

Certification Test Report

FCC ID: U9O-RF220SU
IC: 7084A-RF220SU

FCC Rule Part: 15.247
ISED Canada Radio Standards Specification: RSS-247

ACS Report Number: 15-0531.W06.1C

Manufacturer: Synapse Wireless, Inc.
Model: RF220

Test Begin Date: March 6, 2016
Test End Date: March 24, 2016

Report Issue Date: August 12, 2016



FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: AT-2021

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

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

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This report contains 24 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 Innovation, Science and Economic Development (ISED) Canada's Radio Standards Specification RSS-247 Certification for modular approval.

1.2 Product Description

The Synapse Wireless model RF220 is an IEEE 802.15.4 RF module. The radio contains two antenna paths differentiated by use of an RF switch. Path one terminates into an external U.FI connector, and path two terminates into an R-SMA connection.

Technical Information:

Detail	Description
Frequency Range	2405 - 2475 MHz
Number of Channels	15
Modulation Format	O-QPSK
Data Rates	250kbps (Tested), 500kbps, 1 Mbps, 2Mbps
Number of Inputs/Outputs	2
Operating Voltage	3.3Vdc (via Host)
Antenna Type(s) / Gain(s)	Antenna 1: Pulse W1027 Dipole Antenna / 3.2dBi gain Antenna 2: HyperLink HG2405RD-RSP Dipole Antenna / 5.5dBi gain

Manufacturer Information:

Synapse Wireless
6723 Odyssey Drive
Huntsville, AL 35806

EUT Serial Numbers: 001C2C2AD6627D9D

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

1.3 Test Methodology and Considerations

For radiated emissions three orientations of the EUT were evaluated to determine worst case. The worst case orientation was determined to be the Z orientation.

The EUT provides (2) antenna ports for Tx/Rx diversity. Preliminary measurements for radiated emissions were taken for both ports and worst case data provided where applicable. Worst case antenna port for radiated emissions was the SMA port. For RF conducted measurements, both antenna ports were evaluated in full.

The EUT was connected to an evaluation board to facilitate programming and control.

Multiple antenna types are available for use with the EUT. The highest gain of each antenna type was evaluated for compliance.

Power settings utilized during testing are as follows:

R-SMA Port – LCH Power Setting: 4

R-SMA Port – MCH Power Setting: 2

R-SMA Port – HCH Power Setting: 12

u.fl Port – LCH Power Setting: 7

u.fl Port – MCH Power Setting: 7

u.fl Port – HCH Power Setting: 12

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 ANSI-ASQ National Accreditation Board/ANAB accreditation program, and has been issued certificate number AT-2021 in recognition of this accreditation. 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, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 391271

ISED Canada Lab Code: IC 4175A

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:

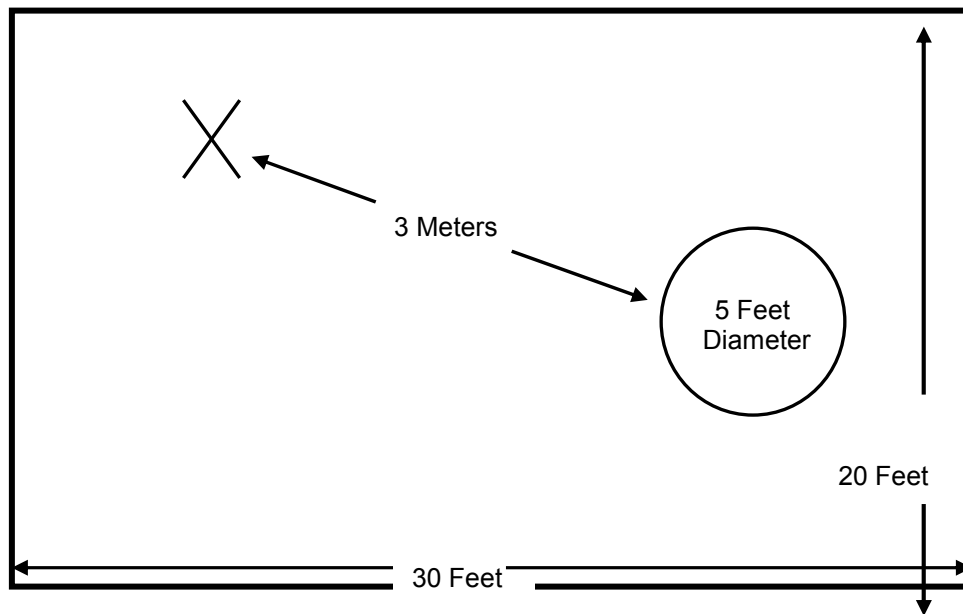


Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

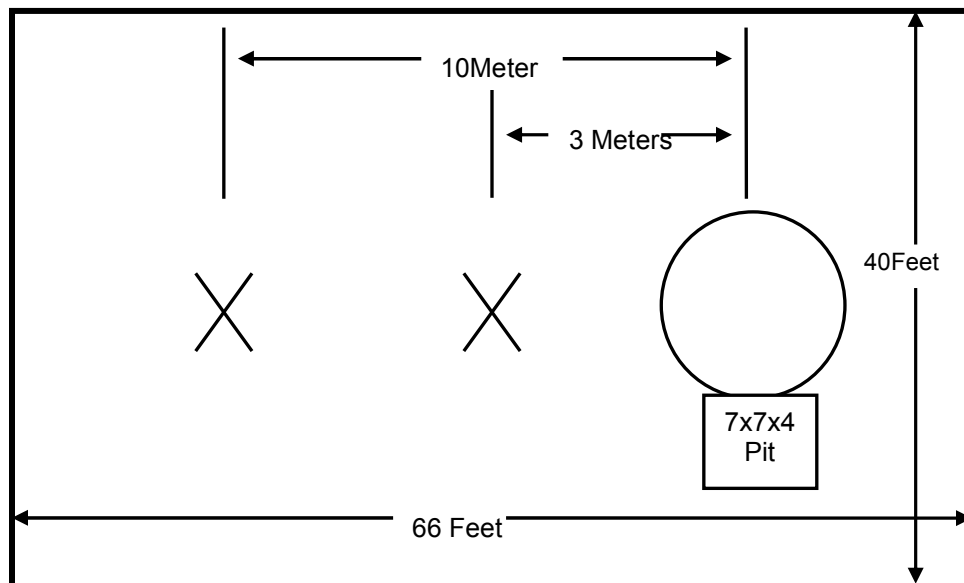


Figure 2.3-2: Open Area Test Site

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 C63.10.

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

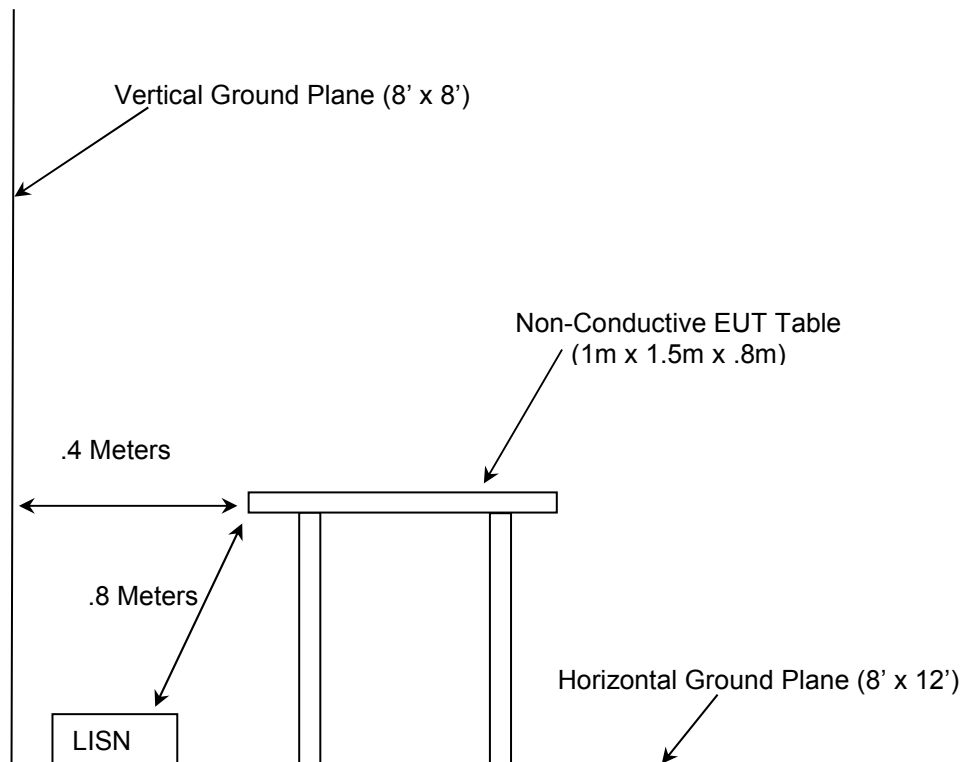


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2016
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- ❖ FCC KDB 558074 D01 DTS Meas Guidance v03r04 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, January 7, 2016
- ❖ ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- ❖ ISED Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 4, Nov 2014.

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	7/14/2015	7/14/2016
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	7/14/2015	7/14/2016
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	2/10/2015	2/10/2017
73	Agilent	8447D	Amplifiers	2727A05624	7/15/2015	7/15/2016
167	ACS	Chamber EMI Cable Set	Cable Set	167	10/20/2015	10/20/2016
267	Agilent	N1911A	Meters	MY45100129	8/24/2015	8/24/2017
268	Agilent	N1921A	Sensors	MY45240184	8/13/2015	8/13/2017
292	Florida RF Cables	480.0-SMR	Cables	None	2/17/2016	2/17/2017
324	ACS	Belden	Cables	8214	5/5/2015	5/5/2016
432	Microwave Circuits	H3G020G4	Filters	264066	5/20/2015	5/20/2016
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/13/2015	7/13/2016
412	Electro Metrics	LPA-25	Antennas	1241	7/24/2014	7/24/2016
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	10/30/2015	10/30/2016
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/3/2015	9/3/2016
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/15/2015	7/15/2016
3010	Rohde & Schwarz	ENV216	LISN	3010	7/10/2015	7/10/2016
RE112	Rohde & Schwarz	ESIB26	Receiver	836119/012	7/16/2015	7/16/2016

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model/Part Number	Serial Number
1	Evaluation Board	Synapse Wireless	500202.01A	N/A
2	Power Adapter	V-INFINITY	EPS050100	N/A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

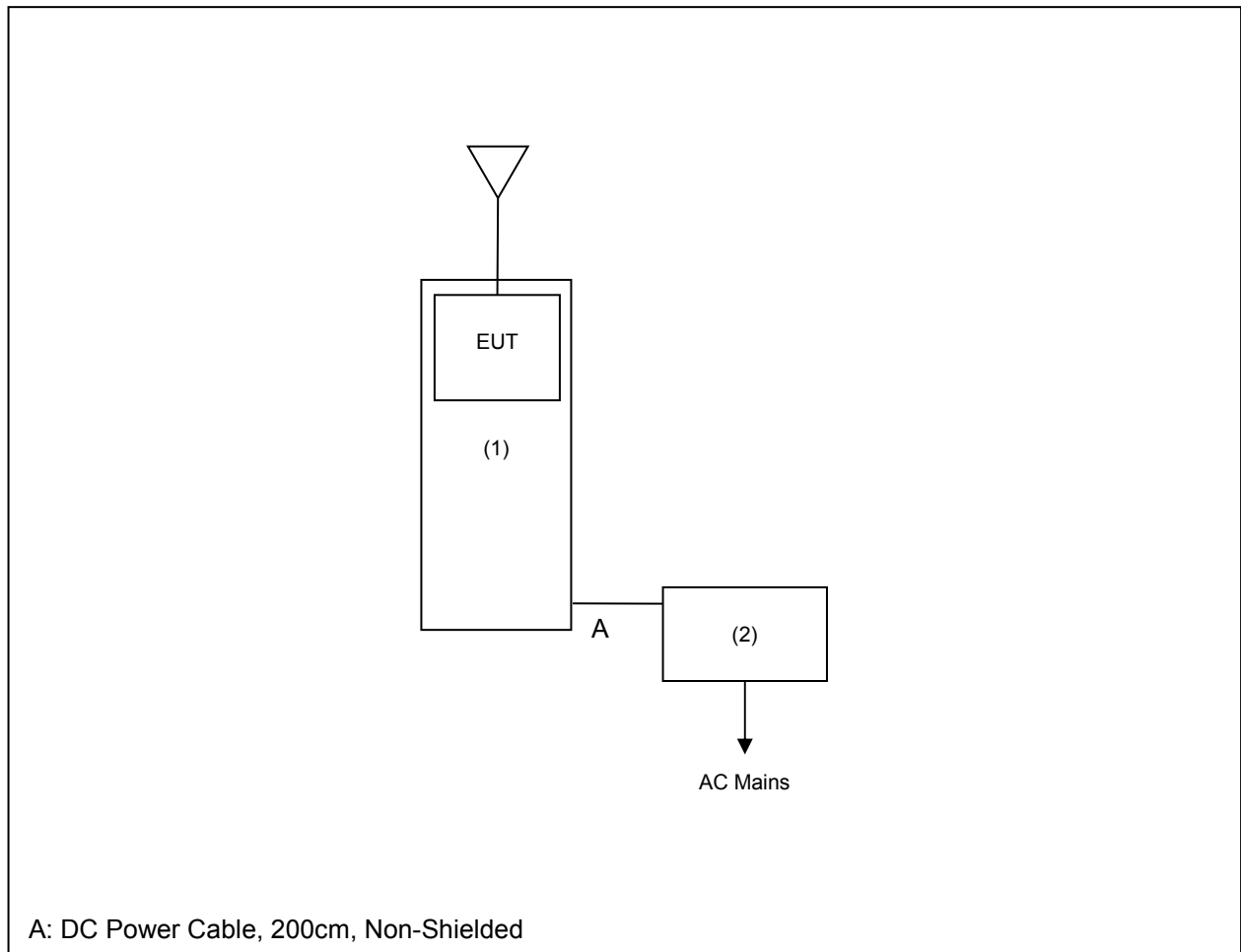


Figure 6-1: Test Setup Block Diagram

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 15.203

The antennas used are a Dipole antenna with 5.5dBi gain and a Dipole antenna with 3.2dBi gain. These antennas are detachable utilizing U.FL or R-SMA coupling to the EUT, therefore satisfying the requirements of Section 15.203.

7.2 Power Line Conducted Emissions – FCC 15.207, ISED Canada: RSS-Gen 8.8

7.2.1 Measurement Procedure

ANSI C63.10 section 6 was the guiding document 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

Table 7.2.2-1: Conducted EMI Results Line 1 – Antenna 1

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.341182	---	34.07	48.96	14.89	L1	9.7
0.341182	48.02	---	59.00	10.98	L1	9.7
0.347595	---	33.49	48.82	15.33	L1	9.7
0.347595	47.69	---	58.85	11.16	L1	9.7
0.348197	---	33.35	48.80	15.45	L1	9.7
0.348197	47.62	---	58.83	11.21	L1	9.7
0.852705	---	27.68	46.00	18.32	L1	9.7
0.852705	42.14	---	56.00	13.86	L1	9.7
0.869740	---	27.38	46.00	18.62	L1	9.7
0.869740	40.84	---	56.00	15.16	L1	9.7
0.877756	---	26.99	46.00	19.01	L1	9.7
0.877756	41.26	---	56.00	14.74	L1	9.7

Table 7.2.2-2: Conducted EMI Results Line 2 – Antenna 1

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.529458	---	16.25	46.00	29.75	N	9.7
0.529458	32.69	---	56.00	23.31	N	9.7
0.851603	---	17.23	46.00	28.77	N	9.7
0.851603	34.73	---	56.00	21.27	N	9.7
1.212725	---	18.67	46.00	27.33	N	9.7
1.212725	36.06	---	56.00	19.94	N	9.7
1.241784	---	12.97	46.00	33.03	N	9.7
1.241784	30.23	---	56.00	25.77	N	9.7
1.543186	---	10.88	46.00	35.12	N	9.7
1.543186	27.92	---	56.00	28.08	N	9.7
1.735771	---	8.26	46.00	37.74	N	9.7
1.735771	25.76	---	56.00	30.24	N	9.7

Table 7.2.2-3: Conducted EMI Results Line 1 – Antenna 2

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.182566	---	34.60	54.23	19.63	L1	9.6
0.182566	48.34	---	64.25	15.91	L1	9.6
0.347194	---	33.32	48.82	15.50	L1	9.7
0.347194	47.63	---	58.86	11.23	L1	9.7
0.353608	---	32.38	48.68	16.30	L1	9.7
0.353608	47.10	---	58.71	11.61	L1	9.7
0.517335	---	26.54	46.00	19.46	L1	9.7
0.517335	41.24	---	56.00	14.76	L1	9.7
0.875050	---	27.28	46.00	18.72	L1	9.7
0.875050	41.61	---	56.00	14.39	L1	9.7
1.206813	---	27.39	46.00	18.61	L1	9.7
1.206813	41.69	---	56.00	14.31	L1	9.7

Table 7.2.2-4: Conducted EMI Results Line 2 – Antenna 2

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.514930	---	16.46	46.00	29.54	N	9.7
0.514930	33.69	---	56.00	22.31	N	9.7
0.523748	---	16.88	46.00	29.12	N	9.7
0.523748	34.77	---	56.00	21.23	N	9.7
0.539279	---	14.91	46.00	31.09	N	9.7
0.539279	31.87	---	56.00	24.13	N	9.7
1.068337	---	12.91	46.00	33.09	N	9.7
1.068337	29.39	---	56.00	26.61	N	9.7
1.100301	---	11.59	46.00	34.41	N	9.7
1.100301	27.58	---	56.00	28.42	N	9.7
1.213727	---	18.21	46.00	27.79	N	9.7
1.213727	35.96	---	56.00	20.04	N	9.7

7.3 6dB / 99% Bandwidth – FCC 15.247(a)(2), ISED Canada: RSS-247 5.2(1)

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r04. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth. A peak detector was used.

7.3.2 Measurement Results

Table 7.3.2-1: 6dB / 99% Bandwidth – R-SMA Antenna Port

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
2405	1.191	2.363
2440	1.332	2.414
2475	1.220	2.402

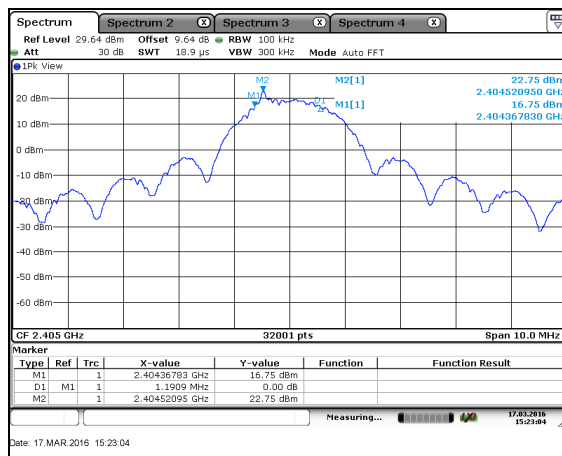


Figure 7.3.2-1: 6dB Bandwidth Plot – LCH

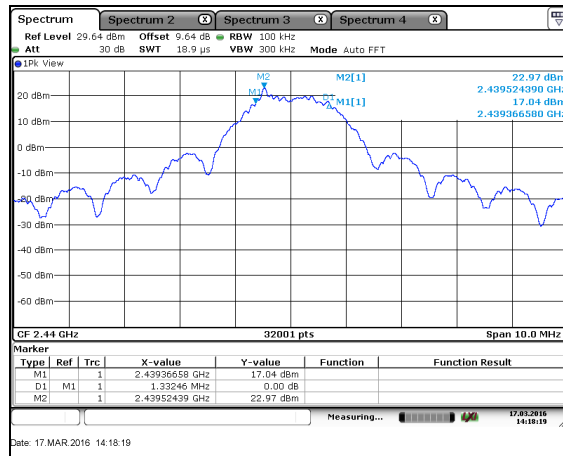


Figure 7.3.2-2: 6dB Bandwidth Plot – MCH

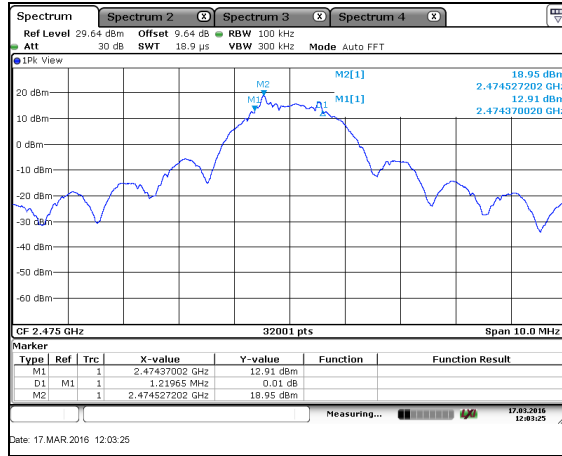


Figure 7.3.2-3: 6dB Bandwidth Plot – HCH

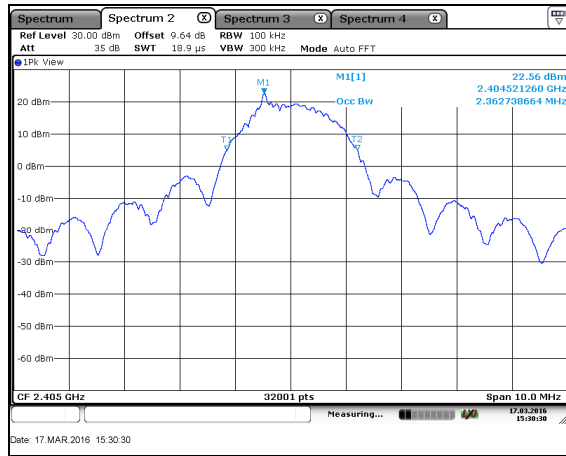


Figure 7.3.2-4: 99% Bandwidth Plot – LCH

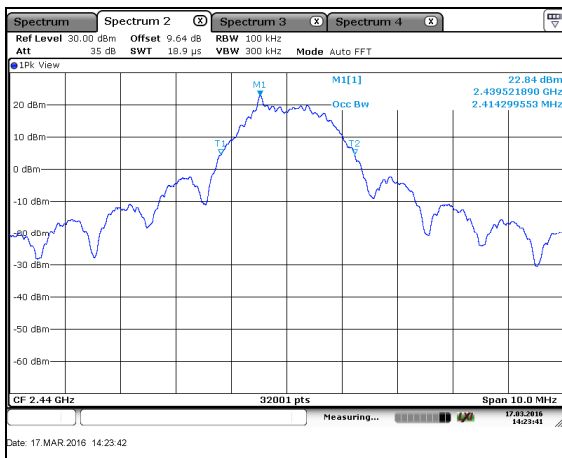


Figure 7.3.2-5: 99% Bandwidth Plot – MCH

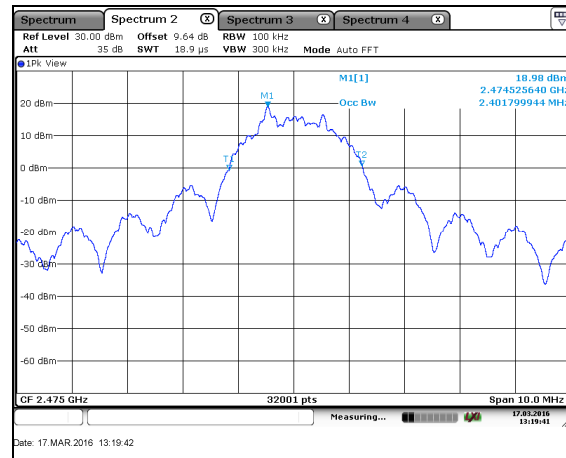


Figure 7.3.2-6: 99% Bandwidth Plot – HCH

Table 7.3.2-2: 6dB / 99% Bandwidth – u.fl Antenna Port

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
2405	1.486	2.393
2440	1.567	2.443
2475	1.573	2.497

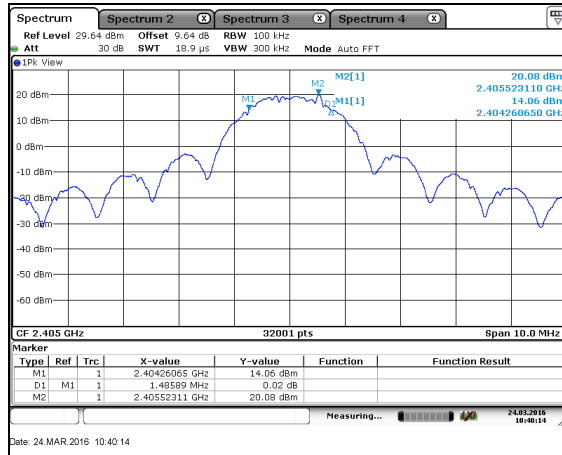


Figure 7.3.2-7: 6dB Bandwidth Plot – LCH

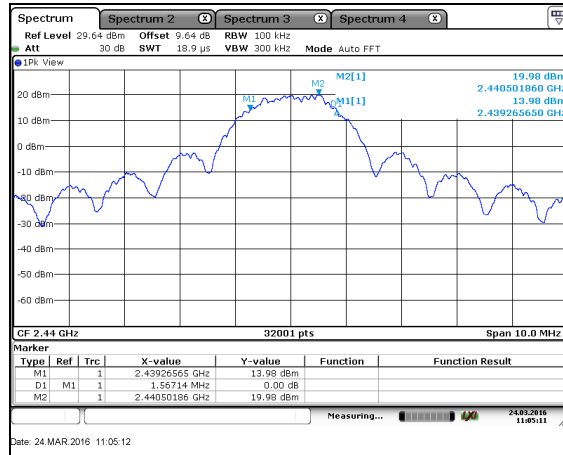


Figure 7.3.2-8: 6dB Bandwidth Plot – MCH

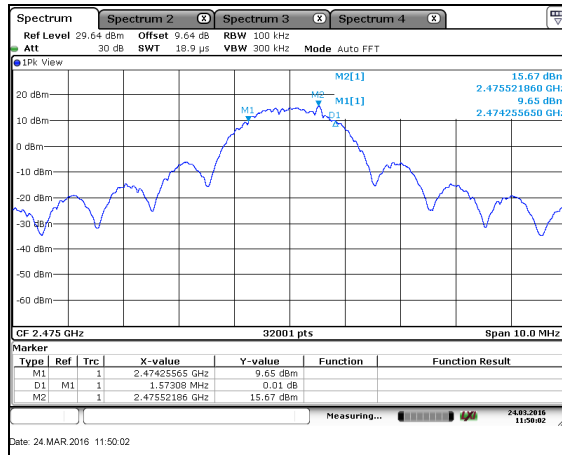


Figure 7.3.2-9: 6dB Bandwidth Plot – HCH

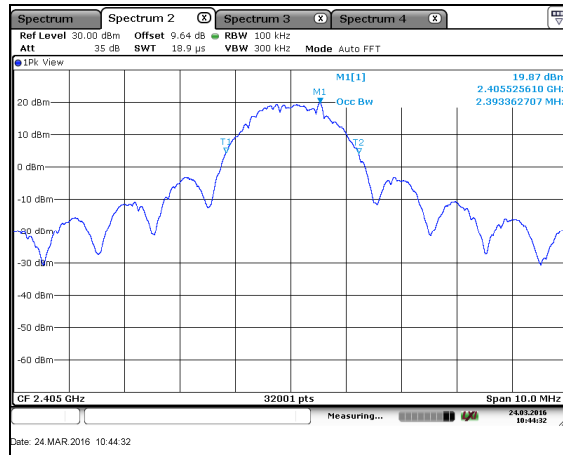


Figure 7.3.2-10: 99% Bandwidth Plot – LCH

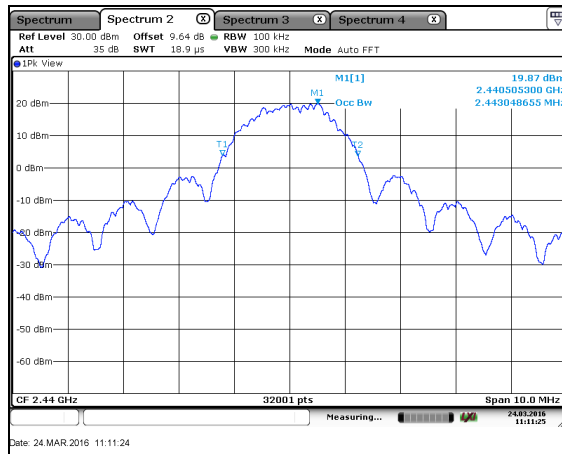


Figure 7.3.2-11: 99% Bandwidth Plot – MCH

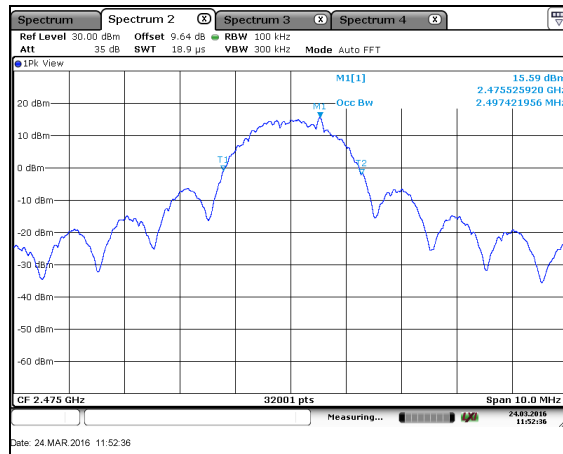


Figure 7.3.2-12: 99% Bandwidth Plot – HCH

7.4 Fundamental Emission Output Power – FCC 15.247(b)(3), ISED Canada: RSS-247 5.4(4)**7.4.1 Measurement Procedure**

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Meas Guidance v03r04 utilizing the PKPM1 Peak power meter method. The RF output of the equipment under test was directly connected to the input of the power meter applying suitable attenuation.

7.4.2 Measurement Results**Table 7.4.2-1: Maximum Conducted Output Power – R-SMA Antenna Port**

Frequency [MHz]	Level [dBm]
2405	24.00
2440	24.15
2475	18.94

Table 7.4.2-2: Maximum Conducted Output Power – u.fl Antenna Port

Frequency [MHz]	Level [dBm]
2405	22.29
2440	22.28
2475	18.68

7.5 Emission Levels – FCC 15.247(d), 15.205, 15.209; ISSED Canada RSS-247 5.5, RSS-Gen 8.9

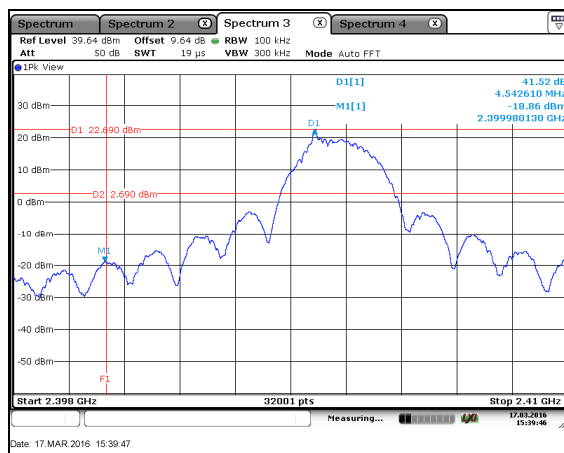
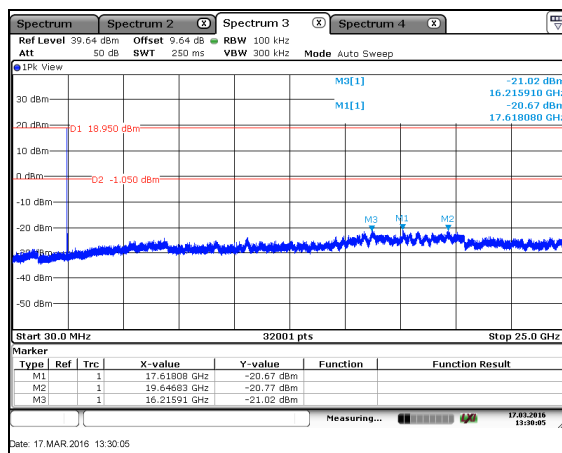
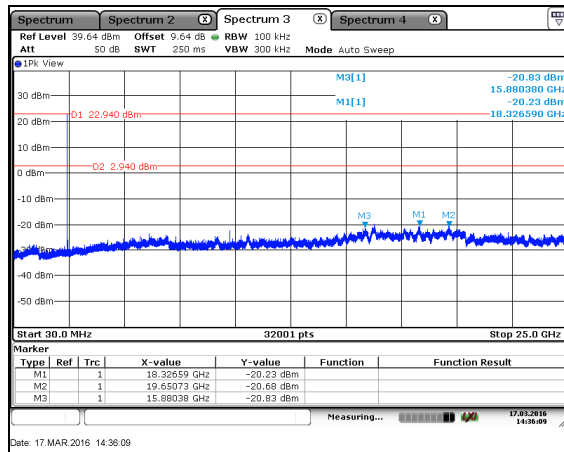
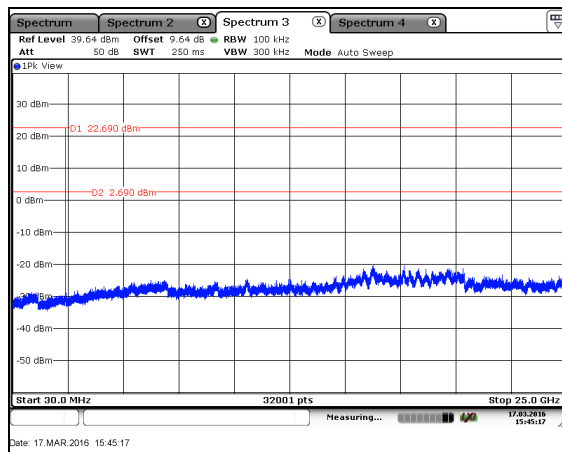
7.5.1 Emissions into Non-restricted Frequency Bands

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 DTS Meas Guidance v03r04. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. Span was set to 1.5 times the DTS Bandwidth. The trace was set to max hold with a peak detector active. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency.

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.

7.5.1.2 Measurement Results



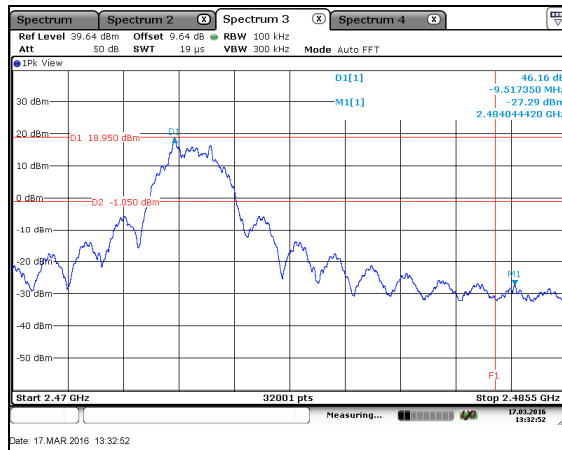


Figure 7.5.1.2-5: Upper Band-edge – HCH R-SMA Port

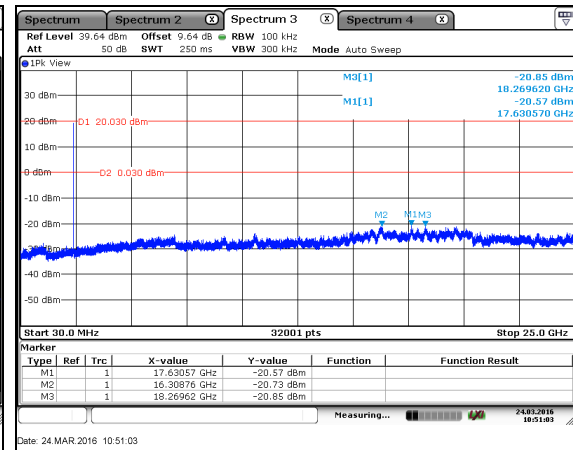


Figure 7.5.1.2-6: 30 MHz – 25 GHz – LCH – u.fl Port

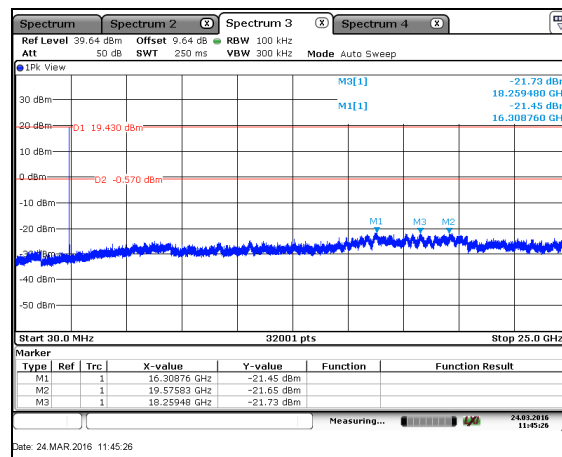


Figure 7.5.1.2-7: 30 MHz – 25 GHz – MCH – u.fl Port

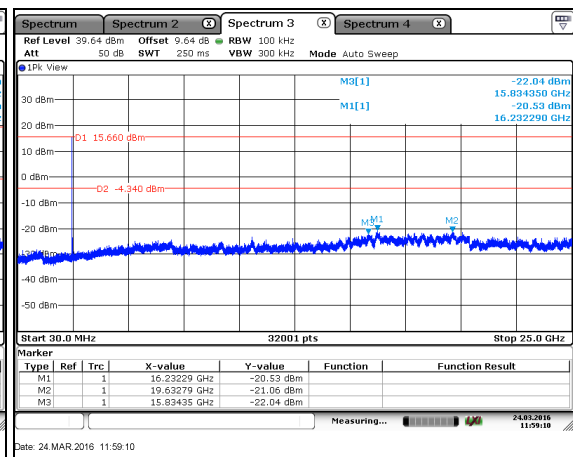


Figure 7.5.1.2-8: 30 MHz – 25 GHz – HCH – u.fl Port

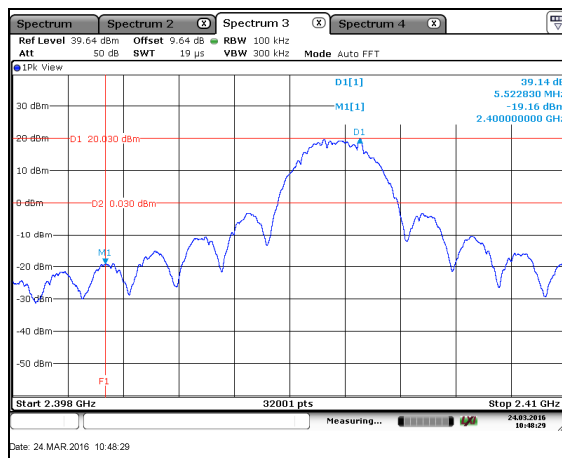


Figure 7.5.1.2-9: Lower Band-edge - LCH – u.fl Port

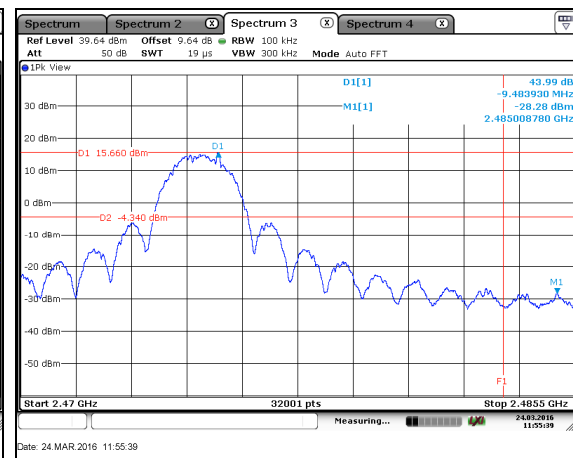


Figure 7.5.1.2-10: Upper Band-edge – HCH – u.fl Port

7.5.2 Emissions into Restricted Frequency Bands – FCC 15.205, 15.209; RSS-Gen 8.9/8.10

7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 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 RBW of 120 kHz and a 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.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.5.2.2 Duty Cycle Correction

For average radiated measurements, using a 13.8% duty cycle, the measured level was reduced by a factor 17.20dB. The duty cycle correction factor is determined using the formula: $20\log(13.8/100) = -17.20\text{dB}$. A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying the application for certification.

7.5.2.3 Measurement Results

Table 7.5.2.3-1: Radiated Spurious Emissions Tabulated Data – Antenna 1

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
Low Channel										
2390	61.03	53.08	H	-5.38	55.65	30.49	74.0	54.0	18.4	23.5
2390	70.15	62.51	V	-5.38	64.77	39.92	74.0	54.0	9.2	14.1
4810	59.76	51.95	H	1.98	61.74	36.73	74.0	54.0	12.3	17.3
4810	63.24	51.46	V	1.98	65.22	36.24	74.0	54.0	8.8	17.8
Middle Channel										
4880	58.85	50.90	H	2.20	61.05	35.90	74.0	54.0	12.9	18.1
4880	63.47	51.41	V	2.20	65.67	36.41	74.0	54.0	8.3	17.6
7320	51.05	42.60	H	7.97	59.02	33.37	74.0	54.0	15.0	20.6
7320	56.66	49.45	V	7.97	64.63	40.22	74.0	54.0	9.4	13.8
12200	53.06	44.60	H	16.05	69.11	43.44	83.5	63.5	14.4	20.1
12200	51.87	42.22	V	16.05	67.92	41.06	83.5	63.5	15.6	22.5
High Channel										
2483.5	65.07	58.01	H	-4.93	60.14	35.88	74.0	54.0	13.9	18.1
2483.5	76.01	68.83	V	-4.93	71.08	46.70	74.0	54.0	2.9	7.3
4950	53.26	45.24	H	2.42	55.68	30.46	74.0	54.0	18.3	23.5
4950	58.70	47.07	V	2.42	61.12	32.29	74.0	54.0	12.9	21.7
7425	46.11	35.31	H	8.03	54.14	26.14	74.0	54.0	19.9	27.9
7425	46.08	35.13	V	8.03	54.11	25.96	74.0	54.0	19.9	28.0

Table 7.5.2.3-2: Radiated Spurious Emissions Tabulated Data – Antenna 2

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
Low Channel										
2390	57.43	49.02	H	-5.38	52.05	26.43	74.0	54.0	22.0	27.6
2390	68.75	60.37	V	-5.38	63.37	37.78	74.0	54.0	10.6	16.2
4810	59.20	51.71	H	1.98	61.18	36.49	74.0	54.0	12.8	17.5
Middle Channel										
4880	63.04	53.69	H	2.20	65.24	38.69	74.0	54.0	8.8	15.3
7320	54.07	45.90	H	7.97	62.04	36.67	74.0	54.0	12.0	17.3
7320	58.47	50.82	V	7.97	66.44	41.59	74.0	54.0	7.6	12.4
High Channel										
2483.5	61.54	50.98	H	-4.93	56.61	28.85	74.0	54.0	17.4	25.1
2483.5	75.33	64.74	V	-4.93	70.40	42.61	74.0	54.0	3.6	11.4

7.5.2.4 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 (Antenna 1)

Corrected Level: $61.03 - 5.38 = 55.65\text{dBuV/m}$
 Margin: $74.0\text{dBuV/m} - 55.65\text{dBuV/m} = 18.4\text{dB}$

Example Calculation: Average (Antenna 1)

Corrected Level: $53.08 - 5.38 - 17.20 = 30.49\text{dBuV}$
 Margin: $54.0\text{dBuV} - 30.49\text{dBuV} = 23.5\text{dB}$

7.6 Maximum Power Spectral Density in the Fundamental Emission – FCC 15.247(e) ISED Canada: RSS-247 5.2(2)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r04 utilizing the PKPSD method. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 3 kHz. The Video Bandwidth (VBW) was set to 10 kHz. Span was set to 1.5 times the occupied bandwidth. The trace was set to max hold and a peak detector was used.

7.6.2 Measurement Results

Table 7.6.2-1: Peak Power Spectral Density – R-SMA Antenna Port

Frequency (MHz)	PSD Level (dBm)
2405	7.76
2440	7.50
2475	3.76

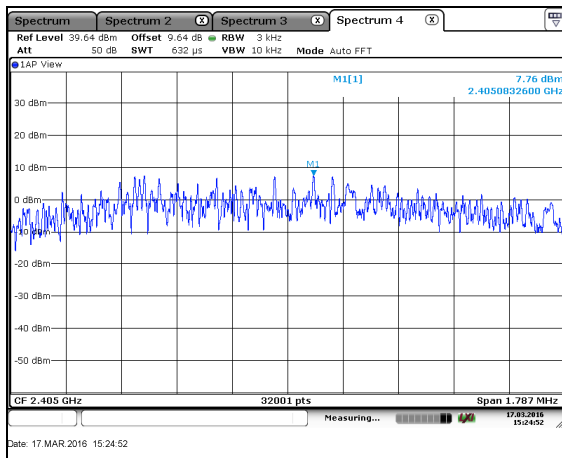


Figure 7.6.2-1: PSD Plot – LCH

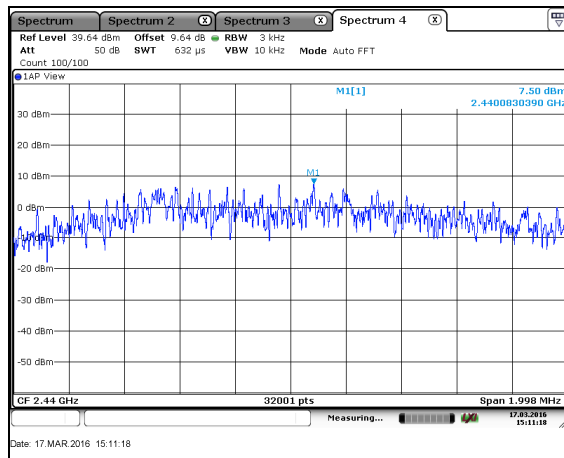


Figure 7.6.2-2: PSD Plot – MCH

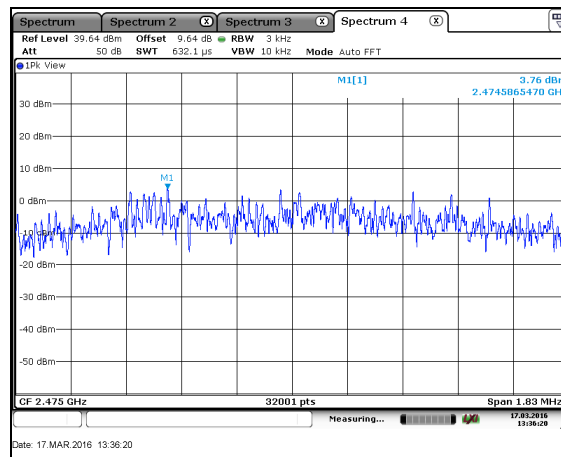


Figure 7.6.2-3: PSD Plot – HCH

Table 7.6.2-2: Peak Power Spectral Density – u.fl Antenna Port

Frequency (MHz)	PSD Level (dBm)
2405	7.29
2440	7.91
2475	3.55

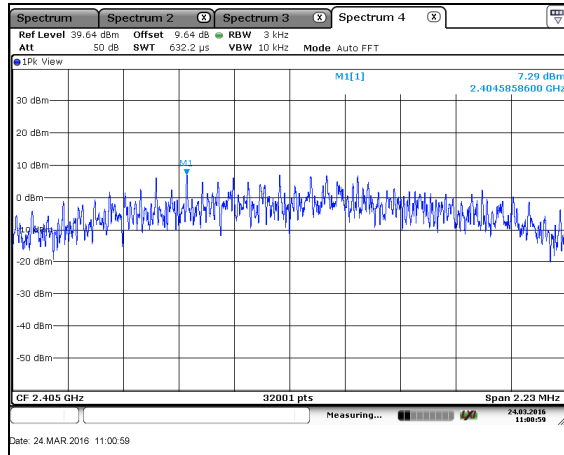


Figure 7.6.2-4: PSD Plot – LCH

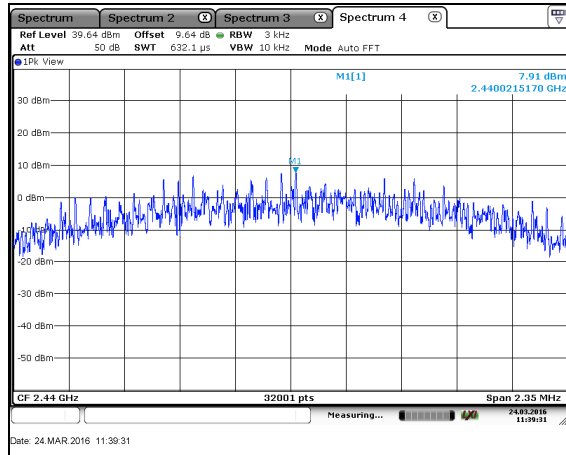


Figure 7.6.2-5: PSD Plot – MCH

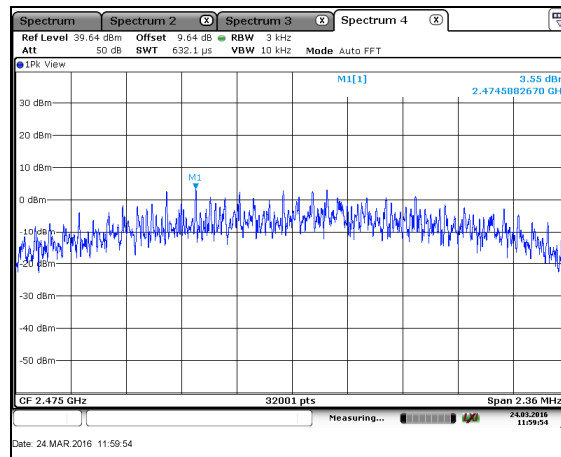


Figure 7.6.2-6: PSD Plot – HCH

8 CONCLUSION

In the opinion of ACS, Inc. the RF220, provided by Synapse Wireless, Inc. meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247.

END REPORT