

Certification Test Report

FCC ID: U9O-RF200

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-210

ACS Report Number: 10-0264.W06.11.A

Manufacturer: Synapse Wireless, Inc.
Model: RF200

Test Begin Date: August 12, 2010
Test End Date: September 2, 2010

Report Issue Date: April 26, 2011



FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

A handwritten signature in black ink, appearing to read "Kirby Munroe", is placed over a horizontal line.

Reviewed by:
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This test report shall not be reproduced except in full. This report may be reproduced in part with prior written consent of ACS, Inc. The results contained in this report are representative of the sample(s) submitted for evaluation.

This report contains 22 pages

TABLE OF CONTENTS

1	GENERAL	3
1.1	PURPOSE.....	3
1.2	PRODUCT DESCRIPTION	3
1.3	TEST METHODOLOGY AND CONSIDERATIONS	3
2	TEST FACILITIES.....	4
2.1	LOCATION	4
2.2	LABORATORY ACCREDITATIONS/RECOGNITIONS/CERTIFICATIONS	4
2.3	RADIATED EMISSIONS TEST SITE DESCRIPTION	5
2.3.1	<i>Semi-Anechoic Chamber Test Site.....</i>	5
2.3.2	<i>Open Area Tests Site (OATS)</i>	6
2.4	CONDUCTED EMISSIONS TEST SITE DESCRIPTION	7
3	APPLICABLE STANDARD REFERENCES.....	7
4	LIST OF TEST EQUIPMENT.....	8
5	SUPPORT EQUIPMENT	9
6	EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM	9
7	SUMMARY OF TESTS.....	10
7.1	ANTENNA REQUIREMENT – FCC: SECTION 15.203	10
7.2	POWER LINE CONDUCTED EMISSIONS – FCC: SECTION 15.207 IC: RSS-GEN 7.2.2.....	10
7.2.1	<i>Measurement Procedure.....</i>	10
7.2.2	<i>Measurement Results</i>	10
7.3	RADIATED EMISSIONS – FCC: SECTION 15.109(UNINTENTIONAL RADIATION) IC: RSS-210 2.6..	12
7.3.1	<i>Measurement Procedure.....</i>	12
7.3.2	<i>Measurement Results</i>	12
7.4	12
7.5	6DB / 99% BANDWIDTH – FCC: SECTION 15.247(A)(2) IC: RSS-210 A8.2(A).....	13
7.5.1	<i>Measurement Procedure.....</i>	13
7.5.2	<i>Measurement Results</i>	13
7.6	PEAK OUTPUT POWER REQUIREMENT - FCC SECTION 15.247(B)(3) IC: RSS-210 A8.4(4).....	15
7.6.1	<i>Measurement Procedure.....</i>	15
7.6.2	<i>Measurement Results</i>	15
7.7	BAND-EDGE COMPLIANCE AND SPURIOUS EMISSIONS-FCC 15.247D IC:RSS-210 2.6, A8.5	16
7.7.1	<i>Band-Edge Compliance of RF Conducted Emissions.....</i>	16
7.7.1.1	Measurement Procedure.....	16
7.7.1.2	Measurement Results	16
7.7.2	<i>RF Conducted Spurious Emissions.....</i>	17
7.7.2.1	Measurement Procedure.....	17
7.7.2.2	Measurement Results	17
7.7.3	<i>Radiated Spurious Emissions (Restricted Bands) - FCC Sec. 15.205 IC: RSS-210 2.6.....</i>	19
7.7.3.1	Measurement Procedure.....	19
7.7.3.2	Duty Cycle Correction	19
7.7.3.3	Measurement Results	19
7.7.3.4	Sample Calculation:	20
7.8	PEAK POWER SPECTRAL DENSITY- FCC SECTION 15.247(E) IC: RSS-210 A8.2(B).....	21
7.8.1	<i>Measurement Procedure.....</i>	21
7.8.2	<i>Measurement Results</i>	21
8	CONCLUSION	22

1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for a single modular approval.

1.2 Product description

The Synapse Wireless RF200 Module is an IEEE 802.15.4 compliant RF module that is approved as an FCC Part 15 unlicensed modular transmitter.

Band of operation: 2405 - 2480 MHz
Number of channels: 16
Channel spacing 5 MHz
Modulation format: O-QPSK
Antenna(s): Pulse 1/4 wavelength dipole - 3.2dBi
Operating Voltage: 9VDC

Manufacturer Information:
Synapse Wireless, Inc.
500 Discovery Drive
Huntsville, AL 35806

Test Sample Serial Number(s): A

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

A test evaluation board was utilized to supply power and program the EUT for test modes. See Section 5.0 – 6.0 for additional details.

A reduction in power was required at channel 26 (2480MHz) for compliance with band-edge limits, therefore measurements were made at both channels 25 and 26 and data for both included in the following report.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 894540

Industry Canada Lab Code: IC 4175A-1

VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

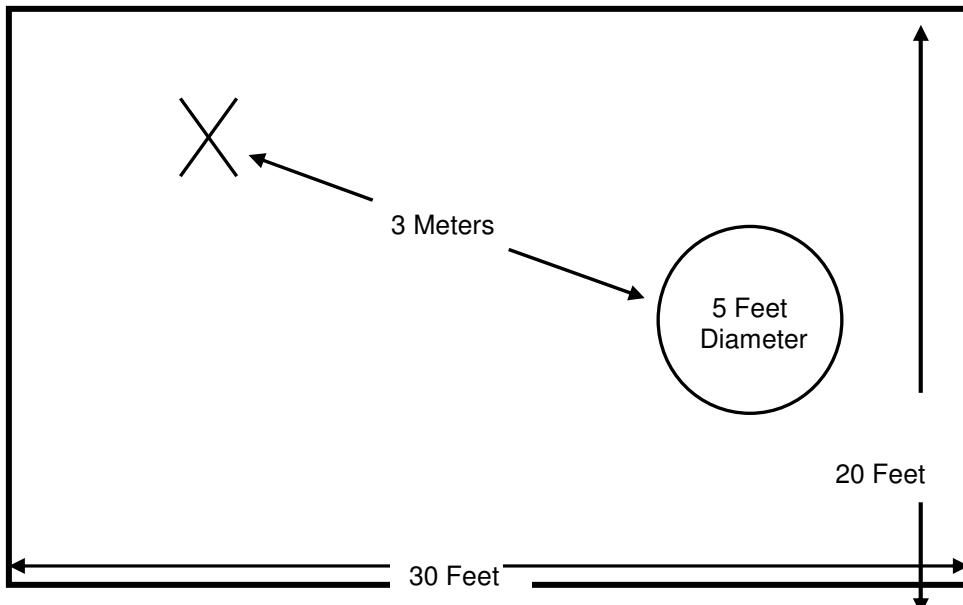


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

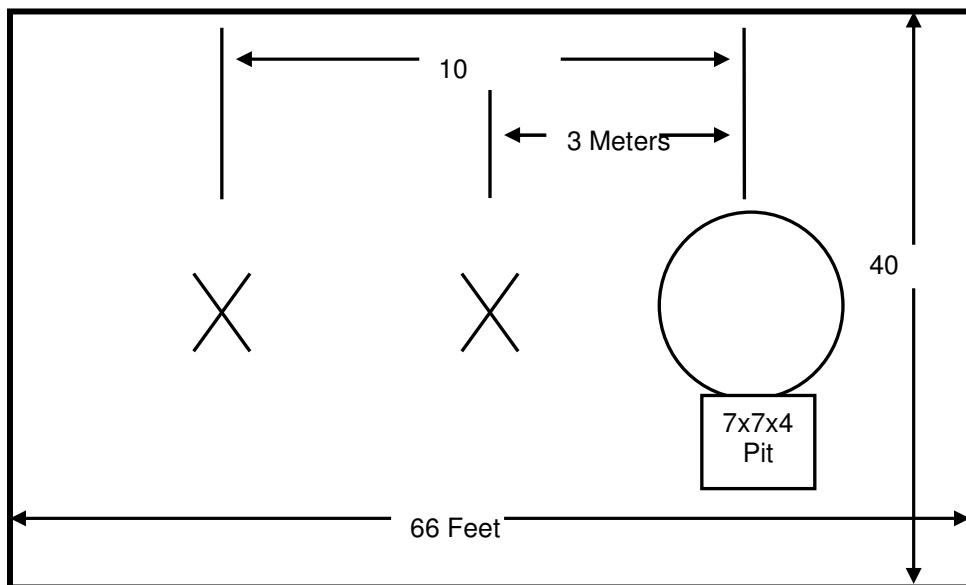


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

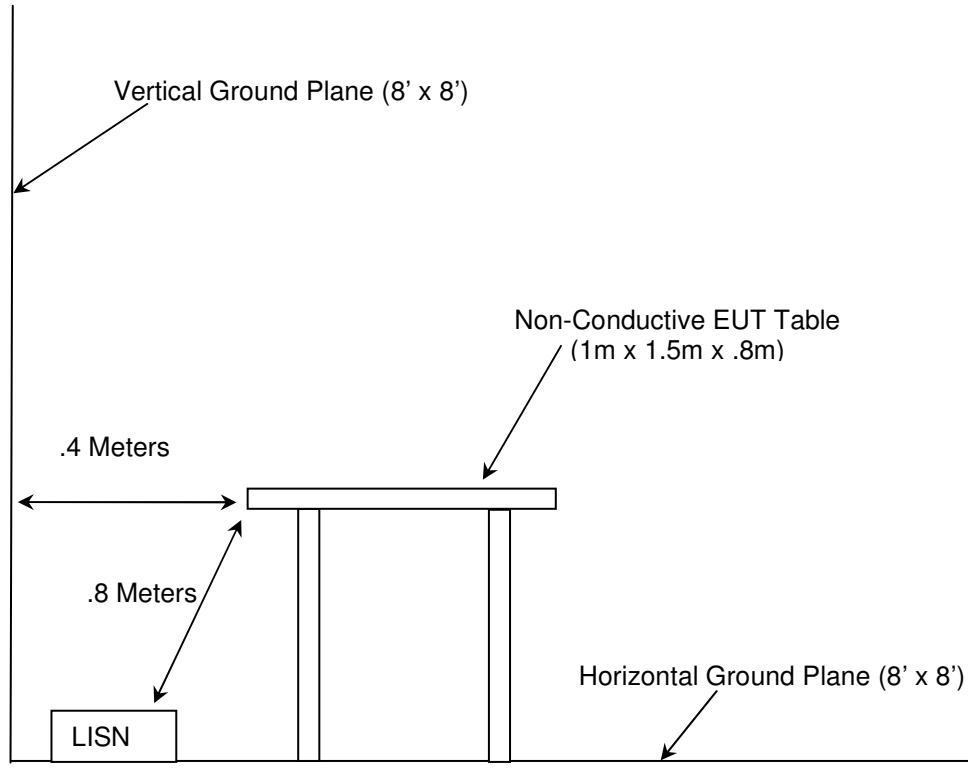


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2010
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2010
- ❖ FCC KDB Publication No. 558074 - Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247), March 2005
- ❖ Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, Dec 2010
- ❖ Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, Dec 2010

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESM - Display	Spectrum Analyzers	833771/007	9/23/2010	9/23/2012
2	Rohde & Schwarz	ESM-Receiver	Spectrum Analyzers	839587/003	9/23/2010	9/23/2012
3	Rohde & Schwarz	ESM - Display	Spectrum Analyzers	839379/011	2/2/2009	2/2/2011
4	Rohde & Schwarz	ESM - Receiver	Spectrum Analyzers	833827/003	2/2/2009	2/2/2011
25	Chase	CBL6111	Antennas	1043	9/13/2010	9/13/2012
30	Spectrum Technologies	DRH-0118	Antennas	970102	5/8/2009	5/8/2011
73	Agilent	8447D	Amplifiers	2727A05624	5/26/2010	5/26/2011
153	EMDO	3825/2	LISN	9411-2268	1/13/2011	1/13/2012
167	ACS	Chamber EM Cable Set	Cable Set	167	1/26/2011	1/26/2012
168	Hewlett Packard	11947A	Attenuators	44829	2/4/2011	2/4/2012
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/7/2010	12/7/2011
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	12/7/2010	12/7/2011
324	ACS	Belden	Cables	8214	7/9/2010	7/9/2011
338	Hewlett Packard	8449B	Amplifiers	3008A01111	10/29/2010	10/29/2011
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	10/5/2010	10/5/2011
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	12/29/2010	12/29/2011
432	Microwave Circuits	H3G020G4	Filters	264066	7/16/2010	7/16/2011
RE39	Rohde & Schwarz	FSU46	Spectrum Analyzers	200009	7/27/2010	7/27/2011

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Test Evaluation Board	Synapse Wireless, Inc.	500225-01BLF	NA
2	5V USB Power Supply	CUI, Inc.	3A-061WU05B	NA

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

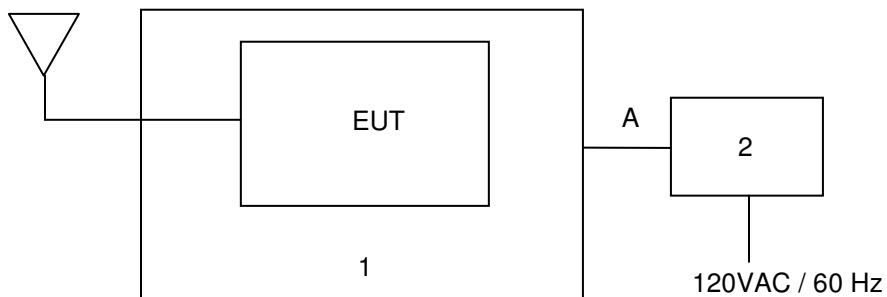


Figure 1: Radiated & AC Power Line Conducted Emissions Setup

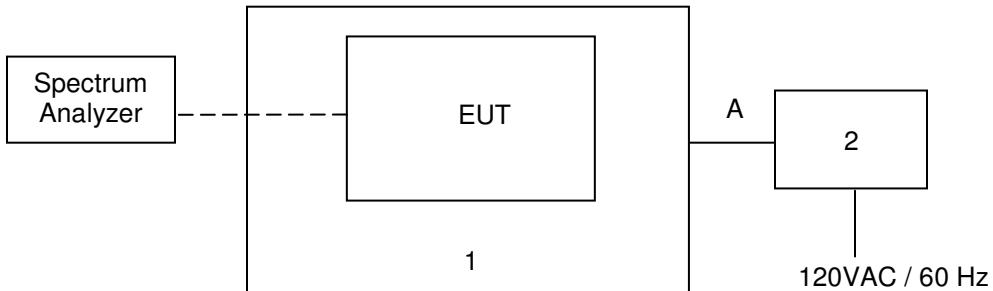


Figure 2: RF Conducted Setup

A – 3m Unshielded USB Cable

Note: For RF conducted measurements, the EUT was connected directly to the RF input of a spectrum analyzer.

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The antenna is a 1/4 wavelength dipole antenna with a measured gain of 3.2 dBi. The coupling is R-SMA thus satisfying FCC Part 15.203.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Results of the test are shown below in and Table 7.2.2-1.

Table 7.2.2-1: Line 1 Conducted EMI Results

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
2.118	31.2	10	73	41.8	L1	FLO	QP
2.19	31.1	10	73	41.9	L1	FLO	QP
2.376	31.3	10	73	41.7	L1	FLO	QP
8.106	28.2	9.9	73	44.8	L1	FLO	QP
8.958	28.4	9.9	73	44.7	L1	FLO	QP
8.994	28.1	9.9	73	45	L1	FLO	QP
9.582	28.6	9.9	73	44.4	L1	FLO	QP
9.618	28.5	9.9	73	44.5	L1	FLO	QP
10.002	28.6	9.9	73	44.4	L1	FLO	QP
10.596	28.1	9.9	73	44.9	L1	FLO	QP
2.082	22	10	60	38	L1	FLO	AVG
2.172	22.2	10	60	37.8	L1	FLO	AVG
2.346	22.5	10	60	37.5	L1	FLO	AVG
8.094	20.9	9.9	60	39.1	L1	FLO	AVG
8.904	20.7	9.9	60	39.3	L1	FLO	AVG
8.982	21.5	9.9	60	38.5	L1	FLO	AVG
9.576	21.7	9.9	60	38.3	L1	FLO	AVG
10.002	21.3	9.9	60	38.7	L1	FLO	AVG
10.506	21.5	9.9	60	38.5	L1	FLO	AVG

Table 7.2.2-2: Line 2 Conducted EMI Results

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
2.136	29.7	10	73	43.3	L2	FLO	QP
2.196	29.6	10	73	43.4	L2	FLO	QP
2.352	29.5	10	73	43.5	L2	FLO	QP
7.392	28.1	10	73	44.9	L2	FLO	QP
9.018	27.6	9.9	73	45.4	L2	FLO	QP
9.138	27.9	9.9	73	45.1	L2	FLO	QP
10.002	28.4	9.9	73	44.6	L2	FLO	QP
10.194	28.2	9.9	73	44.8	L2	FLO	QP
11.436	27.5	9.8	73	45.5	L2	FLO	QP
11.454	27.3	9.8	73	45.7	L2	FLO	QP
2.184	20.3	10	60	39.7	L2	FLO	AVG
2.202	20.2	10	60	39.8	L2	FLO	AVG
2.346	21	10	60	39	L2	FLO	AVG
7.35	20.2	10	60	39.8	L2	FLO	AVG
9.018	21.3	9.9	60	38.7	L2	FLO	AVG
9.246	21	9.9	60	39.1	L2	FLO	AVG
10.002	21.4	9.9	60	38.6	L2	FLO	AVG
10.236	21.3	9.9	60	38.7	L2	FLO	AVG
11.256	21.3	9.8	60	38.7	L2	FLO	AVG
11.574	20.7	9.8	60	39.3	L2	FLO	AVG

7.3 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation) IC: RSS-210 6.1

7.3.1 Measurement Procedure

Radiated emissions tests were performed over the frequency range of 30MHz to 12.5GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements above 30MHz and below 1GHz were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz using a Quasi-peak detector. Above 1GHz, peak and average measurements are taken with the RBW and VBW were set to 1MHz and 3MHz respectively.

7.3.2 Measurement Results

Results of the test are given in Table 7.3.2-1:

7.4

Table 7.3.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
41.33	-----	29.38	v	-15.75	-----	13.63	-----	40.0	-----	26.40
68.91	-----	41.26	V	-18.24	-----	23.02	-----	40.0	-----	17.00
70.8	-----	33.75	v	-18.73	-----	15.02	-----	40.0	-----	25.00
90.06	-----	25.84	V	-8.16	-----	17.68	-----	43.5	-----	25.80
105.55	-----	33.75	v	-12.58	-----	21.17	-----	43.5	-----	22.30
131.43	-----	32.99	V	-12.69	-----	20.30	-----	43.5	-----	23.20

* Note: All emissions above 131.43 MHz were attenuated below the permissible limit.

7.5 6dB / 99% Bandwidth – FCC: Section 15.247(a)(2) IC: RSS-210 A8.2(a)

7.5.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the entire emissions and >> RBW.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission and approximately 20 dB below the peak level. The RBW was to 1% - 3% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth.

7.5.2 Measurement Results

Results are shown below in table 7.4.2-1 and figure 7.4.2-1 to 7.4.2-6:

Table 7.4.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
2405	1.56	2.31
2440	1.50	2.34
2480	1.56	2.40

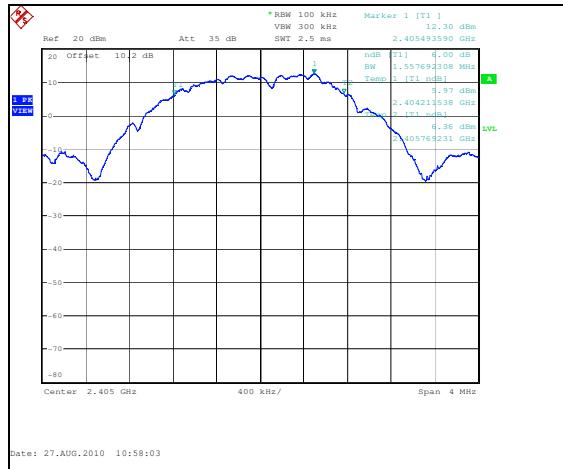


Figure 7.4.2-1: 6dB Bandwidth Plot – 2405MHz

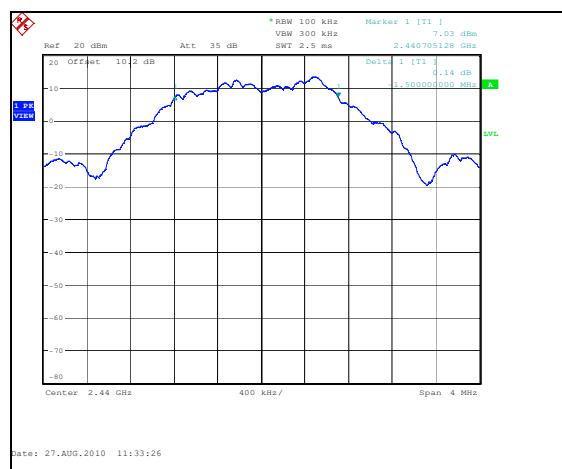
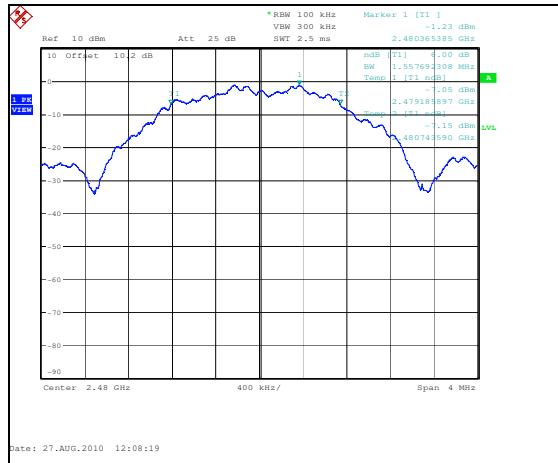
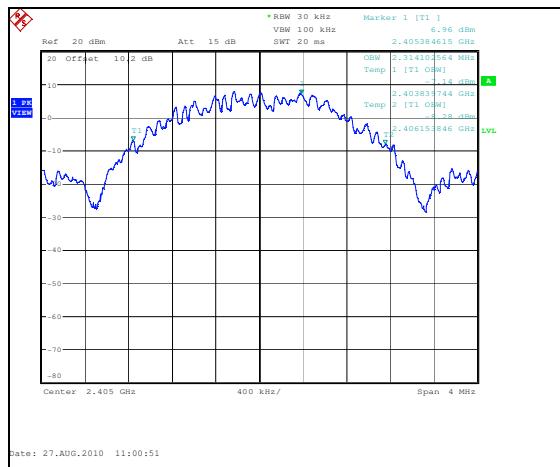


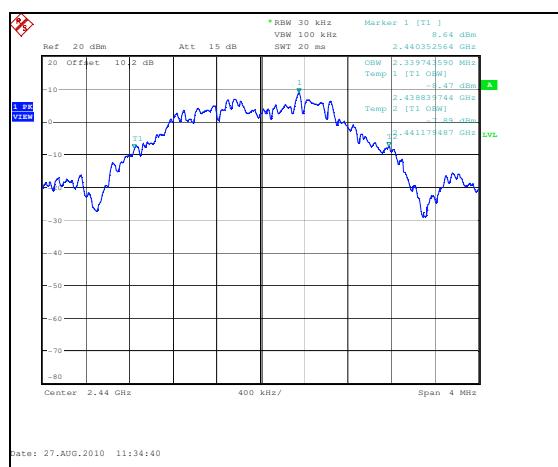
Figure 7.4.2-2: 6dB Bandwidth Plot – 2440MHz



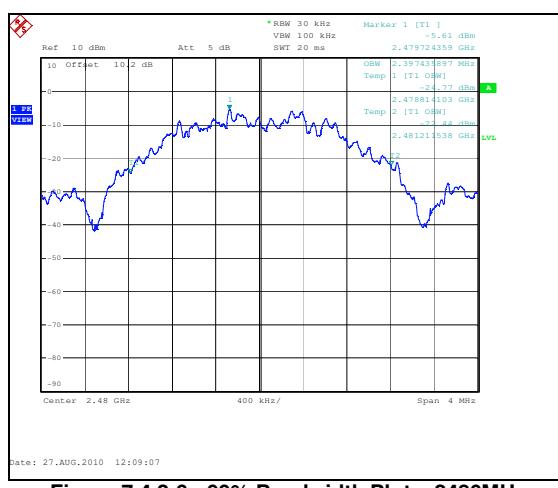
Date: 27.AUG.2010 12:08:19



Date: 27.AUG.2010 11:00:51



Date: 27.AUG.2010 11:34:40



Date: 27.AUG.2010 12:09:07

7.6 Peak Output Power Requirement - FCC Section 15.247(b)(3) IC: RSS-210 A8.4(4)

7.6.1 Measurement Procedure

The Peak Output Power was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)" Power Option 1. The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. Data was collected with the EUT operating at maximum power per channelization. Measurements were made at both 2475MHz and 2480MHz based on the difference in power levels.

7.6.2 Measurement Results

Results are shown below in Table 7.5.2-1 and Figures 7.5.2-1 to 7.5.2-4.

Table 7.5.2-1: Peak Output Power

Frequency (MHz)	Output Power (dBm)
2405	15.82
2440	15.14
2475	14.53
2480	1.76

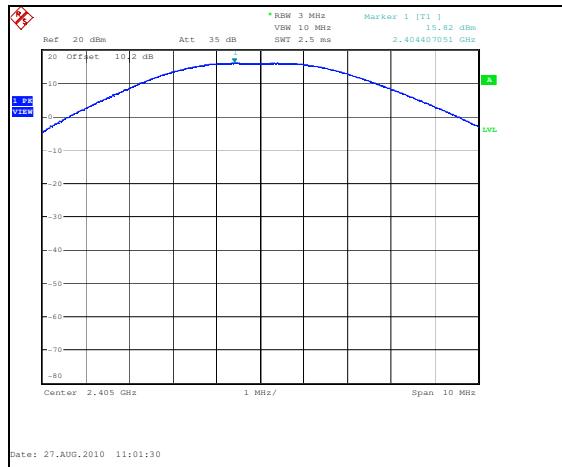


Figure 7.5.2-1: Output power – 2405MHz

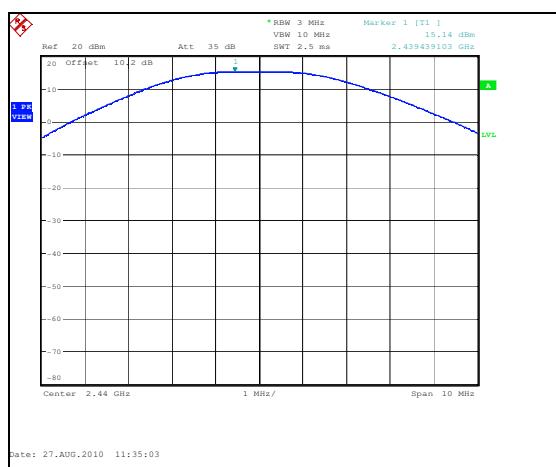


Figure 7.5.2-2: Output power – 2440MHz



Figure 7.5.2-3: Output power – 2475MHz

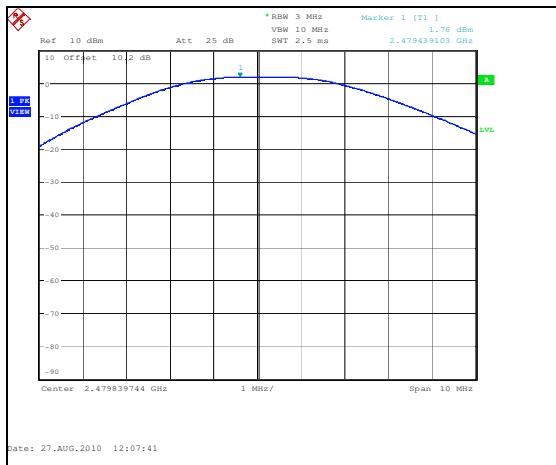


Figure 7.5.2-4: Output power – 2480MHz

7.7 Band-Edge Compliance and Spurious Emissions-FCC 15.247d IC:RSS-210 2.6, A8.5

7.7.1 Band-Edge Compliance of RF Conducted Emissions

7.7.1.1 Measurement Procedure

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. All antenna types were evaluated. Because the upper band-edge coincides with a restricted band, band-edge compliance for the upper band-edge was determined based on absolute radiated field strength measurements.

The lower band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

Band-edge measurements were made at both 2475MHz and 2480MHz based on the difference in power levels.

7.7.1.2 Measurement Results

Band-edge compliance is displayed in Tables 7.6.1.2-1 – 7.6.1.2-2 and Figure 7.6.1.2-1.

Table 7.6.1.2-1: Upper Band-edge Radiated Emissions - 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2483.5	61.01	50.27	H	-4.16	56.85	29.09	74.0	54.0	17.1	24.9
2483.5	74.13	63.64	V	-4.16	69.97	42.46	74.0	54.0	4.0	11.5

Table 7.6.1.2-2: Upper Band-edge Radiated Emissions - 2480MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2483.5	61.67	51.64	H	-4.16	57.51	30.46	74.0	54.0	16.5	23.5
2483.5	77.81	68.29	V	-4.16	73.65	47.11	74.0	54.0	0.3	6.9

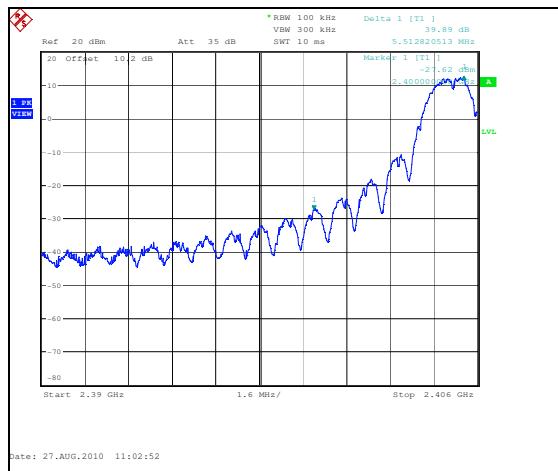


Figure 7.6.1.2-1: Lower Band-edge (Conducted)

7.7.2 RF Conducted Spurious Emissions

7.7.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The EUT was investigated for conducted spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized.

7.7.2.2 Measurement Results

In a 100 kHz bandwidth, the radio frequency power that was produced by the EUT emissions is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. RF Conducted Emissions are displayed in Figures 7.6.2.2-1 through 7.6.2.2-9.

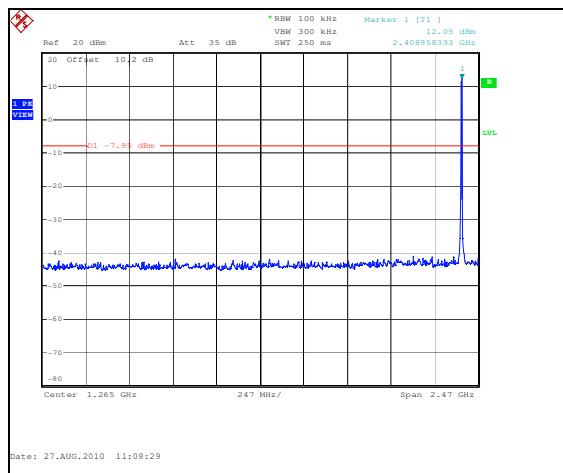


Figure 7.6.2.2-1: 30 MHz – 2.5 GHz – 2405MHz

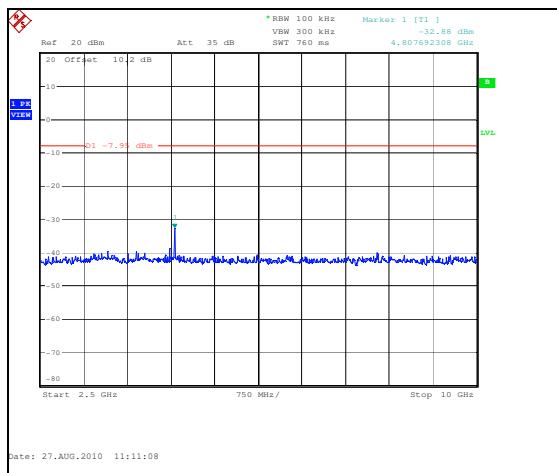


Figure 7.6.2.2-2: 2.5 GHz – 10 GHz – 2405MHz

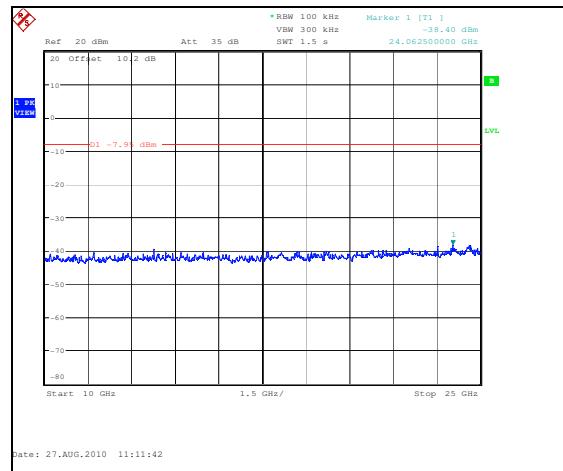


Figure 7.6.2.2-3: 10 GHz – 25 GHz – 2405MHz

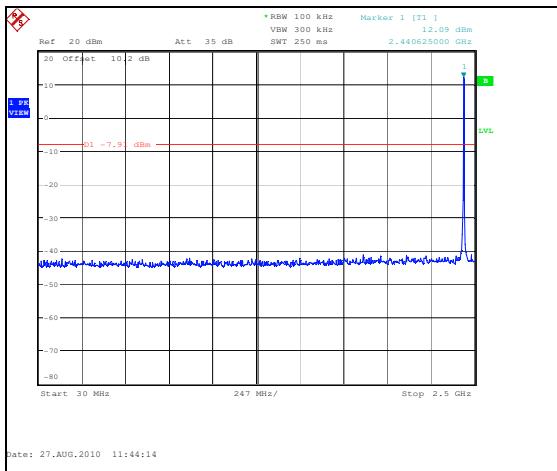


Figure 7.6.2.2-4: 30 MHz – 2.5 GHz – 2440MHz

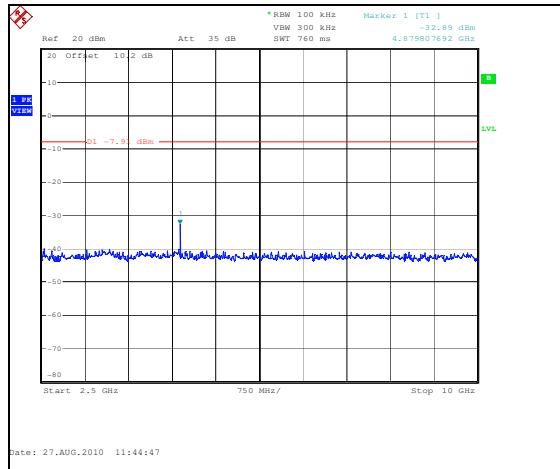


Figure 7.6.2.2-5: 2.5 GHz – 10 GHz – 2440MHz

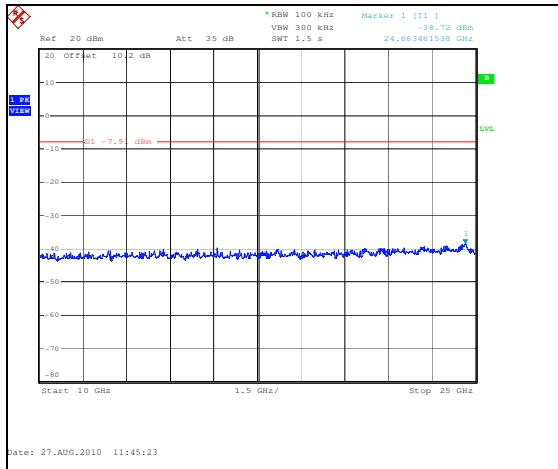


Figure 7.6.2.2-6: 10 GHz – 25 GHz – 2440MHz

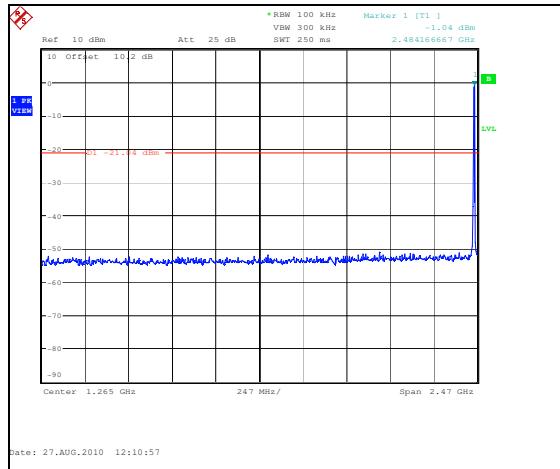


Figure 7.6.2.2-7: 30 MHz – 2.5 GHz – 2480MHz

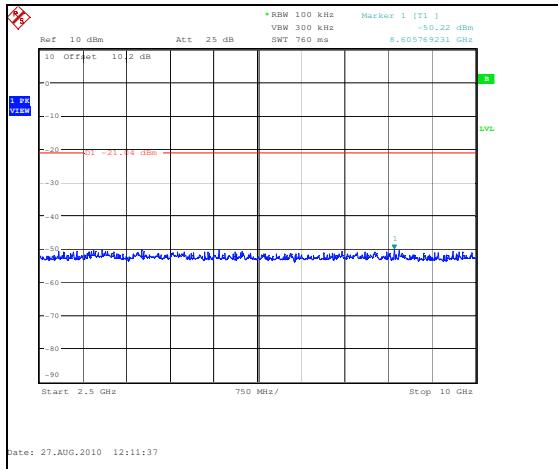


Figure 7.6.2.2-8: 2.5 GHz – 10 GHz – 2480MHz

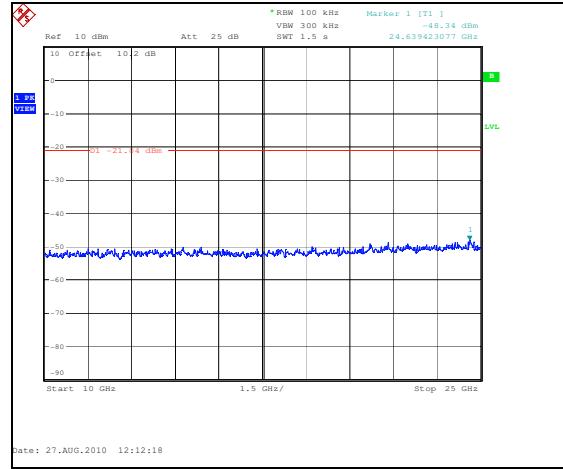


Figure 7.6.2.2-9: 10 GHz – 25 GHz – 2480MHz

7.7.3 Radiated Spurious Emissions (Restricted Bands) - FCC Sec. 15.205 IC: RSS-210 2.6

7.7.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 25 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively. The average emissions were further corrected by applying the duty cycle correction of the EUT for comparison to the average limit.

Each emission found to be in a restricted band as defined by section 15.205 was compared to the radiated emission limits as defined in section 15.209.

7.7.3.2 Duty Cycle Correction

For average radiated measurements, using a 14.1% duty cycle, the measured level was reduced by a factor 17.02dB. The duty cycle correction factor is determined using the formula: $20\log(14.1/100) = -17.02\text{dB}$.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying this report.

7.7.3.3 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 25GHz are reported in the tables below.

Table 7.6.3.3-1: Radiated Spurious Emissions Tabulated Data – 2405MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2390	51.11	41.41	H	-4.67	46.44	19.72	74.0	54.0	27.6	34.3
2390	66.91	58.29	V	-4.67	62.24	36.60	74.0	54.0	11.8	17.4
4810	53.06	44.45	H	3.17	56.23	30.60	74.0	54.0	17.8	23.4
4810	59.06	51.84	V	3.17	62.23	37.99	74.0	54.0	11.8	16.0
12025	59.06	50.47	H	16.31	75.37	49.76	83.5	63.5	8.1	13.7
12025	62.38	54.16	V	16.31	78.69	53.45	83.5	63.5	4.8	10.1

* Note: All emissions above 12025 MHz were attenuated below the permissible limit.

Table 7.6.3.3-2: Radiated Spurious Emissions Tabulated Data – 2440MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4880	56.16	49.59	H	3.38	59.54	35.96	74.0	54.0	14.5	18.0
4880	61.93	55.02	V	3.38	65.31	41.39	74.0	54.0	8.7	12.6
7320	55.12	47.02	H	8.40	63.52	38.41	74.0	54.0	10.5	15.6
7320	61.49	54.31	V	8.40	69.89	45.70	74.0	54.0	4.1	8.3
12200	57.25	49.38	H	17.50	74.75	49.86	83.5	63.5	8.8	13.6
12200	62.23	54.97	V	17.50	79.73	55.45	83.5	63.5	3.8	8.0

* Note: All emissions above 12200 MHz were attenuated below the permissible limit.

Table 7.6.3.3-3: Radiated Spurious Emissions Tabulated Data – 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4950	56.52	48.80	H	3.60	60.12	35.38	74.0	54.0	13.9	18.6
4950	60.02	52.99	V	3.60	63.62	39.57	74.0	54.0	10.4	14.4
7425	56.97	48.90	H	8.55	65.52	40.44	74.0	54.0	8.5	13.6
7425	63.22	55.91	V	8.55	71.77	47.45	74.0	54.0	2.2	6.6
12375	53.98	44.73	H	18.69	72.67	46.40	83.5	63.5	10.8	17.1
12375	57.81	49.48	V	18.69	76.50	51.15	83.5	63.5	7.0	12.3
19800	51.55	40.04	V	15.96	67.51	38.99	83.5	63.5	16.0	24.5

* Note: All emissions above 19800 MHz were attenuated below the permissible limit.

Table 7.6.3.3-4: Radiated Spurious Emissions Tabulated Data – 2480MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
No emissions were detected above the noise floor of the measurement system.										

7.7.3.4 Sample Calculation:

$$R_C = R_U + CF_T$$

Where:

CF_T = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)

R_U = Uncorrected Reading

R_C = Corrected Level

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

DC = Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: $53.06 + 3.17 = 56.23$ dBuV/m

Margin: 74 dBuV/m – 56.23 dBuV/m = 17.8 dB

Example Calculation: Average

Corrected Level: $41.41 - 4.67 - 17.02 = 19.72$ dBuV

Margin: 54 dBuV – 19.72 dBuV = 34.3 dB

7.8 Peak Power Spectral Density- FCC Section 15.247(e) IC: RSS-210 A8.2(b)

7.8.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB Publication No. 558074 "Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)". The emission peaks within the pass band were located and zoomed in on. The spectrum analyzer RBW was set to 3 kHz and VBW 10 kHz. Span was adjusted to 200 kHz and the sweep time was calculated to be 68s ~ (Span/3 kHz).

7.8.2 Measurement Results

Results are shown below in table 7.7.2-1 and figures 7.7.2-1 – 7.7.2-4:

Table 7.7.2-1: Peak Power Spectral Density

Frequency (MHz)	PSD Level (dBm)
2405	0.33
2440	0.23
2475	-2.29
2480	-13.02

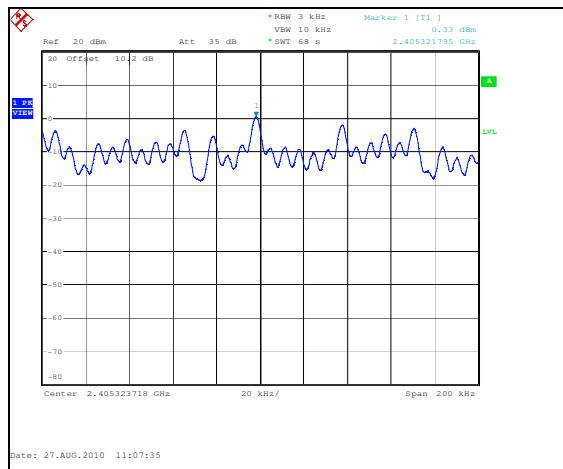


Figure 7.7.2-1: Power Spectral Density Plot – 2405MHz

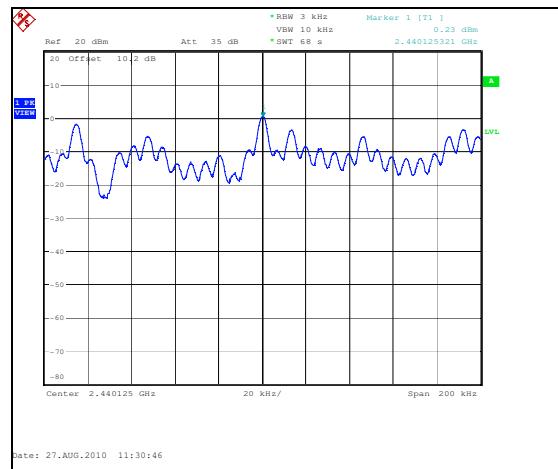


Figure 7.7.2-2: Power Spectral Density Plot – 2440MHz

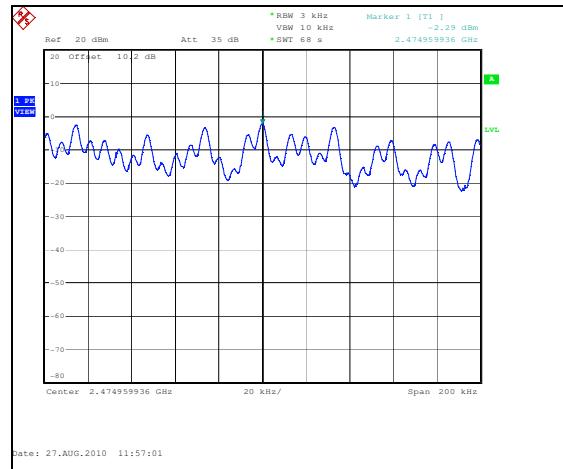


Figure 7.7.2-3: Power Spectral Density Plot – 2475MHz

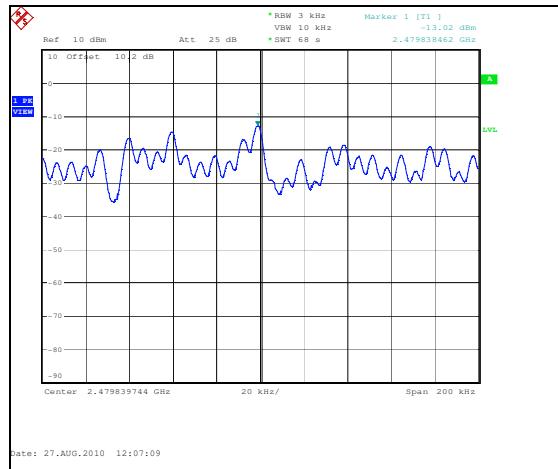


Figure 7.7.2-4: Power Spectral Density Plot – 2480MHz

8 CONCLUSION

In the opinion of ACS, Inc. the RF200, manufactured by Synapse Wireless, Inc. meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT