Quick Start Guide

Sweep Frequency Response Analyzer (SFRA)

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Running an SFRA Test

This guide explains how to set up a Doble M5200, M5300, or M5400 Sweep Frequency Response Analyzer; run a test; and confirm that the test has run successfully.

This document is intended for engineers and field testers who work with an M5200, M5300, or M5400 Sweep Frequency Response Analyzer. It is assumed that you are familiar with professional standards and safety practices.

Safety Requirements

For safe testing, the test setup must meet the following requirements:

- The transformer under test must be completely de-energized and isolated from the system.
- The transformer and the M5000 instrument must share a common ground or earthing point.

Follow your own company rules, policies, and government regulations to ensure safety of personnel and property.

Step 1: Set Up and Run a Shorted Lead Test

This section describes how to connect the cables to the SFRA instrument and perform a basic shorted lead test. **Do not omit this test.** If a cable or cable connection is bad, this test will save you hours of wasted effort.
Connect the Cable and Leads and Run SFRA 5.2

To connect the ground reference cable and test leads and run SFRA:

1. Follow Figure 1 to connect the reference ground and test leads to the instrument. This figure shows an M5300, but the connections are correct for all three instruments.

![Figure 1: Cable and Lead Connections to the SFRA Instrument](image)

<table>
<thead>
<tr>
<th>1</th>
<th>BNC yellow, red, and black connectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Instrument ground</td>
</tr>
<tr>
<td>3</td>
<td>Green reference ground 1 of 2</td>
</tr>
<tr>
<td>4</td>
<td>Green reference ground 2 of 2</td>
</tr>
<tr>
<td>5</td>
<td>Red source lead</td>
</tr>
<tr>
<td>6</td>
<td>Black measurement lead</td>
</tr>
</tbody>
</table>

If you are using an:

- M5200 or M5400—Go to step 2.
- M5300—Power up the M5300 and go to “Step 1: Set Up and Run a Shorted Lead Test” on page 1.

2. Power up the PC. Run the SFRA program by double-clicking the icon or selecting Start→All Programs→Doble Engineering→SFRA.

The main SFRA window opens and displays the Connect to Instrument message (Figure 2).
3. Turn on the SFRA test instrument and wait 20 seconds. During this time:
   a. The power light comes on.
   b. The Test in Progress and System OK indicator lights come on.
   c. The Test in Progress and System OK indicator lights go out.
   d. The System OK indicator light comes on and remains lighted.
4. Attach the Ethernet or USB cable to the instrument and the PC.

   ![Figure 2 Connect to Instrument Message](image)

   **Figure 2 Connect to Instrument Message**

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4. Attach the Ethernet or USB cable to the instrument and the PC.

   ![Figure 3 Select Instrument Window](image)

   **Figure 3 Select Instrument Window**

   5. Click the **Find Instrument** button shown in Figure 2.
      
      The Select Instrument window lists all connected instruments (Figure 2).

   ![Figure 3 Select Instrument Window](image)

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      The Select Instrument window lists all connected instruments (Figure 2).

   ![Figure 3 Select Instrument Window](image)

   **Figure 3 Select Instrument Window**
If no instrument is listed:

- Check the connection between the instrument and the PC.
- Make sure that your antivirus software or firewall is not preventing communication.
- If your instrument is connected to the PC through an Ethernet cable, check the IP address. For instructions, see the *Sweep Frequency Response Analyzer (SFRA) User Guide*.

Click **Continue Searching for Instruments**.

6. Highlight the instrument desired and click **Select Instrument**.

The SFRA window displays the Data Manager tab. Figure 4 shows a cropped image of this tab.

![Data Manager Tab on Main Window](image)

**Figure 4  Data Manager Tab on Main Window**

**Associate the Test Template with a Transformer**

**NOTE:** If the shorted lead test has already been set up in SFRA 5.2, skip this section and go to “Run the Shorted Lead Test” on page 8.

Before a test template can be used, it must be associated with a transformer. This is true even for the shorted lead test, which does not use a transformer. The shorted lead test is provided in a test template called “Lead Diagnostics.” In order to run this test, you create a dummy transformer listing and associate the Lead Diagnostics test template to it.
To associate a test template with a transformer:

1. In the main window of the SFRA software, open the **Edit** menu and select **Edit Apparatus** (Figure 5).

![Figure 5 Edit Apparatus Option on Edit Menu](image)

The Test Equipment Editor window opens (Figure 6).

![Figure 6 Test Equipment Editor](image)

2. Click the **Edit Transformers** button on the right.

The Transformer Editor window opens, displaying the Transformer tab (Figure 7).
3. Click **New** (Figure 7).
   The New Serial Number listing is highlighted. (Figure 8).

4. Enter **Leads** in the Manufacturer field.
5. Enter **0** in the Serial Number field.
6. Click the **Test Templates** tab.
Note that the new serial number, 0, appears in the Transformer list (item #1 Figure 9).

7. Click Select (#2 in Figure 9).
   The Template Editor window appears (Figure 10).

8. Select Lead Diagnostics in the Template list and click OK.
9. Click **OK** again to close the Transformer Editor window, and click **Save and Exit** to close the Test Equipment Editor.

**Run the Shorted Lead Test**

To run the shorted lead test:

1. In the main SFRA window, click **Select Apparatus**.
   The Apparatus Selection window appears.

   ![Apparatus Selection Window](image)

   *Figure 11  Apparatus Selection Window*

2. Select **Leads** in the Manufacturer column and click **OK**.

3. In the Apparatus and Test pane, click **Select Test** (Figure 12).
4. The Test Selection window displays the test contained in the Lead Diagnostics template (Figure 13).

5. Following the directions under the Red Location and Black Location headings in the template, short the red source lead and black measurement lead by connecting the clamps to each other (Figure 14).

CAUTION! Do not connect the measurement clamps to the ground clamps!
6. Short the green reference grounds by connecting the clamps to each other (Figure 14).

![Figure 14 Cable Connections for Shorted Lead Test](image)

| 1 | BNC yellow, red, and black connectors |
| 2 | Instrument ground                     |
| 3 | Green reference ground 1 of 2         |
| 4 | Green reference ground 2 of 2         |
| 5 | Red source lead                       |
| 6 | Black measurement lead                |

7. Click **Start Test** (Figure 15).

![Figure 15 Location of Start Test Button](image)
Running an SFRA Test

The Magnitude tab appears (#1 in Figure 16) and displays the trace as it develops. The Legend pane appears (#2) and a progress bar expands as the test progresses (#3).

Figure 16 Shorted Lead Test in Progress

When the test finishes, the view auto-zooms so that the trace takes up most of the graph. The result should resemble the curve shown in Figure 17.
If the result resembles Figure 18, examine the leads for an open circuit. The open-circuit response is clearly affected by noise.
8. When you are satisfied with the test results:
   a. Disconnect the test lead clamps from each other.
   b. Disconnect the reference ground clamps from each other.


Step 2: Ground the Transformer

Each time the SFRA test leads are connected, disconnected, or moved, apply temporary static-discharge grounds to:

- The bushings to which the SFRA test clamps will be applied and
- Any bushings to which jumpers will be applied

To ground a transformer for SFRA testing:

1. Open the switches to de-energize the transformer and disconnect it from the rest of the substation (Figure 19).

   Figure 19  De-energized and Disconnected Transformer

2. Ground all conductor or bus still connected to the transformer terminals outside of the transformer bushings and windings (Figure 20).

   Figure 20  Grounded Transformer
3. Remove the Isophase or GIS link (Figure 21).

![Figure 21 Removed Isophase or GIS link](image)

4. Apply temporary static-discharge grounds (Figure 22).

![Figure 22 Added Temporary Static-Discharge Grounds](image)

5. Attach the SFRA test leads (Figure 23).

![Figure 23 Connected SFRA Leads](image)
6. Remove static grounds (Figure 24).

7. Isolate terminals not under test and ensure that they are floating, unless otherwise specified in the test template.

**Step 3: Prepare the Transformer for Testing**

For optimal test results, always follow these practices:

- Make good electrical connections. Clean, file, or wire-brush connection points at bushing terminals and bases if necessary.
- Replicate the setup used the last time the transformer was tested. **Any change in setup affects the consistency of test results.** Do not the change tap position, DETC position, or core ground connections from one test to the next.
- Ensure that all three phases are solidly shorted together when you make short-circuit measurements.
- Attach the green reference leads to a stud or bolt at the base of the bushings under test and ensure that good electrical contact is established. Replicate the positions of the reference leads on all three bushings, if possible, to eliminate reference variation as a source of measurement error.

**Step 4: Select and Run a Test**

By running the shorted lead test, you have already followed the complete procedure for running a test. This section does not repeat that procedure.

To run any other test, go to “Run the Shorted Lead Test” on page 8 and apply the procedure to your specific testing concerns.
Keep these considerations in mind:

- The cabling instructions and diagrams in Figure 13 and Figure 14 are unique to the shorted lead test. Make the connections described in your test template instead.

- If your test instrument has been used to test the same transformer before, and the test information is stored in SFRA on your instrument, you can skip “Associate the Test Template with a Transformer” on page 4.