-4-3: 1998 10 V/m
Surge Withstand Capability:	IEC 60255-22-1: 1998 2.5 kV peak common mode 2.5 kV peak differential mode IEEE C37.90.1: 1989 3.0 kV oscillatory 5.0 kV fast transient IEEE C37.90.1: 1989 2.5 kV peak common mode 2.5 kV peak differential mode oscillatory waveform 4 kV at 2.5 kHz and 5 kHz fast transient waveform

Environmental

Cold:	IEC 60068-2-1: 1990 EN 60068-2-1: 1993, Test Ad: Cold, 16 hours at –40ºC
Dry Heat:	IEC 60068-2-2: 1974 EN 60068-2-2: 1993, Test Bd: Dry Heat, 16 hours at +85ºC
Vibration:	IEC 60255-21-1: 1988 EN 60255-21-1: 1995 Class 1 Endurance Class 2 Response IEC 60255-21-2: 1988 EN 60255-21-2: 1995 Class 1 Shock Withstand, Bump Class 2 Shock Response IEC 60255-21-3: 1993 EN 60255-21-3: 1995 Class 2

Safety

Dielectric Strength:	IEC 60255-5: 2000 IEEE C37.90: 1989 2500 Vac on analogs, contact inputs, and contact outputs 3100 Vdc on power supply
Impulse:	IEC 60255-5: 2000 0.5 J, 5 kV

DANGER: Disconnect or de-energize all external connections before opening this device. Contact with hazardous voltages and currents inside this device can cause electrical shock resulting in injury or death.

DANGER: Contact with instrument terminals can cause electrical shock that can result in injury or death.

DANGER: Débrancher tous les raccordements externes avant d'ouvrir cet appareil. Tout contact avec des tensions ou courants internes à l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.

DANGER: Tout contact avec les bornes de l'appareil peut causer un choc électrique pouvant entraîner des blessures ou la mort.

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This product is covered by the standard SEL 10-year warranty. For warranty details, visit www.selinc.com or contact your customer service representative.

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