



L.S. Compliance, Inc.

W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400 Fax: 262-375-4248

COMPLIANCE TESTING OF:

Sideline Receiver

Prepared For:

Simbex, LLC

Attention: Mr. Jeffrey Chu

10 Water Street, Suite 410

Lebanon, NH 03766

Test Report Number:

304555-Tx

Test Dates:

March 7TH through March 28TH, 2005

All results of this report relate only to the items that were tested. This report is not to be reproduced, except in full, without written approval of L. S. Compliance, Inc.

Table of Contents

Section Index	Description	Page
		2
1	L. S. Compliance in Review	3
2	A2LA Certificate of Accreditation	4
3	A2LA Scope of Accreditation	5
4	Validation Letter-U.S. Competent Body for EMC Directive 89/336/EEC	6
5	Signature Page	7
6	Product and General Information	8
7	Introduction	8
8	Product Description	9
9	Test Requirements	10
10	Summary of Test Report	10
11	Radiated Emissions Test	11-20
12	Band-Edge Measurements	21-22
13	Conducted Emissions onto AC Power Line	23-27
14	Occupied Bandwidth	28-29
15	RF Power Output	30-31
16	Spurious RF Emissions	32-33
17	Minimum Channel Separation	34-39
18	Channel Occupancy	40-41
19	Frequency and Power Stability requirements	42
20	Equal Channel Usage	43
21	Pseudorandom Hopping Pattern	43
22	Receiver Synchronization	44
23	Receiver Input Bandwidth	44
24	MPE Calculations	45
Appendix		
A	Test Equipment List	46
B	Antenna Specification Sheets	47
C	Firmware and Setup Instructions	48

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

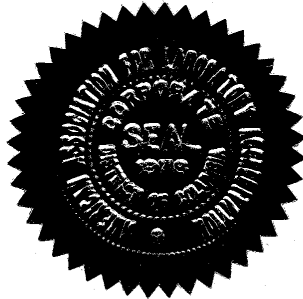
L.S. COMPLIANCE, INC.
Cedarburg, WI

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.



Peter Abney

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:

<u>Test</u>	<u>Test Method(s)</u>
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

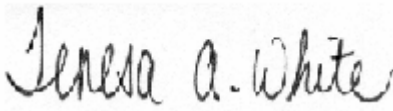
(A2LA Cert. No. 1255-01) 05/13/03
5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-662 2974

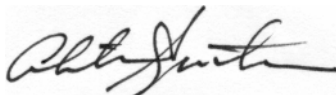


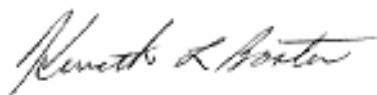
4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC

 <p>1901-2001 NIST CENTENNIAL</p>	 <p>DEPARTMENT OF COMMERCE UNITED STATES OF AMERICA</p>	<p>UNITED STATES DEPARTMENT OF COMMERCE National Institute of Standards and Technology Gaithersburg, Maryland 20899-</p>
<p>January 16, 2001</p>		
<p>Mr. James J. Blaha L.S. Compliance Inc. W66 N220 Commerce Court Cedarburg, WI 53012-2636</p>		
<p>Dear Mr. Blaha:</p>		
<p>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).</p>		
<p>(✓) 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:</p>		
<p>This validation is only for the location noted in the address block, unless otherwise indicated below.</p>		
<p>(✓) Only the facility noted in the address block above has been approved. () Additional EMC facilities: () Additional R&TTE facilities:</p>		
<p>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.</p>		
<p>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.</p>		
		

5. Signature Page

Prepared By:  April 29, 2005
Teresa A. White, Document Coordinator Date

Tested By:  April 29, 2005
Abtin Spantman, EMC Engineer Date

Approved By:  April 29, 2005
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:	Simbex, LLC				
Date(s) of Test:	March 7 th through March 28 th , 2005				
Test Engineer(s):	Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	Sideline Receiver				
Serial #:	15-000313				
Voltage:	5.0 VDC				
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode				

7. Introduction

Between March 7th and March 28th, 2005, a series of Conducted and Radiated RF Emission tests were performed on one sample of the Simbex, LLC, Model Number Sideline Receiver^(Note 1), Serial Number 15-000313, 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 at L.S. Compliance, Incorporated.

All Radiated and Conducted RF 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, 15.205, 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 Radioelectriques (CISPR) Number 16-1, 2003.

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

Note 1: Although the unit has a model name and number listed as: "Sideline Receiver", the unit actually contains a transceiver, of which the transmitter characteristics were tested and the results are presented in this report.

8. Product Description

The system is called the Head Impact Telemetry System™ (HIT System™) and is the first device to continuously monitor, analyze and record a player's on-field head impact experience, and which is practical enough to be used in all game and practice situations. The HIT System not only monitors and records the impact history for all players simultaneously, but also can signal the sidelines staff to the occurrence of an impact that conforms to a Suspect Impact Profile™. The system monitors standard impact measures, such as maximum g's, Head Impact Criteria (HIC), and Gadd Severity Index (GSI), or customized metrics based on any of the components of impact location, impact magnitude, impact duration, linear and angular acceleration components and the exact times. The portion of the system tested and covered by this report is the transmitter characteristics of the transceiver used inside the "Sideline Unit", named the "Sideline Receiver". (Note: The Sideline Receiver actually contains a transceiver.)

The HIT System™ is comprised of four main systems: the MX Encoders, the Sideline Receiver, the Alert Pager, and the Computer. The Sideline Receiver, Alert Pager, and Computer are all stored within a protective Field Case. The MX Encoders are installed inside Riddell VSR-4 and Revolution football helmets, measure impacts as they occur on the field, and transmit impact data to the Sideline Receiver. The Sideline Receiver manages impact information recorded by the MX Encoders and relays it to the Computer, where the data is processed, analyzed, and stored. When impacts matching user selectable Suspect Impact Profiles (SIP's) are received, the Alert Pager System sends a signal to the Alert Beeper, signaling sideline staff that a SIP has occurred.

The Mx Encoder system is comprised of three major elements: a single board radio transceiver, a sensor wiring harness and a three cell 3.6 VDC Nickel Metal Hydride (NiMH) rechargeable battery pack. When fully integrated, the three elements are connected to one another with mating cables and connectors and are encapsulated in a sealed plastic package. The sealed unit is then inserted into a football helmet and firmly attached in place with Velcro strips. Spring loaded pressure tabs press the 7 sensors against the user's skull.

The radio is a frequency hopping spread spectrum transceiver operating in the 902 MHz to 928 MHz ISM band. It transmits with a nominal power of 0.5 watts (+27 dBm) into an integrated PCB trace antenna with a nominal gain of 0 dBi. The transmitter uses direct FSK modulation, with a crystal controlled Phase Locked Loop oscillator. Transmissions occur within a group of 50 channels which are chosen from a pool of 53 available channels. Each radio is programmed with a seed value which determines the table based on a defined pseudorandom generator. Each channel carries a single packet of information for a duration no longer than 52 mS.

The sensor wiring harness is comprised of six solid state single axis accelerometers and a thermistor. Each accelerometer measures impacts received to the helmet and the thermistor measures the wearer's head temperature. Analog signals from these sensors are digitized by the radio's microcontroller and the resulting data is transmitted to a master radio station for further processing.

The battery pack is comprised of three AA size NiMH batteries with a nominal 750 mAHr capacity. The batteries are recharged by an external charger, and must be removed from the helmet for charging.

A deployed HITS System is comprised of a grouping of as many as one hundred individual helmet systems described above and a single Sideline Controller. Each helmet system operates independently and wireless data transfers are made from helmets to their mated Sideline Controller as each helmet is polled by that Sideline Controller. There are no peer to peer communications between helmet units. Because of the unique addressing scheme used, the helmets will not respond to another group's (team's) sideline controller.

Each helmet and sideline controller is uniquely addressed in such a manner that communications may only take place between helmets and their mated sideline controller. The coordination of hop sequences, addresses, etc. is conducted during factory assembly as systems are built to order for a particular customer. The system does not automatically re-configure channel hopping sequences in the field.

The receiver uses direct conversion meaning that there is no offset local oscillator. Individual channel selection occurs within the receiver without the need for external filtering. An overall band-pass filter restricts the receiver to the stated ISM band.

9. Test Requirements

The above mentioned tests were performed in order to determine the compliance of the Simbex, LLC, Model Number Sideline Receiver, Serial Number 15-000313 with limits contained in various provisions of Title 47 CFR, FCC Part 15, including:

15.205	15.247a	15.247d
15.207	15.247b	15.247g
15.209	15.247c	

10. Summary of Test Report

DECLARATION OF CONFORMITY

The Simbex, LLC, Model Number "Sideline Receiver"^(Note 1), Serial Number 15-000313, was found to **MEET** the requirements as described within the specification of Title 47 CFR FCC, Part 15.247, and Industry Canada RSS-210, Section 6.2.2(o) for a Frequency Hopping Spread Spectrum Transmitter.

The enclosed test results pertain to the sample(s) of the test item listed, and only for the tests performed on the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Some emissions are seen to be within 3dB of their respective limits. As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

Note 1: Although the unit has a model name and number listed as: "Sideline Receiver", the unit actually contains a transceiver, of which the transmitter characteristics were tested and the results are presented in this report.

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 continuous modulated transmit mode, using power (5.0VDC, 500mA) as provided by the host USB port on a Laptop computer. The unit has the capability to operate on 53 channels, controllable via special test software program.

The applicable limits apply at a 3 meter distance. Measurements above 5 GHz were performed at a 1.0 meter separation distance. 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 (Ch:00, 902.77 MHz), middle (Ch:27, 915.28 MHz) and high (Ch:52, 927.21 MHz) to comply with FCC Part 15.35. The channels and operating modes were changed using the test software as provided by the manufacturer.

Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 10000 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 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 maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was tested with a monopole antenna only in the vertical orientation (one axis only), as would normally be used, during the investigations to find the highest emission levels.

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). 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 FHSS transmitter [Canada RSS-210, Clause 6.2.2(o)]. The frequencies with significant RF signal strength 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 47 CFR 15.247 (b)(2), is 1 Watt for systems employing at least 50 hopping channels. The harmonic and spurious RF emissions, as measured in any 100 kHz 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).

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 $\mu\text{V/m}$	3 m Limit (dB $\mu\text{V/m}$)	1 m Limit (dB $\mu\text{V/m}$)
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 $\mu\text{V/m}$ to dB $\mu\text{V/m}$:

$$\begin{aligned} \text{dB}\mu\text{V/m} &= 20 \log_{10} (100) \\ &= 40 \text{ dB}\mu\text{V/m} \text{ (from 30-88 MHz)} \end{aligned}$$

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

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at 3 meters} \\ &54.0 + 9.5 = 63.5 \text{ dB}/\mu\text{V/m at 1 meter} \end{aligned}$$

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

$$\begin{aligned} &960 \text{ MHz to } 10,000 \text{ MHz} \\ &500\mu\text{V/m or } 54.0 \text{ dB}/\mu\text{V/m at 3 meters} \\ &54.0 + 20 = 74 \text{ dB}/\mu\text{V/m at 0.3 meters} \end{aligned}$$

Radiated Emissions Data Chart
3 Meter Measurements of Electromagnetic Radiated Emissions
Test Standard: 47CFR, Part 15.205 and 15.247(FHSS)
Frequency Range Inspected: 30 MHz to 10000 MHz

Manufacturer:	Simbex, LLC					
Date(s) of Test:	March 7 th through March 28 th , 2005					
Test Engineer(s):	Tom Smith	√	Abtin Spantman		Ken Boston	
Model #:	Sideline Receiver					
Serial #:	15-000313					
Voltage:	5.0 VDC					
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode					
EUT Power:	√	Single Phase 120VAC		3 Phase ___ VAC		
		Battery	√	Other: Host PC USB Port		
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 93110

The following table depicts the level of significant spurious radiated RF emissions found:

Frequency (MHz)	Antenna Polarity	Channel	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.205 Limit (dBμV/m)	Margin (dB)
133.1	V	Hop	1.00	220	23.7	43.0	19.3
241.4	H	Hop	1.00	70	30.5	46.0	15.5

Notes:

- 1) A Quasi-Peak Detector was used in measurements below 1 GHz, and an Average Detector was used in measurements above 1 GHz. The Peak detector was also used to ensure that the emission levels do not exceed 20 dB beyond the Average limits.
- 2) No significant spurious emissions observed. All spurious emissions were better than 20 dB below the limits.

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 00:

Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.205/15.247 Limit (dBμV/m)	Margin (dB)
902.8 *	V	1.50	0	127.9	131.2	3.3
1805.5	V	1.30	295	59.4	91.3	31.9
2708.3	V	1.00	105	38.7	54.0	15.3
3611.1	V	1.20	195	31.3	54.0	22.7
4513.9	V	1.10	180	30.0	54.0	24.0
5416.6	V	1.05	285	40.2	63.2	23.0
6319.4	V	1.25	120	38.2	100.8	62.6
7222.2	V	1.05	195	40.3	100.8	60.5
8124.9	V	1.15	95	40.7	63.2	22.5
9027.7	V	1.00	0	37.0	63.2	26.2

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 27:

Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.205/15.247 Limit (dBμV/m)	Margin (dB)
915.3 *	V	1.40	0	128.3	131.2	2.9
1830.6	V	1.50	315	59.1	90.1	31.0
2745.8	V	1.00	85	34.9	54.0	19.1
3661.1	V	1.75	190	29.9	54.0	24.1
4576.4	V	1.05	200	29.0	54.0	25.0
5491.7	V	1.15	100	43.6	99.6	56.0
6407.0	V	1.10	185	38.4	99.6	61.2
7322.2	V	1.05	250	42.2	63.2	21.0
8237.5	V	1.10	170	44.1	63.2	19.1
9152.8	V	1.00	0	37.1	63.2	26.1

The following table depicts the level of significant radiated RF fundamental and harmonic emissions seen on Channel 52:

Frequency (MHz)	Antenna Polarity	Height (meters)	Azimuth (0° - 360°)	Measured ERP (dBμV/m)	15.205/15.247 Limit (dBμV/m)	Margin (dB)
927.2 *	V	1.40	0	127.3	131.2	3.9
1854.4	V	1.25	315	64.2	92.0	27.8
2781.6	V	1.05	130	31.8	54.0	22.2
3708.8	V	1.05	0	31.0	54.0	23.0
4636.1	V	1.00	0	28.9	54.0	25.1
5563.3	V	1.05	270	42.9	101.5	58.6
6490.5	V	1.05	180	44.7	101.5	56.8
7417.7	V	1.00	95	42.3	63.2	20.9
8344.9	V	1.00	185	39.2	63.2	24.0
9272.1	V	1.00	0	37.1	101.5	64.4

Notes: 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. The peak detector was used to ensure the peak emissions did not exceed 20 dB above the limits. Measurements above 5 GHz were made at 1 meters of separation from the EUT, and at 0.3 m separation at 18 – 26 GHz.

* Measurements taken to evaluate ERP of fundamental signal.

Close-up view of the EUT base and USB cable



View of the EUT with the Monopole antenna.



Front view of the EUT setup during radiated RF emissions tests



Rear view of the EUT setup during radiated RF emissions tests, showing the host Laptop configuration

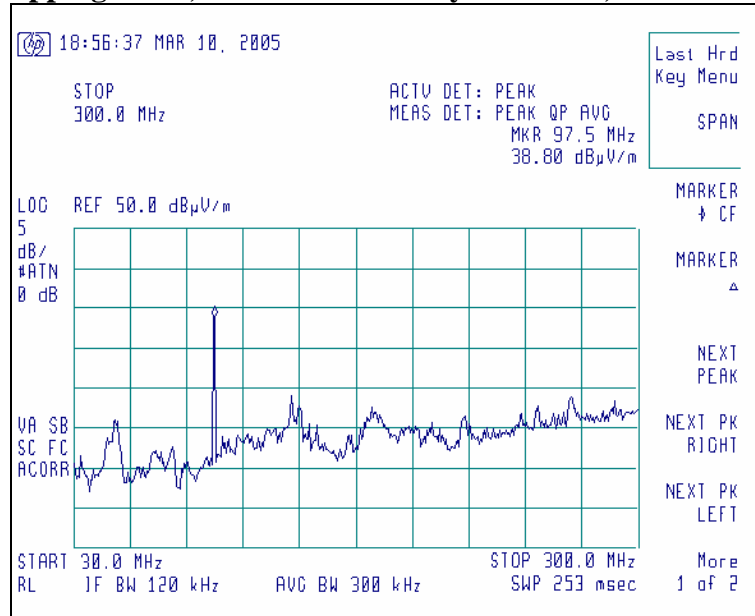


Graphs made during Radiated Emission Testing

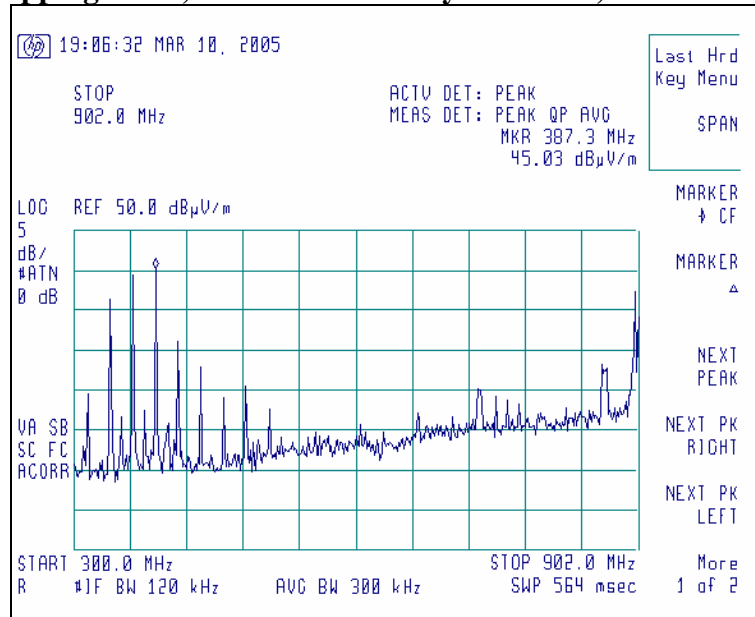
Screen Captures of Radiated RF Emissions:

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 an Average detector function when measuring frequencies above 1 GHz. The signature scans shown here are from worst-case emissions, as measured on channels 00, 27, or 52, or in hopping mode, with the sense and EUT antennas both in vertical polarity for worst case presentations.

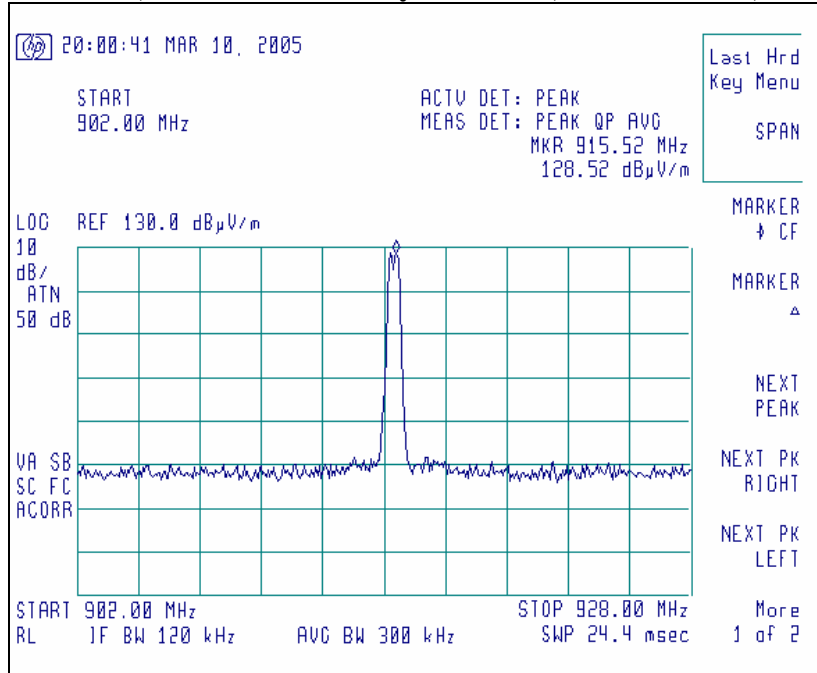
EUT in hopping mode, Antenna Vertically Polarized, 30-300 MHz, at 3m.



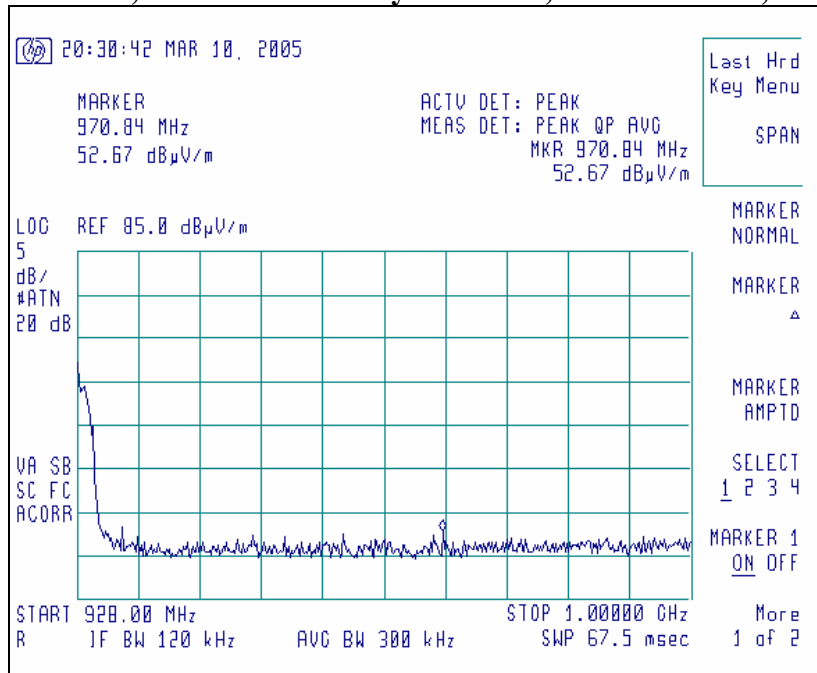
EUT in hopping mode, Antenna Vertically Polarized, 300-902 MHz, at 3m.



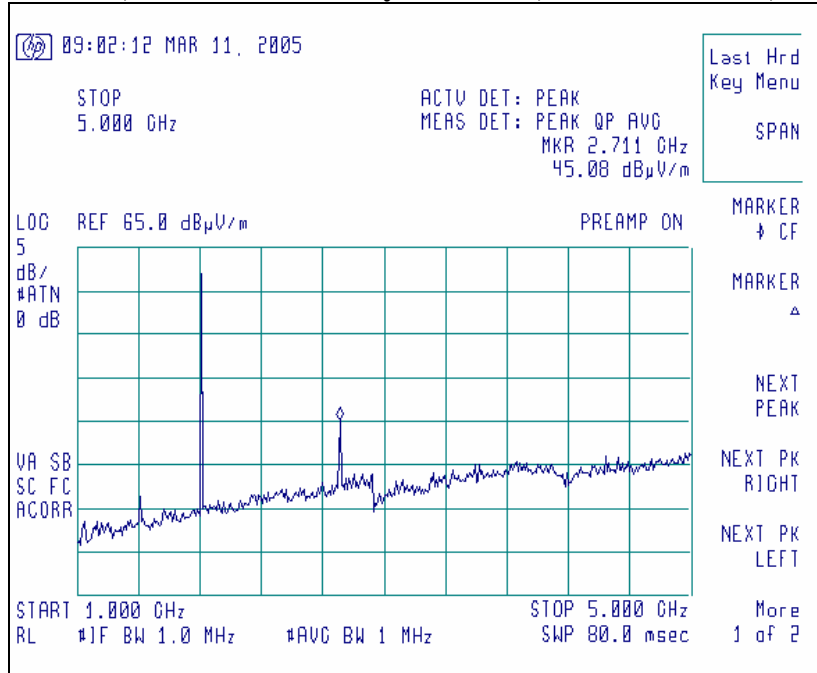
Channel 27, Antenna Vertically Polarized, 902-928 MHz, at 3m.



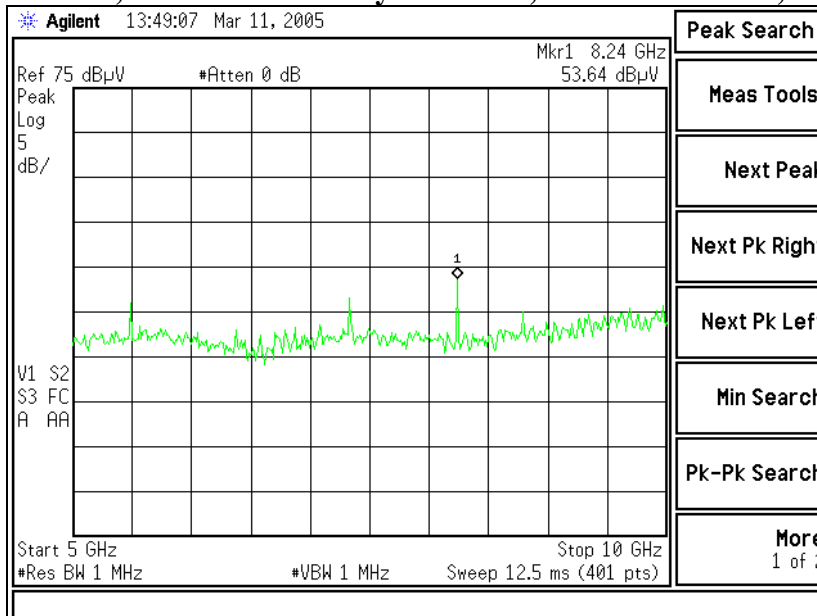
Channel 52, Antenna Vertically Polarized, 928-1000 MHz, at 3m.



Channel 27, Antenna Vertically Polarized, 1000-5000 MHz, at 3m.



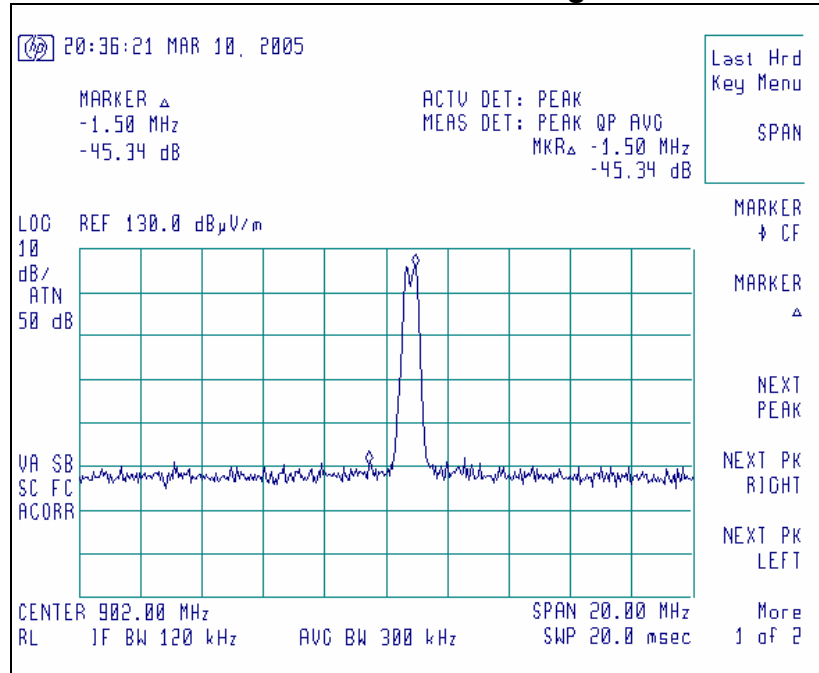
Channel 27, Antenna Vertically Polarized, 5000-10000 MHz, at 1m.



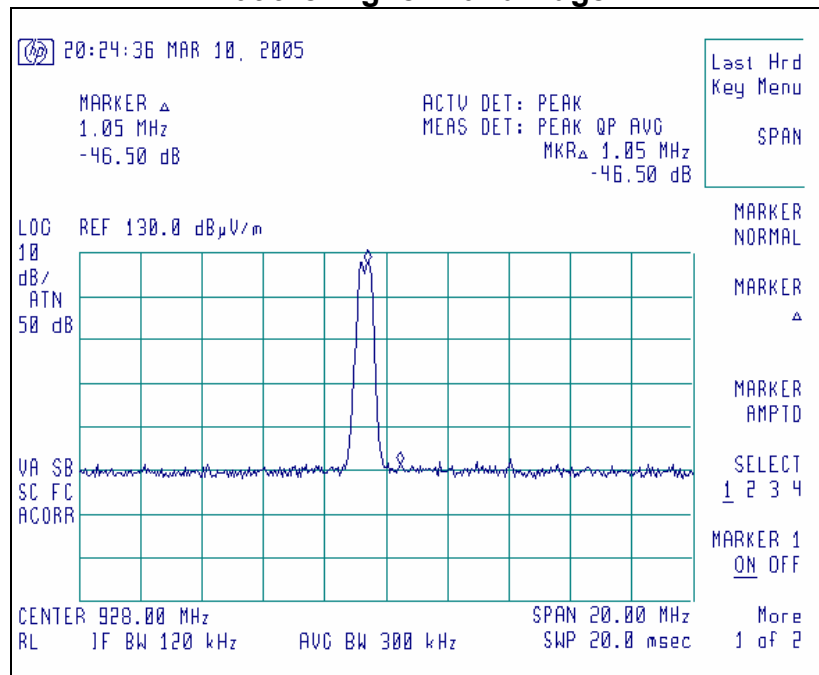
12. **Band-Edge Measurements**

FCC 15.209(b) and 15.247(d) require a measurement of spurious emission levels to be at least 20 dB lower than the fundamental emission level, 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, with emissions meeting the – 20 dBc limit. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source. The EUT was operated at the lowest channel for the investigation of the lower band-edge, and at the highest channel for the investigation of the higher band-edge.

Screen Capture demonstrating -20 dBc compliance at the Lower Band-Edge



Screen Capture demonstrating -20 dBc compliance at the Higher Band-Edge



13. Conducted RF Emissions test on 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 C63.4-2003 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 was connected to a host Laptop PC through the USB port, with the Laptop provided the power source (5VDC, 500mA from USB driver IC) and communication for the EUT. The Laptop was then connected to the 120 VAC Mains. The Laptop power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. 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 investigated in continuous modulated transmit mode for this portion of the testing. 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.

Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

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.

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

* Decreases with the logarithm of the frequency.

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

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

For a frequency of 200 kHz for example:

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

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

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

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

Measurement of Electromagnetic Conducted Emission

Frequency Range inspected: 150 KHz to 30 MHz

Test Standard: FCC 15.207 (a)

Manufacturer:	Simbex, LLC				
Date(s) of Test:	March 7 th through March 28 th , 2005				
Test Engineer:	Tom Smith	√	Abtin Spantman		Ken Boston
Model #:	Sideline Receiver				
Serial #:	15-000313				
Voltage:	5.0 VDC				
Operation Mode:	Normal, continuous transmit, and 'Hopping' mode				
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

Frequency (MHz)	Line	QUASI-PEAK			AVERAGE		
		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)
0.155	L1	43.0	65.7	22.7	22.6	55.7	33.1
0.177	L1	39.3	64.6	25.3	18.9	54.6	35.7
0.243	L1	41.1	62.0	20.9	25.2	52.0	26.8
1.275	L1	28.8	56.0	27.2	22.1	46.0	23.9
1.736	L1	31.6	56.0	24.4	28.4	46.0	17.6
8.898	L1	33.6	56.0	22.4	27.8	46.0	18.2
0.155	L2	45.0	64.6	19.6	25.5	54.6	29.1
0.175	L2	40.2	64.7	24.5	24.2	54.7	30.5
0.244	L2	40.3	62.0	21.7	22.6	52.0	29.4
1.285	L2	31.5	56.0	24.5	26.7	46.0	19.3
1.730	L2	32.8	56.0	23.2	28.0	46.0	18.0
10.34	L2	30.7	56.0	25.3	24.6	46.0	21.4

Notes:

- 1) The emissions listed are characteristic of the power source of the Host Laptop, and did not change by the addition of the EUT.
- 2) The samples data is presented for completeness. All other emissions were better than 20 dB below the limits.
- 3) The system exhibited similar emissions in transmit and receive modes, and across the Low, Middle and High channels tested.

Setup for the Conducted Emissions Test

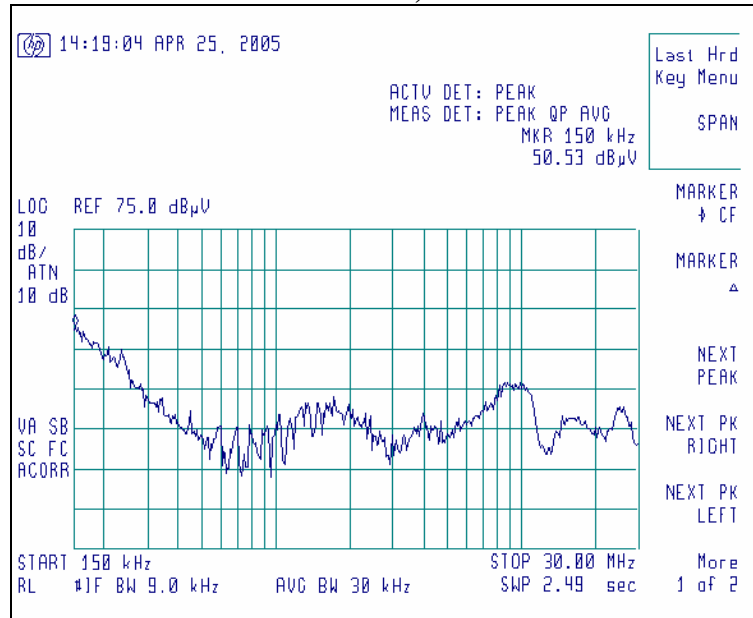


Screen Captures of Conducted AC Mains Emissions:

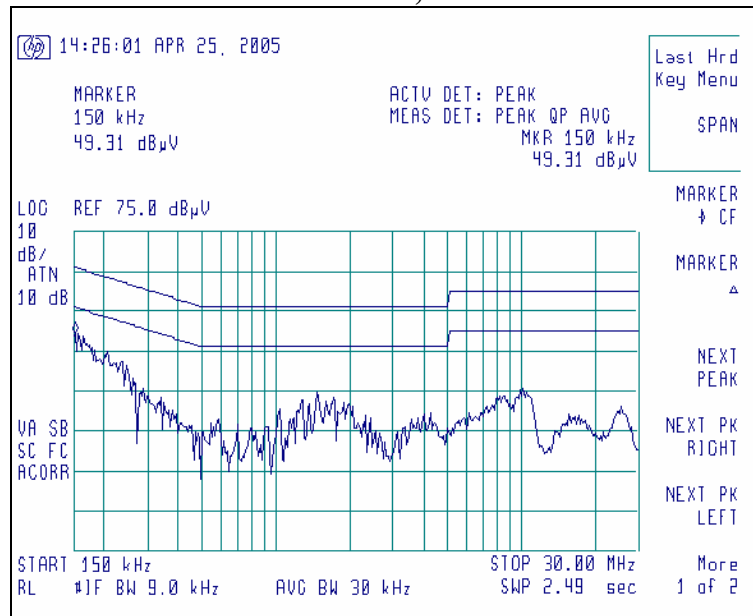
Please note these screen captures represent Peak Emissions. For conducted emission measurements, we utilize both a Quasi-Peak detector function as well as the Average detector function for measurements. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.209.

The signature scans shown here are from channel 27, chosen as being a good representative of channels.

Channel 27, Line 1



Channel 27, Line 2



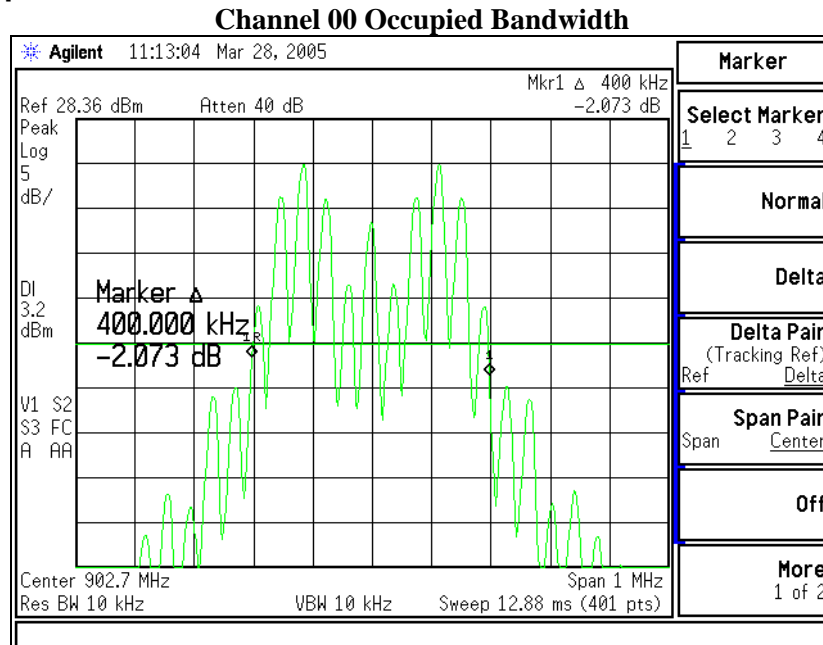
14. Occupied Bandwidth

The 20 dB bandwidth requirement found in FCC Part 15.247(a)(1)(i) states a maximum allowed occupied bandwidth of 500 kHz. For this portion of the tests, a direct conducted 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 without the need for any further corrections. A Hewlett Packard model E4407B spectrum analyzer was used with the resolution bandwidth set to 10 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.

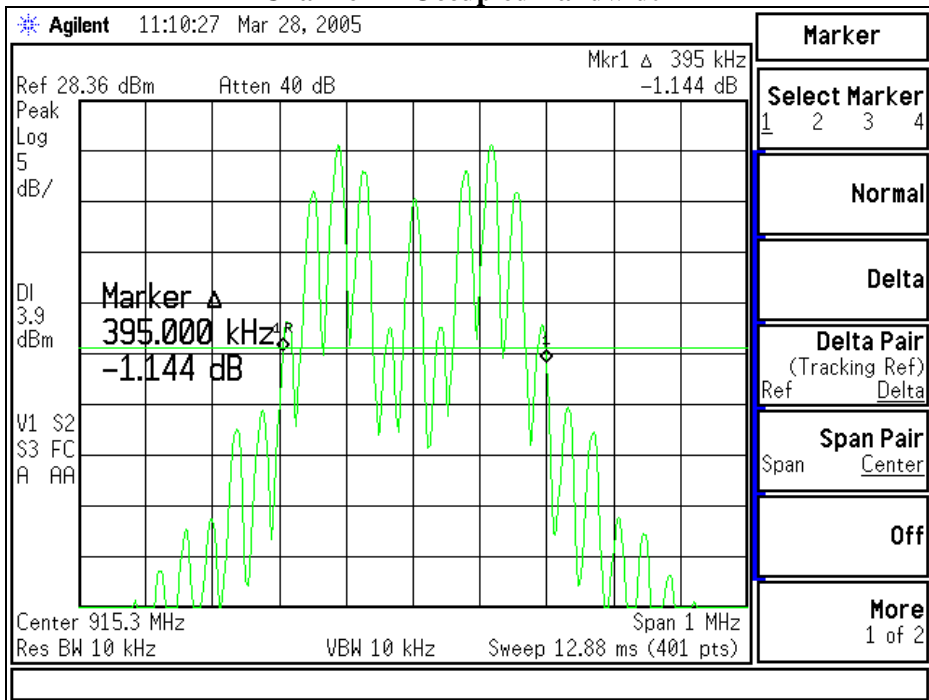
From this data, the closest measurement when compared to the specified limit, is 400 kHz, which is below the maximum limit of 500 kHz.

Channel	Center Frequency (MHz)	Measured 20 dB BW (kHz)	Maximum Limit (kHz)
00	902.8	400	500
27	915.3	395	500
52	927.2	400	500

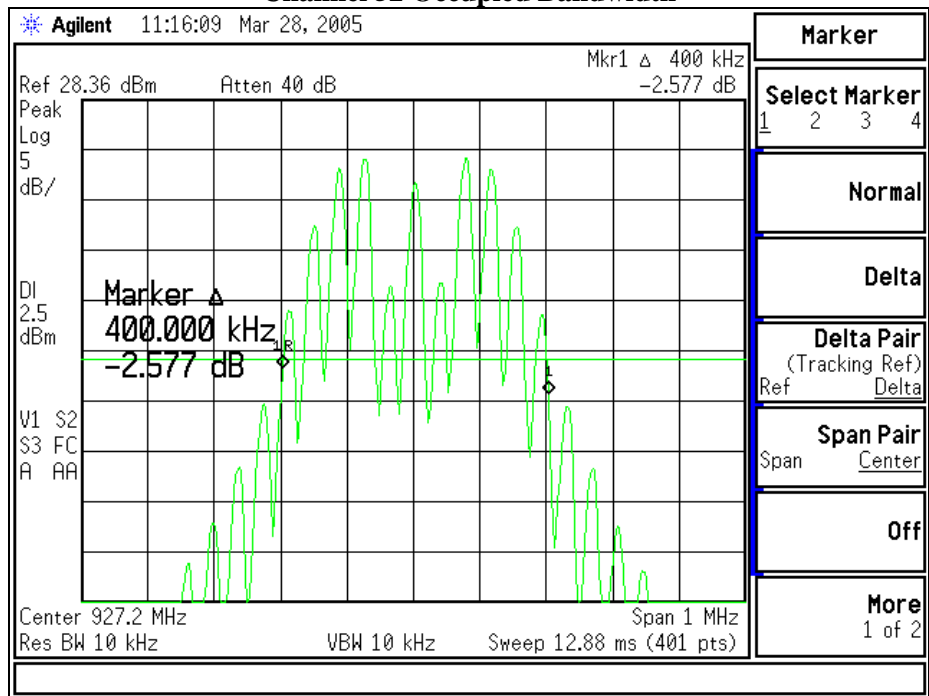
Plots of Occupied Bandwidth



Channel 27 Occupied Bandwidth



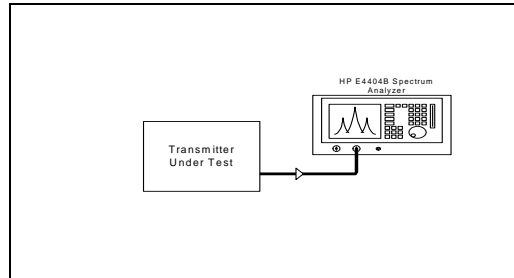
Channel 52 Occupied Bandwidth



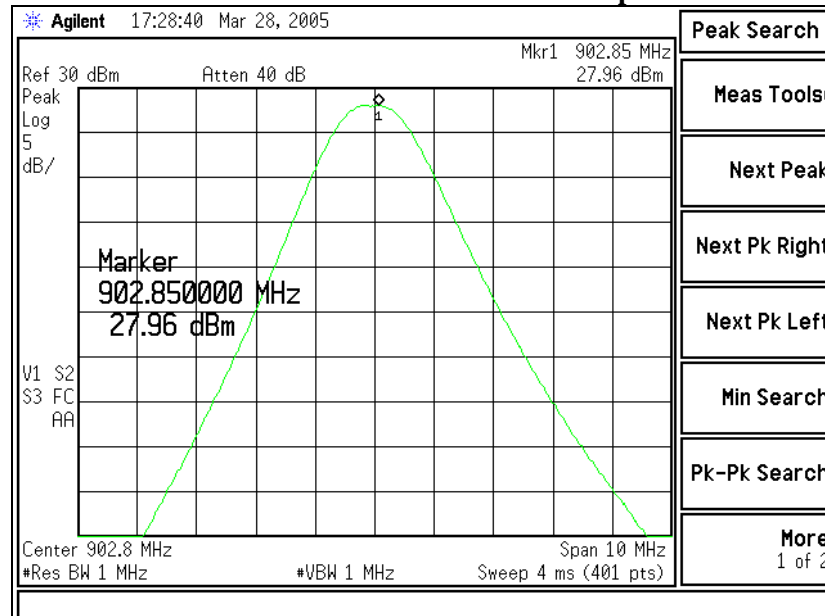
15. Power Output 15.247(b)

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable for the spectrum analyzer. The loss from the cable was added on the analyzer as gain offset settings, there by allowing direct readings of the measurements without the need for any further corrections. 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 1 MHz, and a span of 10 MHz, with measurements from a peak detector presented in the chart below. RF Power Output was also monitored, as described later in this report, while varying the DC voltage as sourced by a DC bench type power supply.

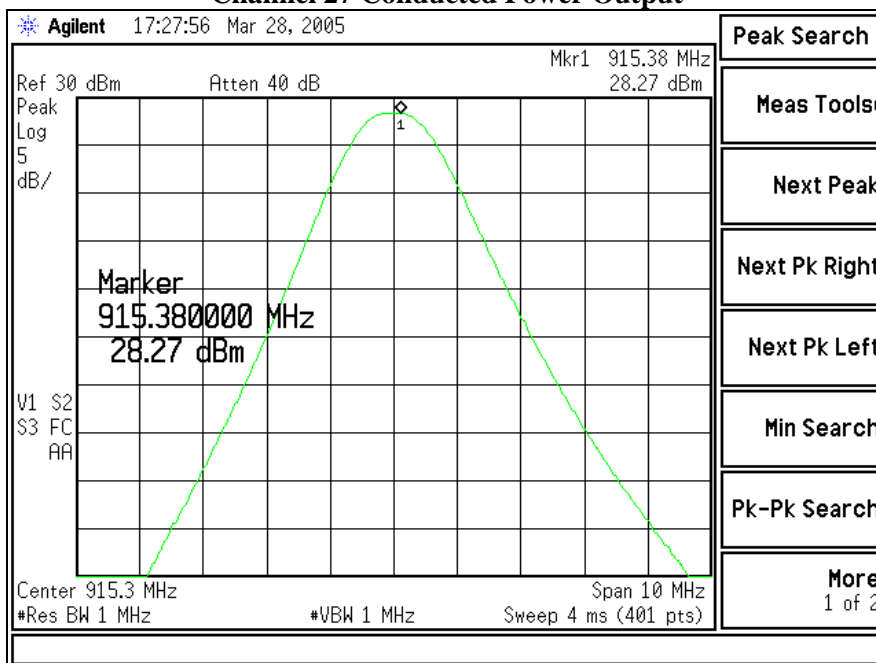
CHANNEL	CENTER FREQ (MHz)	LIMIT (dBm)	MEASURED POWER (dBm)	MARGIN (dB)
00	902.8	+ 30.0	+ 28.0	2.0
27	915.3	+ 30.0	+ 28.3	1.7
52	927.2	+ 30.0	+ 28.0	2.0



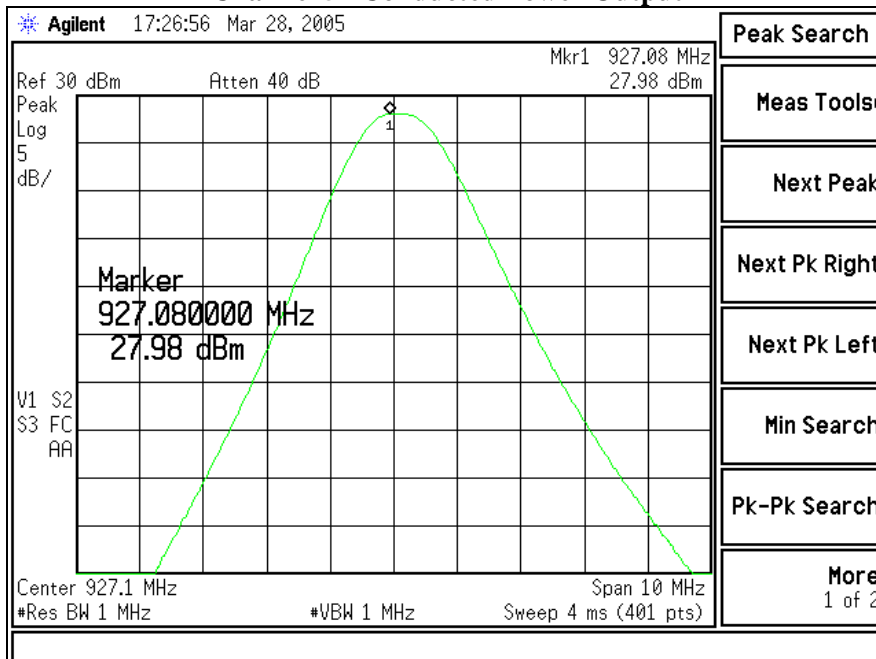
Channel 00 Conducted Power Output



Channel 27 Conducted Power Output



Channel 52 Conducted Power Output



16. 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. The loss from the cable was added on the analyzer as gain offset settings, there by allowing direct readings of the measurements 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 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.

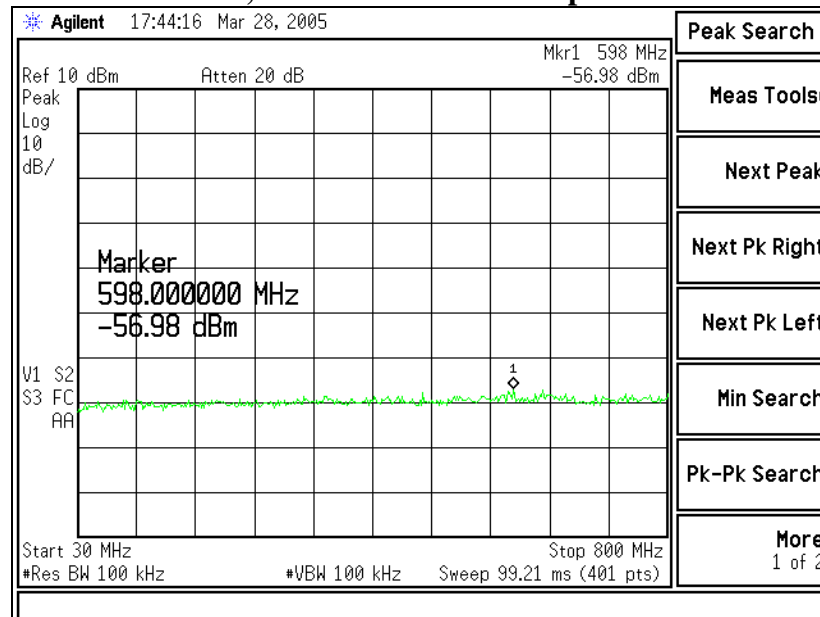
No significant emissions could be noted within -30 dBc of the fundamental level for this product.

	Channel 00	Channel 27	Channel 52
Fundamental	+ 28.0 (dBm)	+ 28.3 (dBm)	+ 28.0 (dBm)
2 nd Harmonic	- 16.9 (dBm)	- 18.7 (dBm)	- 21.9 (dBm)
3 rd Harmonic	- 48.7 (dBm)	- 55.0 (dBm)	- 44.3 (dBm)
4 th Harmonic	- 54.9 (dBm)	- 54.1 (dBm)	- 53.2 (dBm)
5 th Harmonic	Note (1)	Note (1)	Note (1)
6 th Harmonic	Note (1)	Note (1)	Note (1)
7 th Harmonic	Note (1)	Note (1)	Note (1)
8 th Harmonic	Note (1)	Note (1)	Note (1)
9 th Harmonic	Note (1)	Note (1)	Note (1)
10 th Harmonic	Note (1)	Note (1)	Note (1)

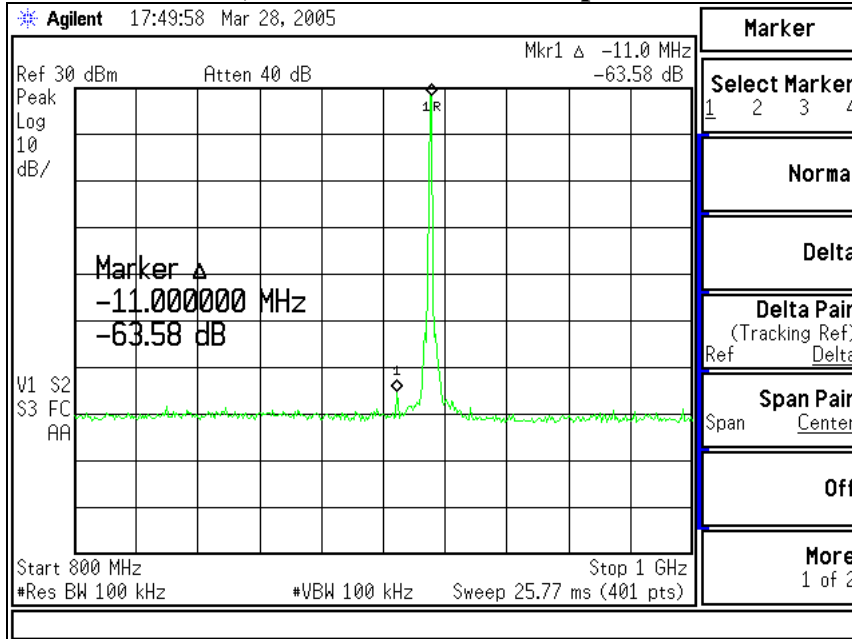
Notes:

(1) Measurement at system noise floor.

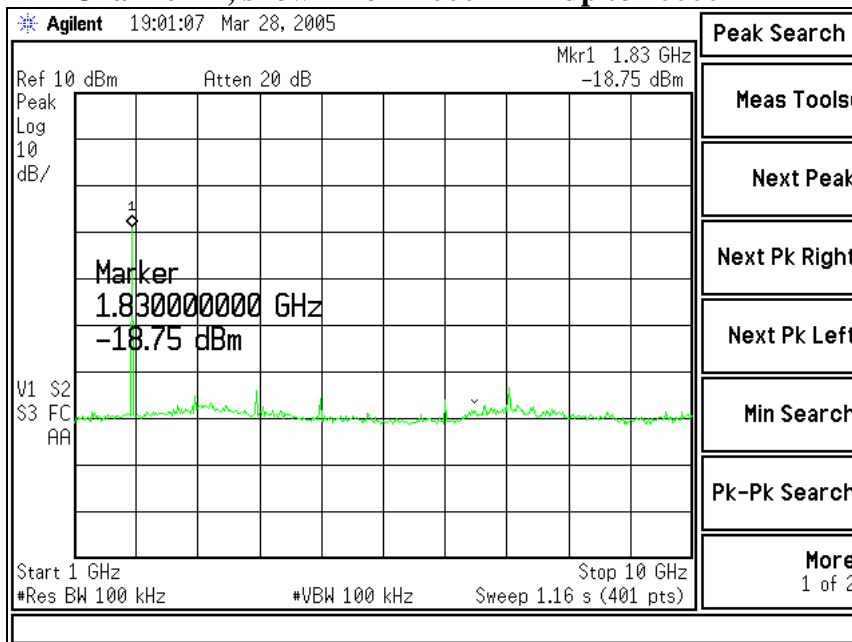
Plots of Conducted Spurious and Fundamental Levels, channel 27 shown as representative. Channel 27, shown from 30 MHz up to 800 MHz



Channel 27, shown from 800 MHz up to 1000 MHz



Channel 27, shown from 1000 MHz up to 10000 MHz



17. Minimum Channel Separation

Part 15.247(a)(1) requires a minimum channel separation of 25 kHz or the equivalent of the 20 dB occupied bandwidth of the fundamental transmission, whichever is greater. An HP E4407B spectrum analyzer was used with a resolution bandwidth of 30 kHz to measure the channel separation of the EUT.

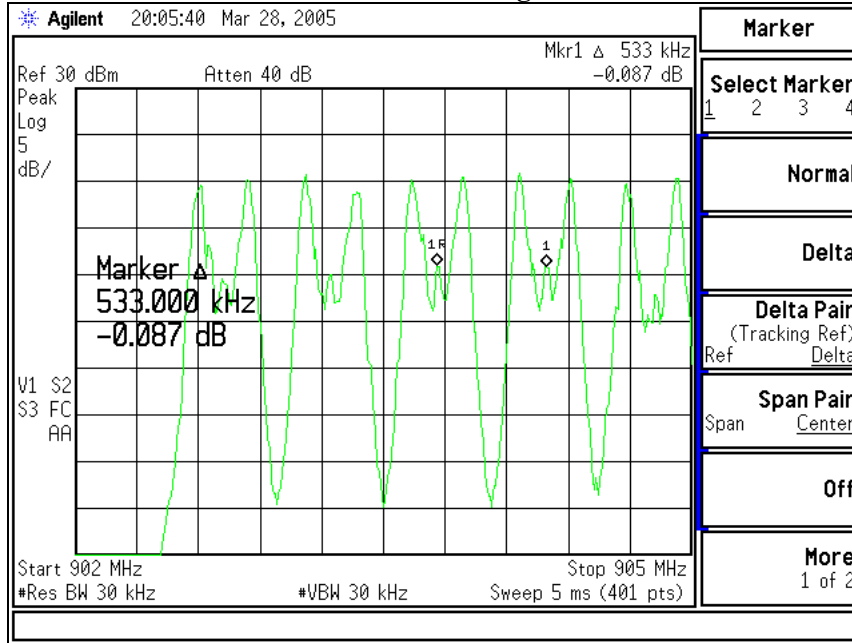
The minimum and maximum adjacent channel-separations measured for this device are 428 kHz and 535 kHz respectively. The maximum occupied bandwidth of the device, as reported in the previous section is 445 kHz. The minimum channel separation for the EUT meets the 25 kHz criteria, as well as the 20 dB occupied bandwidth criteria.

For this EUT, with a -20 dBc OccBW of more than 250 kHz, there is a minimum of 25 hop channels required per 15.247 (a)(1)(i). The following plots describe the spacing, and verify the number of hop channels to be a total of 50.

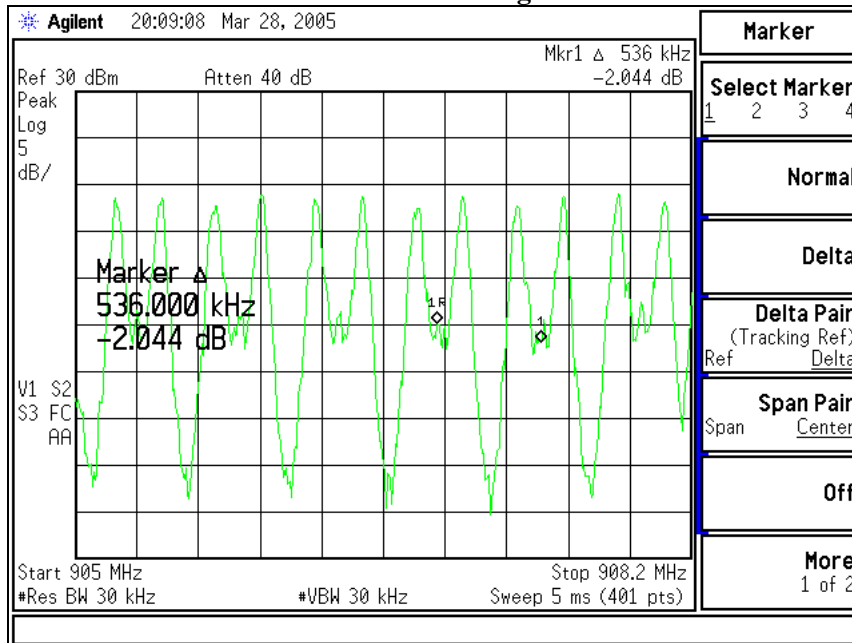
Frequency Span	Number of Channels	Minimum Separation (kHz)
902.0-905.0	5	533
905.0-908.2	6	536
908.2-911.2	7	428
911.2-914.2	6	443
914.2-917.2	7	428
917.2-919.8	6	436
919.8-922.8	6	435
922.8-925.9	5	512
925.9-928.0	2	520

Plots of Channel Separations

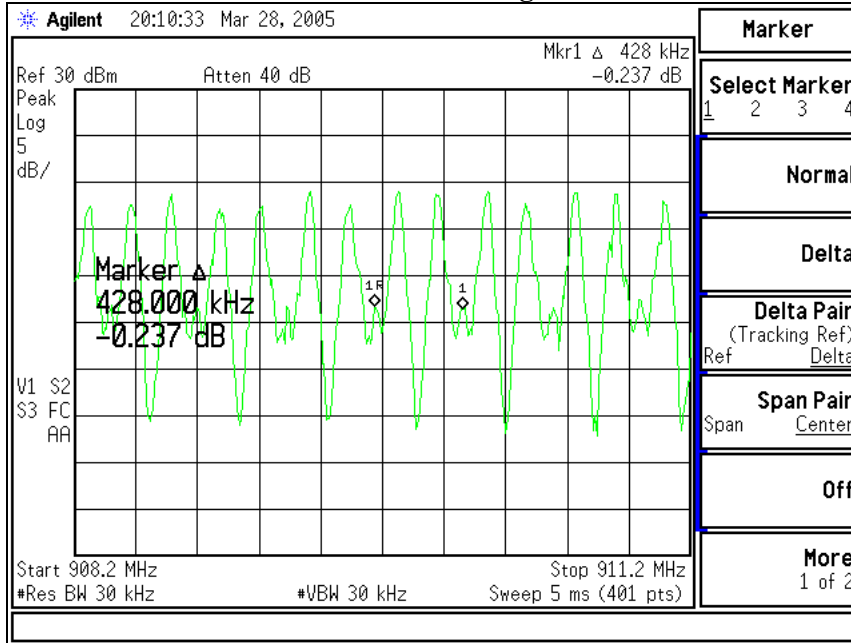
Channels 00 through 04



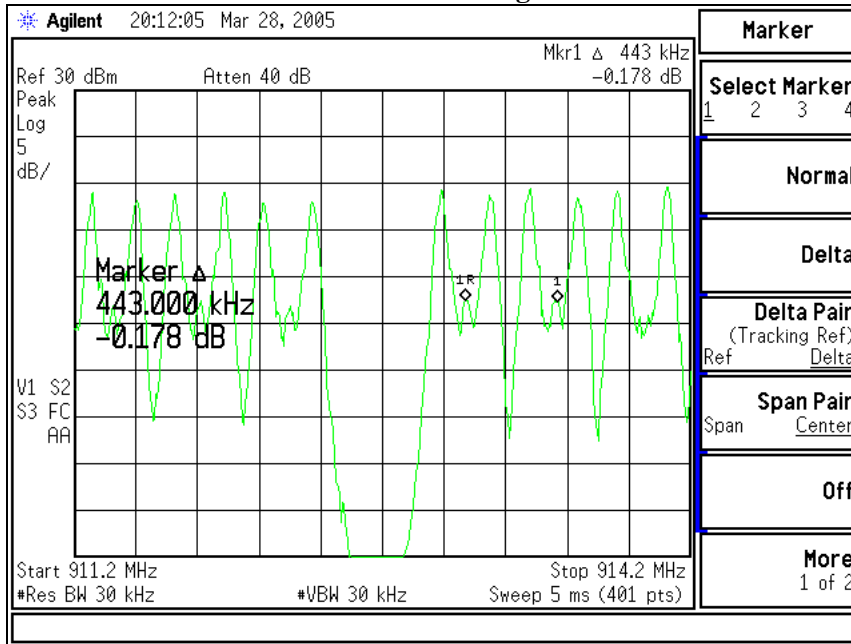
Channels 05 through 10



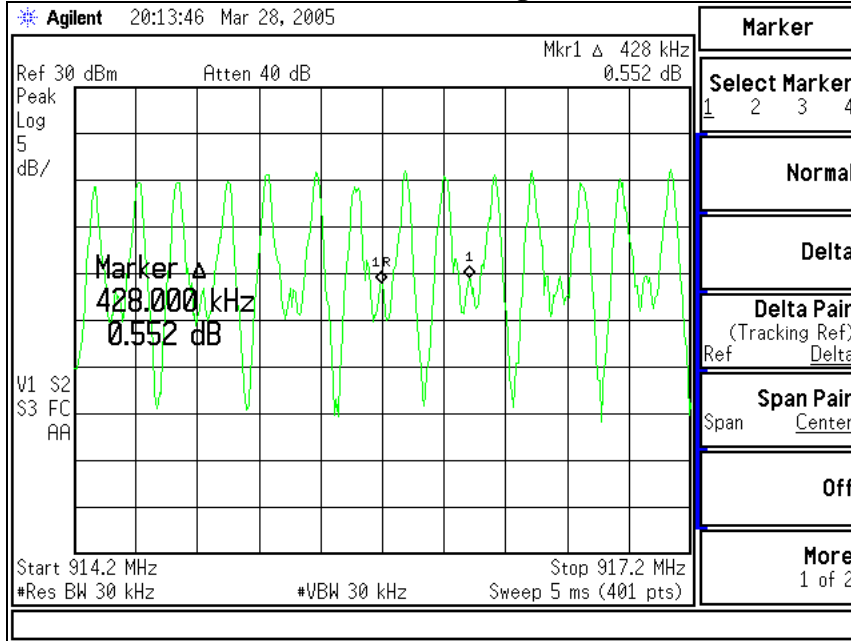
Channels 11 through 17



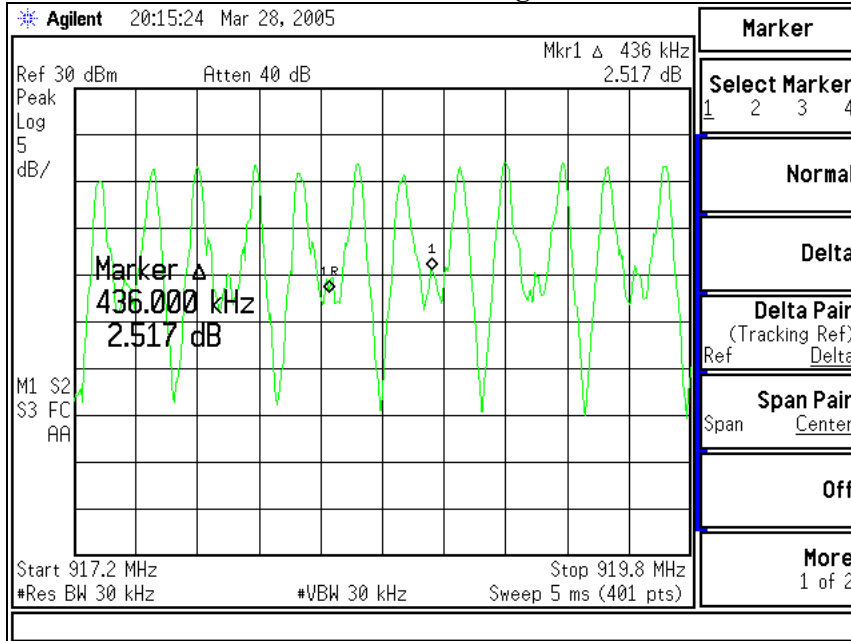
Channels 18 through 24



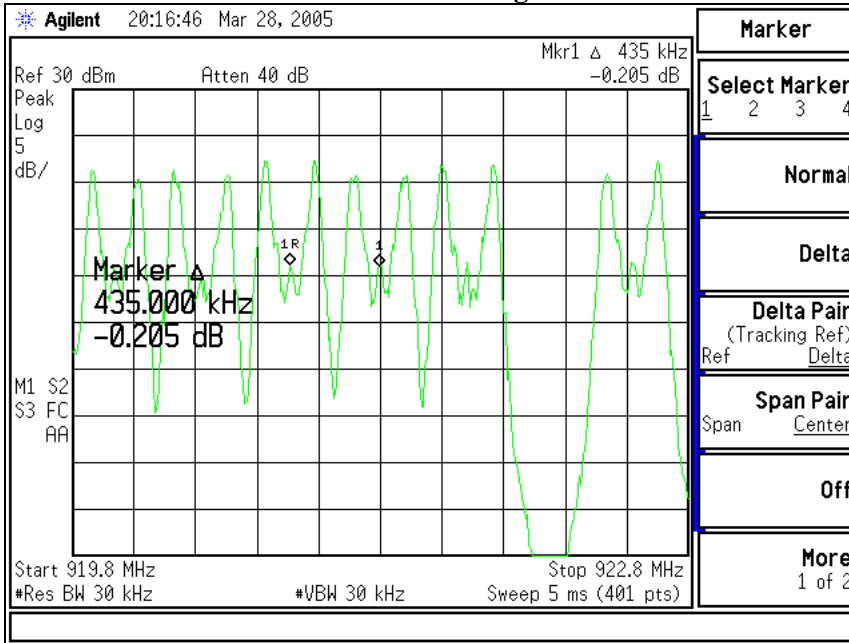
Channels 25 through 31



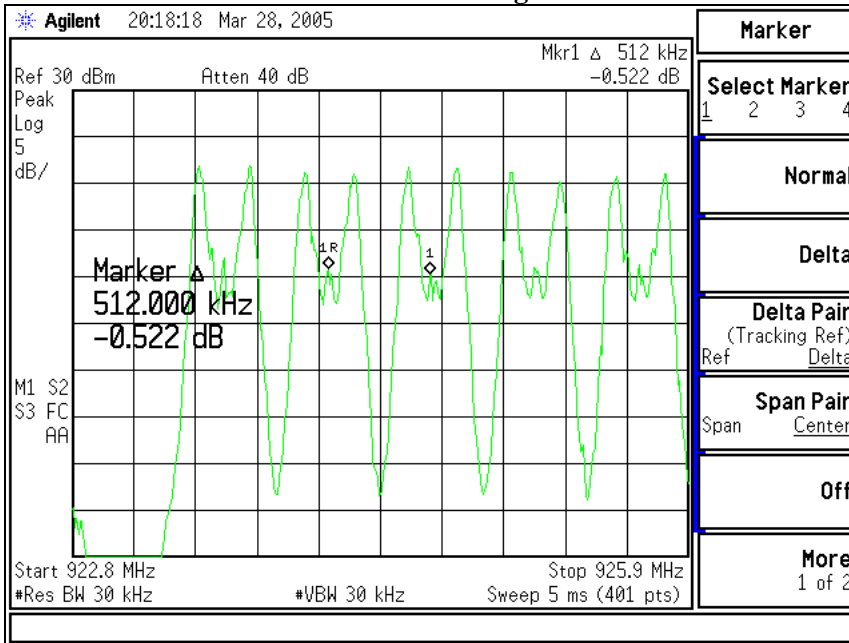
Channels 32 through 37



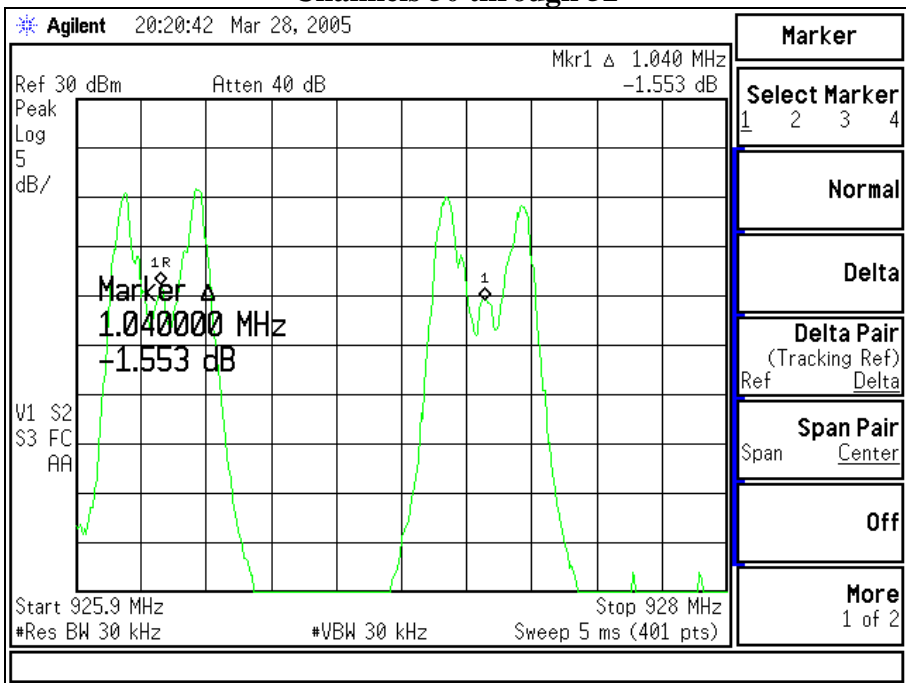
Channels 38 through 43



Channels 44 through 49



Channels 50 through 52



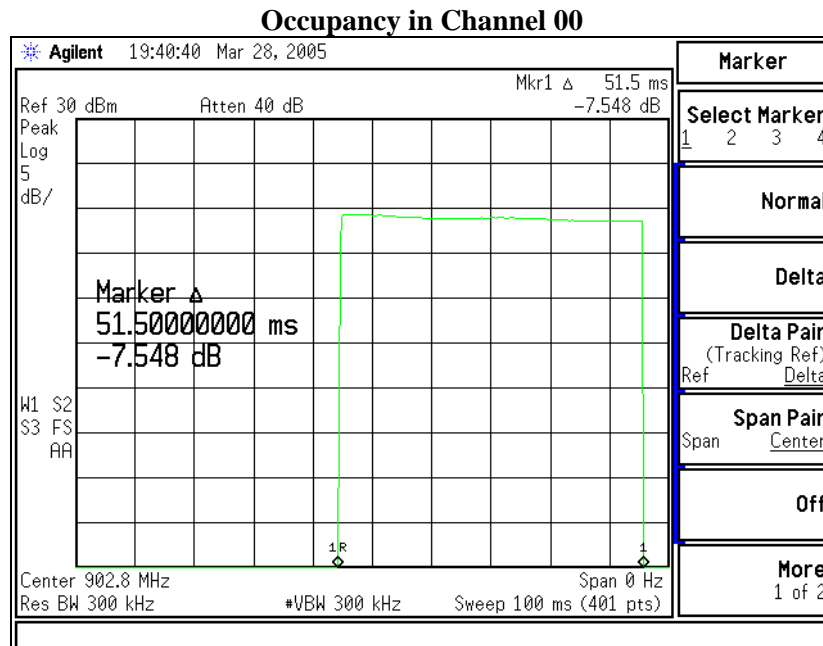
18. Channel Occupancy

Part 15.247(a)(1) requires a channel occupancy, for this device, of no more than 400 milliseconds in a 10 second window. The channel occupancy for this EUT was measured using an HP E4407B spectrum analyzer, set to zero-span at the frequency of interest. With the analyzer in peak-hold mode, the transmission lengths can be measured by adjusting the sweep rate of the analyzer. A suitable sweep rate was used to measure the channel occupancy at the low, mid and high channels.

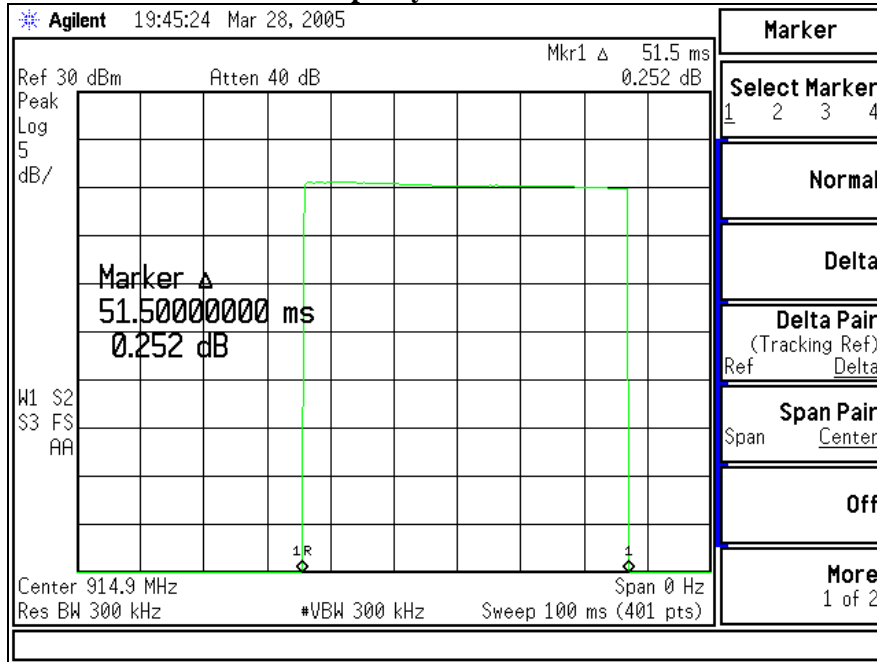
The longest time any transmission will occur on a single channel is 51.50 ms. With a total of 50 channels used, each occupying a 51.50 ms slot, it will take 2.575 seconds for the sequence to repeat. In a 10 second window, each channel would have 3.88 transmission cycles. The maximum occupancy in a 10 second window is calculated by multiplying the 3.88 transmission cycles by 51.50 ms transmission duration per cycle, to arrive at 200 ms total occupancy.

Channel	Frequency (MHz)	Occupancy Per transmission (ms)	Occupancy in any 10 second window (ms)
00	902.8	51.50	200
27	915.3	51.50	200
52	927.2	51.50	200

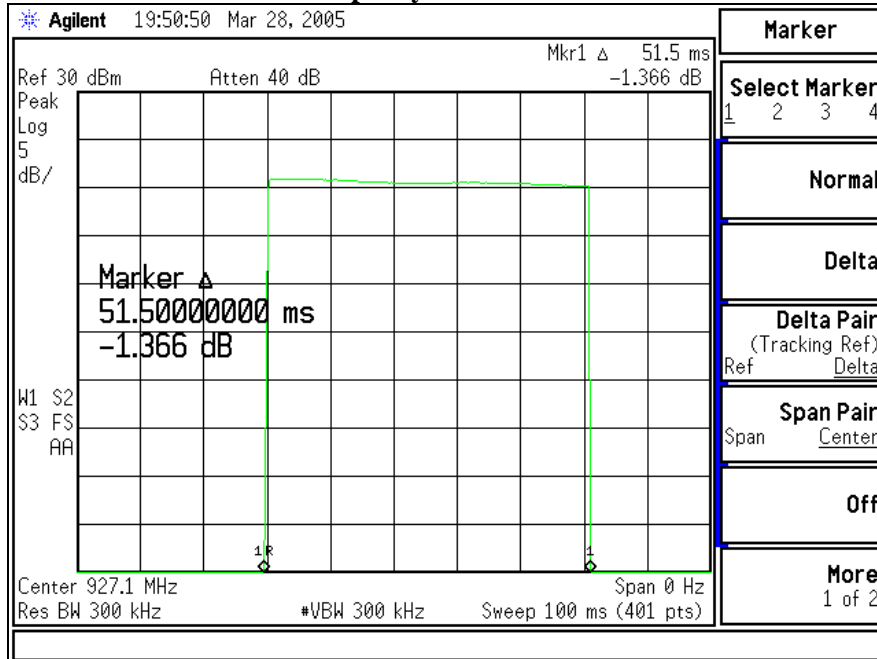
Plots of Channel Occupancy



Occupancy in Channel 26



Occupancy in Channel 52



19. Frequency and Power Stability Requirements

A Spectrum Analyzer was used to measure the frequency at the appropriate frequency markers. For this test, transmitter portion of the EUT placed in continuous transmit CW mode. Power was supplied by an external bench-type variable power supply, and the frequency of operation was monitored using the spectrum analyzer. The frequency was measured with a receiver resolution bandwidth of 300 Hz, and video bandwidth of 300 Hz. The data presented below is from channel 27 presenting sample frequency variation measurements.

DC Voltage Source			
	4.85 V	5.00 V	5.75 V
Channel 00	+17.8 (dBm)	+27.9 (dBm)	+27.9 (dBm)
Channel 27	+18.3 (dBm)	+28.1 (dBm)	+28.3 (dBm)
Channel 52	+16.8 (dBm)	+28.0 (dBm)	+28.0 (dBm)

DC Voltage Source			
	4.85 V	5.00 V	5.75 V
Channel 27	915.25658 (MHz)	915.25703 (MHz)	915.25695 (MHz)

The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved while the power was removed. Upon reinstating the power, the system had to be re-set to operate in normal or test modes, and in doing that it behaved properly. A wide frequency sweep was also investigated, with minimum and maximum input voltages, to ensure that no unexpected anomalies have occurred.

The information on this page is provided by the manufacturer.

20. Equal Channel Usage

50 channels are chosen from a pool of 53 available frequencies. These channels are arrayed in a table which the system uses to determine the next hopping channel. Each radio is programmed with a seed value which determines the table based on a defined pseudorandom generator. Each channel carries a single packet of information for a duration no longer than 52 mS. Each time a transmission is made the system uses the next frequency in the table. The table is started over once the end has been reached. Thus, any given frequency will not be reused until all other frequencies have been accessed.

21. Pseudorandom Hopping Pattern

Each helmet and sideline controller is uniquely addressed in such a manner that communications may only take place between helmets and their mated sideline controller. The coordination of hop sequences, addresses, etc. is conducted during factory assembly as systems are built to order for a particular customer. The system does not automatically re-configure channel hopping sequences in the field.

The hopping table is built using an 8 bit seed into an $X^{15}+1$ pseudorandom number generator giving the possibility of 256 unique pseudorandom hopping tables. Output from the generator is used to pick frequencies from a pool of 53 available channels.

22. Receiver Synchronization

The problem of addressing individual grouping of helmets extends to the selection of RF channels. As described, this system defines a set of 53 channels which covers the 902 – 928 MHz ISM band. Of those 53 channels, only 50 are used within a subset of grouped hop channels. The grouping of the select 50 channels and the order in which the channels are sequenced are determined by a set of pseudorandom number sets.

23. Receiver Input Bandwidth

The receiver uses direct conversion meaning that there is no offset local oscillator. In other words, the receiver local oscillator is tuned to be the same as the radio operating frequency. Individual channel selection occurs within the receiver without the need for external filtering. An overall bandpass filter restricts the receiver to the stated ISM band.

24. MPE Calculations

The following calculations are based on the specifications as provided by the manufacturer for the antenna:

Pacific Wireless Model PAWOD9-5
S/N: 05090005
Omni-directional Antenna with gain of approximately 5 dBi.

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:	<u>28.30</u>	(dBm)
Maximum peak output power at antenna input terminal:	<u>676.083</u>	(mW)
Antenna gain(typical):	<u>5</u>	(dBi)
Maximum antenna gain:	<u>3.162</u>	(numeric)
Prediction distance:	<u>20</u>	(cm)
Prediction frequency:	<u>915</u>	(MHz)
MPE limit for uncontrolled exposure at prediction frequency:	<u>0.62</u>	(mW/cm ²)
Power density at prediction frequency:	0.425334	(mW/cm ²)
Maximum allowable antenna gain:	6.6	(dBi)
Margin of Compliance at 20 cm =		1.6 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	9/16/04	9/16/05
AA960078	EMCO	93146	9701-4855	Log-Periodic Antenna	9/16/04	9/16/05
AA960081	EMCO	3115	6907	Double Ridge Horn Antenna	12/06/04	12/06/05
CC00221C	Agilent	E4407B	US39160256	Spectrum Analyzer	12/06/04	12/06/05
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	Note 1	Note 1
N/A	LSC	Cable	0038	1 Meter RG 214 Cable	Note 1	Note 1
N/A	LSC	Cable	0050	10 Meter RG 214 Cable	Note 1	Note 1
N/A	Pasternack	Attenuator	N/A	10 dB Attenuator	Note 1	Note 1

Note 1 - Equipment calibrated within a traceable system.

Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level, using a coverage factor of k=2.

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 Specification



PAWOD9 DATA SHEET

NLOS Series Vertically Polarized Omni Antenna 900 to 928 MHz Operation

Features

- 900MHz Omni Directional Antenna
- Available in 5, 6, 8 and 11dBi gain models
- 1degree electrical downtilt available on the 11dBi model
- UV Stabilized Fiberglass / Stainless Steel Construction
- 18" Pigtail with Type N Female Connector Standard (6dBi and 8dBi Model: Only)

Applications

- 900 MHz ISM Band Applications
- Non Line of Sight Applications
- WISP Base Station Equipment
- Point to Multi-point Systems

Description

The NLOS Series Omnidirectional Antenna system offered by Pacific Wireless are constructed of UV stabilized fiberglass and Stainless Steel for long service life. Mounting is easy with a dual u-bolt mounting system. The antennas are vertically polarized. The 6dBi and 8dBi come standard with 18" pigtailed terminated in an N female connector. The 5dBi and 11dBi comes standard with an integrated N Female connector. The omni's are DC grounded for lightning protection. New in 2004 is the 11dBi omni with 1 deg electrical downtilt which gives improved close-in coverage.

Specifications

Parameter	Min	Typ	Max	Units
<i>Frequency Range</i>	900		928	MHz
<i>Input Return Loss (S₁₁)</i>		-14		dB
<i>VSWR</i>		1.5:1		
<i>Impedance</i>		50		OHM
<i>Input Power</i>			100	W
<i>Pole Diameter (OD)</i>	1 (25)		2 (51)	Inch (mm)
<i>Operating Temperature</i>	-45		+70	Deg C
<i>Rated Wind Velocity</i>			125 (56)	Mph (m/sec)

*Note: Pacific Wireless does not supply the mounting pole

900 - 928 MHz	OD9-5	OD9-6	OD9-8	OD9-11	OD9-11D1
<i>Gain</i>	5dBi	6dBi	8dBi	11dBi	11dBi
<i>Vertical 3dB Beamwidth</i>	36 Deg	16 deg	10 deg	7 deg	7 deg
<i>Electrical Downtilt</i>	0	0	0	0	1 deg
<i>Weight</i>	1.3 Lbs (.6 Kg)	5.4 Lbs (2.0 Kg)	6.7 Lbs (2.5 Kg)	9.4 Lbs (3.5 Kg)	9.4 Lbs (3.5 Kg)
<i>Length Dimension</i> <i>Diameter = -1.5" (38 mm)</i>	24" (610 mm)	5.6' (1.7 m)	8.5' (2.6 m)	11' (3.4 m)	11' (3.4 m)



Appendix C

Firmware and Setup Instructions

The channel selection and mode of operation selection, on the test sample was accomplished by using specially programmed software, as provided by the manufacturer, on the host Laptop computer. The test software used was "XETI_v2.4.0309", which automatically identified the proper USB port and connected to the EUT.