NVLAP Lab Code 200087-0

SUBMITTAL APPLICATION REPORT

FOR GRANT OF CERTIFICATION

FOR

MODEL: R2N
2412-2462 MHz
Broadband P2MP Digital Transmission System

FOR

MIKROTIK

Pernavas 46
Riga, Latvia LV-1009

Test Report Number: 090218

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP Lab Code 200087-0

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

ENGINEERING TEST REPORT
For APPLICATION of
GRANT of CERTIFICATION

FOR

CFR47, PART 15C - INTENTIONAL RADIATORS
CFR47 Paragraph 15.247
License Exempt Intentional Radiator

For

MIKROTIK
Pernavas 46
Riga, Latvia LV-1009

BROADBAND P2MP Digital Transmission System
Model: R2N
Frequency Range 2412-2462 MHz
FCC ID#: TV7R2N

Test Date: February 18, 2009

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
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Louisburg, KS 66053
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The following information is submitted for consideration in obtaining a Grant of Certification for a License Exempt Intentional Radiator operating under CFR47 Paragraph 15.247.

Name of Applicant:
MIKROTIK
Pernavas 46
Riga, Latvia LV-1009

Model: R2N

FCC I.D.: TV7R2N FRN: 0014 43 1100

Frequency Range: 2412-2462 MHz

Operating Power: 0.1 Watt summed 802.11n antenna port conducted power

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Emissions as per CFR47 paragraphs 2 and 15.205	Complies
Emissions as per CFR47 paragraphs 2 and 15.207	Complies
Emissions as per CFR47 paragraphs 2 and 15.209	Complies
Emissions as per CFR47 paragraphs 2 and 15.247	Complies

Environmental Conditions

Ambient Temperature	23.8° C
Relative Humidity	35%
Atmospheric Pressure	1004.0 mb

Equipment Tested

Equipment	Model	FCC I.D.#
EUT	R2N	TV7R2N
CPU	PP02x	N/A

2.1033(b) Application for Certification

(1) Manufacturer: MIKROTIK

Pernavas 46

Riga, Latvia LV-1009

(2) Identification: Model: R2N

FCC I.D.: TV7R2N

(3) Instruction Book:

Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:

Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:

Refer to Exhibit of Operational Description.

(6) Report of Measurements:

Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:

Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from power received from the authorized AC power adapter and was interfaced with a laptop computer during testing.

(9) Transition Provisions of 15.37 are not being requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

(12) The equipment is not software defined and this section is not applicable.

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2008, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-2003 Document FCC, documents DA00-1407 and DA00-705 and/or TIA/EIA 603-1. Testing for the AC line-conducted emissions were performed as defined in sections 7 and 13.1.3, testing of the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4.

Equipment Function and Testing Procedures

The EUT is a 2412-2462 MHz transmitter used to transmit data in applications offering broadband wireless connectivity. The transmitter portion of the design is received as a module and placed on support interface board incorporated into the system design. The unit is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes the R2N transceiver was connected to the AC power supply and communicating to the laptop computer allowing for operational control of the transmitter and communications over the network interface between the EUT and supporting computer system. The R2N receives power form the supplied AC power adapter connected to utility power systems. No other interfacing options are provided on the design. For testing purposes the R2N and support equipment were powered from the AC power adapter supply and set to transmit in all maximum data modes available. The device is marketed for professionally installed use with permanently attached antenna system and complies with the unique antenna connection requirements. When operating in the 802.11n 40MHz mode, 2x2 mimo configuration, operating frequency segment is limited to 2422 -2452 MHz.

Equipment and Cable Configurations

AC Line Conducted Emission Test Procedure

The R2N operates from DC power only and must be connected to the support system for operation receiving power from the supplied and approved AC power adapter for operation. For testing purposes, the manufacturer supplied AC power adapter was used to power the system. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4. The test setup including the EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50 µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table.

Radiated Emission Test Procedure

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Testing for the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. Refer to photographs in the test setup exhibits for EUT placement during testing.

Units of Measurements

Conducted EMI Data is in dBµV; dB referenced to one microvolt

Radiated EMI Data is in dBµV/m; dB/m referenced to one microvolt per meter

Test Site Locations

Conducted EMI — The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS

Radiated EMI — The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS

Site Approval — Refer to Annex for Site Registration Letter

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List of Test Equipment

A Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

HP 8591 EM Analyzer Settings		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A Analyzer Settings		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/08	10/09
LISN	Comp. Design	1762	2/09	2/10
Antenna	ARA	BCD-235-B	10/08	10/09
Antenna	EMCO	3147	10/08	10/09
Antenna	EMCO	3143	5/08	5/09
Analyzer	HP	8591EM	5/08	5/09
Analyzer	HP	8562A	5/08	5/09

Subpart C - Intentional Radiators

As per CFR47, Subpart C, paragraph 15.247 the following information is submitted.

15.203 Antenna Requirements

The product is marketed with attached antenna configuration as described in accompanying documentation. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled and there are no deviations or exceptions to the specification.

15.205 Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were checked at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. No other significant emission was observed which fell into the restricted bands of operation.

Sample Calculations:

RFS (dBμV/m @ 3m) = FSM(dBμV) + A.F.(dB) - Gain(dB)
= 8.2 + 33.8 -10
= 31.6

Radiated Emissions in Restricted Bands Data (worst-case) 15.205

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2390.0	8.2	10.2	33.4	10.0	31.6	33.6	54.0
2483.5	12.2	15.4	33.8	10.0	36.0	39.2	54.0
4824.0	9.8	16.8	32.7	10.0	32.5	39.5	54.0
4874.0	10.3	16.4	32.7	10.0	33.0	39.1	54.0
4924.0	9.0	17.4	32.8	10.0	16.6	40.2	54.0
7236.0	7.1	8.1	36.2	10.0	33.3	34.3	54.0
7311.0	7.0	7.6	36.3	10.0	33.3	33.9	54.0
7386.0	7.4	7.6	36.4	10.0	16.6	34.0	54.0
12060.0	8.2	9.3	40.0	10.0	38.2	39.3	54.0
12185.0	8.6	8.8	40.0	10.0	38.6	38.8	54.0
12310.0	9.6	8.3	40.3	10.0	16.6	38.6	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions in Restricted Bands 15.205

The EUT demonstrated compliance with the radiated emissions requirements for FCC Part 15C Intentional Radiators. The EUT demonstrated a minimum margin of 13.8 dB below the requirements. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the FCC Part 15C paragraph 15.205 emissions requirements. There were no deviations or exceptions to the specifications.

15.207 AC line Conducted Emissions Procedure

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied AC power adapter for the EUT was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing were carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each radio frequency emission displaying the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures one and two for plots of the AC Line conducted emissions.

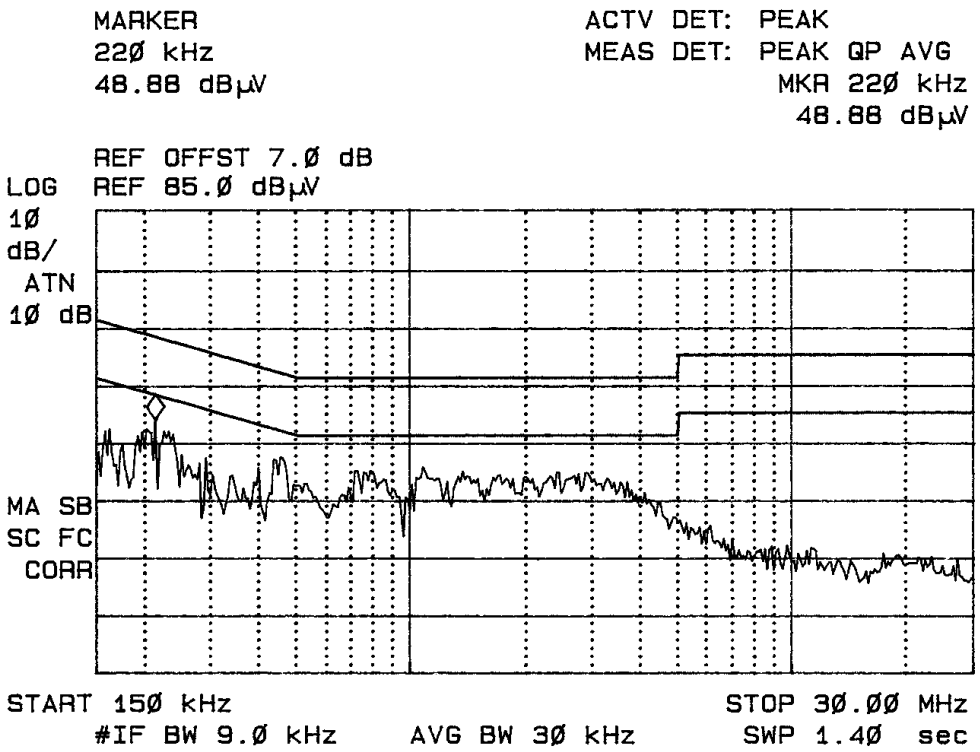

Figure One AC Line Conducted Emissions Line 1

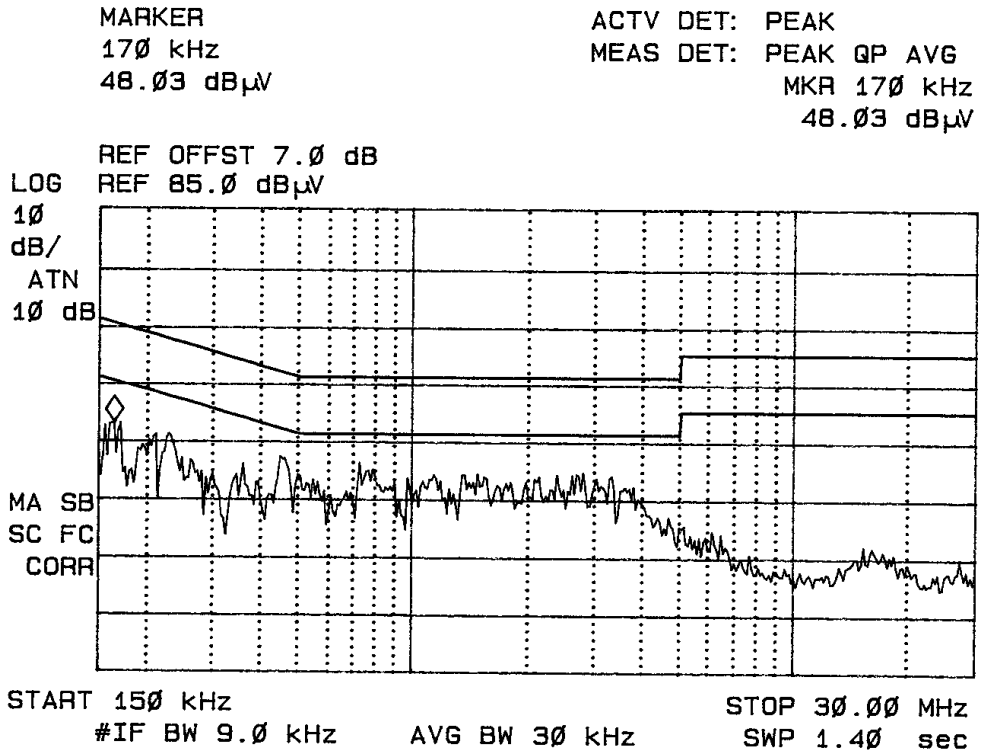

Figure Two AC Line Conducted Emissions Line 2

AC Line Conducted Emissions Data (7 Highest Emissions) 15.207

Frequency band (MHz)	L1 Level (dBµV)			L2 Level (dBµV)			CISPR 22 Limit Q.P. Ave(dBµV)
	Peak	Q.P.	AVE	Peak	Q.P.	AVE	
0.15 – 0.5	48.9	45.3	27.2	48.0	41.3	21.2	65 / 55
0.5 – 5	39.4	35.3	24.6	39.6	34.7	23.6	56 / 46
5 – 10	31.0	25.8	16.7	31.1	23.9	14.4	60 / 50
10 – 15	27.7	20.3	11.2	25.2	18.9	10.3	60 / 50
15 – 20	24.4	18.0	10.2	25.0	19.7	10.3	60 / 50
20 – 25	24.4	18.8	10.3	23.3	16.4	9.9	60 / 50
25 – 30	21.8	18.0	11.3	24.9	21.1	16.1	60 / 50

Other emissions present had amplitudes at least 10 dB below the limit.

Summary of Results for AC Line Conducted Emissions 15.207

The EUT demonstrated compliance with the conducted emissions requirements for CISPR 22 and CFR47 Part 15C equipment. The EUT demonstrated minimum margin of 20.7 dB below the Quasi-Peak limit, and 21.4 dB below the CISPR average limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

15.209 Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available modes with worst-case data recorded. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Plots were made of the radiated frequency spectrum from 30 MHz to 22,000 MHz for the preliminary testing. Refer to figures three through nine for plots of the general radiated emissions spectrum taken in a screen room. The highest radiated emission was then re-maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 30,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and

changing antenna position between horizontal and vertical polarization. Antennas used were Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and or, pyramidal horns and mixers from 4 GHz to 30 GHz, notch filters and appropriate amplifiers were utilized.

Sample Calculations:

RFS = Radiated Field Strength
dBµV/m @ 3m = dBµV + A.F. - Amplifier Gain
dBµV/m @ 3m = 40.4 + 8.2 - 30
= 18.6

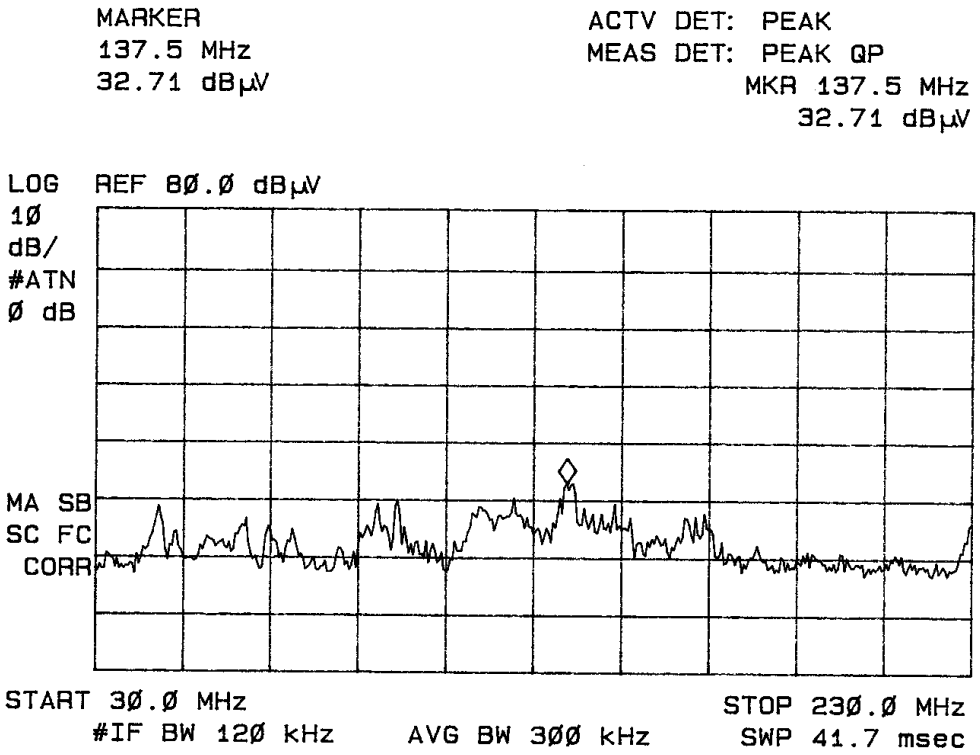

Figure Three General Radiated Emissions taken at 1 meter in screen room

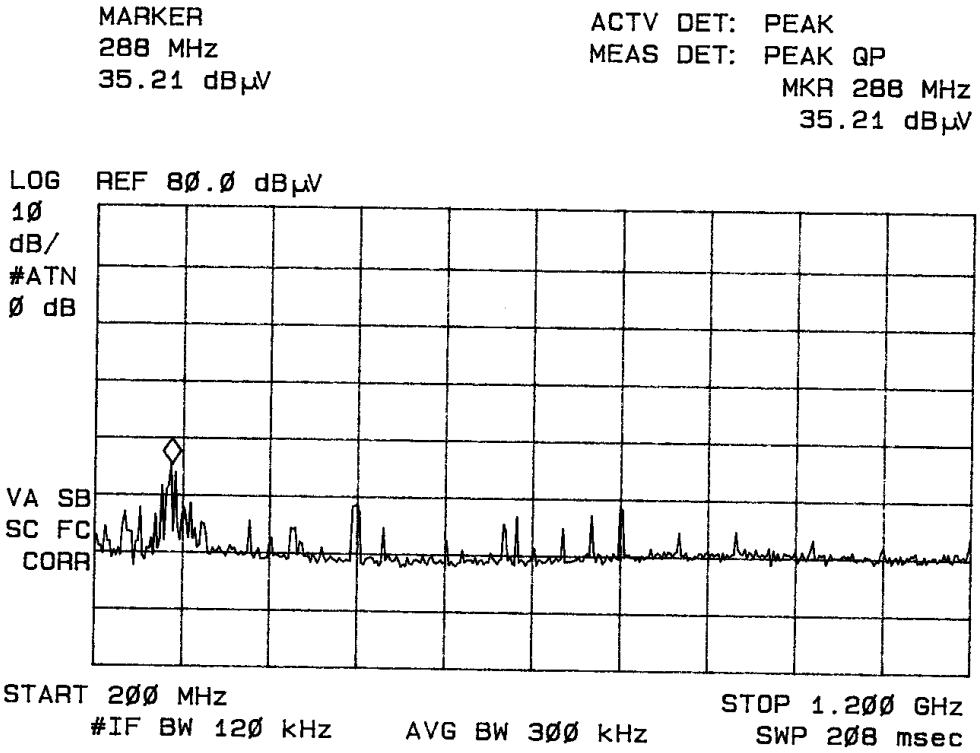

Figure Four General Radiated Emissions taken at 1 meter in screen room

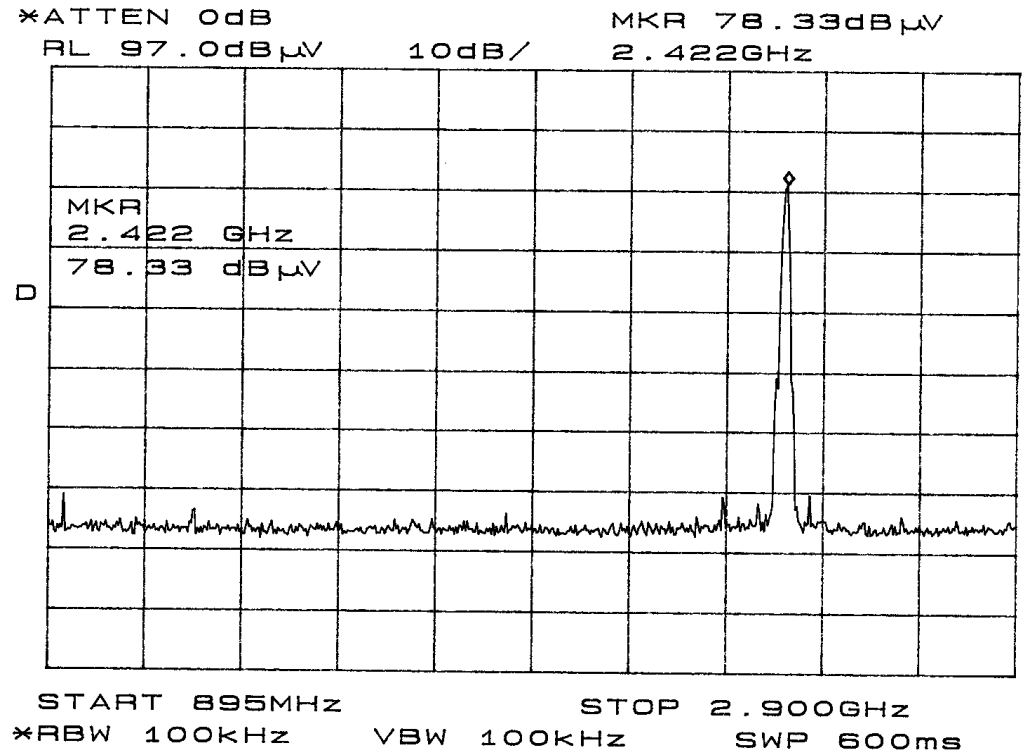

Figure Five General Radiated Emissions taken at 1 meter in screen room

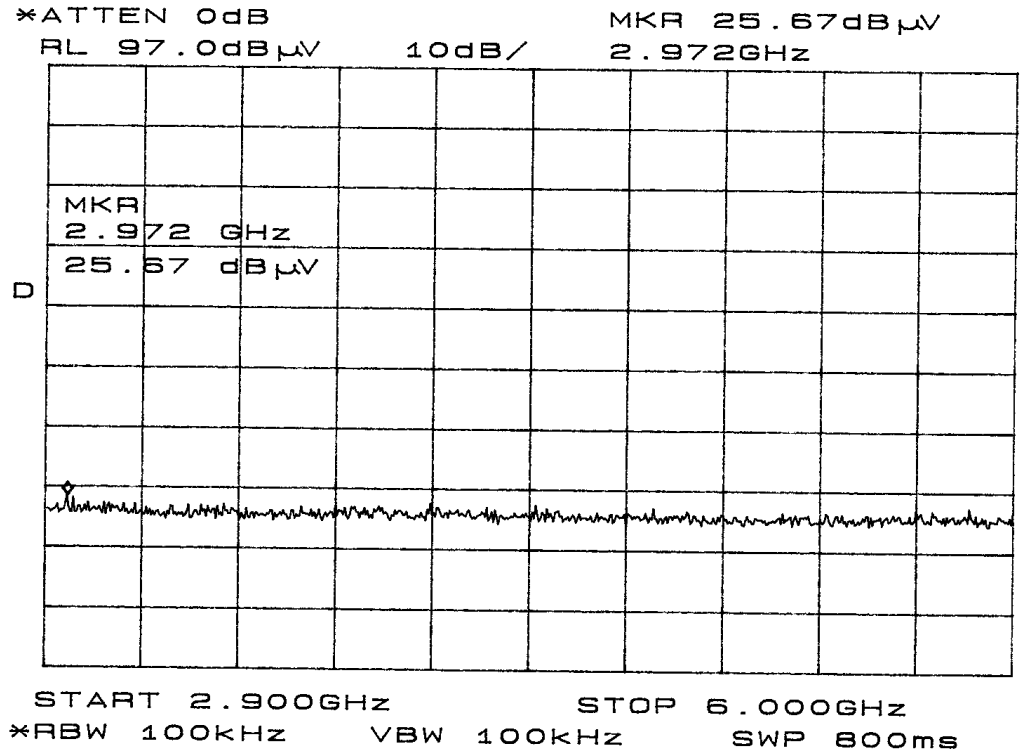

Figure Six General Radiated Emissions taken at 1 meter in screen room

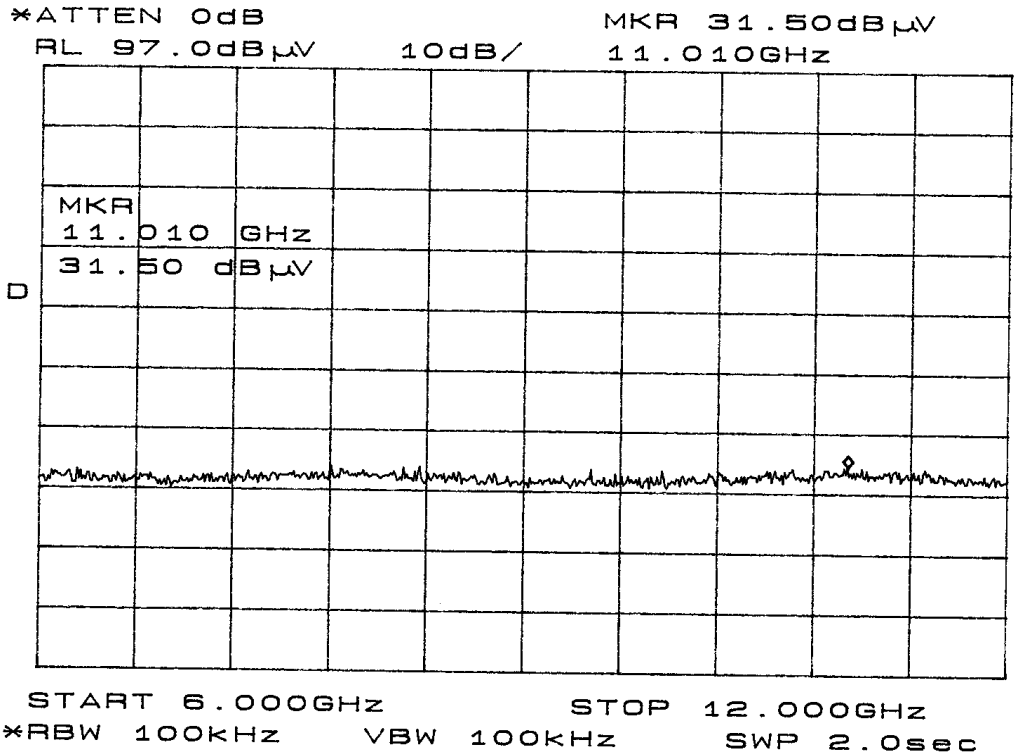

Figure Seven General Radiated Emissions taken at 1 meter in screen room

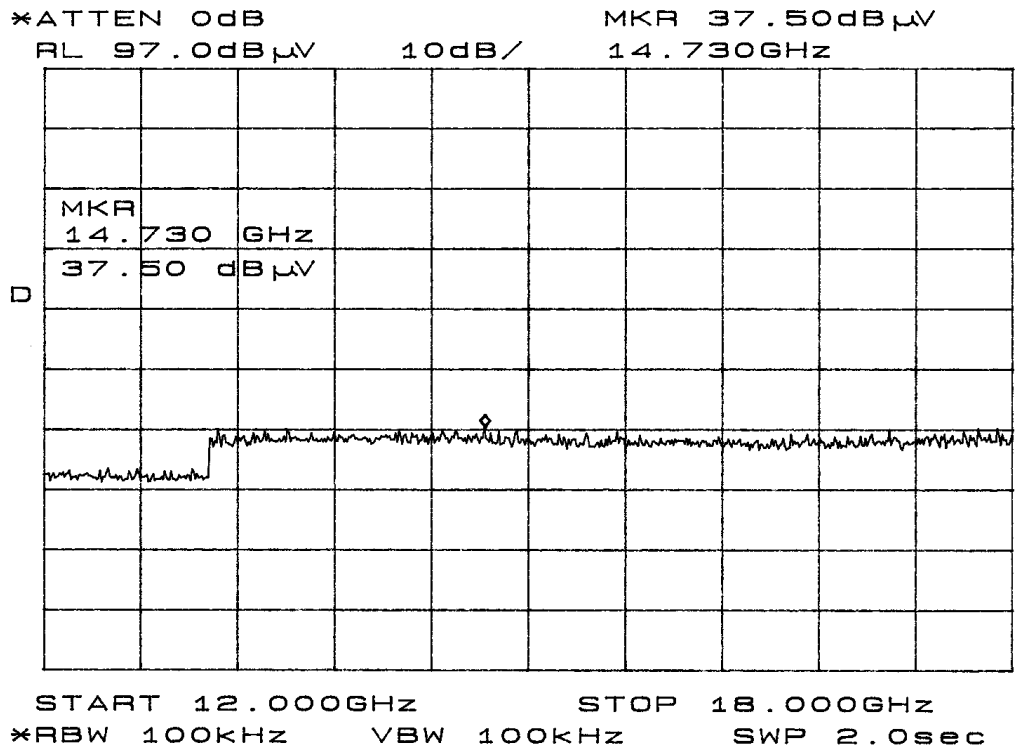

Figure Eight General Radiated Emissions taken at 1 meter in screen room

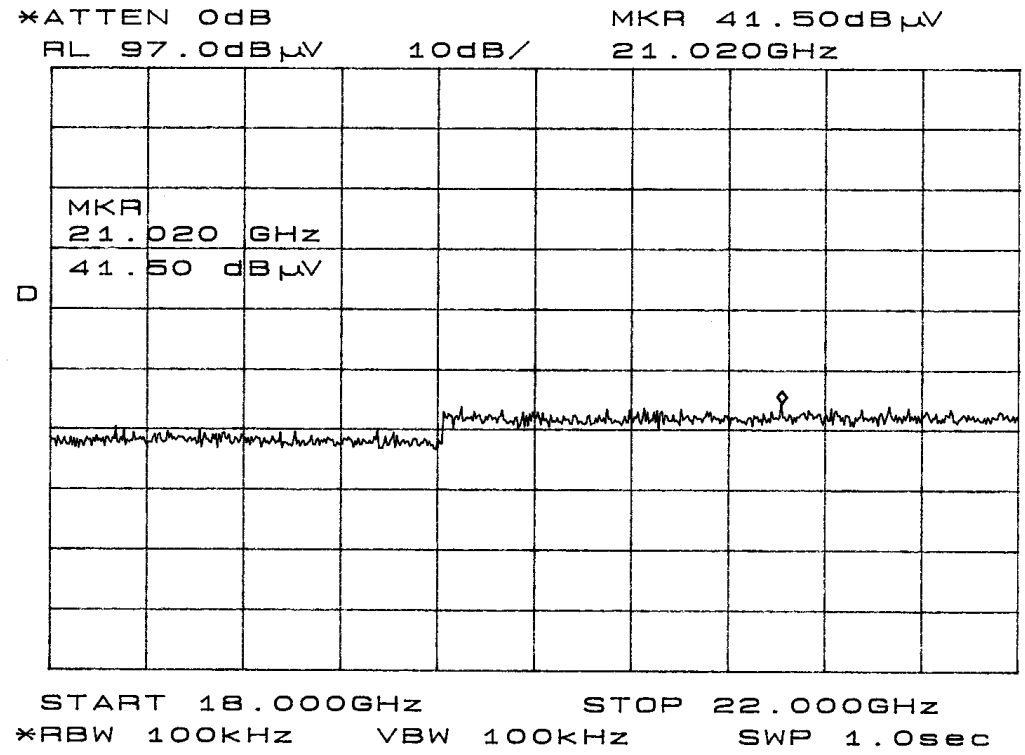

Figure Nine General Radiated Emissions taken at 1 meter in screen room

Radiated Emissions from EUT Data (Highest Emissions) 15.209

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
44.3	40.4	48.7	8.2	30	18.6	26.9	40.0
94.4	50.5	52.3	7.5	30	28.0	29.8	43.5
98.5	52.0	49.8	7.3	30	29.3	27.1	43.5
125.0	50.8	42.6	7.7	30	28.5	20.3	43.5
137.2	52.4	52.6	9.7	30	32.1	32.3	43.5
137.8	52.7	52.5	9.7	30	32.4	32.2	43.5
138.5	56.2	52.9	9.7	30	35.9	32.6	43.5
139.3	57.4	52.9	9.7	30	37.1	32.6	43.5
141.2	59.8	55.4	9.1	30	38.9	34.5	43.5
144.7	57.2	46.0	12.5	30	39.7	28.5	43.5
145.3	58.0	42.1	12.5	30	40.5	24.6	43.5
151.6	57.7	44.5	10.3	30	38.0	24.8	43.5
164.6	52.2	39.7	8.7	30	30.9	18.4	43.5
166.8	52.5	42.4	8.7	30	31.2	21.1	43.5
168.8	52.3	39.1	8.8	30	31.1	17.9	43.5
172.8	52.6	40.2	8.8	30	31.4	19.0	43.5
250.0	45.1	45.2	12.3	30	27.4	27.5	46.0
275.0	47.0	38.9	12.7	30	29.7	21.6	46.0
288.2	47.6	40.0	13.7	30	31.3	23.7	46.0
291.5	49.5	41.9	13.7	30	33.2	25.6	46.0
300.0	59.0	52.9	14.0	30	43.0	36.9	46.0
500.0	48.2	51.1	18.3	30	36.5	39.4	46.0
680.0	41.2	36.8	20.7	30	31.9	27.5	46.0
760.0	41.9	37.7	21.9	30	33.8	29.6	46.0
800.0	50.1	48.8	22.2	30	42.3	41.0	46.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for General Radiated Emissions 15.209

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15C paragraph 15.209 Intentional Radiators. The EUT demonstrated a minimum margin of 3.0 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the CISPR 22 or CFR47 emissions requirements. There were no deviations or exceptions to the specifications.

15.247 Operation in the Band 2400-2483.5 MHz

The power output was measured both at the antenna connection port offered for testing and at the open area test site at a three-meter distance with the authorized antenna system. Figures ten through fourteen demonstrate worst-case antenna conducted emissions and compliance with the requirements of 15.247(c) for emission limitations. Figures fifteen through seventeen demonstrate compliance with maximum output power requirements across the operational frequency band of 15.247. Figures eighteen through twenty-six demonstrate compliance with the minimum 6 db bandwidth requirements of 15.247. Figures twenty-seven through thirty-eight demonstrate compliance to power spectral density per 15.247. Compliance to band edge requirements per 15.209 and 15.247 are demonstrated in radiated emissions tables.

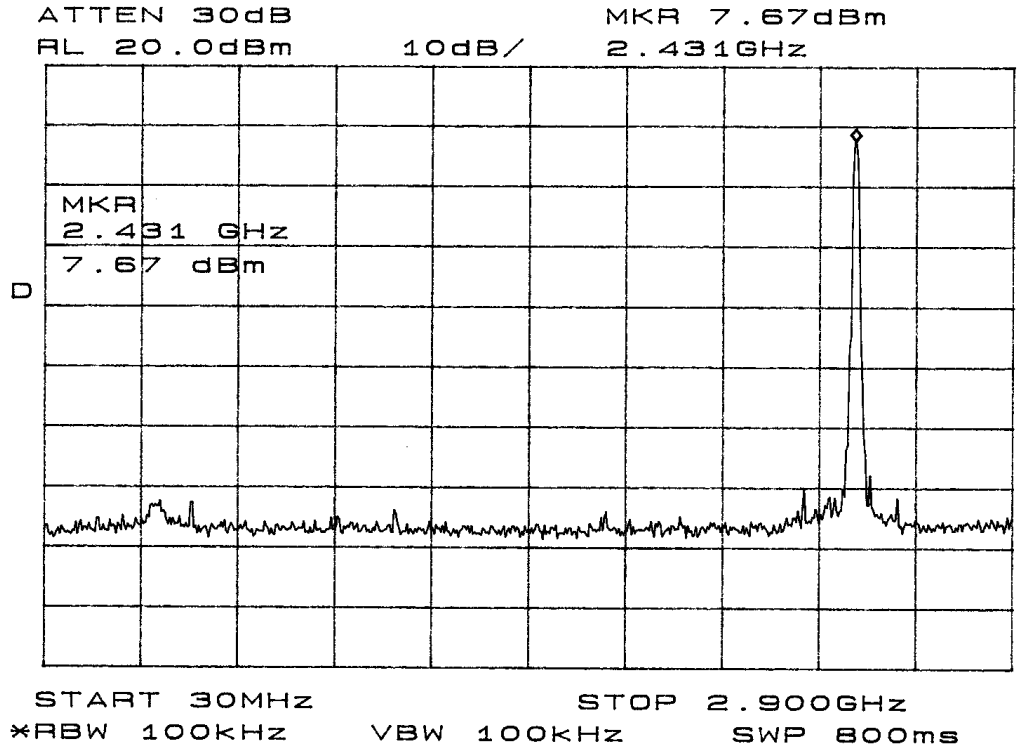

Figure Ten Plot of Antenna Port Conducted Emissions

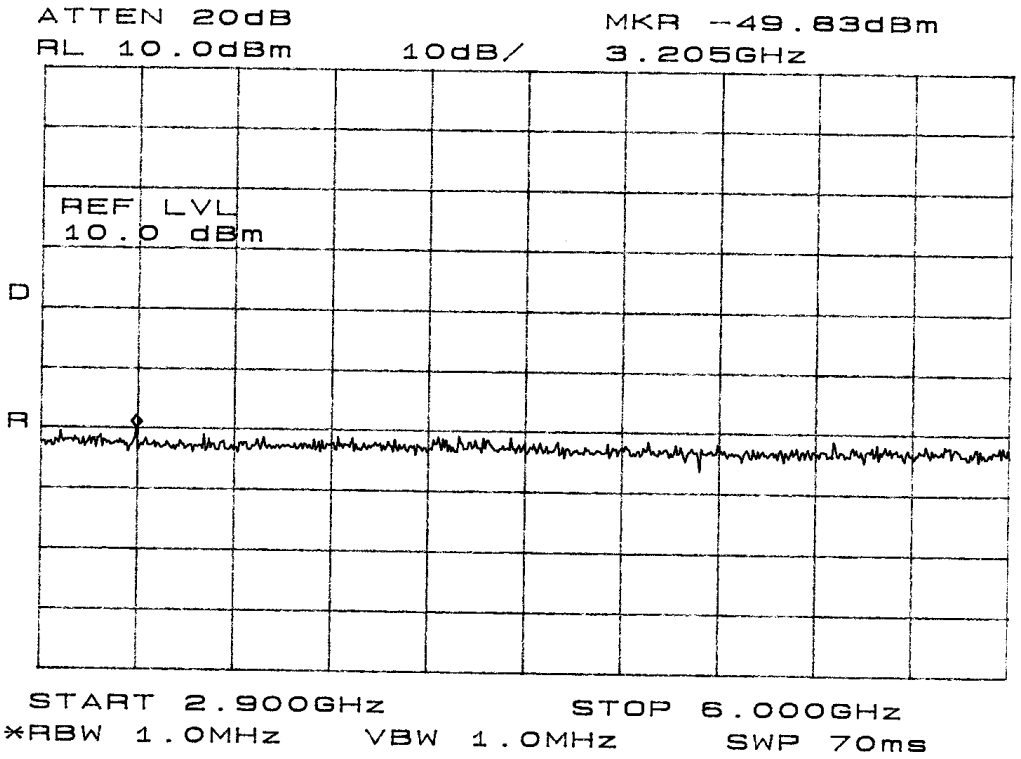

Figure Eleven Plot of Antenna Port Conducted Emissions

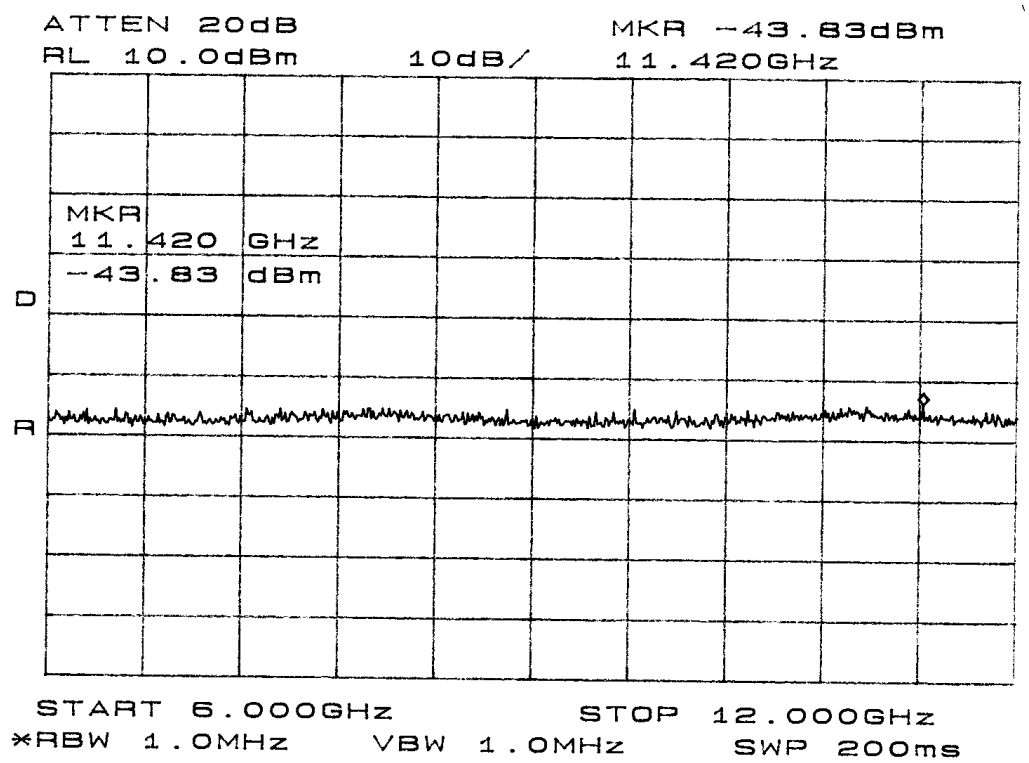

Figure Twelve Plot of Antenna Port Conducted Emissions

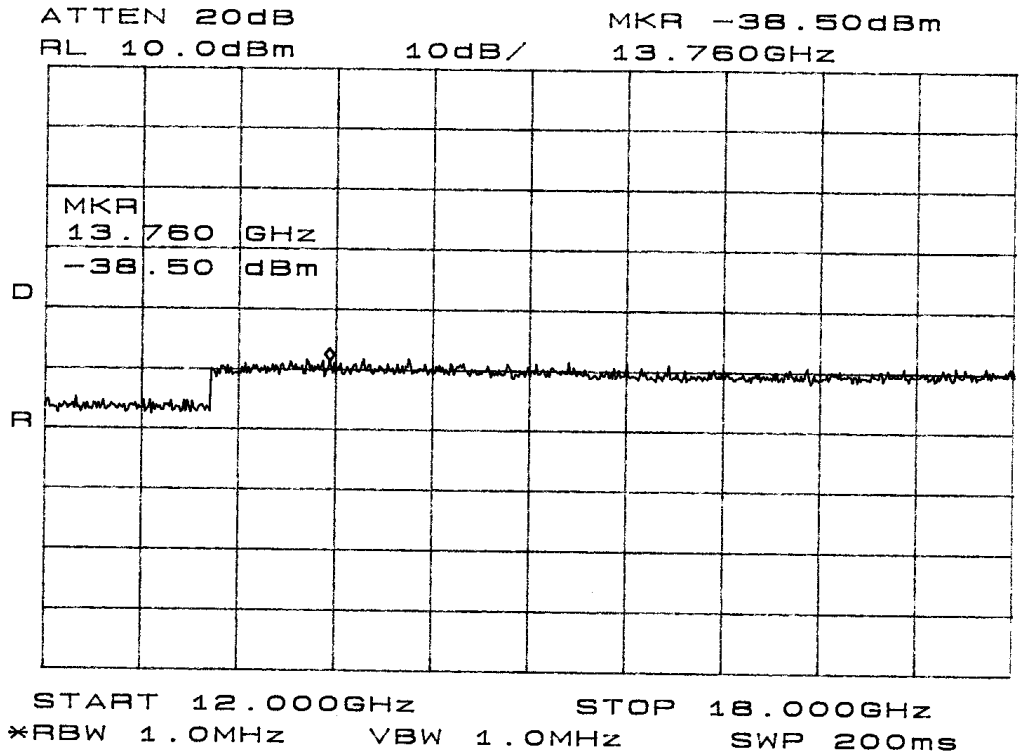

Figure Thirteen Plot of Antenna Port Conducted Emissions

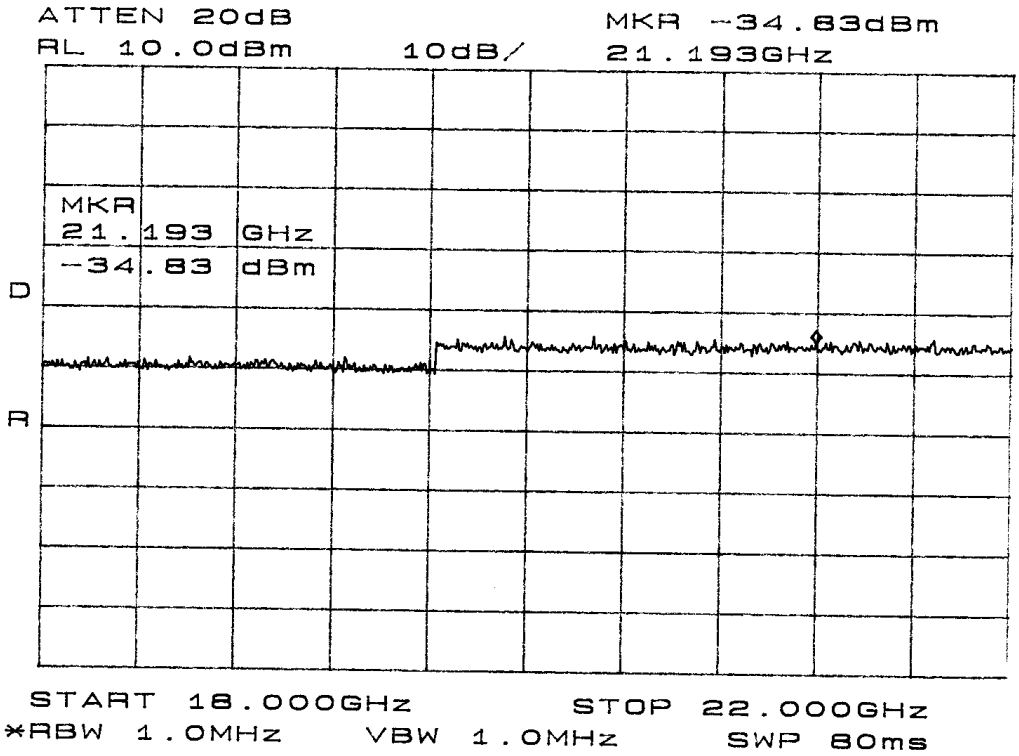

Figure Fourteen Plot of Antenna Port Conducted Emissions

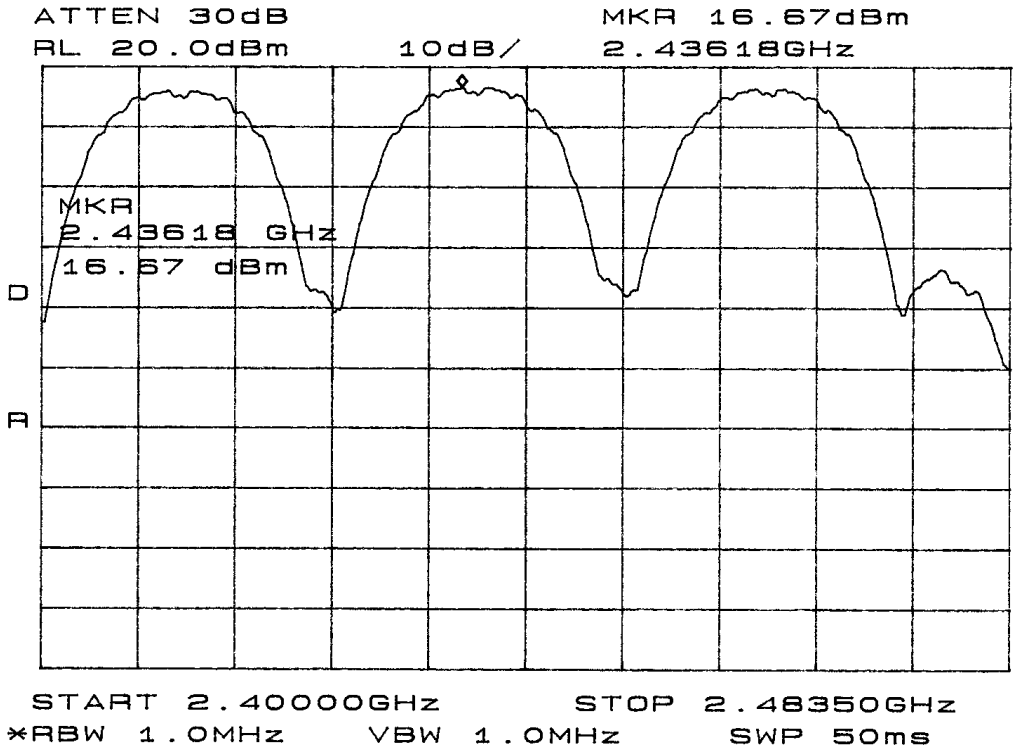

Figure Fifteen Plot of Power Output Across Operational Band (802.11b)

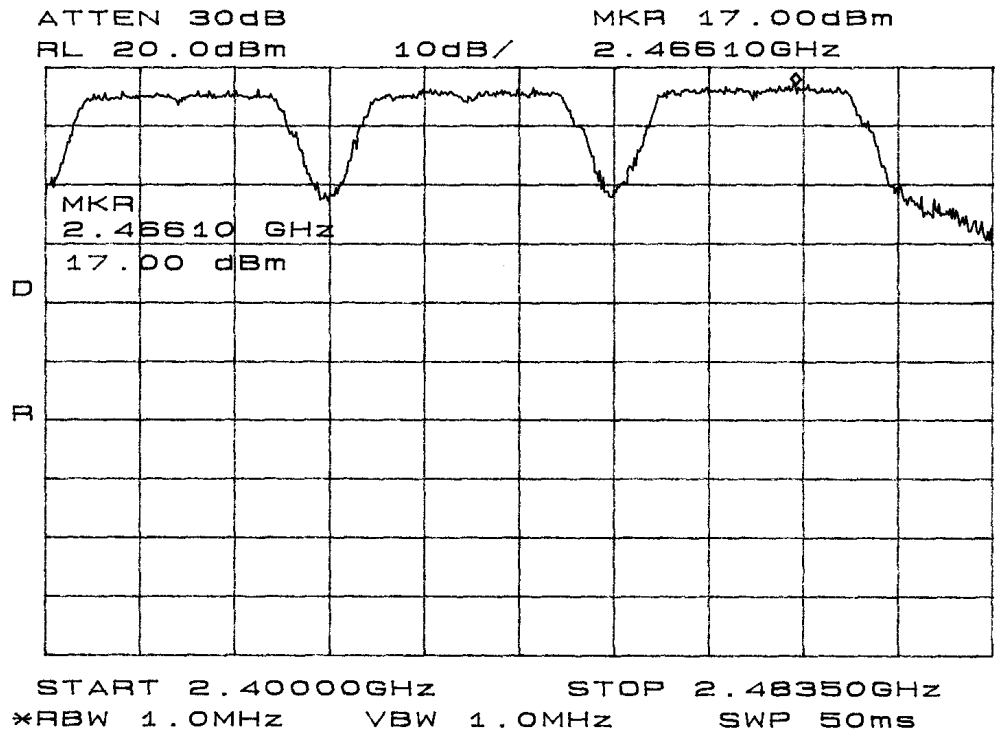

Figure Sixteen Plot of Power Output Across Operational Band (802.11g)

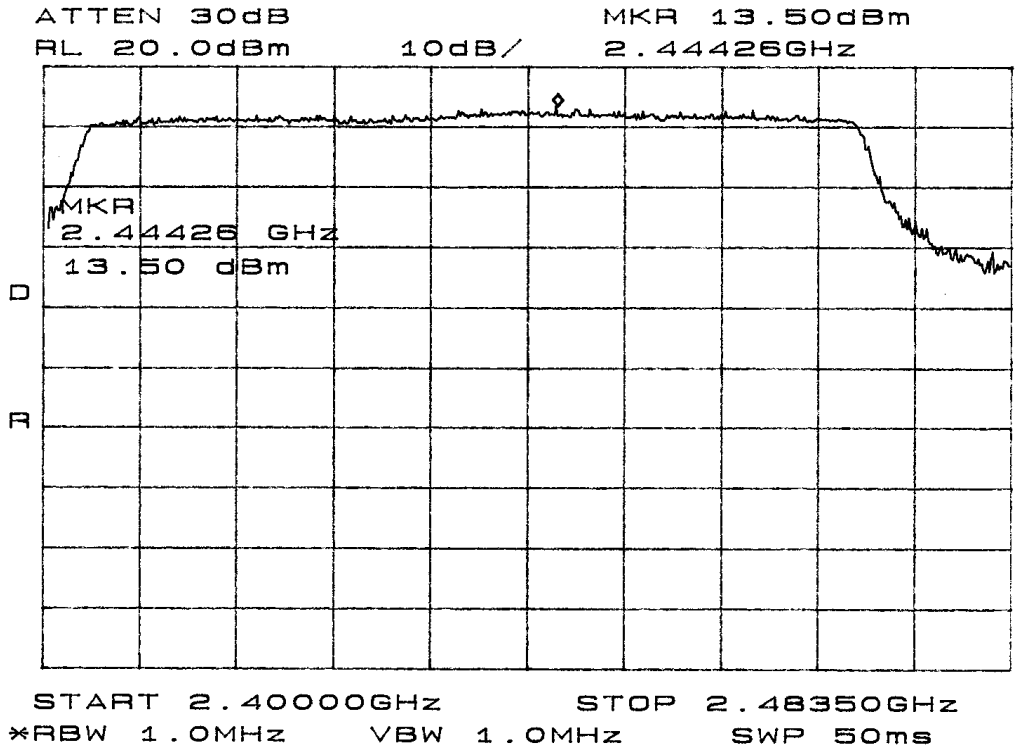

Figure Seventeen Plot of Power Output Across Operational Band (802.11n)

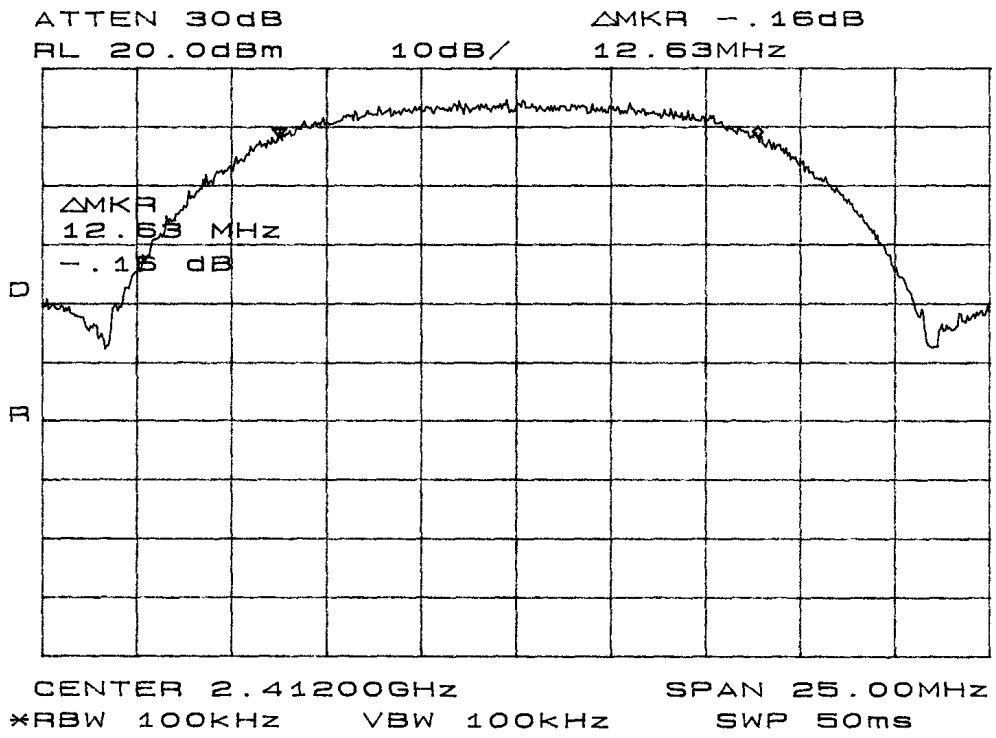

Figure Eighteen Plot of 6dB Band width (802.11b)

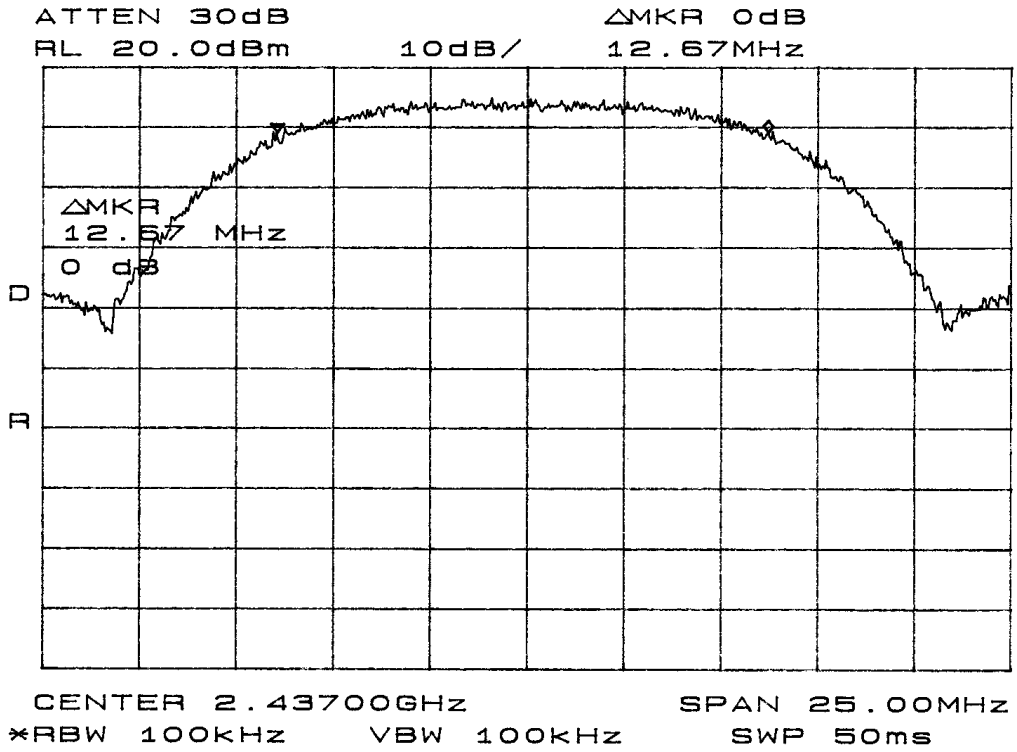

Figure Nineteen Plot of 6dB Band width (802.11b)

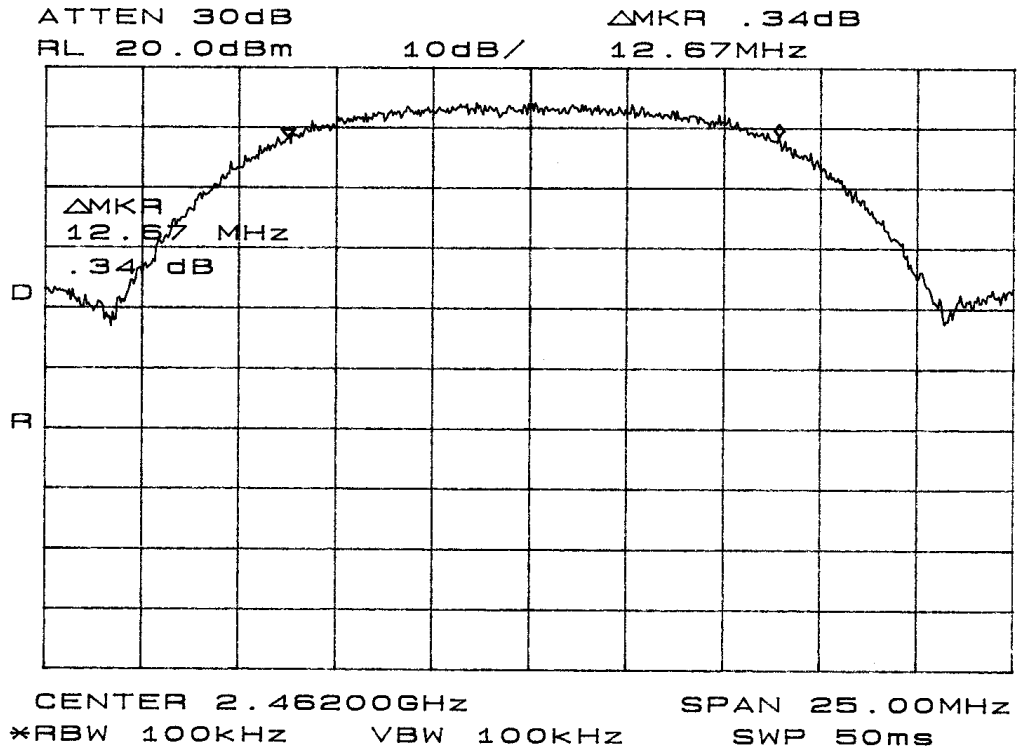

Figure Twenty Plot of 6dB Band width (802.11b)

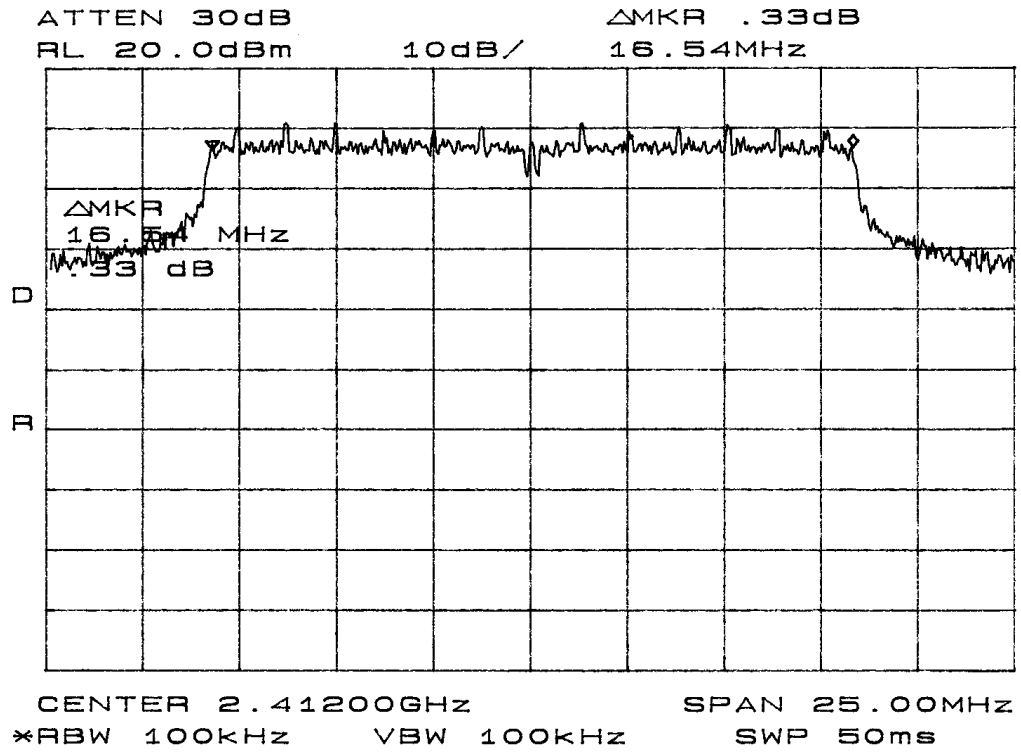

Figure Twenty-one Plot of 6dB Band width (802.11g/n20)

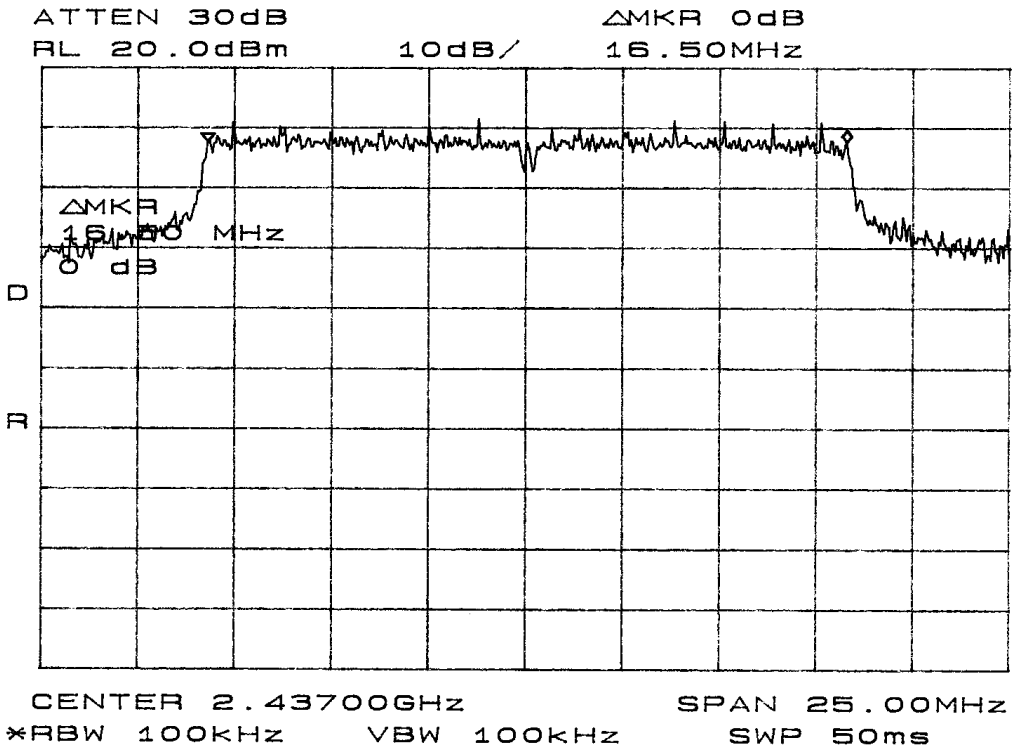

Figure Twenty-two Plot of 6dB Band width (802.11g/n20)

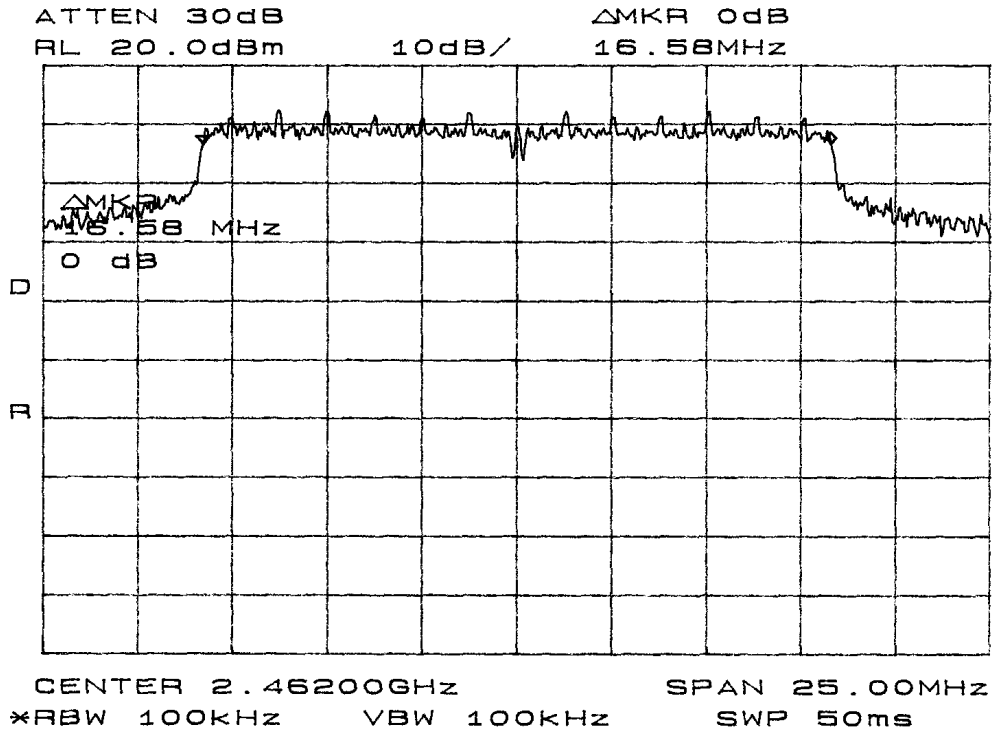

Figure Twenty-three Plot of 6dB Band width (802.11g/n20)

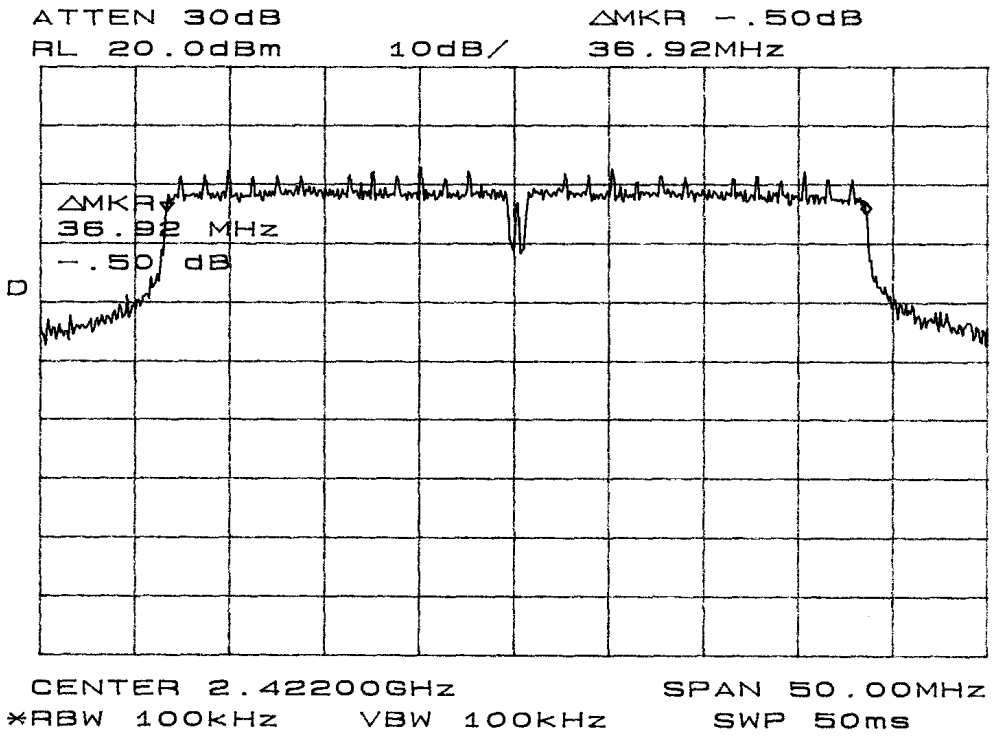

Figure Twenty-four Plot of 6dB Band width (802.11g/n40)

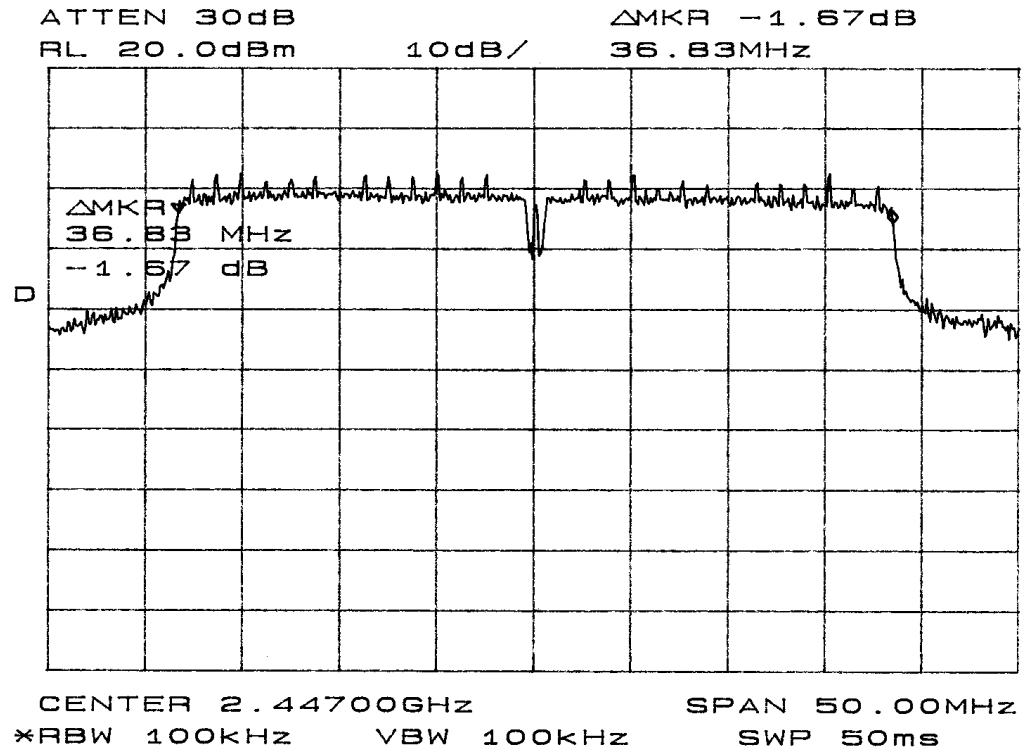

Figure Twenty-five Plot of 6dB Band width (802.11g/n40)

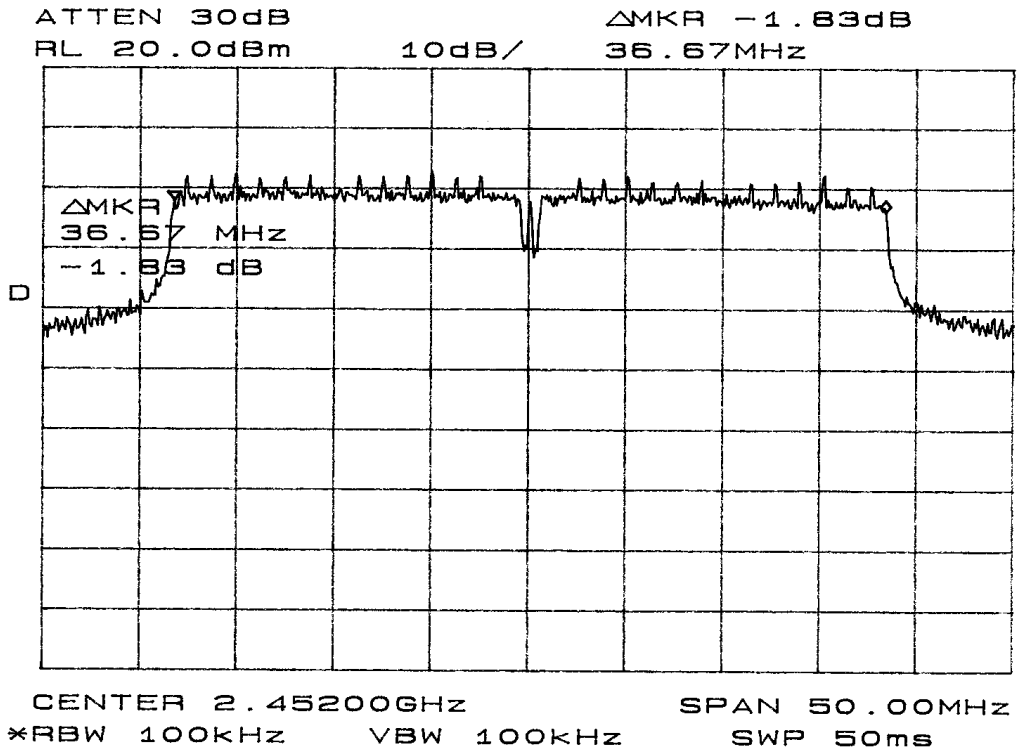

Figure Twenty-six Plot of 6dB Band width (802.11g/n40)

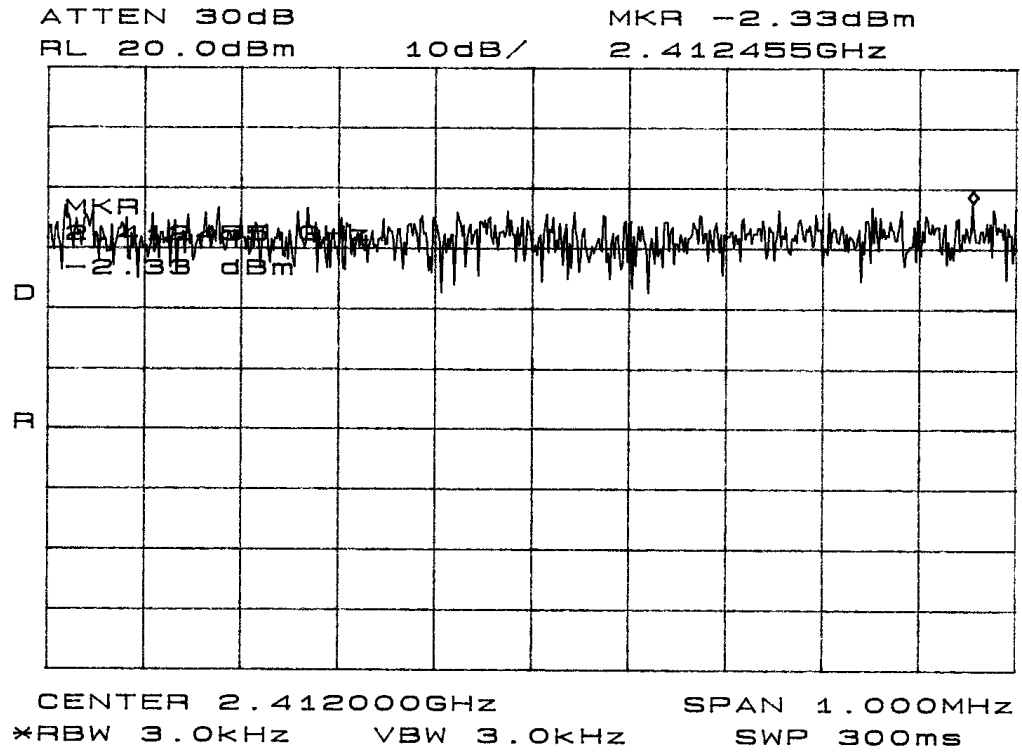

Figure Twenty-seven Plot of Power Spectral Density (802.11b)

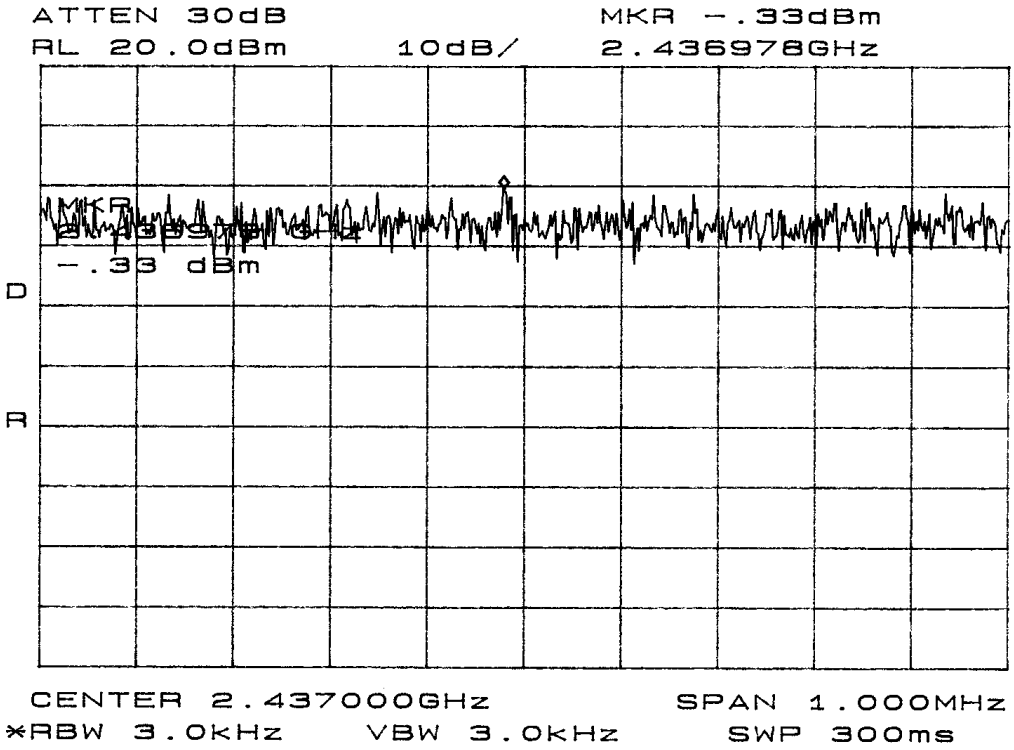

Figure Twenty-eight Plot of Power Spectral Density (802.11b)

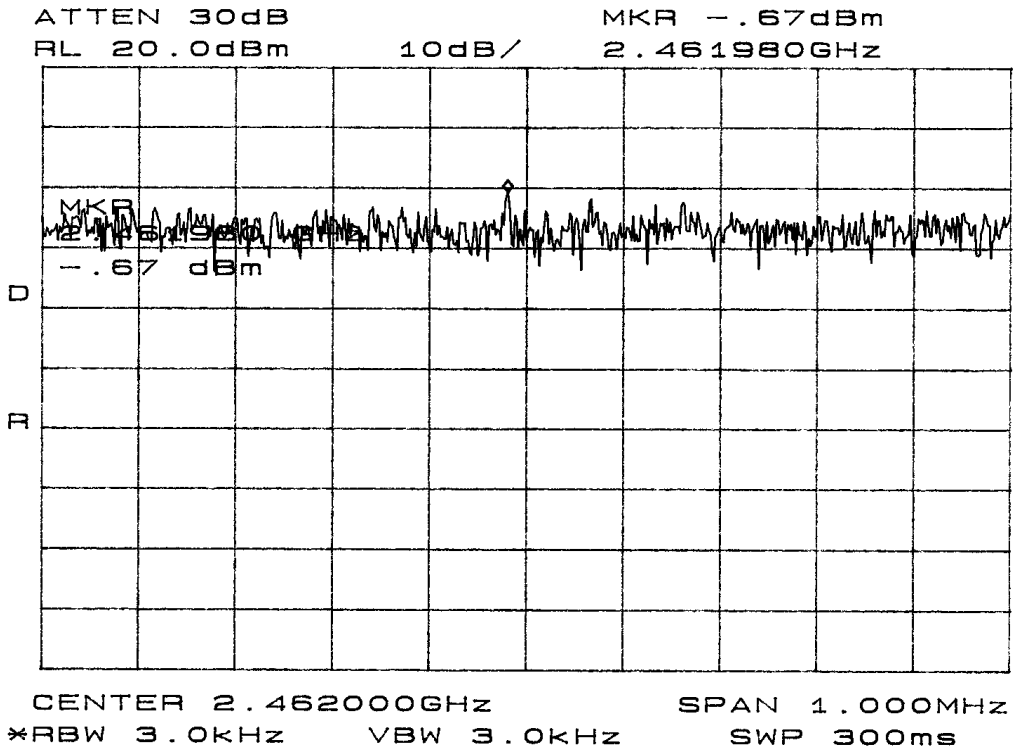

Figure Twenty-nine Plot of Power Spectral Density (802.11b)

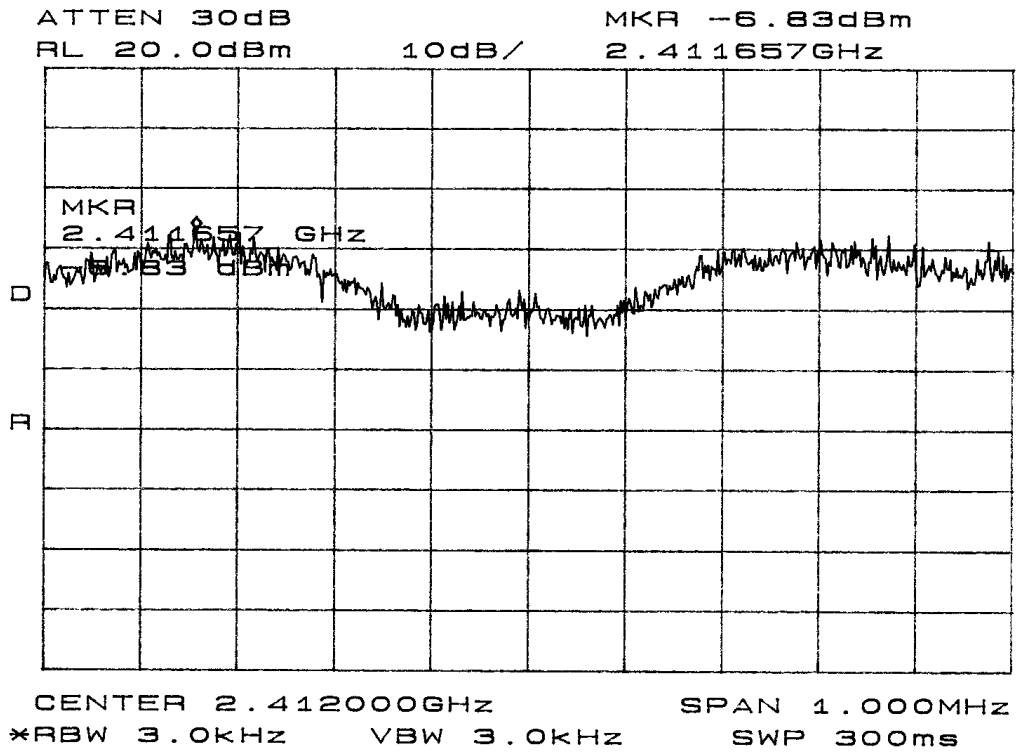

Figure Thirty Plot of Power Spectral Density (802.11g)

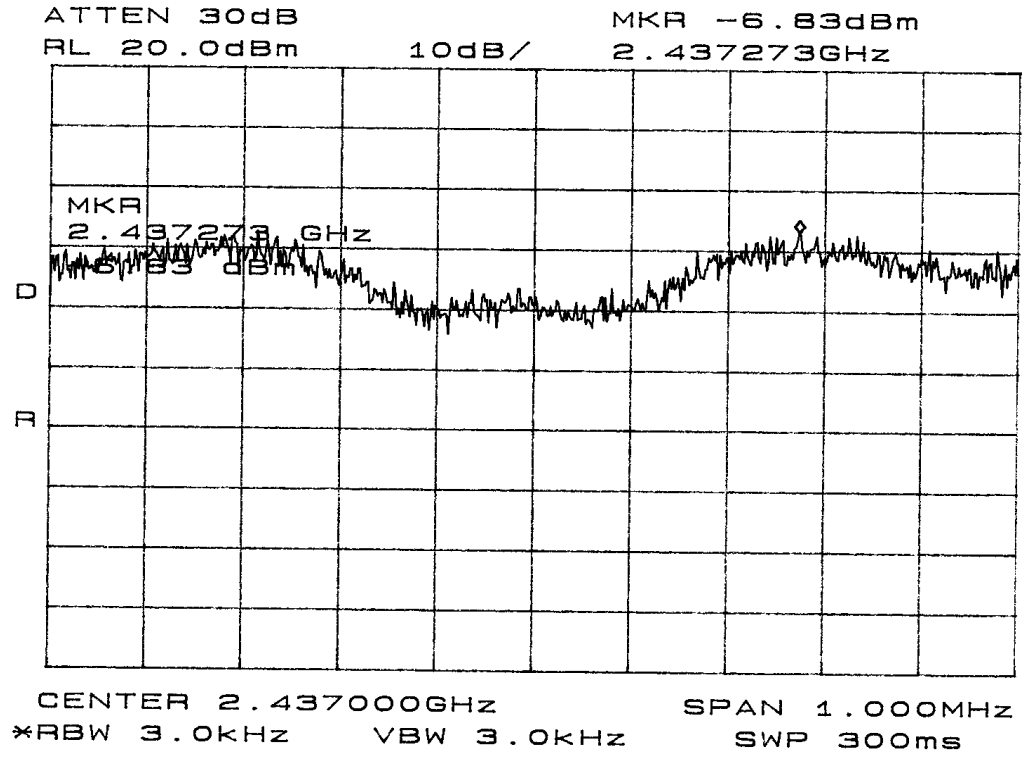

Figure Thirty-one Plot of Power Spectral Density (802.11g)

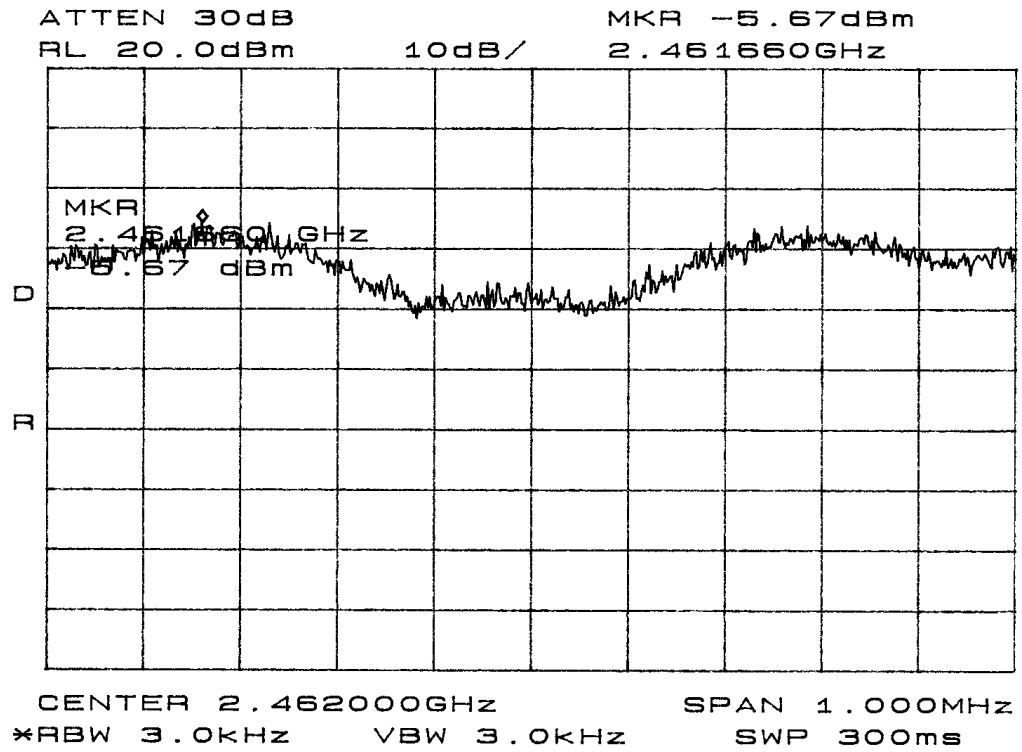

Figure Thirty-two Plot of Power Spectral Density (802.11g)

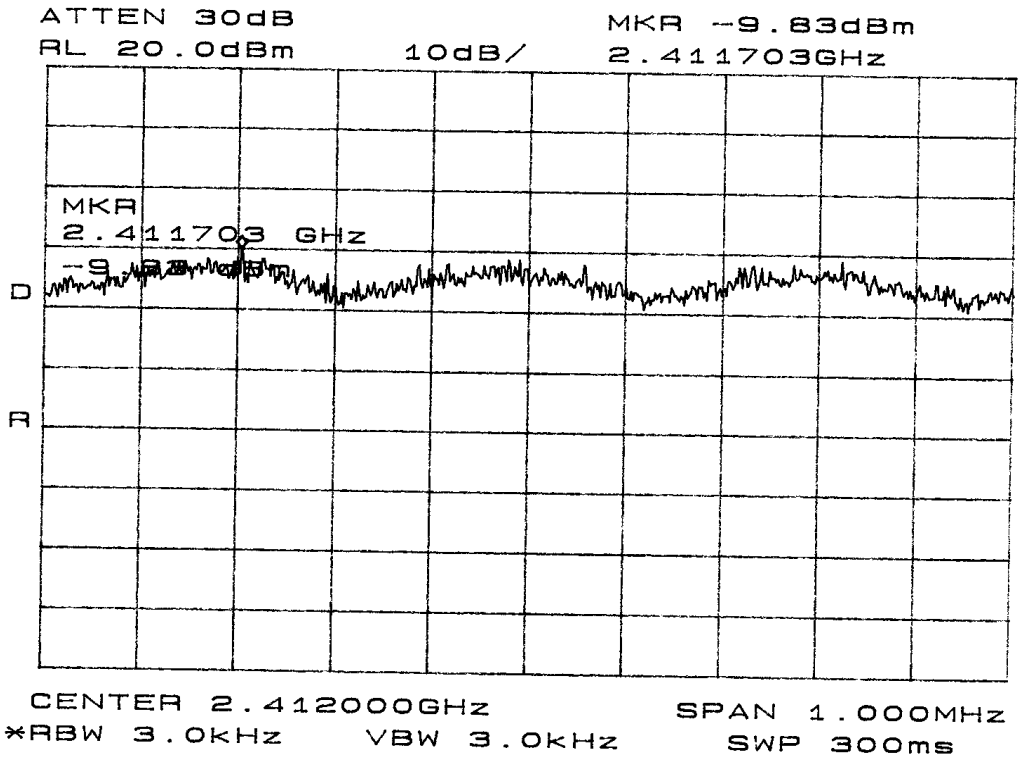

Figure Thirty-three Plot of Power Spectral Density (802.11n)

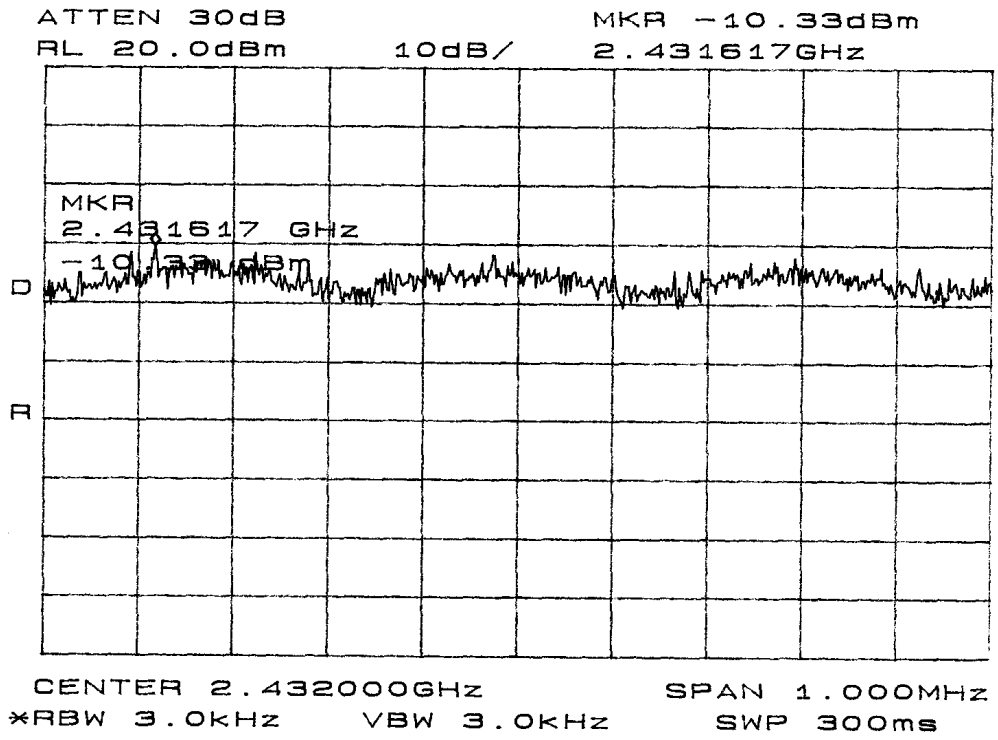

Figure Thirty-four Plot of Power Spectral Density (802.11n)

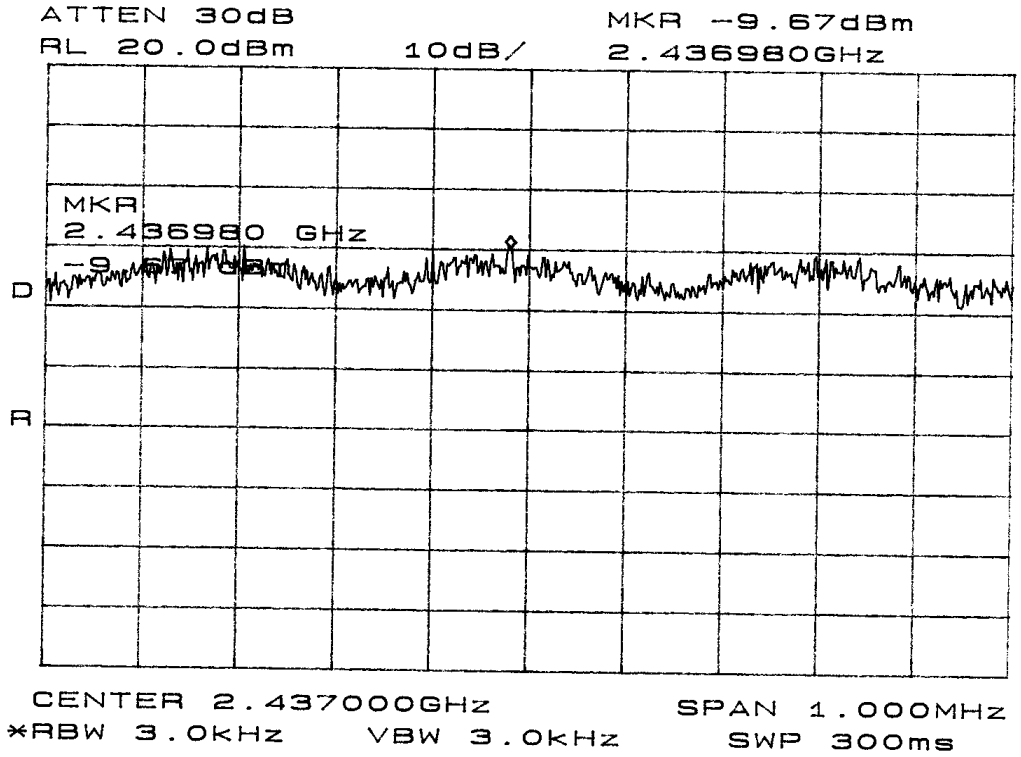

Figure Thirty-five Plot of Power Spectral Density (802.11n)

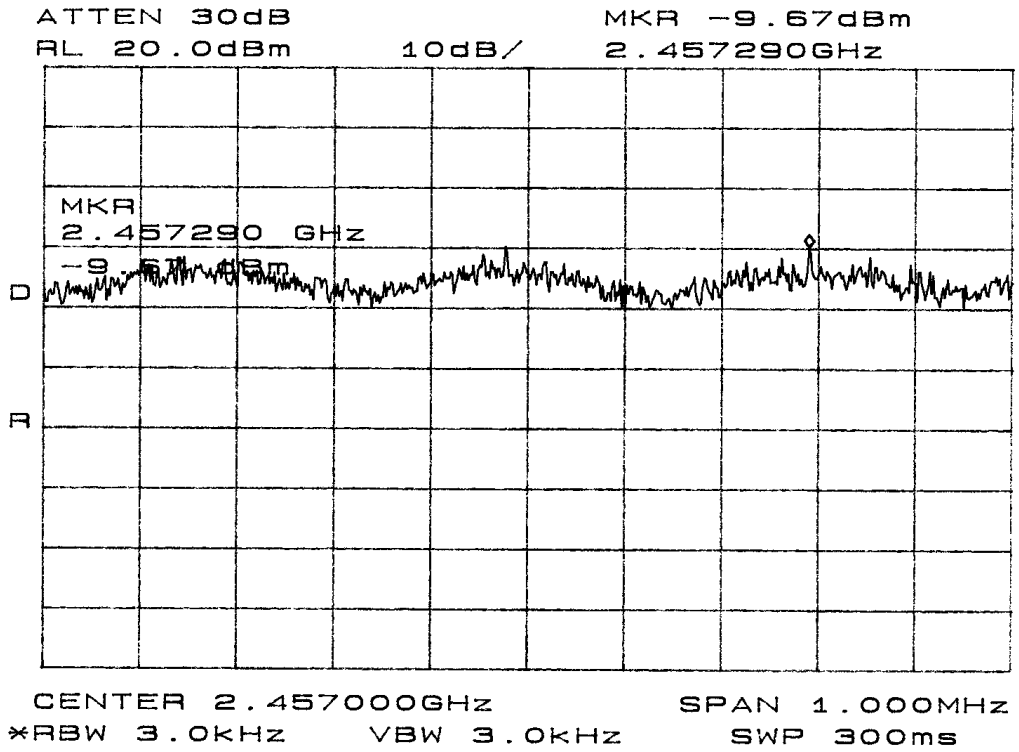

Figure Thirty-six Plot of Power Spectral Density (802.11n)

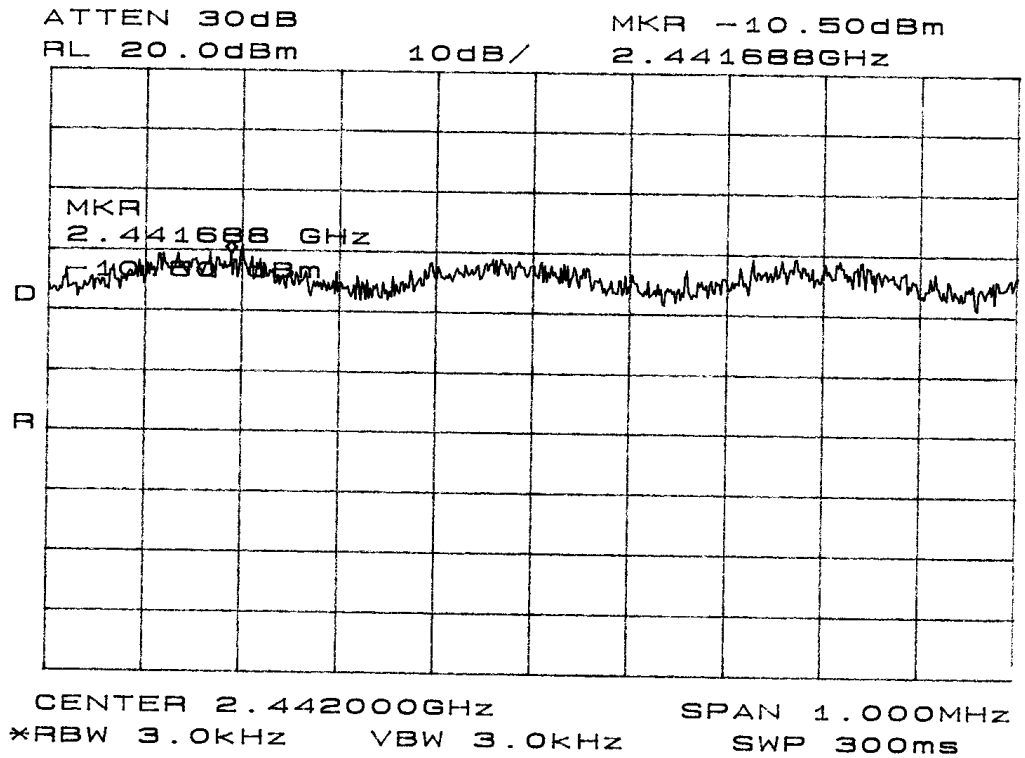

Figure Thirty-seven Plot of Power Spectral Density (802.11n)

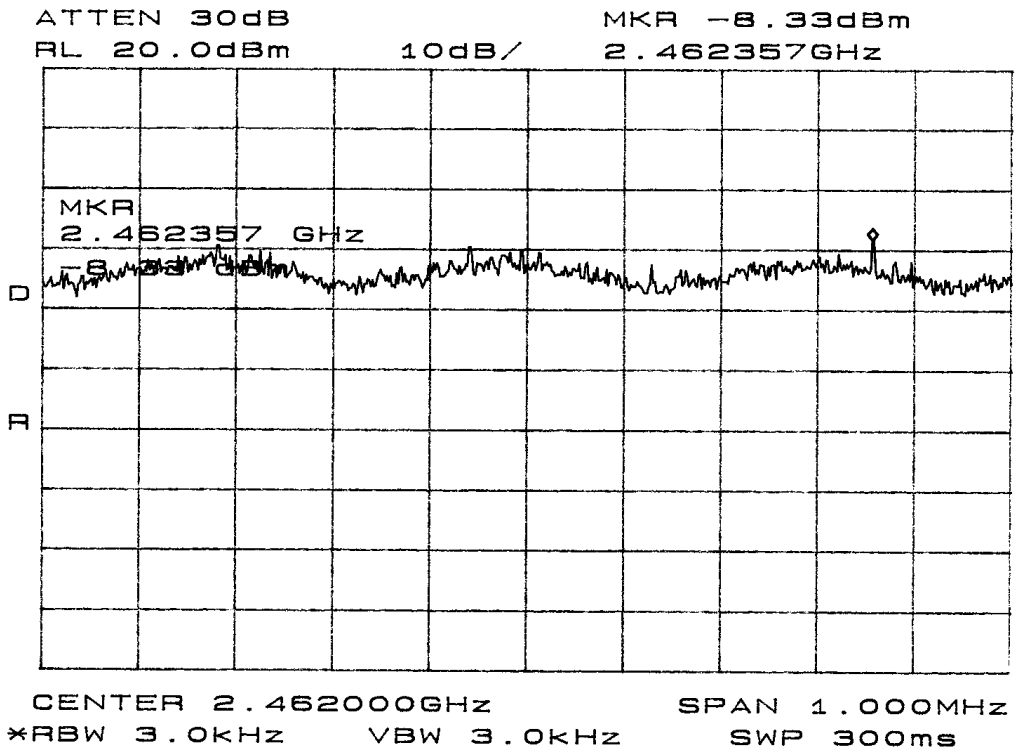

Figure Thirty-eight Plot of Power Spectral Density (802.11n)

Transmitter Antenna Conducted Emissions Data

The antenna conducted output power, power spectral density, and 6-dB bandwidth were measured while operating in available modes. The data reported below represents the worst-case operational conditions.

Frequency MHz	Antenna Conducted Output Power dBm	Occupied Bandwidth MHz	Power Spectral Density dBm
Mode 802.11b			
2412	16.7	12.63	-2.33
2437	16.7	12.67	-0.33
2462	16.6	12.67	-0.67
Mode 802.11g			
2412	17.0	16.54	-6.83
2437	17.0	16.50	-6.83
2462	17.0	16.58	-5.67
Channel 2422, Mode 802.11n			
2412	17.0	36.7	-9.83
2432	16.9	36.7	-10.33
Channel 2447, Mode 802.11n			
2437	16.8	36.8	-9.67
2457	16.9	36.8	-9.67
Channel 2452, Mode 802.11n			
2442	16.8	36.8	-10.50
2462	16.9	36.8	-8.33

Transmitter Radiated Emissions Data

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
Mode 802.11b/g							
2412.0	73.2	79.7	28.1	0	101.3	107.8	--
4824.0	9.8	16.8	32.7	10	32.5	39.5	54.0
7236.0	7.1	8.1	36.2	10	33.3	34.3	54.0
9648.0	7.2	8.0	38.2	10	35.4	36.2	54.0
12060.0	8.2	9.3	40.0	10	38.2	39.3	54.0
2437.0	73.1	80.6	28.1	0	101.2	108.7	--
4874.0	10.3	16.4	32.7	10	33.0	39.1	54.0
7311.0	7.0	7.6	36.3	10	33.3	33.9	54.0
9748.0	7.7	8.1	38.3	10	36.0	36.4	54.0
12185.0	8.6	8.8	40.0	10	38.6	38.8	54.0
2462.0	72.1	80.2	28.1	0	100.2	108.3	--
4924.0	9.0	17.4	32.8	10	31.8	40.2	54.0
7386.0	7.4	7.6	36.4	10	33.8	34.0	54.0
9848.0	8.5	8.2	38.3	10	36.8	36.5	54.0
12310.0	9.6	8.3	40.3	10	39.9	38.6	54.0
Band Edge Compliance							
2400.0	16.3	18.0	33.4	10	39.7	41.4	54.0
2483.5	12.2	15.4	33.8	10	36.0	39.2	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
Mode 802.11n							
2412.0	73.3	81.0	28.1	0	101.4	109.1	--
4824.0	8.3	8.6	32.7	10	31.0	31.3	54.0
7236.0	7.1	7.3	36.2	10	33.3	33.5	54.0
9648.0	7.6	8.0	38.2	10	35.8	36.2	54.0
12060.0	8.0	8.6	40.0	10	38.0	38.6	54.0
2422.0	74.2	79.8	28.1	0	102.3	107.9	--
4844.0	7.4	8.6	32.7	10	30.1	31.3	54.0
7266.0	7.4	8.3	36.2	10	33.6	34.5	54.0
9688.0	7.6	8.0	38.2	10	35.8	36.2	54.0
12185.0	9.0	9.3	40.0	10	39.0	39.3	54.0
2437.0	73.8	80.0	28.1	0	101.9	108.1	--
4874.0	8.0	8.7	32.7	10	30.7	31.4	54.0
7311.0	8.3	8.5	36.3	10	34.6	34.8	54.0
9748.0	7.5	8.4	38.3	10	35.8	36.7	54.0
12185.0	8.3	8.5	40.0	10	38.3	38.5	54.0
2447.0	74.9	79.2	28.1	0	103.0	107.3	--
4894.0	8.0	8.4	32.7	10	30.7	31.1	54.0
7341.0	8.3	8.3	36.4	10	34.7	34.7	54.0
9788.0	8.1	8.6	38.3	10	36.4	36.9	54.0
12235.0	8.8	9.0	40.1	10	38.9	39.1	54.0
2452.0	73.4	80.3	28.1	0	101.5	108.4	--
4904.0	8.1	8.4	32.8	10	30.9	31.2	54.0
7356.0	6.6	7.7	36.4	10	33.0	34.1	54.0
9808.0	8.4	7.5	38.3	10	36.7	35.8	54.0
12260.0	7.4	7.9	40.3	10	37.7	38.2	54.0
2462.0	71.1	80.5	28.1	0	99.2	108.6	--
4924.0	7.6	8.8	32.8	10	30.4	31.6	54.0
7386.0	7.0	8.0	36.4	10	33.4	34.4	54.0
9848.0	8.0	7.8	38.3	10	36.3	36.1	54.0
12310.0	7.9	8.4	40.3	10	38.2	38.7	54.0
Band Edge Compliance							
2400.0	16.5	18.3	33.4	10	39.9	41.7	54.0
2483.5	14.5	15.6	33.8	10	38.3	39.4	54.0

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for Radiated Emissions of Intentional Radiator 15.247

The EUT demonstrated antenna conducted output power of 50 milliwatt (at each antenna port) and had the highest radiated emission of 109.1 dBμV/m at 3 meters at the fundamental frequency of operation. The EUT demonstrated a worst-case of 13.8 dB margin below the limit for the harmonic emissions. The EUT demonstrated compliance with the radiated emissions requirements for CFR47 Part 15.247 Intentional Radiators. There are no measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. The specifications of 15.247 were met; there are no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the CFR47 Part 15C emissions standards. There were no deviations to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Site Registration Letter
- Annex E Industry Canada Site Registration Letter

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm 1.6$ dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

$U = 2\ U_c(y) = 2 \times \pm 1.6$ dB $= \pm 3.2$ dB

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_c(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_c(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Test Equipment List For Rogers Labs, Inc.

The test equipment used is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Oscilloscope Scope: Tektronix 2230	2/09
Wattmeter: Bird 43 with Load Bird 8085	2/09
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/09
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/09
R.F. Generator: HP 606A	2/09
R.F. Generator: HP 8614A	2/09
R.F. Generator: HP 8640B	2/09
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W HP Adapters: 11518, 11519, 11520	5/08
Spectrum Analyzer: HP 8591EM	5/08
Frequency Counter: Leader LDC825	2/09
Antenna: EMCO Biconilog Model: 3143	5/08
Antenna: EMCO Log Periodic Model: 3147	10/08
Antenna: Antenna Research Biconical Model: BCD 235	10/08
Antenna: EMCO Dipole Set 3121C	2/09
Antenna: C.D. B-101	2/09
Antenna: Solar 9229-1 & 9230-1	2/09
Antenna: EMCO 6509	2/09
Audio Oscillator: H.P. 201CD	2/09
R.F. Power Amp 65W Model: 470-A-1010	2/09
R.F. Power Amp 50W M185- 10-501	2/09
R.F. PreAmp CPPA-102	2/09
LISN 50 µHy/50 ohm/0.1 µf	10/08
LISN Compliance Eng. 240/20	2/09
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/09
Peavey Power Amp Model: IPS 801	2/09
Power Amp A.R. Model: 10W 1010M7	2/09
Power Amp EIN Model: A301	2/09
ELGAR Model: 1751	2/09
ELGAR Model: TG 704A-3D	2/09
ESD Test Set 2010i	2/09
Fast Transient Burst Generator Model: EFT/B-101	2/09
Current Probe: Singer CP-105	2/09
Current Probe: Solar 9108-1N	2/09
Field Intensity Meter: EFM-018	2/09
KEYTEK Ecat Surge Generator	2/09

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

Systems Engineer:	A/C Controls Mfg. Co., Inc.	6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc.	5 Years
Electrical Engineer:	Rogers Labs, Inc.	Current

Educational Background

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.

2) Bachelor of Science Degree in Business Administration Kansas State University.

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers

Scot D. Rogers

NVLAP Lab Code 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

June 18, 2008

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: June 18, 2008

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

July 29th, 2008

OUR FILE: 46405-3041
Submission No: 127059

Rogers Labs Inc.
4405 West 259th Terrace
Louisburg KY 66053
USA

Attention: Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the registration / renewal of a 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought **(3040A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please be informed that the Bureau is now utilizing a **new site numbering scheme** in order to simplify the electronic filing process. Our goal is to reduce the number of secondary codes associated to one particular company. The following changes have been made to your records.

Your primary code is: **3041**
The company number associated to the site(s) located at the above address is: **3041A**
The table below is a summary of the changes made to the unique site registration number(s):

New Site Number	Obsolete Site Number	Description of Site	Expiry Date (YYYY-MM-DD)
3041A-1	3041-1	3 / 10m OATS	2010-07-29

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 meter OATS or 3 meter chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to exceed two years. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca
Please reference our file and submission number above for all correspondence.

Yours sincerely,

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