

Report on the Testing of the

Landis + Gyr Technology, Inc.

S6-MCM0

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

Prepared for: Landis + Gyr Technology, Inc.
30000 Mill Creek Ave., Suite 100
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Kirby Munroe	Wireless / EMC Technical and Certification Manager, NA TUV SUD America Inc.	Authorized Signatory	02/17/2022

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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.



A2LA Cert. No. 2955.09

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Contents

1	Report Summary	3
1.1	Report Modification Record.....	3
1.2	Introduction.....	3
1.3	Brief Summary of Results	5
1.4	Product Information	6
1.5	Deviations from the Standard.....	9
1.6	EUT Modification Record	9
1.7	Test Location	10
2	Test Details	11
2.1	Antenna Requirement	11
2.2	Power Line Conducted Emissions	12
2.3	Average Output Power	15
2.4	6dB / 99% Bandwidth	17
2.5	Maximum Power Spectral Density in the Fundamental Emission	22
2.6	Band-Edge Compliance of RF Conducted Emissions	25
2.7	RF Conducted Spurious Emissions	27
2.8	Radiated Spurious Emissions into Restricted Frequency Bands.....	30
2.9	Test Equipment Used.....	36
3	Diagram of Test Set-ups.....	37
4	Accreditation, Disclaimers and Copyright.....	39



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	02/17/2022

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.

Applicant	Raghav Goteti
Manufacturer	Landis + Gyr Technology, Inc
Applicant's Email Address	raghav.goteti@landisgyr.com
Model Number(s)	S6-MCM0
Serial Number(s)	N/A
Module FCC ID	R7PNG0R1X8
Module ISED Certification Number	5294A-NG0R1X8
Hardware Version(s)	25-2564 Rev.AK
Software Version(s)	S6-MCM0 SBS Mode FW: S6SR3D-22.50.001 S6-MCM0 WiSUN Mode FW: S6WR3D-24.01.C04
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, 2021 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	72174490
Date of Receipt of EUT	12/8/2021
Start of Test	12/8/2021
Finish of Test	12/21/2021



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, 2021.

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	-----	11
6 dB Bandwidth	Yes	Pass	15.247(a)(2)	RSS-247 5.2(a)	17
99% Bandwidth	Yes	Pass	-----	RSS-GEN 6.7	17
Avg Output Power	Yes	Pass	15.247(b)(3)	RSS-247 5.4(d)	15
Band-Edge Compliance of RF Conducted Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	25
RF Conducted Spurious Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	27
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	30
Power Spectral Density	Yes	Pass	15.247(e)	RSS-247 5.2(b)	22
Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	12
Duty Cycle	No	-----			-----

1.4 Product Information

1.4.1 Technical Description

The S6-MCM0 is a radio within the Landis & Gyr inside series. It supports half-duplex operation in Sub-GHz band 902 MHz to 928MHz ISM band. It can be integrated into metering, sensor, and controller products, allowing a wide range of devices to communicate on the Landis & Gyr RF Mesh IP Network. This version integrates a radio, microcontroller (MCU), TCXO, serial flash and a linear regulator.

The S6-MCM0 is a fully encapsulated/shielded Multi-chip Module (MCM) device in a 22mm x 23mm form factor. It can be incorporated into a host device (such as the L+G Revelo E360 meter) to provide communications for AMI applications. The S6-MCM0 radio feeds directly into an onboard printed Inverted-F antenna located on the host.

Table 1.4-1 – Wireless Technical Information

Detail	Description
Module FCC ID	R7PNG0R1X8
Module IC ID	5294A-NG0R1X8
Transceiver Model #	S6-MCM0
Modulation Format	IEEE 802.15.4 SUN OFDM
Antenna Type / Description:	Printed Inverted-F Antenna / 1 dBi Gain

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



Figure 1.4.1-1 –Front view of the EUT



Figure 1.4.1-2 – Back view of the EUT

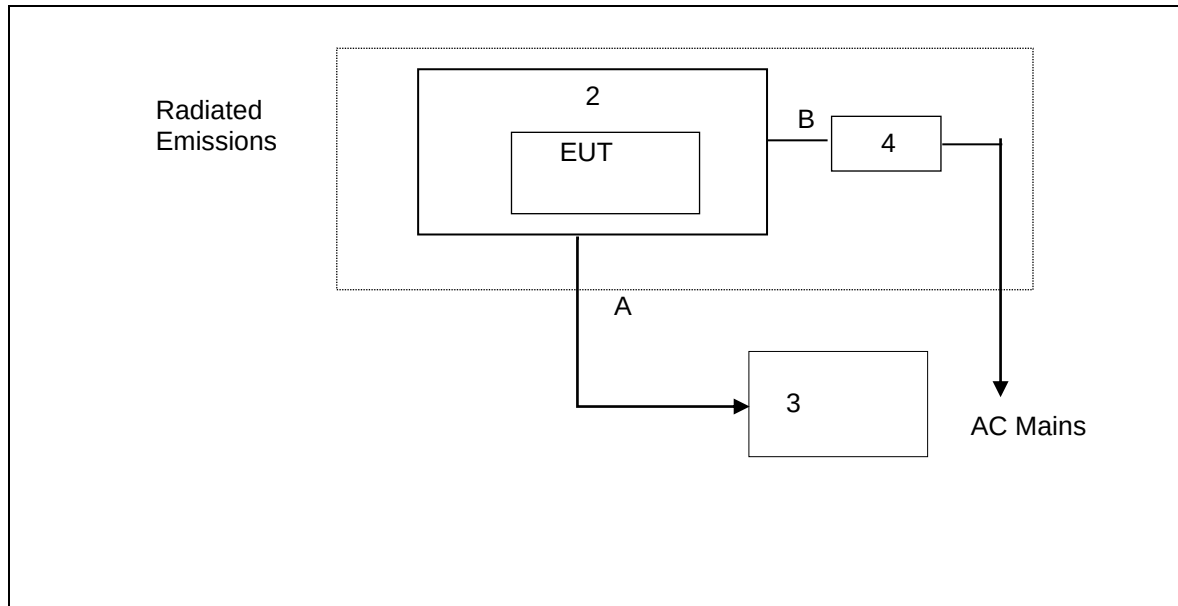


Figure 1.4.1-4 – Test Setup Block Diagram

Table 1.4.1-1 – Cable Descriptions

Item	Cable/Port	Description
A	USB Serial cable	Programming cable connected to laptop
B	Power Supply Cable	Power Supply connected to Isolation Transformer

Table 1.4.1-2 – Support Equipment Descriptions

Item	Make/Model	Description
2	D013D65F	Evaluation Board (Revelo E360 Host PCB)
3	Lenovo	Laptop used for configuring wireless module – Landis + Gyr provided
4	N/A	Isolation Transformer



1.4.2 Modes of Operation

S6-MCM0 model provides 3 distinct proprietary modes of operation using DTS classifications as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Stack / Mode	Data Rates Supported (kbps)	Classification
1	904 – 926.8	20	1200	SBS (802.15.4 SUN OFDM)	MCS0 – MCS6	DTS
2	903.2 – 927.2	21	1200	WiSUN (802.15.4 SUN OFDM)	MCS5 – MCS6	DTS
3	902.8 – 926.8	31	800	WiSUN (802.15.4 SUN OFDM)	MCS3 – MCS5	DTS

1.4.3 Monitoring of Performance

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

For RF conducted measurements, the EUT was connected to the test equipment with a temporary antenna connector to SMA connector.

AC Power Line conducted emissions were performed with the module integrated on a representative host PCB.



Worst case mode for all parameters measured listed below:

Mode	Classification	6dB/99% Bandwidth	Average Output Power	RF Conducted Spurious Emissions	Band-Edge RF Conducted Emissions	RSE into Restricted Frequency Bands	Band-Edge RF Radiated Emissions	Power Spectral Density
		Data Rate (kbps) / MCS						
1	DTS	MCS0	MCS0	MCS0	MCS0	MCS0	NA	MCS0
2	DTS	MCS5	MCS5	MCS5	MCS5	MCS5	NA	MCS5
3	DTS	MCS3	MCS3	MCS3	MCS3	MCS3	NA	MCS3

Power setting during test: Mode of operation 1: 24 dBm
 Mode of operation 2: 22 dBm
 Mode of operation 3: 24 dBm

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		

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
Avg Output Power	Divya Adusumilli	A2LA
6dB / 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	Bhagyashree Chaudhary	A2LA
Band-Edge Compliance of RF Radiated Emissions	N/A	A2LA
Power Spectral Density	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

2.1.2 Equipment Under Test and Modification State

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

2.1.3 Date of Test

12/8/2021

2.1.4 Test Method

N/A

2.1.5 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

2.1.6 Test Results

The EUT utilizes onboard Printed Inverted-F Antenna with peak gain 1 dBi which is provided by the host printed circuit board, 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

12/8/2021

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

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

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
0.56	46	21.3	11.6	9.653	-24.7	PASS
0.65	46	21.3	11.7	9.659	-24.7	PASS
0.74	46	21.1	11.4	9.664	-24.9	PASS
3.94	46	18.8	9.1	9.68	-27.2	PASS
5.38	50	17.8	8	9.72	-32.2	PASS
6.46	50	17.8	8.1	9.71	-32.2	PASS

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

Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
0.56	56	31.8	22.2	9.653	-24.2	PASS
0.65	56	32.1	22.4	9.659	-23.9	PASS
0.74	56	32.2	22.5	9.664	-23.8	PASS
3.94	56	28.9	19.2	9.68	-27.1	PASS
5.38	60	28.5	18.8	9.72	-31.5	PASS
6.46	60	28.3	18.6	9.71	-31.7	PASS

Table 2.2.6-3: Conducted EMI Results-Avg – Line 2

Frequency (MHz)	Avg Limit	Avg Level Corrected	Avg Level	Correction Fact.	Avg Margin	Result
0.5	46.1	21.4	11.8	9.631	-24.7	PASS
0.5	46.1	20.7	11	9.63	-25.4	PASS
0.53	46	26.7	17	9.632	-19.3	PASS
0.81	46	19.5	9.8	9.648	-26.5	PASS
1.68	46	18	8.4	9.666	-28	PASS
1.9	46	16.3	6.6	9.662	-29.7	PASS

Table 2.2.6-4: Conducted EMI Results-QP – Line 2

Frequency (MHz)	QP Limit	QP Level Corrected	QP Level	Correction Fact.	QP Margin	Result
0.5	56.1	25.4	15.8	9.631	-30.7	PASS
0.5	56.1	25.2	15.5	9.63	-30.9	PASS
0.53	56	30.5	20.8	9.632	-25.5	PASS
0.81	56	24.3	14.7	9.648	-31.7	PASS
1.68	56	22.3	12.6	9.666	-33.7	PASS
1.9	56	21.2	11.6	9.662	-34.8	PASS

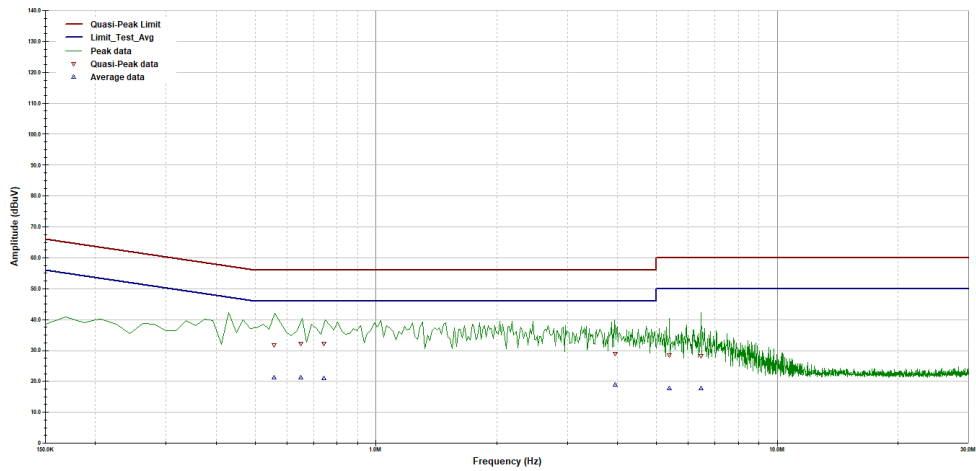


TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 72174490
Model Number - Revelo S6 w MCM0 and Wifi
Part Number - N/A
Serial Number - N/A
Voltage - FCC/IC-Class B; 120Vac/60Hz
Operating Mode - Powered on; 914.8 MHz; CH 53 FSK 50kbps 28dBm



Operator: A Sumner

72179940CE01 LG Revelo S6 900MHz Radio.ttl

Last Data Update 09:01:30 AM, Wednesday, December 08, 2021

Temperature - 22C
Relative Humidity - 26%
RF Bandwidth: 9kHz
VBW if Analyzer: 30kHz

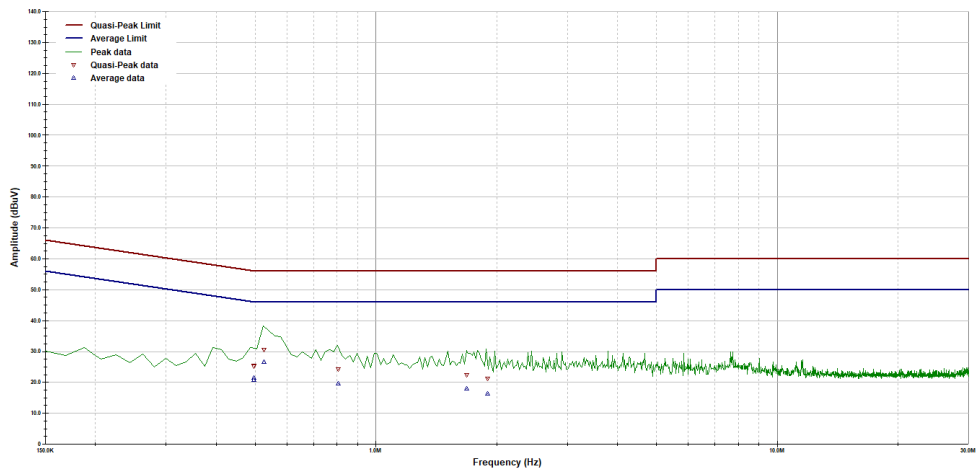
Figure 1: Conducted Emission Plot – Line 1

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 72174490
Model Number - Revelo S6 w MCM0 and Wifi
Part Number - N/A
Serial Number - N/A
Voltage - FCC/IC-Class B; 120Vac/60Hz
Operating Mode - Powered on; 914.8 MHz; CH 53 FSK 50kbps 28dBm



Operator: A Sumner

72179940CE01 LG Revelo S6 900MHz Radio.ttl

Last Data Update 09:14:57 AM, Wednesday, December 08, 2021

Temperature - 22C
Relative Humidity - 26%
RF Bandwidth: 9kHz
VBW if Analyzer: 30kHz

Figure 2: Conducted Emission Plot – Nuetral



2.3 Average Output Power

2.3.1 Specification Reference

FCC Sections: 15.247(b)(3)
ISED Canada: RSS-247 5.4(d)

2.3.2 Equipment Under Test and Modification State

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

2.3.3 Date of Test

12/21/2021

2.3.4 Test Method

The Average conducted output power was measured in accordance with ANSI C63.10 Subclause 11.9.2.3.1 Method AVGPM (Average Power Meter). The RF output port of the EUT was directly connected to the input of an Average power meter. The resulting average 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.

Test Results: Pass

See data below for detailed results.

**Table 2.3.6-1: RF Output Power**

Frequency [MHz]	Average Output Power (dBm)	Data Rate (kbps)	Mode(s)
904.0	24.65	MCS0	1
903.2	22.95	MCS5	2
902.8	24.98	MCS3	3
914.8	24.40	MCS0	1
915.2	22.76	MCS5	2
914.8	24.80	MCS3	3
926.8	23.49	MCS0	1
927.2	21.52	MCS5	2
926.8	23.82	MCS3	3



2.4 6dB / 99% Bandwidth

2.4.1 Specification Reference

FCC Sections: 15.247(a)(2)
ISED Canada: RSS-247 5.2(a), RSS-GEN 6.7

2.4.2 Equipment Under Test and Modification State

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

2.4.3 Date of Test

12/09/2021 – 12/15/2021

2.4.4 Test Method

The 6dB bandwidth was measured in accordance with the ANSI C63.10 Section 11.8. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 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.

2.4.5 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.

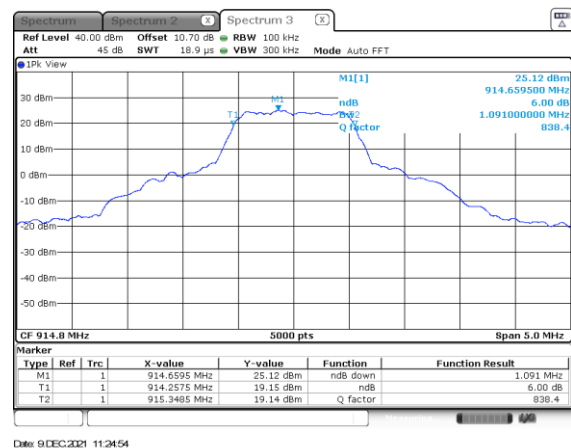
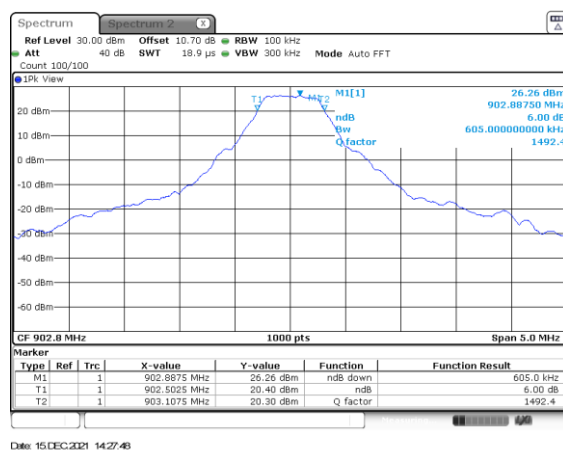
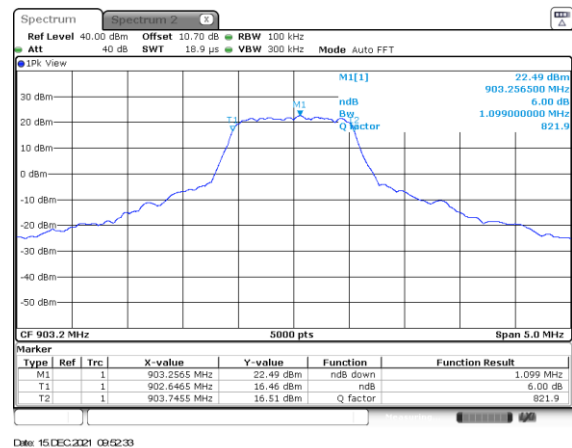
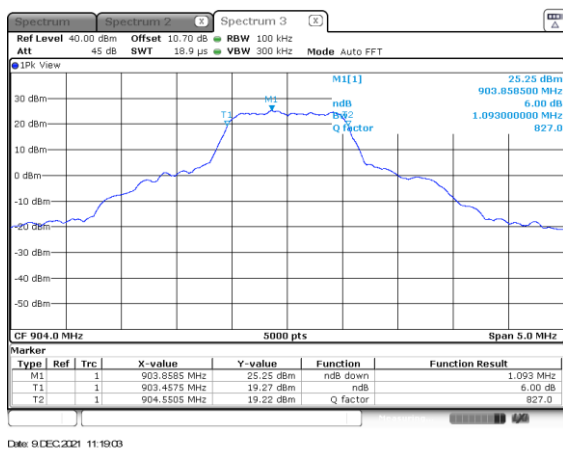
Test Results: Pass

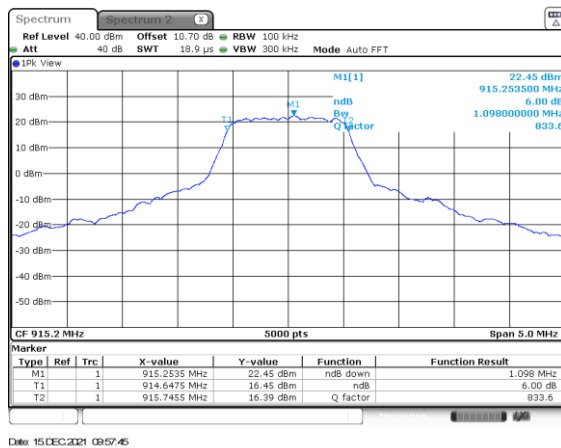
See data below for detailed results.



Table 2.4.6-1: 6dB / 99% Bandwidth

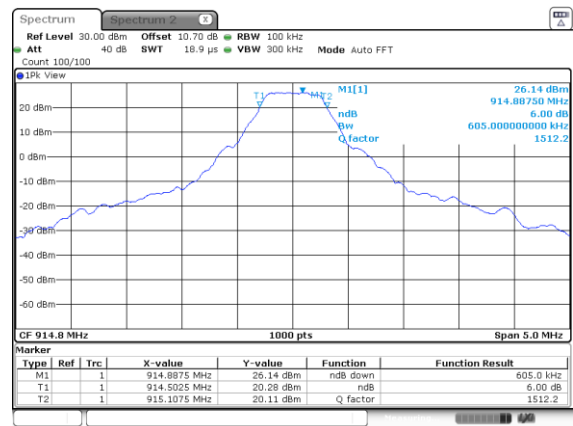
Frequency [MHz]	6dB Bandwidth (kHz)	99% Bandwidth (kHz)	Data Rate (kbps)	Mode(s)
904.0	1093	1151	MCS0	1
903.2	1099	1090	MCS5	2
902.8	605	628	MCS3	3
914.8	1091	1152	MCS0	1
915.2	1098	1090	MCS5	2
914.8	605	626	MCS3	3
926.8	1088	1132	MCS0	1
927.2	1101	1089	MCS5	2
926.8	600	604	MCS3	3





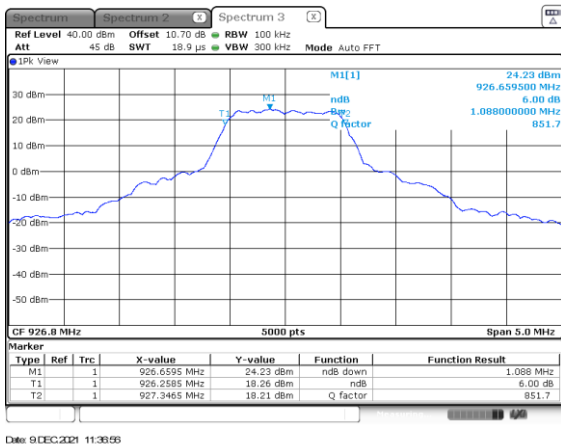
Date: 15 DEC 2021 09:57:45

Figure 2.4.6-5: Mode 2 – 6 dB BW – MCH – MCS5



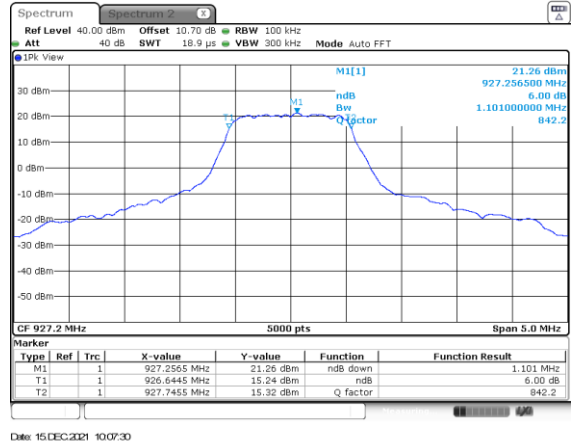
Date: 15 DEC 2021 14:29:10

Figure 2.4.6-6: Mode 3 – 6 dB BW – MCH - MCS3



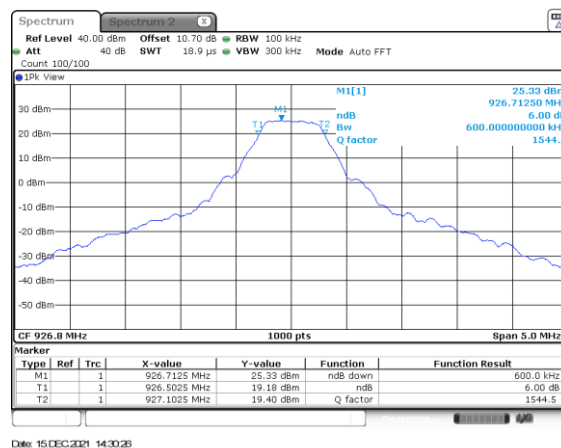
Date: 9 DEC 2021 11:38:58

Figure 2.4.6-7: Mode 1 – 6 dB BW – HCH – MCS0



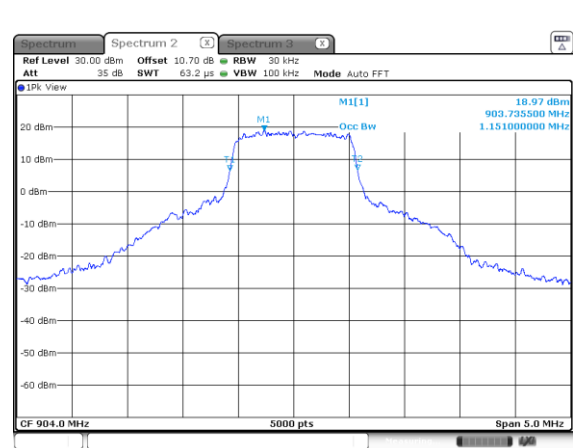
Date: 15 DEC 2021 10:07:30

Figure 2.4.6-8: Mode 2 – 6 dB BW – HCH – MCS5



Date: 15 DEC 2021 14:30:26

Figure 2.4.6-9: Mode 3 – 6 dB BW – HCH – MCS3



Date: 9 DEC 2021 11:08:02

Figure 2.4.6-10: Mode 1 – 99% BW – LCH MCS0

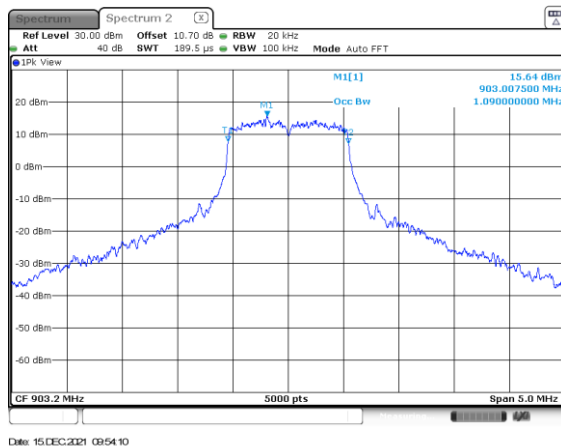


Figure 2.4.6-11: Mode 2 – 99% BW – LCH – MCS5

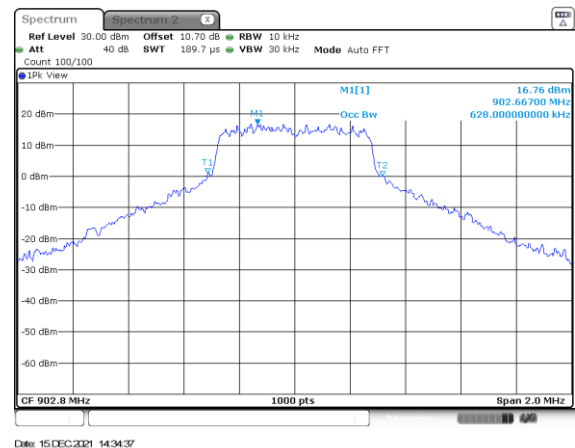


Figure 2.4.6-12: Mode 3 – 99% BW – LCH – MCS3

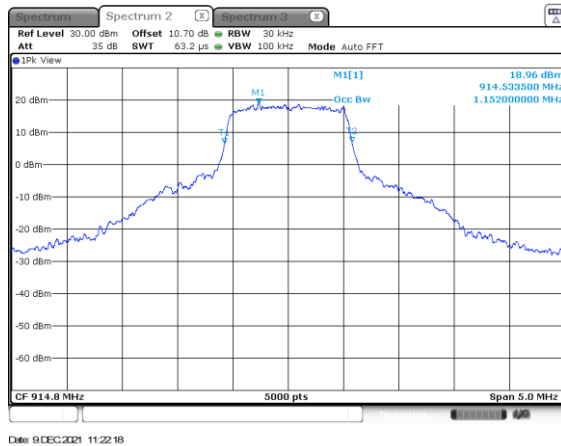


Figure 2.4.6-13: Mode 1 – 99% BW – MCH – MCS0

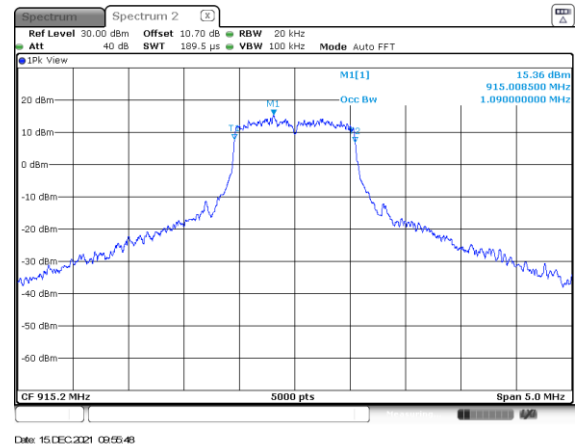


Figure 2.4.6-14: Mode 2 – 99% BW – MCH - MCS5

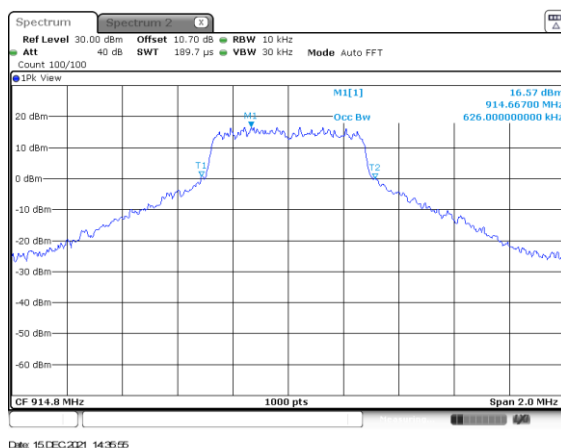


Figure 2.4.6-15: Mode 3 – 99% BW – MCH – MCS3

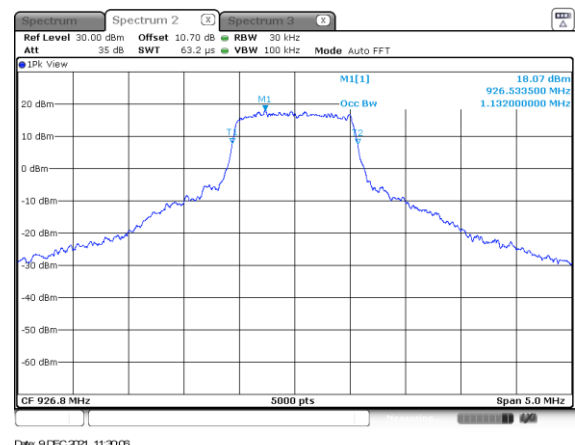


Figure 2.4.6-16: Mode 1 – 99% BW – HCH – MCS0

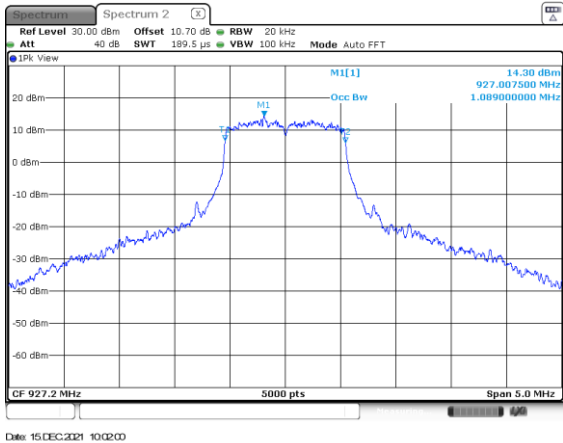


Figure 2.4.6-17: Mode 2 – 99% BW – HCH – MCS5

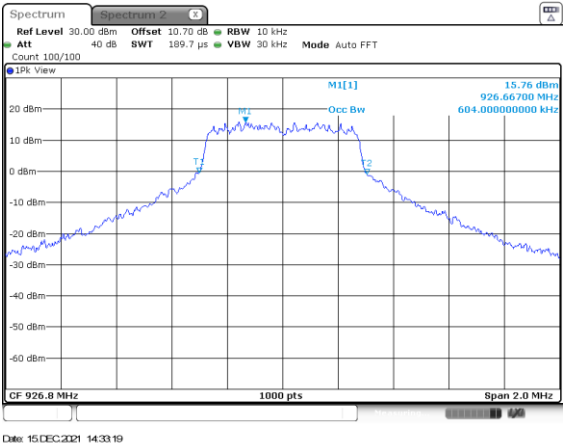


Figure 2.4.6-18: Mode 3 – 99% BW – HCH – MCS3



2.5 Maximum Power Spectral Density in the Fundamental Emission

2.5.1 Specification Reference

FCC Sections: 15.247(e)
ISED Canada: RSS-247 5.2(b)

2.5.2 Equipment Under Test and Modification State

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

2.5.3 Date of Test

12/09/2021 – 12/15/2021

2.5.4 Test Method

The power spectral density was measured in accordance with the ANSI 63.10 Subclause 11.10.3 Method AVGPSD-1. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 3 kHz. The Video Bandwidth (VBW) was set to 10 kHz. Span was set to 1.5 times the OBW. The RMS average detector is used, with the trace set to average hold. The marker is placed on the highest peak of the resulting trace.

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.

Test Results: Pass

See data below for detailed results.



Table 2.5.6-1: RF Power Spectral Density

Frequency [MHz]	Average PSD (dBm)	Data Rate (kbps)	Mode(s)
904.0	2.57	MCS0	1
903.2	0.52	MCS5	2
902.8	3.78	MCS3	3
914.8	2.39	MCS0	1
915.2	0.28	MCS5	2
914.8	3.94	MCS3	3
926.8	1.59	MCS0	1
927.2	-0.25	MCS5	2
926.8	3.00	MCS3	3

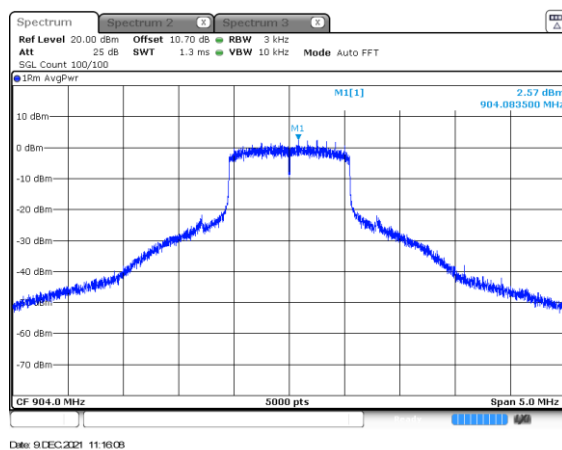


Figure 2.5.6-1: Mode 1 – PSD – LCH – MCS0

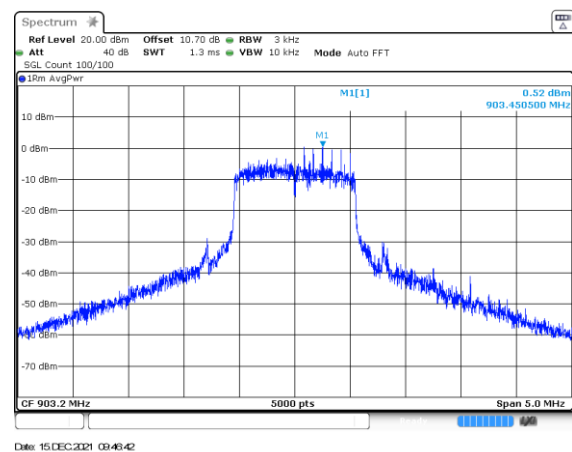


Figure 2.5.6-2: Mode 2 – PSD – LCH – MCS5

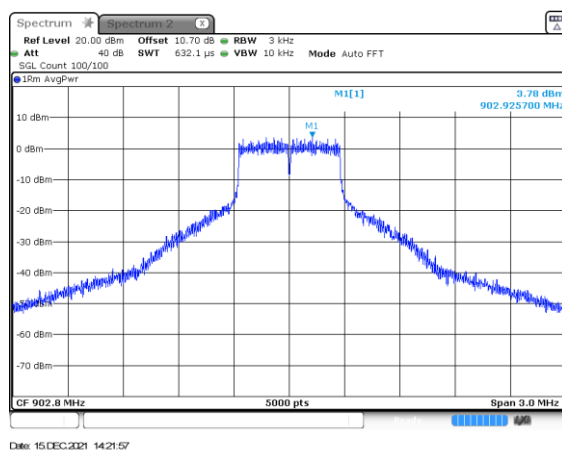


Figure 2.5.6-3: Mode 3 – PSD – LCH – MCS3

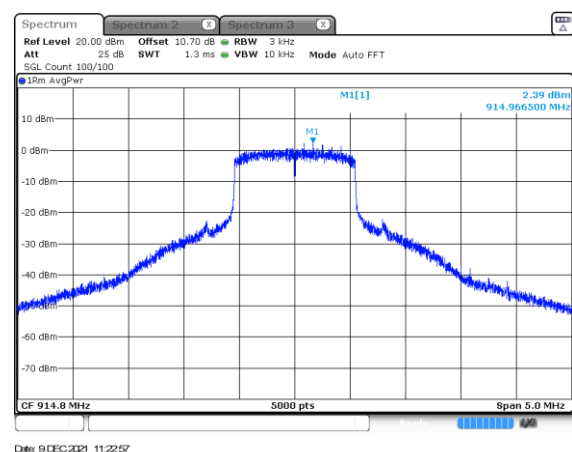
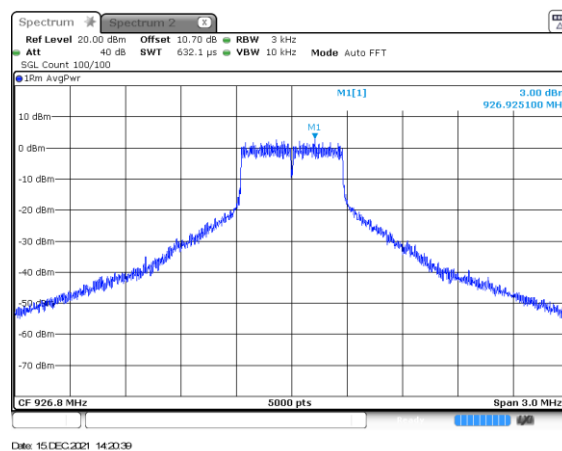
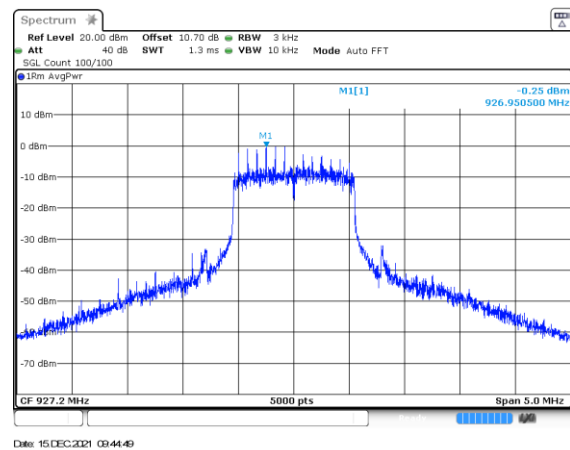
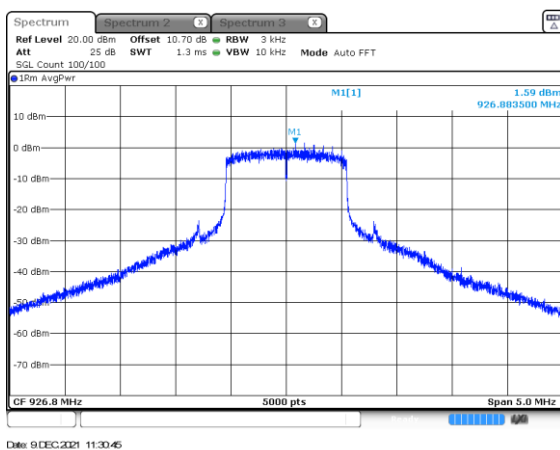
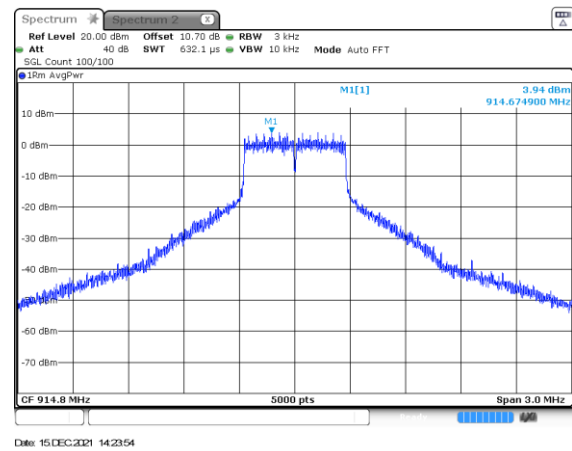
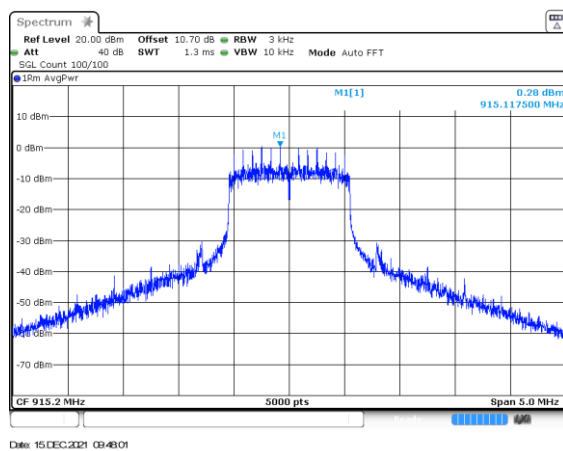


Figure 2.5.6.3-4: Mode 1 – PSD – MCH – MCS0





2.6 Band-Edge Compliance of RF Conducted Emissions

2.6.1 Specification Reference

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

2.6.2 Equipment Under Test and Modification State

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

2.6.3 Date of Test

12/09/2021 – 12/15/2021

2.6.4 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 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).

2.6.5 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.

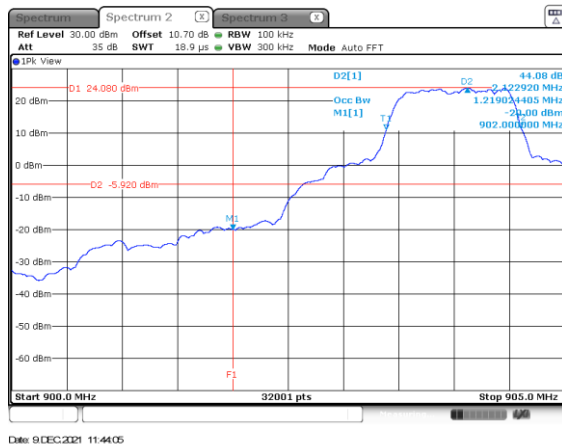
Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.6.6 Test Results

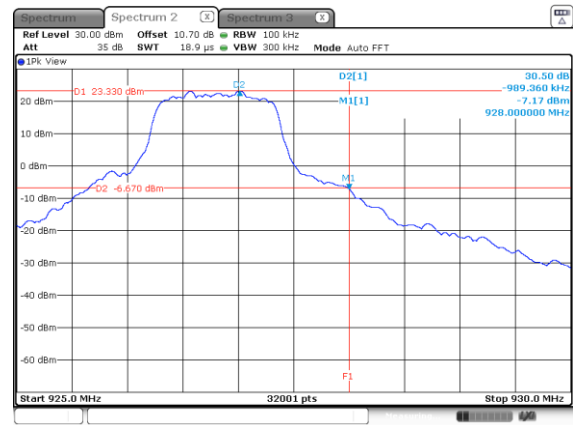
Test Summary: EUT was set to transmit mode.

Test Results: Pass

See data below for detailed results.



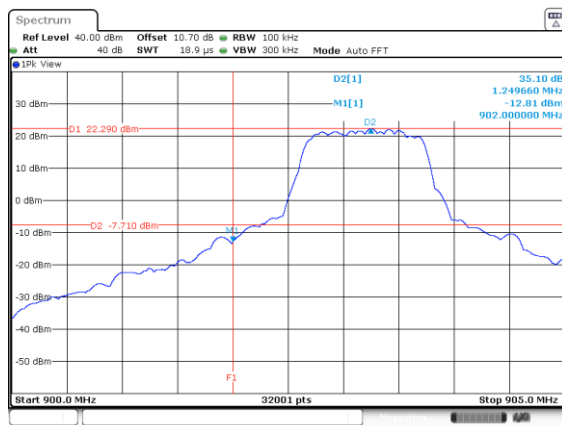
Date: 9 DEC 2021 11:44:05



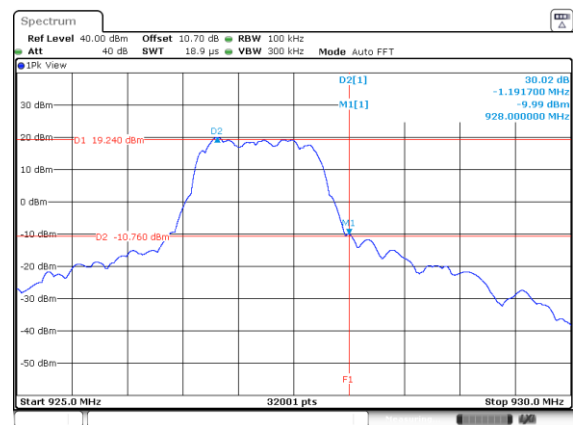
Date: 9 DEC 2021 12:19:34

Figure 2.6.6-1: Lower Band edge – Mode 1 – MCS0

Figure 2.6.6-2: Higher Band edge – Mode 1 – MCS0



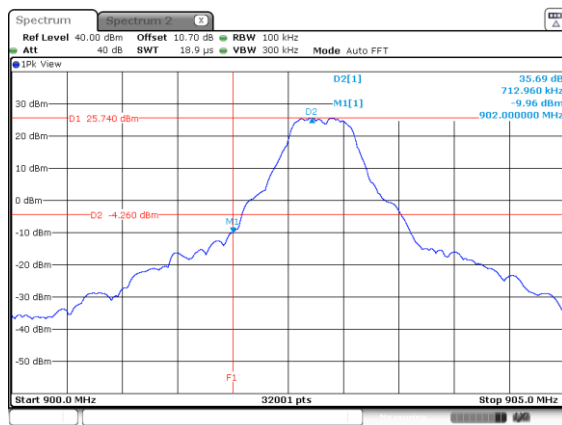
Date: 15 DEC 2021 09:37:36



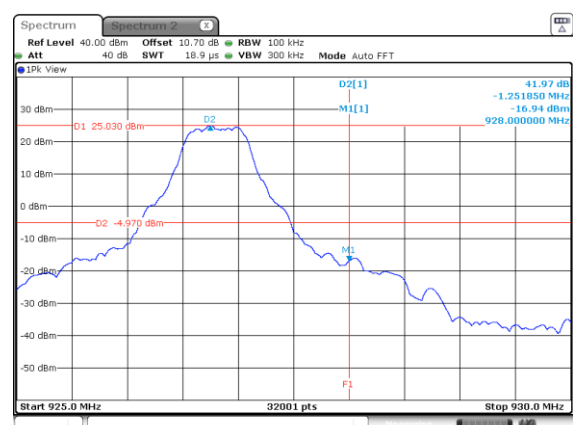
Date: 15 DEC 2021 09:42:28

Figure 2.6.6-3: Lower Band edge – Mode 2 – MCS5

Figure 2.6.6-4: Higher Band edge – Mode 2 – MCS5



Date: 15 DEC 2021 14:15:48



Date: 15 DEC 2021 11:33:19

Figure 2.6.6-5: Lower Band edge – Mode 3 – MCS3

Figure 2.6.6-6: Higher Band edge – Mode 3 – MCS3



2.7 RF Conducted Spurious Emissions

2.7.1 Specification Reference

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

2.7.2 Equipment Under Test and Modification State

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

2.7.3 Date of Test

12/09/2021 – 12/15/2021

2.7.4 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 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).

2.7.5 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.

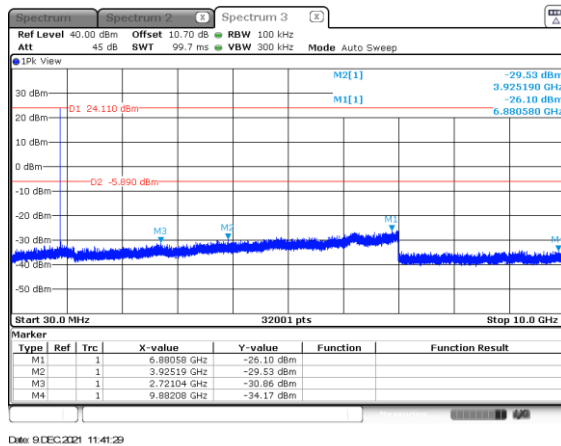
Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.7.6 Test Results

Test Summary: EUT was set to transmit mode.

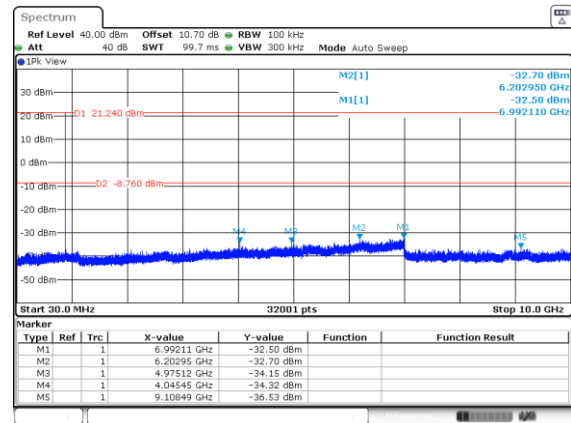
Test Results: Pass

See data below for detailed results.



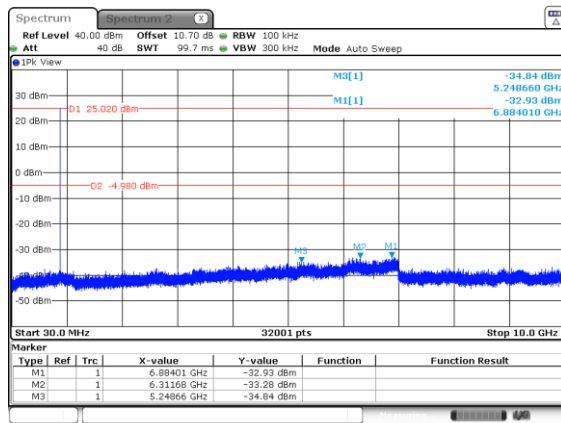
Date: 9 DEC 2021 11:41:29

Figure 2.7.6-1:30MHz – 10GHz – LCH – Mode 1



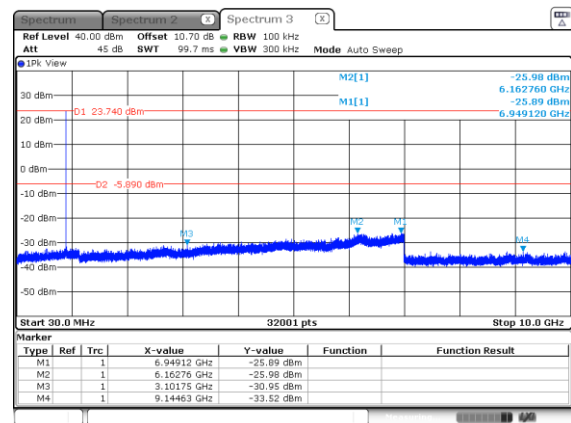
Date: 15 DEC 2021 09:27:28

Figure 2.7.6-2:30MHz – 10GHz – LCH – Mode 2



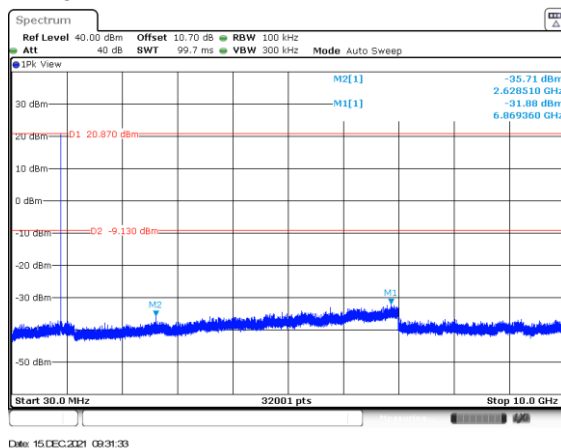
Date: 15 DEC 2021 11:16:23

Figure 2.7.6-3:30MHz – 10GHz – LCH – Mode 3



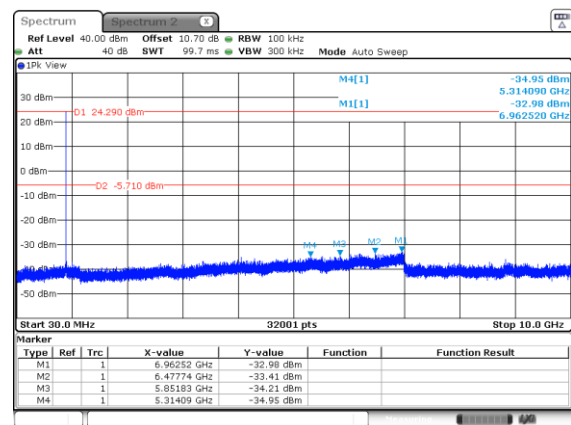
Date: 9 DEC 2021 11:58:42

Figure 2.7.6-4:30MHz – 10GHz – MCH – Mode 1



Date: 15 DEC 2021 09:31:33

Figure 2.7.6-5:30MHz – 10GHz – MCH – Mode 2



Date: 15 DEC 2021 11:18:20

Figure 2.7.6-6:30MHz – 10GHz – MCH – Mode 3

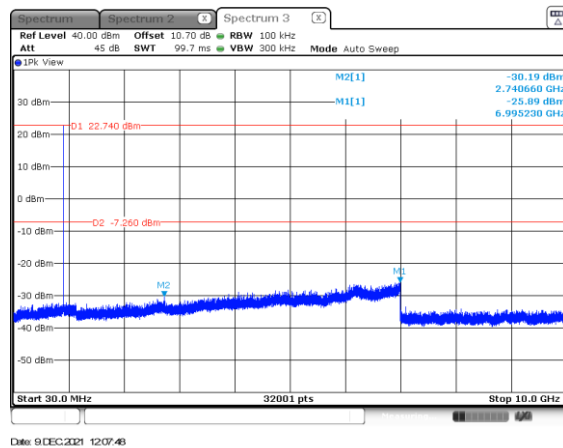


Figure 2.7.6-7:30MHz – 10GHz – HCH – Mode 1

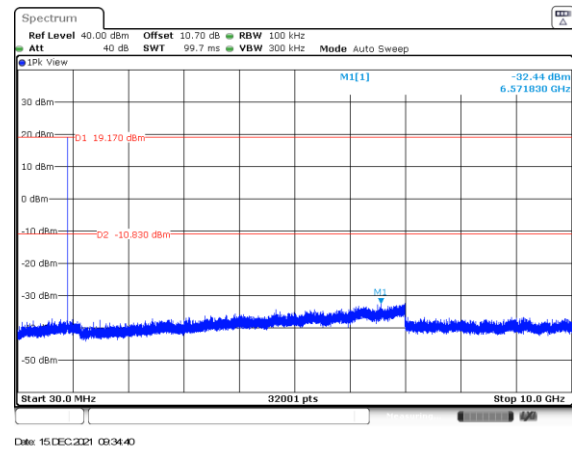


Figure 2.7.6-8:30MHz – 10GHz – HCH – Mode 2

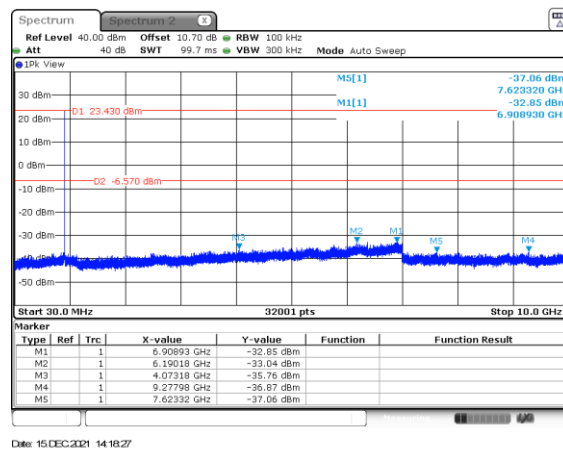


Figure 2.7.6-9:30MHz – 10GHz – HCH – Mode 3



2.8 Radiated Spurious Emissions into Restricted Frequency Bands

2.8.1 Specification Reference

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

2.8.2 Equipment Under Test and Modification State

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

2.8.3 Date of Test

12/8/2021 to 12/10/2021

2.8.4 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.

2.8.5 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.

Test Results: Pass

See data below for detailed results.

Table 2.8.6-1: Radiated Spurious Emissions Tabulated Data – Mode 1

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
LCH										
111.515	35.50	28.20	H	-7.98	-----	20.22	-----	43.5	-----	23.3
111.515	42.60	35.10	V	-7.98	-----	27.12	-----	43.5	-----	16.4
2712	53.70	37.20	H	0.49	54.19	37.69	74.0	54.0	19.8	16.3
2712	55.70	37.60	V	0.49	56.19	38.09	74.0	54.0	17.8	15.9
MCH										
112.773	35.70	28.70	H	-7.88	-----	20.82	-----	43.5	-----	22.7
112.773	42.10	35.40	V	-7.88	-----	27.52	-----	43.5	-----	16.0
2744.34	55.20	38.30	H	0.49	55.69	38.79	74.0	54.0	18.3	15.2
2744.34	55.60	37.80	V	0.49	56.09	38.29	74.0	54.0	17.9	15.7
HCH										
110.376	35.20	29.30	H	-8.07	-----	21.23	-----	43.5	-----	22.3
113.093	42.30	36.20	V	-7.85	-----	28.35	-----	43.5	-----	15.2
2780.4	49.80	34.70	H	0.48	50.28	35.18	74.0	54.0	23.7	18.8
2780.4	52.00	34.90	V	0.48	52.48	35.38	74.0	54.0	21.5	18.6

Table 2.8.6-2: Radiated Spurious Emissions Tabulated Data – Mode 2

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
LCH										
2709.1	49.00	33.60	H	0.49	49.49	34.09	74.0	54.0	24.5	19.9
2709.1	52.00	33.60	V	0.49	52.49	34.09	74.0	54.0	21.5	19.9
MCH										
2745.6	50.50	33.80	H	0.49	50.99	34.29	74.0	54.0	23.0	19.7
2745.6	53.10	34.00	V	0.49	53.59	34.49	74.0	54.0	20.4	19.5
HCH										
2781.6	49.70	33.10	H	0.48	50.18	33.58	74.0	54.0	23.8	20.4
2781.6	51.50	33.40	V	0.48	51.98	33.88	74.0	54.0	22.0	20.1

**Table 2.8.6-3: Radiated Spurious Emissions Tabulated Data – Mode 3**

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
LCH										
2708.4	51.00	34.90	H	0.49	51.49	35.39	74.0	54.0	22.5	18.6
2708.4	52.00	33.90	V	0.49	52.49	34.39	74.0	54.0	21.5	19.6
MCH										
2744.4	51.60	35.70	H	0.49	52.09	36.19	74.0	54.0	21.9	17.8
2744.4	54.50	35.70	V	0.49	54.99	36.19	74.0	54.0	19.0	17.8
HCH										
2780.4	49.80	33.70	H	0.48	50.28	34.18	74.0	54.0	23.7	19.8
2780.4	51.60	34.40	V	0.48	52.08	34.88	74.0	54.0	21.9	19.1

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 – Mode 1Corrected Level: $53.70 + 0.49 = 54.19$ dBuV/mMargin: $74\text{dBuV/m} - 54.19\text{dBuV/m} = 19.8$ dB**Example Calculation: Average – Mode 1**Corrected Level: $37.20 + 0.49 - 0 = 37.69$ dBuVMargin: $54\text{dBuV} - 37.69\text{dBuV} = 16.3$ dB

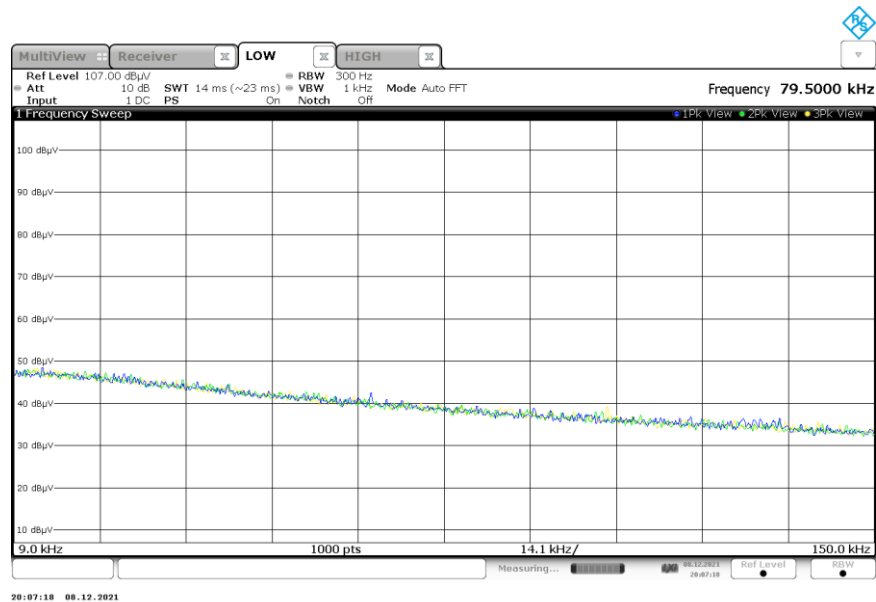


Figure 1: Reference plot for Radiated Spurious Emissions – 9 kHz – 150 kHz – Mode 1

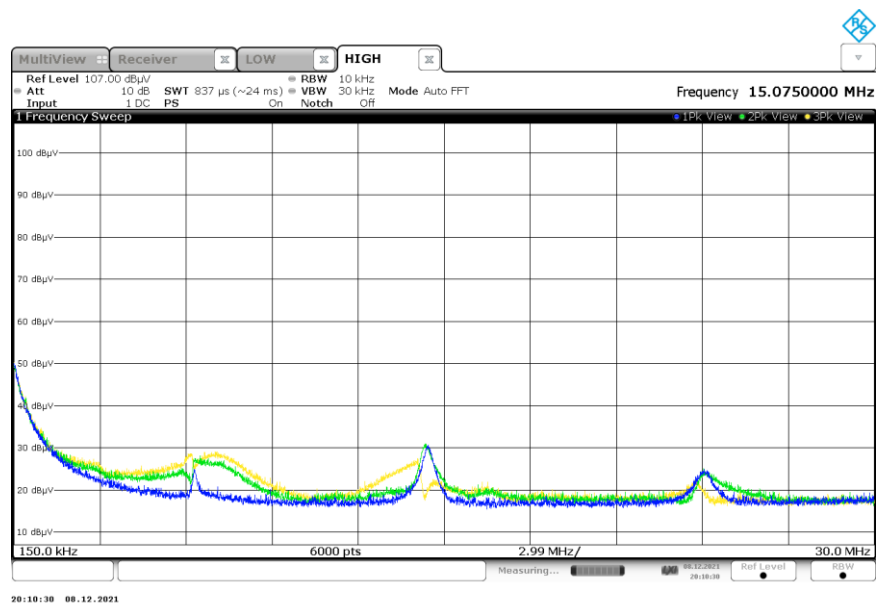


Figure 2: Reference plot for Radiated Spurious Emissions– 150 kHz – 30MHz – Mode 1
Note: Emissions above the noise floor are ambient not associated with the EUT.

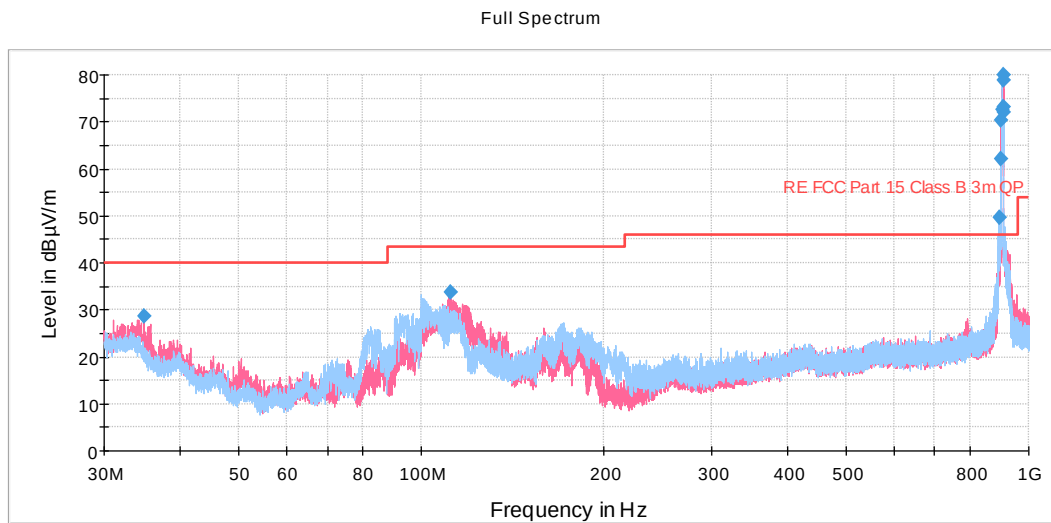


Figure 3: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz – Mode 1
Note: Emissions above the noise floor do not falls within restricted bands.

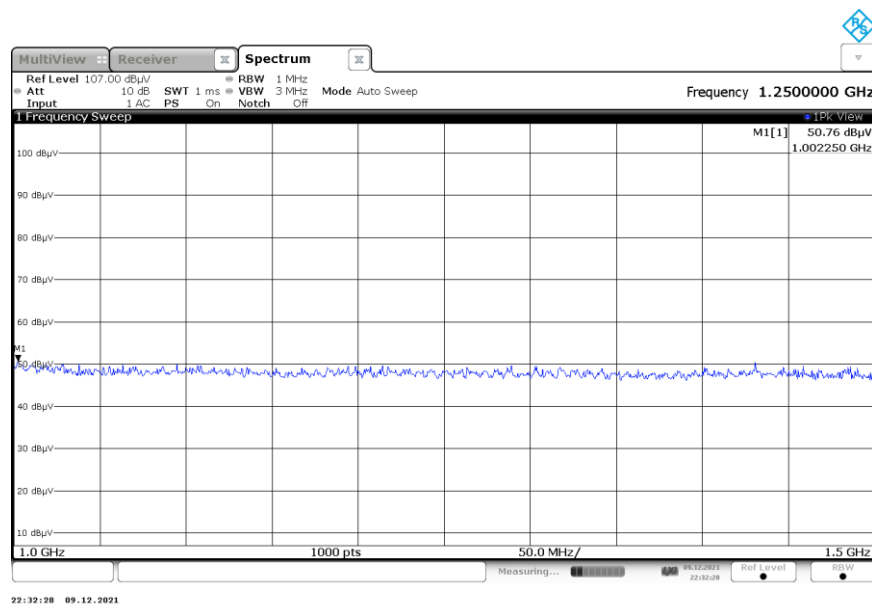


Figure 4: Reference plot for Radiated Spurious Emissions – 1 GHz – 1.5 GHz – Mode 1

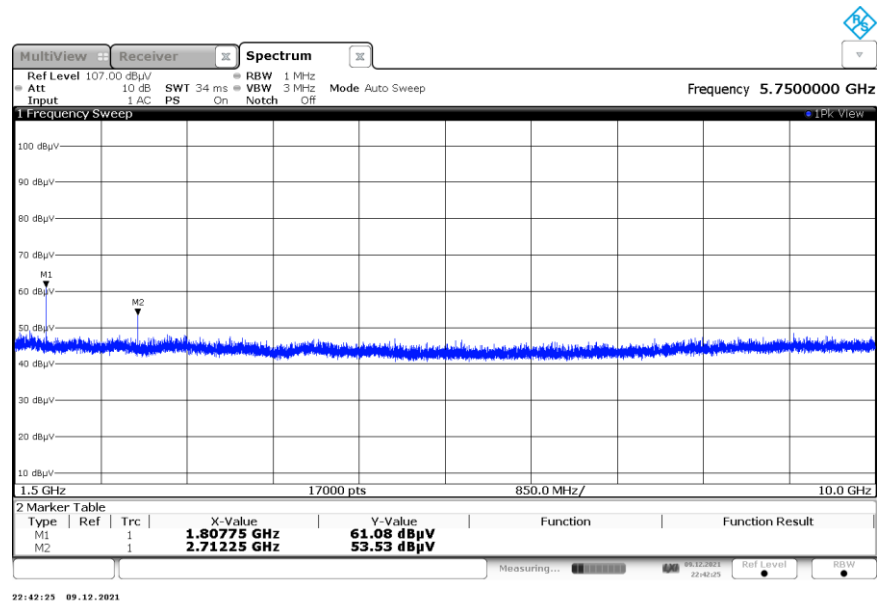


Figure 5: Reference plot for Radiated Spurious Emissions – 1.5 GHz – 10 GHz – Mode 1
Note: Only emissions within restricted bands were evaluated.



2.9 Test Equipment Used

Table 2.9-1 –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	6/8/2021	6/8/2023
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	6/22/2021	6/22/2023
DEMC3161	Ametek CTS Germany GmbH	CBL 6112D	Bilog Antenna; Attenuator	51323	3/19/2021	3/19/2023
884	ETS Lindgren	3117	Horn Antenna	00240106	5/6/2021	5/6/2022
213	TEC	PA 102	Amplifier	44927	7/30/2021	7/30/2022
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	6/9/2021	6/9/2022
882	Rohde & Schwarz	ESW44	Test Receiver	111961	6/24/2021	6/24/2022
836	ETS Lindgren	SAC Cable Set	SAC Cable Set includes 620, 837, 838	N/A	5/11/2021	5/11/2022
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	9/22/2021	9/22/2022
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	9/4/2020	12/4/2021
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	12/4/2021	2/4/2022
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	12/20/2021	12/20/2022
267	Hewlett Packard	N1911A	Power Meter	MY45100129	7/27/2021	7/27/2023
872	Agilent	E7402A	EMC Spectrum Analyzer	US40240258	6/22/2021	6/22/2022
871	Belden	RF Cable	RF Cable(CE Cable)	871	4/2/2021	4/2/2022
861	Com-Power	LI-1100C	Line Impedance Stabilization Network	20180038	2/26/2021	2/26/2022
862	Com-Power	LI01100C	Line Impedance Stabilization Network	20180039	2/26/2021	2/26/2022
144	Omega	RH411	Temp / Humidity Meter	H0103373	12/16/2020	12/16/2022

N/A – Not Applicable

NCR – No Calibration Required

3 Diagram of Test Set-ups

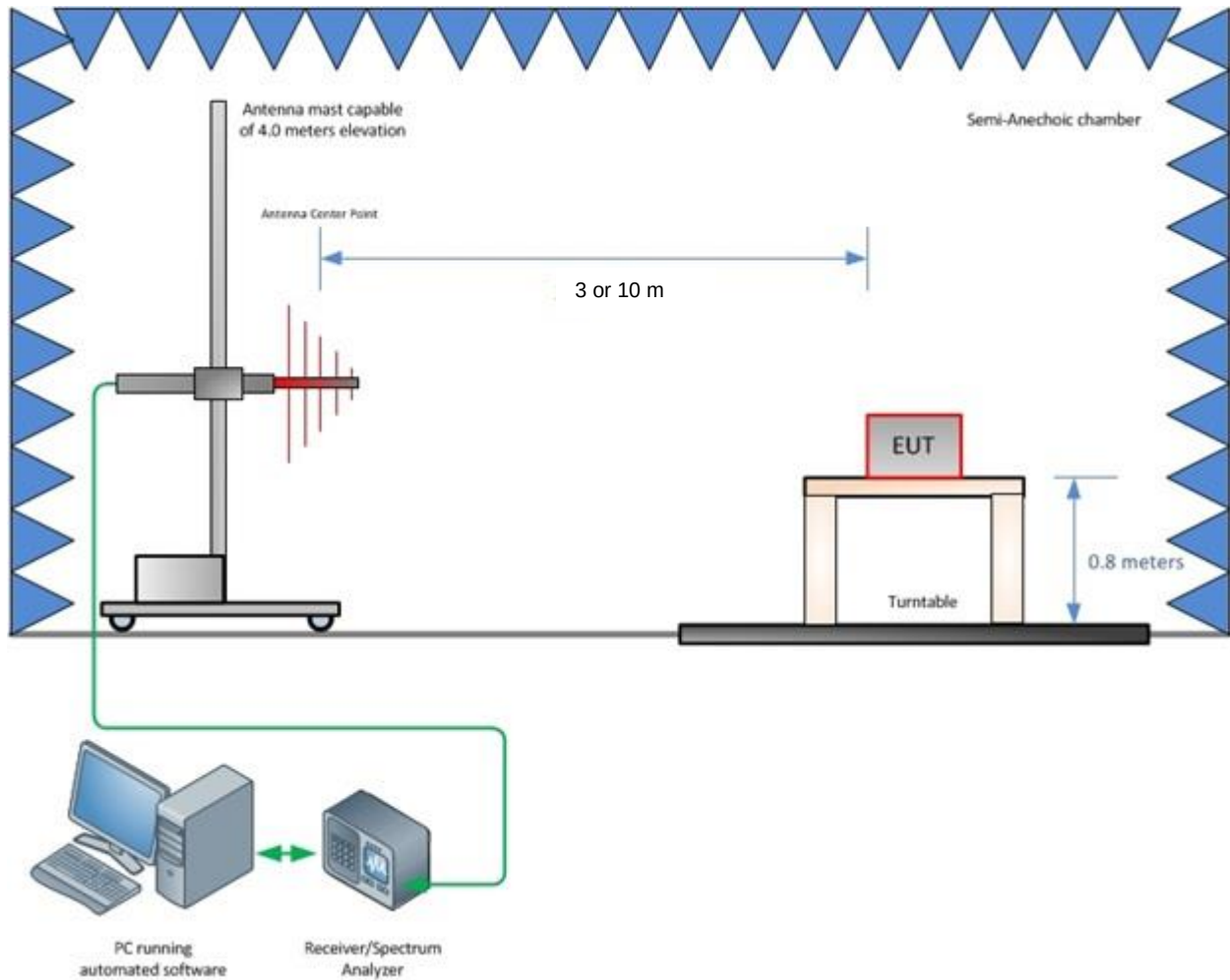


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

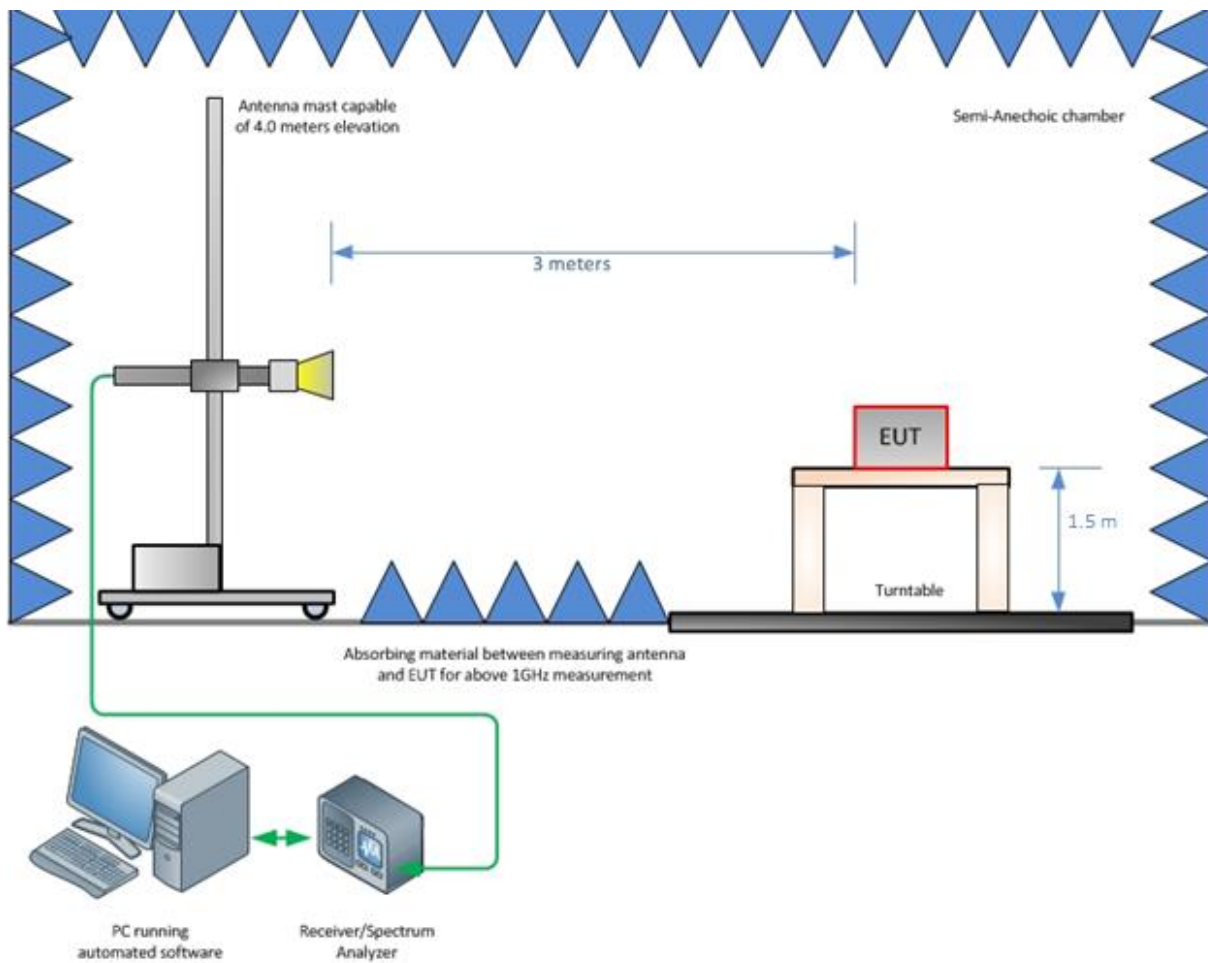


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

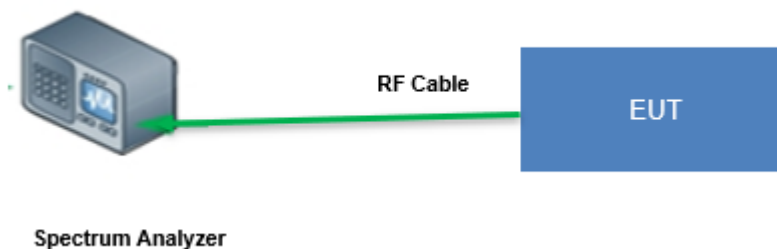


Figure 3-3 – Conducted Test Setup: Antenna Port measurement



4 Accreditation, Disclaimers and Copyright

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STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions

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.