

**BCT-2000 Software  
and  
BCT-128 and BCT-256**

User's Guide



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# Safety Information

- Except as explained in this manual, do not attempt to service Albécorp equipment yourself. Opening the equipment may expose you to dangerous voltages. Refer servicing beyond that described in this manual to authorized personnel.
- Do not allow liquids or moisture to get into the equipment. If liquid does get into the equipment, unplug it immediately and contact your nearest authorized service center or Albécorp directly.
- Ensure equipment is provided adequate ventilation. Do not block equipment ventilation openings.
- Do not exceed equipment voltage or power ratings and capabilities.
- Make sure that equipment is properly grounded.
- Do not let unauthorized persons operate the equipment.

# References

The following IEEE standards are referenced in this manual.

IEEE Std 450-1995: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

IEEE Std 1188-1996: IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.

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Dear Customer,

Congratulations on the purchase of the BCT-2000 Series testing system. The BCT-2000 Series is the latest generation test system engineered by the “Battery Test Experts” at Albécorp. Albécorp has taken its experiences from the field of battery testing since 1973 to develop this new product line.

This state-of-the-art test system is designed with the user in mind, with on-line help, repeatable readings, and, most of all, high reliability using only quality components and products.

All of us at Albécorp are pleased that you have the confidence in our abilities and understanding of the type of system required to perform this critical and necessary battery testing.

Please don't hesitate to contact any of the Albécorp staff or your local representative if you require further information or clarification on the operation and control of your new system.

Once again, thank you for your confidence in Albécorp.

Sincerely,

Derek Albér  
President

# 1. What's New

This section describes the new features in Version 1.07 of the BCT-2000 program.

The following are software changes that do not affect the manual:

- All test setup information is now saved on test setup exit. This ensures settings are saved and eliminates wrong alarm levels and target values.
- Float voltages for batteries of 256 cells or more are now saved to reports.
- Manual mode now steps linearly for all load bank types.
- Cells with intertier voltages greater than the cell voltage now show correct voltage.
- At midnight, the BIOS occasionally advanced the time but not the date. This caused the calculation for elapsed time to show 24 hours, causing the test to end. Tests no longer end at midnight.
- On some charger tests, when the load was incremented during the test, the load and voltage were recorded for the entire test instead of after the change. The report now uses the last known value for time interval.
- Load control has been improved for load banks that have multiple steps with the same weight value. Previously, the scaling factor was incorrectly calculated when a load bank had multiple steps with same weight value. This caused the BCT to take extra time to achieve target value.

The following are changes that affect the manual or the program operation:

- The manual is now available in HTML (Web page viewer) and PDF (Adobe Acrobat viewer) formats on the program disk.
- The manual has more screen shots. Items on the screens are in bold type and followed by full descriptions. Most items on the screens are indexed.
- All cells in reports are now referenced by string name, not string number.
- You can now configure multiple sites with multiple batteries. See the *Location* section.
- At test time, the capacity can now optionally be calculated when the target value is reached. See the *Calculate Capacity at Target* section.
- There are now nudge buttons to nudge the load to within target when in the auto mode. When controlling the load, the BCT is considered on target when the target value plus 1.5% of target value plus 1.5 amps is achieved. For example, on a load of 500 amps, the BCT could set the load at 500 amps plus 1.5% (7.5 amps) plus 1.5 amps, or as high as 509 amps. The Nudge control lets you move the load closer to 500. See the *Running the Test* section.

- In the capacity calculation, the Modified Performance test can now optionally ignore steps when the load is targeted to zero. See the *Ignore Zero Target Steps* section.
- A High/Low voltage warning has been added to Charger test. See the *Charger High/Low Voltage Warning* section.
- Manual mode now has four fixed weight buttons: 1, 5, 10, and 20. These buttons manually control the load to the desired target more quickly than the one button in previous versions. Also, the Manual mode user-defined weight has been increased from 32 to 200 weights per increment. See the *Manual Load Bank Control* section.
- You can now manually exclude cells prior to and during testing without pausing. See the *Cell Exclusion* section.
- The duration and target of the presently running test step and all following test steps can now be modified without pausing the test. See the *Test Steps Area* section.
- On the Charger test, a Voltage/Load History graph replaces the cell graph. History is limited to 10 minutes. See the *Charger Test Screen* section.
- A charger and battery text report of voltage and load is now available. See the *Summary Screen* section.
- Brackets ( < and > ) in reports indicate values that violate thresholds. A color printer is no longer required. See the *Criteria Screen* section.
- The Percentage of Cell Failure in reports is now user definable instead of fixed at 80%. See the *Criteria Screen* section.
- You can now clip the start and end of a report when the BCT doesn't control the load, and there is no load interval at the start and end of the test. See the *Options Screen* section.
- You can now optionally include the start and end step values on a multi-step test. See the *Options Screen* section.
- There is now manual scale control for all graphs. See the *Graph Screen* section.
- A data filter option has been added to screen out abnormal values, such as when a clip lead falls off. See the *Filter Screen* section.
- The Text Export feature is available again for reports. See the *Exporting in Text (.TXT) Format* section.

## **2. BCT General Description**

The BCT-2000 Series battery capacity testing system helps ensure the reliability of the DC bus by determining weaknesses in the battery string and estimating when the battery should be replaced. Capacity testing is the only proven way to determine where the battery is in its life curve. The BCT-2000 lets you determine the amount of energy remaining in the battery. The test system can also help detect faulty intercell connections and weak cells in the battery string.

During a battery discharge test, the BCT-2000 continuously records and displays individual cell voltages, overall battery voltage, current, intertier connections and alarm parameters. Test data can be printed using the BCT report generator or exported to other programs.

The BCT-2000 monitors and displays the voltage of up to 256 cells or modules, and up to eight strings. It can be programmed to discharge a battery under constant current, constant power (KW), or variable current (user defined) profile conditions, and has programmable alarm warning and shut down levels. The BCT controls battery discharge tests at currents up to 4000 amps, and can print data reports upon completion of the discharge test.

Data logging is accomplished with a memory-saving write-by-exception method, which internally records monitored parameter changes that exceed 5 millivolts and stores all data on the hard drive. The write-by-exception method increases data point resolution and updates data faster than other data collection methods.

The BCT-2000 is available as a BCT-128 or a BCT-256 model that tests up to 128 or 256 individual cells or modules respectively. Each system includes two key components: the BCT and a laptop computer. The BCT-128 or BCT-256 data acquisition device incorporates the system and relay boards, control boards for optional Albécorp load banks, and boards to communicate with the laptop computer.

### **3. System Requirements**

The following are the minimum requirements for BCT-2000 system operation.

Microsoft Windows™ 95, 98 or NT4.0.

Personal computer using a Pentium™ 200MHz or higher microprocessor.

16M of memory.

13M of hard disk space available.

CD Drive or a 3.5" high-density (1.44MB) disk drive.

SVGA monitor set to at least 800 x 600.

Mouse or compatible pointing device.

## 4. Software Installation and Backup

The BCT-2000 program is loaded onto the laptop computer at the factory. This program controls all aspects of the BCT-2000 system.

During the calibration process, data is saved to the **BCT2000setup.mdb** file located under `programfiles\alber\bct2000\setup`. This file contains calibration, setup, configuration, and password information. Refer to *Calibration Backup*.

At a minimum, back up **BCT2000setup.mdb** upon receipt of equipment or whenever the unit is calibrated or the password is changed, so the data can be reloaded if the file becomes corrupted. Use Microsoft Explorer™ to back up the file from the hard drive to a 3.5-inch disk.

If the program becomes corrupted, re-install it from the CD program disk or the 3.5-inch disks. The program does not overwrite an existing **BCT2000setup.mdb** file upon re-install. To start installation, insert the CD or Disk 1 into the computer and select **Start|Run** from the Windows desktop. At the Run dialog box, type **d:\setup** (or other appropriate drive letter), then follow the on-screen instructions.

After installation, if the data is still corrupt, copy the backup **BCT2000setup.mdb** file from the 3.5-inch disk over the existing file on the hard drive.

If the backup file is not available, delete **BCT2000setup.mdb** from the hard drive and re-install the program again. When no **BCT2000setup.mdb** file is present, the program creates one. At this point, either recalibrate the BCT system or re-enter the calibration constants (K-factors) from the calibration report before using the BCT system for testing.

To start the BCT-2000 program, double-click the BCT icon on the desktop.

On an 800 x 600 screen, the Windows taskbar hides a portion of some BCT screens. Either drag the taskbar to minimize it, or right click on the taskbar, then select **Properties|Auto Hide** to hide the taskbar.

**WARNING:** The computer power management feature, which automatically shuts down the computer, hard drive, and display after a specified time of inactivity, must either be disabled or set to a time long enough to allow testing without going into the suspend mode. Also check the computer BIOS to determine if power management features have been set.

**WARNING:** For Windows 95 and 98, under Control Panel|System|Performance|File System, in the File System area, confirm that at "Typical role of this machine," Desktop Computer is selected.

**WARNING:** Under Control Panel|System|Performance|Application Performance on Windows NT, set the Boost control to None.

## 5. Password

When you select certain functions, a password dialog box appears. The default password from the factory is: `alber`

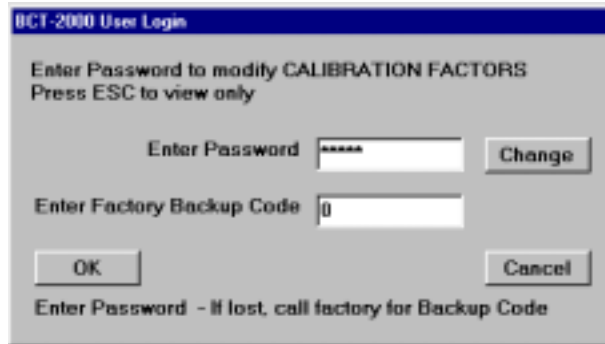


Figure 1. Password

Type the password in the Enter Password box and click OK. To change the password, click Change and follow screen instructions. Some screens that require a password may be viewed without a password but not modified. To view a screen, click Cancel or press ESC.

If the password is changed without authorization or lost, contact Albécorp to obtain a code to unlock the system. Type this code in the Enter Factory Backup Code box and click OK. This puts the password back to the default password `alber`. Change the password as previously described.

## 6. Communication Settings

If the computer does not communicate with the equipment, you may need to select a new COM port. To display the Communication Settings screen, click Communications on the main menu.



**Figure 2. Communication Settings**

Click a button for the COM port setting, then click OK. If the required COM port is not known, you may have to try all four selections to determine which setting establishes communication between the computer and the equipment.

The BCT program communicates with the unit only when in the Test, Diagnostics, and Calibration screens.



## **7. BCT-2000 Initial Test**

Before connecting equipment for an actual test, check all the BCT components for functional operation.

First, test the laptop computer. Remove the computer from its shipping case and connect the power cable. (Refer to the laptop computer manual.) Power up the computer and verify the screen displays the Windows desktop and the BCT-2000 icon. If it does not, contact Albécorp for technical assistance. Power off the computer to end the test.

### **7.1. Initial System Test**

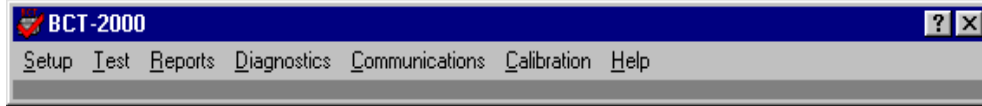
Refer to drawing BCT-2436-D1110 System Block Diagram for connection of the cables from the computer to the BCT-128 or BCT-256 data logging acquisition device. The system has a serial interface, which uses a 9-pin to 9-pin cable. The following steps describe the connections for proper operation:

1. Before making any connections, ensure all equipment is powered off.
2. Connect one end of the 9-pin to 9-pin cable to the serial port of the laptop computer.
3. Connect the other end of the cable to the BCT computer port.
4. Connect the AC power cable to the BCT-128 or BCT-256, and plug the other end into a 120VAC 60Hz receptacle.
5. Unpack the printer. Plug the AC adapter into the small power receptacle on the printer, and the other end into a 120VAC 60Hz receptacle.
6. Connect the male end of the six foot printer cable to the printer cable port near the AC adapter input. Connect the other end to the computer 25-pin D-Sub female connector on the rear of the unit.
7. Load paper into the printer. NOTE: The printer is not required during an actual load test.
8. Unpack the CS-2000 if available. Locate the two test cables and one power cable for the unit. The parallel cables each have a female and male D-Sub, 37-pin connector.
9. Connect the power cable to the CS-2000 and to a 120VAC 60Hz receptacle.
10. Connect one 37-pin cable between the CS-2000 Cell Outputs rear connector and the BCT Cells 1-32 connector.
11. Connect the other 37-pin cable between the CS-2000 System connector and the System connector on the BCT.
12. Power on the four devices: The BCT-128 or 256, the laptop computer, the printer, and the CS-2000.
13. Verify the Windows desktop appears.
14. Click the BCT2000 icon to start the program.
15. On the main menu, select DAM. Verify the BCT relays are clicking.
16. On the DAM dialog box, at Display Board, select 1.

17. On the DAM dialog box, observe A/D counts of at least 10000 if no CS-2000 is connected. Varying the CS-2000 causes the A/D counts to vary.
18. Close the DAM dialog box and exit the BCT program.
19. To test the printer, open a word processing program, select the printer driver, then send output to the printer.
20. After verifying operation, power off the equipment and disconnect the cables. Place all the cables and components back into the shipping cases as found when unpacking.

## 8. Main Menu

The main menu is where all BCT-2000 operations begin.



**Figure 3. BCT-2000 Main Menu**

To start the program and display the main menu, double-click the BCT-2000 icon on the Windows desktop. The Setup, Test, Reports, Diagnostics, Communications, Calibration, and Help screens are accessed from the main menu. Setup information, which includes battery configuration, test steps, alarm levels, and load bank, must be correctly entered for the BCT-2000 to run properly.

The BCT-2000 software polls the cells for data only when the Test, Diagnostics or Calibration screens are open. Polling causes the relays in the BCT-128 or BCT-256 to click. Do not confuse polling with testing, which has defined start and stop parameters.

The following are brief descriptions of the main menu items. See full descriptions elsewhere in this manual.

### 8.1. Setup

Setup accesses the Location, Battery Strings, Test Setup, Intertier, Load Bank, and Contact dialog boxes. Setup determines system operation and control of tests. Open the Setup dialog boxes before running a test or using the system for data logging. Selections let you input information for the battery being tested, and parameters such as cell voltage alarms, overall voltage alarms, number of cells tested, intertier connections, and test program.

### 8.2. Test

The Test screen displays information for monitoring test progress in real time. The screen indicates battery OV (overall voltage), load in amps, power in watts / kilowatts, and capacity if activated. Individual cell or module activity is displayed as a bar graph.

The screen also displays step information, presently active step duration, value, step number, and total test times. The status area indicates the currently-selected cell voltage and test lead numbers. The maximum, minimum, and average cell voltages appear below the status area.

### 8.3. Reports

The Report Generator creates a report of a completed test. This is the only screen that provides a final report or transfers test data to a file. The types of reports and options for creating reports are described in the section *Report Generator*. Report options include Summary, Criteria, Options, Cell Detail, Graph, Filter, and Notes. Report files reside in the **Reports\site name** subdirectory, unless a different subdirectory was selected at time of test.

#### ***8.4. Diagnostics***

Diagnostics allows selection of the DAM, I/V/IT, Load Bank, Bus and Misc dialog boxes, from which BCT-2000 and load control system diagnostics are performed. Use Diagnostics when a problem is encountered, or when performing technical checks with the assistance of Albécorp.

#### ***8.5. Communications***

Select Communications to select the COM port for the computer.

#### ***8.6. Calibration***

Select Calibration when BCT-2000 system calibration is required.

#### ***8.7. Version***

Select Version to access the help files or determine the software version number.

## **9. Recommended Tests**

Prior to performing any type of battery test, you should review battery theory and the battery manufacturer's maintenance and test procedures. Albécorp strongly recommends following the IEEE Std 450-1995 publication on battery maintenance and testing for flooded cells, and IEEE Std 1188-1996 for VRLA batteries. By using the battery manufacturer's suggested testing procedures and those issued by IEEE, you can help ensure a safe, effective load test.

Before performing a load test, determine the type of test to perform, the length of the test, and where to locate the equipment during testing. If the test includes the use of Albécorp DC load banks, a well-ventilated area is required to disperse heat from the resistive load bank. In most cases, the BCT-128 or BCT-256 is placed near the battery being tested, and the load bank is within 50 feet of the battery and BCT.

**WARNING:** Do not place the load bank in a room that has an automatic halon (or other) fire system. The heat generated by the load bank could inadvertently trigger the fire system. Either locate the load banks in a safe area without such a system, or take other measures to prevent the inadvertent activation of the automatic system.

Before connecting the BCT-2000 to the battery being tested, and prior to any load testing, Albécorp recommends performing the following tests on the battery.

### **9.1. Micro-Ohmmeter**

During the battery discharge test, the test system discharges the battery at a high current rate. Ohm's Law shows that a high rate of current through a high resistive connection results in a large amount of power being dissipated through the connection. This could cause excessive heat build-up and result in premature termination of the test. Therefore, use a micro-ohmmeter to ensure there are no high resistive connections between individual cells, modules or intertier connections. Refer to the battery manufacturer's maintenance instructions for a safe range of readings.

### **9.2. Hydrometer**

Prior to load testing, read the specific gravity of the sample electrolyte to confirm the battery is fully charged. Reading cannot be performed on sealed cells, but can easily be done on wet cell batteries. Although this data is not entered into the BCT program, you may want to record it separately and attach it to the final test report. Specific gravity is a good indicator of the present charge of the battery. If all cell float voltage readings are within normal limits, you may limit the hydrometer readings to a 10% sample.

### **9.3. Temperature (Electrolyte)**

While taking specific gravity readings, measure the electrolyte temperature of each cell. Record this data and then calculate the average temperature of the electrolyte in the cells being tested. The BCT-2000 requires that the temperature be entered for certain tests. Use this average value for temperature correcting the load during test setup.

#### **9.4. Temperature (Ambient)**

Record the ambient temperature of the battery room prior to testing. This data is entered into the BCT-2000 program, and the load can be temperature corrected to IEEE standards.

#### **9.5. Equalize Charging**

IEEE Std 450 for flooded cells and Std 1188 for VRLA cells, and most battery manufacturers, recommend that a battery be equalize charged at least seven days before performing a discharge test, and the battery be allowed 72 hours of float condition prior to testing. This charging action should provide optimum capacity results. Contact individual battery companies for their recommendations on this practice.

In an effort to test the battery in an as-found state, occasionally load test the battery in its normal float state, without any prior charging or preparation. This as-found testing checks the effectiveness of the battery maintenance program. (Done as a service test on the BCT.)

#### **9.6. Test History**

Analyze test results from previous tests to determine faulty conditions that may become apparent during the load test. Doing this permits closer observation of cells or connections that were weak, the cause of problems, or possible failures. Correct any problems that stop tests prior to putting the battery back into service and before further testing.

## **10. Connecting the System**

After performing all preliminary tests, prepare and connect the BCT-2000 Series system.

### **10.1. Determine Load Type**

The BCT-2000 System can operate in three different types of load configurations.

#### **10.1.1. Optional Load Banks (Battery Isolated)**

One recommended way to load test a battery is with the battery completely isolated from the system or its associated load, using optional Albécorp Load Banks. In this instance, the charger carries the load until the test ends.

**WARNING:** When using this method, if a loss of power occurs during the load test, there will be no battery on line to support designed operation. Before switching the battery off line from the charger, ensure that design criteria allows for the charger to carry full load. Some organizations require placing a backup battery into service prior to load testing a critical battery.

#### **10.1.2. Optional Load Banks (Supplemental Load)**

A second recommended way to load test a battery is to supplement the service load on the battery with Albécorp load banks. In this case, the battery is left on line and a capacity test is performed using the load bank and system load as a combination total load on the battery. This is done by reading the present load on the battery charger, subtracting that from the discharge load required, and programming the unit for the balance of the theoretical load.

#### **10.1.3. System Load**

Using the system load on the battery allows the system load to be placed directly on the battery, with the BCT-2000 used as a data gathering device. The BCT system will not read current unless a current shunt is installed and optional current sense leads are connected to the shunt. (Done as a rundown test on the BCT.)

## **10.2. BCT-128/BCT-256 Connection Steps**

After completing all preliminary test preparations, connect the BCT-2000 system to the battery being tested. This section describes how to connect equipment for a single string test. Refer to drawing BCT-2436-D1110 for connection of the cables from the computer to the BCT-128 or BCT-256. Refer to drawing BCT-350-D1105 for connection to the cells.

1. Before making any connections, ensure all equipment is powered off.
2. Connect one end of the 9-pin to 9-pin cable to the serial port of the computer.
3. Connect the other end of the cable to the BCT computer port.
4. Connect the AC power cable to the BCT-128 or BCT-256, and plug the other end into a 120VAC 60Hz receptacle.
5. If printing of test results is desired, unpack the printer. Plug the AC adapter into the small power receptacle on the printer, and the other end into a 120VAC 60Hz receptacle. Wait until completion of the test before printing.
6. Connect the male end of the six foot printer cable to the printer cable port near the AC adapter input. Connect the other end to the computer 25-pin D-Sub female connector on the rear of the unit.
7. Load paper into the printer.
8. Connect the DB37 end of the 25 foot sense lead extender cable (DB37 on one end, Amphenol round 37-pin on other end) to the BCT Cell 1-32 port.
9. Connect the black connector end of the red individual cell wire (small numbered clips on one end, Amphenol 37-pin on the other) to the sense lead extender cable. (Open end from above step.)
10. Repeat above two steps for all other extender cables and sense lead cables until there are enough clips for all the cells.
11. Connect one end of another sense lead extender cable to the System connector on the rear of the BCT, and connect the individual red sense leads labeled OV+, OV-, IT-1, IT-2, and so on, to the open end of the sense lead extender cable.
12. Connect the clip labeled OV+ (Overall Voltage+) to the most positive post on the battery. Connect the clip labeled OV- to the most negative post on the battery.
13. Connect Clip 0 from the first set of red sense leads to the positive post of Cell 1. This is the same point the OV+ lead was placed in the previous step.
14. Place Clip 1 on the positive post of Cell 2, unless Cell 1 is the most negative cell. If it is the most negative cell, then connect the lead to the negative post of Cell 2. Continue this step until the entire battery has been outfitted.
15. In installations of more than 32 cells or modules, it is necessary to use another set of sense leads. Connect the "A" lead of each new set to the same post as the last lead from the previous set.
16. The last cell will have two leads: the overall voltage lead and sense lead. Place the clip with the 'Cell Number minus 1' count on the positive post and the Cell Number on the negative post of the final cell.



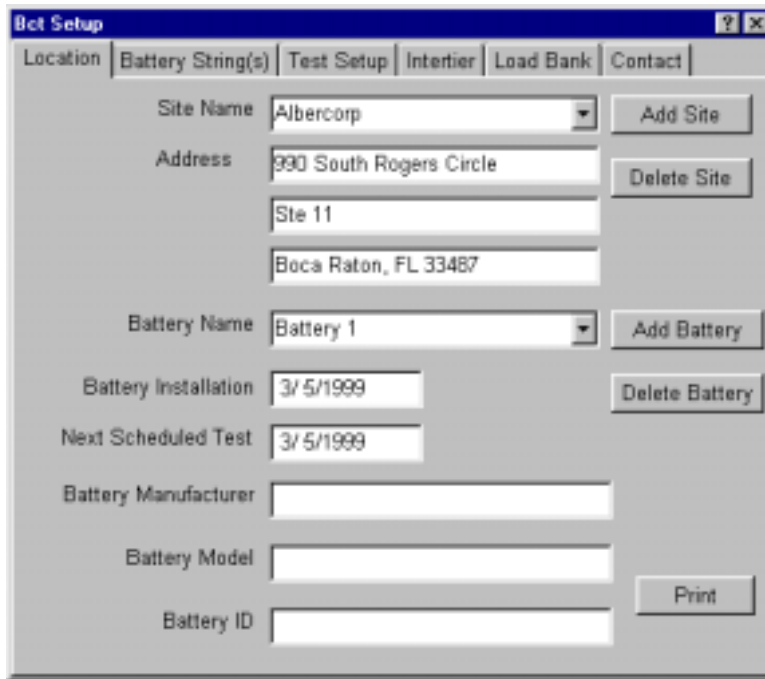
17. Connect the leads labeled IT-1(+) and IT-1(-) to the first intertier connection. Follow this sequence with the remaining IT sense leads. Leave the unused IT sense leads free. Refer to Drawing BCT-350-D1105 for sense lead connection to the individual cells, intertier cables, and overall volts connections.
18. If using Albécorp load banks, do the following:
  - Connect the 50' load control cable (two Amphenol 37-pin connectors on each end) from the BCT Load Control port to the Load Control Input on the side of the optional load bank. This connector is usually labeled J2; however, refer to the drawings that came with the load banks.
  - Connect the heavy load cables from the load banks to the battery as shown in the drawings that came with the load banks.
19. The BCT-2000 is now mechanically ready to perform the desired load test.
20. Power on all the equipment at this time except the Albécorp continuous load banks.
21. After the BCT-2000 system has initialized and the main menu appears on the computer, power on the load banks.
22. When disconnecting any equipment, power down the continuous load bank first, then power down the rest of the system.

## 11. Setting Up the BCT-2000 for Load Test

The BCT-2000 program lets you use the computer to set up all test parameters. Refer to the following Setup dialog box descriptions to program the test parameters. At this point, the BCT-2000 main menu must be displayed. The computer does not need to be connected to the BCT-128 or BCT-256 unit. On the main menu, click Setup. A drop-down menu with Location, Battery Strings, Test Setup, Intertier, Load Bank, and Contact appears. Complete each item as described.

### 11.1. Location

On the Setup menu, click Location. Site and battery information is saved with each test report and permanently saved in the BCT Setup file. Complete all text boxes before performing any test, or reports may have incorrect or missing data.



The screenshot shows the 'Bct Setup' dialog box with the 'Location' tab selected. The dialog has a title bar with a question mark and close button. Below the title bar are six tabs: 'Location', 'Battery String(s)', 'Test Setup', 'Intertier', 'Load Bank', and 'Contact'. The 'Location' tab contains the following fields and buttons:

- Site Name:** A dropdown menu showing 'Albercorp' and an 'Add Site' button.
- Address:** A text box containing '990 South Rogers Circle', a 'Delete Site' button, and two additional text boxes containing 'Ste 11' and 'Boca Raton, FL 33487'.
- Battery Name:** A dropdown menu showing 'Battery 1' and an 'Add Battery' button.
- Battery Installation:** A text box containing '3/ 5/1999' and a 'Delete Battery' button.
- Next Scheduled Test:** A text box containing '3/ 5/1999'.
- Battery Manufacturer:** An empty text box.
- Battery Model:** An empty text box.
- Battery ID:** An empty text box.
- Print:** A button located at the bottom right of the dialog.

Figure 4. Location

**Site Name and Address** - Information in the Site Name text box creates a subdirectory in the BCT Reports directory.

**Battery Name and Dates** - Type the battery installation date and next test date in mm/dd/yy format. NOTE: The present date appended to the battery name is the default file name of the report generated at the time of test.

**Battery Manufacturer, Model and ID** - At Battery ID, note any specific identification number associated with the battery being tested.

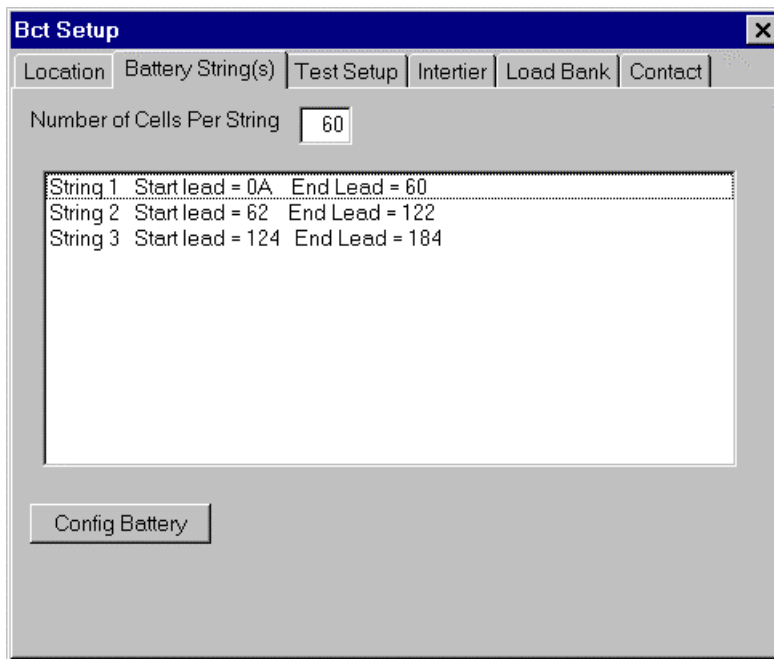
**Add Site / Delete Site** - To add a site, click Add Site. To delete a site, select the site name from the Site Name drop-down list, then click Delete Site. Deleting a site deletes all the battery information assigned to the site.

**Add Battery / Delete Battery** - To add a battery, click Add Battery. To delete a battery, select the battery name from the Battery Name drop-down list, then click Delete Battery. Deleting a battery deletes all the test information assigned to the battery.

**Print** - To print site, battery, configuration, contact, and test information for the currently selected test, click Print.

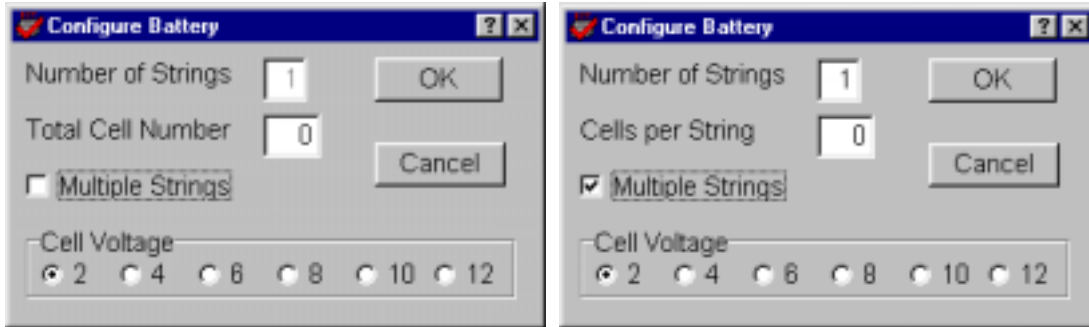
## 11.2. Battery Strings

On the Setup menu, click Battery Strings. The Battery Strings dialog box identifies how many strings and cells per string the BCT-2000 is configured for. Each string has an entry identifying the start test lead and end test lead.



**Figure 5. Battery String**

**Config Battery** - To change the number of strings and cells, click Config Battery. The Configure Battery dialog box appears.



**Figure 6. Configure Battery**

**Number of Strings** - Type the number of strings in Number of Strings. If Multiple Strings is not selected, the Number of Strings box defaults to 1 and cannot be changed.

**Multiple Strings** - If using multiple strings, select the Multiple Strings box, then type the number of strings in Number of Strings.

**Total Cell Number** - If Multiple Strings is not selected, type a value in Total Cell Number.

**Cells per String** - If Multiple Strings is selected, type a value in Cells per String. NOTE: When using multiple strings, this value is the number of cells per string, not the total number of cells.

NOTE: If using multiple strings, the program automatically drops one test lead between strings.

**Cell Voltage** - Click the appropriate Cell Voltage button, then click OK. NOTE: Battery cell voltage initiates the warning and shutdown levels in the test setup. For every two cell volts, the cell warning level is set to 1.75V and cell shutdown to 1.60V. The OV (overall voltage) alarm levels are a multiple of these levels times the number of cells per string. For example, a 6 volt cell voltage defaults to a warning level of 5.25 volts and a shutdown level of 4.80 volts.

NOTE: When a battery is reconfigured, all previously set intertier assignments are cleared.

### **11.3. Test Setup**

On the Setup menu, click Test Setup. The Test Setup dialog box allows selection of test type, discharge to perform, length of the discharge, and load to be applied. Single string applications test a single string; multiple string applications test up to eight strings at one time; charger testing performs a test on the battery charger; and recharge mode monitors the battery during recharging.

### **11.4. Test Types**

You may configure six test types: Performance, Modified Performance, Service, Rundown, Charger, and Recharge. Each type saves specific parameters and test steps. Select a test from the Test Type drop-down list before running a test. Each test is briefly described below; refer to IEEE 450 for more information. Descriptions of items on the dialog boxes follow the six test type descriptions. The areas enabled on the dialog boxes depend on the test type selected.

### 11.4.1. Performance Test

Also known as a capacity test, the performance test uses a programmed constant current or constant power load to project reliability and remaining battery life before replacement is necessary. A performance test has only one step.

Step	Duration (hh:mm:ss)	Amps
1	00:00:00	0

Figure 7. Test Setup: Performance

### 11.4.2. Modified Performance Test

A modified performance test tests battery capacity (similar to a performance test) and the ability of the battery to provide a high-rate, short-duration load cycle. This test may be done in place of a service test. If you type 0 (zero) for Rated Time, the test does not calculate battery capacity.

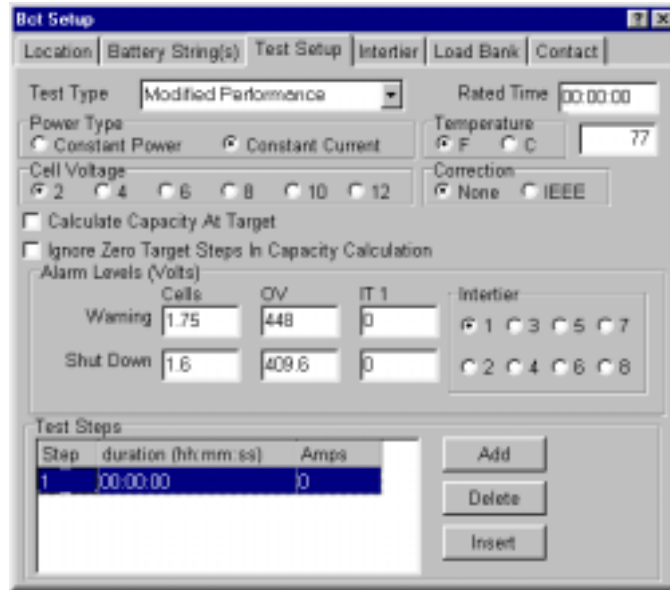


Figure 8. Test Setup: Modified Performance

### 11.4.3. Service Test

A service test determines the battery “as found” ability to satisfy the battery duty cycle.

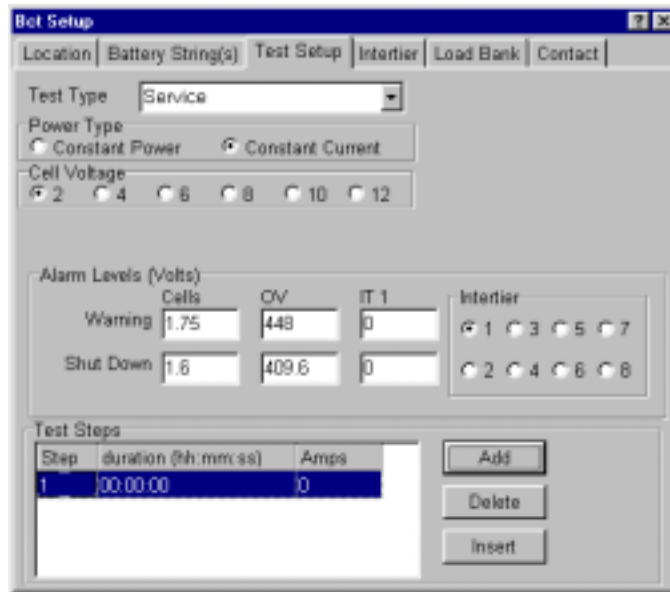


Figure 9. Test Setup: Service

#### 11.4.4. Rundown Test

A rundown test is similar to a service test, except the test uses the system load instead of a controlled load. Rundown has only one step and no shutdown levels.

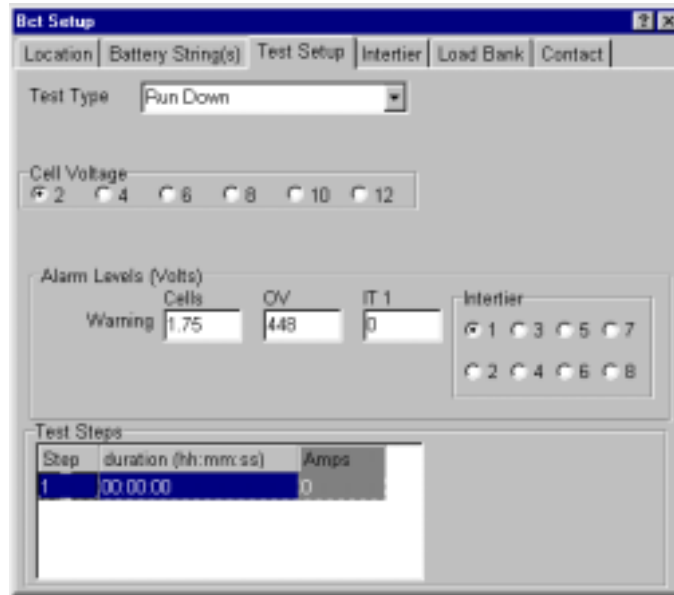


Figure 10. Test Setup: Rundown

#### 11.4.5. Charger Test

When the charger test is selected, the only parameters recorded to the report file are Overall Voltage and Current.

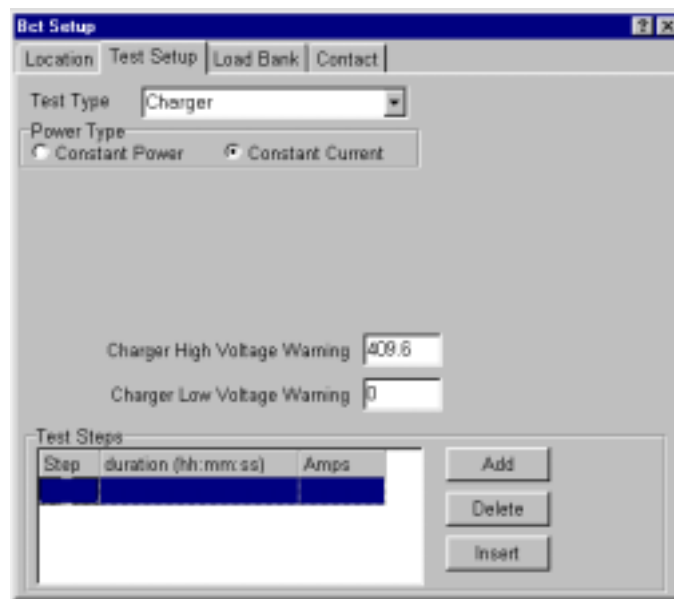


Figure 11. Test Setup: Charger

### 11.4.6. Recharge Test

The recharge test monitors the battery system while it is being recharged. For every two cell volts, the cell warning level is set to 2.33V. The OV warning levels are a multiple of these levels times the number of cells per string. On this test, the levels are high level (maximum) values.

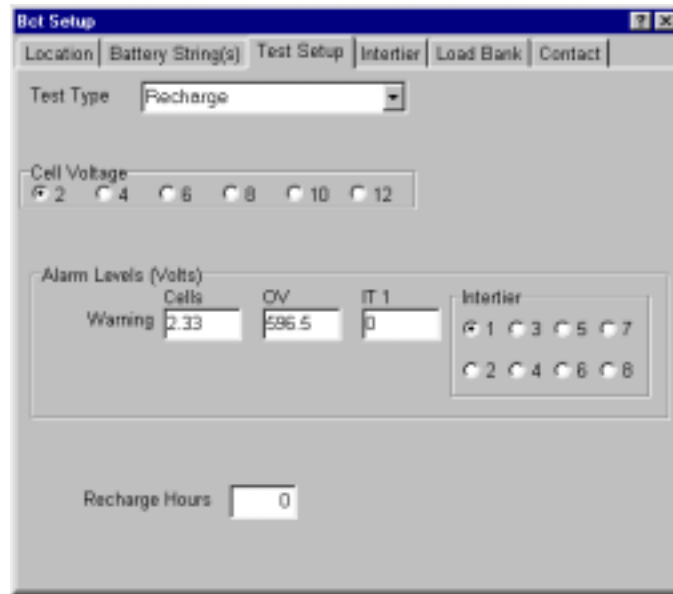


Figure 12. Test Setup: Recharge

## 11.5. Test Setup Parameters

The following items are available on the Test Setup dialog boxes depending on the test type selected.

### 11.5.1. Rated Time

Available for test types: Performance, Modified Performance

Type the manufacturer's specified rated time in the Rated Time box. This value is important for the on-line capacity calculation performed during a single step capacity test. The format is hh:mm:ss. If doing a Modified Performance test, you may leave Rated Time blank.

You may type 0 (zero) for Rated Time on a Modified Performance test. If this is done, the test does not calculate battery capacity at test time. You may enter a Rated Time at report generation.

### 11.5.2. Power Type

Available for test types: Performance, Modified Performance, Service, Charger

**Constant Power** and **Constant Current** - To define power type, click Constant Power or Constant Current. Power type determines if the programmed load is rated in watts or amps. The power type selected applies to all steps; you cannot switch between Constant Power and Constant Current between steps.



### **11.5.3. Temperature and Correction**

Available for test types: Performance, Modified Performance

**Temperature, F and C** - Click F or C (Fahrenheit or Celsius) then, in the Temperature box, type the average electrolyte temperature of the sample number of cells. The program automatically calculates between C and F. For example, if you select C after typing a Fahrenheit value, the value converts to Celsius. To minimize rounding errors, type the value in the known format. For example, if the temperature is in degrees C, select C before typing the value.

**Correction, None and IEEE** - If you enter a temperature other than 77°F (25°C), you may select IEEE temperature correction of the load. To automatically correct to IEEE-450, click IEEE in the Correction area. For no correction, click None. If the IEEE correction option is enabled and the temperature is later changed, all programmed steps are automatically corrected and all loads are compensated throughout the test program. For more information on temperature compensation, refer to IEEE Std 450.

### **11.5.4. Cell Voltage**

Available for test types: Performance, Modified Performance, Service, Rundown, Recharge

Click the button that corresponds to the voltage of an individual cell.

### **11.5.5. Alarm Levels Area**

Available for test types: Performance, Modified Performance, Service, Rundown, Recharge

In the Alarm Levels area, type voltage levels that issue warnings or shutdown during testing. This area lets you set warning and shutdown levels for cells, OV, and intertiers. When an alarm condition occurs, an alarm sounds, the failing cell is logged, and the graph or display area changes color. A beeping alarm from the BCT indicates a warning, and a solid tone indicates a shutdown. Refer to *View Alarms During Test*.

You may change the warning and shutdown test levels for cells, OV, and intertiers when the test is running. Changes are recorded in the test activities portion of the report. Refer to *Alarm Levels*.

NOTE: When cell warning or shutdown levels are changed, the OV warning or shutdown levels are automatically adjusted by the number of cells in the string times the changed level.

NOTE: To disable any of the following warning or shutdown levels, type a 0 (zero) in the box.

**Warning Cells** - Type the alarm voltage level of the individual cell or module to be alarmed. For example, if testing to an average end voltage of 1.75 volts per cell, type 1.75. When any cell falls below 1.75V, an alarm condition occurs. If values are set to 0, the warning is not active.

**Shutdown Cells** - Type the voltage of an individual cell to pause the test. For example, if discharging to 1.75 volts per cell average, you may want to pause the test if any cell falls below 1.65V. In this case, type 1.65 to pause the test when any cell falls below this voltage. If values are set to 0, the shutdown is not active.

**Warning OV** - This box defines the overall battery voltage warning level. Type the overall voltage warning level. For example, if testing 60 cells to an average of 1.75 volts per cell, you may want to be warned when battery voltage is approaching shutdown. If values are set to 0, the warning is not active.

**Shutdown OV** - In most cases, this value determines the end of the test. Type the overall battery end voltage. For example, if testing a 60 cell battery to 1.65 volts per cell, type 99.0 in the box (60 cells x 1.65 volts per cell = 99.0 volts). The system pauses the test when the overall voltage falls below 99.0 volts. If values are set to 0, the shutdown is not active.

**Warning Intertier** and **Shutdown Intertier** - Each intertier can have a warning and/or shutdown level set. To select an intertier, click an Intertier button, then type alarm and warning levels in the Intertier Warning and Shutdown boxes. Select values for each intertier as required. If values are set to 0, the warning or shutdown is not active.

### **11.5.6. Test Steps Area**

Available for test types: Performance, Modified Performance, Service, Rundown, Charger

**Step** - Each step is programmed individually, with a maximum of 99 steps allowed. If Step 1 (or another desired step) is not displayed, scroll to the step, then click the step to highlight it. Exiting a field or pressing ENTER saves the data entered.

**Duration** - Double click on the Duration field for the desired step, and type the time the step is to operate, in hh:mm:ss.

NOTE: If running a capacity test where the battery must perform for a certain time at a single discharge rate, select a time at least 50% longer than Rated Time. The time must be longer than the theoretical run time, so the test shuts down on voltage rather than time, for a more accurate capacity test. For example, if the test is one hour, enter a time of at least 1 hour 30 minutes. This ensures testing to at least 100% of capacity.

**Amps** or **Watts** - Use TAB or the mouse to move to the Amps or Watts field. (The column heading depends on the test type.) Type the amps or watts required when using optional load banks. If using the BCT-2000 as a portable data logging unit without load banks, and the system load or other load control is being used, type 0 in this field.

**Add, Delete** and **Insert** - If this is a performance or rundown test, there is only one step. If this is a modified performance, charger or service test, program the additional required steps. To add more steps, click Add. A new step appears in the list. To delete a step, highlight the step to be deleted by clicking the step, then click Delete. To insert a step, highlight the step that will follow the new step, then click Insert.

### **11.5.7. Calculate Capacity at Target**

Available for test types: Performance, Modified Performance

Select this box to calculate the capacity when the target value is reached. The test time advances only when the target is reached. The test time, but not the test, stops if the load falls below target and resumes when the target is reached.

### **11.5.8. Ignore Zero Target Steps**

Available for test types: Modified Performance

**Ignore Zero Target Steps in Capacity Calculation** - Select this box to ignore steps when the load is targeted to 0 (zero) in the capacity calculation. For any steps targeted to zero, the time of that step will not be used in the capacity calculation.

### **11.5.9. Charger High/Low Voltage Warning**

Available for test types: Charger

**Charger High Voltage Warning** and **Charger Low Voltage Warning** - Type values in these boxes to activate a warning when high or low voltage levels are exceeded. If values are set to 0, the warning is not active.

### **11.5.10. Recharge Hours**

Available for test types: Recharge

**Recharge Hours** - Type the number of hours that the recharge will be monitored.

## 11.6. Intertier

On the Setup menu, click Intertier. This dialog box defines the location of intertier and interrack connections, so the BCT can add the voltage back to the cell that the intertier follows. Otherwise, the cell just before an intertier connection would appear lower in voltage than it actually is.

When using intertier monitoring, an alarm occurs when the intertier voltage drop is greater than the programmed intertier warning level. You can program a warning level and shutdown level for each intertier. For no shutdown, set the intertier shutdown level to 0 (zero).

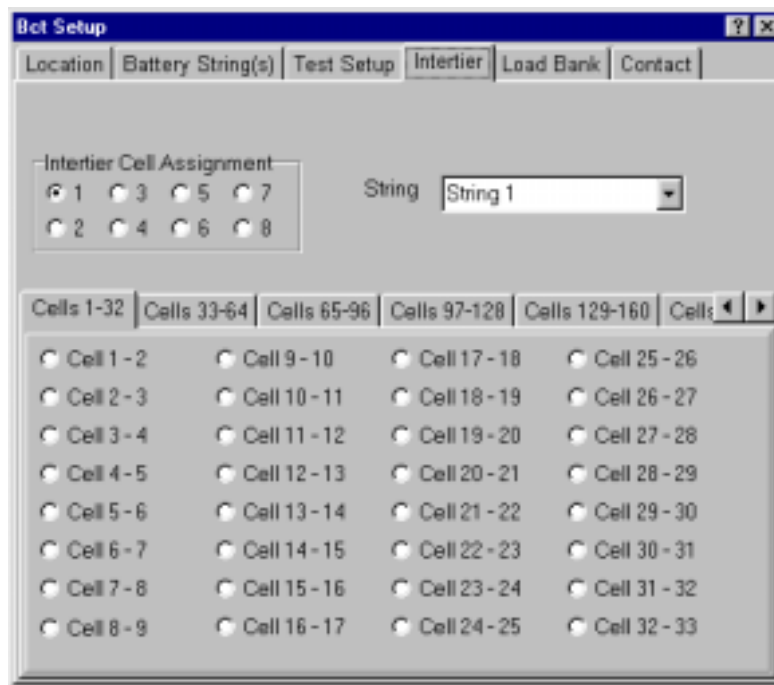


Figure 13. Intertier

**Intertier Cell Assignment** - Intertiers are assigned by string and cell. Select the intertier needing assignment by clicking the appropriate Intertier Cell Assignment button 1 to 8.

**String and Cells** - Assign a string to the intertier from the String drop-down list, then determine the cell pair the intertier is on, and click the appropriate Cell *n-n* button.

Repeat the above steps for all required intertiers. To remove an intertier assignment, double-click the Cell *n-n* button for the intertier. If no Cell button is selected, then no cell pair is assigned to the presently selected intertier. To view more cell pairs, click the left or right arrows.

## 11.7. Load Bank

On the Setup menu, click Load Bank. The Load Bank dialog box appears.

Step	Weight	Step	Weight	Momentary
Step 1	1	Step 9	256	<input type="checkbox"/>
Step 2	2	Step 10	512	<input type="checkbox"/>
Step 3	4	Step 11	1024	<input type="checkbox"/>
Step 4	8	Step 12	0	<input type="checkbox"/>
Step 5	16	Step 13	0	<input type="checkbox"/>
Step 6	32	Step 14	0	<input type="checkbox"/>
Step 7	64	Step 15	0	<input type="checkbox"/>
Step 8	128	Step 16	0	<input type="checkbox"/>

Figure 14. Load Bank

**Load Bank SN/ID, Add, and Delete** - The BCT can configure multiple load bank setups. To select a setup, click a name in the Load Bank SN/ID drop-down list. To add a setup name, click Add. The name "Load Bank *n*" appears in the Load Bank SN/ID box and in the drop-down list. To change this name, overwrite the name in the box with a new name. You can assign ratings and step weights to each load bank setup name. To delete a name in the Load Bank SN/ID box, click Delete.

**Step *n*** - For each load bank setup, type the step weight information.

**Momentary** - If the load bank has momentary load steps on steps 9 through 16, select the appropriate Step *n* boxes in the Momentary area. Selecting Momentary protects the resistors in the load bank by limiting the load test on the step to a maximum of 60 seconds.

**Shunt Rating Amps per mV** - Assign the shunt rating in amps per millivolt. At the Shunt Rating Amps per mV boxes, type the shunt value from the load banks. For example if the shunt is stamped 600/100 (600 amps at 100mV), type 600 in the Shunt Rating Amps box, then type 100 in the per mV box.

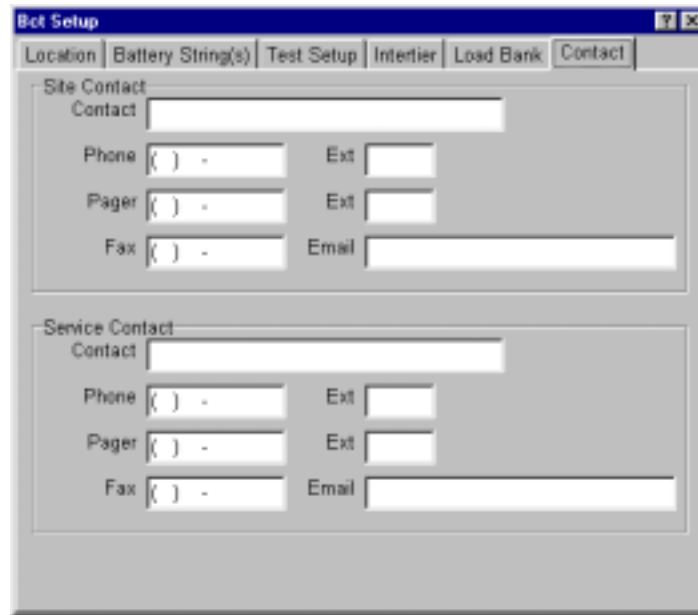
**Auto Detect Step Resistance** - If selected, the BCT calculates the average resistance of all steps with weight information. The net effect of this occurs at the start of the test. The BCT assumes 0.5 amps per weight value. At 0.5 amps per weight value, the BCT turns on the steps needed to achieve the target load. Depending on the actual load banks, the first attempt may be off target by as much as half the desired target load. After these steps are set, the BCT waits for the next load and OV reading. Using the sum of the step weights first set, the BCT calculates the actual amps per weight value, then uses the OV to calculate each step resistance.

NOTE: These resistances are calculated, not actual. If there is a problem controlling the load, the actual resistance of one or more steps may be incorrect. Refer to *Load Bank Diagnostic*.

If Auto Detect Step Resistance is selected, the BCT corrects the load steps at least one more time at the start of the test. If you do not want this to occur, do not select Auto Detect Step Resistance. In this case, select Diagnostics from the main menu, open the Load Bank dialog box, and measure or type the load bank resistance values into only the active Steps boxes (Steps 1 to 16 as required).

### 11.8. Contact

On the Setup menu, click Contact to display the Contact dialog box.



The image shows a screenshot of the 'Bct Setup' dialog box with the 'Contact' tab selected. The dialog box has a title bar with 'Bct Setup' and standard window controls. Below the title bar are several tabs: 'Location', 'Battery String(s)', 'Test Setup', 'InterTier', 'Load Bank', and 'Contact'. The 'Contact' tab is active. The dialog is divided into two main sections: 'Site Contact' and 'Service Contact'. Each section contains a 'Contact' text field, a 'Phone' field with a dropdown menu, an 'Ext' field, a 'Pager' field with a dropdown menu, an 'Ext' field, a 'Fax' field with a dropdown menu, and an 'Email' text field.

Figure 15. Contact

The Contact dialog box is an information screen and has no effect on tests. Type the names of persons responsible for the system at the site and for service, and their telephone numbers and e-mail addresses.

### 11.9. Voltage Polarity

The BCT-2000 systems features automatic polarity sensing, and no user input is required. The system senses when Cell 1 is the most positive or the most negative cell in the string.

## 12. Running the Test

At this point, the BCT-2000 must be connected as described in *Connecting the System* and the main menu displayed. On the main menu, click Test. The BCT Test screen displays all relevant information for monitoring test progress and parameters in a real time mode.

**OV, Amps, KW, and Capacity** - The top of the screen indicates battery OV (overall voltage), load in amps, power in kilowatts, and the present capacity of the battery. (The capacity is calculated only during a Performance or Modified Performance test.)

**Intertier** - The Intertier area displays the voltage of each intertier. Single click on a bar to display the value of an intertier. Double-click the graph to increase it to full screen. In this mode, the graph does not update. To return to normal view, press ESC.

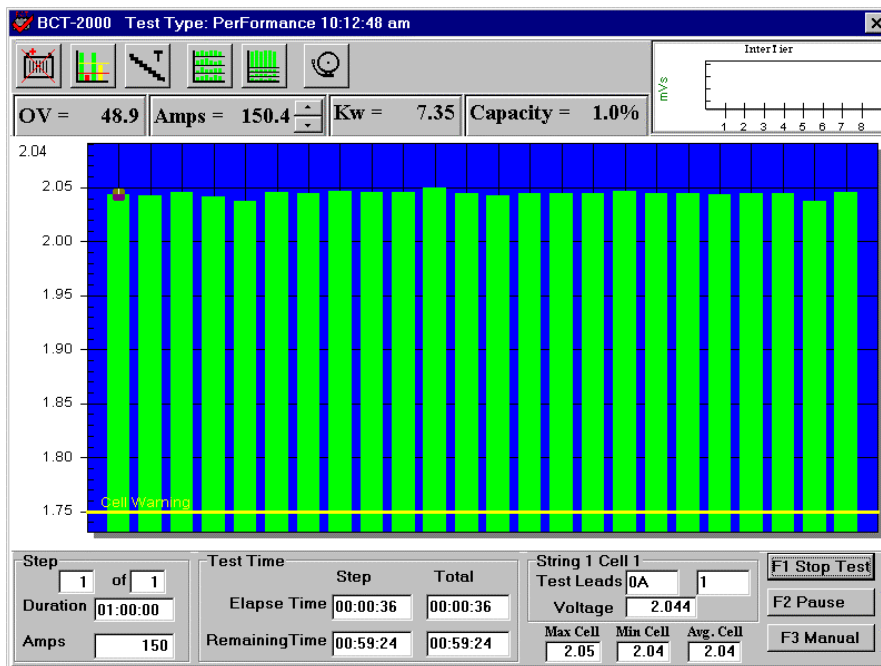


Figure 16. BCT Test

**Nudge** - Next to the Amps value are arrows that slightly increase or decrease (nudge) the load within target when in the auto mode. When controlling the load, the BCT is considered on target when the target current plus 1.5% of target current plus 1.5 amps is achieved. For example, on a load of 500 amps, the BCT-2000 could set the load at 500 amps plus 1.5% (7.5 amps) plus 1.5 amps, or as high as 509 amps. The Nudge control lets you change the load to move the current closer to 500 amps.

**Duration and Test Time** - Individual cells or modules are displayed in a bar graph format. Presently active step duration and target value, in amps or watts, are in the lower left of the screen. The Test Time area displays the present step total test times.

**Test Leads and Voltages** - Click a bar on the graph to cause a cursor ball to appear above the bar. The cursor denotes the cell on which the status area (to the right of Test Time) is reporting. The status area indicates the cell voltages and test lead numbers. The maximum, minimum, and average cell voltages are displayed below the status area.

**Toolbar** - Toolbar items at the top of the screen are for excluding or including cells that went into shutdown, changing alarm levels, changing test step duration and load, changing the number of graph bar lines, zooming in on a bar line, and viewing the alarms list.

At the BCT Test screen, all connected cells are displayed in a bar graph format. Verify the displayed readings of two or three cells and OV (overall volts) with a digital voltmeter. If the display and the DVM do not agree, refer to *System Calibration* in this manual.

### **12.1. Start the Test**

Verify equipment connections are secure and equipment is in operating mode. If using Albécorp load banks, ensure the step weights are configured properly. Refer to *Load Bank*.

**F1 Start Test** - If load banks are being used, set the load bank AC power switches to ON. If no problems are apparent, to start the test, click F1 Start Test on the BCT Test screen or press the F1 key.

During the test, the cells degrade as the load is applied to the battery. Click a bar graph to cause a cursor to appear above the bar. The cursor denotes the cell on which the status area (to the right of Test Time) is reporting. The status area indicates the minimum and maximum cell voltages, average cell voltage, and the test clip lead numbers. If the graph is in the active screen, press the left or right arrow keys to move the cursor to the previous or next cell bar.

At the end of the test, a message indicates the load test is complete. When disconnecting any equipment, power down the continuous load bank first, then power down the rest of the system.

**WARNING:** When disconnecting equipment, power down the load bank first, then the rest of the system.

### **12.2. Load Test Control**

While the test is running, several options are available: Stop Test, Pause, Resume, and Manual.

**F1 Stop Test** - To stop the test, click F1 Stop Test or press F1. A message appears to confirm the test should be stopped.

**F2 Pause and F2 Resume** - To pause the test, click F2 Pause or press F2. Pause lets you make changes. Do not pause the test for extended periods of time during load testing, because the cells will recover during the idle period. When the test is paused, F2 Pause changes to F2 Resume.



### 12.3. Manual Load Bank Control

**F3 Manual** and **F3 Auto** - The system defaults to automatic control. For manual control, click F3 Manual or press F3 after the test has started. To return to automatic mode, click F3 Auto.

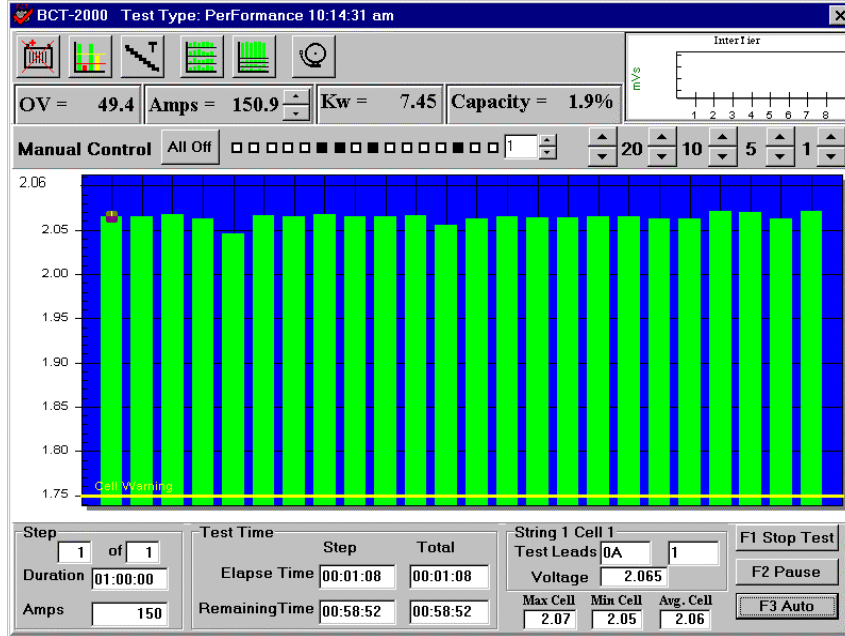


Figure 17. BCT Test in Manual Mode

Typically, select manual mode to control a charger test or if there is a load bank problem. Manually selecting load step weights may help determine which step in the load bank is causing the problem. NOTE: Do not confuse step weights in the load bank with test steps in the program.

When F3 Manual is selected, a toolbar on the screen allows control of the load bank.



Figure 18. Manual Toolbar

**User-Defined Weight Buttons** - The larger arrows to the left of 20 on the toolbar are user-definable. To increase or decrease their load weight per step, type a weight in the box or click the smaller arrows adjacent to the box. The maximum weight value is 200. To increase or decrease the load applied, click the larger arrows. As the value is changed, the 16 square step indicators change. The step enabled in the load bank is displayed as a binary count along the toolbar; when a square is black, that step is on in the load bank.

NOTE: The value in amps of the load change depends on the type of load bank used. Typically, this value is less than one amp per step. For a larger increment, change the user-defined step size on the toolbar. To determine the actual amp value for each weight, divide the load bank's total amp capacity by the total weight count. Refer to the Load Bank screen to determine the total weight count.

**20, 10, 5, 1** and **All Off** - You may also use the 20, 10, 5, and 1 buttons to change the total weight applied to the load. To turn off all the steps, click All Off. When the test is running, you may click F2 Pause to pause the test and remove the load.

NOTE: Instead of using the manual mode to change step weights, you may use the Test Steps dialog box to change the actual load current or power. Refer to *Test Steps*.

## 12.4. View Alarms During Test

The Test screen indicates real-time alarm conditions for cells, intertiers, and OV. During testing, to view the alarm history, click the View Alarms button. Refer to *View Alarms*.

### 12.4.1. Cell Alarm

When a cell goes into alarm, the bar graph for the failing cell changes color, the BCT-128 or BCT-256 alarm sounds, and the cell number and string designation are logged in the alarm history. A cell alarm occurs when the cell voltage drops below the programmed Cell Warning voltage level. The normal bar graph color is green; yellow indicates a warning condition, and red indicates a shutdown. If a cell goes into negative voltage levels, the bar graph for the cell changes to black.

**Cell Warning** - When a cell falls below a warning level, the BCT beeps, but the test does not pause. To silence the alarm, click OK in the Warning message box.

If the Cell Warning level is lowered, the cell comes out of warning and the bar graph returns to green, but the event is retained in the alarm history. Use the Adjust Alarm Levels toolbar button to change the level. Refer to *Alarm Levels*.

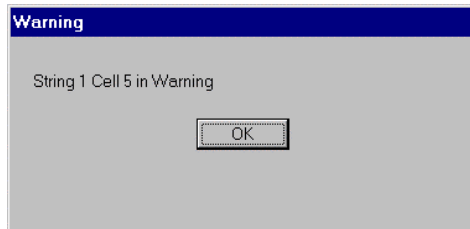


Figure 19. Cell Warning Message

**Cell Shutdown** - When a cell falls below a shutdown level, the BCT sounds a continuous tone, the test pauses, and the Cell Exclusion message box appears.

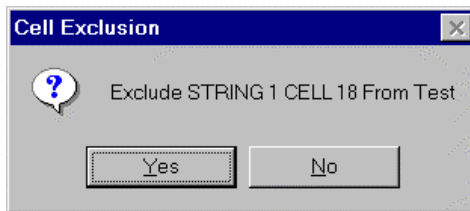


Figure 20. Cell Exclusion Message

To silence the alarm and exclude the cell from the test, click Yes in the Cell Exclusion box. This also causes the bar graph for the cell to no longer be displayed. To silence the alarm and keep the cell in the test, click No. Resume the test if desired.

The faulty cell can be jumpered out and the test resumed. This allows all alarm parameters to disregard the faulty cell if it is excluded.

#### **12.4.2. Intertier Cable Alarm**

When an intertier goes into alarm, the bar graph for the failing intertier changes color, the BCT alarm sounds, and the intertier designation is logged in the alarm history. The normal bar graph color is green; yellow indicates a warning condition, and red indicates a shutdown. The intertier bar graph is on the upper right of the Test screen. Double-click the graph to increase it to full screen. In this mode, the graph does not update. To return to normal view, press ESC.

An intertier cable connection alarm condition occurs when the intertier exceeds the programmed level. The Intertier bar graph indicates the failing intertier. A beeping alarm indicates a warning, and a solid tone indicates a shutdown. To silence the alarm, click Yes in the Intertier Warning or Shutdown message box. Carefully examine the intertier and its connections to determine if it is safe to continue the test.

If the Intertier Warning level is raised, the intertier comes out of alarm and the bar graph returns to green, but the event is retained in the alarm history. Use the Adjust Alarm Levels toolbar button to change the level. Refer to *Alarm Levels*.

#### **12.4.3. Overall Voltage Alarm**

When the overall voltage goes into alarm, the OV display changes color, the BCT alarm sounds, and the OV event is logged in the alarm history. An OV alarm occurs when the overall voltage drops below the programmed Warning voltage level. The normal OV display color is the screen background color; yellow indicates a warning condition, and red indicates a shutdown. The OV = V display is on the upper left of the Test screen.

A beeping alarm indicates a warning, and a solid tone indicates a shutdown. To silence the alarm, click Yes in the Warning or Shutdown message box.

If the OV Warning level is lowered, the OV comes out of alarm and the OV display returns to background color, but the event is retained in the alarm history. Use the Adjust Alarm Levels toolbar button to change the level. Refer to *Alarm Levels*.

## 12.5. Test Screen Toolbar

The Toolbar buttons that appear along the top of the BCT Test screen are shown below.



Figure 21. BCT Test Toolbar

Use the buttons to exclude or include cells that went into shutdown; change alarm levels; change test step duration and load; change the number of graph grid lines; zoom in on a bar axis; and view the alarms list. These buttons are described in the following sections.

### 12.5.1. Cell Exclusion



To remove a cell from the test, click the Exclude Cells button. In the Cell Exclusions dialog box, click **Add Cell**, type the string and cell number, then click Exclude. The string and cell appear in the list in the Cell Exclusions dialog box. A box with a check mark indicates the cell is excluded from the test. To include an excluded cell back into the test, clear the check box. You can exclude cells before a test, and during a test without pausing the test. You can include them back during a test without pausing.

Excluding and including a cell from the test automatically adjusts battery alarm levels by changing the OV warning and shutdown values by one cell level. All items on the cell exclusion list are cleared when the test is exited.

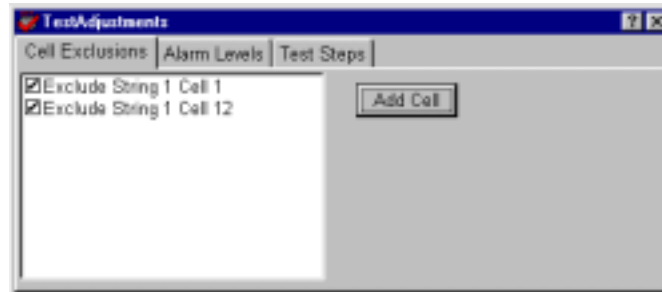


Figure 22. Cell Exclusions

### 12.5.2. Alarm Levels



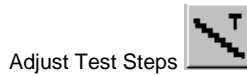
You may change the warning and shutdown levels for cells, OV, and intertiers while the test is running. Click the Adjust Alarm Levels toolbar button. After changing a level, use the TAB or ENTER key or mouse to move to the next box. The new alarm level takes effect immediately. Changes are recorded in the test activities portion of the report.

CAUTION: Changes made to the alarm levels and test steps using the Test Adjustments dialog boxes are valid only for the presently running test and do not permanently change the test setup information.



Figure 23. Alarm Levels

### 12.5.3. Test Steps



Click Adjust Test Steps to add new steps or change the duration or load of the presently running step or subsequent steps. NOTE: You cannot change the duration of a presently running step to less than the elapsed time of the step. Also, steps that have already run cannot be changed. To add a new step, click Add Step.

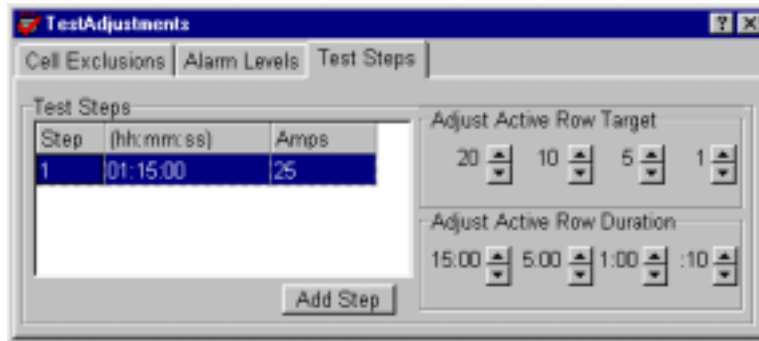


Figure 24. Test Steps - Constant Current

If Constant Current is selected, the Test Steps dialog box has buttons for 20, 10, 5 and 1 amp, or you may type a new value in the Amps column.

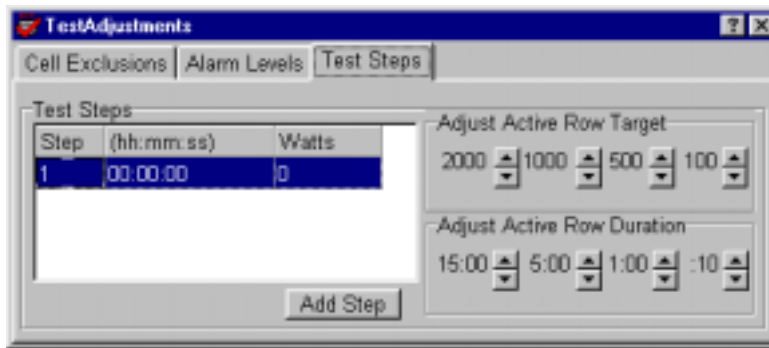


Figure 25. Test Steps - Constant Power

If Constant Power is selected, the Test Steps dialog box has buttons for 2000, 1000, 500 and 100 watts, or you may type a new value in the Watts column.

### 12.5.4. Modify Graph



Use the Change Cell Axis Count or the Zoom on Cell Axis buttons to change the number of X-axis lines (graphs) displayed or to zoom in on a graph. Click Change Cell Axis Count to spread the cells over more than one X-axis. This is useful when there are more than 60 cells in a test.

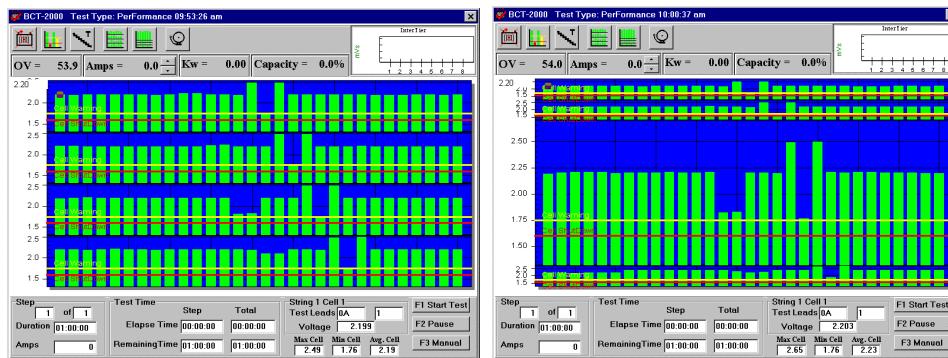


Figure 26. Change Axis and Zoom Axis Results

When more than one X-axis is displayed, you may click Zoom on Cell Axis to increase the size of an axis display.

### 12.5.5. View Alarms



Click the View Alarms button to open a box that lists all cell, intertier, and OV alarms that are occurring or have occurred during the test.

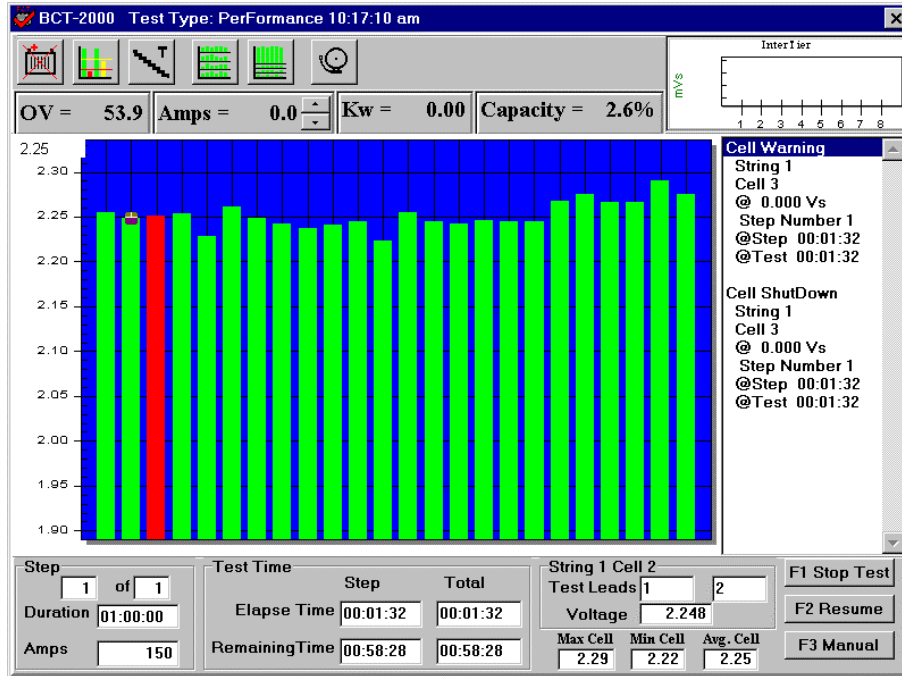


Figure 27. View Alarms

## 12.6. Charger Test Screen

When the Charger test is running, the Charger screen displays a Voltage/Load History graph. Data on this graph enters from the right and moves to the left. This history data is limited to ten minutes on the X-axis (time) display.

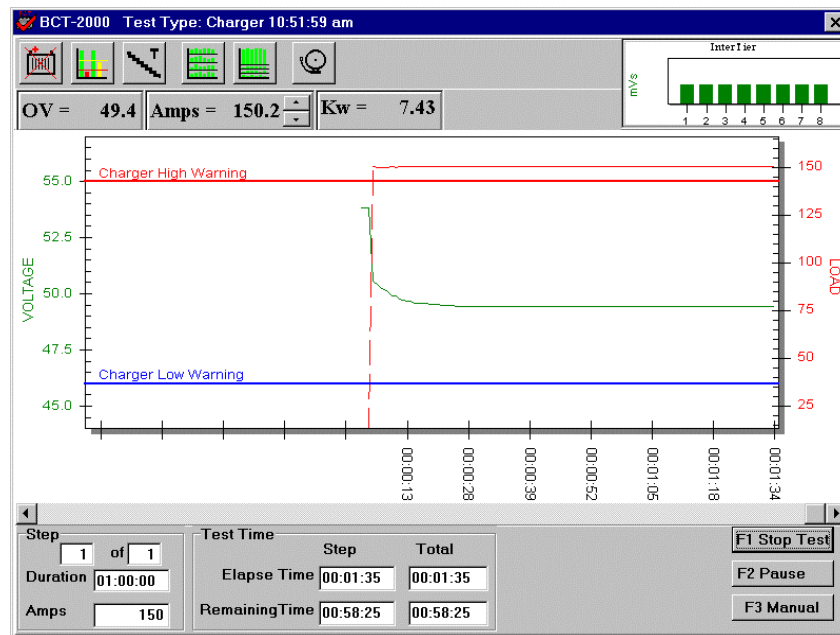


Figure 28. Charger Test

The red curve displays the load in amps. The green curve displays charger voltage.

### **12.7. Hardware Failure**

If the computer senses a board failure or loses communication with the BCT, the test pauses and the screen displays an error message. If load banks are being used, the system shuts them down. Upon communication failure, all selected levels are voided.

Before doing any diagnostics, verify the load banks are powered off and no load is being applied to the battery. During the pause mode, check all cable connections and equipment. After the problem is resolved, the testing may be resumed.



## 13. Report Generator

The BCT Report Generator program reads the test data files generated by the BCT-2000 test software and creates customized reports. After the BCT-2000 system performs a load test, the test data is saved to a file, and it is this data, presented in report format, that battery test personnel rely on to analyze battery system performance. Using the Report Generator, you can display graphs, edit site information, add notes, and customize report pages.

The Report Generator can save reports in several file formats. One format lets you open the report at a later date and modify site information or appearance. Or you may save the report in the archive format, which protects the document against changes to ensure the integrity of the information. In Export mode, the Report Generator exports files in formats that can be used by commercial database programs or text editors.

**Sample Data** - Use the file **reportdemo.btr** (performance test) or **bctdemo.btr** (modified performance test) to try the features in the Report Generator.

### 13.1. Starting the Report Generator

After the system performs a Load Test, you may generate a report for battery data analysis. To generate a report from a completed test, click Reports on the main menu, then open the file. The Reports main dialog box has five buttons and seven tabs.

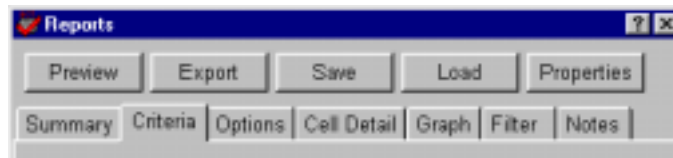


Figure 29. Reports Main Screen (Top)

Click a tab or button to open dialog boxes. The following sections describe the items in each dialog box. To exit the Report Generator, click the × in the upper right corner of the Reports main dialog box.

### 13.2. Opening a Report

When the Report Generator is started, the Open dialog box appears.

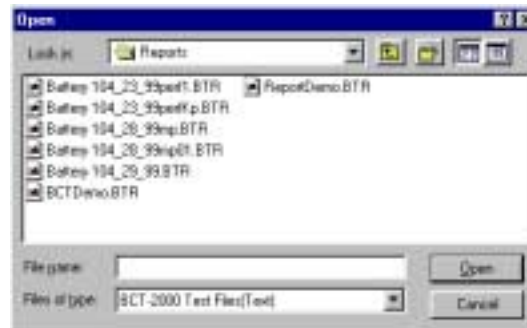


Figure 30. Open

The Files of Type drop-down list lets you select BCT-2000 text (.BTR), binary (.BBR) or archive (.ZRF) files. The BCT-2000 test software generates BTR format; the Report Generator generates BBR and ZRF formats. You must open a file before selecting other options. Select the subdirectory and the file name, then click Open.

### 13.3. Loading a File

**Load** - When certain functions are selected and no file is open, a message indicates a file must be opened. To open a file after the Report Generator is started, click Load and select a file. You do not need to close the old file, as only one text or binary file can be open at a time. However, you may open an archive file while a text or binary file is open. (Refer to *Opening an Archive File*.)

### 13.4. Summary Screen

After a file is opened, the Reports dialog box appears. Click the Summary tab to display the Summary dialog box. Items in this box depend on the type of report selected.

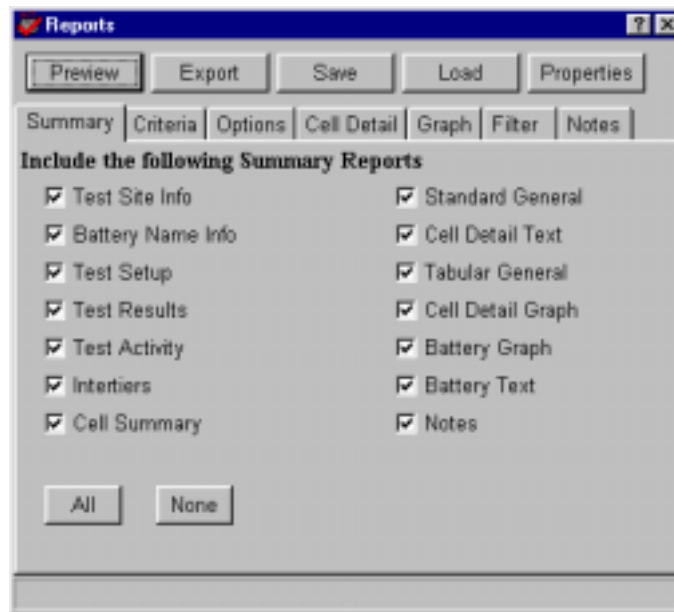
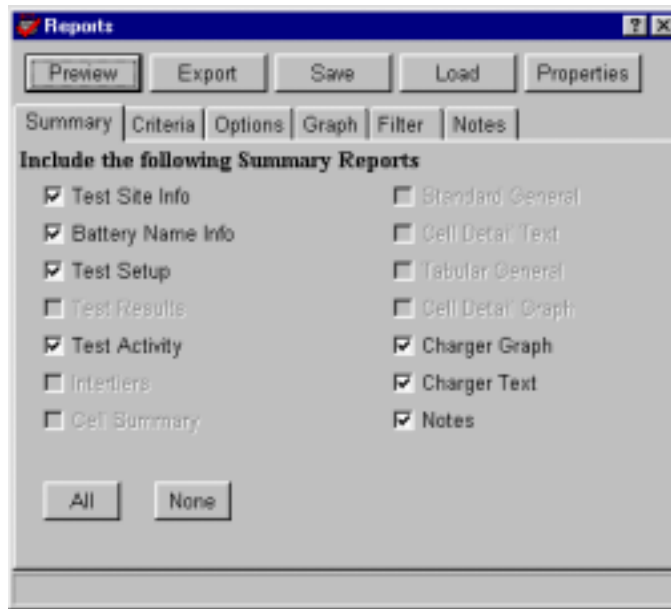


Figure 31. Summary



**Figure 32. Summary for Charger Report**

On the Summary box, select the items to include in the report. If a Charger test report is selected, Battery Graph and Battery Text change to Charger Graph and Charger Text. To select all the items in the Summary box, click All. To clear all the items, click None.

Items in Summary Box	Items on View Reports Form Non-Charger Report	Items on View Reports Form Charger Report
Test Site Info	Site	Site
Battery Name Info	Battery	Battery
Test Setup	Setup	Setup
Test Results	Results	-
Test Activity	Activity	Activity
Intertiers	Intertiers	-
Cell Summary.	Cell Summary	-
Standard General	Standard	-
Cell Detail Text	Cell Detail	-
Tabular General	Tabular	-
Cell Detail Graph	Detail Graph	-
Battery Graph or Charger Graph	Battery Graph	Charger Graph
Battery Text or Charger Text	Battery Text	Charger Text
Notes	Notes	Notes

**Figure 33. Items on View Reports Form**

Each item selected in the Summary box results in a tab appearing on the View Reports Form screen, which opens when Preview is clicked. Refer to *View Reports Form (Preview) Screen*.

### 13.5. Criteria Screen

Click the Criteria tab to display the Criteria dialog box.

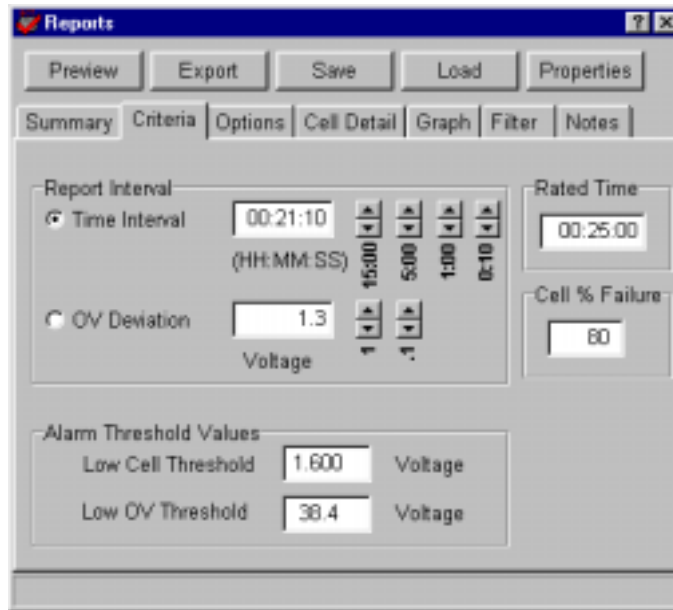
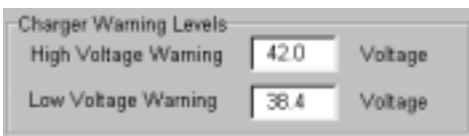


Figure 34. Criteria

**Time Interval** and **OV Deviation** - Click Time Interval or OV Deviation and type a value, or click the time or voltage buttons next to the boxes. The Report Interval determines the frequency of report sampling. Specify time in hours, minutes, and seconds (10 second minimum) or OV deviation in volts (0.2 volt minimum).

**Low Cell Threshold** and **Low OV Threshold** - The Alarm Threshold Values area is enabled for all tests except Charger. The thresholds are the cell and OV shutdown levels entered in test setup, or the last levels entered during the test. On the report, values that violate these thresholds are printed in color and with brackets ( < > ) for black ink printers. These values may be changed if desired.

**High Voltage Warning** and **Low Voltage Warning** - For the Charger test, the Alarm Threshold Values area changes to Charger Warning Levels. These are the warning levels entered in test setup, or the last levels entered during the test. On the report, values that violate these thresholds are printed in color and with brackets ( < > for low threshold violation and > < for high threshold violation) for black ink printers. These values may be changed if desired.



**Rated Time** - Rated Time is used by Capacity test reports and may be modified at report time.

**Cell % Failure** - The percentage of cell failure is used by Capacity test reports and may be modified at report time. The value was previously fixed at 80% for reports, but may now be changed.

NOTE: Changing the threshold, rated time, and percentage failure values affects which cells are indicated on the report as failing.

### 13.6. Options Screen

Click the Options tab to display the Options dialog box.

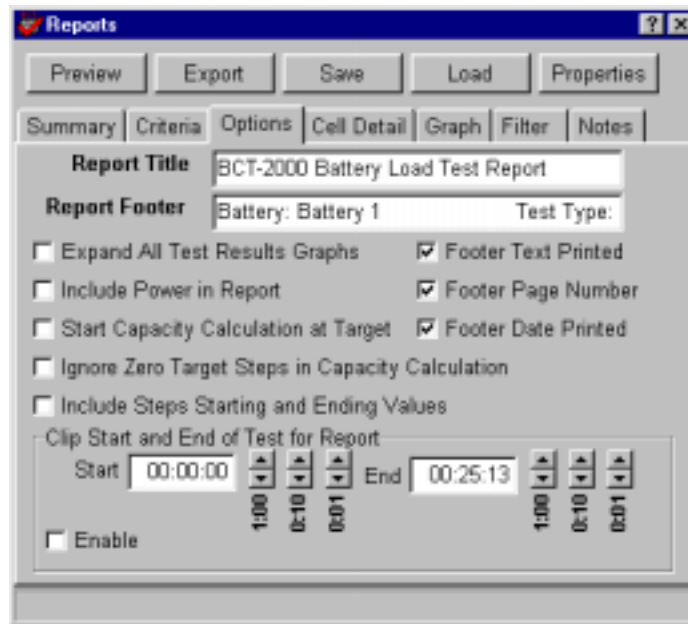


Figure 35. Options

**Report Title** and **Report Footer** - Edit or add text in these boxes if required. The Report Title always prints (unless there is no title text), but you must select the Footer Text Printed check box to print the footer. To print the page number and date, select the Footer Page Number and Footer Date Printed check boxes.

**Expand All Test Results Graphs** - Select this box to display a Drill Down Report for each cell that fails minimum voltage threshold level. This report (graph) appears on screens under the Results tab on the View Reports Form screen. To have the Results tab appear, select Test Results on the Summary dialog box. (Refer to *Drill Down Reports*.)

**Include Power in Report** - Select this box to list power in reports, in addition to voltage and current. This box is available when the test data is not for constant power.

**Start Capacity Calculation at Target** - Select this box to calculate the capacity when the target value is found. All the test times in the report are adjusted by this time. For example, if it takes four seconds to find the target, then all the times in the test report will be minus four seconds. NOTE: If Calculate Capacity at Target was selected during test setup, this option is not available.

**Ignore Zero Target Steps in Capacity Calculation** - Select this box to ignore steps when the load is targeted to 0 (zero) in the capacity calculation. For any steps targeted to zero, the time of that step will not be used in the calculation.

**Include Steps Starting and Ending Values** - For a multi-step test, select this box to see the starting and ending values of the steps. The starting and ending times are included in the report.

**Clip Start and End of Test for Report** - In the Start and End boxes, type the clip values for the start and end of a report in hh:mm:ss format. This is used when the BCT does not control the load, or there is no load interval or low load at the start and end of the test.

To determine the clip values, on the Criteria box, enable OV Deviation. On the Summary box, select only the battery text (.txt) report. To compile the report, click Preview. From the report, determine the time where the voltage drops or current is detected. This is the start clip time. The time where the voltage rises or current is no longer present is the end clip time. Set the end clip time on the Options box to one second less than the actual value found. For example, if the voltage rises at 13 minutes, 00 seconds, type 12 minutes, 59 seconds for the end clip time.

**Enable** - Select this box to clip the start and end times for the report.

### 13.7. Cell Detail Screen

Click the Cell Detail tab to display the Cell Detail dialog box. This box lets you automatically or manually select the cells included in the cell detail report.

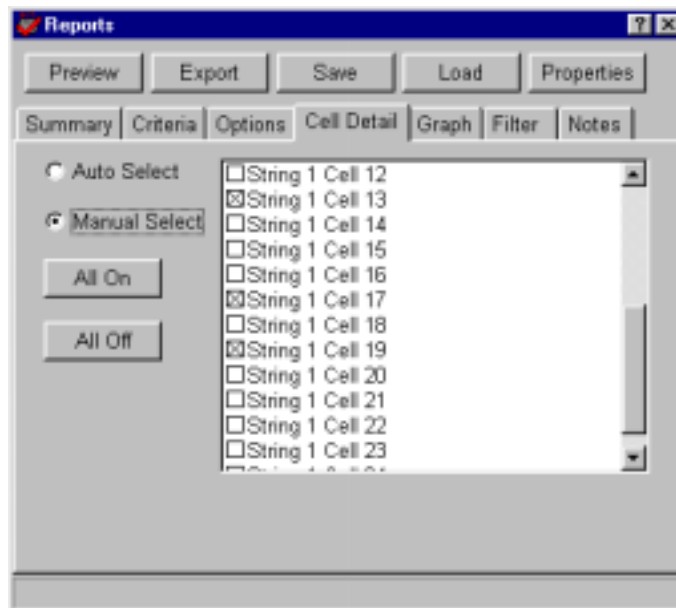


Figure 36. Cell Detail

**Auto Select** - Click Auto Select to automatically select cells that were at or below the low threshold level. In auto select mode, you may manually select additional cells for the report by selecting check boxes in the list. To clear a selection, select the box again. If you later change the low cell threshold on the Criteria box, cells that meet the new criteria are automatically selected, and cells manually selected before the threshold change are not selected.

**Manual Select** - Click the Manual Select button to manually select cells for the report. Add cells to the report by selecting the check boxes. To clear a selection, select the box again. Changing the low cell threshold does not change selected cells when in the manual mode.

**All On** and **All Off** - Click All On to select all cells in the list. Click All Off to clear all cell selections. You may use this feature in auto or manual mode.

### 13.8. Graph Screen

Click the Graph tab to display the Graph dialog box. The values displayed are 10% below the minimum and 10% above the maximum values found during the test.

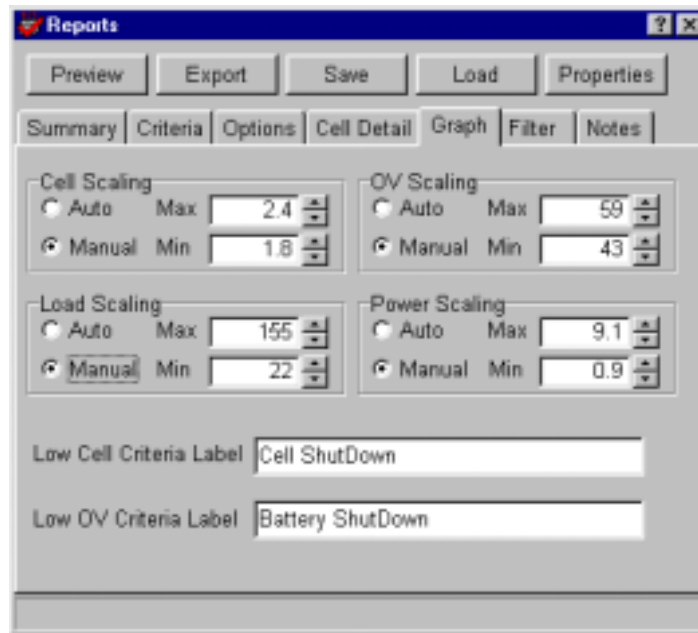


Figure 37. Graph

**Manual** - To change the minimum and maximum values displayed on report graphs, click Manual and select values. The Cell Scaling and OV Scaling values are in volts. Load Scaling is in amps, and Power Scaling is in watts.

**Auto** - If Auto is selected, the graphs are plotted to within 3% of the values.

**Low Cell Criteria Label** and **Low OV Criteria Label** - You may type new graph names in these areas for report graphs.

### 13.9. Filter Screen

Click the Filter tab to display the Filter dialog box. The values displayed are the minimum and maximum values found during the test. This dialog box lets you eliminate bad values, such as those caused when a clip lead falls off.

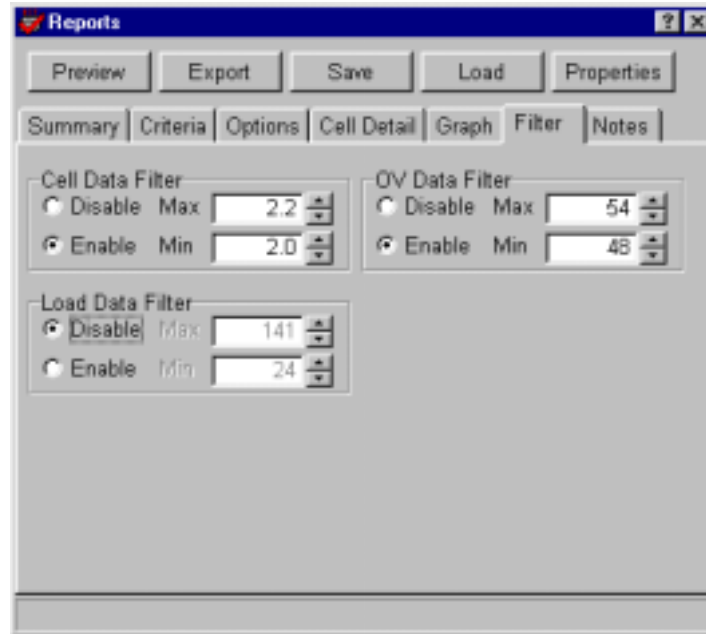


Figure 38. Filter

Disable is the default selection. To change values, click Enable, then type a value or select a value. Cell Data Filter and OV Data Filter values are in volts. The Load Data Filter is in watts.



### 13.10. Notes Screen

Click the Notes tab to display the Notes dialog box.

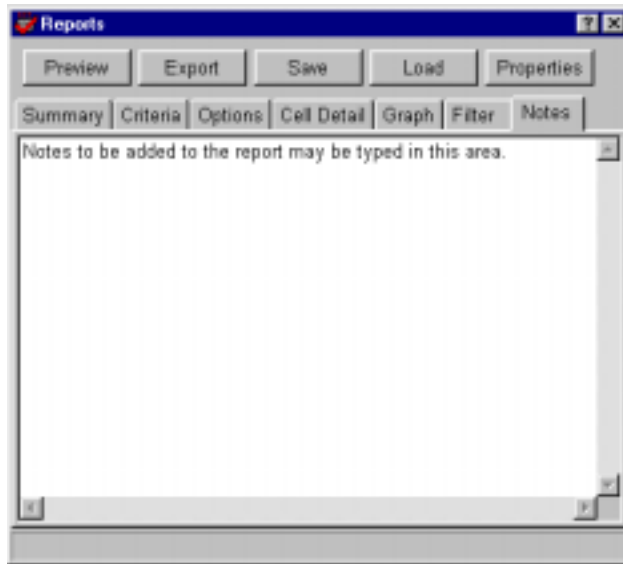


Figure 39. Notes

You may add notes to the report by typing them in this dialog box. Notes may include details about test results or equipment used, and appear on the last page of the report. To make the notes permanent, save the file as a **.BBR** file.

### 13.11. Report Properties Screen

**Properties** - Click the Properties button to display the Report Properties dialog box.

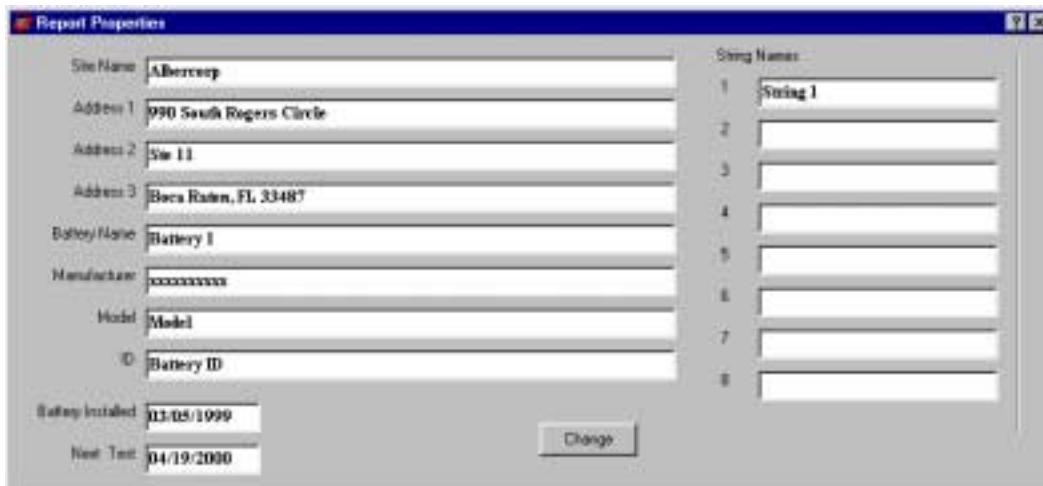


Figure 40. Report Properties

**Change** - Use the Properties dialog box to edit site information, then click Change to cause the changes to take effect. Click the × in the upper right to close the window. To close without saving the changes, do not click Change. To make the changes permanent, save the file as a **.BBR** file.

### 13.12. View Reports Form (Preview) Screen

**Preview** - After all report parameters are selected, to view the report on the screen, click Preview. Each section of the report is displayed one page at a time. To change the size of the page display, click Page, Width or Full. To view different pages in one section, click the first, previous, next or last page buttons at the top of the screen.

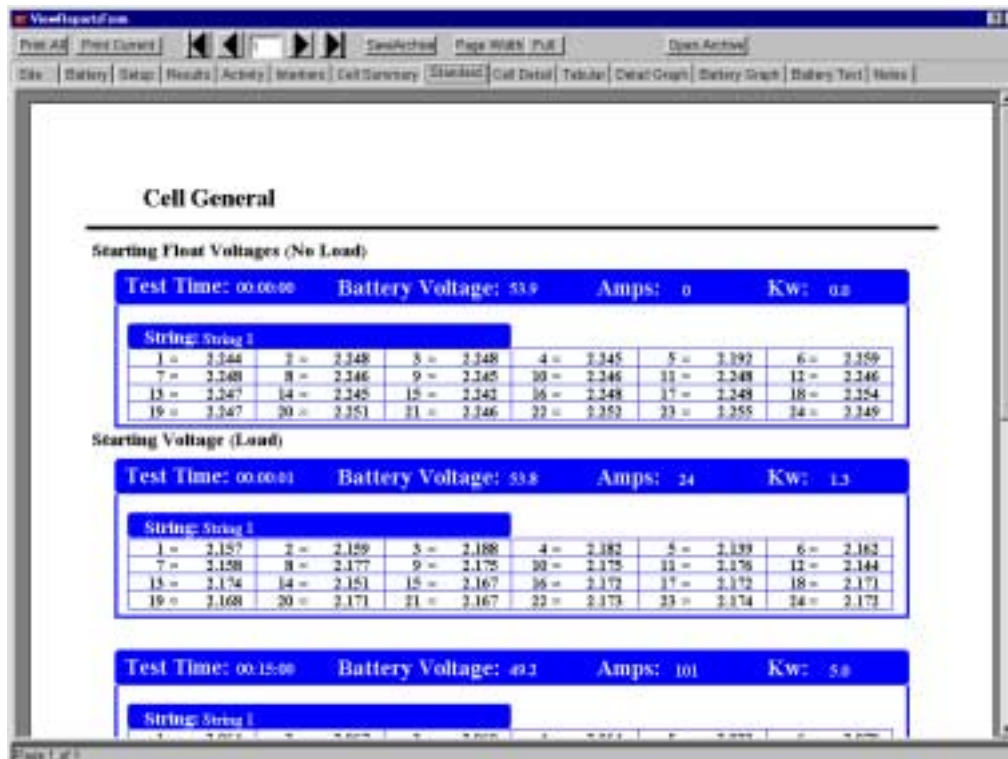


Figure 41. View Reports Form

To view different sections of the report, click the tabs along the top of the screen. A tab appears for each item selected in the Summary box. (Refer to *Summary Screen*.)

### 13.13. Saving a Report

The Report Generator can save a report as a binary file and an archive file. Either file type may be opened later and viewed or printed. Reports are saved by default in the folder last opened, unless a different folder is selected.

### **13.13.1. Binary (.BBR) Format**

**Save** (in Reports) - You may use the Report Generator to open a binary file and customize a report. Select options in the Reports dialog box to create different styles of reports for the same data. To save a report in BBR format, click Save in the Reports box. In the Save As box, select the folder, type the file name, then click Save.

NOTE: BBR files saved with BCT-2000 software Version 1.07 cannot be read by earlier versions of the program.

### **13.13.2. Archive (.ZRF) Format**

**Save Archive** (in View Reports Form) - The Report Generator and the Archive Reader can open archive files. An archive file cannot be changed after it is saved. Archive format lets you distribute the report file while ensuring the integrity of the data. To save a report in ZRF format, click Preview in the Reports box. When the View Reports Form box appears, click Save Archive. In the Save Archive box, select the folder, type the file name, then click Save.

### **13.14. Exporting in Database (.DB) Format**

**Export** (in Reports) - The Report Generator can export a report as a comma-delimited text file for use by commercial database programs. Files saved as comma-delimited text have the extension **.DB**. To save a report in database format, click Export in the Reports dialog box. In the Save In box, select the folder under which the file will be saved. Reports are exported by default to the folder last opened, unless you select a different folder. In the File Name box, type the file name. In the Save As Type box, select DB Format. To save, click the Save button.

In the DB format, data is in the following stream:

Line 1 (Header Information):

Test Location, Test Date, Test Start Time, Test End Time, Battery ID, Battery Type, Installation Date.

Line 2 (Test Information):

Time, Overall Voltage, Current, Cell 1, Cell 2, Cell 3 ..... Cell (x)

### **13.15. Exporting in Text (.TXT) Format**

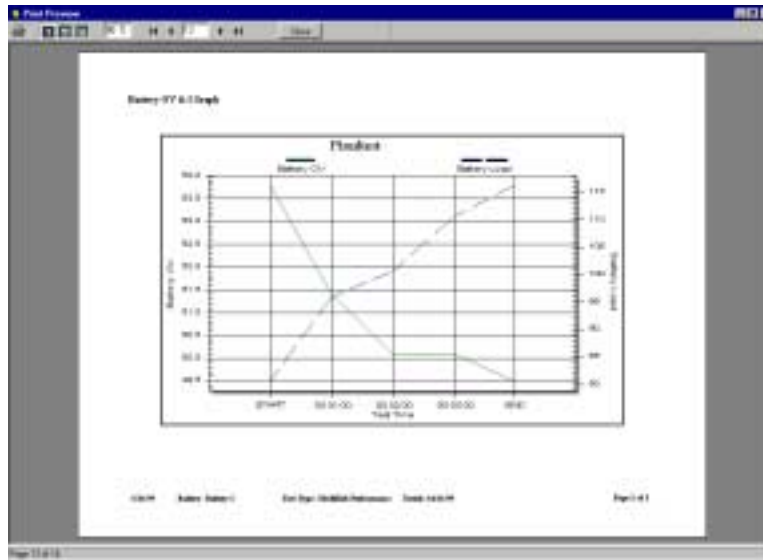
**Export** (in Reports) - The Report Generator can export a report as an ASCII text file for use with a text editor. Files saved as ASCII text have the extension **.TXT**. To save a report in text format, click Export in the Reports dialog box. In the Save In box, select the folder under which the file will be saved. In the File Name box, type the file name. In the Save As Type box, select Text Format. To save, click the Save button.

### **13.16. Printing a Report**

**Print Current** and **Print All** - To print only the pages under the currently-selected tab, click Print Current on the View Reports Form screen. To print all the pages under all the tabs on the screen, click Print All. When Print All is clicked, a print dialog box appears, which lets you specify print all pages, the current page or specific pages, the number of copies, and the printer setup.

### 13.17. Opening an Archive File

**Load** (in Reports) and **Open Archive** (in View Reports Form) - A BCT-2000 Archive (.ZRF) file is the only file type that may be opened while a text or binary file is open. Archive files cannot be changed. To open an archive file, click Load on the Reports dialog box. In the Open box, at Files of Type, select BCT-2000 Archive from the drop-down list, select the file name, then click Open.



**Figure 42. Typical Archive File**

The archive file opens and is displayed. Use the buttons along the top of the screen to change the page size and view different pages. To print the report, click the Print button at the top left. To close the file, click the Close button.

### 13.18. Drill Down Reports

A Drill Down Report (graph) displays the cell voltage versus test time. A report for each cell that fails minimum voltage threshold level can be automatically or manually displayed on the Test Results pages.

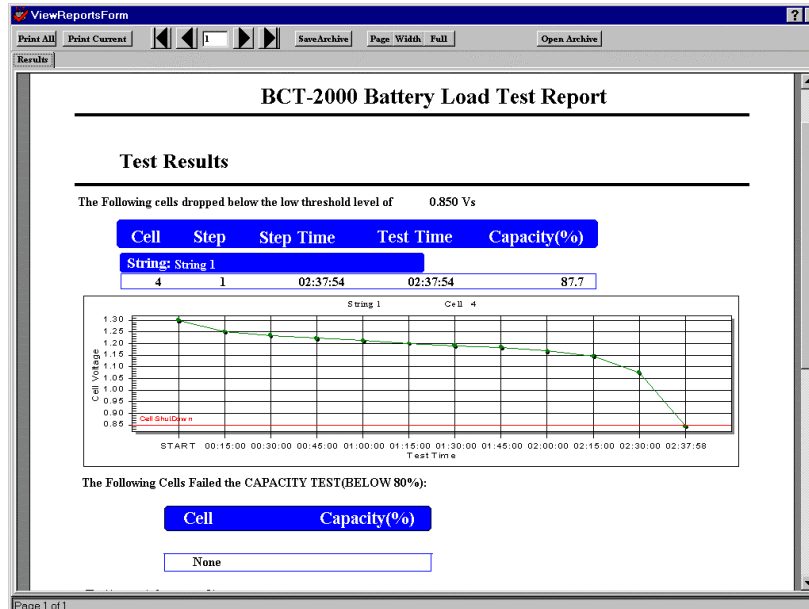


Figure 43. Results with Drill Down Report

To automatically display the Drill Down Reports, select Expand All Test Results Graphs on the Reports Options dialog box.

To manually display a report, click Preview on the Reports dialog box, then click the Results tab to display the Test Results page. This page lists cells that fell below the minimum threshold voltage. Click on a cell description line to display a Drill Down Report for that cell. The report appears under the description line of the selected cell. You may display a report for each failing cell listed. To close a report, click on the same description line.

### 13.19. Archive Reader Program

The BCT-2000 Archive Reader program is a separately distributed program that is used to view and print archive files when the Report Generator program is not available. The Archive Reader is typically distributed with archive files when these files are sent to locations that do not have the Report Generator program. The Archive Reader is packaged with the Report Generator and may be freely copied and distributed with archive files.

## 14. Running Diagnostics

The DAM (Data Acquisition Module), I/V/IT (Current/Voltage/Intertier), Load Bank, Bus and Misc diagnostic screens reside under Diagnostics on the main menu. The dialog boxes perform diagnostics on the BCT system, the I/O control board, the load control board used with load banks, and the load control system.

### 14.1. DAM (Data Acquisition Module)

Use the DAM test for testing boards that may have stuck relays, bad A/D counts, or bad A/D reference.

If not using the CS-2000 calibration source, leave the batteries connected to the BCT during the test. CAUTION: Make certain there is no load on the batteries and no charger is connected, so the A/D counts do not drift.

If using the CS-2000 source, disconnect the batteries before connecting the CS-2000 Cell connector to the board. The source is capable of driving one board at a time. If it is connected to more than one board, loading of the source may occur.

At the A/D Deviation Threshold (+/-) box, type the number of A/D counts that can vary before an error is declared. The default value is  $\pm 10$  counts.

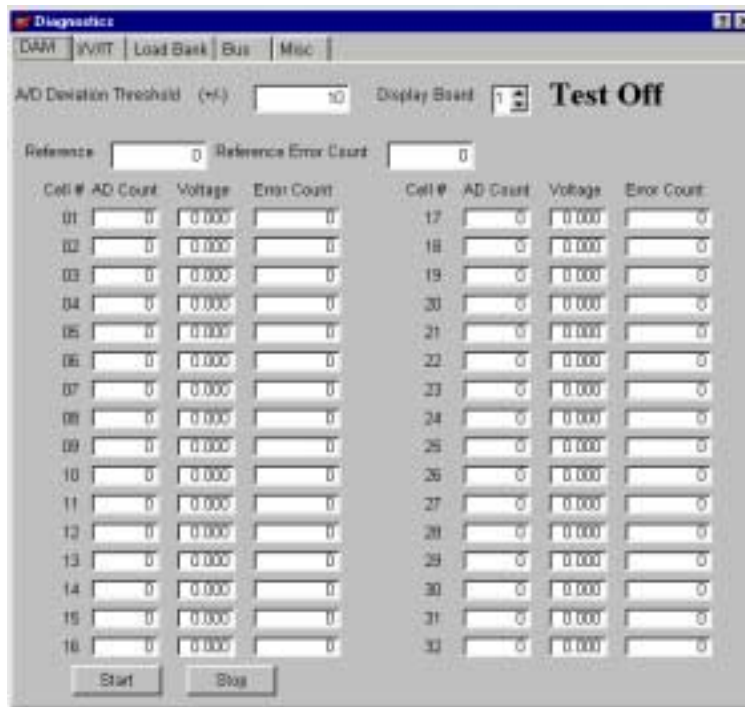


Figure 44. DAM Diagnostics

At the Display Board box, select the board to monitor on the screen. The highest number is 8 with a fully loaded BCT-256. If you select an invalid board number, the display shows zeroes when the test is running.

The Reference box indicates the A/D reference voltage. A count other than 0 in the Reference Error Count box indicates a problem with the system.

To start the test, click Start. The boxes next to each cell number display the cell A/D count and voltage. If the A/D count varies outside the range determined by the A/D Threshold Deviation value, an error is recorded in the error count box. To stop the test, click Stop.

## 14.2. I/V/IT

Use the I/V/IT test for diagnosing intertier connection and voltage problems.

**WARNING:** A CS-2000 must be used for this test. When using the CS-2000 source, disconnect the batteries and the load control cable before connecting the CS-2000 System connector to the board.

At the A/D Deviation Threshold (+/-) box, type the number of A/D counts that can vary before an error is declared. The default value is  $\pm 10$  counts.

The Reference box indicates the A/D reference voltage. A count other than 0 in the Reference Error Count box indicates a problem with the system.

	Count	Voltage	Error Count
Current	0	0.0000	0
Battery	0	0	0
Intertier 1	0	0.0000	0
Intertier 2	0	0.0000	0
Intertier 3	0	0.0000	0
Intertier 4	0	0.0000	0
Intertier 5	0	0.0000	0
Intertier 6	0	0.0000	0
Intertier 7	0	0.0000	0
Intertier 8	0	0.0000	0

**Figure 45. I/V/IT Diagnostics**

To start the test, click Start. The boxes display the A/D count and voltage. If the A/D count varies outside the range determined by the A/D Threshold Deviation value, an error is recorded in the error count box. To stop the test, click Stop.

### 14.3. Load Bank Diagnostic

Load bank diagnostics may be used in two ways. Click a single step On to display the load current, battery voltage, and step resistance; or perform a cumulative resistance test, which saves the individual step resistance to the setup file.

If you do not enable Auto Detect Step Resistance (refer to *Load Bank*), you must enter the resistance for each step. There are two methods to obtain this information, and a combination of the two may be necessary. After resistance values are entered, the data is saved with the load bank setup information for the currently selected load bank.

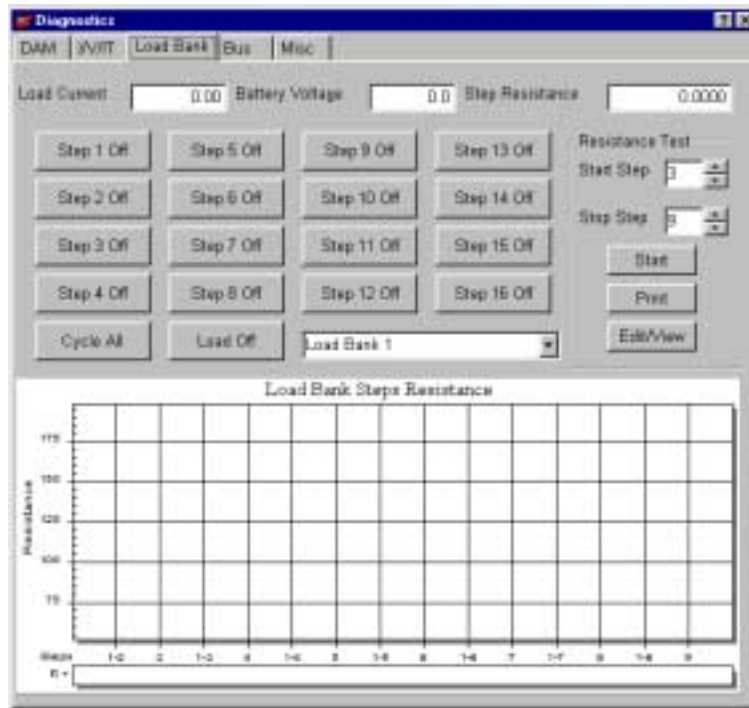


Figure 46. Load Bank Diagnostics

To set up the load bank resistance, first select a Start Step in the Resistance Test group. Depending on shunt rating, selecting Start Step 3 or 4 is recommended, because lower steps produce very low voltages across the shunts, which may result in inaccurate readings.

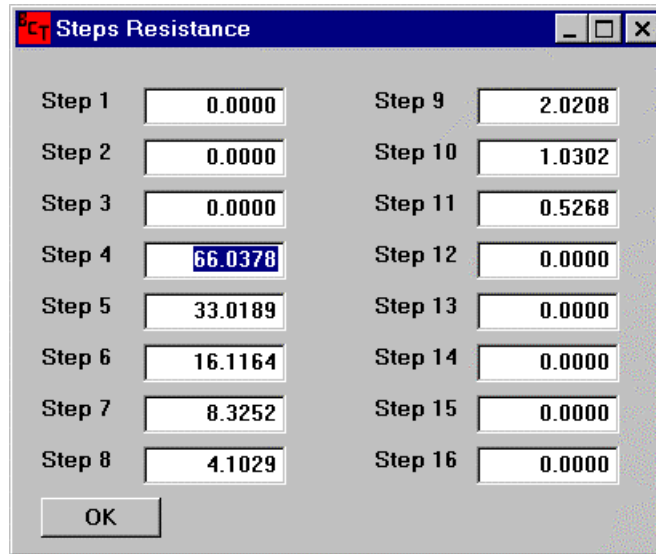
Select a Stop Step in the Resistance Test group. Ensure there is sufficient current to drive the stop step selected.

Verify the Battery Voltage box displays battery or charger voltage. If the voltage is not displayed, fix the electrical connections before continuing with the test.

To begin the load bank resistance test, click Start. The graph fills with resistance values. Observe the bottom axis of the graph, labeled 1-2, 3, 1-3, 4 and so on. Plots on the graph alternately indicate the resistance of an individual step and the cumulative (parallel) resistance of the steps up to that step. Double-click the graph to maximize it. NOTE: If you did not enter the password, the test runs but values are not stored.



When the test is complete, click Edit/View to display the Steps Resistance box.



**Figure 47. Steps Resistance**

After running the load bank resistance test, the Step *n* boxes display the resistance values that were read. To edit steps with no resistance values, read the resistance value on the panel of the load bank and type it into the box for each step. NOTE. Not all load banks will have this information.

You should run the load bank resistance test periodically, especially if there is a problem controlling the load. The test verifies that no step resistance is too high or low. Each step should be approximately half the resistance of the previous step, unless its weight value is not double the weight value of the previous step. Refer to *Load Bank*.

**IMPORTANT NOTE:** If the load bank is used in low and high voltage modes, the values displayed are for the currently selected mode of operation. (See the load banks panel for different voltage settings.) If using both modes of the load bank, add another load bank to the setup (in *Setup – Load Bank*) and repeat the test. Name the load banks Low Voltage and High Voltage. Assign the load bank used for each test type. (Remember that values only need to be entered if Auto Detect Step Resistance is not enabled.)

Click OK to exit the Steps Resistance dialog box.

Click the appropriate Step 1 to 16 on the Load Bank dialog box to turn on the step corresponding to the step number. If power is supplied to the load, the step resistance is displayed. Toggle the button to turn the step on or off. With no power to the load bank, you may use an ohmmeter to read each step resistance.

Results of the load bank diagnostics may be needed by Albécorp to assist in troubleshooting.

#### 14.4. Bus

Typically, this option is used only at the factory during product manufacturing and test. A special bus analysis board is required. The screen displays technical diagnostics for circuit boards in the BCT-2000 system. It is not a user diagnostic screen and should only be used with the assistance of Albécorp technical personnel.



Figure 48. Bus

#### 14.5. Misc

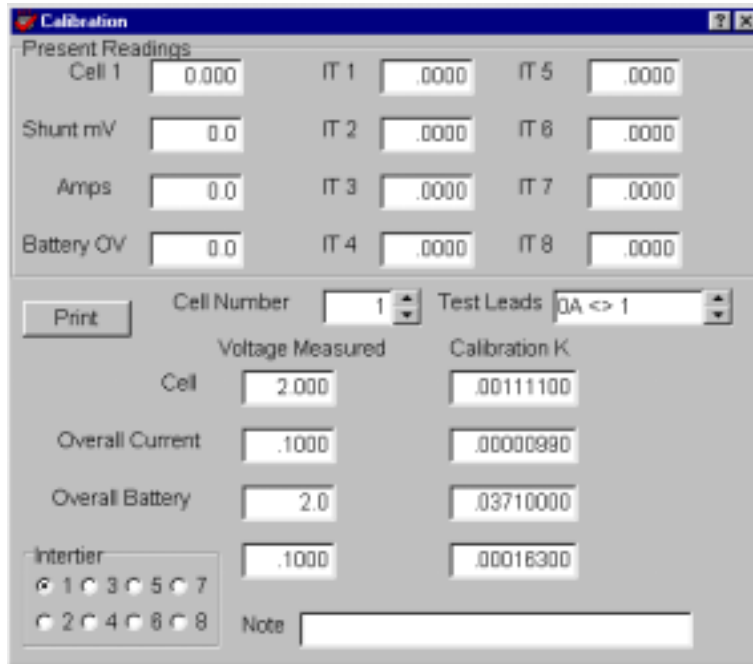
The Misc dialog box permits testing of the audible alarm inside the BCT. To test the alarm, click the Sonalert button to toggle the alarm on and off.



Figure 49. Misc

## 15. System Calibration

This section describes the calibration of the BCT-2000 system. First, check the system in the as-found condition. If all as-found parameters are within specification, calibration does not have to be performed.



The screenshot shows a software window titled "Calibration" with the following fields and controls:

- Present Readings:**
  - Cell 1: 0.000
  - IT 1: .0000
  - IT 5: .0000
  - Shunt mV: 0.0
  - IT 2: .0000
  - IT 6: .0000
  - Amps: 0.0
  - IT 3: .0000
  - IT 7: .0000
  - Battery OV: 0.0
  - IT 4: .0000
  - IT 8: .0000
- Print** button
- Cell Number:** 1 (dropdown)
- Test Leads:** 0A <> 1 (dropdown)
- Voltage Measured:**
  - Cell: 2.000
  - Overall Current: .1000
  - Overall Battery: 2.0
  - Intertier: .1000
- Calibration K:**
  - Cell: .00111100
  - Overall Current: .00000990
  - Overall Battery: .03710000
  - Intertier: .00016300
- Intertier:** Radio buttons for 1, 3, 5, 7, 2, 4, 6, 8.
- Note:** Empty text field.

Figure 50. Calibration

Calibrating the preamp affects the overall current and intertier calibration. If, after completing the as-found readings, you determine that the preamp needs calibration, then the overall current and intertiers will also have to be calibrated.

The following is required for equipment calibration:

- Albércorp CS-2000 calibration source (recommended)

- A 4½ digit calibrated digital multimeter (DMM)

- Two 37-pin ribbon cables for connecting the CS-2000 to the BCT.

If a CS-2000 is not available, use a 0 to 12VDC source for cell calibration, a 100mV source for current calibration, and a 0 to 600VDC source for OV calibration. (This may be a combined 0 to 600VDC source.) The original sense lead harness must be used.

**WARNING:** High voltages exist inside the BCT-2000 system components and on the CS-2000 terminals. Calibration must be performed only by technically qualified persons. Observe electrical safety precautions when removing and installing the BCT cover, and when connecting leads and making adjustments.

### **15.1. Shunt Rating**

Under Setup, open the Load Bank dialog box. At the Shunt Rating Amps and per mV boxes, type the shunt value from the load banks. For example, if the shunt is stamped 600/100 (600 amps at 100mV), type 600 in the Shunt Rating Amps box, then type 100 in the per mV box. Refer to *Load Bank*.

### **15.2. BCT-2000 Calibration Source**

When calibrating the BCT-2000, the use of the CS-2000 calibration source is recommended. If the CS-2000 is not available, use the original sense lead harness to connect to an alternate voltage source. Not using the original cables will result in inaccurate calibration because all input signals are current limited by a resistor in each lead. The CS-2000 simulates these resistive leads.

CAUTION: Using a source other than the CS-2000 without the original sense leads will result in inaccurate calibration.

Make a photocopy of the BCT-2000 Calibration Record each time the equipment is calibrated. Retain these records in the event the equipment needs servicing in the future.

### **15.3. Calibration Setup**

Prepare the BCT and CS-2000 as follows:

1. Power off the BCT-128 or BCT-256 and the CS-2000.
2. Connect a ribbon cable from the CS-2000 Cell connector to the BCT Cell 1 connector.
3. Connect a ribbon cable from the CS-2000 System connector to the BCT System connector.
4. When using the CS-2000 (or equivalent) calibration source, calibrate the BCT-2000 system without any battery cables or load control cables connected to the BCT-128 or BCT-256.
5. Key points to remember before power-up:
  - If using a source other than the CS-2000, use the original sense lead harness to avoid inaccurate calibration.
  - When using any calibration source, remove all battery cables and load cables from the BCT.
  - Calibration must be performed only by technically qualified persons. Dangerous voltages are present.
  - If all as-found parameters are within specification, calibration is not required.
  - If the preamp needs calibration, then the overall current and intertiers must be calibrated.
6. Power on the BCT and the CS-2000.
7. Start the BCT-2000 software.

#### **15.4. Cell As-Found**

1. Complete the Cell – Before Calibration section of the Calibration Record as follows:
2. On the main menu, click Calibration to open the Calibration dialog box.
3. Set the DMM to volts.
4. Connect the DMM to the CS-2000 Cell 1 banana jacks.
5. Set the CS-2000 Cell 1 switch to +12V.
6. Observe the DMM voltage reading. Record the voltage on the Calibration Record under DMM Input.
7. In the Present Readings area of the Calibration dialog box, observe the value in the Cell 1 box. Record the value under Cell – As-Found.
8. Set the CS-2000 Cell 1 switch to +2V.
9. Observe the DMM voltage reading. Record the voltage under DMM Input.
10. Observe the value in the Cell 1 box. Record the value under Cell – As-Found.
11. Remove the DMM from the CS-2000.

#### **15.5. Overall Current As-Found**

1. Complete the Overall Current – Before Calibration section of the Calibration Record as follows:
2. Set the DMM to millivolts.
3. Connect the DMM to the CS-2000 0 – 200mV jacks.
4. Set the CS-2000 Reverse Polarity switch to plus (+).
5. Adjust the CS-2000 for a DMM reading of 50mV. Record the voltage on the Calibration Record under DMM Input.
6. In the Present Readings area, observe the value in the Amps box. Record the value under Overall Current – As-Found.
7. Adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
8. Observe the value in the Amps box. Record the value under Overall Current – As-Found.
9. Adjust the CS-2000 for a DMM reading of 150mV. Record the voltage under DMM Input.
10. Observe the value in the Amps box. Record the value under Overall Current – As-Found.
11. Set the CS-2000 Reverse Polarity switch to minus (-).
12. Repeat steps 5 to 10 for negative inputs of 50mV, 100mV, and 150mV.  
NOTE: The BCT-2000 only displays positive numbers, even though the input is negative.
13. Remove the DMM from the CS-2000.

### **15.6. Overall Battery As-Found**

1. Complete the Overall Battery – Before Calibration section of the Calibration Record as follows:
2. Set the DMM to volts.
3. Connect the DMM to the CS-2000 50V – 600V jacks.
4. Adjust the CS-2000 for a DMM reading of 75V. Record the voltage on the Calibration Record under DMM Input.
5. In the Present Readings area, observe the value in the Battery OV box. Record the value under Overall Battery – As-Found.
6. Adjust the CS-2000 for a DMM reading of 350V. Record the voltage under DMM Input.
7. Observe the value in the OV box. Record the value under Overall Battery – As-Found.
8. Adjust the CS-2000 for a DMM reading of 600V. Record the voltage under DMM Input.
9. Observe the value in the OV box. Record the value under Overall Battery – As-Found.
10. Remove the DMM from the CS-2000.

### **15.7. Intertier As-Found**

1. Complete the Intertier – Before Calibration section of the Calibration Record as follows:
2. Set the DMM to volts.
3. Connect the DMM to the CS-2000 0 – 200mV jacks.
4. Adjust the CS-2000 for a DMM reading of 150mV. Record the voltage on the Calibration Record under DMM Input.
5. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Found.
6. Repeat steps 4 and 5 for Intertiers 2 through 8.
7. Adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
8. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Found.
9. Repeat steps 7 and 8 for Intertiers 2 through 8.
10. Adjust the CS-2000 for a DMM reading of 50mV. Record the voltage under DMM Input.
11. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Found.
12. Repeat steps 10 and 11 for Intertiers 2 through 8.
13. Remove the DMM from the CS-2000.

### **15.8. Preamp Offset and Gain As-Found**

1. Complete the Preamp Offset and Gain – Before Calibration section of the Calibration Record as follows:
2. On the main menu, click Diagnostics, then click I/V/IT on the drop-down menu.
3. Set the DMM to millivolts.
4. Connect the DMM to the CS-2000 0 - 200mV jacks.
5. Set the Reverse Polarity switch to plus (+) and adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
6. Observe the Current Count reading on the I/V/IT dialog box. Record the count under Current Count - As-Found.
7. Set the Reverse Polarity switch to minus (-) and adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
8. Observe the Current Count reading on the I/V/IT dialog box. Record the count under Current Count - As-Found.
9. Remove the DMM from the CS-2000.

### **15.9. Preamp Offset and Gain Calibration**

1. Calibrate if As-Found readings are not within specification:  
The current count at +100mV must be within  $\pm 30$  counts of the count at -100mV.
2. Power off the BCT, remove the BCT cover, and power up the BCT.
3. Locate the I/V/IT board in the BCT. This board has two multiterm pots, RV1 and RV2, on the rear of the top edge.
4. Complete the Preamp Offset and Gain – After Calibration section of the Calibration Record as follows:
5. On the main menu, click Diagnostics, then click I/V/IT on the drop-down menu.
6. Set the DMM to millivolts.
7. Connect the DMM to the CS-2000 0 - 200mV jacks.
8. Set the Reverse Polarity switch to plus (+) and adjust the CS-2000 for a DMM reading of +100mV.
9. Observe, but do not record, the Current Count reading on the I/V/IT dialog box.
10. Set the Reverse Polarity switch to minus (-) and adjust the CS-2000 for a DMM reading of -100mV.
11. Observe, but do not record, the Current Count reading on the I/V/IT dialog box.
12. Adjust RV2 (rear pot) on the I/V/IT board so that the current count at plus polarity is within  $\pm 30$  counts of the current count at minus polarity.
13. Repeat steps 8 to 12 several times until count between plus and minus does not vary more than  $\pm 30$  counts. This sets the preamp offset.
14. When the counts are within specification, set to +100mV and record the DMM Input and Current Count – As Left, then set to -100mV and record the DMM Input and Current Count – As Left.
15. Set the Reverse Polarity switch to plus (+) and adjust the CS-2000 for a DMM reading of +100mV.
16. Adjust RV1 (front pot) on the I/V/IT board for a Current Count of 20001  $\pm 30$  counts on the I/V/IT dialog box. Record the Current Count under Current Count - As-Left. This sets the preamp gain.
17. Remove the DMM from the CS-2000.
18. Close the I/V/IT dialog box.
19. After preamp calibration, the overall current and intertiers must be calibrated.



### **15.10. Cell Calibration**

1. Calibrate if As-Found readings are not within specification: 0.1% of reading  $\pm 0.01V$ .
2. Complete the Cell – After Calibration section of the Calibration Record as follows:
3. On the main menu, click Calibration.
4. Set the DMM to volts.
5. Connect the DMM to the CS-2000 Cell 1 jacks.
6. Set the CS-2000 Cell 1 switch to +12V.
7. Observe the DMM voltage reading. Type the actual reading into the Cell - Voltage Measured box on the Calibration dialog box.
8. Record the DMM voltage on the Calibration Record under DMM Input.
9. Tab to the Overall Current - Voltage Measured box. The Calibration K value changes.
10. In the Present Readings area of the Calibration dialog box, observe the value in the Cell 1 box. Record the value under Cell – As-Left.
11. Set the CS-2000 Cell 1 switch to +2V.
12. Observe the DMM voltage reading. Record the voltage under DMM Input.
13. Observe the value in the Cell 1 box. Record the value under Cell – As-Left.
14. Remove the DMM from the CS-2000.

### **15.11. Overall Current Calibration**

1. Calibrate if the preamp was calibrated or if As-Found readings are not within specification: 0.1% of reading  $\pm 3A$ .
2. Complete the Overall Current – After Calibration section of the Calibration Record as follows:
3. Set the DMM to millivolts.
4. Connect the DMM to the CS-2000 0 – 200mV jacks.
5. Set the Reverse Polarity switch to plus (+).
6. Adjust the CS-2000 for a DMM reading of 100mV. Record the voltage on the Calibration Record under DMM Input.
7. Type the actual reading into the Overall Current – Voltage Measured box. NOTE: Type the reading in volts; for example, for 100 millivolts, type: .1
8. Tab to the Overall Battery - Voltage Measured box. The Calibration K value changes.
9. Adjust the CS-2000 for a DMM reading of 50mV. Record the voltage under DMM Input.
10. In the Present Readings area of the Calibration dialog box, observe the value in the Amps box. Record the value under Overall Current – As-Left.
11. Adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
12. Observe the value in the Amps box. Record the value under Overall Current – As-Left.
13. Adjust the CS-2000 for a DMM reading of 150mV. Record the voltage under DMM Input.
14. Observe the value in the Amps box. Record the value under Overall Current – As-Left.
15. Set the CS-2000 Reverse Polarity switch to minus (-).
16. Repeat steps 9 to 14 for negative inputs of 50mV, 100mV, and 150mV.  
NOTE: The BCT-2000 only displays positive numbers, even though the input is negative.
17. Remove the DMM from the CS-2000.

### **15.12. Overall Battery Calibration**

1. Calibrate if As-Found readings are not within specification: 0.1% of reading  $\pm 0.4V$ .
2. Complete the Overall Battery – After Calibration section of the Calibration Record as follows:
3. Set the DMM to volts.
4. Connect the DMM to the CS-2000 50V – 600V jacks.
5. Adjust the CS-2000 for a DMM reading of 350V.
6. Type the actual reading into the Overall Battery – Voltage Measured box.
7. Tab to the Intertier box. The Calibration K value changes.
8. Adjust the CS-2000 for a DMM reading of 75V. Record the voltage on the Calibration Record under DMM Input.
9. In the Present Readings area, observe the value in the Battery OV box. Record the value under Overall Battery – As-Left.
10. Adjust the CS-2000 for a DMM reading of 350V. Record the voltage under DMM Input.
11. Observe the value in the Battery – OV box. Record the value under Overall Battery – As-Left.
12. Adjust the CS-2000 for a DMM reading of 600V. Record the voltage under DMM Input.
13. Observe the value in the Battery – OV box. Record the value under Overall Battery – As-Left.
14. Remove the DMM from the CS-2000.

### **15.13. Intertier Calibration**

1. Calibrate if the preamp was calibrated or if As-Found readings are not within specification: 0.1% of reading  $\pm 1\text{mV}$ .
2. Complete the Intertier – After Calibration section of the Calibration Record as follows:
3. Set the DMM to volts.
4. Connect the DMM to the CS-2000 0 – 200mV jacks.
5. Click the Intertier 1 button on the Calibration dialog box.
6. Adjust the CS-2000 for a DMM reading of 100mV.
7. Type the actual reading into the Intertier – Voltage Measured box. NOTE: Type the reading in volts; for example, for 100 millivolts, type: .1  
Press ENTER to increment to the next intertier.
8. Repeat steps 6 and 7 for Intertiers 2 through 8.
9. Click Intertier 1 on the Calibration dialog box.
10. Adjust the CS-2000 for a DMM reading of 150mV. Record the voltage on the Calibration Record under DMM Input.
11. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Left.
12. Repeat steps 10 and 11 for Intertiers 2 through 8.
13. Adjust the CS-2000 for a DMM reading of 100mV. Record the voltage under DMM Input.
14. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Left.
15. Repeat steps 13 and 14 for Intertiers 2 through 8.
16. Adjust the CS-2000 for a DMM reading of 50mV. Record the voltage under DMM Input.
17. In the Present Readings area, observe the value in the IT 1 box. Record the value under Intertier – As-Left.
18. Repeat steps 16 and 17 for Intertiers 2 through 8.
19. Remove the DMM from the CS-2000.

#### **15.14. Print a Calibration Report**

After you calibrate the unit, print a calibration report and keep it as proof of timely calibration and as a reference, should any equipment need repair in the future.

The calibration report contains the Calibration K constants. If the calibration file becomes corrupted, refer to the report and re-enter the Calibration K values on the Calibration dialog box. This will save having to recalibrate the BCT.

To print the calibration report, open the Calibration dialog box and click Print.

#### **15.15. Disconnect Equipment**

Observe electrical safety precautions when disconnecting cables and replacing the BCT cover. High voltages may be present.

1. Close the BCT-2000 software.
2. Power off the BCT and the CS-2000.
3. Disconnect the Cell cable and the System cable from the CS-2000 and BCT.
4. Replace the BCT-128 or BCT-256 cover if required.

#### **15.16. Calibration Backup**

During the calibration process, calibration data is saved to the **bct2000setup.mdb** file under `programfiles\alber\bct2000\setup`. It is strongly recommended that you back up this data file to a 3.5-inch disk, to save having to recalibrate the system if the BCT software must be re-installed. Refer to *Software Installation and Backup*.

## **16. Maintenance**

The BCT-2000 Series test system should provide years of service if properly maintained. Clean the laptop computer screen and case using a soft cloth, slightly moistened with water. Do not use commercial or industrial cleaners that may attack the computer display and housing. Never expose the computer or the BCT-128 or BCT-256 to water, high humidity, or dampness.

**WARNING:** Before cleaning any component, ensure the system is disconnected and power to the unit has been shut off

**Sense Leads** - Clean the BCT-2000 sense leads after each use. The acid to which the sense lead clips are exposed during testing should be neutralized often, using a water and baking soda mixture. Brush this mixture onto the sense lead clip, then rinse well with clean, cool tap water. When cleaning the sense lead clips with any water or water based solution, ensure the system is disconnected and power to the unit has been shut off. Dry with a clean, soft cloth.

The BCT-2000 is microprocessor based and has no user-replaceable components. Also, because high voltage exists in several areas in each unit, only knowledgeable users should remove the covers or cowling from devices when required. Failure to comply with this restriction could void the system warranty.

**WARNING:** High voltages exist inside the BCT-2000 system components and on the CS-2000 terminals. Calibration must be performed only by technically qualified persons. Observe electrical safety precautions when removing and installing the BCT cover, and when connecting leads and making adjustments.

The shipping cases will protect the BCT-2000 from normal bumps and bangs when stored properly, and will provide protection during shipment between test sites.

## **17. Upgrading BCT-2000 Software**

Upgrading the BCT-2000 software from the DOS to the Windows version involves the following steps. If you need assistance, contact Albécorp Technical Support.

### **17.1. Replace the 87C52 Processor**

Before the Windows BCT-2000 program can communicate with a BCT-128 or BCT-256 that was being used with the DOS BCT-2000 program, the 87C52 processor must be changed in the BCT-128 or 256.

1. Power down the BCT and disconnect it from AC power.
2. Remove the six screws under plastic caps located along the sides of the BCT cover.
3. Remove the cover.
4. The 87C52 U21 processor is located in a socket on the right-most vertically mounted board.
5. At this point, the technician (you) should be connected to ground with a ground strap, or you should discharge any static electricity by touching a grounded object.

**WARNING:** Notice that the top corner of the socket closest to the front of the BCT is angled. You must align the angled corner of the new chip with this corner before installation. Failure to align the corners will damage the BCT.

6. Using a PLCC chip puller, carefully remove U21 from its socket.  
**CAUTION:** The socket can easily be broken if you are not careful during removal and installation of the chips.
7. Grasp the replacement U21 chip and install it in the socket, making certain that the angled corner of the chip is aligned with the angled corner of the socket.
8. Replace the cover on the BCT, replace the six screws, and put the plastic caps over the screws.
9. Reconnect the BCT to power.

## 17.2. Calibration Constants and Load Bank Configuration

After installing the new Windows BCT software, you must properly configure the calibration constants and load banks before using the system. Record this information from the existing DOS program configuration files as follows:

1. Start the DOS BCT program. From the main menu, select F4 Hardware Diagnostics, then select F1 Calibrate. Record the shunt setting and calibration (K) constants below.

Shunt Rate Value:

\_\_\_\_\_ Amps per \_\_\_\_\_ millivolts

Measurement Point	Calibration K
Cell	
Overall Current	
Overall Battery	
Intertier #1	
Intertier #2	
Intertier #3	
Intertier #4	
Intertier #5	
Intertier #6	
Intertier #7	
Intertier #8	

2. Press ESC to return to the previous menu.



3. Select F2 Load Control Diagnostics, and record the load bank step weights.

Step Number	Step Weight
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

4. Press ESC to return to the previous menu.
5. Press ESC to return to the main menu, and press ESC to exit the program.
6. Start the Windows BCT program by double-clicking the BCT icon. To open the calibration dialog box, select Calibration from the main menu and enter the password `alber`. Type the Calibration K values recorded above.
7. To open the Load Bank setup dialog box, select Load Bank from the Setup menu and enter the password `alber`. Type the shunt rating value recorded above. Type the load bank step weights recorded above.
8. If more than one load bank configuration is required, click the Add button and configure a second load bank. Repeat as necessary to complete the load bank configurations.
9. The Windows BCT program is now ready for operation.

## 18. BCT-2000 Calibration Record

Customer \_\_\_\_\_

P.O. Number \_\_\_\_\_

Calibration Date \_\_\_\_\_

System Serial No. \_\_\_\_\_ Version \_\_\_\_\_

Configured Shunt (amps/mV) \_\_\_\_\_

Configured Load Bank Steps \_\_\_\_\_

Dwg. No. of Load Bank (if known) \_\_\_\_\_

Computer Serial No. \_\_\_\_\_

CELL	Before Calibration		After Calibration 0.1% of reading $\pm 0.01V$	
	DMM Input Reading	Cell (As-Found)	DMM Input Reading	Cell (As-Left)
+12V				
+2V				

OVERALL CURRENT	Before Calibration		After Calibration 0.1% of reading $\pm 3A$	
	DMM Input Reading	Overall Current (As-Found)	DMM Input Reading	Overall Current (As-Left)
+50mV				
+100mV				
+150mV				
-50mV				
-100mV				
-150mV				

OVERALL BATTERY	Before Calibration		After Calibration 0.1% of reading $\pm 0.4V$		
	Selected Input	DMM Input Reading	Overall Battery (As-Found)	DMM Input Reading	Overall Battery (As-Left)
	+75V				
	+350V				
	+600V				

INTERTIER	Before Calibration		After Calibration 0.1% of reading $\pm 1mV$	
	Selected Input	DMM Input Reading	Intertier (As-Found)	DMM Input Reading

INTERTIER 1

	+150mV				
	+100mV				
	+50mV				

INTERTIER 2

	+150mV				
	+100mV				
	+50mV				

INTERTIER 3

	+150mV				
	+100mV				
	+50mV				

INTERTIER 4

	+150mV				
	+100mV				
	+50mV				

INTERTIER	Before Calibration		After Calibration	
	Selected Input	DMM Input Reading	Intertier (As-Found)	DMM Input Reading

INTERTIER 5

+150mV				
+100mV				
+50mV				

INTERTIER 6

+150mV				
+100mV				
+50mV				

INTERTIER 7

+150mV				
+100mV				
+50mV				

INTERTIER 8

+150mV				
+100mV				
+50mV				

PREAMP OFFSET AND GAIN	Before Calibration		After Calibration	
	Selected Input	DMM Input Reading	Current Count (As-Found)	DMM Input Reading
+100mV				
-100mV				

## 19. Run Time Error Messages

Run Time Error Message	Probable Cause
No battery OV detected	Clip leads fell off. I/V/IT board malfunctioning.
Unable to control load. No load detected.	Check shunt connections. Verify load bank has power. I/V/IT board malfunctioning.
Unable to control load. Steps missing or resistance too high or too low.	Resume the test in manual mode and adjust specific loads to determine problem.

## 20. System Specifications

Power Consumption:	BCT-128 ..... 65 Watts
	BCT-256 ..... 75 Watts
Input Voltage:	BCT-128 and BCT-256..... 120VAC, 60Hz or 220VAC, 50Hz

Input	Number of Channels	Reading Range	Accuracy *
Cells	Up to 256	0 to 20V	0.1% of reading $\pm 0.01V$
Overall Volts	1	0 to 300V	0.1% of reading $\pm 0.2V$
		0 to 600V	0.1% of reading $\pm 0.4V$
Current	1	0 to 3000A	0.1% of reading $\pm 3A$
Intertiers	8	0 to 3V	0.1% of reading $\pm 1mV$
Alarms		Warning	Shutdown
Cell		0 to 20V	0 to 20V
Overall Volts		0 to 600V	0 to 600V
Current		N/A	20% of program current for 10 sec
Intertiers		200mV	N/A
Hardware		N/A	Immediate
Input Data Points		Stored At Reading Changes	
Cell Voltages		10mV	
Overall Volts		0.17% of reading	
Current		1A	
Intertiers		End of test reading only	
RAM Update		Every 10 minutes or 1K buffer	

\*Accuracy guaranteed from 40°F to 120°F to 95% relative humidity, non-condensing. Beyond the rated temperature range, accuracy may be degraded by 0.05% per °F.

## 21. Appendix A: BCT-128 Parts List

Quantity	Description	Checked
1	BCT-128 data acquisition logging unit	<input type="checkbox"/>
1	Power cable for BCT	<input type="checkbox"/>
1	Operating manual for BCT-2000 series	<input type="checkbox"/>
1	Laptop computer with power cable and manuals.	<input type="checkbox"/>
1	Computer to BCT cable (10ft.)	<input type="checkbox"/>
1	Cell sense lead labeled 1-32	<input type="checkbox"/>
1	Cell sense lead labeled 32A-64	<input type="checkbox"/>
1	Cell sense lead labeled 64A-96	<input type="checkbox"/>
1	Cell sense lead labeled 96A-128	<input type="checkbox"/>
1	Sense lead labeled OV+/-, IT1-8	<input type="checkbox"/>
5	Sense lead extender cables (25 ft.)	<input type="checkbox"/>
2	Flight approved shipping cases	<input type="checkbox"/>
1	Program disks 1 to 7	<input type="checkbox"/>
1	Certificate of calibration	<input type="checkbox"/>
1	Printer with power adapter, ink-jet cartridges, and manual	<input type="checkbox"/>
1	Printer cable	<input type="checkbox"/>
1	Printer paper package	<input type="checkbox"/>
Optional Equipment		
1	CS-2000 calibration source	<input type="checkbox"/>
1	Power cable for CS-2000	<input type="checkbox"/>
2	37-pin I/V/IT test cable (3 ft)	<input type="checkbox"/>
1	Load control cable (50 ft)	<input type="checkbox"/>

Checked By: \_\_\_\_\_

## 22. Appendix B: BCT-256 Parts List

Quantity	Description	Checked
1	BCT-256 data acquisition logging unit	<input type="checkbox"/>
1	Power cable for BCT	<input type="checkbox"/>
1	Operating manual for BCT-2000 series	<input type="checkbox"/>
1	Laptop computer with power cable and manuals.	<input type="checkbox"/>
1	Computer to BCT cable (10ft.)	<input type="checkbox"/>
1	Cell sense lead labeled 1-32	<input type="checkbox"/>
1	Cell sense lead labeled 32A-64	<input type="checkbox"/>
1	Cell sense lead labeled 64A-96	<input type="checkbox"/>
1	Cell sense lead labeled 96A-128	<input type="checkbox"/>
1	Cell sense lead labeled 128A-160	<input type="checkbox"/>
1	Cell sense lead labeled 160A-192	<input type="checkbox"/>
1	Cell sense lead labeled 192A-224	<input type="checkbox"/>
1	Cell sense lead labeled 224A-256	<input type="checkbox"/>
1	Sense lead labeled OV+/-, IT1-8	<input type="checkbox"/>
9	Sense lead extender cables (25 ft.)	<input type="checkbox"/>
2	Flight approved shipping cases	<input type="checkbox"/>
1	Program disks 1 to 7	<input type="checkbox"/>
1	Certificate of calibration	<input type="checkbox"/>
1	Printer with power adapter, ink-jet cartridges, and manual	<input type="checkbox"/>
1	Printer cable	<input type="checkbox"/>
1	Printer paper package	<input type="checkbox"/>
Optional Equipment		
1	CS-2000 calibration source	<input type="checkbox"/>
1	Power cable for CS-2000	<input type="checkbox"/>
2	37-pin I/V/IT test cable (3 ft)	<input type="checkbox"/>
1	Load control cable (50 ft)	<input type="checkbox"/>

Checked By: \_\_\_\_\_



## 23. Appendix C: Spare Parts

BCT-2000 Series Recommended Spare Parts List.

Part Number	Description	Suggested Quantity
1100-457	Cell Board .....	2
1100-462	I/V/I/T Board.....	1
1100-234	System Board (Serial) .....	1
1100-477	Interface Board.....	1
1100-468	Power Supply .....	1
1100-450	Mother Board Assembly .....	1
1100-458	I/O Harness.....	1
1100-463	Low Voltage Harness .....	1
1100-464	High Voltage Assembly .....	1
1100-469	Fan Assembly.....	1
1100-457	Input Harness.....	2
1100-459	Load Control Harness.....	1
1100-453	Sense Lead Extender Cable Assembly (25ft).....	2
1100-452	Load Control Cable Assembly (50ft) .....	1
2025-012	Computer Interconnect Cable (37P/37P) .....	1
2025-116	Computer Interconnect Cable (37P/9P) .....	1
2025-200	Computer Interconnect Cable (9P/9P) .....	1
6003-001	AC Power Cable (8ft).....	2
2120-012	Sense Lead Clips .....	25
4707-002	10K Resistor.....	25
2025-107	Printer Cable.....	1

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