REVOLUTION

120V and 240V
Single Phase Charger

REVOLUTIONmini Single Phase Charger
Installation & Operation Manual

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power designers sibex

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SAFETY PRECAUTIONS

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

SAVE THESE INSTRUCTIONS

- **High Voltages.** Lethal voltages are present within the charger enclosure whenever the AC line is energized and/or the battery/load is connected. The heat sinks and other internal components present the risk of electric shock.
- **Stored Energy.** To avoid the risk of electric shock, wait at least two minutes after de-energizing the AC line and disconnecting the battery/load before removing the cover.
- **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.
- **Improper Connections.** If the charger is incorrectly wired to input or output devices or wiring is not in accordance with local safety codes and standards, the **Revolution** charger and/or its components are at risk of being damaged.
- **Grounding.** The charger must be connected to an AC power supply incorporating an earth ground. The grounding conductor must be of a size equal to or larger than the line (phase) conductors.
- **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. To minimize the potential for arcing and to reduce the risk of damage to the connector contacts, it is recommended to connect and disconnect a battery when the charger output is **OFF**.

- **Chemical Hazard.** Working with lead-acid batteries may result in exposure to highly corrosive acid. To protect eyes and skin, use the required **P**ersonal **P**rotective **E**quipment (**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.**
- **Use only with rechargeable batteries**. Do not attempt to charge other battery types; doing so may cause equipment damage and result in serious personal injury.
- **Do not expose the charger to rain or snow**. The charger is **NOT** designed for outdoor use.

- **Adequate Cooling Required**. To prevent damage from overheating, proper airflow must be ensured. Do not restrict fan inlets or exhaust outlets. Do not mount the charger in a confined space or where the exhaust air will recirculate.

- **No User Serviceable Parts**. If service is required, contact Power Designers Sibex 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 batteries. All applicable state and local codes must be followed.

  - **N**ational **E**lectrical **S**afety **C**ode (**NESC**), ANSI/IEEE C2-2007 (or latest revision). Copies may be obtained by contacting: The **I**nstitute of **E**lectrical and **E**lectronics **E**ngineers, Inc. (**IEEE**), Publications Office, 10662 Los Vaqueros Circle, P.O. Box 3014, Los Alamitos, CA 90720

    www.ieee.org

  - **N**ational **E**lectrical **C**ode (**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.

INTRODUCING THE REVOLUTIONmini SINGLE PHASE CHARGER

The versatile design of REVOLUTIONmini single phase chargers provide customers with flexibility and optimum battery charging performance.

- Compatible with 24V batteries for the 24V version
- Compatible with 24V/36V/48V batteries for the 48V version.
- 1 and 2 module cabinets up to 1.35 kW per module.
- Up to 90A output for the 24V version and 52A for the 48V version.
- Completely automated. No programming required.
- Integrated SB175 output connector. Output extension cable available.
- Wide range input
- Detachable AC input cable with standard cable included. Other cables available for a variety of outlet and voltage options.
- Simple multi-colored LED indicates charger status.
- Built in handle for portability.
- Integrated benchtop or shelf operation stand. Wall mounting accessory bracket available.

Specifications

Models	Voltage	Number Modules	Nominal Volt (V)	Output Current (A)	Nominal Input Current
RVM-24-120	**120 VAC**	**1**	**24V**	**40A**	**13.5 A**
RVM-24-240	**240 VAC**	**2**	**24V**	**90A**	**8.0 A**
RVM-48-120	**120 VAC**	**1**	**48V**	**26A**	**13.5 A**
RVM-48-240	**240 VAC**	**2**	**48V**	**52A**	**8.0 A**
Input Voltage	**120 or 240 VAC 50/60 Hz Single Phase**				
Power Rating	**1.2kW @120VAC, 2.7kW @ 240VAC**				
Efficiency	**Maximum Power Factor > 90% to 99%**				
	Efficiency up to 95%				
User Interface	**LED**				
Cooling	**Forced air (fans)**				
Dimensions	**11.9” W x 11.9” D x 5.2” H**				
Weight	**1X: ≤ 25 lbs 2X: ≤ 30 lbs**				
Certifications	**UL and cUL listed; CEC Compliant**				

INSTALLATION PROCEDURE

Charger Installation

The following procedure describes proper installation of the **REVOLUTIONmini** series of chargers.

Charger Unpacking and Inspection

Upon receipt of a **REVOLUTION** charger, ensure that there is no physical damage to the chassis or the DC cables. If any damage is apparent, contact the shipping carrier.

- Ensure that the charging area is well ventilated, dry, and clean.
- **Do not expose the charger to rain or snow.** The charger is NOT designed for outdoor use.
- Ambient Temperature Range 0 – 40° C
- Ambient Humidity Range 10-90% RH non-condensing

Do not install or operate the charger if it has any visible damage.

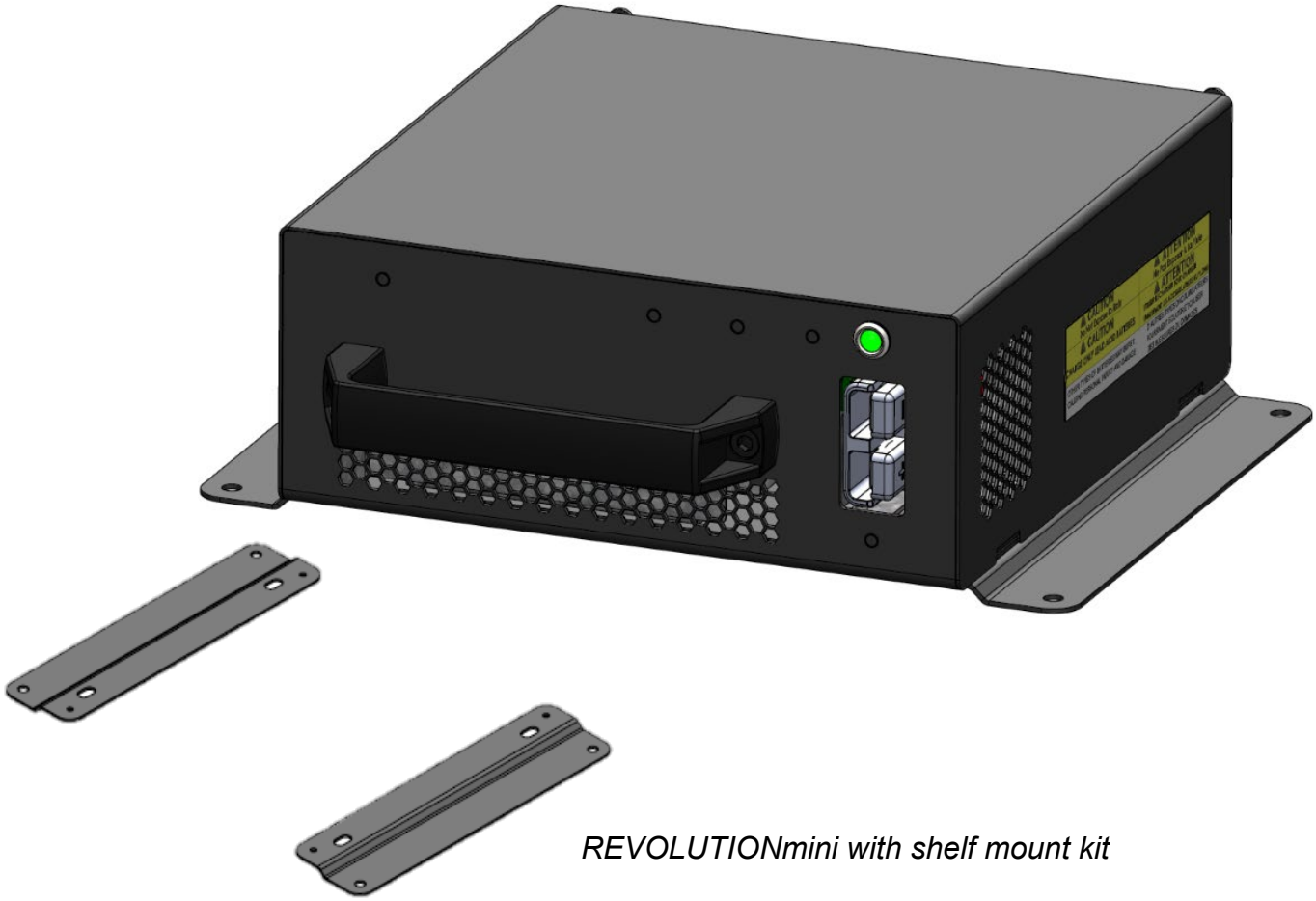
Installation

The REVOLUTIONmini is designed for portability. The charger can be set on a sturdy workbench with no need to bolt in place.

To pack up and go, unplug the charger AC cable and wrap it around the rear Cable Wrap brackets.

REVOLUTIONmini with AC cord wrapped

Optional Shelf Mount Option



REVOLUTIONmini with shelf mount kit

- Charger should be fastened to the mounting surface using 5/16” hardware (User provided).
- Never mount with charger vents facing up.

Shelf mount kit installations details in Appendix

OPERATION PROCEDURE

Getting Started

1. Powering the Charger

- Fit the provided AC cord into the power entry module.
- Plug the AC cord into your power outlet. The LED on the front of the REVOLUTIONmini will turn **Solid Green** indicating it is ready to begin charging.

DANGEROUS VOLTAGES AND CURRENTS ARE PRESENT IN THE AC MAINS WHEN ENERGIZED. ONLY TRAINED PERSONNEL SHOULD PERFORM THESE CHECKS, USING PROPER EQUIPMENT AND PROCEDURES.

2. Charging

Ready to Charge

- To begin charging start by verifying the LED on the front panel is **Solid Green**. This indicates the charger is Ready to Charge.
- When ready, plug the battery to be charged into the integrated SB175 connector on the front of the charger. The charger will begin the charging process, moving through the following stages.

Trickle Charge

- If the battery voltage is below 1.85VPC (Volts Per Cell) the charger will begin with a trickle charge, charging the battery at a rate of 10A for the RVM-XX-120 and 15A for the RVM-XX-240. The RVM-XX-240 will only charge at 10A in this mode if using 120VAC.
- The battery must be above 9V to begin this process. When in this stage the LED on the front panel will be **Flashing Green Yellow**. Once the battery voltage rises above 1.85VPC the charger will transition into Constant Current.
- Entering the Trickle Charge stage is uncommon and will be skipped entirely if the battery that is plugged into the charger is already above 1.85VPC.
- Trickle Charge is limited in duration specified by the Trickle Timer parameter (12 hours).

Constant Current

- In the Constant Current stage, the charger will output the maximum current available as per Table 1. When in this stage the LED on the front panel will be **Solid Yellow**. The charger will remain in this stage until the battery voltage rises to 2.40 VPC, after which it will transition to Constant Voltage.
- CC charge is limited in duration specified by the CC Timer parameter.

Constant Voltage

- In the Constant Voltage stage, the charger will hold the battery voltage at 2.40 VPC. The current required to maintain this voltage will slowly drop as the battery approaches a full charge. When in this stage the LED on the front panel will be **Flashing Yellow**. Once the current drops to 15A for the RVM-XX-120 or 25.0A for the RVM-XX-240 the charger will transition to Finish Charge.
- The CV charger is limited to maximum limited in duration by the Finish Timer parameter (3 hours).

Finish Charge

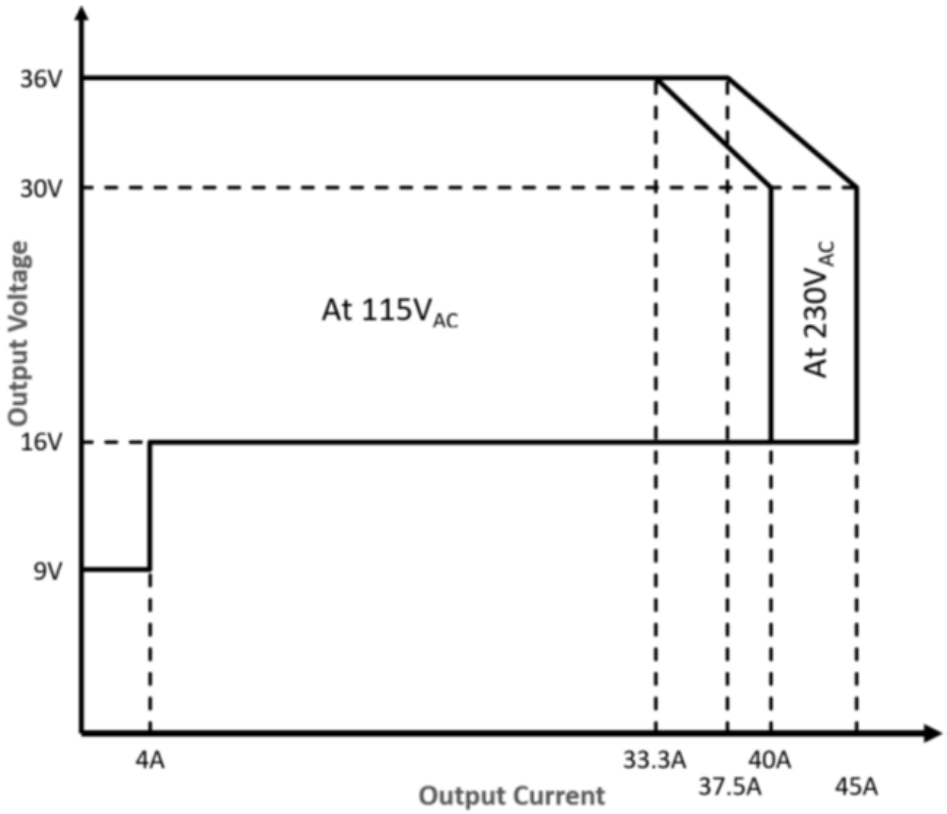
- In the Finish Charge stage, the charging current is 15A for the RVM-XX-120 and 25A for the RVM-XX-240. The RVM-XX-240 will only charge at 15A in this mode if using 120VAC.
- The charge will continue until the Finish Voltage of 2.55VPC is reached or is the battery voltage rise is less than the dV/dt parameters of 2 mVPC (millivolt per cell) for any 20 minute period of charge.
- The Finish Charge state is limited in duration by the Finish Timer parameter (3 hours).
- When in this stage the LED on the front panel will be **Green Yellow**. The charger will remain in this stage until the battery voltage rises to 2.55VPC, or the dV/dt limit is met, after which it will transition to Charge Complete.

Charge Complete

- In the Charge Complete stage, the battery is fully charged and can be safely disconnected from the charger. When in this stage the LED on the front panel will be **Flashing Green**.
- The charger will stay in this stage until the battery is disconnected.

Table 1: Charger Output

Model	Input Voltage	Maximum Output Current	Maximum Output Power
RVM-24-120	120VAC	40A	1200W
	240VAC	45A	1350W
RVM-24-240	120VAC	40A	1200W
	240VAC	90A	2700W
RVM-48-120	120VAC	26A	1200W
	240VAC	26A	1350W
RVM-48-240	120VAC	26A	1200W
	240VAC	52A	2700W



Output of single 24V power module

Charger Status Indicators

The REVOLUTIONmini's status can be easily determined by the multi-color LED on the front panel.

Regular Charge Cycle Status Indicators

Front Panel Light	Charger State
Solid Green	Ready to Charge. No battery connected
Flashing Green Yellow	Trickle Charging. Battery voltage is below 1.85VPC
Solid Yellow	Constant Current Charging. Battery voltage is below 2.40VPC
Flashing Yellow	Constant Voltage Charging. Battery voltage is 2.40VPC
Green Yellow	Finish Charging
Flashing Green	Charge Cycle Completed

Charger Fault Status Indicators

Front Panel Light	Charger State
Solid Red	Charger initialization. If the light persists it indicates that there is a communication problem with the power modules.
Flashing RedGreen	Trickle Timer Timeout. Trickle voltage not reached.
Flashing RedYellow	CC Timer Timeout. CV voltage not reached.
Flashing RedYellowGreen	Connected battery voltage exceeds charger's voltage specification
RedGreenYellow	Charger modules with incompatible voltage ratings are installed

Notes:

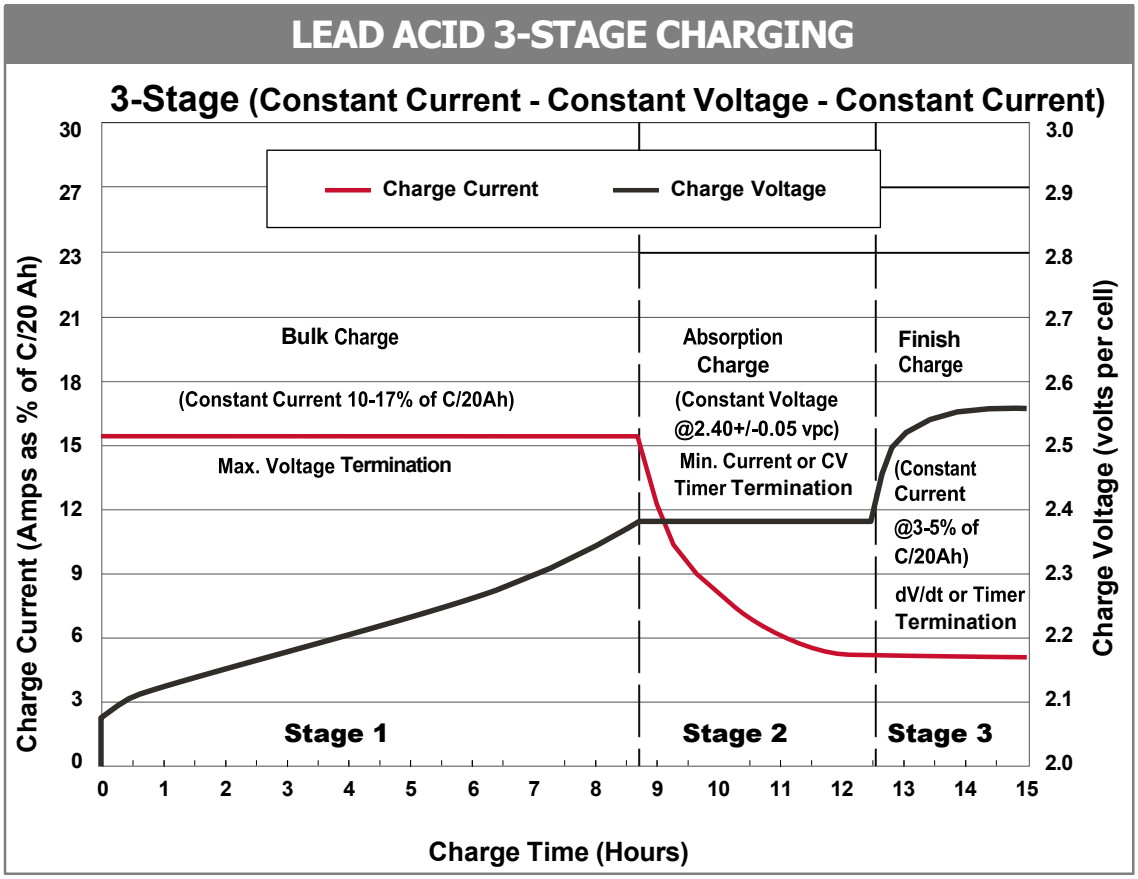
(1) When the charger is powered up it will light the **Red** LED. The initialization process takes about 10 seconds. During the Initialization it will blink the **Red** LED once if a single charge module is enumerated or it will blink the **Red** LED twice if two charge modules are enumerated.

(2) When a battery is connected that was just recently charged or discharged the charger will wait for the battery voltage to settle. The charger will blink the **Green** LED at a rate once per 3 seconds. Once the battery voltage settles the charger will start a charge cycle.

Charging Parameters

The REVOLUTIONmini is a 3-stage charger. The stages consist of CC (Constant Current) Charge, CV (Constant Voltage) Charge and FI (Finish Charge). The TR (Trickle) stage is optional and it will be activated only on a deeply discharged battery if battery voltage is less than 1.85 VPC.

The chart below illustrates the typical 3-stage charging curves



Charger Parameters

Charger Voltage Settings				
Stage \ Voltage	**2 Volt Cell**	**24V**	**36V**	**48V**
Trickle Charge	< 1.85	< 22.2	< 33.3	< 44.4
CC Charge	1.85 - 2.40	22.2 – 28.8	33.3 – 43.2	44.4 – 57.6
CV Charge	2.40	28.8	43.2	57.6
Finish Charge	2.40 - 2.55	28.8 – 30.6	43.2 – 45-9	57.6 - 61.2

Stage \ Current	RVM-24-120	RVM-24-240	RVM-48-120	RVM-48-240
Trickle Charge	10A	15A	10A	15A
CC Charge	40A	90A	26A	52A
CV Charge	40 to 15A	90 to 25A	26 to 15A	52 to 25A
Finish Charge	15A	25A	15A	25A

Stage \ Timer	Max Timer	Timer Expiration
Trickle Charge	12:00	Trickle Timer Timeout
CC Charge	15:00 (24V) 20:00 (48V)	CC Timer Timeout
CV Charge	3:00	Continue with Finish Charge
Finish Charge	3:00	Cycle Completed
Finish dV/dt	< 2mVPC per 20 minutes	Cycle Completed

Cold Weather Temperature Compensation

The charger has a build-in temperature sensor which monitors the ambient temperature. The temperature compensation coefficient is 4mVPC per degree Celsius. The temperature compensation adjustment is made if ambient temperature reading is in the interval between -10 C and 25 C. For temperature measurements outside the specified interval there will be no compensation. The table below illustrates CV charge voltage adjusted with the temperature compensation.

Temperature Compensation in CV mode					
Temp \ Voltage	**2 V**	**24V**	**36V**	**48V**	**Adj. per cell**
25C	2.40	28.8	43.2	57.6	0
10C	2.46	29.5	44.3	59.0	60mV
0C	2.50	30.0	45.0	60.0	100mV
-10C	2.54	30.5	45.7	61.0	140mV

RETURN MATERIAL PROCESS

In the event service is needed.

a. Record the charger serial number;

B. Call Power Designers Sibex with a description of the problem.

Power Designers Sibex will attempt to resolve the problem over the phone. If the issue cannot be resolved in this manner, a Return Material Authorization (RMA) form must be completed and submitted to Power Designers Sibex.

Upon receipt of the completed RMA form, Power Designers Sibex will issue an RMA number for the return. Based on the serial number of the specific charger(s) and the particular problem encountered, Power Designers Sibex will either repair or replace the defective components under warranty.

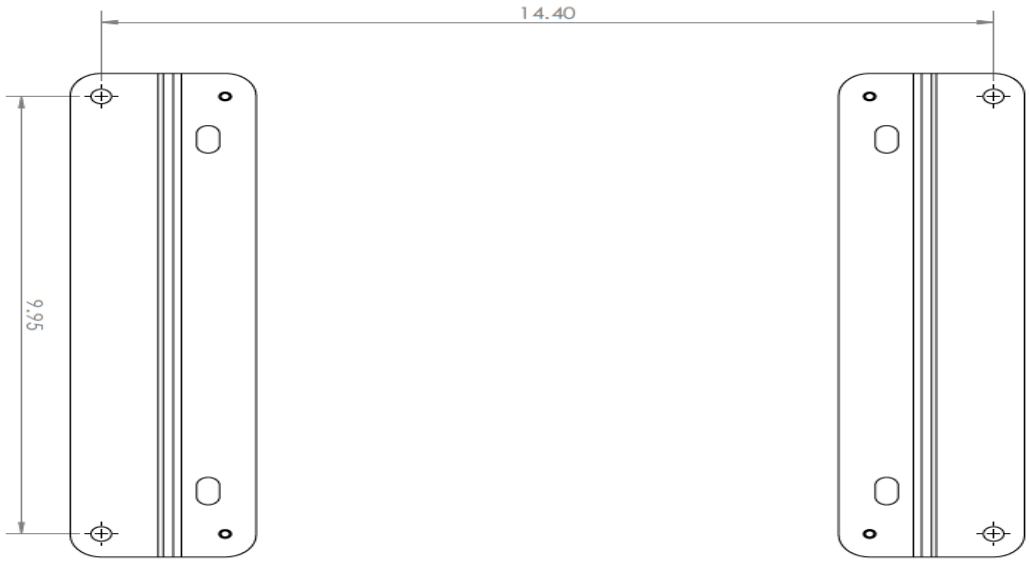
For chargers out of warranty, Power Designers Sibex, upon receipt of the charger and in consideration of a diagnostic fee, will provide a repair estimate.

Power Designers Sibex
RMA Return #
430 N. Suncoast Blvd
Crystal River, FL 34429

Phone: 352.795.0101
Fax: 352.564.0772
Email: service@powerdesigners.com

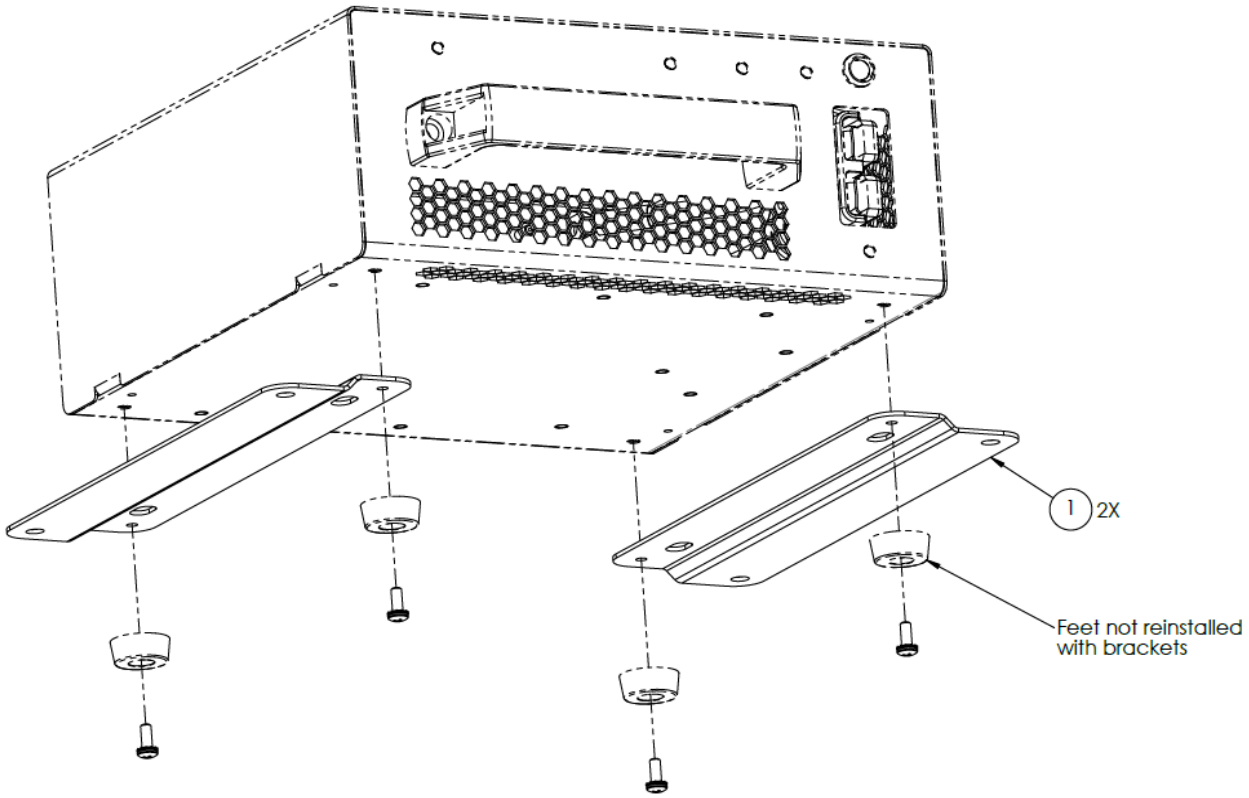
www.powerdesignerssibex.com

Appendix – Shelf Mount Dimensions and Instructions



Install Procedure:

1. Carefully flip the charger on its cover. Use a soft material between the cover and work surface as a shield to prevent scratching.
2. Remove the 4 screws holding the 4 rubber feet in place. These will be used later.
3. Position shelf brackets on the charger base and align the mounting holes.
   Note: The cover screws should be visible and centered within the bracket cutouts. If the cover screws prevent the bracket from sitting flush with the charger base, alignment is incorrect.
4. Install fasteners to mount the shelf brackets. Tighten to **25±2 in-lbs**.



CONTACT INFORMATION

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Phones are answered between 8 a.m. and 4 p.m., Monday through Friday Eastern 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.