

M5500

**Sweep Frequency Response
Analyzer**
Reference Guide



FCC CLASS A NOTE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Legal Matter

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Preface

This guide explains how to set up the M5500 instrument and accessories.

Who Should Read this Guide

This guide is intended for two sets of M5500 users:

- Doble customers
- Doble technical support employees

It is assumed that all readers are familiar with professional standards and safety practices.

Document Conventions

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

- **Bold**—Used for software controls and user-entered text, such as buttons, check boxes, or other items that are clicked or selected. Example:

Click **Close**.

Also, any text you must type in is shown in this typeface:

Example: Type in **1500 ms**.

- **Monospace**—Used for text displayed in the user interface, such as an error message or prompt. Example:

Uploading test results.

Notes, Cautions, 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.

Safety

Read all safety instructions before using the M5500 instrument.

Only trained persons should use this instrument in the commercial/industrial environment for which it is intended.

Operating the M5500 Safely

Please note the following:

- Read this reference guide before connecting and using the M5500 instrument.
- Before every use of the M5500, check all cables for damage.
- DO NOT place any liquids on the M5500 Instrument. Liquid can enter the enclosure through the DC-Power and USB connectors and cause an electrical malfunction.
- DO NOT place excessive stress on the DC-Power and USB connectors.
- DO NOT use any unapproved accessories with M5500 Instrument.
- Doble Engineering Company is not liable for any damage or injury resulting from misuse of this equipment.



Warning: Use of this equipment in a manner not specified by the manufacturer can impair the protections provided by its design.



Warning: The M5500 instrument safety ground connection and test cable connections to the instrument must be made before raising the test cable into an electrical field.

Support

For customer service, contact Doble.

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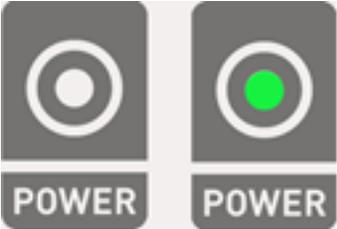
1. Overview

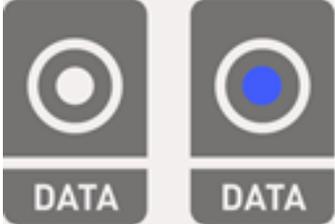
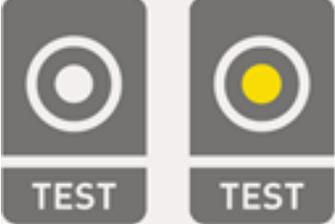
The M5500 Sweep Frequency Response Analyzer test instrument allows the user to investigate the mechanical integrity of transformers, reactors, and other equipment consisting of windings.

The M5500 sends an excitation signal into the apparatus under test and measures the returning signals. Comparing this response to baseline readings or results from other similar units allows you to identify deviations and confirm internal mechanical problems without invasive testing or inspection.

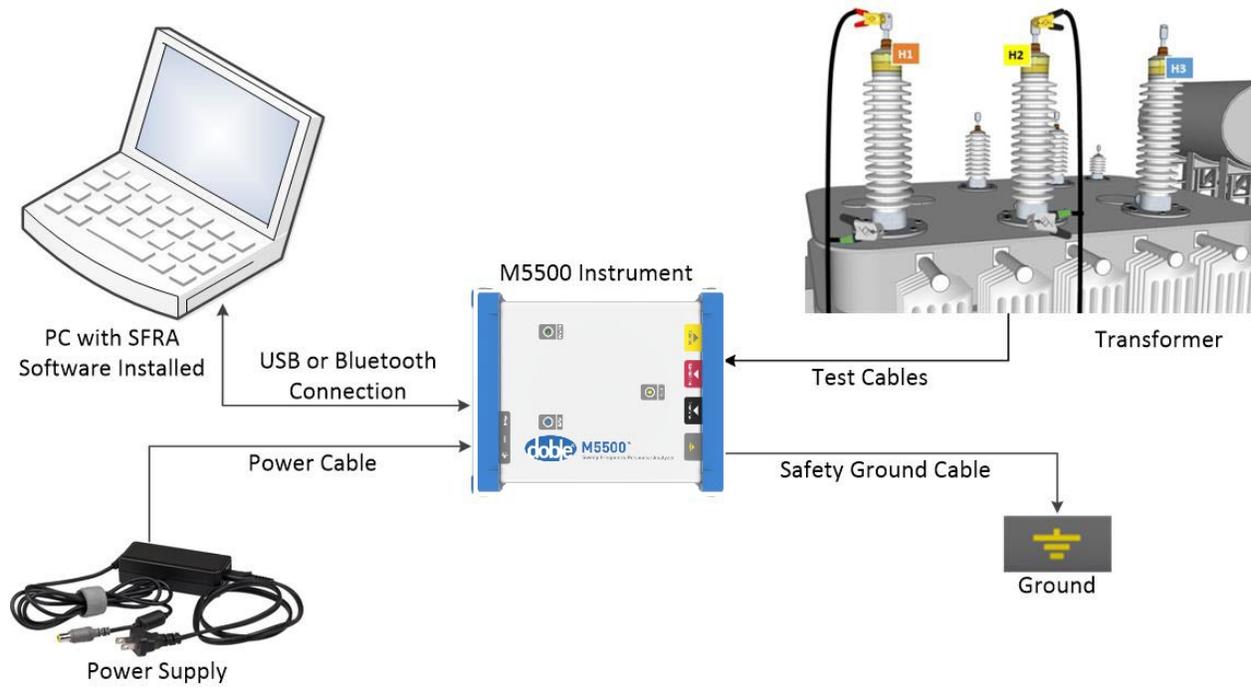
Symbols and Indicators

The table below contains symbols and indicators used on the M5500 and their descriptions.

Symbol/Indicator	Description
	Indicates the location of the Safety Earth Ground connector.
	Indicates the location of the USB-B communication connector.
	Indicates the location of the DC Input Power connector.
	Indicates the location of the external wireless communication antenna.
	The POWER indicator is illuminated green when DC Input Power is applied.

 <p>The image shows two square icons side-by-side. Each icon has a dark grey background with a white circle in the center. Below each circle is a white horizontal bar containing the word 'DATA' in black capital letters. The left icon has a white dot in the center of the circle, while the right icon has a blue dot.</p>	<p>The DATA indicator is illuminated blue when the controlling PC has established communication with the M5500.</p>
 <p>The image shows two square icons side-by-side. Each icon has a dark grey background with a white circle in the center. Below each circle is a white horizontal bar containing the word 'TEST' in black capital letters. The left icon has a white dot in the center of the circle, while the right icon has a yellow dot.</p>	<p>The TEST indicator is illuminated amber when the M5500 is conducting a test sweep - the SOURCE, REFERENCE, and MEASURE channels are active.</p>

2. Setup and Breakdown



Caution: Remove the M5500 completely from its carrying case before operating the instrument.

1. Connect the safety ground cable to the GROUND connector on the M5500 front panel and to the earth ground.
2. Connect the power supply's DC plug into the POWER connector on the M5500 rear panel and the provided line cord into convenience AC power.



Figure 1 Rear Panel

3. After a brief delay and a single beep sound, the POWER light on the M5500 top panel shows solid green.
4. To use USB communication to operate the M5500, connect the USB Type A/B cable from the controlling PC/tablet to the USB connector on the M5500 rear panel.

NOTE: If wireless communication will be used instead of USB, do not connect the USB cable.



Figure 2 Top Panel

5. Connect the SFRA test cable's three BNC plug connectors to the corresponding BNC jacks on the M5500 front panel. The connections are color coded.
6. Run SFRA software (version 6.1 or later, Professional edition) on the controlling PC/tablet and establish communication with the M5500.



Figure 3 Front Panel

Create or load a test file. (For more information, refer to the *Doble SFRA 6 Software User Guide*.)

7. After all pre-test preparations have been completed and communication between the PC and the M5500 has been established, connect the SFRA test cable clamps (red/black) and shield grounds (green) along with any required shorting connections as necessary for each test (sweep) in the test plan.
8. When all tests have been satisfactorily completed, remove all shorting connections and lower the test cables to ground level. Disconnect the test cable, AC and DC power, and finally the safety ground.



Warning: Never connect or disconnect the test cable's BNC connectors unless the entire test cable is at essentially the same level (at ground working level, or at the same height above the ground) as the M5500 instrument.

3. Functional Verification

Included with the M5500 Sweep Frequency Response Analyzer is a Test Reference Module that can be used to verify basic operation of the M5500 instrument and test cable. The module contains a simple filter circuit and has four external posts.

It is recommended to perform the following steps on the M5500 and associated cable when first received to establish a baseline sweep for future comparison.

1. Configure the instrument as described in steps 1 through 6 in [Setup and Breakdown](#).
2. In the SFRA Software create a test file to retain this and future verification sweeps.
3. Connect the test cable clamps (red and black markers) to the appropriate posts on the module. Connect the ground clamps (green markers) to the ground posts on the module. (If using IEC Method 1 shortest-braid connections for your testing, use the jumpers from the braid kit to connect from the ground rings to the ground posts on the module.)
4. Run a sweep using a test line in a custom test plan.
5. Save the sweep result in the test file.
6. If no previous verification sweep is available for comparison, use the typical sweep plot shown below for a rough comparison.
7. If this is not the first verification sweep for this instrument, use the tools in the SFRA software to retrieve a previous good verification sweep and compare them to ensure that the instrument and test cable are working consistently.



Figure 4 M5STR SFRA Test Reference



Figure 5 M5STR Reference Test Connections with Classic Grounds



Figure 6 M5STR Reference Test Connections with IEC Method I Grounds

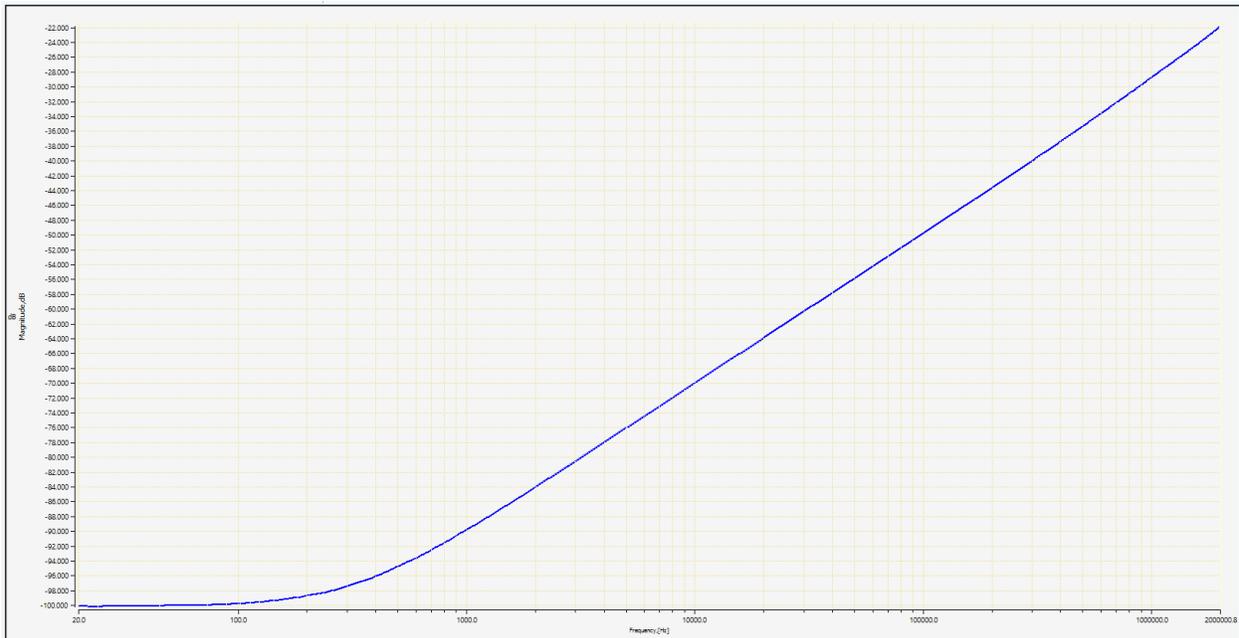


Figure 7 M5STR Reference Test - Typical Response

4. Communications

USB

Communication via USB requires installation of appropriate drivers on the controller PC/tablet. These drivers are included with the SFRA 6 software distribution and automatically installed with the SFRA software. The required USB A/B cable is included in the M5500 instrument's basic cable and accessories kit. With the USB cable connected and the M5500 instrument powered on, the instrument can be discovered from the SFRA 6 Software **Instrument** tab.

Wireless

Communication via wireless requires a PC with Bluetooth® capability. To pair the M5500 to the controlling PC (with the M5500 powered on) follow the process to **Add a Bluetooth Device** on your controller PC/tablet, then select the M5500 instrument from the list of available devices. Once pairing is complete, the instrument can be discovered from the SFRA 6 Software **Instrument** tab.

5. Hardware Updates

Updates to the M5500 internal logic and embedded software (firmware) can be accomplished if necessary, using files provided by Doble via the SFRA Software v6 **Instrument** tab.

Care and Maintenance



Caution: The M5500 instrument has no user serviceable parts inside. Opening the instrument may void your warranty.

The instrument should be kept clean and dry before, during, and after use.

Cleaning

The exterior of the instrument can be cleaned using a soft lint-free cloth dampened lightly with water. If necessary, a small amount of mild detergent can be added to the dampened cloth, followed by wiping with a cloth dampened with water only. Dry with a clean lint-free cloth.

6. Troubleshooting

Symptom	Possible Actions
Can't connect to instrument via USB method	Check USB cable, check that M5500 appears in Windows Device Manager under Ports (COM & LPT), verify FTDI Drivers are installed, verify Search for Serial Port (RS232/USB) is enabled in SFRA 6 Software Instrument tab.
Can't connect to instrument via wireless method	Verify M5500 is paired to controller PC, verify no USB cable is connected, verify Search for Bluetooth instruments is enabled in Instruments tab, verify that the wireless antenna (near the DC power inlet) is not blocked.
Can't connect to instrument when changing from one communication method to the other	Cycle power to the M5500 and re-attempt the connection.
No lights or sounds	Ensure the external power supply AC and DC plugs are fully inserted.
Test results not as expected	Verify that the BNC connectors of the SFRA test cable are connected to the correct ports on the M5500 instrument, verify that all connections to the apparatus under test are to bare metal and correctly placed for the specific test (sweep). Verify operation of instrument and cable operation using the provided test reference and/or shorted-lead tests.

7. Test Cables

Each M5500 instrument kit includes a 60-foot (18 meter) Classic Plus test cable assembly, unless a difference cable option was selected when the system was ordered. Two similar designs are available - the Doble Classic Plus design is standard. The Doble IEC 1 cable set is available as an option.

The Classic Plus cable assembly has integral grounding clamps, but also has ground rings at the top clamps that can be used with an optional braid kit for “shortest braid” (IEC Method 1) testing.

The IEC 1 cable does not have integral grounding clamps and can only be used for shortest braid (IEC Method 1) testing. The IEC 1 cable kit includes the required braid kit.



Figure 8 Doble Classic Plus and IEC 1 Cable Sets

SFRA Classic Plus Part Numbers

18 m (60 ft)	Kit with test cable and Quick Start Guide	030-2297-01
30 m (98.4 ft)	Kit with test cable and Quick Start Guide	030-2297-02
	Optional braid kit	030-1945-01

IEC 1 Part Numbers

18 m (60 ft)	Kit with test cable, braid kit, and Quick Start Guide	030-2266-01
30 m (98.4 ft)	Kit with test cable, braid kit, and Quick Start Guide	030-2266-02
	Extra braid kit	030-1945-01

A. LEGAL NOTICE

Warranty

Equipment Limited Warranty

Doble Engineering Company (DOBLE) warrants the products that it manufactures to be free from defects in material and workmanship for a period of one year from the date shipped from the factory.

During the one year warranty period, DOBLE will repair or replace, at its option, any defective products or components thereof at no additional charge, provided that the product or component is returned, shipping prepaid, to DOBLE. The Purchaser is responsible for insuring any product or component so returned and assumes the risk of loss during shipment. All replaced products and components become the property of DOBLE.

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B. Specifications

Commercial Temperature Range

Operating: -25 °C to 55°C

Storage: -40°C to 85 °C

Relative Humidity: 0% to 95%

Connectors

The M5500 has five connectors:

Connector Type	Label	Location	Description
DC Power Jack 5.5 mm Barrel/2.1 mm Pin	POWER	Rear	24 Vdc Power input
USB, type B	USB	Front	An A-to-B USB cable to connect the M5500 to a computer
BNC coaxial	SOURCE	Front	Output of signal generator
BNC coaxial	REFERENCE	Front	Reference input – measures signal at input to apparatus being tested
BNC coaxial	MEASURE	Front	Measurement input – measures signal at output of apparatus being tested

Dimensions

All dimensions are approximate.

Length: 31 cm (12.25 in)

Width: 24 cm (9.5 in)

Height: 9.4 cm (3.7 in)

Weight

3.2 kg (7 lbs)

Compliance

This instrument conforms to applicable European Union Directives for this class of equipment.

Electrical

The power supply is a 40 W, 24 VDC out - 110-240 V, 50/60 Hz in supply with a detachable AC cord. Doble supplies the correct cord for the purchaser's region.

M5500 Performance Specifications

EXCITATION SOURCE	
Channels	1
Frequency Range	10 Hz - 25 MHz
Output Voltage (pk-pk into 50 Ω)	10 Vdc (default) User selectable from 2.5 - 10 V
Output Protection	Short circuit protected
Source Impedance	50 Ohms
MEASUREMENT CHANNELS	
Channels	2
Sampling	Simultaneous
Frequency Range	10 Hz - 25 MHz
Max. Sampling Rate	100 MS/s
Input Impedance	50 Ohms
Recommended Calibration Interval	1 year
Frequency - Typical	$\leq 0.1\%$
Frequency - Guaranteed	$\leq 0.2\%$

ACCURACY	
Magnitude (guaranteed 20 Hz - 2 MHz)	± 0.1 dB (down to -60 dB) ± 0.5 dB (-60 to -100 dB)
DATA COLLECTION	
Test Method	Sweep Frequency
PC Comm	USB/Wireless
Frequency Range	10 Hz - 25 MHz
Number of Points	1045 points (default) 5000 points maximum per decade (logarithmic) 32000 points maximum (linear)
Dynamic Range (20 Hz - 2 MHz)	> 150 dB
DATA DISPLAY	
Scaling	Linear/Log
Frequency Range	10 Hz - 25 MHz, user defined within frequency range
Plotting	Frequency vs. Magnitude / Phase / Impedance / Ratio
Analysis	Difference, Cross-Correlation, Leakage Channel, Ratio

System Hardware Components

Instrument and Accessories

- M5500 instrument
- 24 VDC power supply (384-0327)
- AC power cord (based on region)
- Carry-case for instrument and accessories (03X-0260-01)
- Test Reference Module (M5STR)
- Optional Transit Case for M5500 instrument and standard cable bag (8000-0116)
- *M5500 Sweep Frequency Response Analyzer Reference Guide*

Cable Bag

- SFRA test cable assembly (standard Classic-Plus cable 030-2297-01*)
*See "Test Cables" on page 18 for information on available test cable options.
- Set of shorting leads (4 each 02B-0026-02)
- Copper battery clips (2 each 212-044)
- USB A/B communication cable (181-0700)
- Instrument safety ground cable (02C-0019-01)