L.S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

COMPLIANCE TESTING OF:

AW900 Wireless Ethernet Link

Prepared For:

AvaLAN Wireless Systems, Inc.
Attention: Mr. Mike Derby
2400 El Camino Real
Suite 317
Mountain View, CA 94040

Test Report Number:

304224 TX TCB Rev. 1

Test Dates:

May 5th -26th , 2004

Table of Contents

1. L. S. Compliance In Review

L.S. Compliance – Accreditations and Listing's

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025 : 1999
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Listing of 3 and 10 meter OATS based on Title 47CFR – Part 2.948
FCC Registration Number: 90757

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A

On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 89/336/EEC, Article 10.2.
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.

Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

2. A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

L.S. COMPLIANCE, INC.
Cedarburg, WI

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. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002 (1994).

Presented this 26th day of March 2003.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2005

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

3. A2LA Scope of Accreditation

American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2005 Certificate Number: 1255-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

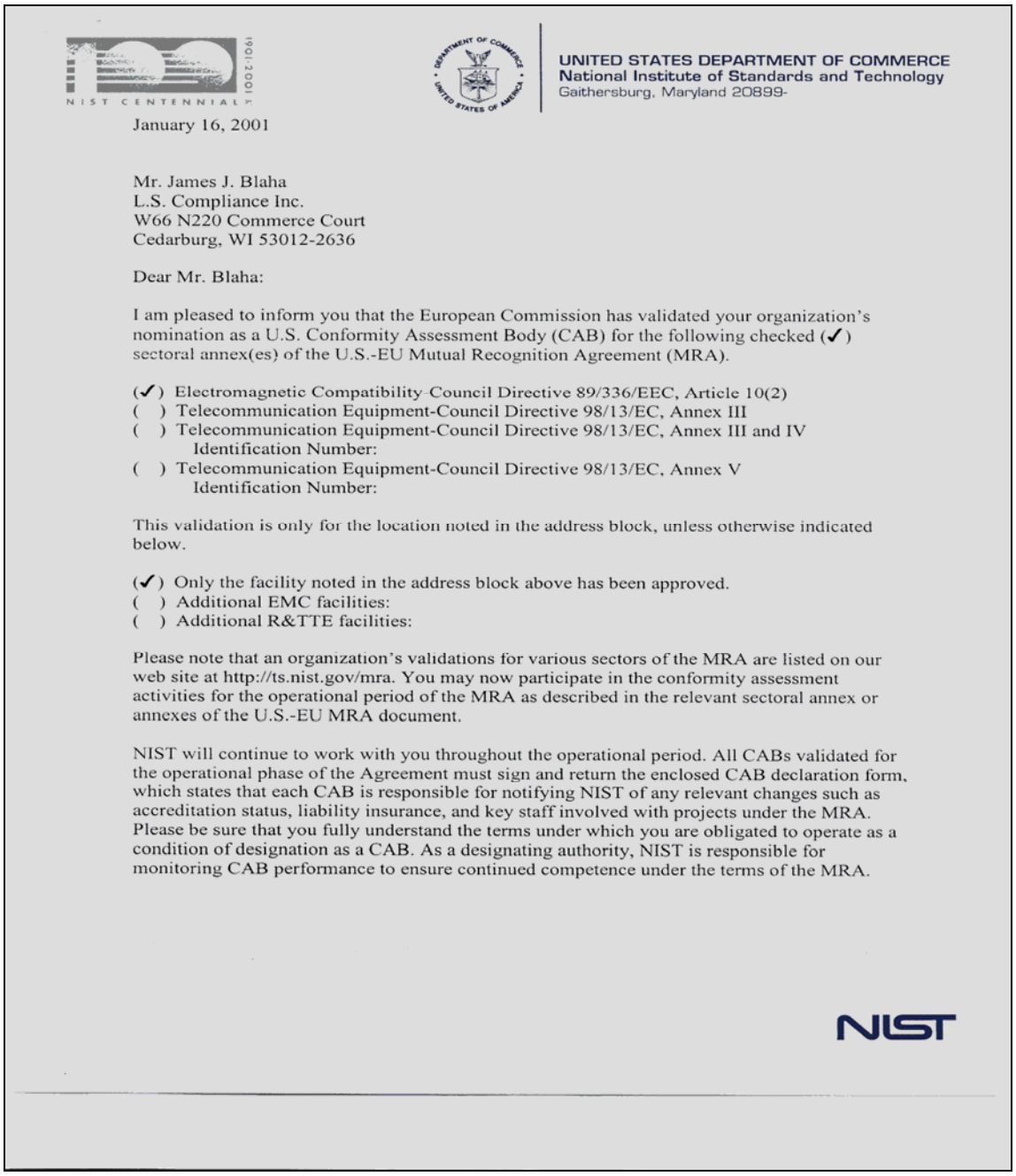
Test	Test Method(s)
Emissions	
Conducted	
Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Radiated	Code of Federal Regulations (CFR) 47, FCC Method Parts 15, 18 using ANSI C63.4; EN: 55011, 55022, 50081-1, 50081-2; CISPR: 11, 12, 14-1, 22; CNS 13438
Current Harmonics	IEC 61000-3-2; EN 61000-3-2
Voltage Fluctuations & Flicker	IEC 61000-3-3; EN 61000-3-3
Immunity	EN: 50082-1, 50082-2 EN 61000-6-2 CISPR: 14-2, 24
Conducted Immunity	
Fast Transients/Burst	IEC 61000-4-4; EN 61000-4-4
Surge	IEC: 61000-4-5; ENV 50142; EN 61000-4-5
RF Fields	IEC: 61000-4-6; ENV 50141; EN 61000-4-6
Voltage Dips/Interruptions	IEC 61000-4-11; EN 61000-4-11

Roxanne M. Robinson

(A2LA Cert. No. 1255-01) 05/13/03 Page 1 of 2

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC



UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

January 16, 2001

Mr. James J. Blaha
L.S. Compliance Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

(✓) Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
Identification Number:
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

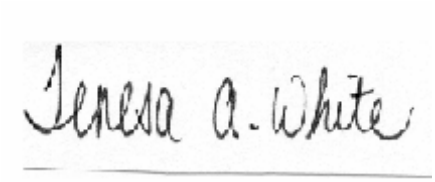
(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

NIST

5. Signature Page



Prepared By: October 25, 2004

Teresa A. White, Document Coordinator Date

Tested By: October 25, 2004

Abtin Spantman, EMC Engineer Date

Approved By: October 25, 2004

Kenneth L. Boston, EMC Lab Manager Date
PE #31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

6. Product and General Information

Manufacturer:	AvaLAN Wireless Systems, Inc.					
Date(s) of Test:	May 5th – 26th, 2004					
Test Engineer(s):		**Tom Smith**	√	**Abtin Spantman**		**Ken Boston**
Model #:	AW900					
Serial #:	M258					
Voltage:	6.0 VDC, 50mA					
Operation Mode:	Normal					

7. Introduction

Between August 9th to August 26th, 2004, a series of Conducted and Radiated Emission tests were performed on one sample of the AvaLAN Wireless Systems AW 900 Wireless Ethernet Link, here forth referred to as the "*Equipment Under Test*" or "*EUT*". These tests were performed using the procedures outlined in ANSI C63.4-2003 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.247 (Industry Canada RSS-210) for a low power transmitter. These tests were performed by Abtin Spantman, EMC Engineer of L.S. Compliance, Incorporated.

All Radiated and Conducted Emission tests were performed upon the EUT to measure the emissions in the frequency bands described in Title 47 CFR, FCC Part 15, including 15.35, 15.209, 15.247 and Industry Canada RSS-210 to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedures described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2003). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 2003.

All tests were performed at L.S. Compliance, Inc., in Cedarburg, Wisconsin, unless otherwise noted.

8. Product Description

The AvaLAN Wireless Systems AW900 is designed to operate as a plug-and-play high speed wireless Ethernet link. The AW900 operates as a 900 MHz digital spread spectrum link with data rates as high as 1.5 Mb/s, making it an ideal replacement for traditional wired DSL/TI internet connections, as well as other high data rate secure communication applications.

The AW900 is typically used in pairs, and is powered by a standard wall type transformer supplying 6.0 VDC @ 500 mA. The AW900 is equipped with an 'RJ-45' type jack as the data access port, and uses a "Nearson" model S467AH-915S whip antenna.

9. Test Requirements

The above-mentioned tests were performed in order to determine the compliance of the AW900 Wireless Ethernet Link with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.31	15.209	15.247d
15.207	15.247a2	15.247e
15.205	15.247b	15.247i

10. Summary of Test Report

DECLARATION OF CONFORMITY

The AvaLAN Wireless Systems AW900 Wireless Ethernet Link was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.247 and I.C. RSS-210, Section 6 for an intentional radiator.

11. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15 and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in normal operation. The applicable limits apply at a 3 meter distance. Measurements above 5 GHz were performed at a 1.0 meter separation distance, with the limits re-calculated for one meter of separation between the EUT and the sense antenna. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (903.125 MHz), medium (915.104 MHz) and high (926.563 MHz) to comply with FCC Part 15.35. A personal computer was used to change the channels and modes of operation via the RS-232 port on the PC, and a special programming header provided on the EUT for these test purposes.

Test Procedure

Radiated RF Field Strength measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 10,000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the sense antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. The attitude for maximum radiated RF emission was found while raising and lowering the antenna height between 1 and 4 meters, and changing the antenna polarization to horizontal and vertical.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a resolution bandwidth of 120 kHz for measurements below 1 GHz (video bandwidth of 300 kHz), and a bandwidth of 1 MHz for measurements above 1 GHz (Video Bandwidth of 1 MHz). The Peak, Quasi-Peak and Average Detector functions were utilized. From 5 GHz to 10 GHz, an HP E4407 Spectrum Analyzer and an EMCO Horn Antenna were used.

Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 for a Digitally Modulated transmitter [Canada RSS-210, Clause 6.2.2(0)]. The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

CALCULATION OF RADIATED EMISSIONS LIMITS

The maximum peak output power of an intentional radiator in the 902-928 MHz band, as specified in Title 47 CFR 15.247 (b)(2), is 1 Watt for systems. The harmonic and spurious RF emissions, as measured in any 100kHz bandwidth, as specified in 15.247 (d), shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c).

FIELD STRENGTH OF FUNDAMENTAL FREQUENCIES:
Operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz are allowed under section 15.247(b)(3), with a maximum peak output power of the intentional radiator not exceeding 1 Watt.

Peak Output Power = 1 Watt = 30 dBm conducted at RF port = 125.23 dBμV/m field intensity at 3 meters.

FIELD STRENGTH OF HARMONICS AND SPURIOUS EMISSIONS:
The spurious emissions, in any 100 kHz bandwidth outside the band of operation, shall be at least 20 dB below that of the fundamental peak power, also measured with a 100 kHz bandwidth. Adherence to the general limits described in section 15.209 is not required, but adherence to the emission limits in restricted bands of operation, as described in section 15.205 is required. The following table depicts the Class B limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals **found in the 15.205 restricted bands.**

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion from field strength μV/m to dBμV/m:
$dB\mu V/m = 20 \log_{10} (100)$
= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

Radiated Emissions Data Chart

3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.247 Digital Modulation
Frequency Range Inspected: 30 MHz to 10,000 MHz

Manufacturer:	AvaLAN Wireless Systems, Inc.							
Date(s) of Test:	May 5th through May 26th, 2004							
Test Engineer(s):		Tom Smith	√	Abtin Spantman		Ken Boston		
Model #:	AW900							
Serial #:	M258							
Voltage:	6VDC from wall-type transformer							
Operation Mode:	continuous transmit, 'Hopping' mode, and 5 channel hopping mode							
EUT Power:	√	Single Phase 115VAC to supply		3 Phase ___VAC				
		Battery		Other:				
EUT Placement:	√	80cm non-conductive table		10cm Spacers				
EUT Test Location:	√	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS				
Measurements:		Pre-Compliance		Preliminary	√	Final		
Detectors Used:	√	Peak	√	Quasi-Peak	√	Average		

Environmental Conditions in the Lab:
Temperature: 20 – 25°C
Relative Humidity: 30 – 60 %

Test Equipment Used:
EMI Measurement Instrument: HP8546A and Agilent E4407B
Log Periodic Antenna: EMCO #93146
Horn Antenna: EMCO #3115
Biconical Antenna: EMCO 93110B
Pre-Amp: Advanced Microwave WLA622-4
Standard Gain Horn: EMCO 3160-09

The following table depicts the level of spurious emissions seen:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.205 Limit (dBμV/m)	Margin (dB)
75.0	V	All	1.00	275	39.1	40.0	0.9
93.3	V	All	1.00	180	33.0	43.5	10.5
100.0	V	All	1.00	180	32.2	43.5	11.3
125.0	V	All	1.00	180	39.9	43.5	3.6
150.0	V	All	1.00	0	36.3	43.5	7.2
187.5	V	All	1.00	0	36.9	43.5	6.6
287.5	H	All	1.20	235	41.7	46.0	4.3
400.0	V	All	1.30	195	41.0	46.0	5.0
612.5	V	All	1.00	260	38.1	46.0	7.9
800.0	H	All	1.00	280	42.8	46.0	3.2
812.5	H	All	1.00	260	40.2	46.0	5.8
937.0	H	All	1.00	280	38.8	46.0	7.2
950.0	V	All	1.15	45	41.7	46.0	4.3
975.0	H	All	1.00	280	41.2	54.0	12.8

Tables containing emission from the fundamental and harmonics can be found on the next page.

Other emissions seen were greater than 20 dB below the limits.

The following table depicts the level of significant radiated Fundamental RF and harmonic emissions.

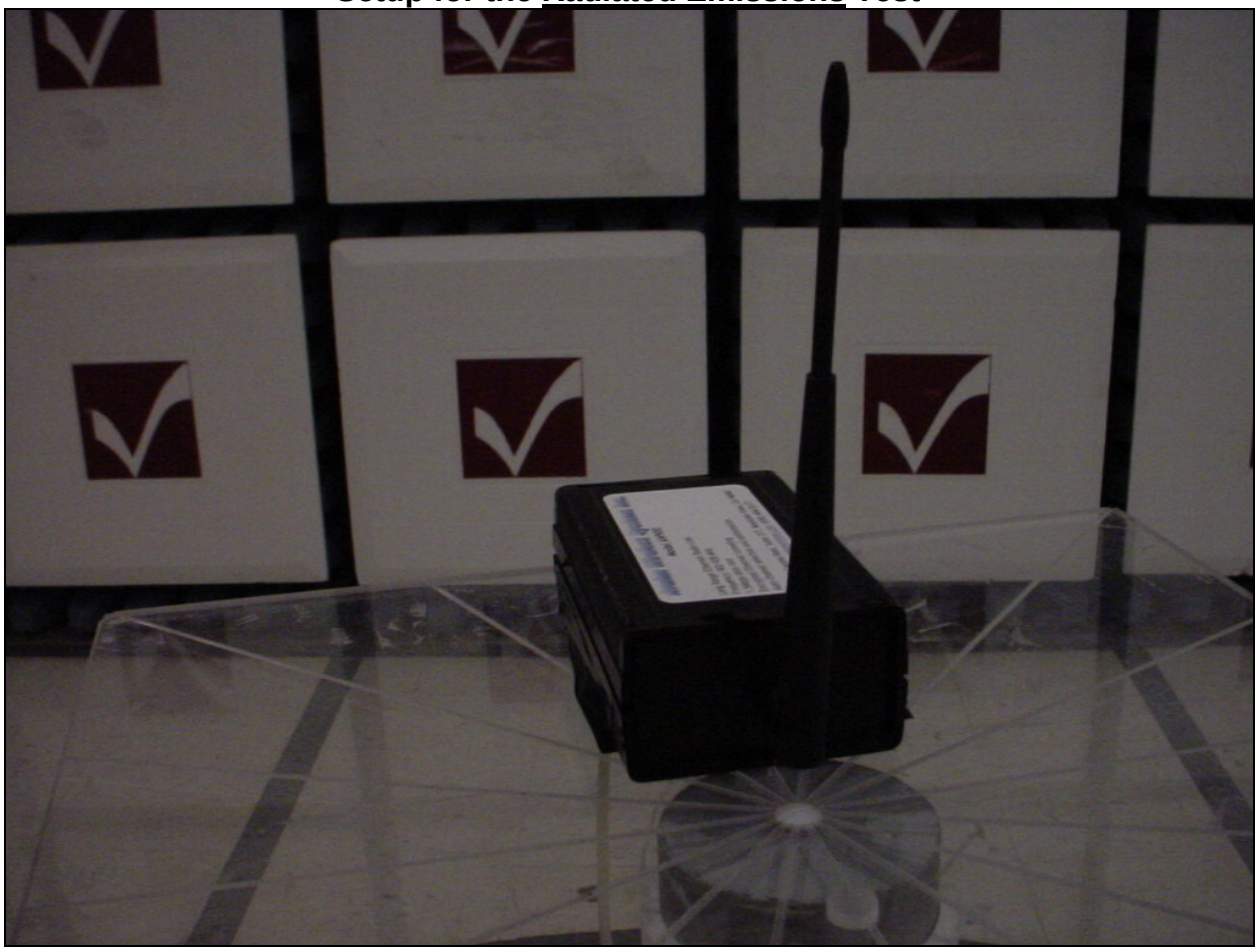
Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBμV/m)	15.205/15.207 Limit (dBμV/m)	Margin (dB)
1091	V	Low	1.00	0	40.7	54.0	13.3
(4) 903.1	V	Low	1.15	65	112.8 *	125.0	12.2
2708	V	Low	1.00	290	52.8	54.0	1.2
3615	V	Low	1.00	305	46.9	54.0	7.1
4518	V	Low	1.40	315	52.7	54.0	1.3
5422	V	Low	1.00	100	61.0	63.5	2.5
8133	V	Low	1.00	85	42.9	63.5	20.6
9027	H	Low	1.00	45	41.6	63.5	21.9
========	========	========	========	========	========	========	========
(4) 915.1	V	Mid	1.15	65	112.5 *	125.0	12.5
2744	V	Mid	1.00	295	50.4	54.0	3.6
3663	V	Mid	1.40	305	48.2	54.0	5.8
4574	V	Mid	1.00	115	48.2	54.0	5.8
7317	H	Mid	1.00	255	57.2	63.5	6.3
8240	H	Mid	1.00	40	40.2	63.5	23.3
9156	V	Mid	1.00	270	48.2	63.5	15.3
========	========	========	========	========	========	========	========
(4) 926.6	V	High	1.15	65	112.2 *	125.0	12.8
2778	V	High	1.00	290	48.0	54.0	6.0
3705	V	High	1.35	300	47.7	54.0	6.3
4631	V	High	1.00	115	44.8	54.0	9.2
7409	H	High	1.00	120	56.8	63.5	6.7
8343	H	High	1.00	180	39.0	63.5	24.5
9262	H	High	1.00	270	47.7	63.5	15.8
========	========	========	========	========	========	========	========

Notes:

1) A Quasi-Peak Detector was used in measurements below 1 GHz, and a Peak as well as an Average Detector was used in measurements above 1 GHz. Only the results from the Average detector are published in the table above.
2) The peak detector was used to ensure the peak emissions did not exceed 20 dB above the average limits.
3) Measurements above 5 GHz were made at 1 meters of separation from the EUT.
4) Measured to confirm compliance of the EIRP of the transmitter.

Photo(s) Taken During Radiated Emission Testing

Setup for the Radiated Emissions Test

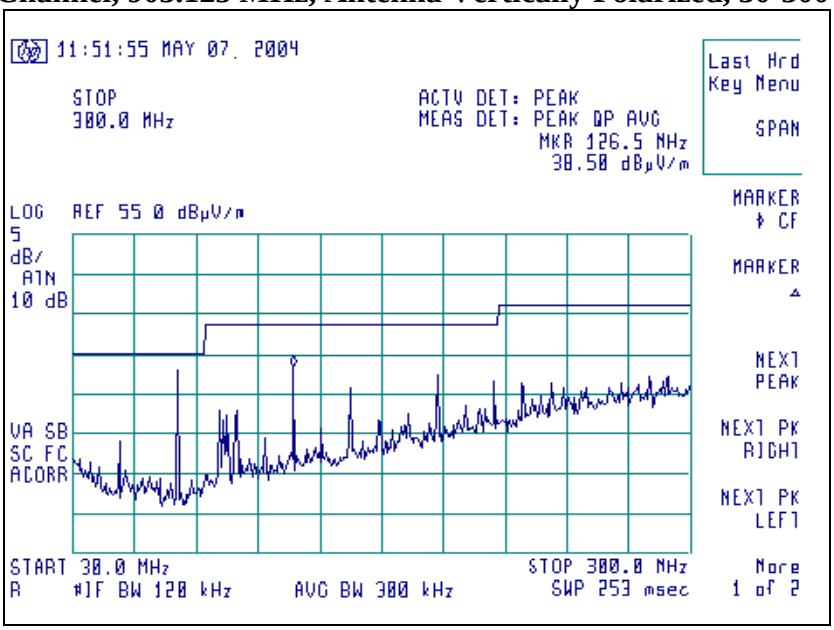


Screen Captures of Radiated RF Emissions:

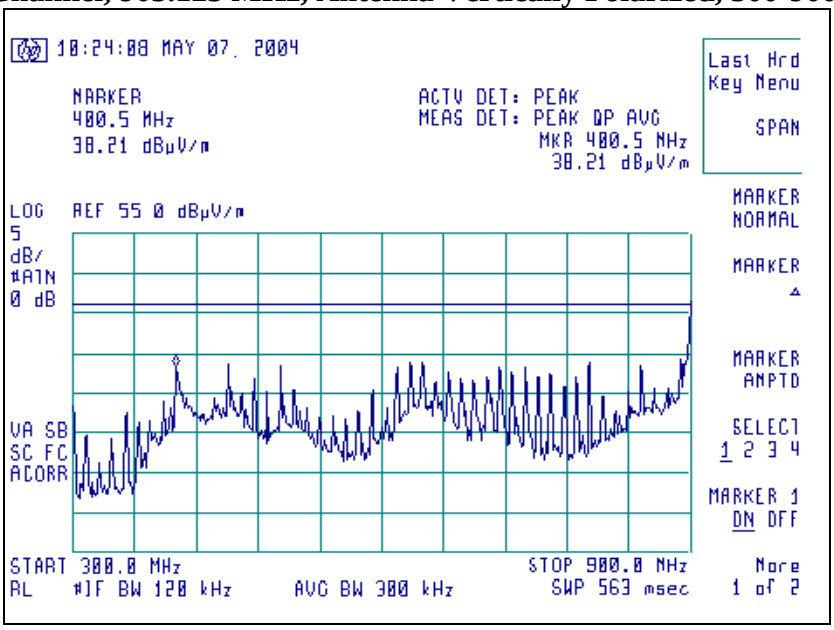
Please note these screen captures represent Peak Emissions. For radiated emission measurements, we utilize a Quasi-Peak detector function when measuring frequencies below 1 GHz, and both an Average and a Peak detector function when measuring frequencies above 1 GHz.

The signature scans shown here are from the Low channel, having the highest emissions, which was chosen as being a good representative of all channels, with the sense and EUT antennas both in vertical polarity for worst case presentations.

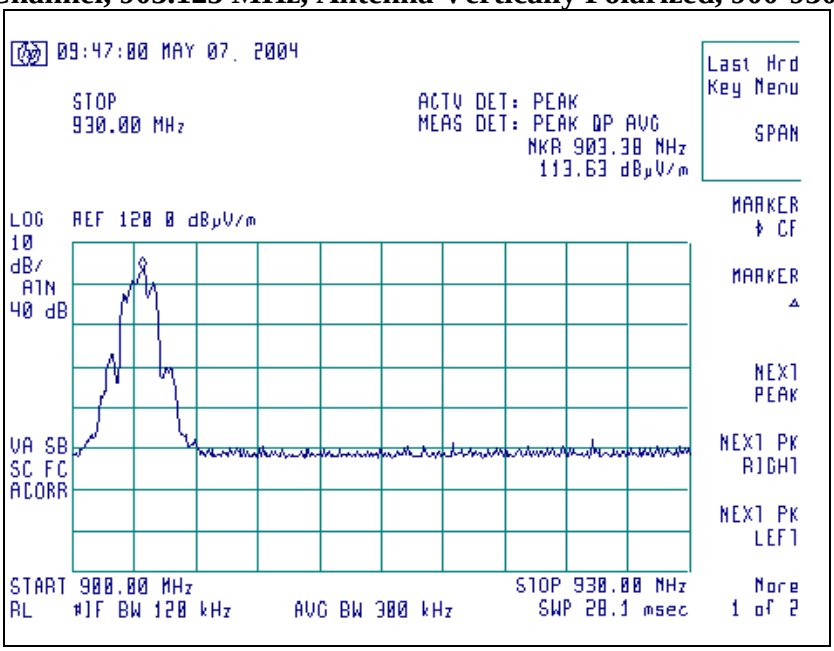
Low Channel, 903.125 MHz, Antenna Vertically Polarized, 30-300 MHz



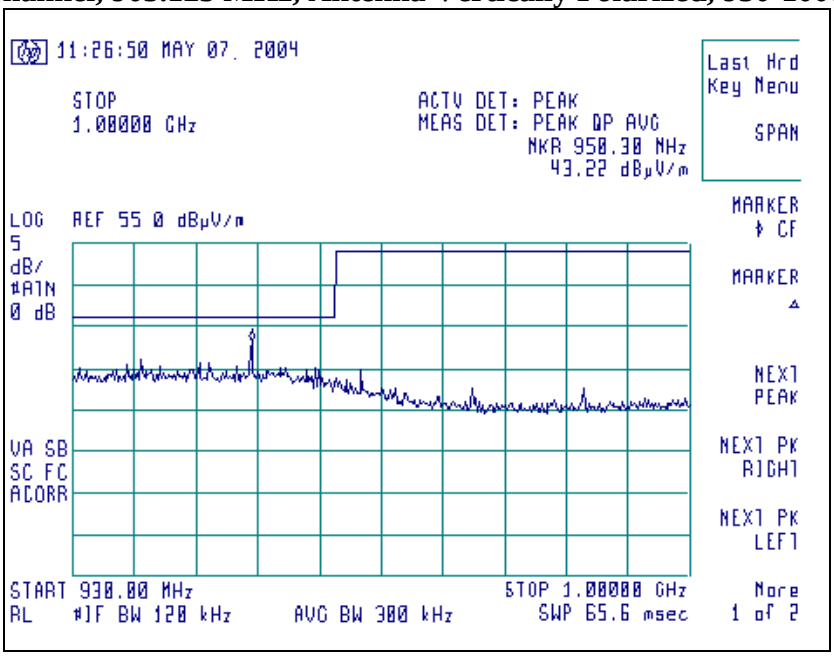
Low Channel, 903.125 MHz, Antenna Vertically Polarized, 300-900 MHz



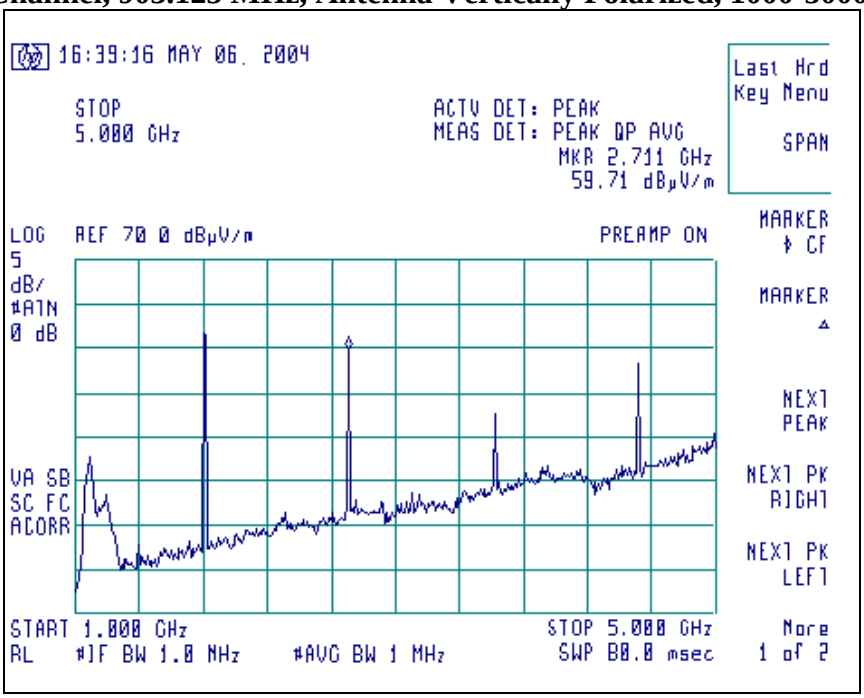
Low Channel, 903.125 MHz, Antenna Vertically Polarized, 900-930 MHz



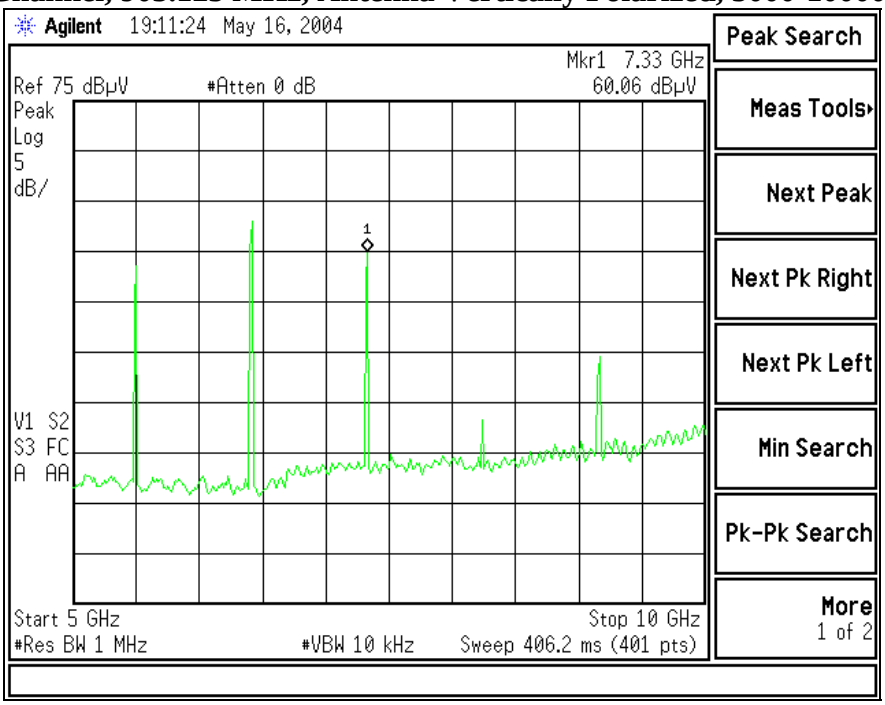
Low Channel, 903.125 MHz, Antenna Vertically Polarized, 930-1000 MHz



Low Channel, 903.125 MHz, Antenna Vertically Polarized, 1000-5000 MHz



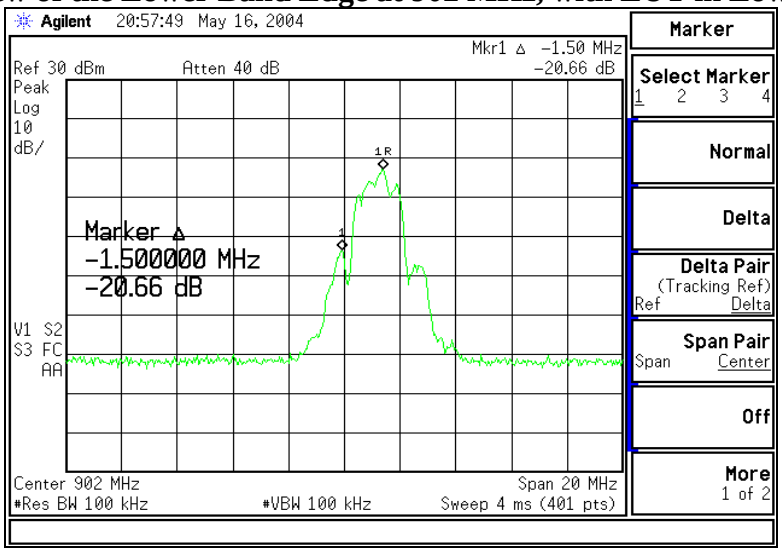
Low Channel, 903.125 MHz, Antenna Vertically Polarized, 5000-10000 MHz



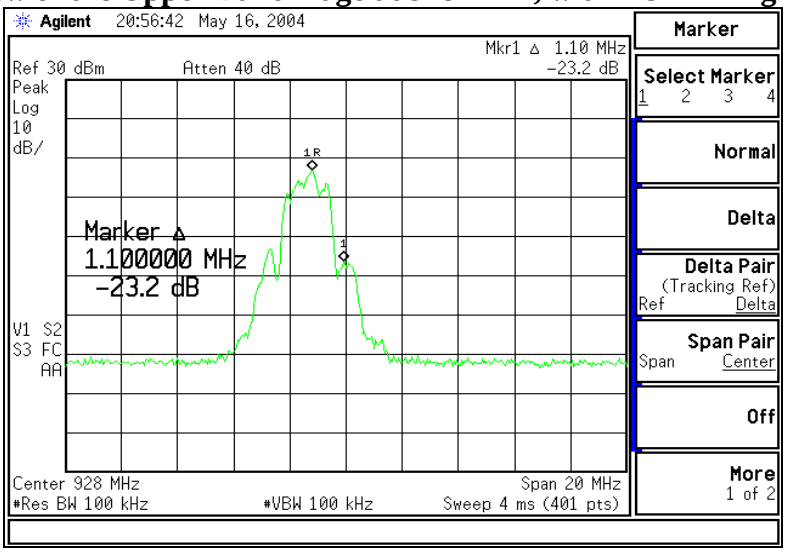
12. Band-Edge Measurements

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels, in particular at the band-edges where the intentional radiator operates. The following screen captures demonstrate compliance of the intentional radiator at the 902-928 MHz band-edges. The EUT was operated at the lowest channel, with continuous modulation, with typical data packets as the modulating source, for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge. The following screen captures demonstrate compliance to 15.247(d) in showing that measured power level of the spurious emissions outside the band are better than 20 dB below that of the fundamental power level, both measured using a 100 kHz resolution bandwidth.

Closer view of the Lower Band Edge at 902 MHz, with EUT in Low Channel



Closer view of the Upper Band Edge at 928 MHz, with EUT in High Channel



13. Conducted Emissions Test, AC Power Line

Test Setup

The Conducted Emissions test was performed at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The test area and setup are in accordance with ANSI C63.4-2001 and with Title 47 CFR, FCC Part 15 (Industry Canada RSS-210). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided inside the Shielded Room via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

Test Procedure

The EUT was placed in normal operating mode for this test. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (2003), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for conformance. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken. Both the Quasi-Peak and Average detector functions were utilized.

Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15, Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

Measurement of Electromagnetic Conducted Emission
In the Shielded Room

Frequency Range inspected: 150 KHz to 30 MHz

Manufacturer:	AvaLAN Wireless Systems, Inc.							
Date(s) of Test:	May 5th – 26th, 2004							
Test Engineer:		Tom Smith	√	Abtin Spantman		Ken Boston		
Model #:	AW900							
Serial #:	M258							
Voltage:	6VDC, 500mA from wall-type transformer							
Operation Mode:	Normal							
Test Location:	√	Shielded Room				Chamber		
EUT Placed On:	√	40cm from Vertical Ground Plane				10cm Spacers		
	√	80cm above Ground Plane				Other:		
Measurements:		Pre-Compliance		Preliminary	√	Final		
Detectors Used:		Peak	√	Quasi-Peak	√	Average		

Environmental Conditions in the Lab:
Temperature: 20 – 25° C
Atmospheric Pressure: 86 kPa – 106 kPa
Relative Humidity: 30 – 60%

Test Equipment Utilized:
EMI Receiver: HP 8546A
LISN: EMCO 3816/2NM
Transient Limiter: HP 119474A

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	Line	Q-Peak Reading (dBµV/m)	Q-Peak Limit (dBµ V/m)	Quasi-Peak Margin (dB)	Average Reading (dBµV/m)	Average Limit (dBµ V/m)	Average Margin (dB)
*** All emissions noted were better than 20 dB below limits. *****							

Notes:

1) The EUT exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested. Representative data presented above is from the Middle channel in transmit mode.
2) The emissions listed are characteristic of the power supply used, and did not change by the EUT.
3) All emissions noted were better than 20 dB below the limits.

Calculation of Conducted Emissions Limits

The following table describes the Class B limits for an unintentional radiator. These limits are obtained from Title 47 CFR, Part 15.107 (a) for Conducted Emissions. These limits also apply for 15.207 compliance.

Frequency (MHz)	Quasi-Peak Limit (dBµV)	Average Limit (dBµV)
0.15 – 0.5	66 – 56 *	56 – 46
0.5 – 5.0	56	46
5.0 – 30.0	60	50

22. Decreases with the logarithm of the frequency.

Sample calculation for the limits in the 0.15 to 0.5 MHz:

$$\text{Limit} = -19.12 \left(\text{Log}_{10} \left(F[\text{MHz}] / 0.15 [\text{MHz}] \right) \right) + 66.0 \text{ dB}\mu\text{V}$$

For a frequency of 200 kHz for example:

$$\text{Quasi-Peak Limit (F=200kHz)} = -19.12 \left(\text{Log}_{10} \left(0.2[\text{MHz}] / 0.15 [\text{MHz}] \right) \right) + 66.0 \text{ dB}\mu\text{V}$$

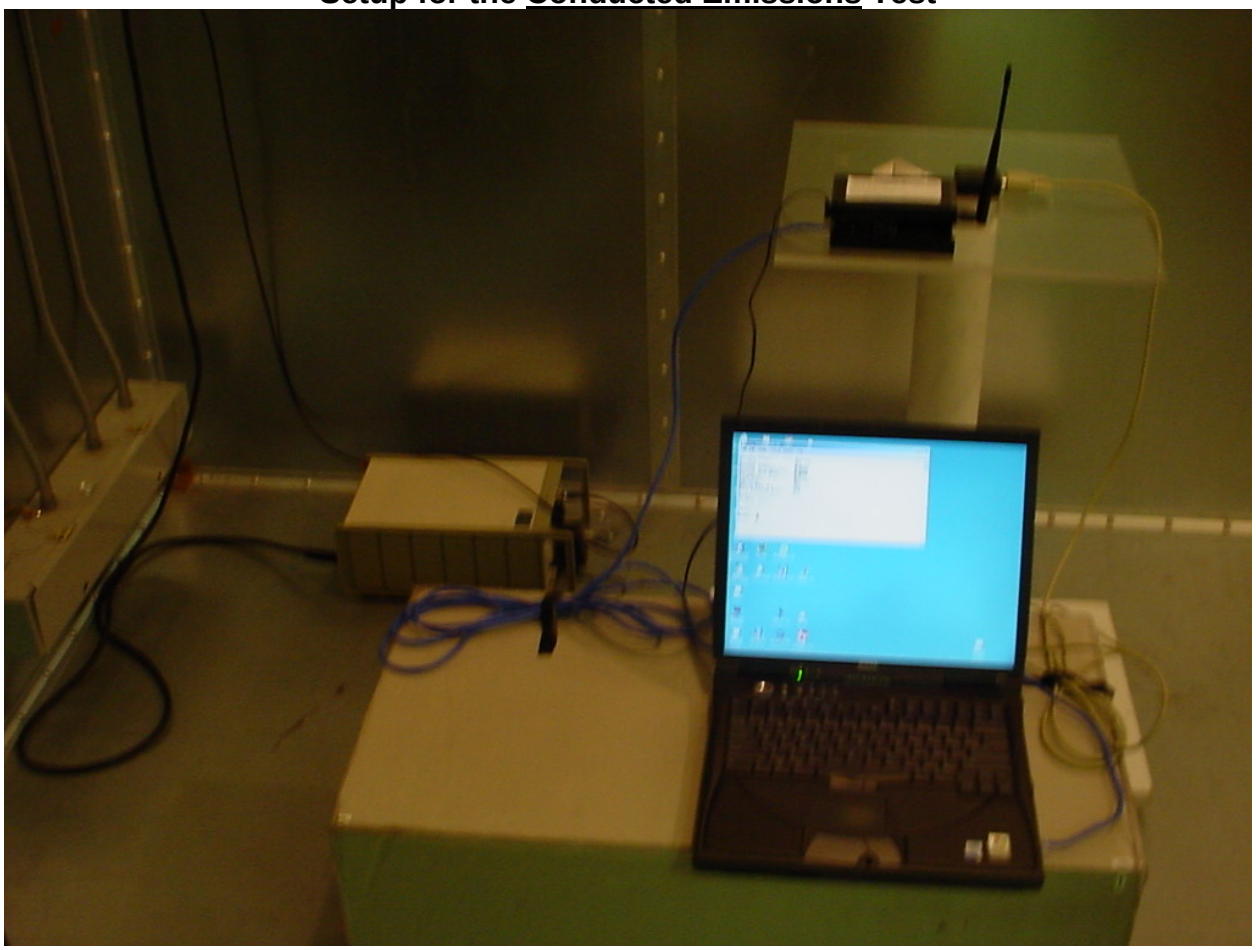
$$\text{Quasi-Peak Limit (F=200kHz)} = 63.6 \text{ dB}\mu\text{V}$$

$$\text{Average Limit (F=200kHz)} = -19.12 \left(\text{LOG}_{10}(0.2[\text{MHz}]/0.15[\text{MHz}]) \right) + 56.0 \text{ dB}\mu\text{V}$$

$$\text{Average Limit (F = 200 kHz)} = 53.6 \text{ dB}\mu\text{V}$$

Photo(s) Taken During Conducted Emission Testing

Setup for the Conducted Emissions Test

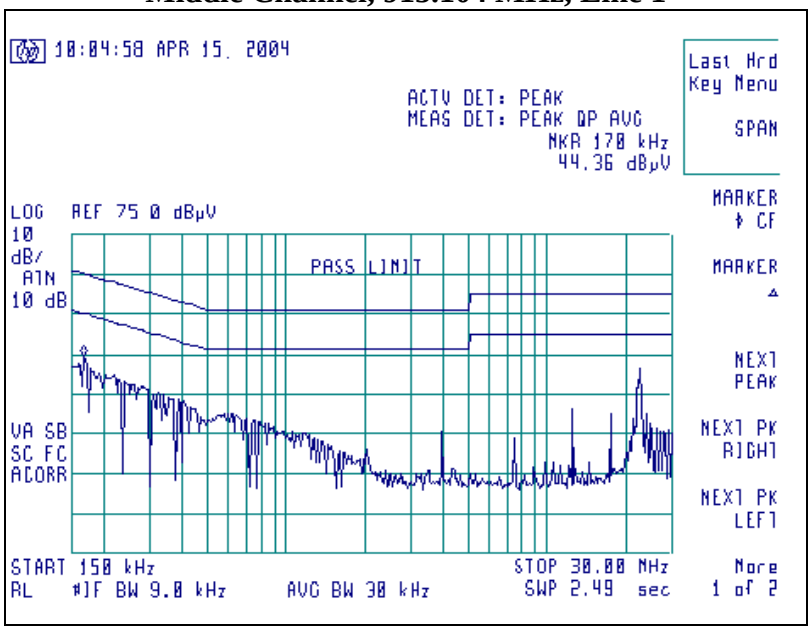


Screen Captures of Conducted AC Mains Emissions:

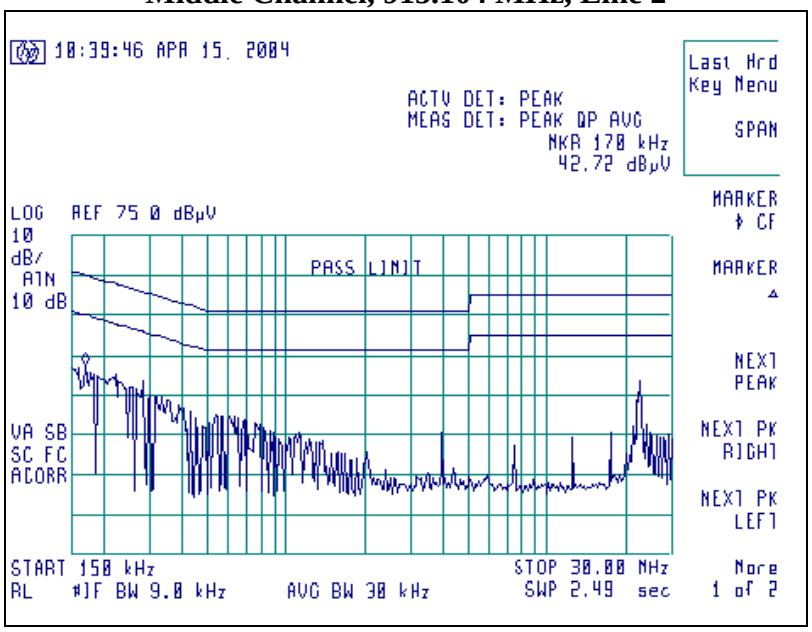
Please note these screen captures represent Peak Emissions. For conducted emission measurements, we utilize both a Quasi-Peak detector function as well as the Average detector function for measurements. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207.

The signature scans shown here are from the Middle Channel, chosen as being a good representative of all channels.

Middle Channel, 915.104 MHz, Line 1



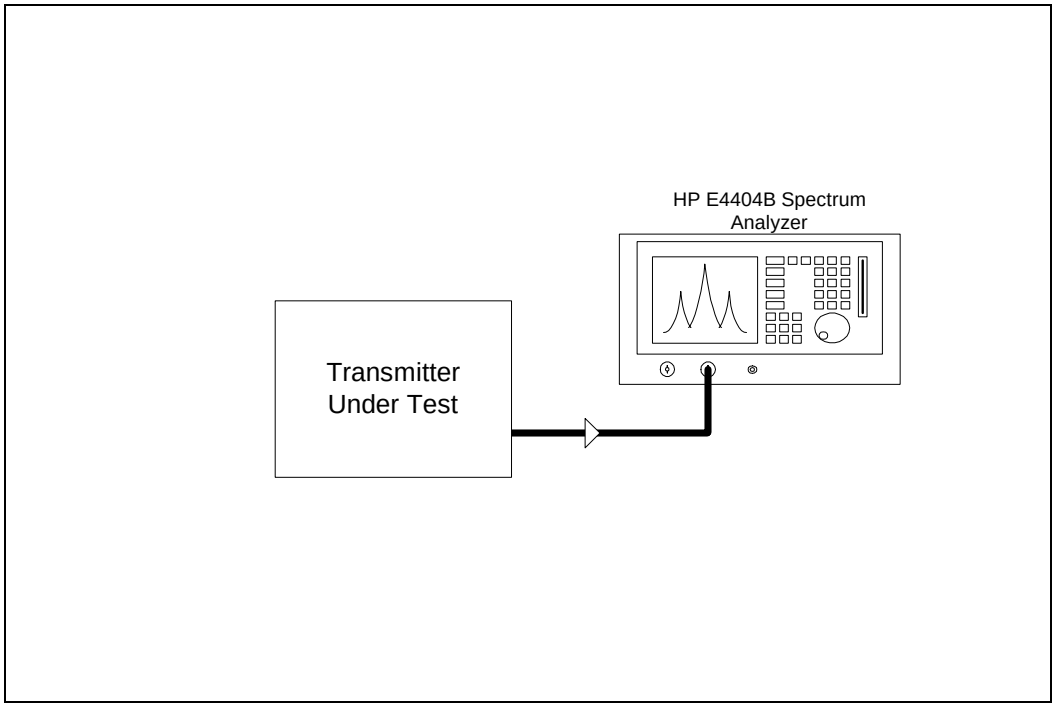
Middle Channel, 915.104 MHz, Line 2



14. Conducted Emissions Test, Power Output 15.247(b)

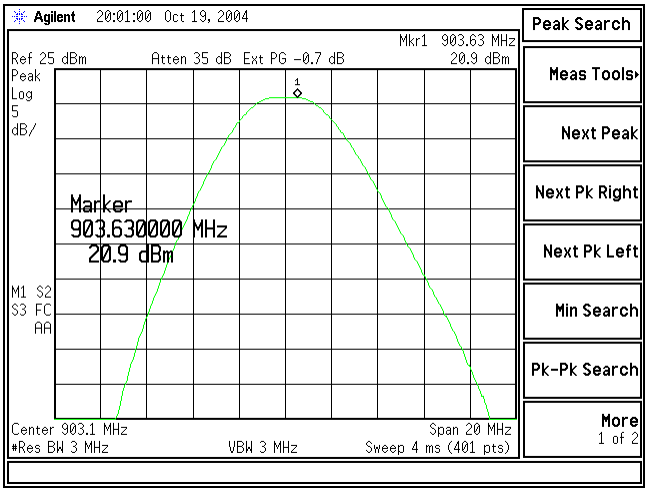
The conducted output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable totaling 0.7 dB were added as a *gain-offset* for direct reading of measurements on the analyzer. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 3 MHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with resolution and video bandwidths set to 3 MHz, and a span of 20 MHz, with measurements from a peak detector presented in the chart below. Power output was also monitored while varying the AC voltage to the AC wall supply. No variation in output was seen while setting the AC voltage to 97.7 VAC (-15%) or to 132.3 VAC (+15%).

CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
Low (06C6)	903.125	+ 30.0	+ 20.91	9.09
Mid (06DD)	915.104	+ 30.0	+ 20.84	9.16
High (06F3)	926.563	+ 30.0	+ 20.88	9.12

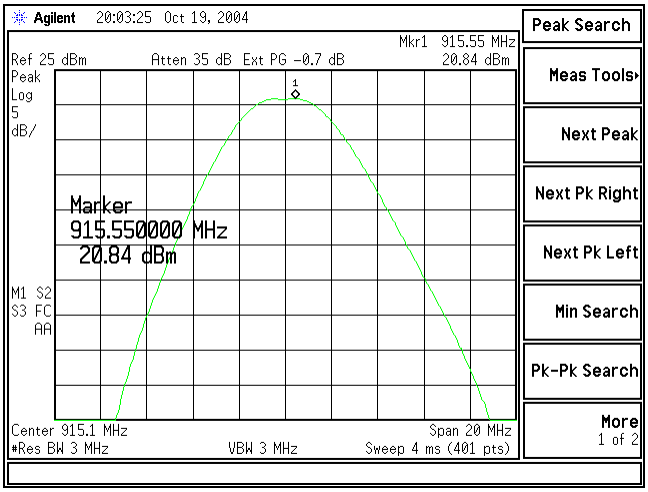


Note: Screen captures taken at RBW=VBW=3MHz and presented for completeness only.

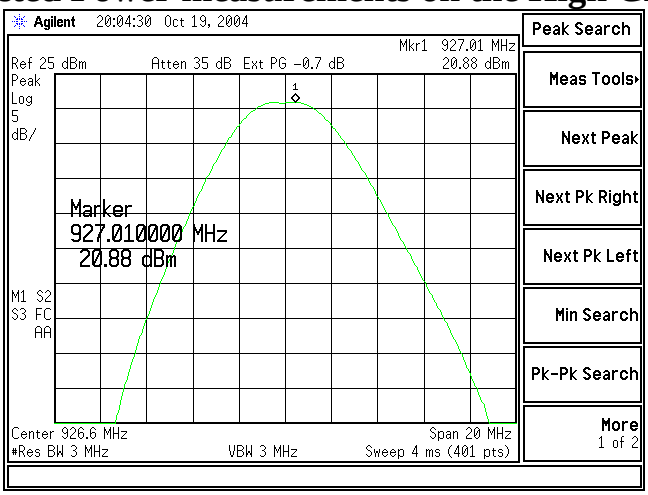
Conducted Power measurements on the Low Channel.



Conducted Power measurements on the Middle Channel.



Conducted Power measurements on the High Channel.



15. Conducted Emissions Test, Spurious Emissions 15.247(d)

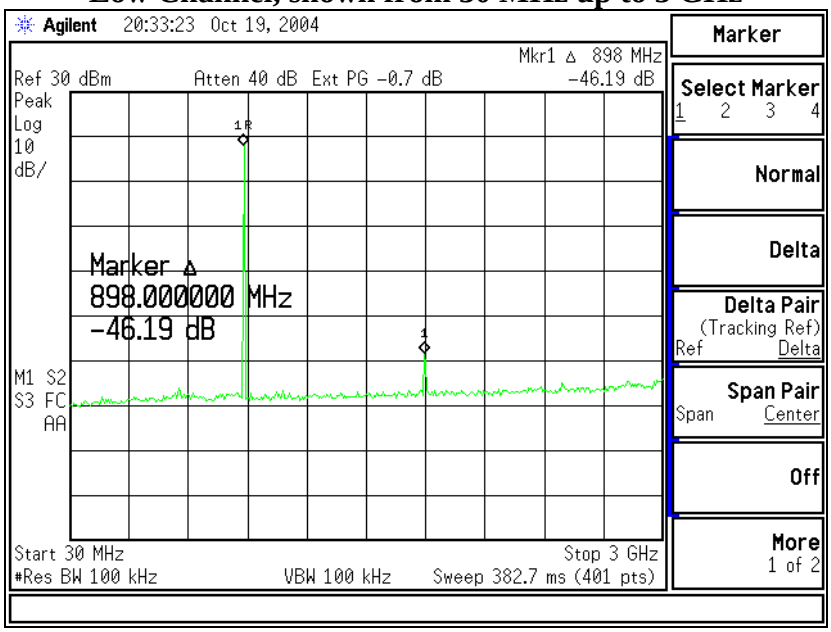
FCC Part 15.247(d) requires a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator totaling 10.5 dB were added on the readings from the analyzer to correct the readings of the measurements. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

No significant emissions could be noted within -50 dBc of the fundamental level for this product.

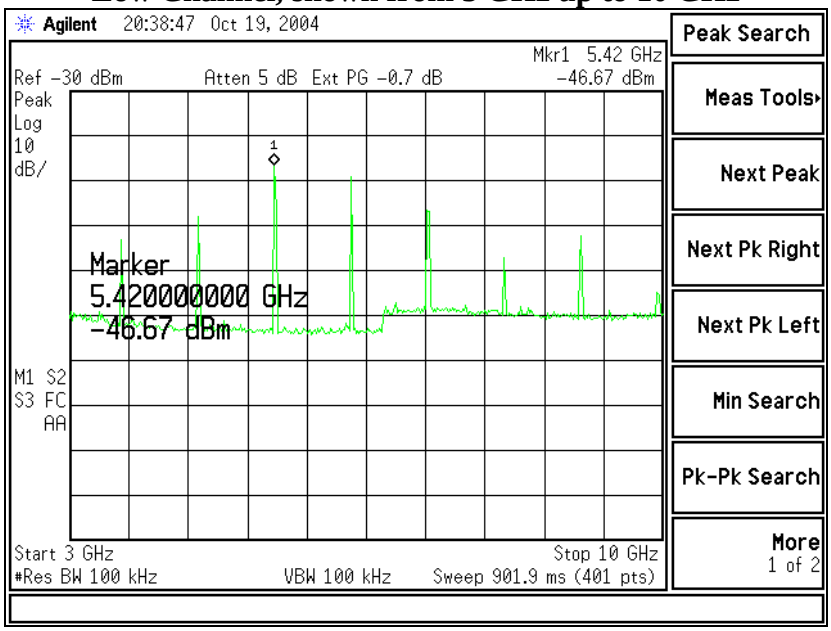
Low Channel		Middle Channel		High Channel	
Freq (GHz)	Pout(dBm)	Freq (GHz)	Pout(dBm)	Freq (GHz)	Pout(dBm)
1.81	-28.0	1.83	-30.0	1.85	-32.3
2.71	-54.0	2.75	-55.2	2.78	-55.0
3.61	-63.7	3.67	-64.0	3.72	-64.7
4.52	-58.0	4.58	-62.3	4.65	-64.7
5.42	-46.6	5.50	-49.1	5.56	-48.7
6.33	-49.0	6.41	-50.7	6.48	-48.6
7.42	-56.5	7.32	-57.4	7.41	-61.1
8.13	-67.2	8.23	-79.9	8.34	-74.7
9.04	-62.3	9.13	-66.3	9.27	-67.3

Plots of Conducted Spurious and Fundamental Levels

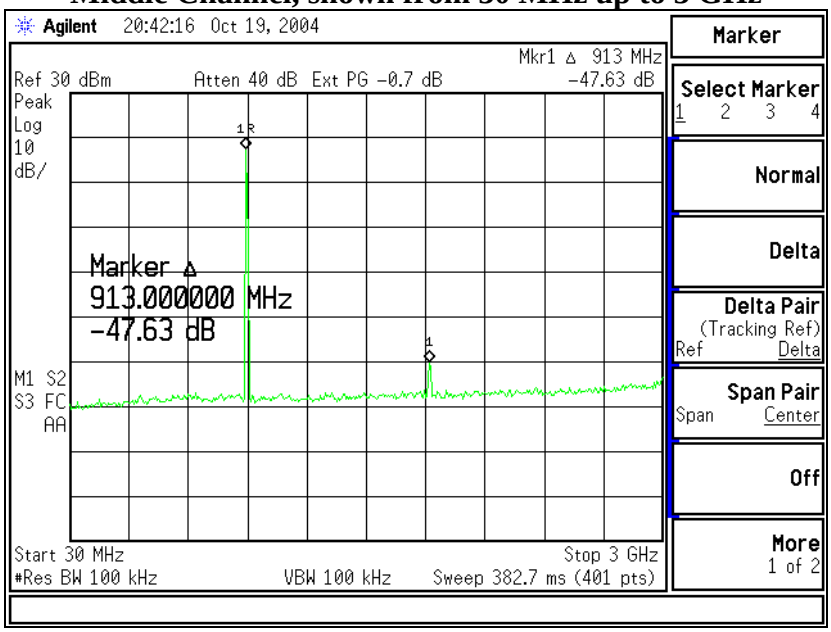
Low Channel, shown from 30 MHz up to 3 GHz



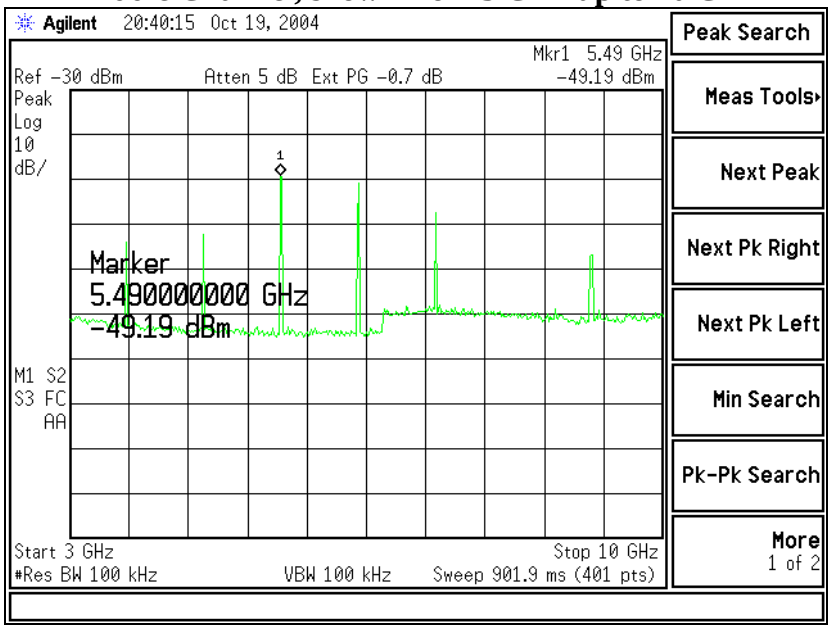
Low Channel, shown from 3 GHz up to 10 GHz



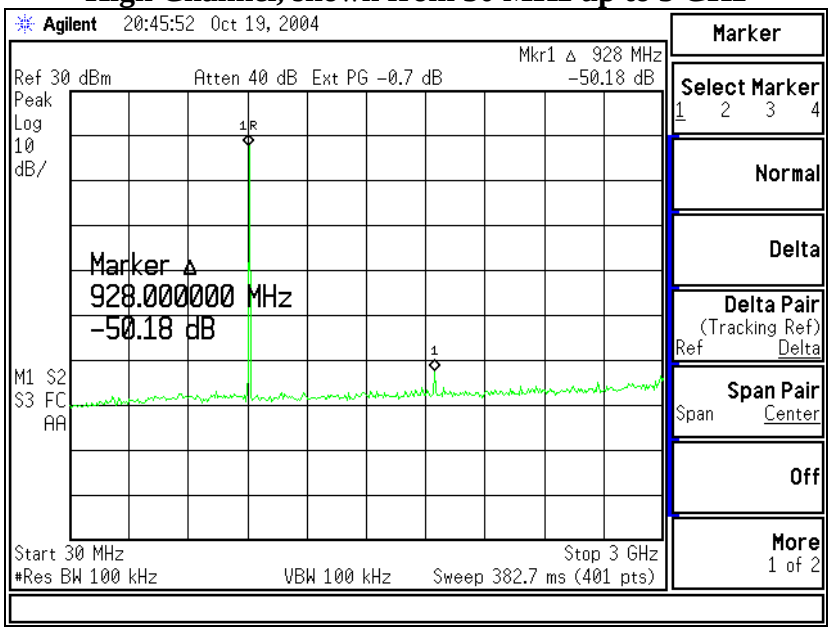
Middle Channel, shown from 30 MHz up to 3 GHz



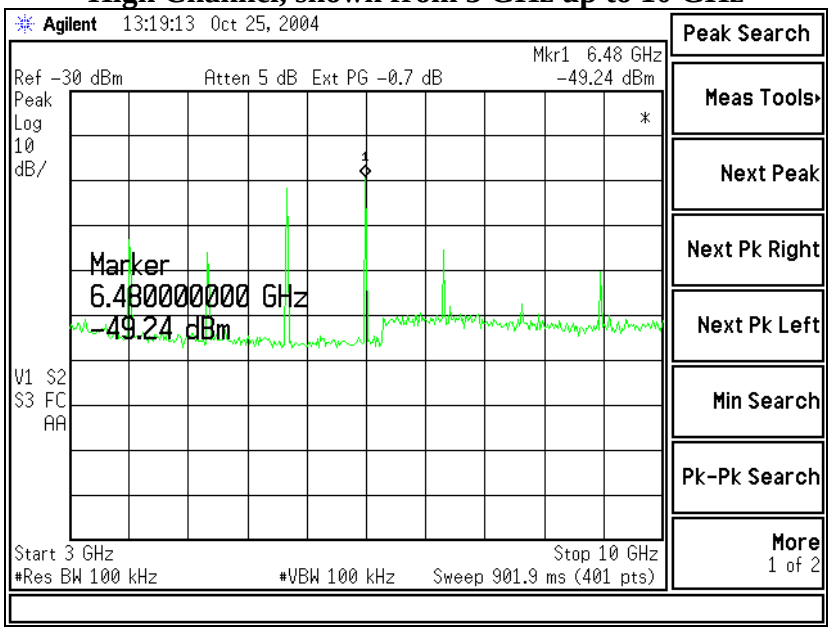
Middle Channel, shown from 3 GHz up to 10 GHz



High Channel, shown from 30 MHz up to 3 GHz



High Channel, shown from 3 GHz up to 10 GHz



16. Conducted Emissions Test, Occupied Bandwidth

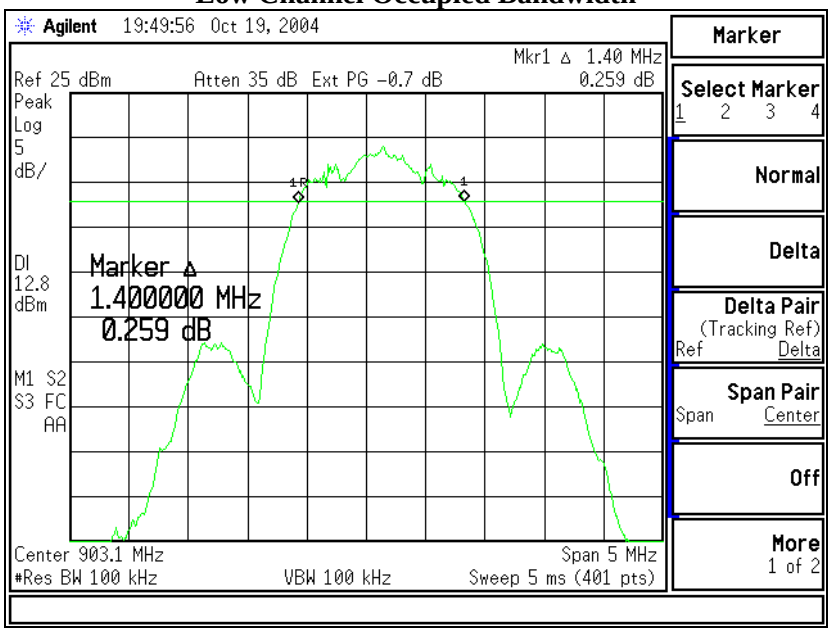
The 6 dB bandwidth requirement found in FCC Part 15.247(a)(2) dictates a minimum occupied bandwidth of 500 kHz. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to the HP E4407B spectrum analyzer. The loss from the cable was added on the analyzer as gain offset settings, there by allowing direct readings of the measurements made without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used in peak-hold mode while measurements were made, as presented in the chart below.

From this data, the bandwidth of the Low Channel was the closest data to the specification limit, at 1400 kHz clearly meets the 500 kHz minimum occupied bandwidth requirements.

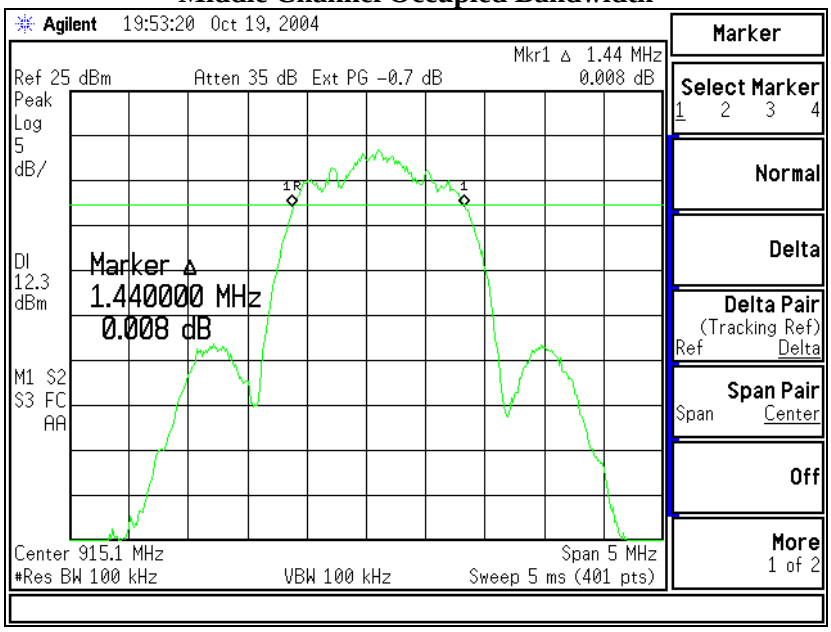
Channel	Center Frequency (MHz)	Measured 6 dB BW (kHz)	Minimum Limit (kHz)
Low (06C6)	903.125	1400	500
Mid (06DD)	915.104	1440	500
High (06F3)	926.563	1430	500

Plots of Occupied Bandwidth

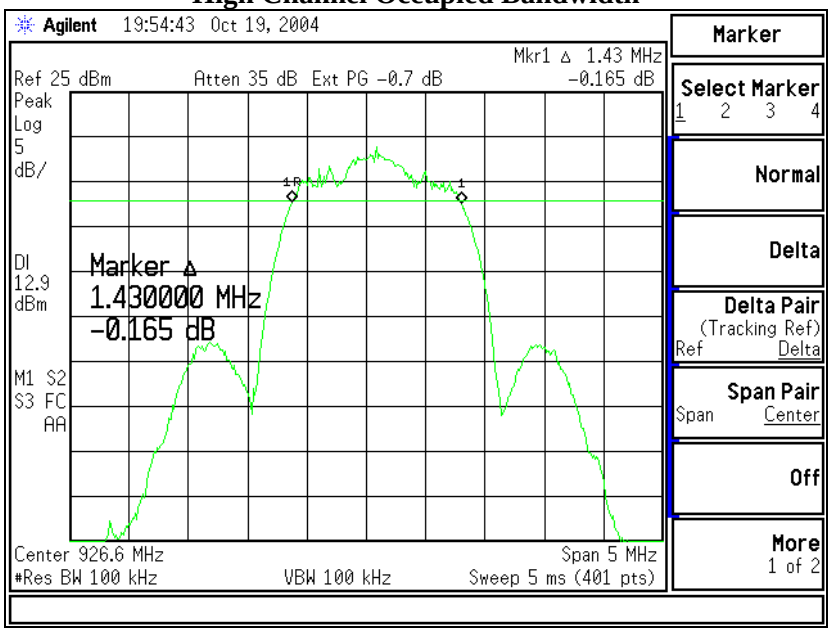
Low Channel Occupied Bandwidth



Middle Channel Occupied Bandwidth



High Channel Occupied Bandwidth

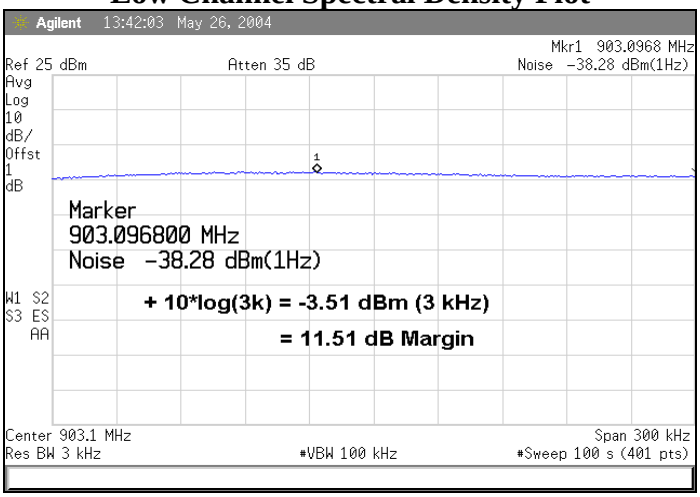


17. Conducted Emissions Test, Spectral Density

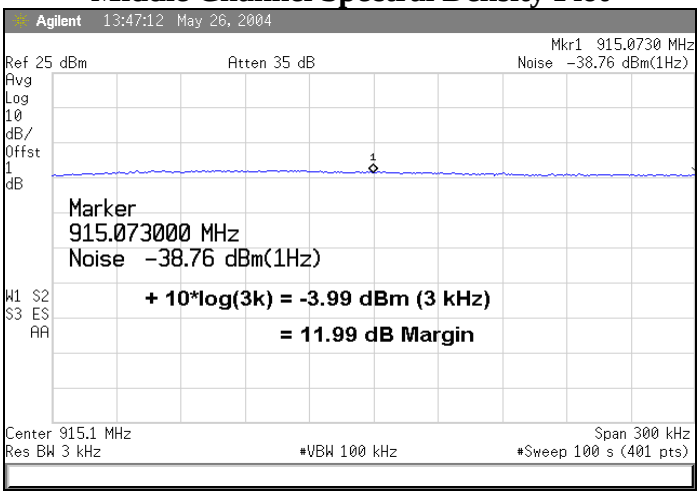
In accordance with FCC Part 15.247(e), the peak power spectral density should not exceed +8 dBm in any 3 kHz band. This measurement was performed along with the conducted power output readings performed as described in Section 14 of this report. The peak output frequency for each representative frequency was scanned, with a narrow bandwidth, and reduced sweep, and a noise power density measurement was performed using the utility built into the HP Analyzer. The resultant density was then corrected to a 3 kHz bandwidth. The highest density was found to be no greater than – 3.51 dBm, which is under the allowable limit by 11.5 dB of margin.

Channel	Frequency (MHz)	Measured Power (dBm)	Correction for 3 kHz (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
Low	903.1	- 38.28	+ 34.8	- 3.51	+ 8.0	11.5
Mid	915.1	- 38.76	+ 34.8	- 3.96	+ 8.0	11.9
High	926.5	- 38.47	+ 34.8	- 3.67	+ 8.0	11.6

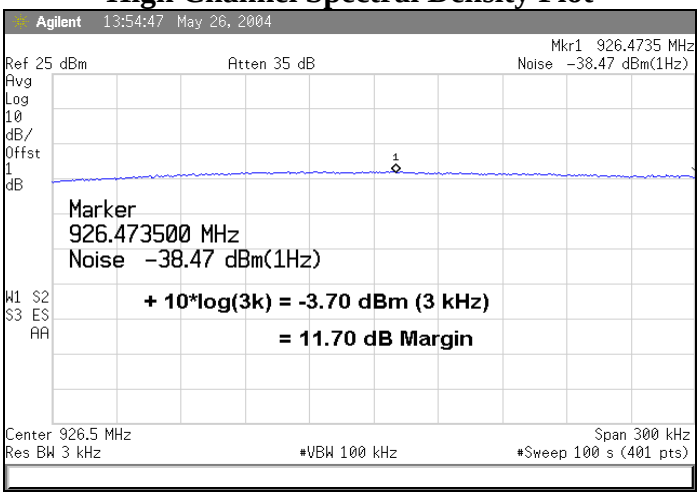
Low Channel Spectral Density Plot



Middle Channel Spectral Density Plot



High Channel Spectral Density Plot



18. MPE Calculations

According to 15.247 (b)(5), the system should operate in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

MPE Calcluation using
Nearson Model: S467AH-915S type antenna:
Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Maximum peak output power at antenna input terminal:	20.91	(dBm)
Maximum peak output power at antenna input terminal:	123.310	(mW)
Antenna gain(typical):	2	(dBi)
Maximum antenna gain:	1.585	(numeric)
Prediction distance:	20	(cm)
Prediction frequency:	915	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	0.6	(mW/cm^2)
Power density at prediction frequency:	0.038880	(mW/cm^2)
Maximum allowable antenna gain:	13.9	(dBi)
Margin of Compliance at 20cm =	9.1	dB

Appendix A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Date	Due
AA960008	EMCO	3816/2NM	9701-1057	Line Impedance Stabilization Network	9/15/04	9/15/05
AA960031	HP	119474A	3107A01708	Transient Limiter	Note 1	Note 1
AA960077	EMCO	93110B	9702-2918	Biconical Antenna	Note 1	Note 1
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/16/04	9/16/05
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	11/14/03	11/14/04
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	11/04/03	11/04/04
EE960004	EMCO	2090	9607-1164	Device Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	9/16/04	9/16/05
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	9/16/04	9/16/05
N/A	LSC	Cable	0011	3 Meter ½" Armored Cable	6/07/04	6/07/05
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	6/07/04	6/07/05
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	6/07/04	6/07/05
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1
EE960147	Advanced Microwave	WLA612	0123101	Pre-Amp. (5-18 GHz)	Note 1	Note 1

Note 1 - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V

Appendix B

Antenna Specifications

P/N S467AM-915S

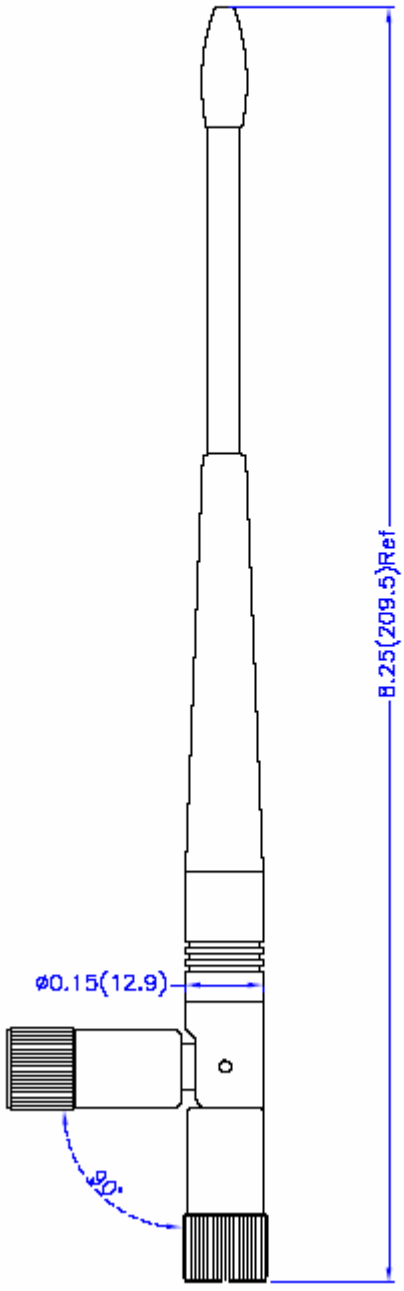
Alternative Connectors

.SMA Reverse Polarity Plug(female)

P/N: S467AH-915S

.SMA Reverse Thread Plug(male)

P/N: S467AT-915S



Electrical Properties:

Frequency Range:	902~928 MHz
Impedance:	50Ω nominal
VSWR:	<2.0:1
Gain:	*2.0 dBi
Radiation:	Omni
Polarization:	Vertical
Wave:	Half Wave Dipole

Mechanical Properties:

Connector:	SMA Plug(male)
Material:	
Whip:	Polyurethene(Black)
Connector:	Brass with black chrome plating
Operation Temp.:	-20°C to +65°C
Storage Temp.:	-30°C to +75°C

TITLE	900MHz ISM Band Swivel Antenna - 467 model	DATE	SHEET 1 OF 1
UNIT In(mm)	DWG. NO. S467AM-915S		A4
SCALE NONE	NEARSON		