TIMCO ENGINEERING, Inc.

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FCC PART 15.247 TEST REPORT

AND IC RSS-210

DIGITAL SPREAD SPECTRUM

Applicant	SAGRAD, INC.
Address	4325 WOODLAND PARK AVE.
	SUITE #101
	WEST MELBOURNE FL 32904 USA
FCC ID	VRA-SG9011203
IC	7420A-SG9011203
Model Number	SPWF01S and SG901-1203
Product Description	WI FI MODULE
Date Sample Received	10/16/2012
Date Tested	10/17/2012
Tested By	Sushant Kadimdivan
Approved By	Mario de Aranzeta
Report Number	2726AUT12TestReport.doc
Test Results	☒ PASS ☐ FAIL

ACCREDITED

Testing Certificate # 0955-01

TABLE OF CONTENT

GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:
☒ fulfill the general approval requirements as identified in this test report
☐ not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

ACCREDITED

Testing Certificate # 0955-01

I attest that the necessary measurements were made, under my supervision, at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, Fl 32669

Authorized Signatory Name:

Mario de Aranzeta C.E.T.
Compliance Engineer/ Lab. Supervisor

Date: November 8, 2012

GENERAL INFORMATION

DUT Specification

Applicable Standard	Part 15.247		
DUT Description	WI FI MODULE		
FCC ID	VRA-SG9011203		
IC	7420A-SG9011203		
Models	SPWF01S, SG901-1203		
Operating Frequency	TX: 2412 MHz – 2462 MHz	802.11 b, g, n	
Number of channels	CH 1 to 11		
DUT Power Source	☐ 110–120Vac/50– 60Hz		
	☒ DC Power		
	☐ Battery Operated Exclusively		
Test Item	☐ Prototype	☒ Pre-Production	☐ Production
Type of Equipment	☒ Fixed	☐ Mobile	☐ Portable
Antenna Connector	UFL		
Antenna	Antenna 1: SG901-1066 Integrated Wi-Fi Antenna		
	Antenna 2: Antenova RUFA 2.4 GHz SMD Antenna		
Test Facility	Timco Engineering Inc. located at 849 NW State Road 45 Newberry, FL 32669 USA.		
Test Conditions	Temperature: 26ºC Relative humidity: 50%		
Test Exercise	The DUT was placed in continuous transmit mode of operation.		

Test Supporting Equipment

Supporting Device	Manufacturer	Model / FCC ID	Serial Number
Evaluation board	Freescale	IMX51	
Evaluation platform	Sagrad	SG923-0011	

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
3-Meter Semi-Anechoic Chamber	Panashield	N/A	N/A	3/12/12	3/12/14
AC Voltmeter	HP	400FL	2213A14499	CAL 6/12/11	6/12/13
Frequency Counter	HP	5385A	2730A03025	CAL 8/17/11	8/17/13
Hygro-Thermometer	Extech	445703	0602	CAL 6/15/11	6/15/13
Modulation Analyzer	HP	8901A	3435A06868	CAL 7/18/11	7/18/13
Digital Multimeter	Fluke	FLUKE-77	35053830	CAL 9/9/11	9/9/13
Analyzer Tan Tower Preamplifier	HP	8449B-H02	3008A00372	CAL 10/28/11	10/28/13
Analyzer Tan Tower Quasi-Peak Adapter	HP	85650A	3303A01690	CAL 10/28/11	10/28/13
Analyzer Tan Tower RF Preselector	HP	85685A	3221A01400	CAL 10/28/11	10/28/13
Analyzer Tan Tower Spectrum Analyzer	HP	8566B Opt 462	3138A07786 3144A20661	CAL 10/28/11	10/28/13
Antenna	ETS	3117	41534	10/5/2012	10/5/2014
Antenna	Electro metrics	LPA-25	1122	5/04/2011	5/04/2013
Antenna	Electro metrics	BIA-25	1171	6/13/2012	6/13/2014
Spectrum Analyzer	R&S	ESIB40	100274	3/16/2012	3/16/2014

TEST PROCEDURES

Radiation Interference: ANSI C63.4-2003 using a spectrum analyzer, a preselector, a quasi-peak adapter, and an appropriate antenna. The analyzer was calibrated in dB above a microvolt at the output of the antenna. The resolution bandwidth was 100 kHz with an appropriate sweep speed and the video bandwidth was 300 kHz up to 1 GHz and 1 MHz with a video BW of 3 MHz above 1 GHz. When an emission was found, the table was rotated to produce the maximum signal strength. The antenna was placed in both the horizontal and vertical planes and the worse case emissions were reported. The spectrum was searched to at least the tenth (10) harmonic of the fundamental.

Formula Of Conversion Factors: The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBμV) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

Example:			
Freq (MHz)	Meter Reading	+ ACF	+ CL = FS
33	20 dBμV	+ 10.36 dB	+ 0.5 = 30.86 dBμV/m @ 3m

Power Line Conducted Interference: The procedure used was ANSI C63.4-2003 using a 50uH LISN. Both lines were observed. The bandwidth of the spectrum analyzer was 10 kHz with an appropriate sweep speed. The spectrum was scanned from 0.15 to 30 MHz.

Occupied Bandwidth: A small sample of the transmitter output was fed into the spectrum analyzer and the attached plot was printed. The vertical scale is set to -10 dBm per division.

Bandwidth 6.0dB: The measurements were made with the spectrum analyzer's resolution bandwidth (RBW)=1 MHz and the video bandwidth (VBW) =3 MHz and the span set as shown on plot.

Power Output: The RF power output was measured at the antenna feed point using a peak power meter.

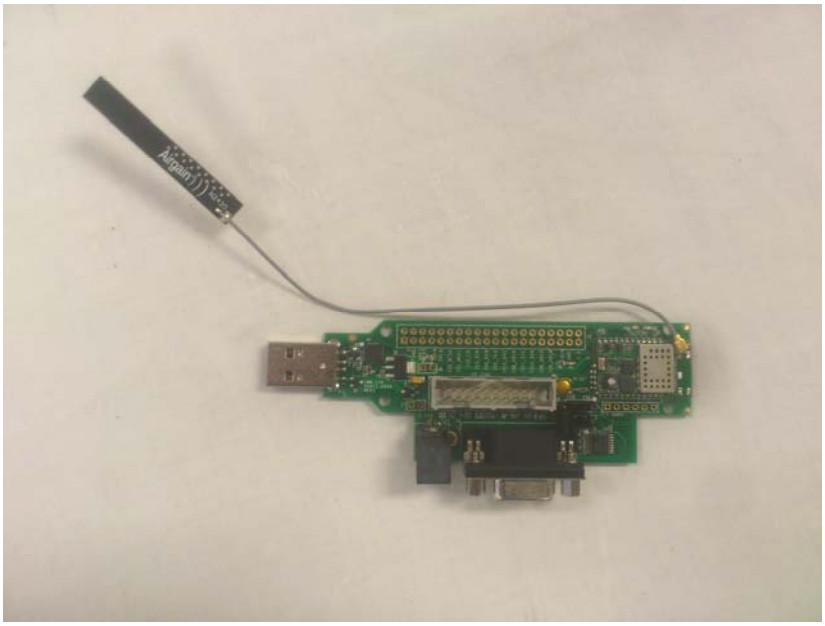
Antenna Conducted Emissions: The RBW=100 kHz, VBW=300 kHz and the span set to 10 MHz and the spectrum was scanned from 30 MHz to the 10th Harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 MHz and the VBW = 3 MHz and the span to 50 MHz.

ANSI C63.4-2003 10.1 Measurement Procedures: The DUT was placed on a table 80 cm high and with dimensions of 1m by 1.5m. The DUT was placed in the center of the table (1.5m side). The table used for radiated measurements is capable of continuous rotation.

When an emission was found, the table was rotated to produce the maximum signal strength. At this point, the antenna was raised and lowered from 1m to 4m. The antenna was placed in both the horizontal and vertical planes. Emissions attenuated more than 20 dB below the permissible value are not reported.

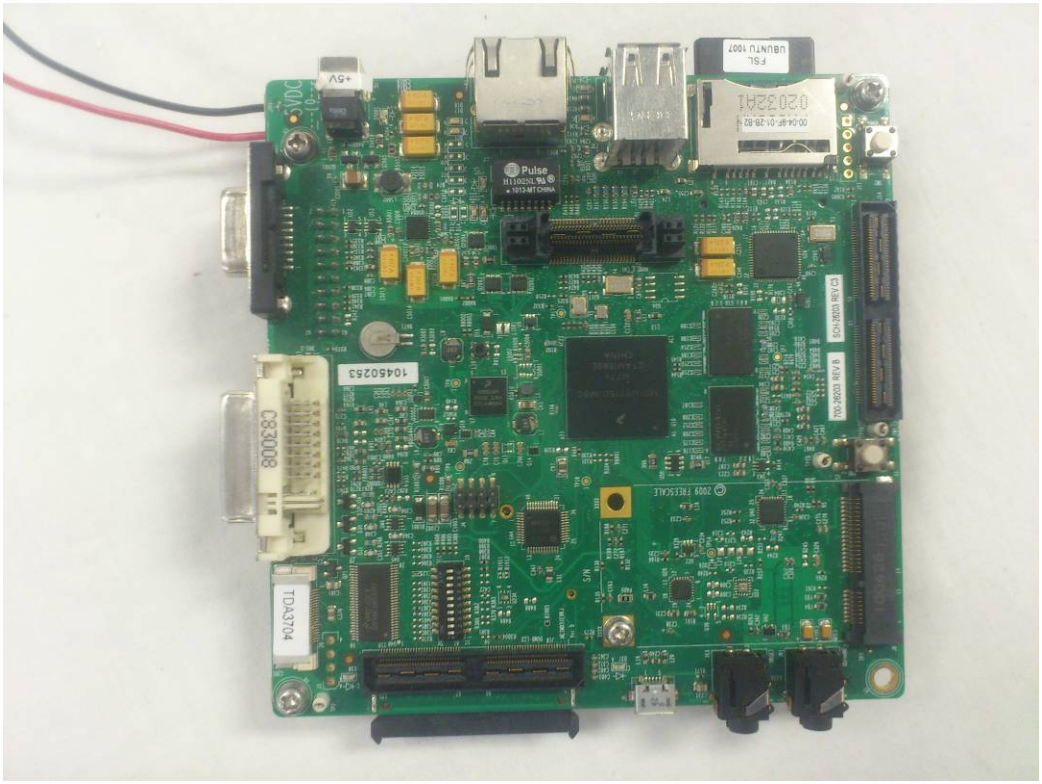
PRODUCT PHOTOS

Product on carrier board with Antenna 1



Product on carrier board with Antenna 2

Supporting Test Equipment



RADIATION INTERFERENCE

Rules Part No.: 15.247, 15.209

Requirements:

Frequency	Limits
Part 15.209	
9 to 490 kHz	2400/F (kHz) µV/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) µV/m @ 30 meters
1705 kHz to 30 MHz	29.54 dBµV/m @ 30 meters
30 – 88	40.0 dBµV/m @ 3 meters
80 – 216	43.5 dBµV/m @ 3 meters
216 – 960	46.0 dBµV/m @ 3 meters
Above 960	54.0 dBµV/m @ 3 meters
Part 15.247	
Fundamental 902 – 928 MHz	127.37 dBµV/m @ 3 meters
Fundamental 2.4 – 2.4835 MHz	127.37 dBµV/m @ 3 meters
Harmonics	54.0 dBµV/m @ 3 meters

Any emissions that fall in the restricted bands (15.205) must be less than or equal to 54 dBµV/m. Spurious emissions not in a restricted band must be 20 dBc. Emissions were measured from the lowest frequency generated or 9 kHz through to the 10th harmonic.

Radiated emissions data was recorded for 802.11 b, 802.11 g modes. and 802.11 n mode was investigated and was found to be identical to 802.11 g.

Test Data: All values are peak unless noted.
Items mark with an * designate a frequency in a restricted band.

Limits above 1000 MHz for Restricted Band: Peak Detector = 74 dBµV/m
Avg Detector = 54 dBµV/m

The limits for 802.11 g mode have been readjusted to Avg = 60 dBµV/m and Peak = 80 dBµV/m to include the 6 dB margin gained by 50 % duty cycle correction.

Both vertical and horizontal antenna polarities were investigated and the worst case was vertical.

802.11 b- Antenna 1

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Det.	Margin dB
2,412.0	2,412.00	74.7	V	3.19	32.42	110.31	Pk.	17
2,412.0	7,235.00	10.3	V	5.74	36.15	52.19	Pk.	38.11
2,412.0	9,647.00	9.0	V	6.79	36.78	52.57	Pk.	37.73
2,412.0	16,884.00	10.5	V	10.23	42.00	62.73	Pk.	27.57
2,412.0	7,235.00	1.8	V	5.74	36.15	43.69	Avg.	46.61
2,412.0	16,884.00	-2.9	V	10.23	42.00	49.33	Avg.	40.97
2,412.0	*4,824.00	15.2	V	4.91	34.39	54.50	Pk.	19.5
2,412.0	*4,824.00	11.5	V	4.91	34.39	50.80	Avg.	3.2
2,412.0	*12,059.00	7.4	V	7.84	38.85	54.09	Pk.	20.0
2,412.0	*14,471.00	10.3	V	9.09	39.75	59.14	Pk.	14.9
2,412.0	*14,471.00	-2.8	V	9.09	39.75	46.04	Avg.	7
2,437.0	2,437.00	77.2	V	3.21	32.47	112.88	Pk.	14.50
2,437.0	60.30	25.4	V	0.53	7.39	33.32	Pk.	59.48
2,437.0	84.40	15.0	H	0.61	9.26	24.87	Pk.	67.93
2,437.0	144.40	15.3	V	0.69	15.63	31.62	Pk.	61.18
2,437.0	180.50	12.9	H	0.82	13.75	27.47	Pk.	65.33
2,437.0	204.00	29.9	H	0.91	12.22	43.03	Pk.	49.77
2,437.0	440.80	19.2	V	1.24	17.59	38.03	Pk.	54.77
2,437.0	662.40	12.3	V	1.66	20.89	34.85	Pk.	57.95
2,437.0	729.60	12.3	H	1.76	21.71	35.77	Pk.	57.03
2,437.0	9,748.00	8.5	V	6.82	36.90	52.22	Pk.	40.58
2,437.0	14,622.00	-2.0	V	9.15	39.92	47.07	Avg.	45.73
2,437.0	14,622.00	11.2	V	9.15	39.92	60.27	Pk.	32.53
2,437.0	17,059.00	9.6	V	10.32	42.00	61.92	Pk.	30.88
2,437.0	17,059.00	-3.6	V	10.32	42.00	48.72	Avg.	44.08
2,437.0	*120.30	25.2	H	0.67	10.56	36.43	Pk.	7.07
2,437.0	*120.30	27.2	V	0.67	10.56	38.43	Pk.	5.1
2,437.0	*240.00	27.1	H	0.98	12.20	40.28	Pk.	5.8
2,437.0	*249.60	29.0	V	1.00	12.87	42.87	Pk.	3.13
2,437.0	*275.20	27.1	H	1.05	14.66	42.81	Pk.	3.19
2,437.0	*4,874.00	14.0	V	4.94	34.42	53.36	Pk.	20.64
2,437.0	*7,310.00	12.8	V	5.79	36.14	54.73	Pk.	19.27
2,437.0	*12,185.00	7.0	V	7.93	38.95	53.88	Pk.	20.12
2,437.0	*4,874.00	10.8	V	4.94	34.42	50.16	Avg.	3.84
2,437.0	*7,310.00	2.9	V	5.79	36.14	44.83	Avg.	9.17

802.11b continued

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Det.	Margin dB
2,462.0	2,462.00	76.6	V	3.22	32.52	112.34	Pk.	15
2,462.0	9,847.00	8.7	V	6.85	37.02	52.57	Pk.	32.56
2,462.0	14,772.00	10.5	V	9.21	40.07	59.78	Pk.	52.57
2,462.0	9,847.00	-4.1	V	6.85	37.02	39.77	Avg.	45.76
2,462.0	14,772.00	-2.7	V	9.21	40.07	46.58	Avg.	43.57
2,462.0	17,234.00	-3.6	V	10.37	42.00	48.77	Avg.	30.27
2,462.0	17,234.00	9.7	V	10.37	42.00	62.07	Pk.	92.34
2,462.0	*4,923.00	11.2	V	4.96	34.45	50.61	Pk.	23.4
2,462.0	*4,923.00	14.9	V	4.96	34.45	54.31	Pk.	19.7
2,462.0	*7,386.00	2.1	V	5.83	36.12	44.05	Avg.	10
2,462.0	*7,386.00	12.0	V	5.83	36.12	53.95	Pk.	20.1
2,462.0	*12,309.00	-5.0	V	8.02	39.05	42.07	Avg.	12
2,462.0	*12,309.00	8.0	V	8.02	39.05	55.07	Pk.	19

802.11 b- Antenna #2

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0	2,412.00	75.3	V	3.19	32.42	110.91	Pk.	16.4
2,412.0	7,236.00	10.4	V	5.74	36.15	52.29	Pk.	38.61
2,412.0	9,645.00	10.9	V	6.79	36.77	54.46	Pk.	36.44
2,412.0	16,884.00	9.8	V	10.23	42.00	62.03	Pk.	28.87
2,412.0	16,884.00	-2.7	V	10.23	42.00	49.53	Avg.	41.37
2,412.0	*4,824.00	13.0	V	4.91	34.39	52.30	Pk.	21.7
2,412.0	*12,062.00	6.6	V	7.84	38.85	53.29	Pk.	20.71
2,412.0	*14,472.00	-2.9	V	9.09	39.75	45.94	Avg.	8.1
2,412.0	*14,472.00	10.2	V	9.09	39.75	59.04	Pk.	14.96
2,437.0	2,437.00	77.0	V	3.21	32.47	112.68	Pk.	14.7
2,437.0	9,748.00	8.4	V	6.82	36.90	52.12	Pk.	40.48
2,437.0	14,633.00	-2.3	V	9.15	39.93	46.78	Avg.	45.82
2,437.0	14,633.00	9.6	V	9.15	39.93	58.68	Pk.	33.92
2,437.0	17,009.00	-2.6	V	10.30	42.00	49.70	Avg.	42.9
2,437.0	17,009.00	9.5	V	10.30	42.00	61.80	Pk.	30.8
2,437.0	*4,874.00	13.1	V	4.94	34.42	52.46	Pk.	21.54
2,437.0	*7,310.00	13.4	V	5.79	36.14	55.33	Pk.	18.67
2,437.0	*12,166.00	7.1	V	7.92	38.93	53.95	Pk.	20.05
2,462.0	2,462.00	73.2	V	3.22	32.52	108.94	Pk.	18.4
2,462.0	*4,924.00	12.7	V	4.96	34.45	52.11	Pk.	21.89
2,462.0	*7,386.00	11.0	V	5.83	36.12	52.95	Pk.	21.05
2,462.0	9,850.00	7.7	V	6.86	37.02	51.58	Pk.	37.4
2,462.0	*12,311.00	6.8	V	8.02	39.05	53.87	Pk.	20.13
2,462.0	14,772.00	9.8	V	9.21	40.07	59.08	Pk.	29.82
2,462.0	17,237.00	9.3	V	10.37	42.00	61.67	Pk.	27.23
2,462.0	14,772.00	-2.5	V	9.21	40.07	46.78	Avg.	42.12
2,462.0	17,237.00	-9.1	V	10.37	42.00	43.27	Avg.	45.63

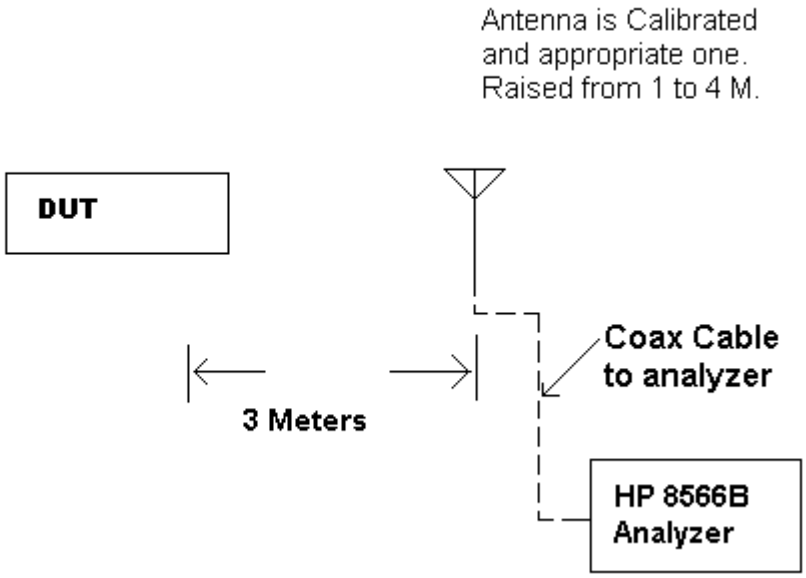
802.11 g- Antenna 1

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0	2,412.00	73.5	V	3.19	32.42	109.11	Pk.	18.2
2,412.0	*4,808.00	9.3	V	4.90	34.38	48.58	Pk.	31.42
2,412.0	7,236.00	8.1	V	5.74	36.15	49.99	Pk.	39.11
2,412.0	9,612.00	8.5	V	6.78	36.73	52.01	Pk.	37.09
2,412.0	*12,032.00	6.1	V	7.82	38.83	52.75	Pk.	27.25
2,412.0	*14,496.00	-2.7	V	9.10	39.79	46.19	Avg.	13.81
2,412.0	*14,496.00	9.8	V	9.10	39.79	58.69	Pk.	58.69
2,412.0	16,907.00	-2.8	V	10.24	42.00	49.44	Avg.	39.66
2,412.0	16,907.00	9.7	V	10.24	42.00	61.94	Pk.	27.16
2,437.0	2,437.00	78.1	V	3.21	32.47	113.78	Pk.	13.6
2,437.0	*4,874.00	9.3	V	4.94	34.42	48.66	Pk.	31.34
2,437.0	*7,313.00	10.1	V	5.79	36.14	52.03	Pk.	27.97
2,437.0	9,745.00	7.2	V	6.82	36.89	50.91	Pk.	42.80
2,437.0	*12,183.00	5.9	V	7.93	38.95	52.78	Pk.	27.22
2,437.0	14,622.00	9.7	V	9.15	39.92	58.77	Pk.	34.93
2,437.0	14,622.00	-3.0	V	9.15	39.92	46.07	Avg.	47.63
2,437.0	17,054.00	9.7	V	10.32	42.00	62.02	Pk.	31.68
2,437.0	17,064.00	-3.2	V	10.32	42.00	49.12	Avg.	44.58
2,462.0	2,462.00	76.0	V	3.22	32.52	111.74	Pk.	15.6
2,462.0	*4,926.00	9.3	V	4.96	34.46	48.72	Pk.	31.28
2,462.0	7,382.00	10.2	V	5.83	36.12	52.15	Pk.	39.6
2,462.0	9,846.00	8.6	V	6.85	37.02	52.47	Pk.	39.3
2,462.0	*12,302.00	7.7	V	8.01	39.04	54.75	Pk.	25.25
2,462.0	14,768.00	9.8	V	9.21	40.07	59.08	Pk.	32.7
2,462.0	17,231.00	10.2	V	10.37	42.00	62.57	Pk.	30.2
2,462.0	*12,302.00	-5.8	V	8.01	39.04	41.25	Avg.	18.8
2,462.0	14,773.00	10.3	V	9.21	40.07	59.58	Pk.	32.12
2,462.0	14,779.00	-2.5	V	9.21	40.08	46.79	Avg.	44.91
2,462.0	17,231.00	-3.2	V	10.37	42.00	49.17	Avg.	42.53

802.11 g- Antenna 2

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0	2,412.00	73.2	V	3.19	32.42	108.81	Pk.	18.5
2,412.0	*4,824.00	9.4	V	4.91	34.39	48.70	Pk.	31.3
2,412.0	7,182.00	9.0	V	5.71	36.16	50.87	Pk.	38
2,412.0	9,678.00	7.9	V	6.80	36.81	51.51	Pk.	37.3
2,412.0	*12,046.00	6.8	V	7.83	38.84	53.47	Pk.	26.53
2,412.0	14,466.00	-2.7	V	9.09	39.74	46.13	Avg	35.67
2,412.0	14,466.00	9.5	V	9.09	39.74	58.33	Pk.	23.47
2,412.0	16,828.00	-2.4	V	10.20	42.00	49.80	Avg.	32
2,412.0	16,828.00	10.1	V	10.20	42.00	62.30	Pk.	19.5
2,437.0	2,437.00	79.3	V	3.21	32.47	114.98	Pk.	12.4
2,437.0	*4,869.00	11.1	V	4.93	34.42	50.45	Pk.	29.55
2,437.0	*7,312.00	10.3	V	5.79	36.14	52.23	Pk.	27.77
2,437.0	*9,726.00	7.7	V	6.82	36.87	51.39	Pk.	28.61
2,437.0	*12,210.00	7.3	V	7.95	38.97	54.22	Pk.	25.78
2,437.0	14,583.00	-2.7	V	9.13	39.88	46.31	Avg.	48.59
2,437.0	14,583.00	9.2	V	9.13	39.88	58.21	Pk.	36.69
2,437.0	17,107.00	-2.6	V	10.33	42.00	49.73	Avg.	45.17
2,437.0	17,107.00	10.5	V	10.33	42.00	62.83	Pk.	32.07
2,462.0	2,462.00	74.5	V	3.22	32.52	110.24	Pk.	17.1
2,462.0	*4,896.00	9.6	V	4.95	34.44	48.99	Pk.	31.01
2,462.0	*7,387.00	10.3	V	5.83	36.12	52.25	Pk.	27.75
2,462.0	9,847.00	8.3	V	6.85	37.02	52.17	Pk.	38.1
2,462.0	*12,313.00	6.7	V	8.02	39.05	53.77	Pk.	26.23
2,462.0	14,767.00	-2.4	V	9.21	40.07	46.88	Avg.	43.32
2,462.0	14,767.00	10.2	V	9.21	40.07	59.48	Pk.	30.72
2,462.0	17,238.00	-3.0	V	10.37	42.00	49.37	Avg.	40.83
2,462.0	17,238.00	9.7	V	10.37	42.00	62.07	Pk.	28.13

Method of Measuring Radiated Spurious Emissions



METHOD OF MEASUREMENT: The procedure used was ANSI standard C63.4-2003 & the FCC/OET Guidance on Measurements for Spread Spectrum Systems – KDB 558074 dated March 23, 2005.

POWER LINE CONDUCTED INTERFERENCE

Rules Part No.: Part 15.207

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBµV)	Average Limits (dBµV)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Decrease with logarithm of frequency		

Test Data: The following plots represent the emissions read for power line conducted. Both lines were observed.

NOT APPLICABLE. PRODUCT IS POWERED BY DC ONLY.

OCCUPIED BANDWIDTH

Rules Part No.: 15.247(a)(2

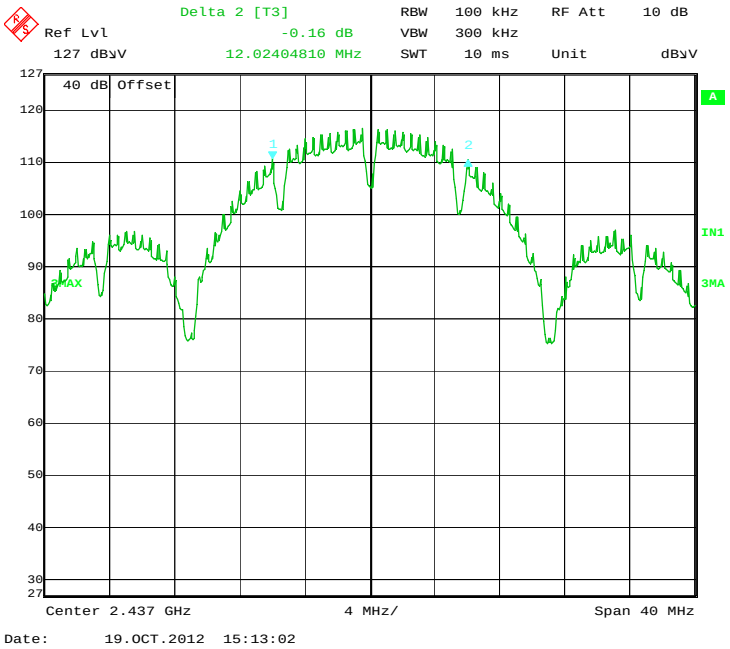
Requirements: The 6 dB bandwidth must be greater than 500 kHz.

Test Data:

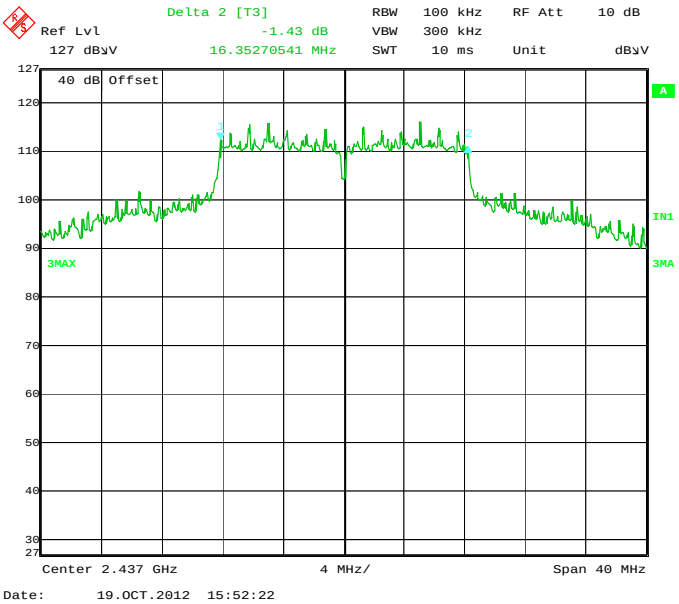
6 and 20 dB bandwidth plots

Three places in the band were measured and the worst case reported.

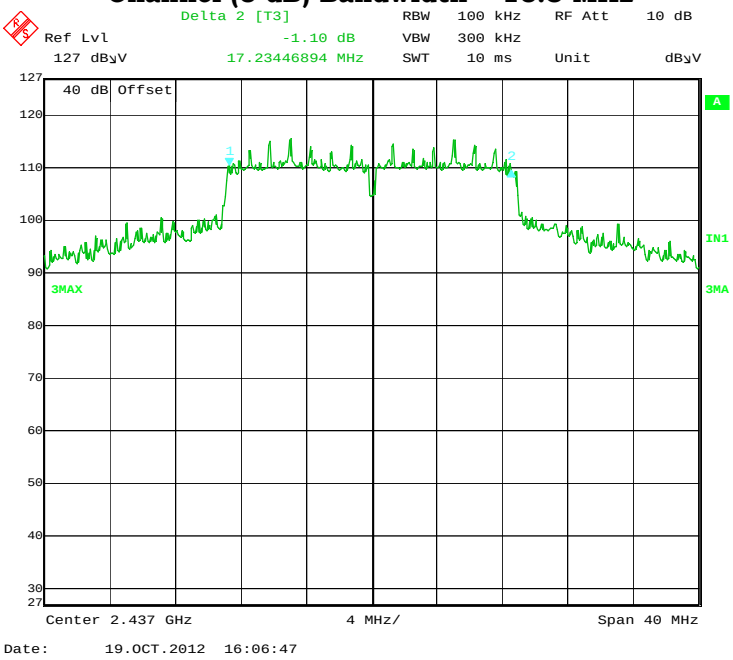
The bandwidths for 802.11g and 802.11n mode was investigated and was found to be identical.



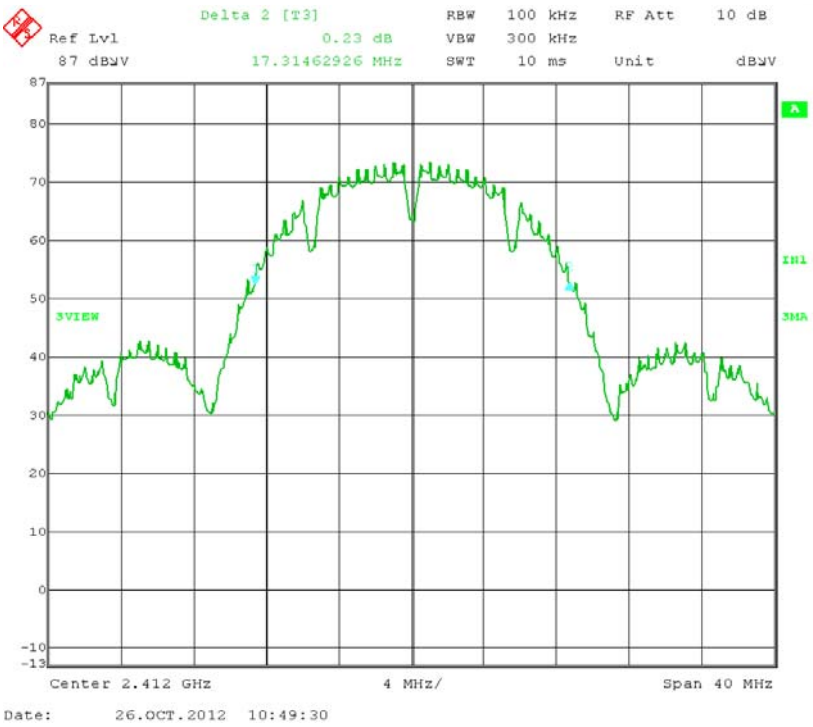
802.11b
Channel 6, conducted
Channel (6 dB) Bandwidth = 12 MHz



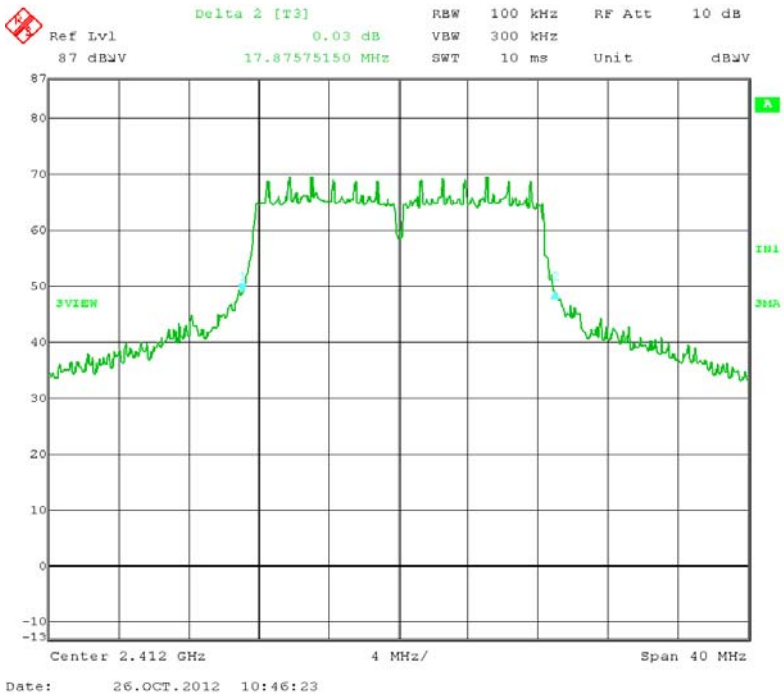
802.11g
Channel 6, conducted
Channel (6 dB) Bandwidth = 16.3 MHz



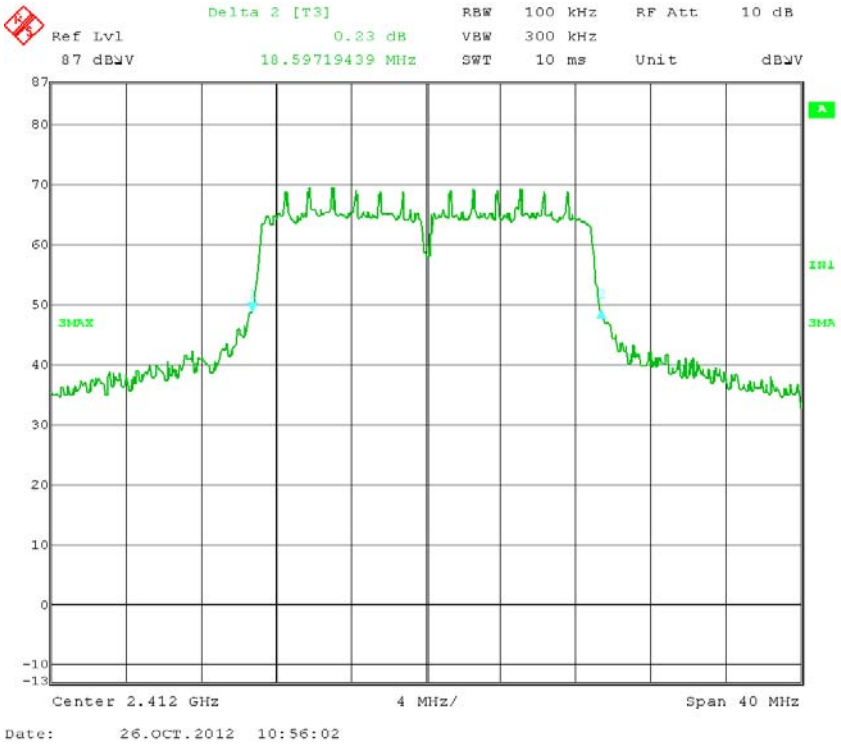
802.11n
Channel 6, conducted
Channel (6 dB) Bandwidth = 17.3 MHz



802.11b , 20 dB Plot –
20 dB Bandwidth = 17.3 MHz



802.11g, 20 dB Plot –
20 dB Bandwidth = 17.4 MHz



802.11n, 20 dB Plot –
20 dB Bandwidth = 18.5 MHz

MAXIMUM CONDUCTED OUTPUT POWER

Rules Part #:15.247(b) 1 Watt conducted, 4W ERP

Procedure: kdb 558074 DTS Measurement guidance

Data:

Firmware settings:

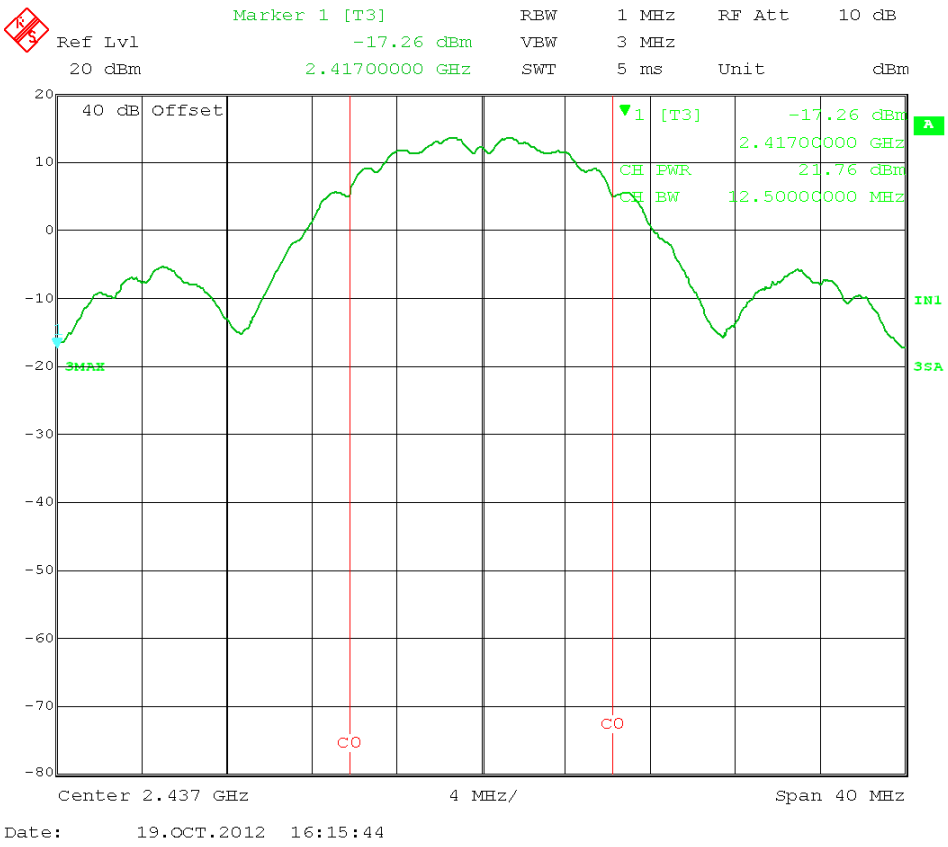
Ch.	b dBm	g dBm	n dBm
1	18	15	15
2	20	20	20
3	20	20	20
4	20	20	20
5	20	20	20
6	20	20	20
7	20	20	20
8	20	20	20
9	20	20	20
10	20	20	20
11	14.5	13	13

MAXIMUM PEAK CONDUCTED OUTPUT POWER

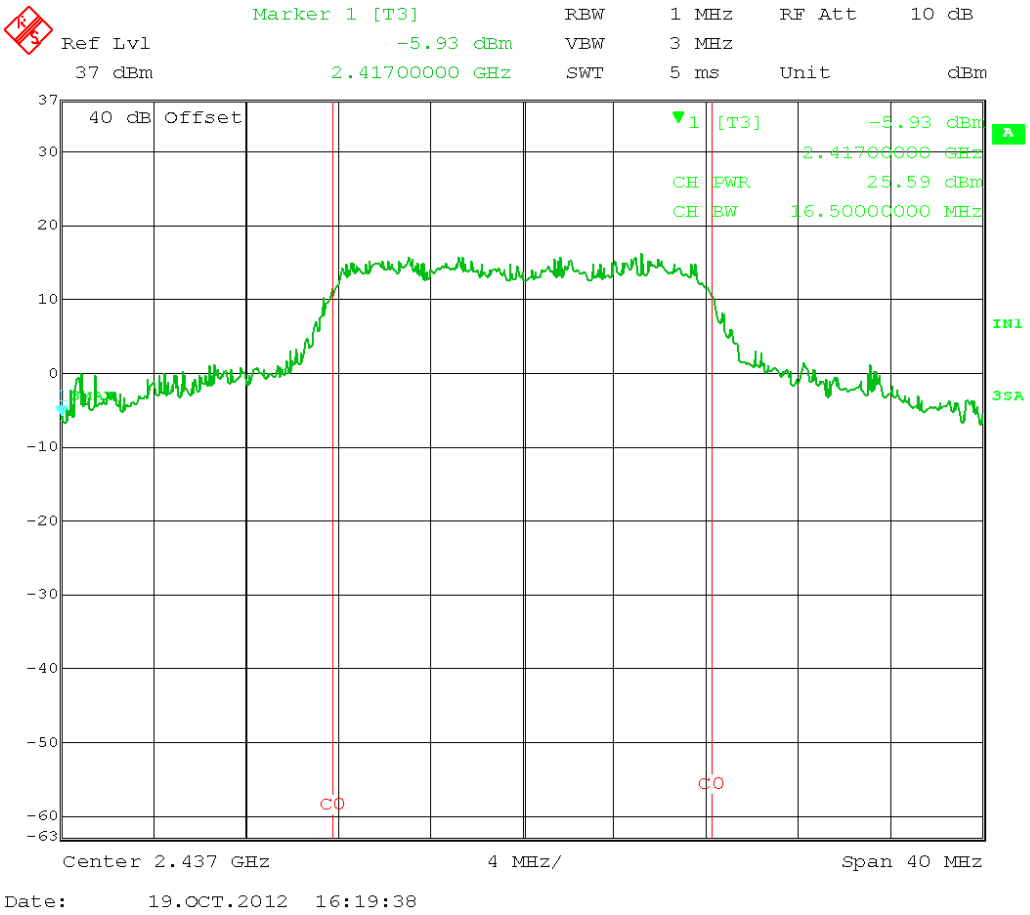
Rules Part #: 15.247(b) 1 Watt conducted, 4W ERP
kdb 558074 DTS Measurement guidance (8.1)

Three places in the band were measured and the worst case reported.

Test Results:



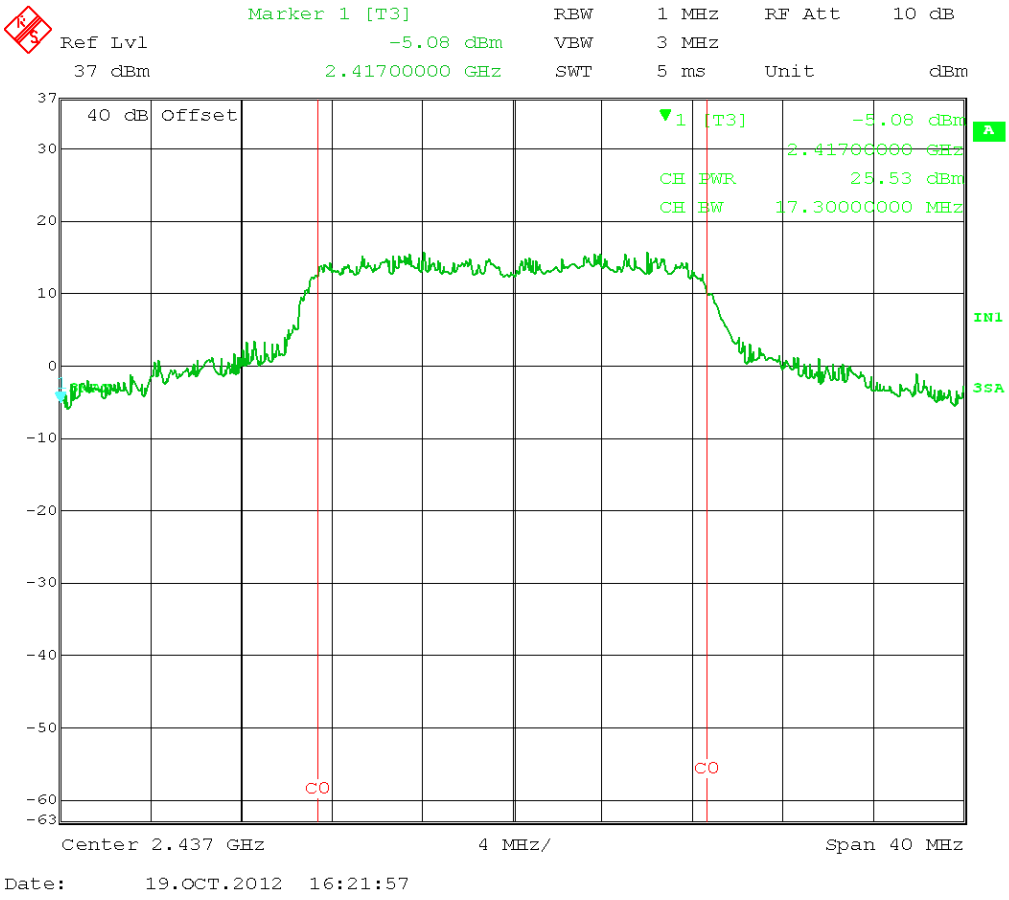
802.11 b
Channel 6, Conducted
Maximum Peak Conducted Power = 21.76 dBm (0.14 W)



802.11 g

Channel 6, Conducted

Maximum Peak Conducted Power = 25.59 dBm (0.36 W)

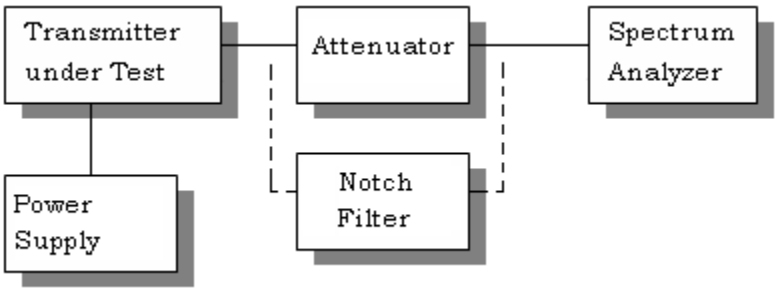


802.11 n
Channel 6, Conducted
Maximum Peak Conducted Power = 25.53 dBm (0.36 W)

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Requirements: Emissions must be at least 20dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW.

15.247(c) Method of Measuring RF Conducted Spurious Emissions



Test Data:

CONDUCTED:
802.11 b

Freq MHz	dBc
2412	
4824	72.6
7236	65.3
9648	83.9
12060	98.4
14472	74.4
16884	106.4
19296	103.4
21708	112.9
24120	113.1

Freq MHz	dBc
2437	
4874	78.8
7311	76.2
9748	88.3
12185	86.3
14622	72
17059	95.1
19496	100.5
21933	116.1
24370	116.1

Freq MHz	dBc
2462	
4924	77.2
7386	79.1
9848	92.2
12310	84.8
14772	106.1
17234	108
19696	113.2
22158	113.9
24620	113.8

802.11 g

Freq MHz	dBc
2412	
4824	85.29
7236	70.19
9648	100.29
12060	97.59
14472	88.29
16884	106.59
19296	110.39
21708	109.19
24120	109.2

Freq MHz	dBc
2437	
4874	84
7311	78.6
9748	97.8
12185	91
14622	82.9
17059	97.1
19496	111.9
21933	117
24370	117.1

Freq MHz	dBc
2462	
4924	82.6
7386	76.2
9848	99.6
12310	84.7
14772	97
17234	107.4
19696	112.1
22158	113.2
24620	113.1

802.11 n

Freq MHz	dBc
2412	
4824	83.5
7236	67.6
9648	100.3
12060	95.7
14472	86
16884	104.9
19296	106.8
21708	106.7
24120	107.1

Freq MHz	dBc
2437	
4874	78.5
7311	74
9748	93.3
12185	87.1
14622	76.5
17059	95.5
19496	109.5
21933	113.1
24370	113.0

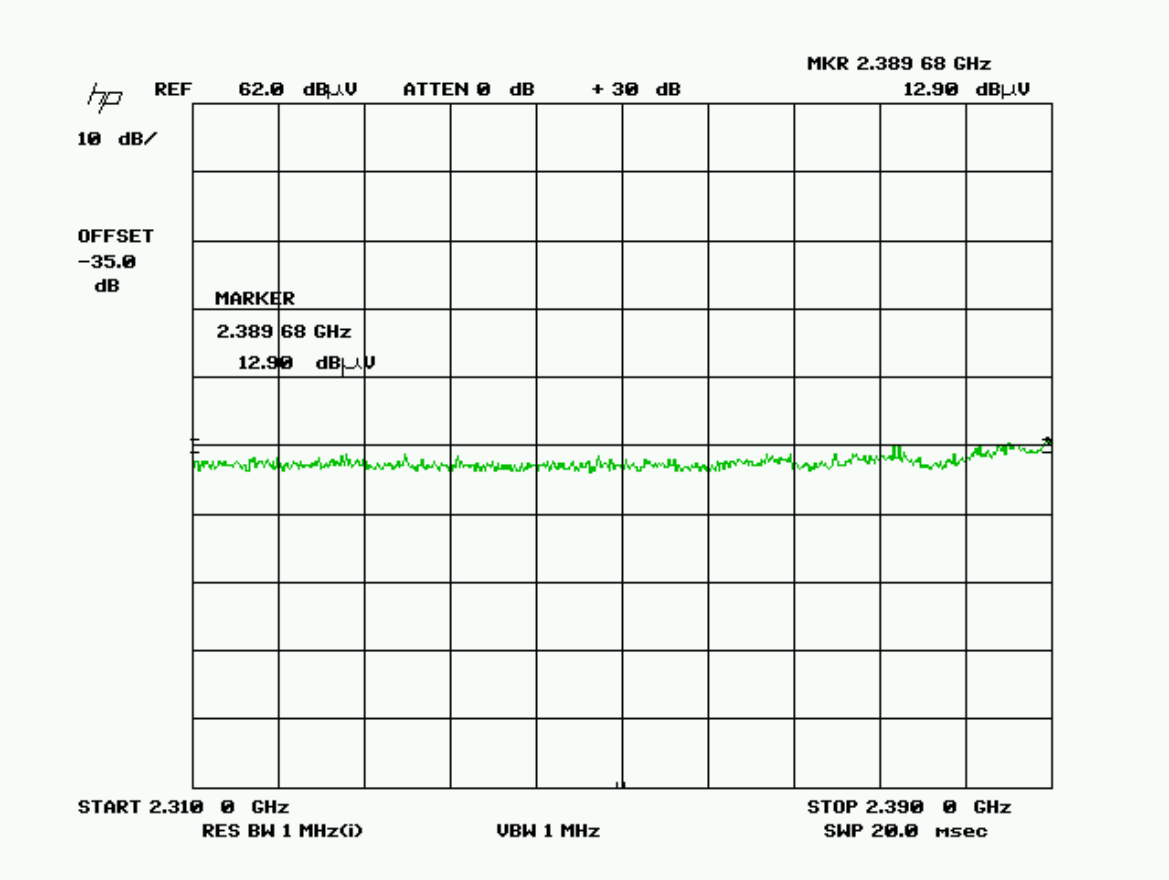
Freq MHz	dBc
2462	
4924	77.1
7386	73.2
9848	93.8
12310	77.8
14772	93.2
17234	105.8
19696	108.3
22158	109.1
24620	109.3

RADIATED SPURIOUS EMISSIONS INTO ADJACENT RESTRICTED BAND

Requirements: Emissions that fall in the restricted bands (15.205). These emissions must be less than or equal to 500 µV/m (54 dBµV/m).

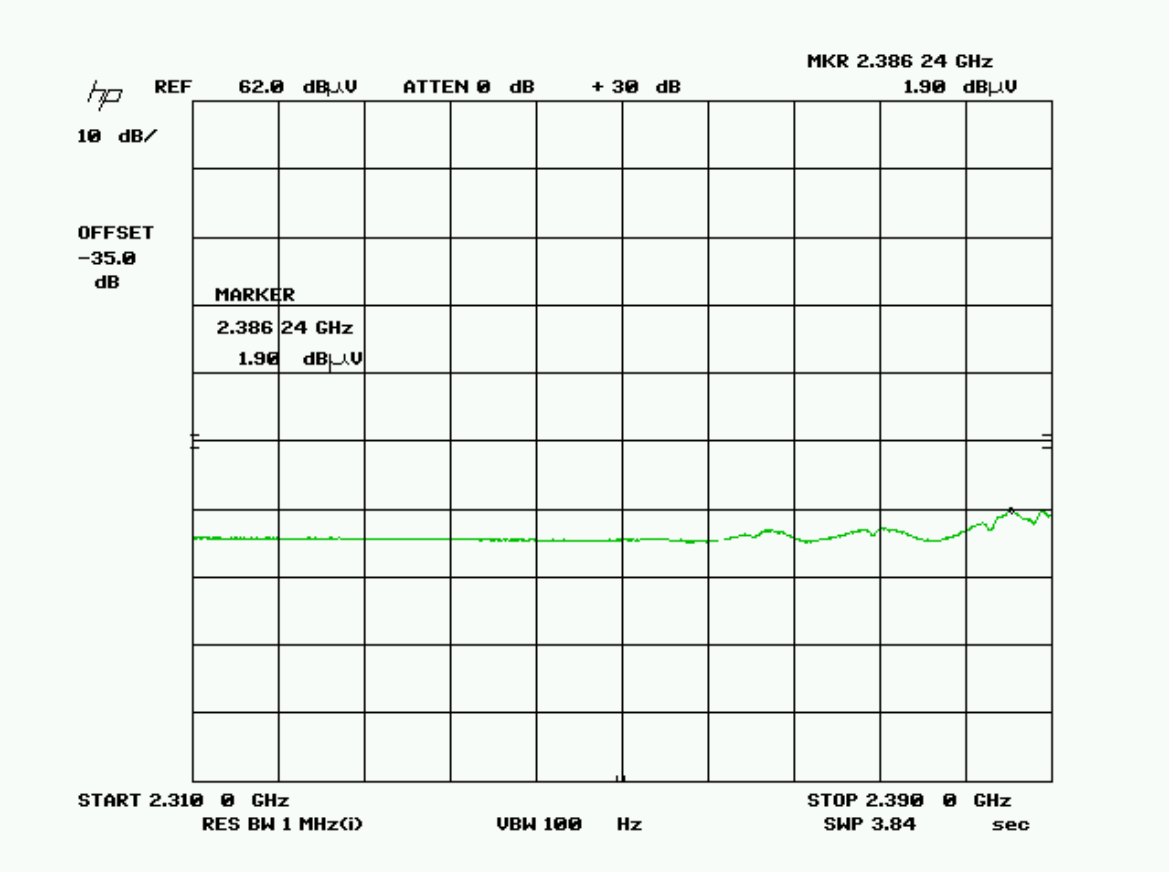
Test Procedure: An in band field strength measurement of the fundamental Emission using the RBW and detector function required by C63.4-2000 and FCC Rules. The procedure was repeated with an average detector and a plot made. The calculated field strength in the adjacent restricted band is presented below.

Horizontal and vertical polarizations were checked and worst case reported.



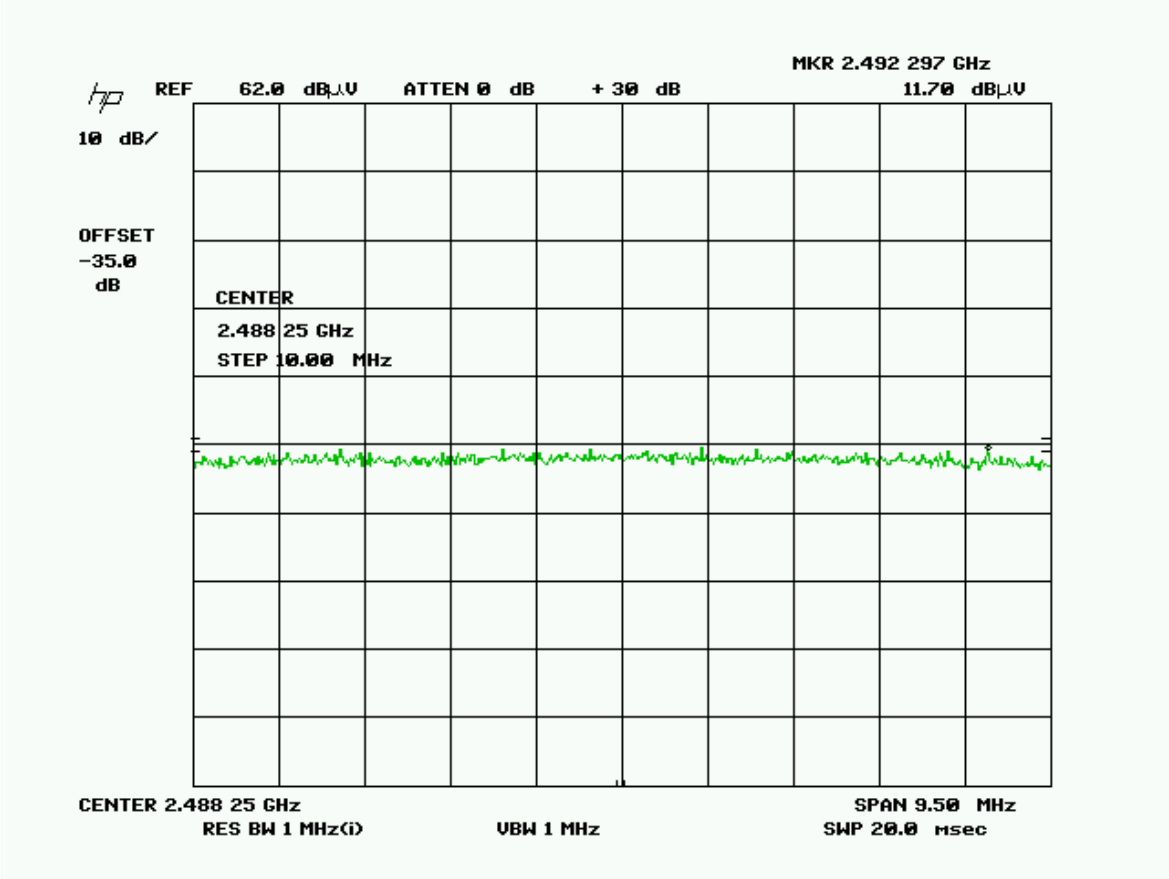
802.11 b, ch 1, 2412 -Lower restricted band peak Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0*	2,389.00	28.9	V	3.17	32.38	64.45	Pk.	9.6



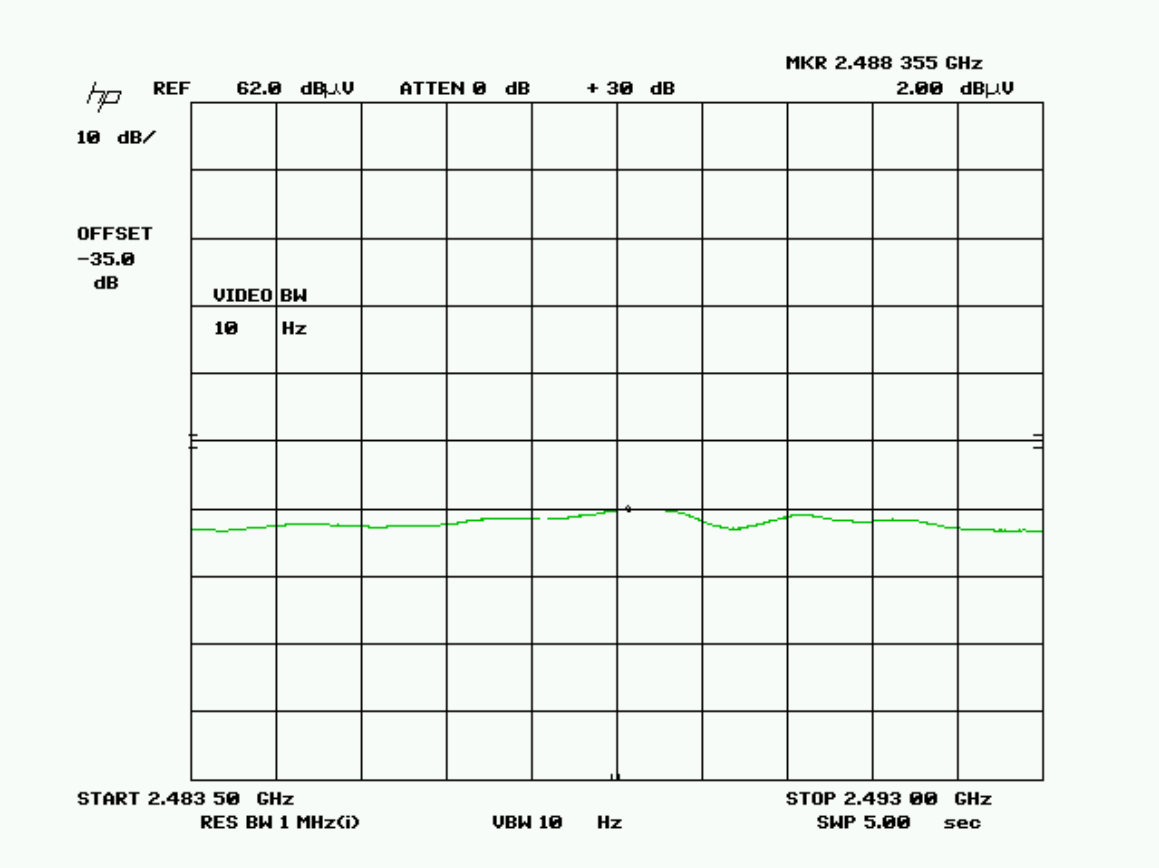
802.11 b, ch 1, 2412-Lower restricted band Average Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0*	2,386.00	17.9	V	3.17	32.37	53.44	Avg.	0.56



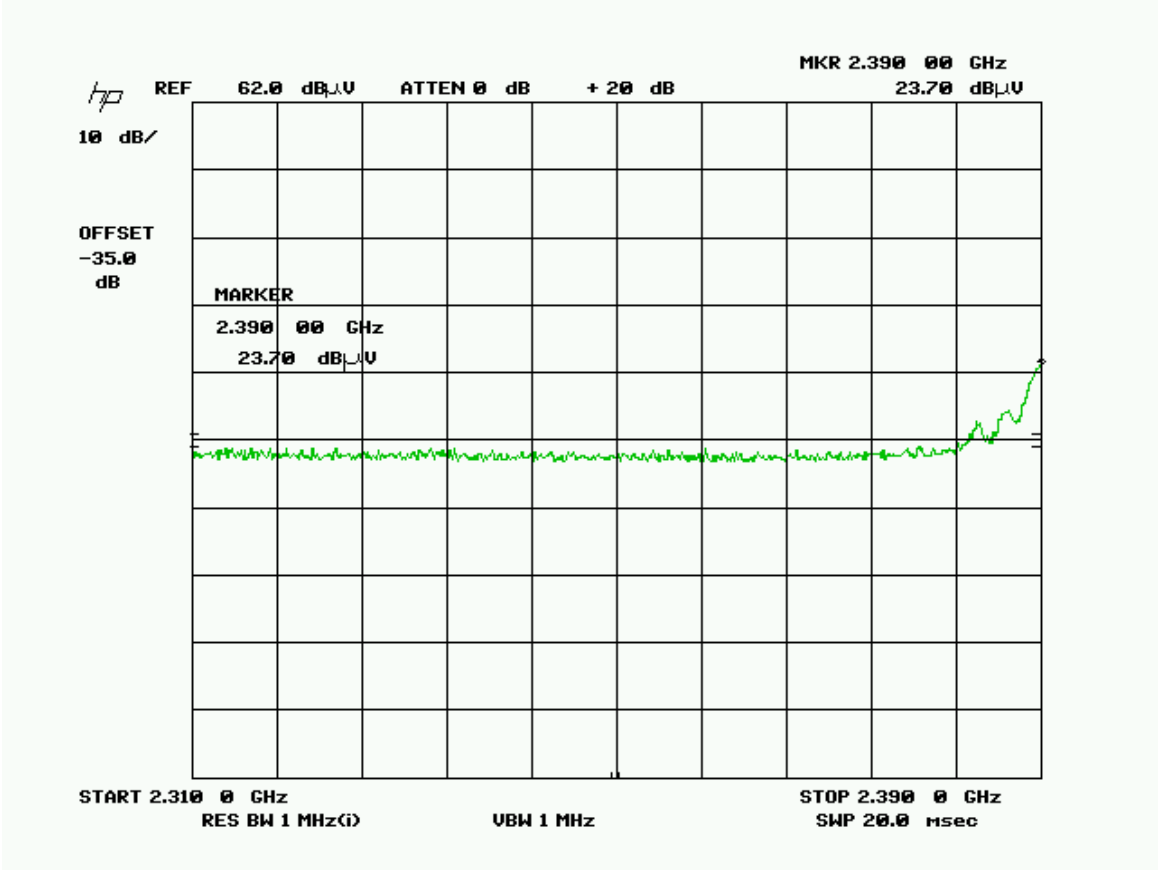
802.11 b, ch11, Upper band edge ch 2462 MHz Peak Vert.- Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,462.0*	2,487.00	27.7	V	3.24	32.57	63.51	Pk.	10.5



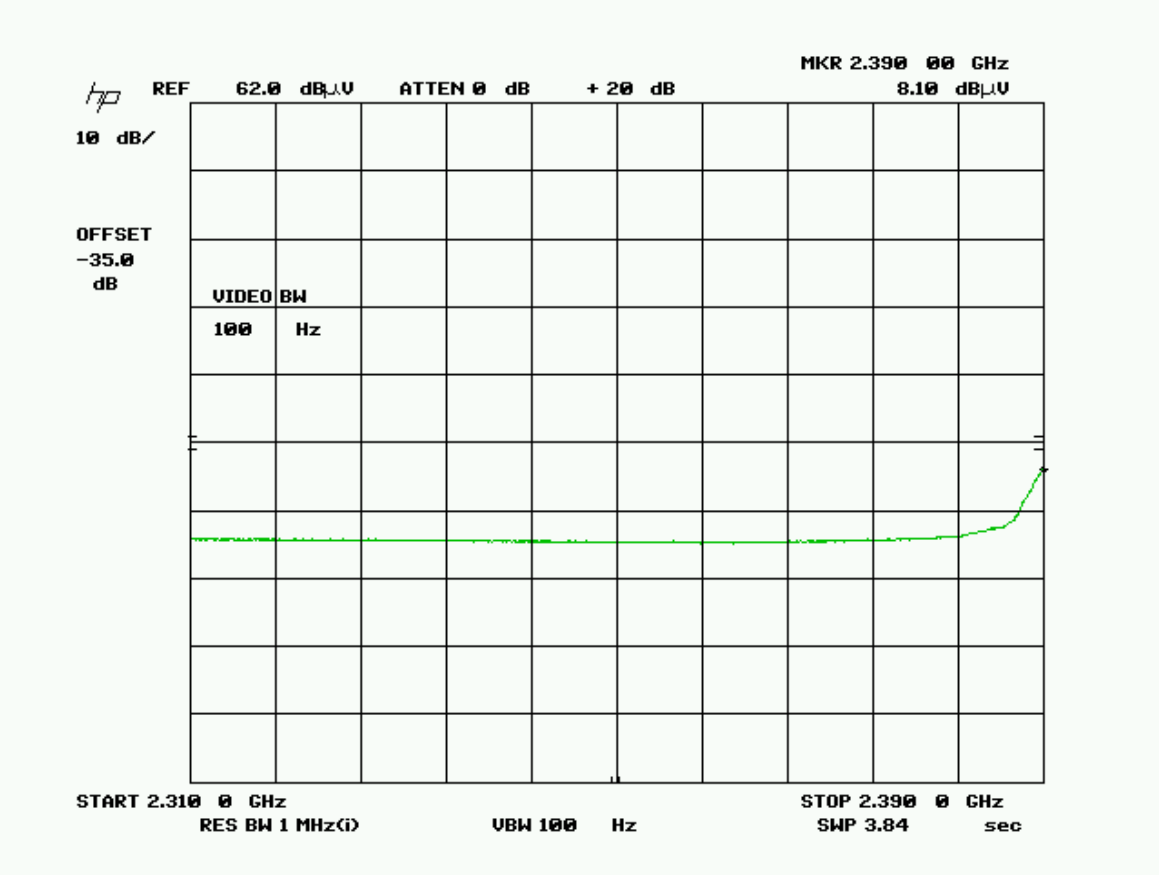
802.11 b, ch11, Upper band edge CH 11, 2462 MHz Average – Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,462.0*	2,488.00	18.0	V	3.24	32.58	53.82	Avg.	0.2



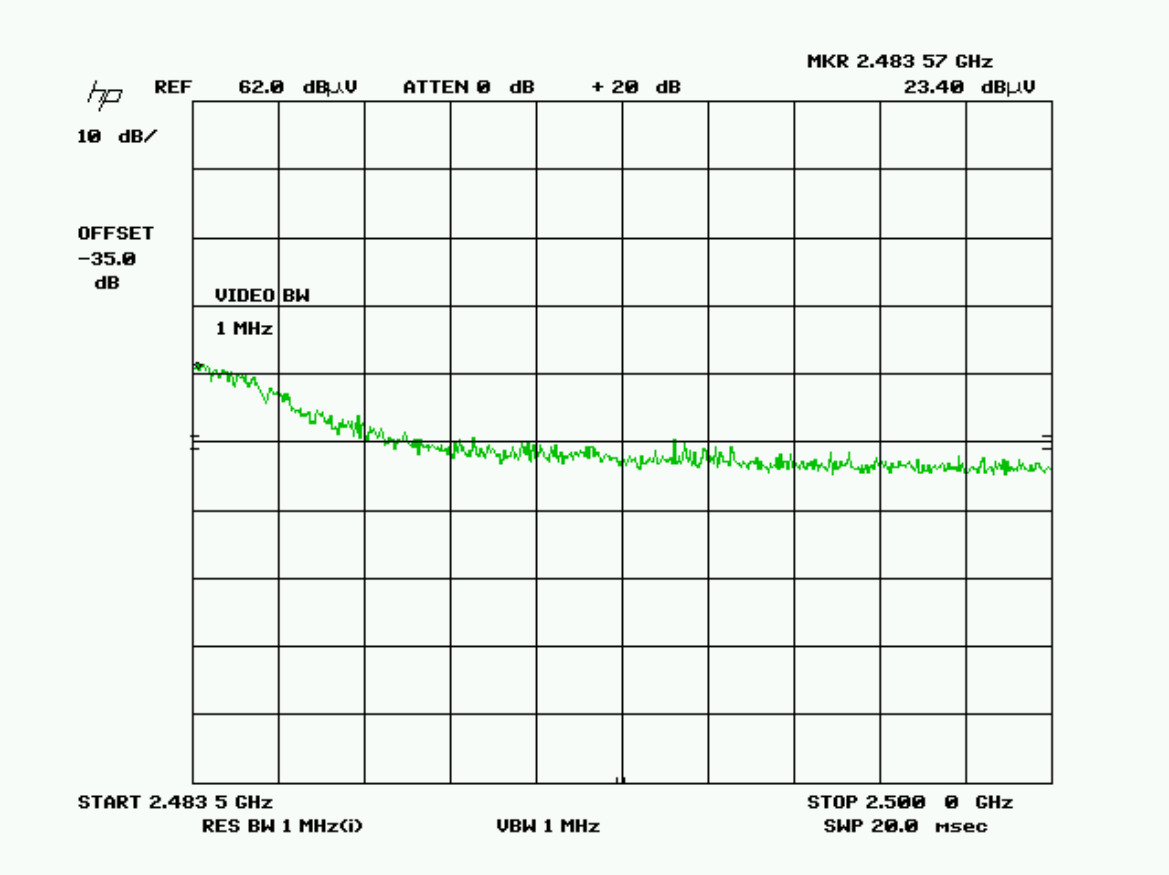
802.11 g, Lower band edge CH 1, 2412 MHz Peak – Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0*	2,390.00	39.7	V	3.17	32.38	75.25	Pk.	4.75



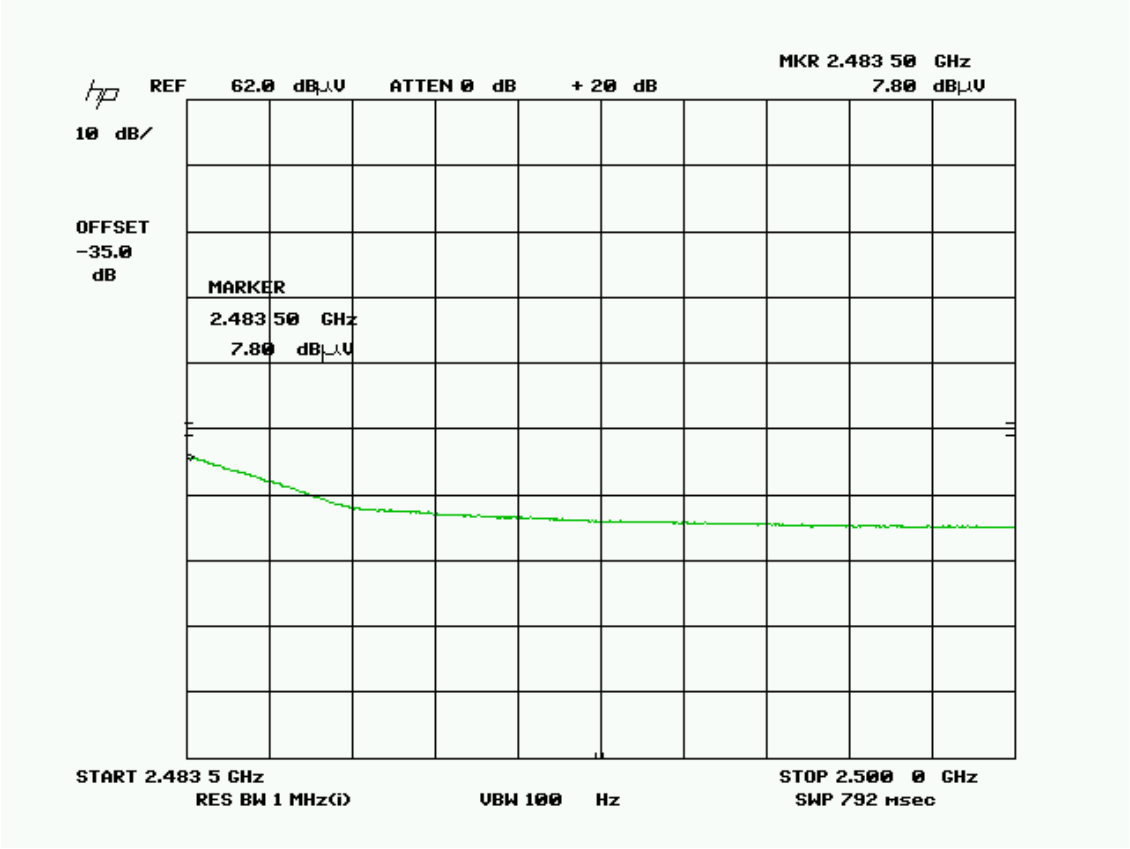
802.11 g, Lower band edge CH 1, 2412 MHz Avg. – Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0*	2,390.00	24.1	V	3.17	32.38	59.65	Avg.	0.35



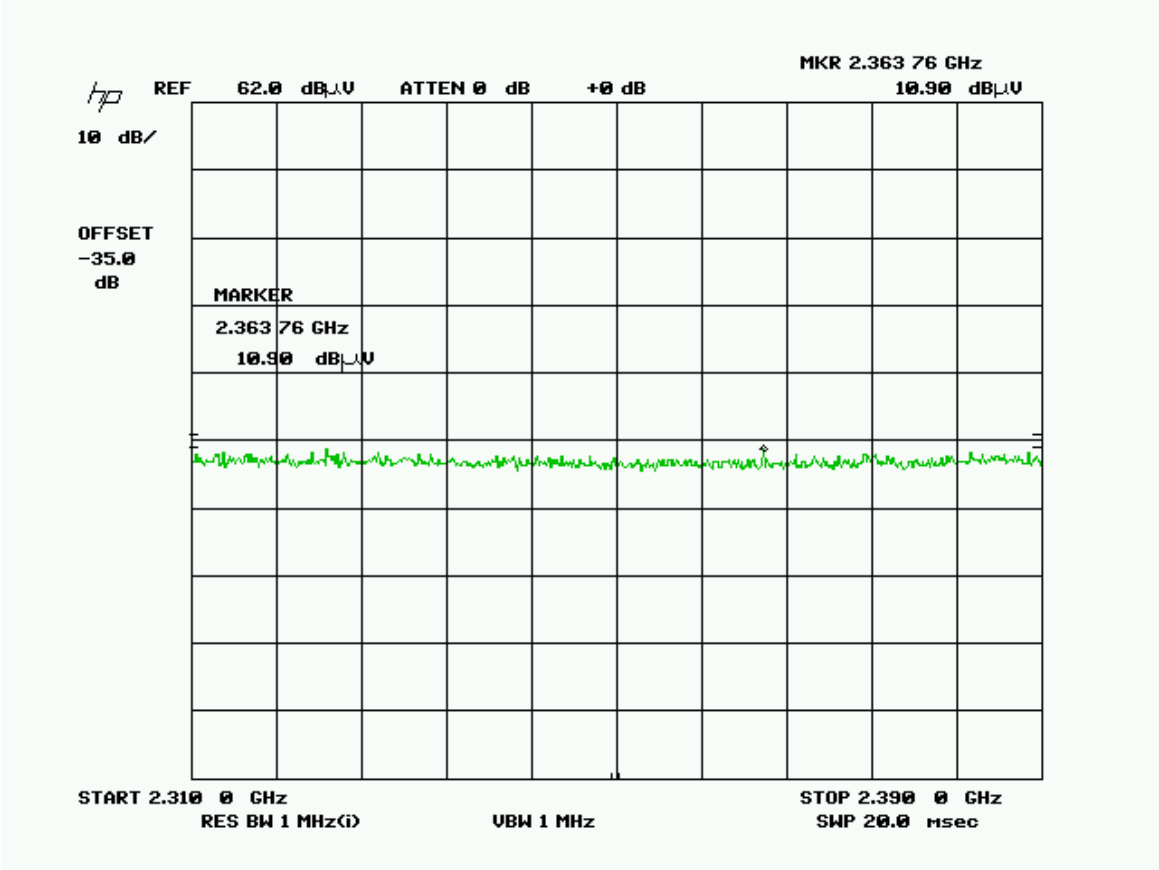
802.11 g, ch11, Upper band edge CH 11, 2462 MHz Peak – Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,462.0*	2,483.50	39.4	V	3.24	32.57	75.21	Pk.	4.8



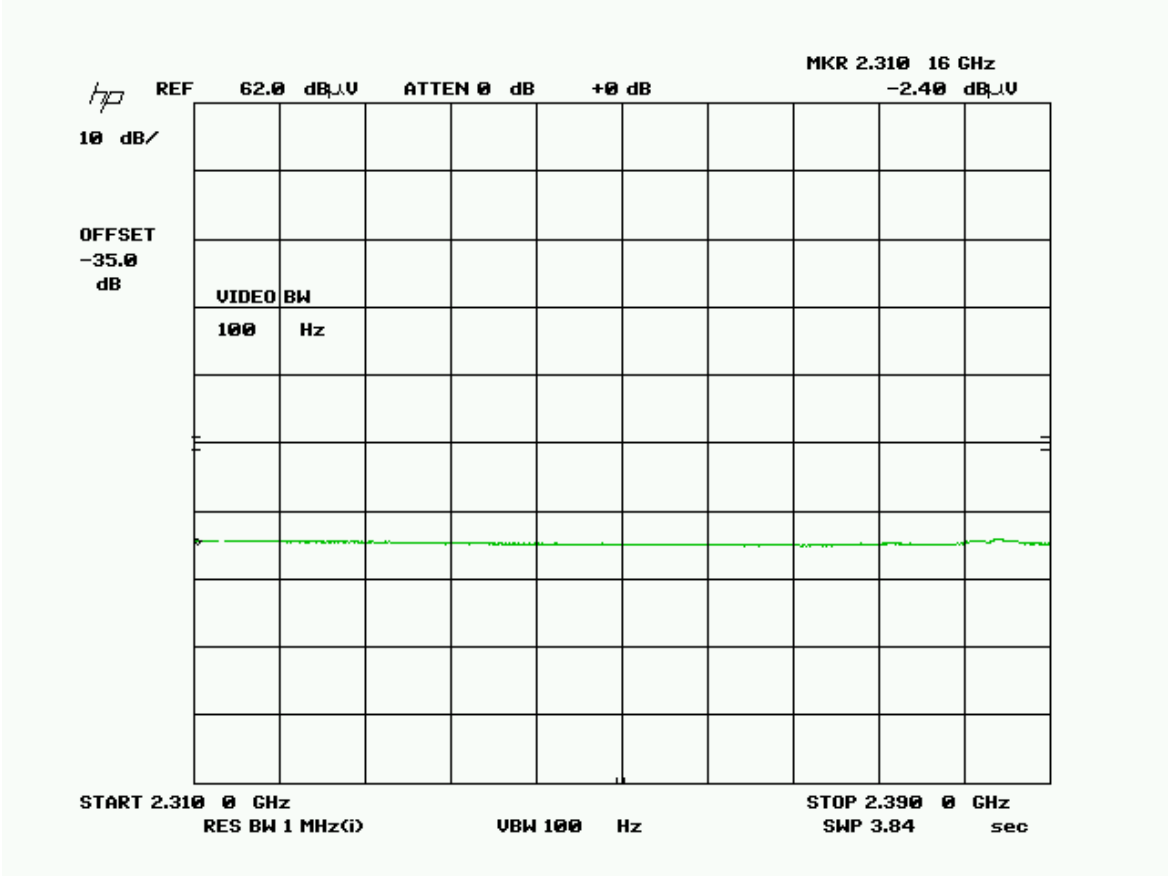
802.11 g, ch11, Upper band edge CH 11, 2462 MHz Avg. – Vert. – Antenna 1
(16 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,462.0*	2,483.50	23.8	V	3.24	32.57	59.61	Avg.	0.4



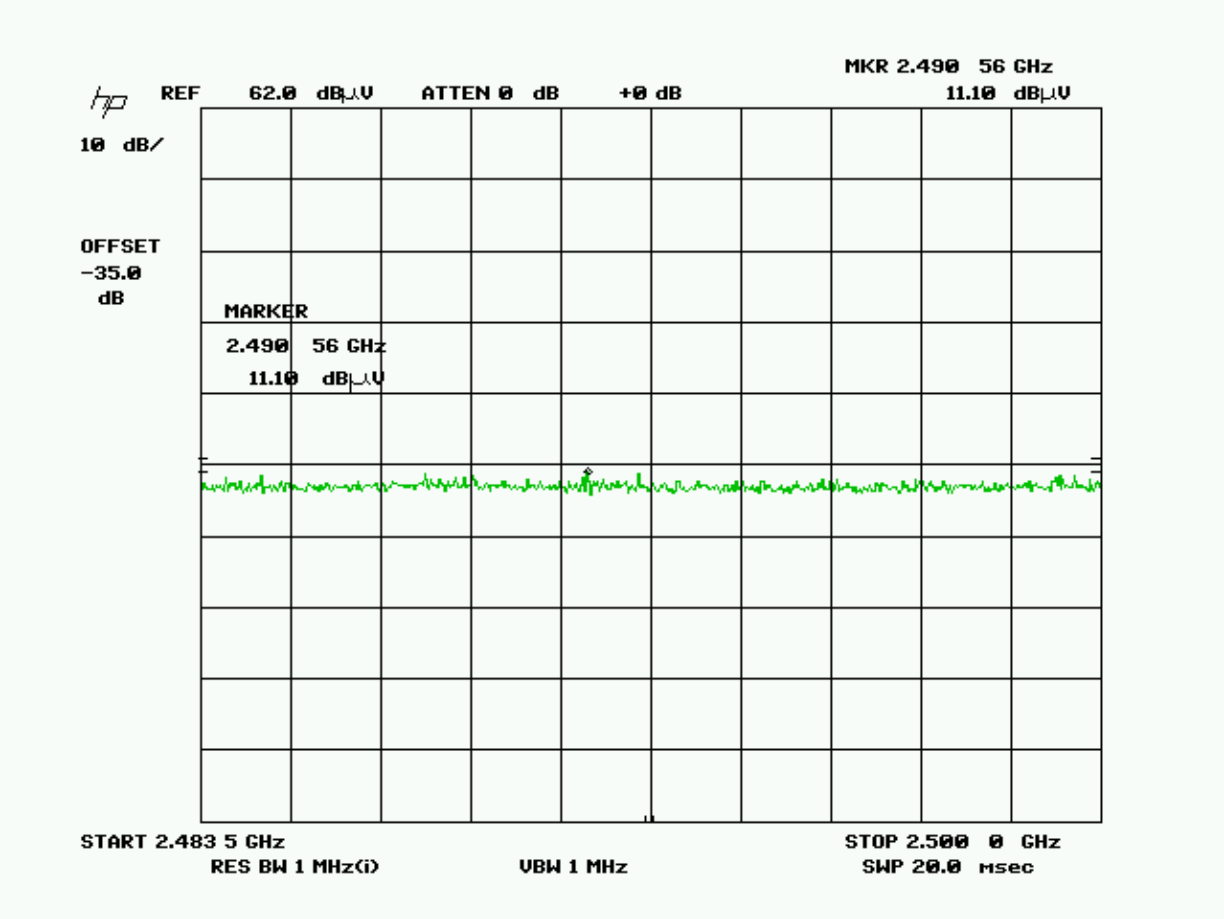
802.11 b, Lower band edge CH 1, 2412 MHz Peak – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,412.0*	2,363.00	30.9	V	3.15	32.33	66.38	Pk.	7.62



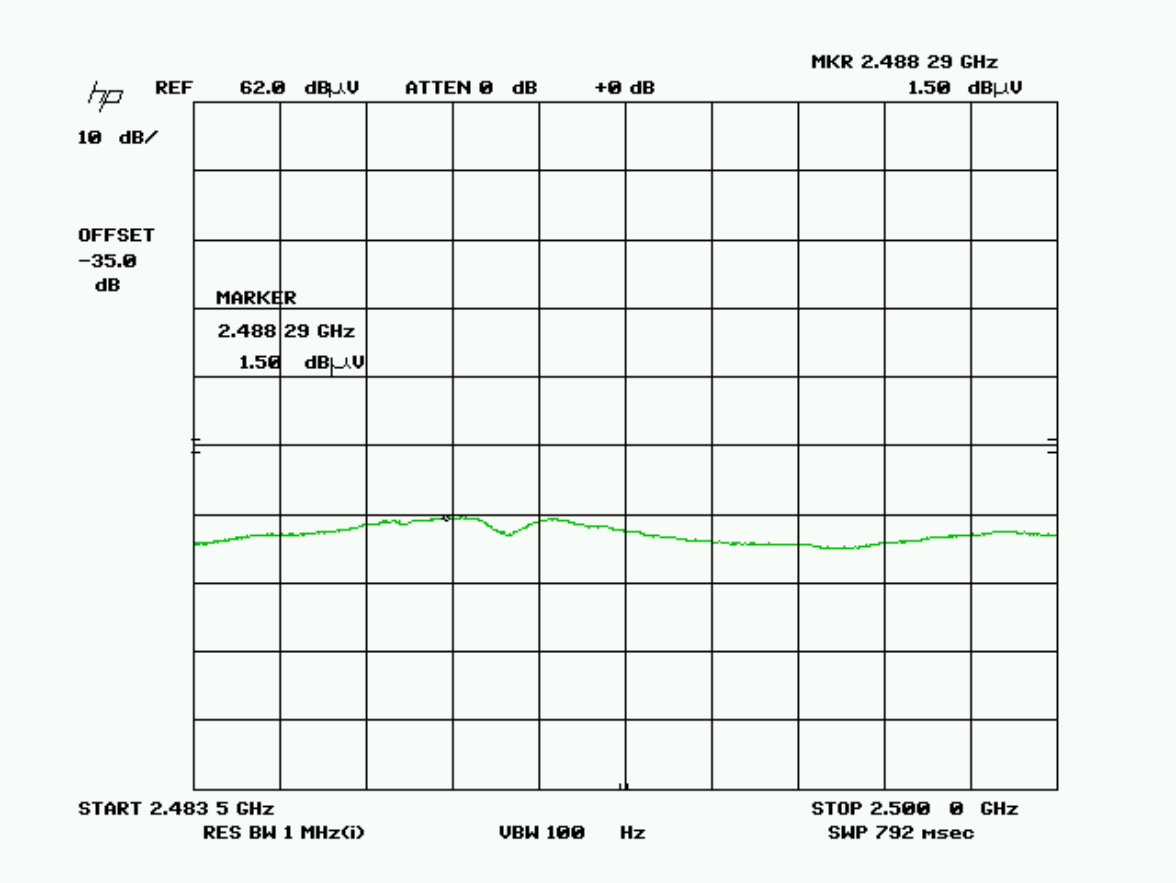
802.11 b, Lower band edge CH 1, 2412 MHz Avg. – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector.	Margin dB
2,412.0*	2,310.00	17.6	V	3.12	32.22	52.94	Avg.	1.06



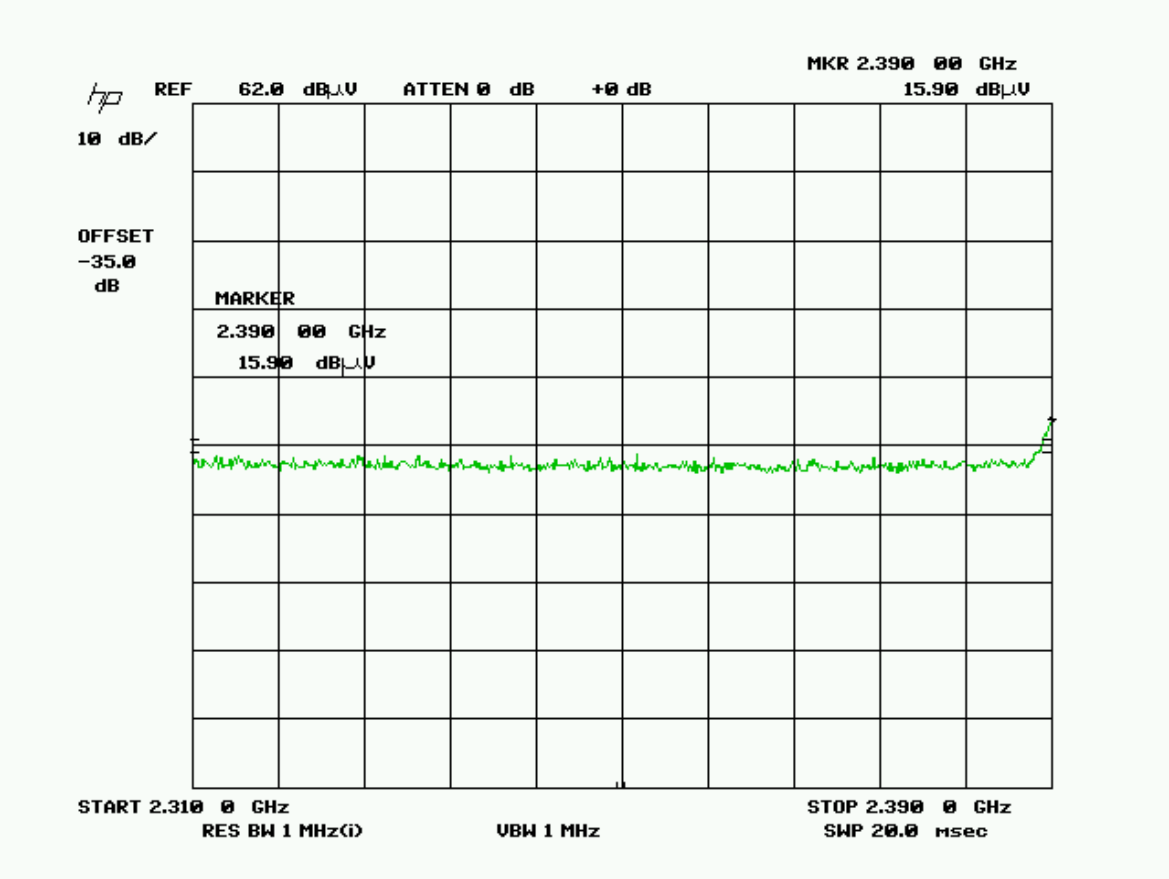
802.11 b, ch11, Upper band edge CH 11, 2462 MHz Peak – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Detector	Margin dB
2,462.0*	2,490.00	31.1	V	3.24	32.58	66.92	Pk.	7.08



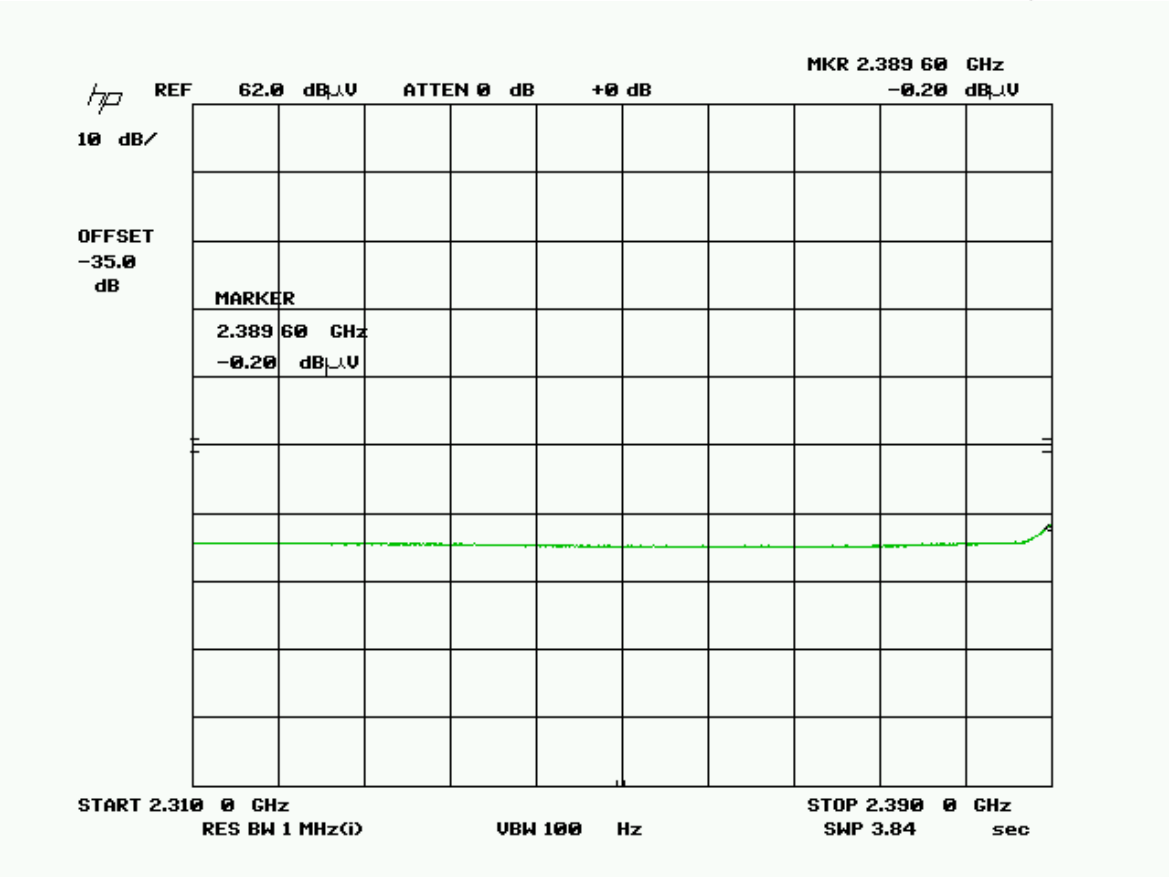
802.11 b, ch11, Upper band edge CH 11, 2462 MHz Avg. – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Det.	Margin dB
2,462.0*	2,488.00	17.5	V	3.24	32.58	53.32	Avg.	0.7



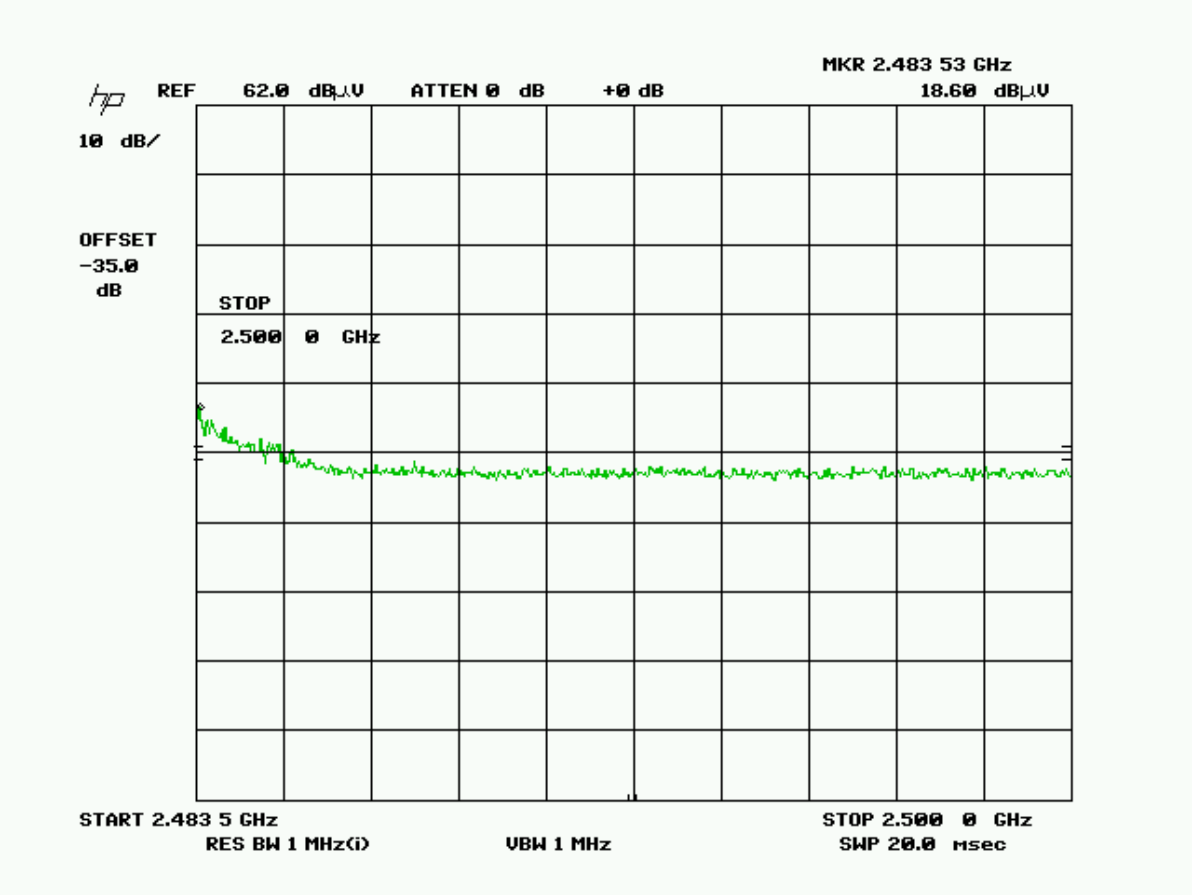
802.11 g, Lower band edge CH 1, 2412 MHz Peak – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Det.	Margin dB
2,412.0*	2,390.00	35.9	V	3.17	32.38	71.45	Pk.	8.55



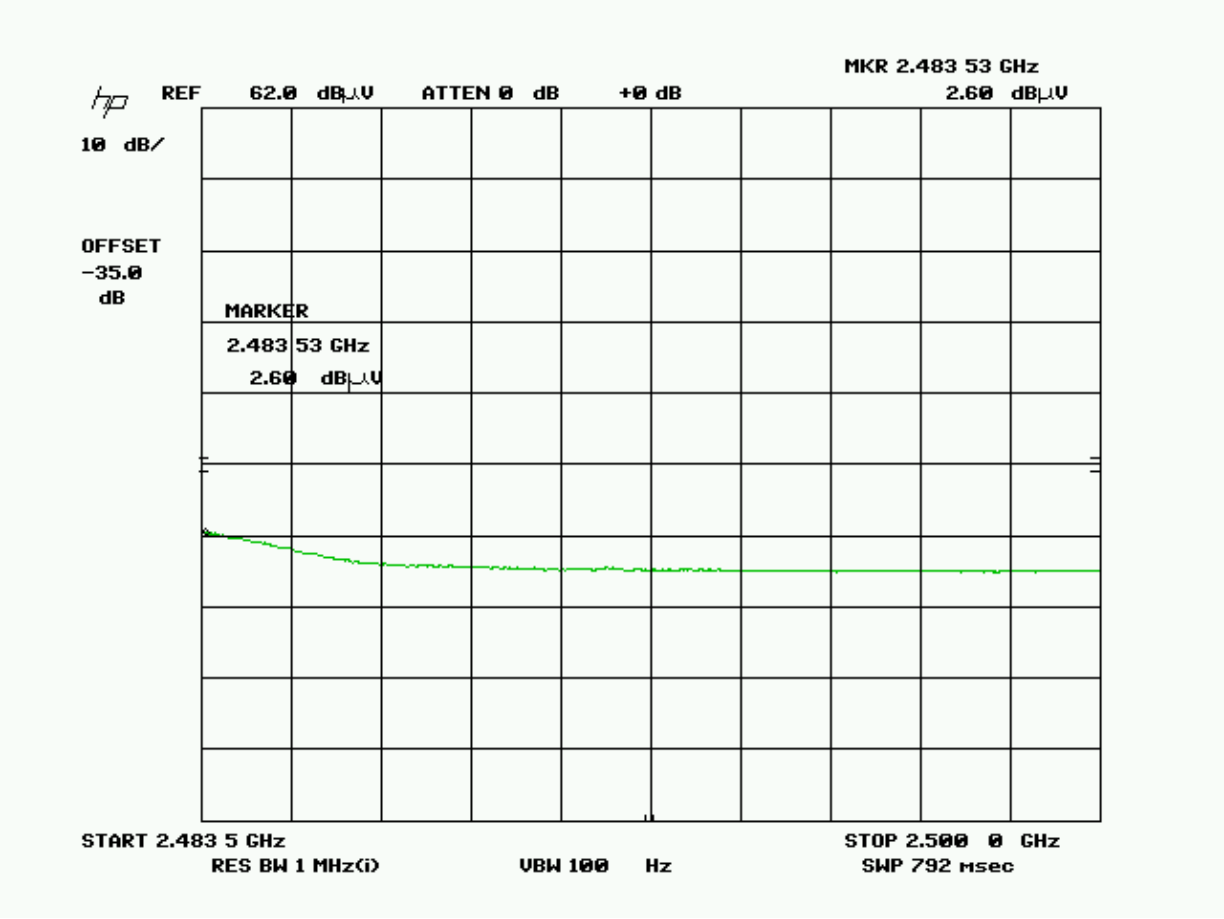
802.11 g, Lower band edge CH 1, 2412 MHz Avg. – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBµV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBµV/m	Det.	Margin dB
2,412.0*	2,390.00	19.8	V	3.17	32.38	55.35	Avg.	4.7



802.11 g, ch11, Upper band edge CH 11, 2462 MHz Peak – Vert. – Antenna 2
(20 dB Attenuator used)

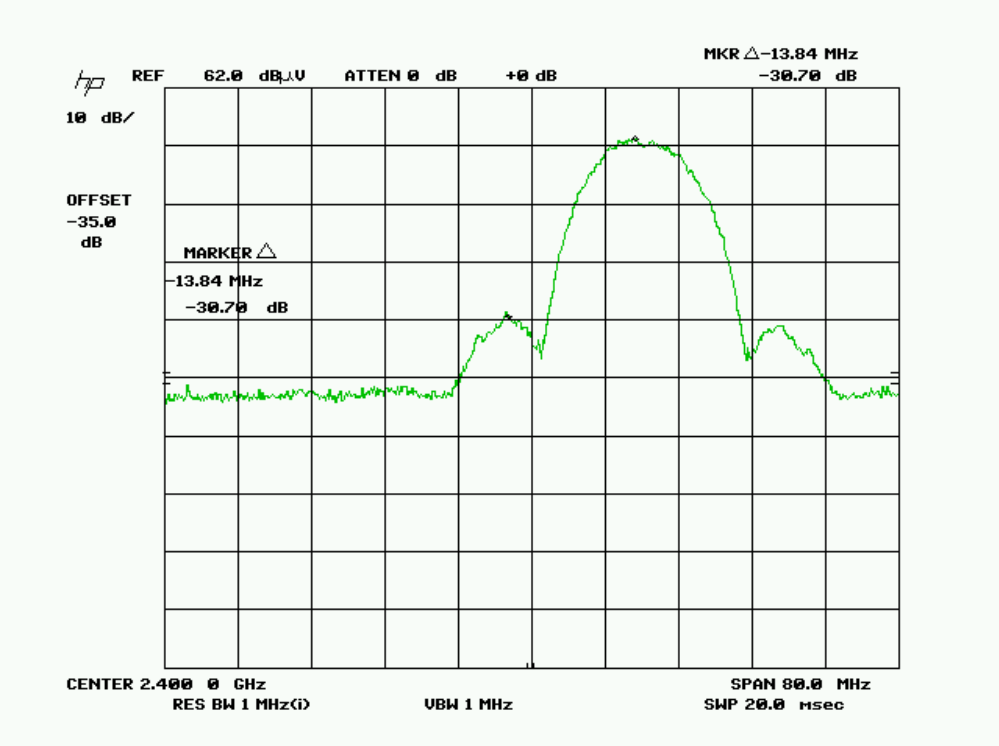
Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Det.	Margin dB
2,462.0*	2,483.50	38.6	V	3.24	32.57	74.41	Pk.	5.59



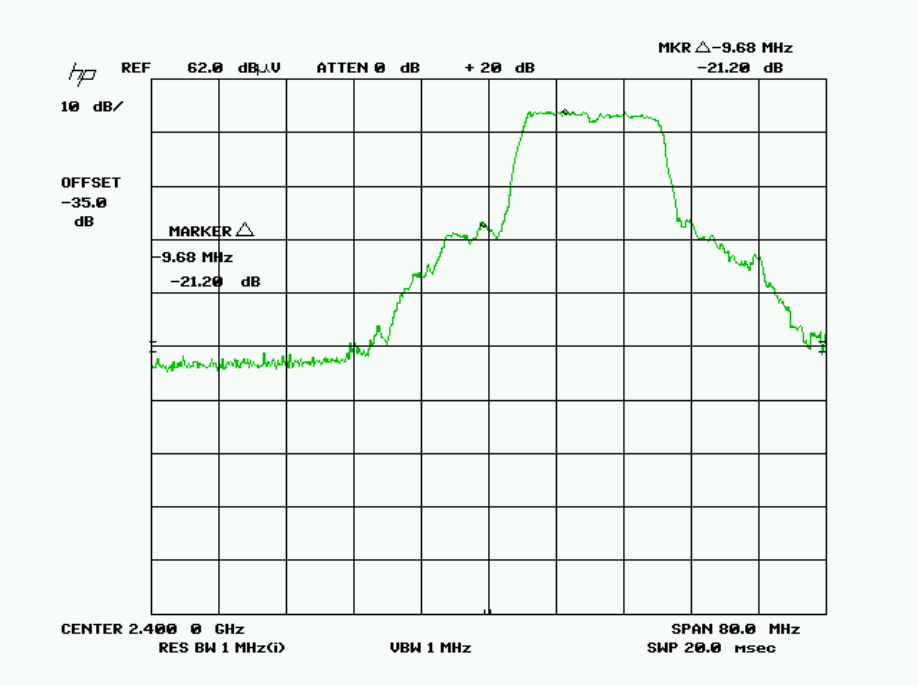
802.11 g, ch11, Upper band edge CH 11, 2462 MHz Avg. – Vert. – Antenna 2
(20 dB Attenuator used)

Tuned Frequency MHz	Emission Frequency MHz	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Det.	Margin dB
2,462.0*	2,483.50	22.6	V	3.24	32.57	58.41	Avg.	1.6

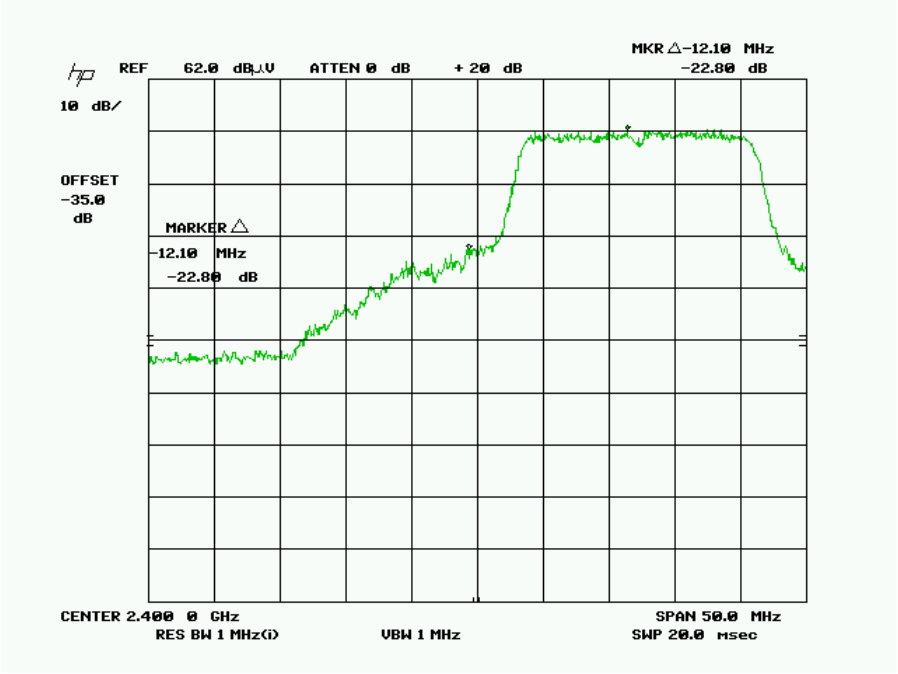
Bandedge 2400 MHz 802.11b



Meets 20 dBc



802.11 g Band edge, Meets 20dBc



802.11 n Band edge, Meets 20dBc

POWER SPECTRAL DENSITY

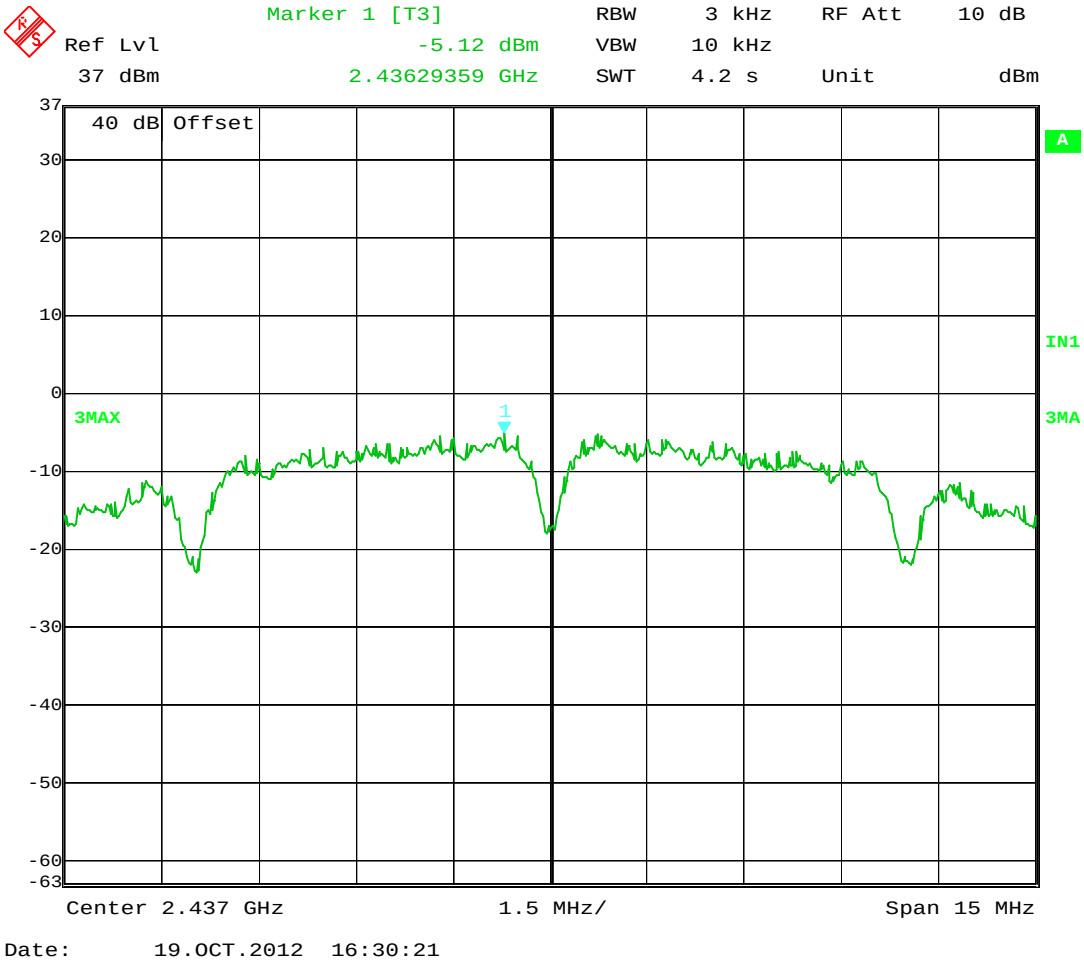
Rules Part No.: 15.247(d)

Requirements: The peak level measured must be less than +8.0 dBm.

Test Data: Three places in the band were measured and the worst case reported.

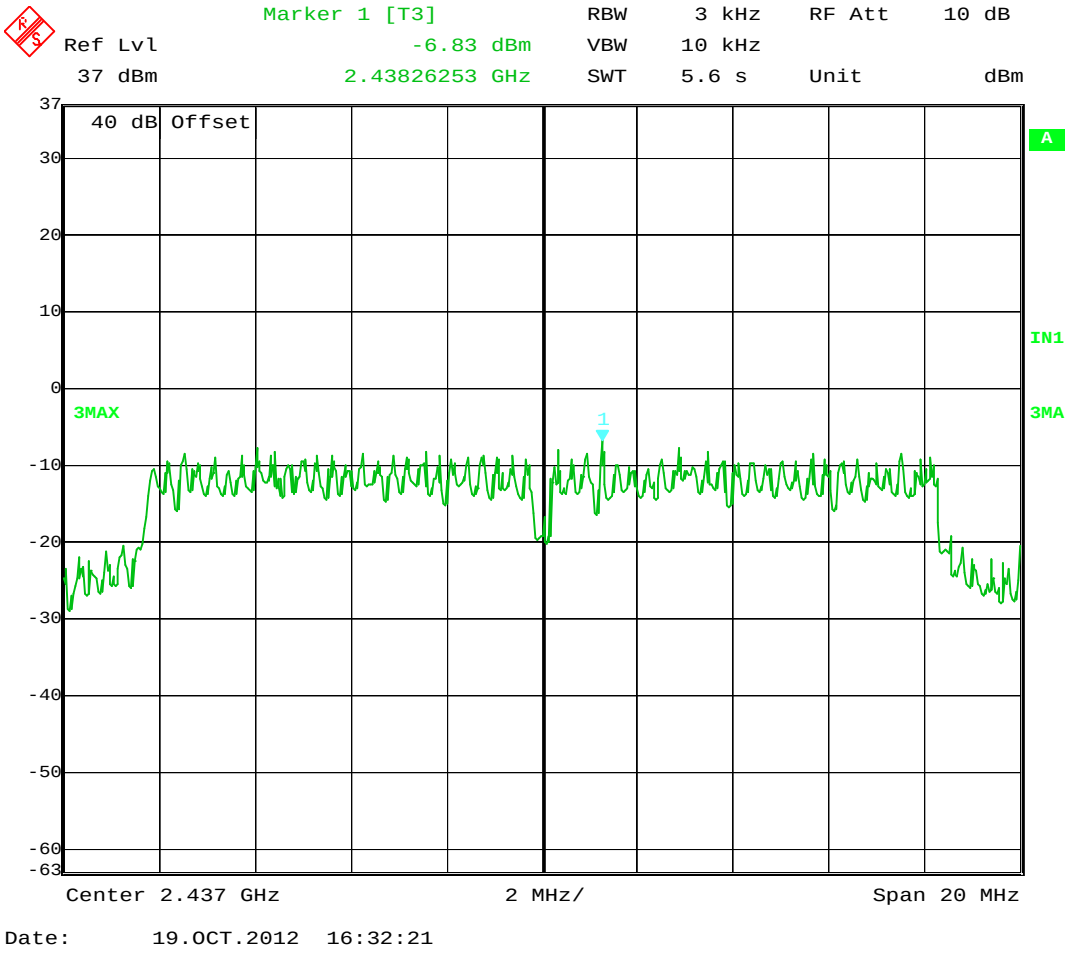
SEE THE FOLLOWING PLOTS

802.11 b



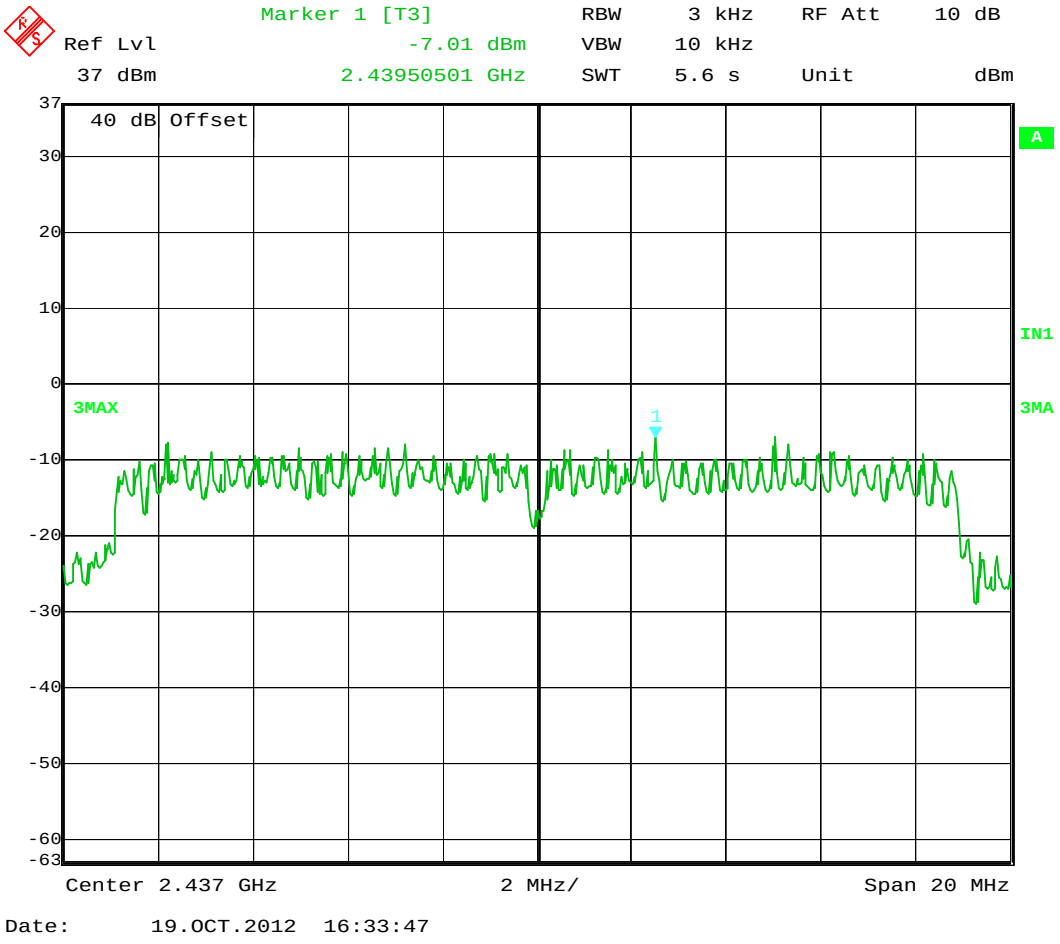
Tuned Frequency MHz	PSD dBm
CH 6, 2437	-5.12

802.11 g



Tuned Frequency MHz	PSD dBm
CH 6, 2437	-6.8

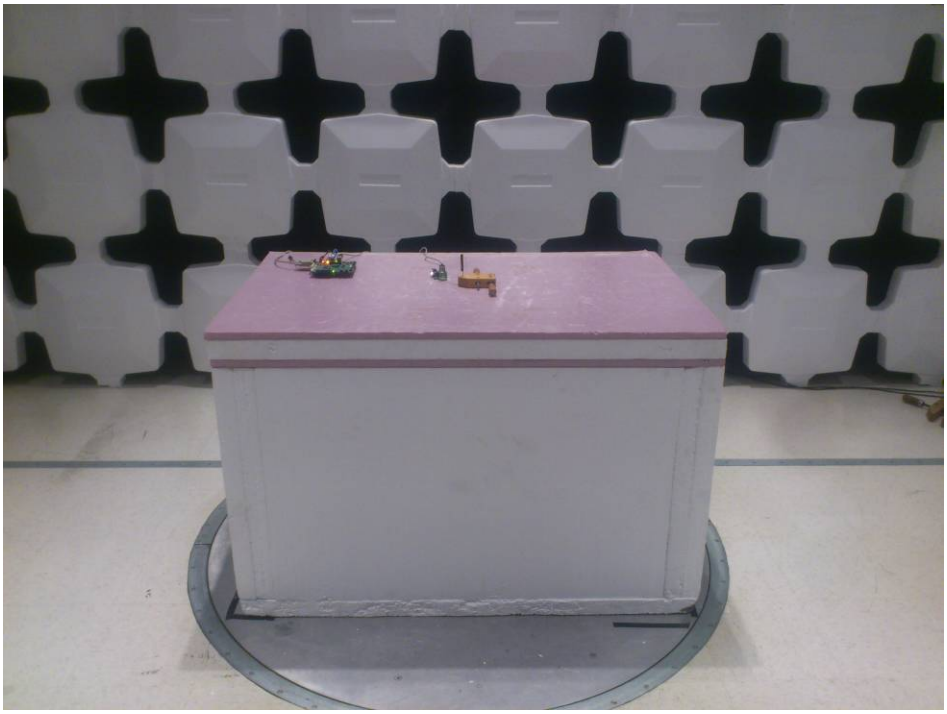
802.11 n



Tuned Frequency MHz	PSD dBm
CH 6, 2437	-7.0

TEST SETUP PHOTOS

Product with Antenna 1



Product with Antenna 2