ITS Intertek Testing Services
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Test Report
for
Colubris Networks
on the
Access Point
Model: Optimist

to

FCC Part 15.407 Subpart E

Test Report #: 3051978
Date of Report: April 2, 2004

Project #s: 3051978
Dates of Test: December 15, 2003 – April 1, 2004

Total No of Pages Contained in this Report: 17

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Table of Contents

1.0 Summary of Tests

Colubris Networks's

Access Point Model: Optimist Serial #: M033-00015

Rule Part	DESCRIPTION OF TEST	RESULTS	REPORT PAGE
15.407(a)(2), (3) 1.1310	RF Output Power and Exposure, 26 dB Bandwidth and Peak Power Spectral Density	Passed	7
15.407(b)(2), (3), (5)	Spurious Emissions	Passed	8
15.407(g)	Frequency Stability	Passed	16

2.0 General Description

2.1 Product Description

The Access Point, Model: Optimist, is a wireless LAN router conforming to the IEEE 802.11a/b/g standards. The normal temperature range of operation is from 0 to 50 degrees celsius. The Optimist unit contains an 802.11a/b/g radio module.

A production version of the EUT was received on December 8, 2003 in good operating condition. As declared by the Applicant, it is identical to production units. An additional radio module with serial number C00840401564C01 and identical RF characteristics to the one installed in the Optimist EUT was provided on March 25, 2004 for further testing of band edge compliance.

Overview of the EUT

Description	Access Point
Model No. , Part No.	Access Point Model: Optimist Serial #: M033-00015
Operating Frequency	IEEE 802.11b/g: 2.412 – 2.462 GHz (Channels 1 – 11) IEEE 802.11a: 5.18-5.32 GHz (Channels 36 – 64) 5.745 – 5.805 GHz (Channels 149 – 161)
Number of Channels	IEEE 802.11b/g: 11 Channels, IEEE 802.11a: 19 Channels
Type of Modulation	IEEE 802.11a/b/g
Operating Temperature	0^0C to +50^0C
Antenna	IEEE 802.11b/g: Cushcraft SRSM2400MRA 2.0 dBi Gain Reverse-SMA IEEE 802.11a: Cushcraft SRSM5150MRA 2.0 dBi Gain Reverse-SMA

The Colubris Networks Access Point, Model: Optimist, has been tested at the request of:

Company: Colubris Networks
420 Armand-Frappier Suite 200
QC, H7V 4B4, Canada

Name of contact: Mr. Claude Robitaille
Telephone: 450-680-1661
Fax: 450-680-1910
Email: claude.robitaille@colubris.com

2.2 Related Submittal(s) Grants

None.

2.3 Test Facility

Site 2C (Middle Site) is a 3m and 10m sheltered EMI measurement range located in a light commercial environment in Boxborough, Massachusetts. It meets the technical requirements of ANSI C63.4-1992 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets of metal are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. A copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

2.4 Test Equipment and Support Equipment

Test Equipment

Description	Manufacturer	Model Number	ITS ID	Serial Number	Cal Due Date
Antenna	EMCO	3142	LOG4	9711-1225	02/18/2004
EMI Receiver Set	Hewlett Packard	8542E	REC2	3520A00125	12/18/2004
RF Filter	Hewlett Packard	85420E	RECFL2	3427A00126	12/18/2004
High Frequency Cable	Megaphase	TM40 K1K1 80	CBL030	CBL030	11/11/2004
Signal Generator	Hewlett Packard	AT-83640B/1	TMP001	3844A00757	10/05/2005
Horn Antenna	EMCO	3115	HORN2	9602-4675	09/03/2004
Horn Antenna	EMCO	3115	HORN1	9512-4632	10/24/2004
Spectrum Analyzer	Rohde & Schwarz	FSEK-30	ROS001	100225	05/26/2004
Temperature/Humidity Chamber	Bryant Manufacturing	TH-5S	SAF187	1207	07/16/2004
Universal Power Meter	Gigatronics	8651A	GIG1	8651298	10/24/2004
Peak Power Sensor	Gigatronics	80354A	GIG2	1821196	10/24/2004
Spectrum Analyer	Agilent	E7405A	AGL001	US40240205	07/02/2004
Attenuator	Weinschel Corporation	47-10-34	WEI8	BD8309	02/15/2004
Attenuator	Mini Circuits	20 dB, 50 Ohm	DS21	DS21	07/08/2004
LISN, 50 uH, 0.01-50 MHz, 24A	Solar Electronics	9252-50-R-24-BNC	LISN11	941713	05/29/2004
Cable, BNC-BNC 10m	Alpha	RG-58C/U	CBLBNC2	CBLBNC2	07/20/2004
Digital Multimeter	Fluke	87	SAF270	52951774	02/24/2004
LISN, 50 uH, 0.01-50 MHz, 24A	Solar Electronics	9252-50-R-24-BNC	LISN13	955107	03/11/2004
Cable, BNC-BNC 10m	Alpha	RG-58C/U	CBL10MS3	CBL10MS3	01/07/2004+
High Frequency Cable	Megaphase	TM40 K1K1 197	CBL027	CBL027	11/11/2004
High Frequency Cable	Megaphase	TM40 K1K1 80	CBL029	CBL029	11/11/2004
High Frequency Horn Antenna	EMCO	3116	TMP002	9310-2222	03/06/2004
Preamplifier 1-40 GHz	Miteq	NSP4000-NF	PRE8	507145	10/22/2004
Variac	Powerstat	3PN236B	POW4	POW4	*
Attenuator	Mini Circuits	20 dB, 50 Ohm	DS26A	DS26A	01/07/2004+
Digital Multimeter	BK Precision	391	SAF013	099050522	5/19/2004
High Frequency Horn Antenna	EMCO	3116	EMCO4	2090	08/28/2004
Digital 4 Line Barometer	Mannix	0ABA116	BAR2	BAR2	07/09/2004

+ - Note that these items were used prior to the calibration due date

Support Equipment			
Description	**Manufacturer**	**Model Number**	**Serial Number**
AC Adapter	Delta Electronics	ADP-10MB	DNT0104007805
Laptop	Dell	Latitude CPt	6V5IL

* - AC Power Voltage was verified using a digital multimeter, listed in the test equipment section.

Cables					
Quantity	**Type**	**Length (m)**	**Shielding**	**Ferrite**	**Connector Type**
1	Ethernet Crossover Cable	2	Foil	None	Metal Side Plating
1	Ethernet Cable	4	Foil	None	Metal Side Plating
1	Serial Cable	1.5	None	None	Plastic
1	AC Adapter AC Cable	2	None	None	Plastic
1	AC Adapter DC Cable	2	None	Built-in	Metal/360

3.0 RF Output Power and Exposure, 26 dB Bandwidth, and Peak Power Spectral Density

15.407(a)(2), (3), 1.1310

3.1 Test Procedure

To measure RF output power, the EUT was connected to a peak RF power meter through a cable with suitable attenuation not to overload the meter. An offset in the meter compensated for the cable and attenuation loss. The 26 dB bandwidth was measured by connecting the EUT to a spectrum analyzer and using a marker delta function to determine the points 26 dB down the power envelope in a 1 MHz resolution bandwidth. The peak power spectral density (PPSD) was then recorded as the maximum value of the fundamental in a 1 MHz bandwidth. The peak excursion of the modulation envelope (PEME) was measured by comparing the maximum emissions level using a 1 MHz resolution bandwidth with first a 3 MHz video bandwidth and then a 30 kHz video bandwidth. The difference between the two values was recorded as the PEME. The highest measured output power was selected for the RF exposure calculation, adjusted for the 2 dBi antenna gain.

Requirement: The RF Power must be below 250 mW (24 dBm) for the band 5.25-5.35 GHz, and below 1 W (30 dBm) for the band 5.725-5.825 GHz. There is no limit on the 26 dB bandwidth, it is used to select limits. The peak power spectral density must not exceed 11 dBm in the 5.25-5.35 GHz band and 17 dBm in the 5.725-5.825 GHz band. The peak excursion of the modulation envelope must not exceed 13 dB. RF exposure must not exceed 1 mW/cm^2 at any distance greater than 20 cm from the EUT.

3.2 Test Results

Results: Passed

Performed 2/6, 11, 27/2004 Equipment: GIG1, GIG2, CBL029, WEI8, ROS001, AGL001, CBL030

Frequency (GHz)	5.25-5.35 GHz Band	Power Reading (dBm)	Power Limit (dBm)	PPSD (dBm)	PPSD Limit (dBm)	PEME (dB)	PEME Limit (dB)
5.28	Channel 56	16.06	24.0	8.5	11.0	6.9	13.0
5.30	Channel 60	16.63	24.0	8.6	11.0	7.6	13.0
5.32	Channel 64	13.22	24.0	4.5	11.0	8.1	13.0
26 dB Bandwidth Channel 60: 29.4 MHz							

Frequency (GHz)	5.725-5.825 GHz Band	Power Reading (dBm)	Power Limit (dBm)	PPSD (dBm)	PPSD Limit (dBm)	PEME (dB)	PEME Limit (dB)
5.745	Channel 149	17.70	30.0	9.8	17.0	7.1	13.0
5.785	Channel 157	20.61	30.0	9.3	17.0	7.4	13.0
5.805	Channel 161	17.20	30.0	9.6	17.0	8.1	13.0
26 dB Bandwidth Channel 157: 25.9 MHz							

Using the maximum measured power of 20.61 dBm plus the 2 dBi antenna gain, the EIRP is 22.61 dBm (182.4 mW). The radius at which the EIRP/(4*Pi*r^2) is equal to 1 mW/cm^2 is 3.80 cm, well within 20cm.

4.0 Field Strength of Spurious Radiation and Line-Conducted Emissions
15.407(b)(2), (3), (5)

4.1 Test Procedure

The transmitter was placed on a wooden turntable. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization were varied, and the EUT was rotated through 360 degrees to identify the maximum level of emissions from the EUT. A max hold function was used to determine maximum field strength.

The Radiated Power was measured by the substitution method using a horn antenna or a biconical antenna connected to a signal generator. Power P (in dBm) was calculated as follows:

$$P = P_{sg} + dB_{adj} - L + G_H$$

Where G_H is the gain of the transmit horn/biconical antenna attached to the signal generator
L is the loss in the cable between the signal generator and the transmit antenna
P_{sg} is the generator output power
dB_{adj} is the adjustment in dB used to correct for the difference between the observed field strengths of the EUT and of the signal generator signal, respectively.

The frequency range up to 40 GHz was investigated.

Band edge compliance was demonstrated via an average conducted measurement at the antenna port on the radio module with serial number C00840401564C01.

Requirement: The isotropic power necessary to duplicate spurious emissions and harmonics must be attenuated below –27 dBm/MHz, and below –17 dBm/MHz in the 10 MHz above and below the band edges Below 1 GHz the power must not exceed the general limits of 15.209. The AC mains must also comply with the limits of 15.207.

4.2 Test Results

Results: Pass

Performed 12/13 & 18/03, 2/7 & 27/2004, 4/1/2004 Equipment: REC2, RECFL2, CBL027, CBL029, PRE8, ROS001, HORN1, LOG4, HORN2, TMP001, CBL030, EMCO4, TMP002, WEI8, AGL001

Frequency (MHz)	Description	Value (dBm)	Limit (dBm)
No emissions were detected above the measuring equipment noise floor which was at least 6 dB below the limit, other than the fundamental emission above 1 GHz			

Radiated Emissions / Interference

Company: Colubris Networks
Engineer: Nicholas Abbondante Location: Site 2
Project #: 3051978 Pressure: 985 mb
Date: 12/18/03 Temp: 17c
Standard: CISPR 22 Humidity: 33%
Class: B Group: 1
Limit Distance: 10 meters
Voltage/Frequency: 120V / 60 Hz

Model #: Optimist Platform
Serial #: M033-00015
Receiver: Agilent E7405A
Antenna: LOG4 2-18-04 V10.ant LOG4 2-18-04 H10.ant
PreAmp: None
Cable(s): Site2, 10M Floor 3-22-04.cbl None
Test Distance: 10 meters
Frequency Range: 30 MHz - 1 GHz

Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Pre-amp Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
V	62.220	21.5	7.1	1.1	0.0	0.0	29.8	30.0	-0.2
V	85.330	14.8	7.3	1.4	0.0	0.0	23.6	30.0	-6.4
V	114.900	8.6	7.4	1.6	0.0	0.0	17.6	30.0	-12.4
V	138.400	11.2	7.5	1.8	0.0	0.0	20.5	30.0	-9.5
V	268.300	11.1	12.9	2.7	0.0	0.0	26.7	37.0	-10.3
V	300.500	7.8	14.0	2.8	0.0	0.0	24.6	37.0	-12.4

Power Supply

Conducted Emissions / Interference

Company: Colubris Networks
Engineer: Nicholas Abbondante Location: Site 2
Project #: 3051978 Pressure: 985mb
Date: 12/13/03 Temp: 17c
Standard: CISPR 22 Humidity: 49%
Class: B Group: 1
Preamp: None
Voltage/Frequency: 120V/60Hz

Model #: Optimist Platform
Serial #: M033-00015
Receiver: HP 8542
Cable: CBL10MS3 1-7-04.cbl
LISN 1, 2: LISN13 [1] 3-11-04.lsn LISN13 [2] 3-11-04.lsn
LISN 3, N: None None
Attenuator: DS26A 1-7-04.att
Frequency Range: 150 kHz - 30 MHz

Net is the sum of worst-case lisn, cable, & attenuator losses, preamp gain, and initial reading

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Quasi-Peak Net dB(uV)	Quasi-Peak Limit dB(uV)	Quasi-Peak Margin dB
0.161	13.3	29.1			52.2	65.4	-13.3
0.444	16.0	15.9			37.8	57.0	-19.2
3.856	12.0	11.8			33.1	56.0	-22.9
11.930	19.2	16.4			40.5	60.0	-19.5
17.840	26.8	21.0			48.5	60.0	-11.5
19.000	18.1	24.4			46.1	60.0	-13.9

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Average Net dB(uV)	Average Limit dB(uV)	Average Margin dB
0.161	-9.4	13.5			36.6	55.4	-18.9
0.444	13.2	10.0			34.9	47.0	-12.1
3.856	-0.4	1.9			23.0	46.0	-23.0
11.930	14.1	14.3			35.6	50.0	-14.4
17.840	23.2	17.4			44.9	50.0	-5.1
19.000	14.3	20.9			42.6	50.0	-7.4

Power Over Ethernet

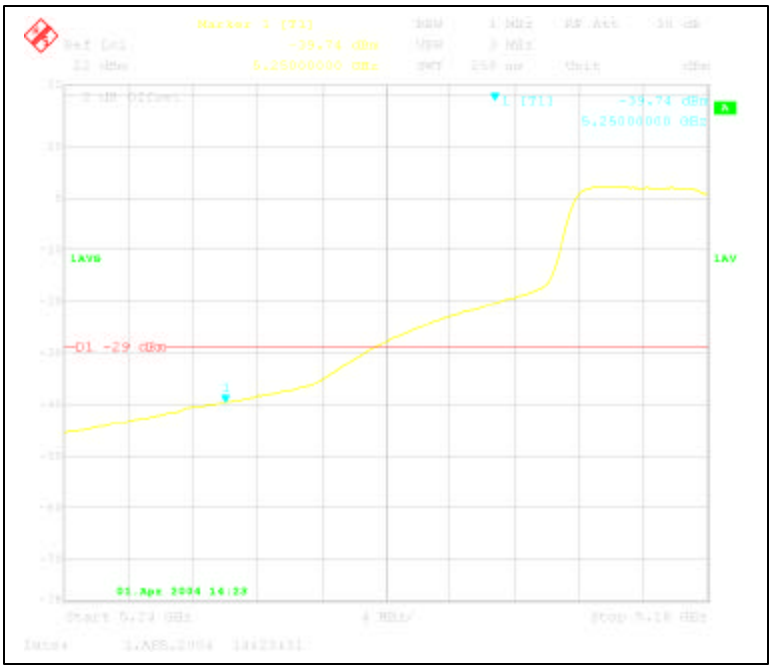
Conducted Emissions / Interference

Company:	Colubris Networks			Model #:	Optimist Platform
Engineer:	Nicholas Abbondante	Location:	Site 2	Serial #:	M033-00015
Project #:	3051978	Pressure:	985mb	Receiver:	HP 8542
Date:	12/13/03	Temp:	17c	Cable:	CBL10MS3 1-7-04.cbl
Standard:	CISPR 22	Humidity:	49%	LISN 1, 2:	LISN13 [1] 3-11-04.lsn LISN13 [2] 3-11-04.lsn
Class:	B	Group:	1	LISN 3, N:	None None
Preamp:	None			Attenuator:	DS26A 1-7-04.att
Voltage/Frequency:	PoE - 120V/60Hz			Frequency Range:	150 kHz - 30 MHz

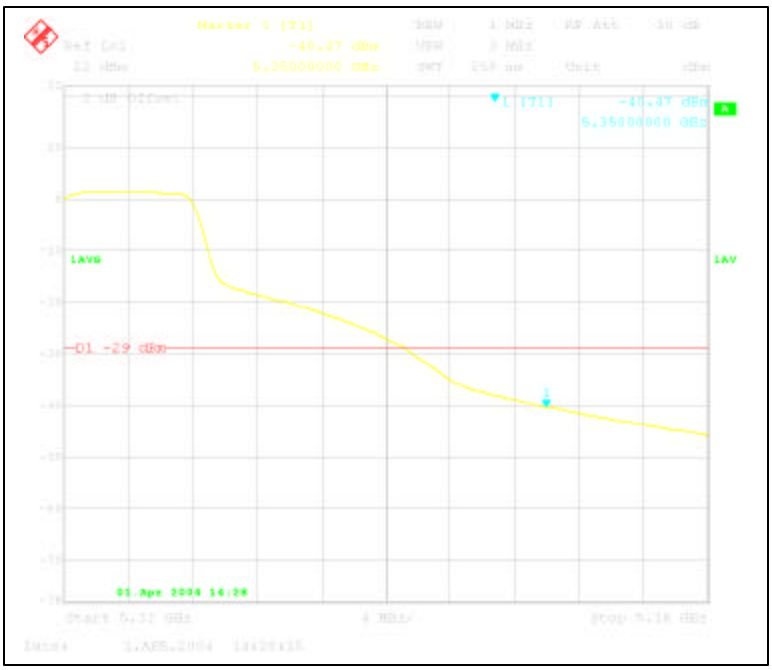
Net is the sum of worst-case lisn, cable, & attenuator losses, preamp gain, and initial reading

Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Quasi-Peak Net dB(uV)	Quasi-Peak Limit dB(uV)	Quasi-Peak Margin dB
0.263	24.5	26.5			48.9	61.3	-12.4
0.957	20.2	20.2			41.5	56.0	-14.5
1.651	19.2	18.9			40.2	56.0	-15.8
8.148	15.4	17.2			38.4	60.0	-21.6
17.350	13.5	11.9			35.1	60.0	-24.9
29.660	9.1	8.3			31.1	60.0	-28.9

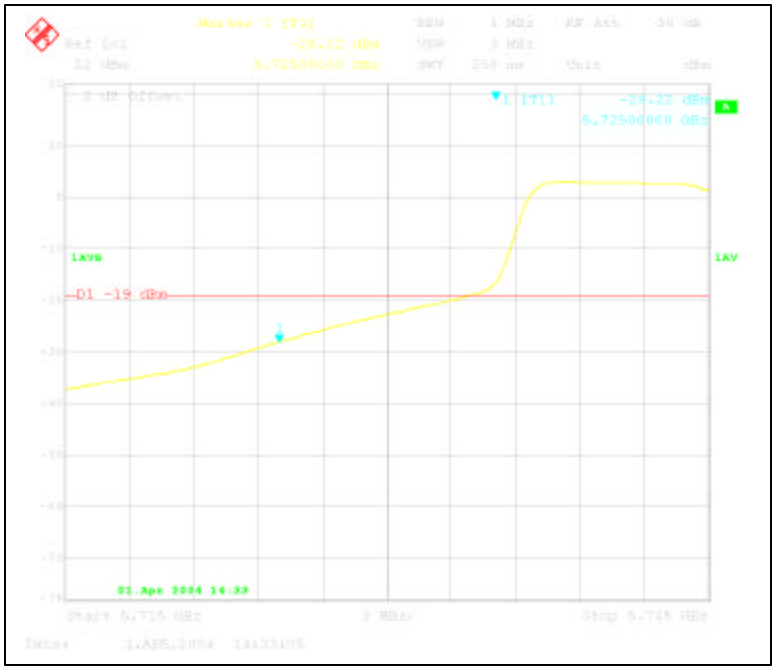
Frequency MHz	Reading Line 1 dB(uV)	Reading Line 2 dB(uV)	Reading Line 3 dB(uV)	Reading Neutral dB(uV)	Average Net dB(uV)	Average Limit dB(uV)	Average Margin dB
0.263	17.1	20.0			42.4	51.3	-8.9
0.957	5.7	7.3			28.6	46.0	-17.4
1.651	-0.7	2.1			23.1	46.0	-22.9
8.148	0.4	2.3			23.5	50.0	-26.5
17.350	-1.7	-3.1			21.4	50.0	-28.6
29.660	-4.3	-5.5			21.6	50.0	-28.4



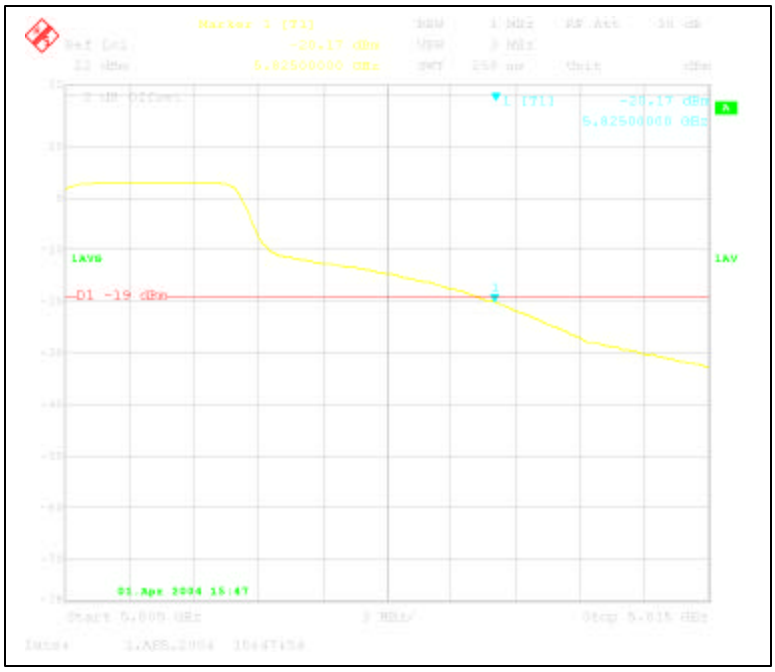
Band Edge Compliance, 5.25 GHz Band Edge Channel 56 (5.28 GHz)



Band Edge Compliance, 5.35 GHz Band Edge Channel 64 (5.32 GHz)

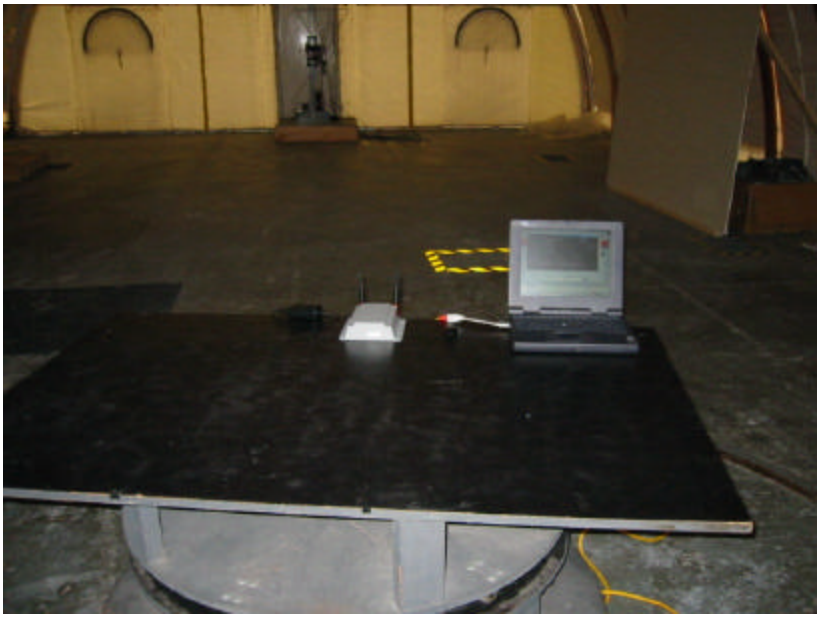


Band Edge Compliance, 5.725 GHz Band Edge Channel 149 (5.745 GHz)

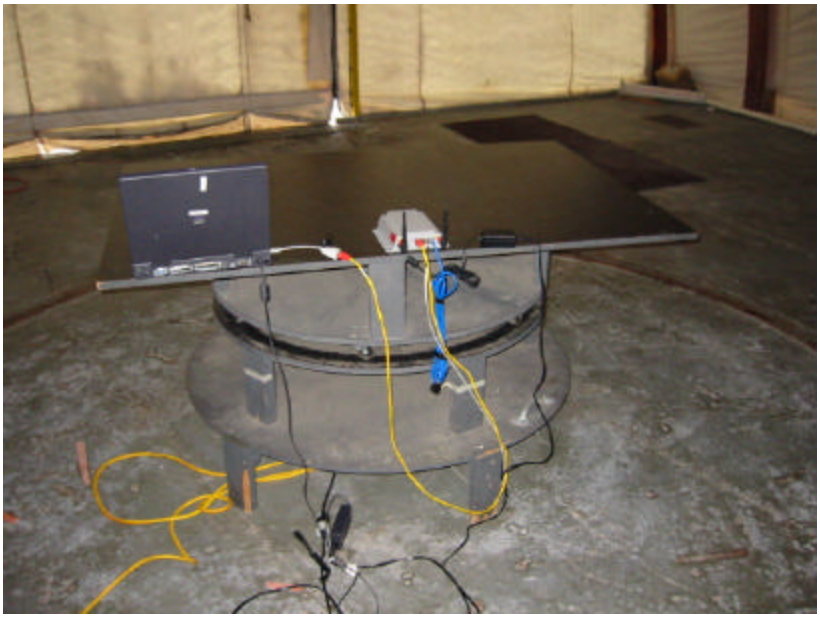


Band Edge Compliance, 5.825 GHz Band Edge Channel 161 (5.805 GHz)

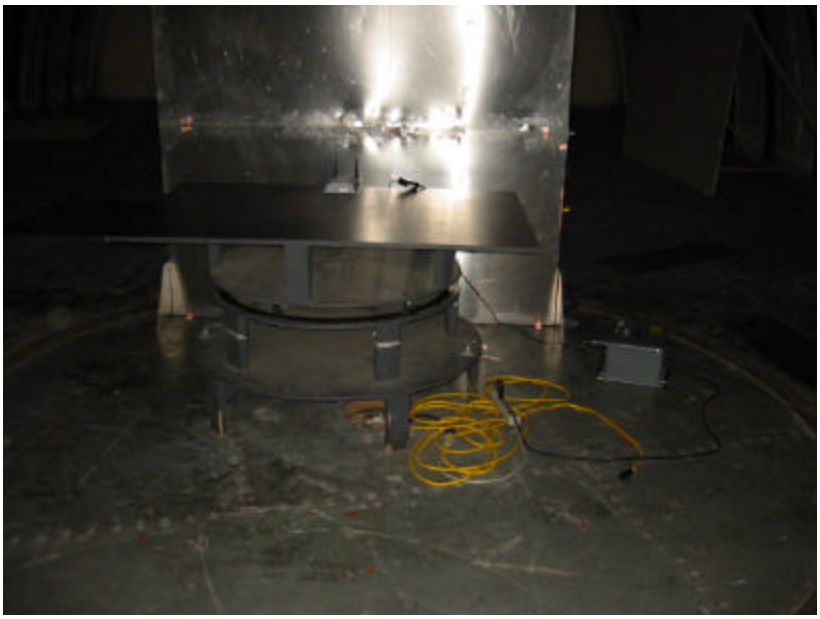
4.3 Configuration Photographs – Spurious Emissions



Radiated Spurious Test Setup, Front View

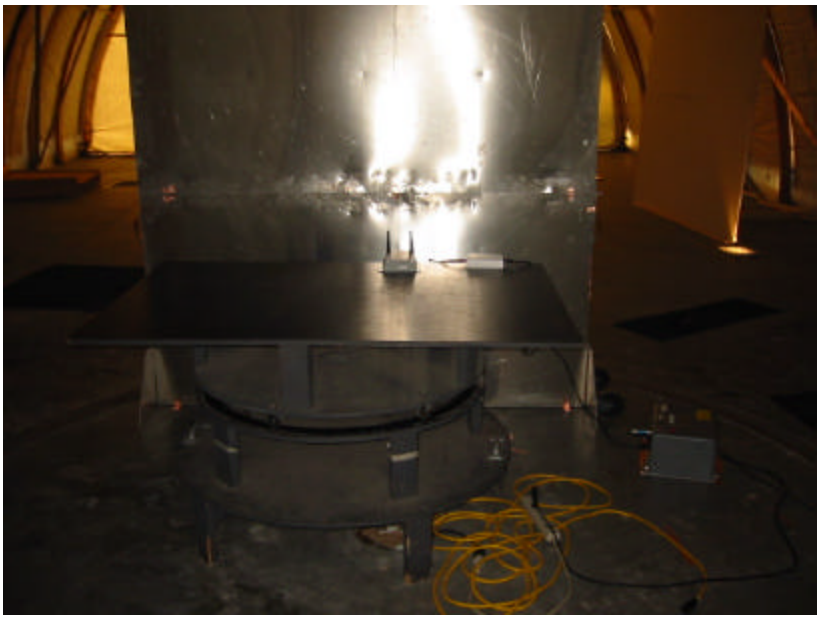


Radiated Spurious Test Setup, Back View



Power Supply Conducted Spurious Test Setup, Front View

Power Supply Conducted Spurious Test Setup, Side View



Power over Ethernet Conducted Spurious Test Setup, Front View

Power over Ethernet Conducted Spurious Test Setup, Side View

5.0 Frequency Stability
15.407(g)

5.1 Test Procedure

The EUT was connected to an external DC power supply (if battery powered) or an AC variac (if AC powered) and set to transmit continuously inside a temperature chamber. A cable for measuring the fundamental frequency was fed into the chamber through an opening insulated to minimize heat flow. After the temperature stabilized, the frequency of the fundamental was recorded from the analyzer.

Requirement: The range of operation must stay within the allowed transmission band.

5.2 Test Results
Performed 2/6/2004 Equipment: SAF187, POW4, SAF270, AGL001, CBL029, WEI8
5.25-5.35 GHz

Temp, C	Voltage	Frequency (GHz)	5.3 GHz Deviation (kHz)
-20	90%	5.299995	5
-10	90%	5.300050	50
0	90%	5.299965	35
10	90%	5.300015	15
20 (Nominal)	90%	5.300050	50
30	90%	5.300020	20
40	90%	5.300050	50
50	90%	5.300045	45
-20	110%	5.299990	10
-10	110%	5.299965	35
0	110%	5.299960	40
10	110%	5.299990	10
20 (Nominal)	110%	5.300025	25
30	110%	5.300025	25
40	110%	5.300025	25
50	110%	5.300045	45

5.725-5.825 GHz

Temp, C	Voltage	Frequency (GHz)	5.785 GHz Deviation (kHz)
-20	90%	5.785045	45
-10	90%	5.784990	10
0	90%	5.784980	20
10	90%	5.785040	40
20 (Nominal)	90%	5.785010	10
30	90%	5.785000	0
40	90%	5.785030	30
50	90%	5.785010	10
-20	110%	5.785015	15
-10	110%	5.784980	20
0	110%	5.785015	15
10	110%	5.785015	15
20	110%	5.785000	0
30	110%	5.785005	5
40	110%	5.785035	35
50	110%	5.785040	40

The maximum observed deviation was 50 kHz. Maximum measured 26 dB bandwidth was 29.4 MHz. High and low channels for the two bands are as follows: channels 149 (5.745 GHz) and 161 (5.805 GHz) in the band 5.725-5.825 GHz, and channels 56 (5.28 GHz) and 64 (5.32 GHz). Given the measured deviation over temperature and voltage as well as the maximum measured channel bandwidth, all channels must be located at least 20 MHz from the band edges in order for the 26 dB power envelope of the fundamental to remain within the assigned band. Channels 149 and 161 are located 20 MHz from the edge of the 5.725-5.825 GHz band, while channels 56 and 64 are located 30 MHz from the edge of the 5.25-5.35 GHz band.

Results: Passed