Intel Corporation

Corporate Product Regulations

Ferrite Clamp/Tube Analysis

CISPR/G/143/CDV

22 December 1999

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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.

II. Test Program

The test program reported in this document was designed to provide a quick indication of the effectiveness of placing ferrite clamps or tubes on cables which leave the turntable on reducing measurement uncertainty between laboratories. One pair of tests was run at each of four laboratories. Each pair consisted of a test with and without ferrite clamps installed on the cables leaving the turntable. The test system investigated was an Intel NetPC with an NEC MultiSync C400 monitor, Keytronic keyboard and Logitech mouse. Other I/O ports on the computer were left unconnected.

The ferrite clamps used were a Schaffner CDN 725 and a Schaffner INA 726. These ferrite clamps are part of the Intel DuPont Site EMC laboratory's IEC 61000-4-6 test system.

III. Test Facility, Equipment and Process

Testing was performed at the following EMC laboratories in the Pacific Northwest region of the United States:

The Intel DuPont Site EMC Laboratory's 3 meter RF semi-anechoic chamber. This chamber is sized to allow full 1 to 4 meter height scans using broad band antennas and has a 2 meter diameter turntable. The chamber is listed with the FCC for class B certification testing of personal computer systems and peripherals. The Intel DuPont Site EMC Laboratory is accredited by A2LA and BSMI (Taiwan) and is approved by the New Zealand Ministry of Commerce, GOST, VCCI (PLC and OATS facilities only) and NEMKO (Test by Manufacturer program). This chamber was used to generate the list of frequencies to be measured at the Open Area Test Sites (OATS) for each of the laboratories.

A Rohde & Schwarz ESBI receiver, Miteq preamplifier and Chase CBL-6112 BiLog antenna were used for the tests, operating under the control of Rohde & Schwarz ES-K1 software.

The frequency range of 30 to 1000 MHz was scanned at 24 turntable positions (15 degree increments), at antenna heights of 100, 250 and 400 cm and at both horizontal and vertical polarities to find signals emitted by the EUT. 15 signals were then identified by the software based on user supplied criteria. These signals were re-measured at the worst case turntable position, antenna height and polarity (from the steps previously checked) to determine their precise frequency. Each signal was then fully maximized by rotating the turntable through a complete 360 degree circle and scanning the antenna from 1 to 4 meters at the worst case

polarity. Once the signal is maximized, a measurement is taken with the quasi-peak detector. This process was repeated with and without the ferrite clamps installed on each of the power cords (PC and monitor).

The frequency lists from the two tests were merged into a single list which was used at each of the five OATS facilities for testing with and without ferrite clamps on the power cords.

OATS Facilities:

Intel DuPont Site EMC Laboratory, DuPont, Washington

10 meter OATS with a 57 by 67 foot ground plane, elevated about 1 foot above grade. The ground screen is 1/4 inch wire mesh, galvanized after weaving hardware cloth. The ground plane around the turntable area, extending beyond the fiberglass reinforced plastic dome is solid sheet metal, welded periodically at the joints. A Hewlett Packard 8546A receiver is used with an EMCO 3143 Biconilog antenna for measurements up to 1 GHz. Power to the EUT is provided via receptacles mounted to the concrete platform under the center of the turntable. These receptacles are fed from the control building via underground conduits.

Intel Oregon Site EMC Laboratory, Hillsboro, Oregon

10 meter OATS with a 57 by 67 foot ground plane, elevated about 6 inches above grade on one side, with the grade sloping away, resulting in the ground plane being about 30 inches above grade on the other side. The ground screen is 1/4 inch wire mesh, galvanized after weaving hardware cloth. The ground plane around the turntable area, extending beyond the fiberglass reinforced plastic dome is solid sheet metal, welded periodically at the joints. A Hewlett Packard 8566B spectrum analyzer with a Hewlett Packard 85685A pre-selector and a Hewlett Packard 85650A quasi peak adapter is used with EMCO 3110B and 3146 antennas for measurements up to 1 GHz. Power to the EUT is provided via receptacles mounted to the concrete platform under the center of the turntable. These receptacles are fed from the control building via conduits routed under the ground plane platform.

The Intel Oregon Site EMC Laboratory is accredited by A2LA, listed with the FCC (OATS and PLC test stands), registered with the VCCI, NEMKO TBM approved, approved by the New Zealand MOC, accredited by the BSMI and is GOST approved.

Northwest EMC, Newberg, Oregon

10 meter OATS with a 24 by 66 foot ground plane, elevated about 12 inches above grade. The ground screen is 1/4 inch wire mesh, galvanized after weaving hardware cloth. A Hewlett Packard 8568B spectrum analyzer with a Hewlett 85650A quasi peak adapter is used with EMCO 3110B and 3146 antennas for measurements up to 1 GHz. Power to the EUT is provided

via an extension cord routed through the center of the turntable. This cord is fed from the control building via conduits routed under ground.

Northwest EMC is accredited by NIST NVLAP, listed with the FCC, registered with the VCCI, NEMKO approved, approved by the New Zealand MOC, accredited by the BSMI and is GOST approved.

CKC Laboratories, Tillamook, Oregon

30 meter OATS with a 34 by 145 foot ground plane, elevated about 42 inches above grade. The ground screen is 1/4 inch wire mesh, galvanized after weaving hardware cloth. Wire mesh is extended from both sides of the ground plane down to grade at about a 60 degree angle to minimize refraction at the edges of the ground plane. A Hewlett Packard 8568B spectrum analyzer with a Hewlett Packard 85650A quasi peak adapter is used a Chase CBL 6111 antenna for measurements up to 1 GHz. Power to the EUT is provided via receptacles in a metal box on top of the turntable, near the center. These receptacles are fed from a circuit breaker panel mounted under the ground plane.

CKC Laboratories is accredited by A2LA, listed with the FCC, registered with the VCCI, NEMKO approved, approved by the New Zealand MOC, accredited by Austel and DAR.

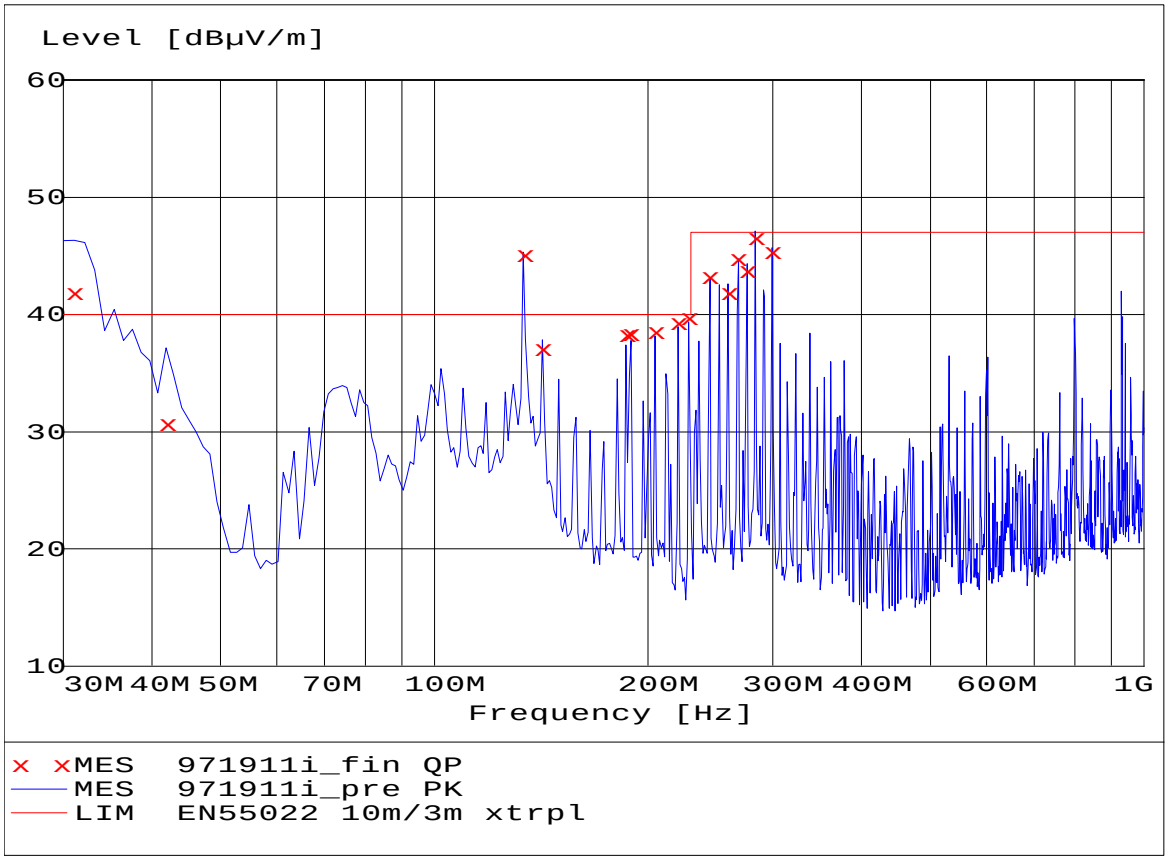
Acme Testing, Acme, Washington

30 meter OATS with a 20 by 50 meter ground plane, at grade. The ground screen is 1/4 inch wire mesh, galvanized after weaving hardware cloth. The ground plane around the turntable area is solid sheet metal, welded periodically at the joints. A Hewlett Packard 8567A spectrum analyzer with a Hewlett Packard 85685A pre-selector and a Hewlett Packard 85650A quasi peak adapter and LN1000A preamplifier is used with EMCO 3110B and 3146 antennas for measurements up to 1 GHz. Power to the EUT is provided via receptacles mounted in the face of the turntable.

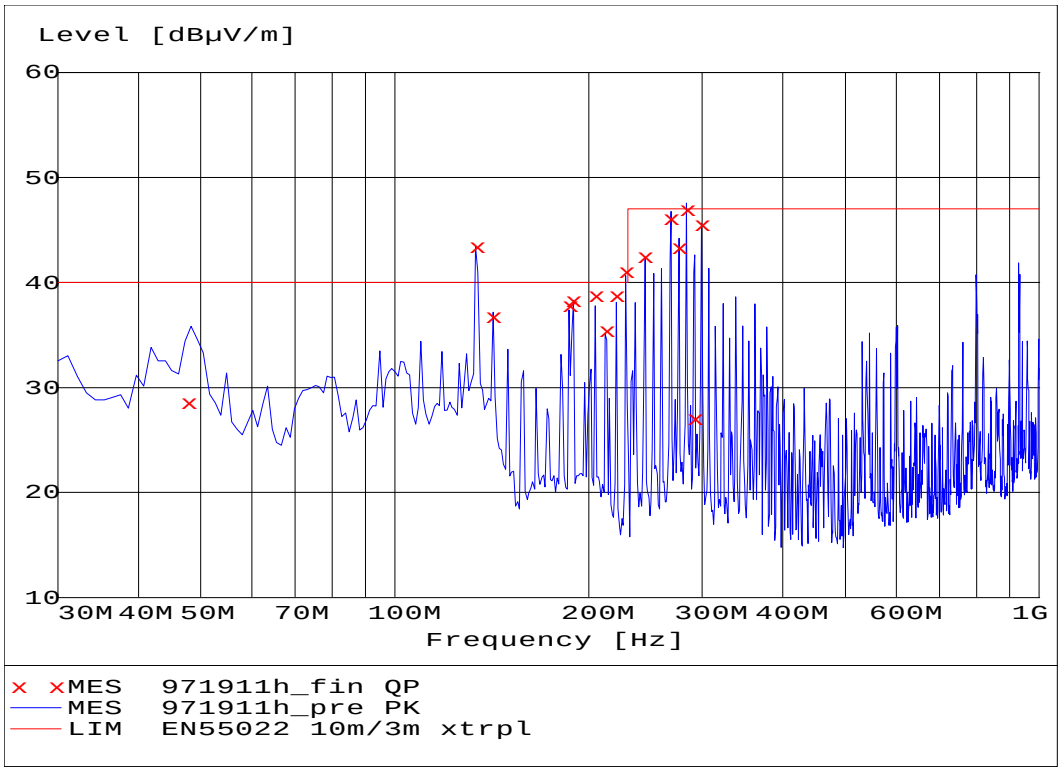
Acme Testing is accredited by A2LA and listed with the FCC.

IV. Test Results

The following graphs show the emissions from the system, with and without ferrite clamps, as measured in the Intel DuPont EMC Laboratory 3 meter RF semi-anechoic chamber. These tests were performed on December 10 to develop the list of frequencies measured at the various OATS facilities. The red Xs show the level and frequency of the final quasi-peak measurements for the top 15 signals for the test. These two lists of 15 frequencies were merged to create the list of 18 frequencies measured at each OATS facility.



System Emissions - No Ferrite Clamps on Power Cords



System Emissions - Ferrite Clamps on Power Cords

The following results were obtained during testing on December 14, 1999 at the Intel DuPont Site EMC Laboratory 10 meter OATS.

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	28.1	14.3	30	-1.9	398	202	Vert
41.90	18.6	10.0	30	-11.4	119	110	Vert
47.70	19.4	8.5	30	-10.6	117	162	Vert
133.50	36.1	10.0	30	6.1	117	141	Vert
141.35	30.6	11.3	30	0.6	117	200	Vert
186.15	25.2	11.6	30	-4.8	364	332	Horz
188.45	30.8	11.7	30	0.8	119	203	Vert
204.15	33.7	12.4	30	3.7	117	196	Vert
212.00	Ambient		30				
219.85	32.7	13.0	30	2.7	119	309	Vert
227.70	31.7	13.3	30	1.7	271	217	Horz
243.40	33.9	13.7	37	-3.1	281	226	Horz
259.10	35.7	14.3	37	-1.3	281	64	Horz
267.00	36.5	14.7	37	-0.5	301	223	Horz
274.80	35.2	15.1	37	-1.8	218	209	Horz
282.65	40.8	15.41	37	3.8	228	211	Horz
290.70	17.8	15.7	37	-19.2	216	220	Horz
298.40	38.2	16.0	37	1.2	218	211	Horz

Intel DuPont Site EMC Lab - No Ferrites on Power Cords

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	23.1	14.3	30	-6.9	115	107	Vert
41.90	19.1	10.0	30	-10.9	117	344	Vert
47.70	17.3	8.5	30	-12.7	118	28	Vert
133.50	36.4	10.0	30	6.4	117	130	Vert
141.35	30.6	11.3	30	0.6	117	215	Vert
186.15	22.3	11.6	30	-7.7	118	66	Vert
188.45	30.6	11.7	30	0.6	117	253	Vert
204.15	32.1	12.4	30	2.1	117	189	Vert
212.00	Ambient		30				
219.85	33.8	13.0	30	3.8	117	298	Vert
227.70	31.5	13.3	30	1.5	332	195	Horz
243.40	32.2	13.7	37	-4.8	364	209	Horz
259.10	33.0	14.3	37	-4.0	323	209	Horz
267.00	37.0	14.7	37	0.0	280	211	Horz
274.80	34.8	15.1	37	-2.2	260	194	Horz
282.65	40.5	15.4	37	3.5	239	217	Horz
290.70	20.8	15.7	37	-16.2	333	203	Horz
298.40	38.4	16.0	37	1.4	208	209	Horz

Intel DuPont Site EMC Lab - Ferrites on Power Cords

The following results were obtained during testing on December 16, 1999 at the Intel Oregon Site EMC Laboratory.

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	31.2	14.2	30	1.2			V
41.90	Ambient		30				
47.70	26.1	10.9	30	-3.9			V
133.50	39.9	13.3	30	9.9			V
141.35	32.8	13.4	30	2.8			V
186.15	24.2	15.5	30	-5.8			H
188.45	32.1	15.6	30	2.1			V
204.15	33.8	12.4	30	3.8			V
212.00	29.7	12.2	30	-0.3			V
219.85	33.2	12.0	30	3.2			V
227.70	33.1	12.2	30	3.1			V
243.40	33.3	12.7	37	-3.7			V
259.10	33.8	13.8	37	-3.2			H
267.00	38.1	14.0	37	1.1			H
274.80	37.1	14.4	37	0.1			H
282.65	43.4	14.9	37	6.4			H
290.70	34.7	15.2	37	-2.3			H
298.40	39.8	15.7	37	2.8			H

Intel Oregon Site EMC Lab - No Ferrites on Power Cords

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	24.1	14.2	30	-5.9			V
41.90			30				
47.70	21.1	10.9	30	-8.9			V
133.50	34.8	13.3	30	4.8			V
141.35	32.7	13.4	30	2.7			V
186.15	24.2	15.5	30	-5.8			H
188.45	30.8	15.6	30	0.8			V
204.15	33.4	12.4	30	3.4			V
212.00	29.9	14.2	30	-0.1			V
219.85	33.7	12.0	30	3.7			V
227.70	33.0	12.2	30	3.0			V
243.40	34.0	12.7	37	-3.0			V
259.10	35.9	13.8	37	-1.1			V
267.00	37.3	14.0	37	0.3			H
274.80	36.2	14.4	37	-0.8			H
282.65	39.8	14.9	37	2.8			H
290.70	33.7	15.2	37	-3.3			H
298.40	39.4	15.7	37	2.4			H

Intel Oregon Site EMC Lab - Ferrites on Power Cords

The following results were obtained during testing on December 17, 1999 at the CKC Laboratories Tillamook EMC Laboratory.

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	24.1	-6.8	30	-5.9			V
41.90	15.2	-13.3	30	-14.8			V
47.70	19.9	-16.6	30	-10.1			V
133.50	36.4	-12.9	30	6.4			V
141.35	28.8	-13.0	30	-1.2			V
186.15	20.4	-14.0	30	-9.6			V
188.45	29.3	-14.6	30	-0.7			H
204.15	29.5	-14.0	30	-0.5			V
212.00	23.6	-13.4	30	-6.4			V
219.85	30.1	-12.6	30	0.1			H
227.70	29.2	-12.0	30	-0.8			H
243.40	33.4	-10.6	37	-3.6			H
259.10	34.1	-10.0	37	-2.9			H
267.00	34.0	-9.9	37	-3.0			H
274.80	39.0	-9.7	37	2.0			H
282.65	33.4	-9.4	37	-3.6			H
290.70	35.4	-9.3	37	-1.6			V
298.40	36.0	-9.2	37	-1.0			H

CKC Laboratories Tillamook EMC Lab - No Ferrites on Power Cords

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	22.7	-6.8	30	-7.3			V
41.90	13.6	-13.1	30	-16.4			V
47.70	11.5	-16.2	30	-18.5			V
133.50	34.1	-12.9	30	4.1			V
141.35	28.3	-12.9	30	-1.7			V
186.15	25.3	-14.8	30	-4.7			H
188.45	28.1	-14.6	30	-1.9			H
204.15	28.2	-14.0	30	-1.8			V
212.00	23.8	-13.4	30	-6.2			V
219.85	31.6	-12.6	30	1.6			V
227.70	29.8	-12.0	30	-0.2			H
243.40	34.3	-10.6	37	-2.7			H
259.10	35.9	-10.0	37	-1.1			H
267.00	32.5	-9.9	37	-4.5			H
274.80	37.8	-9.7	37	0.8			H
282.65	34.7	-9.4	37	-2.3			H
290.70	36.3	-9.3	37	-0.7			H
298.40	36.7	-9.2	37	-0.3			H

CKC Laboratories Tillamook EMC Lab - Ferrites on Power Cords

The following results were obtained during testing on December 20, 1999 at the Northwest EMC Laboratory.

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	Ambient		30				
41.90	Ambient		30				
47.70	Ambient		30				
133.50	37.2	-16.3	30	7.2	1.0	267	V
141.35	31.3	-16.5	30	1.3	1.8	289	V
186.15	Ambient		30				
188.45	32.6	-11.6	30	2.6	1.5	267	V
204.15	34.7	-17.3	30	4.7	1.0	241	V
212.00	30.4	-17.4	30	0.4	4.0	66	H
219.85	32.8	-17.6	30	2.8	1.0	239	V
227.70	33.5	-17.6	30	3.5	3.4	211	V
243.40	34.6	-16.6	37	-2.4	3.0	228	H
259.10	31.3	-15.9	37	-5.7	4.0	159	V
267.00	37.9	-15.5	37	0.9	2.8	253	H
274.80	34.6	-15.1	37	-2.4	3.0	111	H
282.65	38.4	-14.5	37	1.4	4.0	150	V
290.70	28.3	-12.8	37	-8.7	4.0	158	V
298.40	31.9	-13.1	37	-5.1	2.8	193	H

Northwest EMC Lab - No Ferrites on Power Cords

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	Ambient		30				
41.90	Ambient		30				
47.70	Ambient		30				
133.50	37.0	-16.3	30	7.0	1.0	220	V
141.35	31.5	-16.5	30	1.5	1.0	303	V
186.15	Ambient		30				
188.45	33.4	-11.6	30	3.4	1.0	244	V
204.15	34.3	-17.3	30	4.3	1.0	227	V
212.00	29.7	-17.4	30	-0.3	1.0	308	V
219.85	33.7	-17.6	30	3.7	1.0	250	V
227.70	32.4	-17.6	30	2.4	4.0	215	H
243.40	33.9	-16.6	37	-3.1	3.0	24	H
259.10	30.6	-15.9	37	-6.4	1.0	274	V
267.00	36.9	-15.5	37	-0.1	3.0	300	H
274.80	33.3	-15.1	37	-3.7	3.0	195	H
282.65	39.6	-14.5	37	2.6	3	207	H
290.70	28.0	-14.2	37	-9.0	3.6	202	H
298.40	33.3	-13.1	37	-3.7	2.7	202	H

Northwest EMC Lab - Ferrites on Power Cords

The following results were obtained during testing on December 21, 1999 at the Acme Testing EMC Laboratory.

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	Ambient		30				
41.90	14.6	-17.1	30	-15.4		155	V
47.70	20.6	-19.4	30	-9.4		125	V
133.50	34.7	-16.0	30	4.7		105	V
141.35	20.7	-15.7	30	-9.3		175	V
186.15	21.3	-14.1	30	-8.7		90	V
188.45	28.9	-13.9	30	-1.1		245	V
204.15	30.8	-19.0	30	0.8		140	V
212.00	26.5	-19.4	30	-3.5		85	V
219.85	31.7	-19.9	30	1.7		200	V
227.70	32.4	-20.2	30	2.4		145	V
243.40	31.3	-20.0	37	-5.7		150	V
259.10	29.5	-19.1	37	-7.5		160	V
267.00	34.0	-18.5	37	-3.0		160	V
274.80	28.7	-17.8	37	-8.3		350	H
282.65	35.3	-17.3	37	-1.7		140	H
290.70	27.1	-16.7	37	-9.9		140	H
298.50	32.5	-16.2	37	-4.5		120	H

Acme Testing EMC Lab - No Ferrites on Power Cords

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Pol
30.95	Ambient		30				
41.90	14.5	-17.1	30	-15.5		210	V
47.70	13.6	-19.4	30	-16.4		210	V
133.50	34.7	-16.0	30	4.7		210	V
141.35	19.8	-15.7	30	-10.2		190	V
186.15	22.5	-14.1	30	-7.5		95	V
188.45	28.5	-13.9	30	-1.5		250	V
204.15	30.1	-19.0	30	0.1		140	V
212.00	27.1	-19.4	30	-2.9		85	V
219.85	30.8	-19.9	30	0.8		190	V
227.70	30.9	-20.2	30	0.9		150	V
243.40	30.8	-20.0	37	-6.2		160	V
259.10	29.1	-19.1	37	-7.9		165	V
267.00	33.6	-18.5	37	-3.4		155	V
274.80	29.3	-17.8	37	-7.7		170	V
282.65	34.9	-17.3	37	-2.1		185	V
290.70	28.2	-16.7	37	-8.8		155	V
298.40	33.8	-16.2	37	-3.2		100	V

Acme Testing EMC Lab - Ferrites on Power Cords

V. Data Analysis

The first table shows the impact of adding the ferrite clamps to the power cords at each of the laboratories by frequency. As can be seen, most signals from the system assembled for this test are minimally impacted by the addition of ferrite clamps to the power cords. The major impact is to the broad band signals below 50 MHz.

Change by adding ferrite

Frequency MHz	Intel DP	Intel OR	CKC	NW EMC	Acme
30.95	-5.0	-7.1	-1.4		
41.90	0.5		-1.6		-0.1
47.70	-2.1	-5.0	-8.4		-7.0
133.50	0.3	-5.1	-2.3	-0.2	0.0
141.35	0.0	-0.1	-0.5	0.2	-0.9
186.15	-3.0	0.0	4.9		1.2
188.45	-0.2	-1.3	-1.2	0.8	-0.4
204.15	-1.7	-0.4	-1.3	-0.4	-0.7
212.00		0.2	0.2	-0.7	0.6
219.85	1.1	0.5	1.5	0.9	-0.9
227.70	-0.2	-0.1	0.6	-1.1	-1.5
243.40	-1.7	0.7	0.9	-0.7	-0.5
259.10	-2.7	2.1	1.8	-0.7	-0.4
267.00	0.5	-0.8	-1.5	-1.0	-0.4
274.80	-0.4	-0.9	-1.2	-1.3	0.6
282.65	-0.3	-3.6	1.3	1.2	-0.4
290.70	3.0	-1.0	0.9	-0.3	1.1
298.40	0.1	-0.4	0.7	1.4	1.3

Without ferrite clamps installed on the power cords, the following margin to the CISPR 22 Class B limit information was obtained. With a few exceptions, agreement between the laboratories was very good for these emissions from the test sample. The widest spread is generally at frequencies below 50 MHz where this EUT had broad band emissions which changed radically when ferrite clamps were added to the power cords.

Statistics w/o Ferrites

Frequency MHz	Max Margin	Min Margin	Mean Margin	St. Dev. Margin
30.95	-5.9	1.2	-2.2	3.6
41.90	-15.4	-11.4	-13.9	2.2
47.70	-10.6	-3.9	-8.5	3.1
133.50	4.7	9.9	6.9	1.9
141.35	-9.3	2.8	-1.2	4.8
186.15	-9.6	-4.8	-7.2	2.3
188.45	-1.1	2.6	0.7	1.6
204.15	-0.5	4.7	2.5	2.2
212.00	-6.4	0.4	-2.5	3.1
219.85	0.1	3.2	2.1	1.2
227.70	-0.8	3.5	2.0	1.7
243.40	1.3	4.6	3.3	1.2
259.10	-0.5	5.7	2.9	2.5
267.00	4.0	8.1	6.1	2.0
274.80	-1.3	9.0	4.9	3.9
282.65	3.4	13.4	8.3	4.0
290.70	-12.2	5.4	-1.3	7.1
298.40	1.9	9.8	5.7	3.5

As was noted with no ferrite clamps, agreement between the 5 laboratories is fairly good for this test sample. 141.35 MHz has a larger standard deviation and total spread due to readings at one laboratory. Likewise, the high spread and standard deviation at 290.70 MHz is due to one laboratory (a different one than at 141.35 MHz).

Statistics w/ Ferrites

Frequency MHz	Max Margin	Min Margin	Mean Margin	St. Dev. Margin
30.95	-7.3	-5.9	-6.7	0.7
41.90	-16.4	-10.9	-14.3	3.0
47.70	-18.5	-8.9	-14.1	4.2
133.50	4.1	7.0	5.4	1.2
141.35	-10.2	2.7	-1.4	5.2
186.15	-7.7	-4.7	-6.4	1.4
188.45	-1.9	3.4	0.3	2.1
204.15	-1.8	4.3	1.6	2.5
212.00	-6.2	-0.1	-2.4	2.9
219.85	0.8	3.8	2.7	1.4
227.70	-0.2	3.0	1.5	1.3
243.40	0.8	4.3	3.0	1.5
259.10	-0.9	5.9	2.9	3.1
267.00	2.5	7.3	5.5	2.2
274.80	-0.7	7.8	4.3	3.2
282.65	4.7	10.5	7.9	2.8
290.70	-9.2	6.3	-0.6	6.0
298.40	3.3	9.4	6.3	2.7

This table shows the impact of adding ferrite clamps to the power cords in terms of mean margins and standard deviations between labs. With the exception of the broad band signals below 50 MHz, very little change is noted by adding the ferrite clamps to the power cords.

Mean and Standard Deviation w/ and w/o Ferrites

Frequency MHz	Mean Margin w/o Ferrite dB	Mean Margin w/ Ferrite dB	Difference dB	Margin St. Dev. w/o Ferrite dB	Margin St. Dev. w/ Ferrite dB	Difference dB
30.95	-2.2	-6.7	-4.5	3.6	0.7	-2.8
41.90	-13.9	-14.3	-0.4	2.2	3.0	0.8
47.70	-8.5	-14.1	-5.6	3.1	4.2	1.1
133.50	6.9	5.4	-1.5	1.9	1.2	-0.7
141.35	-1.2	-1.4	-0.3	4.8	5.2	0.4
186.15	-7.2	-6.4	0.8	2.3	1.4	-0.9
188.45	0.7	0.3	-0.5	1.6	2.1	0.5
204.15	2.5	1.6	-0.9	2.2	2.5	0.2
212.00	-2.5	-2.4	0.1	3.1	2.9	-0.3
219.85	2.1	2.7	0.6	1.2	1.4	0.2
227.70	2.0	1.5	-0.5	1.7	1.3	-0.4
243.40	3.3	3.0	-0.3	1.2	1.5	0.3
259.10	2.9	2.9	0.0	2.5	3.1	0.6
267.00	6.1	5.5	-0.6	2.0	2.2	0.2
274.80	4.9	4.3	-0.6	3.9	3.2	-0.6
282.65	8.3	7.9	-0.4	4.0	2.8	-1.2
290.70	-1.3	-0.6	0.7	7.1	6.0	-1.1
298.40	5.7	6.3	0.6	3.5	2.7	-0.8

VI. Conclusions

The results show that the ferrite clamps used in the tests (Schaffner CDN 725 EM Clamp and Schaffner INA 726 Isolation Clamp) do have significant impacts on the measured radiated emissions levels. The results show that the addition of ferrite clamps to power cords does not significantly reduce the measurement variation between the 5 laboratories with the single system tested for most of the emissions measured from the system. Broad band emissions below 50 MHz which are most heavily impacted by the addition of the ferrite clamps to the power cords are the only ones which appeared to benefit to any degree. The greatest reduction in standard deviation between having ferrite clamps on the power cords and not having ferrite clamps on the power cords was 2.8 dB. Some standard deviations increased. The vast majority changed by less than 1.0 dB.

This proposal would create a large gap between CISPR 22 and ANSI C63.4 and negate 15 years of efforts to harmonize the test methods in the two standards. The data in this report does not provide a compelling argument to support the creation of this gap.

VII. Recommendations

The results of this study do not support the proposal in CISPR/G/143/CDV.

Further experimentation is required with a number of different system configurations with power and I/O cables leaving the turntable to better evaluate this proposal. With the limited data contained in this report the proposal contained in CISPR/G/143/CDV cannot be supported, nor can it be definitively rejected. Unless and until compelling data can be gathered which shows the benefits of this proposal, the U.S. should cast a NO vote on the resulting FDIS.

VIII. Acknowledgements

The author would like to thank the staff and management of the following laboratories for their prompt scheduling of time for these tests:

Intel Corporation DuPont Site EMC Laboratory, DuPont, Washington
Intel Corporation Oregon Site EMC Laboratory, Hillsboro, Oregon
CKC Laboratories, Tillamook, Oregon
Northwest EMC, Newberg, Oregon
Acme Testing, Acme, Washington

IX. Photographs

The following photographs show the system, with and without the ferrite clamps.

EUT Front View

Rear/Side View w/ Ferrite Clamps on Power Cords

Rear/Side View w/o Ferrite Clamps on Power Cords