



**FCC CFR47 PART 15 SUBPART C
CLASS II PERMISSIVE CHANGE TEST REPORT**

FOR

WIRELESS 802.11b EMBEDDED MODULE

MODEL NUMBER: RCM4400W

FCC ID: VCB-540D144

REPORT NUMBER: 08U12243-1

ISSUE DATE: NOVEMBER 14, 2008

Prepared for

**RABBIT SEMICONDUCTOR INCORPORATED - A DIGI INTERNATIONAL COMPANY
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Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	11/14/08	Initial Issue	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: RABBIT SEMICONDUCTOR INCORPORATED - A DIGI
INTERNATIONAL COMPANY
2900 SPAFFORD STREET
DAVIS, CA 95618, U.S.A.

EUT DESCRIPTION: WIRELESS 802.11B EMBEDDED MODULE

MODEL: RCM4400W

SERIAL NUMBER: D648A3

DATE TESTED: NOVEMBER 12-13, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

TOM CHEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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

4. CALIBRATION AND UNCERTAINTY

4.1. 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.

4.2. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

EUT is a Wireless 802.11b Embedded Module operating in the frequency range 2400-2483.5MHz.

The radio module is manufactured by Rabbit Semiconductor.

5.2. DESCRIPTION OF CLASS II CHANGE

Adding an alternate surface mount chip antenna.

5.3. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	17.61	57.68

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a chip antenna with a maximum peak gain of 3 dBi.

5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Dynamic C rev. 10.21

The test utility software used during testing was RCM4400W_FCC.C

5.6. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power, the highest output power was at mid channel 2437MHz.

The worst-case data rate for this channel is determined to be 2 Mb/s.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
DC Power Supply	HP	E3610A	02844	N/A
Test Fixture	SKY CONNECT, LLC	1616-055-10	NA	N/A
Laptop	DELL	INSPIRON 6400	3001990	DoC
AC adapter	DELL	LA65NS0-00	CN0DF2637161566C	DoC

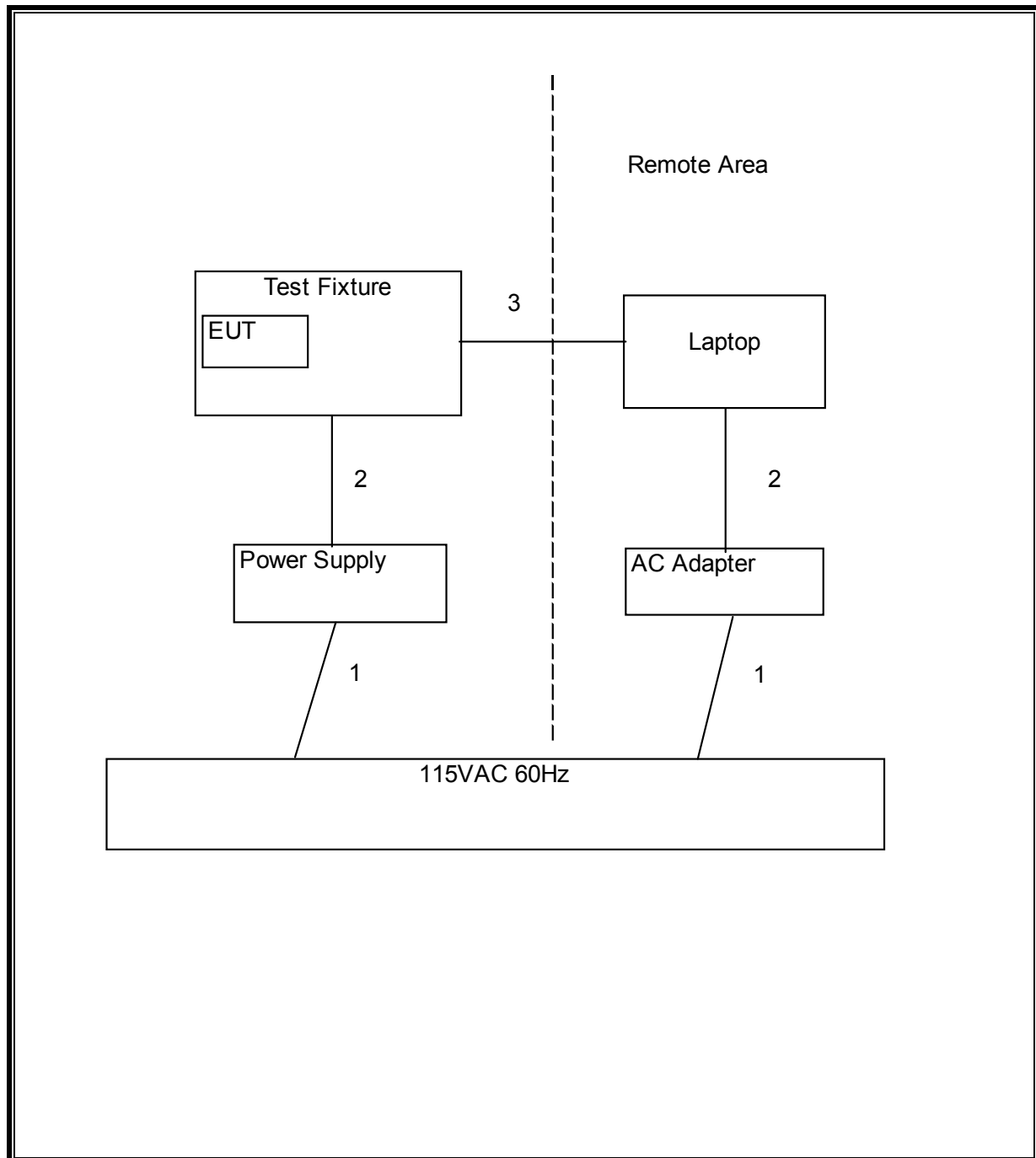
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US 115V	Un-shielded	2m	N/A
2	DC	2	DC	Un-shielded	2m	N/A
3	RS-232	1	DB9	Un-shielded	1m	Connected to Remote Laptop

TEST SETUP

The EUT is installed in a test fixture and is connected to a Laptop during the tests. Test software exercised the radio module.

SETUP DIAGRAM FOR TESTS



6. 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	Asset	Cal Date	Cal Due
Preamplifier, 1300 MHz	Agilent / HP	8447D	N/A	03/31/08	03/31/09
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	04/08/08	10/08/09
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	06/19/08	09/19/09
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	06/19/08	09/19/09
Antenna, Bilog, 2 GHz	Sundt Sciences	JB1	C01016	02/11/08	02/11/09
Antenna, Horn, 18 GHz	EMCO	3115	C00872	04/22/08	04/22/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	08/05/08	08/05/09
Antenna, Horn, 26.5 GHz	ARA	MVH-1826/B	C00980	09/29/07	11/28/08

7. RADIATED TEST RESULTS

7.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

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.

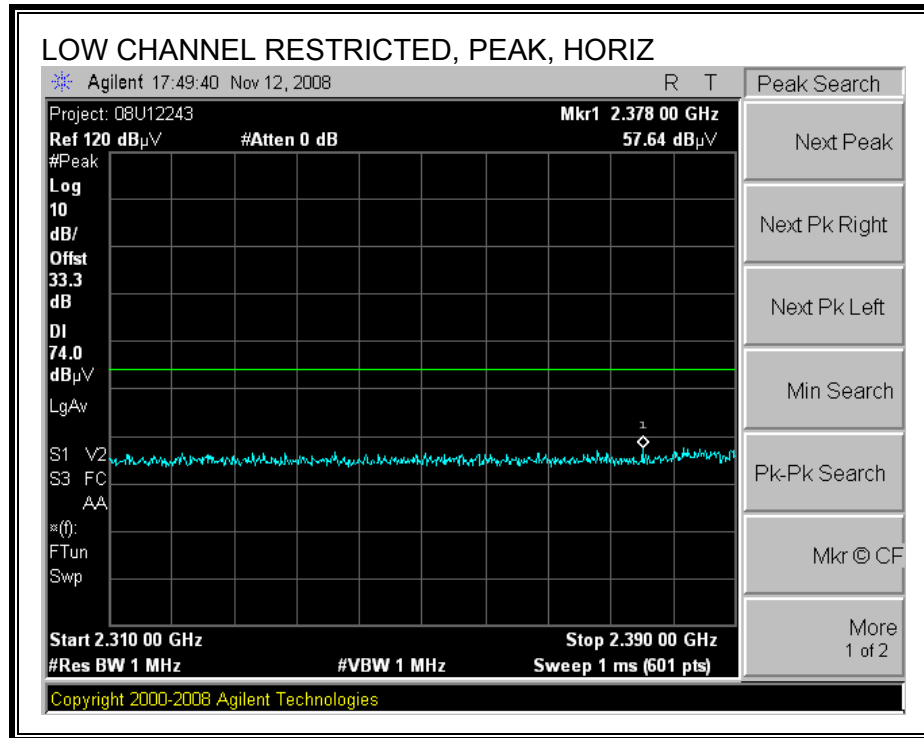
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

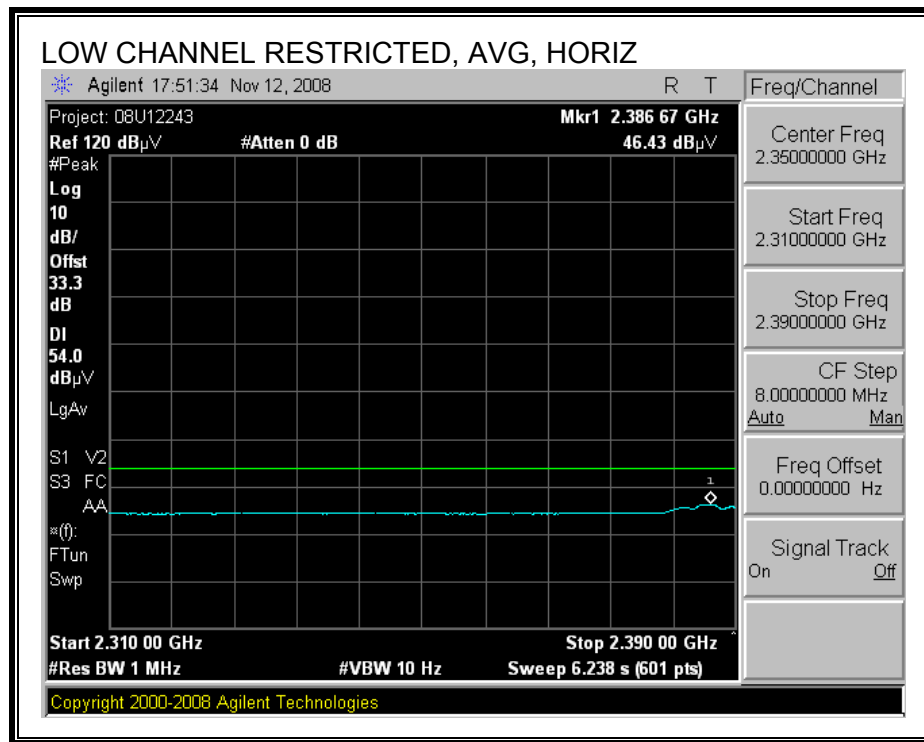
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

7.2. TRANSMITTER ABOVE 1 GHz

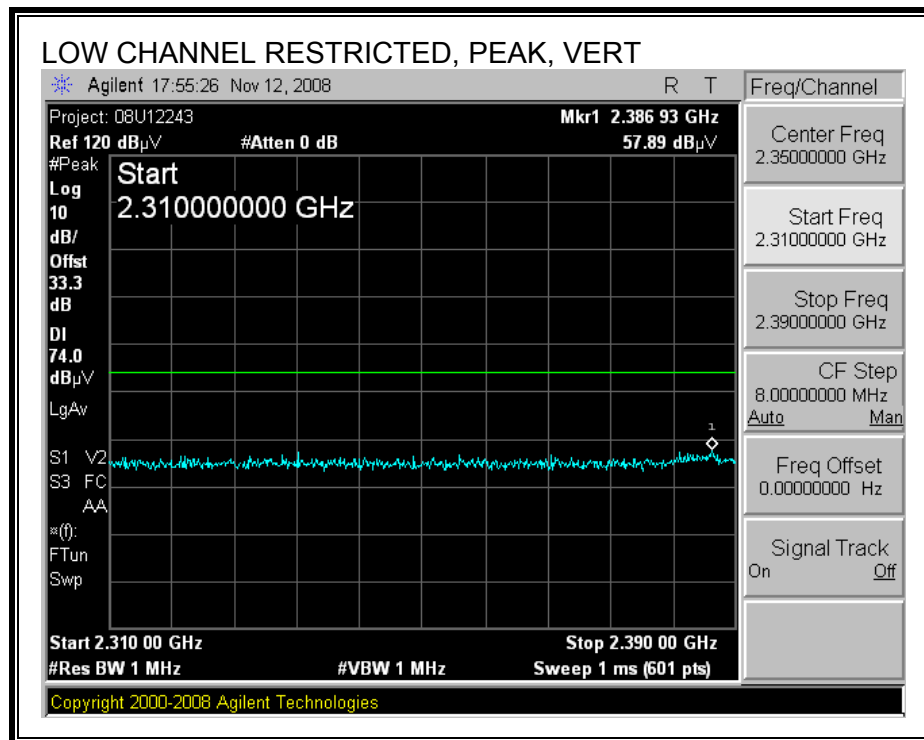
7.2.1. TX ABOVE 1 GHz FOR 802.11b MODE IN THE 2.4 GHz BAND

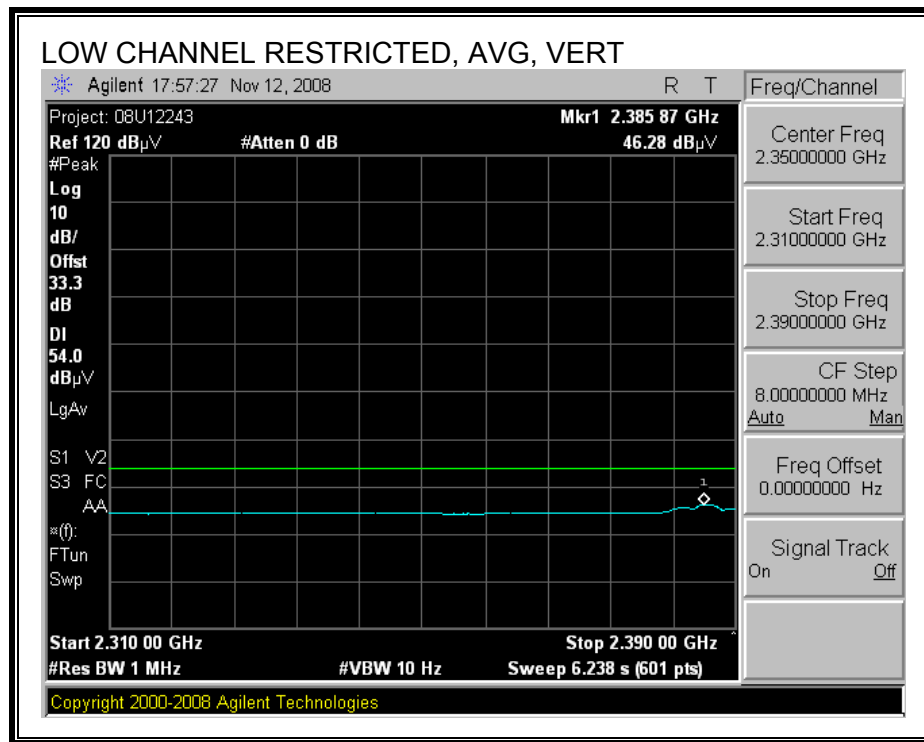
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



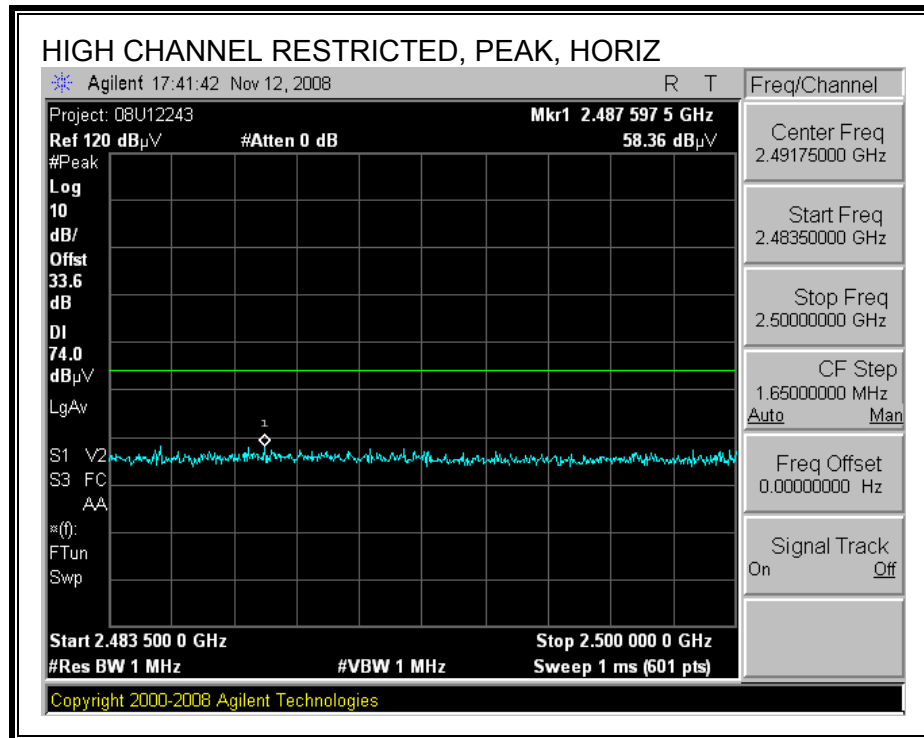


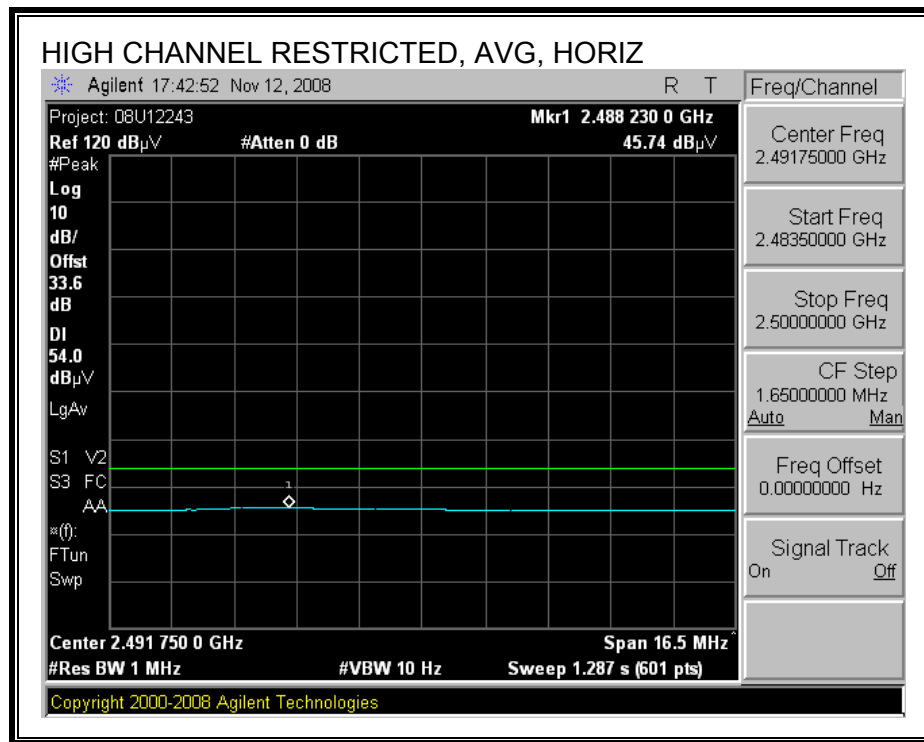
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



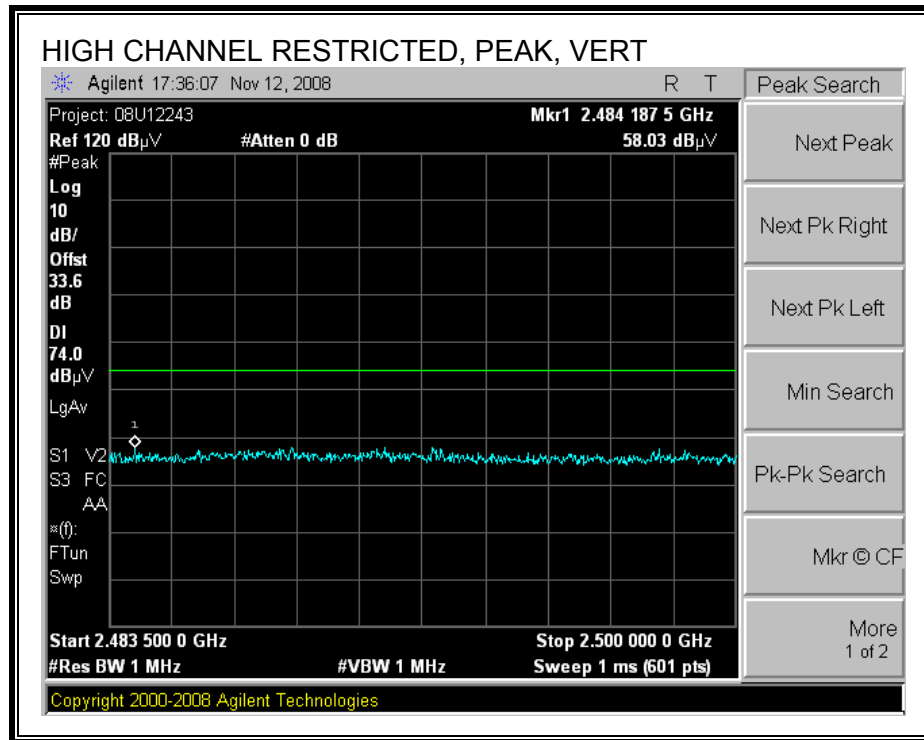


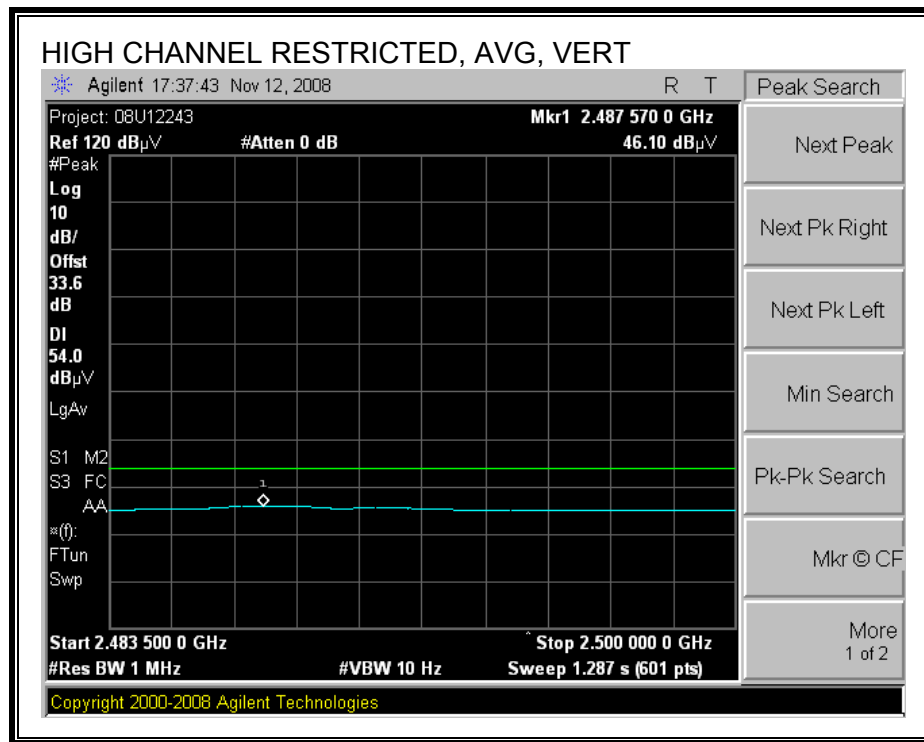
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)



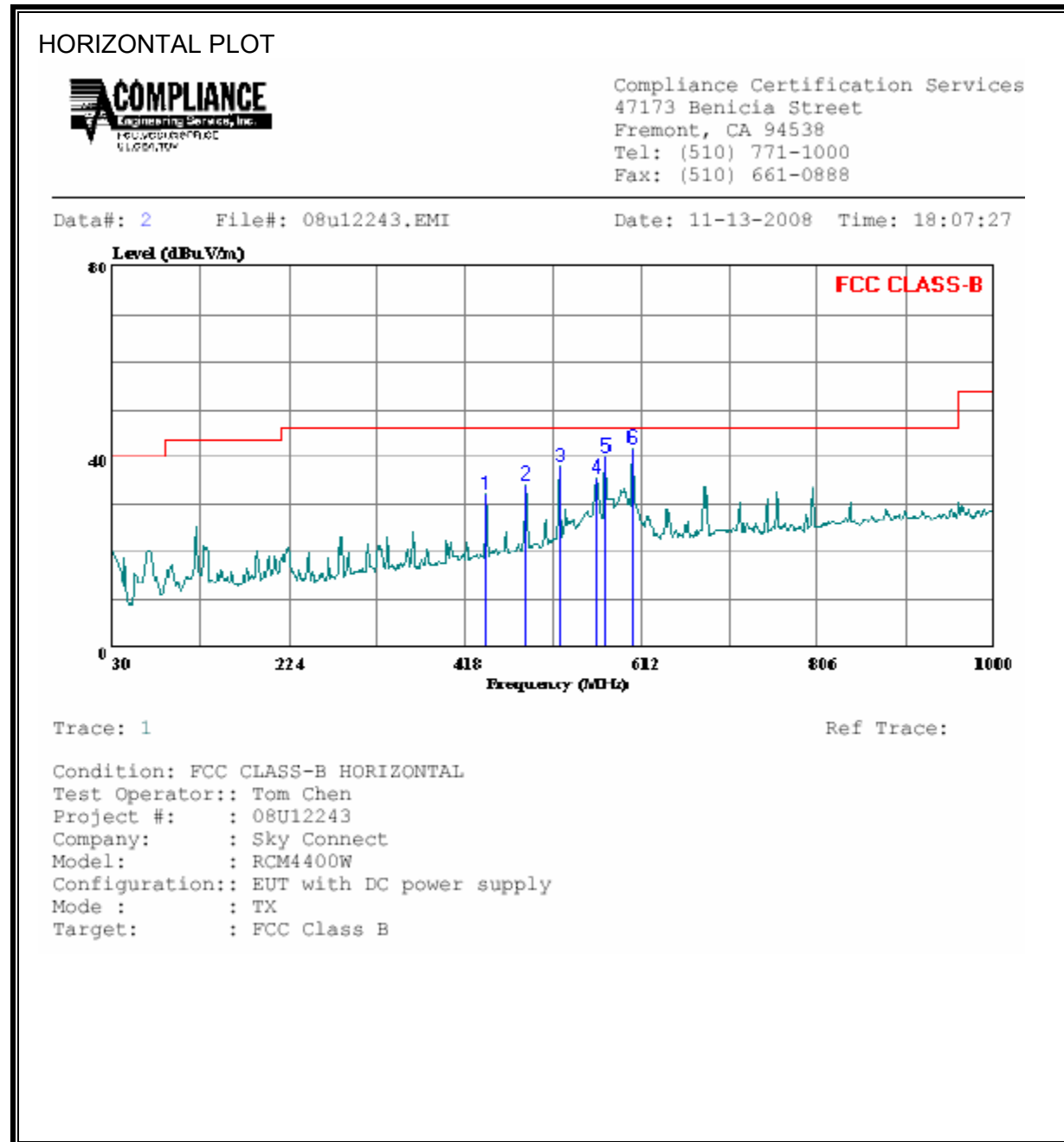


HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement																
Compliance Certification Services, Fremont 5m Chamber																
Company:		Sky Connect														
Project #:		08U12243														
Date:		11/13/2008														
Test Engineer:		Tom Chen														
Configuration:		EUT only														
Mode:		802.11b TX														
Test Equipment:																
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit				
T60; S/N: 2238 @3m			T34 HP 8449B						T89; ARA 18-26GHz; S/N:1049			FCC 15.209				
Hi Frequency Cables																
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter			Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz	
3' cable 22807700			12' cable 22807600			20' cable 22807500						R_001				
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)	
Low Ch, 2412MHz																
4.824	3.0	45.2	41.0	33.7	5.8	-34.8	0.0	0.0	49.9	45.7	74	54	-24.1	-8.3	H	
7.236	3.0	39.0	29.9	36.7	7.2	-34.1	0.0	0.0	48.7	39.6	74	54	-25.3	-14.4	H	
9.648	3.0	35.9	26.1	38.4	8.5	-33.6	0.0	0.0	49.3	39.5	74	54	-24.7	-14.5	H	
4.824	3.0	43.2	35.7	33.7	5.8	-34.8	0.0	0.0	47.9	40.4	74	54	-26.1	-13.6	V	
7.236	3.0	37.8	28.1	36.7	7.2	-34.1	0.0	0.0	47.5	37.8	74	54	-26.5	-16.2	V	
9.648	3.0	37.3	30.4	38.4	8.5	-33.6	0.0	0.0	50.7	43.8	74	54	-23.3	-10.2	V	
Mid Ch, 2437 MHz																
4.874	3.0	44.8	41.3	33.7	5.8	-34.8	0.0	0.0	49.6	46.1	74	54	-24.4	-7.9	H	
7.311	3.0	38.5	29.1	36.7	7.3	-34.1	0.0	0.0	48.4	39.0	74	54	-25.6	-15.0	H	
9.748	3.0	36.7	27.5	38.4	8.6	-33.3	0.0	0.0	50.4	41.2	74	54	-23.6	-12.8	H	
4.874	3.0	44.1	38.8	33.7	5.8	-34.8	0.0	0.0	48.9	43.6	74	54	-25.1	-10.4	V	
7.311	3.0	38.7	29.2	36.7	7.3	-34.1	0.0	0.0	48.6	39.1	74	54	-25.4	-14.9	V	
9.748	3.0	37.7	30.8	38.4	8.6	-33.3	0.0	0.0	51.4	44.5	74	54	-22.6	-9.5	H	
High Ch, 2462MHz																
4.924	3.0	42.7	39.1	33.8	5.9	-34.8	0.0	0.0	47.5	43.9	74	54	-26.5	-10.1	H	
7.386	3.0	40.3	27.2	36.8	7.3	-34.1	0.0	0.0	50.3	37.2	74	54	-23.7	-16.8	H	
9.848	3.0	36.3	24.9	38.4	8.7	-33.1	0.0	0.0	50.3	38.9	74	54	-23.7	-15.1	H	
4.924	3.0	42.1	37.3	33.8	5.9	-34.8	0.0	0.0	46.9	42.1	74	54	-27.1	-11.9	V	
7.386	3.0	45.1	27.5	36.8	7.3	-34.1	0.0	0.0	55.1	37.5	74	54	-18.9	-16.5	V	
9.848	3.0	44.1	30.2	38.4	8.7	-33.1	0.0	0.0	58.1	44.2	74	54	-15.9	-9.8	V	
Rev. 10.15.08																
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									

7.3. WORST-CASE BELOW 1 GHz

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



HORIZONTAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	441.280	38.85	-6.76	32.09	46.00	-13.91	Peak
2	484.930	39.63	-5.24	34.39	46.00	-11.61	Peak
3	521.790	42.36	-4.32	38.04	46.00	-7.96	Peak
4	562.530	39.37	-3.59	35.78	46.00	-10.22	Peak
5	572.230	43.71	-3.38	40.33	46.00	-5.67	Peak
6	601.330	44.84	-2.80	42.04	46.00	-3.96	Peak

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

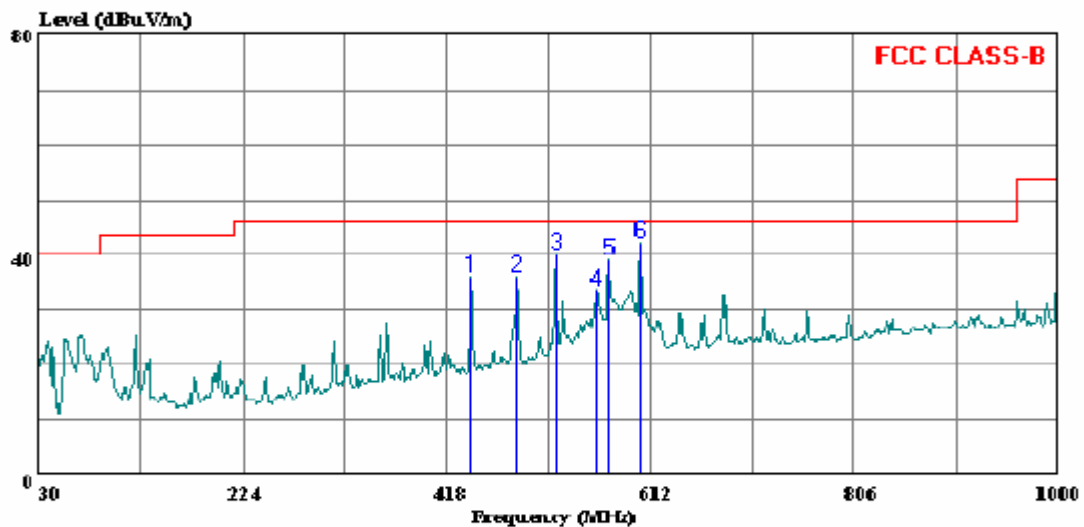
VERTICAL PLOT



Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 4 File#: 08u12243.EMI

Date: 11-13-2008 Time: 18:13:11



Trace: 3

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator:: Tom Chen
Project #: 08U12243
Company: Sky Connect
Model: RCM4400W
Configuration: EUT with DC power supply
Mode: TX
Target: FCC Class B

VERTICAL DATA

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	441.280	42.65	-6.76	35.89	46.00	-10.11	Peak
2	484.930	41.14	-5.24	35.90	46.00	-10.10	Peak
3	521.790	44.62	-4.32	40.30	46.00	-5.70	Peak
4	560.590	37.20	-3.64	33.56	46.00	-12.44	Peak
5	572.230	42.49	-3.38	39.11	46.00	-6.89	Peak
6	601.330	45.00	-2.80	42.20	46.00	-3.80	Peak

8. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§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/cm ²)	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/f ²)	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/f ²)	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/cm ²)	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.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> ^{1.2}
150 000–300 000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616 000 / <i>f</i> ^{1.2}

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, *f*, is in MHz.
2. A power density of 10 W/m² is equivalent to 1 mW/cm².
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

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

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm²

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm² is converted to units of W/m² by multiplying by a factor of 10.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0 \text{ mW/cm}^2$

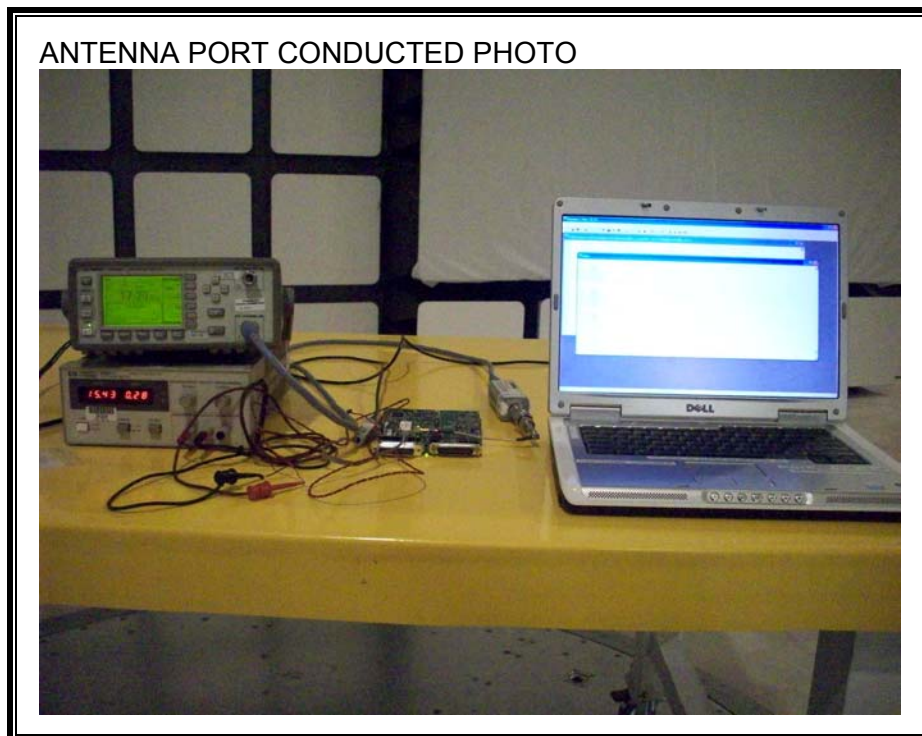
From IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10 \text{ W/m}^2$

RESULTS

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
WLAN	2.4 GHz	20.0	17.61	3.00	0.02	0.23

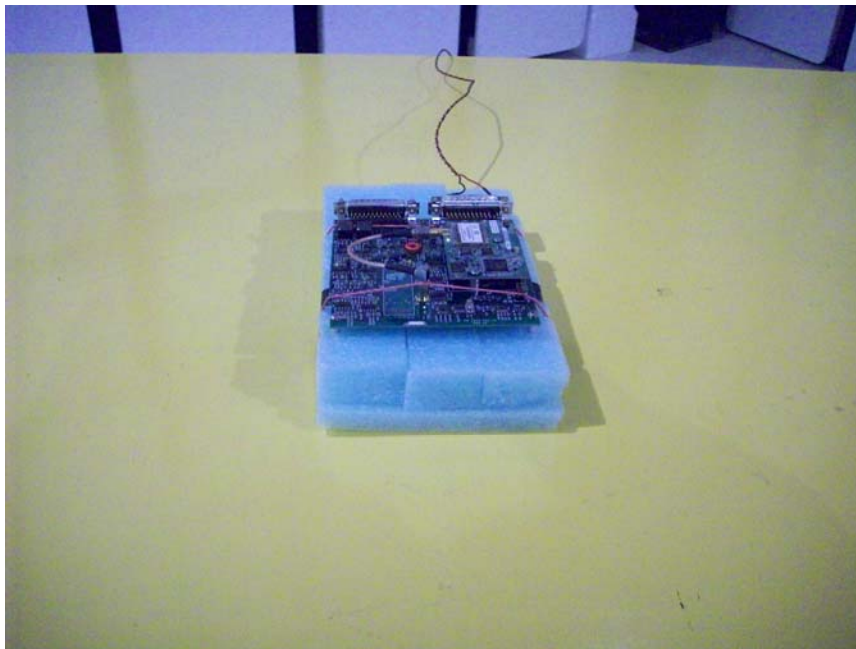
9. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



RADIATED RF MEASUREMENT SETUP FOR PORTABLE CONFIGURATION

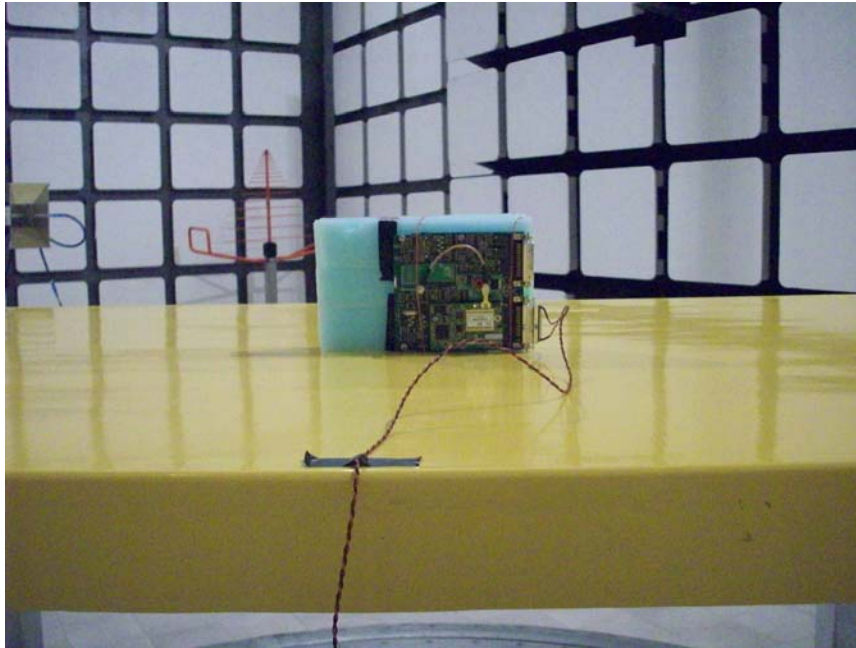
X-AXIS FRONT PHOTO



Y-AXIS FRONT PHOTO



Z-AXIS FRONT PHOTO



END OF REPORT