Test of MeshLinx MWI 5000 Wireless AP

To: FCC Part 90 Subpart Y & IC RSS-111

Test Report Serial No.: MLWI01-A10 Rev B

TEST REPORT

FROM

MiCOM Labs

Test of MeshLinx MWI 5000 Wireless AP

To FCC Part 90 Subpart Y & IC RSS-111

Test Report Serial No.: MLWI01-A10 Rev B

This report supersedes MLWI01-A10 Rev A

Manufacturer: MeshLinx Wireless Inc
1500 International Parkway,
Suite 200
Richardson, Texas 75081 USA

Product Function: 4.9 GHz Wireless Access Point

Copy No: pdf **Issue Date:** 11th July 2008

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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A2LA ACCREDITED
CERTIFICATE #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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ACCREDITATION, LISTINGS & RECOGNITION

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

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

MICOM LABS
Pleasanton, CA

for technical competence in the field of

Electrical Testing

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 14th day of September 2005.

American Association for Laboratory Accreditation
Corporate SEAL 1978 District of Columbia
A2LA

President
For the Accreditation Council
Certificate Number 2381.01
Valid to: November 30, 2007

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

North America

United States of America
Federal Communications Commission (FCC) Listing #: 102167

RECOGNITION

APEC MRA (Asia-Pacific Economic Community Mutual Recognition Agreement)

Conformity Assessment Body (CAB) – MiCOM Labs

Test data generated by MiCOM Labs is accepted in the following countries under the APEC MRA.

Country	Recognition Body	Phase	CAB Identification No.
Australia	Australian Communications and Media Authority (ACMA)	I	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	I	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	I	
Singapore	Infocomm Development Authority (IDA)	I	
Taiwan	Directorate General of Telecommunications (DGT) Bureau of Standards, Metrology and Inspection (BSMI)	I I	

DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	4th September 2007	First issue.
Rev B	11th July 2008	Revised Section 5.1.4 Maximum Permissible Exposure, added statement; *Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

1. TEST RESULT CERTIFICATE

Manufacturer:	MeshLinx Wireless Inc 1500 International Parkway, Suite 200 Richardson, Texas 75081 USA	Tested By:	MiCOM Labs, Inc. 440 Boulder Court Suite 200 Pleasanton California, 94566, USA
EUT:	4.9 GHz Wireless Access Point	Telephone:	+1 925 462 0304
Model:	MWI 5000	Fax:	+1 925 462 0306
S/N:	001		
Test Date(s):	23rd to 27th July 2007	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC Part 90 Subpart Y & IC RSS-111	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.

ACCREDITED
CERTIFICATE #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

Ref.	Publication	Year	Title
(i)	FCC 47 CFR Part 90	2007	Code of Federal Regulations
(ii)	FCC 47 CFR Part 90 Sect 90.210 Sect 90.1215	August 2007	90.210 Emission Masks (Revised requirements) 90.1215 Power Limits (Revised requirements)
(iii)	Industry Canada RSS -111	Issue 2 June 2007	Broadband Public Safety Equipment Operating in the Band 4940 4990 MHz
(iv)	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
(v)	CISPR 22/ EN 55022	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
(vi)	ANSI/TIA-603	2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
(vii)	M 3003	Edition 1 Dec. 1997	Expression of Uncertainty and Confidence in Measurements
(viii)	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
(ix)	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
(x)	A2LA	14th 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.

3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

Details	Description
Purpose:	Test of the MeshLinx MWI 5000 Wireless AP to FCC 47 CFR Part 90 Subpart Y regulations and Industry Canada RSS-111 regulations.
Applicant:	As Manufacturer
Manufacturer:	MeshLinx Wireless Inc 1500 International Parkway, Suite 200, Richardson, Texas 75081 USA
Laboratory performing the tests:	MiCOM Labs, Inc. 440 Boulder Court, Suite 200 Pleasanton, California 94566 USA
Test report reference number:	MLWI01-A10 Rev B
Date EUT received:	23rd July 2007
Dates of test (from - to):	23rd to 27th July 2007
Standard(s) applied:	FCC Part 90 Subpart Y & IC RSS-111
No of Units Tested:	1
Type of Equipment:	4.9 GHz Wireless Access Point
Manufacturers Trade Name:	MeshLinx Wireless Inc
Model:	MWI 5000
Location for use:	Outdoor use.
Declared Frequency Range(s):	4940 to 4990 MHz
Type of Modulation:	QPSK, 16QAM, 64QAM
Operational Bandwidths:	20 MHz
Declared Maximum Output Power:	+16 dBm
ITU Emission Designator:	18M9W7D
Transmit/Receive Operation:	Time Division Duplex (TDD)
Rated Input Voltage and Current:	115 Vac, 0.12 Amps
Operating Temperature Range:	Declared range -30 to +45ºC
Microprocessor(s) Model:	Intel IXP425
Clock/Oscillator(s):	33.33 MHz, 40 MHz, 80 MHz
Frequency Stability:	±20 ppm max
Equipment Dimensions:	14” X 14” X 8”
Weight:	7½ lbs
Primary function of equipment:	Wireless Access Point

3.2. Scope of Test Program

The scope of the test program was to test the MeshLinx Wireless Inc MeshLinx MWI 5000 Wireless AP for compliance against;-

FCC 47 CFR Part 90, Subpart Y regulatory requirements.

18th May 2005 revision of FCC 47 CFR Part 90;-

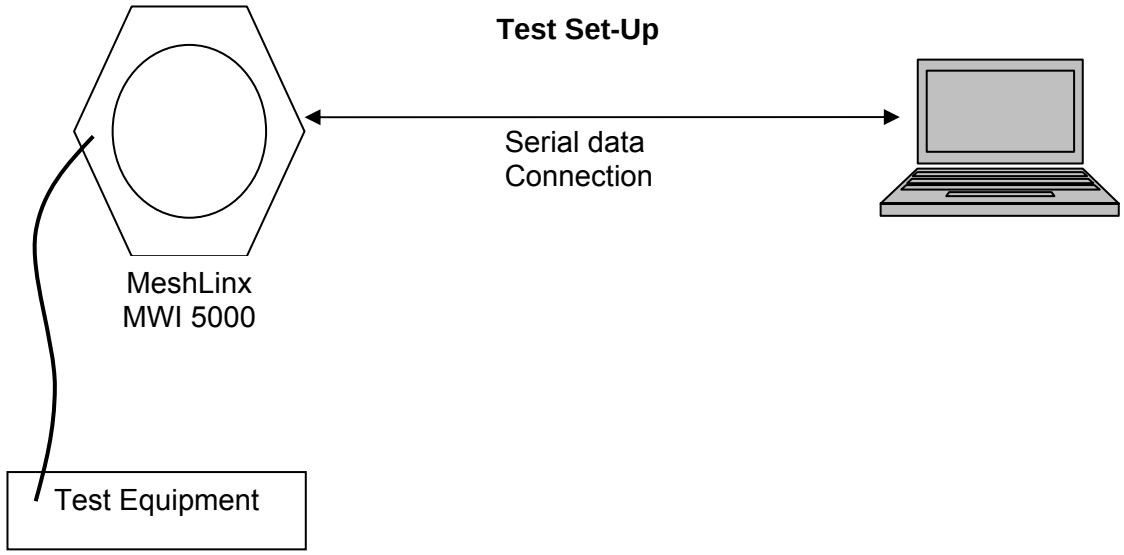
Sub Section 90.210	Emission Masks (revised requirements)
Sub Section 90.1215	Power Limits (revised requirements)

and Industry Canada RSS-111 specifications.

MeshLinx Wireless Inc
MWI 5000
Wireless Access Point

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	Wireless AP	MeshLinx	MWI 5000	001
Support	Laptop PC	Dell	Inspiron	None



3.4. Antenna Details

1. 4.9-5.1GHz 9 dBi Omni Directional Antenna

   Model Number: MT-462006/N/A

3.5. Cabling and I/O Ports

Number and type of I/O ports

1. 10/100 Ethernet
2. Local maintenance terminal 10/100 Ethernet
3. 115 Vac 60 Hz
4. 3 x antenna ports (N-Type connector)

3.6. Test Configurations

Matrix of test configurations

Parameter	Operational Mode	Test Conditions	Bandwidths (MHz)
26 dB / 99% Occupied BW & Emission Mask	Modulated	Ambient 115 Vac 60 Hz	20
Average Output Power			
Peak Power Spectral Density			
Frequency Stability	CW	Temperature and Voltage Variations	N/A
Conducted Spurious Emissions	Modulated	Ambient 115 Vac 60 Hz	20
Radiated Spurious Emissions	Modulated	Ambient 115 Vac 60 Hz	20
AC Wireline Emissions	Modulated	Ambient 115 Vac 60 Hz	20

BW (MHz)	Modulation	
	Low (MHz)	High (MHz)
20	4955	4975

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. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

3.8. Deviations from the Test Standard

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

1. NONE

3.9. Subcontracted Testing or Third Party Data

1. NONE

4. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 90**, **Subpart Y, Industry Canada RSS-111,** and **Industry Canada RSS-Gen.**

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1049; 90.210(L) **4.4**	26 dB / 99% Occupied BW & Emission Mask	Emission mask and bandwidth measurement(s)	Conducted	Complies	5.1.1
2.1046; 90.1215 (a) **4.3**	Output Power	Modulated Output Power	Conducted	Complies	5.1.2
2.1046; 90.1215 (a) **4.3**	Peak Power Spectral Density	Maximum Spectral Density	Conducted	Complies	5.1.3
Subpart C 90.1217	Maximum Permissible Exposure	Exposure to radio frequency energy levels	Calculation	Complies	5.1.4
2.1055(a)(1); 90.213 **4.2**	Frequency Stability	Includes temperature and voltage variations	Conducted	Complies	5.1.5
2.1051; 90.210(m) **4.4/4.5** **6**	Conducted Spurious Emissions at Antenna Port	Emissions from the antenna port 30 MHz – 40 GHz	Conducted	Complies	5.1.6

Section(s)	Test Items	Description	Condition	Result	Test Report Section
2.1053; 90.210(m) **ANSI/TIA-603** **4.4**	Radiated Spurious Emissions	Spurious emissions	Radiated	Complies	5.1.7
Industry Canada only **RSS-Gen §4.8, §6**	Receiver Radiated Spurious Emissions	Emissions above 1 GHz		Complies	*5.1.8.*
15.207 **7.2.2**	AC Wireline Conducted	Emissions 150 kHz–30 MHz	Conducted	Complies	*5.1.9*

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: ***Section3.7*** *Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix*

5. TEST RESULTS

5.1. Device Characteristics

5.1.1. Occupied Bandwidth and Emission Mask

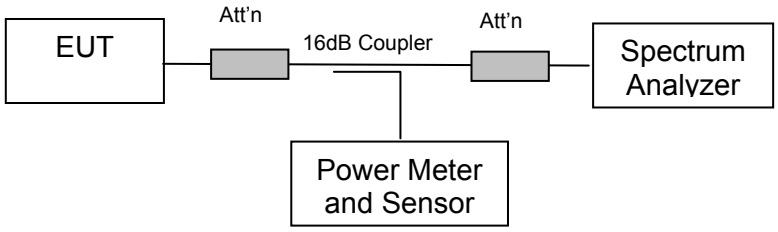
FCC 47 CFR Part 90, Subpart Y; 2.1049; §90.210(L)
Industry Canada RSS-111 §4.4

Test Procedure
The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure the 26 dB and 99% occupied bandwidth and emission mask for the radio. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

For emission masks the zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz.

The EUT is not equipped with an audio low-pass filter.

Test Measurement Set up

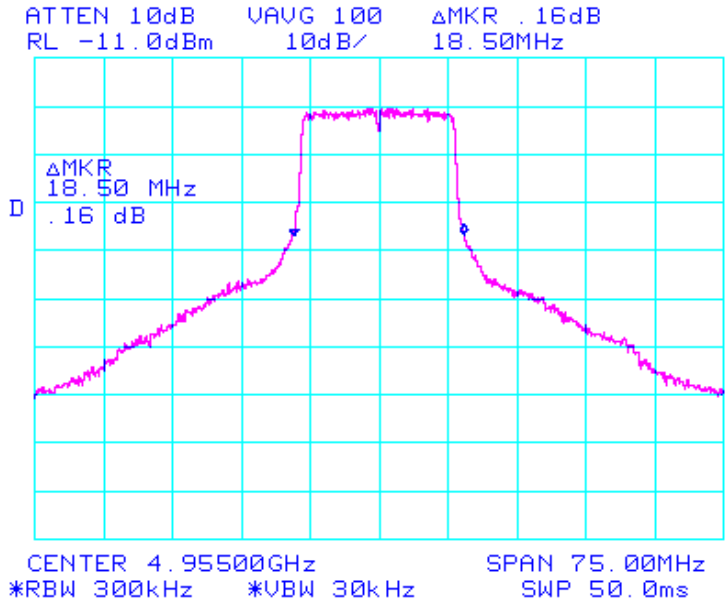


Test set up for Occupied Bandwidth and Mask measurement(s)

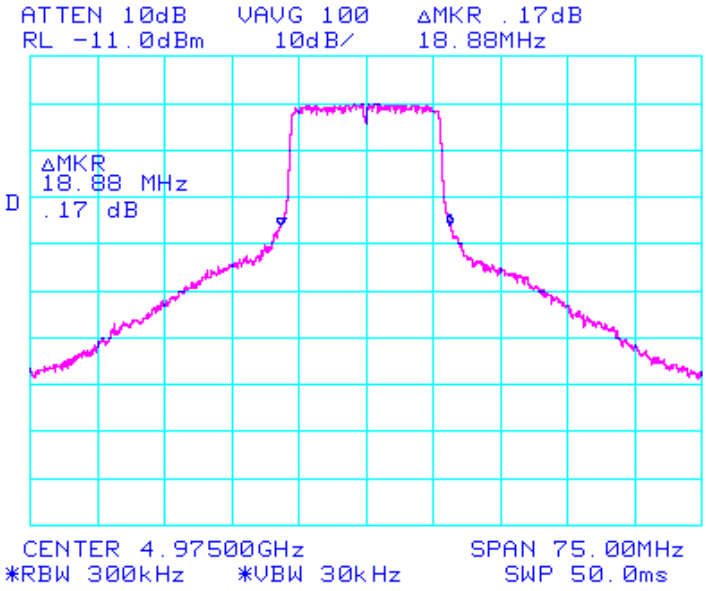
Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Center Frequency (MHz)	26 dB Bandwidth (MHz)
4955	18.50
4975	18.88

4955 MHz 26dB Bandwidth



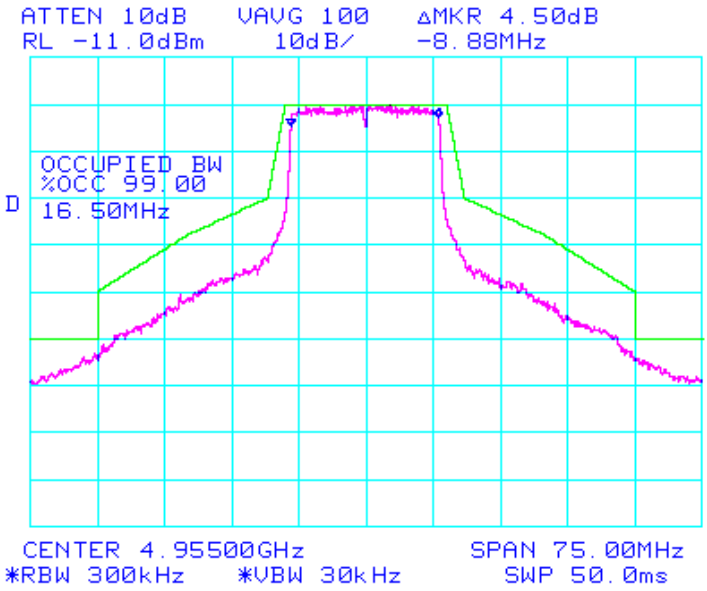
4975 MHz 26dB Bandwidth



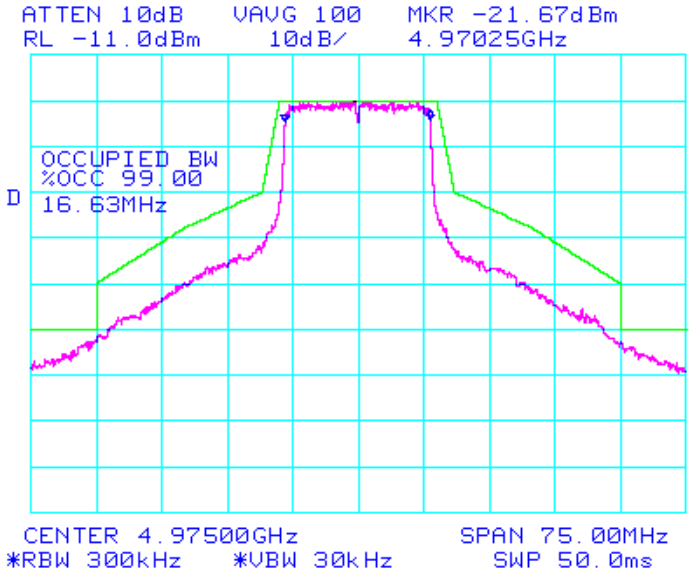
99% Bandwidth

Center Frequency (MHz)	99% Bandwidth (MHz)
4955	16.50
4975	16.63

4955 MHz 99% Bandwidth and Emission Mask



4975 MHz 99% Bandwidth and Emission Mask



Specification Limits
FCC Part §90.210

Limits for Authorized Bandwidth

Frequency Band (MHz) and Related Documents	Spectrum Masks with Audio Filter	Without Audio Filter
4950 – 4990 MHz	L or M	L or M

Reference to the emission masks are provided below

Limits Emission Masks
90.210(L), Emission Mask L. For low power transmitters (20 dBm of less) operating in the 4940 – 4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0 – 45% of the authorized bandwidth (BW) : 0dB.

(2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50 – 55 % of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150 % of the authorized bandwidth: 40 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

Limits Emission Masks (continued)

90.210(m), Emission Mask M. For high power transmitters (greater than 20 dBm) operating in the 4940 – 4900 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0 – 45% of the authorized bandwidth (BW) : 0dB.

(2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: 568 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50 – 55 % of the authorized bandwidth: 26 + 145 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

Note to paragraph m: Low power devices may as an option, comply with paragraph (m).

Laboratory Measurement Uncertainty for Power Measurements

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

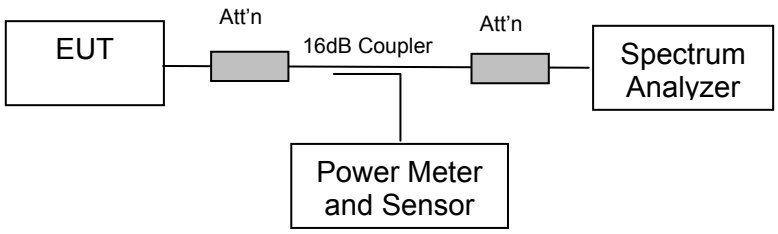
5.1.2. Peak Output Power

FCC 47 CFR Part 90, Subpart Y; 2.1046; §**90.1215**
Industry Canada RSS-111 §**4.3**

Test Procedure

Average power measurements were measured with the use of an average power head. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

Test Measurement Set up



Test set up for Peak and Average Output Power

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Output Power

Center Frequency (MHz)	Output Power (dBm)
4955	+14.6
4975	+14.6

Specification Limits

FCC Part §90.1215(a)

Power limits.

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

Channel Bandwidth (MHz)	Low power peak transmitter power (dBm)	High power peak transmitter power (dBm)
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

(c) The peak transmit power is measured as a conducted emission over any interval of continuous transmission calibrated in terms of an RMS-equivalent voltage. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement conforming to the definitions in this paragraph for the emission in question.

(d) The peak power spectral density is measured as conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected

directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of one MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Output Power'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.3. Peak Power Spectral Density (PPSD)

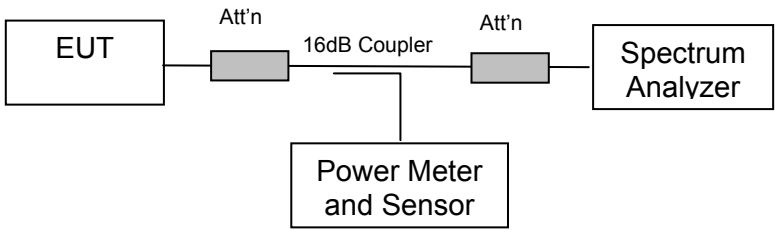
FCC 47 CFR Part 90, Subpart Y; 2.1046; §**90.1215**
Industry Canada RSS-111 §**4.3**

Test Procedure

The test methodology used for this measurement was determined to provide the highest possible PPSD readings.

Peak power spectral density measurements were performed via the spectrum analyzer and plots were recorded. Modulation was ON and the system duty cycle was set for 100% i.e. continuous operation at all times. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

Test Measurement Set up



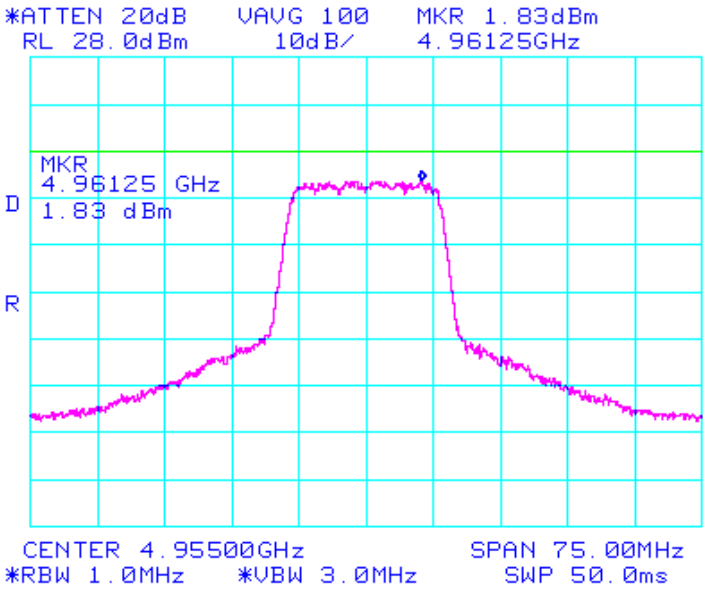
Test set up for Peak Power Spectral Density measurement(s)

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

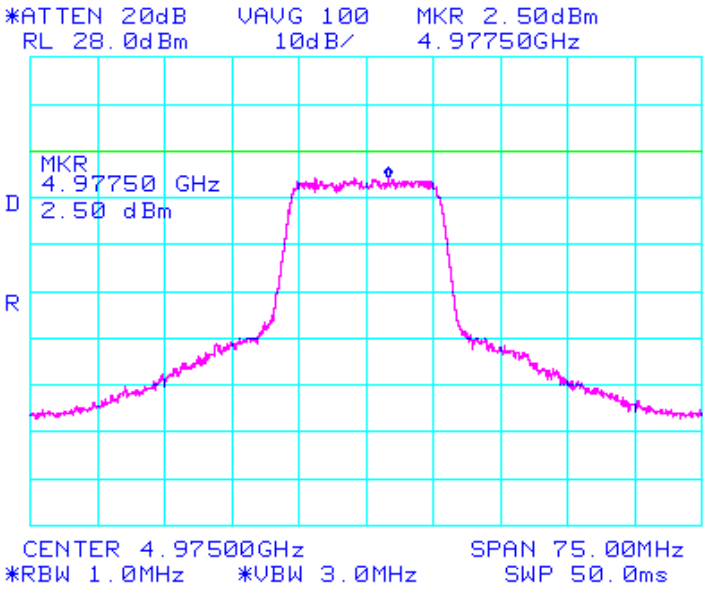
Peak Power Spectral Density

Center Frequency (MHz)	PPSD Maximum Frequency (MHz)	Peak Power Spectral Density(dBm)
4955	4961.25	1.83
4975	4977.50	2.50

4955 MHz - Peak Power Spectral Density



4975 MHz - Peak Power Spectral Density



Specification Limits
FCC Part §90.1215

Refer to the Power Limits Specification in Section 5.1.2 of this report.

Laboratory Measurement Uncertainty for Power Measurement

Measurement uncertainty	±1.33 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of RF Output Power'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.4. Maximum Permissible Exposure

FCC, Part 90 Subpart C §90.1217

Calculations for Maximum Permissible Exposure Levels

Power Density = Pd (mW/cm^2) = EIRP/(4πd^2)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm^2

Freq. Band (GHz)	Antenna Gain (dBi)	Numeric Gain (numeric)	Peak Output Power (dBm)	Peak Output Power (mW)	Calculated Safe Distance @ 1mW/cm^2 Limit (cm)
4.9	+9.0	7.95	+14.6	28.85	4.3*

*Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

Specification

Maximum Permissible Exposure Limits

§15.247(i) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines.

Limit S = 1mW / cm^2 from 1.310 Table 1

Note: for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

RSS-Gen §5.5 Before equipment certification is granted, the applicable requirements of RSS-102 shall be met.

Laboratory Measurement Uncertainty for Power Measurements

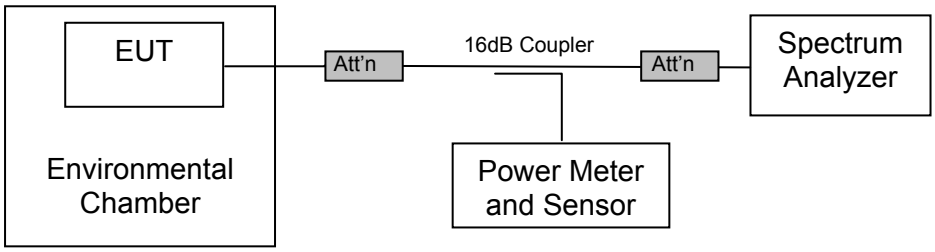
Measurement uncertainty	±1.33dB

5.1.5. Frequency Stability; Temperature Variations, and Voltage Variations

FCC 47 CFR Part 90, Subpart Y; 2.1055(a)(1); §**90.213**
Industry Canada RSS-111 §**4.2**

Test Procedure
The transmitter output was connected to a spectrum analyzer and the frequency stability was measured in a CW (continuous wave) operational mode. Frequency stability was measured through the extremes of temperature on the mid channel only. Before measurements were taken at each temperature the equipment waited until thermal balance was obtained.

Test Measurement Set up



Measurement set up for Frequency Stability

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

TABLE OF RESULTS Frequency Stability

Voltage	Temperature (°C)	FREQUENCY (MHz)
		Channel (CW) 4955 MHz
115 Vac	-30	4954.97221
	-20	4954.96830
	-10	4954.96121
	+0	4954.95413
	+10	4954.94921
	+20	4954.94971
	+30	4954.96230
	+40	4954.99160
	+45	4955.01926
Maximum Frequency Drift with respect to the nominal frequency		+19.26kHz / -50.79kHz +3.89ppm / -10.25ppm

TABLE OF RESULTS Frequency Stability V's Input Voltage Variantion;-

Voltage Variations at Ambient

Temperature	Voltage (Vac, 60 Hz)	FREQUENCY (MHz)
		Channel 4955 MHz
Ambient	+115.0	4954.94971
	+126.5	4954.94973
	+103.5	4954.94973

Manufacturers Specification for Frequency Stability

As no apparent frequency stability limits were provided the manufacturer's specification was used ±20 ppm.

Laboratory Measurement Uncertainty for Frequency Stability

Measurement uncertainty	±0.866 ppm

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-02 'Frequency Measurement'	0070, 0116, 0158, 0193, 0252, 0313, 0314.

5.1.6. Spurious Emissions at Antenna Terminals

FCC 47 CFR Part 90, Subpart Y; 2.1051; §90.210(m)
Industry Canada RSS-111 §4.4

5.1.6.1. Transmitter Conducted Spurious Emissions (30 M- 40 GHz)

Test Procedure
Transmitter conducted spurious emissions were measured for each bandwidth and modulation state. Measurement were made while EUT was operating in a modulated transmit mode of operation, at the appropriate center frequency, 100% duty cycle and maximum power at all times. Conducted spurious emissions were measured to 40 GHz.

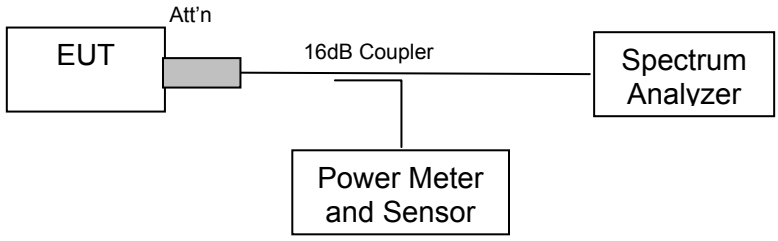
Limits were calculated which depended on average transmit power level(s).

See test report Section 5.1.2 for average power level measurements
Highest and lowest power level: +14.6 dBm

Limit
From FCC Part 90.210 (L)
On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 40 dB.

Spurious Limit: +14.6 – 40 = -25.4 dBm

Test Measurement Set up

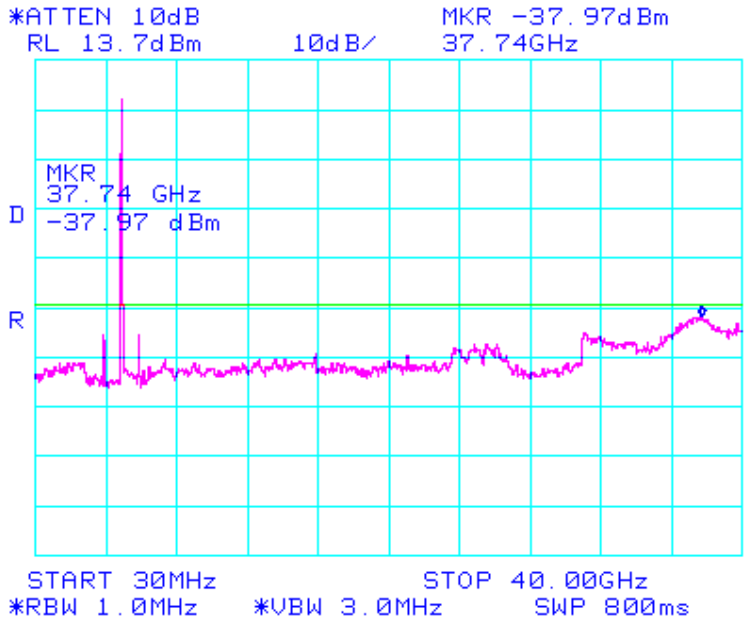


Conducted spurious emission test configuration

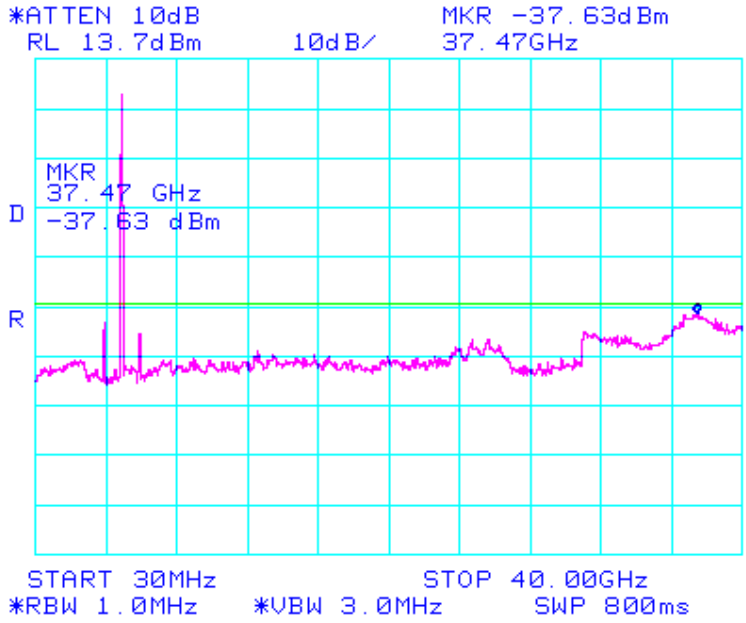
Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Note; Limits shown in the following plots show -35.4 dBm. Actual calculated limit is -25.4 dBm.

4955 MHz Conducted Spurious Emissions 30 MHz – 40 GHz: Limit -35.5 dBm



4975 MHz Conducted Spurious Emissions 30 MHz – 40 GHz: Limit -35.5 dBm



Laboratory Measurement Uncertainty for Conducted Spurious Emissions

Measurement uncertainty	±2.37 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions'	0070, 0116, 0158, 0088, 0252, 0313, 0314

5.1.7. Radiated Spurious Emissions

5.1.7.1. Transmitter Radiated Emissions above 1 GHz

FCC 47 CFR Part 90, Subpart Y; 2.1053; §90.210(m)
ANSI/TIA-603
Industry Canada RSS-111 §4.4

Test Procedure
Measurements were made while EUT was operating in a modulated transmit mode of operation, at the appropriate center frequency, 100% duty cycle and maximum power at all times. Radiated spurious emissions were measured to 40 GHz. Substitution was performed on any emissions observed. The antenna port was attenuated with a 50 Ω termination.

The measurement equipment was set to measure in peak hold mode. The emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode.

The highest emissions relative to the limit are listed for each frequency spanned.

Measurements below 1 GHz utilized 120 KHz RBW, measurements above 1 GHz were performed using a minimum RBW of 1 MHz.

Limits were calculated which depended on average transmit power level(s). See test report Section 5.1.2 for average power level measurements

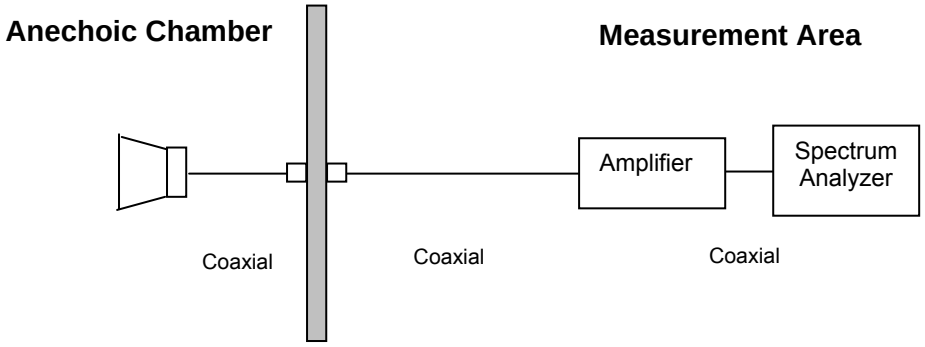
Spurious Emission Limit Calculation
Power Level: +14.6 dBm

Limit
From FCC Part 90.210 (L)
On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 50 dB attenuation.

Attenuation outside 150% Bandwidth is 40 dB

Spurious Limit: +14.6 – 40 = -25.4 dBm

Test Measurement Set up



Measurement set up for Radiated Emission Test

Radio parameters

Antenna ports were terminated in a 50 ohm load.
Radio transmitter set to maximum power.

Maximum Power, Channel 4955 MHz

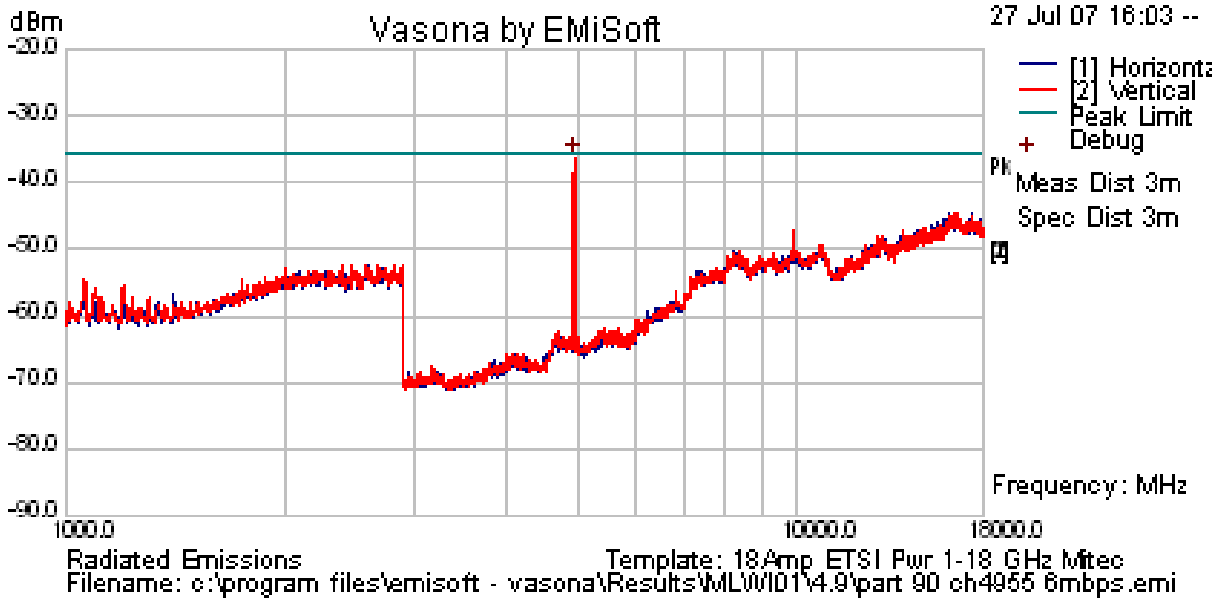
INITIAL INVESTIGATION				SUBSTITUTION RESULTS				
Freq. (MHz)	Pol.	Raw (dBuV)	Res BW (KHz)	Pwr @ Antenna (dBm)	Ant. Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions found within 6 dB of the limit. Emission breaking the limit is the carrier

Note; Limits shown in the following plots show -35.4 dBm. Actual calculated limit is -25.4 dBm,

(40 dB below +14.6 dBm transmitter power)

Channel Frequency 4955 MHz



Radio parameters

Antenna ports were terminated in a 50 ohm load.
Radio transmitter set to maximum power.

Maximum Power, Channel 4955 MHz

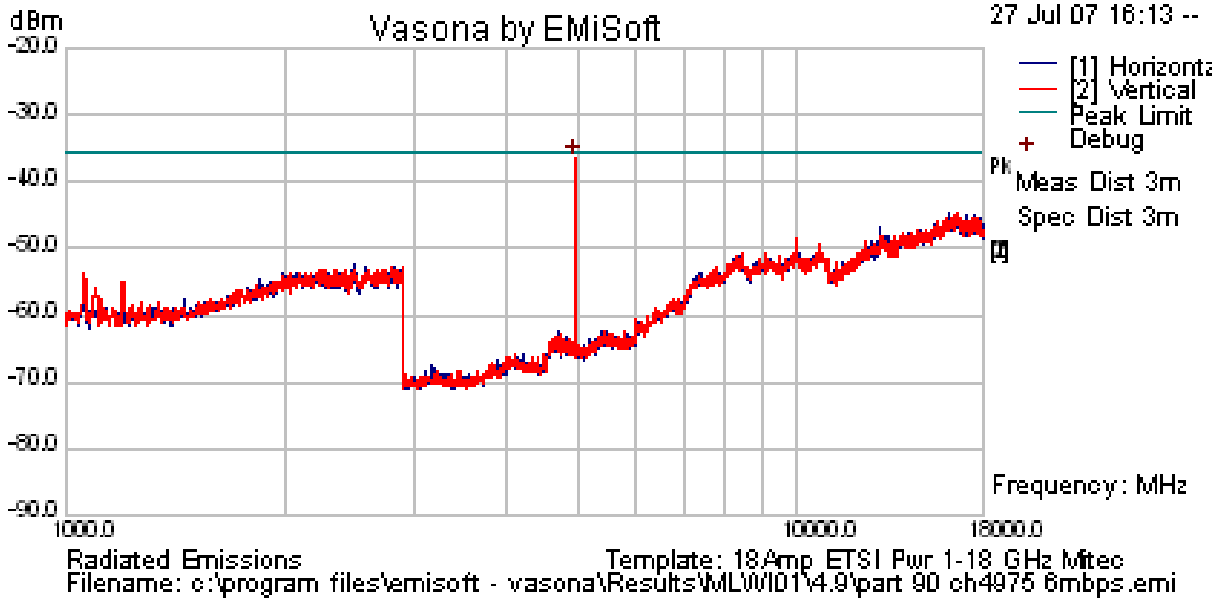
INITIAL INVESTIGATION				SUBSTITUTION RESULTS				
Freq. (MHz)	Pol.	Raw (dBuV)	Res BW (KHz)	Pwr @ Antenna (dBm)	Ant. Gain (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)

No emissions found within 6 dB of the limit. Emission breaking the limit is the carrier

Note; Limits shown in the following plots show -35.4 dBm. Actual calculated limit is -25.4 dBm,

(40 dB below +14.6 dBm transmitter power)

Channel Frequency 4975 MHz



Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB

Traceability

Method	Test Equipment Used
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'	0088, 0104, 0158, 0134, 0310, 0312

5.1.7.2. Transmitter Radiated Spurious Emissions (30M-1 GHz)

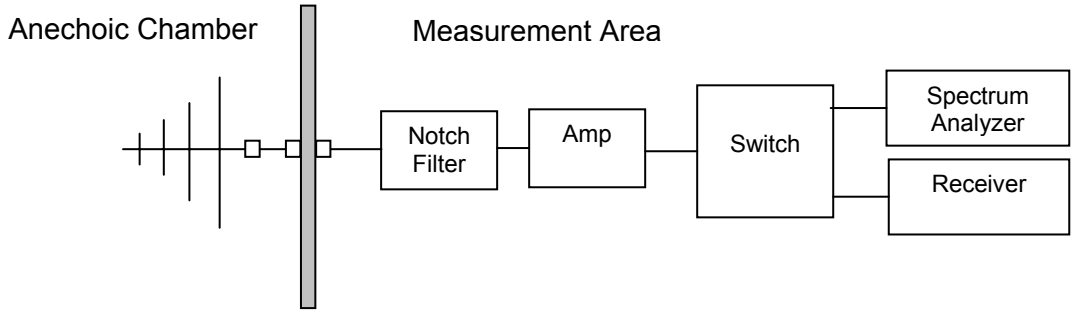
FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-111 §4.4

Test Procedure

Preliminary radiated emissions were measured in the anechoic chamber at a 10-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 with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

System operation was completed with one transmitter terminated in a 50Ω load at maximum power and the second transmitter terminated in the 16.4 dBi Sector antenna.

Test Measurement Set up



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.

$$FS = R + AF + CORR$$

where:

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 51.5dBμV; 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 = 36.3dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

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

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

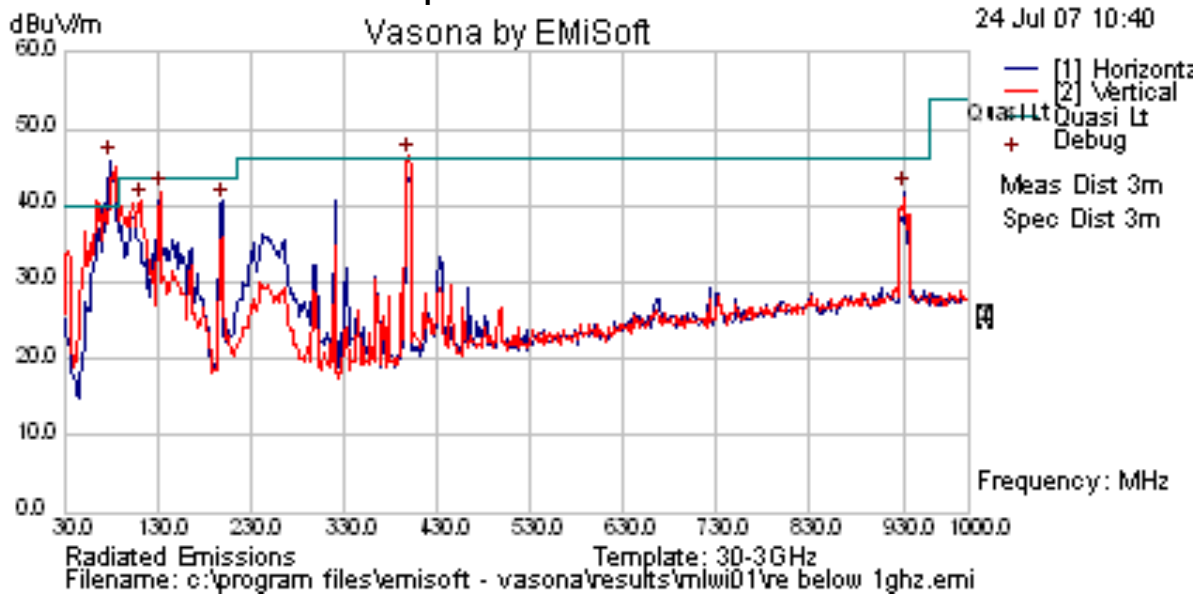
Radio parameters.

Cable connected to the Serial Data port.

TABLE OF RESULTS

Freq. (MHz)	Peak (dBuV/m)	QP (dBuV/m)	QP Lmt (dBuV/m)	QP Margin (dB)	Angle (deg)	Height (cm)	Polarity
110.431	40.53	38.69	43.5	-4.81	348	100	V
133.299	41.91	40.28	43.5	-3.22	223	240	H
398.127	46.43	43.42	46	-2.58	113	102	V

Radiated Spurious Emissions 30 MHz to 1 GHz



5.1.8. Receiver Radiated Spurious Emissions (above 1 GHz)

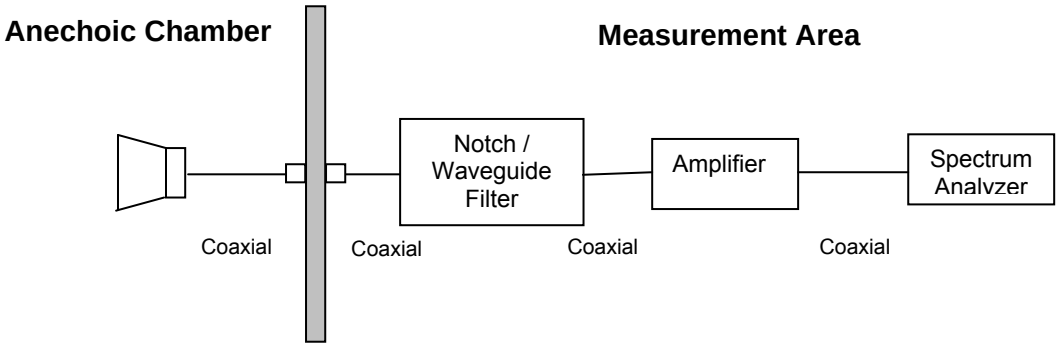
Industry Canada RSS-Gen §4.8, §6

Test Procedure

Radiated emissions above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Test Measurement Set up



Measurement set up for Radiated Emission Test

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

FS = R + AF + CORR - FO

where: FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

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

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

Receiver Radiated Spurious Emissions above 1 GHz

Ambient conditions.
Temperature: 19 to 26°C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Receiver Radiated Spurious Emissions above 1 GHz

Test Setup;-

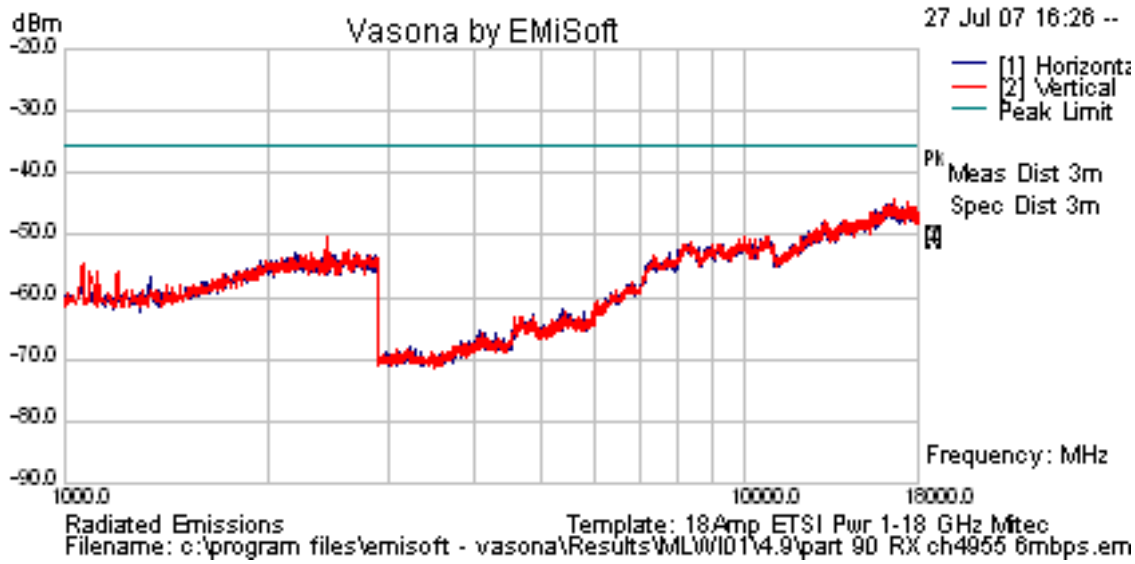
4955 MHz Receiver only

TABLE OF RESULTS –

Freq. (MHz)	Pol. (H/V)	Raw Reading (dBµV/m)	Correction Factor (dB)	Corrected Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

No emissions were found within 6 dB of the average limit.

Radiated Emissions



Specification

Receiver Radiated Spurious Emissions

Industry Canada RSS-Gen §4.8,
The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

RSS-Gen §6
The following receiver spurious emission limits shall be complied with;
(a) If a radiated measurement is made, all spurious emissions hall comply with the limits of Table 1.

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/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

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

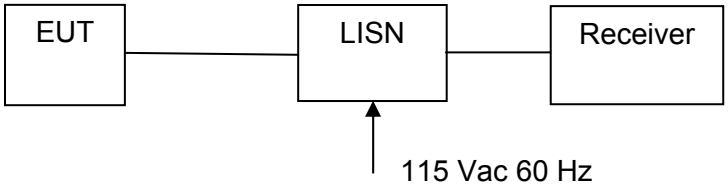
5.1.9. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)

Ambient conditions.
Temperature: 19 to 26 °C Relative humidity: 31 to 57 % Pressure: 999 to 1009 mbar

Radio parameters.
Data Rate(s): 25 KHz
As one of the antenna ports is used as a receive port only two transmitters were configured for operation
Operational Channels: 802.11b Channels 1 and 11.
Power Level: Maximum

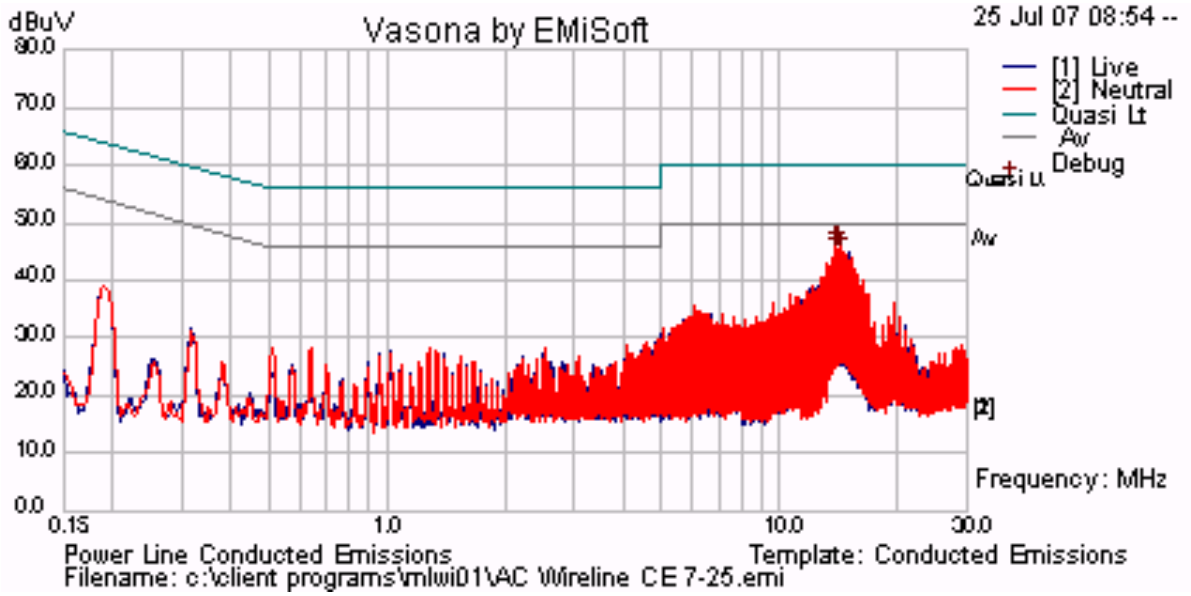
TABLE OF RESULTS –

Freq (MHz)	LIne	Peak (dBµV)	QP (dBµV)	QP Limit (dBµV)	QP Margin (dB)	Ave. (dBµV)	Ave. Limit (dBµV)	Ave. Margin (dB)
13.976	N	46.31	--	--	--	--	--	--
14.084	L	45.36	--	--	--	--	--	--
14.170	N	45.16	--	--	--	--	--	--
14.215	L	45.28	--	--	--	--	--	--
14.301	N	45.97	--	--	--	--	--	--
14.406	L	45.12	--	--	--	--	--	--

Only peak emissions are shown. Quasi Peak and Average emissions were measured and found to be more that 6 dB below the limit.

Peak emissions are shown in the chart below.

AC Wireline - Peak Conducted Emissions –150 kHz – 30 MHz)



Specification

Limit

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

§15.207 (a) Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

Laboratory Measurement Uncertainty for Conducted Emissions

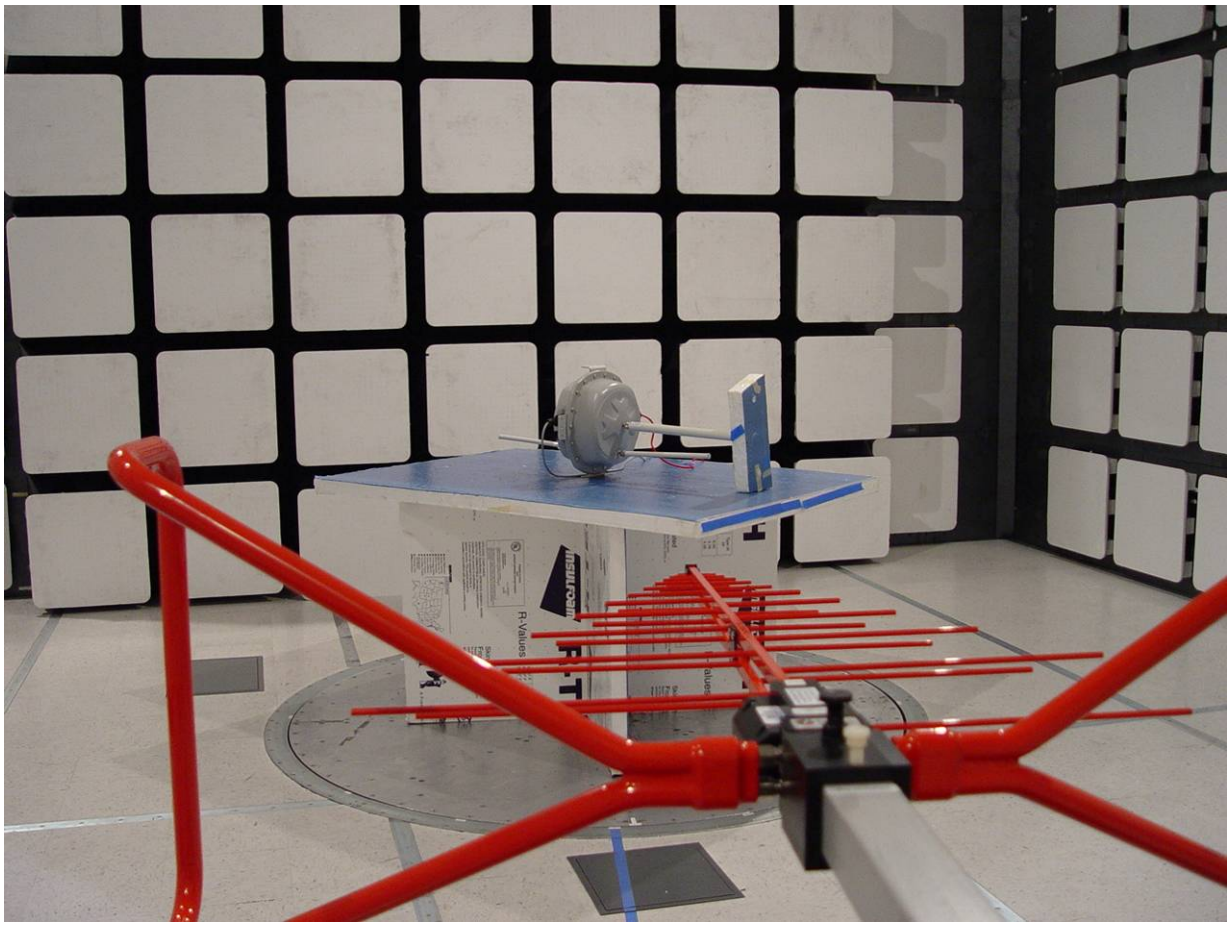
Measurement uncertainty	±2.64 dB

Traceability

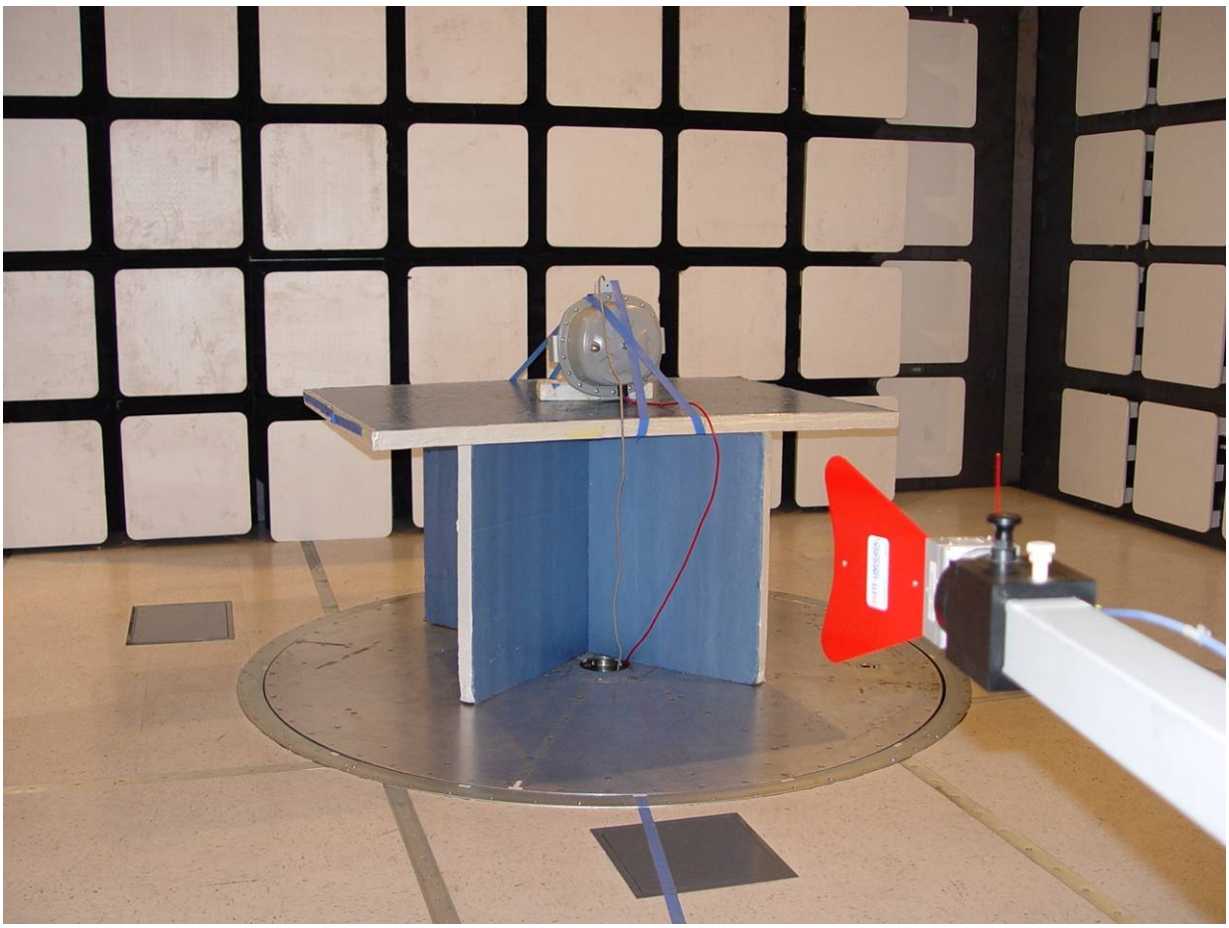
Method	Test Equipment Used
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'	0158, 0184, 0193, 0190, 0293, 0307

6. TEST SET-UP PHOTOGRAPHS

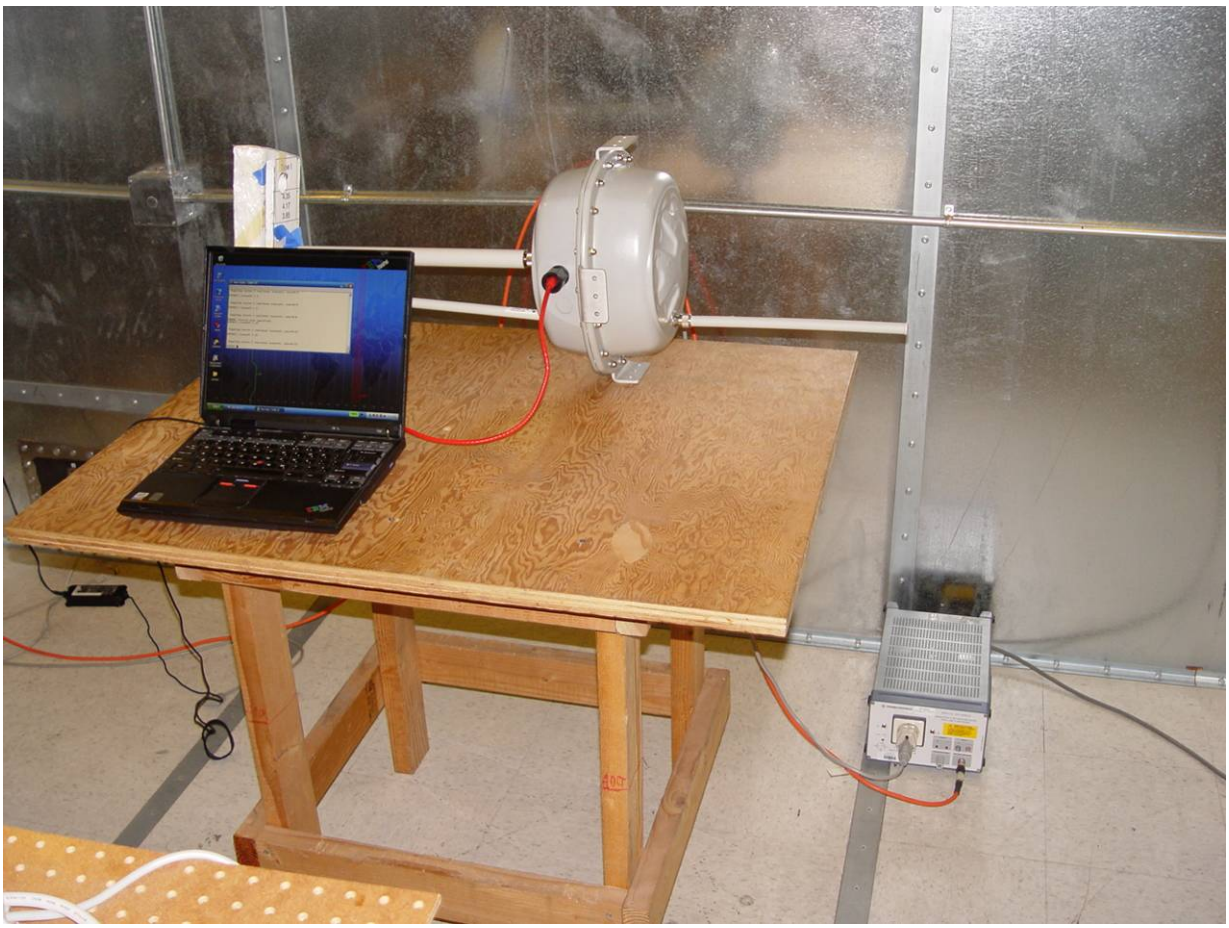
6.1. Radiated Emissions (30 MHz-1 GHz)



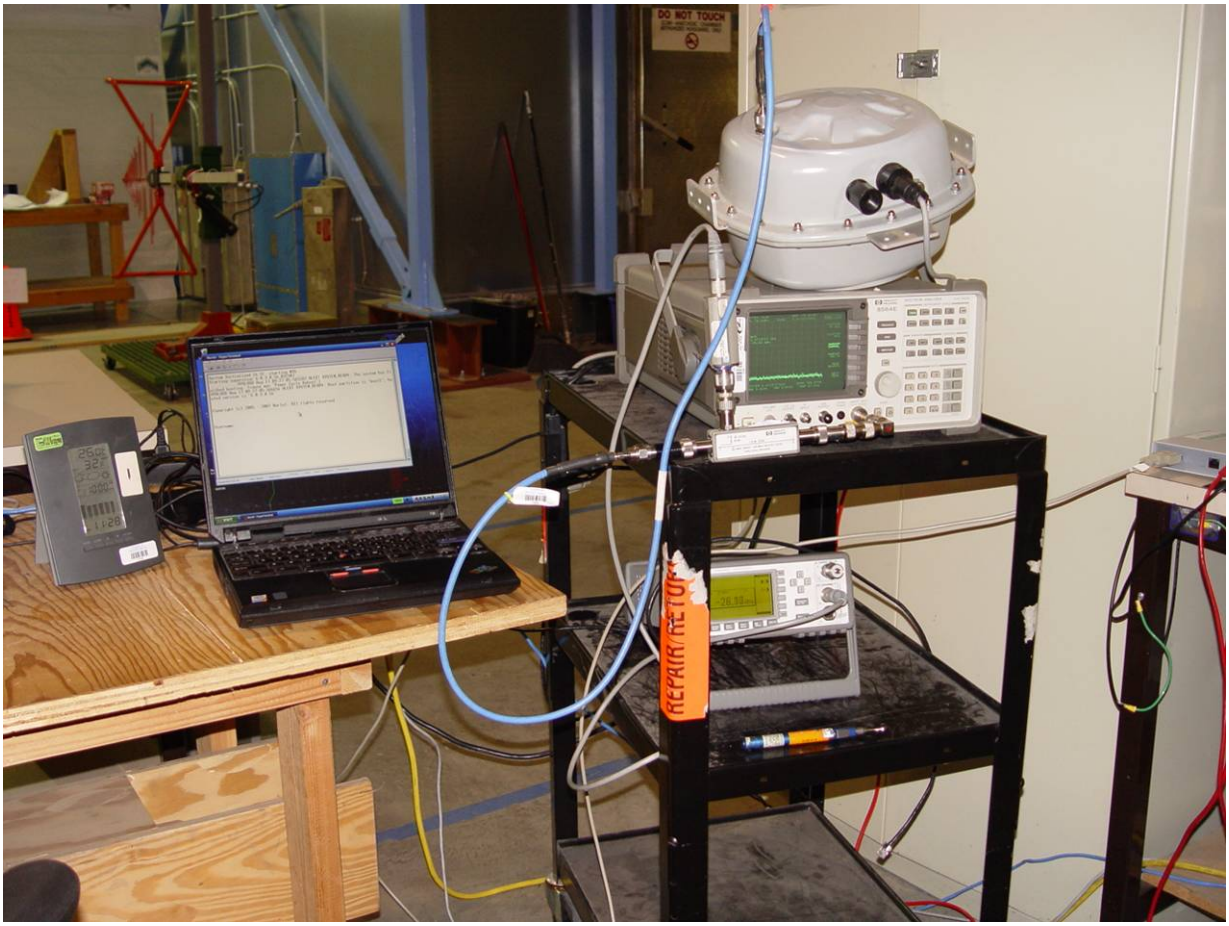
6.2. Spurious Emissions >1 GHz



6.3. AC Wireline Emissions (150 kHz - 30 MHz)



6.4. General Measurement Test Set-Up



7. TEST EQUIPMENT DETAILS

Asset #	Instrument	Manufacturer	Part #	Serial #
0088	Spectrum Analyzer	Hewlett Packard	8564E	3410A00141
0134	Amplifier	Com Power	PA 122	181910
0158	Barometer /Thermometer	Control Co.	4196	E2846
0193	EMI Receiver	Rhode & Schwartz	ESI 7	838496/007
0252	SMA Cable	Megaphase	Sucoflex 104	None
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	30dB N-Type Attenuator	ARRA	N9444-30	1623
0223	Power Meter	Hewlett Packard	EPM-442A	US37480256
0116	Power Sensor	Hewlett Packard	8485A	3318A19694
0117	Power Sensor	Hewlett Packard	8487D	3318A00371
0184	Pulse Limiter	Rhode & Schwartz	ESH3Z2	357.8810.52
0190	LISN	Rhode & Schwartz	ESH3Z5	836679/006
0293	BNC Cable	Megaphase	1689 1GVT4	15F50B001
0301	5.6 GHz Notch Filter	Micro-Tronics	RBC50704	001
0302	5.25 GHz Notch Filter	Micro-Tronics	BRC50703	002
0303	5.8 GHz Notch Filter	Micro-Tronics	BRC50705	003
0304	2.4GHzHz Notch Filter	Micro-Tronics	--	001
0307	BNC Cable	Megaphase	1689 1GVT4	15F50B002
0335	1-18GHz Horn Antenna	ETS- Lindgren	3117	00066580
0337	Amplifier	MiCOM Labs	--	--
0338	Antenna	Sunol Sciences	JB-3	A052907

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