Intel Corporation

CISPR/G/143/CDV

Report Summary

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I. Introduction

CISPR/G/143/CDV proposes amending CISPR Publication 22, 3rd Edition, to include the use of ferrite clamps or tubes on all cables leaving the turntable when performing radiated emissions measurements. The stated purpose of this change is to improve repeatability between different test laboratories. Three test sequences were devised and performed from late August 1999 to January 2000 to evaluate the effectiveness of the proposal and to provide recommendations on the US position on the FDIS that will result from this CDV.

II. Test Programs

Three test programs were executed. These are:

- Comparison of test results on three PC systems in the 3 meter RF semi-anechoic chamber at the Intel DuPont Site EMC Laboratory in August, 1999.
- Comparison of test results on a PC system at 5 laboratories in the Pacific Northwest in December 1999.
- Comparison of test results on a comb generator feeding an IEC 61000-4-6 CDN at 3 laboratories.

The results of each of these test series were documented and provided to the USNC to the IEC / CISPR SC G TAG. Each report also contained a recommendation on the US vote when the FDIS version of this proposal is finally published.

III. Test Program Summaries

A. August 1999 Tests

The tests conducted in August 1999 were designed to assess the impact of adding ferrite clamps to cables leaving the turntable. Concern had been expressed that adding the ferrite clamps might change test results. Three PC systems, of simplified design to limit the number of cables leaving the turntable to 2, were tested, with and without ferrite clamps on the cables leaving the turntable. The results from these tests demonstrated that the addition of ferrite clamps to cables could have a significant impact on measured signal levels from the EUT. Some signals went up while others were reduced. One product which was non-compliant with the limits without the ferrite clamps was brought into compliance by their addition. Another product, however, was nearly brought into non-compliance by the addition of the clamps.

All tests for this sequence were conducted in the 3 meter RF semi-anechoic chamber located in the Intel DuPont Site EMC Laboratory in DuPont, Washington.

Based on these results, a recommendation of a NO vote was made.

B. December 1999 Tests

The tests conducted in December were on a PC system and were performed at five different EMC laboratories. The purpose of these tests was to assess the variation between the laboratories, with and without ferrite clamps on cables leaving the turntable. The EUT was kept to a minimum configuration to limit the number of cables leaving the turntable to two, the number of ferrite clamps available to the Intel DuPont Site EMC Laboratory. The results of these tests showed only a minimal improvement in variation between the laboratories.

The test laboratories used for this round of testing were:

- Intel DuPont Site EMC Laboratory, DuPont, Washington
- Intel Oregon Site EMC Laboratory, Hillsboro, Oregon
- Acme Testing, Acme, Washington
- CKC Laboratories, Tillamook, Oregon
- Northwest EMC, Newburg, Oregon

Based on the minimal improvement in repeatability seen in this round of tests, a NO vote on the part of the US was recommended.

C. January 2000 Tests

The tests conducted in January were on a comb generator driving the RF input port on an IEC 61000-4-6 CDN. The comb generator was powered by an external power supply (fed through the CDN). The only cable leaving the turntable was the power cord from the EUT port of the CDN. Testing was performed at frequency intervals of 5 MHz from 30 MHz to 200 MHz. Vertical polarity was evaluated as that was the expected polarization of signals from the vertically hanging power cord. Three laboratories were used for these experiments. In addition to measuring emissions from the test setup at the three labs with a single ferrite clamp, two additional ferrite clamps were evaluated and characterized at the Hewlett-Packard Camas, Washington facility. This was to find the impact of various clamp types on the results of these tests. The results of these tests show that the addition of ferrite clamps can have a significant impact on improving repeatability between test laboratories when measuring emissions from cables leaving the turntable. These tests also demonstrated that different commercially available ferrite clamps have widely differing input impedances as a function of frequency and that this difference in a key characteristic can have a significant impact on the emissions level measured.

The laboratories used for this round of testing were:

- 10 meter OATS at the Intel DuPont Site EMC Laboratory, DuPont, Washington
- 10 meter OATS at the Intel Oregon Site EMC Laboratory, Hillsboro, Oregon
- 10 meter RF semi-anechoic chamber at Hewlett-Packard, Camas, Washington

Based on the variation in results seen between the different ferrite clamps used in these tests at the Hewlett-Packard facility, a NO vote was again recommended until the proposal calls for more comprehensive specifications for the ferrite clamps. Insertion loss specifications alone are inadequate.

IV. Final Recommendation

All three test sequences demonstrated different results, but all came to the same conclusion. The US should vote NO on the FDIS when released and should recommend to other National Committees that they do likewise. The first sequence demonstrated a lack of consistency between test results when a product is tested with and without ferrite clamps in a single laboratory. The second sequence (with a limited sample size of one) demonstrated minimal improvement in repeatability between laboratories when ferrite clamps were added. Thus, the changes in results demonstrated in the first test sequence were not justified by the limited improvement in repeatability. The third sequence, significantly more controlled in nature than the first two, shows that adding ferrite clamps to power cables can have a significant impact on the repeatability between laboratories, but that the characteristics of the ferrite clamps must be more completely specified to further minimize variability between laboratories.

Based on the results from all three test sequences, the recommendation that the US vote NO on the FDIS which will be released shortly stands. The proposal has merit and with an adequate definition of the characteristics of the ferrite clamps will provide a significant improvement in the repeatability of measurements of radiated emissions from common mode currents flowing on cables with leave the turntable. Without the addition of a specification for the input impedance of the clamp, much variability in results will still exist, reducing the effectiveness of the proposal.