Certification Report

FCC ID: NC3-14024VL
IC: 23669-14024VL

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

Report Number: AT72147289-1C3

Manufacturer: Attenti US Inc
Model: 14024VL

Test Begin Date: March 15, 2019
Test End Date: March 26, 2019

Report Issue Date: March 27, 2019

For Scope of Accreditation Under Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

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This report contains 27 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 Canada's Radio Standards Specification RSS-247 for certification.

1.2 Product description

Product Name: AT1 1-Piece GPS Tracking Device

The Equipment Under Test (EUT) was an Attenti US Inc. AT1-1Piece GPS Tracking Device. The EUT is a small wearable device that communicates via 802.11bgn (HT-20) using an Inventek ISM4343 and a Cellular transceiver in order to track offenders.

This test report covers the operation of the 802.11bgn (HT20) radio only.

Technical Information (Wi-Fi):

Detail	Description
Frequency Range	2412 – 2462 MHz
Number of Channels	11
Modulation Format	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g: OFDM (BPSK, QPSK, 16-QAM, 64-QAM) 802.11n (HT 20): OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
Data Rates	802.11b: 1 – 11 Mbps 802.11g: 6 – 54 Mbps 802.11n (HT 20): 6.5 – 72 Mbps
Number of Inputs/Outputs	1T1R
Operating Voltage	12Vdc
Antenna Type / Gain:	Surface Mount Chip Antenna / 3.0 dBi
Type of equipment:	Portable

Manufacturer Information:
Attenti US Inc.
1838 Gunn Highway
Odessa, FL 33556

Test Sample Serial Number(s): 34441133 (Radiated), Sample #3 (Antenna Port Conducted)

Test Sample Condition: The test sample was provided in working order with no visible defects.

1.3 Test Methodology and Considerations

All modes of operation, including all available data rates, were evaluated during the original certification. The data presented in this report represents the worst case where applicable.

For Radiated Emissions, the EUT was programmed to generate a continuously modulated signal. The EUT was evaluated in multiple orientations to determine worst-case; the worst-case orientation is Z-Axis. See test setup photos for more information.

For power line conducted emissions, the EUT was powered by a representative wall wart power supply.

Software power setting during test: +20dBm (802.11b/g)
+19dBm (802.11n)

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites 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:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

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 5' in diameter and is located 5'6" 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 EMCO Model 1060 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 chase from the turntable to the pit that allows 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 chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

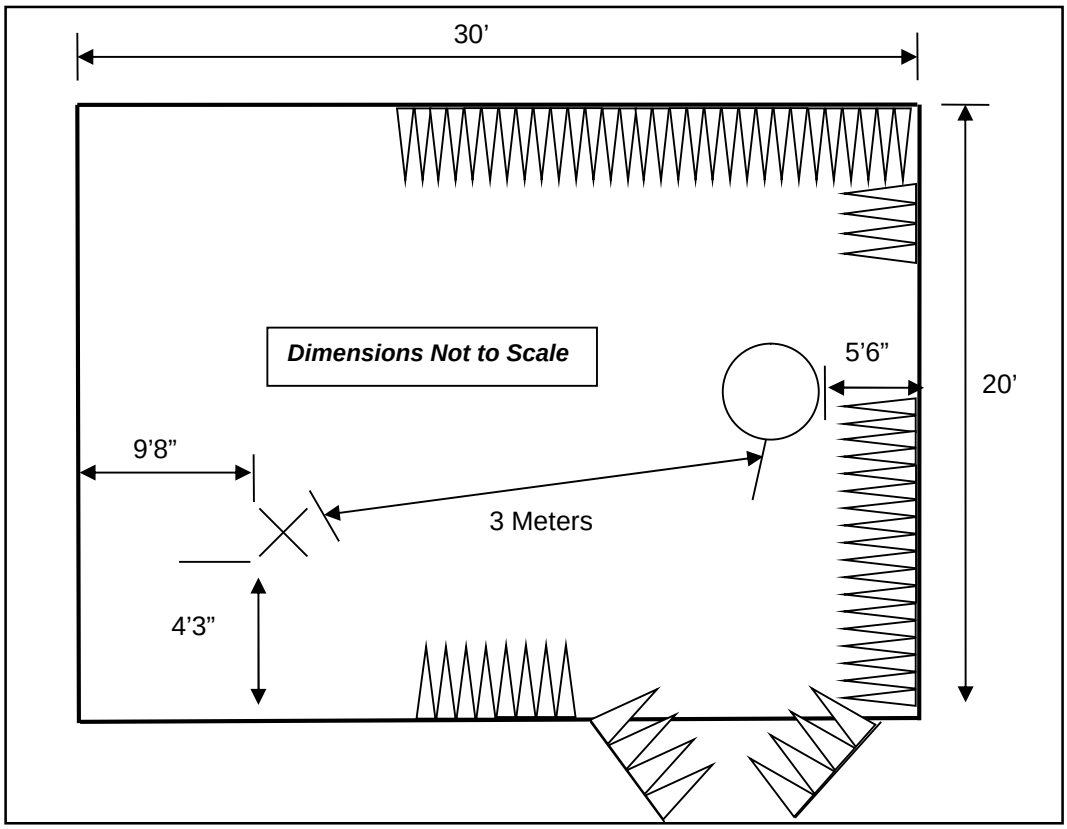

Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" 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 shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

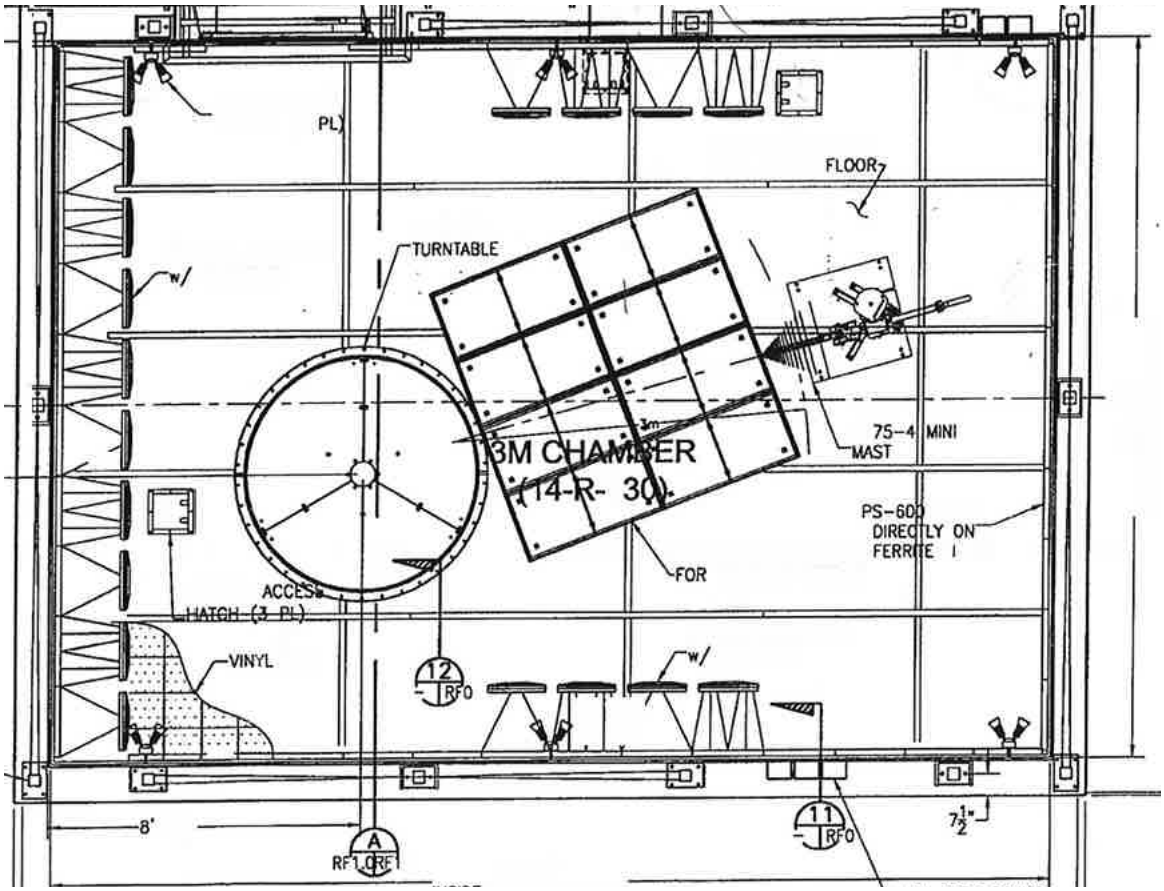

Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane(VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

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.

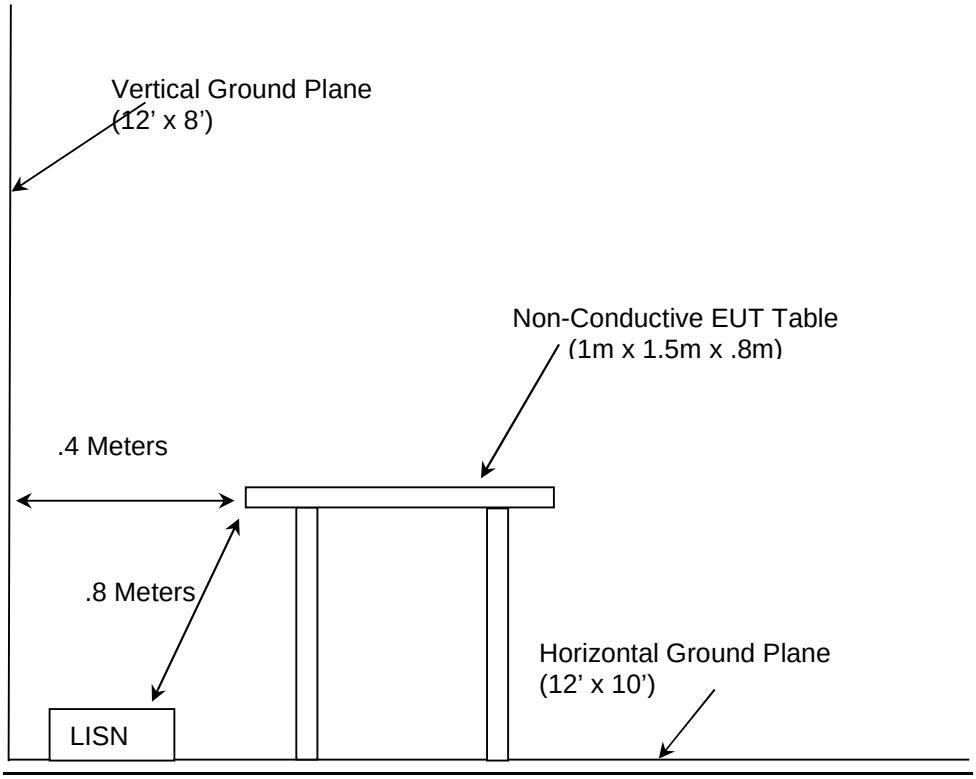

Figure 2.4.1-1: AC Mains Conducted EMI Site

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, 2019
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, April 2018.
- FCC KDB 558074 D01 DTS Meas Guidance v05r01 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, February 11, 2019

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

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
30	Spectrum Technologies	DRH-0118	1-18GHz Horn Antenna	970102	05/09/2017	05/09/2019
144	Omega	RH411	Temp / Humidity Meter	H0103373	10/24/2018	10/24/2020
321	Hewlett Packard	HPC 8447D	Low Freq. Pre-Amp	1937A02809	09/12/2018	09/12/2019
324	ACS	Belden	Conducted EMI Cable	8214	04/05/2018	04/05/2019
335	Suhner	SF-102A	Cable (40GHZ)	882/2A	07/10/2018	07/10/2019
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/11/2017	07/11/2019
345	Suhner Sucoflex	102A	Cable 42(GHZ)	1077/2A	07/10/2018	07/10/2019
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	05/16/2018	05/16/2019
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/30/2018	07/30/2020
638	Rohde & Schwarz	OSP 120	Open Switch and Control Unit	101229	04/28/2017	04/28/2019
651	Rohde & Schwarz	TS-PR26	18GHz to 26.5GHz Pre-Amplifier	100023	07/10/2018	07/10/2019
652	Rohde & Schwarz	3160-09	High Frequency Antenna 18GHz to 26.5GHz	060922-21894	NCR	NCR
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	2/25/2019	2/25/2020
819	Rohde & Schwarz	ESR26	EMI Test Receiver	101345	11/06/2018	11/06/2019
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	08/13/2018	08/13/2019
851	TUV ATLANTA	FMC0101951-100CM	ASAC Cable Set Consisting of 566, 619, and 643	N/A	09/26/2018	09/26/2019
852	Teseq	CBL 6112D	Bilog Antenna; Attenuator	51617	10/15/2018	10/15/2019
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/11/2018	07/11/2019

NCR: No Calibration Required
NOTE: All test equipment was used only during active calibration cycles.

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1†	AC/DC Adapter	JFEC ELECTRONIC TECHNICAL PRODUCT, INC.	JF024WR-1200200UH	NA

† **Used for AC Power Line Conducted Emissions only.**

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A†	DC Power	3m	No	EUT-1

† **Used for AC Power Line Conducted Emissions only.**

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

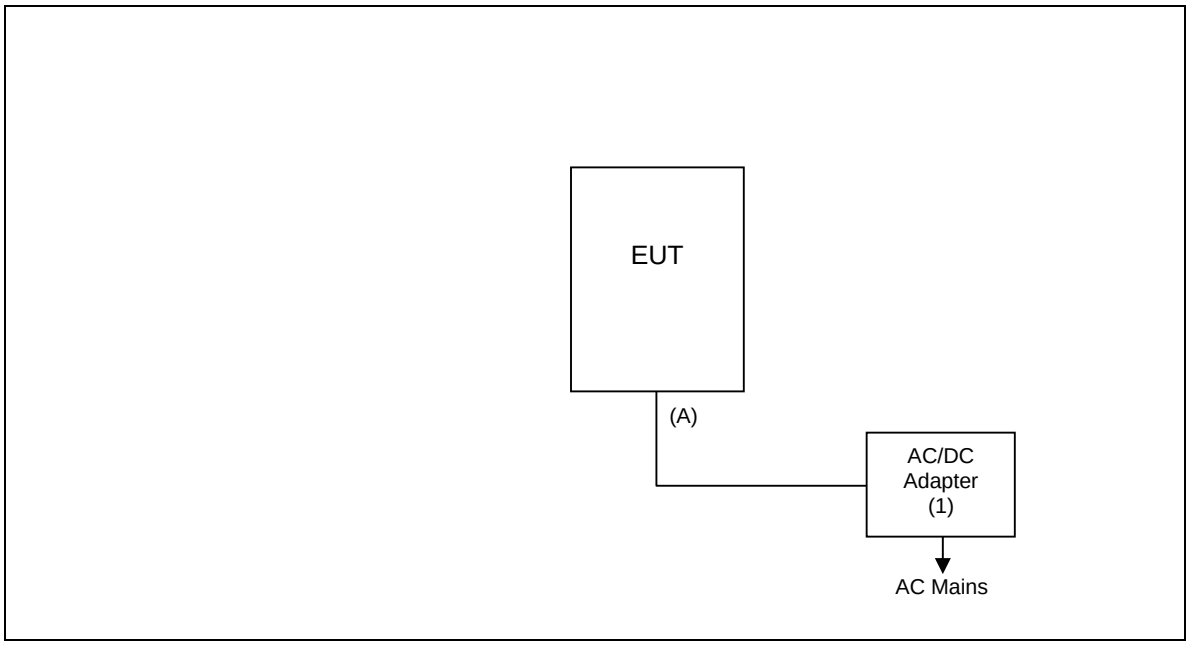

Figure 6-1: EUT System Block Diagram

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: Part 15.203

The antenna is a surface mount chip antenna and is non-detachable without compromising the device, therefore satisfying Part 15.203. The antenna gain is 3.0 dBi.

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 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 = Corrected Reading - Applicable Limit

7.2.2 Measurement Results

Performed by: Tyler Leeson

Table 7.2.2-1: Conducted EMI Results Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBµV)	Average (dBµV)	Quasi-Peak (dBµV)	Average (dBµV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.166	54.39	26.15	65.16	55.16	-10.77	-29.01	9.58
0.194	53.51	23.74	63.86	53.86	-10.35	-30.12	9.58
0.206	51.19	23.15	63.37	53.37	-12.18	-30.22	9.58
0.230	48.76	22.34	62.45	52.45	-13.69	-30.11	9.58
0.250	47.76	22.25	61.76	51.76	-14.00	-29.51	9.58
0.266	45.88	22.25	61.24	51.24	-15.36	-28.99	9.58
0.402	44.75	27.78	57.81	47.81	-13.06	-20.03	9.59
0.410	45.92	30.81	57.65	47.65	-11.73	-16.84	9.59
0.426	48.72	35.83	57.33	47.33	-8.61	-11.50	9.59
0.458	47.30	22.33	56.73	46.73	-9.43	-24.40	9.59

Table 7.2.2-2: Conducted EMI Results Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBµV)	Average (dBµV)	Quasi-Peak (dBµV)	Average (dBµV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.170	52.36	23.16	64.96	54.96	-12.60	-31.80	9.58
0.190	51.68	22.55	64.04	54.04	-12.36	-31.49	9.58
0.206	50.18	22.46	63.37	53.37	-13.19	-30.91	9.58
0.214	48.95	22.42	63.05	53.05	-14.10	-30.63	9.58
0.226	47.60	22.35	62.60	52.60	-15.00	-30.25	9.58
0.242	46.85	22.24	62.03	52.03	-15.18	-29.79	9.58
0.258	44.63	22.23	61.50	51.50	-16.87	-29.27	9.59
0.274	43.31	22.23	61.00	51.00	-17.69	-28.77	9.59
0.282	43.15	22.25	60.76	50.76	-17.61	-28.51	9.59
0.318	41.04	22.27	59.76	49.76	-18.72	-27.49	9.59

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

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 Section 8.2 which references Subclause 11.8 of ANSI C63.10. 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 6dB 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 from 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

7.3.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.3.2-1: 6dB / 99% Bandwidth

Modulation	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)
802.11b	2412	10.150000	15.700000
	2437	10.150000	15.700000
	2462	10.150000	15.500000
802.11g	2412	10.250000	18.300000
	2437	10.250000	18.000000
	2462	10.250000	17.800000
802.11n	2412	10.250000	19.500000
	2437	10.250000	18.900000
	2462	10.250000	18.500000

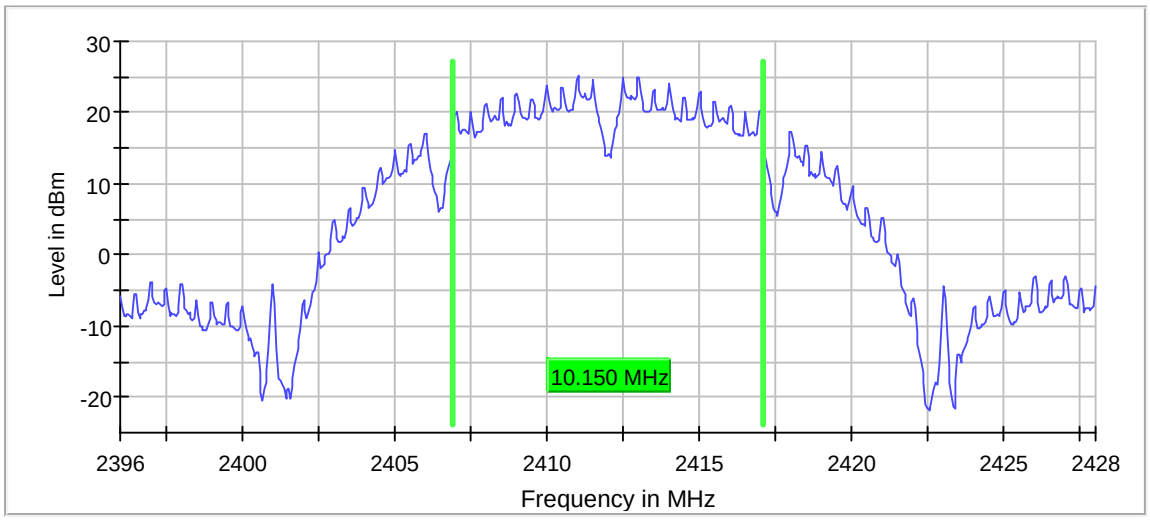

Figure 7.3.2-1: Sample Plot - 6dB BW

Table 7.3.2-2: Sample Measurement Settings (6dB BW)

Setting	Instrument Value	Target Value
Start Frequency	2.39600 GHz	2.39600 GHz
Stop Frequency	2.42800 GHz	2.42800 GHz
Span	32.000 MHz	32.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	640	~ 640
Sweeptime	1.010 ms	AUTO
Reference Level	20.000 dBm	20.000 dBm
Attenuation	25.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	19 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.16 dB	0.50 dB

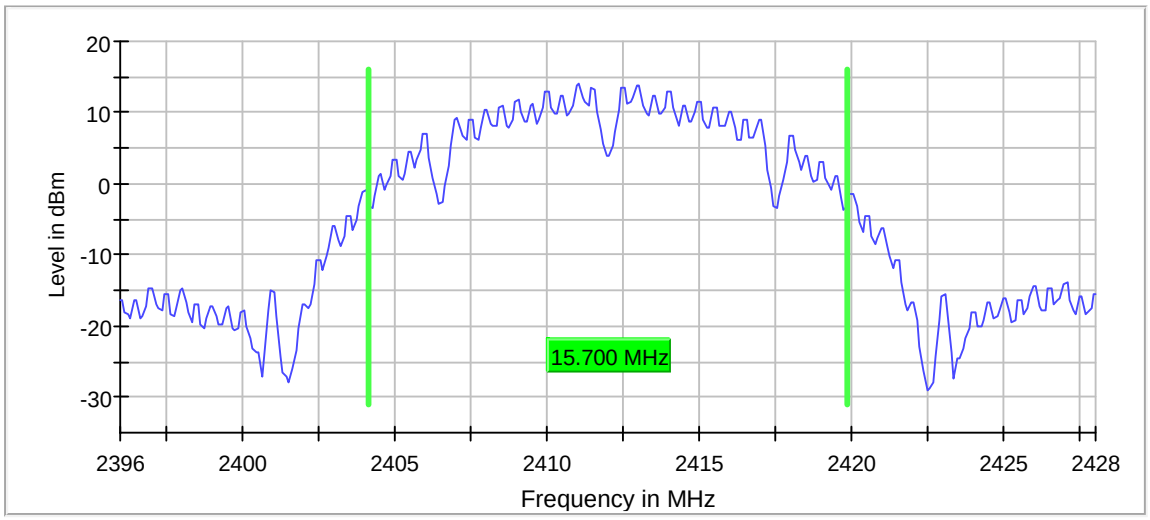

Figure 7.3.2-2: Sample Plot - 99% OBW

Table 7.3.2-3: Sample Measurement Settings (OBW)

Setting	Instrument Value	Target Value
Start Frequency	2.39600 GHz	2.39600 GHz
Stop Frequency	2.42800 GHz	2.42800 GHz
Span	32.000 MHz	32.000 MHz
RBW	200.000 kHz	>= 160.000 kHz
VBW	1.000 MHz	>= 600.000 kHz
SweepPoints	320	~ 320
Sweeptime	18.984 µs	AUTO
Reference Level	20.000 dBm	20.000 dBm
Attenuation	40.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	9 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.30 dB

7.4 Fundamental Emission Output Power – FCC 15.247(b)(3), ISED Canada: RSS-247 5.4(d)

7.4.1 Measurement Procedure

The maximum peak conducted output power was measured in accordance with FCC KDB 558074 D01 utilizing the RBW ≥ DTS Bandwidth method. The RF output of the equipment under test was directly connected to the input of the analyzer applying suitable attenuation. Additionally, to show data relative to the SAR test report, maximum conducted output power was measured utilizing the AVGPM-G method. The RF output of the equipment under test was directly connected to the input of the power sensor applying suitable attenuation. Worst-case power across all data rates is reported.

7.4.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.4.2-1: Maximum Peak Conducted Output Power

Modulation	Frequency (MHz)	Peak Power (dBm)	AVG Power (dBm)
802.11b	2412	20.9	18.2
	2437	20.6	18.1
	2462	20.5	17.7
802.11g	2412	26.4	18.3
	2437	26.2	18.0
	2462	26.0	17.8
802.11n	2412	25.5	17.2
	2437	25.2	17.0
	2462	24.9	16.7

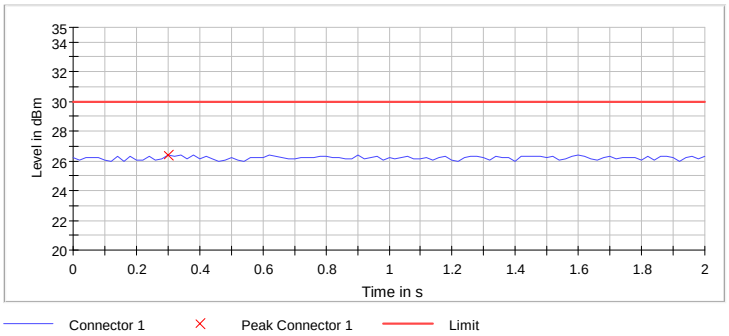

Figure 7.4.2-1: Sample Plot

Table 7.4.2-1: Sample Measurement Settings

Setting	Instrument Value	Target Value
Center Frequency	2.41200 GHz	2.41200 GHz
Span	ZeroSpan	ZeroSpan
RBW	20.000 MHz	>= 18.000 MHz
VBW	28.000 MHz	>= 60.000 MHz
SweepPoints	101	~ 101
Sweeptime	2.000 s	2.000 s
Reference Level	30.000 dBm	30.000 dBm
Attenuation	50.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	10	10
Filter	Channel	Channel
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off

7.5 Emission Levels

7.5.1 Emissions into Non-restricted Frequency Bands – FCC 15.247(d)

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. 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. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 30 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30 MHz to 25 GHz, 10 times the highest fundamental frequency.

7.5.1.2 Measurement Results

Performed by: Jeremy Pickens

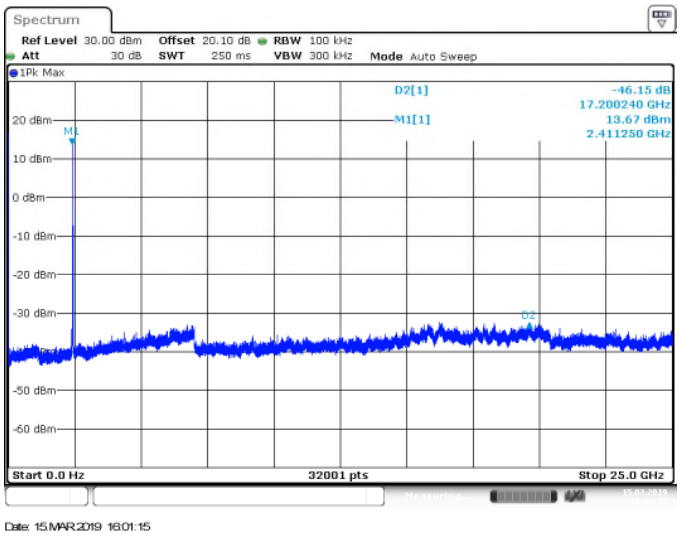

Figure 7.5.1.2-1: LCH – 30MHz–25GHz

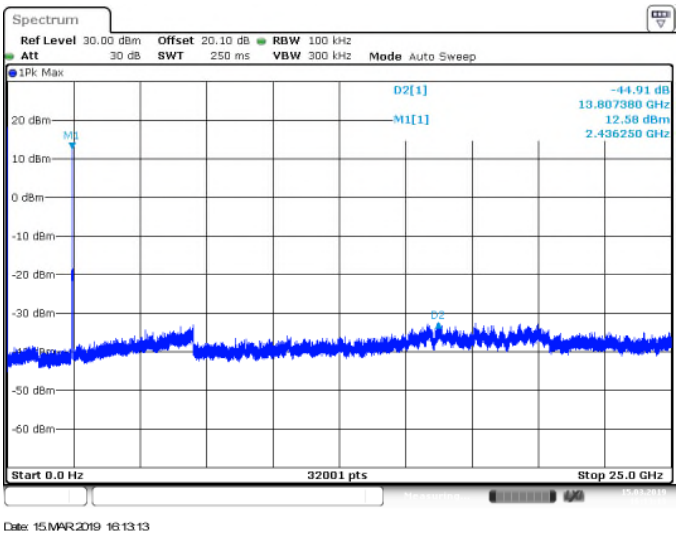

Figure 7.5.1.2-2: MCH – 30MHz–25GHz

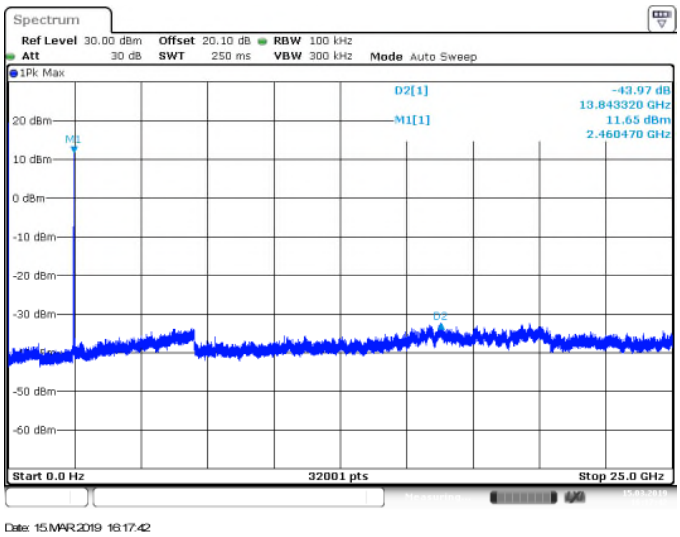

Figure 7.5.1.2-3: HCH – 30MHz–25GHz

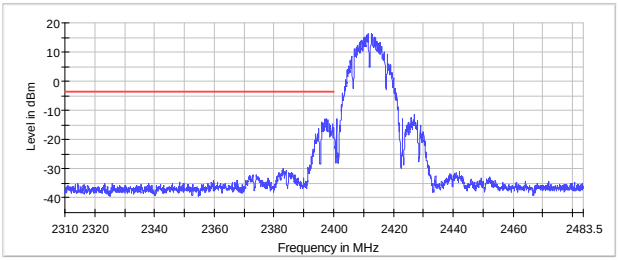

Figure 7.5.1.2-4: Lower Band-edge – 802.11b

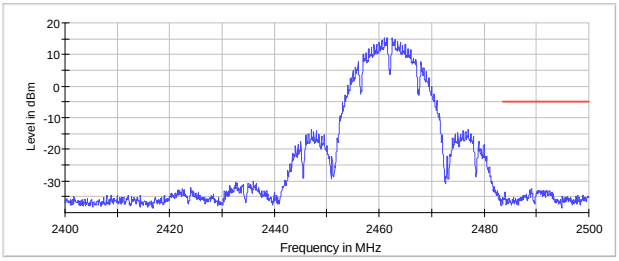

Figure 7.5.1.2-5: Upper Band-edge – 802.11b

Table 7.5.1.2-1: Lower Band-edge – 802.11b

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2396.975000	-12.9	9.2	-3.8	PASS
2397.025000	-12.9	9.2	-3.8	PASS
2397.525000	-13.1	9.3	-3.8	PASS
2397.475000	-13.1	9.3	-3.8	PASS
2398.025000	-13.2	9.5	-3.8	PASS
2397.975000	-13.3	9.6	-3.8	PASS
2396.025000	-14.0	10.3	-3.8	PASS
2395.975000	-14.1	10.4	-3.8	PASS
2396.525000	-14.2	10.5	-3.8	PASS
2396.475000	-14.3	10.5	-3.8	PASS
2398.075000	-14.4	10.7	-3.8	PASS
2397.075000	-14.5	10.8	-3.8	PASS
2398.475000	-14.7	11.0	-3.8	PASS
2398.525000	-14.8	11.0	-3.8	PASS
2396.925000	-14.9	11.1	-3.8	PASS

Table 7.5.1.2-2: Upper Band-edge – 802.11b

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2489.025000	-32.7	27.8	-4.8	PASS
2488.775000	-32.9	28.1	-4.8	PASS
2488.975000	-32.9	28.1	-4.8	PASS
2491.025000	-33.0	28.2	-4.8	PASS
2491.925000	-33.0	28.2	-4.8	PASS
2488.825000	-33.1	28.3	-4.8	PASS
2489.075000	-33.1	28.3	-4.8	PASS
2491.075000	-33.1	28.3	-4.8	PASS
2490.575000	-33.1	28.3	-4.8	PASS
2491.875000	-33.1	28.3	-4.8	PASS
2490.525000	-33.1	28.3	-4.8	PASS
2491.475000	-33.2	28.4	-4.8	PASS
2491.325000	-33.2	28.4	-4.8	PASS
2491.975000	-33.2	28.4	-4.8	PASS
2492.475000	-33.2	28.4	-4.8	PASS

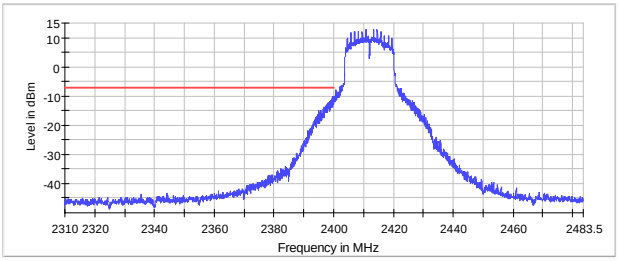

Figure 7.5.1.2-6: Lower Band-edge – 802.11g

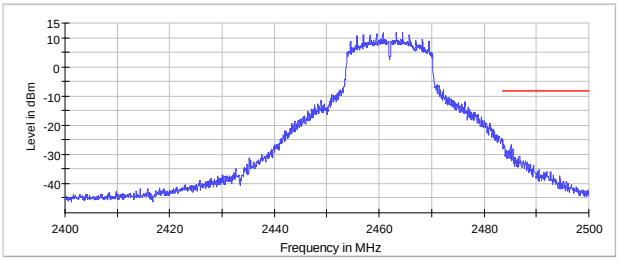

Figure 7.5.1.2-7: Upper Band-edge – 802.11g

Table 7.5.1.2-3: Lower Band-edge – 802.11g

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.475000	-10.1	2.7	-7.3	PASS
2399.525000	-10.3	3.0	-7.3	PASS
2399.825000	-10.7	3.4	-7.3	PASS
2399.875000	-10.8	3.4	-7.3	PASS
2399.425000	-11.3	3.9	-7.3	PASS
2399.225000	-11.6	4.2	-7.3	PASS
2398.875000	-11.6	4.3	-7.3	PASS
2399.125000	-11.7	4.3	-7.3	PASS
2399.175000	-11.8	4.4	-7.3	PASS
2399.775000	-11.8	4.4	-7.3	PASS
2398.525000	-12.0	4.6	-7.3	PASS
2399.725000	-12.0	4.7	-7.3	PASS
2398.625000	-12.0	4.7	-7.3	PASS
2398.825000	-12.0	4.7	-7.3	PASS
2399.275000	-12.0	4.7	-7.3	PASS

Table 7.5.1.2-4: Upper Band-edge – 802.11g

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-24.9	16.7	-8.2	PASS
2483.575000	-26.1	17.8	-8.2	PASS
2483.875000	-26.6	18.4	-8.2	PASS
2485.125000	-26.8	18.6	-8.2	PASS
2485.175000	-27.0	18.7	-8.2	PASS
2483.825000	-27.0	18.8	-8.2	PASS
2483.625000	-27.3	19.1	-8.2	PASS
2483.725000	-28.0	19.7	-8.2	PASS
2483.775000	-28.0	19.7	-8.2	PASS
2483.925000	-28.0	19.7	-8.2	PASS
2485.475000	-28.2	19.9	-8.2	PASS
2483.975000	-28.2	20.0	-8.2	PASS
2485.075000	-28.3	20.1	-8.2	PASS
2485.525000	-28.3	20.1	-8.2	PASS
2483.675000	-28.4	20.1	-8.2	PASS

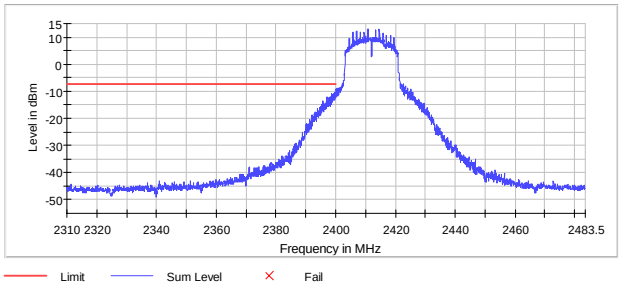

Figure 7.5.1.2-8: Lower Band-edge – 802.11n

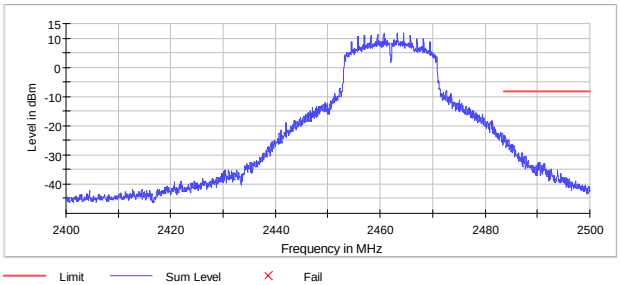

Figure 7.5.1.2-9: Upper Band-edge – 802.11n

Table 7.5.1.2-5: Lower Band-edge – 802.11n

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.475000	-10.4	3.3	-7.1	PASS
2399.525000	-10.4	3.3	-7.1	PASS
2399.875000	-10.9	3.8	-7.1	PASS
2399.125000	-11.0	3.9	-7.1	PASS
2398.525000	-11.0	3.9	-7.1	PASS
2399.825000	-11.1	4.0	-7.1	PASS
2399.975000	-11.1	4.0	-7.1	PASS
2398.475000	-11.1	4.0	-7.1	PASS
2399.175000	-11.3	4.2	-7.1	PASS
2398.875000	-11.3	4.2	-7.1	PASS
2399.775000	-11.5	4.4	-7.1	PASS
2398.925000	-11.8	4.7	-7.1	PASS
2396.975000	-11.9	4.8	-7.1	PASS
2397.025000	-11.9	4.8	-7.1	PASS
2399.075000	-11.9	4.8	-7.1	PASS

Table 7.5.1.2-6: Upper Band-edge – 802.11n

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.875000	-23.5	15.3	-8.2	PASS
2483.825000	-23.7	15.5	-8.2	PASS
2483.625000	-24.4	16.1	-8.2	PASS
2483.925000	-24.4	16.2	-8.2	PASS
2483.525000	-24.5	16.3	-8.2	PASS
2483.575000	-24.7	16.5	-8.2	PASS
2484.225000	-24.7	16.5	-8.2	PASS
2483.675000	-24.9	16.6	-8.2	PASS
2484.275000	-24.9	16.7	-8.2	PASS
2484.525000	-24.9	16.7	-8.2	PASS
2484.475000	-24.9	16.7	-8.2	PASS
2483.725000	-25.1	16.9	-8.2	PASS
2483.775000	-25.7	17.5	-8.2	PASS
2483.975000	-25.8	17.5	-8.2	PASS
2484.575000	-26.1	17.8	-8.2	PASS

7.5.2 Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209, 15.247(d); ISED Canada: RSS-Gen 8.9 / 8.10

7.5.2.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 25 GHz, 10 times the highest fundamental frequency.

Measurements below 30 MHz were performed with a 3-meter separation distance between the EUT and measurement antenna. The EUT was rotated 360° to maximize each emission. The magnetic loop receiving antenna was positioned with its lowest point 1 meter above the ground. The loop antenna was aligned along the site axis, orthogonal to the site axis, and ground-parallel to the site axis.

The spectrum analyzer's resolution and video bandwidths were set to 200 Hz and 1000 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz.

For measurements above 30 MHz, the EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, measurements were made using a quasi-peak detector with a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000 MHz, measurements were made using a peak and average detector with RBW of 1 MHz and a VBW of 3 MHz.

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.

7.5.2.2 Measurement Results

Performed by: Jeremy Pickens, Tyler Leeson

Radiated spurious emissions are reported in Table 7.3.2-1. Emissions not reported were below the noise floor of the measurement system. There were no emissions detected between 30 and 1000MHz.

Table 7.5.2.2-1: Radiated Emissions – 802.11b

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
Spurious Emissions - Low Channel										
2390	63.3	55.9	H	-3.90	59.40	52.00	74.0	54.0	14.6	2.0
2390	61.3	53.1	V	-3.90	57.40	49.20	74.0	54.0	16.6	4.8
4824	51.10	45.20	H	4.59	55.69	49.79	74.0	54.0	18.3	4.2
4824	49.10	40.40	V	4.59	53.69	44.99	74.0	54.0	20.3	9.0
Spurious Emissions - High Channel										
2485.5	60.9	52.1	H	-3.45	57.45	48.65	74.0	54.0	16.5	5.3
2485.5	61.1	50.9	V	-3.45	57.65	47.45	74.0	54.0	16.3	6.5

Table 7.5.2.2-2: Radiated Emissions – 802.11g

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
Spurious Emissions - Low Channel										
2390	75.30	56.30	H	-3.90	71.40	52.40	74.0	54.0	2.6	1.6
2390	70.80	52.60	V	-3.90	66.90	48.70	74.0	54.0	7.1	5.3
4824	46.10	33.30	H	4.22	50.32	37.52	74.0	54.0	23.7	16.5
4824	45.70	33.20	V	4.22	49.92	37.42	74.0	54.0	24.1	16.6
Spurious Emissions - High Channel										
2483.5	76.1	55.3	H	-3.46	72.64	51.84	74.0	54.0	1.4	2.2
2483.5	76.7	55.6	V	-3.46	73.24	52.14	74.0	54.0	0.8	1.9
4924	45.6	32.1	H	4.67	50.27	36.77	74.0	54.0	23.7	17.2
4924	46.9	32.2	V	4.67	51.57	36.87	74.0	54.0	22.4	17.1

Table 7.5.2.2-3: Radiated Emissions – 802.11n

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
Spurious Emissions - Low Channel										
2390	76.10	57.50	H	-3.90	72.20	53.60	74.0	54.0	1.8	0.4
2390	74.70	56.00	V	-3.90	70.80	52.10	74.0	54.0	3.2	1.9
4824	46.30	32.10	H	4.22	50.52	36.32	74.0	54.0	23.5	17.7
4824	46.10	32.10	V	4.22	50.32	36.32	74.0	54.0	23.7	17.7
Spurious Emissions - Mid Channel										
4874	45.8	31.8	H	4.44	50.24	36.24	74.0	54.0	23.8	17.8
4874	44.8	31.7	V	4.44	49.24	36.14	74.0	54.0	24.8	17.9
Spurious Emissions - High Channel										
2483.5	76.3	53.9	H	-3.46	72.84	50.44	74.0	54.0	1.2	3.6
2483.5	76.2	53.8	V	-3.46	72.74	50.34	74.0	54.0	1.3	3.7
4924	47	33.3	H	4.67	51.67	37.97	74.0	54.0	22.3	16.0
4924	47.7	33.3	V	4.67	52.37	37.97	74.0	54.0	21.6	16.0

7.5.3 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 – 802.11n - Low Channel – 2390MHz– Horizontal polarity
Corrected Level: 76.10 – 3.90 = 72.20dBuV
Margin: 74dBuV – 72.20dBuV = 1.8dB

Example Calculation: Average – 802.11n - Low Channel – 2390MHz– Horizontal polarity
Corrected Level: 57.50 – 3.90 = 53.60dBuV
Margin: 54dBuV – 53.60dBuV = 0.4dB

7.6 Maximum Power Spectral Density in the Fundamental Emission

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance 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 initially set to 100 kHz and the Video Bandwidth (VBW) was set to 300 kHz. The span was set to 1.5 times the DTS bandwidth. The trace was set to max hold with the Peak detector active. If the resulting peak measurement was >8dBm, the RBW and VBW were reduced to a minimum of 3kHz and 10kHz respectively, and the measurement was repeated.

7.6.2 Measurement Results

Performed by: Jeremy Pickens

Table 7.6.2-1: Power Spectral Density

Modulation	Frequency (MHz)	PSD (dBm)
802.11b	2412	-3.157
	2437	-2.662
	2462	-2.012
802.11g	2412	7.557
	2437	7.399
	2462	7.329
802.11n	2412	6.872
	2437	6.437
	2462	6.258

Note: Final 802.11b measurements were recorded with a 3kHz RBW and 802.11g/n measurements were recorded with a 100kHz RBW

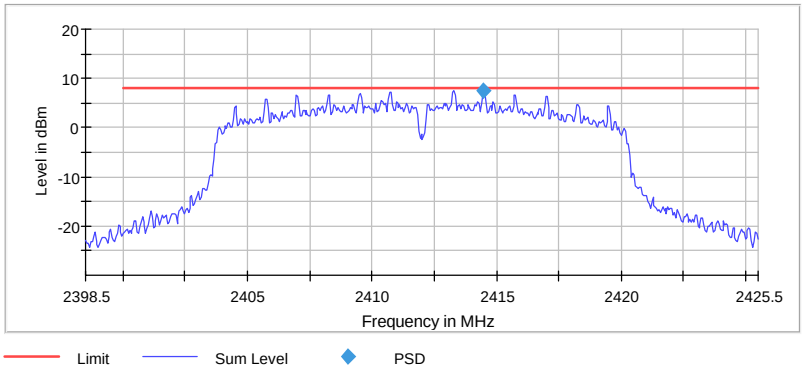

Figure 7.4.2-1: Sample Plot

Table 7.4.2-1: Sample Measurement Settings

Setting	Instrument Value	Target Value
Start Frequency	2.39850 GHz	2.39850 GHz
Stop Frequency	2.42550 GHz	2.42550 GHz
Span	27.000 MHz	27.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	540	~ 540
Sweeptime	1.030 ms	AUTO
Reference Level	20.000 dBm	20.000 dBm
Attenuation	40.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	26 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.48 dB	0.50 dB

7.7 Duty Cycle

7.7.1 Measurement Procedure

The duty cycle was using a fast power sensor and meter in conjunction with the WMS32 software. The software recorded the on and off times over a sample period and reported the duty cycle.

7.7.2 Measurement Results

Performed by: Jeremy Pickens

The results for all the modes of operation are provided below.

Table 7.7.2-1 Duty Cycle Correction Factor

Mode	Duty Cycle [%]	Correction Factor [dB]
802.11b, 1Mbps	99.9	0.0
802.11g, 6Mbps	99.1	0.0
802.11n, MCS0	98.8	0.0

Note: Duty-cycles >98% require no correction

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures (U_{Lab}) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

Table 8-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	± 0.009 %
RF Conducted Output Power	± 0.349 dB
Power Spectral Density	± 0.372 dB
Antenna Port Conducted Emissions	± 1.264 dB
Radiated Emissions ≤ 1 GHz	± 5.814 dB
Radiated Emissions > 1 GHz	± 4.318 dB
Temperature	± 0.860 °C
Radio Frequency	± 2.832 x 10^{-8}
AC Power Line Conducted Emissions	± 3.360 dB

9 CONCLUSION

In the opinion of TÜV SÜD America Inc. the 14024VL manufactured by Attenti US Inc met the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT