Wireless Test Report

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

FCC Rule Part: 15.247

Report Number: 72154502.300

Manufacturer: Elster Solutions LLC
Model: Global Network Interface Card International (GNICI)

Test Begin Date: December 9, 2019
Test End Date: December 18, 2019

Report Issue Date: January 2, 2020

A2LA Cert. No. 2955.18

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 2955.18

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Prepared by:

Chris Gormley
RF Wireless Engineer
TÜV SÜD America Inc.

Reviewed by:

Kirby Munroe
Technical Manager, US Wireless
TÜV SÜD America Inc.

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This report contains 35 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 for the purpose of demonstrating limited modular certification.

1.2 Product description

The Model GNIC Printed Circuit Board Assembly (PCBA) is a limited module that contains a frequency hopping spread spectrum (FHSS) radio operating in the 902-928 MHz ISM frequency band. It also contains circuitry for application control and communications with a host product. The GNIC module connects hosts using Advanced Metering Infrastructure (AMI) that utilizes a proprietary network architecture and protocol devised by Elster Electricity LLC.

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

The GNICI Printed Circuit Board Assembly (PCBA) may also be populated with a pre-approved Zigbee module (FCC ID: QOQ13 / IC: 5123A-13) which does not operate simultaneously with the GNIC 902 – 928 MHz radio. Verification of the Zigbee module is provided in a separate report.

Technical Information:

Mode of Operation	Frequency Range (MHz)	Number of Channels	Data Rates Supported (kbps)	Rated Power (W)
1 (Energy Axis)	916 - 927.6	25	35.5, 142.2	0.25
2 (SynergyNet)	916 - 927.6	25	150, 200	0.25

Modulation Format: FSK
Operating Voltage: 4VDC
Antenna Type / Gain:

Antenna Type	**Antenna Gain**
On-board stamped metal dipole	2.1dBi

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

EUT Serial Numbers: 0101194100243 (conducted); 0101194100241 (radiated)

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

1.3 Test Methodology and Considerations

The GNICI Printed Circuit Board Assembly (PCBA) is a limited module based on the absence of power regulation therefore the evaluation was performed in a representative host device for radiated emissions and AC powerline conducted emissions. The host device is identified as an A4RES watt-hour meter. For the purpose of facilitating RF conducted measurements the module was removed from the host enclosure.

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

Based on radiated measurements of all data rates, the worst-case data rate for mode 1 was 142.2kbps and 150kbps for mode 2.

For AC power line conducted emissions the EUT was evaluated with a typical host in mode 2 as worst case.

The EUT utilizes 25 hopping channels in operating modes 1 and 2 in the range from 916 MHz to 927.6 MHz using multiple hopping tables. Data was collected using multiple hopping tables to show compliance for all possible operating conditions (i.e. hopping band-edge at extreme operating band-edges).

Software power settings during test for mode 1: 7 (Low Channel), 7 (Mid Channel), 7 (High Channel)
Software power setting during test for mode 2: 5 (Low Channel), 5 (Mid Channel), 5 (High Channel)

2 TEST FACILITIES

2.1 Location

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

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

2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America Inc. (Durham) is accredited to ISO/IEC 17025 by A2LA accreditation program, and has been issued certificate number 2955.18 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 and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC and Innovation, Science and Economic Development (ISED) Canada.

FCC Designation Number: US1245
FCC Test Firm Registration Number: 238628
ISED Canada Company Number: 20446

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

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

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

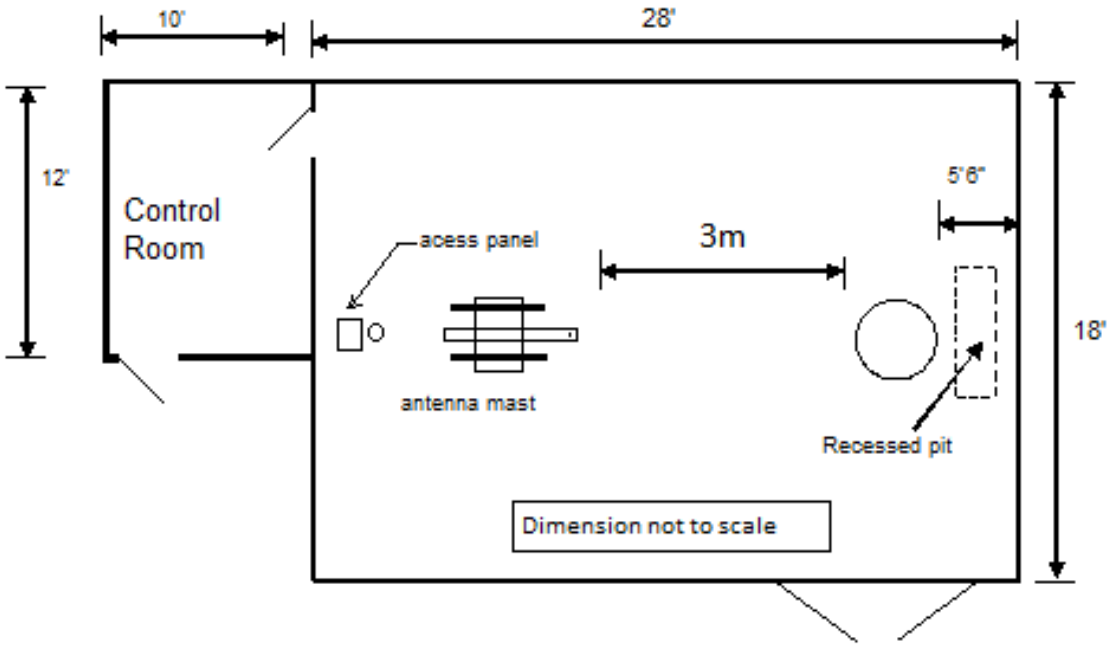


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

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

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

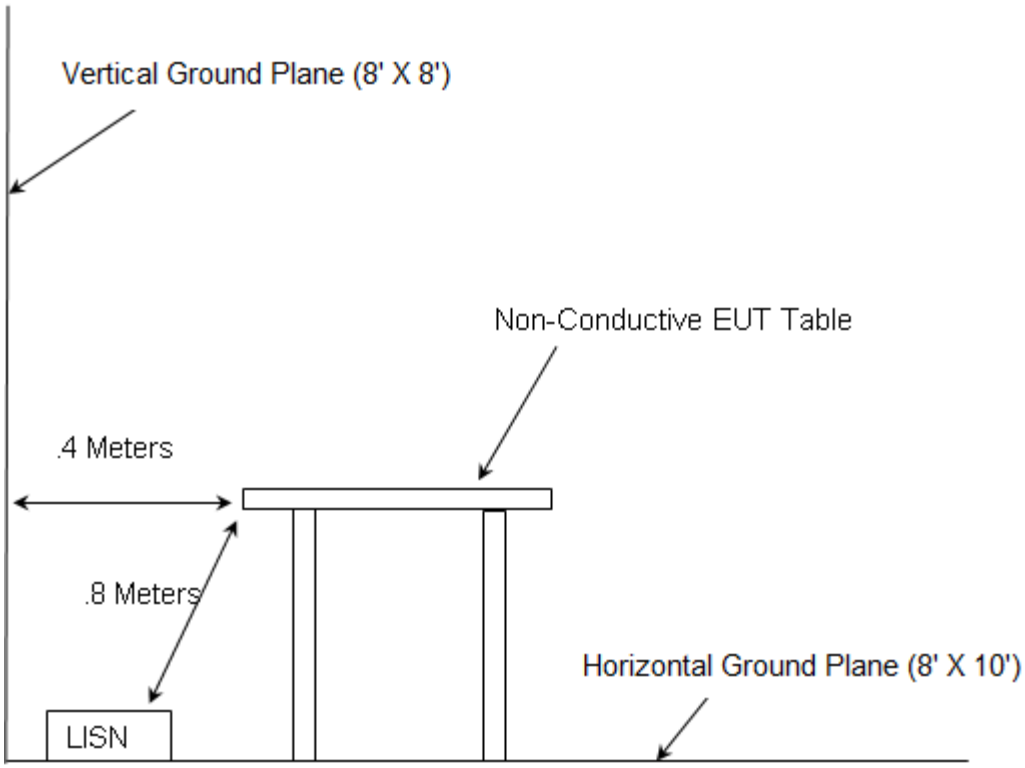


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014: American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2019
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2019
- ISED Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 2, 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 #	Last Calibration Date	Calibration Due Date
DEMC3002	Rohde & Schwarz	ESU40	Receiver	100346	10/31/2018	1/31/2020
DEMC3006	Rohde & Schwarz	TS-PR18	Amplifier	122006	1/22/2019	1/22/2020
DEMC3008	Rohde & Schwarz	NRP2	Meter	103131	2/7/2019	2/7/2020
DEMC3009	Rohde & Schwarz	NRP-Z81	Meter	102397	2/7/2019	2/7/2020
DEMC3012	Rohde & Schwarz	EMC32-EB	Software	100731	NCR	NCR
DEMC3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antenna	2013120203	2/7/2018	2/7/2020
DEMC3029	Micro-Tronics	HPM50108	900MHz HP Filter	134	1/15/2019	1/15/2020
DEMC3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/16/2019	1/16/2020
DEMC3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/16/2019	1/16/2020
DEMC3041	Aeroflex Inmet	18N10W-30	Attenuator	1447	1/15/2019	1/15/2020
DEMC3055	Rohde & Schwarz	3005	Cable	3055	1/22/2019	1/22/2020
DEMC3064	Times	LMR195	Cable	3064	8/15/2019	8/15/2020
DEMC3085	Rohde & Schwarz	FSW43	Spectrum Analyzer	103997	3/28/2019	3/28/2020
DEMC3161	TESEQ	CBL-6112D	Antenna	51323	1/31/2019	1/31/2020

NCR = No Calibration Required
DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.
Asset 3002: Firmware Version: ESU40 is 4.73 SP4
Asset 3012: Software Version: EMC32-B is 10.50.00
Asset 3085: Instrument Firmware 2.41 SP1

5 SUPPORT EQUIPMENT

Table 5-1: EUT and Support Equipment Description – Conducted Measurements

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Elster Solutions	GNIC	0101194100243
2	Circuit Board	Adaptor Board	N/A	TUV 08
3	DC Power Supply	Sorensen	QRD20-4	2716
4	Computer	Dell	Precision 7510	5WRCRF2
5	TTL Converter	BB Electronics	232LPTTL33	0115484046

Table 5-2: Cable Description – Conducted Measurements

Cable #	Cable Type	Length	Shield	Termination
A	Serial to USB	46cm	Yes	4 – 5
B	3 wire Serial	18cm	No	5 – 2
C	Power	60cm	No	3 – 1
D	Ribbon Cable	20cm	No	1 – 2

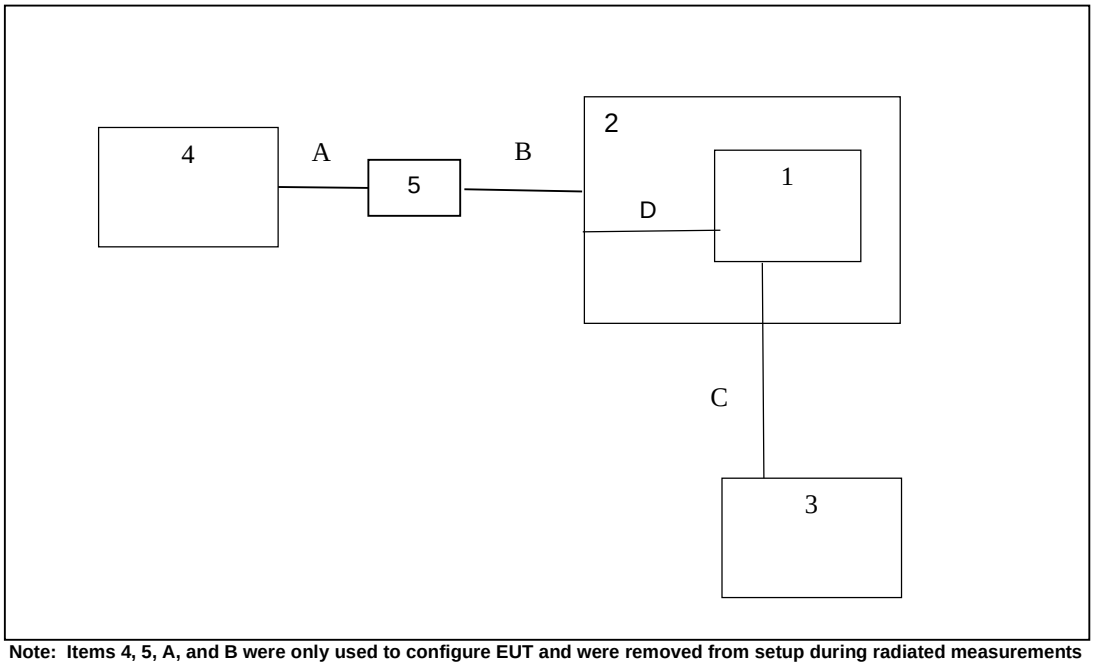
Table 5-3: EUT and Support Equipment Description – Radiated Measurements

Item #	Type Device	Manufacturer	Model/Part #	Serial #
1	EUT	Elster Solutions	GNIC	0101194100241
2	Host	Elster Solutions	A4RES	NXG028945777
3	Computer	Dell	Precision 7510	5WRCRF2
4	TTL Converter	BB Electronics	232LPTTL33	0115484046

Table 5-4: Cable Description – Radiated Measurements

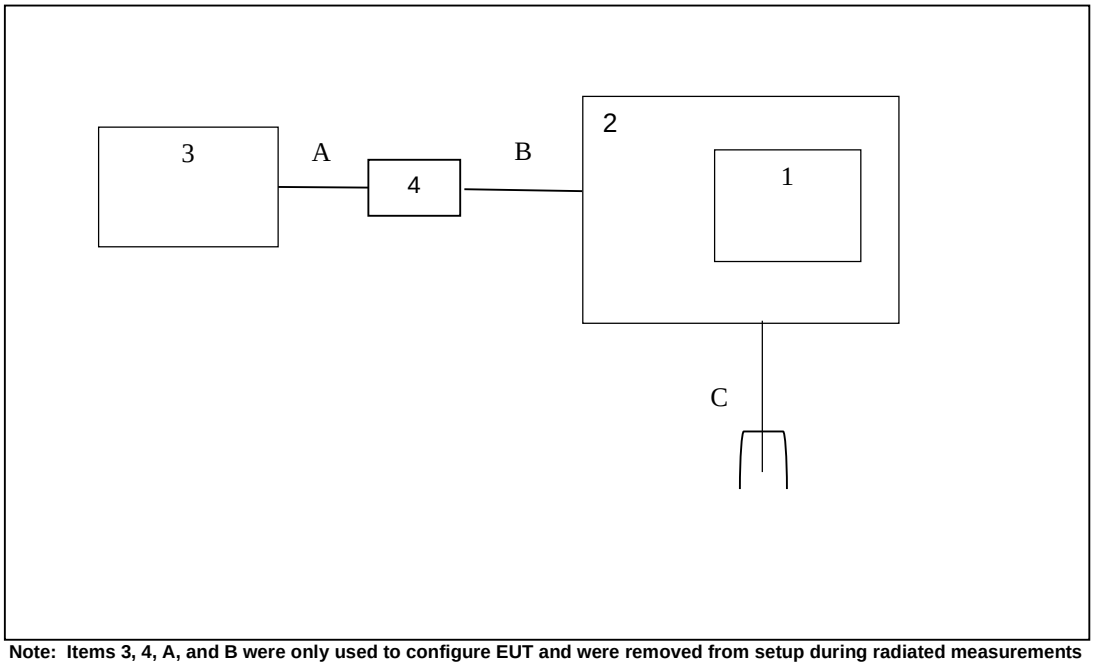
Cable #	Cable Type	Length	Shield	Termination
A	Serial to USB	46cm	Yes	3 – 4
B	3 wire Serial	18cm	No	4 – 2
C	Power	2.1m	No	2 – AC

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



Note: Items 4, 5, A, and B were only used to configure EUT and were removed from setup during radiated measurements

Figure 6-1: Test Setup Block Diagram – Conducted Measurements



Note: Items 3, 4, A, and B were only used to configure EUT and were removed from setup during radiated measurements

Figure 6-2: Test Setup Block Diagram – Radiated Measurements

7 SUMMARY OF TESTS

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

7.1 Antenna Requirement – FCC: 15.203

The is permanantly attached with solder which satifies the requirements in FCC Part 15.203.

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

7.2.1 Measurement Procedure

ANSI C63.10-2013 section 6 was the guiding document for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

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

7.2.2 Measurement Results

Table 7.2.2-1: Conducted EMI Results – Line 1 and Neutral

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Line	Filter	Corr (dB)
0.163500	---	26.01	55.28	29.27	L1	OFF	9.6
0.163500	40.49	---	65.28	24.80	L1	OFF	9.6
0.172500	---	30.96	54.84	23.88	N	OFF	9.7
0.172500	42.01	---	64.84	22.83	N	OFF	9.7
0.231000	---	14.95	52.41	37.46	N	OFF	9.7
0.231000	31.91	---	62.41	30.50	N	OFF	9.7
0.487500	---	29.15	46.21	17.06	L1	OFF	9.6
0.487500	32.54	---	56.21	23.67	L1	OFF	9.6
1.081500	23.89	---	56.00	32.11	N	OFF	9.7
1.081500	---	20.55	46.00	25.45	N	OFF	9.7
1.428000	22.82	---	56.00	33.18	L1	OFF	9.7
1.428000	---	16.97	46.00	29.03	L1	OFF	9.7
2.368500	20.44	---	56.00	35.56	L1	OFF	9.7
2.368500	---	15.60	46.00	30.40	L1	OFF	9.7
3.628500	17.80	---	56.00	38.20	L1	OFF	9.8
3.628500	---	12.16	46.00	33.84	L1	OFF	9.8
21.934500	---	21.16	50.00	28.84	N	OFF	10.3
21.934500	28.68	---	60.00	31.32	N	OFF	10.3
27.240000	---	27.46	50.00	22.54	N	OFF	10.3
27.240000	35.56	---	60.00	24.44	N	OFF	10.3

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

7.3.1 Measurement Procedure (Conducted Method)

The RF output port of the EUT was directly connected to the input of a power meter using 31.0dB of passive attenuation. The device employs < 50 channels at any given time in Mode 1 and Mode 2 therefore the power is limited to 0.25 Watt.

7.3.2 Measurement Results

Table 7.3.2-1: RF Output Power

Frequency (MHz)	Level (dBm)	Limit (dBm)	Data Rate (kbps)
916	22.722	23.98	35.5
916	22.742	23.98	142.2
916	22.658	23.98	150
916	22.658	23.98	200
922	22.899	23.98	35.5
922	22.883	23.98	142.2
922	22.773	23.98	150
922	22.783	23.98	200
927.6	22.834	23.98	35.5
927.6	22.816	23.98	142.2
927.6	22.599	23.98	150
927.6	22.601	23.98	200

7.4 Channel Usage Requirements

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

7.4.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 31.0dB of passive attenuation. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks. The RBW was set to approximately 30% of the channel spacing and adjusted as necessary to best identify the center of each channel. The VBW was set > RBW.

7.4.1.2 Measurement Results

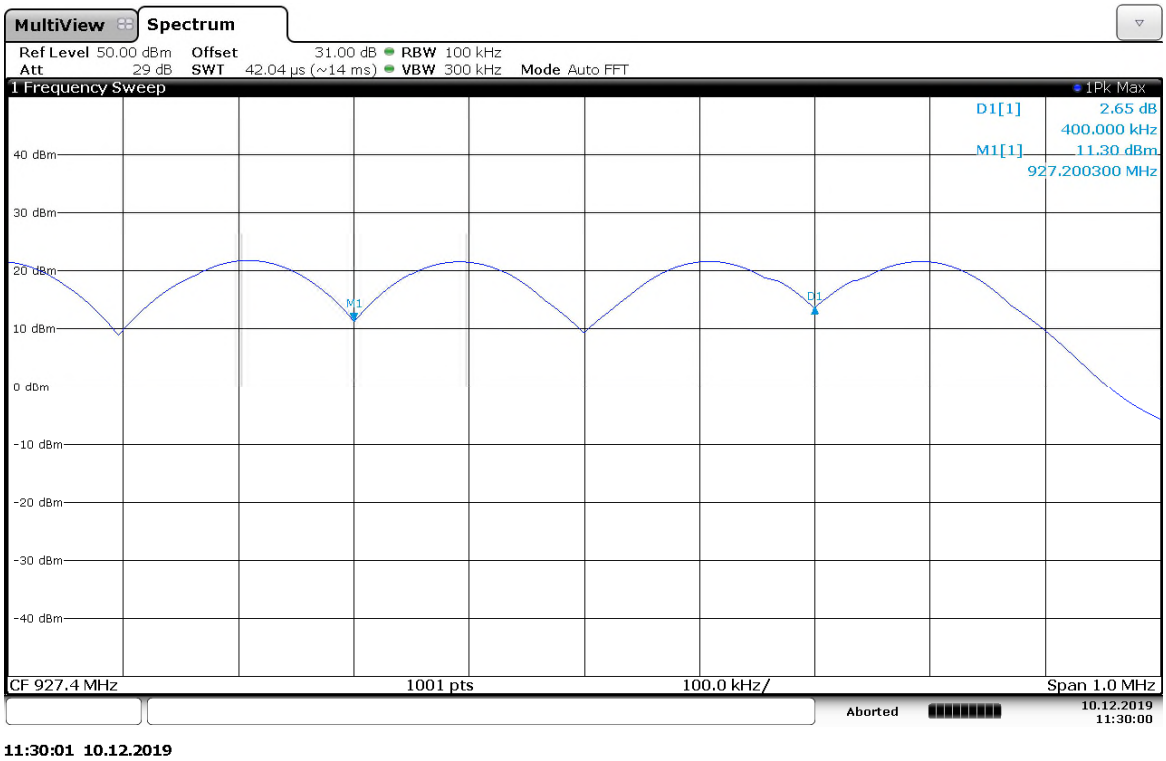
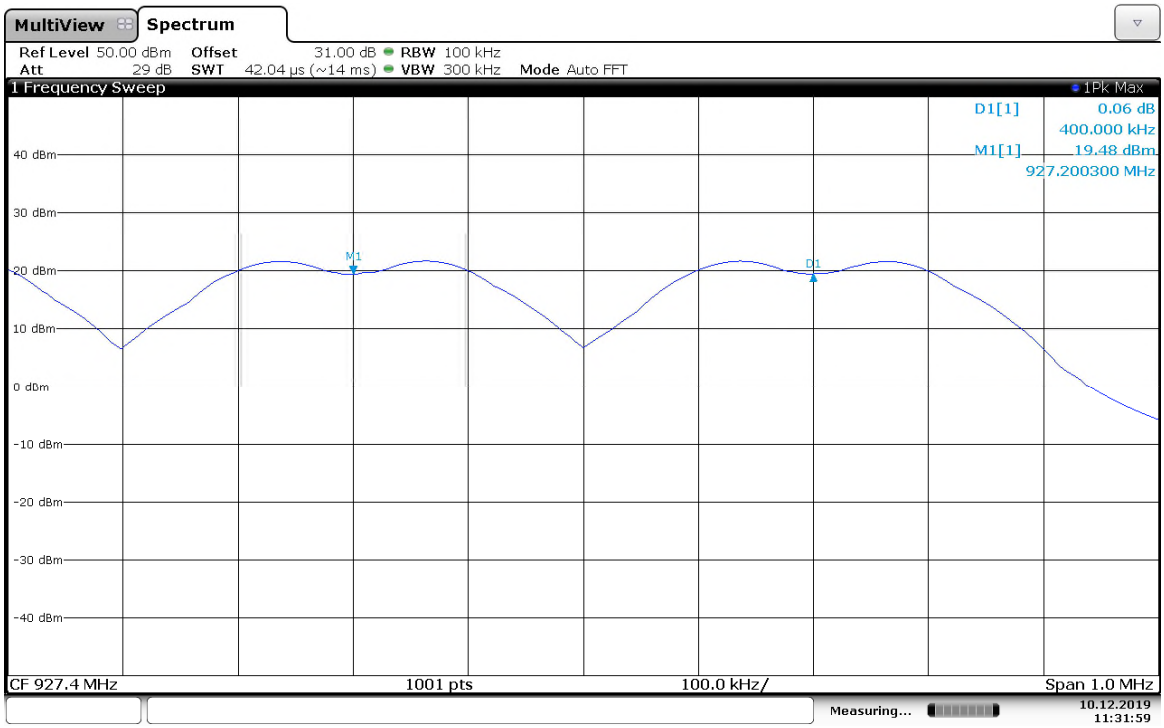
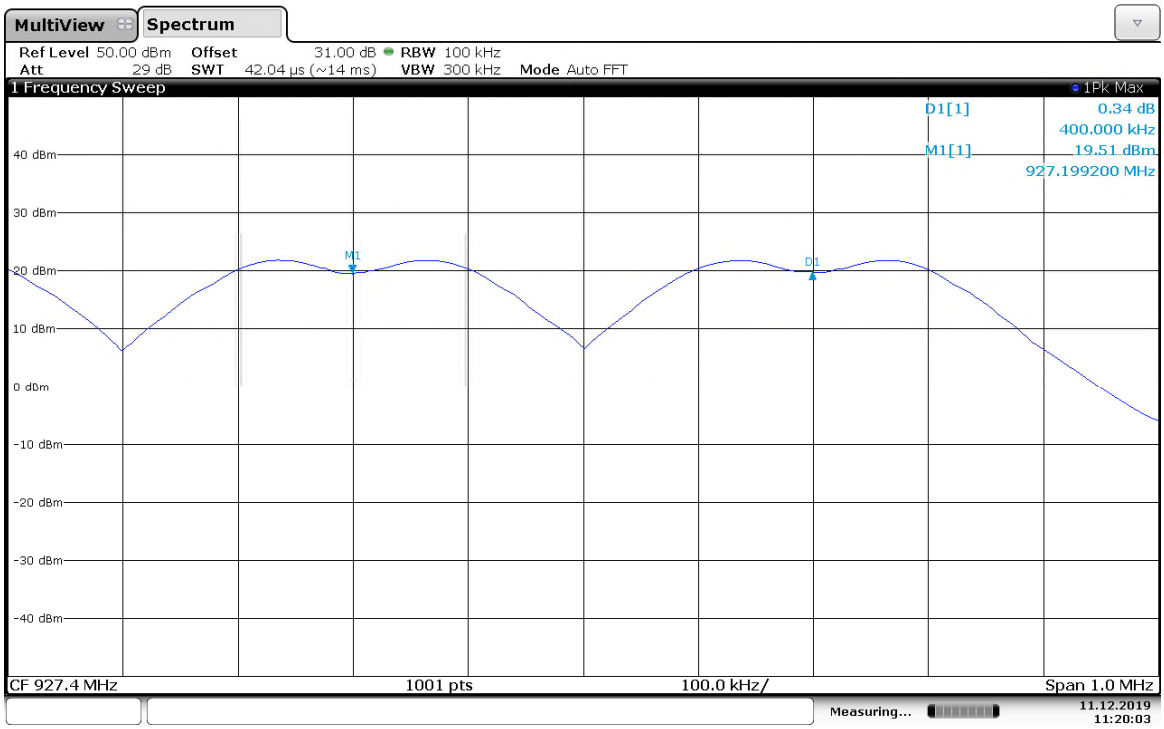


Figure 7.4.1.2-1: Carrier Frequency Separation 35.5kbps



11:32:00 10.12.2019

Figure 7.4.1.2-2: Carrier Frequency Separation 142.2kbps



11:20:03 11.12.2019

Figure 7.4.1.2-3: Carrier Frequency Separation 150kbps

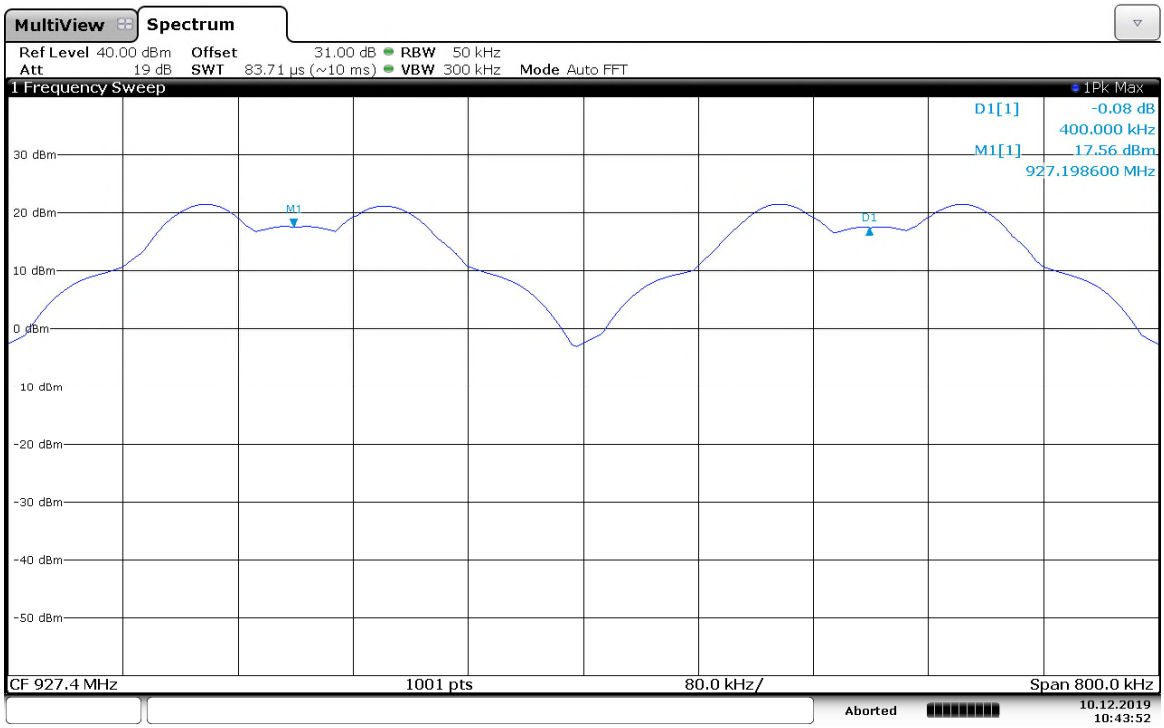


Figure 7.4.1.2-4: Carrier Frequency Separation 200kbps

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

7.4.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 31.0dB of passive attenuation. The span of the spectrum analyzer was set wide enough to capture the frequency band of operation. The RBW was set to < 30% of the channel spacing and VBW set to ≥ RBW.

7.4.2.2 Measurement Results

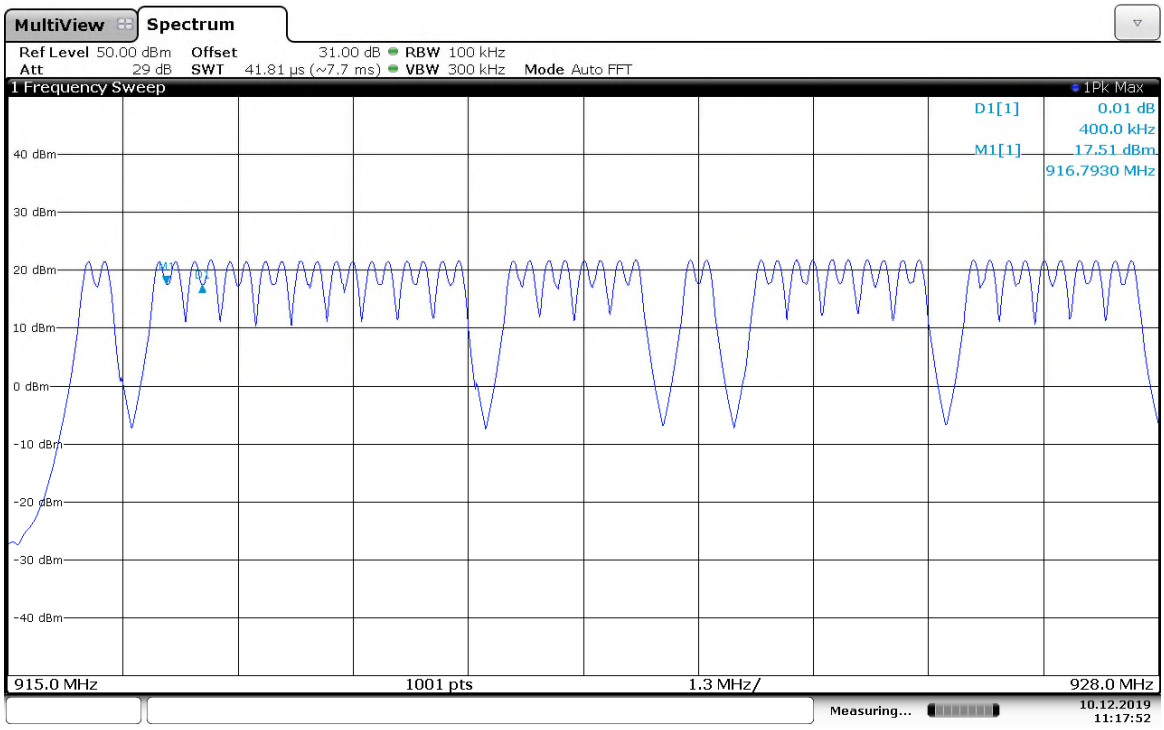
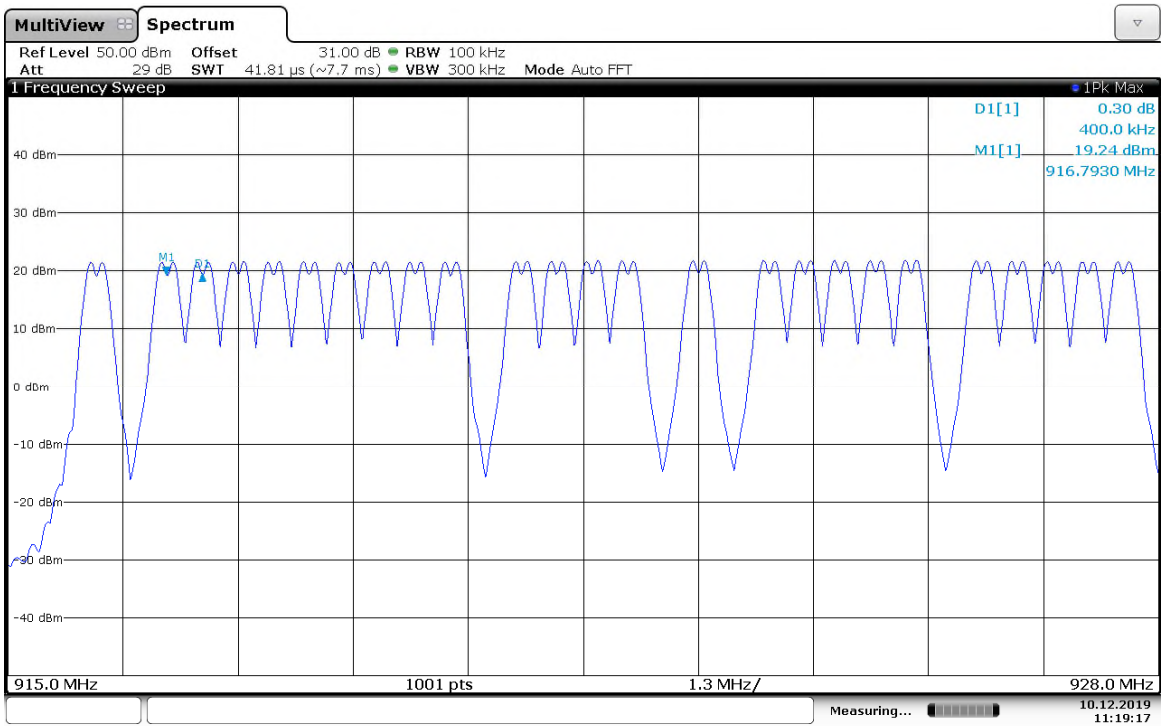


Figure 7.4.2.2-1: Number of Hopping Channels 35.5kbps



11:19:18 10.12.2019

Figure 7.4.2.2-2: Number of Hopping Channels 142.2kbps

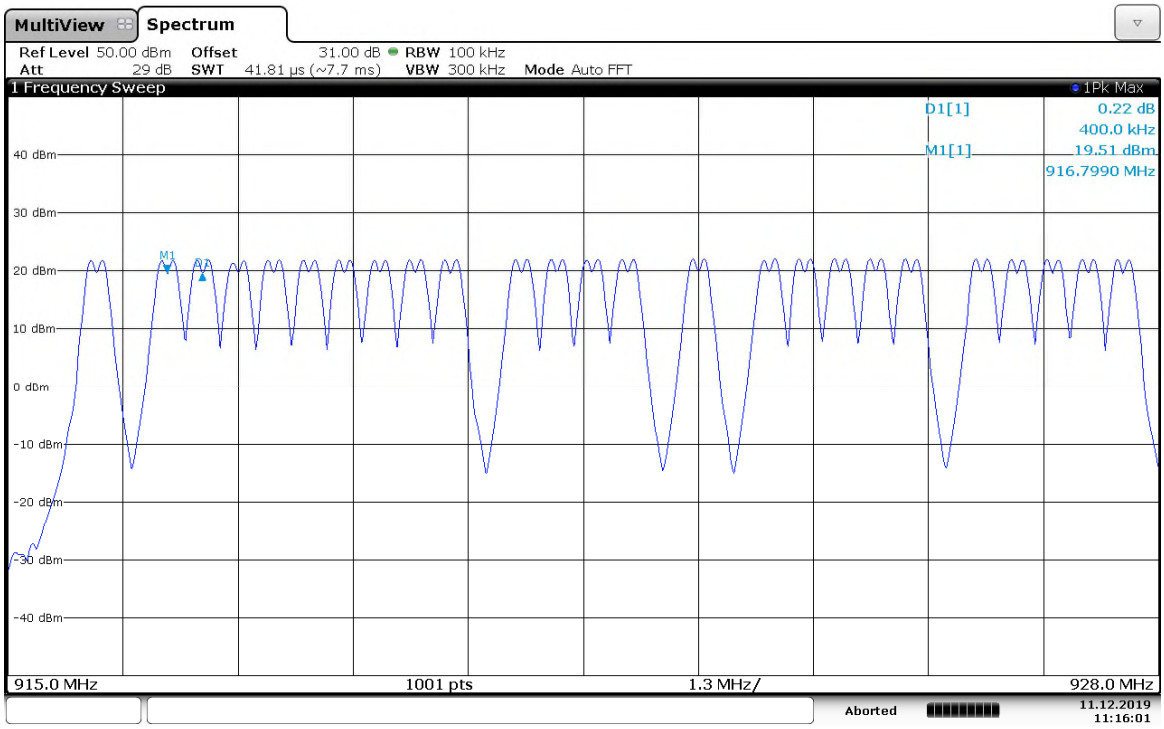


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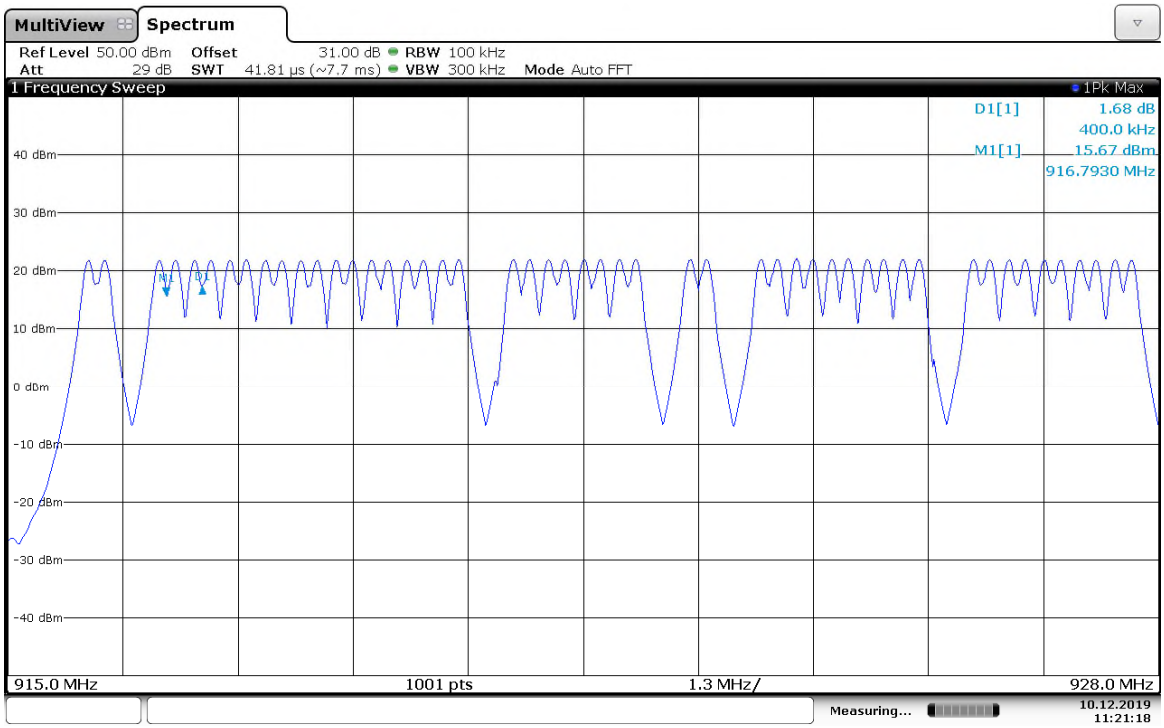
Figure 7.4.2.2-3: Number of Hopping Channels 150kbps



11:21:18 10.12.2019

Figure 7.4.2.2-4: Number of Hopping Channels 200kbps

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

7.4.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 31.0dB of passive attenuation. The span of the spectrum analyzer display was set 0 Hz centered on a hopping channel. The RBW of the spectrum analyzer was set to ≤ the EUT channel spacing and VBW set to ≥ RBW. The Marker Delta function of the analyzer was utilized to determine the dwell time.

7.4.3.2 Measurement Results

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

Mode	Data Rate (kbps)	Single Occurrence	Number of Occurrences	Total Dwell Time (ms)
1	35.5kbps	100ms	2	200ms
1	142.2kbps	37.5ms	7	262.5ms
2	150kbps	24.15ms	8	193.2ms
2	200kbps	24.15ms	8	193.2ms

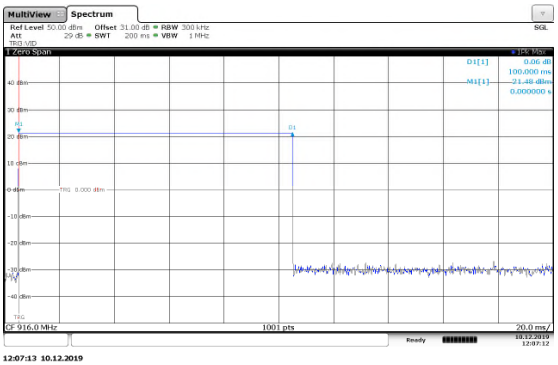


Figure 7.4.3.2-1: Dwell Time 35.5kbps

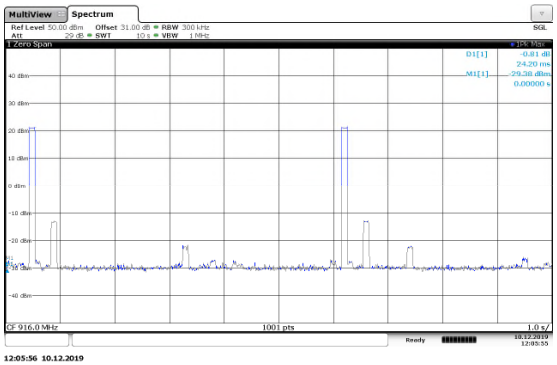


Figure 7.4.3.2-2: Number of Occurrences 35.5kbps

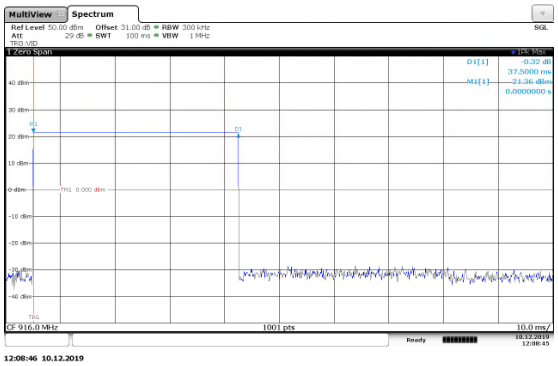


Figure 7.4.3.2-3: Dwell Time 142.2kbps

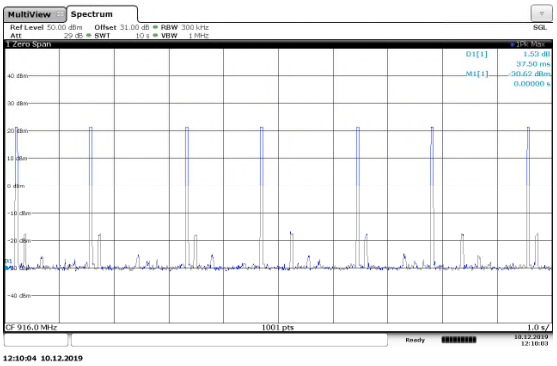


Figure 7.4.3.2-4: Number of Occurrences 142.2kbps

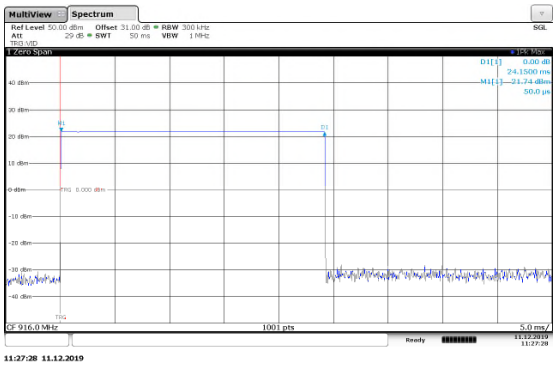


Figure 7.4.3.2-5: Dwell Time 150kbps

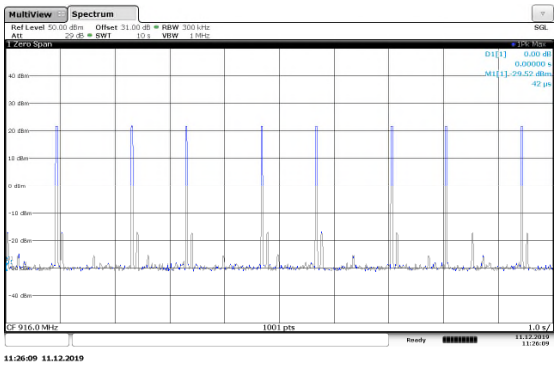


Figure 7.4.3.2-6: Number of Occurrences 150kbps

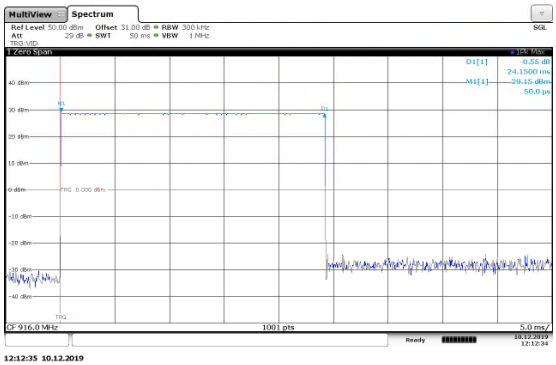


Figure 7.4.3.2-7: Dwell Time 200kbps

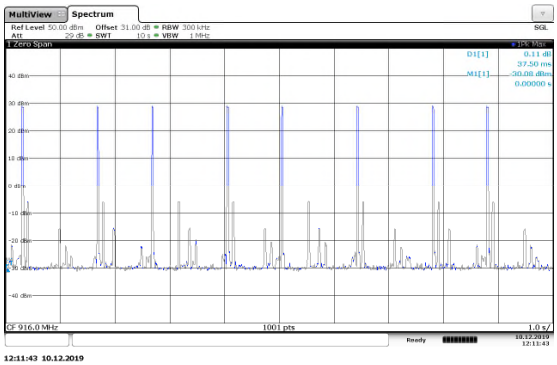


Figure 7.4.3.2-8: Number of Occurrences 200kbps

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

7.4.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using suitable attenuation. The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The VBW of the spectrum analyzer was set to approximately 3 times the RBW. The trace was set to max hold with a peak detector active. The marker delta measurement function of the analyzer was utilized to determine the 20dB 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 between one and a half and five times the OBW. 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 with max hold function 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)
916.0	294.70	296.65	35.5
916.0	332.70	313.58	142.2
916.0	306.70	278.38	150
916.0	252.70	252.73	200
922.0	294.70	299.87	35.5
922.0	332.70	314.08	142.2
922.0	316.70	279.88	150
922.0	263.70	252.60	200
927.6	294.70	279.29	35.5
927.6	332.70	313.10	142.2
927.6	306.09	277.21	150
927.6	262.70	250.16	200

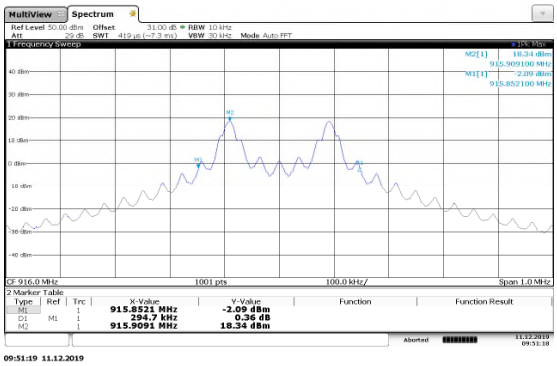


Figure 7.4.4.2-1: 20dB BW Low Channel 35.5kbps

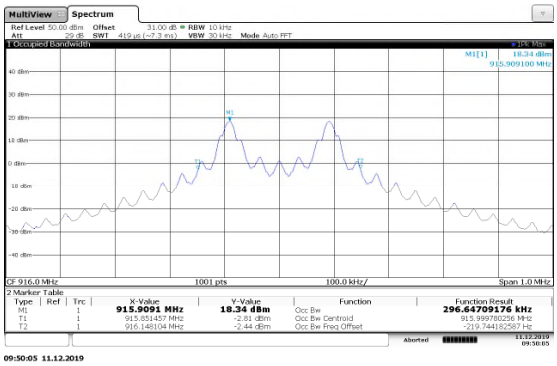


Figure 7.4.4.2-2: 99% OBW Low Channel 35.5kbps

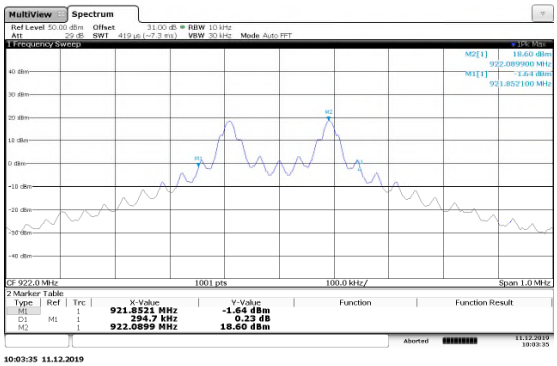


Figure 7.4.4.2-3: 20dB BW Mid Channel 35.5kbps

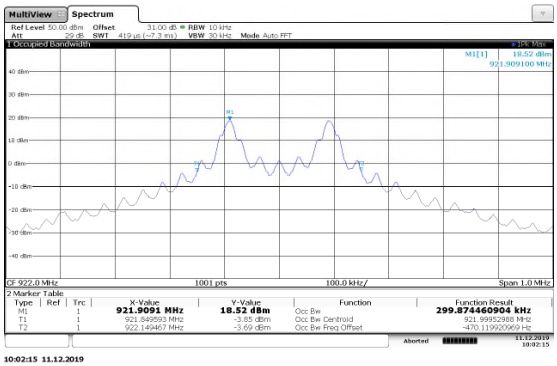


Figure 7.4.4.2-4: 99% OBW Mid Channel 35.5kbps

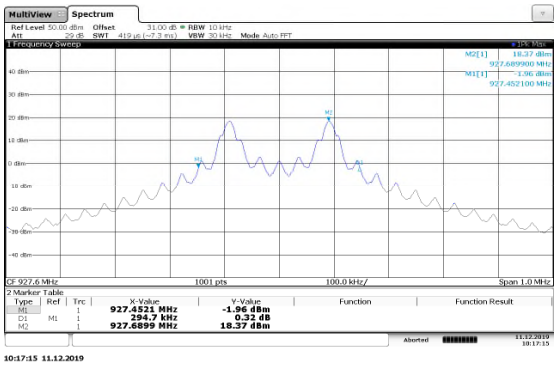


Figure 7.4.4.2-5: 20dB BW High Channel 35.5kbps

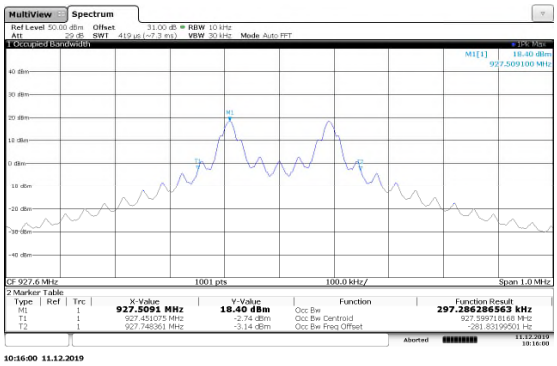


Figure 7.4.4.2-6: 99% OBW High Channel 35.5kbps

Figure 7.4.4.2-7: 20dB BW Low Channel 142.2kbps

Figure 7.4.4.2-8: 99% OBW Low Channel 142.2kbps

Figure 7.4.4.2-9: 20dB BW Mid Channel 142.2kbps

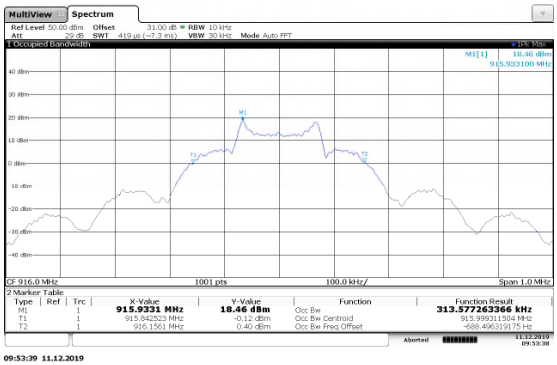


Figure 7.4.4.2-10: 99% OBW Mid Channel 142.2kbps

Figure 7.4.4.2-11: 20dB BW High Channel 142.2kbps

Figure 7.4.4.2-12: 99% OBW High Channel 142.2kbps

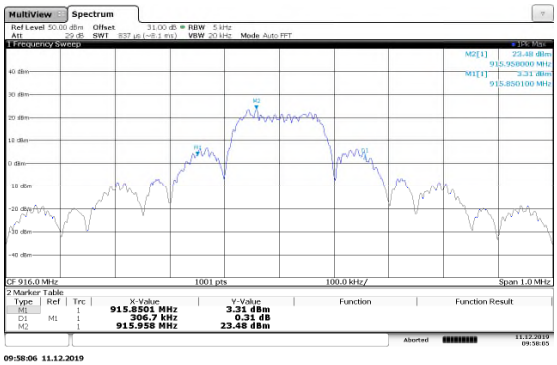


Figure 7.4.4.2-13: 20dB BW Low Channel 150kbps

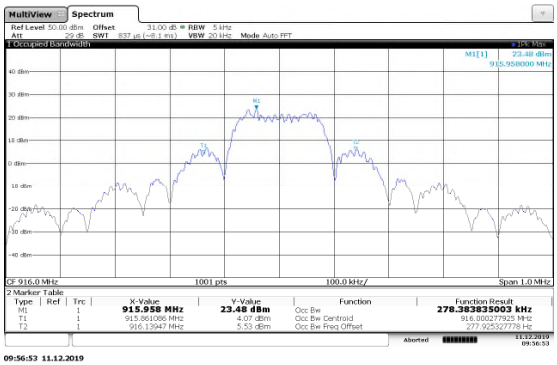


Figure 7.4.4.2-14: 99% OBW Low Channel 150kbps

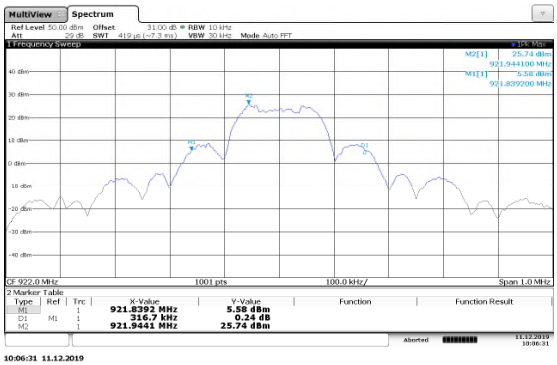


Figure 7.4.4.2-15: 20dB BW Mid Channel 150kbps

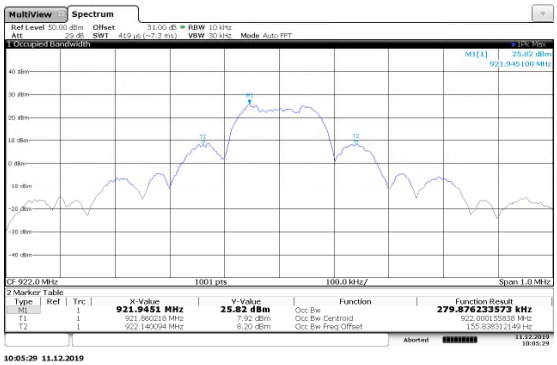


Figure 7.4.4.2-16: 99% OBW Mid Channel 150kbps

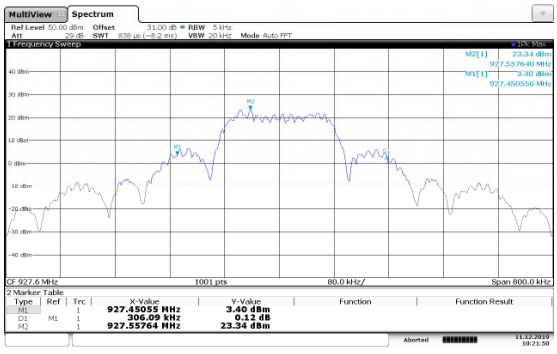


Figure 7.4.4.2-17: 20dB BW High Channel 150kbps

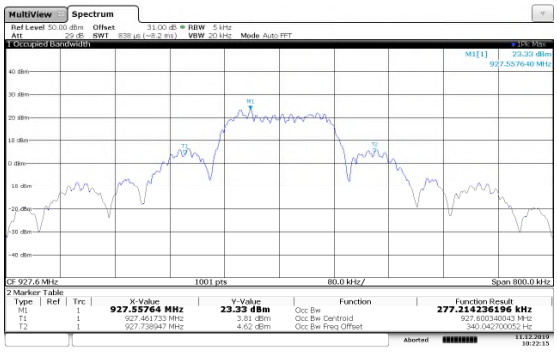


Figure 7.4.4.2-18: 99% OBW High Channel 150kbps

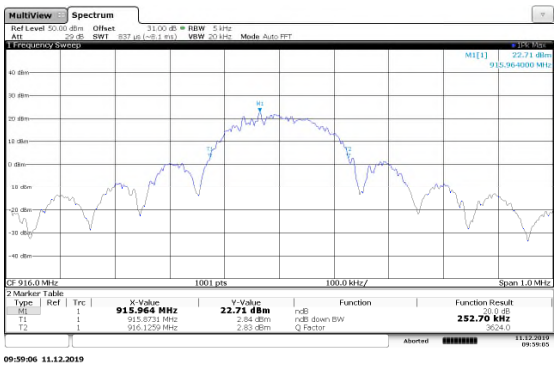


Figure 7.4.4.2-19: 20dB BW Low Channel 200kbps

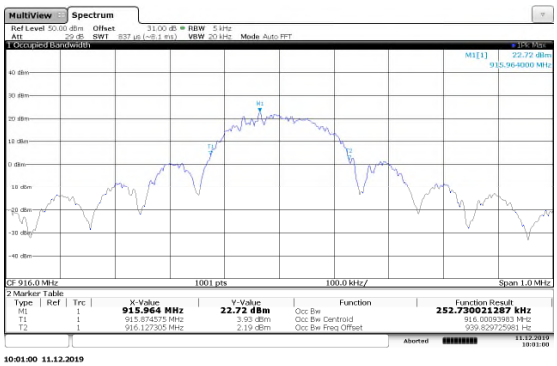


Figure 7.4.4.2-20: 99% OBW Low Channel 200kbps

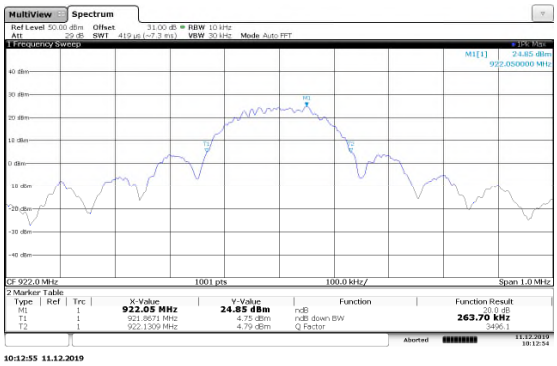


Figure 7.4.4.2-21: 20dB BW Mid Channel 200kbps

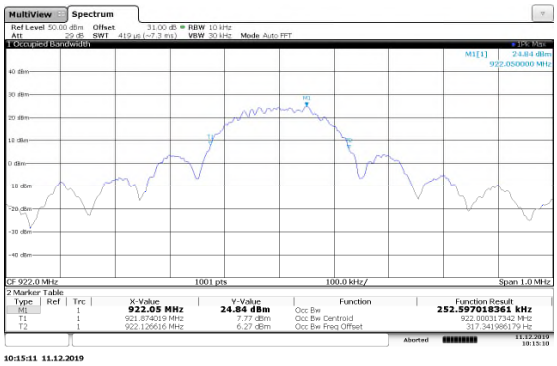


Figure 7.4.4.2-22: 99% OBW Mid Channel 200kbps

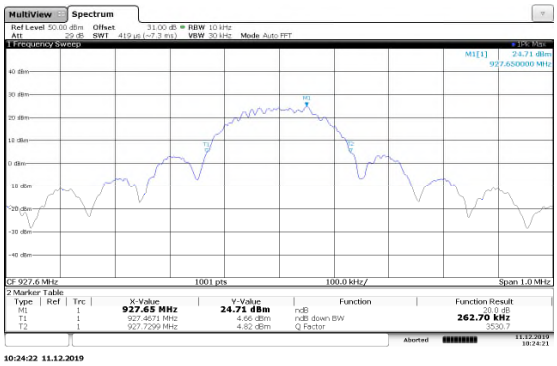


Figure 7.4.4.2-23: 20dB BW High Channel 200kbps

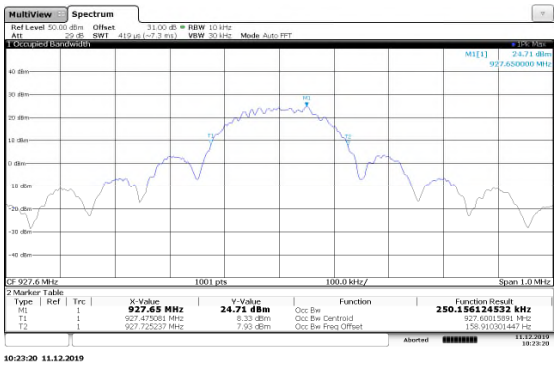


Figure 7.4.4.2-24: 99% OBW High Channel 200kbps

7.5 Band-Edge Compliance and Spurious Emissions

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

7.5.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 31.0dB of passive attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement, the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to 300 kHz.

7.5.1.2 Measurement Results

NON-HOPPING MODE:

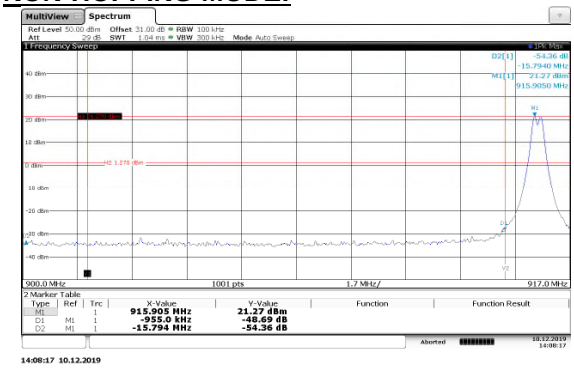


Figure 7.5.1.2-1: Lower Band-edge 35.5kbps

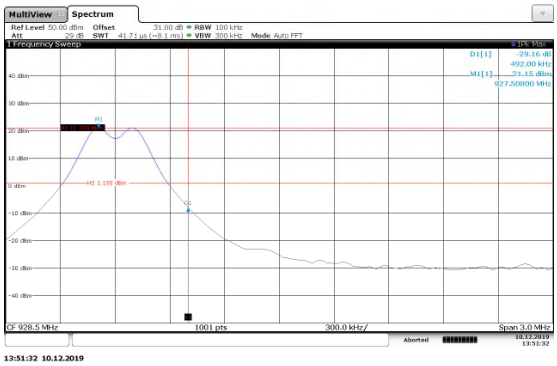


Figure 7.5.1.2-2: Upper Band-edge 35.5kbps

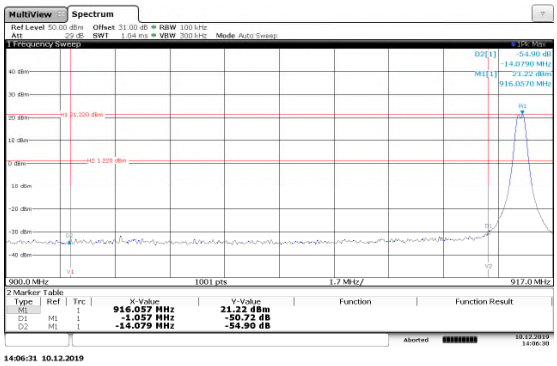


Figure 7.5.1.2-3: Lower Band-edge 142.2kbps

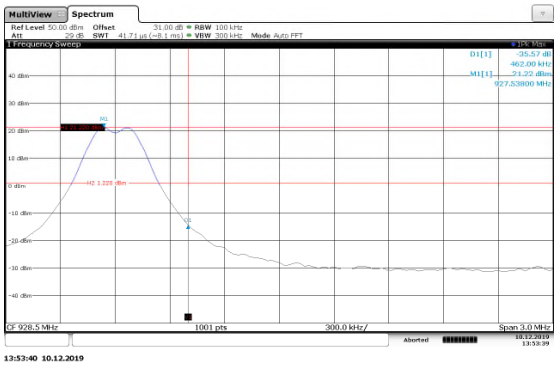


Figure 7.5.1.2-4: Upper Band-edge 142.2kbps

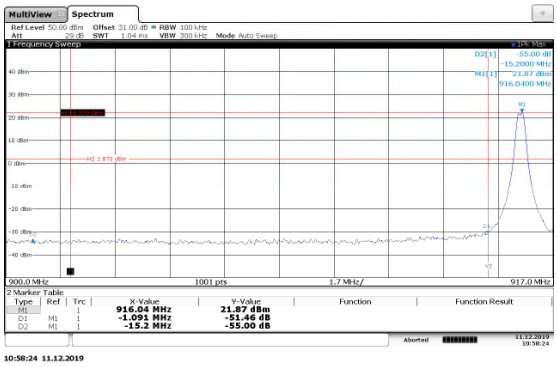


Figure 7.5.1.2-5: Lower Band-edge 150kbps

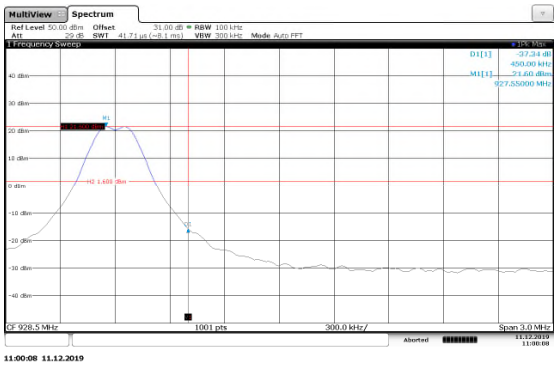


Figure 7.5.1.2-6: Upper Band-edge 150kbps

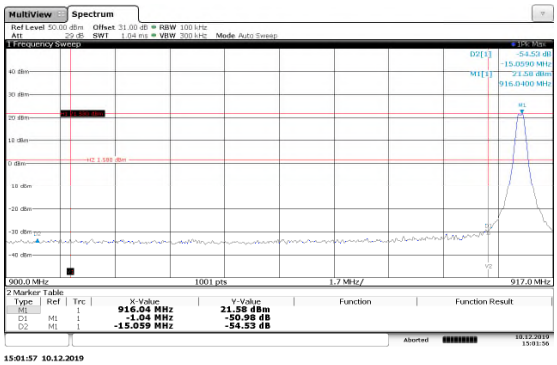


Figure 7.5.1.2-7: Lower Band-edge 200kbps

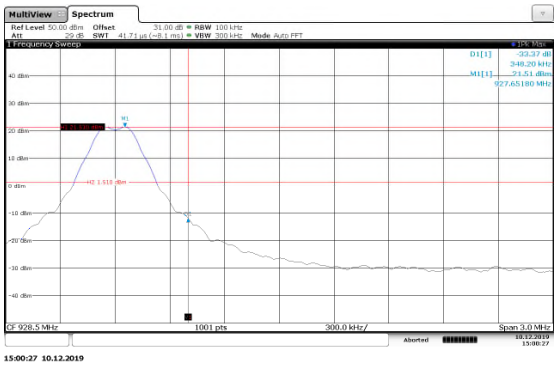


Figure 7.5.1.2-8: Upper Band-edge 200kbps

HOPPING MODE:

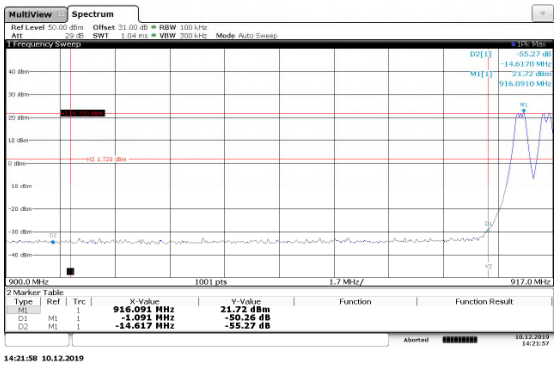


Figure 7.5.1.2-9: Lower Band-edge 35.5kbps

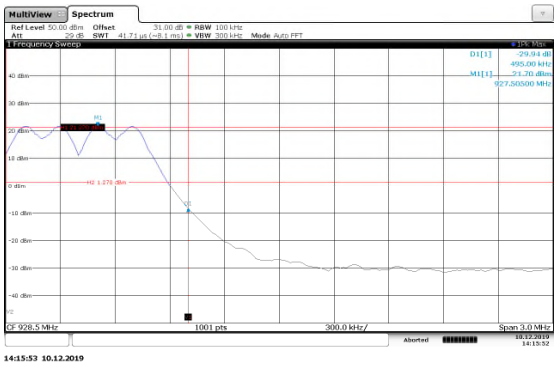


Figure 7.5.1.2-10: Upper Band-edge 35.5kbps

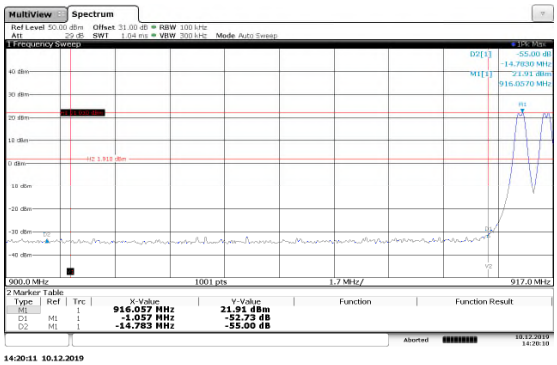


Figure 7.5.1.2-11: Lower Band-edge 142.2kbps

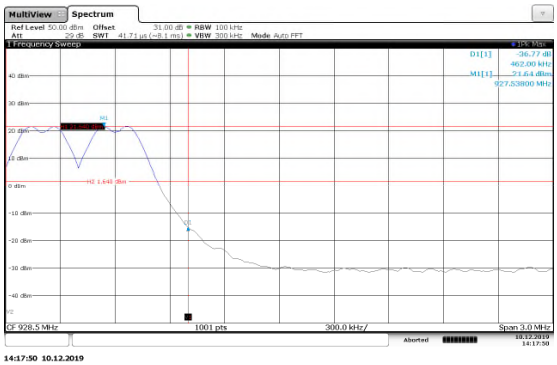


Figure 7.5.1.2-12: Upper Band-edge 142.2kbps

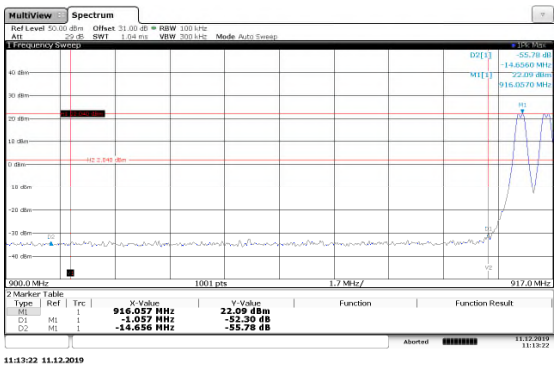


Figure 7.5.1.2-13: Lower Band-edge 150kbps

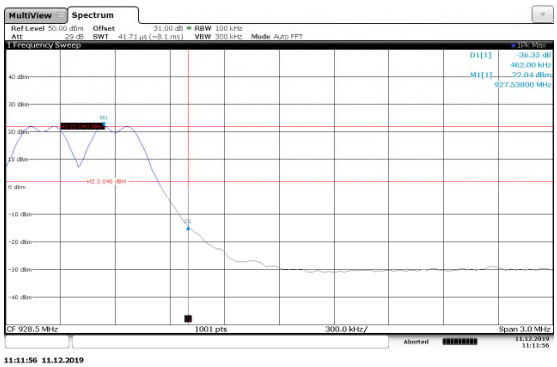


Figure 7.5.1.2-14: Upper Band-edge 150kbps

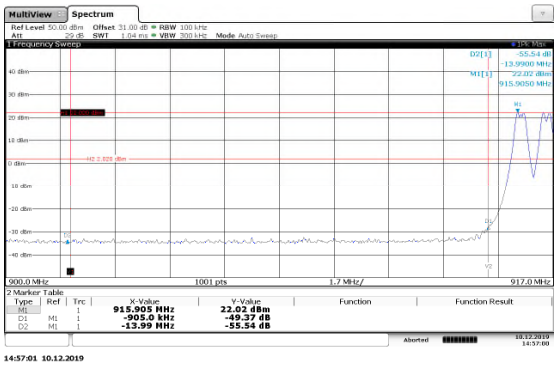


Figure 7.5.1.2-15: Lower Band-edge 200kbps

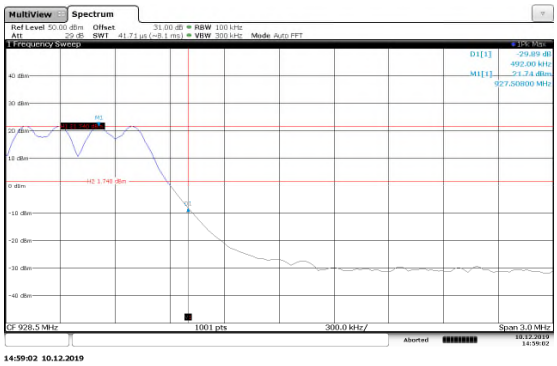


Figure 7.5.1.2-16: Upper Band-edge 200kbps

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

7.5.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer using 31.0dB of passive attenuation. The EUT was investigated for conducted spurious emissions from 30MHz to 10GHz, which corresponds to 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. There were no significant emissions from 9 kHz or lowest frequency generated to 30 MHz.

7.5.2.2 Measurement Results

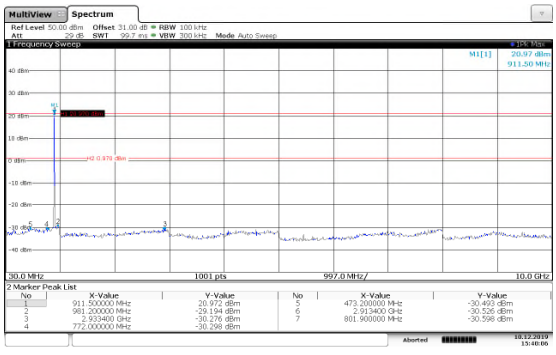


Figure 7.5.2.2-1: 30MHz–10GHz Low Channel 35.5kbps

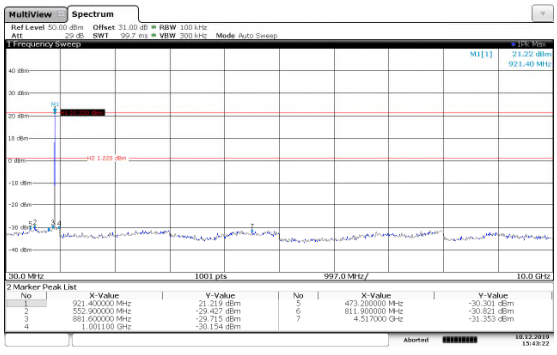


Figure 7.5.2.2-2: 30MHz–10GHz Mid Channel 35.5kbps

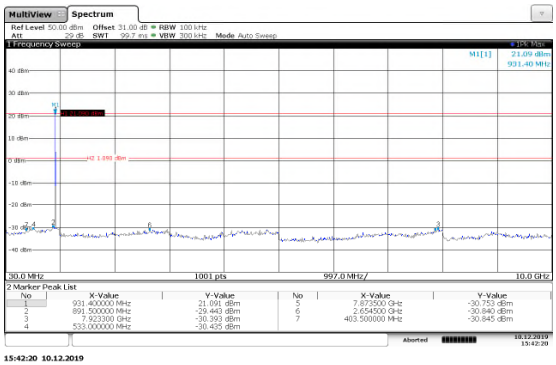


Figure 7.5.2.2-3: 30MHz–10GHz High Channel 35.5kbps

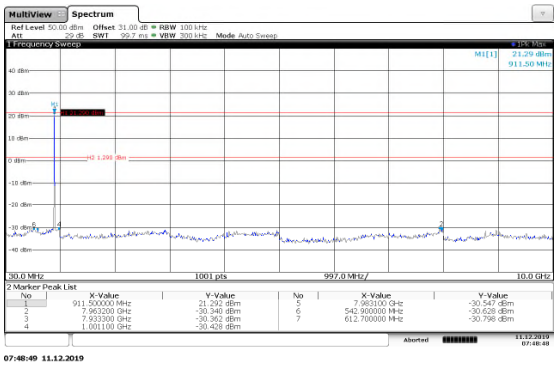


Figure 7.5.2.2-4: 30MHz–10GHz Low Channel 142.2kbps

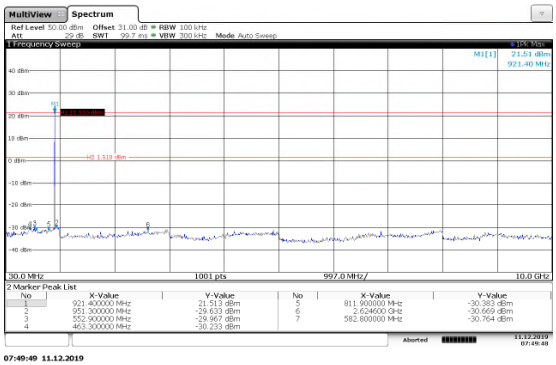


Figure 7.5.2.2-5: 30MHz–10GHz Mid Channel 142.2kbps

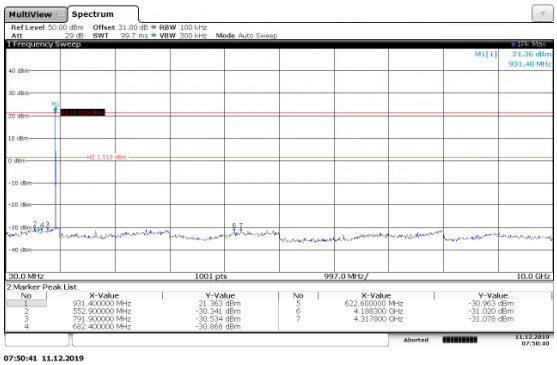
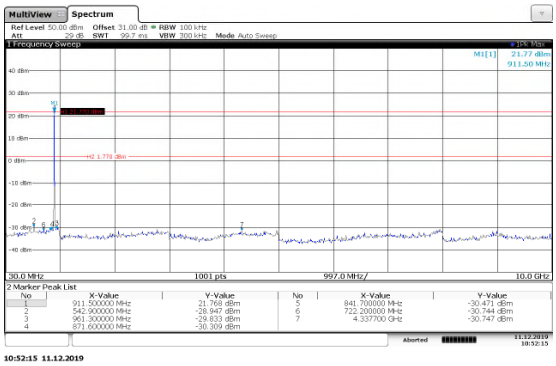


Figure 7.5.2.2-6: 30MHz–10GHz High Channel 142.2kbps



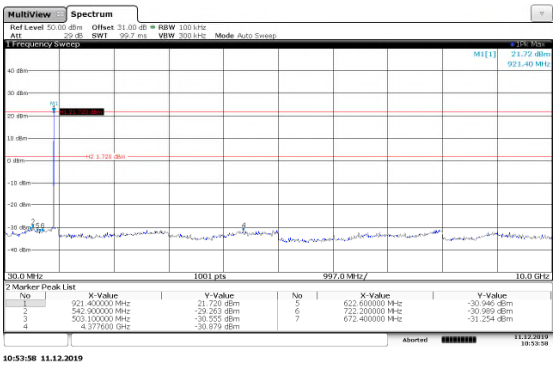
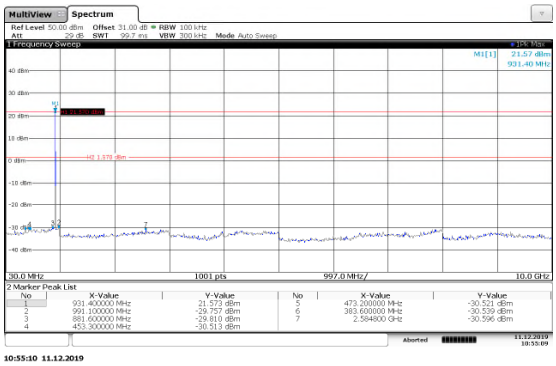


Figure 7.5.2.2-7: 30MHz–10GHz Low Channel 150kbps **Figure 7.5.2.2-8: 30MHz–10GHz Mid Channel 150kbps**



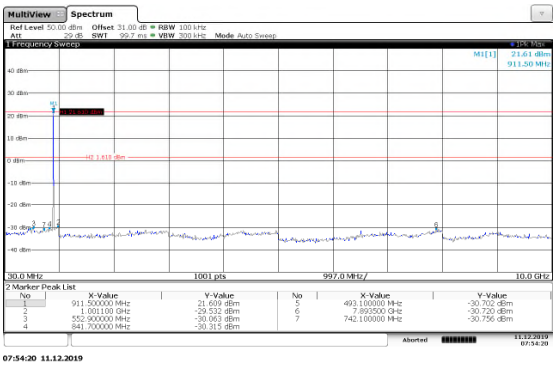
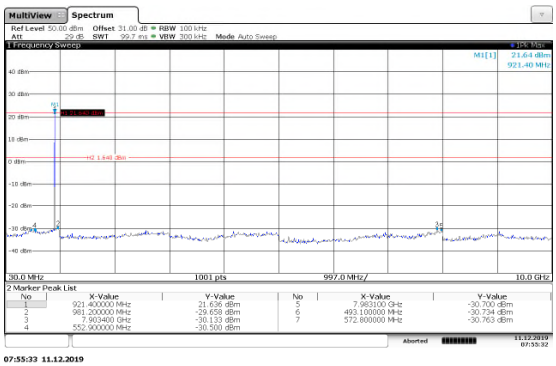


Figure 7.5.2.2-9: 30MHz–10GHz High Channel 150kbps **Figure 7.5.2.2-10: 30MHz–10GHz Low Channel 200kbps**



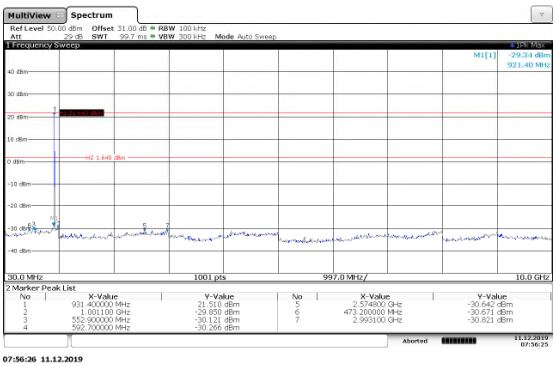


Figure 7.5.2.2-11: 30MHz–10GHz Mid Channel 200kbps **Figure 7.5.2.2-12: 30MHz–10GHz High Channel 200kbps**

7.5.3 Radiated Spurious Emissions – FCC: 15.205, 15.209; 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, which corresponds to 10 times the highest fundamental frequency.

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

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

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

7.5.3.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.5.3.3 Measurement Results

Table 7.5.3.3-1: Radiated Spurious Emissions Tabulated Data - Mode 1

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										
2748	44.10	39.50	H	-2.17	41.93	37.33	74.0	54.0	32.07	16.67
3664	40.60	31.70	V	1.25	41.85	32.95	74.0	54.0	32.15	21.05
4580	37.90	25.20	V	3.63	41.53	28.83	74.0	54.0	32.47	25.17
7328	36.20	23.00	V	8.57	44.77	31.57	74.0	54.0	29.23	22.43
8244	36.70	23.40	V	10.49	47.19	33.89	74.0	54.0	26.81	20.11
9160	37.10	23.30	V	10.55	47.65	33.85	74.0	54.0	26.35	20.15
Mid Channel										
2766	44.90	40.30	H	-2.11	42.79	38.19	74.0	54.0	31.21	15.81
3688	41.80	32.90	V	1.35	43.15	34.25	74.0	54.0	30.85	19.75
4610	38.90	25.60	H	3.62	42.52	29.22	74.0	54.0	31.48	24.78
7376	33.50	20.60	V	8.72	42.22	29.32	74.0	54.0	31.78	24.68
8298	38.00	23.50	H	10.96	48.96	34.46	74.0	54.0	25.04	19.54
8298	37.40	23.40	V	10.96	48.36	34.36	74.0	54.0	25.64	19.64
High Channel										
2782.8	44.80	40.00	H	-2.06	42.74	37.94	74.0	54.0	31.26	16.06
3710.4	41.10	32.90	V	1.45	42.55	34.35	74.0	54.0	31.45	19.65
4638	37.90	25.10	H	3.61	41.51	28.71	74.0	54.0	32.49	25.29
7420.8	31.50	17.90	V	8.86	40.36	26.76	74.0	54.0	33.64	27.24
8348.4	36.70	23.30	V	11.41	48.11	34.71	74.0	54.0	25.89	19.29

Figure 7.5.3.3-1: Radiated Emission Profile 30MHz – 1GHz – Mode 1

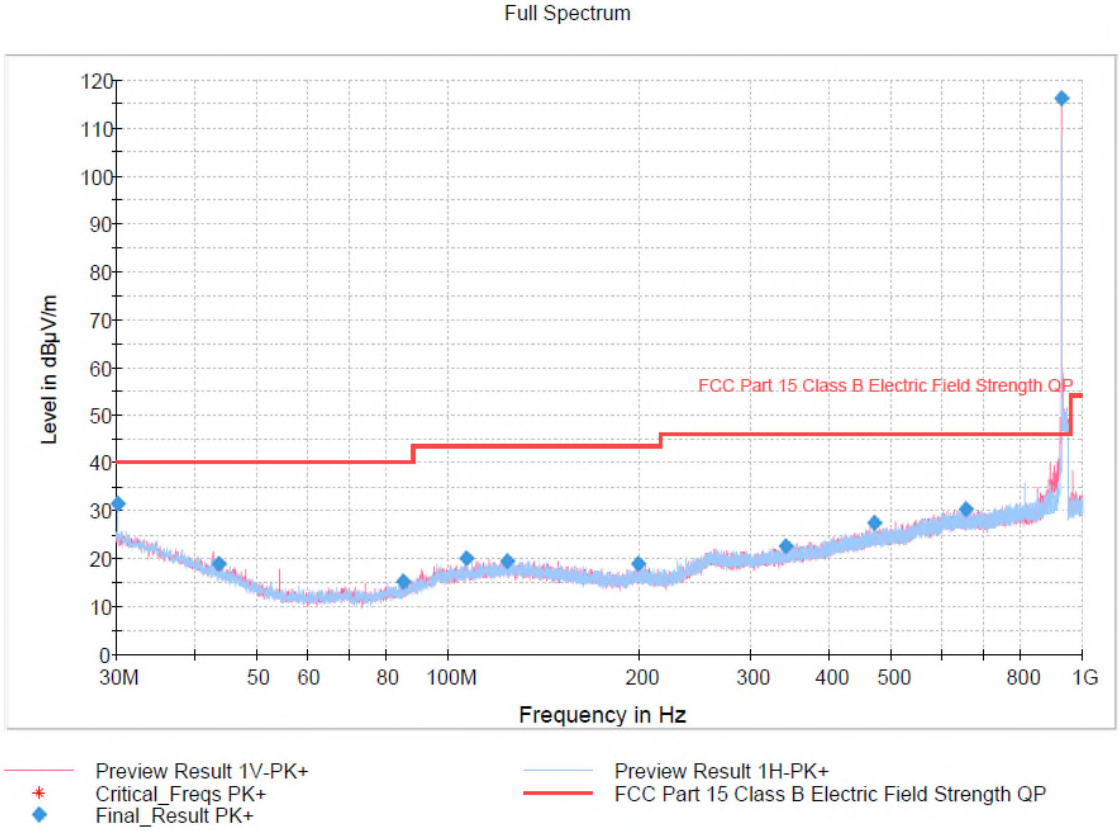


Figure 7.5.3.3-2: Radiated Emission Profile above 1GHz – Mode 1

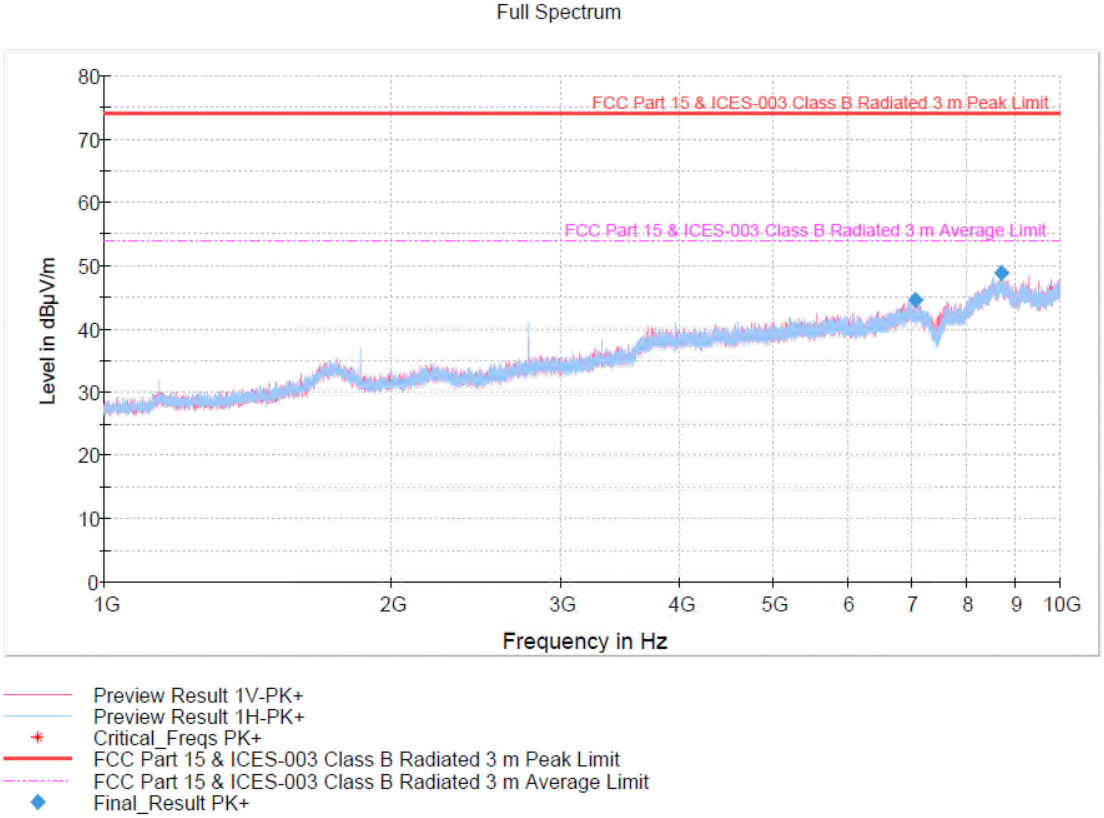


Table 7.5.3.3-2: Radiated Spurious Emissions Tabulated Data - Mode 2

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										
992.75	14.4	11.1	V	27.20	---------	38.30	--------	54.0	---------	15.70
2748	48.50	45.50	H	-2.17	46.33	43.33	74.0	54.0	27.67	10.67
3664	40.20	30.70	V	1.25	41.45	31.95	74.0	54.0	32.55	22.05
4580	37.80	24.50	H	3.63	41.43	28.13	74.0	54.0	32.57	25.87
7328	37.80	25.50	H	8.57	46.37	34.07	74.0	54.0	27.63	19.93
8244	37.20	23.80	H	10.49	47.69	34.29	74.0	54.0	26.31	19.71
9160	36.60	23.40	H	10.55	47.15	33.95	74.0	54.0	26.85	20.05
Mid Channel										
960.32	14.80	10.80	V	26.81	---------	37.61	--------	54.0	---------	16.39
998.78	13.00	9.40	V	27.20	---------	36.60	--------	54.0	---------	17.40
2766	47.90	44.80	H	-2.11	45.79	42.69	74.0	54.0	28.21	11.31
3688	41.80	33.70	V	1.35	43.15	35.05	74.0	54.0	30.85	18.95
4610	39.80	27.90	V	3.62	43.42	31.52	74.0	54.0	30.58	22.48
7376	32.60	20.40	H	8.72	41.32	29.12	74.0	54.0	32.68	24.88
8298	37.10	24.50	H	10.96	48.06	35.46	74.0	54.0	25.94	18.54
High Channel										
965.96	13.00	8.40	V	26.92	---------	35.32	--------	54.0	---------	18.68
2782.8	47.20	42.80	H	-2.06	45.14	40.74	74.0	54.0	28.86	13.26
3710.4	41.90	33.80	V	1.45	43.35	35.25	74.0	54.0	30.65	18.75
4638	40.00	30.70	H	3.61	43.61	34.31	74.0	54.0	30.39	19.69
7420.8	34.10	21.80	V	8.86	42.96	30.66	74.0	54.0	31.04	23.34
8348.4	36.90	23.60	H	11.41	48.31	35.01	74.0	54.0	25.69	18.99

Figure 7.5.3.3-3: Radiated Emission Profile 30MHz – 1GHz – Mode 2

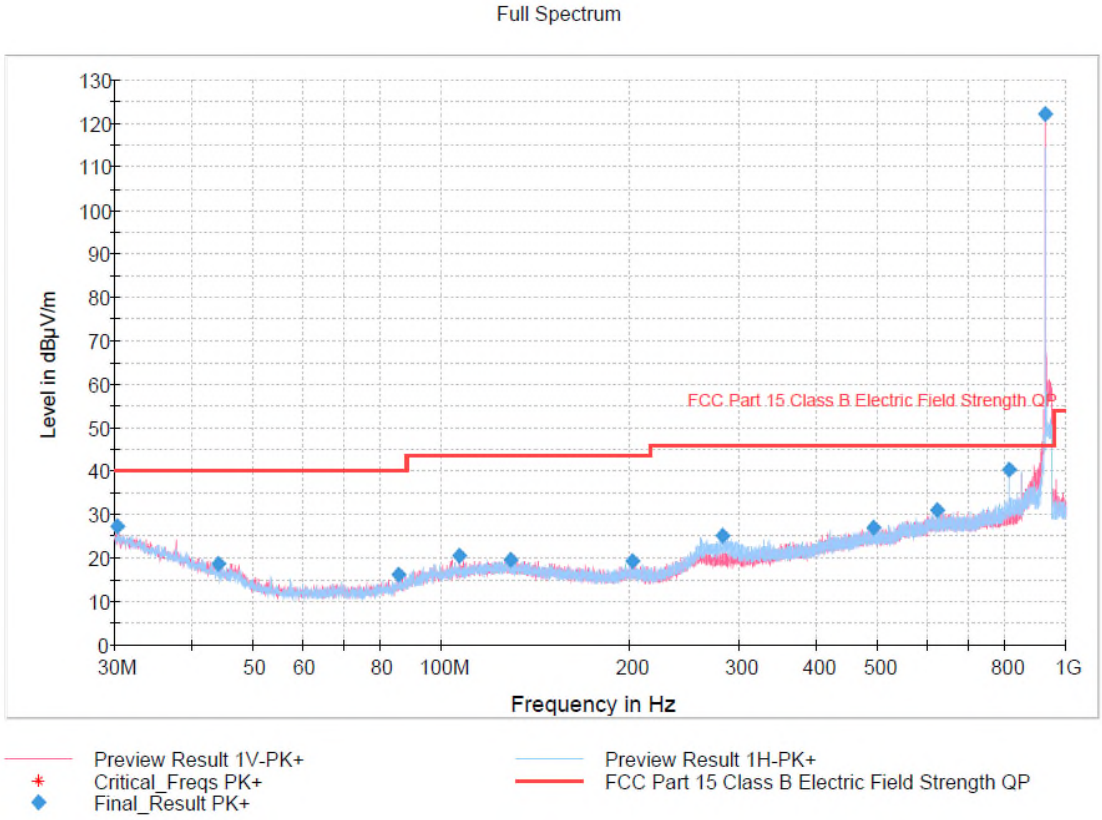
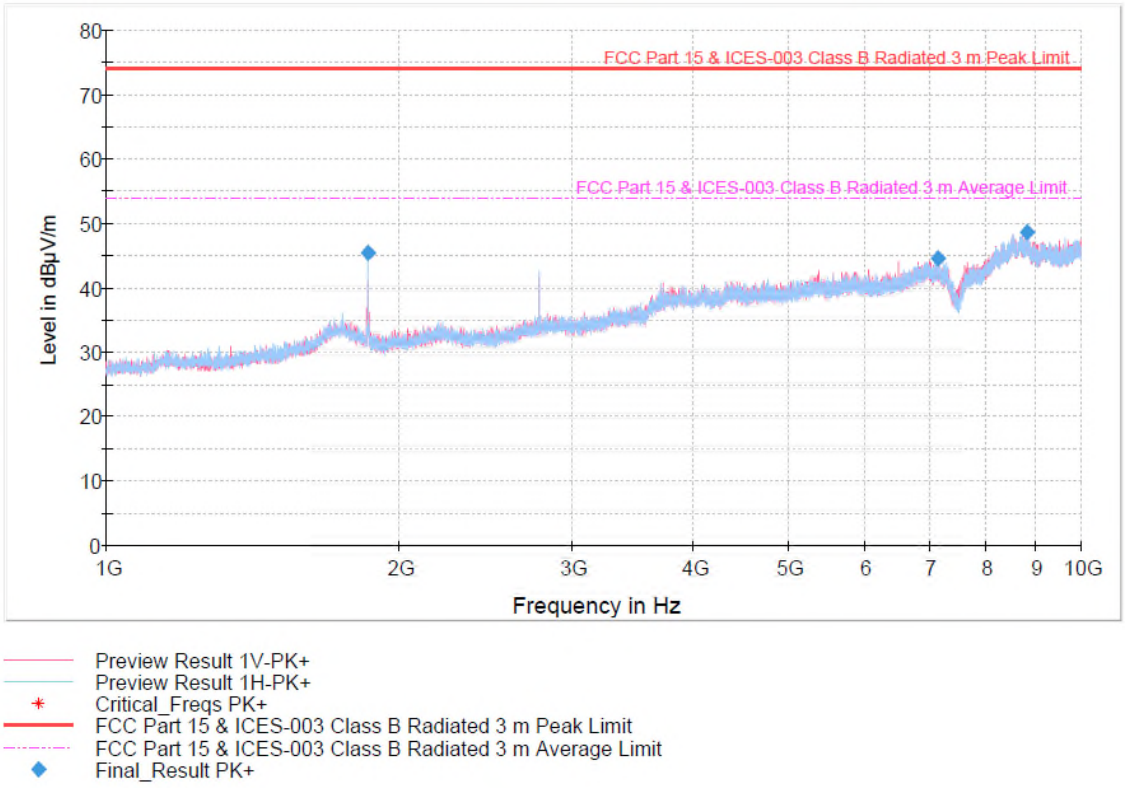


Figure 7.5.3.3-4: Radiated Emission Profile above 1GHz – Mode 2



7.5.3.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: 47.20 - 2.06 = 45.14dBuV/m
Margin: 74dBuV/m – 45.14dBuV/m = 28.86dB

Example Calculation: Average

Corrected Level: 42.80 - 2.06 = 40.74dBuV
Margin: 54dBuV – 40.74dBuV = 13.26dB

8 CONCLUSION

In the opinion of TÜV SÜD America Inc. the Global Network Interface Card International (GNICI), manufactured by Elster Solutions LLC meets the requirements of FCC Part 15 Subpart C and ISED Canada's Radio Standards Specification RSS-247 for the tests documented herein.

END REPORT