

# BC-8000 Field Calibration Procedure (Using the CF-1)

CF-1\_FIELDCAL\_BC8000 Revised 10/16/2019

## INTRODUCTION:

The BC-8000 Battery Capacity Tester and Charger (P/N 4168) performs C1-Ahr capacity testing on 12 and 24-volt lead-acid, Nickel Cadmium, and Lithium Ion aviation batteries. Capacity testing amperage resolution is 0.1A /step for batteries with C1 ratings of 0.5Ahr to 55Ahr. Using the BC Report application, the battery technician can retrieve capacity test data from the BC-8000 to create a printable report that includes test settings, test results, time and date of test, and a battery voltage graph. The BC-8000 is universally line powered 100 to 230VAC 50 to 60hz 1 phase. The recommended calibration interval is 1 year.

The BC-8000 charging amperage resolution is 0.01 amps from 0.050 to 2.50 amps and 0.1 amp from 2.6 to 25 amps. The BC-8000 battery charger voltage range is 3.0V to 36.2V. When operating at 3.0V the maximum amperage is 2 amps. The BC-8000 offers single or two step charging routines and charges constant voltage or constant current.

## SCOPE:

This document provides instructions on how to perform the annual calibration of the BC-8000 using the CF-1 (P/N 4170). The BC-8000 calibration is broken down into the following categories:

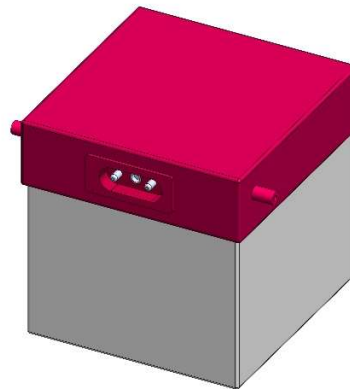
- Verify capacity test timing accuracy.
- Calibrate EPV Cutoff at 10.00 Volts.
- Calibrate EPV Cutoff at 20.00 Volts.
- Calibrate capacity test load current points.
- Calibrate the BC-8000 charger output voltage points.
- Calibrate the BC-8000 charger output current points.
- Optional** Calibrate the Real Time Clock (RTC) chip. The clock is calibrated at the factory. Re-adjustment can be done if the time keeping accuracy is unacceptable. The date and time are set to the current PC time by the BC Report application every time test results are transferred from the BC-8000 to the BC Report application.

## CALIBRATION EQUIPMENT REQUIRED:

1. CF-1 (P/N 4170) Field Calibration Fixture. See *Figure 1*.  
(Available from Advanced Power Products (909) 599-7319 or Concorde Battery (626) 813-1234).
2. Battery adaptor cable assembly (P/N 4161-60) or (P/N 4161-70).  
*Figure 1. Both parts included with the BC-8000 (P/N 4168).*
3. Charged 24-volt battery with C1 25Ahr or greater. *Figure 2*.  
(Used for 0.5A, 2.0A, 8.5A, 15A, and 55A BC-8000 load cell calibration). *Can be two 12-volt batteries connect in series.*
4. Calibrated 6½ digit DMM with frequency measurement. *Figure 3*.
5. (Optional) Calibrated frequency counter with 1 second period measurement and 7 digits or more readout. (For optional Real Time Clock (RTC) Calibration).
6. (Optional) PC computer with BC Report Application (P/N 4161-30) software installed. See *Figure 6*.
7. A 24-volt battery with C1 rating of 25Ahr or greater to calibrate the BC-8000 charger output currents. *Figure 2*. (Should be lightly discharged).  
*Can be two 12-volt batteries connected in series.*
8. Anti-static workspace, Anti-static wrist band, and Red and Black Alligator tipped test leads. See *Figure 4*.



*Figure 1 (P/N 4170) (P/N 4161-60) (PN 4161-70)*



*Figure 2 24-VOLT BATTERY*

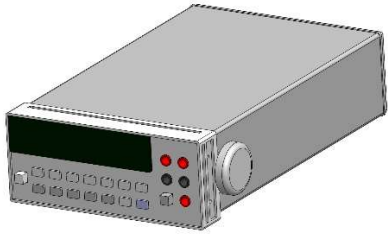


Figure 3 6½ digit DMM with Frequency Measurement

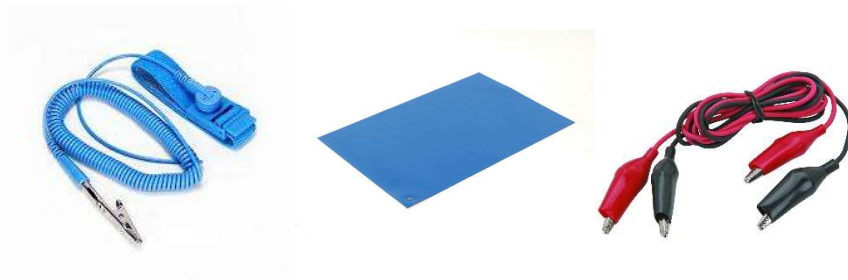


Figure 4 Anti-Static Wrist Band, Anti-Static Mat, and Red & Black test lead.

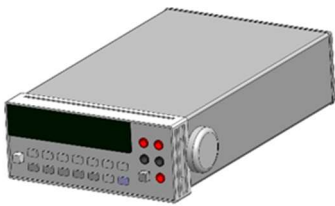


Figure 5 8 Digit Frequency Counter (Optional)



Figure 6 BC Report Flash Drive (P/N 4161-30) (Optional)



Warning: There are ***lethal high voltages*** present inside the BC-8000. Disconnect the BC-8000 AC power cord from the AC power source before removing the cover.



Anti-static precautions must be used when performing BC-8000 calibration procedures. Failure to do so can cause permanent damage to the BC-8000 electronic components.



Never disconnect the BC-8000 DC output cord with dc current applied to a battery or load.



Always wear safety glasses when performing the BC-8000 calibration procedure.



Only perform the BC-8000 calibration procedure in a temperature-controlled environment. (25 deg.C +/- 2 deg. C)

#### **INITIAL SETUP:**

1. Photocopy the Calibration Work Sheet.
2. Place the BC-8000 on to a stable anti-static surface.
3. Attach anti-static wrist strap to chrome fan guard and your wrist.
4. Remove the BC-8000 cover screws. Remove the BC-8000 cover.
5. Do a visual inspection of the BC-8000 internal components for evidence of mechanical or electrical damage. If present, stop and refer the BC-8000 for service.
6. Locate the BC-8000 display circuit board located on the inside of the BC-8000 front panel. Remove the plastic jumper shunt across pins 1 & 3 of FP1. See *Figure 1*.

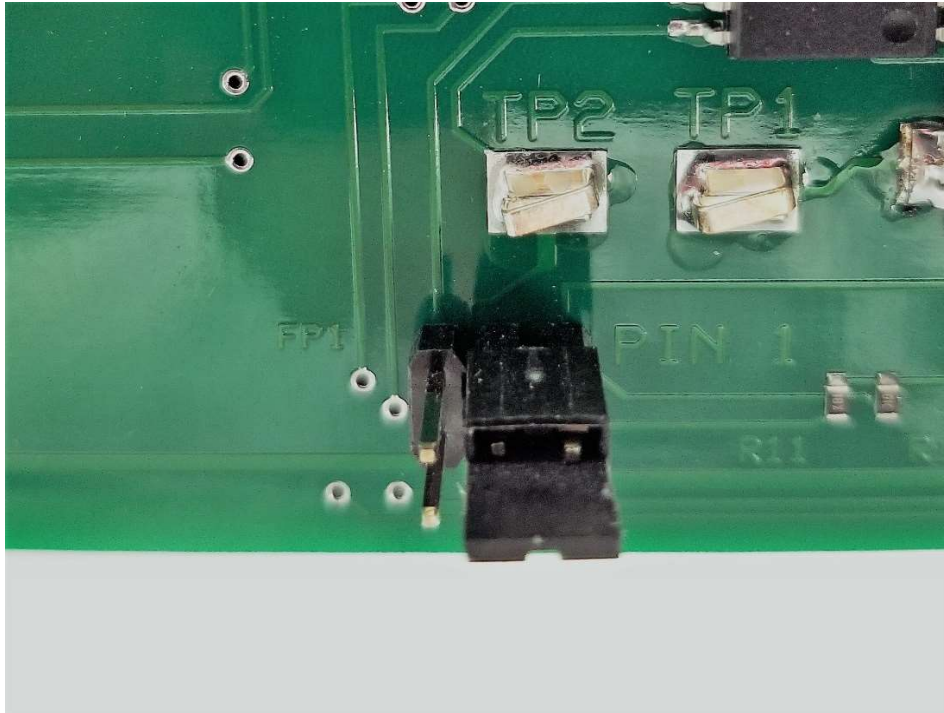



Figure 1

**VERIFY TIMING ACCURACY MEASUREMENT:**

1. Set the DMM to measure frequency.
2. Use shielded test probe wires or twist non-shielded probe wires together to maximize measurement accuracy.
3. Connect DMM COM (-) to TP1 on the display circuit board. See figure 1 for TP1 location.
4. Connect DMM V+ to TP2 on the display circuit board. See figure 1 for TP2 location.
5. Connect BC-8000 to the AC power source.
6. Set the BC-8000 power switch to the ON position.
7. The BC-8000 will display Code: Enter access code 1234. Use the UP and DOWN buttons to change the individual code numbers. Press NEXT button to advance to the next code number. After the final code number (4) is entered, press the NEXT button to enter the calibration menu.
8. The BC-8000 will display CAL CHARGER. Press the UP button until the BC-8000 displays CHK 450Hz. Press NEXT.

9. Set the DMM to frequency measurement. Verify the DMM measured frequency is 449.8 Hz to 450.2 Hz (450 Hz  $\pm$ 0.2 Hz). Press the NEXT button to exit the menu.
10. Write the Frequency measurement reading into the calibration work sheet. (450 Hz) If the output frequency is not 449.8 Hz to 450.2 Hz, the unit must be serviced.
11. This completes the BC-8000 Verify Timing Accuracy.
12. Remove the DMM test leads from the TP1 and TP2.
13. Place the BC-8000 POWER switch to the OFF position.
14. Disconnect the AC power cord from the AC power source.
15. For safety, place the BC-8000 cover lid back on to the BC-8000. Use four (4) of the lid screws removed earlier to temporarily secure the lid. The calibration procedures performed next do not require access to the internal BC-8000 components.

**CALIBRATE 10 and 20-VOLT CUTOFF POINTS (EPV):** Using the CF-1.

1. Plug the BC-8000 AC power cord into the AC power source.
2. Plug the BC-8000 DC output cord P/N4161-50 into the BC-8000 DC output receptacle.
3. Connect the battery adaptor cable assembly (PN 4161-60 or P/N 4161-70) to the 24-volt battery. The RED wire is battery POS (+). The BLACK wire is battery NEG (-).
4. Plug the CF-1 GRAY connector labeled  BATTERY into the GRAY connector of the battery adaptor cable assembly.
5. Plug the GRAY BC-8000 dc output connector into the BLACK CF-1 connector.
6. Connect DMM COM lead to the V- test point on the CF-1.
7. Connect DMM V+ lead to V1+ test point on the CF-1.
8. Set the DMM to measure DC volts. (If using a non-auto ranging voltmeter, set the voltage measurement range to 0-200 Volts).
9. Set the CF-1 toggle switch to the 10-volt setting and use the voltage adjustment knob to obtain a voltage reading of 10-volts  $\pm$ 0.010 volts on the DMM.
10. Set the BC-8000 POWER switch to the ON position.
11. The BC-8000 will display CODE:? Enter the 1234 calibration access code. Use the UP and DOWN buttons to change the number. Press NEXT to advance to the next digit. After all four codes are entered press NEXT.
12. The BC-8000 will be displaying CAL CHARGER. Press the UP button until the CAL VOLTS is displayed. Press Next.
13. The BC-8000 will display CAL VOLTS? 10. Press Next
14. The BC-8000 will now display CAL VOLTS ADJ.

15. Use the BC-8000 UP or DOWN button to adjust the CAL VOLTS ADJ. reading to match the DMM 10.00-volt reading. Press NEXT to save the calibration data. Wait for the word SAVED to appear then disappear.
16. Write the DMM Voltage reading into the calibration work sheet.
10. Set the CF-1 toggle switch to 20-Volt setting and adjust the CF-1 voltage adjustment knob to obtain a voltage reading of 20-volts  $\pm 0.010$  on the DMM.
11. The BC-8000 will display CAL VOLTS. Press NEXT.
12. The BC-8000 will display CAL VOLTS? 10. Press the UP button to change the 10 to 20-volts. Press NEXT.
13. The BC-8000 will display CAL VOLTS ADJ. 20.00.
14. Use the UP or DOWN button to adjust the CAL VOLTS ADJ. reading to match the DMM 20.00-volt reading. Press NEXT to save the calibration data. Wait for the word SAVED to appear then disappear.
15. Write the DMM Voltage reading into the calibration work sheet.
16. This completes the Cutoff voltage calibration procedure.

**CALIBRATE CAPACITY TEST AMPS:** Using the CF-1

1. Remove the BC-8000 GRAY DC output connector from the CF-1 BLACK connector. Plug the GRAY DC output connector into the CF-1 GRAY connector labeled TESTER  $\rightleftarrows$
2. Set the DMM input range to mil-volts (0 to 200mV).
3. Connect DMM COM lead to the CF-1 V- (Black) test point.
4. Connect DMM V+ lead to the CF-1 V2+ (Red) test point.
5. Press the BC-8000 UP button to display CAL AMPS. Press NEXT.
6. The BC-8000 will display CAPACITY Volts? 12. Press the UP button to change the CAPACITY Volts? 12 to 24 volts. Press NEXT.
7. The BC-8000 will display Amps? 0.5 Press NEXT to start the capacity test amps calibration.
8. The BC-8000 cooling fan will start. The BC-8000 will display Amps? 0.5 ADJ.
9. Press the UP or DOWN button to obtain a DMM reading of 0.497 to 0.503 mV ( $0.500 \text{ mV} \pm 0.003 \text{ mV}$ ). Allow a few seconds for the reading to settle. Get as close as possible to 0.500 mV. A DMM reading of 0.500 mV is 0.5 Amps of current flowing from the 24-volt battery.
10. Write the mV reading into the calibration work sheet. (0.5 Amp calibration)
11. Press NEXT to save the calibration data into memory. Wait for the word SAVED to appear and disappear.
12. Press the BC-8000 UP button to select Amps: 2.0. Press NEXT.
13. The BC-8000 cooling fan will start. The BC-8000 will display Amps? 2.0 ADJ.

14. Press the UP or DOWN button to obtain a DMM reading of 1.996 to 2.004 mV ( $2.000 \text{ mV} \pm 0.004 \text{ mV}$ ). Allow a few seconds for the reading to settle. Get as close as possible to 2.000 mV. A DMM reading of 2.000 mV is 2.0 Amps of current flowing from the 24-volt battery.
15. Write the DMM mV reading into the calibration work sheet. (2.0 Amp calibration)
16. Press NEXT to save the calibration data into memory. Wait for the word SAVED to appear and disappear.
17. Press the UP button to select Amps? 8.5. Press NEXT.
18. The BC-8000 cooling fan will start. The BC-8000 will display Amps?8.5 ADJ.
19. Press the UP or DOWN button to obtain a DMM reading of 8.483 to 8.517 mV ( $8.500 \text{ mV} \pm 0.017 \text{ mV}$ ). Allow a few seconds for the reading to settle. Get as close as possible to 8.500mV. A DMM reading of 8.500 mV is 8.5 Amps of current flowing from the 24-volt battery.
18. Write the mV reading into the calibration work sheet. (8.5 Amp calibration)
19. Press NEXT to save the calibration data into memory. Wait for the word SAVED to appear then disappear.
20. Press the UP button to select Amps? 15.0. Press NEXT.
21. The BC-8000 cooling fan will start. The BC-8000 will display Amps?15 ADJ.
22. Press the UP or DOWN button to obtain a DMM reading of 14.970 to 15.030 mV ( $15.00 \text{ mV} \pm 0.030 \text{ mV}$ ). Allow a few seconds for the reading to settle. Get the reading as close as possible to 15.00mV. A DMM reading of 15.00 mV is 15.0 amps of current flowing from the 24-volt battery.
23. Write the mV reading into the calibration work sheet. (15 Amp calibration)
24. Press NEXT to save the calibration data into memory. Wait for the word SAVED to appear then disappear.
25. Press the UP button to select Amps? 55.0. Press NEXT.
26. The BC-8000 cooling fan will start. The BC-8000 will display Amps?55 ADJ.
27. Press UP or DOWN button to obtain a DMM reading of 54.890 to 55.110 mV ( $55.00 \text{ mV} \pm 0.110 \text{ mV}$ ). Allow a few seconds for the reading to settle. Get the reading as close as possible to 55.00 mV. A DMM reading of 55.00mV is 55.0 amps of current flowing from the 24-volt battery.
28. Write the mV reading into the calibration work sheet. (55 Amp calibration)



29. Press NEXT to save the calibration data into memory. Wait for the word SAVED to appear then disappear.
30. This completes the BC-8000 capacity test section calibration.
31. Set the BC-8000 POWER switch to the OFF position.
32. Unplug the BC-8000 DC output GRAY connector from the CF-1.

#### **CALIBRATE BC-8000 CHARGER OUTPUT VOLTAGE:**

1. Attach anti-static wrist strap alligator clip to the BC-8000 chrome fan guard located in the rear. Secure the wrist strap.
2. Plug the battery adaptor P/N 4161-60 into the BC-8000 DC output GRAY connector.
3. Using a RED colored alligator clip tipped test lead, connect the DMM V+ input lead to ring terminal on the RED wire of the P/N 4161-60. Insulate the exposed ring terminal with an insulation sleeve or rubber electrical tape.
4. Using a BLACK colored alligator clip tipped test lead, connect the DMM COM input lead to the ring terminal on the Black wire of the PN 4161-60.
5. Set the DMM to measure DC volts.
6. Set the BC-8000 POWER switch to the ON position.  
The BC-8000 will display Code: Enter access code 1234. Use the UP and DOWN buttons to change the individual code numbers. Press the NEXT button to advance to the next code number. After the final code number (4) is entered, press the NEXT button to enter the calibration menu.
7. The BC-8000 will display "CAL CHARGER". Press NEXT.
8. The BC-8000 will display CAL CHARGER EXIT.
9. Press the UP button.
10. The BC-8000 will display OUT 3.0V. Press NEXT.
11. The BC-8000 will display CAL CHARGER OUT 3.0V WAIT.
12. When the WAIT changes to ADJ. Press the UP or DOWN button observing the DMM display. Adjust the DMM display reading as close as possible to 3.0V. Press NEXT to save the calibration.
13. Press the UP button to select DISP 3.0V. Press NEXT.
14. The BC-8000 will display CAL CHARGER DISP 3.0 WAIT.
15. When the WAIT changes to ADJ., press the UP or DOWN button to adjust the DISP value as close as possible to 3.0V on the LCD display. Press NEXT to save the calibration. (Note: 2.9V is closer to 3.0V than 3.2V). If the difference is equal choose the higher voltage.
16. Press the BC-8000 UP button.
17. Repeat steps 10 thru 14 on all calibration voltage points thru 36-volts.

18. This completes the BC-8000 charger output voltage calibration.  
Remove the test leads from the BC-8000 DC output GRAY connector and the DMM. Unplug the battery adaptor cable assembly from the BC-8000 DC output Gray connector.
19. Press the BC-8000 UP button to proceed to the charger current output calibration.

**CALIBRATE BC-8000 CHARGER CURRENT OUTPUT:** Using the CF-1

The BC-8000 charger output current calibration requires measuring the charge current flowing into a 24-volt battery. The 24-volt battery must be lightly discharged in order to perform the BC-8000 charger current calibration.

1. With the CF-1 already connected to the 24-volt battery, plug the BC-8000 DC output GRAY connector back into the CF-1 GRAY connector labeled TESTER. ⇨
2. Connect the DMM COM test lead to the CF-1 Black V- test point.
3. Connect the DMM V+ test lead to the CF-1 Red V2+ test point.
4. Set the DMM to read dc mil-volts.
5. The BC-8000 will display CAL CHARGER 24V OUT 0.05A.
6. Press NEXT.
7. The BC-8000 will display CAL CHARGER 24V OUT 0.05 WAIT.  
When the Wait changes to ADJ. Press the UP or DOWN button until the DMM displays 0.05mV. ( $0.05A \times 0.001\text{Ohms} = 0.05mV$ ) Record the calibration values on the calibration sheet.
8. Press NEXT.
9. Repeat steps 5 thru 8 for each of the BC-8000 charger output current calibration points (2.5A,2.6A,25A). Note: If the 25A calibration point cannot be calibrated, check the 24-volt battery voltage. If the battery voltage is too high the battery will not accept a 25A charge rate.
10. This completes the BC-8000 charger output current calibration.
11. Set the BC-8000 POWER switch to the OFF position. Remove the AC cord from the AC power source. Disconnect the BC-8000 DC output cord from the CF-1. Disconnect the CF-1 from the 24-volt battery.

BC-8000 charger calibration menu items and associated BC-8000 DC output cord configuration.

OUT 3.0V connect to voltmeter (do not connect to the CF-1)  
 DISP 3.0V connect to voltmeter (do not connect to the CF-1)  
 OUT 8.9V connect to voltmeter (do not connect to the CF-1)  
 DISP 8.9V connect to voltmeter (do not connect to the CF-1)  
 OUT 9.0V connect to voltmeter (do not connect to the CF-1)  
 DISP 9.0V connect to voltmeter (do not connect to the CF-1)  
 OUT 17.9V connect to voltmeter (do not connect to the CF-1)

DISP 17.9V connect to voltmeter (do not connect to the CF-1)  
OUT 18.0V connect to voltmeter (do not connect to the CF-1)  
DISP 18.0V connect to voltmeter (do not connect to the CF-1)  
OUT 36.0V connect to voltmeter (do not connect to the CF-1)  
DISP 36.0V connect to voltmeter (do not connect to the CF-1)

OUT 0.05A connect to the CF-1  
DISP 0.05A connect to the CF-1  
OUT 2.5A connect to the CF-1  
DISP 2.5A connect to the CF-1  
OUT 2.6A connect to the CF-1  
DISP 2.6A connect to the CF-1  
OUT 25.0A connect to the CF-1 (requires a lightly discharged battery)  
DISP 25.0A connect to the CF-1 (requires a lightly discharged battery)

#### **FINALIZATION:**

1. Attach anti-static wrist strap to chrome fan guard and your wrist.
2. Remove the four (4) BC-8000 cover lid screws installed temporarily earlier.
3. Remove the BC-8000 cover lid.
4. Re-install the plastic shorting jumper across pin 1 & 3. See Figure 1.
5. Re-install the BC-8000 cover lid with the case screws. Tighten all the screws.
6. Plug the BC-8000 AC power cord into the AC power source.
7. Set the BC-8000 POWER switch to the ON position.
8. The BC-8000 will display the sign on message and then a MODE menu.  
Note: If the message CODE: is displayed, the plastic shorting jumper is not on 1 & 3 pins correctly. Repeat steps 3 thru 5.
9. The BC-8000 is ready to place back in service.
10. Set the BC-8000 Power switch to the OFF position.
11. Write the calibration due dates of all equipment used in work sheet. Attach a photocopy of the calibration certificates of all the equipment used in this procedure to the work sheet.
12. Write the BC-8000 serial number in work sheet. The serial number is located on the BC-8000 lower rear panel.
13. Sign and date the calibration work sheet.

#### **CALIBRATE REAL TIME CLOCK (RTC) CHIP (OPTIONAL):**

1. Remove the BC-8000 cover lid screws.
2. Connect the BC-8000 AC power cord to the AC power source.
3. Set the BC-8000 POWER switch to the ON position.
4. Connect the USB (P/N 4161-40) cable to an open USB port on a PC with BC Report installed.
5. Connect the remaining USB cable end to the BC-8000 USB port.

6. Start the BC Report application on the Desktop. Press the “Set Date and Time” button. The software will search for the BC-8000 and establish a connection. Enter *invalid report* into the battery serial number rectangular box. Place the desktop mouse/pad pointer on the rectangular box and click on the box. BC Report program window will expand and reveal the RTS calibration boxes.
7. Set frequency counter to measure a 1 second period with 1 micro second resolution. Connect the frequency counter input lead to TP3 (located top center edge of the BC-8000 display pcb).
8. Connect the frequency counter ground lead to TP1. See Figure 1
9. In the BC Report application Measure Period rectangular box, enter 1.0 and press the Set Clock Calibration button. This will turn off RTS clock correction and allow for a measurement of the unadjusted 1 second clock at TP3. Press the Get Clock Calibration button and verify it returned a 00 in the blue box.
10. Read the period on your frequency counter. The acceptable adjustment range is 0.999805 to 1.000192 seconds. Enter the value into the Measured Period rectangular box. The entry requires precision down to 1 microsecond. Press the Set Clock Calibration button. Wait 1 second. Press the Get Clock Calibration button and if you entered a correction value other than 1.000000, it should return something other than 00. The only time it will return 00 is if you entered a period of 1.000000 seconds. (Values very close to 1.000000 may return with a correction value of 00).
11. Your clock is now calibrated. Every 20 seconds, the clock chip will correct its crystal time base by adding or subtracting a few cycles. If you entered a correction value that is between 0.999805 to 1.000192 seconds and is not 1.000000, you will see the period change every 20 seconds. A correction value of 1.000000 causes no correction as it is the perfect value that requires no correction.
12. Remove the frequency counter leads from TP3 and TP1.
13. This completes the RTC calibration procedure.
14. Re-install the BC-8000 cover lid tightening all the screws.
15. Remove USB cable.

## CALIBRATION WORK SHEET

RECORDS - BC-8000 S/N \_\_\_\_\_

Item name	Measured value	Specification	Pass	Fail
450 Hz (TP1 - TP2)		449.8 - 450.2 Hz		
10.0 Volt EPV Cutoff		9.90 - 10.10 Volts		
20.0 Volt EPV Cutoff		19.80 - 20.20 Volts		
Capacity Test		CF-1 Shunt 100mV/100A 0.001 Ohms (+/-0.25%)		
0.5 Amp calibration		0.497 to 0.503 mV		
2.0 Amp calibration		1.996 to 2.004 mV		
8.5 Amp calibration		8.483 to 8.517 mV		
15 Amp calibration		14.970 to 15.030 mV		
55 Amp calibration		54.890 to 55.110 mV		
Charger Vout				
Vout 3.0V				
DISP 3.0V				
Vout 8.9V				
DISP 8.9V				
Vout 17.9V				

DISP 17.9V				
Vout 18.0V				
DISP 18.0V				
Vout 36.0V				
DISP 36.0V				
Charger Amps Out				
Amps Out 0.05A				
DISP 0.05A				
Amps Out 2.5A				
DISP 2.5A				
Amps Out 2.6A				
DISP 2.6A				
Amps Out 25.0A				
DISP 25.0A				

Digital Multi Meter used to measure 450 Hz calibration expiration  
date: \_\_\_\_\_

Digital Multi Meter used to calibrate Voltage and Amperage calibration expiration  
date: \_\_\_\_\_

If the RTC chip was calibrated: Frequency counter calibration expiration  
date: \_\_\_\_\_

Attach a photocopy of the calibration certificates of all the equipment used to in  
this procedure to this work sheet.

BC-8000 Calibration performed  
as specified by: \_\_\_\_\_

Date: \_\_\_/\_\_\_/\_\_\_\_\_