



TEST REPORT

Report Number. : R13162371-E2

Applicant : Hunter Industries
1940 Diamond Street
San Marcos, CA 92078-5120 USA

Model : BTT-200/BTT-201

FCC ID : M3UBTT2

IC : 2772A-BTT2

EUT Description : Bluetooth Tap Timer

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5 + A1

Date Of Issue:
2020-12-09

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
1	2020-11-03	Initial Issue	Mike Antola
2	2020-12-09	Update to Sections 6.1, 9.4 and 9.5	Mike Antola

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Hunter Industries
1940 Diamond Street
San Marcos, CA 92078-5120, USA

EUT DESCRIPTION: Bluetooth Tap Timer

MODEL: BTT-200/BTT-201

SERIAL NUMBER: Non-Serialized

SAMPLE RECEIVE DATE: 2020-06-18

DATE TESTED: 2020-07-24 TO 2020-10-16

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Compliant
ISED RSS-247 Issue 2	Compliant
ISED RSS-GEN Issue 5 + Amendment 1	Compliant

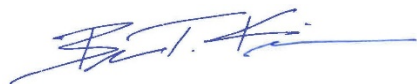
UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. government.

Approved & Released For
UL LLC By:

Prepared By:



Brian T. Kiewra
Project Engineer
Consumer Technology Division
UL LLC

Mike Antola
Staff 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	Compliant	None.
15.247 (b) (3)	RSS-247 5.4 (d)	Output Power	Compliant	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	Compliant	None.
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Compliant	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Compliant	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	See comment	EUT is battery operated.

3. TEST METHODOLOGY

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

4. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 12 Laboratory Drive, Research Triangle Park, North Carolina, USA and 2800 Perimeter Park Dr., Morrisville, North Carolina, USA. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

12 Laboratory Dr.	2800 Perimeter Park Dr.
Site Code: 2180C	
<input type="checkbox"/> Chamber A RTP	<input checked="" type="checkbox"/> North Chamber
<input checked="" type="checkbox"/> Chamber C RTP	<input type="checkbox"/> South Chamber

The above test sites and facilities are covered under FCC Test Firm Registration # 703469. Chambers above are covered under Industry Canada company address and respective code.

UL LLC (RTP) is accredited by NVLAP, Laboratory Code 200246-0

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}
Worst-Case Conducted Disturbance, 9kHz – 30MHz LISN	3.78 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB

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)

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + 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 single-zone, battery-operated BTT tap timer which is Bluetooth enabled (BLE) for automatic irrigation of gardens from a hose faucet. The model tested was BTT-200. Models BTT-200 and BTT-201 are identical, electrically & mechanically. The only difference lies in the thread type used to mate with the hose barb.

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	2.98	1.99

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an ceramic antenna, with a maximum gain of 0 dBi

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was V220

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz and above 18GHz 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 was tested only at 1Mbps data rate as this is the only data rate supported by the device.

BLE tested at 1Mbps as this is the only supported data rate.

6.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
Surface	Microsoft	1724	33448661953
Surface Charger	Microsoft	1800	0C130Y07H7R95

I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	USB	1	Type-B	USB	< 3M	Used to control radio only

TEST SETUP

The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

SETUP DIAGRAMS

Please refer to R13162371-EP1 for setup diagrams

7. MEASUREMENT METHOD

Duty cycle: ANSI C63.10 Subclause 11.6

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

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

8. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
Conducted Room 1					
72822 (PRE0101715)	Spectrum Analyzer	Agilent Technologies	E4446A	2020-01-02	2022-01-02
PWM002 (MY55116001)	RF Power Meter	Keysight Technologies	N1911A	2020-07-31	2021-07-31
PWS001 (MY55120011)	Peak and Avg Power Sensor, 50MHz to 6GHz	Keysight Technologies	N1921A	2020-05-27	2021-05-27
SN 161024885	Environmental Meter	Fisher Scientific	15-077-963	2020-06-27	2021-06-27
76022	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	N/A	N/A
SOFTEMI	EMC Software	UL	Version 2020.07.15		

Test Equipment Used - Radiated Disturbance Emissions (E-field) – Chamber C

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
1-18 GHz					
AT0062	HORN Antenna	ETS-Lindgren	3117	2020-01-30	2021-01-30
Gain-Loss Chains					
C-SAC02	Gain-loss string: 1-18GHz	Various	Various	2020-03-03	2021-03-03
C-SAC02 Path 7	Gain-loss string 1-7GHz	Various	Various	2020-04-03	2021-04-03
Analyzer & Software					
SA0018	Spectrum Analyzer	Agilent	PXA (N9030A)	2020-03-02	2021-03-02
SOFTEMI	EMI Software	UL	Version 9.5 (2020-08-18)		
Additional Equipment used					
HI0085	Temp/Humid/Pressure Meter	EXTECH	SD700	2020-04-20	2021-04-30

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

Equip. ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2020-08-20	2021-08-20
	30-1000 MHz				
AT0074	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB3	2020-07-27	2021-07-27
	1-18 GHz				
AT0072	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-04-27	2021-04-27
	18-40 GHz				
AT0076	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2019-11-07	2020-11-07
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2020-07-29	2021-07-29
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2020-07-29	2021-07-29
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2020-07-28	2021-07-28
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2020-07-31	2021-07-31
	Analyzer & Software				
SA0026	Spectrum Analyzer	Agilent	N9030A	2020-07-16	2021-07-16
SOFTEMI	EMI Software	UL	Version 9.5 (2020-08-18)		
	Additional Equipment used				
s/n 200037610	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

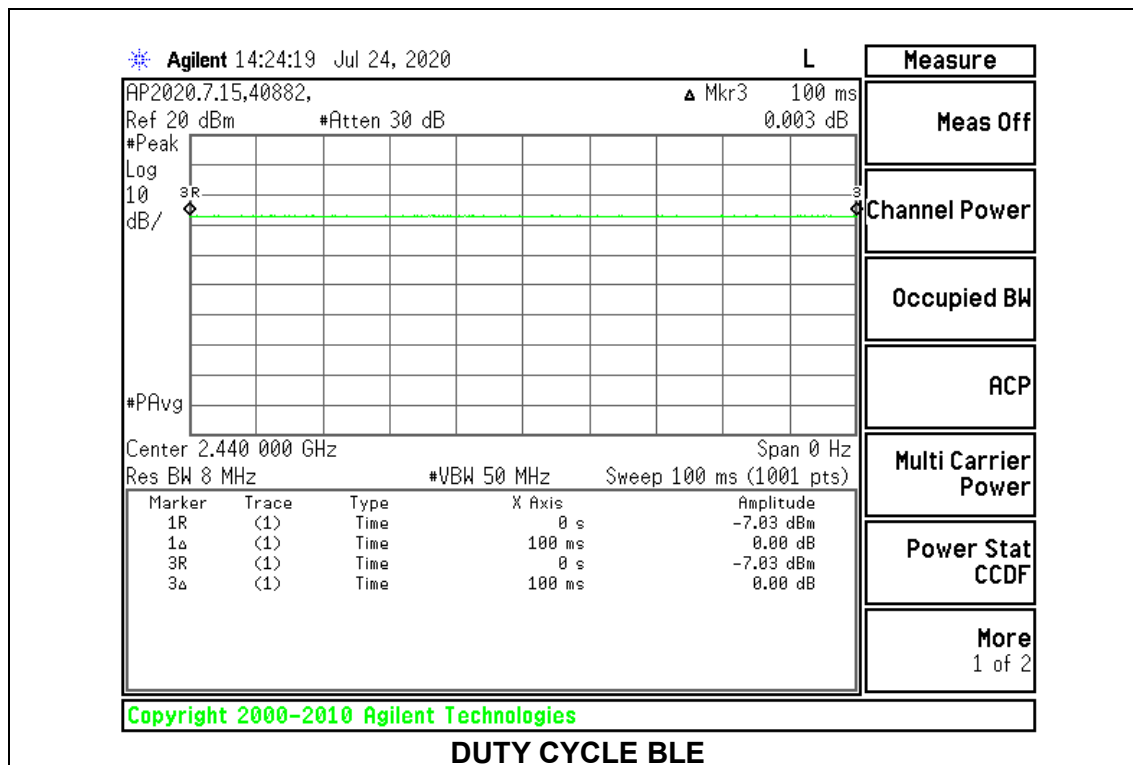
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
2.4GHz Band						
BLE	100.000	100.000	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



9.2. 99% BANDWIDTH

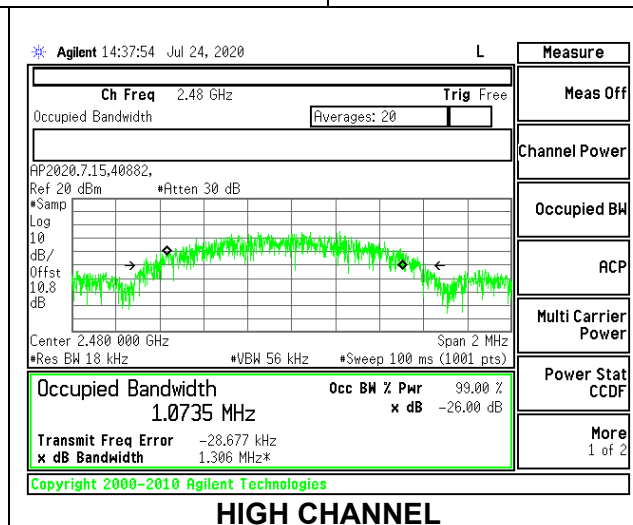
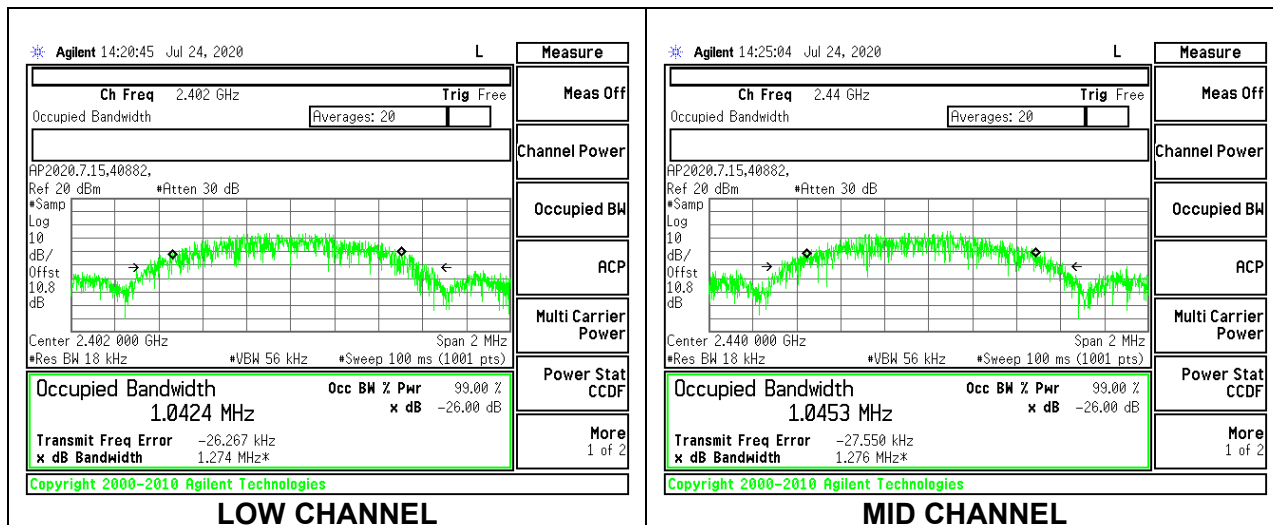
LIMITS

None; for reporting purposes only.

RESULTS

9.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0424
Middle	2440	1.0453
High	2480	1.0735



9.3. 6 dB BANDWIDTH

LIMITS

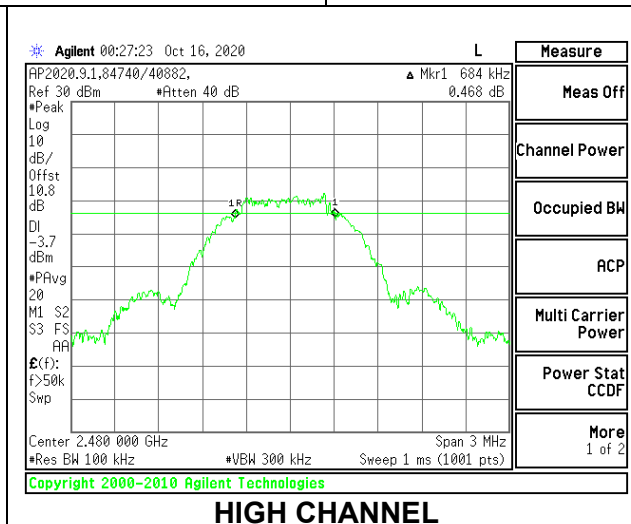
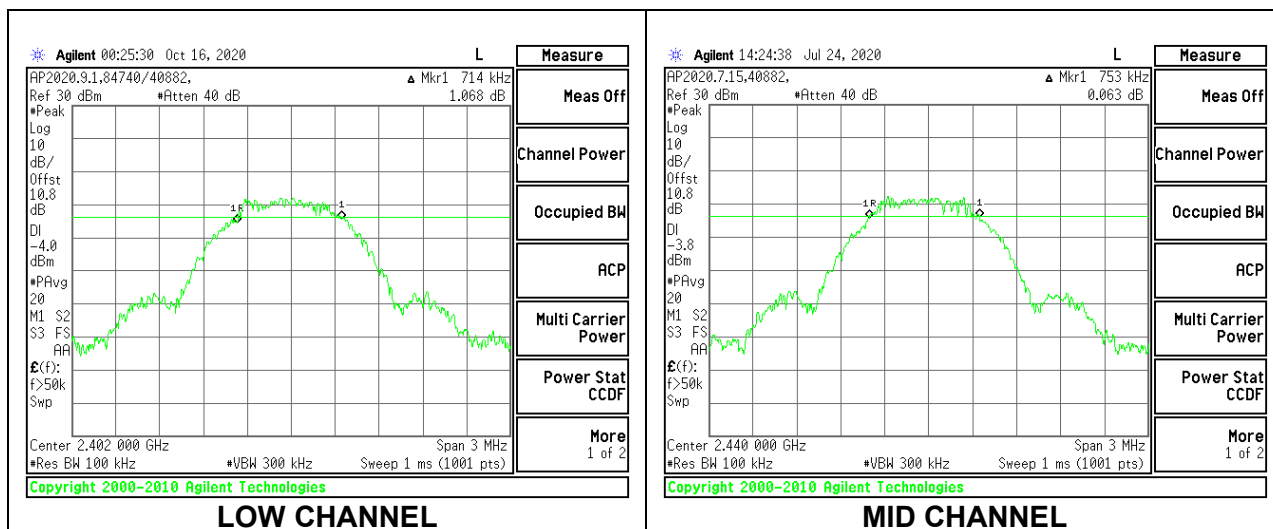
FCC §15.247 (a) (2); RSS-247 5.2 (a)

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	0.7140	0.5
Middle	2440	0.7530	0.5
High	2480	0.6840	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 power meter.

Peak power readings were made with a peak power meter and sensor with a video bandwidth greater than the emission bandwidth. All cable assembly losses, 11.49dB (including 10.29 dB pad and 1.2 dB cable) were entered directly into the power meter to correct the reading for any system losses.

RESULTS

9.4.1. BLE (1Mbps)

Tested By:	84740/40882
Date:	2020-10-15

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.980	30	-27.020
Middle	2440	2.760	30	-27.240
High	2480	2.530	30	-27.470

Test Information

Test Date: 2020-10-15
Tested By: 84740/40882

9.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

Average power readings were made with a power meter and average power sensor with a video bandwidth greater than the emission bandwidth. All cable assembly losses, 11.49dB (including 10.29 dB pad and 1.2 dB cable) were entered directly into the power meter to correct the reading for any system losses.

RESULTS

9.5.1. BLE (1Mbps)

Tested By:	84740/40882
Date:	2020-10-15

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	2.75
Middle	2440	2.56
High	2480	2.31

Test Information

Test Date: 2020-10-15
Tested By: 84740/40882

9.6. POWER SPECTRAL DENSITY

LIMITS

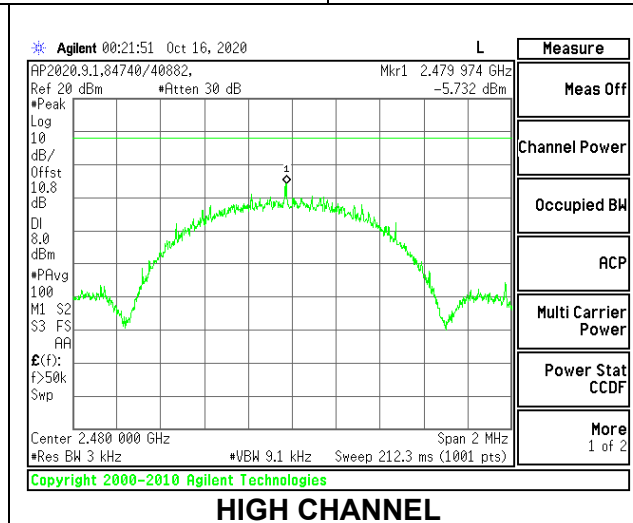
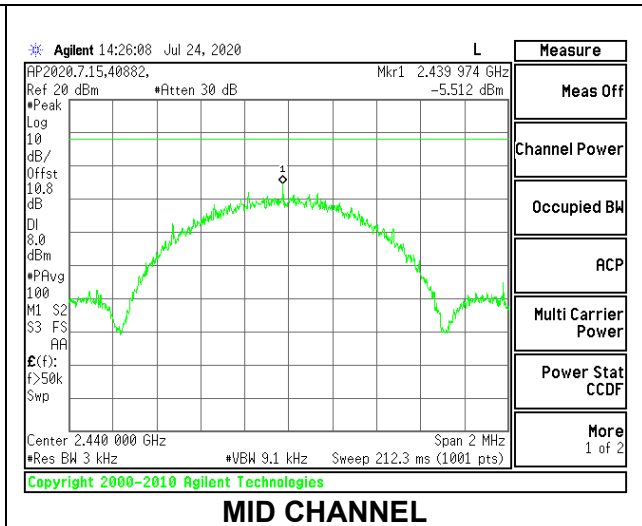
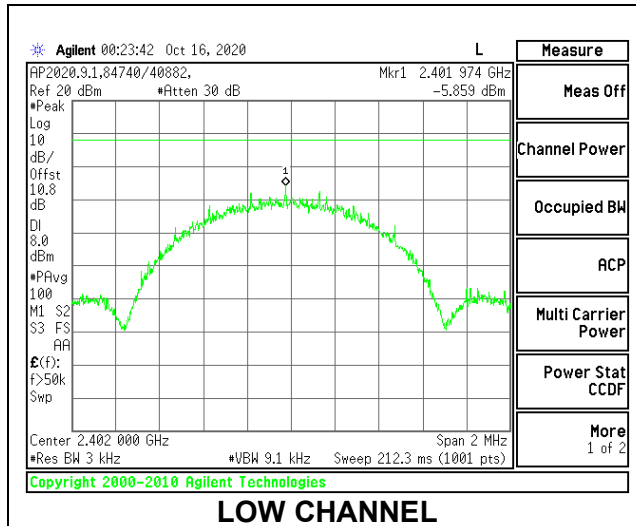
FCC §15.247 (e); RSS-247 (5.2) (b)

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	-5.86	8	-13.86
Middle	2440	-5.51	8	-13.51
High	2480	-5.73	8	-13.73



9.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

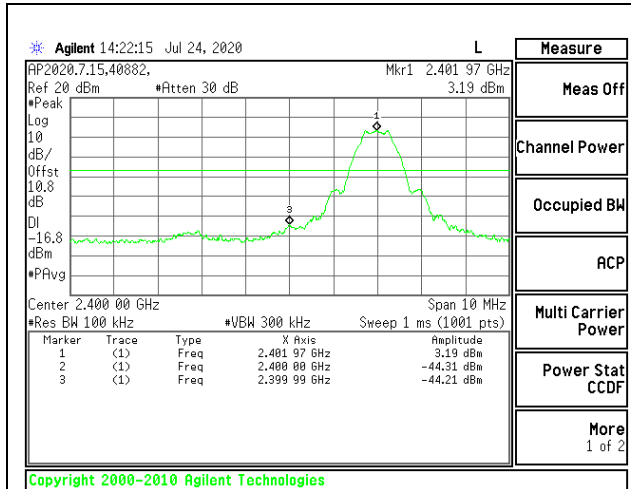
FCC §15.247 (d)

RSS-247 5.5

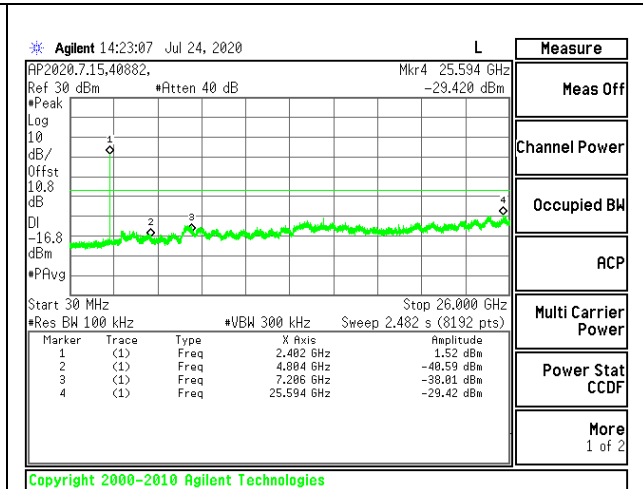
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dBc.

RESULTS

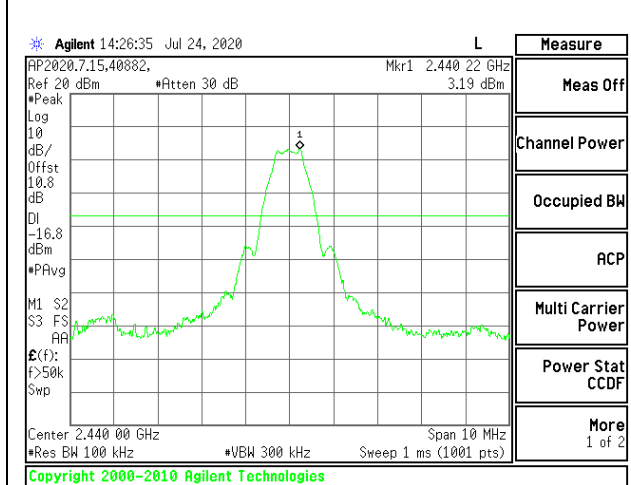
9.7.1. BLE (1Mbps)



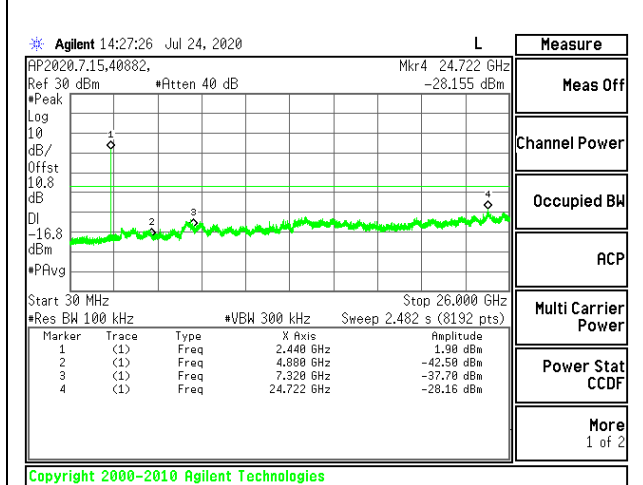
LOW CHANNEL BANDEDGE



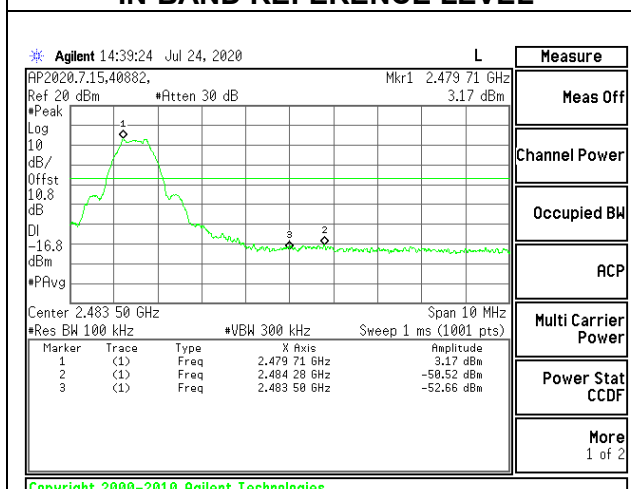
OUT-OF-BAND LOW CHANNEL



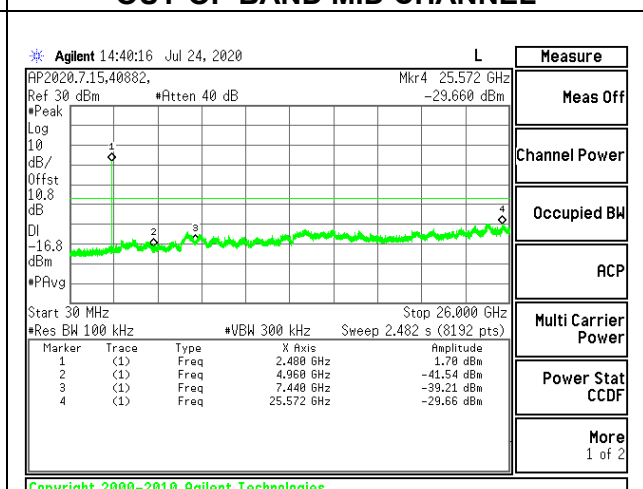
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

RSS-GEN, Section 8.9 and 8.10.

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

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 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.

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 9-150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.

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

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.

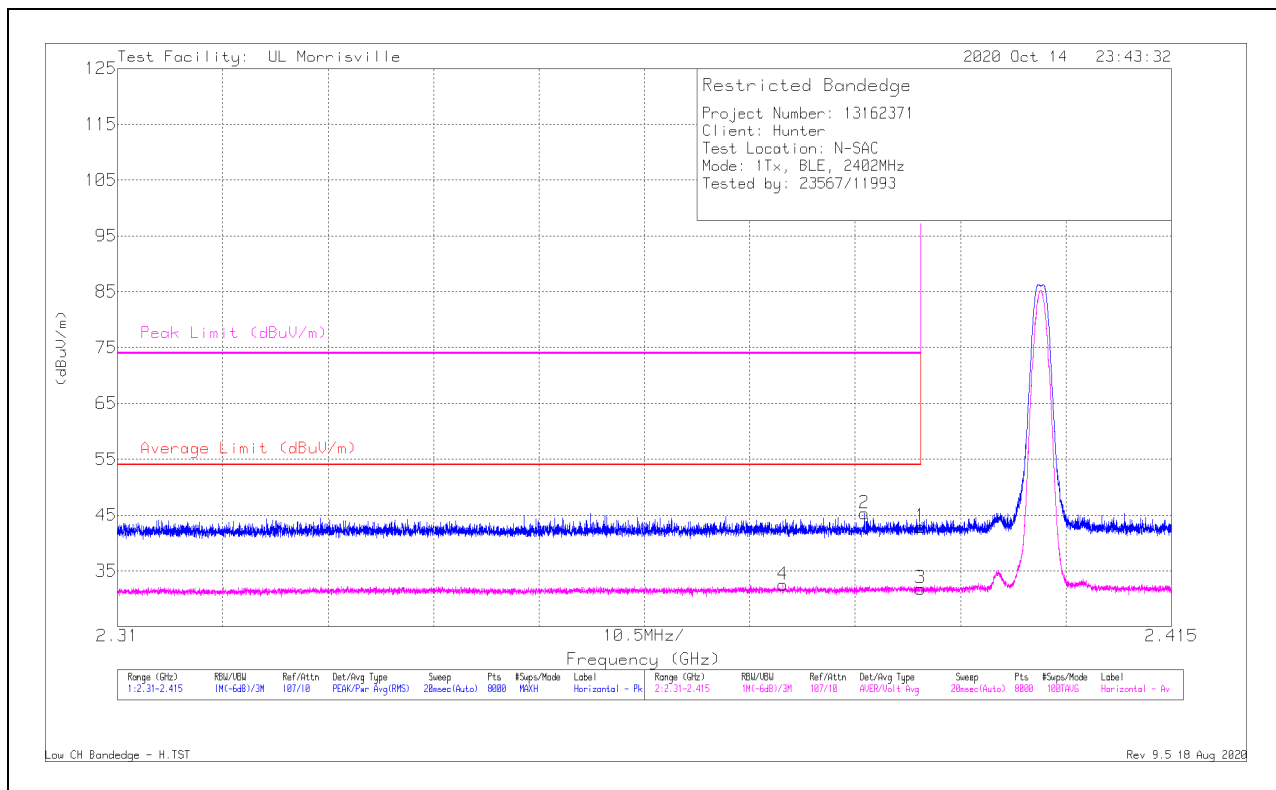
10.2. TRANSMITTER ABOVE 1 GHz

10.2.1. BLE (1Mbps)

Antenna 1

BANDEGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* ** 2.39	35.49	Pk	31.8	-24.4	42.89	-	-	74	-31.11	14	156	H
2	* ** 2.38443	37.87	Pk	31.8	-24.4	45.27	-	-	74	-28.73	14	156	H
3	* ** 2.39	24.45	ADV	31.8	-24.4	31.85	54	-22.15	-	-	14	156	H
4	* ** 2.37629	25.21	ADV	31.7	-24.4	32.51	54	-21.49	-	-	14	156	H

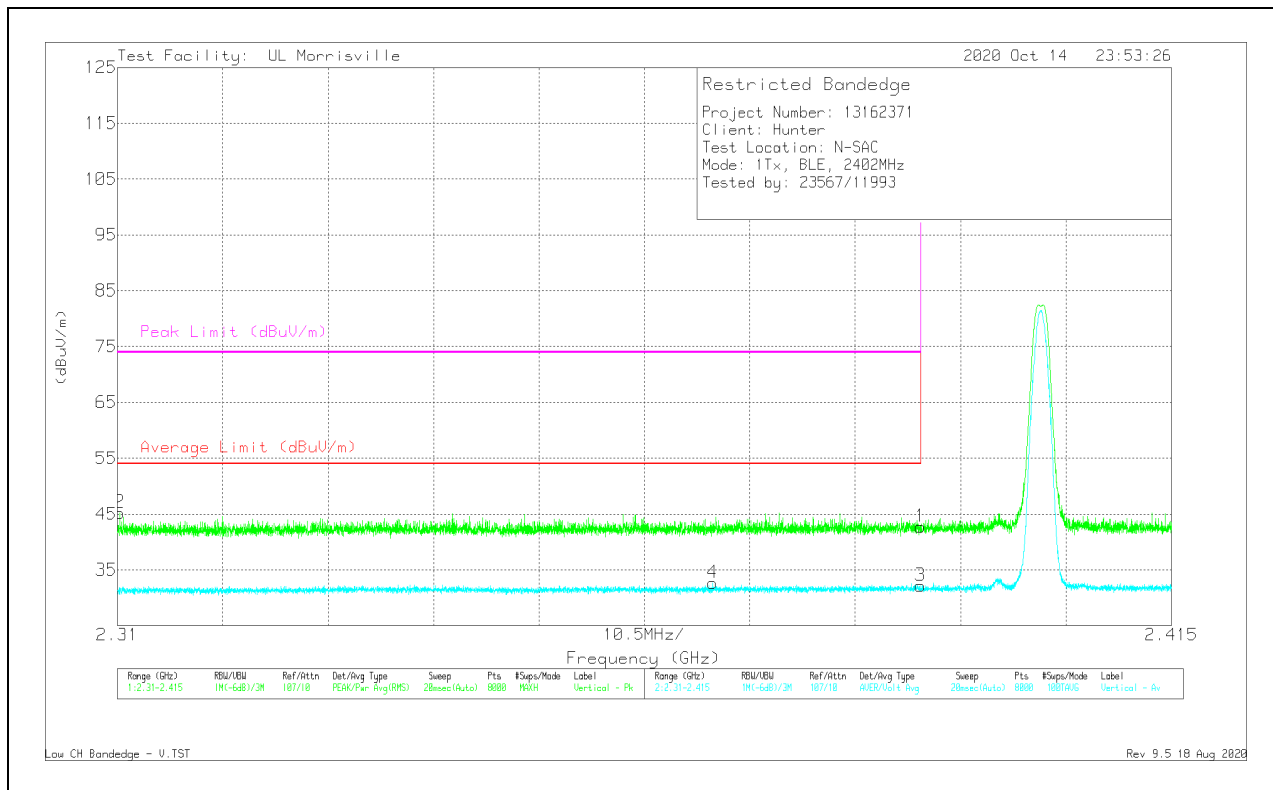
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.39	35.32	PK	31.8	-24.4	42.72	-	-	74	-31.28	301	104	V
2	** 2.31024	37.82	Pk	31.7	-24.3	45.22	-	-	74	-28.78	301	104	V
3	*** 2.39	24.77	ADV	31.8	-24.4	32.17	54	-21.83	-	-	301	104	V
4	*** 2.36931	25.33	ADV	31.7	-24.4	32.63	54	-21.37	-	-	301	104	V

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

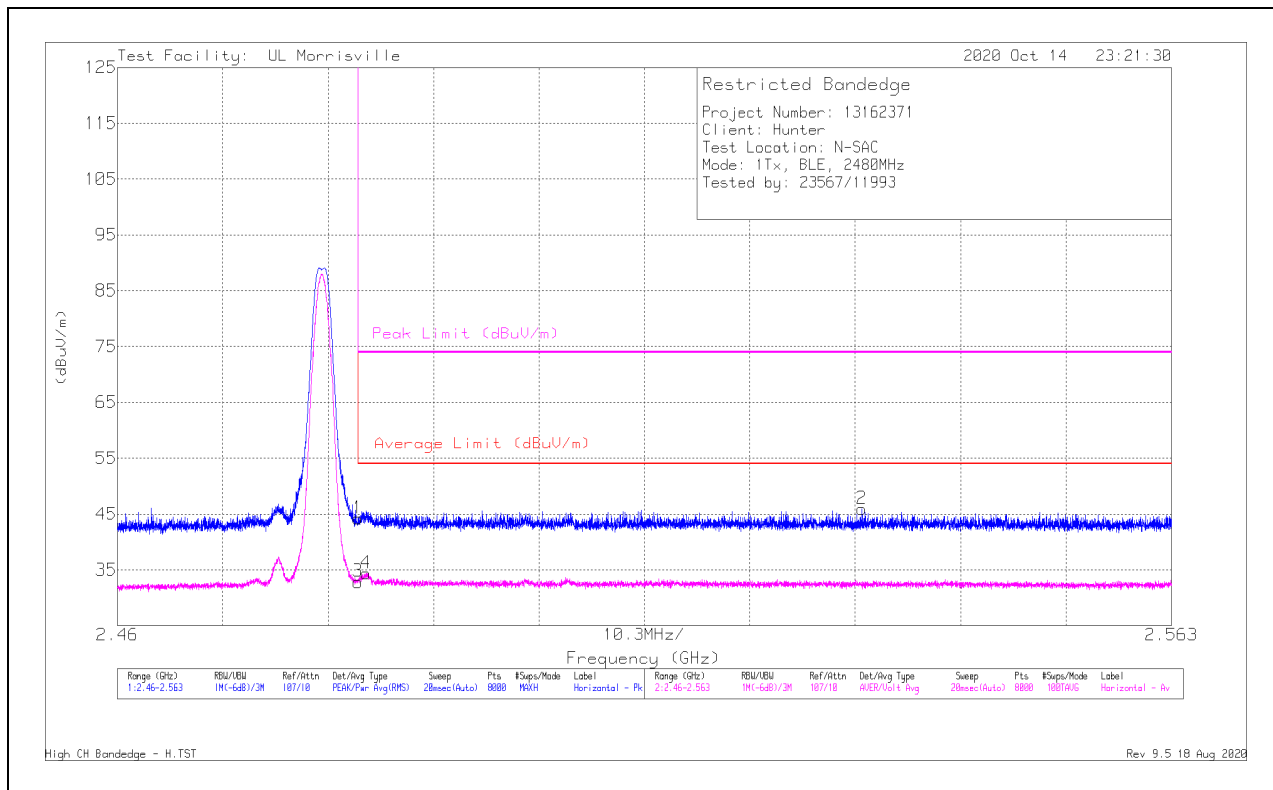
** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.4835	36.1	Pk	32.4	-24.3	44.2	-	-	74	-29.8	66	257	H
2	** 2.53277	37.6	PK	32.5	-24.2	45.9	-	-	74	-28.1	66	257	H
3	*** 2.4835	24.74	ADV	32.4	-24.3	32.84	54	-21.16	-	-	66	257	H
4	*** 2.48432	26.26	ADV	32.4	-24.3	34.36	54	-19.64	-	-	66	257	H

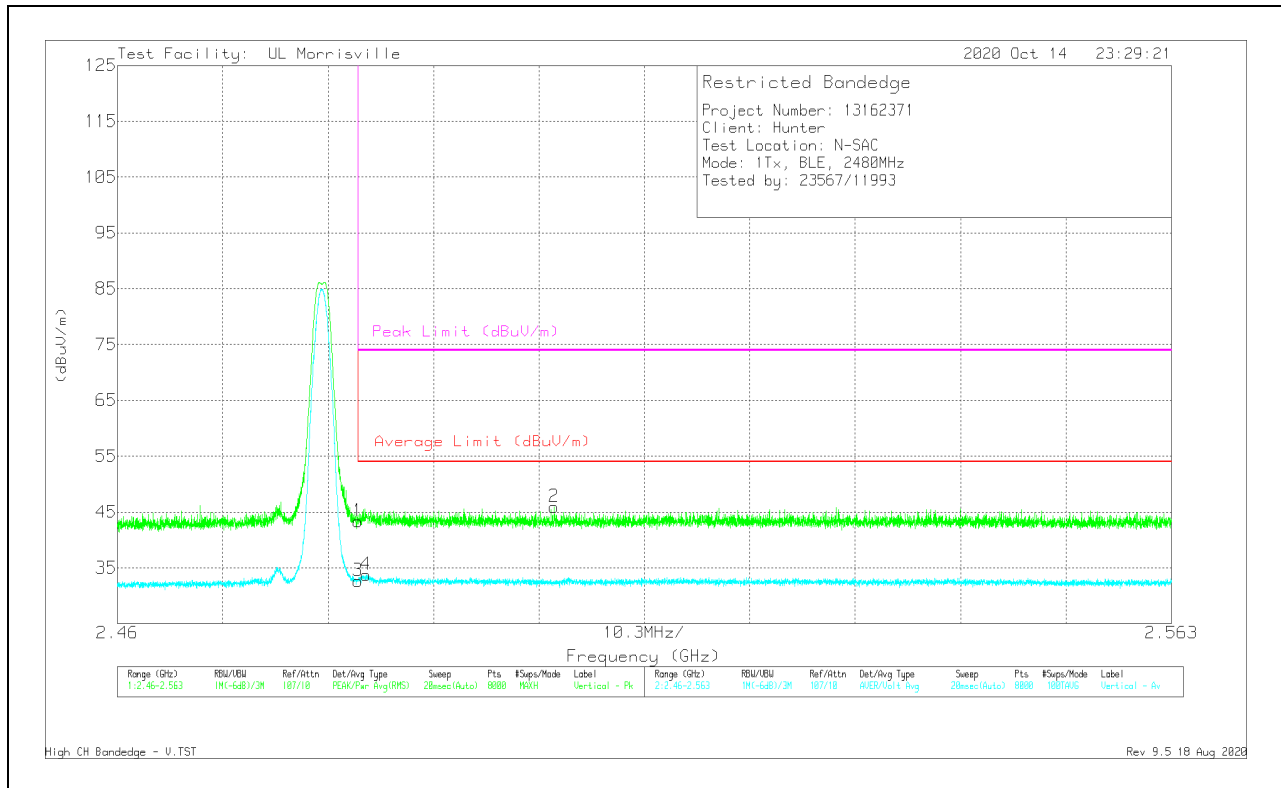
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

ADV - Linear Voltage Average

VERTICAL RESULT

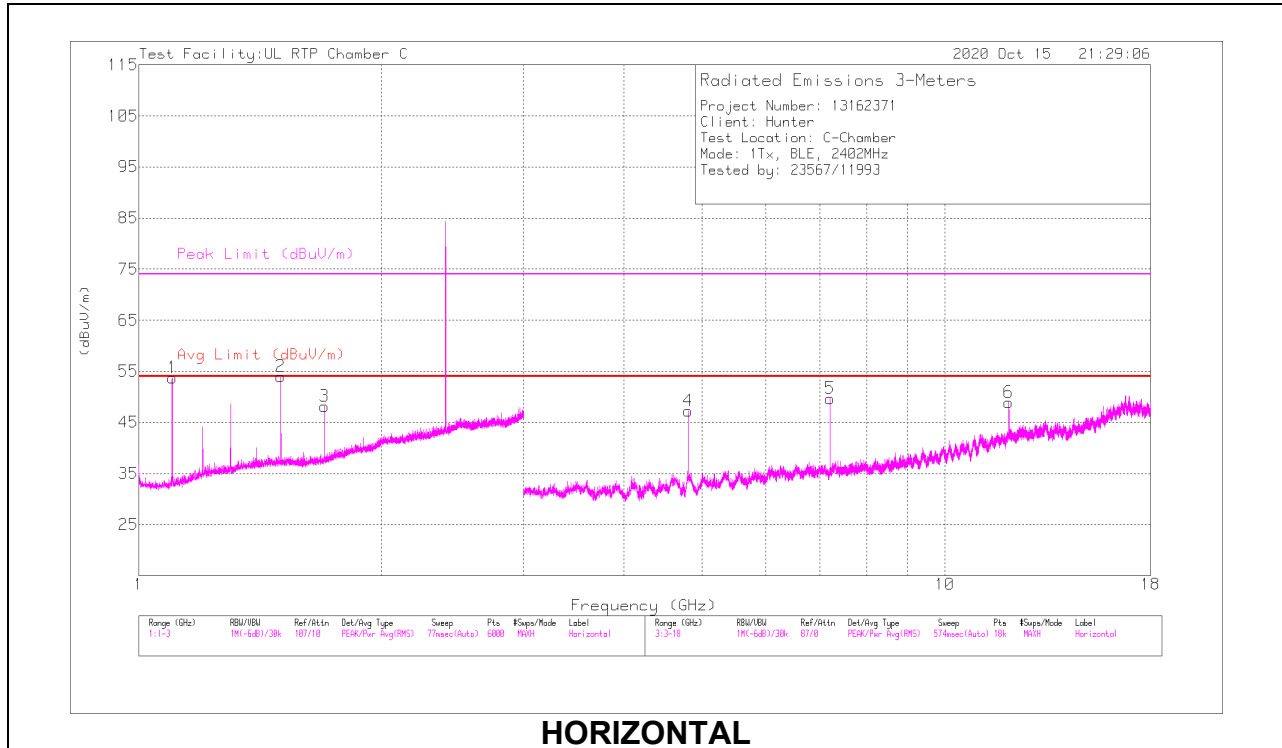


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0067 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 2.4835	35.21	PK	32.4	-24.3	43.31	-	-	74	-30.69	283	288	V
2	** 2.5027	37.79	PK	32.5	-24.4	45.89	-	-	74	-28.11	283	288	V
3	*** 2.4835	24.54	ADV	32.4	-24.3	32.64	54	-21.36	-	-	283	288	V
4	*** 2.4843	25.62	ADV	32.4	-24.3	33.72	54	-20.28	-	-	283	288	V

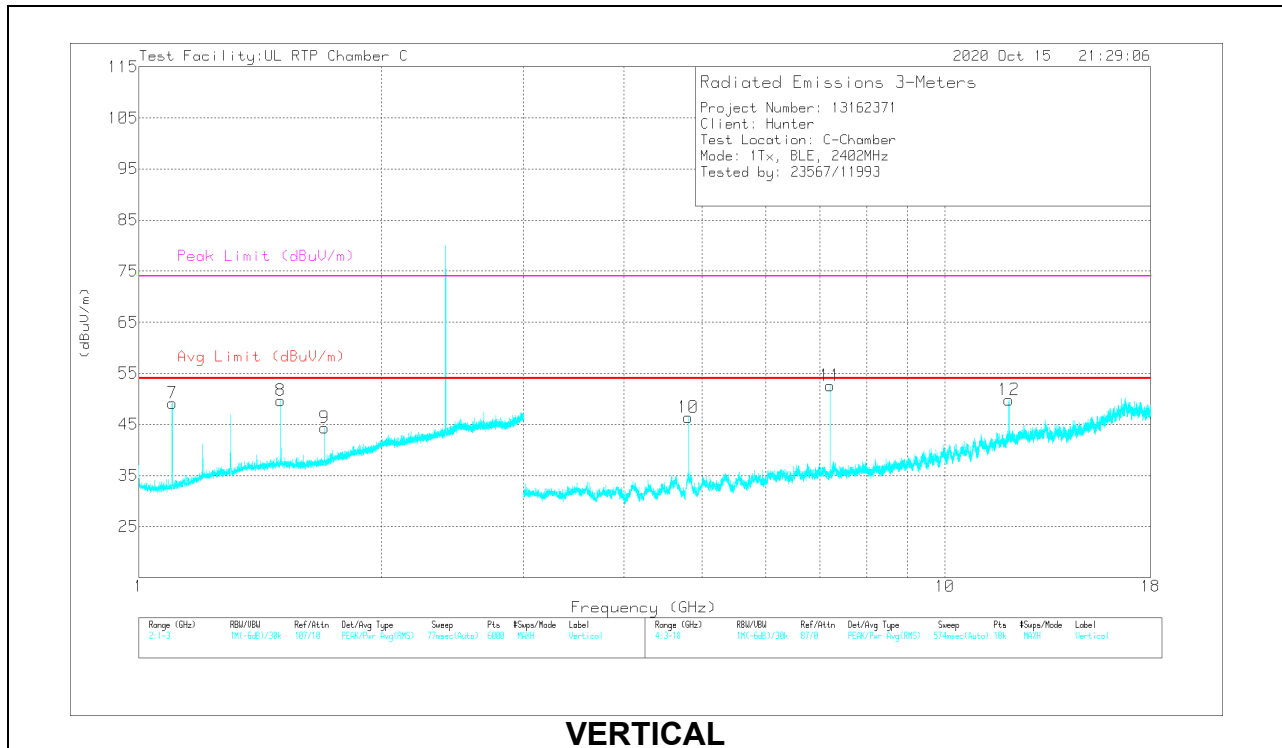
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 ** - indicates frequency in Taiwan NCC LP0002 Restricted Band
 PK - Peak detector
 ADV - Linear Voltage Average

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 dB(/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 1.10001	47.14	PK2	27.3	-21	53.44	-	-	74	-20.56	245	101	H
	*** 1.09998	45.59	ADV	27.3	-21	51.89	54	-2.11	-	-	245	101	H
2	*** 1.49998	45.18	PK2	27.8	-18	54.98	-	-	74	-19.02	188	102	H
	*** 1.49997	42.76	ADV	27.8	-18	52.56	54	-1.44	-	-	188	102	H
3	*** 1.69995	42.06	PK2	29	-19.1	51.96	-	-	74	-22.04	240	246	H
	*** 1.7	38.85	ADV	29	-19.1	48.75	54	-5.25	-	-	240	246	H
7	*** 1.09999	45.25	PK2	27.3	-21	51.55	-	-	74	-22.45	327	241	V
	*** 1.09998	42.84	ADV	27.3	-21	49.14	54	-4.86	-	-	327	241	V
8	*** 1.50001	43.15	PK2	27.8	-18	52.95	-	-	74	-21.05	290	183	V
	*** 1.49999	40.28	ADV	27.8	-18	50.08	54	-3.92	-	-	290	183	V
9	*** 1.69997	39.64	PK2	29	-19.1	49.54	-	-	74	-24.46	212	234	V
	*** 1.69999	34.81	ADV	29	-19.1	44.71	54	-9.29	-	-	212	234	V
4	*** 4.80348	66.63	PK2	34.1	-47.7	53.03	-	-	74	-20.97	182	266	H
	*** 4.80385	60.42	ADV	34.1	-47.8	46.72	54	-7.28	-	-	182	266	H
6	*** 12.00879	53.41	PK2	38.8	-37.3	54.91	-	-	74	-19.09	273	188	H
	*** 12.00878	43.05	ADV	38.8	-37.3	44.55	54	-9.45	-	-	273	188	H
10	*** 4.80354	65.36	PK2	34.1	-47.7	51.76	-	-	74	-22.24	279	251	V
	*** 4.8039	58.91	ADV	34.1	-47.8	45.21	54	-8.79	-	-	279	251	V
12	*** 12.01109	54.81	PK2	38.8	-37.3	56.31	-	-	74	-17.69	276	216	V
	*** 12.01102	45.03	ADV	38.8	-37.3	46.53	54	-7.47	-	-	276	216	V
5	7.20524	59.29	PK	35.7	-45.3	49.69	-	-	-	-	0-360	101	H
11	7.20607	62.2	PK	35.7	-45.3	52.6	-	-	-	-	0-360	101	V

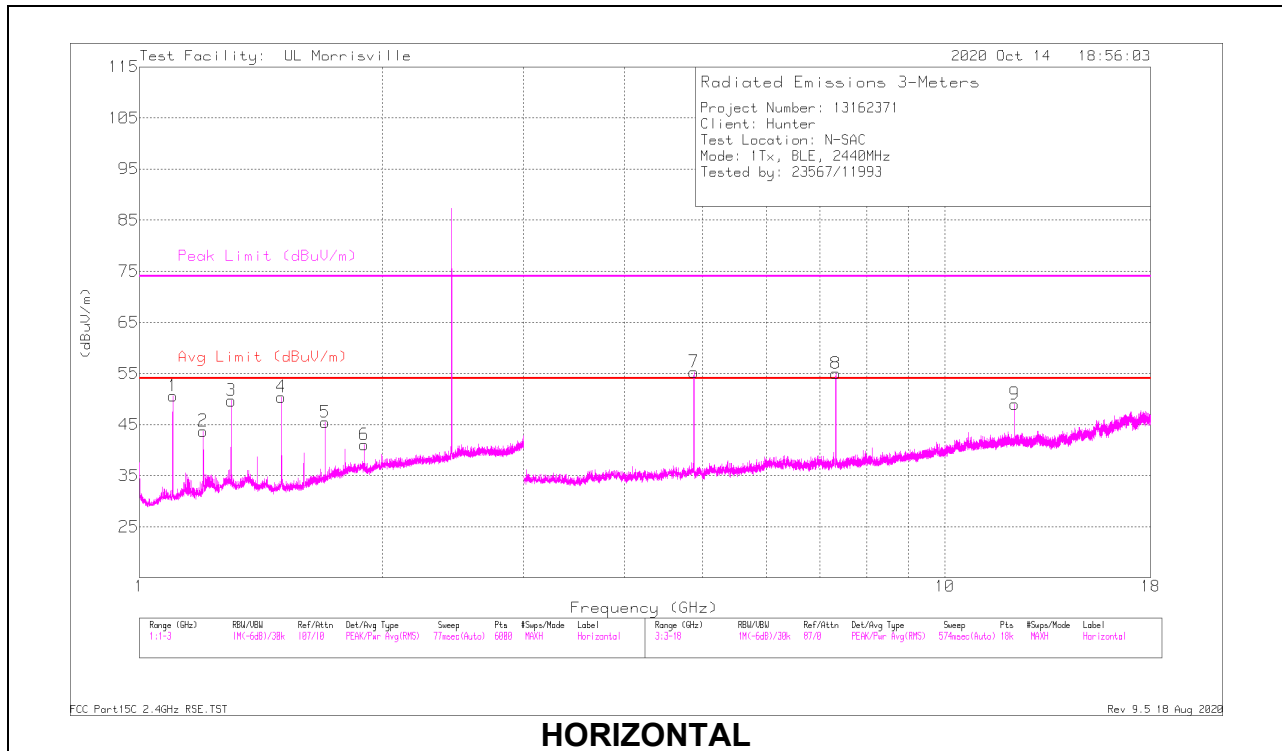
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

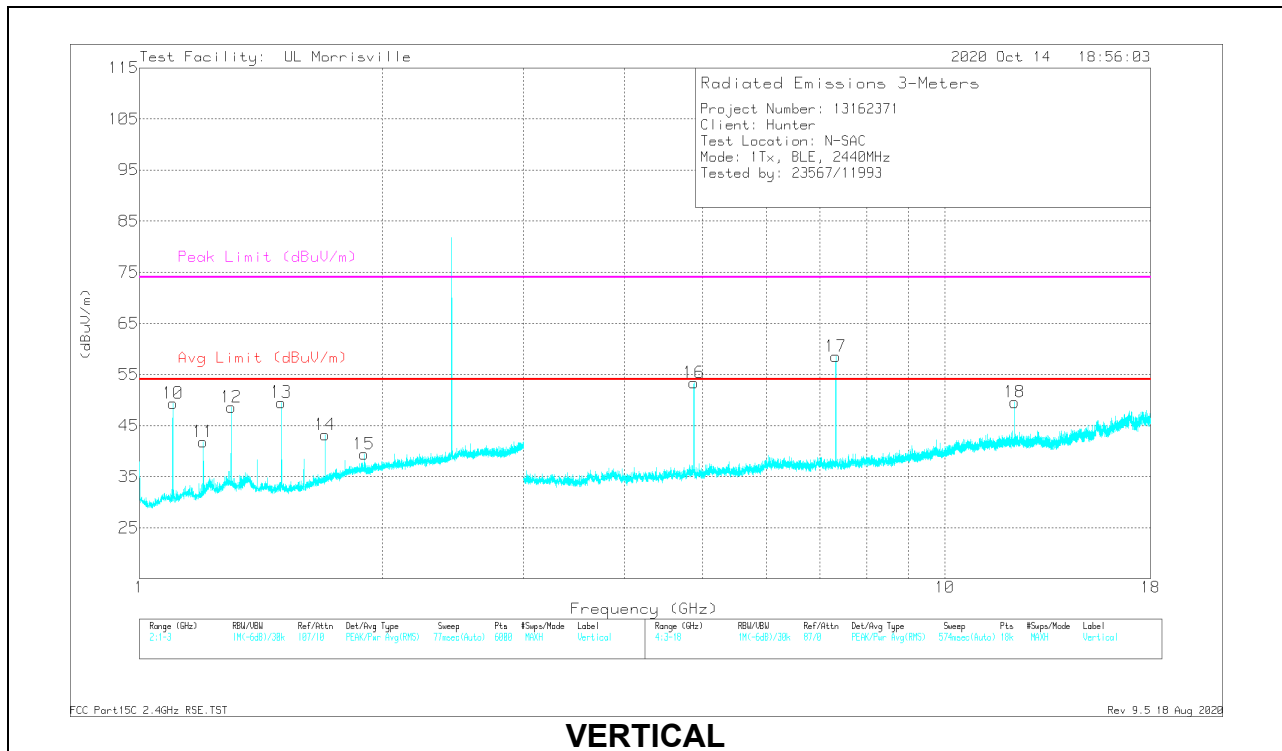
PK2 - Maximum Peak

ADV - Linear Voltage Average

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 dB(/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 1.10004	52.49	PK2	28.1	-26.6	53.99	-	-	74	-20.01	264	115	H
	*** 1.09996	51.18	ADV	28.1	-26.6	52.68	54	-1.32	-	-	264	115	H
2	*** 1.20006	42.18	PK2	28.7	-26	44.88	-	-	74	-29.12	255	125	H
	*** 1.2	37.59	ADV	28.7	-26	40.29	54	-13.71	-	-	255	125	H
4	*** 1.49998	51.07	PK2	27.8	-24.8	54.07	-	-	74	-19.93	208	312	H
	*** 1.49998	49.72	ADV	27.8	-24.8	52.72	54	-1.28	-	-	208	312	H
5	*** 1.69999	44.76	PK2	29	-24.4	49.36	-	-	74	-24.64	202	165	H
	*** 1.69996	41.67	ADV	29	-24.4	46.27	54	-7.73	-	-	202	165	H
3	*** 1.30013	48.06	PK2	29.1	-25.7	51.46	-	-	74	-22.54	341	101	H
	*** 1.30013	45.45	ADV	29.1	-25.7	48.85	54	-5.15	-	-	341	101	H
10	*** 1.09998	48.51	PK2	28.1	-26.6	50.01	-	-	74	-23.99	157	134	V
	*** 1.09998	46.36	ADV	28.1	-26.6	47.86	54	-6.14	-	-	157	134	V
11	*** 1.20003	41.12	PK2	28.7	-26	43.82	-	-	74	-30.18	109	174	V
	*** 1.20003	36.08	ADV	28.7	-26	38.78	54	-15.22	-	-	109	174	V
13	*** 1.5	48.01	PK2	27.8	-24.8	51.01	-	-	74	-22.99	89	215	V
	*** 1.49999	45.96	ADV	27.8	-24.8	48.96	54	-5.04	-	-	89	215	V
14	*** 1.69996	42.06	PK2	29	-24.4	46.66	-	-	74	-27.34	135	215	V
	*** 1.69998	37.5	ADV	29	-24.4	42.1	54	-11.9	-	-	135	215	V
15	** 1.89968	38.43	PK2	30.7	-24.3	44.83	-	-	74	-29.17	97	246	V
	** 1.89998	28.56	ADV	30.7	-24.3	34.96	54	-19.04	-	-	97	246	V
12	*** 1.5	45.4	PK2	27.8	-24.8	48.4	-	-	74	-25.6	296	165	V
	*** 1.5	42.45	ADV	27.8	-24.8	45.45	54	-8.55	-	-	296	165	V
7	*** 4.88047	55.43	PK2	34.1	-31.4	58.13	-	-	74	-15.87	285	225	H
	*** 4.88003	50.02	ADV	34.1	-31.4	52.72	54	-1.28	-	-	285	225	H
8	*** 7.3192	53.18	PK2	35.6	-29.3	59.48	-	-	74	-14.52	130	240	H
	*** 7.31933	46.32	ADV	35.6	-29.3	52.62	54	-1.38	-	-	130	240	H
9	*** 12.20121	43.7	PK2	38.9	-26.6	56	-	-	74	-18	253	224	H
	*** 12.20096	34.21	ADV	38.9	-26.6	46.51	54	-7.49	-	-	253	224	H
16	*** 4.88043	53.57	PK2	34.1	-31.4	56.27	-	-	74	-17.73	31	103	V
	*** 4.87998	47.95	ADV	34.1	-31.4	50.65	54	-3.35	-	-	31	103	V
17	*** 7.31915	53.79	PK2	35.6	-29.3	60.09	-	-	74	-13.91	54	102	V
	*** 7.31931	46.97	ADV	35.6	-29.3	53.27	54	-7.3	-	-	54	102	V
18	*** 12.20111	43.66	PK2	38.9	-26.6	55.96	-	-	74	-18.04	291	111	V
	** 12.20107	33.6	ADV	38.9	-26.6	45.9	54	-8.1	-	-	291	111	V
6	** 1.90022	37.2	PK2	30.7	-24.3	43.6	-	-	74	-30.4	114	114	H
	** 1.89998	25.56	ADV	30.7	-24.3	31.96	54	-22.04	-	-	114	114	H

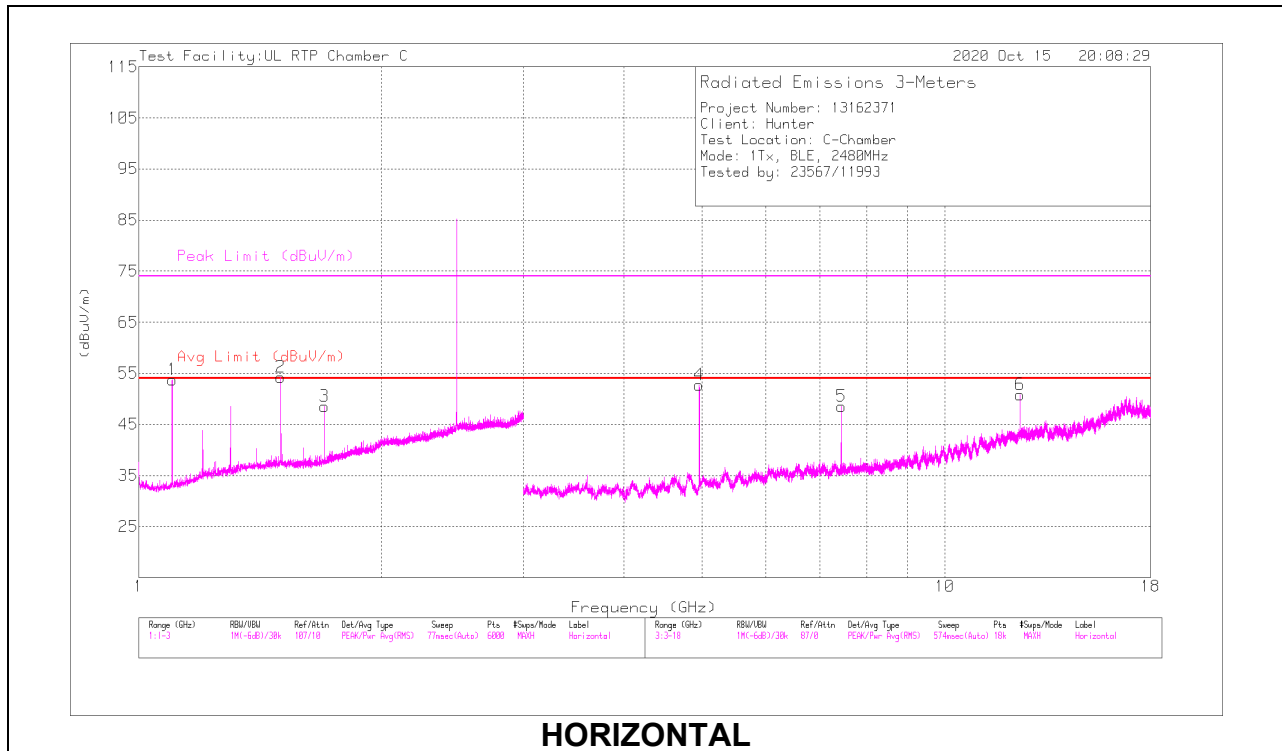
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

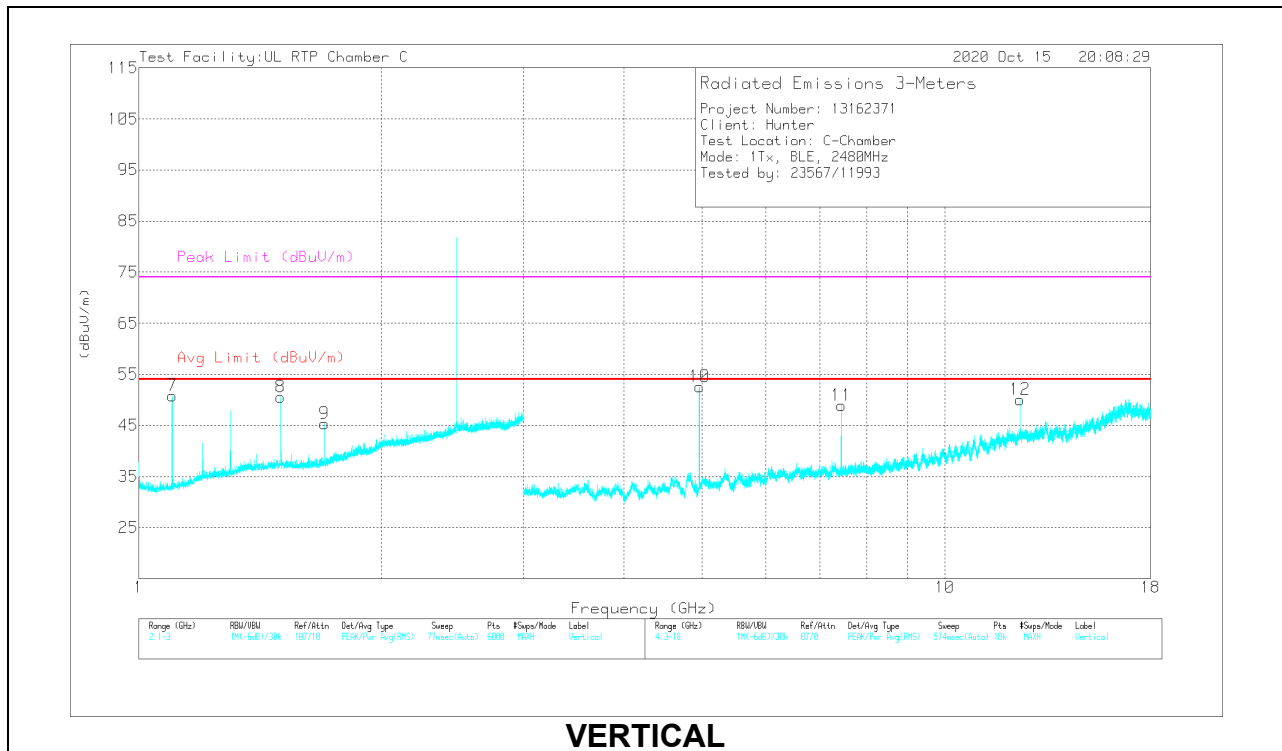
PK2 - Maximum Peak

ADV - Linear Voltage Average

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0072 dB(/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 1.0999	47.74	PK2	27.3	-21	54.04	-	-	74	-19.96	248	101	H
	*** 1.09999	46.06	ADV	27.3	-21	52.36	54	-1.64	-	-	248	101	H
2	*** 1.50001	45.77	PK2	27.8	-18	55.57	-	-	74	-18.43	196	101	H
	*** 1.5	43.83	ADV	27.8	-18	53.63	54	-.37	-	-	196	101	H
3	*** 1.70002	42.36	PK2	29	-19.1	52.26	-	-	74	-21.74	242	252	H
	*** 1.69996	38.92	ADV	29	-19.1	48.82	54	-5.18	-	-	242	252	H
7	*** 1.09994	45.17	PK2	27.3	-21	51.47	-	-	74	-22.53	319	228	V
	*** 1.09999	42.96	ADV	27.3	-21	49.26	54	-4.74	-	-	319	228	V
8	*** 1.49996	43.78	PK2	27.8	-18	53.58	-	-	74	-20.42	308	183	V
	*** 1.49996	40.78	ADV	27.8	-18	50.58	54	-3.42	-	-	308	183	V
9	*** 1.69989	39.92	PK2	29	-19.1	49.82	-	-	74	-24.18	299	216	V
	*** 1.69997	34.81	ADV	29	-19.1	44.71	54	-9.29	-	-	299	216	V
4	*** 4.95943	70.43	PK2	34	-47.4	57.03	-	-	74	-16.97	121	269	H
	*** 4.9601	65.46	ADV	34	-47.4	52.06	54	-1.94	-	-	121	269	H
5	*** 7.44065	60.88	PK2	35.7	-45.3	51.28	-	-	74	-22.72	147	101	H
	*** 7.44064	53.01	ADV	35.7	-45.3	43.41	54	-10.59	-	-	147	101	H
6	*** 12.39862	56.92	PK2	39	-37.4	58.52	-	-	74	-15.48	279	313	H
	*** 12.39873	47.71	ADV	39	-37.4	49.31	54	-4.69	-	-	279	313	H
10	*** 4.96051	67.62	PK2	34	-47.5	54.12	-	-	74	-19.88	278	265	V
	*** 4.95996	62.14	ADV	34	-47.4	48.74	54	-5.26	-	-	278	265	V
12	*** 12.39861	55.63	PK2	39	-37.4	57.23	-	-	74	-16.77	260	245	V
	*** 12.39867	46.12	ADV	39	-37.4	47.72	54	-6.28	-	-	260	245	V
11	*** 7.44072	60.67	PK2	35.7	-45.3	51.07	-	-	74	-22.93	119	101	V
	*** 7.44055	52.87	ADV	35.7	-45.3	43.27	54	-10.73	-	-	119	101	V

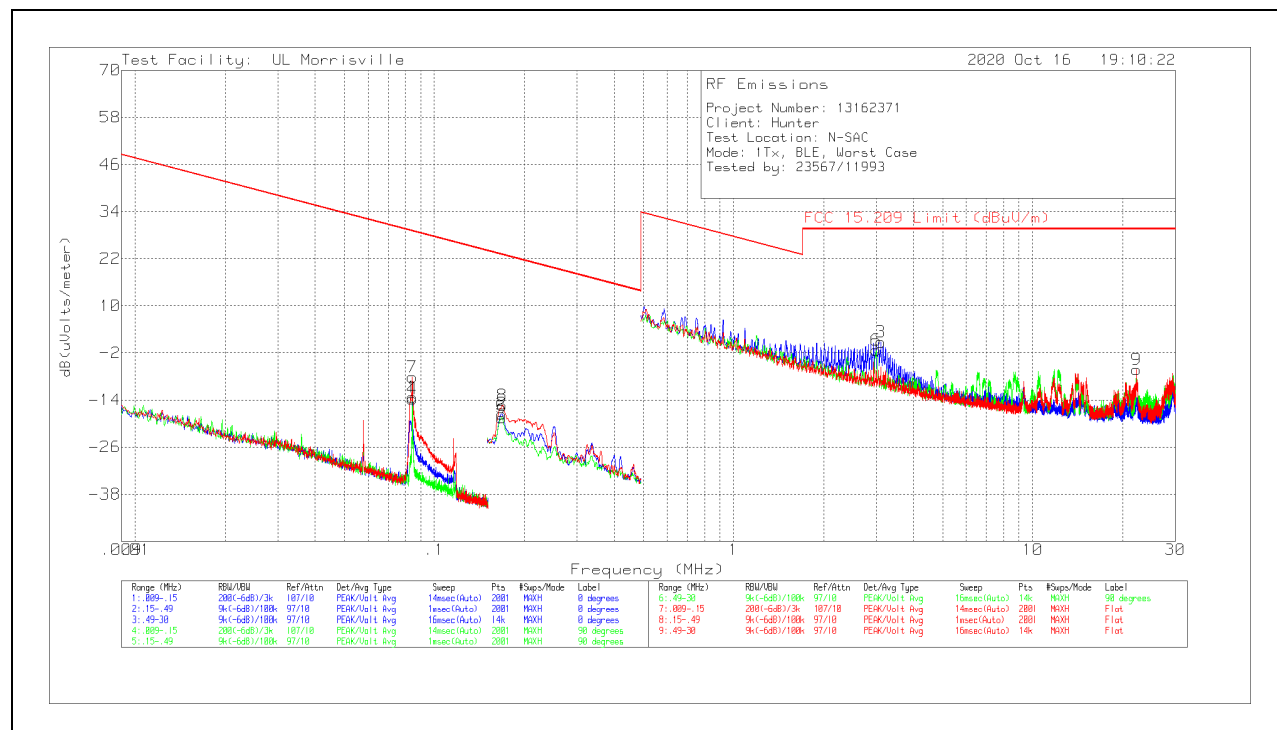
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 ** - indicates frequency in Taiwan NCC LP0002 Restricted Band
 PK2 - Maximum Peak
 ADV - Linear Voltage Average

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 $40 \cdot \log(\text{test distance} / \text{specification distance})$.

The below 30 MHz limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377Ω . For example, the measurement frequency 84.47 KHz resulted in a level of -13.3 dBuV/m, which is equivalent to $-13.3 - 51.5 = -64.8$ dBuA/m, which has the same margin, -42.37 dB, to the corresponding RSS-GEN Table 6 limit as it has to be 15.209(a) limit.

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



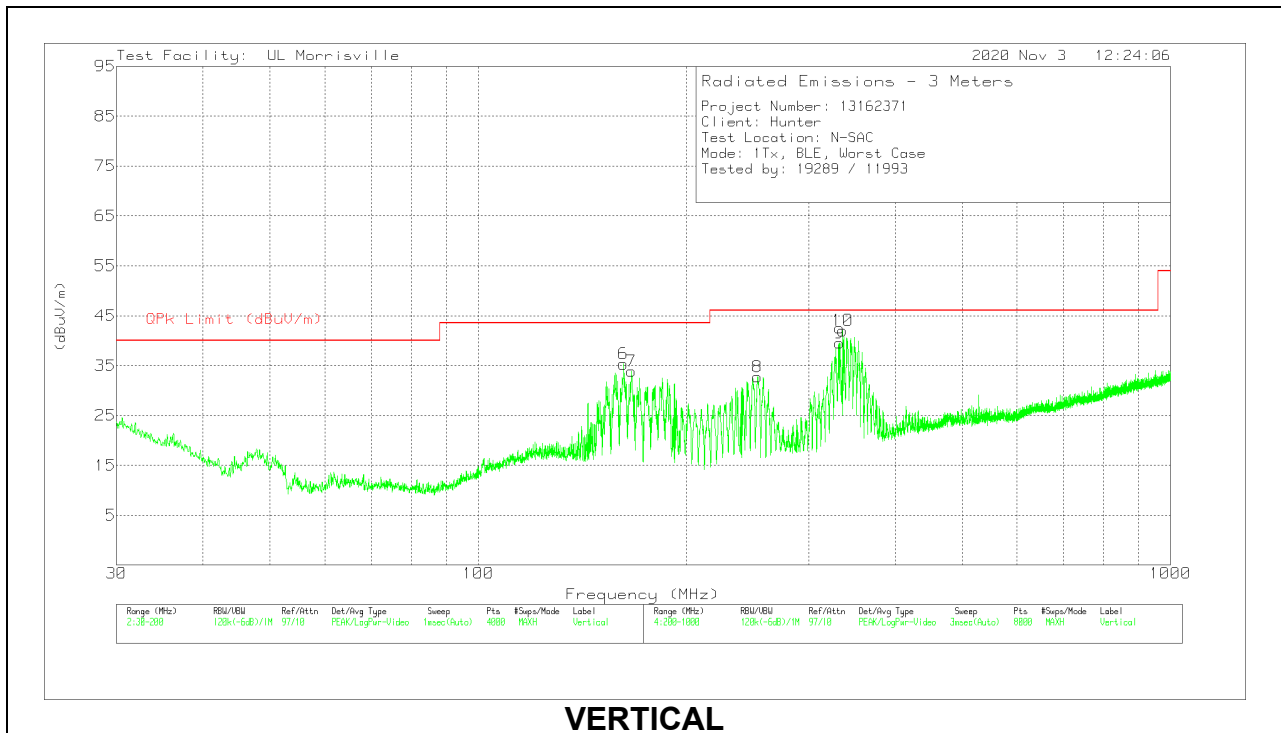
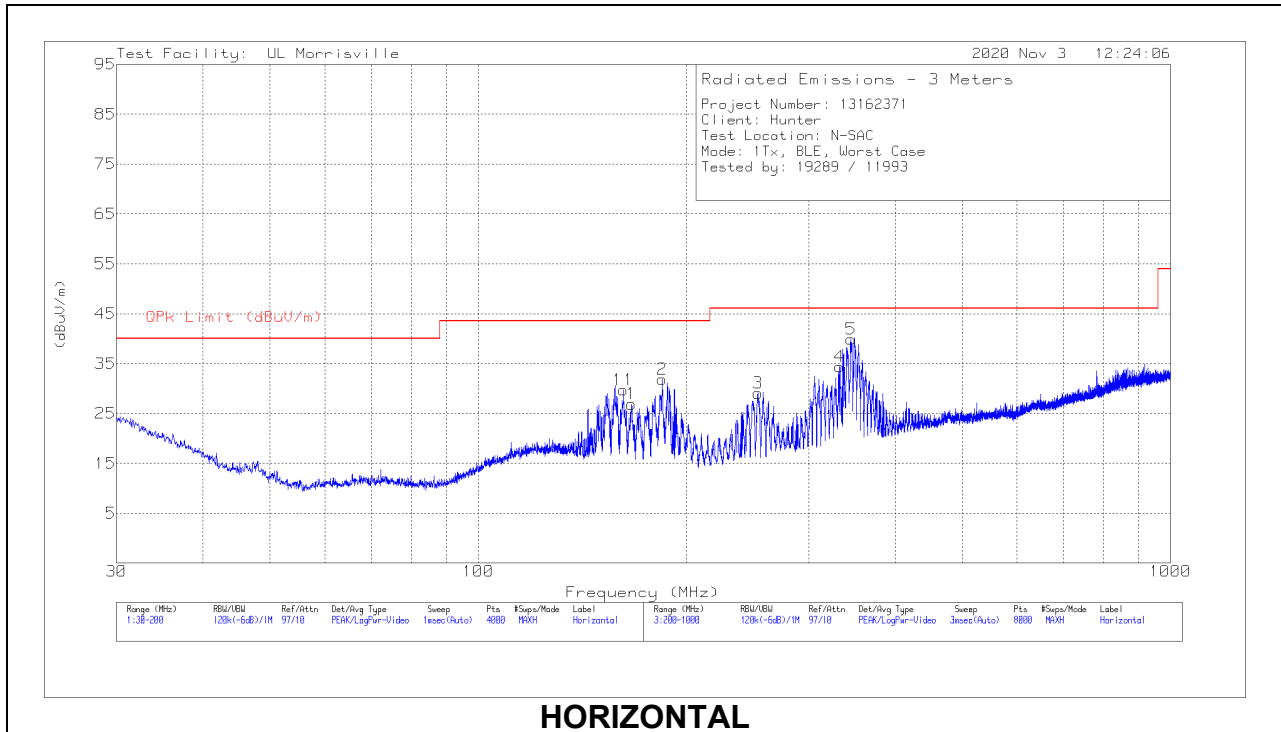
Below 30MHz Data

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)	Antenna Orientation
.08447	55.5	Pk	11.1	.1	-80	-13.3	29.07	49.07	-42.37	0-360	0 deg
.16777	51.56	Pk	10.8	.1	-80	-17.54	23.11	43.11	-40.65	0-360	0 deg
3.10603	29.22	Pk	11.1	.4	-40	.72	29.54	-	-28.82	0-360	0 deg
.08447	55.08	Pk	11.1	.1	-80	-13.72	29.07	49.07	-42.79	0-360	90 deg
.16819	50.59	Pk	10.8	.1	-80	-18.51	23.09	43.09	-41.6	0-360	90 deg
2.99852	27.32	Pk	11.1	.3	-40	-1.28	29.54	-	-30.82	0-360	90 deg
.08447	60.6	Pk	11.1	.1	-80	-8.2	29.07	49.07	-37.27	0-360	90 deg
.16896	53.73	Pk	10.8	.1	-80	-15.37	23.05	43.05	-38.42	0-360	Flat
22.20662	23.12	Pk	9.6	1	-40	-6.28	29.54	-	-35.82	0-360	Flat

Pk - Peak detector

10.4. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0074 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 166.5028	38.51	Pk	18.1	-29.7	26.91	43.52	-16.61	0-360	200	H
6	*** 162.0392	46.74	Pk	18.4	-29.8	35.34	43.52	-8.18	0-360	100	V
7	*** 166.4603	45.4	Pk	18.2	-29.7	33.9	43.52	-9.62	0-360	100	V
3	*** 253.657	40.36	Pk	17.6	-28.9	29.06	46.02	-16.96	0-360	99	H
4	*** 332.7173	42.68	Pk	20.1	-28.4	34.38	46.02	-11.64	0-360	99	H
8	*** 253.3069	44.07	Pk	17.6	-28.9	32.77	46.02	-13.25	0-360	99	V
9	*** 332.8173	47.81	Pk	20.1	-28.4	39.51	46.02	-6.51	0-360	200	V
11	161.9967	41.15	Pk	18.4	-29.8	29.75	-	-	0-360	200	H
2	184.4425	43.95	Pk	17.4	-29.5	31.85	-	-	0-360	99	H
10	336.0177	50.2	Pk	20.1	-28.3	42	-	-	0-360	200	V
5	345.6189	47.87	Pk	20.3	-28.3	39.87	-	-	0-360	99	H

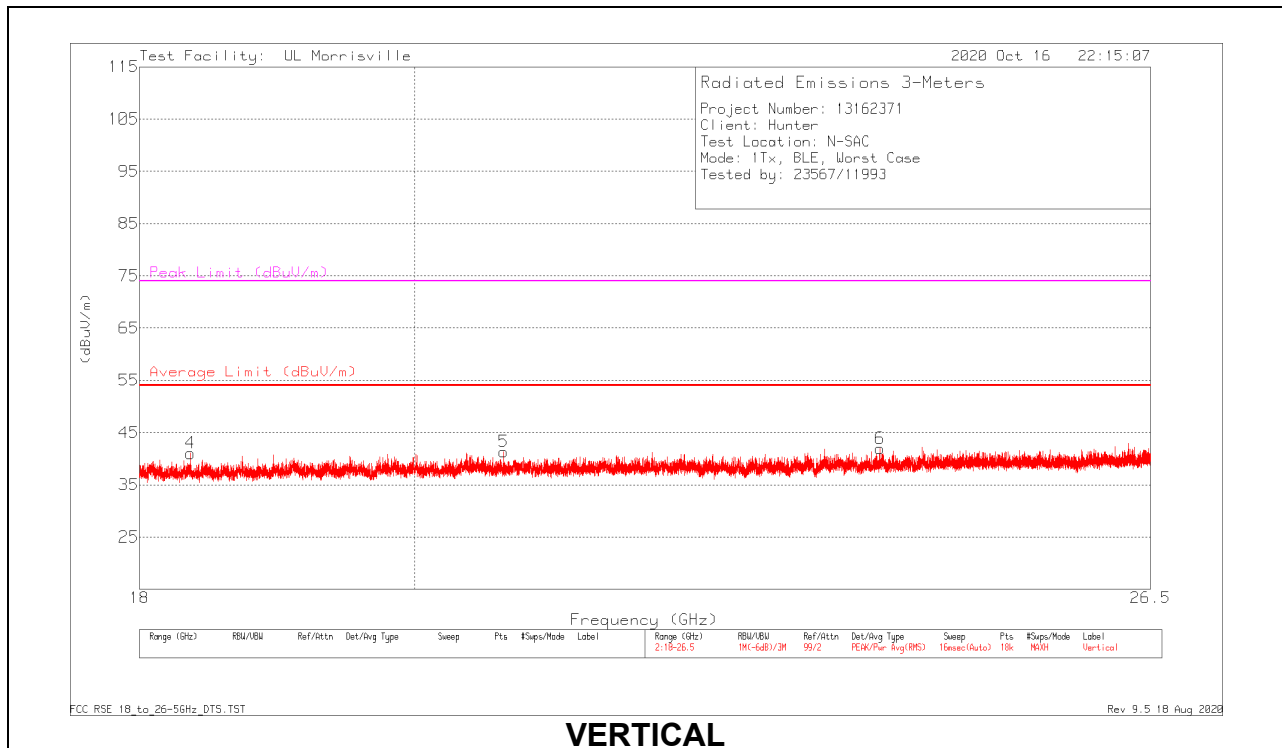
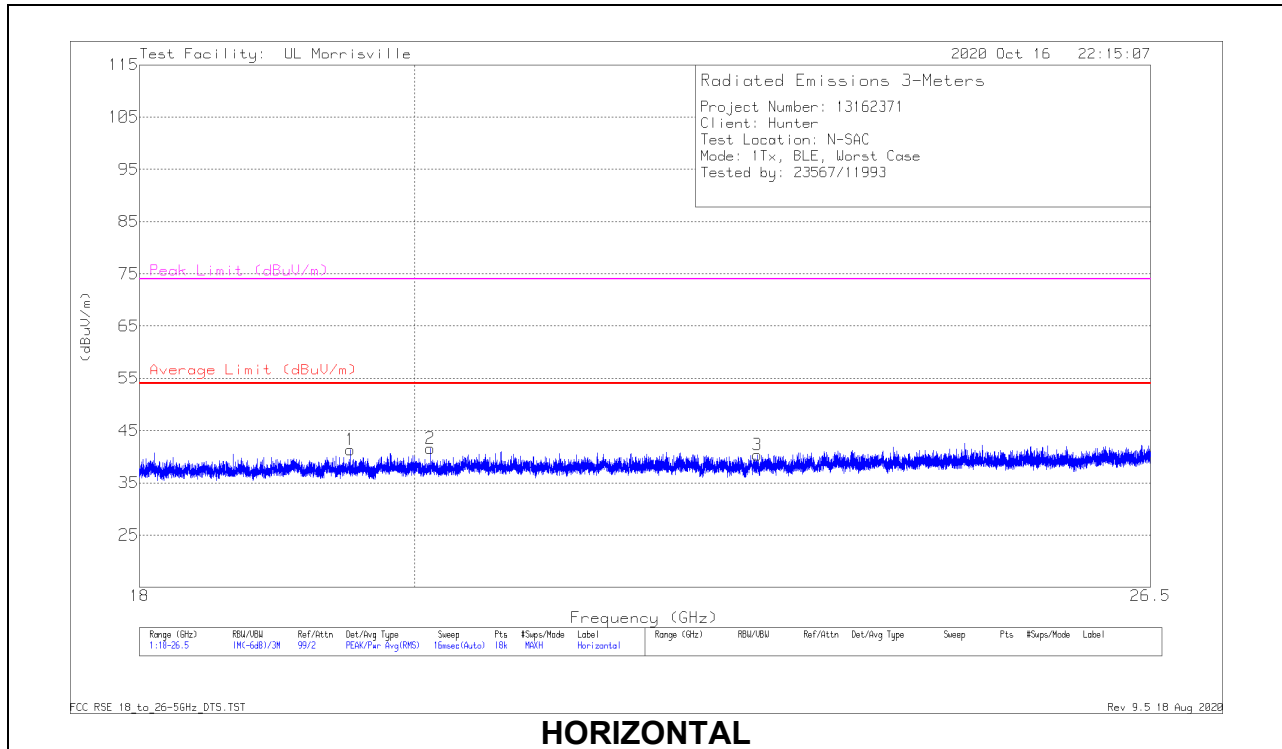
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

** - 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	AT0076 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*** 19.51167	49.4	Pk	32.7	-40.8	41.3	54	-12.7	74	-32.7	0-360	101	H
2	*** 20.11803	49.5	Pk	32.9	-40.8	41.6	54	-12.4	74	-32.4	0-360	250	H
3	*** 22.79851	47.86	Pk	33.6	-41.1	40.36	54	-13.64	74	-33.64	0-360	101	H
4	*** 18.35513	49.13	Pk	32.5	-40.6	41.03	54	-12.97	74	-32.97	0-360	150	V
5	*** 20.68898	49.2	Pk	33	-40.9	41.3	54	-12.7	74	-32.7	0-360	101	V
6	*** 23.89366	48.46	Pk	34.1	-40.6	41.96	54	-12.04	74	-32.04	0-360	250	V

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

** - indicates frequency in Taiwan NCC LP0002 Restricted Band

Pk - Peak detector

11. SETUP PHOTOS

Please refer to R13162371-EP1 for setup photos

END OF TEST REPORT