
EMC Test Report**#0600902F2****Issued 02/28/07****REGARDING THE FCC 15.231E TESTING OF****CHANGES TO THE PCB LAYOUT OF
433.9MHZ TRANSMITTER, MODEL VER-1920****Category: Low Power Transmitter****Judgment: FCC Part 15 – compliant**

Prepared for:

Mr. Bob Wiser
VERSUS Technology
2600 Miller Creek Rd.
Traverse City, MI 49684

Test Date(s):

April 18,19, 2006

Report prepared by:



Gordon Helm, NCE

Report reviewed by:



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Data recorded by:

Gordon Helm, NCE
Test Engineer, AHD

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STATEMENTS CONCERNING THIS REPORT**NVLAP Accreditation: NVLAP Lab Code 200129-0**

The scope of AHD accreditation is the conducted emissions, radiated emissions 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 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.

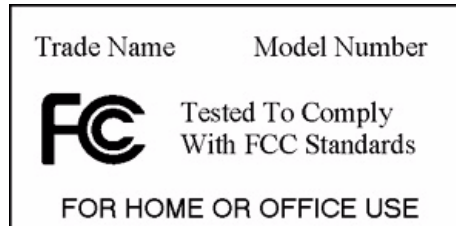
Statement of Test Results Uncertainty: Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: ± 1.4 dB

Retention of Records:

- 1) For equipment verified to comply with FCC regulations, the manufacturer is obliged to retain this report with the product records for two years following the manufacture of the equipment that was tested.

FCC required statements: [Class B Digital Device or Peripheral]

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. For products certified using the Declaration of Conformity approach, the FCC conformity LOGO is to be placed on the Class B Digital Device and a Declaration of Conformity issue with each device sold.



3. For products certified using the Declaration of Conformity approach, the FCC requires a Compliance Information statement (Declaration of Conformity) to accompany each product to the end user.
4. A statement 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.
5. 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.*

SUMMARY OF RESULTS

1. This test series evaluated the Equipment Under Test (EUT) to FCC Part 15.231e.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for periodic operation in the allowed frequency bands above 70MHz, (Part 15.231e).
3. The equipment under test was received on April 18-19, 2006 and this test series commenced on April 18, 2006.
4. The line conducted emission testing does not apply to this product. The device is powered from a 3 volt lithium battery.
5. The measurements made indicate that there are some variations between units.
6. The occupied bandwidth was measured using the -20dBC method with a measurement equipment Resolution Bandwidth of 100KHz. The occupied bandwidth was determined to be 700KHz.
9. The field strength level of the fundamental showed the emission to be 8.7dB below the limit of 72.9dBuV/m.
10. The evaluation of the field strength levels of the harmonics showed the emission nearest the limit occurred at 1302MHz and was measured to be 6.5dB below the limit of 66.9dBuV/m.

Changes made

1. R10 is changed to 300ohm.
2. C7 is changed to 5.6 pF

EUT DESCRIPTION

Description: 434MHz low power transmitter. Personal Badge.

Model: VER-1920

Serial/ID No.: ---

Manufacturer: VERSUS Technology

Details: Plastic chassis
2-layer printed circuit board
3.58MHz, 13.56 MHz Oscillator
433.9 MHz Resonator circuit
operating frequency is approximately 434MHz
3-volt Lithium battery is power source

EUT Pictures

VER-1920 PCB -- top side view

this page

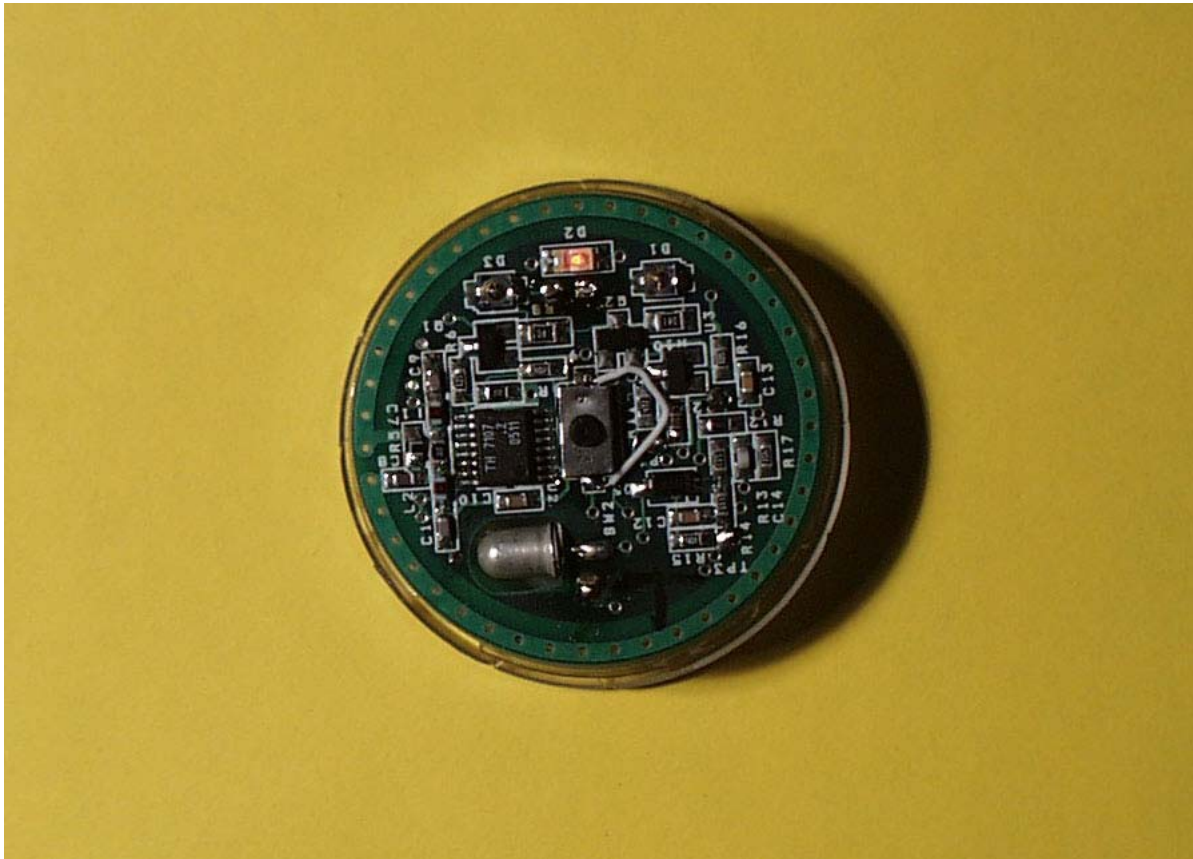
VER-1920 PCB – bottom side view

page 7

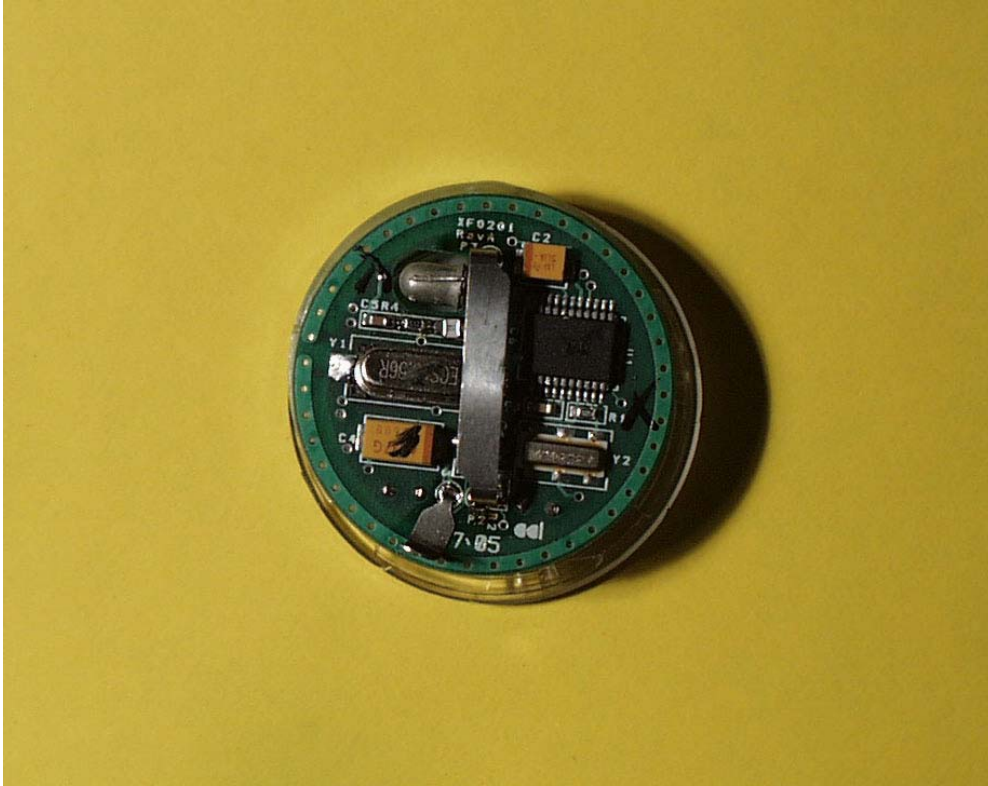
VER-1920 tested – top view

page 7

PCB -TOP VIEW



PCB BOTTOM VIEW

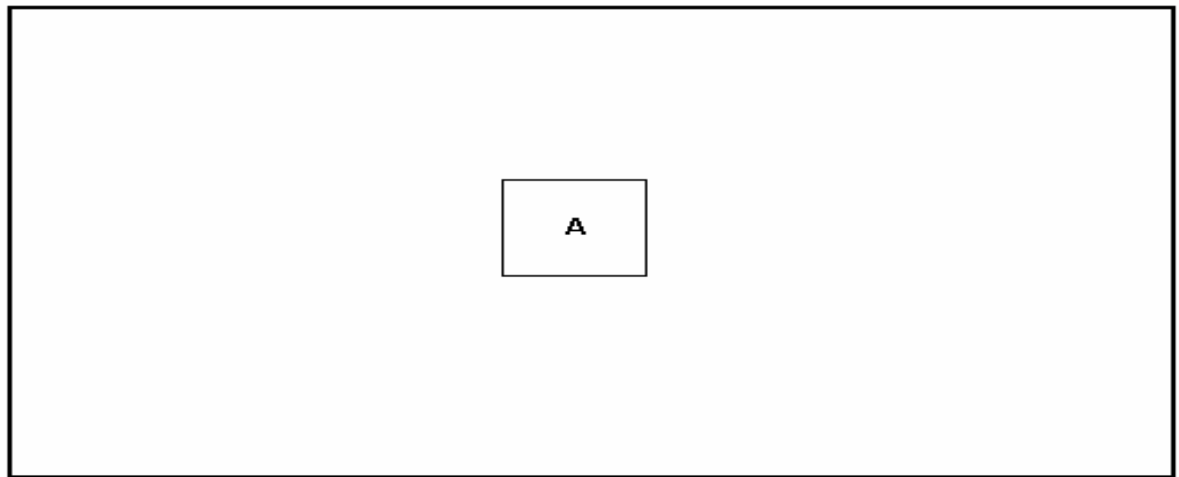


TOP VIEW



EQUIPMENT TESTED:**Support Equipment & Cabling**

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] personal badge	[VERSUS] VER-1920		



setup 1L 3

BASIC EUT SETUP
(Legend designation is above)

Setup Pictures

Block Setup Diagram

this page

Radiated Setup – flat position

page 9

Radiated Setup – end position

page 10

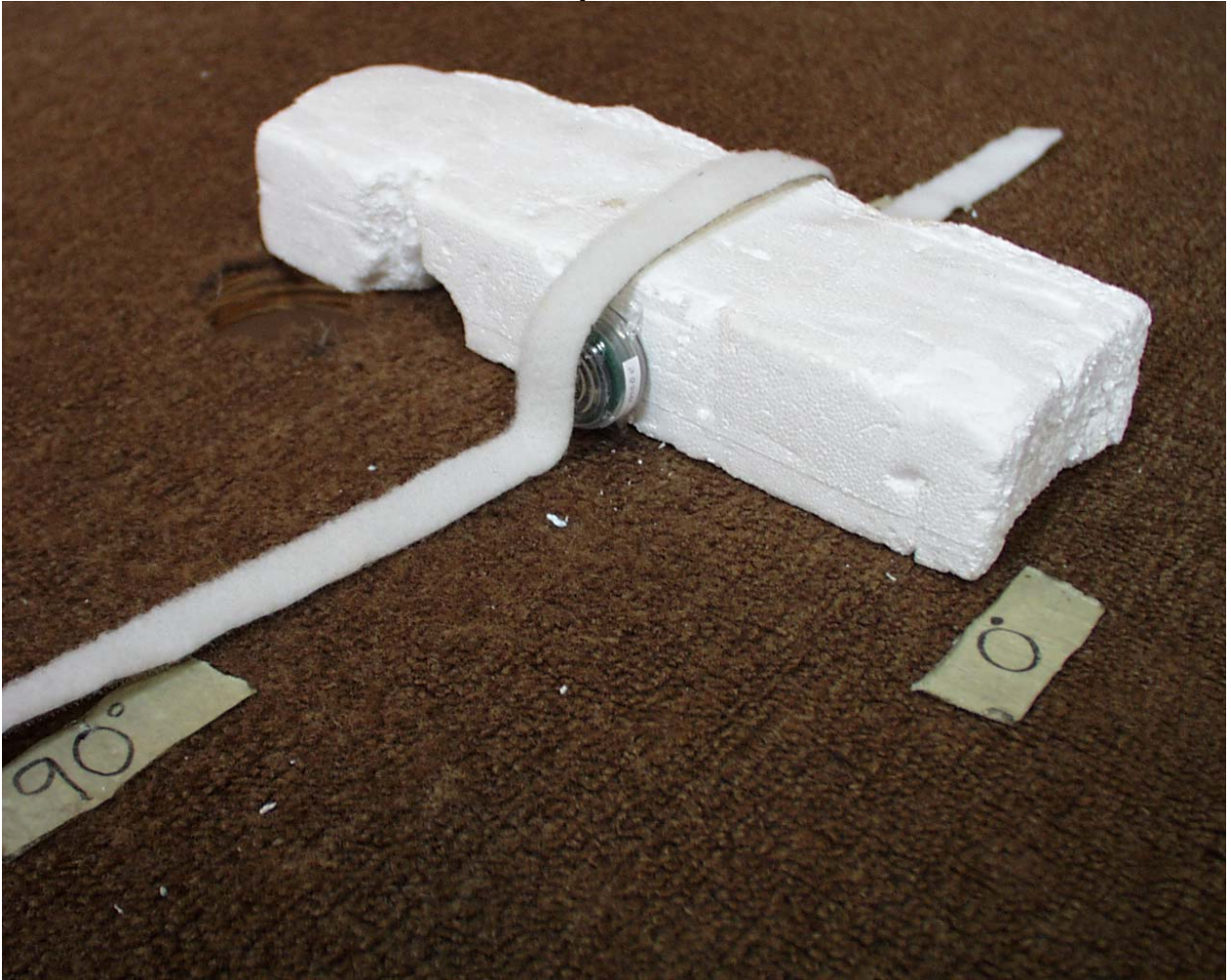
Radiated Setup – side position

page 11

Radiated Setup – Flat orientation



Radiated Setup – End orientation



Radiated Setup – Side orientation



MEASUREMENT REPORT

Standards Applied to Test

ANSI C63.4 - 2001

CFR47 FCC Part 2, Part 15, SubPart C, 15.231e Intentional Radiator; SubPart B, Digital Device
RSS-210 Issue 6, AHD test procedures TP0101-01, TP0102-01

Equipment Configuration

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

- 1) be a representation of the installed configuration, and
- 2) comply with the minimum system configuration of ANSI C63.4.

Test Methodology / Justification

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

For the testing, the EUT was placed at the center of the table 80cm above the ground plane pursuant to ANSI C63.4 for stand-alone equipment. The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.

The pictures in this report, showing test setups, indicate the agreed upon configuration of testing for this product-type.

The internal lithium battery was replaced periodically throughout the testing to ensure that the greatest available battery power was available to the transmitter.

The line conducted emission testing was not performed on this product. In its final configuration the product is powered from an internal lithium battery only.

The EUT transmitted continuously throughout the evaluation.

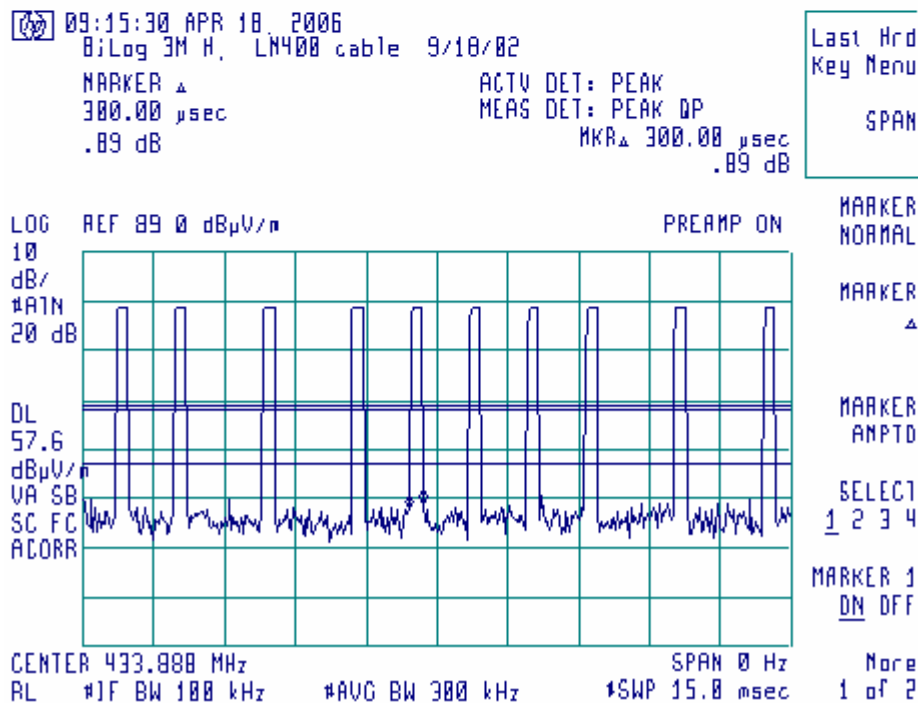
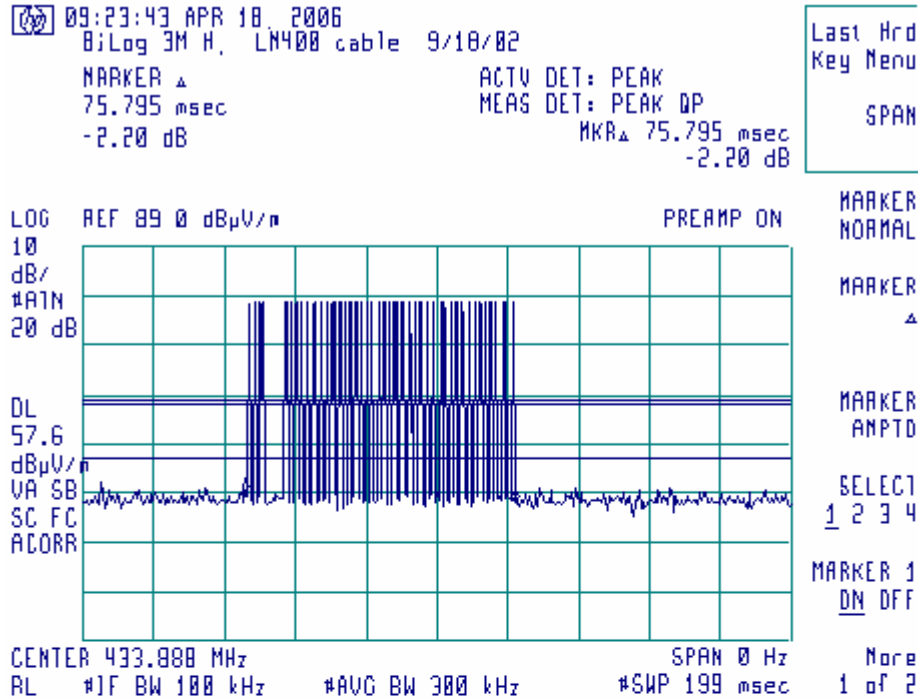
The EUT was placed in three orthogonal positions. At each position measurements were taken with the receive antenna in vertical and horizontal positions.

The EUT was tested with the transmitter in CW mode to determine the azimuth and antenna height to maximize the signal. The EUT was tested with the transmission modulated when evaluating the occupied bandwidth.

This measurement information was compared to the data obtained during earlier testing for FCC submittal.

Variance from Test Procedure

None.

Test Data**Duty Cycle Measurements: [15.231(b)]**

Packet length = 75.8mS

Header Gap = 4.9mS

Bit width = 300uS

Bit period = 938uS

Duty Cycle = ((75.8-4.9)* (300/938))/100= 22.7%

Radiated Field Strength Measurements: [15.231(b), 15.205]

MEASUREMENT PROCEDURE:

1. The EUT was setup to one of the three orthogonal positions.
2. The measurement antenna was positioned in vertical and horizontal polarities.
3. Steps 1-2 were repeated to cover all positions, and polarities.

DUT transmitting at 434MHz,

Freq. MHz	DUT position	Ant. Pol.	Corrected Data Peak Detector dBuV/m	**Duty Cycle Factor dB	Calculated Average Level dBuV/m	FCC Limit 15.231e dBuV/m	Margin dB	Cable +Ant. Factor dB+dB/m
434	flat	H	77.0	12.88	64.12	74.9	10.78	19.3
868	flat	H	51.7	12.88	38.8	52.9	14.1	26.5
1302	flat	V	60.3	12.88	47.42	54	6.5	30.3
1736	flat	V	59.2	12.88	46.32	54	7.7	34.7
2170	end	V	47.1	12.88	34.22	54	19.7	32.1
2604	side	V	52.8	12.88	39.9	54	14.1	34.2
3038	-	-	51 in noise floor	12.88	<38.1	54	>15.8	37.4
3472	side	V	52.3	12.88	39.4	54	14.5	38.6
3906	-	-	53.1 in noise floor	12.88	<40.2	54	>13.7	38.6
4340	-	-	54.8 in noise floor	12.88	<41.9	54	>12.1	39.2

**Duty Cycle factor can vary from approximately 12.88dB to 19.6dB. 12.88dB is used in the table above because it determines the highest possible calculated level of the RF emission from the unit under test.

Occupied Bandwidth [15.231(c)]

The maximum allowed 20dB bandwidth is determined pursuant to 15.23(c). For fundamental signals between 70MHz and 900MHz the bandwidth allowed is 0.25% of the fundamental.

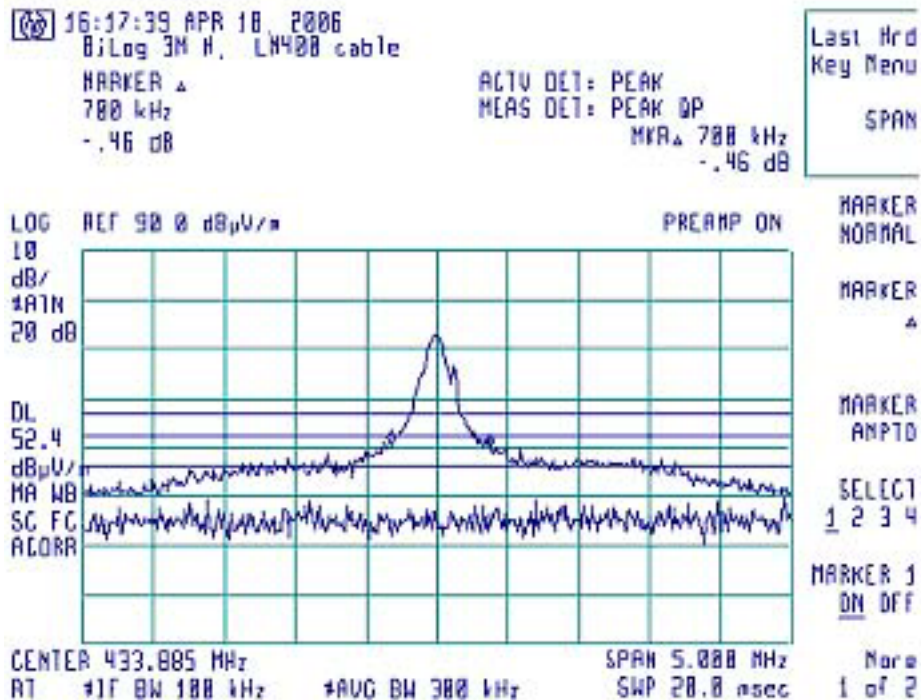
Formula 2: Allowed bandwidth = [Fundamental] x [.0025]

MEASUREMENT PROCEDURE:

1. The EUT was setup to modulate the transmission.
2. The measurement equipment resolution bandwidth was experimentally adjusted to approximately 3% of the final measured occupied bandwidth.
3. The 99% method was used.

Fundamental (MHz)	Measured Bandwidth -20dBC @ 100KHz RBW	LIMIT Fundamental * .0025
434	700 KHz	1085 KHz

This chart shows the measured bandwidth signal.



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 M-152, Dowagiac, Michigan 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC and Industry Canada. The report filed with the FCC is, dated November 5, 1996, was accepted by the FCC in a letter dated January 15, 1997, (31040/SIT 1300F2). The report filed with Industry Canada, dated August 11, 1998, was accepted via a letter dated September 1, 1998, (file:IC3161).

Measurement Equipment Used

Equipment Calibration	Model	S/N	Last Cal	
			Date	Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	18-Aug-05	12 months
RF Receiver Section	HP-85462A	3625A00342	18-Aug-05	12 months
EMCO BiconiLog Antenna	3142	1077	12-Aug-05	12 months
(3-M) LMR-400 Ultra Flex	LMR400	9812-11	05-Nov-05	6 months
Double Ridged Horn	ONO91202-2	A00329	calibration by design & physical inspection.	

Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 22deg.C., the relative humidity 33%.

APPENDIX A

General Measurement Procedures

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.

During the evaluation the transmitter was on continuously.

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.

The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions. Both Vertical and Horizontal RF profiles were evaluated.

The principle settings of the EMI Receiver for radiated testing include:

IF Bandwidth: 120KHz for frequencies less than 1GHz.
1 MHz for frequencies greater than 1GHz.

Detector Function: Peak Mode

The Average levels were determined mathematically based upon the duty cycle of the pulsed modulation of the transmitted signal.

At frequencies up to 1000MHz a BiconiLog broadband antenna was used for measurements.

At frequencies above 1000MHz a double-ridge Horn broadband antenna was used for measurements.

The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.

At each duty cycle, measurements were taken with the receive antenna in vertical and horizontal positions.

The unit was evaluated up to the tenth harmonic of the fundamental as an intentional radiator, and up to 1000MHz as a digital device.

FORMULAS AND SAMPLE CALCULATIONS:

THE HP8546A EMI Receiver has stored in memory the antenna and coax correction factors used in this test. The resultant Field Strength (FS) in dBuV/m presented by the HP8546A is the summation in decibels (dB) of the Received Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF).

Formula 1:
$$FS(\text{dBuV/m}) = RF(\text{dBuV}) + AF(\text{dB/m}) + CF(\text{dB})$$

The resultant Field Strength measurement is recorded using the peak hold detector of the HP8546A.

This recorded peak level is further corrected, by calculation, to an average level by a factor determined by the duty cycle of the pulsed modulation. The duty cycle factor was previously determined to vary between 16.8dB and 19.6dB. The 16.8dB term is used as this results in a calculation of the greatest value of averaged signal strength.

The allowed occupied bandwidth of the fundamental is calculated as

Formula 2:
$$BW(\text{KHz}) = F_o(\text{KHz}) * .0025$$

$$BW = 434000 * .0025 = 1085\text{KHz}$$

Calculation of FCC limits Part 15.231e:

For the frequency range 260MHz - 470MHz, the limit is a linear interpolation between 1500uV/m and 5000uV/m where the limit at 260MHz is 1500uV/m and the limit at 470MHz is 5000uV/m.

A formula to calculate the limit is established with a ratio linearly equating the frequency range to the limit range.

$$(F_o - F_L) / (F_H - F_L) = (L_o - L_L) / (L_H - L_L)$$

where F_o and L_o represent the frequency in question and its limit

where F_L and L_L represent the lower frequency (260MHz) and its limit (1500uV/m).

Where F_H and L_H represent the higher frequency (470MHz) and its limit (5000uV/m).

The calculations for the operating frequencies of this device are:

$$434\text{MHz} \quad (434 - 260) / (470 - 260) = (L_o - 1500) / (5000 - 1500)$$

$$(174 / 210) * (3500) = L_o - 1500$$

$$L_o = 2900 + 1500$$

$$L_o = 4400 \text{ uV/m is LIMIT at 434MHz}$$

The limit in dB terms is calculated as the result of 20 times the log of the uV/m limit.

$$434\text{MHz} \quad \text{dB limit is } 20 * \text{LOG}(4400 \text{ uV/m}) = 72.9 \text{ dBuV/m}$$

Cable Loss

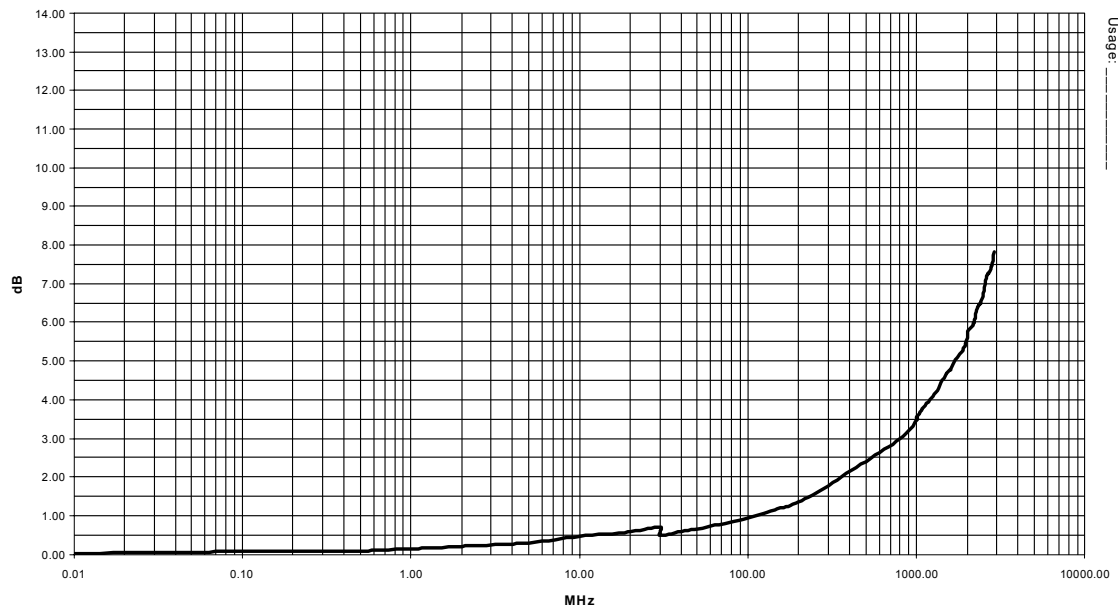
Attenuation of coax cables used during this test.

Radiated at 3 meters; 30MHz through 2900MHz

Coax #9812-11

between Antenna and EMI Receiver

Last Calibration date: 05-Nov-05

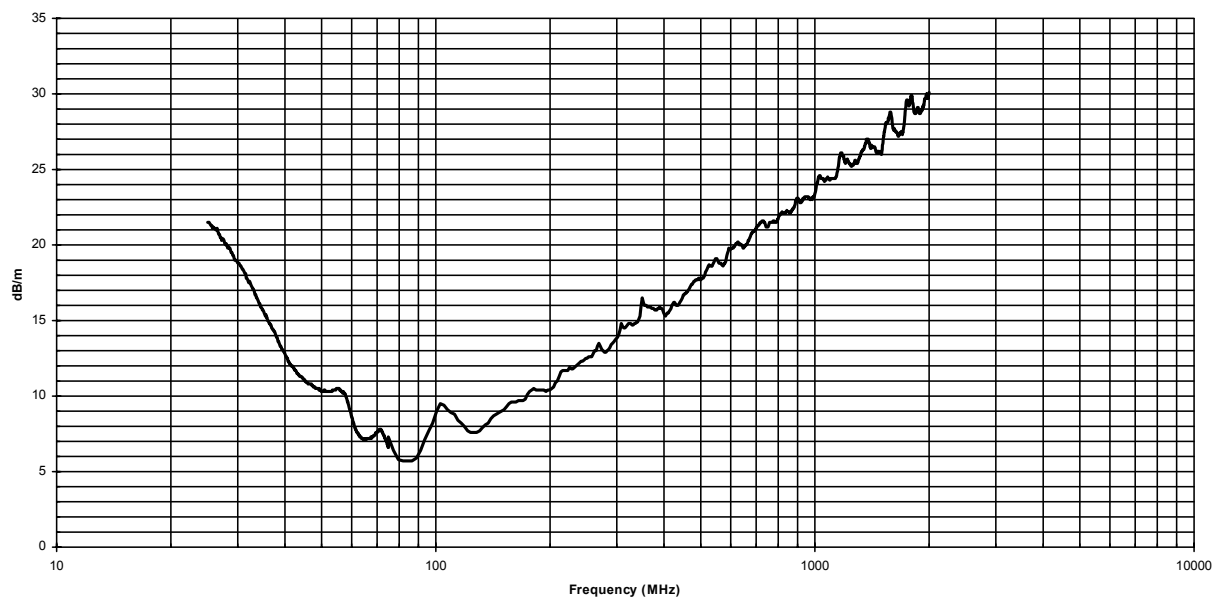


Antenna Factors


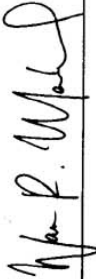
EMCO Model 3142 Antenna #9608-1077

Last Calibration Date; August 12, 2005

3 Meter Distance Factors



AHD Endorsements

<p>United States Department of Commerce National Institute of Standards and Technology</p>	<p>NVLAP[®]</p> <p>Certificate of Accreditation</p>	
<p>ISO/IEC 17025:1999 ISO 9002:1994</p>	<p>AHD (AMBER HELM DEVELOPMENT, L.C.) DOWAGIAC, MI</p>	<p>is recognized by the National Voluntary Laboratory Accreditation Program for satisfactory compliance with criteria set forth in NIST Handbook 150:2001, all requirements of ISO/IEC 17025:1999, and relevant requirements of ISO 9002:1994. Accreditation is awarded for specific services, listed on the Scope of Accreditation, for:</p>
<p>ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS</p>	<p>June 30, 2006</p>	<p> For the National Institute of Standards and Technology NVLAP Lab Code: 200129-0</p>
<p>Effective through</p>	<p>NVLAP-01C (06-01)</p>	

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 17, 2005

Registration Number: 90413

AHD EMC Laboratory
92723 M-152
Dowagiac, MI 49047

Attention: Gordon Helm

Re: Measurement facility located at Sister Lakes
3 & 10 meter site
Date of Renewal: May 17, 2005

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
Phyllis Parrish
Information Technician

NARTE Seal