

# TEST REPORT

**Report Number. :** R14753279-E1

**Applicant :** Starry Inc  
38 Chauncy St, Suite 200  
Boston, MA, 02111  
US

**Model :** S01711

**FCC ID :** 2AGZ3S01711

**EUT Description :** Comet 37 2.0 Radio (BLE Radio)

**Test Standard(s) :** FCC 47 CFR PART 15 SUBPART C: 2023

**Date Of Issue:**

2023-11-03

**Prepared by:**

UL LLC

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## REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
v1	2023-08-09	Initial Issue	Noah Bennett
V2	2023-11-03	TCB Feedback 1: -Corrected Cal dates in section 8	Noah Bennett

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** **Starry Inc.**  
38 Chauncy St, Suite 200  
Boston, MA, 02111  
US

**EUT DESCRIPTION:** Comet 37 2.0 Radio (BLE Radio)

**MODEL:** S01711

**SERIAL NUMBER:** 2329000002

**SAMPLE RECEIPT DATE:** 2023-07-11

**DATE TESTED:** 2023-07-11 TO 2023-07-28

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies

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:



\_\_\_\_\_  
Brian Kiewra  
Project Engineer  
Consumer Technology Division  
UL LLC.

Prepared By:



\_\_\_\_\_  
Noah Bennett  
Engineer  
Consumer Technology Division  
UL LLC.

## 2. TEST RESULTS SUMMARY

This report contains data provided by the applicant 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 (section 6.3)
- 2) Supported Modes, Data Rates, Worst Case Data Rate, and Power Settings (see section 6.5)

FCC Clause	Requirement	Result	Comment
See Comment	Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
15.247 (a) (2)	6dB BW	Complies	None.
15.247 (b) (3)	Output Power		None.
See Comment	Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	PSD	Complies	None.
15.247 (d)	Conducted Spurious Emissions		None.
15.209, 15.205	Radiated Emissions		None.
15.207	AC Mains Conducted Emissions		None.

## 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15C, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01,

## 4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Certificate Number 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
<input checked="" type="checkbox"/>	Building 2800 Suite Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A	US0067	27265	825374

## 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 <sub>Lab</sub>
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:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

#### **MAINS CONDUCTED EMISSIONS**

Where relevant, the following sample calculation is provided:

$$\text{Final Voltage (dBuV)} = \text{Measured Voltage (dBuV)} + \text{Cable Loss (dB)} + \text{Limiter Factor (dB)} + \text{LISN Insertion Loss.}$$

$$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$$

## 6. EQUIPMENT UNDER TEST

### 6.1. EUT DESCRIPTION

The Starry Comet37 2.0 is a customer terminal transmitter / receiver radio for use on Starry's 37 - 40 GHz millimeter-wave (mmWave) network. The Comet37 2.0 utilizes the U-NII-3 5GHz band as a secondary link as well as BLE for provisioning and installation. The system is equipped with a GPS receiver to facilitate precise timing control.

### 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	5.59	3.62

### 6.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

Chain	Designation in Documentation	Type	Frequency Range (MHz)	Maximum Gain (dBi)
0	BLE Antenna	Vertical Polarization Pillar Antenna	2400-2500	3.4

### 6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 7/14/2023 Nightly Development.  
The test utility software used during testing was fcc (Starry Python module) == 7.0.0.

### 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 output power as worst-case scenario. This was found to be 1 Mbps.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle and high channels.

Per customer declarations, the EUT is only meant to operate in 1 orientation. Therefore, all testing was performed in this orientation.

Per customer declarations, the EUT only supports BLE data rates of 1 Mbps and 2 Mbps.



**6.6. DESCRIPTION OF TEST SETUP**

**SUPPORT EQUIPMENT**

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
NUC	Jetway	JBC313U591W-31ACB	19CF319X002872	N/A
GNSS Simulator	Racelogic	LabSat	--	
Starry Link	Starry	S00812	--	
Bias-T	Starry	850-00128	--	
Ethernet Switch	TP-Link	TL-SG108	22241J3004251	
Monitor	Viewsonic	VS15453	V1X203841229	
Keyboard	Dell	SK-8120	CN-04G481-71616-34R-099U-A00	

**I/O CABLES**

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	SMA	1	SMA	SMA	>3M	Provides GPS to EUT
2	RG-6	1	RG-6	RG-6	>3M	Provides power, ground & communication to EUT

**TEST SETUP**

The EUT is connected to a test stand during the tests, which includes a small form factor computer. Test software exercised the radio system.

**SETUP DIAGRAMS**

Please refer to R14753279-EP1 for setup diagrams and setup photos.

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## 7. MEASUREMENT METHOD

6 dB BW: ANSI C63.10 Subclause -11.8.1

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 (Measurement using an RF peak-reading power meter)

Output Power: 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)

Radiated 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 and 6.10.5

General Radiated Spurious Emissions: ANSI C63.10-2013 Section 6.3 to 6.6

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 - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 2)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	<b>0.009-30MHz</b>				
135144	Active Loop Antenna	ETS-Lindgren	6502	2023-01-17	2024-01-17
	<b>30-1000 MHz</b>				
90627	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2022-09-07	2023-09-07
	<b>1-18 GHz</b>				
88761	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2022-09-13	2023-09-13
	<b>18-40 GHz</b>				
78835	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2022-12-15	2023-12-15
77783	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2022-12-15	2023-12-15
	<b>Gain-Loss Chains</b>				
91975	Gain-loss string: 0.009-30MHz	Various	Various	2023-06-06	2024-06-06
91978	Gain-loss string: 25-1000MHz	Various	Various	2023-06-06	2024-06-06
91977	Gain-loss string: 1-18GHz	Various	Various	2023-06-06	2024-06-06
136042	Gain-loss string: 18-40GHz	Various	Various	2023-06-06	2024-06-06
	<b>Receiver &amp; Software</b>				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-03-24	2024-03-24
90416	Spectrum Analyzer	Keysight	N9030A	2023-06-09	2024-06-30
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	<b>Additional Equipment used</b>				
200540	Environmental Meter	Fisher Scientific	15-077-963	2022-10-05	2023-10-05

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
<b>Common Equipment</b>					
<b>Conducted Room 1</b>					
SA0026	Spectrum Analyzer	Keysight Technologies	N9030A	2022-08-02	2023-08-02
90778	RF Power Meter	Keysight Technologies	N1911A	2022-09-10	2023-09-10
PWS001 (PRE0137347)	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2022-07-07	2023-07-31
210642	Environmental Meter	Fisher Scientific	15-077-963	2021-08-16	2023-08-16
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA
<b>Cables/Attenuators</b>					
CBL031	SMA Male to SMA Male Cable Using PE-P141 Coax - 12"	Pasternack	Sucoflex 104PEA	2023-06-27	2024-06-27
226560	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2023-02-16	2024-02-16

Test Equipment Used - Line-Conducted Emissions – Voltage (Morrisville – Conducted 1)

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
CBL087	Coax cable, RG223, N-male to BNC-male, 20-ft.	Pasternack	PE3W06143-240	2023-04-04	2024-04-04
210642	Environmental Meter	Fisher Scientific	15-077-963	2021-08-16	2023-08-16
LISN003	LISN, 50-ohm/50-uH, 250uH 2-conductor, 25A	Fischer Custom Com.	FCC-LISN-50/250-25-2-01	2022-08-01	2023-08-01
75141	EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESCI 7	2022-08-03	2023-08-03
52859	Transient Limiter, 0.009-100MHz	Electro-Metrics	EM-7600	2023-04-04	2024-04-04
92852	AC Power Source	Elgar	CW2501M (s/n 1523A02397)	NA	NA
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
<b>Miscellaneous (if needed)</b>					
LISN008	LISN, 50-ohm/50-uH, 2-conductor, 25A (For support gear only.)	Solar Electronics	8012-50-R-24-BNC	NA	NA

**Notes:**

- All test equipment was within calibration dates at the time of testing. If the calibration due date is before this report date, that testing was done before the calibration expired.

## 9. ANTENNA PORT TEST RESULTS

### 9.1. ON TIME AND DUTY CYCLE

#### LIMITS

None; for reporting purposes only.

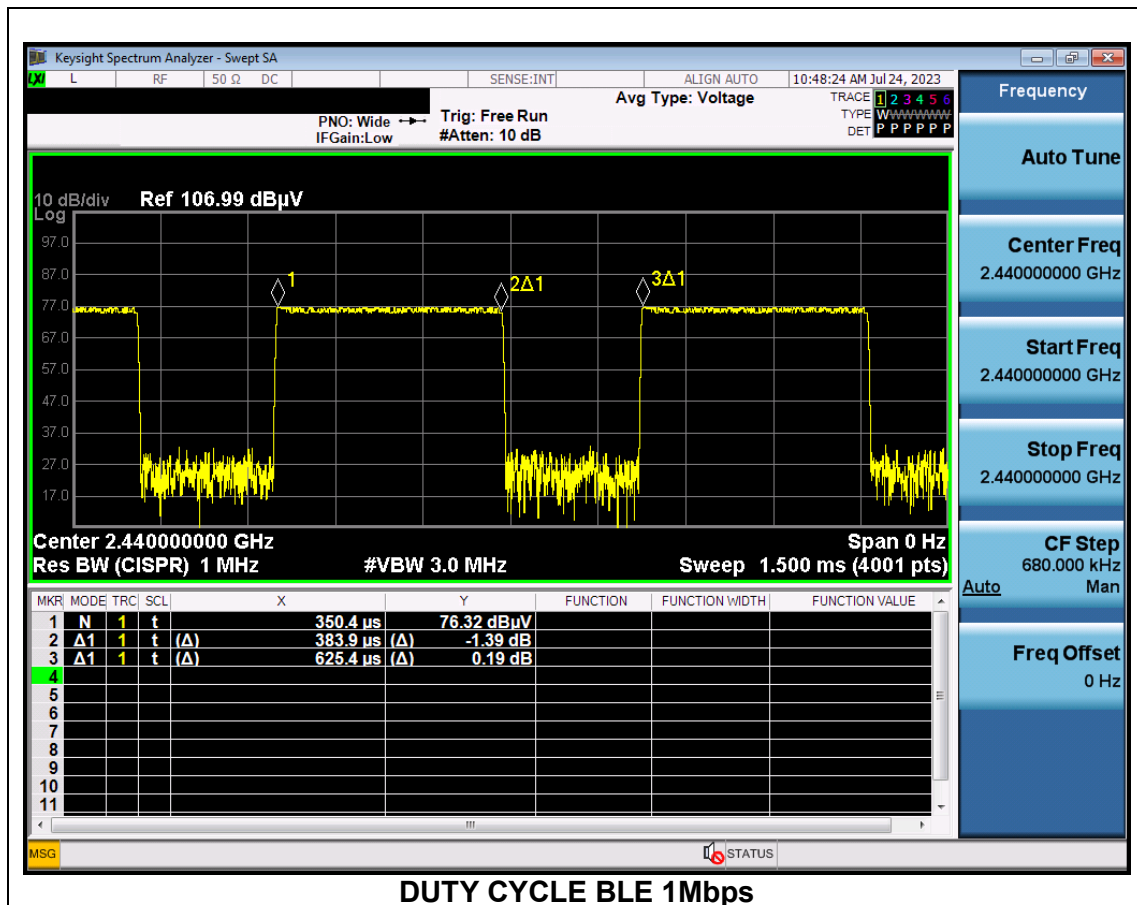
#### PROCEDURE

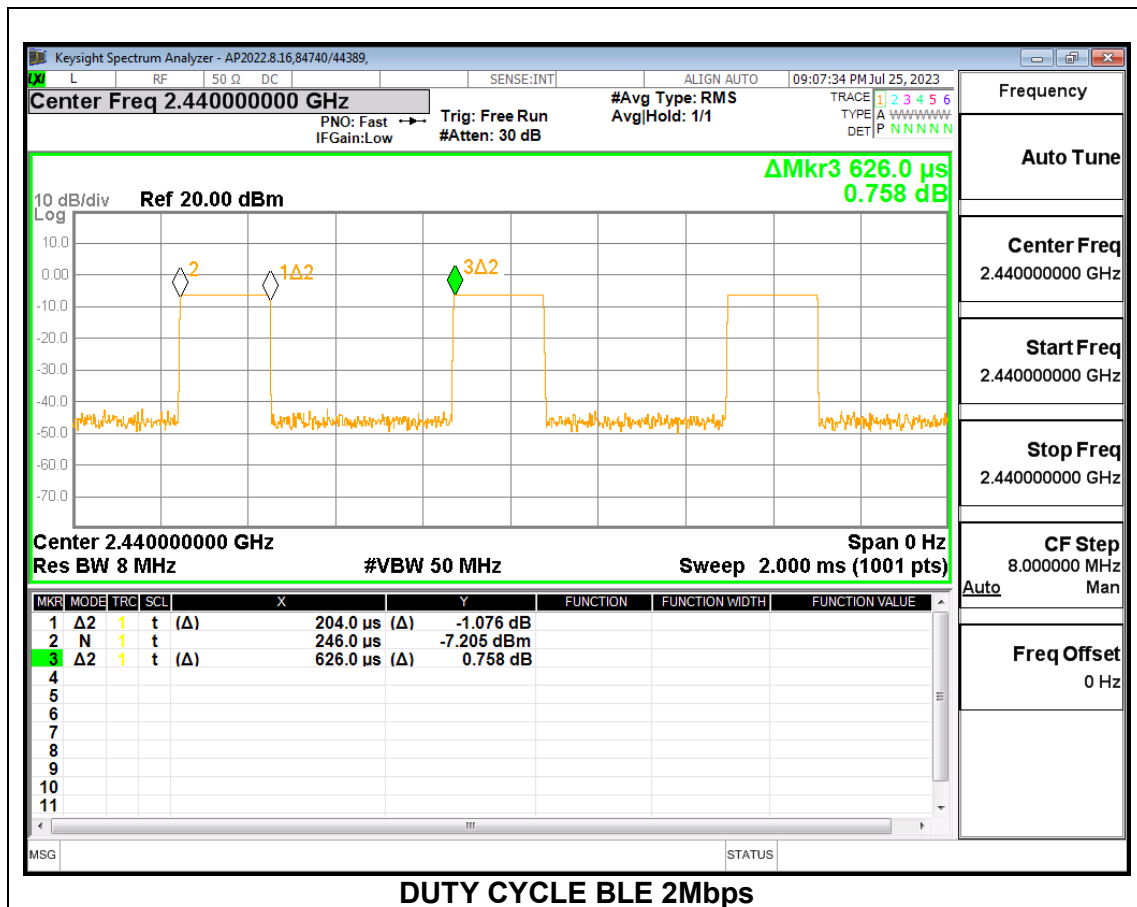
KDB 558074 Zero-Span Spectrum Analyzer Method.

#### 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)
<b>2.4GHz Band</b>						
BLE - 1Mbps	0.384	0.625	0.614	61.38	4.24	2.605
BLE - 2Mbps	0.204	0.626	0.326	32.59	9.74	4.902

#### DUTY CYCLE PLOTS





## 9.2. 6 dB BANDWIDTH

### LIMITS

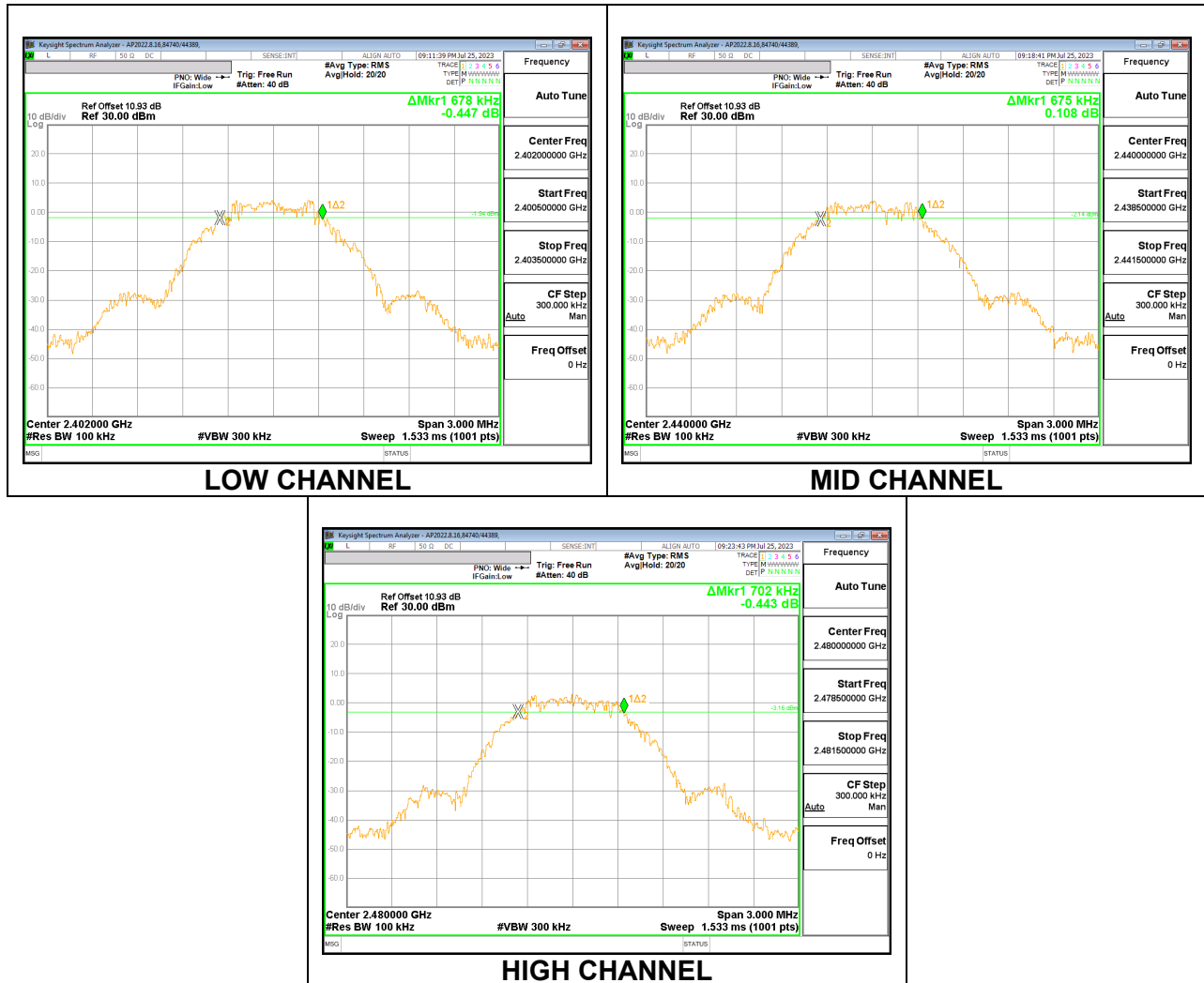
FCC §15.247 (a) (2)

The minimum 6 dB bandwidth shall be at least 500 kHz.

### RESULTS

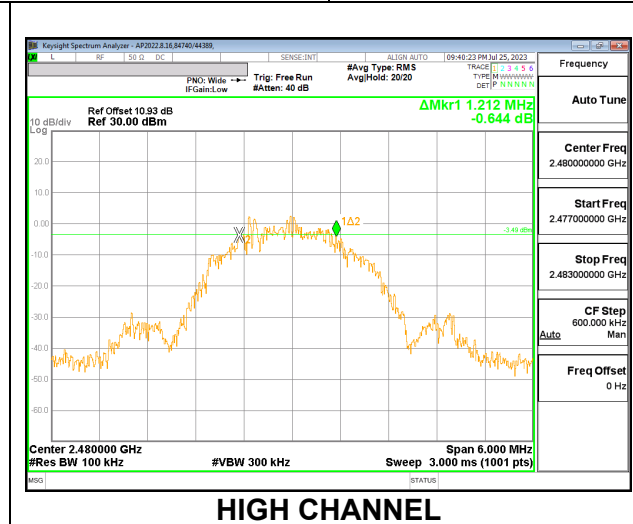
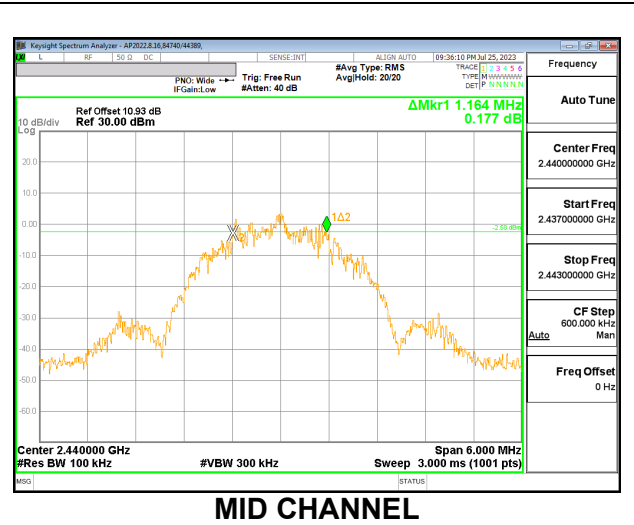
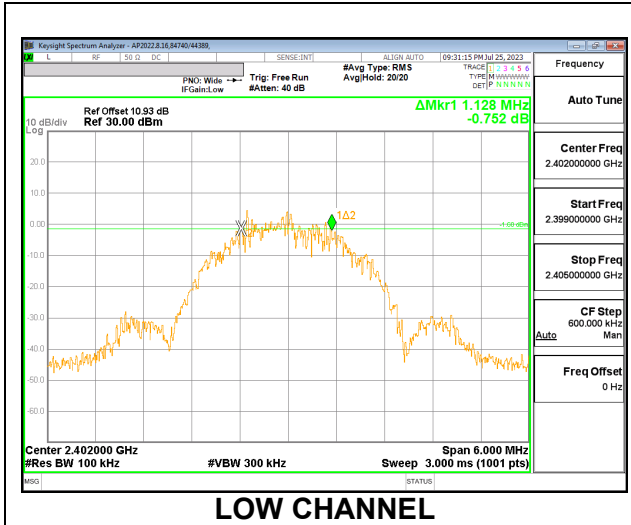
#### 9.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6780	0.5
Middle	2440	0.6750	0.5
High	2480	0.7020	0.5



**9.2.2. BLE (2Mbps)**

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.128	0.5
Middle	2440	1.164	0.5
High	2480	1.212	0.5





### 9.3. OUTPUT POWER

**LIMITS**

FCC §15.247 (b) (3)

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 10.93 dB (including 9.67 dB attenuator, 0.96dB EUT cable and 0.3 dB test cable) was entered as an offset in the power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Peak output power was read directly from power meter.

**RESULTS**

#### 9.3.1. BLE (1Mbps)

<b>Tested By:</b>	84740/44389
<b>Date:</b>	7/25/2023

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.96	30	-24.04
Middle	2440	5.45	30	-24.55
High	2480	4.73	30	-25.27

#### 9.3.2. BLE (2Mbps)

<b>Tested By:</b>	84740/44389
<b>Date:</b>	7/25/2023

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.82	30	-24.18
Middle	2440	5.40	30	-24.60
High	2480	4.67	30	-25.33

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## 9.4. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a gated average power meter.

The cable assembly insertion loss of 10.93 dB (including 9.67 dB attenuator, 0.96dB EUT cable and 0.3 dB test cable) was entered as an offset in the power meter

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband average power sensor. Gated Average output power was read directly from power meter.

### RESULTS

#### 9.4.1. BLE (1Mbps)

<b>Tested By:</b>	84740/44389
<b>Date:</b>	7/25/2023

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>AV power (dBm)</b>
Low	2402	5.59
Middle	2440	5.07
High	2480	4.43

#### 9.4.2. BLE (2Mbps)

<b>Tested By:</b>	84740/44389
<b>Date:</b>	7/25/2023

<b>Channel</b>	<b>Frequency (MHz)</b>	<b>AV power (dBm)</b>
Low	2402	5.56
Middle	2440	5.11
High	2480	4.36

## 9.5. POWER SPECTRAL DENSITY

### LIMITS

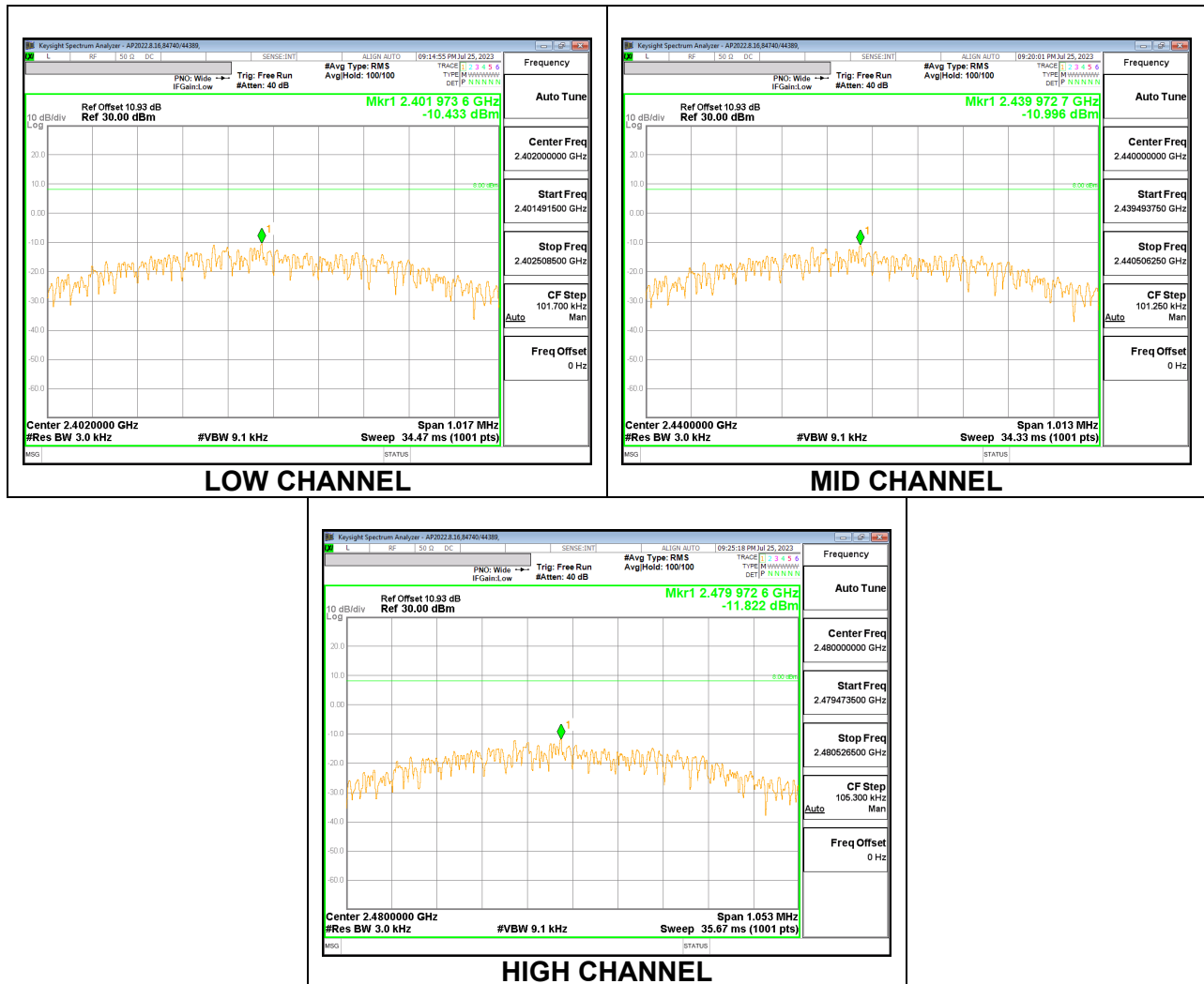
FCC §15.247 (e)

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

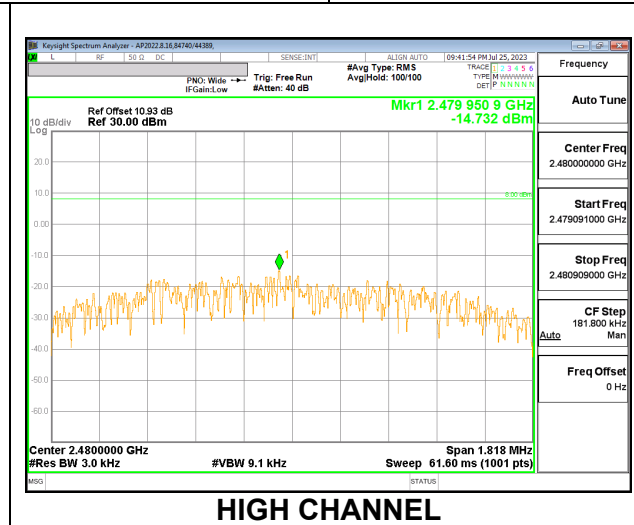
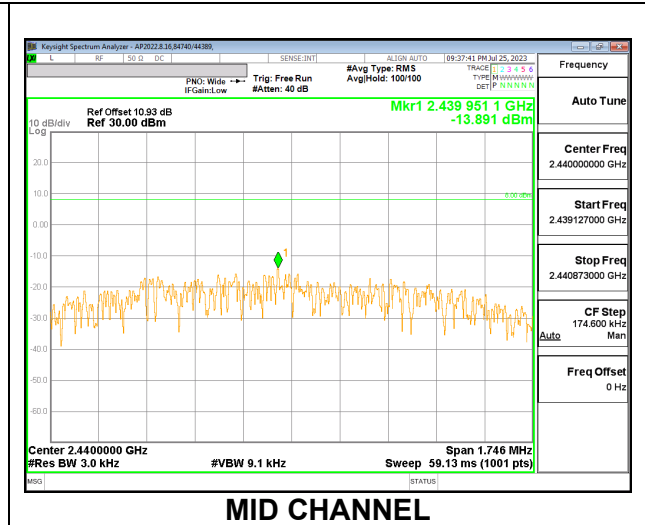
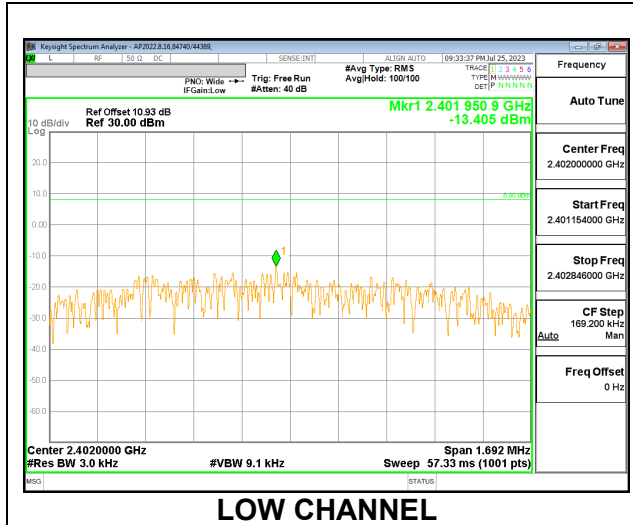
#### 9.5.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-10.43	8	-18.43
Middle	2440	-11.00	8	-19.00
High	2480	-11.82	8	-19.82



**9.5.2. BLE (2Mbps)**

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-13.41	8	-21.41
Middle	2440	-13.89	8	-21.89
High	2480	-14.73	8	-22.73



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## **9.6. CONDUCTED SPURIOUS EMISSIONS**

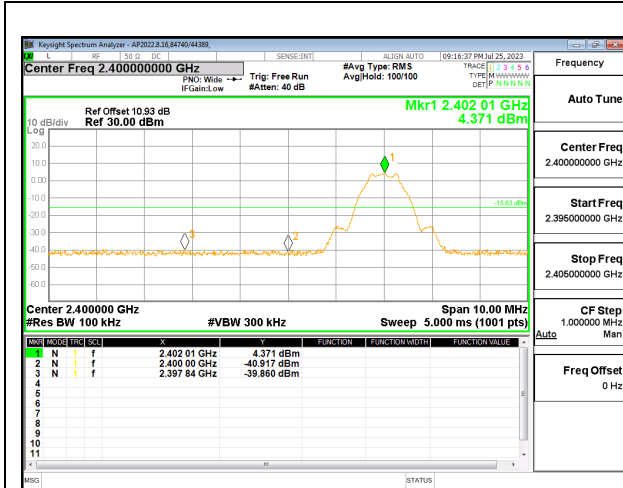
### **LIMITS**

FCC §15.247 (d)

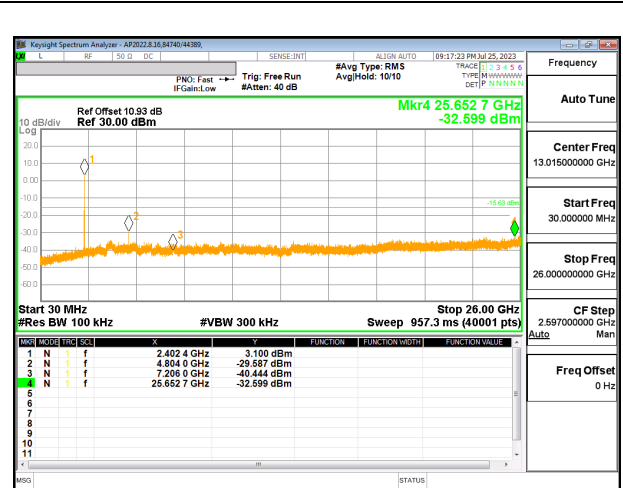
Output power was measured based on the use of a peak measurement, therefore the required attenuation is -20 dBc.

### **RESULTS**

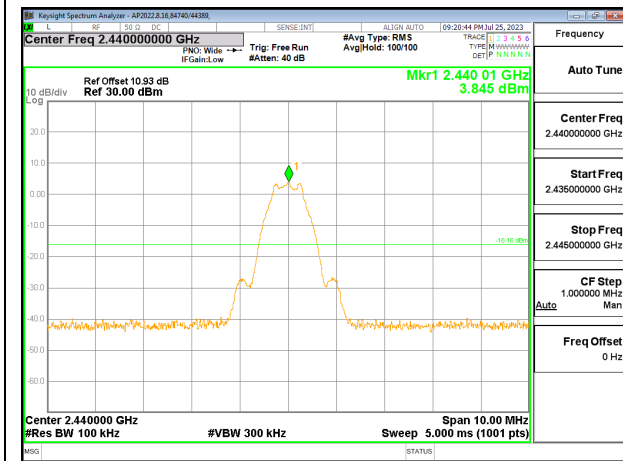
### 9.6.1. BLE (1Mbps)



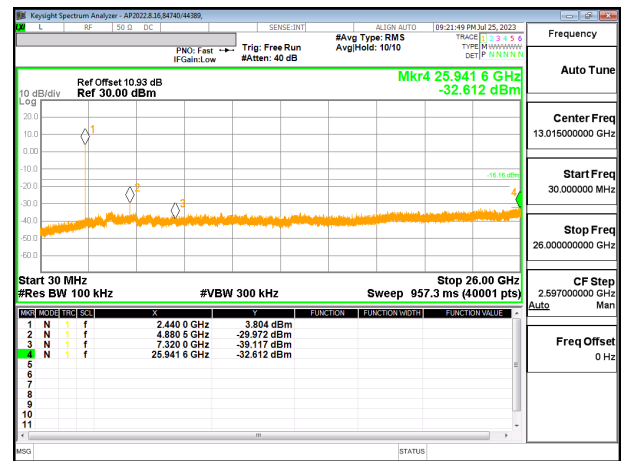
**LOW CHANNEL BANDEDGE**



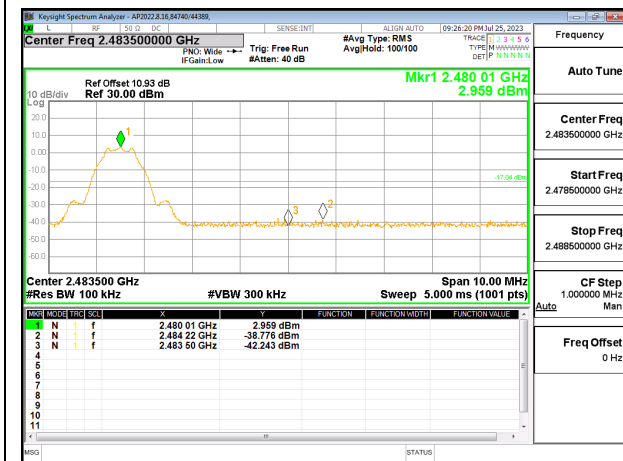
**OUT-OF-BAND LOW CHANNEL**



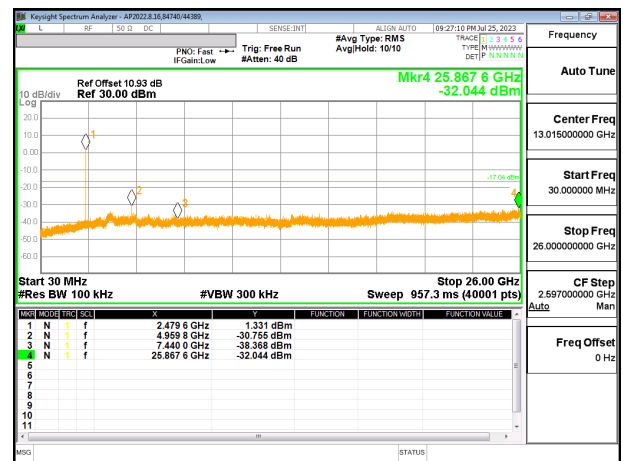
**IN-BAND REFERENCE LEVEL**



**OUT-OF-BAND MID CHANNEL**

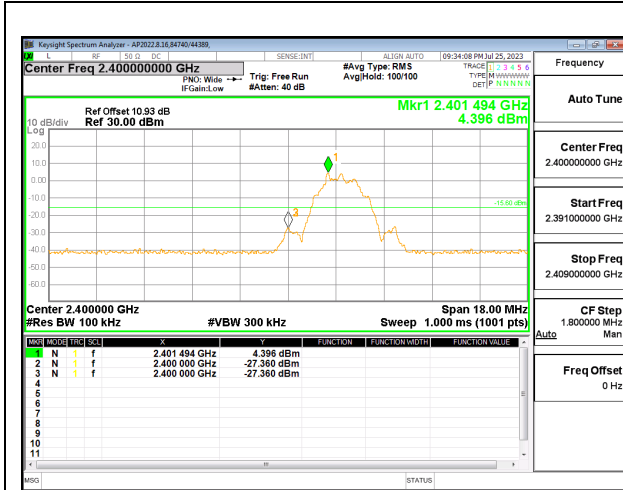


**HIGH CHANNEL BANDEDGE**

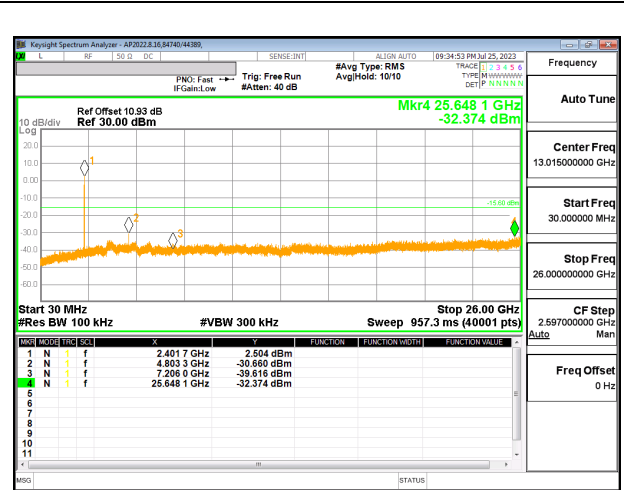


**OUT-OF-BAND HIGH CHANNEL**

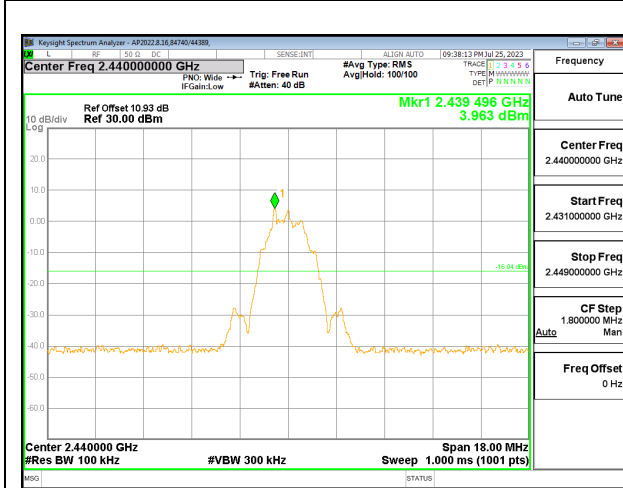
### 9.6.2. BLE (2Mbps)



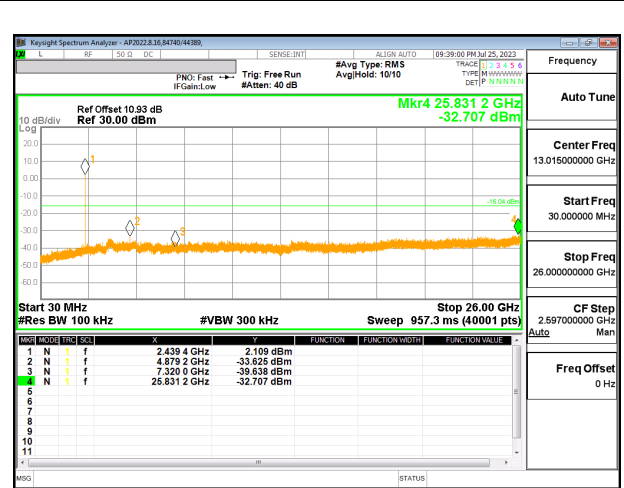
**LOW CHANNEL BANDEDGE**



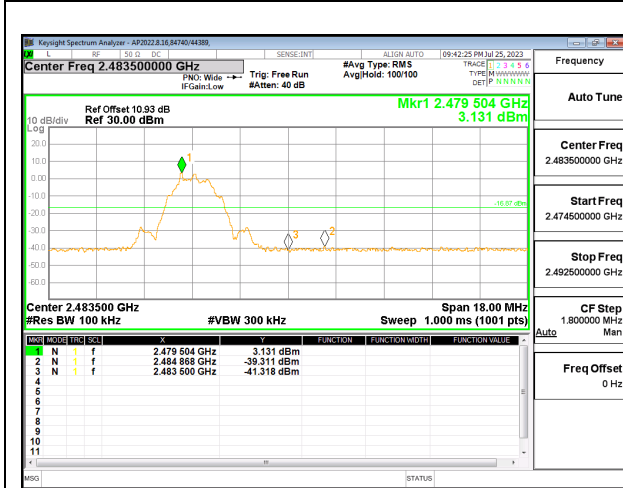
**OUT-OF-BAND LOW CHANNEL**



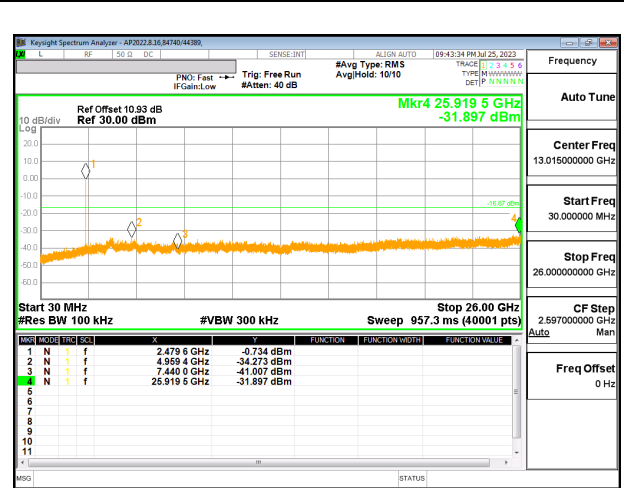
**IN-BAND REFERENCE LEVEL**



**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

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz. For above 1GHz, the EUT was confirmed on a non-conductive test fixture above the ground plane 1.5 m high. 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 PSD 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.



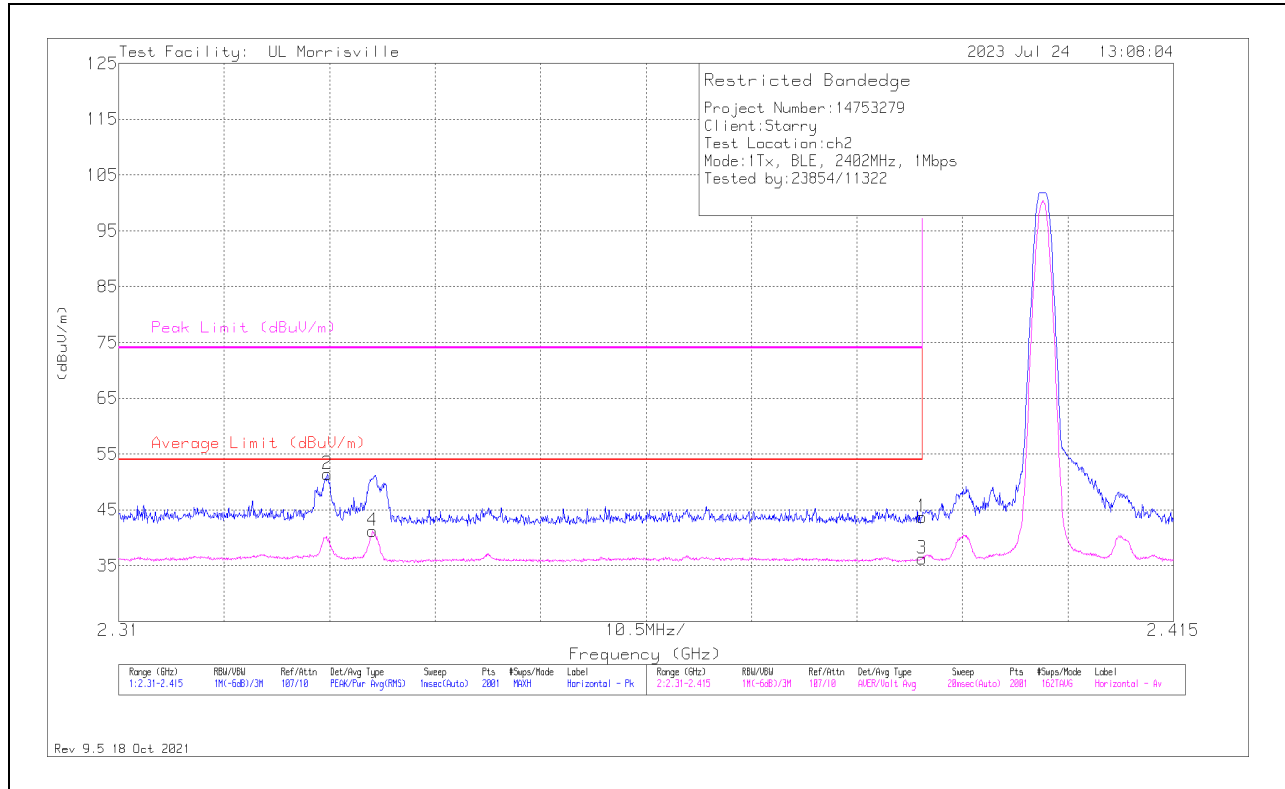
## 10.2. TRANSMITTER ABOVE 1 GHz

### 10.2.1. BLE (1Mbps)

#### Antenna 1

#### BANDEDGE (LOW CHANNEL)

#### HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (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	36.06	Pk	31.8	-24.2	0	43.66	-	-	74	-30.34	72	130	H
2	*** 2.33079	43.41	Pk	32	-24	0	51.41	-	-	74	-22.59	72	130	H
3	*** 2.38996	24.38	ADV	31.8	-24.2	4.24	36.22	54	-17.78	-	-	72	130	H
4	*** 2.33525	29.05	ADV	32	-24.1	4.24	41.19	54	-12.81	-	-	72	130	H

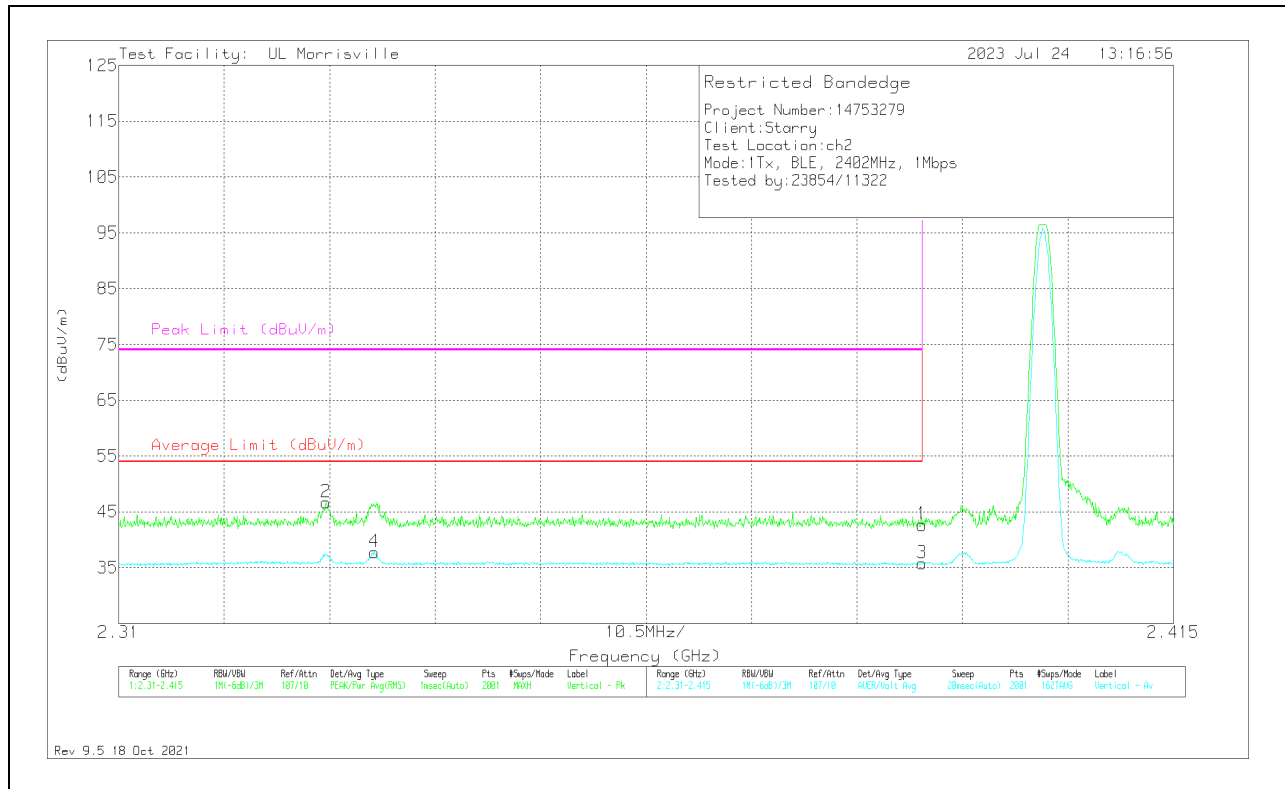
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

### VERTICAL RESULT

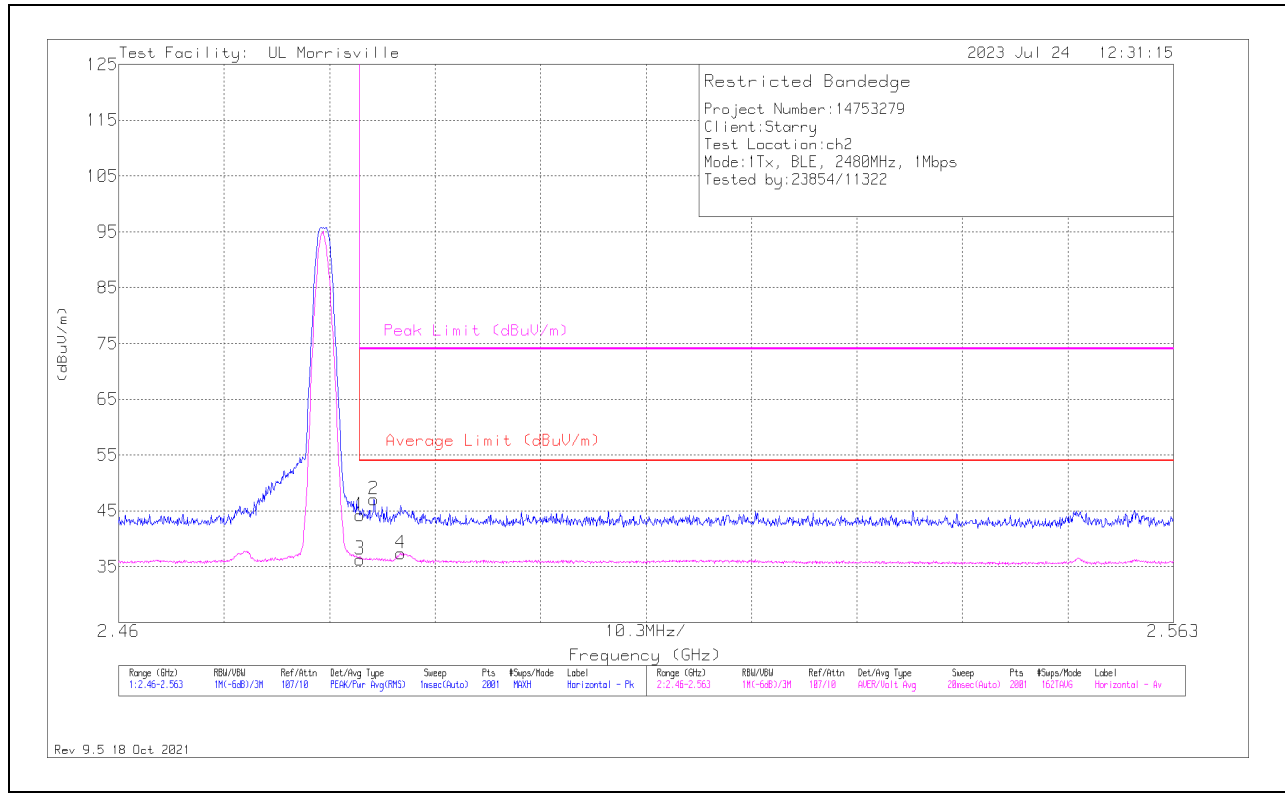


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	35.06	Pk	31.8	-24.2	0	42.66	-	-	74	-31.34	92	343	V
2	*** 2.33063	38.7	Pk	32	-24	0	46.7	-	-	74	-27.3	92	343	V
3	*** 2.38996	23.93	ADV	31.8	-24.2	4.24	35.77	54	-18.23	-	-	92	343	V
4	*** 2.33546	25.66	ADV	32	-24.1	4.24	37.8	54	-16.2	-	-	92	343	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)**

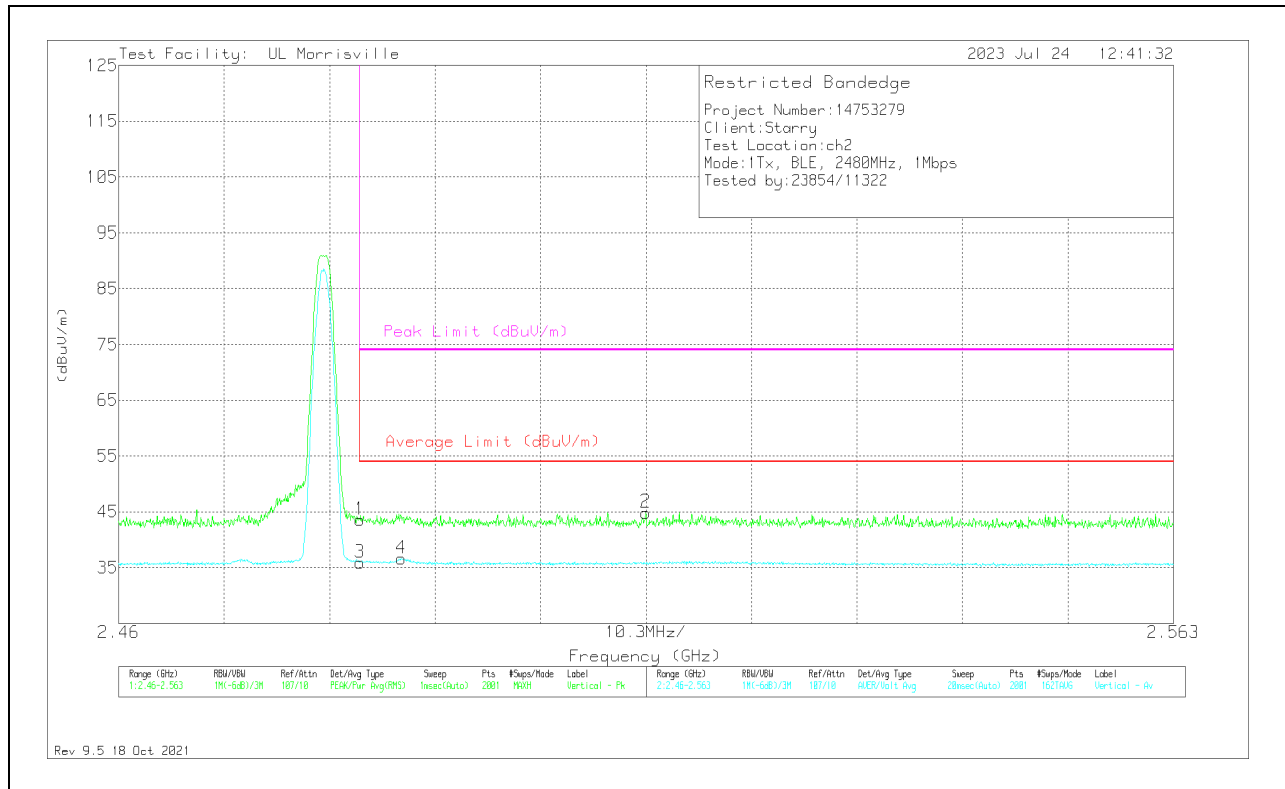
**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (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	36.46	Pk	32.3	-24.5	0	44.26	-	-	74	-29.74	97	221	H
2	*** 2.48493	39.24	Pk	32.3	-24.5	0	47.04	-	-	74	-26.96	97	221	H
3	* ** 2.48354	24.28	ADV	32.3	-24.5	4.24	36.32	54	-17.68	-	-	97	221	H
4	*** 2.48755	25.49	ADV	32.3	-24.6	4.24	37.43	54	-16.57	-	-	97	221	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

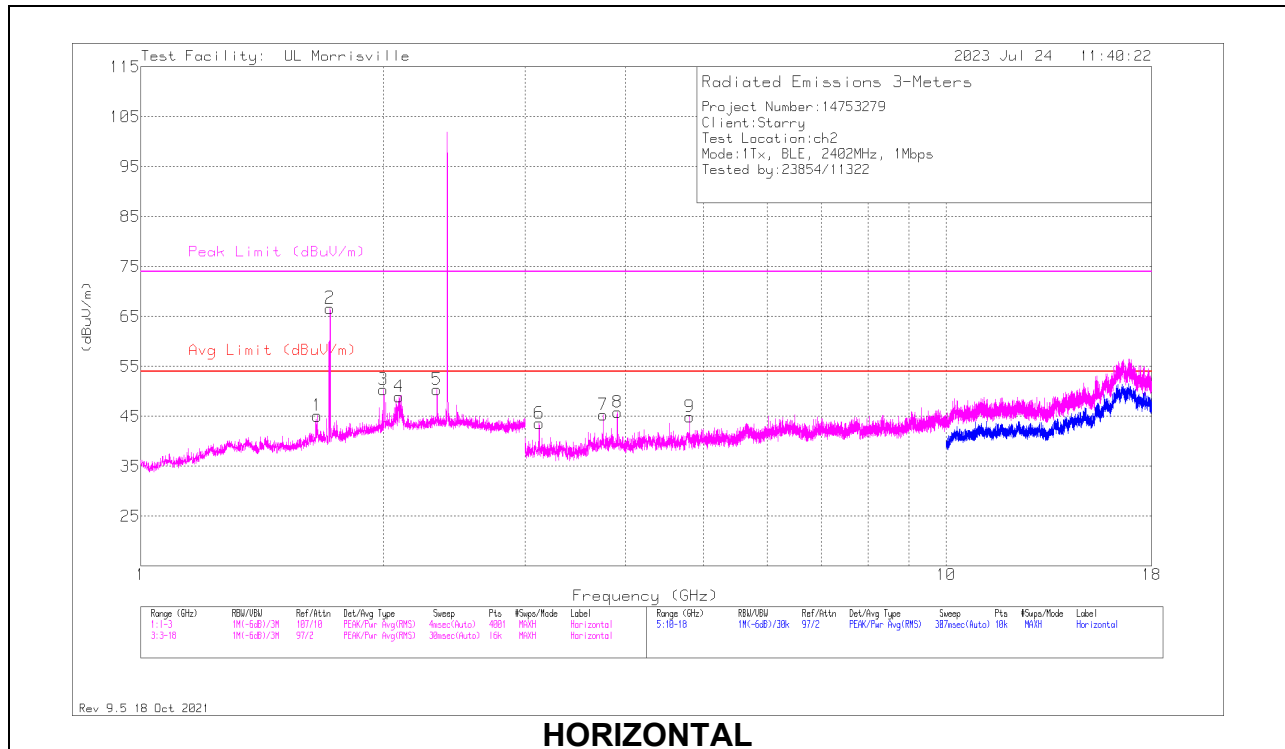


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	35.75	Pk	32.3	-24.5	0	43.55	-	-	74	-30.45	88	358	V
2	** 2.51145	37.19	Pk	32.4	-24.7	0	44.89	-	-	74	-29.11	88	358	V
3	*** 2.48354	23.89	ADV	32.3	-24.5	4.24	35.93	54	-18.07	-	-	88	358	V
4	*** 2.4876	24.72	ADV	32.3	-24.6	4.24	36.66	54	-17.34	-	-	88	358	V

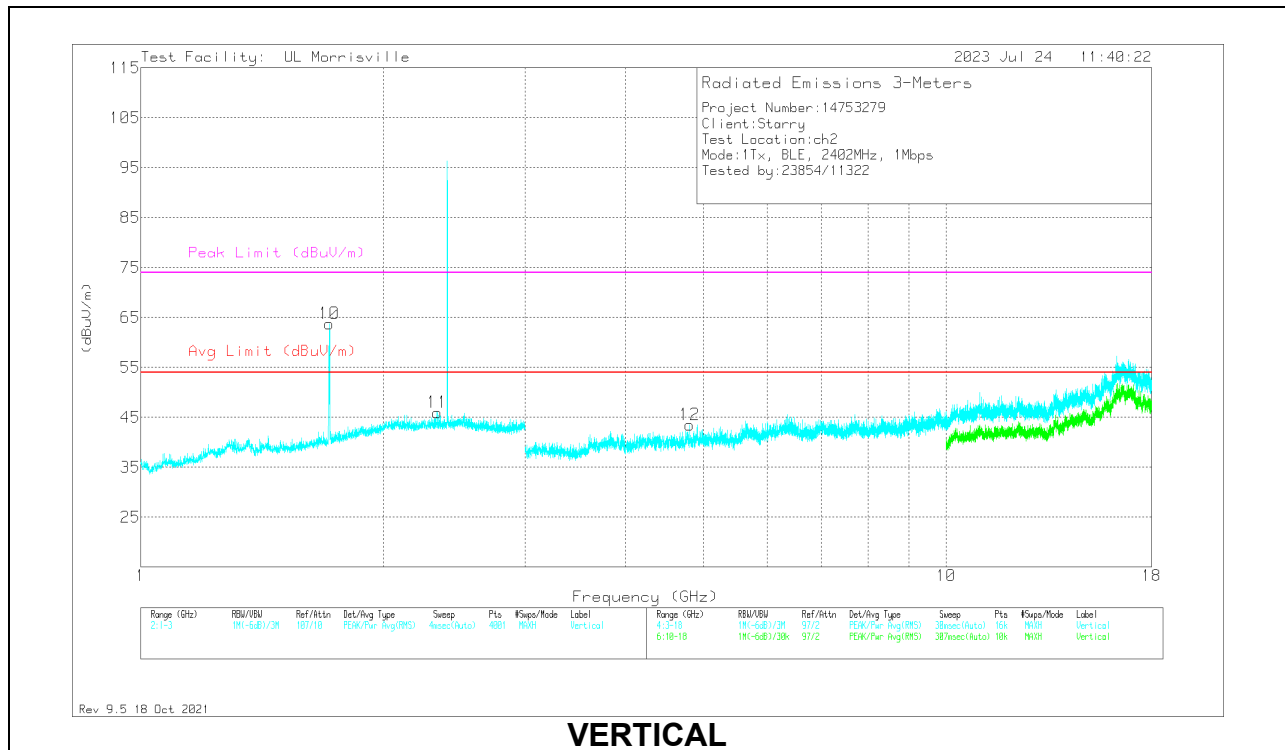
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 \*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band  
 Pk - Peak detector  
 ADV - Linear Voltage Average

**HARMONICS AND SPURIOUS EMISSIONS**

**LOW CHANNEL RESULTS**



**HORIZONTAL**



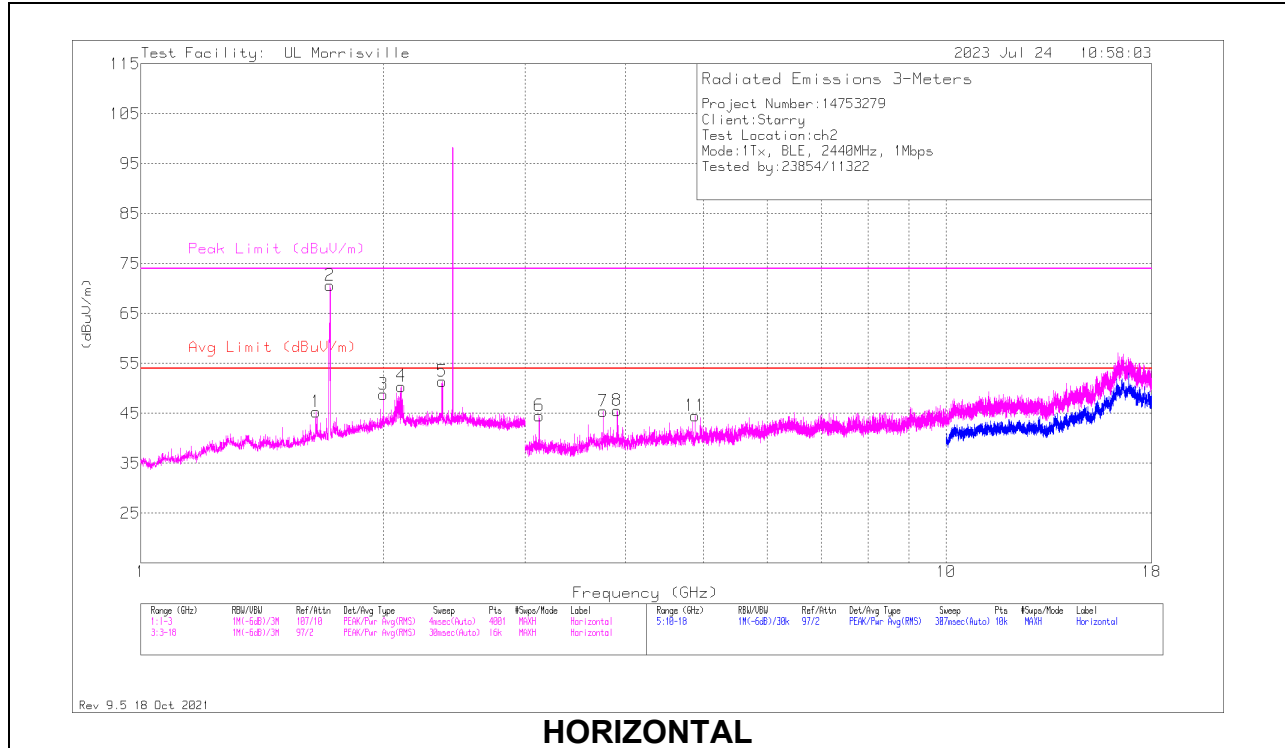
**VERTICAL**

**RADIATED EMISSIONS**

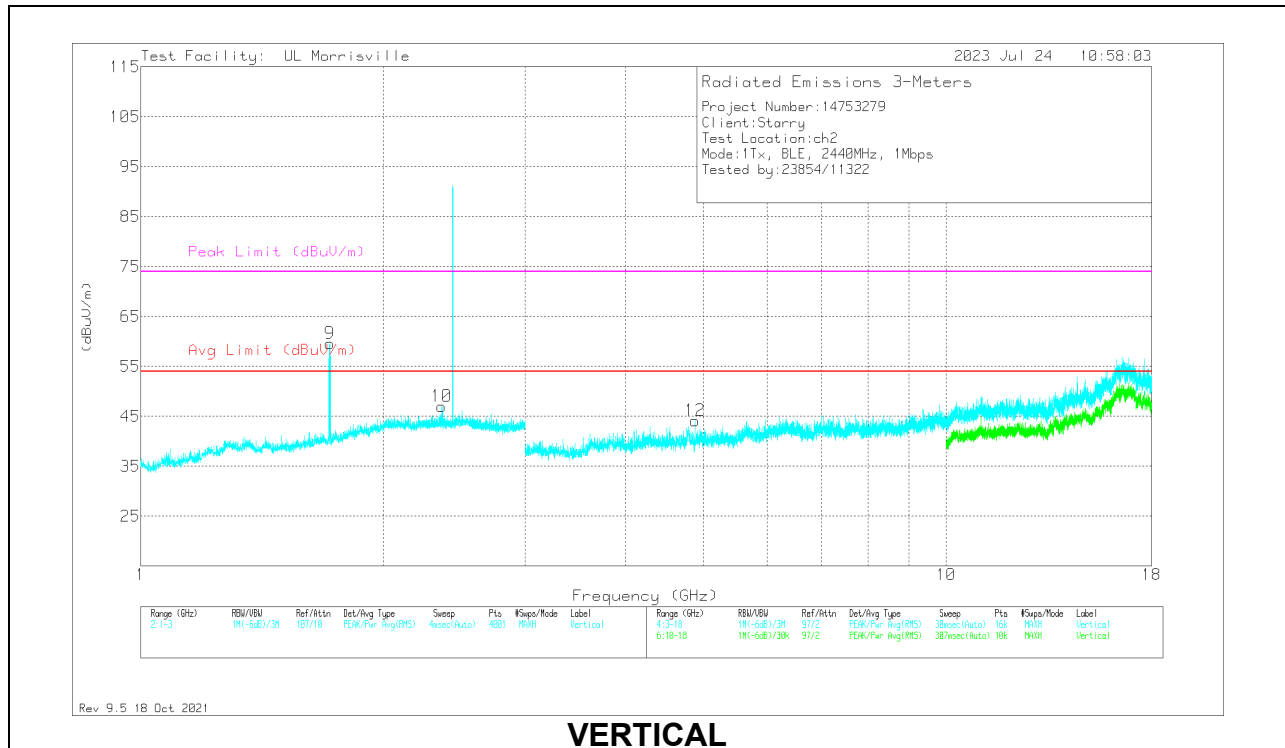
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	** 1.7185	60.27	Pk	29.1	-22.7	0	66.67	-	-	-	-	0-360	101	H
5	*** 2.33067	44.17	PK2	32	-24	0	52.17	-	-	74	-21.83	71	139	H
	*** 2.33064	29.17	ADV	32	-24	4.24	41.41	54	-12.59	-	-	71	139	H
10	** 1.7135	57.5	Pk	29	-22.7	0	63.8	-	-	-	-	0-360	199	V
11	*** 2.3355	38.11	Pk	32	-24.1	0	46.01	54	-7.99	74	-27.99	0-360	199	V
7	*** 3.75	44.44	Pk	33.2	-32.3	0	45.34	54	-8.66	74	-28.66	0-360	200	H
8	*** 3.90656	43.8	Pk	33.4	-31.4	0	45.8	54	-8.2	74	-28.2	0-360	200	H
9	*** 4.80375	40.91	Pk	34	-30	0	44.91	54	-9.09	74	-29.09	0-360	101	H
12	*** 4.80375	39.45	Pk	34	-30	0	43.45	54	-10.55	74	-30.55	0-360	101	V
1	1.6555	39.02	Pk	28.5	-22.4	0	45.12	-	-	-	-	0-360	101	H
3	2	41.72	Pk	31.4	-22.8	0	50.32	-	-	-	-	0-360	101	H
4	2.094	40.51	Pk	31.7	-23.3	0	48.91	-	-	-	-	0-360	199	H
6	3.12469	42.89	Pk	33.1	-32.4	0	43.59	-	-	-	-	0-360	200	H

\* - 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

**MID CHANNEL RESULTS**



**HORIZONTAL**



**VERTICAL**

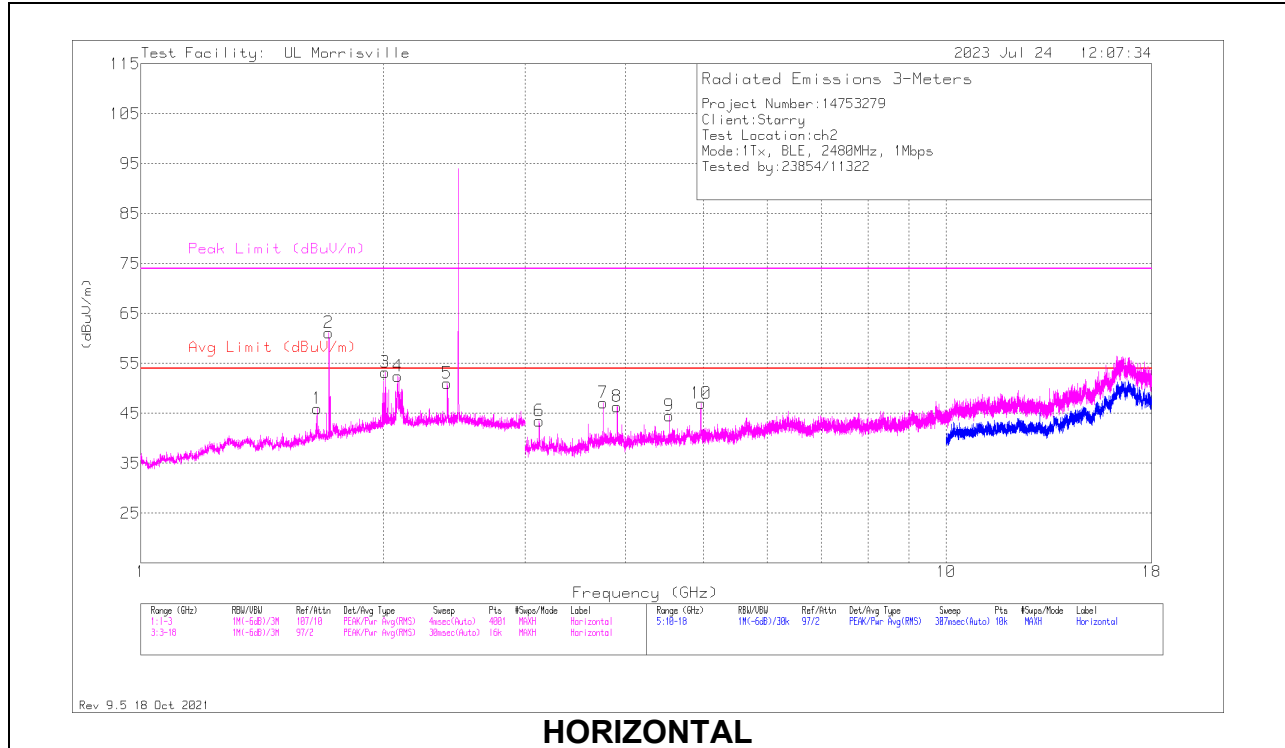
**RADIATED EMISSIONS**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	** 1.7185	64.28	Pk	29.1	-22.7	0	70.68	-	-	-	-	0-360	200	H
5	*** 2.36921	45.54	PK2	31.9	-24.1	0	53.34	-	-	74	-20.66	81	302	H
	*** 2.36925	32.14	ADV	31.9	-24.1	4.24	44.18	54	-9.82	-	-	81	302	H
9	** 1.716	53.16	Pk	29.1	-22.7	0	59.56	-	-	-	-	0-360	101	V
10	** 2.365	39.24	Pk	31.9	-24.1	0	47.04	54	-6.96	74	-26.96	0-360	200	V
7	*** 3.75	44.59	Pk	33.2	-32.3	0	45.49	54	-8.51	74	-28.51	0-360	200	H
8	*** 3.90563	43.57	Pk	33.4	-31.4	0	45.57	54	-8.43	74	-28.43	0-360	200	H
11	*** 4.88063	40.94	Pk	34	-30.4	0	44.54	54	-9.46	74	-29.46	0-360	200	H
12	*** 4.88063	40.49	Pk	34	-30.4	0	44.09	54	-9.91	74	-29.91	0-360	200	V
1	1.65025	39.24	Pk	28.6	-22.5	0	45.34	-	-	-	-	0-360	101	H
3	2	40.21	Pk	31.4	-22.8	0	48.81	-	-	-	-	0-360	101	H
4	2.1055	42.04	Pk	31.6	-23.2	0	50.44	-	-	-	-	0-360	101	H
6	3.12469	43.79	Pk	33.1	-32.4	0	44.49	-	-	-	-	0-360	200	H

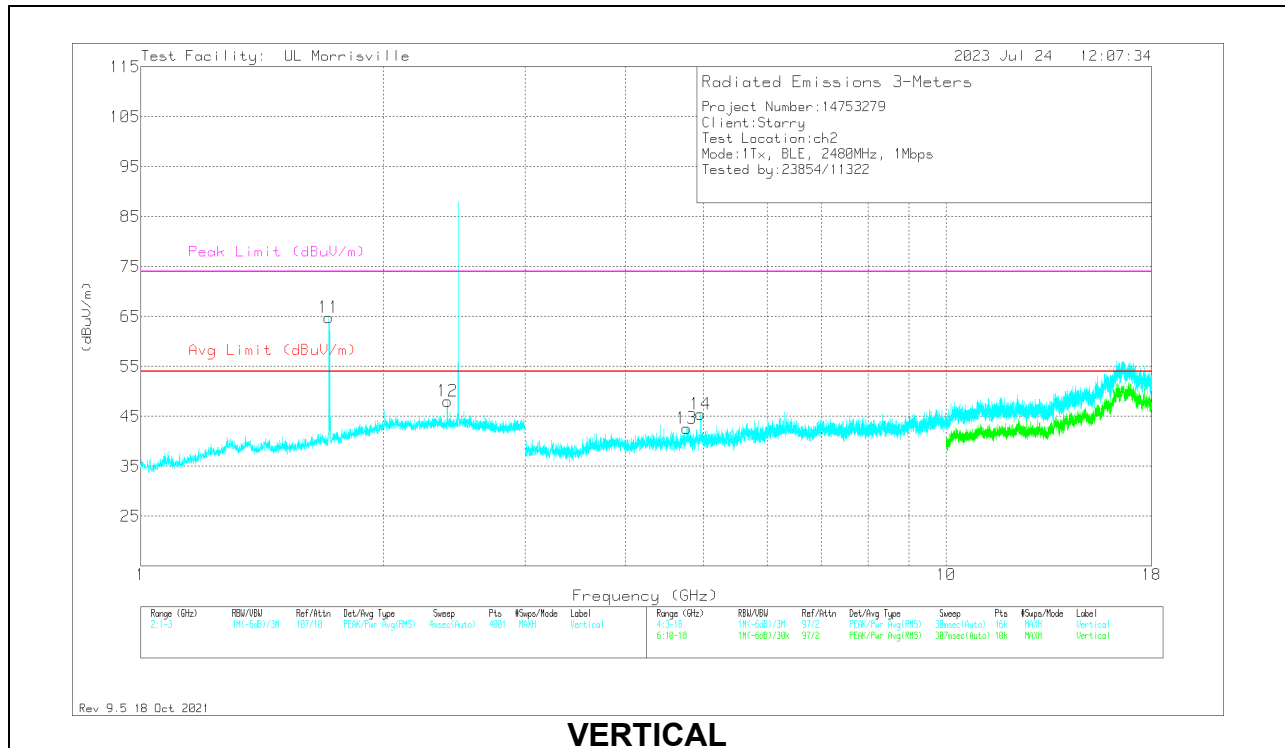
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band  
 \*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band  
 Pk - Peak detector  
 PK2 - Maximum Peak  
 ADV - Linear Voltage Average



**HIGH CHANNEL RESULTS**



**HORIZONTAL**



**VERTICAL**

**RADIATED EMISSIONS**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	** 1.7125	54.9	Pk	29	-22.7	0	61.2	-	-	-	-	0-360	199	H
3	** 2.011	44.49	Pk	31.4	-22.7	0	53.19	-	-	-	-	0-360	199	H
11	** 1.7125	58.46	Pk	29	-22.7	0	64.76	-	-	-	-	0-360	199	V
7	*** 3.75	46.27	Pk	33.2	-32.3	0	47.17	54	-6.83	74	-26.83	0-360	199	H
8	*** 3.90563	44.38	Pk	33.4	-31.4	0	46.38	54	-7.62	74	-27.62	0-360	199	H
9	*** 4.53094	41.51	Pk	33.8	-30.8	0	44.51	54	-9.49	74	-29.49	0-360	101	H
10	*** 4.96031	43.45	Pk	33.9	-30.3	0	47.05	54	-6.95	74	-26.95	0-360	199	H
13	*** 4.7625	39.42	Pk	33.9	-30.7	0	42.62	54	-11.38	74	-31.38	0-360	199	V
14	*** 4.95938	41.87	Pk	33.9	-30.3	0	45.47	54	-8.53	74	-28.53	0-360	199	V
1	1.6555	39.91	Pk	28.5	-22.4	0	46.01	-	-	-	-	0-360	101	H
4	2.085	43.98	Pk	31.7	-23.2	0	52.48	-	-	-	-	0-360	199	H
5	2.4	43.53	Pk	31.8	-24.3	0	51.03	-	-	-	-	0-360	101	H
12	2.406	40.3	Pk	31.9	-24.2	0	48	-	-	-	-	0-360	199	V
6	3.12469	42.78	Pk	33.1	-32.4	0	43.48	-	-	-	-	0-360	101	H

\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

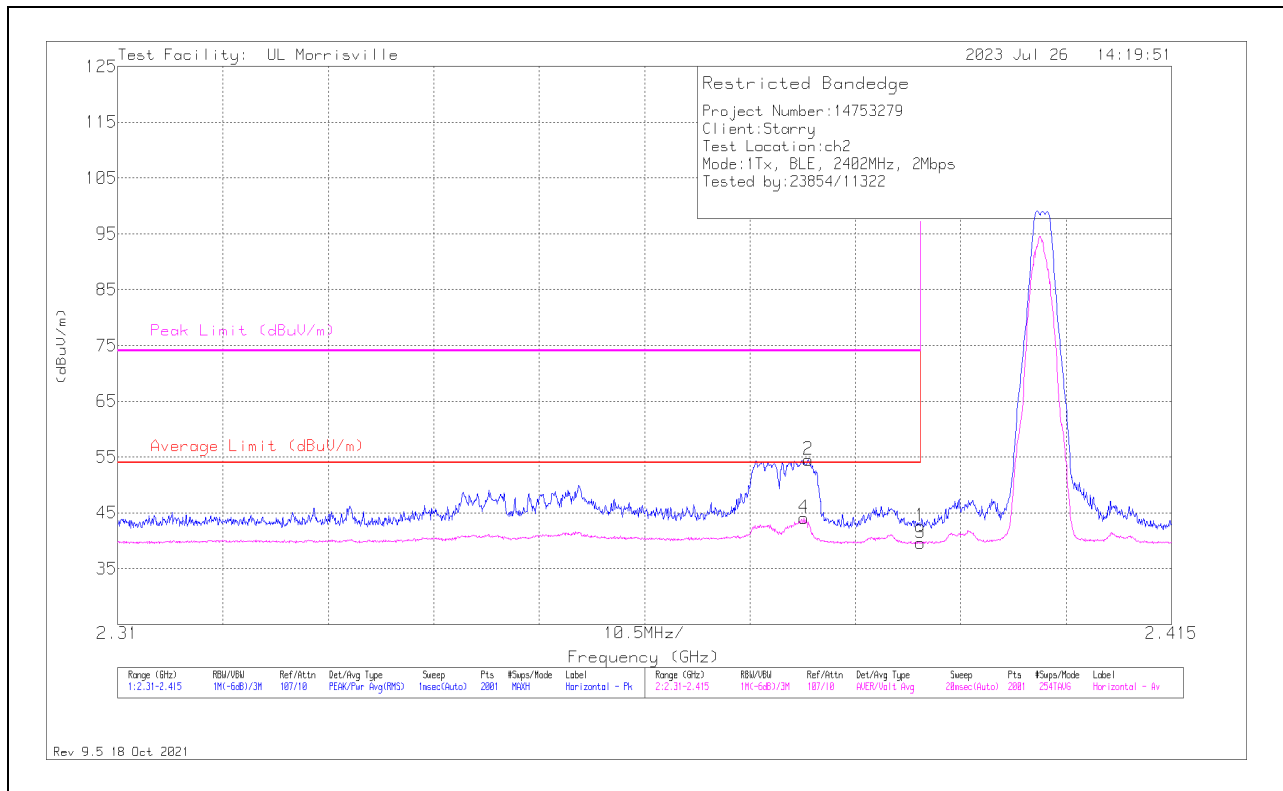
Pk - Peak detector

**10.2.2. BLE (2Mbps)**

**Antenna 1**

**BANDEDGE (LOW CHANNEL)**

**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (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	34.96	Pk	31.8	-24.2	0	42.56	-	-	74	-31.44	86	339	H
2	** 2.37883	46.67	Pk	31.9	-24.1	0	54.47	-	-	74	-19.53	86	339	H
3	*** 2.38996	23.84	ADV	31.8	-24.2	9.74	41.18	54	-12.82	-	-	86	339	H
4	** 2.37836	28.16	ADV	31.9	-24.1	9.74	45.70	54	-8.30	-	-	86	339	H

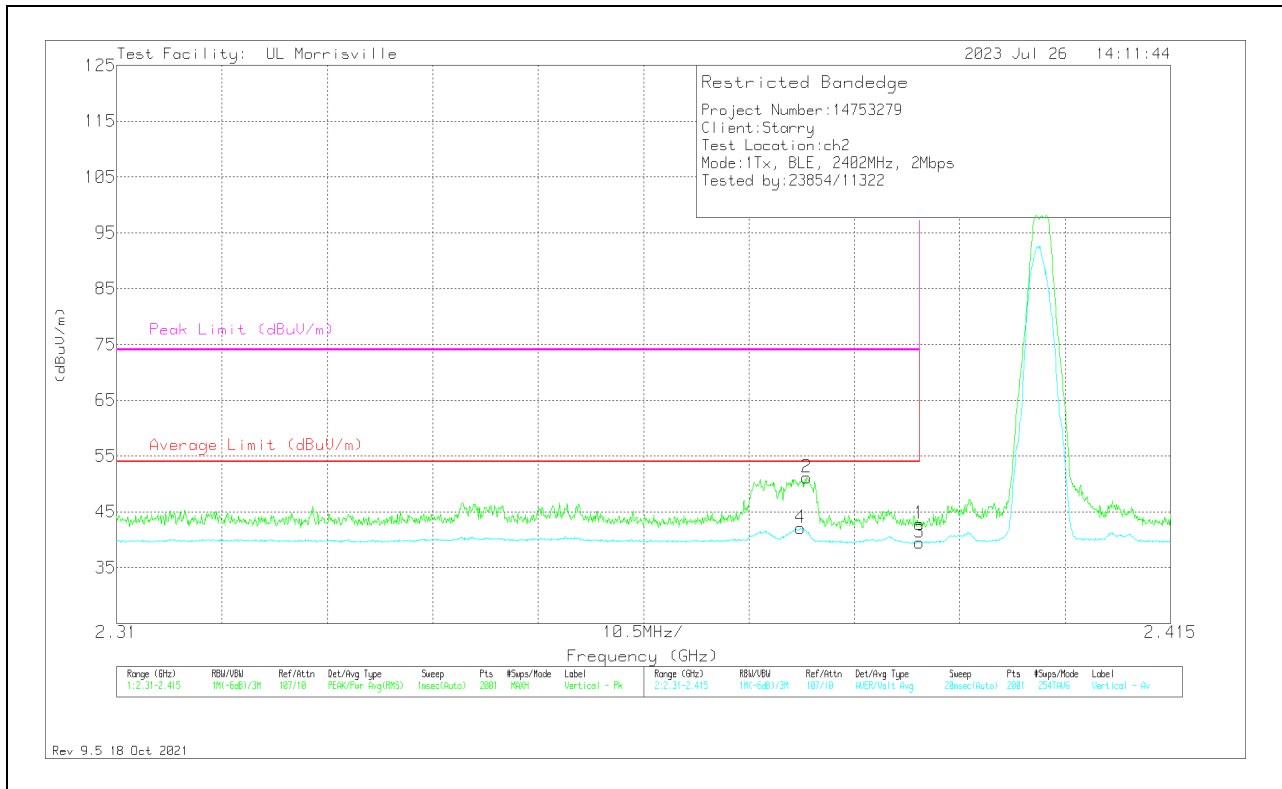
\* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

\*\* - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - , Linear Voltage Average

### VERTICAL RESULT

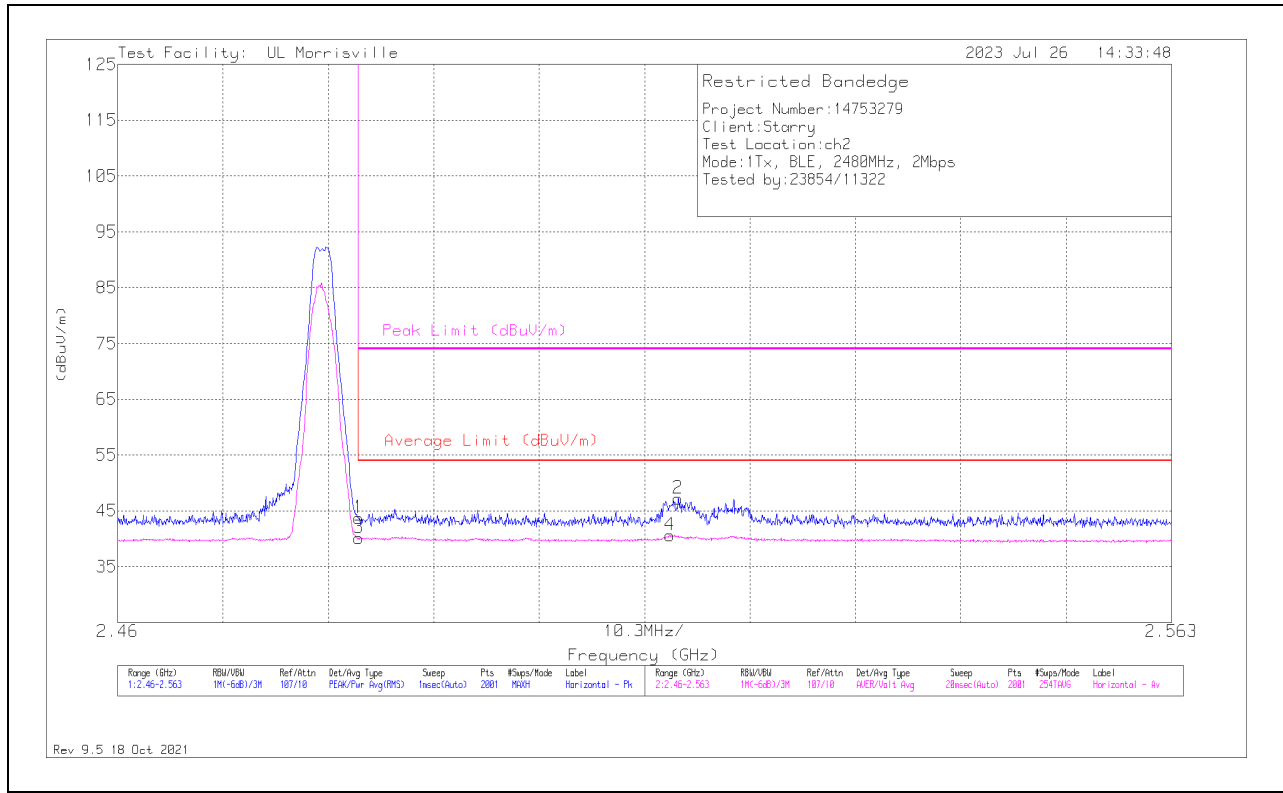


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	35.21	Pk	31.8	-24.2	0	42.81	-	-	74	-31.19	46	379	V
2	*** 2.37878	43.36	Pk	31.9	-24.1	0	51.16	-	-	74	-22.84	46	379	V
3	*** 2.38996	23.74	ADV	31.8	-24.2	9.74	41.08	54	-12.92	-	-	46	379	V
4	*** 2.37815	26.19	ADV	31.9	-24.1	9.74	43.73	54	-10.27	-	-	46	379	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)**

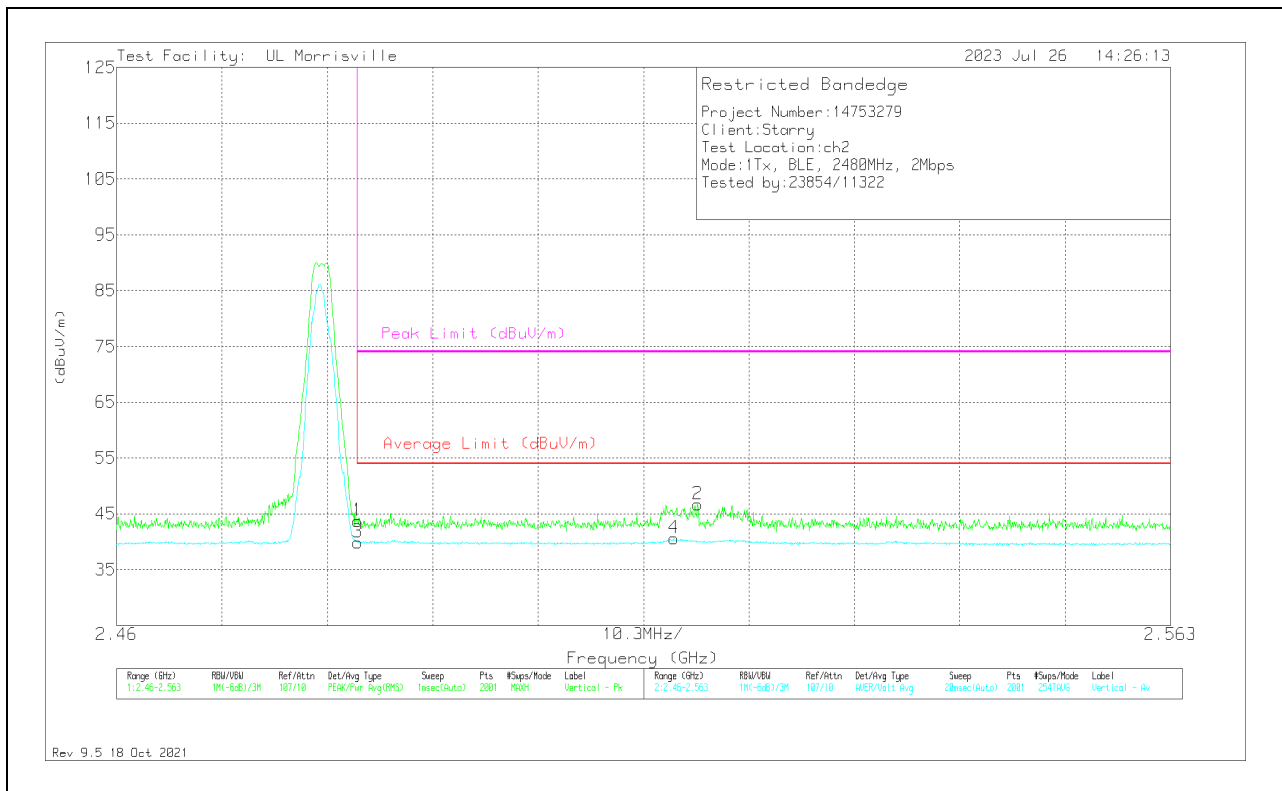
**HORIZONTAL RESULT**



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (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	35.89	Pk	32.3	-24.5	0	43.69	-	-	74	-30.31	86	146	H
2	** 2.5148	39.39	Pk	32.4	-24.6	0	47.19	-	-	74	-26.81	86	146	H
3	* ** 2.48354	24.22	ADV	32.3	-24.5	9.74	41.76	54	-12.24	-	-	86	146	H
4	** 2.51397	24.72	ADV	32.4	-24.6	9.74	42.26	54	-11.74	-	-	86	146	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

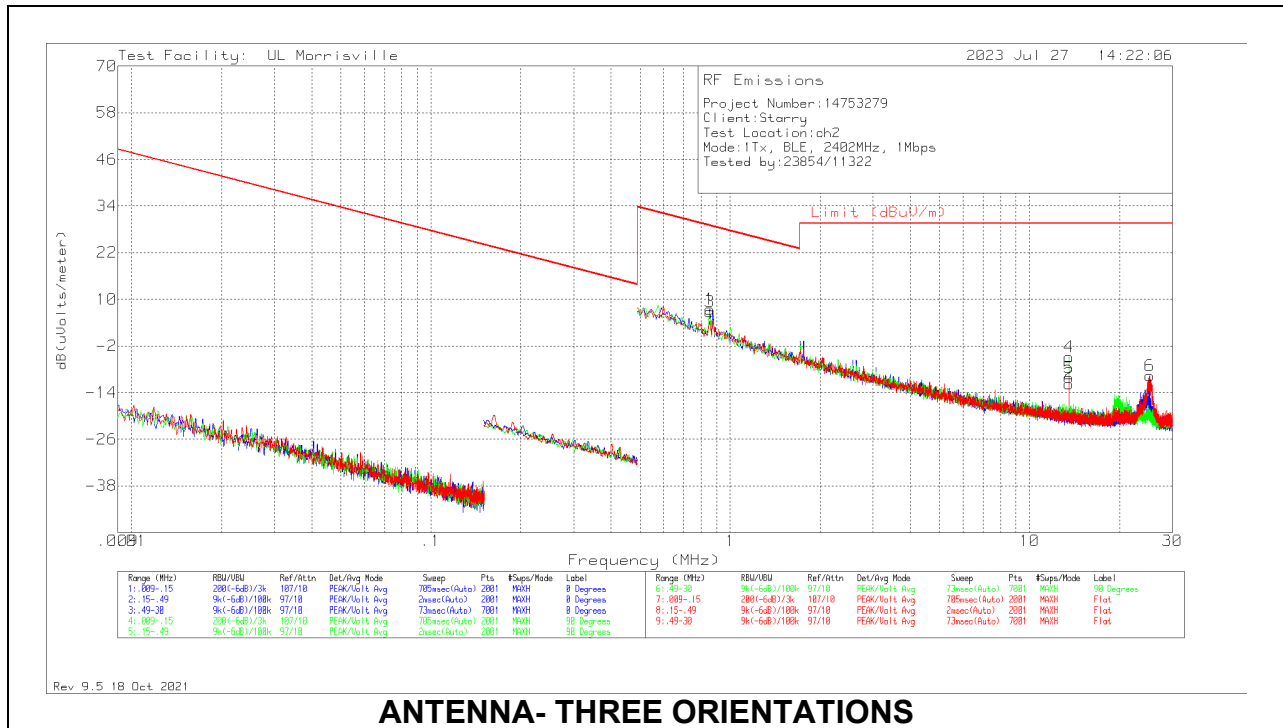


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	88761 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	35.91	Pk	32.3	-24.5	0	43.71	-	-	74	-30.29	31	399	V
2	** 2.5168	38.74	Pk	32.5	-24.6	0	46.64	-	-	74	-27.36	31	399	V
3	*** 2.48354	24	ADV	32.3	-24.5	9.74	41.54	54	-12.46	-	-	31	399	V
4	** 2.51444	24.64	ADV	32.4	-24.6	9.74	42.18	54	-11.82	-	-	31	399	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)



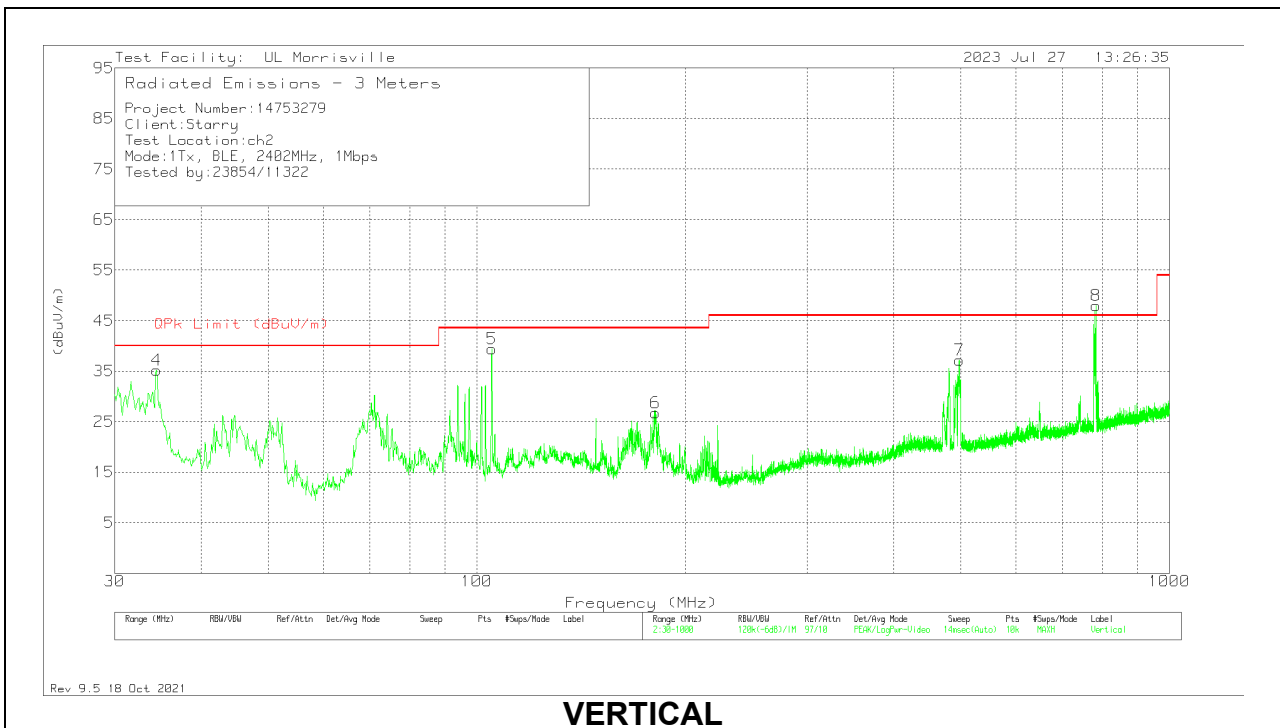
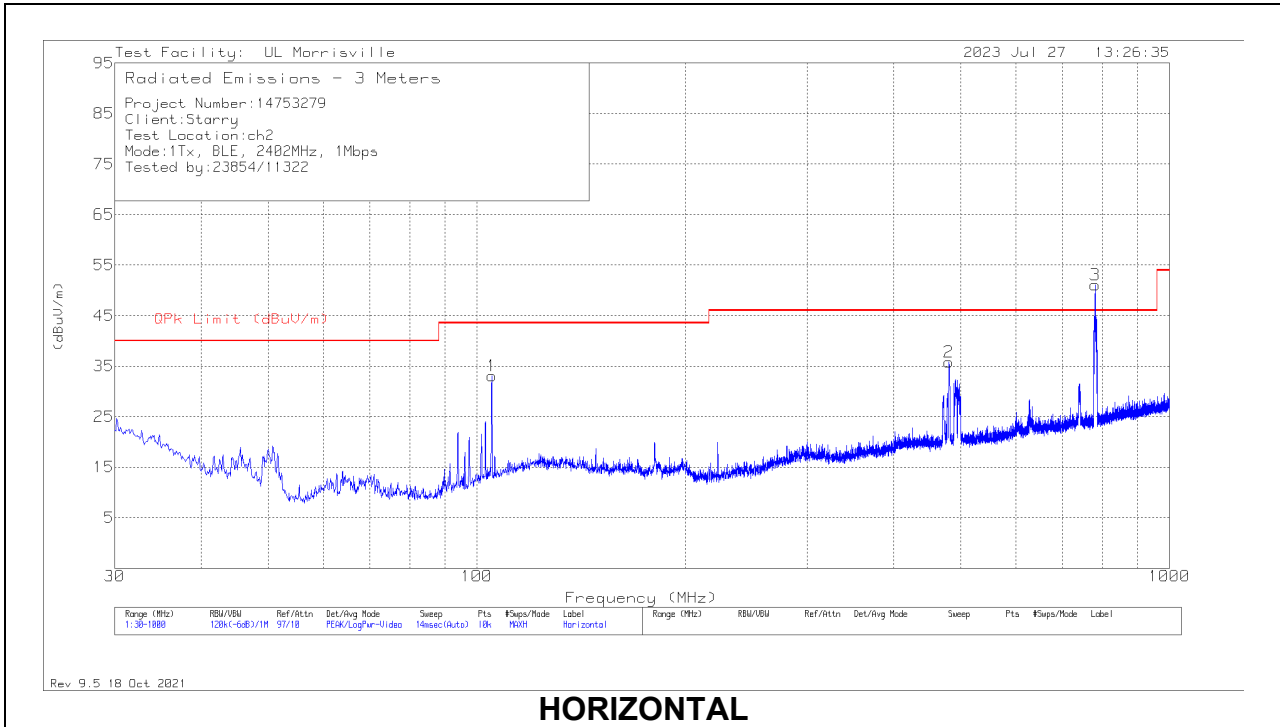
#### ANTENNA- THREE ORIENTATIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
1	.85679	35.01	Pk	12.2	.2	-40	7.41	28.95	-21.54	-	-	0-360	0 degs
3	.85679	34.44	Pk	12.2	.2	-40	6.84	28.95	-22.11	-	-	0-360	90 degs
2	13.5596	17.03	Pk	10.6	.6	-40	-11.77	29.54	-41.31	-	-	0-360	0 degs
4	13.5596	24.03	Pk	10.6	.6	-40	-4.77	29.54	-34.31	-	-	0-360	90 degs
5	13.5596	18.65	Pk	10.6	.6	-40	-10.15	29.54	-39.69	-	-	0-360	Flat
6	25.25057	20.66	Pk	8.8	.9	-40	-9.64	29.54	-39.18	-	-	0-360	Flat

Pk - Peak detector

### 10.4. WORST CASE BELOW 1 GHZ

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





**Below 1GHz Data**

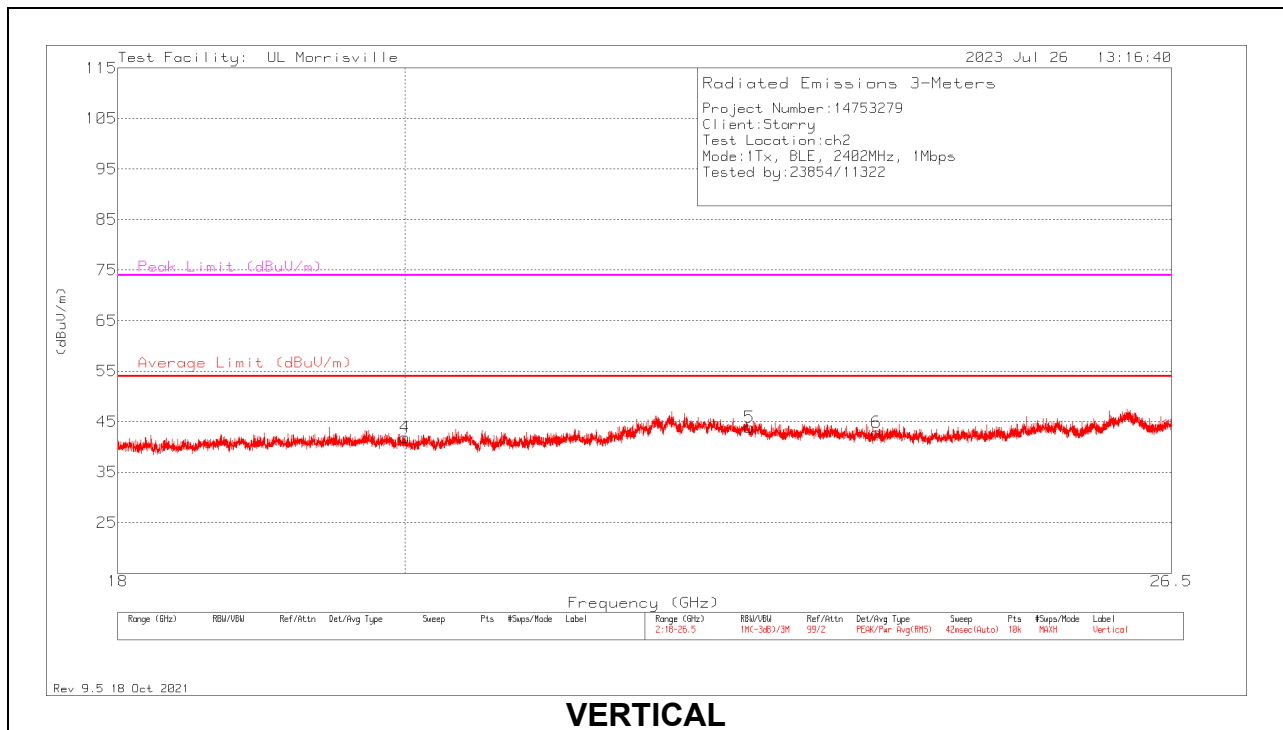
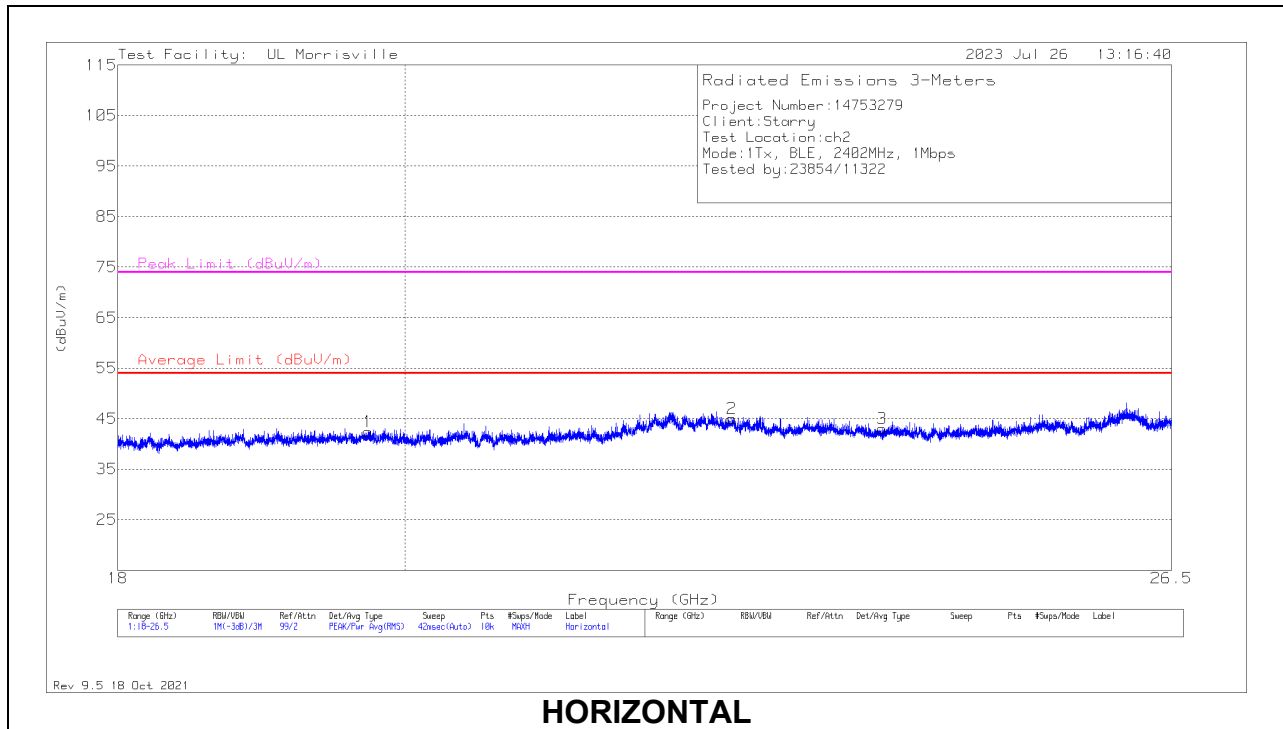
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	90627 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	34.3901	33.31	Qp	24.1	-31.7	25.71	40	-14.29	344	108	V
1	105.078	46.12	Pk	17.8	-30.8	33.12	43.52	-10.4	0-360	299	H
5	105.1485	33.64	Qp	17.8	-30.8	20.64	43.52	-22.88	4	112	V
6	181.223	39.4	Pk	17.5	-30.1	26.8	43.52	-16.72	0-360	101	V
2	480.468	40.73	Pk	23.8	-28.7	35.83	46.02	-10.19	0-360	199	H
7	497.055	41.77	Pk	23.8	-28.4	37.17	46.02	-8.85	0-360	101	V
3	781.3114	18.71	Qp	26.8	-27.3	18.21	46.02	-27.81	146	127	H
8	782.9117	18.38	Qp	26.7	-27.1	17.98	46.02	-28.04	6	173	V

Pk - Peak detector

Qp - Quasi-Peak detector

### 10.5. WORST CASE 18-26 GHZ

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



**18 – 26GHz Data**

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	78835 (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	* ** 19.73298	47.26	Pk	33	-37.9	42.36	54	-11.64	74	-31.64	0-360	150	H
2	* ** 22.55299	47.36	Pk	35.6	-37.9	45.06	54	-8.94	74	-28.94	0-360	300	H
3	* ** 23.83212	46.34	Pk	34.2	-37.5	43.04	54	-10.96	74	-30.96	0-360	101	H
4	* ** 20.0041	46.71	Pk	33.1	-37.9	41.91	54	-12.09	74	-32.09	0-360	101	V
5	* ** 22.69918	46.47	Pk	35.4	-38	43.87	54	-10.13	74	-30.13	0-360	101	V
6	* ** 23.78112	45.88	Pk	34.1	-37.1	42.88	54	-11.12	74	-31.12	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

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## 11. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

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.

### TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

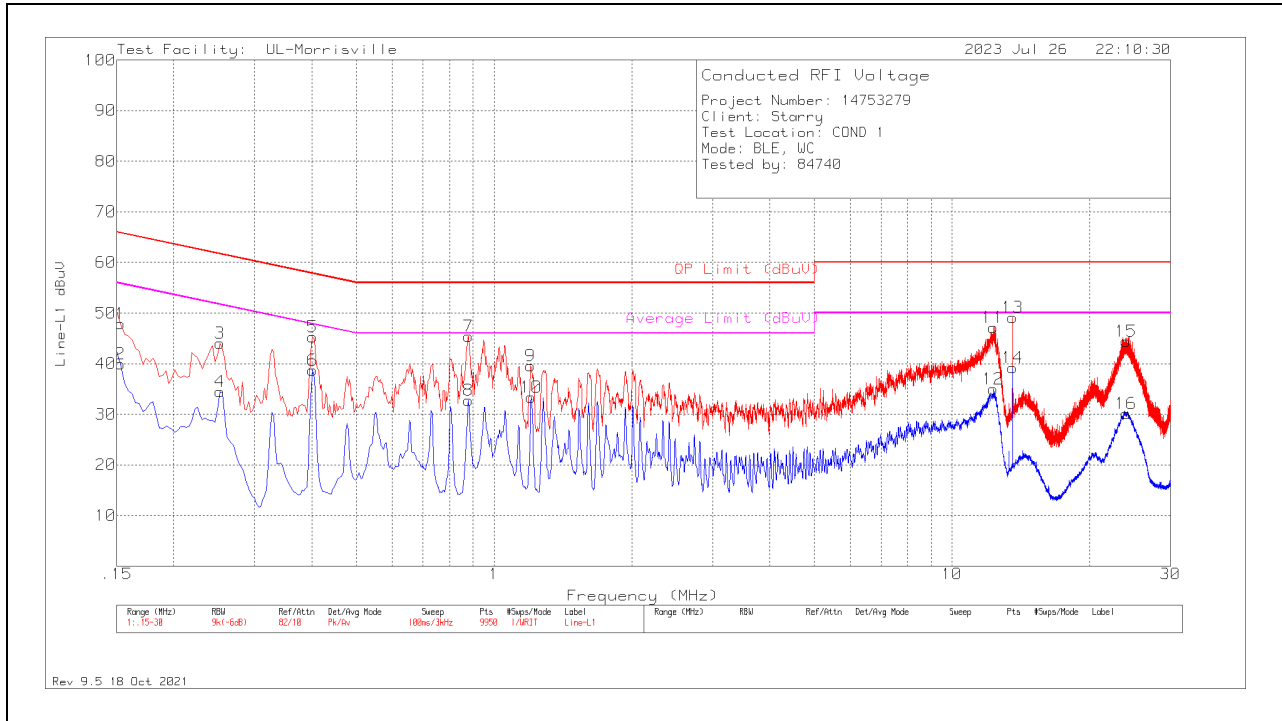
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both lines.

### RESULTS

**11.1.1. AC Power Line Host**

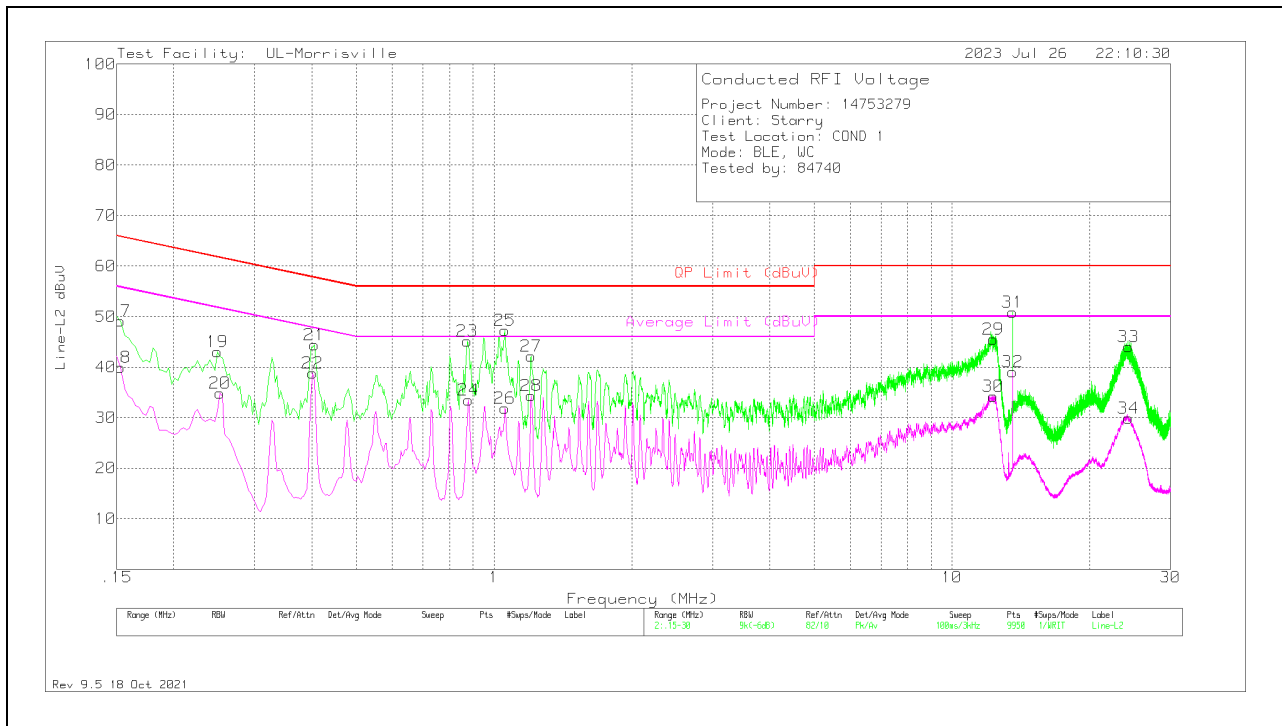
**LINE 1 RESULTS**



Range 1: Line-L1 .15 - 30MHz										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
1	.153	37.93	Pk	.2	9.8	47.93	65.84	-17.91	-	-
2	.153	29.99	Av	.2	9.8	39.99	-	-	55.84	-15.85
3	.252	34.12	Pk	.1	9.8	44.02	61.69	-17.67	-	-
4	.252	24.58	Av	.1	9.8	34.48	-	-	51.69	-17.21
5	.402	35.43	Pk	0	9.8	45.23	57.81	-12.58	-	-
6	.402	28.94	Av	0	9.8	38.74	-	-	47.81	-9.07
7	.879	35.55	Pk	0	9.8	45.35	56	-10.65	-	-
8	.879	22.97	Av	0	9.8	32.77	-	-	46	-13.23
9	1.203	29.76	Pk	0	9.8	39.56	56	-16.44	-	-
10	1.206	23.55	Av	0	9.8	33.35	-	-	46	-12.65
11	12.288	36.99	Pk	.1	10	47.09	60	-12.91	-	-
12	12.318	24.82	Av	.1	10	34.92	-	-	50	-15.08
13	13.56	39.06	Pk	.1	10	49.16	60	-10.84	-	-
14	13.563	29.15	Av	.1	10	39.25	-	-	50	-10.75
15	23.955	33.98	Pk	.2	10.2	44.38	60	-15.62	-	-
16	23.961	19.76	Av	.2	10.2	30.16	-	-	50	-19.84

Pk - Peak detector  
 Av - Average detection

### LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN VCF (dB)	Cbl/Limiter (dB)	Corrected Reading dBuV	QP Limit (dBuV)	Margin (dB)	Average Limit (dBuV)	Margin (dB)
17	.153	39.08	Pk	.2	9.8	49.08	65.84	-16.76	-	-
18	.153	29.9	Av	.2	9.8	39.9	-	-	55.84	-15.94
19	.249	33.12	Pk	.1	9.8	43.02	61.79	-18.77	-	-
20	.252	24.97	Av	.1	9.8	34.87	-	-	51.69	-16.82
21	.405	34.6	Pk	0	9.8	44.4	57.75	-13.35	-	-
22	.402	29.02	Av	0	9.8	38.82	-	-	47.81	-8.99
23	.873	35.31	Pk	0	9.8	45.11	56	-10.89	-	-
24	.879	23.68	Av	0	9.8	33.48	-	-	46	-12.52
25	1.056	37.45	Pk	0	9.8	47.25	56	-8.75	-	-
26	1.056	22.02	Av	0	9.8	31.82	-	-	46	-14.18
27	1.206	32.37	Pk	0	9.8	42.17	56	-13.83	-	-
28	1.206	24.6	Av	0	9.8	34.4	-	-	46	-11.6
29	12.303	35.42	Pk	.1	10	45.52	60	-14.48	-	-
30	12.312	24.12	Av	.1	10	34.22	-	-	50	-15.78
31	13.56	40.79	Pk	.1	10	50.89	60	-9.11	-	-
32	13.56	28.96	Av	.1	10	39.06	-	-	50	-10.94
33	24.321	33.61	Pk	.2	10.2	44.01	60	-15.99	-	-
34	24.285	19.44	Av	.2	10.2	29.84	-	-	50	-20.16

Pk - Peak detector  
 Av - Average detection

## 12. SETUP PHOTOS

Please refer to R14753279-EP1 for setup diagrams and setup photos.

**END OF TEST REPORT**