Certification Test Report

FCC ID: R7PNG0R1S5
IC: 5294A-NG0R1S5

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

Report Number: AT72156409-1C0

Manufacturer: Landis+Gyr Technology, Inc.
Model: N501

Test Begin Date: January 28, 2020
Test End Date: July 6, 2017

Report Issue Date: August 18, 2020

For Scope of Accreditation Under Certificate Number: 2955-09

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

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This report contains 39 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 N501 manufactured by Landis+Gyr Technology, Inc. is a radio for a mesh network.

Technical Information:
The model N501 provides 3 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 - 927.8	239	100	9.6, 19.2, 38.4
3	902.4 - 927.6	64	400	50.0, 150.0, 200.0

Modulation Format: FSK
Antenna Type / Gain: Airgain ET960NPMR2 Rigid Dipole Antenna / 5.7 dBi
Operating Voltage: 3.3 Vdc (supplied via evaluation board)

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

EUT Serial Numbers: 9169F26D (Radiated Emissions)
9160F26D (RF Conducted Emissions)

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. The worst-case data rate for the radiated emission measurements was 9.6kbps.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was Y-position. See test setup photos for more information. 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. The EUT was programmed to generate a continuously modulated signal on a single channel.

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:	Mode 1/2:	251
	Mode 3:	282

2 TEST FACILITIES

2.1 Location

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

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

2.2 Laboratory Accreditations/Recognitions/Certifications

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

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

The Semi-Anechoic Chamber Test Sites, Open Area Test Sites (OATS) and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Designation Accreditation Number:	US1233
FCC Test Site Registration Number:	967699
ISED Canada Lab Code:	23932
VCCI Member Number:	1831
• VCCI Registration Number	A-0295

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20’ x 30’ x 18’ shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5’ in diameter and is located 5’6” from the back wall of the chamber. The chamber is grounded via 1 - 8’ copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3’ x 6’ x 4’ deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4” PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

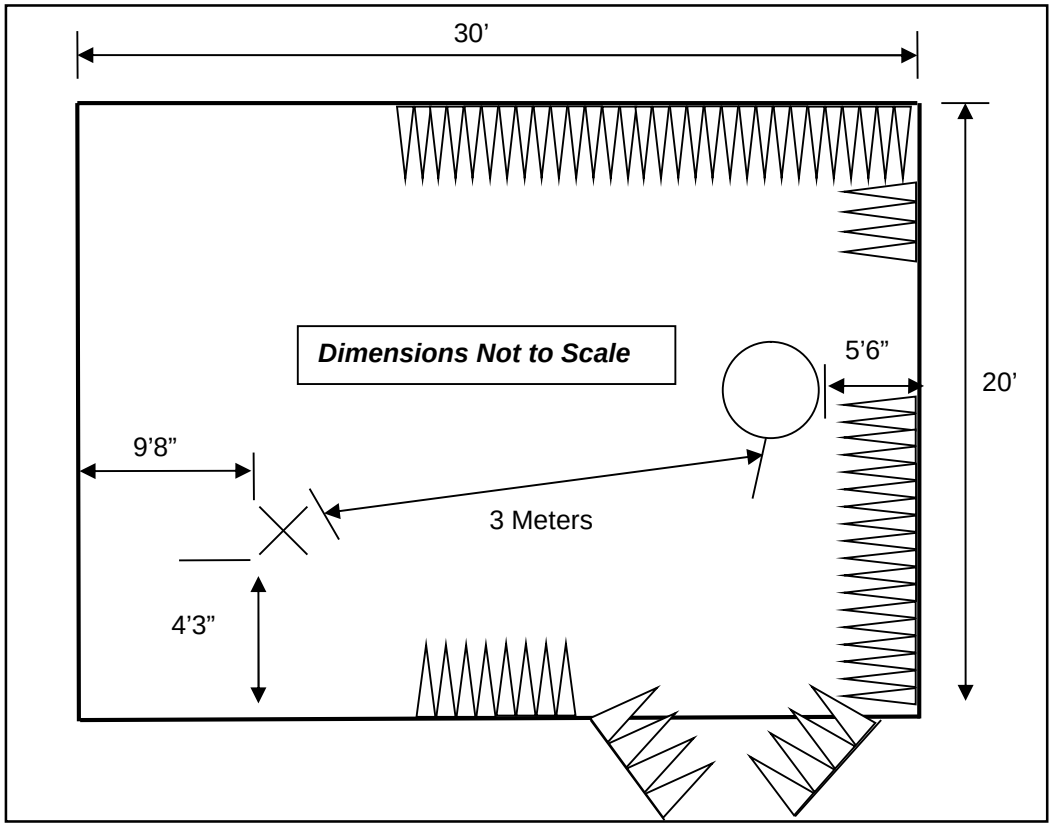

Figure 2.3-1: Semi-Anechoic Chamber Test Site – Chamber A

2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

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

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

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

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

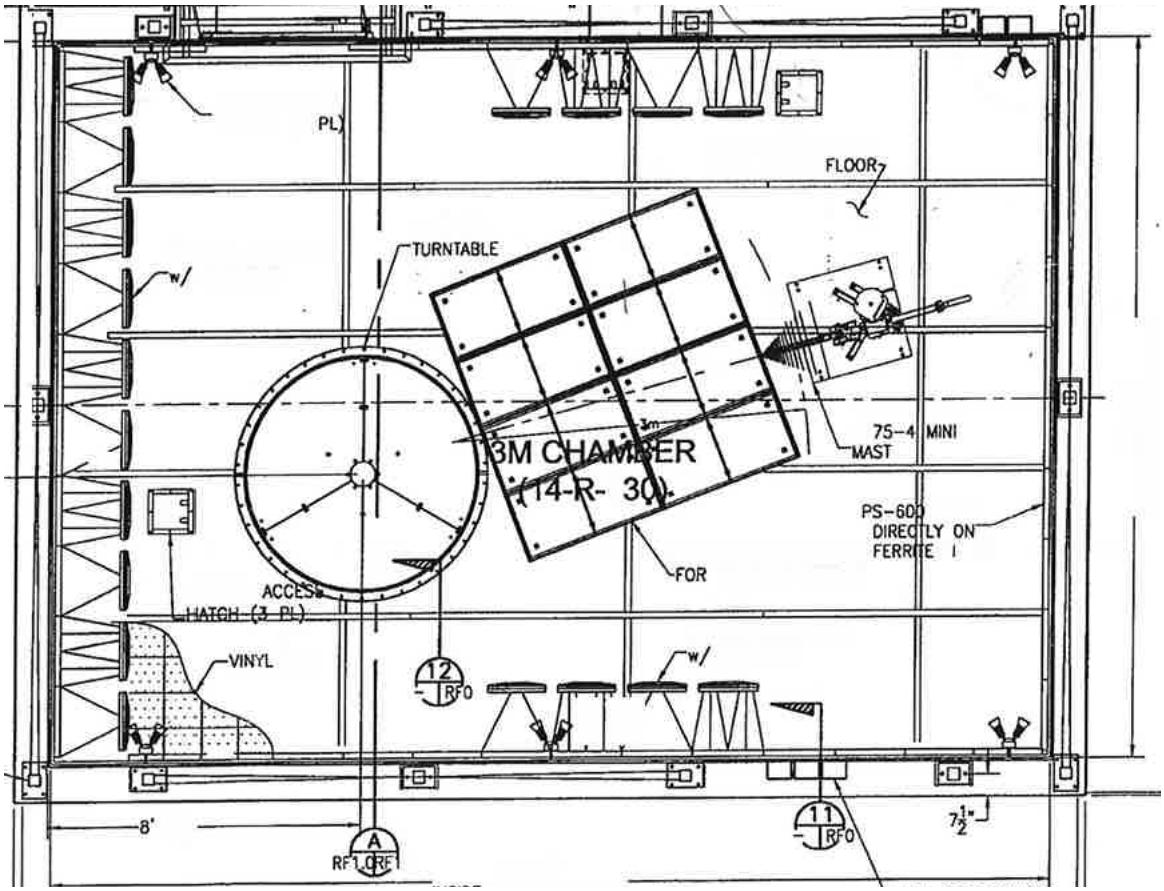

Figure 2.3-2: Semi-Anechoic Chamber Test Site – Chamber B

2.4 Conducted Emissions Test Site Description

2.4.1 Conducted Emissions Test Site

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

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

The site is of sufficient size to test tabletop and floor standing equipment in accordance with ANSI C63.10.

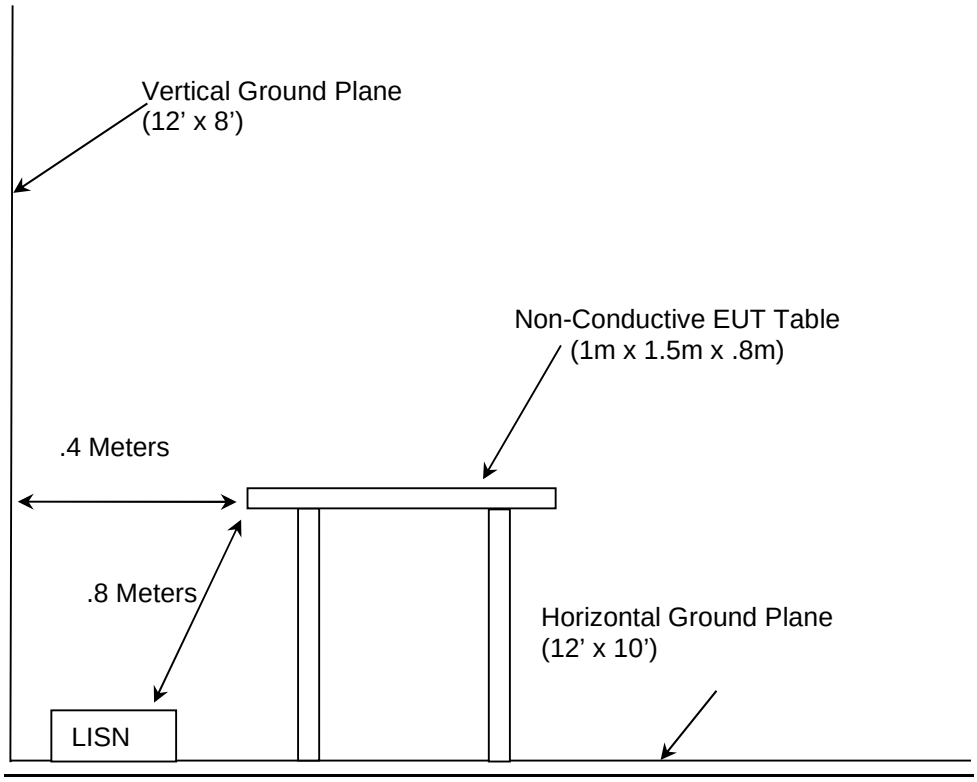

Figure 2.4.1-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- FCC KDB 558074 D01 DTS Meas Guidance v05r02 - Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The FCC Rules, April 2, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, March 2019, Amendment 1

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
267	Hewlett Packard	N1911A	Power Meter	MY45100129	07/26/2019	07/26/2021
268	Hewlett Packard	N1921A	Power Sensor	MY45240184	07/26/2019	07/26/2021
321	Hewlett Packard	HPC 8447D	Low Freq. Pre-Amp	1937A02809	09/12/2019	09/12/2020
324	ACS	Belden	Conducted EMI Cable	8214	03/19/2019	03/19/2020
329	A.H.Systems	SAS-571	Horn Antenna	721	08/27/2019	08/27/2021
331	Microwave Circuits	H1G513G1	Microwave Bandpass Filter	31417	05/31/2019	05/31/2020
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	07/15/2019	07/15/2021
340	Aeroflex/Weinschel	AS-20	Attenuator	7136	07/10/2019	07/10/2020
340	Aeroflex/Weinschel	AS-20	Attenuator	7136	06/23/2020	06/23/2021
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	07/30/2018	07/30/2020
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	02/11/2019	02/11/2021
813	PMM	9010	EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz	697WW30606	03/03/2020	03/03/2021
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	05/11/2020	05/11/2021
853	Teseq	CBL 6112D; 6804.17.A	Bilog Antenna; Attenuator	51616; 20181110A	10/15/2018	10/15/2020
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	07/10/2019	07/10/2020
RE880	Rhode & Schwarz USA	ESW44	Test Receiver	1206247	11/06/2019	11/06/2020

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

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	Wall Wart Power Supply	CUI Inc.	SWI24-12-N	N/A

Table 5-2: Cable Description

Item	Cable Type	Length	Shield	Termination
A	U.FL Cable/RF cable	93cm	Yes	EUT – Antenna
B	DC Power Wires	180cm	No	Wall Wart Power Supply – Evaluation Board

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

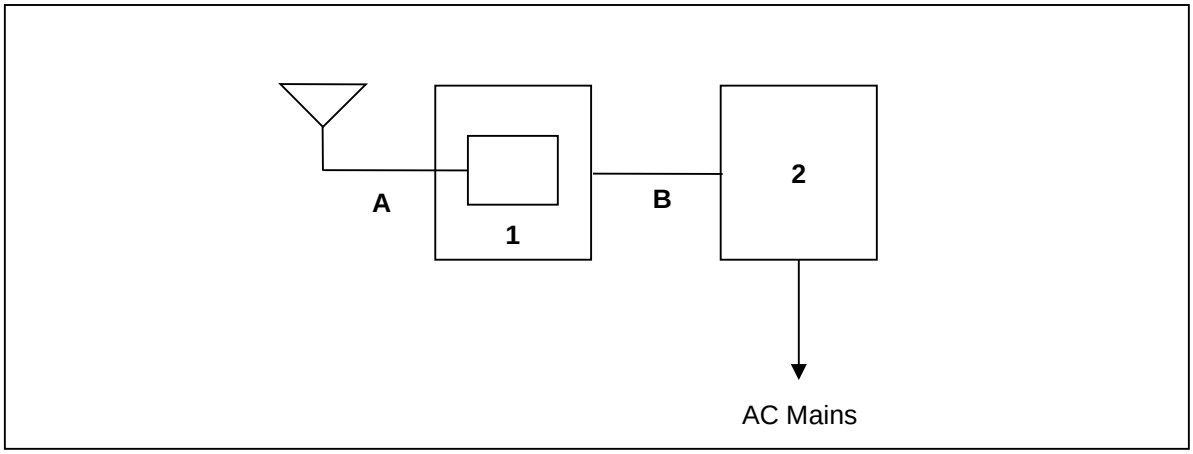

Figure 6-1: Test Setup Block Diagram

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: Section 15.203

The external antenna is an Airgain ET960NPMR2 Rigid Dipole Antenna with 5.7dBi 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 section 6 was the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Corrected Reading – Applicable Limit

7.2.2 Measurement Results

Performed by: Tyler Leeson

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.15	42.71	22.36	66.00	56.00	23.3	33.6	9.60
0.1805372	37.70	19.43	64.46	54.46	26.8	35.0	9.57
0.3291	29.88	17.86	59.47	49.47	29.6	31.6	9.62
0.4508494	27.01	18.06	56.86	46.86	29.9	28.8	9.65
11.94075	25.68	17.90	60.00	50.00	34.3	32.1	9.92
17.38838	24.68	15.96	60.00	50.00	35.3	34.0	9.89

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Corrected Reading		Limit		Margin		
	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dBuV)	Average (dBuV)	Quasi-Peak (dB)	Average (dB)	Correction (dB)
0.17985	39.60	22.60	64.49	54.49	24.9	31.9	9.63
0.3138	30.15	18.27	59.87	49.87	29.7	31.6	9.63
0.4089	34.04	19.66	57.67	47.67	23.6	28.0	9.65
0.6169	23.45	16.72	56.00	46.00	32.6	29.3	9.70
12.00045	25.08	15.71	60.00	50.00	34.9	34.3	9.88
17.52456	25.95	15.72	60.00	50.00	34.1	34.3	9.88

7.3 Peak Output Power – FCC: Section 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. The device employs >50 channels therefore the power is limited to 1 Watt. All data rates were evaluated.

7.3.2 Measurement Results

Performed by: Chris Gormley

Table 7.3.2-1: RF Output Power

Frequency [MHz]	Peak Output Power (dBm)	Data Rate (kbps)	Mode(s)
902.3	29.82	9.6	1 / 2
902.3	29.83	19.2	1 / 2
902.3	29.86	38.4	1 / 2
902.4	29.81	50.0	3
902.3	29.89	115.2	1
902.4	29.74	150.0	3
902.4	29.76	200.0	3
915.0	29.50	9.6	1 / 2
915.0	29.51	19.2	1 / 2
915.0	29.49	38.4	1 / 2
915.2	29.33	50.0	3
915.0	29.50	115.2	1
915.2	29.33	150.0	3
915.2	29.31	200.0	3
927.8	28.48	9.6	1 / 2
927.8	28.48	19.2	1 / 2
927.8	28.48	38.4	1 / 2
927.6	28.27	50.0	3
927.8	28.51	115.2	1
927.6	28.24	150.0	3
927.6	28.25	200.0	3

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 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 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

Performed by: Chris Gormley

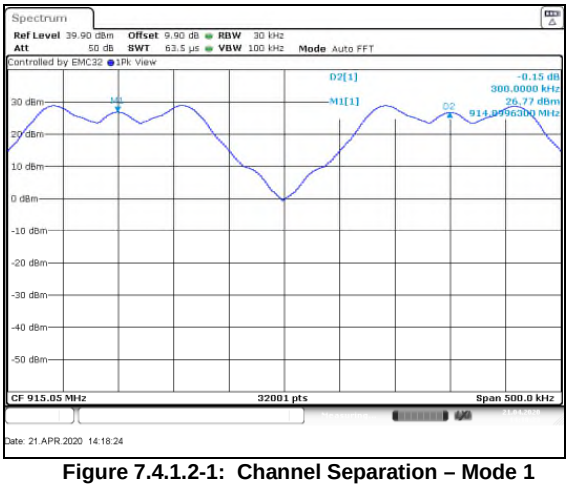

Figure 7.4.1.2-1: Channel Separation – Mode 1

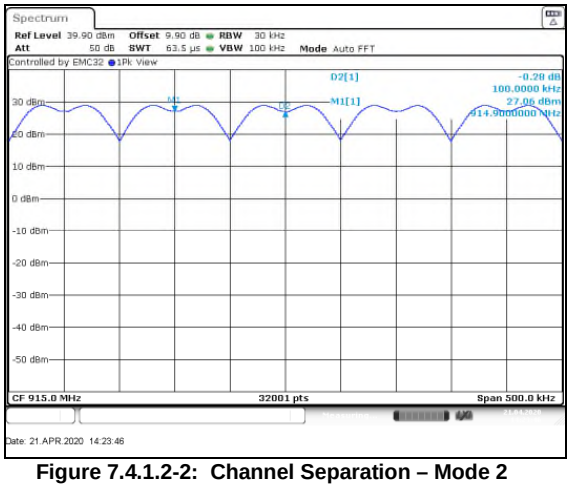

Figure 7.4.1.2-2: Channel Separation – Mode 2

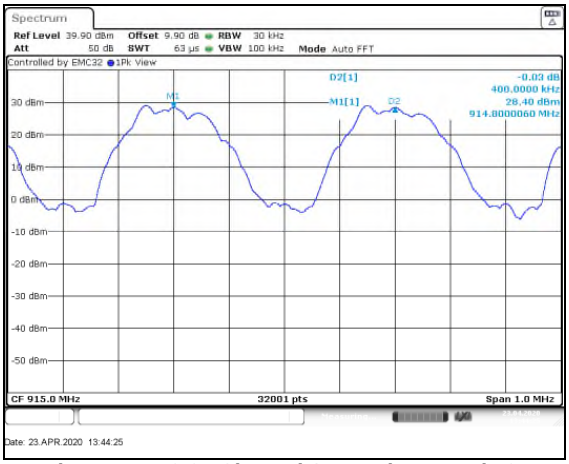

Figure 7.4.1.2-3: Channel Separation – Mode 3

7.4.2 Number of Hopping Channels – FCC: Section 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 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

Performed by: Chris Gormley, Ryan McGann

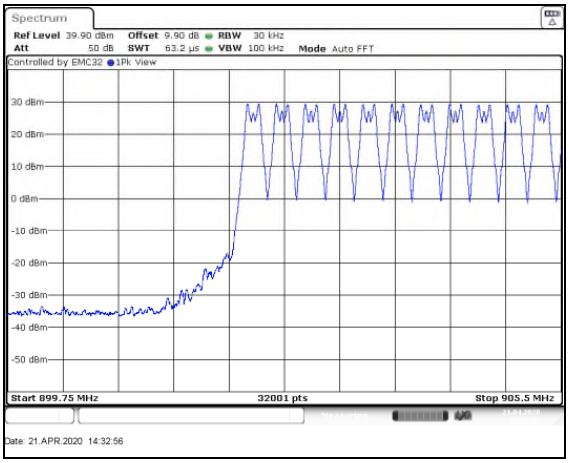

Figure 7.4.2.2-1: Mode 1 (86 Channels)

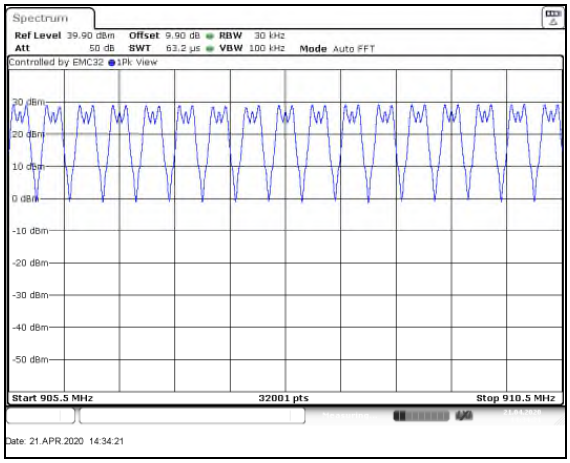

Figure 7.4.2.2-2: Mode 1 (86 Channels)

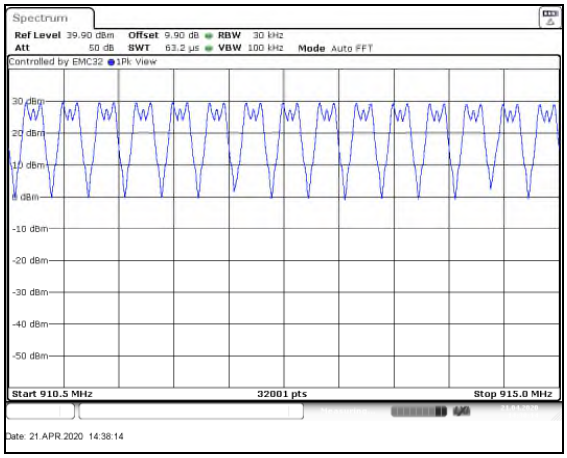

Figure 7.4.2.2-3: Mode 1 (86 Channels)

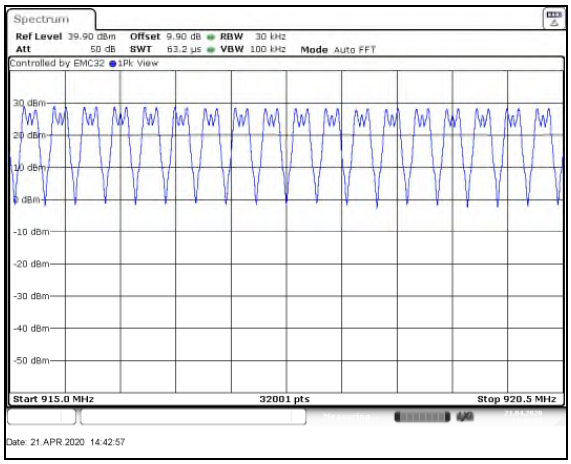

Figure 7.4.2.2-4: Mode 1 (86 Channels)

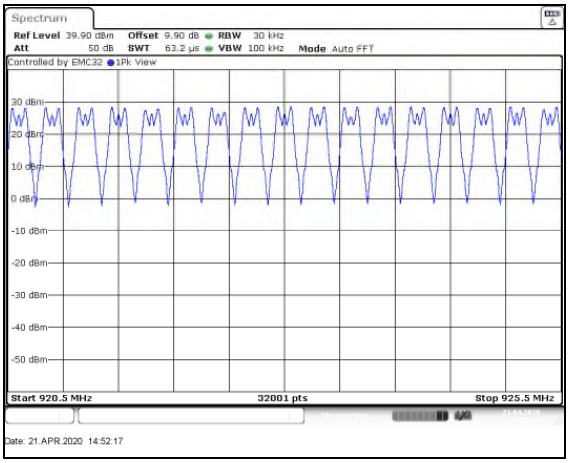

Figure 7.4.2.2-5: Mode 1 (86 Channels)

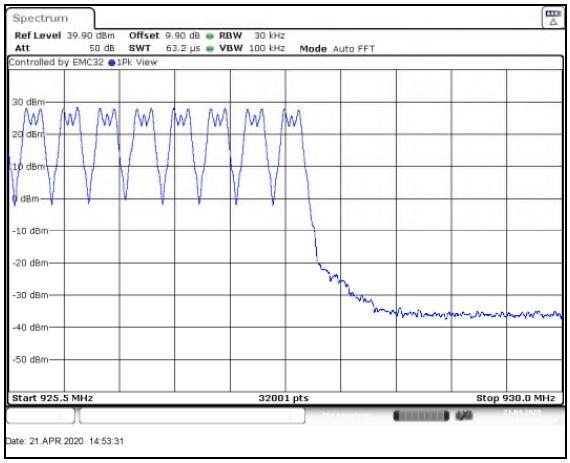

Figure 7.4.2.2-6: Mode 1 (86 Channels)

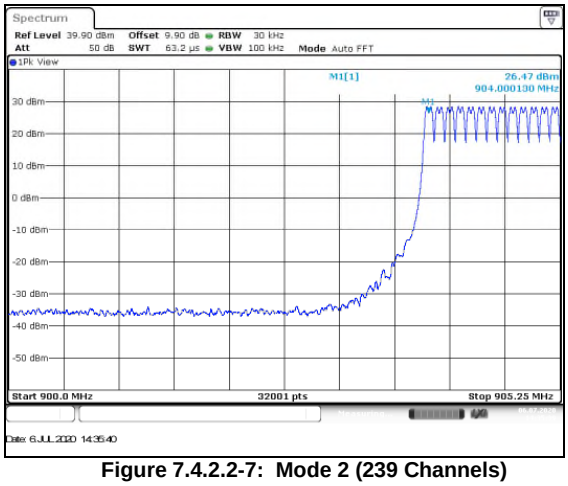

Figure 7.4.2.2-7: Mode 2 (239 Channels)

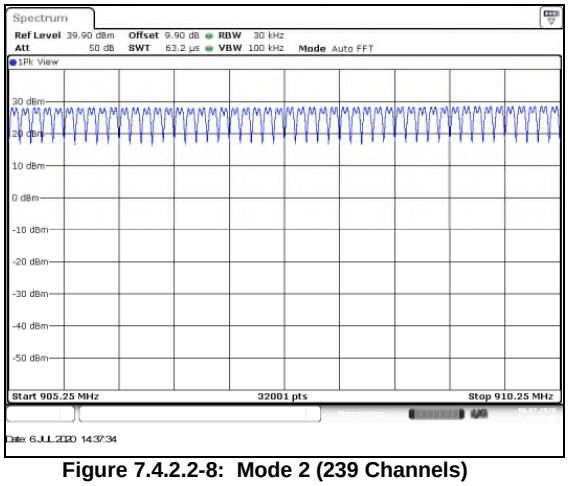

Figure 7.4.2.2-8: Mode 2 (239 Channels)

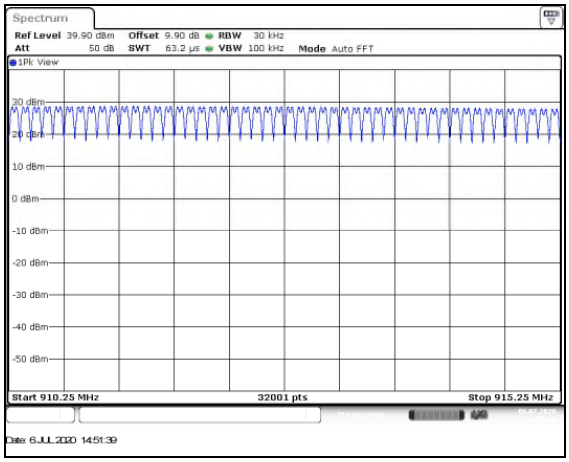

Figure 7.4.2.2-9: Mode 2 (239 Channels)

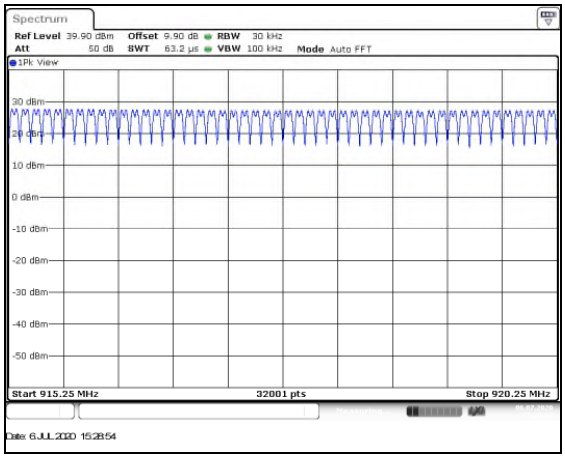

Figure 7.4.2.2-10: Mode 2 (239 Channels)

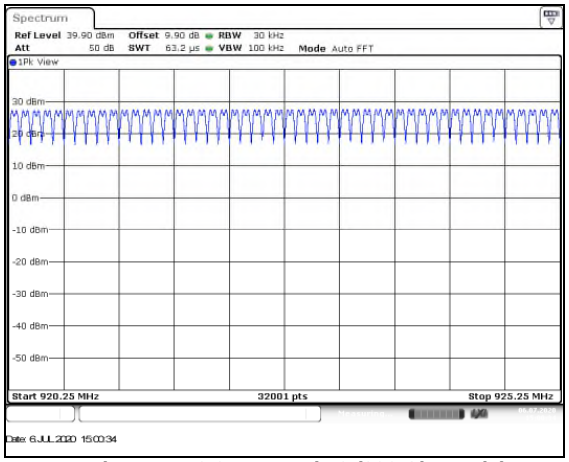

Figure 7.4.2.2-11: Mode 2 (239 Channels)

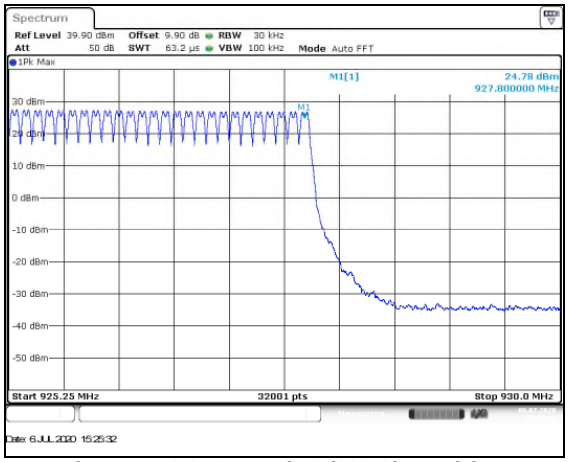

Figure 7.4.2.2-12: Mode 2 (239 Channels)

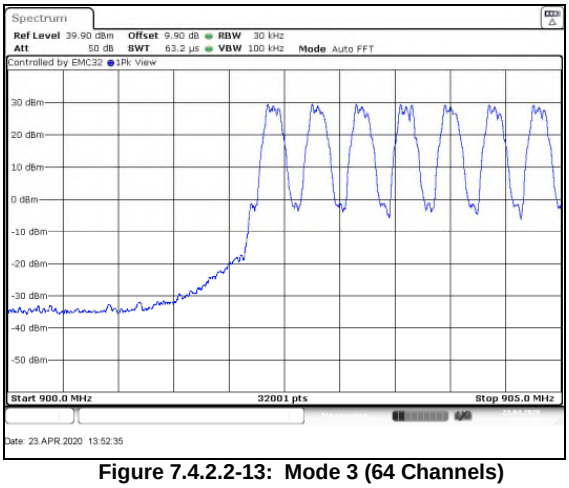

Figure 7.4.2.2-13: Mode 3 (64 Channels)

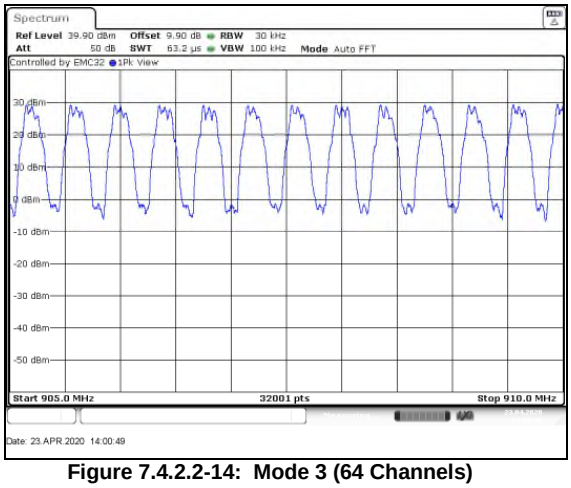

Figure 7.4.2.2-14: Mode 3 (64 Channels)

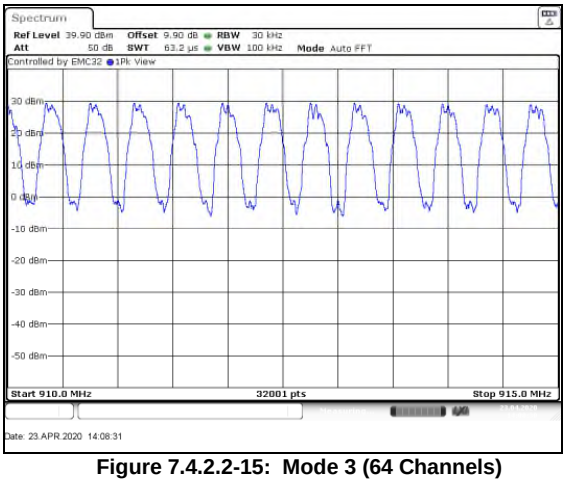

Figure 7.4.2.2-15: Mode 3 (64 Channels)

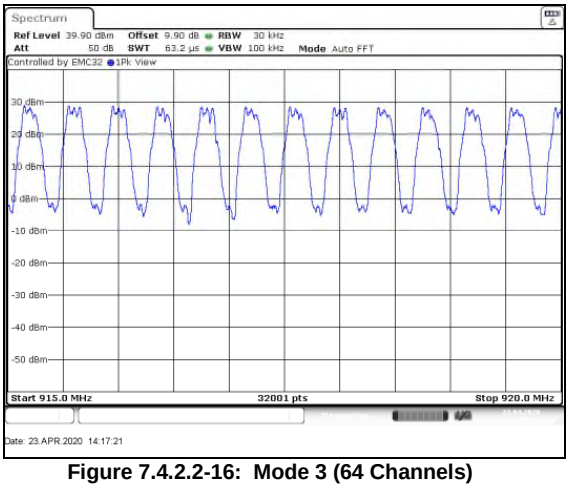

Figure 7.4.2.2-16: Mode 3 (64 Channels)

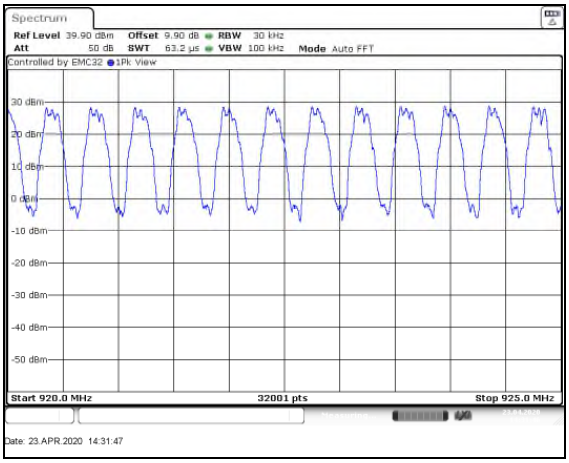

Figure 7.4.2.2-17: Mode 3 (64 Channels)

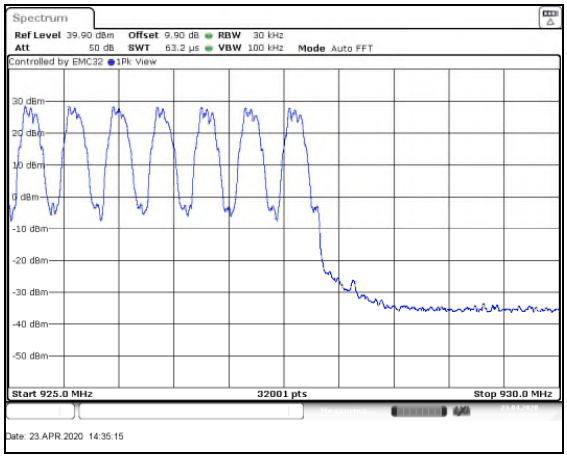

Figure 7.4.2.2-18: Mode 3 (64 Channels)

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

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.

7.4.4 20dB / 99% Bandwidth – FCC: Section 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 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

Performed by: Chris Gormley

Table 7.4.4.2-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]	Data Rate (kbps)	Mode(s)
902.3	21.5259	20.682	9.6	1 / 2
902.3	43.0627	43.227	19.2	1 / 2
902.3	86.95	86.052	38.4	1 / 2
902.4	104.778	107.747	50.0	3
902.3	219.063	207.415	115.2	1
902.4	155.198	152.886	150.0	3
902.4	205.212	202.337	200.0	3
915.0	21.5478	20.668	9.6	1 / 2
915.0	42.800	43.063	19.2	1 / 2
915.0	87.7941	86.232	38.4	1 / 2
915.2	104.996	111.012	50.0	3
915.0	218.759	205.330	115.2	1
915.2	155.214	152.605	150.0	3
915.2	205.228	202.494	200.0	3
927.8	21.6431	20.781	9.6	1 / 2
927.8	42.191	43.133	19.2	1 / 2
927.8	86.974	85.677	38.4	1 / 2
927.6	104.825	107.809	50.0	3
927.8	219.649	205.915	115.2	1
927.6	155.167	152.230	150.0	3
927.6	205.056	202.416	200.0	3

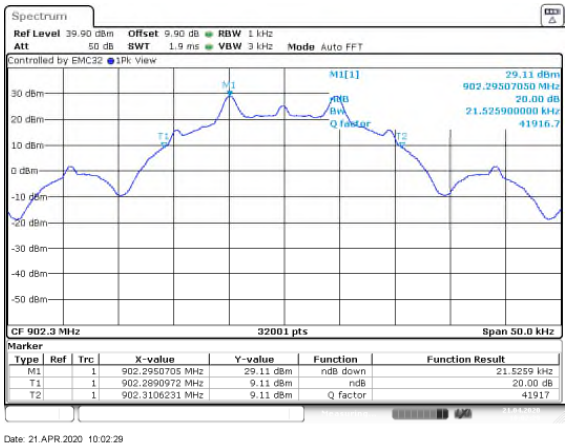

Figure 7.4.4.2-1: 20dB BW Low Channel - 9.6kbps

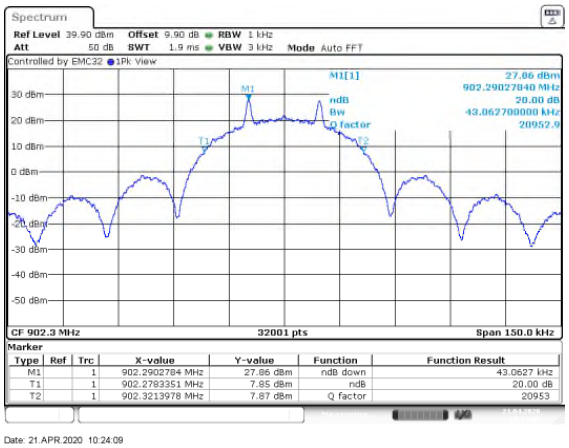

Figure 7.4.4.2-2: 20dB BW Low Channel – 19.2kbps

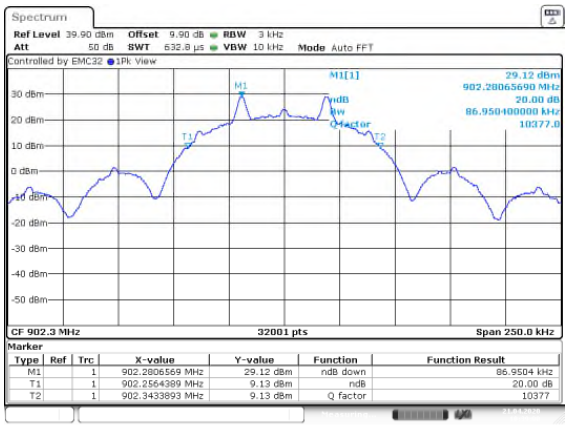

Figure 7.4.4.2-3: 20dB BW Low Channel – 38.4kbps

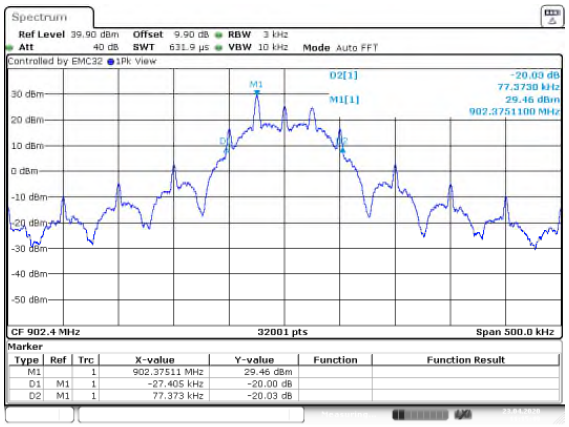

Figure 7.4.4.2-4: 20dB BW Low Channel – 50.0kbps

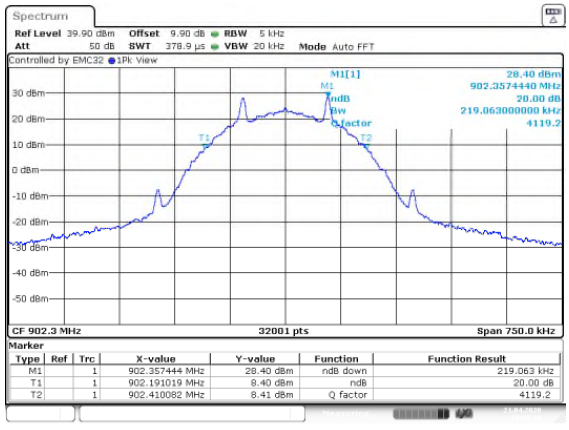

Figure 7.4.4.2-5: 20dB BW Low Channel – 115.2kbps

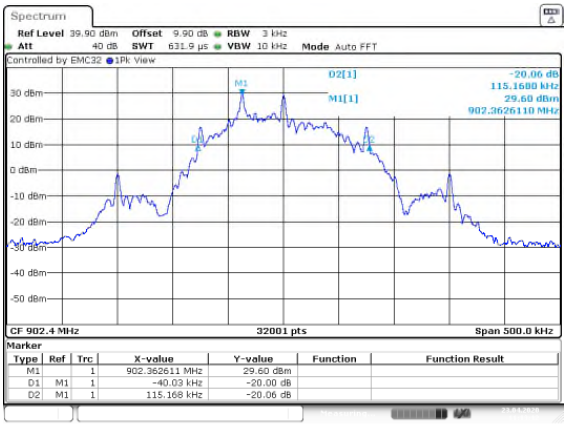

Figure 7.4.4.2-6: 20dB BW Low Channel – 150.0kbps

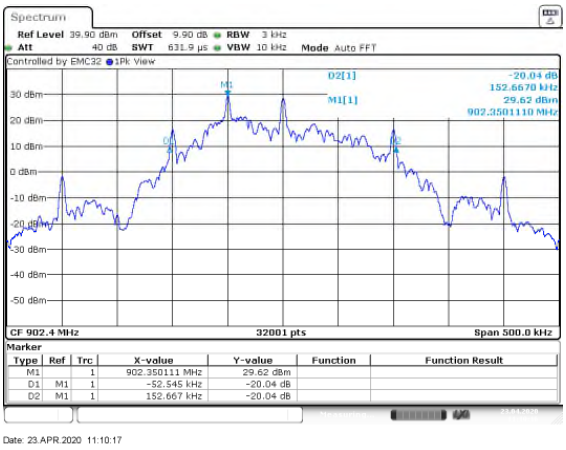

Figure 7.4.4.2-7: 20dB BW Low Channel – 200.0kbps

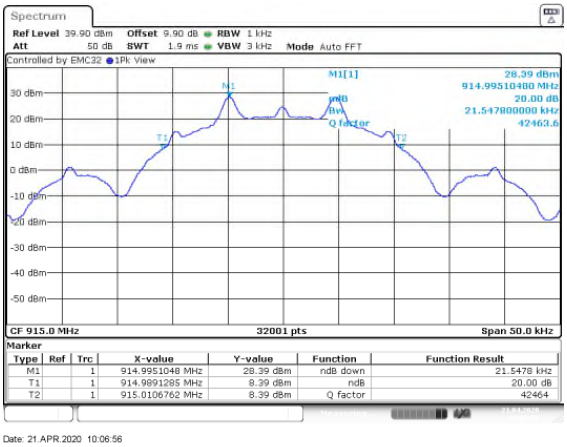

Figure 7.4.4.2-8: 20dB BW Mid Channel – 9.6kbps

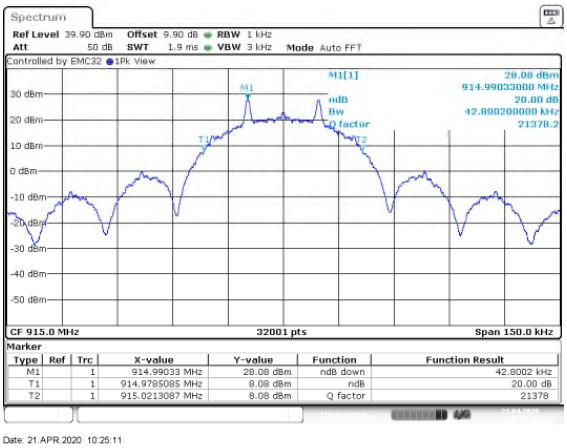

Figure 7.4.4.2-9: 20dB BW Mid Channel – 19.2kbps

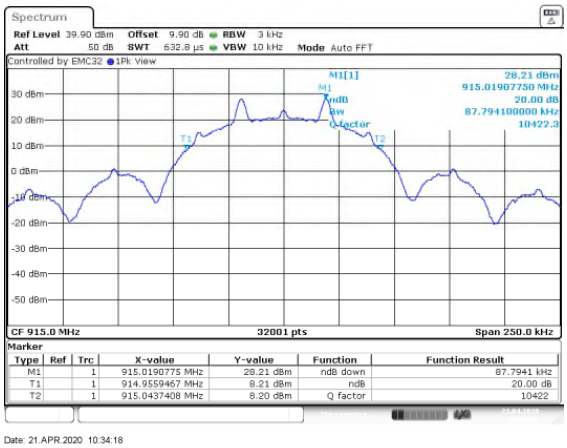

Figure 7.4.4.2-10: 20dB BW Mid Channel – 38.4kbps

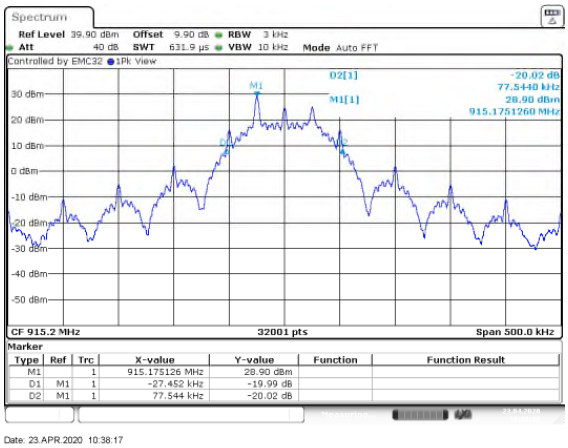

Figure 7.4.4.2-11: 20dB BW Mid Channel – 50kbps

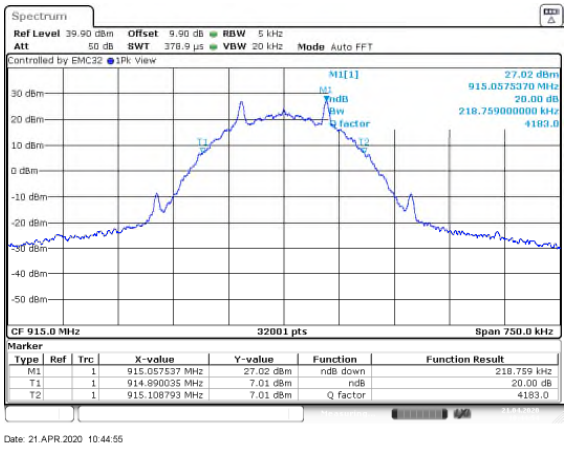

Figure 7.4.4.2-12: 20dB BW Mid Channel – 115.2kbps

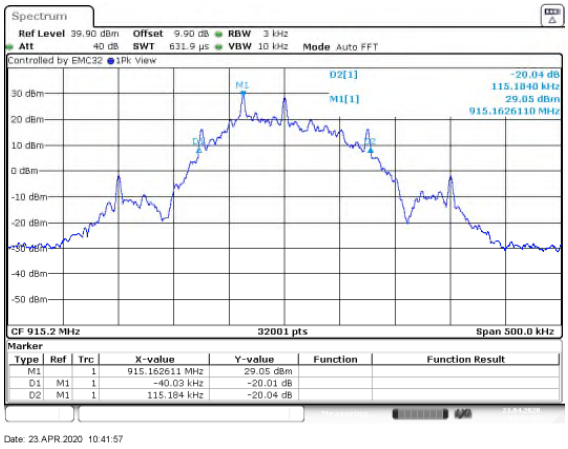

Figure 7.4.4.2-13: 20dB BW Mid Channel – 150kbps

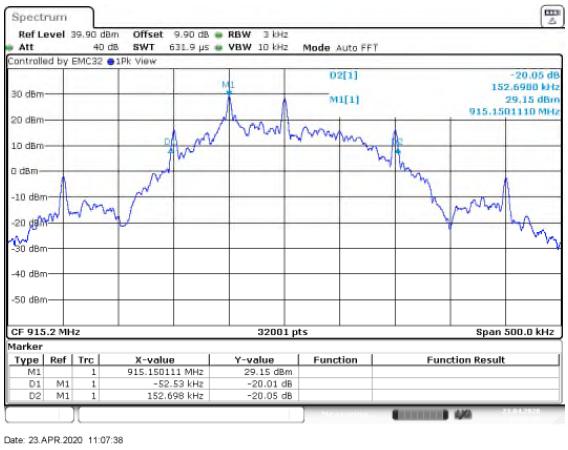

Figure 7.4.4.2-14: 20dB BW Mid Channel – 200kbps

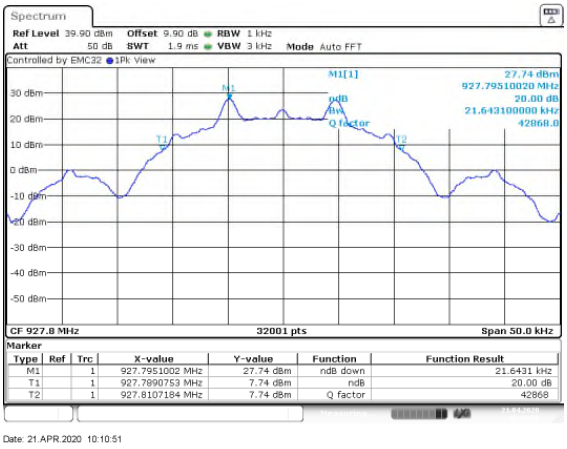

Figure 7.4.4.2-15: 20dB BW High Channel - 9.6kbps

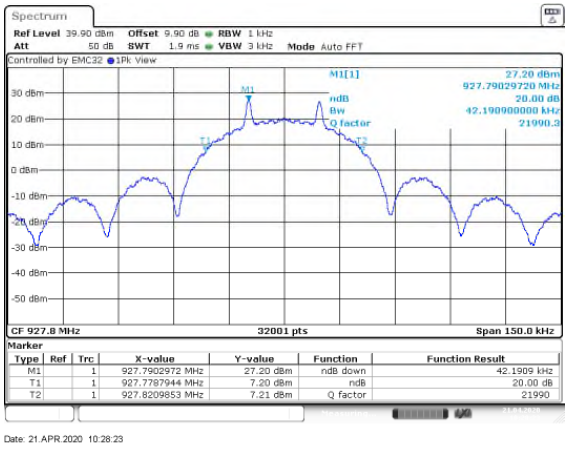

Figure 7.4.4.2-16: 20dB BW High Channel – 19.2kbps

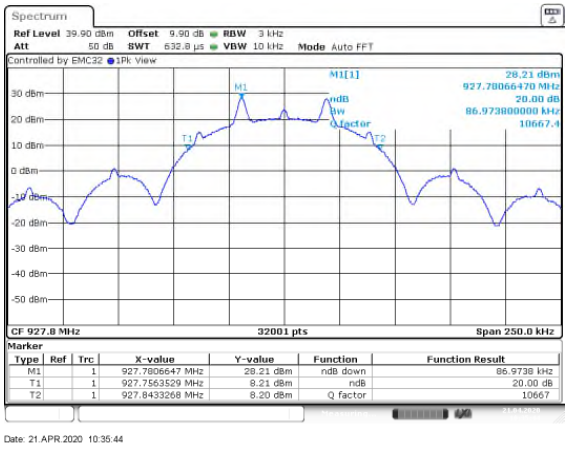

Figure 7.4.4.2-17: 20dB BW High Channel – 38.4kbps

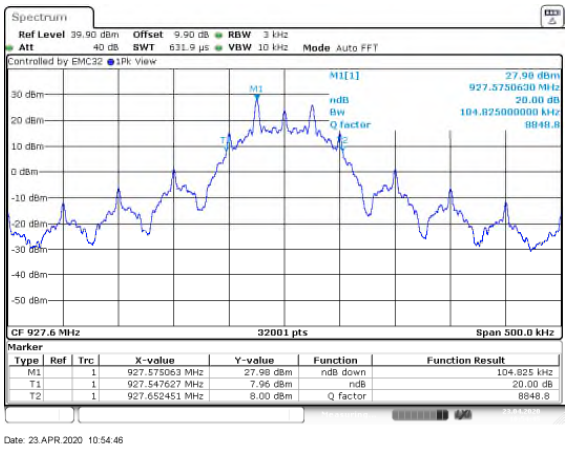

Figure 7.4.4.2-18: 20dB BW High Channel – 50.0kbps

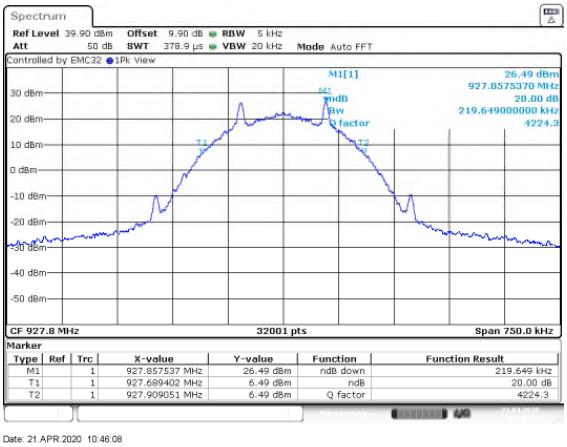

Figure 7.4.4.2-19: 20dB BW High Channel – 115.2kbps

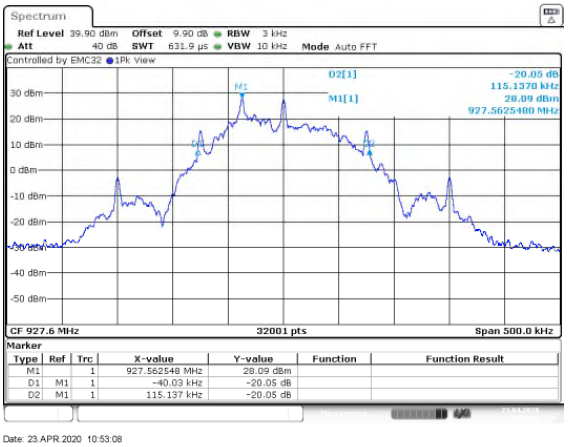

Figure 7.4.4.2-20: 20dB BW High Channel – 150.0kbps

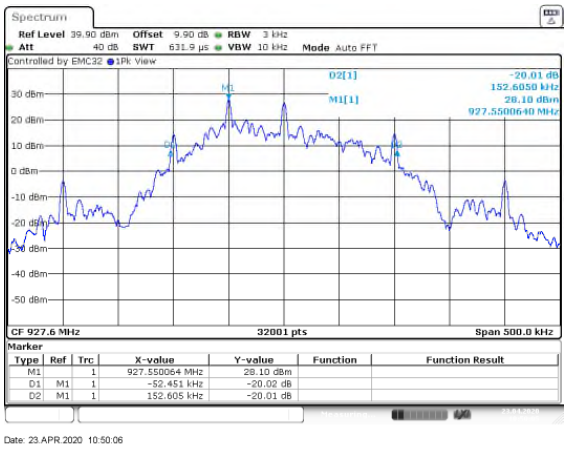

Figure 7.4.4.2-21: 20dB BW High Channel – 200kbps

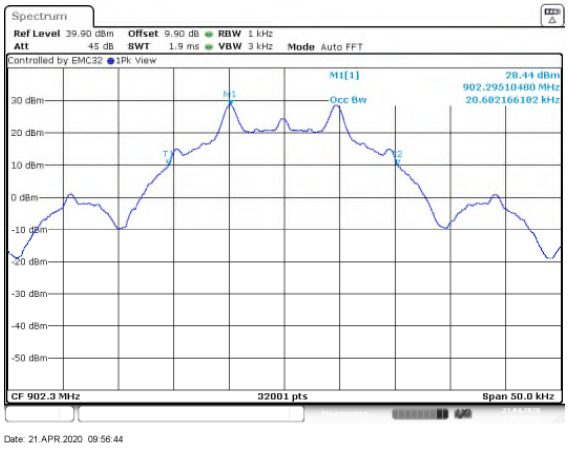

Figure 7.4.4.2-22: 99% BW Low Channel - 9.6kbps

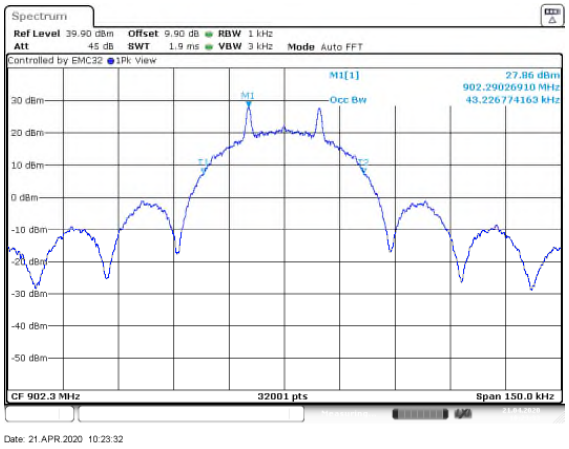

Figure 7.4.4.2-23: 99% BW Low Channel – 19.2kbps

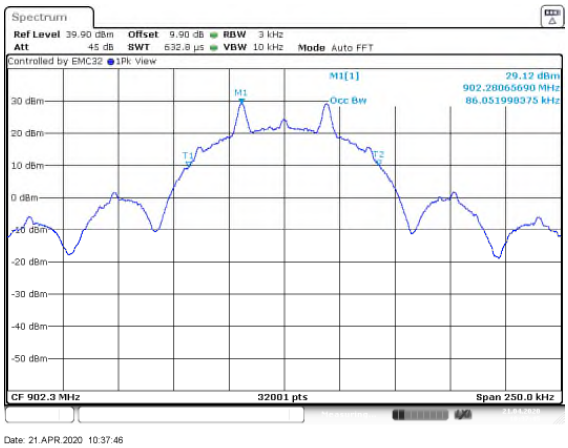

Figure 7.4.4.2-24: 99% BW Low Channel – 38.4kbps

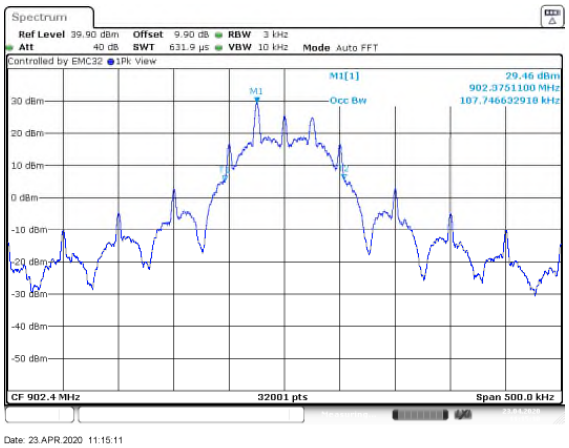

Figure 7.4.4.2-25: 99% BW Low Channel – 50.0kbps

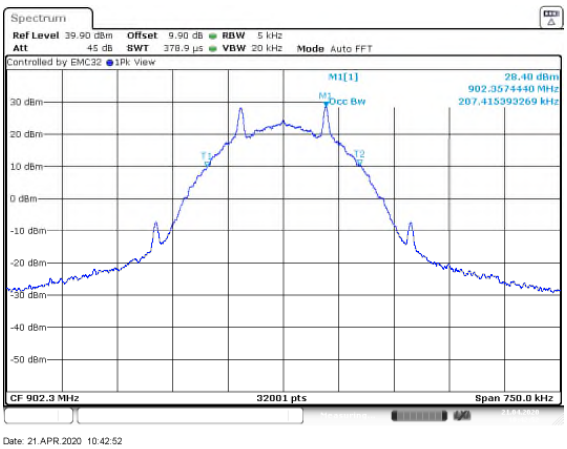

Figure 7.4.4.2-26: 99% BW Low Channel – 115.2kbps

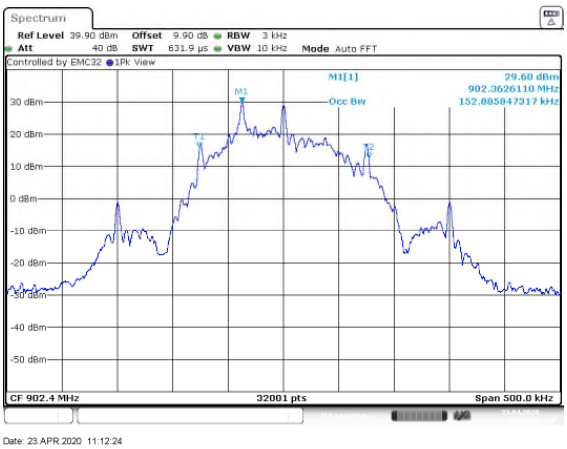

Figure 7.4.4.2-27: 99% BW Low Channel – 150kbps

Figure 7.4.4.2-28: 99% BW Low Channel – 200kbps

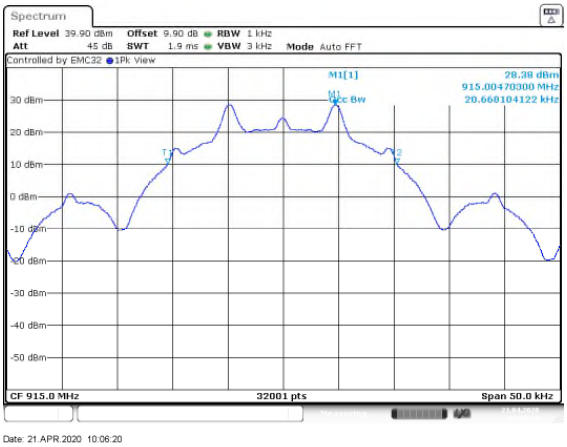

Figure 7.4.4.2-29: 99% BW Mid Channel - 9.6kbps

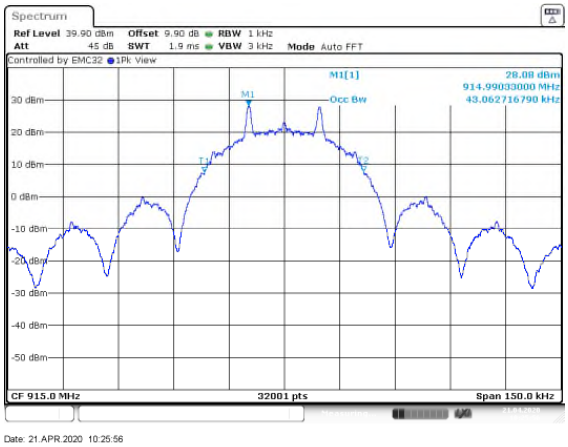

Figure 7.4.4.2-30: 99% BW Mid Channel – 19.2kbps

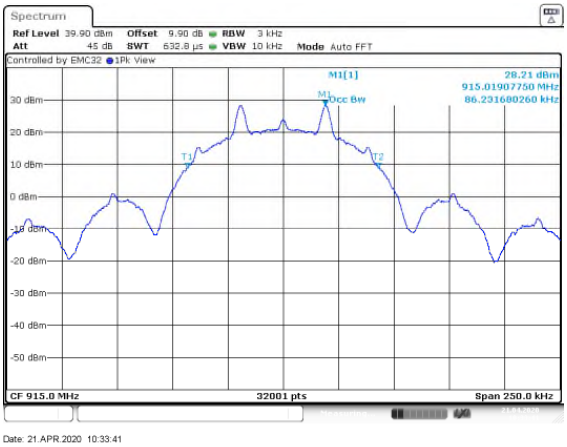

Figure 7.4.4.2-31: 99% BW Mid Channel – 38.4kbps

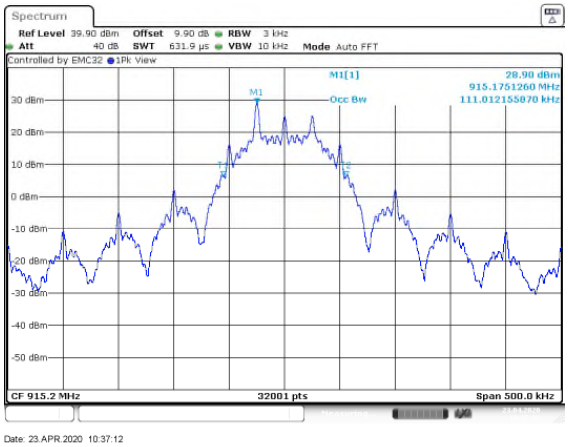

Figure 7.4.4.2-32: 99% BW Mid Channel – 50.0kbps

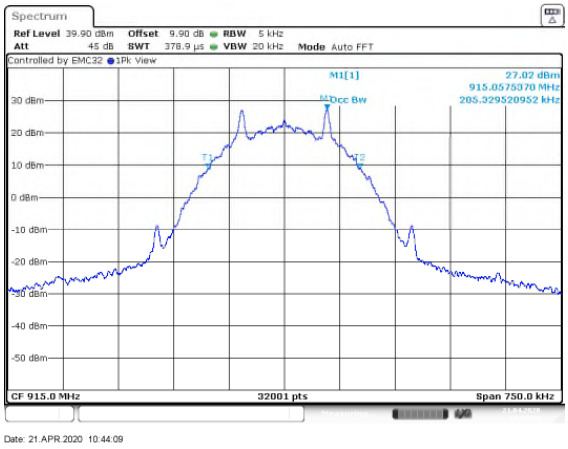

Figure 7.4.4.2-33: 99% BW Mid Channel – 115.2kbps

Figure 7.4.4.2-34: 99% BW Mid Channel – 150kbps

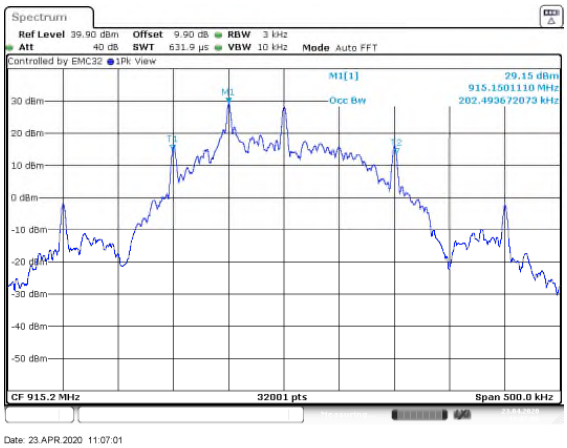

Figure 7.4.4.2-35: 99% BW Mid Channel – 200kbps

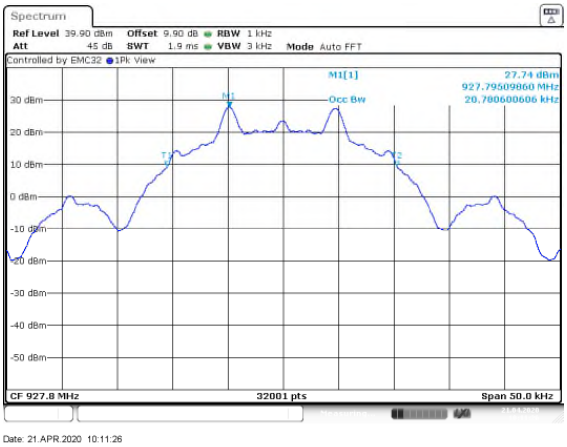

Figure 7.4.4.2-36: 99% BW High Channel - 9.6kbps

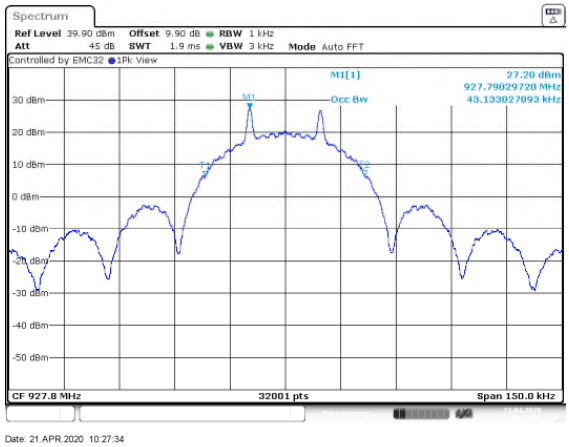

Figure 7.4.4.2-37: 99% BW High Channel – 19.2kbps

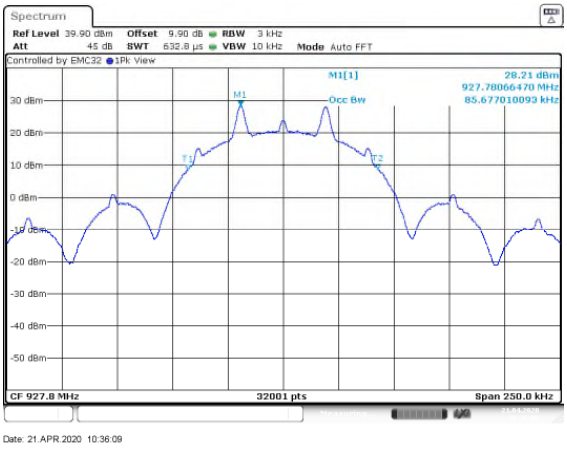

Figure 7.4.4.2-38: 99% BW High Channel – 38.4kbps

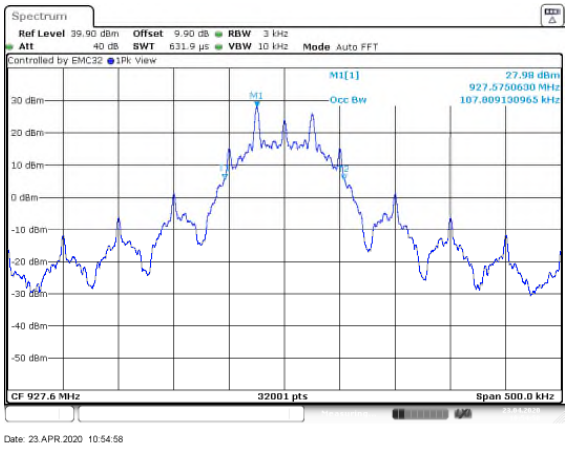

Figure 7.4.4.2-39: 99% BW High Channel – 50.0kbps

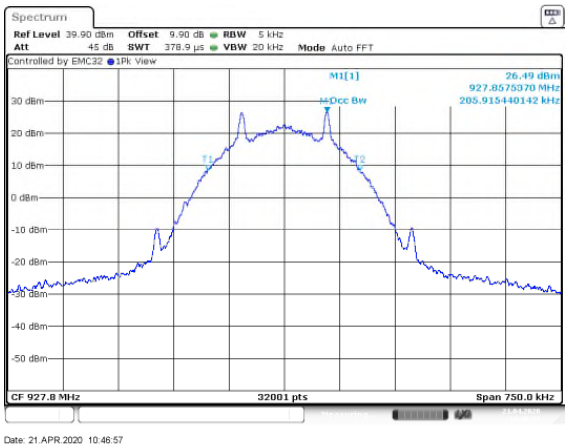

Figure 7.4.4.2-40: 99% BW High Channel – 115.2kbps

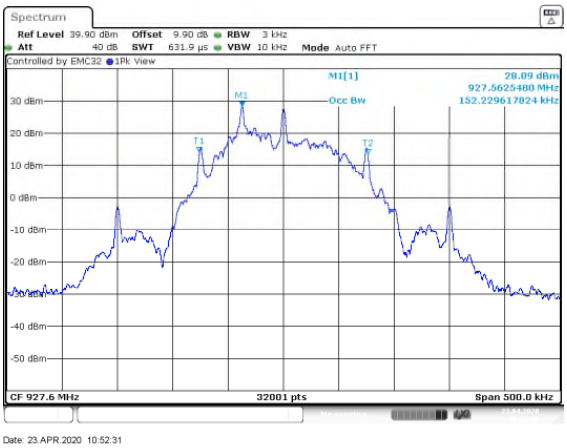

Figure 7.4.4.2-41: 99% BW High Channel – 150kbps

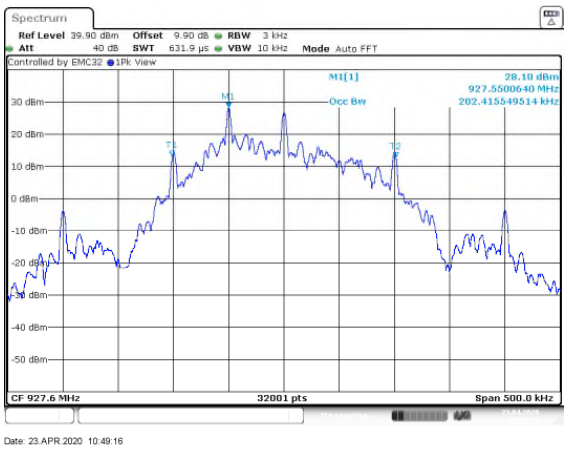

Figure 7.4.4.2-42: 99% BW High Channel – 200kbps

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, and 200.0kbps in Mode 3.

7.5.1.2 Measurement Results

Performed by: Chris Gormley

NON-HOPPING MODE:

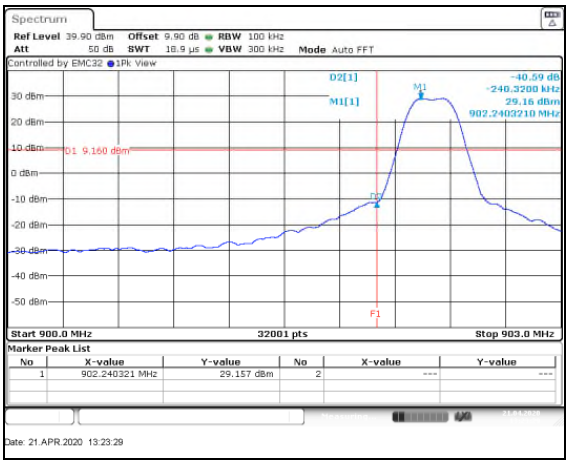

Figure 7.5.1.2-1: Lower Band-edge – Mode 1

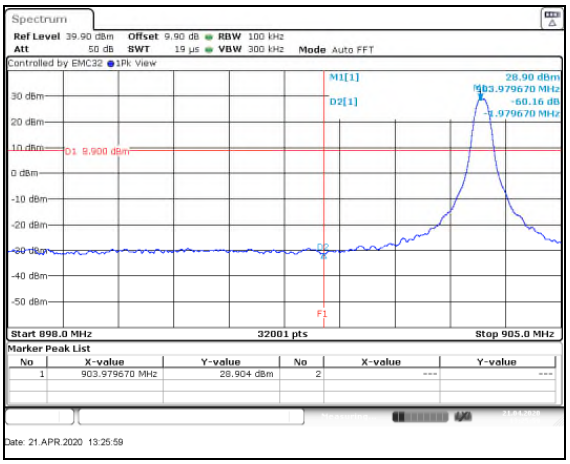

Figure 7.5.1.2-2: Lower Band-edge – Mode 2

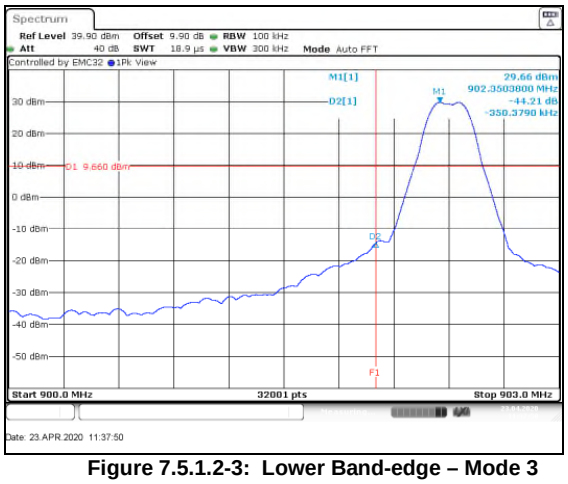

Figure 7.5.1.2-3: Lower Band-edge – Mode 3

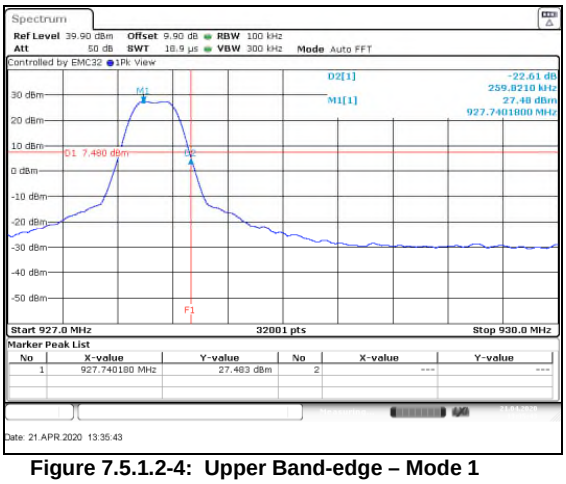

Figure 7.5.1.2-4: Upper Band-edge – Mode 1

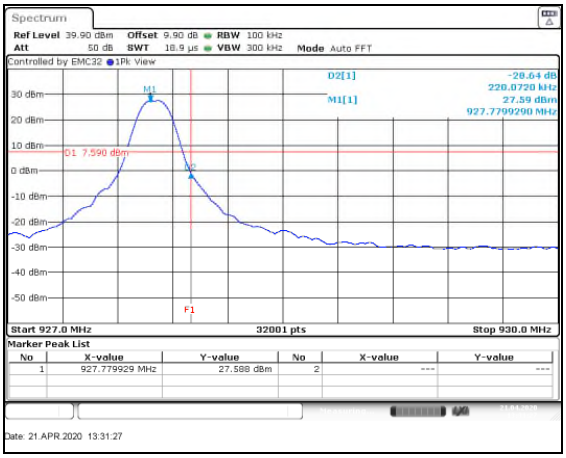

Figure 7.5.1.2-5: Upper Band-edge – Mode 2

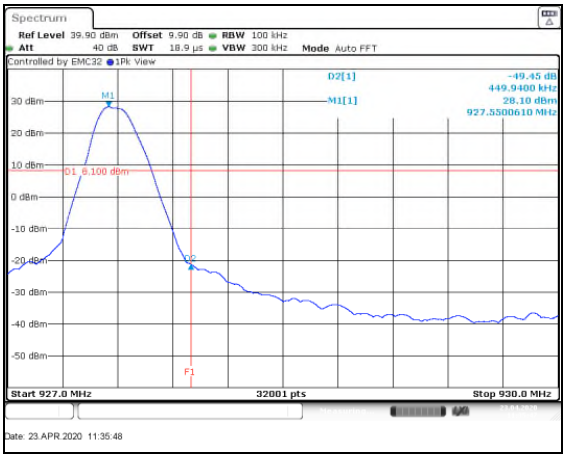

Figure 7.5.1.2-6: Upper Band-edge – Mode 3

HOPPING MODE:

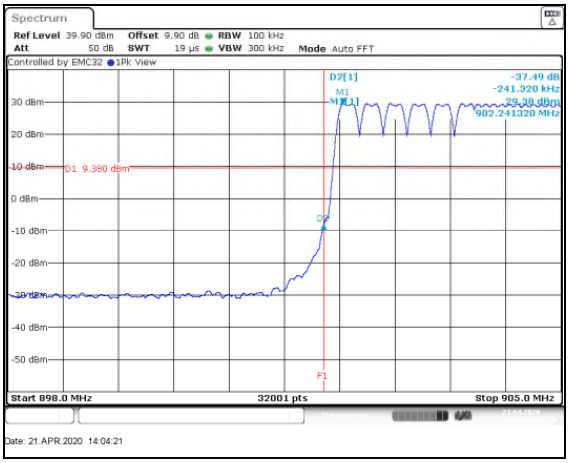

Figure 7.5.1.2-7: Lower Band-edge – Mode 1

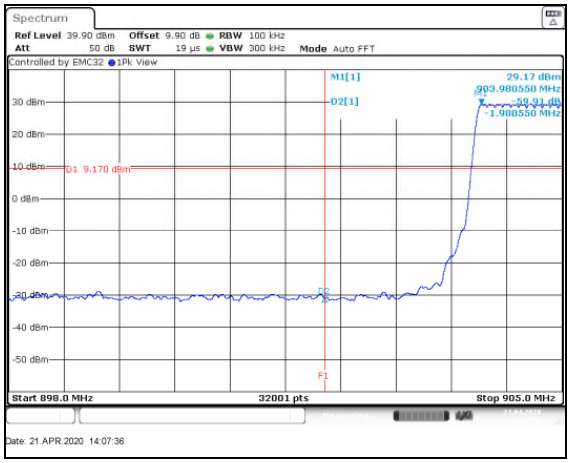

Figure 7.5.1.2-8: Lower Band-edge – Mode 2

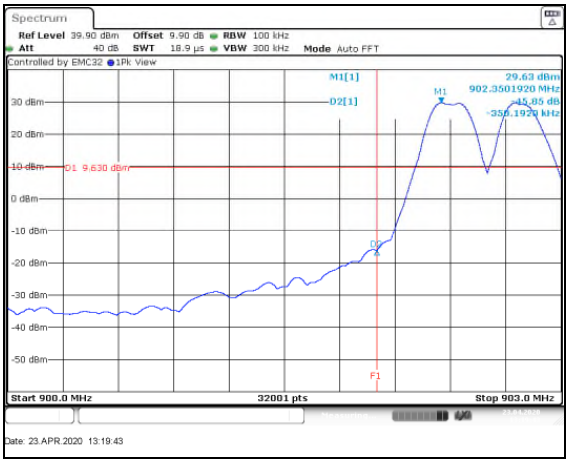

Figure 7.5.1.2-9: Lower Band-edge – Mode 3

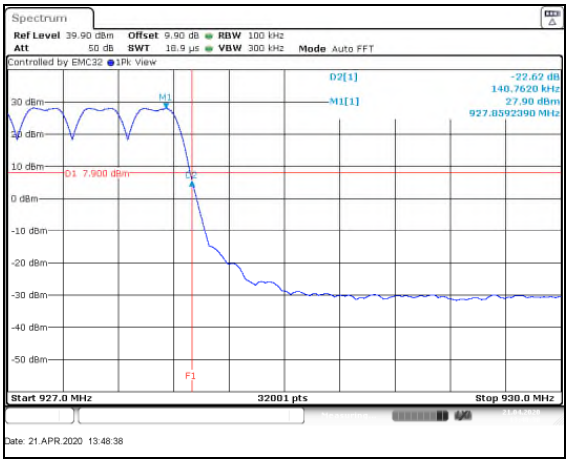

Figure 7.5.1.2-10: Upper Band-edge – Mode 1

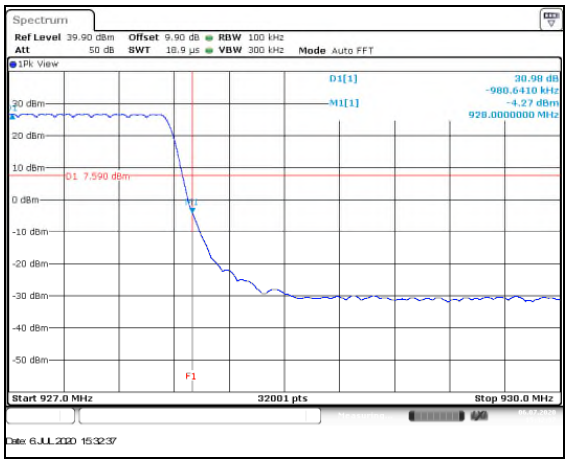

Figure 7.5.1.2-11: Upper Band-edge – Mode 2

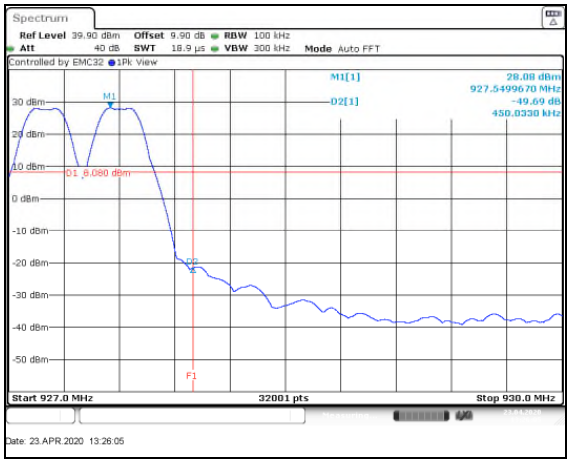

Figure 7.5.1.2-12: Upper Band-edge – Mode 3

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

Performed by: Chris Gormley

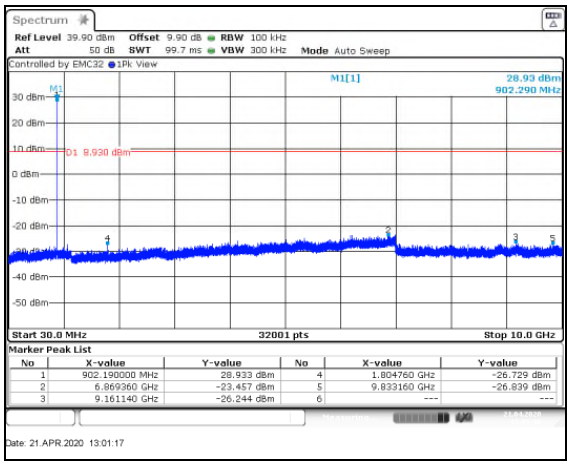

Figure 7.5.2.2-1: 30 MHz – 10 GHz – Low Channel

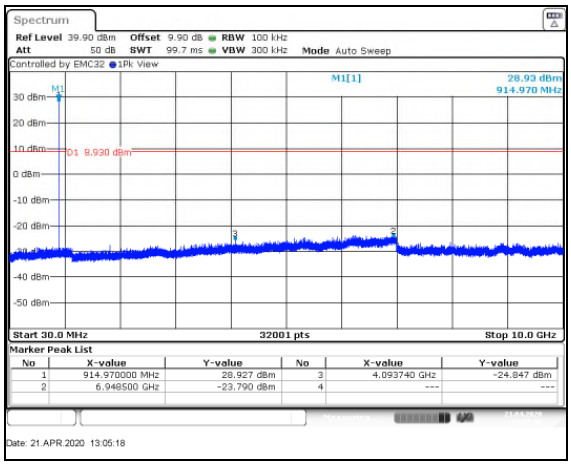

Figure 7.5.2.2-2: 30 MHz – 10 GHz – Mid Channel

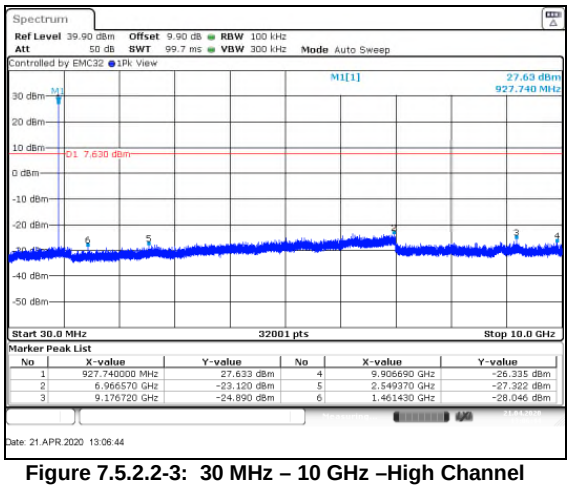

Figure 7.5.2.2-3: 30 MHz – 10 GHz –High Channel

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 meters 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

Performed by: Art Sumner, Chris Gormley

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										
1025.35	60.40	47.00	V	-13.03	47.37	33.97	74.0	54.0	26.6	20.0
2706.9	54.60	45.80	H	-2.30	52.30	43.50	74.0	54.0	21.7	10.5
2706.9	53.10	40.30	V	-2.30	50.80	38.00	74.0	54.0	23.2	16.0
3609.2	54.90	44.50	H	-0.33	54.57	44.17	74.0	54.0	19.4	9.8
3609.2	53.10	39.00	V	-0.33	52.77	38.67	74.0	54.0	21.2	15.3
4511.5	55.60	47.10	H	2.41	58.01	49.51	74.0	54.0	16.0	4.5
4511.5	53.70	42.80	V	2.41	56.11	45.21	74.0	54.0	17.9	8.8
5413.8	54.80	46.60	H	4.50	59.30	51.10	74.0	54.0	14.7	2.9
5413.8	53.00	42.30	V	4.50	57.50	46.80	74.0	54.0	16.5	7.2
Middle Channel										
1036.71	58.50	45.90	V	-12.95	45.55	32.95	74.0	54.0	28.4	21.0
2745	54.50	43.70	H	-2.06	52.44	41.64	74.0	54.0	21.6	12.4
2745	52.90	40.60	V	-2.06	50.84	38.54	74.0	54.0	23.2	15.5
3660	54.20	43.60	H	0.00	54.20	43.60	74.0	54.0	19.8	10.4
3660	53.40	40.50	V	0.00	53.40	40.50	74.0	54.0	20.6	13.5
4575	62.30	48.10	H	2.66	64.96	50.76	74.0	54.0	9.0	3.2
4575	58.30	45.70	V	2.66	60.96	48.36	74.0	54.0	13.0	5.6
High Channel										
1038.51	56.60	43.00	V	-12.93	43.67	30.07	74.0	54.0	30.3	23.9
2783.4	56.00	47.90	H	-1.82	54.18	46.08	74.0	54.0	19.8	7.9
2783.4	54.00	42.60	V	-1.82	52.18	40.78	74.0	54.0	21.8	13.2
3711.2	54.90	44.50	H	0.34	55.24	44.84	74.0	54.0	18.8	9.2
3711.2	52.80	39.60	V	0.34	53.14	39.94	74.0	54.0	20.9	14.1
4639	55.80	49.00	H	2.91	58.71	51.91	74.0	54.0	15.3	2.1
4639	53.90	45.00	V	2.91	56.81	47.91	74.0	54.0	17.2	6.1

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: 55.80 + 2.91 = 58.71dBuV/m
Margin: 74dBuV/m – 58.71dBuV/m = 15.3dB

Example Calculation: Average

Corrected Level: 49.00 - 2.91 - 0 = 51.91dBuV
Margin: 54dBuV – 51.91dBuV = 2.1dB

8 ESTIMATION OF MEASUREMENT UNCERTAINTY

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

Table 8-1: Estimation of Measurement Uncertainty

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

9 CONCLUSION

In the opinion of TÜV SÜD America, Inc. the N501, 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.

Appendix A: Plots

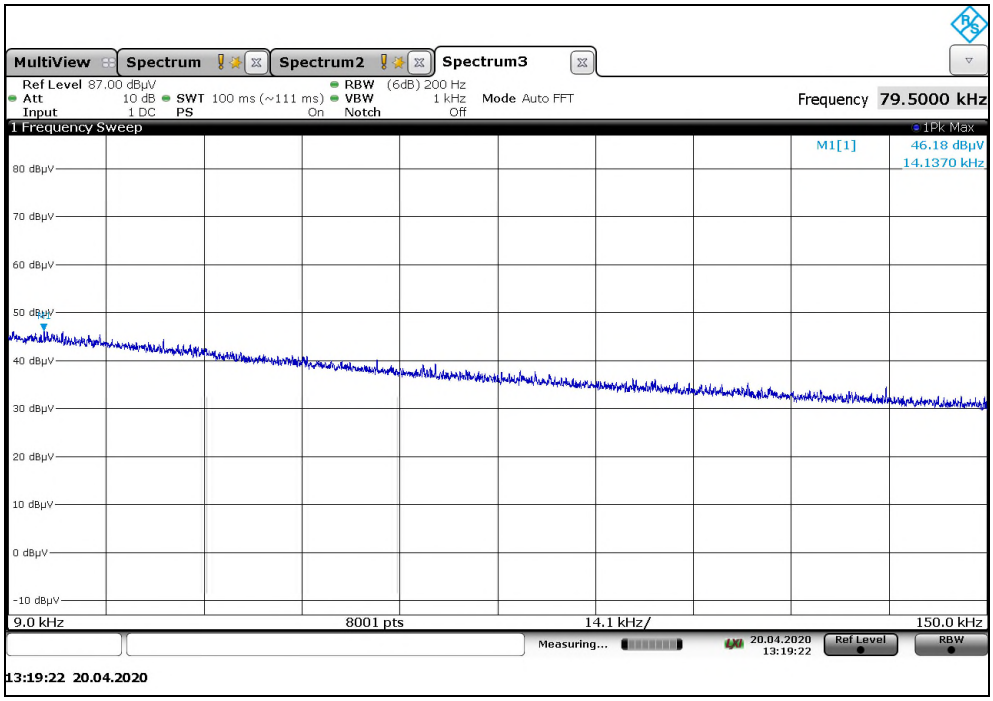

Figure A-1: Radiated Emissions – 9 kHz – 150 kHz

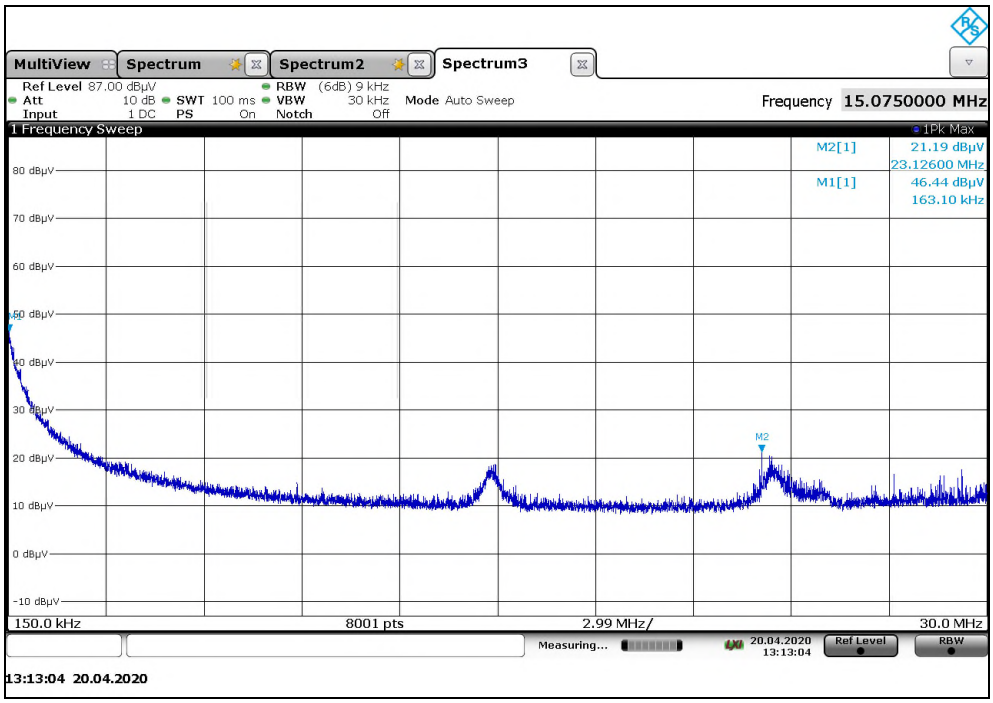

Figure A-2: Radiated Emissions – 150 kHz to 30 MHz

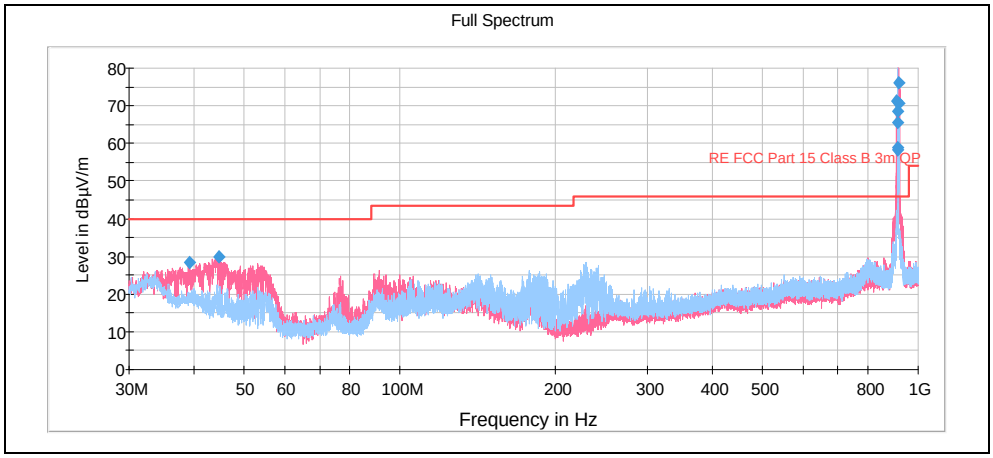

Figure A-3: Radiated Emissions – 30 MHz – 1GHz

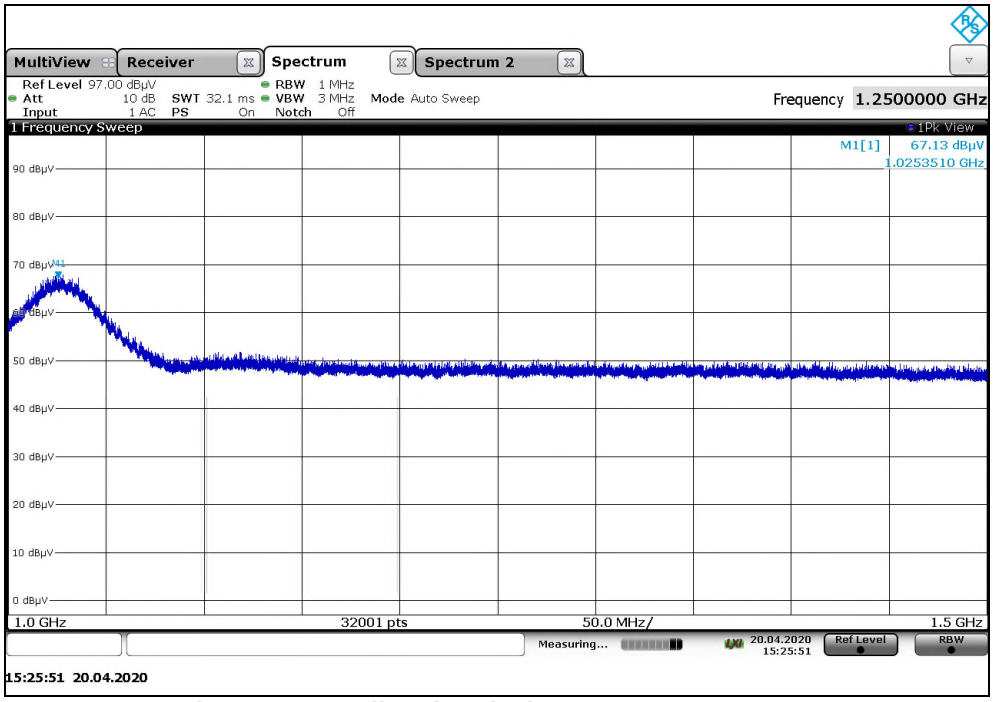

Figure A-4: Radiated Emissions – 1 GHz – 1.5 GHz

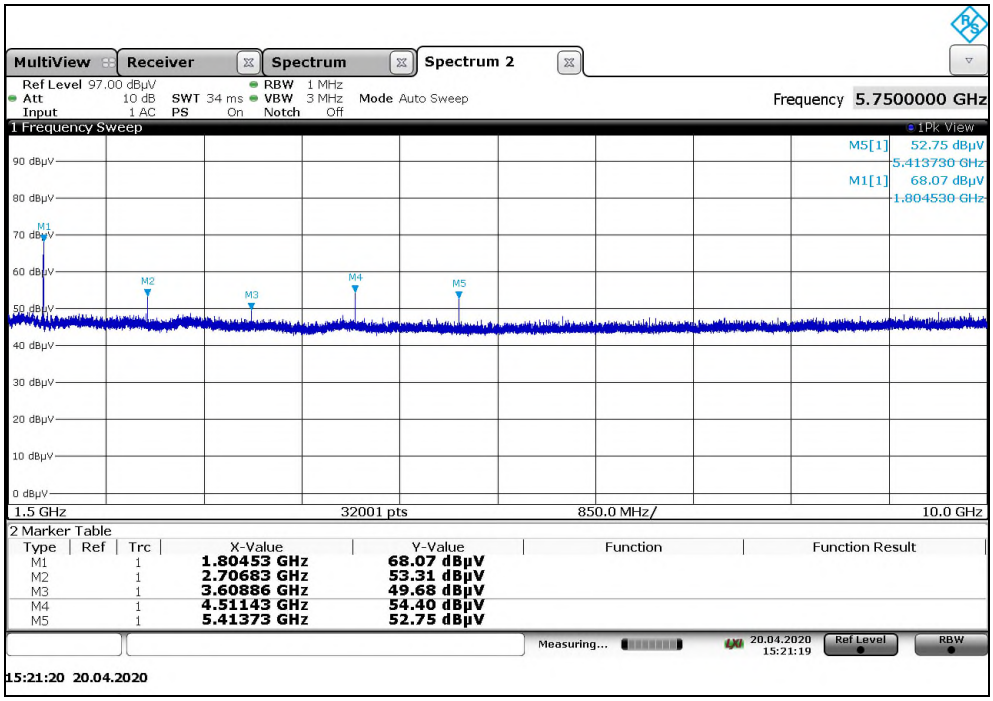

Figure A-5: Radiated Emissions – 1.5 GHz – 10 GHz

END REPORT