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## **Baker DX Series Static Motor Analyzer Quick Reference Guide**

**Part number: 71-031 EN V1**

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## **Baker DX Series**

### **Static Motor Analyzer**

#### **Quick Reference Guide**

*For use with 4 kV, 6 kV, 6 kV HO (high output), 12 kV, 12 kV HO, 15 kV and 15A models.*

*Reference number of the user manual: 71-031 EN*

*Revision: V1*

*Date of publication: December 2018*

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 **CAUTION**

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the device is used in its installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the product manual, may cause harmful interference to radio communications. If this equipment causes harmful interference, the user is required to correct the interference.

Because of the phenomena being observed and the material properties being measured, this equipment emits radioelectric energy when in active test mode. It must be ensured that this radio energy does not cause any damage to people or equipment located nearby.

 **WARNING**

Never exceed the maximum operational capabilities of the Baker DX tester, power supplies, or Baker ZTX accessory. If the equipment is used in a manner not specified by Megger, the protection provided by the equipment may be impaired.

Be sure to follow all safety procedures prescribed by your company, industry, and applicable standards. Failure to observe these safety precautions may result in death or serious electric shock.

**Reference for additional information**

The Baker DX quick reference guide is designed to provide users with an overview of the analyzer and its basic testing and operating procedures. For complete safety information and detailed device information, user license agreement, CE compliance, and more information on additional features, refer to the Baker DX User Manual.

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# 1. Baker DX instrument overview

## Front panel controls

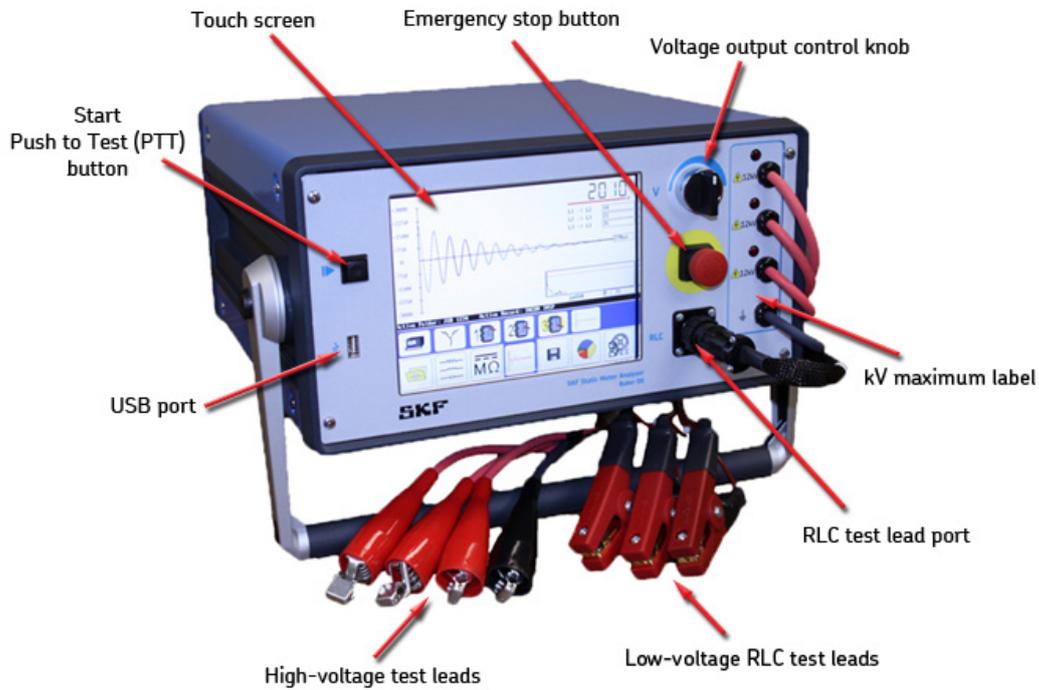


Figure 1. Front panel controls

## Rear panel controls

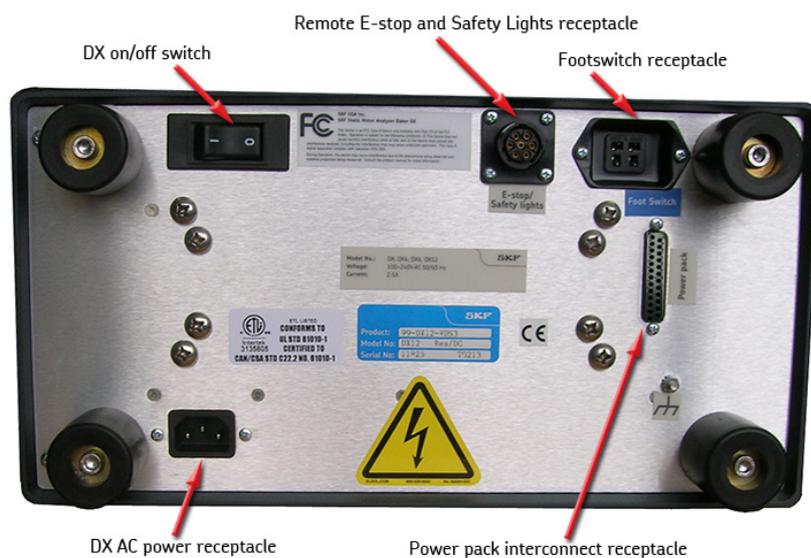
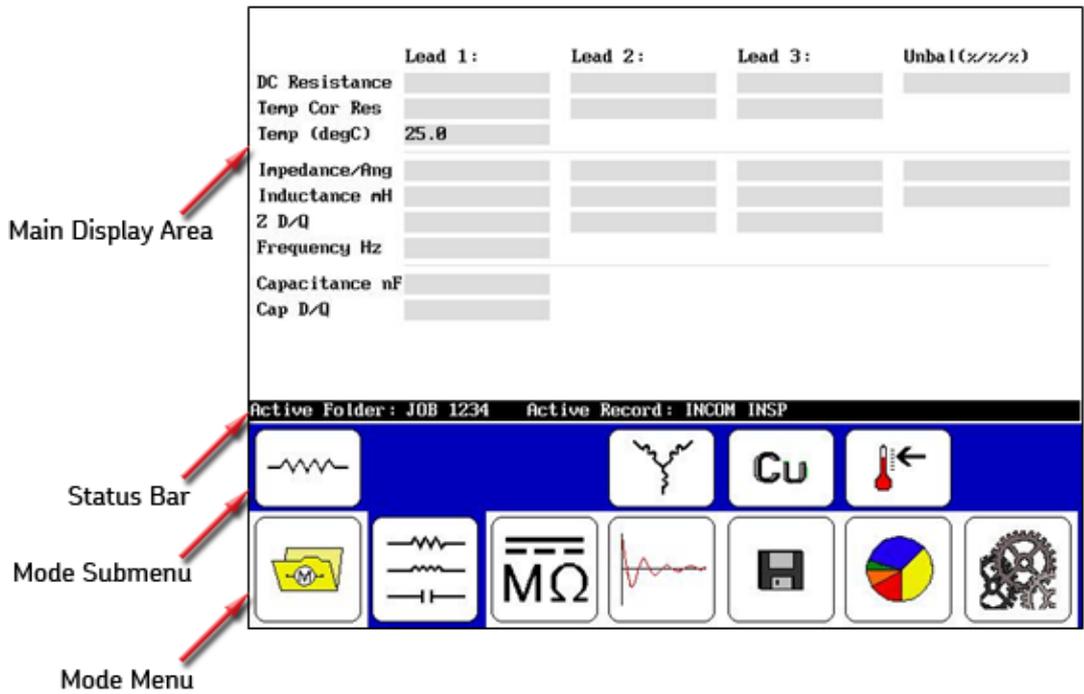


Figure 2. Rear panel controls

### User interface main elements

**NOTE**

This section provides an introduction to the Baker DX software user interface elements. For further details about the various modes, Mode submenus, popup menus and other elements that can appear during testing, refer to the Baker DX User Manual.



**Figure 3. User interface main elements.**

**Main Display Area**—displays all measurements, test results, and more as you execute your tests.

**Status Bar**—displays information about the Active Folder and Active Record. The elements show you where the information will be saved for the motor currently under test. The right third of the Status Bar is dynamic, displaying additional information such as the date and time, a running clock, notice of active ZS Override mode, PTT Locked indicator, or a test counter when needed.

**Mode Submenu**—items here change depending on the mode selected along with other items selected via the **Mode Submenu** itself or popup menus that appear in the **Display Area**.

**Mode Menu**—used to select the main mode of operation. Test and function modes are described below. The **Mode Menu** does not change, and is always available.

## Test and function modes

The large icons in the **Mode Menu** at the bottom of the touch screen represent the primary test modes. When a **Mode Menu** icon is touched, the icon will be surrounded by a blue background that indicates which mode the unit is in. The blue background also connects the selected mode with its submenu above.

The graphic below identifies the test and function modes that become active when you touch the corresponding icons.

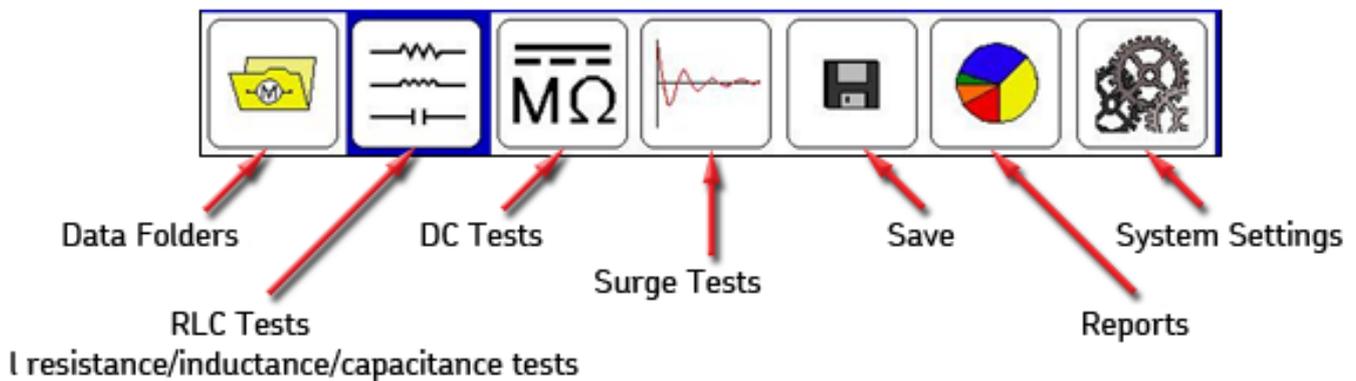


Figure 4. Mode menu icon descriptions.

## Mode submenus

The control icons for each mode appear in the submenu just above the **Mode Menu**. The **Mode Submenu** icons correspond to the **Mode Menu** item selected. In the following example, we see the descriptions of the **Mode Submenu** icons that appear when the **RLC Tests** icon is touched.

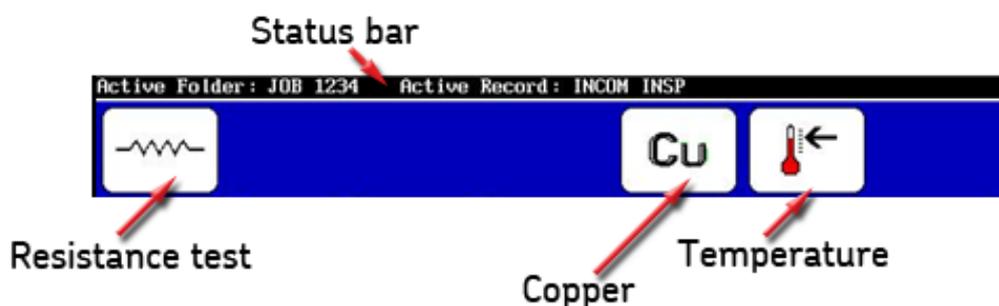


Figure 5. Mode submenu icons example.

## Popup menus

Popup menus appear when specific functions are selected during the testing process. In the example below, a popup appears in the **Main Display Area** when the **RLC test selection** icon is touched.

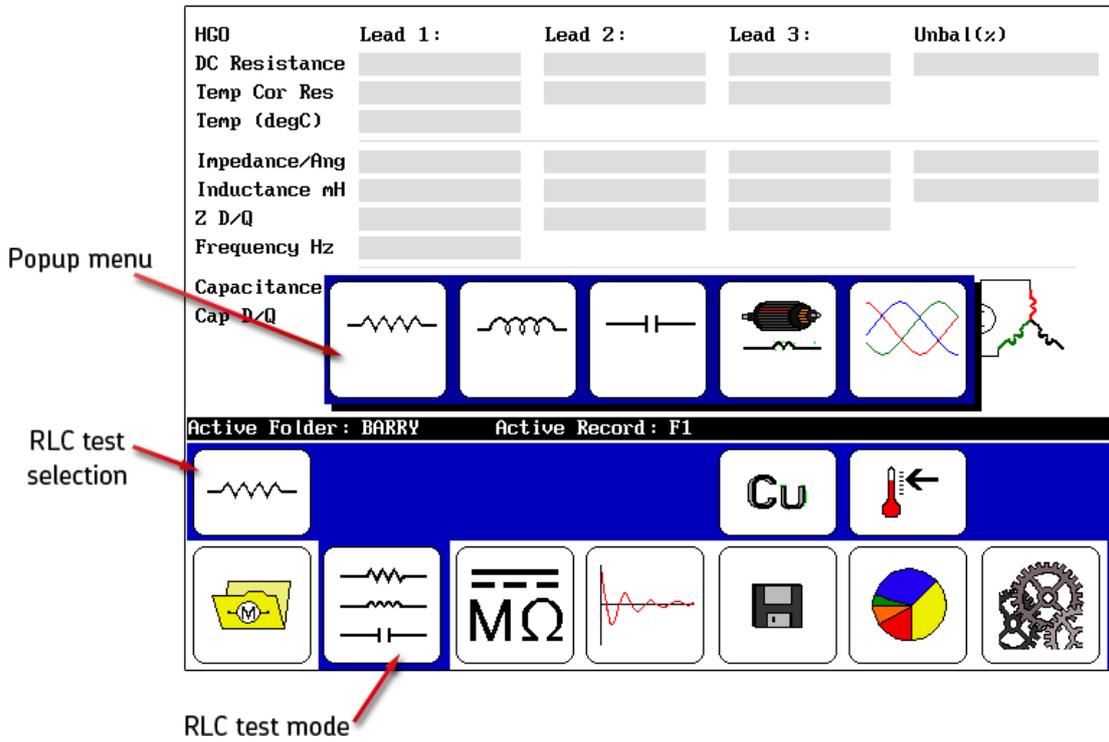


Figure 6. Popup menu appearing when the RLC test selection icon is touched.

The details of this popup menu are provided in the example below.

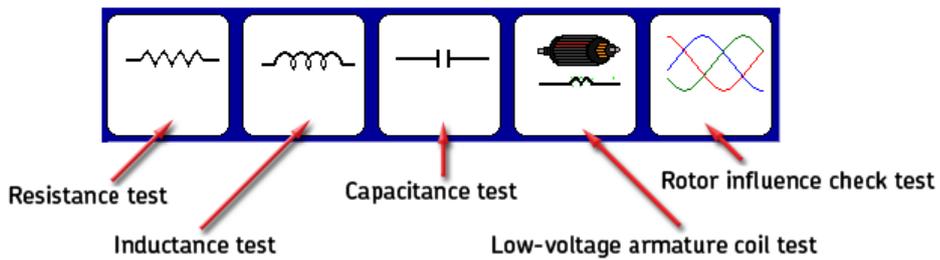


Figure 7. Popup menu icon descriptions for test type selection.

During HiPot testing, the top bar is active and can display two of the three measurement types shown—either voltage and current, or voltage and megohms as shown in this example. The grayed-out type is inactive.

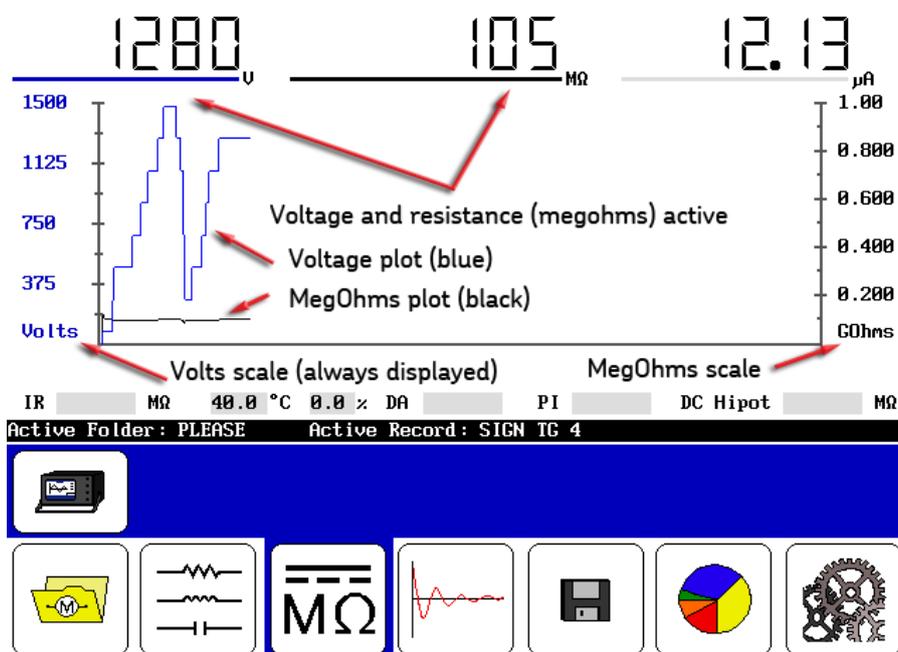


Figure 8. Top bar showing voltage and megohms active.

To select which measurement type to activate, simply touch either the megohms or current displays.

Depending on what is selected (megohms or current), the scale on the right side changes. The plot line in the **Main Display Area** also changes (black for megohms and red for current).

**NOTE**

While touching the values for current or megohm will change the measurements and scales presented, touching the screen in other parts of the Main Display Area will cause the unit to stop testing, which will be recorded as a user abort.

The voltage scale is always displayed and its plot color is blue.

In surge mode, the elements change based on the type of coil selected for testing. In each mode, a pulse counter shows you the number of pulses applied at a specific voltage during the test. If the voltage changes (such as during ramp up) the counter starts over.

The pulse count also appears in the test report.

## 2. Preparing for testing

### Select the location for saving data

1. Ensure that the proper active folder and record for saving data are selected. As you execute your tests, you will be prompted to save the test data as each test mode completes.
2. In the **Mode Menu**, press the **Data Folders** icon. Touching this icon brings the **Folder** and **Record** lists into the **Display Area** as shown below.

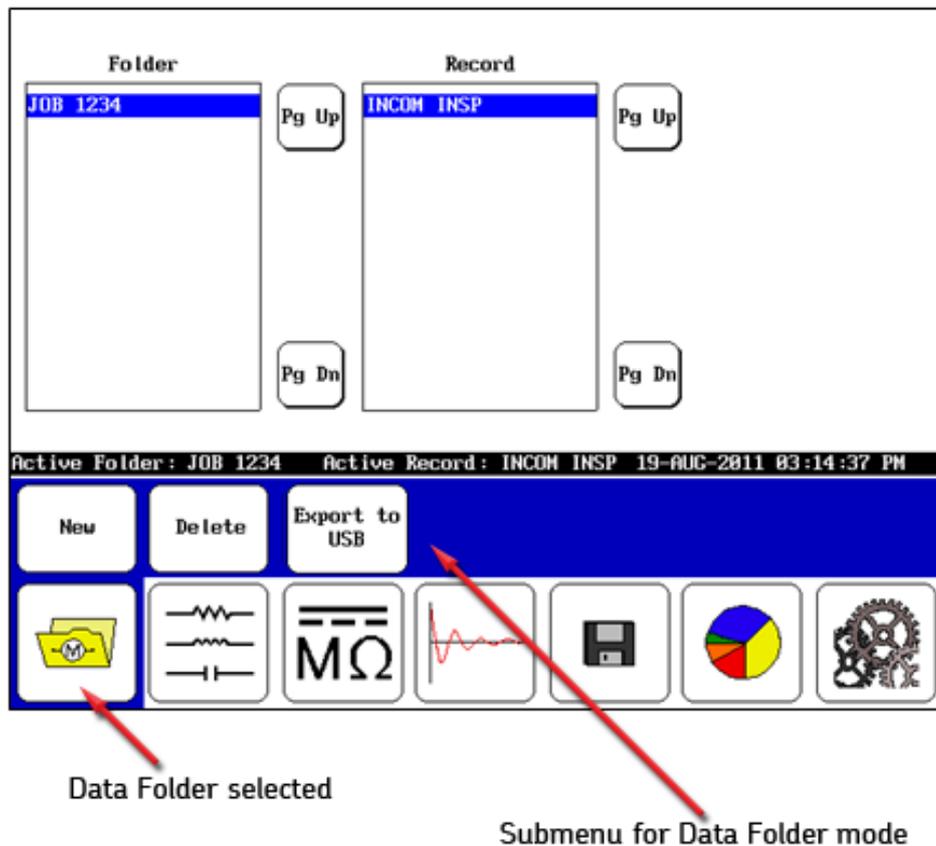


Figure 9. Selecting the active folder and record for saving test data.

3. Touch the record and folder you want to use for your testing. The selected location will appear in the **Status Bar** as **Active Folder** and **Active Record**.

## Viewing test results

1. To view existing data, touch the **Report** icon in the mode menu.
2. When you touch a folder in the **Folder** list, such as the **MEGGER** folder in the following example, the folder will be highlighted and all associated records that are in that folder will appear in the **Record** list.
3. Touch/highlight an item in the **Record** list and the results associated with the highlighted record will appear in the **Results** list.

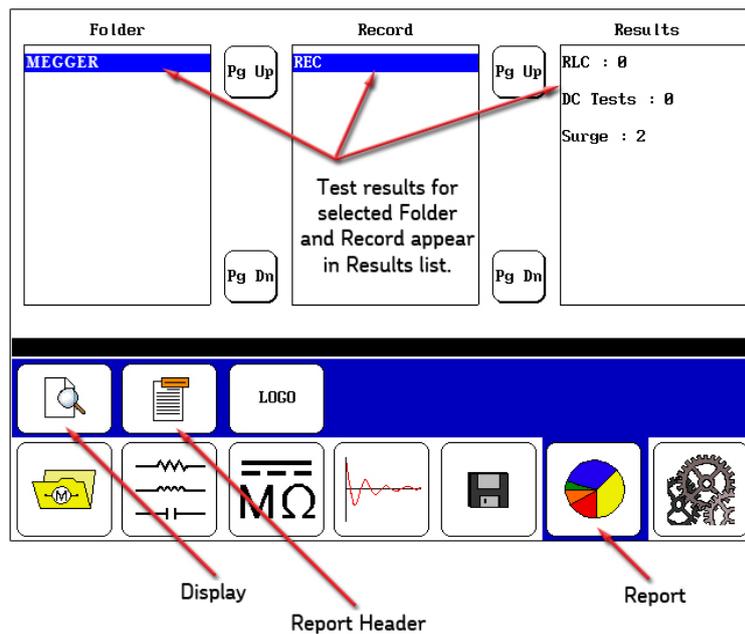


Figure 10. Record results.

4. When you touch the **Display** icon (which functions like a print preview), submenu items appear that allow results shown in the **Main Display Area** to be viewed according to test type, or to be printed.

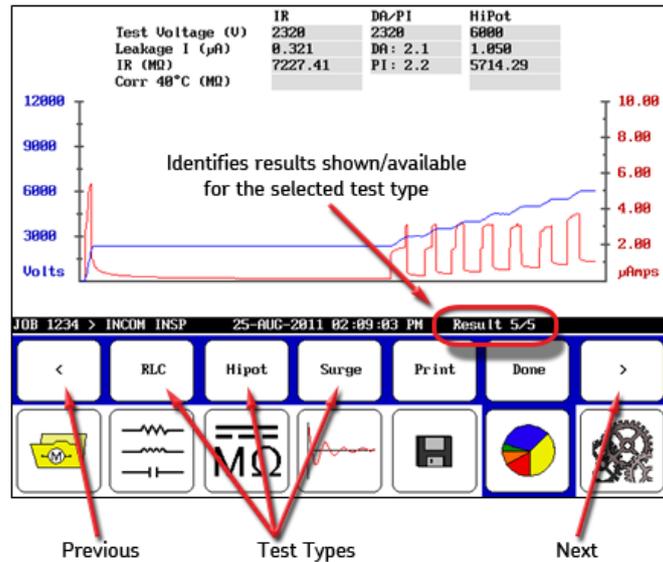


Figure 11. Display submenu icons.

- The **Previous** and **Next** arrows allow you to go through the results that are available for the selected test type.

**NOTE**

The test type selection icons are located just above their corresponding icons in the **Mode Menu**.

- An entry on the right side of the **Status Bar** shows you which result is displayed out of the total number of available results.
- Touch the **Print** button to print your report to a printer attached to the USB port.
- Touch the **Done** button to return the **Display Area** to the report panel.

**Determining a known-good coil to use as a reference**

Some types of testing require using a known good coil as a reference for comparing coil waveforms collected. If you will be conducting such tests and have not already established a reference (and known-good coil), this process shows you how to identify a known-good coil so that you can set the reference test for comparisons to other coils to be tested.

For details on this process, refer to the Baker DX User Manual.

**Rotor effect on testing**

When possible, remove or secure the rotor before testing. Rotors can affect testing results, particularly if they move (even slightly) during testing. Some issues can be erroneous high resistance imbalance in coil testing due to increased inductance, inability to polarize for DA/PI testing, or frequency shift in one or more waveform values during surge testing. An erratic PP EAR will often result and the shift could even trip the EAR limits.

## 3. Basic testing procedures

### Recommended testing sequence

1. Resistance, inductance/impedance, capacitance tests
2. DC tests (insulation resistance, DA/PI, and HiPot/step voltage)
3. Surge tests
4. PD tests (requires optional PD module)

Perform a sequence of progressively more rigorous tests.

If a test fails, troubleshoot, diagnose, and repair the problem before continuing with the next test in the sequence.

### Test leads used during testing

1. Resistance, inductance, capacitance/impedance tests: low voltage test leads; connections modified during capacitance testing
2. DC tests: high-voltage test leads
3. Surge tests: high-voltage test leads
4. PD tests: high-voltage test leads

### Conducting resistance, inductance, and capacitance tests

This unit performs coil resistance tests using low voltages (with low-voltage leads). Further testing (such as DC-HiPot or surge testing) is not necessary until the coil resistance measurement is acceptable.

Coil inductance tests look for changes in a winding's inductance brought about by shorted turns in the coils. Inductance readings for three-phase motors can be compared to each other with the knowledge that the inductance for the three phases should be very close to each other unless there is a short in one of the coils. Inductance measurements can also be compared to previous measurements or values specified by the original equipment manufacturers. Inductance testing also provides impedance values and angles.

DX capacitance tests measure only capacitance and D/Q. No impedance values or phase angle values are included.

### Resistance test procedures

1. Select the folder and record to use and check the **Status Bar** to ensure that the **Active Folder** and **Active Record** display the desired folder and record to be used.

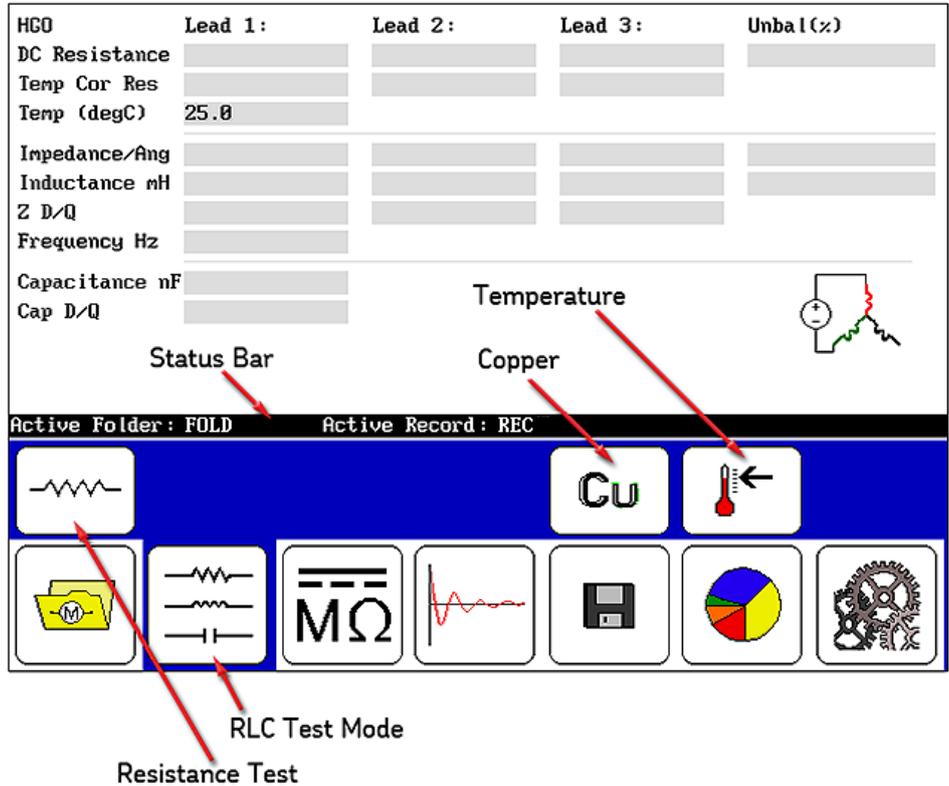


Figure 12. Resistance test start screen.

2. Touch the **RLC Test Mode** icon.
3. The **Resistance Test** icon appears as the default RLC test selection.
4. If performing temperature compensation, touch the icon for the proper type of conductor metal: aluminum or copper (**Copper** icon shown above).
5. If you need to define temperature compensation, touch the **Temperature** icon, then use the popup keypad to input actual winding (not ambient) temperatures. Otherwise, skip to step 7.
6. The default temperature is 25° C; key in the actual winding temperature to use for compensation and touch **Done**.

**NOTE**

The default temperature to correct to is defined in the User Settings. Refer to the Baker DX User Manual for more information.

- Push and release the **Start (PTT)** button to run the resistance test. The resistance test will be run for all three phases automatically. The "Leads Energized" message will appear at the top of the display. When the test finishes, the unbalance will display along with the resistance results.

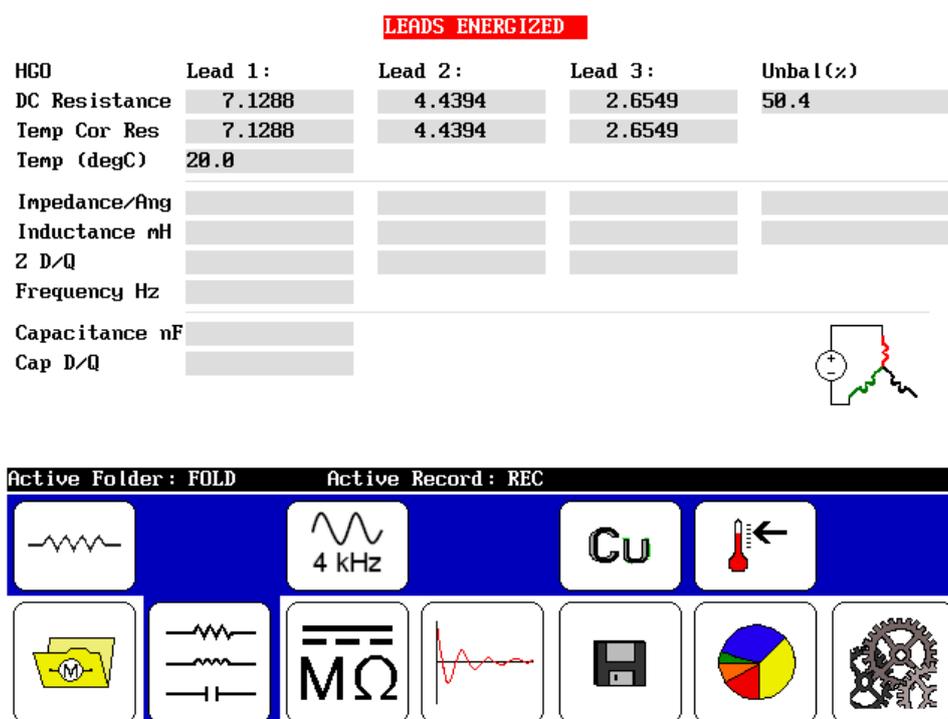


Figure 13. Resistance test results screen.

- If this resistance test was run as a standalone test, save the results. Saving resistance data at this time is not necessary if you plan to collect inductance and/or capacitance tests data as well; it can all be saved together when the tests complete. When you have completed your setup, close the screen.

Inductance testing is conducted in a similar manner.

- Touch the **RLC test selection** icon then touch the **Inductance test** icon in the popup menu.
- Touch the **Frequency** icon then touch the frequency value in the popup menu.
- Push and release the **Start (PTT)** button to run the inductance test. The inductance test will be run for all three phases automatically. The "Leads Energized" message will again appear at the top of the display.

Capacitance testing is also conducted in a similar manner; though cable connections will need to be adjusted during that process.

**Lead cautions still apply, but you must modify connections of the RLC test leads to a capacitor test configuration.**

1. Connect RLC test lead No. 1 to any motor lead.
2. Connect RLC test lead No. 2 to ground.
3. Disconnect RLC test lead No. 3 and **leave disconnected**.

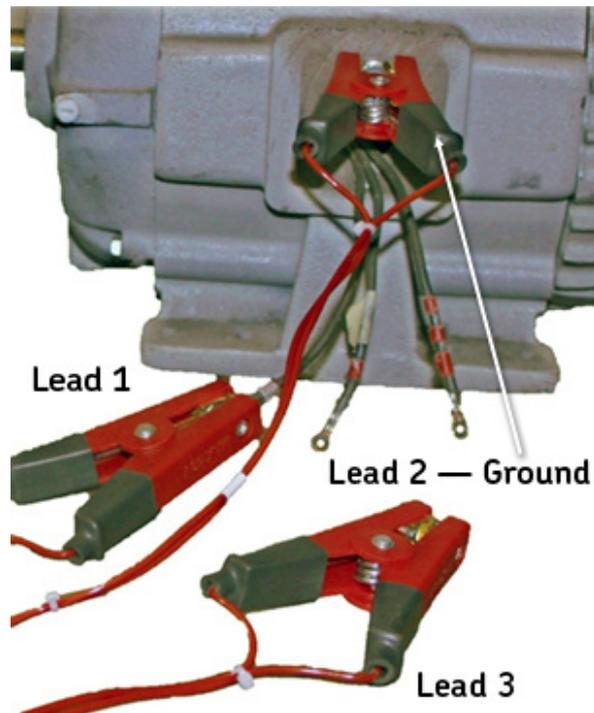


Figure 14. Capacitance test lead connections.

4. Touch the **RLC test selection** icon then touch the **Capacitance test** icon in the popup menu.
5. Push and release the **Start (PTT)** button to run the capacitance test.

## Conducting DC tests

### NOTE

Because the motor's operating voltage is the basis for the test voltages used, you must determine the input values before starting DC or Surge tests.

Using VLL = 480 volts as an example, the base value for the DC and Surge tests would be:

$$(2 \times VLL) + 1,000 = 1,960 \text{ volts (2000 volts)}$$

Refer to the *Baker DX User Manual*, "Appendix C — DC and surge tests voltages" for more in-formation.

1. Ensure that the **Active Folder** and **Active Record** are those that you want to use for the DC tests.

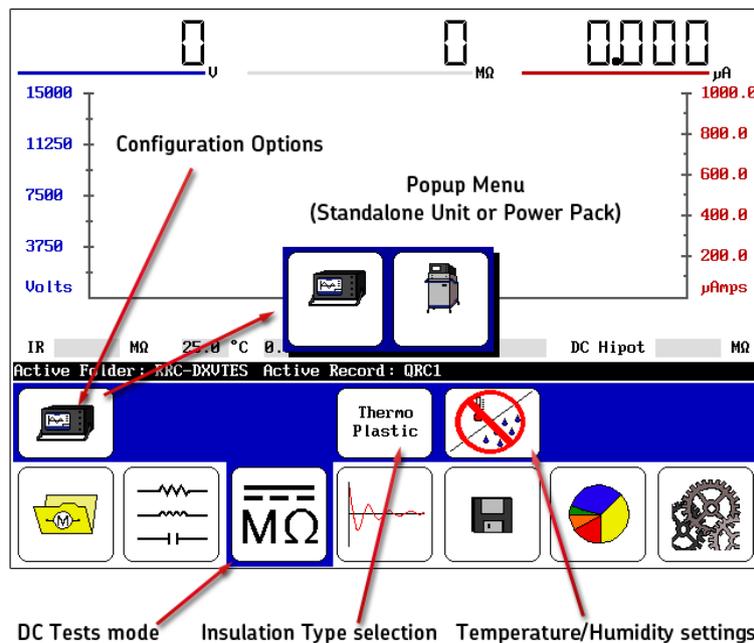


Figure 15. DC Tests start screen.

2. Touch the **DC Tests** icon then the **Configuration Options** icon when it appears in the submenu. Icons for installed options will appear in a popup menu, presenting a choice of operation such as testing on a standalone unit or a power pack.
3. For this example, touch the **Standalone Unit** icon.
4. If you know the type of insulation used in your motor, you can specify that by touching the **Insulation Type** selection icon. Choices include Thermo Plastic or Thermo Setting.

### Compensating temperature and recording humidity

- 5. To compensate temperature and/or record humidity, touch the **Temperature/humidity** icon; otherwise, skip to step 7.
- 6. The following popup menu is used to enable/disable temperature and humidity compensation and to select the compensation needed for these test elements when compensation is enabled.

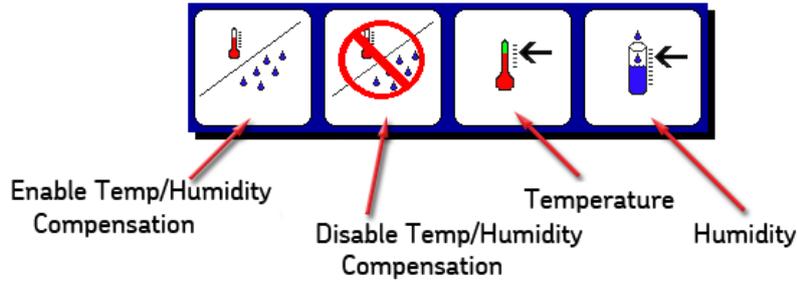


Figure 16. Temperature and humidity compensation popup menu.

- a. Touch the **Enable Compensation** icon or the **Temperature** icon.
  - b. The default temperature is 40° C; use the keypad to enter the actual motor temperature then touch **Done**.
  - c. For reference purposes, you can specify the humidity by touching the **Humidity** icon then use the keypad to enter the percentage of relative humidity.
  - d. Touch **Done** after making your entry.
7. Push and hold the **Start (PTT)** button; the following controls appear.

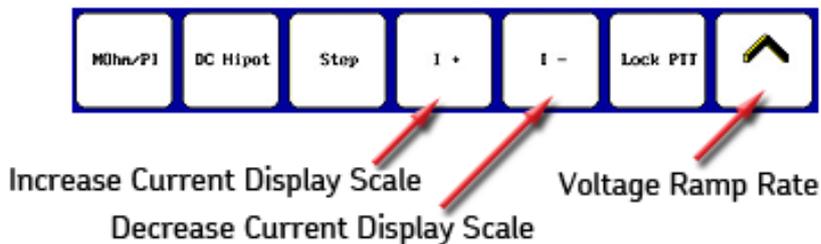


Figure 17. Test submenu items.

- a. If hands-free testing is desired, touch the **Lock PTT** icon. When the icon changes to a yellow highlight as shown in the example below, release the **Start (PTT)** button. When the **Lock PTT** icon has yellow highlighting, PTT functions are locked. The submenu will look like the following example while the tests are running:

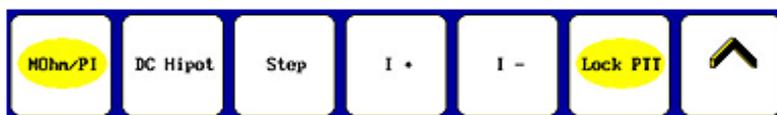


Figure 18. Test submenu items with Locked PTT and MOhm/PI test selected (both identified by yellow highlights).

**WARNING**

Never leave the unit unattended when using the Lock PTT feature. High voltage may be present, which could result in injury or death from severe electrical shock.

- b. Rotate the **Voltage Output Control** knob on the front panel to raise the target voltage level (for example, 500 volts for a 480- volt motor). Use the **Fast** or **Slow Ramp Rate** controls as needed to fine tune the level.



Figure 19. Ramp Rate controls.

- c. Use the **Increase Current Display Scale (I+)** or **Decrease Current Display Scale (I-)** icons as needed to adjust the current's scale.
  - d. After setting the target voltage, touch the **MOhm/PI** icon to start the megohm insulation resistance (IR), dielectric analysis (DA), and polarization index (PI) tests.
8. The **Status Bar** displays a countdown timer for each of the megohm, step voltage, and DC HiPot tests as shown in the following example.

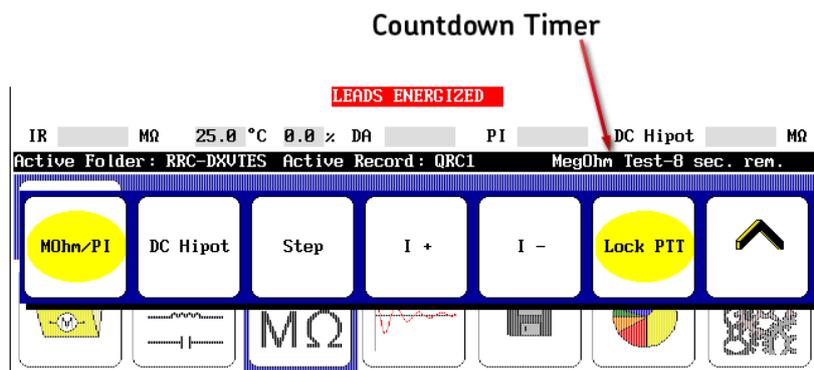


Figure 20. Status Bar with Countdown Timer.

- e. As each test progresses, the software displays the test results in the fields located just above the **Status Bar**. The IR results appear after 60 seconds, the DA results after 180 seconds, and the PI test after 600 seconds.

### Conduct step voltage (optional)

Following the PI test, conduct a step voltage test if it suits your needs.

1. Touch the **Fast** or **Slow** icons as desired to adjust the ramp rate.
2. Use the **Voltage Output Control** knob to set the voltage to the desired maximum level for example, 2000 volts for a 480-volt motor).
3. Touch the **DC-Hipot** icon to run the 60-second test.
4. When the test completes, release the **Start (PTT)** button or touch the **Lock PTT** icon to unlock if you were using hands-free mode.

**CAUTION**

**Allow the unit to discharge completely before disconnecting test leads.**

**NOTE**

Pressing PTT or touching the screen during testing will stop the test, and will be reported as "user abort" status.

5. Touch the **Save** icon to save the test results to the active folder and record.

The demonstrated DC tests were chained together in a recommended best practice approach, but you may separate and perform them individually or in other combinations as required or preferred.

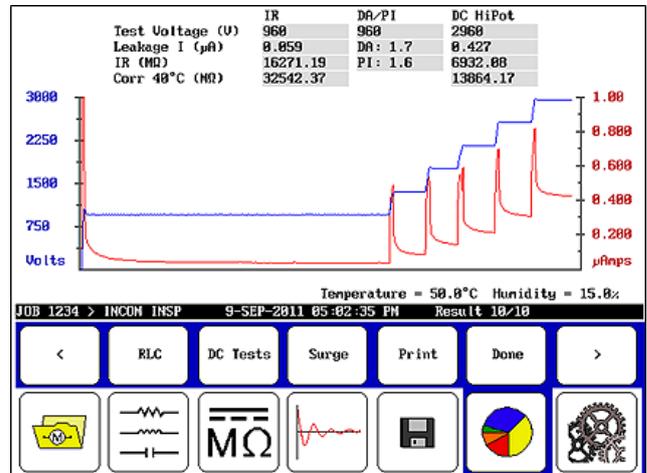


Figure 21. DC Tests results screen from Reports.

### Conducting Surge tests

1. Ensure that the **Active Folder** and **Active Record** are those that you want to use for the subsequent tests, and that the **Configuration Options** icon is set to **Standalone**.

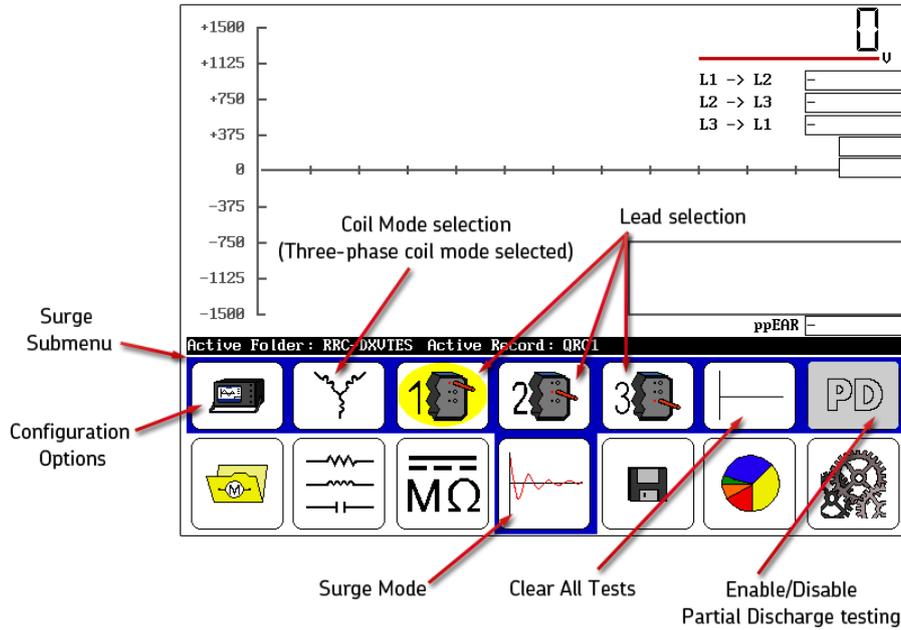


Figure 22. Surge test start screen.

2. Touching the **Coil Mode Selection** icon in the **Mode Submenu** brings up the popup menu shown below to select the mode needed. For this example, touch the **Three-phase coil mode** icon.

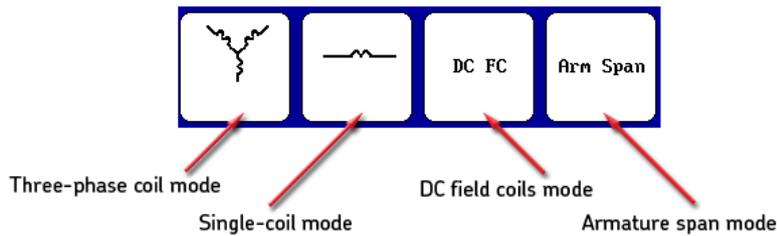


Figure 23. Coil Mode Selection popup menu.

3. The **Lead Selection** icons default to coil No. 1 to start the test.
4. As noted earlier, the operating voltage is the basis for the test voltage used during Surge testing. For this example, we continue to use the 480-volt motor with a maximum testing voltage of 2000 volts.
5. Press and hold the **Start (PTT)** button. The following popup menu appears.

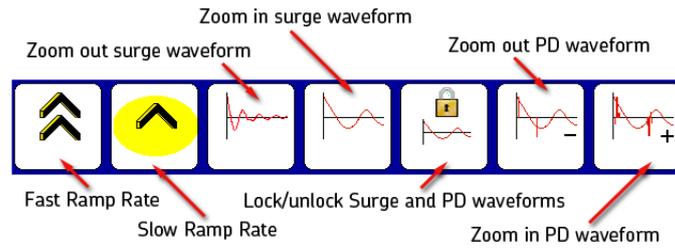


Figure 24. Ramp rate and waveform zoom popup menu.

6. Use the **Fast/Slow Ramp** Rate icons to control the rate of voltage change while turning the **Voltage Output Control** knob clockwise to raise the voltage to the desired test level. Release the knob when the test voltage is reached.
7. Use the **Surge waveform zoom** icons to adjust the time display scale of the surge waveform.
8. Release the **PTT** button after the desired number of surge pulses have been applied at the target test voltage level.
9. If the winding is a wye or delta configuration, select lead 2 and repeat Steps 5–8 then repeat for lead 3.

**NOTE**

To facilitate comparison of leads, you will not be able to select different time scales for leads 2 and 3.

10. The results of the winding tests of a wye or delta configuration will appear, as shown below. Save your results at this time. Performing subsequent surge tests will overwrite the displayed results.

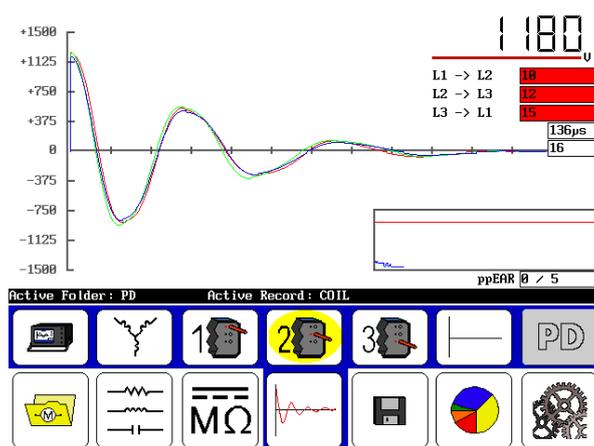


Figure 25. Surge test results screen.

## Performing Partial Discharge tests—three-phase coil mode

Partial Discharge (PD) testing is conducted during surge testing. When PD testing is enabled, additional elements appear on the surge test screen as shown in the example below displaying the PD data collected.

PD testing follows the same procedure as surge testing, with the addition of enabling PD. If you are not already there, ensure that the tester is in surge testing mode.

1. For this example, touch the **Standalone Unit** icon then the **Coil Mode Selection** icon in the **Mode Submenu**.
2. From the popup menu, select the **Three-phase coil mode** icon.
3. The **Lead Selection** icons default to lead 1 to start the test.
4. Touch the **Enable PD** icon on the right side of the screen. This activates the detector circuit and tells the tester to display PD data on the surge graph.

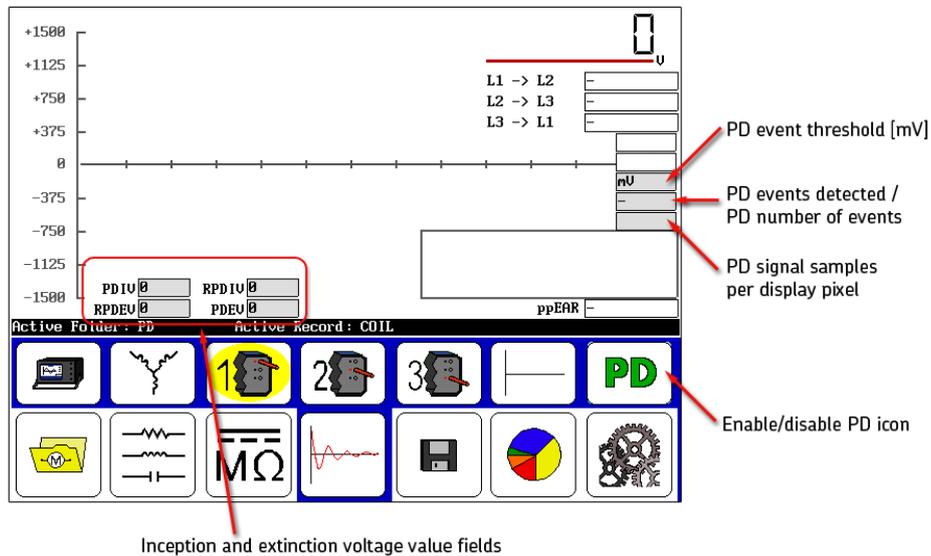


Figure 26. Enabling PD testing adds elements to the start screen.

### NOTE

For additional information on PD testing and related screen elements, refer to the *Baker DX User Manual*.

5. Hold down the **PTT** button and use the **Voltage Output Control** knob to ramp up the voltage slowly and evenly.
6. Touch the **Fast Ramp Rate** icon to ramp at the higher rate if desired, but ensure that ramping is slow enough to allow observation of PD events. The ramping up process is used to collect partial discharge inception voltage (PDIV) and RPDIV (R = repeated) data.
7. Increase the voltage to the target test voltage only. Partial discharge may or may not occur.

As the voltage increases, if there is partial discharge the PD waveform will display pulse activity (indicating that partial discharge is occurring) when the expanded view is selected as shown in the example below. The default view shows the PD waveform fully zoomed in.

When PD activity exceeds the threshold value, a PD pulse occurs, the PDIV level is reached, and the surge voltage value is recorded as PDIV.

A red **PD** indicator also appears just left of the zero reference on the Y-axis.

As you continue to increase the voltage, the activity will become more pronounced and more frequent. At the point where more than 50 percent of the surge pulses have a PD pulse, the software records the current surge voltage level as RPDIV.

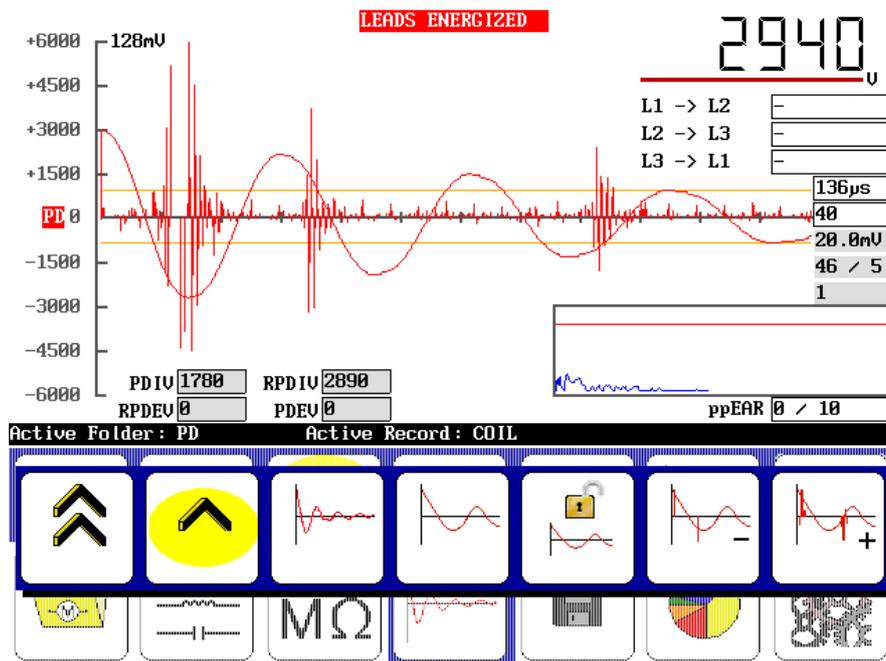


Figure 27. Example of acquired inception voltages (PDIV and RPDIV).

8. To acquire the extinction voltages, continue to hold down the **PTT** button and use the **Voltage Control knob** to ramp down the voltage slowly and evenly.
9. Touch the **Slow Ramp Rate** icon to ramp down at the slower rate if not already selected. We recommend using the slow ramp rate for PD testing.

As the voltage decreases, the occurrence of PD pulses decreases. At the point where less than 50 percent of the surge pulses have a PD pulse, the software records the surge voltage level as RPDEV. As the voltage continues to ramp down, the software continually records the surge voltage level at which a PD pulse is detected. The last recorded value is saved as the PDEV (the lowest voltage at which the detector senses a PD pulse).

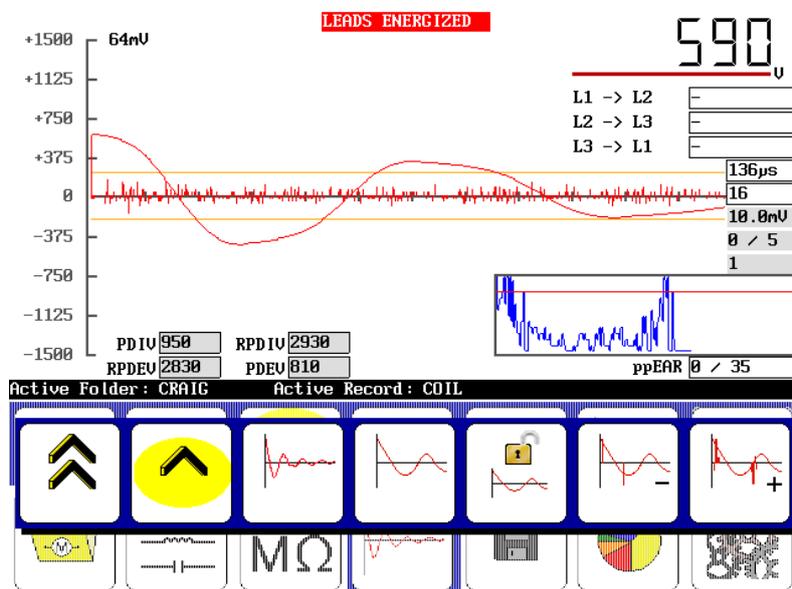


Figure 28. Example of acquired extinction voltages (PDEV and RPDEV).

10. When you finish acquiring the extinction thresholds for the first phase, release the PTT button.
11. Touch the **Lead 2** icon and repeat the process for the second phase then **Lead 3** in turn.
12. Testing the second and third phases is identical to testing the first phase. After you complete phase 3 testing, save your results.

### PD data reporting—three-phase coil mode

Partial discharge (PD) tests are reported differently depending on whether the test was being conducted in single-coil mode or three-phase coil mode.

In three-phase coil mode, results are reported in two ways. The first report is the normal surge report with the PD data included. The waveform displayed is the peak waveform captured during the testing process for each phase. The PD signal is overlaid on the surge waveform and displayed with the resolution used during the preceding surge test.

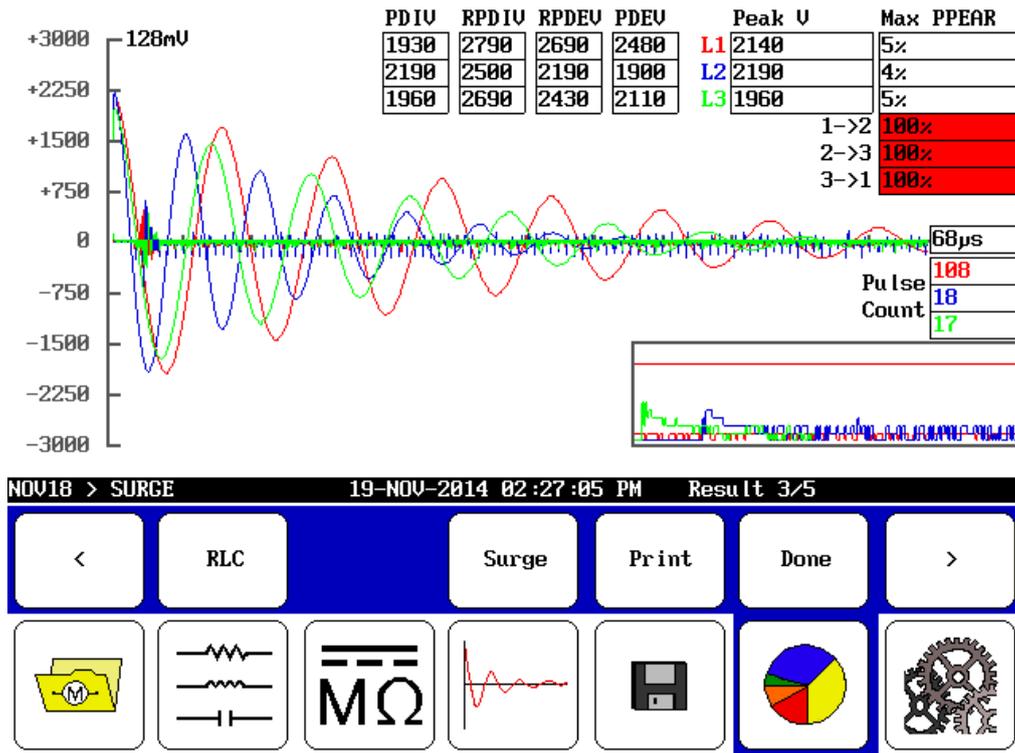


Figure 29. PD three-phase report. PD data overlaid on surge waveform.

The values for PDIV, RPDIV, RPDEV, and PDEV are indicated for each phase in the table at the top center portion of the display.

Tapping the display will switch to a house plot view where the three phases are displayed with their respective PD activity for each surge pulse that occurred during testing.

The X-axis corresponds to the individual surge pulses, and its width is determined by the test phase with the most pulses. If the duration of tests for each phase is uneven, the shorter phases will not extend across the entire graph. For this reason, you should attempt to keep the duration of each test approximately the same length.

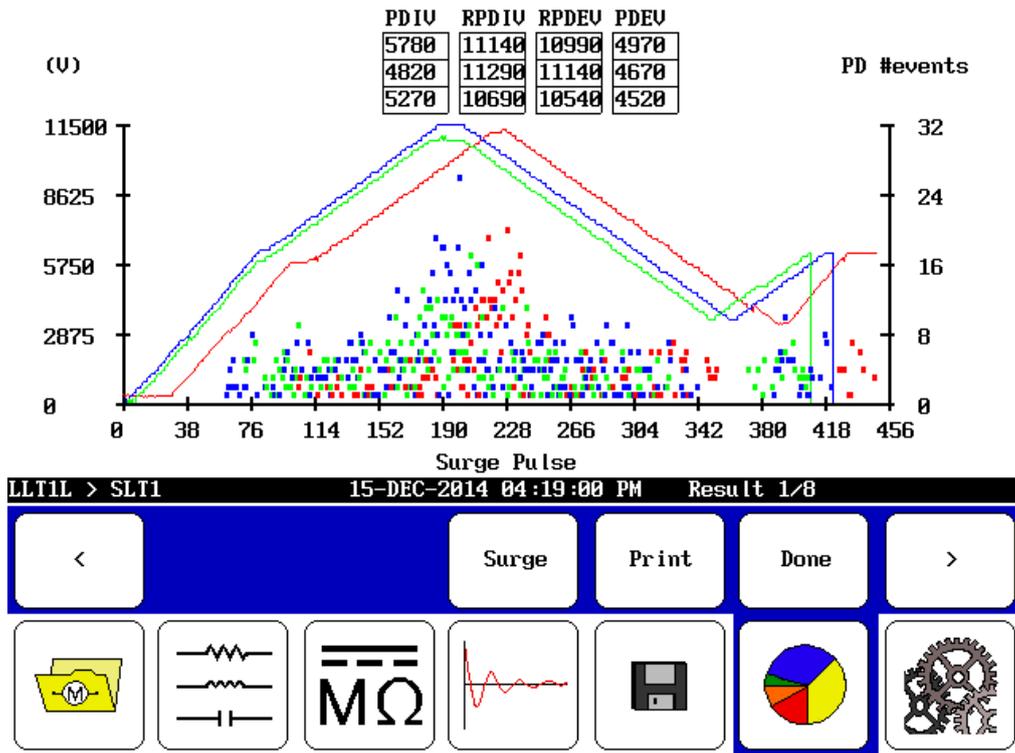


Figure 30. PD three-phase house plot report view.

The left axis shows the voltage of the surge pulse. The waveforms are indicated by solid colored lines for each phase.

The right axis shows the number of PD events recorded for each pulse. In this view, you can see how the PD activity rises and falls with the surge voltage.