TEST REPORT

Report Number : R14541906-E2

Applicant	:	Oxit, LLC 3131 Westinghouse Blvd Charlotte, NC 28273, USA
Model	:	Sense Asset+
FCC ID	:	2AYW9-SENSE-APLUS
EUT Description	:	Omni-Id Sense Asset Communication Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C: 2023 ISED RSS-247 ISSUE 2: 2017 ISED RSS-GEN ISSUE 5 + A2: 2021

Date Of Issue:
2023-11-07

Prepared by:
UL LLC
12 Laboratory Dr.
Research Triangle Park, NC 27709 U.S.A.
TEL: (919) 549-1400

ACCREDITED
CERT #0751.06

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2023-02-24	Initial Issue	Charles Moody
V2	2023-08-14	Updated Test Equipment Section	Charles Moody
V3	2023-11-07	Revised Antenna Type and Gain Info	Charles Moody

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Oxit, LLC
3131 Westinghouse Blvd
Charlotte, NC 28273, USA

EUT DESCRIPTION: Omni-Id Sense Asset Communication Device

MODEL: Asset Sense+

SERIAL NUMBER: Non-Serialized

SAMPLE RECEIPT DATE: 2022-12-30, 2023-01-11

DATE TESTED: 2023-01-03 TO 2023-02-20

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5 + 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.

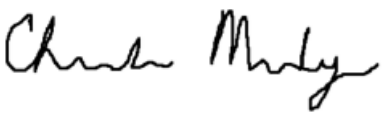
The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. 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

2. TEST RESULTS SUMMARY

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

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	ANSI C63.10 Section 11.6.
-	RSS-GEN 6.7	99% OBW	Reporting purposes only	ANSI C63.10 Section 6.9.3.
15.247 (a) (2)	RSS-247 5.2 (a)	6dB BW	Complies	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	Complies	None.
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	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Not Performed	EUT is Battery Powered

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15: 2023, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, RSS-GEN Issue 5 + A2: 2021, and RSS-247 Issue 2: 2017.

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: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
☒	Building: 2800 Perimeter Park Dr. Suite B Morrisville, NC 27560, U.S.A		27265	

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

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

5.2. DECISION RULES

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

5.3. MEASUREMENT UNCERTAINTY

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

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

Uncertainty figures are valid to a confidence level of 95%

5.4. SAMPLE CALCULATION

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

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

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Omni-Id Sense Asset that contains a BLE and a LoRa radio. This report covers the full testing of the BLE radio as well as the simultaneous transmission of the BLE and LoRa radio.

6.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402-2480	BLE (GFSK)	2.12	1.63

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

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

The BLE radio utilizes a printed Inverted F antenna, with a maximum gain of 1 dBi.

The LoRa radio utilizes a helical antenna, with a maximum gain of 2.15 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was version 1.0.

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz and above 18GHz emission were performed with the EUT set to transmit at the channel with highest power spectal density 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 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 the X orientation.

The EUT operates at its only mode and data rate as stated below:
BLE (GFSK): 1Mbps

For simultaneous transmission, the EUT was tested under the worst-case modes of both BLE and LoRa radios.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	T450	PC0BHFNX	-

I/O CABLES

I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	6 Pin	1	I/O	Programmer Cable	<1M	Used to Configure EUT Radio Prior to Testing

TEST SETUP

The EUT is connected to a support laptop to configure the radio prior to emissions testings. However, for final emissions scans, the EUT was disconnected from the support laptop.

SETUP DIAGRAM

Please refer to R14541906-EP1 for setup diagrams

7. MEASUREMENT METHOD

On time and Duty Cycle: ANSI C63.10 subclause 11.6

6 dB BW: ANSI C63.10 Subclause -11.8.1 RBW ≥ DTS BW

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

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power
Output Power: ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using A gated RF average-reading power meter)

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

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

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

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

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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 2				
HI0090	Environmental Meter	Fisher Scientific	15-077-963	2022-07-20	2023-07-20
PWM001	RF Power Meter	Keysight	N1912A	2022-08-30	2023-08-30
PWS001	Wideband Power Sensor	Keysight	N1921A	2022-07-02	2023-07-02
PWS004	Peak and Avg Power Sensor: 50MHz – 6 GHz	Keysight	E9323A	2022-08-04	2023-08-04
SA0025	Spectrum Analyzer	Keysight	N9030A	2022-05-02	2023-05-02
76022	DC Power Supply	CircuitSpecialists.com	CSI3005X5	-	-
MM0167	True RMS Multimeter	Keysight	U1232A	2021-08-17	2023-08-17
SOFTEMI	Antenna Port Software	UL	Version 2022.8.16	NA	NA
	Additional Equipment used				
226565	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CENTRICRF	C18S2-10	2022-05-03	2023-05-03
226560	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CENTRICRF	C18S2-10	2022-05-03	2023-05-03
226559	SMA Coaxial 10dB Attenuator 25MHz-18GHz	CENTRICRF	C18S2-10	2022-05-03	2023-05-03
**CBL101	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz, 39.3", Connectors 2	CARLISLE INTERCONNECT TECHNOLOGIES	UFA147A-0-0180-200200	2022-01-24	2023-01-24
**CBL098	Micro-Coax UTiFLEX Cable Assembly, Low Loss,40Ghz, 39.3", Connectors 2	CARLISLE INTERCONNECT TECHNOLOGIES	UFA147A-0-0180-200200	2022-01-24	2023-01-24

**NOTE: Testing with this equipment was performed prior to 2023-01-24. Therefore, at the time of testing, all equipment was in calibration.

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

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0059	Active Loop Antenna	ETS-Lindgren	6502	2022-09-29	2023-09-29
	1-18 GHz				
AT0067	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2022-05-24	2023-05-24
	Gain-Loss Chains				
C4-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2022-05-20	2023-05-20
C4-SAC03	Gain-loss string: 1-18GHz	Various	Various	2022-05-20	2023-05-20
	Receiver & Software				
**206496	Spectrum Analyzer	Rohde & Schwarz	ESW44	2022-02-15	2023-02-15
SA0026	Spectrum Analyzer	Agilent	N9030A	2022-08-02	2023-08-02
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
220929	Environmental Meter	Fisher Scientific	15-077-963 (s/n 181474409)	2022-10-05	2023-10-05

**NOTE: Testing with this equipment was performed prior to 2023-02-15. Therefore, at the time of testing, all equipment was in calibration.

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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.
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2022-09-07	2023-09-07
	1-18 GHz				
206211	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2022-03-21	2023-03-21
	18-40 GHz				
204704	Horn Antenna, 18-26.5GHz	Com-Power	AH-626	2022-07-11	2023-07-11
	Gain-Loss Chains				
C2-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2022-05-10	2023-05-10
C2-SAC03	Gain-loss string: 1-18GHz	Various	Various	2022-05-10	2023-05-10
C2-SAC04	Gain-loss string: 18-40GHz	Various	Various	2022-05-10	2023-05-10
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2022-03-08	2023-03-08
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
200540	Environmental Meter	Fisher Scientific	15-077-963 s/n 181474409	2022-10-05	2023-10-05

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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, ANSI C63.10 Section 11.6

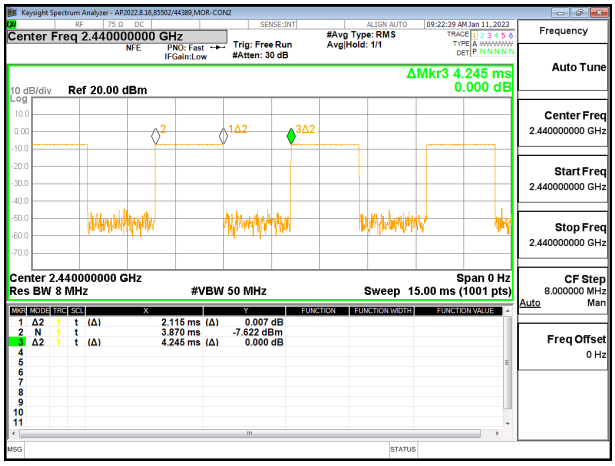
ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)
2.4GHz Band				
BLE (GFSK)	2.115	4.245	0.498	49.82

*Note: The manufacturer has declared an operational duty cycle of 10% over a 100ms window for the BLE Radio. The correction factor, therefore, would be 20log(1/0.1) = 20 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(1/0.1) = 20 dB

DUTY CYCLE PLOTS



DUTY CYCLE BLE (GFSK)

9.2. 99% BANDWIDTH

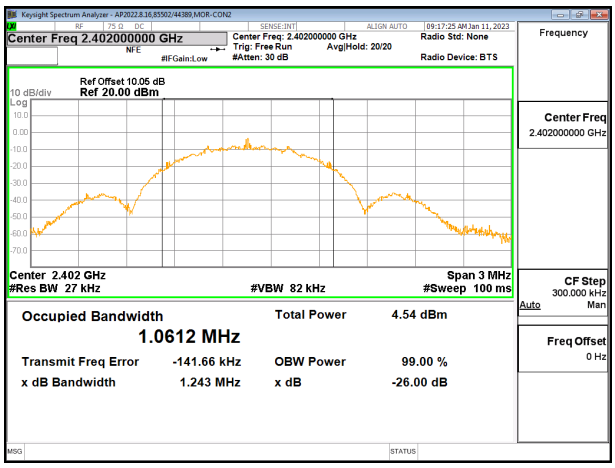
LIMITS

None; for reporting purposes only.

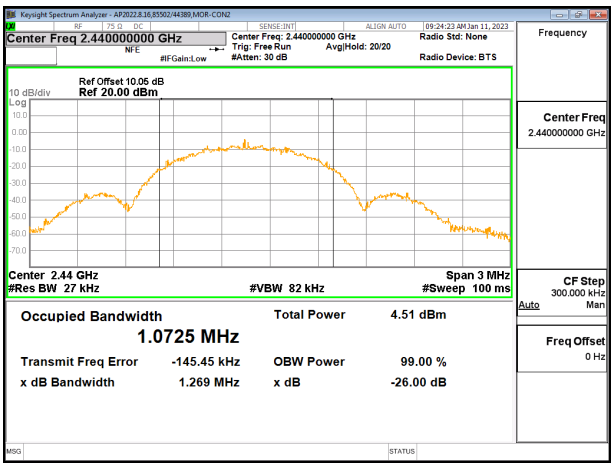
RESULTS

9.2.1. BLE (GFSK) MODE

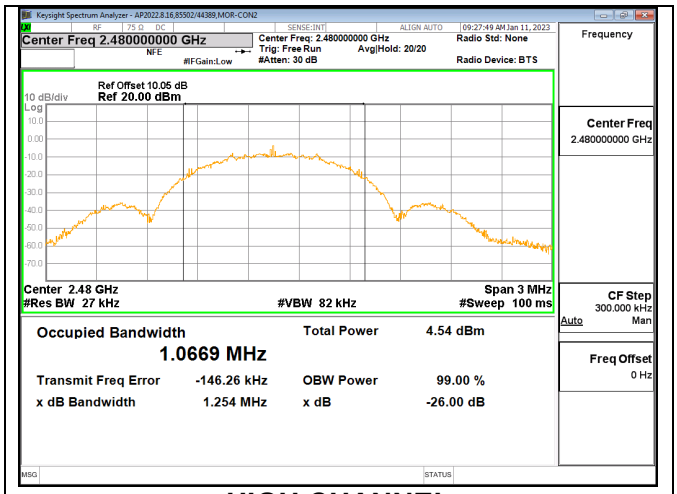
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0612
Middle	2440	1.0725
High	2480	1.0669



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

9.3. 6 dB BANDWIDTH

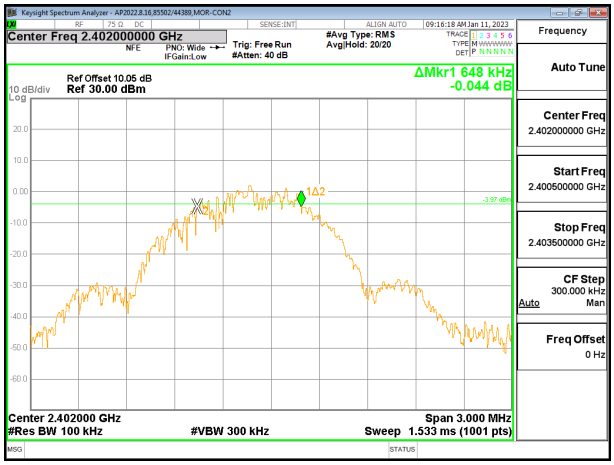
LIMITS

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

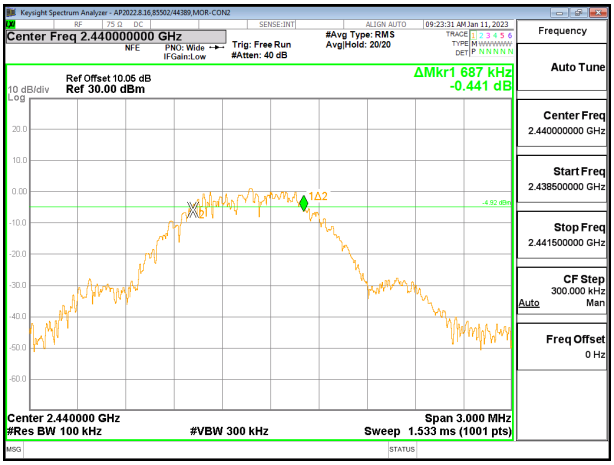
RESULTS

9.3.1. BLE (GFSK) MODE

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.648	0.5
Mid	2440	0.687	0.5
High	2480	0.714	0.5



LOW CHANNEL



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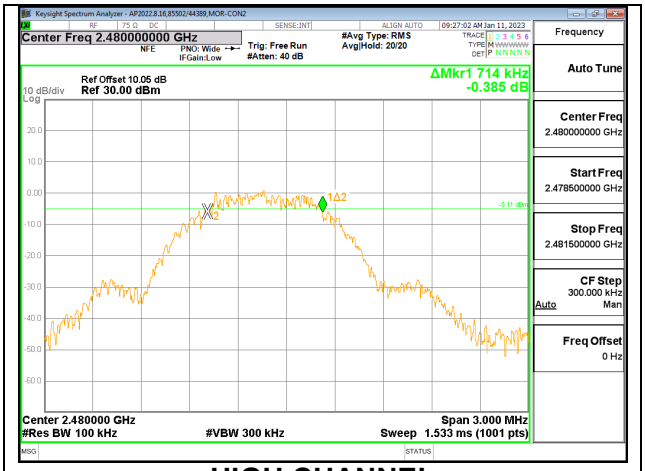

HIGH CHANNEL

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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 6dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The cable assembly insertion loss of 10.05 dB (including 9.65 dB pad and 0.4 dB cable) was entered as an offset in the power meter.

The peak output power was read directly from a power meter via a connection to a wideband power sensor.

RESULTS

9.4.1. BLE (GFSK) MODE

Tested By:	85502/44389
Date:	2023-01-11

Limits

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.98	30	-28.02
Mid	2440	2.07	30	-27.93
High	2480	2.12	30	-27.88

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The cable assembly insertion loss of 10.05 dB (including 9.65 dB pad and 0.4 dB cable) was entered as an offset in the gated average meter.

The gated average output power was read directly from a power meter via a connection to a wideband power sensor.

RESULTS

9.5.1. BLE (GFSK) MODE

Test Engineer:	85502/44389
Test Date:	2023-01-11

Channel	Frequency (MHz)	AV Power (dBm)
Low	2402	1.89
Mid	2440	1.97
High	2480	2.03

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9.6. POWER SPECTRAL DENSITY

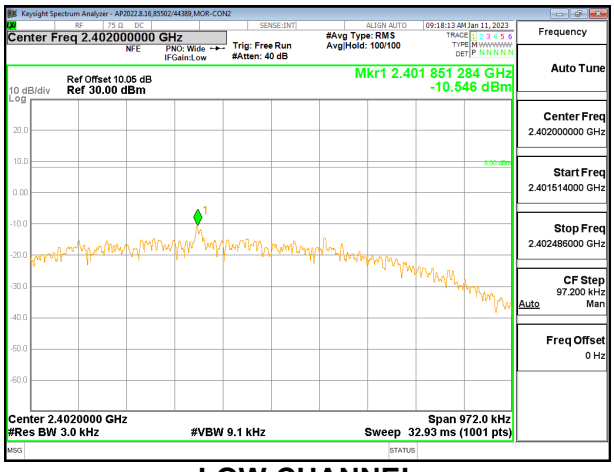
LIMITS

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.

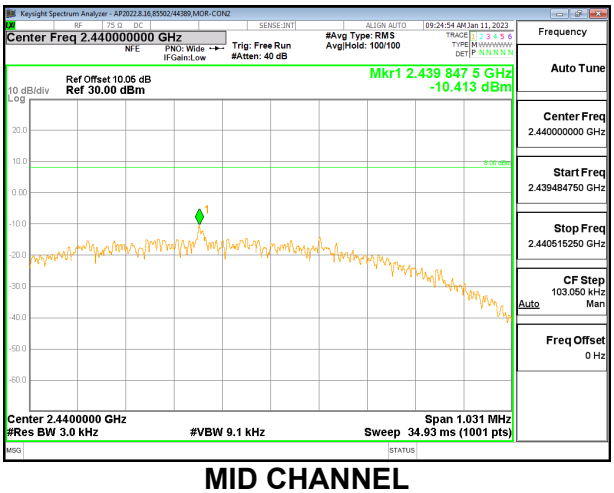
RESULTS

9.6.1. BLE (GFSK) MODE

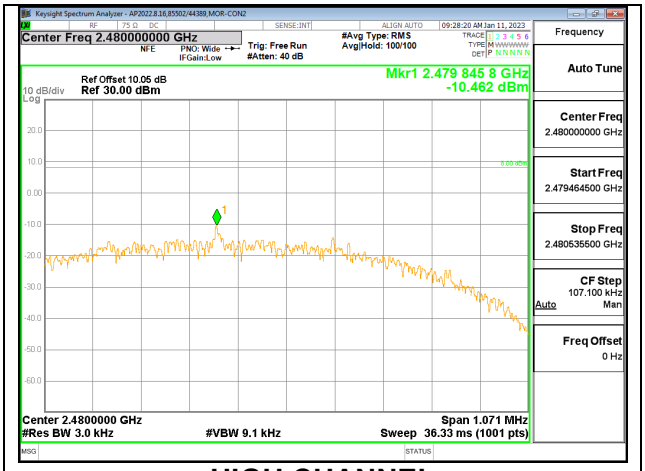
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-10.546	8	-18.55
Middle	2440	-10.413	8	-18.41
High	2480	-10.462	8	-18.46



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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9.7. CONDUCTED SPURIOUS EMISSIONS

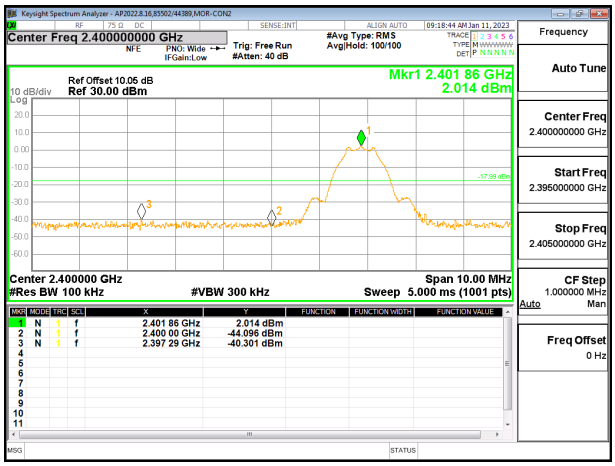
LIMITS

FCC §15.247 (d)
RSS-247 5.5

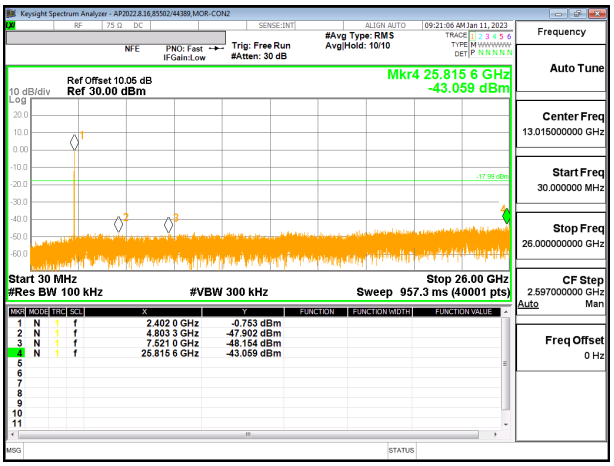
Output power was measured based on the use of peak measurement, therefore the required attenuation is -20 dBc.

RESULTS

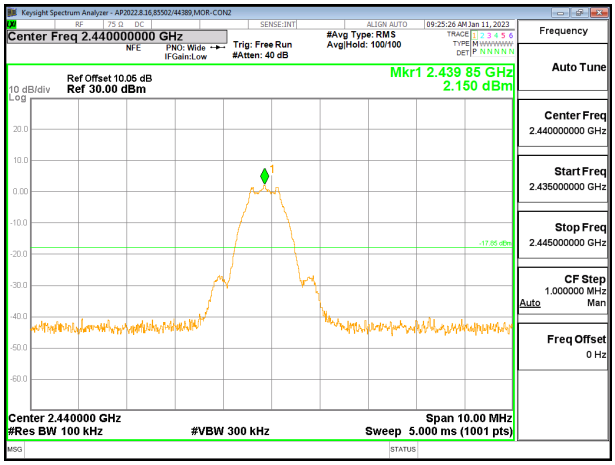
9.7.1. BLE (GFSK) MODE



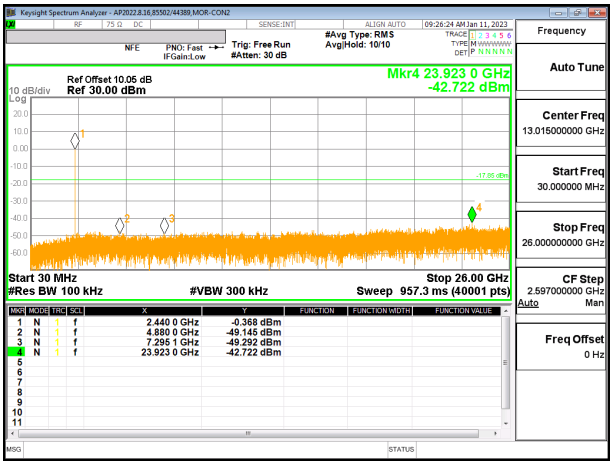
LOW CHANNEL BANDEDGE



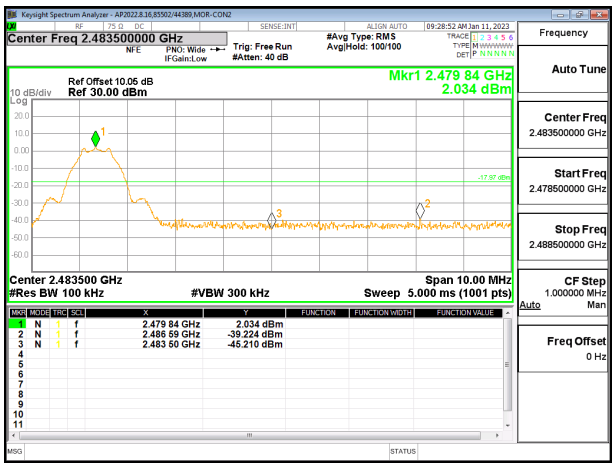
OUT-OF-BAND LOW CHANNEL



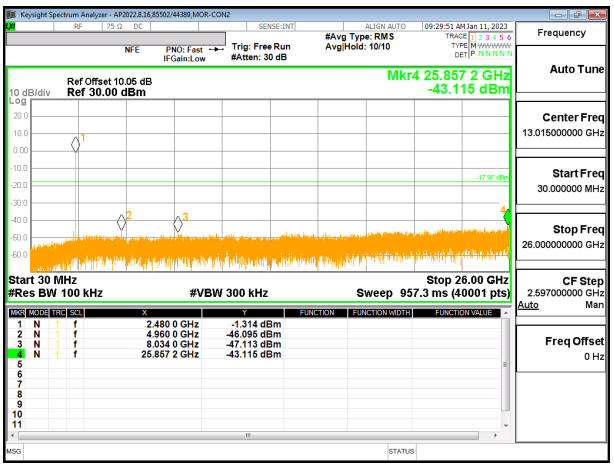
IN-BAND REFERNCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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10. RADIATED TEST RESULTS

10.1. LIMITS

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	6.37/F(kHz) @ 30 m	-
1.705 - 30	.08 @ 30m	-
Frequency Range (MHz)	**Field Strength Limit (uV/m) at 3 m**	**Field Strength Limit (dBuV/m) at 3 m**
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

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

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

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

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements. For average measurements, the DC Correction factor was applied to the 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 power spectral density was tested.

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

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

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

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

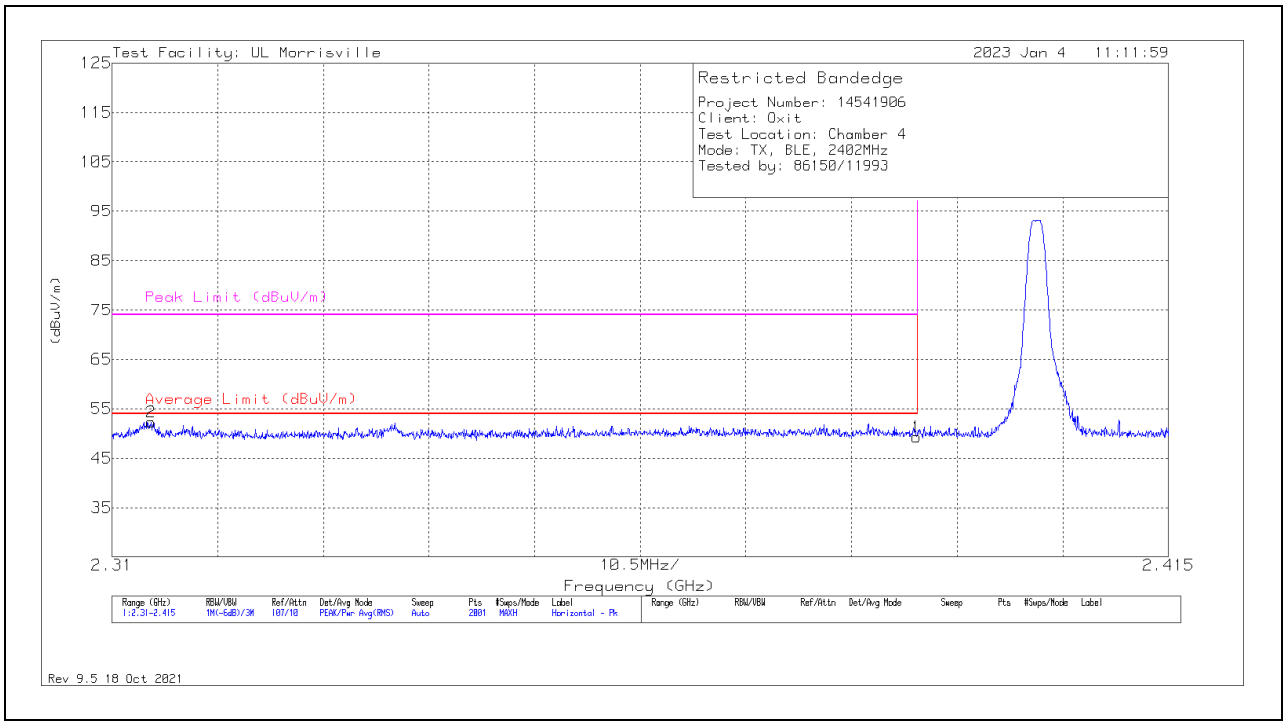
OFS and chamber correlation testing had been performed and chamber measured test result is the worst-case test result.

10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. TX ABOVE 1 GHz BLE (GFSK) MODE IN THE 2.4 GHz BAND

BANDEDGE (LOW CHANNEL, 2402MHz)

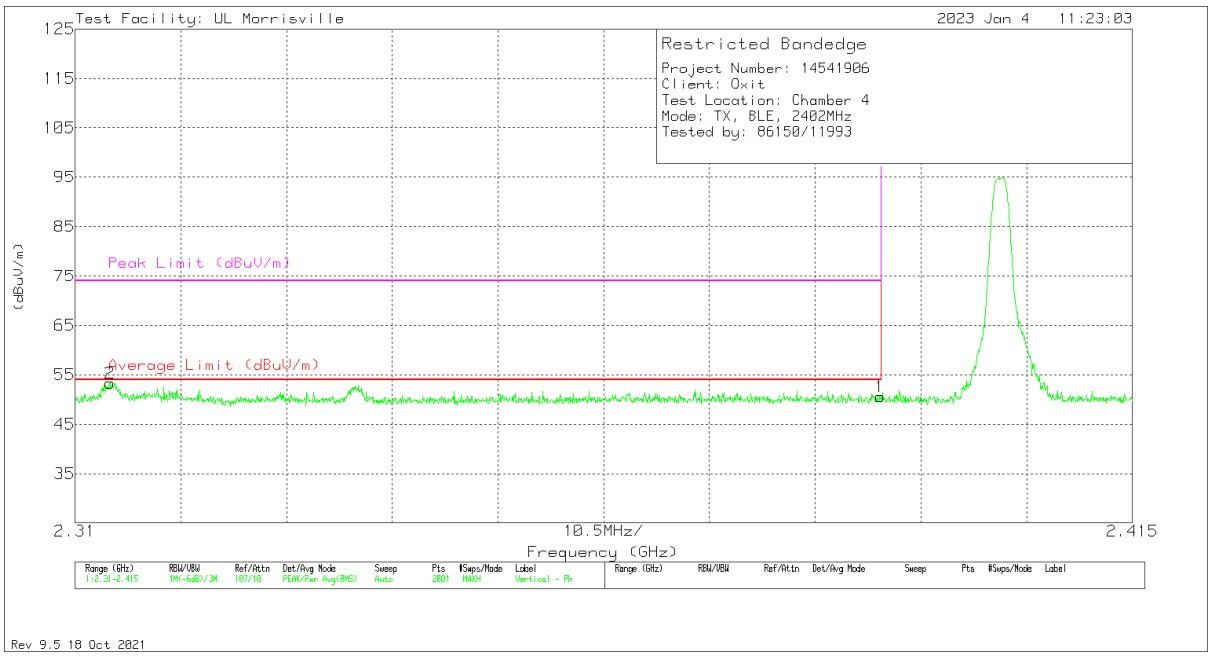
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (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	30.76	Pk	32.2	-13.6	0	49.36	-	-	74	-24.64	195	338	H
1	* ** 2.38996	30.76	Pk	32.2	-13.6	-20	29.36	54	-24.64	-	-	195	338	H
2	* ** 2.31389	34.14	Pk	32.1	-13.9	0	52.34	-	-	74	-21.66	195	338	H
2	* ** 2.31389	34.14	Pk	32.1	-13.9	-20	32.34	54	-21.66	-	-	195	338	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	AT0067 (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	32.01	Pk	32.2	-13.6	0	50.61	-	-	74	-23.39	135	372	V
1	* ** 2.38996	32.01	Pk	32.2	-13.6	-20	30.61	54	-23.39	-	-	135	372	V
2	* ** 2.31347	35.15	Pk	32.1	-13.9	0	53.35	-	-	74	-20.65	135	372	V
2	* ** 2.31347	35.15	Pk	32.1	-13.9	-20	33.35	54	-20.65	-	-	135	372	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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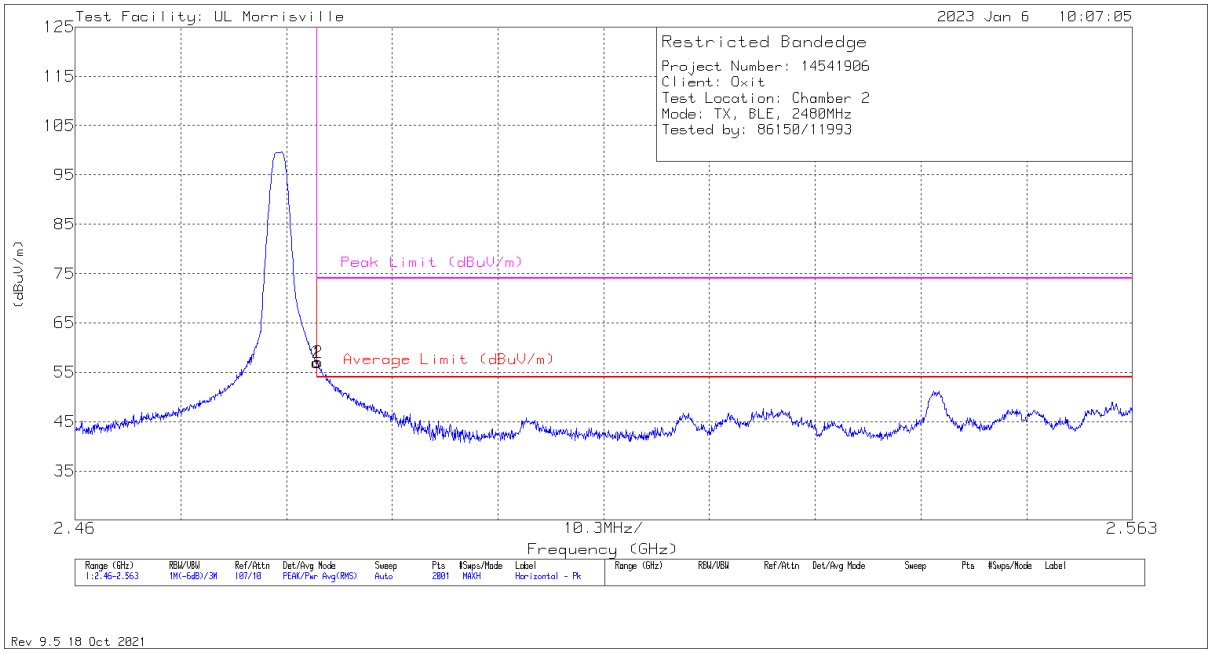
BANDEDGE (HIGH CHANNEL, 2480MHz)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206211 (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	48.99	Pk	32.3	-24.3	0	56.99	-	-	74	-17.01	261	112	H
1	* ** 2.48354	48.99	Pk	32.3	-24.3	-20	36.99	54	-17.01	-	-	261	112	H
2	* ** 2.48364	49.06	Pk	32.3	-24.3	0	57.06	-	-	74	-16.94	261	112	H
2	* ** 2.48364	49.06	Pk	32.3	-24.3	-20	37.06	54	-16.94	-	-	261	112	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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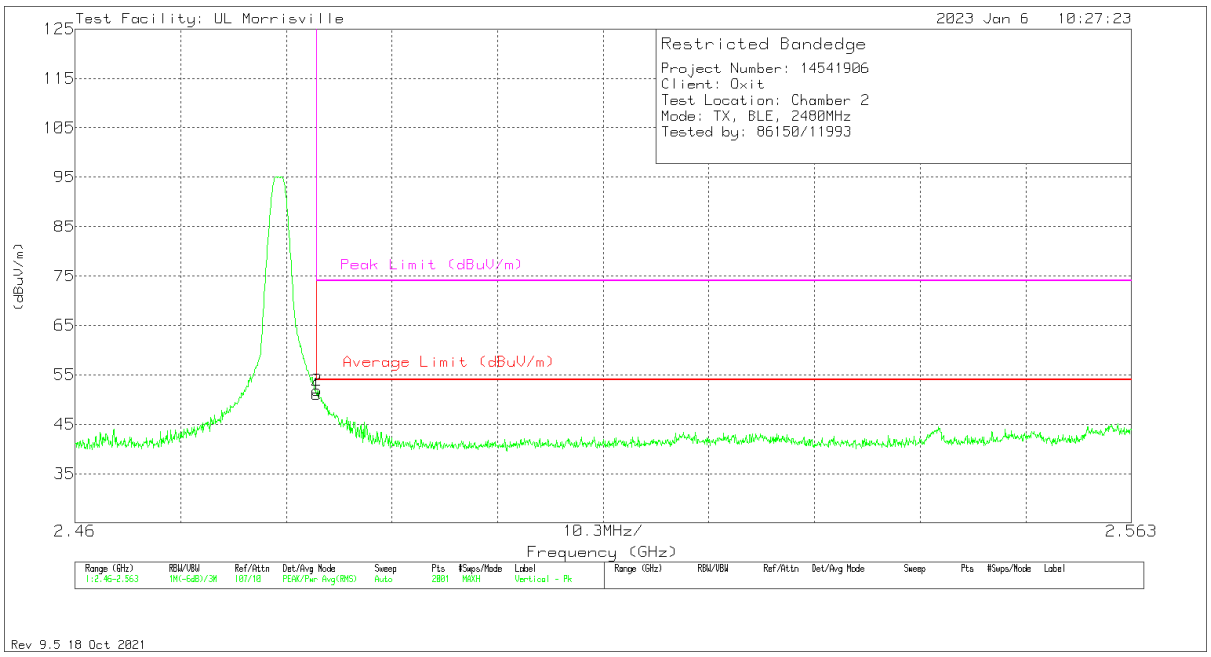
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206211 (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	43.03	Pk	32.3	-24.3	0	51.03	-	-	74	-22.97	157	372	V
1	* ** 2.48354	43.03	Pk	32.3	-24.3	-20	31.03	54	-22.97	-	-	157	372	V
2	* ** 2.48359	43.87	Pk	32.3	-24.3	0	51.87	-	-	74	-22.13	157	372	V
2	* ** 2.48359	43.87	Pk	32.3	-24.3	-20	31.87	54	-22.13	-	-	157	372	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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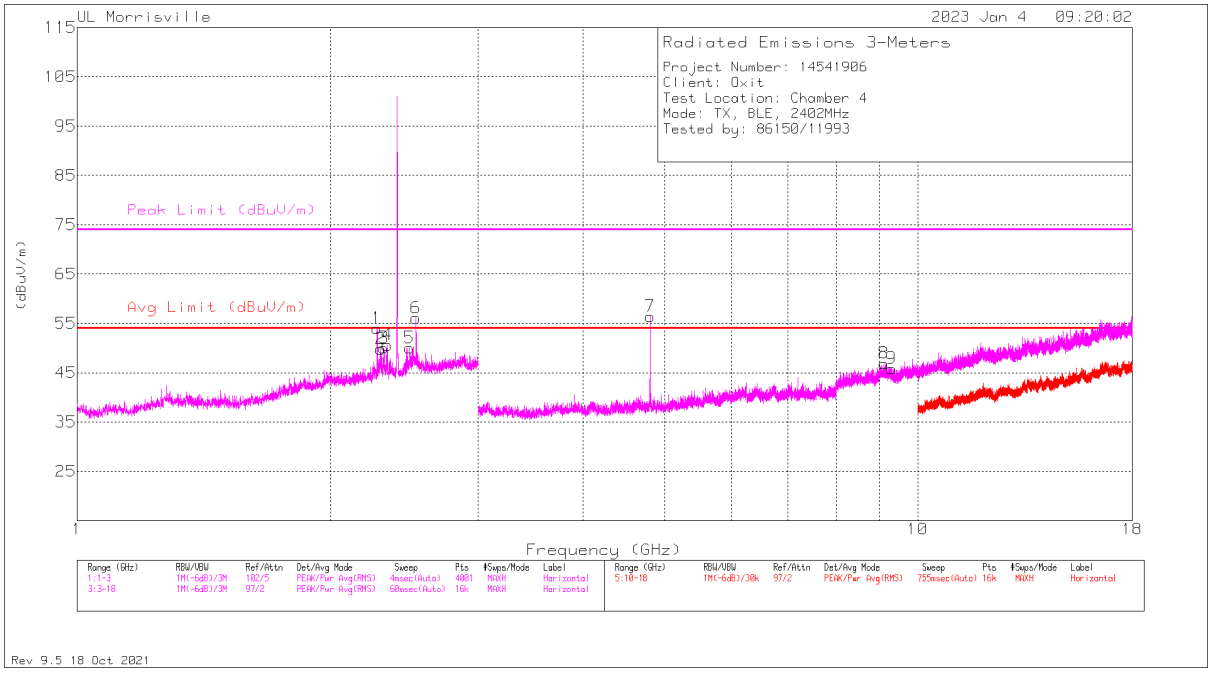
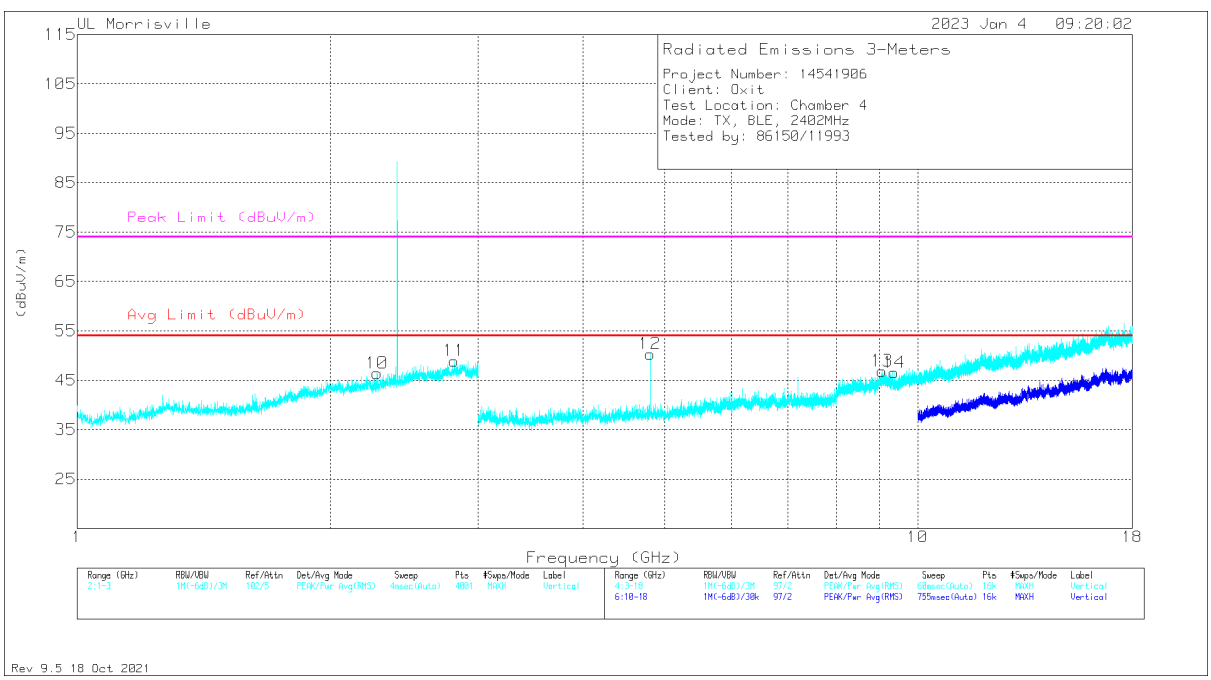
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL, 2402MHz RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (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	* ** 2.27368	39	PK2	32	-13.9	0	57.1	-	-	74	-16.9	260	102	H
	* ** 2.27368	39	PK2	32	-13.9	-20	37.1	54	-16.9	-	-	260	102	H
2	* ** 2.29435	31.83	PK2	32	-13.8	0	50.03	-	-	74	-23.97	180	382	H
	* ** 2.29435	31.83	PK2	32	-13.8	-20	30.03	54	-23.97	-	-	180	382	H
3	* ** 2.31734	31.12	PK2	32	-13.8	0	49.32	-	-	74	-24.68	242	379	H
	* ** 2.31734	31.12	PK2	32	-13.8	-20	29.32	54	-24.68	-	-	242	379	H
4	* ** 2.33776	32.76	PK2	32.1	-13.8	0	51.06	-	-	74	-22.94	262	378	H
	* ** 2.33776	32.76	PK2	32.1	-13.8	-20	31.06	54	-22.94	-	-	262	378	H
5	* ** 2.49043	35.61	PK2	32.6	-13.6	0	54.61	-	-	74	-19.39	243	118	H
	* ** 2.49043	35.61	PK2	32.6	-13.6	-20	34.61	54	-19.39	-	-	243	118	H
6	** 2.5297	40.12	PK2	32.7	-13.5	0	59.32	-	-	74	-14.68	237	107	H
	** 2.5297	40.12	PK2	32.7	-13.5	-20	39.32	54	-14.68	-	-	237	107	H
10	* ** 2.274	28.32	Pk	32	-13.9	0	46.42	54	-7.58	74	-27.58	0-360	200	V
11	* ** 2.80881	29.03	PK2	32.6	-12.8	0	48.83	-	-	74	-25.17	115	140	V
	* ** 2.80881	29.03	PK2	32.6	-12.8	-20	28.83	54	-25.17	-	-	115	140	V
7	* ** 4.80353	58.26	PK2	34.1	-31.8	0	60.56	-	-	74	-13.44	344	101	H
	* ** 4.80353	58.26	PK2	34.1	-31.8	-20	40.56	54	-13.44	-	-	344	101	H
8	* ** 9.11625	36.3	Pk	36.2	-25.6	0	46.9	54	-7.1	74	-27.1	0-360	100	H
9	* ** 9.30938	34.73	Pk	36.4	-25.3	0	45.83	54	-8.17	74	-28.17	0-360	100	H
12	* ** 4.8036	55.23	PK2	34.1	-31.8	0	57.53	-	-	74	-16.47	111	238	V
	* ** 4.8036	55.23	PK2	34.1	-31.8	0	37.53	54	-16.47	-	-	111	238	V
13	* ** 9.06844	35.98	Pk	36.1	-25.2	0	46.88	54	-7.12	74	-27.12	0-360	200	V
14	* ** 9.37781	35.58	Pk	36.5	-25.5	0	46.58	54	-7.42	74	-27.42	0-360	200	V

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

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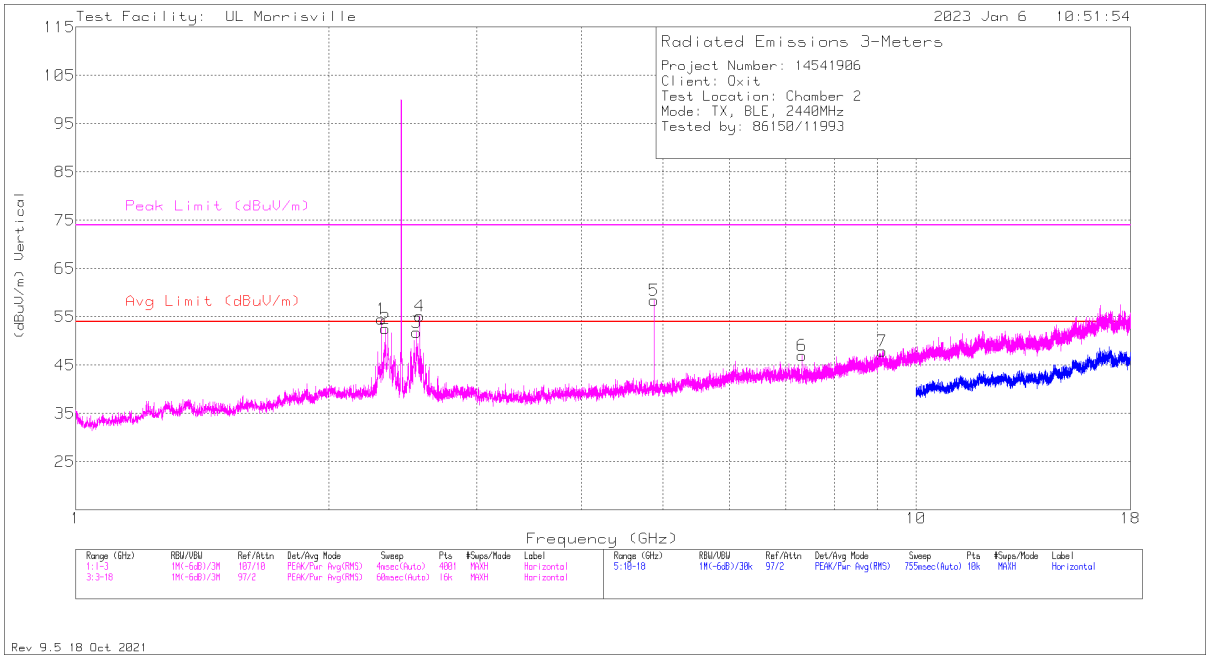
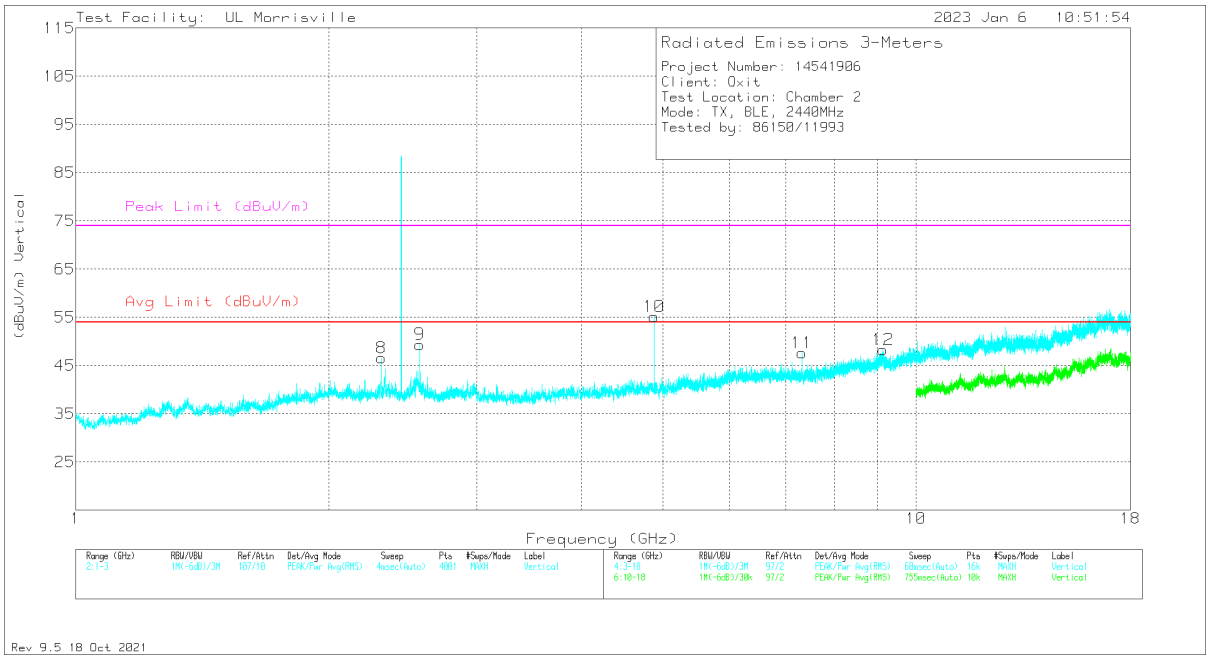
MID CHANNEL, 2440MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	206211 (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	* ** 2.31208	48.91	PK2	31.7	-23.8	0	56.81	-	-	74	-17.19	88	127	H
	* ** 2.31208	48.91	PK2	31.7	-23.8	-20	36.81	54	-17.19	-	-	88	127	H
2	* ** 2.33645	47.27	PK2	31.9	-24	0	55.17	-	-	74	-18.83	83	107	H
	* ** 2.33645	47.27	PK2	31.9	-24	-20	35.17	54	-18.83	-	-	83	107	H
3	** 2.54372	47.02	PK2	32.5	-24.7	0	54.82	-	-	74	-19.18	71	128	H
	** 2.54372	47.02	PK2	32.5	-24.7	-20	34.82	54	-19.18	-	-	71	128	H
4	** 2.56754	49.87	PK2	32.4	-25.2	0	57.07	-	-	74	-16.93	67	129	H
	** 2.56754	49.87	PK2	32.4	-25.2	-20	37.07	54	-16.93	-	-	67	129	H
8	* ** 2.312	38.68	Pk	31.7	-23.8	0	46.58	54	-7.42	74	-27.42	0-360	200	V
9	** 2.56807	46.89	PK2	32.4	-25.2	0	54.09	-	-	74	-19.91	354	344	V
	** 2.56807	46.89	PK2	32.4	-25.2	-20	34.09	54	-19.91	-	-	354	344	V
5	* ** 4.87943	57.44	PK2	33.9	-30.8	0	60.54	-	-	74	-13.46	160	108	H
	* ** 4.87943	57.44	PK2	33.9	-30.8	-20	40.54	54	-13.46	-	-	160	108	H
6	* ** 7.32	38.2	Pk	35.6	-26.8	0	47	54	-7	74	-27	0-360	199	H
7	* ** 9.11438	37.16	Pk	36.2	-25.4	0	47.96	54	-6.04	74	-26.04	0-360	101	H
10	* ** 4.87945	54.85	PK2	33.9	-30.8	0	57.95	-	-	74	-16.05	261	269	V
	* ** 4.87945	54.85	PK2	33.9	-30.8	-20	37.95	54	-16.05	-	-	261	269	V
11	* ** 7.31906	38.7	Pk	35.6	-26.7	0	47.6	54	-6.4	74	-26.4	0-360	199	V
12	* ** 9.14307	38.62	PK2	36.2	-25.2	0	49.62	-	-	74	-24.38	161	304	V
	* ** 9.14307	38.62	PK2	36.2	-25.2	-20	29.62	54	-24.38	-	-	161	304	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

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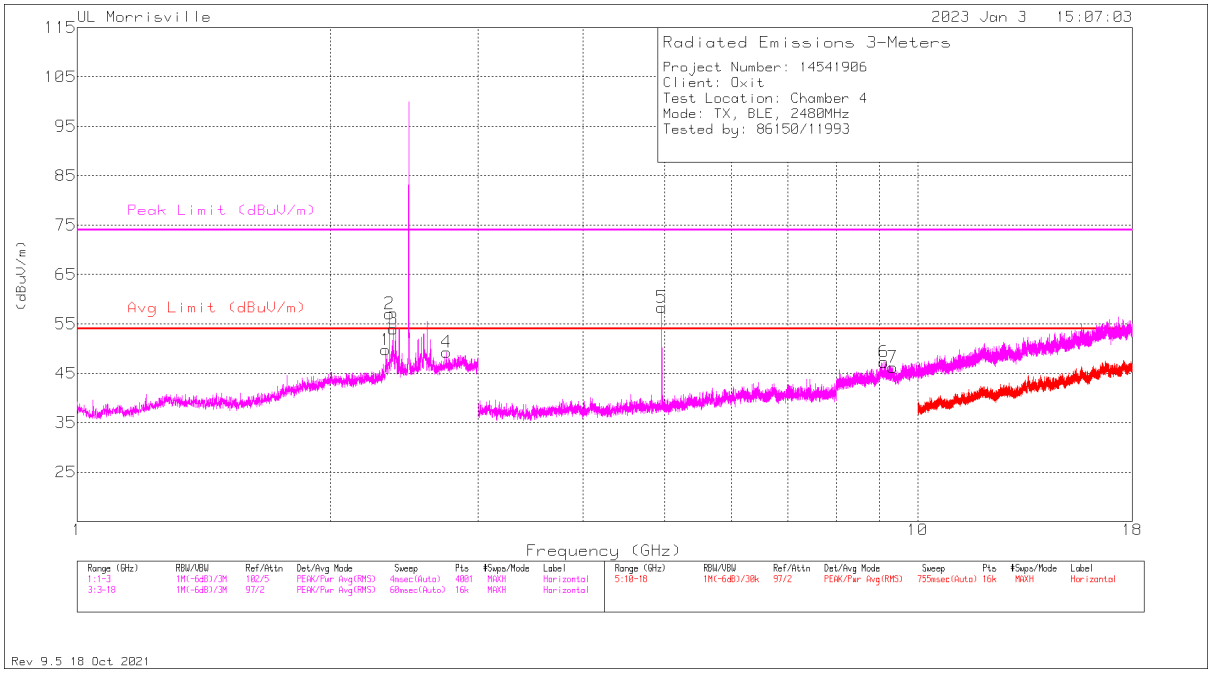
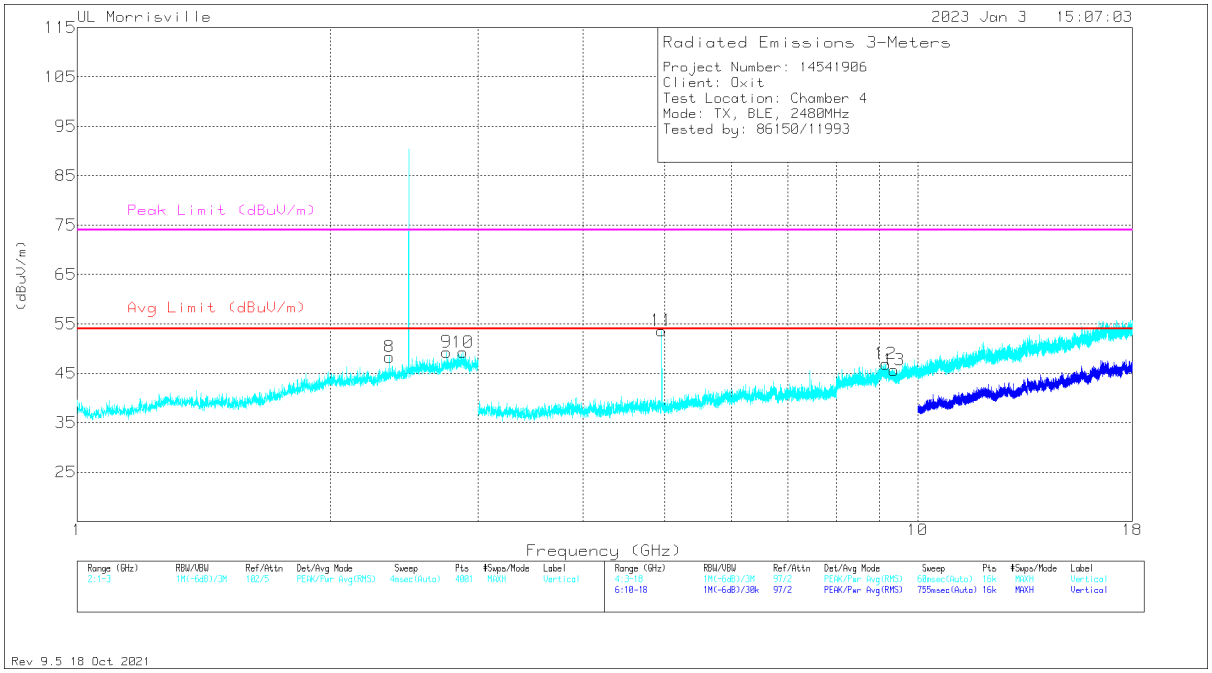
HIGH CHANNEL, 2480MHz RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (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	* ** 2.32726	31.18	PK2	32.1	-13.8	0	49.48	-	-	74	-24.52	60	379	H
	* ** 2.32726	31.18	PK2	32.1	-13.8	-20	29.48	54	-24.52	-	-	60	379	H
2	* ** 2.35187	32.64	PK2	32.1	-13.8	0	50.94	-	-	74	-23.06	77	377	H
	* ** 2.35187	32.64	PK2	32.1	-13.8	-20	30.94	54	-23.06	-	-	77	377	H
3	* ** 2.3763	34.01	PK2	32.2	-13.7	0	52.51	-	-	74	-21.49	62	376	H
	* ** 2.3763	34.01	PK2	32.2	-13.7	-20	32.51	54	-21.49	-	-	62	376	H
4	* ** 2.75342	29.13	PK2	32.4	-13	0	48.53	-	-	74	-25.47	324	146	H
	* ** 2.75342	29.13	PK2	32.4	-13	-20	28.53	54	-25.47	-	-	324	146	H
8	* ** 2.35212	36.2	PK2	32.1	-13.8	0	54.5	-	-	74	-19.5	329	312	V
	* ** 2.35212	36.2	PK2	32.1	-13.8	-20	34.5	54	-19.5	-	-	329	312	V
9	* ** 2.74828	29.89	PK2	32.4	-13	0	49.29	-	-	74	-24.71	235	372	V
	* ** 2.74828	29.89	PK2	32.4	-13	-20	29.29	54	-24.71	-	-	235	372	V
10	* ** 2.87528	29.5	PK2	32.7	-12.6	0	49.6	-	-	74	-24.4	294	167	V
	* ** 2.87528	29.5	PK2	32.7	-12.6	-20	29.6	54	-24.4	-	-	294	167	V
5	* ** 4.95953	59.22	PK2	34	-31.5	0	61.72	-	-	74	-12.28	189	118	H
	* ** 4.95953	59.22	PK2	34	-31.5	-20	41.72	54	-12.28	-	-	189	118	H
6	* ** 9.11719	36.7	Pk	36.2	-25.6	0	47.3	54	-6.7	74	-26.7	0-360	100	H
7	* ** 9.33563	35.13	Pk	36.4	-25.3	0	46.23	54	-7.77	74	-27.77	0-360	100	H
11	* ** 4.95922	54.2	PK2	34	-31.5	0	56.7	-	-	74	-17.3	300	229	V
	* ** 4.95922	54.2	PK2	34	-31.5	-20	36.7	54	-17.3	-	-	300	229	V
12	* ** 9.15938	36.71	Pk	36.2	-26	0	46.91	54	-7.09	74	-27.09	0-360	200	V
13	* ** 9.37406	34.74	Pk	36.5	-25.6	0	45.64	54	-8.36	74	-28.36	0-360	200	V

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

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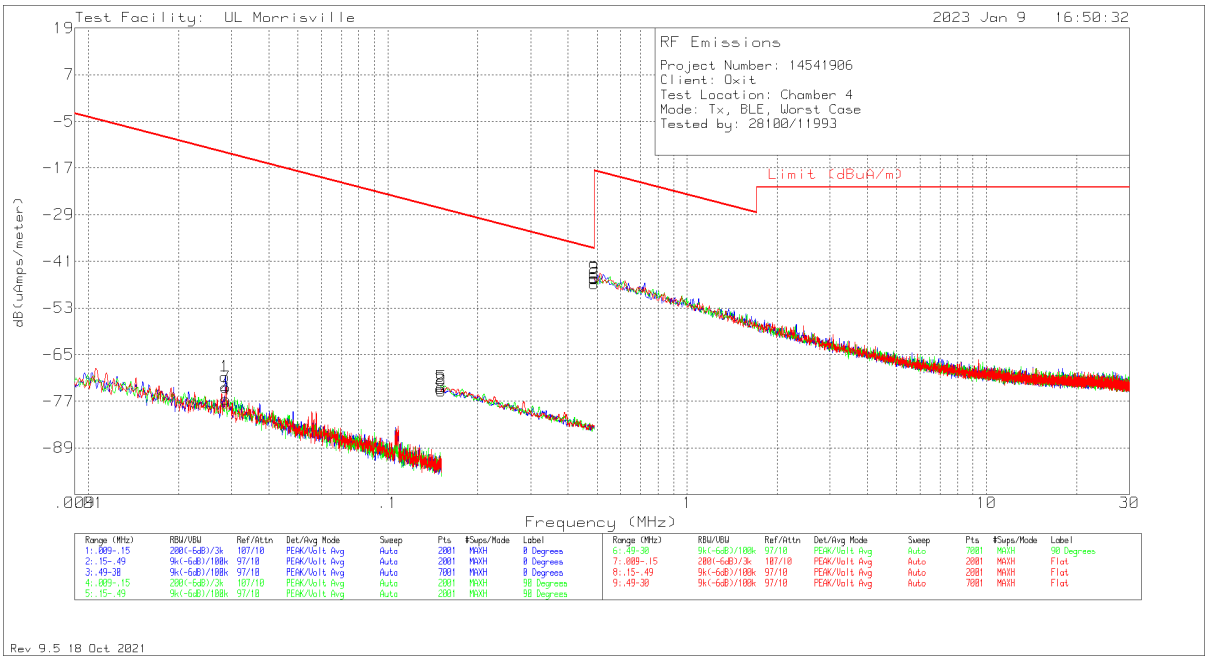
10.3. WORST CASE BELOW 30MHZ

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 H FIELD

Below 30MHz Data H FIELD

Marker	Frequency (MHz)	Meter Reading (dBuA)	Det	AT0059 (dBuV/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
1	.02867	47.07	Pk	-37.8	0	-80	-70.73	-13.04	6.96	-57.69	0-360	0 degs
4	.02874	41.4	Pk	-37.8	0	-80	-76.4	-13.06	6.94	-63.34	0-360	90 degs
7	.02874	44.45	Pk	-37.8	0	-80	-73.35	-13.06	6.94	-60.29	0-360	Flat
2	.15	47.04	Pk	-40.9	.1	-80	-73.76	-27.42	-7.42	-46.34	0-360	0 degs
8	.15085	46.51	Pk	-40.9	.1	-80	-74.29	-27.47	-7.47	-46.82	0-360	Flat
5	.15102	47.57	Pk	-40.9	.1	-80	-73.23	-27.48	-7.48	-45.75	0-360	90 degs
3	.49	35.45	Pk	-41	.1	-40	-45.45	-37.7	-17.7	-7.75	0-360	0 degs
6	.49	34.15	Pk	-41	.1	-40	-46.75	-37.7	-17.7	-9.05	0-360	90 degs
9	.49	35.51	Pk	-41	.1	-40	-45.39	-37.7	-17.7	-7.69	0-360	Flat

Pk - Peak detector

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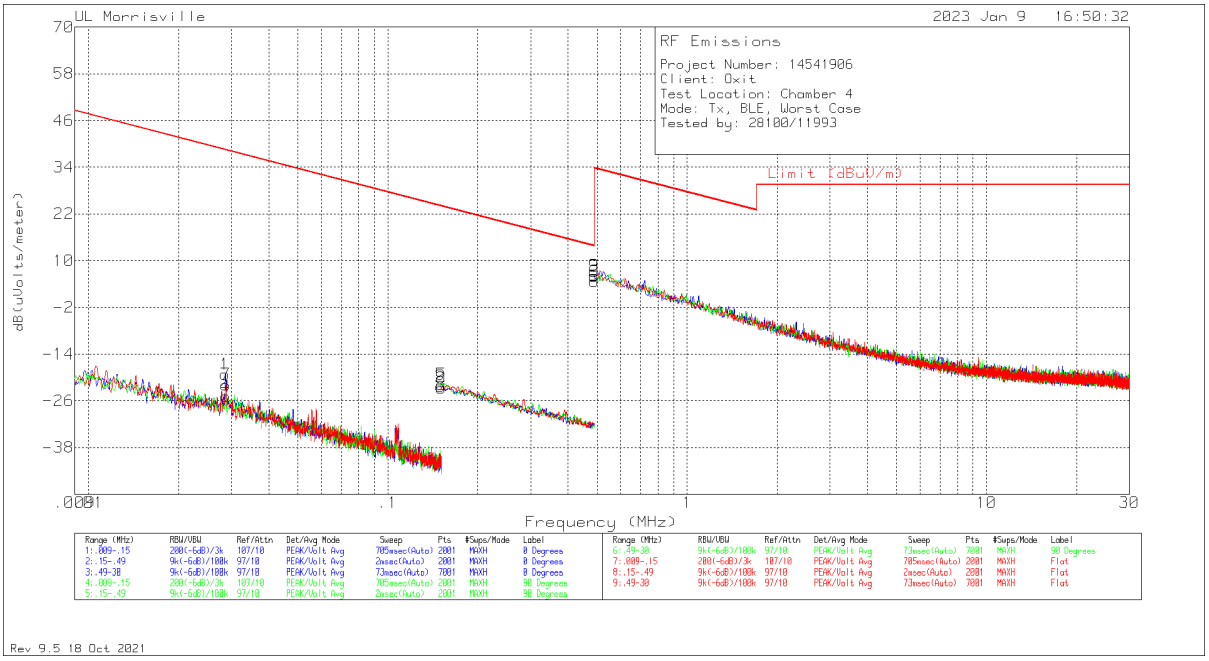

ANTENNA- THREE ORIENTATIONS E FIELD

Below 30MHz Data E FIELD

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0059 (dBuV/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
1	.02867	47.07	Pk	13.7	0	-80	-19.23	38.46	58.46	-57.69	0-360	0 degs
4	.02874	41.4	Pk	13.7	0	-80	-24.9	38.44	58.44	-63.34	0-360	90 degs
7	.02874	44.45	Pk	13.7	0	-80	-21.85	38.44	58.44	-60.29	0-360	Flat
2	.15	47.04	Pk	10.6	.1	-80	-22.26	24.08	44.08	-46.34	0-360	0 degs
8	.15085	46.51	Pk	10.6	.1	-80	-22.79	24.03	44.03	-46.82	0-360	Flat
5	.15102	47.57	Pk	10.6	.1	-80	-21.73	24.02	44.02	-45.75	0-360	90 degs
3	.49	35.45	Pk	10.5	.1	-40	6.05	13.8	33.8	-7.75	0-360	0 degs
6	.49	34.15	Pk	10.5	.1	-40	4.75	13.8	33.8	-9.05	0-360	90 degs
9	.49	35.51	Pk	10.5	.1	-40	6.11	13.8	33.8	-7.69	0-360	Flat

Pk - Peak detector

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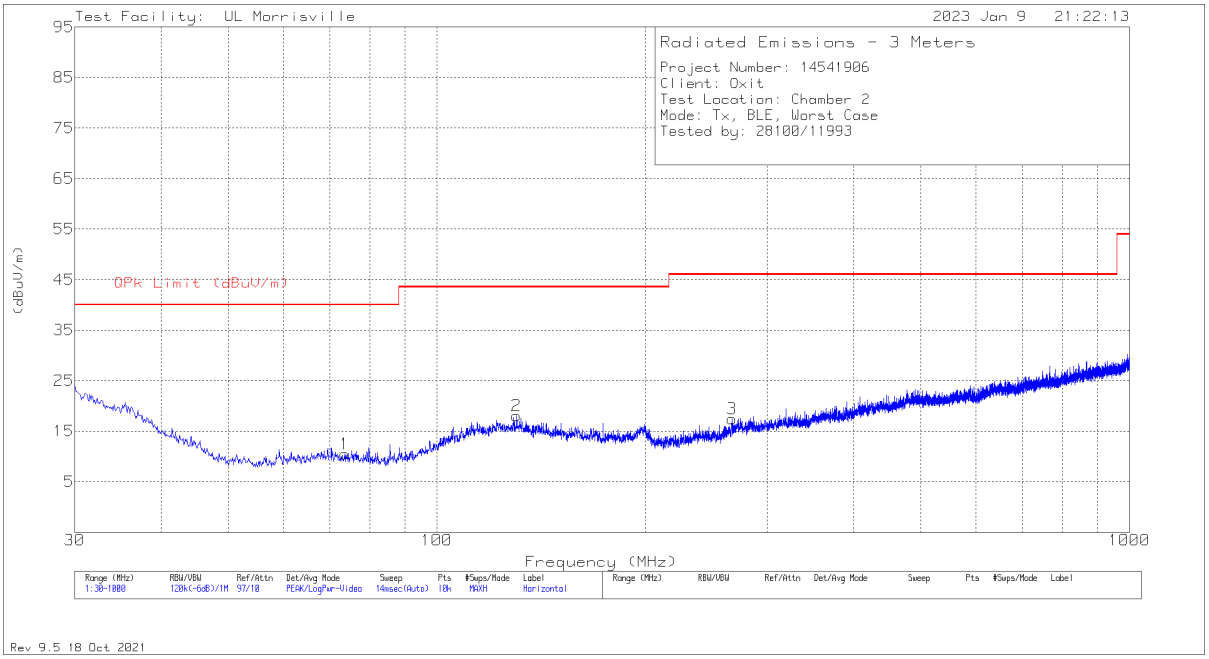
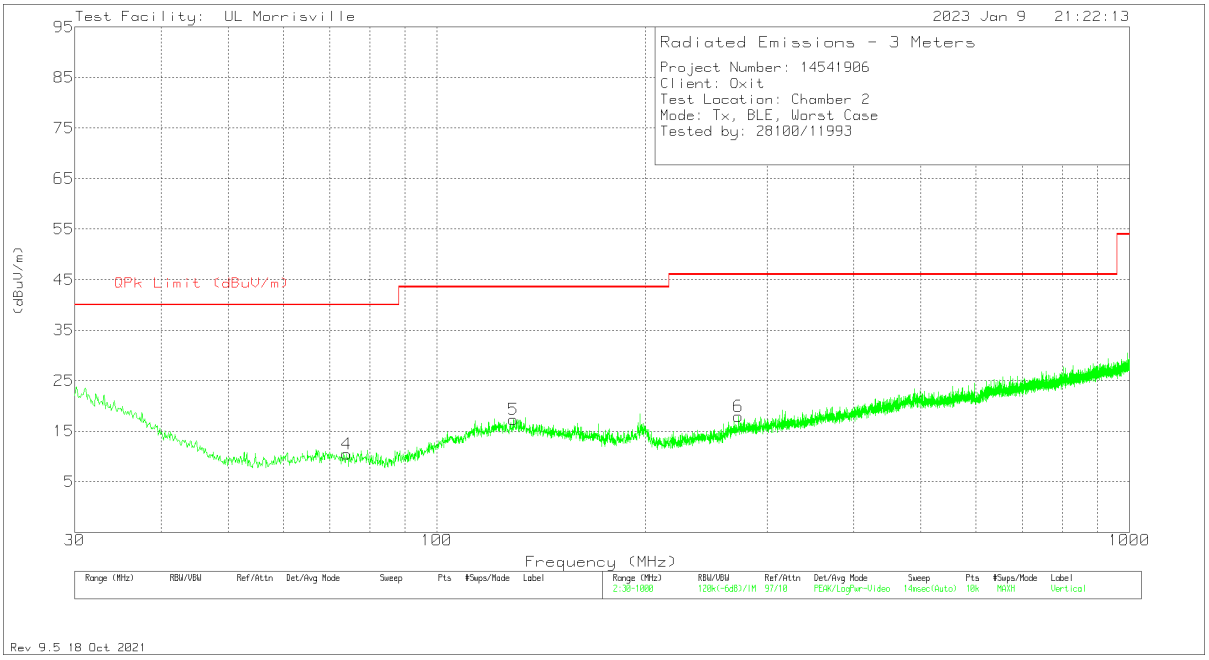
10.4. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



VERTICAL

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 73.553	26.92	Pk	14.4	-30.8	10.52	40	-29.48	0-360	199	H
2	* ** 130.395	28.27	Pk	19.9	-30.1	18.07	43.52	-25.45	0-360	299	H
3	* ** 267.068	27.46	Pk	18.9	-28.9	17.46	46.02	-28.56	0-360	199	H
4	* ** 74.038	27.03	Pk	14.3	-30.8	10.53	40	-29.47	0-360	101	V
5	* ** 129.037	27.64	Pk	19.9	-30.2	17.34	43.52	-26.18	0-360	199	V
6	* ** 272.694	27.78	Pk	19.2	-29.1	17.88	46.02	-28.14	0-360	199	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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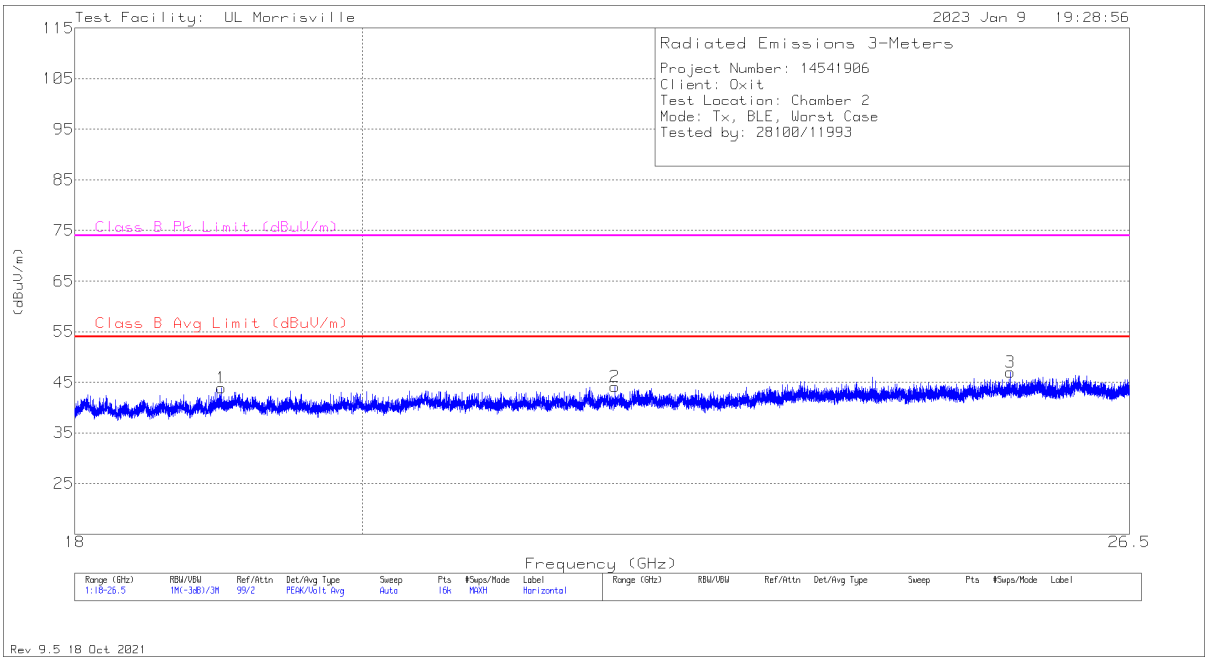
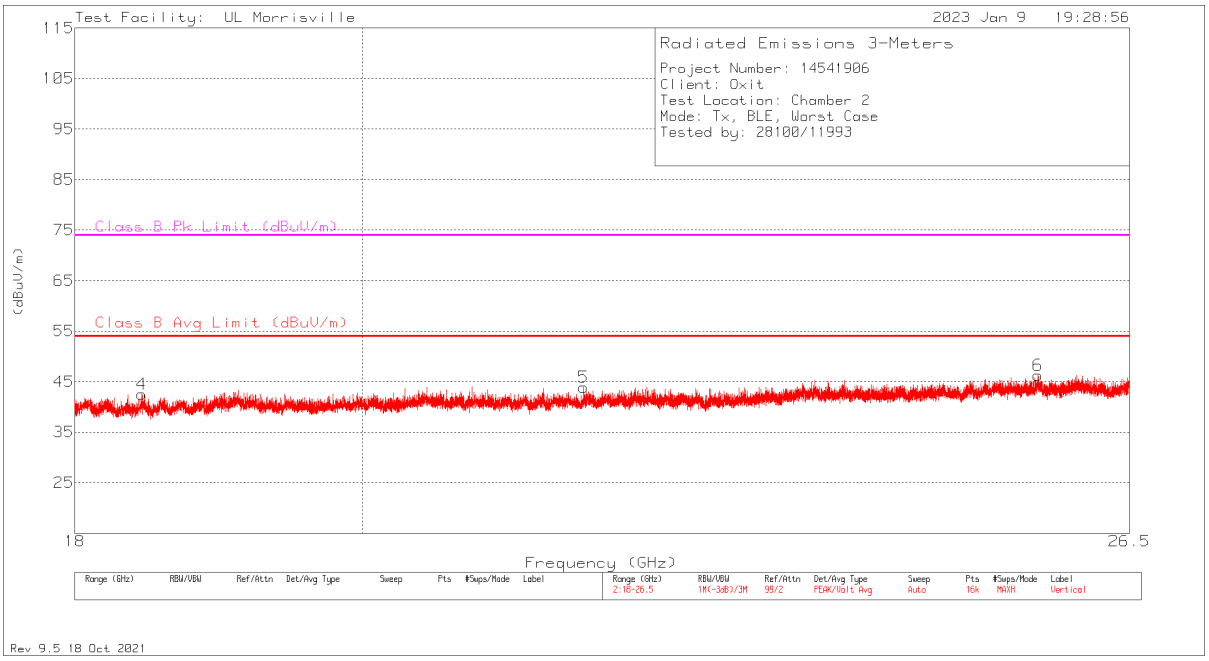
10.5. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

18 – 26GHz Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	204704 (dB/m)	Gain/Loss (dB)	Corrected Reading (dBuV/m)	Class B Avg Limit (dBuV/m)	Margin (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	18.44941	48.05	Pk	33.1	-38.6	42.55	54	-11.45	74	-31.45	0-360	200	V
1	18.99284	48.39	Pk	33.8	-38.3	43.89	54	-10.11	74	-30.11	0-360	300	H
5	21.69196	47.96	Pk	34.3	-38.4	43.86	54	-10.14	74	-30.14	0-360	150	V
2	21.94429	47.89	Pk	34.5	-38.3	44.09	54	-9.91	74	-29.91	0-360	101	H
3	25.36532	47.75	Pk	36.1	-36.9	46.95	54	-7.05	74	-27.05	0-360	200	H
6	25.6235	46.7	Pk	36	-36.4	46.3	54	-7.7	74	-27.7	0-360	200	V

Pk - Peak detector

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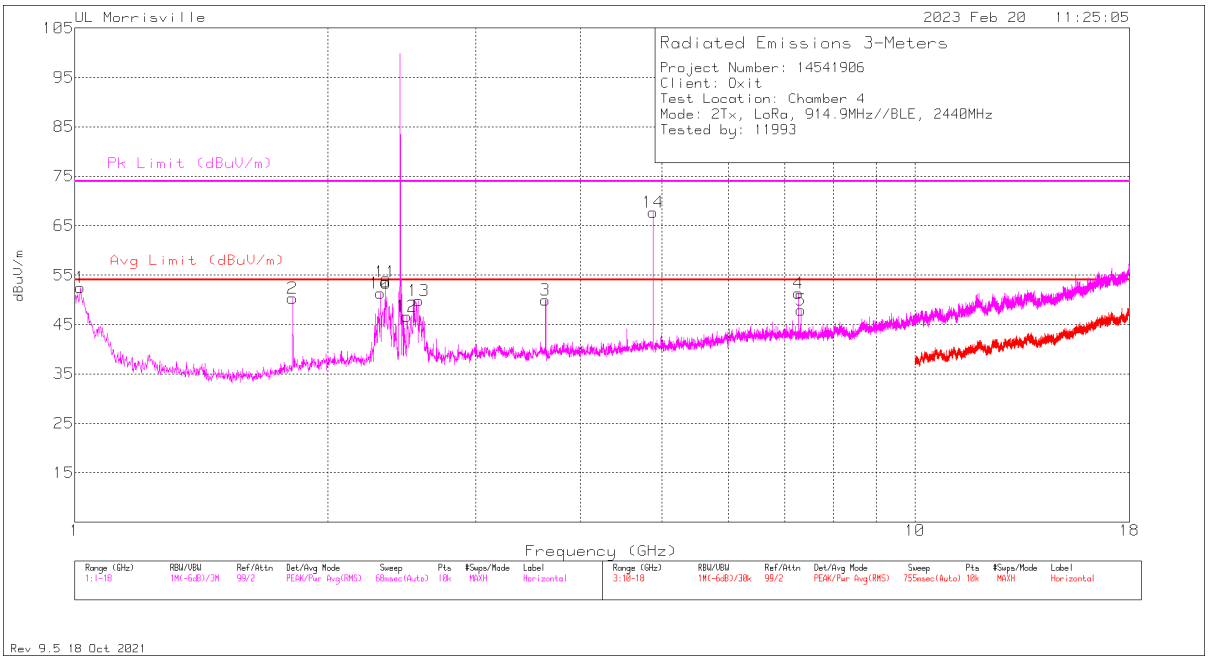
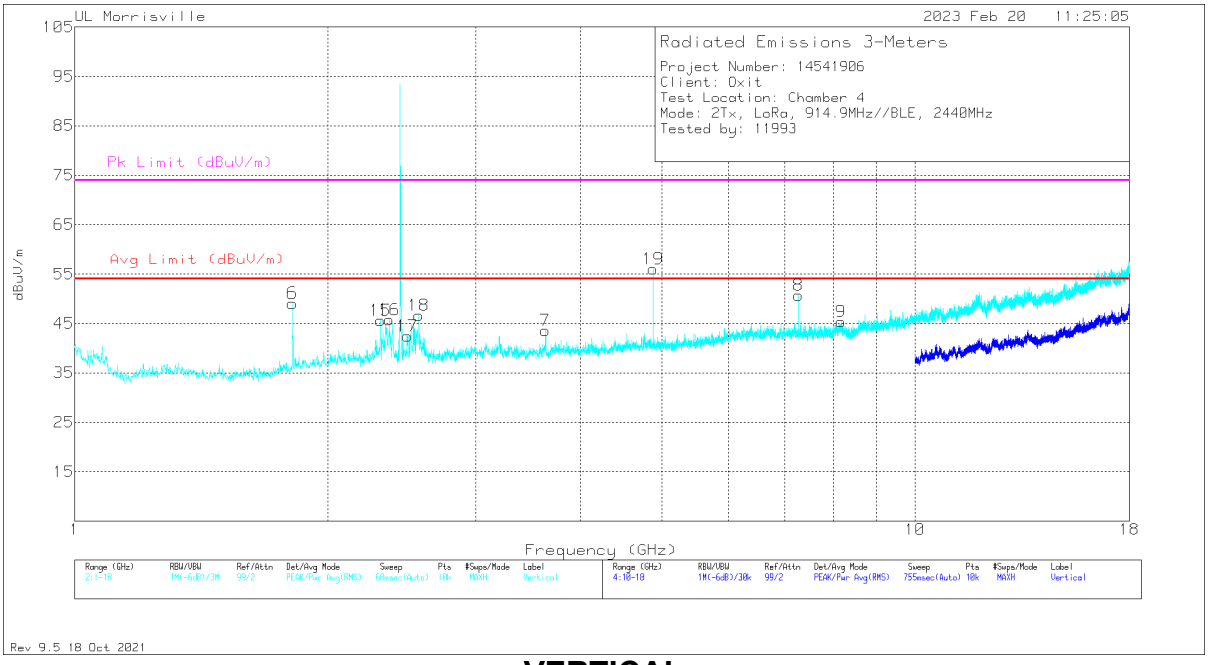
10.6. SIMULTANIOUS TX 1-18 GHz

SIM TX SPURIOUS EMISSIONS 1-18 GHz (WORST-CASE BLE/LORA CONFIGURATIONS)



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Gain/Loss (dB)	Filter (dB)	Corrected Reading dBuV/m	Avg Limit (dBuV/m)	Margin (dB)	Pk Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.01681	61.71	PK2	27.4	-35.5	1.9	55.51	-	-	74	-18.49	10	192	H
	* 1.01738	46.28	V1TV	27.4	-35.5	1.9	40.08	54	-13.92	-	-	10	192	H
3	* 3.63429	52.45	PK2	33.1	-34.4	.4	51.55	-	-	74	-22.45	300	102	H
	* 3.63441	49.57	V1TV	33.1	-34.4	.4	48.67	54	-5.33	-	-	300	102	H
4	* 7.26873	46.52	PK2	35.7	-28.5	.5	54.22	-	-	74	-19.78	290	101	H
	* 7.26882	42.02	V1TV	35.7	-28.5	.5	49.72	54	-4.28	-	-	290	101	H
5	* 7.3206	40.61	Pk	35.6	-28.9	.6	47.91	54	-6.09	74	-26.09	0-360	100	H
10	* 2.3122	58.36	PK2	32.1	-36.2	.4	54.66	-	-	74	-19.34	244	130	H
	* 2.31189	39.64	V1TV	32.1	-36.2	.4	35.94	54	-18.06	-	-	244	130	H
11	* 2.34423	58.99	PK2	32.1	-36.3	.4	55.19	-	-	74	-18.81	248	104	H
	* 2.34391	40.02	V1TV	32.1	-36.3	.4	36.22	54	-17.78	-	-	248	104	H
12	* 2.4858	49.78	Pk	32.6	-36.1	.4	46.68	54	-7.32	74	-27.32	0-360	100	H
14	* 4.87919	67.55	PK2	34	-32.3	.4	69.65	-	-	74	-4.35	244	118	H
	* 4.87969	45.77	V1TV	34	-32.3	.4	47.87	54	-6.13	-	-	244	118	H
7	* 3.6333	44.53	Pk	33.1	-34.4	.4	43.63	54	-10.37	74	-30.37	0-360	400	V
8	* 7.26942	43.57	PK2	35.7	-28.5	.5	51.27	-	-	74	-22.73	264	104	V
	* 7.26884	37.65	V1TV	35.7	-28.5	.5	45.35	54	-8.65	-	-	264	104	V
9	* 8.1672	37.07	Pk	35.7	-27.9	.5	45.37	54	-8.63	74	-28.63	0-360	400	V
15	* 2.3124	49.36	Pk	32.1	-36.2	.4	45.66	54	-8.34	74	-28.34	0-360	400	V
16	* 2.3685	49.41	Pk	32.2	-36.2	.4	45.81	54	-8.19	74	-28.19	0-360	400	V
17	* 2.49005	45.59	Pk	32.6	-36.1	.4	42.49	54	-11.51	74	-31.51	0-360	400	V
19	* 4.87956	56.93	PK2	34	-32.3	.4	59.03	-	-	74	-14.97	75	270	V
	* 4.87968	38.76	V1TV	34	-32.3	.4	40.86	54	-13.14	-	-	75	270	V
2	1.816	55.64	Pk	30.6	-36.3	.4	50.34	-	-	-	-	0-360	100	H
6	1.816	54.42	Pk	30.6	-36.3	.4	49.12	-	-	-	-	0-360	400	V
13	2.5674	52.84	Pk	32.7	-36.2	.5	49.84	-	-	-	-	0-360	100	H
18	2.5674	49.67	Pk	32.7	-36.2	.5	46.67	-	-	-	-	0-360	400	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
PK2 - Maximum Peak
V1TV - VB=1/Ton, Linear Voltage Average where: Ton is packet duration

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11. SETUP PHOTOS

Please refer to R14541906-EP1 for setup photos

END OF TEST REPORT

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