

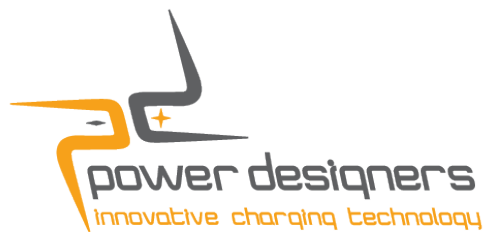
powertrac™

BATTERY DATA LOGGER



PTSP+ 12-84V

Installation & Reference Guide



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POWERTRAC™ SP+ BATTERY DATA LOGGER SERIES

PowerTrac™ SP+ is an event-based, real-time battery data logging system. It continuously acquires battery parameters, processes information and stores relevant data when an *event change* occurs. An event change occurs when the battery state switches between charge, discharge, and idle/open.

When an event change occurs and after a programmed time delay, the **PowerTrac™** system saves a record of the elapsed event's summary information. Each data field in this record is called an event parameter. The system records global parameters of accumulated amp-hours charge and discharge, and accumulated hours of charge, discharge, and open time.

The **PowerTrac™** memory stores these listed parameters:

Real-Time Parameters:

- Present Battery Voltage
- Present Battery Current
- Present Battery Temperature
- Cumulative Amp-Hours
- Present Time and Date

Event Parameters:

- Event Type: charge, discharge, open
- Event Battery ID
- Event Factory ID
- Event Amp-Hours
- Event Hours
- Event Alarms:
 - **Over Current—(OC)**
 - **Over Temperature—(OT)¹**
 - **Electrolyte Level—(EL)²**
 - **Over Voltage—(OV)**
 - **Under Voltage—(UV)³**
 - **Power—(PWR)**
- Event Start Time
- Event Duration
- Event End Voltage
- Regenerative Amp-Hours
- Event Kilowatt Hours: charge, discharge
- Event End State of Charge
- Event Max Voltage with a Max Voltage Time Stamp
- Event Min Voltage with a Min Voltage Time Stamp

- Event Max Temp with a Max Temp Time Stamp
- Event Max Current with a Max Current Time Stamp

Global Parameters:

- Total Amp-Hours: charge, discharge
- Total Hours: charge, discharge
- Total Hours: open circuit
- Cycle Counter
- Event Counter

NOTES:

1. **OT**, the over temperature alarm, is controlled by setting the Hi Temp Alarm on the **Alarms** screen. When the relay option is ordered, two additional temperatures may be entered to control the relay on and off values.
2. When ordered, the **EL** sensor monitors electrolyte levels. If levels rise or fall outside parameters, a delay engages, followed by an EL alarm. Control of the delay and alarm is entered on the **Alarms** screen.
3. When ordered, the **UV** relay is controlled by setting **UV** relay **OFF Voltage Per Cell (VPC)** on the **Alarms** screen.

SAFETY PRECAUTIONS

BEFORE ATTEMPTING TO INSTALL AND OPERATE THE DATA LOGGER, READ THIS MANUAL CAREFULLY

This manual contains important instructions for the **PowerTrac™ SP+** series battery data logger that shall be followed during installation and operation of this data logger. Only qualified personnel should install, operate, or service this equipment.

SAVE THESE INSTRUCTIONS



- **High Voltages.** Lethal voltages are present within the data logger enclosure whenever the battery is connected.
- **High Current Levels.** Do not touch uninsulated battery connectors or terminals. All tools should be adequately insulated to avoid the possibility of shorting connections. Inspect cables often for damage to the insulation. Replace cracked or worn cables immediately.

Explosive Gases. Working in the vicinity of a lead-acid battery is dangerous. Batteries generate explosive gases during charge and discharge. To reduce the risk of ignition, follow these safety instructions as well as those published by the battery manufacturer.



- **Chemical Hazard.** Working with lead-acid batteries may result in exposure to highly corrosive acid. To protect eyes and skin, use the required **Personal Protective Equipment (PPE)** as mandated by your employer and local regulations. At a minimum, wear safety goggles and skin protection while connecting the battery charger or working in the vicinity of lead-acid batteries.
- **Follow the battery manufacturer's published instructions when installing, charging, and servicing batteries.**
- **Do not expose the data logger to rain or snow.** The data logger is **NOT** designed for outdoor use.



- **No User Serviceable Parts.** If service is required, contact Power Designers USA LLC or its service representative.
- **These instructions assume a certain level of competence by the installer and/or user.** The following practices and codes contain relevant information, and should be consulted for safe installation, testing, handling, and maintenance of rechargeable lead-acid batteries. All applicable state and local codes must be followed.
 - **National Electric Safety Code (NESC)**, ANSI/IEEE C2-2007 (or latest revision). Copies may be obtained by contacting: The Institute of Electrical and Electronics Engineers, Inc. (IEEE), Publications Office, 10662 Los Vaqueros Circle, P.O. Box 3014, Los Alamitos, CA 90720
www.ieee.org
 - **National Electrical Code (NEC)** NFPA-70 (or latest version) available from: National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02269
www.nfpa.org
 - **Federal Codes**
 - 29CFR1926.441 Batteries and Battery Chargers
 - 29CFR1910.305 (j) Wiring Methods, Components and Equipment for General Use
 - OSHA Directive STD 01-08-002, including 29CFR1910.151(c) Medical Services and First Aid; 29CFR1926.50 and 29CFR1926.51, Medical Service and First Aid, and Sanitation, respectively; applicable to electric storage battery charging and maintenance areas.
 - **EMC Compliance**

This device complies with Part 15 section 103 of FCC Rules as a digital device used exclusively as a power system in public utilities or industrial plants.

Operation is subject to the following two conditions:

 - (1) This device may not cause harmful interference.
 - (2) This device must accept any interference received, including interference that may cause undesired operation.

TECHNICAL SPECIFICATIONS

Nominal Battery Voltage	12 V–84 V
Operating Voltage	10 V–120 V
Voltage Resolution	± 0.01 volts
Operating Temperature	-25°C–60°C
Temperature Resolution	± 0.1°C
Operating Current Draw	61 mA at 12 V 21 mA at 48 V
Current Resolution	± 0.1 A
Communication Interface	IR port
Temperature Interface	R25 = 5k thermistor
Data Storage	256k bytes flash memory (~11 months [341 days] at 15 events/day)
Battery Backup (Time)	CR 2032
Protection	<ul style="list-style-type: none"> ➤ Over voltage ➤ Over current ➤ Reverse polarity protection
Current Shunt	Standard 50 mV shunt
Dimensions	6.625" x 2.0" x 1.0"
Packaging	<ul style="list-style-type: none"> ➤ Sealed, splash proof ➤ UL 94 V-0
Optional Equipment	<ul style="list-style-type: none"> ➤ Electrolyte sensor ➤ RS-232 ➤ RS-485 ➤ Internal thermistor
Inline (Pos. Lead) Fuse	<ul style="list-style-type: none"> ➤ 3 AG glass body, 2-0 amp time delay

PACKAGE CONTENTS

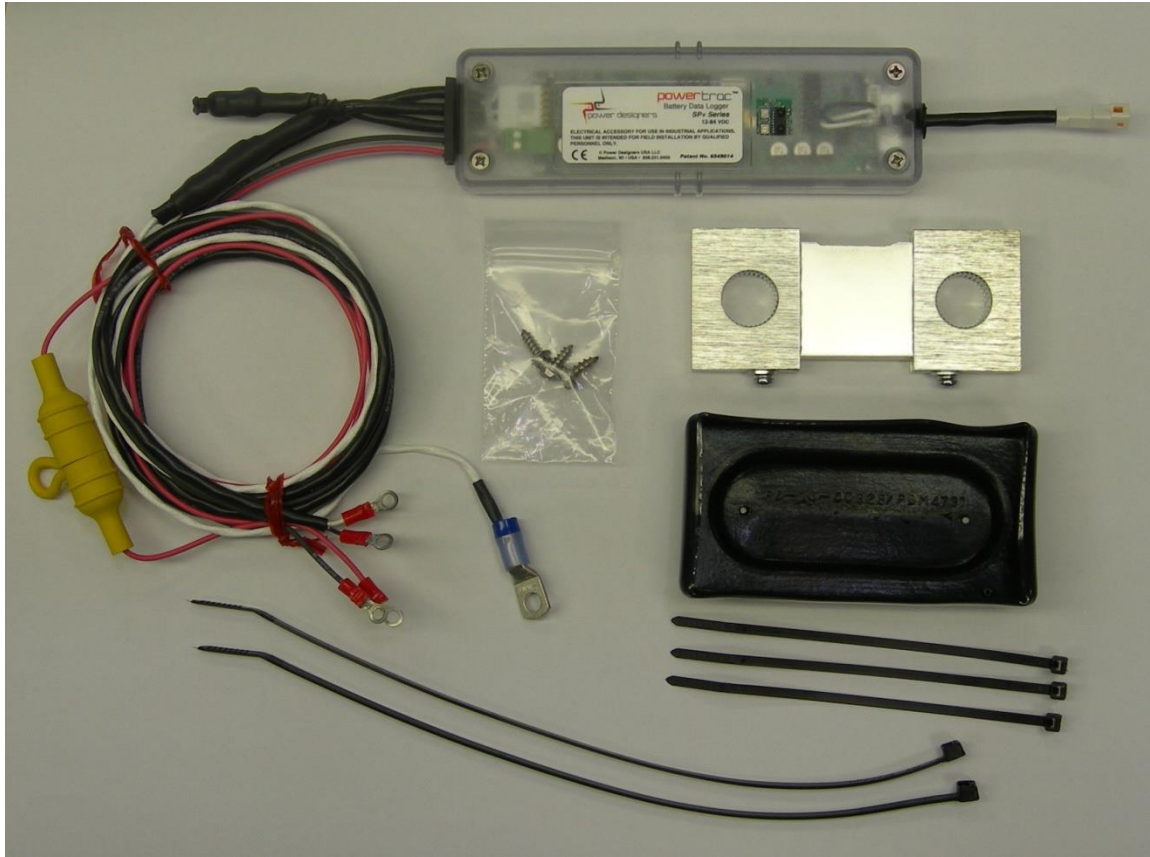


Figure 1: PowerTrac™ SP+ package contents

The **PowerTrac™ SP+** package contains the following items:

- 1 **PowerTrac™** battery data logger
- 1 shunt: weld-on or bolt-on, sold separately*
- 1 shunt cover: included with the shunt purchase*
- 1 CD: includes **PowerTrac™** Windows® analysis software, software for the combination programming and data retrieval device, and **PowerTrac™** user manuals
- Tie wraps
- 2 self-tapping #8 screws for fastening the power leads
- 1 self-tapping #10 screw for fastening the external temperature sensor, when provided

If any of the items listed are missing, please contact Power Designers USA LLC for replacement.

* Shunt and cover are sold separately and are required for **PowerTrac™** operation.

A close up of the **PowerTrac™** (Figure 2) shows the **InfraRed (IR)** window. The IR transceiver is accessed through the clear plastic cover to the right of the product label. The unit serial number is located in the upper right corner of the product, visible through a window on the back of the enclosure. The serial number is also stored in the unit's memory and can be extracted with the Palm or Pocket PC.



Figure 2: Close-up top view of the PowerTrac™ SP+ unit

The current shunt is sold separately and is used for measuring battery current. Two shunt styles are available: a bolt-on shunt (Figure 3) for sealed batteries, or a weld-on shunt for flooded batteries (Figure 4). **Please note: the weld-on shunt must be soldered in place.**

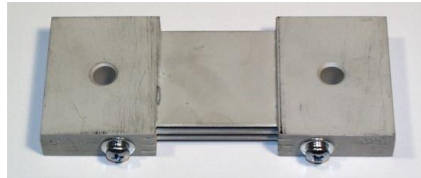


Figure 3: Bolt-on shunt



Figure 4: Weld-on shunt

PowerTrac™ current sense terminals work with 50 mV output shunts only.

HARDWARE INSTALLATION

Shunt Installation

CAUTION: DO NOT APPLY THE BATTERY VOLTAGE TO THE SHUNT SENSE LEADS. THIS WILL DAMAGE THE UNIT AND VOID THE WARRANTY.

WARNING: The shunt should replace an intercell connector nearest to the negative post, as shown in Figure 5.

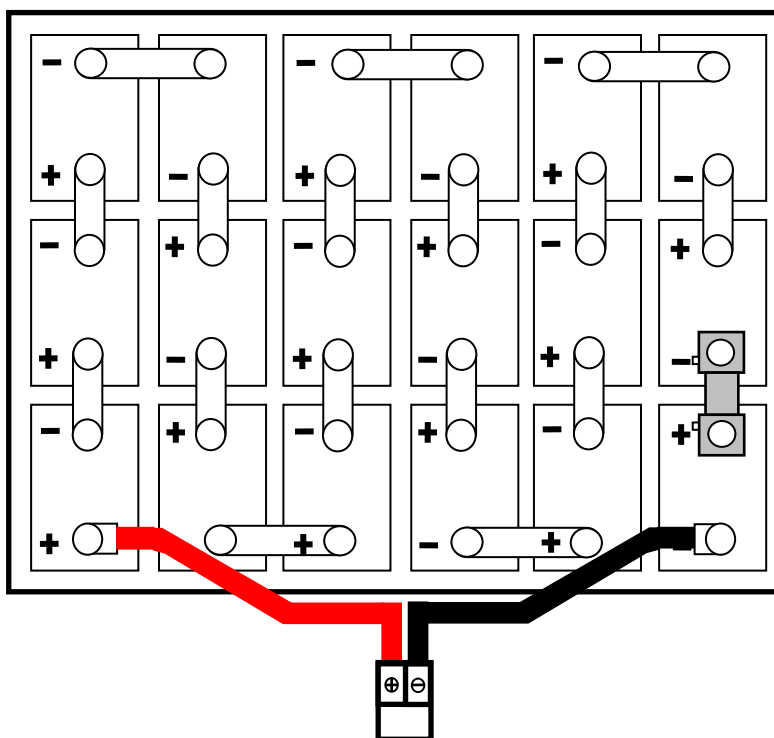


Figure 5: Shunt installation for a representative 36 V industrial flooded battery

WARNING: For series connected battery modules (6 V or 12 V batteries), the shunt should be installed in series with the negative terminal of the battery as shown.

NOTE: For this style of battery, the shunt lead connections are reversed. The red or white wire is connected to the battery side of the shunt, and the black wire is connected to the cable side.

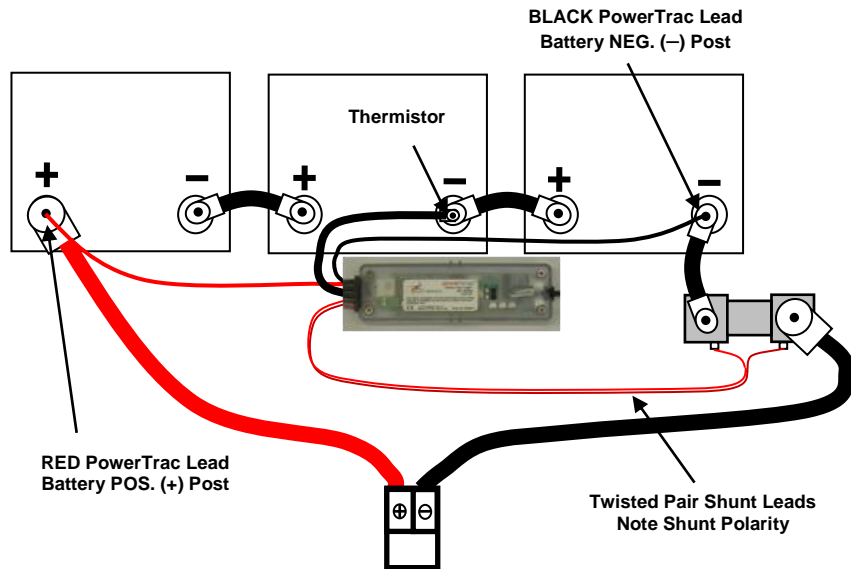


Figure 6: PowerTrac™ SP+ and shunt installation for a 36 V series battery

Connecting the Bolt on Shunt—Sealed Battery

1. Remove the intercell connector nearest the **negative post, the one interconnecting the last two cells.**
2. Position the shunt over the posts.
3. Replace the bolts and tighten securely.

Connecting the Shunt—Flooded Battery

1. Move the battery to a well-ventilated area. Open the vent caps and allow any excess hydrogen gas to clear, close the vent caps.
2. Using an **Intercell Connector Removal Tool** (see Appendix, page 21 of this manual), remove the **intercell connector nearest to the negative post leaving the post centers.**
3. Clean the posts and area around the base of the posts.



Figure 7: Remove the last intercell connector and clean the posts

4. Place corrosion-preventive felt washers (see Appendix, page 21 of this manual) over the posts. Wet the felt washers with water. Felt washers help protect the battery seal bushings from damage that may lead to acid venting from the battery posts under the shunt, which can result in severe corrosion damage to the shunt.
5. Position the shunt, centered over the posts, so the side-mount screws can be easily accessed.

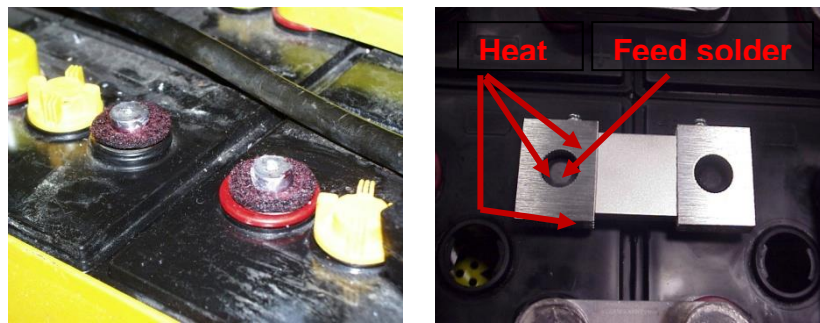
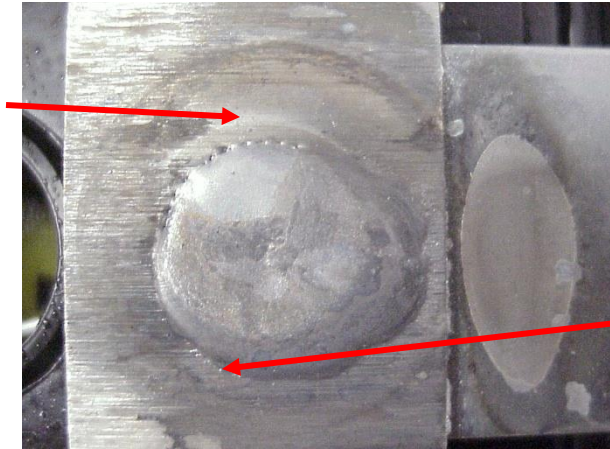


Figure 8: Place the felt washer, then the shunt, and solder

6. Using distributed heating, solder the shunt to the battery using a tin/lead alloy (60/40 or 50/50) solder bar. Adding flux helps to create a good solder joint but is not necessary. Make sure to fill the shunt post holes to the top with solder. Solder both ends of the shunt.
7. Clean off excess solder from the shunt and battery.
8. Pressure-test both cells to assure that the seals have not been compromised.

The following is an example of a well-soldered shunt.

Notice solder wicked into shunt via distributed heat



Notice solder adhered to end block and did not puddle

Figure 9: Well-soldered connection

Shunt Installation Tips

1. To ensure a good connection between the shunt terminals and the battery posts, make sure direct heat is applied to the shunt terminals at the point where the shunt meets the posts. Then feed the solder into the shunt terminal holes until it fills the void completely.
2. If the solder is not adhering to the shunt, a slower, less intense preheat may be necessary to get the entire end block to the same temperature, not just the surface.
3. Failure to properly install the shunt may result in inconsistent readings due to an intermittent connection and, on a multipost battery, unequal current distribution.

CAUTION: DO NOT SIMPLY MELT THE BAR SOLDER INTO THE SHUNT TERMINAL HOLES WITHOUT HEATING THE SHUNT TERMINALS. THIS WILL RESULT IN A COLD SOLDER CONNECTION. SOLDERING SHOULD BE DONE VIA THE HEATING ACTION OF THE SHUNT TERMINALS, NOT THE TORCH.

PowerTrac™ SP+ Installation

The standard **PowerTrac™ SP+** has two separate battery voltage sense leads, two shunt sense leads (twisted and sleeved), and one temperature sense lead, as shown in Figure 10.

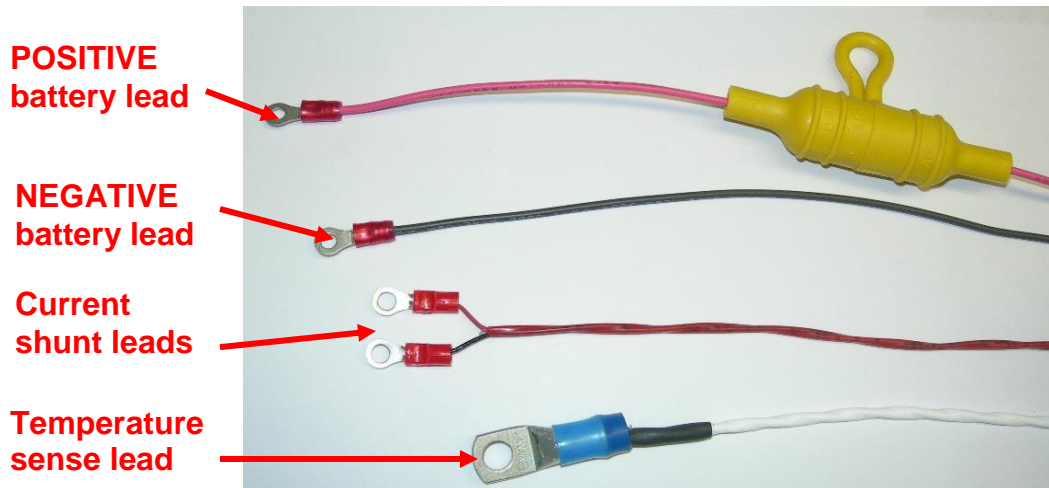


Figure 10: PowerTrac™ SP+ leads

CAUTION: DO NOT CUT THE TEMPERATURE SENSE WIRE. This wire has a thermistor integrated into the lug and is used to measure battery temperature. Cutting this wire will result in erroneous temperature readings.

TOOLS REQUIRED:

1. #2 Phillips screwdriver for attaching shunt leads to shunt.
2. 1/4-inch hex driver and #26 drill bit (and drill) for installing #8 screws for the power leads.
3. If the external thermistor is used, a 5/16-inch hex driver and #18 drill bit (and drill) is required to install the #10 self-tapping screw.
4. If the internal thermistor (part option **-IT**) is used, a 7/16-inch drill bit is also required.



Figure 11: Internal thermistor (order option -IT)

Installing the PowerTrac™ SP+ on a battery

1. Drill a hole in the battery negative and positive posts slightly smaller than the diameter of a #8 self-tapping screw; a #26 drill bit is suggested. Attach the single **BLACK** wire to the negative battery post and the single **RED** wire to the positive battery post.

2. Attach the **black/red** or black/white (twisted and sleeved) wire pair to the shunt using the screws provided (**See Note A, following**).

NOTE A: The **black** shunt wire must be attached to the shunt on the side closer to the **negative** battery cable (with the shunt placed before the negative post). In Figure 12, the **black** wire connects to the positive post of the last cell and the **red** (or white) shunt wire connects to the negative post of the second-to-last cell. Failure to attach properly will result in reversing the charge and discharge amperes, resulting in inaccurate data; for example, when charging the battery, if a discharge event is recorded, the shunt polarity must be corrected.

3. At the innermost intercell connector, drill a hole in the intercell connector slightly smaller than diameter of a #10 self-tapping screw; a #18 drill bit is suggested. Attach the temperature sense lead to the intercell connector.
4. Use the wire ties to route the wires securely on top of the battery and secure the **PowerTrac™ SP+** to the battery or an intercell connector. The **PowerTrac™** data collection unit can be placed anywhere on the battery. It may be best to install the **PowerTrac™** near an edge to make downloads convenient.
5. Verify all screws are secure. Loose connections can cause difficult-to-diagnose problems.
6. Install the rubberized shunt cover over the shunt.

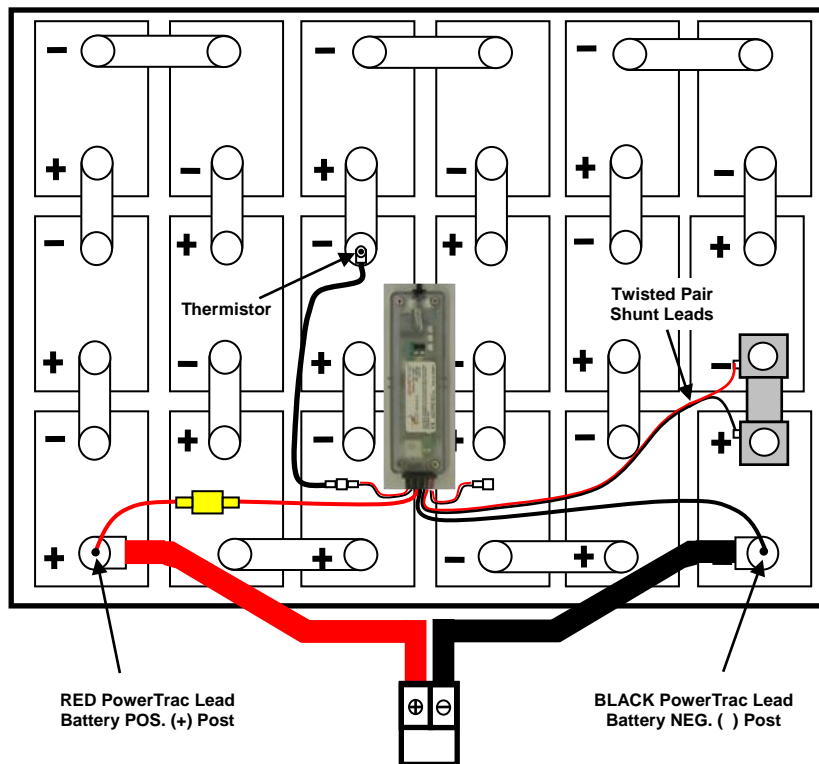


Figure 12: PowerTrac™ SP+ and shunt installation for a 36 V industrial battery

Internal Thermistor (optional)

An optional internal thermistor may be added to a battery in place of the standard external thermistor. The internal thermistor provides a more accurate measurement of the electrolyte temperature than the external sensor.

To install an internal temperature sensor on a battery:

1. The internal temperature sensor should be located at an inner cell of the battery. Drill a 7/16-inch hole near the center of the cover of the cell. **NOTE: Take care when drilling to control the depth to avoid hitting the plates inside the cell; prevent drill shavings from falling into the cell.**
2. Thread the sensor into the cell cover.
3. Neatly route the sensor wires on top of the battery.

Electrolyte Sensor Installation (optional)

An EL sensor may be added to a battery and connected to the **PowerTrac™ SP+**. The sensor is used to trigger an alarm and provide a status on each event showing an adequate or inadequate electrolyte level. This feature must be enabled in the **PowerTrac™**.

To install an electrolyte sensor on a battery:

1. Follow the manufacturer's instructions for installing the EL sensor into one of the innermost cells of the battery.
2. The EL sensor probe and EL sensor reference must be a minimum of 1½ to a

maximum of ten cells apart for proper operation with the **PowerTrac™**.
Figure 13 shows 2½ cells.

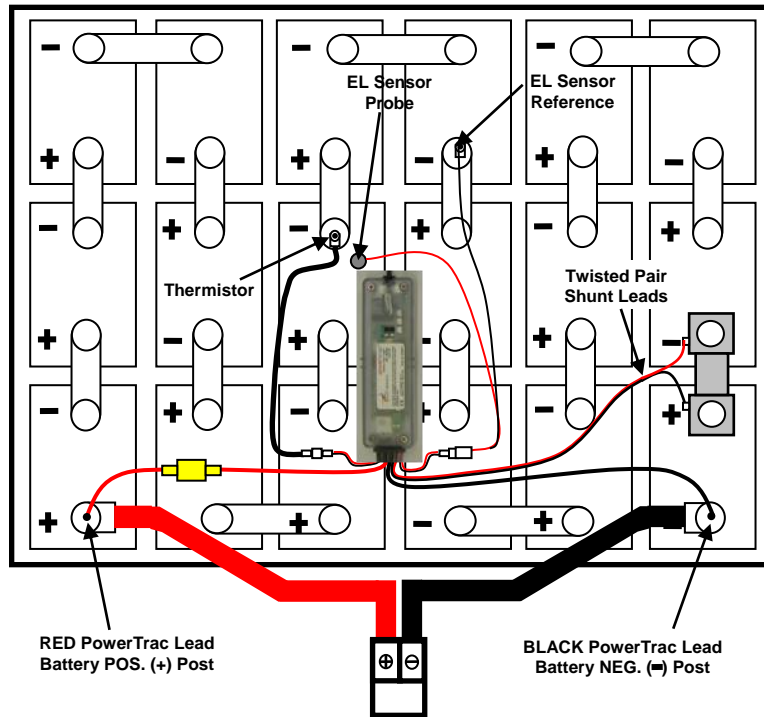


Figure 13: Electrolyte sensor installation

3. To activate the EL sensor, a software setting change is required. This change is covered in the **PowerTrac™ SP+ Setup, *Setting Alarm Parameters***.

HARDWARE INSTALLATION IS NOW COMPLETE. THE UNIT IS READY TO HAVE THE PARAMETERS PROGRAMMED AND SHUNT CALIBRATED

OPERATION

The **PowerTrac™ SP+** Battery Data Logging system is comprised of three components: the **PowerTrac™** data logger, a current shunt, and a combination programming and data retrieval device. A Windows® program is used to generate reports of battery operation.

The **PowerTrac™** data-logging unit incorporates a microprocessor design that offers advanced programming and data logging capabilities. **PowerTrac™** continuously measures and logs battery voltage, current, and temperature, from which it calculates performance data.

PowerTrac™ derives its power from the battery through the same leads used to measure battery voltage. A precision current shunt measures battery current. This shunt must be in-line with the battery cables to capture the total current flow through the battery. The shunt typically replaces an intercell connector between the positive terminal of the most negative cell and the negative terminal of the next cell. For batteries with multiple parallel intercell connections, the number of posts must be adjusted. For best performance, shunt calibration must always be performed when the **PowerTrac™** is installed.

PowerTrac™ is event-based, and records are reported for each of the battery states as defined:

- **Open** or **Idle** state—battery is neither charging nor discharging
- **Charge** state—battery is charging
- **Discharge** state—battery is discharging.

The battery state for event purposes is determined by comparing the measured current to a preset, open circuit level, and by polarity. When the current absolute value is higher than the open circuit limit, the battery state is either charge or discharge, while below this level it is open. To eliminate records triggered by noise or short time events, a delay timer is provided for each state change.

PowerTrac™ has the capability to log more than 5,100 events. Each event contains more than 24 items of information. When the memory is full, the oldest event is replaced by the newest event on a **First-In First-Out (FIFO)** basis. **PowerTrac™** uses nonvolatile memory to store settings and event data.

There are three methods to download information from **PowerTrac™**:

- Infrared
- RS-232 using the **PowerTrac™** Windows® software or custom software
- RS-485 using an intelligent Power Designers USA LLC charger.

The IR method is the quickest and most portable means of retrieving data from **PowerTrac™**. When a download is initiated, the events saved in the **PowerTrac™** are transferred to the PDA device at a rate of 100–200 events per second. The file is

saved in the **File List** of the **PowerTrac™** application with the file name set to the **Battery ID**. Subsequent downloads from the same **PowerTrac™** are saved as **Battery ID_x**, with the x starting at one and increasing with each download. IR communications may be used even when a wired communication method is in use.

PowerTrac™ Palm or Pocket PC software allows users to view event data, summary data, and unit settings information for each individual file downloaded in the **File List**.

Transferring the downloaded files to the computer from the PDA is accomplished via the HotSync or ActiveSync programs provided by Palm or Pocket PC OS. All files with **Battery ID_x** name format are compared and combined during transfer into a single database file, ensuring that new data is seamlessly added to the database. After transferring the file(s) to the computer, **PowerTrac™** Windows® software is used to view, sort, summarize, and chart the data. **PowerTrac™** Windows® software has the ability to sort by date and time, view each event, and summarize by day, battery, cycle, and site-specific location. Reports, charts, and exception conditions may be printed as well.

Via the RS-232 communication option, **PowerTrac™** acts as a real-time data acquisition and recording device. **PowerTrac™** software samples data from the data-logger at rates up to one sample per second. Data for time, temperature, voltage, current, and amp-hours may either be uploaded and saved in a database for further analysis, or may be charted for voltage and/or current versus time, as well as exported to Excel® or **Comma-Separated Values (CSV)** formats.

SOFTWARE INSTALLATION

The **PowerTrac™ SP+** requires **setup and calibration before operation**. Setup and calibration is covered in the ***Pocket PC Reference Guide***, along with the ***Palm Reference Guide***. Based on the handheld device chosen, refer to the appropriate manual for operation of the **PowerTrac™** with a Pocket PC or Palm.

A separate ***Software Reference Guide*** covers the desktop utilities for data analysis and reporting.

The manuals are listed for reference:

Software Reference Guide	MAN-100001-00
Pocket PC Reference Guide	MAN-100002-00
Palm Reference Guide	MAN-100003-00

SOFTWARE LICENSE AGREEMENT

This license agreement is a legal agreement between Power Designers USA LLC of Madison, Wisconsin, the author and licensor of the software, and the end user licensee of the software.

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4. Licensor owns all rights in the software including any incorporated images or text.
5. Should the licensee fail to comply with any terms or conditions of this agreement this agreement will immediately and automatically terminate without notice.
6. The licensor of this software does not guarantee that this software is free from bugs or free from viruses.

To the maximum extent permitted by applicable law, the software and documentation are provided "as is" and the licensor disclaims all other warranties and conditions, expressed or implied, including, but not limited to, implied warranties of merchantability, fitness for a particular purpose, conformance with description, title and non-infringement of third party rights.

To the maximum extent permitted by applicable law, in no event shall the licensor be liable for any indirect, incidental, consequential, special or exemplary damages or lost profits whatsoever (including, without limitation, damages for loss of business profits, business interruption, loss of business information, or any other pecuniary loss) arising out of the use or inability to use the software product, even if the licensor has been advised of the possibility of such damages. In any case, the licensors' cumulative and entire liability to the licensee or any other party for any loss or damages resulting from any claims, demands or actions arising out of or relating to this agreement shall not exceed the purchase price paid for this license.

Should any term of these terms and conditions be declared void or unenforceable by any court of competent jurisdiction, such declaration shall have no effect on the remaining terms hereof.

WARRANTY INFORMATION

Power Designers USA LLC (**PD**) hereby warrants its **PowerTrac™ SP+** battery monitor (the “Product”) pursuant to the following terms and conditions:

1. PD fully warrants the Product against defective materials and workmanship for a period of one (1) year from date of shipment (the “Warranty Period”).
2. PD shall determine in its sole discretion when tested under PD’s supervision, whether the Product contains defective materials or workmanship during the Warranty Period. If PD determines that the Product is defective, it shall, at its option, either (a) repair the Product at its expense, or (b) furnish a suitable replacement Product. Replaced or repaired Product shall be warranted for the remaining term of the original warranty period.
3. In order to assert a claim under the Limited Warranty, the Product must be shipped by Customer to PD F.O.B. Power Designers USA LLC, destination, freight prepaid and allowed, with a written explanation of the defect in materials or workmanship or damage to the Product.

The following actions shall render this Limited Warranty void:

- a. Improper installation of the Product;
 - b. Use of the Product for a purpose other than its intended purpose;
 - c. Failure to follow PD’s instructions concerning proper installation or use of the Product;
 - d. The negligence of a person or entity other than PD in the installation or use of the Product; and
 - e. Repair or modifications of the Product by any party other than PD or one of its authorized agents.
4. The occurrence of any event or action set forth in Sections 3(a) through 3(e) of this Limited Warranty shall result in the voidance of this Limited Warranty;
 5. PD makes no other warranty, express or implied or of any nature, with regard to the Product. The remedy set forth in this limited warranty is the Customer’s exclusive remedy for any breach of warranty. PD shall not be liable in any event for any consequential, special, incidental or indirect damages arising out of or in connection with the use of, or inability to use, the product.

APPENDIX

Intercell Connector Removal Tool

Available from:

MSP Machining (<http://www.mspmachining.com/index1.html>)



Corrosion-Preventive Felt Washers

Available from:

NAPA Auto Parts (<https://www.napaonline.com/default.aspx>)

Part # BK 7302312 (Red), BK 7302313 (Green)

PART NUMBER LIST

Contact Power Designers USA LLC for information with regard to common part numbers and field replaceable parts.

Item Description	PD Part #
PowerTrac™ SP+ (standard) w/ external temp sensor	PTSP+ 12-84V-S
PowerTrac™ SP+ w/ internal temp sensor	PTSP+ 12-84V-IT
PowerTrac™ SP+ w/ electrolyte level sensor	PTSP+ 12-84V-EL
PowerTrac™ SP+ w/ internal temp sensor and electrolyte level sensor	PTSP+ 12-84V-ITEL
PowerTrac™ SP+ w/ RS-485 ready (no harness to aux. connectors)	PTSP+ 12-84V-485R
PowerTrac™ SP+ w/ RS-485 (includes harness to Euro style aux. connectors)	PTSP+ 12-84V-485
PowerTrac™ SP+ w/ RS-485 & internal temp sensor	PTSP+ 12-84V-IT-485
PowerTrac™ SP+ w/ RS-485 & electrolyte level sensor	PTSP+ 12-84V-EL-485
PowerTrac™ SP+ w/ RS-485, internal temp sensor and electrolyte level sensor	PTSP+ 12-84V-ITEL-485
PowerTrac™ SP+ with RS-232	PTSP+ 12-84V-232
500 A/50 mV bolt-on shunt for sealed batteries	PTBS-500
500 A/50 mV weld-on shunt for flooded batteries	PTCS-500
External temperature sensor for PowerTrac™ SP+	PC-THEX-5k
Internal temperature sensor for PowerTrac™ SP+	PC-THIN-5k

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Main Office Fax: 608.231.9979
Service Department: 608.216.9295

Phones are answered between 9 a.m. and 5 p.m., Monday through Friday Central Time. After-hours calls are answered by voice mail and returned on the next business day. Questions and comments can also be submitted via fax or email.