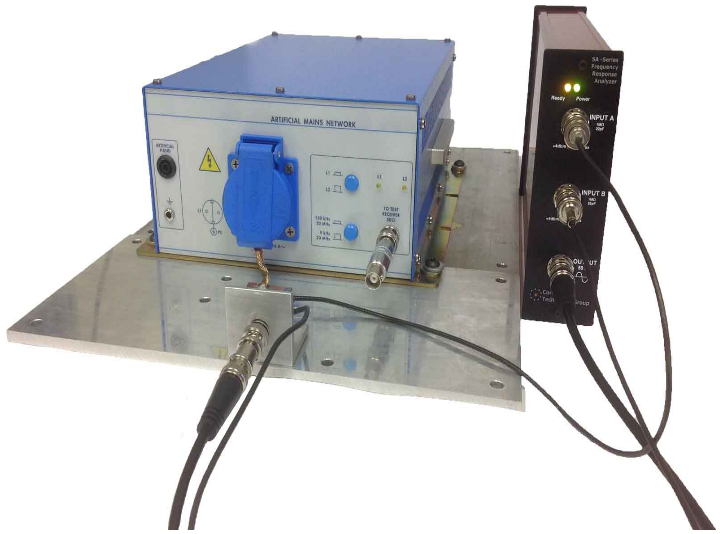
Core Technology Group

Application Note, AN-7

Measuring a Line Impedance Stabilization Network (LISN)



Conducted emissions is a measure of the amount of Electromagnetic Interference (EMI) that is conducted from a unit under test (EUT) to the outside world via the power cables. A Line Impedance Stabilization Network (LISN) is used for conducted emissions testing, and is inserted between the power mains and the EUT.

The LISN is a passive network that serves to isolate the test system with a reference impedance, and provide a measurement point to monitor the conducted emissions. The measurement bandwidth is in the 9Khz to 30Mhz region. A spectrum analyzer or RF noise meter is used to monitor the conducted emissions of the EUT via an RF (BNC) connector to a (test receiver) port on the LISN.

This application note demonstrates how the **SA-100 Vector Network Analyzer** can be used to measure and verify the operation of an LISN device for:

- magnitude and phase of the impedance at the EUT terminal with respect to ground with the receiver terminated in 50 ohms.

- insertion loss between each EUT terminal and corresponding receiver port,

- isolation between each mains terminal and corresponding receiver port,

Figure 1 illustrates a circuit model for a single channel LISN. Most LISN devices have two identical channels; one for power and another for return.

The input (Power Source) is connected to the AC main. Capacitor, C2 and inductor, L1 form a filter to help reject high frequency noise from the main power

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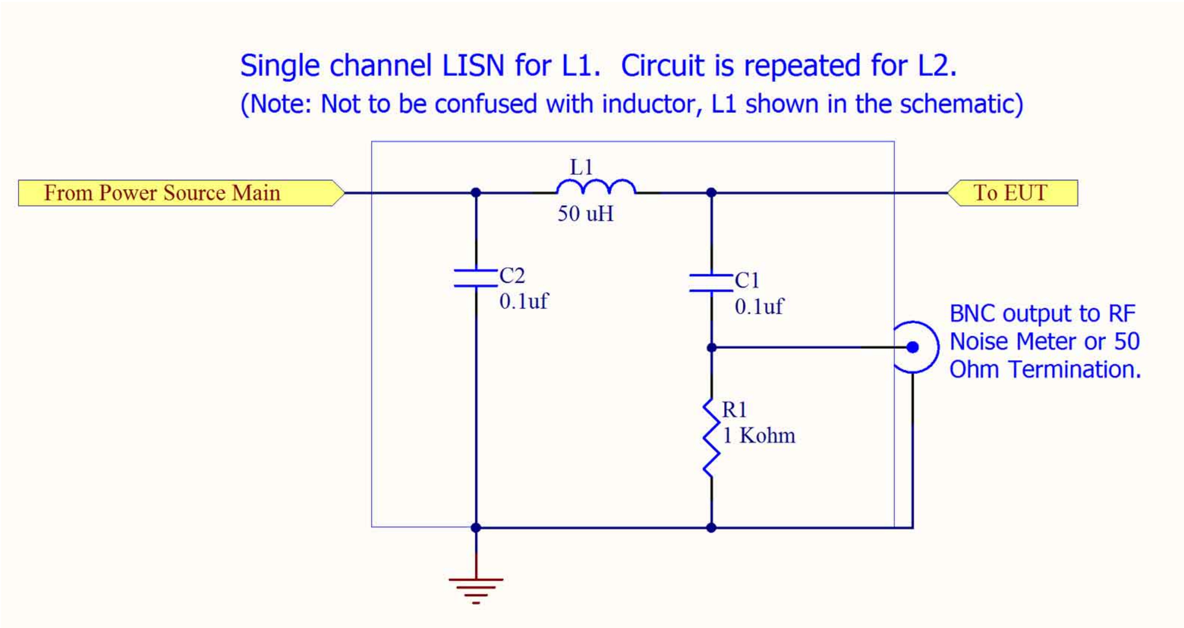

Figure 1. Circuit model of an LISN as outlined in ANSI C63.4-2003.

source so that it does not affect the unit under test or influence the noise measurements. Additionally, the filter also serves to supress any emissions from the EUT back to the AC main power. The unit under test (EUT) is connected to the output side of the LISN. A high pass circuit comprised of C1 and R1 is used to couple the emissions from the EUT to a connector at the test receiver port on the LISN. A spectrum analyzer or noise meter (terminated in 50 ohms) is used to monitor the emissions.

As mentioned, an LISN usually has two identical circuits, one line for the power source, and one line for the power return. These are denoted L1 (Line One) and L2 (Line Two). This allows conducted emissions measurements to be taken for each line independently.

Some LISN devices may have dedicated BNC monitoring ports for each line circuit or a single BNC connector with a means to switch from one line to the other.

A network analyzer, such as the SA Series Vector Network Analyzer, can be used to characterize an LISN by injecting a series of test signals over the desired frequency range and plotting the systems response.

Figure 2 illustrates the test setup using the SA-100 Vector Network Analyzer to measure the EUT terminal impedance. This test verifies the basic intent of an LISN, which is to provide a constant 50 ohm source impedance to the power lines of the EUT. The constant impedance serves to standardize the conducted emissions testing and allows repeatable results. Figure 3 shows the corresponding

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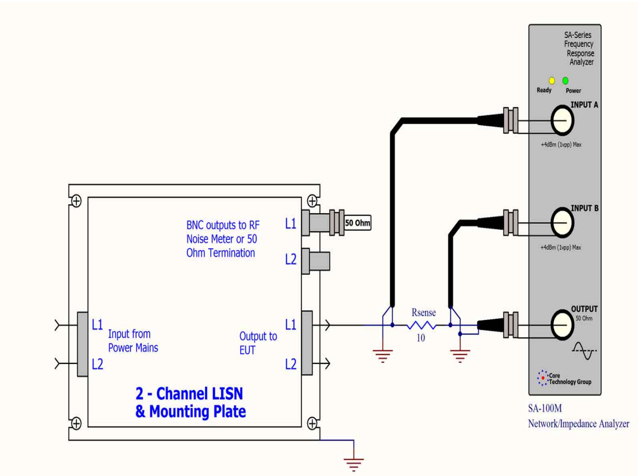

Figure 2. Test setup for measuring the EUT terminal impedance.

screen output of the EUT impedance with phase and magnitude displayed.

The software enables the user to display the data in a number of graphical formats including bode, impedance, magnitude and phase. Cursor display and annotation capability help to clearly present and analyze the results.

Figures 4 and 5 illustrate the Print Options window and some additional utilities that include options to send the plot output to a web browser, along with the ability to add html formatting to further enhance your presentation.

Additionally, an export function is provided to enable the user to send data to a csv file for spreadsheet analysis or custom presentations.

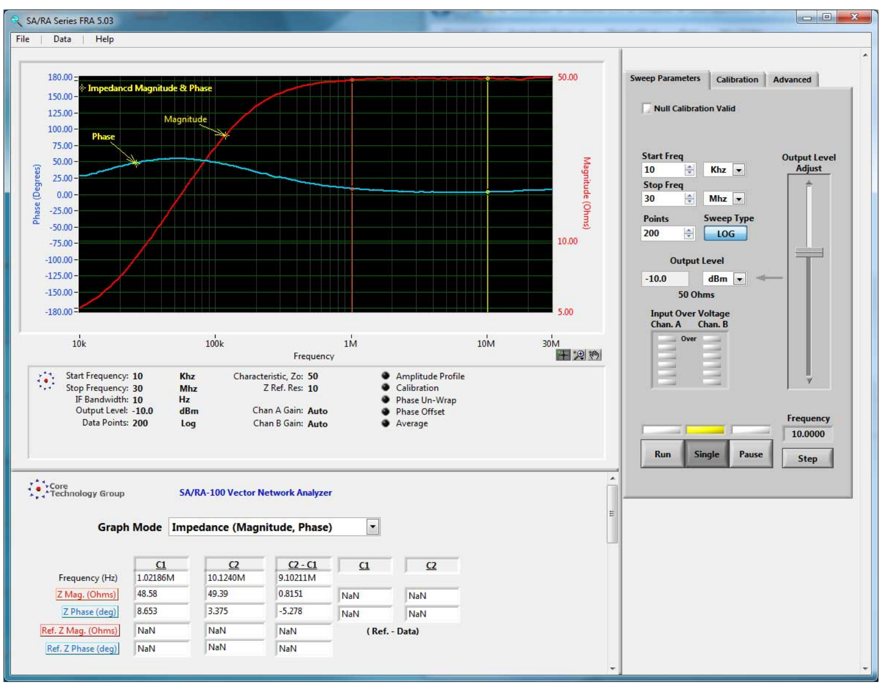

Figure 3. Graphical output for the EUT terminal impedance showing magnitude and phase.

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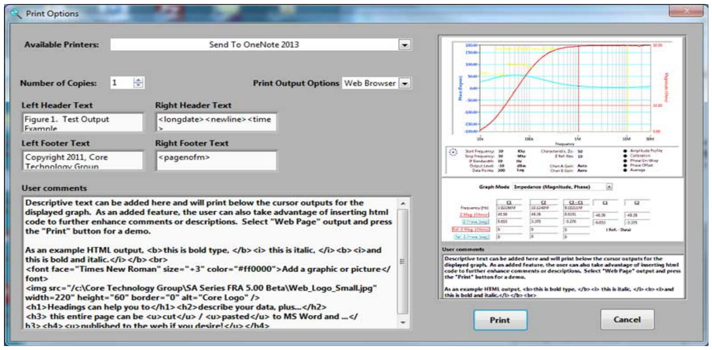

Figure 4. Print options window. Titles, headers and HTML formatting can be added to enhance presentation of the data.

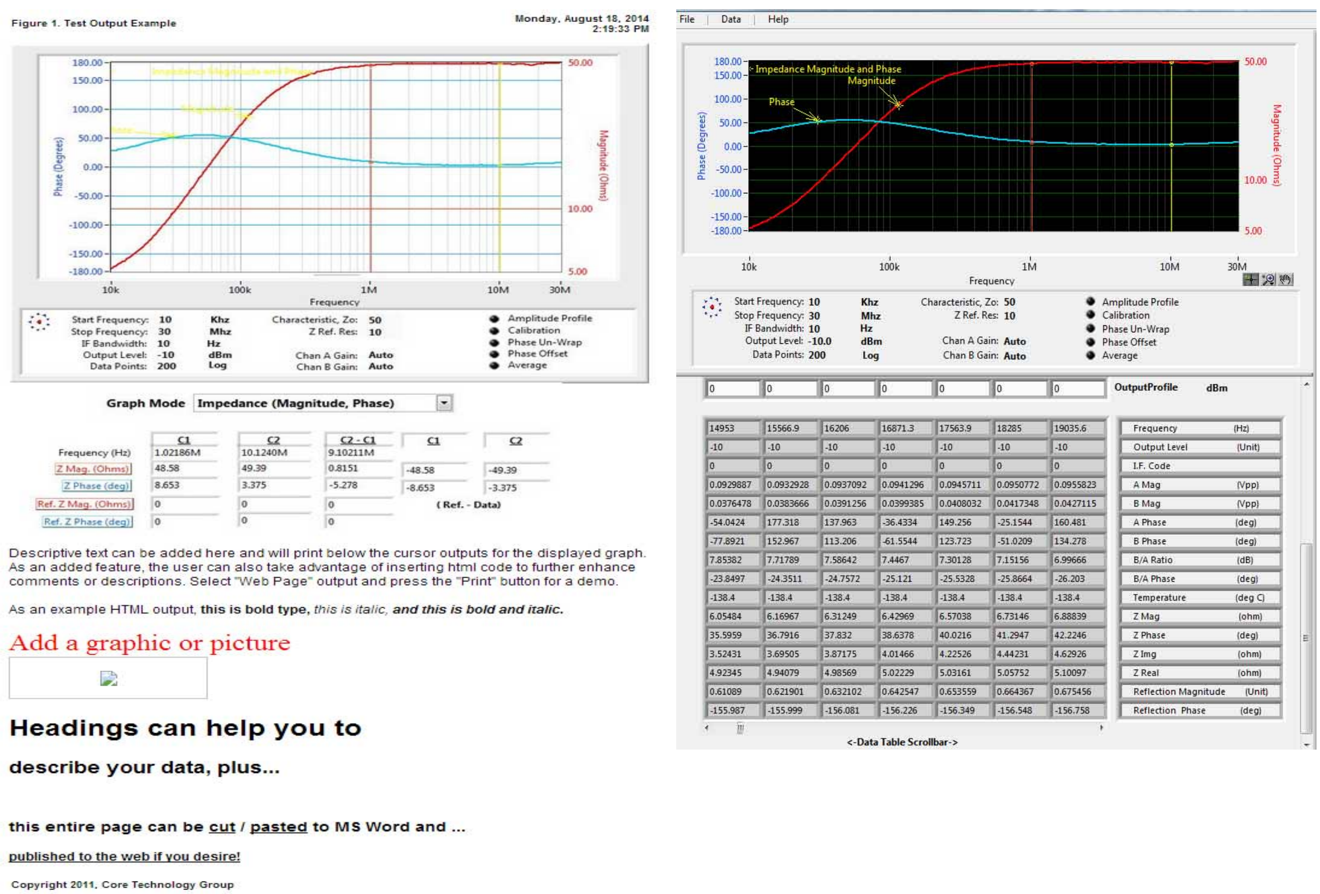

Figure 5. Webpage output showing graph output, HTML enhancement capability, and screen with scrollable tabular data. Data is also exportable to csv file for spreadsheet apps.

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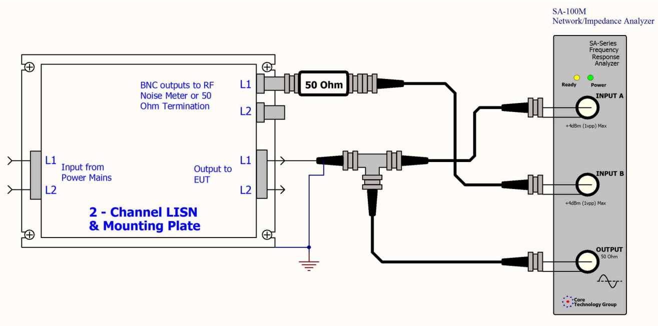

Figure 6. Test setup for EUT terminal and receiver port insertion loss (transfer function).

Figure 6 shows the test setup to measure the insertion loss between the EUT output and the receiver port. Any emissions present on the power lines of the EUT are coupled to the receiver port and terminated into 50 ohms. Knowledge of the insertion loss figures at each frequecy will allow proper compensation of the test results for more accurate reporting.

Figure 7. shows the graphical output for the insertion loss test.

Figure 8 illustrates the test setup using the SA-100 Vector Network Analyzer to measure the isolation between each main terminal and corresponding receiver port. This isolation is required to insure that noise present on the AC main source is not coupled to the receiver port and falsely influencing the measurement. Figure 9 is a screen shot of the analyzer output .

This application note has outlined some of the verification testing on an LISN (Line Impedance Stabilization Network) that can be performed with a vector network analyzer such as the SA Series from Core Technology Group. The demonstrations included measuring input/output isolation, receiver port insertion loss and output terminal impedance. Further information

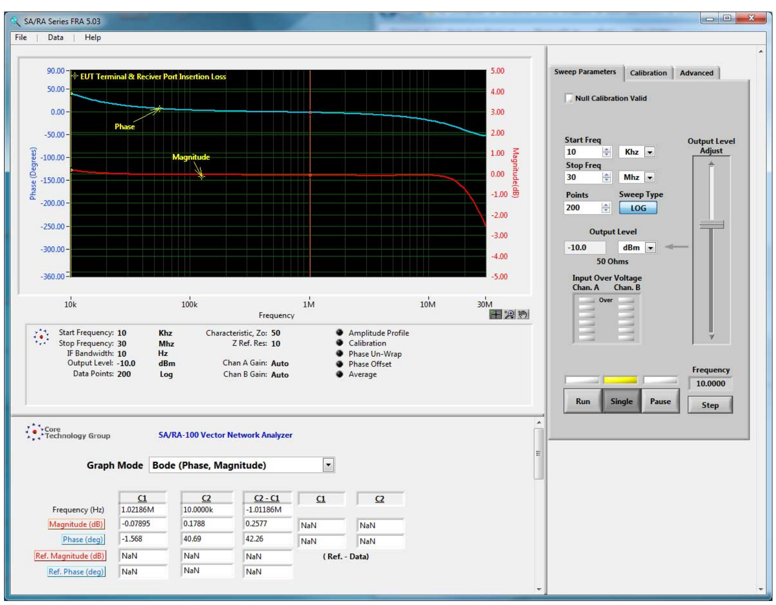

Figure 7. Graphical output (bode plot) for EUT terminal and receiver port insertion loss.

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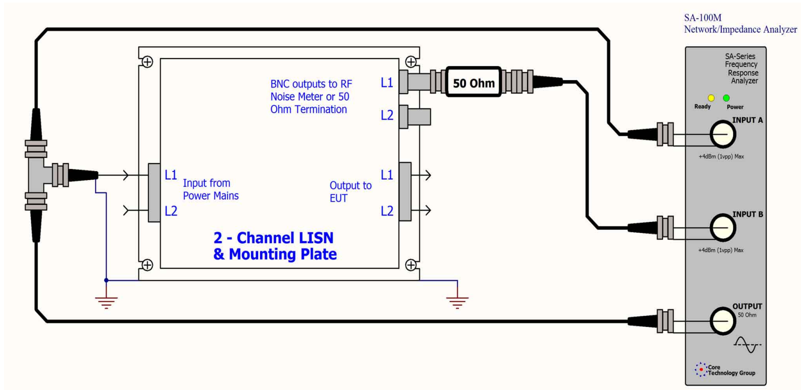

Figure 8. Test setup using the SA-100 measuring main and receiver port isolation.

on LISN requirements can be found in ANSI C63.4-2003 section 4.1.2 and MIL-STD-461F.

Additional application notes can be found at **www.coretechgroup.com**.

We welcome your questions or comments, and would be happy to discuss your testing requirements with you.

Figure 9. Bode plot of main and receiver port isolation showing test parameters, cursors and annotations.

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