Amber Helm Development L.C.
92723 Michigan Hwy-152
Sister Lakes, MI 49047

EMC Test Report

#1001342FX
Issued 05/03/2010

Regarding the FCC 15.247 testing of

Gateway Unit

Model Number: 31570002-00
Grantee FCC Registration Number: 0018833475 Grantee Code: X3R
FCC ID: X3R-31570002-00 Equipment Class: K1D

Category: 2.4 GHz Intentional Radiating Transceiver Device

Judgments: FCC Article 15.247, FCC Part 15 Intentional Radiator – Compliant

NVLAP LAB CODE 200129-0

Prepared for:

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Test Date(s): 03/25/10-05/27/10

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Report reviewed by

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Statements concerning this report

NVLAP Accreditation: NVLAP Lab Code 200129-0
The scope of AHD accreditation are the test methods of:

IEC/CISPR 22:	Limits and methods measurement of radio disturbance characteristics of information technology equipment.
FCC Method – 47 CFT Part 15:	Digital Devices.
AS/NZS 3548:	Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment.
IEC61000-4-2 and Amend.1:	Electrostatic Discharge Immunity
IEC61000-4-5:	Surge Immunity

Test Data:
This test report contains data included in the scope of NVLAP accreditation.

Subcontracted Testing:
This report contains data recorded at the University of Michigan Radiation Laboratory. The University of Michigan test facility is located at 8501 Beck Road, Belleville, Michigan 48111. This test facility has been fully described and accepted by the FCC and Industry Canada. This facility was utilized to measure emissions occurring at frequencies greater than 6GHz.

Test Traceability:
The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

Limitations on results:
The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

Limitations on copying:
This report shall not be reproduced, except in full, without the written approval of AHD.

Limitations of the report:
This report shall not be used to claim product endorsement by NVLAP, FCC, or any agency of the US Government.

Statement of Test Results Uncertainty:
Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: +/- 1.4 dB

Retention of Records:
For equipment verified to comply with FCC regulations, the manufacturer is obliged to retain this report with the product records for ten years following the manufacture of the equipment that was tested.

For equipment verified to comply with RSS-210, the manufacturer is obliged to retain this report with the product records for as long as the model is being marketed in Canada.

FCC Required user statements:

Applies to: [Class B Digital Device or Peripheral].

For products satisfying the FCC Part 15 Class B requirements the following are to be satisfied:

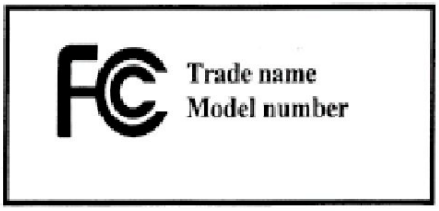
1. The following statement is required to be labeled on the product or, if the device is too small, in the user's manual:

   This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2. A statement is required to be placed in the User's Manual shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
3. The User's Manual shall include this or similar statement:

   NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
   - *Reorient or relocate the receiving antenna.*
   - *Increase the separation between the equipment and receiver.*
   - *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
   - *Consult the dealer or an experienced radio/TV technician for help.*

4. For products certified using the Declaration of Conformity approach,
   a. The FCC conformity LOGO is to be placed on the Class B Digital Device.



   b. The FCC requires a Compliance Information statement (Declaration of Conformity) to accompany each product to the end user.

Summary of Results

1. The device model number 31570002-00 was tested for compliance with FCC Regulations, Part 15, SubPart C.
2. The device uses the same PCB as the device model 31570002 tested on 11/12/09. The only physical difference between this presented 31570002-00 model and the previously tested 31570002 model is that the nonconductive plastic enclosure was changed. For this reason, duty cycle evidence plots are taken from the previously tested 3157002 data, as reported in AHD report 0901300FX issued 2/1/2010. New transmit, receive, and spurious, and conducted emissions data are provided in this report.
3. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for operation in the 2400-2483.5 MHz frequency band, article 15.247, as a frequency hopping system.
4. These tests were performed at AHD EMC Laboratory following the procedures outlined in ANSI C63.4.
5. The test results apply to model 31570002-00.
6. The equipment under test was received on 03/25/10 and this test series commenced on 03/25/10.
7. In 120VAC 60Hz operation, the conducted emission level nearest the limit during normal tx / rx operation occurred at 21 KHz. The signal was measured to be 14.85dB below the Class B Quasi-Peak limit and 20.25 dB below the Class B Average limit when measuring neutral to ground.
8. The spurious radiated emission level nearest the limit during normal tx / rx operation occurred at 90.85 MHz vertically polarized. This signal was measured to be 6.56 dB below the Class B Quasi-peak limit.
9. The radiated fundamental Local Oscillator emission level nearest the limit occurred at 2545 MHz. The signal was measured to be 10.29 dB below the FCC class B average limit.
10. The radiated harmonic Local Oscillator emission level nearest the limit occurred 12725 MHz. This signal was measured to be 8 dB below the FCC class B average limit.
11. All radiated fundamental signals were measured within the FCC 15.247 band limits of 2400 MHz and 2483 MHz.
12. A maximized data rate mode was used to measure transmit power in peak detector mode, therefore a correction factor corresponding to the normal operational duty cycle is required to correlate peak measurements to the limits expressed in terms of average detection. The width of a transmitted packet was measured in the model 31570002 0901300FX AHD report dated 2/10/2010, and recorded as 20.79 mSec. The time period from one packet to the next was measured to be 285.3 mSec. Over the FCC 15.35c specified 100 mSec period, the packet width represents a 20.79% duty cycle, or –13.6 dB correction factor.
13. The fundamental transmission level was measured using radiated emissions measurements. The formula used to convert measured electrical field strength to conducted power was EIRP = ((D^2*E^2)/30G. The distance used in the measurement was 3 Meters (D=3) and

the antenna gain factor used in calculations was one (G=1). While the manufacturer specified antenna gain is specified at 2.15dB, a gain factor of one is used in the calculations to ensure worst case calculations.

14. The radiated fundamental transmit emission level nearest the limit occurred at 2474.42 MHz. The field strength level of the fundamental was observed to be 123.61 mW below the average limit of 125mW. The EUT was positioned on the FLAT orientation and the receive antenna oriented in the Horizontal polarization.
15. The radiated second harmonic transmit emission level nearest the limit occurred at 4884.18 MHz. The field strength level was observed to be 4.17 dB below the average limit of 54dBuV/m (500uV/m). The EUT was positioned on the SIDE orientation and the receive antenna oriented in the Horizontal polarization.
16. The radiated upper level harmonic transmit emission level nearest the limit occurred at 24735 MHz. The field strength level was observed to be 10.98 dB below the average limit of 54 dBuV/m (500uV/m).
17. Radiated band edge measurements nearest the limit occurred at 2483.61 MHz. The average field strength level was observed to be 28.20 dB below the average limit of 54 dBuV/m.
18. As a frequency hopping device, the system operates on 26 channels, with one channel left blank. This meets the minimum 15 channel requirement of 15.247.a.1
19. As a frequency hopping device, the system operates with each channel occupying a 645 KHz 20 dB bandwidth, and each channel separated by 2.525 MHz. The carrier separation is 1.88 MHz wider than the 20dB bandwidth, satisfying the 15.247.a.1 requirement for channel separation.
20. The algorithm used for selecting hopping frequencies is pseudo random in nature, using the base channel as an algorithmic “seed” frequency. The algorithm ensures equal distribution among available channels during operation.
21. The time occupied per any channel in any 10.4 second cycle (0.4 seconds*26 channels) is by design at most 31.18 mSec, satisfying the maximum 15.247.a.iii limit of 400 mSec on any channel per cycle.
22. The antenna used in the system is integrated on the system PCB, and has a specified maximum gain of 2.15dB.
23. In frequency hopping mode, the peak in band 100KHz BW signal strength is 100.88 dBuV or 15.65 dBm EIRP. The 100 KHz band edge signals are more than 20dB below the peak, satisfying the 15.247.d requirements.
24. Under normal operating conditions, the general public is not exposed to this device. However, even under conditions of exposure to this device at a distance of 2.5 cm, the expected exposure is .018 mw/cm^2, or 0.982mw/cm^2 under the FCC 1.1310 general population limit of 1 mw/cm^2.
25. With regard to SAR evaluation, the worst case EIRP of 1.39 mW is 23.1 mW below the FCC KDB 447948 recommended SAR evaluation limit of 24.5 mW at 2.45 GHz.

Changes Made to Achieve Compliance:

1. Transmit level reduced to a setting of “P –1”

EUT Descriptions

Model: Gateway

Model number: 31570002

Serial/ID No: 3409K001757

Antenna: 2.15 dB gain, Integrated on PCB

PCB: 33070004D

Description:

This device is a frequency hopping radio controlled Solar Array Management System Gateway. The device utilizes 25 frequency hopping channels, with each channel separated by 10 of the possible 256 channels. The exact subset of 25 hopping channels utilized depends on the initial channel selected during initialization. The frequency usage, channel selection, and hopping algorithms are described in Exhibit B.

Specifications:

Input Power: USB

Outputs Signals: USB, 2.4 GHz

Input Signals: USB, 2.4 GHz Receive

Channel Frequencies:

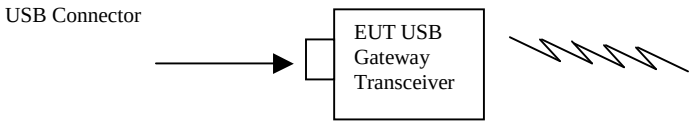
Ch	Freq, MHz
0	2410.000
1	2410.253
2	2410.505
3	2410.758
4	2411.011
5	2411.263
6	2411.516
7	2411.769
8	2412.021
9	2412.274
10	2412.527
11	2412.780
12	2413.032
13	2413.285
14	2413.538
15	2413.790
16	2414.043
17	2414.296
18	2414.548
19	2414.801
20	2415.054
21	2415.306
22	2415.559
23	2415.812
24	2416.064
25	2416.317
26	2416.570
27	2416.823
28	2417.075
29	2417.328
30	2417.581
31	2417.833
32	2418.086
33	2418.339
34	2418.591
35	2418.844
36	2419.097
37	2419.349
38	2419.602
39	2419.855
40	2420.107
41	2420.360
42	2420.613
43	2420.865
44	2421.118
45	2421.371
46	2421.624
47	2421.876

Example: Ch 0 Hopping freq:

0	2410.000
10	2412.527
20	2415.054
30	2417.581
40	2420.107
50	2422.634
60	2425.161
70	2427.688
80	2430.215
90	2432.742
100	2435.269
110	2437.795
120	2440.322
130	2442.849
140	2445.376
150	2447.903
160	2450.430
170	2452.957
180	2455.483
190	2458.010
200	2460.537
210	2463.064
220	2465.591
230	2468.118
240	2470.645

Ch	Freq	Ch	Freq	Ch	Freq	Ch	Freq	Ch	Freq
48	2422.129	97	2434.510	146	2446.892	195	2459.274	244	2471.655
49	2422.382	98	2434.763	147	2447.145	196	2459.526	245	2471.908
50	2422.634	99	2435.016	148	2447.397	197	2459.779	246	2472.161
51	2422.887	100	2435.269	149	2447.650	198	2460.032	247	2472.413
52	2423.140	101	2435.521	150	2447.903	199	2460.284	248	2472.666
53	2423.392	102	2435.774	151	2448.156	200	2460.537	249	2472.919
54	2423.645	103	2436.027	152	2448.408	201	2460.790	250	2473.171
55	2423.898	104	2436.279	153	2448.661	202	2461.042	251	2473.424
56	2424.150	105	2436.532	154	2448.914	203	2461.295	252	2473.677
57	2424.403	106	2436.785	155	2449.166	204	2461.548	253	2473.929
58	2424.656	107	2437.037	156	2449.419	205	2461.801	254	2474.182
59	2424.908	108	2437.290	157	2449.672	206	2462.053	255	2474.435
60	2425.161	109	2437.543	158	2449.924	207	2462.306		
61	2425.414	110	2437.795	159	2450.177	208	2462.559		
62	2425.667	111	2438.048	160	2450.430	209	2462.811		
63	2425.919	112	2438.301	161	2450.682	210	2463.064		
64	2426.172	113	2438.553	162	2450.935	211	2463.317		
65	2426.425	114	2438.806	163	2451.188	212	2463.569		
66	2426.677	115	2439.059	164	2451.440	213	2463.822		
67	2426.930	116	2439.312	165	2451.693	214	2464.075		
68	2427.183	117	2439.564	166	2451.946	215	2464.327		
69	2427.435	118	2439.817	167	2452.198	216	2464.580		
70	2427.688	119	2440.070	168	2452.451	217	2464.833		
71	2427.941	120	2440.322	169	2452.704	218	2465.085		
72	2428.193	121	2440.575	170	2452.957	219	2465.338		
73	2428.446	122	2440.828	171	2453.209	220	2465.591		
74	2428.699	123	2441.080	172	2453.462	221	2465.844		
75	2428.951	124	2441.333	173	2453.715	222	2466.096		
76	2429.204	125	2441.586	174	2453.967	223	2466.349		
77	2429.457	126	2441.838	175	2454.220	224	2466.602		
78	2429.709	127	2442.091	176	2454.473	225	2466.854		
79	2429.962	128	2442.344	177	2454.725	226	2467.107		
80	2430.215	129	2442.596	178	2454.978	227	2467.360		
81	2430.468	130	2442.849	179	2455.231	228	2467.612		
82	2430.720	131	2443.102	180	2455.483	229	2467.865		
83	2430.973	132	2443.354	181	2455.736	230	2468.118		
84	2431.226	133	2443.607	182	2455.989	231	2468.370		
85	2431.478	134	2443.860	183	2456.241	232	2468.623		
86	2431.731	135	2444.113	184	2456.494	233	2468.876		
87	2431.984	136	2444.365	185	2456.747	234	2469.128		
88	2432.236	137	2444.618	186	2457.000	235	2469.381		
89	2432.489	138	2444.871	187	2457.252	236	2469.634		
90	2432.742	139	2445.123	188	2457.505	237	2469.886		
91	2432.994	140	2445.376	189	2457.758	238	2470.139		
92	2433.247	141	2445.629	190	2458.010	239	2470.392		
93	2433.500	142	2445.881	191	2458.263	240	2470.645		
94	2433.752	143	2446.134	192	2458.516	241	2470.897		
95	2434.005	144	2446.387	193	2458.768	242	2471.150		
96	2434.258	145	2446.639	194	2459.021	243	2471.403		

EUT Block Diagram:



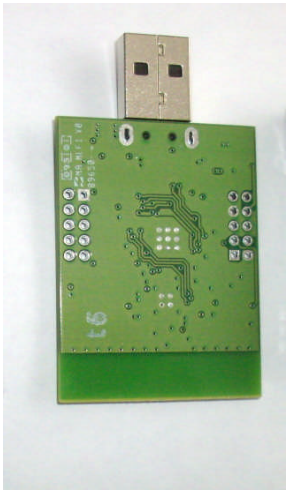
EUT Pictures

Exterior Front View

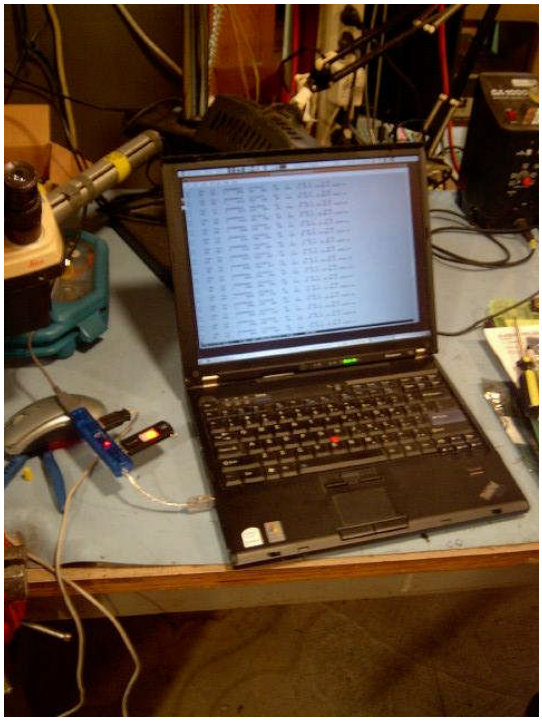
Exterior Rear View

Interior PCB Top View

Interior PCB Bottom View



Gateway Control Application View

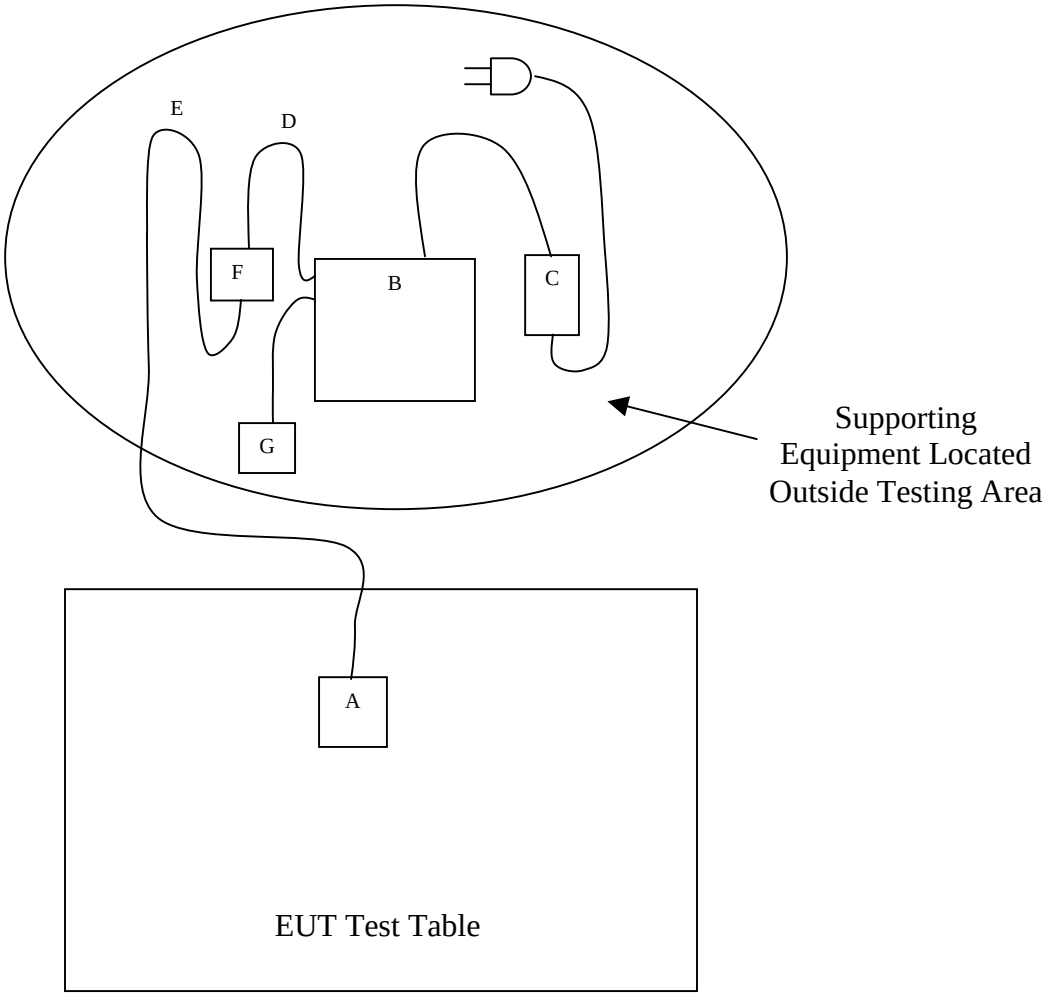


Equipment Test Setup:

Support Equipment & Cabling

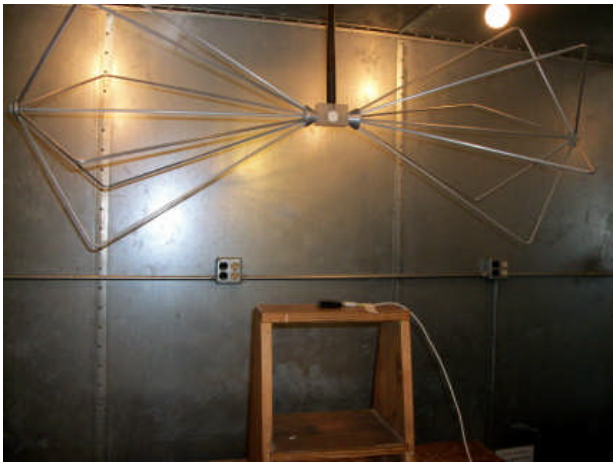
Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	EUT Gateway Transceiver	31570002-00	3409K001757	2.4 GHz TRANSCEIVER
B	Application Controlling Laptop	IBM T43	1871-FUI	1 Meter Shielded
C	Laptop Power Supply	IBM 08k8208		
D	USB Cable			1 Meter
E	USB Cable			3 Meter
F	USB 4 port Hub	Belkin FSU304	CZ81178284	
G	USB Mouse			

Block Diagram



Setup Pictures

Spurious Radiated Prescreen Setup



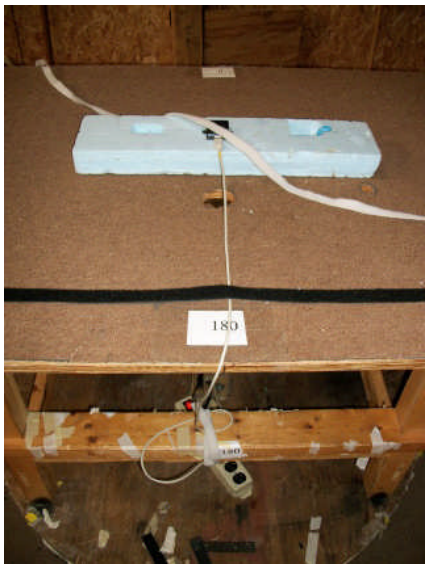
Conducted Setup Front View

Conducted Setup Rear View

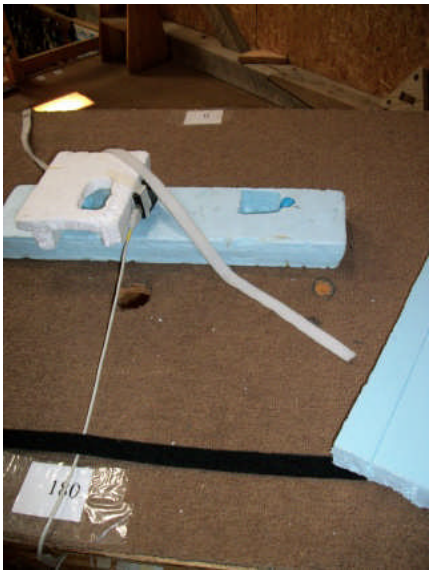
Spurious and Rx Radiated Setup Front View

Spurious and Rx Radiated Setup Rear View

Transmit Setup Flat Orientation



Transmit Setup End Orientation



Transmit Setup Side Orientation

Measurement Report

Standards Applied to Test

ANSI C63.4 – 2003
CFR47 FCC Part 15, SubPart B, Class B limits
AHD test procedures TP0101-01, TP0102-01

Equipment Configuration

For the testing, the placement of the EUT and the support equipment was selected to –

- Be a representation of a configuration typical of user installation, and
- Comply with the minimum system configuration of ANSI C63.4.

Test Methodology

Line Conducted:

Detailed Line Conducted test methodology is located in Appendix A.

The cable losses of the coax used in line conducted testing are charted in this appendix.

Radiated:

Spurious, transmit, and receive radiated testing was performed at a 3 meter open field test site, and completed according to the procedures in FCC 15, SubPart B with supporting instructions from ANSI C63.4. Please reference Appendix A for further details on Test Methodology.

A scan of the EUT was made in a shielded room to study the emission profile of this EUT. This scan indicated low level spurious emissions from the unit.

The suspect spurious signals recorded in the shielded room prescan for each module were then measured at the 3-meter open area test site. Spurious radiated emissions were measured in normal operating tx/rx mode.

For transmit signal strength measurement, the EUT was configured to operate in a maximized packet rate mode and measurements were taken at the mid-range fundamental and second harmonic frequencies (2442, 4884 MHz) in two polarizations (horizontal, vertical) and three orientations (flat, side, and end.) This was done to determine the EUT orientation that maximized emissions.

Once positioned in the maximized orientation, the EUT was tested at the low (2410 MHz), mid range (2442 MHz), and high (2474 MHz) operating frequencies within the EUT's operating range.

Because the EUT has an integrated antenna, measurements were converted from electrical field strength (dBuV/m) to EIRP (watts and dBm) using the formula P = (ED)^2/30.

Because maximized packet rate mode was utilized to test the device, zero span (time scale) measurements were taken to determine PWM duty cycle attenuation over a 100 mSec period. Based on these findings, the maximized data rate mode (peak) measurements were then compensated –13.6 dB to provide average transmit signal strength for comparison to FCC limits.

Upper level harmonics were measured to10 harmonics (24 GHz) over the total range of operating frequencies. Worst case signal conditions were recorded at harmonics of the low, mid, and high operating range frequencies.

For receive operation, the EUT was exercised at the low (2410 MHz), medium (2442 MHz), and high (2474 MHz) frequencies within the EUT's operating range, as well as 5 harmonics (12 GHz) of those frequencies. Signals that were below ambient noise levels were evaluated at a closer (1 Meter) distance to the EUT and scaled at 20dB/decade for comparison to 3 meter FCC limits. Worst case signal conditions were recorded.

Tx and Rx Harmonics over 6 GHz were measured at the U of M test Site (see Appendix.)

In addition, a variety of 15.247 specific band edge measurements were taken, in both frequency hopping and digital modulation modes.

The EUT under test was placed per ANSI C63.4

The EUT was exercised as follows:

1. Device was powered via external power supply
2. The device was activated via Gateway Transceiver Control Application
3. Receive Operation was evidenced by Local Oscillator signal
4. Transmit Operation was evidenced by Transmit Signal

The pictures, in the preceding pages, show the position of the equipment and cabling that produced the maximum signal level.

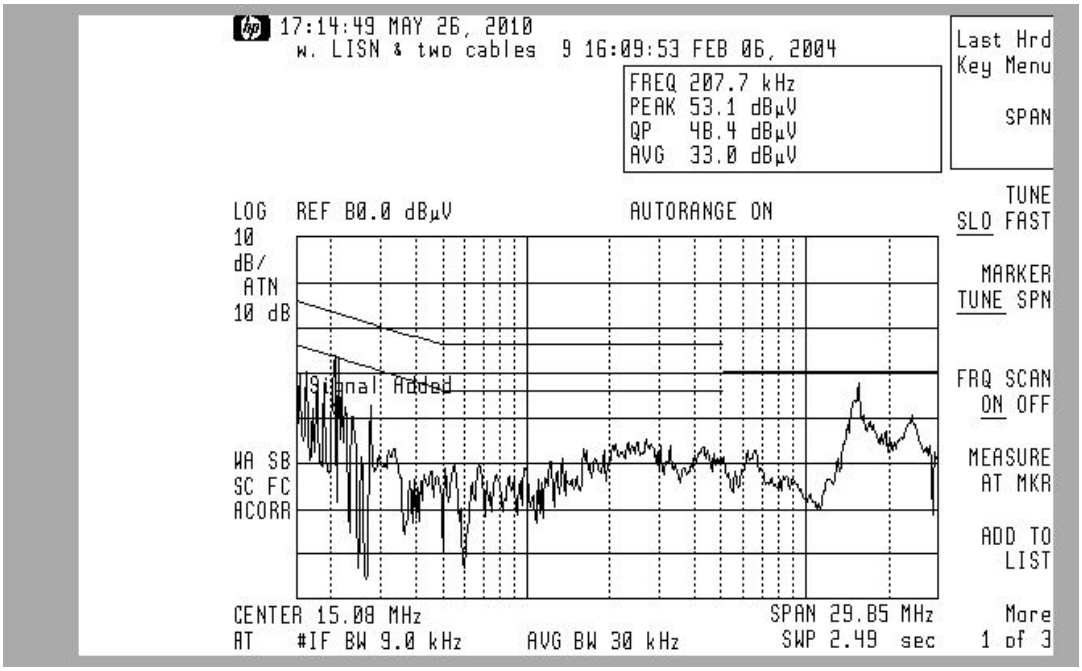
Variance from Test Procedure:

None

Test Data

Line Conducted:

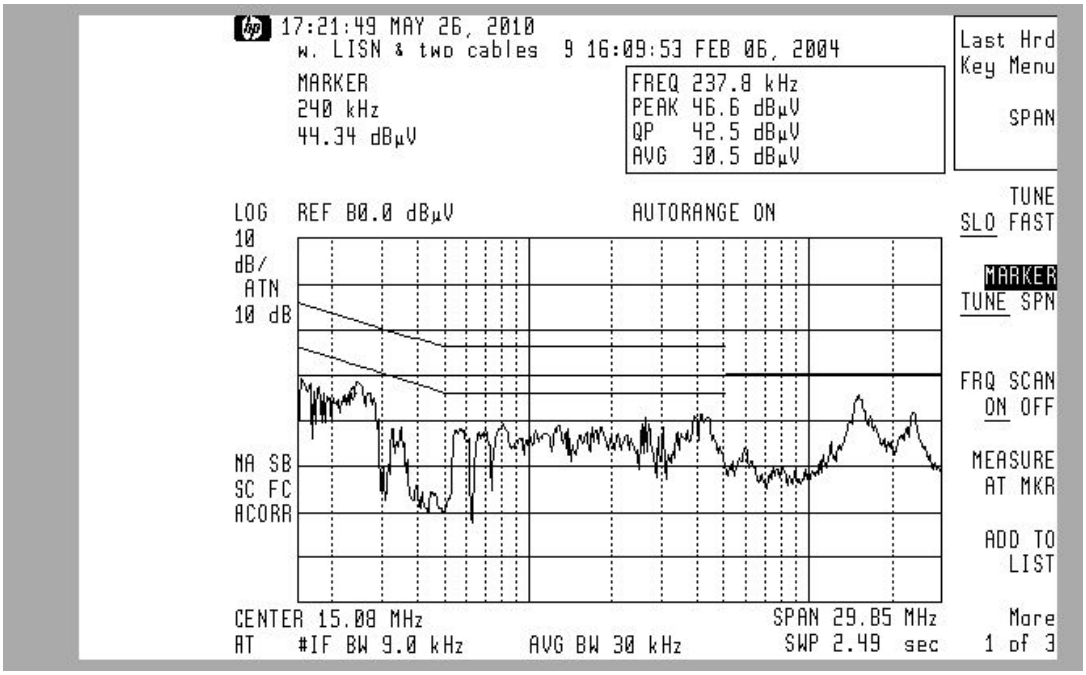
NEUTRAL to Ground Measurement.
Class B Plot of Peak Values



NEUTRAL to Ground Conducted
Class B Tabulated Measurements

Frequency	dBuV Reading		FCC / EN55022 dBuV Class B Limit		dB Margin	
MHz	QP	Avg	QP	Avg	QP	Avg
0.21	**48.44**	**33.04**	63.29	53.29	14.85	20.25
0.17	**43.00**	**23.29**	65.00	55.00	22.00	31.71
0.32	**29.00**	**22.25**	59.67	49.67	30.67	27.42
1.70	**30.00**	**23.00**	56.00	46.00	26.00	23.00
2.70	**31.00**	**23.00**	56.00	46.00	25.00	23.00
14.00	**37.00**	**28.00**	60.00	50.00	23.00	22.00

PHASE to Ground Measurement.
Class B Plot of Peak Values

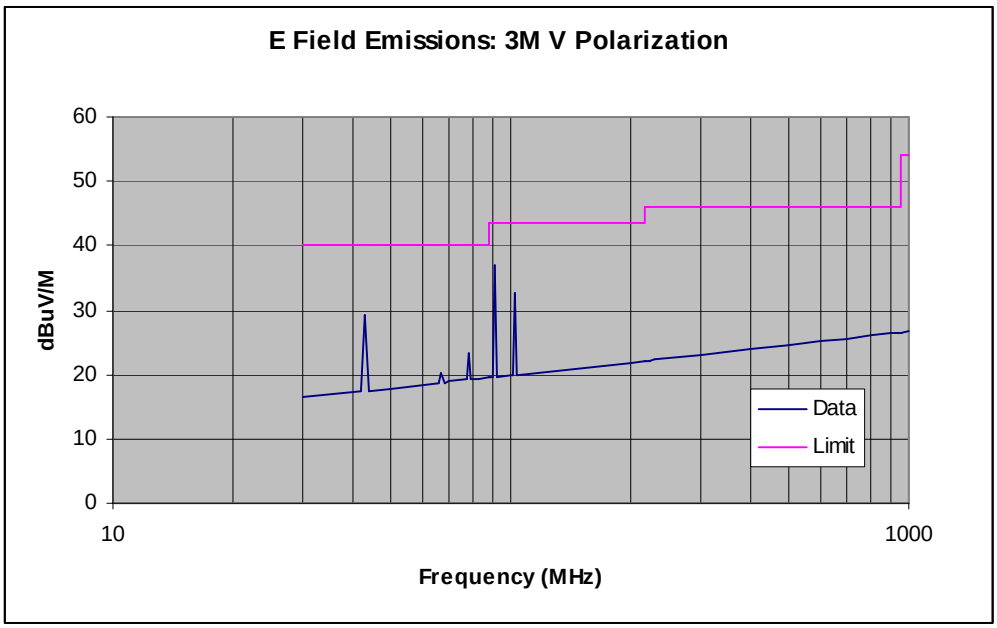


PHASE to Ground Conducted
Class B Tabulated Measurements

Frequency	dBuV Reading		FCC / EN55022 dBuV Class B Limit		dB Margin	
MHz	QP	Avg	QP	Avg	QP	Avg
0.20	**46.00**	**33.00**	63.61	53.61	17.61	20.61
0.28	**42.50**	**30.50**	60.82	50.82	18.32	20.32
0.14	**41.00**	**15.00**	66.57	56.57	25.57	41.57
0.53	**35.00**	**20.00**	56.00	46.00	21.00	26.00
0.80	**34.00**	**29.00**	56.00	46.00	22.00	17.00
15.00	**40.00**	**30.00**	60.00	50.00	20.00	20.00

Radiated Spurious Emissions

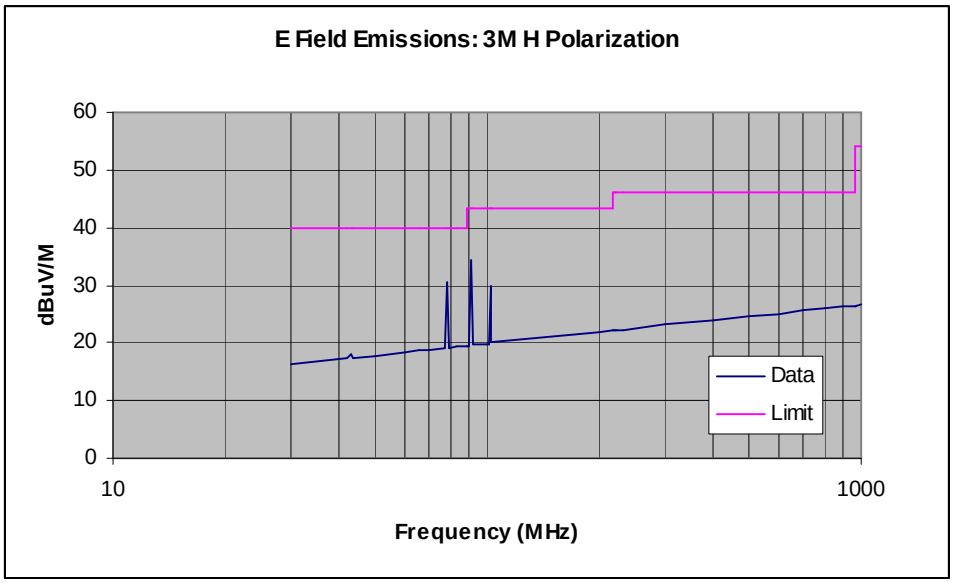
Vertically Polarized 3 Meter
Class B Graph of Spurious Quasi-Peak Measurements



Class B Tabulated Spurious Quasi-Peak Measurements

Frequency	Corrected Quasipeak Measurement	Turntable Azimuth	Antenna Height	FCC Class B Limit	Margin
MHz	dBuV/m	deg	Mtr	dBuV/m	dBuV/m
43.09	**29.19**	**220**	**1.0**	**40.00**	**10.81**
67.00	**20.10**	**0**	**1.0**	**40.00**	**19.90**
78.40	**23.18**	**0**	**1.0**	**40.00**	**16.82**
90.85	**36.94**	**0**	**1.0**	**43.50**	**6.56**
102.24	**32.68**	**0**	**1.0**	**43.50**	**10.82**
221.09	**14.45**	**0**	**1.0**	**46.00**	**31.55**

Horizontally Polarized
Class B Graph of Spurious Quasi-Peak Measurements



Class B Tabulated Quasi-Peak Measurements

Frequency	Corrected Quasipeak Measurement	Turntable Azimuth	Antenna Height	FCC Class B Limit	Margin
MHz	dBuV/m	deg	Mtr	dBuV/m	dBuV/m
43.10	**17.98**	**0**	**2.0**	**40.00**	**22.02**
67.02	**17.54**	**0**	**2.0**	**40.00**	**22.46**
78.16	**30.51**	**260**	**2.0**	**40.00**	**9.49**
91.12	**34.44**	**260**	**2.0**	**43.50**	**9.06**
102.63	**29.86**	**260**	**2.0**	**43.50**	**13.64**
221.12	**12.46**	**260**	**2.0**	**46.00**	**33.54**

Radiated Receive Local Oscillator Emissions

Class B Tabulated Average Measurements

Frequency	Corrected Average Measurement	Turntable Azimuth	Antenna Height	FCC Class B Limit	Margin Class B
MHz	dBuV/m	deg	Mtr	dBuV/m	dBuV/m
2470.00	**43.14**	**-**	**1.00**	**54.00**	**10.86**
2510.00	**42.54**	**-**	**1.00**	**54.00**	**11.46**
2545.00	**43.71**	**-**	**1.00**	**54.00**	**10.29**
5090.00	**33.87**	**-**	**1.00**	**54.00**	**20.13**
7635.00	**39.37**	**-**	**1.00**	**54.00**	**14.63**
10180.00	**39.32**	**-**	**1.00**	**54.00**	**14.68**
12725.00	**46.00**	**-**	**1.00**	**54.00**	**8.00**

note: Measurements at all frequencies represent noise floor measurement, no actual signals were detected

Radiated Transmit Emissions

Fundamental Worst Case Tabulated Measurements

Frequency	Corrected Peak Measurement	EUT orientation	Compensated Average Measurement	V/m	EIRP	Turntable Azimuth	Antenna Height	FCC 15.247 limit	Margin
MHz	dBuV/m		dBuV/m	V/m	mW	deg	Mtr	mW	mW
2409.85	**108.00**	**h-flat**	**94.40**	**0.05**	**0.83**	**160**	**1.1**	**125.0**	**124.17**
2442.14	**109.36**	**h-flat**	**95.76**	**0.06**	**1.13**	**60**	**1.8**	**125.0**	**123.87**
2474.42	**110.25**	**h-flat**	**96.65**	**0.07**	**1.39**	**270**	**1.4**	**125.0**	**123.61**

Second Harmonic Worst Case Tabulated Measurements

Frequency	Corrected Peak Measurement	EUT orientation	Compensated Average Measurement	Turntable Azimuth	Antenna Height	FCC limit	Margin Class B
MHz	dBuV/m		dBuV/m	deg	Mtr	dBuV/m	dBuV/m
4819.88	**61.46**	**h-flat**	**47.86**	**60**	**1.5**	**54.0**	**6.14**
4884.18	**63.43**	**h-side**	**49.83**	**160**	**1.4**	**54.0**	**4.17**
4948.74	**61.64**	**h-flat**	**48.04**	**140**	**1.5**	**54.0**	**5.96**

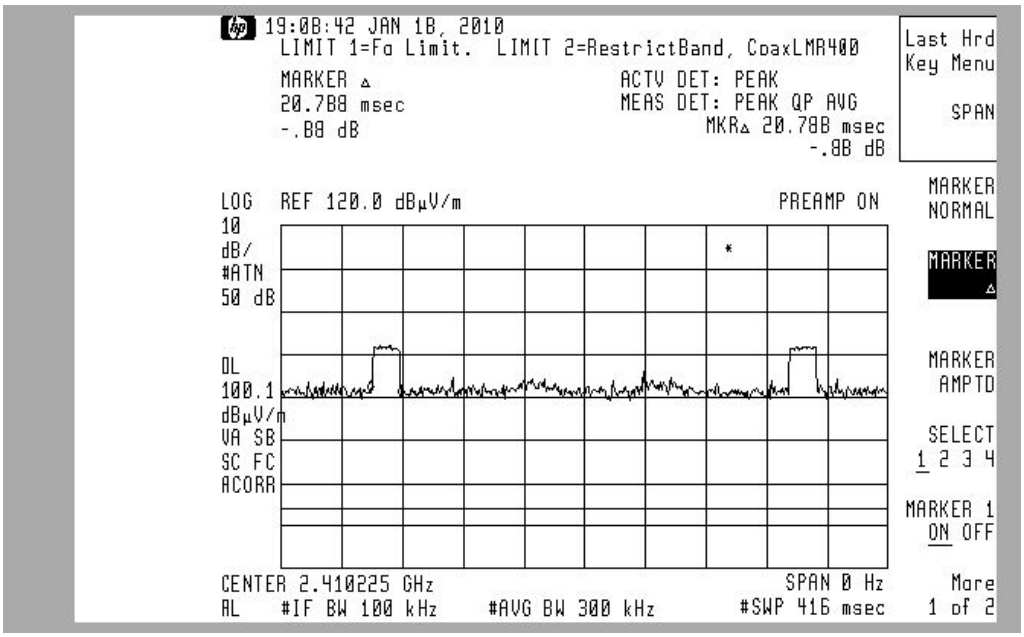
Upper Harmonic Worst Case
Tabulated Measurement

Frequency	Corrected Peak Measurement	Compensated Average Measurement	Turntable Azimuth	Antenna Height	Average FCC limit	Margin Class B
MHz	dBuV/m	dBuV/m	deg	Mtr	dBuV/m	dBuV/m
7230.00	**52.34**	**38.74**	**-**	**1.00**	**54.00**	**15.26**
7327.50	**51.52**	**37.92**	**-**	**1.00**	**54.00**	**16.08**
7420.50	**52.99**	**39.39**	**-**	**1.00**	**54.00**	**14.61**
9640.00	**50.42**	**36.82**	**-**	**1.00**	**54.00**	**17.18**
9770.00	**54.89**	**41.29**	**-**	**1.00**	**54.00**	**12.71**
9894.00	**55.96**	**42.36**	**-**	**1.00**	**54.00**	**11.64**
12050.00	**47.16**	**33.56**	**-**	**1.00**	**54.00**	**20.44**
12212.50	**44.48**	**30.88**	**-**	**1.00**	**54.00**	**23.12**
12367.50	**45.33**	**31.73**	**-**	**1.00**	**54.00**	**22.27**
14460.00	**54.78**	**41.18**	**-**	**1.00**	**54.00**	**12.82**
14655.00	**53.70**	**40.10**	**-**	**1.00**	**54.00**	**13.90**
14841.00	**53.01**	**39.41**	**-**	**1.00**	**54.00**	**14.59**
16870.00	**46.95**	**33.35**	**-**	**1.00**	**54.00**	**20.65**
17097.50	**45.70**	**32.10**	**-**	**1.00**	**54.00**	**21.90**
17314.50	**48.63**	**35.03**	**-**	**1.00**	**54.00**	**18.97**
19280.00	**47.83**	**34.23**	**-**	**1.00**	**54.00**	**19.77**
19540.00	**50.48**	**36.88**	**-**	**1.00**	**54.00**	**17.12**
19788.00	**51.32**	**37.72**	**-**	**1.00**	**54.00**	**16.28**
21690.00	**52.20**	**38.60**	**-**	**1.00**	**54.00**	**15.40**
21982.50	**52.95**	**39.35**	**-**	**1.00**	**54.00**	**14.65**
22261.50	**55.11**	**41.51**	**-**	**1.00**	**54.00**	**12.49**
24100.00	**53.59**	**39.99**	**-**	**1.00**	**54.00**	**14.01**
24425.00	**55.35**	**41.75**	**-**	**1.00**	**54.00**	**12.25**
24735.00	**56.62**	**43.02**	**-**	**1.00**	**54.00**	**10.98**

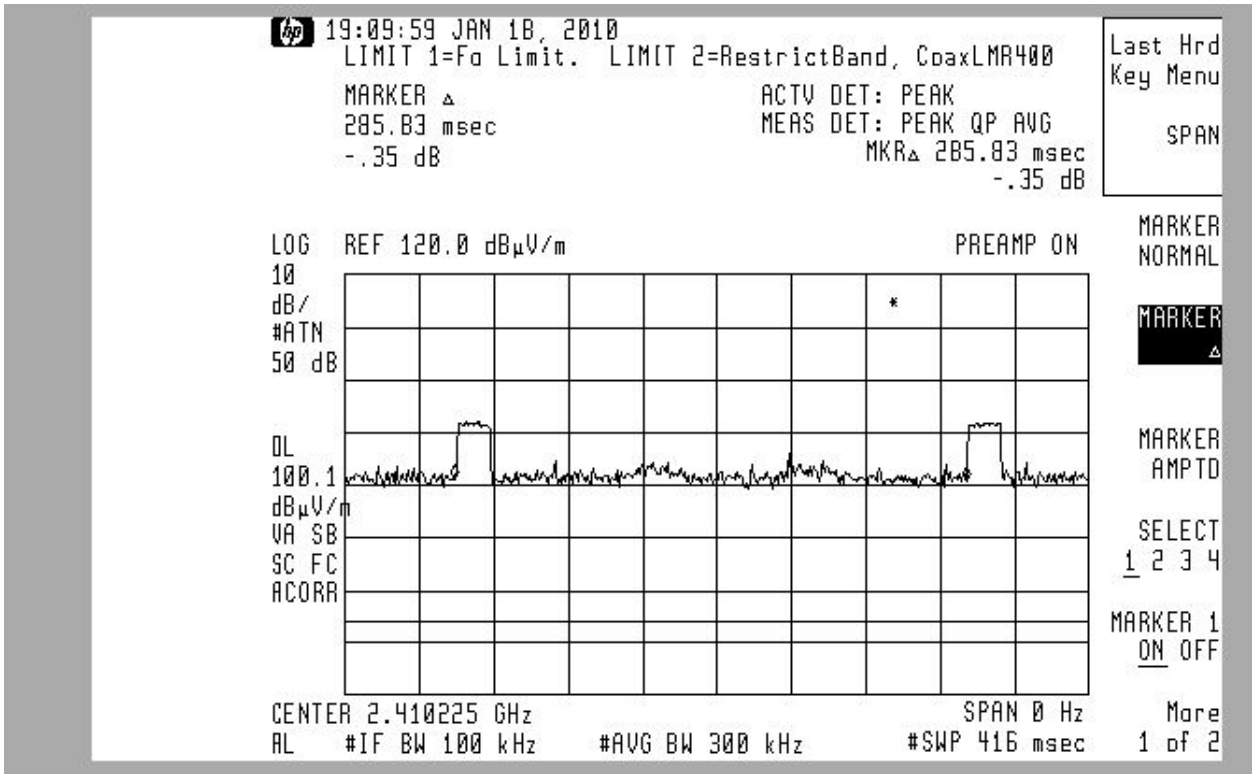
Band Edge
Tabulated Measurement

Frequency	Average Measurement	EUT orientation	Turntable Azimuth	Antenna Height	Average FCC Class B limit	Margin Class B
MHz	dBuV/m		deg	Mtr	dBuV/m	dBuV/m
2400.00	**12.80**	**h-flat**	**0.00**	**2.20**	**54.00**	**41.20**
2483.61	**25.80**	**h-flat**	**30.00**	**2.10**	**54.00**	**28.20**

Transmit Duty Cycle Pulse Width Plot

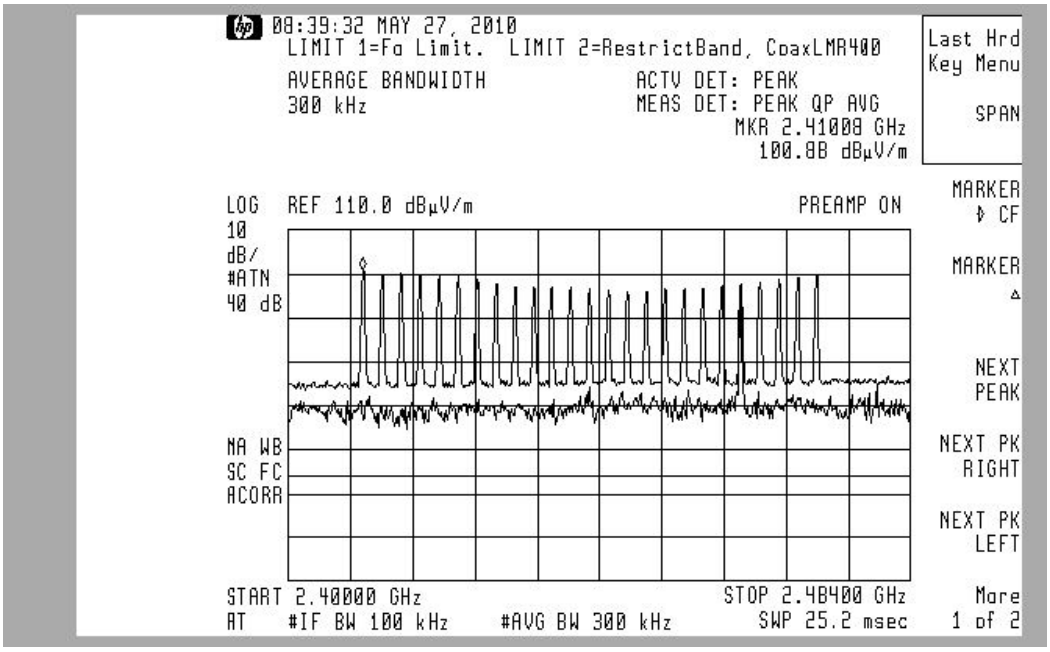


Transmit Duty Cycle Period Plot

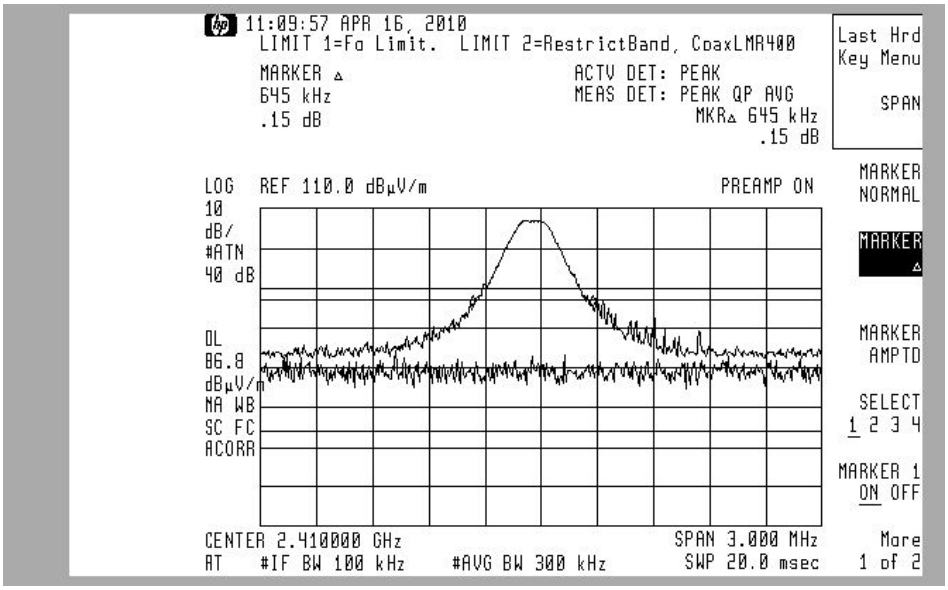


15.247 Specific Transmit Emissions, Hopping Frequency Mode

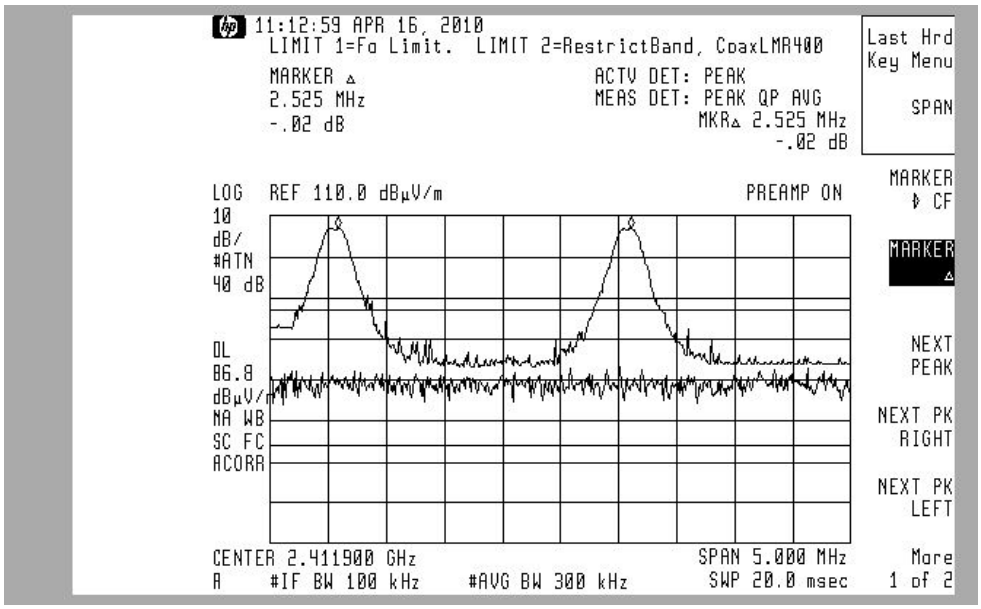
25 Channel Plot



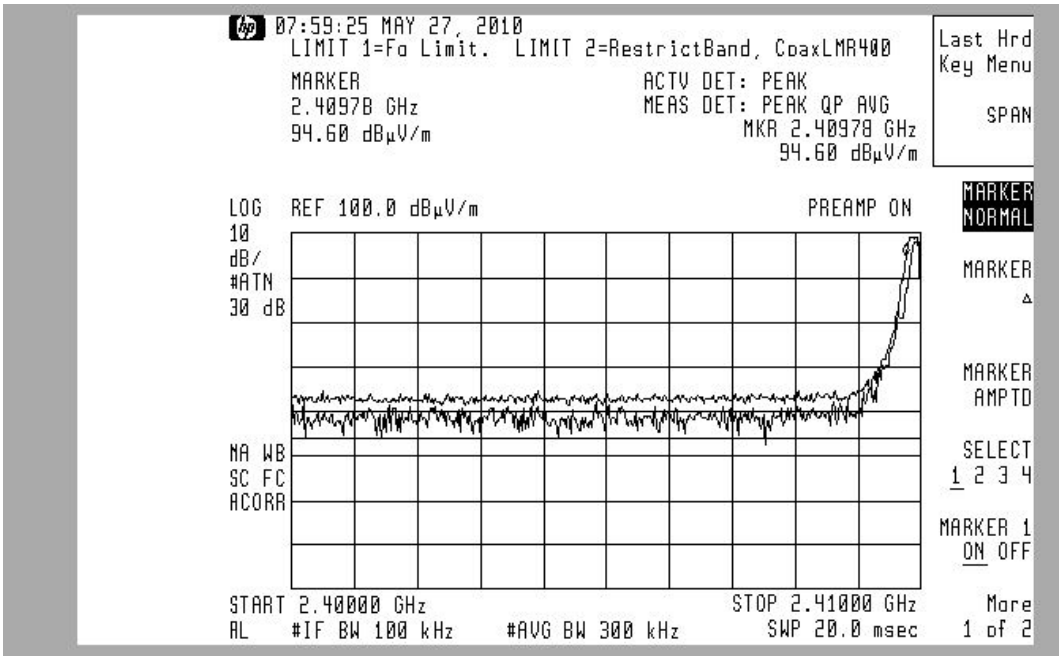
20 dB Bandwidth Plot



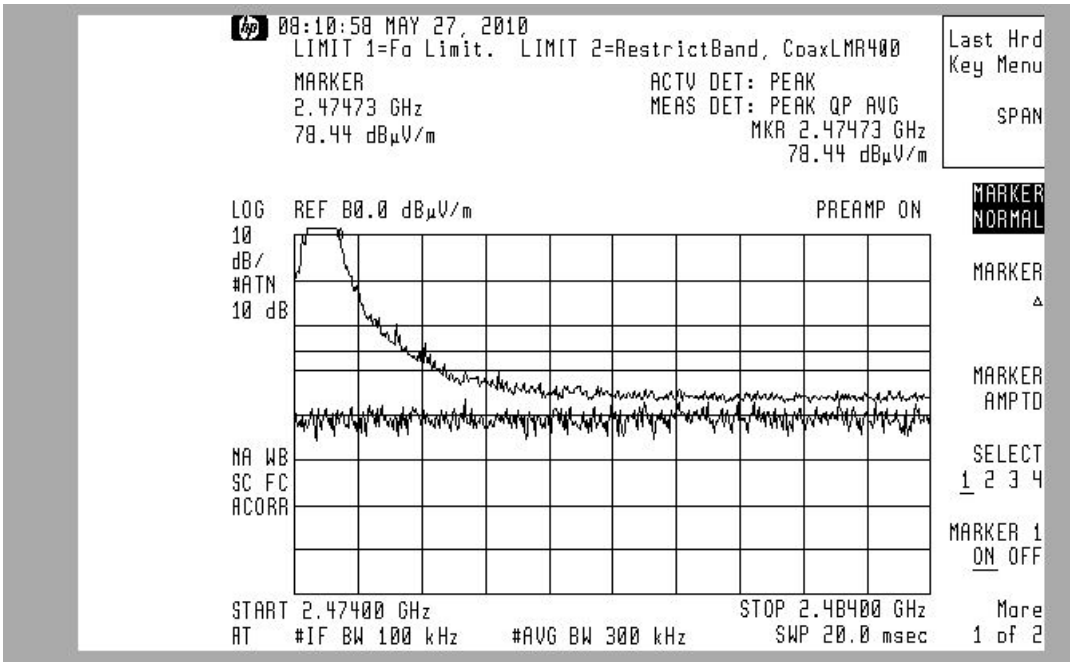
Carrier Separation



100kHz BW Low End Max



100kHz BW High End Max



Tabulated 15.247 Frequency Hopping Data

15.247 Reference	Spec Data	Units	Spec	Data	Margin
	Operating Mode		Frequency Hopper / Digital Modulation	Frequency Hopper	NA
a.1	Min # of channels		15	26	11
a.1	Channel Carrier Frequencies		2400-2483	2410-2475	NA
a.1	channel 20 dB BW	MHz	None	0.645	NA
a.1	Min Carrier separation	MHz	0.645	2.525	1.88
a.1	hopping algorithm		Pseudo Random, equal distribution		
a.1.iii	max time occupied per channel	msec	400	31.18	368.82
b.1	max power (eirp)	mw	125	1.39	123.61
b.4	max antenna gain		6	2.15	3.85
d	measured in band 100 KHz BW signal	dBuV	None	100.88	NA
d	measured in band "skirt" 100KHz BW signal	dBuV	80.88	78.44	2.44
d	max in band 100 KHz BW Power	dBm	None	5.65	NA
d	max in band "skirt" 100KHz BW Power	dBm	-14.35	-16.79	2.44

RF Exposure Calculation:

Tabulated RF Exposure Calculations

FCC Spec Reference	Spec Data	Units	Spec	Data	Margin
KDB 447948 D01	min SAR Evaluation Limit = 60/2.45GHz	mW	24.490	1.390	23.100
15.203	Fixed Antenna	NA	Antenna unchangeable by end user	Integrated PCB Antenna	
1.1310	Max Occupational Exposure (assuming distance of 2.5cm) using formula EIRP/(4*(pi)*(d^2))	mW/cm^2	5.000	0.018	4.982
1.1310	General Population Exposure (assuming distance of 2.5cm) using formula EIRP/(4*(pi)*(d^2))	mW/cm^2	1.000	0.018	0.982

Measurement Facilities & Equipment

Test Site

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 Michigan Hwy152, Sister Lakes, 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC (No.90413) and Industry Canada (file:IC3161).

Measurement Equipment Used

Equipment	Model	S/N	Last Cal Date	Calibration Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	25 July-09	12 months
RF Receiver Section	HP-85462A	3625A00342	25 July-09	12 months
EMCO BiconiLog Antenna	3142	1069	27-July-09	12 months
Solar LISN	8012-50-R-24-BNC	962137	3-Aug-09	12 months
Solar LISN	8012-50-R-24-BNC	962138	23-July-09	12 months
(LCI) Double shielded 50ohm Coax	RG58/U	920809	10-Mar-10	12 months
(3-m) LMR-400 Ultra Flex	LMR400	C090804	18-May-10	6 months
(3-m) CS-3227 RG8	CS-3227	C060914	18-May-10	6 months
(10-m) Amelco 50ohm Coax	RG213U	9903-10ab	18-May-10	6 months
Double Ridged Horn	ONO91202-2	A00329	27-July-09	12 months
Schaffner ESD	NSG432	01027	04-Feb-10	12 months

Test Site 2

The University of Michigan test facility is located at 8501 Beck Road, Belleville, Michigan 48111. This test facility has been fully described and accepted by the FCC and Industry Canada.
This facility was utilized to measure emissions occurring at frequencies greater than 6GHz.

Measurement Equipment Used

Equipment	Model	S/N	Last Cal Date	Calibration Interval
C-Band Std. Gain Horn	UM NRL design		calibration by design & physical inspection.	
XN-Band Std. Gain Horn	UM NRL design		calibration by design & physical inspection.	
X-Band Std. Gain Horn	SA 12-8.2	730	calibration by design & physical inspection.	
Avantek RF amplifier	AFT-12665		28-July-09	12 months
3ft Low Loss coax	RG142	-	with Avantek amp	
Spectrum Analyzer	HP 8593E	3412A01131	2-June-09	12 months

Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 72 deg F, the relative humidity 40 %.

APPENDIX A

Measurement Procedures

Line Conducted

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm from the ground floor and 40cm from the vertical conducting plane in the prescribed setup per ANSI C63.4. This table is housed in a shielded enclosure to prevent the detection of unwanted ambients.

The EUT, or host unit if applicable, was connected to the LISN being monitored by the EMI Receiver. The remaining support devices requiring mains power were connected to a second LISN.

The EUT was continuously exercised by methods supplied by the manufacturer.

While monitoring the display of the EMI Receiver, via remote video monitor, the cables were manipulated to determine a position that maximized the emissions being observed. Once the highest amplitude relative to the limit was determined for the Phase current carrying line the procedure was repeated for the Neutral current carrying line.

The configuration that created an emission closest to the limit was used during the course of taking final measurements. Pictures of this final configuration are recorded in this report.

The principal settings of the EMI Receiver for line conducted testing include:

Bandwidth = 9KHz

Detector Function: scanning and signal search = Peak Detection Mode
measurements = Quasi Peak Detection and Average Detection

The cable losses of the coax used in line conducted testing are charted in this appendix.

Radiated

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm from the open field site ground plane in the prescribed setup per ANSI C63.4, Figure 9(c).

The table sits upon a remote controlled turntable. The receiving antenna, located at the appropriate standards distance of 3 or 10 meters from the table center, is also remote controlled.

The EUT was continuously exercised by software supplied by the manufacturer.

Preliminary tests were done at the 3 meter open field test site. The final tests are done at the appropriate standards distance of 3 or 10 meters. The "Biconical/Log Periodic" broadband antenna connected to an EMI Receiver, meeting CISPR 16, is used throughout the testing.

During the preliminary scans and while monitoring the display of the EMI Receiver, the turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions. At the significant emissions, the cables were manipulated to determine a position that maximized the emissions being observed. Once the cable position was determined that presented the highest amplitude relative to the limit for Vertical polarized emissions the procedure was repeated for the Horizontal polarization.

The configuration that created an emission closest to the limit was used during the course of taking final measurements. Pictures of this final configuration are recorded in this report.
The principal settings of the EMI Receiver for radiated testing include:

Bandwidth:	120kHz
Detector Function:	scanning and signal search = Peak Mode
	measurements = Quasi Peak Mode.
Search Range:	30MHz to 1000MHz or to 2GHz as appropriate

The cable loss of the coax used in radiated scanning is charted in this appendix.
The antenna factors, for the test distance used, are charted in this appendix.

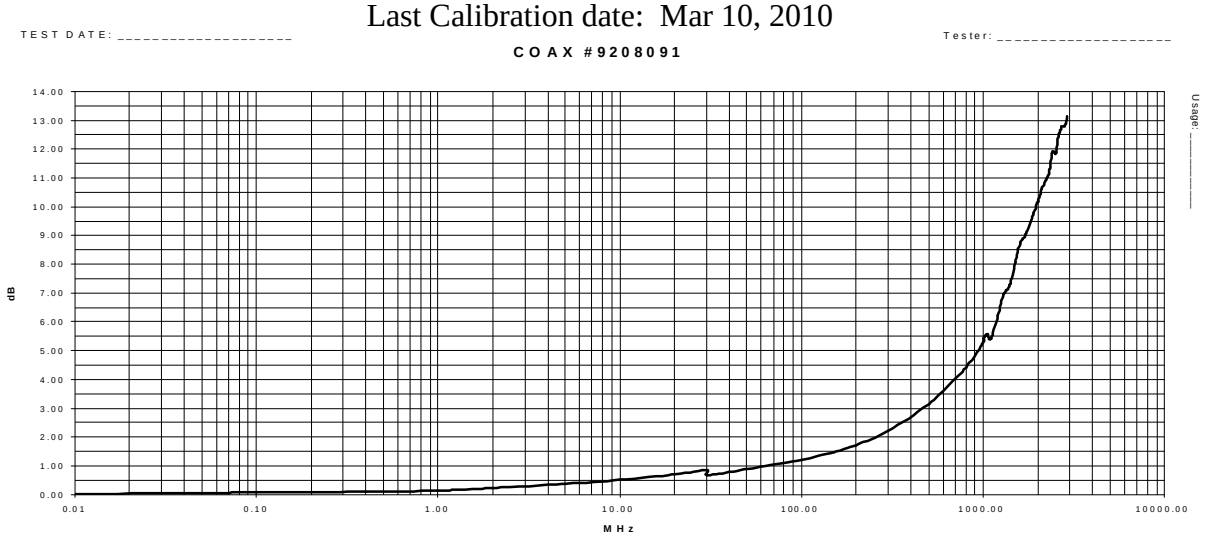
The resultant Field Strength (FS) is a summation in decibels (dB) of the Indicated Receiver Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF). If a PreAmplifier (PA) is used, its gain (dB) is subtracted from the above sum.

Formula 1: FS(dBuV/m) = RF(dBuV) + AF(dB/m) +CF(dB) - PA(dB)
To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

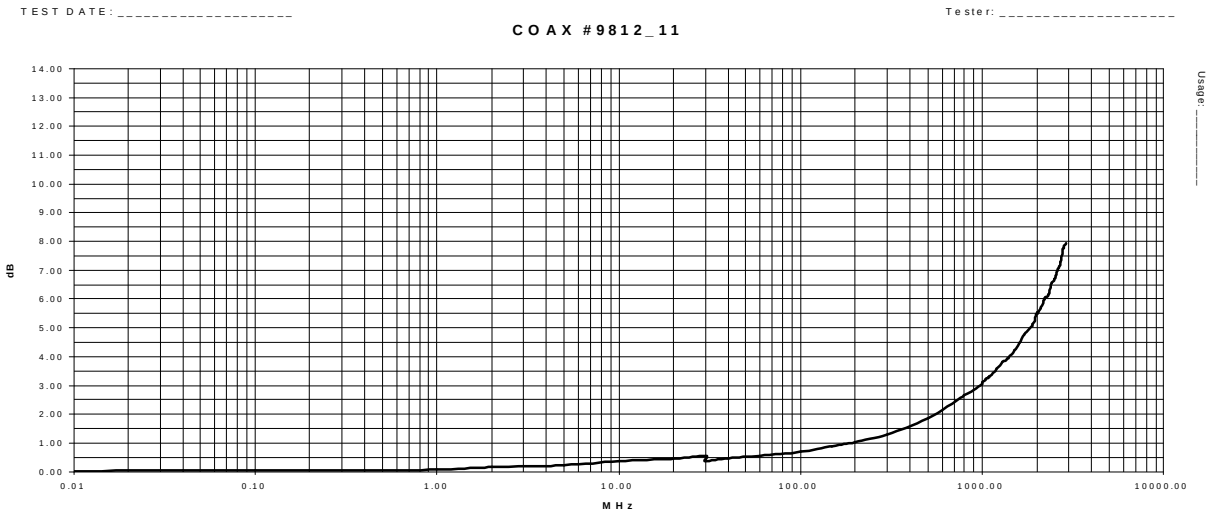
Formula 2: FS(uV/m) = AntiLog[(FS(dBuV/m))/20]

Cable Loss

Line Conducted 150KHz through 30MHz, Coax #920809
Last Calibration date: Mar 10, 2010

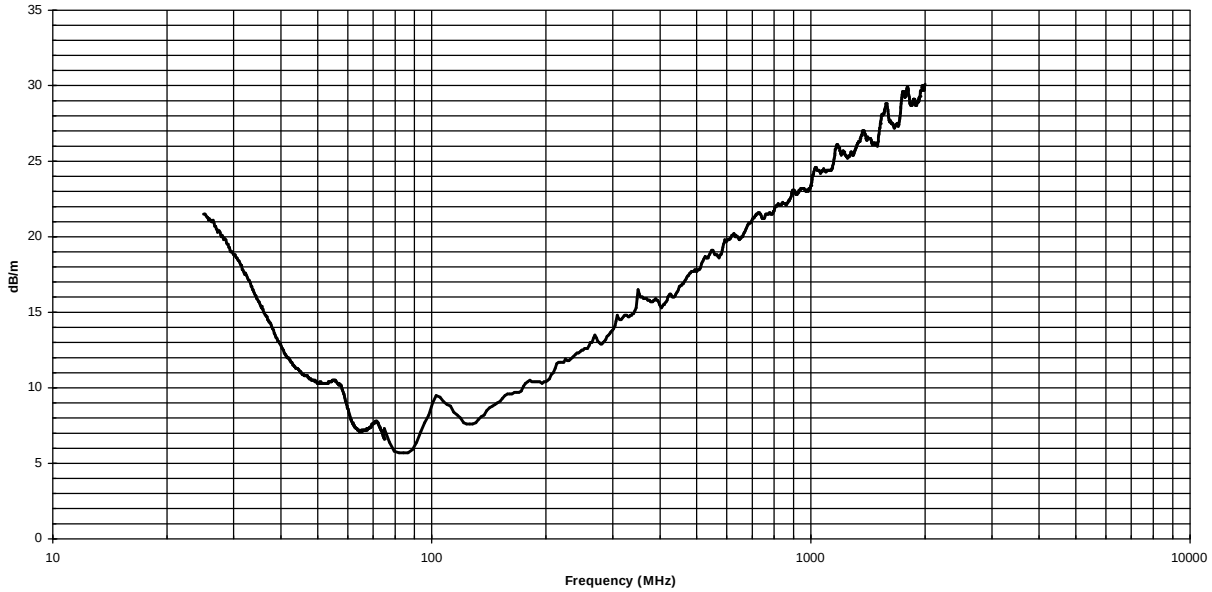


Radiated at 3 meters; 30MHz through 3000MHz, Coax #C090804
Last Calibration date: May 18, 2010

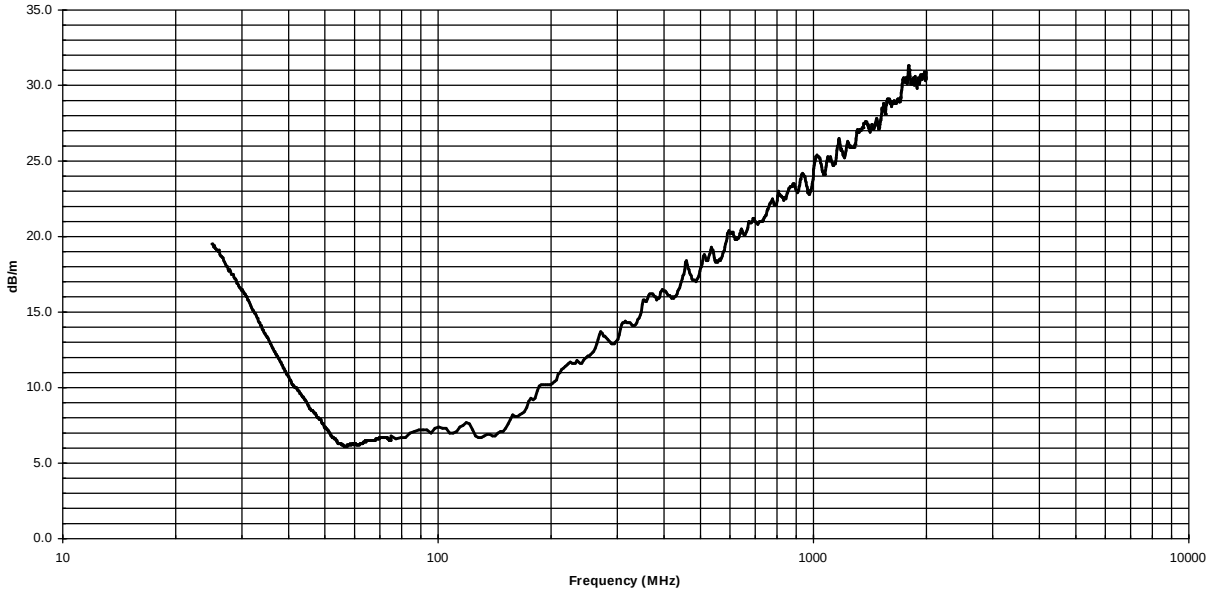


Antenna Factors

EMCO Model 3142 Antenna #1069
Last Calibration Date; 27-July-09
3 Meter Distance Factors



10 Meter Distance Factors



AHD Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200129-0

AHD (Amber Helm Development, L.C.)
Dowagiac, MI

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2010-07-01 through 2011-06-30
Effective dates

Sally S. Bruce
For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-28)

FEDERAL COMMUNICATIONS COMMISSION
Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

March 02, 2010

Registration Number: 90413

AHD EMC Laboratory
92723 M-152,
Dowagiac, MI 49047

Attention: Gordon Helm, President

Re: Measurement facility located at Sister Lakes
3 & 10 meter site
Date of Renewal: March 02, 2010

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NARTE Seal