

TEST REPORT

Report Number. : R15899798-E1

Applicant : Ecolab Inc
655 LONE OAK DR BLDG F MS F6
EAGAN, MN, USA 55121

Model : RT Standard IR Sensor

FCC ID : Z9O-53007129

IC : 10060A-53007129

EUT Description : Battery Powered BLE Sensor

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 4
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:

2026-01-08

Prepared by:

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	2026-01-08	Initial Issue	Noah Bennett

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Ecolab Inc
655 LONE OAK DR BLDG F MS F6
EAGAN, MN, USA 55121

EUT DESCRIPTION: Battery Powered BLE Sensor

MODEL: RT Standard IR Sensor

SERIAL NUMBER: *DUT4, DUT2*

SAMPLE RECEIPT DATE: 2025-08-05

DATE TESTED: 2025-08-05 THRU 2025-09-04

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 4	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

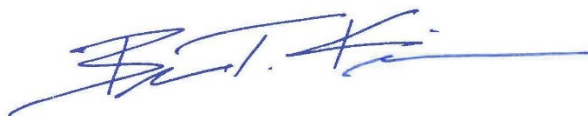
UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the sample tested, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to ensure 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:

Prepared By:



Brian Kiewra
Project Engineer
Consumer, Medical and IT Segment
UL LLC



Noah Bennett
Engineer Project Associate
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 correctly integrating customer-provided data with measurements performed by UL LLC.

Below is a list of the data provided by the customer:

- 1) Antenna gain and type (section 6.3)
- 2) Supported Data-Rates and Power Settings. Orientation of Operation (Section 6.5)
- 3) Software, Firmware and Hardware Versions of EUT (section 6.4)
- 4) Worst-Case operational Duty Cycle (section 9.1)

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 6.3.1 (a)	6dB BW	Compliant	None.
15.247 (b) (3)	RSS-247 6.3.2 (d)	Output Power		None.
See Comment		Average power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (e)	RSS-247 6.3.1 (b)	PSD	Compliant	None.
15.247 (d)	RSS-247 6.6	Conducted Spurious Emissions		None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		None.
15.207	RSS-Gen 8.8	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 15,
- ANSI C63.10-2020, (**FCC**)
- ANSI C63.10-2020+Cor. 1-2023+C63.10a-2024 + Errata to C63.10a-2024 (**ISED**)
- 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 4.

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
☒	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	ULab
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Occupied Bandwidth	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) / 0.45 dB (AV)
Unwanted Emissions, Conducted	1.94 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Time Domain Measurements	3.39%
Temperature	0.57°C
Humidity	3.39%
DC Supply Voltages	0.57%

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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Battery Powered BLE Sensor.

The EUT supports the following technologies:

Wireless technologies	Frequency Band(s)	Operating mode(s)
Bluetooth	2.4 GHz	LE 1 & 2 Mbps LE S2 & S8
Notes: 1) The EUT operated in a 1x1 SISO mode.		

This report covers the full testing of the BLE radio.

6.2. MAXIMUM OUTPUT POWER

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

Antenna	Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
ANT 1	2402 - 2480	BLE	20.45	110.94

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Chain	Designation in Documentation	Frequency Range (MHz)	Maximum Gain (dBi)
0	Inverted-F PCB Trace Antenna	2402 – 2482	3.27

6.4. SOFTWARE AND FIRMWARE

EUT HW Version: REV-02

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz were performed with the EUT set to transmit at the mode and channel with highest output power as worst-case scenario.

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. The EUT was set to transmit at Max power. The worst-case modes for both output power and PSD are reported for Radiated. For output power, worst-case was 2Mbps. Worst-Case PSD was 125Kbps.

125Kbps power was reduced to pass PSD limits. The Pset was "0078". (12dBm).

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.

The EUT was connected to a DC power supply for radiated testing as worst-case.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Support Phone	Apple	iPhone 12	QVH1F424W1	-

I/O CABLES

I/O Cable List						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	DC	1	Barrel	Unshielded	<3m	Used to Power EUT via DC Power Supply.

TEST SETUP

The EUT is configured to transmit at max power via terminal commands through a companion app. The Support phone was not subject to test.

SETUP DIAGRAMS

Please refer to R15899798-EP1 for setup diagrams

7. MEASUREMENT METHOD

On-Time and Duty Cycle: ANSI C63.10 Section 11.6.

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW $\geq$ DTS BW

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 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)

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

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

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.
	Conducted Room 1				
90416	Spectrum Analyzer	Keysight Technologies	N9030A	2025-7-31	2026-07-31
CBL092	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz	Carlisle Interconnect Technologies	UFA147A-2-0360- 200200	2025-05-09	2026-05-09
Cbl010	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz	Carlisle Interconnect Technologies	UFA147A-2-0360- 200200	2025-6-6	2026-6-6
Pad III	SMA Coaxial 10dB Attenuator	CentricRF	C18S2-10	2025-08-18	2026-08-18
207726	Temp/Humid Chamber	Thermotron	SM-32-8200	2025-01-15	2026-01-15
179892	Environmental Meter 161024885	Fisher Scientific	15-077-963	2025-08-05	2026-08-05
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA
Power Software	Boonton Power Analyzer	Boonton	Version 3.0.13.0	NA	NA

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 1)

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
0.009-30MHz					
65682	Active Loop Antenna	ETS-Lindgren	6502	2023-10-03	2025-10-03
	30-1000 MHz				
90629	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2024-01-30	2026-01-30
	1-18 GHz				
135143	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2024-02-07	2026-02-07
	18-40 GHz				
91186	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2024-05-16	2026-05-16
	Gain-Loss Chains				
91974	Gain-loss string: 0.009-30MHz	Various	Various	2025-05-31	2026-05-31
91976	Gain-loss string: 25-1000MHz	Various	Various	2025-05-31	2026-05-31
91979	Gain-loss string: 1-18GHz	Various	Various	2025-05-31	2026-05-31
135999	Gain-loss string: 18-40GHz	Various	Various	2025-05-31	2026-05-31
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2025-05-12	2026-05-12
90411	Spectrum Analyzer	Keysight	N9030A	2025-07-30	2026-07-30
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
NA	DC Power Supply	BK Precision	1715A	NA	NA
241205	Environmental Meter	Fisher Scientific	15-077-963	2025-08-05	2027-08-05

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

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
88761	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-10-05	2025-10-05
	Gain-Loss Chains				
91977	Gain-loss string: 1-18GHz	Various	Various	2025-05-31	2026-05-31
	Receiver & Software				
206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2025-07-29	2026-07-29
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
239540	Environmental Meter	Fisher Scientific	15-077-963	2025-08-05	2027-08-05

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						
Declared Operational DC	2.000	100.000	0.020	2.00%	33.98	0.500
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
BLE 125Kbps	100.000	100.000	1.000	100.00%	0.00	0.010
BLE 500Kbps	100.000	100.000	1.000	100.00%	0.00	0.010

KDB 558074 D01 15.247 Meas Guidance v05r02 Section 11.Q3(a): Protocol-Limited Duty Cycle Correction Factors

For Radiated test results, Average readings were calculated using KDB 558704 D01 11.Q3(a), where the operational duty cycle of 33.98dB, as declared by the manufacturer and calculated below, was subtracted from the Peak measurements.

$$\begin{aligned}\text{Duty Cycle Correction Factor (dB)} &= 20 \cdot \log(1/\text{DC}) \\ &= 20 \cdot \log(1/2\%) \\ &= 33.98\text{dB}\end{aligned}$$

Note: As tested, Duty Cycle was 100%.

DUTY CYCLE PLOTS



9.2. 99% BANDWIDTH

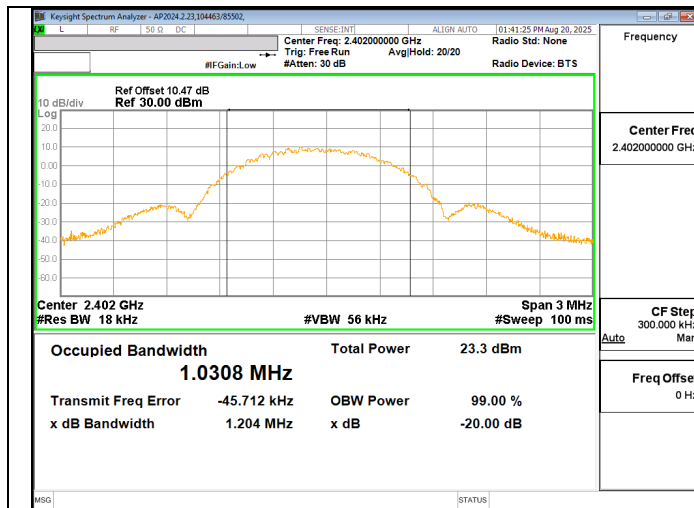
LIMITS

None; for reporting purposes only.

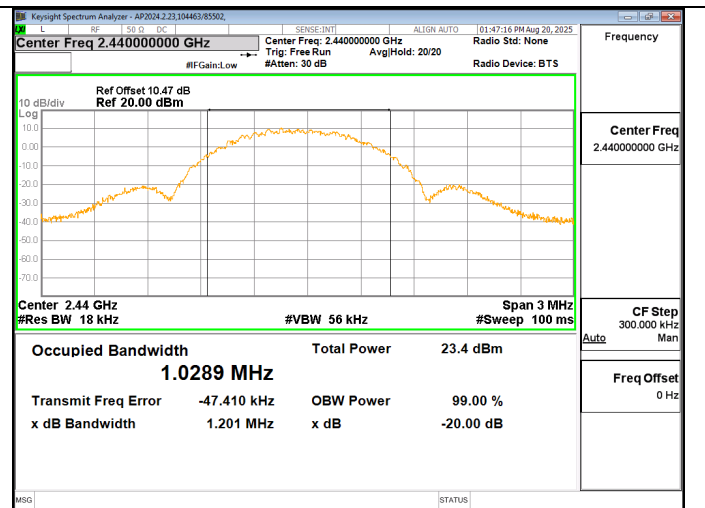
RESULTS

9.2.1. BLE (1Mbps)

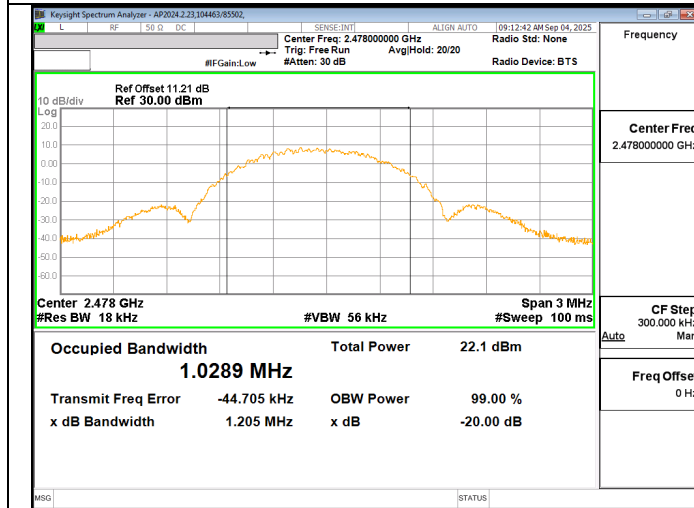
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0308
Middle	2440	1.0289
High	2478	1.0289
High	2480	1.0284



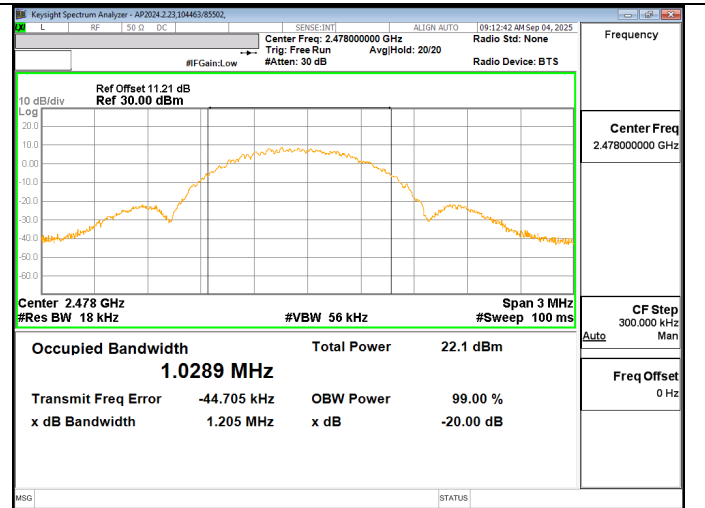
LOW CH



MID CH



HIGH CH (2478)



HIGH CH (2480)

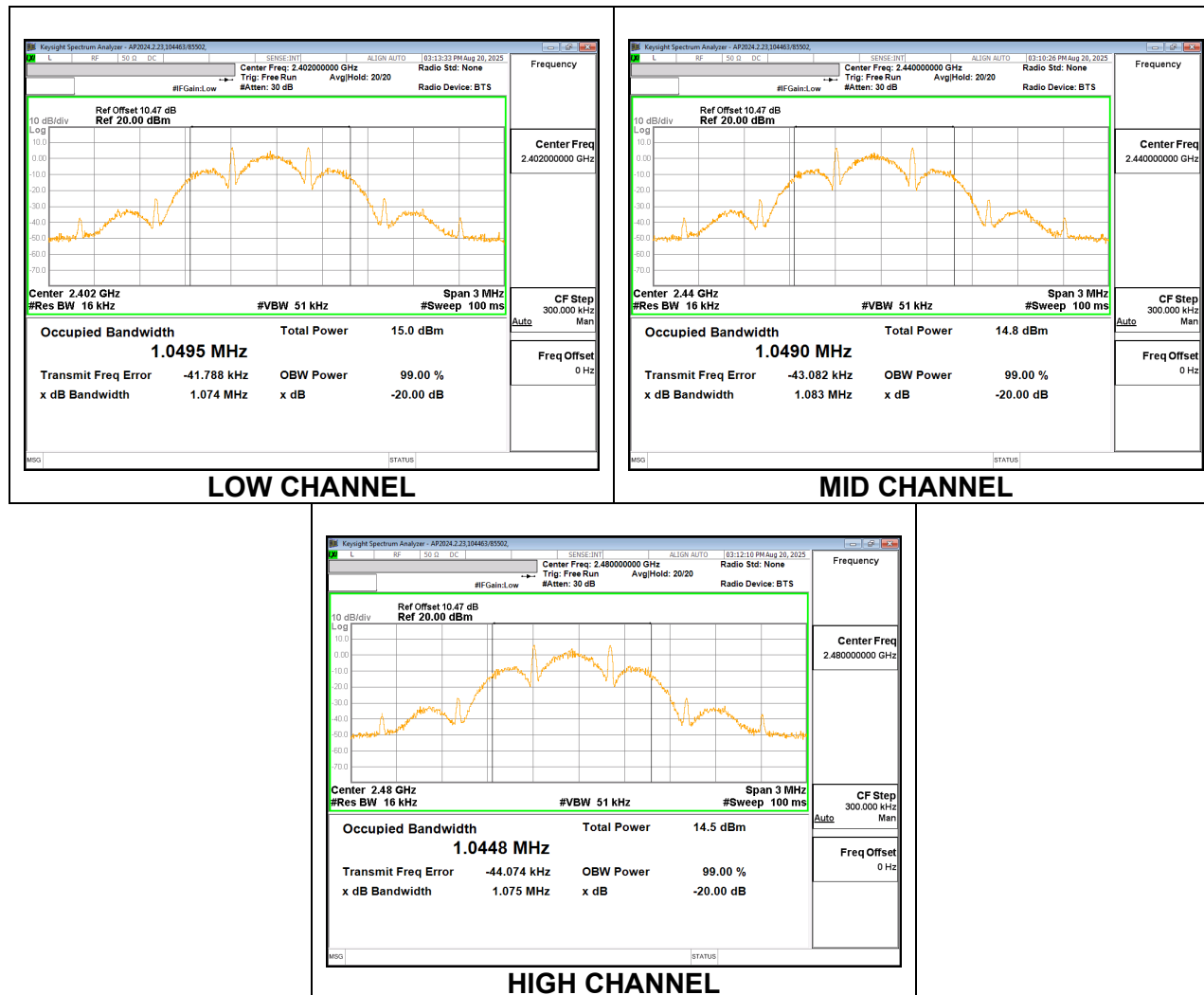
9.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0938
Middle	2440	2.0986
High	2480	2.1053



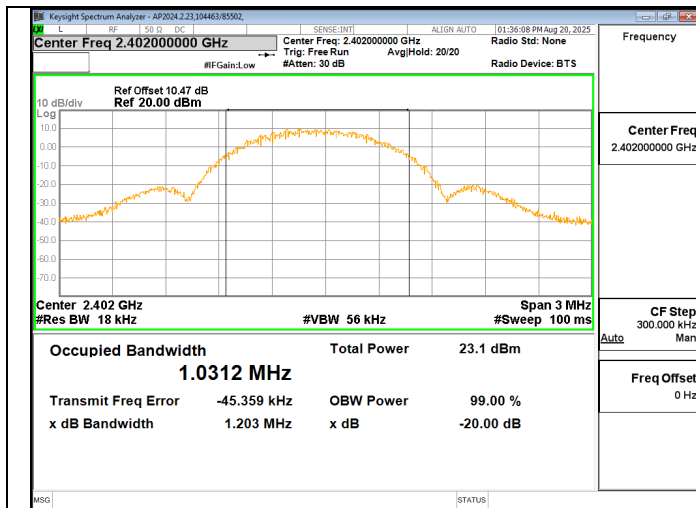
9.2.3. BLE (125Kbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0495
Middle	2440	1.0490
High	2480	1.0448

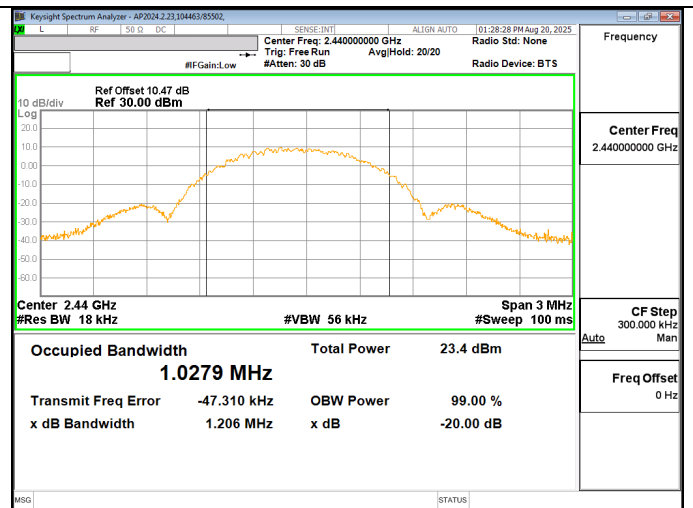


9.2.4. BLE (500Kbps)

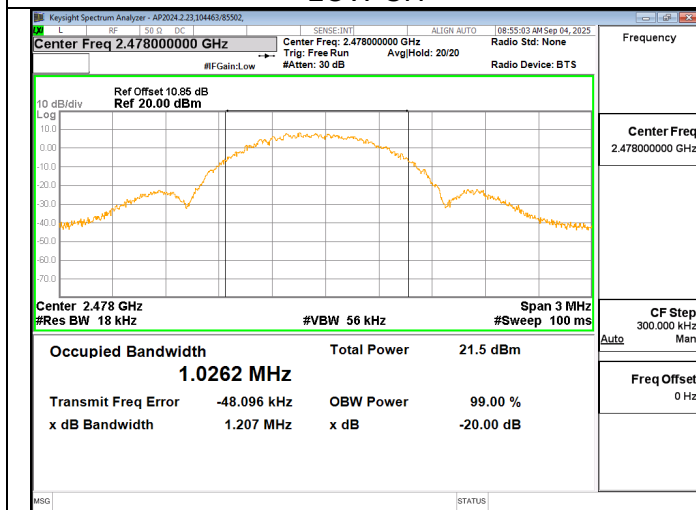
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0312
Middle	2440	1.0279
High	2478	1.0262
High	2480	1.0254



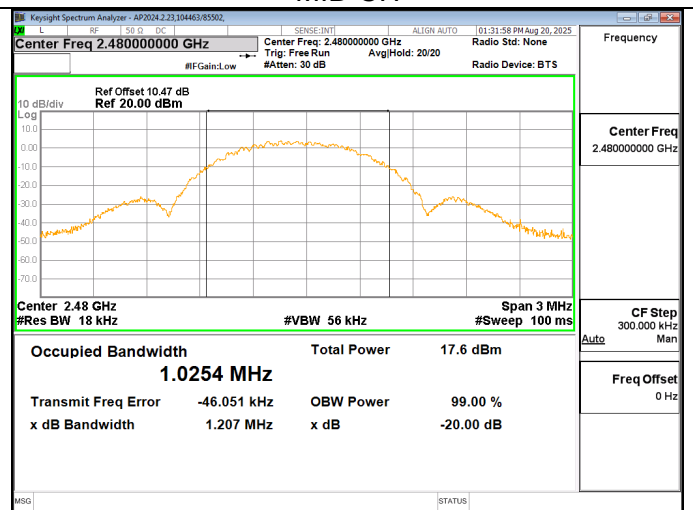
LOW CH



MID CH



HIGH CH (2478)



HIGH CH (2480)

9.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

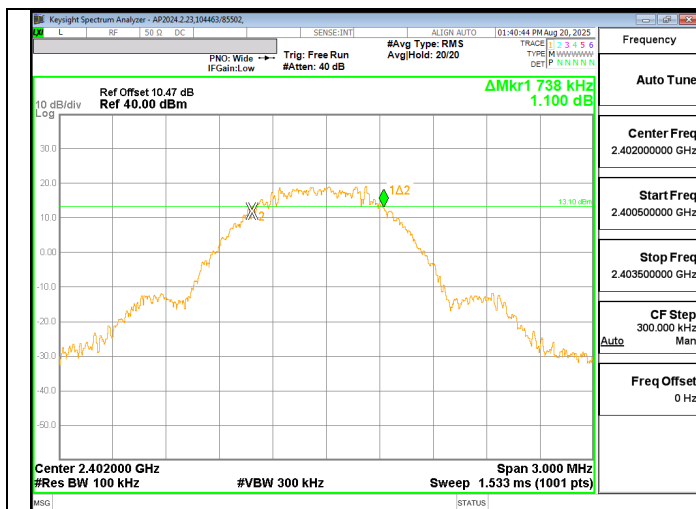
RSS-247 6.3.1 (a)

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

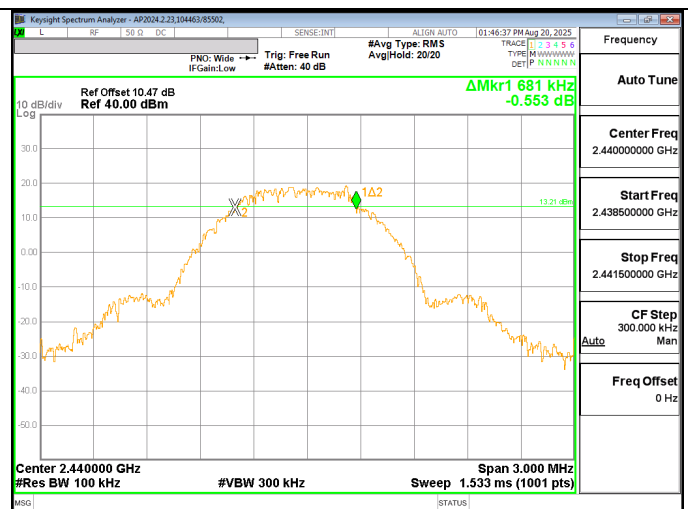
RESULTS

9.3.1. BLE (1Mbps)

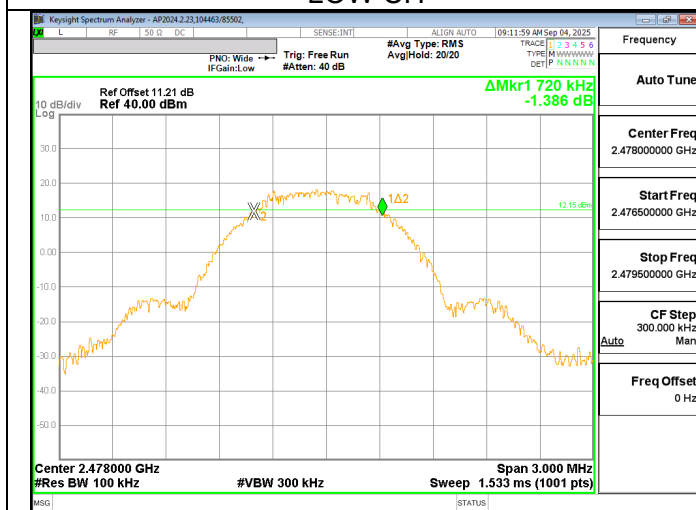
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.738	0.5
Middle	2440	0.681	0.5
High	2478	0.720	0.5
High	2480	0.683	0.5



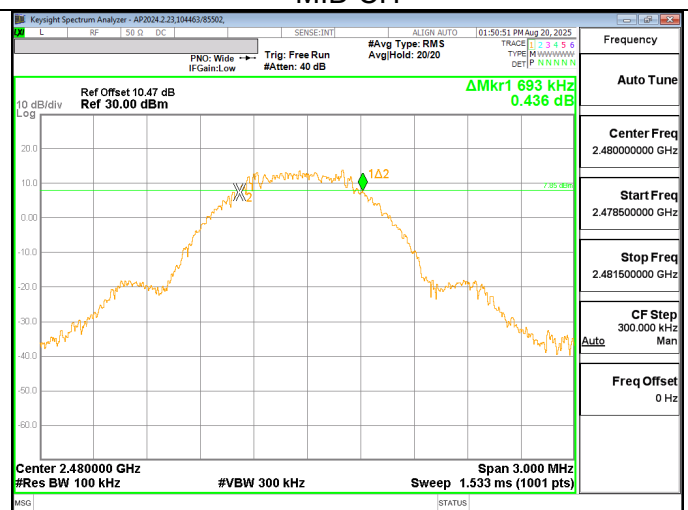
LOW CH



MID CH



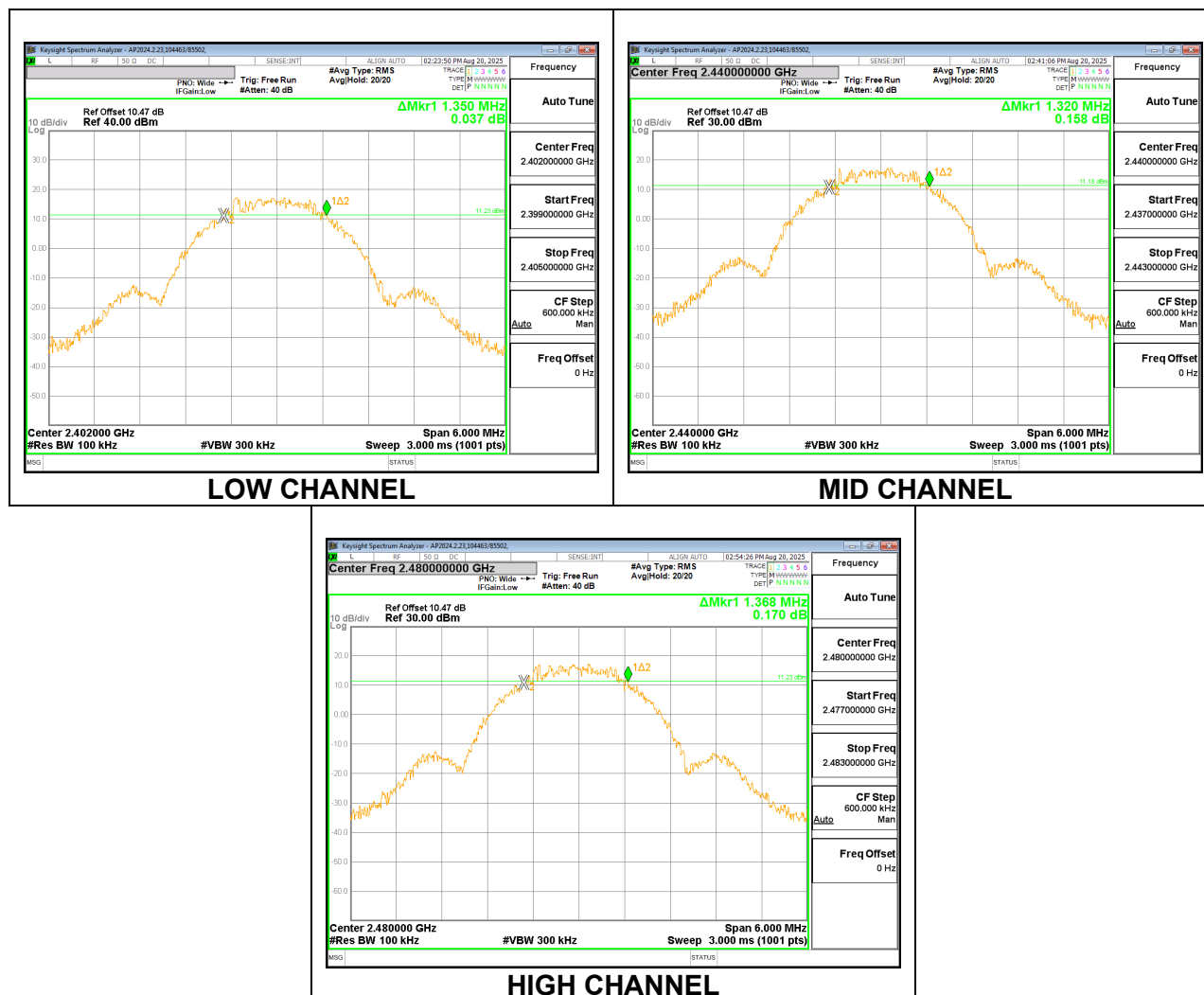
HIGH CH (2478)



HIGH CH (2480)

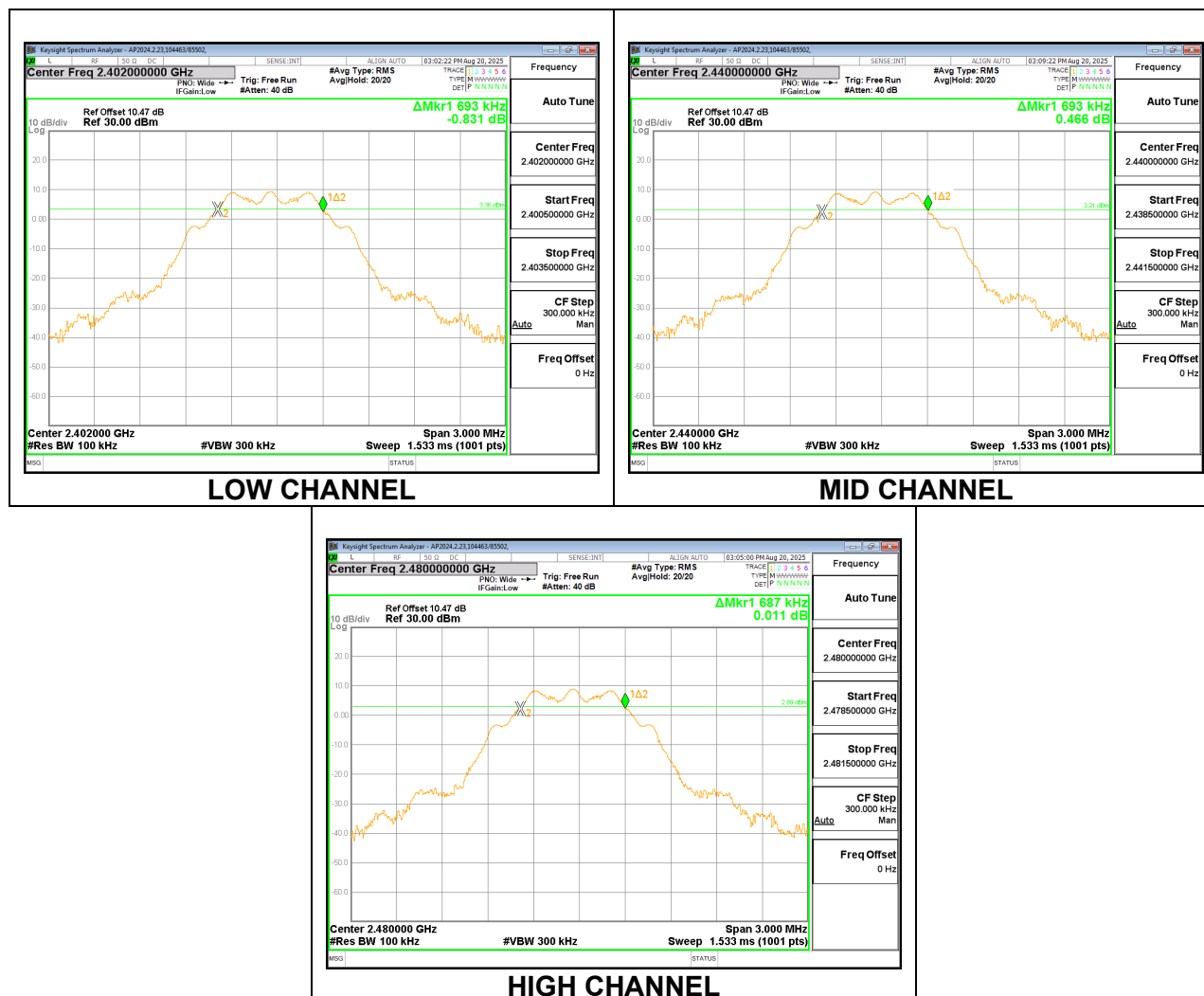
9.3.2. BLE (2Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.350	0.5
Middle	2440	1.320	0.5
High	2480	1.368	0.5



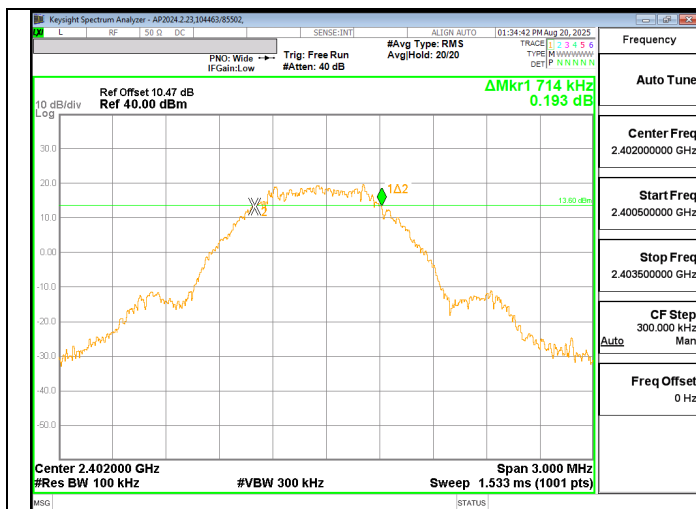
9.3.3. BLE (125Kbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.693	0.5
Middle	2440	0.693	0.5
High	2480	0.687	0.5

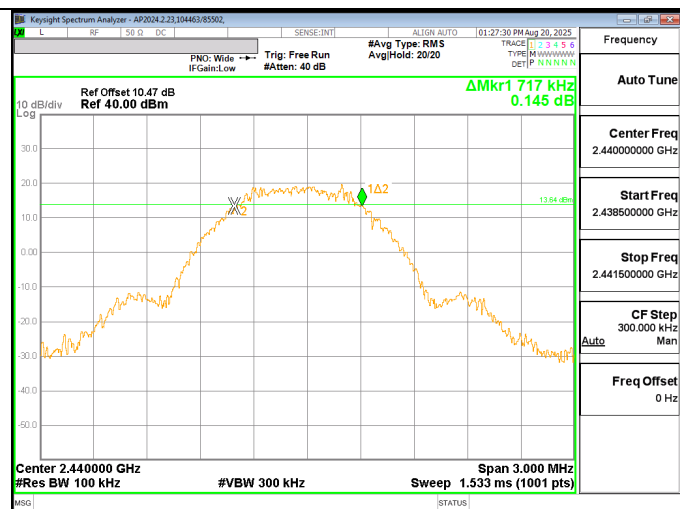


9.3.4. BLE (500Kbps)

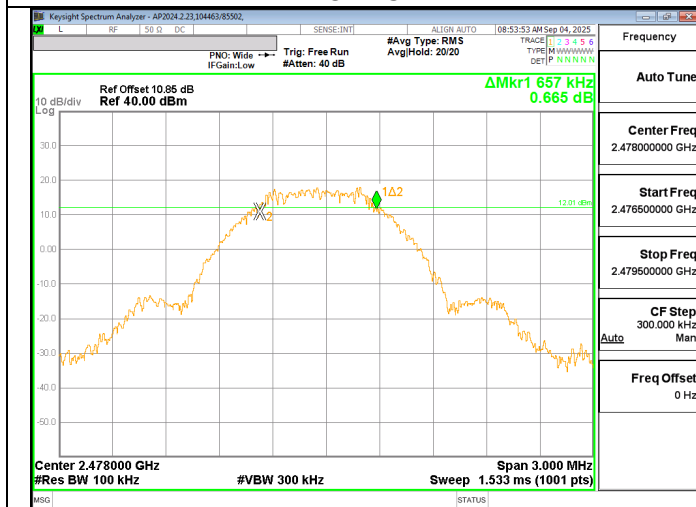
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.714	0.5
Middle	2440	0.717	0.5
High	2478	0.657	0.5
High	2480	0.699	0.5



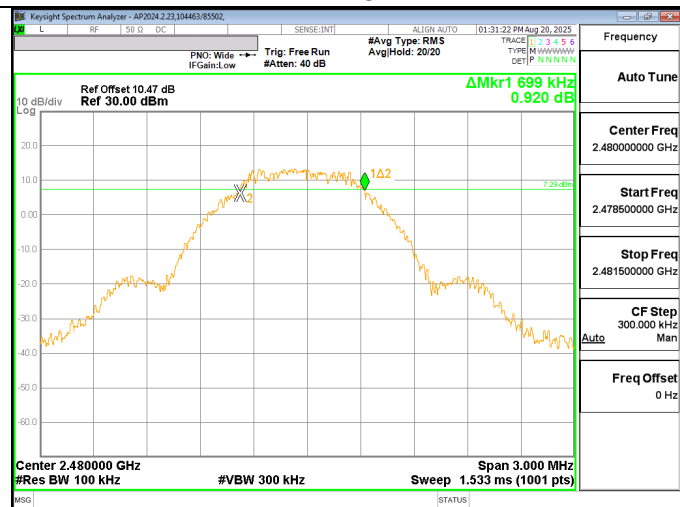
LOW CH



MID CH



HIGH CH (2478)



HIGH CH (2480)

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 wideband power meter.

The cable assembly insertion loss of 10.11 dB (including 9.73 dB pad and 0.38 dB EUT 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 peak power sensor. Peak output power was read directly from power meter. Average Power was measured via a gated method.

RESULTS

Tested On: 8/21/25; 9/4/25

Tested By: 104463/85502

9.4.1. BLE (1Mbps)

Channel	Frequency (MHz)	Avg Power Reading (dBm)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.242	20.428	30	-9.572
Middle	2440	20.241	20.437	30	-9.563
High	2478	18.889	19.070	30	-10.930
High	2480	14.452	14.652	30	-15.348

9.4.2. BLE (2Mbps)

Channel	Frequency (MHz)	Avg Power Reading (dBm)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.255	20.451	30	-9.549
Middle	2440	20.244	20.358	30	-9.642
High	2480	20.157	20.376	30	-9.624

9.4.3. BLE (125Kbps)

Channel	Frequency (MHz)	Avg Power Reading (dBm)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.481	12.678	30	-17.322
Middle	2440	12.203	12.402	30	-17.598
High	2480	11.880	12.070	30	-17.930

9.4.4. BLE (500Kbps)

Channel	Frequency (MHz)	Avg Power Reading (dBm)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	20.230	20.414	30	-9.586
Middle	2440	20.220	20.428	30	-9.572
High	2478	18.895	19.080	30	-10.920
High	2480	14.396	14.589	30	-15.411

9.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

RSS-247 (6.3.1) (b)

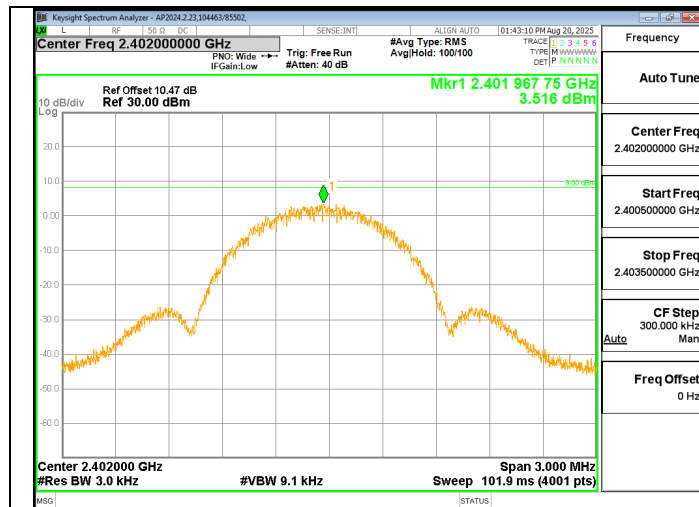
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

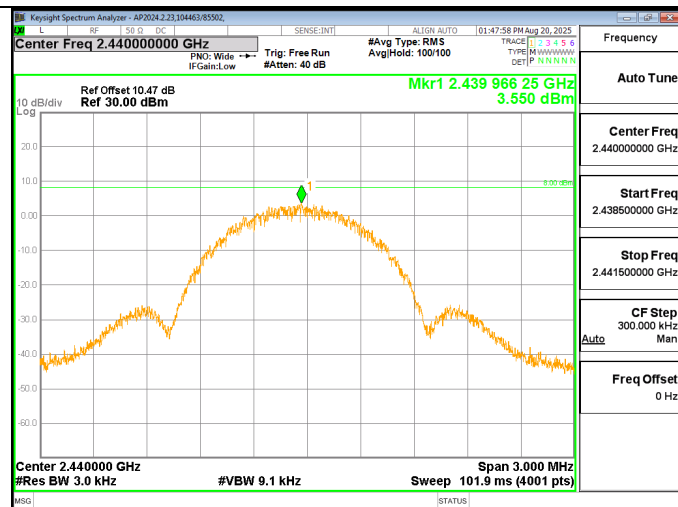
Note: Corrected PSD is the Sum of Measured PSD, and EUT cable loss of 0.38dB.

9.5.1. BLE (1Mbps)

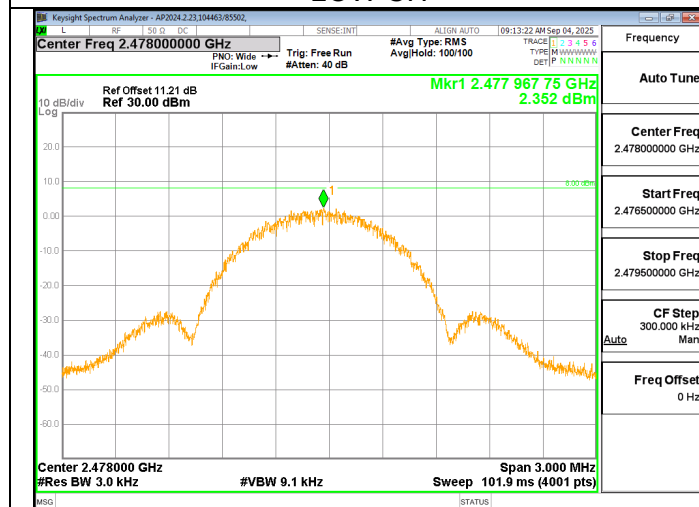
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Corrected PSD (dBm/3KHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	3.516	3.896	8	-4.48
Middle	2440	3.550	3.930	8	-4.45
High	2478	2.352	2.732	8	-5.65
High	2480	-2.194	-1.814	8	-10.19



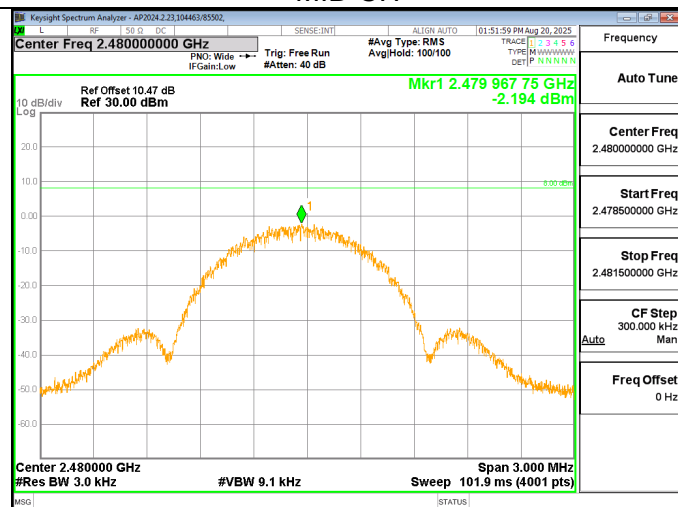
LOW CH



MID CH



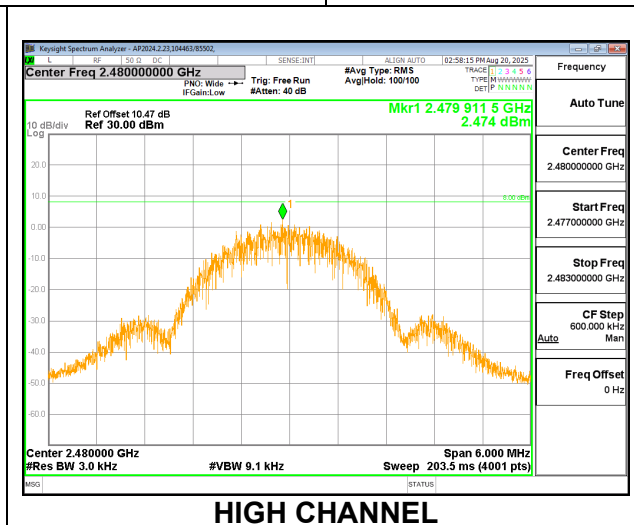
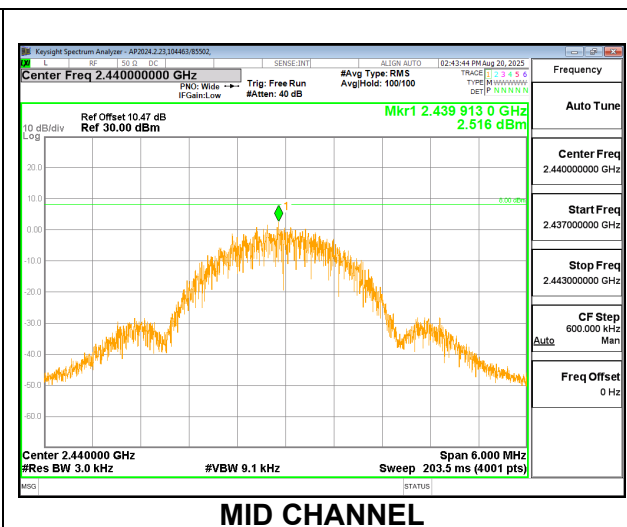
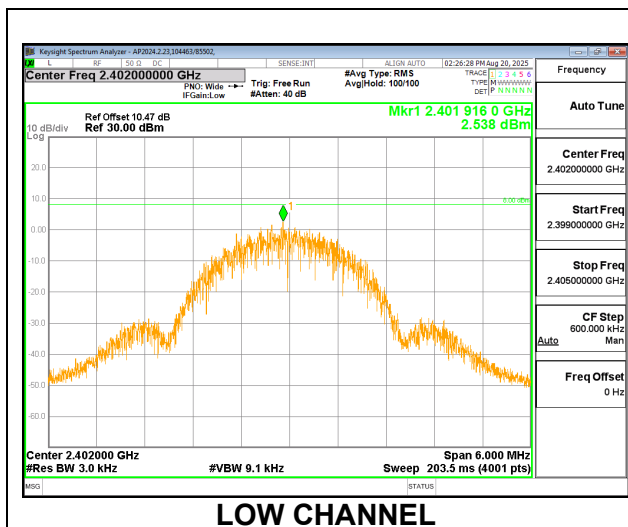
HIGH CH (2478)



HIGH CH (2480)

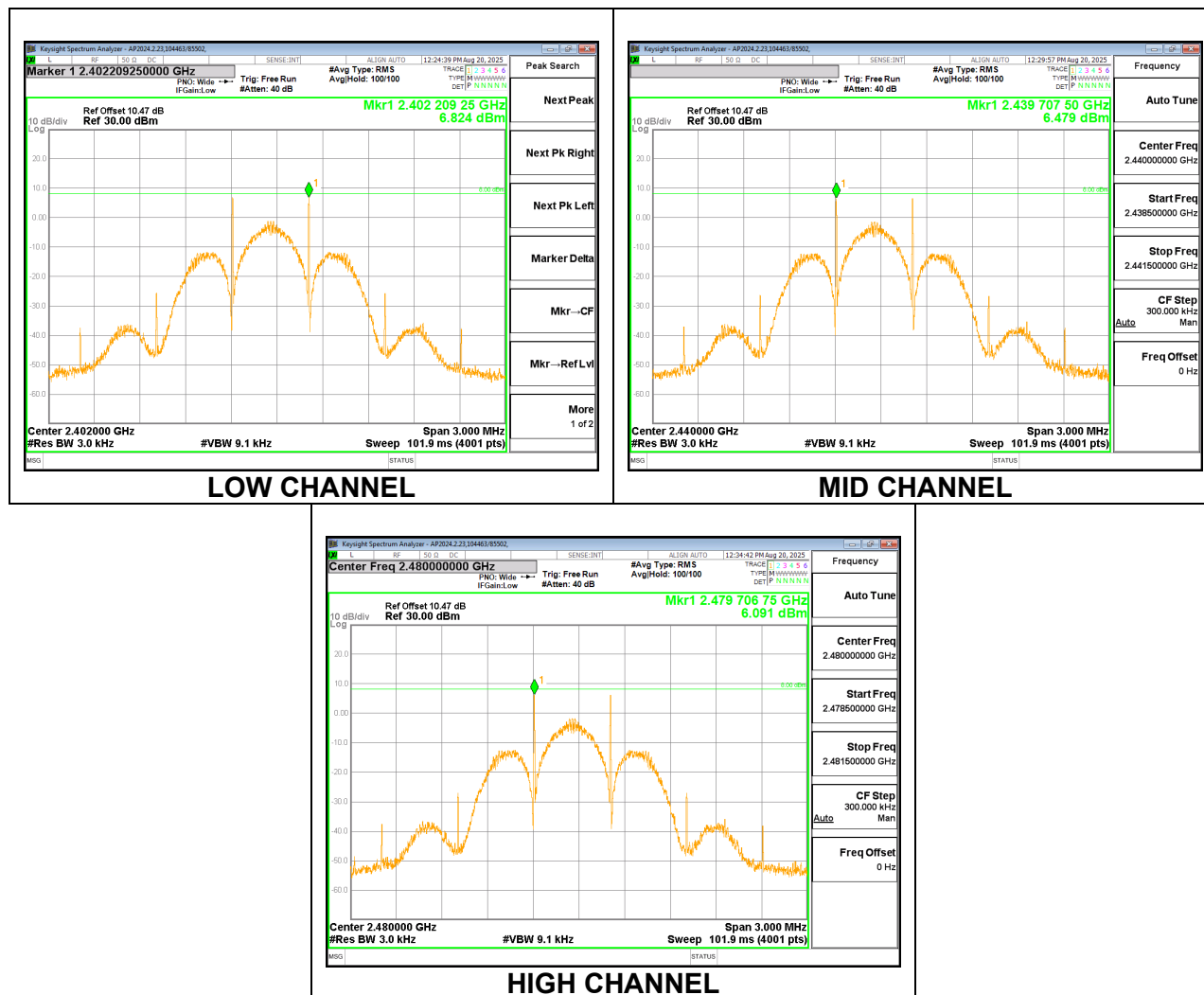
9.5.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Corrected PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	2.538	2.918	8	-5.46
Middle	2440	2.516	2.896	8	-5.48
High	2480	2.474	2.854	8	-5.53



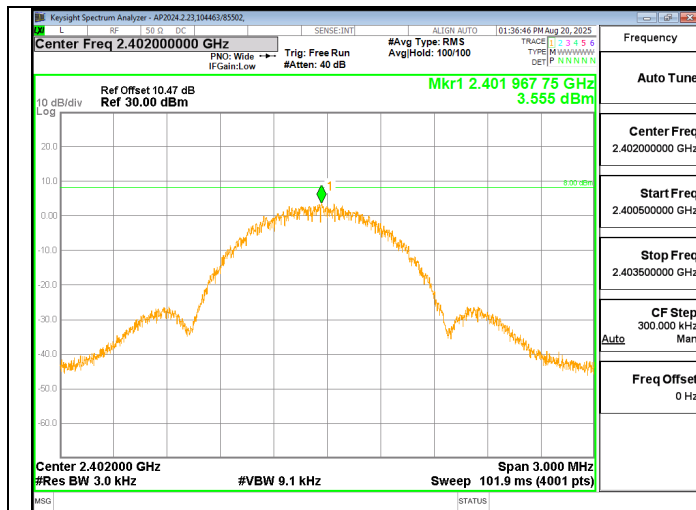
9.5.3. BLE (125Kbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Corrected PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	6.82	7.20	8	-1.18
Middle	2440	6.48	6.86	8	-1.52
High	2480	6.09	6.47	8	-1.91

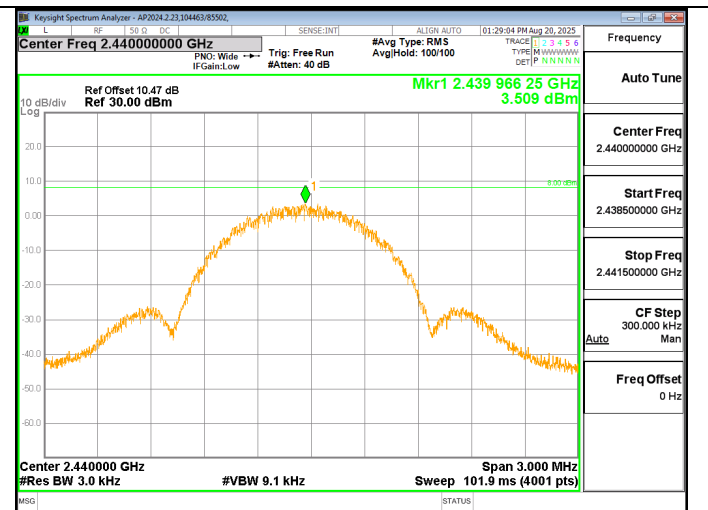


9.5.4. BLE (500Kbps)

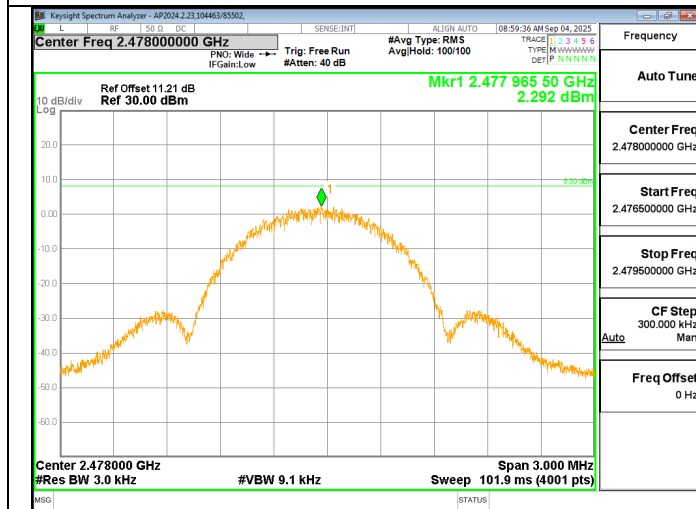
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Corrected PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	3.555	3.935	8	-4.45
Middle	2440	3.509	3.889	8	-4.49
High	2478	2.292	2.672	8	-5.71
High	2480	-2.203	-1.823	8	-10.20



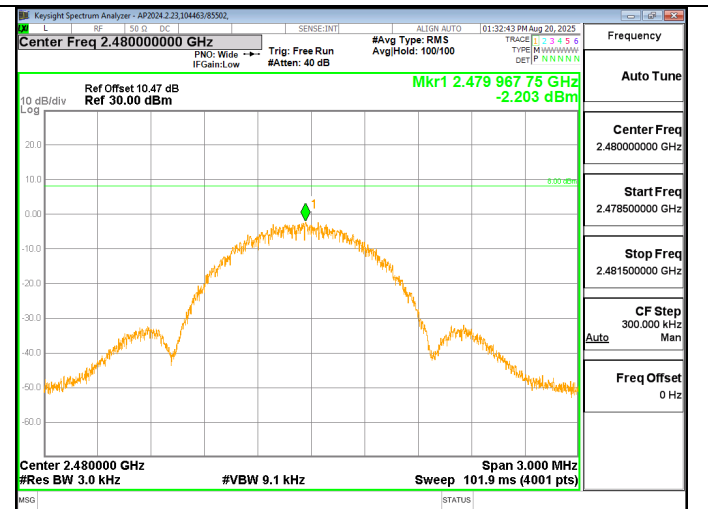
LOW CH



MID CH



HIGH CH (2478)



HIGH CH (2480)

9.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

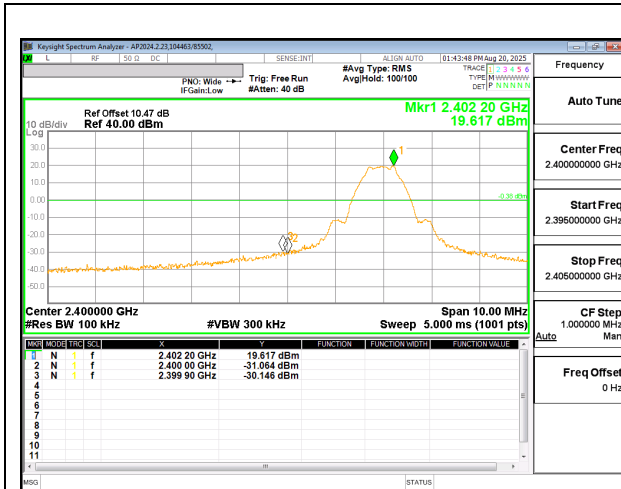
FCC §15.247 (d)

RSS-247 6.6

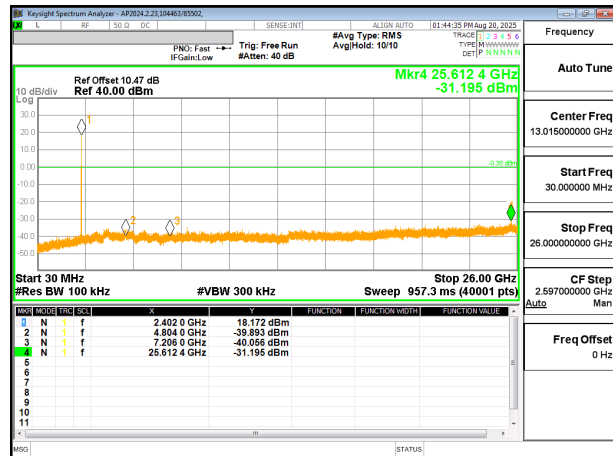
Output power was measured based on the use of a peak measurement, therefore the required attenuation is -20 dBc.

RESULTS

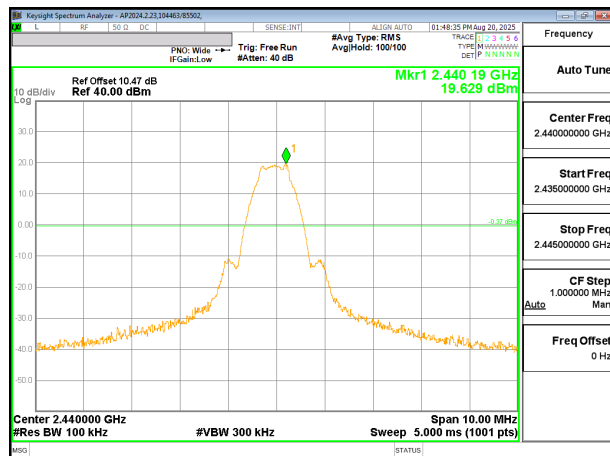
9.6.1. BLE (1Mbps)



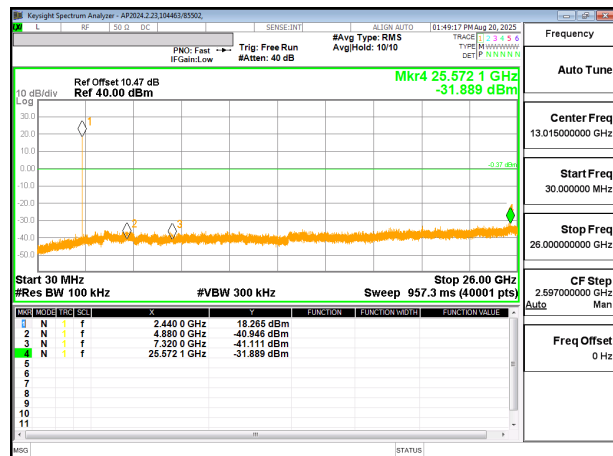
LOW CHANNEL BANDEDGE



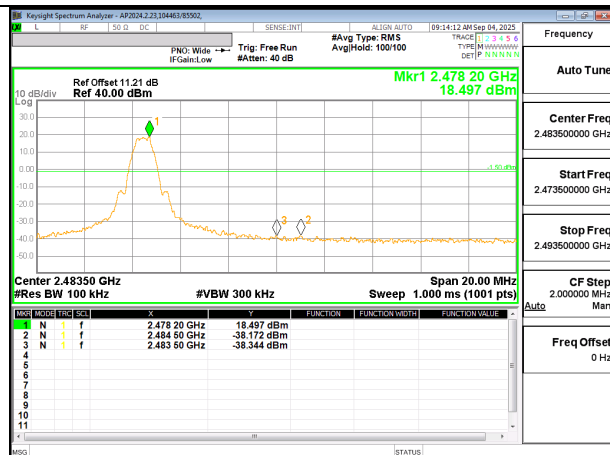
OUT-OF-BAND LOW CHANNEL



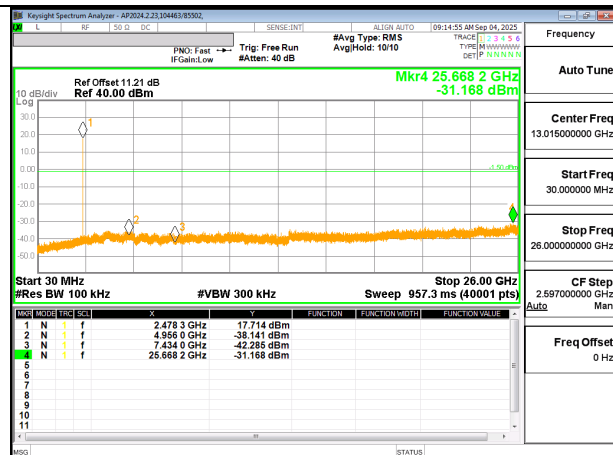
IN-BAND REFERENCE LEVEL



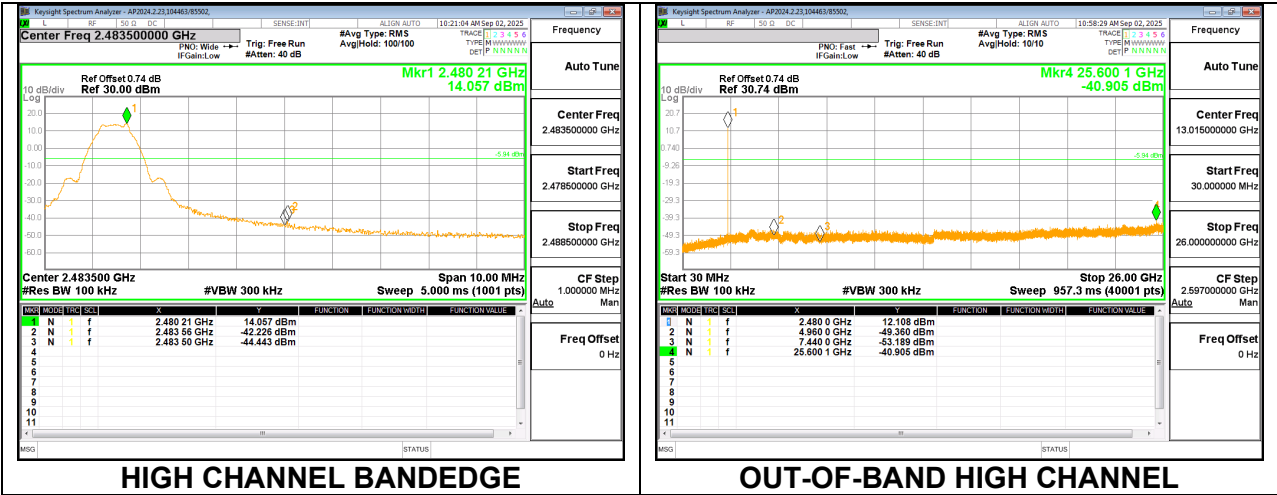
OUT-OF-BAND MID CHANNEL



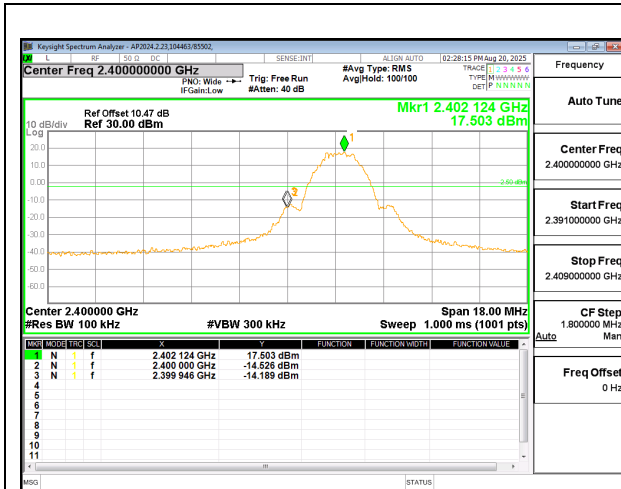
HIGH CHANNEL (2478) BANDEDGE



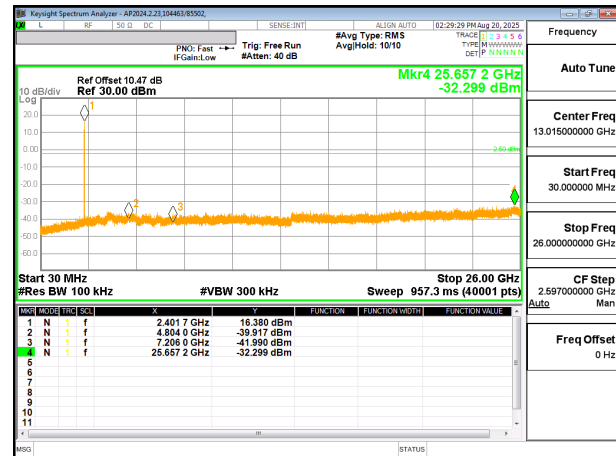
OUT-OF-BAND HIGH CHANNEL (2478)



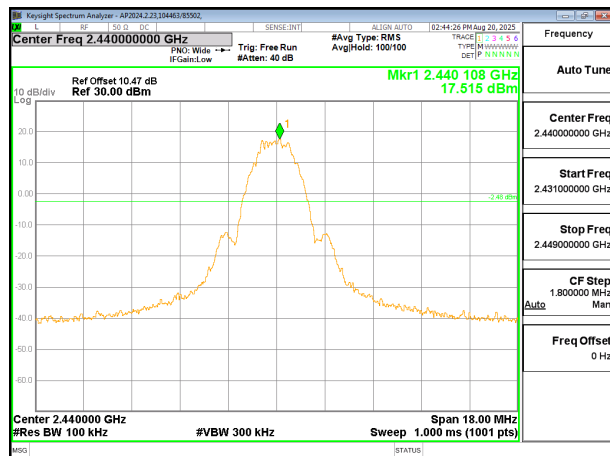
9.6.2. BLE (2Mbps)



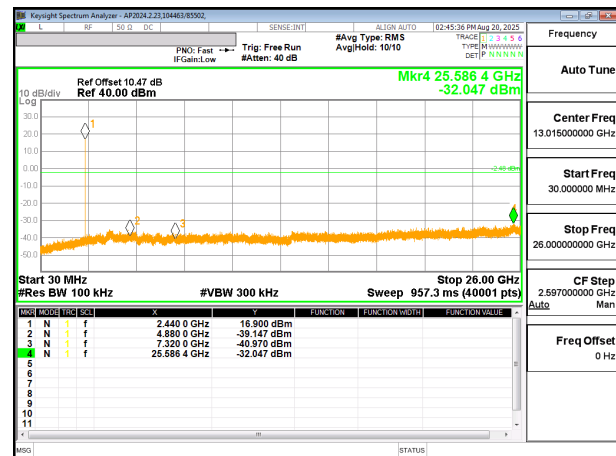
LOW CHANNEL BANDEDGE



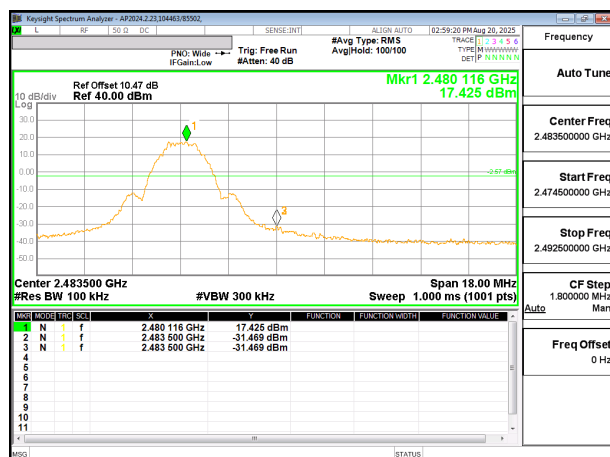
OUT-OF-BAND LOW CHANNEL



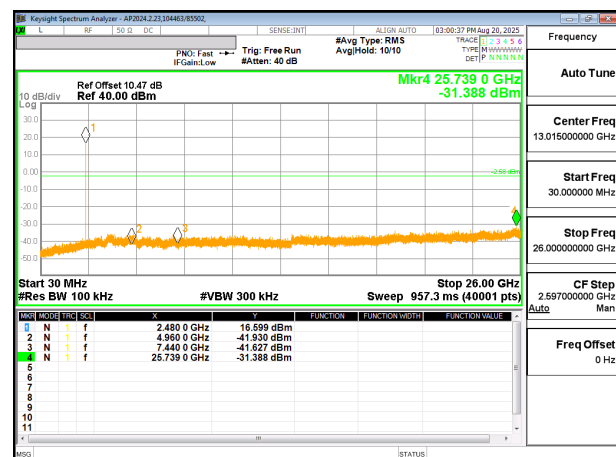
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

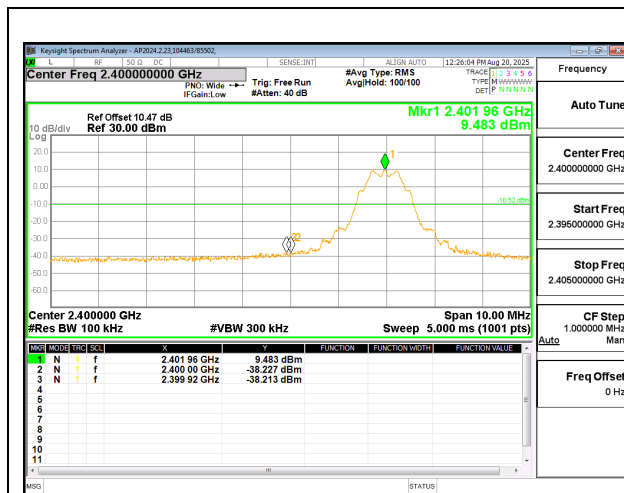


HIGH CHANNEL BANDEDGE

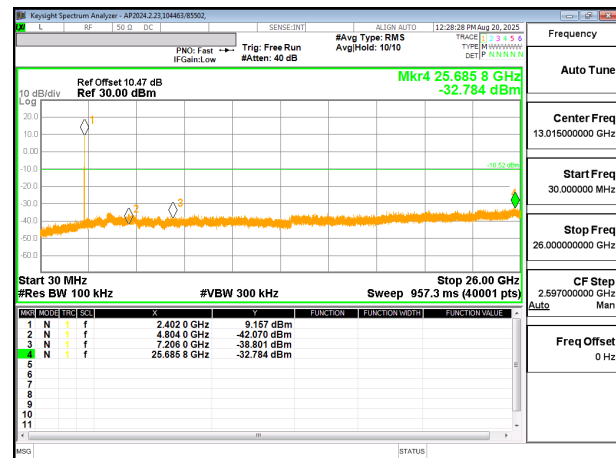


OUT-OF-BAND HIGH CHANNEL

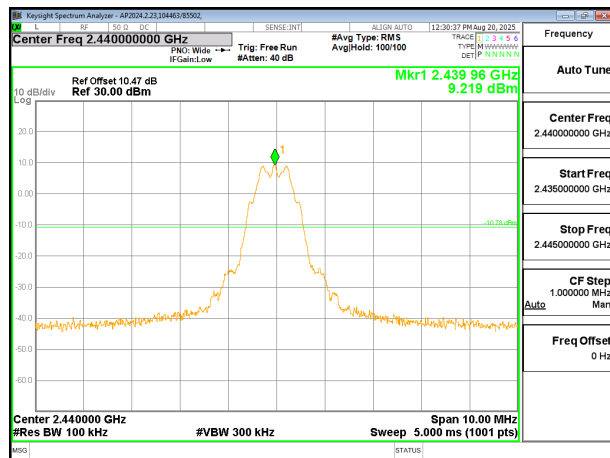
9.6.3. BLE (125Kbps)



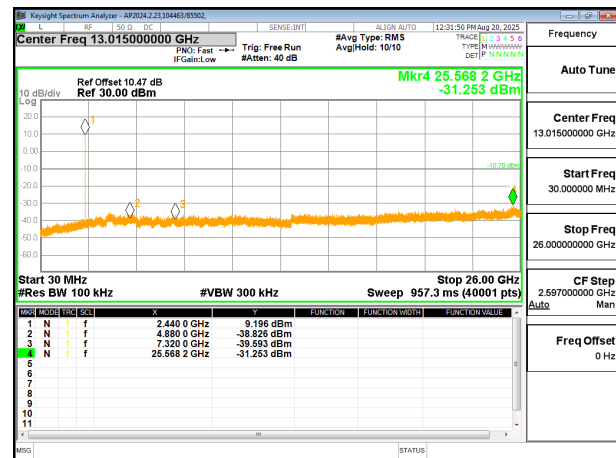
LOW CHANNEL BANDEDGE



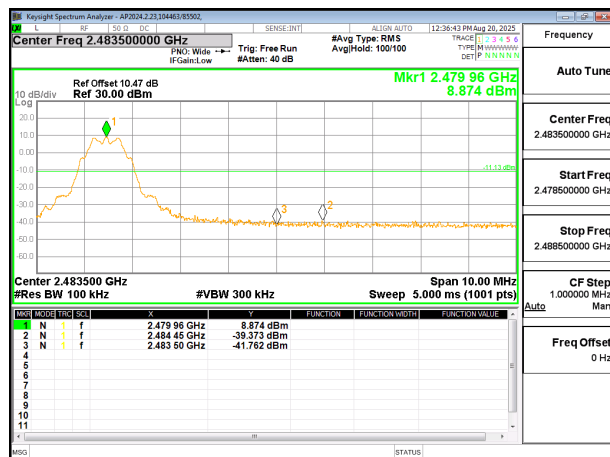
OUT-OF-BAND LOW CHANNEL



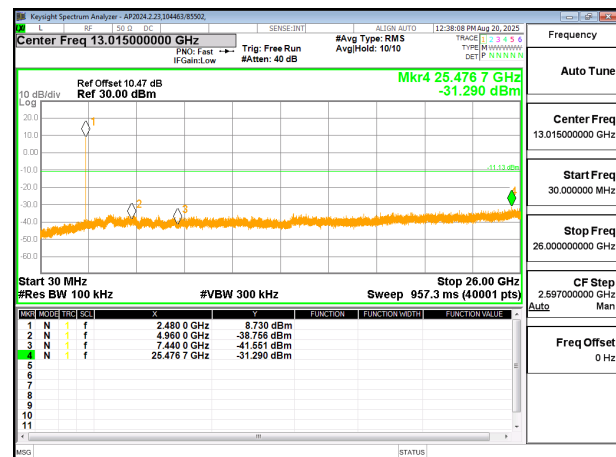
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

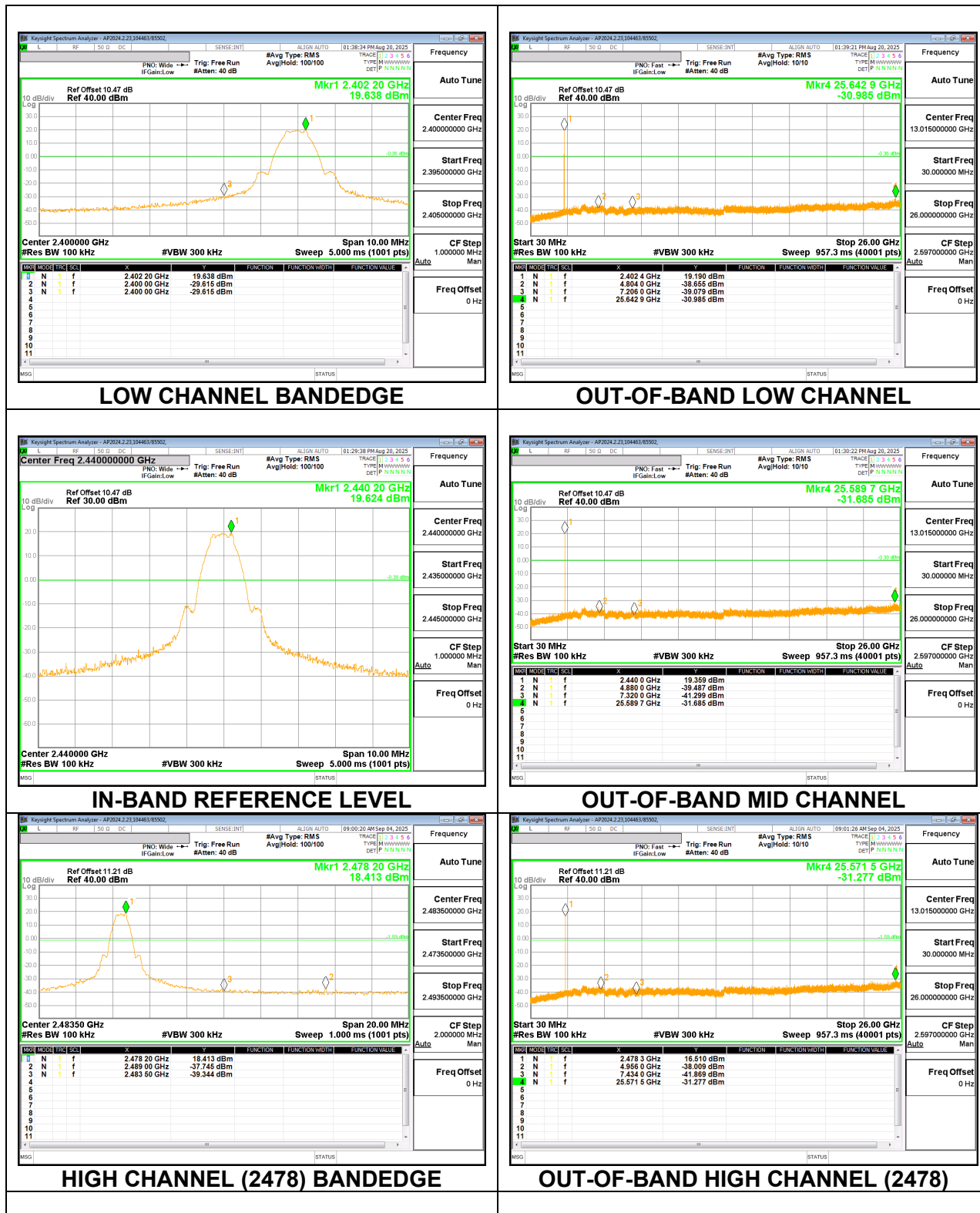


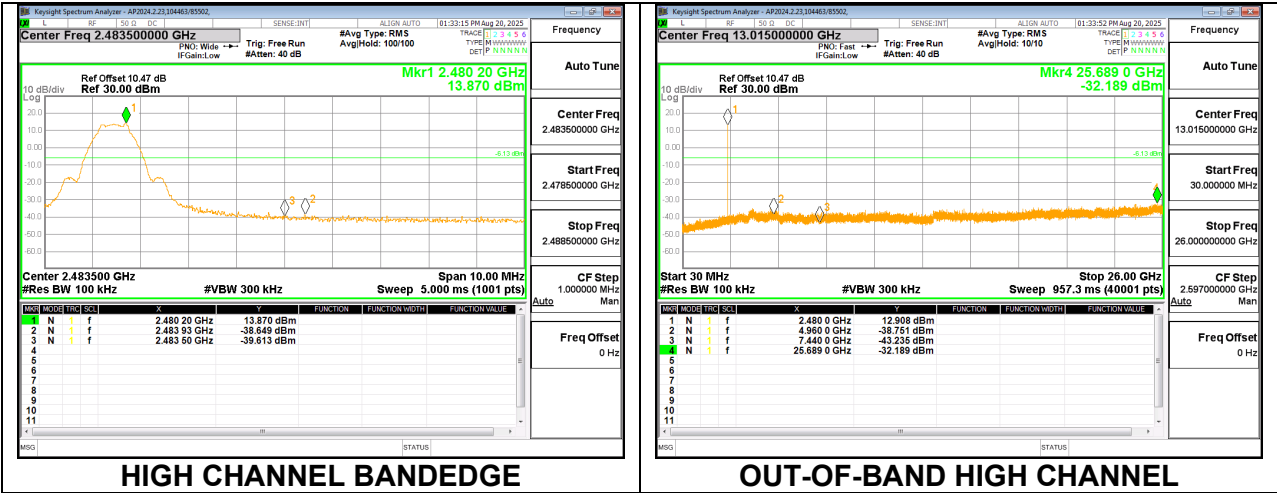
HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

9.6.4. BLE (500Kbps)





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 (kHz)	Field Strength Limit (uA/m) at 3 m	Field Strength Limit (dBuV/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 30 KHz 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. For Average measurements, the operational duty cycle was applied to the Peak for RMS average measurements.

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 output power 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).

Based 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.

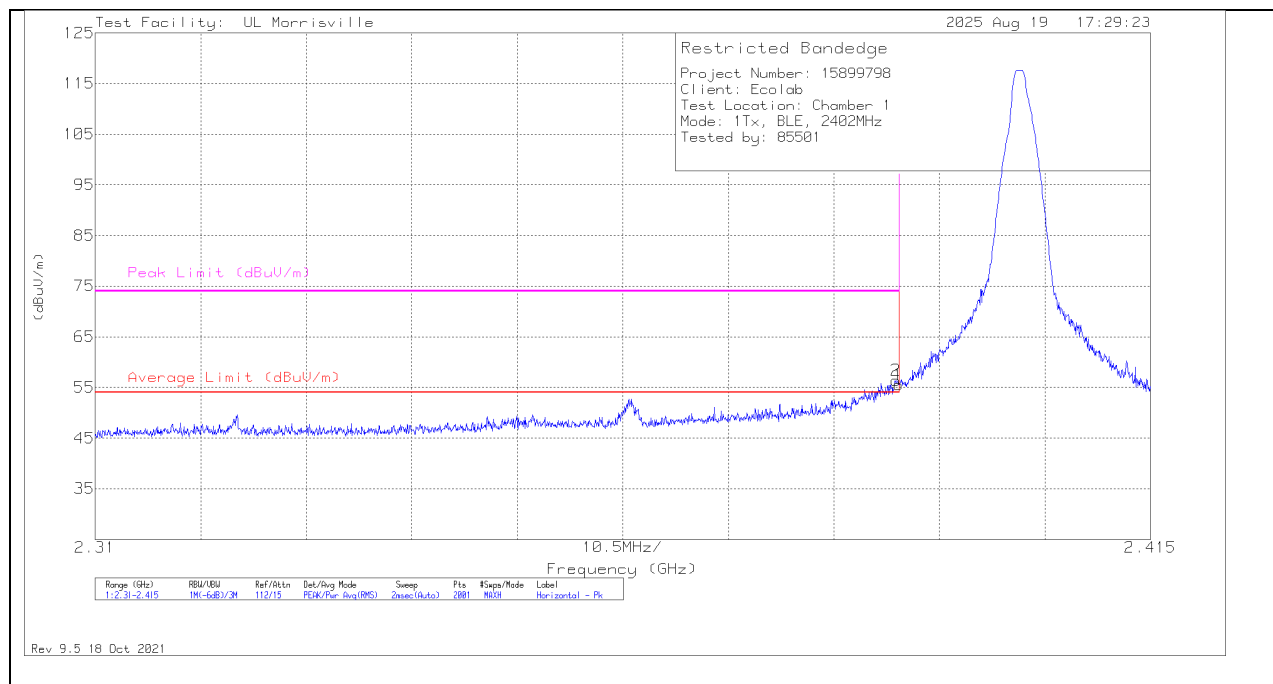
KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

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) BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



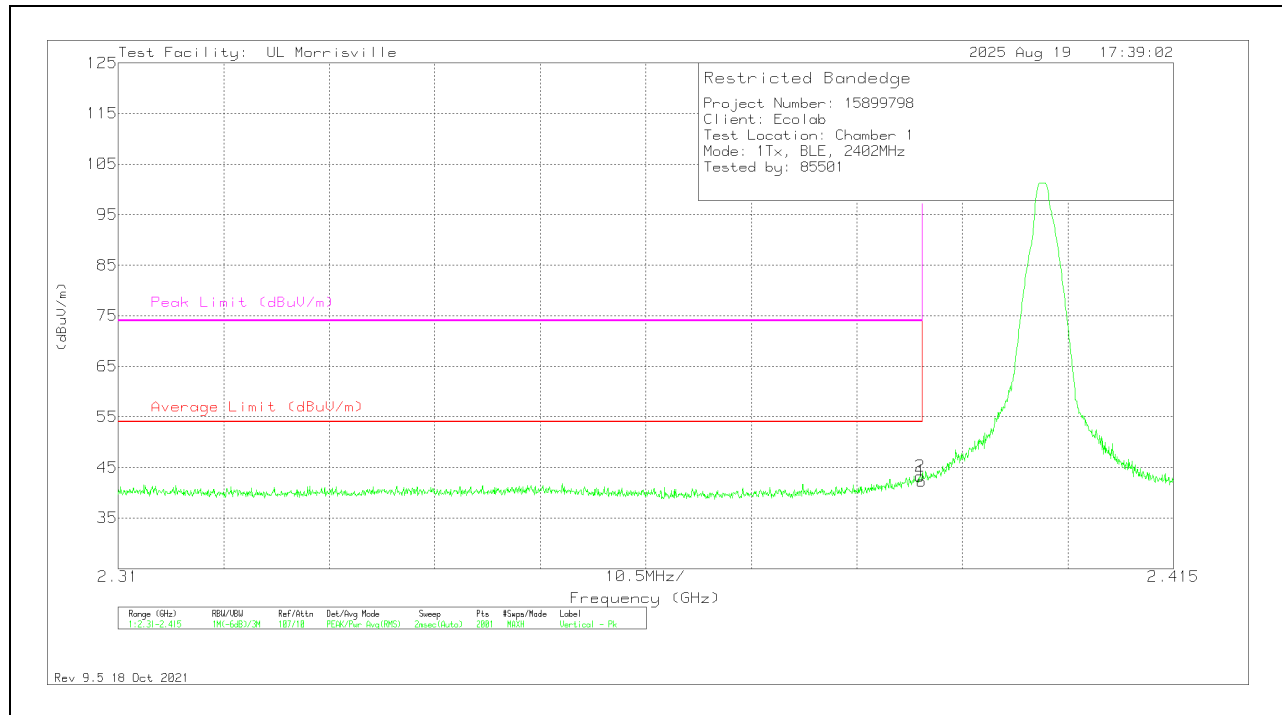
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	48.78	Pk	31.9	-25.1	0	55.58	-	-	74	-18.42	0	124	H
2	*** 2.3897	49.64	Pk	31.9	-25.1	0	56.44	-	-	74	-17.56	0	124	H
	*** 2.38996	48.78	Pk	31.9	-25.1	-33.98	21.6	54	-32.4	-	-	0	124	H
	*** 2.3897	49.64	Pk	31.9	-25.1	-33.98	22.46	54	-31.54	-	-	0	124	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	35.54	Pk	31.9	-25.1	0	42.34	-	-	74	-31.66	181	163	V
2	* ** 2.3898	36.52	Pk	31.9	-25.1	0	43.32	-	-	74	-30.68	181	163	V
	* ** 2.38996	35.54	Pk	31.9	-25.1	-33.98	8.36	54	-45.64	-	-	181	163	V
	* ** 2.3898	36.52	Pk	31.9	-25.1	-33.98	9.34	54	-44.66	-	-	181	163	V

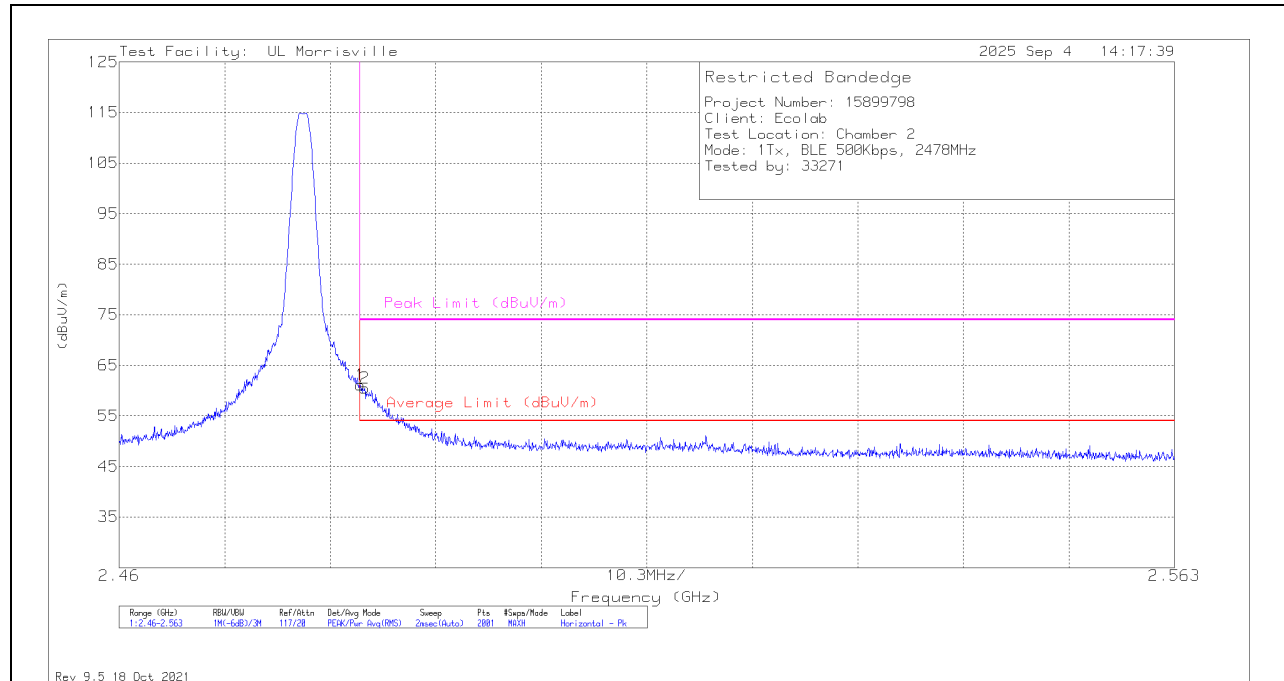
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL 2478)

HORIZONTAL RESULT



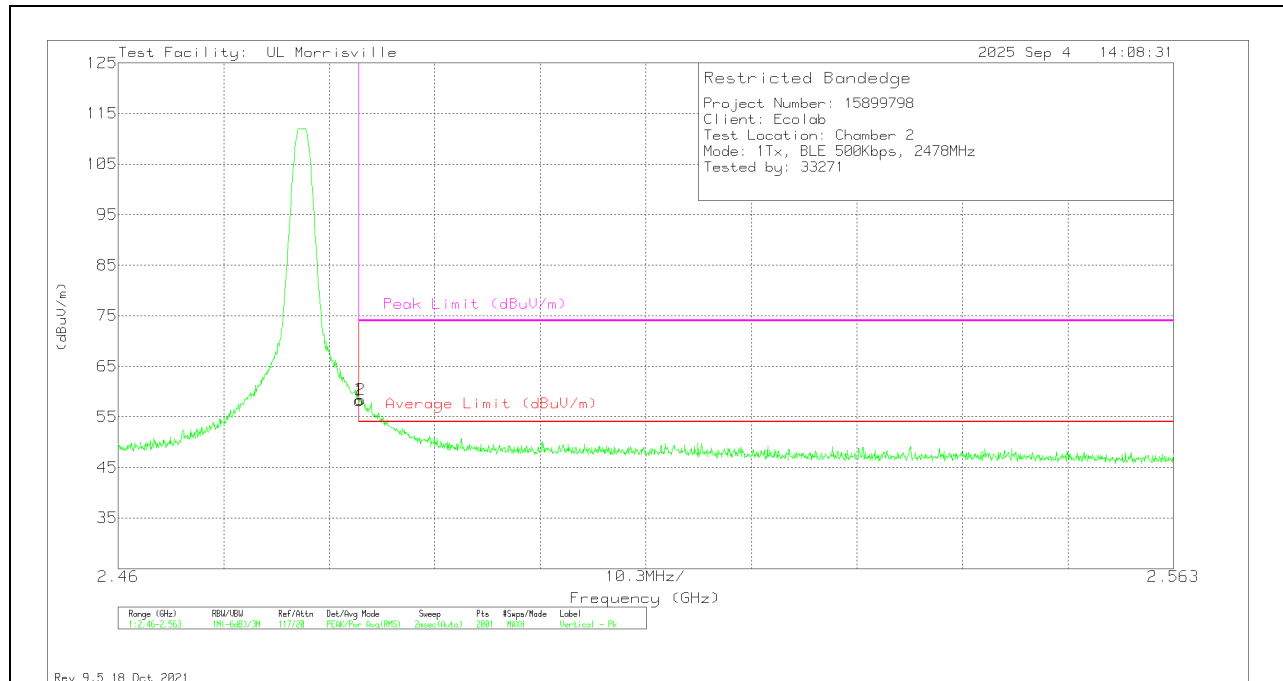
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	54.4	Pk	32.2	-25.5	0	61.1	-	-	74	-12.9	349	110	H
2	*** 2.48395	53.75	Pk	32.2	-25.5	0	60.45	-	-	74	-13.55	349	110	H
	*** 2.48354	54.4	Pk	32.2	-25.5	-33.98	27.12	54	-26.88	-	-	349	110	H
	*** 2.48395	53.75	Pk	32.2	-25.5	-33.98	26.47	54	-27.53	-	-	349	110	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	51.62	Pk	32.2	-25.5	0	58.32	-	-	74	-15.68	299	397	V
2	*** 2.48364	51.65	Pk	32.2	-25.5	0	58.35	-	-	74	-15.65	299	397	V
	*** 2.48354	51.62	Pk	32.2	-25.5	-33.98	24.34	54	-29.66	-	-	299	397	V
	*** 2.48364	51.65	Pk	32.2	-25.5	-33.98	24.37	54	-29.63	-	-	299	397	V

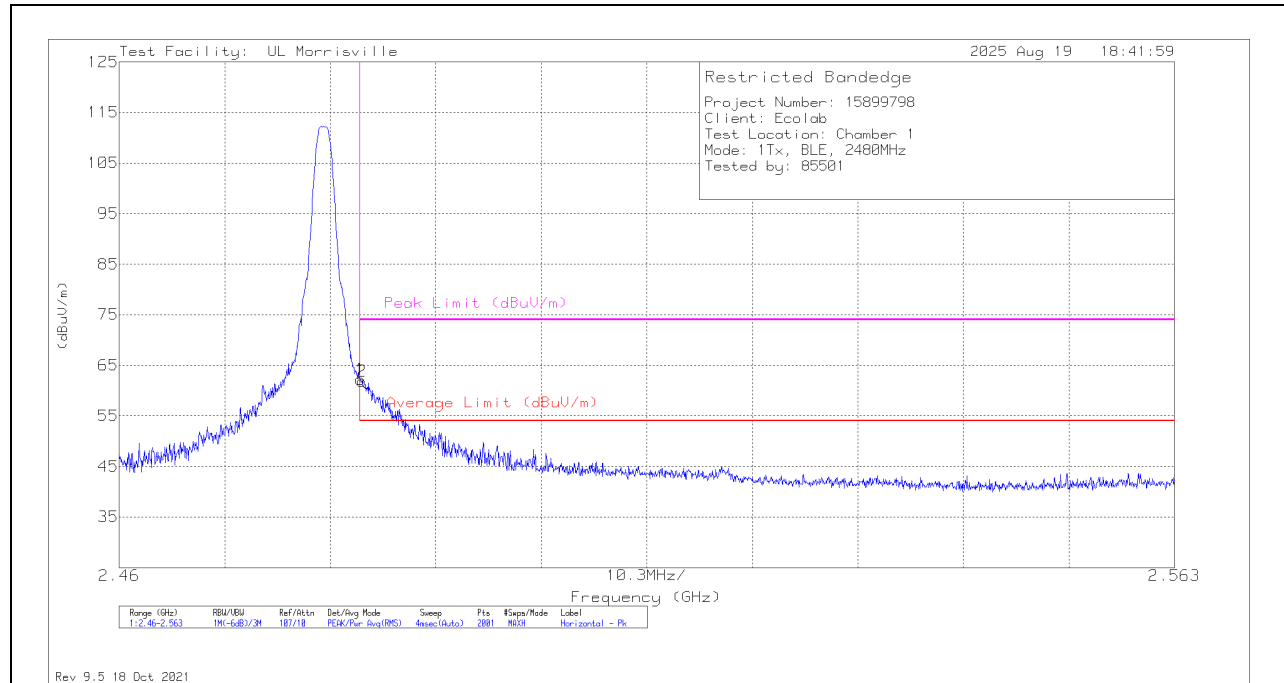
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL 2480)

HORIZONTAL RESULT



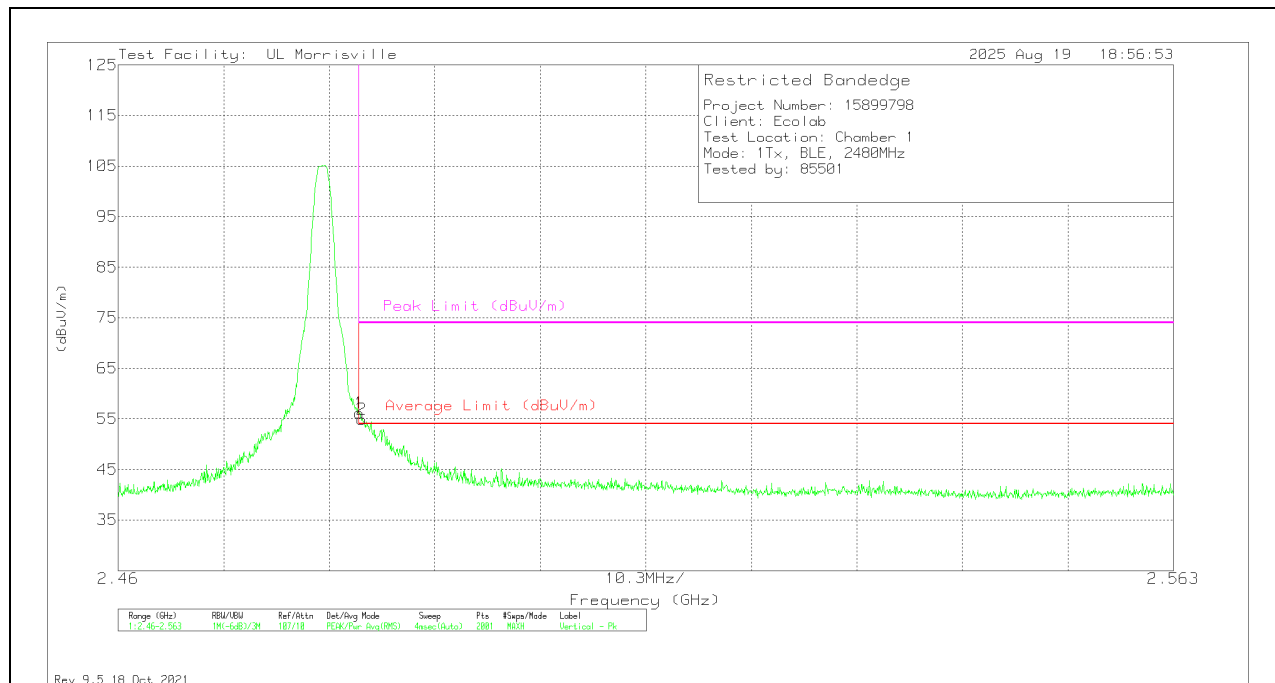
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	54.43	Pk	32.2	-24.4	0	62.23	-	-	74	-11.77	2	114	H
2	*** 2.48369	54.08	Pk	32.2	-24.4	0	61.88	-	-	74	-12.12	2	114	H
	*** 2.48354	54.43	Pk	32.2	-24.4	-33.98	28.25	54	-25.75	-	-	2	114	H
	*** 2.48369	54.08	Pk	32.2	-24.4	-33.98	27.9	54	-26.1	-	-	2	114	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	48.36	Pk	32.2	-24.4	0	56.16	-	-	74	-17.84	23	354	V
2	* ** 2.48379	47.14	Pk	32.2	-24.4	0	54.94	-	-	74	-19.06	23	354	V
	* ** 2.48354	48.36	Pk	32.2	-24.4	-33.98	22.18	54	-31.82	-	-	23	354	V
	* ** 2.48379	47.14	Pk	32.2	-24.4	-33.98	20.96	54	-33.04	-	-	23	354	V

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

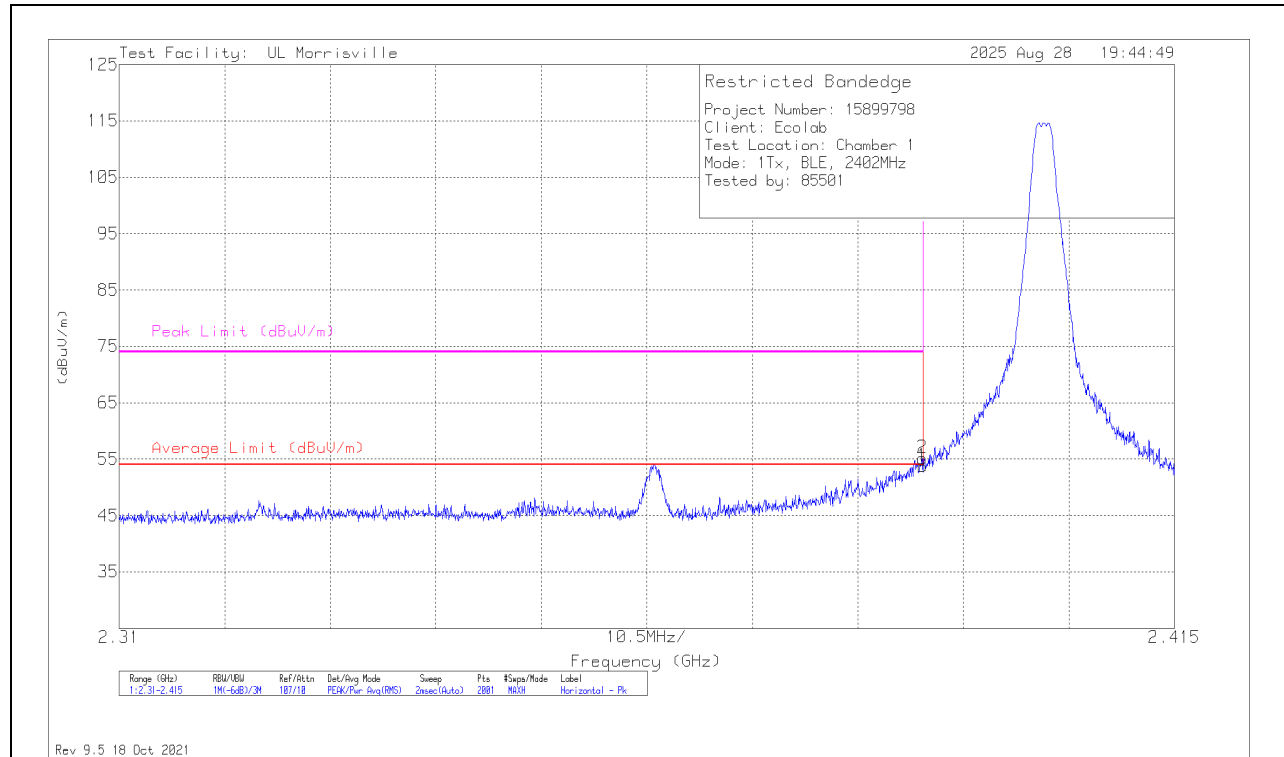
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10.2.2. BLE (2Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



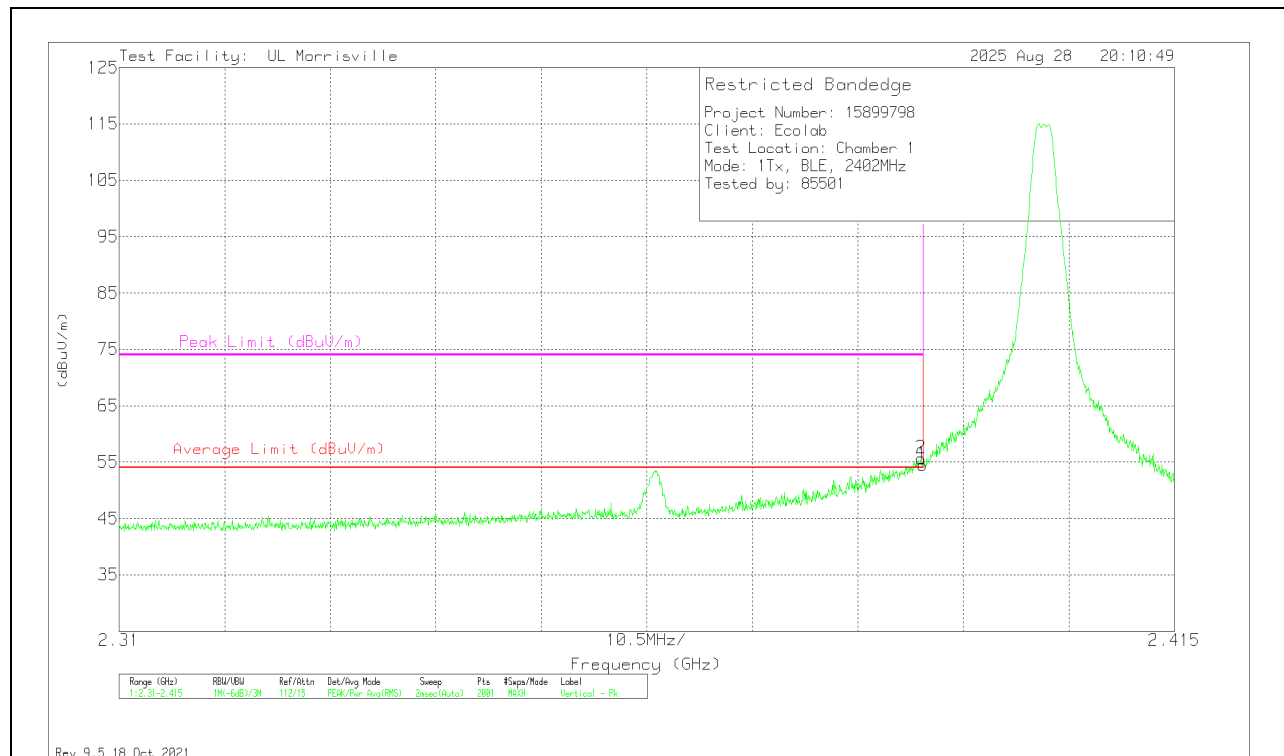
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	46.94	Pk	31.9	-25.1	0	53.74	-	-	74	-20.26	187	219	H
2	*** 2.38991	48.34	Pk	31.9	-25.1	0	55.14	-	-	74	-18.86	187	219	H
	*** 2.38996	46.94	Pk	31.9	-25.1	-33.98	19.76	54	-34.24	-	-	187	219	H
	*** 2.38991	48.34	Pk	31.9	-25.1	-33.98	21.16	54	-32.84	-	-	187	219	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	47.79	Pk	31.9	-25.1	0	54.59	-	-	74	-19.41	263	311	V
2	*** 2.3898	48.83	Pk	31.9	-25.1	0	55.63	-	-	74	-18.37	263	311	V
	*** 2.38996	47.79	Pk	31.9	-25.1	-33.98	20.61	54	-33.39	-	-	263	311	V
	*** 2.3898	48.83	Pk	31.9	-25.1	-33.98	21.65	54	-32.35	-	-	263	311	V

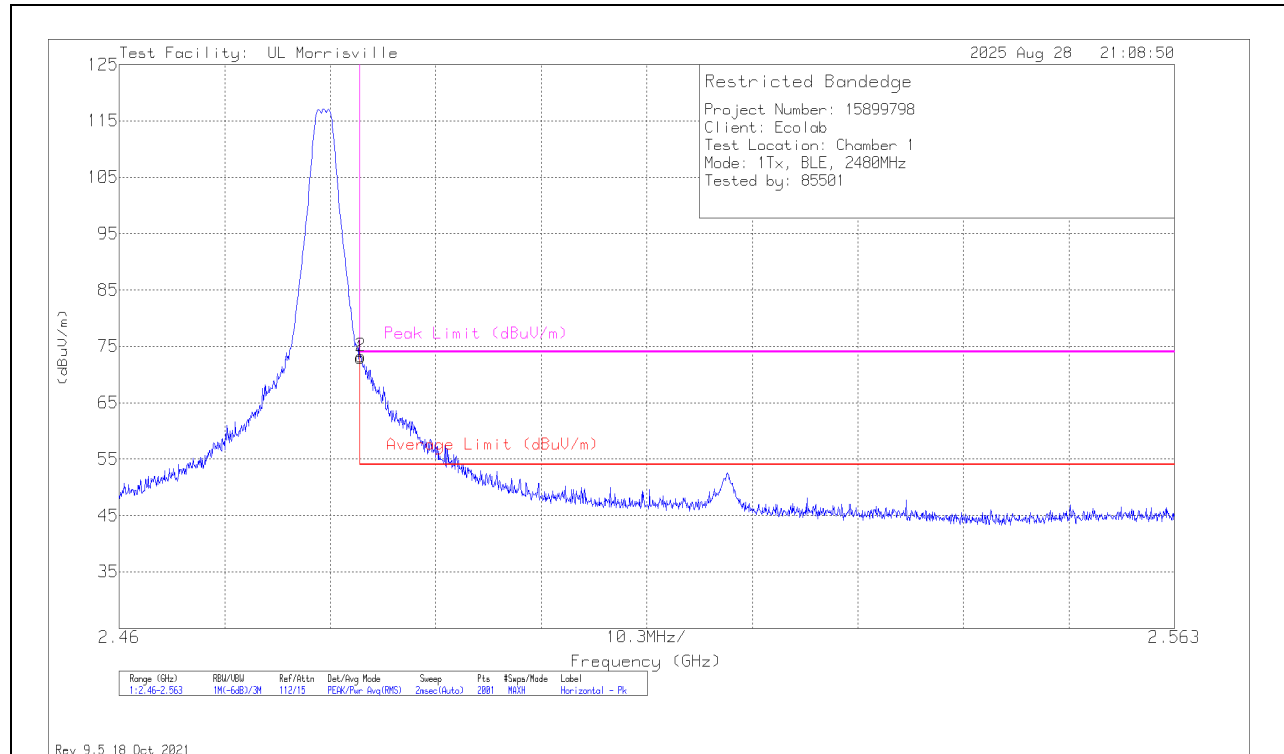
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



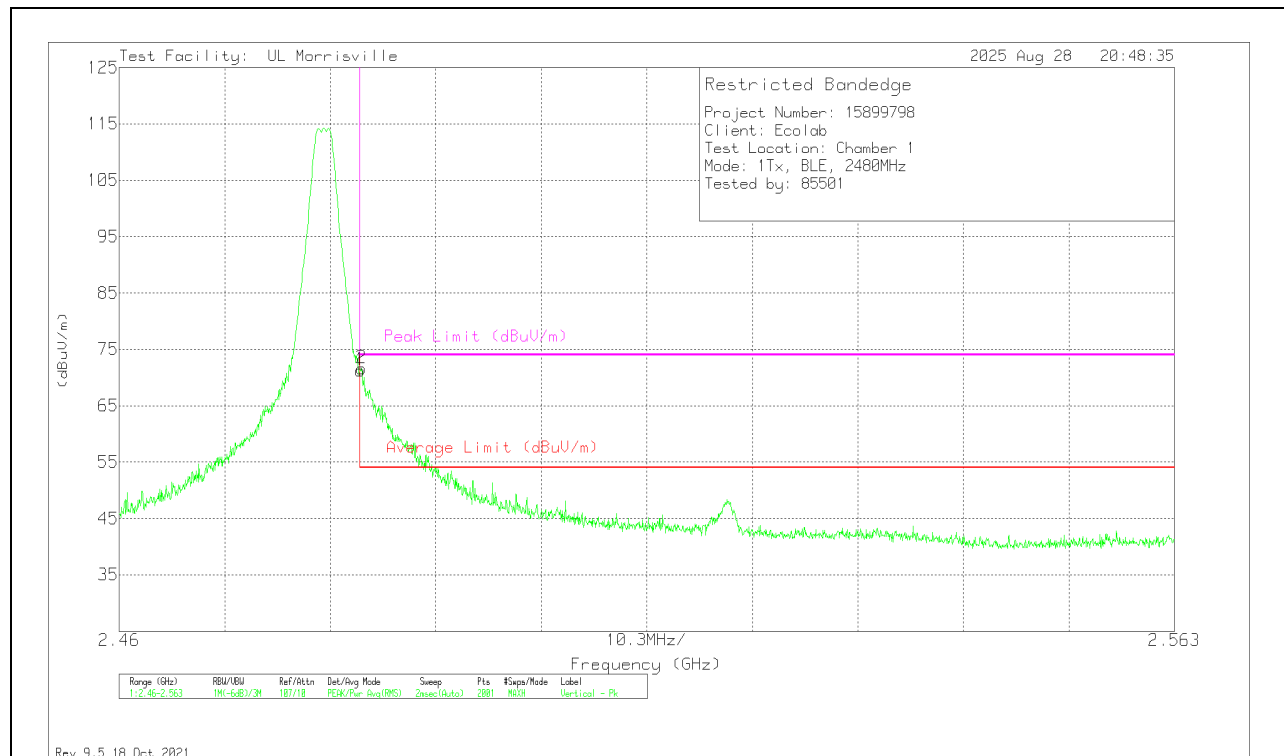
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	65.15	Pk	32.2	-24.4	0	72.95	-	-	74	-1.05	193	104	H
2	*** 2.48359	65.42	Pk	32.2	-24.4	0	73.22	-	-	74	-0.78	193	104	H
	*** 2.48354	65.15	Pk	32.2	-24.4	-33.98	38.97	54	-15.03	-	-	193	104	H
	*** 2.48359	65.42	Pk	32.2	-24.4	-33.98	39.24	54	-14.76	-	-	193	104	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	63.52	Pk	32.2	-24.4	0	71.32	-	-	74	-2.68	235	324	V
2	*** 2.48364	63.86	Pk	32.2	-24.4	0	71.66	-	-	74	-2.34	235	324	V
	*** 2.48354	63.52	Pk	32.2	-24.4	-33.98	37.34	54	-16.66	-	-	235	324	V
	*** 2.48364	63.86	Pk	32.2	-24.4	-33.98	37.68	54	-16.32	-	-	235	324	V

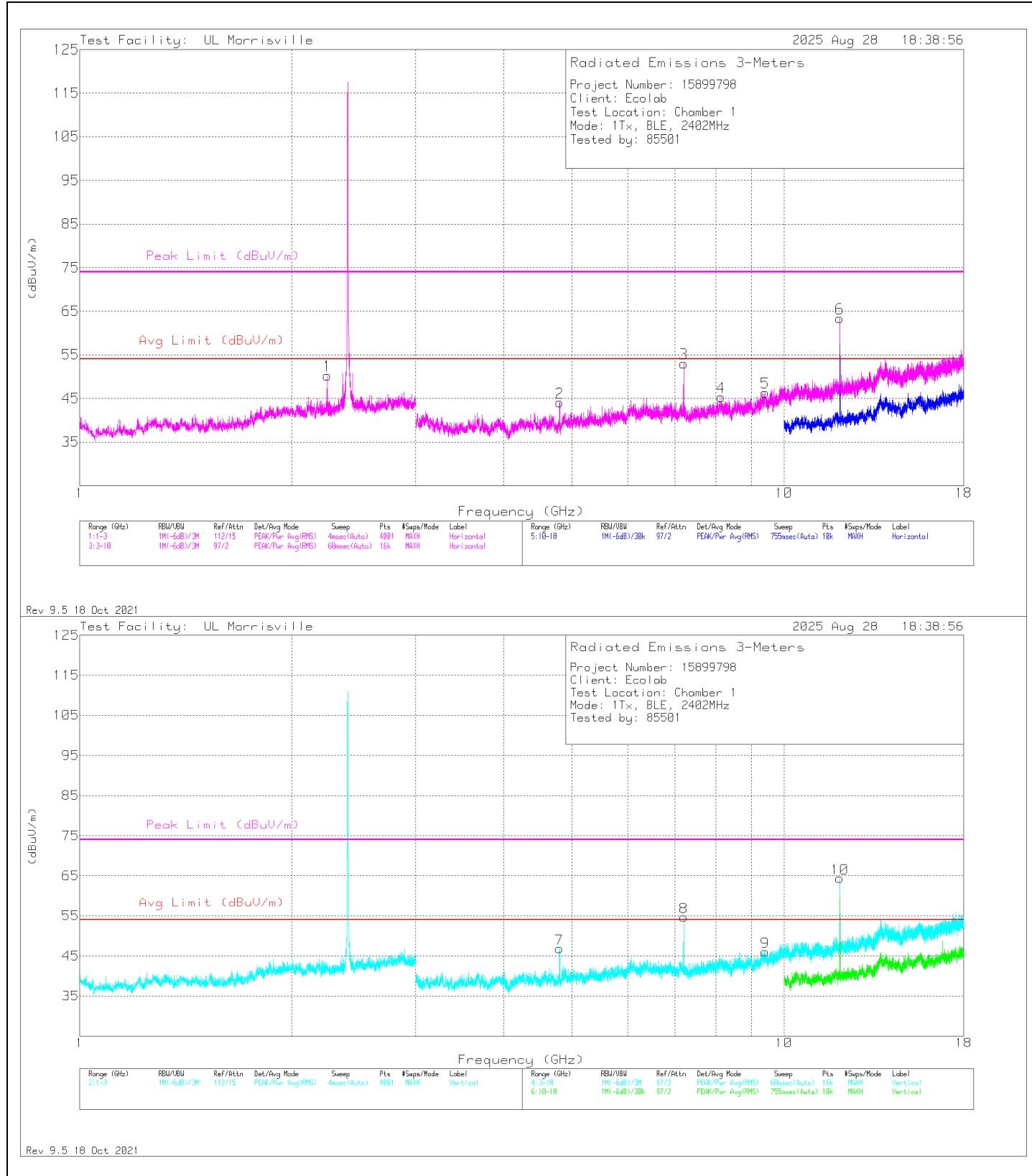
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

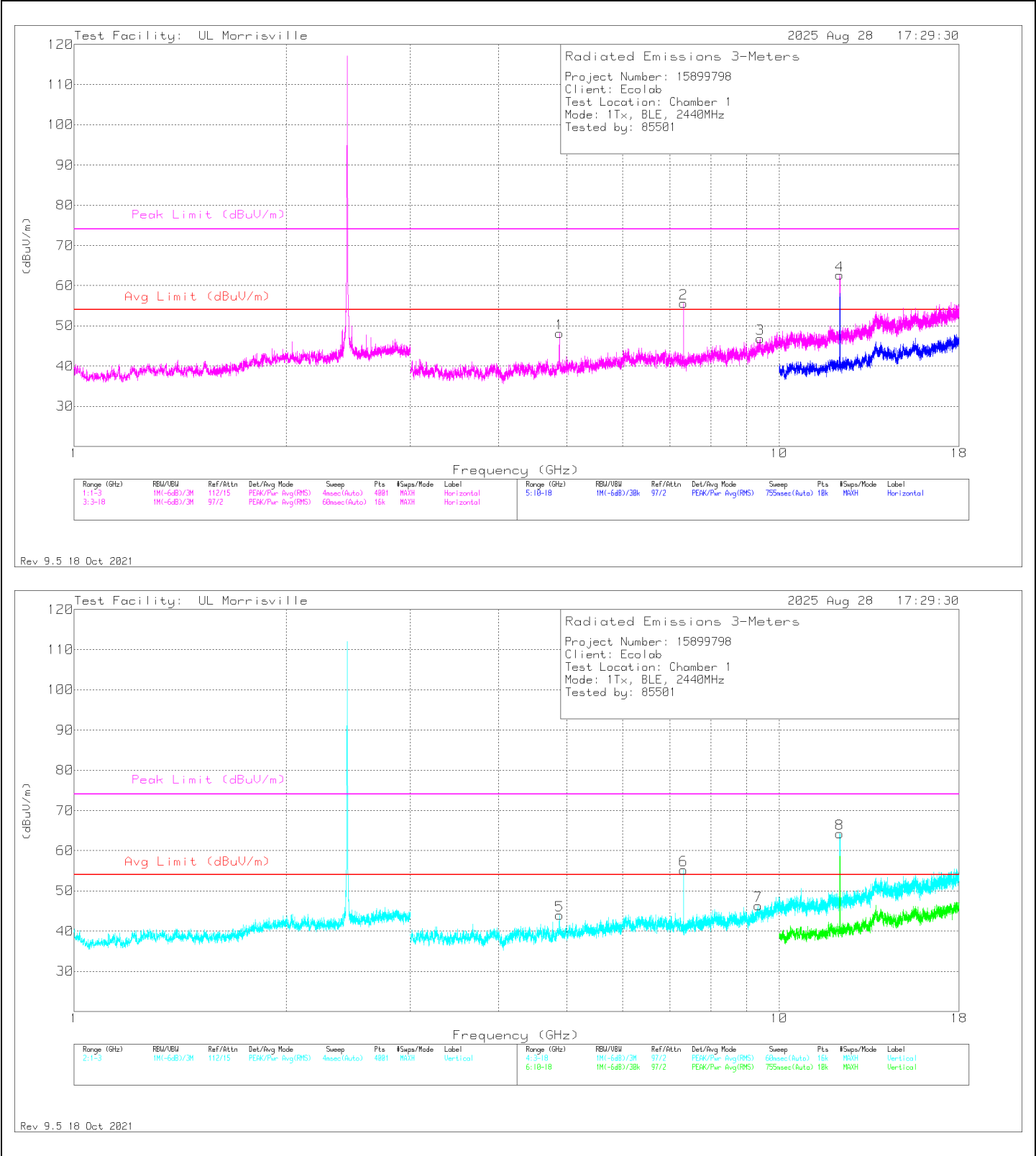
LOW CHANNEL RESULTS



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	*** 2.24594	48.37	PK2	31.6	-24.3	0	55.67	-	-	74	-18.33	182	153	H
	*** 2.24594	48.37	PK2	31.6	-24.3	-33.98	21.69	54	-32.31	-	-	182	153	H
2	*** 4.80375	57.14	Pk	33.9	-47	0	44.04	54	-9.96	74	-29.96	0-360	101	H
4	*** 8.14594	50.53	Pk	35.9	-41.1	0	45.33	54	-8.67	74	-28.67	0-360	101	H
5	*** 9.40875	50.35	Pk	36.3	-40.3	0	46.35	54	-7.65	74	-27.65	0-360	101	H
6	*** 12.00733	68.07	PK2	38.7	-38.7	0	68.07	-	-	74	-5.93	49	134	H
	*** 12.00733	68.07	PK2	38.7	-38.7	-33.98	34.09	54	-19.91	-	-	49	134	H
7	*** 4.80281	59.94	Pk	33.9	-47	0	46.84	54	-7.16	74	-27.16	0-360	101	V
9	*** 9.40313	50.15	Pk	36.3	-40.4	0	46.05	54	-7.95	74	-27.95	0-360	101	V
10	*** 12.01218	68.04	PK2	38.7	-38.7	0	68.04	-	-	74	-5.96	239	134	V
	*** 12.01218	68.04	PK2	38.7	-38.7	-33.98	34.06	54	-19.94	-	-	239	134	V
3	7.20469	59.97	Pk	35.4	-42.4	0	52.97	-	-	-	-	0-360	101	H
8	7.2075	61.8	Pk	35.4	-42.5	0	54.7	-	-	-	-	0-360	101	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

MID CHANNEL RESULTS



Test Facility: UL Morrisville

2025 Aug 28 17:29:30

Radiated Emissions 3-Meters

Project Number: 15899798

Client: Ecolab

Test Location: Chamber 1

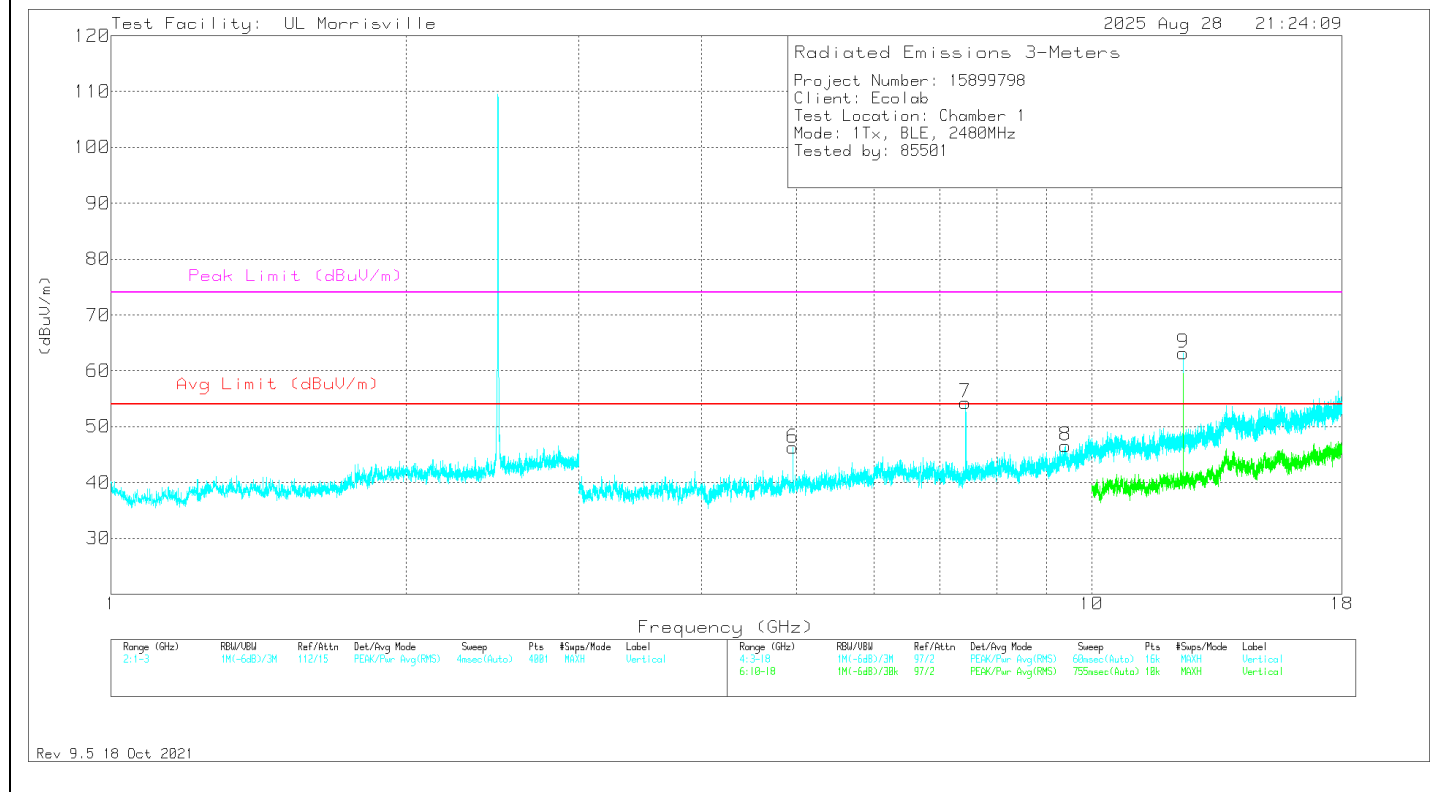
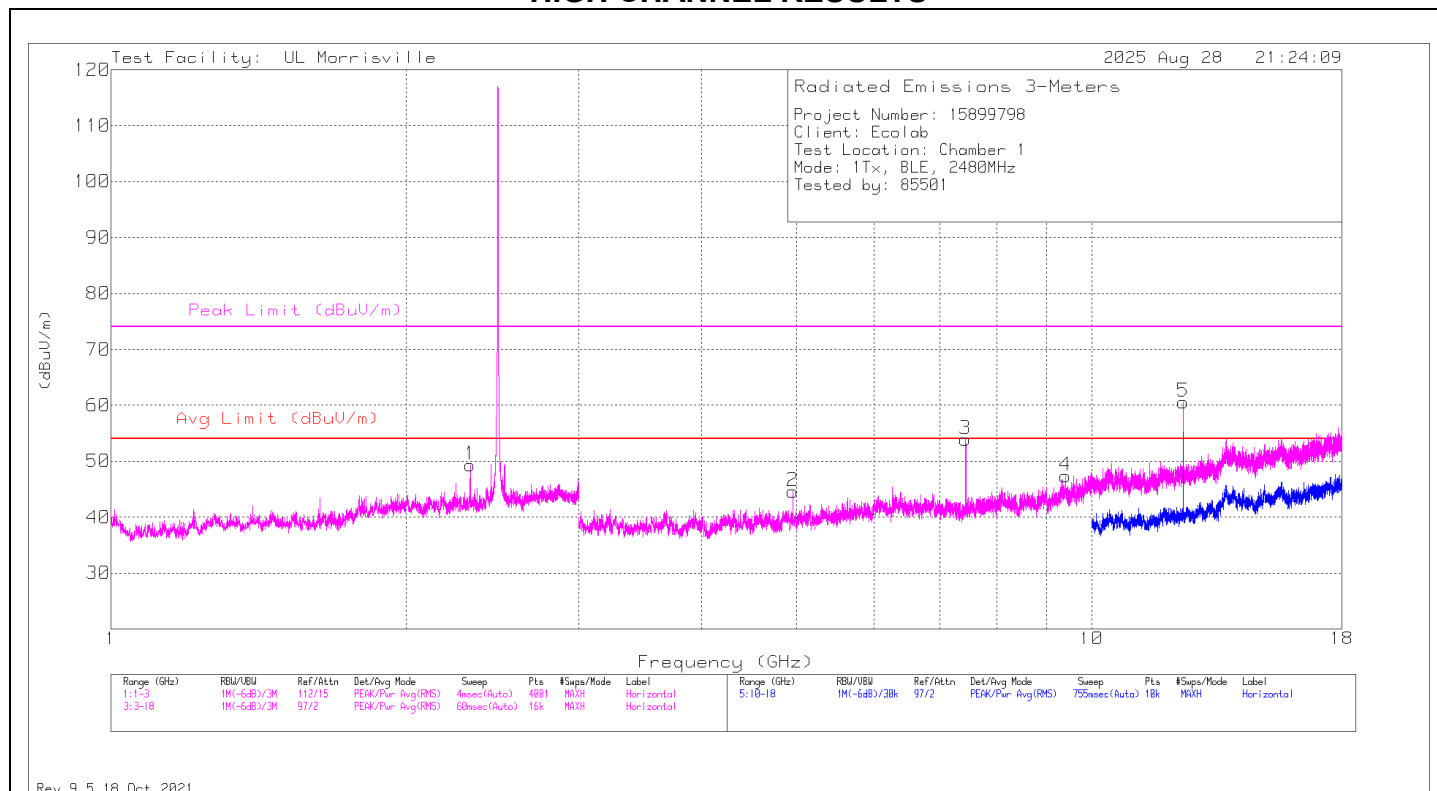
Mode: 1Tx, BLE, 2440MHz

Tested by: 85501

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	*** 4.88005	65.16	PK2	34	-45.4	0	53.76	-	-	74	-20.24	9	107	H
	*** 4.88005	65.16	PK2	34	-45.4	-33.98	19.78	54	-34.22	-	-	9	107	H
2	*** 7.32129	65.9	PK2	35.4	-43.3	0	58	-	-	74	-16	36	106	H
	*** 7.32129	65.9	PK2	35.4	-43.3	-33.98	24.02	54	-29.98	-	-	36	106	H
3	*** 9.40688	50.7	Pk	36.3	-40.2	0	46.8	54	-7.2	74	-27.2	0-360	101	H
4	*** 12.19732	66.76	PK2	38.8	-38.5	0	67.06	-	-	74	-6.94	280	163	H
	*** 12.19732	66.76	PK2	38.8	-38.5	-33.98	33.08	54	-20.92	-	-	280	163	H
5	*** 4.87875	55.22	Pk	34	-45.3	0	43.92	54	-10.08	74	-30.08	0-360	101	V
6	*** 7.31842	60.38	PK2	35.4	-43.1	0	52.68	-	-	74	-21.32	184	111	V
	*** 7.31842	60.38	PK2	35.4	-43.1	-33.98	18.7	54	-35.3	-	-	184	111	V
7	*** 9.34125	50.58	Pk	36.2	-40.5	0	46.28	54	-7.72	74	-27.72	0-360	101	V
8	*** 12.1973	66.04	PK2	38.8	-38.5	0	66.34	-	-	74	-7.66	358	165	V
	*** 12.1973	66.04	PK2	38.8	-38.5	-33.98	32.36	54	-21.64	-	-	358	165	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

HIGH CHANNEL RESULTS



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	*** 2.32393	48.39	PK2	31.7	-24.9	0	55.19	-	-	74	-18.81	187	168	H
	*** 2.32393	48.39	PK2	31.7	-24.9	-33.98	21.21	54	-32.79	-	-	187	168	H
2	*** 4.96031	56.06	Pk	34.2	-45.7	0	44.56	54	-9.44	74	-29.44	0-360	101	H
3	*** 7.44129	61.12	PK2	35.4	-42.6	0	53.92	-	-	74	-20.08	198	154	H
	*** 7.44129	61.12	PK2	35.4	-42.6	-33.98	19.94	54	-34.06	-	-	198	154	H
4	*** 9.40969	51.57	Pk	36.3	-40.5	0	47.37	54	-6.63	74	-26.63	0-360	101	H
5	*** 12.39733	65.57	PK2	38.7	-38	0	66.27	-	-	74	-7.73	52	133	H
	*** 12.39733	65.57	PK2	38.7	-38	-33.98	32.29	54	-21.71	-	-	52	133	H
6	*** 4.95938	57.74	Pk	34.2	-45.7	0	46.24	54	-7.76	74	-27.76	0-360	101	V
7	*** 7.4384	65.25	PK2	35.4	-42.6	0	58.05	-	-	74	-15.95	237	127	V
	*** 7.4384	65.25	PK2	35.4	-42.6	-33.98	24.07	54	-29.93	-	-	237	127	V
8	*** 9.4125	51.08	Pk	36.3	-40.8	0	46.58	54	-7.42	74	-27.42	0-360	200	V
9	*** 12.39732	67.84	PK2	38.7	-38	0	68.54	-	-	74	-5.46	235	131	V
	*** 12.39732	67.84	PK2	38.7	-38	-33.98	34.56	54	-19.44	-	-	235	131	V

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

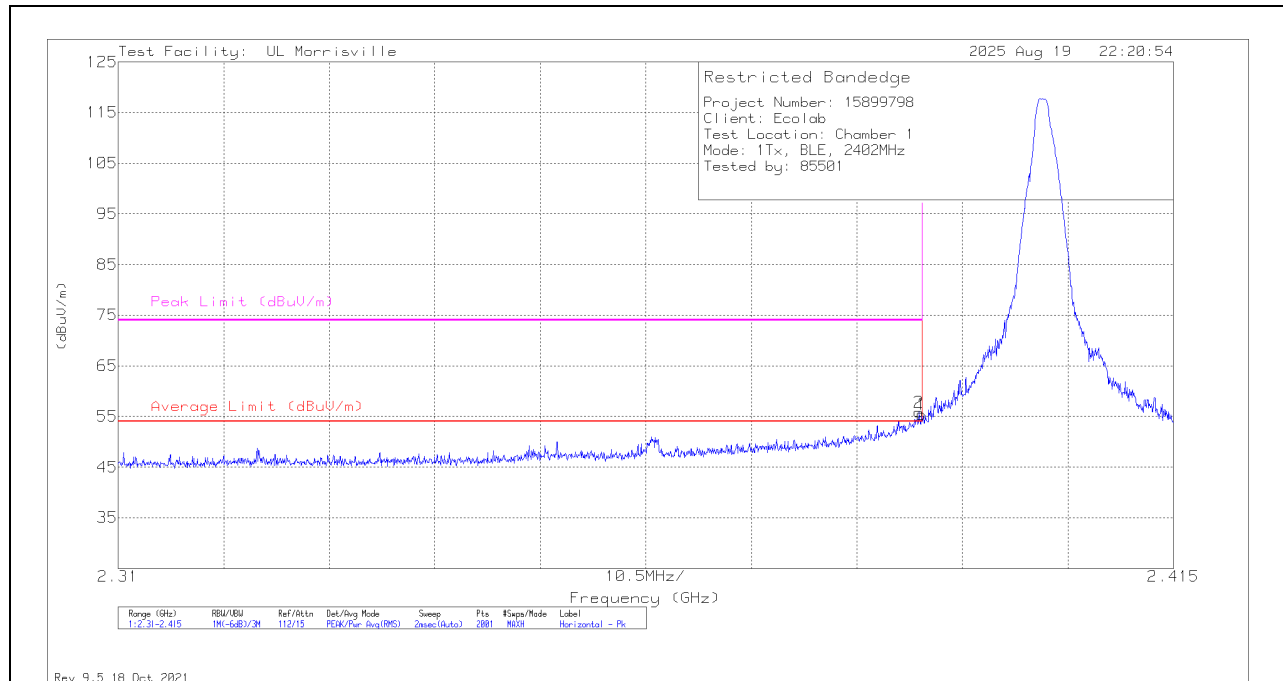
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

10.2.1. BLE (500Kbps) BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



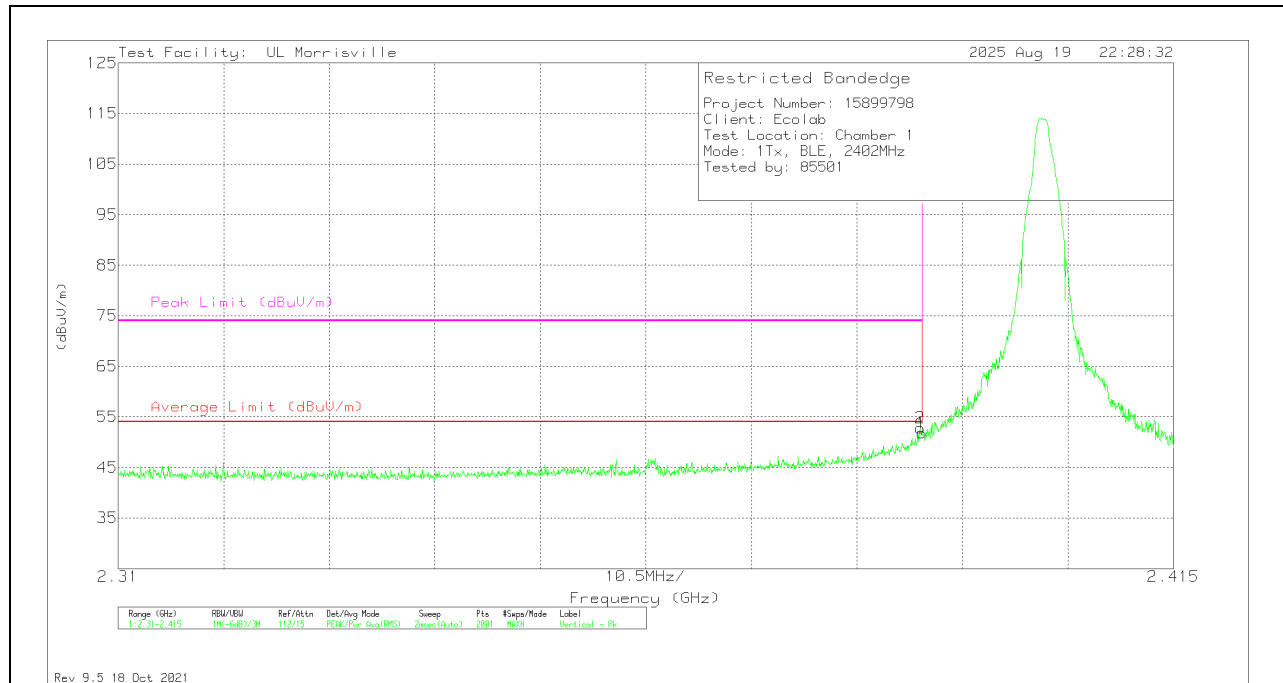
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	48.58	Pk	31.9	-25.1	0	55.38	-	-	74	-18.62	13	149	H
2	*** 2.3897	49.05	Pk	31.9	-25.1	0	55.85	-	-	74	-18.15	13	149	H
	*** 2.38996	48.58	Pk	31.9	-25.1	-33.98	21.4	54	-32.6	-	-	13	149	H
	*** 2.3897	49.05	Pk	31.9	-25.1	-33.98	21.87	54	-32.13	-	-	13	149	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	135143 (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	44.97	Pk	31.9	-25.1	0	51.77	-	-	74	-22.23	62	341	V
2	* ** 2.3898	46.03	Pk	31.9	-25.1	0	52.83	-	-	74	-21.17	62	341	V
	* ** 2.38996	44.97	Pk	31.9	-25.1	-33.98	17.79	54	-36.21	-	-	62	341	V
	* ** 2.3898	46.03	Pk	31.9	-25.1	-33.98	18.85	54	-35.15	-	-	62	341	V

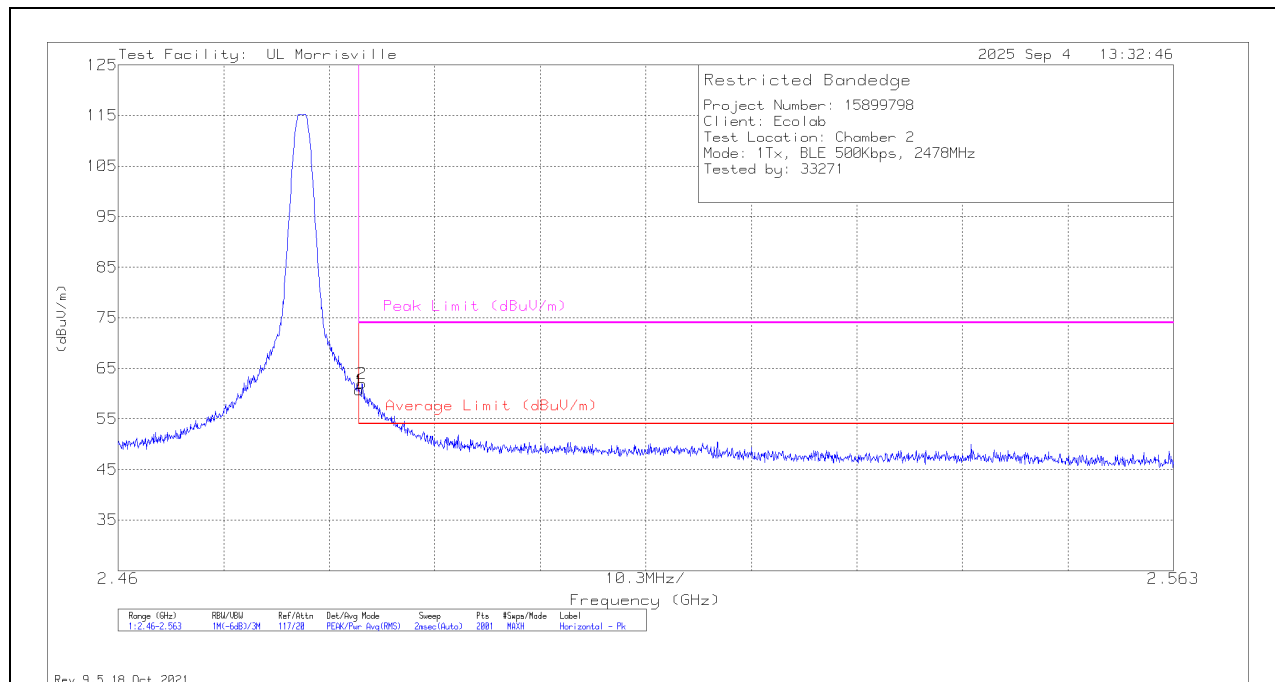
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL 2478)

HORIZONTAL RESULT



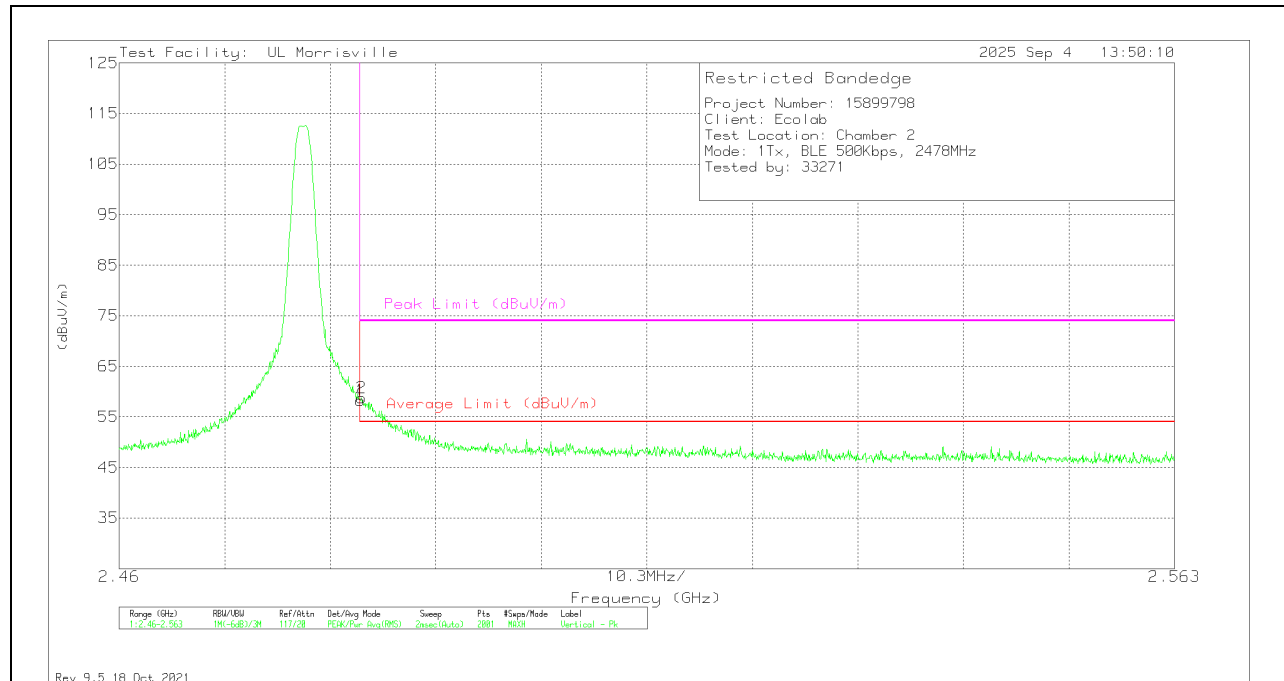
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	53.98	Pk	32.2	-25.5	0	60.68	-	-	74	-13.32	262	109	H
2	*** 2.48379	55.34	Pk	32.2	-25.5	0	62.04	-	-	74	-11.96	262	109	H
	*** 2.48354	53.98	Pk	32.2	-25.5	-33.98	26.7	54	-27.3	-	-	262	109	H
	*** 2.48379	55.34	Pk	32.2	-25.5	-33.98	28.06	54	-25.94	-	-	262	109	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	51.56	Pk	32.2	-25.5	0	58.26	-	-	74	-15.74	220	396	V
2	*** 2.48364	52.05	Pk	32.2	-25.5	0	58.75	-	-	74	-15.25	220	396	V
	*** 2.48354	51.56	Pk	32.2	-25.5	-33.98	24.28	54	-29.72	-	-	220	396	V
	*** 2.48364	52.05	Pk	32.2	-25.5	-33.98	24.77	54	-29.23	-	-	220	396	V

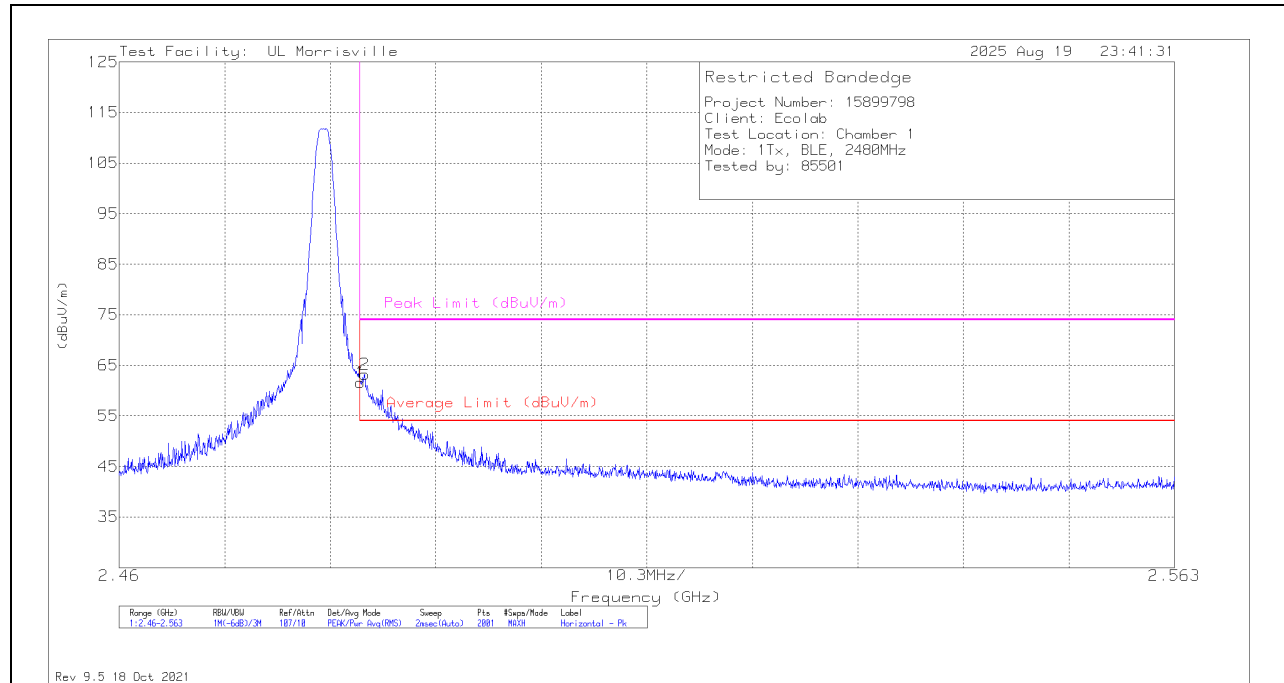
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL 2480)

HORIZONTAL RESULT



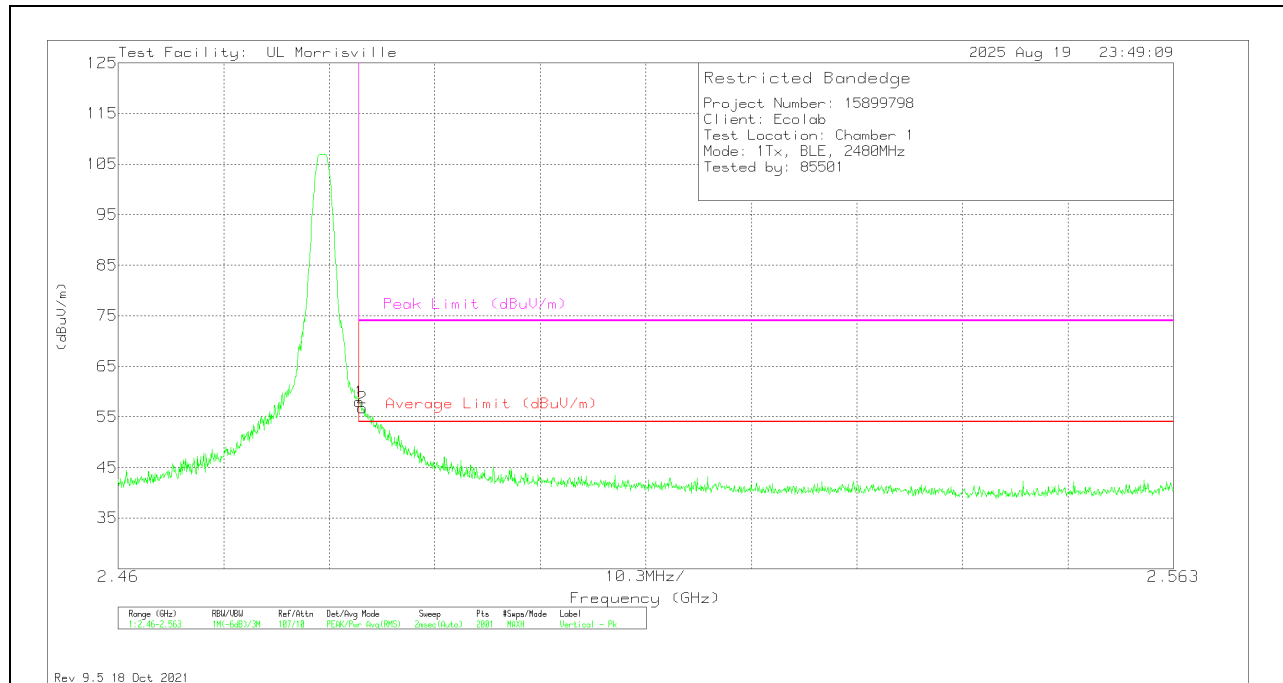
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	53.78	Pk	32.2	-24.4	0	61.58	-	-	74	-12.42	7	147	H
2	*** 2.48395	55.41	Pk	32.2	-24.4	0	63.21	-	-	74	-10.79	7	147	H
	*** 2.48354	53.78	Pk	32.2	-24.4	-33.98	27.6	54	-26.4	-	-	7	147	H
	*** 2.48395	55.41	Pk	32.2	-24.4	-33.98	29.23	54	-24.77	-	-	7	147	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	50.17	Pk	32.2	-24.4	0	57.97	-	-	74	-16.03	47	359	V
2	* ** 2.48384	49.02	Pk	32.2	-24.4	0	56.82	-	-	74	-17.18	47	359	V
	* ** 2.48354	50.17	Pk	32.2	-24.4	-33.98	23.99	54	-30.01	-	-	47	359	V
	* ** 2.48384	49.02	Pk	32.2	-24.4	-33.98	22.84	54	-31.16	-	-	47	359	V

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

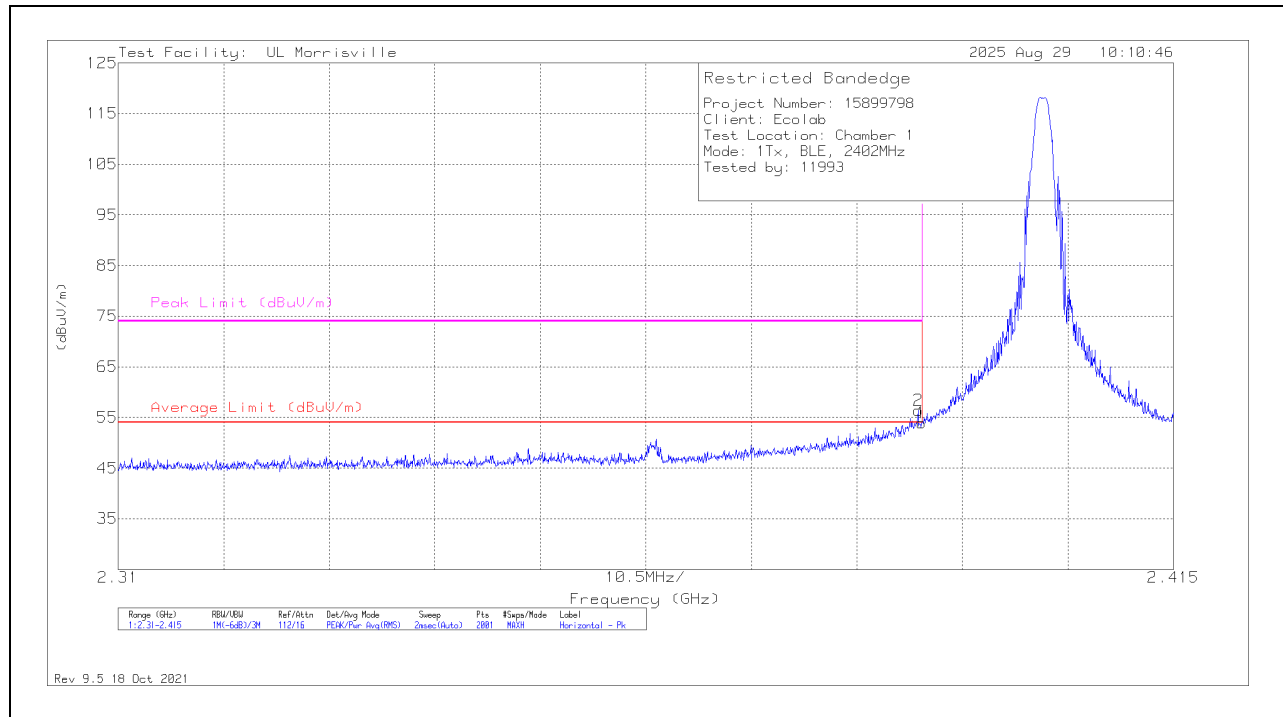
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

10.2.2. BLE (125Kbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



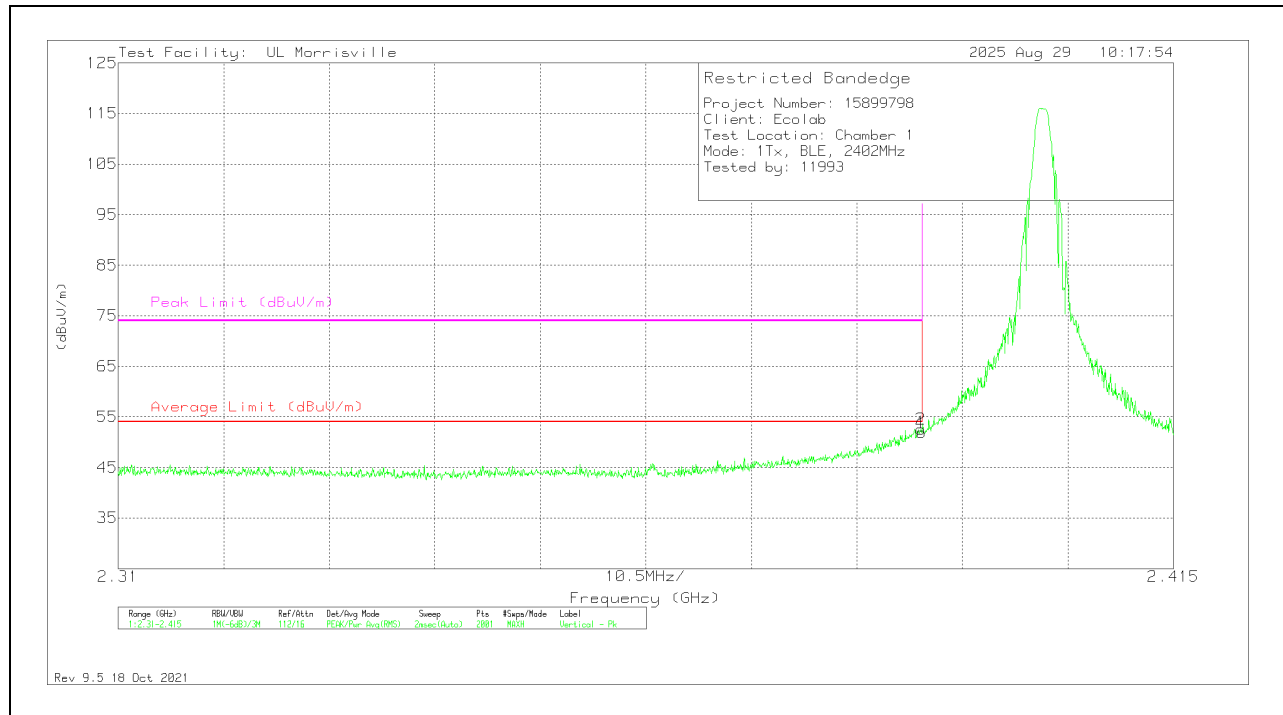
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.38996	47.09	Pk	31.9	-25.1	0	53.89	-	-	74	-20.11	182	160	H
2	*** 2.38959	49.57	Pk	31.9	-25.1	0	56.37	-	-	74	-17.63	182	160	H
	*** 2.38996	47.09	Pk	31.9	-25.1	-33.98	19.91	54	-34.09	-	-	182	160	H
	*** 2.38959	49.57	Pk	31.9	-25.1	-33.98	22.39	54	-31.61	-	-	182	160	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	45.13	Pk	31.9	-25.1	0	51.93	-	-	74	-22.07	253	391	V
2	*** 2.38985	45.78	Pk	31.9	-25.1	0	52.58	-	-	74	-21.42	253	391	V
	*** 2.38996	45.13	Pk	31.9	-25.1	-33.98	17.95	54	-36.05	-	-	253	391	V
	*** 2.38985	45.78	Pk	31.9	-25.1	-33.98	18.6	54	-35.4	-	-	253	391	V

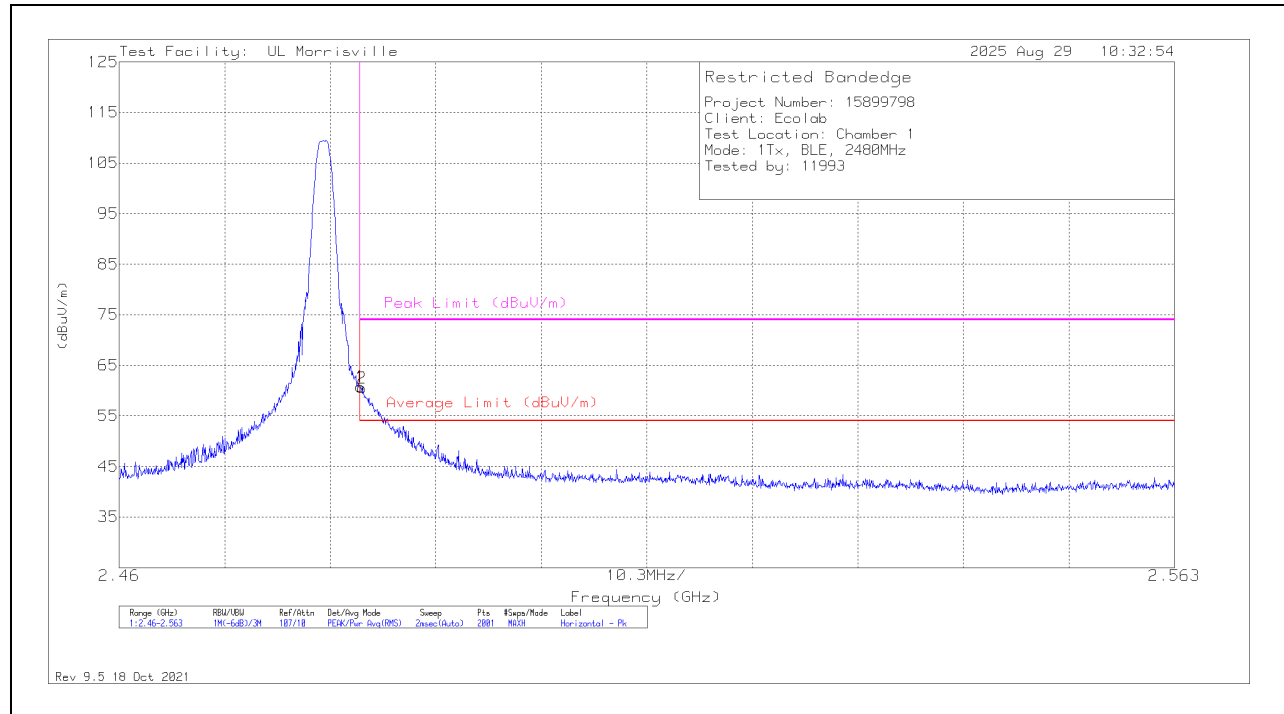
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



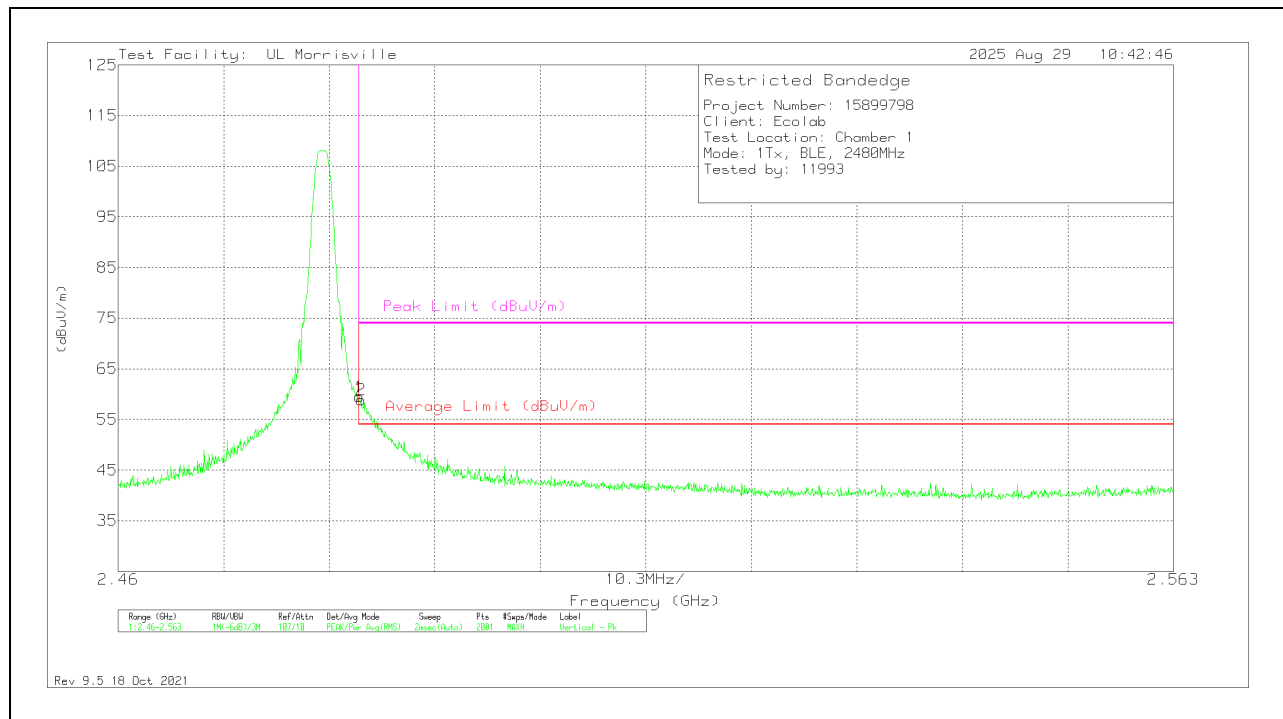
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (dB/m)	Gain/Loss (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.48354	53	Pk	32.2	-24.4	0	60.8	-	-	74	-13.2	94	151	H
2	*** 2.48369	52.75	Pk	32.2	-24.4	0	60.55	-	-	74	-13.45	94	151	H
	*** 2.48354	53	Pk	32.2	-24.4	-33.98	26.82	54	-27.18	-	-	94	151	H
	*** 2.48369	52.75	Pk	32.2	-24.4	-33.98	26.57	54	-27.43	-	-	94	151	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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	51.65	Pk	32.2	-24.4	0	59.45	-	-	74	-14.55	25	358	V
2	*** 2.48374	51.08	Pk	32.2	-24.4	0	58.88	-	-	74	-15.12	25	358	V
	*** 2.48354	51.65	Pk	32.2	-24.4	-33.98	25.47	54	-28.53	-	-	25	358	V
	*** 2.48374	51.08	Pk	32.2	-24.4	-33.98	24.9	54	-29.1	-	-	25	358	V

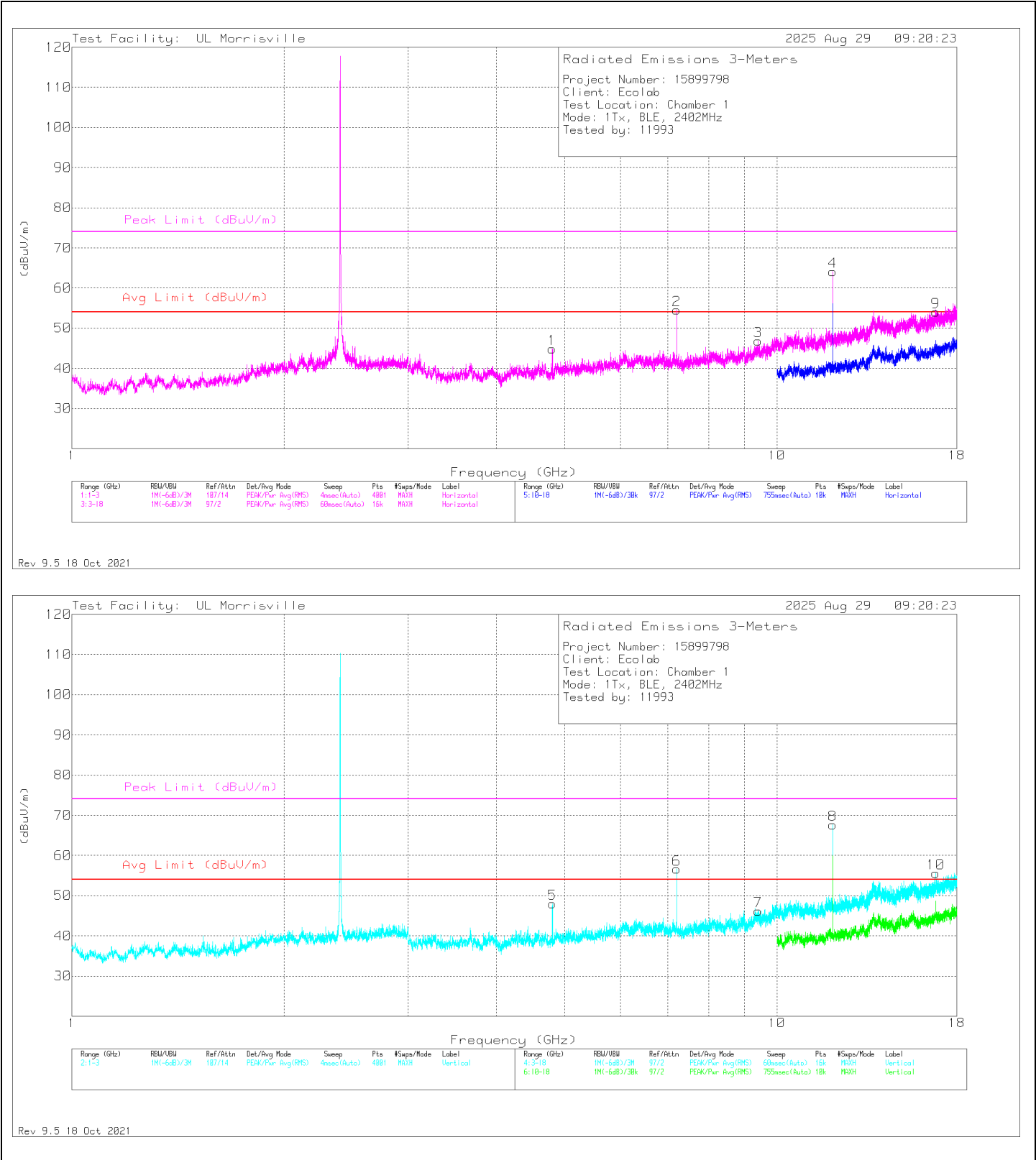
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



Test Facility: UL Morrisville

2025 Aug 29 09:20:23

Radiated Emissions 3-Meters

Project Number: 15899798

Client: Ecolab

Test Location: Chamber 1

Mode: 1Tx, BLE, 2402MHz

Tested by: 11993

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	*** 4.80281	57.94	Pk	33.9	-47	0	44.84	54	-9.16	74	-29.16	0-360	101	H
3	*** 9.40125	51.03	Pk	36.3	-40.5	0	46.83	54	-7.17	74	-27.17	0-360	101	H
4	*** 12.01098	67.38	PK2	38.7	-38.7	0	67.38	-	-	74	-6.62	52	119	H
	*** 12.01098	67.38	PK2	38.7	-38.7	-33.98	33.4	54	-20.6	-	-	52	119	H
5	*** 4.80419	64.59	PK2	33.9	-47	0	51.49	-	-	74	-22.51	46	107	V
	*** 4.80419	64.59	PK2	33.9	-47	-33.98	17.51	54	-36.49	-	-	46	107	V
7	*** 9.41063	50.51	Pk	36.3	-40.6	0	46.21	54	-7.79	74	-27.79	0-360	101	V
8	*** 12.01096	69.11	PK2	38.7	-38.7	0	69.11	-	-	74	-4.89	2	162	V
	*** 12.01096	69.11	PK2	38.7	-38.7	-33.98	35.13	54	-18.87	-	-	2	162	V
2	7.20656	61.56	Pk	35.4	-42.4	0	54.56	-	-	-	-	0-360	101	H
6	7.20656	63.58	Pk	35.4	-42.4	0	56.58	-	-	-	-	0-360	101	V
9	16.81219	49.6	Pk	40.9	-36.5	0	54	-	-	-	-	0-360	101	H
10	16.81219	51.17	Pk	40.9	-36.5	0	55.57	-	-	-	-	0-360	101	V

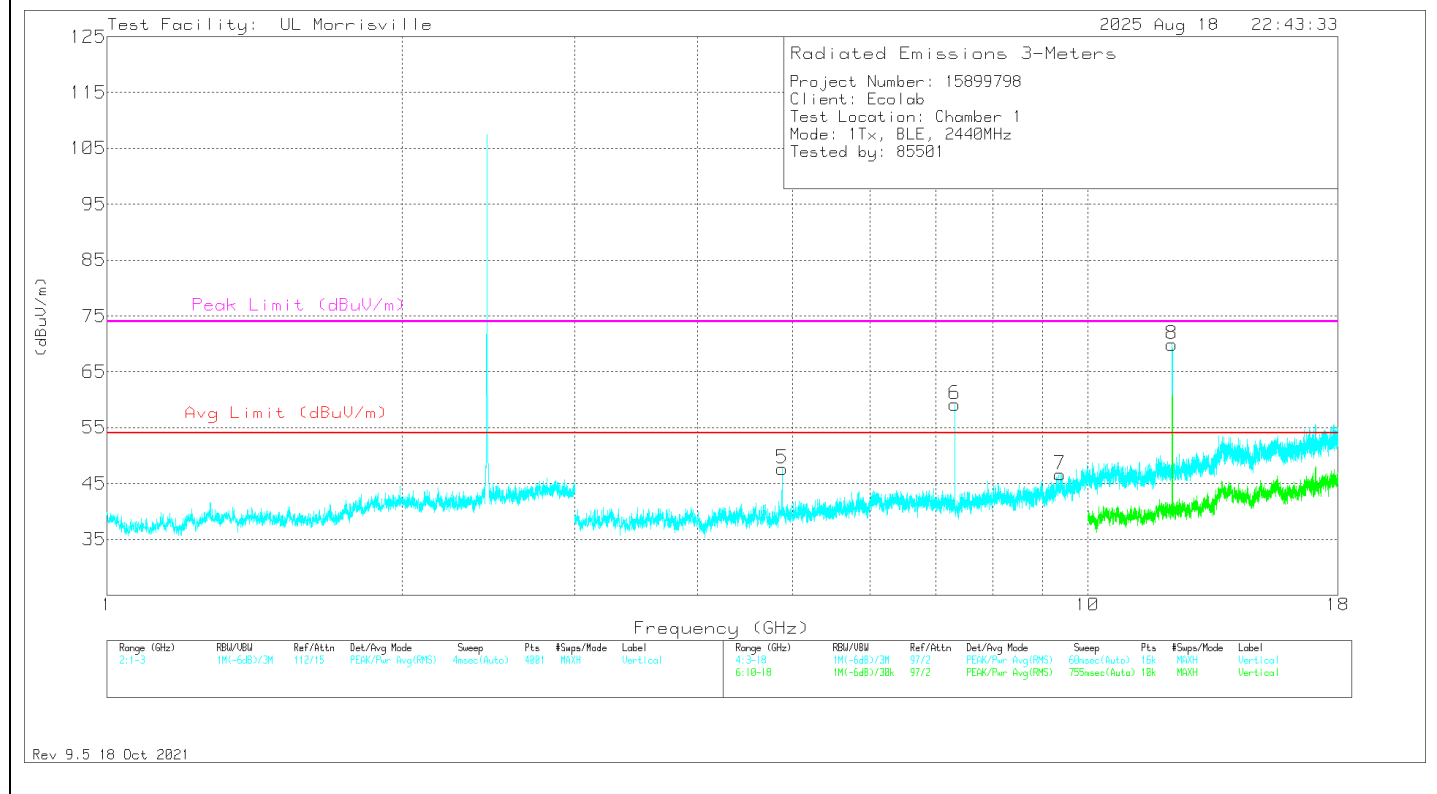
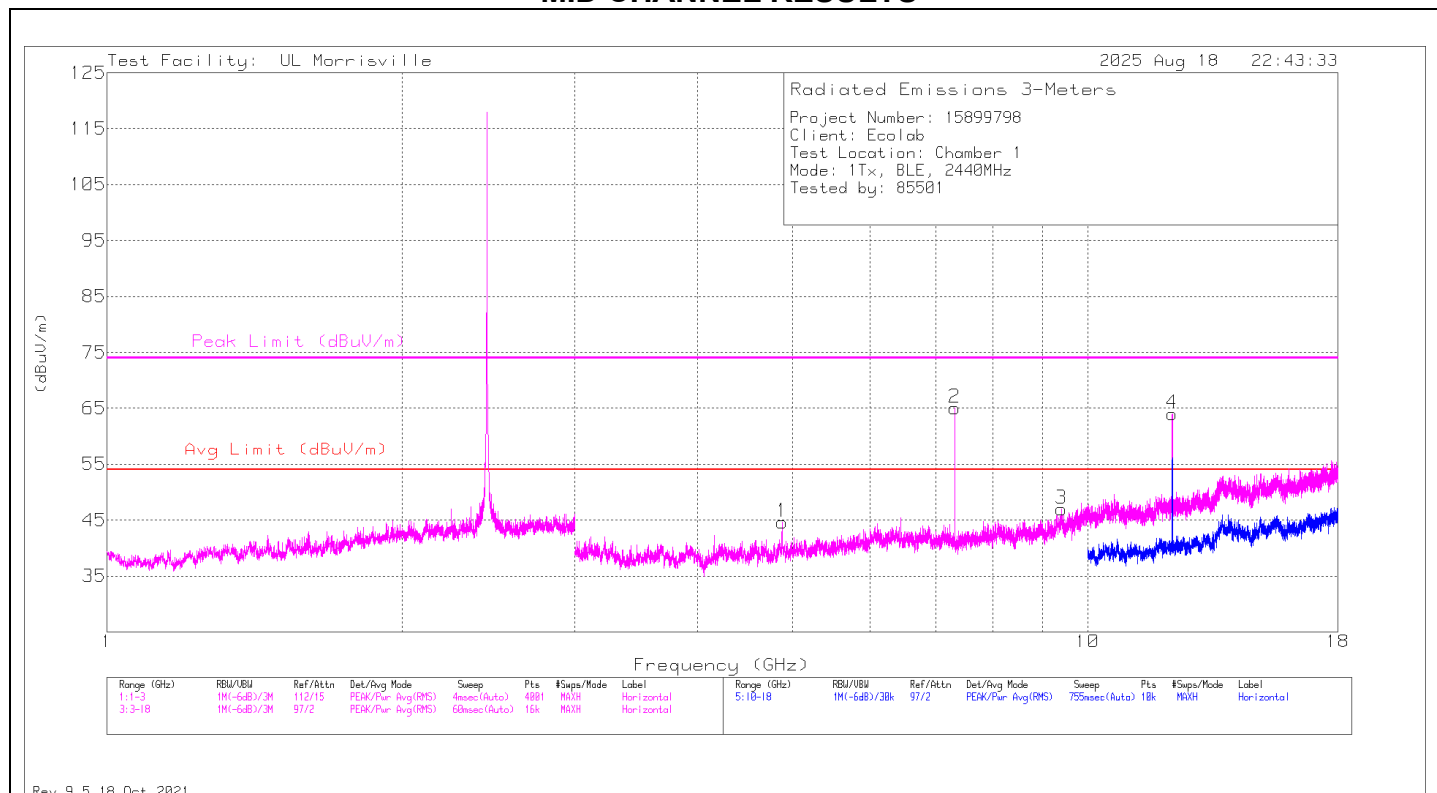
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

MID CHANNEL RESULTS



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	* ** 4.87875	55.94	Pk	34	-45.3	0	44.64	54	-9.36	74	-29.36	0-360	101	H
2	* ** 7.32052	73.55	PK2	35.4	-43.3	0	65.65	-	-	74	-8.35	326	102	H
	* ** 7.32052	73.55	PK2	35.4	-43.3	-33.98	31.67	54	-22.33	-	-	326	102	H
3	* ** 9.40406	50.99	Pk	36.3	-40.3	0	46.99	54	-7.01	74	-27.01	0-360	101	H
4	* ** 12.20087	68.76	PK2	38.8	-38.4	0	69.16	-	-	74	-4.84	241	130	H
	* ** 12.20087	68.76	PK2	38.8	-38.4	-33.98	35.18	54	-18.82	-	-	241	130	H
5	* ** 4.87969	59.08	Pk	34	-45.4	0	47.68	54	-6.32	74	-26.32	0-360	101	V
6	* ** 7.31904	67.39	PK2	35.4	-43.1	0	59.69	-	-	74	-14.31	298	138	V
	* ** 7.31904	67.39	PK2	35.4	-43.1	-33.98	25.71	54	-28.29	-	-	298	138	V
7	* ** 9.37688	51.45	Pk	36.2	-41	0	46.65	54	-7.35	74	-27.35	0-360	101	V
8	* ** 12.19838	70.3	PK2	38.8	-38.5	0	70.6	-	-	74	-3.4	53	128	V

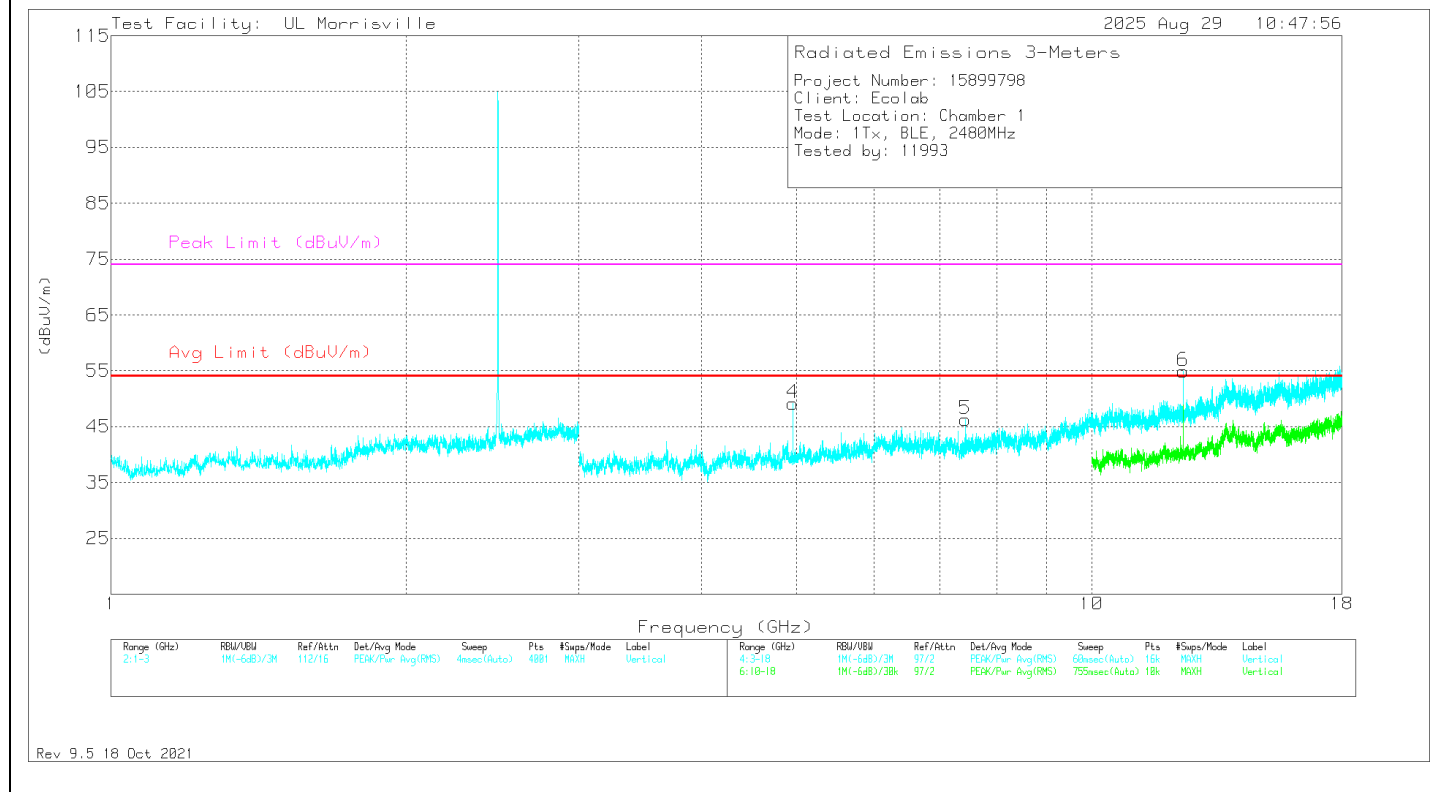
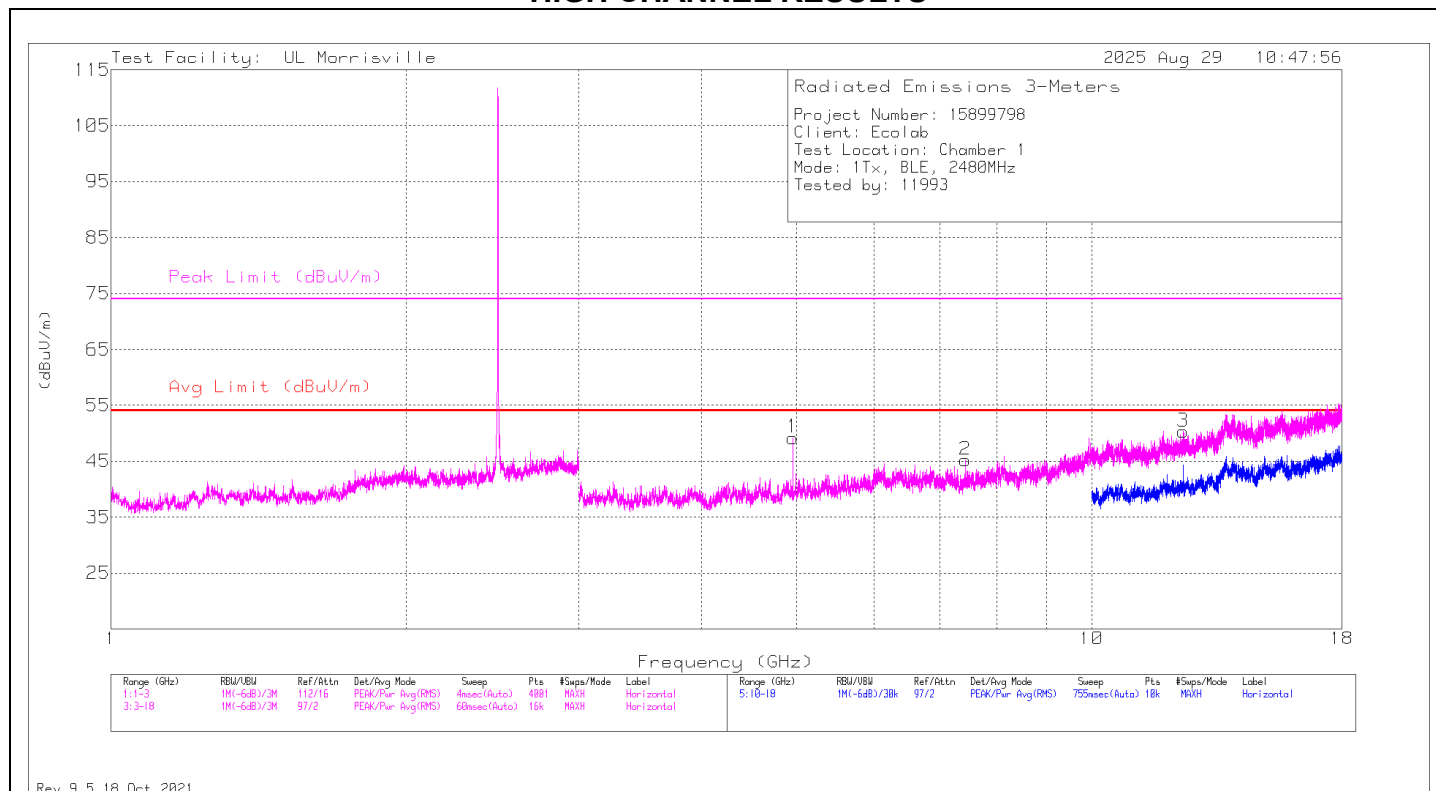
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

HIGH CHANNEL RESULTS



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	135143 (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
1	* ** 4.96036	62.89	PK2	34.2	-45.7	0	51.39	-	-	74	-22.61	7	116	H
	* ** 4.96036	62.89	PK2	34.2	-45.7	-33.98	17.41	54	-36.59	-	-	7	116	H
2	* ** 7.44	52.37	Pk	35.4	-42.6	0	45.17	54	-8.83	74	-28.83	0-360	101	H
3	* ** 12.3986	54.56	PK2	38.7	-38	0	55.26	-	-	74	-18.74	238	139	H
	* ** 12.3986	54.56	PK2	38.7	-38	-33.98	21.28	54	-32.72	-	-	238	139	H
4	* ** 4.95943	63.23	PK2	34.2	-45.7	0	51.73	-	-	74	-22.27	247	120	V
	* ** 4.95943	63.23	PK2	34.2	-45.7	-33.98	17.75	54	-36.25	-	-	247	120	V
5	* ** 7.44	53.52	Pk	35.4	-42.6	0	46.32	54	-7.68	74	-27.68	0-360	101	V
6	* ** 12.401	58.48	PK2	38.7	-38.1	0	59.08	-	-	74	-14.92	49	129	V
	* ** 12.401	58.48	PK2	38.7	-38.1	-33.98	25.1	54	-28.9	-	-	49	129	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

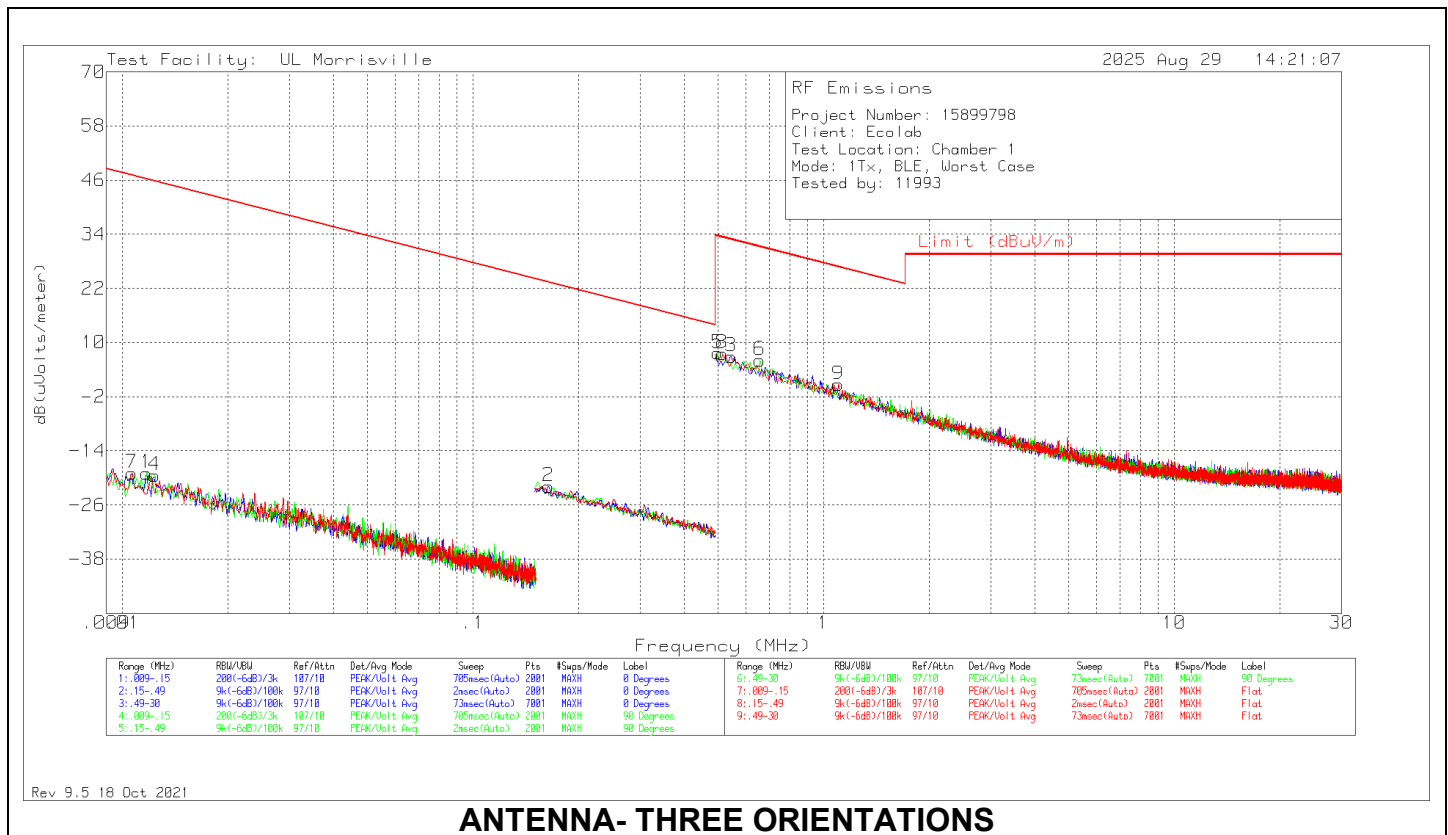
Pk - Peak detector

PK2 - Maximum Peak

10.3. WORST CASE BELOW 30MHZ

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were $40 \cdot \log(\text{test distance} / \text{specification distance})$.

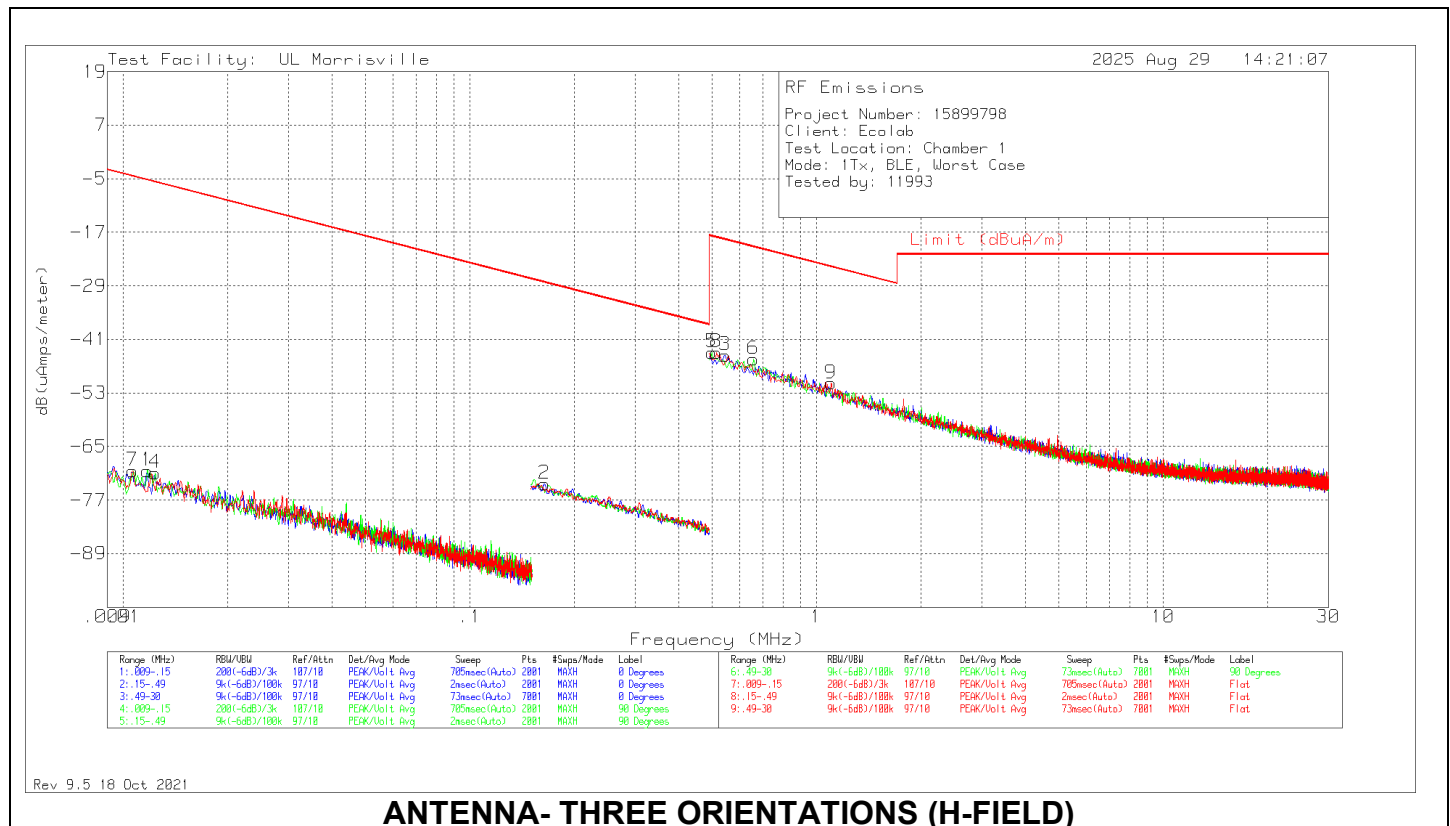
SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	ANT (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	QP/AV Limit (dBuV/m)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
7	.01063	42.36	Pk	18.6	.1	-80	-18.94	47.07	67.07	-66.01	0-360	Flat
1	.0117	42.78	Pk	18.1	.1	-80	-19.02	46.24	66.24	-65.26	0-360	0 degs
4	.01234	42.6	Pk	17.8	.1	-80	-19.5	45.78	65.78	-65.28	0-360	90 degs
2	.16403	47.02	Pk	11	.1	-80	-21.88	23.31	43.31	-45.19	0-360	0 degs
5	.49843	36.52	Pk	11	.1	-40	7.62	33.65	-	-26.03	0-360	90 degs
8	.5153	36.5	Pk	11	.1	-40	7.6	33.36	-	-25.76	0-360	Flat
3	.54481	35.82	Pk	11	.1	-40	6.92	32.88	-	-25.96	0-360	0 degs
6	.65864	34.92	Pk	11	.1	-40	6.02	31.23	-	-25.21	0-360	90 degs
9	1.10132	29.44	Pk	11	.2	-40	.64	26.77	-	-26.13	0-360	Flat

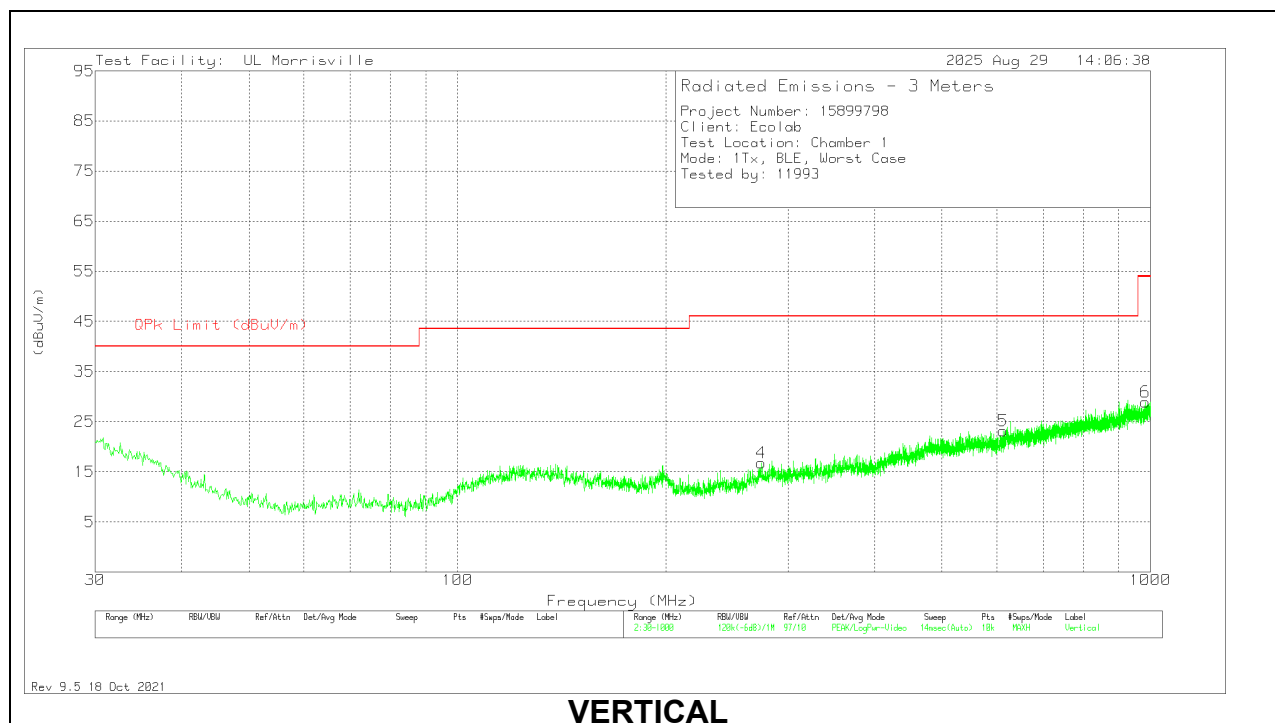
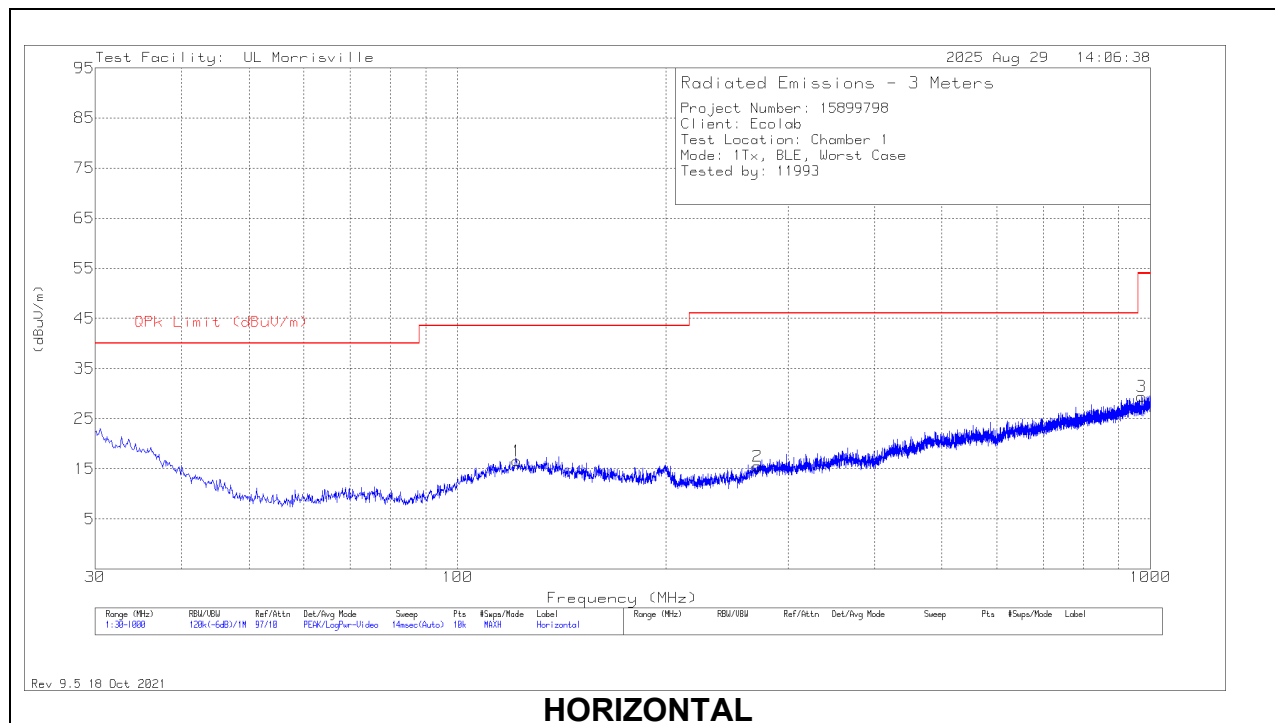


ANTENNA- THREE ORIENTATIONS (H-FIELD)

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	ANT (dB/m)	Gain/Loss (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	QP/AV Limit (dBuA/m)	PK Limit (dBuA/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
7	.01063	42.36	Pk	-32.9	.1	-80	-70.44	-4.43	15.57	-66.01	0-360	Flat
1	.0117	42.78	Pk	-33.4	.1	-80	-70.52	-5.26	14.74	-65.26	0-360	0 degs
4	.01234	42.6	Pk	-33.7	.1	-80	-71	-5.72	14.28	-65.28	0-360	90 degs
2	.16403	47.02	Pk	-40.5	.1	-80	-73.38	-28.19	-8.19	-45.19	0-360	0 degs
5	.49843	36.52	Pk	-40.5	.1	-40	-43.88	-17.85	-	-26.03	0-360	90 degs
8	.5153	36.5	Pk	-40.5	.1	-40	-43.9	-18.14	-	-25.76	0-360	Flat
3	.54481	35.82	Pk	-40.5	.1	-40	-44.58	-18.62	-	-25.96	0-360	0 degs
6	.65864	34.92	Pk	-40.5	.1	-40	-45.48	-20.27	-	-25.21	0-360	90 degs
9	1.10132	29.44	Pk	-40.5	.2	-40	-50.86	-24.73	-	-26.13	0-360	Flat

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	90629 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 121.859	27.28	Pk	20	-30.7	16.58	43.52	-26.94	0-360	399	H
2	* ** 270.948	25.77	Pk	19.4	-29.7	15.47	46.02	-30.55	0-360	199	H
3	* ** 971.288	25.76	Pk	29	-25.3	29.46	53.97	-24.51	0-360	399	H
4	* ** 274.149	26.77	Pk	19.5	-29.5	16.77	46.02	-29.25	0-360	100	V
5	* ** 613.164	26.67	Pk	25.1	-28.6	23.17	46.02	-22.85	0-360	100	V
6	* ** 983.413	24.99	Pk	29.3	-25.4	28.89	53.97	-25.08	0-360	100	V

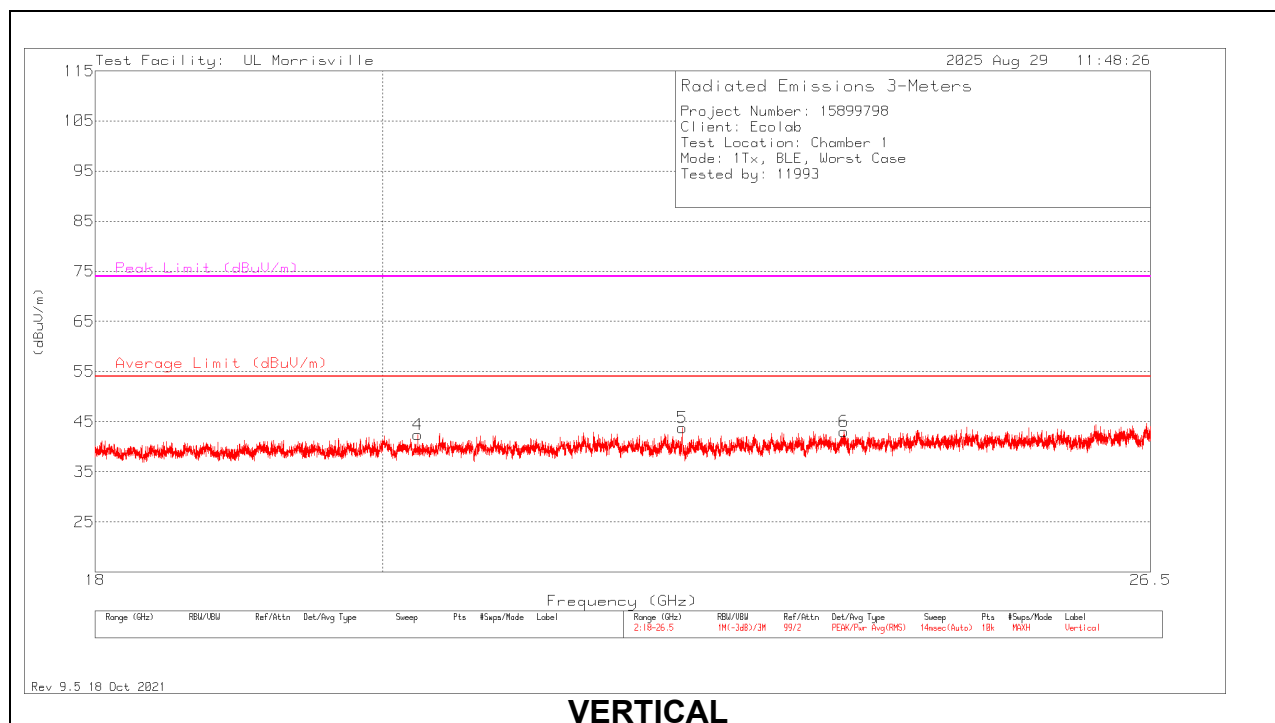
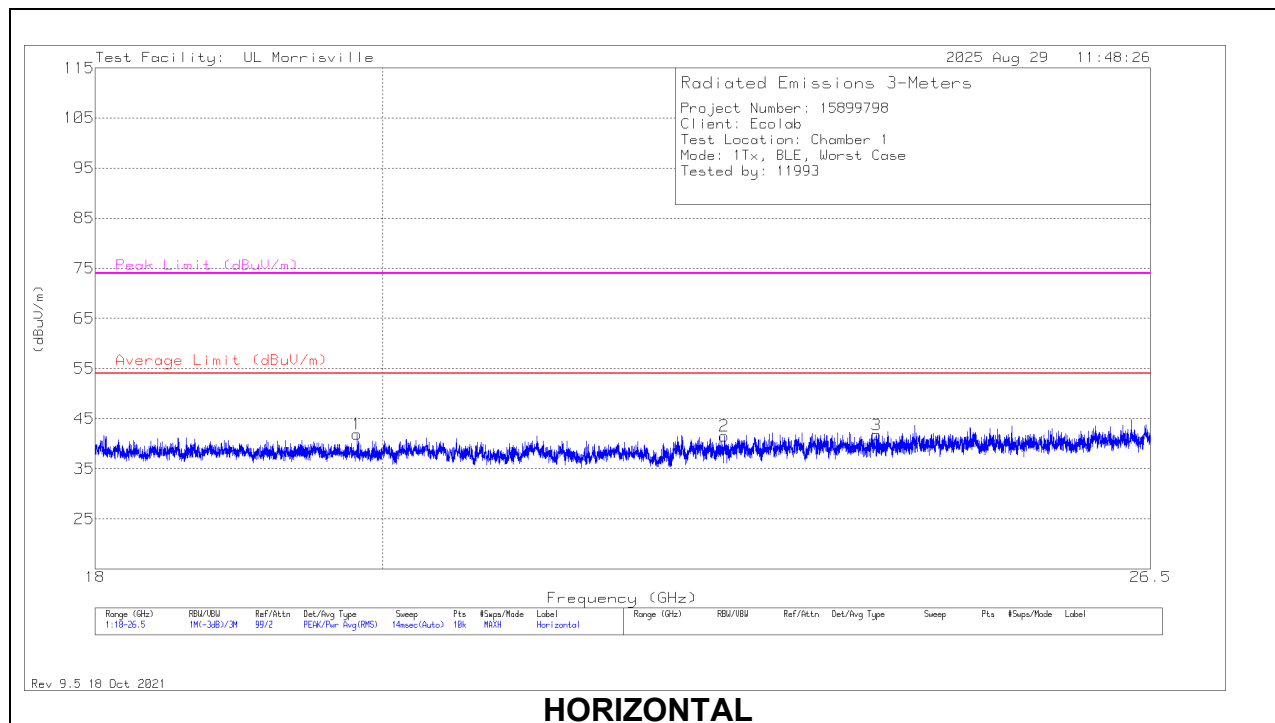
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - 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	91186 (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	* ** 19.81408	49.13	Pk	32.5	-39.7	41.93	54	-12.07	74	-32.07	0-360	299	H
2	* ** 22.66697	48.28	Pk	33.4	-40.1	41.58	54	-12.42	74	-32.42	0-360	299	H
3	* ** 23.9676	47.42	Pk	33.8	-39.5	41.72	54	-12.28	74	-32.28	0-360	299	H
4	* ** 20.25868	49.5	Pk	32.6	-39.7	42.4	54	-11.6	74	-31.6	0-360	151	V
5	* ** 22.32268	50.34	Pk	33.3	-39.9	43.74	54	-10.26	74	-30.26	0-360	101	V
6	* ** 23.68622	48.31	Pk	33.9	-39.2	43.01	54	-10.99	74	-30.99	0-360	300	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

11. SETUP PHOTOS

Please refer to R15899798-EP1 for setup photos

END OF TEST REPORT