Wireless Test Report

FCC ID: QZC-UFTR1
IC: 4557A-UFTR1

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

TÜV SÜD Report Number: 17-3005.W06.1A

Manufacturer: Elster Solutions LLC
Model: UFTR1

Test Begin Date: January 25, 2017
Test End Date: May 31, 2017

Report Issue Date: June 1, 2017

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

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

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This report contains 34 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 ISED Canada's Radio Standards Specification RSS-247 Certification.

1.2 Product description

The UFT is housed in a 3.67" x 4.25" x 1.35" plastic enclosure. This enclosure is then mounted to a rotating plastic clip used to attach the device to the user's waist/belt

A 3.7V (nominal voltage) 6600 mAh Lithium battery is mounted inside the plastic enclosure with the PCBA and serves as the main power source for the system.

The battery is charged via a micro-usb port (5V) located at the top of the enclosure, and is charged via a battery controller IC which prevents over/under voltage and provides the appropriate charging current of 0.2C.

The output of the battery controller is fed to a buck-boost regulator which provides a 3.3V source to all other ICs on the PCBA

The 900 MHz radio may operate in two modes: (Mode 1) The Energy Axis (EA) mode at low power or (Mode 2) NGC mode at low power. The EA mode is Elster's legacy mode of operation while the NGC mode is for future use and is compliant with the IEEE 802.15.4g standard for Smart Metering Utility Networks.

The 900MHz antenna is a chip antenna mounted onto the PCBA. The Bluetooth module has an on-board chip antenna as well.

The 900 and 450 MHz radio subsystems are both operated by one Si4467 transceiver. The 900 MHz and 450 MHz transmit path is selected via an RF switch IC. The Bluetooth operation of the device is controlled by a separate preapproved module (FCCID: PI4411B) and operates independently

The 450 MHz radio only has a transmit mode operation (FCCID: QZC-UFTR1), while the 900 MHz radio is bi-directional. The 450 MHz radio can be transmitting while the 900 MHz radio is in receive mode, and the Bluetooth module can be in transmit or receive mode at any given time, regardless of other radio modes.

Technical Information:

Mode of Operation	Frequency Range (MHz)	Number of Channels	Data Rates Supported (kbps)
1	902.4 - 927.6	25	35.5, 142.2
2	902.4 - 927.6	64	50, 150, 200

Modulation Format: FSK
Operating Voltage: 3.7Vdc
Antenna Type / Gain: Chip / 2.56dBi

Manufacturer Information:
Elster Solutions, LLC
208 S. Rogers Lane
Raleigh, NC 27610

EUT Serial Numbers: 0004

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

1.3 Test Methodology and Considerations

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

The unit was powered using a battery for testing. For the radiated emissions, the EUT was evaluated in the three orthogonal planes and all data rates. The worst-case orientation was Y polarization and the worst case data rate was 200kbps.

For AC power line conducted emissions the EUT was evaluated with the battery charging and transceiver in transmit.

Software power settings during test for mode 1: 24 (Low Channel), 21 (Mid Channel), 19 (High Channel)

The EUT is capable of simultaneous transmission with respect to the 900 MHz transmitter and the Bluetooth transmitter. Therefore, an evaluation was performed with both transmitters transmitting simultaneous with passing results.

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America Inc.
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Registered Test Site Number: 637011
ISED Canada Test Site Registration Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of an 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm 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 short #6 copper wire. 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 turntable. 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.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase 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:

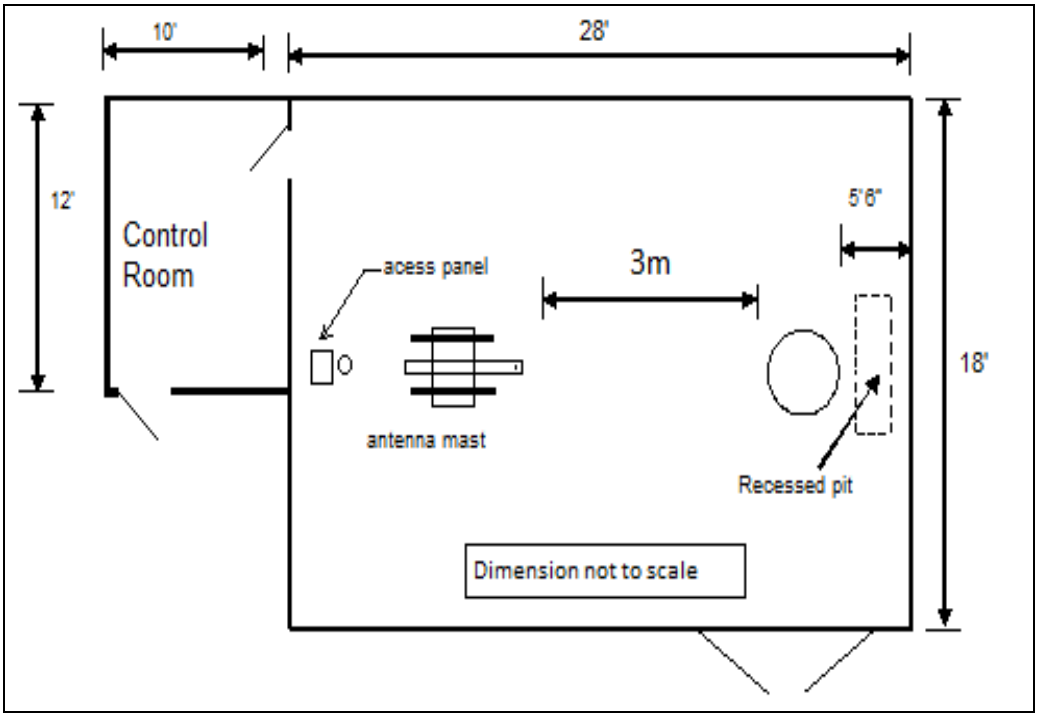

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

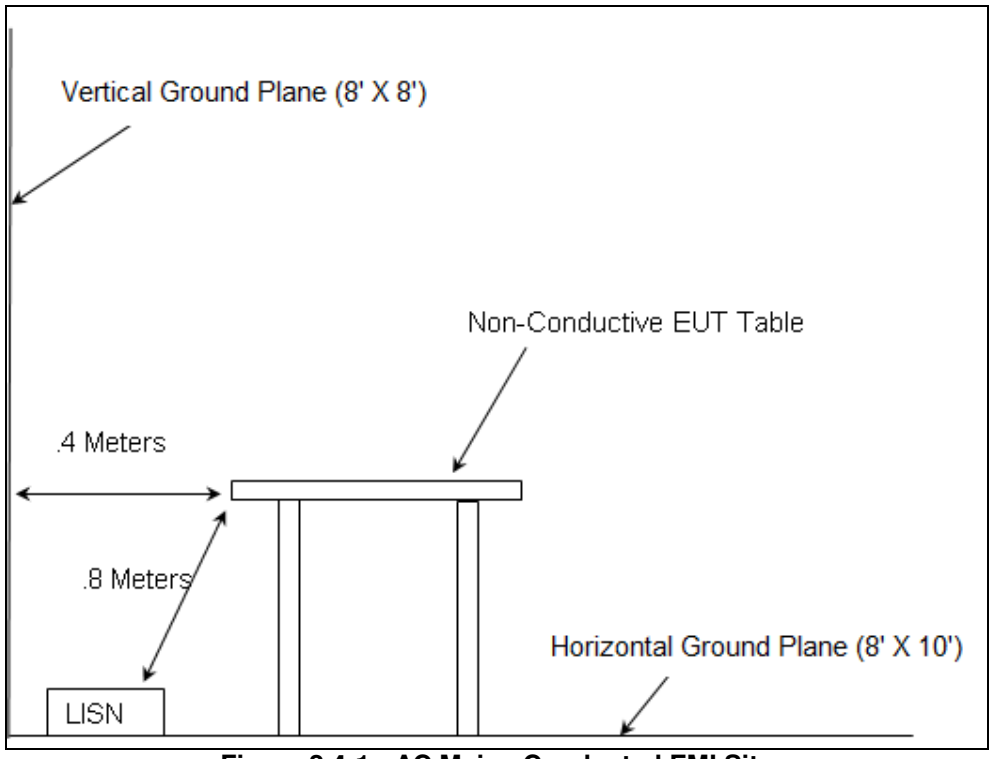

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- 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, 2017
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2017
- 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 2, Feb. 2017
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, 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

Asset ID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
277	EMCO	93146	Antennas	9904-5199	9/12/2016	9/12/2018
626*	EMCO	3110B	Antennas	9411-1945	2/29/2016	2/28/2017
3002	Rohde & Schwarz	ESU40	Receiver	100346	1/12/2017	1/12/2018
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	1/11/2017	1/11/2018
3008*	Rohde & Schwarz	NRP2	Meter	103131	1/28/2016	1/28/2017
3009*	Rohde & Schwarz	NRP-Z81	Meter	102397	1/28/2016	1/28/2017
3011	Rohde & Schwarz	ENV216	LISN	3011	1/12/2017	1/12/2018
3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
3029	Micro-Tronics	HPM50108	Filter	134	1/13/2017	1/13/2018
3036	Hasco, Inc.	HLL142-S1-S1-24	Cables	2450	1/11/2017	1/11/2018
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/3/2017	1/3/2018
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/3/2017	1/3/2018
3049	Aeroflex Inmet	26AH-20	Attenuator	1443	1/11/2017	1/11/2018
3051	Mountain View Cable	BMS-RG400-264.0-BMS	Cables	3051	1/3/2017	1/3/2018
3055	Rohde & Schwarz	3005	Cables	3055	1/3/2017	1/3/2018
3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	8/9/2016	8/9/2017

Note: *The testing was performed prior to the calibration due date.
NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset 3002: Firmware Version: ESU40 is 4.73 SP4
Asset 3012: Software Version: EMC32-B is 9.15
Asset 3085: Instrument Firmware 2.41 SP1

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Elster Solutions, LLC	Belt Clip Radio	0004

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
	None			

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

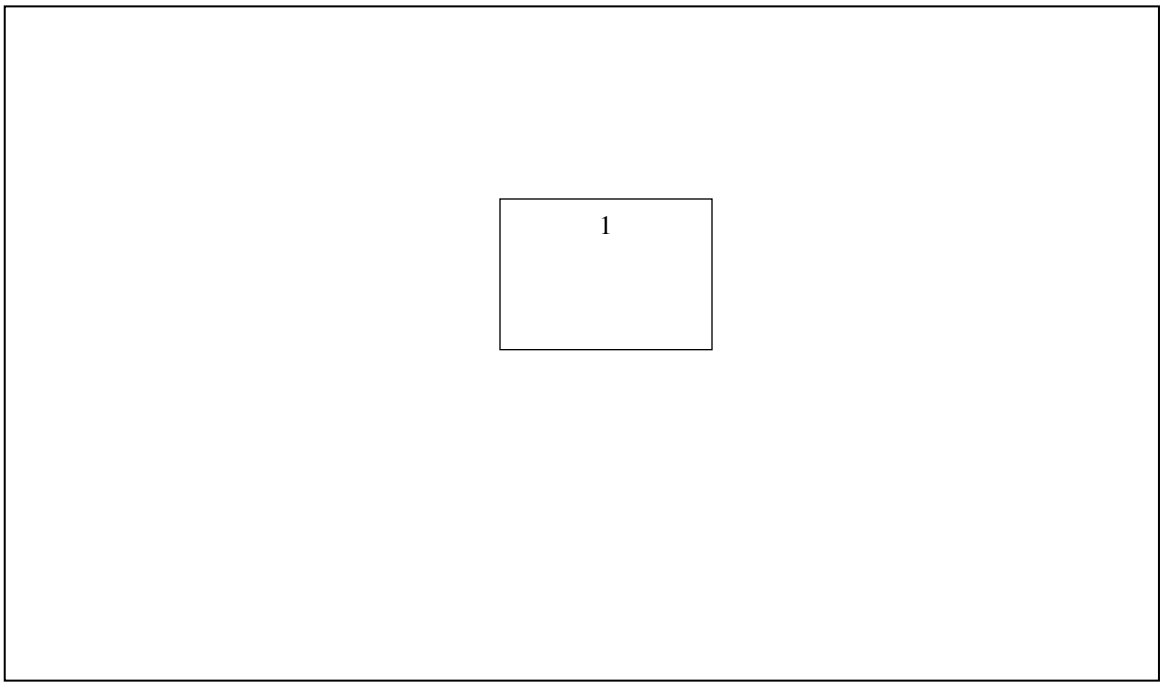

Figure 6-1: Test Setup Block Diagram

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 antenna is an intergral antenna. Therefore, the requirements of FCC Part 15. 203 are met.

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

7.2.1 Measurement Procedure

ANSI C63.10-2013 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

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.190000	---	29.00	53.88	24.88	2000.0	9.000	L1	OFF	9.6
0.190000	41.64	---	63.90	22.26	2000.0	9.000	L1	OFF	9.6
0.520000	---	25.36	46.00	20.64	2000.0	9.000	L1	OFF	9.6
0.520000	38.77	---	56.00	17.23	2000.0	9.000	L1	OFF	9.6
1.240000	---	21.15	46.00	24.85	2000.0	9.000	L1	OFF	9.7
1.240000	34.46	---	56.00	21.54	2000.0	9.000	L1	OFF	9.7
1.632000	---	24.92	46.00	21.08	2000.0	9.000	L1	OFF	9.7
1.632000	36.33	---	56.00	19.67	2000.0	9.000	L1	OFF	9.7
3.528000	---	25.91	46.00	20.09	2000.0	9.000	L1	OFF	9.8
3.528000	36.06	---	56.00	19.94	2000.0	9.000	L1	OFF	9.8
3.708000	---	25.92	46.00	20.08	2000.0	9.000	L1	OFF	9.8
3.708000	36.40	---	56.00	19.60	2000.0	9.000	L1	OFF	9.8
4.044000	---	25.57	46.00	20.43	2000.0	9.000	L1	OFF	9.8
4.044000	35.63	---	56.00	20.37	2000.0	9.000	L1	OFF	9.8
4.228000	---	25.41	46.00	20.59	2000.0	9.000	L1	OFF	9.8
4.228000	35.38	---	56.00	20.62	2000.0	9.000	L1	OFF	9.8
6.658000	---	26.10	50.00	23.90	2000.0	9.000	L1	OFF	9.9
6.658000	36.33	---	60.00	23.67	2000.0	9.000	L1	OFF	9.9
13.142000	---	29.92	50.00	20.08	2000.0	9.000	L1	OFF	10.0
13.142000	39.72	---	60.00	20.28	2000.0	9.000	L1	OFF	10.0

Table 7.2.2-2: Conducted EMI Results – Neutral

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.552000	---	20.06	46.00	25.94	2000.0	9.000	N	OFF	9.6
0.552000	35.29	---	56.00	20.71	2000.0	9.000	N	OFF	9.6
1.092000	---	20.07	46.00	25.93	2000.0	9.000	N	OFF	9.6
1.092000	33.66	---	56.00	22.34	2000.0	9.000	N	OFF	9.6
1.332000	---	17.71	46.00	28.29	2000.0	9.000	N	OFF	9.6
1.332000	31.09	---	56.00	24.91	2000.0	9.000	N	OFF	9.6
3.468000	---	21.22	46.00	24.78	2000.0	9.000	N	OFF	9.7
3.468000	31.77	---	56.00	24.23	2000.0	9.000	N	OFF	9.7
4.164000	---	20.48	46.00	25.52	2000.0	9.000	N	OFF	9.8
4.164000	30.90	---	56.00	25.10	2000.0	9.000	N	OFF	9.8
6.082000	---	21.84	50.00	28.16	2000.0	9.000	N	OFF	9.8
6.082000	31.77	---	60.00	28.23	2000.0	9.000	N	OFF	9.8
12.570000	---	27.11	50.00	22.89	2000.0	9.000	N	OFF	10.0
12.570000	34.42	---	60.00	25.58	2000.0	9.000	N	OFF	10.0
12.730000	---	27.38	50.00	22.62	2000.0	9.000	N	OFF	10.0
12.730000	34.75	---	60.00	25.25	2000.0	9.000	N	OFF	10.0
12.934000	---	27.46	50.00	22.54	2000.0	9.000	N	OFF	10.0
12.934000	34.68	---	60.00	25.32	2000.0	9.000	N	OFF	10.0
13.154000	---	27.45	50.00	22.55	2000.0	9.000	N	OFF	10.0
13.154000	34.76	---	60.00	25.24	2000.0	9.000	N	OFF	10.0

7.3 Peak Output Power – FCC: 15.247(b)(2); ISED Canada: RSS-247 5.4(a)

7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a peak power meter using suitable attenuation. The device employs < 50 channels at any given time in Mode 1 therefore the power is limited to 0.25 Watt. The device employs > 50 channels at any given time in Mode 2 therefore the power is limited to 1 Watt.

7.3.2 Measurement Results

Table 7.3.2-1: RF Output Power

Frequency (MHz)	Level (dBm)	Data Rate (kbps)	Modulation
902.4	23.97	35.5	FSK
902.4	23.95	142.2	FSK
902.4	23.95	50	FSK
902.4	23.95	150	FSK
902.4	23.97	200	FSK
914.8	23.76	35.5	FSK
914.8	23.76	142.2	FSK
914.8	23.75	50	FSK
914.8	23.73	150	FSK
914.8	23.77	200	FSK
927.6	23.51	35.5	FSK
927.6	23.50	142.2	FSK
927.6	23.51	50	FSK
927.6	23.50	150	FSK
927.6	23.53	200	FSK

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: 15.247(a)(1); ISED Canada: RSS-247 5.1(b)

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks. The RBW was set to approximately 30% of the channel spacing and adjusted as necessary to best identify the center of each channel. The VBW was set > RBW.

7.4.1.2 Measurement Results

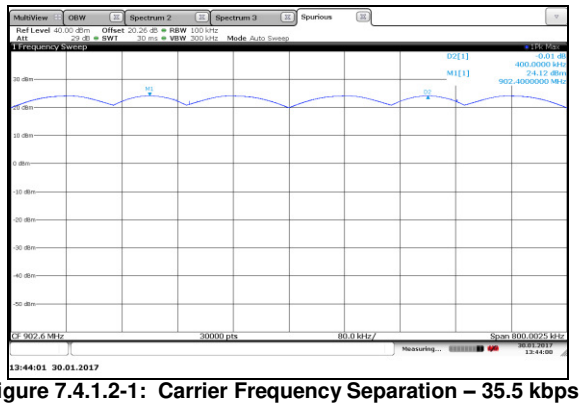

Figure 7.4.1.2-1: Carrier Frequency Separation – 35.5 kbps

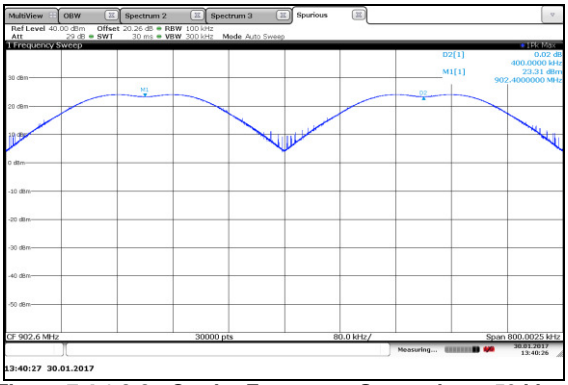

Figure 7.4.1.2-2: Carrier Frequency Separation – 50 kbps

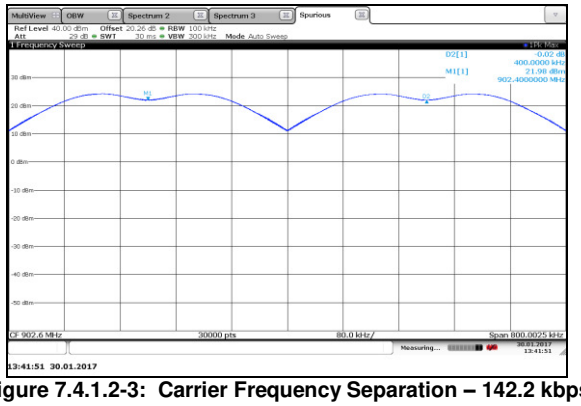

Figure 7.4.1.2-3: Carrier Frequency Separation – 142.2 kbps

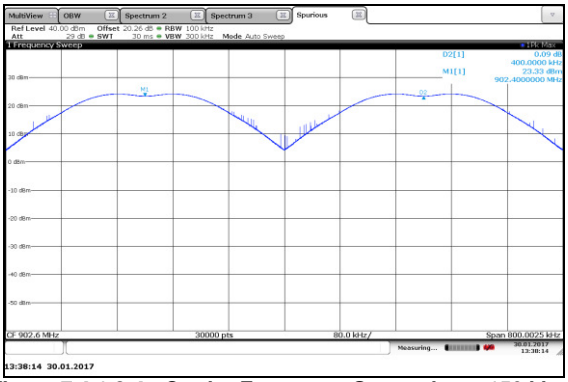

Figure 7.4.1.2-4: Carrier Frequency Separation – 150 kbps

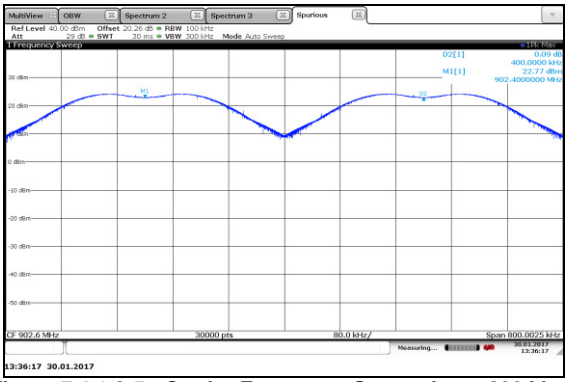

Figure 7.4.1.2-5: Carrier Frequency Separation – 200 kbps

7.4.2 Number of Hopping Channels – FCC: 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c)

7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to < 30% of the channel spacing and VBW set to ≥ RBW.

7.4.2.2 Measurement Results

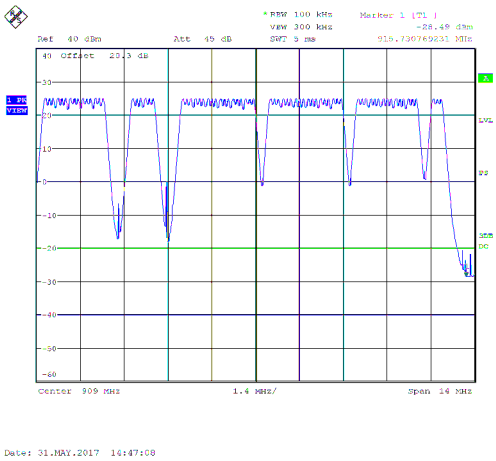

Figure 7.4.2.2-1: Number of Hopping Channels – 35.35 kbps

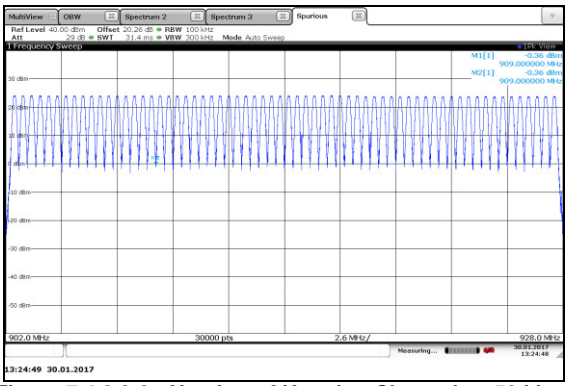

Figure 7.4.2.2-2: Number of Hopping Channels – 50 kbps

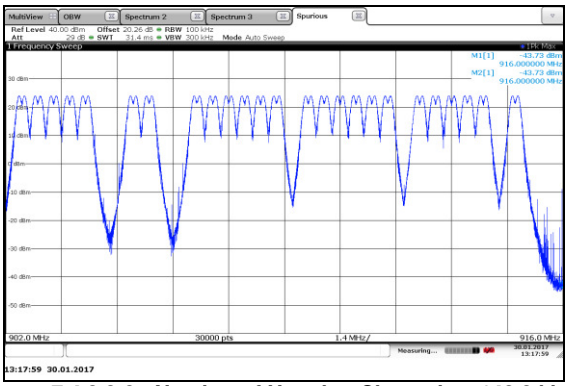

Figure 7.4.2.2-3: Number of Hopping Channels – 142.2 kbps

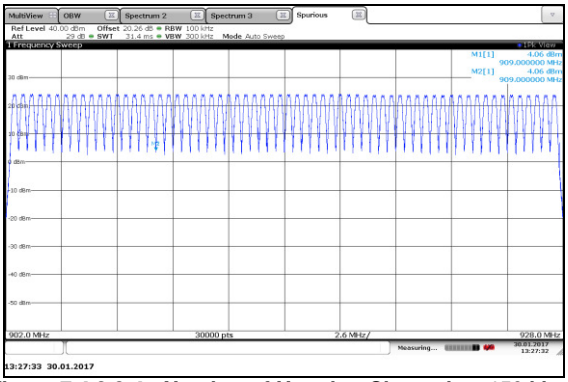

Figure 7.4.2.2-4: Number of Hopping Channels – 150 kbps

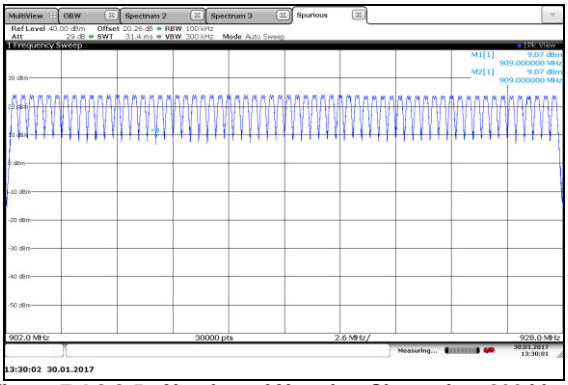

Figure 7.4.2.2-5: Number of Hopping Channels – 200 kbps

7.4.3 Channel Dwell Time – FCC: 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(c)

7.4.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer display was set 0 Hz centered on a hopping channel. The RBW of the spectrum analyzer was set to ≤ the EUT channel spacing and VBW set to ≥ RBW. The Marker Delta function of the analyzer was utilized to determine the dwell time.

7.4.3.2 Measurement Results

Table 7.4.3.2-1: Channel Dwell Time (10 Second Sweep)

Mode	Data Rate (kbps)	Single Occurrence	Number of Occurrences	Total Dwell Time (ms)
1	35.5kbps	102.48	2	204.96
1	142.2kbps	27.20	7	190.4
2	200kbps	25.06	4	100.24

Table 7.4.3.2-2: Channel Dwell Time (20 Second Sweep)

Mode	Data Rate (kbps)	Single Occurrence	Number of Occurrences	Total Dwell Time (ms)
2	50kbps	25.37	7	177.59
2	150kbps	24.98	7	174.86

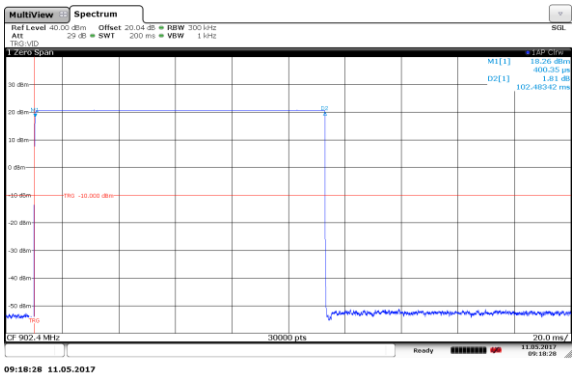

Figure 7.4.3.2-1: Dwell Time – 35.5kbps

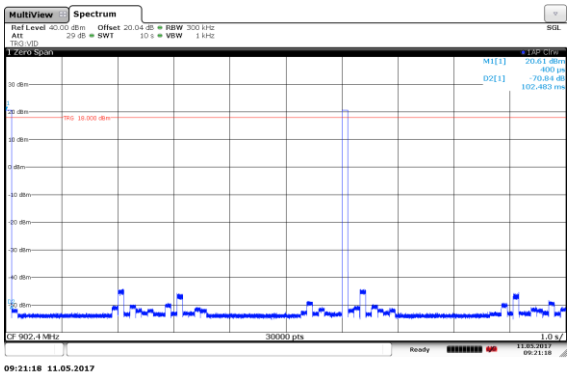

Figure 7.4.3.2-2: Number of Hops – 35.5kbps

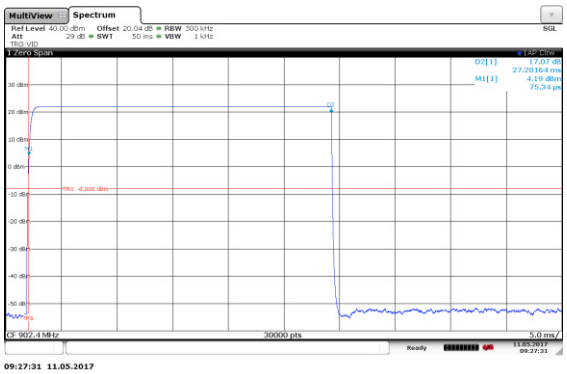

Figure 7.4.3.2-1: Dwell Time – 142.2kbps

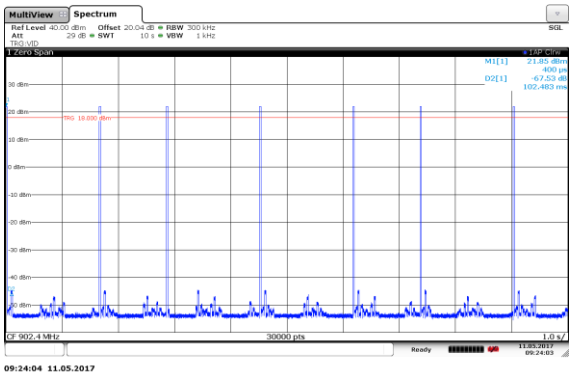

Figure 7.4.3.2-2: Number of Hops – 142.2kbps

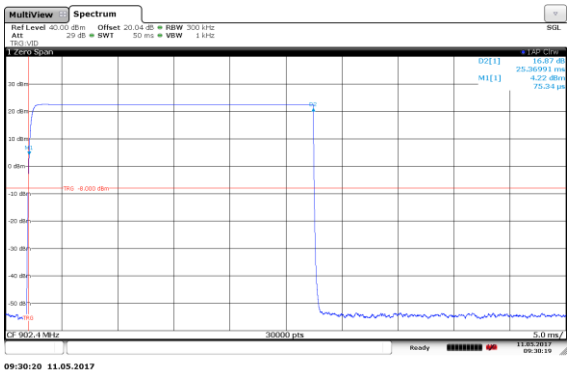

Figure 7.4.3.2-1: Dwell Time – 50kbps

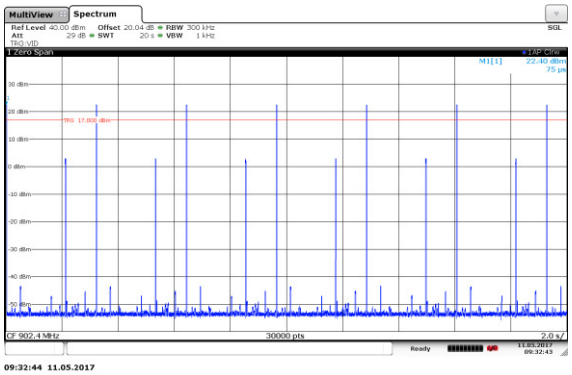

Figure 7.4.3.2-2: Number of Hops – 50kbps

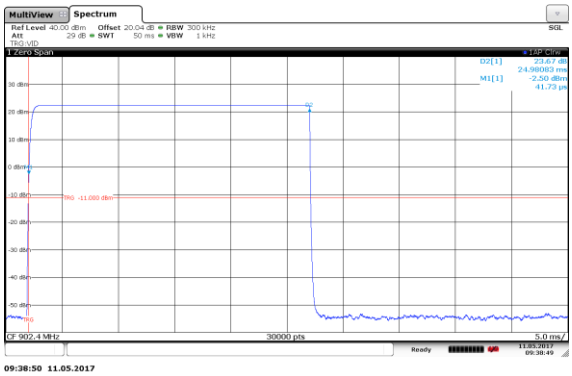

Figure 7.4.3.2-1: Dwell Time – 150kbps

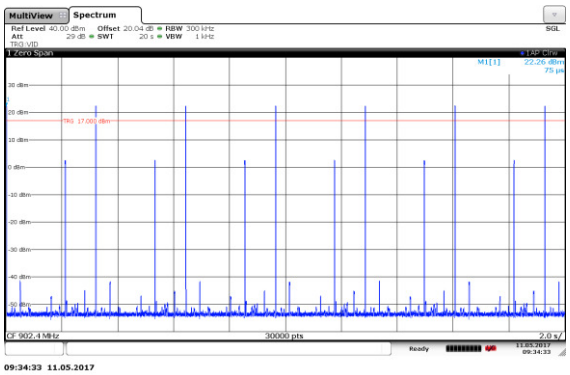

Figure 7.4.3.2-2: Number of Hops – 150kbps

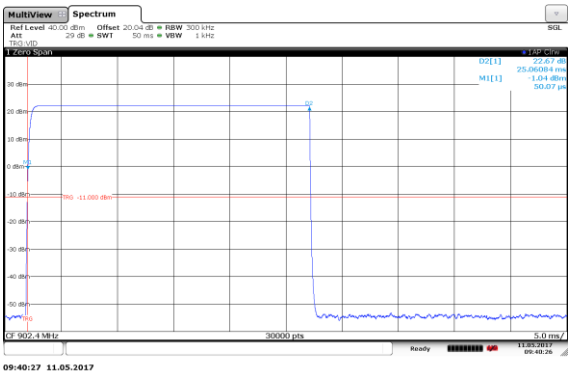

Figure 7.4.3.2-1: Dwell Time – 200kbps

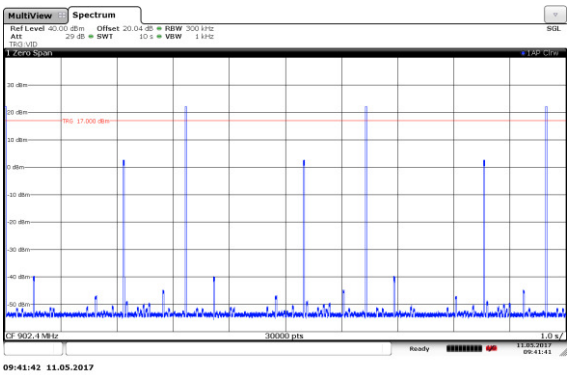

Figure 7.4.3.2-2: Number of Hops – 200kbps

7.4.4 20dB / 99% Bandwidth – FCC: 15.247(a)(1)(i), ISED Canada: RSS-247 5.1(c)

7.4.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The marker delta measurement function of the analyzer was utilized to determine the 20 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.

7.4.4.2 Measurement Results

Table 7.4.4.2-1: 20dB / 99% Bandwidth

Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	Data Rate (kbps)
902.4	359.1	371.374	35.5
902.4	335.767	322.539	142.2
902.4	119.982	119.024	50
902.4	201.983	195.563	150
902.4	271.267	253.625	200
916.0	320.067	371.331	35.5
916.0	337.9	324.076	142.2
916.0	121.38	117.712	50
916.0	201.75	195.589	150
916.0	266.867	253.512	200
927.6	320.6	372.242	35.5
927.6	338.233	323.934	142.2
927.6	119.7	118.798	50
927.6	201.6	195.384	150
927.6	267.333	254.347	200

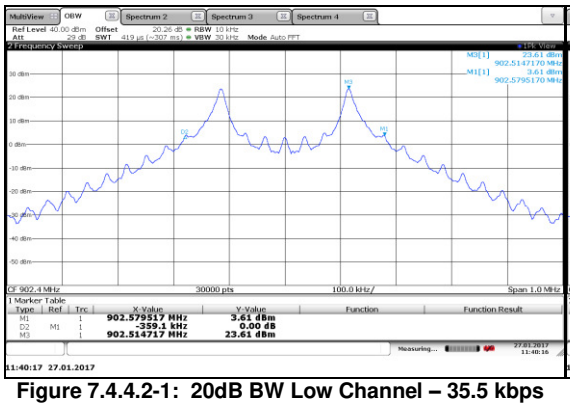

Figure 7.4.4.2-1: 20dB BW Low Channel – 35.5 kbps

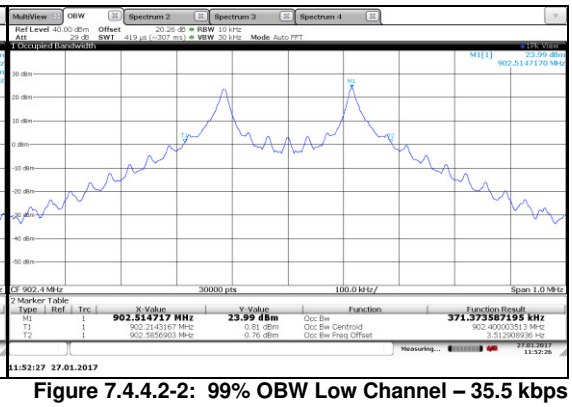

Figure 7.4.4.2-2: 99% OBW Low Channel – 35.5 kbps

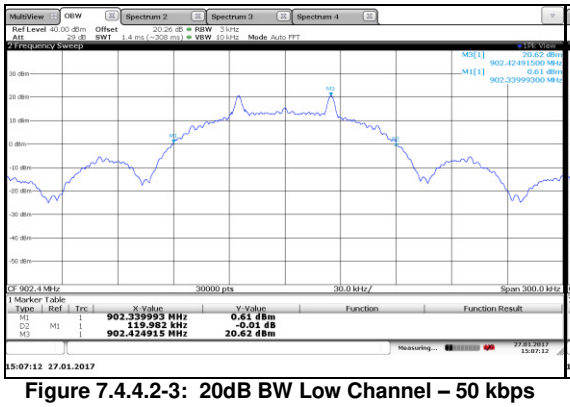

Figure 7.4.4.2-3: 20dB BW Low Channel – 50 kbps

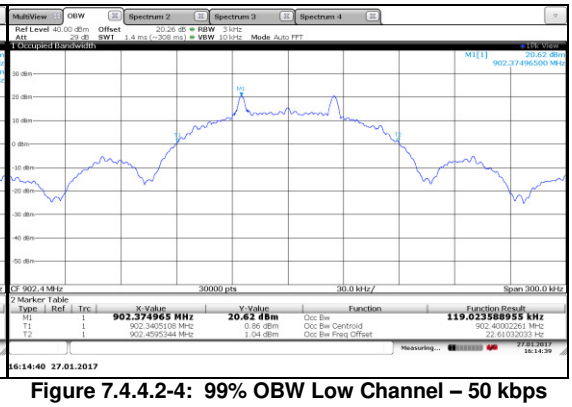

Figure 7.4.4.2-4: 99% OBW Low Channel – 50 kbps

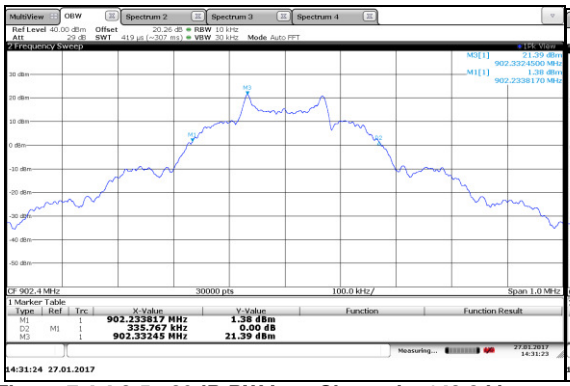

Figure 7.4.4.2-5: 20dB BW Low Channel – 142.2 kbps

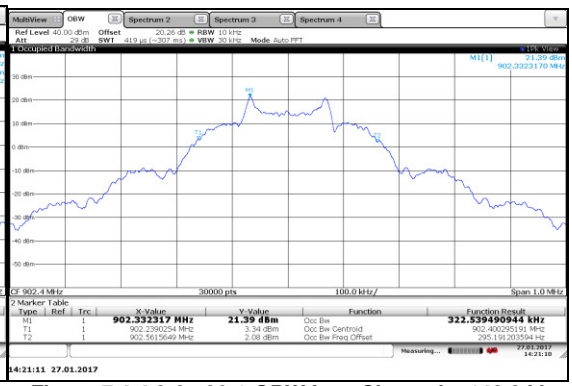

Figure 7.4.4.2-6: 99% OBW Low Channel – 142.2 kbps

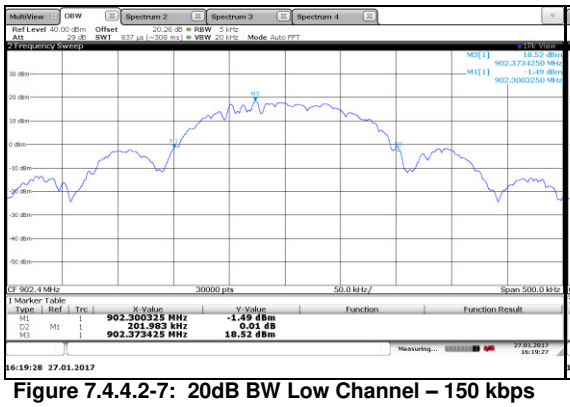

Figure 7.4.4.2-7: 20dB BW Low Channel – 150 kbps

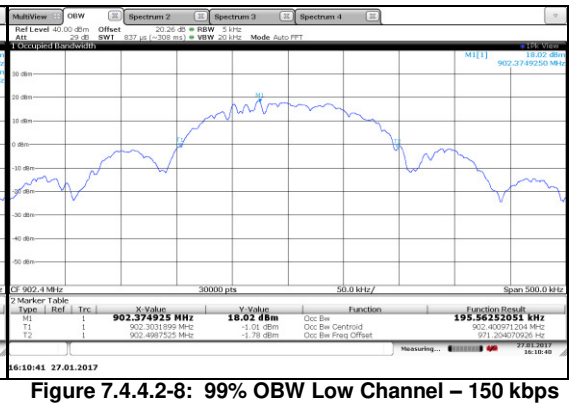

Figure 7.4.4.2-8: 99% OBW Low Channel – 150 kbps

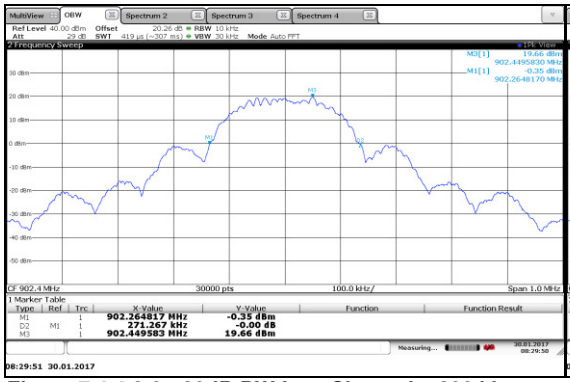

Figure 7.4.4.2-9: 20dB BW Low Channel – 200 kbps

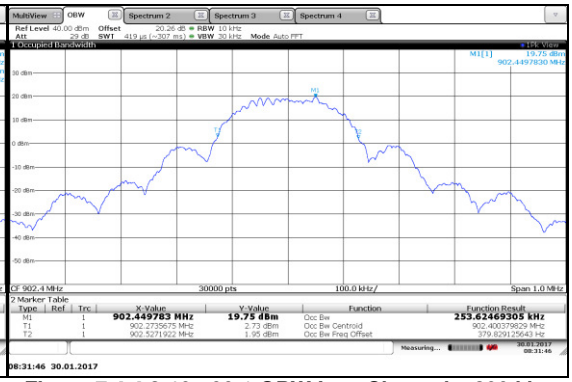

Figure 7.4.4.2-10: 99% OBW Low Channel – 200 kbps

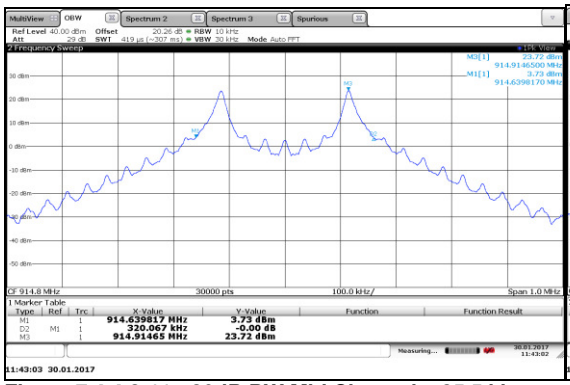

Figure 7.4.4.2-11: 20dB BW Mid Channel – 35.5 kbps

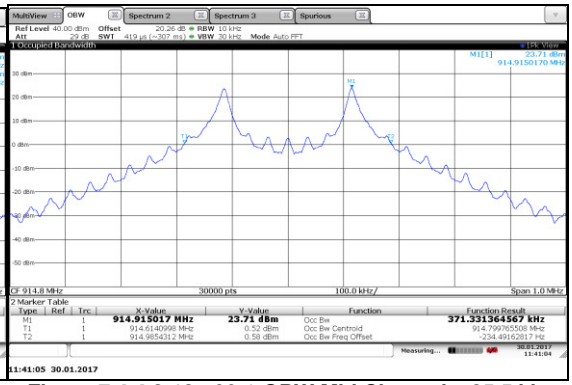

Figure 7.4.4.2-12: 99% OBW Mid Channel – 35.5 kbps

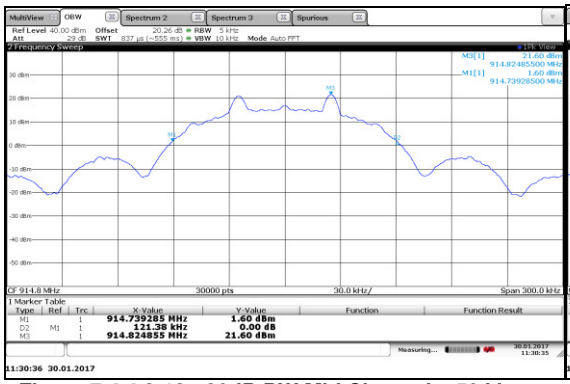

Figure 7.4.4.2-13: 20dB BW Mid Channel – 50 kbps

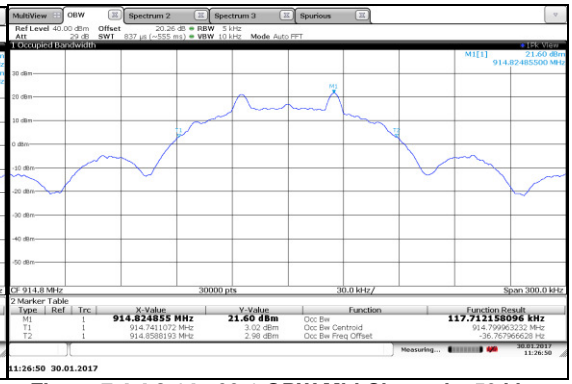

Figure 7.4.4.2-14: 99% OBW Mid Channel – 50 kbps

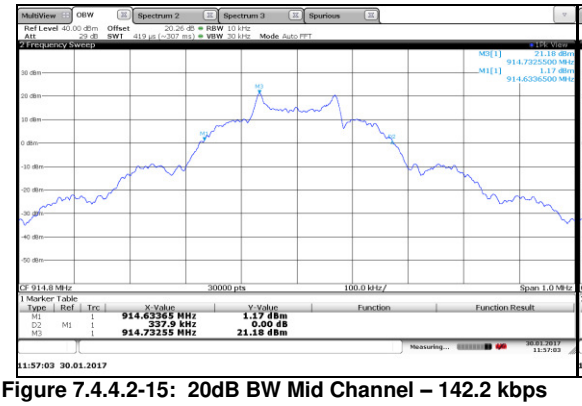

Figure 7.4.4.2-15: 20dB BW Mid Channel – 142.2 kbps

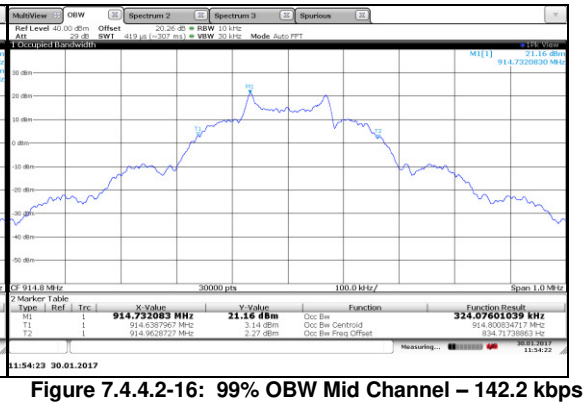

Figure 7.4.4.2-16: 99% OBW Mid Channel – 142.2 kbps

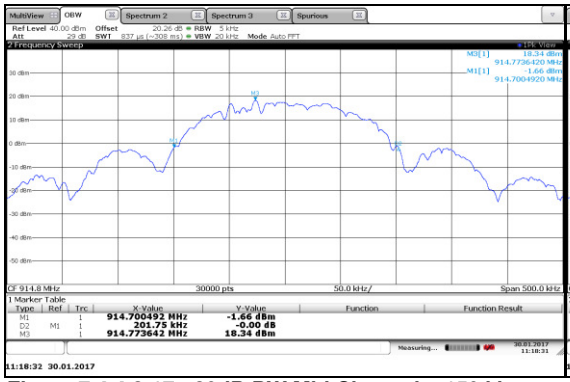

Figure 7.4.4.2-17: 20dB BW Mid Channel – 150 kbps

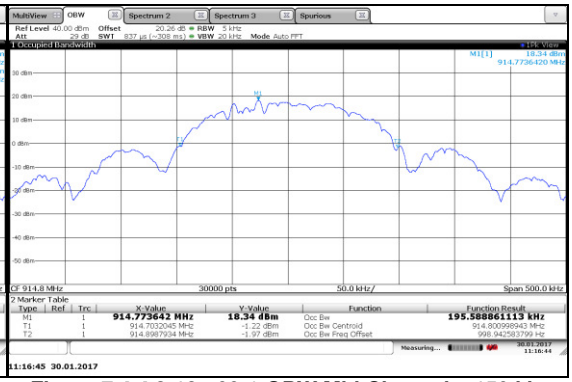

Figure 7.4.4.2-18: 99% OBW Mid Channel – 150 kbps

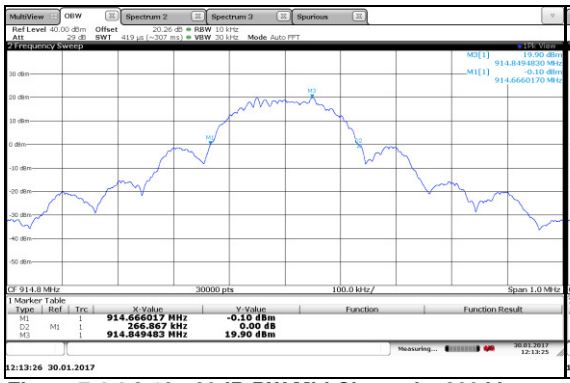

Figure 7.4.4.2-19: 20dB BW Mid Channel – 200 kbps

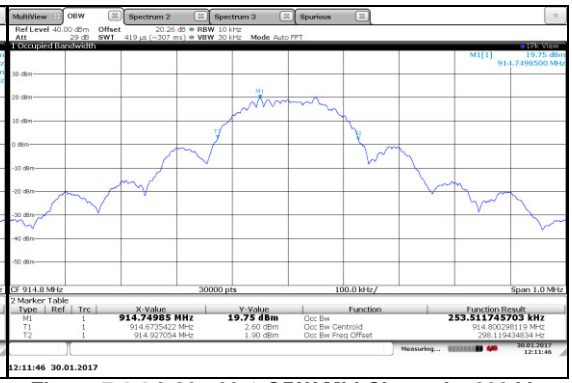

Figure 7.4.4.2-20: 99% OBW Mid Channel – 200 kbps

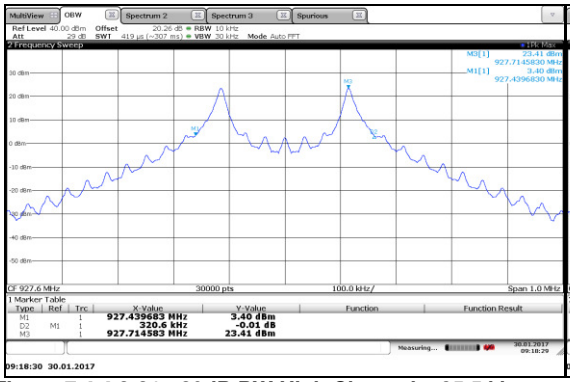

Figure 7.4.4.2-21: 20dB BW High Channel – 35.5 kbps

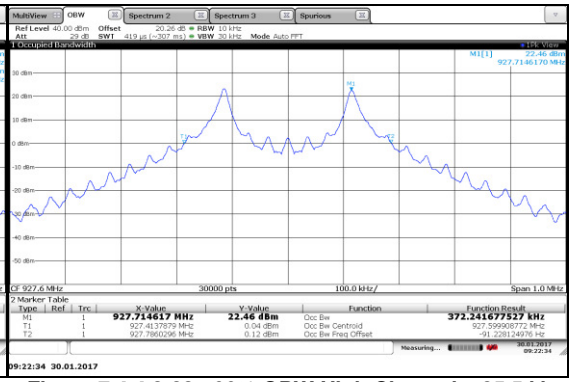

Figure 7.4.4.2-22: 99% OBW High Channel – 35.5 kbps

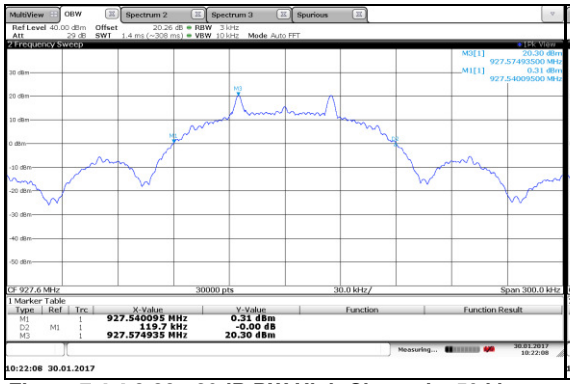

Figure 7.4.4.2-23: 20dB BW High Channel – 50 kbps

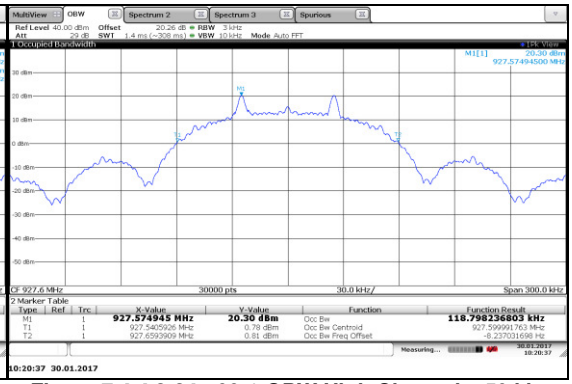

Figure 7.4.4.2-24: 99% OBW High Channel – 50 kbps

Figure 7.4.4.2-25: 20dB BW High Channel – 142.2 kbps

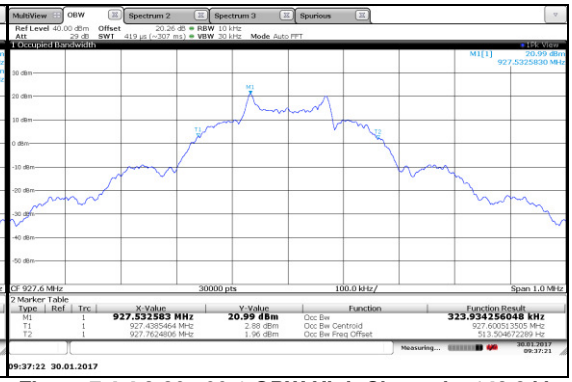

Figure 7.4.4.2-26: 99% OBW High Channel – 142.2 kbps

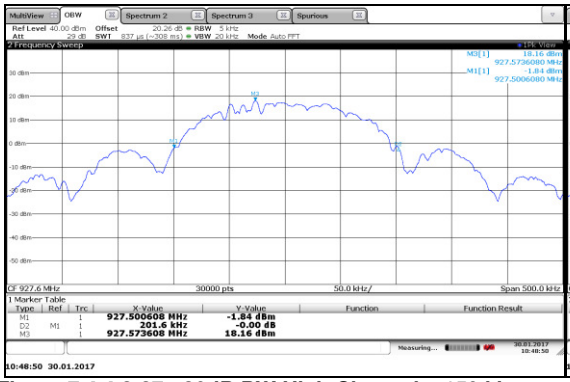

Figure 7.4.4.2-27: 20dB BW High Channel – 150 kbps

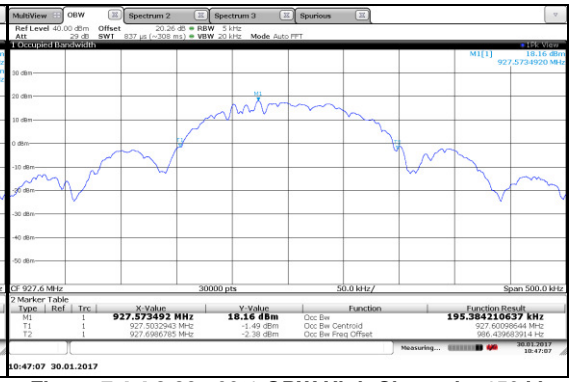

Figure 7.4.4.2-28: 99% OBW High Channel – 150 kbps

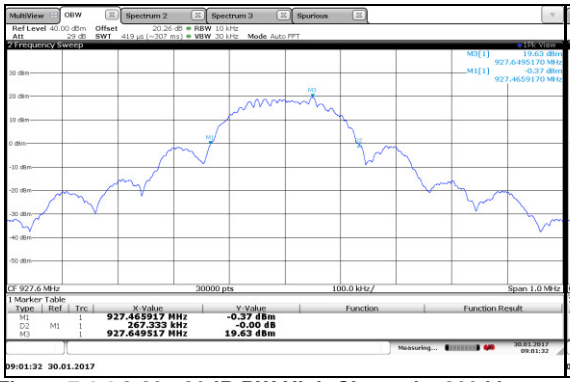

Figure 7.4.4.2-29: 20dB BW High Channel – 200 kbps

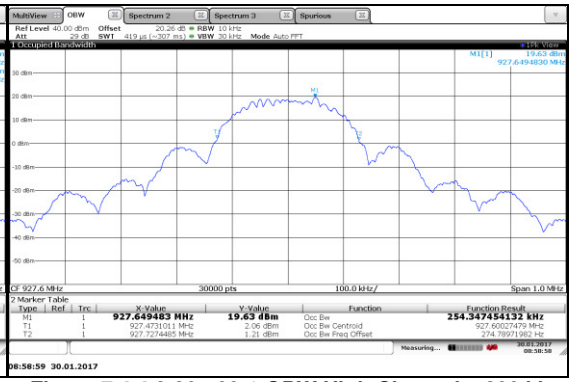

Figure 7.4.4.2-30: 99% OBW High Channel – 200 kbps

7.5 Band-Edge Compliance and Spurious Emissions

7.5.1 Band-Edge Compliance of RF Conducted Emissions – FCC: 15.247(d); ISED Canada RSS-247 5.5

7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement, the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.5.1.2 Measurement Results

NON-HOPPING MODE:

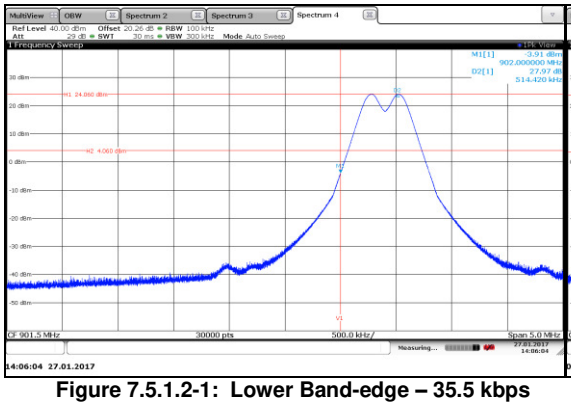

Figure 7.5.1.2-1: Lower Band-edge – 35.5 kbps

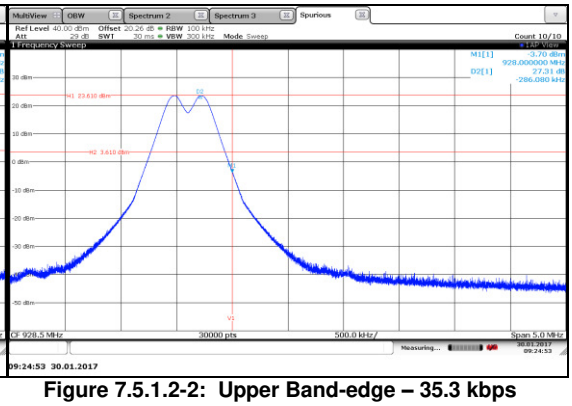

Figure 7.5.1.2-2: Upper Band-edge – 35.3 kbps

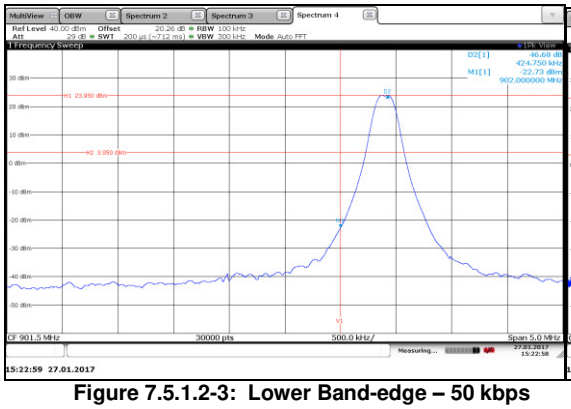

Figure 7.5.1.2-3: Lower Band-edge – 50 kbps

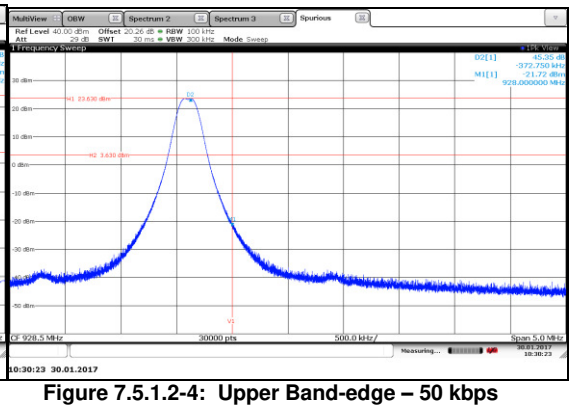

Figure 7.5.1.2-4: Upper Band-edge – 50 kbps

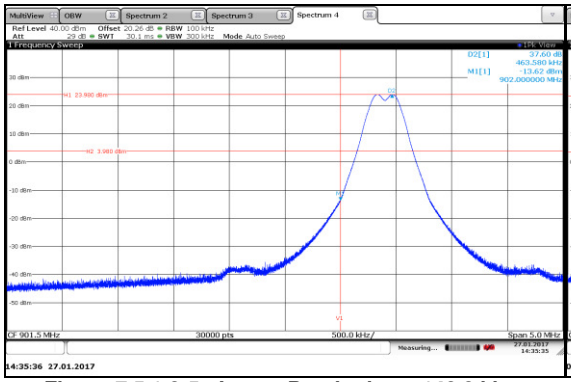

Figure 7.5.1.2-5: Lower Band-edge – 142.2 kbps

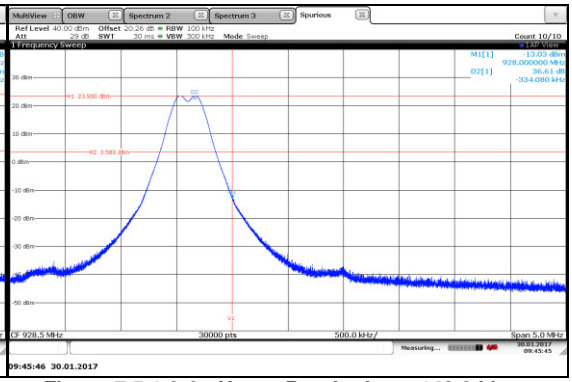

Figure 7.5.1.2-6: Upper Band-edge – 142.2 kbps

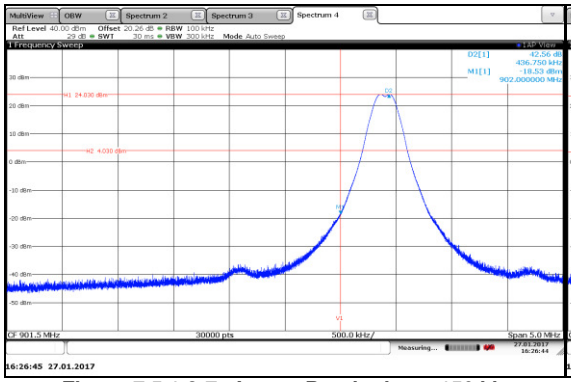

Figure 7.5.1.2-7: Lower Band-edge – 150 kbps

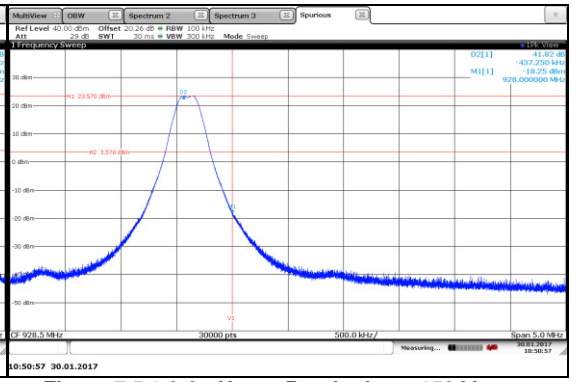

Figure 7.5.1.2-8: Upper Band-edge – 150 kbps

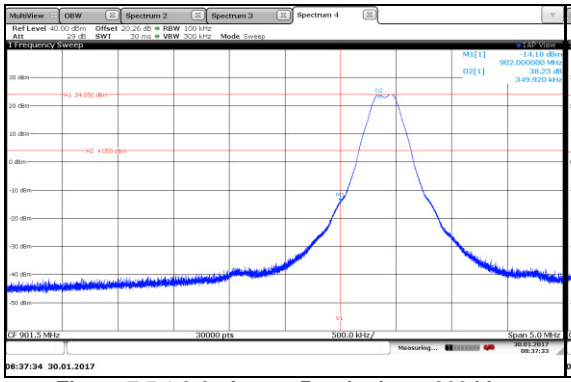

Figure 7.5.1.2-9: Lower Band-edge – 200 kbps

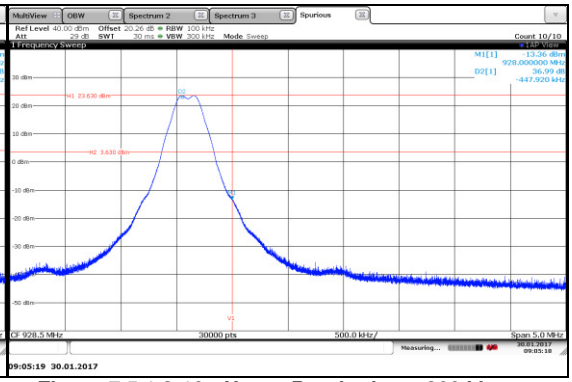

Figure 7.5.1.2-10: Upper Band-edge – 200 kbps

HOPPING MODE:

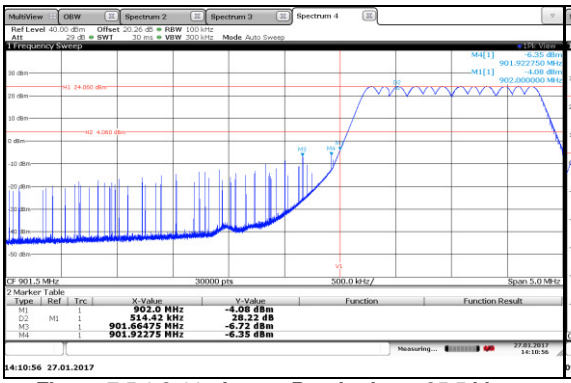

Figure 7.5.1.2-11: Lower Band-edge – 35.5 kbps

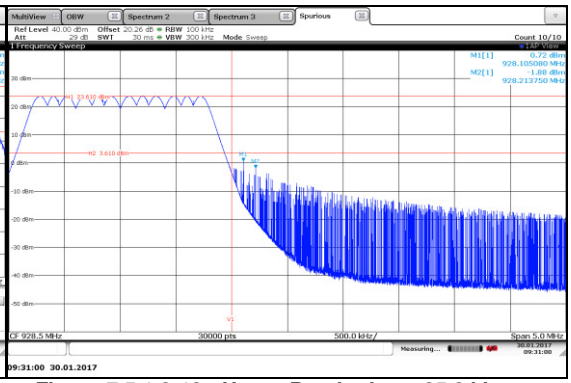

Figure 7.5.1.2-12: Upper Band-edge – 35.3 kbps

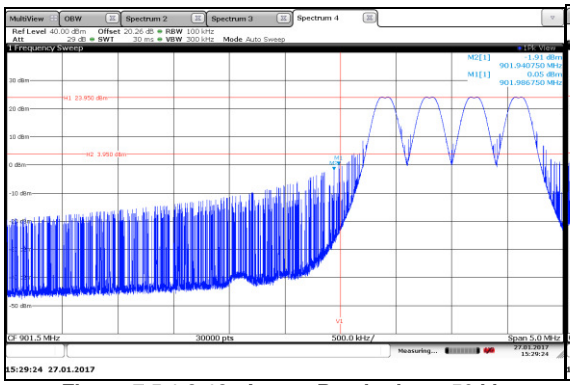

Figure 7.5.1.2-13: Lower Band-edge – 50 kbps

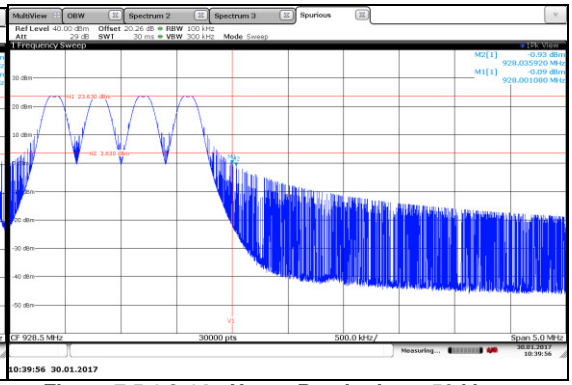

Figure 7.5.1.2-14: Upper Band-edge – 50 kbps

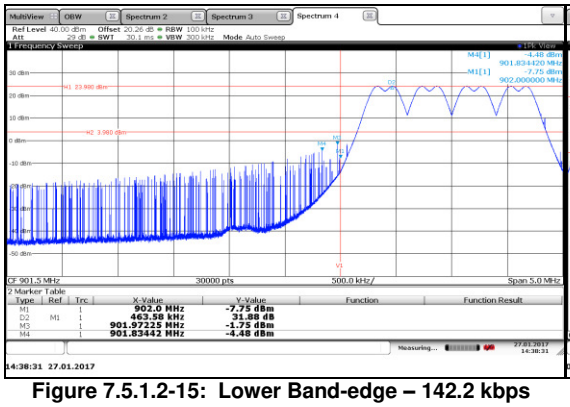

Figure 7.5.1.2-15: Lower Band-edge – 142.2 kbps

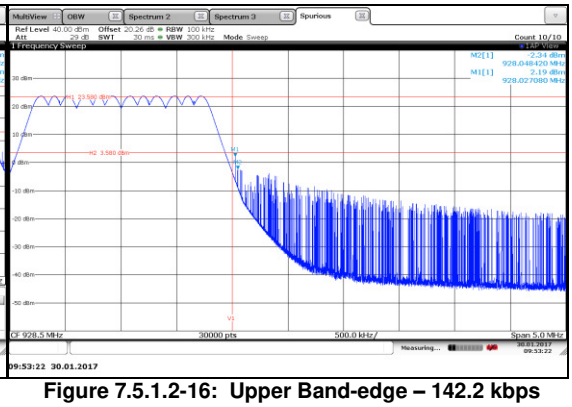

Figure 7.5.1.2-16: Upper Band-edge – 142.2 kbps

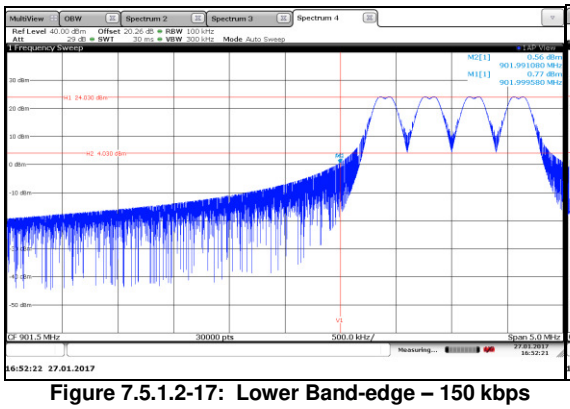

Figure 7.5.1.2-17: Lower Band-edge – 150 kbps

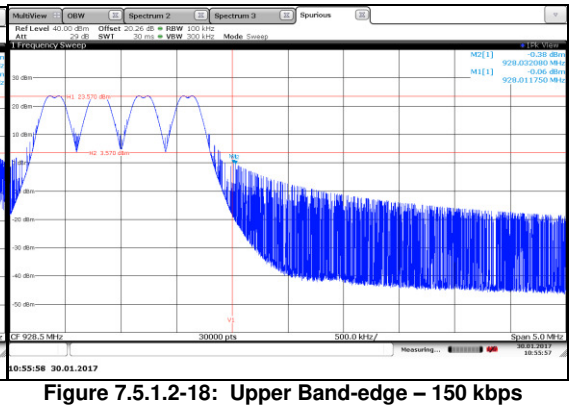

Figure 7.5.1.2-18: Upper Band-edge – 150 kbps

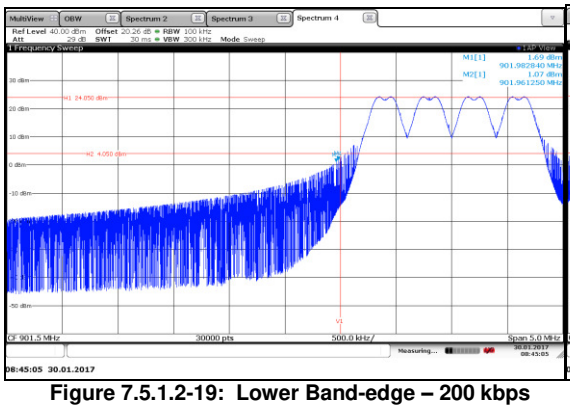

Figure 7.5.1.2-19: Lower Band-edge – 200 kbps

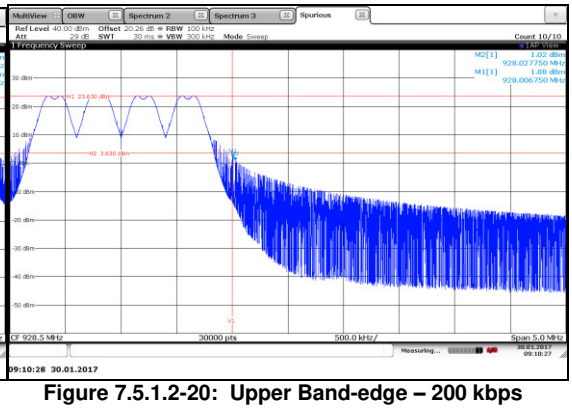

Figure 7.5.1.2-20: Upper Band-edge – 200 kbps

7.5.2 RF Conducted Spurious Emissions – FCC: 15.247(d); ISED Canada RSS-247 5.5

7.5.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100kHz. A peak detector function was used with the trace set to max hold.

7.5.2.2 Measurement Results

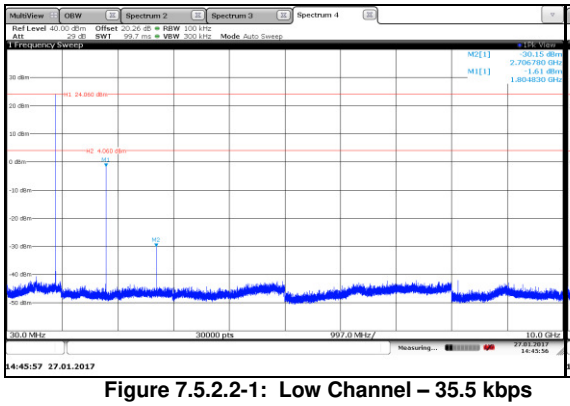

Figure 7.5.2.2-1: Low Channel – 35.5 kbps

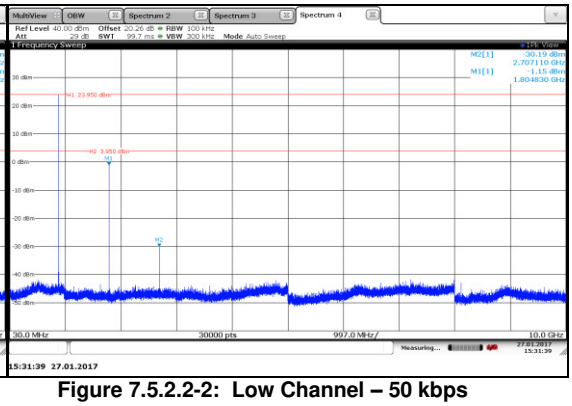

Figure 7.5.2.2-2: Low Channel – 50 kbps

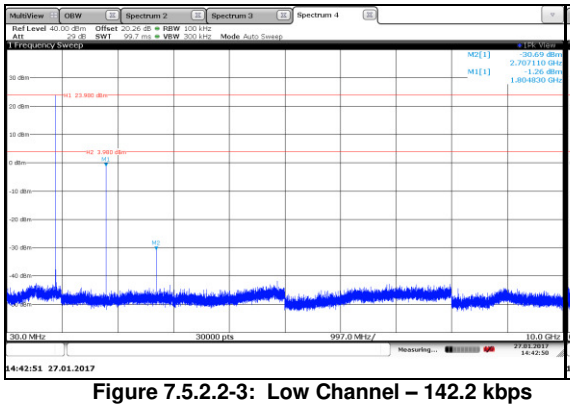

Figure 7.5.2.2-3: Low Channel – 142.2 kbps

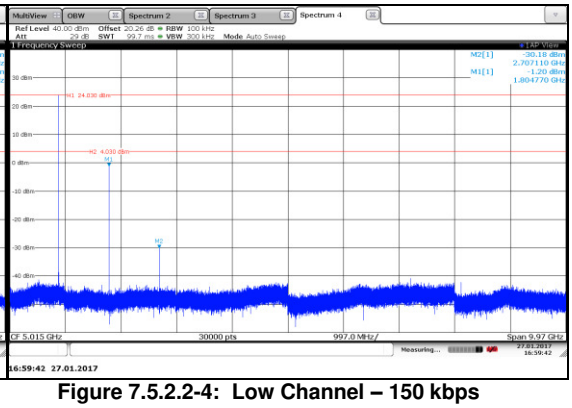

Figure 7.5.2.2-4: Low Channel – 150 kbps

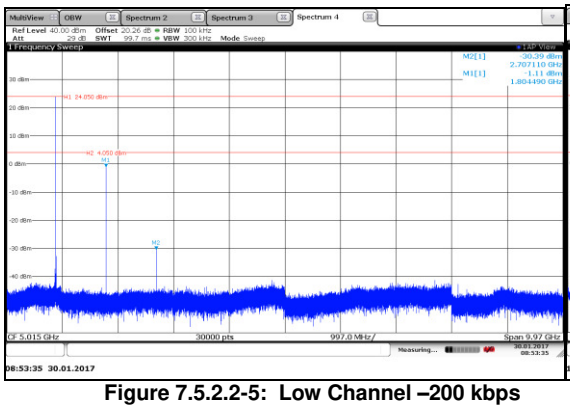

Figure 7.5.2.2-5: Low Channel –200 kbps

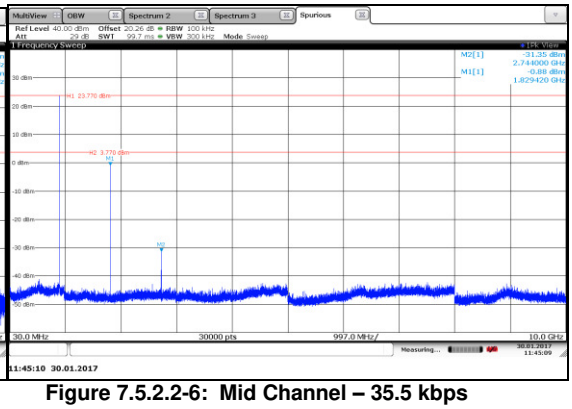

Figure 7.5.2.2-6: Mid Channel – 35.5 kbps

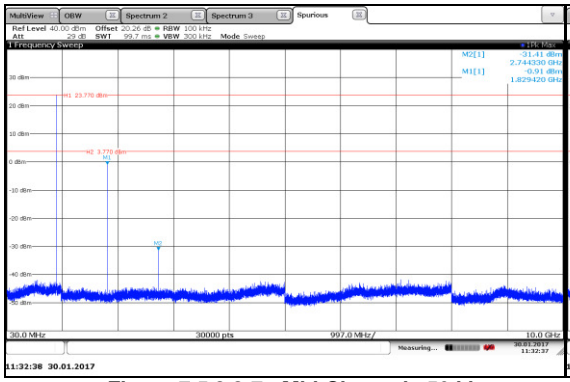

Figure 7.5.2.2-7: Mid Channel –50 kbps

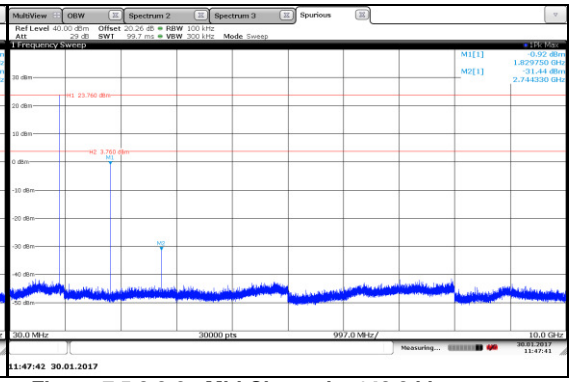

Figure 7.5.2.2-8: Mid Channel – 142.2 kbps

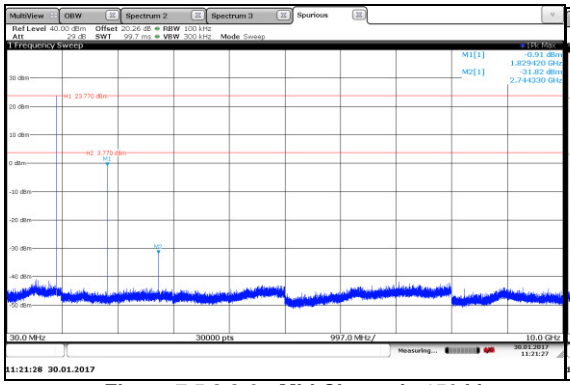

Figure 7.5.2.2-9: Mid Channel –150 kbps

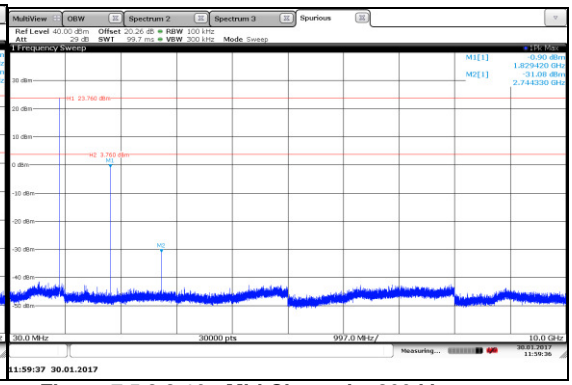

Figure 7.5.2.2-10: Mid Channel – 200 kbps

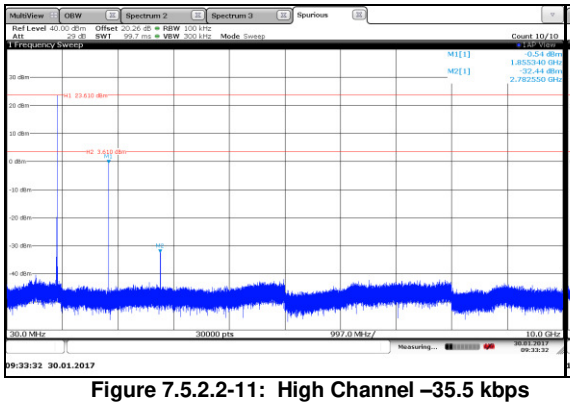

Figure 7.5.2.2-11: High Channel –35.5 kbps

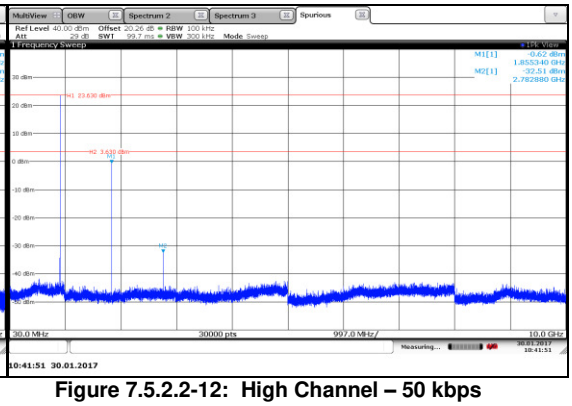

Figure 7.5.2.2-12: High Channel – 50 kbps

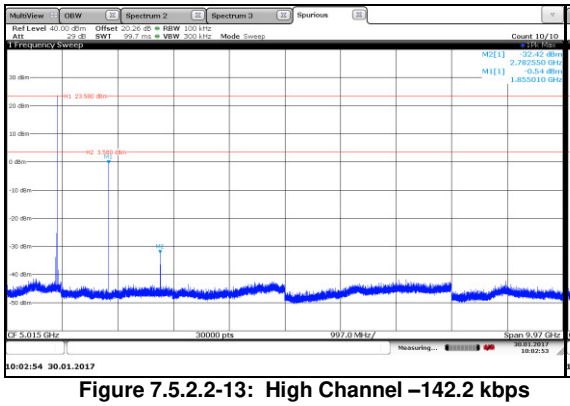

Figure 7.5.2.2-13: High Channel –142.2 kbps

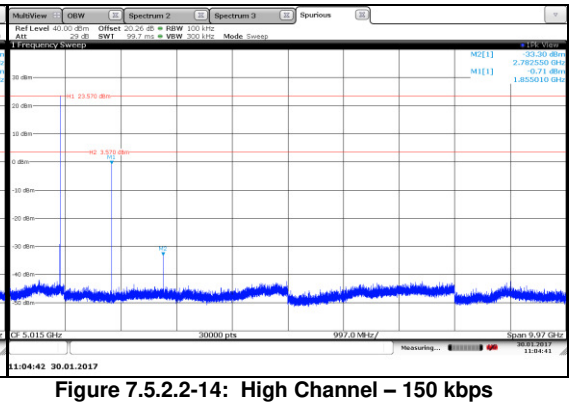

Figure 7.5.2.2-14: High Channel – 150 kbps

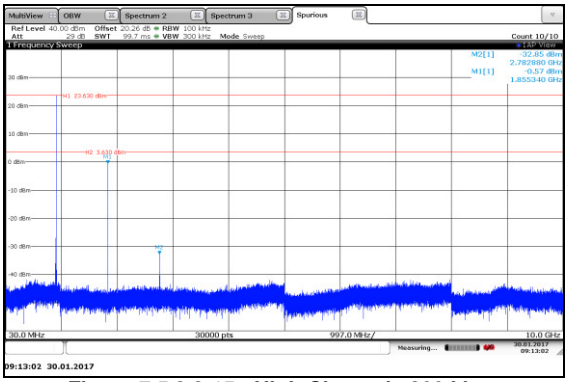

Figure 7.5.2.2-15: High Channel –200 kbps

7.5.3 Radiated Spurious Emissions – FCC: 15.205, 15.209; ISED Canada RSS-Gen 8.9/8.10

7.5.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 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 3MHz respectively.

The EUT was caused to generate a continuous modulated carrier on the hopping channel.

Each emission found to be in a restricted band was compared to the applicable radiated emission limits.

7.5.3.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.5.3.3 Measurement Results

Table 7.5.3.3-1: Radiated Spurious Emissions Tabulated Data

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
Low Channel										
2707.2	41.61	33.62	H	-2.45	39.16	31.17	74.0	54.0	34.8	22.8
2707.2	43.40	36.90	V	-2.45	40.95	34.45	74.0	54.0	33.0	19.5
3609.6	44.83	38.40	H	0.94	45.77	39.34	74.0	54.0	28.2	14.7
3609.6	45.32	39.20	V	0.94	46.26	40.14	74.0	54.0	27.7	13.9
4512	40.76	28.90	H	3.55	44.31	32.45	74.0	54.0	29.7	21.5
4512	40.90	28.80	V	3.55	44.45	32.35	74.0	54.0	29.5	21.6
5414.4	38.98	25.80	H	4.01	42.99	29.81	74.0	54.0	31.0	24.2
5414.4	38.50	25.90	V	4.01	42.51	29.91	74.0	54.0	31.5	24.1
8121.6	39.10	26.10	H	9.73	48.83	35.83	74.0	54.0	25.2	18.2
8121.6	38.05	24.30	V	9.73	47.78	34.03	74.0	54.0	26.2	20.0
Middle Channel										
2744.4	40.80	31.40	H	-2.35	38.45	29.05	74.0	54.0	35.5	24.9
2744.4	42.33	33.70	V	-2.35	39.98	31.35	74.0	54.0	34.0	22.6
3659.2	45.96	39.30	H	1.08	47.04	40.38	74.0	54.0	27.0	13.6
3659.2	43.82	36.80	V	1.08	44.90	37.88	74.0	54.0	29.1	16.1
4574	39.94	26.70	H	3.54	43.48	30.24	74.0	54.0	30.5	23.8
4574	41.62	31.50	V	3.54	45.16	35.04	74.0	54.0	28.8	19.0
7318.4	38.11	24.30	H	7.66	45.77	31.96	74.0	54.0	28.2	22.0
7318.4	38.04	25.00	V	7.66	45.70	32.66	74.0	54.0	28.3	21.3
8233.2	38.49	25.20	H	10.22	48.71	35.42	74.0	54.0	25.3	18.6
9148	36.60	23.40	H	11.24	47.84	34.64	74.0	54.0	26.2	19.4
966.35	17.40	11.80	H	24.37	---------	36.17	--------	54.0	---------	17.8
966.35	23.80	20.50	V	24.37	---------	44.87	--------	54.0	---------	9.1
High Channel										
2782.8	44.33	37.80	H	-2.24	42.09	35.56	74.0	54.0	31.9	18.4
2782.8	45.38	39.20	V	-2.24	43.14	36.96	74.0	54.0	30.9	17.0
3710.4	41.74	32.30	H	1.23	42.97	33.53	74.0	54.0	31.0	20.5
3710.4	44.07	35.50	V	1.23	45.30	36.73	74.0	54.0	28.7	17.3
4638	41.62	29.40	H	3.52	45.14	32.92	74.0	54.0	28.9	21.1
4638	40.25	25.50	V	3.52	43.77	29.02	74.0	54.0	30.2	25.0
7420.8	41.36	29.50	H	8.18	49.54	37.68	74.0	54.0	24.5	16.3
7420.8	40.82	28.60	V	8.18	49.00	36.78	74.0	54.0	25.0	17.2
8348.4	44.35	33.50	H	10.73	55.08	44.23	74.0	54.0	18.9	9.8
8348.4	41.61	30.10	V	10.73	52.34	40.83	74.0	54.0	21.7	13.2
979	10.26	6.00	H	24.93	---------	30.93	--------	54.0	---------	23.1
979	19.33	15.90	V	24.93	---------	40.83	--------	54.0	---------	13.2

7.5.3.4 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: 44.83 + 0.94 = 45.77dBuV/m
Margin: 74dBuV/m – 45.77dBuV/m = 28.23dB

Example Calculation: Average

Corrected Level: 38.40 + 0.94 - 0 = 39.34dBuV
Margin: 54dBuV – 39.34dBuV = 14.66dB

8 CONCLUSION

In the opinion of TÜV SÜD America Inc. the UFTR1, manufactured by Elster Solutions meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT