TEST REPORT

Report Number: R14956064-E8

Applicant	:	Whoop Inc. 1 Kenmore Square, Suite 601 Boston, MA 02215, USA
Model	:	WB50
FCC ID	:	2AJ2X-WB50
IC	:	22056-WB50
EUT Description	:	Charger
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C: 2024 ISED RSS-247 ISSUE 3: 2023 ISED RSS-GEN ISSUE 5 + A1 + A2: 2021

Date Of Issue:
2024-07-19

Prepared by:
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CERT #0751.06

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024-07-10	Initial Issue	Chandler Stanley
V2	2024-07-19	Editorial – corrected model number, FCC ID, and IC	Chandler Stanley

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UL LLC
12 Laboratory Dr., RTP, NC 27709, U.S.A. TEL:(919) 549-1400

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Whoop Inc.
1 Kenmore Square, Suite 601
Boston, MA 02215, USA

EUT DESCRIPTION: Charger

MODEL: WB50

SERIAL NUMBER: B5APD001559

SAMPLE RECEIPT DATE: 2024-06-17

DATE TESTED: 2024-06-17 TO 2024-06-27

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C: 2024	See Section 2
ISED RSS-247 Issue 3: 2023	See Section 2
ISED RSS-GEN Issue 5 + A1 + A2: 2021	See Section 2

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
UL LLC By:

Jeff Moser
Operations Manager
Consumer, Medical and IT Segment
UL LLC

Prepared By:

Chandler Stanley
Engineer
Consumer, Medical and IT Segment
UL LLC

2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.
Below is a list of the data provided by the customer:

1. Antenna gain and type (see section 6.3)
2. Supported data rates (see section 6.5)

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	Complies	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power		
See Comment		Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 5.2 (b)	PSD	Complies	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions		
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2020, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A1 + A2, and RSS-247 Issue 3.

4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, certification # 0751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A		27265	

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	U_{Lab}
Radio Frequency (Spectrum Analyzer)	141.2 Hz
Occupied Channel Bandwidth	1.22%
RF output power, conducted	1.3 dB (PK) 0.45 dB (AV)
Power Spectral Density, conducted	2.47 dB
Unwanted Emissions, conducted	1.94 dB
All emissions, radiated	6.01 dB
Conducted Emissions (0.150-30MHz) - LISN	3.40 dB
Temperature	0.57°C
Humidity	3.39%
DC Supply voltages	1.70%

Uncertainty figures are valid to a confidence level of 95%.

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a charger that is used to charge the battery of a wearable strap and contains both a BLE and WPT radio. This report covers the full emissions testing of the BLE radio.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE - 1Mbps	8.04	6.37
2402 - 2480	BLE - 2Mbps	8.04	6.37

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

The radio utilizes an integral PIFA antenna, with a maximum gain of 2.86 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 3.13.1.0.

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest power spectral density as worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at power setting 8 on low and high channels, as well as middle channel for radiated spurious emissions. Radiated Spurious emissions was performed on the worst-case PSD mode (1Mbps).

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Dell	Latitude 7320	FPC60F3	-
AC Adapter	DeWalt	DXMA1310851	C42107	NA
Laptop	Dell	P112F	N/A	N/A

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB C	1	USB C	Shielded	<3m	Connects the battery to the AC Adapter

TEST SETUP

The EUT is connected to a support laptop to configure the EUT radio module prior to testing. For final testing, the EUT was disconnected from the support laptop and connected to an ac adapter in order to keep the EUT powered throughout testing.

SETUP DIAGRAM

Please refer to R14956064-EP4 for setup diagrams

7. MEASUREMENT METHOD

On Time and Duty Cycle: ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2020 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.2 Method PKPM1 Peak-reading power meter
ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Conducted emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11 and 6.10.4

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1, 6.3-6.6 and 6.10.5

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
	Conducted Room 2				
90416	Spectrum Analyzer	Keysight Technologies	N9030A	2023-06-09	2024-06-30
238710	Environmental Meter	Fisher Scientific	15-077-963	2023-06-27	2024-06-27
211057	Real-Time Peak Power Sensor 50MHz to 8GHz	Boonton	RTP5000	2023-08-01	2024-08-01
SOFTEMI	Antenna Port Software	UL	Version 2024.2.23	NA	NA
Power Software	Boonton Power Analyzer	Boonton	Version 3.0.13.0	NA	NA

Test Equipment Used - Wireless Conducted Attenuators, Cables, and Couplers

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Cables				
188125 (CBL099)	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz, 39.3", Connectors 2	Carlisle Interconnect Technologies	UFA147A-0-0180-200200	2024-04-11	2025-04-11

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 4)

Equip. ID	Description	Manufacturer /Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
135144	Active Loop Antenna	ETS-Lindgren	6502	2024-01-24	2025-01-24
	30-1000 MHz				
90628	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-01-02	2026-01-02
	1-18 GHz				
89509	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-05-23	2025-05-23
	18-40 GHz				
204704	Horn Antenna, 18-26.5GHz	Com-Power	AH-826	2023-07-20	2025-07-20
	Gain-Loss Chains				
207638	Gain-loss string: 0.009-30MHz	Various	Various	2024-05-22	2025-05-22
207639	Gain-loss string: 25-1000MHz	Various	Various	2024-05-22	2025-05-22
207640	Gain-loss string: 1-18GHz	Various	Various	2024-05-22	2025-05-22
225795	Gain-loss string: 18-40GHz	Various	Various	2024-05-22	2025-05-22
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2024-04-16	2025-04-16
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
241204	Environmental Meter	Fisher Scientific	15-077-963	2023-09-05	2025-09-05

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

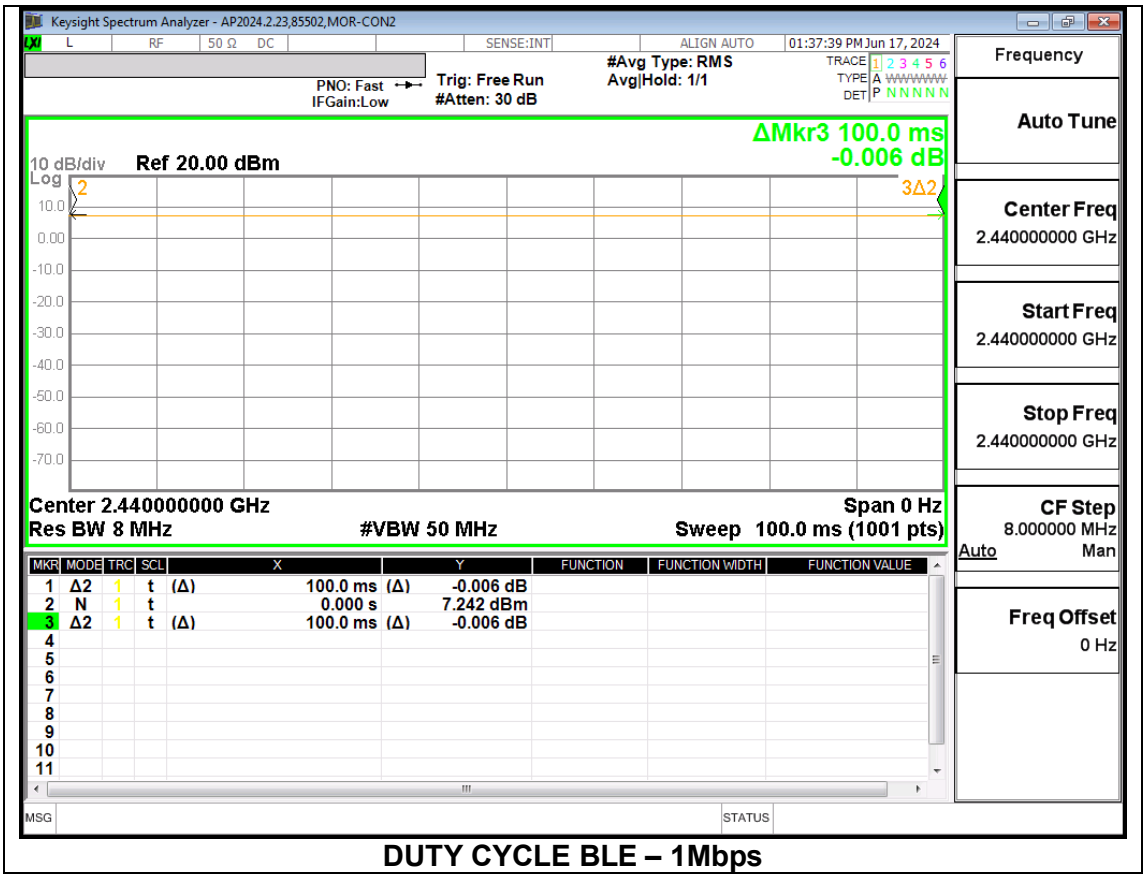
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

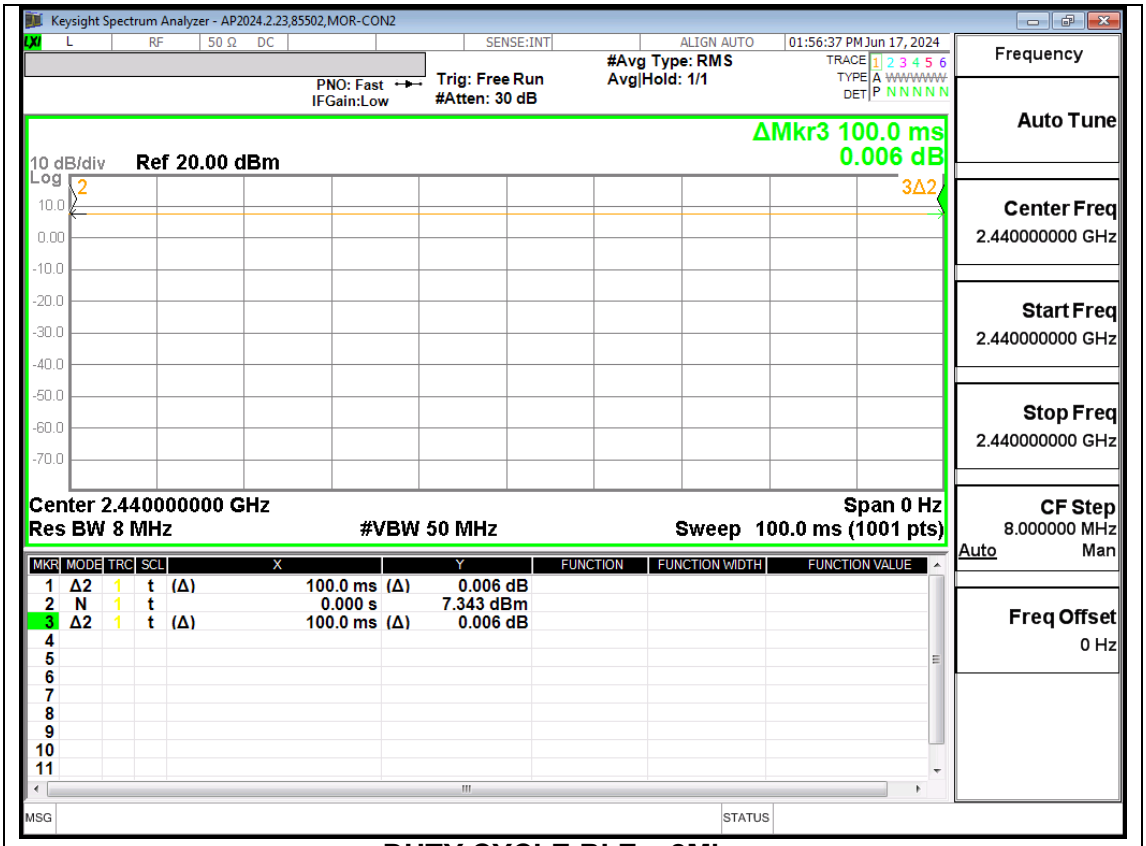
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
BLE - 1Mbps	100.000	100.000	1.000	100.00	0.00	0.010
BLE - 2Mbps	100.000	100.000	1.000	100.00	0.00	0.010

DUTY CYCLE PLOTS



DUTY CYCLE BLE – 1Mbps



DUTY CYCLE BLE – 2Mbps

9.2. 99% BANDWIDTH

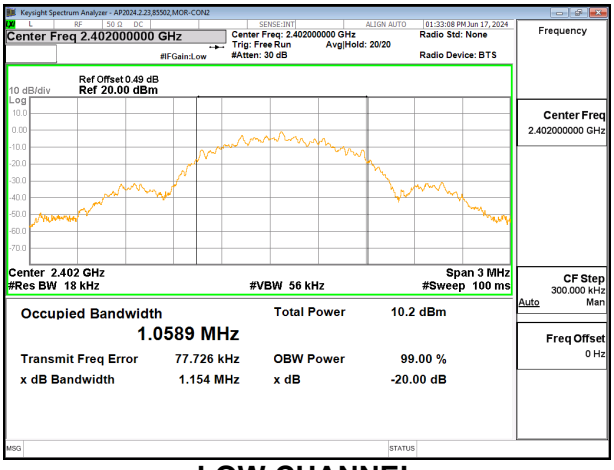
LIMITS

None; for reporting purposes only.

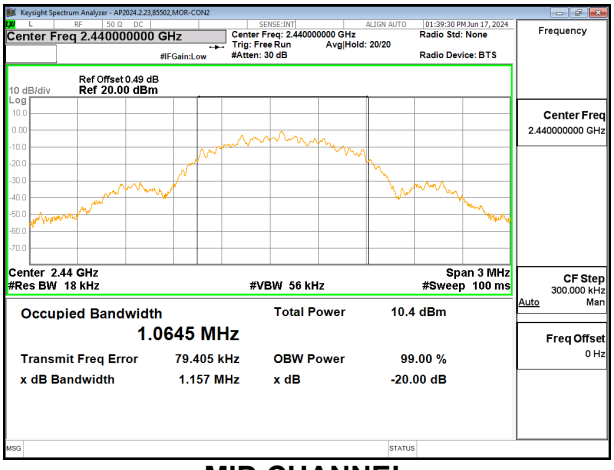
RESULTS

9.2.1. BLE (1Mbps)

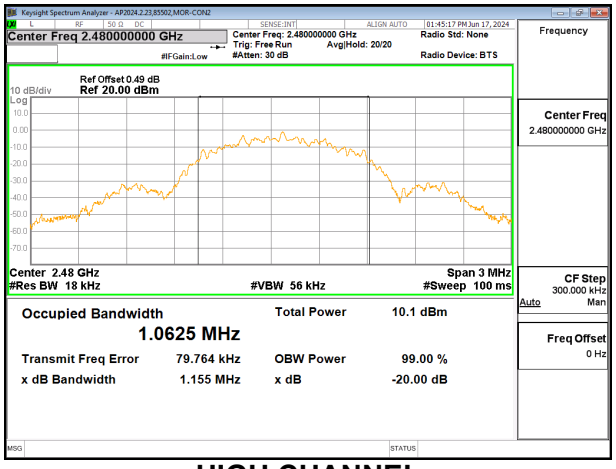
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0590
Middle	2440	1.0650
High	2480	1.0630



LOW CHANNEL



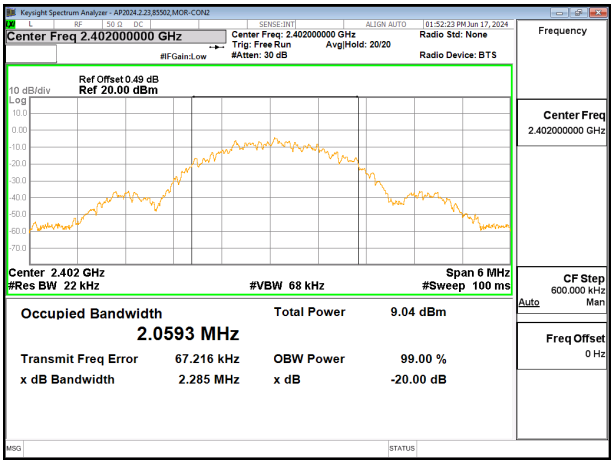
MID CHANNEL



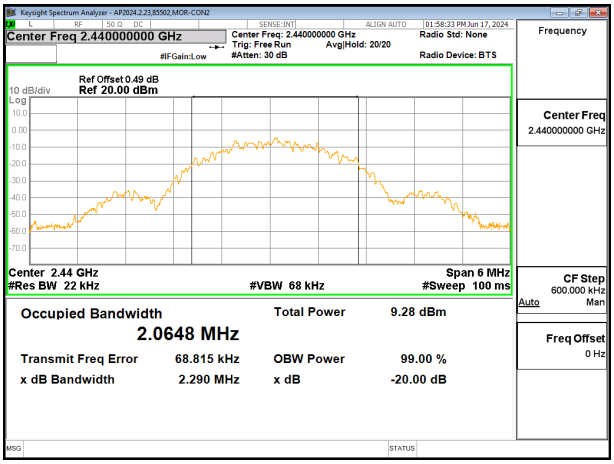
HIGH CHANNEL

9.2.2. BLE (2Mbps)

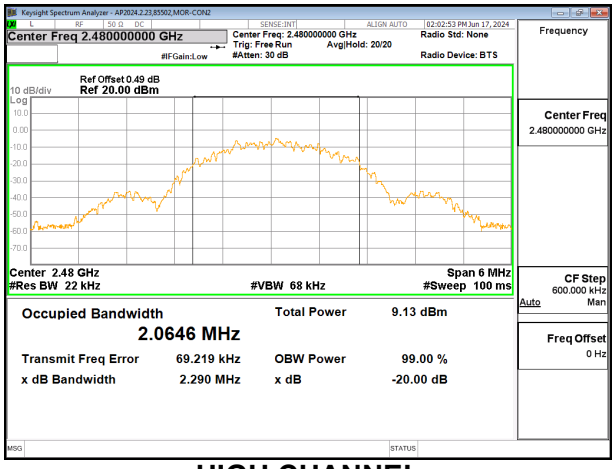
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0590
Middle	2440	2.0650
High	2480	2.0650



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.3. 6 dB BANDWIDTH

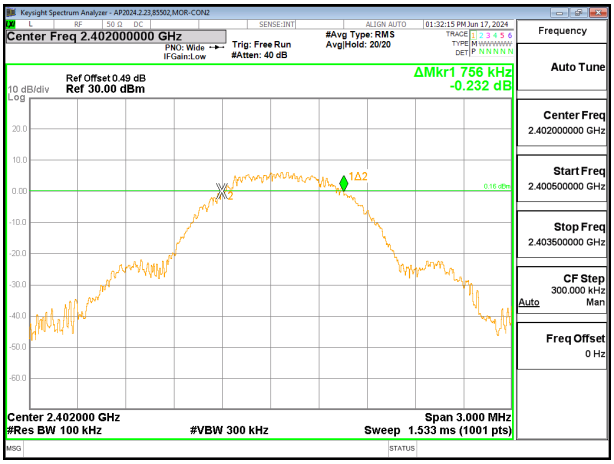
LIMITS

FCC §15.247 (a) (2)
RSS-247 5.2 (a)
The minimum 6 dB bandwidth shall be at least 500 kHz.

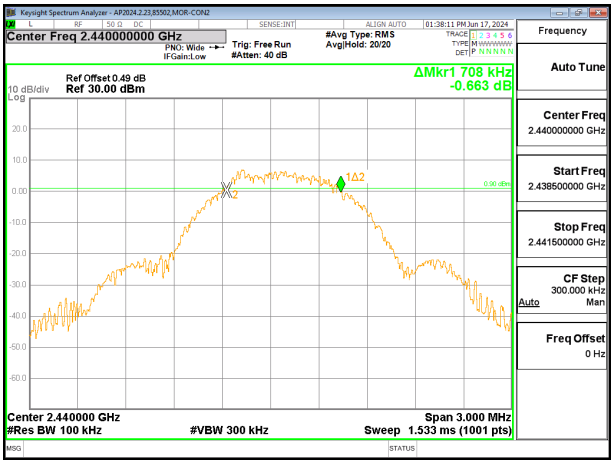
RESULTS

9.3.1. BLE (1Mbps)

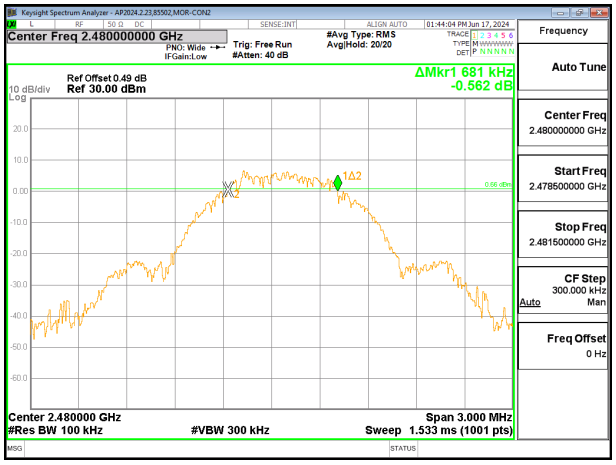
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7560	0.5
Middle	2440	0.7080	0.5
High	2480	0.6810	0.5



LOW CHANNEL



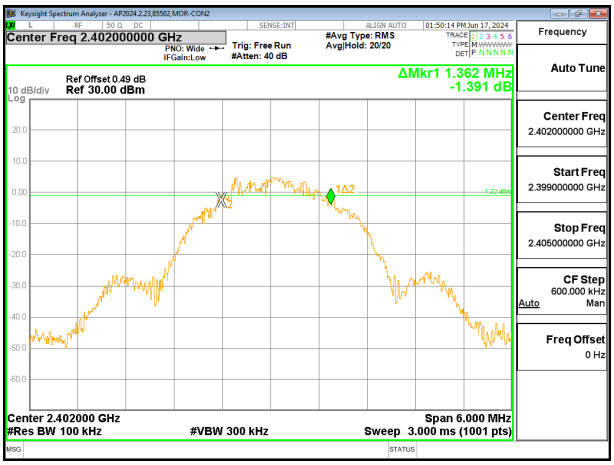
MID CHANNEL



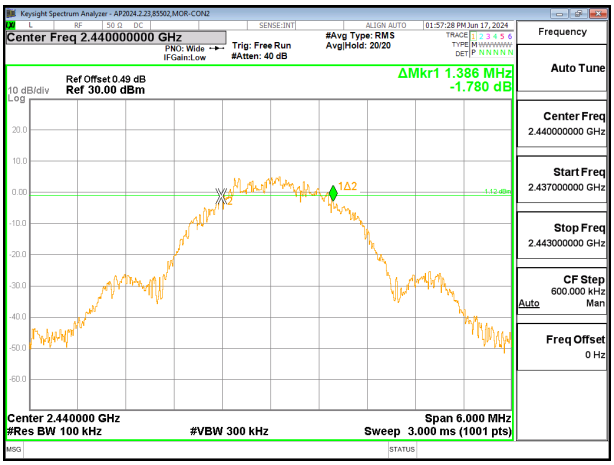
HIGH CHANNEL

9.3.2. BLE (2Mbps)

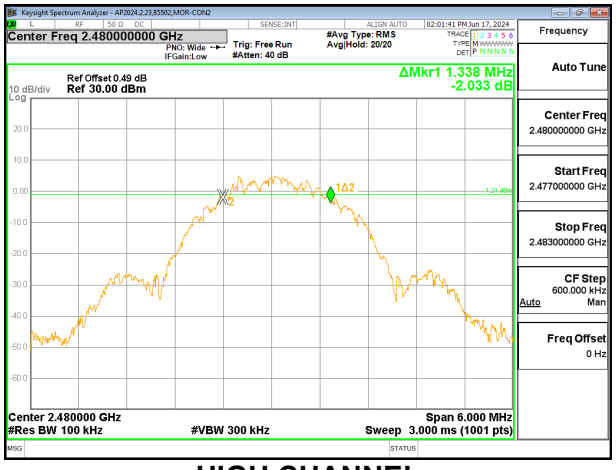
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.3620	0.5
Middle	2440	1.3860	0.5
High	2480	1.3380	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE
The transmitter output is connected to a power meter.

The cable assembly insertion loss of .27 dB (including .27 EUT cable) was entered as an offset in the power meter to allow for a peak reading of power.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband power sensor. Peak output power was read directly from power meter.

RESULTS

9.4.1. BLE (1Mbps)

Tested By:	88502
Date:	2024-06-17

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.040	30	-21.960
Middle	2440	8.040	30	-21.960
High	2480	8.030	30	-21.970

9.4.2. BLE (2Mbps)

Tested By:	88503
Date:	2024-06-17

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.030	30	-21.970
Middle	2440	8.040	30	-21.960
High	2480	7.940	30	-22.060

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of .27 dB (including .27 dB EUT cable) was entered as an offset in the power meter to allow for a peak reading of power.

The power output was measured on the EUT antenna port using SMA cable connected to a power meter via wideband average power sensor. Gated average output power was read directly from power meter.

RESULTS

9.5.1. BLE (1Mbps)

Tested By:	88502
Date:	2024-06-17

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	7.83
Middle	2440	7.83
High	2480	7.75

9.5.2. BLE (2Mbps)

Tested By:	88502
Date:	2024-06-17

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	7.82
Middle	2440	7.82
High	2480	7.74

9.6. POWER SPECTRAL DENSITY

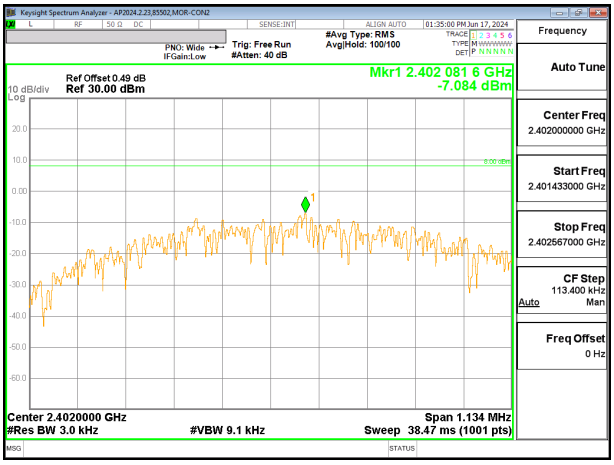
LIMITS

FCC §15.247 (e)
RSS-247 (5.2) (b)
The 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.

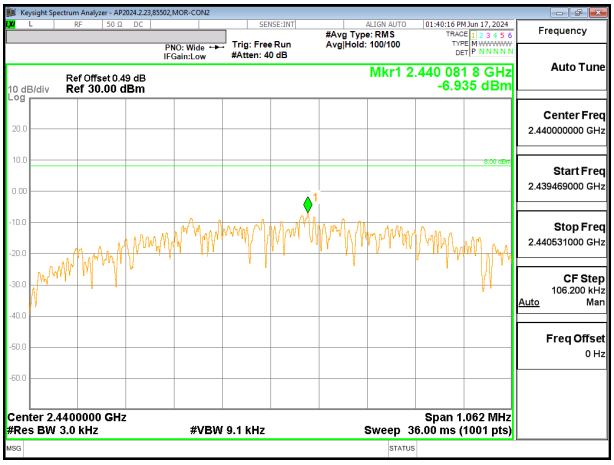
RESULTS

9.6.1. BLE (1Mbps)

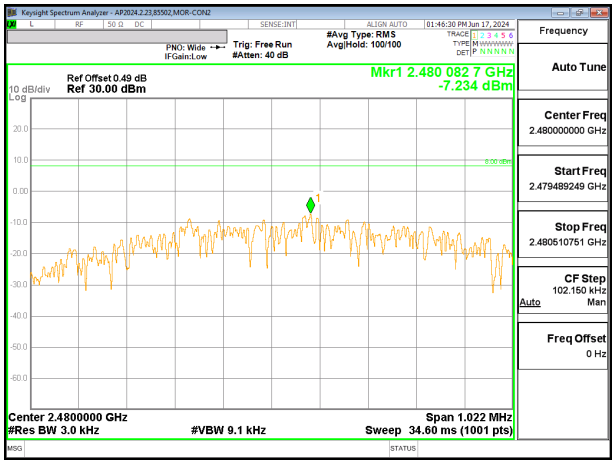
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-7.08	8	-15.08
Middle	2440	-6.94	8	-14.94
High	2480	-7.23	8	-15.23



LOW CHANNEL



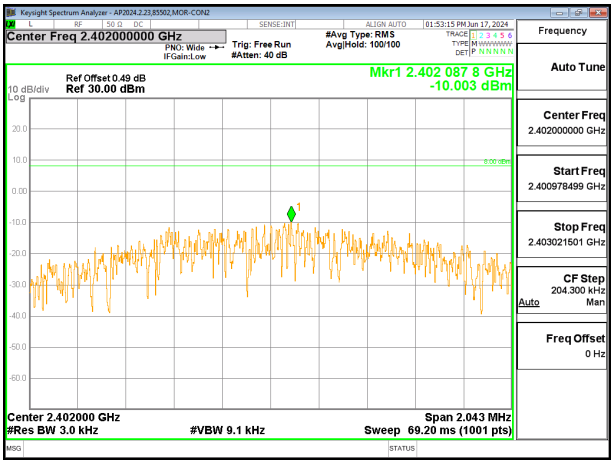
MID CHANNEL



HIGH CHANNEL

9.6.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-10.00	8	-18.00
Middle	2440	-9.79	8	-17.79
High	2480	-9.93	8	-17.93



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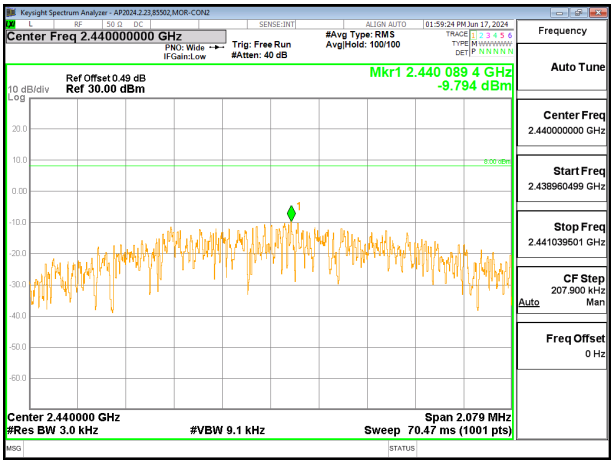

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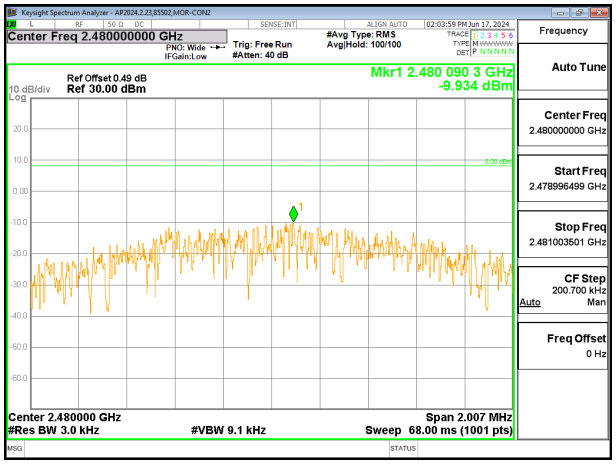


HIGH CHANNEL

9.7. CONDUCTED SPURIOUS EMISSIONS

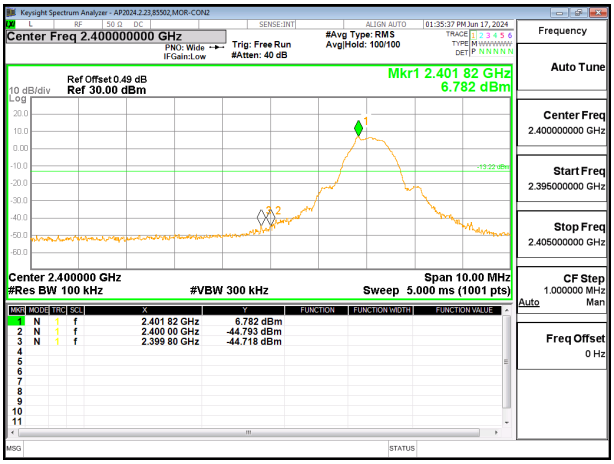
LIMITS

FCC §15.247 (d)
RSS-247 5.5

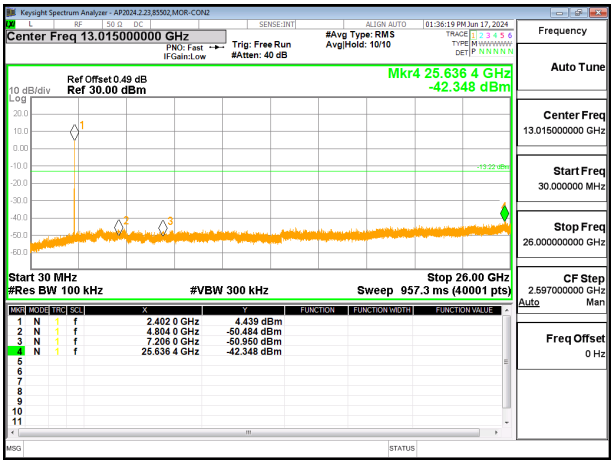
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

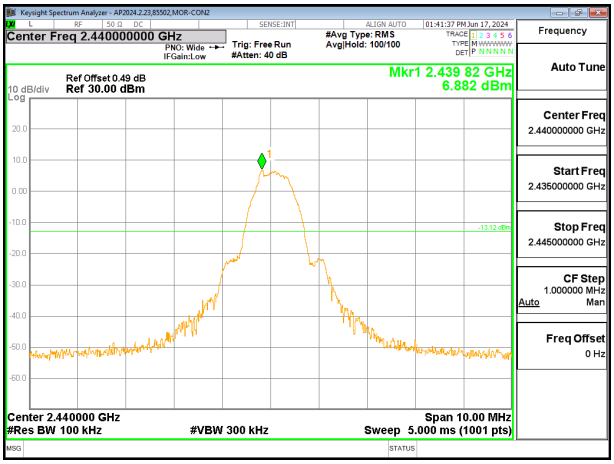
9.7.1. BLE (1Mbps)



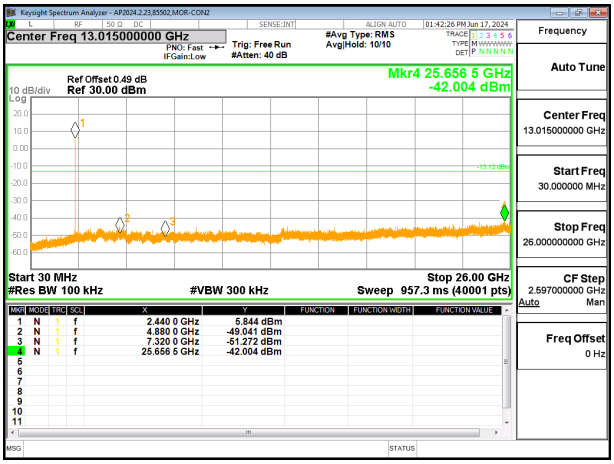
LOW CHANNEL BANDEDGE



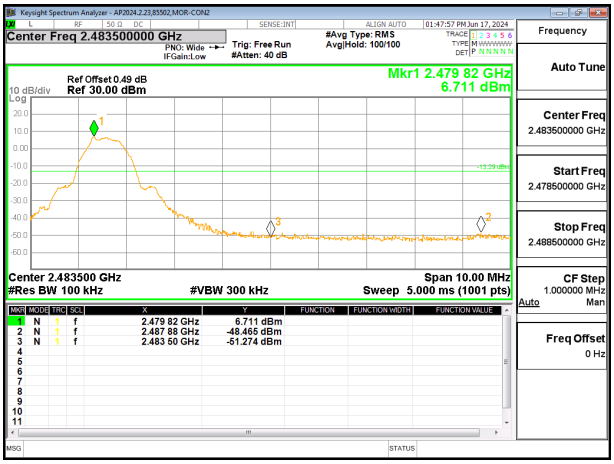
OUT-OF-BAND LOW CHANNEL



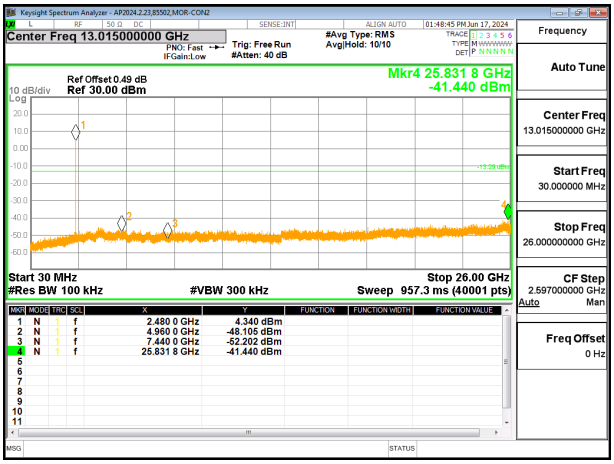
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

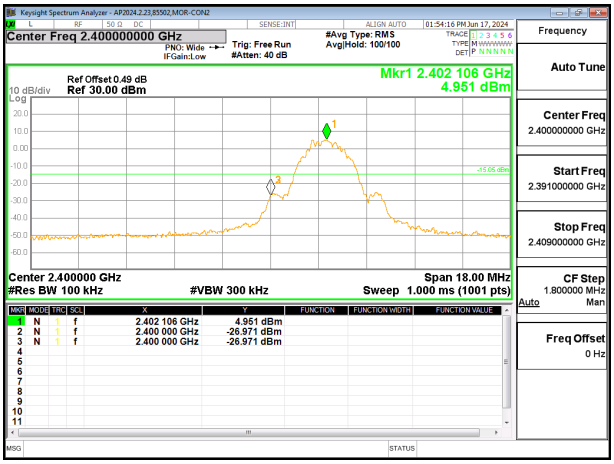


HIGH CHANNEL BANDEDGE

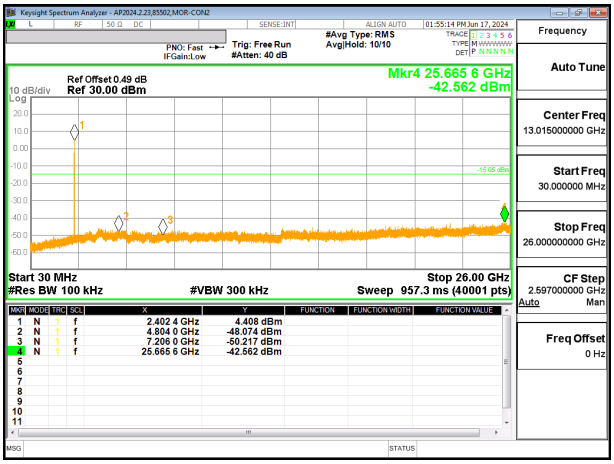


OUT-OF-BAND HIGH CHANNEL

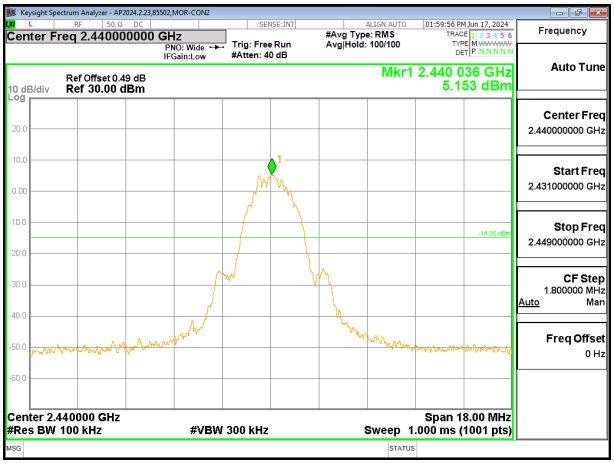
9.7.2. BLE (2Mbps)



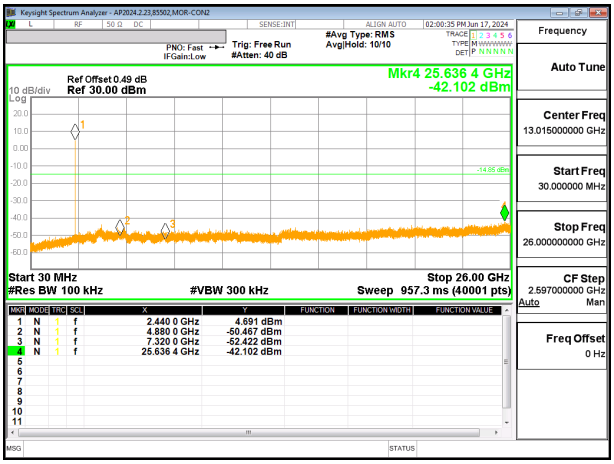
LOW CHANNEL BANDEDGE



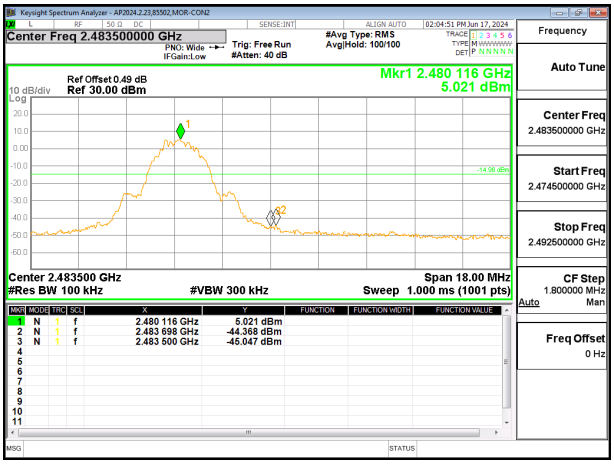
OUT-OF-BAND LOW CHANNEL



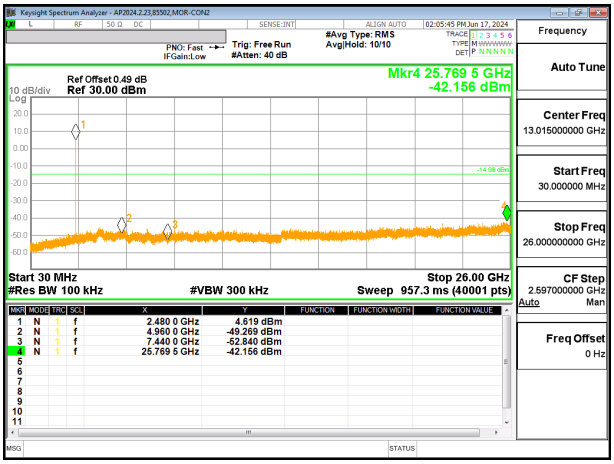
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uA/m) at 3 m	Field Strength Limit (dBuA/m) at 3 m
0.009-0.490	6.37/F(kHz) @ 300 m	-
0.490-1.705	63.7/F(kHz) @ 30 m	-
1.705 - 30	0.08 @ 30m	-
Frequency Range (MHz)	**Field Strength Limit (uV/m) at 3 m**	**Field Strength Limit (dBuV/m) at 3 m**
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements. Linear Voltage Averaging was used.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest power spectral density was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

3D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

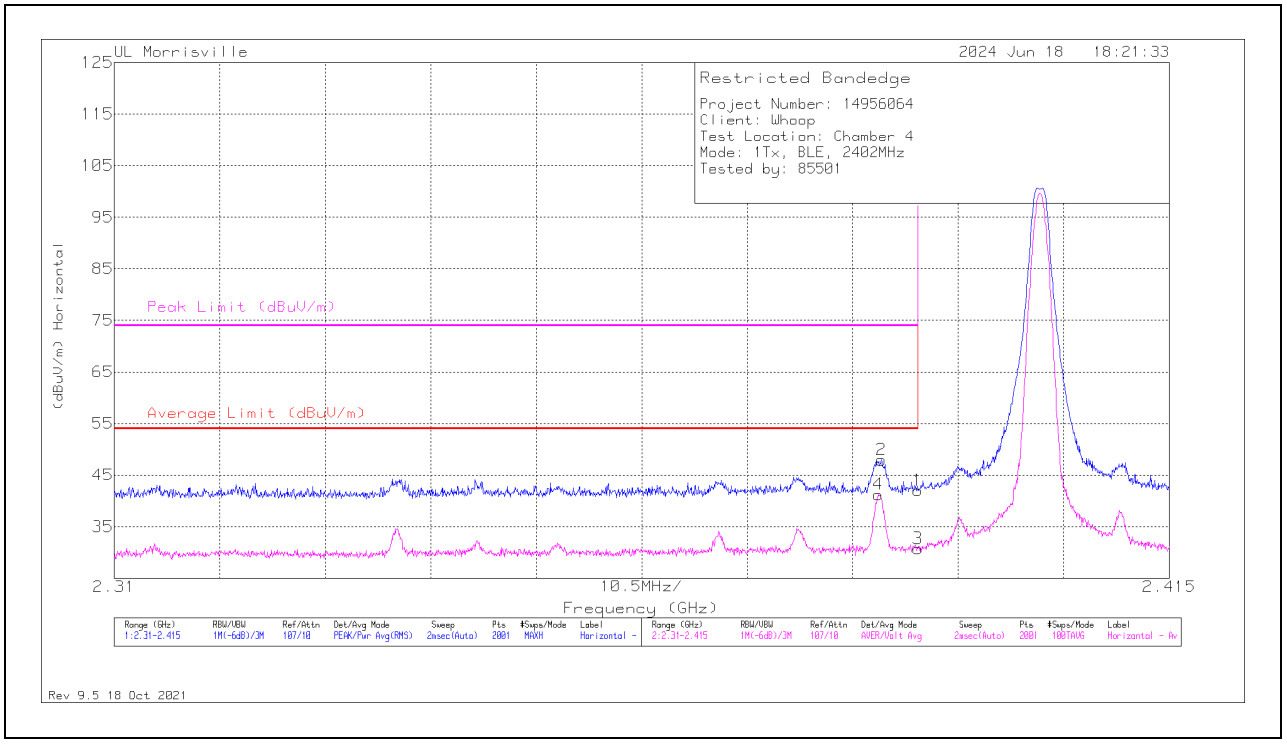
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

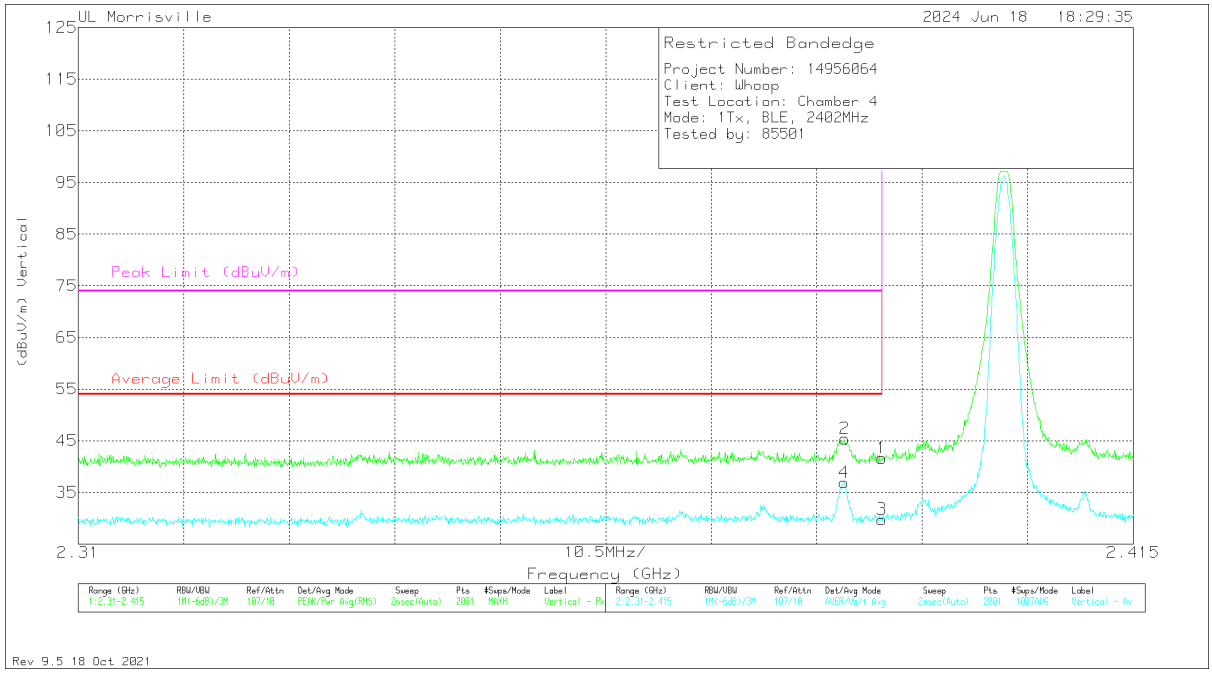
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.38996	33.21	Pk	32	-23.2	42.01	-	-	74	-31.99	24	153	H
2	* ** 2.38634	39.27	Pk	32	-23.3	47.97	-	-	74	-26.03	24	153	H
3	* ** 2.38996	21.93	ADV	32	-23.2	30.73	54	-23.27	-	-	24	153	H
4	* ** 2.38602	32.44	ADV	32	-23.2	41.24	54	-12.76	-	-	24	153	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

VERTICAL RESULT

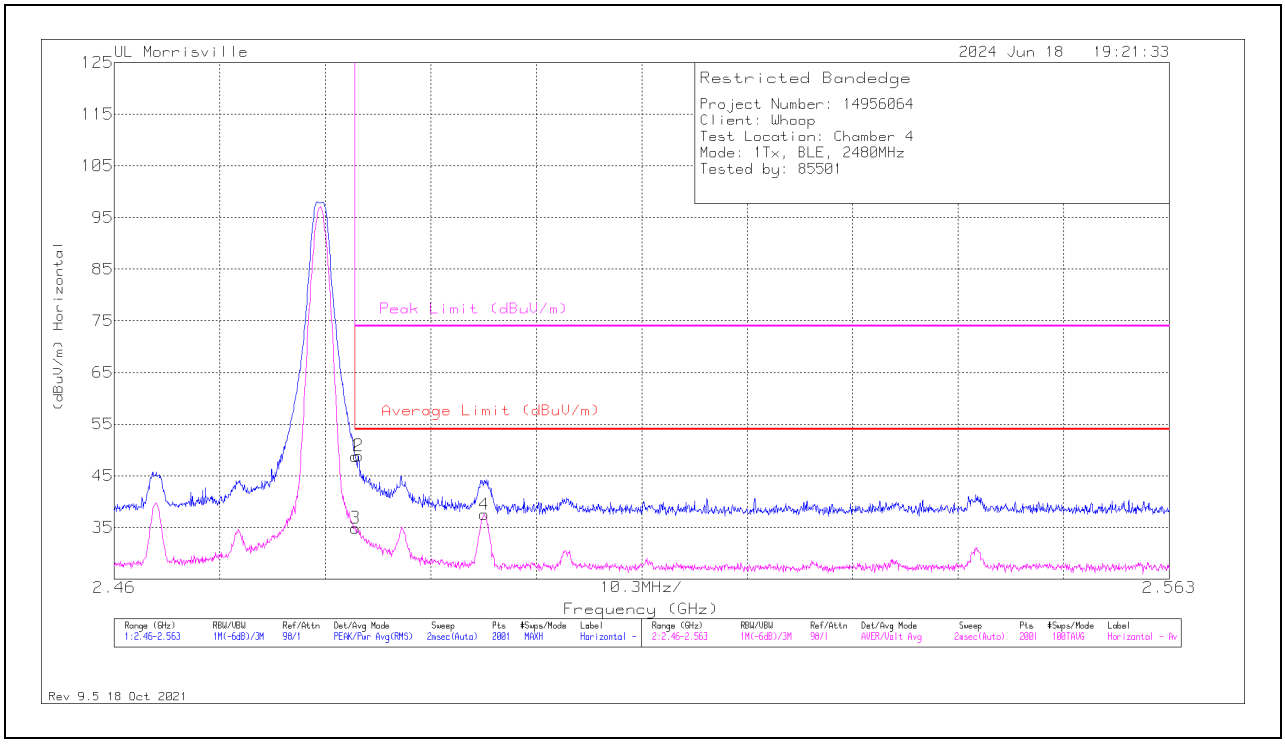


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.38996	32.83	Pk	32	-23.2	41.63	-	-	74	-32.37	341	116	V
2	* ** 2.38628	36.69	Pk	32	-23.3	45.39	-	-	74	-28.61	341	116	V
3	* ** 2.38996	20.97	ADV	32	-23.2	29.77	54	-24.23	-	-	341	116	V
4	* ** 2.38623	28.19	ADV	32	-23.3	36.89	54	-17.11	-	-	341	116	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

BANDEDGE (HIGH CHANNEL)

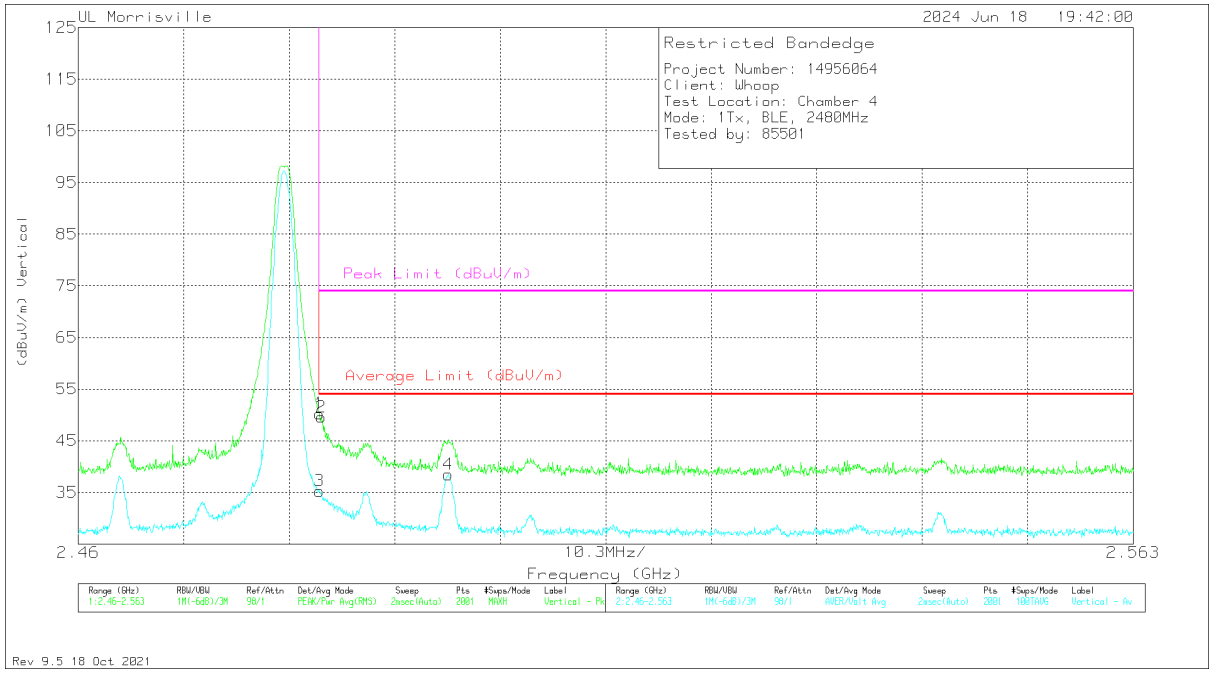
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	39.26	Pk	32.3	-22.8	48.76	-	-	74	-25.24	169	187	H
2	* ** 2.48384	39.37	Pk	32.3	-22.8	48.87	-	-	74	-25.13	169	187	H
3	* ** 2.48354	25.37	ADV	32.3	-22.8	34.87	54	-19.13	-	-	169	187	H
4	* ** 2.4961	28.02	ADV	32.3	-22.8	37.52	54	-16.48	-	-	169	187	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

VERTICAL RESULT

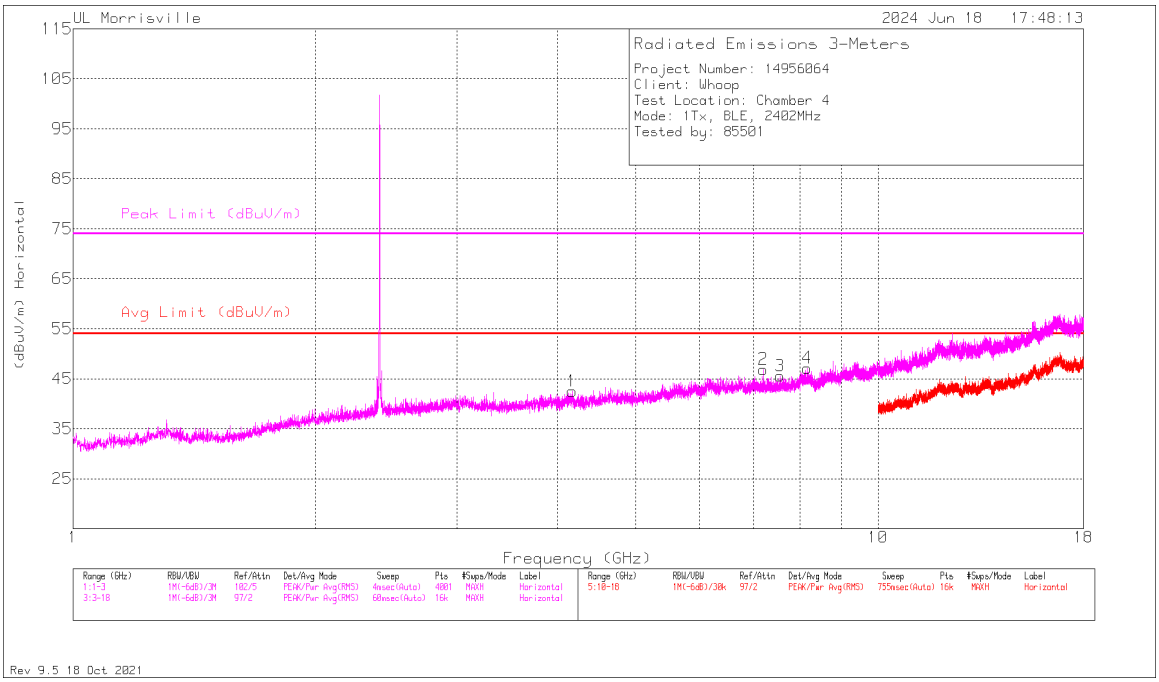


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	40.73	Pk	32.3	-22.8	50.23	-	-	74	-23.77	165	361	V
2	* ** 2.48374	40.08	Pk	32.3	-22.8	49.58	-	-	74	-24.42	165	361	V
3	* ** 2.48354	25.78	ADV	32.3	-22.8	35.28	54	-18.72	-	-	165	361	V
4	* ** 2.4961	28.97	ADV	32.3	-22.8	38.47	54	-15.53	-	-	165	361	V

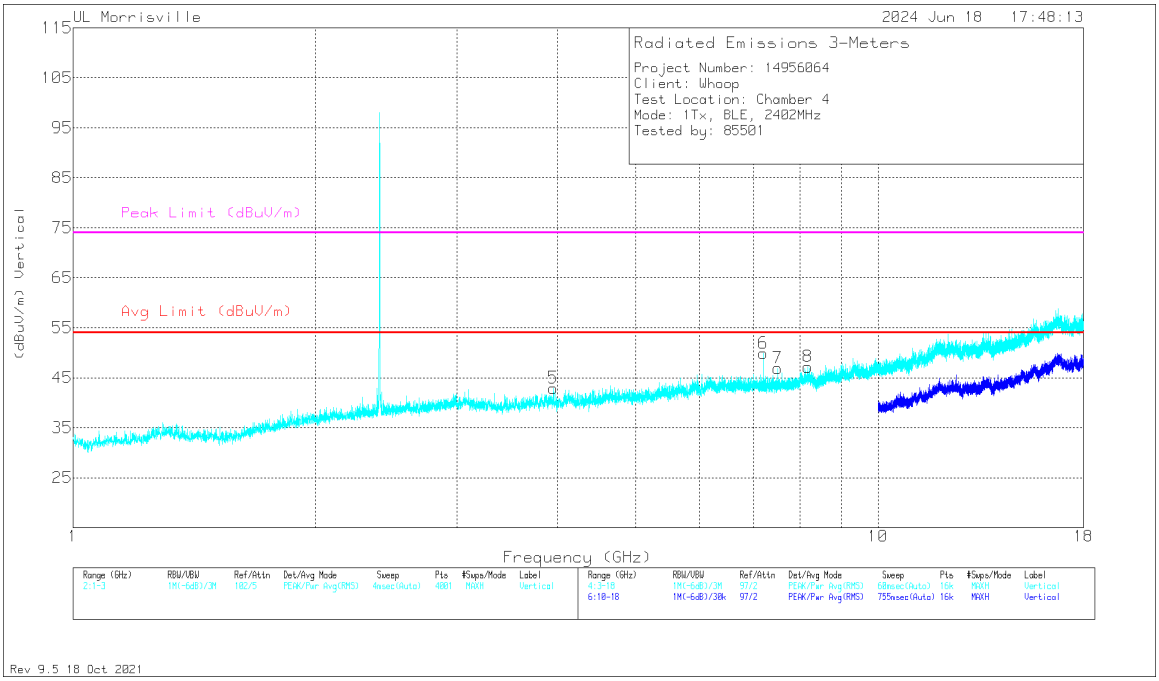
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



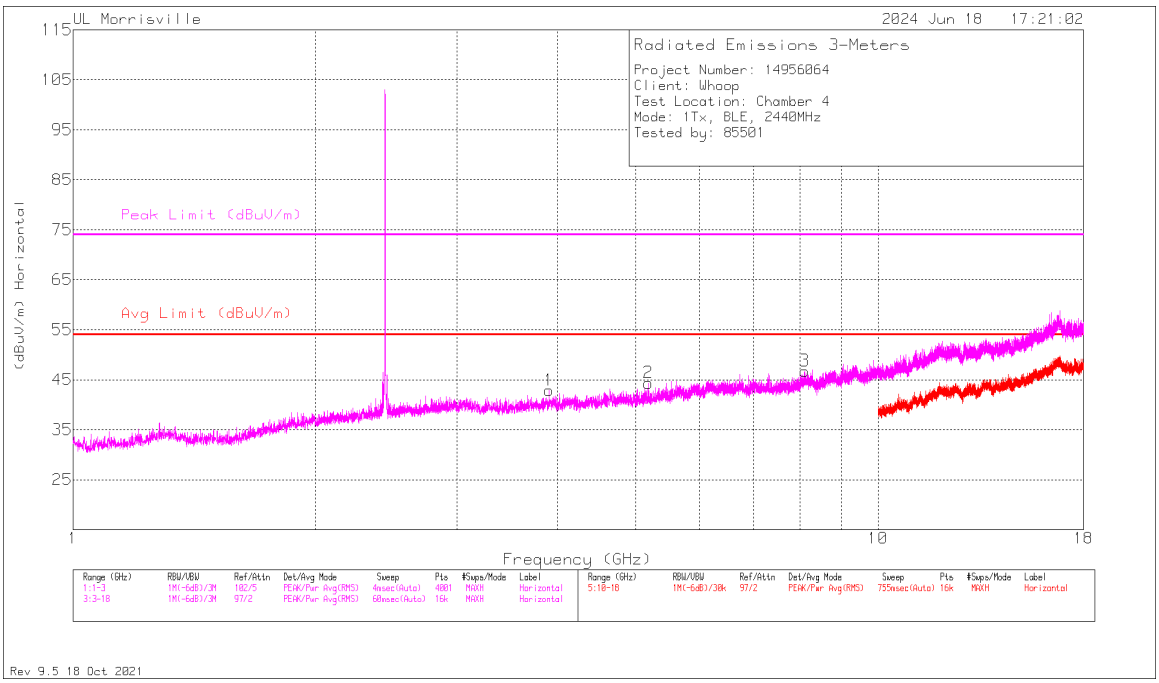
VERTICAL

RADIATED EMISSIONS

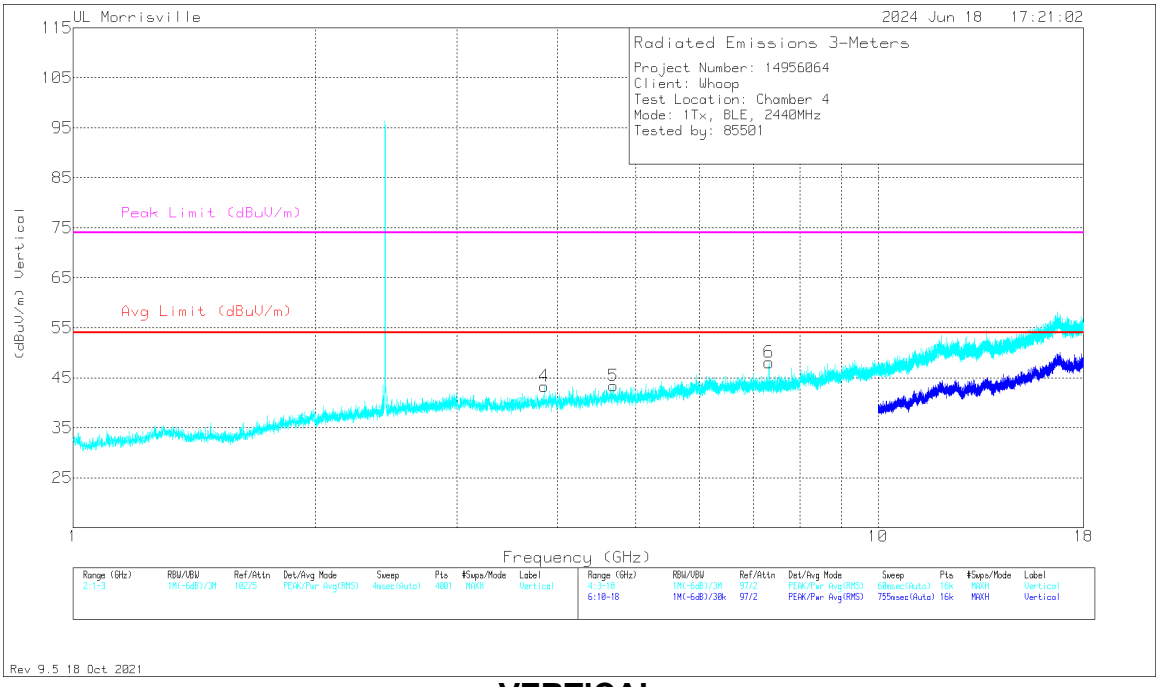
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 4.16906	40.19	Pk	33.5	-31.2	42.49	54	-11.51	74	-31.51	0-360	100	H
3	* ** 7.55531	37.44	Pk	35.7	-27.6	45.54	54	-8.46	74	-28.46	0-360	100	H
4	* ** 8.16188	37.91	Pk	35.8	-26.6	47.11	54	-6.89	74	-26.89	0-360	100	H
5	* ** 3.94781	41.03	Pk	33.4	-31.5	42.93	54	-11.07	74	-31.07	0-360	200	V
7	* ** 7.50469	38.91	Pk	35.6	-27.6	46.91	54	-7.09	74	-27.09	0-360	200	V
8	* ** 8.17594	37.77	Pk	35.8	-26.4	47.17	54	-6.83	74	-26.83	0-360	200	V
2	7.20563	38.95	Pk	35.6	-27.7	46.85	-	-	74	-	0-360	100	H
6	7.20563	41.99	Pk	35.6	-27.7	49.89	-	-	74	-	0-360	200	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

MID CHANNEL RESULTS



HORIZONTAL



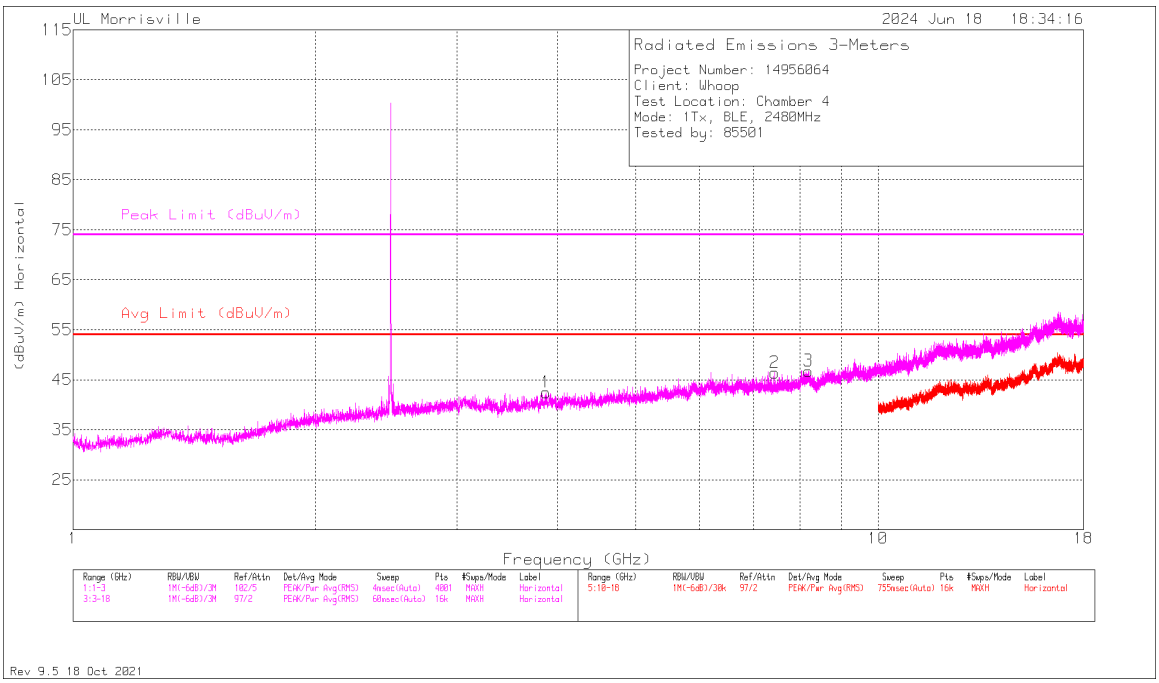
VERTICAL

RADIATED EMISSIONS

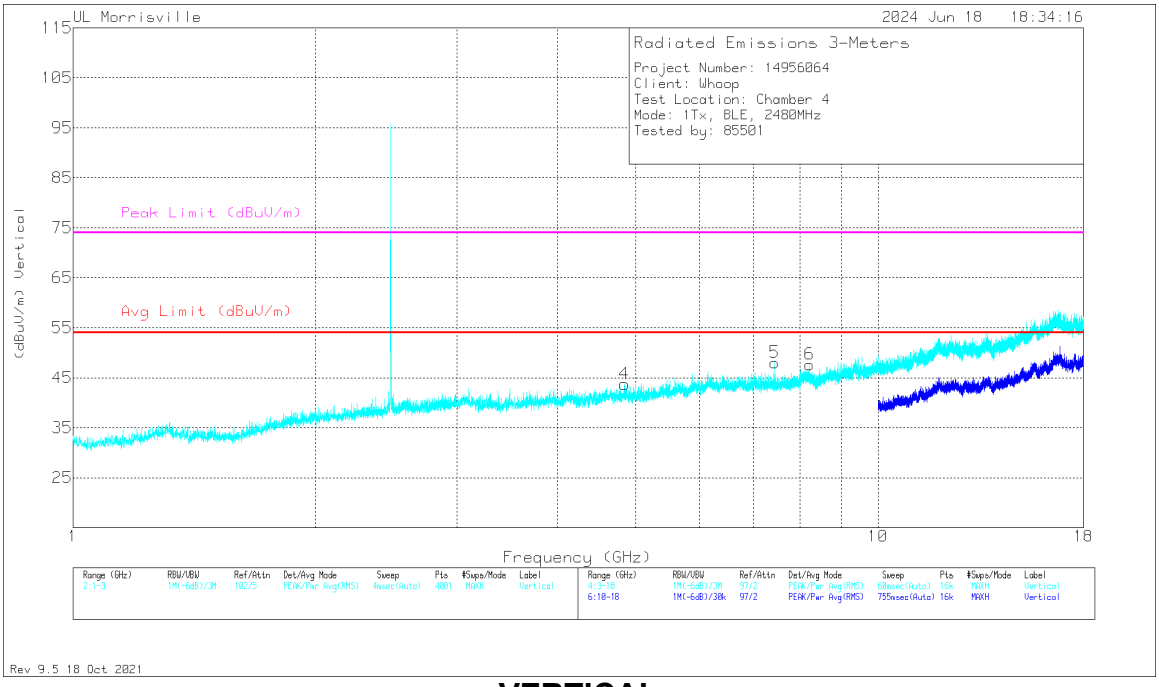
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 3.90094	41.89	Pk	33.3	-32.3	42.89	54	-11.11	74	-31.11	0-360	100	H
2	** 5.18344	40.66	Pk	34.2	-30.5	44.36	54	-9.64	74	-29.64	0-360	100	H
3	* ** 8.11125	37.85	Pk	35.8	-26.9	46.75	54	-7.25	74	-27.25	0-360	100	H
4	* ** 3.84609	42.88	Pk	33.4	-33	43.28	54	-10.72	74	-30.72	0-360	200	V
5	* ** 4.69031	40.2	Pk	34.1	-30.9	43.4	54	-10.6	74	-30.6	0-360	200	V
6	* ** 7.31954	43.21	PK2	35.6	-27.7	51.11	-	-	74	-22.89	133	238	V
	* ** 7.32088	34.69	ADV	35.6	-27.7	42.59	54	-11.41	-	-	133	238	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 3.86625	41.55	Pk	33.4	-32.5	42.45	54	-11.55	74	-31.55	0-360	100	H
2	* ** 7.44094	38.61	Pk	35.7	-27.9	46.41	54	-7.59	74	-27.59	0-360	100	H
3	* ** 8.19281	37.16	Pk	35.8	-26.2	46.76	54	-7.24	74	-27.24	0-360	100	H
4	* ** 4.84219	40.83	Pk	34.1	-31.2	43.73	54	-10.27	74	-30.27	0-360	200	V
5	* ** 7.43965	43.62	PK2	35.7	-27.9	51.42	-	-	74	-22.58	137	220	V
	* ** 7.44085	34.78	ADV	35.7	-27.9	42.58	54	-11.42	-	-	137	220	V
6	* ** 8.22469	38.17	Pk	35.8	-26.3	47.67	54	-6.33	74	-26.33	0-360	200	V

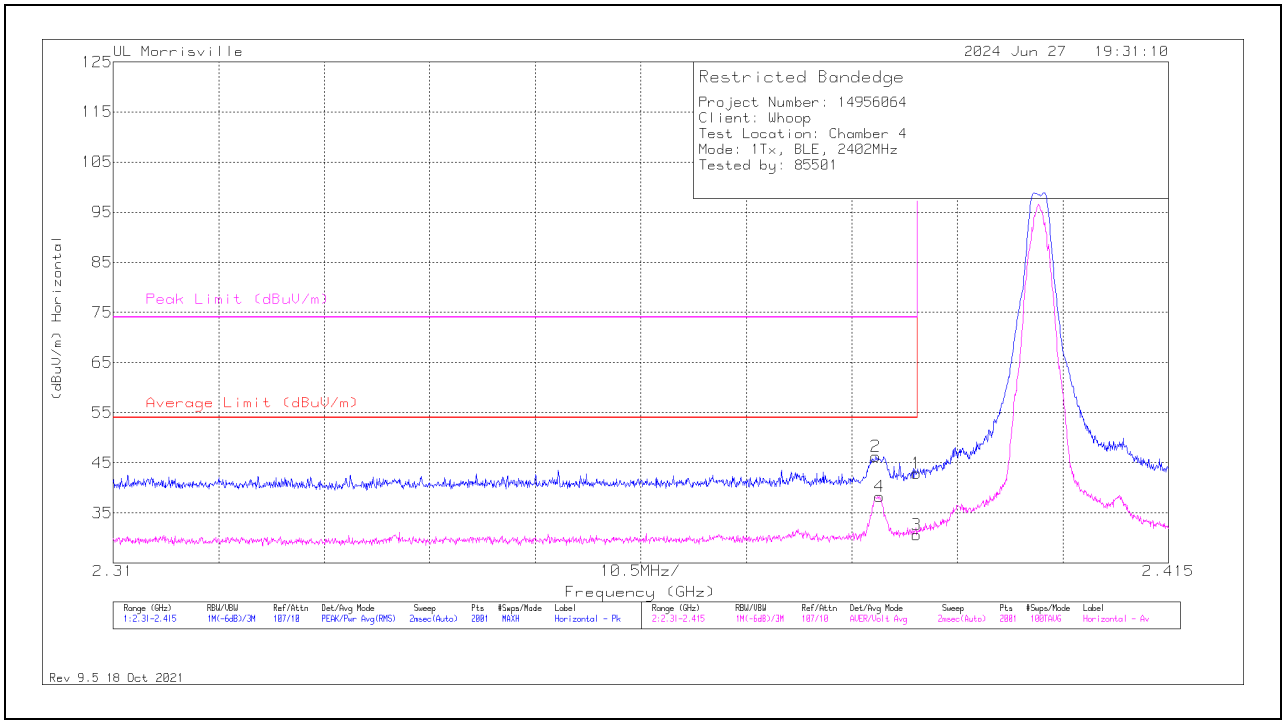
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
ADV - Linear Voltage Average

10.2.2. BLE (2Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

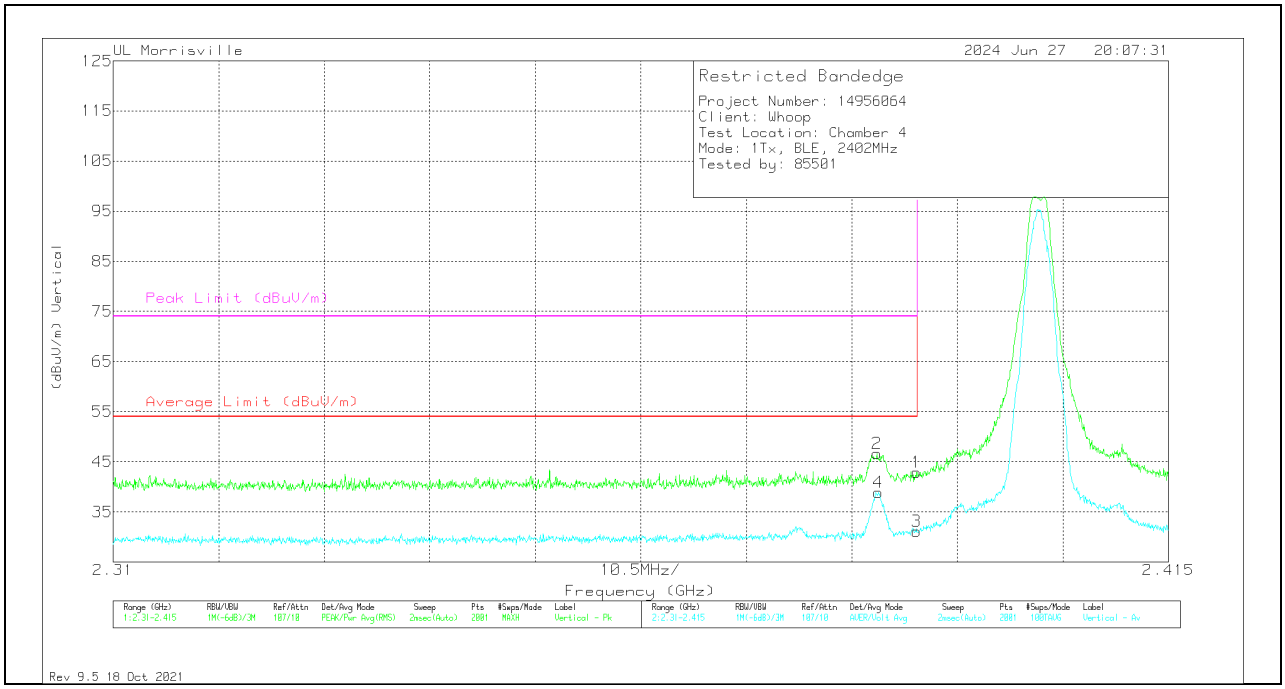
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.38996	34.06	Pk	32	-23.2	42.86	-	-	74	-31.14	236	336	H
2	* ** 2.38586	37.51	Pk	32	-23.2	46.31	-	-	74	-27.69	236	336	H
3	* ** 2.38996	21.84	ADV	32	-23.2	30.64	54	-23.36	-	-	236	336	H
4	* ** 2.38623	29.59	ADV	32	-23.3	38.29	54	-15.71	-	-	236	336	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

VERTICAL RESULT

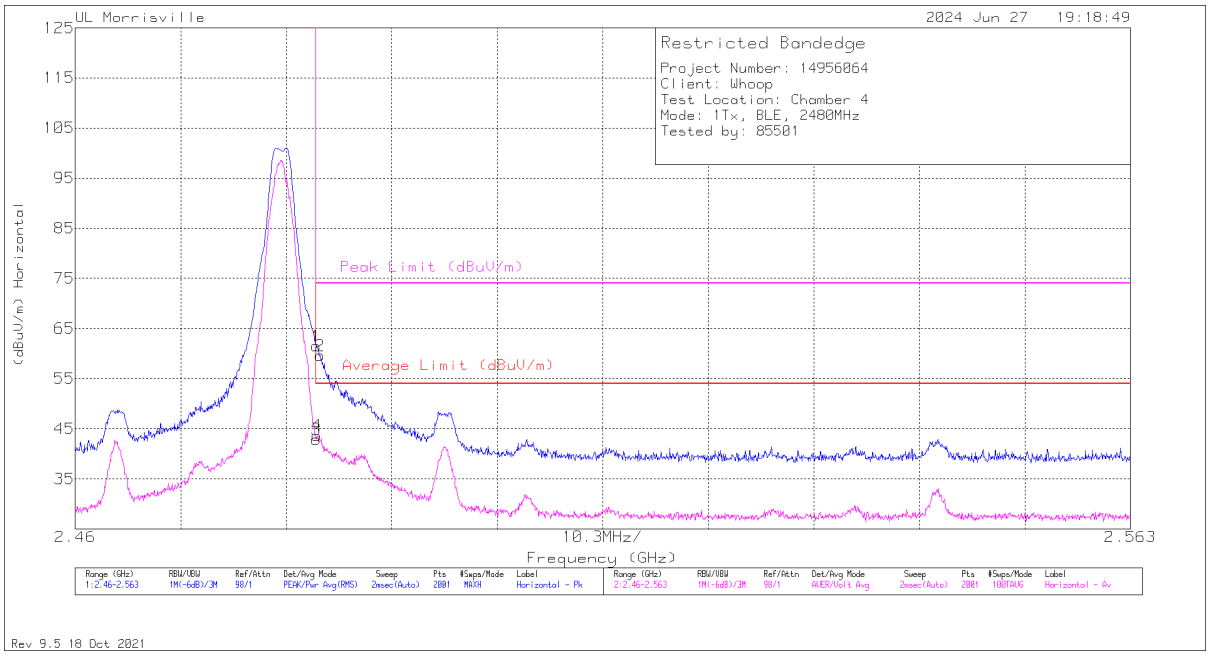


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.38996	34.11	Pk	32	-23.2	42.91	-	-	74	-31.09	292	384	V
2	* ** 2.38602	37.87	Pk	32	-23.2	46.67	-	-	74	-27.33	292	384	V
3	* ** 2.38996	22.31	ADV	32	-23.2	31.11	54	-22.89	-	-	292	384	V
4	* ** 2.38613	30.15	ADV	32	-23.3	38.85	54	-15.15	-	-	292	384	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

BANDEDGE (HIGH CHANNEL)

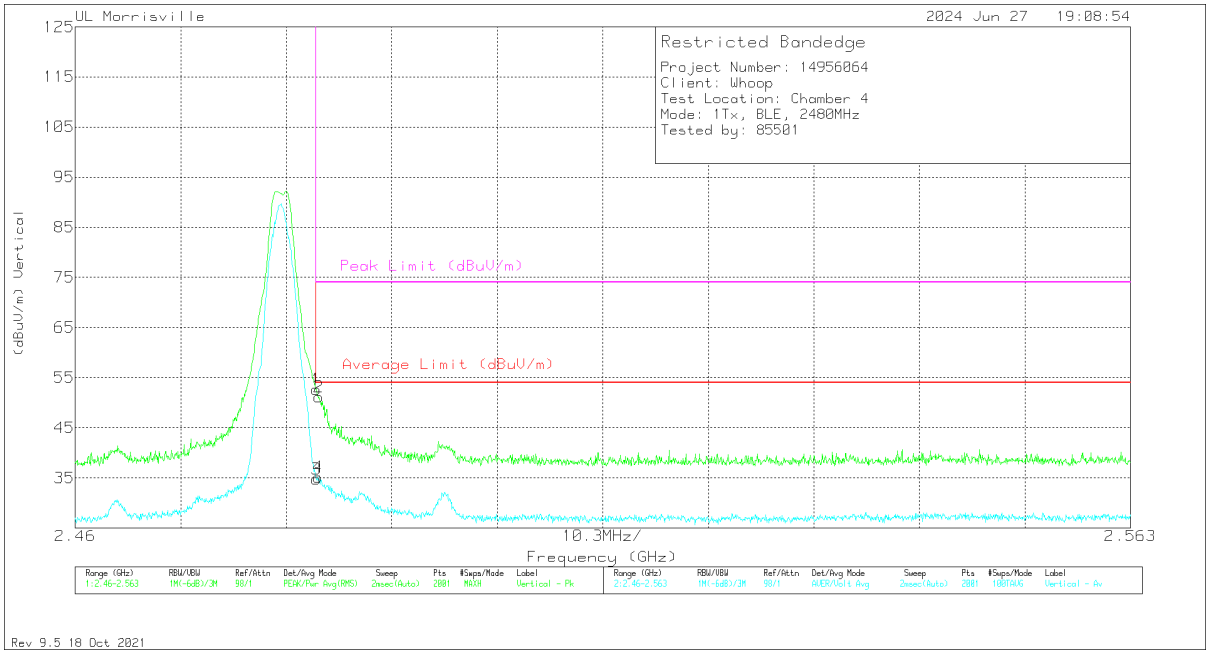
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	51.99	Pk	32.3	-22.8	61.49	-	-	74	-12.51	170	224	H
2	* ** 2.4839	50.1	Pk	32.3	-22.8	59.6	-	-	74	-14.4	170	224	H
3	* ** 2.48354	33.44	ADV	32.3	-22.8	42.94	54	-11.06	-	-	170	224	H
4	* ** 2.48359	34.16	ADV	32.3	-22.8	43.66	54	-10.34	-	-	170	224	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

VERTICAL RESULT

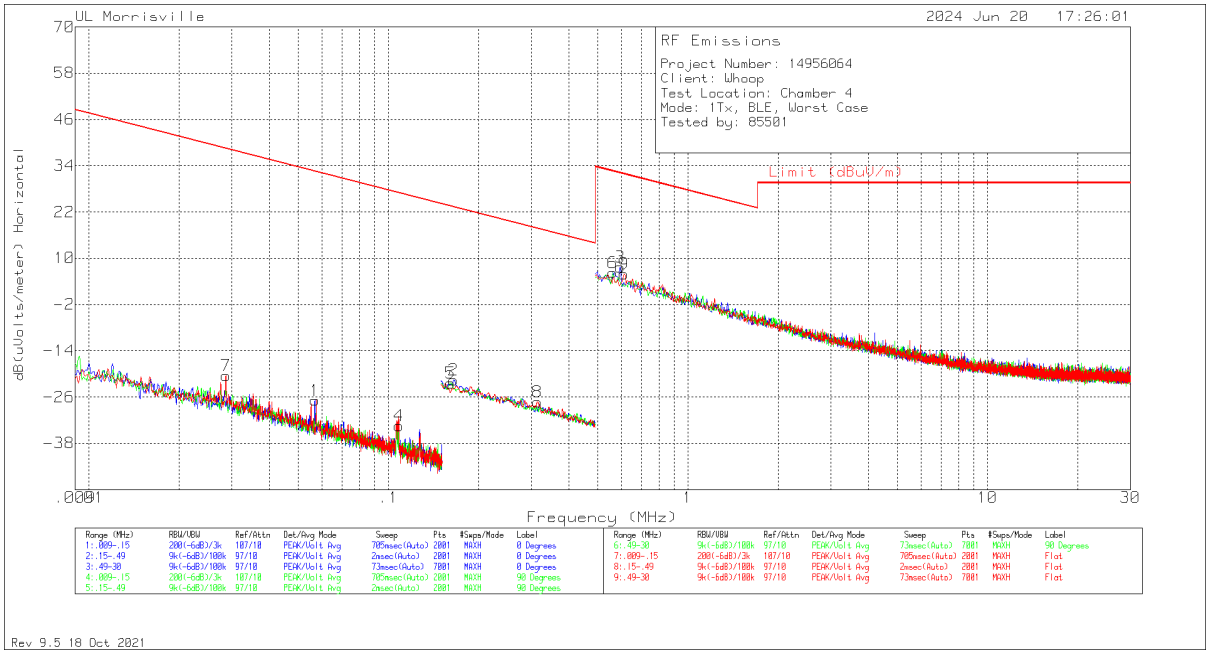


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	43.17	Pk	32.3	-22.8	52.67	-	-	74	-21.33	202	358	V
2	* ** 2.48379	41.63	Pk	32.3	-22.8	51.13	-	-	74	-22.87	202	358	V
3	* ** 2.48354	25.29	ADV	32.3	-22.8	34.79	54	-19.21	-	-	202	358	V
4	* ** 2.48369	25.61	ADV	32.3	-22.8	35.11	54	-18.89	-	-	202	358	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
ADV - Linear Voltage Average

10.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

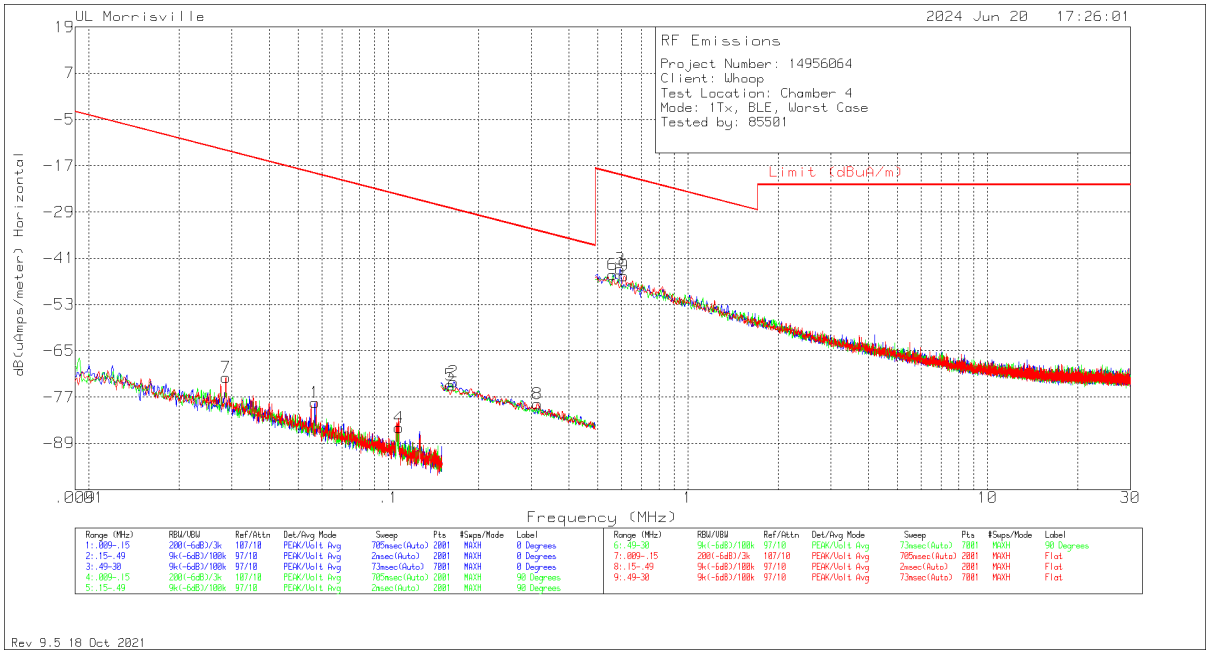


ANTENNA - THREE ORIENTATIONS – E FIELD

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dBuV/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
7	.02867	45.89	Pk	13.6	.1	-80	-20.41	38.46	-58.87	0-360	400	Flat
1	.05678	41.43	Pk	11.6	.1	-80	-26.87	32.52	-59.39	0-360	400	0 degs
4	.10833	35.31	Pk	11.1	.1	-80	-33.49	26.91	-60.4	0-360	400	90 degs
5	.16139	46.47	Pk	11.1	.1	-80	-22.33	23.45	-45.78	0-360	400	90 degs
2	.1653	47.25	Pk	11.1	.1	-80	-21.55	23.24	-44.79	0-360	400	0 degs
8	.3149	41.67	Pk	11	.1	-80	-27.23	17.64	-44.87	0-360	400	Flat
6	.56167	35.11	Pk	11.1	.1	-40	6.31	32.61	-26.3	0-360	400	90 degs
3	.5954	36.36	Pk	11.2	.1	-40	7.66	32.11	-24.45	0-360	400	0 degs
9	.61226	34.64	Pk	11.2	.1	-40	5.94	31.87	-25.93	0-360	400	Flat

Pk - Peak detector



ANTENNA- THREE ORIENTATIONS – H FIELD

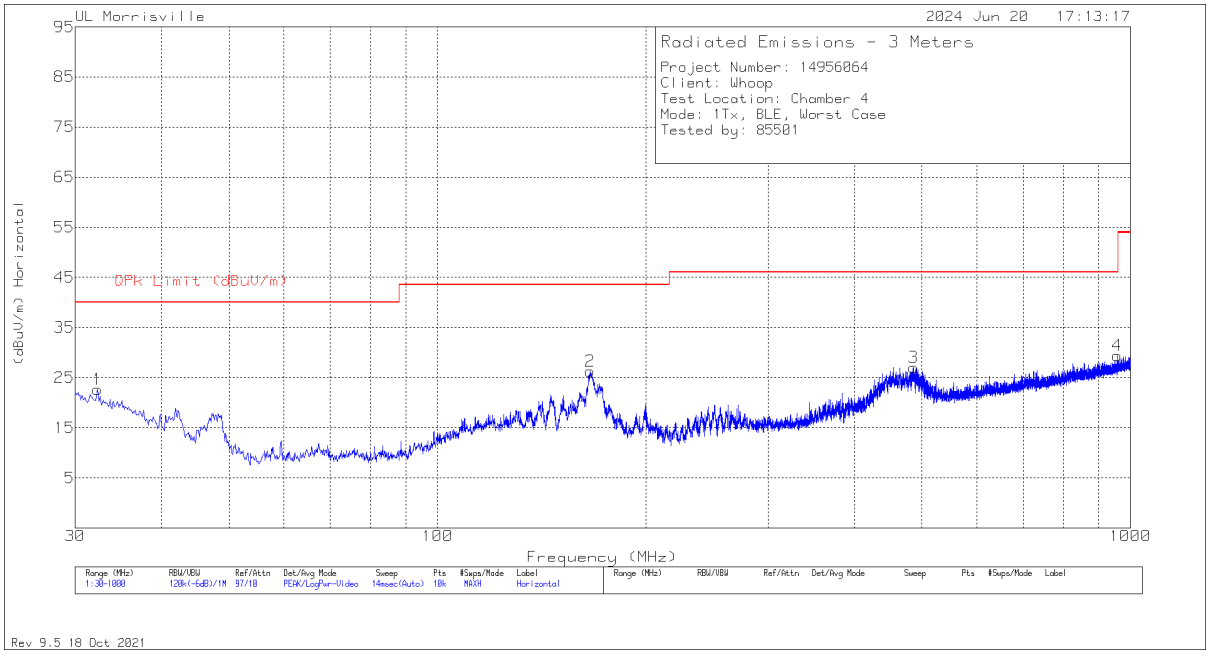
Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dBuV/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	Limit (dBuA/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
7	.02867	45.89	Pk	-37.9	.1	-80	-71.91	-13.04	-58.87	0-360	400	Flat
1	.05678	41.43	Pk	-39.9	.1	-80	-78.37	-18.98	-59.39	0-360	400	0 degs
4	.10833	35.31	Pk	-40.4	.1	-80	-84.99	-24.59	-60.4	0-360	400	90 degs
5	.16139	46.47	Pk	-40.4	.1	-80	-73.83	-28.05	-45.78	0-360	400	90 degs
2	.1653	47.25	Pk	-40.4	.1	-80	-73.05	-28.26	-44.79	0-360	400	0 degs
8	.3149	41.67	Pk	-40.5	.1	-80	-78.73	-33.86	-44.87	0-360	400	Flat
6	.56167	35.11	Pk	-40.4	.1	-40	-45.19	-18.89	-26.3	0-360	400	90 degs
3	.5954	36.36	Pk	-40.3	.1	-40	-43.84	-19.39	-24.45	0-360	400	0 degs
9	.61226	34.64	Pk	-40.3	.1	-40	-45.56	-19.63	-25.93	0-360	400	Flat

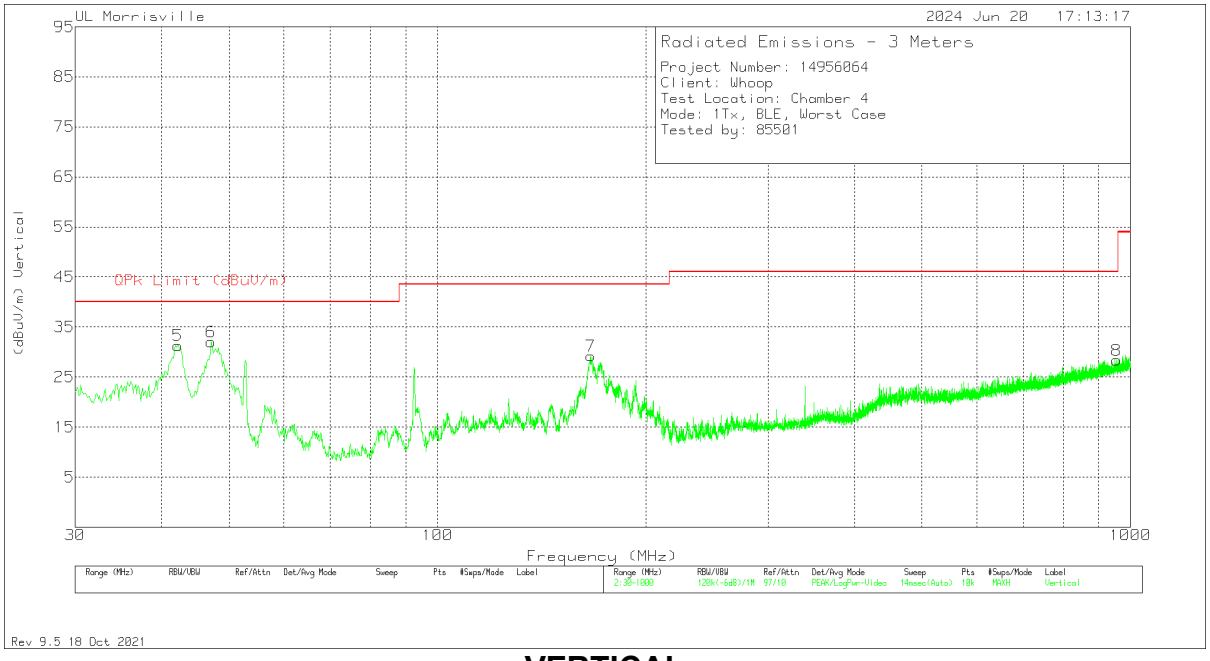
Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

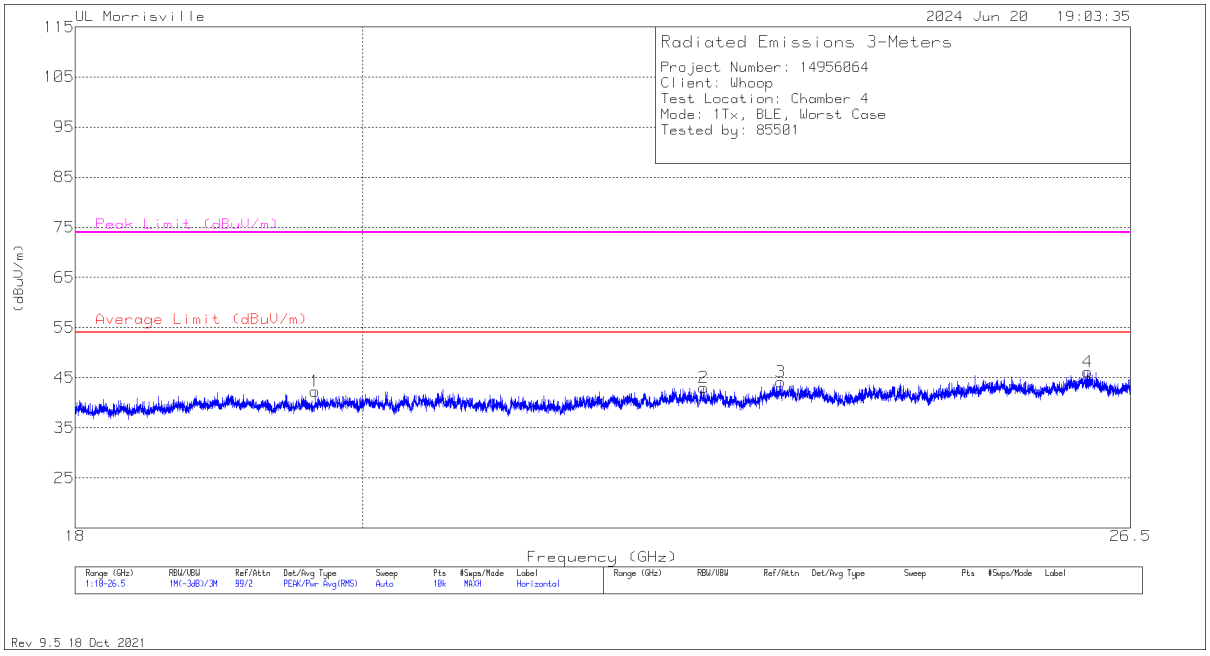
Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90628 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	32.328	29.47	Pk	25.3	-32.1	22.67	40	-17.33	0-360	100	H
5	42.222	44.81	Pk	18.4	-31.9	31.31	40	-8.69	0-360	100	V
6	47.072	48.59	Pk	15.3	-31.9	31.99	40	-8.01	0-360	100	V
2	166.091	38.97	Pk	18.3	-31	26.27	43.52	-17.25	0-360	100	H
7	166.382	41.92	Pk	18.3	-31	29.22	43.52	-14.3	0-360	100	V
3	485.997	32.81	Pk	23.8	-29.6	27.01	46.02	-19.01	0-360	100	H
8	955.574	26.15	Pk	28.8	-26.6	28.35	46.02	-17.67	0-360	200	V
4	956.544	27.15	Pk	28.8	-26.5	29.45	46.02	-16.57	0-360	100	H

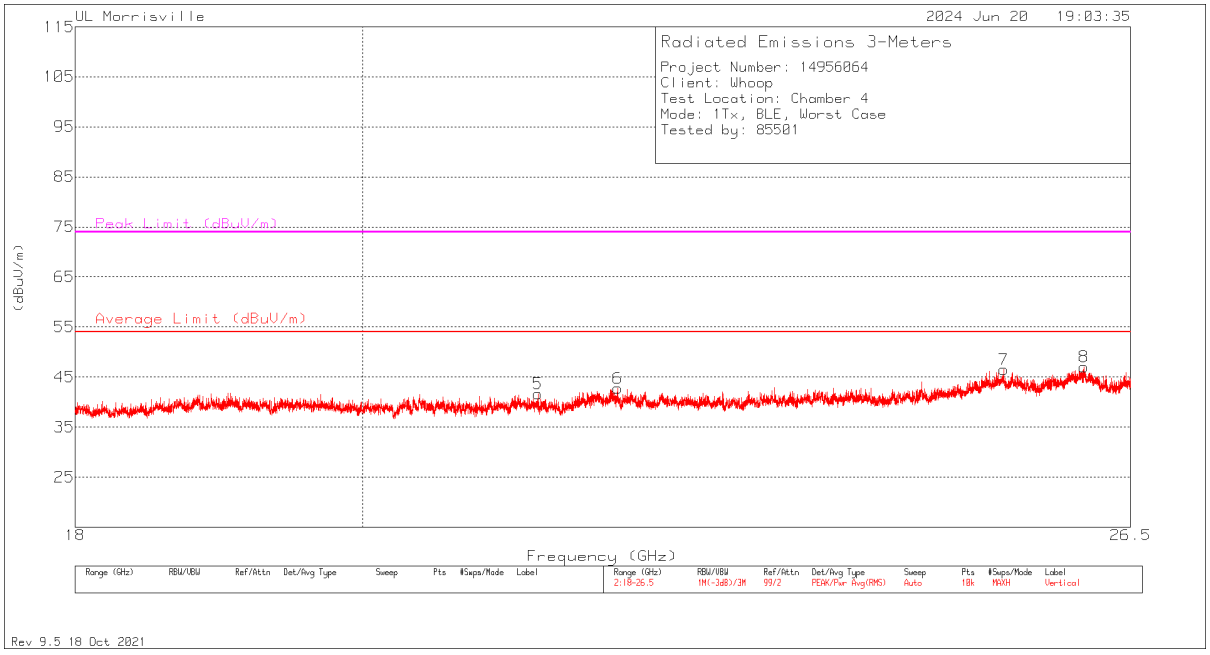
Pk - Peak detector

10.5. WORST CASE 18-26 GHZ

SPURIOUS EMISSIONS 18-26 GHz (WORST-CASE CONFIGURATION)



HORIZONTAL



VERTICAL

18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	204704 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 19.65393	49.91	Pk	33.2	-40.8	42.31	54	-11.69	74	-31.69	0-360	100	H
2	* ** 22.66433	48.6	Pk	34.2	-39.8	43	54	-11	74	-31	0-360	100	H
5	* ** 21.32657	48.9	Pk	33.4	-40.6	41.7	54	-12.3	74	-32.3	0-360	150	V
6	21.95975	48.23	Pk	34.2	-39.7	42.73	54	-11.27	74	-31.27	0-360	200	V
3	23.31197	48.83	Pk	34.4	-39.1	44.13	54	-9.87	74	-29.87	0-360	100	H
7	25.29907	46.98	Pk	35.7	-36.2	46.48	54	-7.52	74	-27.52	0-360	150	V
8	26.05039	47.6	Pk	35.2	-35.8	47	54	-7	74	-27	0-360	200	V
4	26.08949	46.78	Pk	35.2	-35.8	46.18	54	-7.82	74	-27.82	0-360	250	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)
RSS-Gen 8.8

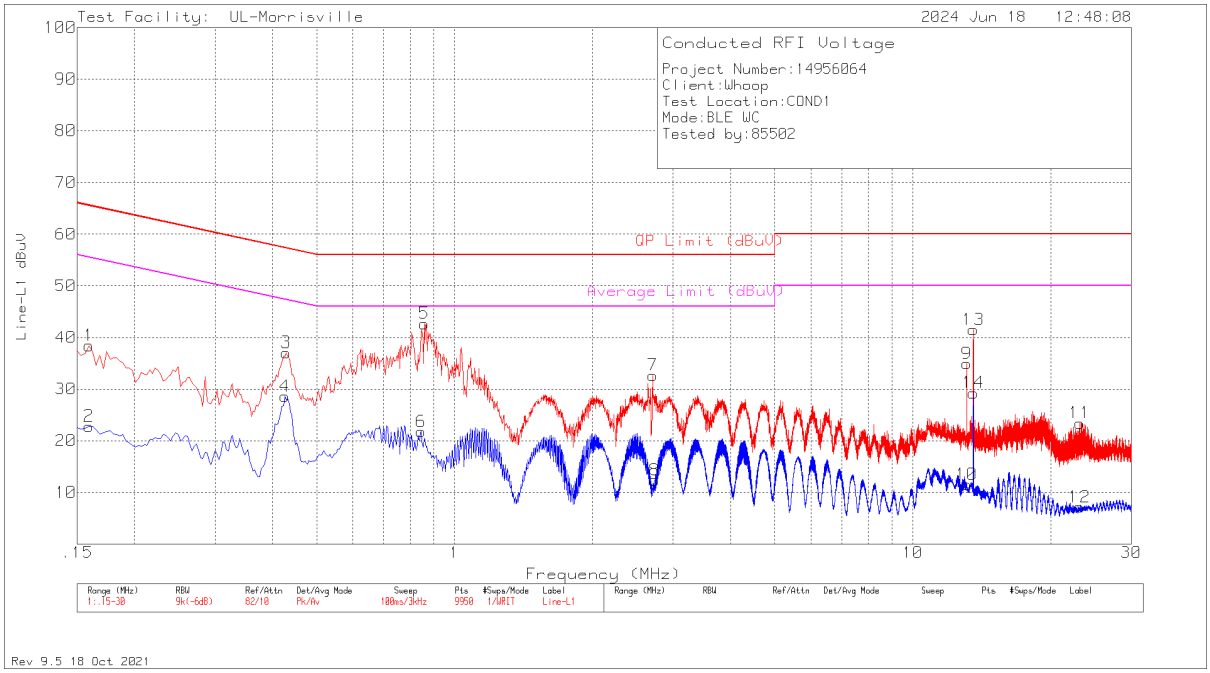
Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

RESULTS

Conducted Emissions Graph

Line 1



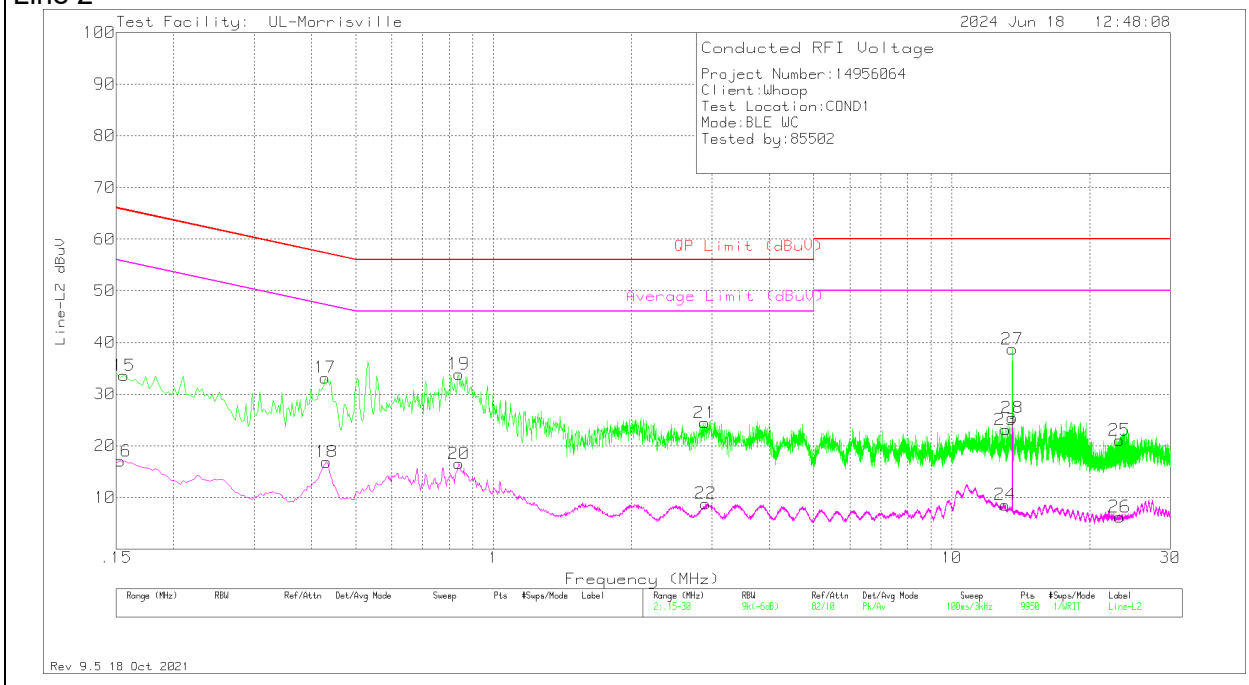
Conducted Emissions Data Points

Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VDF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.159	28.32	Pk	.3	9.8	38.42	65.52	-27.1	-	-
2	.159	12.7	Av	.3	9.8	22.8	-	-	55.52	-32.72
3	.429	27.16	Pk	.1	9.8	37.06	57.27	-20.21	-	-
4	.426	18.69	Av	.1	9.8	28.59	-	-	47.33	-18.74
5	.858	32.78	Pk	.1	9.8	42.68	56	-13.32	-	-
6	.846	11.86	Av	.1	9.8	21.76	-	-	46	-24.24
7	2.706	22.79	Pk	.1	9.8	32.69	56	-23.31	-	-
8	2.733	2.46	Av	.1	9.8	12.36	-	-	46	-33.64
9	13.131	24.82	Pk	.1	10	34.92	60	-25.08	-	-
10	13.11	1.44	Av	.1	10	11.54	-	-	50	-38.46
11	23.145	12.93	Pk	.3	10.2	23.43	60	-36.57	-	-
12	23.112	-3.35	Av	.3	10.2	7.15	-	-	50	-42.85
13	13.563	31.3	Pk	.2	10	41.5	60	-18.5	-	-
14	13.56	19.07	Av	.2	10	29.27	-	-	50	-20.73

Pk - Peak detector
Av - Average detection

Conducted Emissions Graph

Line 2



Conducted Emissions Data Points

Range 2: Line-L2 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VDF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
15	.156	23.47	Pk	.3	9.8	33.57	65.67	-32.1	-	-
16	.153	6.93	Av	.3	9.8	17.03	-	-	55.84	-38.81
17	.429	23.27	Pk	.1	9.8	33.17	57.27	-24.1	-	-
18	.432	6.97	Av	.1	9.8	16.87	-	-	47.21	-30.34
19	.84	23.98	Pk	.1	9.8	33.88	56	-22.12	-	-
20	.84	6.63	Av	.1	9.8	16.53	-	-	46	-29.47
21	2.889	14.55	Pk	.1	9.8	24.45	56	-31.55	-	-
22	2.904	-1.09	Av	.1	9.8	8.81	-	-	46	-37.19
23	13.104	13.01	Pk	.1	10	23.11	60	-36.89	-	-
24	13.08	-1.53	Av	.1	10	8.57	-	-	50	-41.43
25	23.223	10.56	Pk	.3	10.2	21.06	60	-38.94	-	-
26	23.256	-4.29	Av	.3	10.2	6.21	-	-	50	-43.79
27	13.56	28.5	Pk	.2	10	38.7	60	-21.3	-	-
28	13.56	15.21	Av	.2	10	25.41	-	-	50	-24.59

Pk - Peak detector
Av - Average detection
Ca - CISPR average detection

12. SETUP PHOTOS

Please refer to 14956064-EP4 for setup photos

END OF TEST REPORT