DATRON

Performance You Require. Value You Expect.®

PRC-BC4

Multiple Battery Charger

Operator/Technical Manual

Manual Part No. PRC-BC4-MS
Release Date: May 2016
Revision: G

Datron World Communications Inc.

995 Joshua Way, Suite A
Vista, CA 92081, U.S.A.
Phone: (760) 597-1500 Fax: (760) 597-1510
E-Mail: customerservice@dtwc.com
www.dtwc.com

Revision History

Date of Revision	Revision Letter	Description of Changes	Pages Affected
02/93	D1	Last update.	All
09/06	E	Convert to FrameMaker and overall update.	All
06/11	F	Updated the Charger board component locations diagrams (738100) and parts list (PRC-BC4CHG). Updated the Display board component locations diagram (738101) and parts list (PRC-BC4DIS).	4-4, 4-7 4-16, 4-17
05/16	G	Update manual format Update parts lists to latest revisions	All 4-7, 4-11

Warranty

Datron World Communications, Inc.

This manual, as well as the software described in it, is furnished under license and may only be used or copied in accordance with the terms of such license. The information in this manual is furnished for informational use only, and is subject to change without notice. It should not be construed as a commitment by Datron. Datron assumes no responsibility or liability for any errors or inaccuracies that may appear in this book.

Except as permitted by such license, no part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, recording, or otherwise without the prior written permission of Datron.

Software License Agreement and Warranty

This software is licensed to the user (licensee) under the express terms and conditions of Datron's software licensing policies and agreement as outlined below. By receiving and installing this software package the user (licensee) has indicated acceptance of the terms and conditions of this agreement presented herewith.

As used in this document, the term "Software" shall refer to the application or control software in machine readable format and the hardware protection key, along with any or all supporting documentation, as well as all updated or enhanced versions of the program supplied to the user at later date(s). This software license does not include source code, and therefore, no license is granted with respect to source code of any kind utilized directly or indirectly in any Datron or Datron supplied third party product. Note, in some cases, covered software may be included in Datron products in RAM or ROM, and/or forms of machine readable code, not readily accessible to the user or licensee.

In consideration of the terms and conditions of this agreement, Datron grants the user a non-exclusive, nontransferable license to install and operate one copy of the program. Licensee agrees not to attempt, aid, authorize, or direct any effort, either directly or indirectly to reverse engineer or reverse compile the Software. Licensee further agrees they or their agents are not authorized to make derivative versions or changes to the Software.

Title to and ownership of the Software shall at all times remain with Datron and/or its licensors. Further, no license is granted to copy or reproduce in any form whatsoever the Software supplied without the express written permission of Datron, prior to any such contemplated action.

Datron may terminate this agreement and discontinue further warranty coverage at any time due to failure to comply with the terms and conditions of this agreement.

In such an event, Datron will provide the user with written notice of such a "failure-to-comply" and the user will have 10 days to demonstrate that a remedy has been implemented. If the user fails to perform, the agreement will be terminated by further written notice from Datron. Upon termination, the user shall immediately return all original Software, documentation, and any copies of each to Datron.

This Software is licensed "AS IS" and Datron provides a warranty that covers the media upon which the Software is embedded for a period of 30 days from receipt of the product. Under this warranty policy Datron's sole obligation shall be to replace or repair, at Datron's discretion, any such media that in Datron's opinion proves defective.

The user is obligated to provide Datron with a detailed description of possible defects along with sample material such that Datron can reproduce the identified defects.

By receipt and use, user (licensee) acknowledges that certain software developed or distributed by Datron is controlled by one or more governmental agencies. The user (licensee) herewith acknowledges they will take all necessary actions to comply with applicable regulations concerning the use of licensed software. Further, Datron is under no obligation to supply source code or documentation of its software for any reason.

Datron makes no representation, express or implied, with respect to any Software licensed under this document as to its fitness for any particular purpose or intended use.

Furthermore, Datron shall have no liability under this agreement for any incidental, special, or consequential damages arising out of the use of any supplied software programs. Datron reserves the right to make periodic changes in it's software for any purpose without any obligation to notify users.

One Year Limited Warranty and Remedies

Datron warrants that its equipment is free from defects in design, materials, and workmanship for a period of 12 months from the date of installation of the equipment, but in no event later than 15 months from the date of shipment. If the equipment does not provide satisfactory service due to defects covered by this warranty, Datron will, at its option, replace or repair the equipment free of charge.

Should it be impractical to return the equipment for repair, Datron will provide replacements for defective parts contained in the equipment for a period of 12 months from the date of installation of the equipment, but in no event later than 15 months from the date of shipment.

This warranty is limited to the original purchaser and is not transferable. Repair service performed by Datron is warranted for the balance of the original warranty or 90 days, whichever is longer.

Exclusive Warranty

There are no other warranties beyond the warranty as contained herein. No agent, employee, or representative of Datron has any authority to bind Datron to any affirmation, representation, or warranty concerning the equipment or its parts that is not in conformity with the warranties contained herein.

EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, ARE MADE WITH RESPECT TO THE EQUIPMENT OR THE PARTS CONTAINED THEREIN, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND DATRON EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN.

Limitations of Warranty

This warranty does not cover: Physical damage to the equipment or its parts that does not involve defects in design, material, or workmanship, including the following:

- Damage by impact, liquids, temperature, or gases.
- Damage to the equipment or its parts caused by lightning, static discharge, voltage transients, or application of incorrect supply voltages.
- Defects or failures caused by unauthorized attempts to repair or modify the equipment.
- Defects or failures caused by Buyer abuse or misuse.

Return of Equipment - Domestic

To obtain performance of any obligation under this warranty, the equipment must be returned freight prepaid to:

Technical Support Services
Datron World Communications Inc.
3055 Enterprise Court
Vista, California 92081

The equipment must be packed securely. Datron shall not be responsible for any damage incurred in transit. A letter containing the following information must be included with the equipment:

a. Model, serial number, and date of installation.
b. Name of dealer or supplier of the equipment.
c. Detailed explanation of problem.
d. Return shipping instructions.
e. Telephone or fax number where Buyer may be contacted.

Datron will return the equipment prepaid by United Parcel Service, Parcel Post, or truck. If alternate shipping is specified by Buyer, freight charges will be made collect.

Return of Equipment - International

Contact Datron or your local Representative for specific instructions. Do not return equipment without authorization. It is usually not possible to clear equipment through U.S. Customs without the correct documentation. If equipment is returned without authorization, Buyer is responsible for all taxes, customs duties, clearance charges, and other associated costs.

Parts Replacement

The following instructions for the supply of replacement parts must be followed:

a. Return the parts prepaid to:
"Customer Service"
Datron World Communications Inc.
3055 Enterprise Court
Vista, California 92081; and

b. Include a letter with the following information:
1. Part number
2. Serial number and model of equipment
3. Date of installation

Parts returned without this information will not be replaced. In the event of a dispute over the age of the replacement part, components date-coded over 24 months previously will be considered out of warranty.

Remedies

Buyer's sole remedies and the entire liability of Datron are set forth above. In no event will Datron be liable to Buyer or any other person for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of use of, or inability to use the equipment.

Safety Considerations

This product and manual must be thoroughly understood before attempting installation and operation. To do so without proper knowledge can result in equipment failure and bodily injury.

Caution: Before applying AC power, be sure that the equipment has been properly configured for the available line voltage. Attempted operation at the wrong voltage can result in damage and voids the warranty. See the manuals section on installation. DO NOT operate equipment with cover removed.

Earth Ground

All Datron products are supplied with a standard, 3-wire, grounded AC plug. **DO NOT** attempt to disable the ground terminal by using 2-wire adapters of any type. Any disconnection of the equipment ground causes a potential shock hazard that could result in personal injury. DO NOT operate any equipment until a suitable ground has been established. Consult the manual section on grounding.

Servicing

Only trained personnel should perform product repair. To avoid electric shock, **DO NOT** open the case unless qualified to do so.

Various measurements and adjustments described in this manual are performed with AC power applied and the protective covers removed. Capacitors (particularly the large power supply electrolytic type) can remain charged for a considerable time after the unit has been shut off. Use particular care when working around them, as a short circuit can release sufficient energy to cause damage to the equipment and possible injury.

To protect against fire hazard, always replace line fuses with ones of the same current rating and type (normal delay, slow blow, etc.). **DO NOT** use higher value replacements in an attempt to prevent fuse failure. If fuses are failing repeatedly this indicates a probable defect in the equipment that needs attention.

Use only genuine Datron factory parts for full performance and safety of this product.

Made in the USA

Contents

Chapter 5: Maintenance

Chapter 1: Introduction

1.1 PRC-BC4

The PRC-BC4 is a multiple battery charger designed to charge up to four BB-LA6 lead-calcium batteries simultaneously. The PRC-BC4 can use a 110 or 220 VAC power source (50 or 60 Hz); it can also use a 20 to 30V DC power source.

The PRC-BC4 includes the following features:

- Up to four battery charging capacity
- 3-level charging circuitry
- AC or DC power source
- Front panel status LEDs for each charging station
- Front panel reset button for each charging station

1.2 Specifications

PRC-BC4 Specifications

Note: All specifications subject to change without notice or obligation.

Characteristic	Description
General	
Input voltage	110/220 VAC or 20 to 30 VDC
Input current	1A (max.) at 110 VAC 0.5A (max.) at 220 VAC 5A (max.) at 20 to 30 VDC
Input protection	Fully protected on DC input and battery outputs
Electrical	
Bulk charging rate	1.1A (C/5)
Bulk to overcharge transition voltage	14.0 VDC
Overcharge terminate current	110 mA (c/50)
Float charge voltage	13.3 VDC
Float to bulk transition voltage	12.0 VDC
Temperature coefficient on voltage levels	-12 mV/°C
Current drain on battery with power off	5 µA (max.)
Nominal charge time with 80% discharged battery	6 hrs
Mechanical	
Weight	4.3 kg (9.5 lbs.)
Size (HWD)	4.0 in. x 9.5 in. x 11.0 in. (10 cm x 24 cm x 28 cm.)
Panel indicators	**POWER ON** and **FAULT**, **CHARGING**, and **READY** for each charger circuit
Operating controls	**POWER** switch, **RESET** button for each charger circuit

Characteristic	Description
Environmental	
Temperature Operating	0° to +60°C (ambient)

BB-LA6 Battery Specifications

Characteristic	Description
Electrical	
Nominal capacity	6 Ah
Nominal voltage	12 VDC
Max. instantaneous output current	30A at 20°C
Max. continuous output current	7A at 20°C
Internal resistance	0.02 ohm max. (fully charged)
Percent of original capacity versus storage time	90% after 3 months 80% after 6 months 60% after 12 months
Mechanical	
Weight	5.5 lbs. (2.5 kg)
Size (HWD)	3.7 in. x 9.5 in. x 2.3 in. (9.4 cm x 24.2 cm x 5.8 cm.)

CY-2562 Battery Box Specifications

Characteristic	Description
Mechanical	
Weight	0.5 lbs. (0.23 kg)
Size	3.0 in. x 4.0 in. x 11.0 in. (7.5 cm x 10 cm x 28 cm.)

Chapter 2: Installation

2.1 Unpacking

The PRC-BC4 is shipped in a heavy-duty corrugated cardboard carton. Do not discard the cartons and packing materials in case the equipment needs to be reshipped.

Inspect the PRC-BC4 for possible damage during shipment. Check all accessories against the packing list. The packing list should include the following items:

- PRC-BC4 multiple battery charger
- AC power cord
- DC power cord
- Four battery charging cables
- CY-2562 battery box

2.2 Power Configuration

2.2.1 AC Input Power

The PRC-BC4 can be configured for 110 or 220 VAC by opening the case and changing the connections on the power transformer. A label on the case indicates to what input voltage the transformer is set, however it is prudent to visually inspect the power transformer to verify what input voltage it is configured to accept (refer to Figure 2-2 on page 2-3).

CAUTION: Always remember to remove the AC power cable before opening the PRC-BC4 case. If the charger is energized, the technician is exposed to dangerous voltages that can cause personal injury or death from electrical shock.

To access the power transformer:

1. Make sure the PRC-BC4 is turned off and disconnected from any power source (see **CAUTION** above).

2. Place the PRC-BC4 so the front panel is faced away from you. Locate and remove the four captive screws that hold the front panel to the case (refer to Figure 2-1 below).

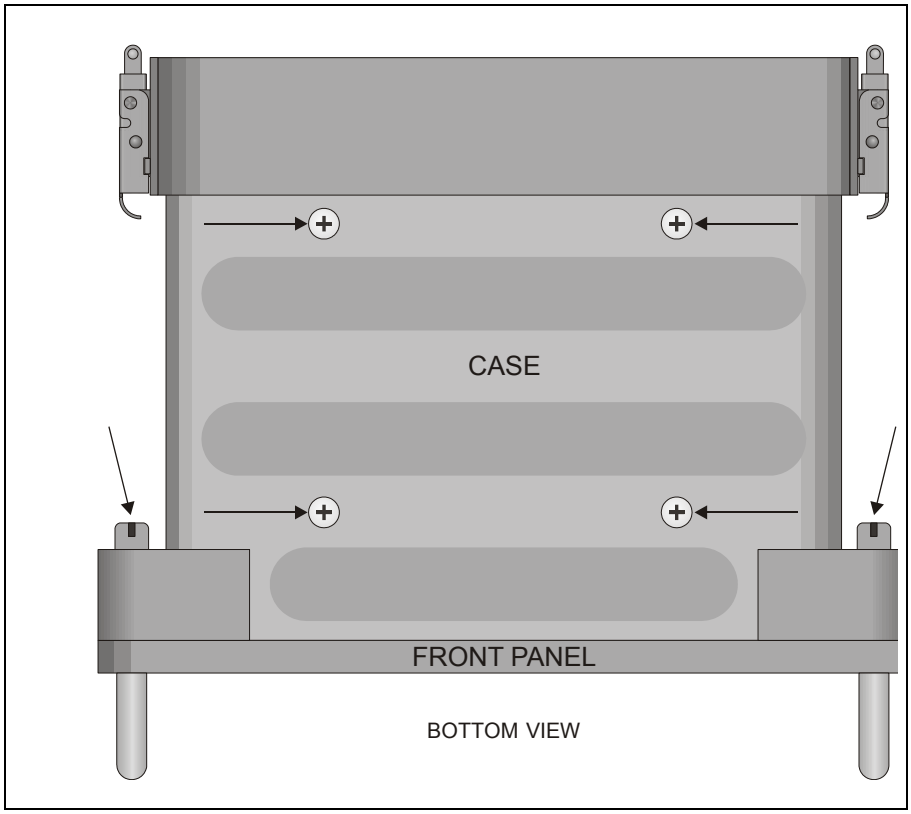

Figure 2-1 Captive and Chassis Screws

3. Place the PRC-BC4 so the bottom side is facing you. Remove the four screws that hold the inside chassis to the case.
4. Slide the chassis out of the case.
5. Note the connections on the power transformer behind the regulator circuit board.

To configure the PRC-BC4 for a 220 VAC power source:

1. Desolder terminals 3, 4, 5 and 6
2. Remove the jumper wires between terminal 3 and terminal 4, and the jumper between terminal 5 and terminal 6 (refer to Figure 2-2 on page 2-3).
3. Install one of the jumpers between terminal 4 and terminal 5.
4. Resolder terminals 3, 4, 5, 6.
5. Reverse steps 2 through 4 in the previous procedure to reassemble the PRC-BC4.

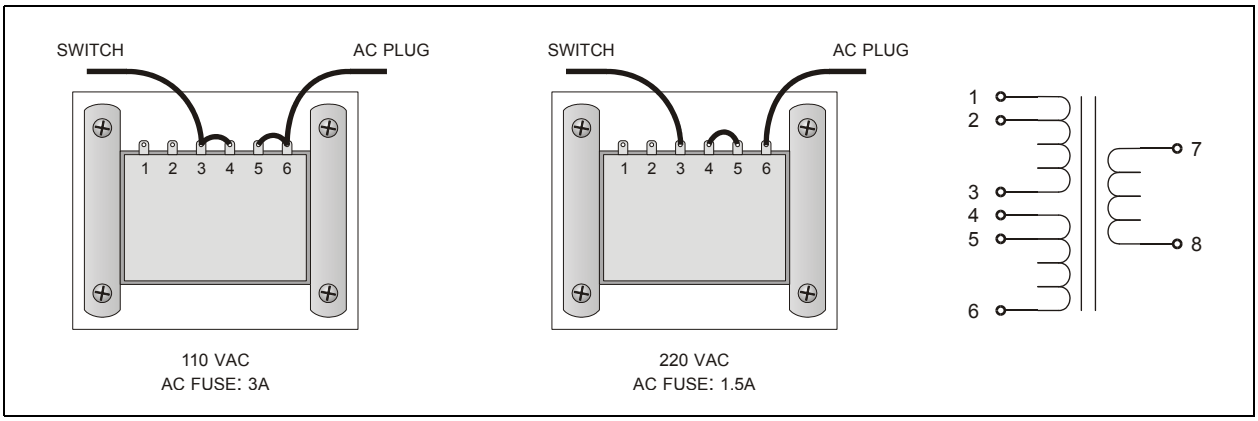

Figure 2-2 Power Transformer Connections

The PRC-BC4 is shipped with a molded AC power cable with a 3-wire plug and jack. It may be necessary to modify the plug to fit non-standard US AC receptacles. The following table provides the color codes for the conductors in the AC power cable.

Wire Type	US Standard Color Code	International Color Code
Phase	Black	Brown
Neutral	White	Blue
Ground	Green	Green/yellow stripe

2.2.2 DC Input Power

The PRC-BC4 also ships with a 2-wire (14 AWG) DC power cable. One end of the cable is unterminated so the appropriate connector can be added to connect to a DC power source. The power source must provide 20 to 30 VDC and be capable of supplying 5A. A vehicle battery is a typical DC power source.

The front panel **DC INPUT** connector is wired according to Figure 2-3 below.

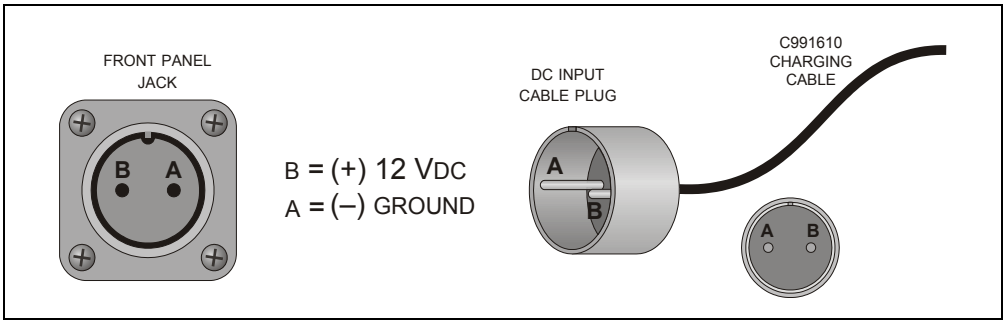

Figure 2-3 DC Power Connection

CAUTION: Do not operate the PRC-BC4 when connected to both an AC and DC power source.

The PRC-BC4 does not require any alignment or adjustment for normal operation.

2.2.3 Output Power

The PRC-BC4 provides 12 VDC to up to four BB-LA6 lead-calcium batteries.

Chapter 3: Operation

The PRC-BC4 interface consists of four BB-LA6 battery external charging stations: three accessed from the front panel and a fourth from the rear of the chassis (refer to Figure 3-2 on page 3-2).

CAUTION: Use the PRC-BC4 to charge BB-LA6 lead-calcium batteries only. Attempting to recharge lithium, magnesium or other battery types may result in explosion or release of toxic material.

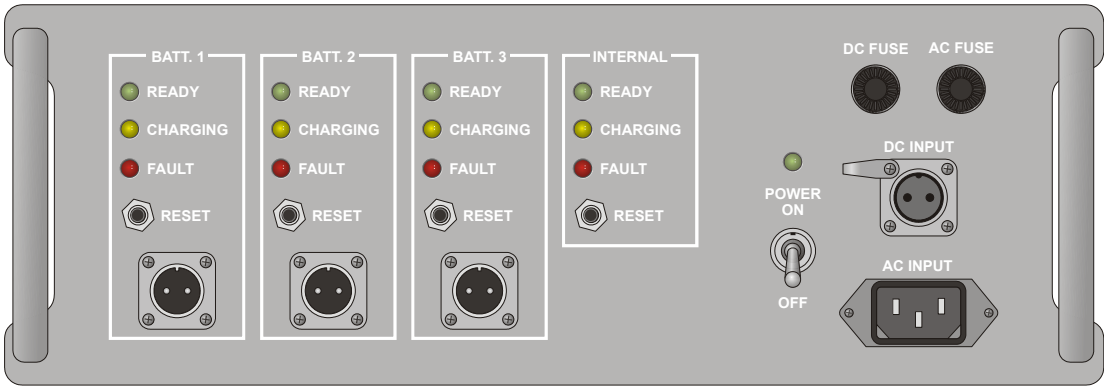

Figure 3-1 PRC-BC4 Front Panel

To set up the PRC-BC4 for charging operation:

1. Make sure the power transformer is configured correctly for the intended power source (refer to Figure 2-2 on page 2-3).
2. Do one of the following:
   - Connect the AC power cable to the front panel **AC INPUT** connector and an AC (110 or 220 VAC) power source.
   - Connect the DC power cable (C991609) to the front panel **DC INPUT** connector and a DC (20 to 30 VDC) power source.

3. Connect up to three DC charging cables (C991610) from the front panel charging station connectors to BB-LA6 batteries.
4. Install an additional BB-LA6 battery to the rear of the PRC-BC4.

To charge BB-LA6 batteries:

1. Turn the front panel **POWER** switch to **ON**.
2. Push the front panel **RESET** button to start charging for each charging station.
3. Observe the front panel status LEDs for the charging stations in use. The yellow **CHARGING** LED should be lit. Table 3-1 below provides additional LED indications.

Table 3-1 Status LED Indications

LED	Meaning	Required Action
FAULT	Battery fuse is blown or battery voltage is below 4 VDC. **Note:** It is normal for the **FAULT** LED to go on if you press **RESET** when a battery is not installed.	Check battery fuse. If the battery fuse is okay, the battery is faulty. Discard the battery.
CHARGING	Battery is charging normally.	None.
READY	Battery is fully charged.	Remove battery. The battery may be left connected to the charger.

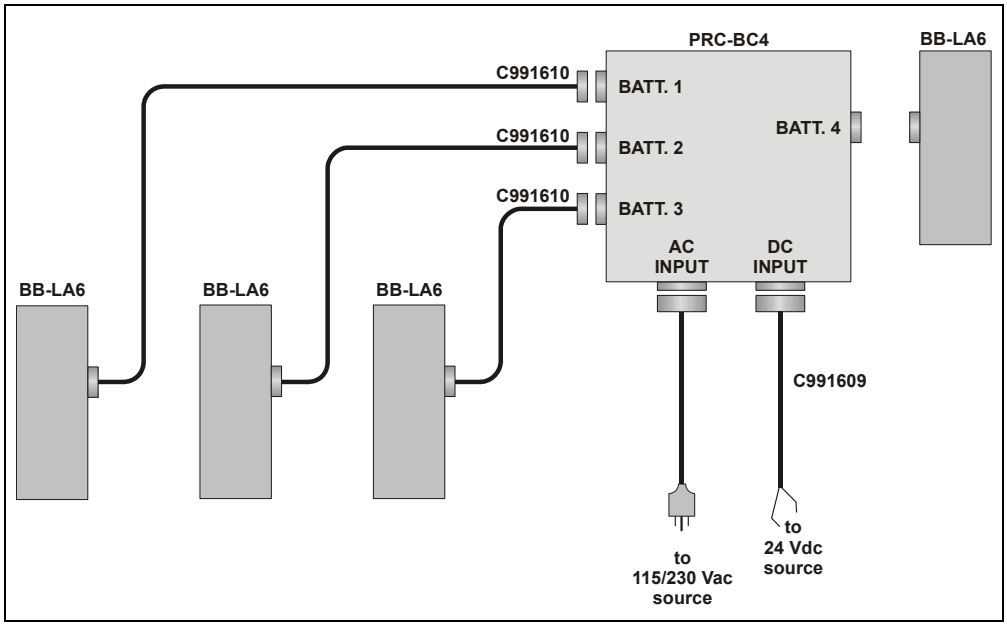

Figure 3-2 Charging Configuration

Chapter 4: Technical Description

This chapter provides a detailed description of the circuitry that the PRC-BC4 uses to charge BB-LA6 batteries.

4.1 Input Power

The PRC-BC4 derives input power for either an AC (110 or 220 VAC) or DC (20 to 30 VDC) power source. Both power sources are switched using the front panel **POWER** switch.

4.1.1 AC Power Supply

The internal AC power supply uses a standard, monolithic full-wave diode bridge as the rectifier. The power transformer uses a split primary coil configurable for a 110 or 220 VAC power source. The phase line is switched and fused.

Capacitors C14, C15 and C16 form the AC filter circuit that limits ripple to about 2 Vpp at the full rated output. Switch S5 is a normally-closed thermostat that opens at approximately 167° F (75° C). The thermostat switch is wired in series with DC fuse F2 so that if the chassis temperature exceeds the 167° F set point, the PRC-BC4 temporarily turns off.

The Display board includes transient-absorbing diode D13, that provides protection against large spikes. If D13 detects a transient greater than 32 VDC, it goes into short mode, pulling the raw DC supply line to ground, which causes the fuse to blow.

4.1.2 DC Power Supply

The PRC-BC4 can operate from a 20 to 30 VDC DC power source. The DC power line is also filtered with capacitors C14, C15 and C16. Diode D5 provides reverse-current protection so that current does not flow to the DC input connector when the PRC-BC4 is using an AC power source.

4.2 Charging Circuit

The PRC-BC4 consists of four charging circuits with the three charging stations interfaced through the front panel and the fourth through the power connector on the back. Since all four charging circuits are identical, the following technical description only references charging circuit BATT 1.

The PRC-BC4 charges BB-LA6s in three charging state levels:

- Bulk charge
- Overcharge
- Float charge

4.2.1 Bulk Charge State

Each charging stations includes charger IC U1, that detects voltage and controls the charge levels. When an operator connects a BB-LA6 to the charge station, U1 detects voltage on the output line and initiates the bulk charge state. U1 also samples voltage through divider resistors R2 and R5 at the sampling input pin 12. Pin 7, normally at ground, provides the lower reference for the divider. When power is removed, pin 7 floats so that no current can flow out of the battery when the power is turned off.

The bulk charge begins when the voltage on pin 12 exceeds 2.5 VDC, which corresponds to 5.0 VDC from the battery. If the battery voltage is lower than 5V, the charger remains in fault condition and no current flows to the battery. This protects the PRC-BC4 from BB-LA6s with shorted cells.

Series pass transistor Q1 controls the charge current to the BB-LA6. In the bulk charge state, charger IC U1 drives Q1 through pin 16. Resistor R4, in series with the Q1 emitter, provides current-limiting and current-sensing that allows U1 to maintain the charge current at 1.1A. Capacitor C1 provides filtering for internal driver Q1. Diode D1 prevents the BB-LA6 from discharging when the PRC-BC4 is turned off.

The bulk charge state continues until the BB-LA6 voltage reaches the preset level (14.0 VDC) determined by the ratio of resistors R1, R3 and R6 sampled at pin 13. When the battery voltage reaches 14.0 VDC, the charging circuit goes into the overcharge state.

4.2.2 Overcharge State

The overcharge state maintains the battery voltage at 14.0 VDC until the current decreases by 10% of the bulk charge current (110 mA). This state brings the BB-LA6 back to full capacity without damaging the cells.

Charger IC pin 1, the charge state output, toggles when the charge current drops by 10% of the bulk charge current. The overcharge terminate pin (pin 8) connects to pin 1. When pin 1 toggles, it forces the charger into float state.

4.2.3 Float State

The float state maintains the battery voltage at 13.3 VDC. Charger IC U1 changes the cutoff voltage by changing pin 10 from ground (in the bulk charge state) that places R1 in parallel with R3, to a high impedance that places R1 in series with R3, shifting Vcutoff to 13.3V. The PRC-BC4 uses whatever current (up to 1.1A) necessary to maintain this voltage. The BB-LA6 is now fully charged and can be left on the charger in this state for many years.

If for some reason the BB-LA6 voltage drops below 12 VDC, the PRC-BC4 returns to the bulk charge state and repeats the charge cycle.

4.3 Status LEDs

The front panel LEDs provide charge level status. Charger IC U1 provides two signals to control the status LEDs: the enable comparator output at pin 11 and the state level output at pin 10.

4.3.1 Fault LED

The enable comparator output (pin 11) goes directly to the Display board where it drives the **FAULT** LED through current limiting resistor R2. It also drives the base of Q1 that shunts voltage away from diodes D1 and D2 when it is conducting, preventing the **CHARGING** and **READY** LEDs from lighting.

4.3.2 Charge LED

The state level output (pin 10) drives the inverting input to operational amplifier U5B. The non-inverting input is fixed at 1.3 VDC. Pin 10 is at ground potential during the bulk charge and overcharge states keeping the output of U5B high. When U5B is high (near B+ voltage but always greater than 12 VDC), the **CHARGING** LED conducts through R8; it also reverse-biases the **READY** LED so that it cannot light up.

4.3.3 Ready LED

During the float charge state, pin 10 goes to a high impedance condition with the voltage level equal to pin 13 (normally about 2.5 VDC). This causes U5B to go low. When the U5B output is low (near ground potential), the **READY** LED conducts through D3 and R5. The 12V supply provides the voltage for the **CHARGE** and **READY** LEDs.

4.4 Component Locations, Schematic, and Parts List

This section includes the component locations diagrams, schematic, and parts lists for the Charger board.

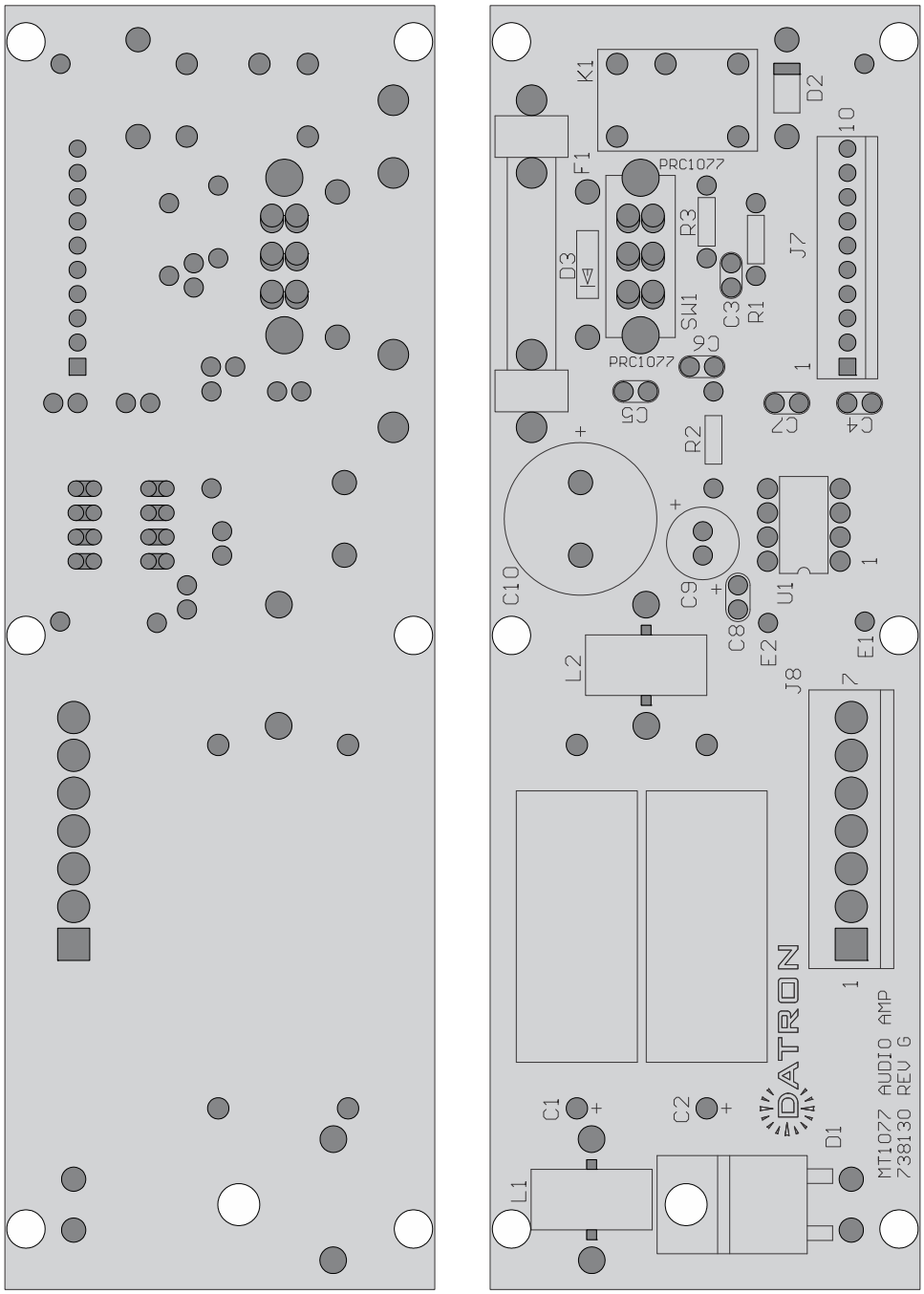

Figure 4-1 Charger Board Component Locations (738100 Rev. F)

REV	EDN	DESCRIPTION	DATE	APPR
C	MISC-212	994003 WAS 991203	10-11-90	
D	PRC-ACC-064	Q1 THRU 4 WAS MJE2955T	02-05-91	
E	ECO-05-0166	ADDED 4 RESISTORS BB	07-18-05	

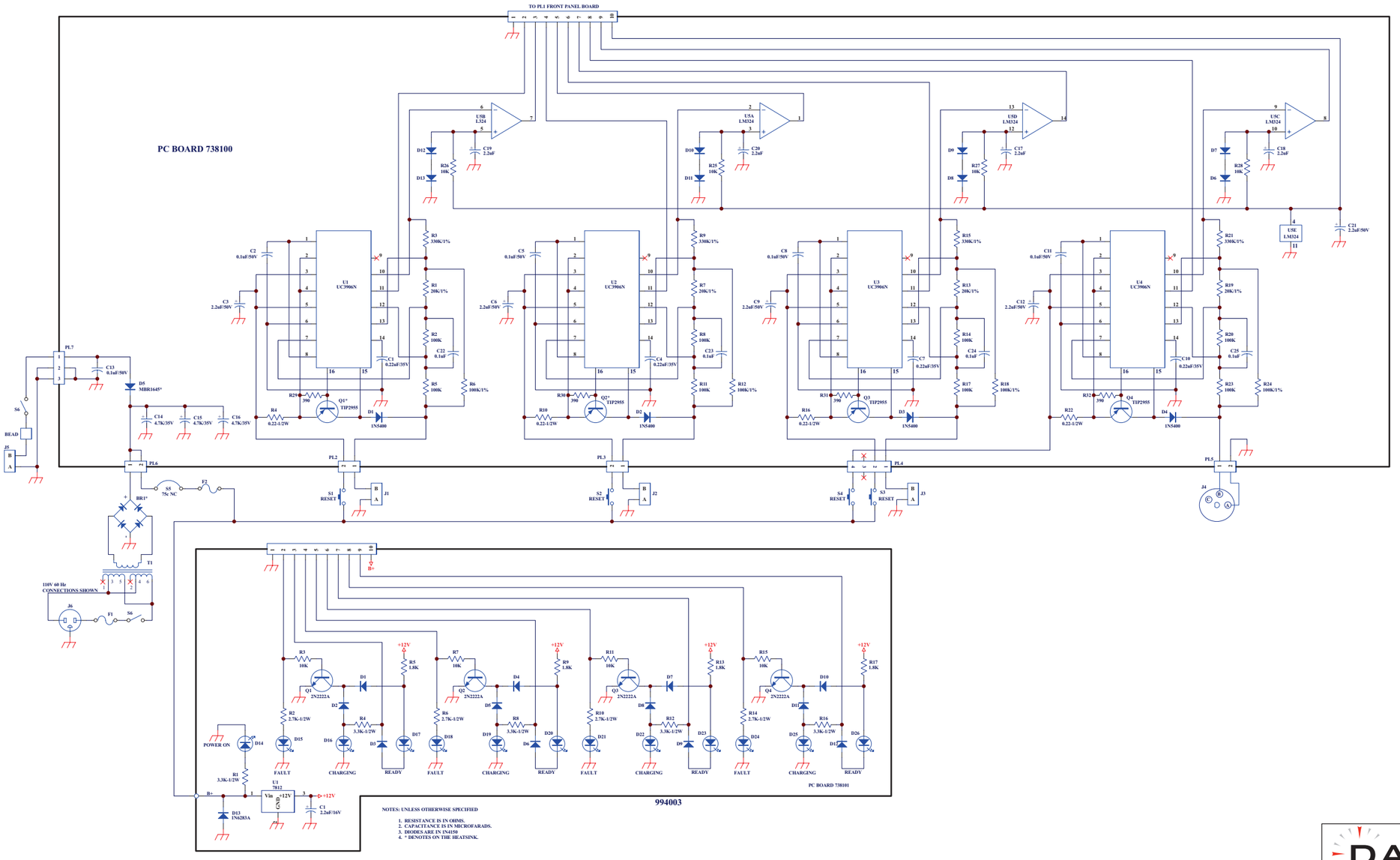

Figure 4-2
PRC-BC4
Battery Charger
Schematic Diagram
(994003 Rev. E)

Datron World Communications, Inc.
3055 Enterprise Ct.
Vista CA 92081-8362
TEL:(760) 597-1500
FAX:(760) 597-1510

DATRON
Performance You Require. Value You Expect.™

Title: Schematic	PRC-BC4 BATTERY CHARGER			
Size: D	Drawn: B.BROOKS	Date: 07-18-05	Drawing Number: 994003	Rev: E
	Appr:	Date:		
File: 994003E.SCH	Date: 24-Jul-2007	Time: 09:02:34	Sheet: 1 of 1	

Table 4-1 Charger Board Parts List (PRC-BC4CHG Rev. T)

Designator	Part Number	Description
C1	254224	“CAP, 0.22UF POLY 100V 5% 11X13X10LS”
C10	254224	“CAP, 0.22UF POLY 100V 5% 11X13X10LS”
C11	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C12	230020	“CAP,2.2MF ELECT”
C13	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C14	230502	“CAP,4700MF 35V ELECT”
C15	230502	“CAP,4700MF 35V ELECT”
C16	230502	“CAP,4700MF 35V ELECT”
C17	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C18	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C19	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C2	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C20	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
C21	230020	“CAP,2.2MF ELECT”
C22	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C23	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C24	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C25	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C3	230020	“CAP,2.2MF ELECT”
C4	254224	“CAP, 0.22UF POLY 100V 5% 11X13X10LS”
C5	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C6	230020	“CAP,2.2MF ELECT”
C7	254224	“CAP, 0.22UF POLY 100V 5% 11X13X10LS”
C8	275104	“CAP, 0.1UF X7R 50V 10% RAD 0.1S”
C9	230020	“CAP,2.2MF ELECT”
D1	320103	“DIODE, 1N5400 3A 50V DO-201AD”
D10	320002	“DIODE, 1N4148/1N4150 DO-35”
D11	320002	“DIODE, 1N4148/1N4150 DO-35”
D12	320002	“DIODE, 1N4148/1N4150 DO-35”
D13	320002	“DIODE, 1N4148/1N4150 DO-35”
D2	320103	“DIODE, 1N5400 3A 50V DO-201AD”

Table 4-1 Charger Board Parts List (PRC-BC4CHG Rev. T)

Designator	Part Number	Description
D3	320103	“DIODE, 1N5400 3A 50V DO-201AD”
D4	320103	“DIODE, 1N5400 3A 50V DO-201AD”
D5	320126	“DIODE,MBR1645 SCHTKY 16A TO220”
D6	320002	“DIODE, 1N4148/1N4150 DO-35”
D7	320002	“DIODE, 1N4148/1N4150 DO-35”
D8	320002	“DIODE, 1N4148/1N4150 DO-35”
D9	320002	“DIODE, 1N4148/1N4150 DO-35”
PL1	610144	“HEADER,MLX,10PIN,.100”
PL2	610105	“HEADER, 1X2 W/LB-LOCK 0.1 TH”
PL3	610105	“HEADER, 1X2 W/LB-LOCK 0.1 TH”
PL4	610148	“HEADER,MLX,4PIN,.100,”
PL5	610105	“HEADER, 1X2 W/LB-LOCK 0.1 TH”
PL6	610165	“HEADER,MLX,2PIN,.156,W/LK”
PL7	610209	“HEADER,MLX,3PIN,.156,POLAR”
Q1	310137	“XSTR,TIP2955 PNP 15A TO-218”
Q2	310137	“XSTR,TIP2955 PNP 15A TO-218”
Q3	310137	“XSTR,TIP2955 PNP 15A TO-218”
Q4	310137	“XSTR,TIP2955 PNP 15A TO-218”
R1	127203	“RES, 20K OHM 1/4W 1% MF”
R10	144002	“RES, 0.22 OHM 1W 5% MOX”
R11	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R12	127104	“RES, 100K MF 1/4W 1% TH”
R13	127203	“RES, 20K OHM 1/4W 1% MF”
R14	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R15	127334	“RES, 330K OHM 1/4W 1% MF”
R16	144002	“RES, 0.22 OHM 1W 5% MOX”
R17	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R18	127104	“RES, 100K MF 1/4W 1% TH”
R19	127203	“RES, 20K OHM 1/4W 1% MF”
R2	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R20	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R21	127334	“RES, 330K OHM 1/4W 1% MF”

Table 4-1 Charger Board Parts List (PRC-BC4CHG Rev. T)

Designator	Part Number	Description
R22	144002	“RES, 0.22 OHM 1W 5% MOX”
R23	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R24	127104	“RES, 100K MF 1/4W 1% TH”
R25	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R26	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R27	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R28	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R29	124391	“RES,390 OHM 1/4W 5% CF”
R3	127334	“RES, 330K OHM 1/4W 1% MF”
R30	124391	“RES,390 OHM 1/4W 5% CF”
R31	124391	“RES,390 OHM 1/4W 5% CF”
R32	124391	“RES,390 OHM 1/4W 5% CF”
R4	144002	“RES, 0.22 OHM 1W 5% MOX”
R5	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R6	127104	“RES, 100K MF 1/4W 1% TH”
R7	127203	“RES, 20K OHM 1/4W 1% MF”
R8	124104	“RES, 100K OHM, 1/4W, 5%, CF”
R9	127334	“RES, 330K OHM 1/4W 1% MF”
U1	330325	“IC, UC3906N”
U2	330325	“IC, UC3906N”
U3	330325	“IC, UC3906N”
U4	330325	“IC, UC3906N”
U5	330030	“IC,LIN,LM324N,DIP14,OP-AMP”
XU1	621004	“SOCKET, IC DIP-16 PIN”
XU2	621004	“SOCKET, IC DIP-16 PIN”
XU3	621004	“SOCKET, IC DIP-16 PIN”
XU4	621004	“SOCKET, IC DIP-16 PIN”
XU5	621005	“SOCKET, IC DIP-14 PIN”

4.5 Display Board

The Display board includes all the **FAULT**, **CHARGING**, and **READY** LEDs for each charging station on the PRC-BC4.

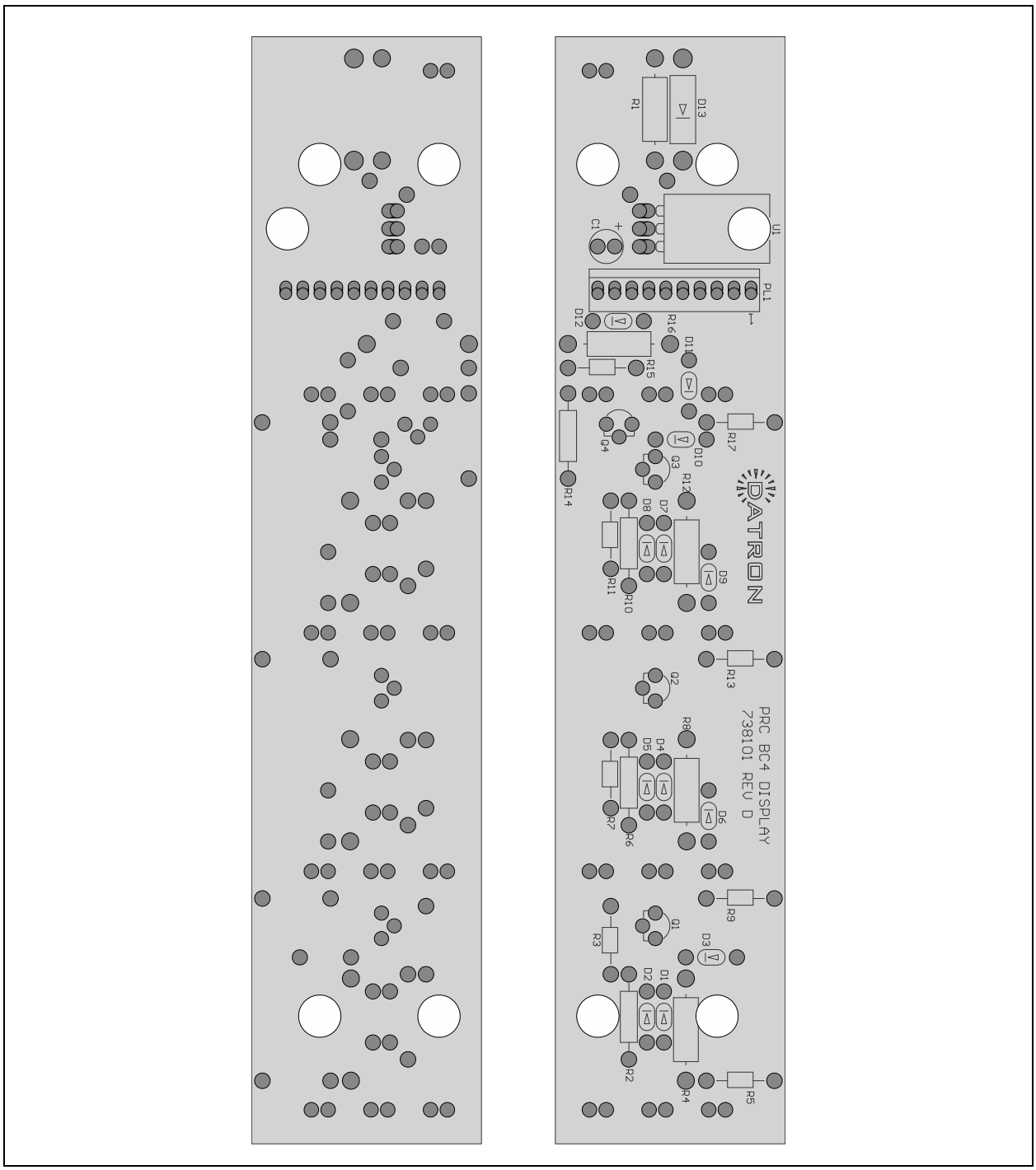

Figure 4-3 Display Board Component Locations (738101 Rev. D)

Table 4-2 Display Board Parts List (PRC-BC4DIS Rev. F)

Designator	Part Number	Description
C1	241020	“CAP, 2.2UF, TA, 16V, 20%, DIP, 0.1LS”
D1	320002	“DIODE, 1N4148/1N4150 DO-35”
D10	320002	“DIODE, 1N4148/1N4150 DO-35”
D11	320002	“DIODE, 1N4148/1N4150 DO-35”
D12	320002	“DIODE, 1N4148/1N4150 DO-35”
D13	320211	“DIODE, 1N6283A 28V TVS DO-204”
D14	320416	“LED, GREEN 28D T1-3/4”
D15	320415	“LED,RED”
D16	320417	“LED,YELLOW”
D17	320416	“LED, GREEN 28D T1-3/4”
D18	320415	“LED,RED”
D19	320417	“LED,YELLOW”
D2	320002	“DIODE, 1N4148/1N4150 DO-35”
D20	320416	“LED, GREEN 28D T1-3/4”
D21	320415	“LED,RED”
D22	320417	“LED,YELLOW”
D23	320416	“LED, GREEN 28D T1-3/4”
D24	320415	“LED,RED”
D25	320417	“LED,YELLOW”
D26	320416	“LED, GREEN 28D T1-3/4”
D3	320002	“DIODE, 1N4148/1N4150 DO-35”
D4	320002	“DIODE, 1N4148/1N4150 DO-35”
D5	320002	“DIODE, 1N4148/1N4150 DO-35”
D6	320002	“DIODE, 1N4148/1N4150 DO-35”
D7	320002	“DIODE, 1N4148/1N4150 DO-35”
D8	320002	“DIODE, 1N4148/1N4150 DO-35”
D9	320002	“DIODE, 1N4148/1N4150 DO-35”
PL1	610144	“HEADER,MLX,10PIN,.100”
Q1	310057	“XISTOR,NPN,PN2222A,TO92”
Q2	310057	“XISTOR,NPN,PN2222A,TO92”
Q3	310057	“XISTOR,NPN,PN2222A,TO92”

Table 4-2 Display Board Parts List (PRC-BC4DIS Rev. F)

Designator	Part Number	Description
Q4	310057	“XISTOR,NPN,PN2222A,TO92”
R1	137332	“RES,3.3K OHM 1/2W 1% MF”
R10	137272	“RES, 2.7K OHM 1/2W 5% CF”
R11	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R12	137332	“RES,3.3K OHM 1/2W 1% MF”
R13	124182	“RES, 1.8K OHM, 1/4W, 5%, CF”
R14	137272	“RES, 2.7K OHM 1/2W 5% CF”
R15	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R16	137332	“RES,3.3K OHM 1/2W 1% MF”
R17	124182	“RES, 1.8K OHM, 1/4W, 5%, CF”
R2	137272	“RES, 2.7K OHM 1/2W 5% CF”
R3	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R4	137332	“RES,3.3K OHM 1/2W 1% MF”
R5	124182	“RES, 1.8K OHM, 1/4W, 5%, CF”
R6	137272	“RES, 2.7K OHM 1/2W 5% CF”
R7	124103	“RES, 10K OHM, 1/4W, 5%, CF”
R8	137332	“RES,3.3K OHM 1/2W 1% MF”
R9	124182	“RES, 1.8K OHM, 1/4W, 5%, CF”
U1	330007	“IC, LM340T-12 VREG 12V 1A TO-220”

Chapter 5: Maintenance

This chapter provides a test procedure for verifying the PRC-BC4 functionality and a troubleshooting procedure for isolating a fault.

5.1 Functional Test

Use the following test procedure to verify that the PRC-BC4 is working properly. If the PRC-BC4 fails one of the checks, refer to Table 5-1 on page 5-4.

5.1.1 Required Materials

Use the following materials to perform the PRC-BC4 functional tests:

- DC Power supply (6 to 20 VDC output at 5A minimum)
- Electrolytic capacitor (30,000 to 150,000 µF 25 VDC)
- Resistor (6.8 ohms 10W)
- Resistor (2.2 ohms 5W)
- Resistor (82 ohms 3W)
- DC VOM (high impedance input)
- DC Ammeter (3A scale minimum)
- Clip jumpers
- Heat gun or blow torch

5.1.2 Test Procedure

The following checks use the electrolytic capacitor to simulate a BB-LA6 battery.

Charging Circuit Check

1. Set up the PRC-BC4 using an AC input power source. Connect a C991610 charging cable to charging station **BATT 1**.
2. Use the DC power supply to charge the electrolytic capacitor between 6 and 13 VDC.
3. Use the clip jumpers to connect one of the C991610 charging cables to the capacitor as if it were a BB-LA6 (refer to Figure 5-1 on page 5-2).

4. The **READY** LED for charging station **BATT 1** should light up in a few seconds. If it does not, measure the capacitor voltage to make sure it is greater than 6 VDC. If the capacitor voltage is above 6 VDC, the charger circuit has a fault.

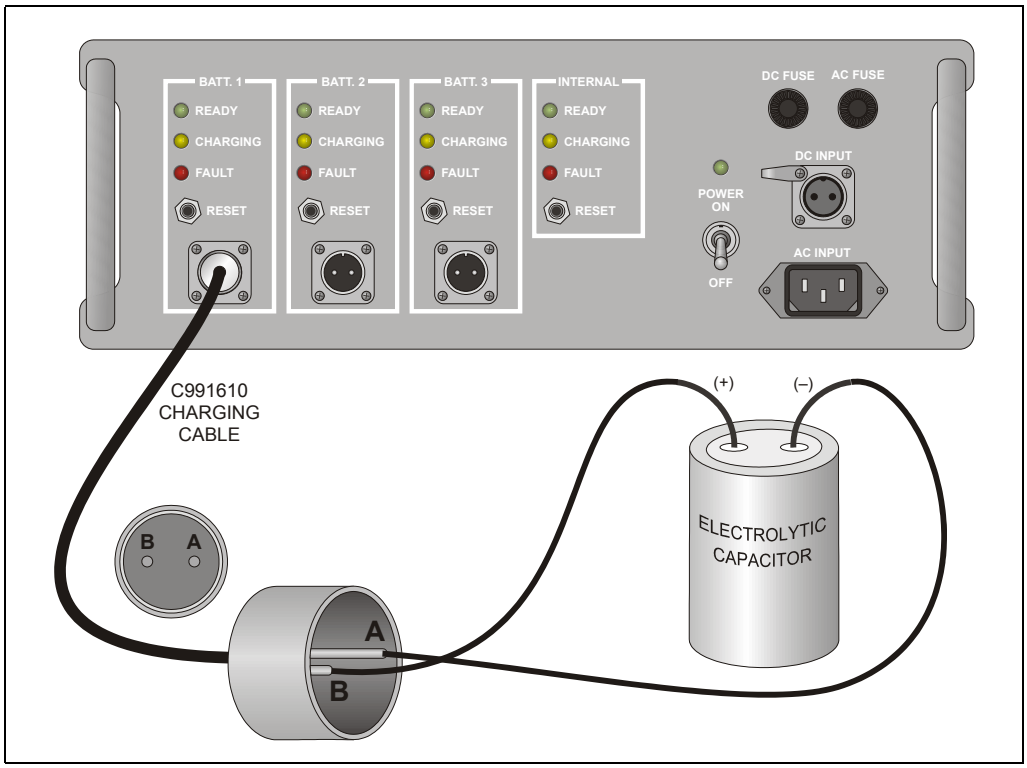

Figure 5-1 Charger Output Check Setup

DC Current Check

1. Connect the DC ammeter, 6.8 ohm and 2.2 ohm resistors in series and connect them across the capacitor (refer to Figure 5-2 on page 5-3).
2. Measure the DC current. It should be 1.1A ±0.1A. The **CHARGING** LED for charging station **BATT 1** should be lit when the ammeter and resistors are connected.
3. Disconnect the ammeter and resistors. The **READY** LED should light up after a few seconds.

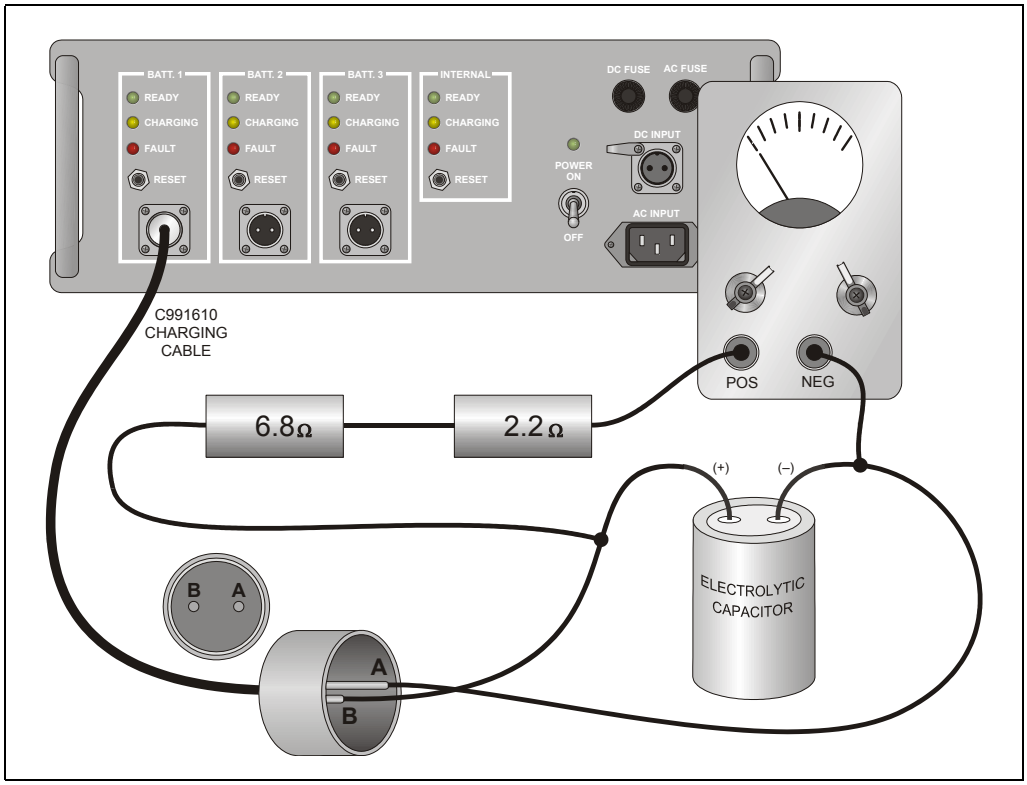

Figure 5-2 DC Current Check Setup

DC Output Check

1. Connect the DC voltmeter across the capacitor.
2. Connect the 82 ohm resistor across the capacitor.
3. Measure the DC voltage. It should be 13.3 ±0.2 VDC.

Reset Circuit Check

1. Press and hold the **RESET** button and observe the capacitor discharging.
2. Release the **RESET** button when the capacitor voltage is between 6 and 10 VDC. The **CHARGING** LED should light up.

Overcharge Voltage Check

1. Measure the DC voltage across the 82 ohm resistor. It should be 14.0 ±0.2 VDC.

Undervoltage Protection Circuit Check

1. Connect the 2.2 ohm resistor across the capacitor.
2. Observe that the **FAULT** LED lights up after a few seconds.

Repeat the previous checks for the other charging stations.

Reverse Current Protection

1. Connect the 82 ohm resistor across the front panel DC input pins.
2. Measure the DC voltage across the 82 ohm resistor. It should be 0.0 ±0 VDC.

DC Input Circuitry Check

1. Disconnect the AC input power source and connect the DC input power source.
2. Adjust the DC supply voltage to between 20 and 30 VDC.
3. Verify that the charger is working normally by performing the previous checks (exclude the reverse-current protection check) on charging station **BATT 1**.

Chassis Over-Temperature Protection:

1. Remove the PRC-BC4 chassis from the case (refer to "Power Configuration" on page 2-1).
2. Use a heat source such as a heat gun or torch to heat the thermostat until it trips.
3. Check that the PRC-BC4 shuts off until the thermostat trips back on.

This concludes the functional test. If the PRC-BC4 failed any of the previous steps, refer to "Troubleshooting" below.

5.2 Troubleshooting

5.2.1 Index to Test Procedure

If the PRC-BC4 fails a test procedure, Table 5-1 refers to a specific place in the troubleshooting procedure.

Table 5-1 Troubleshooting Index

Failed Test Section	Troubleshooting Section
"Charging Circuit Check" on page 5-1	Refer to "Current Source" on page 5-5.
"DC Current Check" on page 5-2, step 2	Refer to "Bulk Charging Current Regulation" on page 5-6.
"DC Current Check" on page 5-2, step 3	Refer to "Current Source" on page 5-5.
"DC Output Check" on page 5-3	Refer to "Float Charge Voltage" on page 5-6.
"Reset Circuit Check" on page 5-3	Refer to "Reset Function" on page 5-6.
"Overcharge Voltage Check" on page 5-3	Refer to "Overcharge Voltage" on page 5-7.

Table 5-1 Troubleshooting Index

Failed Test Section	Troubleshooting Section
"Undervoltage Protection Circuit Check" on page 5-3	Refer to "Undervoltage Protection" on page 5-7.
"Reverse Current Protection" on page 5-4	Refer to "Reverse Current Protection" on page 5-7.
"DC Input Circuitry Check" on page 5-4	Refer to "Reverse Current Protection" on page 5-7.

5.2.2 Troubleshooting Procedure

The following troubleshooting procedure provides specific steps to isolate faults. Since all four charging circuits are identical, for steps that deal with the charging circuit, this procedure references components in the first charging station (**BATT 1**).

Note: The term IC refers to the UC309N charger IC, and the term op amp refers to the LM324 operational amplifier.

Current Source

This section assumes a failure occurred during the "DC Input Circuitry Check" procedure on page 5-4 if the **READY** LED does not light up.

1. Measure the DC voltage at the rectifier bridge BR1 (+) terminal. It should be 20 ±3.0 VDC for AC operation; if not, refer to "AC Power Supply" on page 5-7.

   For DC operation the DC voltage at the rectifier bridge should be about 1 VDC less than the DC supply voltage; if not, refer to "Reverse Current Protection" on page 5-4.

2. Observe the front panel status LEDs. If none of them are lit, refer to "Status LEDs" on page 5-8.
3. If the **CHARGING** LED is lit, skip to step 7.
4. With more than 6 VDC across the capacitor, the **FAULT** LED should now be lit. On the IC, measure the DC voltage at pin 7. If it is more than 100 mV, replace the IC.
5. On the IC, measure the DC voltage at pin 12. If it is less than 3 VDC, check the resistive divider (R5, R2) at pin 12.
6. On the IC, check for a short circuit at pin 11 (pin 11 should be high). This output pin drives the **FAULT** LED through a series resistor on the Display board. If the **FAULT** LED is not lit, replace the IC.
7. The **CHARGING** LED should now be lit. If more than one LED is lit, refer to "Status LEDs" on page 5-8.
8. On pass transistor MJE2955, measure the voltage from the emitter to the base. If it is between 0.6 to 1.0 VDC, skip to step 9.

If the voltage is below 0.6 VDC, replace the IC. If the voltage is above 1.0 VDC, replace the transistor.

9. Using an ohmmeter (or a diode checker), measure the forward and reverse resistance of series diode 1N5400. If the forward resistance is less than 10 ohms and the reverse resistance is very high (mega ohms), the diode is okay; replace the pass transistor; if not, replace the diode.

Bulk Charging Current Regulation

This section assumes a failure occurred during the "DC Current Check" procedure on page 5-2 if the **CHARGING** LED does not light up.

1. If the DC current is okay, but the **CHARGING** LED is not lit, refer to "Current Source" on page 5-5.
2. Measure the DC voltage across the 0.2 ohm current sense resistor. If it is not 0.25 ± 0.02 VDC, refer to "Status LEDs" on page 5-8.
3. Turn off the power and measure the resistance of the 0.2 ohm resistor R2. If it is not within 5% tolerance, replace the resistor.
4. Refer to "Current Source" on page 5-5.

Float Charge Voltage

This section assumes a failure occurred during the "Float Charge Voltage" procedure on page 5-6 if the float charge voltage is out of specification. The float charge voltage should be 13.3 VDC.

1. R1 (20 k ohm) and R6 (100 k ohm) are 1% resistors that form a voltage divider that sets the float charge voltage. Turn the PRC-BC4 off (remove the AC power cable), and measure the resistance of these resistors to verify they are within 5% of their stated value.
2. Turn the PRC-BC4 on and verify that the float charge voltage is within specification (13.3 VDC). If it is significantly out of specification, refer to "Current Source" on page 5-5 (step 8).

Reset Function

This section assumes a failure occurred during the "Reset Circuit Check" procedure on page 5-3 if the DC voltage does not drop when pressing the **RESET** button. Turn the PRC-BC4 on for the following checks.

1. On the IC, measure the DC voltage on pin 3. Press and hold the **RESET** button and observe that the voltage drops to 0 VDC.
2. If the voltage does not drop, inspect the **RESET** switch and associated wiring.

Overcharge Voltage

This section assumes a failure occurred during the "Overcharge Voltage Check" procedure on page 5-3 if the overcharge voltage is not set at 14.0 VDC.

1. R1 (20 k ohm), R6 (100 k ohm) and R3 (330 k ohm) are 1% resistors that set the overcharge voltage. Turn the PRC-BC4 off (remove the AC power cable), and measure the resistance of these resistors to verify they are within 5% of their stated value.
2. Turn the PRC-BC4 on and verify that the overcharge voltage is within specification (it should be 14.0 VDC), refer to "Current Source" on page 5-5 (step 8).

Undervoltage Protection

This section assumes a failure occurred during the "Undervoltage Protection Circuit Check" procedure on page 5-3 if the **FAULT** LED does not light when an undervoltage condition (possible shorted battery cell) exists.

1. Turn the PRC-BC4 on.
2. If no status LEDs are lit, refer to "Status LEDs" on page 5-8, also, refer to "Current Source" on page 5-5 (step 5).

Reverse Current Protection

This section assumes a failure occurred during the "Reverse Current Protection" procedure on page 5-7 if diode D5 fails to provide reverse current protection. Turn the PRC-BC4 off for the following checks.

1. On the DC input power line, measure the resistance across D5. If the forward resistance is less than 10 ohms and the reverse resistance in very high (mega ohms) the diode is okay; if not, replace the diode.
2. Measure the resistance from the DC input connector J5 pin B to PL7 pin 1. If it is not a dead short, check S6 and the associated wiring, also refer to "AC Power Supply" on page 5-7.

AC Power Supply

The section assumes a problem with the AC input power circuit. Turn the PRC-BC4 off for the following checks.

CAUTION: Always turn the power off and remove the power source before making any resistance measurements.

1. Visually inspect the AC and DC fuses. If either fuse is blown, skip to step 4.
2. Measure the resistance across the thermostat S5. The thermostat is closed until the chassis temperature reaches 75°C. Use a heat source to open the thermostat; it should measure infinity when open and a dead short when closed.

3. If the fault only occurs when using an external DC power source, check all internal and external wiring and connections.
4. Check rectifier bridge BR1 by measuring the resistance across each of the four internal diodes. If the forward resistance is less than 10 ohms and the reverse resistance in very high (mega ohms), the diode is okay; if it is not, replace the diode.
5. On rectifier bridge BR1, measure the resistance from the (+) terminal to the (–) terminal. If the resistance shows a short, lift all the connections to the bridge and remeasure. If the measurement still shows a short, replace the rectifier bridge. If there is no short, skip to step 8.
6. Remove DC fuse F2. If the resistance measurement in step 5 still shows a short, check each of the power supply filter capacitors for short circuits. Replace any capacitors that are shorted and remeasure across the bridge terminals.
7. If the resistance measurement in step 6 still shows a short with the DC fuse removed, the short is on the inboard side of the fuse. The short can be isolated by lifting the various connectors or pressing each **RESET** button one at a time.
8. Measure the resistance of the power transformer windings. The resistance should be a very low resistance (typically less than 10 ohms).

Status LEDs

This section assumes the status LEDs are either not lighting or lighting at the wrong time.

1. Turn the PRC-BC4 on. If more than one LED lights up at one time, turn the PRC-BC4 off and measure the resistance across each diode on the Display board.
2. If the **FAULT** LED lights up properly, skip to step 5.

FAULT LED Failure:

1. If the **FAULT** LED is not lighting up correctly, measure the voltage at charger IC pin 11. The measured voltage should be at least 10 VDC during a fault (battery is under 4 VDC) condition; if it is not, replace the charger IC.
2. If the voltage measured in step 1 is okay but the **FAULT** LED does not light up, check the LED and the series resistor wiring.
3. Measure the voltage on the op amp non-inverting input pin. It should be 1.2 to 1.5 VDC; if it is not, turn the PRC-BC4 off and measure the resistance to determine if it is shorted to ground. If there is no short,

measure the resistance across the bias diodes and series 10 k ohm resistor.

4. If the **READY** LED does not light up properly, proceed to step 3 in the following procedure (**CHARGE** LED Failure).
5. If the **FAULT** LED lights up at the same time as other LEDs, replace the transistor on the Display board and go back to step 3.

CHARGE LED Failure:

1. If the **CHARGING** LED does not light up properly, measure the op amp output voltage during the bulk charge or overcharge states. If it is not 15 VDC or more, measure the voltage on the op amp inverting pin. If it is not at 0 VDC, replace the IC.
2. Measure the voltage across the transistor on the Display board; it should be near ground potential if it is conducting. If it is always conducting, the **CHARGING** and **READY** LEDs never light up. If this is the case check the associated wiring.
3. On the Display board, measure the DC voltage at the 12 VDC regulator (U1) output pin (pin 3). If it is not 12 ±1.5 VDC, turn off the input power (AC or DC) and measure the resistance to ground at output of the regulator chip. If the output is not shorted, replace the regulator chip.
4. During the float charge state, measure the op amp output voltage. If it is not 2 VDC or less, measure the voltage on the inverting pin (pin 6). It should be greater than 1.5 VDC; if it is not, replace the charger IC.