SFRA Software 6

User Guide

TP-SFRA-UG Rev C

11/2022

Contents

Preface

This guide is intended for anyone who works with SFRA software. It is assumed that the reader is familiar with professional standards and safety practices.

This document uses two special typefaces to indicate particular kinds of information:

- **Bold Arial** type identifies elements of the SFRA software user interface elements that you click, press, or select. Example:

  Type in **1500 ms** and click **Close**.

- `Monospaced` type identifies text that is displayed in the user interface, such as an error message or prompt. Example:

  `Uploading test results.`

Notes and Warnings

This document uses icons to draw your attention to information of special importance, as follows.

Note: Notes provide supplemental information that may apply to only some circumstances.

Caution: Cautions provide information that prevents damage to hardware or data.

Warning: Warnings provide information about anything that can affect operator health.

Support

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1. Introduction

This chapter describes the SFRA instrument hardware and software and introduces SFRA testing. It contains the following sections:

M5200, M5300, M5400, and M5500 SFRA Instruments

Sweep Frequency Response Analysis (SFRA) testing is a non-intrusive way to identify mechanical changes inside a transformer. Changes in the internal configuration produce different frequency responses that indicate a range of failure modes.

The M5200, M5300, M5400, and M5500 Sweep Frequency Response Analyzers measure and record the frequency-response characteristics of transformer windings.

Note: The M5200, M5300, and M5400 are legacy instruments and are no longer in production.

Note: The M5300 is not compatible with any version of SFRA 6 software.

The following table describes the four SFRA instruments.

SFRA Instruments

Name	Description	Image
M5200	Requires an external laptop. Testing functions are identical to those of the M5300 and M5400.	

SFRA Instruments (Continued)

Name	Description	Image
M5300	Has a built-in laptop, keyboard, and display. Testing functions are identical to those of the M5200 and M5400. Not compatible with SFRA 6.2.1 software.	
M5400	A compact version of the M5200 that requires an external laptop. Testing functions are identical to those of the M5200 and M5300.	
M5500	Doble's latest generation SFRA test set.	

Software

The M5200, M5400, and M5500 are controlled by a user-supplied Windows PC device running Doble SFRA software which is supplied with the instrument.

PC Requirements

SFRA 6 software is designed to run on Microsoft's Windows 10 operating system.

Note: Doble expects that SFRA 6 will work with Windows 7, however, Doble has not tested this software running on the Windows 7 operating system.

Note: SFRA 6.2.1 software or later is best viewed with a screen resolution of 1360 x 768.

Communication Requirements

SFRA 6.2.1 software supports communication with the various models of Doble SFRA instruments using the methods listed below:

- **M5200**
  - Ethernet LAN
  - USB
- **M5400**
  - Ethernet LAN
  - USB
- **M5500**
  - USB
  - Bluetooth

2. Installing SFRA Software

This chapter explains how to install SFRA 6.2.1 software and provides an overview of the SFRA 6.2.1 software user interface. It contains the following sections:

Installing SFRA 6.2.1 Software

The SFRA software is tested and supported for use with Microsoft Windows 10 operating systems. You must have administrator privileges to install this software.

Perform the following steps to install SFRA 6.2.1 software.

1. Download the software from the Doble web site or run the installer from the medium provided with your instrument.
2. Double-click **setup** (setup.exe).

   The Welcome screen is displayed.

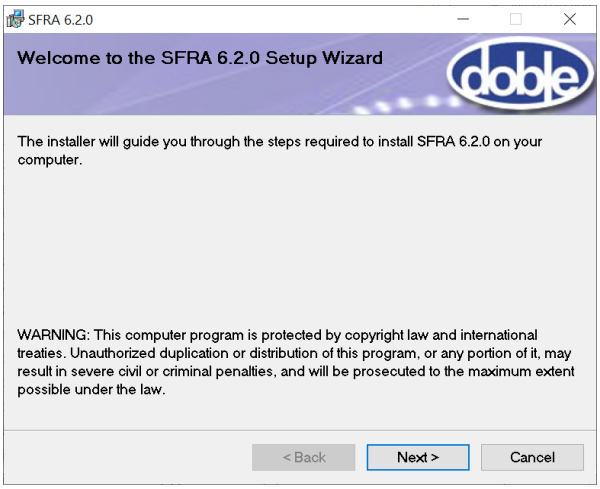


Figure 1 - Welcome Window - Example

3. Click **Next**.

   The License Agreement is displayed.

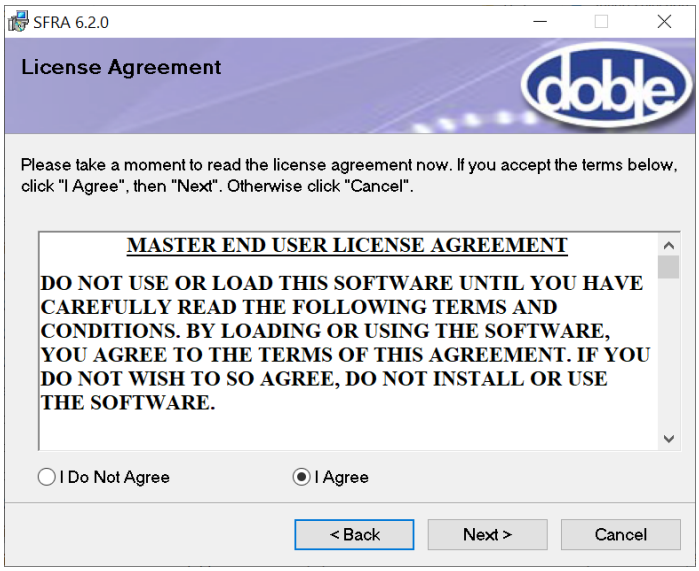


Figure 2 - License Agreement

4. Select the **I Agree** radio button and click **Next**.
   The Confirm Installation window is displayed.

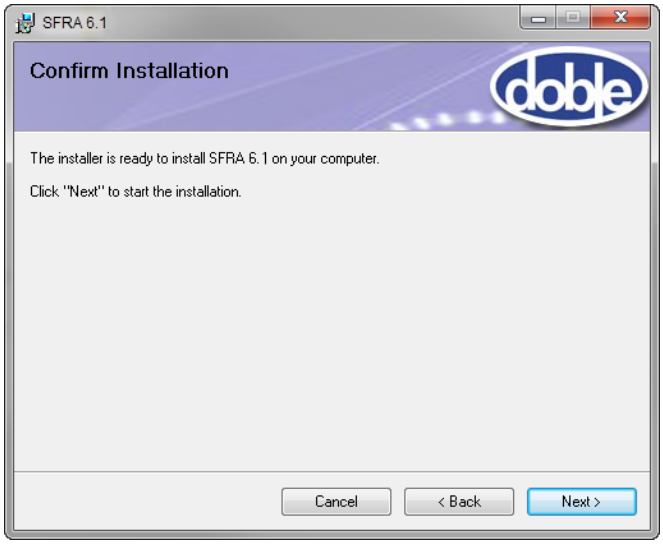


Figure 3 - Confirm Installation Window

5. Click **Next** to confirm the installation.
   The Installation Complete window is displayed.

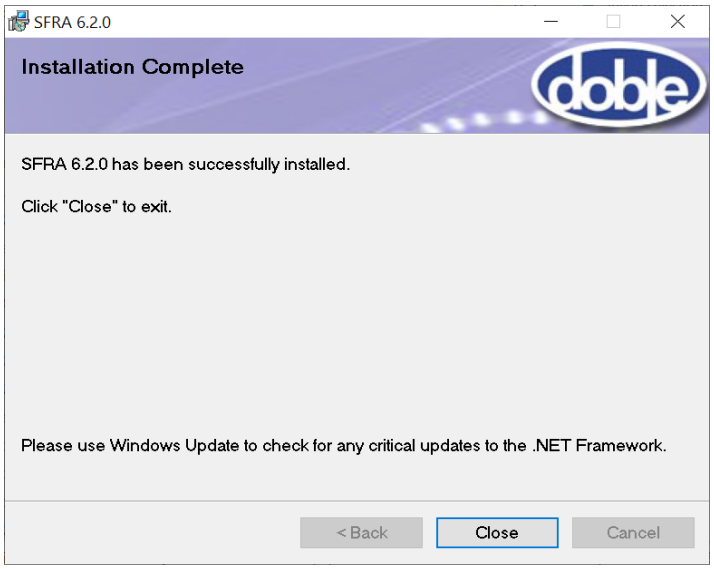


Figure 4 - Installation Complete Window

6. When the installation is complete, click **Close**.

Follow the procedure in Licensing to activate a license.

Refer to Migrating Editable Lists (page 1), if you are upgrading from SFRA Software 5 and have Editable Lists that you want to migrate to SFRA Software 6.2.1.

Migrating Editable Lists

Editable lists are the .XML files that can be updated with the information used in certain Nameplate fields.

The editable lists are found in the following directory: *C:\Users\USERNAME\Documents\Doble Engineering\SFRA\Common*. This is the default location, check with your system administrator if you are unsure of the location of the editable lists.

The following are the editable lists stored in the Common folder:

- mfrc.xml - Contains the manufactures' information and is typically maintained by Doble.
- location.xml - Contains asset location or a list of asset locations.
- company.xml - Contains asset owner's company name or list of company names.
- division.xml - Contains the name of the division of the company or a list of company divisions.

The three editable lists that you may want to preserve are location, division, and company. You should only migrate your old mfrc.xml file if you have added manufacturer data to it that has not been included in the standard mfrc file from Doble. Install SFRA 6 software before moving any of these files.

Perform the following steps to copy your DTA /SFRA editable lists to SFRA software 6.

1. Ensure that no SFRA applications are running.
2. On your desktop, navigate to the common folder in the following location: *C:\Users\USERNAME\Documents\Doble Engineering\DTA\Common* or: *C:\Users\USERNAME\Documents\Doble Engineering\SFRA\Common*.
3. Copy the editable .xml files that you want to migrate to this location in place of the default files.

3. Setting Up a Test Session

This chapter explains how to set up a test session using a new file or existing file. It contains the following sections:

Differences between SFRA 5 and SFRA 6

SFRA 5 software created a separate file for every single test (also commonly referred to as a sweep or a trace). If a user ran nine tests on a transformer in SFRA 5 software, nine different files would result.

With SFRA 6 software, all tests run on the same apparatus in a single day are saved as a single test session in one test file. If a user runs nine tests on the same apparatus in one day, one file contains that day's test session. A test session has an associated creation date. When subsequent testing is performed on the same apparatus, the tester creates a new test session with the current date, typically within that same test file. This makes it easy to compare the new tests to a previous session's results and keeps all the test sessions for an apparatus in one test file

Creating a New File

Test files are files that store all information relating to a specific apparatus. Tests run on a single apparatus in a single day are considered one test session. Each test session is saved in the test file, referenced by test date.

Perform the following steps to create a new test file.

1. Click **Test Files** in the top menu.
2. Click **New Test File**.

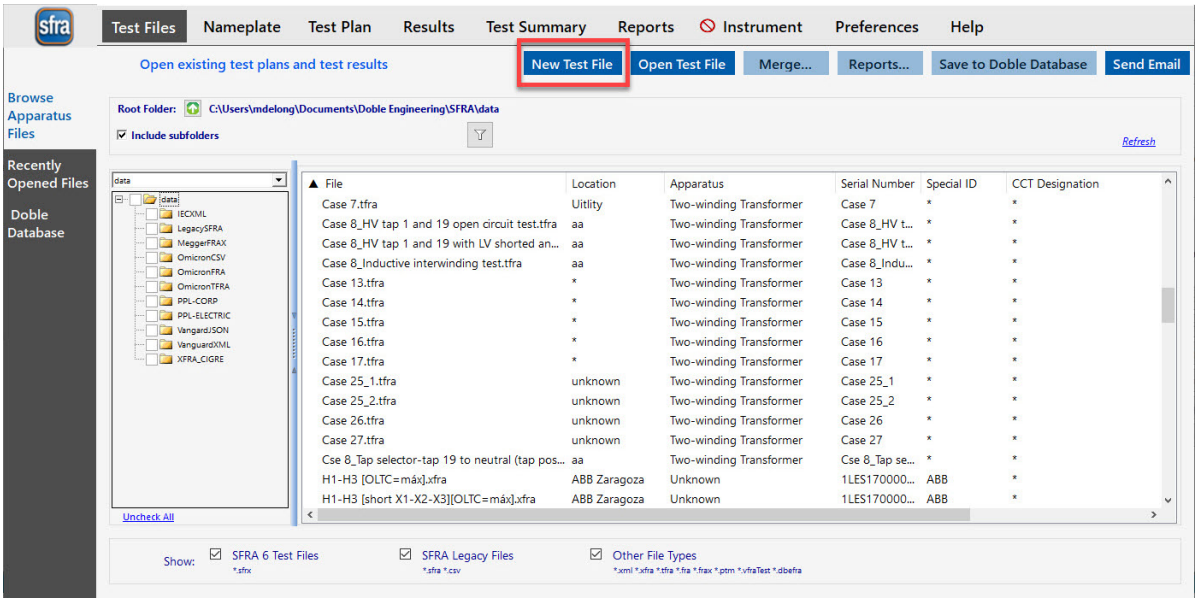


Figure 5 - New Test File

3. Enter the **Tester** name and click **Yes**.

> **Note:** The prompt for a Tester name can be disabled in Preferences\Configuration.

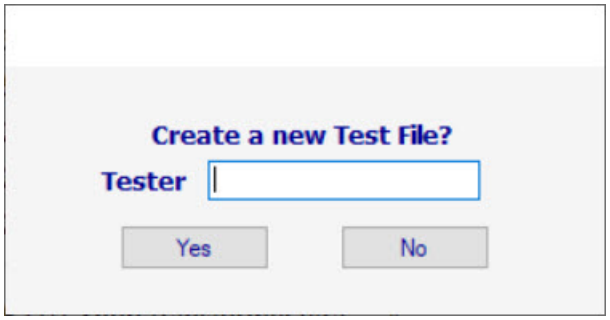


Figure 6 - Create New Test File

The New Apparatus window opens.

4. (Optional) Select either check box if you want to use the nameplate information from an existing DTA file. The correct apparatus type must be selected before you attempt to import a DTA nameplate.

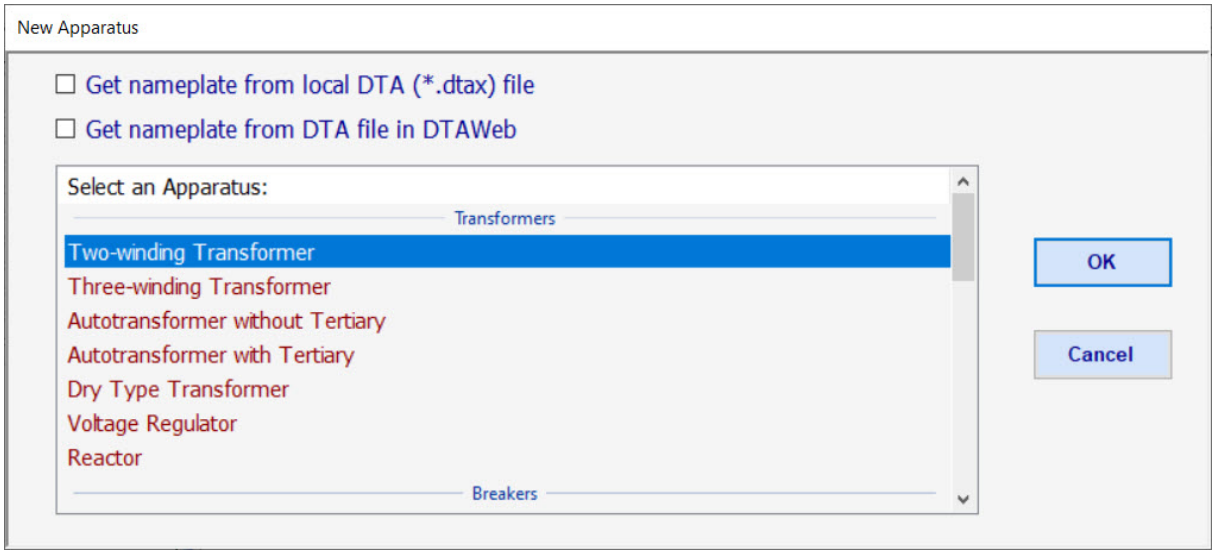


Figure 7 - New Apparatus

5. Click an option from the **Select an Apparatus** list and click **OK**.
6. If you selected a check box stating that you wanted to use nameplate data from an existing file, the Select DTA File window will appear. Locate the file and click **OK**.

   The Nameplate window will open. Proceed to Nameplate.

Opening a File

Perform the following steps to open a file.

1. Click **Test Files** in the top menu and **Browse Apparatus Files** in the left menu.

   If you have recently used the test file you want to open, check the **Recently Opened Files** menu. If the test file you need is stored in the Doble Database, then use the **Doble Database** menu to locate and download the file.
2. Do one of the following:
   - Select the **Include subfolders** check box to view all files contained in a folder and all subfolders stored within that folder. By selecting this check box, you do not have to manually open every subfolder contained in a folder in order to see its contents.
   - Leave the **Include subfolders** check box unselected if you wish to view only the files contained in a selected folder.
3. Select the desired folder using the folder tree in the left pane.
4. At the bottom of the screen, select the file types you want to show:

- SFRA 6 Test Files.
- SFRA Legacy files - SFRA 6.2.1 software converts the SFRA legacy file to a compatible format.
- Other File Types - SFRA 6.2.1 software opens test files created using certain software from other vendors of SFRA test equipment.

5. Optionally click the filter icon to filter the files by name.
6. Double-click a file to open it.

> **Caution:** Ensure you select the correct apparatus type if prompted. If you find that you have selected the wrong type, return to the original test files and re-open.

7. When opening any file other than an SFRA 6 (.sfrx) file (including non-Doble files) the SFRA 6 software asks you to identify the Apparatus Type, Figure 8. SFRA 6 will suggest an apparatus type based on the information in the file, with the default being Two-winding Transformer when the software can't make a different suggestion. In the prompt, select the correct apparatus type for the file and click **OK**.

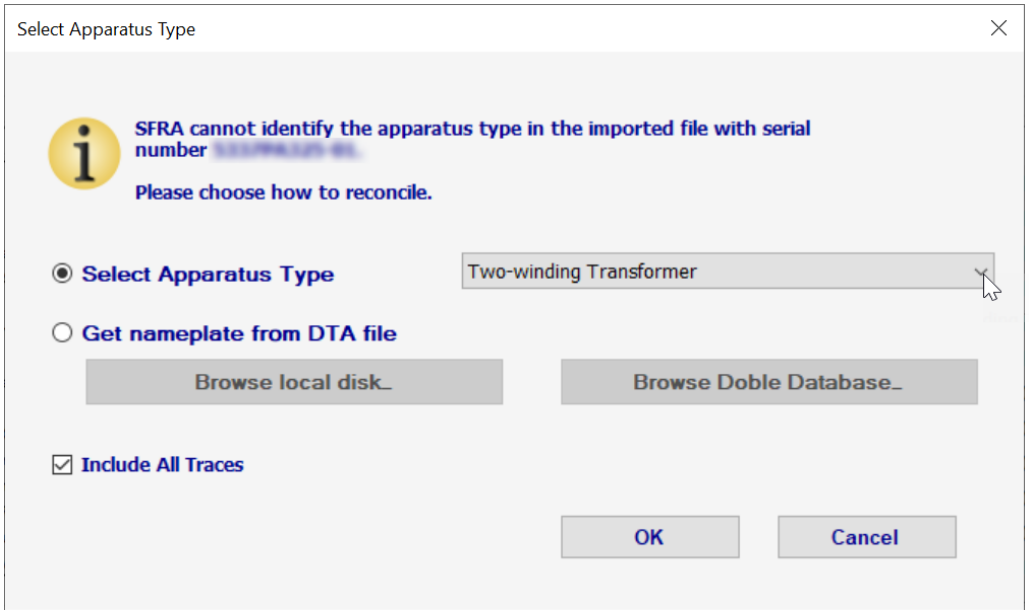


Figure 8 - Select Apparatus Type

If you are not sure which apparatus type to select or just want to quickly open the file to view results, any selection from the drop-down list can be used. However, if the results are then saved into an SFRA 6 test file, the contents of that file (or files) will be saved into an SFRA 6 test file with the selected apparatus type. You can re-import the results with the correct apparatus type selected if the wrong selection was made originally, and the incorrect file should be discarded.

If a DTA software file (.dtax) exists for the apparatus, the nameplate information from that file (including its apparatus type) can be imported instead. This will replace the nameplate data from the file being opened.

Tap Changer Wizard

When opening certain SFRA v5 files, the Tap Changer Wizard opens to confirm the tap changer positions in the file. Click **OK** to confirm the tap changer positions, or click **Skip This File** if desired, but note that the skipped file will not be loaded into SFRA.

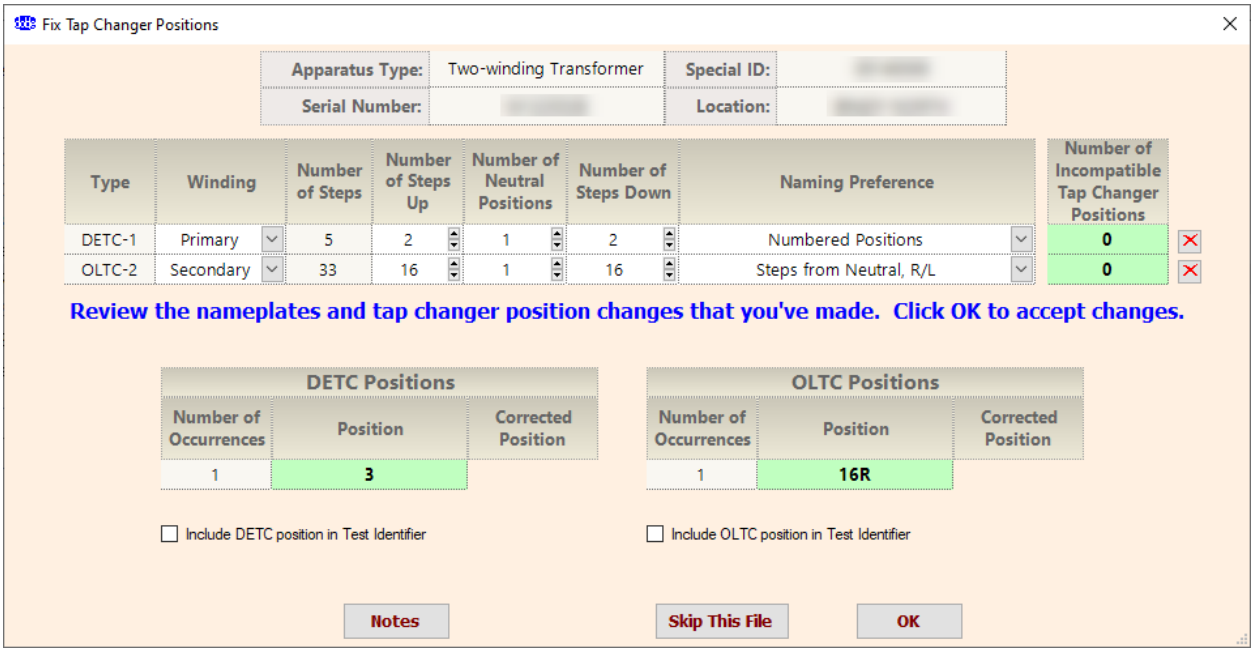


Figure 9 - Tap Changer Wizard

Test File Management

Right click one or multiple test files to view the options to manage test files:

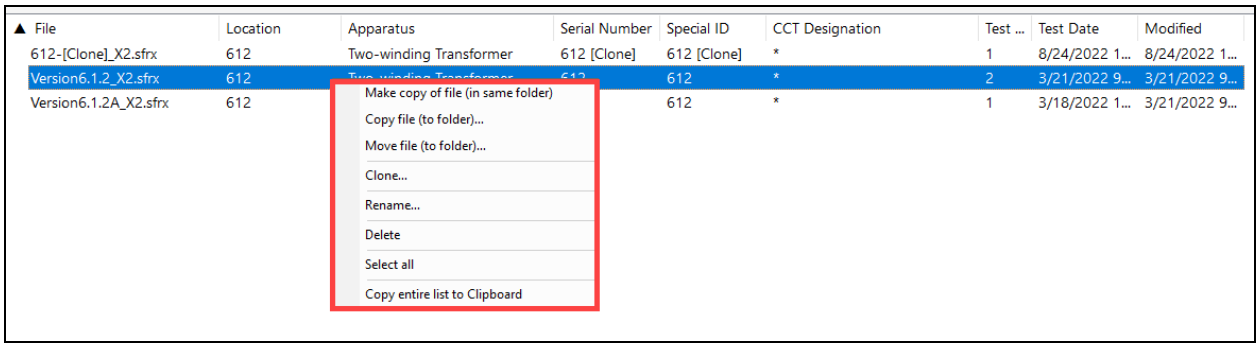


Figure 10 - File Options Drop Down

- **Make copy of file (in same folder)**: Copies the selected file(s) in the same folder.
- **Copy file (to folder)**: Copies the selected file(s) to another folder. Use the pop up window to navigate to a folder, or select the **Make New Folder** option.
- **Move file (to folder)**: Moves the selected file(s) to a different folder. Use the pop up window to navigate to a folder, or select the **Make New Folder** option.
- **Clone(...)**: Clones the selected file(s) in the same folder. Cloned files maintain tests defined in Standard and Custom test lists from the original file's most recent test session. A new file name is generated, defining the new file as a clone, however you can choose to name the file manually.
- **Rename(...)**: Renames the selected file. Type a new file name in the pop up window and click **OK**.
- **Delete**: Deletes the selected file(s).
- **Select all**: Selects all files.
- **Copy entire list to Clipboard**: Copies the entire file list to the clipboard.

Merging SFRA Files

You can merge two SFRA 6 software files if they have the same Nameplate information. For example, if someone copied a file and there are two files for the same apparatus with different test sessions, you can merge them to view all the test sessions in one file.

Two .sfrx files are merge candidates if they meet the following criteria.

- The files are for the same apparatus type.
- The **Filename Basis** fields match.
- The other nameplate fields do not contain any conflicting data. (An empty field will not constitute a conflict in this case.)

The software will automatically notify the user that files are merge candidates if that preference option is selected and the merge candidate files are visible in the **Browse Apparatus File** list. If the user selects files that are not merge candidates and attempts to merge them manually then the software will report all mismatched fields that would need to be corrected to enable a merge.

Refer to Merging a New File with an Existing File (page 1), if you are merging a new file.

Refer to Merging Existing Files (page 1), if you are merging existing files.

Merging a New File with an Existing File

When saving a file, SFRA software checks to see if there are any existing files that match the information in the new file you are saving.

Perform the following steps to merge a new and an existing file.

1. Click **Test Files** in the top menu.
2. Click **New Test File**.
3. Fill in the appropriate nameplate information.

4. Click **Save**. If another file is visible in the Browse Apparatus Files list and is a merge candidate with the new file, the Merge window will appear.

Note: The Merge prompt will only appear if **Automatically detect merge candidates in file browser** is enabled in Preferences\Configuration.

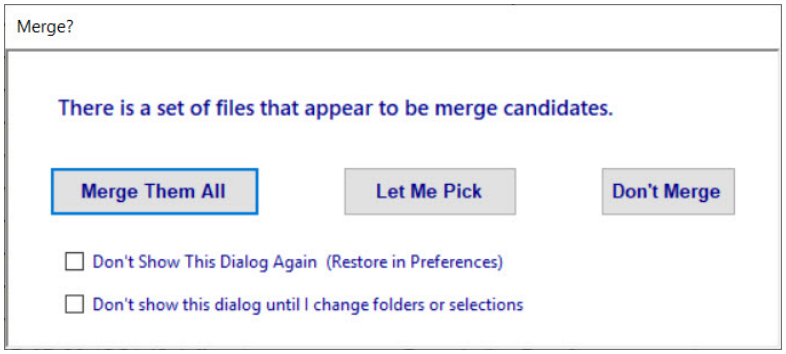


Figure 11 - Merge Window

5. Click **Merge Them All** to merge all the similar files.
6. Click **Let Me Pick** to open the Merge Candidates window. Select the files you want to merge then click **Merge**.

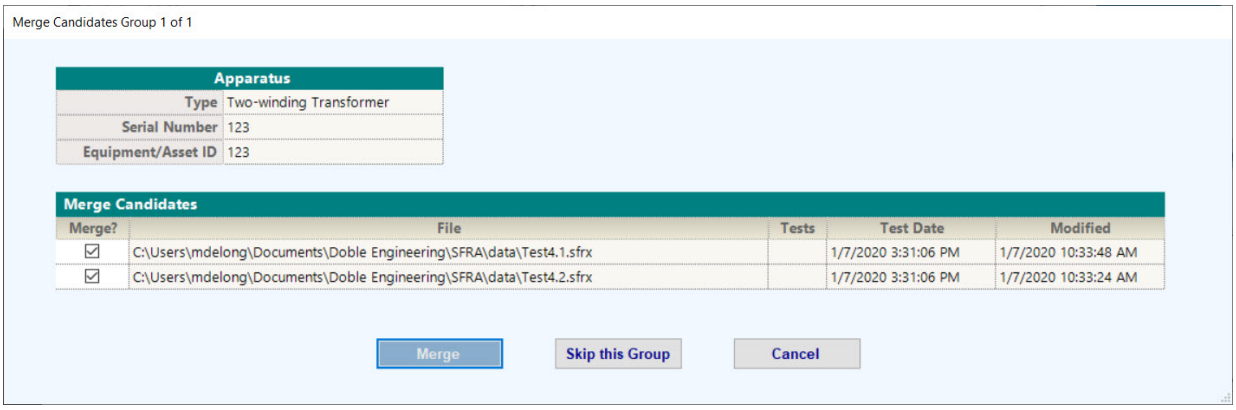


Figure 12 - Merge Candidates

7. Click **Don't Merge** to save the new file without merging.

   The Save As window will open after you choose whether or not to merge the file.

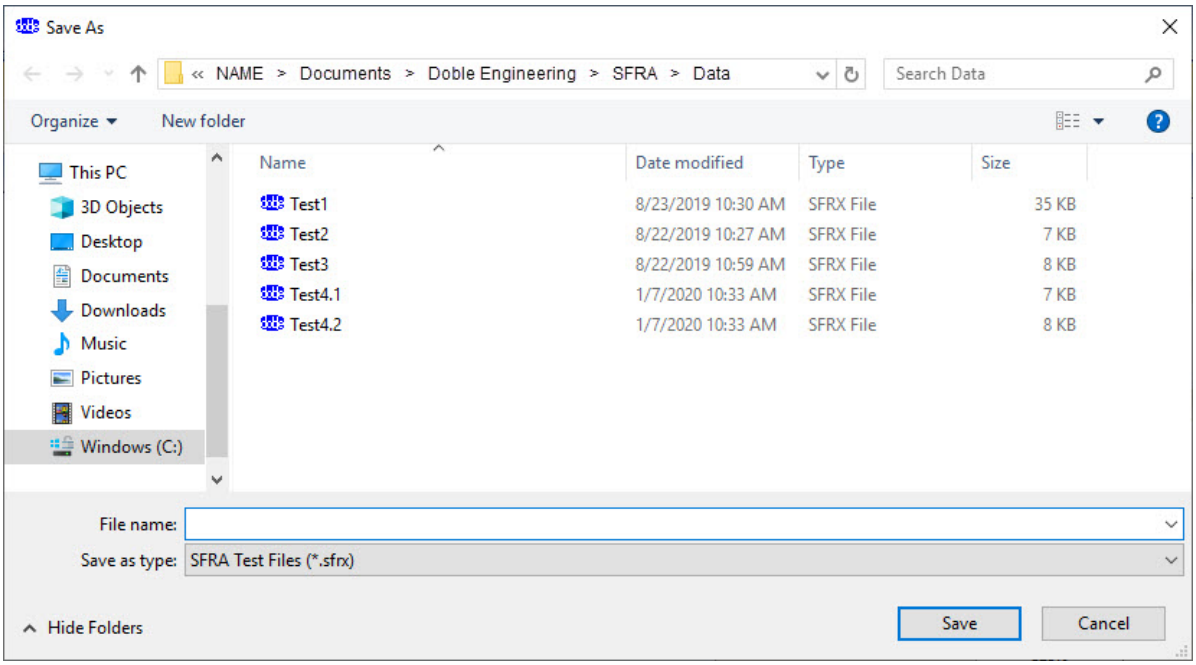


Figure 13 - Save As

8. Enter a file name then click **Save**.

> **Note:** The files that you merged are renamed and preserved in the original location but do not appear in the Test Files menu after merging.

Merging Existing Files

1. Click **Test Files** from the top menu.
2. Hold **Ctrl** on the keyboard and select the files to merge.
3. Click **Merge**.

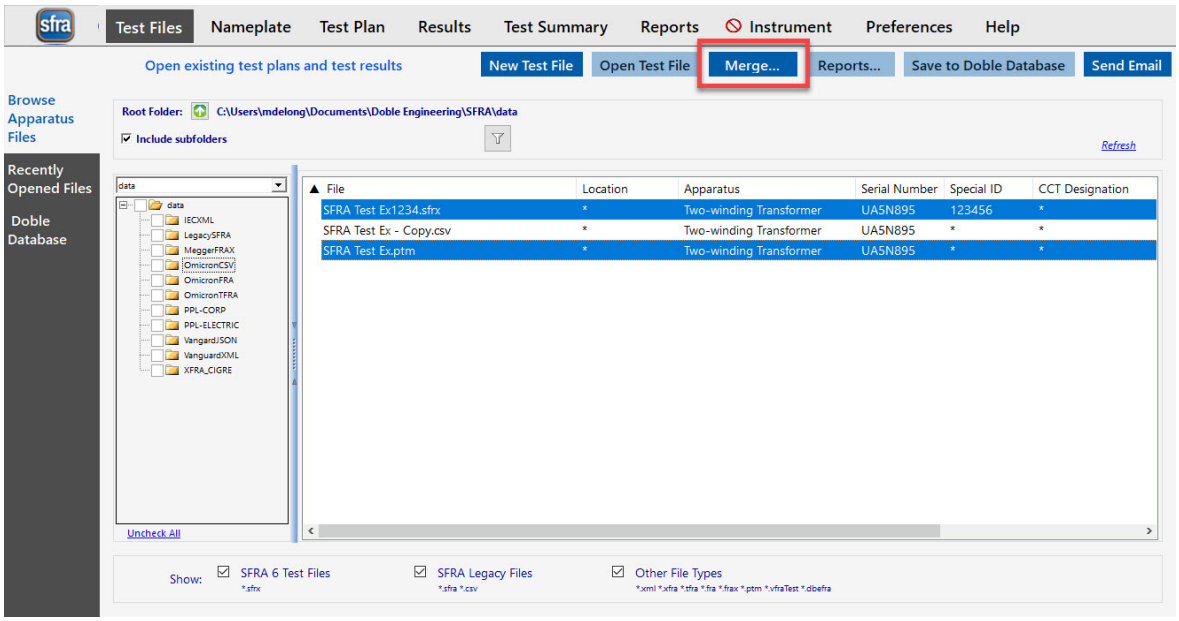


Figure 14 - Merge Button

4. Select the file name and location to save the new file. Click **Save**.

> **Note:** The files that you merged are renamed and preserved in the original location but do not appear in the Test Files menu after merging.

Nameplate

The Nameplate menu contains information about the apparatus you are testing.

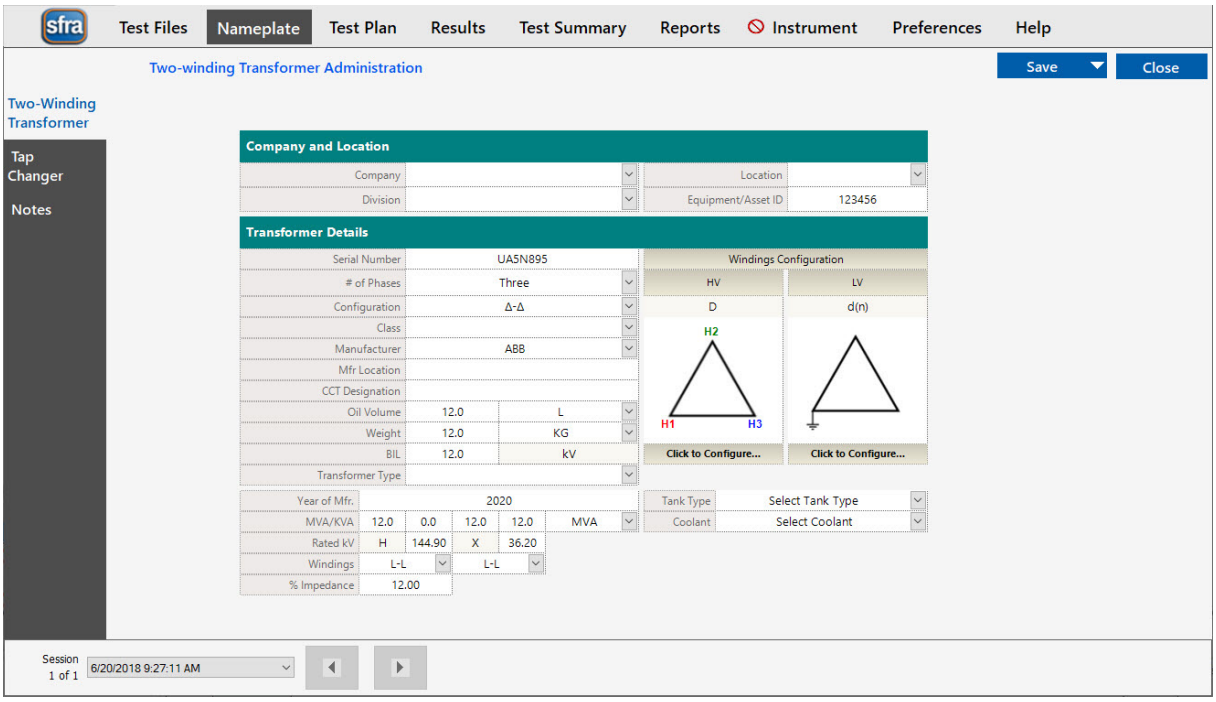


Figure 15 - Nameplate Menu

The only fields required to save a newly created test file are what are specified in the **Filename Basis** selection in the Preferences/Configuration menu.

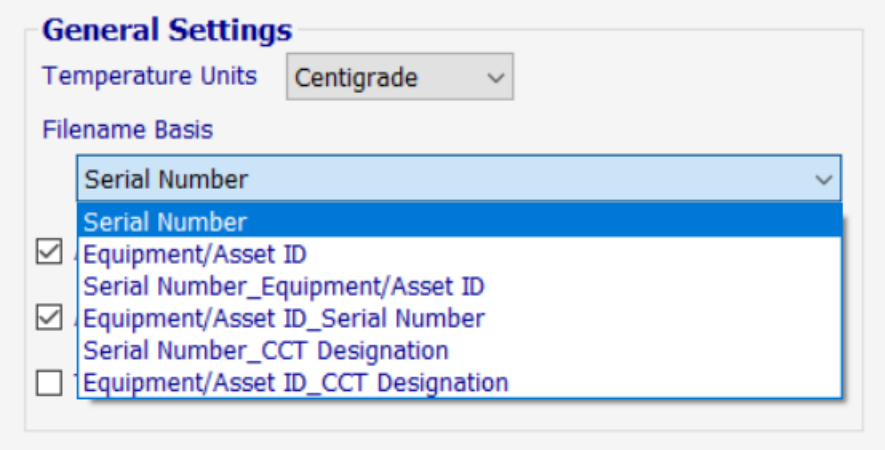


Figure 16 - Filename Basis

After the apparatus fields have been filled-in, click **Save** Actions.

Note: Click Save to save the test file whenever you edit information. Saving the file saves changes made in all tabs.

Adding Tap Changers

The Tap Changer menu is used for adding tap changers to transformers. Tap changer positions influence test results, so it is important to always define tap changer nameplates and record tap changer positions in test rows before running a test.

Note: Not all transformers have tap changers. If your transformer does not, you can skip this section.

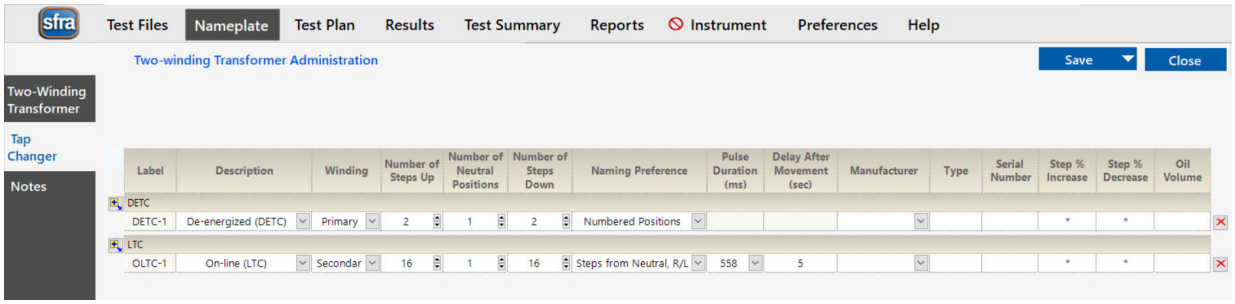


Figure 17 - Tap Changer Menu

Perform the following steps to add a tap changer:

1. Click **Nameplate** in the top menu.
2. Click **Tap Changer** in the left menu.
3. Click the **+** icon at the left of the grid to add a DETC or LTC.

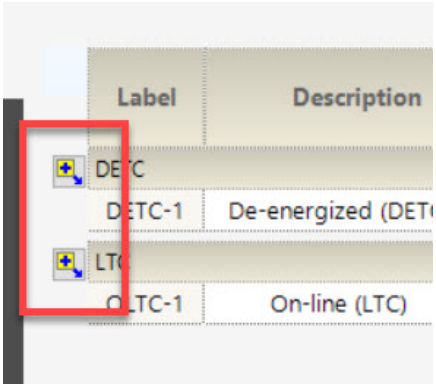


Figure 18 - Add DETC or LTC

4. Enter (or adjust as necessary) the following fields:
   - Winding: Indicate whether it is primary or secondary. (Required)
   - Number of Steps Up (Required)
   - Number of Neutral Positions (Required)

- Number of Steps Down (Required)
- Naming Preference
- Pulse Duration (msec) (LTC only)
- Delay After Movement (sec) (LTC only)
- Manufacturer
- Type
- Serial Number
- Step % Increase
- Step % Decrease
- Oil Volume

5. (Optional) Click the **X** icon to the right of the row to remove a tap changer.

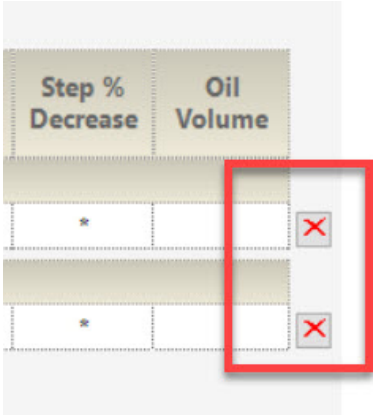


Figure 19 - Remove Tap Changer

6. Click **Save**.

Adding a Note

The Notes menu is used for recording notes specific to the apparatus being tested and should not be session specific. You can write notes and paste images into the document that will remain with the test file.

Information specific to a particular test session should be recorded in the Notes menu for that session configuration and conditions, or any other information that will aide in repeating the test as closely as possible the next time it is done on this apparatus. See Notes (By Session) for information on recording session notes.

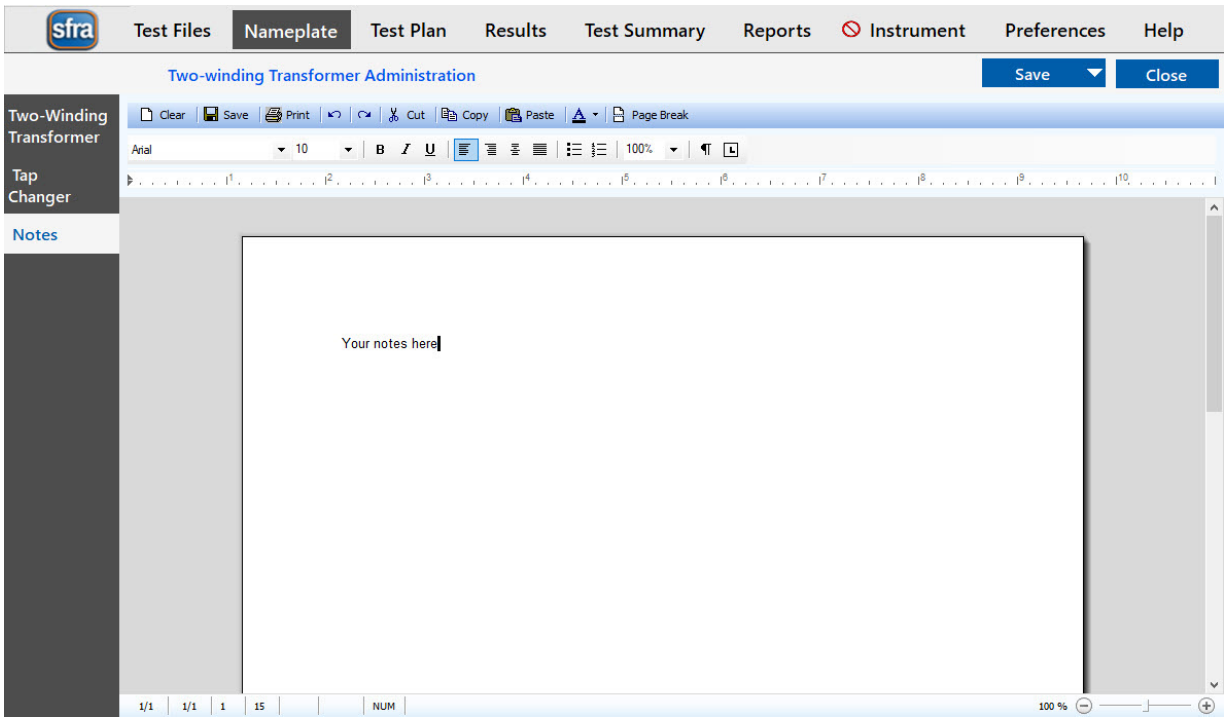


Figure 20 - Notes - Example

Perform the following steps to add a note.

1. Click **Nameplate** in the top menu.
2. Click **Notes** in the left menu.
3. Record any notes, including graphics into the notes document.
4. Click **Save** .

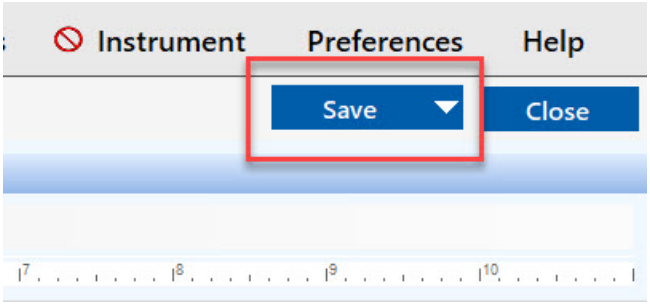


Figure 21 - Notes: Save

Test Plan

The Test Plan menu allows you to select the tests you need to perform. A test session is all the tests you run in a specified time period. Typically, all tests in a test session are run at

roughly the same time — for example, in the course of a workday. A test row is one test type within a test session.

Note: If you select the Test Plans menu under the Test Plan menu and you haven't configured the Nameplate information, you will get the warning that "A Standard Test Plan cannot be created until you specify the Configuration on the Nameplate panel."

Note: You cannot select a standard test plan until the number of Phases and Configuration values have been specified on the nameplate. You can create or run Custom Tests at any time.

Test List

The Test List menu shows how many test sessions in this file include SFRA results. The Reason selection field allows the tester to designate the reason for the selected test session. The Conducted This Session field will indicate whether SFRA testing has already been conducted in the selected test session.

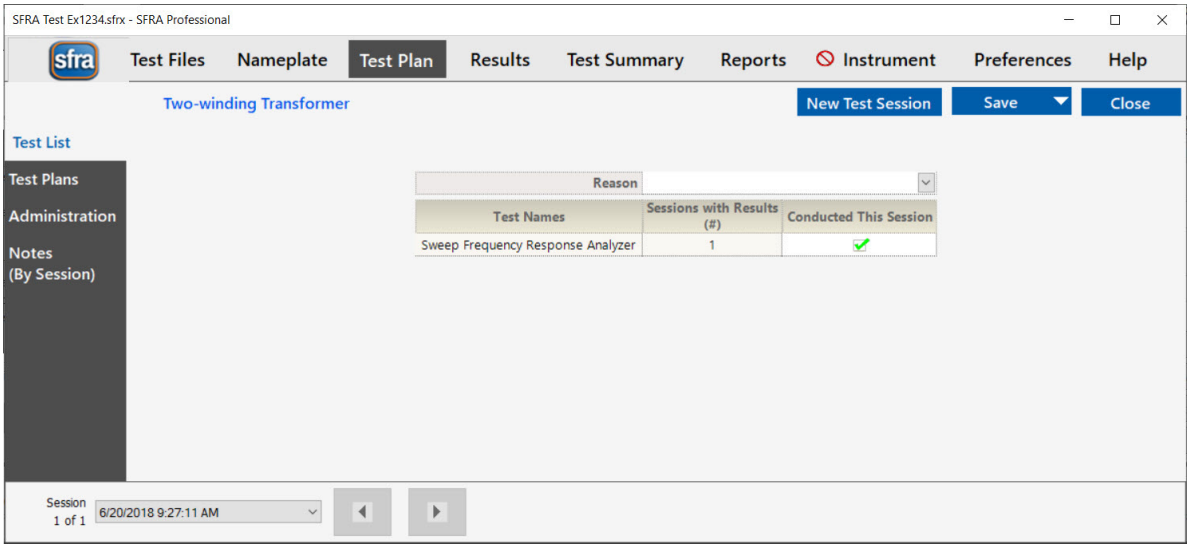


Figure 22 - Test List - Example

On each day that you run any tests on an apparatus, click **New Test Session**. This keeps the current day's results separate from the previous test session's results.

Note: If this is a new file, you do not have to click New Test Session. The first test session is automatically created.

You can change between test sessions by clicking the left or right arrows on the bottom of the screen.

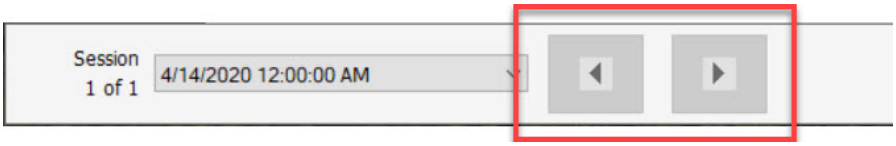


Figure 23 - Test Session Arrows

After running a test, a green check mark is displayed in the **Conducted This Session** column.

Test Plan

Test plans are the set of test sweeps you are going to run on the transformer. Each row in a test plan is a test line.

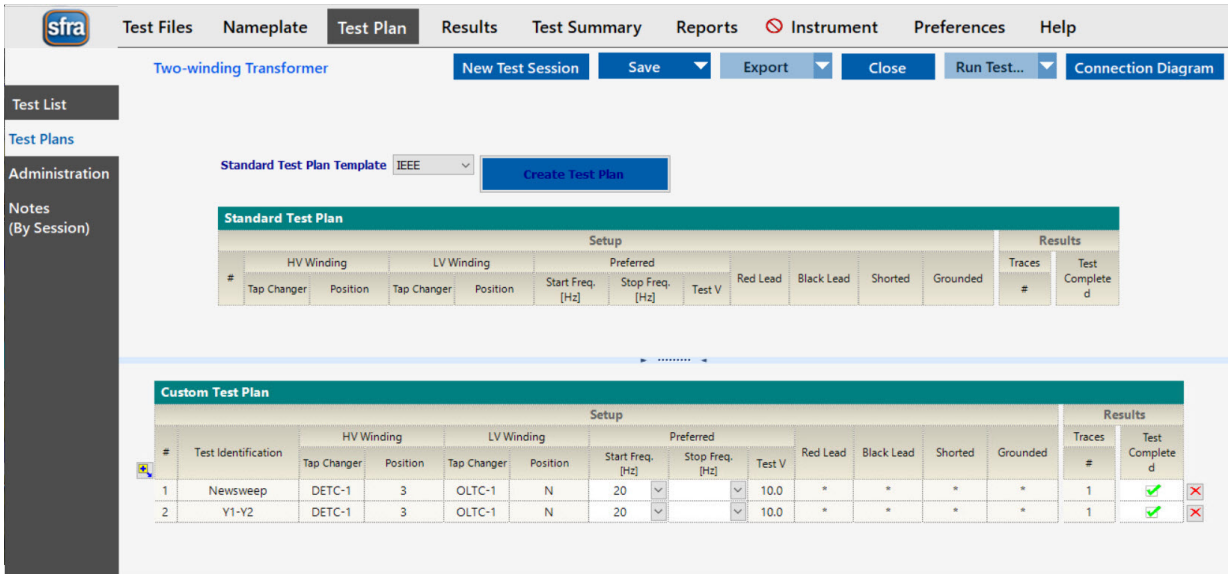


Figure 24 - Test Plans Menu

There are two types of test plans: standard and custom.

For information on standard test plans, refer to Creating a Standard Test Plan (page 1).

For information on custom test plans, refer to Creating a Custom Test Plan (page 1).

Click **Connection Diagram** to open the test procedure window. This window displays a diagram showing typical connection methods.

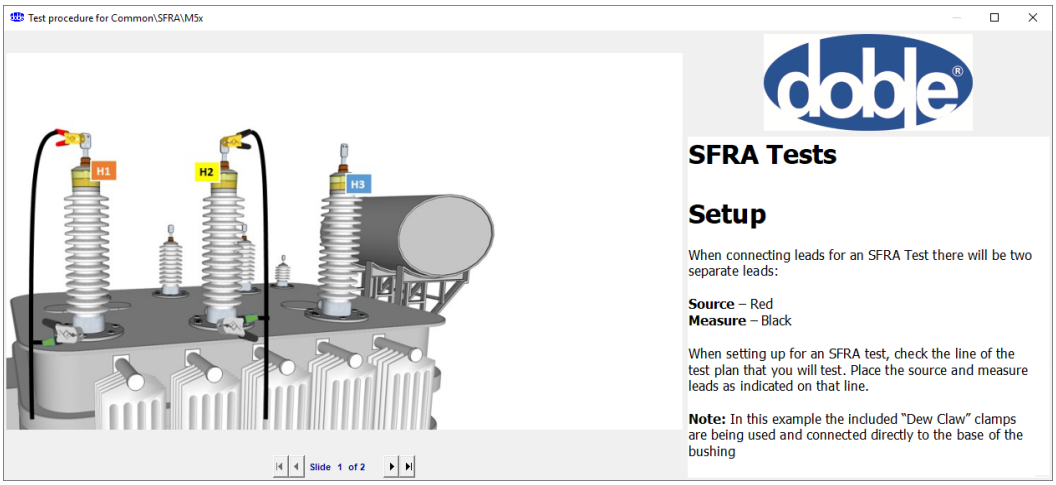


Figure 25 - Connection Diagram Example

Creating a Standard Test Plan

The Standard Test Plan template is a predefined test plan that you cannot edit. The selection of which test plan style (IEEE, IEC, etc.) to be used is usually a company-wide decision. Generally, all testing for a company should use the same standard.

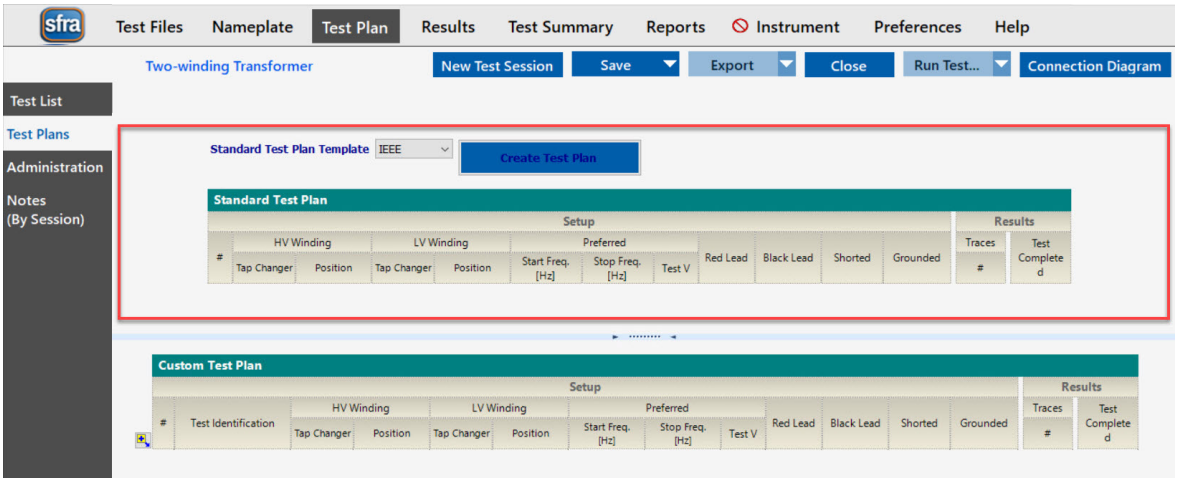


Figure 26 - Standard Test Plan Section

Standard test plans exist for:

- 2-Winding Transformer (IEEE, IEC)
- 3-Winding Transformer (IEEE, IEC)
- Auto-transformer without Tertiary (IEEE)
- Auto-transformer with Tertiary (IEEE)

Note: Standard test plans cannot be created until you specify the configuration on the Nameplate panel.

Perform the following steps to create a standard test plan.

1. Click **Test Plan** in the top menu.
2. Click **Test Plans** in the left menu.
3. Select an option from the **Standard Test Plan Template** drop-down.

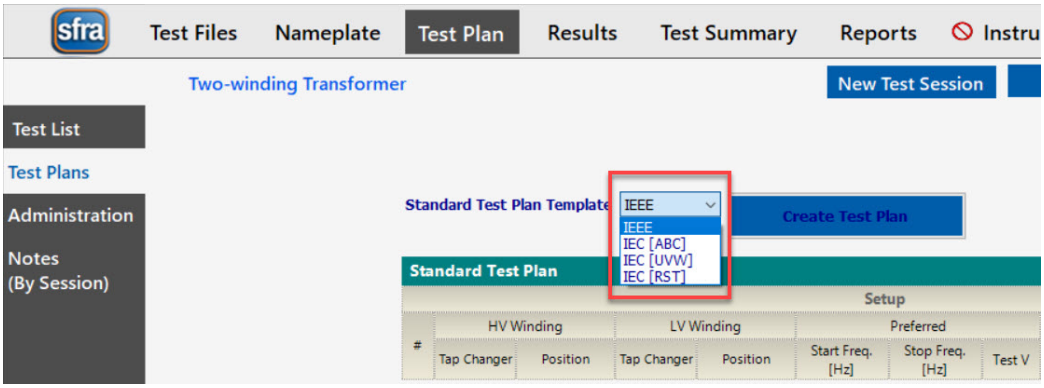


Figure 27 - Standard Test Plan Template Options

4. Complete the following test plan setup fields:
   - Start Freq. -[Hz] (Default=20 Hz, Min=10 Hz)
   - Stop Freq. - [Hz] (Default=2 MHz, M5500 Max=25 MHz, Others Max=20 MHz)
   - Test V - (Default = 10 V Peak-Peak into 50 Ohms). This column is only configurable when using an M5500 instrument. It must be set between 2.5 and 10 volts.
     - This setting can be saved in the test file, but test results do not currently record the test voltage used.
   - Tap Changer Positions

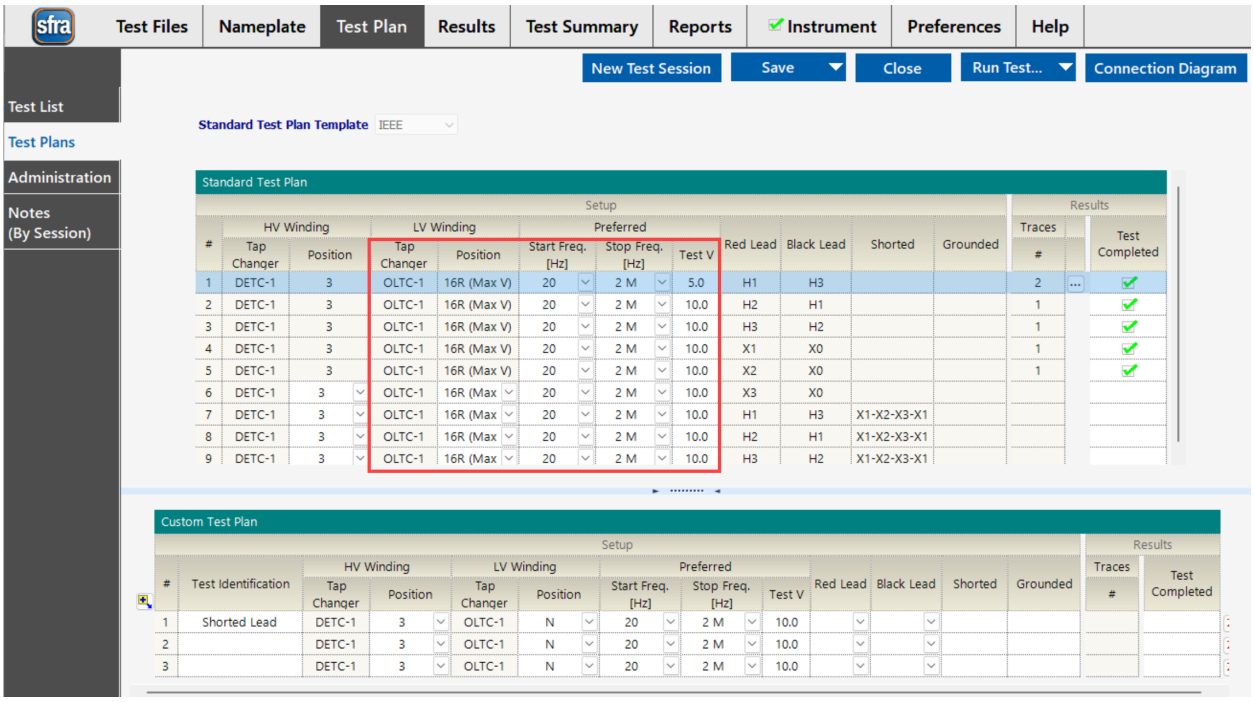


Figure 28 - Test Plan Setup Fields

> **Note:** In a standard plan, only tap changer positions and frequencies can be changed from the default values. Once a test has been performed for a row, its Tap Changer Position values are locked and cannot be changed in that session.

5. Click the **X** icon to remove a row, if required.

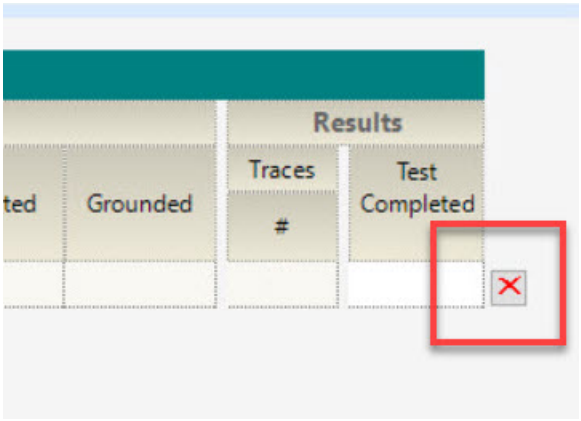


Figure 29 - Remove Test Plan Row

6. Click **Save**.

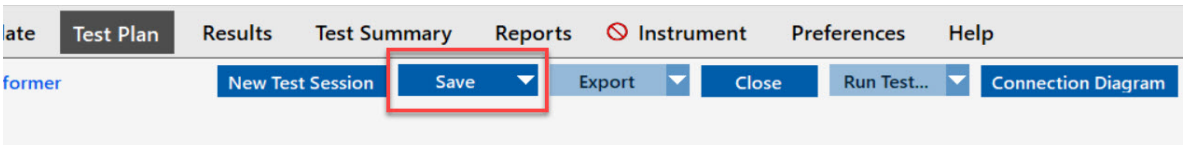


Figure 30 - Save Test Plan

Creating a Custom Test Plan

If you want to run different tests instead of standard tests or in addition to the standard tests, or if the apparatus does not have any standard test plan definitions, you can create a custom test plan. Custom test plans are displayed in the lower section of the screen.

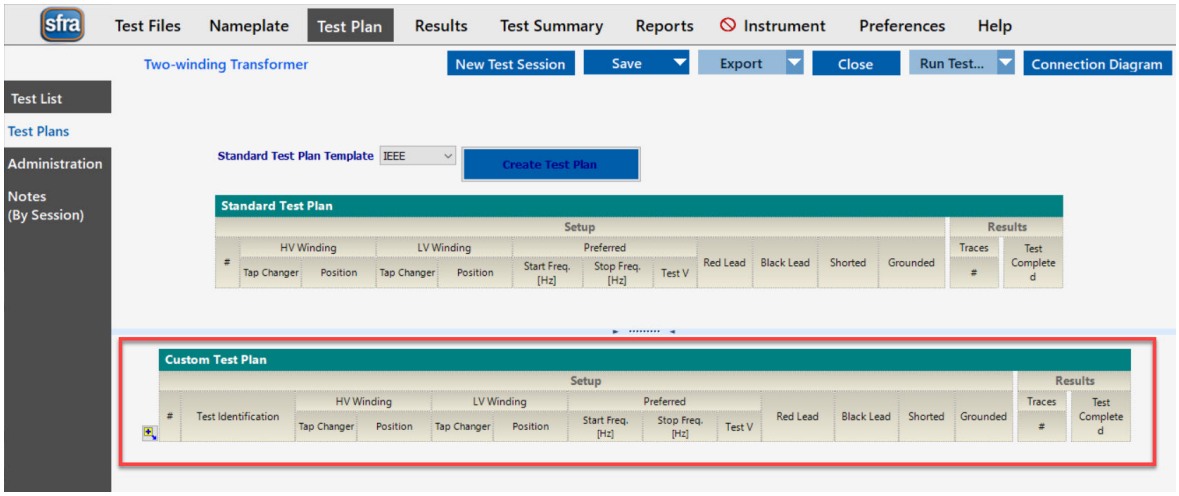


Figure 31 - Custom Test Plan Section

Perform the following steps to create a custom test plan.

1. Click **Test Plan** in the top menu.
2. Click **Test Plans** in the left menu.
3. Click the **+** icon under the **Custom Test Plan** grid to add a row.

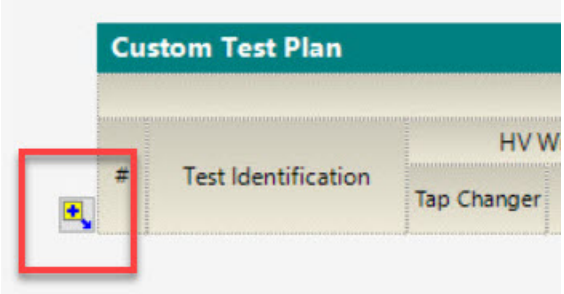


Figure 32 - Add Custom Test Plan

4. Complete the following test plan fields:
   - Test Identification
   - Start Freq. [Hz] (Default = 20 Hz, Min=10 Hz)
   - Stop Freq. [Hz] (Default = 2 MHz, M5500 Max=25 MHz, Others Max=20 MHz)
   - Test V (Default = 10 V Peak-Peak into 50 Ohms)
     - This column is only configurable when using an M5500 instrument. It must be set between 2.5 and 10 volts.
   - Red Lead (Position)
   - Black Lead (Position)
   - Shorted (Terminals)
   - Grounded (Terminals)
   - Tap Changer Positions

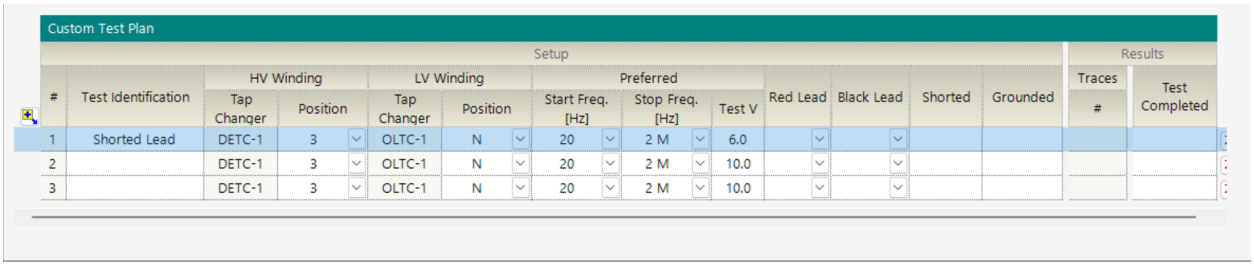


Figure 33 - Custom Test Plan Fields

5. Click the **X** icon to remove a row, if required.

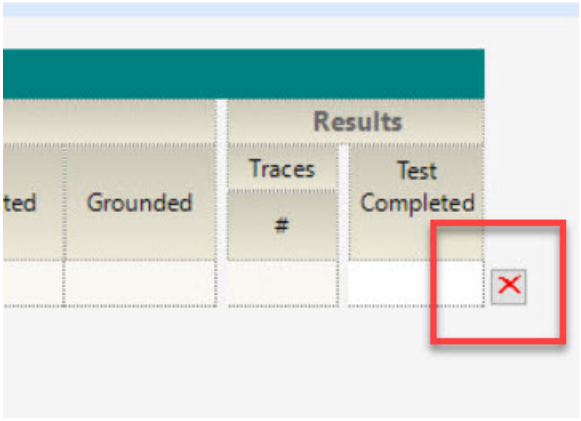


Figure 34 - Remove Test Plan Row

6. Click **Save**.

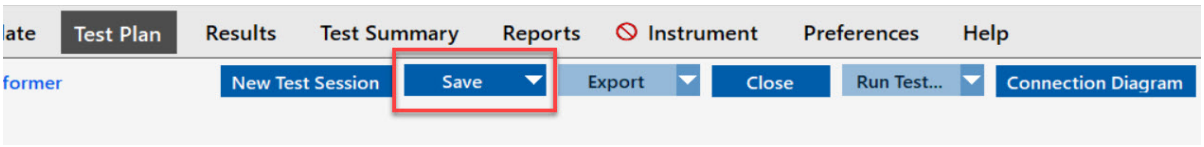


Figure 35 - Save Test Plan

Administration

The Administration menu is used for recording information about the test session. Session-specific information not contained on the Administration menu can be recorded in the Notes (By Session) menu, see Notes (By Session).

The instrument information is maintained by SFRA software to track the instrument used to run the test session. This information cannot be edited.

Note: Some fields might not be used, depending on the instrument.

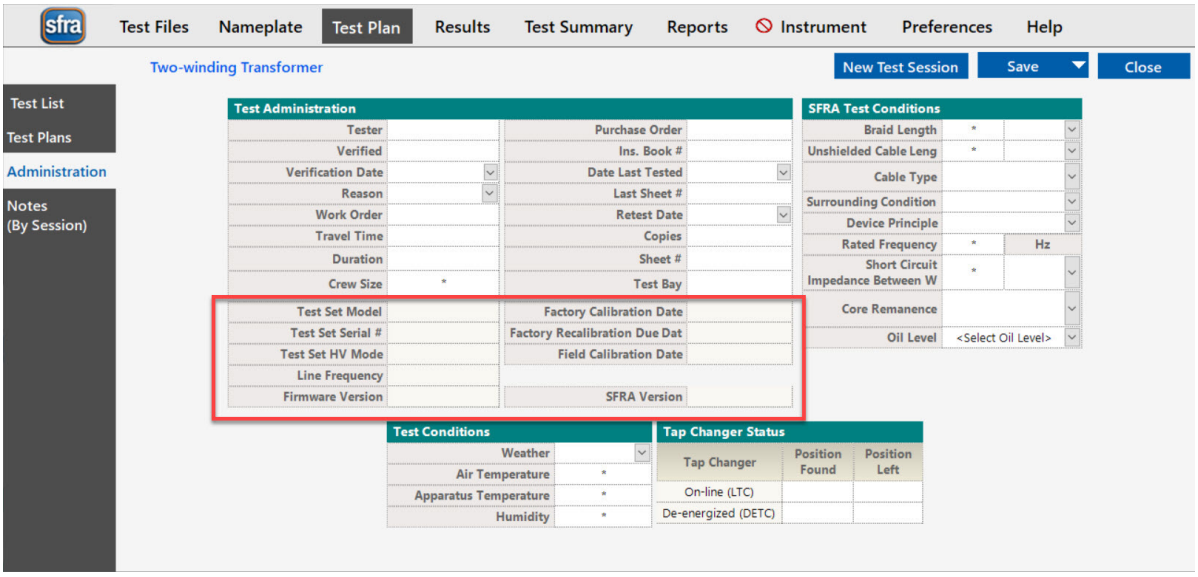


Figure 36 - Instrument Information

Recording Test Session Information

Perform the following steps to record test session information.

1. Click **Test Plan** in the top menu.
2. Click **Administration** in the left menu.
3. Complete the fields with a white background. Anything with a gray background is provided by SFRA software and cannot be edited.
4. Click **Save**.

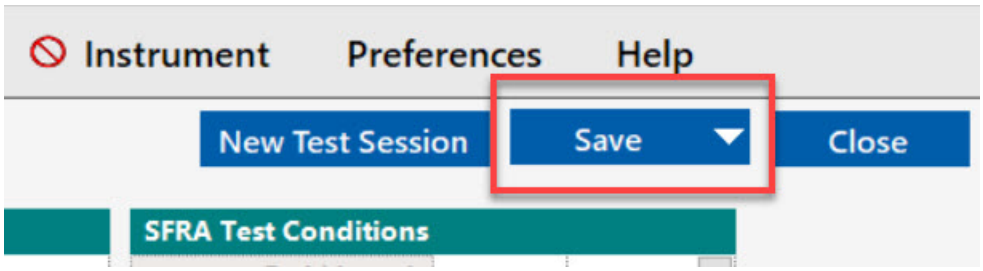


Figure 37 - Administration - Save

Notes (By Session)

The Notes (By Session) menu allows the user to add notes for the test session. These notes are used for recording information that was not recorded in the Administration menu.

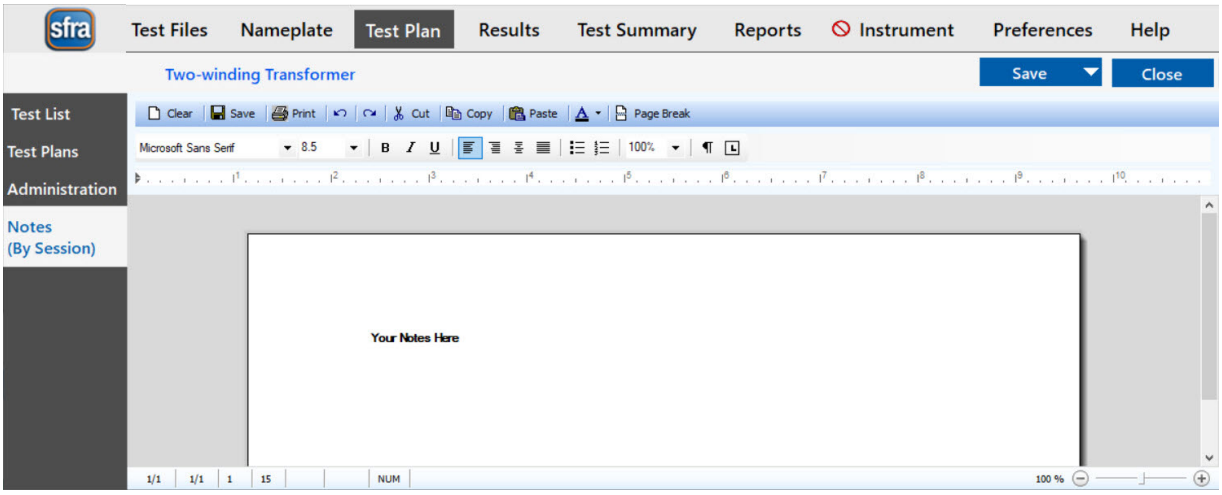


Figure 38 - Notes (By Session)

Perform the following steps to add a note.

1. Click **Test Plan** in the top menu.
2. Click **Notes (By Session)** in the left menu.
3. Record any notes, including graphics into the notes document.
4. Click **Save** in the notes document toolbar.

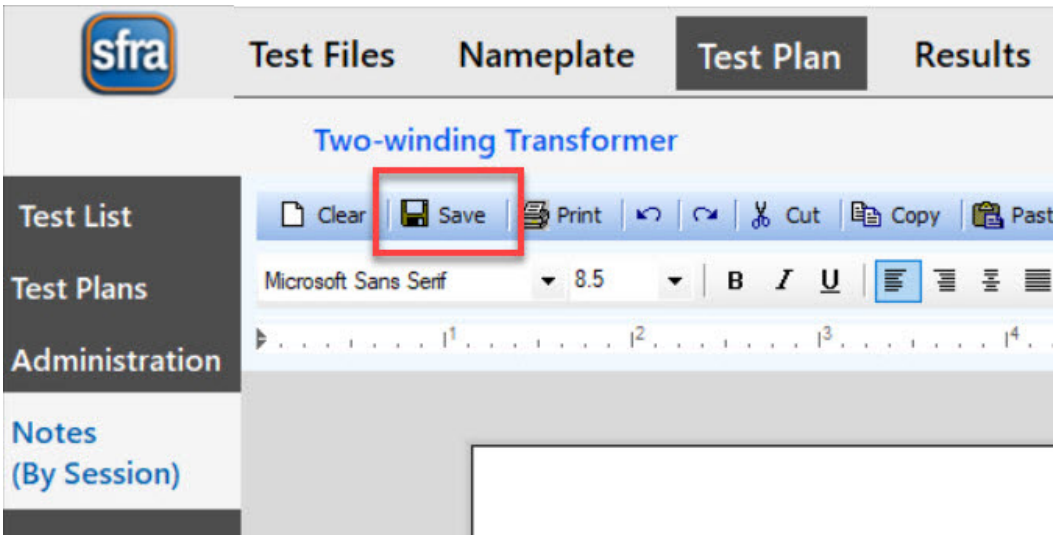


Figure 39 - Notes (By Session) Save

Preferences

The Preferences menu enables users to configure various settings for SFRA software. These preferences are saved globally.

The Preferences menu contains the following menus:

- Configuration
- Doble Database
- General

Configuration

The Configuration menu allows you to edit SFRA software settings.

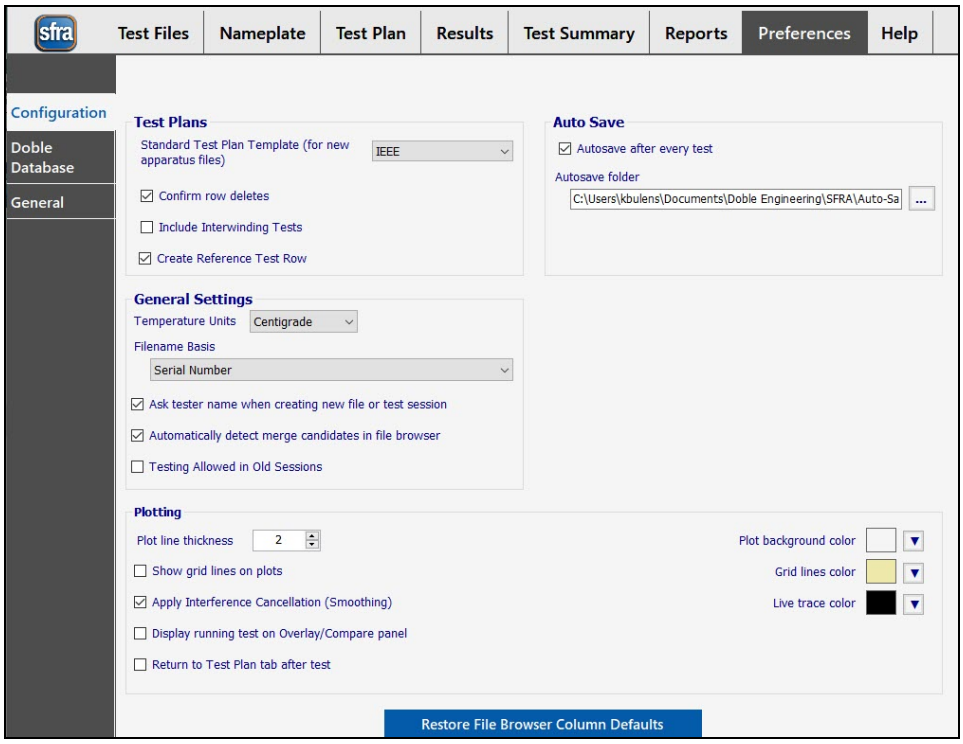


Figure 40 - Configurations Menu

The following settings can be edited in the Configuration menu:

- Test Plans
  - Standard Test Plan Template (for new apparatus files): This is the default value that is displayed in the Standard Test Plan panel's drop-down. This can be overridden until the user clicks Create Test Plan.
  - Confirm row deletes
  - Include Interwinding tests: When toggled, SFRA includes interwinding test lines when creating a standard test plan.
  - Create Reference Test Row: Adds a reference test line to the custom test plan.
- General Settings
  - Temperature Units
  - Filename Basis (This setting also determines the minimum information required to save a new test file.)
  - Ask for tester name on new file or test session
  - Automatically detect merge candidates in file browser
  - Testing allowed in Old Sessions
- Plotting
  - Plot line thickness
  - Show grid lines on Plots
  - Apply Interference Cancellation (Smoothing)

- Display running test on Overlay/Compare Panel
  - When enabled, past results can be viewed in active sweep view.
- Plot background color
- Grid lines color
- Live trace color

- Auto Save
  - Autosave after every test
  - Save folder

Note: The autosave file is a backup file. The autosave file is created as a backup in case SFRA software is closed without saving. Enabling this setting generates an autosave file every time you run a test. When you click Save, the autosave file is deleted.

- Instrument
  - Logarithmic Scaling
    - the instrument uses logarithmic spacing of frequencies when calculating sampling points. If not selected, linear spacing is used.
  - Number of Test Points
    - The default value for all instruments is 1,045 points.
    - For M5400 and other legacy instruments, the maximum number of points supported is 1,850.
    - For the M5500 when using logarithmic scaling, the maximum number of points supported is 5,000 per decade.
    - For the M5500 when using linear scaling, the maximum number of points supported is 32,000 total.
  - Use Tuned Frequency List
    - When selected, the instrument uses the fixed frequency points list used by legacy M5-series instruments.

- M5500 only
  - Instrument Filter
    - Standard - optimized for fast sweep speed
    - Adaptive - optimized for maximum dynamic range across the full sweep at the cost of reduced sweep speed
    - High Pass - optimized for dynamic range in the lower frequencies
    - Noise reduction - optimized for reduction of noise around line frequencies
    - Noise Reduction with High Pass
  - Reverse Sweep

- When selected, the M5500 sweeps from high frequency to low frequency (like legacy M5-series instruments)

The default configuration of the file browser columns can be restored by clicking **Restore File Browser Column Defaults**.

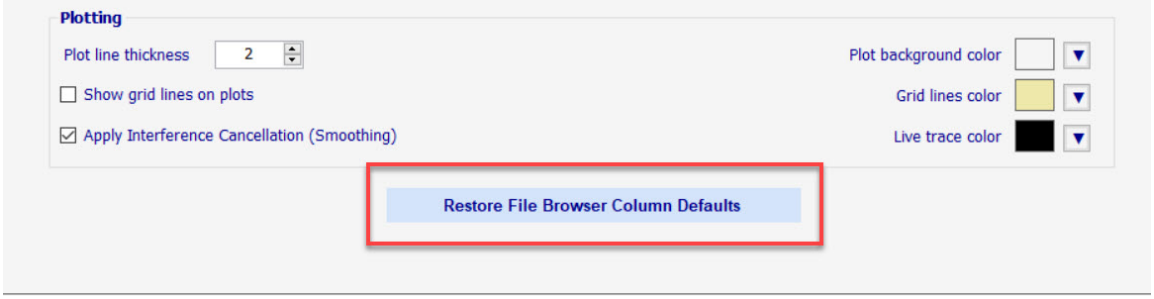


Figure 41 - Restore File Browser Column Defaults

Doble Database

The Doble Database menu allows you to edit your database preferences.

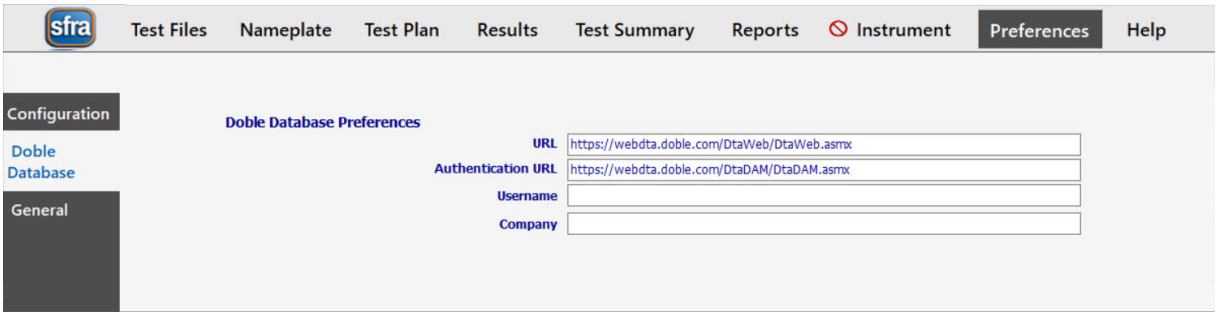


Figure 42 - Doble Database Menu

The following settings can be edited in the Doble Database menu:

- Doble Database Preferences
  - URL
  - Authentication URL
  - Username
  - Company

Note: If your company uses the Doble Customer Authenticator Module, enter your company name as it appears in the database. The **Company** field is also useful for a company that has an outside vendor do Doble tests and wants to view the data in its own database while allowing the vendor to also view the data in their own database.

General

The General menu allows you to edit the primary settings.

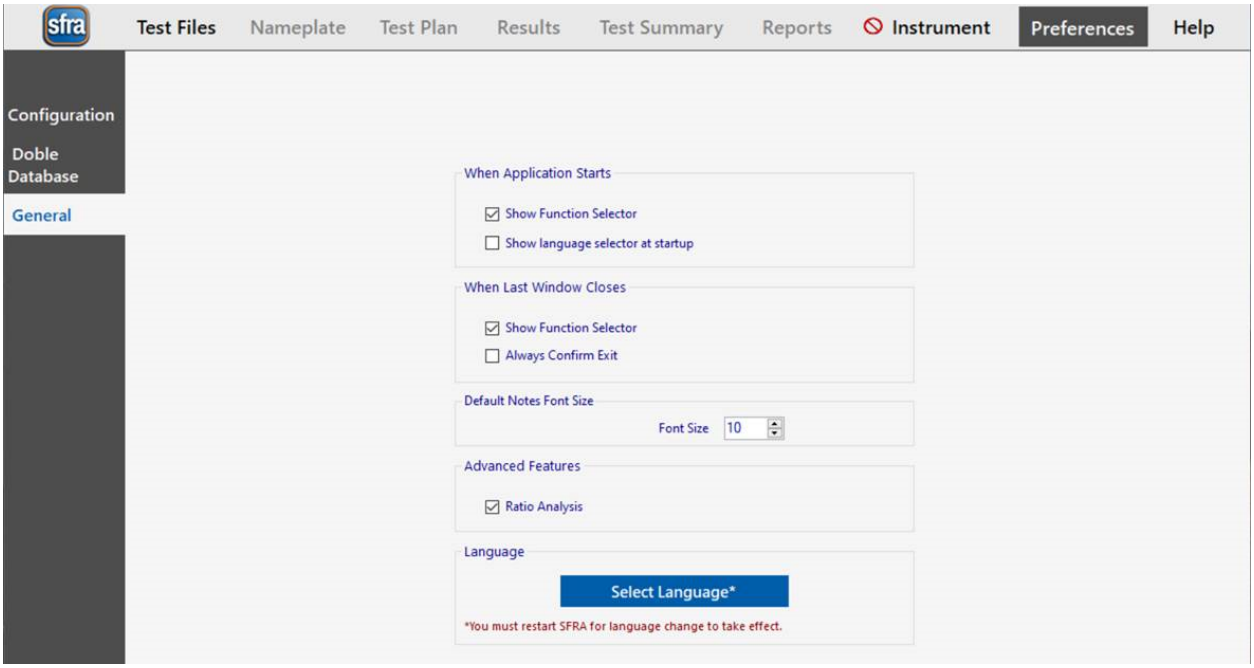


Figure 43 - General Menu

The following settings can be edited in the General menu:

- When Application Starts
  - Show Function Selector
  - Show language selector at startup
- When Last Window Closes
  - Show Function Selector
  - Always Confirm Exit
- Default Notes Font Size
  - Font Size
- Advanced Features
  - Ratio Analysis

        - When selected in SFRA v6 Pro software, the Ratio Analysis feature is enabled in the Results screen
- Language
    - Select Language

4. Connecting to an Instrument

This chapter describes how to establish communication between the SFRA 6.2.1 software and the Doble SFRA instrument. It contains the following sections:

Instrument

The Instrument menu is available when a Professional license is activated. The menu shows the available options for the instrument being tested.

Each time SFRA software is started, it automatically searches for an available instrument. If no instrument is found, a red circle symbol will appear on the Instrument menu.

Figure 44 - No Instrument Connected

If SFRA software has connected to an instrument, a green check mark appears beside Instrument in the top menu.

Figure 45 - Instrument Connected

Connecting Via Serial Port/USB

Perform the following steps to connect an instrument via a serial port or USB.

1. Ensure the instrument is connected to your system.
2. Click **Instrument** in the top menu.
3. Click **Available Instruments** in the left menu.
4. Select the **Search for serial port (RS232/USB) connected instruments** check box.
5. You may optionally toggle the Specific Serial Port check box and select a port from the drop down.

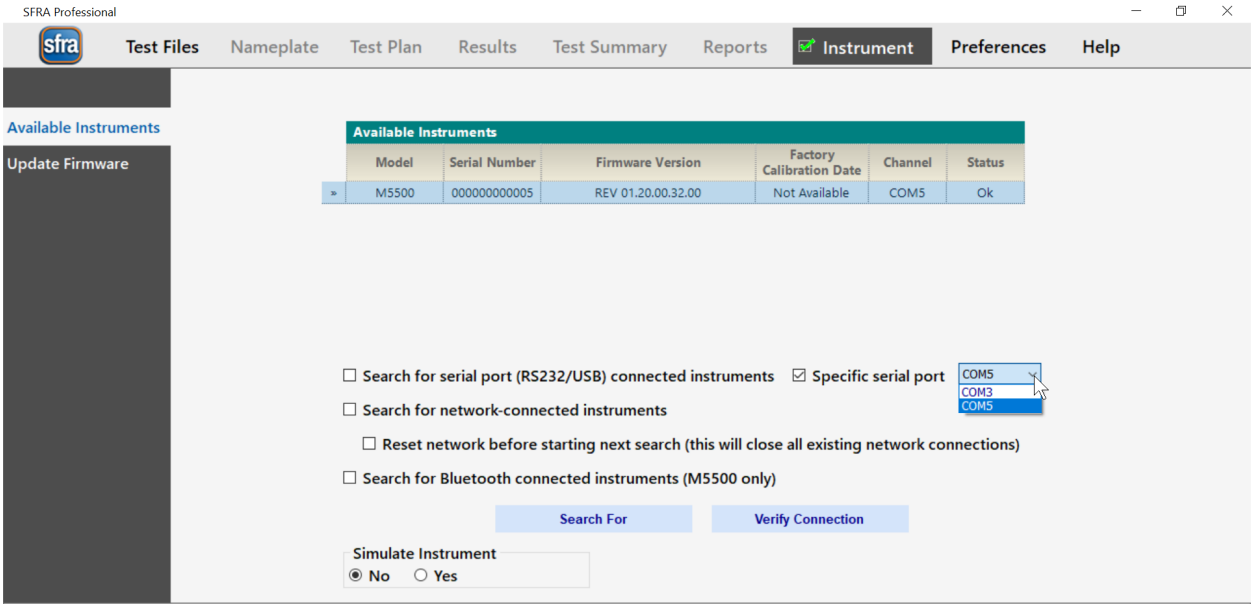


Figure 46 - Search For a Specific Serial Port

6. (Optional) To save search time, uncheck the other search option check boxes.
7. Click **Search For**.

   The **Searching for instruments** message will appear in the window.

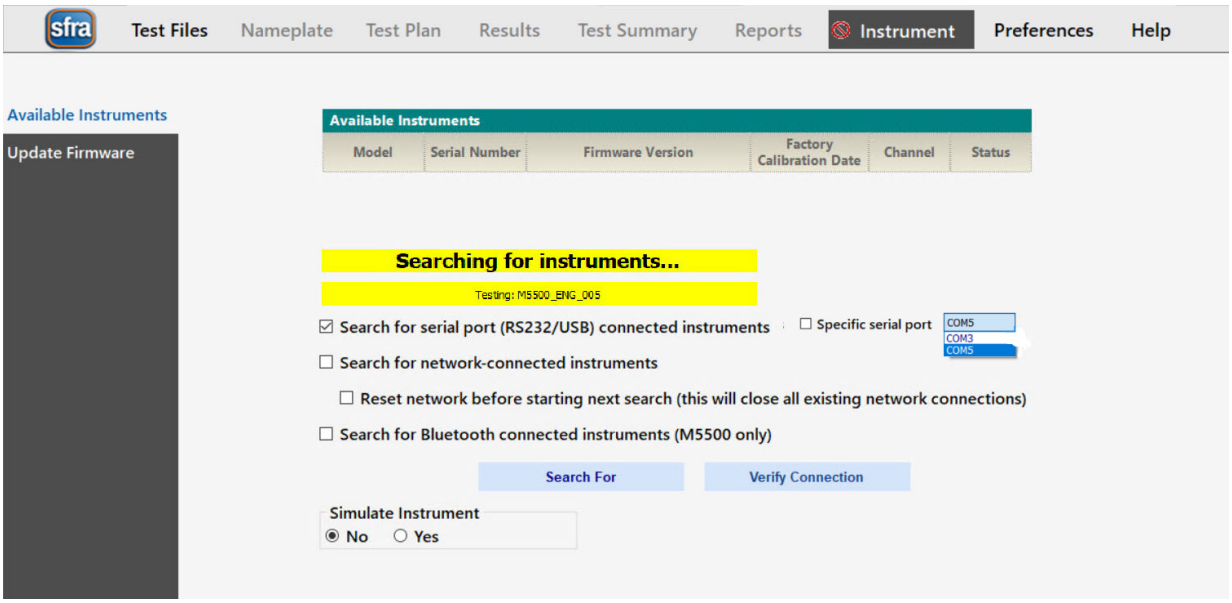


Figure 47 - Searching for Instruments via Serial Port

Once the instrument is found, the instrument name and details will appear in the **Available Instruments** grid at the top of the page.

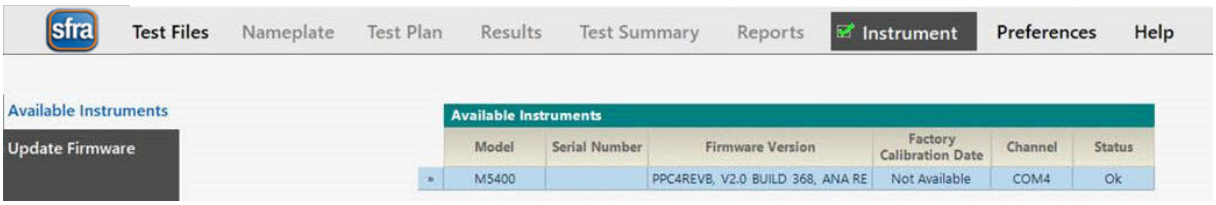


Figure 48 - Available Instruments Grid

Connecting Via Network

Perform the following steps to connect an instrument via a network.

1. Click **Instrument** in the top menu.
2. Click **Available Instruments** in the left menu.
3. Select the **Search for network connected instruments** check box.
4. (Optional) To save search time, uncheck the other search option check boxes.
5. Click **Search For**.

   The **Searching for instruments** message will appear in the window.

> **Note:** In most cases only a single instrument will be discovered. Some network connected instruments might list two IP addresses - either one will work.

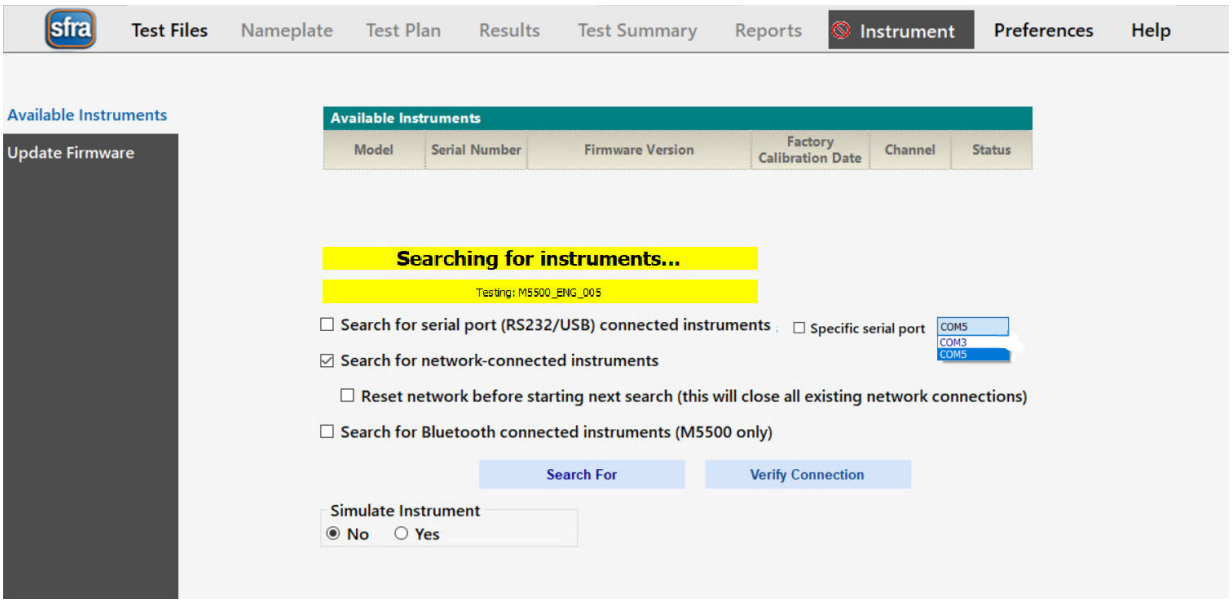


Figure 49 - Searching for Instruments via Network

Connecting Via Bluetooth

Perform the following steps to connect an instrument via Bluetooth.

Note: Bluetooth connectivity is only available for M5500 instruments.

1. On your system:
   a. Go to your controller PC system's Settings and turn on Bluetooth.
   b. Select the option to add a Bluetooth device.
   c. Select the M5500 instrument to connect.
2. On SFRA software:
   a. Click **Instrument** in the top menu.
   b. Click **Available Instruments** in the left menu.
   c. Select the **Search for Bluetooth connected instruments (M5500 only)** check box.
   d. (Optional) To save search time, uncheck the other search option check boxes.
   e. Click **Search For**.

   The **Searching for instruments** message will appear in the window.

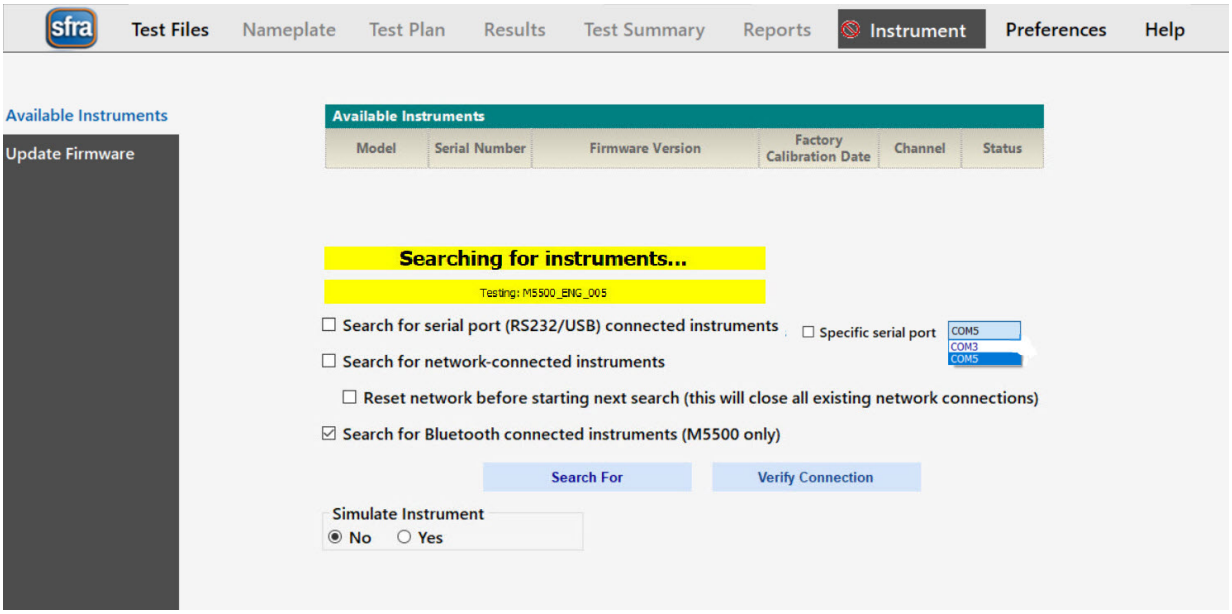


Figure 50 - Searching for Instruments via Bluetooth

5. Running a Test

This chapter describes how to run a test. It contains the following sections:

Running a Test from a Test Plan

Note: The following procedure assumes you have an open test file and are in a current test session. An attempt to run a test in a session created more than 24 hours ago will result in a prompt to create a new session.

Perform the following steps to run a test.

1. Click **Test Plan** in the top menu.
2. Click **Test Plans** in the left menu.
3. Select a test from the test plan and click **Run Test**.

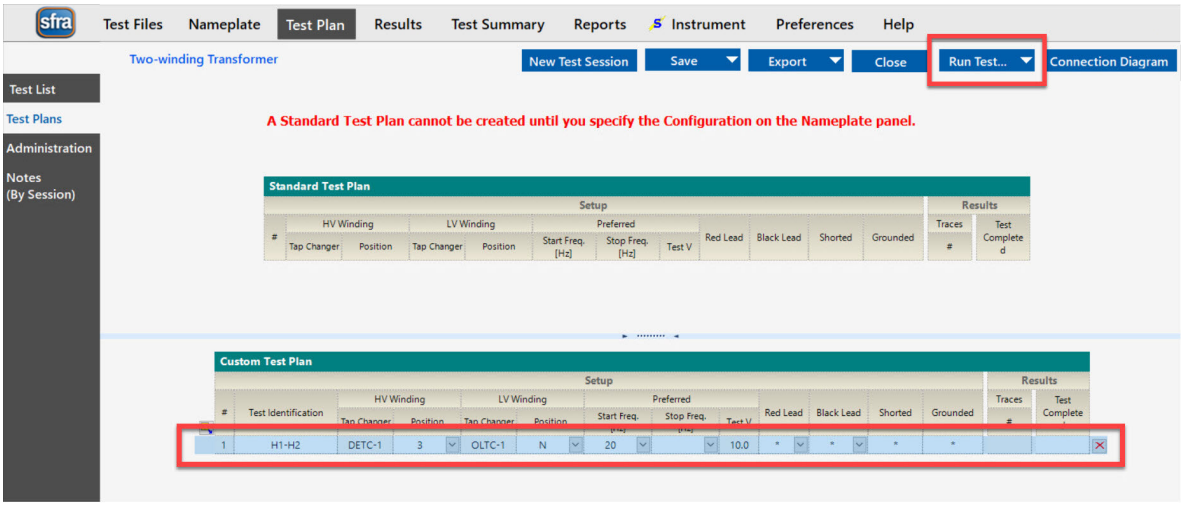


Figure 51 - Run Test

Note: You can only run tests in the most recent test session.

Note: Ensure you are in a new test session. For more information, refer to Test Plan.

4. After the test is completed, select whether to save or discard the test results.

Figure 52 - Save or Discard Results

5. If you click **Save Test Results**, enter the following test conditions:
   - Weather
   - Air Temperature
   - Apparatus Temperature
   - Humidity
   - Oil Level

Note: You will only be asked for these fields once per test session.

6. Provide the values for the fields if they are available.

Note: If the values are not readily available, they can be left blank and filled out under the Test Plan/Administration menu.
If you fill in all of the fields, you won't be prompted again during that session. But if you leave any or all of the fields blank, you'll be prompted every time you run a test.

The Results menu is displayed.

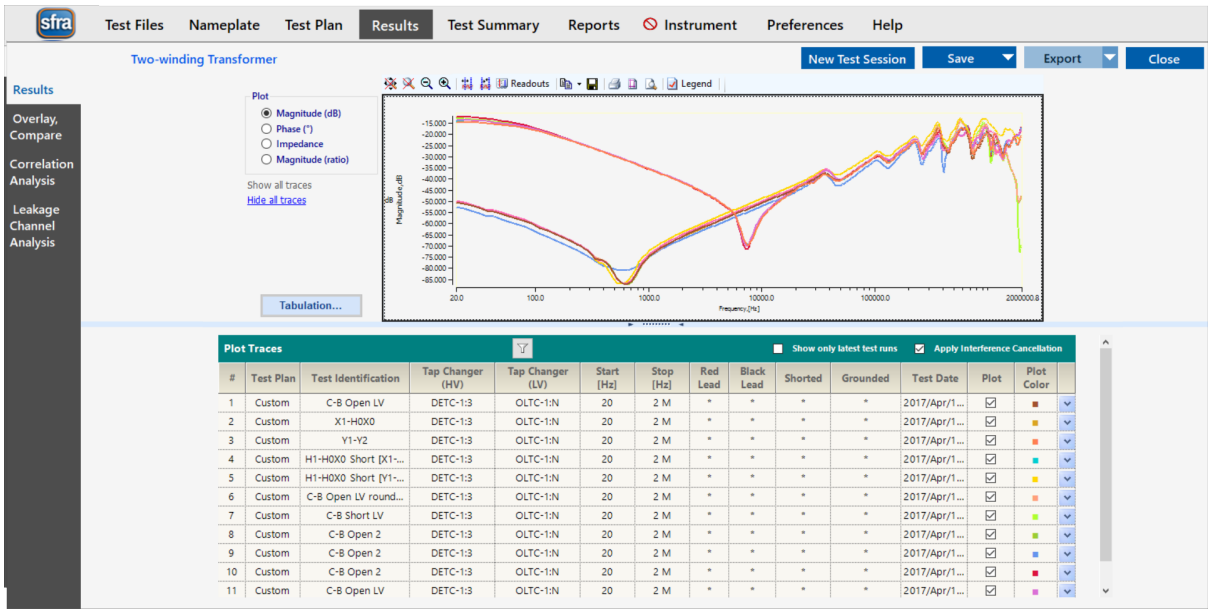


Figure 53 - Results - Example

7. Return to step 2 and continue running tests until you have saved at least one good test for each line in the test plan.

Running a Simulated Test

The simulator mode allows you to demonstrate what it looks like to run a sweep when you have no SFRA instrument or test specimen available.

> **Note:** An open test file with at least one test plan row is all that is required to simulate a test.

The following procedure uses an existing test file to simulate an instrument. It's also possible to do this by creating a new test file and adding a single row to the custom test plan.

Perform the following steps to simulate an instrument and run a simulated test.

1. Click **Test Files** in the top menu.
2. Select a test file then click **Open Test File**.

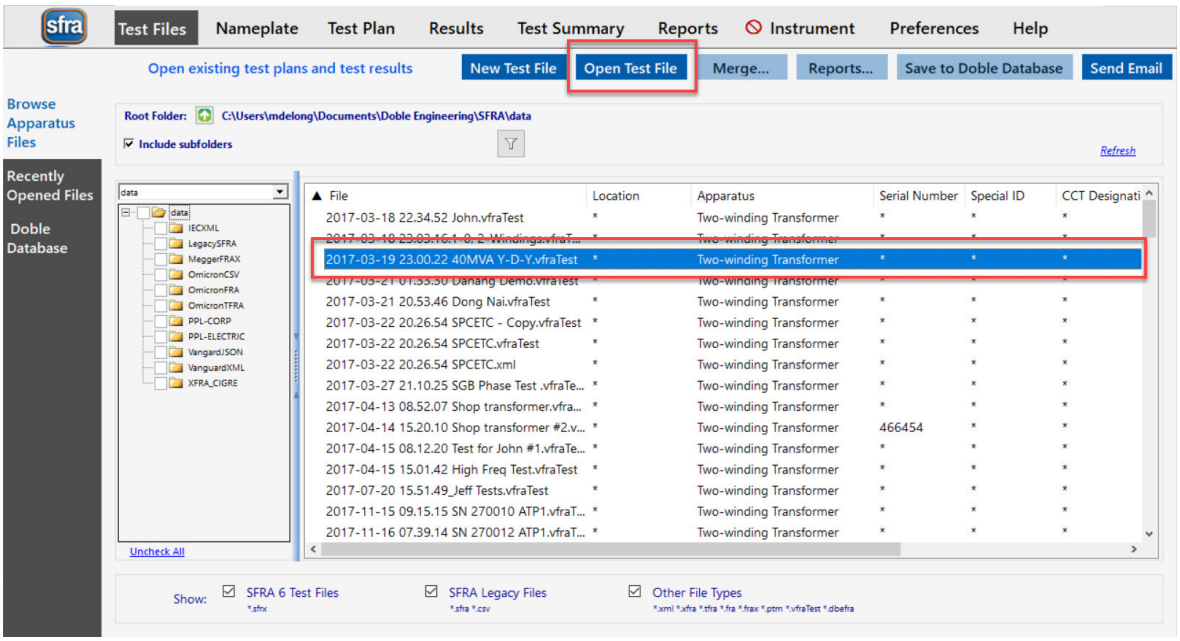


Figure 54 - Open Test File

3. Click **Instrument** in the top menu, select **Yes** under **Simulate Instrument**.

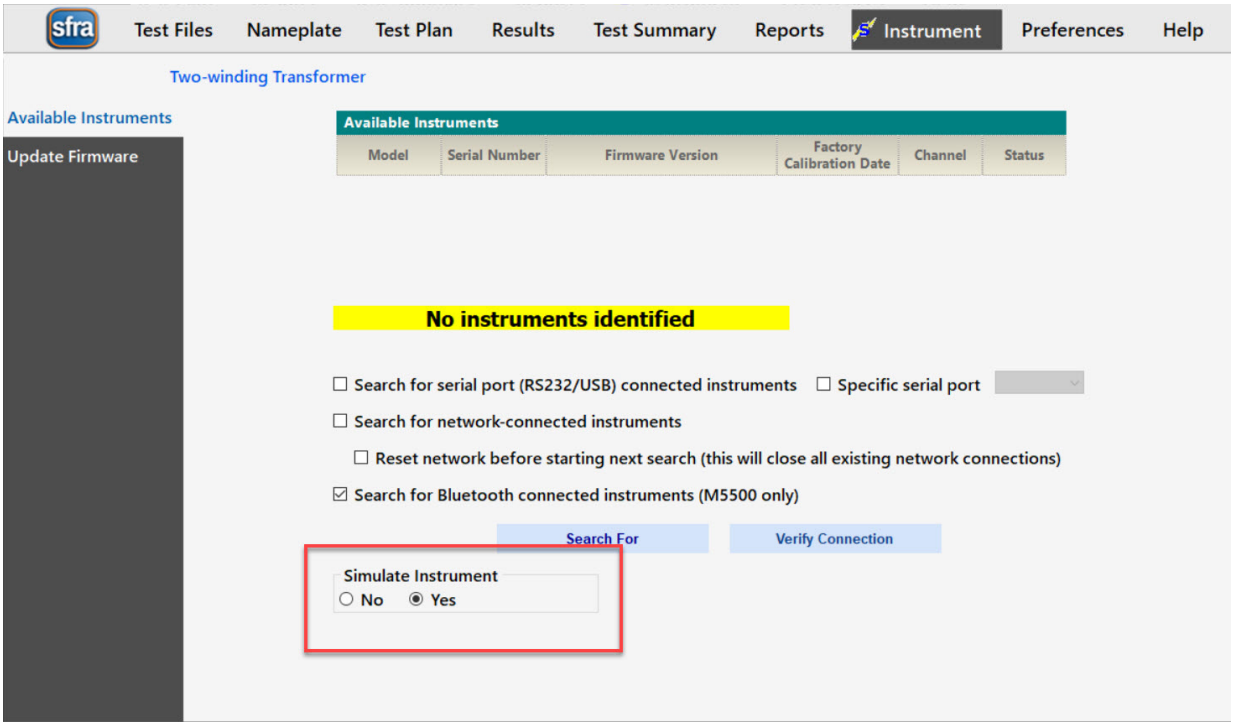


Figure 55 - Simulate Instrument

4. Click **Test Plan** in the top menu and click **Test Plans** in the left menu.

5. Click **New Test Session**, fill in the Tester field, then click **Yes**.

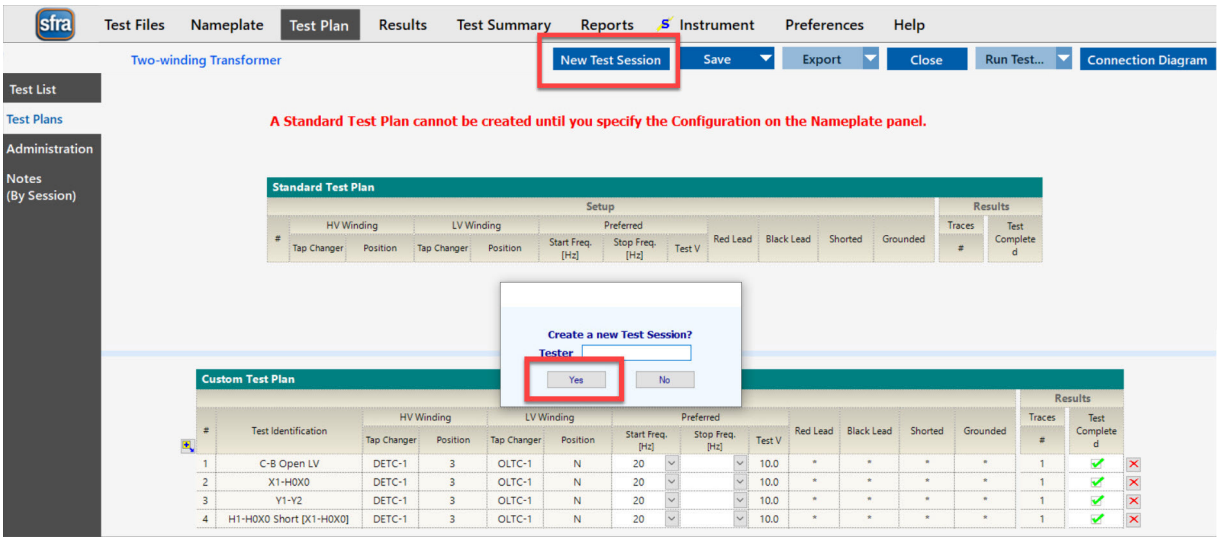


Figure 56 - Create New Session

6. Select a row and click **Run Test**.

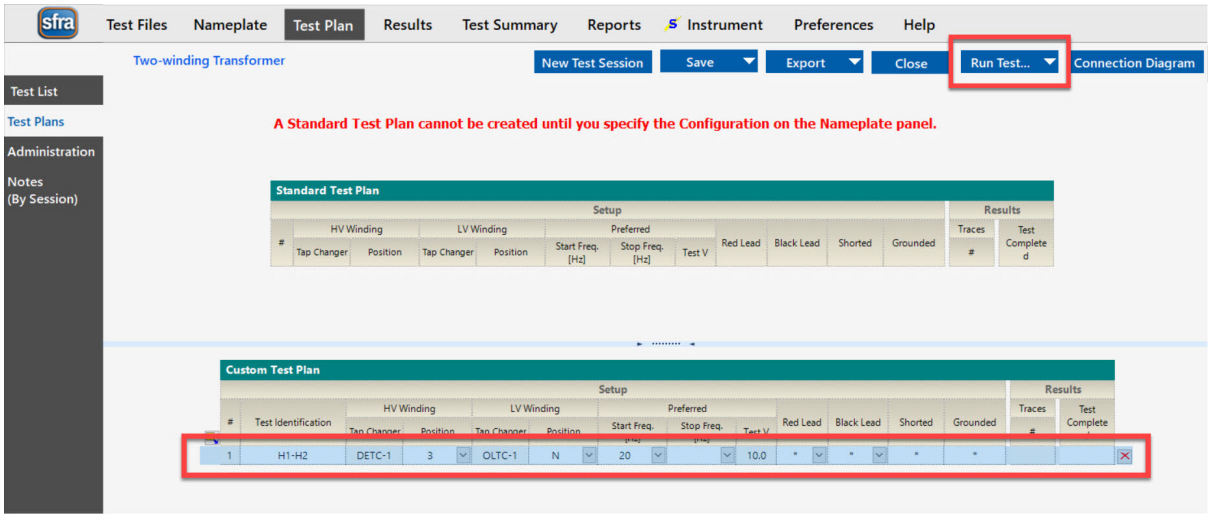


Figure 57 - Run Test

The simulator begins the test.

7. After the test completes, click **Save Test Results** or **Discard Test Results**.

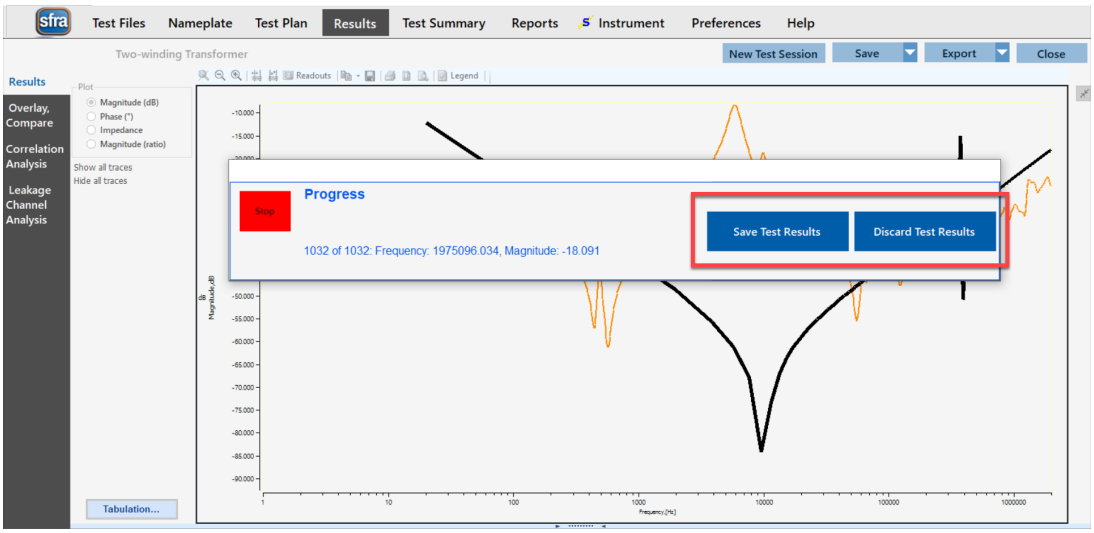


Figure 58 - Test Complete

Note: Simulated test results are best viewed on a logarithmic frequency scale. If needed, right-click the X axis to change the scale from the default (linear) to logarithmic.

6. Analyzing Test Results

This chapter describes the methods for analyzing the test results. It includes the following sections.

Results

The Results menu contains the following menus:

- Results
- Overlay, Compare
- Correlation Analysis
- Leakage Channel Analysis
- Ratio Analysis

Results

The Results menu shows traces of the test results. The grid in the lower panel combines all test rows from the Standard Test and Custom Test plan grids. The Test Plan cell identifies the origin.

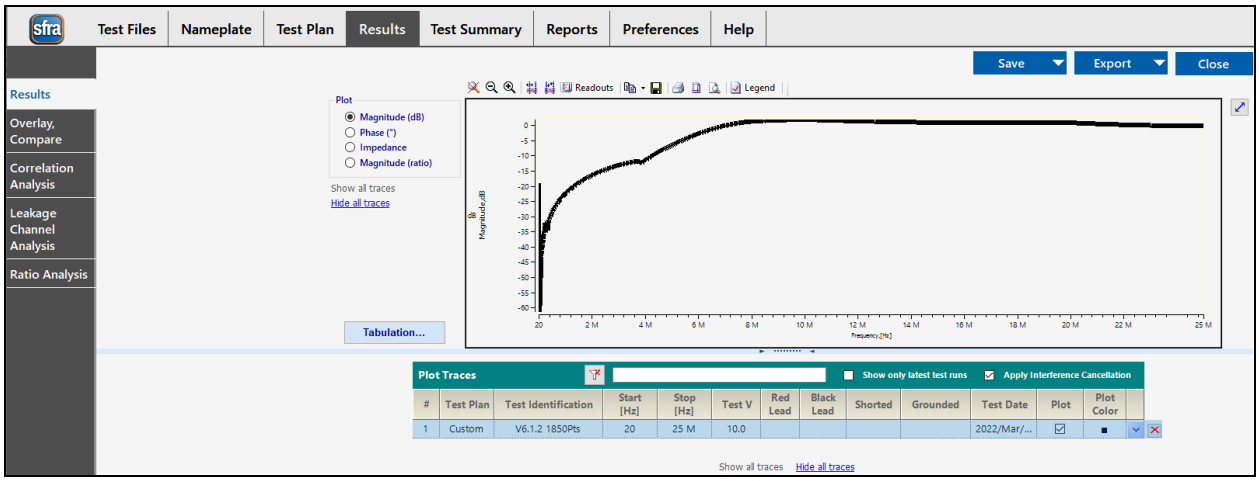


Figure 59 - Results Menu

Plot Traces

Note: The vertical cursor lines in the plot are not constrained to exact test point frequencies, so the X and Y readouts may not exactly match the test points captured in a Tabulation Table. The values that display are based on interpolating both the x and y readouts using neighboring points.

You can select one of the following options to change how results are displayed.

- **Magnitude (dB)**

  The Magnitude chart displays magnitude in dB versus frequency. This is the default display mode.

- **Phase (°)**

  The Phase chart displays phase angle versus frequency. Phase is rarely used but can be useful when looking at whether a measurement is more inductive or more capacitive.

- **Impedance**

  The Impedance chart displays impedance (Z ohms) versus frequency using the magnitude and phase results for calculation.

- **Magnitude (ratio)**

  The Ratio chart plots magnitude ratio, Vin/Vout versus frequency. This is used to determine if there is a discrepancy between two windings and determine which winding has an error. The magnitude ratio determines the deviation and the direction of the traces.

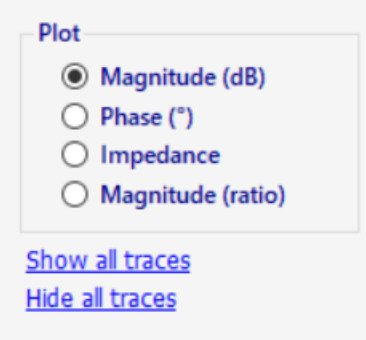


Figure 60 - Results Plot Options

Click the enlarge icon at the top-right of the chart to view the chart full screen. Click the same icon to return to normal screen.

Figure 61 - Enlarge Chart

When some or all traces are hidden, you can select **Show all traces** to display all traces in the list, or you can click **Hide all traces** to remove all traces from the chart display.

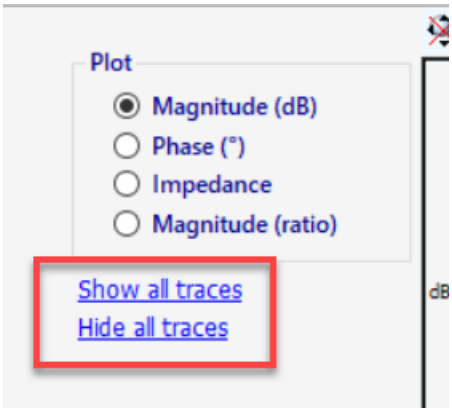


Figure 62 - Show All Traces/Hide All Traces

You can click **Tabulation** to view the raw data of the trace results in a separate window.

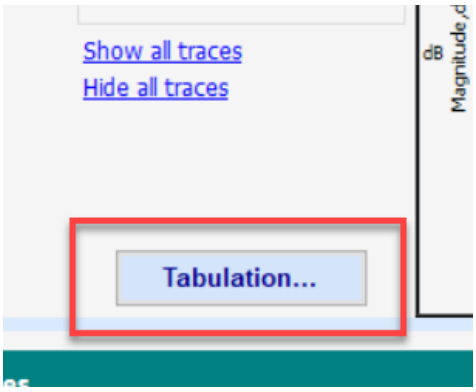


Figure 63 - Tabulation

The following options can be used to change the display of the results in the chart.

- In the Plot Traces grid:
  - Uncheck the check box in the **Plot** column to remove a result from the chart.
  - Select a color for the result in the **Plot Color** column.
  - Select a test row to make the corresponding trace bold in the chart.

Plot Traces — Show only latest test runs — Apply Interference Cancellation

#	Test Plan	Test Identification	Tap Changer (HV)	Tap Changer (LV)	Start [Hz]	Stop [Hz]	Red Lead	Black Lead	Shorted	Grounded	Test Date	Plot	Plot Color
1	Custom	H2-H0X0_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	H2	H0X0	Y1-Y2-Y...	none	2017/May/...	☐	
2	Custom	X3-H0X0_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	X3	H0X0	none	none	2017/May/...	☐	
3	Custom	Y1-Y2_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	Y1	Y2	none	none	2017/May/...	☐	
4	Custom	Y2-Y3_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	Y2	Y3	none	none	2017/May/...	☐	
5	Custom	H2-H0X0_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	H2	H0X0	X1-X2-X...	none	2017/May/...	☐	
6	Custom	X1-H0X0_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	X1	H0X0	Y1-Y2-Y...	none	2017/May/...	☐	
7	Custom	Y3-Y1_2017-05-...	DETC-1:3	OLTC-1:N	20	2 M	Y3	Y1	none	none	2017/May/...	☐	

Figure 64 - Results Options

Results Toolbar

The toolbar contains options for viewing and saving the chart.

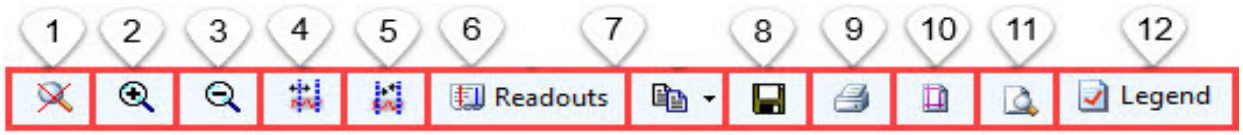


Figure 65 - Results Toolbar with Callouts

The following list defines the options in the toolbar that are shown in the above figure:

1. Reset zoom: zooms out but only displays the traces you've selected
2. Zoom in: zooms in on the chart
3. Zoom out: zooms out on the chart

4. Show Data Cursors: displays data cursors that can be moved to tell you the specific values at various points. You can add multiple cursors.
5. Move Cursors into view: allows you to see the cursors
6. Readouts: displays the values for the cursor for each trace. This dialog box opens automatically when you click **Readouts**.
7. Copy icon to copy the chart to the clipboard.
8. Save to save the chart as a .png file.
9. Print to print the chart.
10. Setup Page for Printing to set the Print settings.
11. Print preview to preview the chart.
12. Legend to view the legend for the plot in a pop-up window. You can move this to different a different monitor.

Cursor Options

Click **Readouts** or the Show Data Cursors icon to open the **Cursor Values** window.

Figure 66 - Cursor Values

In the Cursor Values window, click the drop-down next to a cursor color to view additional options.

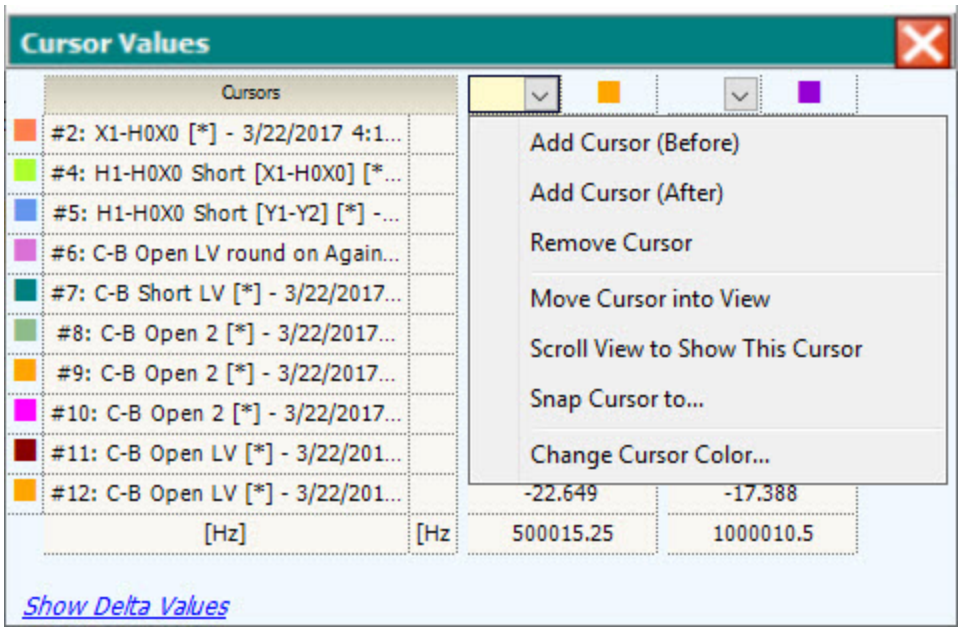


Figure 67 - Cursor Options

The following options are available:

- Select **Add Cursor (Before)** to add a new cursor before the existing cursor.
- Select **Add Cursor (After)** to add a new cursor after the existing cursor.
- Select **Remove Cursor** to delete it.
- Select **Move Cursor into View** to move the cursor into the plot. From there, you can click and drag it to where you want.
- Select **Scroll View to Show This Cursor** to move the view horizontally to see the cursor. This does not change the zoom level.
- Select **Snap Cursor to** select a place to move the cursor to move the cursor to defined places. You can move the cursor to the Zero Crossing, Threshold, Transition, Next Minimum, and Next Maximum.
- Select **Change Cursor Color** to edit the cursor color.

Save, Export Test Results

Test results can be saved using the Save and Export buttons at the top-right of the Results window.

Figure 68 - Save, Export

Saving test results creates a .sfrx file for the entire test file; you can name the file and choose a save location on your PC.

Test results can be exported to the following formats:

- CSV
- IEC
- CIGRE
- .sfra file readable by SFRA 5 software.

To export test results, select a row in the Plot Traces grid, then use the Export control and select the desired format.

All export formats can export either a select group of traces or all traces in a file.

Note: SFRA v5 does not support all fields that exist in SFRA v6, so while the fundamental sweep data will be viewable in SFRA v6 software, some information specific to version 6 can be lost during the export.

The export function turns all selected test results contained in the SFRA v6 test file (all results in all test sessions) into individual .sfrx files

Note: Due to limitations of the SFRA v5 software, any test result exported from SFRA v6 that contains more than the default number of points will not be completely displayed when opened in SFRA v5.

Overlay, Compare

The Overlay, Compare menu contains a chart that has the same abilities as the Results menu and provides additional features. Like the Results menu, it is initially populated with the standard test plan and custom test plan test results.

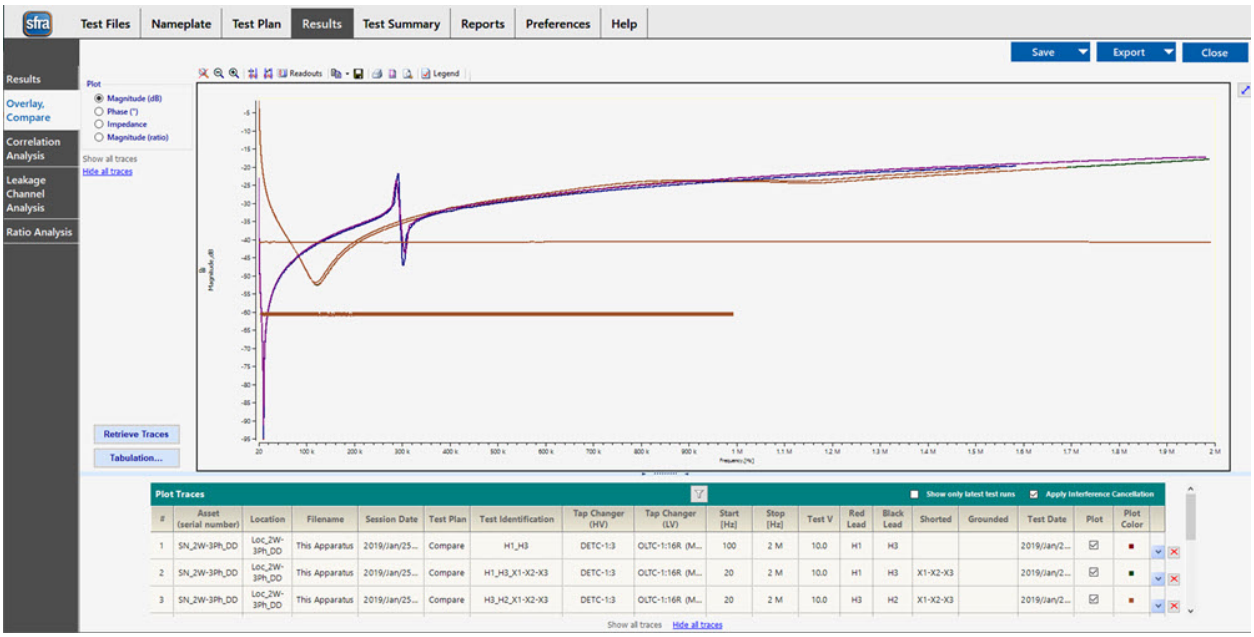


Figure 69 - Overlay, Compare Menu

On this menu, you can retrieve traces from a different file or test session and compare them to traces from the current session.

Perform the following steps to make this comparison:

1. Click **Retrieve Traces** to open the Retrieve Traces window.

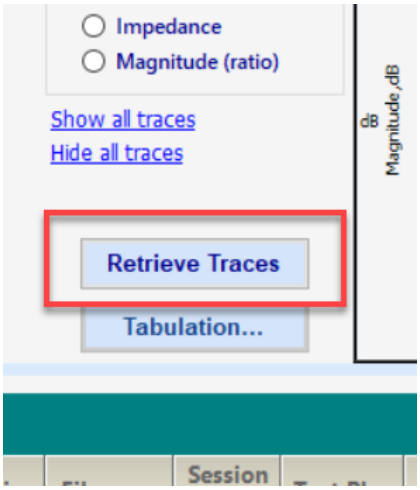


Figure 70 - Retrieve Traces

2. Select the traces to compare. You can select all traces in a given session by clicking the check box next to a session name, or expand a session with the **[+]** button to select traces individually.

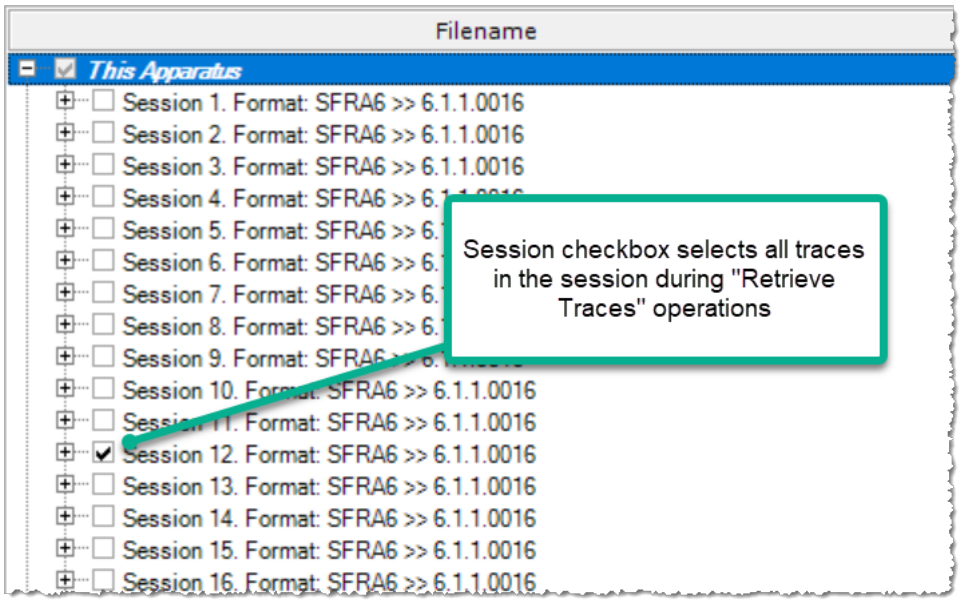


Figure 71 - Select Traces

3. Click **OK**.

   The trace is displayed in the plot and the top of the Plot Traces grid.

4. (Optional) To remove the retrieved trace, click the delete icon. You may also delete multiple traces at once.

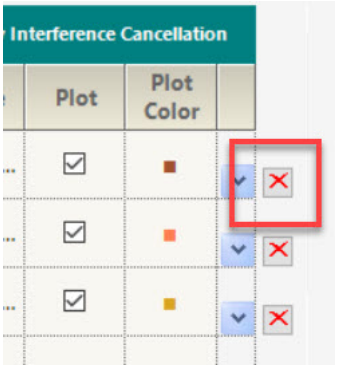


Figure 72 - Delete Trace

Plot Traces

Note: The vertical cursor lines in the plot are not constrained to exact test point frequencies, so the X and Y readouts may not exactly match the test points captured in a Tabulation Table. The values that display are based on interpolating both the x and y readouts using neighboring points.

You can select one of the following options to change how results are displayed.

- **Magnitude (dB)**

  The Magnitude chart displays magnitude in dB versus frequency. This is the default display mode.

- **Phase (°)**

  The Phase chart displays phase angle versus frequency. Phase is rarely used but can be useful when looking at whether a measurement is more inductive or more capacitive.

- **Impedance**

  The Impedance chart displays impedance (Z ohms) versus frequency using the magnitude and phase results for calculation.

- **Magnitude (ratio)**

  The Ratio chart plots magnitude ratio, Vin/Vout versus frequency. This is used to determine if there is a discrepancy between two windings and determines which winding has an error. The magnitude ratio determines the deviation and the direction of the traces.

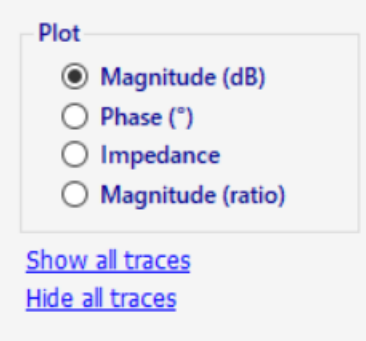


Figure 73 - Overlay, Compare Plot Options

Click the enlarge icon at the top-right of the chart to view the chart full screen. Click the same icon to return to normal screen.

Figure 74 - Enlarge Chart

When some or all traces are hidden, you can select **Show all traces** to display all traces in the list, or you can click **Hide all traces** to remove all traces from the chart display.

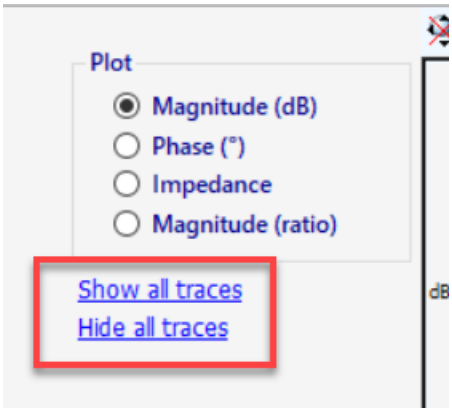


Figure 75 - Show All Traces/Hide All Traces

Click **Tabulation** to view the raw data of the trace results in a separate window.

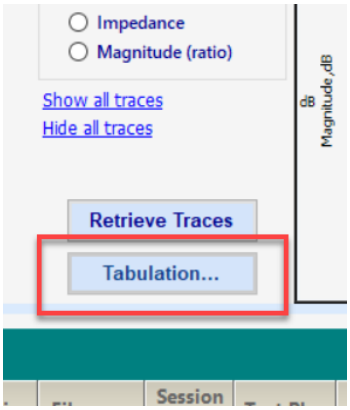
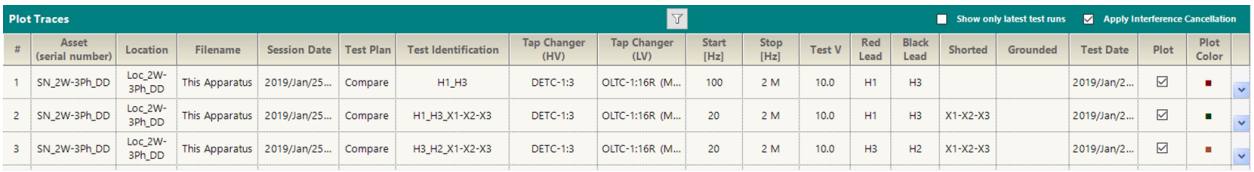


Figure 76 - Tabulation

The following options can be used to change the display of the results in the chart.

- In the Plot Traces grid:
  - Uncheck the check box in the **Plot** column to remove a result from the chart.
  - Select a color for the result in the **Plot Color** column.
  - Select a test row to make the corresponding trace bold in the chart.



#	Asset (serial number)	Location	Filename	Session Date	Test Plan	Test Identification	Tap Changer (HV)	Tap Changer (LV)	Start [Hz]	Stop [Hz]	Test V	Red Lead	Black Lead	Shorted	Grounded	Test Date	Plot	Plot Color
1	SN_2W-3Ph_DD	Loc_2W-3Ph_DD	This Apparatus	2019/Jan/25...	Compare	H1_H3	DETC-1:3	OLTC-1:16R (M...	100	2 M	10.0	H1	H3			2019/Jan/2...	☑	
2	SN_2W-3Ph_DD	Loc_2W-3Ph_DD	This Apparatus	2019/Jan/25...	Compare	H1_H3_X1-X2-X3	DETC-1:3	OLTC-1:16R (M...	20	2 M	10.0	H1	H3	X1-X2-X3		2019/Jan/2...	☑	
3	SN_2W-3Ph_DD	Loc_2W-3Ph_DD	This Apparatus	2019/Jan/25...	Compare	H3_H2_X1-X2-X3	DETC-1:3	OLTC-1:16R (M...	20	2 M	10.0	H3	H2	X1-X2-X3		2019/Jan/2...	☑	

Figure 77 - Results Options

Overlay, Compare Toolbar

The toolbar contains options for viewing and saving the chart.

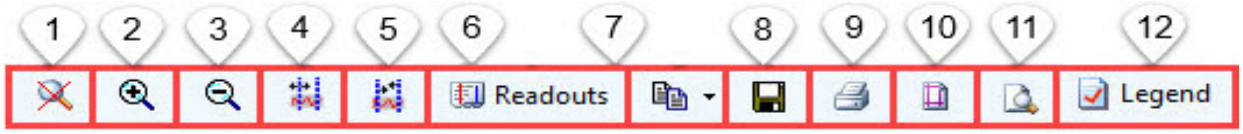


Figure 78 - Overlay, Compare Toolbar with Callouts

The following list defines the options in the toolbar that are shown in the above figure:

1. Reset zoom: zooms out but only displays the traces you've selected
2. Zoom in: zooms in on the chart
3. Zoom out: zooms out on the chart
4. Show Data Cursors: displays data cursors that can be moved to tell you the specific values at various points. You can add multiple cursors.
5. Move Cursors into view: allows you to see the cursors
6. Readouts: displays the values for the cursor for each trace. This dialog box opens automatically when you click **Readouts**.
7. Copy icon to copy the chart to the clipboard.
8. Save to save the chart as a .png file.
9. Print to print the chart.
10. Setup Page for Printing to set the Print settings.
11. Print preview to preview the chart.
12. Legend to view the legend for the plot in a pop-up window. You can move this to different a different monitor.

Cursor Options

Click **Readouts** or the Show Data Cursors icon to open the **Cursor Values** window.

Figure 79 - Cursor Values

In the Cursor Values window, click the drop-down next to a cursor color to view additional options.

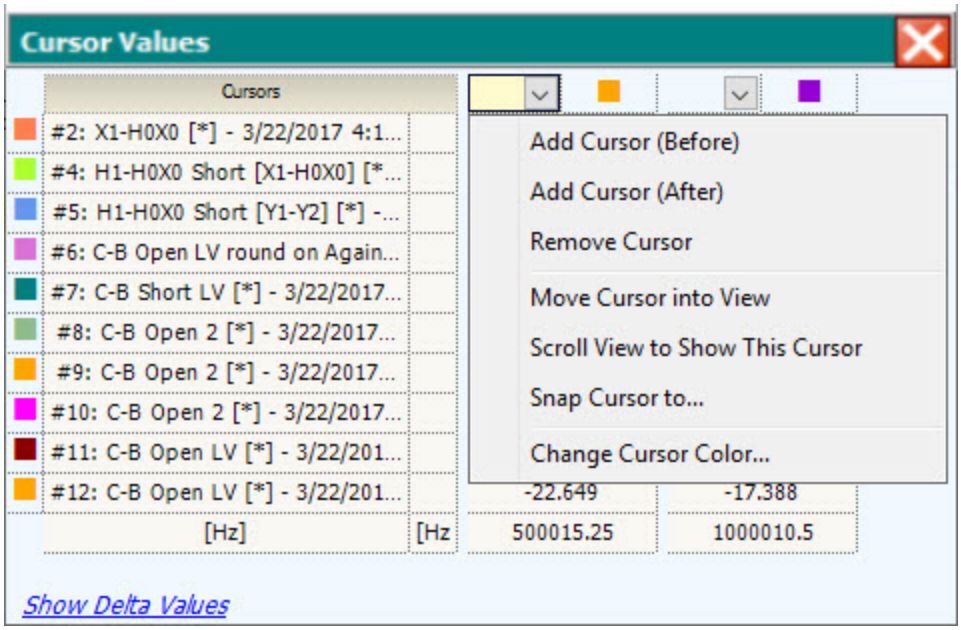


Figure 80 - Cursor Options

The following options are available:

- Select **Add Cursor (Before)** to add a new cursor before the existing cursor.
- Select **Add Cursor (After)** to add a new cursor after the existing cursor.
- Select **Remove Cursor** to delete it.

- Select **Move Cursor into View** to move the cursor into the plot. From there, you can click and drag it to where you want.
- Select **Scroll View to Show This Cursor** to move the view horizontally to see the cursor. This does not change the zoom level.
- Select **Snap Cursor to** select a place to move the cursor to move the cursor to defined places. You can move the cursor to the Zero Crossing, Threshold, Transition, Next Minimum, and Next Maximum.
- Select **Change Cursor Color** to edit the cursor color.

Correlation Analysis

The Correlation Analysis menu enables you to compare two test traces and determine how similar they are.

The upper plot displays Magnitude (dB) versus Frequency (Hz). You can drag the vertical band markers and see their values reflected in the Correlation Values grid in the Analysis Details window.

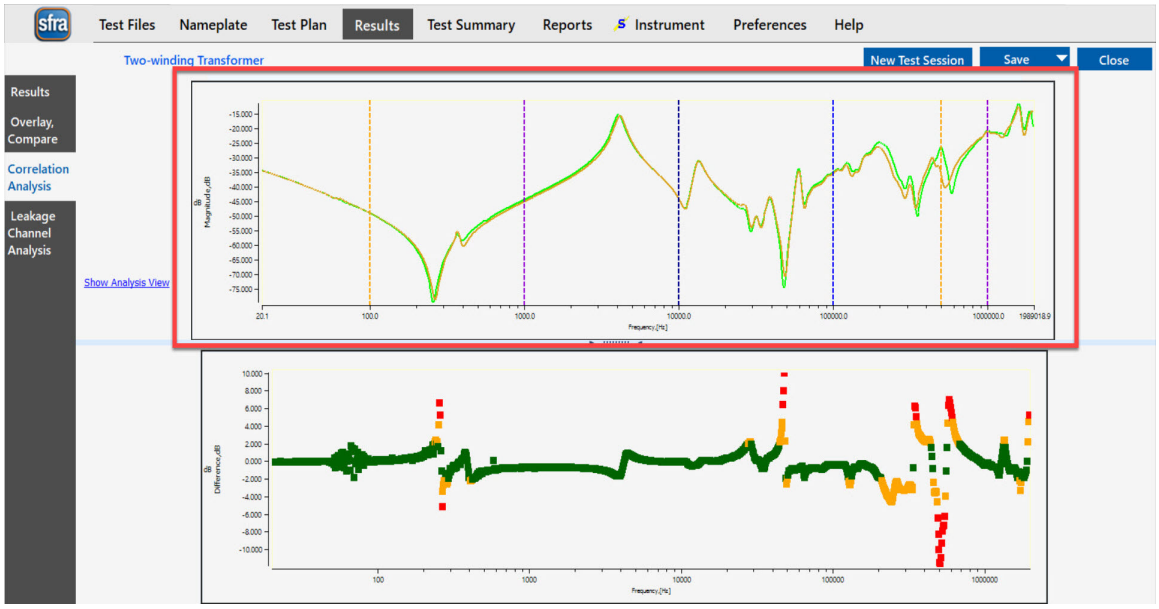


Figure 81 - Magnitude (dB) versus Frequency (Hz)

The lower plot displays Difference (dB) versus Frequency (Hz). The chart compares the magnitude values of the two traces at each frequency point and calculates the difference. Differences below the Marginal threshold display in green. Differences between the Marginal and Out of Range threshold display in yellow. Differences above the Out of Range threshold display in red.

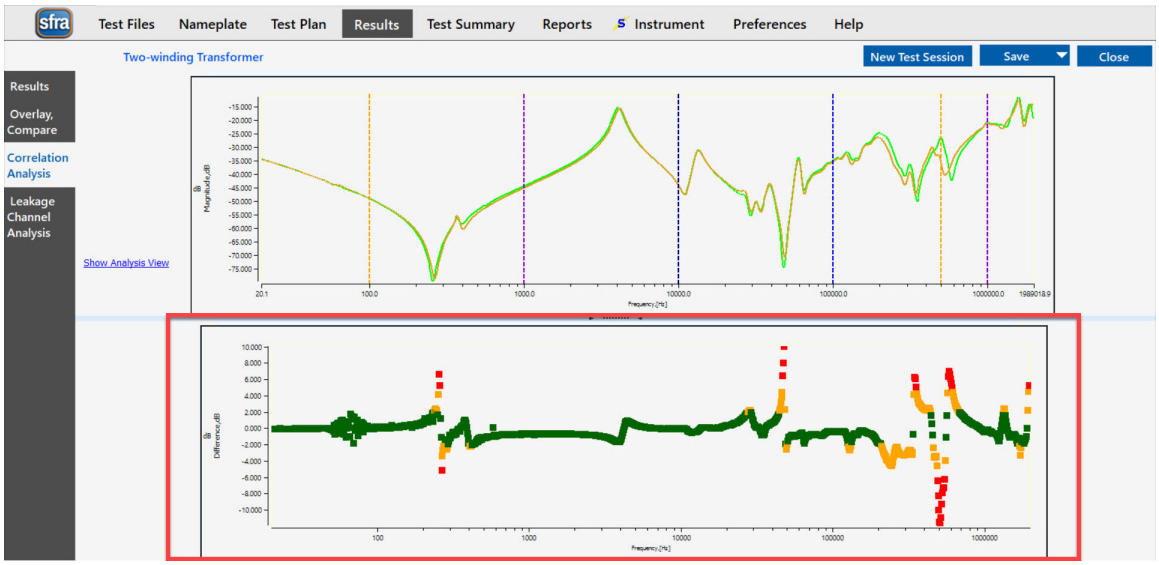


Figure 82 - Difference (dB) versus Frequency (Hz)

The Analysis Details window shows the correlation between the selected test rows across various frequency bands.

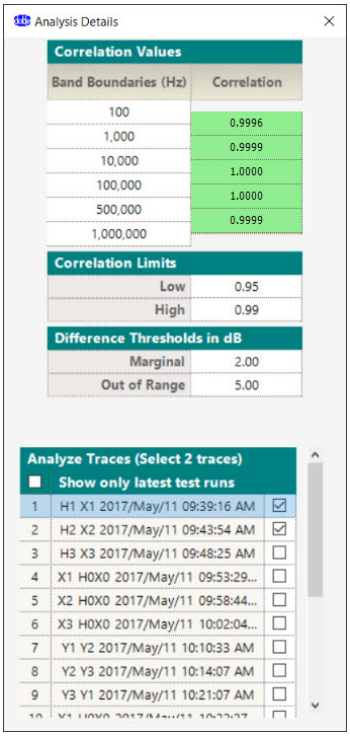


Figure 83 - Analysis Details Window

In general, SFRA software data is evaluated by the user. The user should decide whether the deviation of the trace being evaluated from the benchmark trace is acceptable. If points on the trace fall outside the defined limits, SFRA software notifies the user.

Compare Two Traces

Perform the following steps to compare two traces.

1. Click **Correlation Analysis** in the left menu. The Analysis Details window opens.
2. Select two traces from the **Analyze Traces** grid.

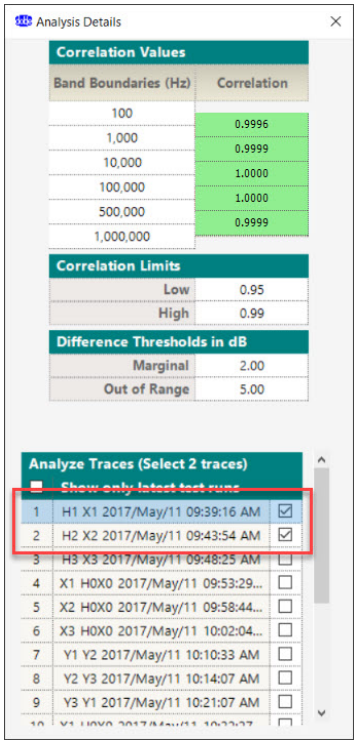


Figure 84 - Analyze Traces

The correlation values are calculated automatically, and the correlation is plotted on the chart.

3. (Optional) Click and drag the boundaries on the chart or manually edit the **Band Boundaries (Hz)** values in the Analysis Details window.

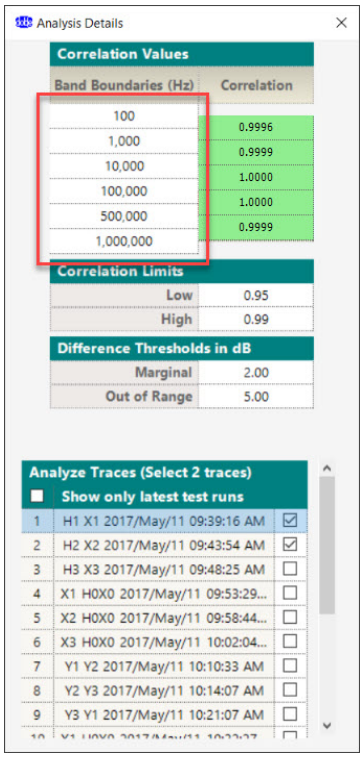


Figure 85 - Band Boundaries

4. (Optional) Set the low and high **Correlation Limits** values in the Analysis Details window. These are the minimum and maximum correlation factors. Bands that fall below the low correlation limit are highlighted in red in the Correlation Values grid. Bands that exceed the high correlation limit are highlighted in green in the Correlation Values grid.

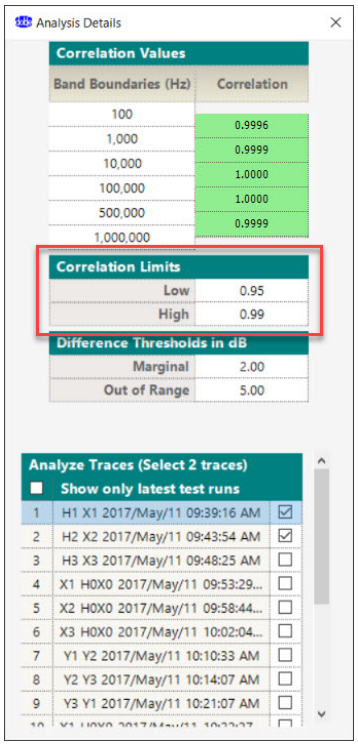


Figure 86 - Correlation Limits

5. (Optional) Set the marginal and out of range values for **Difference Thresholds in dB** in the Analysis Details window. The differences are displayed graphically in the bottom section of the screen.

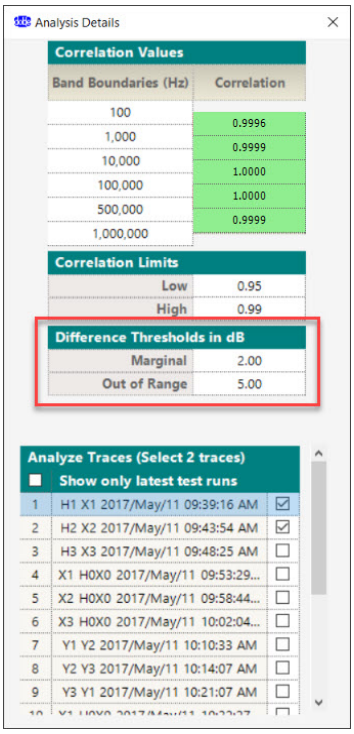


Figure 87 - Difference Thresholds in dB

Leakage Channel Analysis

The Leakage Channel Analysis menu allows automatic analysis of the leakage channel of the transformer. For a valid analysis, you must have a test session open in the Results menu that includes at least two short-circuit tests (tests lines with entries in the Shorted column).

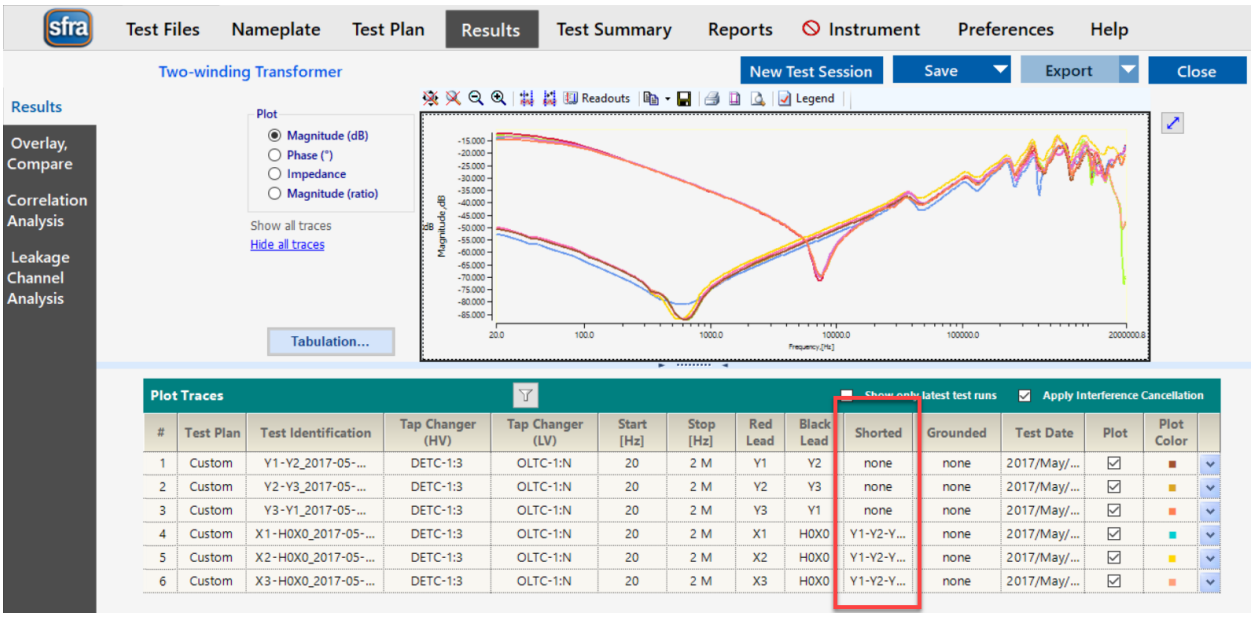


Figure 88 - Results Menu: Shorted Column

Viewing Leakage Channel Analysis Data

Perform the following to view leakage channel analysis data.

1. In the **Results** menu, ensure that only the test lines with entries in the Shorted column are selected in the Plot column.

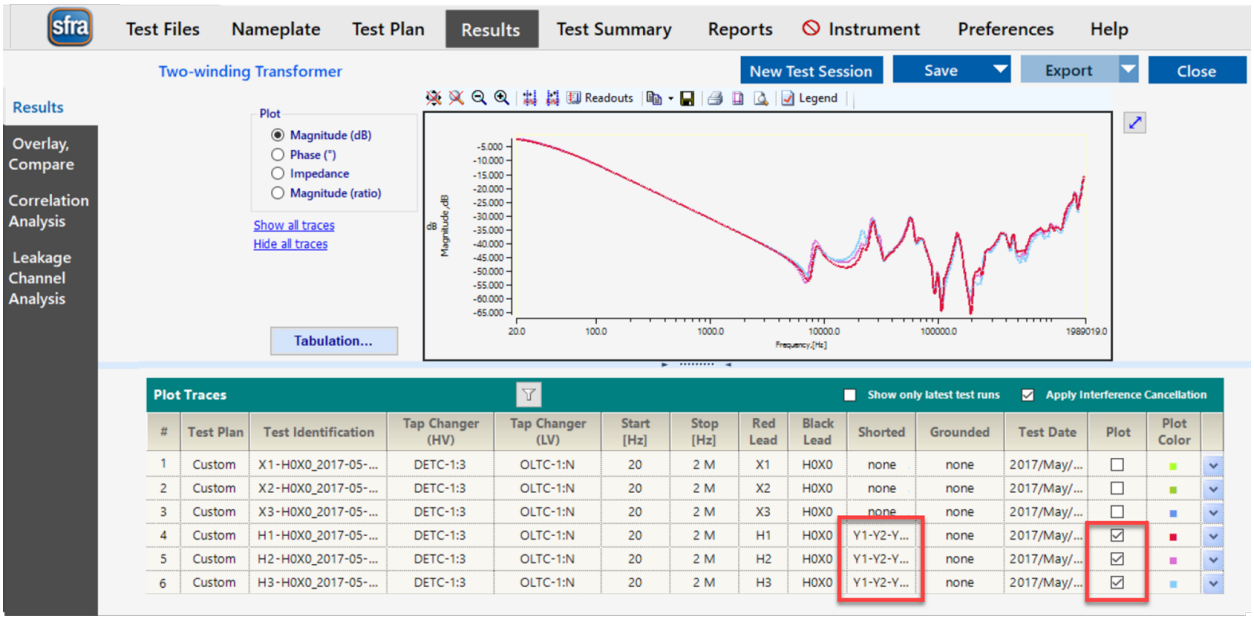


Figure 89 - Results Menu: Shorted Test Lines

2. Click **Leakage Channel Analysis** in the left menu.

3. Select one row to be your baseline by selecting the **Baseline** column's check box. Select a row or rows for analysis by selecting the **Analyze** column's check box.

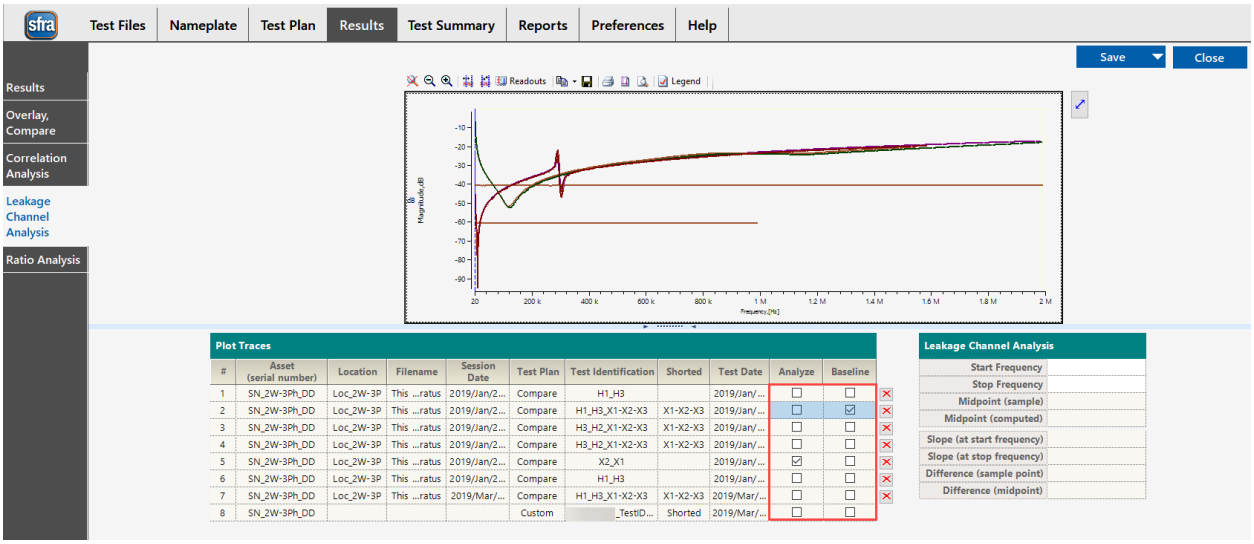


Figure 90 - Plot Trace Baseline

4. Leakage Analysis compares the Magnitude values and shows the results of the analysis in the **Leakage Channel Analysis** grid. You can evaluate how far the traces deviate from each other at the automatically calculated frequency.

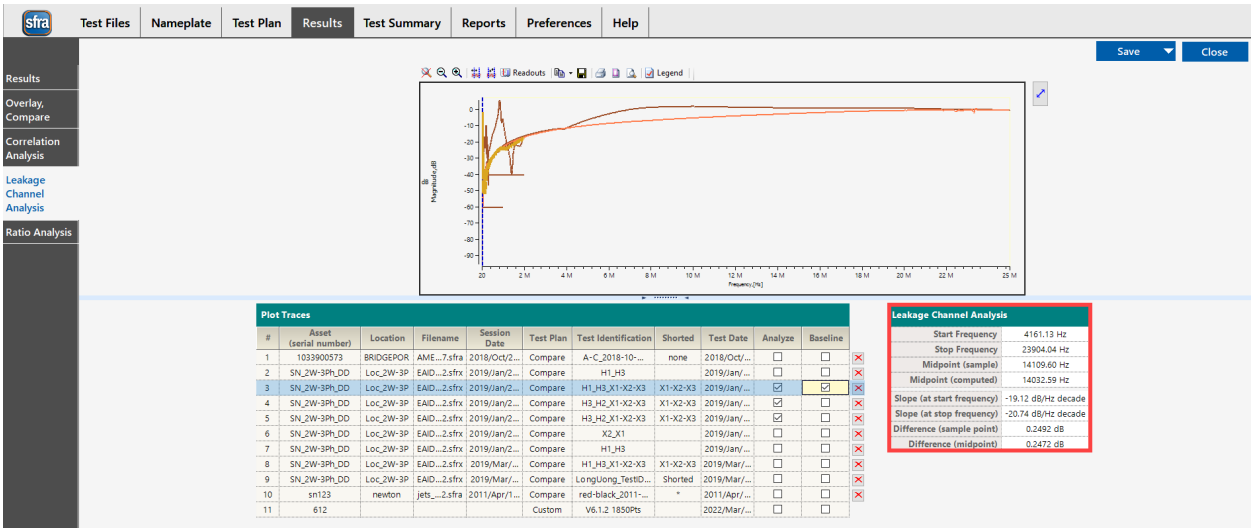


Figure 91 - Leakage Channel Analysis Results

Ratio Analysis

Note: In order to use ratio analysis, the option must be turned on in the **Preferences→General** tab, under advanced settings.

The Ratio Analysis menu enables you to plot and analyze the ratio value of selected traces from inductive inter-winding tests. This is used to determine if there is a discrepancy between two windings and determine which winding has an error. The Magnitude Ratio determines the deviation and the direction of the traces.

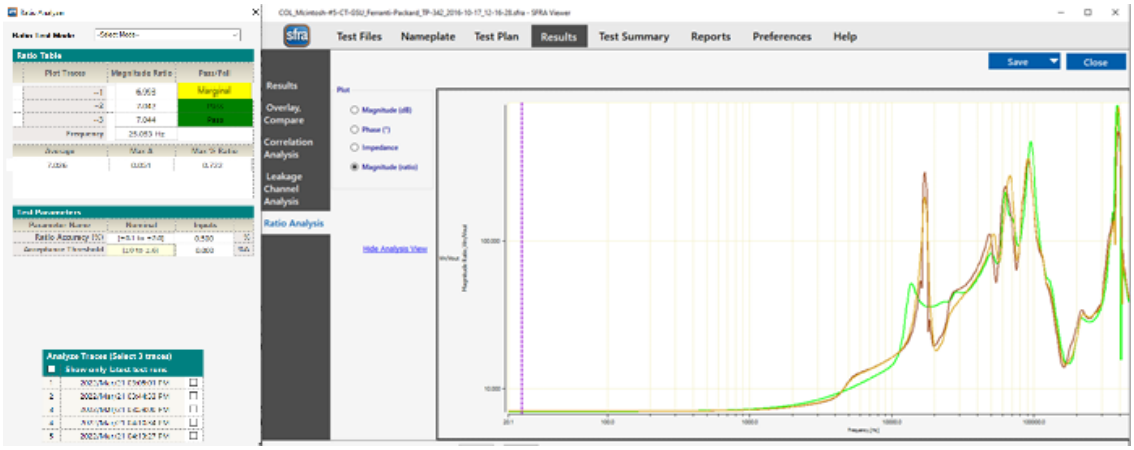


Figure 92 - SFRA Ratio Analysis

Viewing Ratio Analysis Data

Perform the following to view ratio analysis data.

1. In the **Results** menu, select the plot **Magnitude (ratio)**, then click **Ratio Analysis** from the left menu. The Ratio Analyzer window opens.
2. Select three traces from the list in the Ratio Analyzer window.

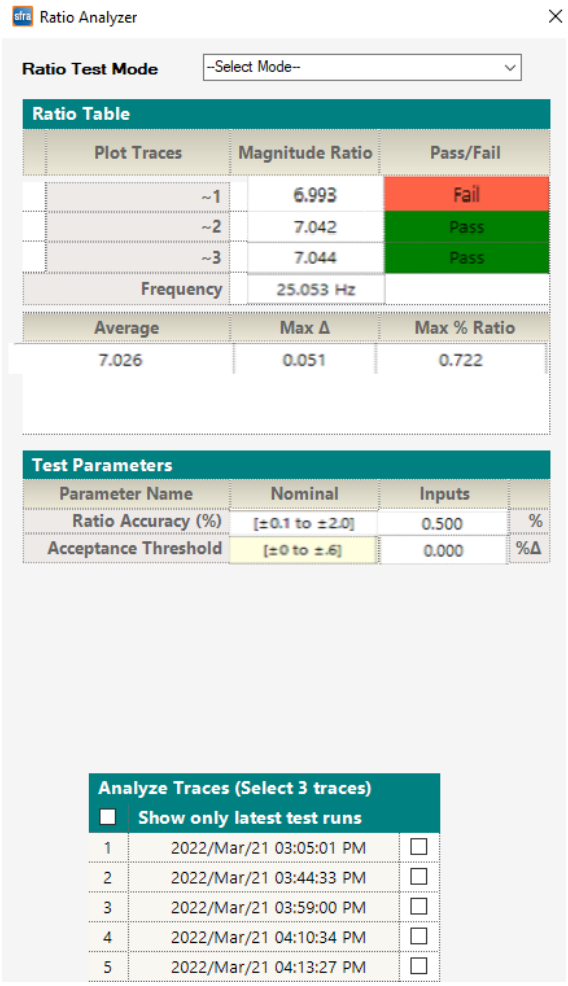


Figure 93 - Ratio Analyzer Window - Select Traces

Ratio Analyzer calculates the Average, the maximum deviation (Max Δ) and percentage deviation (Max Δ % Ratio) of the three selected traces at the frequency of the reading cursor.

Pass/Fail rating and the message at the bottom of the Table are also provided to describe the condition of the tested phases according to Table 1 with the color code: Green/Pass, Yellow/marginal, and Red/Fail.

3. You can select any frequency via the **Frequency** column and analyze the ratio of the selected traces, but Doble recommends frequencies below 200Hz and provides three pre-set frequencies (25, 38 and 78 Hz) for a quick frequency selection.
4. You can also modify the values in the **Input Value** fields. The first value is the **Ratio Accuracy** in percentage, which defines the pass/fail limit of the **Max Δ% Ratio**; 0.5 is recommended and the default value. The second value is the **Acceptance Threshold**, which represents the margin of the pass/fail limit; the default value is zero, i.e. the limit

has no margin. In the example above, **Ratio Accuracy (%)** = 0.5 and **Acceptance Threshold** = 0 meaning that any deviation (%) exceeding 0.5 results in a Failed test.

The ratio value is plotted on the Results window once three traces are selected:

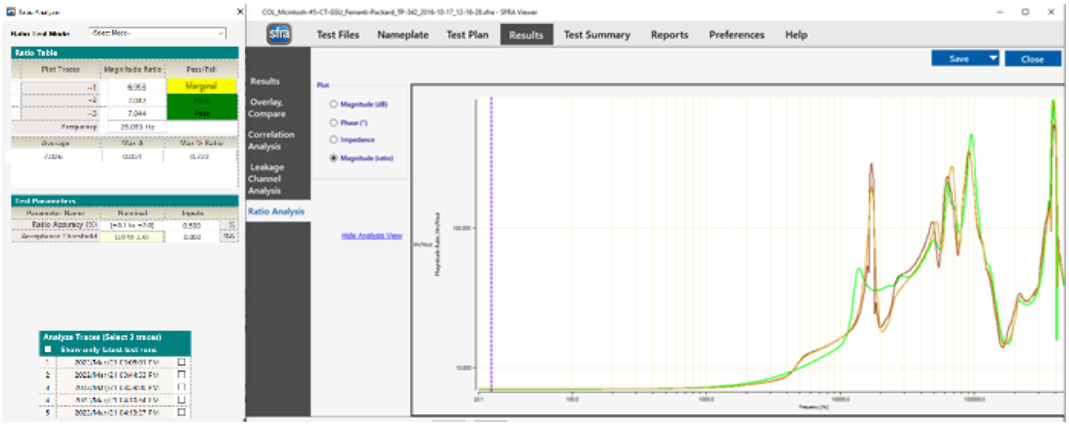


Figure 94 - Ratio Analysis

Test Summary

The Test Summary menu contains the History menu. This menu shows a list of all test sessions for the file.

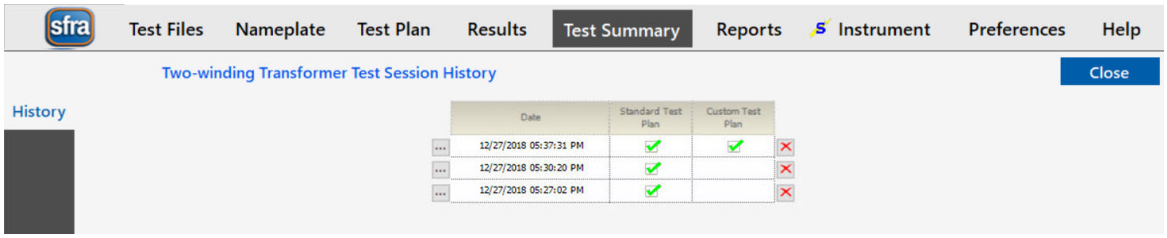


Figure 95 - Test Summary

A green check mark is displayed for tests completed in that test session.

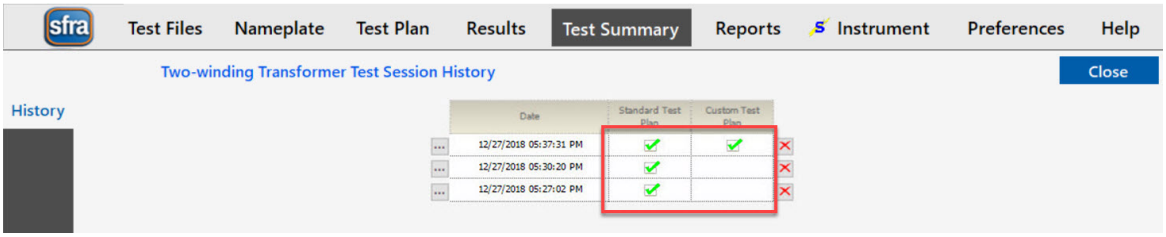


Figure 96 - History Completed Tests

Click the ellipses icon next to a test session to navigate to the Test List for that session.

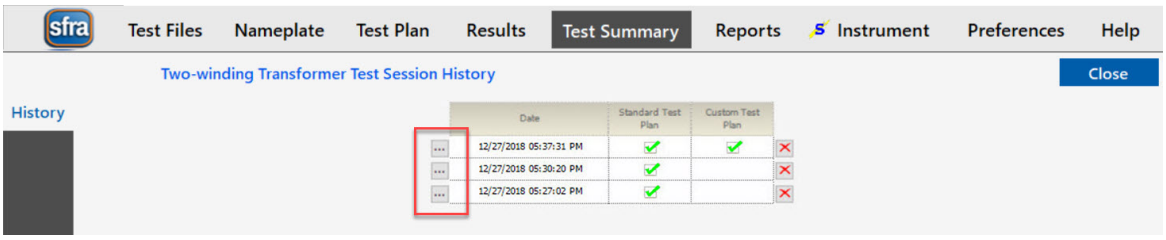


Figure 97 - Open Test List

Click the delete icon to delete the test data for that date.

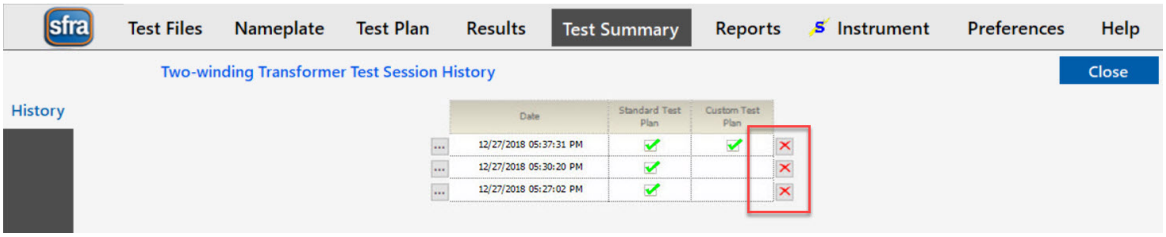


Figure 98 - Delete History

7. Help

The Help menu shows information about the version of SFRA software you are using.

Click **SFRA Help** to view the help for SFRA software.

Click **About** from the left menu to view the SFRA software version you are using.

Click **License** from the left menu to view the current license or enter a new license.

8. Uploading Files to DTA Web

This chapter describes how to upload files from SFRA software to DTA Web. It contains the following sections.

Note: Before uploading files to DTA Web, navigate to the Preferences menu in SFRA software. Enter the URL in the Doble Database menu.

Connecting to the Doble Database

Perform the following steps to connect to the Doble Database.

1. Click **Test Files** in the top menu, click **Doble Database** from the left menu.
2. Click the database icon.

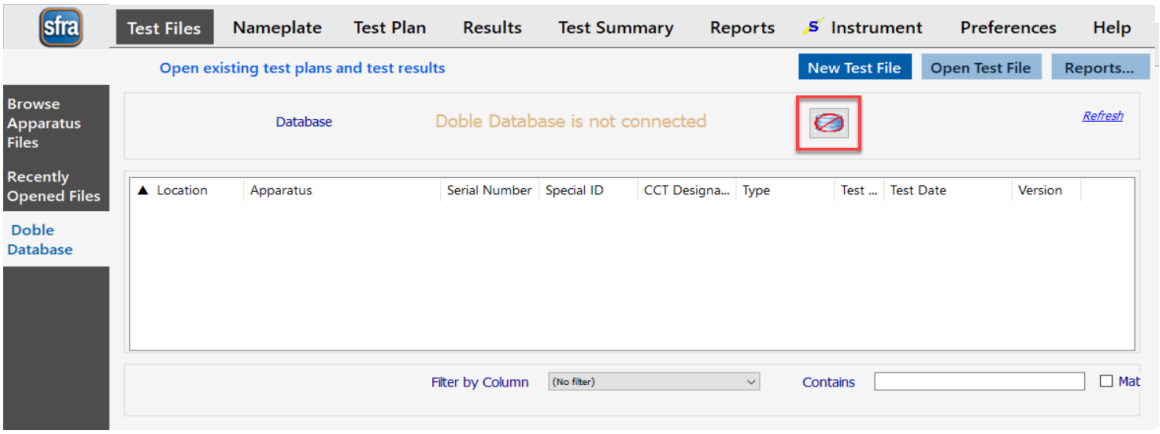


Figure 99 - Doble Database Icon

3. Enter the following information:
   - Username: Usually your email address.
   - Password: Usually the DTA Web password or a password used by your company
   - Company: Leave blank unless your manager or DTA Web administrator provided this information

Note: The default values for the **URL** and **Authentication URL** fields should be used unless you are directed to change them (in Preferences\Doble Database menu).

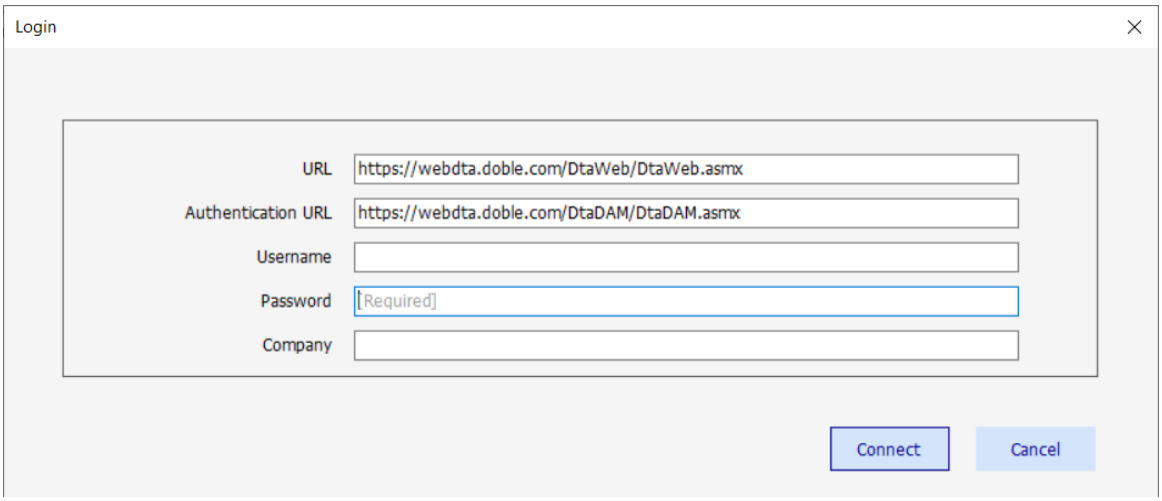


Figure 100 - Doble Database Login

The Doble Database window opens.

Save to the Doble Database

Perform the following steps to save a file to the Doble Database:

1. Confirm that SFRA software is connected to the Doble Database.
2. Do one of the following, depending on your current location in the SFRA software user interface:
   - Click **Test Files** in the top menu, click **Browse Apparatus Files** or **Recently Opened Files** from the left menu. Select a file then click **Save to Doble Database**. The file does not have to be open.
   - From within an open file, select **Save to Doble Database** from the Save drop-down list.

   The **Upload to Database** window displays one or more databases. If you don't see any database, talk to your Doble Database administrator about your access permissions.
3. Select the database.
4. (Optional) Select Use the same database for all files in this group.
5. Click **OK**.

9. M5500 Firmware Update

Perform the following steps to update the M5500 firmware.

Note: Ensure you are connected to an M5500 Instrument.

1. Click the **Instrument** top menu.
2. Click the **Update Firmware** left menu.
3. Click **Browse** to navigate to the directory containing the firmware update files.

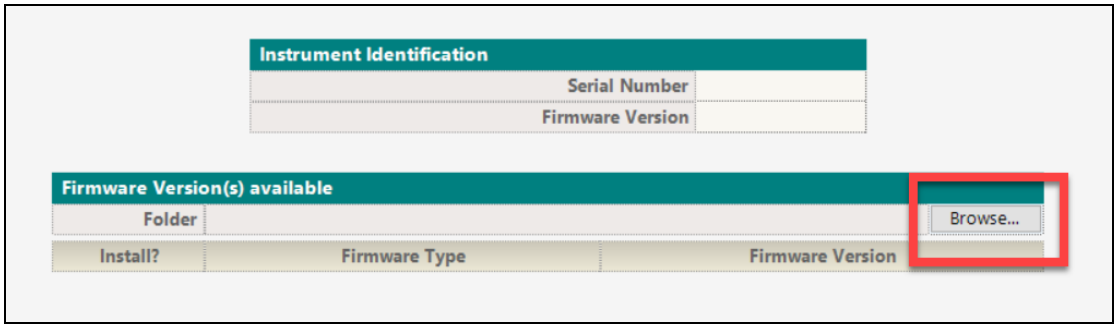


Figure 101 - Browse Button

4. Select any valid firmware file for this instrument and click **Open**. All firmware files in the folder will be available in the next step.

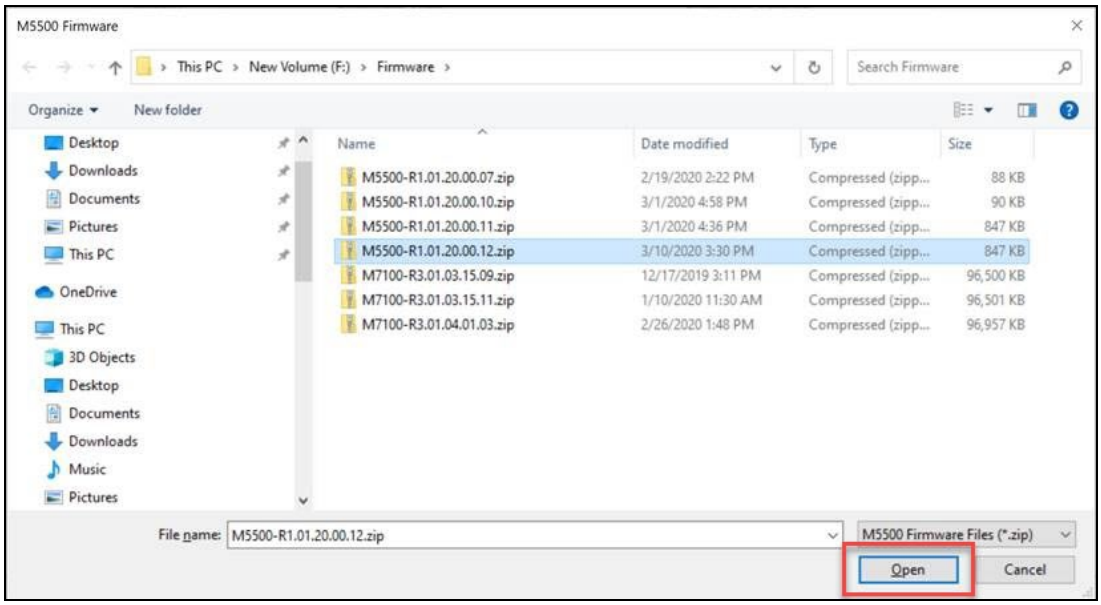


Figure 102 - Open Firmware File

The firmware files from the directory will be listed in the Update Firmware view. Only firmware packages that are valid for the connected instrument will be available for upload.

5. Select the firmware version for upload then click **Install Firmware**.

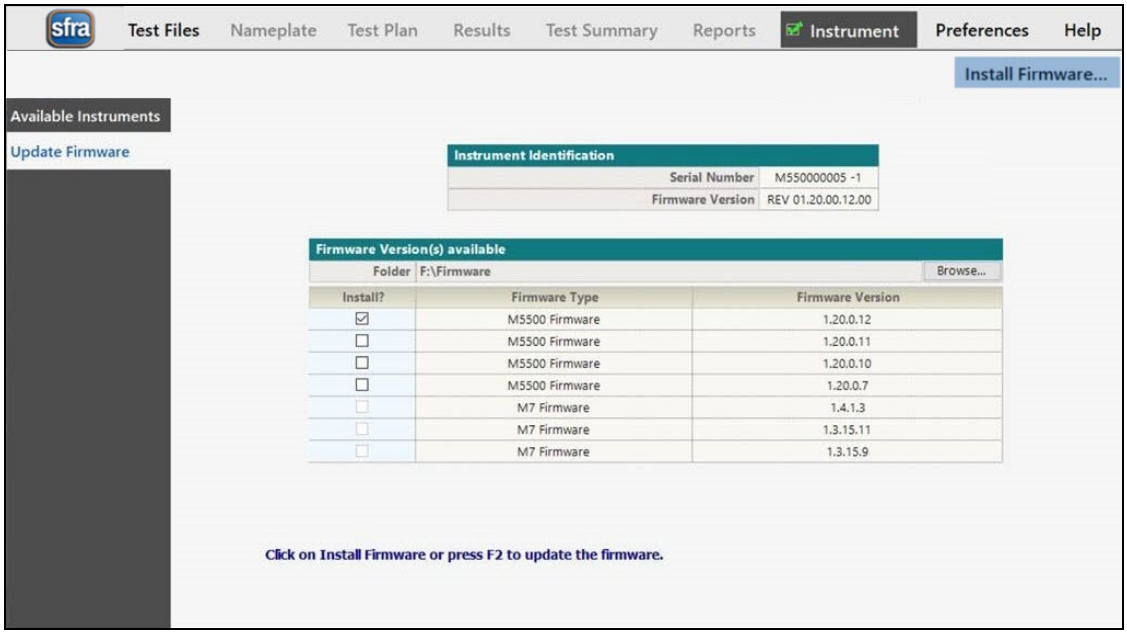


Figure 103 - Install Firmware

6. An update warning dialog will appear. Click **Yes** to continue.

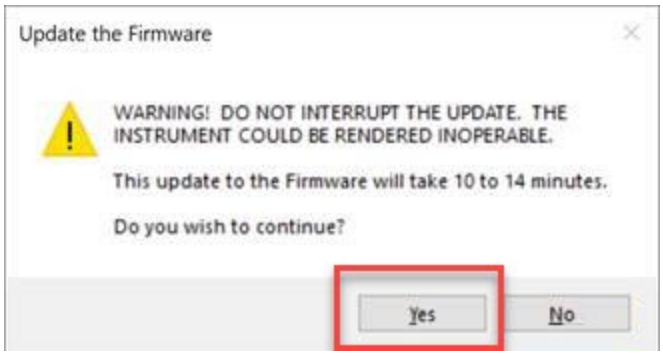


Figure 104 - Update Firmware Warning

The status of the firmware upload will be shown in a progress bar.

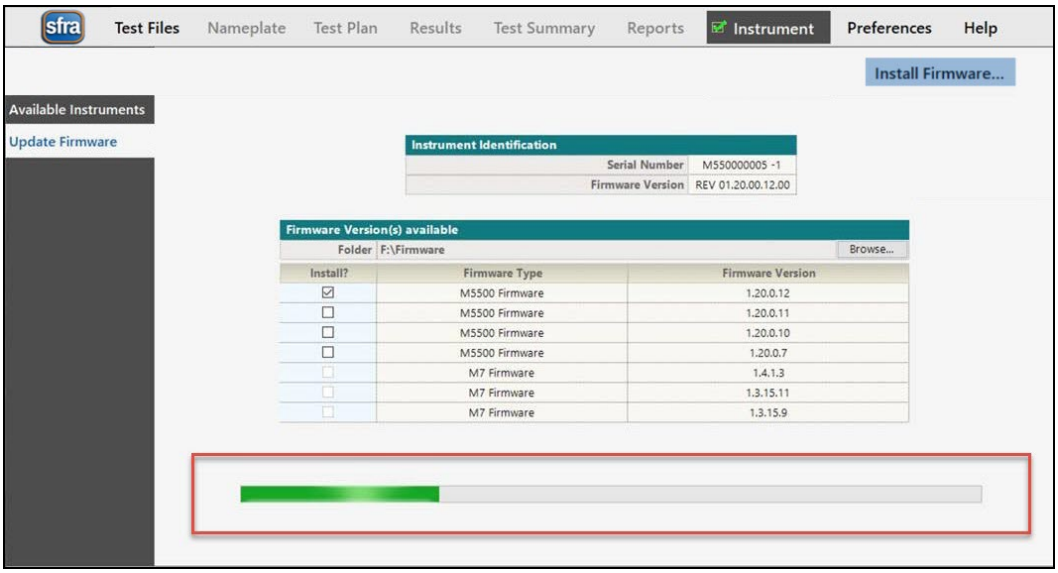


Figure 105 - Update Firmware Status Bar

A message is displayed once the upload is complete.

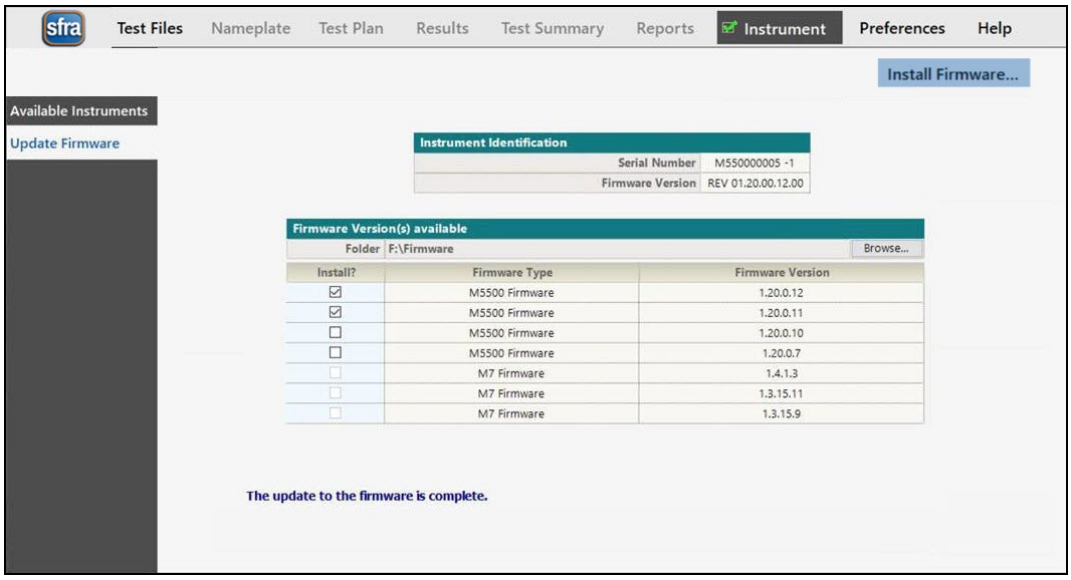


Figure 106 - Update Firmware Complete

7. Once complete, the software will prompt you to cycle power to the instrument to complete the process. Click **OK**.

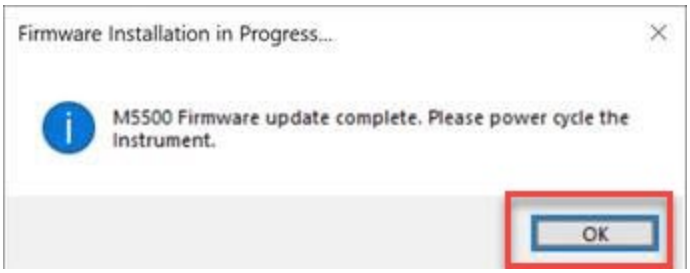


Figure 107 - Firmware Installation Progress

8. Remove power from the M5500 for at least 30 seconds, then apply power and reconnect to the instrument.

In the unlikely event of a failed upload, an error message will be displayed instead of the completion message. You should copy the error text or capture a screenshot and contact Doble for support.

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2. If DOBLE is unable to deliver replacement disks which are free from defects in materials and workmanship, Purchaser may terminate this agreement. By returning the software product and all copies thereof in any form and affirming compliance with this requirement in writing, DOBLE will refund the purchase price.

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For equipment maintenance, contact:

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Marlborough, MA 01752 USA

Telephone: 888-443-6253
Email: customerservice@doble.com
Web: www.doble.com

B. Theory of Operation

This appendix presents the theoretical underpinnings of SFRA testing. It contains the following sections.

Transformer Damage and SFRA Software Testing

Although power transformers are specified to withstand the mechanical forces arising from shipping and subsequent in-service events, damage sometimes still occurs.

- **Transportation damage** can occur if clamping and restraints are inadequate; such damage may lead to core and winding movement.
- **In-service damage** can occur from events such as faults and lightning. The most severe in-service forces arise from system faults and are axial and radial in nature. If the forces are excessive, radial buckling or axial deformation can occur. With a core form design, the principal forces are radially directed, whereas in a shell-form unit, they are axially directed. This difference is likely to influence the types of damage found.

Once a transformer is damaged, even if only slightly, its ability to withstand further short circuits is reduced. Utility personnel need to identify such damage. Most methods have distinct drawbacks. Visual inspection is costly and does not always produce the desired results. During a field inspection, the oil must be drained, and confined-entry rules apply. Since so little of the winding is visible, little damage can be seen, other than displaced support blocks. Often, a complete teardown is required to identify the problem.

There is a relationship between the geometric configuration of the internals of a transformer and the distributed electrical elements inside the winding and core assembly. These elements can be represented as an RLC network, and such a network will have a frequency dependent transfer function. Changes to the geometric configuration will affect the impedance of the RLC network, and thus produce a different frequency response.

How SFRA Software Identifies Damage to Transformers

The primary objective of SFRA software is to determine how the impedance of a test specimen behaves over a specified range of frequencies. The impedance is a distributive

network of real and reactive electrical components. The components are passive and can be modeled by resistors, inductors, and capacitors. The reactive properties of a given test specimen depend on, and are sensitive to, changes in frequency. The change in impedance versus frequency can be dramatic in many cases. This behavior becomes apparent when we model impedance as a function of frequency. The result is a transfer function representation of the RLC network in the frequency domain.

Frequency response analysis is generally applied to a complex network of passive elements. For practical purposes, we will consider only resistors, inductors, and capacitors as passive circuit elements, and they are assumed to be ideal. These three fundamental elements are the building blocks for various physical devices, such as transformers, motors, generators, and other electrical apparatus.

It is important to understand the difference between the physical device and the mathematical model we intend to use. When large and complex systems are electrically analyzed, we are often faced with a poorly defined distributed network. A distributed network contains an infinite number of infinitely small RLC elements. For example, transmission lines are generally distributed in nature.

It is practical to model such distributed systems by lumping the basic RLC components together, resulting in a lumped network. Lumping elements together for a single frequency is a trivial task, but when system modeling requires spanning a significant frequency interval, producing a suitable lumped model becomes difficult.

When a transformer is subject to SFRA software testing, the leads are configured to use four terminals. These four terminals can be divided into two unique pairs—one pair each for the input and output. These terminals can be modeled in a two-terminal pair or a two-port network configuration as shown in Figure 108.

Note: Formulas in this section are simplified approximations.

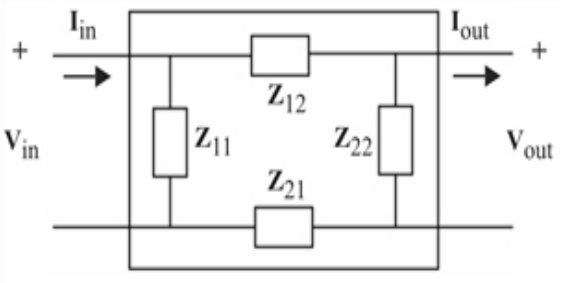

Figure 108 - Two-Port Network

Solving for the open-circuit impedance for each lumped element forms the impedances Z11, Z22, Z12, and Z21. It should be noted that the negative terminals are short- circuited when transformers are tested. The transformer tank is common for both negative and lower terminals. The transformer tank and lead ground shields must be connected together

to achieve a common-mode measurement. This assures that no external impedance is measured. Applying the connection in this manner helps reduce the effects of noise. It is important to obtain a zero impedance between the lower or negative terminals to assure a repeatable measurement.

The transfer function of an RLC network is the ratio of the output and input frequency responses when the initial conditions of the network are zero. Both magnitude and phase relationships can be extracted from the transfer function. The transfer function helps us better understand the input/output relationship of a linear network. The transfer function also represents the fundamental characteristics of a network and is a useful tool in modeling such a system.

The transfer function is represented in the frequency domain and is denoted by the Fourier variable *H(jω)*, where (*jω*) denotes the presence of a frequency-dependent function, and ω= 2π*f*. The Fourier relationship for the input/output transfer function is given by:

$$H(j\omega) = \frac{V_{output}(j\omega)}{V_{input}(j\omega)}$$

When a transfer function is reduced to its simplest form, it generates a ratio of two polynomials. The main characteristics, such as half-power and resonance, of a transfer function occur at the roots of the polynomials.

The goal of SFRA software is to measure the impedance model of the test specimen. When we measure the transfer function *H(jω)*, it does not isolate the true specimen impedance *Z (jω)*. The true specimen impedance *Z(jω)* is the RLC network, which is positioned between the instrument leads, and it does not include any impedance supplied by the test instrument.

It must be noted that when using the voltage relationship, *H(jω)* is not always directly related to *Z(jω)*. For *Z(jω)* to be directly related to *H(jω),* a current must be substituted for the output voltage and then ohm's Law can be realized. However, SFRA software uses the voltage-ratio relationship to determine *H(jω)*. Since SFRA software uses a 50-ohm impedance- match measuring system, the 50-ohm impedance must be incorporated into *H (jω)*. The next equation shows the relationship of *Z(jω)* to *H(jω)*:

$$H(j\omega) = \frac{50}{Z(j\omega) + 50}$$

It is often useful to plot the magnitude and phase relationship of the transfer function in logarithmic format. The units of magnitude and phase are in decibels (dB) and degrees, respectively. Magnitude and phase are represented as follows:

$$A(dB) = 20 \log_{10}(H(j\omega))$$
$$A(\theta) = \tan^{-1}(H(j\omega))$$

This format takes advantage of the asymptotic symmetry by using a logarithmic scale for frequency. Plotting the phase relationship with the magnitude data helps determine whether the system is resistive, inductive, or capacitive. It is often useful to compare resonance in the magnitude plots with the zero crossings in the phase relationship.

Test Cable Lengths

The cables and connectors supplied with the M5000 instruments are made from low-loss RG-58 RF coaxial cable, with the shields grounded to the instrument chassis through a standard connector. The instrument requires a matched impedance signal cable and performs a single-end measurement—that is, the signal is measured with respect to the instrument ground. The shield of the signal cable must be connected to the chassis using a 50-ohm impedance-matched RF BNC connector. The test leads should not be modified in any manner.

Practical field experience indicates that the leads should be approximately 18 m / 60 ft. This is the shortest length useful to test the largest transformers from a location on the ground, adjacent to the unit. Nevertheless, lead length determines the maximum effective frequency. Longer cables that are 30 m / 100 ft in length are available but should only be used when the shorter cables are not an option.

Doble Standard Grounding (IEC Method II)

The standard cable shield grounds connect the cable shields to the transformer ground at the base of the bushing. These ground connections are 3.6 m / 12 ft back from the terminal connection, on the measurement ends of the cables. If this is not long enough to reach from the bushing terminal to the base of the bushing, a 30 m / 100 ft cable is available, with ground connections 5.4 m / 18 ft back from the terminal connection. There may be a slight difference seen in the high upper frequencies on the traces obtained using 60 ft. cables as opposed to 100 ft. cables. This grounding style is available in the Doble "Classic Plus" SFRA test cables, which can also support testing using the IEC Method I "Shortest Braid" technique.

Shortest Braid Grounding (IEC Method I)

An alternative method for grounding the test leads to the base of the bushing uses conductive ground braid running from a ground ring near the top clamp of the test cable, down the length of the bushing. The braid is then picked up by a separate clamp and connected to ground at the base of the bushing. This method ensures that the shield ground length is only as long as it needs to be. Generally speaking, it does not improve the diagnostic quality of the test, and it is most important that subsequent SFRA tests of a particular apparatus are performed using the same method as was used previously. The

shortest braid method can be performed using the Doble "Classic Plus" cables (with an optional braid kit) or with Doble "IEC I" cables that come with the braid kit but do not have the Doble Classic ground clamps built-in.

Transformer

SFRA software tests measure only the RLC network of the transformer. To maintain consistency and repeatability of measurements, make sure that all terminals not under test are isolated and floating. To maintain a balanced and symmetrical approach, where a delta winding is completed and grounded external to the transformer tank, the delta should be complete but floating. Such windings are frequently used for regulation; where such windings are grounded internal to the tank, it is necessary to leave that ground in place — but we should expect asymmetry in the results.

We could measure a frequency response with the remaining terminals grounded, but it could not be compared to a response measured with floating terminals, which would display a different RLC response.

C. Licensing

A license provides access to a specific set of software functions. The following describes how to apply a license to your installed software.

Requirements

- SFRA software installed on a PC
- License issued by Doble

Functionality

indicates the types of access granted by each SFRA Software license.

SFRA Software License Editions and Included Functions

Feature	Viewer	Professional
Overlays	Yes	Yes
Correlation Analysis	Yes	Yes
Doble Database	Yes	Yes
Reports	Yes	Yes
Leakage Analysis	Yes	Yes
Ratio Analysis	Yes	Yes
Connect to Instruments	---	Yes
Connect to M5500	---	Yes
Run Tests	---	Yes
Create/Step Setup	---	Yes
Instrument Simulation	---	Yes
Connect Diagrams	Yes	Yes

New Installations

The first time you run the software after installation, you must activate your software license.

Perform the following steps to activate your software license.

1. Enter the key you were given, then click **Apply License**.
   The license activation key required window will open.

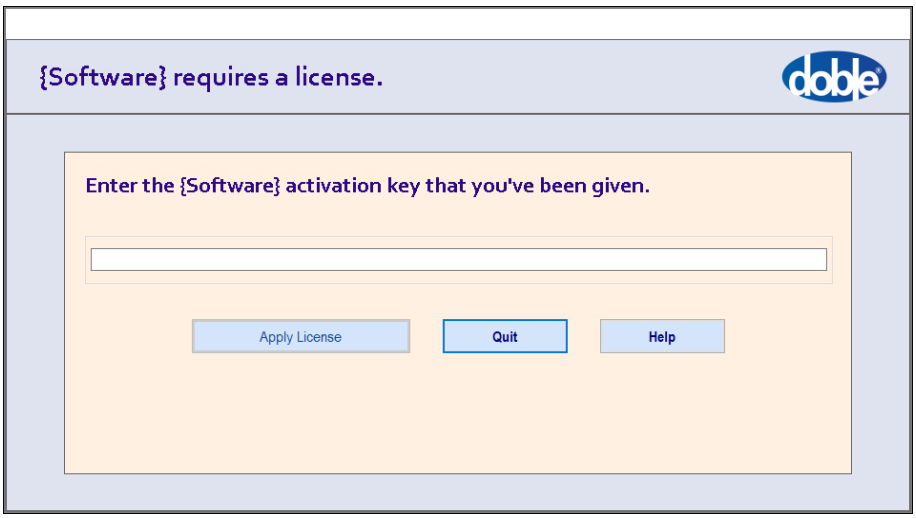

Figure 109 - License Activation Key Required Window - Example

2. Click **Activate Product**.
   The registration information window will open.

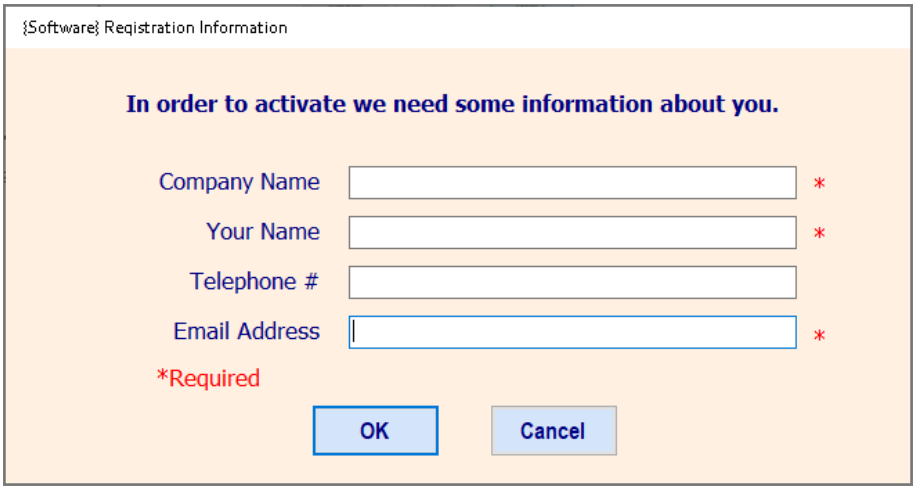

Figure 110 - Registration Information Window - Example

3. Fill in the following fields:
   - Company Name
   - Your Name
   - Telephone #

- Email Address

4. Click **OK**.

   A pop-up that may appear while the application is connecting to the Doble License Server.

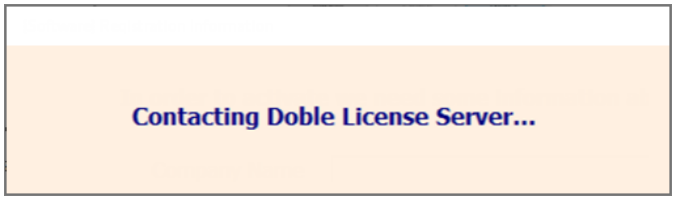

Figure 111 - Contacting Server Window

- If your license is validated by Doble, a confirmation message will appear.

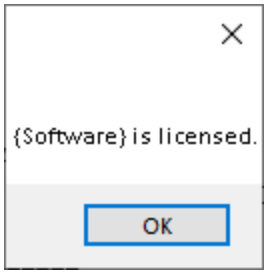

Figure 112 - License Activation Conformation - Example

5. Click **OK**. The software will open. Installation and licensing are complete.

   If the internet connection fails, the Internet Access Failed window will open. You can activate the license manually. Go to step 5.

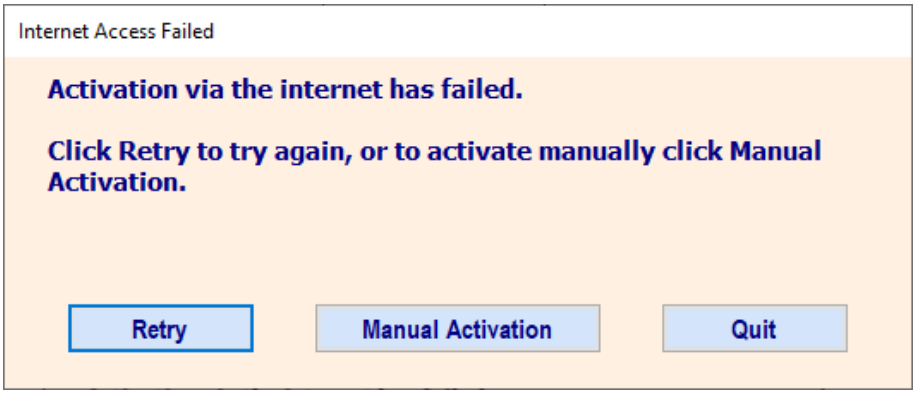

Figure 113 - Internet Access Failed Window

6. Click **Manual License Activation**.

The Manual License Activation window will open.

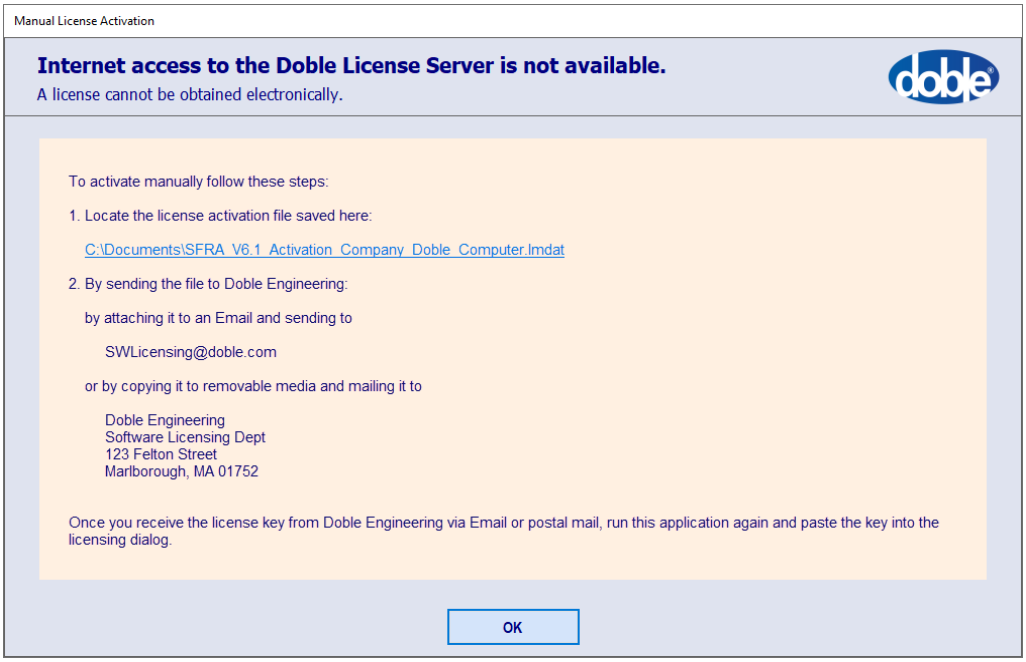

Figure 114 - Manual License Activation Window - Example

7. Follow the below steps listed in the Manual License Activation window to manually activate the license:
    - Locate the license activation file saved at the location specified in the Manual License Activation window.
    - Send the license activation file to Doble Engineering to the specified email or mail it to the specified address.

    Doble will send you an activation key after receiving your activation file.

    After receiving the activation key, open the software and return to step 1.

Changing a License

1. To change a license, click **Help** from the top menu and **License** from the left menu.

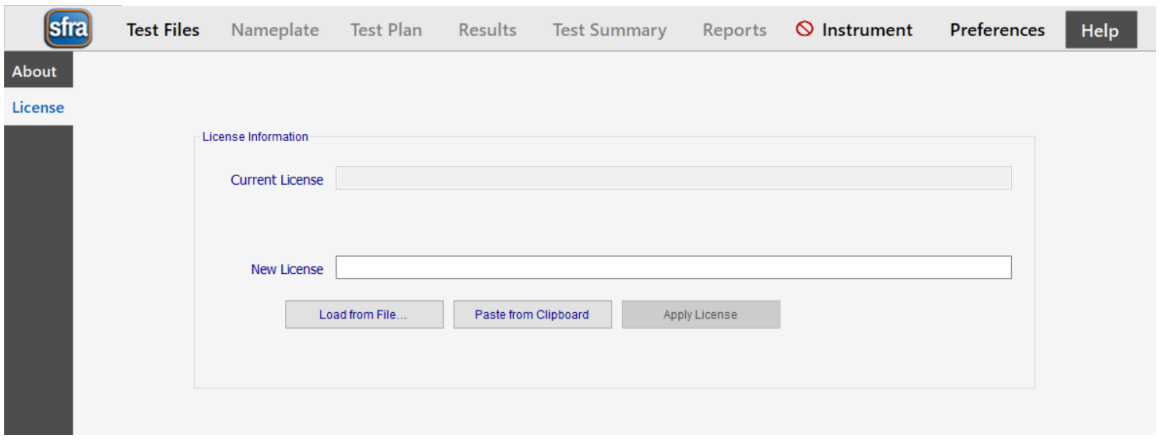

Figure 115 - License Menu - Example

2. Enter your license information and click **Apply License**.

   The registration information window will open.

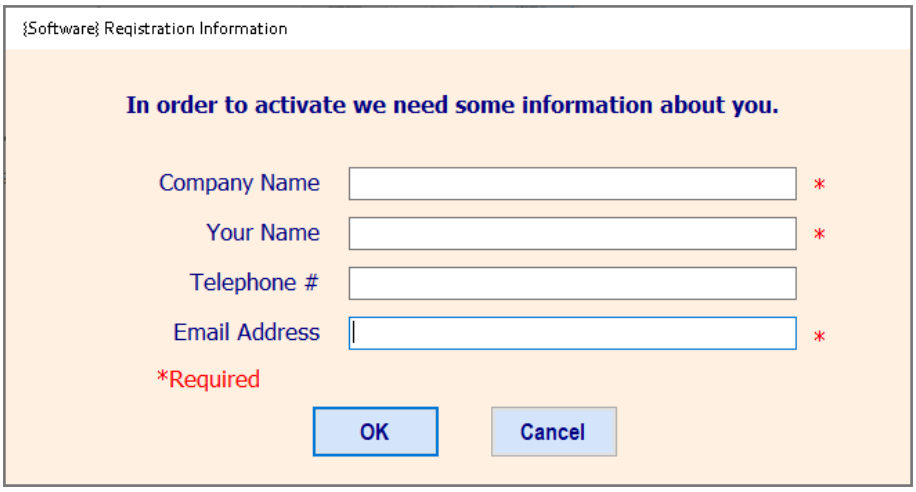

Figure 116 - Registration Information Window - Example

3. Fill in the following fields:
   - Company Name
   - Your Name
   - Telephone #
   - Email Address
4. Click **OK**.

   The Update License window will open.

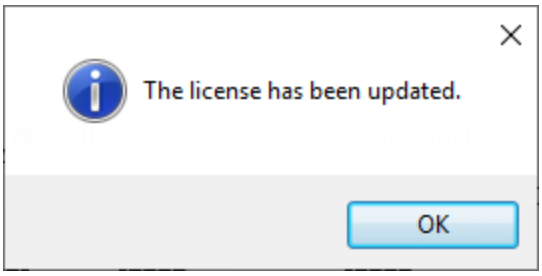

Figure 117 - Update License Window

5. Click **OK**.
6. Exit the software completely and restart it.