



CERTIFICATION TEST REPORT

Report Number: 12791034-E1V2

Applicant : APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

Model : A2187

FCC ID : BCGA2187

IC : 579C-A2187

EUT Description : TRACKING TAG

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

Date Of Issue:
September 08, 2020

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	8/14/2020	Initial Issue	Jingang Li
V2	9/8/2020	Address TCB's questions	Chin Pang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: Tracking Tag

MODEL: A2187

SERIAL NUMBER: FDFZ83MUP119

DATE TESTED: 08/05/2019-08/25/2020

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

UL Verification Services Inc. 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.

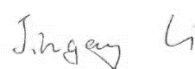
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



Chin Pang
Senior Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Jingang Li
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

2. 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.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. 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.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
<input type="checkbox"/> Chamber A (IC:2324B-1)	<input checked="" type="checkbox"/> Chamber D (IC:22541-1)	<input type="checkbox"/> Chamber I (IC: 2324A-5)
<input type="checkbox"/> Chamber B (IC:2324B-2)	<input type="checkbox"/> Chamber E (IC:22541-2)	<input type="checkbox"/> Chamber J (IC: 2324A-6)
<input type="checkbox"/> Chamber C (IC:2324B-3)	<input type="checkbox"/> Chamber F (IC:22541-3)	<input type="checkbox"/> Chamber K (IC: 2324A-1)
	<input type="checkbox"/> Chamber G (IC:22541-4)	<input type="checkbox"/> Chamber L (IC: 2324A-3)
	<input type="checkbox"/> Chamber H (IC:22541-5)	<input type="checkbox"/> Chamber M (IC: 2324A-2)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. 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.

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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a location tracking tag. It has user replaceable battery. It has integrated antenna which not accessible to user. The device supports Bluetooth LE, NFC and UWB.

5.2. 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, 1Mbps	4.50	2.82
2404 - 2478	BLE, 2Mbps	4.47	2.80

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an IFA antenna, with a maximum gain of -3.2 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 1A186

5.5. WORST-CASE CONFIGURATION AND MODE

The EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that Y (Landscape) orientation was the worst-case orientation.

Radiated band edge, harmonic, and spurious emissions from 1GHz to 18GHz were performed with the EUT was set to transmit at highest power on Low/Middle/High channels.

Radiated emissions below 30MHz, below 1GHz, 18-26GHz and power line conducted emissions were performed with the EUT transmits at the channel with the highest output power as worst-case scenario.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Power Supply, DC	HEWLET PACKARD	E3601A	KR24104150	DoC
Transmission Board	N/A	V3.1	N/A	N/A
Laptop	Apple	A1502	HRP003436	QDS-BRCM1080
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA

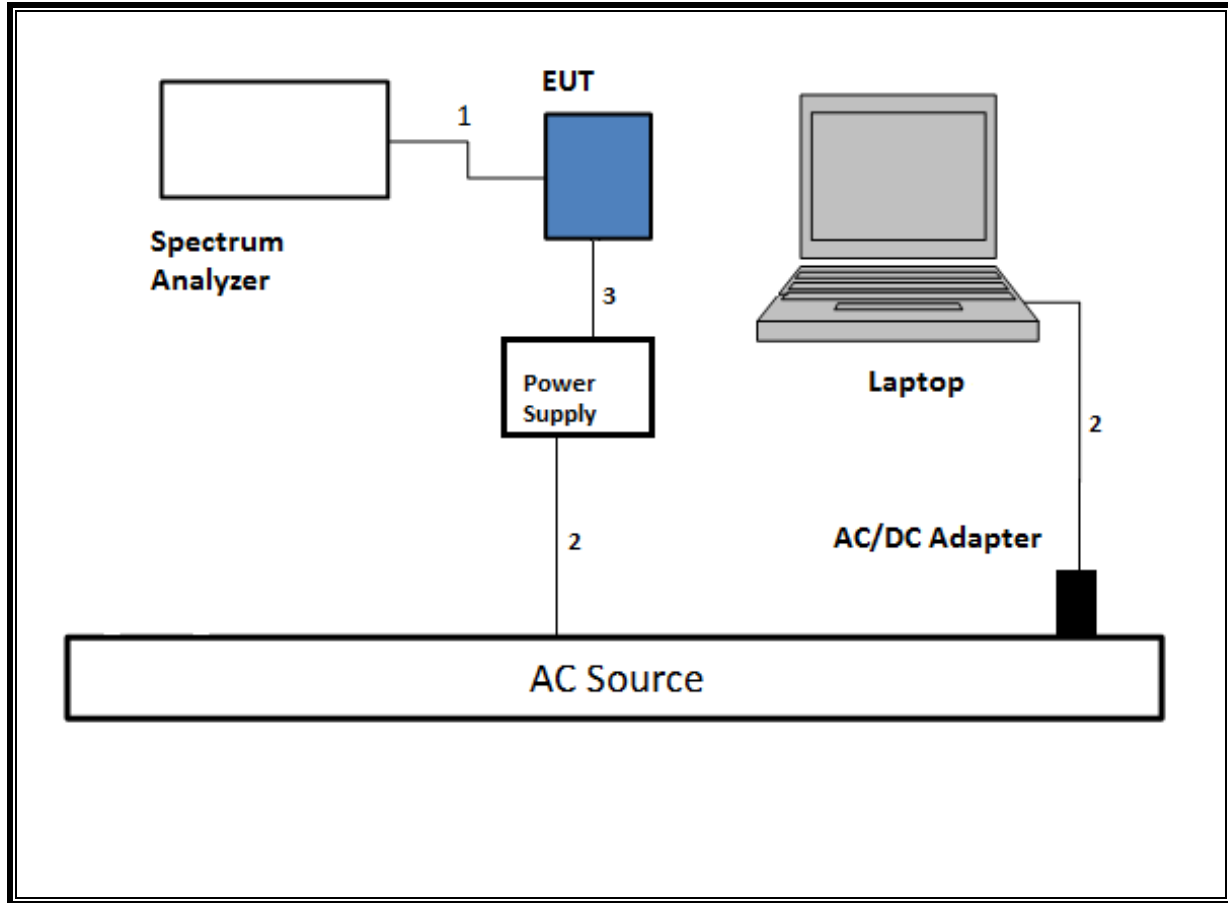
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	AC	1	AC	Un-shielded	2	N/A
3	Banana Plugs	1	Aligator Clips	Un-shielded	2	N/A

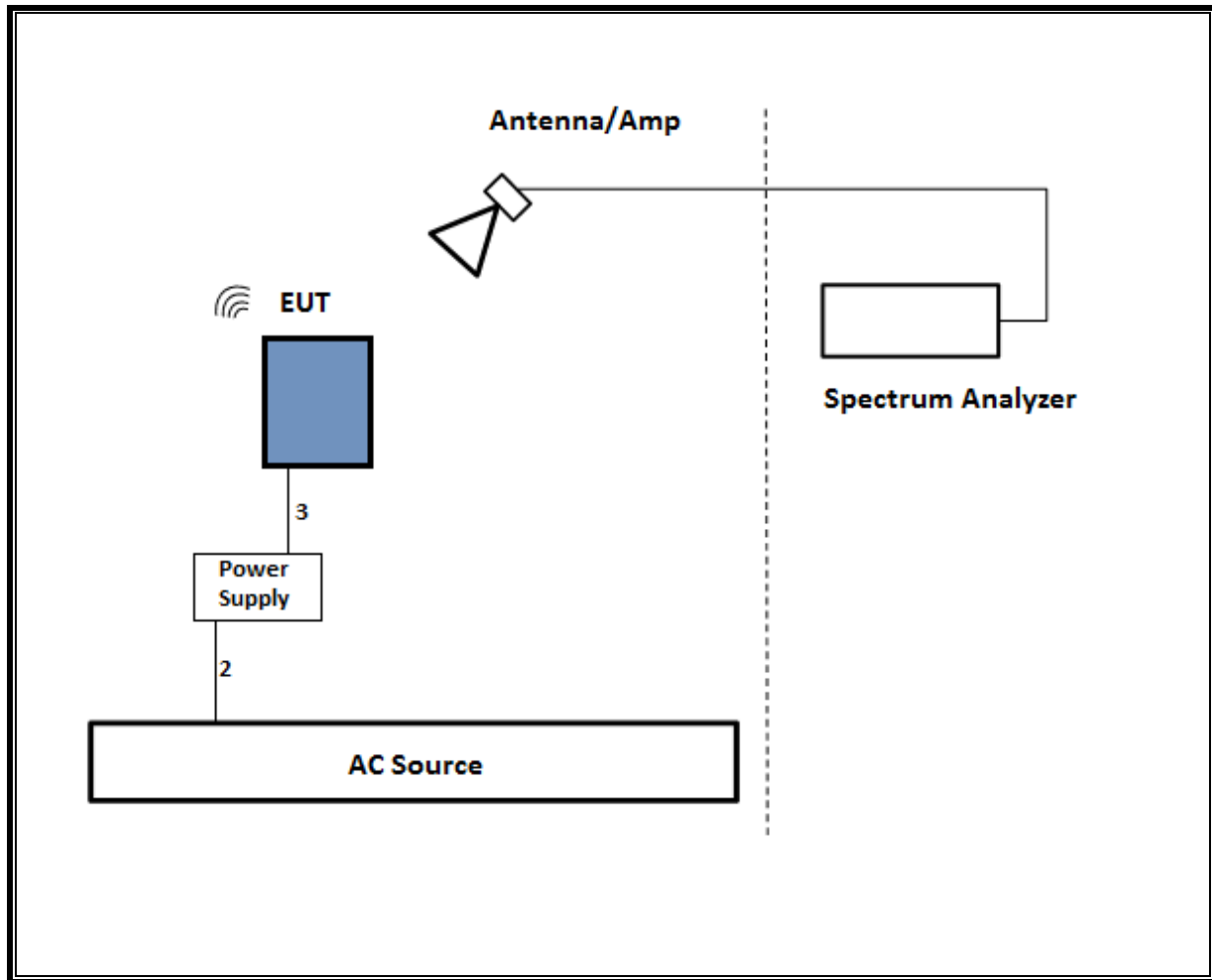
TEST SETUP

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

SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS BELOW 1GHz AND ABOVE 1GHz



6. MEASUREMENT METHOD

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 -11.9.2.3.1 Measurement using gated average 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

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

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.2 Integration method -Peak detection

Band-edge: ANSI C63.10 Subclause -11.13.3.3 Integration method -Trace averaging with continuous transmission at full power

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

7. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
*Amplifier, 10KHz to 1GHz, 32dB	Sonoma Instrument Co.	310N	T286	07/31/2020	07/31/2019
*Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	T185	06/06/2020	06/06/2019
*Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T712	02/27/2020	02/27/2019
*EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179377	02/15/2020	02/15/2019
*Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T863	05/30/2020	05/30/2019
*Amplifier, 1 to 18GHz, 35dB	Amplical	AFS42-00101800-25-S-42	T1567	01/26/2020	01/26/2019
*Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T447	08/13/2020	08/13/2019
*Antenna Horn 18 to 26.5GHz	ARA	MWH-1826/B	T449	08/13/2020	08/13/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T906	01/22/2020	01/22/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T905	01/24/2020	01/24/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T339	01/21/2021	01/21/2020

UL AUTOMATION SOFTWARE			
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016

*Testing is completed before equipment expiration date.

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

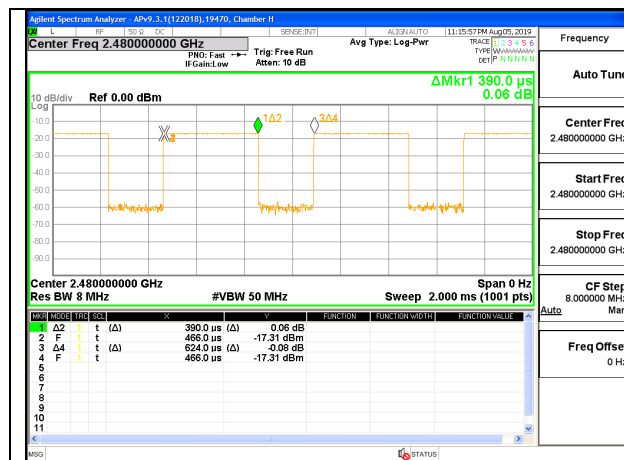
PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

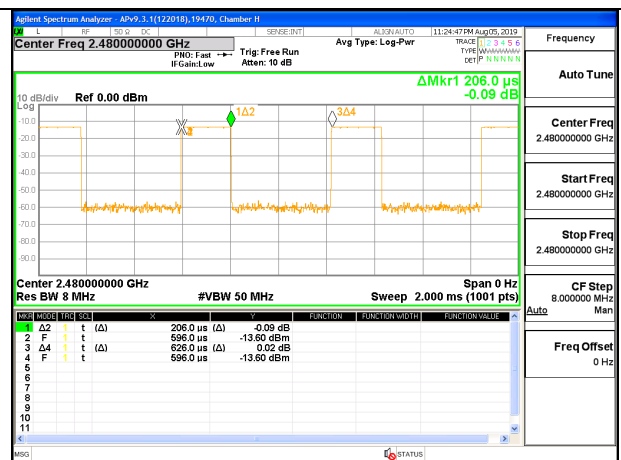
ON TIME AND DUTY CYCLE RESULTS

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, 1Mbps	0.390	0.624	0.625	62.50%	2.04	2.564
BLE, 2Mbps	0.206	0.626	0.329	32.91%	4.83	4.854

DUTY CYCLE PLOTS



BLE 1Mbps



BLE 2Mbps

8.2. 99% BANDWIDTH

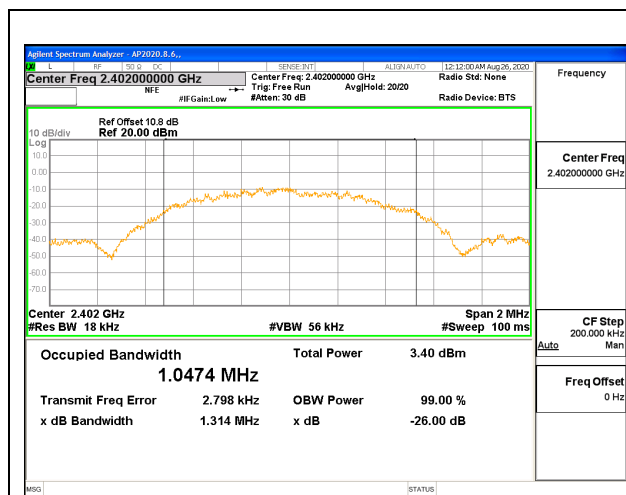
LIMITS

None; for reporting purposes only.

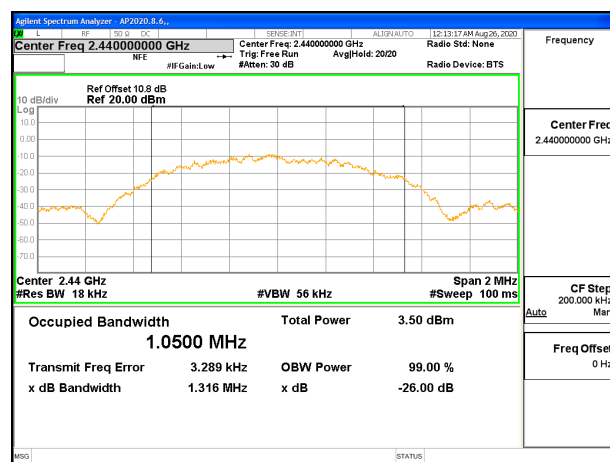
RESULTS

8.2.1. BLE (1Mbps)

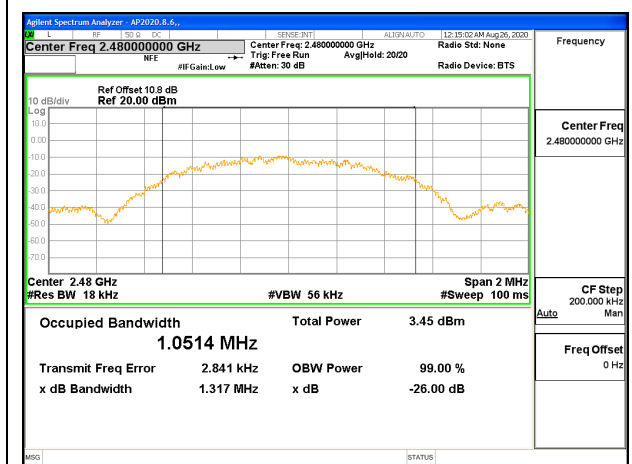
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.047
Middle	2440	1.050
High	2480	1.051



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2404	2.0704
Middle	2440	2.0743
High	2478	2.0743



8.3. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

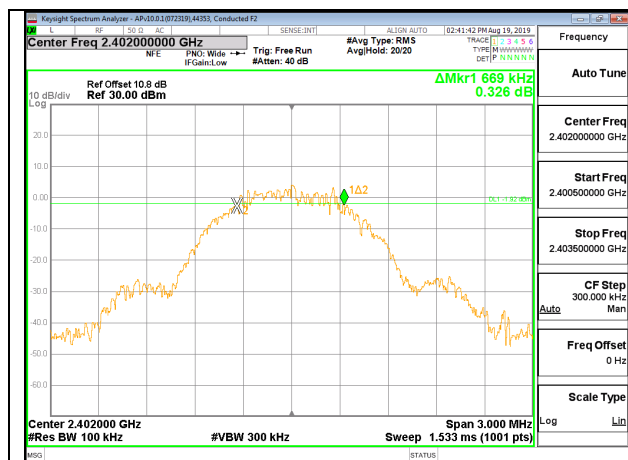
RSS-247 5.2 (a)

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

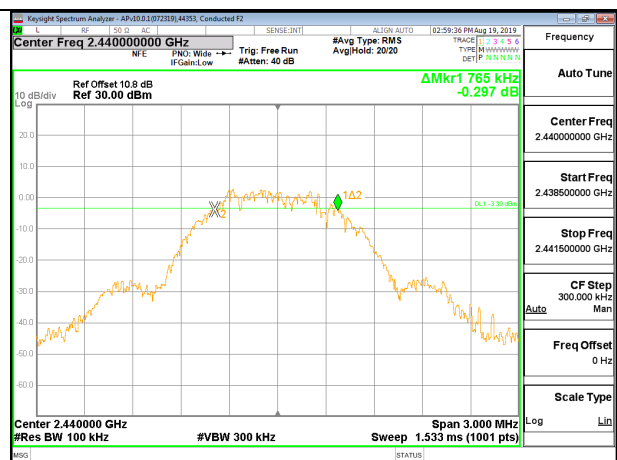
RESULTS

8.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.669	0.5
Middle	2440	0.765	0.5
High	2480	0.711	0.5



LOW CHANNEL



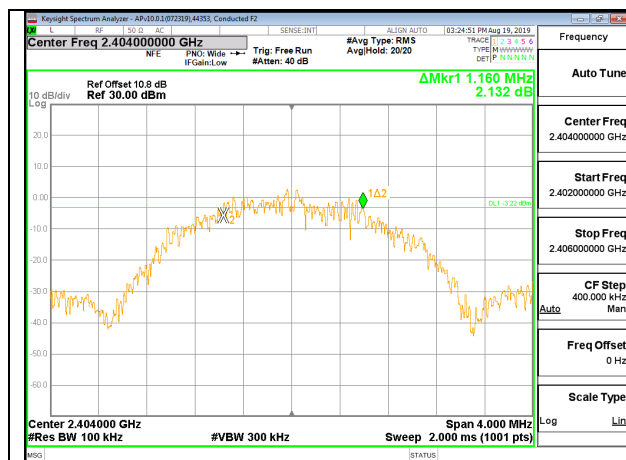
MID CHANNEL



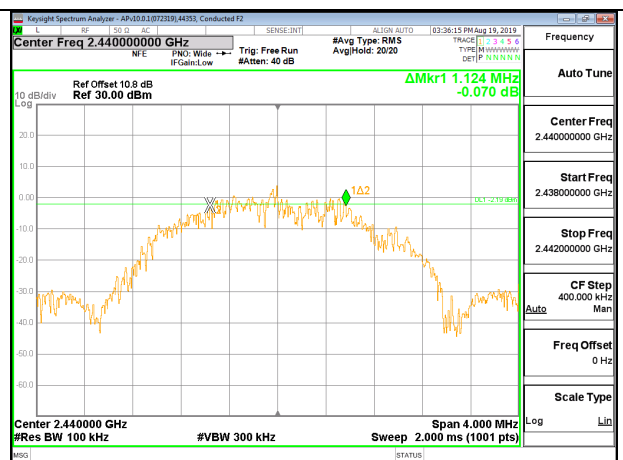
HIGH CHANNEL

8.3.2. BLE (2Mbps)

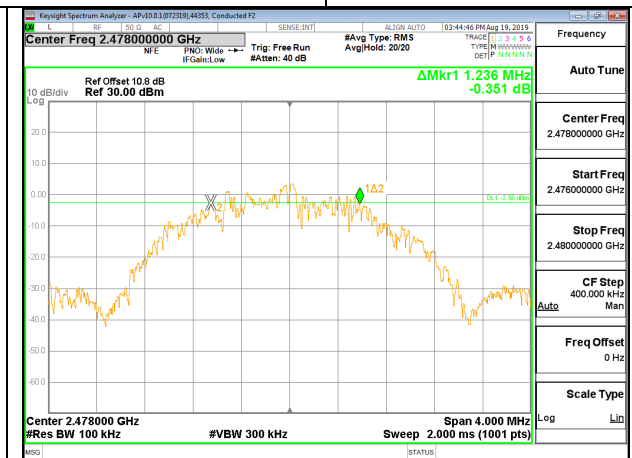
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2404	1.160	0.5
Middle	2440	1.124	0.5
High	2478	1.236	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)

RSS-247 5.4 (d)

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

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

8.4.1. BLE (1Mbps)

Tested By:	39919
Date:	11/4/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.45	30	-25.550
Middle	2440	4.50	30	-25.500
High	2480	4.49	30	-25.510

8.4.2. BLE (2Mbps)

Tested By:	39919
Date:	11/4/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2404	4.45	30	-25.550
Middle	2440	4.46	30	-25.540
High	2478	4.47	30	-25.530

8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.5 dB (including 10 dB pad and 0.5 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

8.5.1. BLE (1Mbps)

Tested By:	39919
Date:	11/4/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	4.29
Middle	2440	4.32
High	2480	4.33

8.5.2. BLE (2Mbps)

Tested By:	39919
Date:	11/4/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2404	4.33
Middle	2440	4.35
High	2478	4.36

8.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

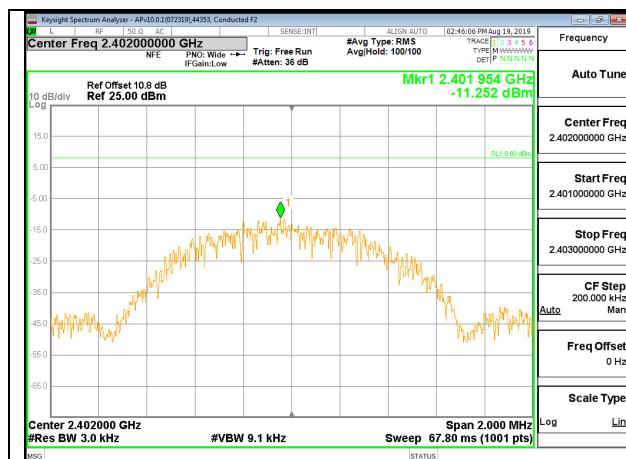
RSS-247 (5.2) (b)

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.

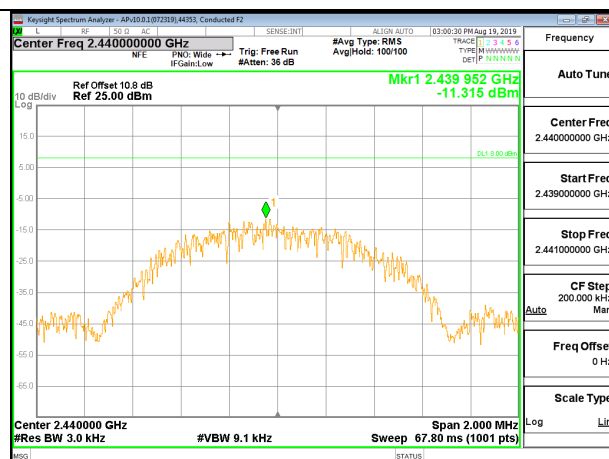
RESULTS

8.6.1. BLE (1Mbps)

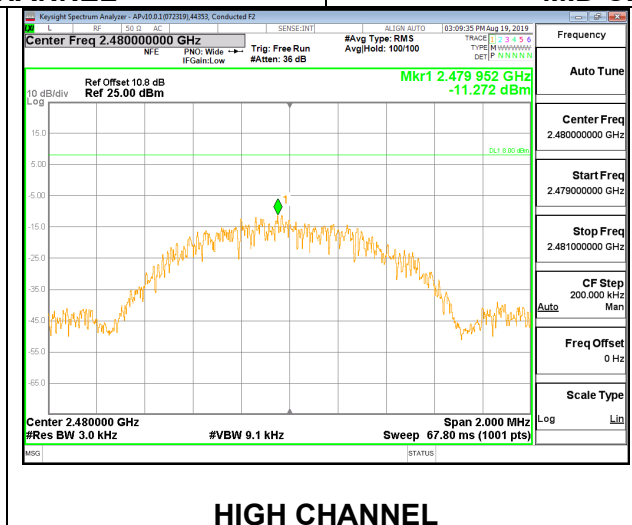
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-11.25	8	-19.25
Middle	2440	-11.32	8	-19.32
High	2480	-11.27	8	-19.27



LOW CHANNEL



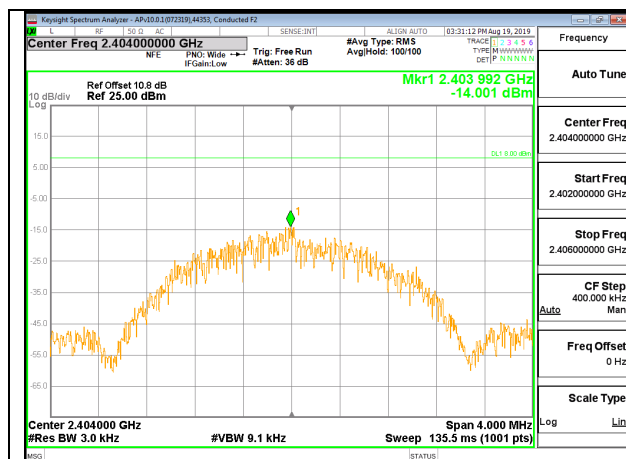
MID CHANNEL



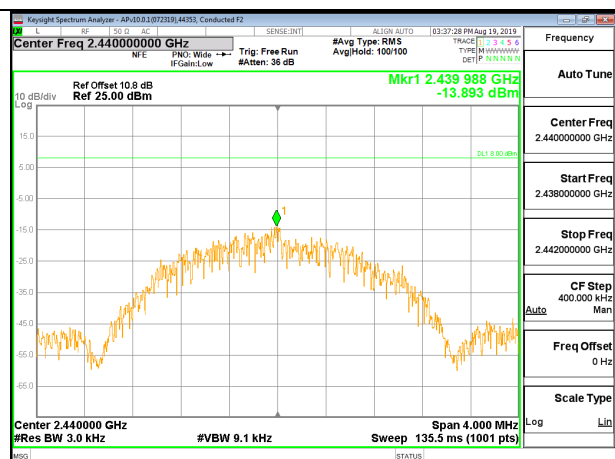
HIGH CHANNEL

8.6.2. BLE (2Mbps)

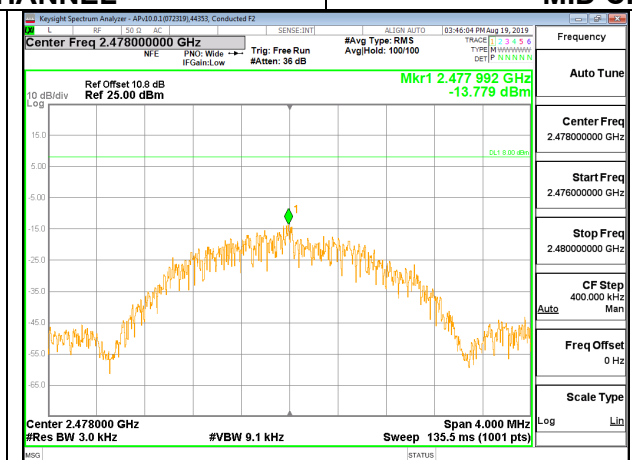
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2404	-14.00	8	-22.00
Middle	2440	-13.89	8	-21.89
High	2478	-13.78	8	-21.78



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

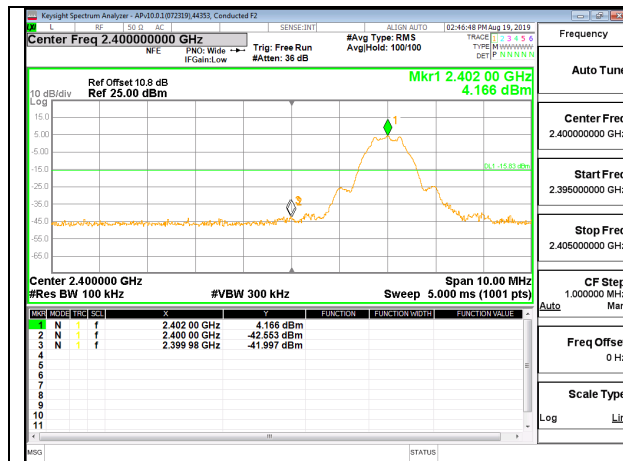
FCC §15.247 (d)

RSS-247 5.5

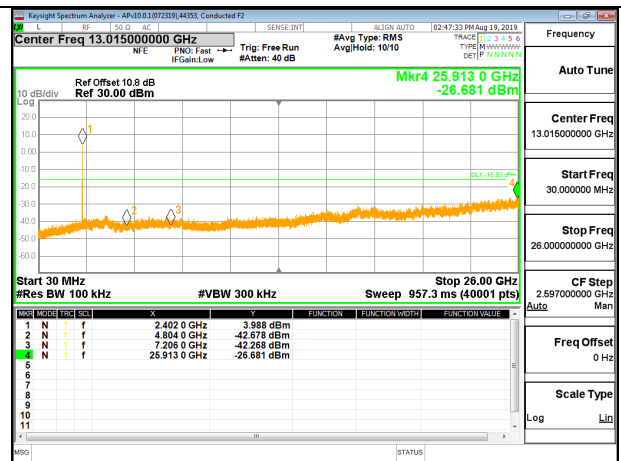
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

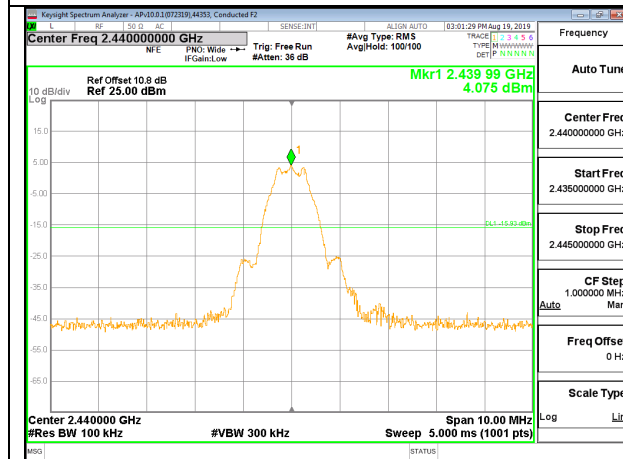
8.7.1. BLE (1Mbps)



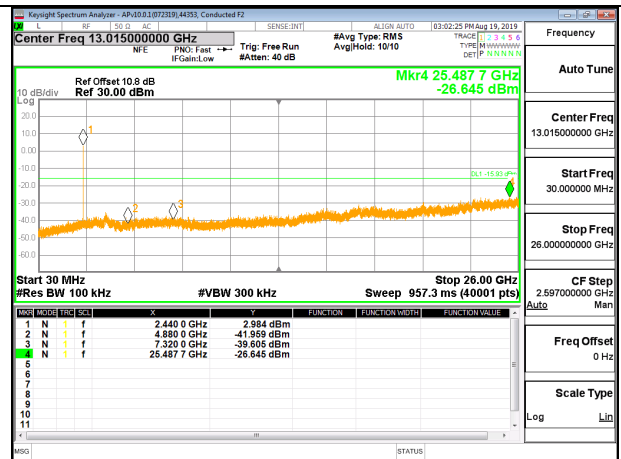
LOW CHANNEL BANDEDGE



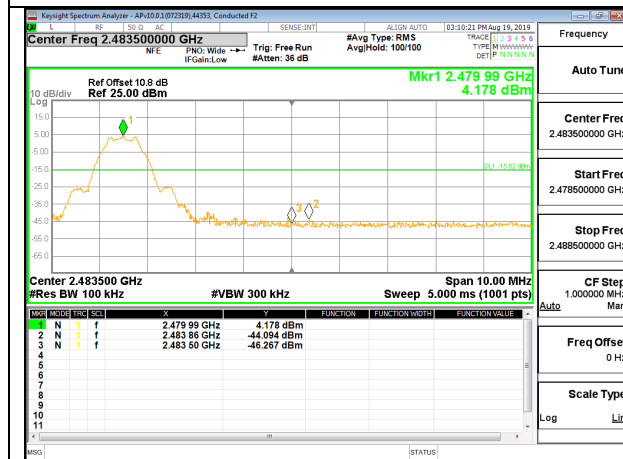
OUT-OF-BAND LOW CHANNEL



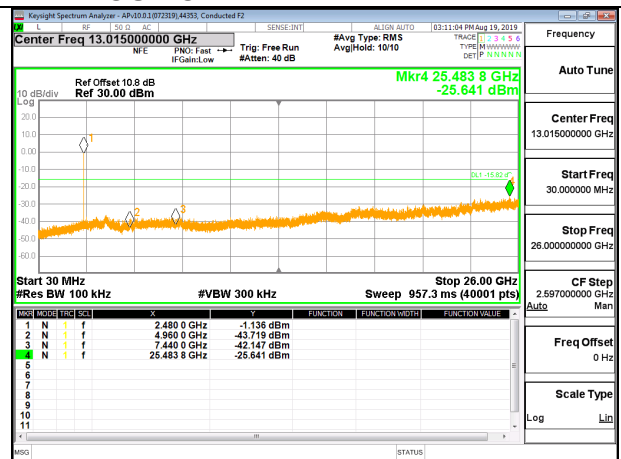
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

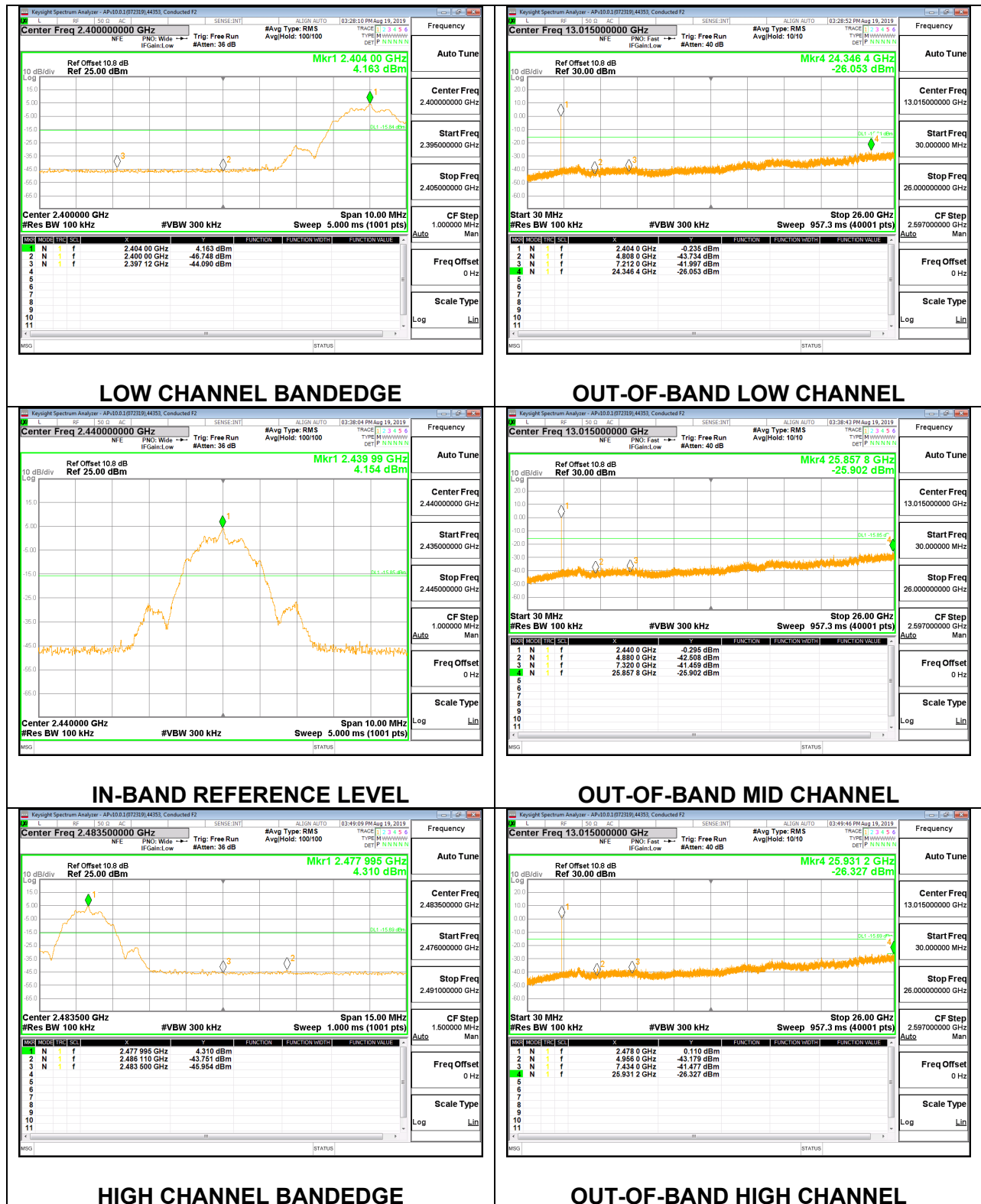


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

8.7.2. BLE (2Mbps)



9. RADIATED TEST RESULTS

9.1. 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.

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. Peak detection is used unless otherwise noted as quasi-peak.

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 scans above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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

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

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

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.

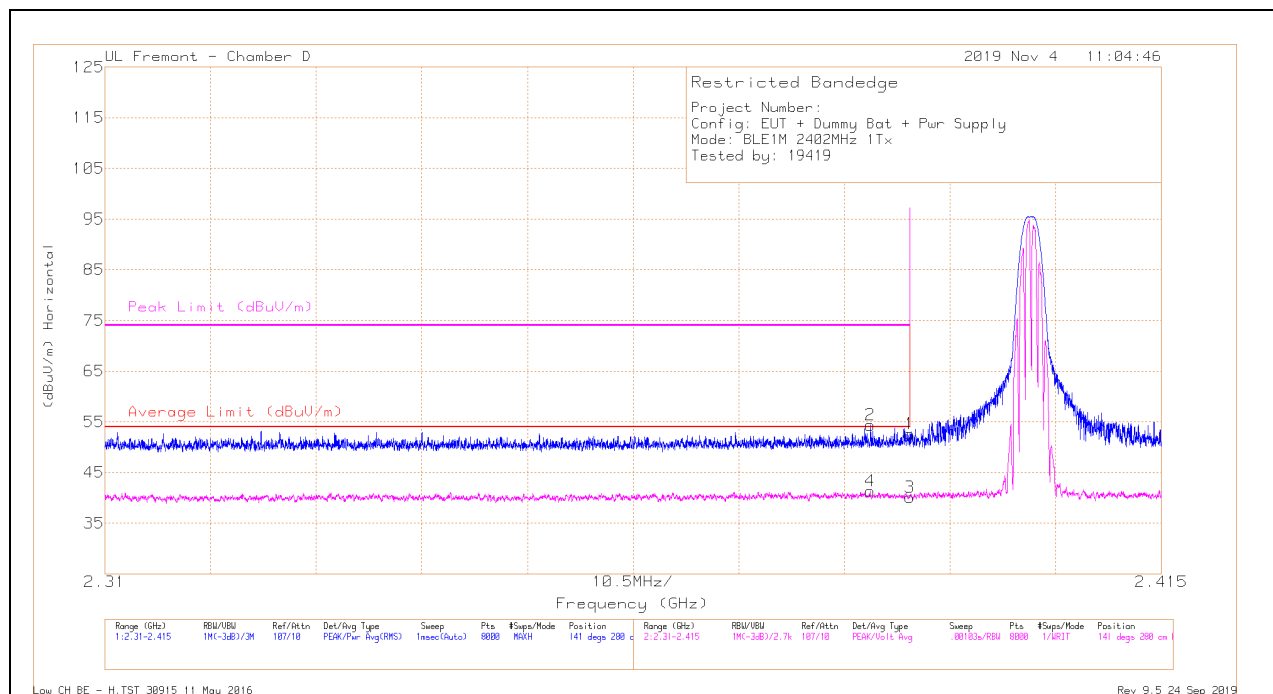
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BLE (1Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



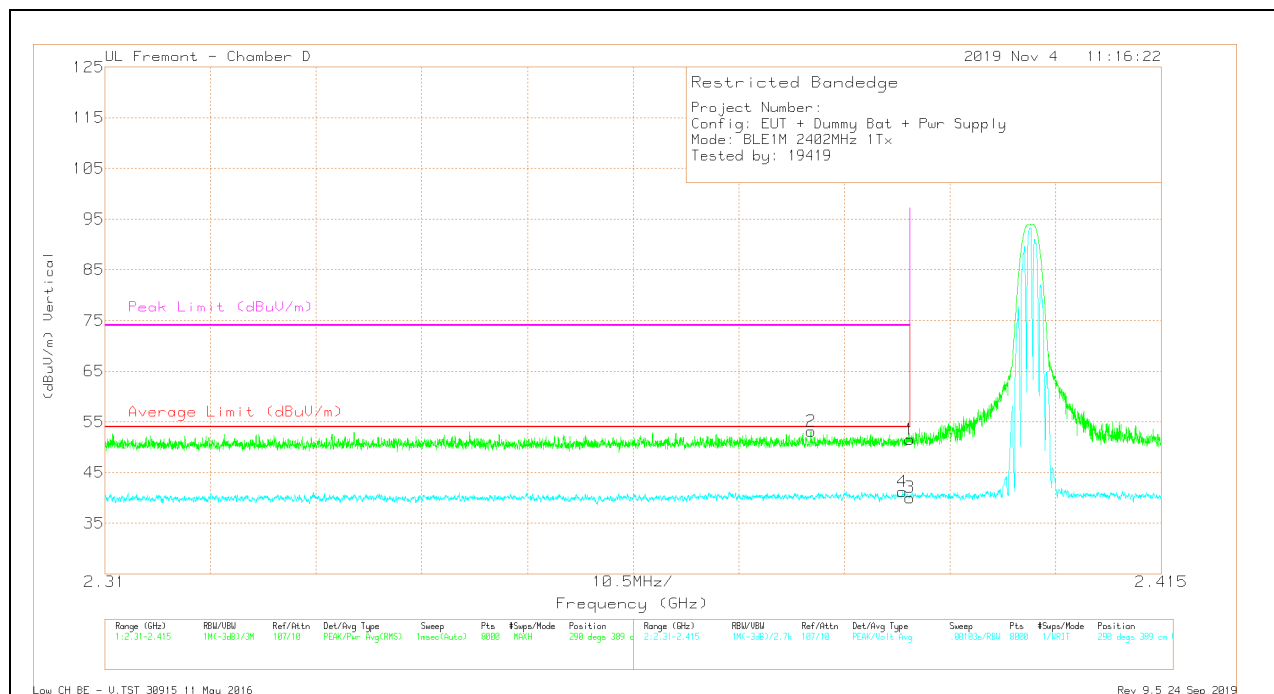
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.11	Pk	32	-20.5	52.61	-	-	74	-21.39	141	280	H
2	* 2.38608	42.93	Pk	32	-20.6	54.33	-	-	74	-19.67	141	280	H
3	* 2.39	28.56	VA1T	32	-20.5	40.06	54	-13.94	-	-	141	280	H
4	* 2.38606	29.92	VA1T	32	-20.6	41.32	54	-12.68	-	-	141	280	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT

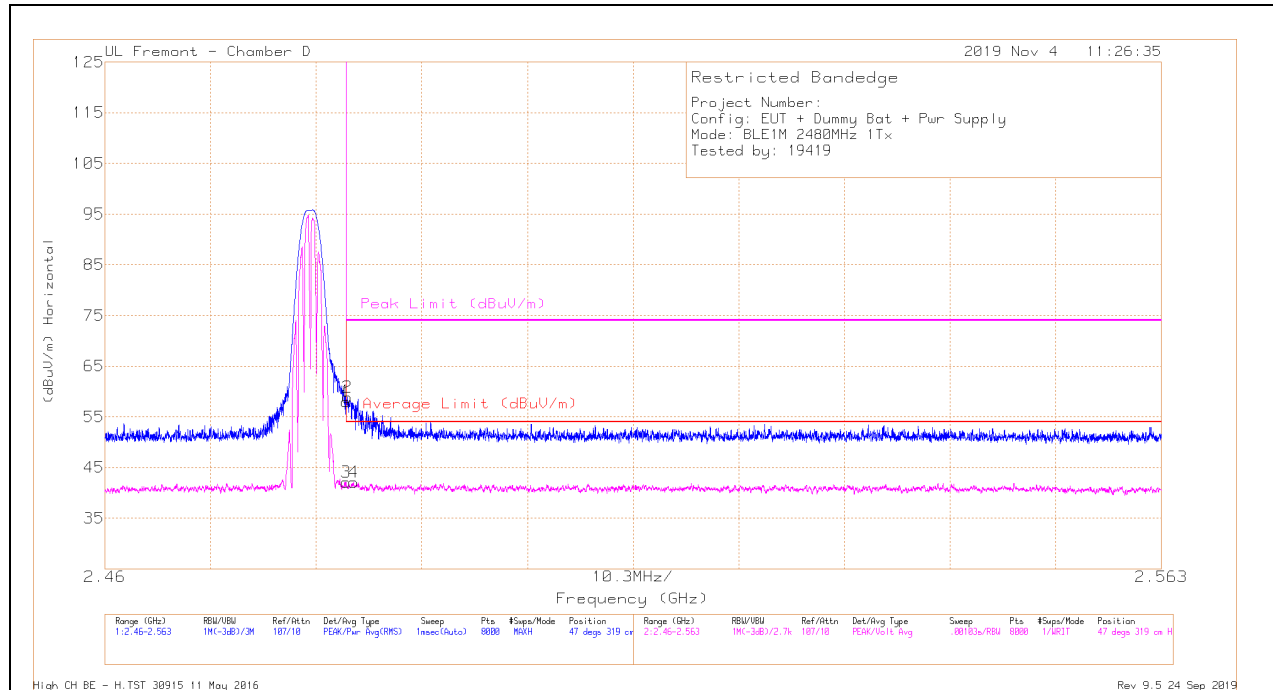


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dBm)	Amp/Cbl/FiltriPa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.05	Pk	32	-20.5	51.55	-	-	74	-22.45	290	389	V
2	* 2.38018	41.75	Pk	31.9	-20.5	53.15	-	-	74	-20.85	290	389	V
3	* 2.39	28.55	VA1T	32	-20.5	40.05	54	-13.95	-	-	290	389	V
4	* 2.38926	29.7	VA1T	32	-20.5	41.2	54	-12.8	-	-	290	389	V

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

BANDEDGE (HIGH CHANNEL)**HORIZONTAL RESULT**

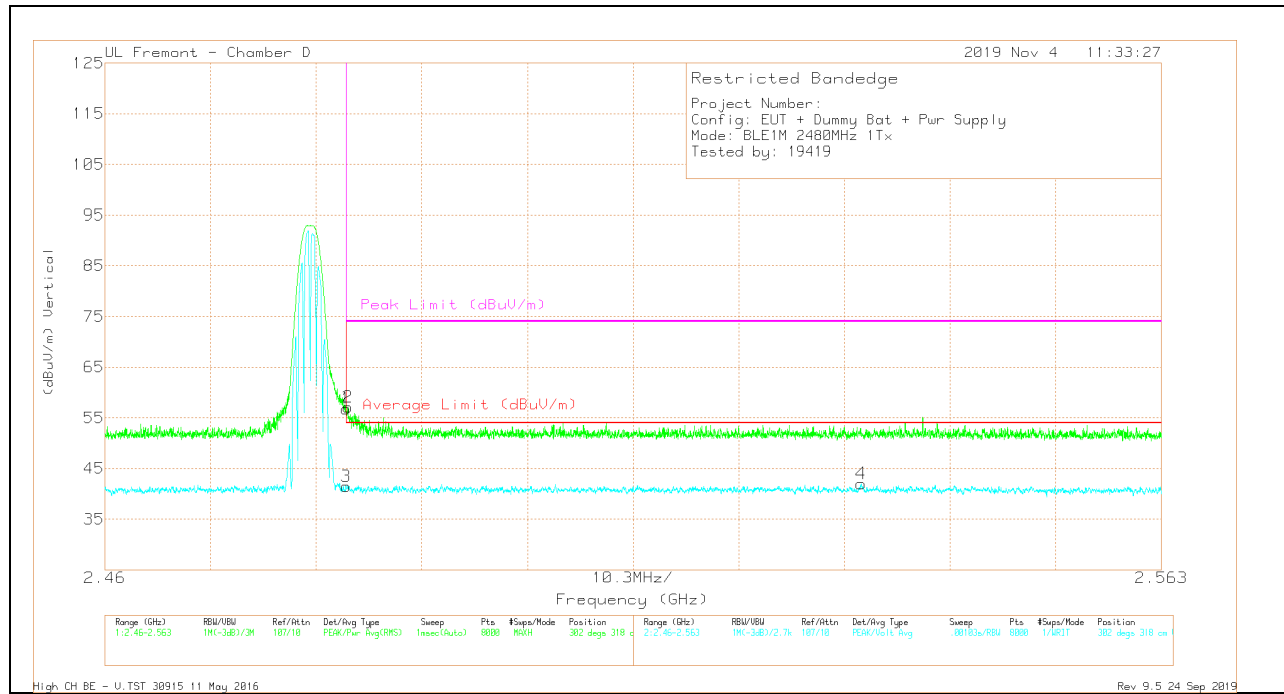
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	46.15	Pk	32.4	-20.5	58.05	-	-	74	-15.95	47	319	H
2	* 2.48366	46.93	Pk	32.4	-20.5	58.83	-	-	74	-15.17	47	319	H
3	* 2.4835	30.15	VA1T	32.4	-20.5	42.05	54	-11.95	-	-	47	319	H
4	* 2.48426	30.25	VA1T	32.3	-20.5	42.05	54	-11.95	-	-	47	319	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dBm)	Amp/Cbl/Filtr/Pa d (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	44.91	Pk	32.4	-20.5	56.81	-	-	74	-17.19	302	318	V
2	* 2.48368	45.18	Pk	32.4	-20.5	57.08	-	-	74	-16.92	302	318	V
3	* 2.4835	29.62	VA1T	32.4	-20.5	41.52	54	-12.48	-	-	302	318	V
4	2.53373	30.23	VA1T	32.2	-20.4	42.03	54	-11.97	-	-	302	318	V

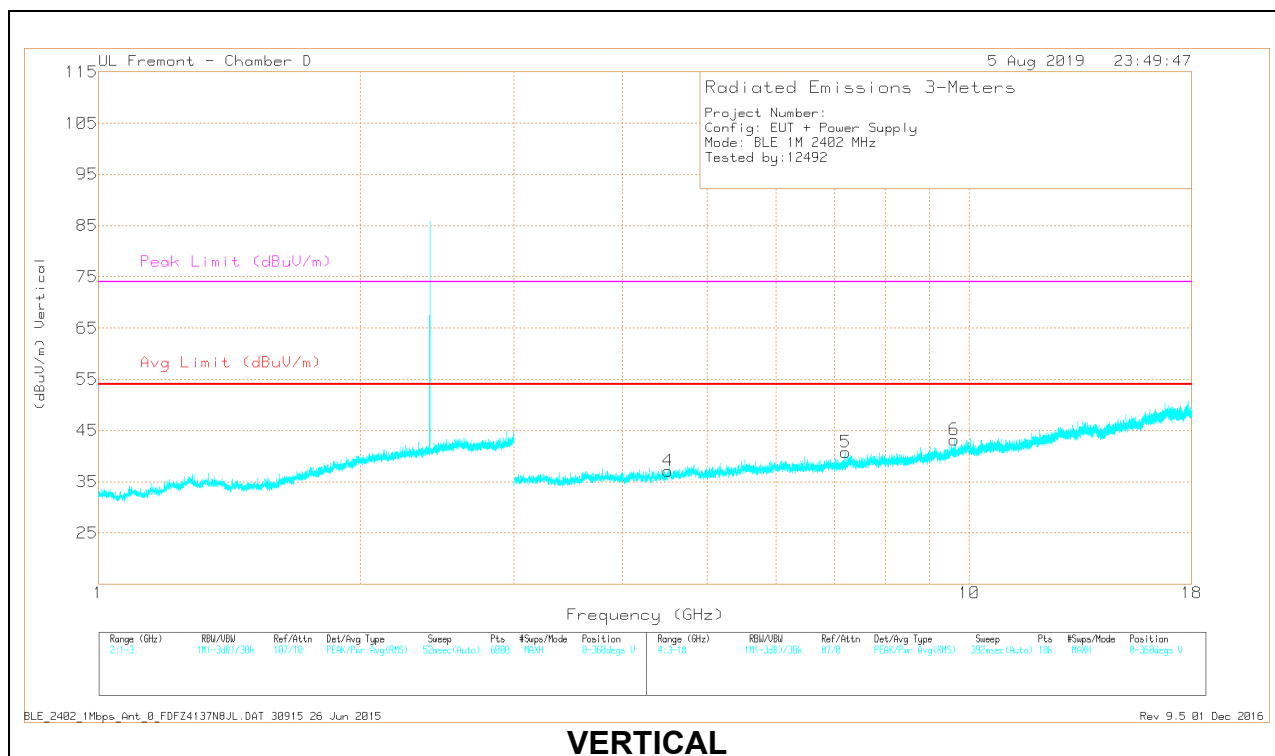
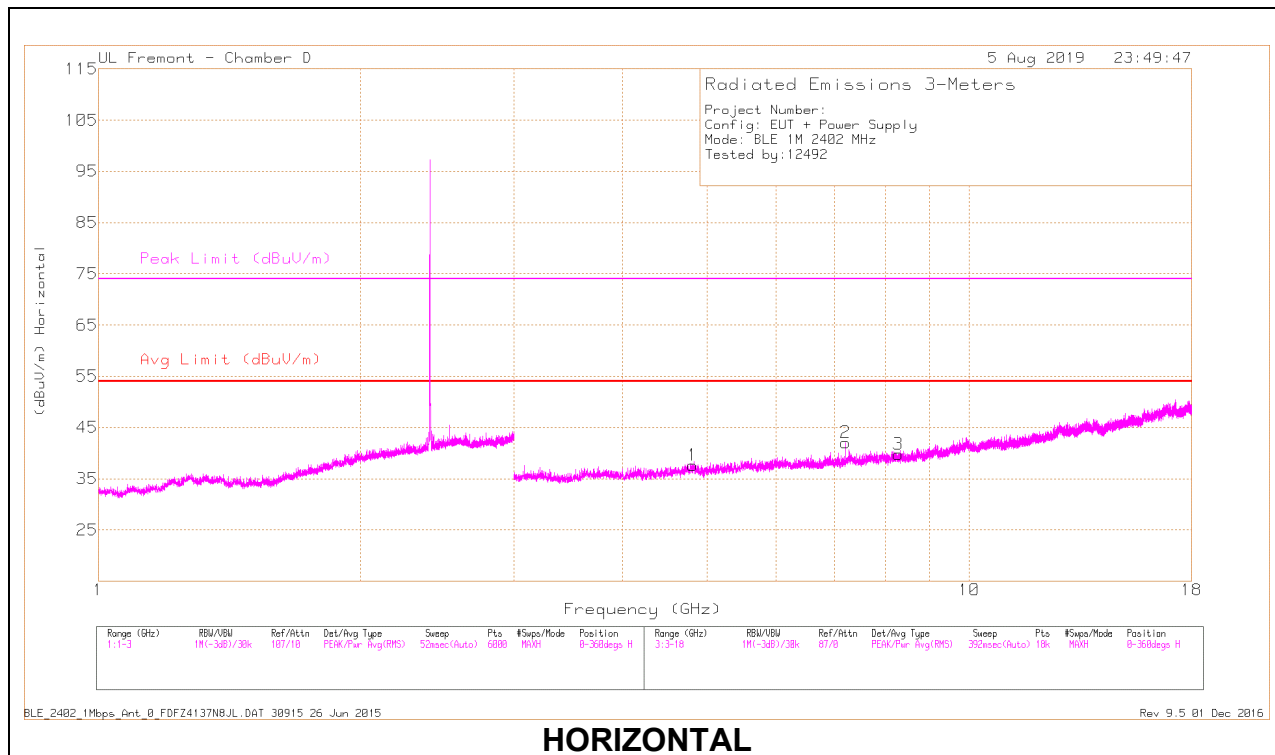
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

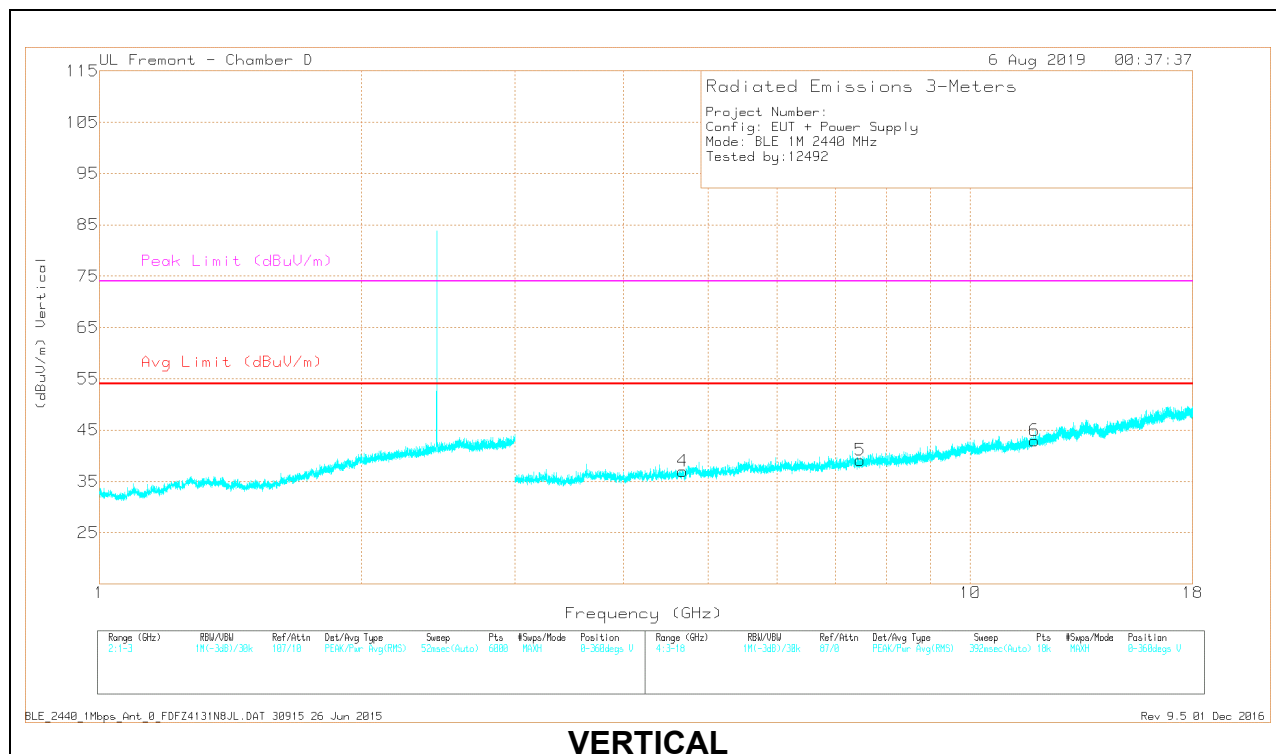
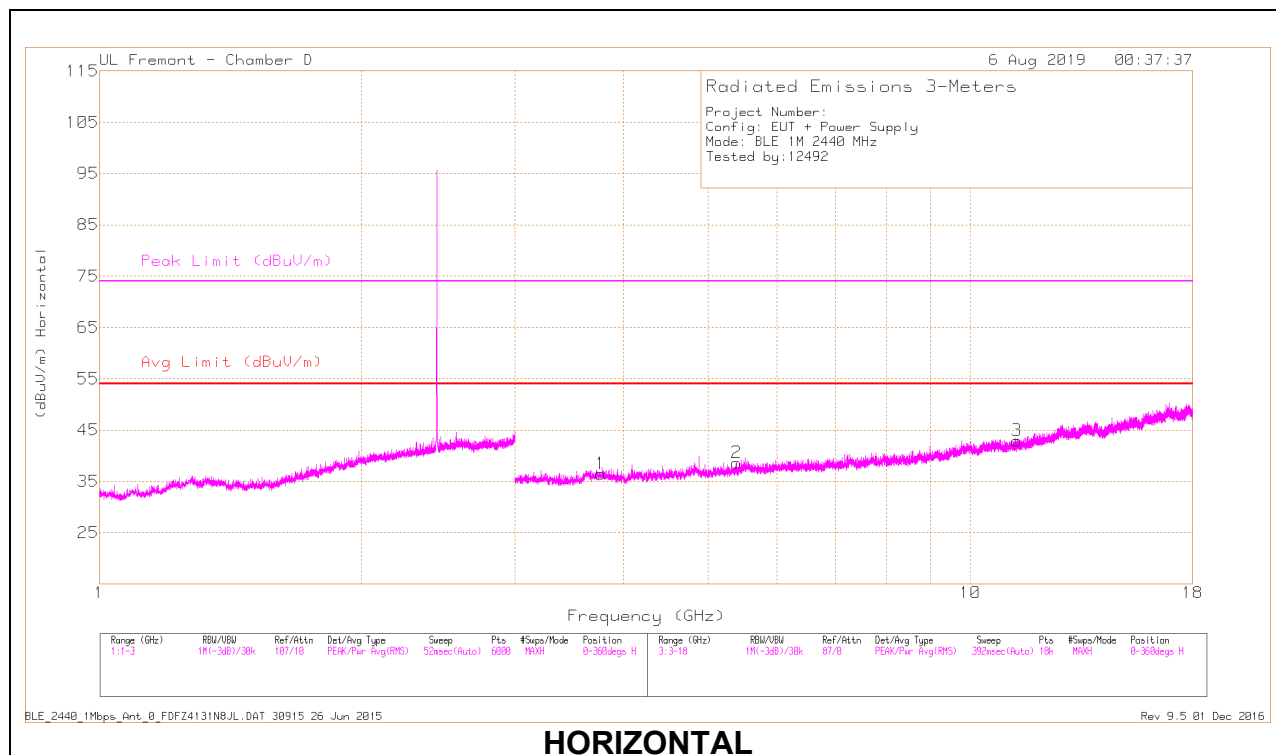
MArker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.814	36.07	PKFH	34.4	-30.3	40.17	-	-	74	-33.83	116	188	H
	* 4.815	23.15	VA1T	34.4	-30.3	27.25	54	-26.75	-	-	116	188	H
3	* 8.282	33.42	PKFH	36.1	-25.8	43.72	-	-	74	-30.28	107	254	H
	* 8.28	19.93	VA1T	36.1	-25.9	30.13	54	-23.87	-	-	107	254	H
4	* 4.509	36.05	PKFH	34.1	-30.4	39.75	-	-	74	-34.25	356	255	V
	* 4.511	23.25	VA1T	34.1	-30.4	26.95	54	-27.05	-	-	356	255	V
2	7.205	34.69	PKFH	36	-28.1	42.59	-	-	-	-	139	400	H
	7.205	23.58	VA1T	36	-28.1	31.48	-	-	-	-	139	400	H
5	7.205	35.51	PKFH	36	-28.1	43.41	-	-	-	-	343	167	V
	7.205	23.54	VA1T	36	-28.1	31.44	-	-	-	-	343	167	V
6	9.607	31.99	PKFH	36.8	-24.3	44.49	-	-	-	-	6	133	V
	9.607	19.97	VA1T	36.8	-24.3	32.47	-	-	-	-	6	133	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

MID CHANNEL RESULTS



RADIATED EMISSIONS

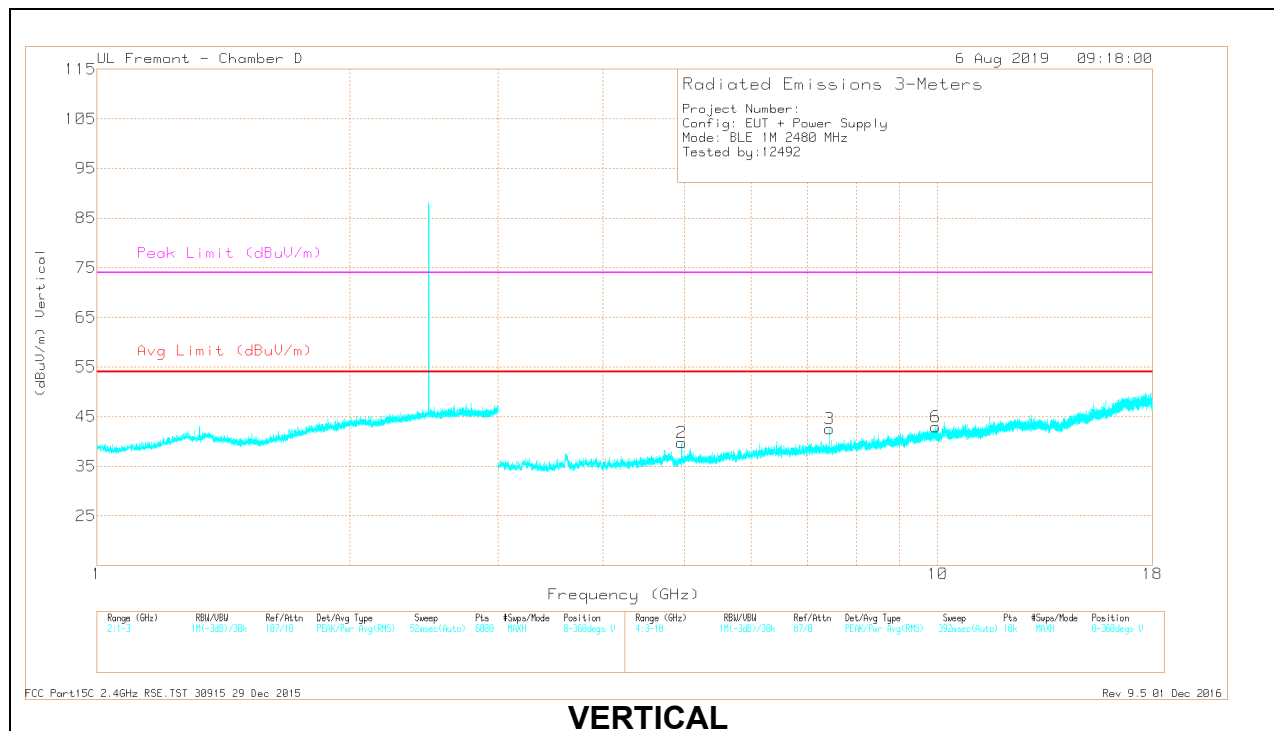
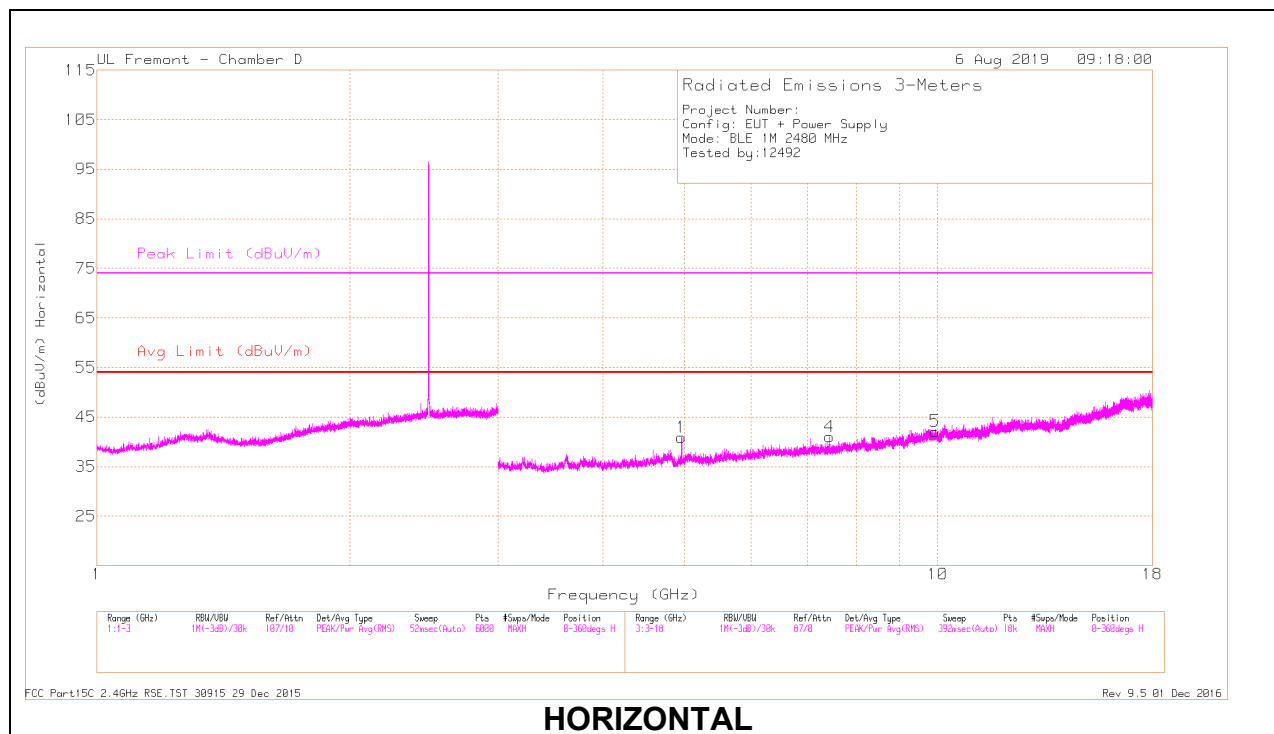
Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.764	35.86	PKFH	33.5	-31	38.36	-	-	74	-35.64	136	285	H
	* 3.762	23.68	VA1T	33.5	-31	26.18	54	-27.82	-	-	136	285	H
2	* 5.388	34.51	PKFH	34.9	-29.1	40.31	-	-	74	-33.69	178	397	H
	* 5.388	22.41	VA1T	34.9	-29.1	28.21	54	-25.79	-	-	178	397	H
3	* 11.316	29.22	PKFH	38	-23.6	43.62	-	-	74	-30.38	174	189	H
	* 11.319	15.98	VA1T	38	-23.6	30.38	54	-23.62	-	-	174	189	H
4	* 4.673	37.32	PKFH	34.2	-30	41.52	-	-	74	-32.48	134	194	V
	* 4.671	24.09	VA1T	34.2	-30	28.29	54	-25.71	-	-	134	194	V
5	* 7.473	32.13	PKFH	36	-27.4	40.73	-	-	74	-33.27	351	212	V
	* 7.47	19.82	VA1T	36.1	-27.5	28.42	54	-25.58	-	-	351	212	V
6	* 11.839	32	PKFH	38.5	-23	47.5	-	-	74	-26.5	105	272	V
	* 11.839	16.86	VA1T	38.5	-23	32.36	54	-21.64	-	-	105	272	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/ Filtr/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	* 4.96	40.89	PKFH	34	-27.5	47.39	-	-	74	-26.61	301	398	H
	* 4.96	31.47	VA1T	34	-27.5	37.97	54	-16.03	-	-	301	398	H
2	* 7.441	35.06	PKFH	35.5	-24.5	46.06	-	-	74	-27.94	186	174	H
	* 7.439	21.3	VA1T	35.5	-24.5	32.3	54	-21.7	-	-	186	174	H
5	* 7.441	37.91	PKFH	35.5	-24.5	48.91	-	-	74	-25.09	320	106	V
	* 7.44	26.65	VA1T	35.5	-24.5	37.65	54	-16.35	-	-	320	106	V
4	* 4.959	39.91	PKFH	34	-27.5	46.41	-	-	74	-27.59	310	380	V
	* 4.96	30.29	VA1T	34	-27.5	36.79	54	-17.21	-	-	310	380	V
3	9.919	17.95	VA1T	36.9	-20.7	34.15	-	-	-	-	194	104	H
	9.921	31.89	PKFH	36.9	-20.7	48.09	-	-	-	-	194	104	H
6	9.933	17.6	VA1T	36.9	-20.7	33.8	-	-	-	-	78	179	V
	9.934	32.99	PKFH	36.9	-20.7	49.19	-	-	-	-	78	179	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

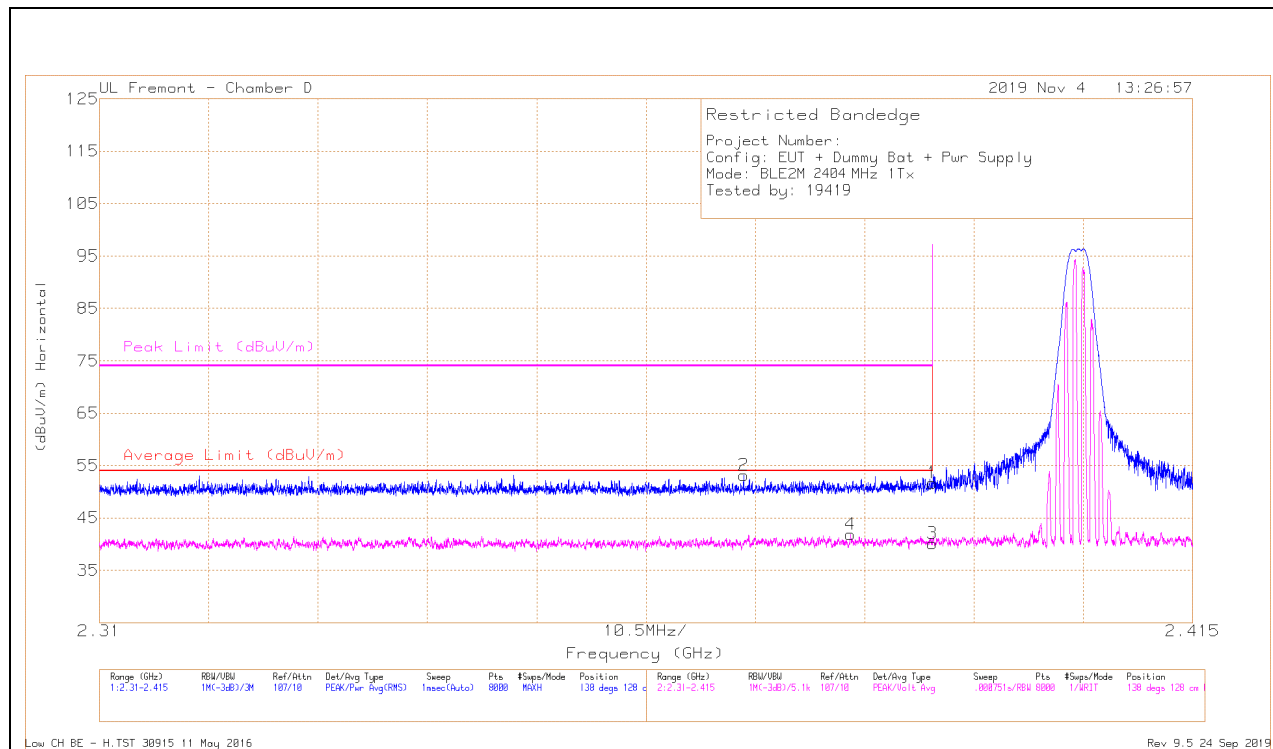
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

9.2.2. BLE (2Mbps)

Antenna 1

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degr)	Height (cm)	Polarity
1	* 2.39	40.21	Pk	32	-20.5	51.71	-	-	74	-22.29	138	128	H
2	* 2.37188	41.81	Pk	31.9	-20.6	53.11	-	-	74	-20.89	138	128	H
3	* 2.39	28.62	VA1T	32	-20.5	40.12	54	-13.88	-	-	138	128	H
4	* 2.38213	30.5	VA1T	32	-20.6	41.9	54	-12.1	-	-	138	128	H

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

PK - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBV)	Det	AF T712 (dB/m)	Amp/Cbl/FiltriPa d (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	39.98	Pk	32	-20.5	51.48	-	-	74	-22.52	178	303	V
2	* 2.38673	41.78	Pk	32	-20.6	53.18	-	-	74	-20.82	178	303	V
3	* 2.39	28.76	VA1T	32	-20.5	40.26	54	-13.74	-	-	178	303	V
4	* 2.37842	30.47	VA1T	31.9	-20.5	41.87	54	-12.13	-	-	178	303	V

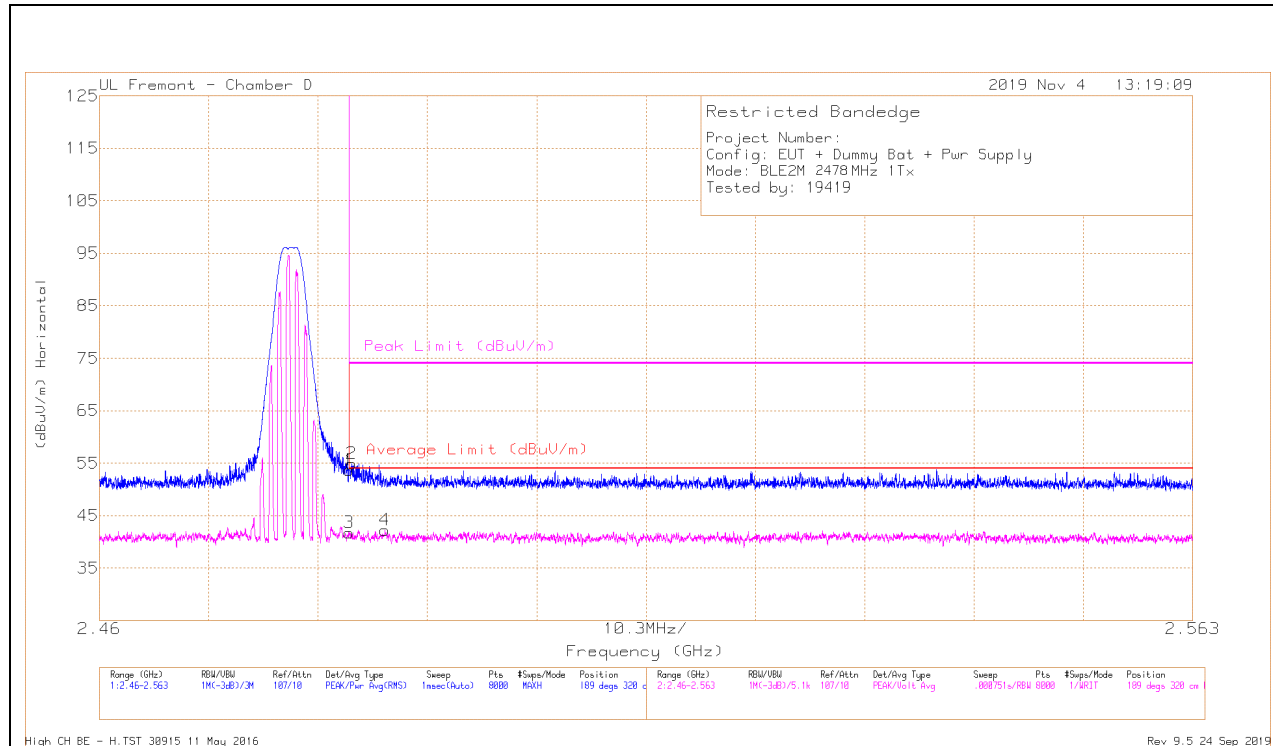
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



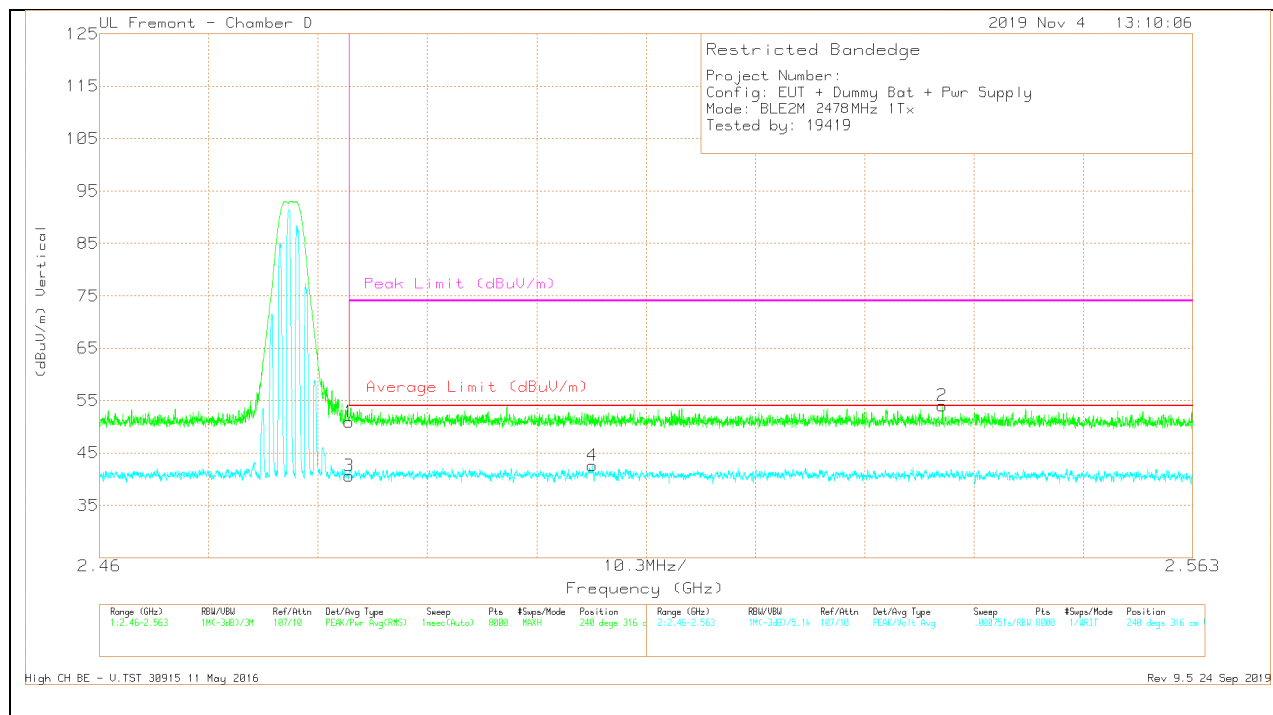
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.73	Pk	32.4	-20.5	53.63	-	-	74	-20.37	189	320	H
2	* 2.48378	43.03	Pk	32.4	-20.5	54.93	-	-	74	-19.07	189	320	H
3	* 2.4835	29.87	VA1T	32.4	-20.5	41.77	54	-12.23	-	-	189	320	H
4	* 2.48689	30.46	VA1T	32.3	-20.5	42.26	54	-11.74	-	-	189	320	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fitr/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	39.06	Pk	32.4	-20.5	50.96	-	-	74	-23.04	240	316	V
3	*2.4835	28.73	VA1T	32.4	-20.5	40.63	54	-13.37	-	-	240	316	V
4	2.50643	30.77	VA1T	32.3	-20.5	42.57	54	-11.43	-	-	240	316	V
2	2.53941	42.07	Pk	32.2	-20.3	53.97	-	-	74	-20.03	240	316	V

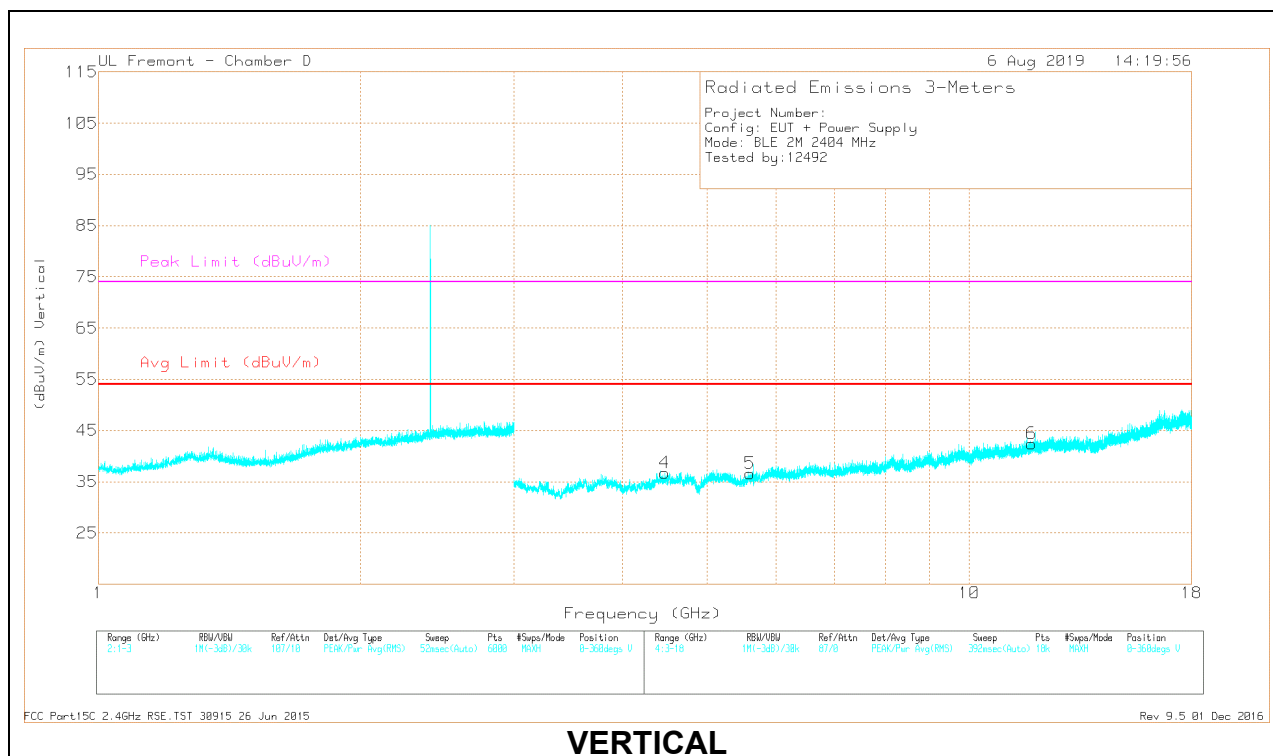
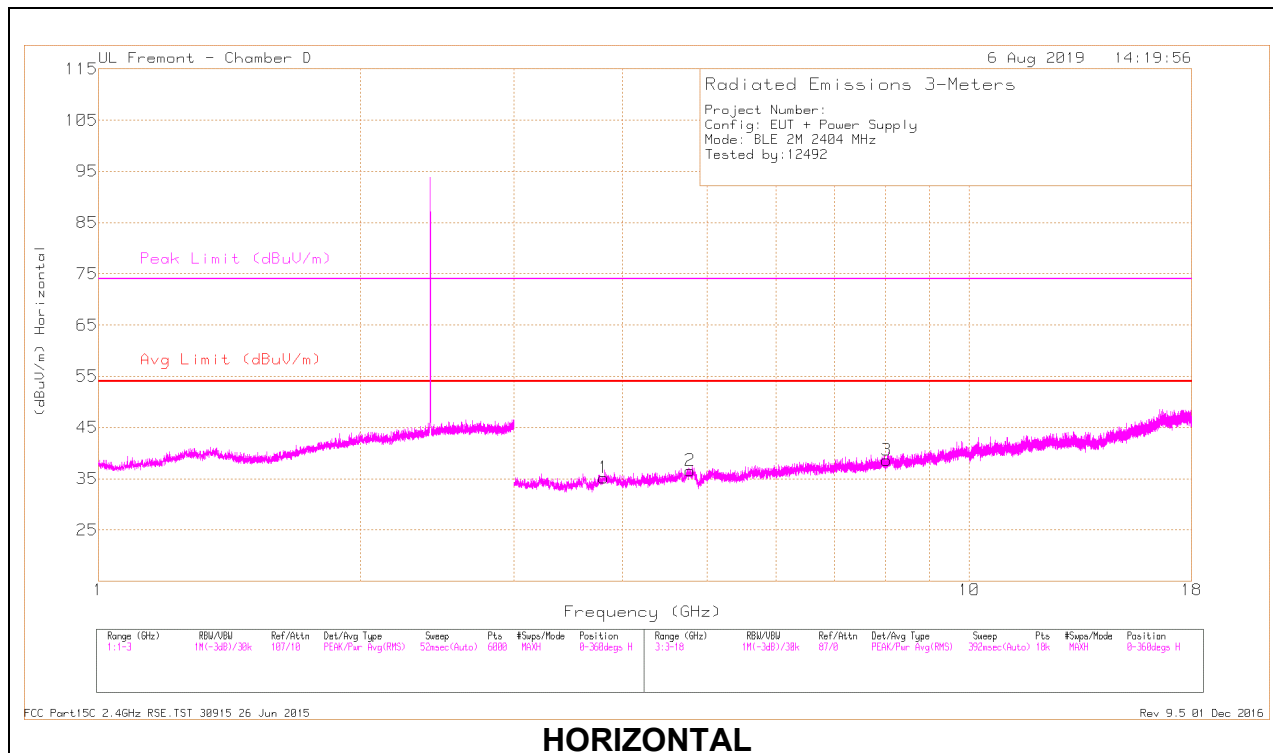
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

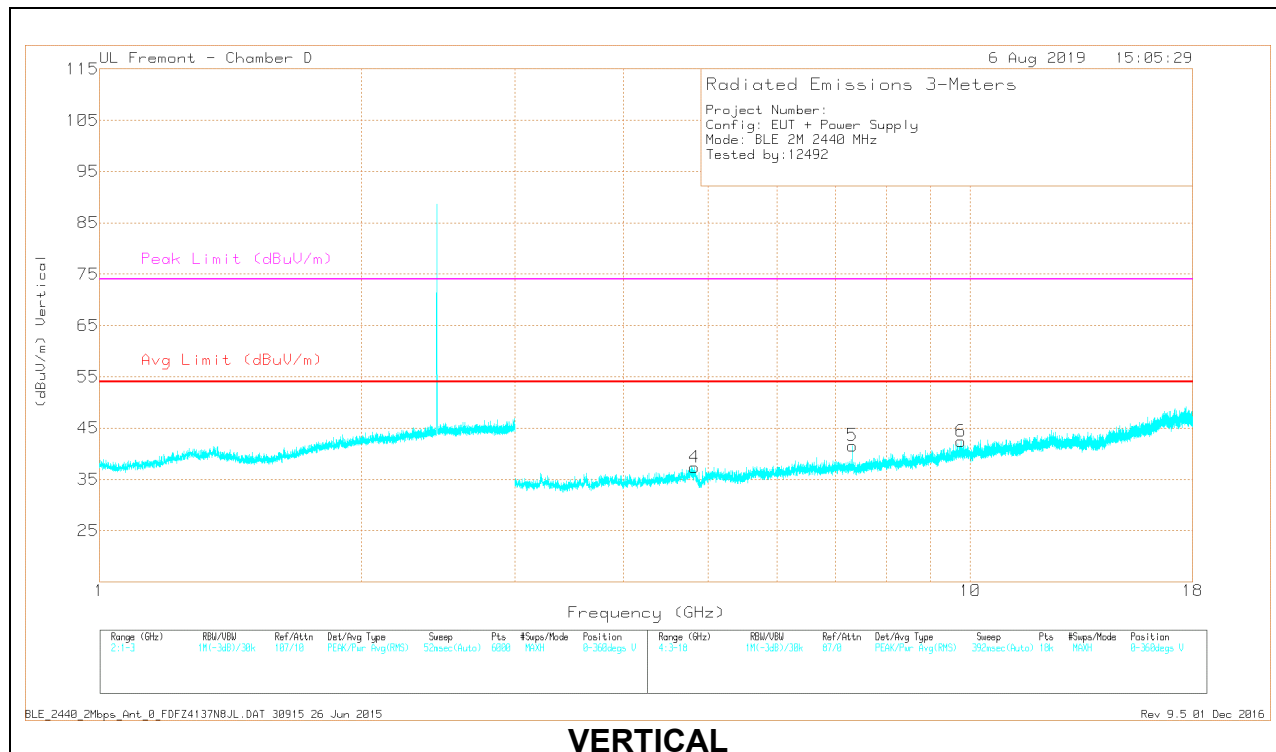
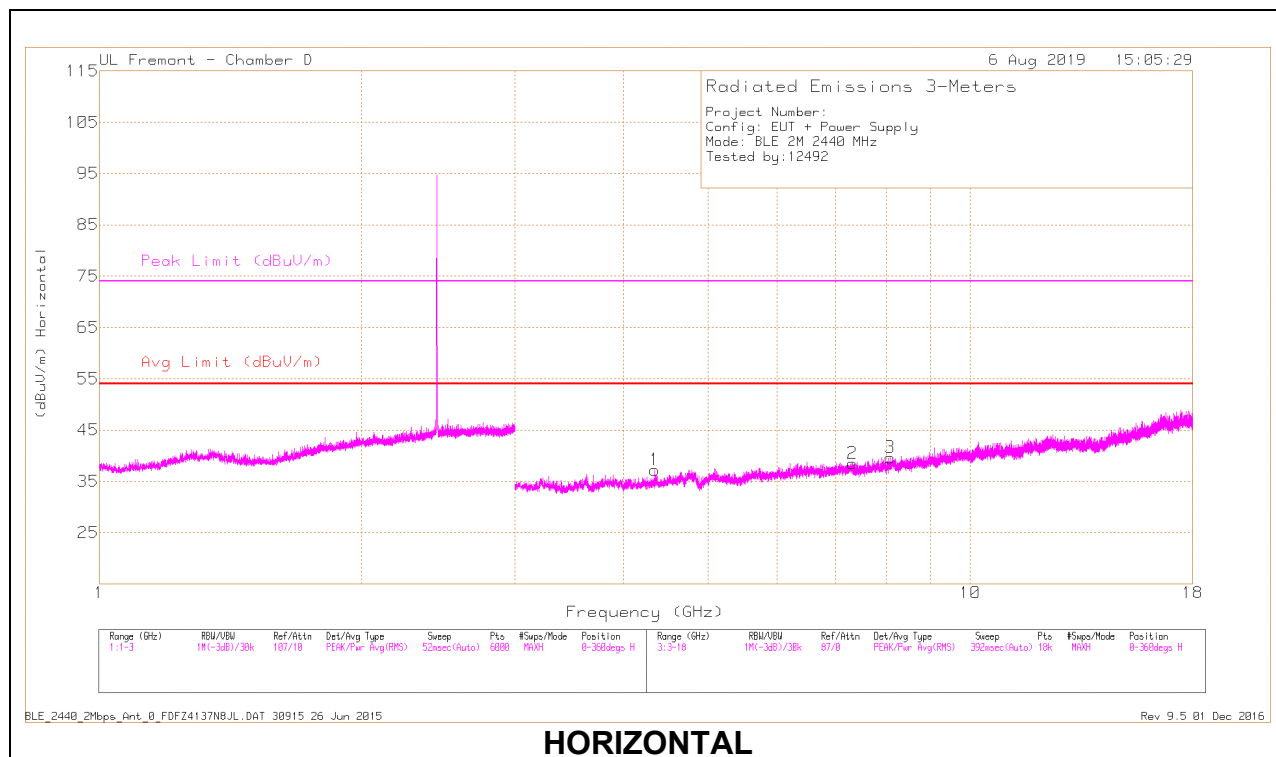
Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.801	35.43	PKFH	33.5	-28.2	40.73	-	-	74	-33.27	193	274	H
	* 3.802	23.65	VA1T	33.5	-28.2	28.95	54	-25.05	-	-	193	274	H
2	* 4.78	35.5	PKFH	34	-26.7	42.8	-	-	74	-31.2	237	291	H
	* 4.78	22.97	VA1T	34	-26.6	30.37	54	-23.63	-	-	237	291	H
3	* 8.034	32.66	PKFH	35.7	-24.1	44.26	-	-	74	-29.74	130	167	H
	* 8.034	20.2	VA1T	35.7	-24	31.9	54	-22.1	-	-	130	167	H
6	* 11.787	31.49	PKFH	38.5	-21.2	48.79	-	-	74	-25.21	315	311	V
	* 11.788	16.74	VA1T	38.5	-21.2	34.04	54	-19.96	-	-	315	311	V
4	4.474	37.19	PKFH	33.6	-27.6	43.19	-	-	-	-	67	286	V
	4.475	23.34	VA1T	33.6	-27.6	29.34	-	-	-	-	67	286	V
5	5.598	34.39	PKFH	34.6	-26.5	42.49	-	-	-	-	277	145	V
	5.598	21.83	VA1T	34.6	-26.5	29.93	-	-	-	-	277	145	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

MID CHANNEL RESULTS



RADIATED EMISSIONS

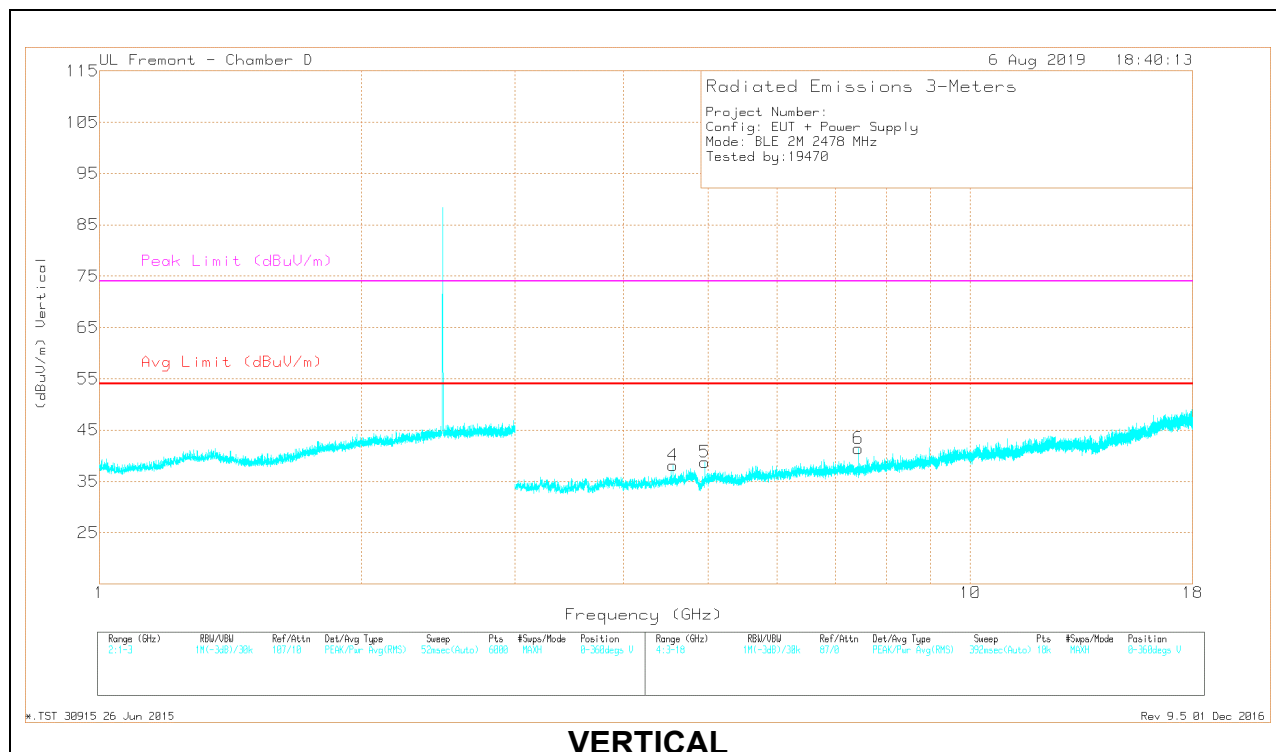
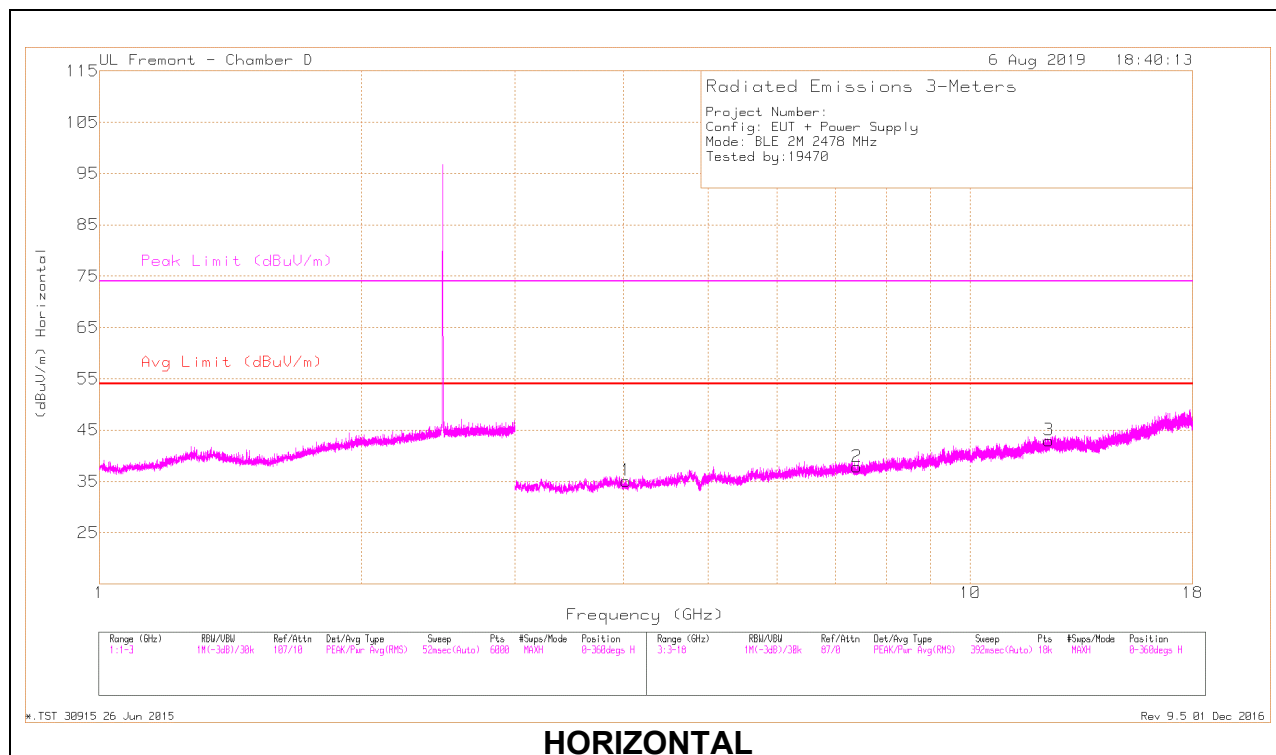
Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/ Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.344	27.21	PKFH	33.6	-28.4	32.41	-	-	74	-41.59	123	154	H
	* 4.345	8.43	VA1T	33.6	-28.4	13.63	54	-40.37	-	-	123	154	H
2	* 7.319	26.28	PKFH	35.4	-25.1	36.58	-	-	74	-37.42	269	151	H
	* 7.321	6.36	VA1T	35.5	-25.1	16.76	54	-37.24	-	-	269	151	H
3	* 8.093	26.09	PKFH	35.7	-23.9	37.89	-	-	74	-36.11	212	189	H
	* 8.093	8.32	VA1T	35.7	-23.9	20.12	54	-33.88	-	-	212	189	H
4	* 4.821	27.46	PKFH	34	-27	34.46	-	-	74	-39.54	189	215	V
	* 4.822	7.08	VA1T	34	-27	14.08	54	-39.92	-	-	189	215	V
5	* 7.321	35.53	PKFH	35.5	-25.1	45.93	-	-	74	-28.07	291	110	V
	* 7.319	27.03	VA1T	35.4	-25.1	37.33	54	-16.67	-	-	291	110	V
6	9.761	7.84	VA1T	36.9	-21.6	23.14	-	-	-	-	63	147	V
	9.762	26.04	PKFH	36.9	-21.6	41.34	-	-	-	-	63	147	V

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

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/ Filtr/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	* 4.028	35.55	PKFH	33.5	-28.5	40.55	-	-	74	-33.45	24	200	H
	* 4.025	25.38	VA1T	33.5	-28.5	30.38	54	-23.62	-	-	24	200	H
2	* 7.406	32.48	PKFH	35.4	-25	42.88	-	-	74	-31.12	89	187	H
	* 7.406	22.72	VA1T	35.5	-25	33.22	54	-20.78	-	-	89	187	H
3	* 12.301	31.56	PKFH	38.9	-21.9	48.56	-	-	74	-25.44	131	224	H
	* 12.299	20.93	VA1T	38.9	-21.8	38.03	54	-15.97	-	-	131	224	H
4	* 4.553	34.48	PKFH	33.9	-27.6	40.78	-	-	74	-33.22	299	392	V
	* 4.554	25.24	VA1T	33.9	-27.6	31.54	54	-22.46	-	-	299	392	V
5	* 4.955	37.46	PKFH	34	-27.6	43.86	-	-	74	-30.14	76	102	V
	* 4.956	30.95	VA1T	34	-27.6	37.35	54	-16.65	-	-	76	102	V
6	* 7.433	35.23	PKFH	35.5	-24.7	46.03	-	-	74	-27.97	156	117	V
	* 7.432	27.79	VA1T	35.5	-24.7	38.59	54	-15.41	-	-	156	117	V

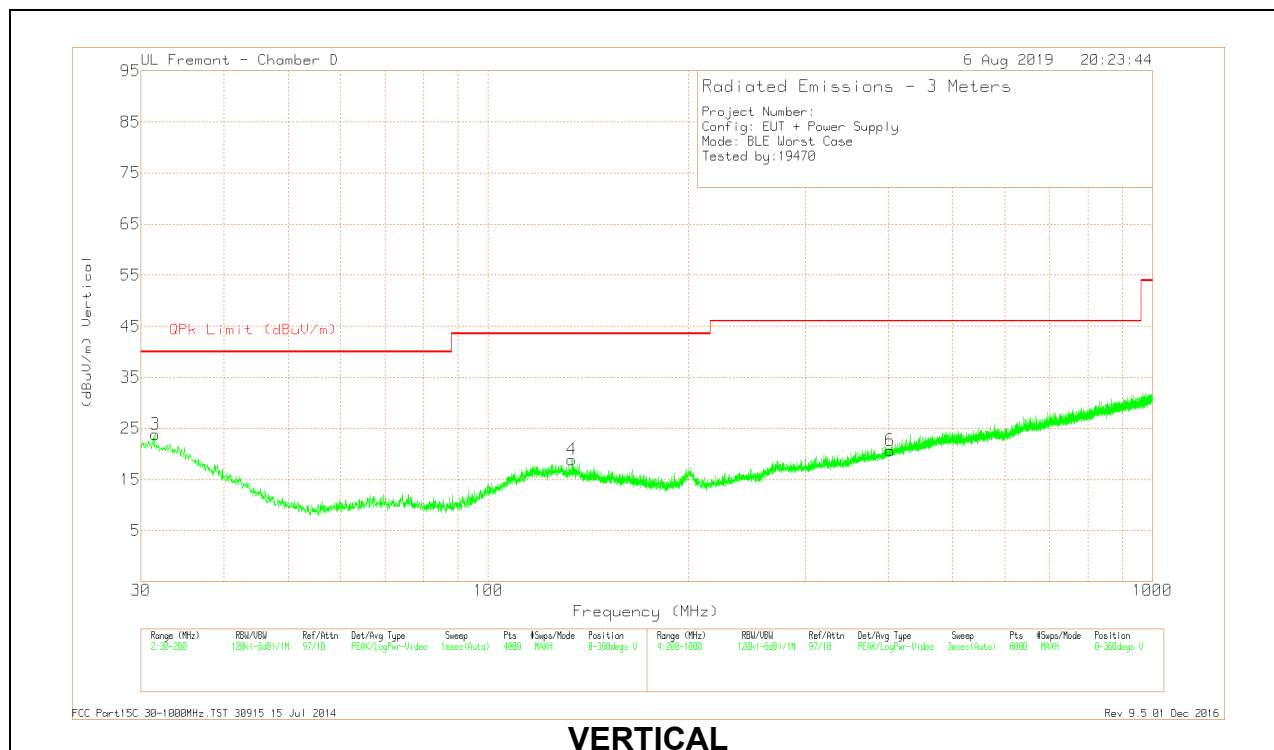
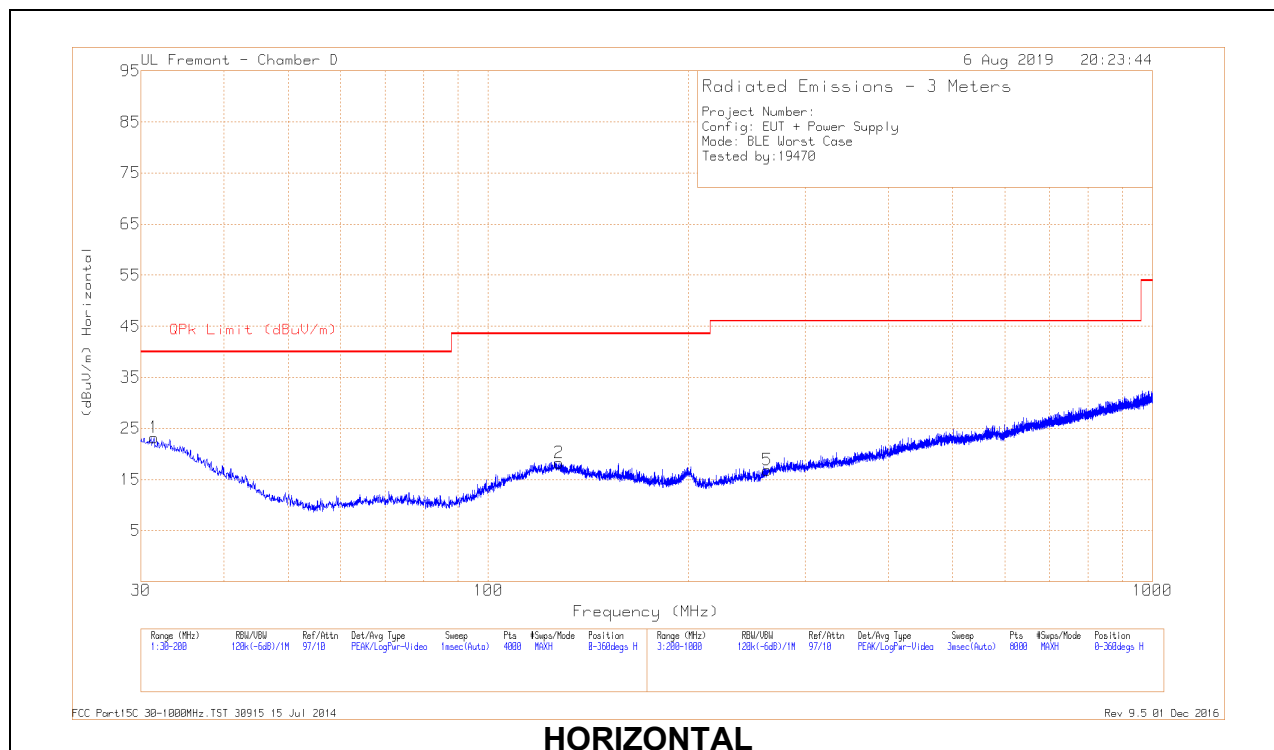
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

9.3. WORST CASE BELOW 1 GHZ

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

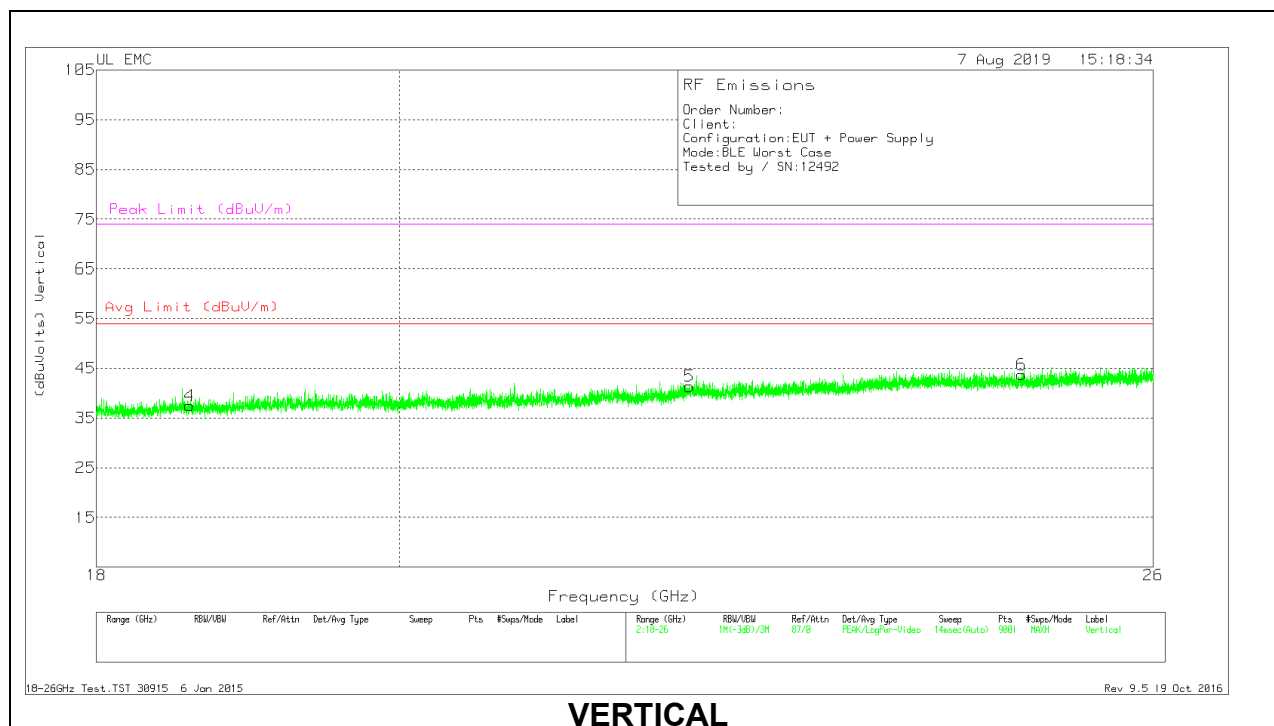
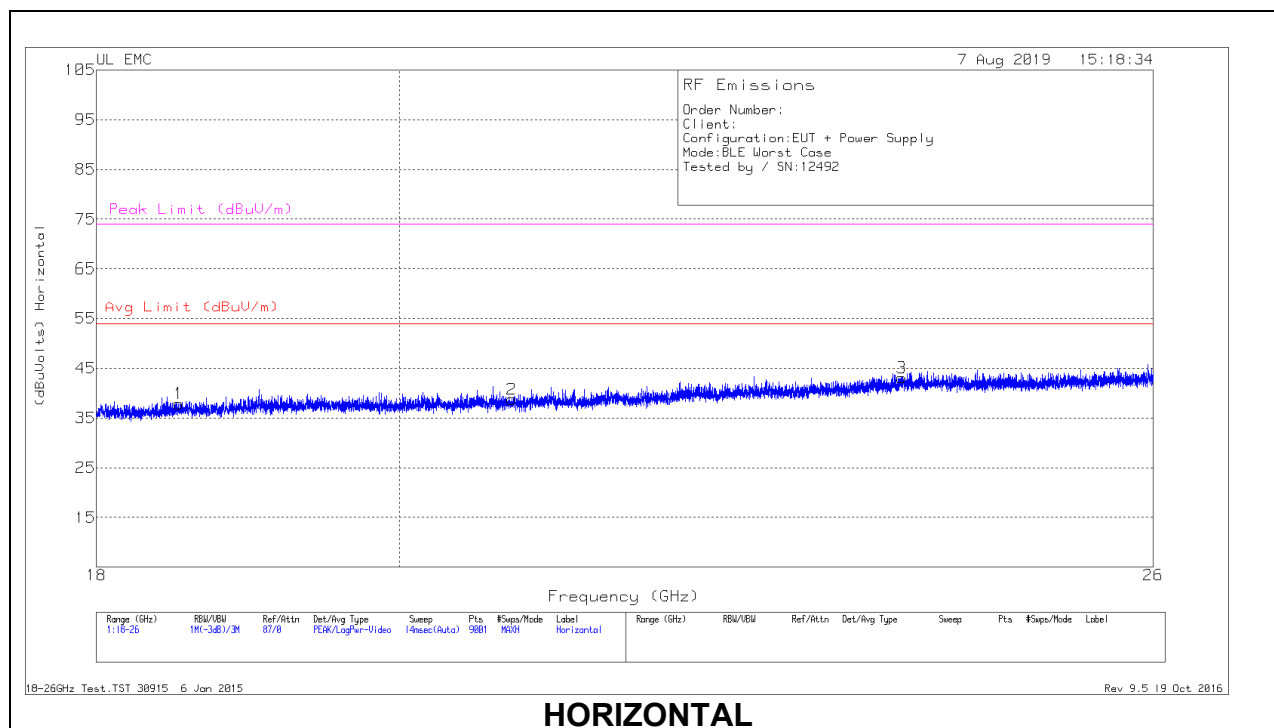


Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 127.8603	29.11	Pk	19.9	-30.8	18.21	43.52	-25.31	0-360	399	H
4	* 133.6843	30.01	Pk	19.6	-30.7	18.91	43.52	-24.61	0-360	100	V
5	* 263.3082	28.23	Pk	18.5	-29.9	16.83	46.02	-29.19	0-360	101	H
6	* 402.6263	28.16	Pk	21.6	-29.1	20.66	46.02	-25.36	0-360	101	V
1	31.4029	29.19	Pk	25.7	-31.7	23.19	40	-16.81	0-360	101	H
3	31.5304	29.97	Pk	25.6	-31.7	23.87	40	-16.13	0-360	100	V

9.4. WORST CASE 18-26 GHZ

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



18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 AF (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	18.523	36.65	Pk	32.4	-21.7	-9.5	37.85	54	-16.15	74	-36.15
2	20.798	36.64	Pk	33	-21.4	-9.5	38.74	54	-15.26	74	-35.26
3	23.822	37.9	Pk	34.2	-19.5	-9.5	43.1	54	-10.9	74	-30.9
4	18.594	36.4	Pk	32.4	-21.8	-9.5	37.5	54	-16.5	74	-36.5
5	22.124	37.75	Pk	33.4	-20.3	-9.5	41.35	54	-12.65	74	-32.65
6	24.834	38.31	Pk	34.4	-19.5	-9.5	43.71	54	-10.29	74	-30.29

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 [*]	56 to 46 [*]
0.5-5	56	46
5-30	60	50

^{*} Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines

RESULTS

Note: Since EUT is battery operated, therefore, AC Line test is not required

11. SETUP PHOTOS

Please refer to 12791034-EP1V1 for setup photos

END OF TEST REPORT