Alber
Trust Your Batteries™

CELLCORDER™
CRT-400 Cell Resistance Tester

Quick Start Instructions
Operating Instructions

Powering On the Cellcorder

1. Press and release the green **Power Key**.

   Power ⏸

2. The firmware version number appears.

   Alber
   TRUST YOUR BATTERIES

   System Initializing
   ● ○ ○ ○ ○
   Flash Vers.##.#####
   Boot Vers.##.#####

3. If readings are in temporary storage, messages appear.

4. To save readings, insert the USB flash drive and press **Yes/F1**. Whether you select **Yes** or **No/F2**, readings stay in memory.

   Readings are in
   temporary storage.
   Save readings to
   the USB device?

   YES   NO   HELP

5. To clear readings from the memory, press **Yes/F1**. Do this if you are starting a new set of readings.

   Do you want to erase
   the readings from
   temporary storage?

   YES   NO

6. To keep readings in memory, press **No/F2**. Do this if you are not finished taking readings or want to examine the readings.

7. The **Main Menu** appears.

   CELLCORDER
   CRT-400

   TEST   VIEW   LOAD   CRT
   MODE   RESULTS DATA   SETUP
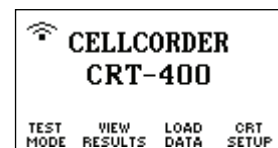
Note: It is highly recommended that the calibration constants are saved to the USB flash drive.

Powering Off the Cellcorder

1. Press and hold the green **Power Key**.

Power

```
System is now
shutting down
      3
```

```
System is now
shutting down
      2
```

```
System is now
shutting down
      1
```

```
  Release
Power Button
```

2. Powering off doesn't automatically delete voltage or resistance readings from memory.

3. If readings are in memory, you are prompted to save them.

```
Readings are in
temporary storage.
Save readings to
the USB device?
YES    NO    HELP
```

```
Do you want to erase
the readings from
temporary storage?
YES      NO
```

Taking Voltage Readings

1. Connect the voltage probes to the Cellcorder and select **Test Mode/F1**.

```
       CELLCORDER
        CRT-400

TEST    VIEW    LOAD    CRT
MODE  RESULTS   DATA   SETUP
```

2. From the Test Mode menu, select **F1-Voltage**.

```
Test Mode
F1 - Voltage
F2 - Resistance
F3 - S.G./Temp.

VOLT    RES  SG/TEMP  BACK
```

3. If "**Resume Test**" appears, put the probes on the cell.

```
    CELL 001

   13.50 Volts
  (RESUME TESTING)
DVM              DONE
```

Warning

Don't measure voltages greater than 20V DC.

4. If "**Stored in Memory**" appears, retest the cell or change the cell number by typing a number and pressing **Enter**.

```
    CELL 001

   13.50 Volts
  (STORED IN MEMORY)
DVM          RETEST  DONE
```

5. When the unit beeps, remove the probes. The cell number advances automatically to the next cell.

The Cellcorder is also a Digital Voltmeter (DVM)

1. In the voltage mode, select **DVM** by pressing the **F1** button.

```
        CELL 001

       13.50 Volts
        (RESUME TESTING)
   DVM              DONE
```
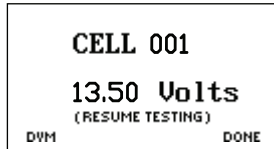
2. The screen displays the measured voltages.

3. Readings are not saved in **DVM** mode.

```
   13.50  Volts
   WARNING! 20VDC
   maximum input
                CANCEL
```
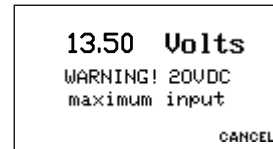
Taking Resistance Radings

1. Connect the resistance test leads to the Cellcorder and select **Test Mode/F1**.

```
     CELLCORDER
       CRT-400

   TEST   VIEW   LOAD   CRT
   MODE RESULTS  DATA  SETUP
```
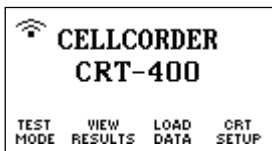
2. From the **Test** menu, select **F2-Resistance**.

```
   Test Mode
   F1 - Voltage
   F2 - Resistance
   F3 - S.G./Temp.

   VOLT   RES  SG/TEMP BACK
```
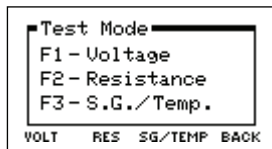
3. Select the **Amp Hour rate/F2** of the cell being tested. Specify the number of **Intercell connections/F3** per cell.

```
   Amp Hours:            ▲
                         H
   Intercell             E
         Type:           L
                         P
                         ▼
   TEST   AMP   INTER
          HOUR  CELL  BACK
```

4. Select **Test/F1**.

Voltage

Internal Cell Resistance

```
   CELL - ###   Vc(    )●
   ##.###Vc Ric1)----- μΩ
            Ric2)----- μΩ
      Rc    Ric3)----- μΩ
   #####μΩ  Ric4)----- μΩ
                    DONE
```
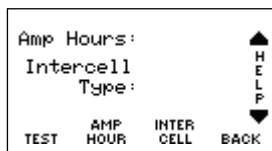
(mem) Voltage Readings Stored in Memory
(act) Actual Voltage Reading

Up to 4 Intercell Readings
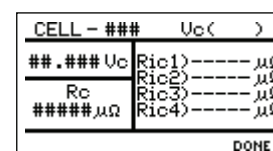
No VFloat Readings Exist. Now What?

If "No VFloat readings exist. Are you sure you want to continue?" appears. Choose **No/F2**, read voltage, then resume resistance testing. Reading voltage before resistance results in more accurate voltage readings because skewing is not a factor. If you choose **Yes/F1**, voltage and resistance are read concurrently. Concurrent readings are subject to the skewing effect.

5. Connect the leads to the cell. See lower-left for some examples; refer to the CRT-400 User's Guide for more details. Press the orange **Test** button. The display shows test progress.

```
     TEST PROGRESS

   ████████
   0%           100%
                STOP
```
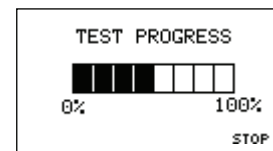
6. When the unit beeps, remove the probes. When leads are moved, the cell number advances automatically to the next cell.

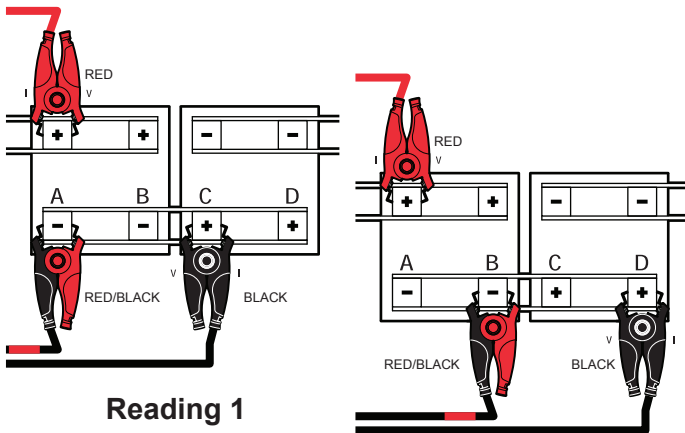7. When finished testing, press the **Done/F4** button.

```
   CELL - ###   Vc(    )
   ##.###Vc Ric1)----- μΩ
            Ric2)----- μΩ
      Rc    Ric3)----- μΩ
   #####μΩ  Ric4)----- μΩ
                    DONE
```

Connecting the Resistance Leads

These figures show connections for dual post cells.

● **Take two readings.**

Read with the intercell leads connected from terminal posts A to C.

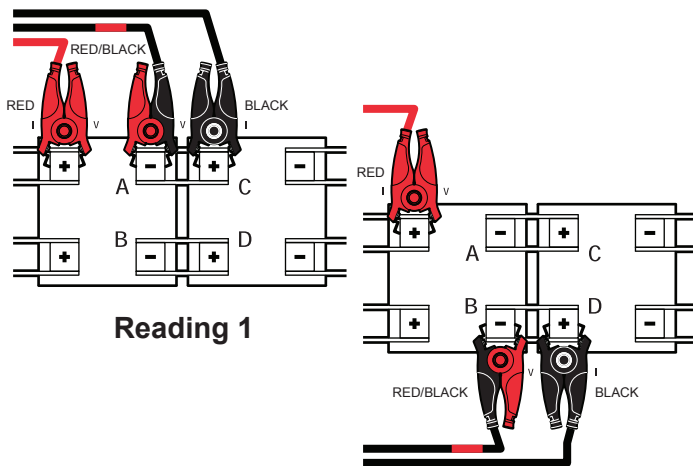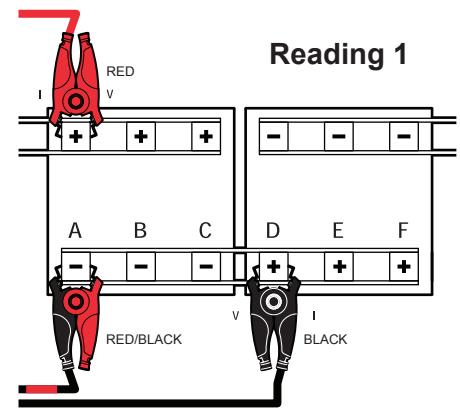Then read with the intercell leads connected from terminal posts B to D.
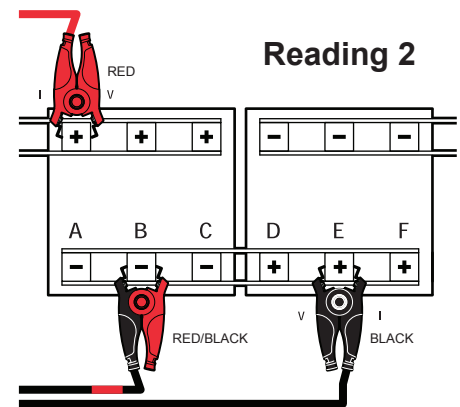
Reading 1

Reading 2

● **Take two readings.**

Read with the intercell leads connected from terminal posts A to C.

Then read with the intercell leads connected from terminal posts B to D.

Reading 1

Reading 2

These figures show connections for triple post cells.

● **Take three readings.**

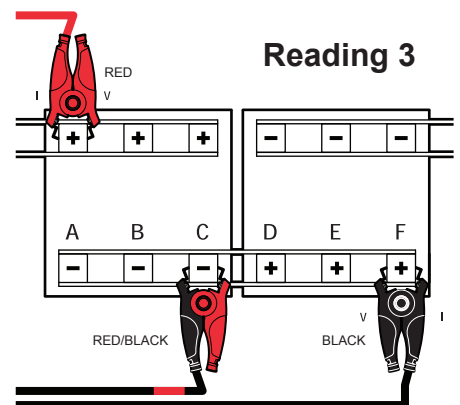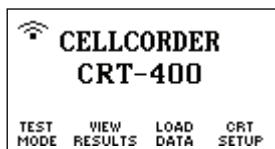Read with the intercell leads connected from terminal posts A to D.

Reading 1

● Then read with the intercell leads connnected from terminal posts B to E.

Reading 2

● Then read with the intercell leads connnected from terminal posts C to F.

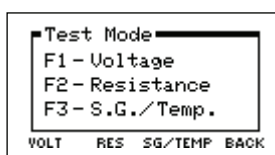**Reading 3**

Transferring Specific Gravity and Temperature Readings

Saving the Readings

Saving New Data Readings to the USB Flash Drive

1. On the CRT-400, select a cell data file to transfer **Specific Gravity** and **Temperature** readings into. This can be readings that already exist in memory or you can open a previously saved set of readings from the USB flash drive.
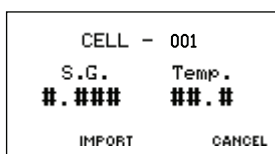
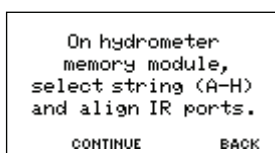2. From the **Main Menu**, select **Test Mode/F1**.

```
 ((( CELLCORDER
      CRT-400

 TEST   VIEW    LOAD    CRT
 MODE  RESULTS  DATA   SETUP
```

3. From the **Test Mode** menu, select **F3-S.G./Temp**.

```
 ┌Test Mode■■■■■■■
 │F1 - Voltage
 │F2 - Resistance
 │F3 - S.G./Temp.

 VOLT   RES  SG/TEMP  BACK
```

4. From the **SG/Temp** screen, select **Import** by pressing **F2**.

```
      CELL -  001

    S.G.      Temp.
   #.###      ##.#

    IMPORT       CANCEL
```

5. On the **Data Module**, select a channel (**A-H**) of data to transfer.

```
   On hydrometer
  memory module,
  select string (A-H)
  and align IR ports.

   CONTINUE       BACK
```

6. Align the **Data Module** and **CRT-400 IR port**.

7. On the CRT-400 press **F2** for **Continue**.

```
   Receiving data

               CANCEL
```
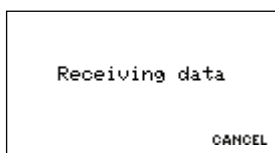
8. When transfer is done, the **S.G./Temp**. value from Cell 1 appears.

```
      CELL -  001

    S.G.      Temp.
   #.###      ##.#

    IMPORT       CANCEL
```
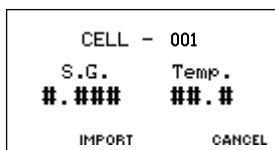
9. Select **Import/F2** to save the file to the USB flash drive.

1. Make sure the Cellcorder has been charged properly.

2. The USB flash drive may be placed into the left side USB port on the Cellcorder before or after the Cellcorder is powered on.

3. Follow the prompts on the Cellcorder's LCD accordingly.

4. When prompted to save readings to USB flash drive, select **Yes/F1**.

5. Follow the prompts and enter the file name and select **Save/F2**.

6. If the file already exists, a **Warning** displays, asking for overwrite confirmation. Press **F1** to overwrite the file or **F2** to enter a new file name.

7. The USB flash drive has now stored the new data.

   Note: Do not remove the USB flash drive while accessing data, writing to a file, reading information, etc.
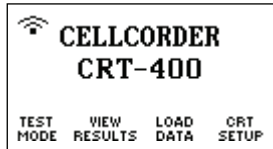
Warning

Never leave the USB flash drive plugged into the Cellcorder when performing tests or while the Cellcorder is connected to a battery for testing.
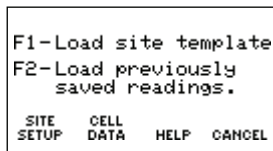
Readings cleared from Cellcorder temporary storage cannot be retrieved unless they have been saved to the USB flash drive or PC.

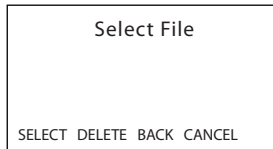| Loading the Readings	Wireless Headset Operation

Loading Data Readings from the USB Flash Drive

1. Insert a USB flash drive with readings into the Cellcorder. From the Main Menu, select **F3-Load Data**.

```
 CELLCORDER
   CRT-400

TEST    VIEW    LOAD    CRT
MODE  RESULTS  DATA   SETUP
```

2. Select **F2-Cell Data**.

```
F1-Load site template
F2-Load previously
   saved readings.

SITE    CELL
SETUP   DATA   HELP  CANCEL
```

3. **Select-F2** the file from the list provided.

```
        Select File




SELECT  DELETE  BACK  CANCEL
```

Recommended Steps to Save CAL-K

The **CAL-K** are calibration constants that are utilized for calibration correction during calibration. In the event these constants are lost, they can be restored easily.
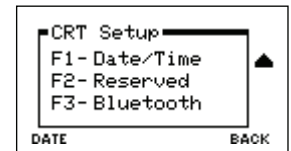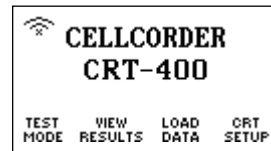
It is highly recommended that the calibration constants are saved to the USB flash drive.

To save the constants:

1. Make sure the CRT is powered on.
2. Select **Shift**, then the number **7** from the keypad.
3. Enter the password '**1234**' and press **Enter**.
4. Select **Calibration** by pressing the number **1** on the keypad.
5. Choose **CAL-K** by selecting **F2**.
6. Select **F2** once again to confirm the **Backup**.
7. Enter a File Name and select **F2** to so **Save**.

Using the *Bluetooth*® Headset

1. Make sure the CRT and the *Bluetooth* wireless headset are charged properly.
2. Power the *Bluetooth* headset on.
3. Power the CRT on. The CRT automatically attempts to connect to the last stored wireless device when powered on.
4. To connect manually to a stored headset, select **CRT Setup/F4** and use the down arrow key to go to **F3-Bluetooth**, press **F3**.

```
 CELLCORDER           CRT Setup
   CRT-400         F1- Date/Time    ▲
                   F2- Reserved
TEST   VIEW  LOAD  CRT   F3- Bluetooth
MODE RESULTS DATA SETUP
                    DATE          BACK
```

5. The last stored device will display, press **F2** to connect.
6. When connecting to a new headset:
   a. Press **F1-New**.
   b. Now press **F1-Headset**.
   c. Place the *Bluetooth* device in discovery mode.
   d. Press **F2** to **Continue**.
   e. When *Bluetooth* devices are found, a list is populated.

```
        Headset
          xjhdfeifooa
        Model xyzxyx


NEW  CONNECT  DELETE  CANCEL
```
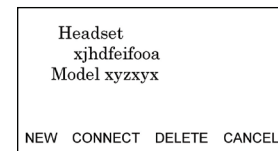
   Use the arrow keys to select the desired *Bluetooth* device and press **F1**.
7. Once the *Bluetooth* headset and the CRT are connected, press **F1-Test Mode**.
8. Choose the desired test by pressing either **F1**, **F2**, or **F3**.

```
 Test Mode
 F1 - Voltage
 F2 - Resistance
 F3 - S.G./Temp.

VOLT   RES  SG/TEMP BACK
```
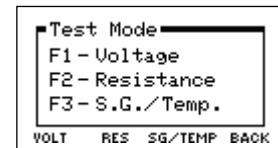
9. Place the *Bluetooth* headset on your ear for test status information.

# Files Used by the CRT-400 Cellcorder and Battery Analysis System (BAS) Program

There are many file types used with the Cellcorder and BAS program, and they are fully described in the user's guides. This section describes the two most common file types.

.CDF Cell Data File -

Created by the CRT-400 when saving readings to the USB flash drive. It is the transport file that gets data from the CRT-400 to the computer. This file contains one set or multiple sets (if in multi-string mode) of readings for a complete string of batteries. The Battery Analysis System (BAS) program imports this file into an ADF file.

.ADF Accumulated Data File -

Contains sets of readings that were imported from CDF files. One ADF file can contain many CDF files from the same string. This gives the BAS program the ability to trend over many sets (different dates) of data. Create one ADF file for each string or one battery with parallel strings. Every time readings are taken for that string, import the data in the CDF file into the ADF file.
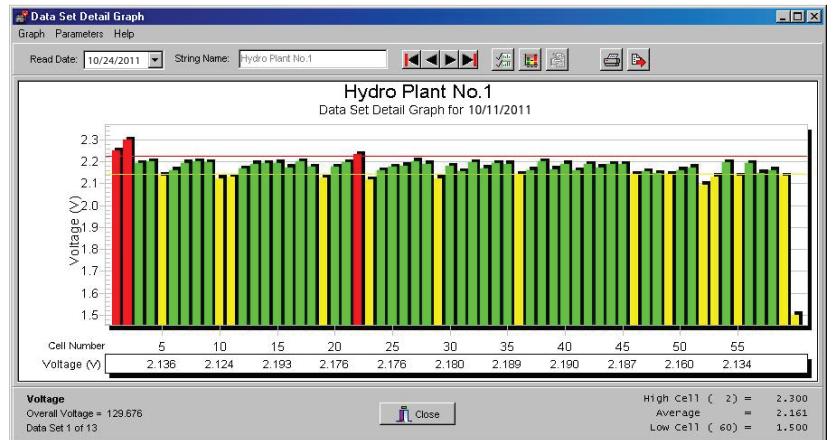
## Importing a CDF File into an ADF File
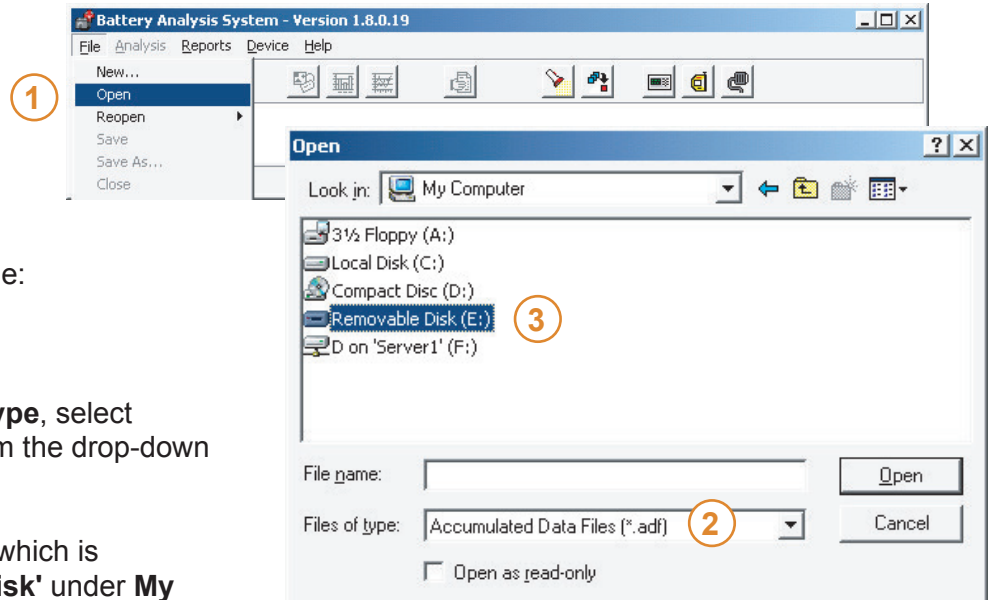
To import a **CDF** file into an **ADF** file:

1. Select **File** then **Open.**

2. In the **Open** dialog box at **File Type**, select **Cellcorder Data File (*.cdf)** from the drop-down list.

3. Navigate to the USB flash drive which is normally labeled **'Removable Disk'** under **My Computer**.

4. In the **Confirmation** dialog box, click **Import to Existing File** or **Create New File**. Both buttons refer to an **ADF** file.

Note: If this is the first time importing, click **Create New File** and then, each time you take additional readings for that string, click **Import to Existing File** and select the appropriate previously-created ADF file.

If **Import to Existing File** is selected, navigate to the desired **ADF** file and select it. The new data will be added to the existing data as a new read date when viewing the readings.

If **Create New File** is selected, the **Configuration Information** dialog box appears. This box can be configured using the **CRT-400 template** setup or with the configurator in the program. You can change or add information by using **File** then **Properties.**
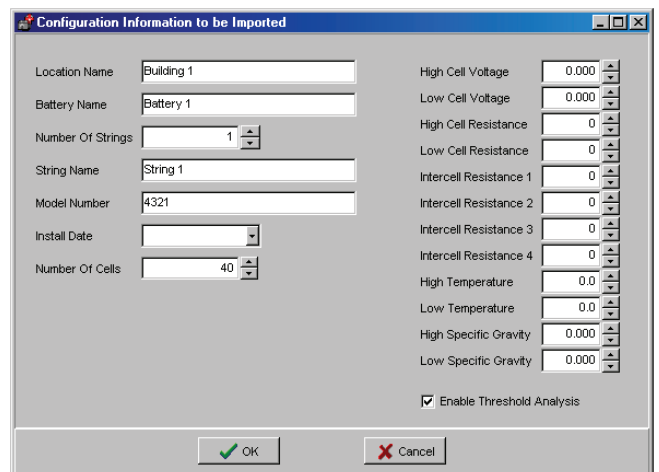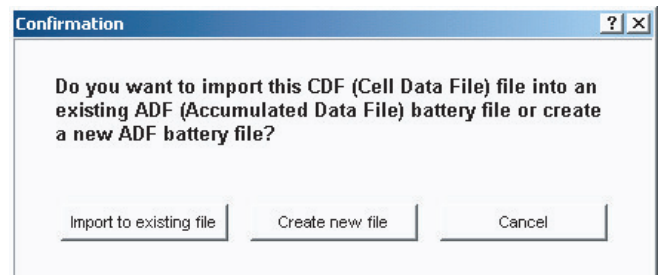
Viewing Battery File Properties

This page describes the five **File Properties** pages, which you may use to edit battery data.

Open a file, click **File** then **Properties**. You must click **File** then **Save** to save changes.

The **General** page shows details and allows editing of these details, such as location name, battery name, number of strings, string name, battery model, temperature scale, installation date and number of cells/jars. The temperature scale and number of cells will affect the battery data file. The number of data sets, most recent read date, overall voltage, and average resistance are also shown on the general page.

Note: Do not use identical battery names in the same location name or identical string names in the same battery name.
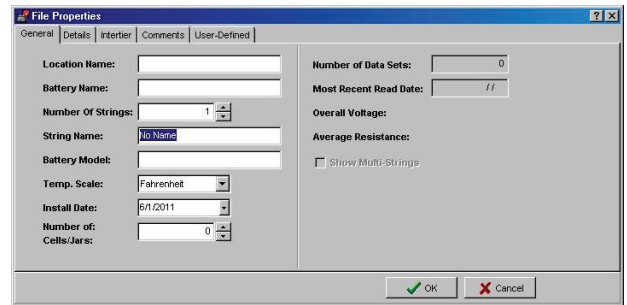

The **Details** page displays a table of values for all cells with data. Columns display cell number, cell voltage, internal resistance, intercell R1 to R4 resistance, specific gravity, and temperature. This list view can display cell data in colors based on threshold values, and intertier cell data in bold.

The **Intertier** page manually or automatically marks cells in a battery as intertier cells to indicate they are on the boundary of an intertier connection. By convention, only the cell with the lower cell number is marked. For example, if Cell 10 is the last cell of one string and connected to Cell 11, which is the first cell of the next string, only Cell 10 is marked as an intertier cell.
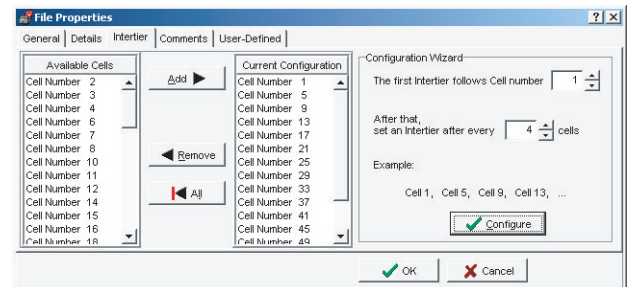
The **Comments** page has a text editor for typing comments, such as the date and type of readings taken or when connectors were cleaned. The **Select a New Read Date** dialog box lets you associate comments with a read date. To save a **Comments** page as a template, click the **Save As New Comment Template** button.
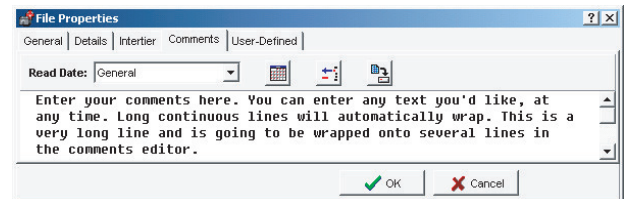
Use the **User-Defined** page to list reference notes. The notes, which can be included in reports, might identify pilot cells or equipment such as chargers.

Viewing Battery Readings

To show a graph of an **ADF Battery File**: Click **File** then **Open** on the main menu and select a file name, then click **Analysis, Data Set** then **Detail**. To enlarge a graph area, drag a rectangle across it. To return to normal size, right-click the graph and click **Undo Zoom**.
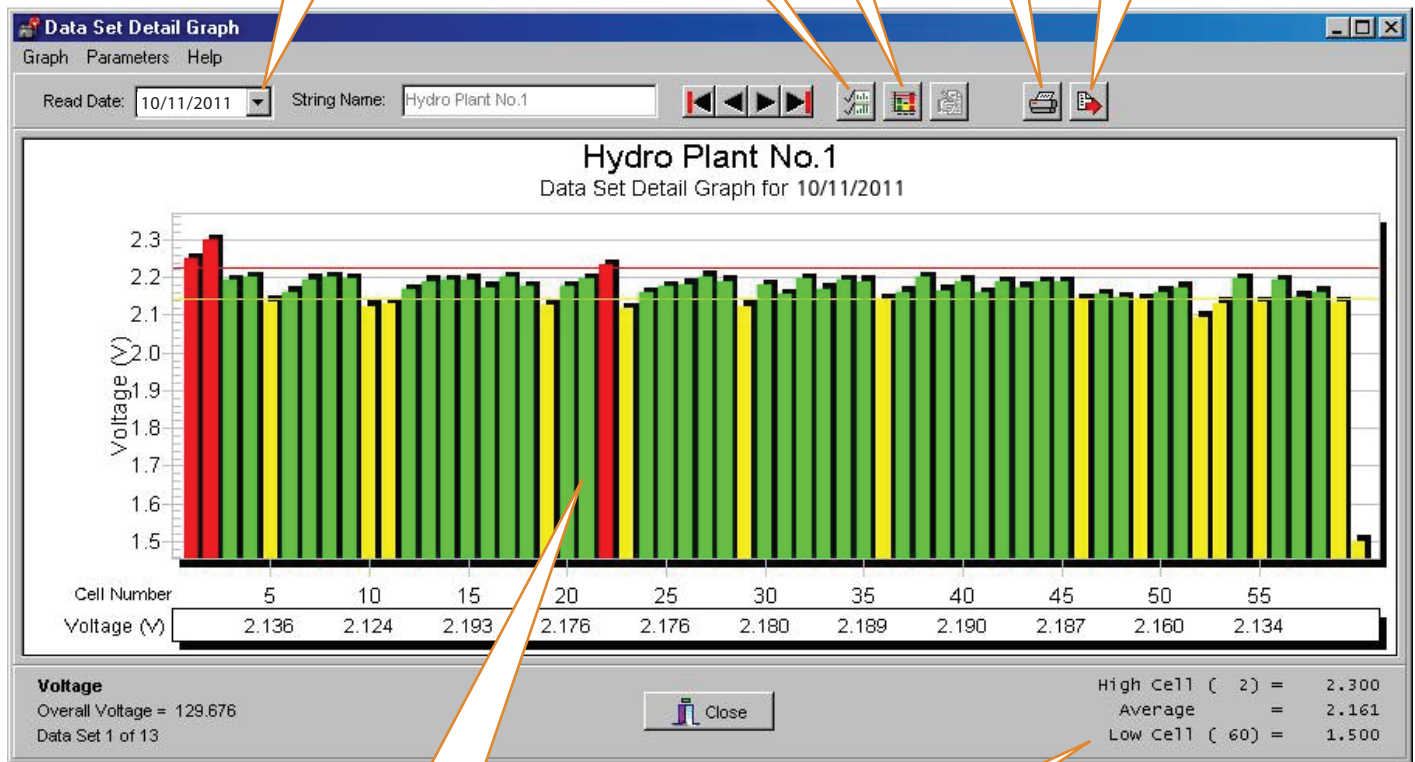
View voltage, resistance, intercell resistance, temperature or SG.

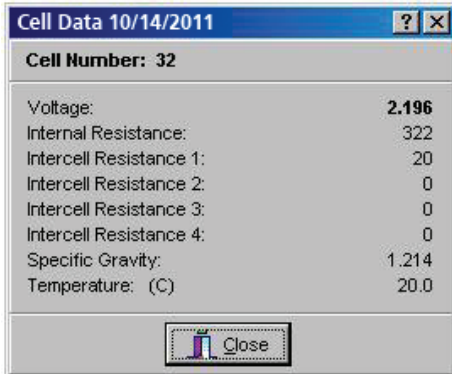**Set threshold display properties and the graph scale.**

View different data sets by selecting a date from the list.

Print the graph.

Export to a file or the clipboard.

Shows the minimum, maximum and average values of the readings.

Bar Graph Cell Data

To display text data for a cell, click on a bar. The **Cell Data** box shows **Cell Number**, **Cell Voltage**, **Internal Resistance**, **Intercell Resistance**, **Specific Gravity** and **Temperature** when available.

Trending a Parameter Over Time

Trending a specific parameter can help identify a problem:

1. Open a file with at least two data sets and click the **View Battery Data Set Graphs** button.

2. Click a cell in the graph, then click **Parameters, Trend then Cells**.

3. Click the **Select Which Parameters Appear in Graph** button.

4. On the **Data Subsets** box, select **Internal Resistance** only. A **Battery Cell Trend Graph** displays the cell values over time.

5. Click a data point or date to display details in the **Cell Data** box. If the box does not appear, enable it under **File** then **Preferences**.
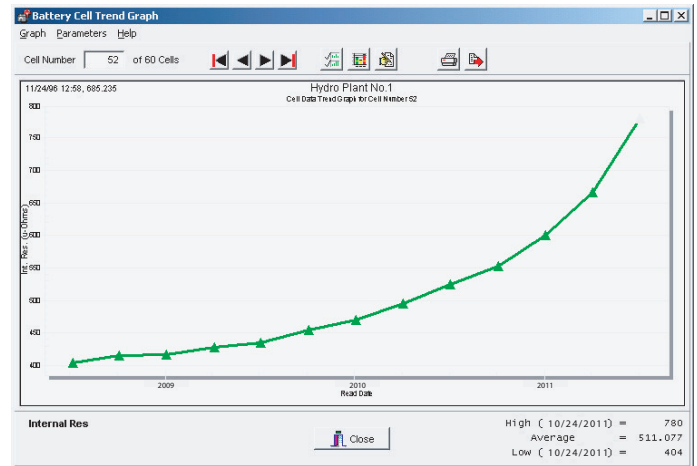
Trending a Parameter Average Over Time

Trending a parameter average helps identify inconsistencies in a battery system, and trending internal resistance averages helps determine a battery's end of life. The average summaries on the internal resistance screen are calculated to reduce false averages. The calculation eliminates cells above or below the true average by 25%, and then recalculates a new Modified Average.

1. Open a file with at least two Data Sets and click the **View Battery Data Set Graphs** button.

2. Click a cell in the graph, then click **Parameters, Trend** then **Cell Averages**.

3. Click the **Select Which Parameters Appear in Graph** button.

4. On the **Data Subsets** box, select **Internal Resistance** only. A **Battery Cell Averages Trend Graph** displays internal resistance over time.

5. Click a data point or date to display details in the **Cell Data** box.
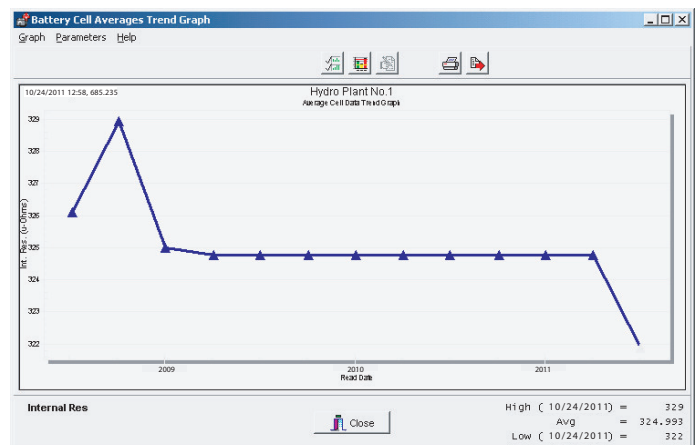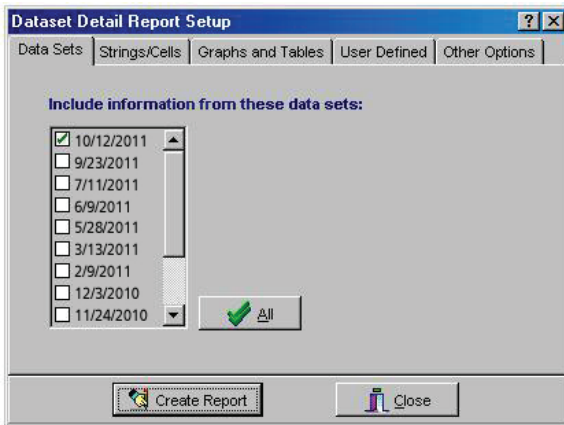
Generating Reports

The **BAS Report Generator** creates five reports: a **Detail**, **Comparison**, **Threshold Deviation**, **Cell Trend**, and **Cell Average Trend Report** with lists, graphs or both.

Click **Create Report** after setup. View saved reports using the **Archive Reader**. Buttons on report pages change view size, print, and save as a **ZRF** archive file. To save the text portion as a text file, select **TXT** in the **Save As Type** field.

Data Set Detail

This report creates lists and graphs of selected Data Sets. Clicking **Reports, Data Set** then **Detail** opens five setup pages: **Data Sets** selects sets of readings to include. **Strings/Cells** identifies cell range. **Graphs and Tables** includes tabular or graph information. **User Defined** defines user fields and comments. **Other Options** offers title, date, time, page number, size and footer.

Threshold Deviation Report

The **Data Set Threshold Report** creates a list that shows threshold violations of selected data sets.

Data Set Comparison Report

This report compares selected data sets referenced to one data set.

Click **Reports, Data Set** then **Comparison**. All data set dates except the reference can be in one report.
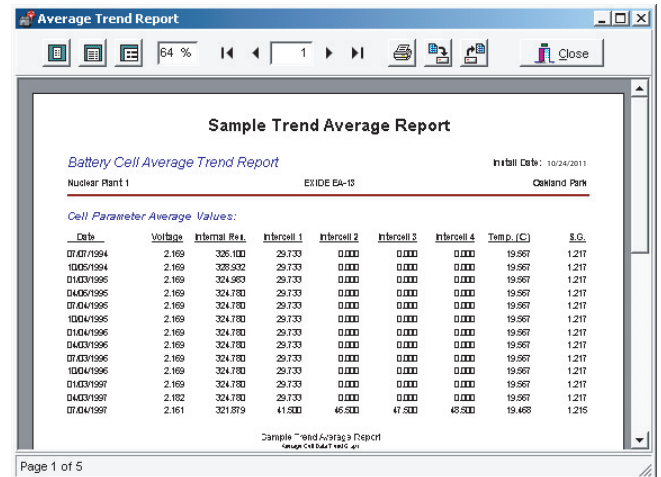
Cell Trend Report

This report creates a tabular list of selected data sets with respect to time.

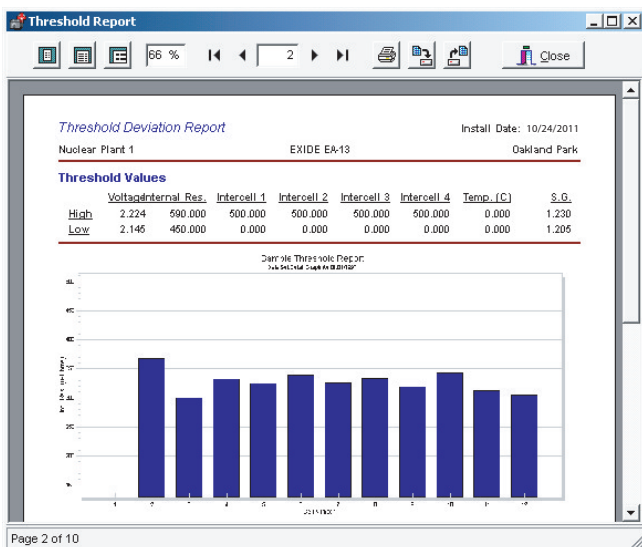Click **Reports, Trend** then **Cells**.

Cell Average Trend Report

This report creates a tabular list of selected data sets averages with respect to time.

Click **Reports, Trend** then **Cell Averages**.

Archive Reader

The **Archive Reader** displays and prints reports that were generated and saved with the **Report Generator**. To start the reader:

Click **Reports** then **Load** and open a report file. You may open a previously saved report any time the **Archive Reader** is on screen. The reader opens **CRT-400 ZRF** report files and may be downloaded from the Albér Web site: www.alber.com.