

Test of WhereWand II Adapter

To: FCC 47 CFR Part 15.209 & IC RSS-210

Test Report Serial No.: ETSD04-A4 Rev A



TEST REPORT

FROM



Test of WhereWand II Adapter
to

FCC 47 CFR Part 15.209 & IC RSS-210

Test Report Serial No.: ETSD04-A4 Rev A

This report supersedes: None

Manufacturer: WhereNet
2858 De La Cruz Blvd.
Santa Clara
California 95050, USA

Product Function: 2.4 GHz Active RFID Tag

Copy No: pdf **Issue Date:** 27th June '07

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
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CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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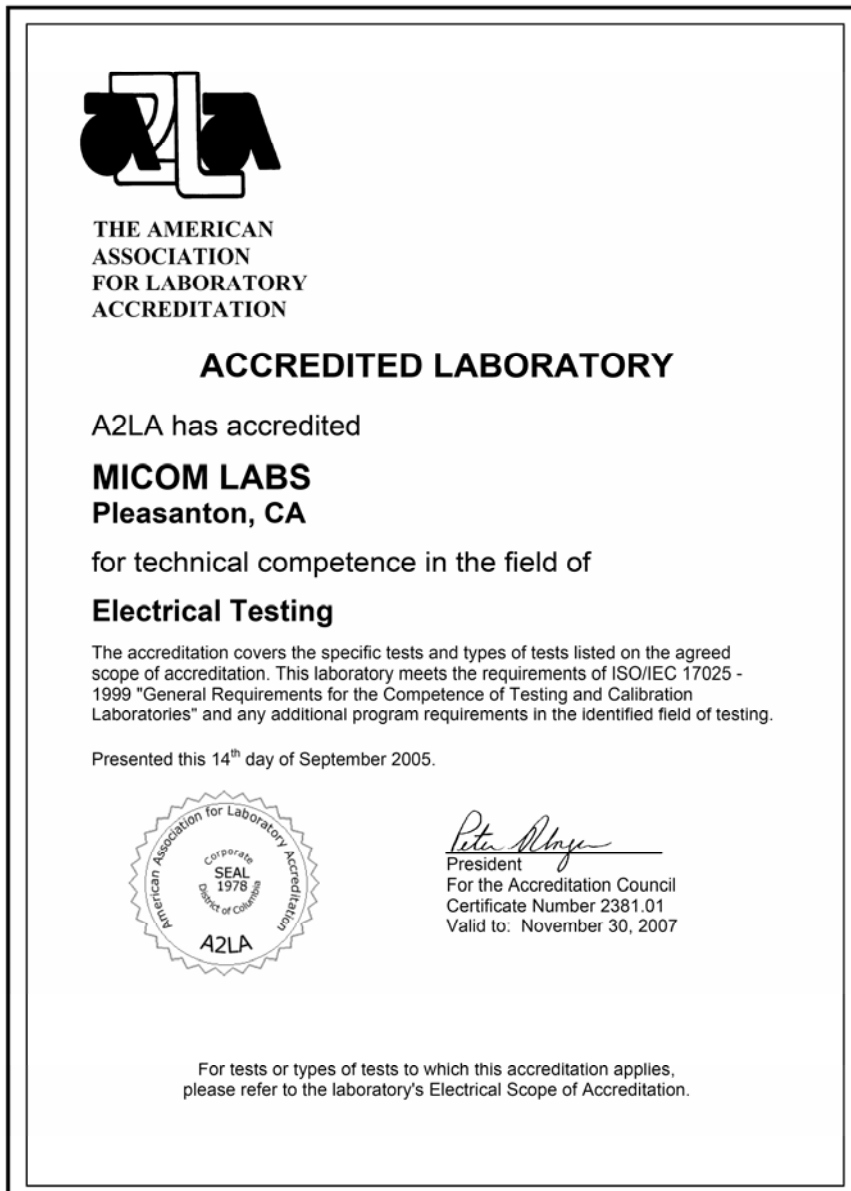
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ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



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LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America

Federal Communications Commission (FCC) Listing #: 102167

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	27 th June 2007	First issue.

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1. TEST RESULT CERTIFICATE

Manufacturer: WhereNet 2858 De La Cruz Blvd. Santa Clara California 95050, USA	Tested By: MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT: WhereWand II Adapter	Telephone: +1 925 462 0304
Model: WND-2100-00AA	Fax: +1 925 462 0306
S/N: Not Available	
Test Date(s): 1st to 6th June '07	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.209 & IC RSS-210	EQUIPMENT COMPLIES

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

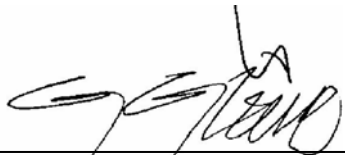
Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:



CERTIFICATE #2381.01



Graeme Grieve
Quality Manager MiCOM Labs,



Gordon Hurst
President & CEO MiCOM Labs, Inc.

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2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 15.209	2006	Code of Federal Regulations
(ii)	Industry Canada RSS-210	Issue 6 Sept. 2005	Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)
(iii)	ANSI C63.4	2003	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
(iv)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(v)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(vi)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(vii)	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
(viii)	A2LA	14 th September 2005	Reference to A2LA Accreditation Status – A2LA Advertising Policy

2.2. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.



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3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the WhereNet WhereWand II Adapter Model WND-2100-00AA to FCC Part 15.209 and Industry Canada RSS-210 regulations
Applicant:	As Manufacturer
Manufacturer:	WhereNet 2858 De La Cruz Blvd. Santa Clara California 95050, USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	ETSD04-A4 Rev A
Date EUT received:	1st June 2007
Standard(s) applied:	FCC 47 CFR Part 15.209 & IC RSS-210
Dates of test (from - to):	1st to 6th June '07
No of Units Tested:	2
Type of Equipment:	RFID Active Tag
Manufacturers Trade Name:	WhereWand
Model:	WhereWand II Adapter
Location for use:	Indoor/Outdoor use
Declared Frequency Range(s):	2400 - 2483.5 MHz, 114 to 127 kHz
Type of Modulation:	DSSS, OOK, FSK magnetic transmit
Declared Nominal Output Power:	DSSS: 0 dBm \pm 1.5 dB OOK: 0 dBm \pm 1.5 dB
EUT Modes of Operation:	DSSS, OOK, FSK magnetic transmit
Transmit/Receive Operation:	Time Division Duplex
Software Revision	1.1.0 (0)
Rated Input Voltage and Current:	5 Vdc, 40 mA
Operating Temperature Range:	Declared range 0 to +55°C
Microprocessor(s) Model:	Integrated LEON SPARC
Clock/Oscillator(s):	3 MHz, 30.521783 MHz
Frequency Stability:	\pm 20 ppm
Equipment Dimensions:	4.4"x2.7"x1.1"
Weight:	135 grams
Primary function of equipment:	RFID and real time local positioning and tracking device

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3.2. Scope of Test Program

The scope of the test program was to test the WhereNet, WhereWand RFID and real time local positioning and tracking device for compliance against FCC 47 CFR Part 15.209 and Industry Canada RSS-210 specifications.

FCC CFR 47 Part 15, subsection 15.209

Industry Canada RSS-210 Section 2.6

The WhereWand RFID real time local positioning and tracking device has three modes of operation which are not operating simultaneously;

DSSS & OOK: 2441.75 MHz

FSK magnetic transmit: 114.7 to 127 KHz

WhereNet WhereWand II WND-2100-00AA





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3.3. Equipment Model(s) and Serial Number(s)

Type (EUT/Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	WhereWand II RFID Tag	WhereNet	WND-2100-00AA	--
Support	Laptop	Dell		

3.4. Antenna Details

Antenna Type	Gain (dBi)	Manufacturer	Model No.	Serial No.
Ceramic Chip	+1.5	Johanson	2450AT45A100	--

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. NONE

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3.6. Test Configurations

Matrix of test configurations

Operational Mode	# Operating Channel(s)	Frequencies (MHz)
FSK	3	114.7 to 127 KHz

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.

3.7. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. None

3.8. Subcontracted Testing or Third Party Data

Radiated emissions are tested below and verified above 1 GHz at TUV Rheinland of North America's 10m chamber located at the following address;-

2305 Mission College Blvd.
Santa Clara
California 95054
USA

TUV Rheinland of North America IC Registration Number: IC 4453-1

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4. TEST SUMMARY

The following table represents the list of measurements required under the **FCC CFR47 Part 15.209** and **Industry Canada RSS-210 Section 2.6**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.209 2.6	Field Strength	Radiated Emission Limits, general requirements	Radiated	Complies	5.1.1
15.209(a)	Radiated Emissions	Emissions < 1 GHz	Radiated	Complies	5.1.2

Note 1: Test results reported in this document relate only to the items tested

Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

Note 3: Section 3.7 Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

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5. TEST RESULTS

5.1.1. Field Strength

FCC, Part 15 Subpart C §15.209
Industry Canada RSS-210 §2.6

Test Procedure

The field strength measurement was performed as a radiated test in a 3-meter anechoic chamber. The EUT was placed on a table 0.8 m above the ground-plane and emissions maximized through 360° rotation of the turntable, measurement distance 3m. A magnetic loop antenna was placed 0.8 m above the ground plane for measurement purposes. The limits specified at 300 meters were extrapolated for the 3 m measurement distance.

Peak, average and quasi-peak detectors were used to report the results of the intentional radiator.

The RFID transmitter was transmitting continuously at maximum power.

Limit Calculation

125KHz limit extrapolated to a 3 meter measurement distance (40dB/decade)

Field strength in $\mu\text{V/m}$ = $2,400/F$ (F in KHz) = $19.2 \mu\text{V/m}$
 $2,400/125 = 19.2 \mu\text{V/m}$

Conversion to $\text{dB}\mu\text{V/m}$ = $25.66 \text{dB}\mu\text{V/m}$

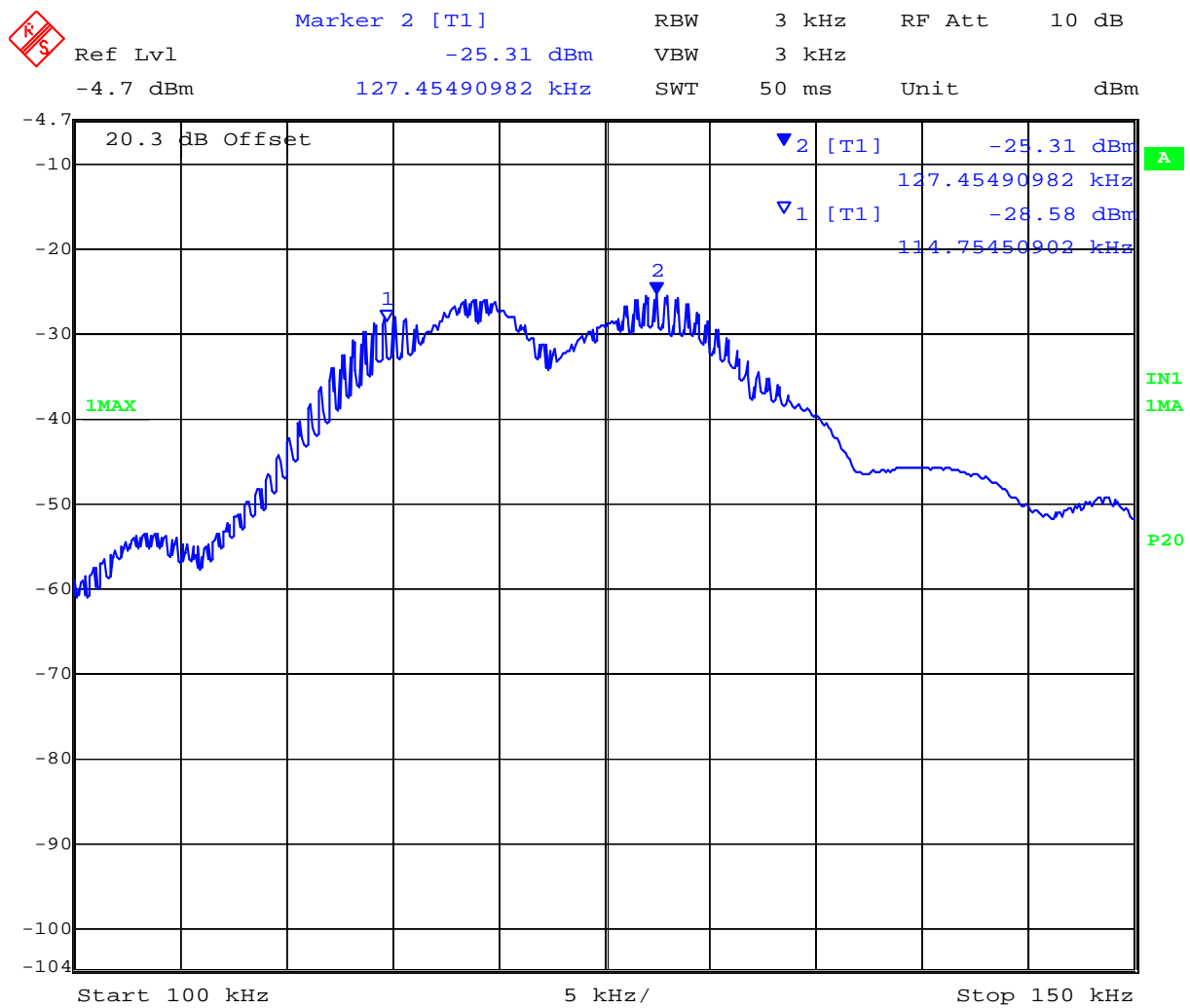
Limit = $25.66 \text{dB}\mu\text{V/m} + 80\text{dB} = 105.66\text{dB}\mu\text{V/m}$

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Measurement Results for Field Strength (9 kHz – 30 MHz)

Frequency (kHz)	Ave (dBuV/m)	Ave Limit (dBuV/m)	Ave Margin (dB)
114.75	78.42	105.66	-27.24
127.46	81.69	105.66	-23.97



Date: 1.JUN.2007 15:47:53

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Specification

Limits

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

2.6 Table 3 lists the permissible levels of unwanted emissions of transmitters and receivers as specified below.

Frequency(MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (meters)
0.009-0.490	2400/F (F in KHz)	300
0.490-1.705	24000/F (F in KHz)	30
1.705-30.0	30	30

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312, 0336

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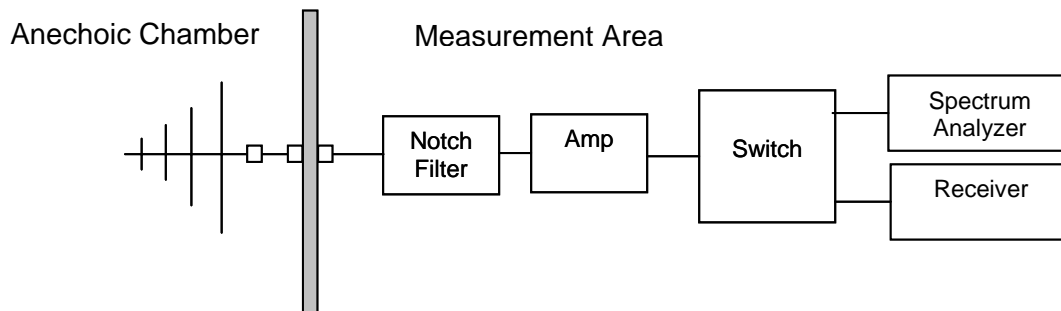
5.1.1.1. Radiated Spurious Emissions

FCC, Part 15 Subpart C §15.205/ §15.209

Test Procedure

Preliminary radiated emissions are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarity. The emissions are recorded with a spectrum analyzer in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode. Only the highest emissions relative to the limit are listed.

Test Measurement Set up



The product was initially tested to find worst case orientation for the maximization of spurious emissions. Worst case orientation was used for all emission testing.



Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

where: $FS = R + AF + CORR$

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:

Given a Receiver input reading of 51.5dB μ V; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu\text{V/m}))}$$

$$40 \text{ dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250\mu\text{V/m}$$

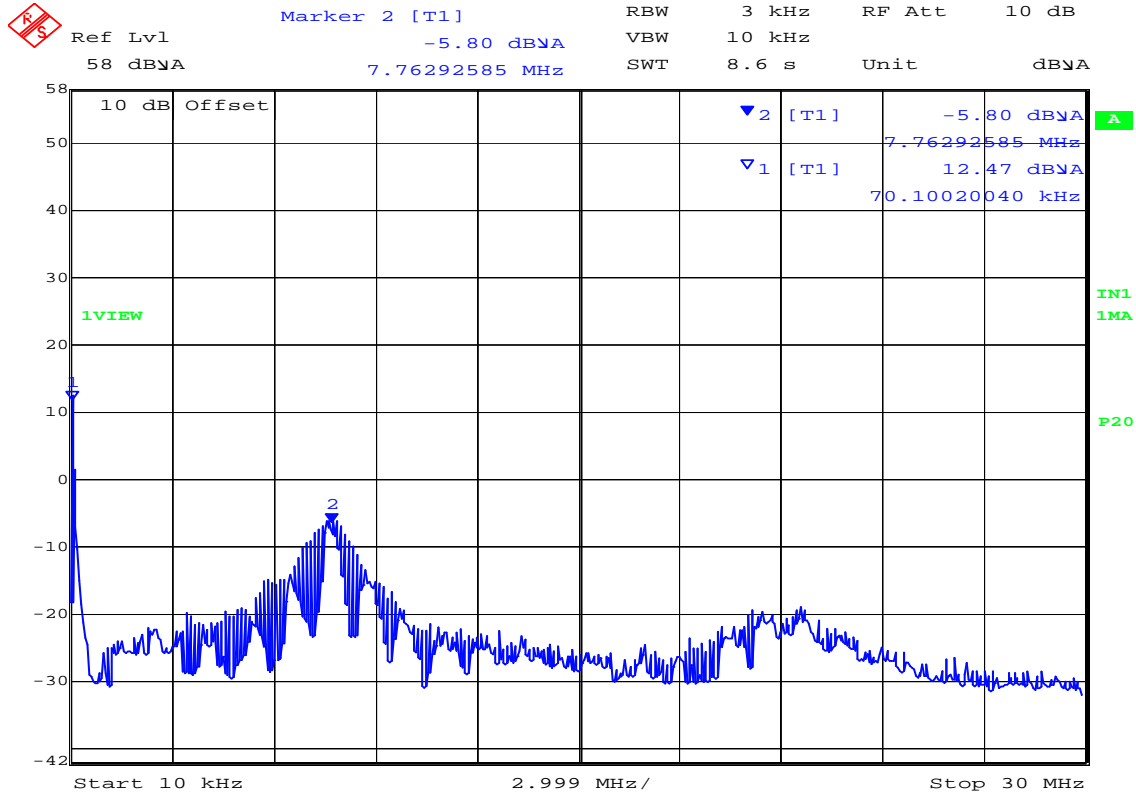
Measurement Results for Spurious Emissions (30 MHz – 1 GHz)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar



Radiated Spurious Emissions 10 kHz to 30 MHz



Date: 1.JUN.2007 21:19:46

Limit per FCC 15.209 = 2400/F in kHz (< 490 KHz)

Worst case limit (lowest limit) will be at highest fundamental frequency – 127 KHz

Limit 127 kHz (@ 300m) = 18.89 uV/m = 25.52 dBuV/m

Limit @ 7.763 MHz = 30 uV/m = 29.5 dBuV/m (30m)

Correction factor for 3m measurement distance = $10 * \text{Log} (300/3)^2 = +40\text{dB} (<490 \text{ kHz})$

Limit @ 127 KHz = 25.52 + 40 = **65.52 dBuV/m**

Correction factor 3m measurement distance = $10 * \text{Log} (30/3)^2 = +20\text{dB} (1.705-30 \text{ MHz})$

Limit @ 7.763 MHz = 29.5 + 20 = **49.5 dBuV/m**

Conversion from dBuA to dBuV/m = +34dB

Measured value at 127 KHz = 12.5 + 34 = **46.5 dBuV/m @ 3m measurement distance**

Margin = 46.5 - 65.52 = -19.02dB

Measured value @ 7.763 MHz = 29.5 + 34 = **28.2 dBuV/m @ 3m measurement distance**

Margin = 28.2 – 49.5 = -21.3 dB

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Specification

Limits

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

2.6 Table 3 lists the permissible levels of unwanted emissions of transmitters and receivers as specified below.

Frequency(MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (meters)
0.009-0.490	2400/F (F in KHz)	300
0.490-1.705	24000/F (F in KHz)	30
1.705-30.0	30	30

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Radiated Spurious Emissions 30 MHz to 1 GHz

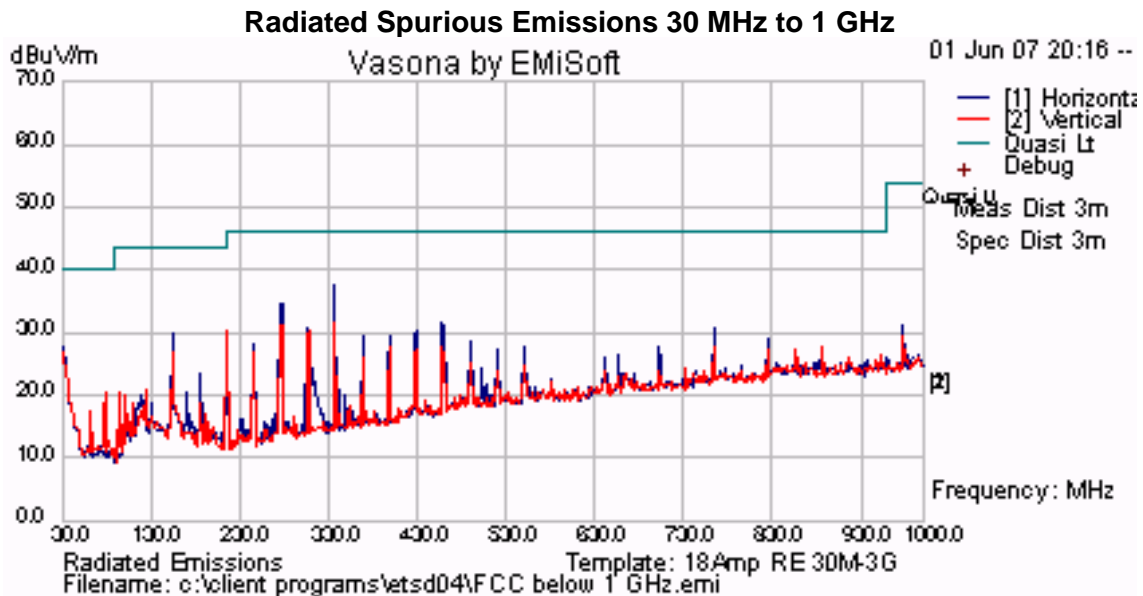


TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity

No emissions were found within 6 dB of the limit

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Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

§15.209 (a) and RSS-Gen §2.2 Limit Matrix

Frequency(MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Field Strength ($\text{dB}\mu\text{V}/\text{m}$)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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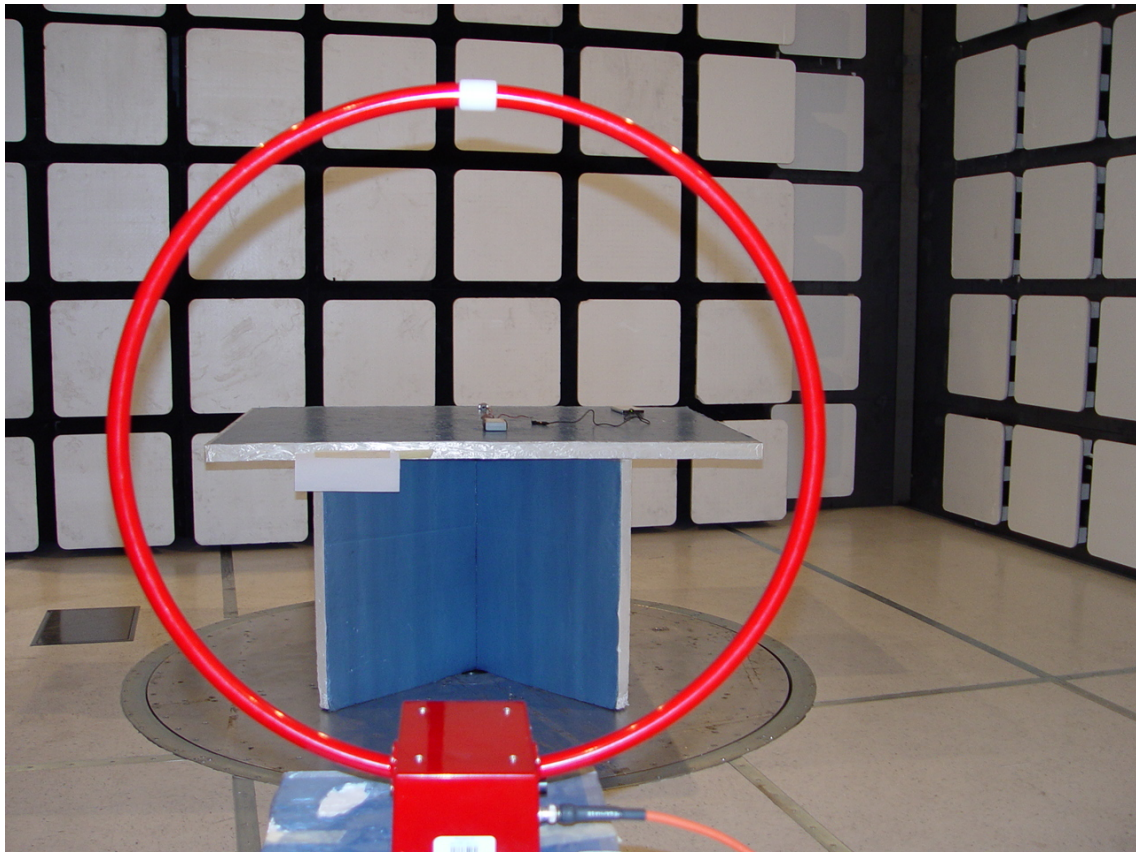
Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312, 0336

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6. PHOTOGRAPHS

6.1. Transmitter carrier output levels (9 kHz - 30 MHz) and Spurious Emissions



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7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Model #	Serial #
0070	Power Meter	Hewlett Packard	437B	3125U13554
0336	Active Loop Antenna 9 kHz to 30 MHz	EMCO	6502	00060498
0104	Horn Antenna	The Electro-Mechanics Company	3115	9205-3882
0116	Power Sensor	Hewlett Packard	R8485A	3318A19694
0134	Amplifier	ComPower	PA-122	181910
0156	Barometer /Thermometer	Control Co.	4196	E2844
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	K-Cable	Megaphase	Sucoflex 104	Unknown
0304	2.4GHz Notch Filter	Micro-Tronics	BRM50701	001
0310	2m SMA Cable	Micro-Coax	UFA210A-0- 0787-3G03G0	209089-001
0312	3m SMA Cable	Micro-Coax	UFA210A-1- 1181-3G0300	209092-001
0313	Coupler	Hewlett Packard	86205A	3140A01285
0314	30 dB N-Type Attenuator	ARRA	N944-30	1623

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