Excellence in Compliance Testing

Certification Test Report

FCC ID: U9O-RF200
IC: 7084A-RF200

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

ACS Report Number: 12-0163.W04.1A

Manufacturer: Synapse Wireless, Inc.
Model: RF200

Test Begin Date: May 21, 2012
Test End Date: May 21, 2012

Report Issue Date: June 25, 2012

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.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 14 pages

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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 Class II Permissive Change.

The purpose of this Class II Permissive Change is to include a new antenna type.

1.2 General

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.

Technical Details:

Band of operation:	2405 - 2480 MHz
Number of channels:	16
Channel spacing	5 MHz
Modulation format:	O-QPSK
Antenna(s) Type / Gain:	Integrated F-Antenna; 0dBi gain
Operating Voltage:	9VDC

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

Test Sample Serial Number: 9E08

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.

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

Power setting 2405 – 2475 MHz: 6
Power setting 2480 MHz (Channel 26): 15

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: 511277
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:

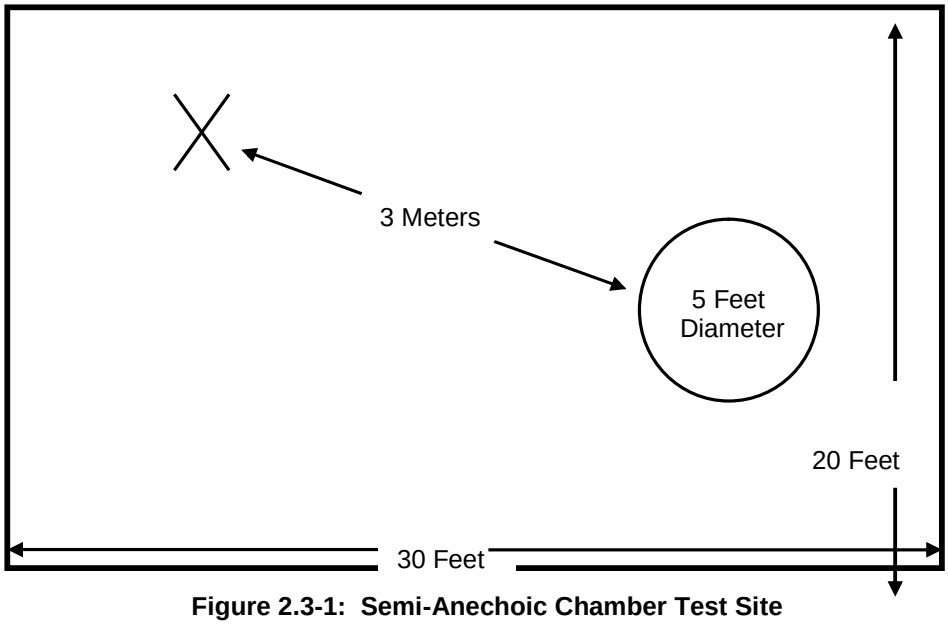

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

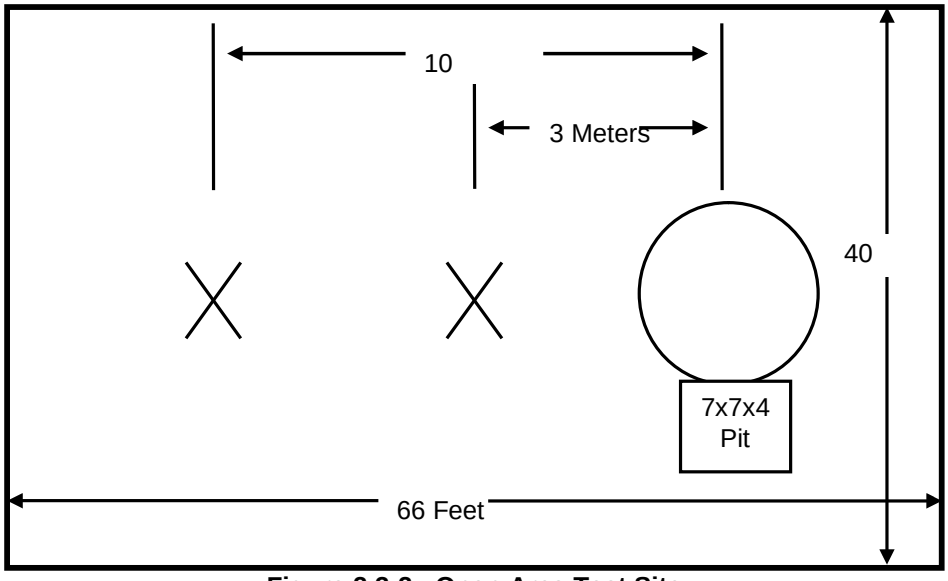

Figure 2.3-2: Open Area Test Site

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 ground 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:

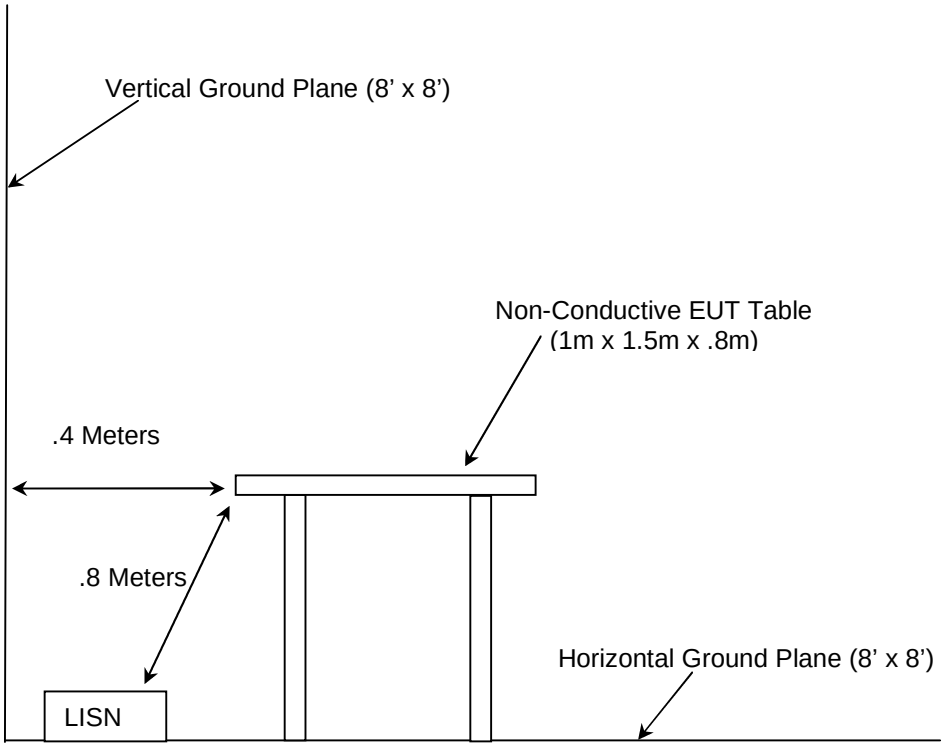

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2009: 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, 2012
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2012
- 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	ESMI - Display	Spectrum Analyzers	833771/007	9/23/2011	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2011	9/23/2012
3	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	839379/011	5/26/2011	5/26/2013
4	Rohde & Schwarz	ESMI - Receiver	Spectrum Analyzers	833827/003	5/26/2011	5/26/2013
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/27/2011	4/27/2013
40	EMCO	3104	Antennas	3211	2/11/2011	2/11/2013
73	Agilent	8447D	Amplifiers	2727A05624	9/30/2011	9/30/2012
153	EMCO	3825/2	LISN	9411-2268	1/13/2011	1/13/2013
167	ACS	Chamber EMI Cable Set	Cable Set	167	12/21/2011	12/21/2012
168	Hewlett Packard	11947A	Attenuators	44829	2/1/2012	2/1/2013
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/2/2011	12/2/2012
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	4/2/2012	4/2/2013
324	ACS	Belden	Cables	8214	7/6/2011	7/6/2012
334	Rohde&Schwarz	3160-10	Antennas	45576	11/4/2010	NCR
335	Suhner	SF-102A	Cables	882/2A	8/29/2011	8/29/2012
338	Hewlett Packard	8449B	Amplifiers	3008A01111	3/1/2012	8/31/2012
345	Suhner Sucoflex	102A	Cables	1077/2A	8/29/2011	8/29/2012
412	Electro Metrics	LPA-25	Antennas	1241	7/28/2010	7/28/2012
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	12/2/2011	12/2/2012
432	Microwave Circuits	H3G020G4	Filters	264066	7/11/2011	7/11/2012

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-053WP05	NA

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

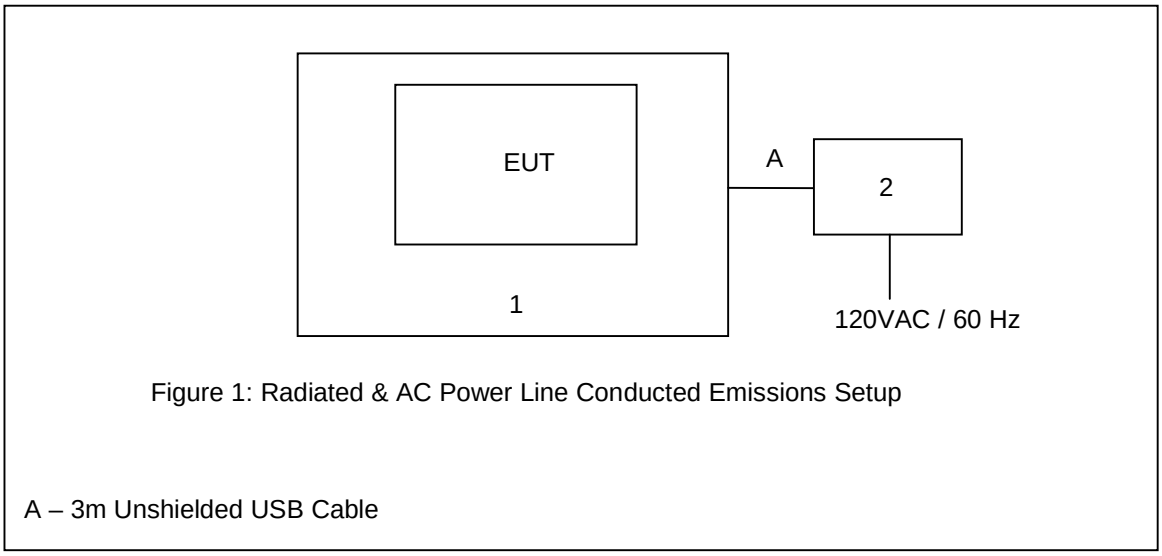

Figure 1: Radiated & AC Power Line Conducted Emissions Setup

A – 3m Unshielded USB Cable

Figure 6-1: Test Setup Block Diagram

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 PCB Integrated F type antenna with a maximum gain of 0 dBi.

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 Tables 7.2.2-1 to 7.2.2-2.

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.204000	31.00	9.9	63	32.5	L1	FLO	QP
0.360000	19.80	10.0	59	38.9	L1	FLO	QP
0.462000	15.30	10.0	57	41.4	L1	FLO	QP
0.558000	13.70	10.0	56	42.3	L1	FLO	QP
0.624000	21.50	10.0	56	34.5	L1	FLO	QP
0.696000	17.90	10.1	56	38.1	L1	FLO	QP
0.834000	15.00	10.0	56	41.0	L1	FLO	QP
0.888000	13.90	10.0	56	42.1	L1	FLO	QP
1.224000	16.70	10.0	56	39.3	L1	FLO	QP
1.446000	14.90	10.0	56	41.1	L1	FLO	QP
0.264000	9.50	10.0	51	41.8	L1	FLO	AV
0.360000	10.00	10.0	49	38.7	L1	FLO	AV
0.462000	8.70	10.0	47	38.0	L1	FLO	AV
0.492000	8.90	10.0	46	37.2	L1	FLO	AV
0.606000	10.40	10.0	46	35.6	L1	FLO	AV
0.720000	9.80	10.1	46	36.2	L1	FLO	AV
0.810000	10.90	10.1	46	35.1	L1	FLO	AV
0.900000	9.60	10.0	46	36.4	L1	FLO	AV
1.290000	8.70	10.0	46	37.3	L1	FLO	AV
1.380000	8.20	10.0	46	37.8	L1	FLO	AV

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
0.306000	25.80	10.0	60	34.3	L2	FLO	QP
0.462000	15.00	10.0	57	41.7	L2	FLO	QP
0.492000	17.50	10.0	56	38.6	L2	FLO	QP
0.522000	21.00	10.0	56	35.0	L2	FLO	QP
0.594000	16.70	10.0	56	39.3	L2	FLO	QP
0.678000	14.90	10.0	56	41.1	L2	FLO	QP
0.882000	13.60	10.0	56	42.4	L2	FLO	QP
1.266000	13.50	10.0	56	42.5	L2	FLO	QP
1.686000	13.80	10.0	56	42.2	L2	FLO	QP
2.100000	12.50	10.0	56	43.5	L2	FLO	QP
0.354000	9.50	10.0	49	39.4	L2	FLO	AV
0.456000	9.20	10.0	47	37.5	L2	FLO	AV
0.492000	9.20	10.0	46	36.9	L2	FLO	AV
0.558000	8.30	10.0	46	37.7	L2	FLO	AV
0.660000	8.50	10.0	46	37.5	L2	FLO	AV
0.732000	9.00	10.1	46	37.0	L2	FLO	AV
0.876000	8.30	10.0	46	37.7	L2	FLO	AV
1.206000	9.10	10.0	46	36.9	L2	FLO	AV
1.608000	8.70	10.0	46	37.3	L2	FLO	AV
2.058000	7.90	10.0	46	38.1	L2	FLO	AV

7.3 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC:RSS-210 2.2, A8.5

7.3.1 Band-Edge Compliance

7.3.1.1 Measurement Procedure

The EUT was investigated at the low and high channels of operation to determine band-edge compliance.

Radiated band-edge compliance at the restricted bands was determined based on the measurement of the absolute field strength.

Band-edge measurements were made at both 2475MHz and 2480MHz due to the difference in power settings.

7.3.1.2 Measurement Results

Band-edge compliance is shown in Tables 7.3.1.2-1 and 7.3.1.2-2.

Table 7.3.1.2-1: Upper Band-edge Radiated Emissions - 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2483.5	69.00	59.02	H	-5.07	63.93	36.94	74.0	54.0	10.1	17.1
2483.5	72.07	62.45	V	-5.07	67.00	40.37	74.0	54.0	7.0	13.6

Table 7.3.1.2-2: Upper Band-edge Radiated Emissions - 2480MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
2483.5	69.66	59.43	H	-5.07	64.59	37.35	74.0	54.0	9.4	16.7
2483.5	73.20	62.84	V	-5.07	68.13	40.76	74.0	54.0	5.9	13.2

7.3.2 Radiated Spurious Emissions (Restricted Bands)

7.3.2.1 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 was compared to the applicable radiated emission limits.

7.3.2.2 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: 20log (14.1/100) = -17.02dB.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying the original certification filing.

7.3.2.3 Measurement Results

Radiated spurious emissions found in the band of 30MHz to 25GHz are reported in Table 7.3.2.3-1 to 7.3.2.3-4 below.

Table 7.3.2.3-1: Radiated Spurious Emissions Tabulated Data – 2405MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4810	58.67	50.72	H	2.11	60.78	35.81	74.0	54.0	13.2	18.2
4810	61.07	53.87	V	2.11	63.18	38.96	74.0	54.0	10.8	15.0
12025	57.41	48.95	H	14.74	72.15	46.68	83.5	63.5	11.3	16.9
12025	55.29	46.67	V	14.74	70.03	44.40	83.5	63.5	13.5	19.1

Table 7.3.2.3-2: Radiated Spurious Emissions Tabulated Data – 2440MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4880	57.40	49.76	H	2.28	59.68	35.02	74.0	54.0	14.3	19.0
4880	61.49	54.56	V	2.28	63.77	39.82	74.0	54.0	10.2	14.2
7320	58.36	50.60	H	7.85	66.21	41.43	74.0	54.0	7.8	12.6
7320	65.53	58.52	V	7.85	73.38	49.35	74.0	54.0	0.6	4.6
12200	55.19	46.89	H	15.89	71.08	45.77	83.5	63.5	12.4	17.8
12200	55.22	46.86	V	15.89	71.11	45.74	83.5	63.5	12.4	17.8

Table 7.3.2.3-3: Radiated Spurious Emissions Tabulated Data – 2475MHz

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
4950	59.05	52.12	H	2.45	61.50	37.55	74.0	54.0	12.5	16.4
4950	62.81	56.03	V	2.45	65.26	41.46	74.0	54.0	8.7	12.5
7425	56.21	47.98	H	7.81	64.02	38.78	74.0	54.0	10.0	15.2
7425	62.10	54.99	V	7.81	69.91	45.79	74.0	54.0	4.1	8.2
12375	53.83	44.50	H	17.04	70.87	44.53	83.5	63.5	12.6	19.0
12375	54.25	45.39	V	17.04	71.29	45.42	83.5	63.5	12.2	18.1

Table 7.3.2.3-3: Radiated Spurious Emissions Tabulated Data – 2480MHz

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

7.3.2.4 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: 58.67 + 2.11 = 60.78dBuV/m
Margin: 74dBuV/m – 60.78dBuV/m = 13.2dB

Example Calculation: Average

Corrected Level: 50.72 + 2.11 - 17.02 = 35.81dBuV
Margin: 54dBuV – 35.81dBuV = 18.2dB

8 CONCLUSION

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

END REPORT