FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

HIGH RATE POINT-TO-POINT WIRELESS BRIDGE

MODEL NUMBER: RL54-BR-23, RL54-BR-26

FCC ID: SAMRWIRL54BR1

REPORT NUMBER: 04U2751-1

ISSUE DATE: JUNE 9, 2004

Prepared for
RAPIDWAVE, INC.
6296A SAN IGNACIO AVENUE
SAN JOSE, CA 95119

Prepared by
COMPLIANCE CERTIFICATION SERVICES
561F MONTEREY ROAD,
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1. TEST RESULT CERTIFICATION

COMPANY NAME: RAPIDWAVE, INC.
6296A SAN IGNACIO AVENUE
SAN JOSE, CA 95119

EUT DESCRIPTION: HIGH RATE POINT-TO-POINT WIRELESS BRIDGE

MODEL: RL54-BR-23, RL54-BR-26

DATE TESTED: JUNE 4-8, 2004

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

MICHAEL HECKROTTE
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

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2. EUT DESCRIPTION

The EUT is an 802.11a high rate point-to-point wireless bridge.

The transmitter has a maximum peak conducted output power as follows:

Frequency Band (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5745 - 5825	802.11a	23.49	223.36
5760 - 5800	802.11a Turbo	23.54	225.94

The EUT with model name as RL54-BR-23 had an antenna gain of 23 dBi, the EUT with model name as RL54-BR-26 has an antenna gain of 26 dBi.

All operations are point-to-point configurations.

2.1. MODIFICATIONS

1. In order to pass the radiated emission limits, RJ45 Shielded cables were used for connecting the EUT to the Laptop running ART software.

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3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/2001, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

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No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

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5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

Uncertainty figures are valid to a confidence level of 95%.

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5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Spectrum Analyzer 20 Hz ~ 44 GHz	Agilent	E4446A	US42070220	4/1/2005
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	6717	2/4/2005
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	11/21/2004
RF Filter Section	HP	85420E	3705A00256	11/21/2004
30MHz---- 2Ghz	Sunol Sciences	JB1 Antenna	A121003	12/22/2004
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	12/3/2004
Antenna, Horn, 18 ~ 26 GHz	ARA	MWH-1826/B	1013	2/4/2005
Preamplifier, 1 ~ 26 GHz	Miteq	NSP10023988	646456	6/25/2004
PreAmplifier 26-40 GHz	Miteq	NSP4000-SP2	924343	8/1/2004
Peak Power Meter	Agilent	E4416A	GB41291160	11/7/2004
Peak / Average Power Sensor	Agilent	E9327A	US40440755	11/7/2004
LISN, 10 kHz ~ 30 MHz	FCC	50/250-25-2	114	10/13/2004
Site A Line Stabilizer / Conditioner	Tripplite	LC-1800a	A0051681	CNR
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/13/2004
EMI Test Receiver	R & S	ESHS 20	827129/006	7/17/2004
AC Power Source, 10KVA	ACS	AFC-10K-AFC-2	J1568	CNR
Band Reject Filter	Micro-tronics	BRC 13192	002	CNR

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6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	ZE500OS	TW31900069	DoC
8 Port Workgroup Switch	LinkSys	EZXS88W	N/A	DoC
POE	D-Link	DWL-P100	N/A	DoC
AC/DC Adapter	Bothhand Enterprise	PSA9P8-AM-H-LK	R030602	DoC
AC/DC Adapter	HP	ADP-90HB	LTT030926596	DoC
EUT Power Adapter	Bothhand Enterprise	SA06L48-V	R00034602049	DoC

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	**AC**	**2**	**US 115V**	**Un-shielded**	**1.5m**	**N/A**
2	**DC**	**3**	**DC**	**Un-shielded**	**2m**	**N/A**
3	**Ethernet**	**2**	**RJ45**	**Shielded**	**8m**	**N/A**
4	**Ethernet**	**1**	**RJ45**	**Shielded**	**3m**	**N/A**

TEST SETUP

EUT was connected to a laptop at remote location, ART software was used to control the operation of the EUT, using ART software channel number and output power was controlled.

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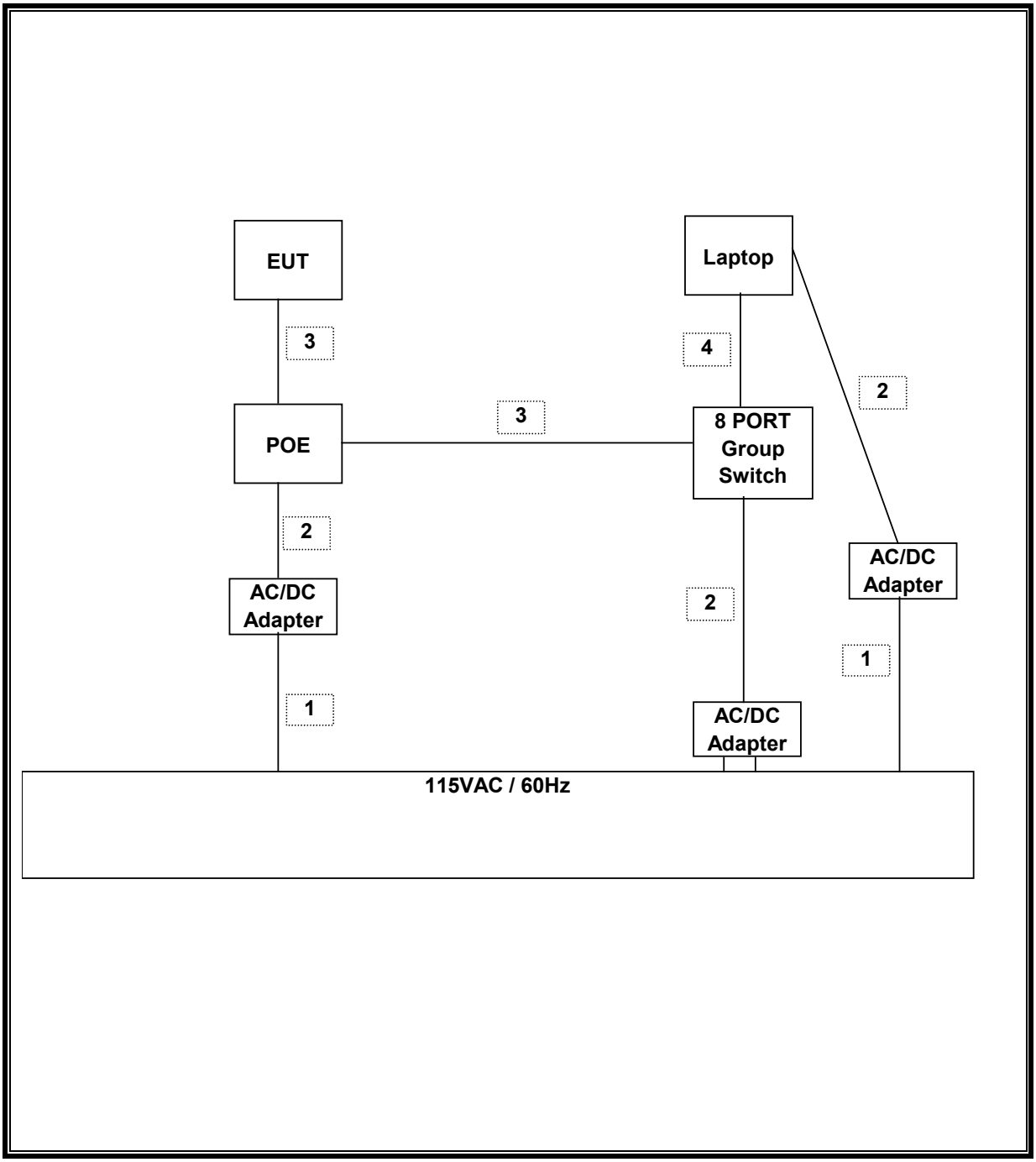
SETUP DIAGRAM FOR TESTS



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6.1. 6 dB BANDWIDTH

LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

5.8 GHz BAND RESULTS

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5745	16420	500	15920
Middle	5785	16420	500	15920
High	5825	16420	500	15920

802.11a Turbo Mode

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5760	32580	500	32080
High	5800	32580	500	32080

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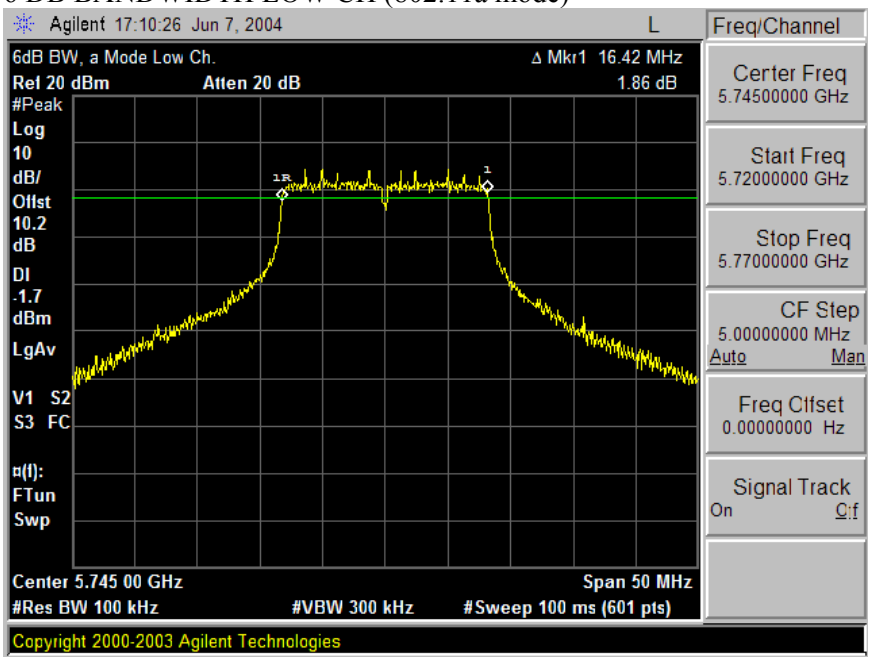
6 DB BANDWIDTH (802.11a MODE)

6 DB BANDWIDTH LOW CH (802.11a mode)



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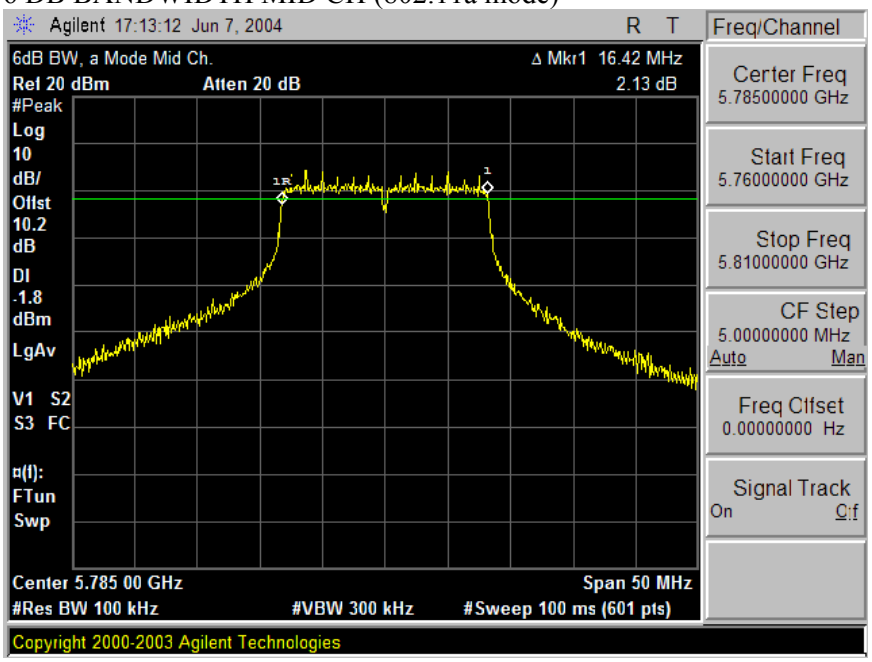
6 DB BANDWIDTH MID CH (802.11a mode)



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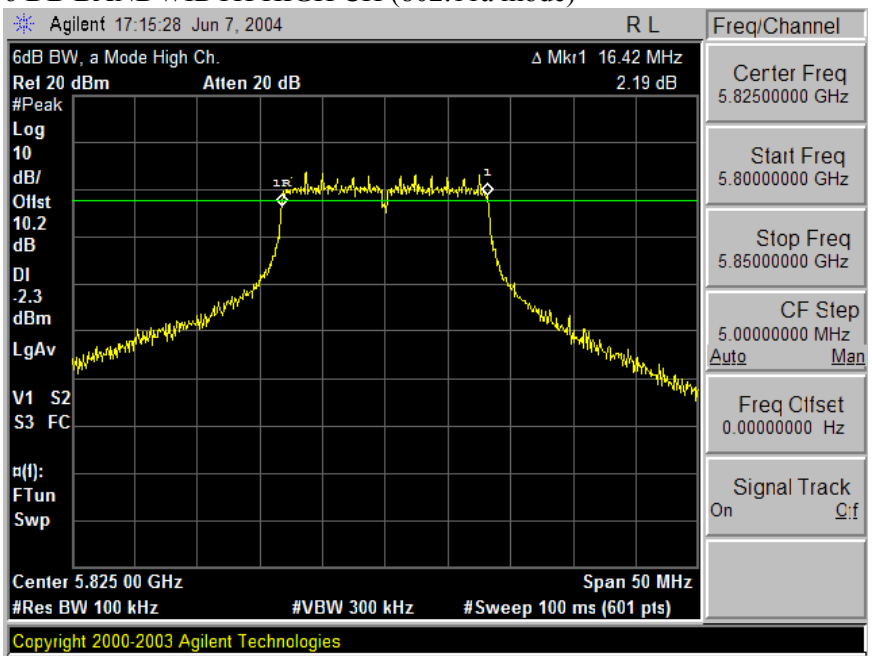
6 DB BANDWIDTH HIGH CH (802.11a mode)



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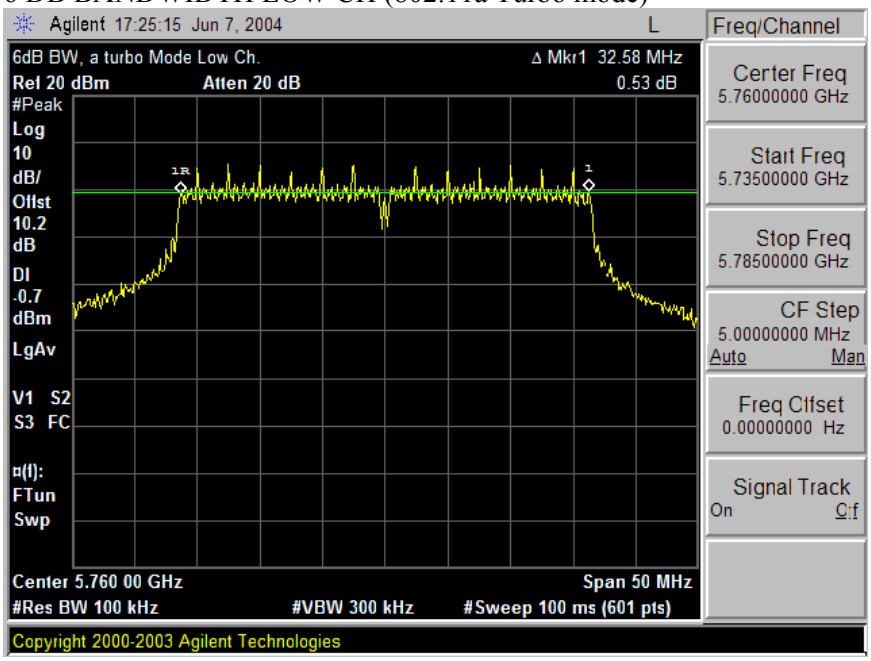
6 DB BANDWIDTH (802.11a TURBO MODE)

6 DB BANDWIDTH LOW CH (802.11a Turbo mode)



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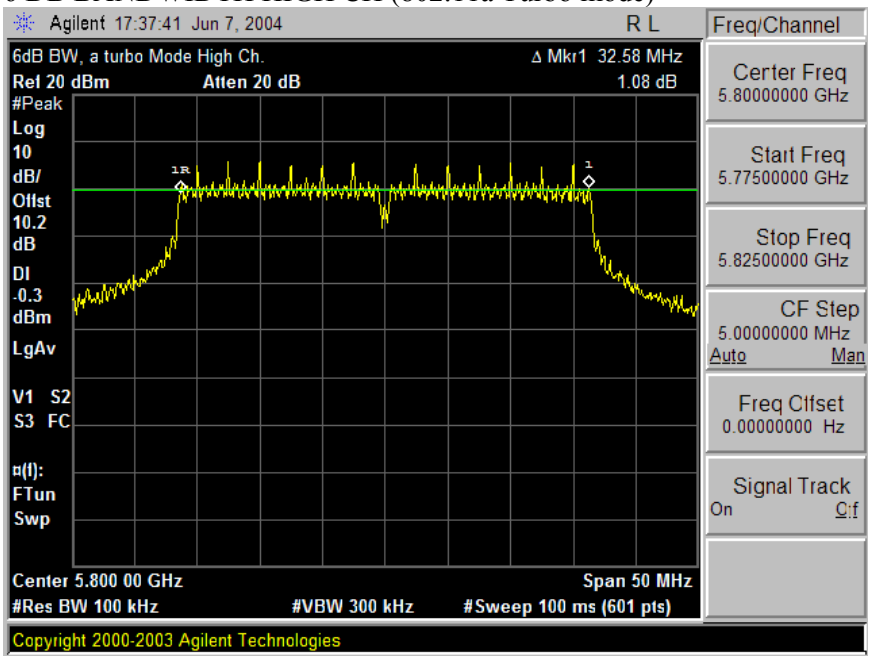
6 DB BANDWIDTH HIGH CH (802.11a Turbo mode)



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6.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

5.8 GHz BAND RESULTS

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5745	16.5618
Middle	5785	16.5289
High	5825	16.5386

802.11a Turbo Mode

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5760	33.4784
High	5800	33.5588

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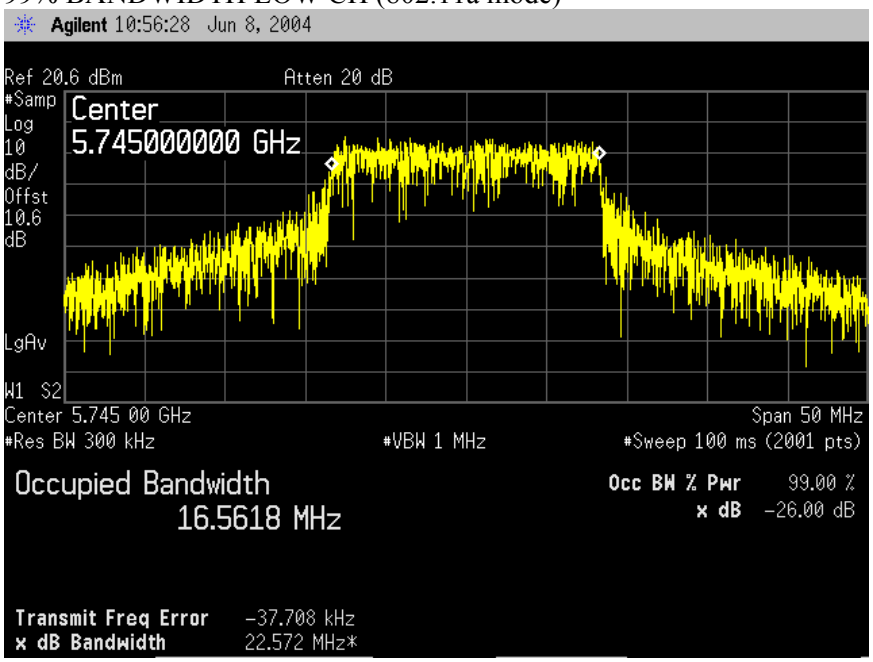
99% BANDWIDTH (802.11a MODE)

99% BANDWIDTH LOW CH (802.11a mode)



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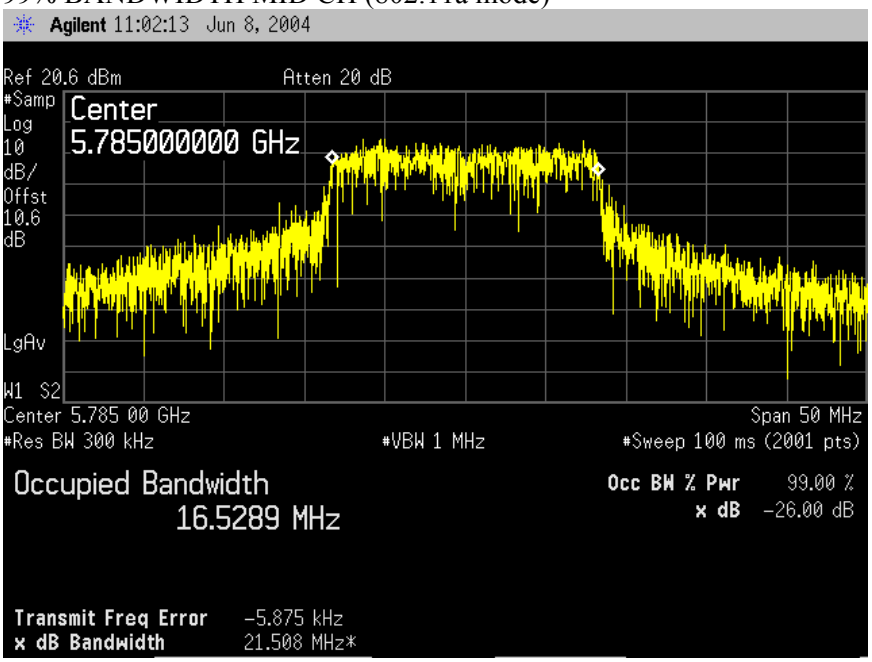
99% BANDWIDTH MID CH (802.11a mode)



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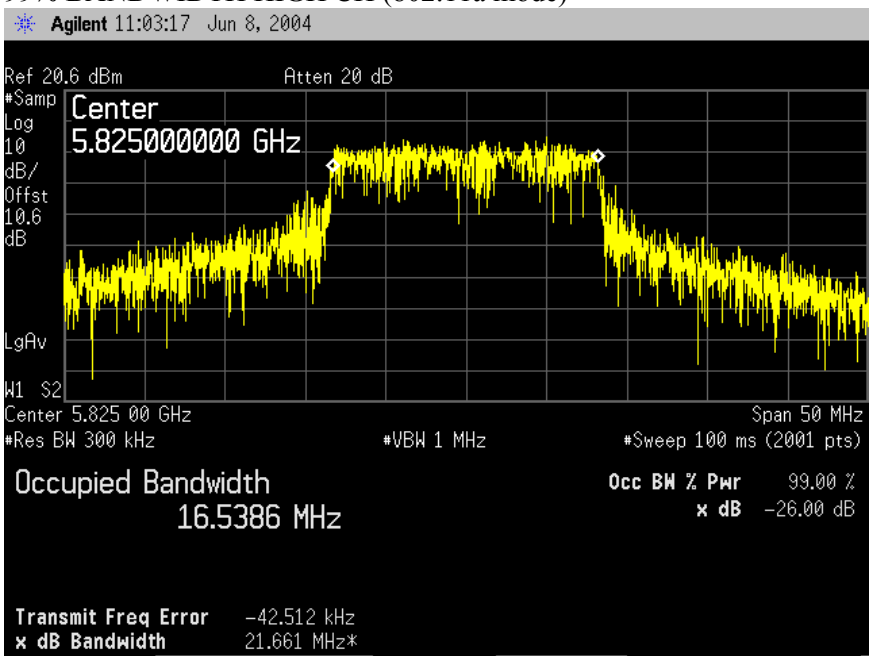
99% BANDWIDTH HIGH CH (802.11a mode)



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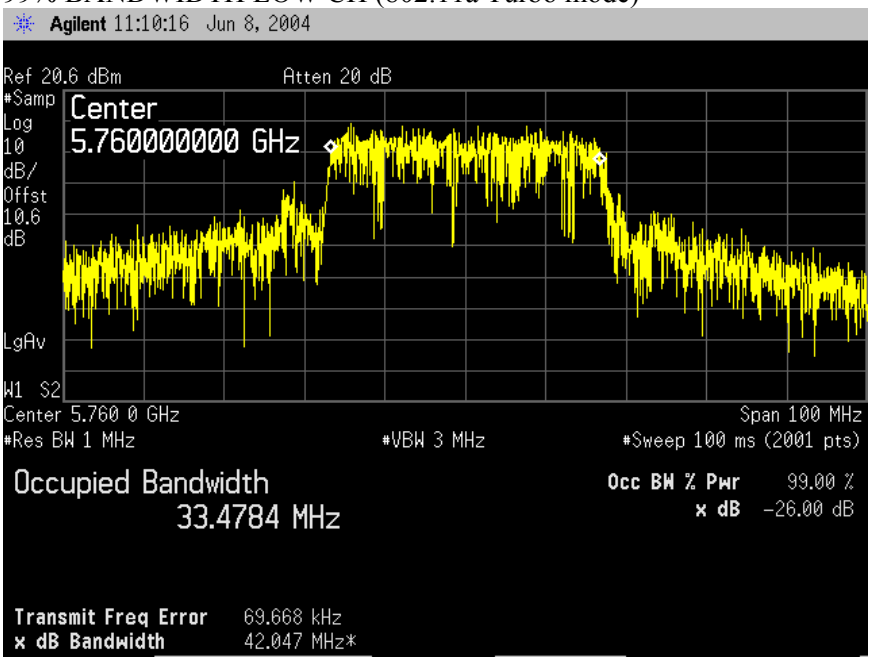
99% BANDWIDTH (802.11a TURBO MODE)

99% BANDWIDTH LOW CH (802.11a Turbo mode)



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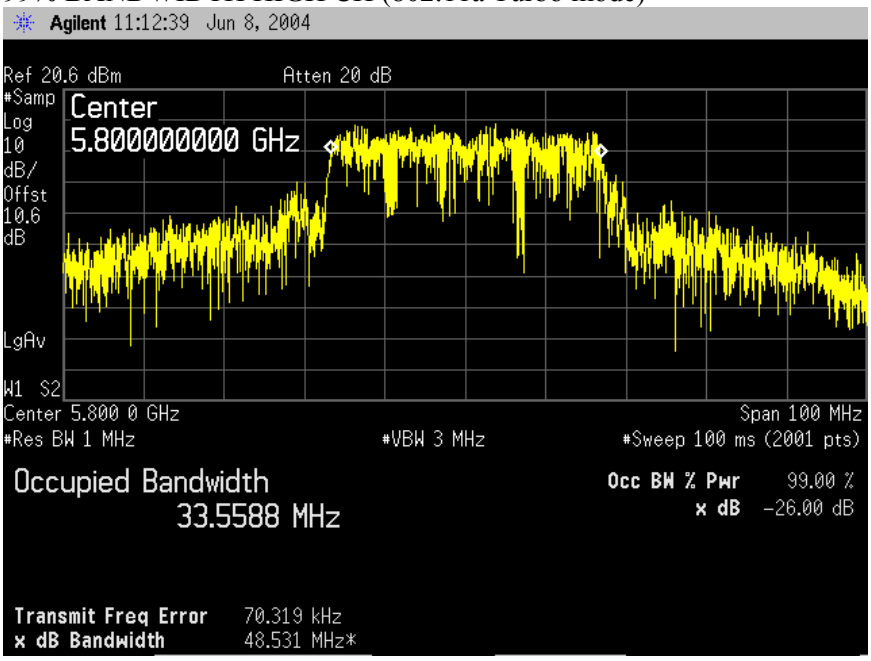
99% BANDWIDTH HIGH CH (802.11a Turbo mode)



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6.3. PEAK OUTPUT POWER

PEAK POWER LIMIT

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

§15.247 (b) (4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is 26 dBi, point to point operation, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.

5.8 GHZ BAND RESULTS

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	23.49	30	-6.51
Middle	5785	22.53	30	-7.47
High	5825	22.43	30	-7.57

802.11a Turbo Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5760	23.36	30	-6.64
High	5800	23.54	30	-6.46

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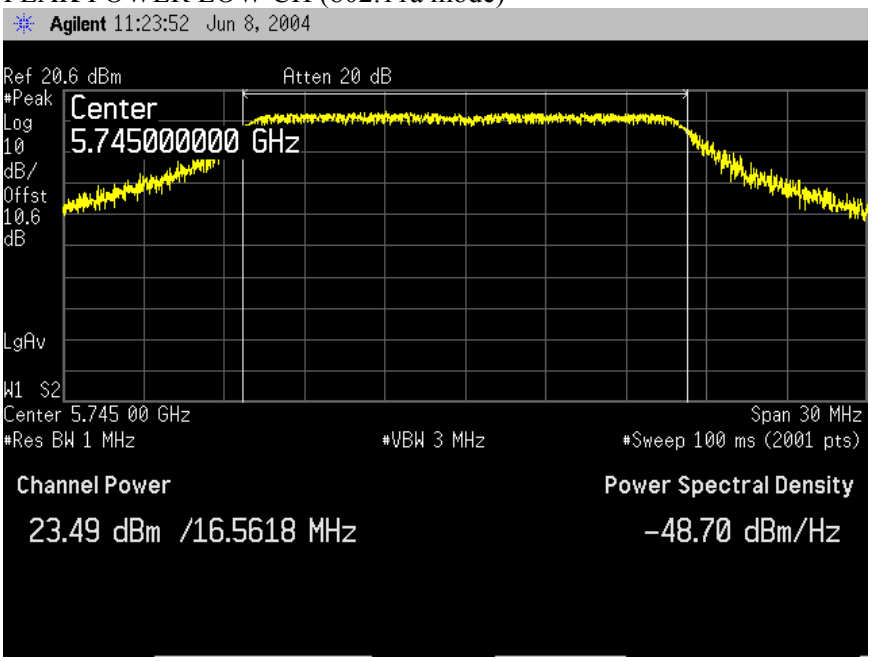
OUTPUT POWER (802.11a MODE)

PEAK POWER LOW CH (802.11a mode)



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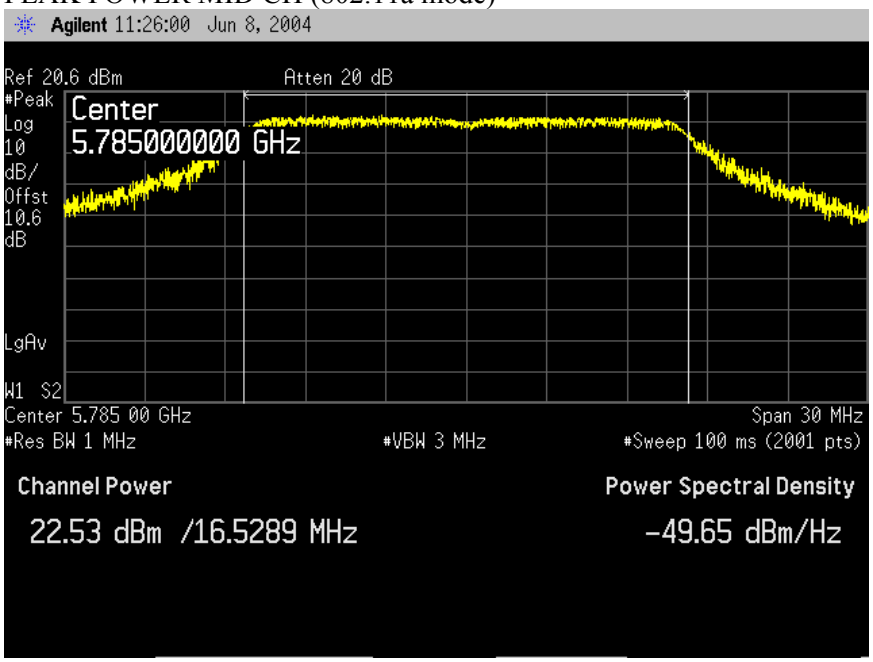
PEAK POWER MID CH (802.11a mode)



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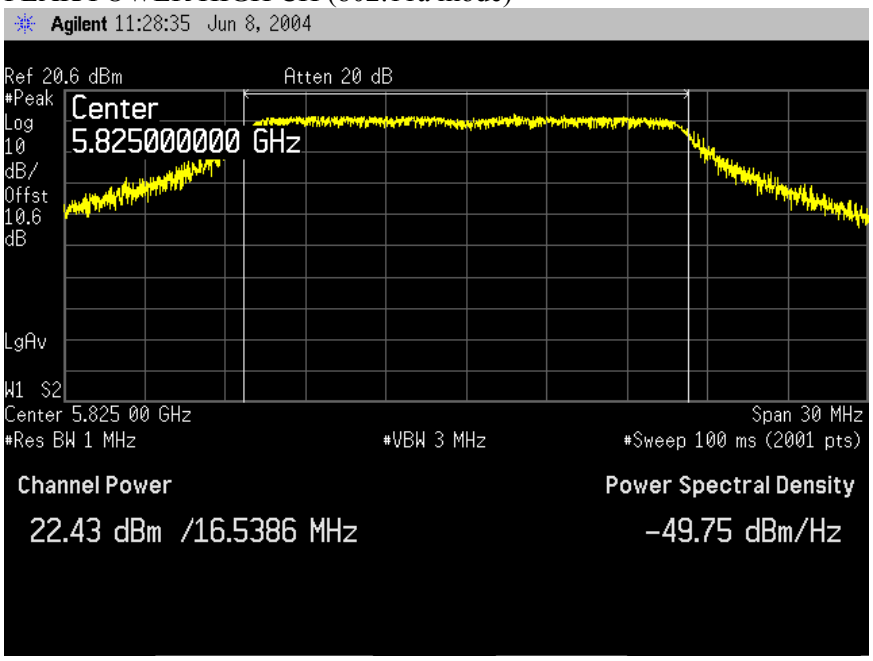
PEAK POWER HIGH CH (802.11a mode)



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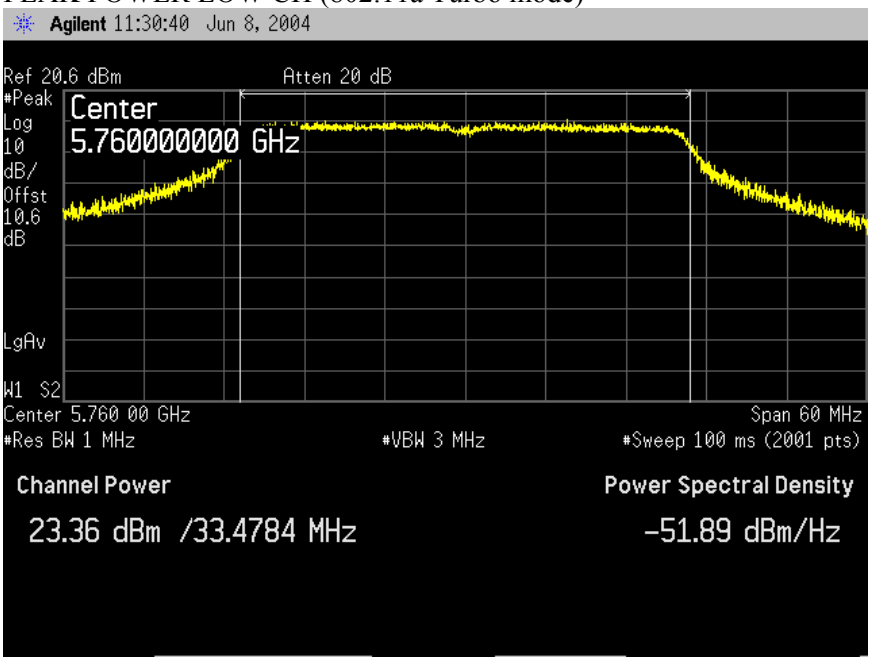
OUTPUT POWER (802.11a TURBO MODE)

PEAK POWER LOW CH (802.11a Turbo mode)



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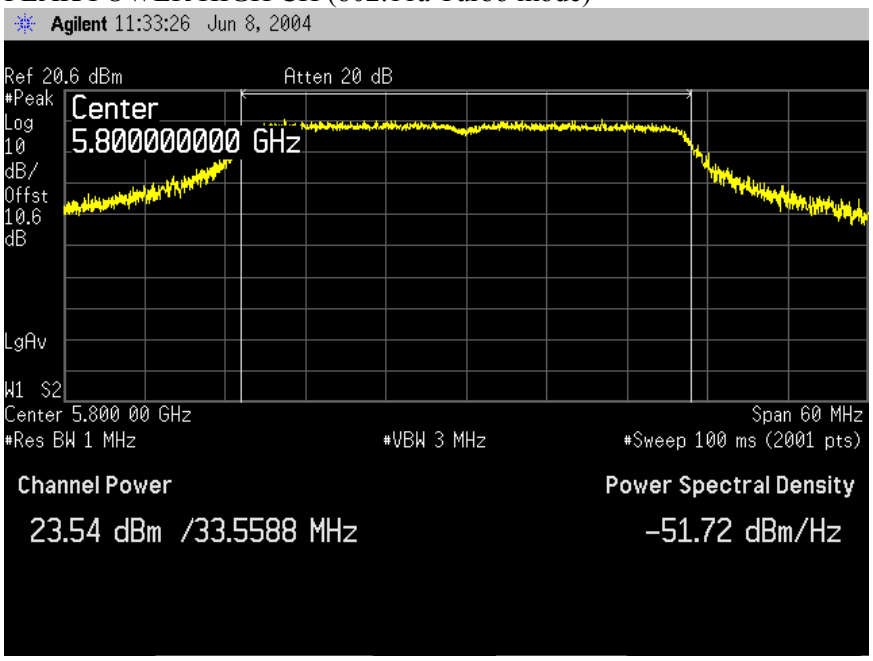
PEAK POWER HIGH CH (802.11a Turbo mode)



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6.4. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f²)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

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CALCULATIONS

Given

$E = \sqrt{(30 * P * G)} / d$

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

yields

$d = 0.282 * 10 ^ ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

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LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

5.8 GHz BAND RESULTS

No non-compliance noted:

Mode	Power Density Limit (mW/cm^2)	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
802.11a	1.0	23.49	26.00	84.09
802.11a Turbo	1.0	23.54	26.00	84.58

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6.5. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

5.8 GHZ BAND RESULTS

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5745	15.94
Middle	5785	15.60
High	5825	15.20

802.11a Turbo Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5760	16.60
High	5800	16.80

The cable assembly insertion loss of 10.6 dB (including 10 dB pad and 0.6 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

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6.6. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.247 (d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer, the maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz and VBW > 3 kHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

5.8 GHz BAND RESULTS

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-5.32	8	-13.32
Middle	5785	-6.13	8	-14.13
High	5825	-5.39	8	-13.39

802.11a Turbo Mode

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5760	-6.59	8	-14.59
High	5800	-4.87	8	-12.87

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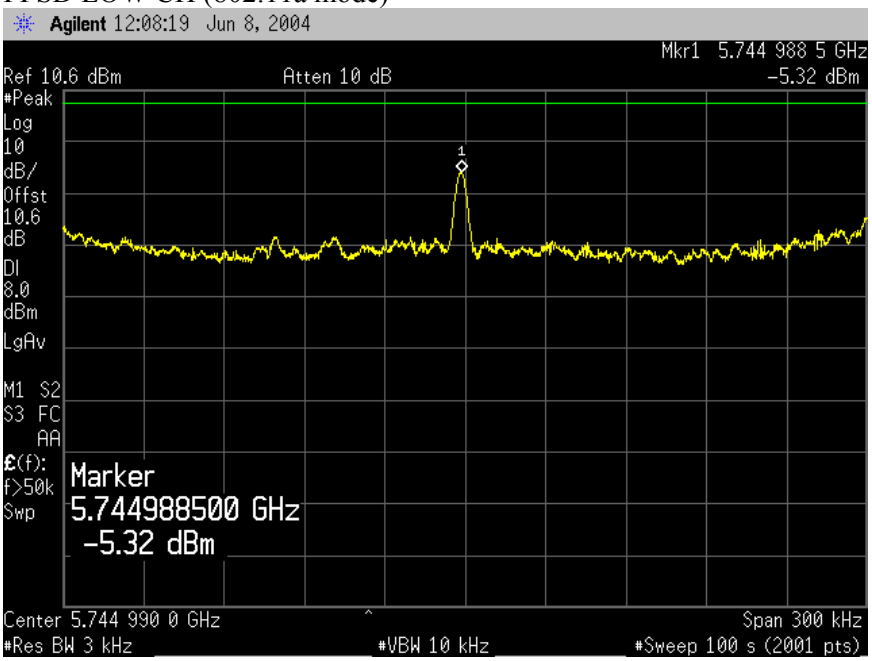
PEAK POWER SPECTRAL DENSITY (802.11a MODE)

PPSD LOW CH (802.11a mode)



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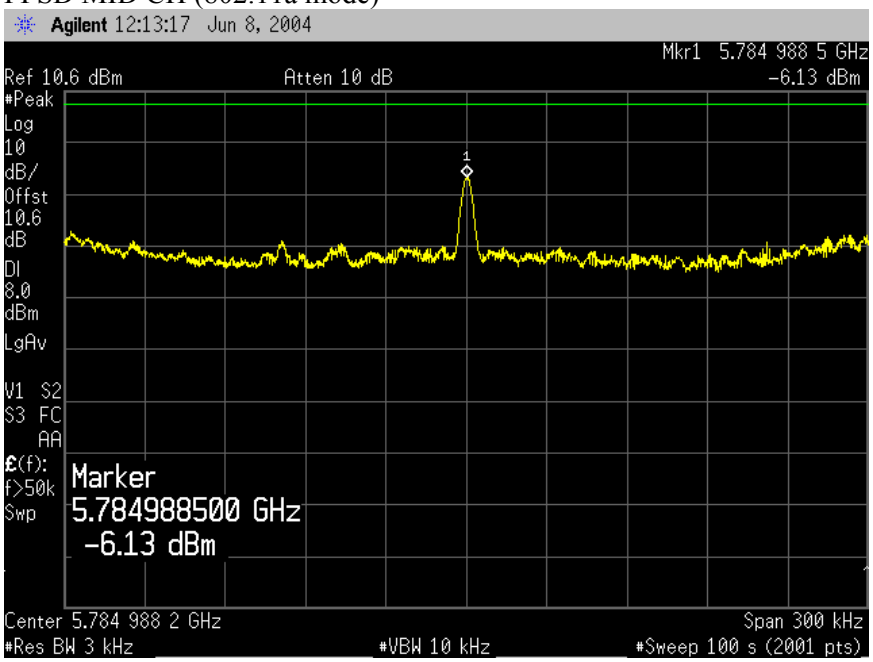
PPSD MID CH (802.11a mode)



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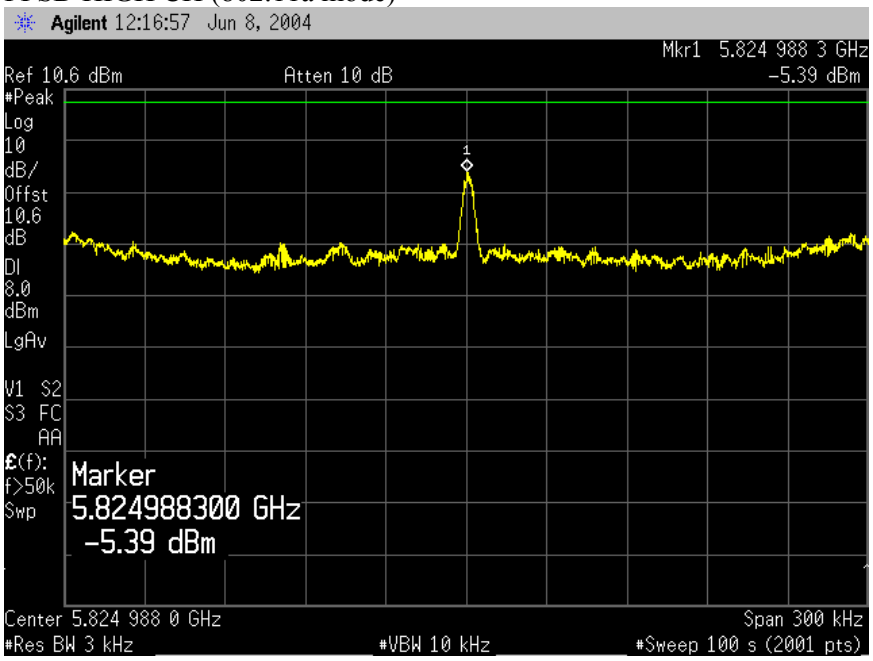
PPSD HIGH CH (802.11a mode)



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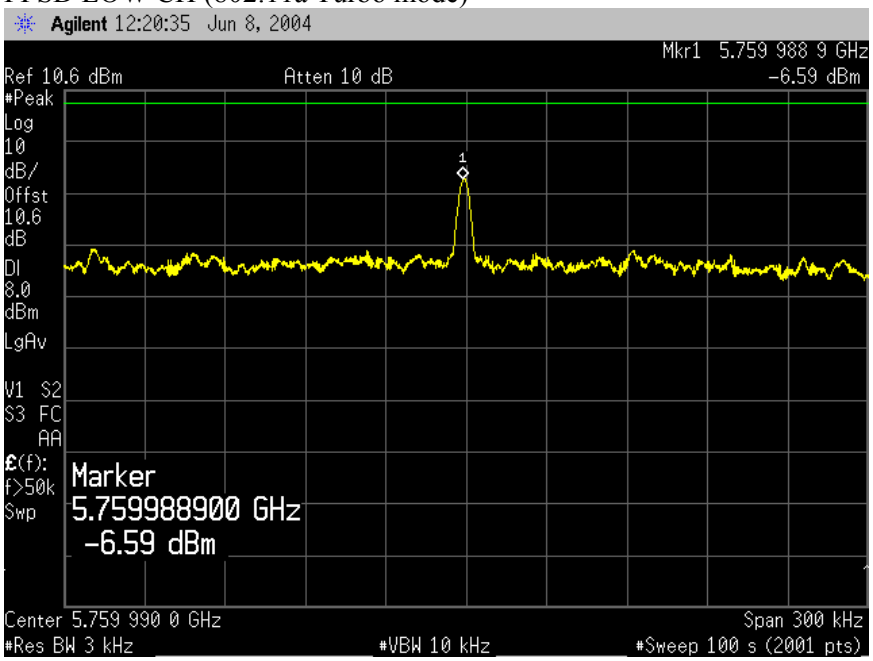
PEAK POWER SPECTRAL DENSITY (802.11a TURBO MODE)

PPSD LOW CH (802.11a Turbo mode)



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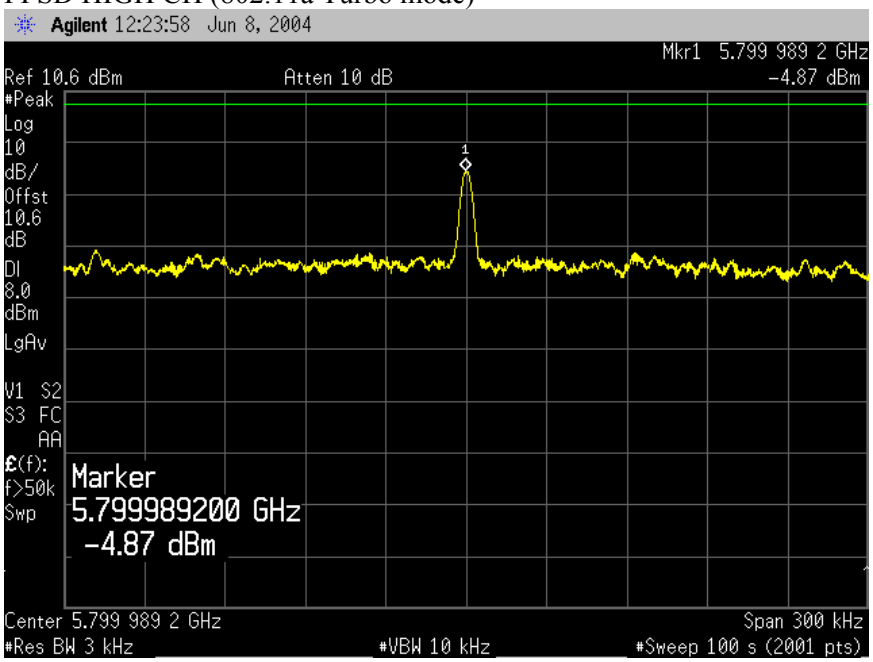
PPSD HIGH CH (802.11a Turbo mode)



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6.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions, which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 5.8 GHz band.

RESULTS

No non-compliance noted:

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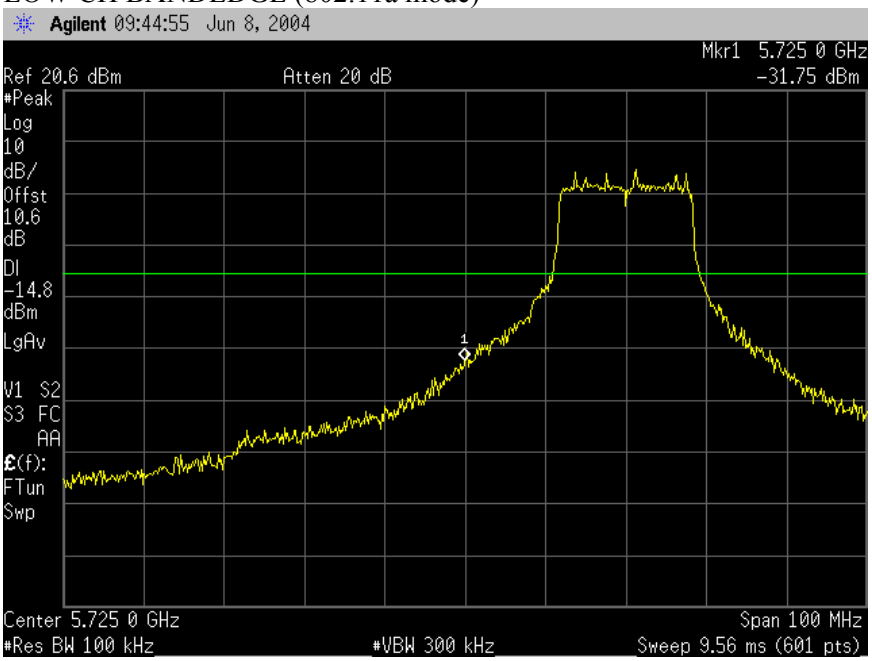
SPURIOUS EMISSIONS, LOW CHANNEL (802.11a MODE)

LOW CH BANDEDGE (802.11a mode)



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LOW CH SPURIOUS (802.11a mode)

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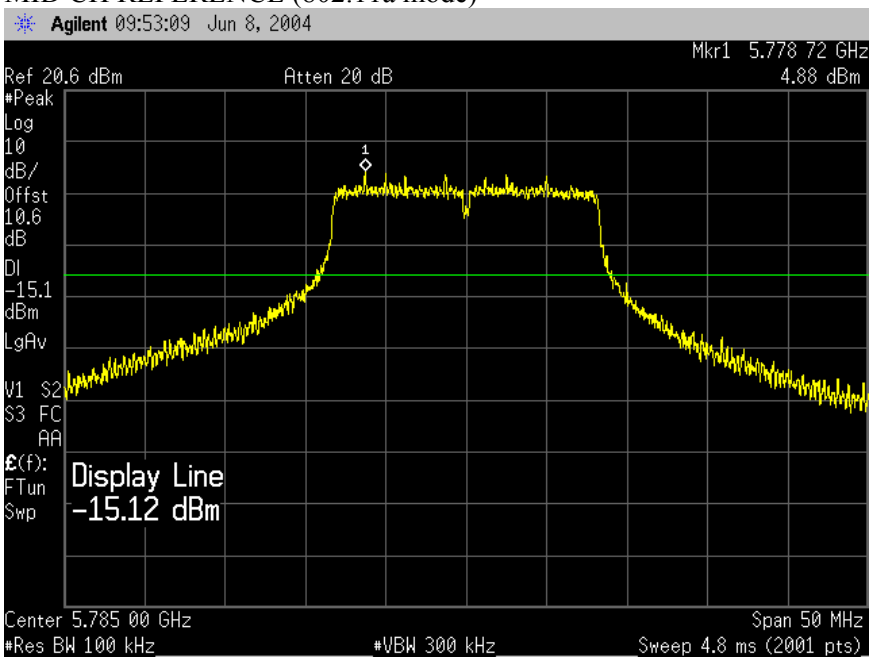
SPURIOUS EMISSIONS, MID CHANNEL (802.11a MODE)

MID CH REFERENCE (802.11a mode)



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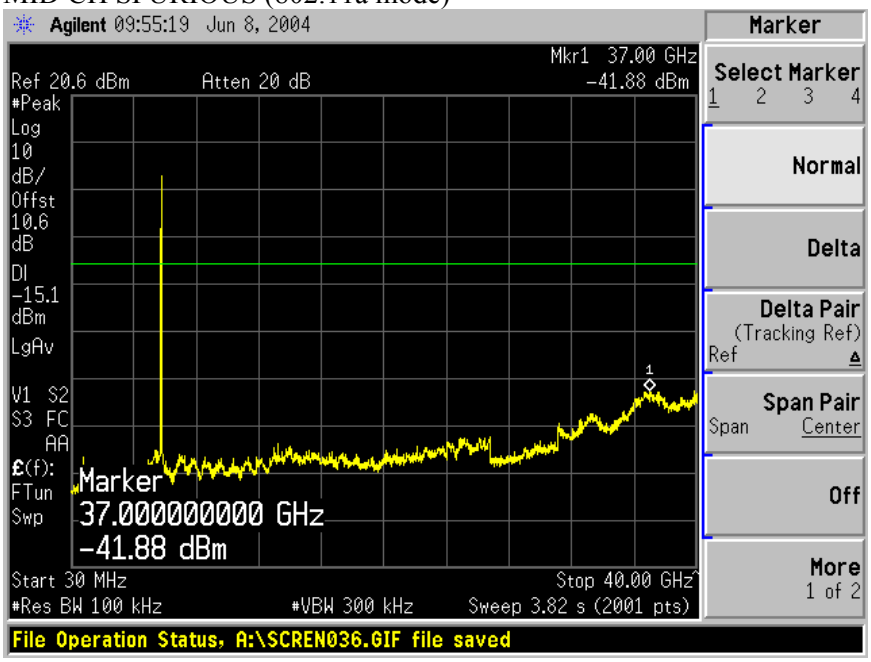
MID CH SPURIOUS (802.11a mode)



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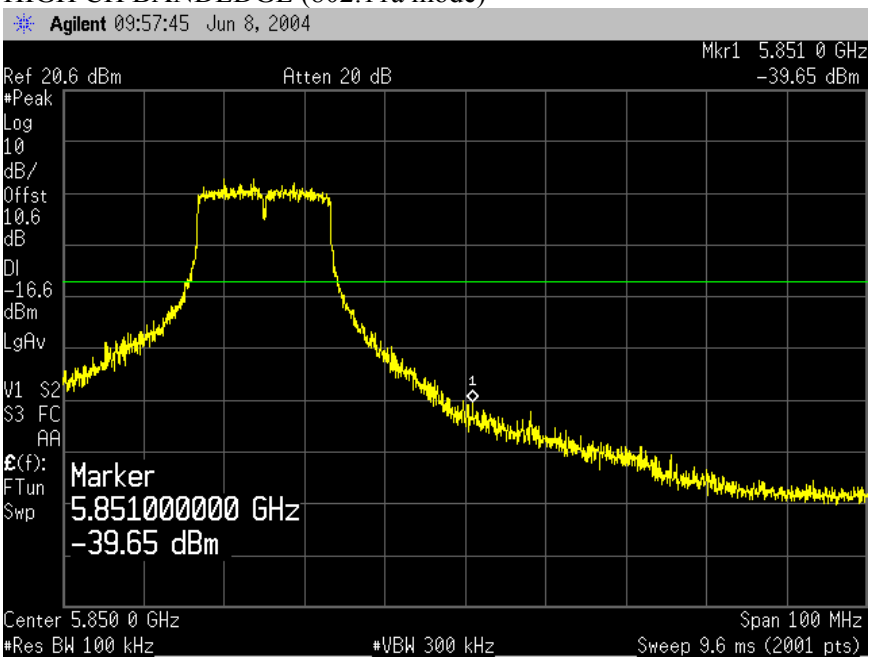
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a MODE)

HIGH CH BANDEDGE (802.11a mode)



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HIGH CH SPURIOUS (802.11a mode)

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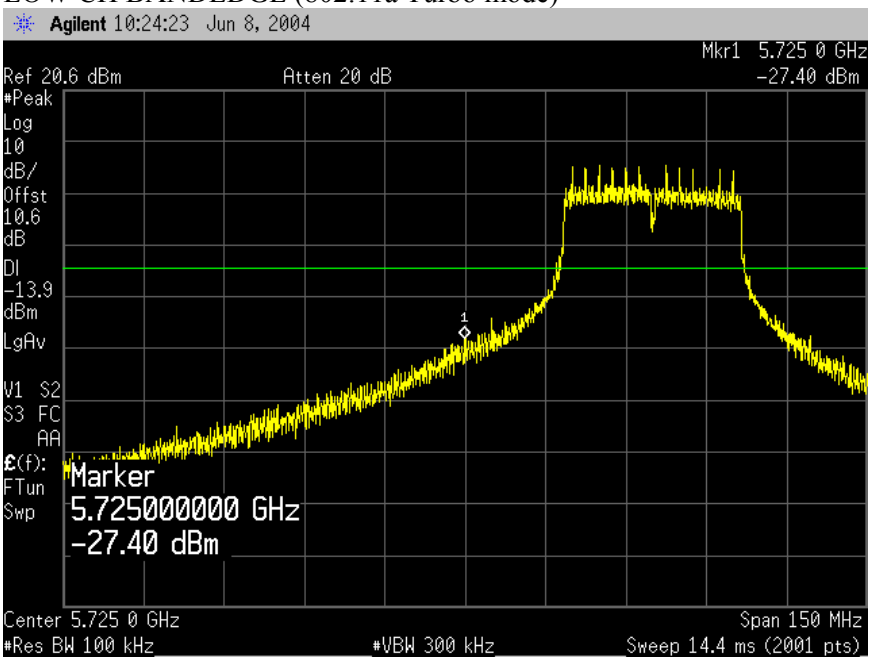
SPURIOUS EMISSIONS, LOW CHANNEL (802.11a TURBO MODE)

LOW CH BANDEDGE (802.11a Turbo mode)



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LOW CH SPURIOUS (802.11a Turbo mode)

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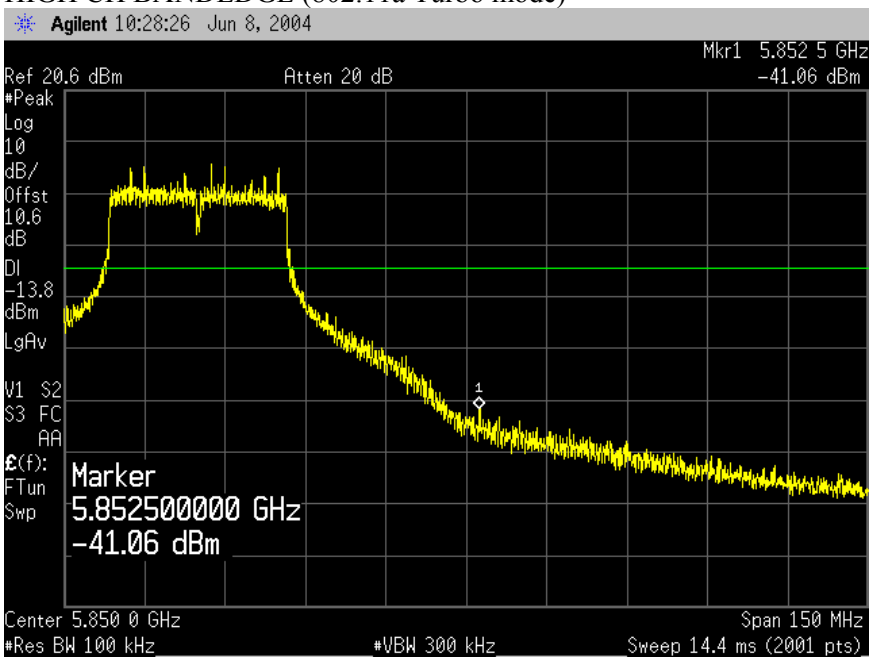
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11a TURBO MODE)

HIGH CH BANDEDGE (802.11a Turbo mode)



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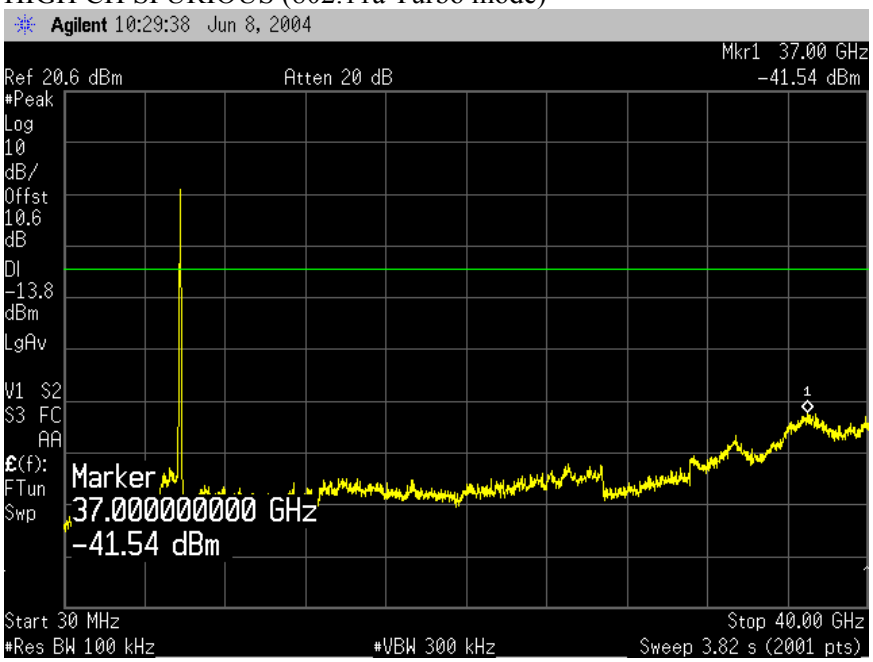
HIGH CH SPURIOUS (802.11a Turbo mode)



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7. APPLICABLE LIMITS AND TEST RESULTS

7.1. RADIATED EMISSIONS

7.1.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

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

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

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

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

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

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TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels of the 5.8 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

RESULTS

No non-compliance noted:

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7.1.2. TRANSMITTER RADIATED EMISSIONS ABOVE 1 GHZ

HARMONICS AND SPURIOUS EMISSIONS (a NORMAL AND TURBO MODES) / 23 dBi Unit

06/07/04 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: VIEN TRAN
Project #: 04U2751-1
Company: RAPIDWAVE
EUT Descrip.: 802.11a HIGH RATE POINT TO POINT WIRELESS BRIDGE WITH 2 ANTENNAS
EUT M/N: RAPIDLINK 54_23dBi_18dBm POWER OUTPUT
Test Target: FCC15.247
Mode Oper: TX LOW / MID / HI CHANNELS

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T60; S/N: 2238 @3m	HP 8593EM Analyzer	T87 Miteq 924342	T88 Miteq 16-40GHz	T117; ARA 18-26GHz; S/N:1013

Hi Frequency Cables
☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Peak Measurements:
1 MHz Resolution Bandwidth
1MHz Video Bandwidth

Average Measurements:
1 MHz Resolution Bandwidth
10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
LOW CH 5745MHz															
11.490	9.8	47.0	33.9	38.7	6.1	-41.5	0.0	1.0	51.2	38.2	74.0	54.0	-22.8	-15.8	V
11.490	9.8	45.7	32.9	38.7	6.1	-41.5	0.0	1.0	49.9	37.1	74.0	54.0	-24.1	-16.9	H
MID CH 5785MHz															
11.570	9.8	46.7	34.6	38.8	6.1	-41.6	0.0	1.0	51.0	38.9	74.0	54.0	-23.0	-15.1	V
11.570	9.8	44.8	33.0	38.8	6.1	-41.6	0.0	1.0	49.1	37.3	74.0	54.0	-24.9	-16.7	H
HI CH 5825MHz															
11.650	9.8	45.9	33.1	38.9	6.1	-41.7	0.0	1.0	50.2	37.4	74.0	54.0	-23.8	-16.6	V
11.650	9.8	47.1	35.3	38.9	6.1	-41.7	0.0	1.0	51.4	39.5	74.0	54.0	-22.6	-14.5	H
TURBO MODE															
LOW CH 5760MHz															
11.520	9.8	45.0	33.0	38.7	6.1	-41.5	0.0	1.0	49.3	37.3	74.0	54.0	-24.7	-16.7	V
11.520	9.8	44.6	32.6	38.7	6.1	-41.5	0.0	1.0	48.9	36.9	74.0	54.0	-25.1	-17.1	H
MID CH 5780MHz															
11.560	9.8	46.0	32.0	38.8	6.1	-41.6	0.0	1.0	50.3	36.3	74.0	54.0	-23.7	-17.7	V
11.560	9.8	44.8	33.1	38.8	6.1	-41.6	0.0	1.0	49.1	37.4	74.0	54.0	-24.9	-16.6	H
HI CH 5800MHz															
11.600	9.8	46.4	33.5	38.8	6.1	-41.6	0.0	1.0	50.7	37.8	74.0	54.0	-23.3	-16.2	V
11.600	9.8	45.3	32.8	38.8	6.1	-41.6	0.0	1.0	49.6	37.1	74.0	54.0	-24.4	-16.9	H

NO OTHER EMISSION WERE DETECTED UP TO 10TH HARMONIC

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

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HARMONICS AND SPURIOUS EMISSIONS (a NORMAL AND TURBO MODES) / 26 dBi Unit

06/07/04 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: VIEN TRAN
Project #: 04U2751-1
Company: RAPIDWAVE
EUT Descrip.: 802.11a HIGH RATE POINT TO POINT WIRELESS BRIDGE WITH 2 ANTENNAS
EUT M/N: RAPIDLINK 54_26dBi_18dBm POWER OUTPUT
Test Target: FCC15.247
Mode Oper: TX LOW / MID / HI CHANNELS

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T60; S/N: 2238 @3m	HP 8593EM Analyzer	T87 Miteq 924342	T88 Miteq 16-40GHz	T117; ARA 18-26GHz; S/N:1013

Hi Frequency Cables
☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Peak Measurements:
1 MHz Resolution Bandwidth
1MHz Video Bandwidth

Average Measurements:
1 MHz Resolution Bandwidth
10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
LOW CH 5745MHz															
11.490	9.8	49.8	37.9	38.7	6.1	-41.5	0.0	1.0	54.1	42.2	74.0	54.0	-19.9	-11.8	V
11.490	9.8	49.6	37.7	38.7	6.1	-41.5	0.0	1.0	53.8	41.9	74.0	54.0	-20.2	-12.1	H
MID CH 5785MHz															
11.570	9.8	47.9	35.8	38.8	6.1	-41.6	0.0	1.0	52.1	40.1	74.0	54.0	-21.9	-13.9	V
11.570	9.8	46.0	33.2	38.8	6.1	-41.6	0.0	1.0	50.3	37.5	74.0	54.0	-23.7	-16.5	H
HI CH 5825MHz															
11.650	9.8	47.7	35.6	38.9	6.1	-41.7	0.0	1.0	52.0	39.9	74.0	54.0	-22.0	-14.1	V
11.650	9.8	46.6	34.8	38.9	6.1	-41.7	0.0	1.0	50.9	39.0	74.0	54.0	-23.1	-15.0	H
TURBO MODE															
LOW CH 5760MHz															
11.520	9.8	46.9	34.9	38.7	6.1	-41.5	0.0	1.0	51.2	39.2	74.0	54.0	-22.8	-14.8	V
11.520	9.8	45.7	33.8	38.7	6.1	-41.5	0.0	1.0	50.0	38.1	74.0	54.0	-24.0	-15.9	H
MID CH 5780MHz															
11.560	9.8	48.3	35.6	38.8	6.1	-41.6	0.0	1.0	52.6	39.9	74.0	54.0	-21.4	-14.1	V
11.560	9.8	47.4	35.3	38.8	6.1	-41.6	0.0	1.0	51.7	39.6	74.0	54.0	-22.3	-14.4	H
HI CH 5800MHz															
11.600	9.8	45.0	32.4	38.8	6.1	-41.6	0.0	1.0	49.3	36.7	74.0	54.0	-24.7	-17.3	V
11.600	9.8	44.1	31.2	38.8	6.1	-41.6	0.0	1.0	48.4	35.5	74.0	54.0	-25.6	-18.5	H

NO OTHER EMISSION WERE DETECTED UP TO 10TH HARMONIC

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

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7.1.3. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

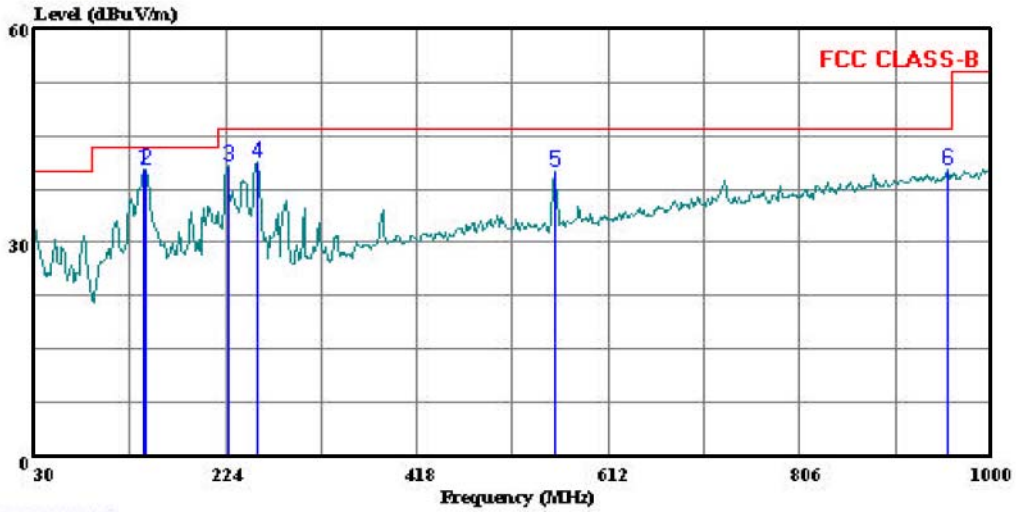
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT – 23 dBi Unit

COMPLIANCE Engineering Service, Inc.

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 10 File#: RAD0604.EMI Date: 06-04-2004 Time: 15:36:19



(Audix ATC)

Trace: 9 Ref Trace:

```
Condition: 3m HORIZONTAL
Test Operator:    : Frank Ibrahim
Project #:        : 04U2751-1
Company:          : RapidWave
EUT:              : 802.11 w/ Turbo High Rate Point to Point
                  : Wireless Bridge w/ 23 dBi Gain Antenna
Model No:         : RL54-BR-23
Configuration:    : Stand Alone EUT , w/ peripherals at
                  : Remote Location
Target of Test:   : FCC B, 15.209
Mode of Operation: TX ON at Mid Channel, Normal Mode
                  : Full Power
```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HORIZONTAL DATA – 23 dBi

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	140.580	Peak	24.97	15.23	40.20	43.50	-3.30
2	142.520	Peak	25.23	15.01	40.24	43.50	-3.27
3	225.940	Peak	27.80	13.11	40.91	46.00	-5.09
4	256.980	Peak	26.84	14.45	41.29	46.00	-4.71
5	557.680	Peak	18.73	21.17	39.90	46.00	-6.10
6	955.380	Peak	13.23	26.95	40.18	46.00	-5.82

COMPLIANCE CERTIFICATION SERVICES DOCUMENT NO: CCSUP4031A
561F MONTEREY ROAD, MORGAN HILL, CA 95037 USA TEL: (408) 463-0885 FAX: (408) 463-0888
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HORIZONTAL PLOT – 26 dBi Unit

COMPLIANCE Engineering Service, Inc.
FCC,VCCI,CISPR,CE UL,CSA,TÜV

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

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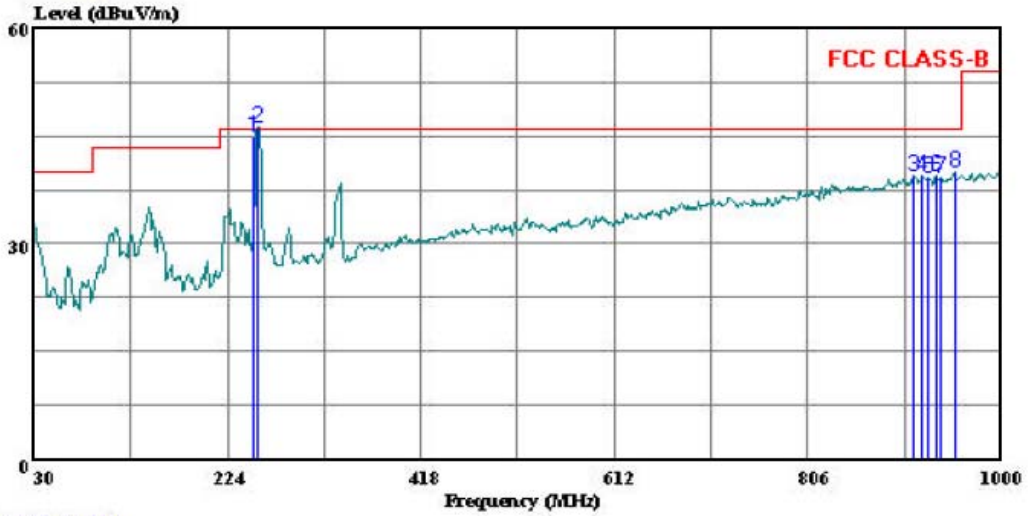

(Audix ATC)
Trace: 17 Ref Trace:

Condition: 3m HORIZONTAL
Test Operator : Frank Ibrahim
Project #: : 04U2751-1
Company: : RapidWave
EUT: : 802.11 w/ Turbo High Rate Point to Point
: Wireless Bridge w/ 26 dBi Gain Antenna
Model No: : RL54-BR-26
Configuration: : Stand Alone EUT , w/ peripherals at
: Remote Location
Target of Test: : FCC B, 15.209
Mode of Operation: TX ON at Mid Channel, Normal Mode
: Full Power
: Used RJ45 Shielded cables

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HORIZONTAL DATA – 26 dBi

		Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
		MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1		250.000	QP	30.88	14.02	44.90	46.00	-1.10
2	*	255.040	Peak	31.98	14.35	46.33	46.00	0.33
3		911.730	Peak	12.95	26.47	39.42	46.00	-6.58
4		921.430	Peak	12.63	26.73	39.36	46.00	-6.64
5		926.280	Peak	12.40	26.76	39.16	46.00	-6.84
6		934.040	Peak	12.76	26.81	39.57	46.00	-6.43
7		938.890	Peak	12.28	26.84	39.12	46.00	-6.88
8		953.440	Peak	13.14	26.91	40.05	46.00	-5.95

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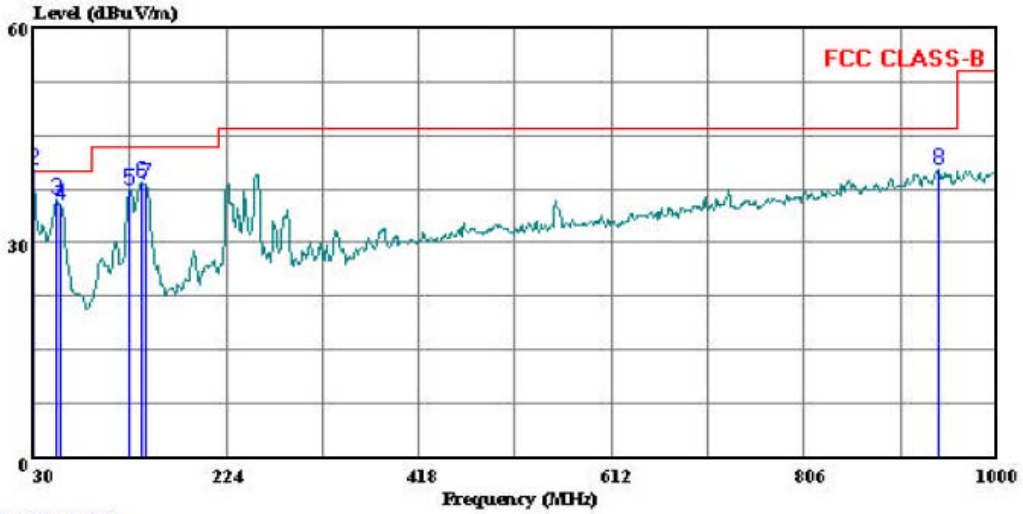
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT – 23 dBi

COMPLIANCE Engineering Services, Inc.
FCC,VCCI,CISPR,CE
UL,CSA,TUV

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 8 File#: RAD0604.EMI Date: 06-04-2004 Time: 15:25:49



(Audix ATC)

Trace: 3 Ref Trace:

```
Condition: 3m VERTICAL
Test Operator:    : Frank Ibrahim
Project #:        : 04U2751-1
Company:          : RapidWave
EUT:              : 802.11 w/ Turbo High Rate Point to Point
                  : Wireless Bridge w/ 23 dBi Gain Antenna
Model No:         : RL54-BR-23
Configuration:    : Stand Alone EUT , w/ peripherals at
                  : Remote Location
Target of Test:   : FCC B, 15.209
Mode of Operation: TX ON at Mid Channel, Normal Mode
                  : Full Power
```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VERTICAL DATA – 23 dBi

		Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
		MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1		30.000	QP	236.00	-200.00	36.00	40.00	-4.00
2	*	30.000	Peak	17.30	22.95	40.25	40.00	0.25
3		53.280	Peak	27.21	9.01	36.22	40.00	-3.78
4		58.130	Peak	26.54	8.73	35.27	40.00	-4.73
5		126.030	Peak	22.03	15.48	37.51	43.50	-5.99
6		138.640	Peak	23.23	15.32	38.55	43.50	-4.95
7		143.490	Peak	23.42	14.86	38.28	43.50	-5.23
8		940.830	Peak	13.44	26.83	40.27	46.00	-5.73

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VERTICAL PLOT – 26 dBi

COMPLIANCE Engineering Services, Inc.
FCC,VCCI,CISPR,CE
UL,CSA,TUV

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

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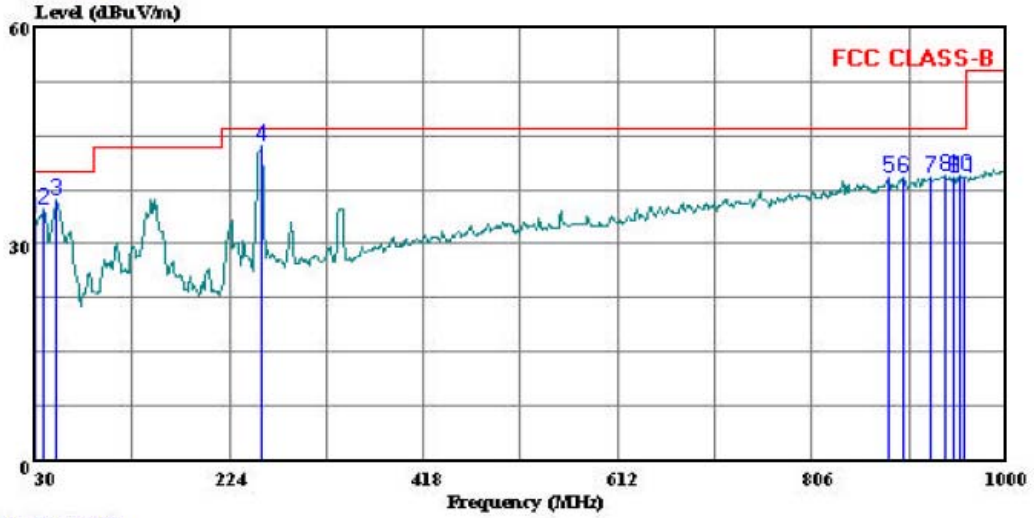

(Audix ATC)

Trace: 21 Ref Trace:

```
Condition: 3m HORIZONTAL
Test Operator:    : Frank Ibrahim
Project #:        : 04U2751-1
Company:          : RapidWave
EUT:              : 802.11 w/ Turbo High Rate Point to Point
                  : Wireless Bridge w/ 26 dBi Gain Antenna
Model No:         : RL54-BR-26
Configuration:    : Stand Alone EUT , w/ peripherals at
                  : Remote Location
Target of Test:   : FCC B, 15.209
Mode of Operation: TX ON at Mid Channel, Normal Mode
                  : Full Power
                  : Used RJ45 Shielded cables
```


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VERTICAL DATA – 26 dBi

Page: 1

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	30.000	Peak	10.66	22.95	33.61	40.00	-6.39
2	38.730	Peak	17.67	17.09	34.76	40.00	-5.24
3	51.340	Peak	26.94	9.20	36.14	40.00	-3.86
4	256.980	Peak	29.08	14.45	43.53	46.00	-2.47
5	882.630	Peak	13.40	25.84	39.24	46.00	-6.76
6	897.180	Peak	13.17	26.12	39.29	46.00	-6.71
7	924.340	Peak	12.47	26.74	39.21	46.00	-6.79
8	938.890	Peak	12.58	26.84	39.42	46.00	-6.58
9	948.590	Peak	12.32	26.88	39.20	46.00	-6.80
10	953.440	Peak	12.56	26.91	39.47	46.00	-6.53
11	958.290	Peak	12.39	26.93	39.32	46.00	-6.69

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7.2. POWERLINE CONDUCTED EMISSIONS

LIMIT

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

The lower limit applies at the boundary between the frequency ranges.

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

No non-compliance noted:

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6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	53.40	--	--	0.00	66.00	56.00	-12.60	-2.60	L1
0.23	46.90	--	--	0.00	63.83	53.83	-16.93	-6.93	L1
0.53	42.42	--	--	0.00	56.00	46.00	-13.58	-3.58	L1
0.15	51.34	--	--	0.00	66.00	56.00	-14.66	-4.66	L2
0.23	46.38	--	--	0.00	63.83	53.83	-17.45	-7.45	L2
6.77	44.38	--	--	0.00	60.00	50.00	-15.62	-5.62	L2
6 Worst Data									

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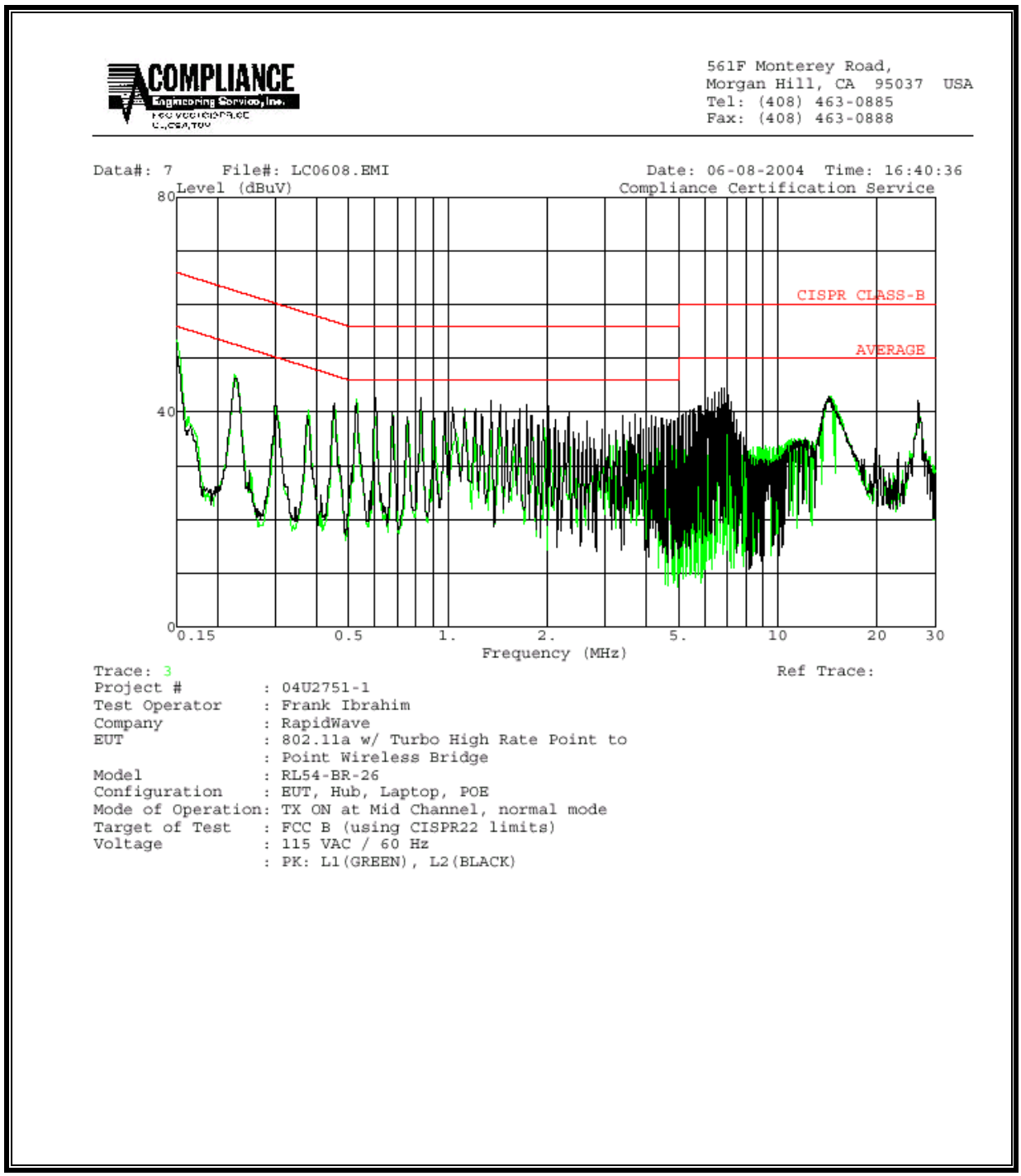
LINE 1 AND LINE 2 RESULTS



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8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

ANTENNA PORT CONDUCTED PHOTO

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RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO / 23 dBi Unit

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RADIATED BACK PHOTO / 23 dBi Unit

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RADIATED FRONT PHOTO / 26 dBi Unit

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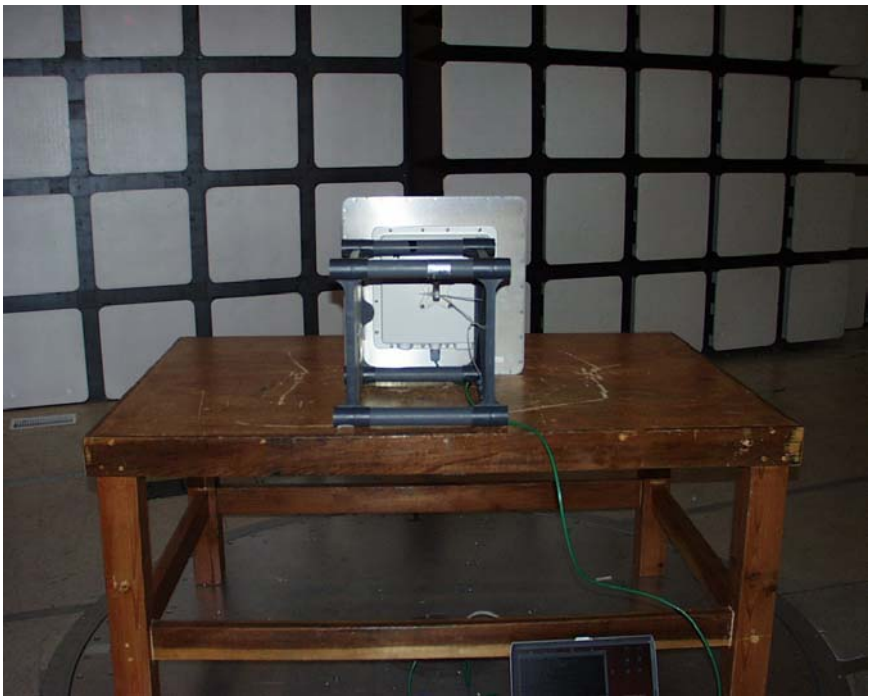
RADIATED BACK PHOTO / 26 dBi Unit



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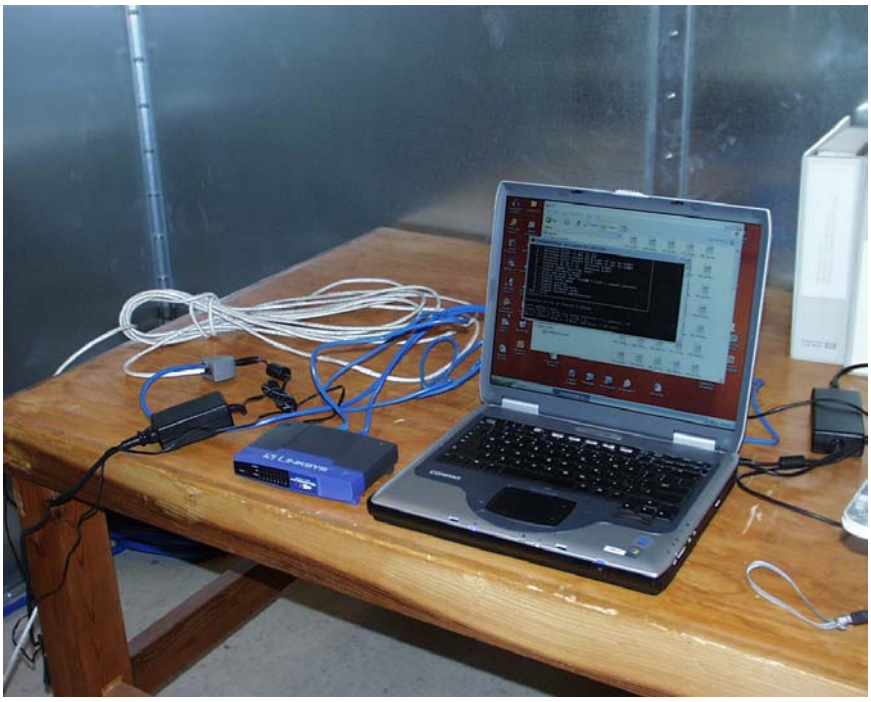
SUPPORT EQUIPMENT
PHOTO



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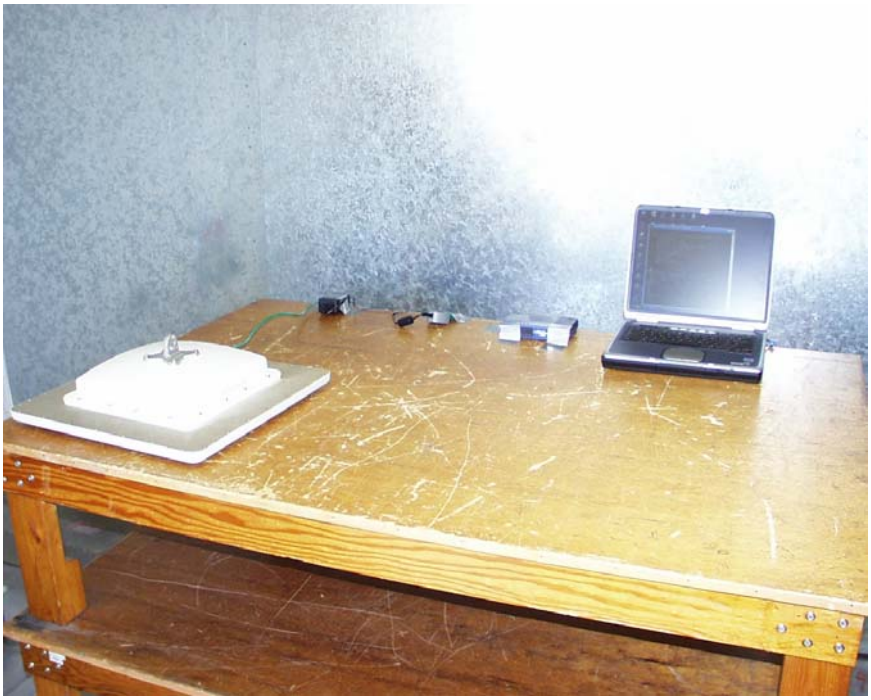
POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO



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LINE CONDUCTED BACK PHOTO

END OF REPORT

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