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Product Compliance Solutions

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Amended
FCC/ISED Test Report

Prepared for:	**701x Inc.**
Address:	**700 Main Avenue Fargo, North Dakota 58103**
EUT:	**xTag v6**
Test Report No:	**R240111-70-E1A**
FCC ID:	**2AZT3-701XT2**
Approved by:	

Blake Winter
EMC Test Engineer,
iNARTE #EMC-50662-E

DATE:	**March 7, 2024**
Total Pages:	**36**

ilac-MRA A2LA ACCREDITED
TESTING LABORATORY
CERTIFICATE NO. 1953.01

REVISION PAGE

Rev. No.	Date	Description
Original	26 February 2024	Issued by BWinter Reviewed by KVepuri Prepared by BWinter
A	1 March 2024	Revision by BWinter 1. Add cellular module FCC ID. 2. Add results of module integration verification.
B	7 March 2024	Revision by BWinter 1. Add EUT FCC ID to cover page and EUT description.

CONTENTS

1.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

(1) US Code of Federal Regulations, Title 47, Part 15
(2) ISED RSS-Gen, Issue 5
(3) ISED RSS-247, Issue 3

ANSI C63.10-2020 was used as a test method, with guidance from KBD 558074 D01 v05

APPLIED STANDARDS AND REGULATIONS		
Standard Section	**Test Type**	**Result**
FCC Part 15.203	Unique Antenna Requirement	Internal Antenna
FCC Part 15.35 RSS Gen, Issue 5, Section 6.10	Duty Cycle	NA (100% duty cycle)
FCC Part 15.247(b)(3) RSS-247 Issue 3 Section 5.4(d)	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 3 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 5, Section 7.3	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247 (unrestricted) RSS-247 Issue 3 Section 5.5, RSS-Gen Issue 5, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(e) RSS-247 Issue 3 Section 5.2 (b)	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 3 Section 5.5	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 5, Section 8.8	Conducted Emissions	NA: Solar powered rechargeable battery
KDB 996369 D04 Using ANSI C63.10-2013, Section 6.5, 6.6 FCC ID:	Transmitter Radiated Emissions; Compare with Original Grant	Pass

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

Summary
The Equipment Under Test (EUT) was xTag v6, an animal tracking tag, FCC ID 2AZT3-701XT2, manufactured by 701x Inc. It has a Bluetooth Low Energy module that transmits and receives in the 2400 to 2483.5 MHz band, and it has a cellular module, FCC ID XMR2021BG770AGL, that is checked for modular integration.

EUT	701x xTag
EUT Received	2/7/2024, 2/20/2024
EUT Tested	2/7/2024 - 2/8/2024 and 2/21/2024
Serial No.	D11D, D2A6
Operating Band	2400 – 2483.5 MHz
Device Type	DTS
Power Supply	Solar powered rechargeable battery (no AC power)
Antenna	Internal, Kyocera Antenna 9001978

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 DESCRIPTION OF TEST MODES

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency (MHz)
Low	2402
Middle	2440
High	2480

These are the only three representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, highest and one channel in the middle.

2.3 DESCRIPTION OF SUPPORT UNITS

None

3.0 LABORATORY DESCRIPTION

3.1 LABORATORY DESCRIPTION

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number:	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests.

3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Karthik Vepuri	Test Engineer	Review of Results
2	Blake Winter	Test Engineer	Testing and Report

Notes:
All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

3.3 TEST EQUIPMENT

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Keysight MXE Signal Analyzer (26.5GHz)**	N9038A	MY56400083	July 17, 2023	July 17, 2025
SunAR RF Motion	JB1	A091418	July 26, 2023	July 26, 2024
ETS EMCO Red Horn Antenna	3115	00218576	July 31, 2023	July 31, 2024
ETS EMCO Amplifier*	3115-PA	00218576	January 22, 2024	January 22, 2026
Trilithic High Pass Filter*	6HC330	23042	June 5, 2023	June 5, 2025
ETS – Lindgren- VSWR on 10m Chamber***	10m Semi-anechoic chamber-VSWR	4740 Discovery Drive	July 30, 2020	July 30, 2024
NCEE Labs-NSA on 10m Chamber*	10m Semi-anechoic chamber-NSA	NCEE-001	May 25, 2022	May 25, 2024
TDK Emissions Lab Software	V11.25	700307	NA	NA
RF Cable (preamplifier to antenna)*	MFR-57500	90-195-040	June 5, 2023	June 5, 2025
RF Cable (antenna to 10m chamber bulkhead)*	FSCM 64639	01E3872	June 5, 2023	June 5, 2025
RF Cable (10m chamber bulkhead to control room bulkhead)*	FSCM 64639	01E3864	June 5, 2023	June 5, 2025
RF Cable (control room bulkhead to test receiver)*	FSCM 64639	01F1206	June 5, 2023	June 5, 2025
N connector bulkhead (10m chamber)*	PE9128	NCEEBH1	June 5, 2023	June 5, 2025
N connector bulkhead (control room)*	PE9128	NCEEBH2	June 5, 2023	June 5, 2025

*Internal Calibration
**2 year cal cycle
***4 Year Cal Cycle

Notes:
All equipment is owned by NCEE Labs and stored permanently at NCEE Labs facilities.

3.4 GENERAL TEST PROCEDURE AND SETUP FOR RADIO MEASUREMNTS

Radiated Test Setup

All the radiated measurements were taken at a distance of 3m from the EUT. The information regarding resolution bandwidth, video bandwidth, span and the detector used can be found in the graphs provided in the Appendix C. All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

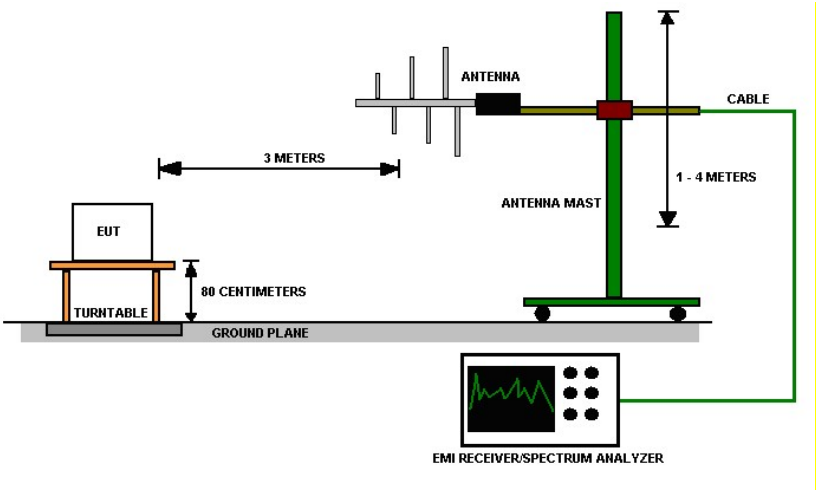

Figure 1 - Radiated Emissions Test Setup, 30MHz – 1GHz

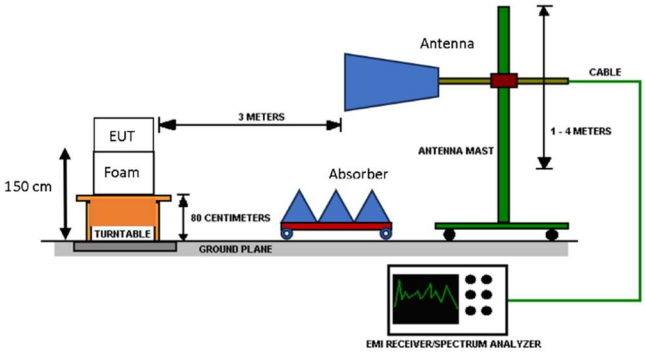

Figure 2 - Radiated Emissions Test Setup, 1GHz – 18GHz

4.0 DETAILED RESULTS

Radiated Radio Measurements									
CHANNEL	Occupied Bandwidth (kHz)	6 dB Bandwidth (kHz)	Field Strength (dBuV) at 3m	Antenna Gain (dBi)	Radiated Peak Power (dBm)*	Radiated Peak Power (mW)	Field Strength PSD (dBuV) at 3m	PSD EIRP (dBm)**	RESULT
Low	1052	654	94.70	1.8	-2.33	0.58	81.07	-14.16	Pass
Mid	1058	694	95.90	3.0	-2.33	0.58	82.41	-12.82	Pass
High	1059	666	97.05	3.0	-1.18	0.76	84.06	-11.17	Pass
6 dB Bandwidth Limit >= 500 kHz			Peak Output Power Limit = 30 dBm; PSD Limit = 8 dBm						

*Peak Power (dBm) = EIRP (dBm) – Antenna Gain (dBi); EIRP (dBm) = Field Strength (dBuV) – 95.23 dB at 3m.
**PSD EIRP (dBm) = Field Strength PSD (dBuV) – 95.23 dB at 3m.

Unrestricted Band-Edge							
CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level (dBuV)	Relative Fundamental (dBuV)	Measurement Type	Delta (dB)	Min Delta (dB)	Result
Low	2400	37.70	61.68	Peak	23.98	20	Pass
High	2483.5	17.69	63.55	Peak	45.86	20	Pass

Peak Limit- Restricted Band-Edge						
CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level (dBuV/m @ 3m)	Measurement Type	Limit (dBuV/m @ 3m)*	Margin	Result
Low	2386.30	47.56	Peak	73.98	26.42	Pass
High	2483.90	49.84	Peak	73.98	24.14	Pass
*Limit shown is the peak limit taken from FCC Part 15.209.						

Average Limit- Restricted Band-Edge						
CHANNEL	**Band edge /Measurement Frequency (MHz)**	**Highest out of band level (dBuV/m @ 3m)**	**Measurement Type**	**Limit (dBuV/m @ 3m)***	**Margin**	**Result**
Low	2388.23	38.37	Average	53.98	15.61	Pass
High	2483.55	40.45	Average	53.98	13.53	Pass
*Limit shown is the average limit taken from FCC Part 15.209.						

4.1 DUTY CYCLE

Duty cycle is 100%. No correction factor is applied.

4.2 RADIATED EMISSIONS

Test Method: ANSI C63.10:2013, Section 6.5, 6.6

Limits for radiated emissions measurements:

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

Test procedures:

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements from 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 6dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise, the emissions that did not have 6 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions. The results are presented for the axis that had the highest emissions.

h. The orientation with the worst-case emissions was used for final measurements.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

Deviations from test standard:

No deviation.

Test setup:

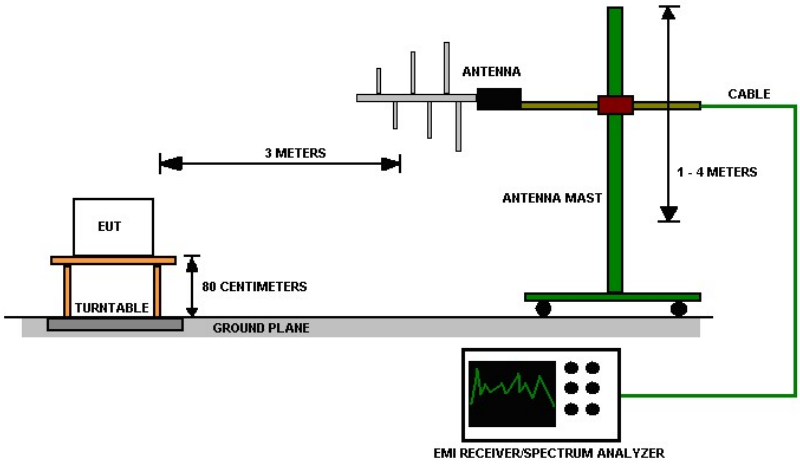

Figure 3 - Radiated Emissions Test Setup, 30MHz – 1GHz

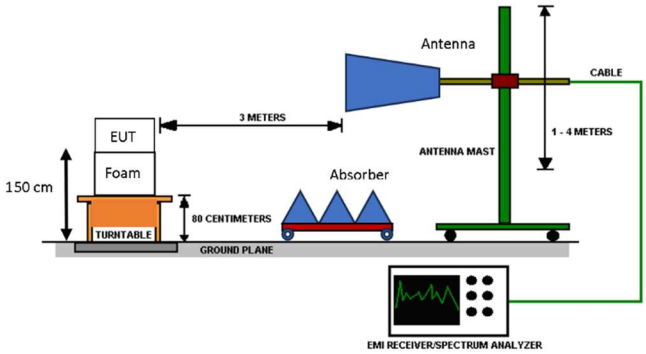

Figure 4 - Radiated Emissions Test Setup, 1GHz – 18GHz

EUT operating conditions
The EUT was powered by an internal battery that is solar rechargeable. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

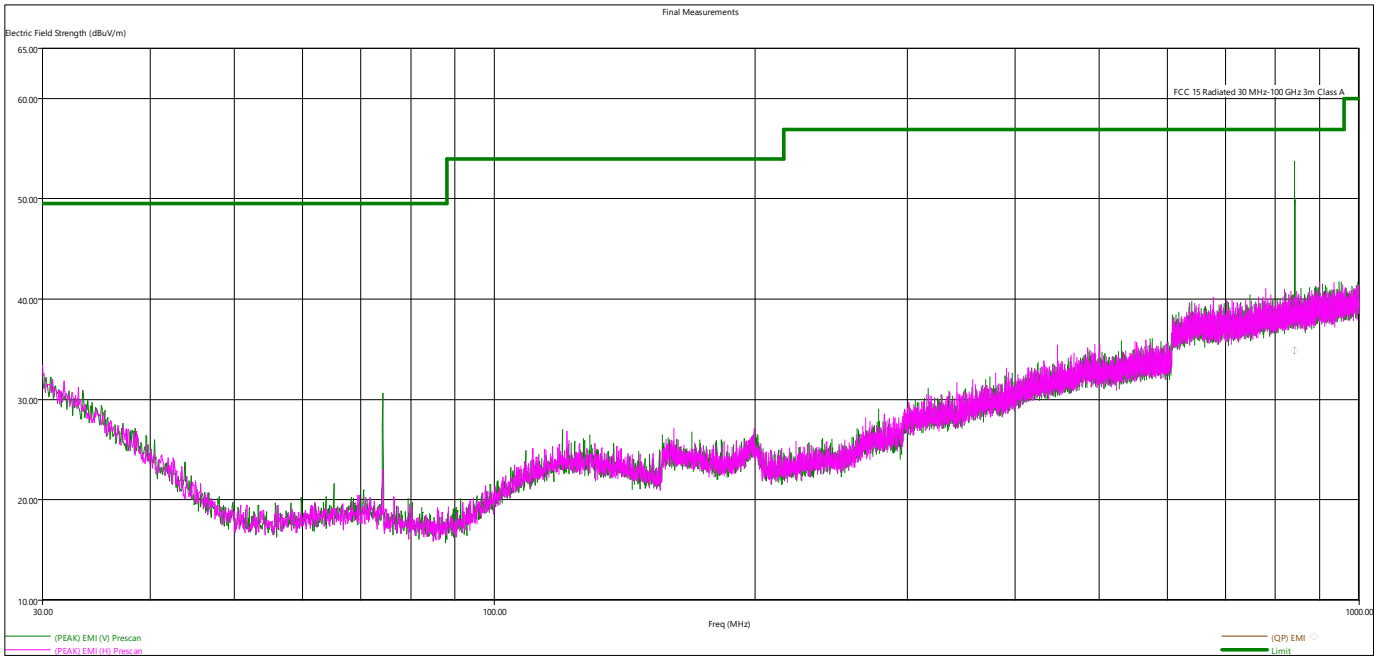

Figure 5 - Radiated Emissions Plot, 30 MHz-1 GHz Low Channel, x-axis

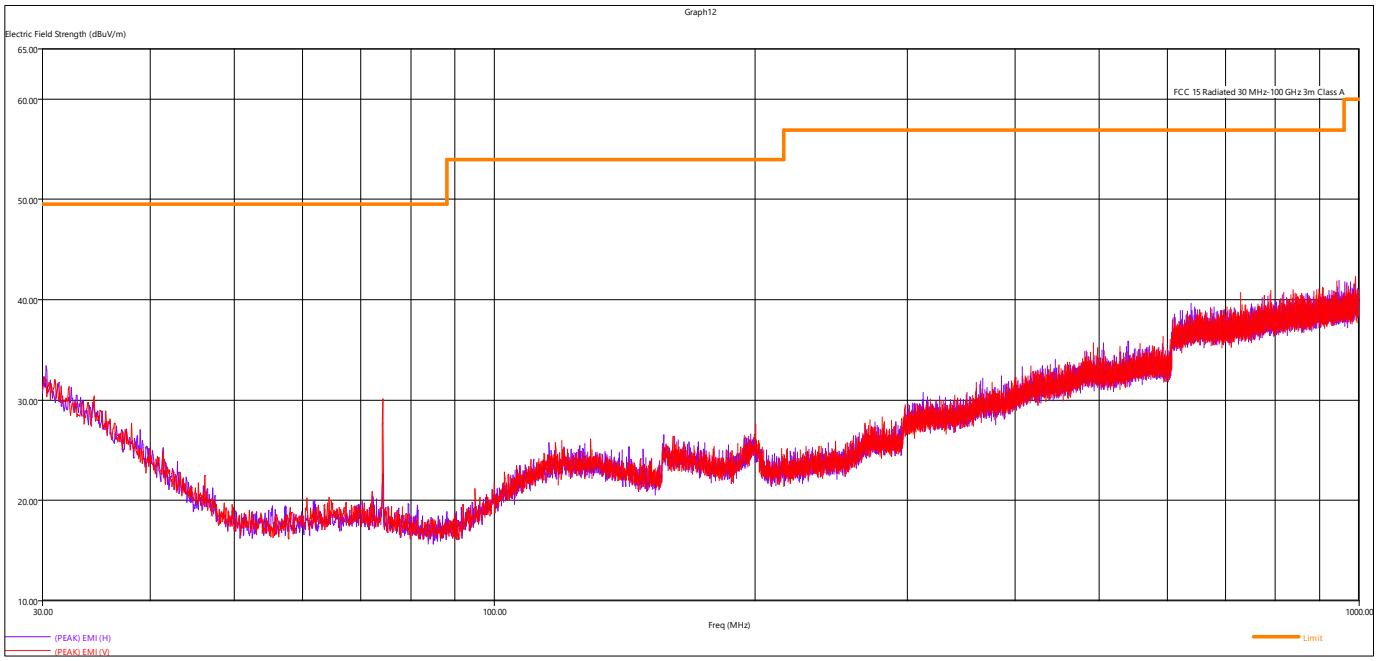

Figure 6 - Radiated Emissions Plot, 30 MHz-1 GHz, Mid Channel, y-axis

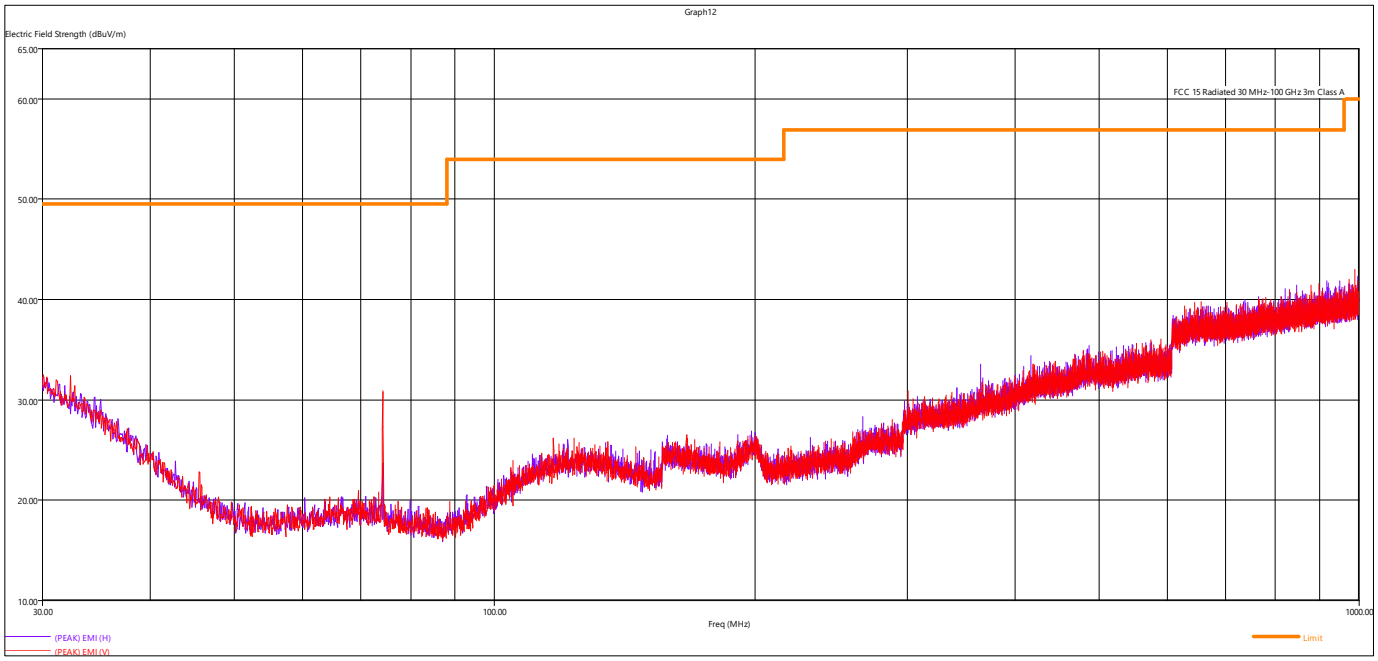

Figure 7 - Radiated Emissions Plot, 30 MHz-1 GHz High Channel, z-axis

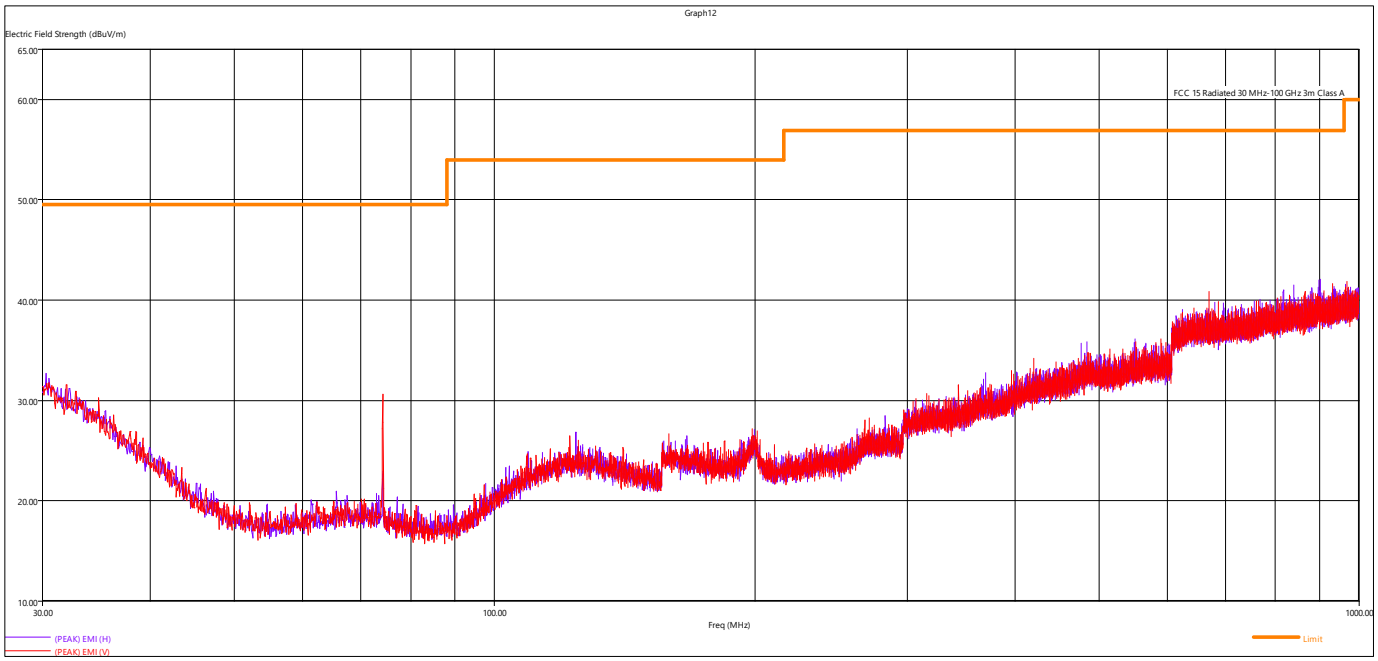

Figure 8 - Radiated Emissions Plot, 30 MHz-1 GHz, Receive Mode

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value - Emission level.
5. The EUT was measured in both the horizontal and vertical orientation. The position with the highest emissions was used for all testing.
6. FCC ID XMR2021BG770AGL cellular module emissions were compared with the results from the original grant are compliant.
7. Emissions from intermodulation products between the cellular module and the BLE module were compliant.

Quasi-Peak Measurements, 30 MHz -1 GHz, Low Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
842.678640	34.94	56.90	21.96	235.26	200.00	V

Quasi-Peak Measurements, 30 MHz -1 GHz, Mid Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
All measurements were found to be at least 6dB below the limit line.						

Quasi-Peak Measurements, 30 MHz -1 GHz, High Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
All measurements were found to be at least 6dB below the limit line.						

Quasi-Peak Measurements, 30 MHz -1 GHz, Receive Mode						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
All measurements were found to be at least 6dB below the limit line.						

Peak Measurements, 1 GHz - 25 GHz, Low Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
2402.356000	97.45	NA	NA	258.85	151.25	V
4803.668000	51.37	79.50	28.13	207.74	191.50	H

Peak Measurements, 1 GHz - 25 GHz, Mid Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
1867.928000	62.81	79.50	16.69	232.46	101.25	V
2440.290000	96.48	NA	NA	174.55	129.25	V
4879.922000	50.85	79.50	28.65	232.64	180.25	H

Peak Measurements, 1 GHz - 25 GHz, High Channel						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
1777.572000	62.00	79.50	17.50	517.11	318.50	H
2479.852000	97.28	NA	NA	198.37	151.00	V
4959.660000	46.86	79.50	32.64	267.14	175.25	H

Peak Measurements, 1 GHz - 25 GHz, Receive Mode						
Frequency	**Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
No peak emissions were within 6dB of the average limit.						

Average Measurements, 1 GHz- 25 GHz, Low Channel						
Frequency	**Average Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
2402.356000	94.25	NA	NA	258.85	151.25	V
4803.668000	44.19	59.50	15.31	207.74	191.50	H

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

Average Measurements, 1 GHz- 25 GHz, Mid Channel						
Frequency	**Average Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
1867.928000	49.49	59.50	10.01	232.46	101.25	V
2440.290000	93.98	NA	NA	174.55	129.25	V
4879.922000	45.34	59.50	14.16	232.64	180.25	H

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

Average Measurements, 1 GHz - 25 GHz, High Channel						
Frequency	**Average Level**	**Limit**	**Margin**	**Height**	**Angle**	**Pol**
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm.**	**deg.**	
1777.572000	48.54	59.50	10.96	517.11	318.50	H
2479.852000	95.20	NA	NA	198.37	151.00	V
4959.660000	37.97	59.50	21.53	267.14	175.25	H

The EUT was maximized in all 3 orthogonal axes. The worst-case is shown in the table above.

Note that the test lab had limited capability with regards to how the cellular module transmits. Power measured was not found to be higher than what was reported in the original grant with FCC ID: XMR2021BG770AGL.

Intermodulation products were evaluated when the radios was active and the measurements were found to be lower than the certified values.

The duty cycle was sporadic, so average measurements were not compared.

4.3 PEAK OUTPUT POWER

Test Method: ANSI C63.10, Section(s) 7.8.5

Limits of bandwidth measurements:
For a DTS system, the output power is required to be less than 1000 mW or 30 dBm.

Power was measured over the air and calculated from field strength measurements at 3m at the maximum EIRP

Test procedure: Radiated.

Deviations from test standard:
No deviation.

Test setup:

See Section 3.4 and 4.2

EUT operating conditions:
The EUT was powered by an internal battery that is solar rechargeable. The EUT was set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:
Refer to section 4.0 for the results table.

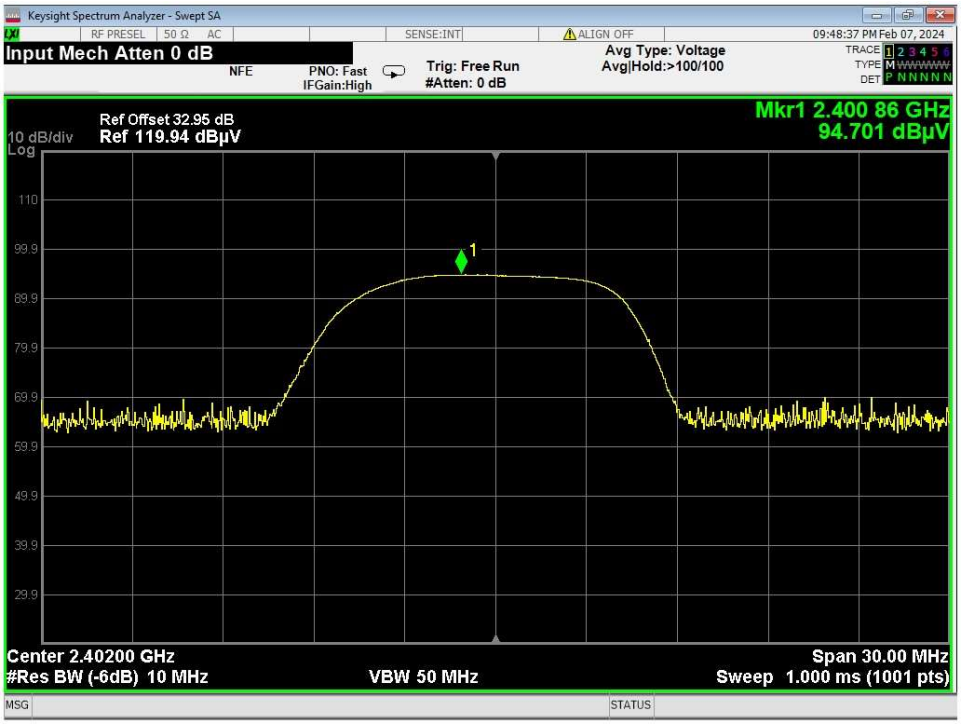

Figure 9 – Output Power Field Strength, Low Channel
Corrected values measured at 3m.

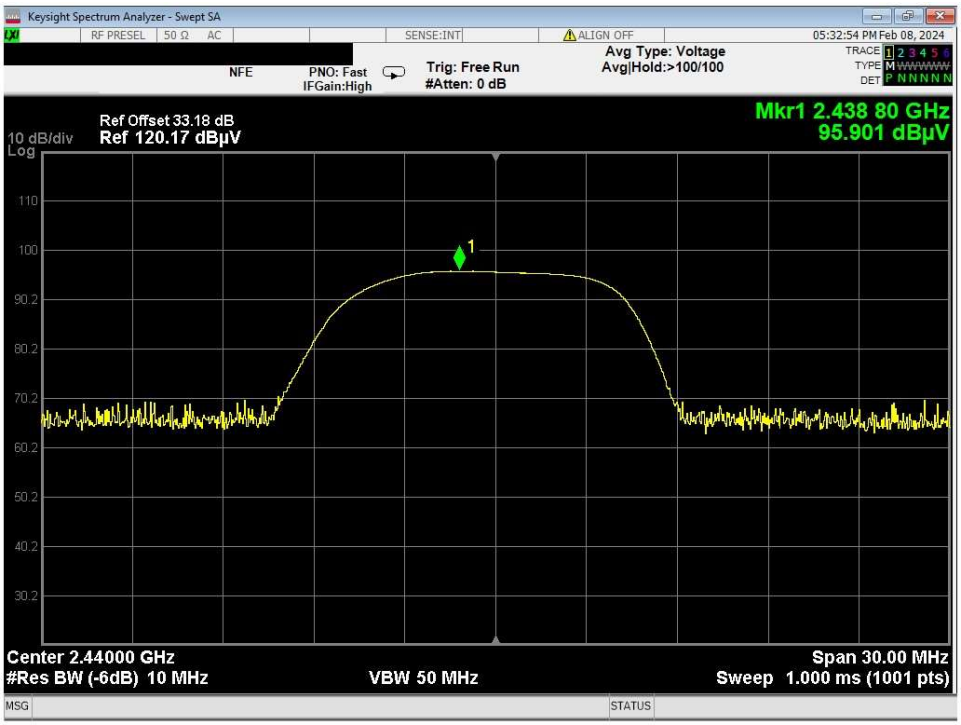

Figure 10 – Output Power Field Strength, Mid Channel
Corrected values measured at 3m.

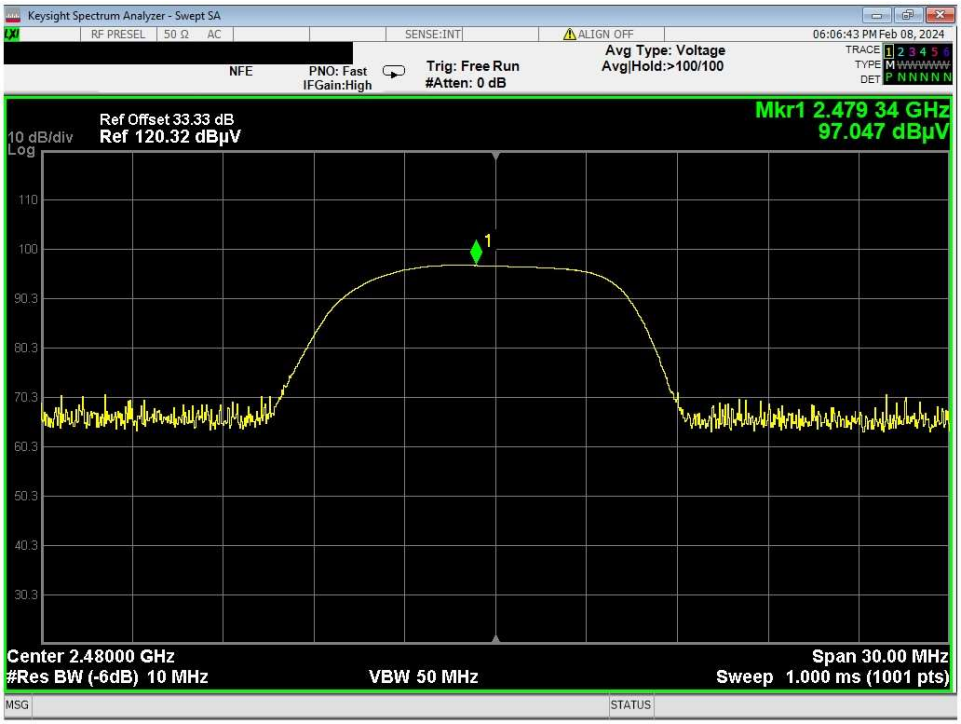

Figure 11 – Output Power Field Strength, High Channel
Corrected values measured at 3m.

4.4 Bandwidth

Test Method: ANSI C63.10, Section(s) 6.9.2 (6 dB BW)
ANSI C63.10, Section(s) 6.9.3 (99% BW)

Limits of bandwidth measurements:
From FCC Part 15.247 (1) (i) and RSS-247 5.1(c)

The minimum allowed 6 dB bandwidth of the DTS channel is 500 kHz.

Test procedures:
Bandwidth measurement was taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 kHz RBW.

The 6dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

The 99% occupied bandwidth was measured using the test receiver's occupied bandwidth function.

Test setup:

All the measurements were done at 3m test distance while operating at low, mid, and high channels. See Section 4.3 for more details.

Deviations from test standard:
No deviation.

Test setup:

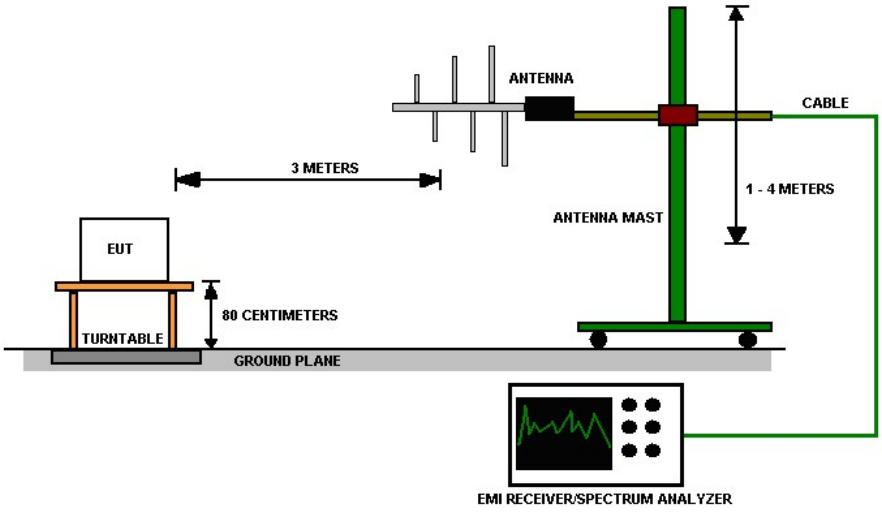

Figure 12 - Bandwidth Measurements Test Setup, 30MHz – 1GHz

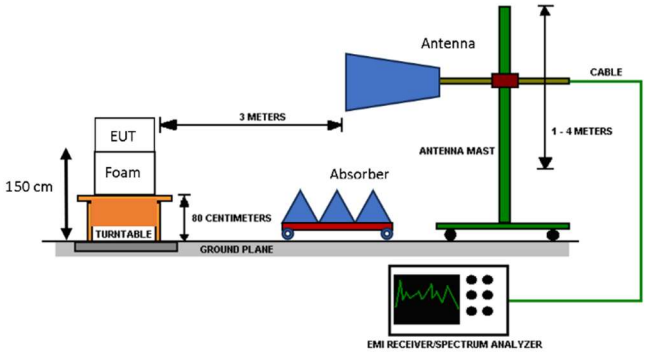

Figure 13 - Bandwidth Measurements Test Setup, 1GHz – 18GHz

EUT operating conditions:
The EUT was powered by internal battery unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

Test results:

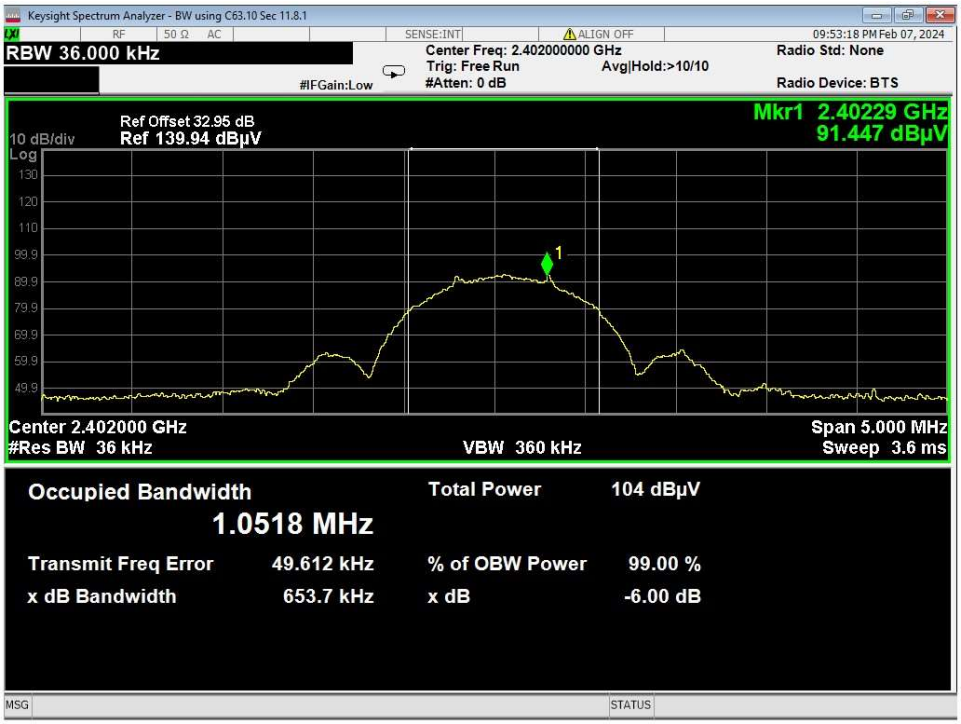

Figure 14 –Bandwidth, Low Channel

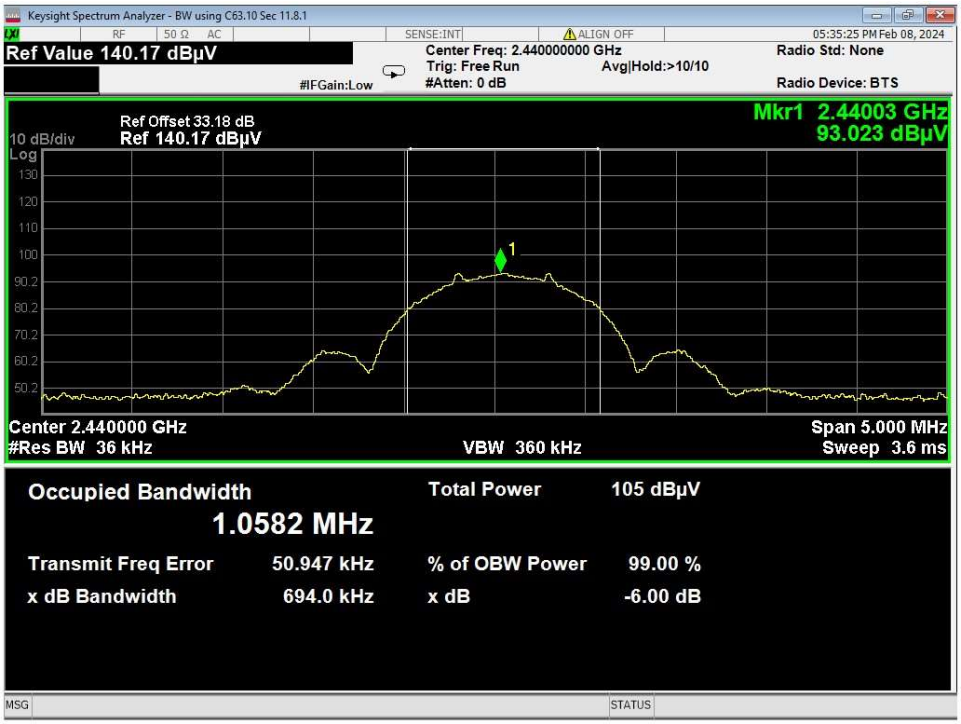

Figure 15 - Bandwidth, Mid Channel

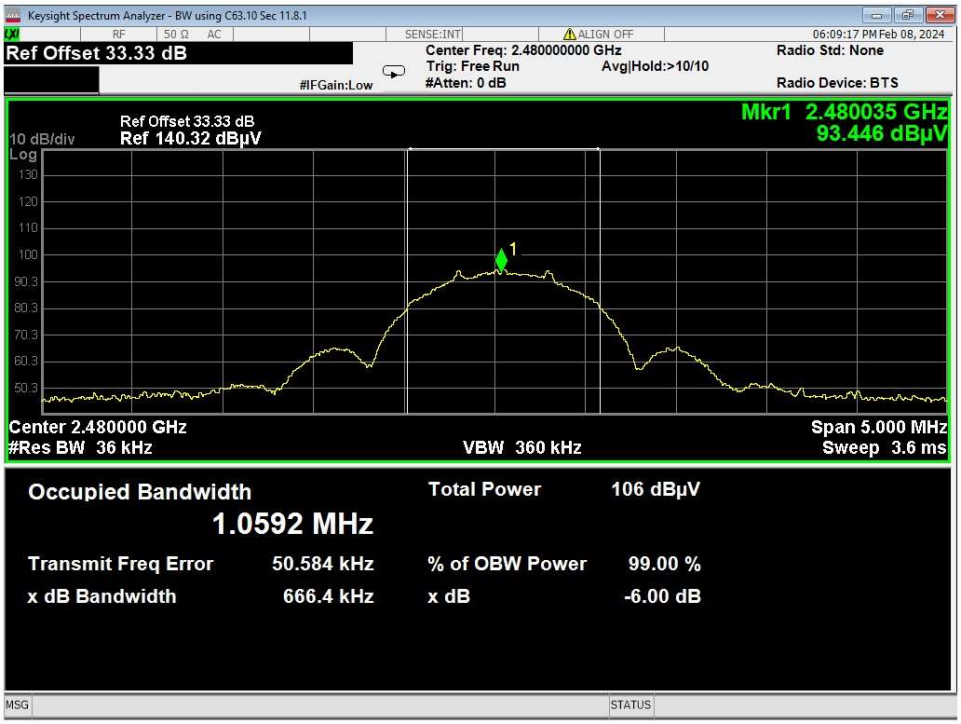

Figure 16 - Bandwidth, High Channel

4.5 BANDEDGES

Test Method: ANSI C63.10, Section(s) 6.10.6

Limits of bandedge measurements:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

Test procedures:
All measurements were taken at a distance of 3m from the EUT.

The EUT was maximized in all 3 orthogonal positions in a similar manner as described in Section 4.2.

Deviations from test standard:
No deviation.

Test setup:
All the measurements were done at 3m test distance while operating on the highest and lowest channel depending on which band edge was investigated.

EUT operating conditions:
The EUT was powered by an internal battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

Test results: Refer to section 4.0 for the results table.

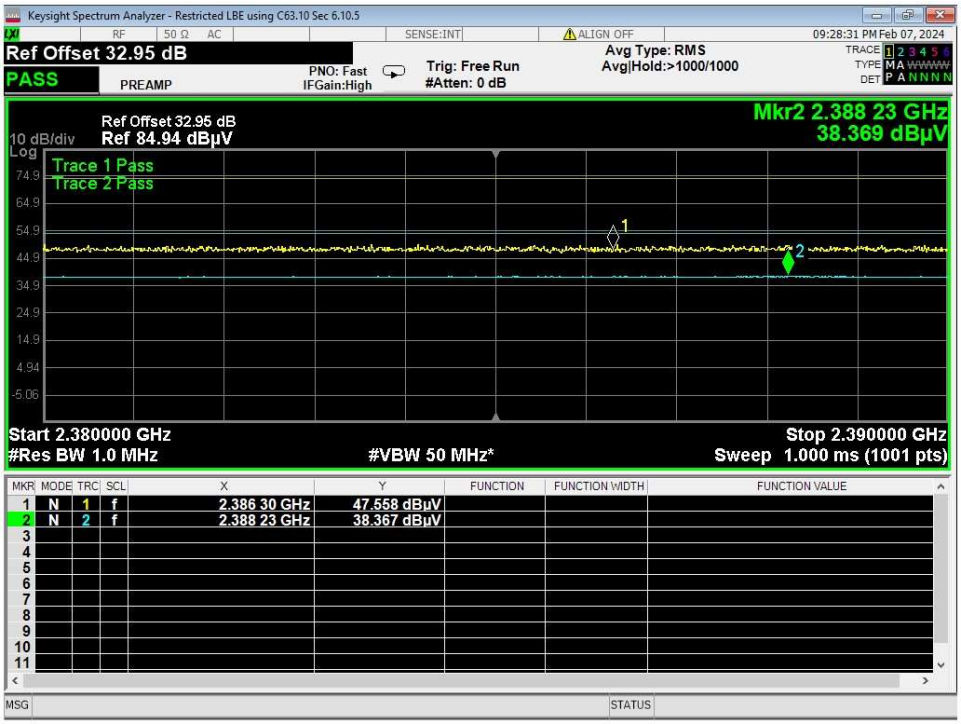

Figure 17 – Band-edge Measurement, Low Channel, Restricted Frequency Corrected values measured at 3m.

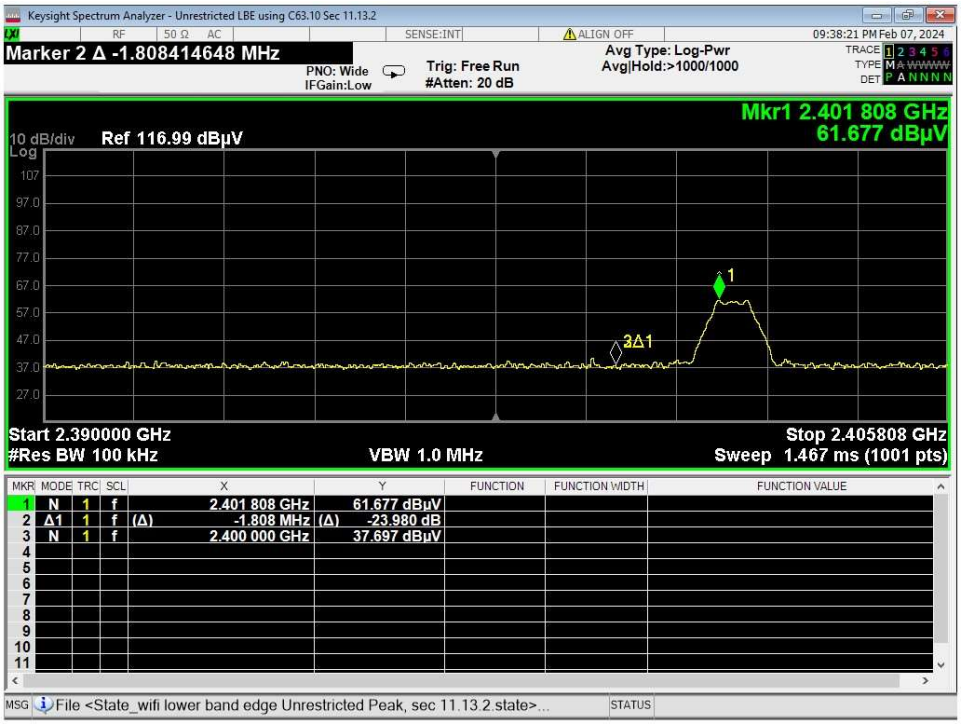

Figure 18 –Band-edge Measurement, Low Channel, Unrestricted Frequency

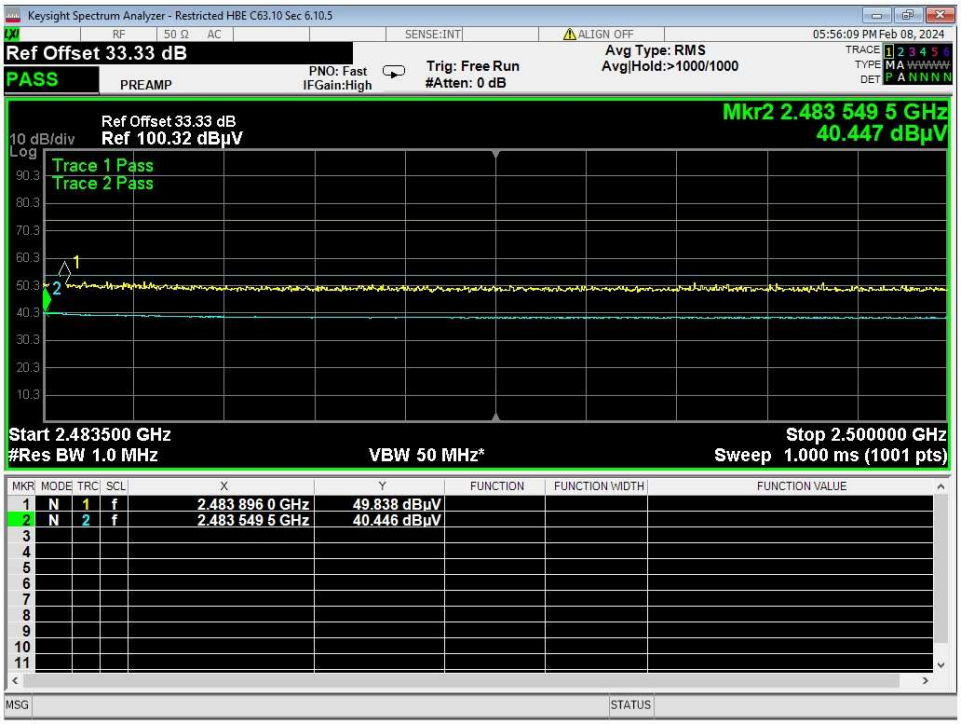

Figure 19 – Band-edge Measurement, High Channel, Restricted Frequency Corrected values measured at 3m.

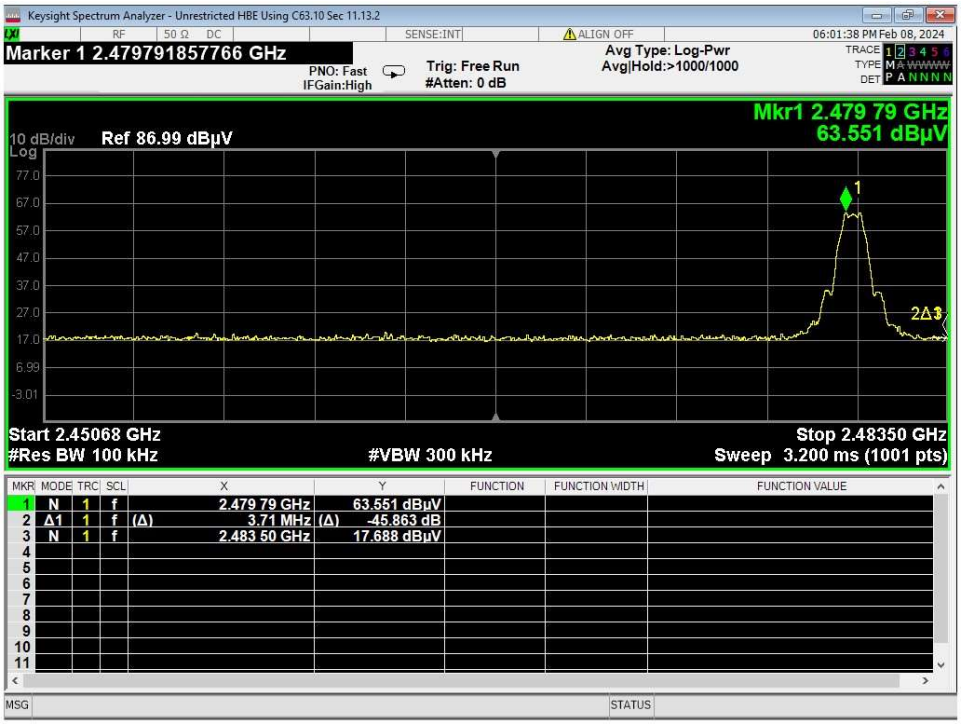

Figure 20 –Band-edge Measurement, High Channel, Unrestricted Frequency

4.6 POWER SPECTRAL DENSITY

Test Method: All the radio measurements were performed using the sections from ANSI C63.10, details about the section used can be found in the spectrum analyzer titles on the graph.

Limits of power measurements:

For FCC Part 15.247 Device:
The maximum PSD allowed is 8 dBm.

Test procedures:
Details can be found in section 3.4 of this report.

Deviations from test standard:
No deviation.

Test setup:
Details can be found in section 3.4 of this report.

EUT operating conditions:
The EUT was powered by an internal battery and set to transmit mode.

Test results:
Pass
Comments:
1. All the measurements were found to be compliant.
2. Tabulated data is listed in section 4.0.

Figure 21 – EIRP Power Spectral Density, Low Channel
Corrected values measured at 3m.

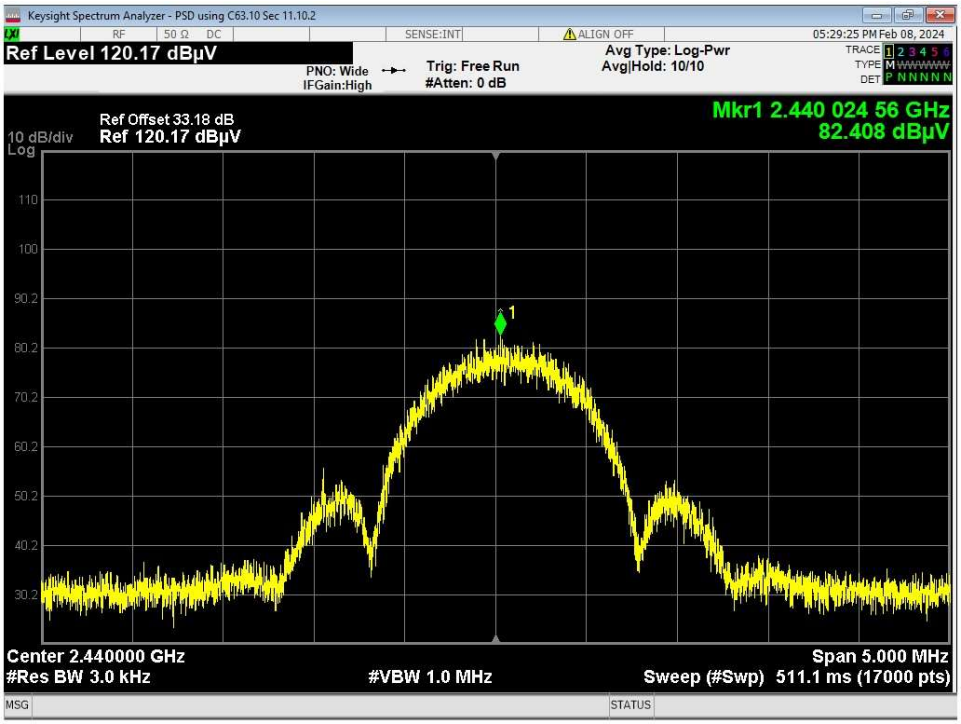

Figure 22 – EIRP Power Spectral Density, Mid Channel
Corrected values measured at 3m.

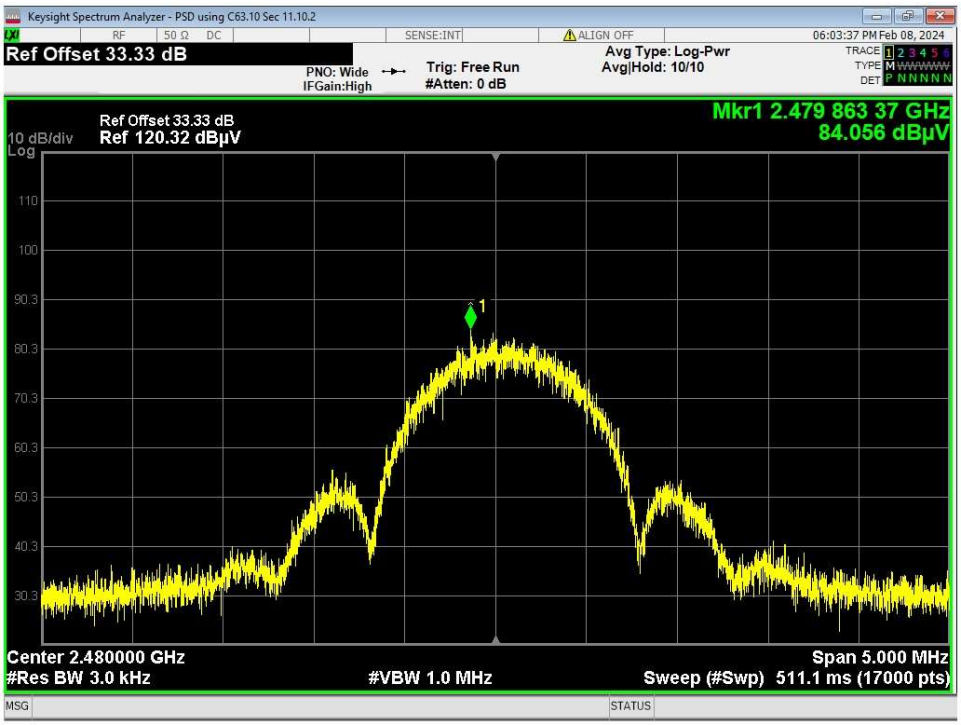

Figure 23 – EIRP Power Spectral Density, High Channel
Corrected values measured at 3m.

APPENDIX A: SAMPLE CALCULATION

Radiated Emissions

The field strength is calculated in decibels (dB) by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = R + AF - (-CF + AG)$$

where FS = Field Strength

R = Receiver Amplitude Receiver reading in dBµV

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Preamplifier Amplifier Gain

Assume a receiver reading of 55.00 dBµV is obtained. The Antenna Factor of 12.00 and a Cable Factor of 1.10 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.10 dBµV/m.

FS = 55.00 + 12.00 – (-1.10 + 20.00) = 48.1 dBµV/m

The 48.1 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

Level in µV/m = Common Antilogarithm [(48.1 dBµV/m)/20]= 254.1 µV/m

Conducted Emissions

Receiver readings are compared directly to the conducted emissions limits in decibels (dB) by adding the cable loss and LISN insertion loss to the receiver reading. The basic equations with a sample calculation is as follows;

$$FS = R + IL - (-CF)$$

where V = Conducted Emissions Voltage Measurement

R = Receiver reading in dBµV

IL = LISN Insertion Loss

CF = Cable Attenuation Factor

APPENDIX B – MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels apply to tests performed in this test report:

Test	Frequency Range	NCEE Labs Uncertainty Value (dB)	Maximum Uncertainty Values per CISPR 16-4-2:2011/A1:2018
AC Line Conducted Emissions	150kHz - 30MHz	3.03	3.60
Radiated Emissions, 3m	30MHz - 1GHz	4.19	5.34
Radiated Emissions, 3m	1GHz – 18GHz	5.08	5.48

Expanded uncertainty values are calculated to a confidence level of 95%.

NCEE Labs meets the maximum uncertainty requirements per CISPR 16-4-2:2011/A1:2018, and therefore does not require a minimum passing margin to state that an EUT is less than the field strength limits of the applicable CISPR, IEC or EN limit per CISPR 16-4-2:2011/A1:2018, Section 4.1.

NCEE Labs employs tilting when testing at 3m test distance. The maximum uncertainty associated with this method is used.

Maximum uncertainty values show the worse-case of all test distances used.

REPORT END