



TEST REPORT

Report Number. : R13768241-E1

Applicant : Braun GMBH
CAPA Sulzbacher Strasse 40
Schwalbach am Taunus, 65824, DE

Model : 3776

FCC ID : USQ3776

IC : 6856A-3776

EUT Description : Toothbrush

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C: 2021
ISED RSS-247 ISSUE 2: 2017
ISED RSS-GEN ISSUE 5 + A2:2021

Date Of Issue:
2022-01-28

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



REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2021-12-17	Initial Issue	Haley Ackun
V2	2021-12-28	Revised model number Corrected typo in test date Added 18-26GHz horn in test equipment	Brian Kiewra
V3	2022-01-25	Added 2Mbps data	Niklas Haydon
V4	2020-01-26	Update model number	Niklas Haydon
V5	2022-01-28	Updated data with DCCF	Haley Ackun

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Braun GMBH
CAPA Sulzbacher Strasse 40
Schwalbach am Taunus, 65824, DE

EUT DESCRIPTION: Toothbrush

MODEL: 3776

SERIAL NUMBER: 3776-i05-L4-PS-G011-357

SAMPLE RECEIPT DATE: 2021-09-16

DATE TESTED: 2021-09-22 TO 2022-01-19

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C: 2022	See Section 2
ISED RSS-247 Issue 2: 2017	See Section 2
ISED RSS-GEN Issue 5 + A2: 2021	See Section 2

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

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

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

Approved & Released For
UL LLC. By:



Brian T. Kiewra
Project Engineer/Operations Leader
Consumer Technology Division
UL LLC.

Prepared By:



Haley Ackun
Laboratory Engineer
Consumer Technology Division
UL LLC.

2. TEST RESULTS SUMMARY

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	Refer to Section 10.2.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Not Applicable	The EUT is battery operated.

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.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15: 2022, 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, cert. # 0751.06 for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input type="checkbox"/>	Building: 12 Laboratory Dr RTP, NC 27709, U.S.A	US0067	2180C	825374
<input checked="" type="checkbox"/>	Building: 2800 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	UNCERTAINTY
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%
Time	3.39%

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

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

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

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

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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a toothbrush with a BLE transceiver.

6.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	BLE	9.17	8.26

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PCB trace inverted-F antenna, with a maximum gain of -3 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was
iO5: Galaxy_IO5_release_V1_1210_03092021_e7271b7_302.

The test utility software used during testing was ESTI.

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 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 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 supports two data rate (1Mbps, 2Mbps). 1Mbps was determined to be worst case for emissions due to higher power spectral density; therefore all final radiated emissions were performed with the EUT transmitting at 1 Mbps except for band edge which was performed at both 1Mbps and 2Mbps.

The radio does not operate while charging occurs, therefore AC Line conducted emissions were not performed.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
None.				

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None						

TEST SETUP

Test software exercised the radio card.

SETUP DIAGRAMS

Please refer to R13768241-EP1 for setup diagrams

7. MEASUREMENT METHOD

Duty Cycle: ANSI C63.10 Section 11.6

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 -11.9.1.3 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)

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

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

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

8. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2021-08-19	2022-08-19
	30-1000 MHz				
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2021-02-19	2022-02-19
	1-18 GHz				
AT0078	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-11-19	2021-11-19
	18-40 GHz				
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2021-11-04	2022-11-04
AT0061	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2020-10-30	2021-10-30
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2021-07-20	2022-07-20
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2021-07-20	2022-07-20
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2021-07-20	2022-07-20
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2021-07-20	2022-07-20
	Receiver & Software				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-30	2022-03-30
SOFTEMI	EMI Software	UL	Version 9.5 (09 Aug 2021)		
	Additional Equipment used				
s/n 200037610	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Note: All equipment in calibration at time of use.

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2021-05-03	2022-05-03
	Gain-Loss Chains				
S-SAC03	Gain-loss string: 1-18GHz	Various	Various	2021-07-09	2022-07-09
	Receiver & Software				
197955	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-10	2022-03-10
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				
HI0095	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

Test Equipment Used - Wireless Conducted Measurement Equipment

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
SA0025	Spectrum Analyzer	Keysight Technologies	N9030A	2021-04-01	2022-04-01
PWM001	Power Meter	Keysight Technologies	N1912A	2021-07-16	2022-07-16
PWS003	Power Sensor	Keysight Technologies	E9323A	2021-05-27	2022-05-27
HI0091	Environmental Meter	Fisher Scientific	15-077-963	2021-07-12	2022-07-12
SOFTEMI	Antenna Port Software	UL	Version 2021.8.18 and 2021.11.3		

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

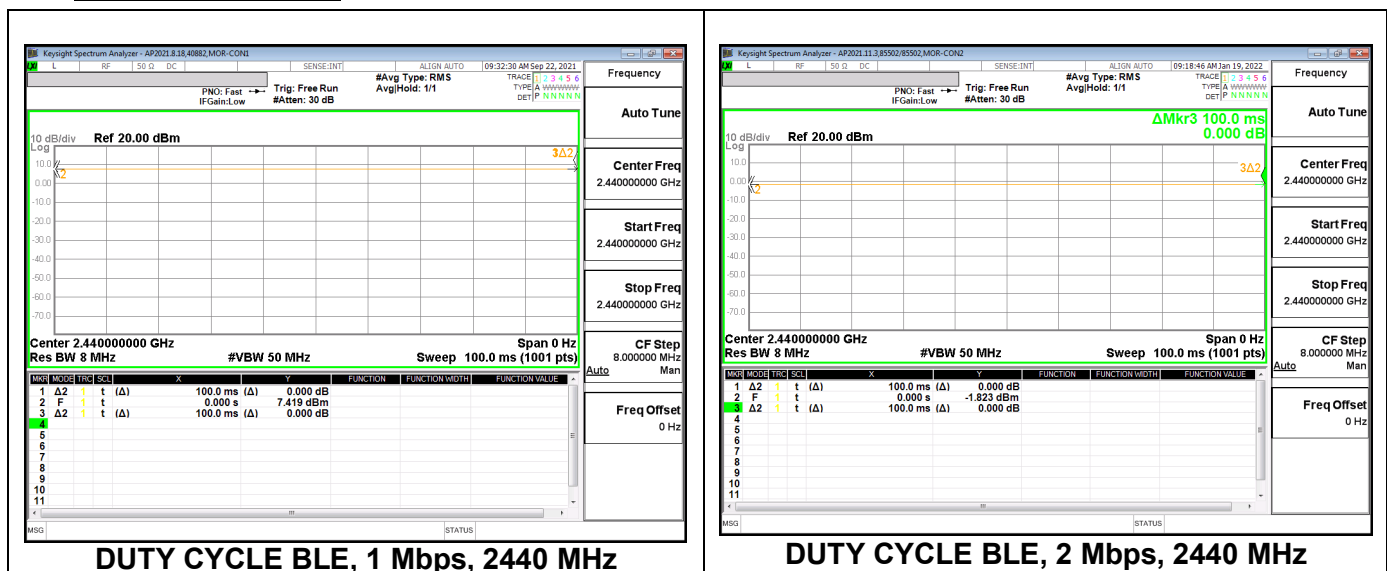
KDB 558074 Zero-Span Spectrum Analyzer Method.

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 (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
BLE 1 Mbps	100.000	100.000	1.000	100.00%	0.00	0.010
BLE 2 Mbps	100.000	100.000	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



*Note: The operational duty cycle of the EUT is 9.45% as declared by the manufacturer. This value is used to derive the duty cycle correction factor used in this report. A duty cycle correction factor of -20.49 was applied to all radiated average data. See calculation below.

$$\text{Duty Cycle Correction Factor} = 20 \cdot \log(\text{DC}) = 20 \cdot \log(0.0945) = -20.49 \text{ dB}$$

The customer is responsible for providing justification of this declared duty cycle.

9.2. 99% BANDWIDTH

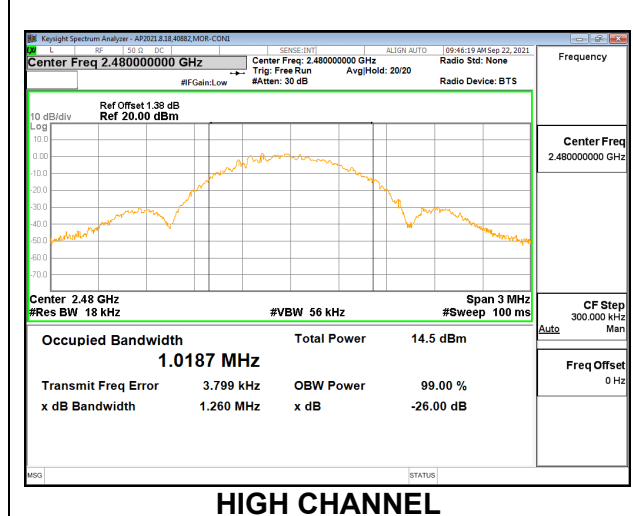
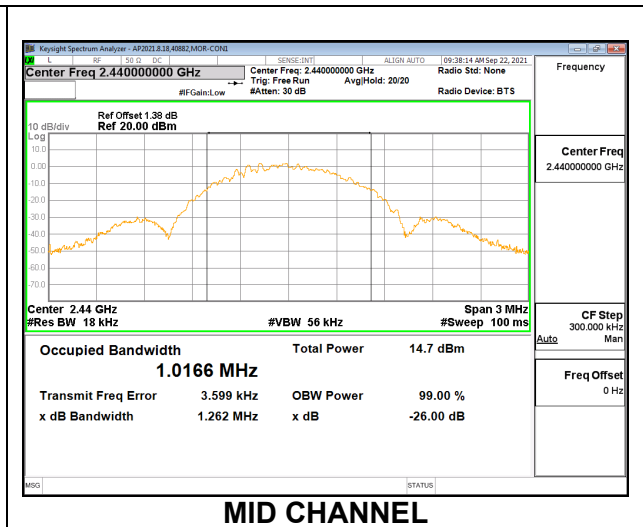
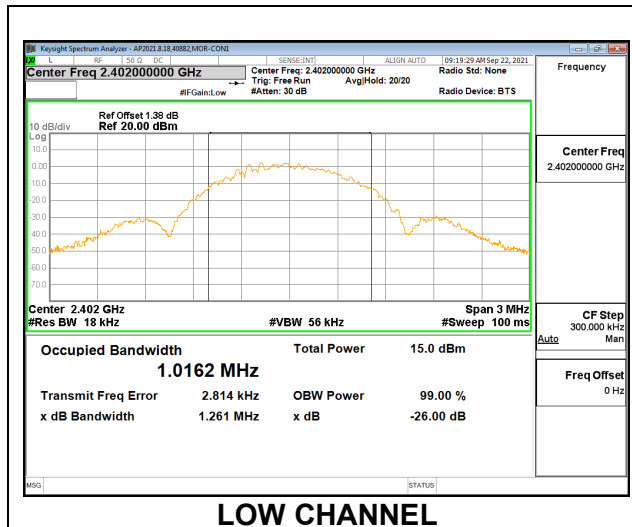
LIMITS

None; for reporting purposes only.

RESULTS

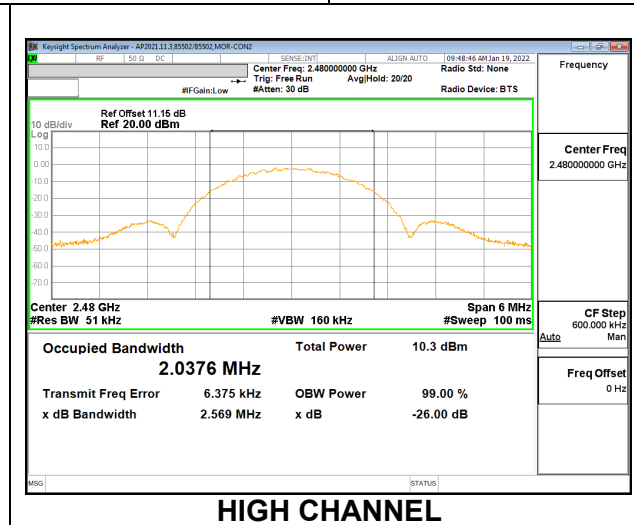
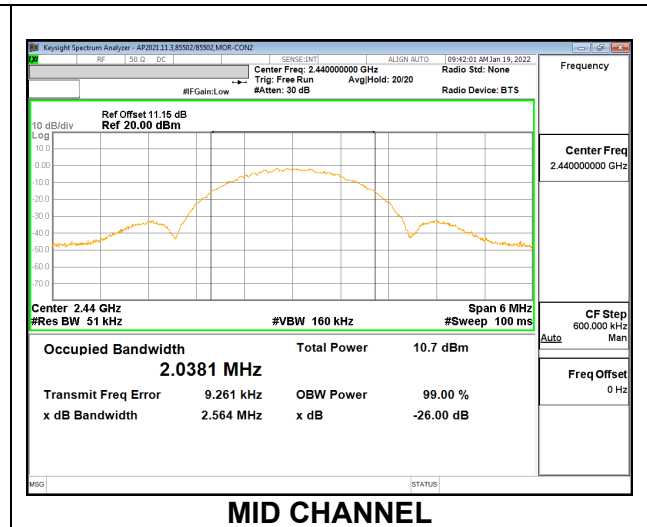
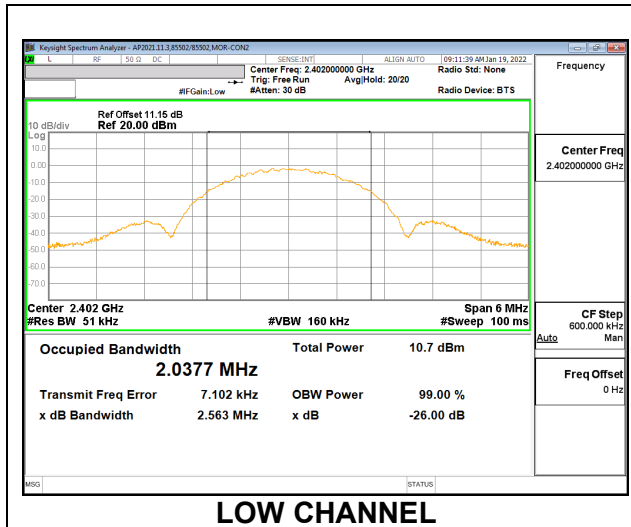
9.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0162
Middle	2440	1.0166
High	2480	1.0187



9.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0377
Middle	2440	2.0381
High	2480	2.0376



9.3. 6 dB BANDWIDTH

LIMITS

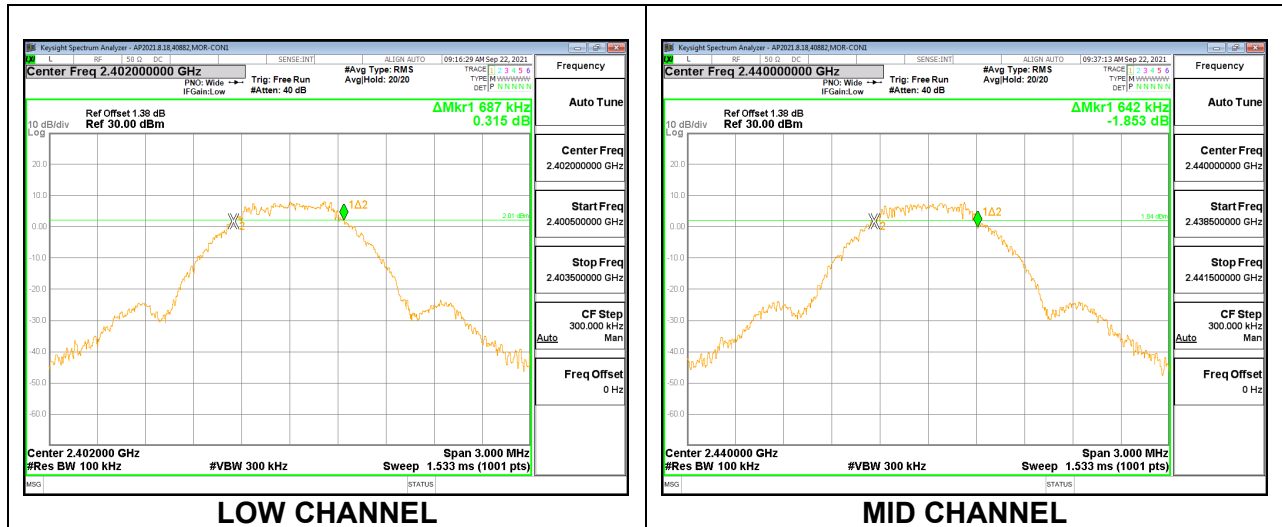
FCC §15.247 (a) (2)
 RSS-247 5.2 (a)

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

RESULTS

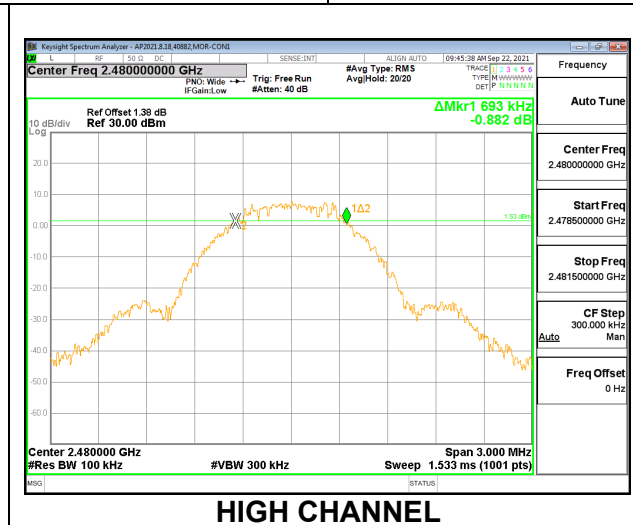
9.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.6870	0.5
Middle	2440	0.6420	0.5
High	2480	0.6930	0.5



LOW CHANNEL

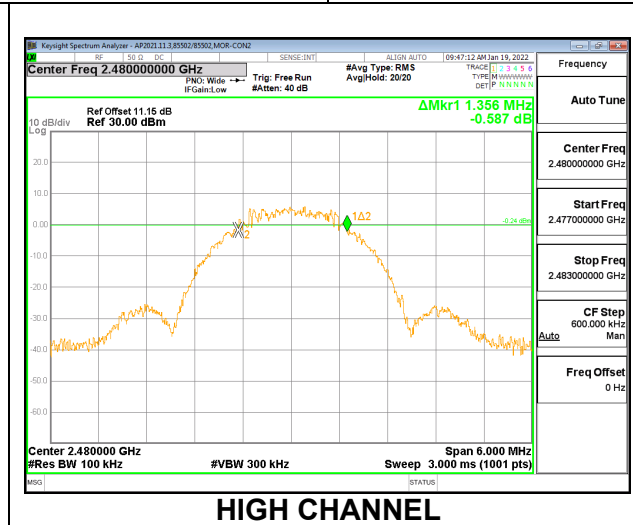
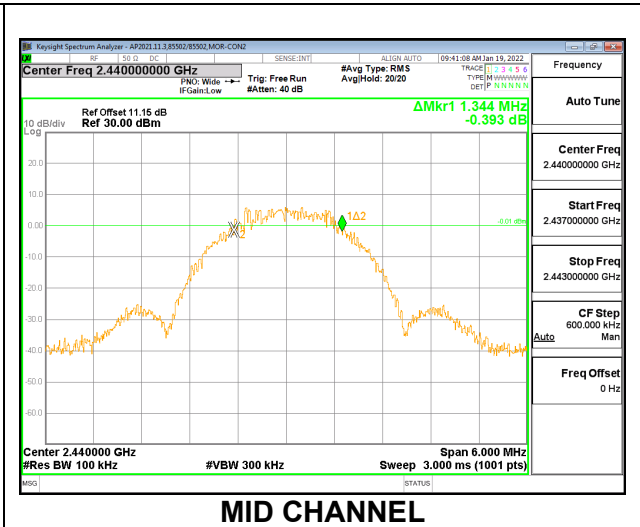
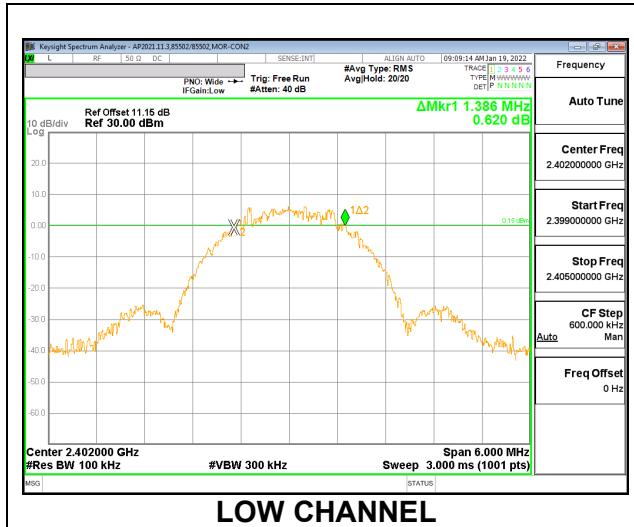
MID CHANNEL



HIGH CHANNEL

9.3.2. BLE (2Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.386	0.5
Middle	2440	1.344	0.5
High	2480	1.356	0.5



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 peak power meter.

The cable assembly insertion loss of 1.38 dB (cable) was entered as an offset in the power meter.

RESULTS

9.4.1. BLE (1Mbps)

Tested By:	40882
Date:	2021-09-22

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.09	30	-20.910
Middle	2440	9.10	30	-20.900
High	2480	8.97	30	-21.030

9.4.2. BLE (2Mbps)

Tested By:	85502/40882
Date:	2022-01-19

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.17	30	-20.830
Middle	2440	9.03	30	-20.970
High	2480	8.80	30	-21.200

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

The cable assembly insertion loss of 1.38 dB (cable) was entered as an offset in the power meter.

RESULTS

9.5.1. BLE (1Mbps)

Tested By:	40882
Date:	2021-09-22

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	9.03
Middle	2440	9.06
High 2	2480	8.93

9.5.2. BLE (2Mbps)

Tested By:	85502/40882
Date:	2022-01-19

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	9.15
Middle	2440	9.00
High 2	2480	8.78

9.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

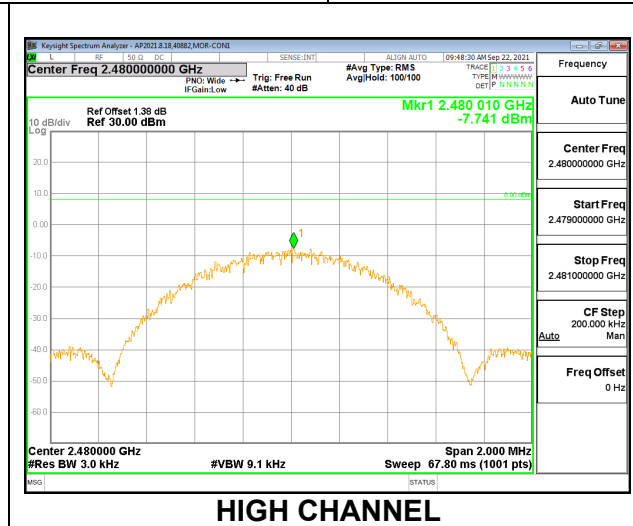
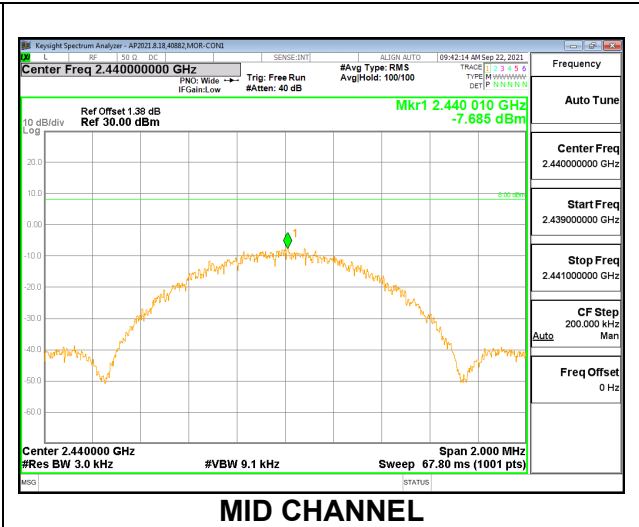
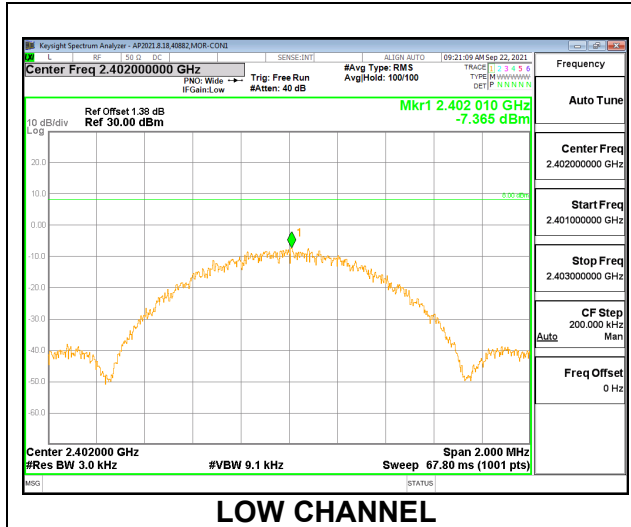
RSS-247 (5.2) (b)

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

RESULTS

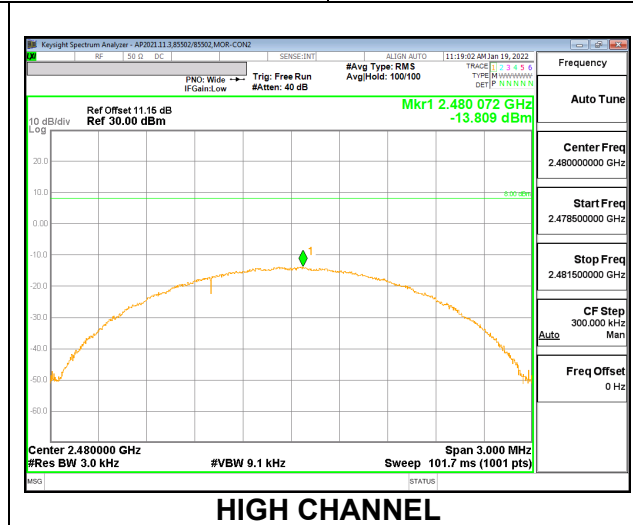
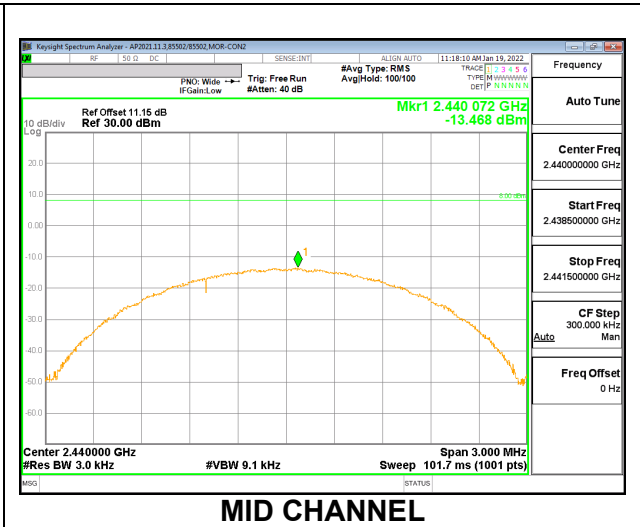
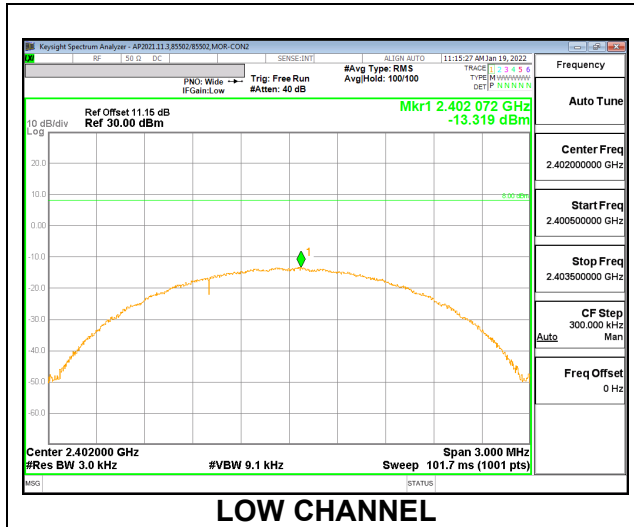
9.6.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-7.365	8	-15.37
Middle	2440	-7.685	8	-15.69
High	2480	-7.741	8	-15.74



9.6.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-13.319	8	-21.32
Middle	2440	-13.468	8	-21.47
High	2480	-13.809	8	-21.81



9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

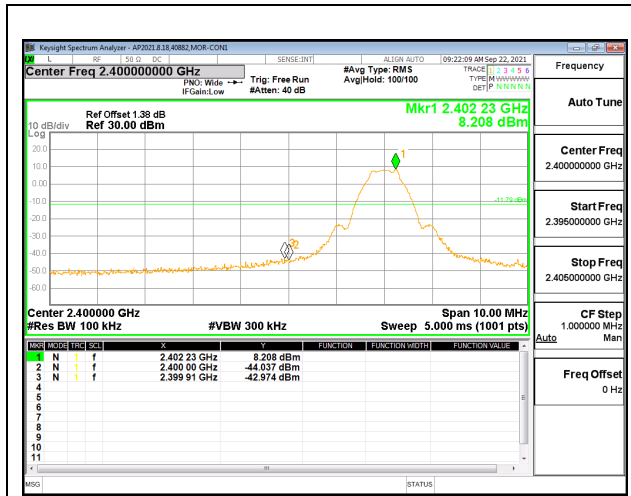
FCC §15.247 (d)

RSS-247 5.5

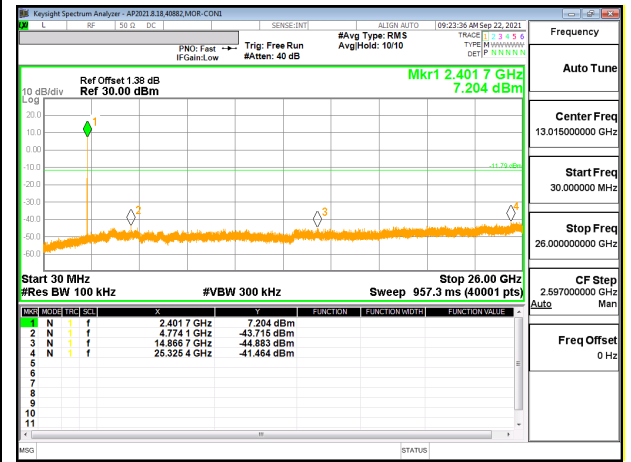
Output power was measured based on the use of a peak measurement, therefore the required attenuation is -20 dBc.

RESULTS

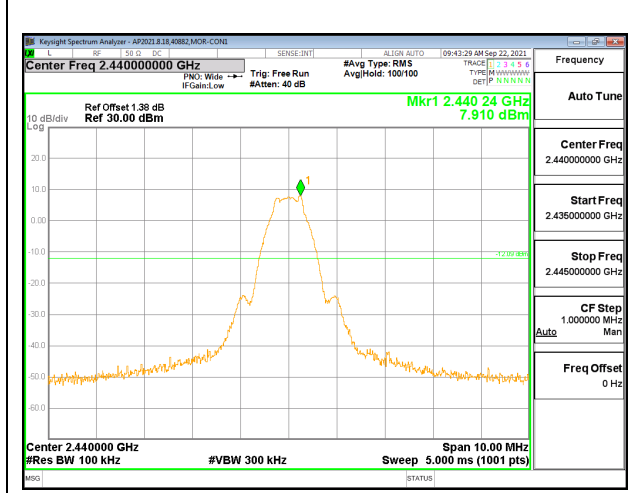
9.7.1. BLE (1Mbps)



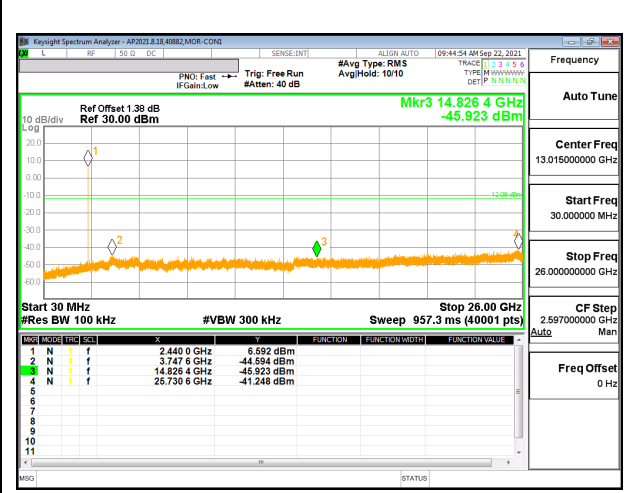
LOW CHANNEL BANDEDGE



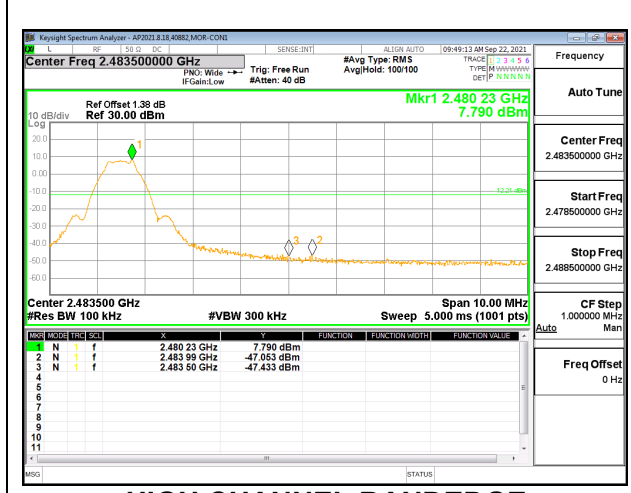
OUT-OF-BAND LOW CHANNEL



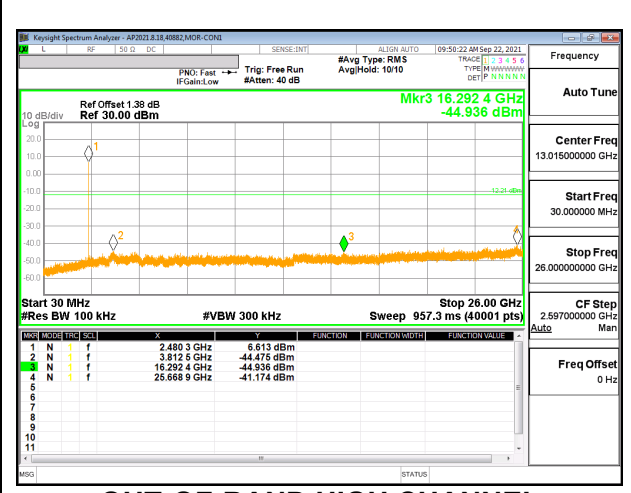
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

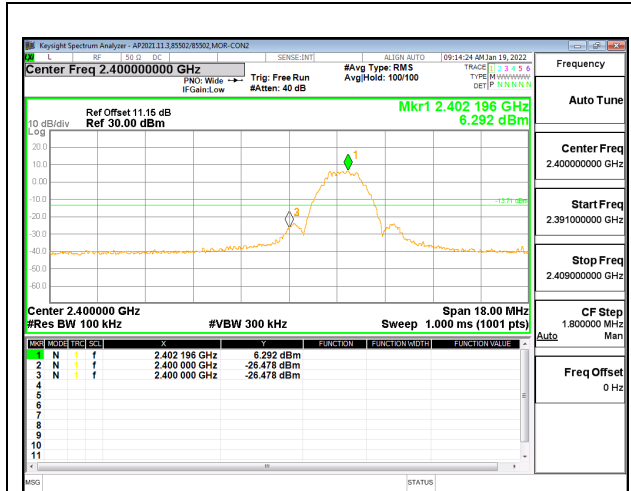


HIGH CHANNEL BANDEDGE

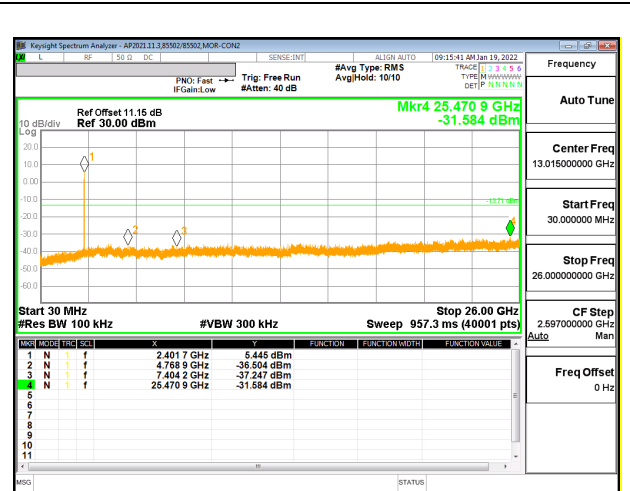


OUT-OF-BAND HIGH CHANNEL

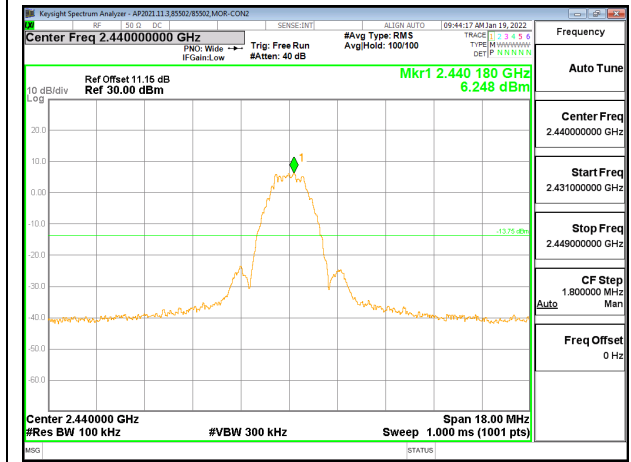
9.7.2. BLE (2Mbps)



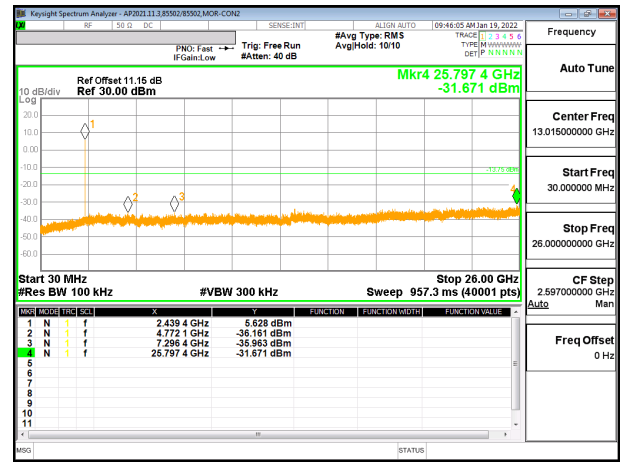
LOW CHANNEL BANDEDGE



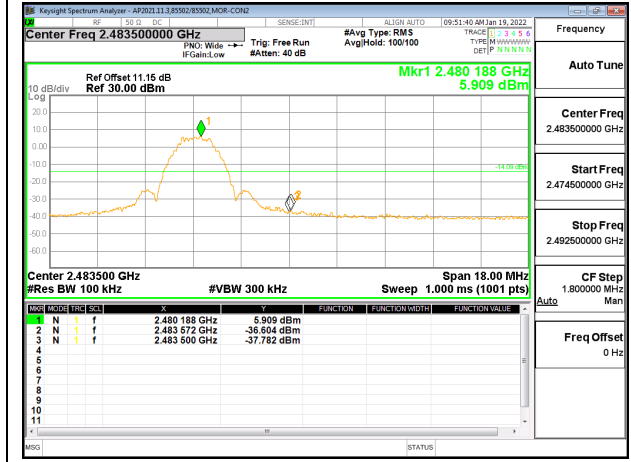
OUT-OF-BAND LOW CHANNEL



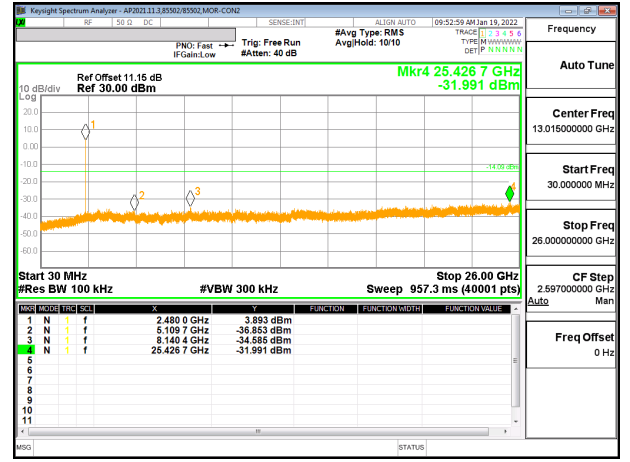
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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

RSS-GEN, Section 8.9 and 8.10.

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

TEST PROCEDURE

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

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

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

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for linear voltage averaging 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).

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

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

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

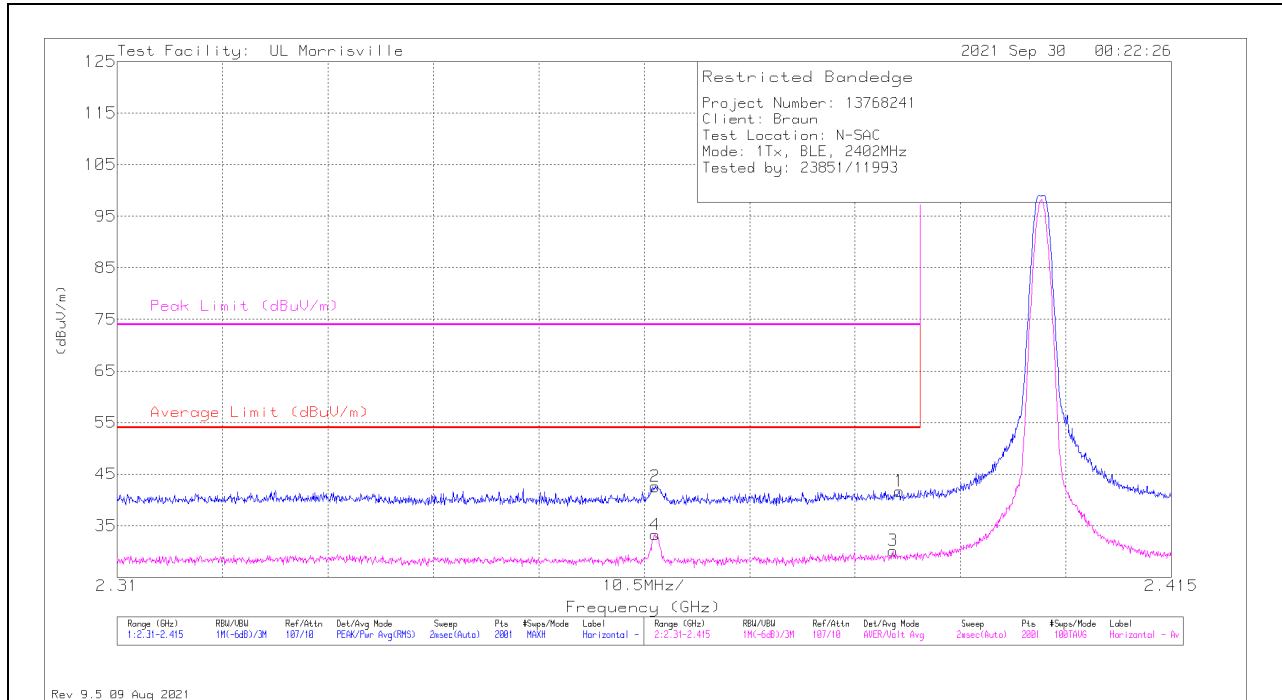
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (1Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Pad (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	*** 2.38791	34.2	Pk	31.8	-24.3	0	41.7	-	-	74	-32.3	294	100	H
2	** 2.3636	35.4	Pk	31.7	-24.5	0	42.6	-	-	74	-31.4	294	100	H
3	*** 2.38728	22.65	ADV	31.8	-24.3	-20.49	9.66	54	-44.34	-	-	294	100	H
4	** 2.3636	26.05	ADV	31.7	-24.5	-20.49	12.76	54	-41.33	-	-	294	100	H

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

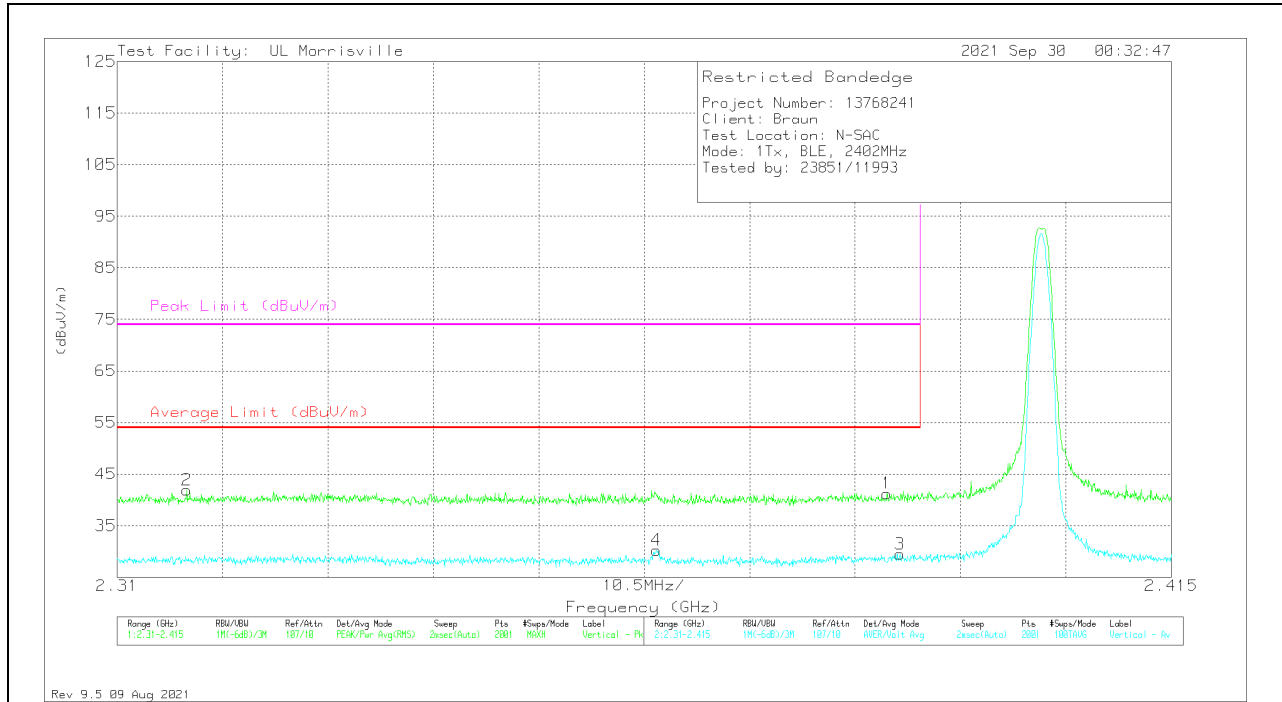
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Pad (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	* ** 2.38665	33.74	Pk	31.8	-24.3	0	41.24	-	-	74	-32.76	141	242	V
2	* ** 2.31693	34.49	Pk	31.7	-24.3	0	41.89	-	-	74	-32.11	141	242	V
3	* ** 2.38796	21.99	ADV	31.8	-24.3	-20.49	9.00	54	-45.00	-	-	141	242	V
4	* ** 2.36371	23.04	ADV	31.7	-24.5	-20.49	9.75	54	-44.25	-	-	141	242	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

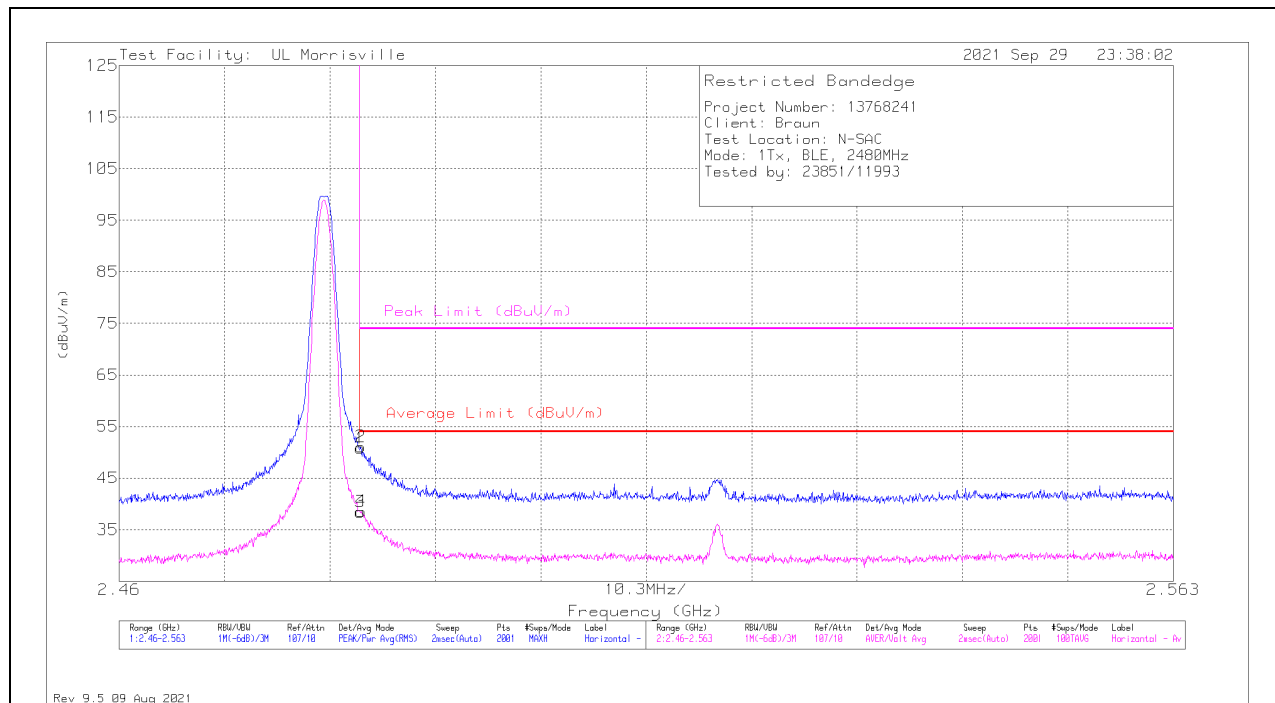
Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Pad (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	42.98	Pk	32.4	-24.6	0	50.78	-	-	74	-23.22	302	189	H
2	*** 2.48359	43.26	Pk	32.4	-24.6	0	51.06	-	-	74	-22.94	302	189	H
3	*** 2.48354	30.66	ADV	32.4	-24.6	-20.49	17.97	54	-36.03	-	-	302	189	H
4	*** 2.48364	30.66	ADV	32.5	-24.6	-20.49	18.07	54	-35.93	-	-	302	189	H

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

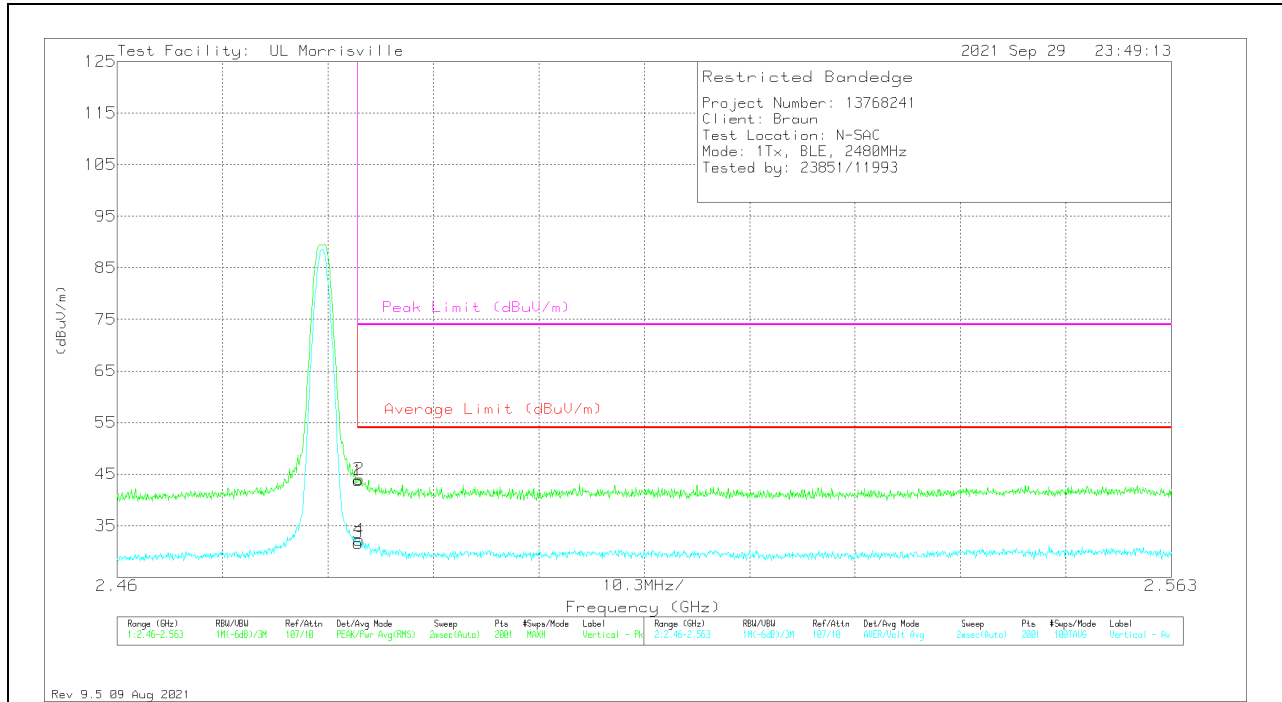
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.48354	35.92	Pk	32.4	-24.6	0	43.72	-	-	74	-30.28	123	313	V
2	* ** 2.48364	36.11	Pk	32.5	-24.6	0	44.01	-	-	74	-29.99	123	313	V
3	* ** 2.48354	23.84	ADV	32.4	-24.6	-20.49	11.15	54	-42.85	-	-	123	313	V
4	* ** 2.48364	24.35	ADV	32.5	-24.6	-20.49	11.76	54	-42.24	-	-	123	313	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

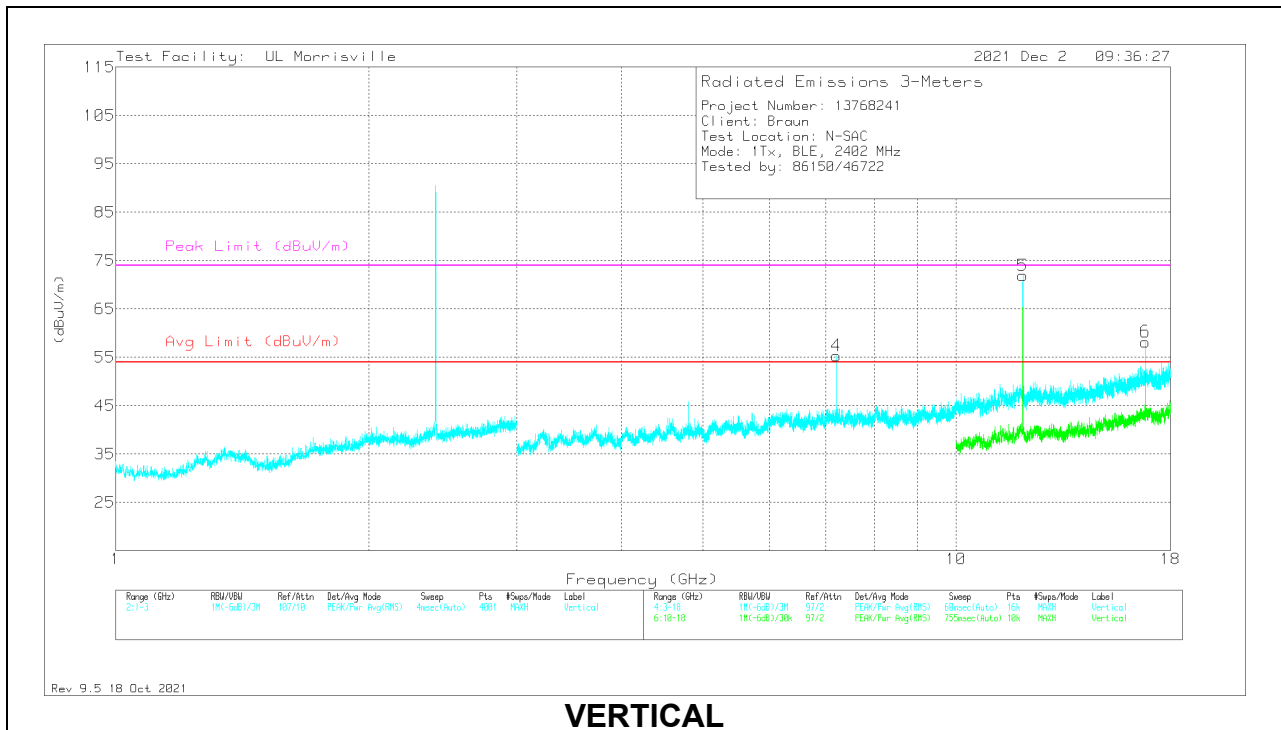
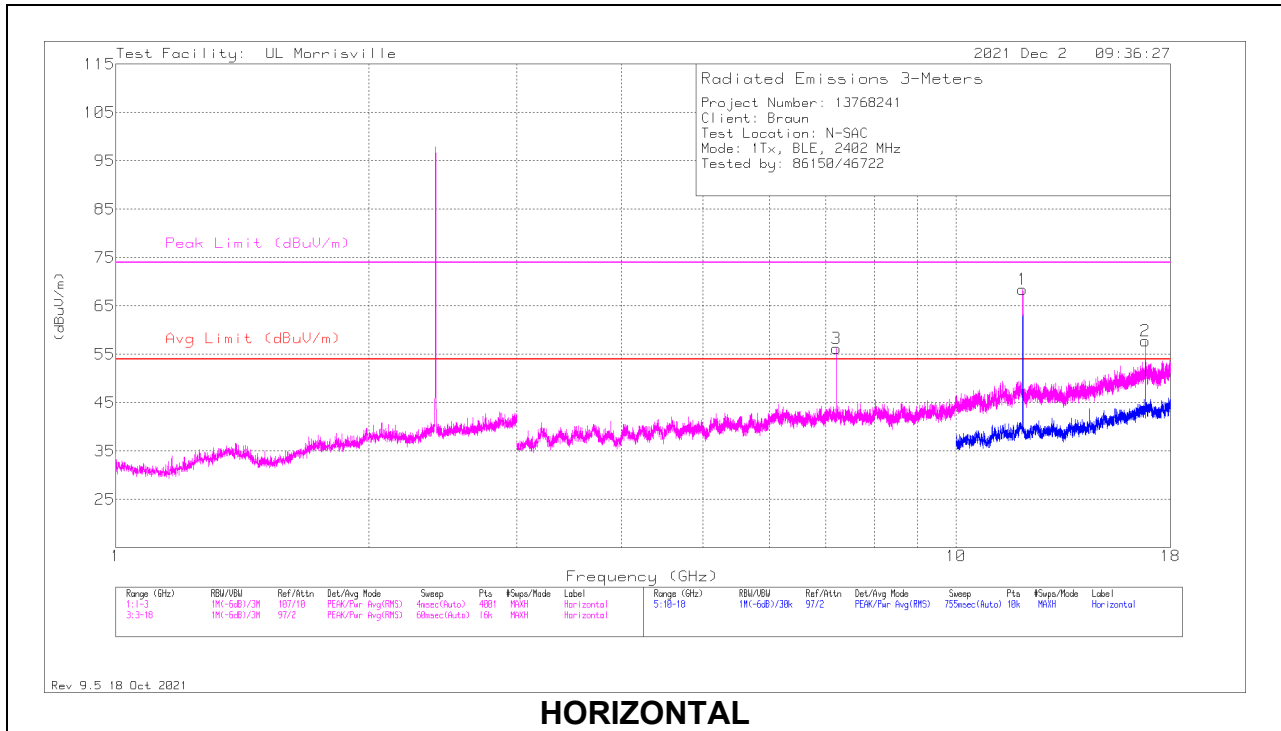
Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr (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	* ** 12.01131	55.39	PK2	38.8	-24.9	0	69.29	-	-	74	-4.71	348	104	H
	* ** 12.00902	49.11	ADV	38.8	-25	-20.49	42.42	54	-11.58	-	-	348	104	H
5	* ** 12.01131	59.16	PK2	38.8	-24.9	0	73.06	-	-	74	-.94	23	108	V
	* ** 12.01114	53.96	ADV	38.8	-24.9	-20.49	47.37	54	-6.63	-	-	23	108	V
3	7.20656	50.43	Pk	35.5	-29.7	0	56.23	-	-	-	-	0-360	101	H
4	7.20656	49.57	Pk	35.5	-29.7	0	55.37	-	-	-	-	0-360	101	V
2	16.81313	41.65	Pk	41.4	-25.3	0	57.75	-	-	-	-	0-360	101	H
6	16.81313	42.13	Pk	41.4	-25.3	0	58.23	-	-	-	-	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

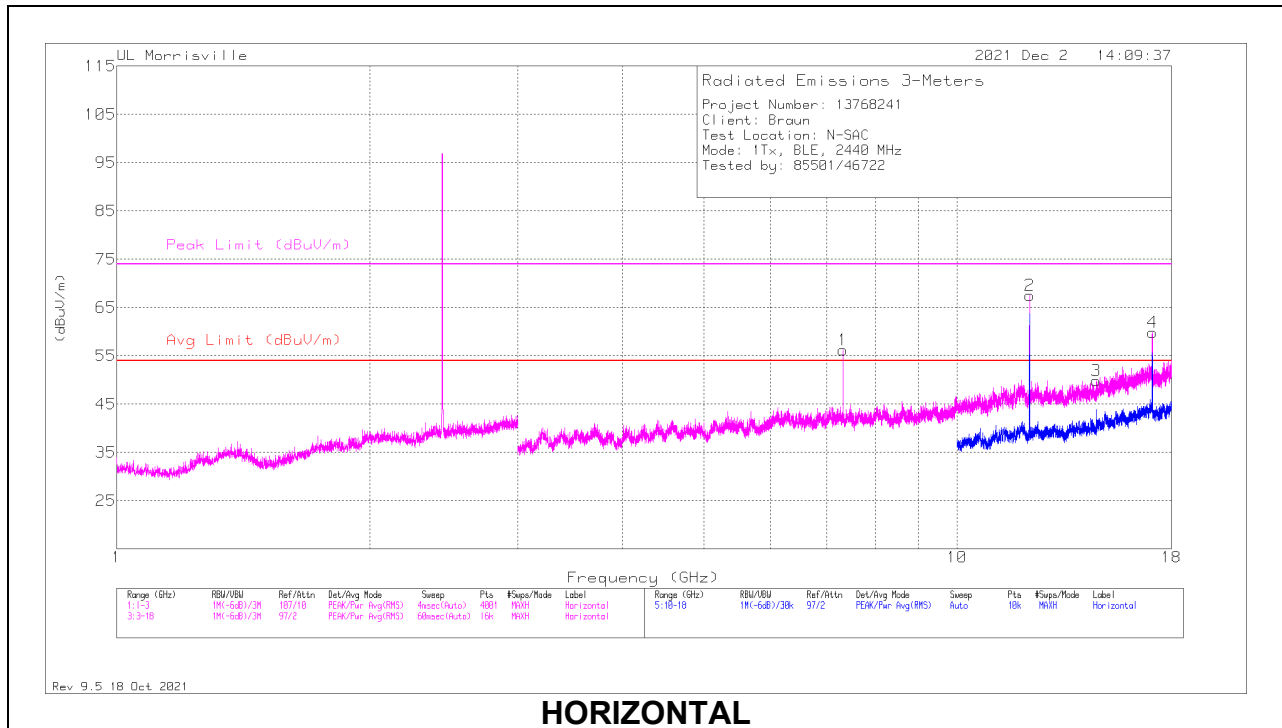
Pk - Peak detector

PK2 - Maximum Peak

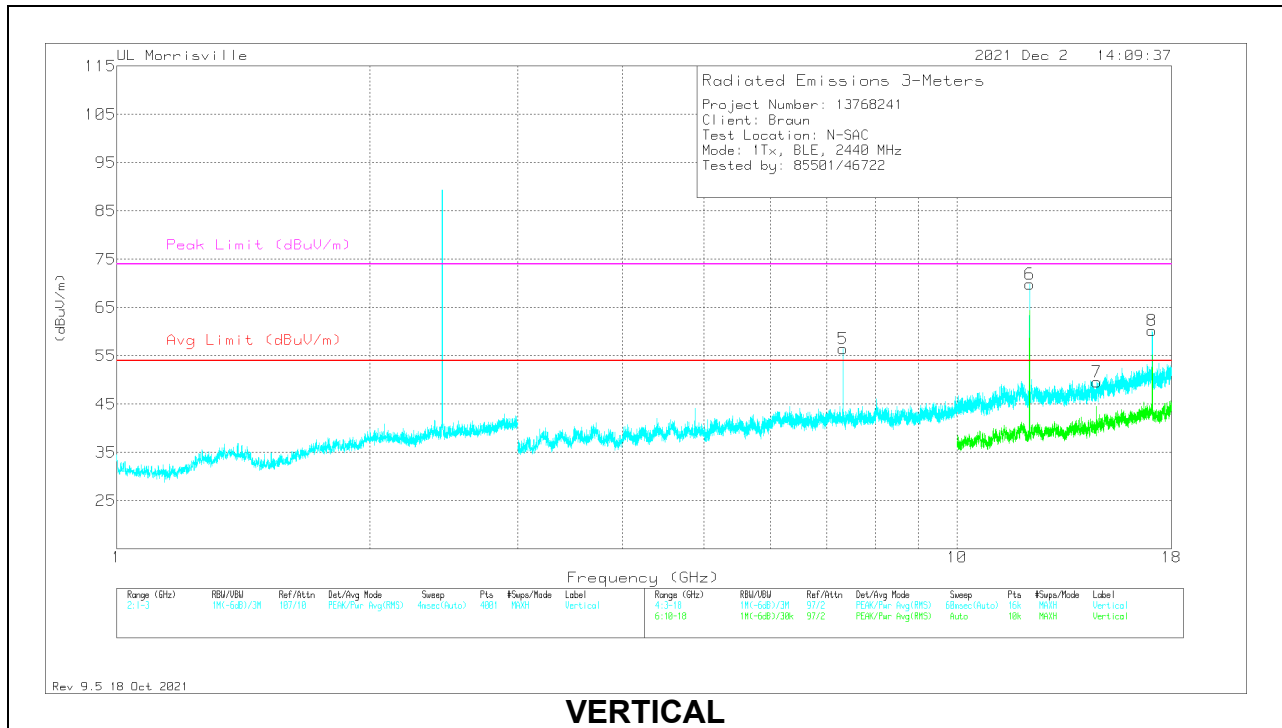
ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr (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	*** 7.31937	50.33	PK2	35.6	-28.5	0	57.43	-	-	74	-16.57	306	103	H
	*** 7.31946	44.36	ADV	35.6	-28.5	-20.49	30.97	54	-23.03	-	-	306	103	H
5	*** 7.32081	50.64	PK2	35.6	-28.4	0	57.84	-	-	74	-16.16	135	106	V
	*** 7.32053	44.09	ADV	35.6	-28.4	-20.49	30.80	54	-23.20	-	-	135	106	V
2	*** 12.19884	54.9	PK2	38.8	-26	0	67.7	-	-	74	-6.3	350	108	H
	*** 12.19896	48.38	ADV	38.8	-26	-20.49	40.69	54	-13.31	-	-	350	108	H
6	*** 12.20129	57.61	PK2	38.8	-26.1	0	70.31	-	-	74	-3.69	24	110	V
	*** 12.20117	51.29	ADV	38.8	-26.1	-20.49	43.50	54	-10.50	-	-	24	110	V
3	14.64188	36.63	Pk	39.6	-26.4	0	49.83	-	-	-	-	0-360	199	H
7	14.67281	34.97	Pk	39.6	-25	0	49.57	-	-	-	-	0-360	101	V
8	17.07938	42.86	Pk	41.2	-23.8	0	60.26	-	-	-	-	0-360	101	V
4	17.08219	42.56	Pk	41.2	-23.9	0	59.86	-	-	-	-	0-360	199	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

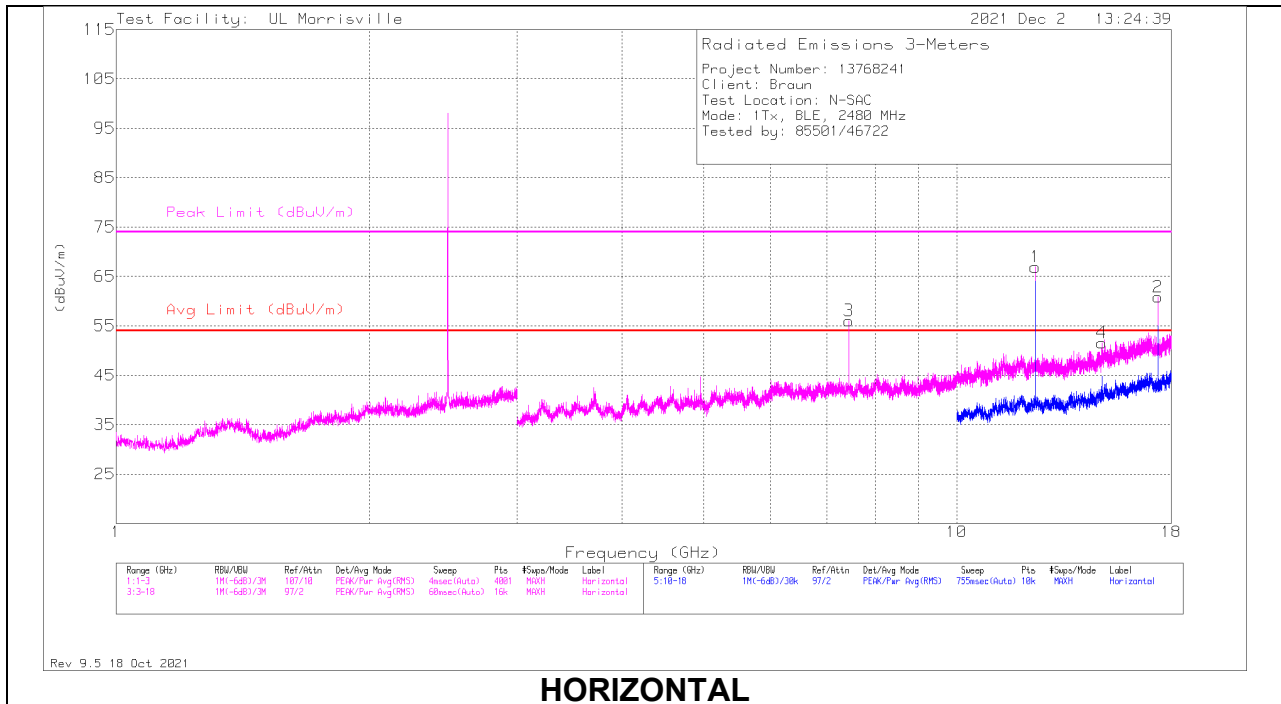
Pk - Peak detector

PK2 - Maximum Peak

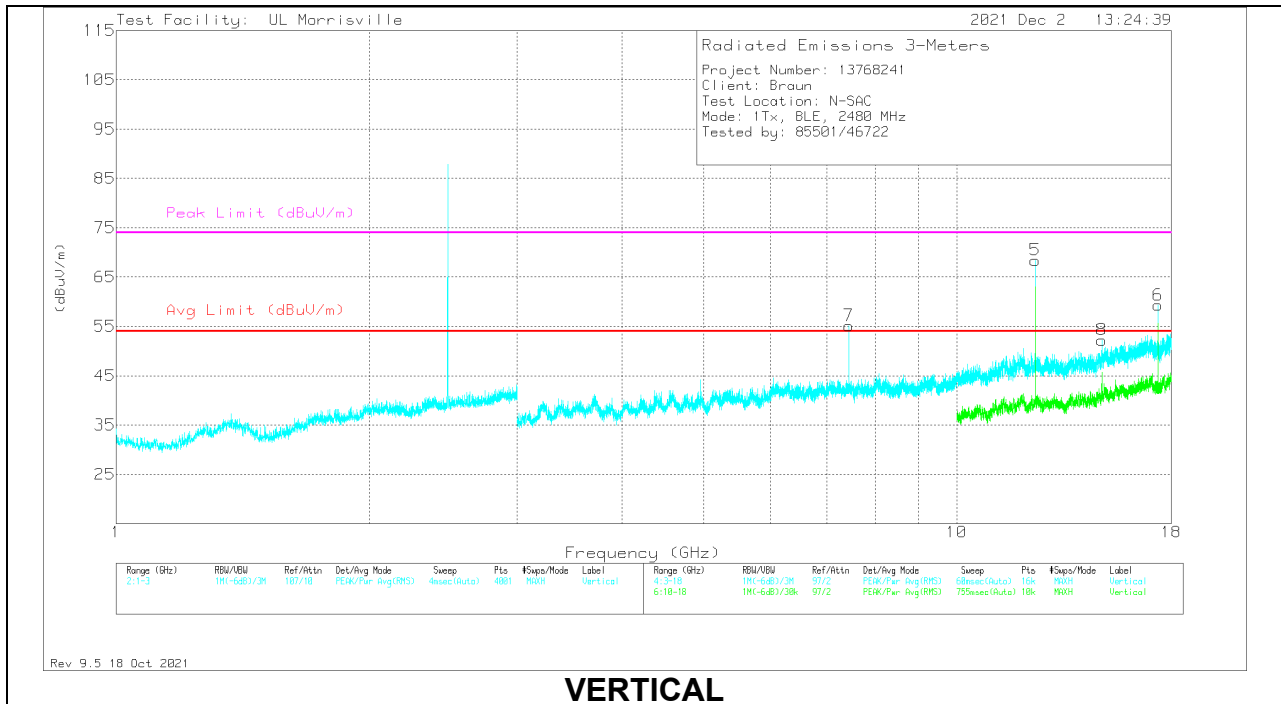
ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr (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	* ** 12.39885	54.68	PK2	38.8	-25.9	0	67.58	-	-	74	-6.42	124	109	H
	* ** 12.39905	48.36	ADV	38.8	-25.9	-20.49	40.77	54	-13.23	-	-	124	109	H
3	* ** 7.44069	50.89	PK2	35.6	-28.8	0	57.69	-	-	74	-16.31	305	114	H
	* ** 7.4394	44.25	ADV	35.6	-28.6	-20.49	30.77	54	-23.23	-	-	305	114	H
5	* ** 12.40122	55.87	PK2	38.8	-25.8	0	68.87	-	-	74	-5.13	22	106	V
	* ** 12.40121	49.62	ADV	38.8	-25.8	-20.49	42.13	54	-11.87	-	-	22	106	V
7	* ** 7.43927	50.1	PK2	35.6	-28.5	0	57.2	-	-	74	-16.8	331	146	V
	* ** 7.43939	43.7	ADV	35.6	-28.6	-20.49	30.11	54	-23.89	-	-	331	146	V
4	14.88188	37.86	Pk	39.8	-26.1	0	51.56	-	-	-	-	0-360	101	H
8	14.88188	38.55	Pk	39.8	-26.1	0	52.25	-	-	-	-	0-360	200	V
2	17.35875	43.24	Pk	41	-23.4	0	60.84	-	-	-	-	0-360	101	H
6	17.35875	41.71	Pk	41	-23.4	0	59.31	-	-	-	-	0-360	200	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

ADV - Linear Voltage Average

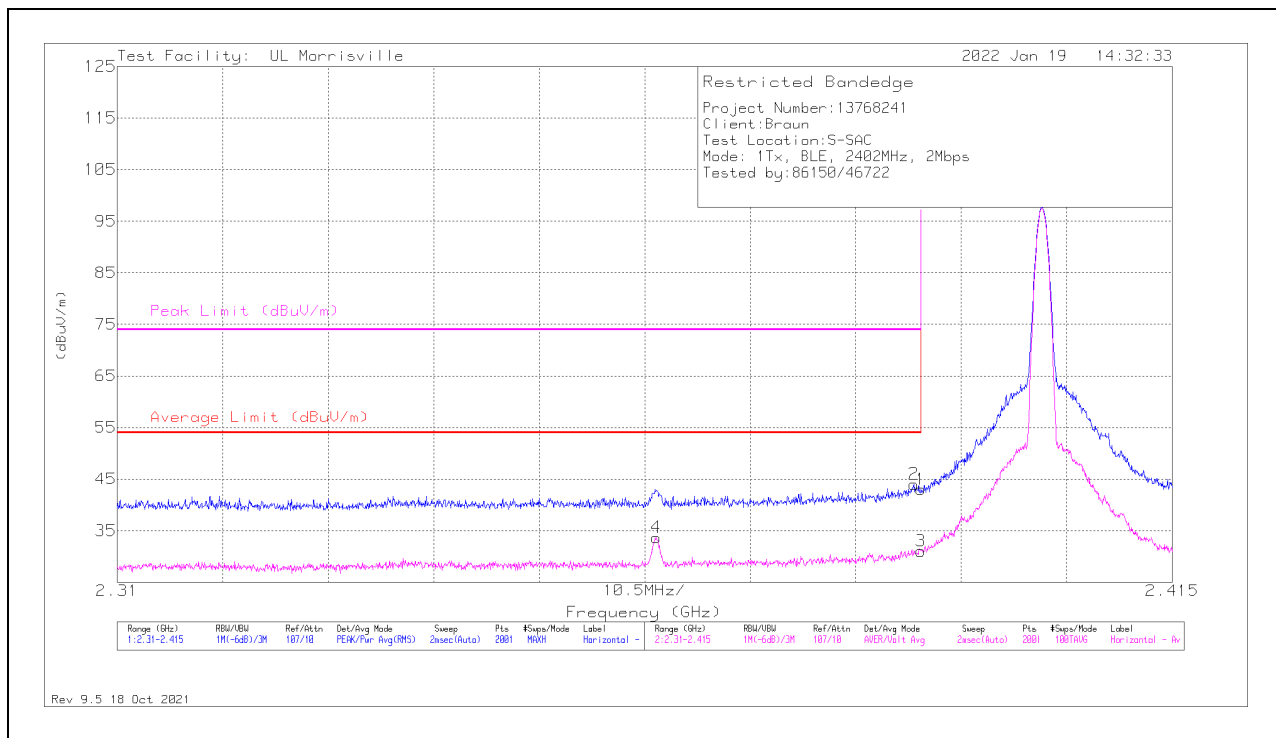
N Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

10.2.2. BLE (2Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Pad (dB)	Duty Cycle Correction Factor	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	35.19	Pk	31.9	-24.1	0	42.99	-	-	74	-31.01	358	133	H
2	* ** 2.38928	36.23	Pk	31.9	-24.1	0	44.03	-	-	74	-29.97	358	133	H
3	* ** 2.38996	23.24	ADV	31.9	-24.1	-20.49	10.55	54	-43.45	-	-	358	133	H
4	* ** 2.36366	25.78	ADV	32.2	-24.3	-20.49	12.33	54	-41.67	-	-	358	133	H

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

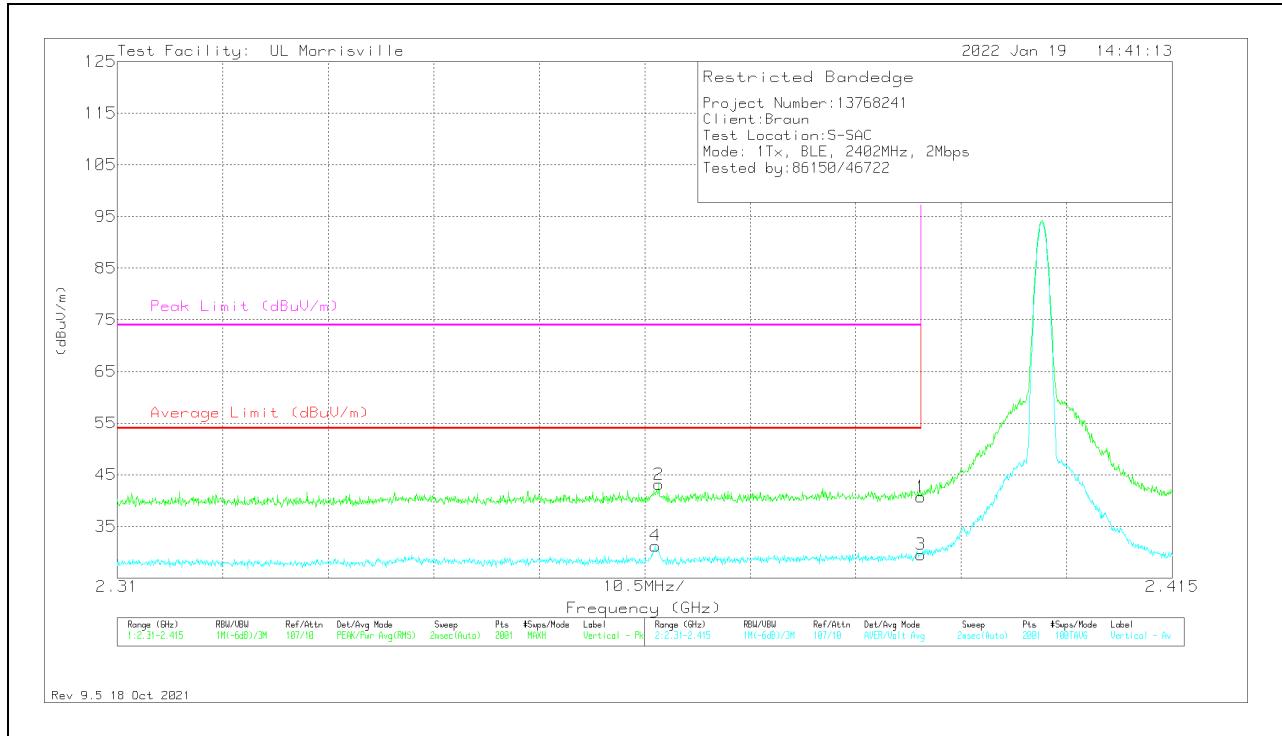
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Pad (dB)	Duty Cycle Correction Factor	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	32.9	Pk	31.9	-24.1	0	40.7	-	-	74	-33.3	217	204	V
2	* ** 2.36392	35.31	Pk	32.2	-24.4	0	43.11	-	-	74	-30.89	217	204	V
3	* ** 2.38996	21.75	ADV	31.9	-24.1	-20.49	9.06	54	-44.94	-	-	217	204	V
4	* ** 2.36355	23.35	ADV	32.2	-24.3	-20.49	10.76	54	-43.24	-	-	217	204	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

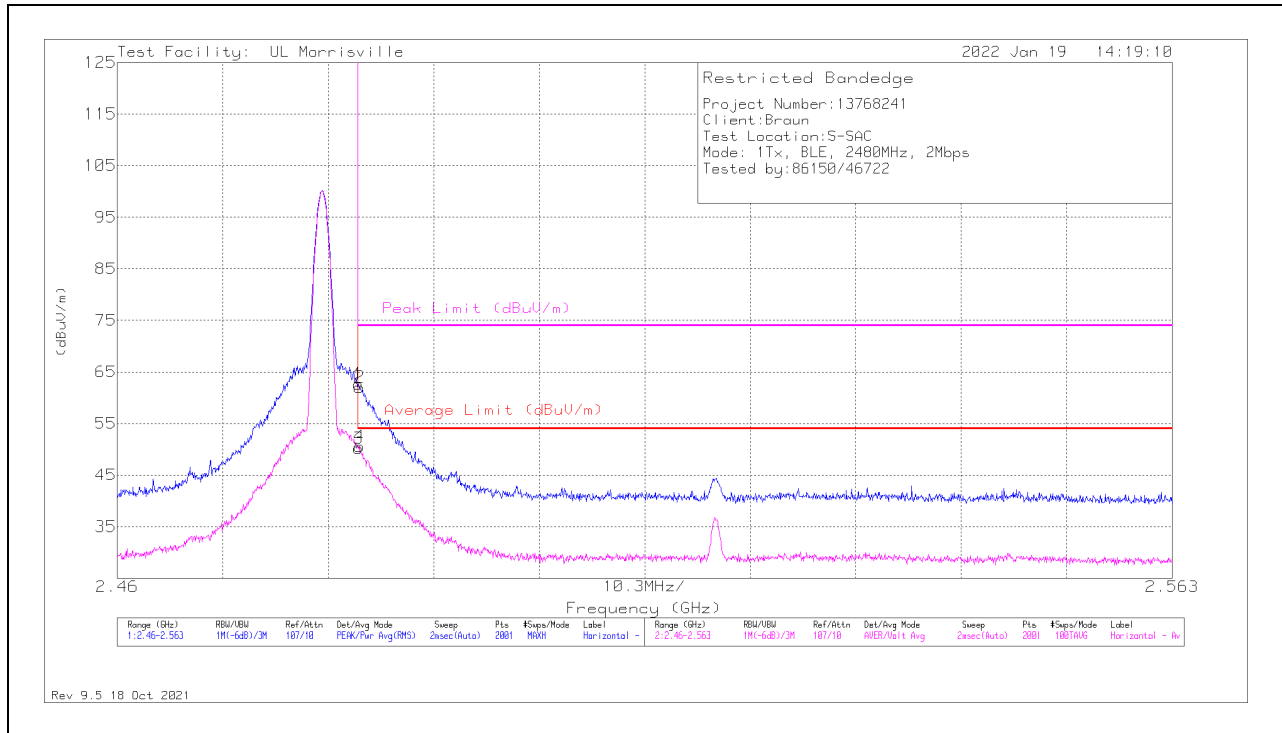
Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Pad (dB)	Duty Cycle Correction	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	54.73	Pk	32.5	-24.6	0	62.63	-	-	74	-11.37	351	142	H
2	* ** 2.48364	54.13	Pk	32.5	-24.6	0	62.03	-	-	74	-11.97	351	142	H
3	* ** 2.48354	42.28	ADV	32.5	-24.6	-20.49	29.69	54	-24.31	-	-	351	142	H
4	* ** 2.48364	42.66	ADV	32.5	-24.6	-20.49	30.07	54	-23.93	-	-	351	142	H

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

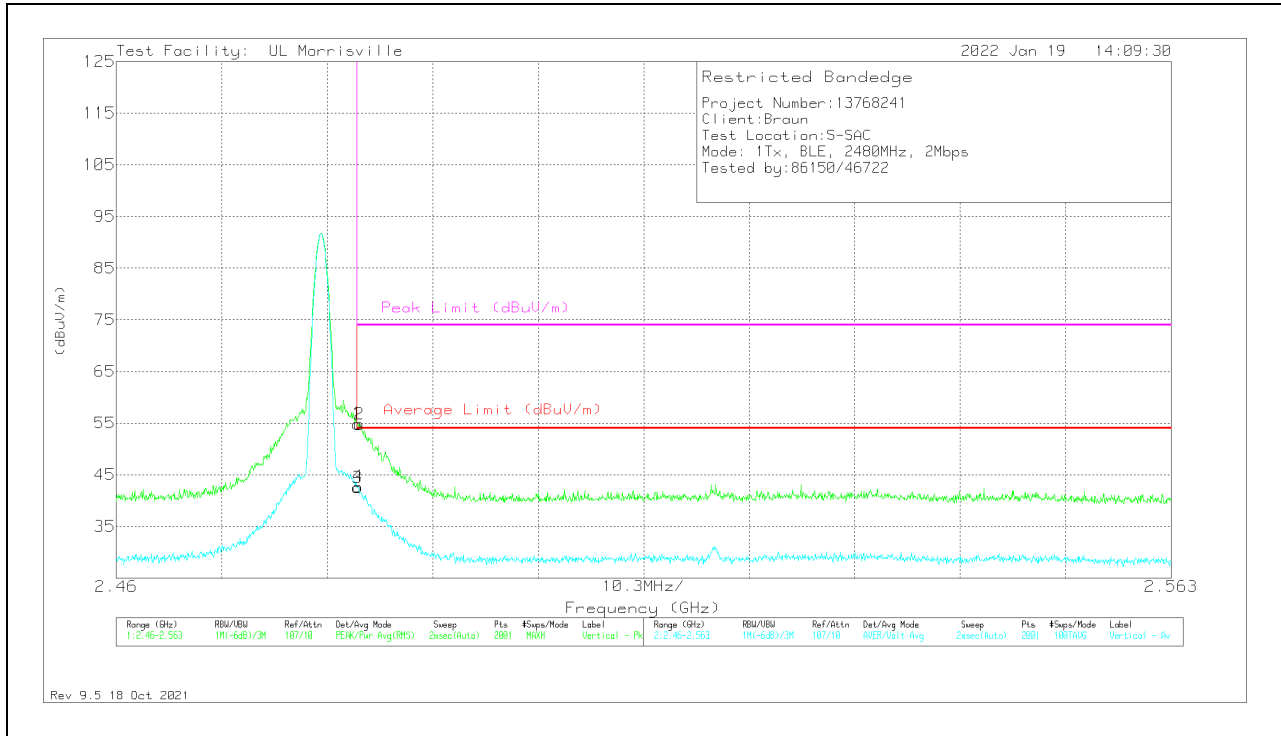
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 (dB/m)	Amp/Cbl/Pad (dB)	Duty Cycle Correction Factor	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	46.98	Pk	32.5	-24.6	0	54.88	-	-	74	-19.12	212	165	V
2	*** 2.48374	46.88	Pk	32.5	-24.6	0	54.78	-	-	74	-19.22	212	165	V
3	*** 2.48354	34.62	ADV	32.5	-24.6	-20.49	22.09	54	-31.91	-	-	212	165	V
4	*** 2.48359	34.79	ADV	32.5	-24.6	-20.49	22.20	54	-31.80	-	-	212	165	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

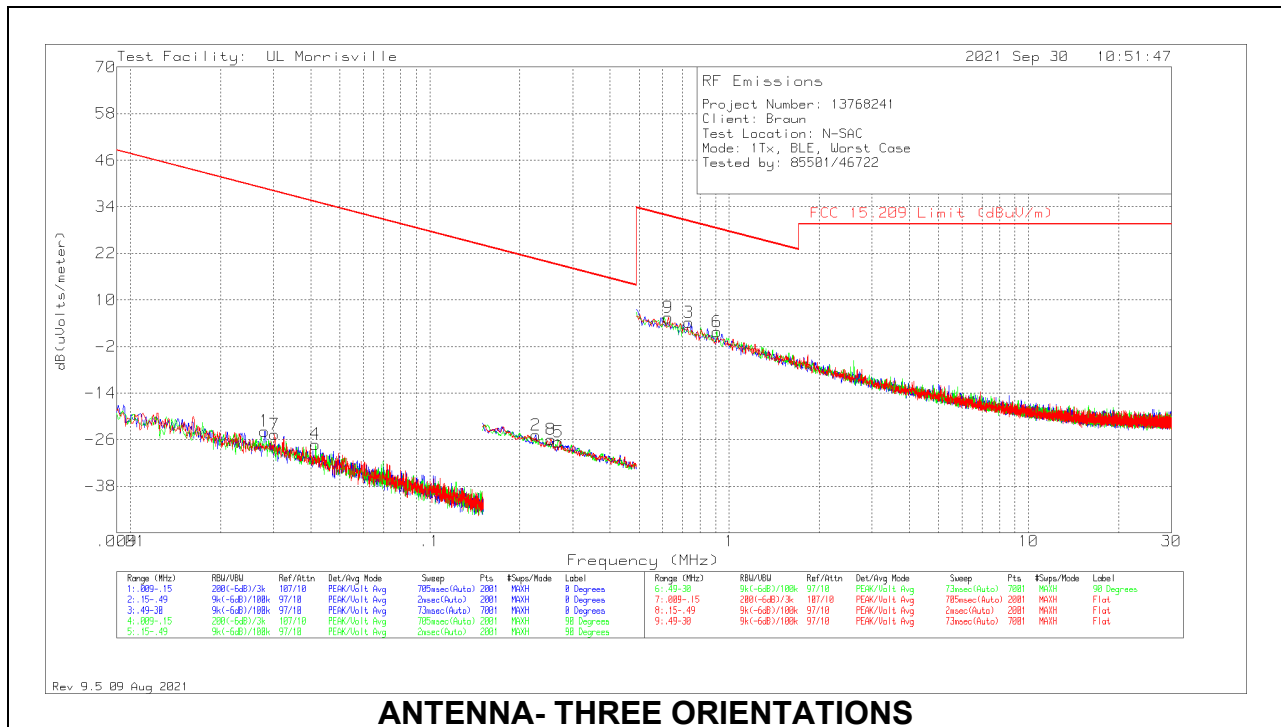
ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

10.3. WORST CASE BELOW 30MHZ

Note for below 30 MHz scans: 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).

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION E-FIELD)



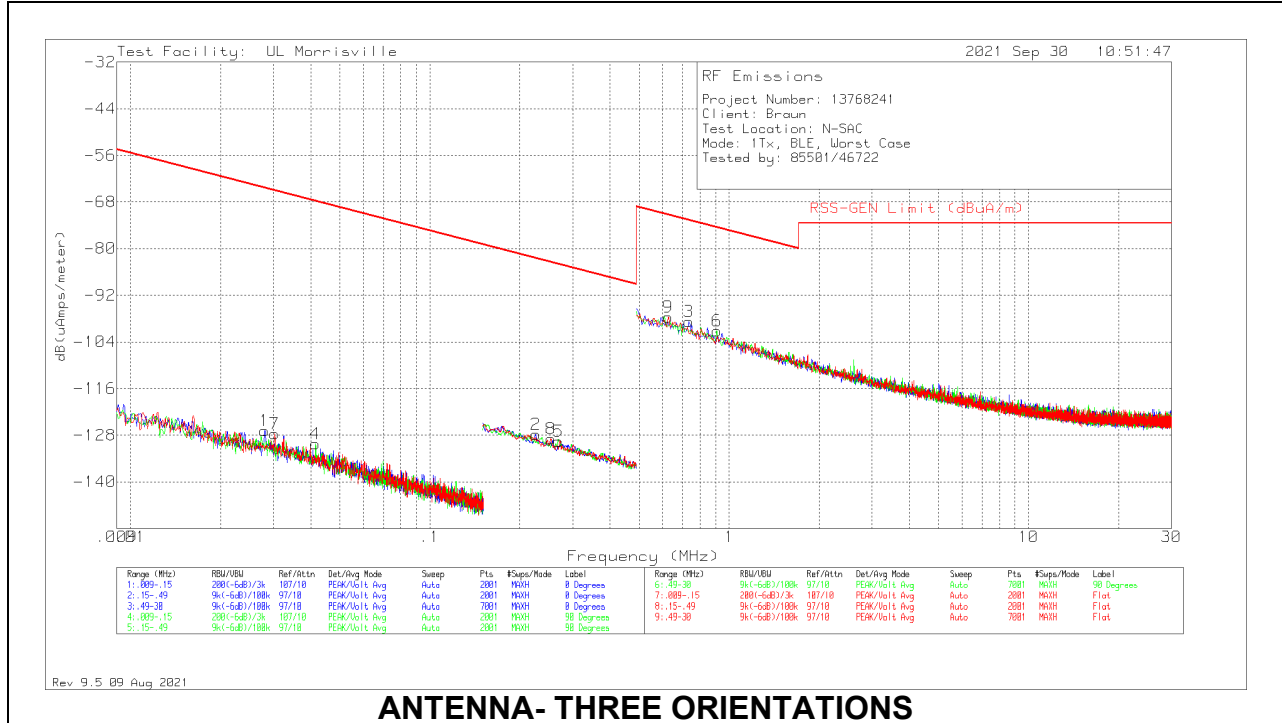
ANTENNA- THREE ORIENTATIONS

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 Qp/Av Limit (dBuV/m)	FCC 15.209 Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
1	.0281	42.62	Pk	13.5	.1	-80	-23.78	38.63	58.63	-62.41	0-360	404	0 degs
7	.03037	41.9	Pk	13.3	.1	-80	-24.7	37.96	57.96	-62.66	0-360	404	Flat
4	.04152	40.23	Pk	12.5	.1	-80	-27.17	35.24	55.24	-62.41	0-360	404	90 degs
2	.22574	43.84	Pk	11.2	.1	-80	-24.86	20.53	40.53	-45.39	0-360	404	0 degs
8	.25353	42.75	Pk	11.2	.1	-80	-25.95	19.52	39.52	-45.47	0-360	404	Flat
5	.26951	42.15	Pk	11.2	.1	-80	-26.55	18.99	38.99	-45.54	0-360	404	90 degs
9	.62491	34.03	Pk	11.2	.2	-40	5.43	31.69	-	-26.26	0-360	404	Flat
3	.73453	32.72	Pk	11.3	.2	-40	4.22	30.28	-	-26.06	0-360	404	0 degs
6	.9116	30.31	Pk	11.3	.2	-40	1.81	28.41	-	-26.6	0-360	404	90 degs

Pk - Peak detector

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION H-FIELD)



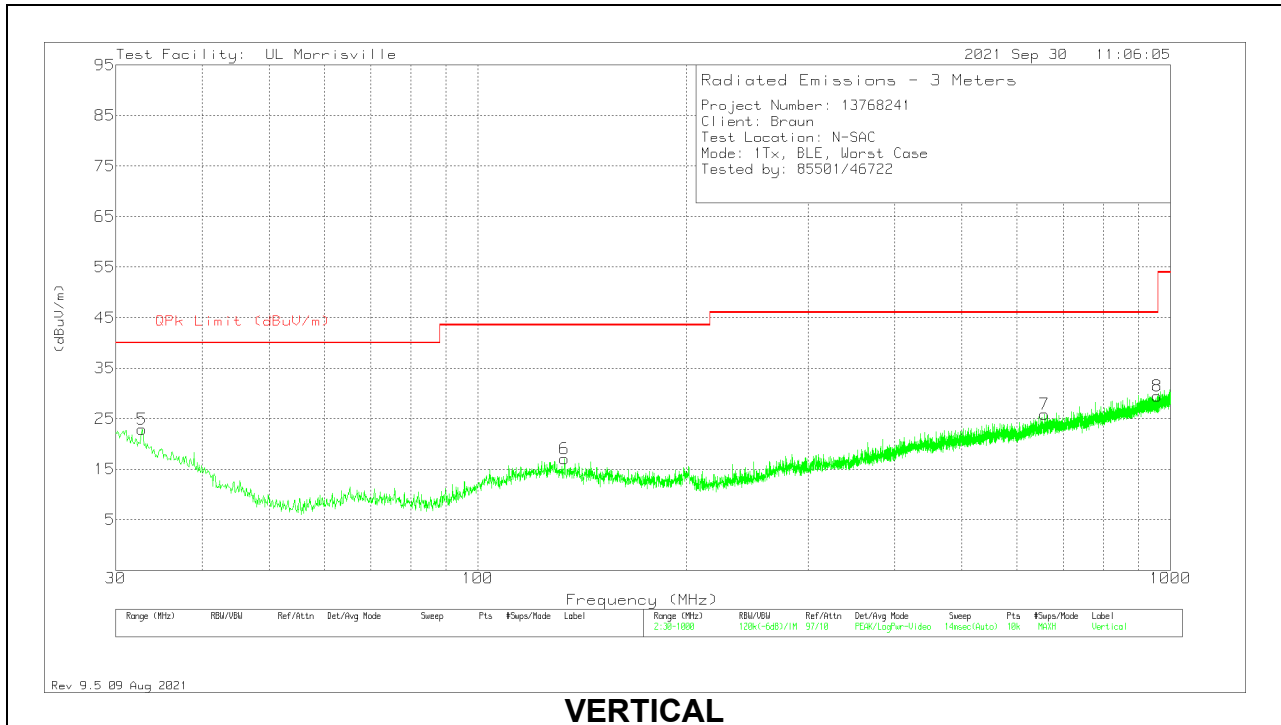
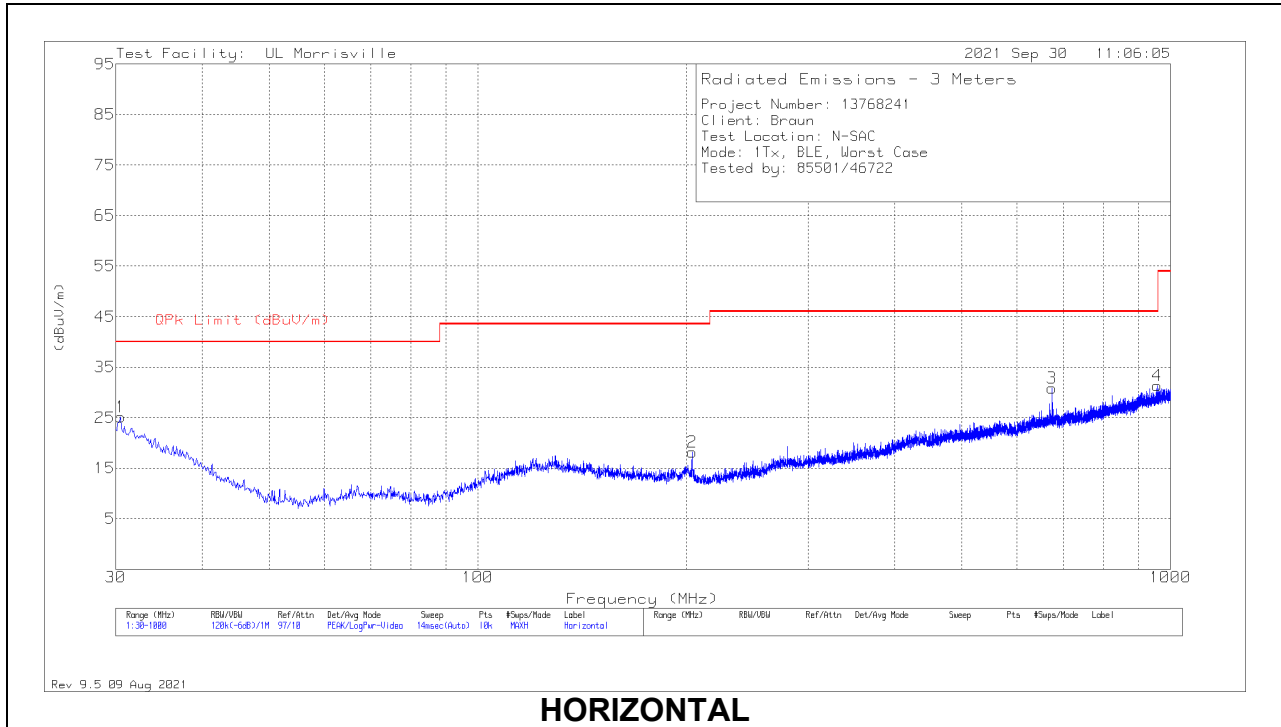
Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uAmps/meter)	RSS-GEN Limit Qp/Av (dBuA/m)	RSS-GEN Limit Pk (dBuA/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
1	.0281	42.62	Pk	-89.5	.1	-80	-126.78	-64.37	-44.37	-62.41	0-360	404	0 degs
7	.03037	41.9	Pk	-89.7	.1	-80	-127.7	-65.04	-45.04	-62.66	0-360	404	Flat
4	.04152	40.23	Pk	-90.5	.1	-80	-130.17	-67.76	-47.76	-62.41	0-360	404	90 degs
2	.22574	43.84	Pk	-91.8	.1	-80	-127.86	-82.47	-62.47	-45.39	0-360	404	0 degs
8	.25353	42.75	Pk	-91.8	.1	-80	-128.95	-83.48	-63.48	-45.47	0-360	404	Flat
5	.26951	42.15	Pk	-91.8	.1	-80	-129.55	-84.01	-64.01	-45.54	0-360	404	90 degs
9	.62491	34.03	Pk	-91.8	.2	-40	-97.57	-71.31	-	-26.26	0-360	404	Flat
3	.73453	32.72	Pk	-91.7	.2	-40	-98.78	-72.72	-	-26.06	0-360	404	0 degs
6	.9116	30.31	Pk	-91.7	.2	-40	-101.19	-74.59	-	-26.6	0-360	404	90 degs

Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0066 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.485	29.25	Pk	27.1	-31.2	25.15	40	-14.85	0-360	200	H
5	32.716	28.46	Pk	25.7	-31.3	22.86	40	-17.14	0-360	100	V
6	133.305	27.48	Pk	19.7	-30.1	17.08	43.52	-26.44	0-360	100	V
2	203.921	29.85	Pk	17.7	-29.4	18.15	43.52	-25.37	0-360	98	H
7	657.493	26.33	Pk	26.2	-26.6	25.93	46.02	-20.09	0-360	100	V
3	674.856	30.86	Pk	26.3	-26.3	30.86	46.02	-15.16	0-360	300	H
8	957.223	24.13	Pk	29.2	-23.8	29.53	46.02	-16.49	0-360	100	V
4	957.999	26.08	Pk	29.2	-23.9	31.38	46.02	-14.64	0-360	400	H

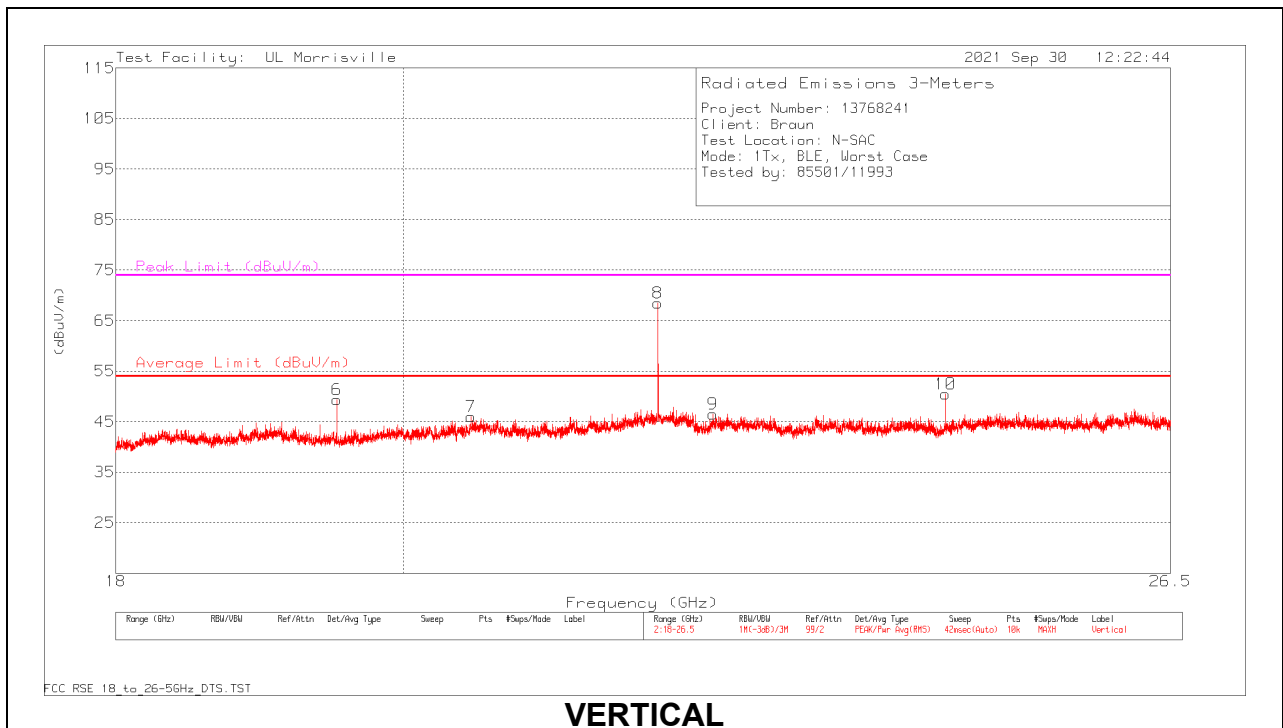
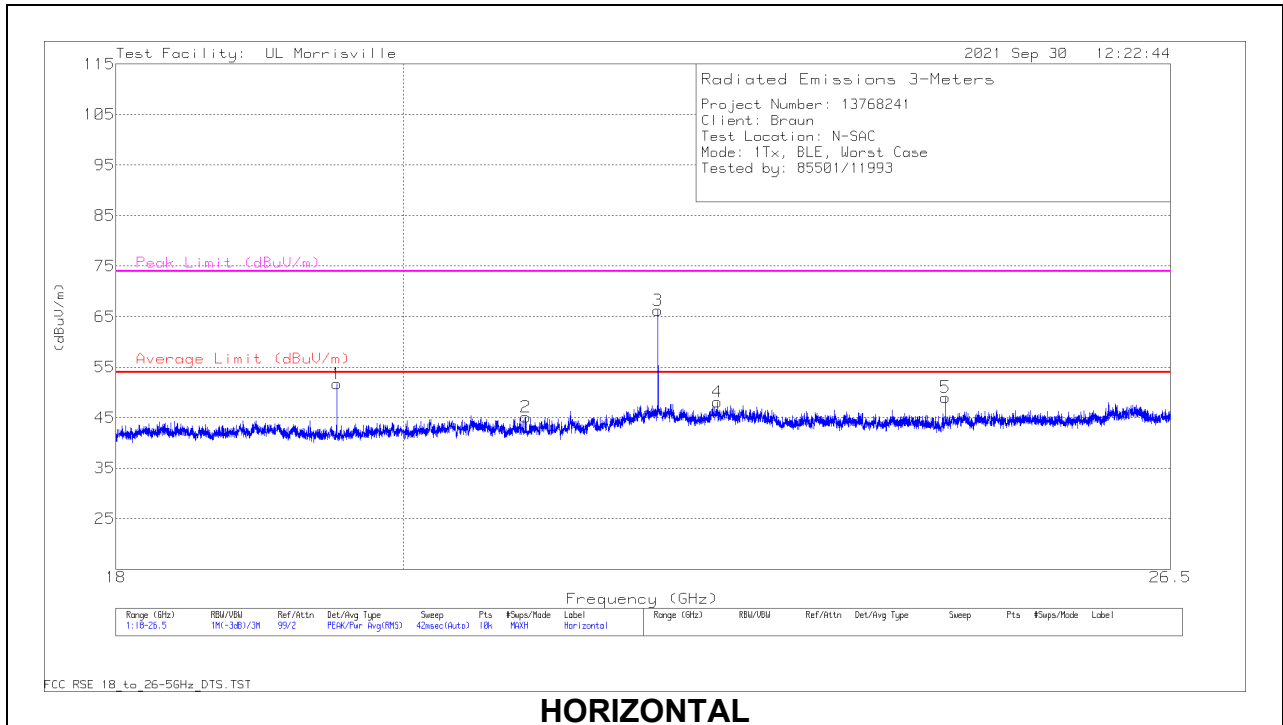
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - 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	AT0063 AF (dB/m)	Amp/Cbl (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 19.52013	59.3	PK2	33.5	-39.7	0	53.1	-	-	74	-20.9	275	110	H
	* ** 19.52011	56.42	ADV	33.5	-39.7	-20.49	29.73	54	-24.27	74	-23.78	275	110	H
2	* ** 20.92116	50.5	Pk	34.1	-39.5	0	45.1	54	-8.9	74	-28.9	0-360	250	H
4	* ** 22.44353	50.27	PK2	36.5	-39.3	0	47.47	-	-	74	-26.53	159	322	H
	* ** 22.4434	37.51	ADV	36.5	-39.3	-20.49	14.22	54	-49.78	74	-39.29	159	322	H
6	* ** 19.52	58.79	PK2	33.5	-39.7	0	52.59	-	-	74	-21.41	287	251	V
	* ** 19.52015	55.61	ADV	33.5	-39.7	-20.49	28.92	54	-25.08	74	-24.59	287	251	V
7	* ** 20.50555	50.96	Pk	34.1	-39.1	0	45.96	54	-8.04	74	-28.04	0-360	250	V
9	* ** 22.40511	49.23	Pk	36.6	-39.3	0	46.53	54	-7.47	74	-27.47	0-360	300	V
3	21.95975	69.02	Pk	37	-39.8	0	66.22	-	-	74	-7.78	0-360	101	H
8	21.95975	71.27	Pk	37	-39.8	0	68.47	-	-	74	-5.53	0-360	200	V
10	24.39986	54.22	Pk	35	-38.7	0	50.52	-	-	74	-23.48	0-360	300	V
5	24.40071	52.74	Pk	35	-38.7	0	49.04	-	-	74	-24.96	0-360	101	H

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

PK2 - Maximum Peak

ADV - Linear Voltage Average

Note: DCCF of -20.49 is based on the operational duty cycle. Refer to section 9.1.

11. SETUP PHOTOS

Please refer to R13768241-EP1 for setup photos

END OF TEST REPORT