Amber Helm Development L.C.
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Sister Lakes, MI 49047

EMC Test Report

#1501928FX247
Issued 4/2/15

Regarding the FCC Part 15 testing

Model Railroad Signal

Model Number: AC101-RC

Category: 15.247 Transceiver Device
FCC ID 2AEB9AC101-RC
Judgments: FCC Part 15.247 – Compliant

NVLAP LAB CODE 200129-0

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Niles, Mi. 49120

Test Date(s): 3/6/2015-3/9/2015

Report prepared by: Report reviewed by

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Test Engineer, AHD

Table of Contents

Statements concerning this report

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

IEC/CISPR11: Limits and methods of measurement of electrical disturbance characteristics of Industrial, Scientific, and Medical Radio-Frequency Equipment
IEC/CISPR 22: Limits and methods measurement of radio disturbance characteristics of information technology equipment.
FCC: Method 47 CFR Part 15 Subpart B: Unintentional Radiators.
FCC: Method 47 CFR Part 18 – Industrial, Scientific, and Medical Equipment
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 does not contain data produced under subcontract.

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: +/- 2.3 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:

FCC Part 18 ISM Devices:

1. For all industrial, scientific, medical (ISM) devices, the instruction manual or, if no instruction manual is provided, the product packaging, must provide information that addresses the following: (1) interference potential of the device, (2) maintenance of the system and (3) simple measures that can be taken to correct interference. RF lighting devices must add a statement similar to the following: "This product may cause interference to radio equipment and should not be installed near maritime safety communications equipment, ships at sea or other critical navigation or communications equipment operating between 0.45-30 MHz." (Section 18.213)

   In addition, Part 18 devices that are authorized under the DoC procedure shall also include in the instruction manual, on a separate sheet, or on the packaging the following: (1) identification of the product (e.g. name and model number), (2) a statement similar to "This device complies with Part 18 of the FCC Rules" (Section 18.212), and (3) the name and address of the responsible party (Section 2.909).

2. For products certified using the Declaration of Conformity approach, this FCC conformity LOGO is to be placed on the ISM Device.

FCC Part 15 Class A or B Digital Devices or Peripherals:

For products satisfying the FCC Part 15 Class A or 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.

For an FCC Part 15 Class A digital device or peripheral, the user instructions shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. 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. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Modifications not expressly approved by the manufacturer could void the user's authority to operated the equipment under FCC rules.

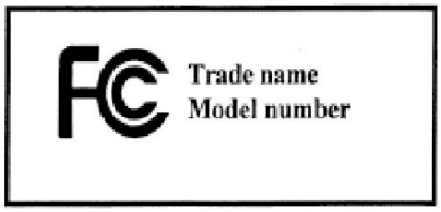
Additionally, for products satisfying the FCC Part 15 Class B requirements the following are to be satisfied:

1. 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:

i. Reorient or relocate the receiving antenna.
ii. Increase the separation between the equipment and receiver.
iii. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
iv. Consult the dealer or an experienced radio/TV technician for help.

2. 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.

Industry Canada Required user statements:

Applies to: [Category II Equipment]

1. For products satisfying the ICES-003, RSS-Gen and RSS-210 Issue 6 requirements the following are to be satisfied:

   User manuals for license-exempt LPDs shall contain the following or equivalent statements in a conspicuous position:

"Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device."

If the antenna is detachable (i.e. selectable by the user), see the user manual requirement in Section 7.1.4. The following instructions in the user manual are also required:

"To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropic radiated power (e.i.r.p.) is not more than that permitted for successful communication."

The above statements may be placed on the device instead of the manual.

2. User Manual:

   User manual shall also contain text declaring compliance to the limits found in this Standard in both English and French.

3. Equipment Labels:

   Equipment subject to certification under the applicable RSS's, shall be permanently labeled on each item, or as an inseparable combination. The label must contain the following information for full compliance:

   (a) the certification number, prefixed by the term "IC:";
   (b) the manufacturer's name, trade name or brand name; and
   (c) a model name or number.

   Equipment for which a certificate has been issued is not considered certified if it is not properly labeled.

   The information on the Canadian label can be combined with the manufacturer's other labeling requirements.

   If the device size is too small to put a label, the label can be included in the user's manual, upon agreement with Industry Canada.

Summary of Results

1. The device model number AC101-RC was tested for compliance with FCC Regulations, Part 15.247 These tests were performed at AHD EMC Laboratory following the procedures outlined in FCC part 15.247.d and ANSI C63.4 as applicable.
2. The device FCCID is 2AEB9AC101-RC.
3. The transmitter test results apply to the AC101-RC.
4. This device is compliant as a 15.247 hopping device in the frequency range of 2400-2483.5 MHz.
5. The chip PCB used in this product is specified to have 0.5 dBi gain at 2.4 GHz.
6. The equipment under test was received on 3/6/2015 and this test series commenced on 3/6/2015.
7. Device operates on 9VDC or 3.6VDC battery so no conducted testing was performed.
8. Device fundamental and harmonic measurements were made by accumulating maximum peak hold across the operational frequency range to determine the worst case frequency, and performing peak measurements at the worst case frequency.
9. Worst case fundamental transmit signal was measured using field strength measurement, subtracting antenna gain, and converting to equivalent conducted power. The signal was measured to be 124.62 mW under the 15.247 peak limit.
10. The worst case spurious transmit harmonic was measured at 4937.00 MHz. This signal is also within a restricted band. Using Duty Cycle Correction to calculate the average measurement, the signal was measured 374.25 uV or 12.01 dB under the 15.209 Average limit.
11. The worst case 4937.00 MHz peak signal level was measured to be 12.01 dB below the peak limit of 74 dBuV/m.
12. No non-harmonic spurious signals were observed between 1 GHz and 25 GHz.
13. The worst case non-transmit mode spurious emission was measured at 836.01 MHz horizontally polarized. The signal was measured to be 22.74 dB below the FCC Class B limit.
14. No receive mode local oscillator signals were observed.
15. This hopping mode device utilizes 25 channels, which complies with the specified minimum with a margin of 10 channels.
16. This device demonstrated a worst case 20 dB bandwidth that complies with the 500 kHz maximum specification with 167 kHz margin.
17. This device demonstrated a worst case carrier separation that complies with the minimum specification (20 dB band width) with 1692 kHz of margin.
18. This device utilizes a fixed pseudorandom sequence by design that evenly distributes hopping among all channels during each cycle.
19. The device demonstrated an 122.7 mSec occupied channel time in 10 seconds, which provides 277.3 mSec of margin compared to the 400 mSec specification.

20. This device demonstrated 100 KHz Bandwidth low band edge radiated signal strength 43.67 dB below the limit.
21. This device demonstrated 100 KHz Bandwidth high edge radiated signal strength 39.77 dB below the limit.
22. As an FCC 2.1091 mobile device, FCC 1.310 maximum power density limit of 1 mw/cm^2 at 20 cm applies. Given the device EIRP of .431 mW, power density can be calculated as S =EIRP/4*pi*20cm^2 =8.6E-5 mW/cm^2, which is well under the limit of 1mW/cm^2.

Changes Made to Achieve Compliance:

1. None

EUT Description

Model: Model Railroad Signal

Model number: AC101-RC

Serial/ID No: AHD-001

Description: : Dip Switch Configurable Signal is designed to communicate with 1-2 other identical signal devices for the purpose of visually signaling the location and direction of model trains using colored LED's. Uses non-certified 2.4 GHz FHSS Module and PCB Chip antenna.

Antenna:

Mfg: Antenna Factor
Model: 712-ANT-2.45-chp-t
Gain Spec: 0.5 dBi
Form Factor: PCB Chip Antenna

PCB: Main PCB: SBSC RF V2 2015

Hopper Transmit Module:

MFG: Linx Technologies
Model: 714-HUM-2.4-RC
Hopping Sequence and Algorithm: Pseudo Random non-repeating based on starting frequency. See Hopping Specification Below
Hopping Frequency Range: 2.420.25-2.468.25
Hopping Sequence and Algorithm: See Hopping Specification Below
Hopping Channel Frequencies: See Hopping Specification Below

Specifications:

Input Power: 9V DC or 3.6 VDC Batteries. Note that the panel housing for the 3.6V battery is extended as compared to the 9V housing.

Outputs Signals: 2400-2483.5 MHz 15.247 hopping device.

Input Signals: Position Sensors

Hopping Specifications:

Frequency Hopping

The module incorporates a Frequency Hopping Spread Spectrum (FHSS) algorithm. This provides immunity from narrow-band interference and complies with FCC and IC guidelines.

The module uses 25 RF channels as shown in Figure 35. Each channel has a time slot of 13.33ms before the module hops to the next channel. This equal spacing allows a receiver to hop to the next channel at the correct time even if a packet is missed. Up to seven consecutive packets can be missed without losing synchronization.

The hopping pattern (sequence of transmit channels) is determined from the transmitter's address. Each sequence uses all 25 channels, but in different orders. Once a transmission starts, the module continues through a complete cycle. If the input line is taken low in the middle of a cycle, the module continues transmitting through the end of the cycle to ensure balanced use of all channels.

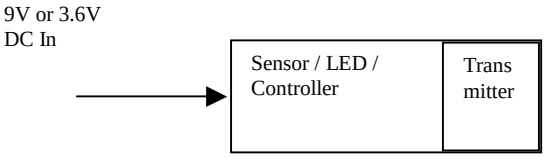
Frequency hopping has several advantages over single channel operation. Hopping systems are allowed a higher transmitter output power, which results in longer range and better performance within that range. Since the transmission is moving among multiple channels, interference on one channel causes loss on that channel but does not corrupt the entire link. This improves the reliability of the system.

Channel Frequencies

Channel Number	HUM-2.4-RC Frequency (MHz)
1	2,420.25
2	2,422.25
3	2,424.25
4	2,426.25
5	2,428.25
6	2,430.25
7	2,432.25
8	2,434.25
9	2,436.25
10	2,438.25
11	2,440.25
12	2,442.25
13	2,444.25
14	2,446.25
15	2,448.25
16	2,450.25
17	2,452.25
18	2,454.25
19	2,456.25
20	2,458.25
21	2,460.25
22	2,462.25
23	2,464.25
24	2,466.25
25	2,468.25

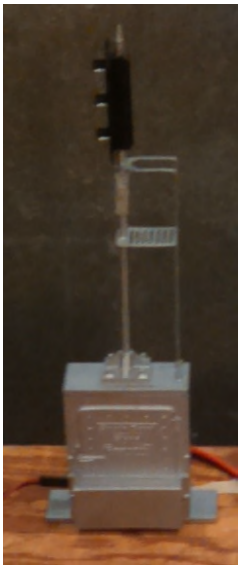
Figure 35: HumRC™ Series Transceiver RF Channel Frequencies

EUT Block Diagram:



EUT Pictures

3.6V Exterior View Front



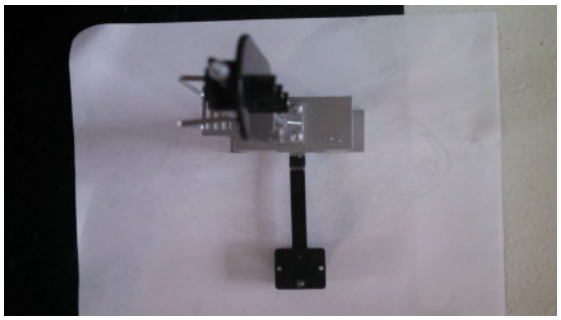
9V Front View

Exterior View Rear

Exterior Left Side View

Exterior Right Side View

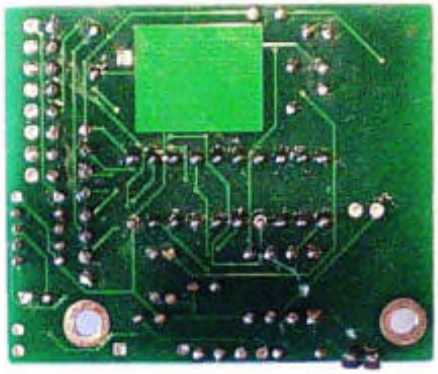
Exterior Top View



Exterior Bottom View

PCB Top View

PCB Bottom View

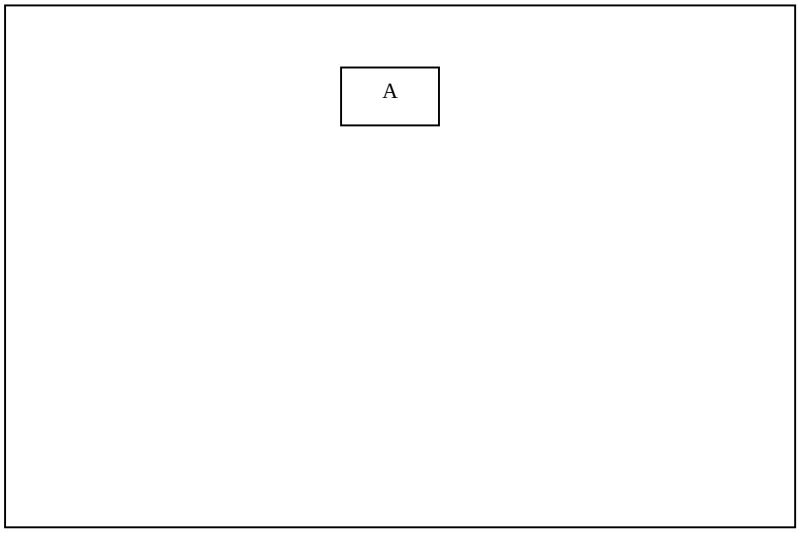


Equipment Test Setup:

Support Equipment & Cabling

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	**Model Railroad Signal**	AC101-RC	AHD-001	15.247 transceiver device

Block Diagram



Setup Pictures

Radiated Prescreen Setup

Front Radiated Setup

Rear Radiated Setup

Measurement Report

Standards Applied to Test

ANSI C63.4 – Radio Noise Emissions 2003.12
CFR47 FCC Part 15.247
AHD/SEI test procedures TP0101LC, TP0102RA
EN55022 ITE Disturbance 2005.11
EN61000-6-3 Generic 2007.2

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

Transmit:

Transmit radiated testing was performed at a 3 meter open field test site, and completed according to the procedures in FCC 15.247 with supporting instructions from ANSI C63.4 and FCC public notice DA 00-0075 from March 30 2000.

Device fundamental and harmonic measurements were made by accumulating low, mid, and high band maximum peak hold measurements across the frequency range.

Conducted Signal Strength Measurements were calculated by measuring peak radiated field strength at 3 Meters in dBuV/M, subtracting antenna gain in dBi, and converting to equivalent conducted power using the formula P=(ED)^2/30, where P is the power in watts, E is field strength in V/M, D is distance in Meters.

Average data was calculated by measuring peak signals and using a duty cycle correction factor of -20dB (measured duty cycle correction was -27.76 dB.)

All measurements were performed by manipulating the device orientation until a maximum signal strength measurement was recorded.

The following 15.247 test parameter setups apply to transmit test:

15.247 Reference	Spec Data	Units	Span Spec	RBW Spec	VBW Spec
a.1.i	Min # of channels		Channel Width	>1% of Span	>RBW
a.1	max channel 20 dB BW	kHz	2 to 3*OBW	>1% of OBW	>RBW
a.1	Min Carrier separation	kHz	Capture 2 peaks	>1% of span	>RBW
a.1.iii	max time occupied per channel in 10 seconds	mSec	0 Hz	1 MHz	>RBW
b.1	max power (e.i.r.p.)	mw	> 5*20 dB BW	1 MHz	>RBW
d	measured low, high band edge 20 dB below peak limits	dBuV	Enough to capture band edge plus noise	100 kHz	>RBW

Radiated Spurious Measurements:

Spurious 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 signals recorded in the shielded room prescan for each module were then measured at the 3-meter open area test site.

The EUT was scanned for radiated energy up to 26 GHz to meet FCC 15.33.a.1 requirements.

The EUT under test was placed per ANSI C63.4

The EUT was exercised as follows:

1. Device was powered via 9VDC Battery
2. The device was activated automatically
3. Evidence of operation was provided by signal measurement

The cables were manipulated to produce the highest signal level relative to the limit.

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

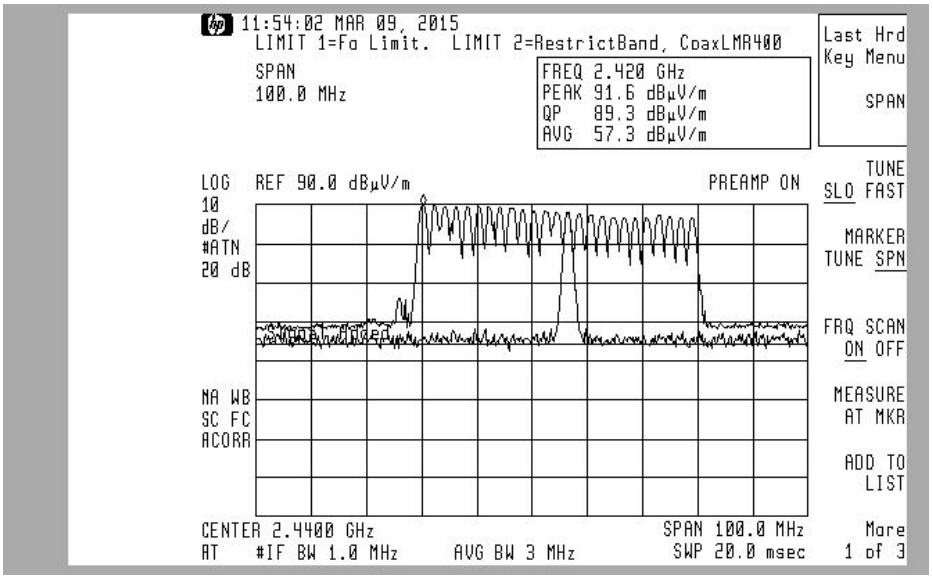
Transmit Fundamental Equivalent Conducted Power

Measured Frequency	Peak Measurement at 3M	Antenna Gain	Equivalent Conducted Energy	Equivalent Conducted Energy	Equivalent Conducted Power 1000*(ED)^2/30	FCC Limit	Margin
MHz	dBuV/M	dBi	dBuV	V/M	mW	mW	mW
2420.23	**91.57**	**0.500**	**91.070**	**3.577E-02**	**0.384**	**125.00**	**124.62**
2445.63	**69.58**	**0.500**	**69.080**	**2.844E-03**	**0.002**	**125.00**	**125.00**
2469.00	**85.40**	**0.500**	**84.900**	**1.758E-02**	**0.093**	**125.00**	**124.91**

Transmit Fundamental EIRP

Measured Frequency	Peak at 3M	Peak Measurement at 3M	EIRP 1000*(ED)^2/30	FCC Limit	Margin
MHz	dBuV/M	V/M	mW	mW	mW
2420.23	**91.57**	**3.789E-02**	**0.431**	**125.00**	**124.57**
2445.63	**69.58**	**3.013E-03**	**0.003**	**125.00**	**125.00**
2469.00	**85.40**	**1.862E-02**	**0.104**	**125.00**	**124.90**

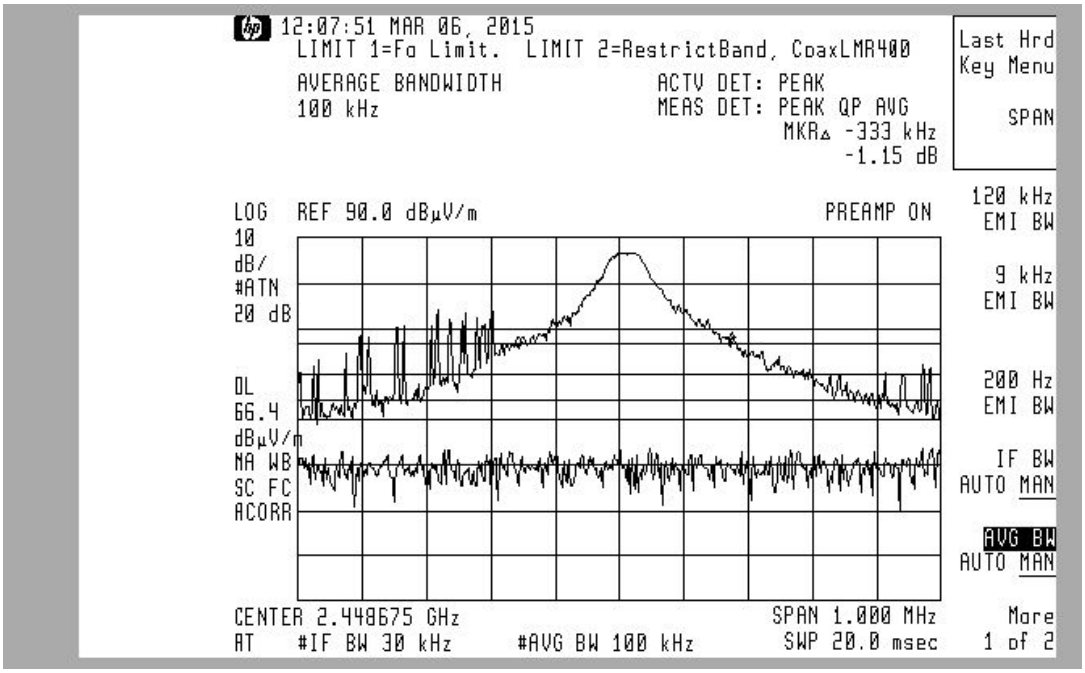
Worst Case Transmit Fundamental Plot



Transmit 20dB BW Measurements

Measured Frequency	20 dBc Bandwidth Measurement	FCC Limit	Margin
MHz	kHz	kHz	kHz
2448.00	**333.00**	**500**	**167**

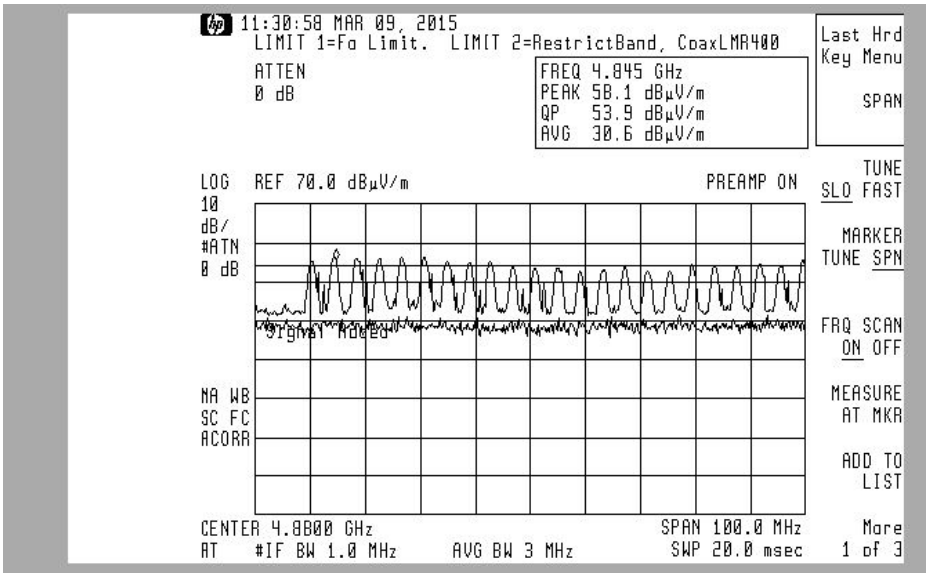
20 dB Bandwidth Plot



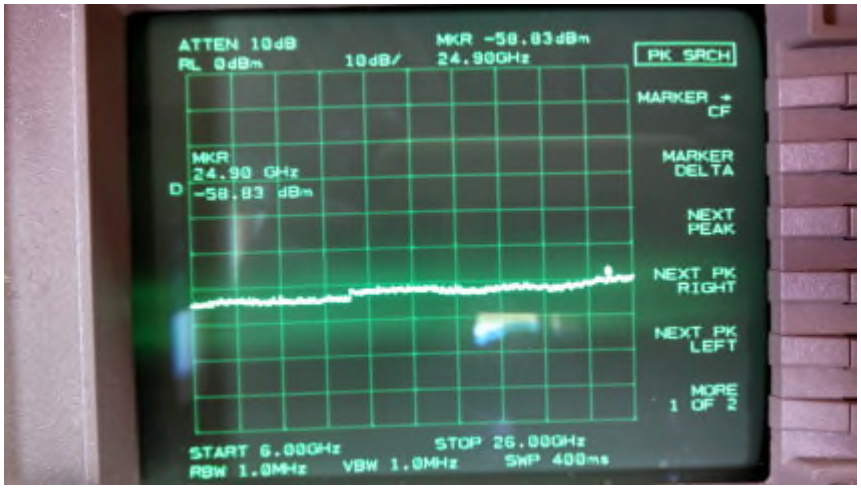
Second Harmonic Worst Case Measurement

Measured Frequency	Peak	-20dB Duty Cycle Adjusted Average	Avg at 3M	FCC Limit	Margin
MHz	dBuV/M	dBuV/M	uV/M	uV/M	uV/M
4844.77	**58.10**	**38.10**	**80.35**	**500.00**	**419.65**
4889.13	**55.94**	**35.94**	**62.66**	**500.00**	**437.34**
4937.00	**61.99**	**41.99**	**125.75**	**500.00**	**374.25**

Second Harmonic Plot



Upper Harmonic 3 Meter Plot



***Note – No Upper Harmonic Signals were found**

Restricted Band Harmonic Peak Compliance

Restricted Band Average Data

Measured Frequency	Peak	-20dB Duty Cycle Adjusted Average	Avg at 3M	FCC Limit	Margin
MHz	dBuV/M	dBuV/M	uV/M	uV/M	uV/M
***2483.50**	**31.80**	**NA**	**38.90**	**500.00**	**461.10**
4844.77	**58.10**	**38.10**	**80.35**	**500.00**	**419.65**
4889.13	**55.94**	**35.94**	**62.66**	**500.00**	**437.34**
4937.00	**61.99**	**41.99**	**125.75**	**500.00**	**374.25**

*Noise Floor Measurement, margin calculated from peak.

Restricted Band Peak Data

Measured Frequency	Avg at 3M	FCC Limit	Margin
MHz	dBuV/M	dB	dB
4937.00	**61.99**	**74.00**	**12.01**

Transmit Mode Non-Harmonic Spurious Emissions

3M Tabulated Emissions Vertically Polarized

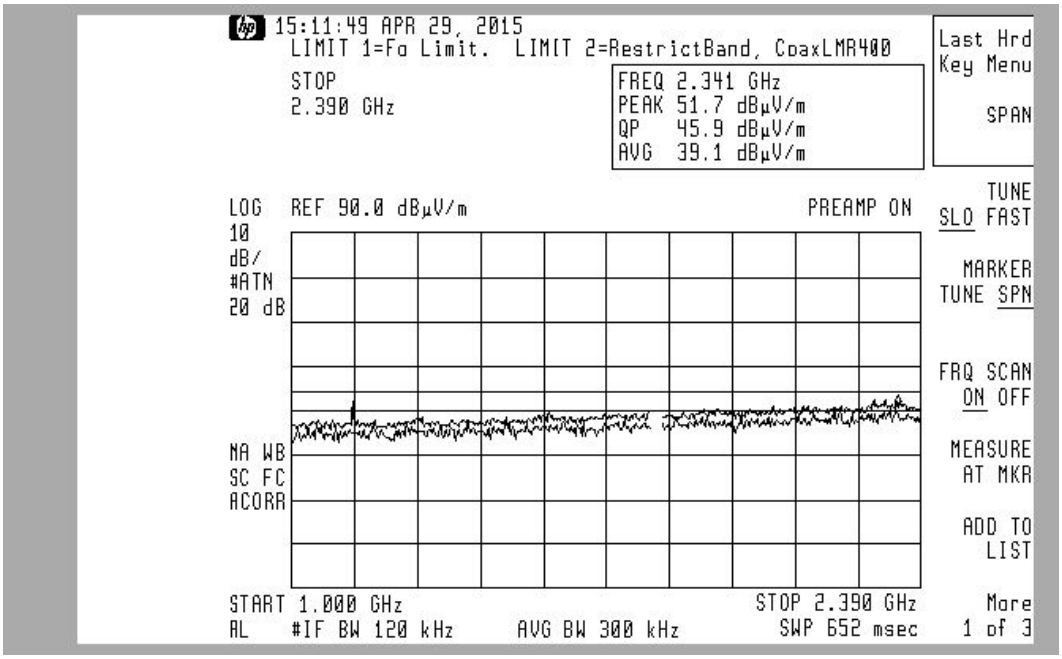
Frequency	Corrected Quasipeak Measurement	Turntable Azimuth	Antenna Height	FCC Class B Limit	Margin Class B
MHz	dBuV/m	deg	Mtr	dBuV/m	dB
202.70	**13.11**	**0**	**1.0**	**43.50**	**30.39**
668.51	**21.63**	**0**	**1.0**	**46.00**	**24.37**
836.07	**22.33**	**0**	**1.0**	**46.00**	**23.67**
927.37	**23.29**	**0**	**1.0**	**46.00**	**22.71**

3M Tabulated Emissions Horizontally Polarized

Frequency	Corrected Quasipeak Measurement	Turntable Azimuth	Antenna Height	FCC Class B Limit	Margin
MHz	dBuV/m	deg	Mtr	dBuV/m	dB
669.11	**20.74**	**0**	**2.0**	**46.00**	**25.26**
836.01	**22.28**	**0**	**2.0**	**46.00**	**23.72**
927.16	**23.26**	**0**	**2.0**	**46.00**	**22.74**

Spurious Emissions Plot at 3M – 2.4 GHz to 26 GHz

Spurious Emissions Plot – 1 GHz to 2.4 GHz

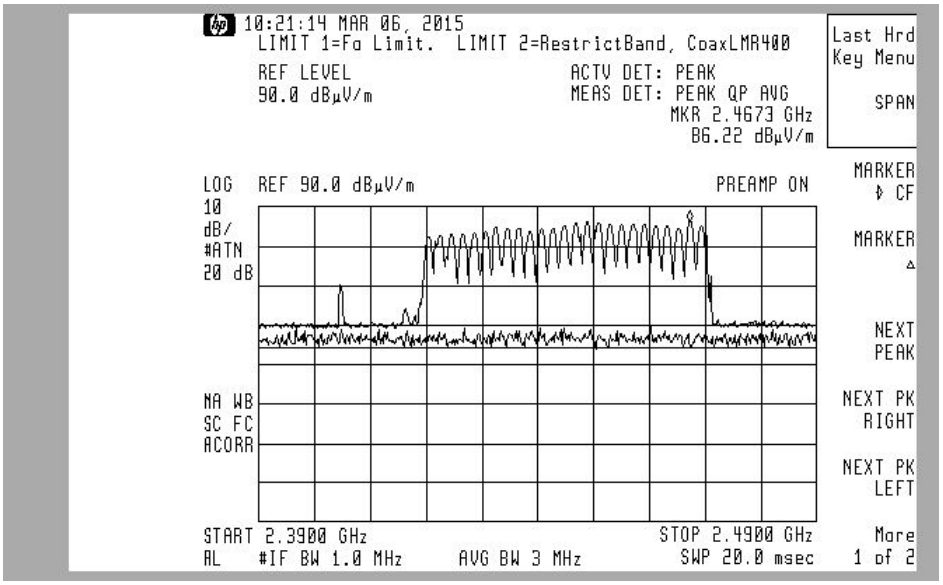


Radiated Receive Local Oscillator Emissions

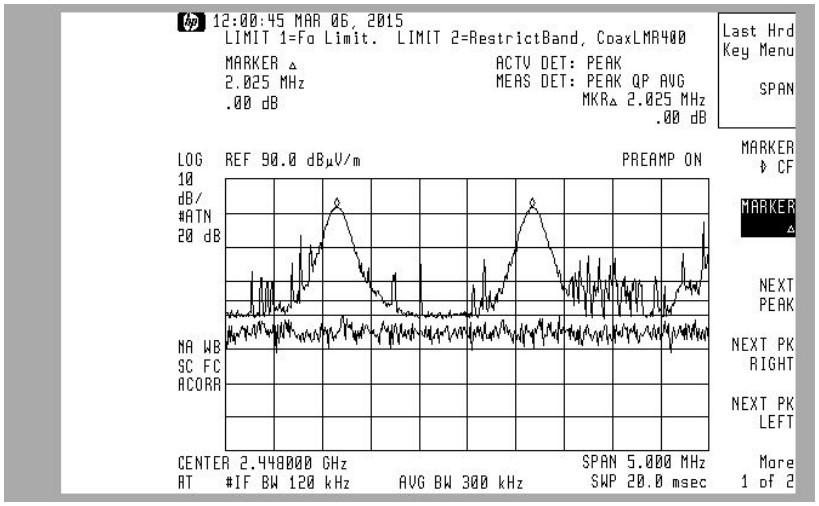
No Receive Mode Oscillator signals were observed.

15.247 Specific Transmit Emissions

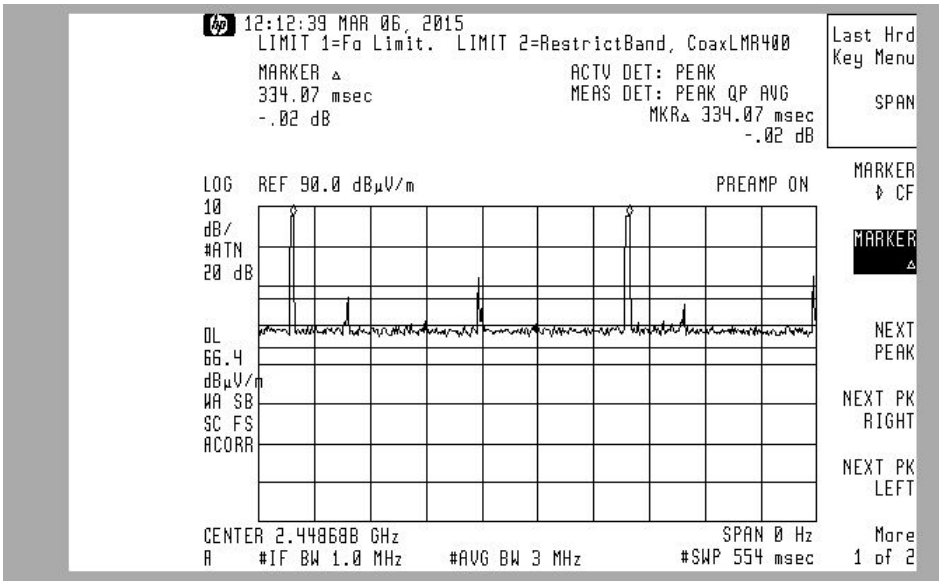
25 Channel Plot



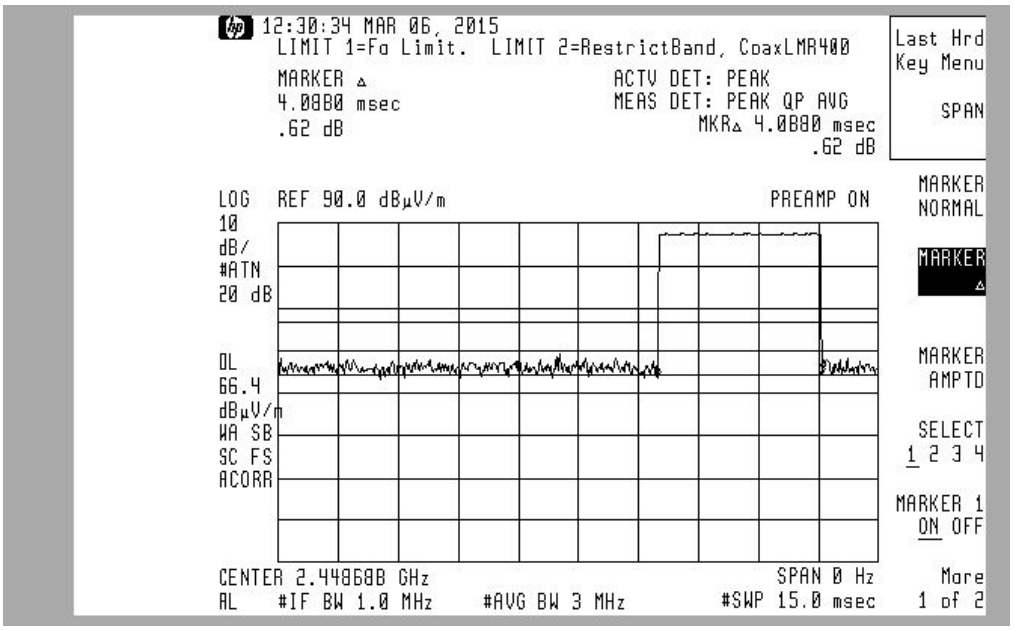
Carrier Separation Plot



Plot Demonstrating Time Between Cycles

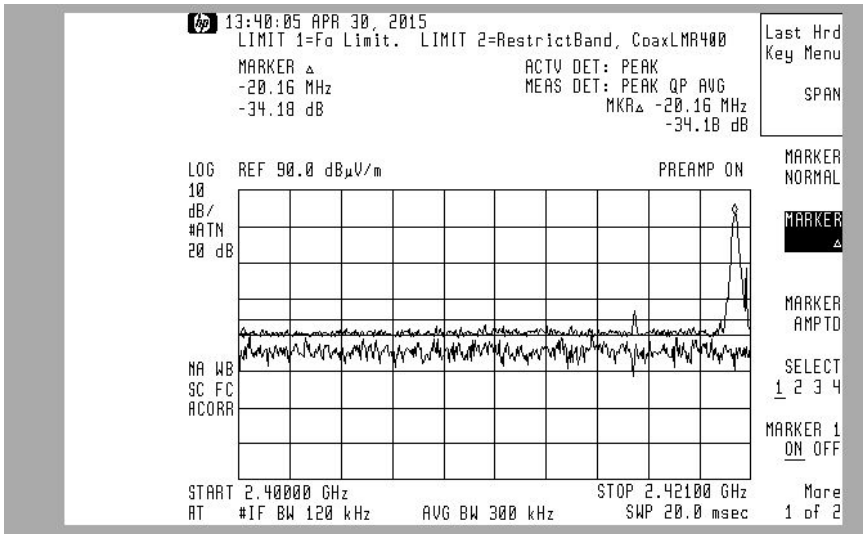


Plot Demonstrating Channel "On" Time

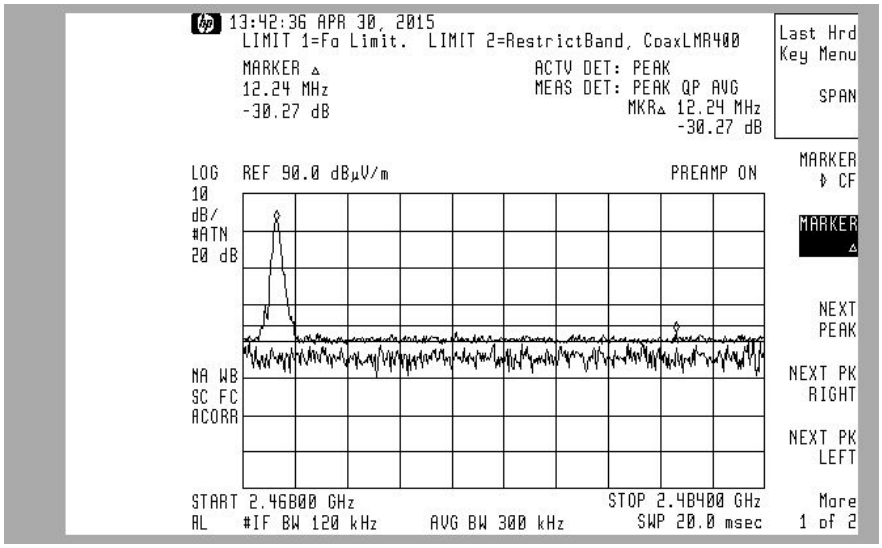


Note: 10 seconds/.334 msec/cycle = 30 cycles in 10 seconds * 4.09 mSec on / cycle = 122.7 mSec in 10 seconds. Also note that since cycle length = 334 mSec, duty cycle in any 100mSec period = 4.09%. Per DA00-705, duty cycle correction = 20log(.0409)= -27.76. Therefore a –20dB duty cycle correction is used in calculations.

100 kHz Low Band Edge Plot



100 kHz High Band Edge Plot



Tabulated Band Edge Measurements

Measured Frequency	Peak at 3M	FCC Limit (20 dB Below Peak)	Margin
MHz	dBuV/M	dB	dB
***2399.00**	**27.90**	**71.57**	**43.67**
***2483.50**	**31.80**	**71.57**	**39.77**

* Noise Floor

Tabulated 15.247 Data

15.247 Reference	Spec Data	Units	Spec	Data	Margin
	Operating Mode		Frequency Hopper / Digital Modulation	Frequency Hopper	NA
a.1.iii	Min # of channels		15	25	10
a.1	Channel Carrier Frequencies	MHz	2400-2483.5	2420.25-2468.25	NA
a.1.I	max channel 20 dB BW	kHz	500	333	167
a.1	Min Carrier separation	kHz	333	2025	1692
a.1	hopping algorithm		Pseudo Random, equal distribution	Compliant	NA
a.1.iii	max time occupied per channel in 10 seconds	msec	400	122.7	277.3
b.1	max power (equivalent conducted)	mw	125	0.384	124.616
b.4	max antenna gain	dBi	6	0.5	5.5
d	measured low band edge 100KHz BW signal - 15.209 Limit	dBuV	71.57	27.90	43.67
d	measured high band edge 100KHz BW signal - 15.209 Limit	dBuV	71.57	31.80	39.77

Exposure Exclusion Factor Calculation

As an FCC 2.1091 mobile device, FCC 1.310 maximum power density limit of 1 mw/cm^2 at 20 cm applies. Given the device EIRP of .431 mW, power density can be calculated as

S =EIRP/4*pi*20cm^2

=8.6E-5 mW/cm^2, which is well under the limit of 1mW/cm^2.

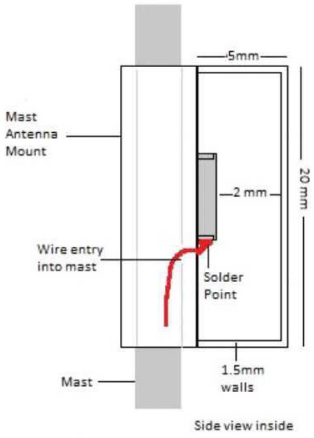
If calculated as a portable device, the device is not intended to be body worn, however it is possible that the device position will be adjusted by hand while the device is operating. Therefore extremity limits and exclusions could apply.

As the setup pictures illustrate, the closest distance from user hand while holding outside of device case to radiating antenna is 3.5 mm. Using KDB 447498 D01V5r01 exclusion factor formula: min SAR Evaluation Limit = (mW/mm distance)*f^.5, < 7.5 for extremity contact, the extremity factor is calculated to be .191, leaving a margin of 7.309. Therefore device does not require additional SAR testing.

Tabulated Exclusion Factor

FCC Spec Reference	Spec Data	Distance (mm)	Frequency (GHz)	Maximum EIRP Data (mW)	Extremity / Body Contact Factor	Extremity / Body Contact Limit	Margin
KDB 447498 D01V5r01	min SAR Evaluation Limit = (mW/distance)*f^.5 < 3 for body contact, < 7.5 for extremity contact	3.50	2.400	0.431	0.191	7.500	7.309

Exclusion Factor Distance to User Measurement Pictures



Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 67 deg F, the relative humidity 35%.

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 signal testing between 30 MHz and 1 GHz 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 principal settings of the EMI Receiver for radiated testing above 1 GHz include:

Bandwidth:	1 MHz
Detector Function:	scanning and signal search = Peak Mode
	Duty Cycle Compensated Measurements = Peak Mode
	Direct Signal Measurements = Average Mode.
Search Range:	Above 1000MHz as required

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]

Measurement Facilities & Equipment

Test Site

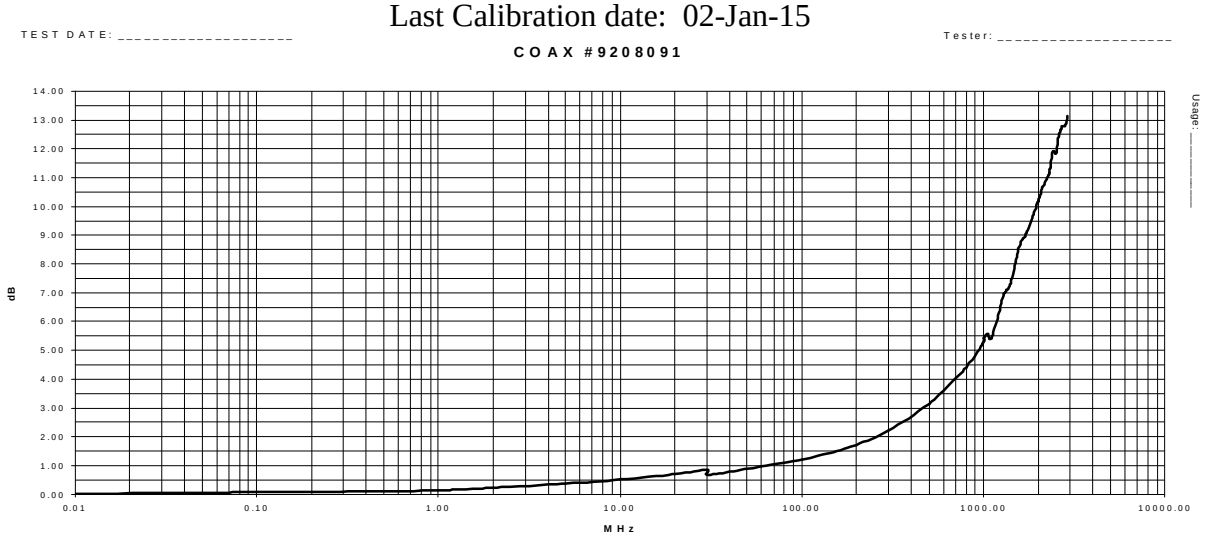
Test Site:
The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 Michigan Hwy152, Sister Lakes, 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC (No.90413) and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

Measurement Equipment Used

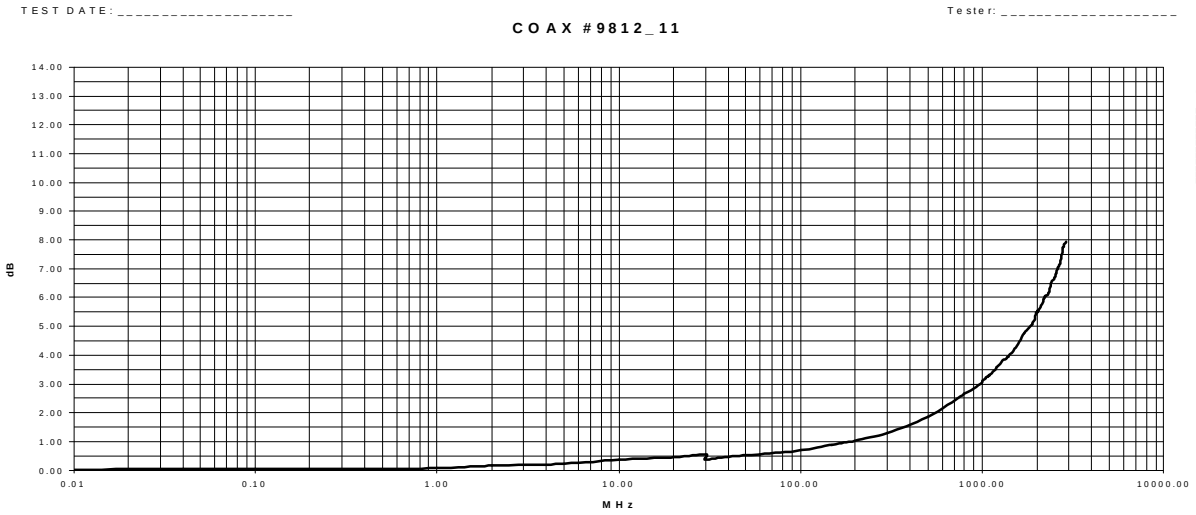
Equipment	Model	S/N	Last Cal Date	Calibration Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00267	22 Jan-15	12 months
RF Receiver Section	HP-85462A	3807A00437	22 Jan-15	12 months
EMCO BiconiLog Antenna	3142	1069	13- Feb-15	12 months
EMCO Double Ridged Horn	3115	7770	20-Sept-14	12 months
Solar LISN	8012-50-R-24-BNC	962137	9 Mar-15	12 months
Solar LISN	8012-50-R-24-BNC	962138	23-Dec-14	12 months
(3-m) LMR-400 Ultra Flex	LMR400	C090804	02-Jan-15	6 months
(3-m) CS-3227 RG8	CS-3227	C060914	02-Jan-15	6 months
(10-m) Amelco 50ohm Coax	RG213U	9903-10ab	02-Jan-15	6 months
(LCI) Double shielded 50ohm Coax	RG58/U	920809	01-July-14	12 months
Keytek Surge	711B	8511854	05-May-14	12 months
Schaffner ESD	NSG432	01027	06-May-14	12 months
Schaffner EFT	NSG600/641	0113	05-May-14	12 months
EMCO Loop	6205	2164	22-Sept-12	36 months

Cable Loss

Line Conducted 150KHz through 30MHz, Coax #920809
Last Calibration date: 02-Jan-15

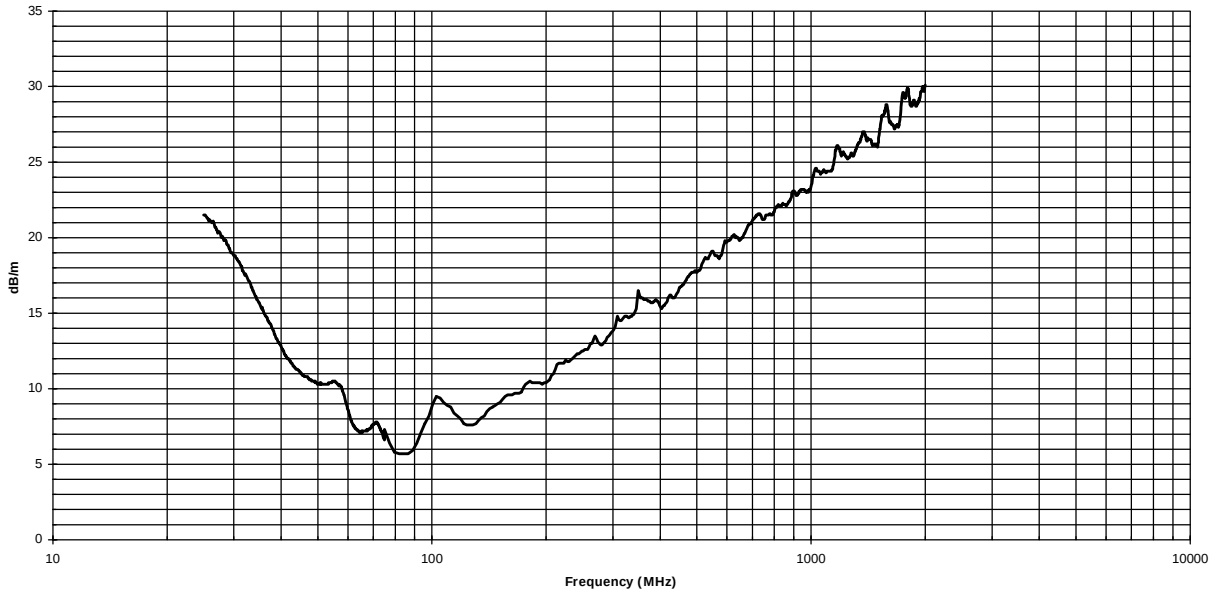


Radiated at 3 meters; 30MHz through 3000MHz, Coax #C090804
Last Calibration date: 02-Jan-15

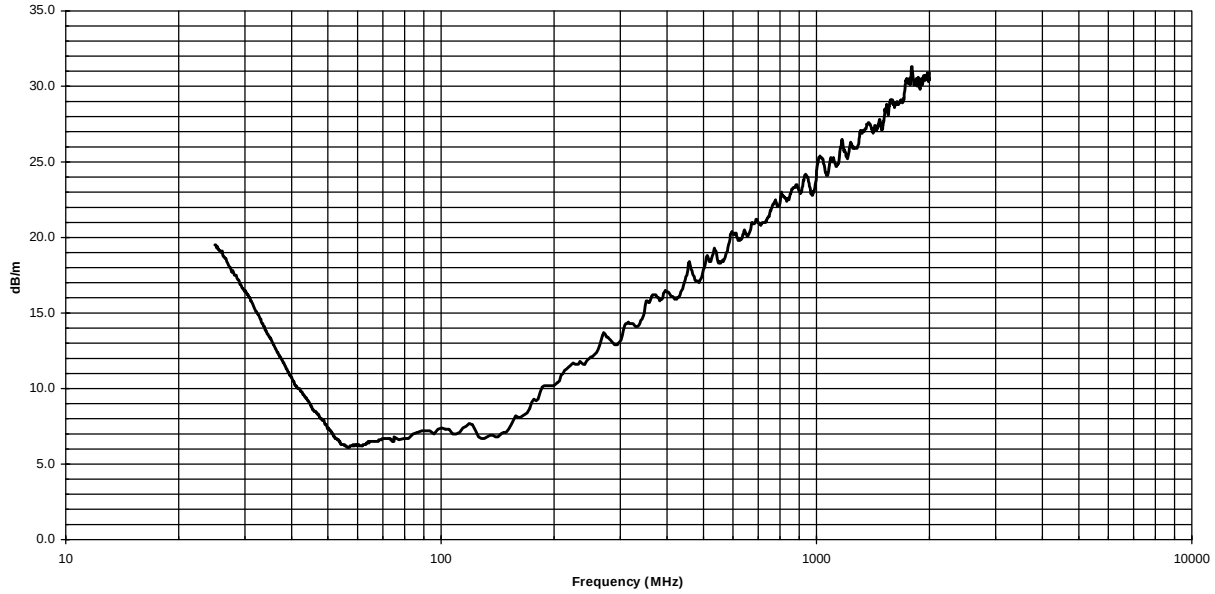


Antenna Factors

EMCO Model 3142 Antenna #1069
Last Calibration Date; 13- Feb-15
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.)
Sister Lakes, 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).

2014-07-01 through 2015-06-30
Effective dates

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 06, 2015

AHD (Amber Helm Development, L.C.)
92723 Michigan Highway 152,
Sister Lakes, MI 49047

Attention: Gordon Helm

Re: Accreditation of AHD (Amber Helm Development, L.C.)
Designation Number: US5339
Test Firm Registration #: 559716

Dear Sir or Madam:

We have been notified by National Voluntary Laboratory Accreditation Program that AHD (Amber Helm Development, L.C.) has been accredited as a Conformity Assessment Body (CAB).

At this time AHD (Amber Helm Development, L.C.) is hereby designated to perform compliance testing on equipment subject to Declaration Of Conformity (DOC) and Certification under Parts 15 and 18 of the Commission's Rules.

This designation will expire upon expiration of the accreditation or notification of withdrawal of designation.

Sincerely,

George Tannahill

George Tannahill
Electronics Engineer

NARTE SEAL