

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 3, August 2023

Prepared for: Landis + Gyr Technology, Inc.
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Thierry Jean-Charles	Senior Engineer TÜV SUD America Inc.	Authorized Signatory	3/29/2024

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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.



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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	3/29/2024

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 support a Class II Permissive Change.

The purpose of this Class II Permissive Change is to add new dipole antenna to their pre-approved module holding FCC ID: R7PNG0R1X8 / IC ID: 5294A-NG0R1X8

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)	25-6500 Rev. BD
Software Version(s)	S6-MCM0 SBS Mode FW: S6SR3D-26.16 S6MCM0 WiSUN Mode FW: S6WR3D-26.16
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, 2024
	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 3, August 2023.
Order Number	72197962



Date of Receipt of EUT	3/7/2024
Start of Test	3/7/2024
Finish of Test	3/14/2024
Related Document(s)	<p>ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Device.</p> <p>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</p> <p>US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2024.</p> <p>ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)</p>



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
Carrier Frequency Separation	No	Not Tested	15.247(a)(1)	RSS-247 5.1(b)	-----
Number of Hopping Channels	No	Not Tested	15.247(a)(1)(i)	RSS-247 5.1(c)	-----
Channel Dwell Time (FHSS / Hybrid)	No	Not Tested	15.247(a)(1)(i) 15.247(f)	RSS-247 5.1(c) RSS-247 5.3(a)	-----
20 dB Bandwidth	No	Not Tested	15.247(a)(1)(i)	RSS-247 5.1(c)	-----
99% Bandwidth	No	Not Tested	-----	RSS-GEN 6.7	-----
Peak Output Power	Yes	Pass	15.247(b)(2)	RSS-247 5.4(a)	15
Avg Output Power (Hybrid)	Yes	Pass	15.247(b)(3)	RSS-247 5.4(a)	17
Band-Edge Compliance of RF Conducted Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	21
RF Conducted Spurious Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	24
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	26
Power Spectral Density (Hybrid)	Yes	Pass	15.247(e)	RSS-247 5.2(b)	19
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 Revelo E360.

Table 1.4.1-1 – Wireless Technical Information

Detail	Description
Module FCC ID	R7PNG0R1X8
Module IC ID	5294A-NG0R1X8
Transceiver Model #	S6-MCM0
Modulation Format	IEEE 801.15.4 SUN FSK, IEEE 801.15.4 SUN OFDM
*Antenna Type / Description:	The EUT's internal PIFA antenna, which resides on the PCBA, couples to an external flexible dipole antenna which is wrapped around the meter's plastic enclosure. The flexible dipole antenna around the plastic enclosure connects to a 5.7 dBi dipole antenna via a 2.5 ft coaxial cable. The total antenna gain is 1.26 dBi

*Note: Antenna information declared by the customer.

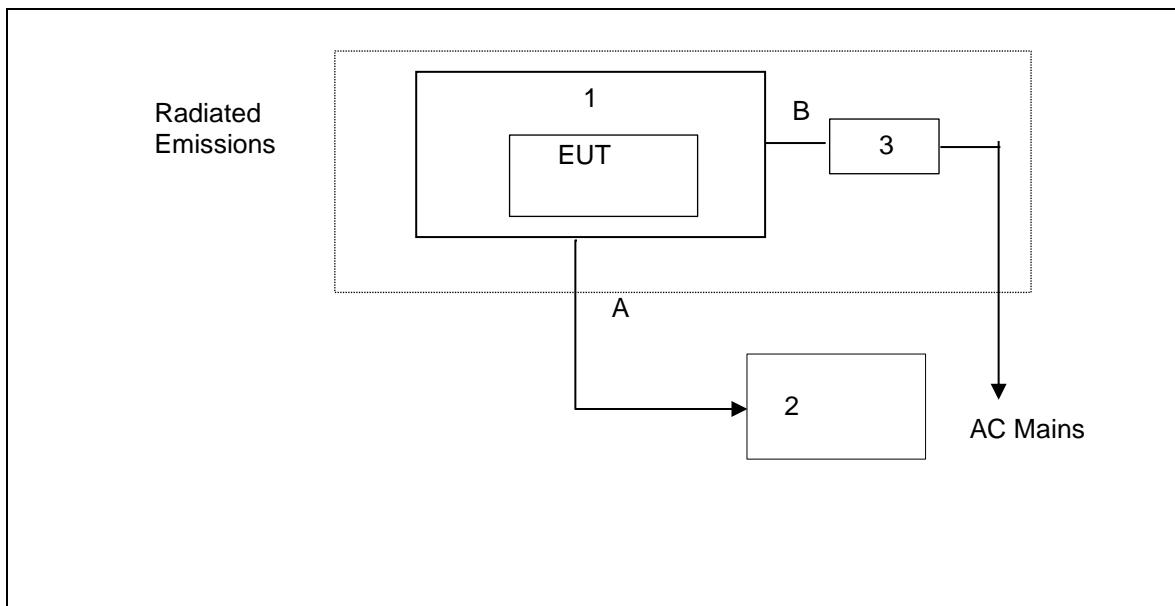
A full description and detailed product specification details are available from the manufacturer.



Figure 1.4.1-1 –View of the Conducted EUT



Figure 1.4.1-2 – View of the Radiated EUT

**Figure 1.4.1-3 – Test Setup Block Diagram****Table 1.4.1-2 – 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 1.4.1-3 – Support Equipment Descriptions

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



1.4.2 Modes of Operation

S6-MCM0 model provides 5 distinct proprietary modes of operation using both FHSS and hybrid classifications as outlined below.

Mode of Operation	Frequency Range (MHz)	Number of Channels	Channel Separation (kHz)	Stack / Mode	Data Rates Supported (kbps)	Classification
1	902.4 – 927.6	64	400	SBS (802.15.4 SUN FSK)	50, 150 & 200	FHSS
2	902.2 – 927.8	129	200	WSN (802.15.4 SUN FSK)	50	FHSS
3	902.4 – 927.6	64	400	WSN (802.15.4 SUN FSK)	150, 200	FHSS
4	902.4 – 927.6	64	400	SBS (802.15.4 SUN OFDM)	MCS3 – MCS6	Hybrid
5	902.4 – 927.6	64	400	WSN (802.15.4 SUN OFDM)	MCS2 – MCS3	Hybrid

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	20dB/99% Bandwidth	Number of Hopping Channels	Carrier Frequency Separation	Peak Output Power	Average Output Power	RF Conducted Spurious Emissions	Band-Edge RF Conducted Emissions	RSE into Restricted Frequency Bands	Power Spectral Density
		Data Rate (kbps) / MCS								
1	FHSS	****	****	****	50, 150, 200	NA	*	200	*	NA
2	FHSS	****	****	****	50	NA	50	50	50	NA
3	FHSS	**	**	**	**	NA	**	**	**	NA
4	Hybrid	***	***	***	NA	***	***	***	***	***
5	Hybrid	****	****	****	NA	MCS2	MCS2	MCS2	MCS2	MCS2

* Addressed by mode 2 (50 kbps data rate for all other mode 1 parameters covered by mode 2 where otherwise not indicated)

** Addressed by mode 1

*** Addressed by mode 5

**** Addressed in the original filing report.

Power setting during test: Mode of operation 1: Index: 21 dBm

Mode of operation 2: Index: 18 dBm

Mode of operation 5: Index: 21 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	Bhagyashree Chaudhary	A2LA
Peak / Average Output Power	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
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

3/7/2024

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 couples the internal PIFA antenna, which resides on the PCBA, to an external flexible antenna wrapped around the meter's plastic enclosure. The flexible antenna around the plastic enclosure connects to a 5.7 dBi dipole antenna via a 2.5 ft coaxial cable. The total gain is 1.26 dBi, 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

3/14/2024

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
0.62	46	21.8	12.1	9.657	-24.2	PASS
0.84	46	19.8	10.1	9.671	-26.2	PASS
1.41	46	23.2	13.4	9.705	-22.8	PASS
1.59	46	20.7	11	9.721	-25.3	PASS
2.05	46	21	11.3	9.772	-25	PASS
3.84	46	20	10.2	9.78	-26	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
0.62	56	31.2	21.5	9.657	-24.8	PASS
0.84	56	30	20.4	9.671	-26	PASS
1.41	56	30.2	20.5	9.705	-25.8	PASS
1.59	56	30.1	20.4	9.721	-25.9	PASS
2.05	56	30.5	20.7	9.772	-25.5	PASS
3.84	56	29.1	19.3	9.78	-26.9	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
0.79	46	20.5	10.9	9.647	-25.5	PASS
0.9	46	20.5	10.8	9.654	-25.5	PASS
1.06	46	20.4	10.8	9.667	-25.6	PASS
1.16	46	20.2	10.6	9.679	-25.8	PASS
1.62	46	21.2	11.5	9.729	-24.8	PASS
2.67	46	18.1	8.3	9.777	-27.9	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
0.79	56	30.9	21.3	9.647	-25.1	PASS
0.9	56	30.4	20.8	9.654	-25.6	PASS
1.06	56	30.9	21.2	9.667	-25.1	PASS
1.16	56	28.2	18.5	9.679	-27.8	PASS
1.62	56	27.8	18.1	9.729	-28.2	PASS
2.67	56	27.4	17.6	9.777	-28.6	PASS

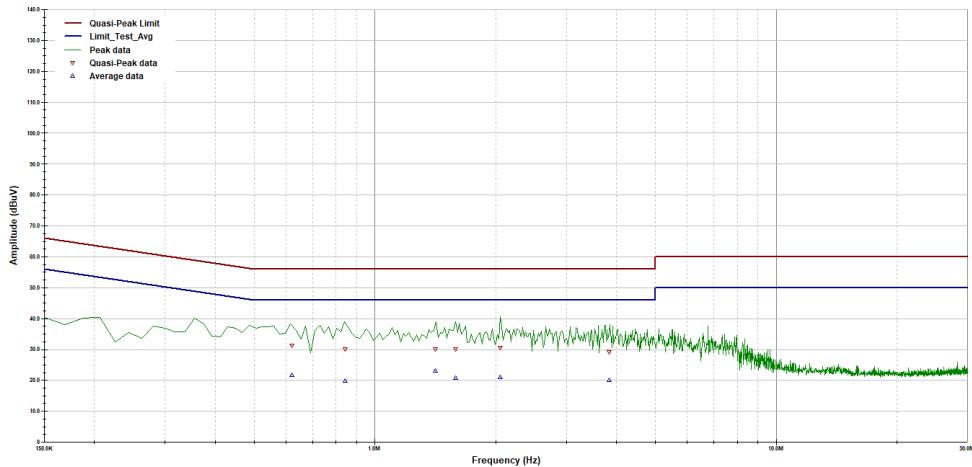


TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 1 Results

EUT Name - 72197962 L+G
 Model Number - Revelo S6 MCMO
 Part Number - N/A
 Serial Number - N/A
 Voltage - FCC/C/Class B: 120Vac/60Hz
 Operating Mode - Radio on; FHSS mode



Operator: Shree

Temperature = 23C
 Relative Humidity = 40%

AC Mains Class B.011

RF Bandwidth: 9kHz
 VBW If Analyzer: 30kHz

Last Data Update 02:45:16 PM, Thursday, March 14, 2024

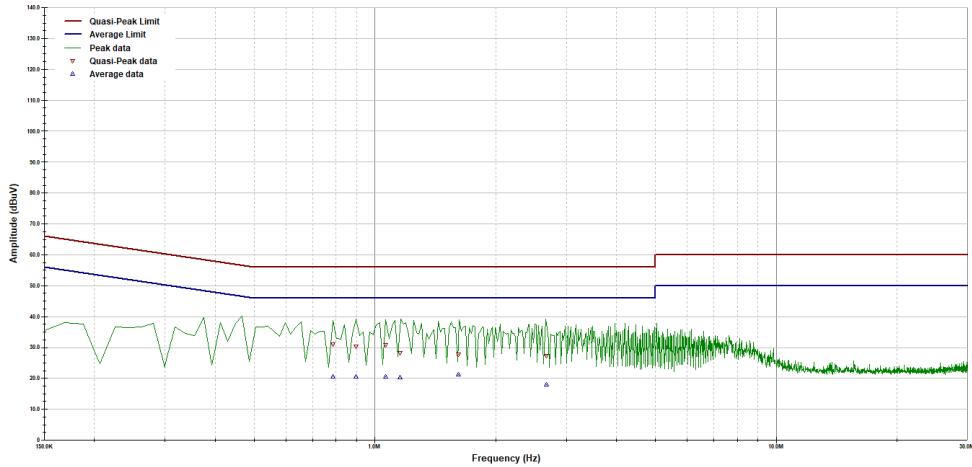
Figure 1: Conducted Emission Plot – Line 1

TUV SUD America

Conducted RF Emissions, 150 kHz to 30 MHz

Line Under Test Number 2 Results

EUT Name - 72197962 L+G
 Model Number - Revelo S6 MCMO
 Part Number - N/A
 Serial Number - N/A
 Voltage - FCC/C/Class B: 120Vac/60Hz
 Operating Mode - Radio on; FHSS mode



Operator: Shree

Temperature = 23C
 Relative Humidity = 40%

AC Mains Class B.011

RF Bandwidth: 9kHz
 VBW If Analyzer: 30kHz

Last Data Update 02:53:32 PM, Thursday, March 14, 2024

Figure 2: Conducted Emission Plot – Neutral



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 “0”, as noted in §1.6.

2.3.3 Date of Test

03/07/2024

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.

Test Results: Pass

See data below for detailed results.



Table 2.3.6-1: RF Output Power - FHSS

Frequency [MHz]	Peak Output Power (dBm)	E.I.R.P (dBm)	Data Rate (kbps)	Mode(s)
902.4	28.58	29.84	50	1
902.4	28.56	29.82	150	1
902.4	28.57	29.83	200	1
902.2	28.58	29.84	50	2
914.8	28.33	28.33	50	1
914.8	28.34	28.34	150	1
914.8	28.32	28.32	200	1
915.0	28.33	28.33	50	2
927.6	27.80	29.06	50	1
927.6	27.80	29.06	150	1
927.6	27.89	29.15	200	1
927.8	27.80	29.06	50	2



2.4 Average Output Power

2.4.1 Specification Reference

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

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

3/7/2024

2.4.4 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.

Note: This measurement method was evaluated for Hybrid Classification.

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: RF Output Power - Hybrid**

Frequency [MHz]	Average Output Power (dBm)	E.I.R.P (dBm)	Data Rate (kbps)	Mode(s)
902.4	24.26	25.52	MCS2	5
915.2	24.17	25.43	MCS2	5
927.6	23.12	24.38	MCS2	5



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

3/7/2024

2.5.4 Test Method

The power spectral density was measured in accordance with the ANSI 63.10 Subclause 11.10.3 Method AVGPSD (AVGPSD). 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.

Note: This test requirement is evaluated for only Hybrid Classification.

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- Hybrid

Frequency [MHz]	Average PSD (dBm)	Data Rate (kbps)	Mode(s)
902.4	4.34	MCS2	5
915.2	5.06	MCS2	5
927.6	4.58	MCS2	5

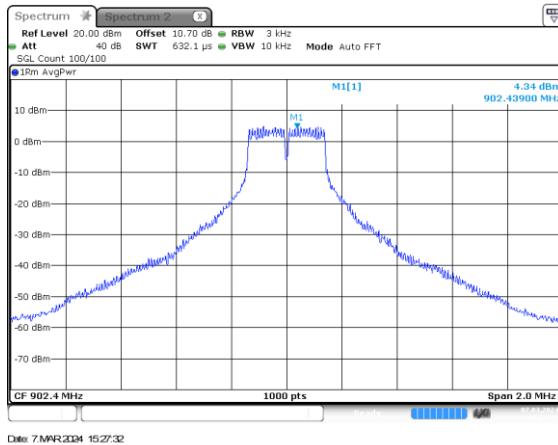


Figure 2.5.6-1: Mode 5 – PSD – LCH – MCS2

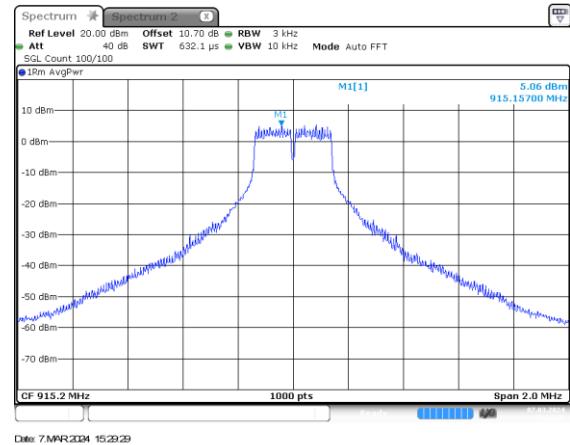


Figure 2.5.6-2: Mode 5 – PSD – MCH – MCS2

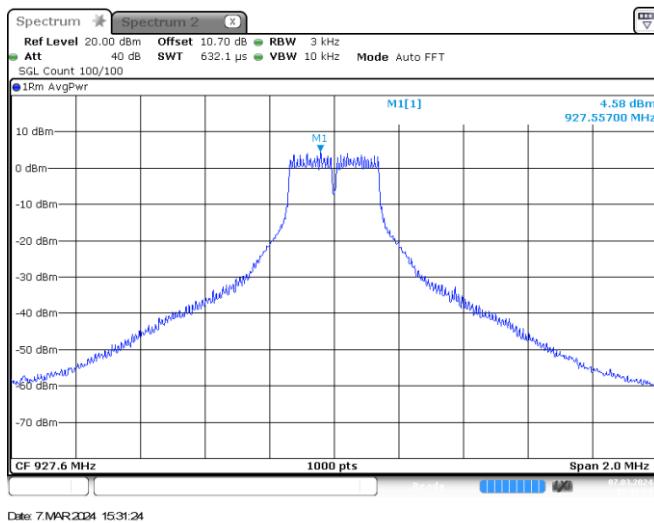


Figure 2.5.6-3: Mode 5 – PSD – HCH – MCS2



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

03/07/2024

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 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) Mode 1, and 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) Mode 5 band edge frequency attenuated by 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.



HOPPING MODE:

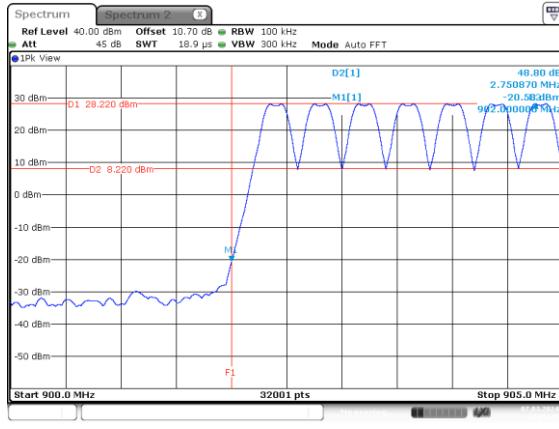


Figure 2.6.6-1: Lower Band edge – Mode 1 – 200kbps

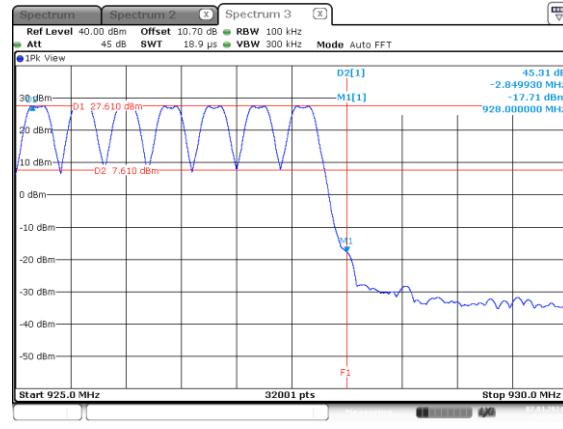


Figure 2.6.6-2: Higher Band edge – Mode 1 – 200kbps

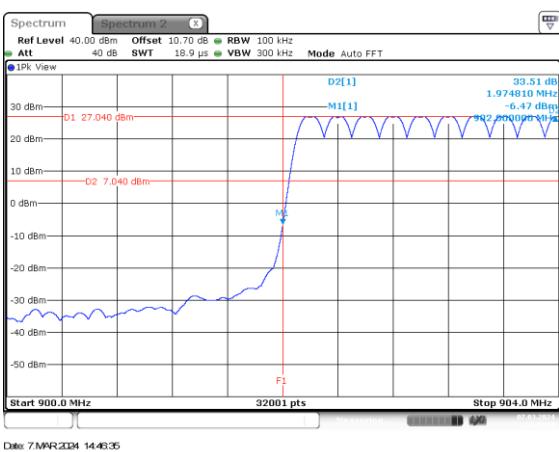


Figure 2.6.6-3: Lower Band edge – Mode 2 – 50kbps

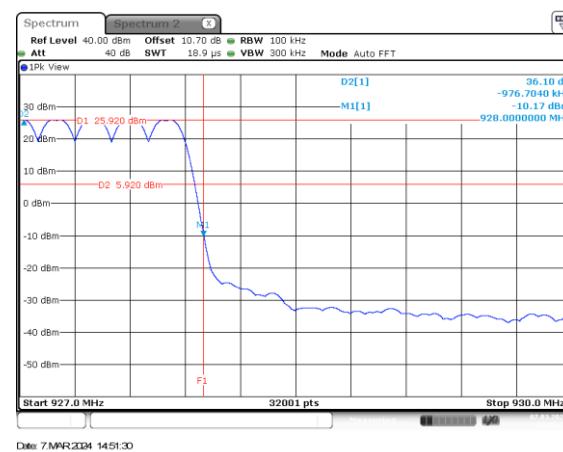


Figure 2.6.6-4: Higher Band edge – Mode 2 – 50kbps

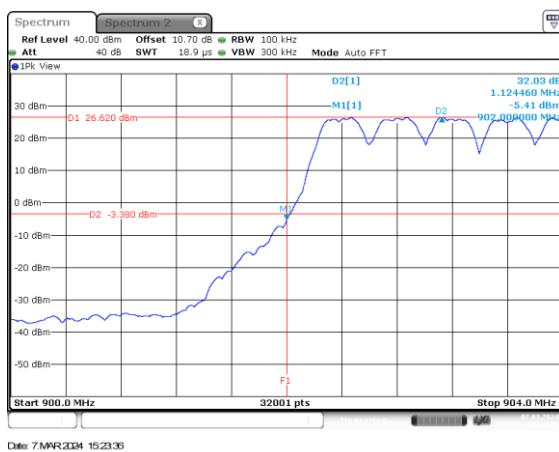


Figure 2.6.6-5: Lower Band edge – Mode 5 – MCS2

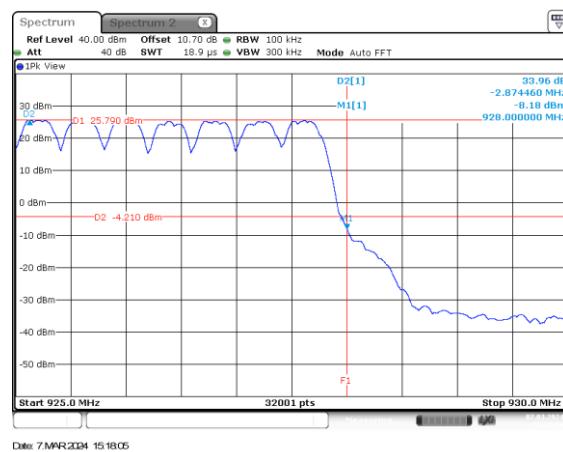


Figure 2.6.6-6: Higher Band edge – Mode 5 – MCS2



NON-HOPPING MODE:

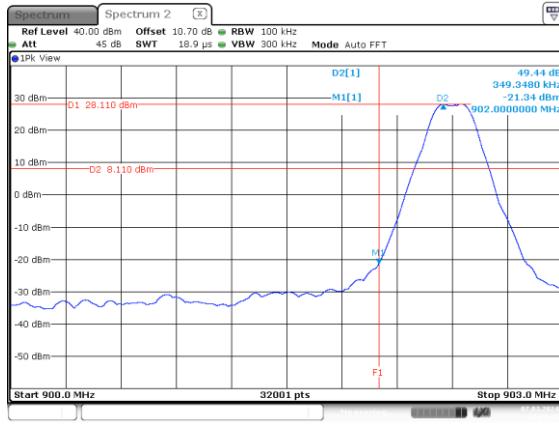


Figure 2.6.6-7: Lower Band edge – Mode 1 – 200kbps

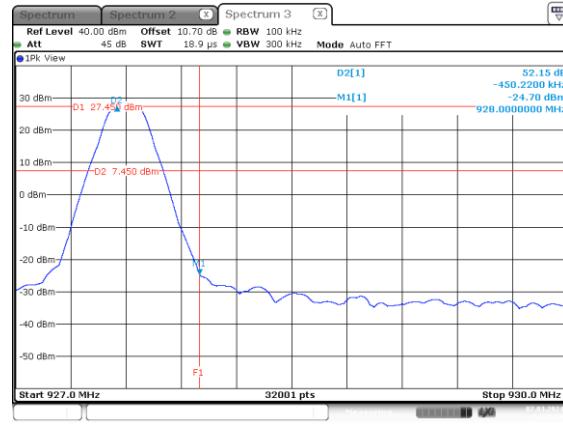


Figure 2.6.6-8: Higher Band edge – Mode 1 – 200kbps

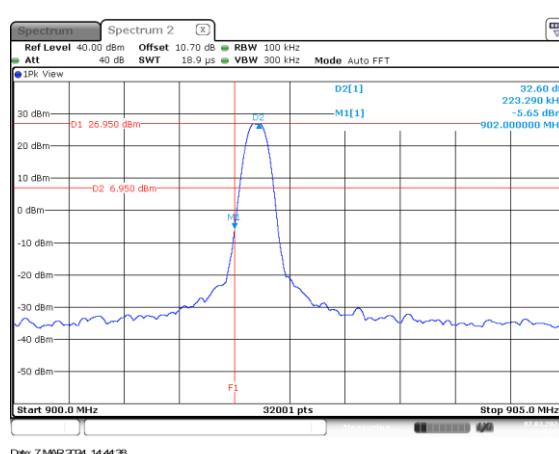


Figure 2.6.6-9: Lower Band edge – Mode 2 – 50kbps

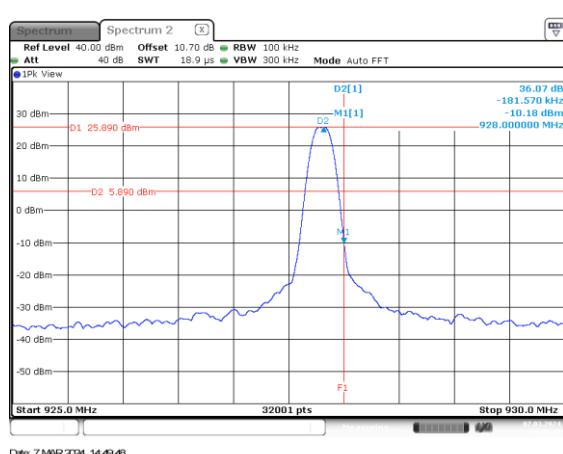


Figure 2.6.6-10: Higher Band edge – Mode 2 – 50kbps

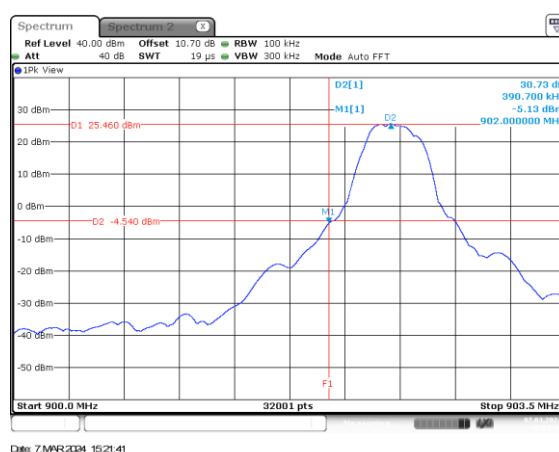


Figure 2.6.6-11: Lower Band edge – Mode 5 – MCS2

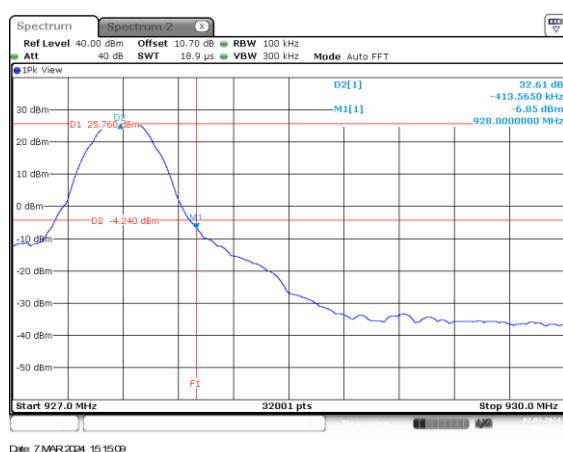


Figure 2.6.6-12: Higher Band edge – Mode 5 – MCS2



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

03/07/2024

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 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). Mode 2 conducted spurious emissions 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). Mode 5 conducted spurious emissions attenuated by 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.

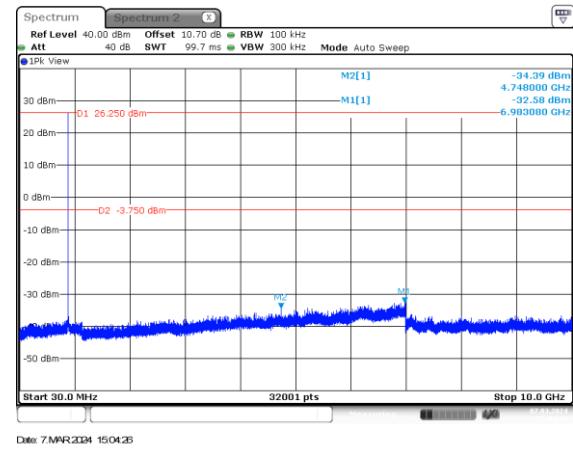
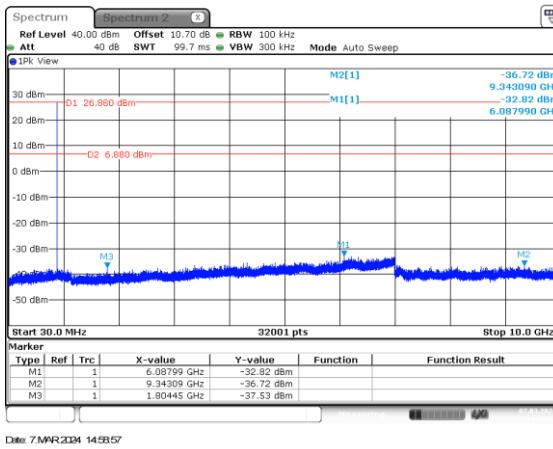
Ambient Temperature	22.3 °C
Relative Humidity	53.8 %
Atmospheric Pressure	972.2 mbar

2.7.6 Test Results

Test Summary: EUT was set to transmit mode.

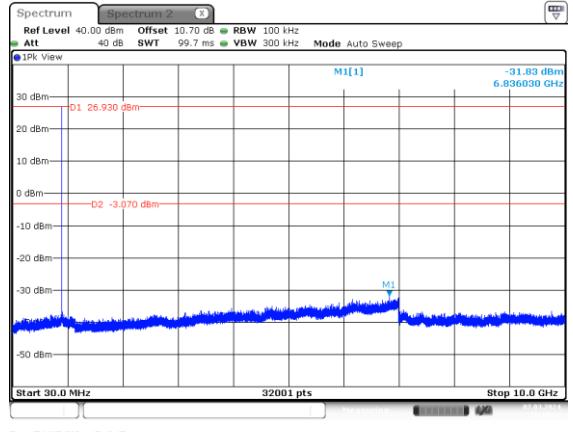
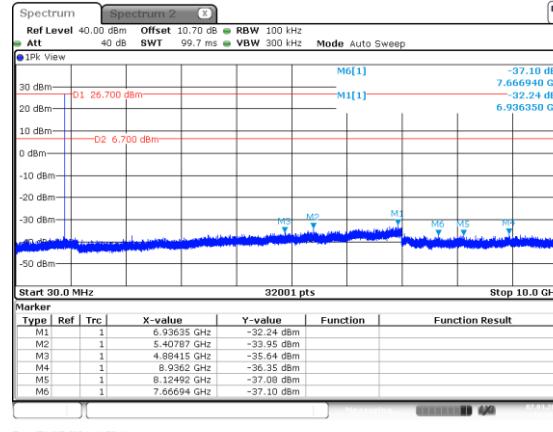
Test Results: Pass

See data below for detailed results.



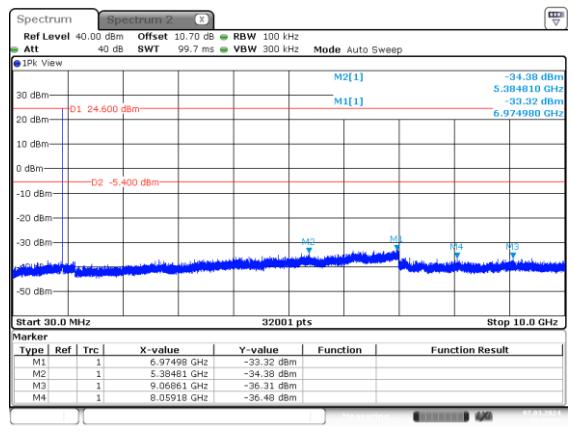
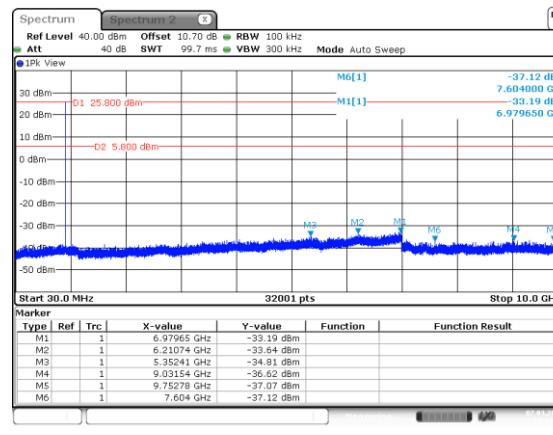
Date: 7/MAR/2024 14:58:57

Date: 7/MAR/2024 15:04:25

Figure 2.7.6-1:30MHz – 10GHz – LCH – Mode 2**Figure 2.7.6-2:30MHz – 10GHz – LCH – Mode 5**

Date: 7/MAR/2024 14:58:41

Date: 7/MAR/2024 15:10:17

Figure 2.7.6-3:30MHz – 10GHz – MCH – Mode 2**Figure 2.7.6-4:30MHz – 10GHz – MCH – Mode 5**

Date: 7/MAR/2024 14:54:24

Date: 7/MAR/2024 15:13:12

Figure 2.7.6-5:30MHz – 10GHz – HCH – Mode 2**Figure 2.7.6-6:30MHz – 10GHz – HCH – Mode 5**



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

03/11/2024 to 03/13/2024

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 2

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	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m	dB	dB	H/V	Pass/Fail	Pass/Fail
LCH – 902.2MHz									
84.856	----	29.301	----	40	----	10.7	H	----	PASS
123.045	----	32.03	----	43.5	----	11.47	H	----	PASS
129.616	----	29.565	----	43.5	----	13.93	H	----	PASS
55.757	----	24.847	----	40	----	15.15	V	----	PASS
84.76	----	28.791	----	40	----	11.21	V	----	PASS
130.586	----	35.966	----	43.5	----	7.53	V	----	PASS
2706.575	50.329	39.429	74	54	23.671	14.571	H	PASS	PASS
3608.425	48.517	36.117	74	54	25.483	17.883	H	PASS	PASS
2706.575	51.229	34.929	74	54	22.771	19.071	V	PASS	PASS
3608.425	48.017	34.817	74	54	25.983	19.183	V	PASS	PASS
MCH – 915 MHz									
85.556	----	29.511	----	40	----	10.49	H	----	PASS
122.999	----	31.206	----	43.5	----	12.29	H	----	PASS
130.252	----	30.126	----	43.5	----	13.37	H	----	PASS
54.926	----	25.437	----	40	----	14.56	V	----	PASS
130.98	----	35.877	----	43.5	----	7.62	V	----	PASS
148.677	----	31.768	----	43.5	----	11.73	V	----	PASS
2744.825	49.298	36.998	74	54	24.702	17.002	H	PASS	PASS
3660.05	50.776	39.276	74	54	23.224	14.724	H	PASS	PASS
2744.825	50.298	37.598	74	54	23.702	16.402	V	PASS	PASS
3660.05	48.976	35.876	74	54	25.024	18.124	V	PASS	PASS
HCH – 927.8 MHz									
85.487	----	29.87	----	40	----	10.13	H	----	PASS
122.853	----	31.291	----	43.5	----	12.21	H	----	PASS
132.241	----	30.113	----	43.5	----	13.39	H	----	PASS
54.179	----	26.514	----	40	----	13.49	V	----	PASS
83.075	----	27.773	----	40	----	12.23	V	----	PASS
130.592	----	35.467	----	43.5	----	8.03	V	----	PASS
2783.075	48.37	36.57	74	54	25.63	17.43	H	PASS	PASS
3710.85	48.382	34.982	74	54	25.618	19.018	H	PASS	PASS
2783.075	48.47	35.77	74	54	25.53	18.23	V	PASS	PASS
3710.85	48.382	34.782	74	54	25.618	19.218	V	PASS	PASS

**Table 2.8.6-2: Radiated Spurious Emissions Tabulated Data – Mode 5**

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	dB μ V/m	dB μ V/m	dB μ V/m	dB μ V/m	dB	dB	H/V	Pass/Fail	Pass/Fail
LCH – 902.4 MHz									
111.24	----	29.226	----	43.5	----	14.27	H	----	PASS
120.698	----	29.232	----	43.5	----	14.27	H	----	PASS
126.469	----	27.123	----	43.5	----	16.38	H	----	PASS
55.223	----	23.472	----	40	----	16.53	V	----	PASS
132.944	----	32.247	----	43.5	----	11.25	V	----	PASS
138.012	----	29.303	----	43.5	----	14.2	V	----	PASS
2707	50.429	37.529	74	54	23.571	16.471	H	PASS	PASS
3609.275	49.317	34.917	74	54	24.683	19.083	H	PASS	PASS
2707	51.029	33.029	74	54	22.971	20.971	V	PASS	PASS
MCH – 915.2 MHz									
81.456	----	21.73	----	40	----	18.27	H	----	PASS
113.659	----	24.398	----	43.5	----	19.1	H	----	PASS
124.038	----	27.13	----	43.5	----	16.37	H	----	PASS
55.751	----	24.097	----	40	----	15.9	V	----	PASS
74.548	----	25.969	----	40	----	14.03	V	----	PASS
129.421	----	32.598	----	43.5	----	10.9	V	----	PASS
2745.675	50.463	35.963	74	54	23.537	18.037	H	PASS	PASS
3660.7	54.367	36.667	74	54	19.633	17.333	H	PASS	PASS
2745.675	51.763	34.863	74	54	22.237	19.137	V	PASS	PASS
3660.7	48.276	34.076	74	54	25.724	19.924	V	PASS	PASS
HCH – 927.6 MHz									
110.46	----	27.971	----	43.5	----	15.53	H	----	PASS
120.116	----	29.466	----	43.5	----	14.03	H	----	PASS
129.136	----	27.865	----	43.5	----	15.63	H	----	PASS
124.892	----	28.711	----	43.5	----	14.79	V	----	PASS
131.169	----	33.189	----	43.5	----	10.31	V	----	PASS
2782.65	49.666	35.566	74	54	24.334	18.434	H	PASS	PASS
2782.65	48.366	33.366	74	54	25.634	20.634	V	PASS	PASS
3710.425	49.282	34.982	74	54	24.718	19.018	H	PASS	PASS

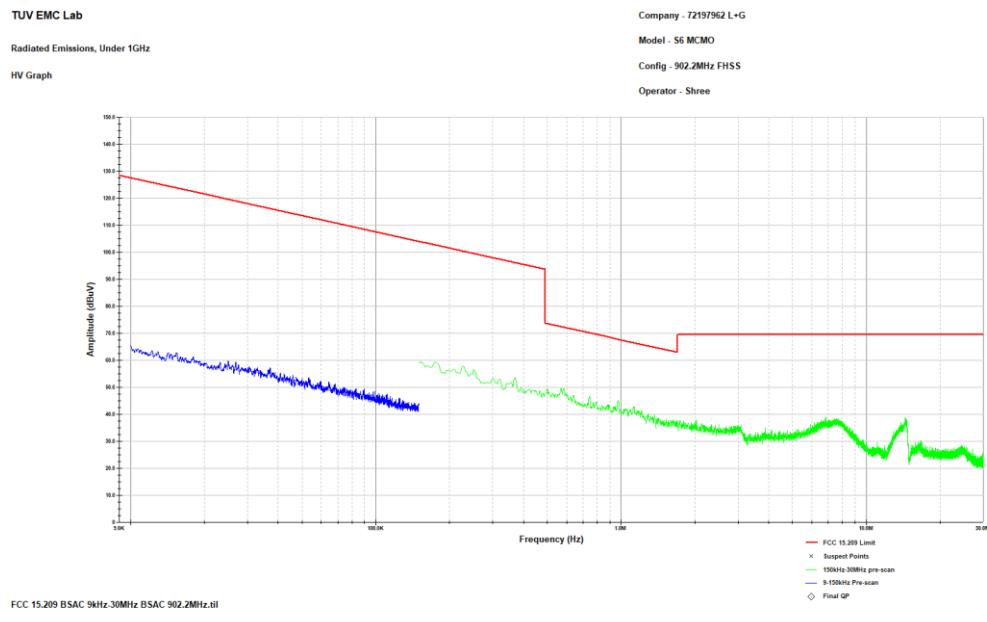


Figure 1: Reference plot for Radiated Spurious Emissions – 9 kHz – 30 MHz – Co-axial – Mode 2 - LCH

Note: Emissions above the noise floor are ambient not associated with the EUT.

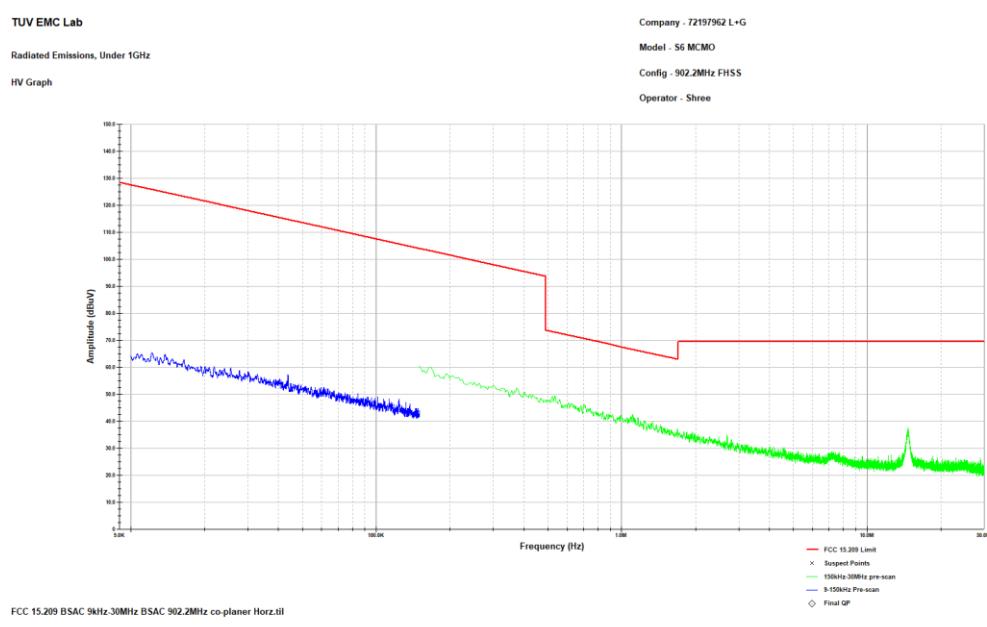


Figure 2: Reference plot for Radiated Spurious Emissions– 9 kHz – 30 MHz – Co-Planar Horizontal – Mode 2 - LCH

Note: Emissions above the noise floor are ambient not associated with the EUT.

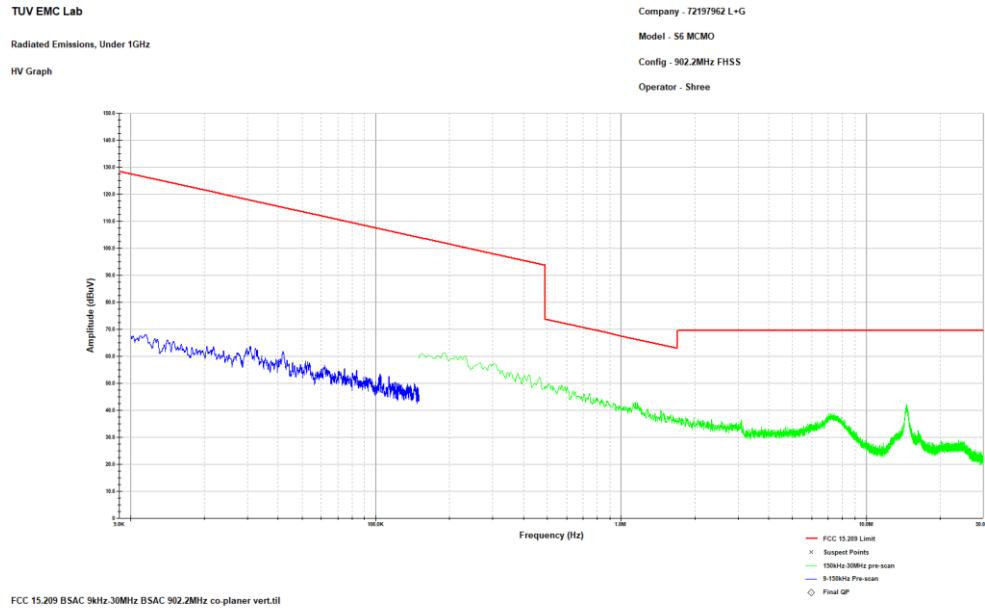


Figure 3: Reference plot for Radiated Spurious Emissions– 9 kHz – 30 MHz – Co-Planar Vertical – Mode 2 - LCH

Note: Emissions above the noise floor are ambient not associated with the EUT.

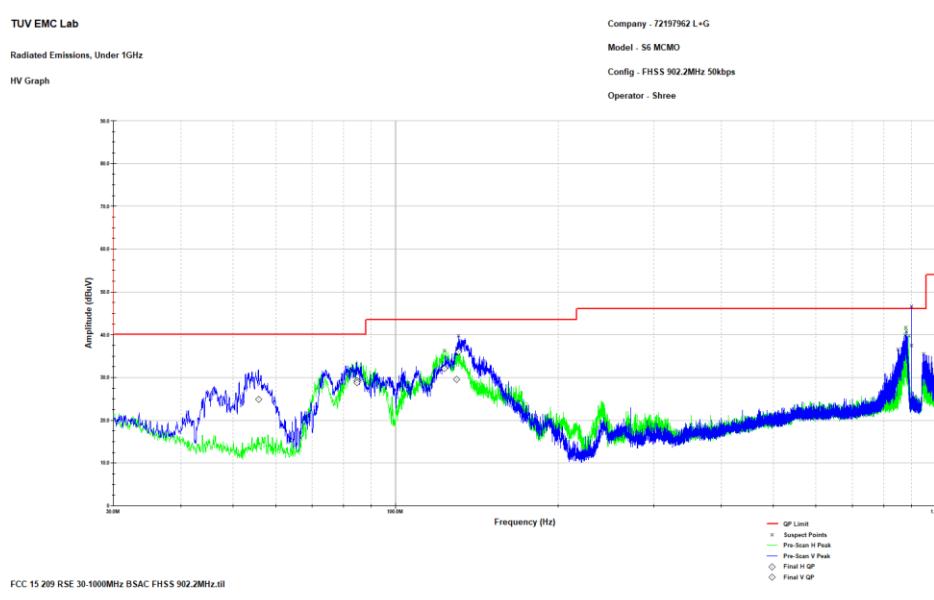


Figure 4: Reference plot for Radiated Spurious Emissions – 30 MHz – 1 GHz – Mode 2 - LCH

Note: Emissions above the noise floor do not fall within restricted bands.

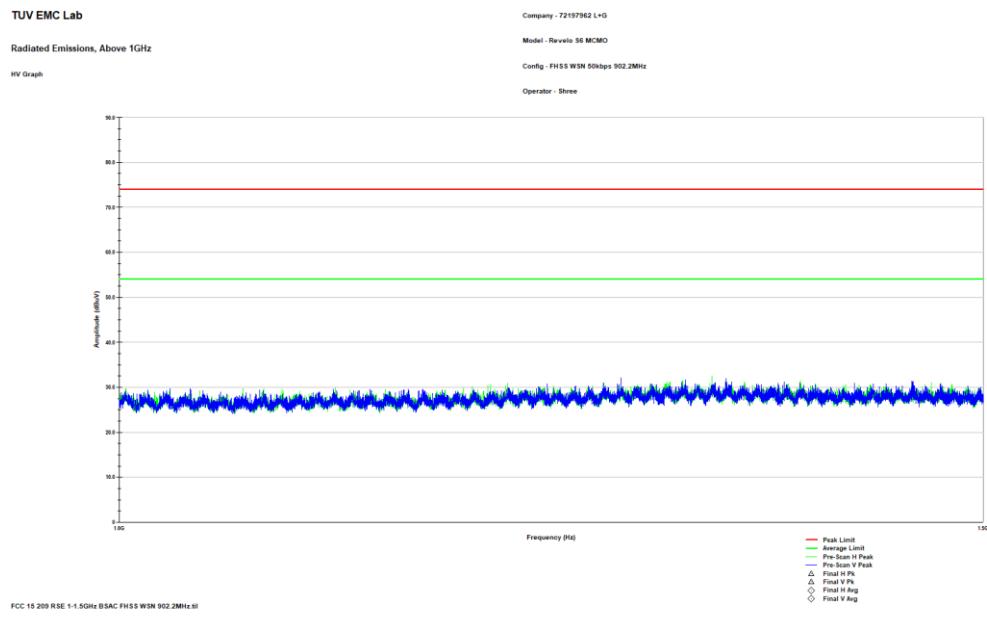


Figure 5: Reference plot for Radiated Spurious Emissions – 1 GHz – 1.5 GHz – Mode 2 - LCH

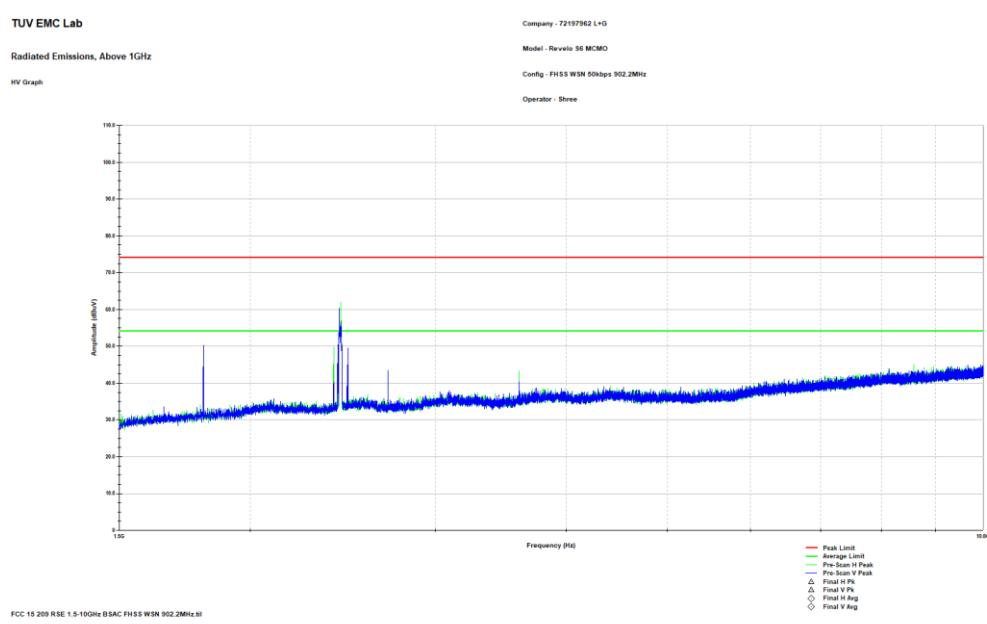


Figure 6: Reference plot for Radiated Spurious Emissions – 1.5 GHz – 10 GHz – Mode 2 - LCH
Note: Only emissions within restricted band were evaluated.



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	06/20/2023	06/20/2024
338	Hewlett Packard	8449B	High Frequency Pre-Amp	3008A01111	6/22/2023	6/22/2025
853	Teseq	CBL6112D	BiLog Antenna	51616	11/01/2022	11/01/2024
884	ETS Lindgren (EMCO)	3117	DOUBLE-RIDGED GUIDE ANTENNA	240106	05/16/2023	05/16/2025
889	Com Power	PAM 103	Pre-amplifier	18020215	10/02/2023	10/02/2024
432	Microwave Circuits	H3G020G4	Highpass Filter	264066	6/16/2023	6/16/2024
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	10/02/2023	10/02/2024
20	Teledyne Storm Microwave	R-90-195-036	BSAC Cable	N/A	07/13/2023	07/13/2024
21	Teledyne Storm Microwave	R-90-195-072	BSAC Cable	N/A	07/13/2023	07/13/2024
622	Rohde & Schwarz	FSV40 (v3.40)	FSV Signal Analyzer 10Hz to 40GHz	101338	12/06/2023	12/06/2024
827	(-)	TS8997 Rack Cable Set	TS8997 Rack Cable Set	N/A	01/02/2024	01/02/2025
267	Hewlett Packard	N1911A	Power Meter	MY45100129	6/22/2023	6/22/2025
872	HP	E7402A	EMI Receiver	US40240258	6/22/2023	6/22/2024
871	ACS	n/a	Conducted EMI Cable	871	3/24/2023	3/24/2024
3010	Rohde & Schwarz	ENV216	Two-Line V-Network	3010	6/21/2023	6/21/2024
144	Omega	RH411	Temp / Humidity Meter	H0103373	02/03/2023	02/03/2025

N/A – Not Applicable

3 Diagram of Test Set-ups

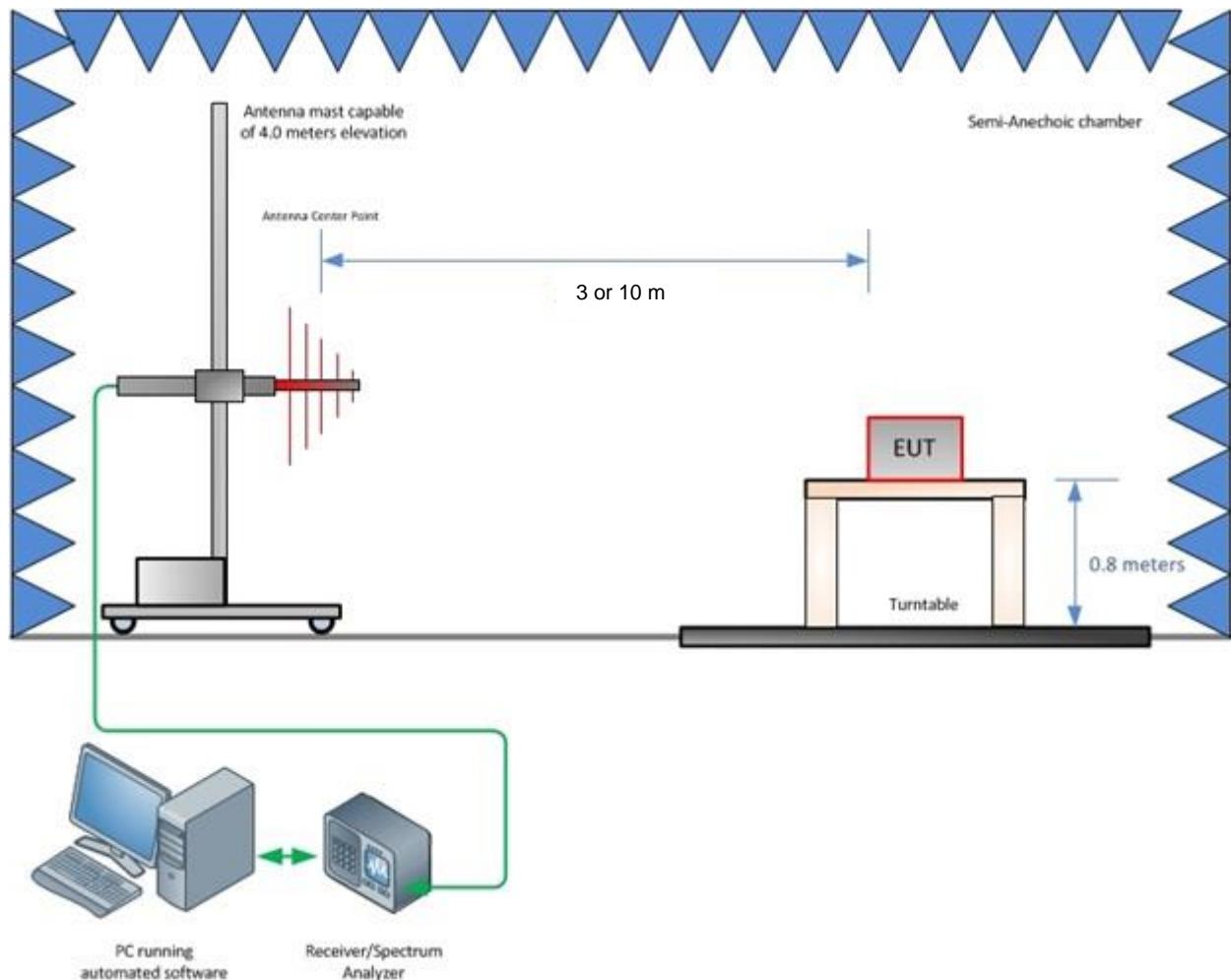


Figure 3-1 – Radiated Emissions Test Setup up to 1 GHz

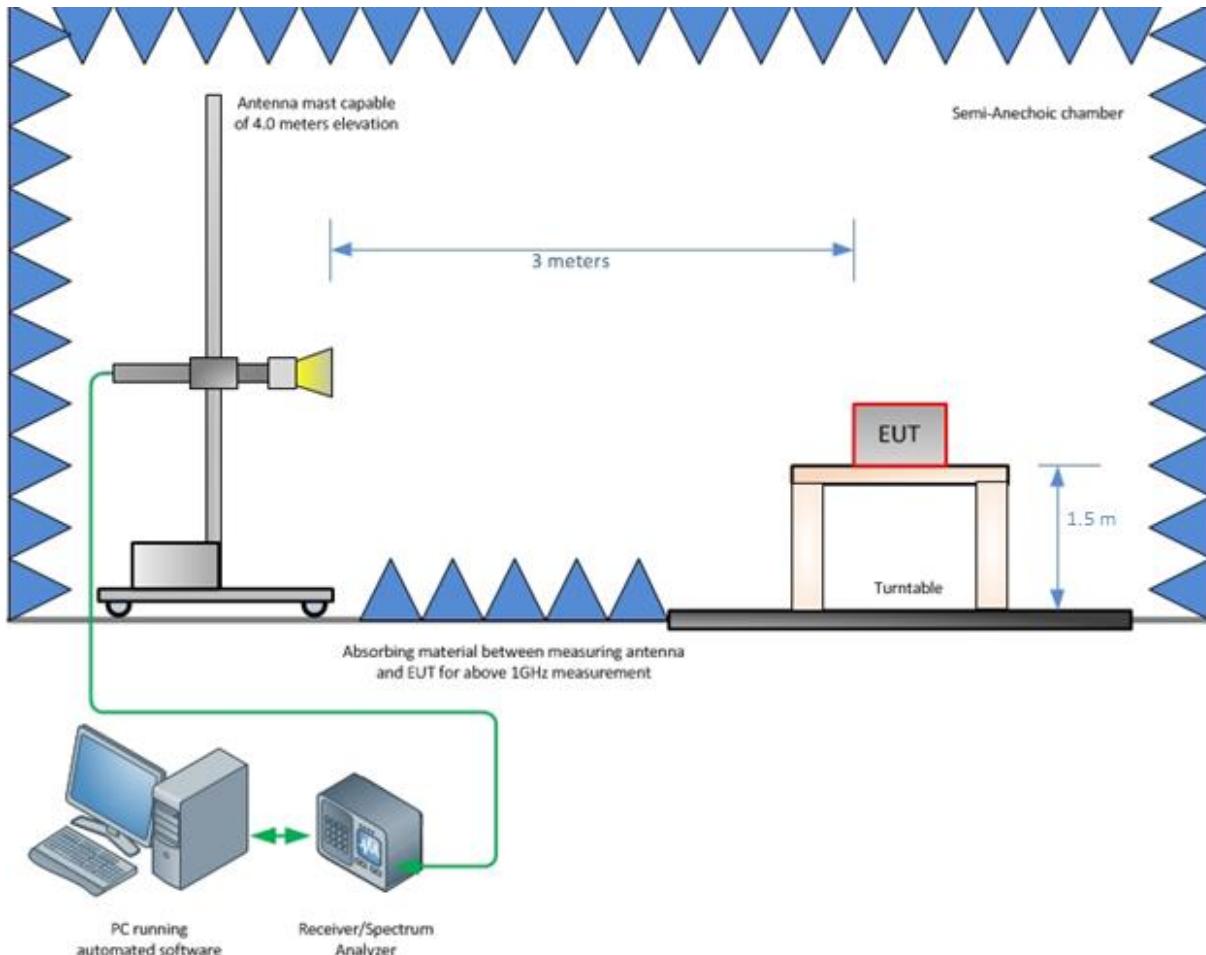


Figure 3-2 – Radiated Emissions Test Setup above 1 GHz

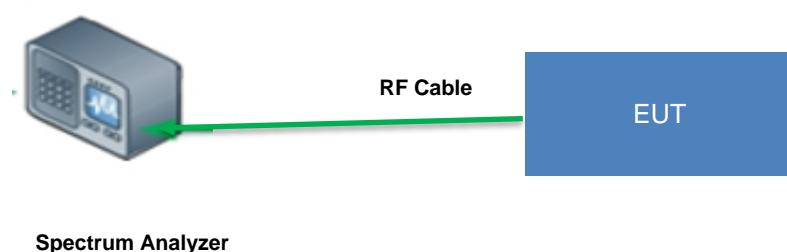


Figure 3-3 – Conducted Test Setup: Antenna Port measurement



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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.