celltron®
ULTRA

*Universal Stationary
Battery Analyzer*

*For testing stationary batteries
used in UPS systems, power
utility, and telecommunications
industries*

INSTRUCTION MANUAL

INNOVATION   TECHNOLOGY   QUALITY   WORLDWIDE

Chapter 1: Introduction

This manual provides operating instructions for the Midtronics Celltron® ULTRA Universal Stationary Battery Analyzer. The instructions will help you to properly configure the analyzer, select test parameters, conduct tests, and manage data. It also provides information on product maintenance, warranty, and service.

NOTE: The analyzer and manual use the word "jar" when referring to a monobloc, which can contain 1 to 8 cells.

⚠ *Safety*

IMPORTANT: Read this instruction manual before using the analyzer.

WARNING: To avoid electric shock when testing jars, follow your company's safety practices and these guidelines:

* Wear safety glasses or a face shield.

* Wear protective rubber gloves.

* Wear a protective apron or shop coat.

* Perform service work only for which you have been trained.

* Do not disconnect the battery cables from power systems during the test without authorization.

* Do not place yourself in an electrical circuit.

* Avoid simultaneous contact with the jar and with frame racks or hardware that may be grounded.

* Do not operate the Celltron ULTRA with the battery charger (AC adapter) attached.

* Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

About The Analyzer

The **Celltron ULTRA** performs conductance testing on stationary batteries used in UPS systems, power utility, and telecommunications industries. Its advanced analysis and data management tools are designed for universal use in the following applications regardless of configuration:

UPS Systems, 120, 220/240, 480, 600 volts

Power Utility (Switching, SCADA, etc.)

Telecom OSP, – 48/+24 volts

Telecom Central Office, – 48/+24 volts

CATV

The analyzer features two backlit graphical LCD, a digital multimeter, a USB port for data storage and transfer to a PC. The analyzer software includes an icon-based menu and pre-loaded data on over 200 battery models to expedite testing and record-keeping.

Test Capability

The **Celltron ULTRA** tests lead-acid batteries that are 2, 4, 6, 8, 10, 12, 14, and 16 V. The analyzer can test batteries providing power to a load (in service) or not providing power (not in service).

Measurements

The analyzer measures the status of a jar in voltages and conductance values. It displays conductance values in mhos ($\mho$). Ampere hours (Ah) are a typical measurement of jar capacity; however, they are difficult to measure without knowing the load to which the jars supply power. Midtronics recommends that you compare test results to a conductance reference value. For more information about determining a reference value, refer to Chapter 3.

Test Range

The analyzer has an operating range of 0 to 20,000 ℧. This range includes jars that have about 5 to 6000 Ah of reserve capacity.

Kit accessories

Item	Description
X Clamps	166.7 mm (6.56 in.) length clamps and 50.8 mm (2.0 in.) maximum opening
X Probes	Cables with 152.4 mm (6 in) probes with rotating heads and 27.7 mm (0.5 in) tips for quick contact with large jar posts
Probe-extender kit	Lighted probes for increasing visibility in confined jar racks and cabinets
Digital infrared temperature sensor	Measures jar temperature in Celsius or Fahrenheit
SD memory card reader	Transfers test data to a PC through a USB port
Midtronics printer with an AC adapter (120 Vac, 60 Hz)	Handheld printer with infrared receiver for data transmitted by the Celltron ULTRA; includes battery charger (output 10.2 Vdc, 800 mA) for charging the printer's NiMH batteries
Infrared IR receiver and CD with PC software	IR receiver that attaches to a PC serial port and software that enables you to view and save test data on a PC
AC adapter, 120 Vac, 60 Hz (Optional adapter: 110 to 240 Vac, 50/60 Hz)	Charger for the analyzer's internal NiMH battery pack (output 12 Vdc, 100 mA)
Spare NiMH battery pack	7.2 V, 2500 mAh
Spare extender lamps	Lamps are replaceable: peel them off; use alcohol wipes to clean the surface, and attach the new lamps
Carrying Case	Hard side carrying case.

Chapter 2: Description

Display, keypad, and connections
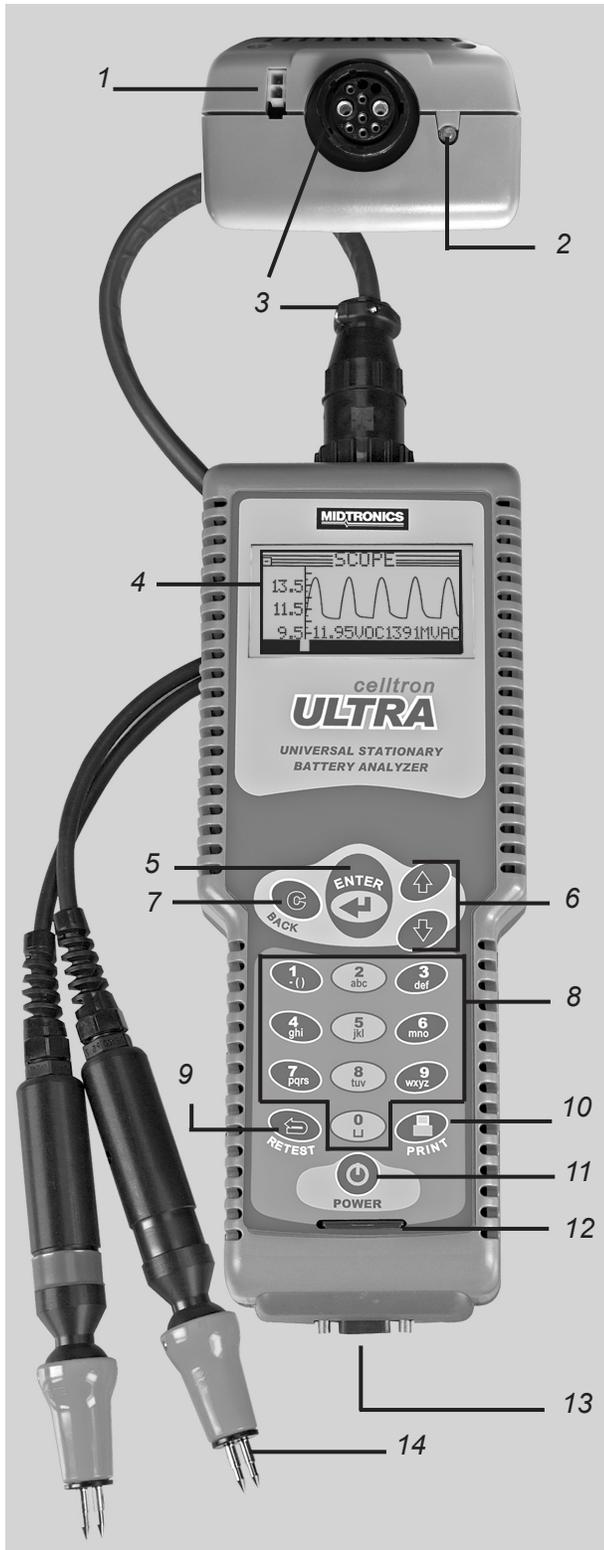
**NOTE:** The analyzer shuts off after approximately 2 minutes of inactivity to conserve its battery pack.

1   **Connector for the NiMH battery pack charger**

2   **Infrared (IR) data transmitter**

Sends test data to an IR printer or to a PC with an optional IrDA cable and software

3   **Connector for clamps or probes cables**

4   **Display** (showing oscilloscope)

Battery pack charge level

TITLE

Selection/Option Area

Status/Instruction Areas
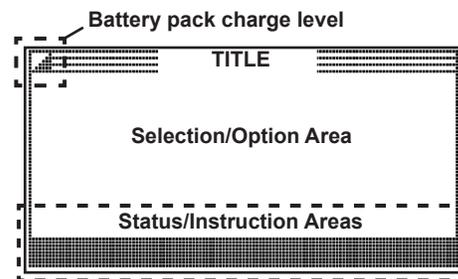
5   **ENTER key**
Press to select items and move to the next screen

6   **ARROW keys**
Press to scroll to preset selections or to highlight menus (⬆ scrolls left through the icons, and ⬇ scrolls right)

7   **BACK (C) key**
Press to clear/cancel entries or go back

8   **Alphanumeric keys**
Press to **ENTER** selections or user-defined names in screens that allow direct entry of data

9   **RETEST key**
Press to retest a set of jar posts or a strap just after you test it

10   **PRINT key**
Press to send test data to IR printer

11   **POWER button**

12   **SD (Secure Digital) card**
Removable memory storage for test data

13   **Serial connector**
For an optional bar code reader

14   **DuraProbe cable set**

Selection screens

When you turn on the analyzer it will default to the last menu screen displayed. To move back to the Main Menu, press the **BACK** key as each submenu appears.

The Main Menu has six menus: BATTERY SETUP, TEST, REPORTS, UTILITIES SETUP, DMM (Digital Multimeter), and BATTERY MANAGER. The menus have several submenus or options to help you set up the analyzer for testing, automate portions of the test process, and manage test data. The settings contain factory defaults that you can overwrite using the keypad. For more information, refer to the sections in the manual on selecting test parameters and utilities. The keys you use to enter data depend on the type of selections displayed. There are four types:

Menu icons

A menu icon is a graphical representation of a function you can select and use, such as the BATTERY SETUP icon in the Main Menu.

To select an icon, use the **ARROW** (⬆ or ⬇) keys to highlight it, and press the **ENTER** key. To return to the previous menu, press the **BACK** key.

Scrolling lists

Scrolling lists contain items that extend above and below the screen or the selection box that contains them. To indicate that there are more items, the symbols ⬍ appear to the right of the first item on the list. To select from a list, use the **ARROW** keys to scroll to the item and press **ENTER**.

Check boxes

Lists that fit the screen have check boxes before each item. Use the **ARROW** keys to place the check in the box next to your selection, or use the numeric keys to enter the item number. Press **ENTER** to select.

Alphanumeric selections

Some selections require you to use the alphanumeric keypad. These "user-defined" selections are indicated by a blinking horizontal line (cursor) to the right of the last character. Display the character, symbol, or number you want by rapidly pressing its key as many times as needed. If you pause, the cursor moves to the right. To backspace one character, press the **BACK** key. To enter a space between characters, press the key twice. Press **ENTER** when finished.

Menu Structure

This section describes the menu structure using a tree diagram to help you navigate through the screens. Selectable items are capitalized or in bold, and screen titles are italic.

You can find more detailed information on how to select options and test parameters in Chapters 4 and 5.

Main Menu Icon

Battery Setup (Menu Icon)
The BATTERY SETUP menu displays options for setting new test parameters, starting a test with stored parameters, deleting test files, and formatting the memory card.

NEW (TEST) (Icon)
The NEW (test) menu enables you to set test parameters for a string. When you select this icon, the screen displays RENAME NEW STRING.

STRING ID
RENAME NEW STRING
FACTORY TEST (default name)
Press ENTER to create a new string name (up to 500 strings).

STRING ID (alphanumeric selection)
FACTORY TEST_
A string ID stores your test parameters, eliminating the need to re-ENTER data each time you test. The last name created is the default name. Use the BACK key to clear the default characters and the alphanumeric keys to create a new name. Press ENTER to begin selecting your test parameters.

STRING INFO (scrolling parameters list)
[NEW STRING NAME]
The string name you created appears at the top of the parameters list. The name is highlighted, enabling you to change it before selecting your test parameters.

TECH ID 1 (default name)
Press ENTER to create a technician ID of up to 20 alphanumeric characters. The ID will be linked to the new string ID.

SELECT TECH (alphanumeric selection)
Use the **BACK** key to clear the default characters. Use the alphanumeric keys to create a new name

JARS PER STRING
Press **ENTER** to select the number of jars you are testing per string.

JARS PER STRING (scrolling/numeric keys)

The number of jars you can select (1 to 480) de-ends on whether you are testing JARS ONLY or JARS & 1 STRAP, JARS & 2 STRAPS and the number of POSTS PER JAR.

VOLTS PER JAR
Press **ENTER** to select the number of volts per jar.

VOLTS PER JAR (scrolling/numeric)
Select the number of volts per jar (2, 4, 6, 8, 10, 12, 14, or 16 V).

LOW VOLTAGE
Press **ENTER** to set the low voltage threshold for a jar.

LOW VOLTAGE (scrolling/numeric)
The range (**1.000** to **22.000**) depends on the VOLTS PER JAR.

JARS ONLY
Press **ENTER** to select a test mode.

MODE (check boxes)
JARS ONLY
Test only the jars on the string.

JARS & 1 STRAP
Test jars and their connections on the string.

JARS & 2 STRAPS
Test jars and their connections on the string.

POSTS PER JAR
Press **ENTER** to select the number of posts per jar.

POSTS PER JAR (scrolling/numeric keys) Select **2**, **4**, **6**, or **8**.

BATTERY MANAGER (scrolling)
Press **ENTER** to select a jar manufacturers and model, and computer a reference value.

SELECT MANUFACTURER
Press **ENTER** to display jar manufacturers and models.

SELECT MFGR (scrolling/alphanumeric)
Select from an alphabetical list of approximately 16 manufacturers, or select USER VENDOR (three available) to create a name for an unlisted manufacturer.

SELECT MODEL (scrolling/alphanumeric)
Select from an alphabetical list of over 200 models, or select USER DEFINED (approx. 64 available) to create a name for an unlisted model.

REFERENCE DEVELOPER
Press **ENTER** to have the analyzer compute a reference value.

REF DEVELOPER (scrolling/numeric)
Select a percentage of jars on the string on which to base a reference (from **0** to **100%**).

REFERENCE (scrolling/alphanumeric)
The default is dashes (– – – – – – ℧).
Press **ENTER** to change the value. This setting uses the manufacturer's reference value for the model of jar selected in BATTERY MANAGER. If you use REFERENCE DEVELOPER, the setting displays asterisks (∗∗∗∗∗) and cannot be changed.

VOLT & CONDUCTANCE (default)
Press **ENTER** to measure volts only; volts and conductance simultaneously; or voltage first, then conductance.

MODE (check boxes)
VOLTAGE ONLY
VOLT & CONDUCTANCE
VOLTS THEN CONDUCT(ANCE)

TEMPERATURE
Press **ENTER** to select the units of measure and the temperature of the string. Conductance measurements

change with jar temperature. To compensate, the ULTRA uses the temperature you select to adjust the percentage of the reference value.

> *TEMP. UNITS* (check boxes)
> DEGREES F
> DEGREES C
>
> > TEMPERATURE (scrolling/numeric)
> > Range: 0 to 50 ℃ (32 to 122 ℉).

AC RIPPLE

Press **ENTER** to select the string's AC ripple.

> *AC RIPPLE* (scrolling/numeric)
> Select from **0.000** to **99.999** volts.

DC FLOAT V.

Press ENTER to select the string's DC float voltage.

> *DC FLOAT* (scrolling/numeric)
> Select from **0.00** to **600.00** volts.

DC FLOAT A.

Press **ENTER** to select the string's DC float current.

> *DC FLOAT A.*(scrolling/numeric)
> Select from **0.000** to **99.999** amps.

SAVE AND TEST

This option enables you to save your test parameters and start a test. If the analyzer is not connected to a jar, it prompts you to connect to one before it starts the test.

SAVE AND CONTINUE

This option enables you to save your settings without starting a test. When you press **ENTER**, your test setup is saved under the string name you created. You are then returned to the BATTERY SETUP menu.

OPEN (icon)

To use a saved test setup, press **ENTER**. The parameters list will appear; however, you cannot change certain parameters without erasing string test data for completed tests.

> *STRING INFO* **(scrolling)**
> Scroll to the string name to start the test.
>
> > **WARNING**
> > The analyzer will warn you that a test using the string name/setup was already performed. If you want to change parameters, it will recommend that you use the NEW (TEST) function. Press **ENTER** to continue or the **BACK** key to cancel.
> >
> > > *STRING INFO* **(scrolling parameters list)**
> > > The parameters list will appear. Verify that these are the parameters you want to use, and scroll to SAVE AND TEST. Otherwise, make changes using the NEW (TEST) function.**Main Menu** (menu icon)

BATTERY SETUP (menu icon) (Continued from OPEN)

> **DELETE (icon)**
> To delete a saved test setup, press **ENTER**.
>
>> *STRING INFO (***scrolling)**
>> Scroll to the site name and press ENTER.
>>
>>> **WARNING**
>>> The analyzer will ask if you want to delete the file. Press **ENTER** to continue or the **BACK** key to cancel.
>
> **DELETE ALL FILES (icon)**
> Press **ENTER** to delete all files.
>
>> **WARNING**
>> The analyzer will ask if you want to delete all files. Press **ENTER** to continue or the **BACK** key to cancel.
>
> **FORMAT (icon)**
> Press **ENTER** to format the SD card.
>
>> **WARNING**
>> The analyzer will inform you that formatting will erase all disk data.
>> Press **ENTER** to continue or the **BACK** key to cancel.

TEST (icon)
The analyzer will test using the parameters file last used or saved. If there is no test setup in memory, the analyzer will use the default parameters. If the cables are not connected before you select the TEST option, the screen prompts you to connect to a jar or strap. Press **ENTER** after you connect the cables to the jar posts.

REPORTS (menu icon)
Press **ENTER** to view and manage data.

> **STRING SUMMARY (icon)**
> Press **ENTER** to see test results for a string.
>
>> *STRING INFO* **(scrolling)**
>> Select a string name and press **ENTER**.
>>
>>> *STRING SUMMARY* **(scrolling)**
>>> Scroll to display the complete test data.

JAR DATA (icon)
Press **ENTER** to see test results for jars and straps.

> *STRING INFO* **(scrolling)**
> Select a string name and press **ENTER**.
>
>> *STRAP [number/letter]* (scrolling)
>> *JAR [number/letter]* (scrolling)

TRANSFER (icon)

Press **ENTER** to transfer test results to a PC via the infrared (IR) receiver and the PC software included in the Celltron ULTRA kit.

TRANSFER DATA (check boxes)
TRANSFER ALL DATA
Transfer all test data in memory.

SELECT FILE (scrolling)
Transfer the test data for a string.

ADD BATTERY

Select this option to create a placeholder in the test results for a dead or missing battery when you are finished testing.

STRING INFO **(scrolling)**
Select a string name and press ENTER to display the string's test results.

JAR ID [number/letter] **(scrolling)**
Scroll to the jar number after which you want to insert a placeholder, and press **ENTER**. If you have selected JARS & 1 STRAP or JARS & 2 STRAPS as the test mode, you must also add a placeholder for the strap.

WARNING
The analyzer will ask you to verify the location before creating the placeholder. Press **ENTER** to continue or the **BACK** key to cancel.

TEST COUNTER (icon)

Press **ENTER** to see the total number of tests performed since the analyzer was first used.

REPORTS (menu icon)

VERSION (icon)

Press **ENTER** to display the serial numbers of the analyzer, cable, flash memory, and EEPROM firmware versions. The information will be helpful when you call Midtronics for software updates, service, and parts.

UTILITIES SETUP (menu icon)

Press **ENTER** to display the UTILITIES SETUP menu. This menu has seven utilities, four of which support the test process.

WARNING (icon)

Press **ENTER** to select a percentage of the reference value below which a jar and string must fall to generate a warning or failure notice.

STRING INFO **(scrolling)**
Select a site name and press ENTER.

STRING INFO **(scrolling)**
STRING WARN
Press **ENTER**.

STRING INFO **(scrolling/numeric)**
Select from **0** to **100**%.

STRING FAIL
Press **ENTER**.

    STRING INFO **(scrolling/numeric)**
    Select from **0** to **100**%.

JAR WARN
Press **ENTER**.

    STRING INFO **(scrolling/numeric)**
    Select from **0** to **100**%.

JAR FAIL
Press **ENTER**.

    STRING INFO **(scrolling/numeric)**
    Select from **0** to **100**%.

SAVE AND CONTINUE
Press **ENTER** to return to the UTILITIES SETUP Menu.

TEMP (icon)
Press **ENTER** to select the temperature unit of measure.

    TEMP. UNITS (check boxes)

    DEGREES F

    DEGREES C

MODE (icon)
Press **ENTER** to select a test startup mode.

    MODE **(check boxes)**
    MANUAL START
    This mode prompts you to press **ENTER** to start a test when you connect to the next jar while in the jar results screen.

    AUTO START
    This mode begins a test automatically when you connect to the jar.

CLOCK (icon)
Press ENTER to set the date and time.

    CLOCK ADJUST **(scrolling)**
    The date format is DD/MM/YYYY (Day/Month/Year).
    A 24-hour clock keeps the time.

DISPLAY (icon)
Press **ENTER** to adjust the display contrast and the amount of time the screen background stays illuminated.

    DISPLAY OPTIONS **(scrolling)**
    CONTRAST LEVEL
    Press **ENTER**.

        CONTRAST LEVEL **(scrolling)**
        The range is **0** (lightest) to **10** (darkest).

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BACKLIGHT TIME (scrolling)
Press **ENTER**.

BACKLIGHT TIME (scrolling)
Select the duration of the backlight when the analyzer is inactive. The range is **0** to **10** seconds.

LANGUAGE (icon)
Press **ENTER** to select a language.

LANGUAGE (check boxes)
7 LANGUAGES: ENGLISH, GERMAN, SPANISH, ITALIAN, FRENCH, PORTUGUESE AND RUSSIAN

UPDATE (icon)
The UPDATE utility installs ULTRA software upgrades from an SD memory card.

MAIN MENU (icon)
Displays the Main Menu.

DMM (icon)
Press **ENTER** to display the digital multimeter menu.

DC VOLTS (icon)
Press **ENTER**.

DC VOLTMETER

The DC voltmeter measures from real-time DC voltage from 0 to 25 Vdc.

AC VOLTS (icon)
Press **ENTER**.

AC VOLTMETER
The AC voltmeter measures real-time AC voltage from 0 to 10 Vac.

SCOPE (icon)

SCOPE
Real-time voltage trace with a range of 0 to 25 Vdc and four options: AUTO SETUP, RUN/HOLD, TIME DISPLAY, and FFT DISPLAY.

(To **CURRENT**)

Main Menu (menu icon)

DMM (icon) (Continued from **SCOPE**)

CURRENT (icon)
CURRENT
Connect to the jar to estimate the AC ripple current in the jar.

BATTERY MANAGER (icon)
Press **ENTER** to add or edit models and reference values in the database.
SELECT MFGR (scrolling)
Select from an alphabetical list of 16 manufacturers, or select USER VENDOR (3 available) for an unlisted manufacturer.

SELECT MODEL (scrolling)
Select from an alphabetical list of over 200 models, or select USER DEFINED (64 available) for an unlisted model.

EDIT MFGR (scrolling)
(Selected manufacturer name)
Accept the manufacturer name by scrolling past it, or select it to create a user-defined name.
MFGR ID
Edit the manufacturer name.

EDIT MODEL
(Selected model name)
Accept the model name by scrolling past it, or select it to create a user-defined name.

MODEL ID
Edit the model name.

REFERENCE
Press **ENTER** to change the value.

BATTERY RATING
Select a reference value. The range is **0** to **20,000** ℧.

SAVE AND CONTINUE
Press **ENTER** to save the settings and return to the Main Menu.

Chapter 3: Determining a reference value

Before you test a string

- Note the voltage of the jars

- Determine a reference value

- Set options in the UTILITIES SETUP menu

- Set test parameters in the BATTERY SETUP menu

Reference values are average conductance values from a sample of strong jars similar in condition and age. Generally, a sample of 30 new or healthy batteries is tested to obtain a value representative of a new online battery 90 days after installation. You can compare reference values to test results from a string. The differences between test results and reference values help you determine the string's capacity to provide enough conductance for the load. Differences can reflect how a string was treated, installed, or maintained.

Options in determining a reference value

If you want a value specific to the string you are testing, Midtronics recommends that you create your own reference value. The following options are listed in the order you should take to obtain a reference value.

- Consult your company documentation for reference values that were created for the string you are testing.

- Test a sample of jars. Refer to *Testing a sample of jars to establish a reference value* in this chapter.

- Test the jars in the string and use the highest conductance value as a reference value.

- Use the average from STRING SUMMARY after you test the string. Refer to *Using the average in STRING SUMMARY* in this chapter).

- Use REFERENCE DEVELOPER to determine a reference value based on a selected percentage of jars on the string with the highest conductance value.

- Use the reference value in the BATTERY MANAGER database for the model of jar you are testing. If the model is not in the database, contact the battery manufacturer or visit www.midtronics.com for a list of reference values for common jar types.

The reference values in STRING SUMMARY, BATTERY MANAGER, and on the website are only guidelines. Midtronics updates the website with new reference values when they are created. If you create a reference value for a jar model, e-mail the value and information to net@midtronics.com or fax it to 630-323-7752 (Attn: Reference value list).

CAUTION: Do not use the Celltron ULTRA to test the entire string at once. Test only individual jars/batteries.

IMPORTANT: Always test on the lead post for the most consistent results. To prevent lower measures, avoid tests on stainless-steel hardware or bolts.

Notes:

- The first time you turn on or connect the Celltron ULTRA, it will display a reminder to set preferences for the temperature units (Celsius or Fahrenheit) and the jar and string WARN/FAIL thresholds. Although you can press the **BACK** key to bypass the message, it will continue to appear until you change or accept the default settings.

- To protect its circuitry, the analyzer will not turn on if the clamps/probes are connected in reverse polarity (red to negative, black to positive).

- Power outages can affect test results. Do not test the string if a power outage occurred recently and the string is boost-charged.

- If the last file created, opened, or used does not match any files on the memory card, the analyzer will beep and display FILE NOT FOUND. The analyzer's internal EEPROM memory stores the last test used. When the analyzer powers on, it looks for the last file used on the memory card. To prevent the message from reappearing, insert the card containing the file, open an existing file, or create a new file on the card.

Testing a sample of jars

1. Choose at least 30 jars from one manufacturer with the same make, model, power rating, age (within 6 months), and service history.

2. Record this information about the jars:

   - Jar manufacturer

   - Model number

   - Date of manufacture

   - Date of installation

   - Condition in which the jar operates, such as charge voltage (volts per cell), temperature, and DC current through the jar

   - Visible warnings, such as leaking acid, corrosion, or distorted jar cases

3. Test the jars. See *Chapter 6: Testing*.

4. Test one jar five times in a row on float charge. Conductance results should be within ± 2% of each other.

NOTE: If the test results do not conform to this pattern, an electrical signal might be present in the system.

5. Calculate the average conductance of the jars. Do not include jars that are higher or lower than 30% from the average because they might be outside an acceptable range.

Using the average in STRING SUMMARY

If you cannot obtain a reference value for a string, test the string and use the average conductance value (AVG. MHOS) in the STRING SUMMARY as your reference value. If jars in the string have been replaced recently, test the new jars, especially if they correlate to the HIGH jar value in STRING SUMMARY. For more information, see *Chapter 7: Test results*.)

Chapter 4: Utilities

The UTILITIES SETUP menu has eight options, three of which support the test process. If you make no selections, the analyzer uses the default settings. For the critical WARNING and TEMP settings, the analyzer will remind you with a PREFERENCES NOT SET message until you change or accept the default settings.

The utilities are:

- WARNING (voltage threshold for failing jars and strings)

- TEMP (Celsius or Fahrenheit)

- MODE (auto or manual test startup)

- CLOCK (date and time)

- DISPLAY (contrast and backlight duration)

- LANGUAGE (selecting the language)

- UPDATE (update the Celltron ULTRA software)

Selecting a warn/fail threshold (WARNING)

The WARNING utility enables you to set the percentages of the reference value below which a jar and string must fall to generate a WARN or a FAIL notice on the printed test results. A question mark (?) appears next to jars and strings as a warning. An exclamation mark (!) appears if the jar or string is failing.

Table 4: Defaults for a jar and string in service

STRING WARN	<70%	JAR WARN	<70%
STRING FAIL	<60%	JAR FAIL	<60%

1. Press the **ARROW** keys to highlight the WARNING icon in the UTILITIES SETUP menu, and press **ENTER**.

2. Press the **ARROW** keys to select a STRING NAME, and press .

3. Press the **ARROW** keys to scroll to a selection: STRING WARN, STRING FAIL, JAR WARN, or JAR FAIL and press **ENTER**. Press the **ARROW** keys to set percentages, and press **ENTER** to select. Repeat the process for each screen you want to print.

Selecting Celsius or Fahrenheit (TEMP)

Select Celsius or Fahrenheit as a unit of measure before setting your test parameters in BATTERY SETUP. The last saved TEMP selection becomes the default unit of measure.

1. Press the **ARROW** keys to highlight the UTILITIES SET-UP icon, and press **ENTER**.

2. Press the **ARROW** keys to highlight the TEMP icon, and press **ENTER**.

3. Press the **ARROW** keys (or use the numeric keys) to check the box next to DEGREES F or DEGREES C, and press **ENTER** to select.

Selecting a manual or automatic test-start mode (MODE)

The MODE utility has two test-start modes. AUTO START starts a test automatically when you connect to the next jar from the jar results screen. The setting allows you to keep your hands free to use probes.

MANUAL START, which is the default, prompts you to press **ENTER** to begin a test after you connect to the jar.

1. Press the **ARROW** keys to highlight the MODE icon in the UTILITIES SETUP menu, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keys) to check the box next to MANUAL START or AUTO START.

3. Press **ENTER** to select.

4. Press the **BACK** key to return to the UTILITIES SETUP menu.

Setting the date and time (CLOCK)

The clock utility includes settings for the analyzer's 24-hour internal clock and for the date and time, which are printed on test reports. Although the date and time are set at the factory, you may need to make changes based on your time zone.

1. Press and hold the **POWER** button until the analyzer turns on.

2. Press the **ARROW** keys to highlight the UTILITIES SET-

UP icon, and press **ENTER**.

NOTE: If you select an option you do not want, press **ENTER** to return to the Main Menu.

3. Use the **ARROW** keys to highlight the CLOCK icon, and press **ENTER**.

4. To highlight the characters you want to change, press **ENTER**. To move backward, press **BACK**. To make changes, press the **ARROW** keys to select the number of the month, day, year, hour, and minutes.

5. To have the analyzer accept your changes, press **ENTER** to move past the minutes setting.

Adjusting the display contrast (CONTRAST LEVEL)

1. Press the **ARROW** keys to highlight the UTILITIES SET-UP icon, and press **ENTER**.

2. Press the **ARROW** keys to highlight the DISPLAY icon, and press **ENTER**.

3. Press the **ARROW** keys to highlight CONTRAST LEVEL, and press **ENTER**.

4. Press the **ARROW** keys (or use the numeric keys) to adjust the contrast from **0** (lightest) to **10** (darkest).

5. Press **ENTER** to select.

Adjusting the display's backlight duration (BACKLIGHT TIME)

This option turns off the screen illumination after a selected period of time to conserve the analyzer's battery pack.

1. Press the **ARROW** keys to highlight the UTILITIES SET-UP icon, and press **ENTER**.

2. Press the **ARROW** keys to highlight the DISPLAY icon, and press **ENTER**.

3. Press the **ARROW** keys to highlight BACKLIGHT TIME, and press **ENTER**.

4. Press the **ARROW** keys (or use the numeric keys) to adjust the time the display stays backlit from 0 seconds (off) to 10 seconds.

5. Press **ENTER** to select.

Selecting the language (LANGUAGE)

There are seven selectable languages in the Celltron ULTRA software for the display and printed reports:

1. Press the **ARROW** keys to highlight the UTILITIES SET-UP icon, and press **ENTER**.

2. Press the **ARROW** keys to highlight the LANGUAGE icon, and press **ENTER**.

3. Press the **ARROW** keys (or use the numeric keypad) to move the dot to the option button of your choice.

4. Press **ENTER** to accept.

Using UPDATE to install new software

This utility enables you to update the analyzer's software using an SD card. Contact your Midtronics sales representative or Midtronics Customer service for information about the current version.

To update the software from a SD card containing the update files:

1. Insert the new memory card into the analyzer and press the **POWER** key.

2. FILE NOT FOUND will appear on the display.

3. Press the **BACK** key twice to display the Main Menu.

4. Press the **ARROW** keys to highlight the UTILITIES SET-UP icon, and press **ENTER**.

5. Press the **ARROW** keys to highlight the UPDATE icon, and press **ENTER**.

6. SOFTWARE WILL BE CHANGED, DO YOU WANT TO CONTINUE? Press **ENTER** to update the analyzer's software.

NOTE: It will take several minutes to complete the update.

Chapter 5: Selecting test parameters

If you are testing a string for the first time, use the NEW test menu in BATTERY SETUP to create a string name and choose its test parameters. If you make no selections, the analyzer uses the default settings when you test the string. (See *Menu structure* in *Chapter 2*.)

To begin: Make sure the memory card is inserted correctly. The card's label should face the keypad. Press and hold the **POWER** button.

- The first time you turn on or connect the Celltron ULTRA, it will display a reminder to set preferences for the temperature units (Celsius or Fahrenheit) and the jar and string WARN/FAIL thresholds. Although you can press the **BACK** key to bypass the message, it will continue to appear until you change or accept the default settings.

- To protect its circuitry, the analyzer will not turn on if the clamps/probes are connected in reverse polarity (red to negative, black to positive).

- If the last file created, opened, or used does not match any files on the memory card, the analyzer will beep and display FILE NOT FOUND. The analyzer's internal EEPROM memory stores the last test used. When the analyzer powers on, it looks for the last file used on the memory card. To prevent the message from reappearing, insert the card containing the file, open an existing file, or create a new file on the card.

Creating a string name (FACTORY TEST)

A string name stores your test parameters, eliminating the need to reenter data each time you test. The default name is FACTORY TEST (or the last name created), which you can overwrite with any 20-character combination of letters, numbers, or symbols using the alphanumeric keypad.

1. Press the **ARROW** keys to highlight the BATTERY SET-UP icon, and press **ENTER**.

2. Press the **ARROW** keys to highlight the NEW icon, and press **ENTER**.

3. When the prompt RENAME NEW STRING appears, press

ENTER to create a new string name.

4. The default string name or the last string tested will appears. Press **ENTER** for the editing screen.

5. The cursor will blink to the right of the last character. To backspace and overwrite characters, press the **BACK** key as many times as needed.

6. Enter the character, symbol, or number you want by rapidly pressing its key as many times as needed. If you pause, the cursor moves to the right. To enter a space between characters, press the ⊔ key twice.

7. Press **ENTER** when finished.

8. The string name you created appears at the top of the parameters list. The name is highlighted, enabling you press **ENTER** to change it again before selecting your test parameters. To continue selecting parameters press the **ARROW** keys. Creating a TECH ID

Press **ENTER** to create a technician ID of up to 20 alphanumeric characters. The ID will be linked to the new string ID. The default name is TECH ID (or the last ID created), which you can overwrite with any combination of letters, numbers, or symbols using the alphanumeric keypad.

1. Press the **ARROW** keys to highlight TECH ID 1 (factory default) or the last ID created.

2. The editing screen will appear. The cursor will blink to the right of the last character. To backspace and overwrite characters, press the **BACK** key as many times as needed.

3. Enter the character, symbol, or number you want by rapidly pressing its key as many times as needed. If you pause, the cursor moves to the right. To enter a space between characters, press the ⊔ key twice.

4. Press **ENTER** when finished.

Selecting the number of JARS PER STRING

The default is 24. The number of jars you can test depends on whether you are testing JARS ONLY, JARS & 1 STRAP, or JARS & 2 STRAPS and number of POSTS PER JAR.

Table 5: Maximum of jars per string

JARS ONLY Max. number of jars	JARS & 1 STRAP Max. number of jars	JARS & 2 STRAPS Max. number of jars
480 jars for 2 posts	240 jars for 2 posts	120 jars for 2 posts
240 jars for 4 posts	120 jars for 4 posts	60 jars for 4 posts
160 jars for 6 posts	80 jars for 6 posts	40 jars for 6 posts
120 jars for 8 posts	60 jars for 8 posts	30 jars for 8 posts

1.   Press the **ARROW** keys to highlight JARS PER STRING, and press **ENTER**.

2.   Press the **ARROW** keys (or use the numeric keypad) to scroll to the number of jars.

IMPORTANT: Be sure to count and **ENTER** the correct number of jars you are testing.

3.   Press **ENTER** to select.

Selecting the number of VOLTS PER JAR

The default is 2.

1.   Press the **ARROW** keys to highlight VOLTS PER JAR, and press **ENTER**.

2.   Press the **ARROW** keys (or use the numeric keypad) to scroll to the number of volts.

3.   Press **ENTER** to accept.

Setting the LOW VOLTAGE threshold

1.   Press the **ARROW** (or use the numeric keypad) to highlight LOW VOLTAGE, and press **ENTER**.

2.   Press the **ARROW** to scroll to the number of volts.

3.   Press **ENTER** to accept.

Table 6: Low voltage threshold ranges and defaults

Range	Default	Range	Default
1.000 to 2.750 V for a 2 V jar	2.1 V	5.000 to 13.800 V for a 10 V jar	10.5 V
2.000 to 5.500 V for a 4 V jar	4.2 V	6.000 to 16.500 V for a 12 V jar	12.6 V
3.000 to 8.250 V for a 6 V jar	6.3 V	7.000 to 19.250 V for a 14 V jar	14.7 V
4.000 to 11.000 V for an 8 V jar	8.4 V	8.000 to 22.000 V for a 16 V jar	16.8 V

Selecting a test mode (JARS ONLY)

The default is JARS ONLY.

1. Press the **ARROW** keys to highlight JARS ONLY, JARS & 1 STRAP, or JARS & 2 STRAPS in the *STRING INFO* list, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keypad) to check the box next to JARS ONLY, JARS & 1 STRAP, or JARS & 2 STRAPS.

3. Press **ENTER** to accept.

Selecting the number of POSTS PER JAR

The default is 2.

1. Press the **ARROW** keys to highlight POSTS PER JAR, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keypad) to scroll to the number of posts.

3. Press **ENTER** to accept. Using a reference value from the database (BATTERY MANAGER)

If there is no reference value for the string you are testing, you can use a reference value for the jar model in the BATTERY MANAGER database. The reference value is used only for this particular test setup. If you want to permanently add a reference value or a new jar model to the database, see "Adding jar model information to the database."

1. Press the **ARROW** keys to highlight BATTERY MANAGER, and press **ENTER**.

2. Press the **ARROW** keys to highlight SELECT MANUFAC-TURER, and press **ENTER**.

3. Press the **ARROW** keys to highlight a manufacturer (or USER VENDOR for an unlisted manufacturer), and press **ENTER**.

4. Press the **ARROW** keys to highlight a model name.

5. Press **ENTER** to accept.

Using REFERENCE DEVELOPER to calculate a reference value

If there is no reference value for the string you are testing, you can use REFERENCE DEVELOPER to calculate a value based on an average of the top 30% of the jars in the string,

or on a percentage of your choice.

1. Press the **ARROW** keys to highlight BATTERY MANAGER, and press **ENTER**.

2. Press the **ARROW** keys to highlight REFERENCE DEVELOPER, and press **ENTER**.

3. Press **ENTER** to accept the default, or press the **ARROW** keys (or use the numeric keypad) to select the percentage of jars in the string.

4. Press **ENTER** to accept.

Selecting a REFERENCE value

This setting uses the manufacturer's reference value for the model of jar selected in Battery Manager. If you use REFERENCE DEVELOPER, the setting displays asterisks (*****) and cannot be changed. The range is 0 (test without a reference value) to 20,000 $\mho$. If you test without a reference value, dashes appear in reference fields on the display and in the test results.

1. Press the **ARROW** keys to highlight REFERENCE, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keypad) to select a value.

3. Press **ENTER** to accept.

Selecting what to measure (VOLT & CONDUC-TANCE)

The default is VOLT & CONDUCTANCE.

1. Press the **ARROW** keys to highlight VOLT & CONDUCTANCE, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keypad) to check the box next to your choice: VOLTAGE ONLY, VOLT & CONDUCTANCE, VOLTS THEN CONDUCT(ANCE).

NOTE: Select VOLTS THEN CONDUCT(ANCE) if you are measuring conductance and do not want conductance testing to affect your voltage measurements. After you measure the voltage of the jars (or jars and straps) in a string, disconnect, then reconnect to the first jar in the string to complete the test by measuring conductance.

3. Press **ENTER** to accept.

NOTE: Once you start the conductance portion of the VOLTS THEN CONDUCTANCE test, you will not be able retest voltage. Be sure to review your voltage reading before you start your conductance portion of the test.

Selecting the string TEMPERATURE

The default is 25 °C (77 °F). Conductance measurements vary by jar temperature. To compensate, the analyzer uses the TEMPERATURE value to adjust the percentage of the reference value you set in the UTILITIES SETUP as the WARN/FAIL threshold. The percent is compensated to 25 °C (77 °F). Compensation is adjusted at 0.7% per degree Celsius between 0 °C and 35 °C. (The kit includes an infrared temperature sensor and instructions.)

1. Press the **ARROW** keys to highlight TEMPERATURE, and press **ENTER**.

2. Press the **ARROW** keys (or use the numeric keypad) to select a value.

3. Press **ENTER** to accept.

Saving the BATTERY SETUP

To save your settings for later use, press the **ARROW** keys to highlight SAVE AND CONTINUE, and press **ENTER**. You are returned to the NEW test menu. To use a saved BATTERY

SETUP to test a string, see *Selecting the TEST option* in *Chapter 6: Testing*.

To save your settings for immediate testing, connect the clamps or probes and press the **ARROW** to highlight SAVE AND TEST. Press **ENTER** to start the test. (See *Chapter 6: Testing*.)

Adding jar model information to the database

To add new jar models and conductance reference values to the database, use BATTERY MANAGER in the Main Menu. The BATTERY MANAGER available in BATTERY SETUP allows you to change a reference value only for a particular data file. It does not save the change as a selection for new test setups. You can also edit a model name or add a new model using BATTERY MANAGER in the Main Menu.

Changing a reference value

1. Press the **ARROW** keys to highlight the BATTERY MANAGER in the Main Menu, and press **ENTER**.

2. Press the **ARROW** keys to select a manufacturer, and press **ENTER**.

3. To change a reference value for a model in the database, press the **ARROW** keys to select the model name, and press **ENTER**.

4. In the *EDIT MFGR* screen, press the **DOWN ARROW** to

select REFERENCE, and press **ENTER**.

NOTE: If you change the model name and save it, the new name overwrites the original model name in the database.

5.   Press the **ARROW** keys (or use the numeric keypad) to select a new reference value, and press **ENTER**.

6.   To save, press the **DOWN ARROW** to select SAVE AND CONTINUE, and press **ENTER**.

Adding a jar model

1.   Press the **ARROW** keys to highlight the BATTERY MANAGER in the Main Menu, and press **ENTER**.

2.   Press the **ARROW** keys to select a manufacturer, and press **ENTER**.

3.   Press the **ARROW** keys to select one of the numbered USER DEFINED names, and press **ENTER**.

4.   In the *MODEL ID* screen, your USER DEFINED selection is highlighted. Press **ENTER** to change the name.

5.   The cursor blinks to the right of the last space or character in the name. Display the character, symbol, or number you want by rapidly pressing its key as many times as needed. If you pause, the cursor moves to the right. To backspace one character, press the **BACK** key. To enter a space between characters, press the ⎵ key twice. Press **ENTER** when finished.

6.   In the *MODEL ID* screen, press the **DOWN ARROW** to select REFERENCE, and press **ENTER**.

7.   Press the **ARROW** keys (or use the numeric keypad) to select a new reference value.

8.   To save, press the **DOWN ARROW** to select SAVE AND CONTINUE and press **ENTER**.

Chapter 6: Testing

Testing a string requires consistent practices in the procedures in this section and keeping records of the test results. Midtronics recommends that you establish a testing routine to monitor conductance loss and prevent failures.

CAUTION: Do not use the Celltron ULTRA to test the entire string at once. Test only individual jars/batteries.

IMPORTANT: Always test on the lead post for the most consistent results. To prevent lower measures, avoid tests on stainless-steel hardware or bolts.

NOTES:

- To protect its circuitry, the analyzer will not turn on if the clamps/probes are connected in reverse polarity (red to negative, black to positive).

- Power outages can affect test results. Do not test the string if a power outage occurred recently and the string is boost-charged.

Selecting clamps or probes

To determine if probes or clamps are appropriate for your test, consider whether you will be testing a small number of jars, or many jars and straps in a string.

Probes are best for quick testing of jars and straps on a string and for making contact with small posts or straps. Cables keep your hands free to use the analyzer's keypad and to retest without reconnecting.

If you choose a probe cable set, do one of the following:

- Select AUTO START in the UTILITIES SETUP menu to keep both hands free to hold the probes.

- Have someone hold the analyzer while you connect the probes to the jars during testing.

- If your analyzer has a belt hook, hang the analyzer from your utility belt while holding the probes.

Attaching the cable to the analyzer

1. Turn off the analyzer.

2. Insert the connector at the end of the cable into the cable port at the top of the analyzer.

3. Hand-tighten the plastic ring at the base of the connector.

How the analyzer labels jars and straps

The analyzer assigns labels to jars and straps based on the order in which you test them. It displays these labels in the test results to help you keep track of the jar posts and straps you have tested and lets you know the jar posts and straps you still need to test.

Label information

The labels consist of numbers and letters that correspond to the:

- locations and connections of jar posts and straps

- direction in which you test the jars

The label identifies:

- jar or strap

- number of the jar

- position of the posts

Jar labels

The analyzer labels a jar in its memory with the letter "J." It adds a number that designates the sequence in which you tested the jar. If there is more than one set of jar posts, it adds another letter that designates the set of positive and negative posts you test on a jar.

For example, in the label "J23C," "J" means you tested a jar, "23" is the twenty-third jar you tested, and "C" is the third set of posts you tested on that jar. *Figure 1* shows an example of the labels for a jar when testing the posts from left to right.

If the jars you are testing have one set of posts, the analyzer does not assign a letter. For example, "J23" means the jar has one set of posts.
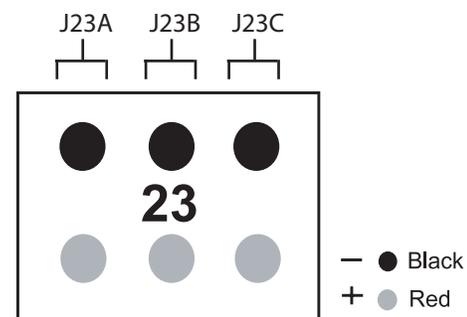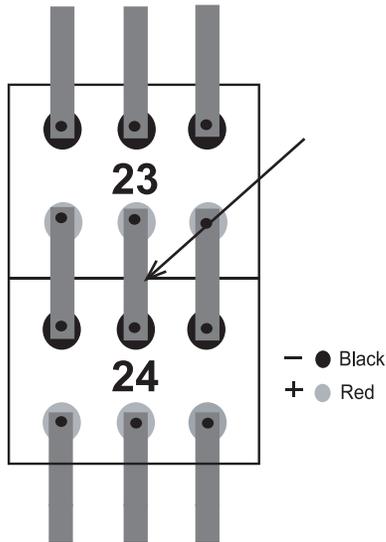

Figure 1: Labels for a jar with 6 posts

S23B

Figure 2: Label for a strap

Strap labels

The analyzer uses "S" for strap. It assigns a number to the jar that is connected to the strap. It assigns a letter that corresponds to the letter for the set of posts the strap is connecting.

For example, in the label "S23B," "S" means you tested a strap, "23" is the number of the jar connected to the strap, and "B" is the second strap you tested for that jar. *Figure 2* shows an example of this label.

Recommendations

The recommendations in this section will help you to manage jar and string information and determine a test pattern.

Recording jar information

Because conductance values vary with such factors as age, temperature, and site conditions, record the following information each time you test:

- power load

- physical condition of the jars

- site condition

- jar rating

You can use the Midtronics PC software to enter this information after you test the string and download the test results. If you do not have the PC software, keep this information for reference in a convenient area the next time you test. If you are unsure about the condition of a jar, ask for help from someone familiar with the jar's history before you test.

Identifying jars and straps

To make sure the test results correlate to the same jar or strap each time you test, identify the jars and straps on the string with a sticker label.

Determining a test pattern

To make testing a consistent and fluid process, determine a test pattern before connecting to the jar.

The test order of posts and straps

You must test all posts and straps on a jar before testing the next jar in the string. You can test jar posts in any direction as long as you are consistent. However, you must test a jar post and then the strap that connects it before you test the next post
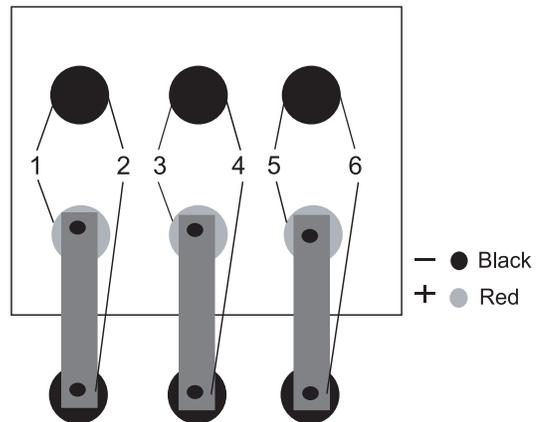

Figure 3: Pattern for testing posts and straps

In *Figure 3, step 1* the test pattern shows the clamps/probes connection between the first set of positive and negative posts. *Step 2* shows the clamps/probes connection between the negative post and the end of the strap that attaches to the next jar. *Step 2* ensures that you test the entire strap and its connections. *Steps 3* through *6* repeat the process. (Refer to *Attaching the cable to jar posts* and *Attaching the cable to a strap* in this chapter.)

The test pattern for a string

First test at the jar post, then at the strap. After testing the jar posts and straps, test the next jar in the direction in which the straps and jar cables connect the jars (*Figure 4*).

The numbers on the jars indicate the direction you should test based on the connections. The straps connect the jars from top to bottom, and the cables connect the jars from side to side.

Starting the test

When you insert a memory card and turn on the analyzer, it will scan the card for files that are compatible with the current version of the analyzer's software. If the files are in an older format, you will not be able to save new test results to the card. The analyzer will display:

!OUTDATED CARD FILE!
SAVE FILES TO
COMPUTER. THEN DELETE
FROM CARD
OR PRESS ENTER TO
DELETE ALL FILES NOW.

To save the older files to a computer, refer to *Transferring files to a PC from the memory card* in *Chapter 7: Test results and reports*.

To test a string, attach the clamp or probe cables to the first jar in the string.

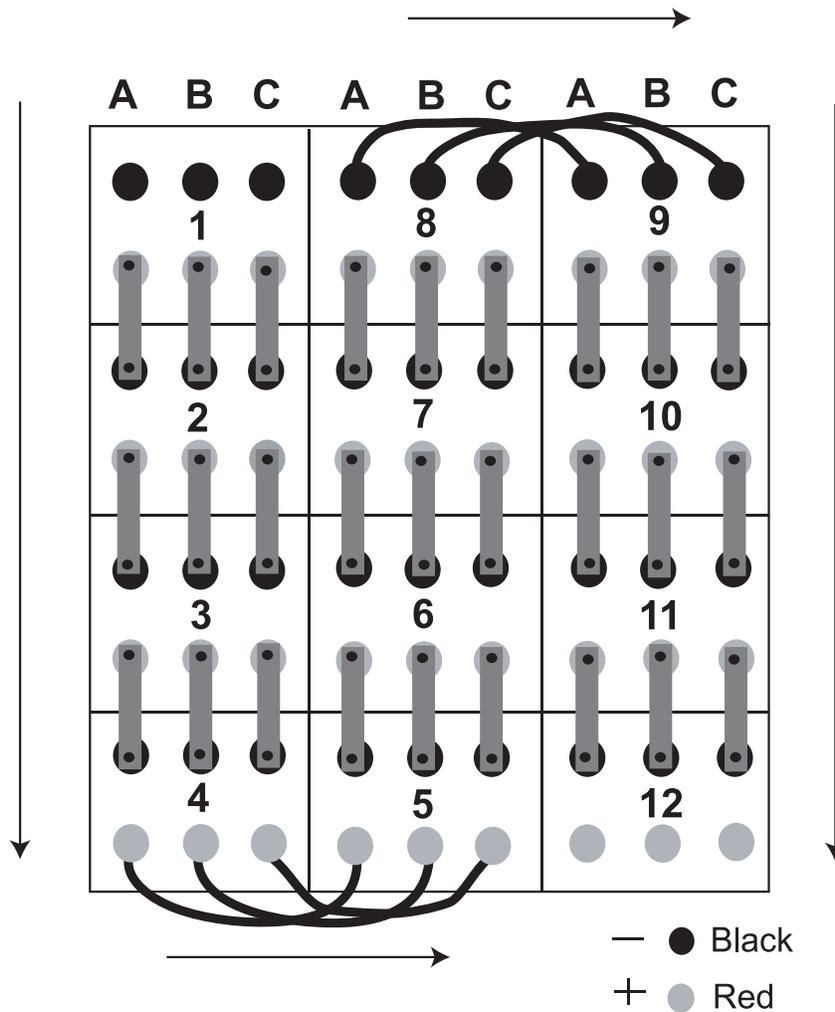**NOTE:** Connect the probes in the same positions as the clamps in the illustrations.

Figure 4: Pattern for testing jars in a string

Guidelines

- Do not place clamps or probes on stainless steel hardware, such as bolt heads, washers, or threaded posts. Stainless steel hardware can yield low conductance values. If you have to test on stainless steel, record it in your testing records.

- The jars might have grease on the terminals and connections to prevent corrosion. You do not have to wipe off the grease before attaching the clamps or connecting the probes.

- Test each jar in the same location or position. Changing the location of the test point might vary test results.

Attaching the cable to jar posts

1. Attach the black clamp or probe tip to the black (–) terminal. Refer to *Figure 5*.

2. Attach the red clamp or probe tip to the red (+) terminal.

Selecting the last used test setup with the TEST option

If you select the TEST option in the Main Menu and connect to a battery, the analyzer tests using the parameters from your last test setup or, if there is no setup in memory, the default parameters.

Using the OPEN option

The OPEN option enables you to view the parameters of a saved test setup. You can also use OPEN to change any parameters **EXCEPT**:

> JARS ONLY / JARS & 1 STRAP / JARS & 2 STRAPS
> POSTS PER JAR
> JARS PER STRING
> VOLTS PER JAR
> VOLT & CONDUCTANCE / VOLTAGE ONLY / VOLTS THEN CONDUCT(ANCE)

If you change these parameters you will erase the string's test data. If you need to change them, use the NEW (TEST) function and save the setup.
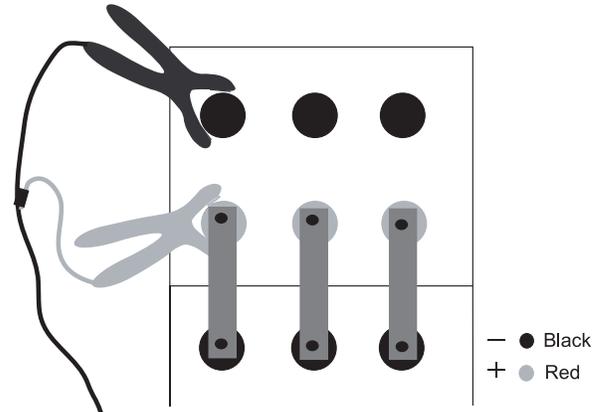
To use the OPEN option:

Figure 5: Attaching the cable to jar posts

1. Press the **ARROW** keys to highlight the BATTERY SETUP icon in the Main Menu, and press **ENTER**.

2. Press the **ARROW** keys to highlight the OPEN icon in the BATTERY SETUP menu, and press **ENTER**.

3. Press the **ARROW** keys to select a test setup, and press **ENTER**.

4. The analyzer will alert you that testing for that string was completed:

> TESTING OF STRING
> IS COMPLETE
> TO SET UP AND TEST A
> NEW STRING, PRESS 'C'
> THEN SELECT 'NEW'

5. Scroll through the list and verify or change parameters.

6. Scroll to SAVE AND CONTINUE to exit or SAVE AND TEST to test a string.

    NOTE: If you are not connected to the jar, the analyzer prompts you to connect. Connect the clamps or probes, and press **ENTER** to start the test.

IMPORTANT: If you are measuring VOLTS THEN CONDUCTANCE, disconnect from the last jar in the string after the voltage test. Reconnect to the first jar and press **ENTER** to test for conductance. (The analyzer displays TESTING JAR 1 when you reconnect.)

The analyzer beeps twice when the test is done. The analyzer beeps longer if:

- the conductance value is below the reference value

- the percentage of the reference is below the values for WARN or FAIL

- the voltage level is below the LOW VOLTS value

7. After reviewing the first set of results, choose one of the following based on the type of testing you are doing:

   - If you are testing jars only, test the next set of jar posts (if you have more than one set of posts), or test the next jar in the string. Refer to *Determining a test pattern* in this chapter.

   - If you are testing jars and straps, follow the steps in *Attaching the cable to a strap* in this chapter.

Attaching the cable to a strap

1. Remove the red clamp or probe from the red (+) terminal.

2. Attach the red clamp or probe at the end of the strap above the black (–) terminal on the next jar. Refer to *Figure 6*.
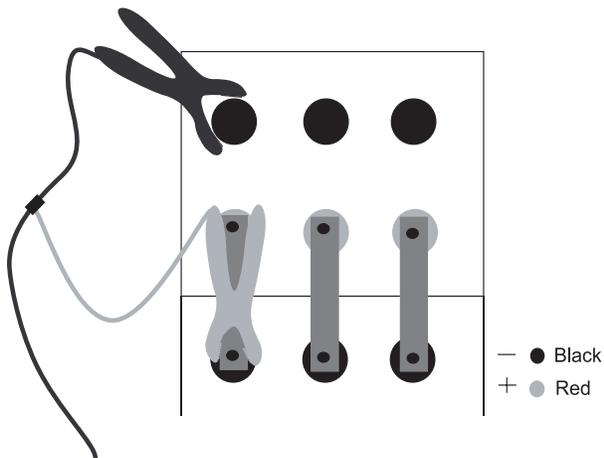

— ● Black
+ ● Red

Figure 6. Attaching the cable to a strap

3. Choose one of the following based on the number of posts the jars have:
   - If the jar has more than one set of posts, attach the black and red clamps or probes to the next set of posts on the jar.

   - If the jar has one set of posts, test the jar connected to the jar you just tested. Follow the steps in *Attaching the cable to jar posts* in this chapter.

4. Repeat the steps in *Attaching the cable to jar posts* and *Attaching the cable to a strap* in this chapter until you are finished testing the string.

5. Refer to *Chapter 7: Test results* to view test results or *Retesting jar posts or straps* below to retest the set of jar posts or straps.

Retesting jar posts or straps

Factors such as operating and site conditions, and manufacturer changes, can affect test results. If you accept results under these conditions, your maintenance routine might not have an accurate history. To verify results, you can retest a set of jar posts or straps right after you test them. Or you can test the rest of the string before you retest certain jar posts or straps.

Retesting after immediately testing the jar post or strap

To retest a set of jar posts or a strap just after you test it, press RETEST. The analyzer displays new test results.

Retesting after testing the string

To retest a set of jar posts or a strap after you test the entire string:

1. Remove the clamps/probes from the set of jar posts or the strap.

2. Press and hold the **POWER** button to turn on the analyzer.

3. Press the **ARROW** keys to highlight the REPORTS icon in the Main Menu, and press **ENTER**.

4. Press the **ARROW** keys to highlight the JAR DATA icon, and press **ENTER**.

5. Press the **ARROW** keys to scroll to the string file that has the jar or strap you want to retest, and press **ENTER**.

6. Press the **ARROW** keys to scroll to the jar or strap you

want to retest.

7. Press the **RETEST** key.

8. After retesting, the analyzer will display the new results. To retest another jar or strap, scroll to it and press the **RETEST** key.

9. Press the **BACK** key to end.

Adding a placeholder for a missing or dead jar/ battery

You can create a placeholder for a dead or missing battery by using the ADD BATTERY option in the REPORTS MENU. There are two ways to add a placeholder.

NOTE: If you have selected JARS & 1 STRAP or JARS & 2 STRAPS as the test mode, you must also add a placeholder for the strap.

When testing a string

1. When the analyzer displays the last good test results, disconnect from the jar and press the **BACK** key to return to the Main Menu. Select the TEST icon, and press **ENTER**.

2. The analyzer will display the following screen:

> ===WARNING===
> CONNECT TO
> JAR XX
> RED LEAD TO POSITIVE
> POST, BLACK LEAD TO
> NEGATIVE POST!
> PRESS '5' TO ADD JAR

NOTE: XX is the battery ID of the battery whose place is being taken.

3. If you press **5**, the analyzer will add a placeholder to the stored data readings:

> Battery XX

> Voltage 0.0 volts
> Conductance 0 mhos

When testing VOLTS THEN CONDUCTANCE, the PRESS 5 TO ADD JAR option is available only during the voltage part of the test. During conductance testing the analyzer will skip batteries with 0 volts. You can add a placeholder by selecting the ADD BATTERY option in the REPORTS menu at any time.

When testing is finished

You can add a placeholder later for a dead or missing battery via the ADD BATTERY option in the REPORTS menu.

1. Press the **ARROW** keys to highlight the REPORTS icon in the Main Menu, and press **ENTER**.

2. In the STRING INFO screen press the **ARROW** keys to highlight a string name.

3. In the test results screen, scroll to the battery after which you want the placeholder.

4. The analyzer will display:

> INSERT PLACEHOLDER
> 0.0V and 0 MHOS
> AT LOCATION
> JAR XX
> AND SHIFT OTHER DATA?
> The place holder will be:
> Battery ID 0
> VOLTAGE 0.0 volts
> Conductance 0 mhos

NOTE: To add the placeholder at the end of the data list, select the TEST icon, press **ENTER**, and press the **5** key to add a jar.

Chapter 7: Test results and reports

After you test a string, you can view and interpret test results, and archive the results to establish a maintenance history.

Viewing test results

After you test a string, the analyzer saves the test results that are displayed on the screen. You can view test results as many times as you want until you delete the string.

String test results

To view a summary of averages, and high and low values:

1. Press the **ARROW** keys to highlight the REPORTS icon in the Main Menu, and press **ENTER**.

2. Press the **ARROW** keys to highlight the STRING SUMMARY icon, and press **ENTER**.

3. Press the **ARROW** keys to scroll a string name and press **ENTER**.

4. The first screen of test results appears. Press the **ARROW** keys to move to the second screen and **BACK** again.

5. Press **BACK** to exit to the REPORTS menu.

Jar and strap test results

To view the test results for individual jars and straps that were displayed as you tested the string:

1. Press the **ARROW** keys to highlight the REPORTS icon in the Main Menu, and press **ENTER**.

2. Press the **ARROW** keys to highlight the JAR DATA icon, and press **ENTER**.

3. Press the **ARROW** keys to display results for all jars (and straps, if tested) in the string. You can retest jars or straps by pressing the **RETEST** key. See *Retesting after testing the string* in *Chapter 6: Testing*.

4. Press the **BACK** key to exit to the REPORTS menu.

The format and contents of printed and displayed test results differ slightly. See *Interpreting test results* in this chapter for an explanation of the test values and a comparison of formats.

For printing and archiving, see *Archiving test results* in this chapter.

Interpreting test results

String summary (for a string of 12 V jars)

The test results in the STRING SUMMARY (STRING STATISTICS on the printout) are averages for the jar posts and straps in the string. If you tested without a reference value, dashes appear in the fields that are marked in this example with asterisks (*).

STRING ID

ABC TEST

TECHNICIAN:

ABC123

BATTERY MANUFACTURE:

XYZ STATIONARY BATTERY

BATTERY MODEL:

MODEL 12345

☐ on printout only

⬚ on display only

9/28/2005

3:35 PM

STRING STATISTICS

* REFERENCE :	1000S	mhos (siemens) value selected in BATTERY SETUP
JARS :	4	Number of jars in the string
JARS TESTED :	4	Number of jars tested
* AVERAGE MHOS :	775S	Average conductance mhos/siemens for the string
* AVERAGE % :	77%	Percentage of the reference value for the string
* DECISION :	GOOD	GOOD, WARN (?), or FAIL (!)
* LOW JAR : J4	50%	Percentage of the reference value for the jar (J4 = fourth jar tested) with the lowest conductance value.
* HIGH JAR : J1	90%	Percentage of the reference value for the jar with the highest conductance value. (J1 = first jar tested)
* STRING % J1	86%	The string's average compared to the highest jar (i.e., the string's 775 avg. mhos divided by the measured 900 mhos of highest jar.
TEMPERATURE :	72 °C	Temperature selected in BATTERY SETUP
AVG. VOLTAGE :	13.917V	Avg. voltage of the string.
VOLTS PER JAR :	12V	Number of volts per jar selected in BATTERY SETUP
STRING WARN % (?) :	70%	
STRING FAIL % (!) :	60%	Percentages of the reference value selected in UTILITIES SETUP below which the string and jars must fall to generate WARN (?) and FAIL (!) notices
JAR WARN % (?) :	70%	
JAR FAIL % (!) :	60%	
LOW VOLTAGE:	12.600V	Low voltage threshold selected in BATTERY SETUP for the string.
DC FLOAT V. :	53.50V	String float voltage
DC FLOAT A. :	0.047A	String float current (amps)
AC RIPPLE :	0.059V	String AC ripple voltage

Jar statistics

The JAR STATISTICS report shows the volt and mhos/siemens results for jars with their measured percentages of the reference value (%REF) you selected in BATTERY SETUP. (If you tested without a reference value, dashes appear in reference fields.) If you tested both the jars and straps in a string, the report shows resistance measurements (μOhm) for the strap in place of the percentage of the reference value. JAR STATISTICS appears only in the printout and prints after STRING STATISTICS.

Jar data

The values in JAR DATA (JAR STATISTICS on the printout) are the test results for jar posts and straps. The analyzer displays and prints results in the order in which jar and straps were tested. The format is the same for displayed and printed results. If you print results from JAR DATA, the printout will show the results for the selected jar or strap, not the entire string.

Results for JARS ONLY (for a string of 12 V jars)

JAR STATISTICS

JAR	VOLTS	MHOS	%REF
1	2.263	900	90%
2	2.262	890	89%
3	2.265	720	72%
4	!2.051	690?	69%

Low volts warning (!)

In MHOS column: 4 with a ? to indicate that it is below the WARN threshold percentage of the reference value (FAIL= !, WARN = ?)

Results for JARS AND STRAPS with 4 posts

JAR STATISTICS

JAR	VOLTS	MHOS	μOhm
J1A	2.011	224!	6
J1B	2.263	900	9
J2A	2.262	890	7
J2B	2.262	890	6

The analyzer uses letter designations if the jar has more than one set of posts

A = first set of +/− posts tested on the jar

B = second set of +/− posts tested on the jar

In μOhm column:

Resistance measurements in microhms of strap connections

Results for JARS
(if AC voltage/current ripple present)

JAR STATISTICS

JAR	VOLTS	MHOS	%REF
J1	2.263	900	90%
AC mV : 132		AC A : 2.2	
J2	2.262	890	89%
AC mV : 40		AC A : 0.6	

NOTE: You can retest any jar or strap displayed in JAR DATA. Refer to *Retesting after testing the string* in *Chapter 6.*

**NOTE: The analyzer displays and prints dashes (−−−−−) if you selected VOLTS ONLY in BATTERY SETUP, or if you selected VOLTS THEN CONDUCTANCE, but did not complete the conductance measurement.

First jar tested

Decision on jar condition

** Jar mhos/siemens

Jar percentage of ref. value

Ref. value selected in BATTERY SETUP

J1	
G: GOOD	VOLTS: GOOD
900℧	2.263VDC
90%	0.0A AC
0% 60%	
REF: 1000℧	TEMP: 25 °C
🖶 PRINT	'C' END

Jar is above low voltage warning threshold

Estimated AC current in the battery string

Jar FAIL threshold of 60% of the ref. value

Temperature selected in BATTERY SETUP

First strap tested

Strap resistance in microhms

Reference value selected in BATTERY SETUP

S1	
G:	VOLTS: GOOD
6μΩ	2.263VDC
REF: 1000℧	TEMP: 25 °C
🖶 PRINT	'C' END

Jar is above low voltage warning threshold

Temperature selected in BATTERY SETUP

Determining the strength of the string

To help you determine the strength of the string, use the percentages of the reference value from STRING SUMMARY for all of the jar posts and straps. Table 7 lists ranges of reference value percentages, jar condition, and a recommended action to take.

Archiving test results

Archiving test data on site can help you:

- Compare results for changes or trends in string performance

- Recognize when your string needs maintenance or repair

- Provide warranty data for your supplier

Options

There are three ways you can archive test results using the accessories included in the kit:

- Print test results with the IR printer

- Transfer test results to a PC through the IR receiver, serial cable, and PC software

- Copy test results to a PC from the analyzer's memory card

Table 7: String strength related to % of reference value

% of the reference value	String strength	Recommended action
> 70%	Good condition	Check the jars for physical damage
60–69%	Warning	Check for problems and refer to: ✓ test results or other information about the string to determine the cause of low readings ✓ your company procedures for jar maintenance ✓ *IEEE standard 1188-1996: Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated, Lead-Acid (VRLA) Jars for Stationary Application*
< 60%	Fail	Replace the jars. Refer to your company jar replacement procedures or IEEE standard 1188-1996

Printing the STRING SUMMARY results

1. Turn on the printer by pressing the **MODE** button.

2. Press the **ARROW** keys to highlight the REPORTS icon, and press **ENTER**.

3. Press the **ARROW** keys to highlight the STRING SUMMARY icon, and press **ENTER**.

4. Press the **ARROW** keys to select the string name, and press **ENTER**.

5. Align the analyzer's IR transmitter (to the right of the cable connector) with the IR receiver on the printer (below the **MODE** button).

6. Press the **PRINT** key. Keep the IR transmitter and receiver aligned for as long as it takes to print.

7. Press the **BACK** key to end.

Printing the JAR DATA results

1. Turn on the printer by pressing the **MODE** button.

2. Press the **ARROW** keys to highlight the REPORTS icon, and press **ENTER**.

3. Press the **ARROW** keys to highlight the JAR DATA icon, and press **ENTER**.

4. Press the **ARROW** keys to select the string name, and press **ENTER**.

5. Press the **ARROW** keys to select a jar or strap screen, and press **ENTER**.

6. Align the analyzer's IR transmitter (to the right of the cable connector) with the IR receiver on the printer (below the **MODE** button).

7. Press the **PRINT** key. Keep the IR transmitter and receiver aligned for as long as it takes to print.

8. Repeat steps 5, 6, and 7 for each screen you want to print.

9. Press the **BACK** key to end.

Transferring test results to a PC with the IR receiver (TRANSFER)

You can transfer one file at a time or all files simultaneously to a PC with the software and IR receiver included in the kit.

After installing the software according to the installation instructions:

1. Press the **ARROW** keys to highlight the REPORTS icon in the **Main Menu**, and press **ENTER**.

2. Press the **ARROW** keys to highlight the TRANSFER icon in the REPORTS MENU, and press **ENTER**.

To transfer data for every string tested:

3. Align the analyzer's IR transmitter (to the right of the cable connector) with the IR receiver.

4. Place a check in the box next to TRANSFER ALL DATA, and press **ENTER**. The Main Menu appears when the transfer is complete.

To transfer data for a particular string:

3. Align the analyzer's IR transmitter (to the right of the cable connector) with the IR receiver.

4. Place a check in the box next to SELECT FILE. Scroll to the string name containing the test data you want to

transfer, and press **ENTER**. The data will take several seconds to transfer after which the Main Menu appears.

Transferring files to a PC from the memory card

The Celltron ULTRA uses an SD memory card to store test data, which can be uploaded to a PC. An SD card reader, which connects to a USB port, is included in the kit. The files have the extension .csv and open in Microsoft Excel. You can purchase SD memory cards at any office supply or computer store. Starting with the Revision H software, the Celltron ULTRA accepts 32 MB to 1 G cards. Larger storage sizes are not compatible.

IMPORTANT: The memory card stores data as "read only." To avoid corrupting the data on the card, do not remove the label and unlock the card to copy files from the PC. When you purchase a new SD card, make sure its tab is in the locked position before using. The Celltron ULTRA can read and write files when the card is in the locked position. Always keep the card's tab in the locked position to prevent files from being corrupted by your PC's operating system. Format the card using the FORMAT option in BATTERY SETUP before using.

1. Connect the card reader to the USB port on the PC.

2. Insert the memory card into the card reader.

3. Save the files into a directory on your hard drive.

Additional options in the REPORTS menu

In addition to the test data options, the REPORTS menu has two sources of information that are helpful in tracking the analyzer's usage and software maintenance:

Counting the number of tests performed (TEST COUNTER)

The Celltron ULTRA automatically keeps track of the number of tests performed. Select the TEST COUNTER icon and press **ENTER** to see the total number of tests performed since the analyzer was first used.

Finding the analyzer software VERSION

Select the VERSION icon and press **ENTER** to display the serial numbers of the analyzer, cable, flash memory, and EEPROM firmware versions. The information will be helpful when you call Midtronics for software updates, service, and parts.

Chapter 8: Digital Multimeter (Dmm)

To use the Celltron ULTRA multimeter, press the **ARROW** keys to highlight the Dmm icon in the Main Menu, and press **ENTER**. Press the **ARROW** keys to highlight one of the four meters in the Dmm Menu, and press **ENTER** to select. Press the **BACK** key when finished.

DC voltmeter

The DC voltmeter measures from real-time DC voltage from 0 to 25 Vdc. The voltmeter displays the voltage as a value with an analog meter graphic.

AC voltmeter

The AC voltmeter measures real-time AC voltage from 0 to 10 Vac. The voltmeter displays millivolts as a value with an analog meter graphic.

Scope

The scope provides a real-time voltage trace with a range of 0 to 25 Vdc. Scope options include:

1. Auto setup

Press **1** to enable the scope to autorange.

2. Run/hold

Press **2** to toggle between **RUN** mode (measure and display signal) or **HOLD** mode (freeze signal).

3. Time Display

Press **3** to place the scope in time mode. The horizontal axis is in seconds and the vertical axis is in volts.

4. FFT display

Press **4** to place the scope in frequency mode. The horizontal axis is in hertz and the vertical axis is in volts.

Current

Connect to the jar posts to estimate the AC ripple current through the jar.

Chapter 9: Troubleshooting

The troubleshooting tips in this section will help you resolve most testing and printing problems. For problems with the printer, digital temperature gun, or the PC software application, refer to their manuals or call Midtronics Customer Service for assistance. (See *Patents, Limited Warranty, Service*.)

Screen does not power on during testing (no text/graphics)

✓ Check the connection to the jar.

✓ The jar voltage might be too low (less than 1 volt) to test.

✓ The analyzer's battery pack might need to be recharged or replaced.

| Full | 75% | 50% | 25% | Recharge |
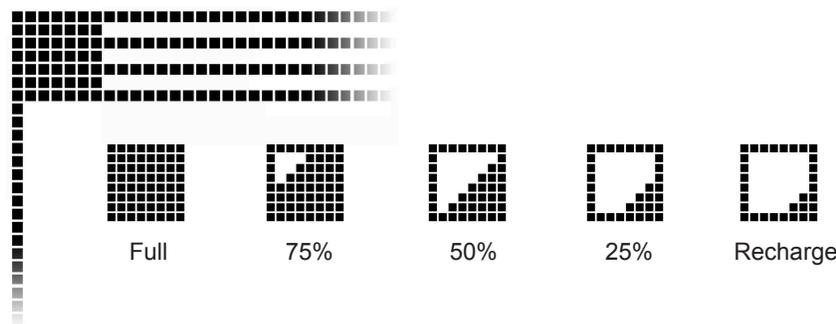
in *Display, keypad, and connections* in *Chapter 2*.

2. Connect the power of the AC adapter to an AC outlet.

3. Periodically turn on the analyzer and check if the charge level indicator is black. When the battery pack is fully charged, disconnect the adapter from the analyzer and the AC outlet.

NOTE: The maximum charge time is 16 to 18 hours. Do not overcharge.

If the analyzer fails to advance to the next jar count, try to retest.

Replacing the analyzer battery pack

If the screen does not power on after recharging, replace the battery pack.

1. The battery compartment is on the back of the analyzer. Press the arrow on the cover of the battery compartment door.

Recharging the analyzer battery pack

The square in the upper left corner of the display indicates the charge level of the battery pack. The square is black when the battery pack is fully charged. It gradually changes to white as the charge level declines.

Recharge the analyzer battery pack if:

✓ The display does not turn on when you press the **POWER** button.

✓ The screen displays:

> **WARNING**
> INTERNAL BATTERY LOW!
> REPLACE BATTERIES SOON!

1. Insert the AC adapter plug into the connector as shown

2. Slide the cover in the direction of the arrow.

3. Disconnect the pack and remove it.

4. Place the new pack (with the label facing up) into the battery compartment.

5. Connect the battery pack cables.

6. Slide the cover into place.

If the problem persists, call Midtronics Customer Service. (See *Patents, Limited Warranty, Service.*)

Probe tip is bent or stops retracting

To replace a damaged a probe tip:

1. Grasp the probe tip with pliers at the top of the sleeve.

CAUTION: Do not grasp the sleeve that encases the tips. You can damage the probe.

2. Pull the tip straight out.

3. Grasp the replacement tip with the pliers and insert it into the sleeve.

4. Push the probe tip into a soft surface, such as cardboard, until it hits the bottom of the sleeve.

NOTE: To obtain replacement tips, contact Midtronics Customer Service. (See *Patents, Limited Warranty, Service*.)

FILE NOT FOUND

If the last file created, opened, or used does not match any files on the memory card, the analyzer will beep and display FILE NOT FOUND. The analyzer's internal EEPROM memory stores the last test used. When the analyzer powers on, it looks for the last file used on the memory card. To prevent the message from reappearing when you turn on the analyzer, insert the card containing the file, open an existing file, or create a new file on the card.

Data is corrupt on the memory card

If you are unable to select a string name, or the display shows garbled characters, the data on the card might be corrupt. Try to salvage the files by copying them to your PC using the card reader included in the kit (USB port required). Reformat the memory card using the FORMAT option in the BATTERY SETUP menu. **Do not copy the files BACK to the memory card.**

If the label has been removed, make sure the tab on the card is in the locked position. To avoid corrupting the data, do not unlock the card to copy files from the PC. When you purchase a new SD card, place the tab in the locked position before using.

Test results do not print or print incorrectly

STATUS LED

When a printer fault occurs, the **STATUS LED** flashes. You can identify the fault by the number of sequential flashes:

Solutions

✓ If the IR transmitter and receiver are not aligned,

all the data may not print. The infrared ports on the top of the analyzer and on the printer (below the **MODE** button) should be pointed directly at each other. The maximum distance for reliable transmission between the ports is 18 inches (45 cm).

To realign, press the **BACK** key to cancel the print. Verify alignment between the analyzer and printer; then try to print the test results again.

✓ If the message PRINTING appears on the screen, but no data are printing, press the **BACK** key to cancel the print. Turn off the printer and charge the printer battery for at least 15 minutes before attempting to print again. Align the analyzer and printer IR transmitters and print again.

✓ Make sure the printer is on. The printer shuts off after two minutes of inactivity to conserve the battery. To turn the printer on, briefly press the **MODE** button. The green **STATUS** light should turn on. Make sure you are using the Midtronics printer provided with the Celltron ULTRA. Other printers may not be compatible.

✓ Direct sunlight interferes with infrared data transmission/receiving. If the printer is not receiving data, remove the printer and the Celltron ULTRA from direct sunlight. If the printed characters are not clear or are partially missing, recharge the battery and reprint.

✓ Verify that the correct printer is selected in the analyzer. Press the **ARROW** keys to highlight the UTILITIES SETUP icon in the Main Menu, and press **ENTER**.

✓ Verify that a compatible communications protocol is selected in the printer setup. IrDA Mode is compatible with the Midtronics printer ("IRDA Physical Layer" on the printer's self-test printout). Refer to the printer manual for information.

✓ If you are unable to print after ensuring the analyzer is functioning, the printer is on, the batteries are good, and the IR transmitter and receiver are aligned, see the printer manual for further instructions or call Midtronics. (See *Patents, Limited Warranty, Service*.)

Sequence	Condition	Solution
* * *	Paper out	Fit new paper
** ** **	Thermal head too hot	Allow head to cool
*** *** ***	Batteries low	Recharge printer batteries for 16 hours

Product Specifications

Model Number:

CTU-6000 (analyzer); CTU-6000 KIT

Applications:

Tests individual lead-acid cells or monoblocs (up to 16 volts) in any common configuration

Voltage:

1.5–20.0 Vdc

Conductance:

100–19,990 siemens

Test Data Storage:

500 string locations of 480 test results stored internally

Accuracy:

± 2% across test range

Voltmeter Resolution:

5 mV

User Programmable Functions:

- Preset values for over 250 battery types

- Low voltage alarm setting

- Low conductance warning

- Low conductance failure

- Test mode (pushbutton/autostart)

Calibration:

Auto-calibration before every test; no future calibration required

Connectorized Test Cable Options:

- Dual contact clamps

- Dual contact probes

- Custom cables by quotation

Power Requirements:

9.6 V, 1800 mAh, NiMH internal swappable battery and charger

Display:

LCD—FSTN

66.52 mm x 33.25 mm (2.62 in x 1.31 in), 128 x 64 pixels, 40-degree viewing angle, contrast ratio 8, green LED backlight

Keypad:

Stainless-steel dome, polycarbonate overlay, 1,000,000 actuations

Data Transfer:

Infrared protocol, half-duplex IrDA protocol, RS-232 printer, SD flash card

Environmental Operating Range:

0 to +40 ˚C, 95% relative humidity, non-condensing

Storage Temperature:

–20 to 82 ˚C

Over-Voltage Protection:

- Auto-reset disconnect

- Reverse polarity protected

Housing Material:

Acid resistant ABS plastic santoprene overmold

Analyzer Dimensions:

280 mm x 105 mm x 80 mm (11 in x 4 in x 3 in)

Case Dimensions:

485 mm x 395 mm x 180 mm

19 in x 15.5 in x 7 in

Analyzer Weight:

1.18 kg (2.6 lb)

CTU-6000 Kit Shipping Weight:

Approximately 5 kg (11 lb)

Patents

The Celltron ULTRA Universal Stationary Battery Analyzer is made in the U.S.A. by Midtronics, Inc. and is protected by one or more of the following U.S. Patents: 6633165; 6623314; 6621272; 6597150; 6586941; 6566883; 6556019; 6544078; 6534993; 6507196; 6497209, 6495990; 6469511; 6466026; 6466025; 6465908; 6456045; 6445158; 6441585; 6437957; 6424158; 6417669; 6392414; 6377031; 6363303; 6359441; 6351102; 6332113; 6331762; 6329793; 6323650; 6316914; 6313608; 6313607; 6310481; 6304087; 6294897; 6294896; 6262563; 6259254; 6249124; 6225808; 6222369; 6172505; 6172483; 6163156; 6137269; 6104167; 6091245; 6081098; 6051976; 6037777; 6037751; 6002238; 5945829; 5914605; 5871858; 5831435; 5821756; 5757192; 5656920; 5598098; 5592093; 5589757; 5585728; 5583416; 5574355; 5572136; 5469043; 5343380; 5140269; 4912416; 4881038; 4825170; 4816768; 4322685; 3909708; 387391; and 387391. Other U.S. and Foreign patents issued and pending. This product may utilize technology exclusively licensed to Midtronics, Inc. by Johnson Controls, Inc. and/or Motorola, Inc.

Limited Warranty

The Celltron ULTRA is warranted to be free of defects in materials and workmanship for a period of one year from date of purchase. Midtronics will, at our option, repair or replace the unit with a remanufactured unit. This limited warranty applies only to the Celltron ULTRA analyzer, and does not cover any other equipment, static damage, water damage, overvoltage damage, dropping the unit, or damage resulting from extraneous causes including owner misuse. Midtronics is not liable for any incidental or consequential damages for breach of this warranty. The warranty is void if owner attempts to disassemble the unit or to modify the cable assembly.

Service

To obtain service, purchaser should contact Midtronics for a Return Authorization number, and return the unit to Midtronics freight prepaid, Attention: RA# _____. Midtronics will service the analyzer and reship the next scheduled business day following receipt, using the same type carrier and service as received. If Midtronics determines that the failure was caused by misuse, alteration, accident, or abnormal condition of operation or handling, purchaser will be billed for the repaired product and it will be returned freight prepaid with freight charges added to the invoice. Battery analyzer beyond the warranty period are subject to the repair charges in effect at that time. Optional remanufacturing service is available to return the tester to like-new condition. Out-of-warranty repairs will carry a 3-month warranty. Remanufactured units purchased from Midtronics are covered by a 6-month warranty.

MIDTRONICS **www.midtronics.com**

Corporate Headquarters
Willowbrook, IL USA
Phone: 1.630.323.2800

Canadian Inquiries
Toll Free: 1.866.592.8053

Midtronics b.v.
European Headquarters
IJsselstein, The Netherlands
Serving Europe, Africa, the Middle East, and The Netherlands
Phone: +31 306 868 150

European Sales Locations
IJsselstein, The Netherlands
Paris, France
Dusseldorf, Germany

Midtronics China Office
China Operations
Shenzhen, China
Phone: +86 755 8202 2037

Midtronics India
Mumbai, India
Phone: +91.989 237 6661

Asia/Pacific (excluding China)
Contact Corporate Headquarters
Phone: +1.630.323.2800