TEST REPORT

Report Number: R14933686-E1

Applicant	:	Rain Bird Corporation 9491 Ridgehaven Court San Diego, CA 92123, USA
Model	:	ESPBAT-BT1, ESPBAT-BT2, ESPBAT-BT4, ESPBAT-BT6
FCC ID	:	QVP-001BAT
IC	:	4748A-001BAT
EUT Description	:	Lawn Sprinkler Control
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C: 2023 ISED RSS-247 ISSUE 3: 2023 ISED RSS-GEN ISSUE 5 + A2: 2021

Date Of Issue:
2023-12-19

Prepared by:
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CERT #0751.06

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2023-10-13	Initial Issue	Charles Moody
V2	2023-12-19	Revised Antenna Gain	Charles Moody

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Rain Bird Corporation
9491 Ridgehaven Court
San Diego, CA 92123, USA

EUT DESCRIPTION: Lawn Sprinkler Control

MODEL: ESPBAT-BT1, ESPBAT-BT2, ESPBAT-BT4, ESPBAT-BT6

SERIAL NUMBER: 4C:A1:61:90:B3:A4

SAMPLE RECEIPT DATE: 2023-08-24, 2023-08-30

DATE TESTED: 2023-08-30 TO 2023-09-28

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

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

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

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

Approved & Released For
UL LLC By:

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

Prepared By:

Charles Moody
Electrical Engineer
Consumer, Medical and IT Segment
UL LLC

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2. TEST RESULTS SUMMARY

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

1. Antenna gain and type (see section 6.4)
2. Supported data rates (see section 6.6)

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

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC 47 CFR Part 2, FCC 47 CFR Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A2, and RSS-247 Issue 3.

4. FACILITIES AND ACCREDITATION

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

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

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5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

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

5.2. DECISION RULES

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

5.3. MEASUREMENT UNCERTAINTY

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

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

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

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

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a lawn sprinkler controller with a BLE radio. This report covers the full emissions testing of the BLE radio.

6.2. MODEL DIFFERENCES

The difference between each model variant is the number of irrigation zone outputs, which associated components are populated or depopulated depending on the model, ESPBAT-BTX where 'X' represents the number of outputs. There is no difference in the radio circuitry and the only difference is the number of outputs. Therefore, the BLE test data for ESPBAT-BT6, which was tested, is representative of ESPBAT-BT1, ESPBAT-BT2 and ESPBAT-BT4 as it was the worst-case of all models.

6.3. 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	6.24	4.21

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

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

Frequency Range	Antenna Gain (Peak, dBi)	Antenna Type
2400-2500	2.35	PCB

6.5. SOFTWARE AND FIRMWARE

The firmware version used during testing was CBOS v4.2.0.

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6.6. 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 average output power as worst-case scenario. This was found to be low channel, 2402MHz.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low and high channels for band edge, as well as mid channel for radiated emissions. This testing was performed with the EUT in its only mode of operation, battery powered, and at its only supported data rate of 1Mbps.

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

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6.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Support Laptop	Lenovo	Yoga 7 16IAP7	PF49WDF9	N/A
Support Laptop	Lenovo	ThinkPad T14 Gen 3	PF4FKVY8	N/A
Solenoid (x7)	Rain Bird	27FE23A	N/A	N/A
Rain Sensor	Rain Bird	RSDBEX	29JL22-13	N/A

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	I/O	1	Wire	Unshielded	<3m	Connects EUT to Rain Sensor
2	I/O	7	Wire	Unshielded	<3m	Connects EUT to Solenoids

TEST SETUP

The EUT is configured prior to testing using a support laptop. The laptop is disconnected for final testing.

SETUP DIAGRAMS

Please refer to R14933686-EP1 for setup diagrams

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7. MEASUREMENT METHOD

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

6 dB BW: ANSI C63.10 Subclause -11.8.1

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

Output Power: ANSI C63.10 Subclause -11.9.2.3.1 Method PKPM1 Peak-reading power meter
ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

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

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

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8. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
	Conducted Room 1				
90411	Spectrum Analyzer	Keysight Technologies	N9030A	2023-08-02	2024-08-02
135121	RF Power Meter	Keysight Technologies	N1911A	2023-07-12	2024-07-31
90779	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2023-04-03	2024-04-03
179892	Environmental Meter	Fisher Scientific	15-077-963	2023-07-26	2024-06-31
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA
	Conducted Room 2				
238710	Environmental Meter	Fisher Scientific	15-077-963	2023-06-27	2024-06-27
90410	Spectrum Analyzer	Keysight Technologies	N9030A	2023-06-14	2024-06-14
135121	RF Power Meter	Keysight Technologies	N1911A	2023-07-12	2024-07-31
90779	Peak and Avg Power Sensor, 50MHz to 18GHz	Keysight Technologies	N1921A	2023-04-03	2024-04-03
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA

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

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Common Equipment				
	Attenuators				
226561	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2023-02-16	2024-02-16
226565	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CentricRF	C18S2-10	2023-02-16	2024-02-16
	Cables				
CBL091	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz	Carlisle Interconnect Technologies	UFA147A-2-0360-200200	2023-02-17	2024-02-17
CBL105	Micro-Coax UTiFLEX Cable Assembly, Low Loss	Carlisle Interconnect Technologies	UFB-197C-0-0160-300300	2023-02-17	2024-02-17

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

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	30-1000 MHz				
90629	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2023-01-06	2024-01-06
	1-18 GHz				
89509	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2023-05-23	2025-05-23
	18-40 GHz				
78835	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2022-12-15	2023-12-15
	Gain-Loss Chains				
207639	Gain-loss string: 25-1000MHz	Various	Various	2023-05-17	2024-05-17
207640	Gain-loss string: 1-18GHz	Various	Various	2023-05-17	2024-05-17
225795	Gain-loss string: 18-40GHz	Various	Various	2023-05-17	2024-05-17
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-04-10	2024-04-10
90416	Spectrum Analyzer	Keysight	N9030A	2023-06-09	2024-06-30
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
200540	Environmental Meter	Fisher Scientific	15-077-963	2022-10-05	2023-10-05

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

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
135144	Active Loop Antenna	ETS-Lindgren	6502	2023-01-17	2024-01-17
	Gain-Loss Chains				
91975	Gain-loss string: 0.009-30MHz	Various	Various	2023-06-06	2024-06-06
	Receiver & Software				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2023-02-02	2024-02-02
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
239540	Environmental Meter	Fisher Scientific	15-077-963	2023-07-19	2025-07-19

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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.

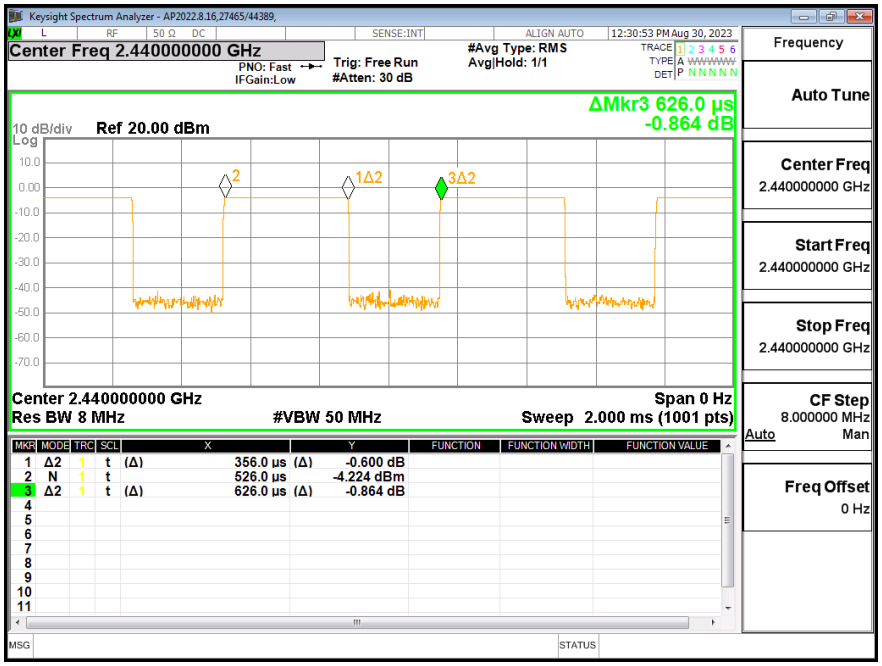
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)
2.4GHz Band				
BLE 1Mbps	0.356	0.626	0.569	56.87

*Note: The manufacturer has declared an operational duty cycle of 9.3% over a 100ms window for the BLE Radio. The correction factor, therefore, would be 20log(1/0.093) = 20.63 dB. Using KDB 558074 D01 Answer 3 (a), a duty cycle correction will be subtracted from the Peak reading to derive an Average reading. See calculation below.

Duty Cycle Correction Factor = 20*log(1/DC) = 20*log(1/0.093) = 20.63 dB

DUTY CYCLE PLOTS



DUTY CYCLE BLE 1Mbps

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9.2. 99% BANDWIDTH

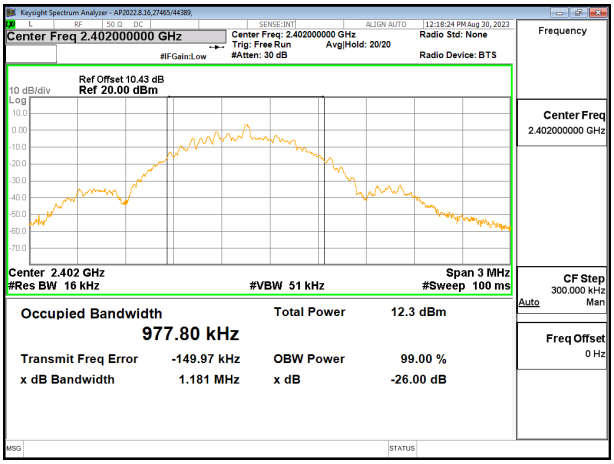
LIMITS

None; for reporting purposes only.

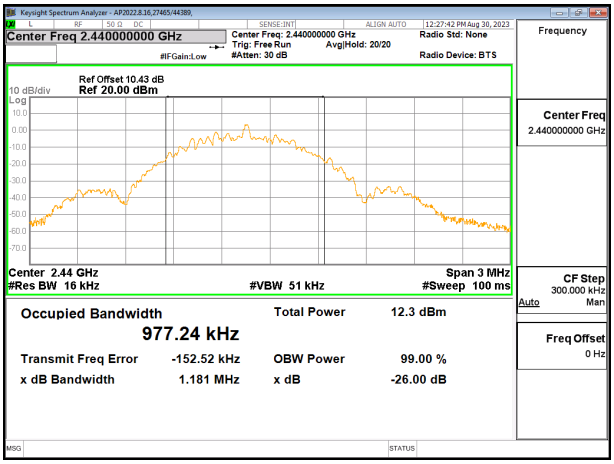
RESULTS

9.2.1. BLE (1Mbps)

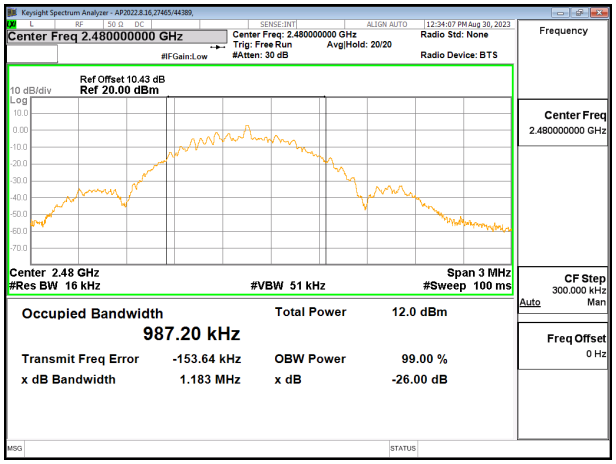
Channel	Frequency (MHz)	99% Bandwidth (kHz)
Low	2402	977.80
Middle	2440	977.24
High	2480	987.20



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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9.3. 6 dB BANDWIDTH

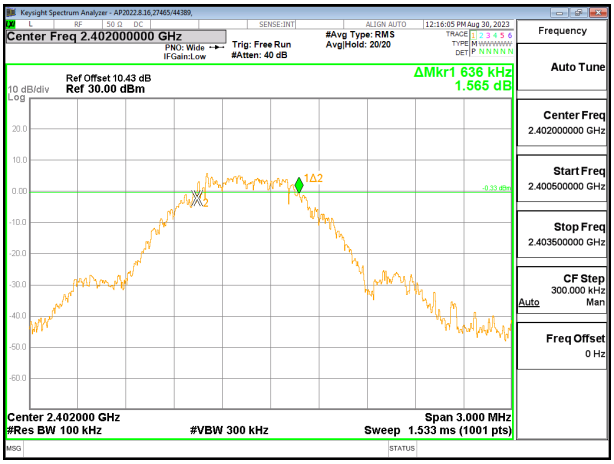
LIMITS

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

RESULTS

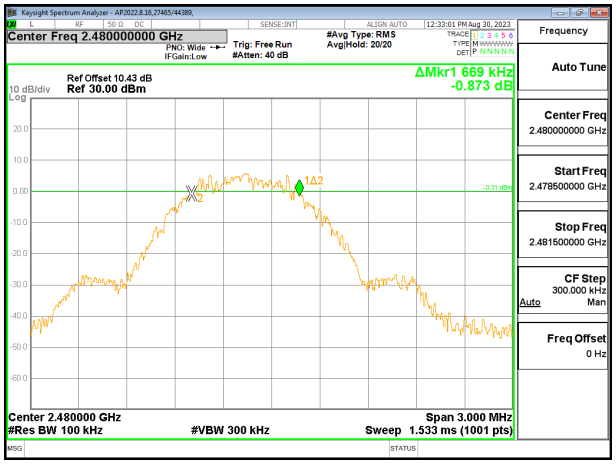
9.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.636	0.500
Middle	2440	0.645	0.500
High	2480	0.669	0.500



LOW CHANNEL

MID CHANNEL



HIGH CHANNEL

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9.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)
RSS-247 5.4 (d)

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.43 dB (including 9.68 dB pad, 0.21 dB cable, and 0.54 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 average power sensor. Peak output power was read directly from the power meter.

RESULTS

9.4.1. BLE (1Mbps)

Tested By:	27465/44389
Date:	2023-08-30

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	6.24	30	-23.76
Middle	2440	6.15	30	-23.85
High	2480	6.03	30	-23.97

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9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.43 dB (including 9.68 dB pad, 0.21 dB cable, and 0.54 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 average power sensor. Gated average output power was read directly from power meter.

RESULTS

9.5.1. BLE (1Mbps)

Tested By:	27465/44389
Date:	2023-08-30

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	6.10
Middle	2440	6.07
High	2480	5.94

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9.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)
RSS-247 (5.2) (b)

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

RESULTS

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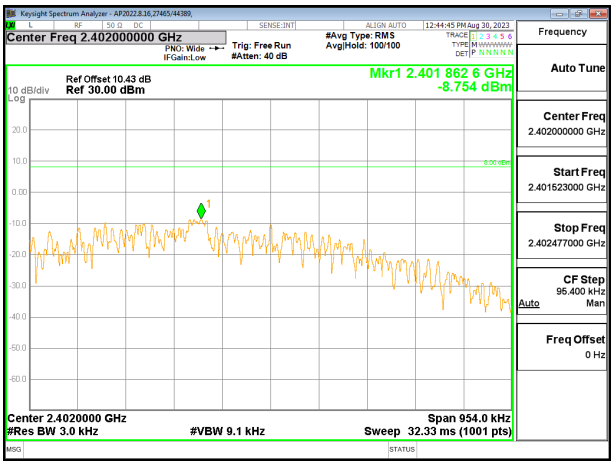
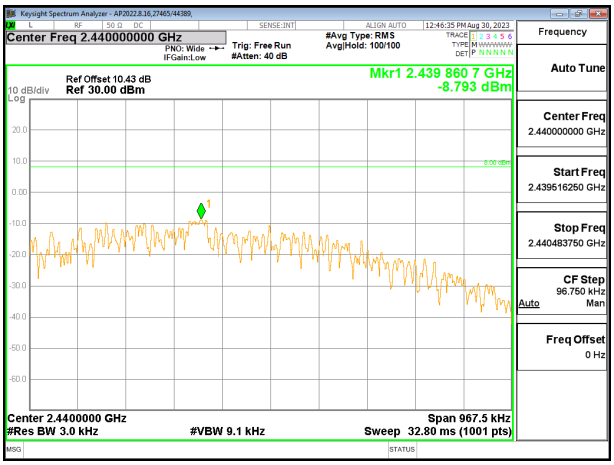
9.6.1. BLE (1Mbps)

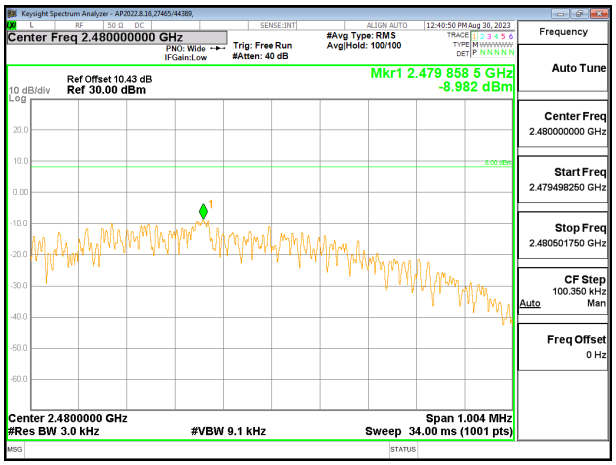
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-8.754	8	-16.754
Middle	2440	-8.793	8	-16.793
High	2480	-8.962	8	-16.962



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)
RSS-247 5.5

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

RESULTS

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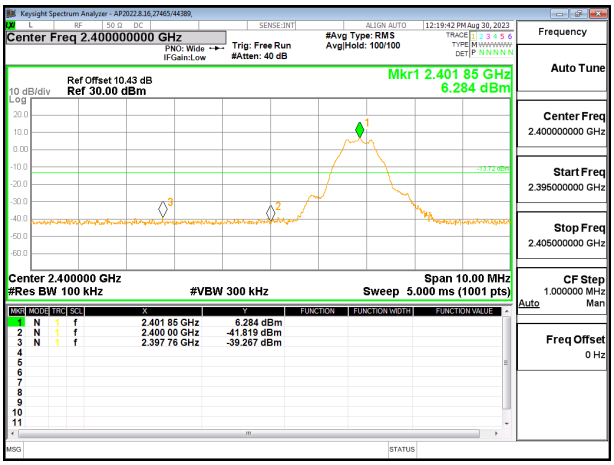
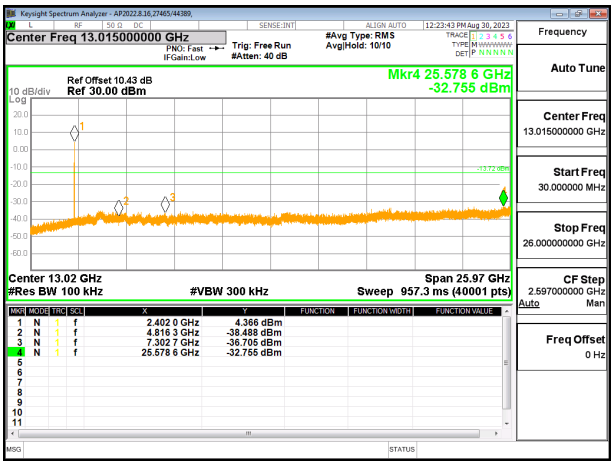
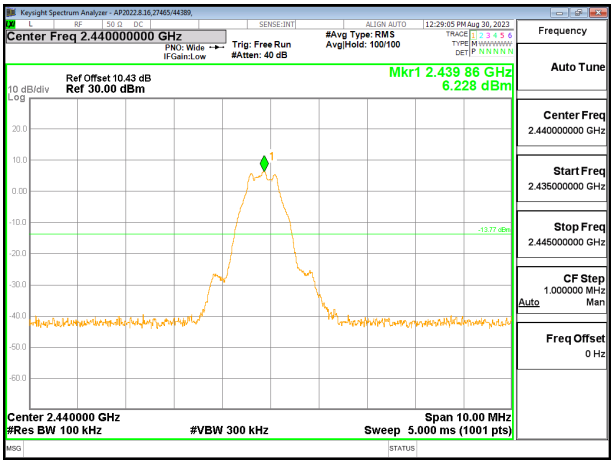
9.7.1. BLE (1Mbps)



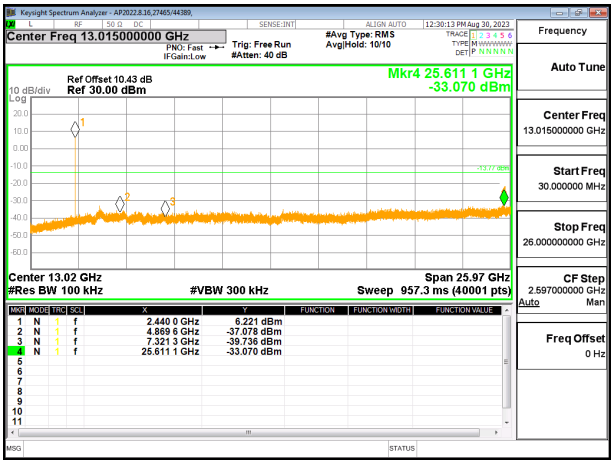
LOW CHANNEL BANDEDGE



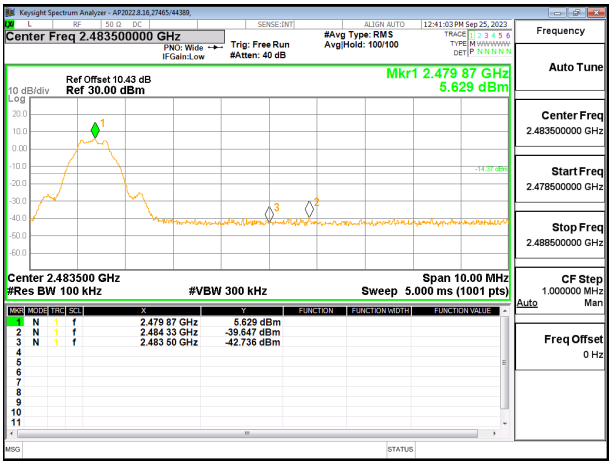
OUT-OF-BAND LOW CHANNEL



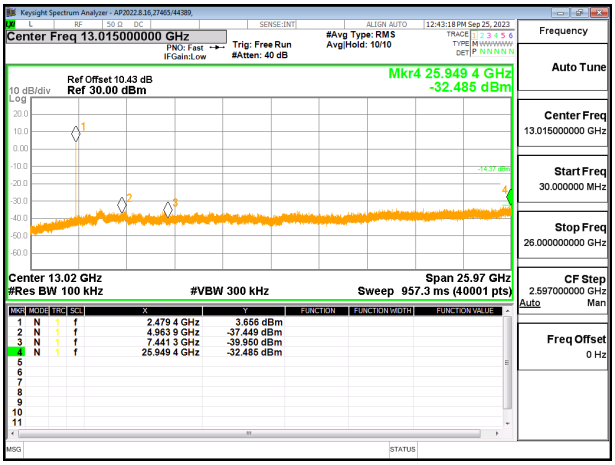
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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

RSS-GEN, Section 8.9 and 8.10.

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

TEST PROCEDURE

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

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

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

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measurements. For average measurements, the DC Correction factor was applied to peak 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 average 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.

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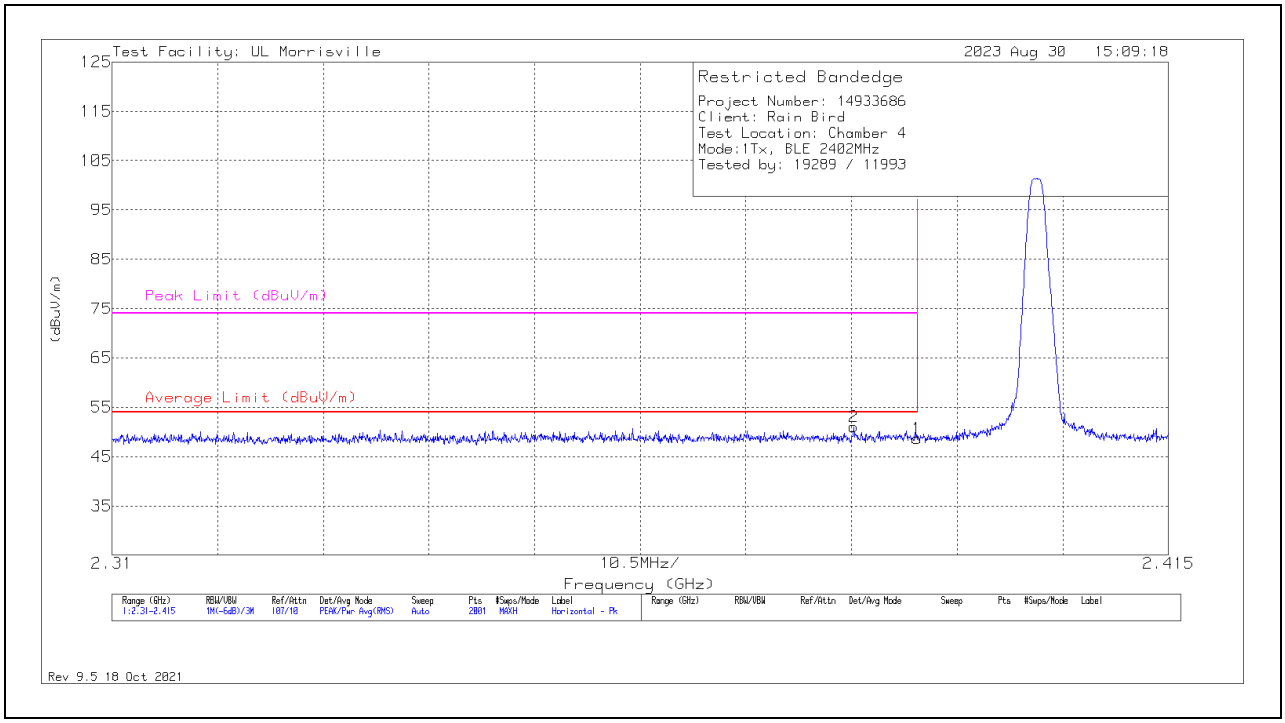
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (1Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 2390	29.85	Pk	32	-13.2	0	48.65	-	-	74	-25.35	52	116	H
1	* ** 2390	29.85	Pk	32	-13.2	-20.63	28.02	54	-25.98	-	-	52	116	H
2	* ** 2383.71	32.36	Pk	32	-13.3	0	51.06	-	-	74	-22.94	52	116	H
2	* ** 2383.71	32.36	Pk	32	-13.3	-20.63	30.43	54	-23.57	-	-	52	116	H

* - 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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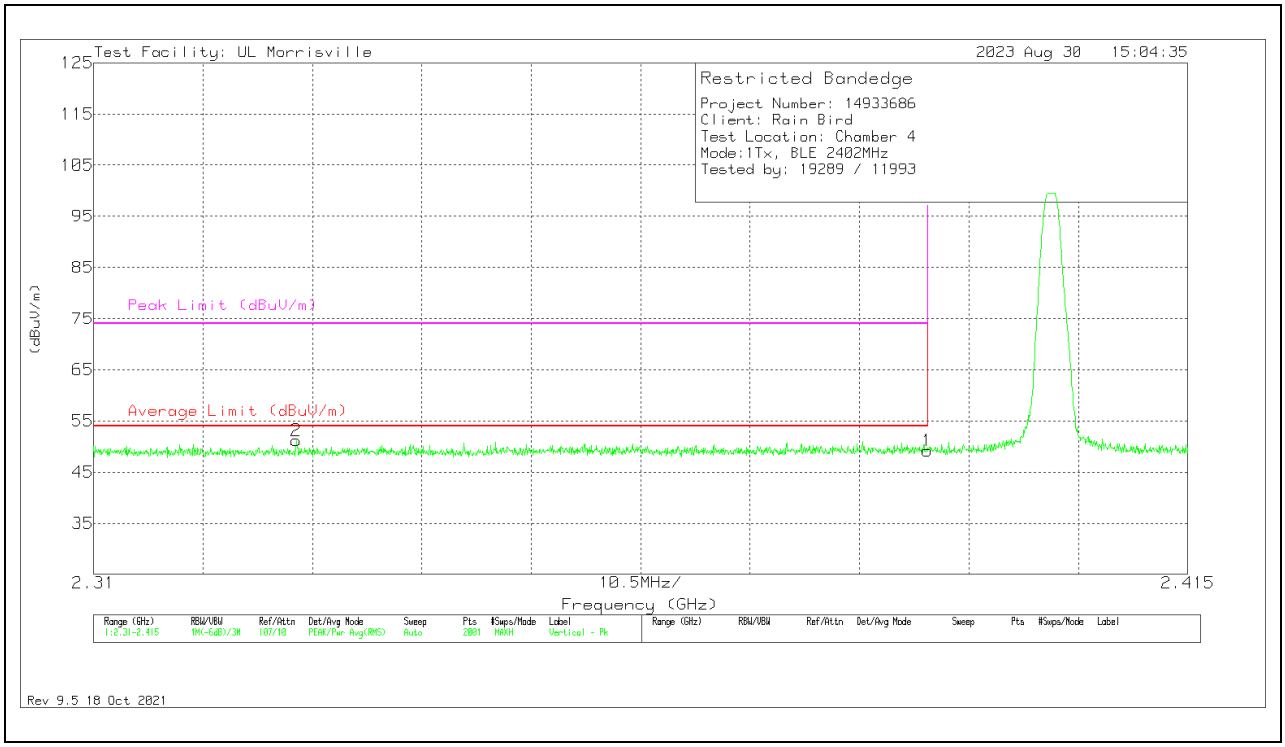
VERTICAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 2390	30.38	Pk	32	-13.2	0	49.18	-	-	74	-24.82	263	113	V
1	* ** 2390	30.38	Pk	32	-13.2	-20.63	28.55	54	-25.45	-	-	263	113	V
2	* ** 2329.425	32.45	Pk	31.9	-13.2	0	51.15	-	-	74	-22.85	263	113	V
2	* ** 2329.425	32.45	Pk	31.9	-13.2	-20.63	30.52	54	-23.48	-	-	263	113	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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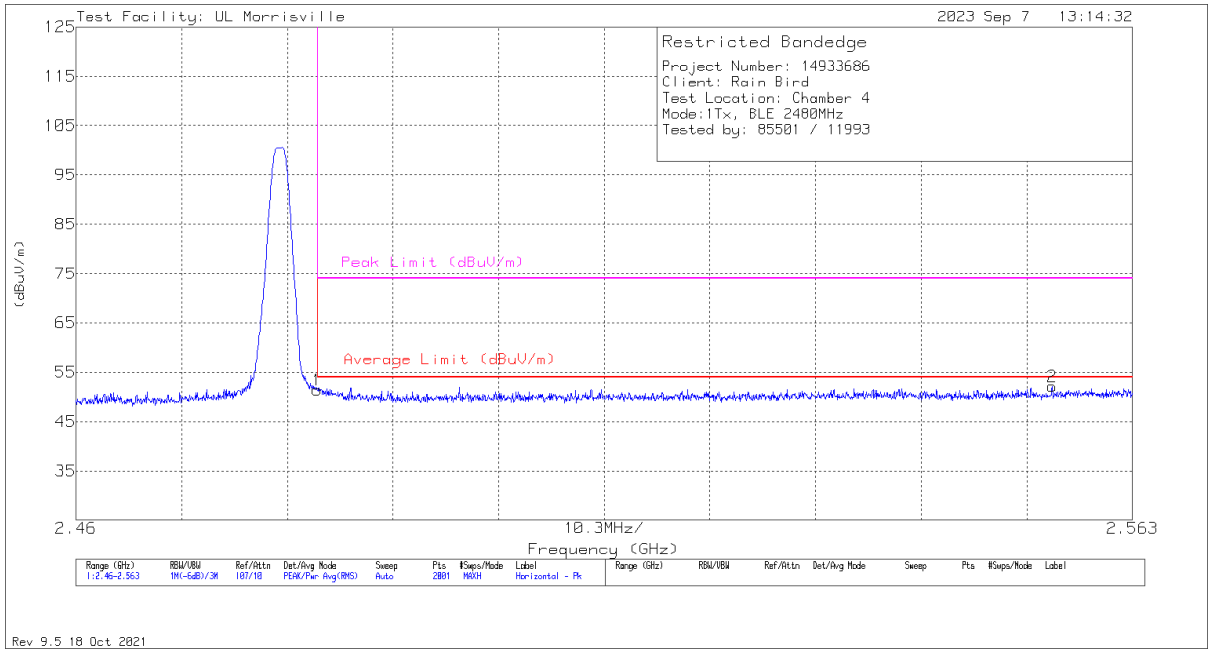
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 2483.5	32.03	Pk	32.3	-12.9	0	51.43	-	-	74	-22.57	45	102	H
1	* ** 2483.5	32.03	Pk	32.3	-12.9	-20.63	30.80	54	-23.20	-	-	45	102	H
2	** 2555.172	32.51	Pk	32.5	-12.9	0	52.11	-	-	74	-21.89	45	102	H
2	** 2555.172	32.51	Pk	32.5	-12.9	-20.63	31.48	54	-22.52	-	-	45	102	H

* - 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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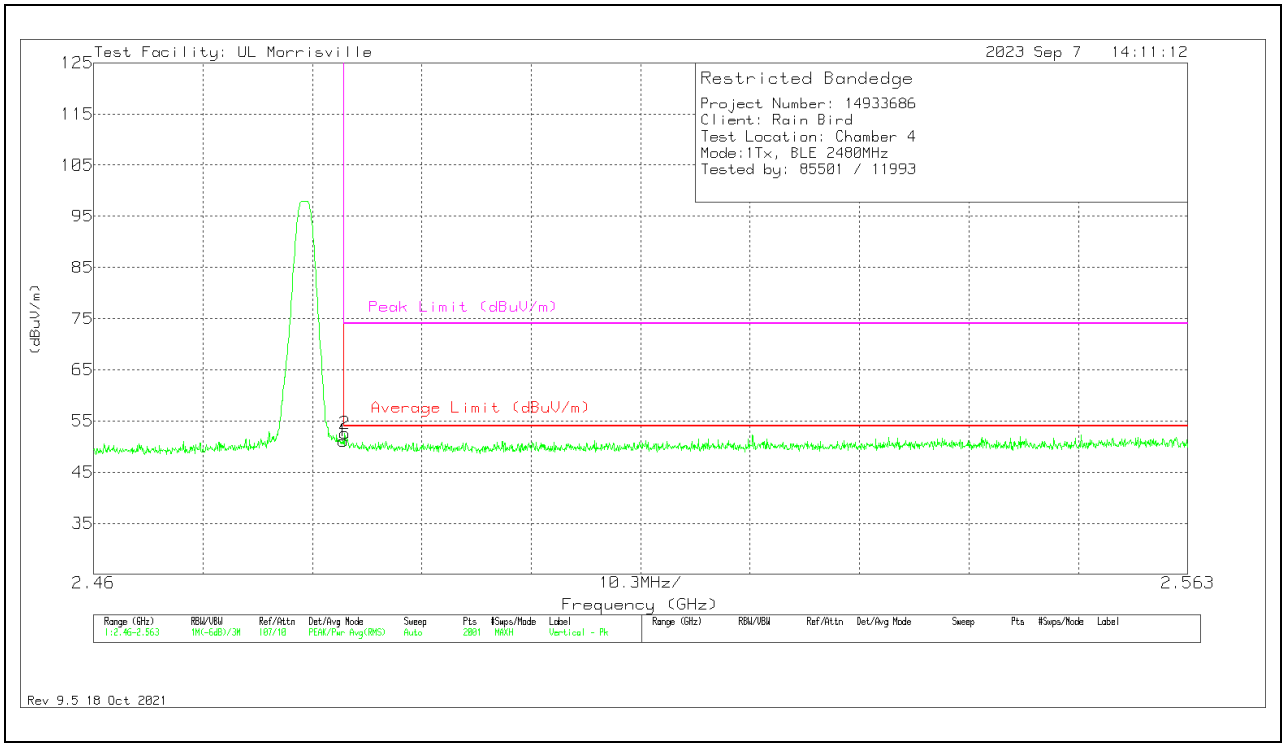
VERTICAL RESULT



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 2483.5	31.73	Pk	32.3	-12.9	0	51.13	-	-	74	-22.87	271	113	V
1	* ** 2483.5	31.73	Pk	32.3	-12.9	-20.63	30.50	54	-23.50	-	-	271	113	V
2	* ** 2483.639	33.19	Pk	32.3	-12.9	0	52.59	-	-	74	-21.41	271	113	V
2	* ** 2483.639	33.19	Pk	32.3	-12.9	-20.63	31.96	54	-22.04	-	-	271	113	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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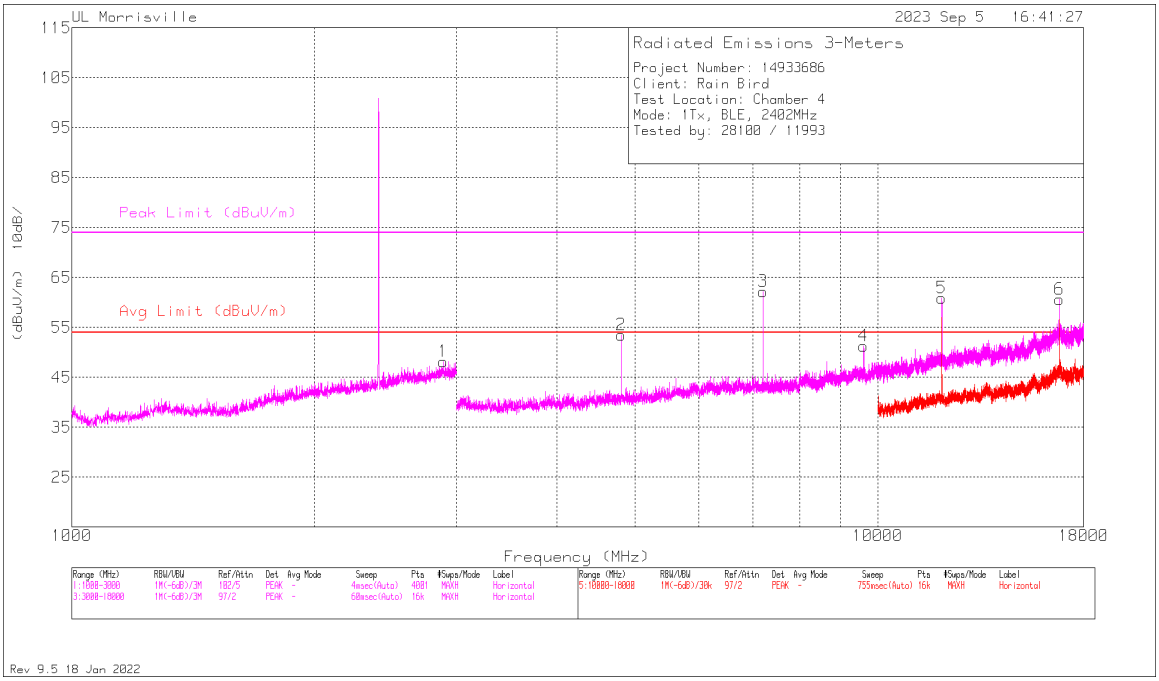
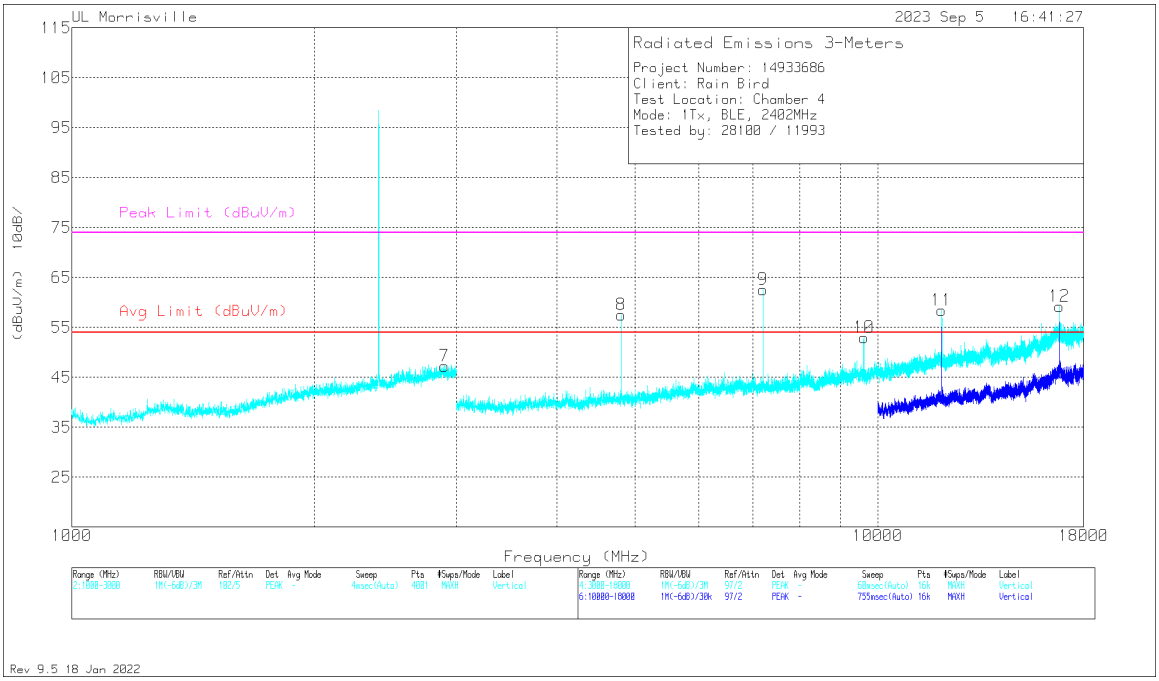
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 2890	27.76	Pk	32.5	-12.1	0	48.16	54	-5.84	74	-25.84	0-360	100	H
7	* ** 2899.5	26.76	Pk	32.5	-12	0	47.26	54	-6.74	74	-26.74	0-360	200	V
2	* ** 4804.115	52.55	PK2	34.1	-31.7	0	54.95	-	-	74	-19.05	0	109	H
2	* ** 4804.115	52.55	PK2	34.1	-31.7	-20.63	34.32	54	-19.68	-	-	0	109	H
5	* ** 12010.432	48.94	PK2	38.7	-23.7	0	63.94	-	-	74	-10.06	93	161	H
5	* ** 12010.432	48.94	PK2	38.7	-23.7	-20.63	43.31	54	-10.69	-	-	93	161	H
8	* ** 4804.199	49.63	PK2	34.1	-31.7	0	52.03	-	-	74	-21.97	248	134	V
8	* ** 4804.199	49.63	PK2	34.1	-31.7	-20.63	31.40	54	-22.60	-	-	248	134	V
11	* ** 12007.958	40.17	PK2	38.7	-23.5	0	55.37	-	-	74	-18.63	162	199	V
11	* ** 12007.958	40.17	PK2	38.7	-23.5	-20.63	34.74	54	-19.26	-	-	162	199	V
9	7204.688	54.99	Pk	35.6	-28	0	62.59	-	-	-	-	0-360	200	V
3	7206.563	54.54	Pk	35.6	-28	0	62.14	-	-	-	-	0-360	100	H
4	9606.563	39.67	Pk	36.8	-25.2	0	51.27	-	-	-	-	0-360	100	H
10	9608.438	41.44	Pk	36.8	-25.3	0	52.94	-	-	-	-	0-360	200	V
6	16811.25	38.37	Pk	41.9	-19.6	0	60.67	-	-	-	-	0-360	100	H
12	16811.25	36.95	Pk	41.9	-19.6	0	59.25	-	-	-	-	0-360	200	V

* - indicates frequency in CFR47 Pt15 / IC RSS-Restricted Band
** - indicates frequency in Taiwan NCC LP0002 Restricted Band
Pk - Peak detector
PK2 - Maximum Peak

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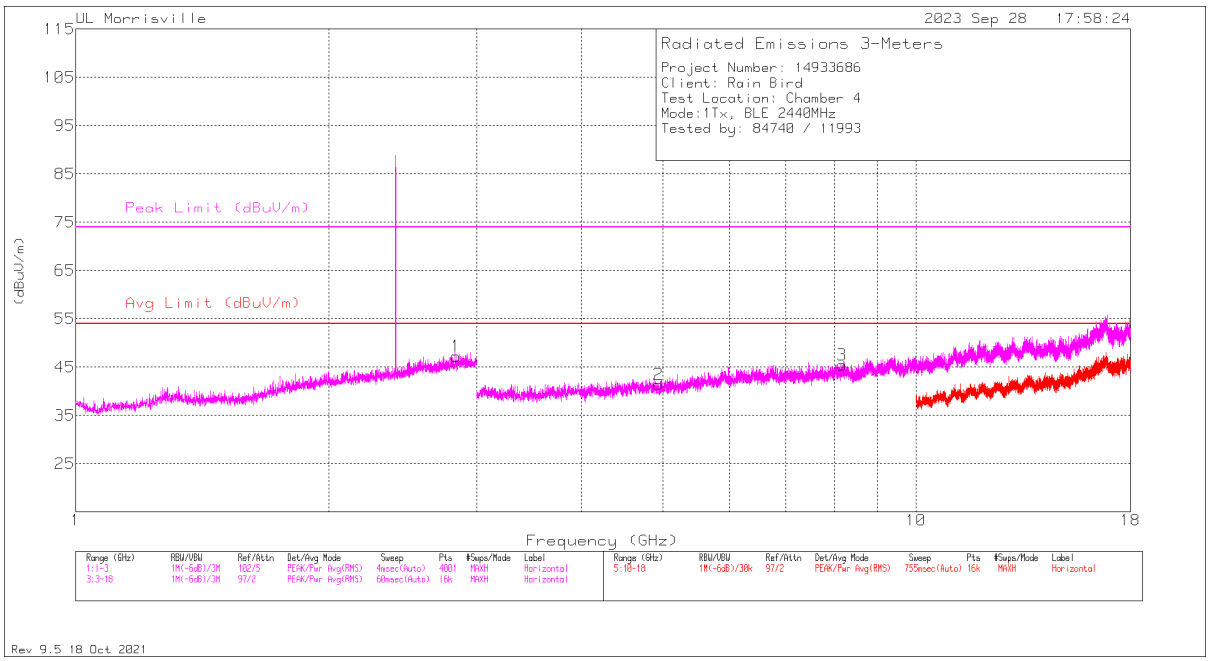
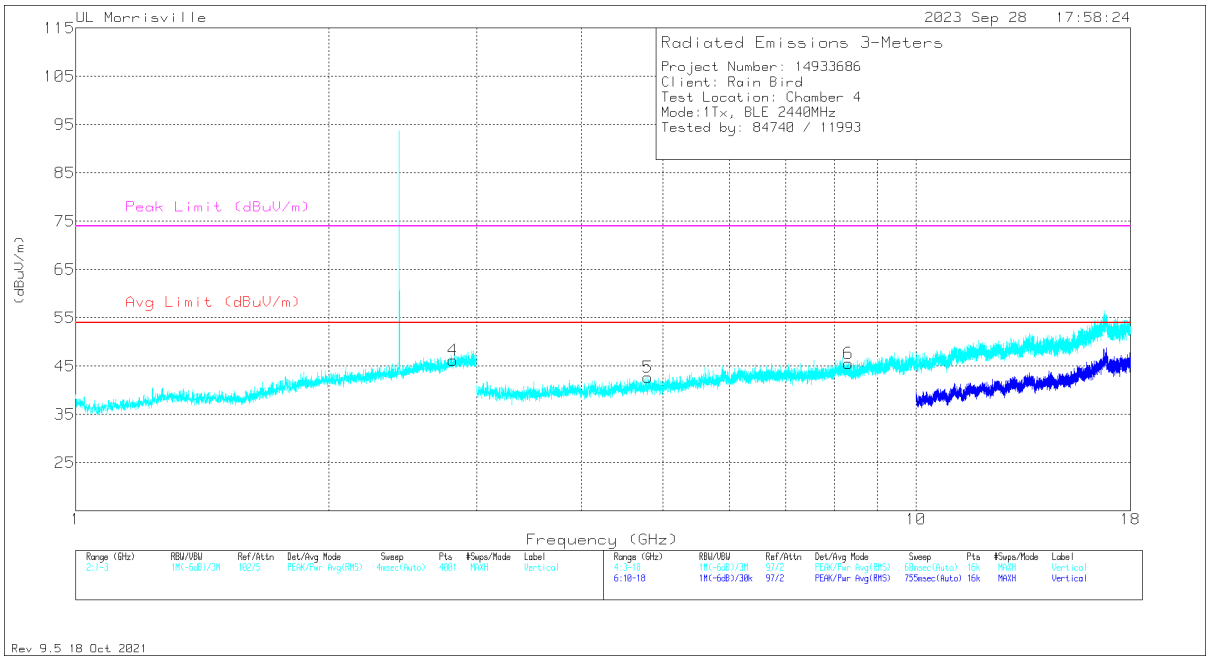
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	89509 ACF (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.838	27.34	Pk	32.3	-12.4	47.24	54	-6.76	74	-26.76	0-360	100	H
4	* ** 2.8095	26.17	Pk	32.5	-12.5	46.17	54	-7.83	74	-27.83	0-360	200	V
2	* ** 4.94063	38.53	Pk	33.9	-31	41.43	54	-12.57	74	-32.57	0-360	100	H
3	* ** 8.16281	36.71	Pk	35.8	-27.1	45.41	54	-8.59	74	-28.59	0-360	100	H
5	* ** 4.79438	40.32	Pk	34.1	-31.7	42.72	54	-11.28	74	-31.28	0-360	200	V
6	* ** 8.30344	36.74	Pk	35.8	-27	45.54	54	-8.46	74	-28.46	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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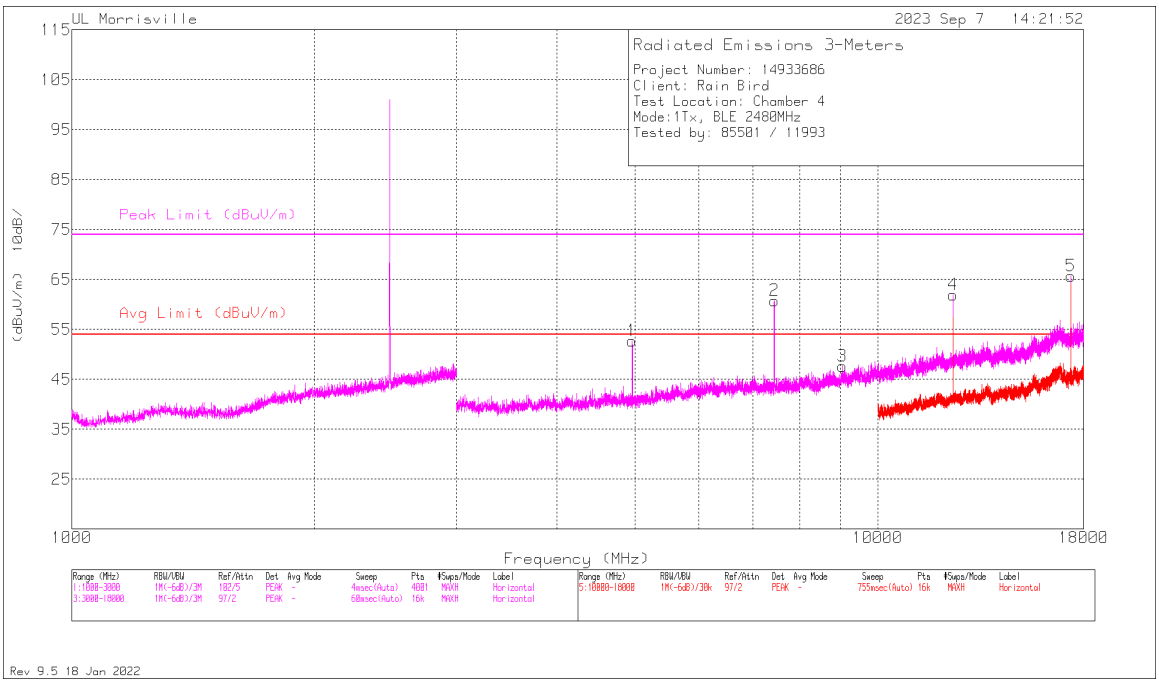
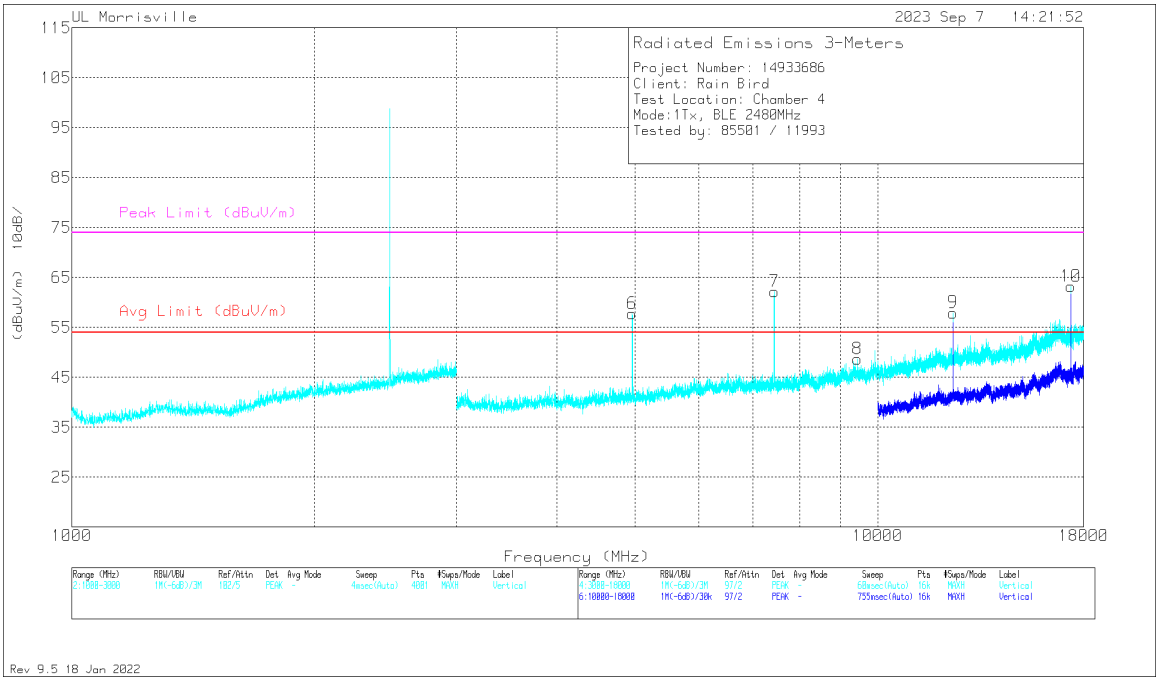
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	89509 ACF (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	* ** 4959.165	52.02	PK2	33.9	-31.4	0	54.52	-	-	74	-19.48	340	346	H
1	* ** 4959.165	52.02	PK2	33.9	-31.4	-20.63	33.89	54	-20.11	-	-	340	346	H
2	* ** 7438.739	54.75	PK2	35.7	-28	0	62.45	-	-	74	-11.55	337	187	H
2	* ** 7438.739	54.75	PK2	35.7	-28	-20.63	41.82	54	-12.18	-	-	337	187	H
3	* ** 9035.625	36.11	Pk	36.2	-24.7	0	47.61	54	-6.39	74	-26.39	0-360	100	H
4	* ** 12399.298	48.18	PK2	38.9	-23	0	64.08	-	-	74	-9.92	349	109	H
4	* ** 12399.298	48.18	PK2	38.9	-23	-20.63	43.45	54	-10.55	-	-	349	109	H
6	* ** 4959.183	55.19	PK2	33.9	-31.4	0	57.69	-	-	74	-16.31	276	354	V
6	* ** 4959.183	55.19	PK2	33.9	-31.4	-20.63	37.06	54	-16.94	-	-	276	354	V
7	* ** 7439.545	55.26	PK2	35.7	-28	0	62.96	-	-	74	-11.04	32	196	V
7	* ** 7439.545	55.26	PK2	35.7	-28	-20.63	42.33	54	-11.67	-	-	32	196	V
8	* ** 9437.083	37.82	PK2	36.7	-25.6	0	48.92	-	-	74	-25.08	300	101	V
8	* ** 9437.083	37.82	PK2	36.7	-25.6	-20.63	28.29	54	-25.71	-	-	300	101	V
9	* ** 12399.162	45.74	PK2	38.9	-22.9	0	61.74	-	-	74	-12.26	338	222	V
9	* ** 12399.162	45.74	PK2	38.9	-22.9	-20.63	41.11	54	-12.89	-	-	338	222	V
10	17358.735	42.93	PK2	41.2	-19.4	0	64.73	-	-	-	-	359	164	V
5	17360.58	45.59	PK2	41.2	-18.6	0	68.19	-	-	-	-	90	242	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

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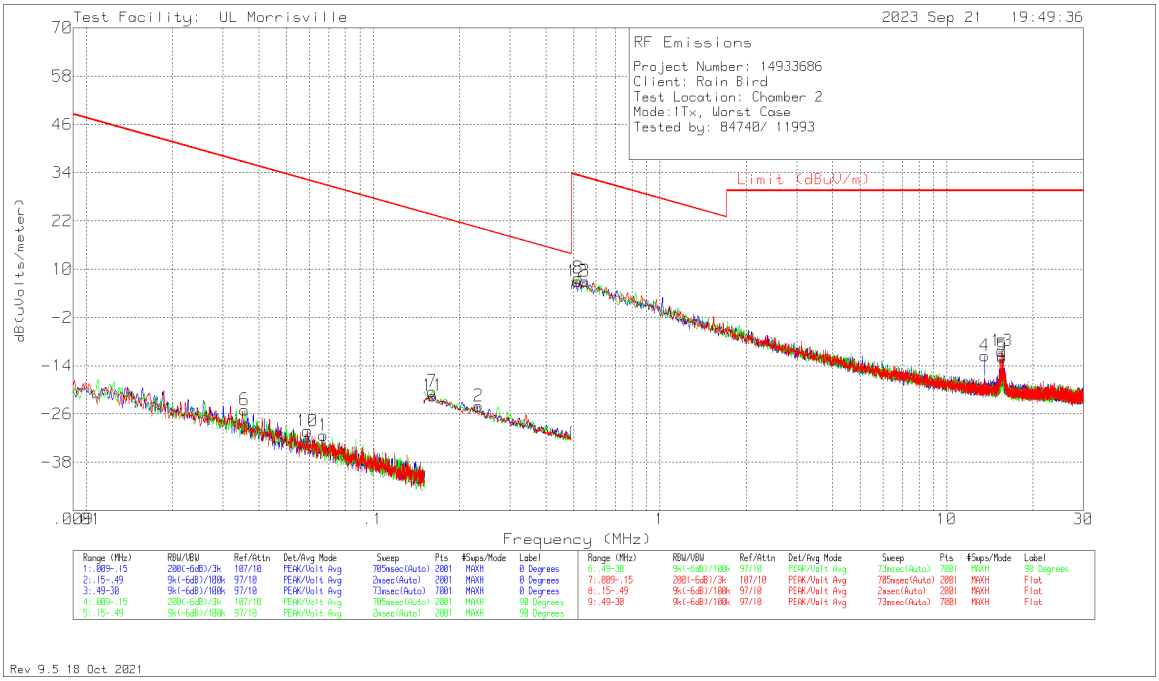
10.3. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)

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*Log (test distance / specification distance).



ANTENNA- THREE ORIENTATIONS E FIELD

Below 30MHz Data

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)	PK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Loop Angle
6	.0357	41.24	Pk	13.7	.1	-80	-24.96	36.55	56.55	-61.51	0-360	90 degs
10	.05906	37.13	Pk	12.5	.1	-80	-30.27	32.18	52.18	-62.45	0-360	Flat
1	.06722	36.2	Pk	12.4	.1	-80	-31.3	31.05	51.05	-62.35	0-360	0 degs
7	.16114	47.31	Pk	12.2	.1	-80	-20.39	23.46	43.46	-43.85	0-360	90 degs
11	.16173	46.25	Pk	12.2	.1	-80	-21.45	23.43	43.43	-44.88	0-360	Flat
2	.23347	43.69	Pk	12.2	.1	-80	-24.01	20.24	40.24	-44.25	0-360	0 degs
12	.5153	34.69	Pk	12.2	.1	-40	6.99	33.36	-	-26.37	0-360	Flat
8	.51951	35.51	Pk	12.2	.1	-40	7.81	33.29	-	-25.48	0-360	90 degs
3	.54902	34.71	Pk	12.2	.1	-40	7.01	32.81	-	-25.8	0-360	0 degs
4	13.5596	17.29	Pk	10.6	.6	-40	-11.51	29.54	-	-41.05	0-360	0 degs
13	15.57906	18.67	Pk	10.3	.7	-40	-10.33	29.54	-	-39.87	0-360	Flat
5	15.60858	17.69	Pk	10.3	.7	-40	-11.31	29.54	-	-40.85	0-360	0 degs
9	15.61279	17.16	Pk	10.3	.7	-40	-11.84	29.54	-	-41.38	0-360	90 degs

Pk - Peak detector

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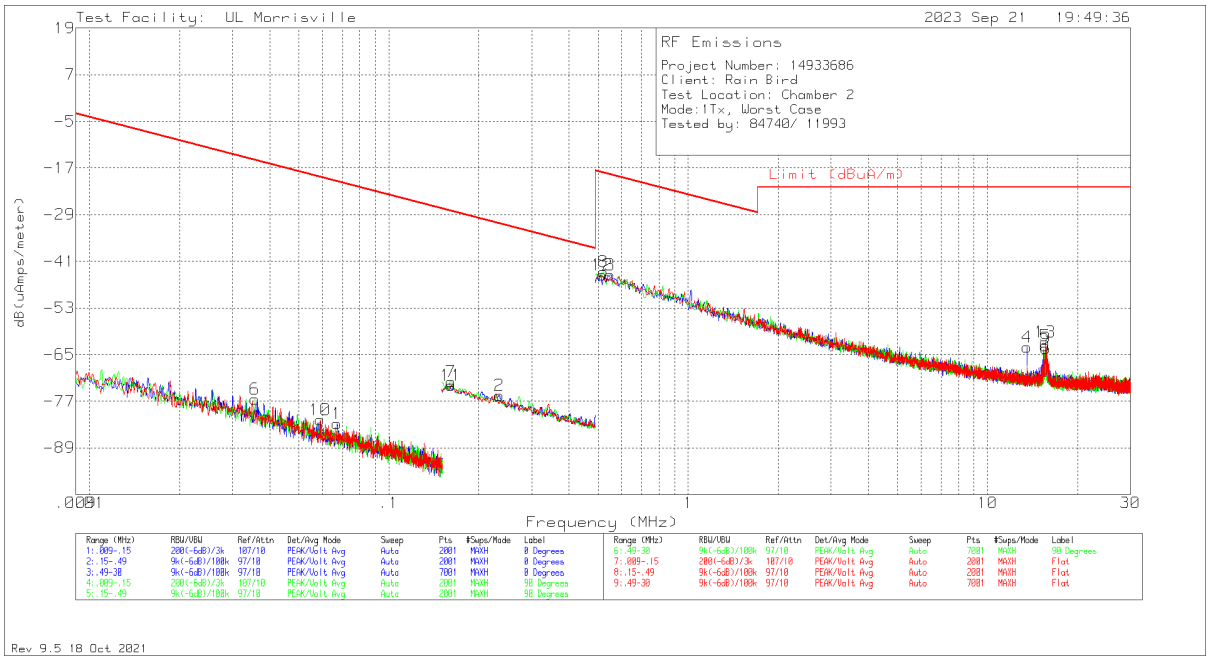

ANTENNA- THREE ORIENTATIONS H FIELD

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	135144 (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
6	.0357	41.24	Pk	-37.8	.1	-80	-76.46	-14.95	-5.05	-61.51	0-360	90 degs
10	.05906	37.13	Pk	-39	.1	-80	-81.77	-19.32	0.68	-62.45	0-360	Flat
1	.06722	36.2	Pk	-39.1	.1	-80	-82.8	-20.45	-0.45	-62.35	0-360	0 degs
7	.16114	47.31	Pk	-39.3	.1	-80	-71.89	-28.04	-8.04	-43.85	0-360	90 degs
11	.16173	46.25	Pk	-39.3	.1	-80	-72.95	-28.07	-8.07	-44.88	0-360	Flat
2	.23347	43.69	Pk	-39.3	.1	-80	-75.51	-31.26	-11.26	-44.25	0-360	0 degs
12	.5153	34.69	Pk	-39.3	.1	-40	-44.51	-18.14	-	-26.37	0-360	Flat
8	.51951	35.51	Pk	-39.3	.1	-40	-43.69	-18.21	-	-25.48	0-360	90 degs
3	.54902	34.71	Pk	-39.3	.1	-40	-44.49	-18.69	-	-25.8	0-360	0 degs
4	13.5596	17.29	Pk	-40.9	.6	-40	-63.01	-21.96	-	-41.05	0-360	0 degs
13	15.57906	18.67	Pk	-41.2	.7	-40	-61.83	-21.96	-	-39.87	0-360	Flat
5	15.60858	17.69	Pk	-41.2	.7	-40	-62.81	-21.96	-	-40.85	0-360	0 degs
9	15.61279	17.16	Pk	-41.2	.7	-40	-63.34	-21.96	-	-41.38	0-360	90 degs

Pk - Peak detector

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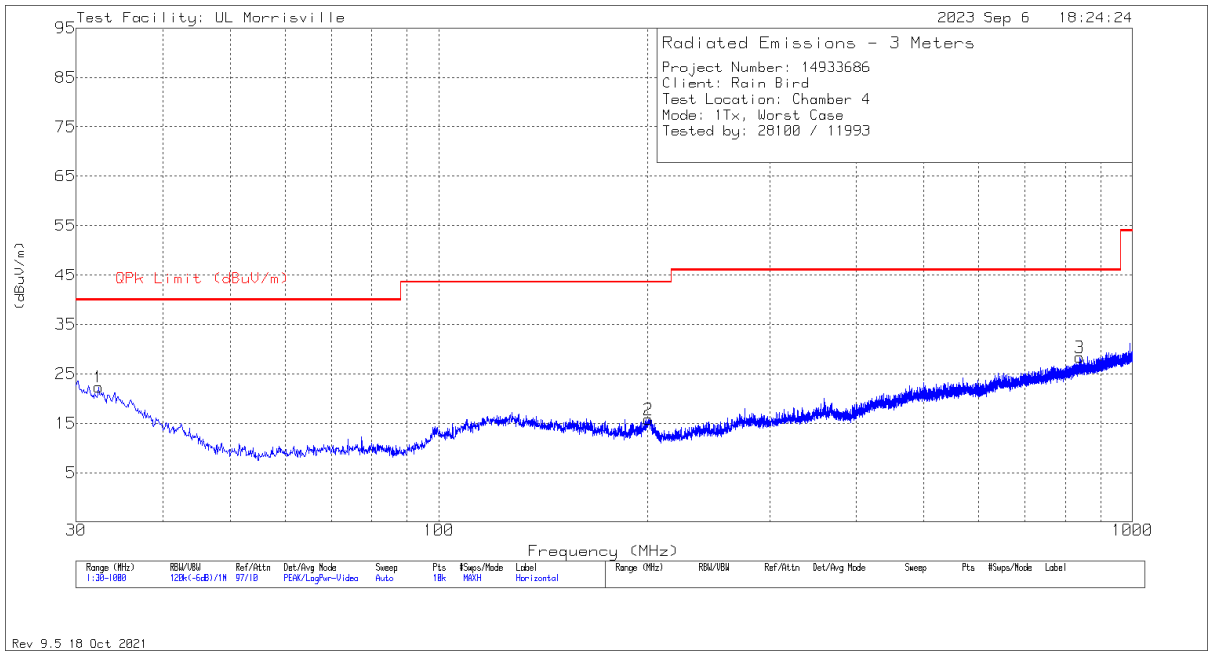
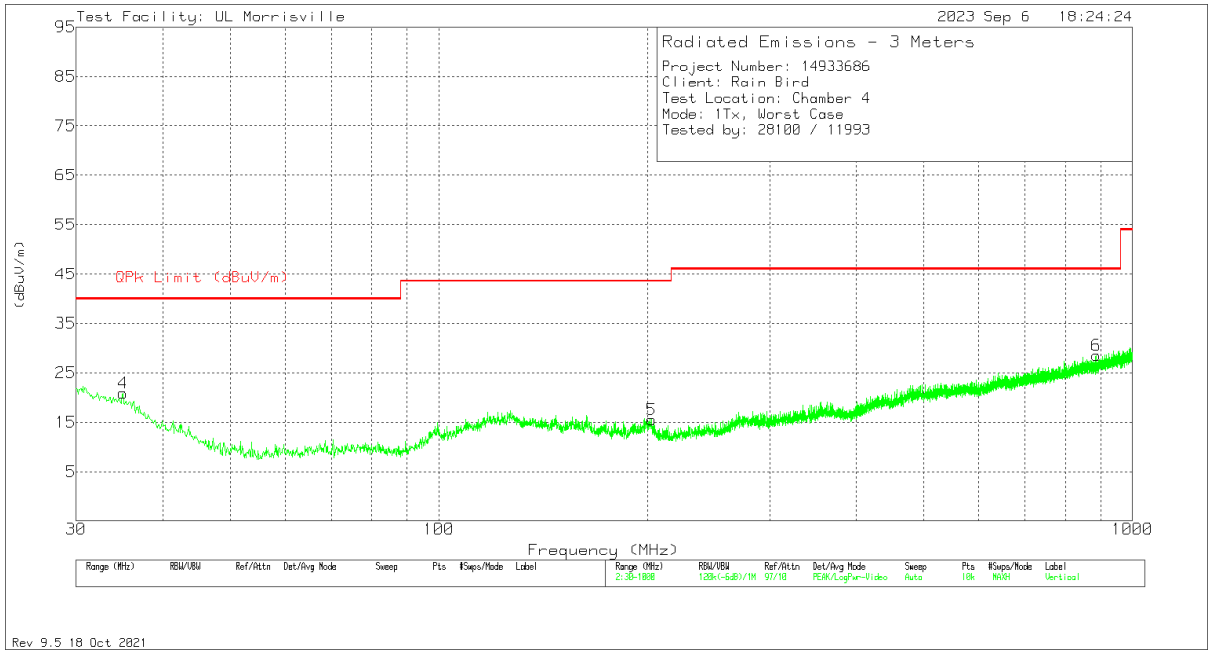
10.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



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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	32.328	28.51	Pk	25.5	-31.7	22.31	40	-17.69	0-360	200	H
4	35.044	28.87	Pk	23.6	-31.6	20.87	40	-19.13	0-360	100	V
2	200.623	26.76	Pk	18.9	-29.9	15.76	43.52	-27.76	0-360	300	H
5	202.757	26.92	Pk	18.5	-29.9	15.52	43.52	-28	0-360	100	V
3	839.465	26.31	Pk	27.9	-25.9	28.31	46.02	-17.71	0-360	100	H
6	887.189	25.95	Pk	28	-25.4	28.55	46.02	-17.47	0-360	200	V

Pk - Peak detector

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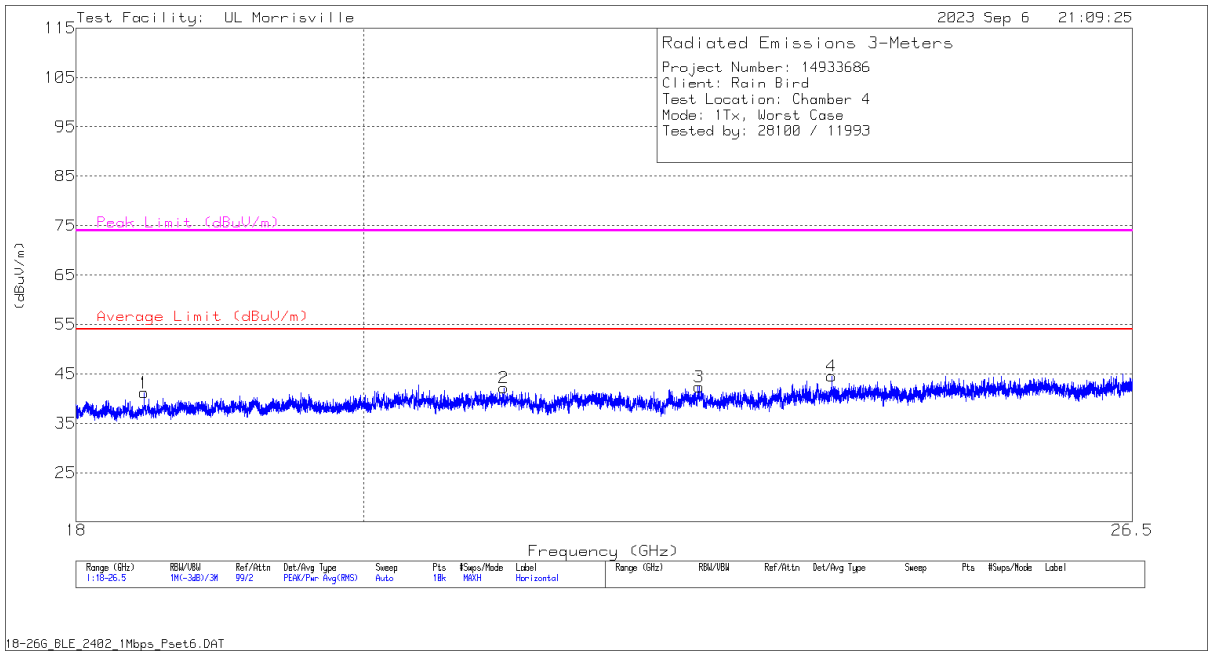
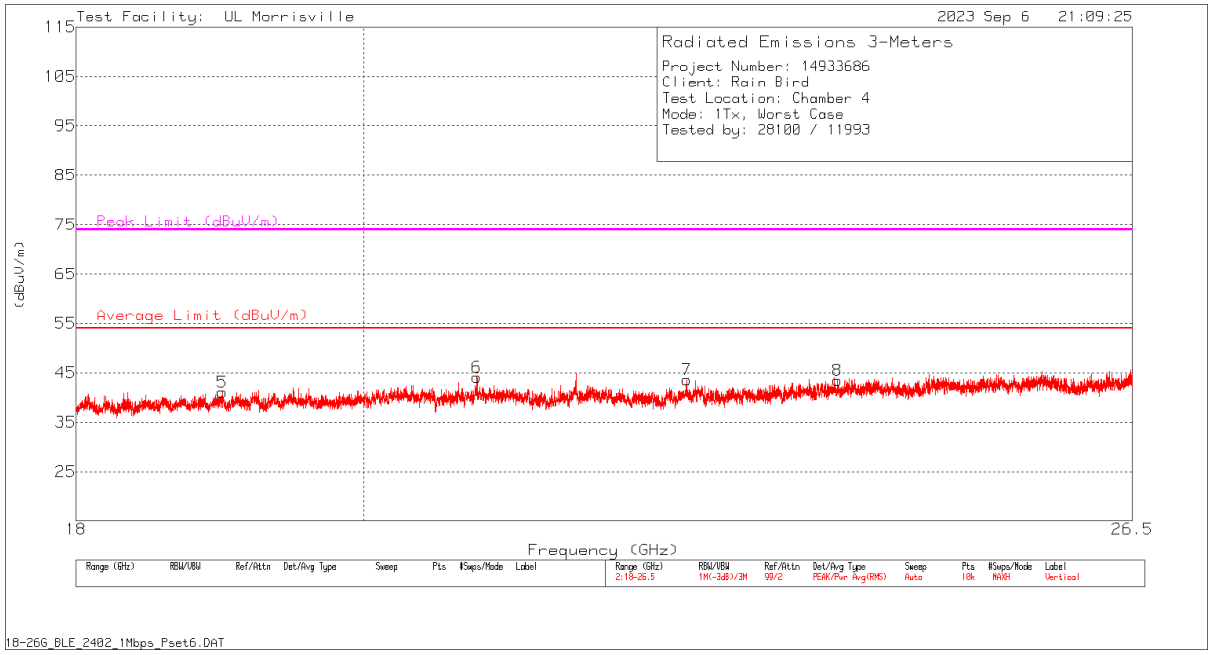
10.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

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18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	204704 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 18.453855	48.05	Pk	33	-39.9	41.15	54	-12.85	74	-32.85	0-360	250	H
2	* ** 21.050345	47.88	Pk	33.7	-39.4	42.18	54	-11.82	74	-31.82	0-360	250	H
3	* ** 22.609939	46.7	Pk	34.3	-38.6	42.4	54	-11.6	74	-31.6	0-360	250	H
4	* ** 23.735226	46.83	Pk	34.5	-36.8	44.53	54	-9.47	74	-29.47	0-360	250	H
5	* ** 18.989301	47.42	Pk	33.6	-39.9	41.12	54	-12.88	74	-32.88	0-360	300	V
6	* ** 20.844666	49.74	Pk	33.4	-39	44.14	54	-9.86	74	-29.86	0-360	150	V
7	* ** 22.510499	47.82	Pk	34.2	-38.4	43.62	54	-10.38	74	-30.38	0-360	150	V
8	* ** 23.787921	45.89	Pk	34.4	-36.8	43.49	54	-10.51	74	-30.51	0-360	250	V

Pk - Peak detector

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11. SETUP PHOTOS

Please refer to R14933686-EP1 for setup photos

END OF TEST REPORT

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