

Interpretation/explanation Request 2004-C63-SC1-6

14 February 2005

From: David Bare [dbare@elliottlabs.com]
Sent: Friday, February 04, 2005 5:02 PM
To: d.heirman@ieee.org
Subject: LISN Measurements

Don -

I would appreciate your opinion concerning an interpretation of clause 4.4.3 of ANSI C63.4:2003.

We recently had an audit of our laboratory by our accreditation body (A2LA) and one of the items that the auditor indicated as a deficiency was the method we use to calibrate out LISNs. He quoted paragraph 4.4.3 of ANSI C63.4 which says "The LISN shall be measured as it is used for testing a product." The auditor said that he interpreted this to mean that LISNs must be calibrated on the test site where they will be used and setup as they would be for testing a product.

I argued that this meant that the LISN is to be calibrated using the extensions which are attached to the LISN for interfacing with the EUT and bonded to a ground plane in a similar fashion as implemented for EUT measurements and it was not necessary to measure the LISN on the test site.

Of course, if the LISN is permanently installed on the site, it would most likely be easier to take the calibration equipment to the site.

As an aside, requiring LISN calibrations on the test site would prevent a calibration laboratory from performing LISN calibrations unless they traveled to the labs with their calibration equipment.

As you are on the C63.4 committee (are you still the vice chair?), could you respond to this and confirm our interpretation so that we may forward your response to our auditor.

Thanks and Best regards,

David Bare
Elliott Laboratories Inc.

The following response from the C63 Subcommittee 1 is considered an explanation of the clause in ANSI C63.4

In response to the question on the application of ANSI C63.4, the following explanation and background are offered.

Several clauses have to be reviewed to come to the explanation that will follow at the end of this request. First

Clause 4.1.2 states:

A LISN having an impedance characteristic within the limits shown in Figure 1 is required for ac conducted emission measurements. When the “measuring instrument” ports are terminated in 50 ohms, the characteristic impedance in Figure 1 shall be present at the EUT ports of the LISN. Figure 2 and Figure 3 show two circuits that when carefully constructed can provide the impedance characteristics of Figure 1 (for use with connecting cable, see also 5.2.3.1).

Explanation for Clause 4.1.2: This clause sets the stage for LISN use and its meeting the impedance requirement shown in the Figure 1 for two conditions: LISN where the EUT plugs directly into the LISN and where the EUT plugs into a power cord connected to the EUT port of the LISN. Clause 5.2.3.1 was specifically written for the latter condition which existed at radiated emission test sites where the LISN is mounted below the ground plane for table top testing and where the LISN is mounted above the ground plane for floor standing equipment. The latter was allowed as it was considered that leaving the LISN on top of the ground plane next to floor standing equipment would not affect significantly the radiated emissions.

5.2.3.1 LISN connected to the reference groundplane

Where use of a LISN is required (see Clause 7), it shall be placed on and electrically bonded to the top surface of, or immediately beneath, the reference groundplane and bonded to the groundplane. If LISNs are kept on the test site for radiated emission measurements, it is preferred that they be installed under the reference groundplane with the ac power receptacle flush with the reference groundplane. Otherwise, NSA requirements may not be able to be met.

Explanation for clause 5.2.3.1: The preference for mounting the LISN below the ground plane is to avoid moving the LISN depending on whether table top or floorstanding equipment is being measured. Mounting under the ground plane allows performing conducted emission measurements for both types of EUT. If the LISN is permanently mounted under the ground plane (or turntable), in all likelihood cabling will be used to connect between the LISN output and the actual outlet where the EUT is connected above the ground plane.

The next paragraph carries on assuming that an “extension cord” is used.

The impedance at the receptacle end of any cable connected to the EUT end of the LISN (as contrasted to the impedance at the LISN terminals given in Figure 1), with the measuring instrument port of the LISN terminated in 50 ohm, shall be within +30% and –20% of the nominal LISN impedance shown in Figure 1 over the frequency range of the network to be used. See 4.1.2. If the attenuation (insertion loss) between the EUT receptacle and the measuring instrument port on the LISN is more than 0.5 dB, (see Annex E as an example of a method of measurement) it shall be taken into account when calculating the EUT emission levels. The site reference groundplane is the ground reference for the LISN.

Explanation: The next paragraph cautions that if an RF filter is used on the AC supply input of the LISN, the filter then becomes part of LISN installation. The isolation transformer is part of the AC supply and not considered part of the LISN installation.

Ambient noise may be present on the ac powerlines at some locations and at some frequencies within the frequency range of interest. If the levels are sufficient to cause interference with readings made using an LISN, filtering of the ac power may be required. The filter should be inserted between the ac power supply and the ac input connection to the LISN, preferably as close as possible to the LISN to reduce interference pickup by the leads between the filter and the LISN. Where an isolation transformer is used between the ac power supply and the LISN, care shall be taken to ensure that this transformer’s rating is large enough to not affect the peak current drawn by the EUT (this may require up to ten times the kilovolt-ampere rating of the EUT). If other than air core inductors are used in the LISN, they shall be in a linear permeability range at the peak currents drawn by the EUT.

Explanation of Clause 4.4.3 Now to the specific review of the 4.4.3 clause repeated below. First the clause differentiates between LISNs that are not permanently installed at a test site and those that are permanently installed. This is the explanation for why the sentence “The LISN shall be measured as it is used for testing products” was included. From the explanation above, where the permanently installed LISN is below the groundplane (allowing radiated emission measurements to be made for table top EUTs) or where the LISN is above the ground plane (allowed for floor standing equipment) and where “extension” cords are used must meet the impedance specification. Clearly for such permanent installations, the LISN installation impedance must be calibrated with calibration instrumentation at the location of the EUT end of the “extension” cord. For non-permanent installations, the LISN (with any extension cord if used) can be calibrated off the test site as intended.

4.4.3 LISN impedance and insertion loss measurements

The impedance and insertion loss of each LISN used in testing emissions shall be measured over the frequency range of use. The LISN shall be measured as it is used for testing a product. An acceptable procedure for performing these measurements is given in Annex E. See 5.2.3.1 for testing a permanently installed LISN. The LISN should be checked routinely to ensure acceptable performance. See 4.4.1.

Conclusion:

Calibration of LISNs can be performed away from the test site but still using any “extension” cords and any RF filters when used on the power source line side of the LISN except when the LISN is installed permanently to a ground plane as noted in Clause 5.2.3.1. In the latter instance, the LISN must be calibrated as installed and where installed.