

# How to use a Comparison Noise Emitter (CNE) or York Reference Source (YRS) to check Line Impedance Stabilisation Network (LISN) performance

## Conducted emissions verifications

As with other pre-test checks, the purpose of this exercise is to make an initial reference measurement on a system that is known to be good, and then to repeat the measurement at regular intervals to verify the continued correct operation.

A typical conducted emissions measurement e.g. CISPR 22 (EN 55022) uses a receiver or spectrum analyser to measure the RF emissions on the mains supply due to the equipment under test (EUT). The RF component is extracted from the mains supply using an Artificial Mains Network (AMN) or Line Impedance Stabilisation Network (LISN), which serves the dual role of providing a known source impedance and a means of coupling the mains borne RF into the (typically 50  $\Omega$ ) measurement analyser (see Figure 1). LISNs are usually capable of selecting the mains conductor to be examined e.g. Live or Neutral for a single-phase device, referenced to either the equipment earth or to a separate measurement ground. Unlike receivers and analysers which include self calibration capabilities, LISNs require an external means of verifying their performance. Transient limiters are often included as well in the test setup to protect the measurement equipment and these also need to be checked to ensure that they do not introduce errors, for example following partial breakdown of the semiconductor.

## Procedure

The verification or pre-test check performed is one of substitution. Figures 2 and 3 show a CNE noise source coupled to the LISN to verify the setup used in a laboratory mains power conducted emissions test. The earth lead attached to the LISN adaptor is required for protection purposes. When the LISN is plugged into the mains supply, a current of around 0.75 A flows through the safety earth due to the large capacitances between the current carrying conductors and earth.

One limitation imposed on this measurement is the need to protect the noise source from high voltages (see Note 1). For this reason it is highly recommended that the test is carried out with no mains supply to the LISN, or at least, only

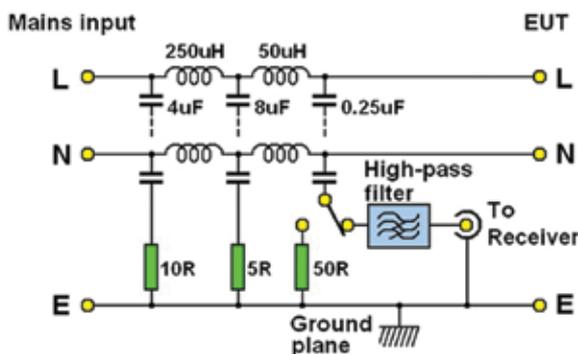


Figure 1. CISPR 16 Line Impedance Stabilisation Network

to the LISNs control circuit (if applicable). Similarly, the LISN adapter couples the CNE signal to the neutral connection of an IEC 320 (EN 60320) plug so that, if the LISN has to be powered, only the relatively safe neutral is connected. Any cabling intended to couple the CNE to another mains supply system, or using other types of connector, must bear in mind this limitation.

Restricting signal injection to the neutral line, it is still possible to monitor the response of the LISNs live path due to the coupling between the live and neutral conductors in the mains cable used. The actual response gained will depend significantly on the cable itself, so using the same cable for repeat verifications is essential to making a worthwhile measurement.

Figure 4 shows the receiver output plot across the frequency range (peak and average detectors) for this verification measurement, which may be a subset of the intended test or, as in this case, a complete run through. A simple go/no-go comparison would be performed against the reference measurement to determine whether the test setup is satisfactory. This may be performed in software, by visual comparison, or by the introduction of limit boundaries on the printed graph.

**Note 1:** Under normal test conditions the LISN would be powered up, supplying mains voltage to the EUT. Although the LISN adapter provides some degree of protection, the need to provide good coupling for the RF signal from the reference source restricts the level of protection that can be applied.

Applying mains level voltages will damage the reference source. The UK mains supply employs a neutral connection that is connected to earth, for example at the distribution transformer. Allowing for cable voltage drops due to return current flow, this still results in a maximum permissible voltage on the neutral of around 6 V with respect to earth, and this may be enough to cause a soft failure of the reference source output stages over a period of time.

Some mains supplies around the world provide balanced live and neutral lines, as does the use of isolation transformers, so the option of choosing a low voltage conductor is not possible.

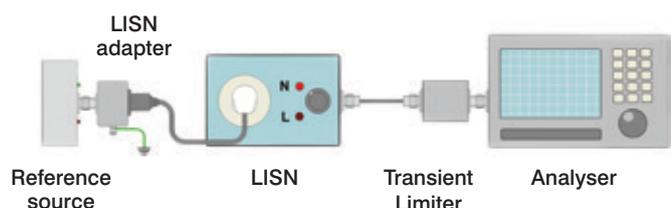


Figure 2. LISN verification setup using a CNE and LISN adapter

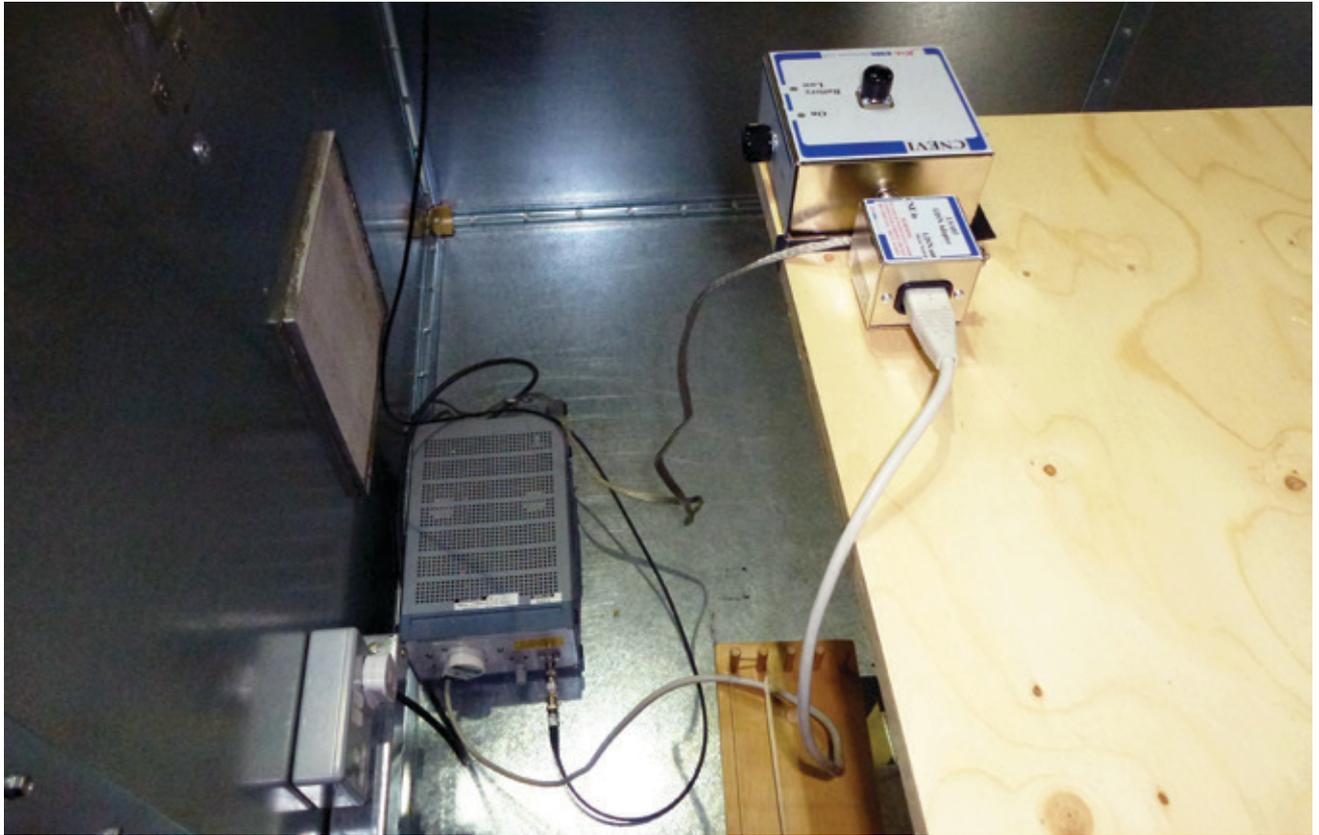


Figure 3. LISN verification setup using a CNE

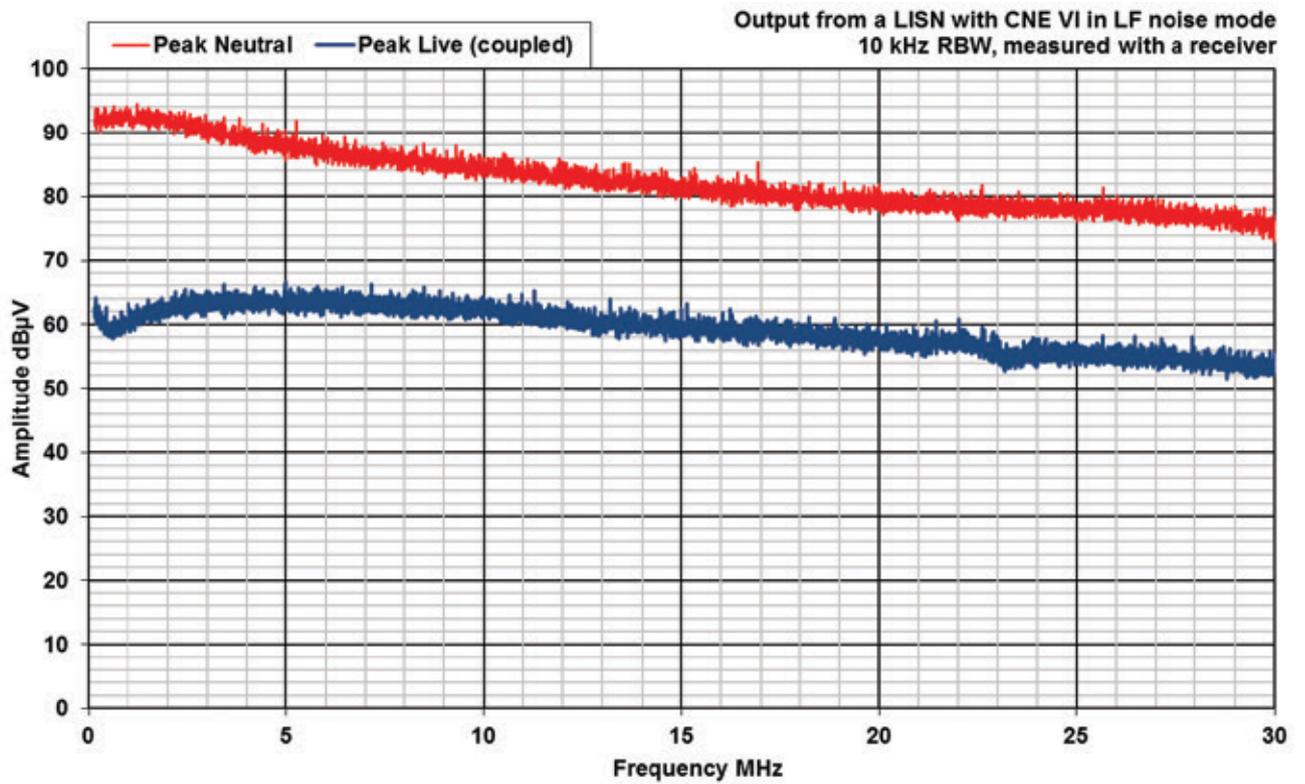


Figure 4. Peak and average measurements of LISN output using the test setup shown in Figure 3