Certification Test Report

FCC ID: R7PNG1R1S1
IC: 5294A-NG1R1S1

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

Report Number: AT72127440.1C1

Manufacturer: Landis+Gyr Technology, Inc.
Model: NIC AM

Test Begin Date: January 27, 2017
Test End Date: March 31, 2017

Report Issue Date: April 15, 2018

For 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.

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This report contains 36 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 Certification for modular approval.

1.2 Product description

The Landis+Gyr Network Bridge provides the basis for a powerful RF wireless mesh network for remote data collection and end device monitoring and control in the 900 MHz ISM Band. The Network Bridge supports full two-way peer-to-peer communication to all devices within the network. The product offers advanced functionality, such as individual message prioritization, additional memory for localized intelligence, and it is based on the Linux operating system. The N2200/N2250 provides interface and control to distribution equipment and critical devices that require low latency.

Technical Information:
The model NIC AM provides 4 distinct frequency hopping modes of operation as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Data Rates Supported (kbps)
1	902.3 - 927.8	86	300	9.6, 19.2, 38.4, 115.2
2	904.0 - 927.9	240	100	9.6, 19.2, 38.4
3	902.5 - 927.5	51	500	300
4	902.2 - 927.8	129	200	50.0
5	902.4 - 927.6	64	400	150, 200

Modulation Format: FSK/GFSK
Antenna Type / Gain: Omnidirectional Whip / 5.5 dBi
Operating Voltage: 5 Vdc

Manufacturer Information:
Landis+Gyr Technology, Inc.
30000 Mill Creek Ave., Suite 100
Alpharetta, GA 30022

EUT Serial Numbers: FCC1

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. The data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was X-position. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

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

For RF Conducted measurements, the EUT was connected to the test equipment with a U.FL to SMA connector. The EUT was programmed to generate a continuously modulated signal on each channel evaluated.

Software power setting during test: 55

2 TEST FACILITIES

2.1 Location

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

TÜV SÜD America, Inc
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. 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 23597
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:

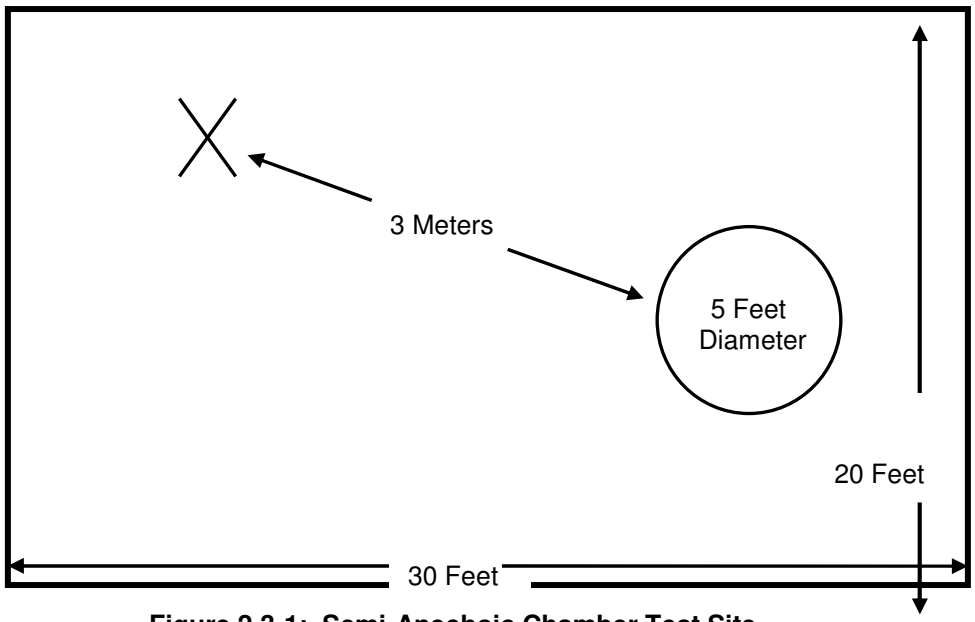

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

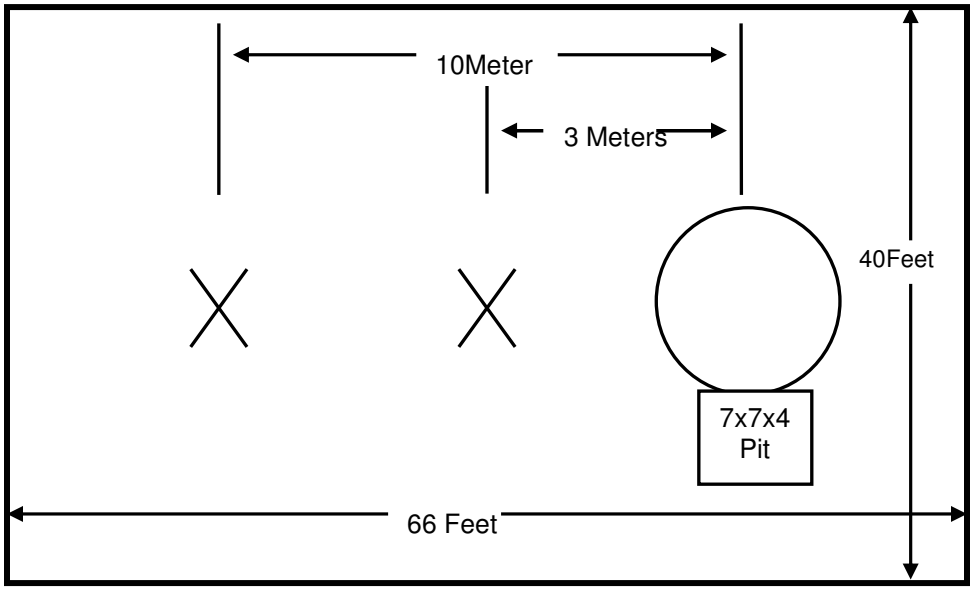

Figure 2.3-2: Open Area Test Site

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 ANSI C63.10.

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

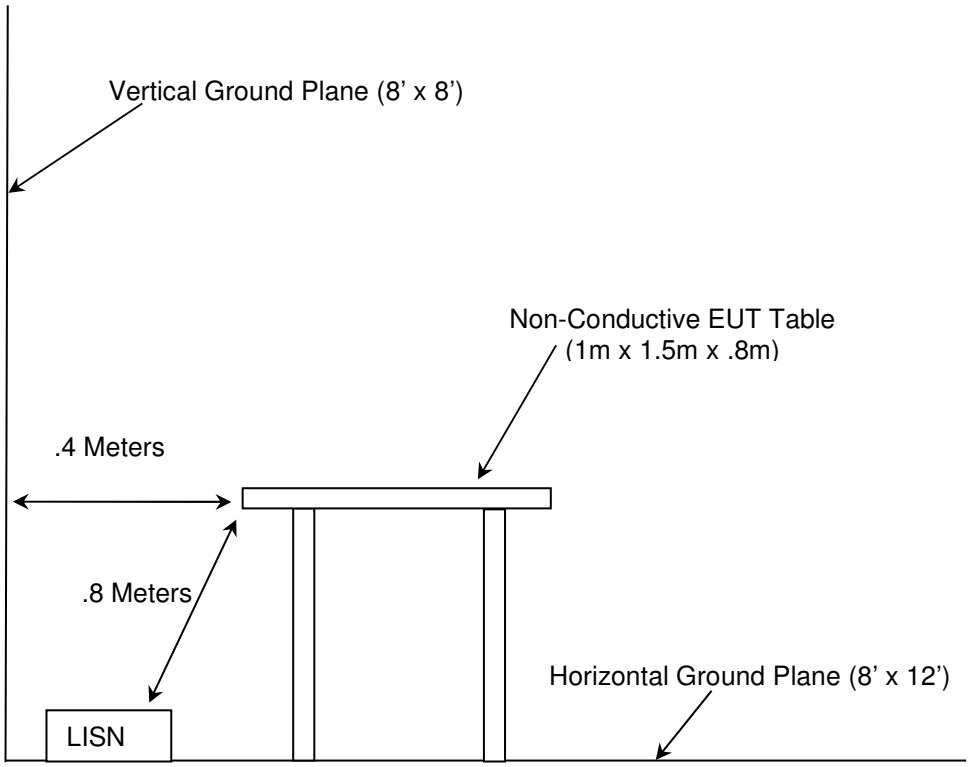

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: 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
- Industry 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, February 2017.
- Industry 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
30	Spectrum Technologies	DRH-0118	Antennas	970102	4/30/2015	4/30/2017
40	EMCO	3104	Antennas	3211	6/8/2016	6/8/2018
73	Agilent	8447D	Amplifiers	2727A05624	7/21/2016	7/21/2017
167	ACS	Chamber EMI Cable Set	Cable Set	167	9/30/2016	9/30/2017
267	Agilent	N1911A	Meters	MY45100129	8/24/2015	8/24/2017
268	Agilent	N1921A	Sensors	MY45240184	8/13/2015	8/13/2017
324	ACS	Belden	Cables	8214	5/2/2016	5/2/2017
331	Microwave Circuits	H1G513G1	Filters	31417	5/13/2016	5/13/2017
338	Hewlett Packard	8449B	Amplifiers	3008A01111	8/21/2015	8/21/2017
340	Aeroflex/Weinschel	AS-20	Attenuators	7136	7/12/2016	7/12/2017
412	Electro Metrics	LPA-25	Antennas	1241	8/8/2016	8/8/2017
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	10/27/2016	10/27/2017
616	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	N/A	9/2/2016	9/2/2017
622	Rohde & Schwarz	FSV40	Analyzers	101338	7/15/2016	7/16/2018
676	Florida RF Labs	SMS-290AW-480.0-SMS	Cables	MFR2Y194	11/4/2016	11/4/2017
3010	Rohde & Schwarz	ENV216	LISN	3010	7/11/2016	7/11/2017
RE135	Rohde & Schwarz	FSP30	Spectrum Analyzers	835618/031	10/31/2016	10/31/2017
RE619	Rohde & Schwarz	ESU26	Receivers	100190	11/5/2014	11/5/2017

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Evaluation Board	Landis + Gyr	N/A	N/A
2	Bench Power Supply	Agilent	6286A	2109A-06095
3	Wall Wart Power Supply	CUI Inc.	SWI24-12-N	N/A

Table 5-2: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	RF Cable	40 cm	Yes	EUT - Antenna
B	DC Power Cable	200 cm	No	1 – 2
C	AC Power Cable	150 cm	No	2 – AC Mains
D	DC Power Cable	150 cm	No	1 - 3

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

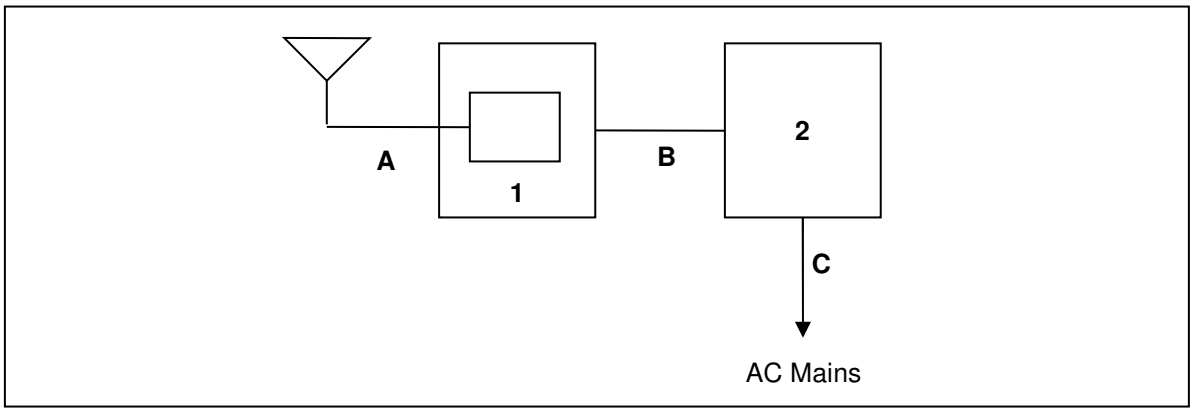

Figure 6-1: Test Setup Block Diagram – Radiated Emissions

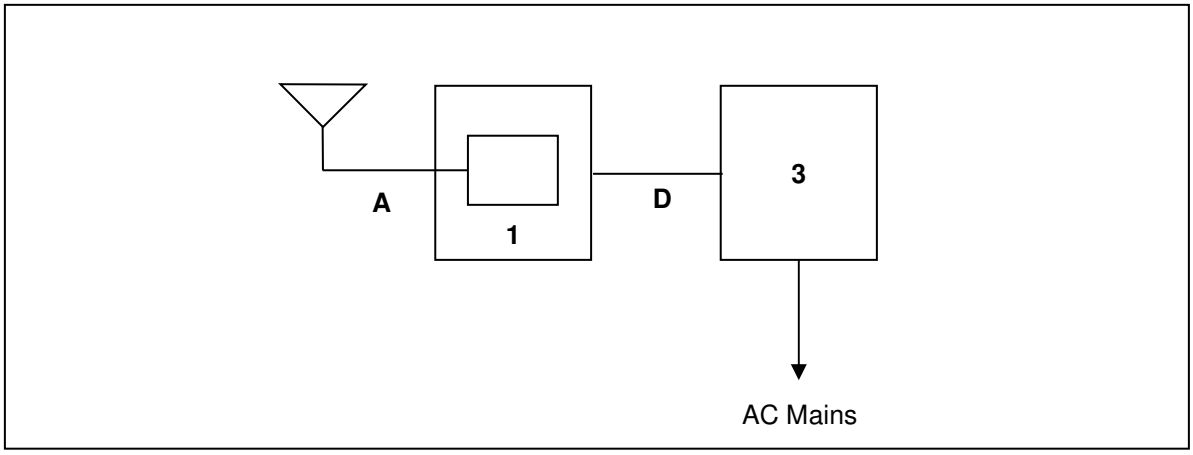

Figure 6-2: Test Setup Block Diagram – Power Line Conducted Emissions

7 SUMMARY OF TESTS

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

7.1 Antenna Requirement – FCC: Section 15.203

The external antenna is a Omnidirectional Whip with 5.5dBi gain and is connected to the board via an U.FL coaxial RF connector, therefore satisfying the requirements of Section 15.203.

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

7.2.1 Measurement Procedure

ANSI C63.10 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

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.574125	---	5.68	46.00	40.32	L1	9.6
0.574125	11.41	---	56.00	44.59	L1	9.6
14.956834	---	17.29	50.00	32.71	L1	9.8
14.956834	26.96	---	60.00	33.04	L1	9.8
15.115666	---	18.75	50.00	31.25	L1	9.8
15.115666	27.71	---	60.00	32.29	L1	9.8
15.140334	---	18.40	50.00	31.60	L1	9.8
15.140334	28.09	---	60.00	31.91	L1	9.8
15.343666	---	14.15	50.00	35.85	L1	9.8
15.343666	25.01	---	60.00	34.99	L1	9.8
15.900000	---	19.20	50.00	30.80	L1	9.8
15.900000	27.26	---	60.00	32.74	L1	9.8

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit (dBuV)	Margin (dB)	Line	Correction (dB)
	Quasi-Peak (dBuV)	Average (dBuV)				
0.169875	---	8.92	54.97	46.05	N	9.6
0.169875	17.71	---	64.97	47.26	N	9.6
0.317375	---	22.44	49.78	27.34	N	9.6
0.317375	25.30	---	59.78	34.48	N	9.6
0.509000	---	5.17	46.00	40.83	N	9.6
0.509000	11.99	---	56.00	44.01	N	9.6
0.626500	---	7.19	46.00	38.81	N	9.6
0.626500	13.35	---	56.00	42.65	N	9.6
0.844000	---	8.65	46.00	37.35	N	9.7
0.844000	14.38	---	56.00	41.62	N	9.7
1.121000	---	10.10	46.00	35.90	N	9.7
1.121000	14.35	---	56.00	41.65	N	9.7

7.3 Peak Output Power – FCC: Section 15.247(b)(2); ISED Canada: RSS-247 5.4(1)

7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a power meter. The device employs >50 channels therefore the power is limited to 1 Watt.

All data rates were evaluated and worst case reported. Worst case data rate was 50kbps for 902.2 MHz and 9.6kbps for all other frequencies evaluated.

7.3.2 Measurement Results

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Level [dBm]
902.2	29.01
902.3	29.13
915.0	28.95
927.8	28.85

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1); ISED Canada: RSS-247 5.1(2)

7.4.1.1 Measurement Procedure

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

Carrier frequency separation was measured for all modes of operation and data presented in section 7.4.1.2 below.

7.4.1.2 Measurement Results

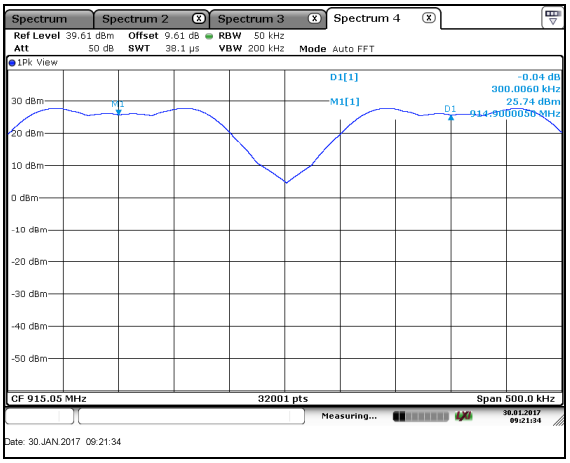

Figure 7.4.1.2-1: Mode 1

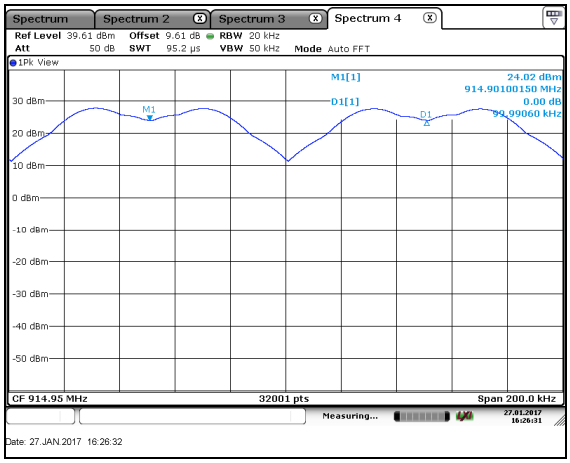

Figure 7.4.1.2-2: Mode 2

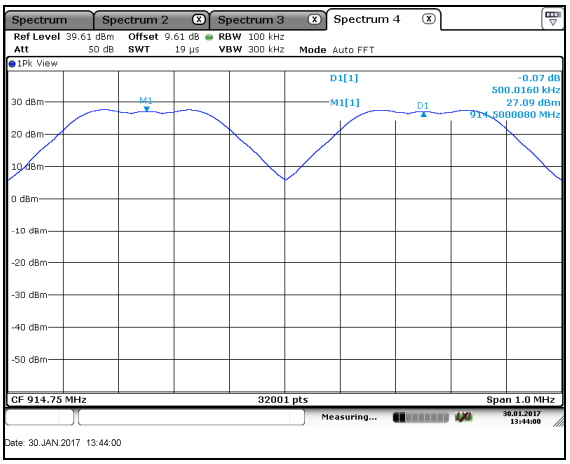

Figure 7.4.1.2-3: Mode 3

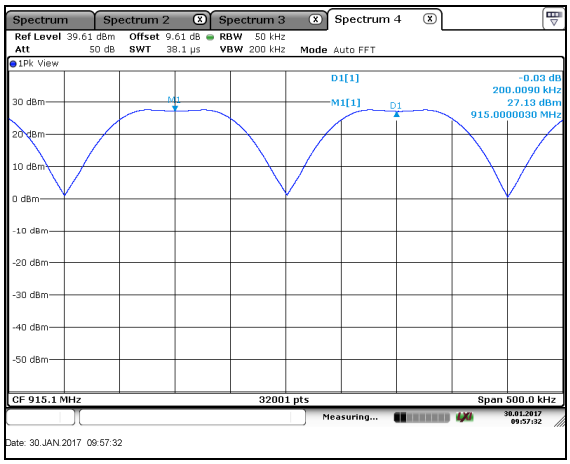

Figure 7.4.1.2-4: Mode 4

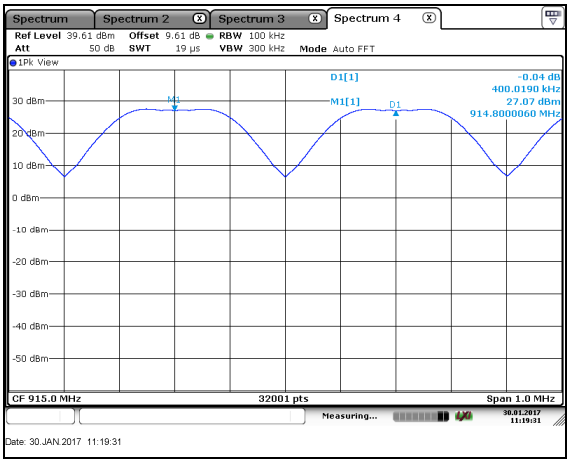

Figure 7.4.1.2-5: Mode 5

7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(3)

7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with suitable attenuation. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to less than 30% of the channel spacing or the 20dB bandwidth, whichever is smaller. The VBW was set to ≥ RBW.

The number of hopping channels was measured for the modes of operation and data presented in section 7.4.2.2 below.

7.4.2.2 Measurement Results

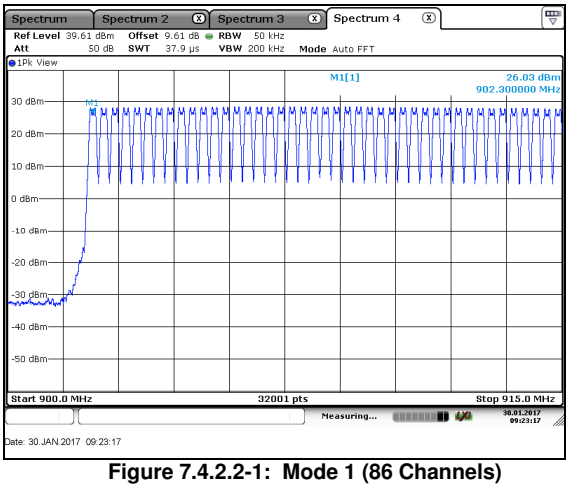

Figure 7.4.2.2-1: Mode 1 (86 Channels)

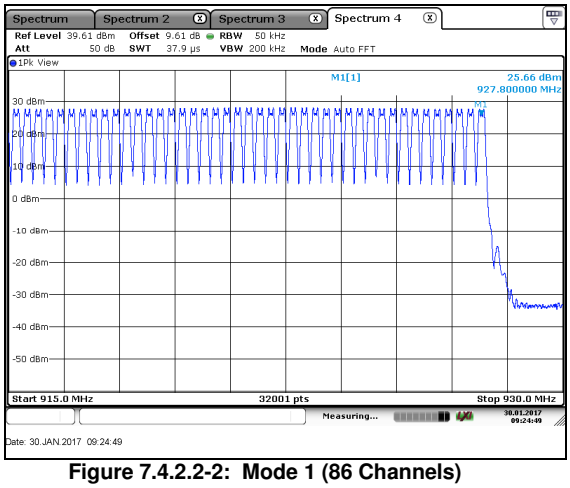

Figure 7.4.2.2-2: Mode 1 (86 Channels)

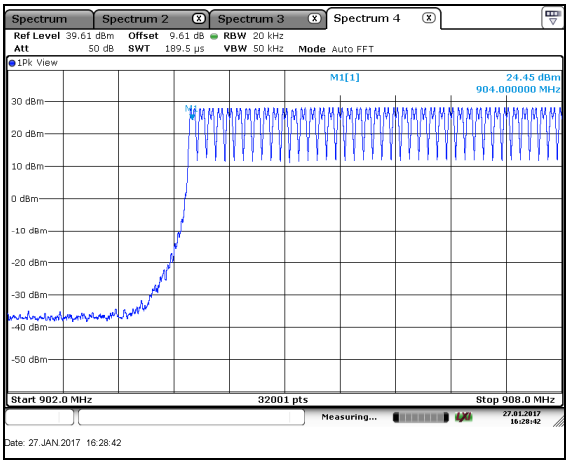

Figure 7.4.2.2-3: Mode 2 (240 Channels)

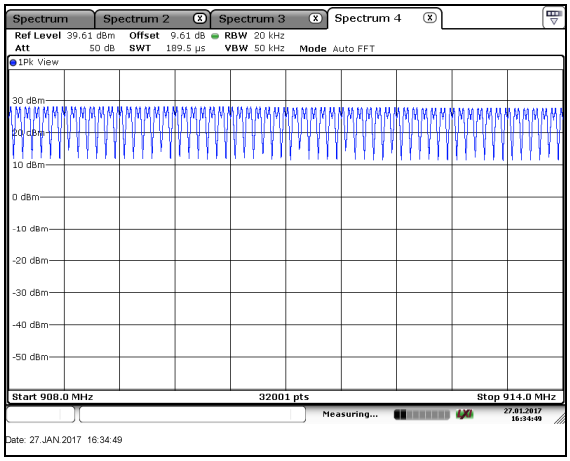

Figure 7.4.2.2-4: Mode 2 (240 Channels)

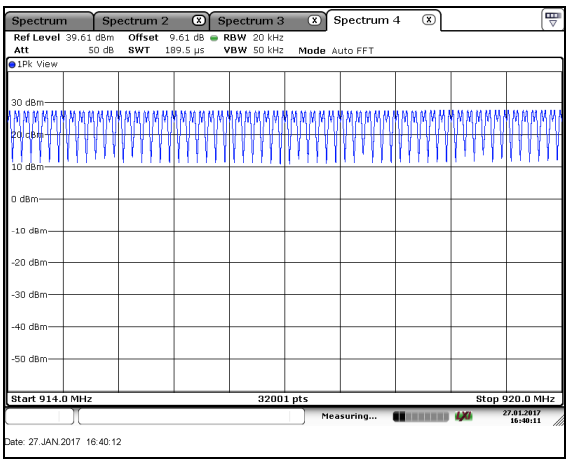

Figure 7.4.2.2-5: Mode 2 (240 Channels)

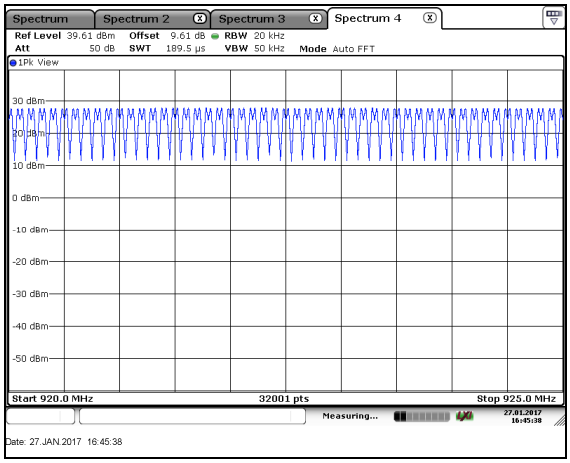

Figure 7.4.2.2-6: Mode 2 (240 Channels)

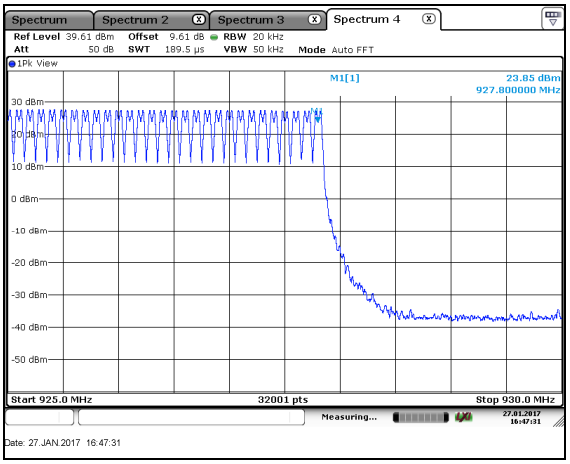

Figure 7.4.2.2-7: Mode 2 (240 Channels)

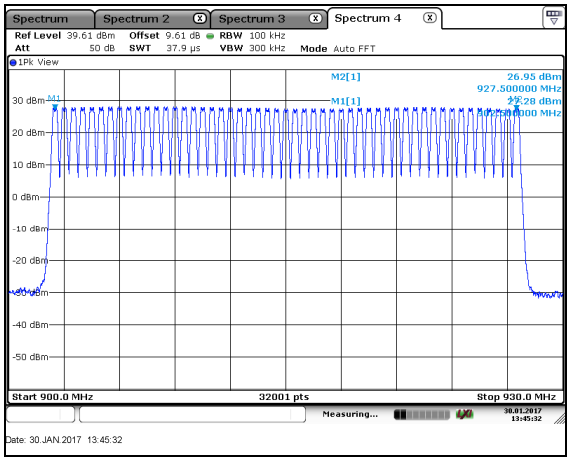

Figure 7.4.2.2-8: Mode 3 (51 Channels)

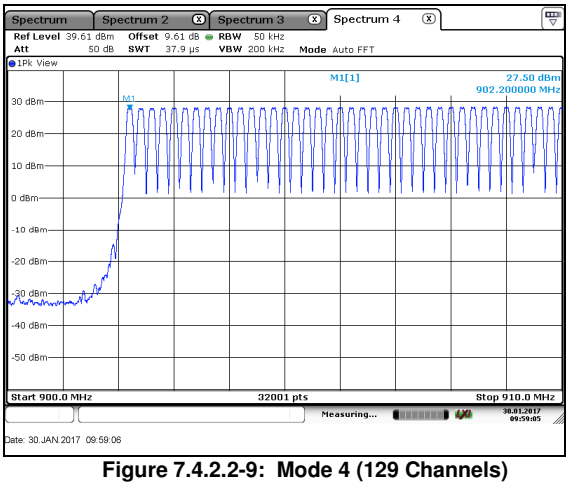

Figure 7.4.2.2-9: Mode 4 (129 Channels)

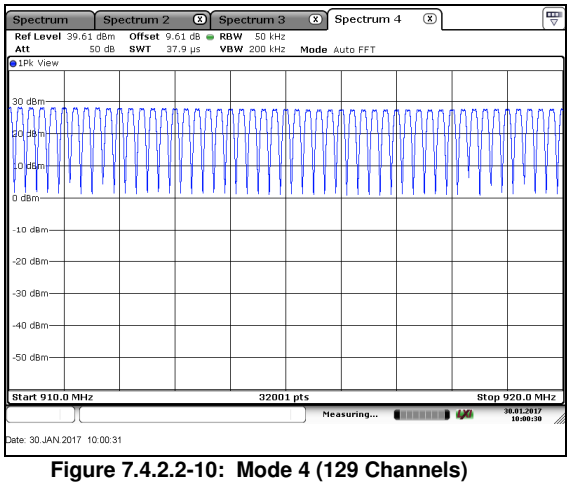

Figure 7.4.2.2-10: Mode 4 (129 Channels)

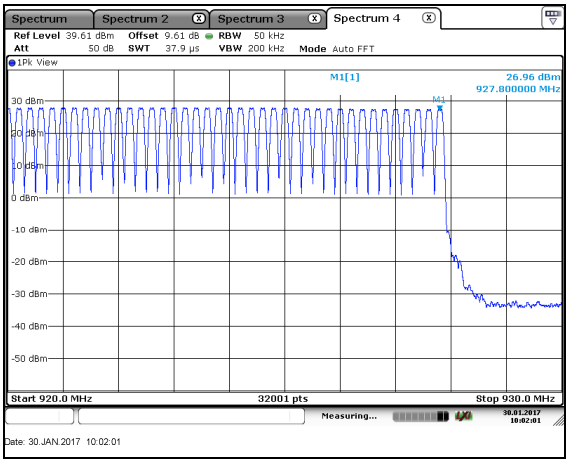

Figure 7.4.2.2-11: Mode 4 (129 Channels)

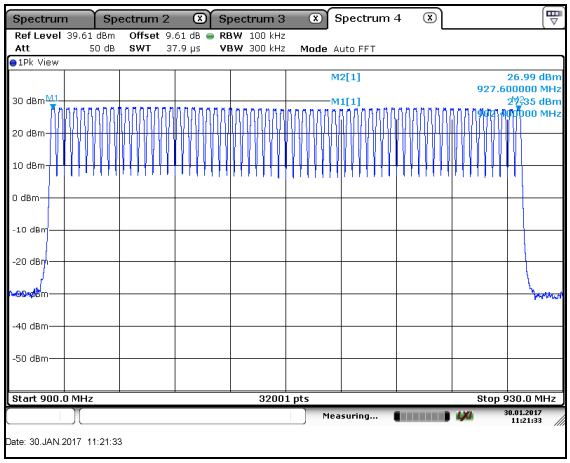

Figure 7.4.2.2-12: Mode 5 (64 Channels)

7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(3)

7.4.3.1 Measurement Procedure

The EUT test mode does not generate a worst case channel dwell time therefore a detailed engineering analysis is provided in the theory of operation.

As described in the theory of operation, the maximum channel transmitter dwell time is < 400ms per channel hop with the minimum period of 700ms between hops. Therefore the maximum time of occupancy on any one channel within a 10s or 20s period is <400ms for all modes of operation.

7.4.4 20dB / 99% Bandwidth – FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(3)

7.4.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer with 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 Delta and ndB down functions of the analyzer were 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)	Mode(s)
902.3	21.76	20.73	9.6	1 / 2
902.3	43.65	43.19	19.2	1 / 2
902.3	88.43	85.96	38.4	1 / 2
902.2	101.58	89.48	50.0	4
902.3	231.52	208.96	115.2	1
902.4	179.51	159.20	150.0	5
902.4	243.26	211.79	200.0	5
902.5	362.80	318.62	300.0	3
915.0	21.84	20.83	9.6	1 / 2
915.0	43.84	43.18	19.2	1 / 2
915.0	89.00	86.13	38.4	1 / 2
915.0	101.87	89.52	50.0	4
915.0	211.21	207.31	115.2	1
915.0	181.18	159.17	150.0	5
915.0	244.94	212.64	200.0	5
915.0	363.18	317.43	300.0	3
927.8	21.83	20.78	9.6	1 / 2
927.8	43.78	43.19	19.2	1 / 2
927.8	88.69	86.07	38.4	1 / 2
927.8	101.98	89.29	50.0	4
927.8	231.69	207.01	115.2	1
927.6	179.12	159.14	150.0	5
927.6	244.89	212.15	200.0	5
927.5	360.71	318.58	300.0	3

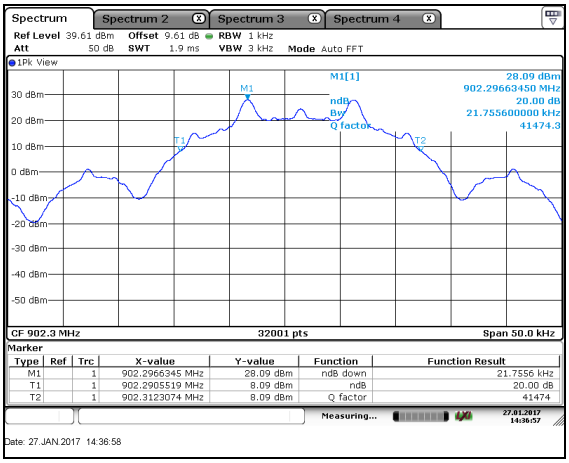

Figure 7.4.4.2-1: 20dB BW Low Channel - 9.6kbps

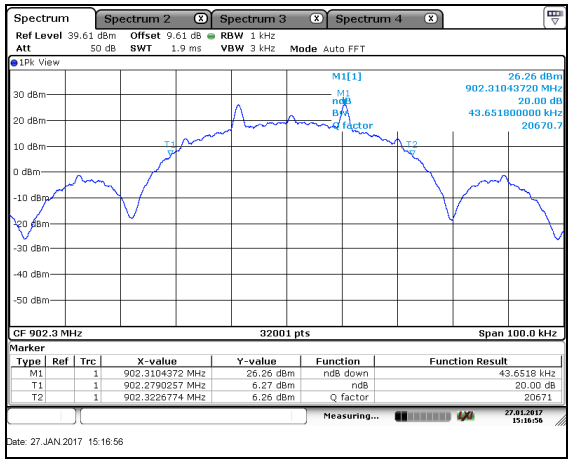

Figure 7.4.4.2-2: 20dB BW Low Channel – 19.2kbps

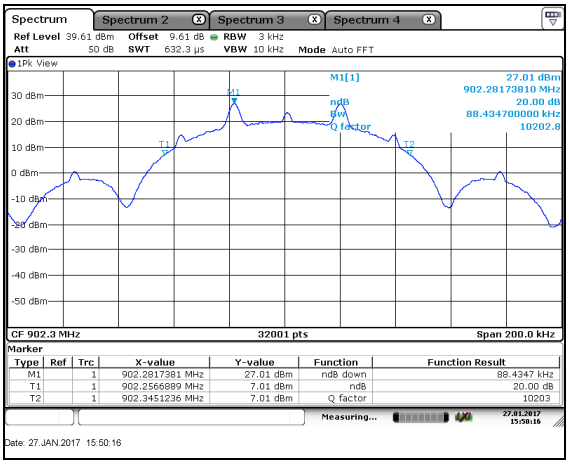

Figure 7.4.4.2-3: 20dB BW Low Channel – 38.4kbps

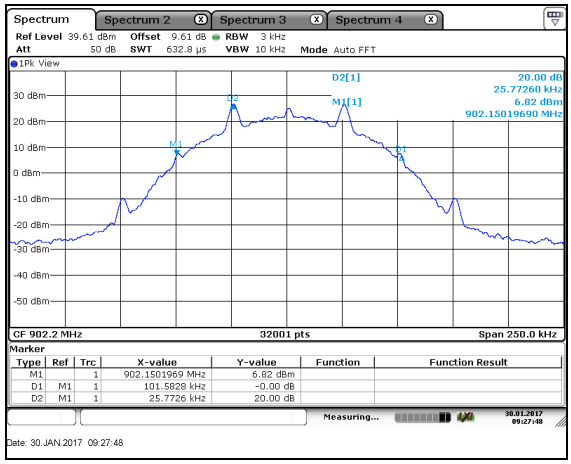

Figure 7.4.4.2-4: 20dB BW Low Channel – 50.0kbps

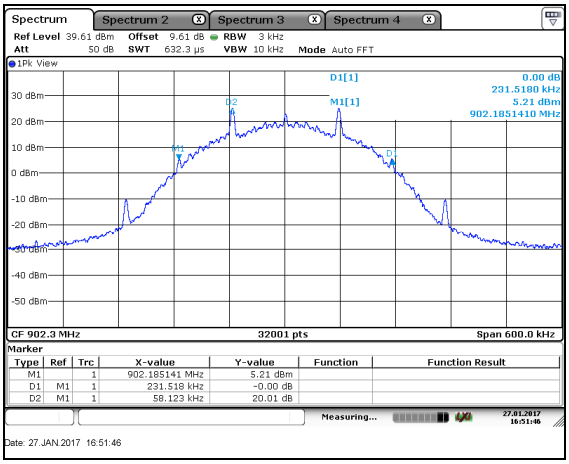

Figure 7.4.4.2-5: 20dB BW Low Channel – 115.2kbps

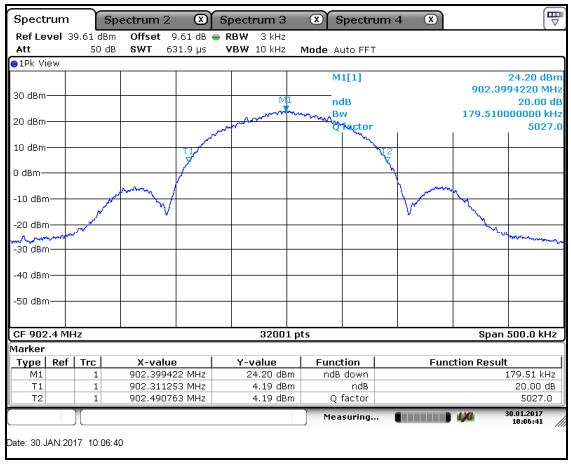

Figure 7.4.4.2-6: 20dB BW Low Channel – 150.0kbps

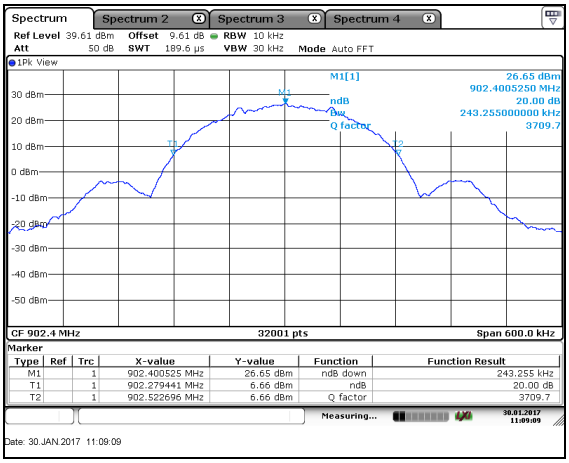

Figure 7.4.4.2-7: 20dB BW Low Channel – 200.0kbps

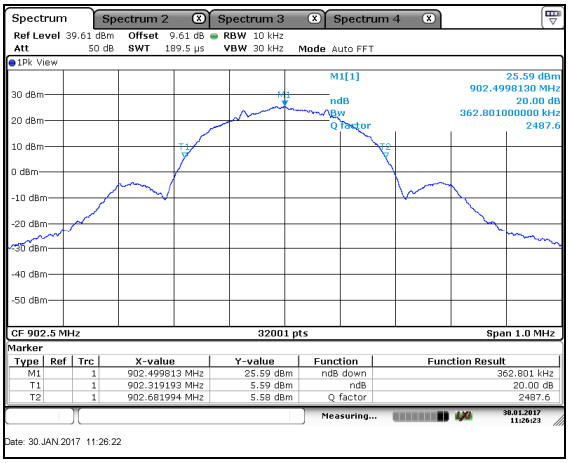

Figure 7.4.4.2-8: 20dB BW Low Channel – 300.0kbps

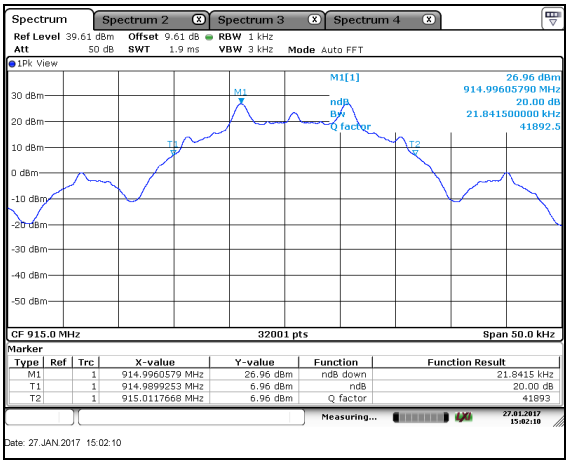

Figure 7.4.4.2-9: 20dB BW Mid Channel - 9.6kbps

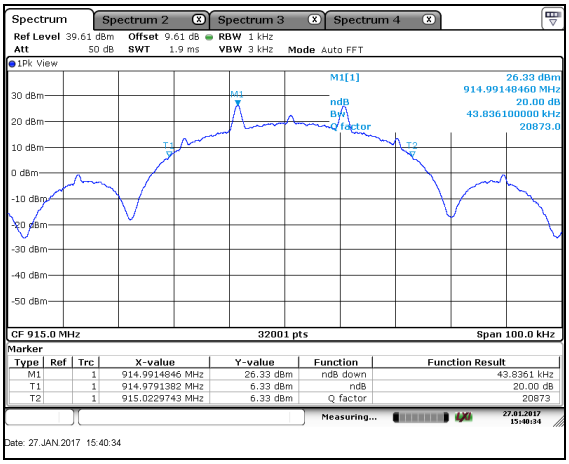

Figure 7.4.4.2-10: 20dB BW Mid Channel – 19.2kbps

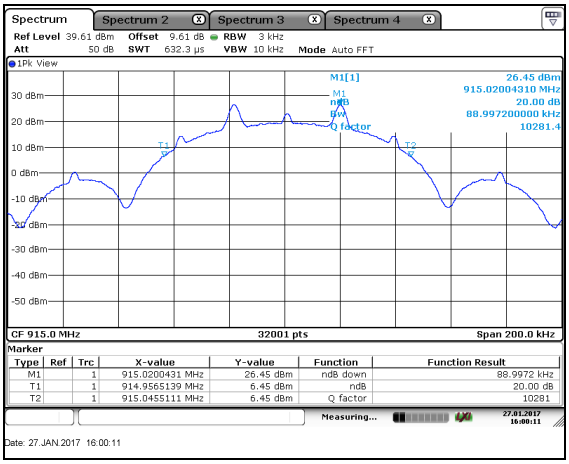

Figure 7.4.4.2-11: 20dB BW Mid Channel – 38.4kbps

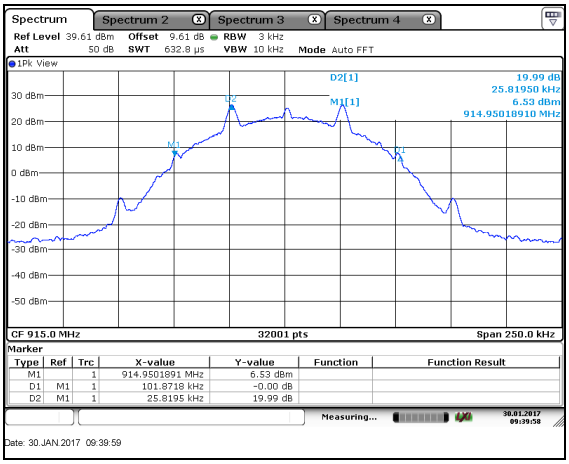

Figure 7.4.4.2-12: 20dB BW Mid Channel – 50.0kbps

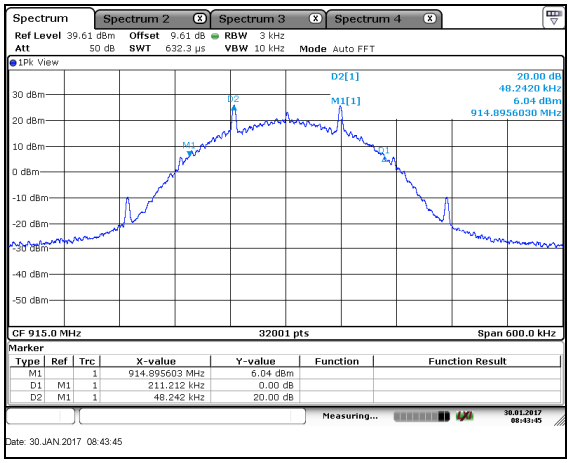

Figure 7.4.4.2-13: 20dB BW Mid Channel – 115.2kbps

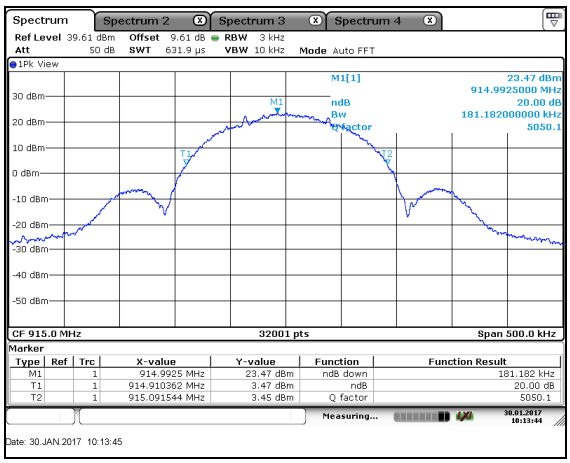

Figure 7.4.4.2-14: 20dB BW Mid Channel – 150.0kbps

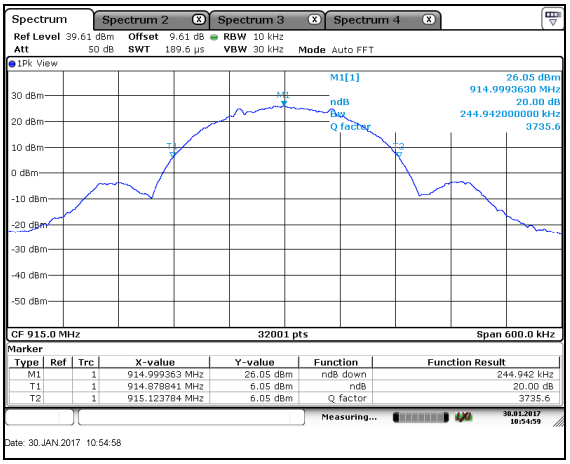

Figure 7.4.4.2-15: 20dB BW Mid Channel – 200.0kbps

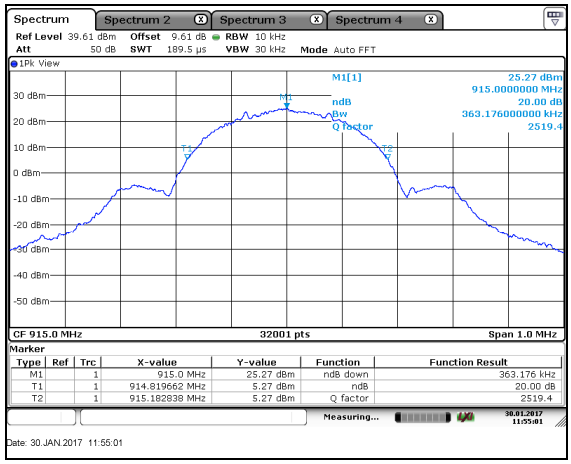

Figure 7.4.4.2-16: 20dB BW Mid Channel – 300.0kbps

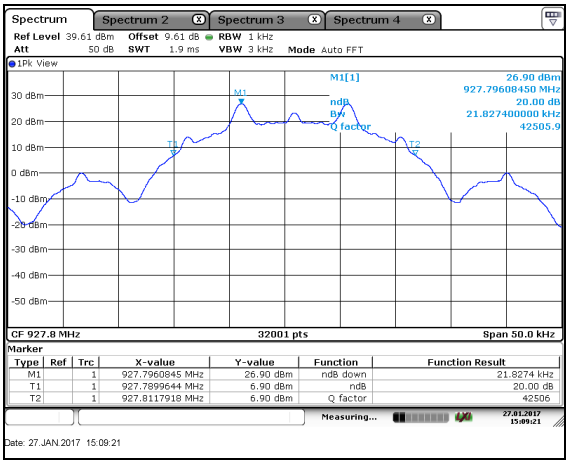

Figure 7.4.4.2-17: 20dB BW High Channel - 9.6kbps

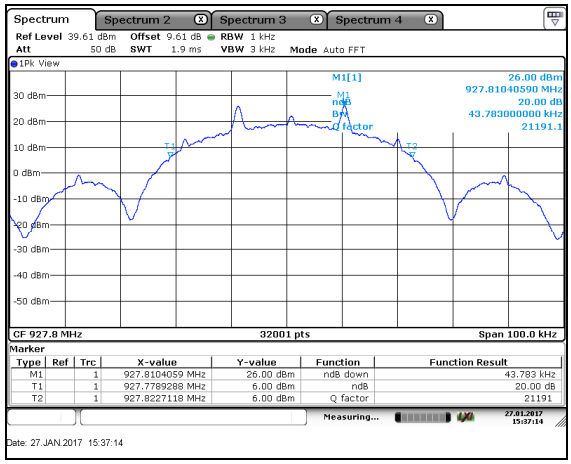

Figure 7.4.4.2-18: 20dB BW High Channel – 19.2kbps

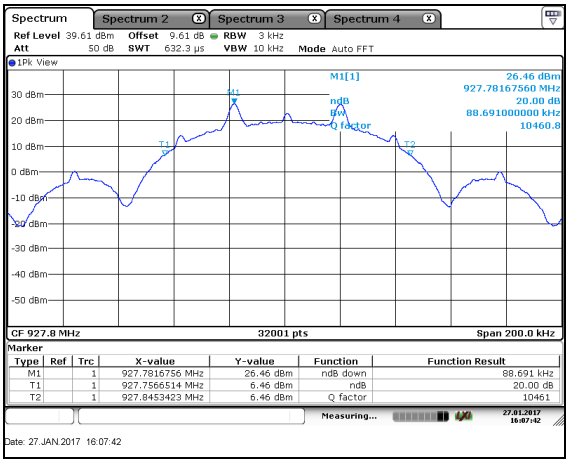

Figure 7.4.4.2-19: 20dB BW High Channel – 38.4kbps

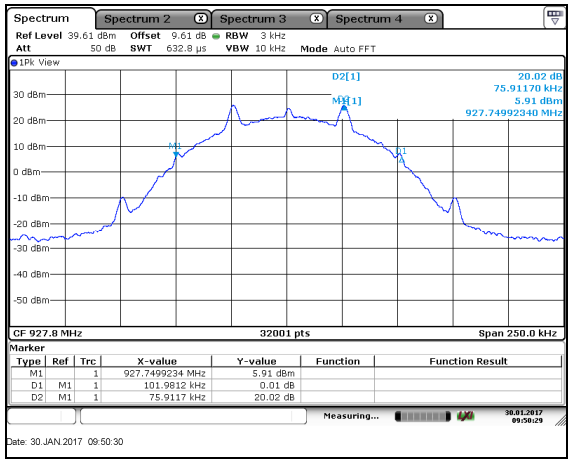

Figure 7.4.4.2-20: 20dB BW High Channel – 50.0kbps

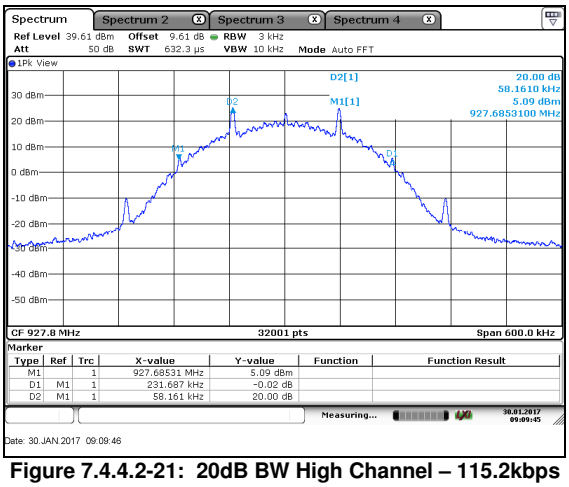

Figure 7.4.4.2-21: 20dB BW High Channel – 115.2kbps

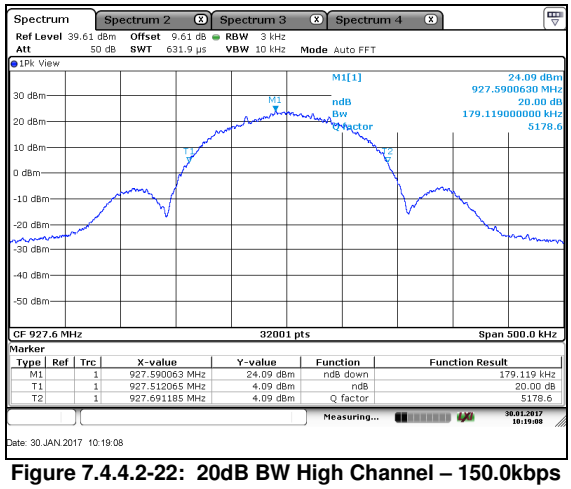

Figure 7.4.4.2-22: 20dB BW High Channel – 150.0kbps

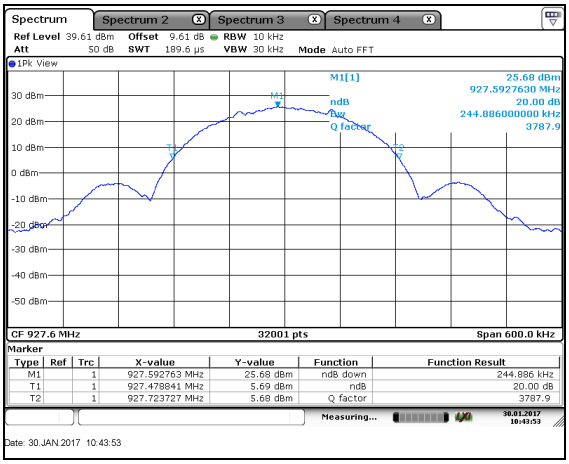

Figure 7.4.4.2-23: 20dB BW High Channel – 200.0kbps

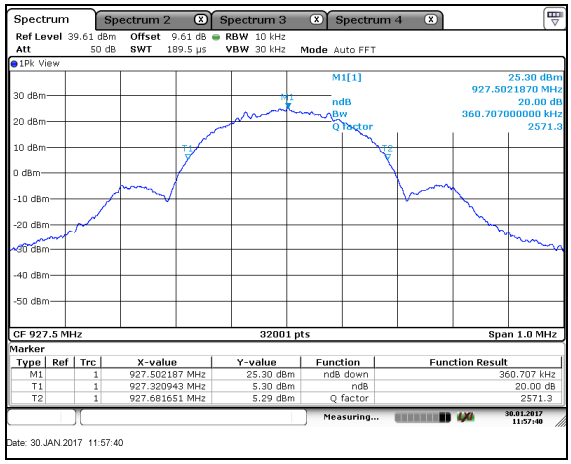

Figure 7.4.4.2-24: 20dB BW High Channel – 300.0kbps

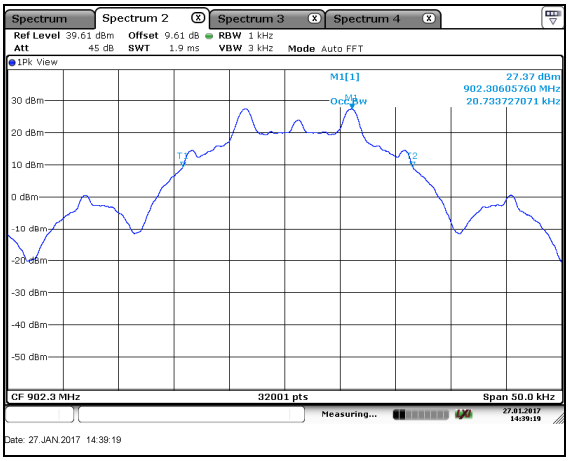

Figure 7.4.4.2-25: 99% BW Low Channel - 9.6kbps

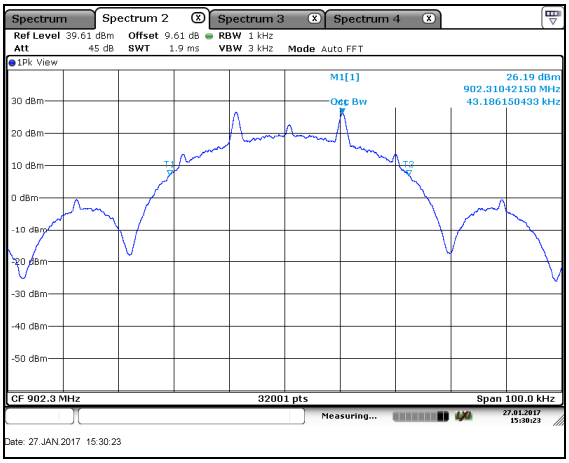

Figure 7.4.4.2-26: 99% BW Low Channel – 19.2kbps

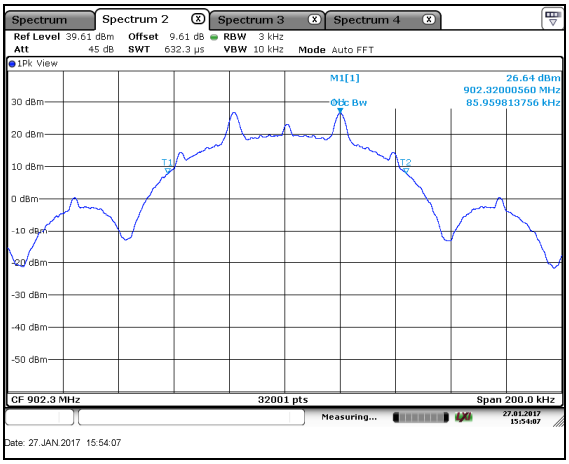

Figure 7.4.4.2-27: 99% BW Low Channel – 38.4kbps

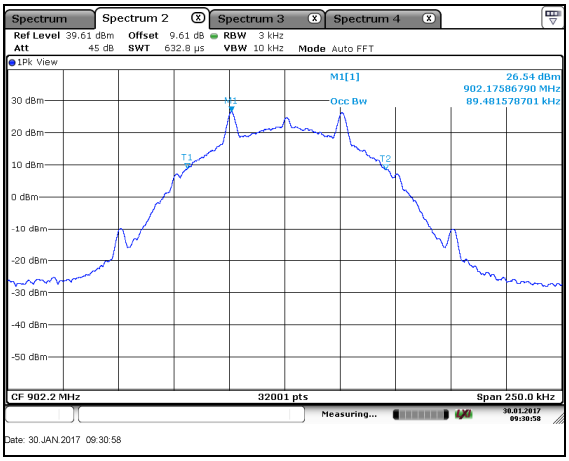

Figure 7.4.4.2-28: 99% BW Low Channel – 50.0kbps

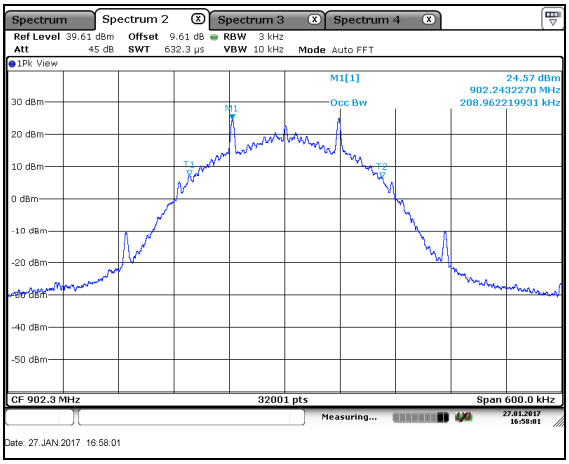

Figure 7.4.4.2-29: 99% BW Low Channel – 115.2kbps

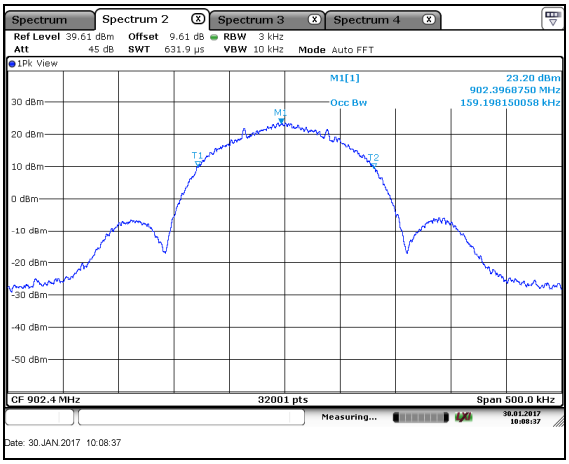

Figure 7.4.4.2-30: 99% BW Low Channel – 150.0kbps

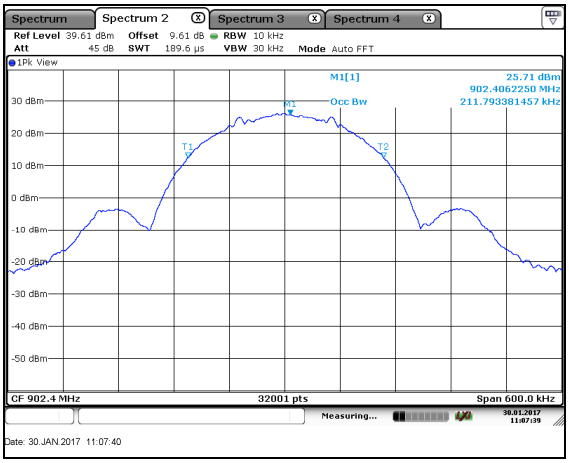

Figure 7.4.4.2-31: 99% BW Low Channel – 200.0kbps

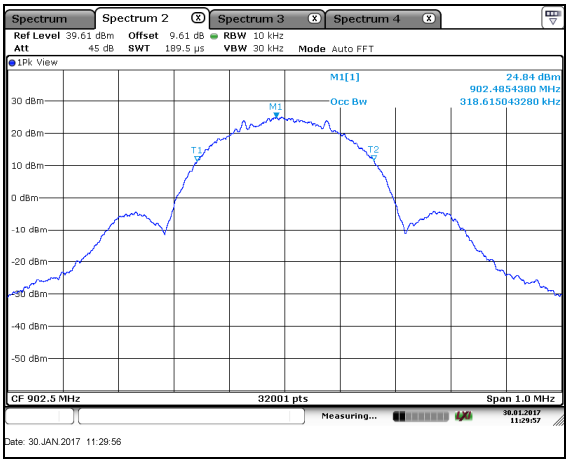

Figure 7.4.4.2-32: 99% BW Low Channel – 300.0kbps

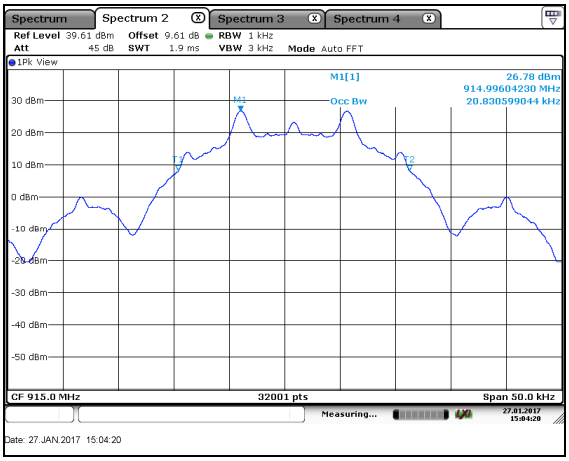

Figure 7.4.4.2-33: 99% BW Mid Channel - 9.6kbps

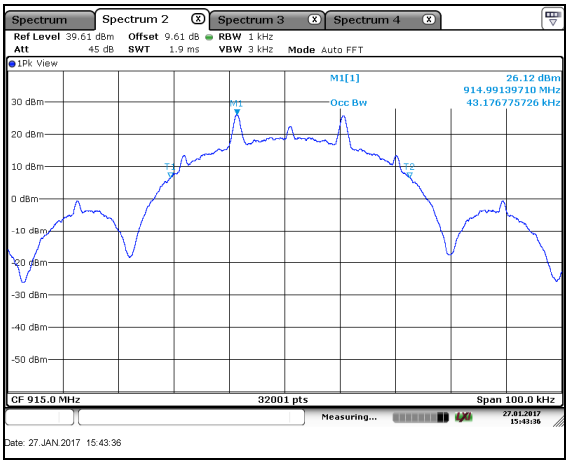

Figure 7.4.4.2-34: 99% BW Mid Channel – 19.2kbps

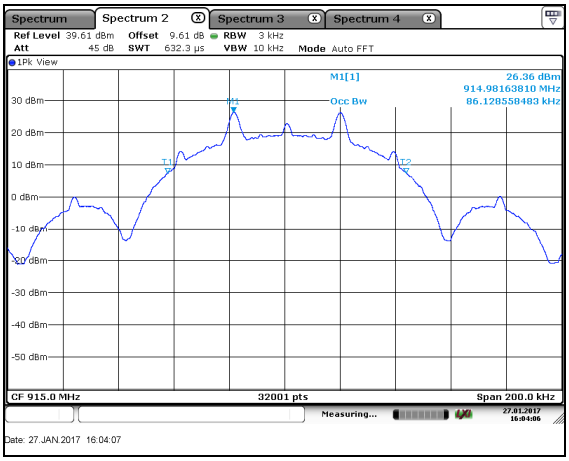

Figure 7.4.4.2-35: 99% BW Mid Channel – 38.4kbps

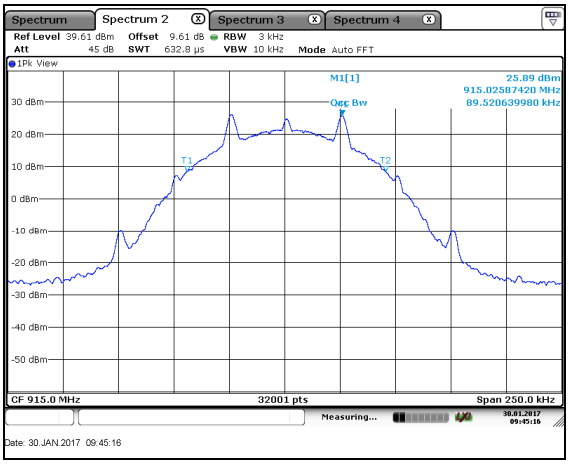

Figure 7.4.4.2-36: 99% BW Mid Channel – 50.0kbps

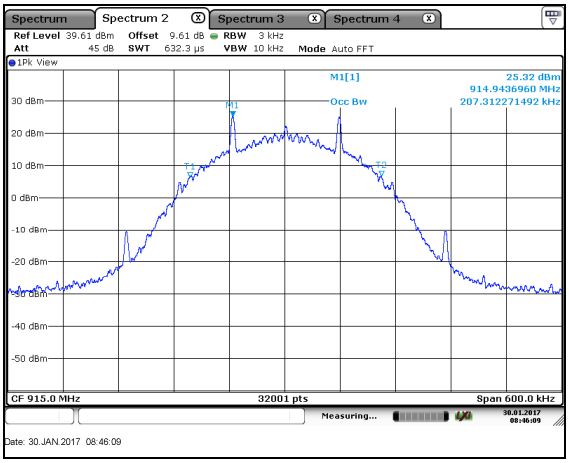

Figure 7.4.4.2-37: 99% BW Mid Channel – 115.2kbps

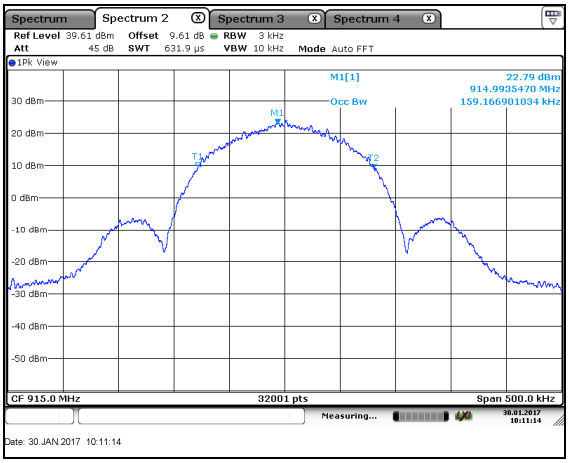

Figure 7.4.4.2-38: 99% BW Mid Channel – 150.0kbps

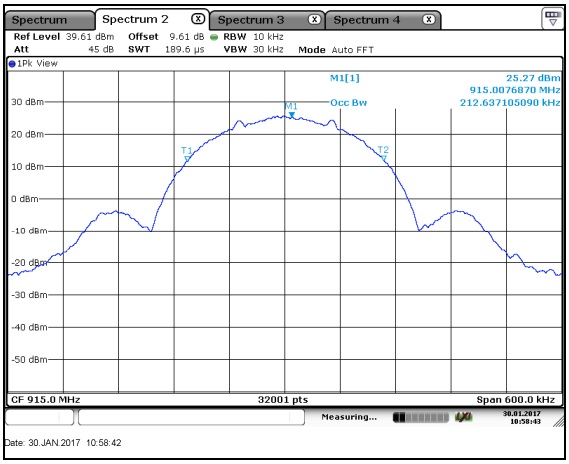

Figure 7.4.4.2-39: 99% BW Mid Channel – 200.0kbps

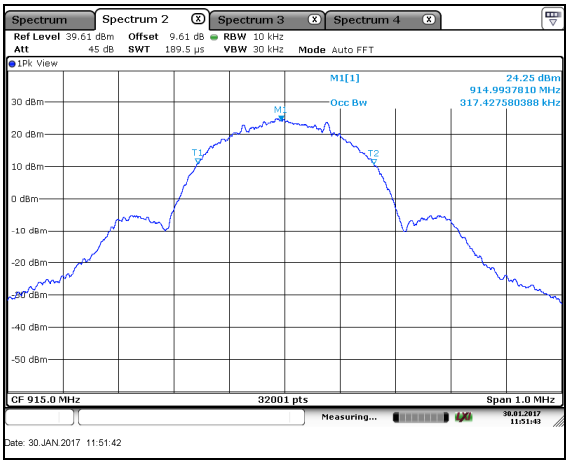

Figure 7.4.4.2-40: 99% BW Mid Channel – 300.0kbps

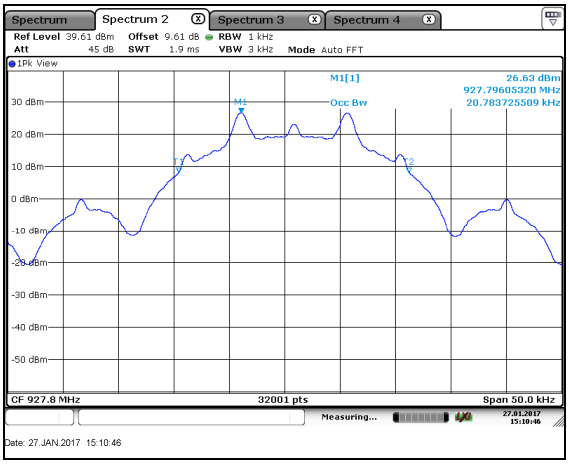

Figure 7.4.4.2-41: 99% BW High Channel - 9.6kbps

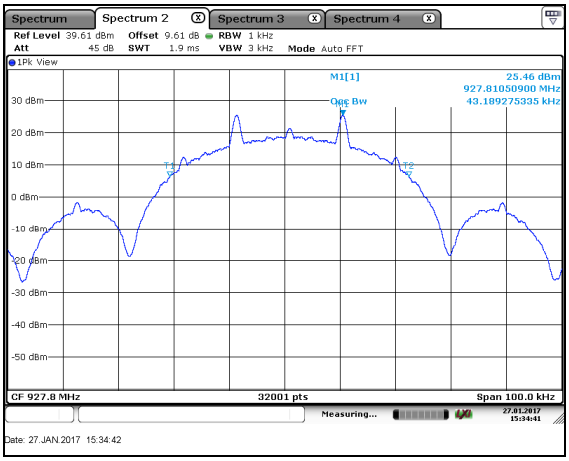

Figure 7.4.4.2-42: 99% BW High Channel – 19.2kbps

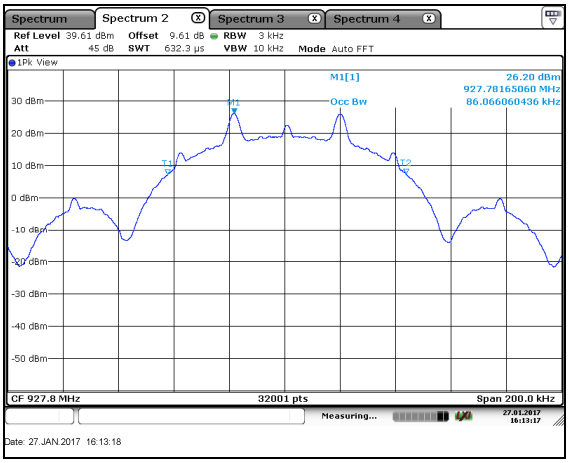

Figure 7.4.4.2-43: 99% BW High Channel – 38.4kbps

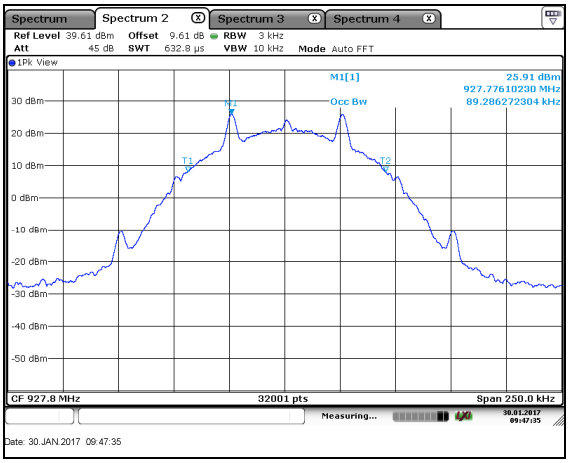

Figure 7.4.4.2-44: 99% BW High Channel – 50.0kbps

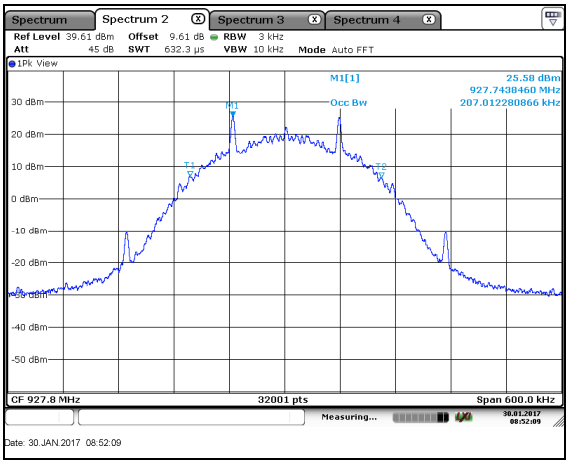

Figure 7.4.4.2-45: 99% BW High Channel – 115.2kbps

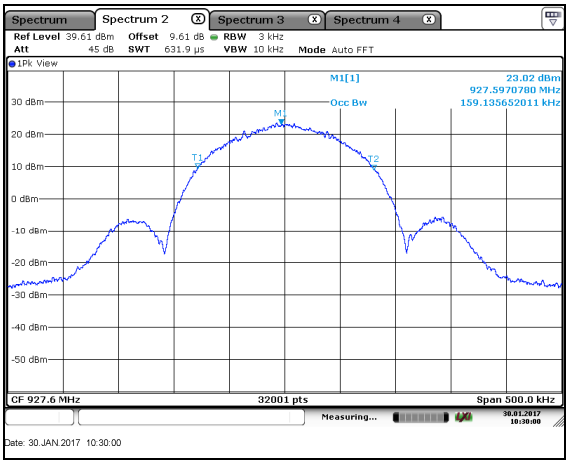

Figure 7.4.4.2-46: 99% BW High Channel – 150.0kbps

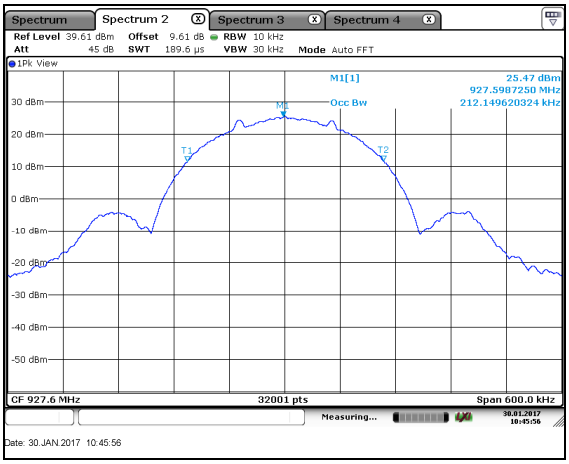

Figure 7.4.4.2-47: 99% BW High Channel – 200.0kbps

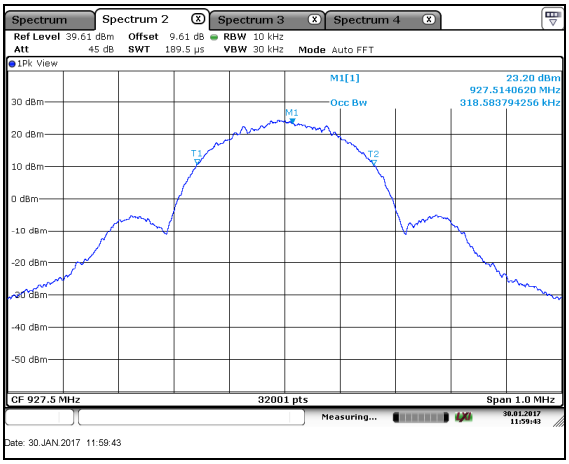

Figure 7.4.4.2-48: 99% BW High Channel – 300.0kbps

7.5 Band-Edge Compliance and Spurious Emissions

7.5.1 Band-Edge Compliance of RF Conducted Emissions – FCC: Section 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 with 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 100kHz and the VBW was set to 300kHz.

Band-edge was evaluated for all combinations of operating modes and data rates. Worst case reported utilized 115.2kbps in Mode 1, 38.4kbps in Mode 2, 300.0kbps in Mode 3, 50.0kbps in Mode 4 and 200.0kbps in Mode 5.

7.5.1.2 Measurement Results

NON-HOPPING MODE:

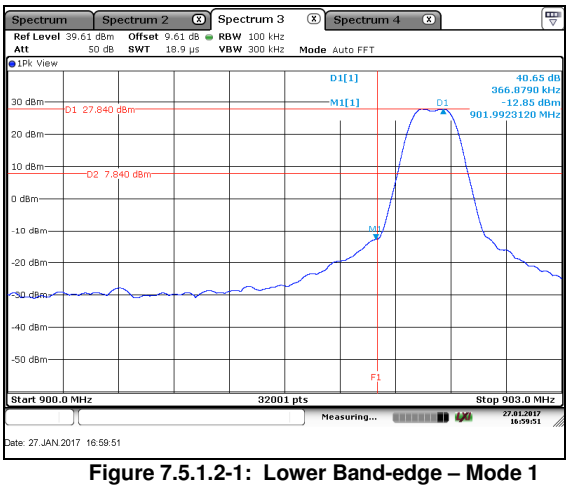

Figure 7.5.1.2-1: Lower Band-edge – Mode 1

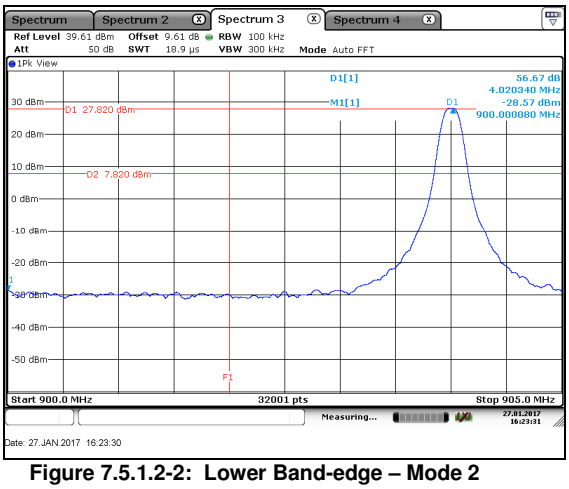

Figure 7.5.1.2-2: Lower Band-edge – Mode 2

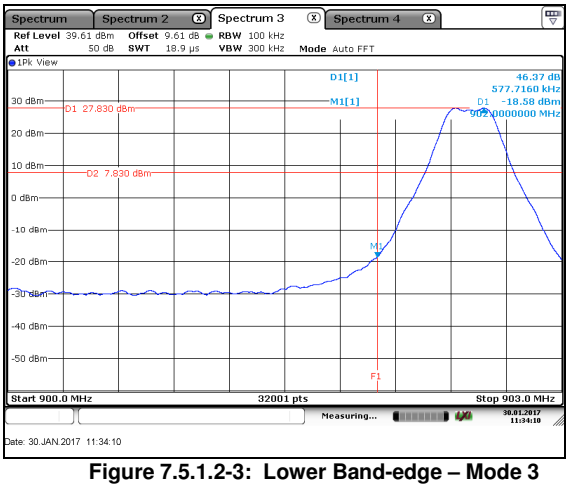

Figure 7.5.1.2-3: Lower Band-edge – Mode 3

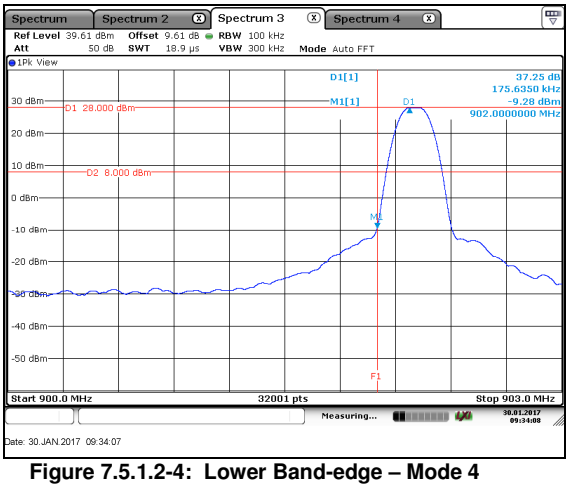

Figure 7.5.1.2-4: Lower Band-edge – Mode 4

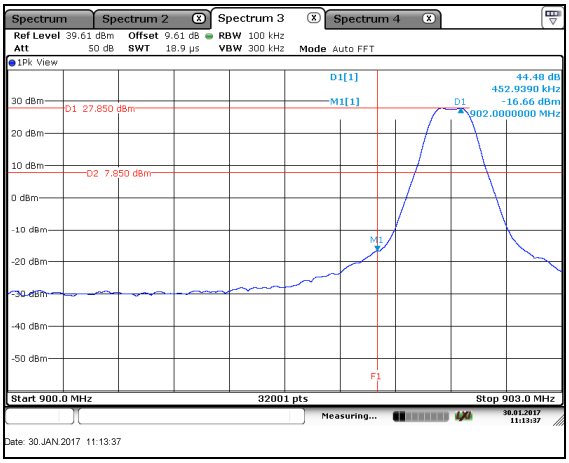

Figure 7.5.1.2-5: Lower Band-edge – Mode 5

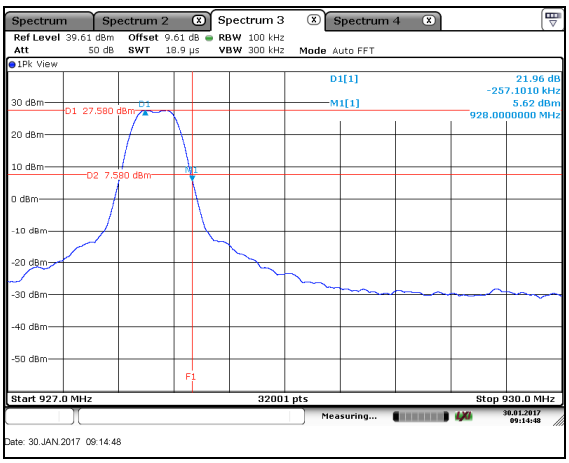

Figure 7.5.1.2-6: Upper Band-edge – Mode 1

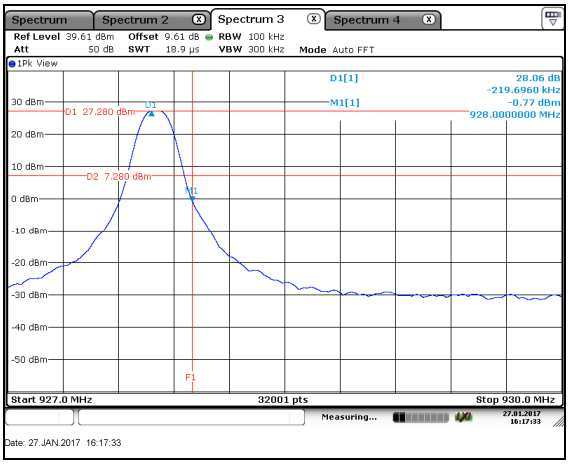

Figure 7.5.1.2-7: Upper Band-edge – Mode 2

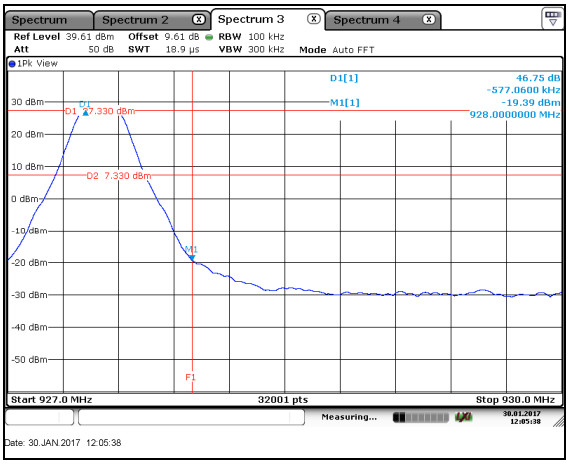

Figure 7.5.1.2-8: Upper Band-edge – Mode 3

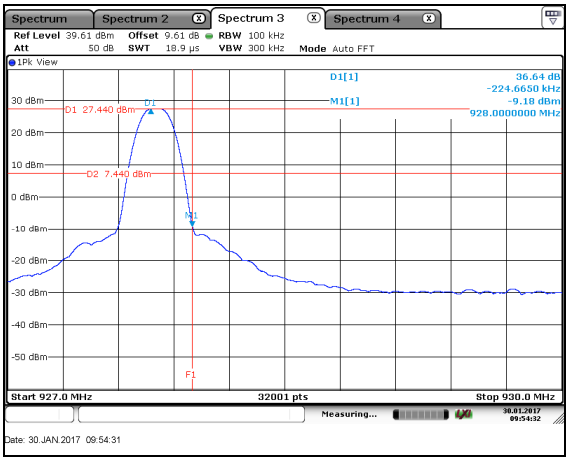

Figure 7.5.1.2-9: Upper Band-edge – Mode 4

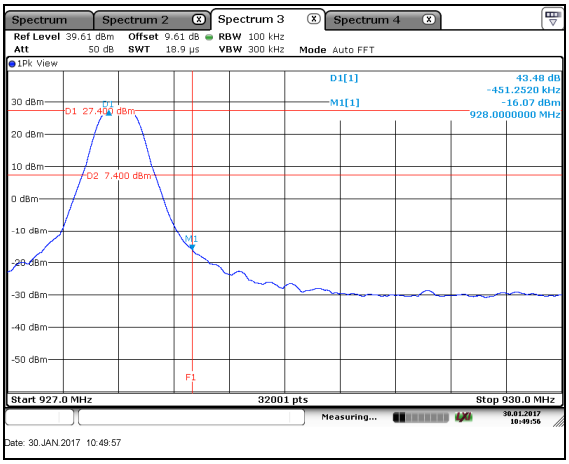

Figure 7.5.1.2-10: Upper Band-edge – Mode 5

HOPPING MODE:

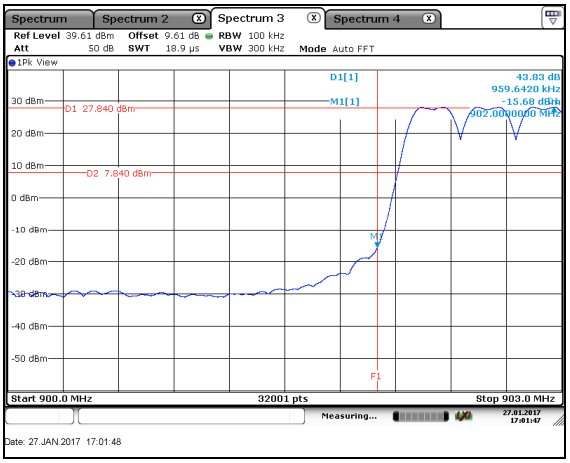

Figure 7.5.1.2-11: Lower Band-edge – Mode 1

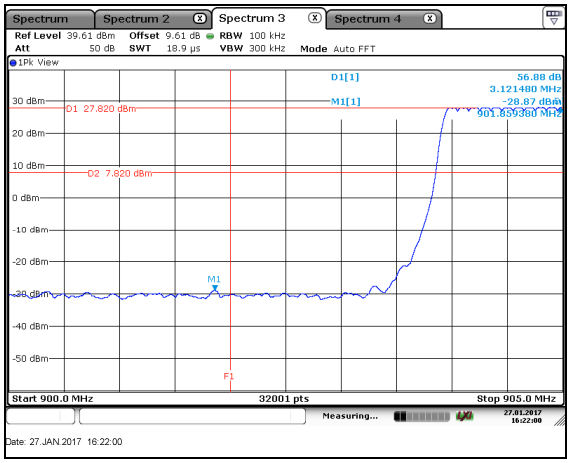

Figure 7.5.1.2-12: Lower Band-edge – Mode 2

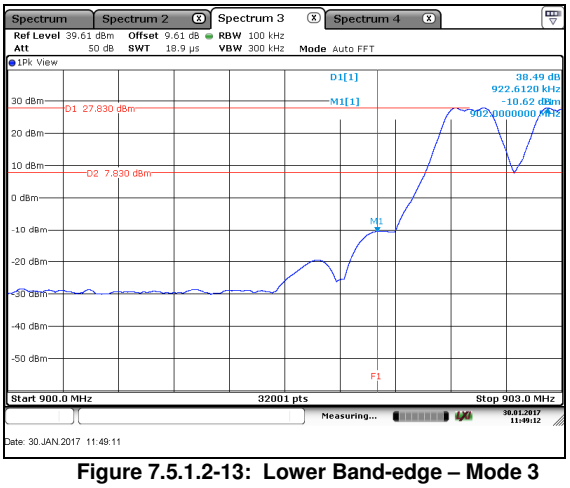

Figure 7.5.1.2-13: Lower Band-edge – Mode 3

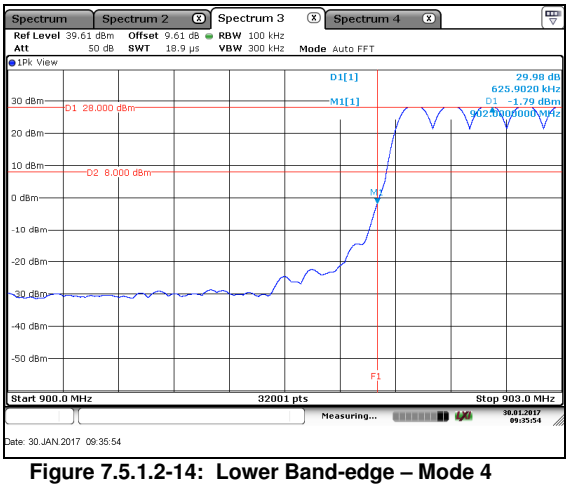

Figure 7.5.1.2-14: Lower Band-edge – Mode 4

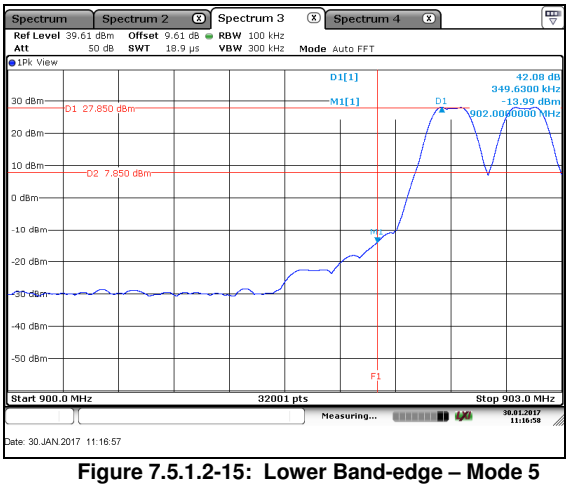

Figure 7.5.1.2-15: Lower Band-edge – Mode 5

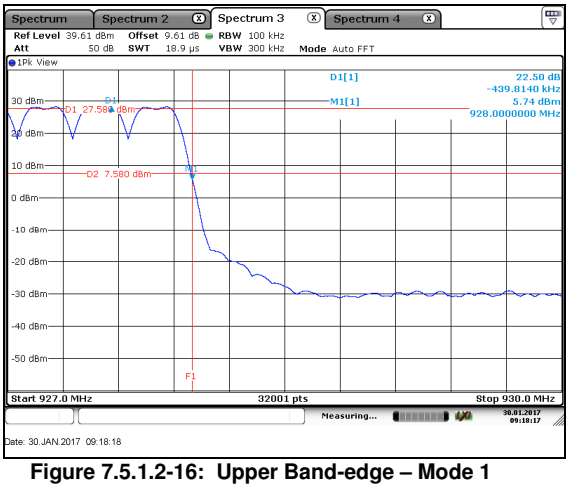

Figure 7.5.1.2-16: Upper Band-edge – Mode 1

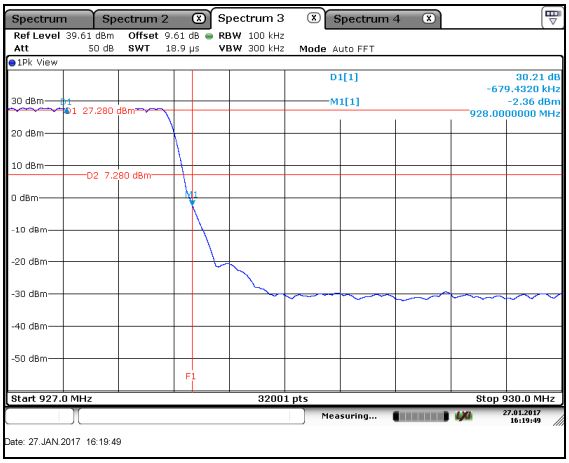

Figure 7.5.1.2-17: Upper Band-edge – Mode 2

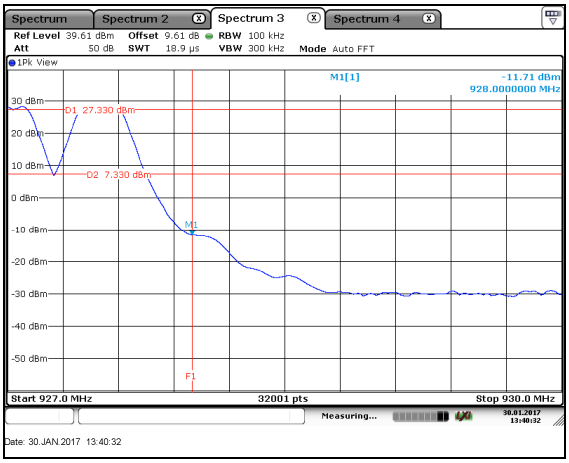

Figure 7.5.1.2-18: Upper Band-edge – Mode 3

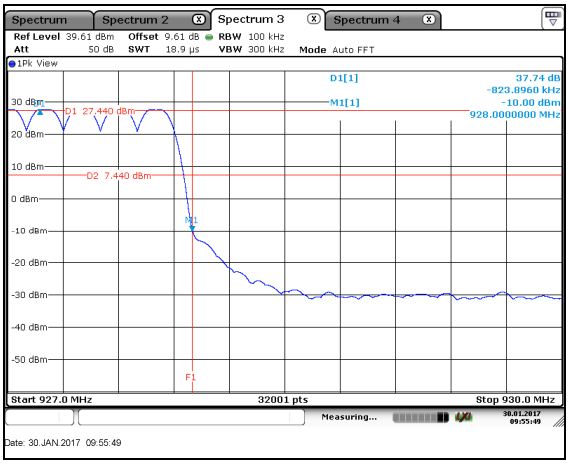

Figure 7.5.1.2-19: Upper Band-edge – Mode 4

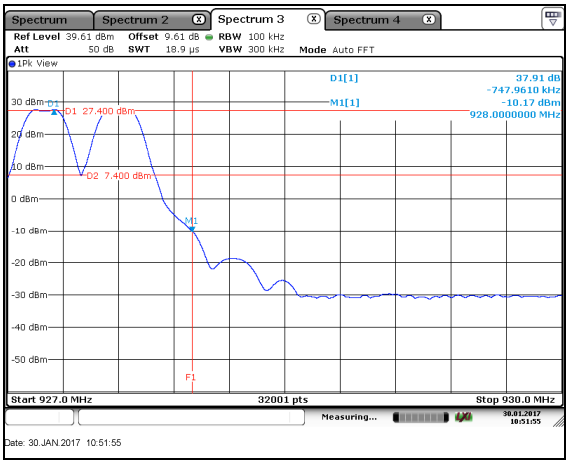

Figure 7.5.1.2-20: Upper Band-edge – Mode 5

7.5.2 RF Conducted Spurious Emissions – FCC: Section 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. 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

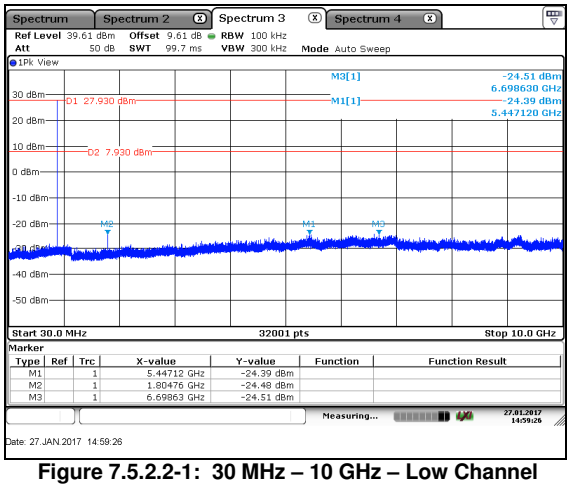

Figure 7.5.2.2-1: 30 MHz – 10 GHz – Low Channel

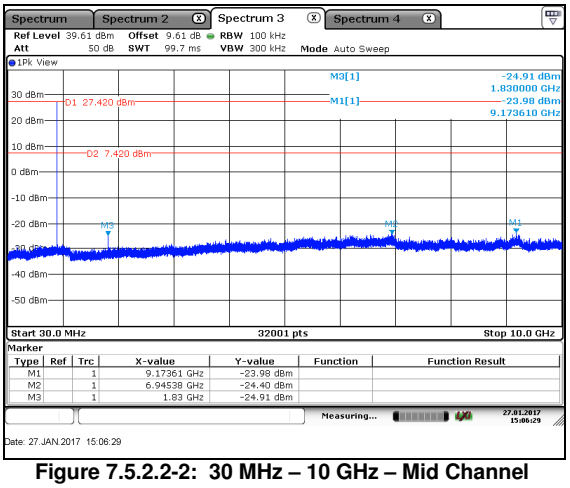

Figure 7.5.2.2-2: 30 MHz – 10 GHz – Mid Channel

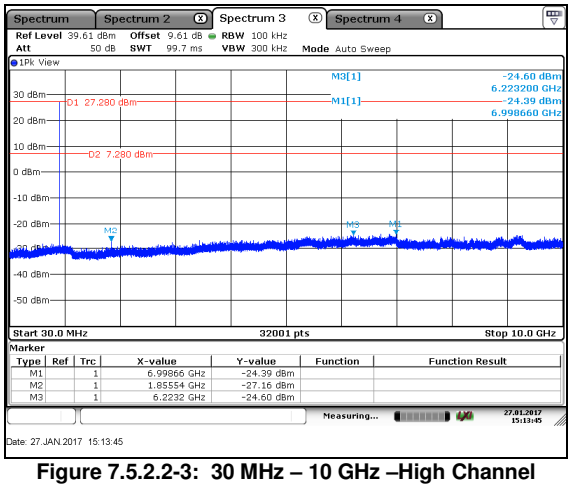

Figure 7.5.2.2-3: 30 MHz – 10 GHz –High Channel

7.5.3 Radiated Spurious Emissions – FCC: Section 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 1 meter to 4 meter so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz 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.

Radiated spurious emissions were evaluated for all combinations of operating modes and data rates with worst case data provided.

7.5.3.2 Measurement Results

Table 7.5.3.2-1: 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										
2706.6	50.90	43.60	H	-3.91	46.99	39.69	74.0	54.0	27.0	14.3
2706.6	53.10	48.20	V	-3.91	49.19	44.29	74.0	54.0	24.8	9.7
3608.8	48.20	36.00	H	-0.98	47.22	35.02	74.0	54.0	26.8	19.0
3608.8	47.20	34.30	V	-0.98	46.22	33.32	74.0	54.0	27.8	20.7
4511	49.00	37.60	H	0.54	49.54	38.14	74.0	54.0	24.5	15.9
4511	48.20	35.90	V	0.54	48.74	36.44	74.0	54.0	25.3	17.6
5413.2	46.80	33.70	H	3.40	50.20	37.10	74.0	54.0	23.8	16.9
5413.2	47.00	33.70	V	3.40	50.40	37.10	74.0	54.0	23.6	16.9
8119.8	47.60	34.30	H	8.00	55.60	42.30	74.0	54.0	18.4	11.7
8119.8	48.30	36.00	V	8.00	56.30	44.00	74.0	54.0	17.7	10.0
Middle Channel										
2745	52.40	46.90	H	-3.80	48.60	43.10	74.0	54.0	25.4	10.9
2745	52.80	47.40	V	-3.80	49.00	43.60	74.0	54.0	25.0	10.4
3660	48.90	38.30	H	-0.80	48.10	37.50	74.0	54.0	25.9	16.5
3660	48.00	35.30	V	-0.80	47.20	34.50	74.0	54.0	26.8	19.5
4575	49.80	39.00	H	0.74	50.54	39.74	74.0	54.0	23.5	14.3
4575	47.80	34.80	V	0.74	48.54	35.54	74.0	54.0	25.5	18.5
8235	47.60	35.10	H	8.16	55.76	43.26	74.0	54.0	18.2	10.7
8235	47.00	34.20	V	8.16	55.16	42.36	74.0	54.0	18.8	11.6
High Channel										
2783.4	51.00	43.50	H	-3.69	47.31	39.81	74.0	54.0	26.7	14.2
2783.4	53.10	47.50	V	-3.69	49.41	43.81	74.0	54.0	24.6	10.2
3711.2	48.10	35.30	H	-0.61	47.49	34.69	74.0	54.0	26.5	19.3
3711.2	47.80	34.60	V	-0.61	47.19	33.99	74.0	54.0	26.8	20.0
4639	48.50	36.90	H	0.95	49.45	37.85	74.0	54.0	24.6	16.2
4639	47.60	33.80	V	0.95	48.55	34.75	74.0	54.0	25.5	19.3
7422.4	47.20	34.40	V	7.78	54.98	42.18	74.0	54.0	19.0	11.8
8350.2	48.00	35.60	H	8.33	56.33	43.93	74.0	54.0	17.7	10.1
8350.2	47.60	34.20	V	8.33	55.93	42.53	74.0	54.0	18.1	11.5

7.5.3.3 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

Corrected Level: 50.90 - 3.91 = 46.99dBuV/m
Margin: 74dBuV/m – 46.99dBuV/m = 27.0dB

Example Calculation: Average

Corrected Level: 43.60 - 3.91 - 0 = 39.69dBuV
Margin: 54dBuV – 39.69dBuV = 14.3dB

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 ℃
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 NIC AM, manufactured by Landis+Gyr Technology, Inc. meets the requirements of FCC Part 15 subpart C and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247.

END REPORT