



**ENGINEERING TEST REPORT**

**NUMBER: 10216476EICES1**

**ON**

**Model No.(s):**  
BB-BONE-000

**IN ACCORDANCE WITH:**  
**ICES-003, ISSUE 4: 2004**

**TESTED FOR:**  
Circuitco Electronics  
1380 Presidential, Suite 100  
Richardson, Texas 75081

**TESTED BY:**  
Nemko USA, Inc.  
802 N. Kealy  
Lewisville, Texas 75057-3136

**Total Pages 19**



NVLAP Lab Code 100426-0

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**APPROVED BY:** *Art Ruvalcaba*  
Art Ruvalcaba, EMC Engineer

**DATE:** 14-Nov-2011

**TESTED BY:** *Brian Boyea*  
Brian Boyea, EMC Engineer

**DATE:** 2-Nov-2011

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## Section 1. Summary of Test Results

### General:

**All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with ICES-003, Issue 4 February, 2004, Class B, Interference-Causing Equipment Standard, Digital Apparatus in accordance with the measurement method described in: Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22-02 "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment"

Frequencies were initially identified in a semi-anechoic chamber. Amplitude measurements were made in a semi-anechoic chamber. Details of the chamber are on file with the FCC and Industry Canada.

### Abstract:

### Emissions:

Name of Test	Basic Standard	Results
Conducted Emissions (Mains port)	ICES-003, Issue 4 February, 2004	Complies
Radiated Emissions	ICES-003, Issue 4 February, 2004	Complies

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE: **NONE**

## Section 2. Equipment Under Test (E.U.T.)

Manufacturer: Circuitco Electronics  
Name: BeagleBone  
Model Number: BB-BONE-000  
Serial Number: 22  
Part Number: BB-BONE-000  
Production Status: Pre-Production  
E.U.T. Arrival Date: 11/2/11

**Description of E.U.T.:**  
Development Board

### **Clock, Oscillator, Highest Frequencies Utilized:**

25MHz,24MHz,48MHz,100MHz

### **Modifications Incorporated in E.U.T.**

The E.U.T. has not been modified from what is described by the brand name and unique type identification stated above.

### **Justification:**

The E.U.T. was configured for testing as per typical installation. Position and bundling of cables were investigated to establish maximum amplitude of emissions.

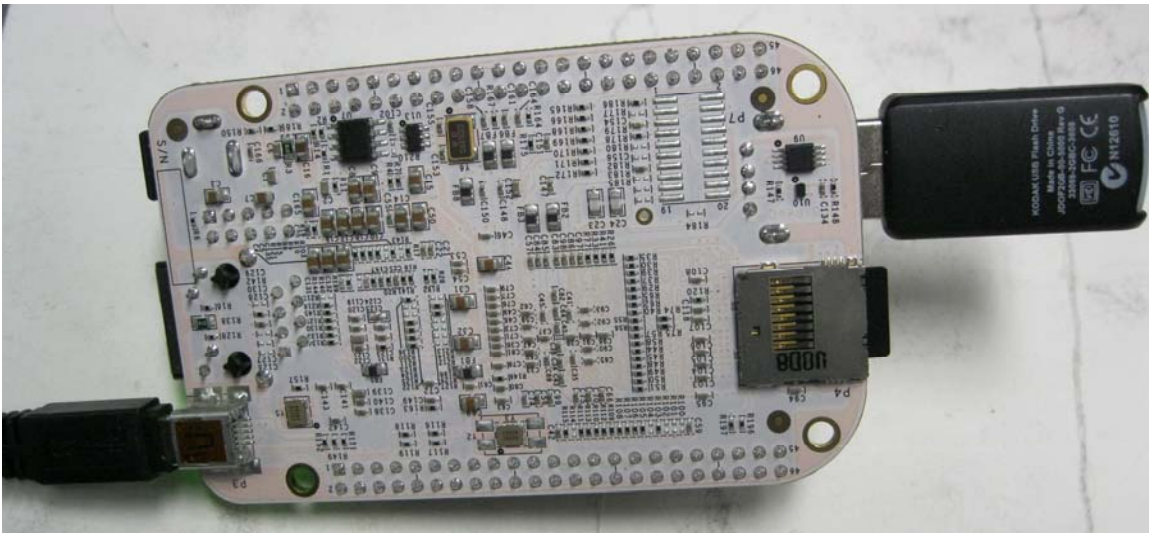
### **Exercise Program:**

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

The EUT was in the following exercise mode:

Powered on running.

**E.U.T. Photographs:**

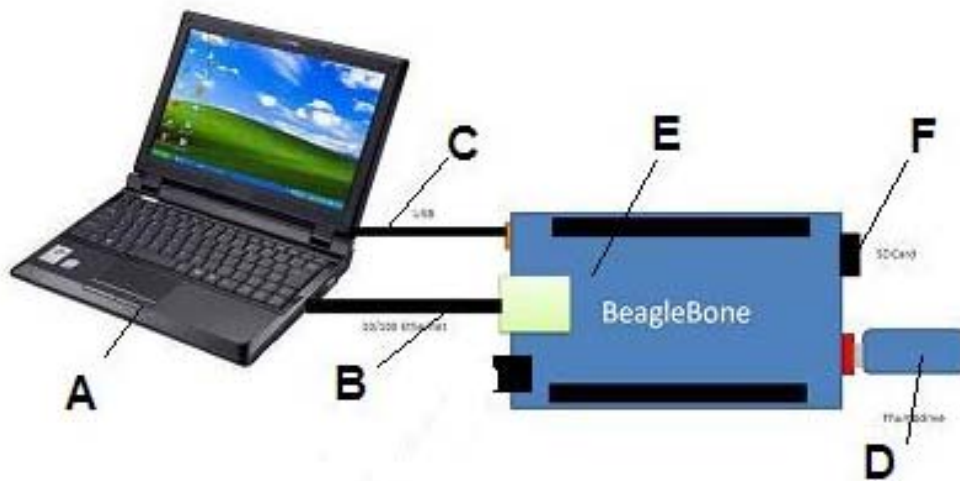


### Section 3. Equipment Configuration

Equipment Configuration List:			
Item	Description	Identification: (M/N #, S/N #, P/N #, Rev.)	
(A)	Laptop	Dell Latitude S/N E6410 15665268 601	
(B)	Ethernet Cable	Fry's	
(C)	USB Cable	Qualtek 3021003-03	
(D)	2GB Thumbdrive	Kodak 2GB	
(E)	EUT	BeagleBone S/N 22 Rev B	
(F)	SD Card	Kingston 2GB	
(G)			
(H)			
(I)			
(J)			

EUT Power and Interfaces:			
Item	Description	Type	Qty
i.			
ii.	USB Cable to the PC	5	1



## Section 4. Conducted Emissions (Mains ports)

### Purpose:

The test is intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for conducted emissions as defined by ICES-003, Issue 4, February 2004, Class B, in accordance with the measurement method described in: Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22-02.

### Specification Limits:

Limits for conducted disturbance at the mains ports

Frequency Range (MHz)	Quasi-peak Limits (dBuV)	Average Limits (dBuV)
0.15 to 0.50	66-56	56-46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

### Method of Measurement (Procedure CISPR 22):

Measurements were made using a spectrum analyzer with 10 kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 9 kHz bandwidth, CISPR Quasi-Peak detector.

### Test Method:

See Section 6.



Test #: CEPV-01  
Tested By: Brian Boyea  
Date of Tests: 11/2/11  
Test Conditions:  
Test Voltage: 120 Vac  
Temperature: 25°C  
Humidity: 45%

**Test Results:**

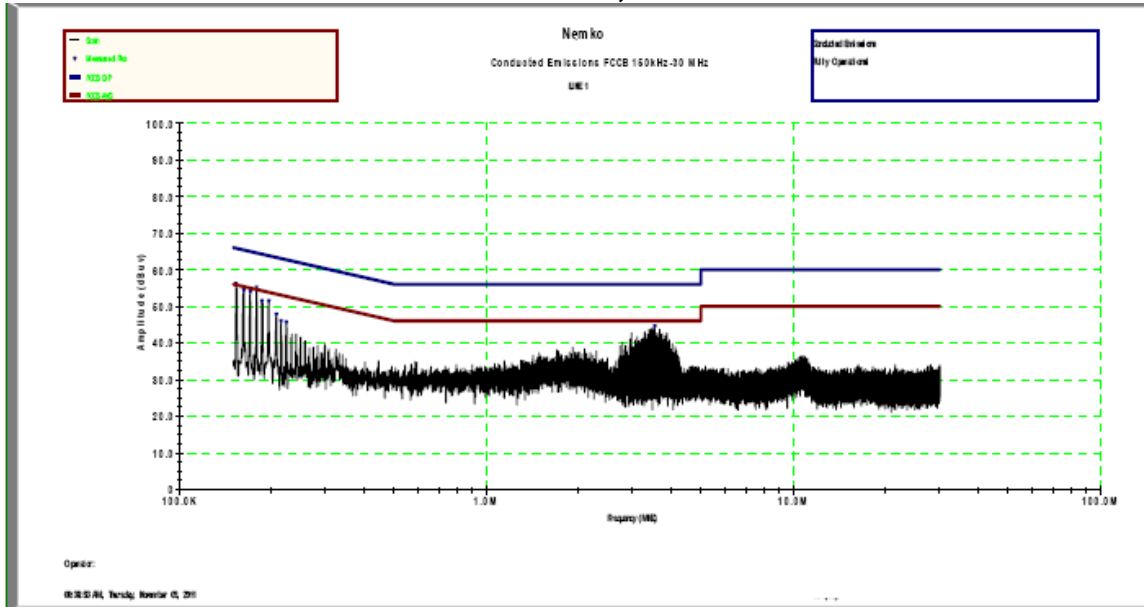
The E.U.T. complies.  
The Conducted Emissions were measured on the power cube of the lab computer

**TEST EQUIPMENT**

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
674	Limiter	Hewlett Packard	11947A	3107A02200	01-Nov-2011	01-Nov-2012
704	Filter, High Pass, 5KHz	Solar Electronics	7930-5.0	933126	01-Nov-2011	01-Nov-2012
749	Cable, 6m	Nemko USA, Inc.	RG223		25-Feb-2011	25-Feb-2012
811	1.5m Cable Assy	Nemko USA, Inc.	RG223		25-Feb-2011	25-Feb-2012
1258	LISN .15mhz-30mhz	EMCO	3825/2	1305	31-Oct-2011	31-Oct-2012
1663	Spectrum Analyzer	Rohde & Schwartz	FSP3	100073	2-Sept-2011	2-Sept-2013



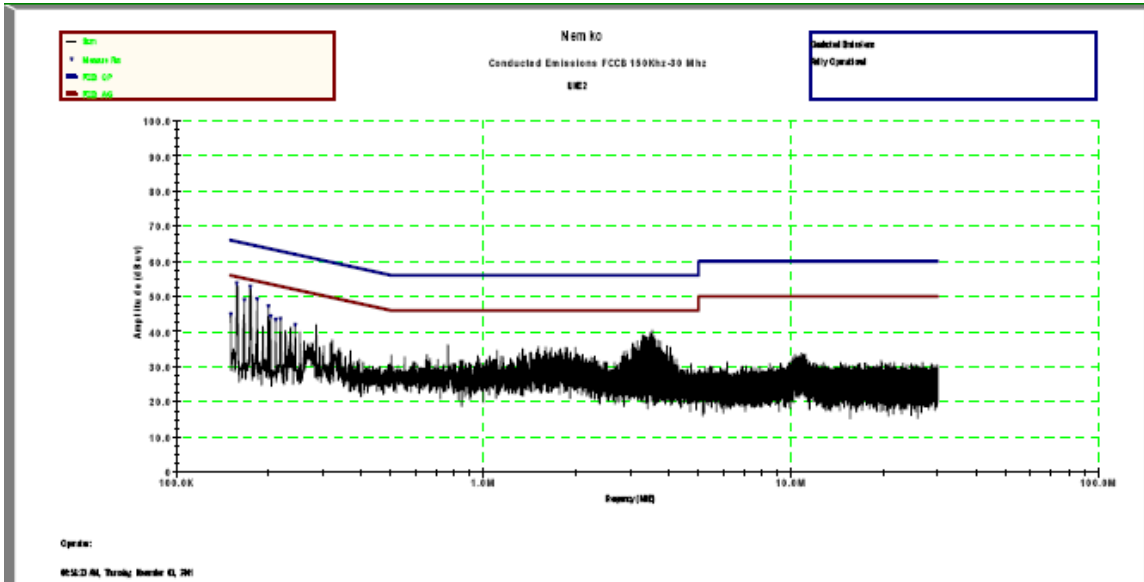
**Test Data –Conducted Emissions, Power Lines Test#CEPV-01**



Nemko  
 Line 1 Final QP/AVG  
 Operator: Brian

Frequency MHz	FCCB QP LIMIT	FCCB AVG LIMIT	AVG Meas	AVG Margin	QP Meas	QP Margin
0.15	65.88	55.88	36.01	-19.87	53.10	-12.78
0.16	65.66	55.66	35.04	-20.63	51.47	-14.19
0.17	65.43	55.43	32.89	-22.54	49.19	-16.24
0.18	65.24	55.24	30.13	-25.11	51.11	-14.13
3.52	56.00	46.00	24.48	-21.52	37.12	-18.88

Line 2



FCC B Conducted Emissions  
 Nemko  
 Line 2 Peaks  
 Operator: Brian

Frequency MHz	Peaks	FCC B AVG Limit	FCC B QP Limit	Avg Margin	QP Margin
0.151	44.96	55.98	65.98	-11.02	-21.02
0.157	53.78	55.79	65.79	-2.01	-12.01
0.167	49.08	55.52	65.52	-6.45	-16.45
0.174	52.81	55.31	65.31	-2.50	-12.50
0.184	49.27	55.04	65.04	-5.77	-15.77
0.200	47.20	54.58	64.58	-7.38	-17.38
0.203	44.32	54.49	64.49	-10.17	-20.17
0.211	43.38	54.26	64.26	-10.88	-20.88
0.218	43.65	54.05	64.05	-10.39	-20.39
0.244	41.92	53.32	63.32	-11.40	-21.40

Conducted Emissions  
 Fully Operational

**Test Photographs - Test #      CEPV-01**



## Section 5. Radiated Emissions

### Purpose:

The test is intended to demonstrate the compliance of the Equipment Under Test (E.U.T.) to the limits for radiated emissions as defined by ICES-003, Issue 4 February, 2004, Class B, in accordance with the measurement method described in: Canadian Standards Association Standard CAN/CSA-CEI/IEC CISPR 22-02.

### Specification Limits:

Limits for radiated disturbance of Class B

Frequency Range (MHz)	3m Limits (dBuV)	10m Limits (dBuV)
30-230	40.0	30.0
230-1000	47.0	37.0

### Test Method:

See Section 6.



**Test #:** REHE-01  
**Tested By:** Brian Boyea  
**Date of Tests:** 11/2/11  
**Test Conditions:**  
**Test Voltage:** 120 Vac  
**Temperature:** 25°C  
**Humidity:** 45%

**Test Results:**

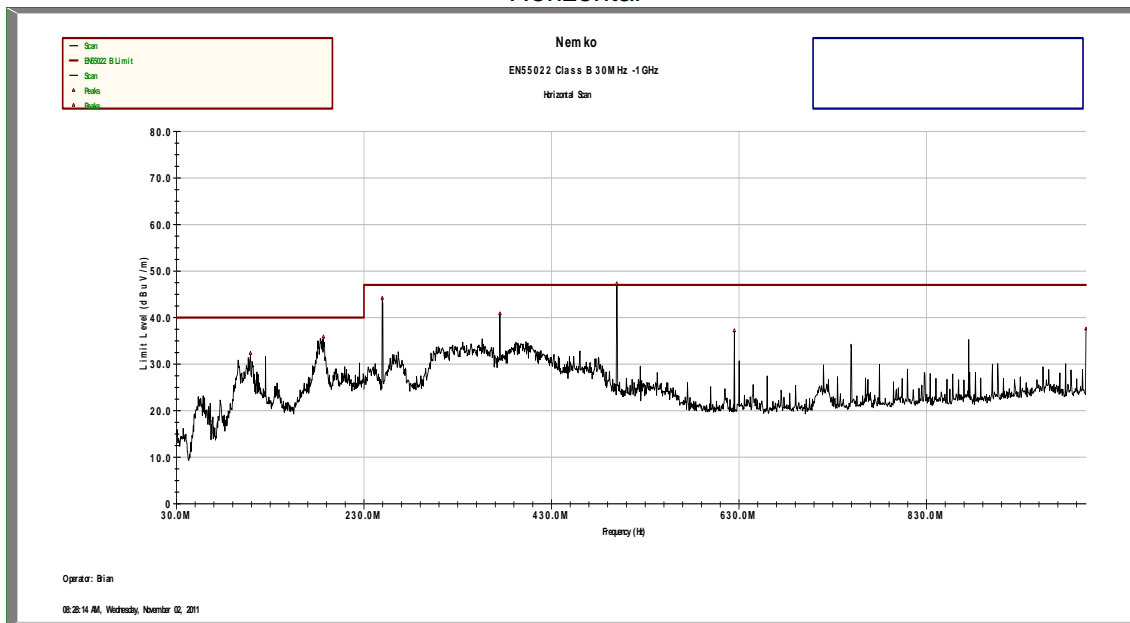
The E.U.T. complies.

**TEST EQUIPMENT**

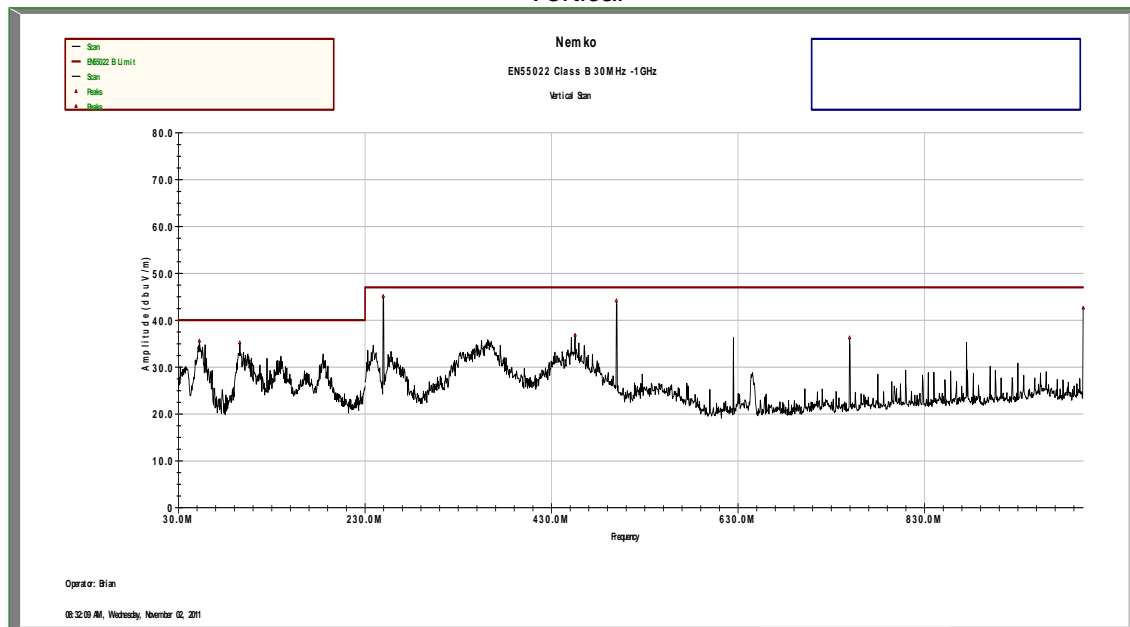
Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
1	3m Semi-Anechoic Chamber	Nemko USA, Inc.	Chamber	1	26-Sept-2011	26-Sept-2012
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	20-July-2011	20-July-2012
1025	Preamplifier, 25dB	Nemko USA, Inc.	LNA25	399	23-Feb-2011	23-Feb-2012
1304	Antenna, Horn	Electro Metrics	RGA-60	6151	24-Nov-2010	24-Nov-2012
1763	Antenna, Bilog	Schaffner	CBL 6111D	22926	11-Feb-2011	11-Feb-2012
1767	Receiver, EMI Test 20Hz - 26.5 GHz - 150 - +30 dBm LCD	Rohde & Schwartz	ESIB26	837491/0002	01-Dec-2010	01-Dec-2011
1783	Cable Assy, 3m Chamber	Nemko	Chamber		26-Sept-2011	26-Sept-2012

### Test Data – Radiated Emissions, Electric Field, Test# REHE-01

#### Horizontal



#### Vertical





Nemko, Lewisville, TX  
FCC 3 Meter Chamber  
Final Quasi Peak Measurements  
Operator: Brian

Frequency MHz	Limit	Horizontal QP	QP Margin	Vertical QP	Vertical Margin
51.94	40.00			29.38	-10.63
95.77	40.00			28.36	-11.64
108.82	40.00	31.05	-8.95		
186.27	40.00	26.21	-13.79		
250.01	47.00	44.81	-2.19	42.72	-4.28
375.03	47.00	36.57	-10.43		
455.75	47.00			28.43	-18.57
499.99	47.00	44.44	-2.56		
500.03	47.00			32.94	-14.06
625.01	47.00	38.47	-8.53		
750.01	47.00			34.36	-12.64
999.98	47.00	43.17	-3.83	41.85	-5.15

30 MHz to 1GHz was the spectrum searched.  
RBW = 120kHz  
VBW = 120kHz

**Test Photos**

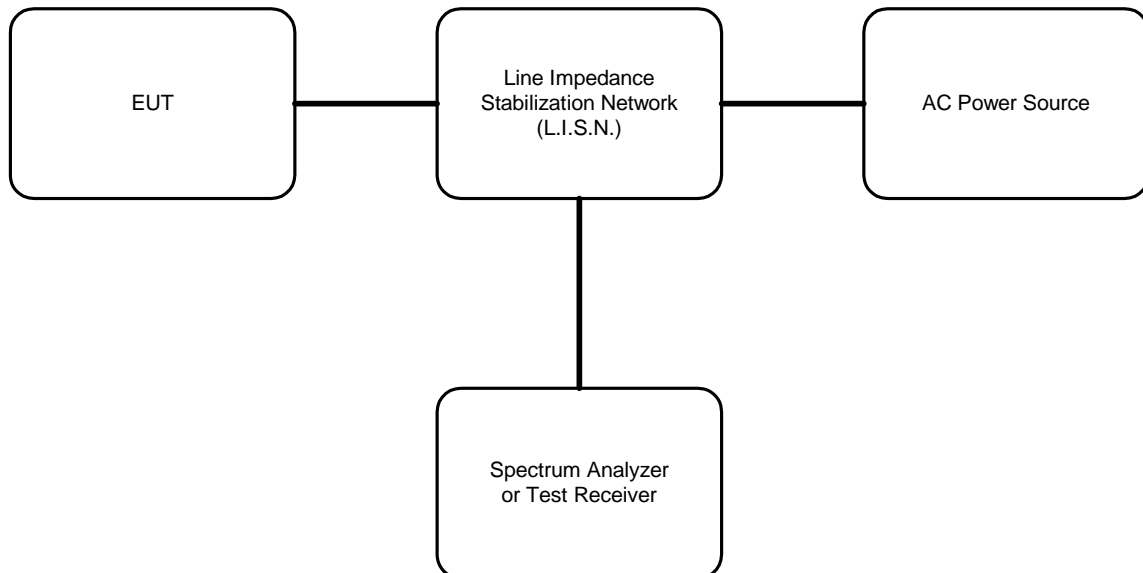




## Section 6 Test Methods and Block Diagrams. Conducted Emissions (Mains Ports)

- Applicable Test Standard: CFR 47, FCC Pt 15, Subpart B
- The test set-up is as per the test configuration diagram.
- The E.U.T. is configured as typically used.
- The E.U.T. and any accessories are operated with typical load conditions.
- Conducted power line measurements are made from 150 kHz to 30 MHz.
- For each current carrying conductor of each power cord associated with the E.U.T., the emission closest to the limit is recorded.
- Initial measurements are made using a spectrum analyzer with 10 kHz RBW, peak detector. If emissions are below the Average limit, the unit is deemed to be compliant.
- Any emissions within 6dB of the quasi peak limit are measured using a test receiver with 9 kHz bandwidth, CISPR quasi-peak detector.
- Bandwidths used on the test receiver are those specified in CISPR 16-1.

### Test Configuration - Power line Conducted Emissions:



## Radiated Emissions

### Test Method:

- Applicable Test Standard: CISPR 22: 2006 for Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
- The test set-up in the semi-anechoic chamber is as per the test configuration diagram.
- The E.U.T. is configured as typically used.  
The equipment was tested for radiated emissions from 30 MHz to 1000 MHz in accordance with the requirements of ICES-003. Equipment with oscillator frequencies above 108 MHz were tested to the fifth harmonic or in accordance with the requirements of CAN/CSA-CEI/IEC CISPR 22-02. Details of the chamber are on file with the FCC and Industry Canada.
- Variations in antenna height, antenna polarization, and E.U.T. azimuth are explored to produce the emission that has the highest amplitude relative to the limit.
- If less than six emissions are better than 20 dB below the limit, the noise level of the measuring instrument at representative frequencies is also reported.

## Test Configuration - Radiated Emissions

### Radiated Pre-scan:

