

Why So Many Different Types of LISNs? AN-105LISN

The Line Impedance Stabilization Network, or LISN, as it is commonly called, is used for the measurement of conducted emissions on power lines. The basic setup for the conducted emissions test is as shown in Figure 1. The LISN gets its power from the ordinary wall outlet and feeds the power to the Equipment Under Test (EUT). Any RF noise generated by the EUT is separated by the LISN and fed to the spectrum analyzer for measurement or recording.

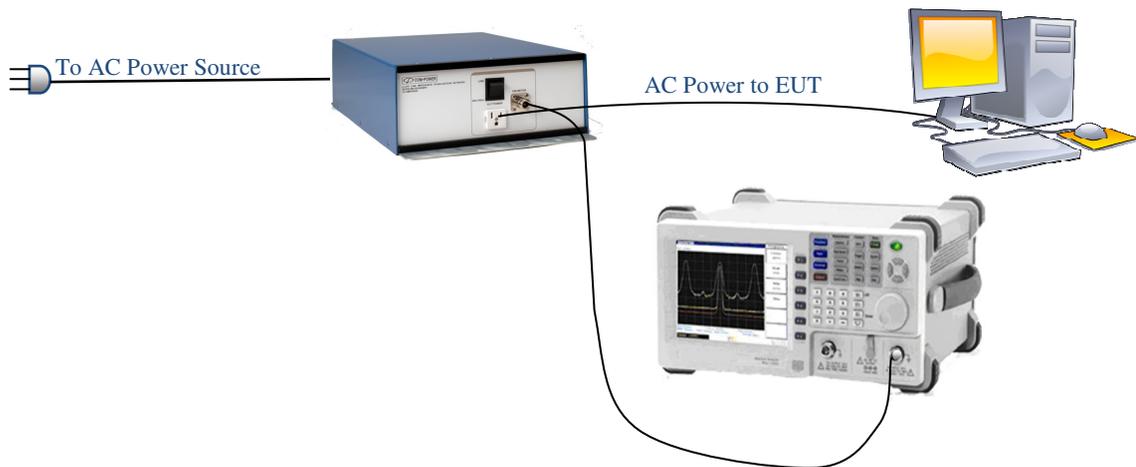


Figure 1

Functions performed by the LISN:

The LISN performs four important functions. These are described below.

Stable Line Impedance:

The first function is to provide stable, normalized impedance on the power line. This is important because the power line impedance through a standard wall outlet can vary greatly depending on how and where the wiring is connected.

The amount of EUT noise present at the LISN measurement port is directly related to the impedance of the power line vs the impedance of the EUT. These two impedances effectively create a voltage divider network for the EUT noise, allowing only a fraction of the noise voltage to reach the measurement port. Therefore, the ability to achieve reliable and consistent measurement results depends highly on the reliability and consistency of the LISN impedance during the test.

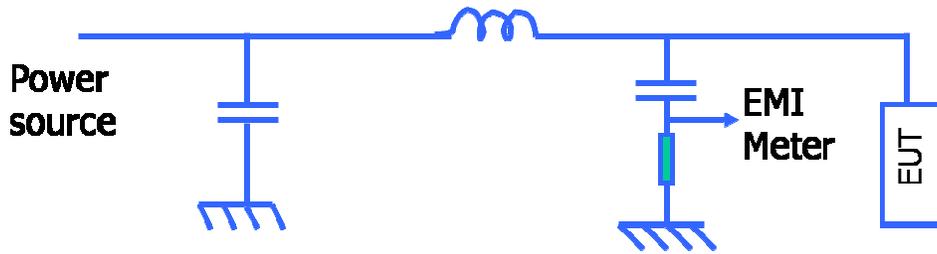
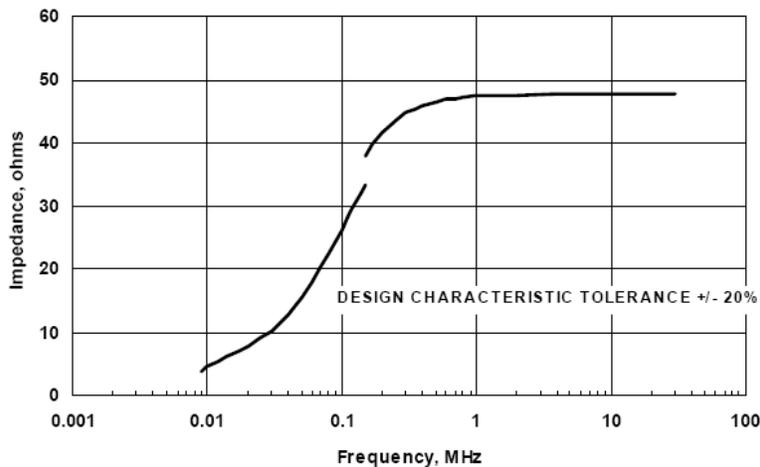


Figure 2

The FCC and CISPR “recommended” circuit for the LISN is shown in Figure 2 above. However, this simple circuit may not always perform as intended because of stray capacitances and inductances present in the constructed circuit, as they have significant impact on the circuit performance at RF frequencies. In particular, the stray capacitance may cause resonance, and as a result the impedance may have unexpected dips. The LISN has to be designed and built very carefully in order to comply with the curve shown in figure 3 across the entire frequency range.



NOTE -The discontinuity in the curve is due to the impedance values being derived from the two different circuits for the 9 kHz to 150 kHz and 150 kHz to 30 MHz frequency ranges.

Figure 3

LISN Prevents External Noise Coupling In

Another very important function of the LISN is to isolate the external noise which may be present on the power line. The 50 micro-Henry inductance presents a high impedance to the outside RF noise while allowing the lower frequency power to flow through to the EUT. The first 1.0 microfarad line to ground capacitor forms the first stage of a two-stage filter, working with the inductor to accomplish this goal.

Suitable Connection to the Measuring Equipment

A spectrum analyzer or EMI receiver is typically used as the measuring meter for this test. The input stage of these devices is very sensitive, and prone to damage. The LISN is designed to allow the low-level RF noise from the EUT to easily couple through the 0.1-microfarad capacitor to the 50-ohm input of the measuring meter, while the 10k-ohm resistor reduces the low frequency power line voltage.

Knowing the basic functions of the LISN, it will be easy to understand why so many different types of LISNs are needed. One reason is that the LISNs are used for different tests and correspondingly different frequency ranges. Let us consider first the 50 micro-Henry LISN discussed above. This LISN is used for FCC compliance as well as CISPR testing in the range of 150 kHz to 30 MHz. However, if the testing required begins at 10 kHz, a two stage circuit is needed with an additional L-section comprised of a 250 micro-Henry inductor and an 8-microfarad capacitor. This LISN with the extra filter works better in the 10 kHz to 150 kHz region than the single stage circuit 50 micro-Henry LISN.

Also, the value of the inductor is based on the anticipated inductance of the power line for the intended installation of the product. As discussed previously, MIL-STD specifies a 50 micro-Henry inductor for the LISN. This value was selected because it represents the inductance of power distribution wiring running for approximately 50 meters, which is representative of a wiring system on a ship or cargo aircraft. However, for smaller platforms such as fighter aircraft, inductance values may be substantially lower than 50 μ H, in which case 5 μ H LISNs are recommended.

In addition, higher EUT current requirements require higher current handling components, which add to the variety of LISNs needed. The current handling capability of an LISN has two important aspects; temperature and saturation of the inductor. The characteristics required by the regulations do not include the performance testing under load. Therefore, some suppliers manufacture LISNs that use inductors with magnetic core material. Inadequate current carrying capability would be discovered easily due to temperature rise. However, saturation of core may not be discovered easily. Utilizing air core inductors avoids saturation and unreliable operation.

Operating voltages may also be a reason for additional models of LISNs. LISNs are made for AC voltage operation as well as DC. The working voltage levels also may be different. Finally, the number of phases in the power supply may require more variations in the LISN types.

A question may arise as to why different standards require different test frequencies. The answer to this question can be quite complicated. However, a simple answer is simply that the standards take into account the operating environment for the types of equipment covered by each standard.

So, the extensive line of LISNs covers multiple standards, operating frequencies, operating voltages and currents. The list of LISNs available from Com-power is constantly growing. A list of LISN available currently is given below:

Table of LISNs:

LISN Model	Frequency Range (MHz)	Inductor uH	Current Rating Amps	EMI Test Specification
LI-125	0.15-30	50	25	FCC, CISPR 11/22/13/14/15/, EN, AS/NZS
LI-150	0.15-30	50	50	FCC, CISPR, EN, AS/NZL
LI-325	0.15-400	5	25	FAA - RTCA DO160C,D,E,F
LI-400	0.01-10	50	30	MIL-STD 461D, E, F
LI-550	0.01-108	5	50	CISPR 25
LIN-115	0.15-30	50	15	FCC, CISPR, EN, AS/NZS
LI-215	0.01-30	250 & 50	15	CISPR EN.
LI-210	0.01-30	250 & 50	10	CISPR, EN

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