

Report on the Testing of the

Itron, Inc.
NIC

In accordance with:
FCC 47 CFR part 15.247
ISED RSS-247 Issue 2, February 2017

Prepared for: Itron, Inc.
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West Union, South Carolina 29696 USA



America

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A handwritten signature in black ink, appearing to read "Jean-Charles, Thierry".

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Jean-Charles, Thierry	Senior Engineer TUV SUD America Inc.	Authorized Signatory	8/1/2023

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

FCC Accreditation Designation Number US1233
FCC Test Site Registration Number 967699
Innovation, Science, and Economic Development Canada Lab Code 23932

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with the standards listed above.



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Table 1.1-1 – Modification Record

Issue	Description of Change	Date of Issue
0	First Issue	3/23/2023
1	Second issue	7/12/2023
2	Third Issue	08/01/2023

1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein to add an additional mode to the 900 MHz DSS radio on pre-approved module having FCC ID: SK9NIC / IC: 864G-NIC.

Applicant	Christopher O'Steen
Manufacturer	Ittron, Inc
Applicant's Email Address	Christopher.O'steen@itron.com
Model Name	NIC
Serial Number(s)	11090012006
FCC ID	SK9NIC
ISED Certification Number	864G-NIC
Hardware Version(s)	576035-003 (Rev3)
Software Version	101.12.1673
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal Regulation (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2022 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.
Order Number	72186194
Date of Receipt of EUT	2/6/2023
Start of Test	2/6/2023



Finish of Test

7/26/2023

Related Document(s)

ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device.

FCC OET KDB 558074 D01 15.247 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

US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2022.

ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

Table 1.3-1: Test Result Summary

Test Parameter	Test Plan (Yes/No)	Test Result	FCC 47 CFR Rule Part	ISED Canada's RSS	Test Report Page No
Antenna Requirement	Yes	Pass	15.203, 15.204	-----	10
Carrier Frequency Separation	Yes	Pass	15.247(a)(1)	RSS-247 5.1(b)	16
Number of Hopping Channels	Yes	Pass	15.247(a)(1)(i)	RSS-247 5.1(c)	18
Channel Dwell Time	Yes	Pass	15.247(a)(1)(i)	RSS-247 5.1(c)	20
20 dB Bandwidth	Yes	Pass	15.247(a)(1)(i)	RSS-247 5.1(c)	22
99% Bandwidth	Yes	Pass	-----	RSS-GEN 6.7	21
Peak Output Power	Yes	Pass	15.247(b)(2)	RSS-247 5.4(a)	14
Band-Edge Compliance of RF Conducted Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	28
RF Conducted Spurious Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	32
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	36
Power Spectral Density	No	Not Tested	15.247(e)	RSS-247 5.2(b)	-----
Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	11
Duty Cycle	No	-----			-----



1.4 Product Information

1.4.1 Technical Description

The Itron HW 4.1 NIC is a network interface card which includes a 900MHz radio. The module operates on DC Voltage which is supplied by a host device.

This test report documents the compliance of additional technical parameters identified below:

Table 1.4-1 – General Information

Detail	Description
FCC ID	SK9NIC
ISED Certification Number	864G-NIC
Model(s) / HVIN(s)	NIC
PMN(s)	IPv6 Mesh NIC Module
Operating Voltage	12Vdc
Antenna Type / Description:	*External Omnidirectional / 3 dBi (Laird, P/N: TRA9023P)

*Note: Only the External Omnidirectional / 3 dBi (Laird, P/N: TRA9023P) antenna is applicable to the additional modes included.

Table 1.4-2 – Technical Parameters

Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Modulation Format	Data Rates Supported (kbps)
902.4 – 927.6	64	400	FSK	50, 150
902.3 – 926.9*	83	300	FSK	100
902.4 – 927.6	64	400	OFDM	200, 600
902.4 – 927.6	64	400	DSSS	12.5
902.4 – 927.6*	64	400	GFSK	300
902.3 – 926.9*	83	300	GFSK	150, 200

*Note: New modes to the original certification to be addressed in this report

A full description and detailed product specification details are available from the manufacturer.



Figure 1.4.1-1: Front Side of the EUT



Figure 1.4.1-2: Back Side of the EUT

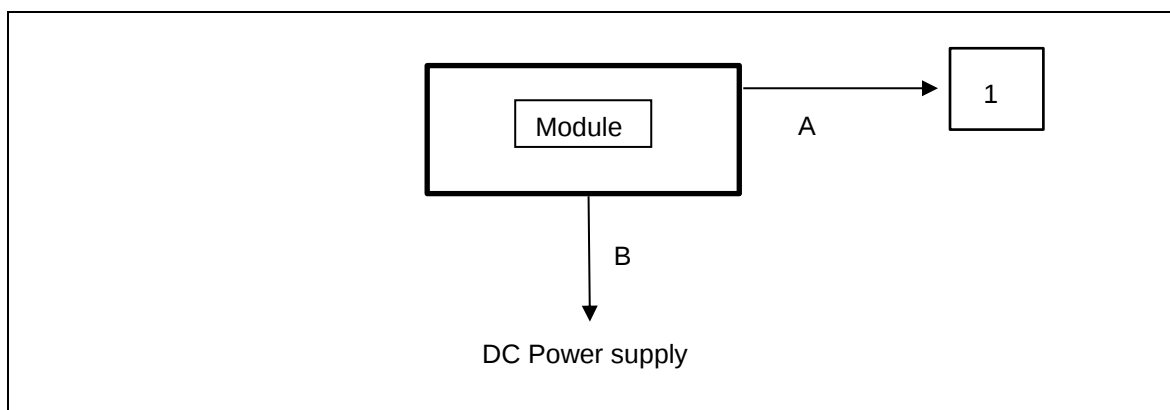


Figure 1.4.1-3 –Test Setup Block Diagram

Table 1.4.1-1 – Cable Descriptions

Item	Cable/Port	Description
A	USB Serial cable	Programming cable connected to laptop
B	DC Power Supply Cable	DC power supply

Table 1.4.1-2 – Support Equipment Descriptions

Item	Make/Model	Description
1	DELL	Laptop used for configuring module



1.4.2 Modes of Operation

The Itron HW 4.1 NIC is a network interface card which includes a 900MHz radio. This test report documents the compliance of the 900 MHz FHSS transceiver mode of operation. NIC module provides the following modes of operation using FHSS classification as outlined below and is an addition to the existing modes included in the original evaluation. See section 1.4.1 for additional detail.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Modulation Format	Data Rates Supported (kbps)	Classification
1	902.3 – 926.9	83	300	GFSK	150, 200	FHSS
2	902.4 – 927.6	64	400	GFSK	300	FHSS
3	902.3 – 926.9	83	300	FSK	100	FHSS

1.4.3 Monitoring of Performance

For RF conducted measurements, all modes of operation, including all available data rates, were evaluated. For radiated emissions, the worst-case data rate is represented in this report.

The worst-case data rate for GFSK modulation was 300kbps.

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

For RF conducted measurements, the EUT was connected to the test equipment with a QMA to SMA adapter.

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

Software power setting during test: Mode of operation 1 ,2 & 3: 30

1.5 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

1.6 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.



Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	Initial State		
1	Added Dwell time measurement data as requested by client	Bhagyashree	7/10/2023
2	Client added an additional mode	Divya	07/26/2023

The equipment was tested as provided without any modifications.

1.7 Test Location

TÜV SÜD conducted the following tests at our Alpharetta, GA test laboratory.

Test Name	Name of Engineer(s)	Accreditation
Antenna Requirement	Divya Adusumilli	A2LA
Power Line Conducted Emissions	Divya Adusumilli	A2LA
Peak Output Power	Divya Adusumilli	A2LA
Carrier Frequency Separation	Divya Adusumilli	A2LA
Number of Hopping Channels	Divya Adusumilli	A2LA
Dwell Time	Bhagyashree Chaudhary	A2LA
20dB / 99% Bandwidth	Divya Adusumilli	A2LA
Band-Edge Compliance of RF Conducted Emissions	Divya Adusumilli	A2LA
RF Conducted Spurious Emissions	Divya Adusumilli	A2LA
Radiated Spurious Emissions into Restricted Frequency Bands	Divya Adusumilli	A2LA

Office address:
TÜV SÜD America
5945 Cabot Parkway, Suite 100
Alpharetta, GA 30005, USA



2 Test Details

2.1 Antenna Requirement

2.1.1 Specification Reference

FCC Section: 15.203, 15.204

2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.1.3 Date of Observation

7/26/2023

2.1.4 Test Method

N/A

2.1.5 Environmental Conditions

N/A

2.1.6 Observation

The EUT utilizes external omnidirectional antenna with peak gain 3 dBi. Connection to the module is via QMA connector, therefore satisfying the requirements of Section 15.203.



2.2 Power Line Conducted Emissions

2.2.1 Specification Reference

FCC Section: 15.207
ISED Canada: RSS-Gen 8.8

2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state "0", as noted in §1.6.

2.2.3 Date of Test

2/13/2023

2.2.4 Test Method

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

2.2.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar



2.2.6 Test Results

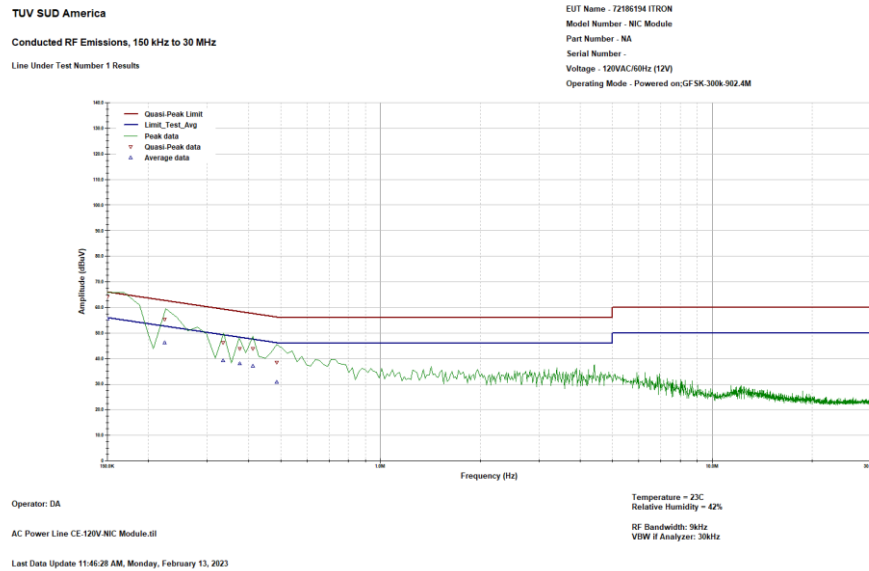


Figure 2.2.6-1: Conducted Emission Plot – Line 1

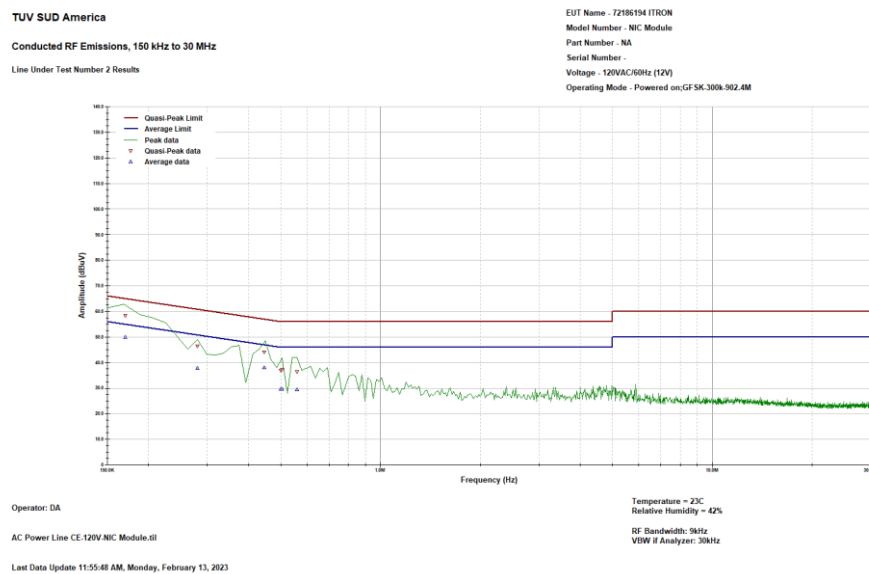


Figure 2.2.6-2: Conducted Emission Plot – Neutral

**Table 2.2.6-1: Conducted EMI Results-Avg – Line 1**

Frequency	Avg Limit	Avg Level Corr	Avg Level	CF	Avg Margin	Result
MHz	dBuV	dBuV	dBuV	dB	dB	
0.15	56	55.5	45.8	9.682	-0.5	PASS
0.22	53.9	46.1	36.4	9.671	-7.8	PASS
0.34	50.7	39.3	29.6	9.658	-11.4	PASS
0.38	49.6	38	28.4	9.656	-11.5	PASS
0.41	48.5	37.1	27.5	9.654	-11.4	PASS
0.49	46.4	30.9	21.2	9.651	-15.5	PASS

Table 2.2.6-2: Conducted EMI Results-QP – Line 1

Frequency	QP Limit	QP Level Corr	QP Level	CF	QP Margin	Result
MHz	dBuV	dBuV	dBuV	dB	dB	
0.15	66	64.1	54.4	9.682	-1.9	PASS
0.22	63.9	55.3	45.6	9.671	-8.6	PASS
0.34	60.7	46.2	36.6	9.658	-14.5	PASS
0.38	59.6	43.9	34.2	9.656	-15.7	PASS
0.41	58.5	43.7	34.1	9.654	-14.7	PASS
0.49	56.4	38.4	28.7	9.651	-18	PASS

Table 2.2.6-3: Conducted EMI Results-Avg – Neutral

Frequency	Avg Limit	Avg Level Corr	Avg Level	CF	Avg Margin	Result
MHz	dBuV	dBuV	dBuV	dB	dB	
0.17	55.4	49.8	40.1	9.673	-5.6	PASS
0.28	52.3	37.7	28.1	9.662	-14.5	PASS
0.45	47.5	38.1	28.5	9.638	-9.4	PASS
0.5	46	29.6	20	9.63	-16.4	PASS
0.5	46	29.6	20	9.63	-16.4	PASS
0.56	46	29.5	19.8	9.634	-16.5	PASS

Table 2.2.6-4: Conducted EMI Results-QP – Neutral

Frequency	QP Limit	QP Level Corr	QP Level	CF	QP Margin	Result
MHz	dBuV	dBuV	dBuV	dB	dB	
0.17	65.4	58.4	48.8	9.673	-7	PASS
0.28	62.3	46.5	36.8	9.662	-15.8	PASS
0.45	57.5	44	34.4	9.638	-13.5	PASS
0.5	56	36.8	27.2	9.63	-19.2	PASS
0.5	56	37.3	27.6	9.63	-18.7	PASS
0.56	56	36.4	26.8	9.634	-19.6	PASS



2.3 Peak Output Power

2.3.1 Specification Reference

FCC Sections: 15.247(b)(2)
ISED Canada: RSS-247 5.4(a)

2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.3.3 Date of Test

02/06/2023 – 07/26/2023

2.3.4 Test Method

The maximum conducted peak output power was measured in accordance with ANSI C63.10 Subclause 7.8.5 Method PKPM (Peak Power meter). The RF output port of the EUT was directly connected to the input of a peak power meter. The resulting peak value was recorded.

2.3.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.3.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See data below for detailed results.



Table 2.3.6-1: RF Output Power

Frequency [MHz]	Peak Output Power (dBm)	E.I.R.P (dBm)	Data Rate (kbps)	Mode(s)
902.3	29.75	32.75	150	1
915.2	29.33	32.33	150	1
926.9	28.99	31.99	150	1
902.3	29.85	32.85	200	1
915.3	29.52	32.52	200	1
926.9	28.98	31.98	200	1
902.4	29.92	32.92	300	2
915.2	29.43	32.43	300	2
927.6	29.04	32.04	300	2
902.3	29.43	32.43	100	3
915.2	29.08	32.08	100	3
926.9	28.73	31.73	100	3



2.4 Carrier Frequency Separation

2.4.1 Specification Reference

FCC Sections: 15.247(a)(1)
ISED Canada: RSS-247 5.1(b)

2.4.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.4.3 Date of Test

02/06/2023 – 07/26/2023

2.4.4 Test Method

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 $\geq$ RBW.

2.4.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.4.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See below plots for detailed results.

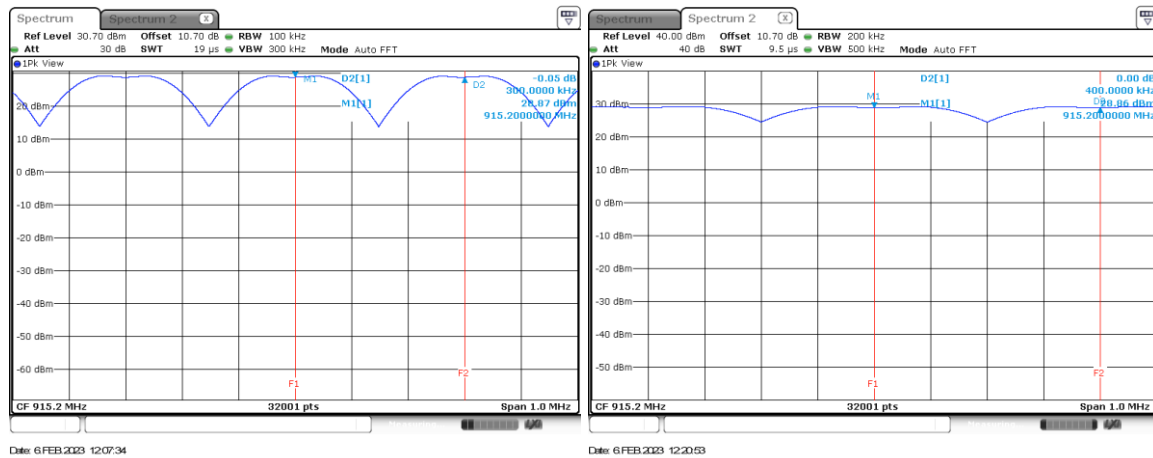


Figure 2.4.6-1: Channel Separation – Mode 1 – 150 / 200 kbps

Figure 2.4.6-2: Channel Separation – Mode 2 – 300kbps

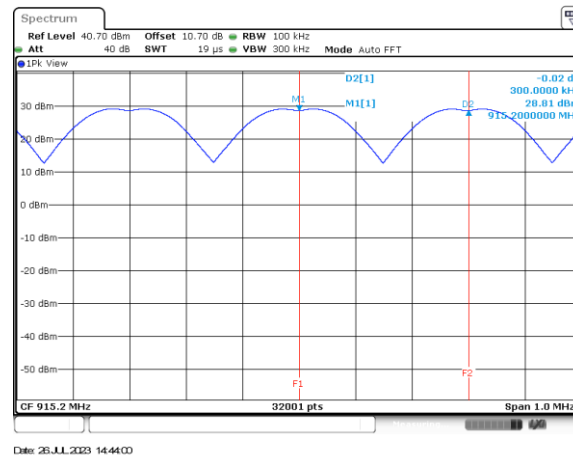


Figure 2.4.6-3: Channel Separation – Mode 3 – 100kbps - FSK



2.5 Number of Hopping Channels

2.5.1 Specification Reference

FCC Sections: 15.247(a)(1)(i)
ISED Canada: RSS 247 5.1 (c)

2.5.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.5.3 Date of Test

02/06/2023 – 07/26/2023

2.5.4 Test Method

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 $\geq$ RBW.

2.5.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.5.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See below plots for detailed results.

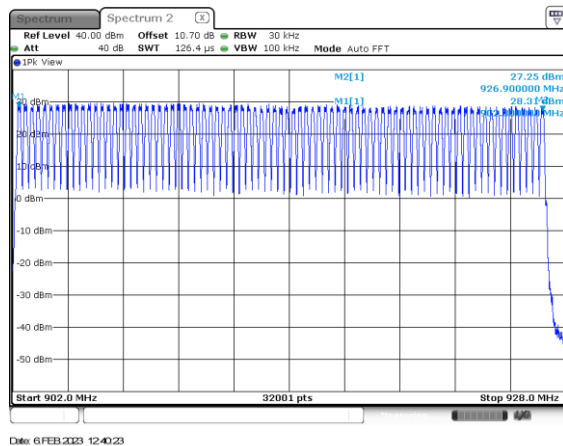


Figure 2.5.6-1: Mode 1 – 150 / 200 kbps (83 Channels)

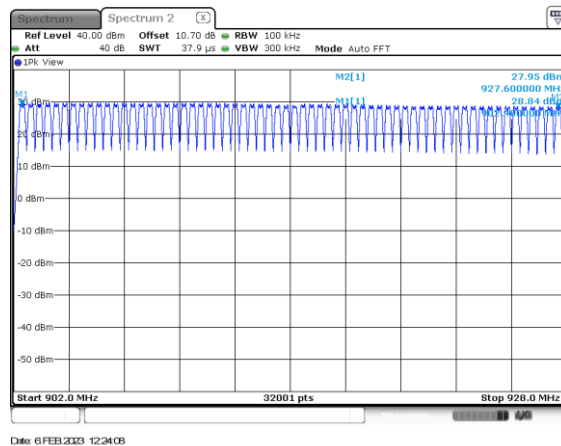


Figure 2.5.6-2: Mode 2 – 300 kbps (64 Channels)

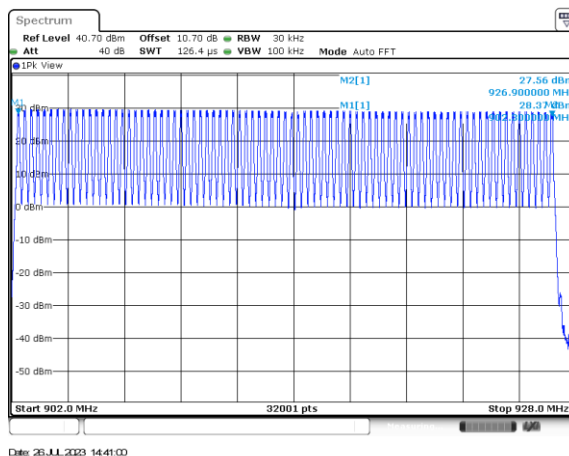


Figure 2.5.6-3: Mode 3 – 100 kbps (83 Channels) – FSK



2.6 Channel Dwell Time

2.6.1 Specification Reference

FCC Sections: 15.247(a)(1)(i), 15.247 (f)
ISED: RSS-247 5.1(c), RSS-247 5.3(a)

2.6.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “1”, as noted in §1.6.

2.6.3 Date of Test

7/7/2023

2.6.4 Test Method

Dwell time measurements were recorded using the test methods defined in ANSI C63.10, Section 7.8.4. The limit is 0.4 seconds within a 20 second period for devices using more than 50 hopping channels or within 10 seconds for devices using more than 25 hopping channels.

The worst-case modulation and data rate GFSK150 was measured.

2.6.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.6.6 Test Results

Test Results: Pass

See below plots for detailed results.



Table 2.6.6-1: Dwell Time

Worst-Case Channel Spacing (kHz)	Modulation Format	Data Rate (kbps)	Time on Single Hop (ms)	Number of hops per 20 seconds	Time on channel per 20 seconds (ms)	Limit (ms)
300	GFSK	150	68.3114	4	273.2456	400

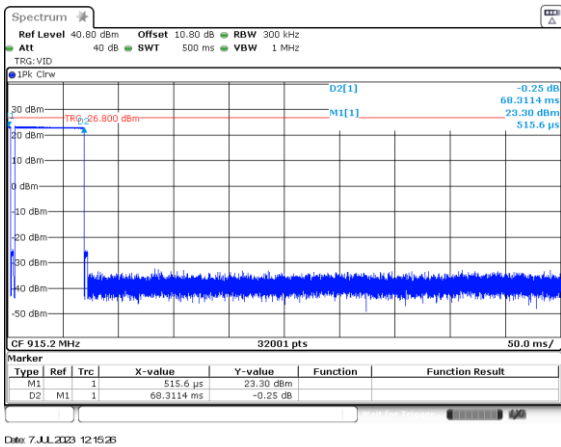


Figure 2.6.6-1: Dwell Time – 300kHz Spacing – Single Hop

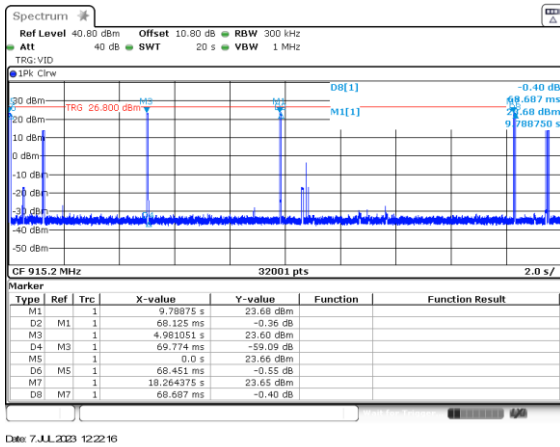


Figure 2.6.6-2: Dwell Time – 300kHz Spacing – 20 Seconds



2.7 20dB / 99% Bandwidth

2.7.1 Specification Reference

FCC Sections: 15.247(a)(1)(i)
ISED Canada: RSS-247 5.1(c), RSS-GEN 6.7

2.7.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.7.3 Date of Test

02/06/2023 – 07/26/2023

2.7.4 Test Method

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.

2.7.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.7.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See data below for detailed results.

Table 2.7.6-1: 20dB / 99% Bandwidth

Frequency [MHz]	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	Data Rate	Mode(s)
902.3	181.000	160.700	150 kbps	1
915.2	181.000	160.700	150 kbps	1
926.9	181.000	160.500	150 kbps	1
902.3	244.100	215.700	200 kbps	1
915.2	244.000	215.700	200 kbps	1
926.9	244.000	215.400	200 kbps	1
902.4	365.800	318.200	300 kbps	2
915.2	364.800	318.200	300 kbps	2
927.6	365.400	318.200	300 kbps	2
902.3	130.800	129.700	100 kbps	3
915.2	130.900	129.800	100 kbps	3
926.9	130.500	129.700	100 kbps	3

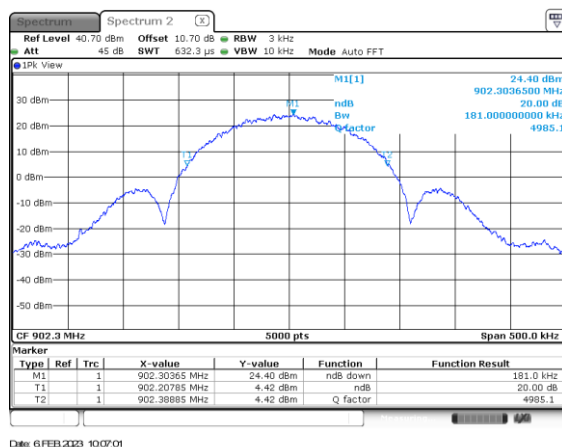


Figure 2.7.6-1: Mode 1 – 20 dB BW – LCH – 150 kbps

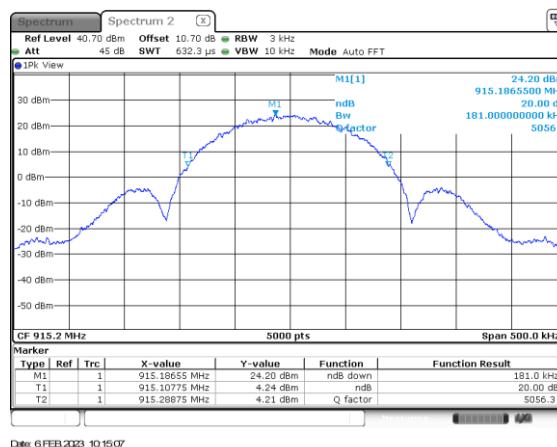
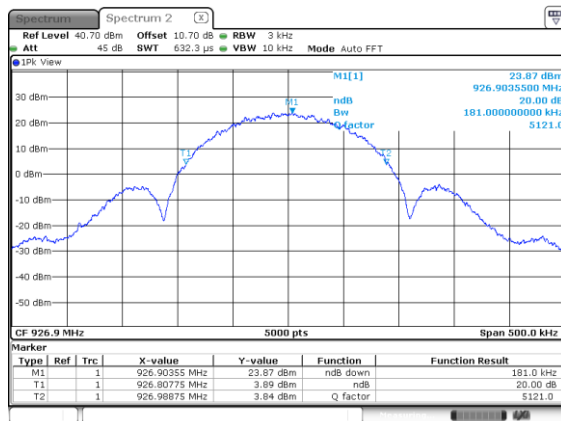
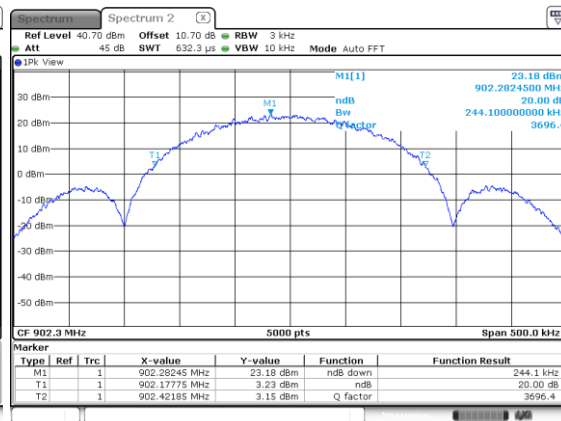


Figure 2.7.6-2: Mode 1 – 20 dB BW – MCH – 150 kbps



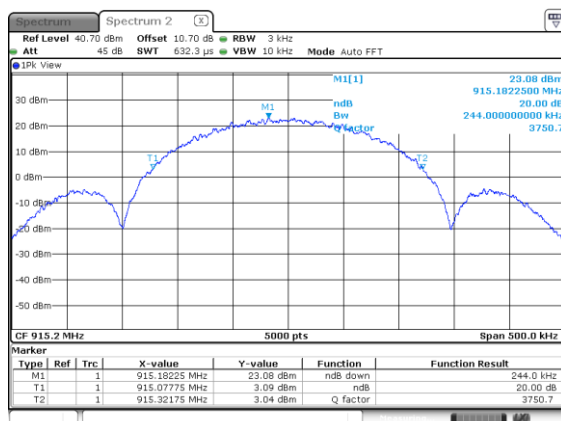
Date: 6 FEB.2023 10:19:01

Figure 2.7.6-3: Mode 1 – 20 dB BW – HCH – 150 kbps



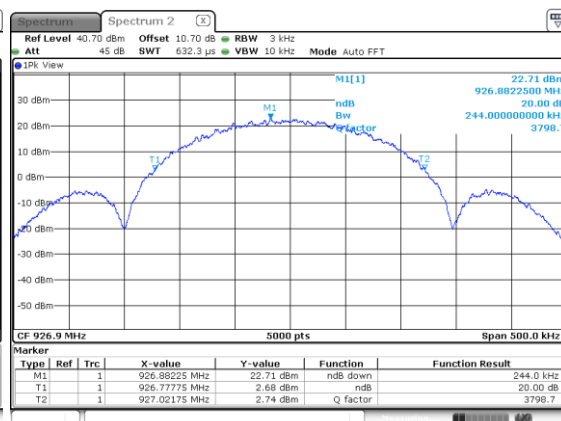
Date: 6 FEB.2023 10:35:16

Figure 2.7.6-4: Mode 1 – 20 dB BW – LCH – 200 kbps



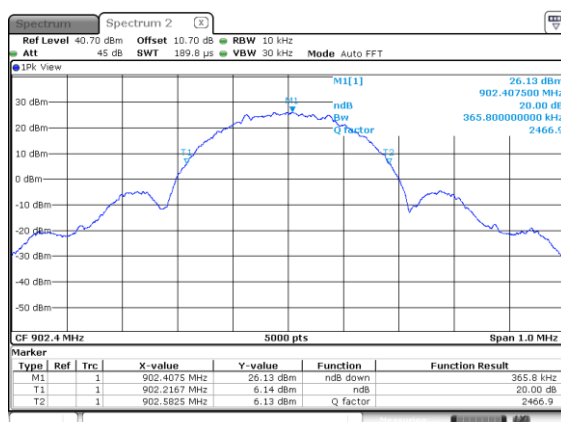
Date: 6 FEB.2023 10:27:51

Figure 2.7.6-5: Mode 1 – 20 dB BW – MCH – 200 kbps



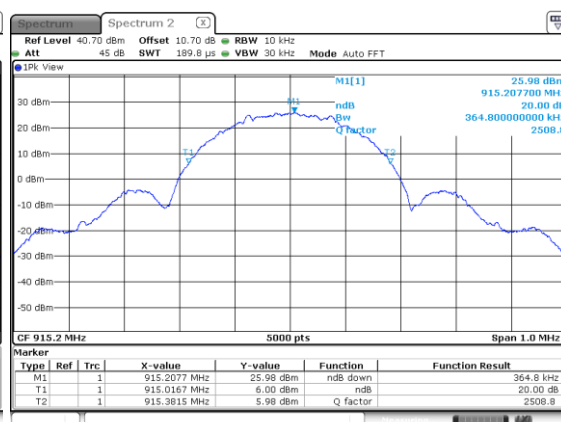
Date: 6 FEB.2023 10:23:54

Figure 2.7.6-6: Mode 1 – 20 dB BW – HCH – 200 kbps



Date: 6 FEB.2023 10:40:03

Figure 2.7.6-7: Mode 2 – 20 dB BW – LCH – 300 kbps



Date: 6 FEB.2023 10:44:22

Figure 2.7.6-8: Mode 2 – 20 dB BW – MCH – 300 kbps

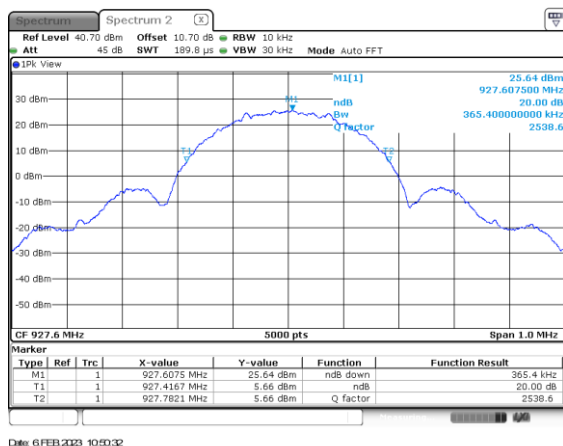


Figure 2.7.6-9: Mode 2 – 20 dB BW – HCH – 300 kbps

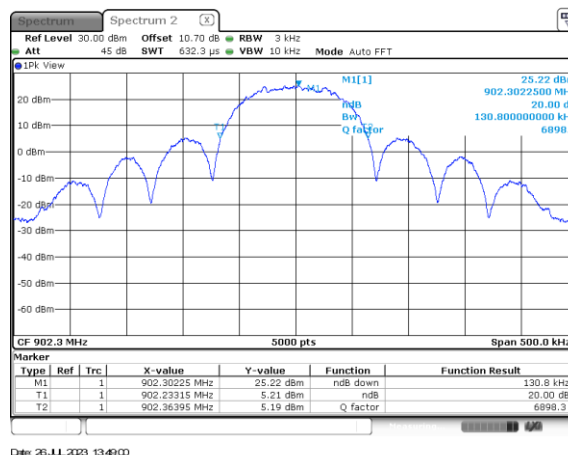


Figure 2.7.6-10: Mode 3 – 20 dB BW – LCH – 100 kbps – FSK

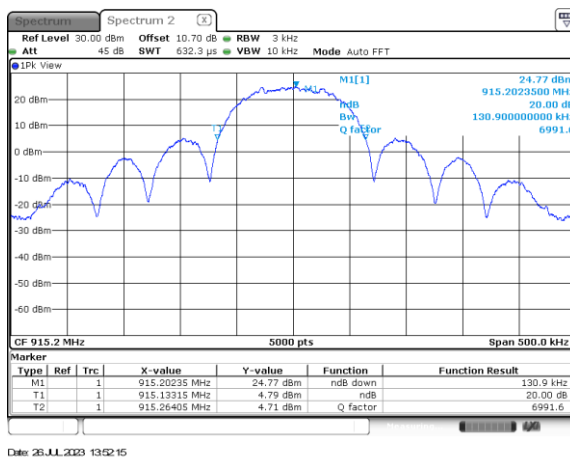


Figure 2.7.6-11: Mode 3 – 20 dB BW – MCH – 100 kbps – FSK

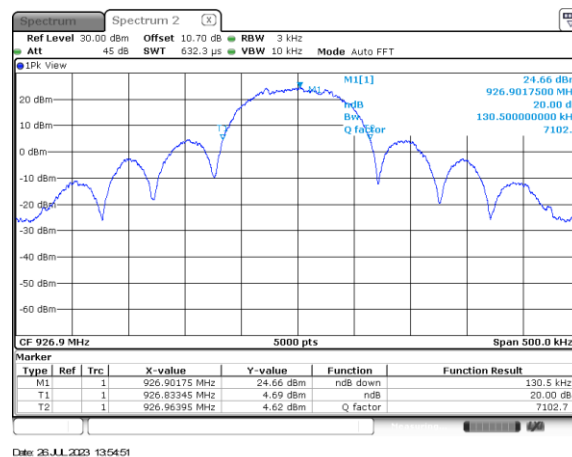


Figure 2.7.6-12: Mode 3 – 20 dB BW – HCH – 100 kbps – FSK

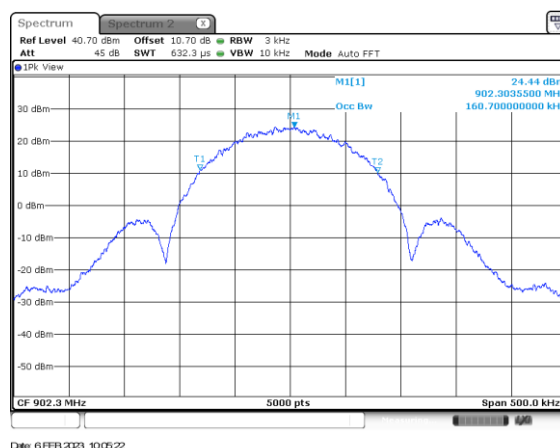


Figure 2.7.6-13: Mode 1 – 99% OBW – LCH – 150 kbps

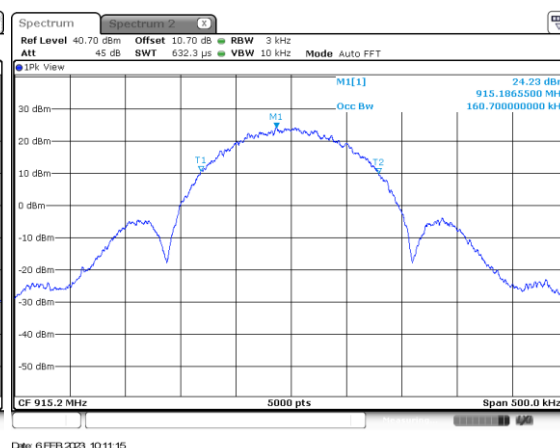


Figure 2.7.6-14: Mode 1 – 99% OBW – MCH – 150 kbps

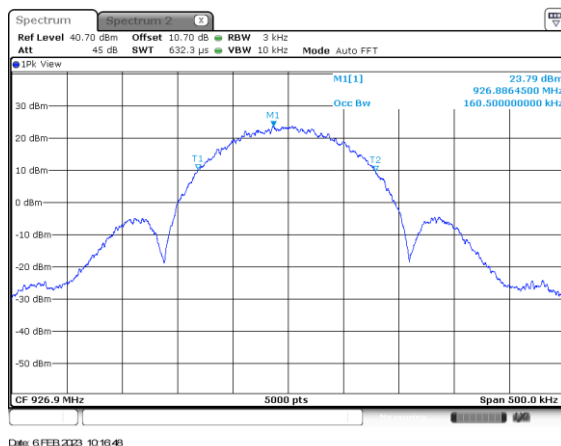


Figure 2.7.6-15: Mode 1 – 99% OBW – HCH – 150 kbps

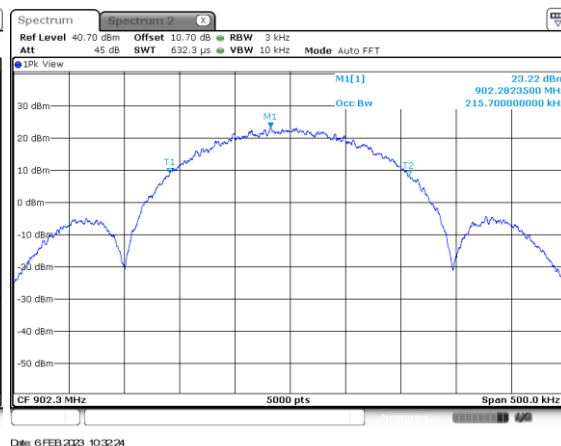


Figure 2.7.6-16: Mode 1 – 99% OBW – LCH – 200 kbps

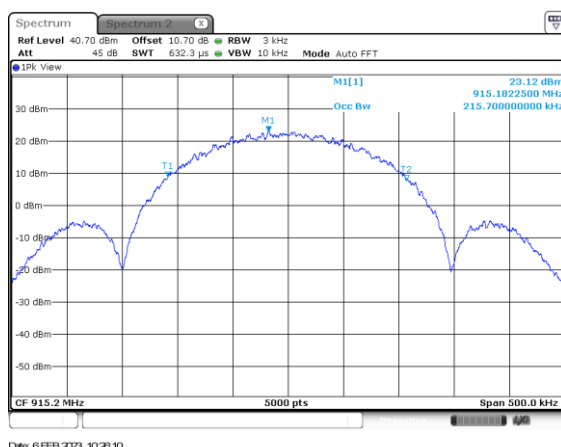


Figure 2.7.6-17: Mode 1 – 99% OBW – MCH – 200 kbps

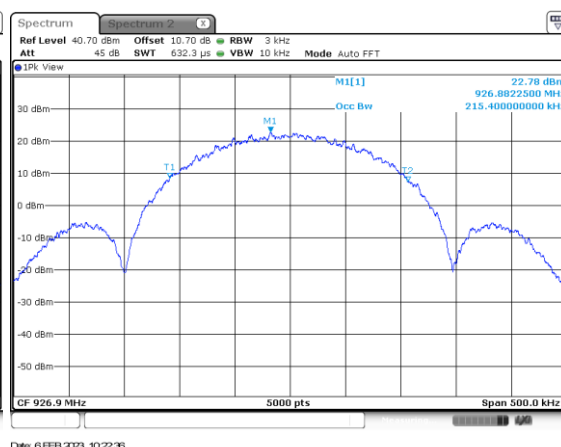


Figure 2.7.6-18: Mode 1 – 99% OBW – HCH – 200 kbps

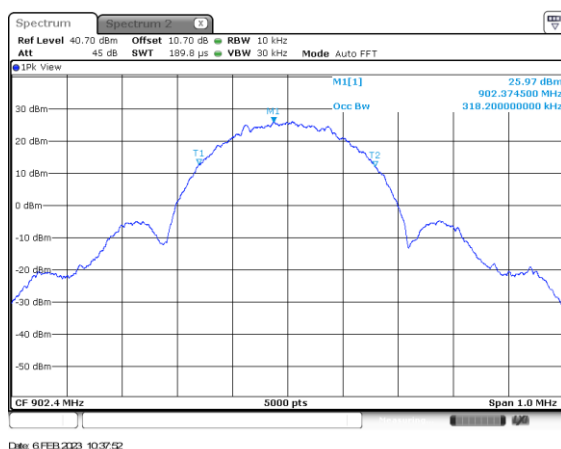


Figure 2.7.6-19: Mode 2 – 99% OBW – LCH – 300 kbps

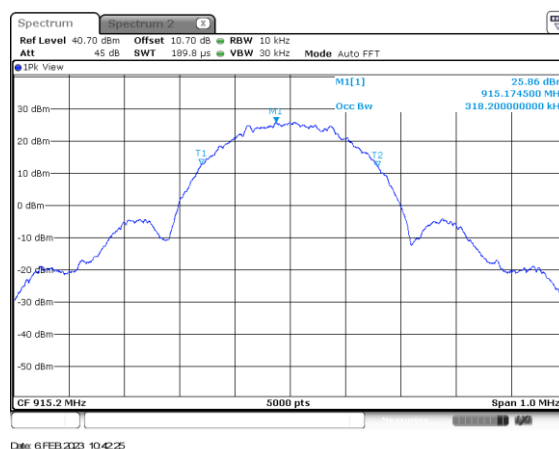
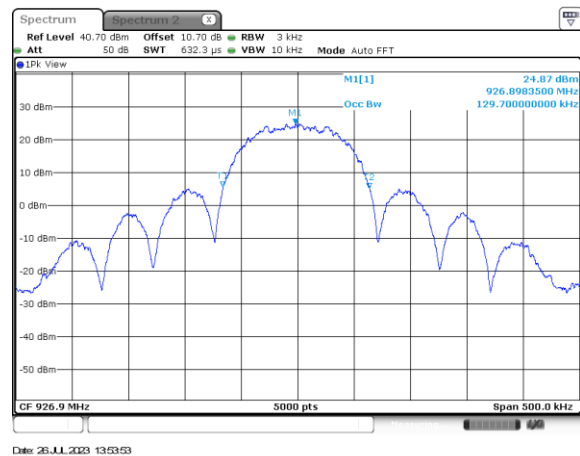
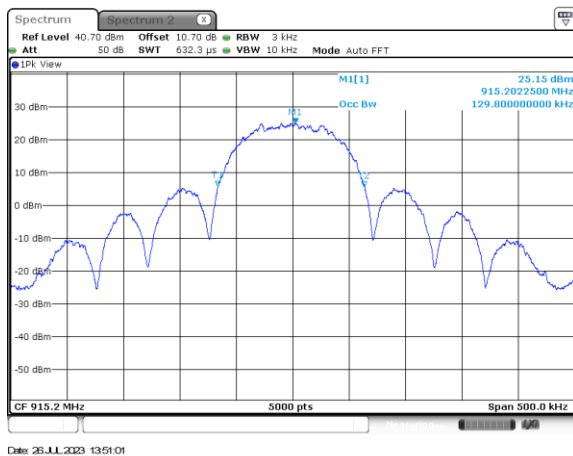
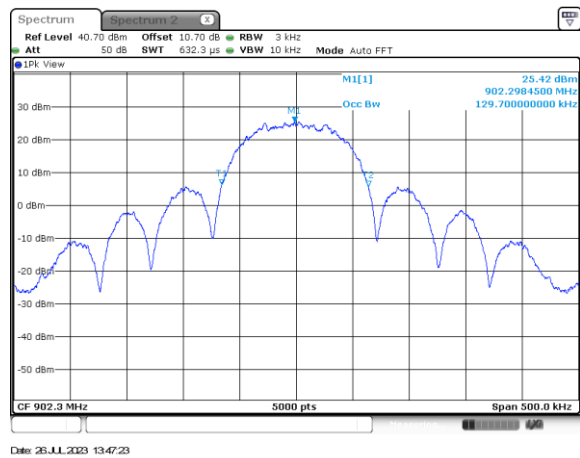
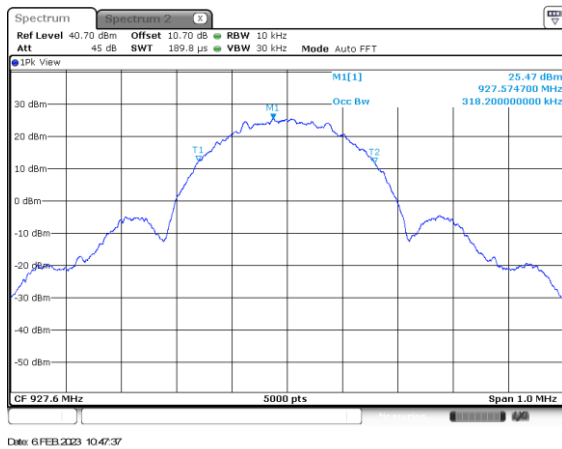


Figure 2.7.6-20: Mode 2 – 99% OBW – MCH – 300 kbps





2.8 Band-Edge Compliance of RF Conducted Emissions

2.8.1 Specification Reference

FCC Sections: 15.247(d)
ISED Canada: RSS-247 5.5

2.8.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.8.3 Date of Test

02/06/2023 – 07/26/2023

2.8.4 Test Method

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.

If the maximum peak conducted output power procedure was used to determine compliance, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc) Modes 1 & 2 band edge frequency attenuated by 20 dBc

If maximum conducted (average) output power was used to determine compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

2.8.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.8.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See data below for detailed results.



HOPPING MODE:

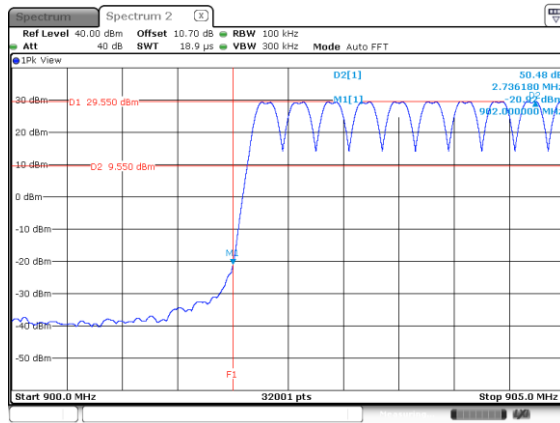


Figure 2.8.6-1: Lower Band edge – Mode 1 – 150kbps

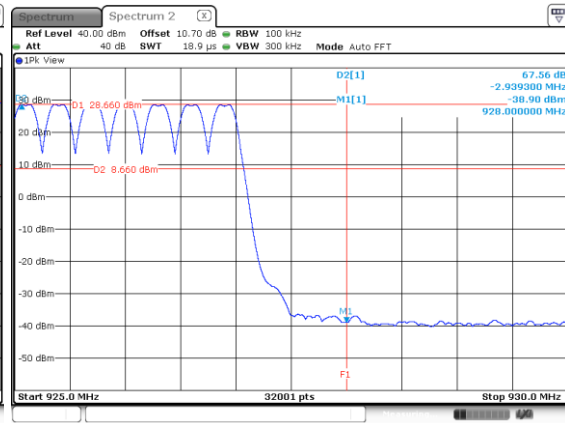


Figure 2.8.6-2: Upper Band edge – Mode 1 – 150kbps

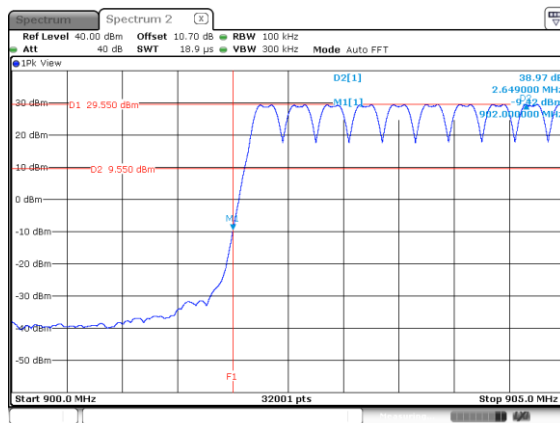


Figure 2.8.6-3: Lower Band edge – Mode 1 – 200 kbps

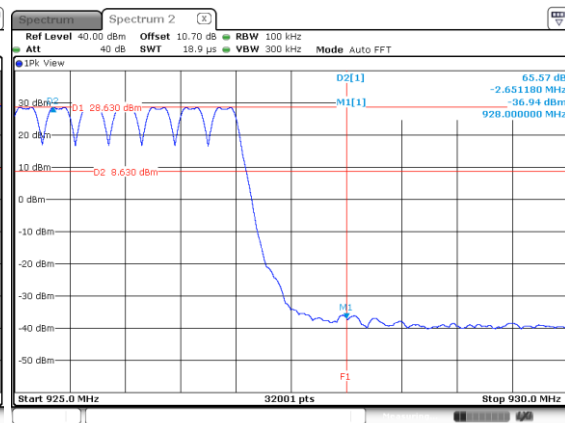


Figure 2.8.6-4: Upper Band edge – Mode 1 – 200 kbps

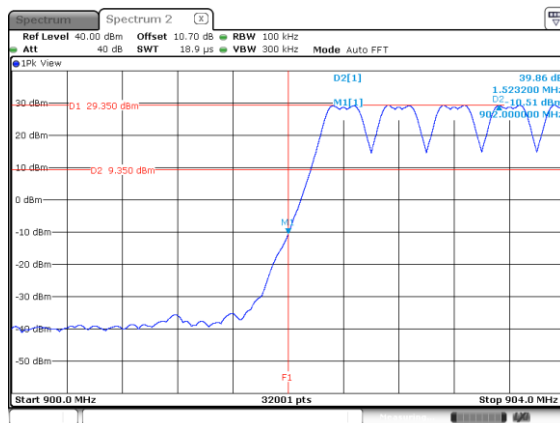


Figure 2.8.6-5: Lower Band edge – Mode 2 – 300 kbps

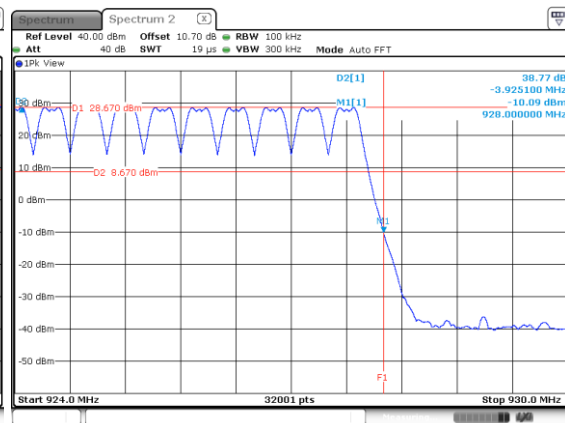
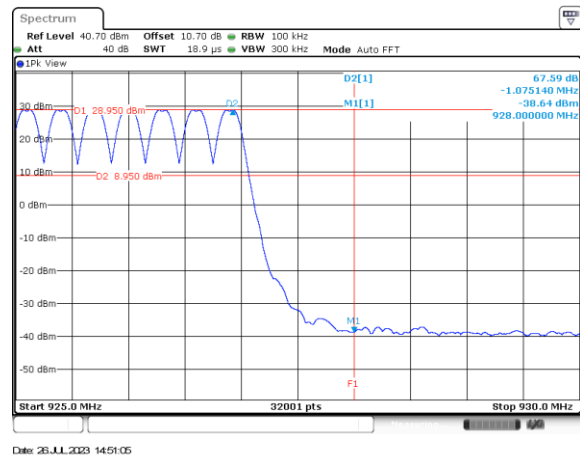
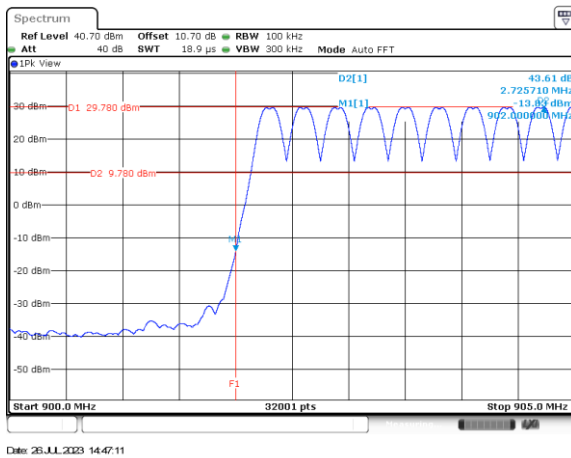
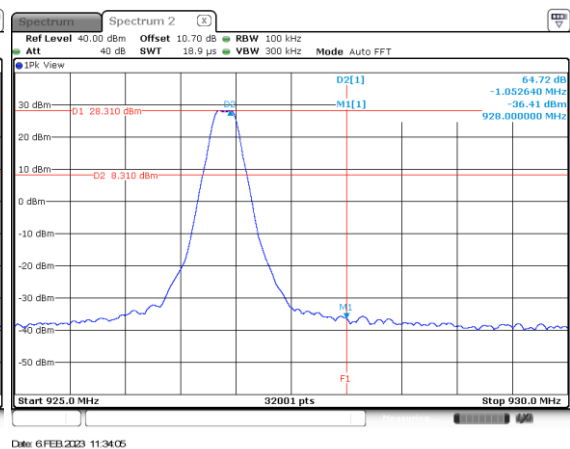
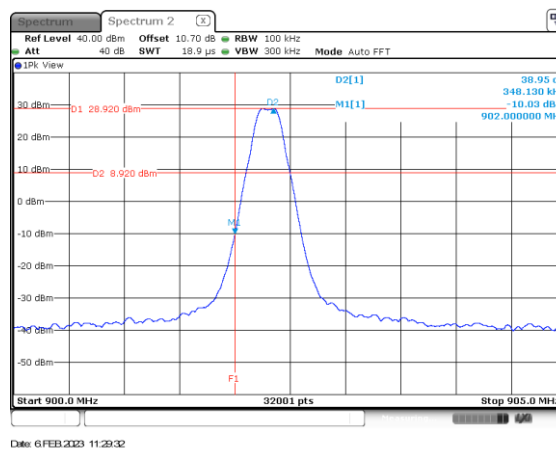
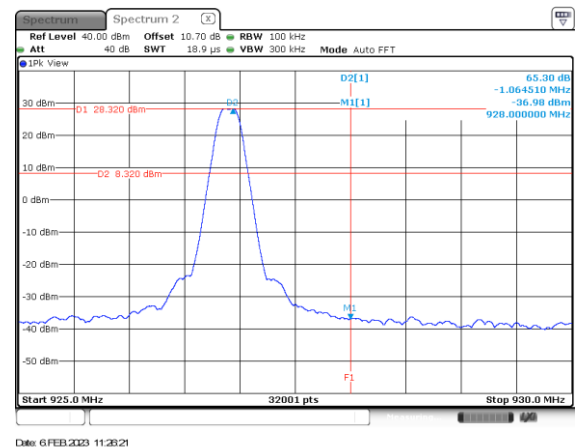
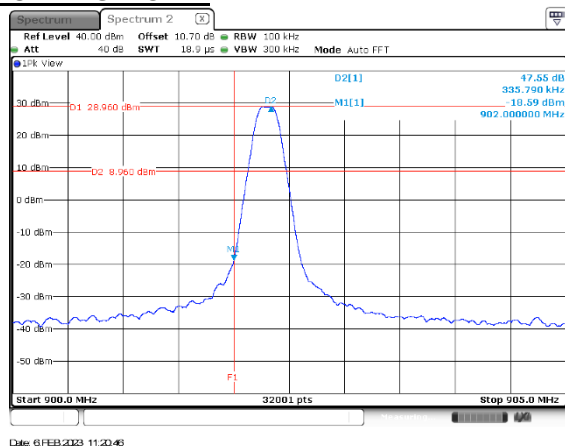


Figure 2.8.6-6: Upper Band edge – Mode 2 – 300 kbps



NON-HOPPING MODE:



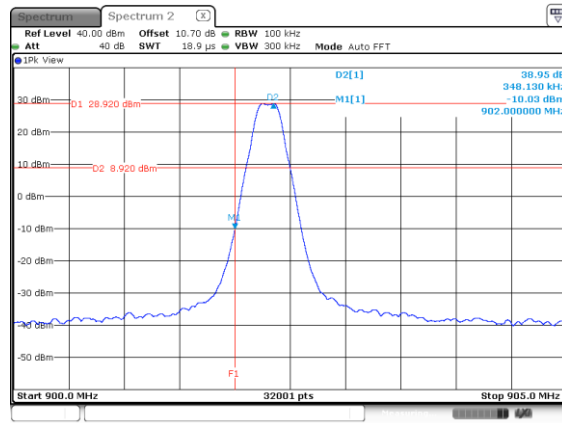


Figure 2.8.6-13: Lower Band edge – Mode 2 – 300 kbps

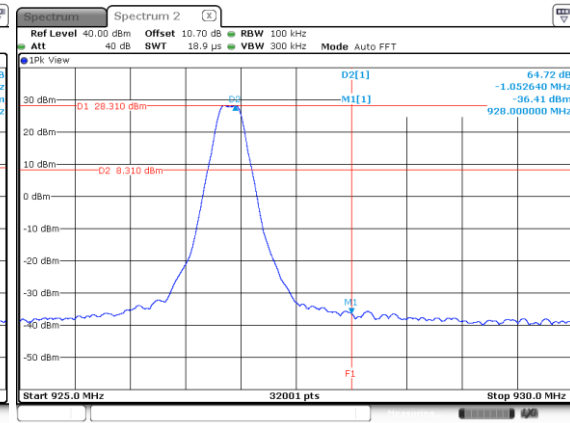


Figure 2.8.6-14: Upper Band edge – Mode 2 – 300 kbps

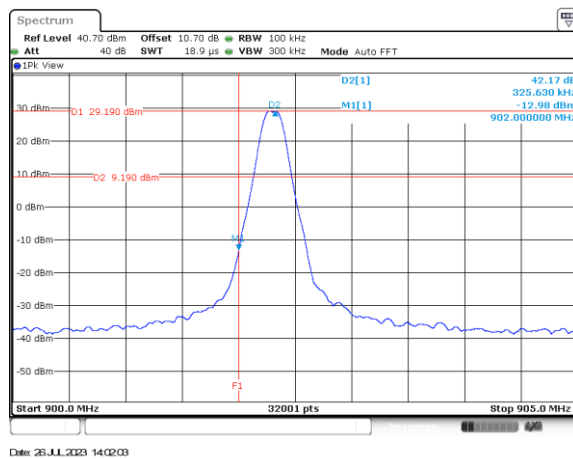


Figure 2.8.6-15: Lower Band edge – Mode 3 – 100 kbps

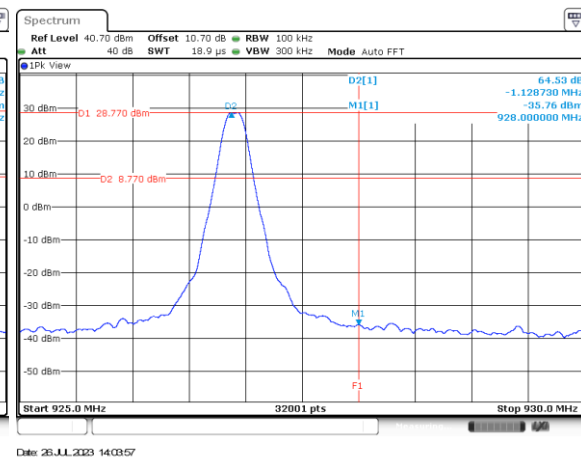


Figure 2.8.6-16: Upper Band edge – Mode 3 – 100 kbps



2.9 RF Conducted Spurious Emissions

2.9.1 Specification Reference

FCC Sections: 15.247(d)
ISED Canada: RSS-247 5.5

2.9.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “2”, as noted in §1.6.

2.9.3 Date of Test

02/06/2023 – 07/26/2023

2.9.4 Test Method

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 10 GHz, 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.

If the maximum peak conducted output power procedure was used to determine compliance, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

If maximum conducted (average) output power was used to determine compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

2.9.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

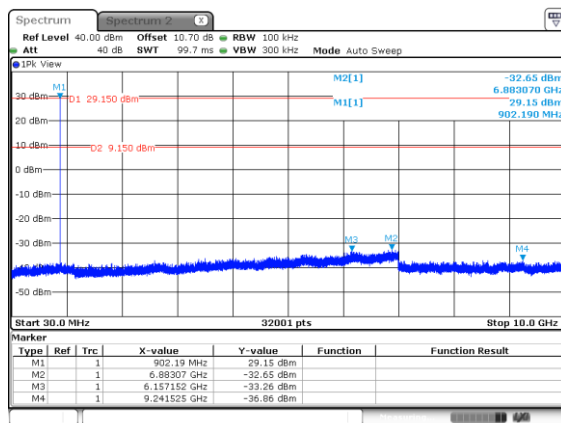
Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.9.6 Test Results

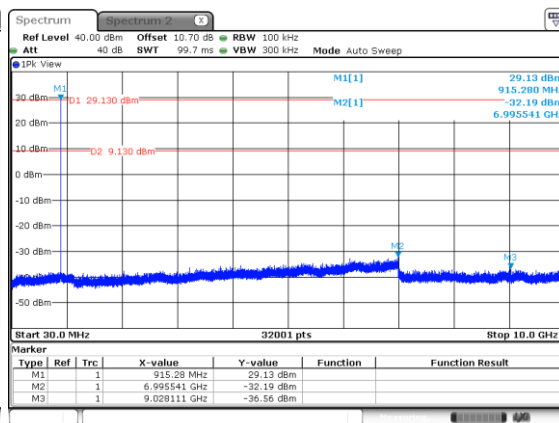
Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See data below for detailed results.



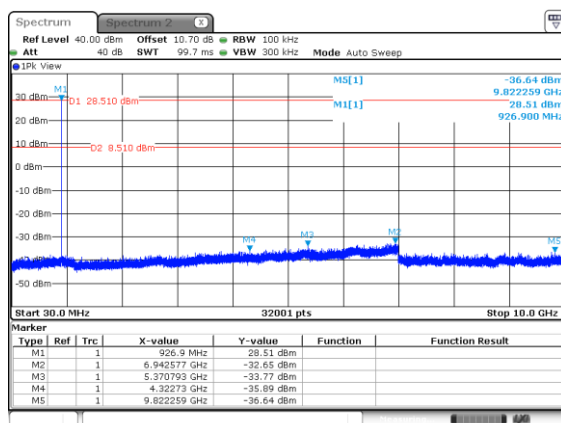
Date: 6 FEB 2023 11:19:03



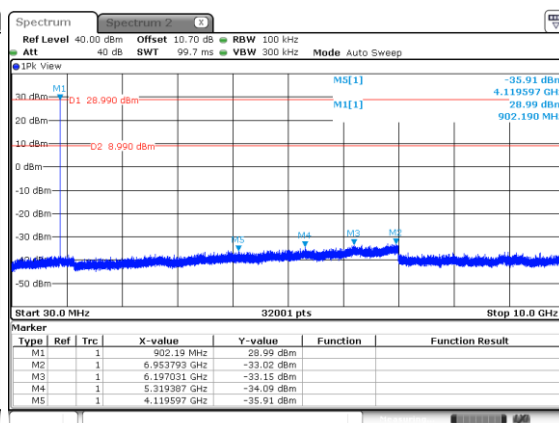
Date: 6 FEB 2023 11:23:02

Figure 2.9.6-1:30MHz–10GHz – LCH – Mode 1–150 kbps

Figure 2.9.6-2:30MHz–10GHz – MCH – Mode 1-150kbps



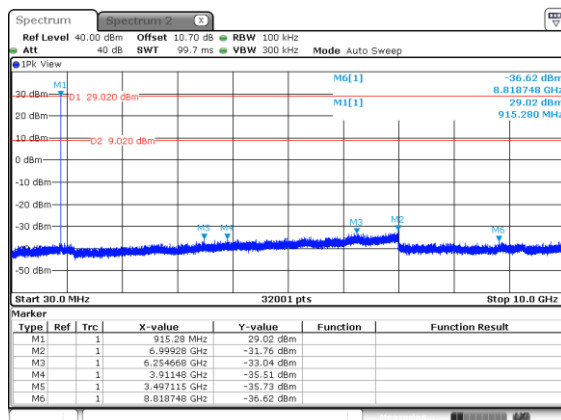
Date: 6 FEB 2023 11:24:44



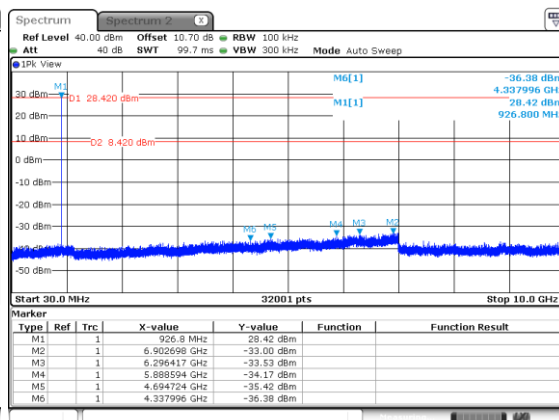
Date: 6 FEB 2023 11:28:14

Figure 2.9.6-3:30MHz–10GHz – HCH – Mode 1 -150kbps

Figure 2.9.6-4:30MHz–10GHz – LCH – Mode 1-200 kbps



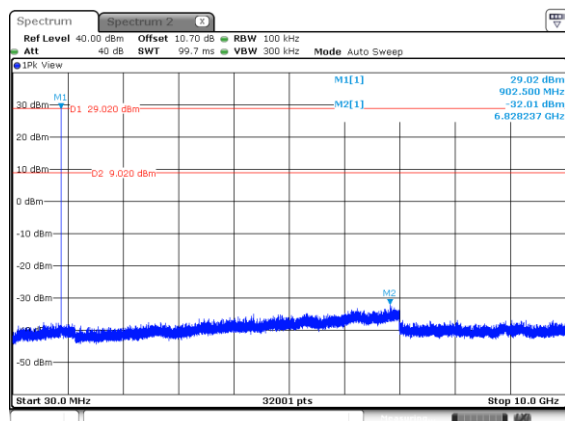
Date: 6 FEB 2023 11:31:29



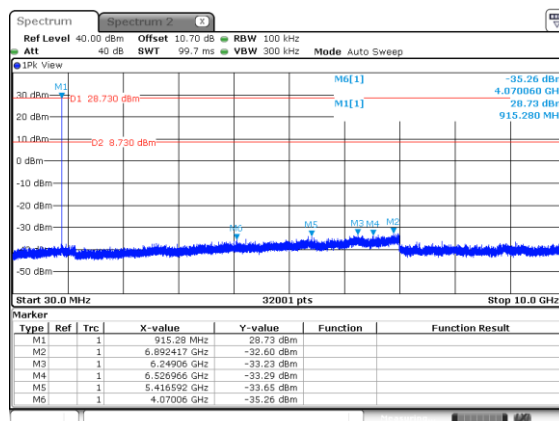
Date: 6 FEB 2023 11:32:47

Figure 2.9.6-5: 30MHz-10GHz - MCH - Mode 1-200 kbps

Figure 2.9.6-6: 30MHz-10GHz - HCH - Mode 1-200 kbps



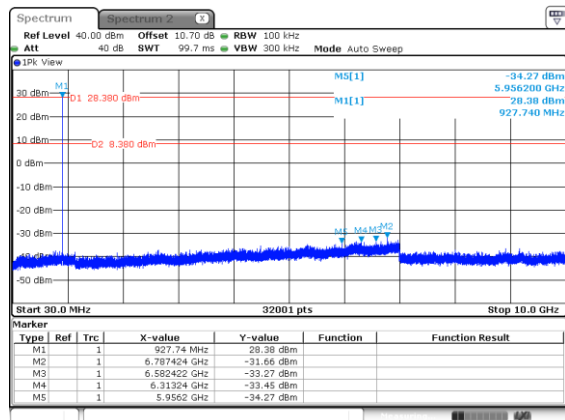
Date: 6 FEB 2023 11:38:41



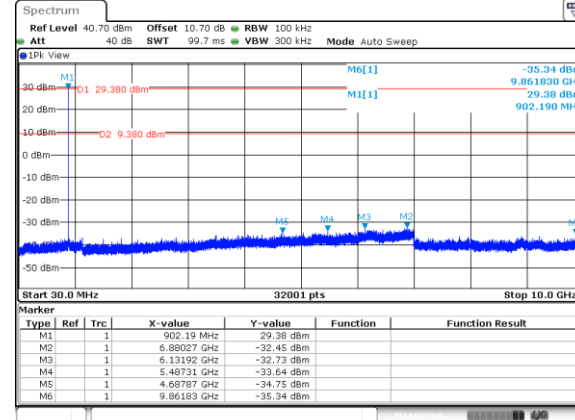
Date: 6 FEB 2023 11:38:37

Figure 2.9.6-7: 30MHz-10GHz - LCH - Mode 2-300 kbps

Figure 2.9.6-8: 30MHz-10GHz - MCH - Mode 2-300 kbps



Date: 6 FEB 2023 11:41:14



Date: 26 JUL 2023 14:00:23

Figure 2.9.6-9: 30MHz-10GHz - HCH - Mode 2-300 kbps

Figure 2.9.6-10: 30MHz-10GHz - LCH - Mode 3-100 kbps

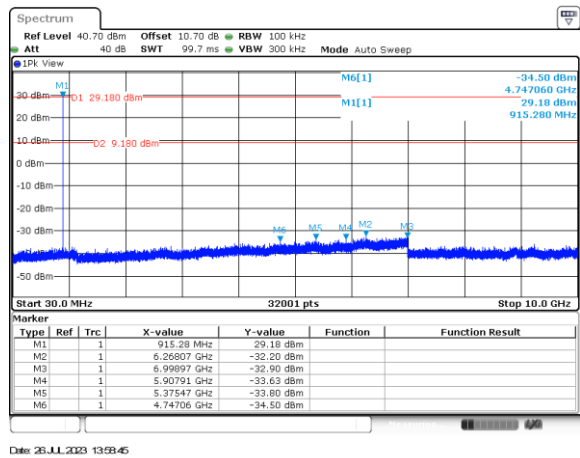


Figure 2.9.6-11:30MHz-10GHz – MCH – Mode 3-100 kbps

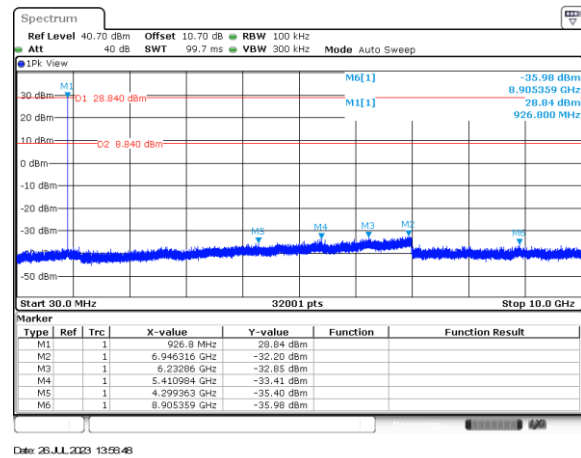


Figure 2.9.6-12:30MHz-10GHz – HCH – Mode 3-100 kbps



2.10 Radiated Spurious Emissions into Restricted Frequency Bands

2.10.1 Specification Reference

FCC Sections: 15.205, 15.209.
ISED Canada: RSS – Gen 8.9/8.10

2.10.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

2.10.3 Date of Test

02/08/2023 to 02/09/2023

2.10.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 10 GHz, 10 times the highest fundamental frequency of 900 MHz. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

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 150 kHz, quasi-peak measurements were made using a resolution bandwidth RBW of 300 Hz and a video bandwidth VBW of 1 kHz and frequencies between 150 kHz and 30MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 10 kHz and a video bandwidth VBW of 30 kHz. For frequencies between 30 MHz and 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 100 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW of 1 MHz and VBW of 3 MHz.

2.10.5 Environmental Conditions

The EUT was evaluated within the temperature, humidity and pressure range of the EUT as specified by the standard. The laboratory shall have an ambient temperature range of 15°C to 35°C, relative humidity range of 30% to 60% and atmospheric pressure range of 86 kPa to 106 kPa.

Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar



2.10.6 Test Results

Test Summary: EUT was set to transmit mode as per sections 1.4.2 / 1.4.3.

Test Results: Pass

See data below for detailed results.

Table 2.10.6-1: Radiated Spurious Emissions Tabulated Data – Mode 2 – 300 kbps

Frequency	Peak Value	QP/Avg Value	Peak Limit	QP/Avg Limit	Peak Margin	QP/Avg Margin	Polarity	Peak Limit Results	QP/Avg Limit Results
MHz	dBμV/m	dBμV/m	dBμV/m	dBμV/m	dB	dB	H/V	Pass/Fail	Pass/Fail
LCH – 902.4 MHz									
118.148	-----	22.323	-----	43.5	-----	-21.18	H	-----	PASS
133.137	-----	16.275	-----	43.5	-----	-27.22	H	-----	PASS
162.674	-----	16.537	-----	43.5	-----	-26.96	H	-----	PASS
118.123	-----	29.365	-----	43.5	-----	-14.13	V	-----	PASS
133.137	-----	27.03	-----	43.5	-----	-16.47	V	-----	PASS
162.524	-----	29.814	-----	43.5	-----	-13.69	V	-----	PASS
2707.425	48.83	37.292	74	54	-25.17	-16.71	H	PASS	PASS
9594.15	53.991	39.929	74	54	-20.01	-14.07	H	PASS	PASS
2706.975	49.231	39.563	74	54	-24.77	-14.44	V	PASS	PASS
9698.625	54.067	40.292	74	54	-19.93	-13.71	V	PASS	PASS
MCH – 915.2 MHz									
117.882	-----	31.729	-----	43.5	-----	-11.77	H	-----	PASS
132.677	-----	29.801	-----	43.5	-----	-13.7	H	-----	PASS
162.189	-----	37.622	-----	43.5	-----	-5.88	H	-----	PASS
118.005	-----	21.752	-----	43.5	-----	-21.75	V	-----	PASS
132.678	-----	40.06	-----	43.5	-----	-3.44	V	-----	PASS
162.162	-----	42.887	-----	43.5	-----	-0.61	V	-----	PASS
162.524	-----	28.664	-----	43.5	-----	-14.84	V	-----	PASS
2745.375	47.266	34.969	74	54	-26.73	-19.03	H	PASS	PASS
2745.825	49.993	40.889	74	54	-24.01	-13.11	V	PASS	PASS
HCH – 927.6 MHz									
117.883	-----	32.828	-----	43.5	-----	-10.67	H	-----	PASS
132.651	-----	30.234	-----	43.5	-----	-13.27	H	-----	PASS
162.063	-----	35.962	-----	43.5	-----	-7.54	H	-----	PASS
117.929	-----	38.41	-----	43.5	-----	-5.09	V	-----	PASS
132.672	-----	40.5	-----	43.5	-----	-3	V	-----	PASS
162.209	-----	42.356	-----	43.5	-----	-1.14	V	-----	PASS
2782.575	47.19	33.825	74	54	-26.81	-20.18	H	PASS	PASS
2782.575	50.379	40.64	74	54	-23.62	-13.36	V	PASS	PASS



TUV EMC Lab

Radiated Emissions, Under 1GHz

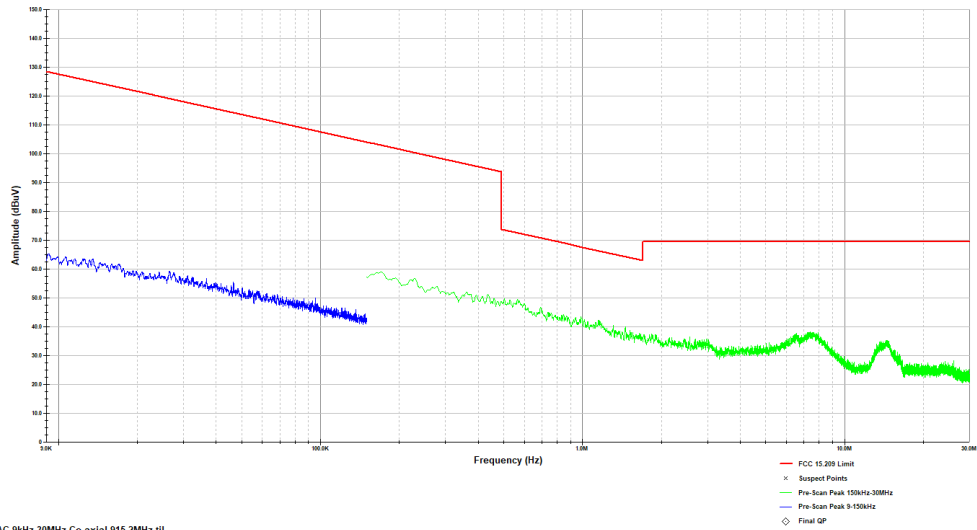
HV Graph

Company - 72186194 Iron

Model - Dual Mesh PMR NIC

Config - 915.2MHz GFSK-300kbps

Operator - Divya



FCC 15.209 BSAC 9kHz-30MHz Co-axial 915.2MHz.ttl

Last Data Update 03:11:41 PM, Wednesday, July 12, 2023

Figure 1: Reference plot for Radiated Spurious Emissions – 9 kHz – 30 MHz – Mode 2 – 300 kbps – Coaxial

TUV EMC Lab

Radiated Emissions, Under 1GHz

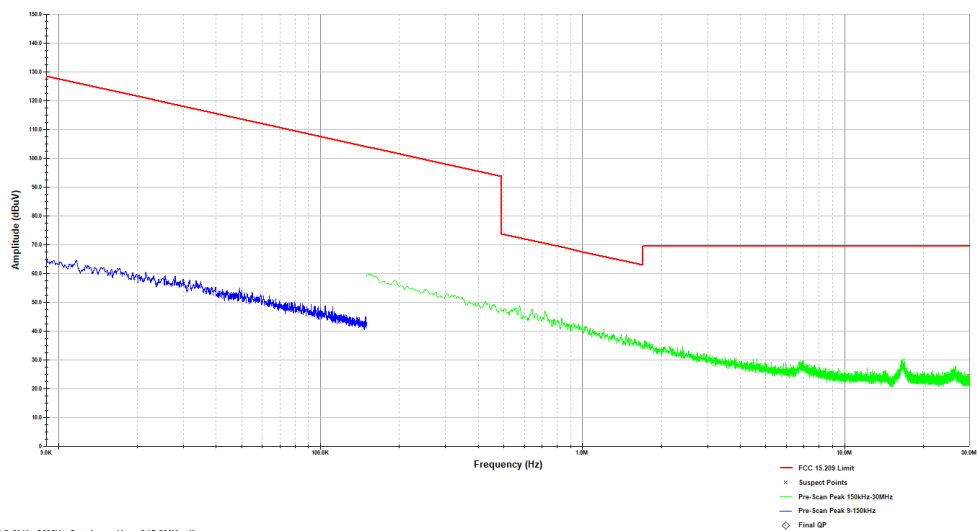
HV Graph

Company - 72186194 Iron

Model - Dual Mesh PMR NIC

Config - 915.2MHz GFSK-300kbps

Operator - Divya



FCC 15.209 BSAC 9kHz-30MHz Co-planar Horiz 915.2MHz.ttl

Last Data Update 03:07:33 PM, Wednesday, July 12, 2023

Figure 2: Reference plot for Radiated Spurious Emissions – 9 kHz – 30 MHz – Mode 2 – 300 kbps – Co-planar Horizontal



TUV EMC Lab

Radiated Emissions, Under 1GHz

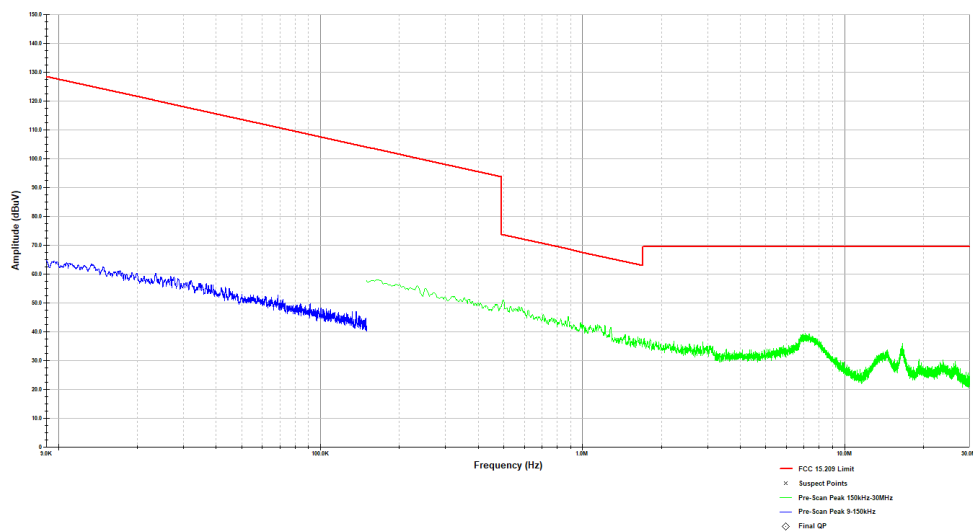
HV Graph

Company - 72186194 Iron

Model - Dual Mesh PMR NIC

Config - 915.2MHz GFSK - 300kbps

Operator - Divya



FCC 15.209 BSAC 9kHz-30MHz Co-planar Vert 915.2MHz.ttl

Last Data Update 03:10:51 PM, Wednesday, July 12, 2023

Figure 3: Reference plot for Radiated Spurious Emissions – 9 kHz – 30 MHz – Mode 2 – 300 kbps – Co-planar Vertical

TUV EMC Lab

Radiated Emissions, Under 1GHz

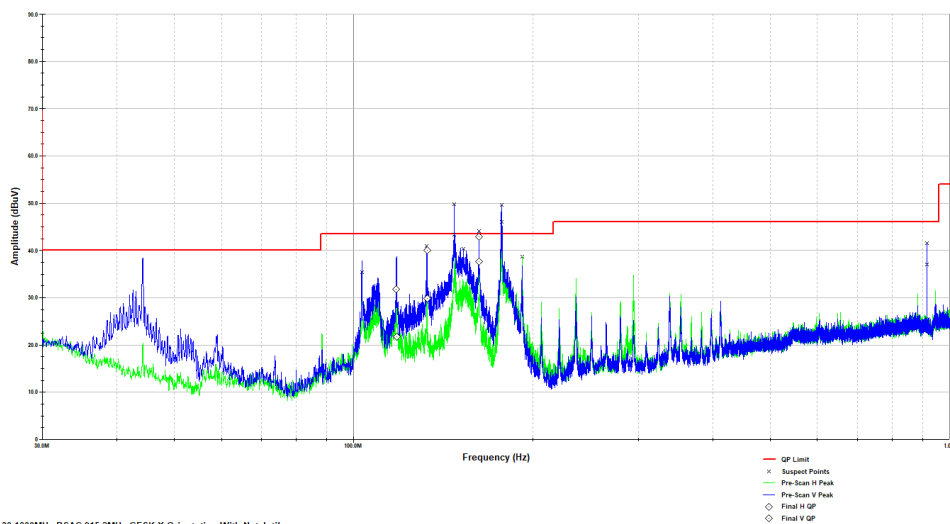
HV Graph

Company - 72186194 Iron

Model - Dual Mesh PMR NIC

Config - 915.2M-GFSK-300kbps -With Notch

Operator - Divya



FCC 15.209 RSE 30-1000MHz BSAC 915.2MHz-GFSK-X-Orientation-With Notch.ttl

Last Data Update 11:32:20 AM, Wednesday, February 08, 2023

Figure 4: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz – Mode 2 – 300 kbps
Note: Emissions within restricted bands only were evaluated.



TUV EMC Lab

Radiated Emissions, Above 1GHz

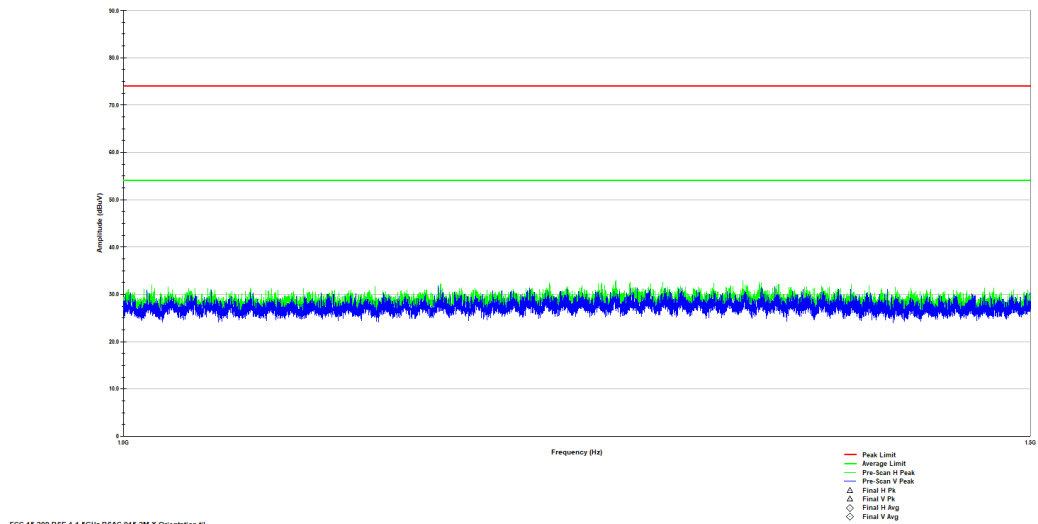
HV Graph

Company - Itron 72186194

Model - Dual Mesh PMR NIC

Config - 915.2M - GF SK 300kbps

Operator - Divya

**Figure 5: Reference plot for Radiated Spurious Emissions – 1 GHz – 1.5 GHz – Mode 2 – 300 kbps**

TUV EMC Lab

Radiated Emissions, Above 1GHz

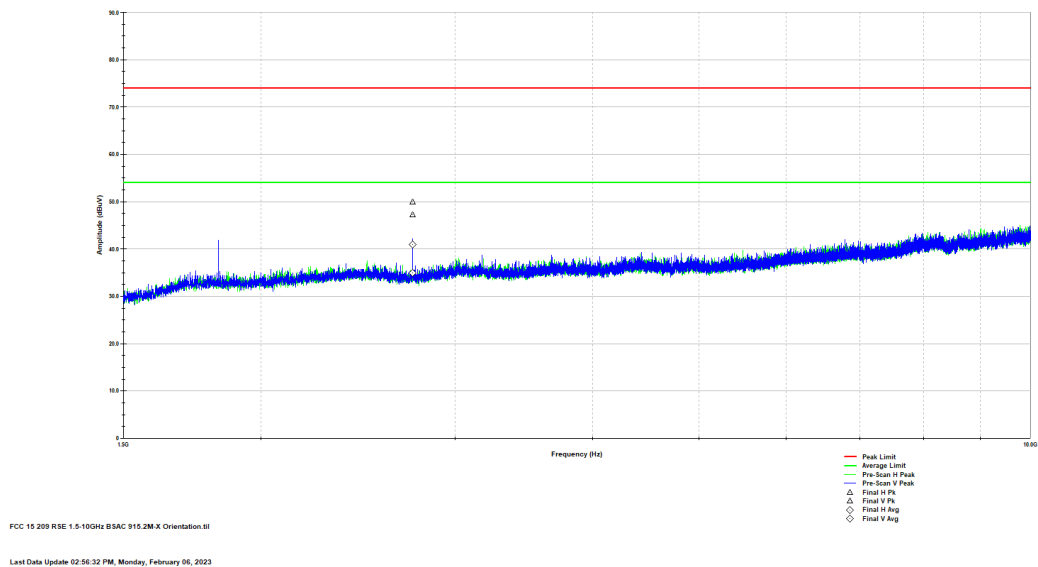
HV Graph

Company - Itron 72186194

Model - Dual Mesh PMR NIC

Config - 915.2MHz - GF SK 300kbps

Operator - Divya

**Figure 6: Reference plot for Radiated Spurious Emissions – 1.5 GHz – 10 GHz – Mode 2 – 300 kbps**
Note: Emissions within restricted bands only were evaluated.



2.11 Test Equipment Used

Table 2.11-1 –Equipment List

Asset ID	Manufacturer	Model	Equipment Type	Serial Number	Last Calibration Date	Calibration Due Date
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	06/08/2021	06/08/2023
628	EMCO	6502	Active Loop Antenna 10kHz-30MHz	9407-2877	06/20/2023	06/20/2024
853	Teseq	CBL6112D	BiLog Antenna	51616	7/15/2021	7/15/2023
852	Teseq	CBL6112D	BiLog Antenna	51617	11/01/2022	11/01/2024
884	ETS Lindgren (EMCO)	3117	DOUBLE-RIDGED GUIDE ANTENNA	240106	5/6/2021	5/6/2023
884	ETS Lindgren (EMCO)	3117	DOUBLE-RIDGED GUIDE ANTENNA	240106	05/16/2023	05/16/2025
889	Com Power	PAM 103	Pre-amplifier	18020215	9/27/2022	9/27/2023
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	6/22/2021	6/22/2023
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	06/22/2023	06/22/2025
882	Rohde & Schwarz	ESW44	ESW44 EMI TEST RECEIVER	101961	7/14/2022	7/14/2023
882	Rohde & Schwarz	ESW44	ESW44 EMI TEST RECEIVER	101961	06/21/2023	06/21/2024
22	Teledyne Storm Microwave	90-195-456	BSAC Cable	N/A	10/7/2022	10/7/2023
20	Teledyne Storm Microwave	R-90-195-036	BSAC Cable	N/A	7/12/2022	7/12/2023
20	Teledyne Storm Microwave	R-90-195-036	BSAC Cable	N/A	7/13/2023	7/13/2024
21	Teledyne Storm Microwave	R-90-195-072	BSAC Cable	N/A	7/12/2022	7/12/2023
21	Teledyne Storm Microwave	R-90-195-072	BSAC Cable	N/A	7/13/2023	7/13/2024
337	Microwave Circuits	H1G513G1	Microwave filter	282706	5/31/2022	5/31/2023
337	Microwave Circuits	H1G513G1	Microwave filter	282706	5/31/2023	5/31/2024
827	Rohde & Schwarz	RF Cable set	TS8997 Rack cable set	N/A	12/21/2022	12/21/2023
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	10/05/2022	10/05/2023
267	Hewlett Packard	N1911A	Power Meter	MY45100129	7/27/2021	7/27/2023
872	HP	E7402A	EMI Receiver	US40240258	6/21/2022	6/21/2023
872	HP	E7402A	EMI Receiver	US40240258	6/22/2023	6/22/2024
871	ACS	n/a	Conducted EMI Cable	871	4/1/2022	4/1/2023
871	ACS	n/a	Conducted EMI Cable	871	03/24/2023	03/24/2024
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	6/22/2022	6/22/2023

N/A – Not Applicable

3 Diagram of Test Set-ups

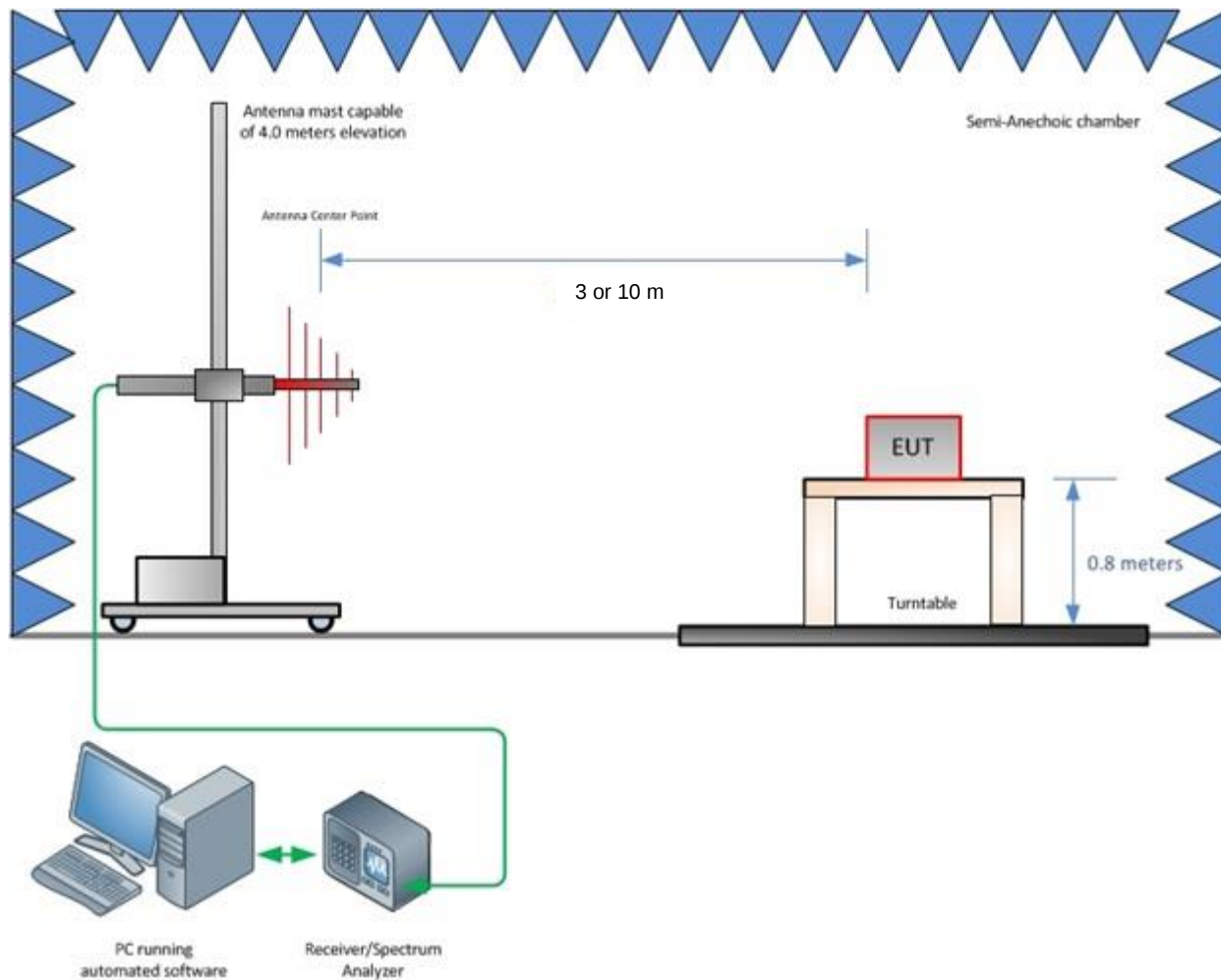


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

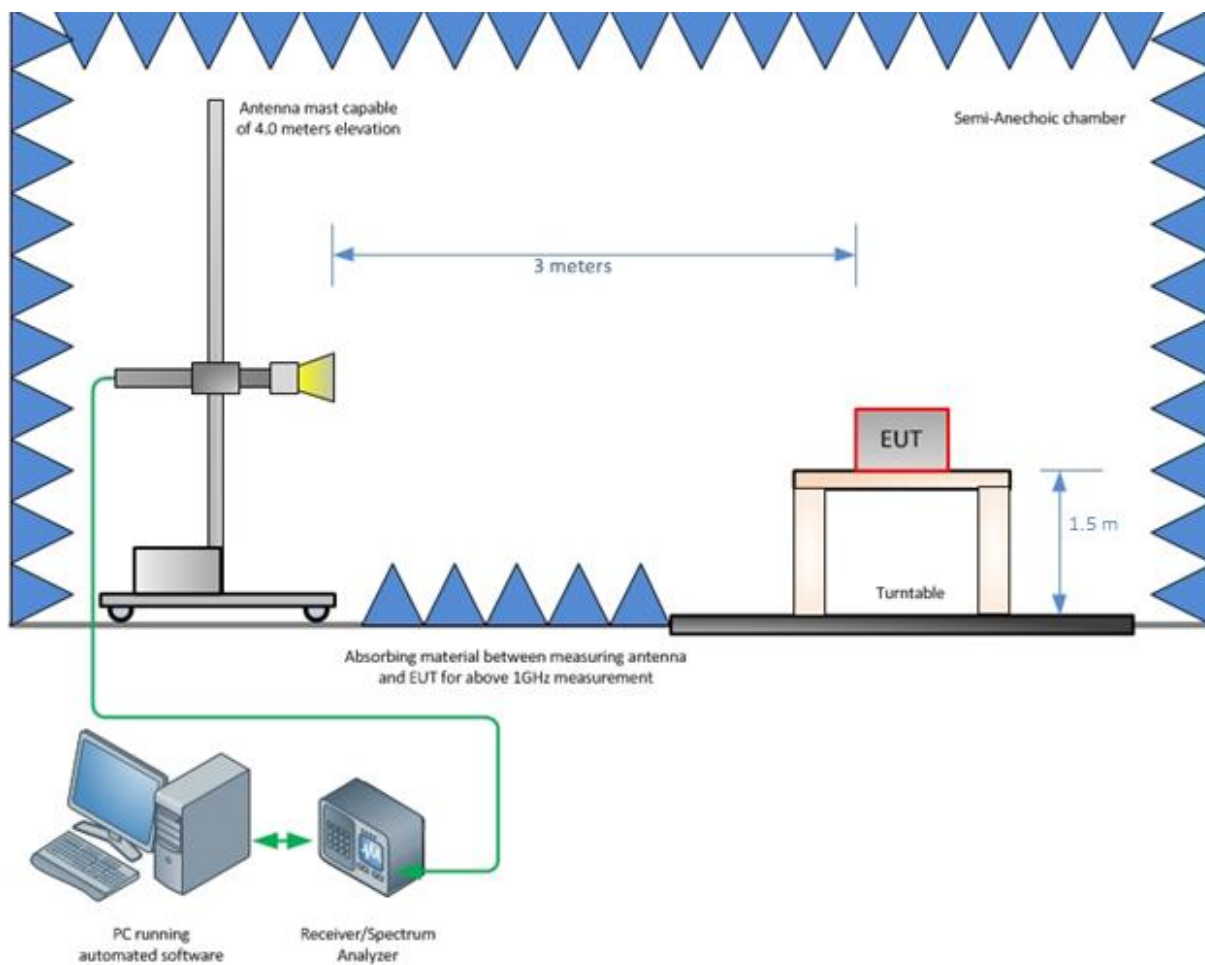


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

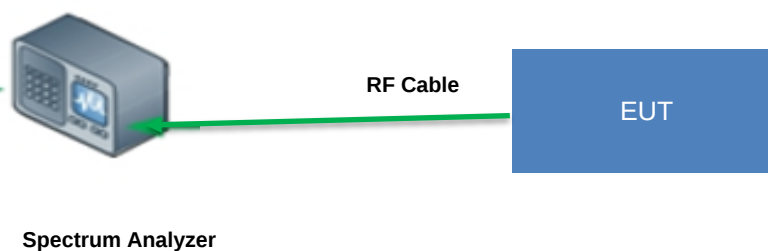


Figure 3-3 – Conducted Test Setup: Antenna Port measurement



4 Accreditation, Disclaimers and Copyright

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STATEMENT 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 4-1: Estimation of Measurement Uncertainty

Parameter	U_{lab}
Occupied Channel Bandwidth	$\pm 0.009 \%$
RF Conducted Output Power	$\pm 0.349 \text{ dB}$
Power Spectral Density	$\pm 0.372 \text{ dB}$
Antenna Port Conducted Emissions	$\pm 1.264 \text{ dB}$
Radiated Emissions $\leq 1 \text{ GHz}$	$\pm 5.814 \text{ dB}$
Radiated Emissions $> 1 \text{ GHz}$	$\pm 4.318 \text{ dB}$
Temperature	$\pm 0.860 \text{ }^{\circ}\text{C}$
Radio Frequency	$\pm 2.832 \times 10^{-8}$
AC Power Line Conducted Emissions	$\pm 3.360 \text{ dB}$

TEST EQUIPMENT

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications.