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TEST REPORT

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Laboratory Accreditations (per ISO/IEC 17025:2017)

ACCREDITED
CERT #3657.02

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Manufacturer:	**Bitstrata Systems Inc.**
Address:	101-116 Research Drive Saskatoon, SK S7N 3R3

Equipment Tested:	**Libra Module**
Model Number(s):	M1000
FCC ID:	2BAFL-GC848354
ISED ID:	30137-GC848354
FVIN:	2.2.7

REVISION HISTORY

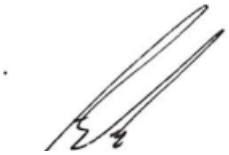
Date	Report Number	Details	Author's Initials
August 18, 2023	E10959-2301_Bitstrata_Libra_FCC_ISED_Rev0.0	Initial draft	AH
August 18, 2023	E10959-2301_Bitstrata_Libra_FCC_ISED_Rev0.1	Draft	AH
August 22, 2023	E10959-2301_Bitstrata_Libra_FCC_ISED_Rev1.0	Final	AH
All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.			

REPORT AUTHORIZATION

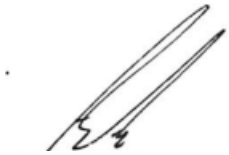
The data documented in this report is for the test equipment provided by the manufacturer and the results relate only to the item tested. The tests were conducted on the sample equipment as requested by the manufacturer for the purpose of demonstrating compliance with the standards outlined in Section I of this report as agreed upon by the Manufacturer under the quote 23RH02073R2.

The Manufacturer is responsible for the tested product configurations, continued product compliance, and for the appropriate auditing of subsequent products as required.

This report may comprise a partial list of tests that are required for FCC and ISED. A Declaration of Conformity can only be produced by the manufacturer. This is to certify that the following report is true and correct to the best of our knowledge.



Testing Performed by
Alec Hope
Senior RF/EMC Engineer



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QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC, Canada	CA9543	9543A	3657.02

EMC Facility Burnaby BC, Canada

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1 EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of the Bitstrata Systems Inc Libra Module as per Sections 1.2 and 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 23RH02073R2:

- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart B – Unintentional Radiators
- **FCC Title 47 Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiators
- **RSS-Gen Issue 5** – General Requirements and Information for the Certification of Radio Apparatus
- **RSS-247 Issue 2 –** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices
- **ICES-003 Issue 7 –** Information Technology Equipment (including Digital Apparatus) – Limits and Methods of Measurement

1.3 Summary of Results

The following testing was performed pursuant to FCC Title 47 Part 15 and Industry Canada ICES-003 to demonstrate the testimony to "FCC, IC, & CE" mark Electromagnetic Compatibility testing for the product.

No.	Test	Applicable Standard	Test Method	Result
1	Antenna Requirements	FCC 47 CFR Part 15.203 RSS-Gen Issue 5: 6.8	ANSI C63.10 - 2013	Complies
2	Peak Output Power and EIRP	FCC 47 CFR Part 15.247 RSS-247 Issue 2: 5.4	ANSI C63.10 – 2013 FCC KDB 558074 D01	Complies
3	Power Spectral Density	FCC 47 CFR Part 15.247 RSS-247 Issue 2: 5.2	ANSI C63.10 – 2013 FCC KDB 558074 D01	Complies
4	20 dB Bandwidth	FCC 47 CFR Part 15.247 RSS-247 Issue 2: 5.2	ANSI C63.10 – 2013 FCC KDB 558074 D01	Complies
5	Duty Cycle	N/A	ANSI C63.10 – 2013 FCC KDB 558074 D01	N/A
6	Band-Edge	FCC 47 CFR Part 15.247 RSS-247 Issue 2: 5.5	ANSI C63.10 - 2013	Complies
7	Radiated Emissions: Rx Mode	FCC 47 CFR Part 15.109 RSS-Gen Issue 5: 7.3 ICES-003 Issue 7: 3.2.2	ANSI C63.4 - 2014	Complies
8	Raduated Spurious Emissions	RSS-Gen Issue 5: 6.13 RSS-Gen Issue 5: 8.9 RSS-Gen Issue 5: 8.10	ANSI C63.10 - 2013	Complies

Note: Duty cycle measured to calculate Duty Cycle Correction Factor (DCCF) if applicable.

Table 1: Applicable test standards and associated test methods

Note: The gain of the antenna(s) is provided by the client to measure or calculate test results and is not independently measured by QAI.

2 GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as a complete system.

Figure 1: EUT

Equipment Under Test (EUT)

Equipment	Libra Module
Description	2.4 GHz Bluetooth Low Energy (BLE) module
Manufacturer	Bitstrata Systems Inc.
Model No.	M1000
Serial No.	Sample 1
Clock frequencies tuned upon within the EUT: Highest frequency generated within the EUT:	32.768 kHz, 24 MHz 2483.5 MHz

Equipment Under Test (EUT) – RF Information

RF device type	2.4 GHz Bluetooth Low Energy (BLE) module
Model No. (HVIN)	M1000
Operating frequency	2400 – 2483.5 MHz
Number of available	40
Channel separation	2 MHz
Channel bandwidth	1200 kHz
Output Power/Transmitter	-21 dBm to +5 dBm
Modulation type	GFSK
Test Channels (L, M, H)	2402 MHz, 2440 MHz, 2480 MHz
Data Rate	1 Mbps
Adaptive	No
Geo-location-capable	No
Number of antennas	1
Antenna type	Chip antenna
Antenna gain	0.5 dBi

Notes: None.

Equipment Under Test (EUT) – General Information

Tested as	Tabletop
Dimensions	3.3 x 2.5 x 0.9 cm
Declared operating temperature range:	-40°C to +85°C
Input power	3.3V DC, 25mA, 83 mW
Grounded	3x ground pins
Device use	Mobile – Separation distance of 20 cm from the human body

Notes: None.

Test Modes

Test	Transmitter State	Power
1	ON – continuously transmitting, 1 Mbps	Battery powered
2	OFF – Rx Only	Battery powered

Auxiliary Manufacturer Supplied Equipment

Equipment	Manufacturer	Product Description	Model No.
Aux 1	Lenovo	Laptop	Thinkpad T550
Aux 2	Apple	Cellphone	iPhone 5S

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	24 °C
Relative Humidity	38 %

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1.5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1ºC
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohde & Schwarz. Transducer factors such as antenna factors, cable losses and amplifier gains were stored in the test templates which are used to perform the emissions measurements. After the test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Q-Peak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Ant. Ht. (cm)	Pol	Turntable Position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Table 2: Sample Quasi-Peak Correction Data – Radiated

Quasi-Peak reading shown in the table above is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

Or

Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)

The final Quasi peak reading shown in the data is calculated by the software using following equation:

Corrected Quasi-Peak (dBµV/m) = Raw Quasi-Peak Reading + Antenna factor + Cable loss

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	Q-Peak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	44.3	1000.000	9.000	GND	0.6	21.7	66.0

Table 3: Sample Quasi-Peak Correction Data - Conducted Emissions

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150	27.2	1000.000	9.000	GND	0.6	28.8	56.0

Table 4: Sample Average Correction Data- Conducted Emissions

Quasi Peak or Average reading shown in the preceding table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

Corr.(dB) = Antenna factor + Cable loss

The final Quasi-peak or Average reading shown in the data is calculated by the software using following equation:

Corr. Quasi-Peak/Average Reading (dBµV) = Raw Quasi-Peak/Average Reading + Antenna factor + Cable loss

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

Margin(dB) = Limit – Quasi-Peak or Average reading

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.

Emissions Test Equipment

Sl. NO.	Manufacturer	Model	Description	Serial No.	S/W Version	Calibration Due Date
1	EMCO	6502	22" Loop antenna	2178	N/A	2025-Dec-5
2	ETS Lindgren	3117	Horn Antenna, 1.0-18 GHz	75944	N/A	2026-Jan-28
3	ETS Lindgren	2165	Turntable	00043677	N/A	N/A
4	ETS Lindgren	2125	Mast	00077487	N/A	N/A
5	ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A	N/A
6	Hewlett Packard	8449B	Preamplifier (1-26 GHz)	2933A00198	N/A	2025-Feb-15
7	Maturo Gmbh	BAM 4.0-P	Mast	365	3382.01	N/A
8	Rohde & Schwarz	ESW44	EMI Receiver	101604	4.73 SP4	2025-Jul-20
9	Rohde & Schwarz	FSU	Spectrum Analyzer	101388	4.71 SP6	2025-May-13
10	Sunol Sciences	SM46C	Turntable	051204-2	N/A	N/A
11	Sunol Sciences	JB1	Biconilog Antenna 30MHz – 2GHz	A070209	N/A	2026-Jan-4

Note: Equipment listed above has 3-year calibration intervals.

Measurement Software

Sl. No.	Manufacturer	Model	Version	Description
1	Rhode & Schwarz	EMC 32	10.35.10	Emissions Test Software

3 DATA & TEST RESULTS

3.1 Antenna Requirements

Date Performed: June 29, 2023

Test Standard: FCC CFR 47 Part 15.203
IC RSS-Gen Issue 7 Section 6.8

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Regulations:

The purpose of this requirement is to make certain that no other antenna, except for that provided by the responsible party, shall be used with the Equipment-Under-Test (EUT) as defined in Section 1.1.

"An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." … "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in the Part are not exceeded."

Data:

Ant.	Manufacturer	Part Number	Type	Connection	Max Gain (dBi)
1	Johanson Technology Inc.	2450AT18B100E	Chip	Soldered	0.5

Note: Antenna gain provided by manufacturer

3.2 RF Peak Output Power and EIRP

Date Performed: June 29, 2023

Test Standard: FCC CFR 47 Part 15.247
ISED RSS-247 Issue 2: 5.4

Test Method: ANSI C63.10:2013
FCC KDB 558074 D01 DTS Measurement Guidance V04
Span = 10 MHz, RBW = 2 MHz, VBW = 5 MHz
Trace stabilization time: 3.5 minutes

Modifications: None.

Final Result: Complies

Applicable Regulation:

FCC CFR 47 Part 15.247 (b)(3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: maximum output power 1 W. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (eg alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

ISED RSS-247 Issue 2: 5.4

For DTSs employing digital modulation techniques operating in the bands 902-28 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The EIRP shall not exceed 4W, except for fixed point-to-point systems.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per FCC KDB 558074 D01 DTS Measurement Guidance V04.

Measurement Data and Plots:

Carrier Frequency (MHz)	Raw Peak (dBm)	Correction Factor[1] (dB)	Corrected Peak Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)	Results
2402	3.92	0.74	4.66	30 dBm	25.34	Complies
2440	3.79	0.77	4.56	30 dBm	25.44	Complies
2480	3.57	0.88	4.45	30 dBm	25.55	Complies

[1] Correction factor consists of cable loss, external attenuator, and adapter(s)

Table 5: RF Peak Output Power

Carrier Frequency (MHz)	Peak Conducted Output Power (dBm)	Antenna Gain[1] (dBi)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Results
2402	4.66	0.5	5.16	30 dBm	24.84	Complies
2440	4.56	0.5	5.06	30 dBm	24.94	Complies
2480	4.45	0.5	4.95	30 dBm	25.05	Complies

[1] Antenna gain provided by manufacturer

Table 6: EIRP

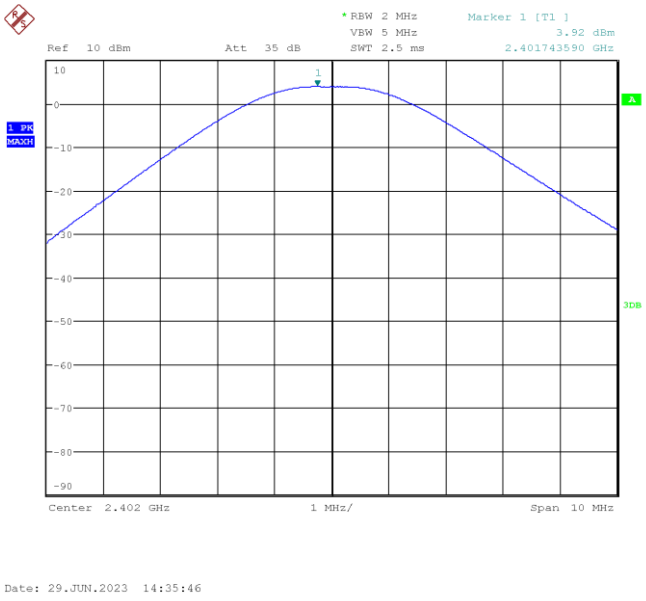

Figure 2: Peak Output Power – Lowest Frequency

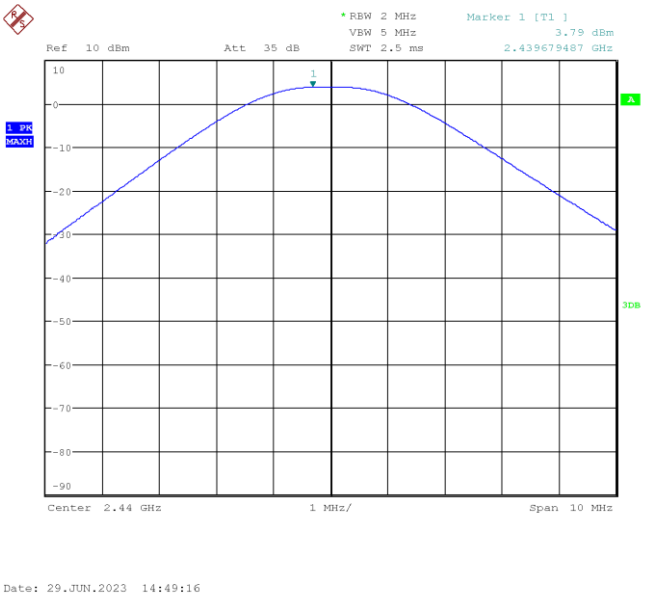

Figure 3: Peak Output Power - Middle Frequency

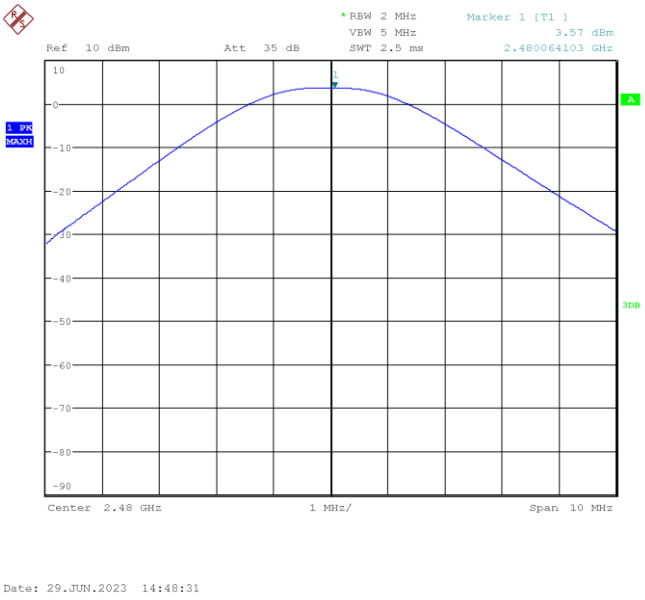

Figure 4: Peak Output Power - Highest Frequency

3.3 Power Spectral Density (PSD)

Date Performed: August 9, 2023

Test Standard: FCC CFR 47 Part 15.247
ISED RSS-247 Issue 2

Test Method: ANSI C63.10:2013
FCC KDB 558074 D01 DTS Measurement Guidance V04
Span = 2 MHz, RBW = 3 kHz, VBW = 10 kHz
Trace stabilization time: 3.5 minutes

Modifications: None.

Final Result: Complies

Applicable Regulation:

FCC CFR 47 Part 15.247 (e)

For digitally modulated systems, the power spectral density conducted\ from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

ISED RSS-247 Issue 2:

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per FCC KDB 558074 D01 DTS Measurement Guidance V04.

Measurement Data and Plots:

Carrier Frequency (MHz)	Raw Output (dBm/3kHz)	Correction Factor[1] (dB)	Corrected PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)	Results
2402	-5.77	0.74	-5.03	8	13.03	Complies
2440	-6.23	0.77	-5.46	8	13.46	Complies
2480	-6.32	0.88	-5.44	8	13.44	Complies

[1] Correction factor consists of cable loss, external attenuator, and adapter(s)

Table 7: RF Power Spectral Density (PSD)

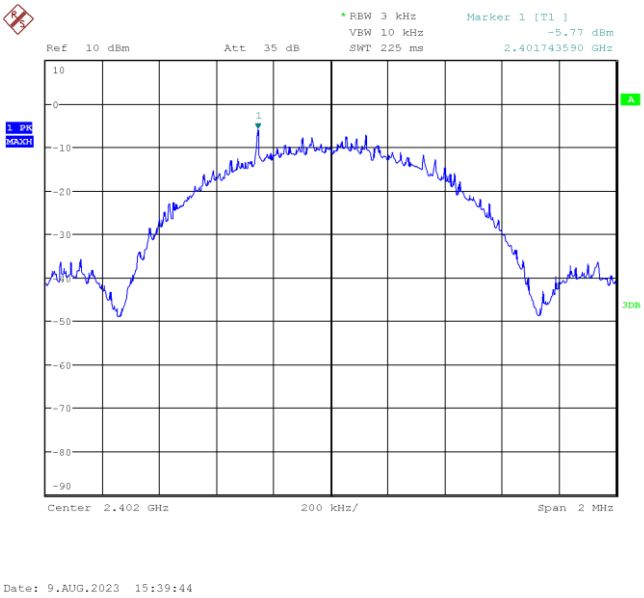

Figure 5: Power Spectral Density – Lowest Frequency

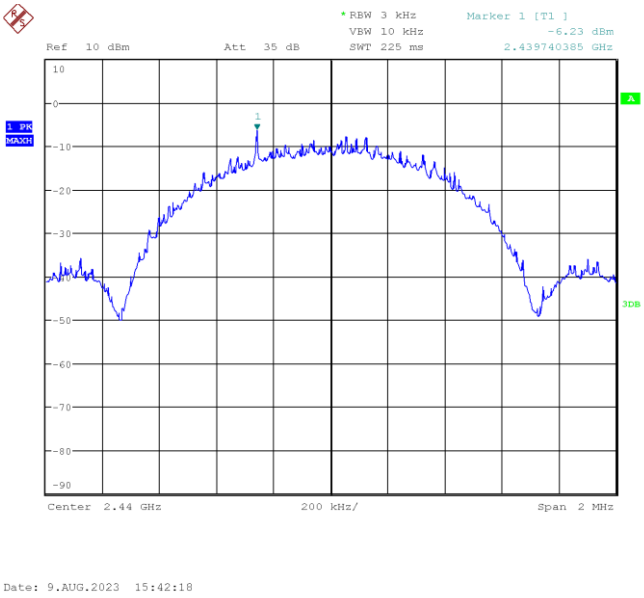

Figure 6: Power Spectral Density - Middle Frequency

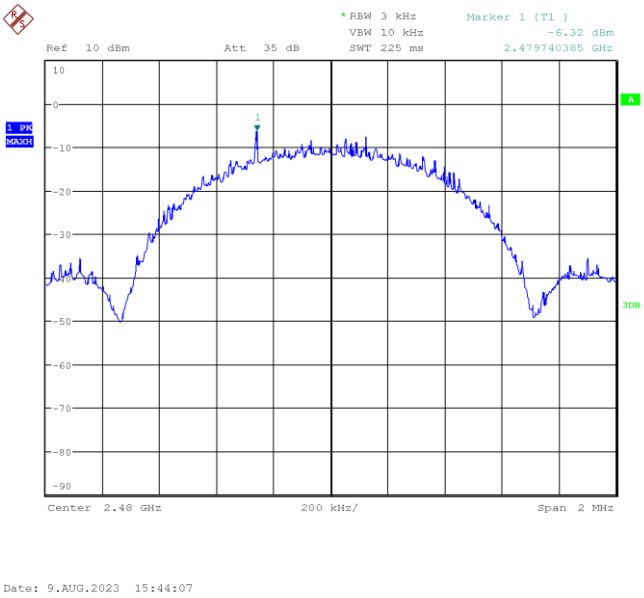

Figure 7: Power Spectral Density - Highest Frequency

3.4 20 dB Bandwidth

Date Performed: June 29, 2023

Test Standard: FCC CFR 47 Part 15.247
ISED RSS-247 Issue 2

Test Method: ANSI C63.10:2013
FCC KDB 558074 D01 DTS Measurement Guidance V04
Span = 2 to 5 x OBW, RBW = 1 to 5% of OBW, VBW = 3 x RBW
Ref Level > 10log(OBW/RBW) above signal peak

Modifications: None

Final Result: Complies

Applicable Regulations:

FCC CFR 47 Part 15.247 (e)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

ISED RSS-247 Issue 2:

The minimum 6 dB bandwidth shall be 500 kHz.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10: 2013, 7.4.

A spectrum analyzer or other instrument providing a spectral display is recommended for these measurements. When using a spectrum analyzer or other instrument providing a spectral display, the video bandwidth shall be set to a value at least three times greater than the IF bandwidth of the measuring instrument to avoid the introduction of unwanted amplitude smoothing. Video filtering is not used during occupied bandwidth tests.

Measurement Data and Plots:

Channels	Carrier Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Result
Low	2402	1242	500	Complies
Middle	2440	1226	500	Complies
High	2480	1234	500	Complies

Table 8: 20 dB Bandwidth Results

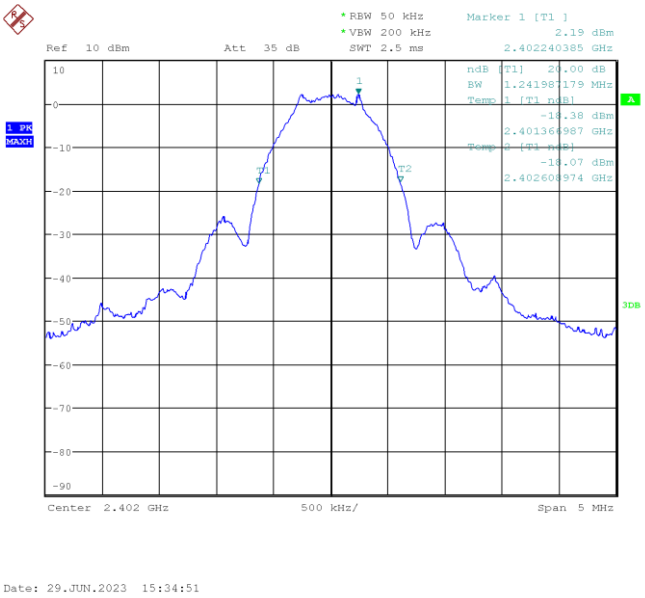

Figure 8: 20 dB Bandwidth – Low Channel

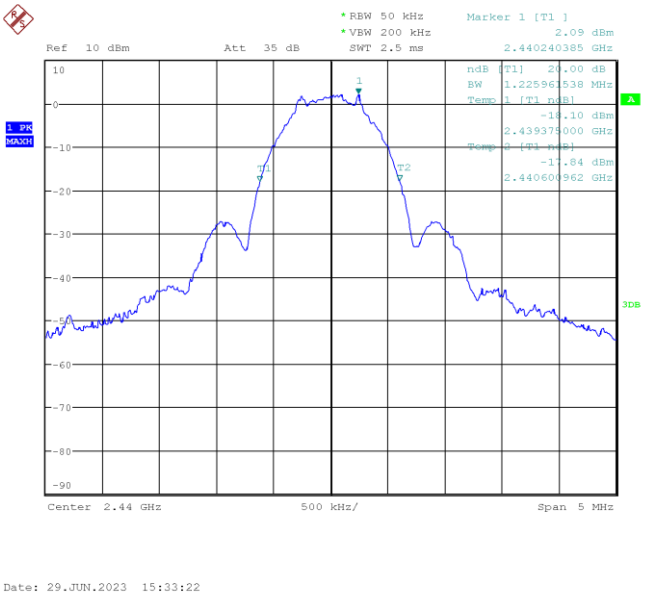

Figure 9: 20 dB Bandwidth - Middle Channel

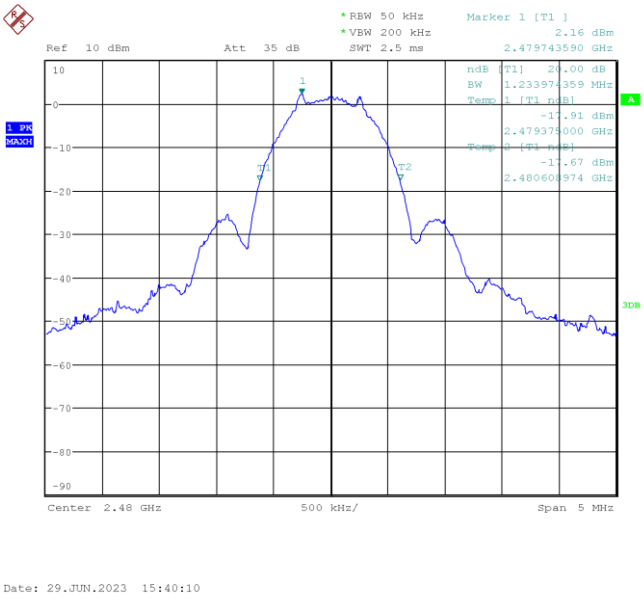

Figure 10: 20 dB Bandwidth - High Channel

3.5 Duty Cycle

Date Performed: June 29, 2023

Test Standard: N/A

Test Method: ANSI C63.10:2013
FCC KDB 558074 D01 DTS Measurement Guidance V04
Span = 0 MHz, Sweep Time = 10 ms

Modifications: None.

Final Result: N/A

Applicable Regulation:

N/A

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per FCC KDB 558074 D01 DTS Measurement Guidance V04.

Measurement Data and Plots:

Carrier Frequency (MHz)	Sweep Time (ms)	Tx ON Time (ms)	Duty Cycle	DCCF (dB)	Results
2402	10	10	100 %	0 dB	N/A
2440	10	10	100 %	0 dB	N/A
2480	10	10	100 %	0 dB	N/A

Table 9: Duty Cycle

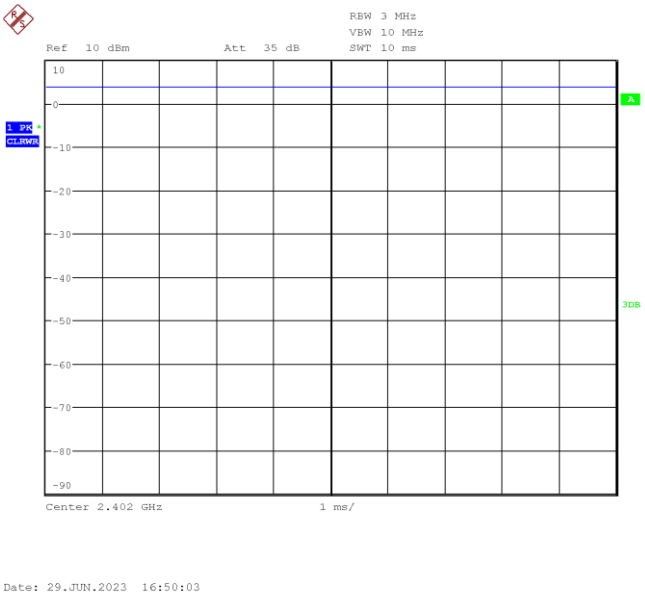

Figure 11: Duty Cycle – Lowest Frequency

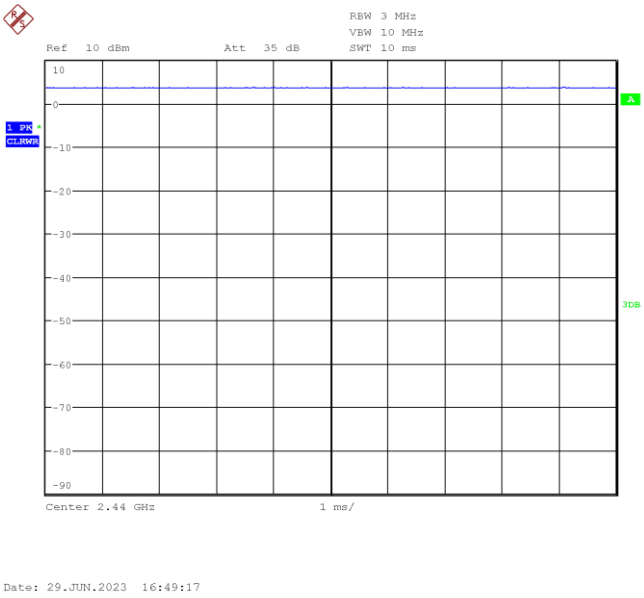

Figure 12: Duty Cycle - Middle Frequency

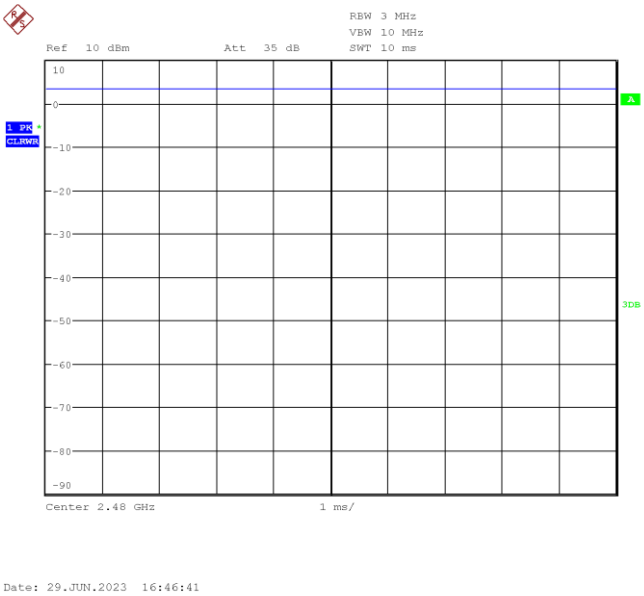

Figure 13: Duty Cycle - Highest Frequency

3.6 Out-Of-Band Emissions (Band Edge)

Date Performed: June 29, 2023

Test Standard: FCC CFR 47 Part 15.247
ISED RSS-247 Issue 2

Test Method: ANSI C63.10:2013
Span = Wide enough to capture the peak level of the emission closest to the band edge, as well as any modulation products that fall outside of the band.
Ref Level = High enough to keep the signal from overdriving the input mixer
RBW = 100 kHz, VBW = 300 kHz
Trace Detector: Peak, Trace: Max Hold

Modifications: None

Final Result: Complies

Applicable Regulation:

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, shall be at least 20 dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

Test Setup:

The EUT was tested outside the SAC via output conducted measurements per ANSI C63.10:2013.

Measurement Data and Plots:

Band Edge	Modulation	Highest Out of Band Emission	Limit	Result
Low	GFSK	< -40 dB	-20 dB	Complies
High	GFSK	< -50 dB	-20 dB	Complies

Table 10: Band Edge Results

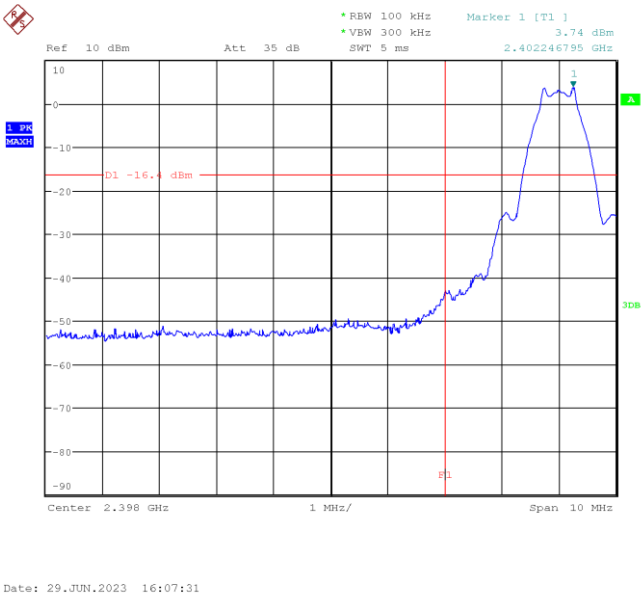

Figure 14: Band Edge - Low Channel

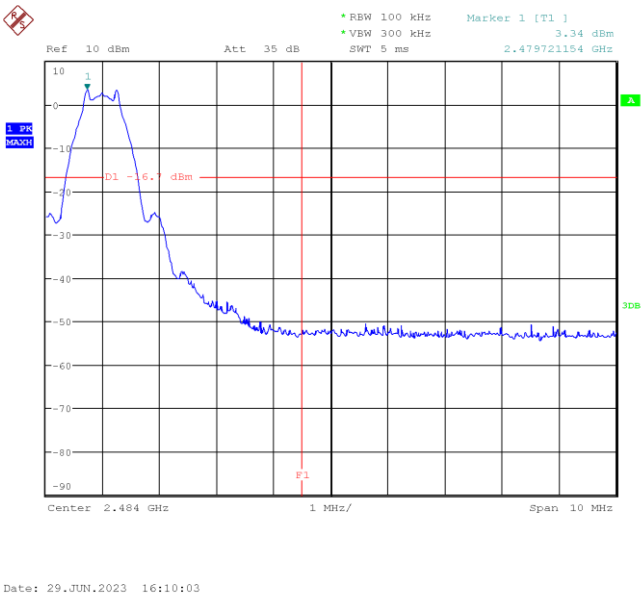

Figure 15: Band Edge - High Channel

3.7 Radiated Emissions: Rx Mode

Date Performed: June 26, 2023

Test Standard: FCC 47 CFR Part 15.33
FCC 47 CFR Part 15.205
FCC 47 CFR Part 15.209
ICES-003 Issue 7
RSS-Gen Issue 5

Test Method: ANSI C63.4:2014

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.33 (a)(1), (5): Frequency range of radiated measurements

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

FCC 47 CFR Part 15.109 (a): Radiated emission limits

Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following table:

Frequency, *f* (MHz)	**Maximum Field strength Quasi-peak (dBµV/m at 3 m)**
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.	

RSS-Gen Issue 5: 7.3 Receiver radiated emissions limits

Spurious emissions from receivers shall not exceed the radiated emissions limits shown in the following table:

Frequency, *f* (MHz)	**Maximum Field strength Quasi-peak (dBµV/m at 3 m)**
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.	

ICES-003 Issue 7: 3.2.2 Radiated emission limits

The quasi-peak limits for the electric component of the radiated field strength emitted from ITE or digital apparatus, within 30 MHz to 1 GHz, for a measurement distance of 3 m or 10 m, are:

Frequency Range (MHz)	Class A (3 m) Quasi-peak (dBµV/m)	Class A (10 m) Quasi-peak (dBµV/m)	Class B (3 m) Quasi-peak (dBµV/m)	Class B (10 m) Quasi-peak (dBµV/m)
30 – 88	50.0	40.0	40.0	30.0
88 – 216	54.0	43.5	43.5	33.1
216 – 230	56.9	46.4	46.0	35.6
230 – 960	57.0	47.0	47.0	37.0
960 - 1000	60.0	49.5	54.0	43.5

At and above 1 GHz, except for outdoor units of home satellite receiving systems, the ITE or digital apparatus shall comply with:

Frequency Range (MHz)	Class A Average (dBµV/m)	Class A Peak (dBµV/m)	Class B Average (dBµV/m)	Class B Peak (dBµV/m)
1 - F_M	60	80	54	74

F_M is determined by:

Highest internal frequency (F_X)	Highest measurement frequency (F_M)
$F_X \leq 108$ MHz	1 GHz
108 MHz $\leq F_X \leq$ 500 MHz	2 GHz
500 MHz $\leq F_X \leq$ 1 GHz	5 GHz
$F_X >$ 1 GHz	5 x F_X up to a maximum of 40 GHz

Test Setup:

The EUT was tested in a 3 m SAC and was positioned on the front of the turntable. The transmitter was set for continuous transmission. The radiated output of the device was measured for all emissions from 30 MHz up to the 5th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed as indicated in the test photos.

Measurement Data and Plots:

Frequency MHz	QuasiPeak (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
31.8354	22.96	127.0	H	267	27.1	40.00	17.04	Complies
935.8996	27.57	342.0	H	268	31.7	46.00	18.43	Complies

Table 11: Unintentional Radiated Emissions: 30 MHz - 1 GHz

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1998.1880	---	34.39	349.0	H	164	1.5	50.00	15.61	Complies
2464.5680	---	34.52	149.0	H	13	0.3	50.00	15.48	Complies
4780.3360	---	36.92	249.0	H	240	7.0	54.00	17.08	Complies
5560.7480	---	37.45	249.0	H	330	7.7	54.00	16.55	Complies
15672.9440	---	37.83	244.0	V	104	12.2	54.00	16.17	Complies
16680.3040	---	38.90	193.0	V	291	12.9	54.00	15.10	Complies

Table 12: Unintentional Radiated Emissions: 1 GHz - 18 GHz

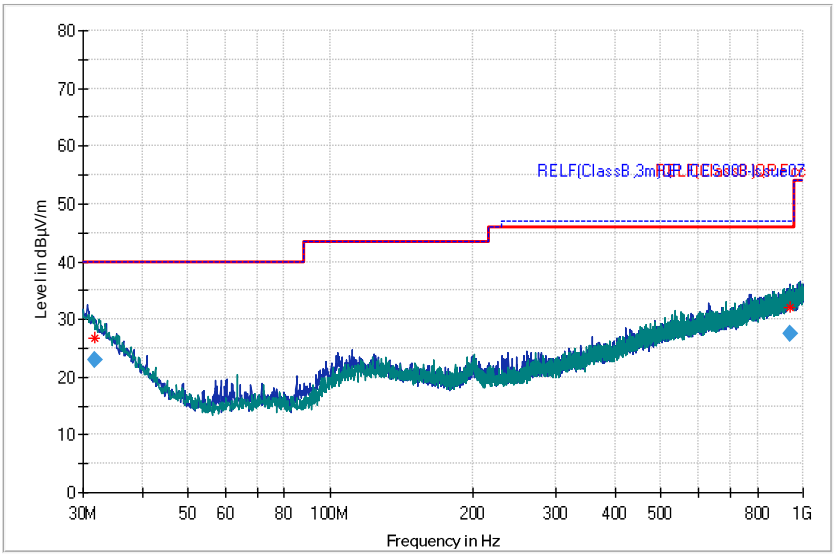

Figure 16: Radiated Emissions: Rx Mode 30-1000MHz Measured at 3m

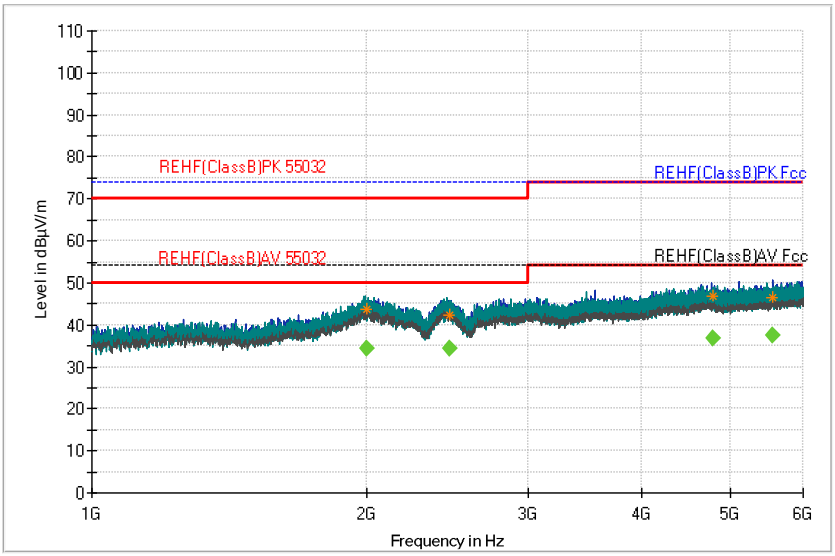

Figure 17: Radiated Emissions: Rx Mode 1-6 GHz Measured at 3m

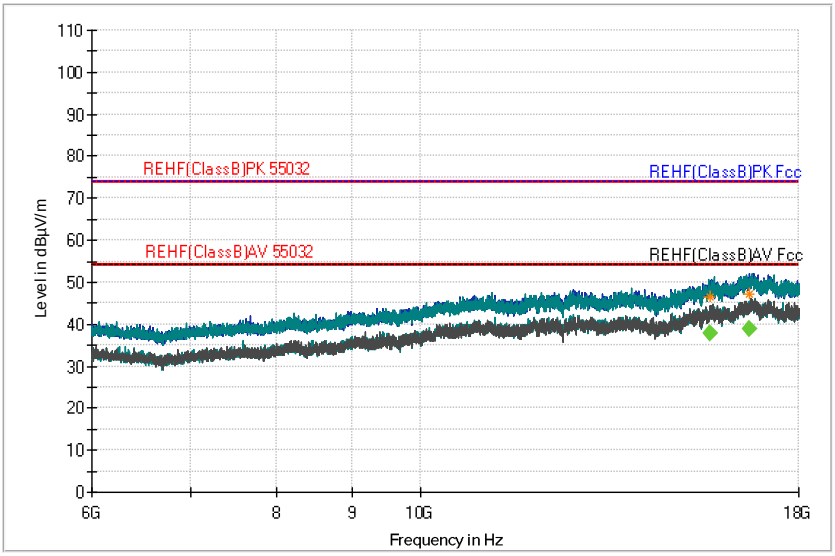

Figure 18: Radiated Emissions: Rx Mode 6-18 GHz Measured at 3m

3.8 Radiated Spurious Emissions

Date Performed: June 26, 2023 - June 27, 2023

Test Standard: FCC 47 CFR Part 15.33
FCC 47 CFR Part 15.205
FCC 47 CFR Part 15.209
RSS-Gen Issue 5
RSS-247 Issue 2

Test Method: ANSI C63.10:2013

Modifications: None

Final Result: Complies

Applicable Standard:

FCC 47 CFR Part 15.33 (a)(1), (5): Frequency range of radiated measurements

For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

FCC 47 CFR Part 15.205 (a), (b): Restricted bands of operation

Only spurious emissions are permitted in any of the frequency bands listed below:

FCC 15.205 Restricted Bands			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits show in § 15.209

FCC 47 CFR Part 15.209 (a): Radiated emission limits; general requirements

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	20*log(2400/F(kHz)) + 40 dB
0.490 – 1.705	20*log(24000/F(kHz)) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector	

RSS-Gen Issue 5: 8.9 Transmitter emission limits

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in the following table. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Frequency, *f* (MHz)	Maximum Field strength Quasi-peak (dBµV/m at 3 m)
0.009 – 0.490	20*log(6.37/F(kHz)) + 20*log(377) + 40 dB
0.490 – 1.705	20*log(63.7/F(kHz)) + 20*log(377) + 20 dB
1.705 – 30.0	49.5
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0
Note 1: The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges. **Note 2:** The emissions limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz., 110-490 kHz. and above 1000 MHz. Radiated emission limits in these two bands are based on measurements employing a linear average detector	

RSS-Gen Issue 5: 8.10 Restricted frequency bands

Restricted frequency bands, identified in the following table, are designed primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply:

a) The transmit frequency, including fundamental components of modulation, of license-exempt radio apparatus shall not fall within the restricted frequency bands listed in the following table.
b) Unwanted emissions that fall into restricted frequency bands shall comply with the limits specified in RSS-Gen Issue 5: 8.9
c) Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in RSS-Gen Issue 5: 8.9

RSS-Gen Restricted Bands			
MHz	**MHz**	**MHz**	**GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	
13.36-13.41			

RSS-247 Issue 2: 5.5 Unwanted emissions

> In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Test Setup:

The EUT was tested in a 3 m SAC and was positioned on the front of the turntable. The transmitter was set for continuous transmission. The radiated output of the device was measured for all emissions from 10 kHz up to the 10th harmonic of the highest fundamental frequency. The EUT was pre-scanned in 3 different orthogonal orientations and was found to radiate highest when placed as indicated in the test photos.

Measurement Data and Plots:

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.5587	50.76 [1]	---	100.0	H	174	20.9	72.66	21.90	Complies
1.4681	45.78 [1]	---	100.0	V	231	21.0	64.30	18.52	Complies
29.8572	36.00 [1]	---	100.0	V	120	18.5	69.50	33.50	Complies
30.5144	24.33 [1]	---	325.0	V	328	28.1	40.00	15.67	Complies
107.6231	14.20 [1]	---	225.0	H	109	19.5	43.50	29.30	Complies
202.0926	18.50 [1]	---	323.0	H	180	20.5	43.50	25.00	Complies
949.8794	27.26 [1]	---	228.0	H	289	31.8	46.00	18.74	Complies
1990.7360	---	34.85	100.0	H	4	1.4	50.00	15.15	Complies
2802.2400	---	33.99	149.0	V	246	1.2	50.00	16.01	Complies
4778.0880	---	37.26	299.0	H	29	7.0	54.00	16.74	Complies
4803.8000	---	46.95	349.0	H	138	7.0	54.00	7.05	Complies
15669.2080	---	37.57	261.0	H	276	12.1	54.00	16.43	Complies
16739.5480	---	40.09	177.0	V	159	12.9	54.00	13.91	Complies

[1] Quasi-Peak detector used

Table 13: Radiated Spurious Emissions: 10 kHz - 26 GHz, Low Channel

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
1.4710	45.68 [1]	---	100.0	H	189	21.0	64.28	18.60	Complies
30.3047	24.39 [1]	---	189.0	H	301	28.2	40.00	15.61	Complies
112.3185	13.69 [1]	---	319.0	H	162	20.3	43.50	29.81	Complies
200.3871	15.98 [1]	---	315.0	H	329	20.8	43.50	27.52	Complies
952.3183	27.25 [1]	---	275.0	H	174	31.8	46.00	18.75	Complies
2007.6400	---	34.73	199.0	H	249	1.5	50.00	15.27	Complies
2758.1640	---	33.36	150.0	H	160	1.1	50.00	16.64	Complies
4879.9080	---	47.81	150.0	H	130	7.0	54.00	6.19	Complies
11890.9720	---	34.61	136.0	H	328	7.6	54.00	19.39	Complies
12668.8560	---	35.04	176.0	V	15	7.5	54.00	18.96	Complies
15582.5680	---	36.96	177.0	V	225	11.5	54.00	17.04	Complies
16804.9880	---	39.24	208.0	H	198	12.9	54.00	14.76	Complies

[1] Quasi-Peak detector used

Table 14: Radiated Spurious Emissions: 10 kHz - 26 GHz, Mid Channel

Frequency MHz	MaxPeak (dBuV/m)	Average (dBuV/m)	Height (cm)	Pol	Azimuth (°)	Corr. (dB/m)	Limit (dBuV/m)	Margin (dB)	Result
0.5885	50.67 [1]		100.0	V	282	20.9	72.21	21.54	Complies
1.4687	45.73 [1]		100.0	V	239	21.0	64.29	18.57	Complies
1.1204	44.87 [1]		100.0	V	53	21.1	66.64	21.77	Complies
1.4703	46.61 [1]		100.0	V	250	21.0	64.28	17.68	Complies
31.2669	23.44 [1]		180.0	H	356	27.5	40.00	16.56	Complies
109.7302	15.76 [1]		122.0	H	328	19.9	43.50	27.74	Complies
194.8126	14.12 [1]		377.0	V	296	19.9	43.50	29.38	Complies
416.4333	18.89 [1]		315.0	V	223	24.4	46.00	27.11	Complies
930.4253	27.51 [1]		143.0	V	105	31.7	46.00	18.49	Complies
2016.9000	---	34.37	299.0	H	247	1.4	50.00	15.63	Complies
2959.3360	---	33.60	249.0	V	233	1.5	50.00	16.40	Complies
4640.2520	---	36.60	200.0	H	69	6.7	54.00	17.40	Complies
12784.6800	---	36.05	240.0	V	78	7.5	54.00	17.95	Complies
15584.3400	---	36.97	314.0	V	175	11.5	54.00	17.03	Complies
16796.5040	---	39.17	286.0	H	286	12.9	54.00	14.83	Complies

[1] Quasi-Peak detector used

Table 15: Radiated Spurious Emissions: 10 kHz - 26 GHz, High Channel

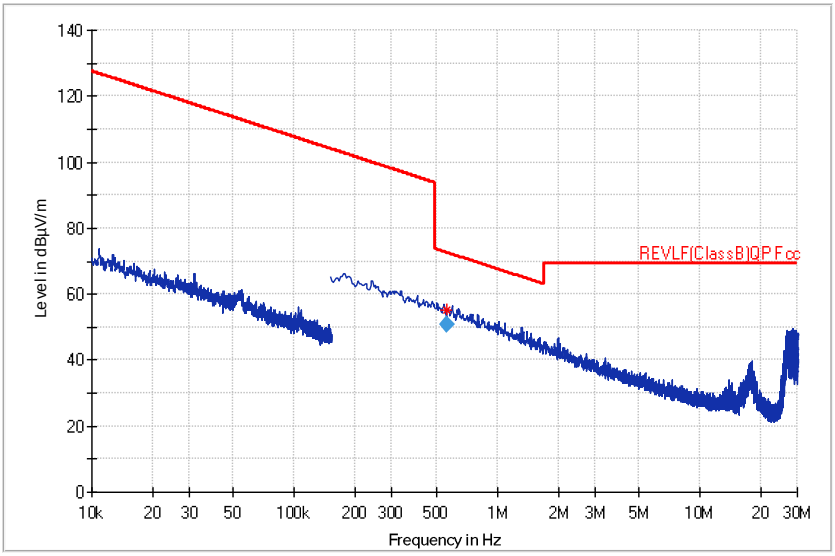

Figure 19: Radiated Spurious Emissions: 10 kHz - 30 MHz, Horizontal, Low Channel

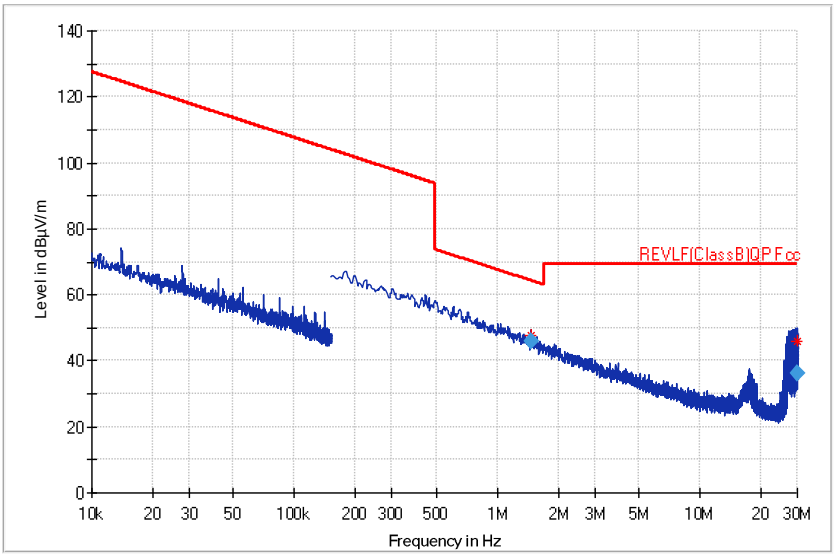

Figure 20: Radiated Spurious Emissions: 10 kHz - 30 MHz, Vertical, Low Channel

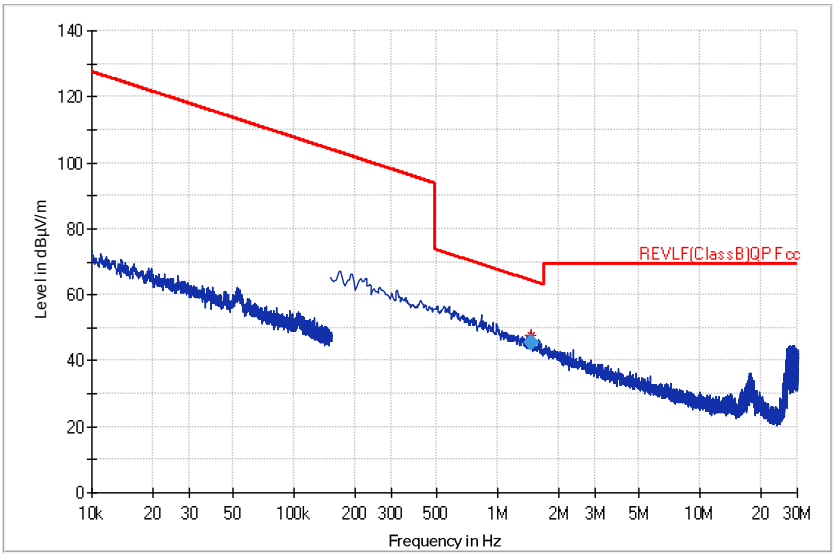

Figure 21: Radiated Spurious Emissions: 10 kHz - 30 MHz, Horizontal, Mid Channel

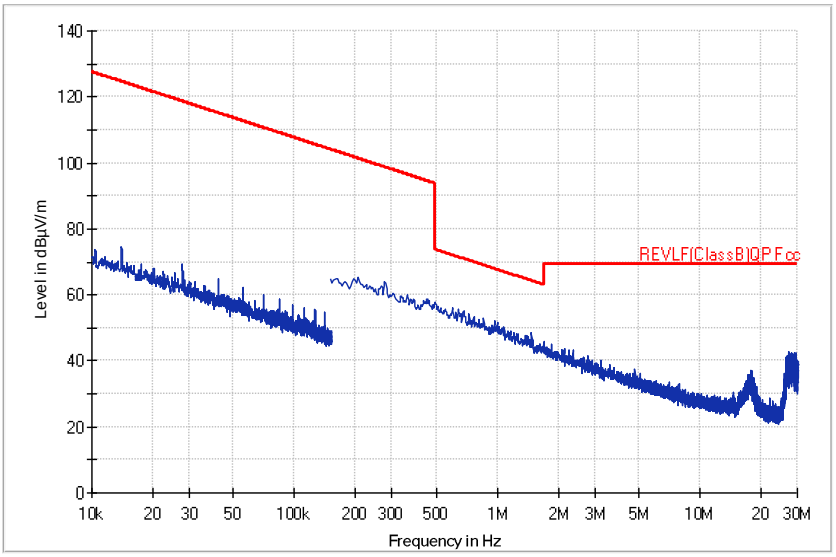

Figure 22: Radiated Spurious Emissions: 10 kHz - 30 MHz, Vertical, Mid Channel

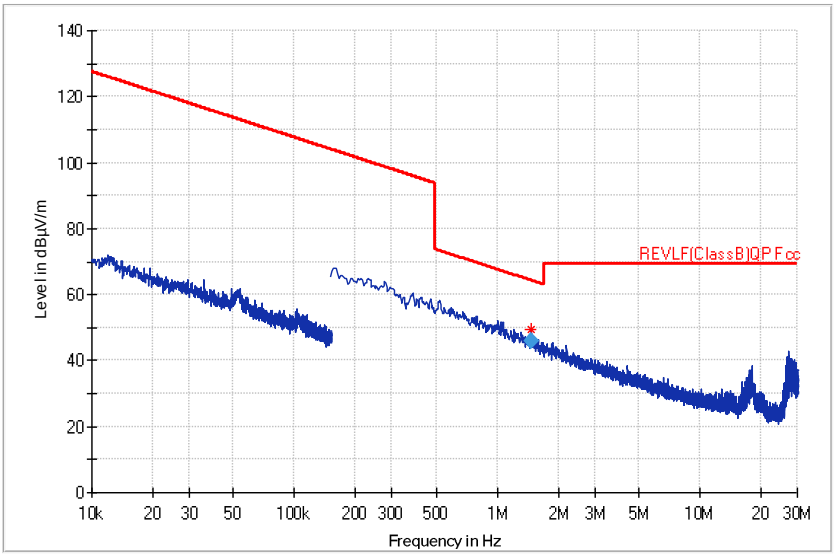

Figure 23: Radiated Spurious Emissions: 10 kHz - 30 MHz, Horizontal, High Channel

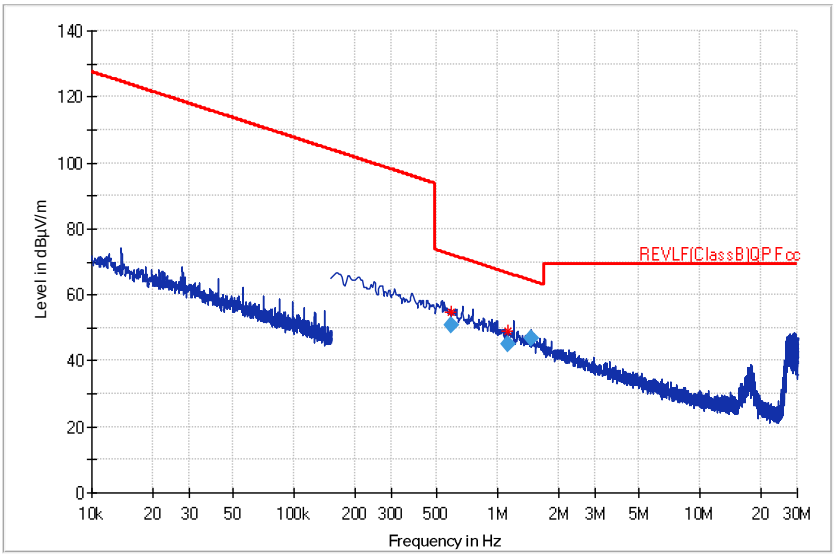

Figure 24: Radiated Spurious Emissions: 10 kHz - 30 MHz, Vertical, High Channel

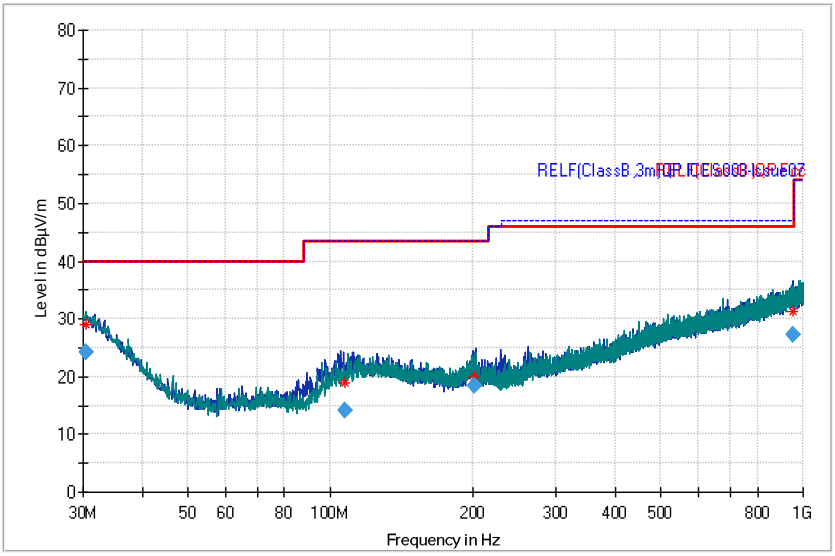

Figure 25: Radiated Spurious Emissions: 30 MHz – 1 GHz, Low Channel

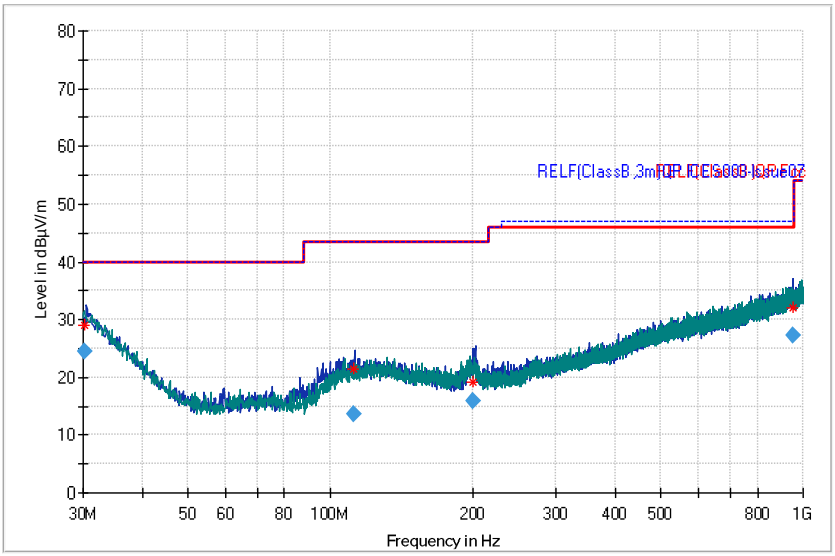

Figure 26: Radiated Spurious Emissions: 30 MHz – 1 GHz, Mid Channel

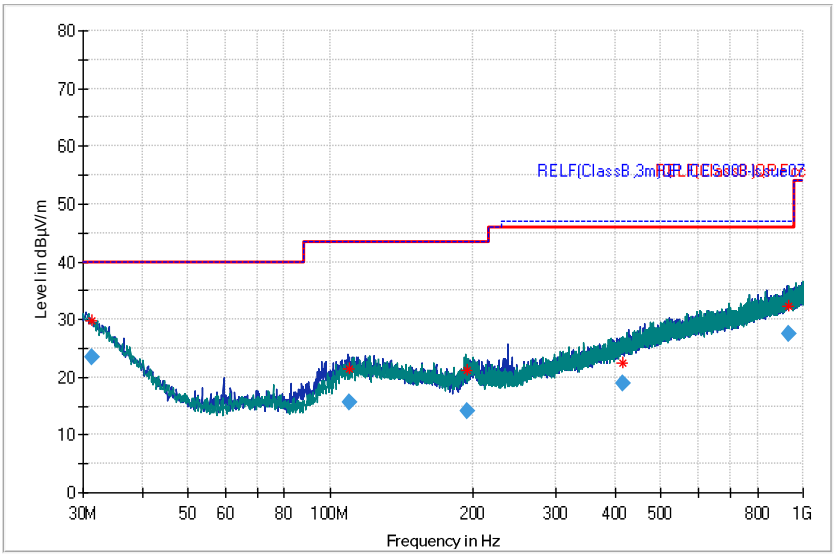

Figure 27: Radiated Spurious Emissions: 30 MHz – 1 GHz, High Channel

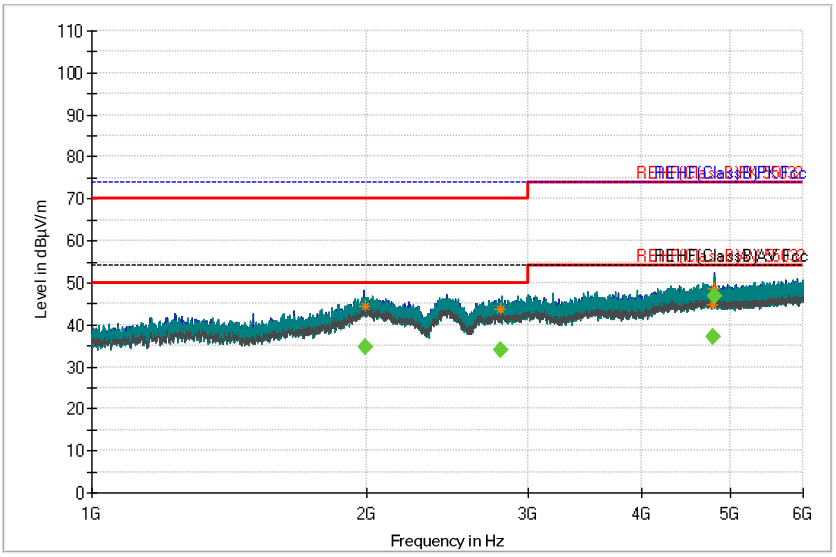

Figure 28: Radiated Spurious Emissions: 1 GHz – 6 GHz, Low Channel

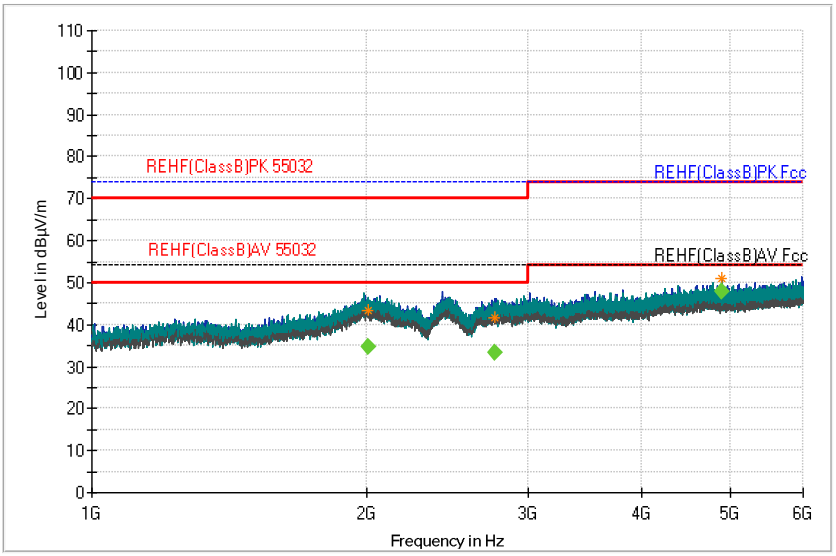

Figure 29: Radiated Spurious Emissions: 1 GHz – 6 GHz, Mid Channel

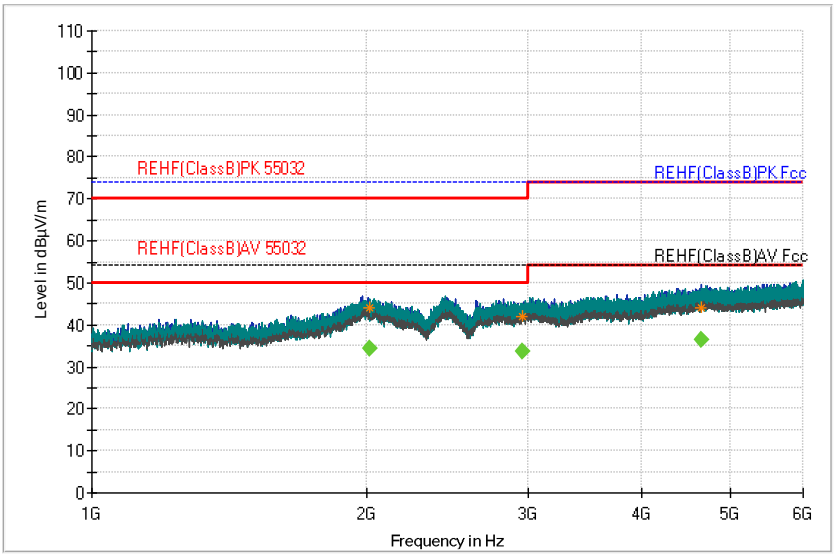

Figure 30: Radiated Spurious Emissions: 1 GHz – 6 GHz, High Channel

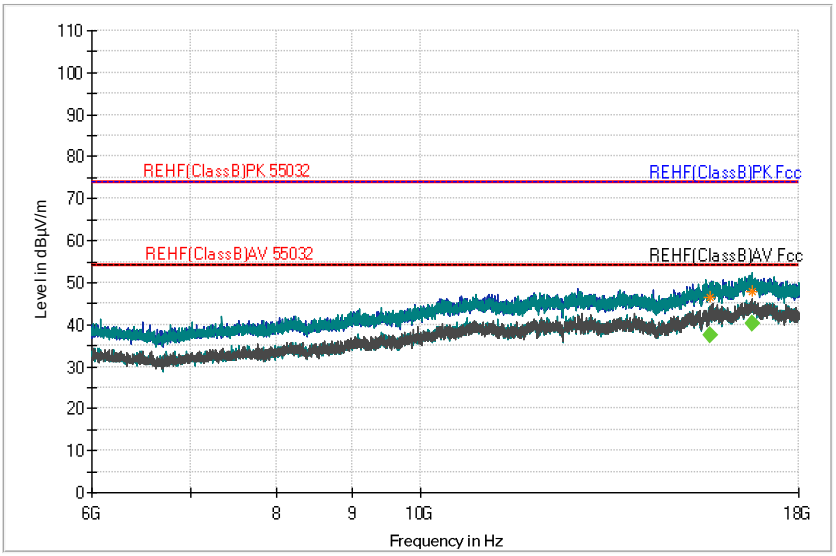

Figure 31: Radiated Spurious Emissions: 6 GHz – 18 GHz, Low Channel

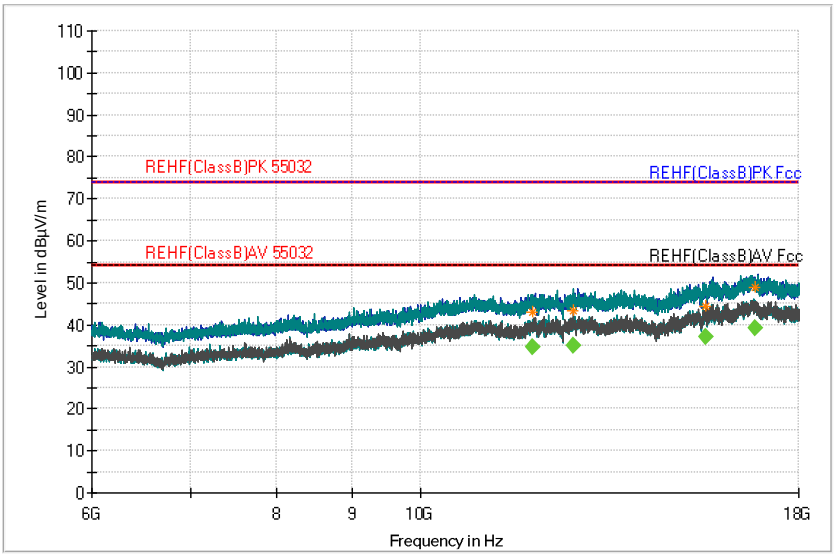

Figure 32: Radiated Spurious Emissions: 6 GHz – 18 GHz, Mid Channel

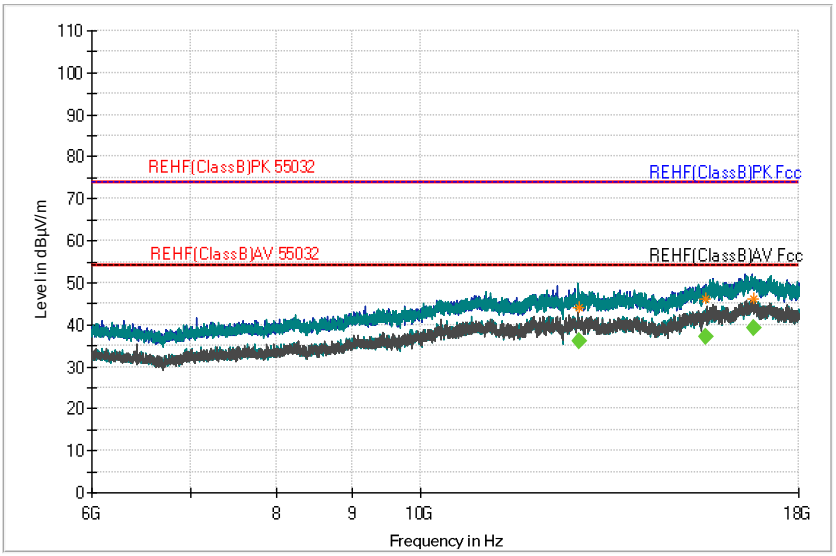

Figure 33: Radiated Spurious Emissions: 6 GHz – 18 GHz, High Channel

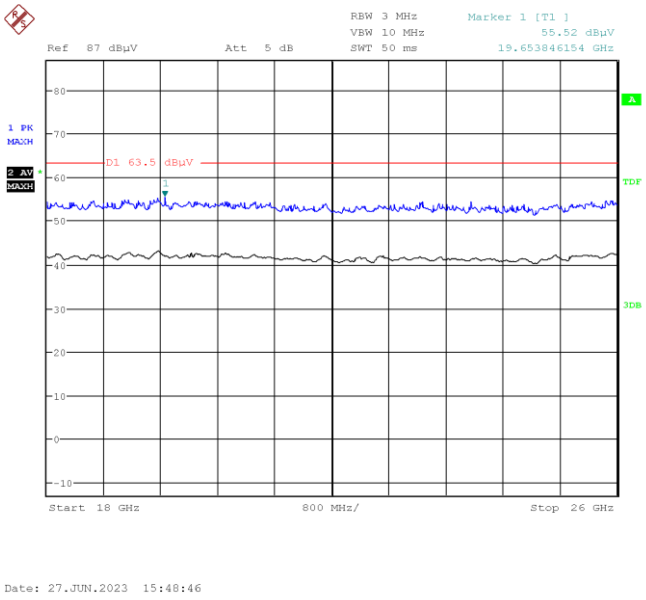

Figure 34: Radiated Spurious Emissions: 18 GHz – 26 GHz, Vertical, Low Channel

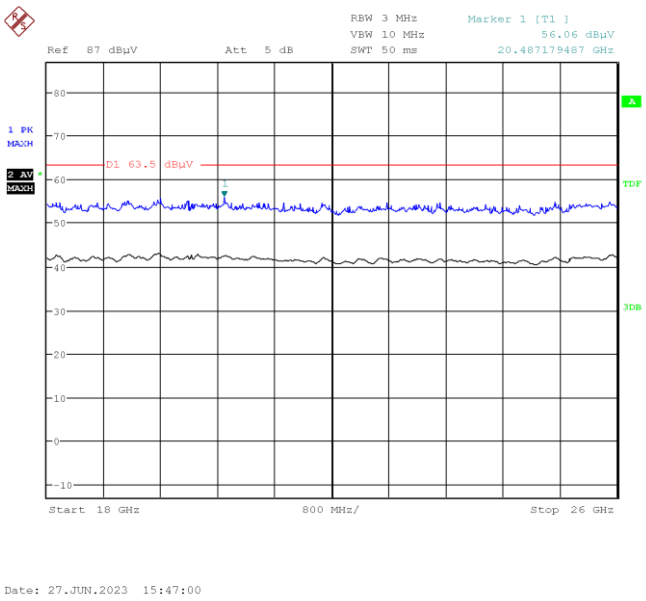

Figure 35: Radiated Spurious Emissions: 18 GHz – 26 GHz, Horizontal, Low Channel

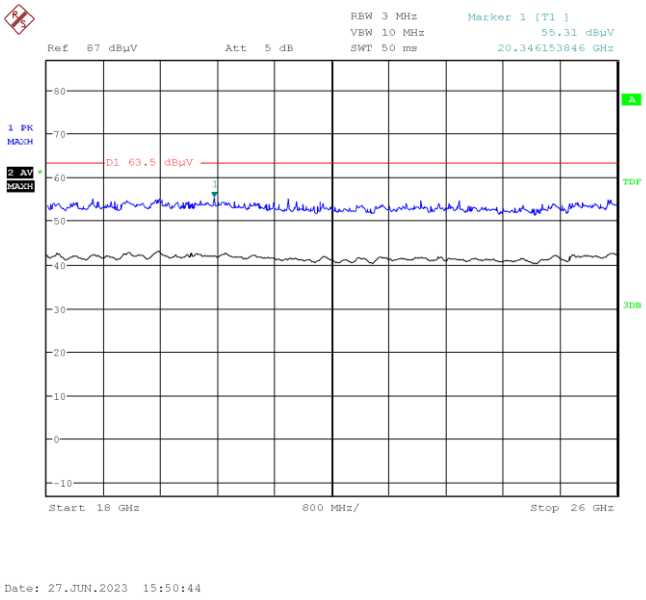

Figure 36: Radiated Spurious Emissions: 18 GHz – 26 GHz, Vertical, Mid Channel

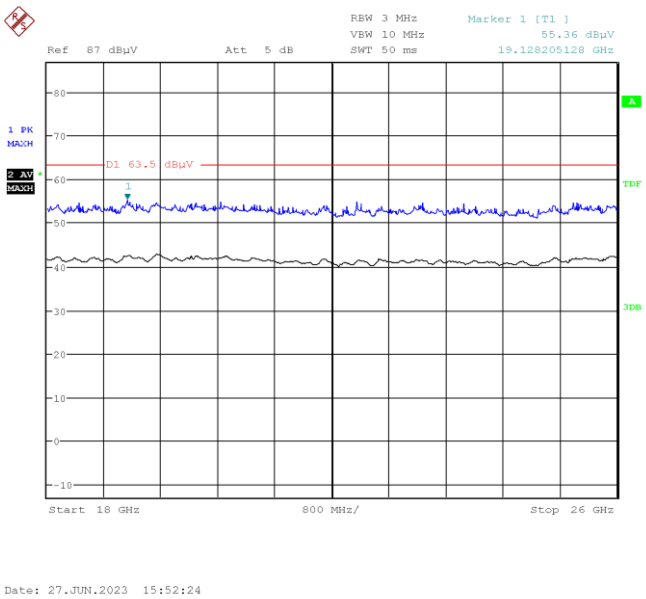

Figure 37: Radiated Spurious Emissions: 18 GHz – 26 GHz, Horizontal, Mid Channel

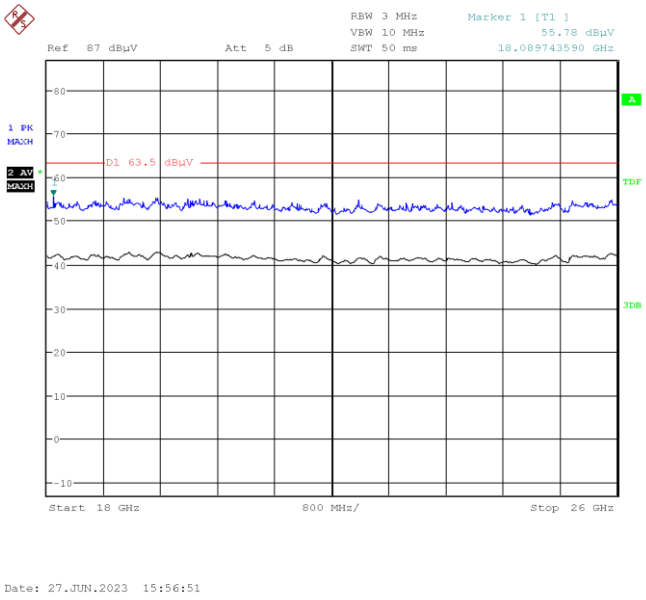

Figure 38: Radiated Spurious Emissions: 18 GHz – 26 GHz, Vertical, High Channel

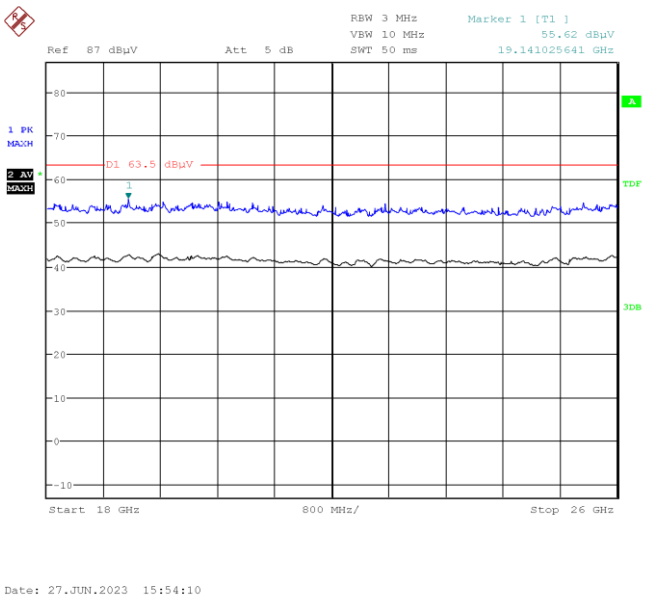

Figure 39: Radiated Spurious Emissions: 18 GHz – 26 GHz, Horizontal, High Channel

Appendix A: Test Setup Photos

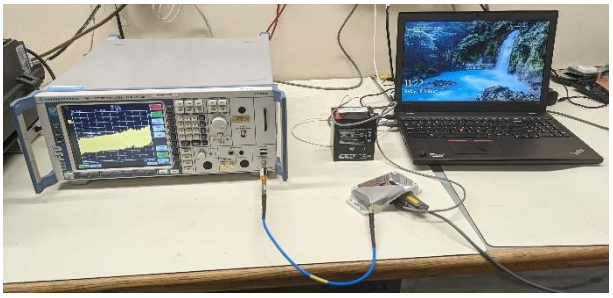

Figure 40: RF Conducted Emissions

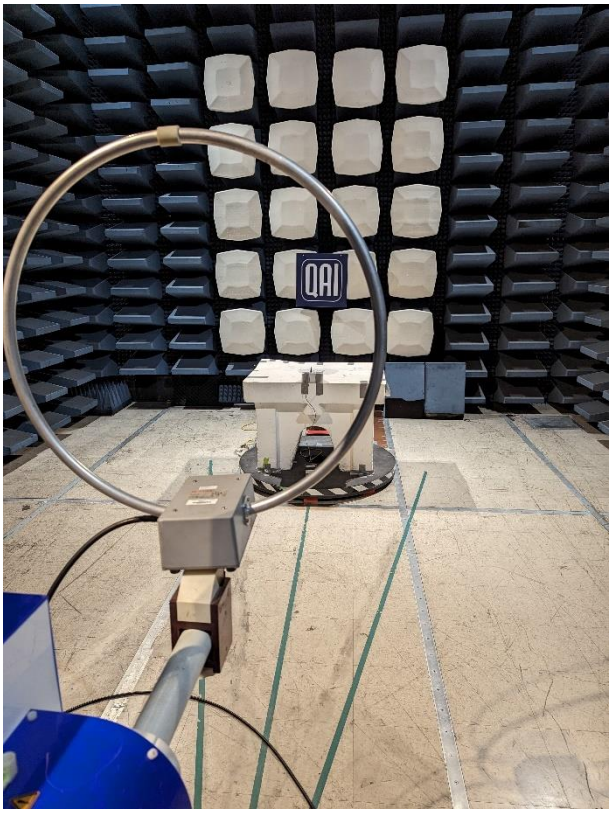

Figure 41: Radiated Emissions: 0.01-30 MHz

Figure 42: Radiated Emissions: 30-1000 MHz

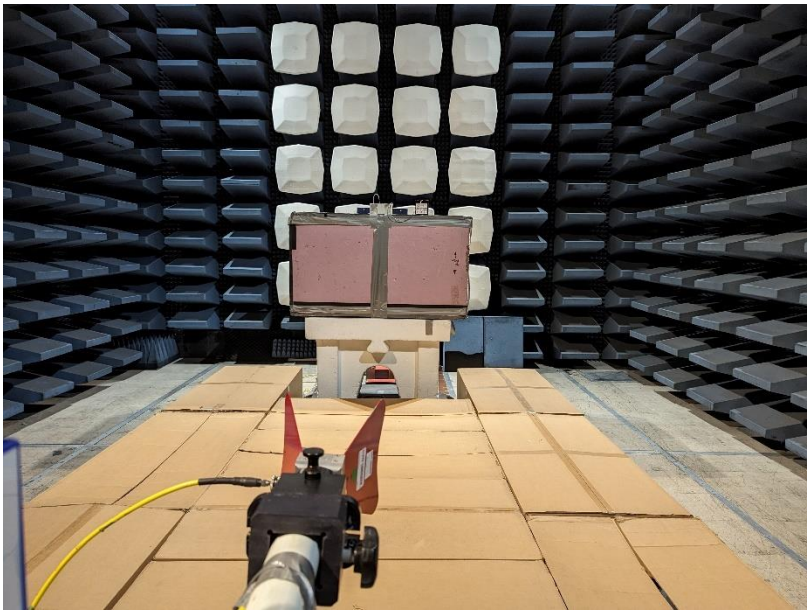

Figure 43: Radiated Emissions: 1-18 GHz

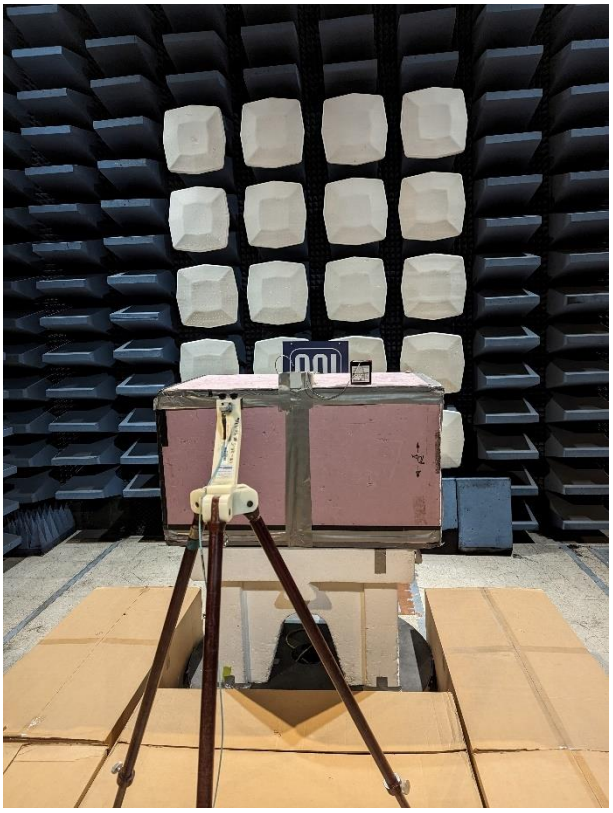

Figure 44: Radiated Emissions: 18-26 GHz

Appendix B: Abbreviations

Abbreviation	Definition
AC	Alternating Current
AM	Amplitude Modulation
CE	European Conformity
CISPR	Comité International Spécial des Perturbations Radioélectriques (International Special Committee on Radio Interference)
DC	Direct Current
EFT	Electrical Fast Transient
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
FCC	Federal Communications Commission
FVIN	Firmware Version Identification Number FVIN
IC	Industry Canada
ICES	Interference Causing Equipment Standard
IEC	International Electrotechnical Commission
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
SAC	Semi-Anechoic Chamber

END OF REPORT