



CERTIFICATION TEST REPORT

Report Number. : 12742033-E6V4

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

Model : A2048

FCC ID : BCGA2048

IC : 579C-A2048

EUT Description : RIGHT EARBUD

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

Date Of Issue:

April 17, 2019

Prepared by:

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	4/10/2019	Initial Issue	Tony Li
V2	4/11/2019	Fixed FCC ID	Chin Pang
V3	4/16/2019	Addressed TCB Questions	Tony Li
V4	4/17/2019	Addressed TCB 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: RIGHT EARBUD

MODEL: A2048

SERIAL NUMBER: CC2YC01KLYY5 (Conducted) & CC2YC09HLYY5 (Radiated)

DATE TESTED: MARCH 20 – APRIL 4, 2019

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:



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Prepared By:



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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
☐ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☐ Chamber I (ISED:2324A-5)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☐ Chamber J (ISED:2324A-6)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED:2324A-1)
	☒ Chamber G (ISED:22541-4)	☐ Chamber L (ISED:2324A-3)
	☐ Chamber H (ISED:22541-5)	

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

A2048 is a Bluetooth earbud for the right ear. It has an integral battery, microphone and antenna. It can charge via bottom contacts with charging case.

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 (1M)	5.06	3.21
2402 - 2480	BLE (2M)	5.06	3.21

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)
2.4	-4.90

5.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 1A610

5.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 30MHz, below 1GHz, above 18GHz, and power line conducted 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 Y (Landscape) orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y (Landscape) orientation.

There were no emissions found below 30MHz within 20dB of the limit.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	Macbook Pro	C02P41RZG086	FCC DoC
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
Charger Case	Apple	A2078	CC2909500NDLYY13N	579C-A2078
10dB Fixed Attenuator	Pasternack	PE7087-10	Label ID: 178584	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	2	N/A
2	USB	1	Lightning	Shielded	1	N/A
3	Antenna	1	SMA	Un-Shielded	0.3	To spectrum Analyzer

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
NA						

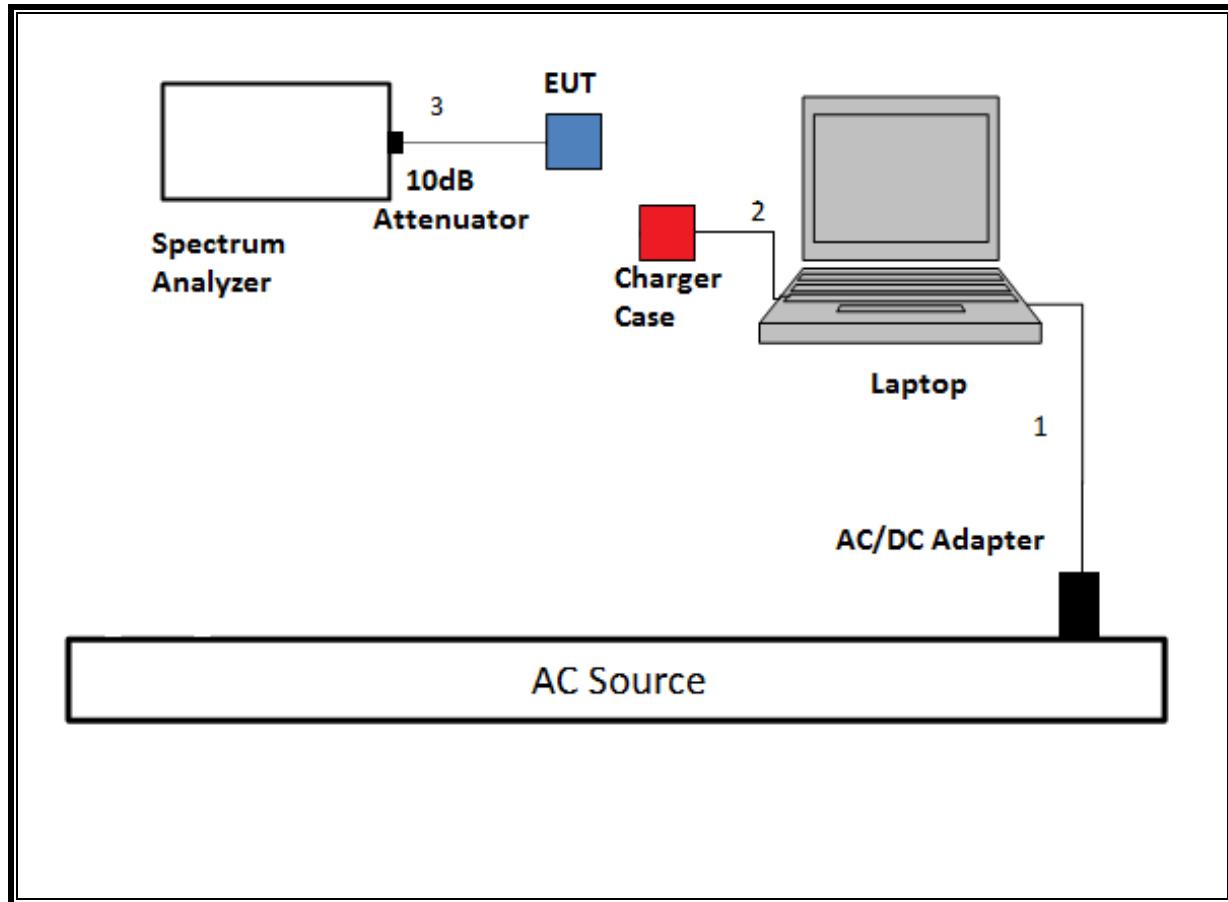
I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

Cable No	Port	# of identical	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Un-shielded	1	N/A
2	USB	1	Lightning	Shielded	1	N/A

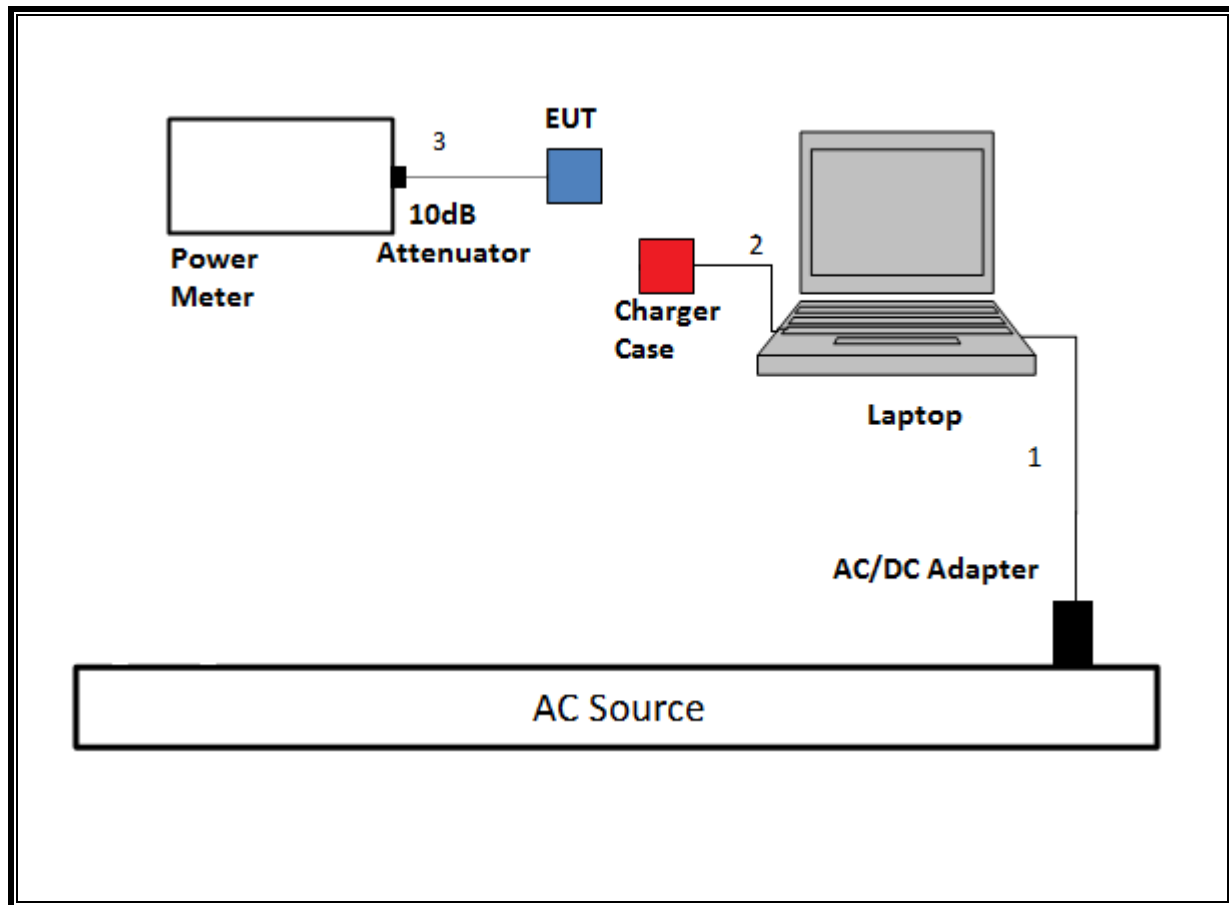
TEST SETUP

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

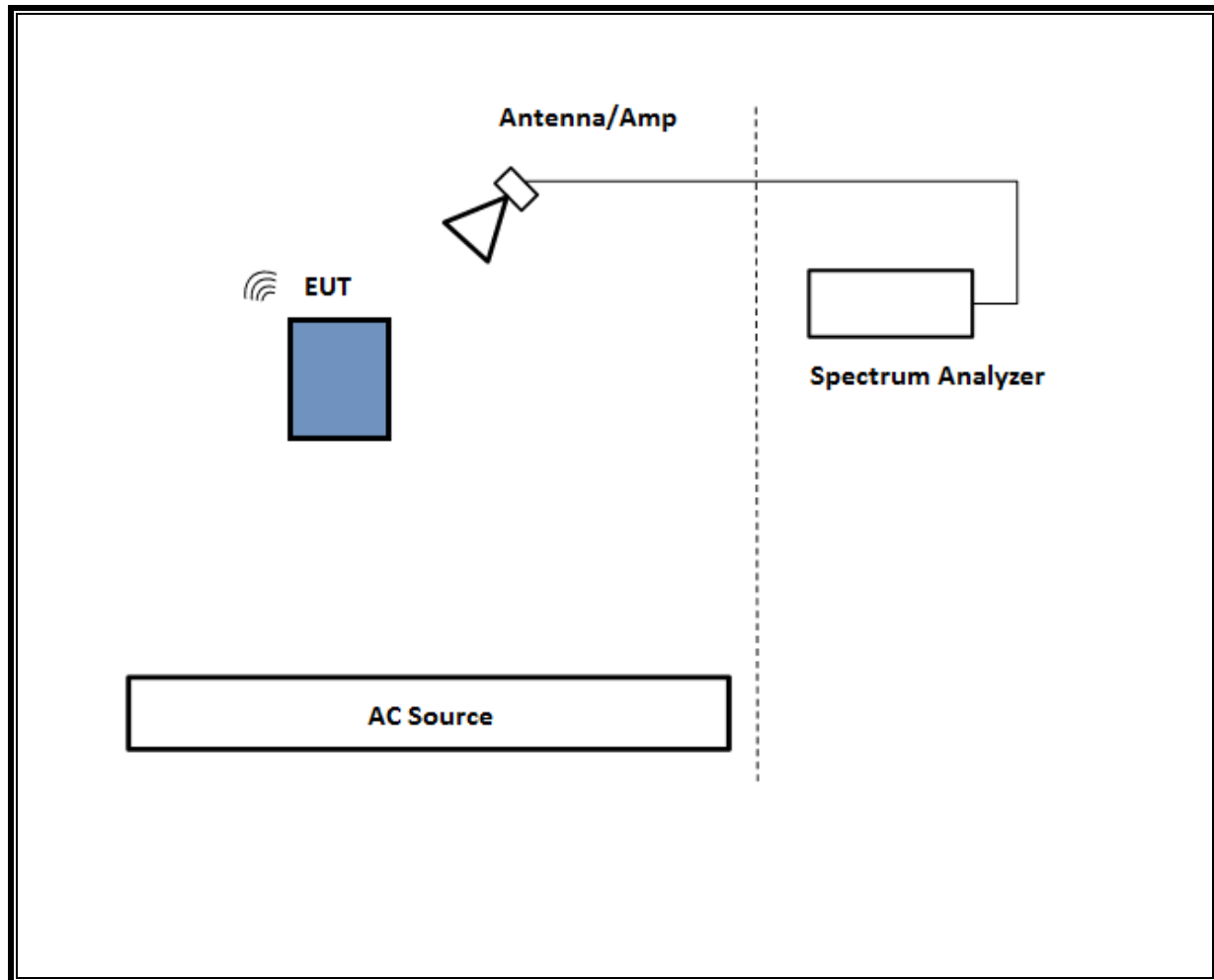
SETUP DIAGRAM FOR CONDUCTED TESTS



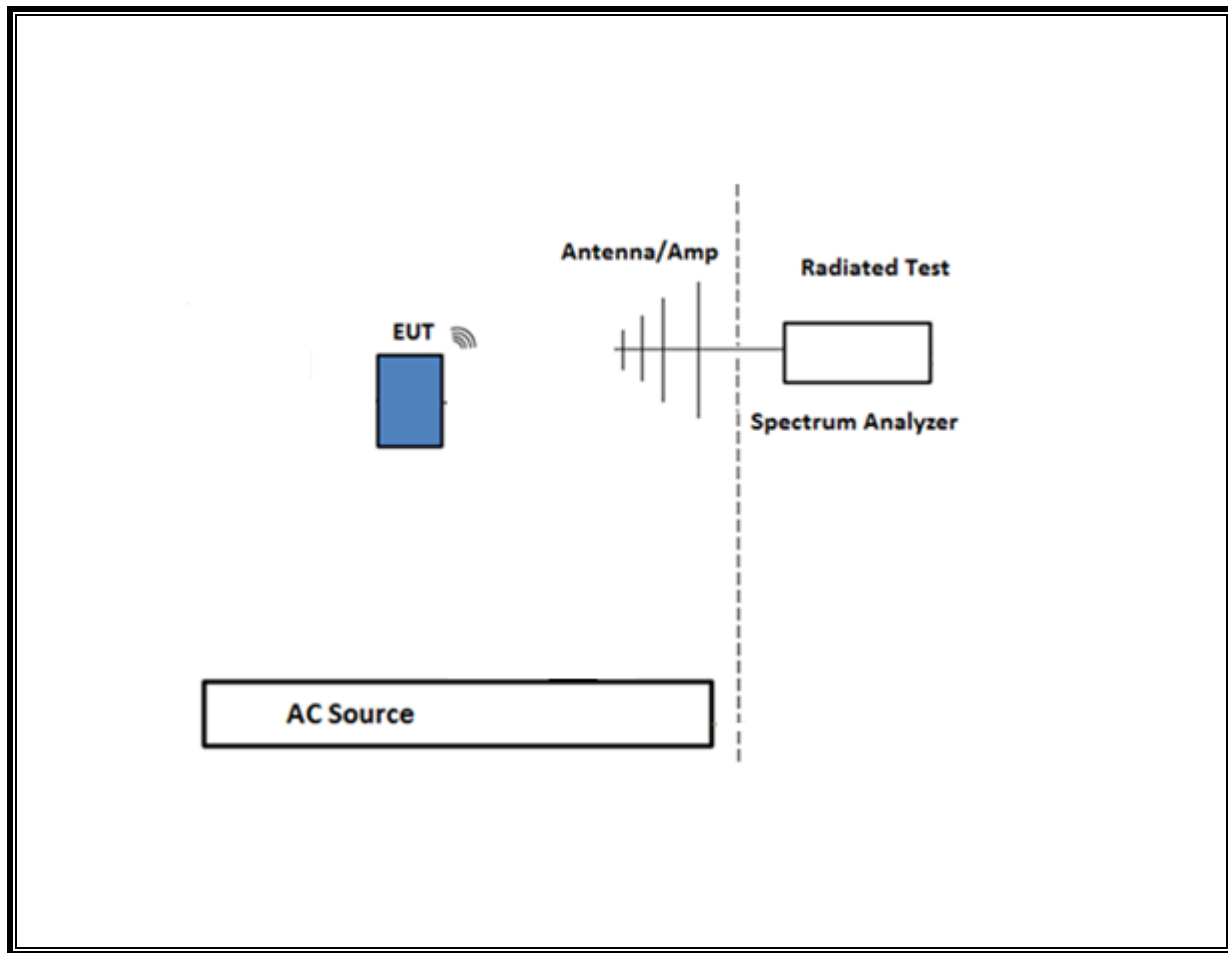
SETUP DIAGRAM FOR CONDUCTED TESTS: POWER METER CONFIGURATION



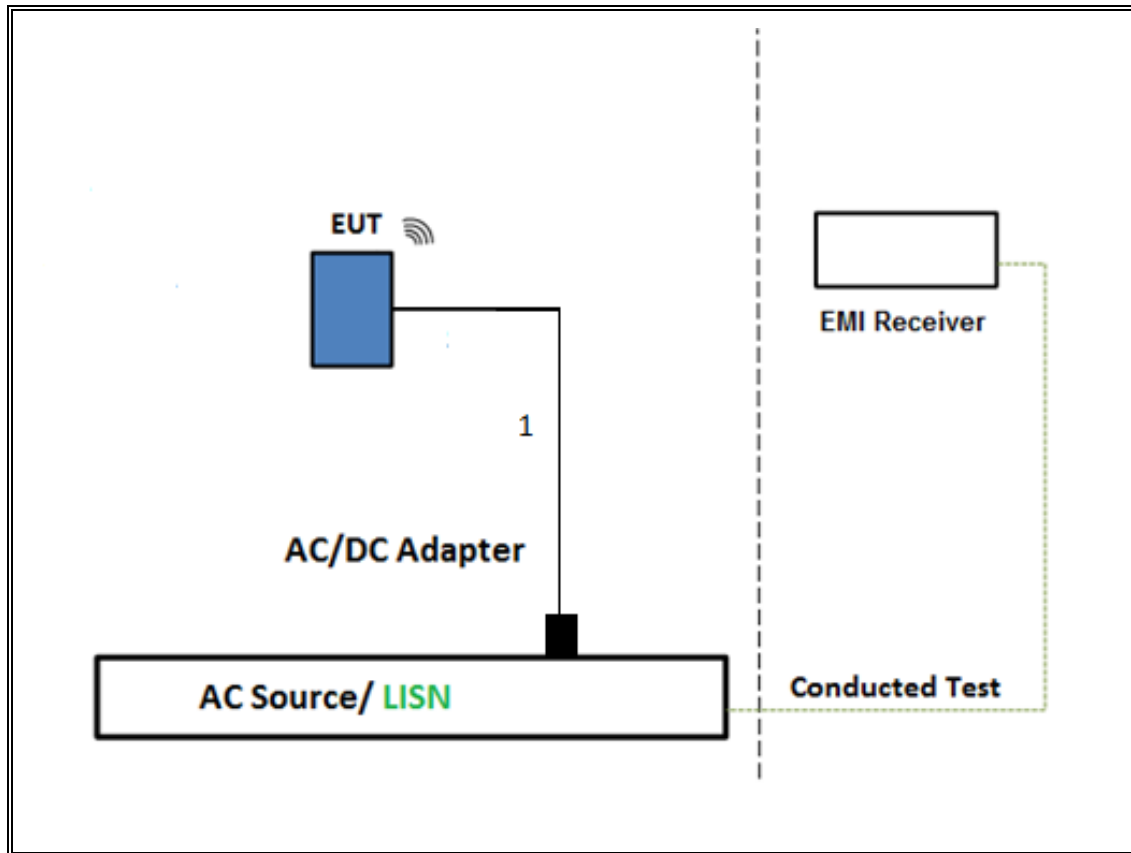
SETUP DIAGRAM FOR RADIATED TESTS ABOVE 1GHz



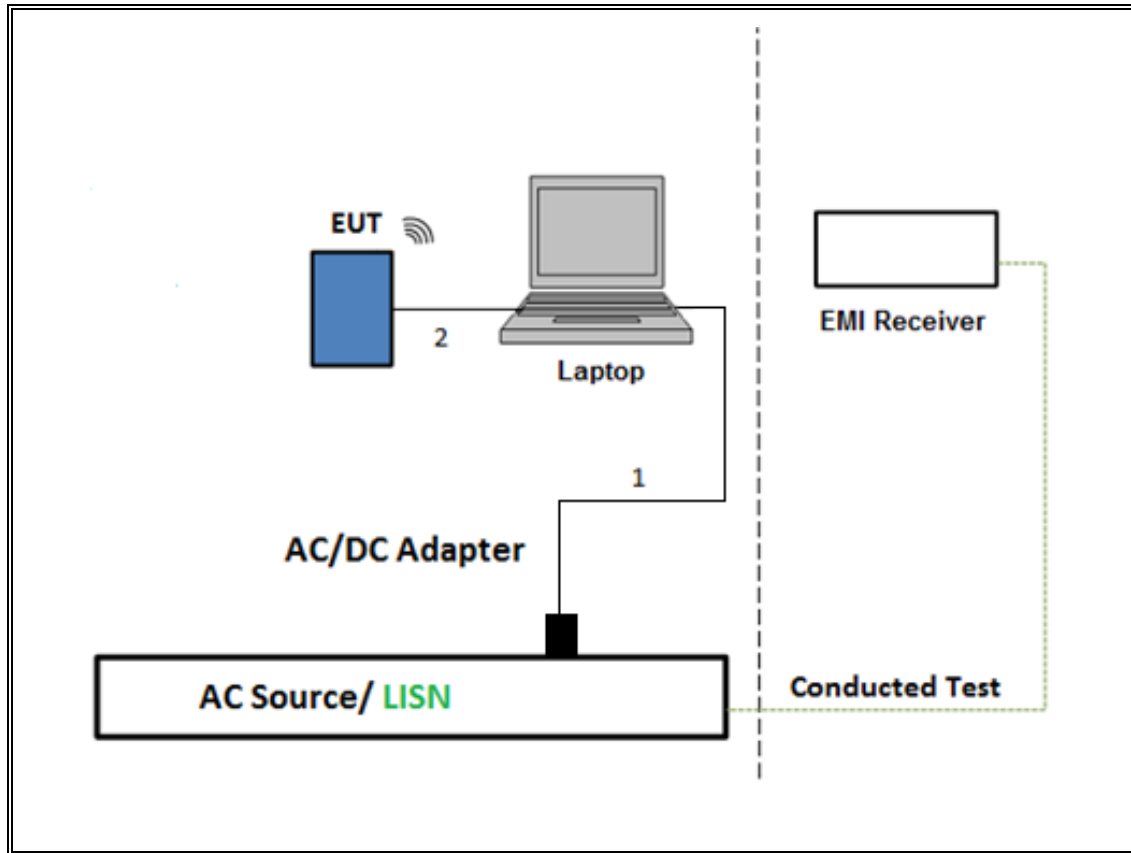
SETUP DIAGRAM FOR BELOW 1GHz



TEST SETUP- AC LINE CONDUCTED: CHARGER CONFIGURATION



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



6. MEASUREMENT METHOD

On Time and Duty Cycle: KDB 558074 D01 v05r02, Section 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 Peak power meter method

Output Power: ANSI C63.10 Subclause -11.9.2.3.1 Method AVGPM (Measurement using an RF average-reading power meter)

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

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

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
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1616	10/18/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB1	T185	04/19/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T120	07/02/2019
Filter, HPF 3.0GHz	MICRO-TRONICS	HPM17543	T898	05/19/2019
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	03/23/2020
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	06/16/2019
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T227	10/29/2019
Power Sensor	Power Sensor	Keysight	T1226	02/06/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A-544	T1113	01/22/2020
Thermo-Hygrometer	Contact East	445703	T909	02/26/2020
AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESC17	T1436	02/23/2020
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2019
**LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/19/2019
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	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

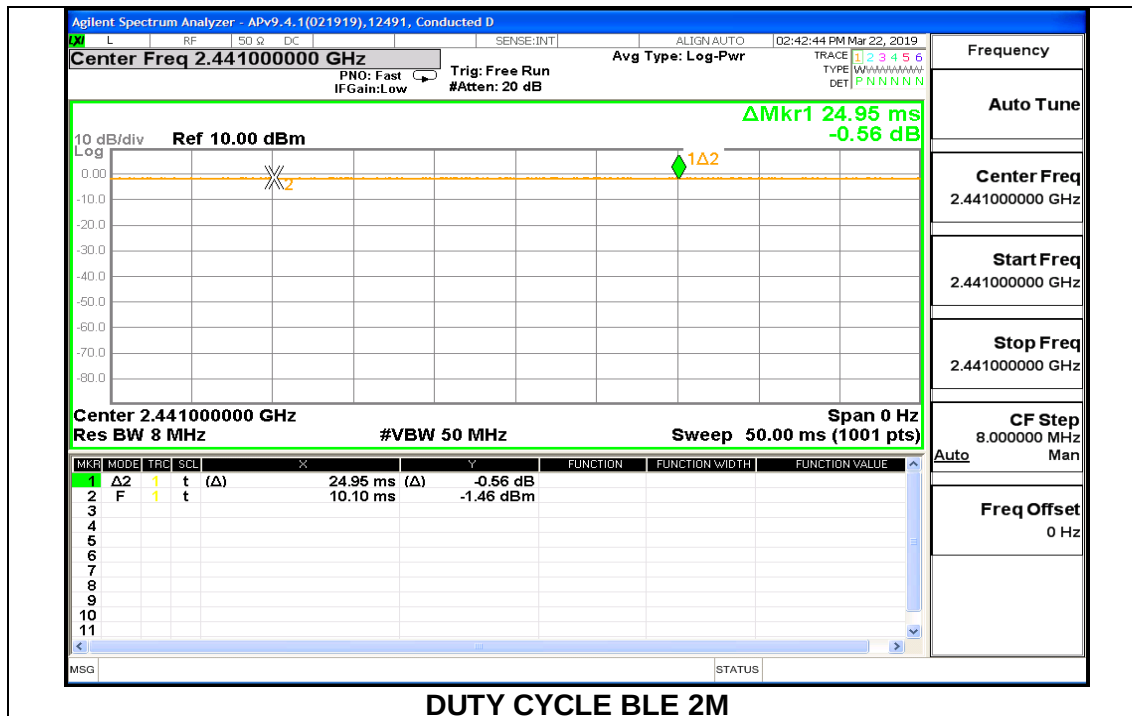
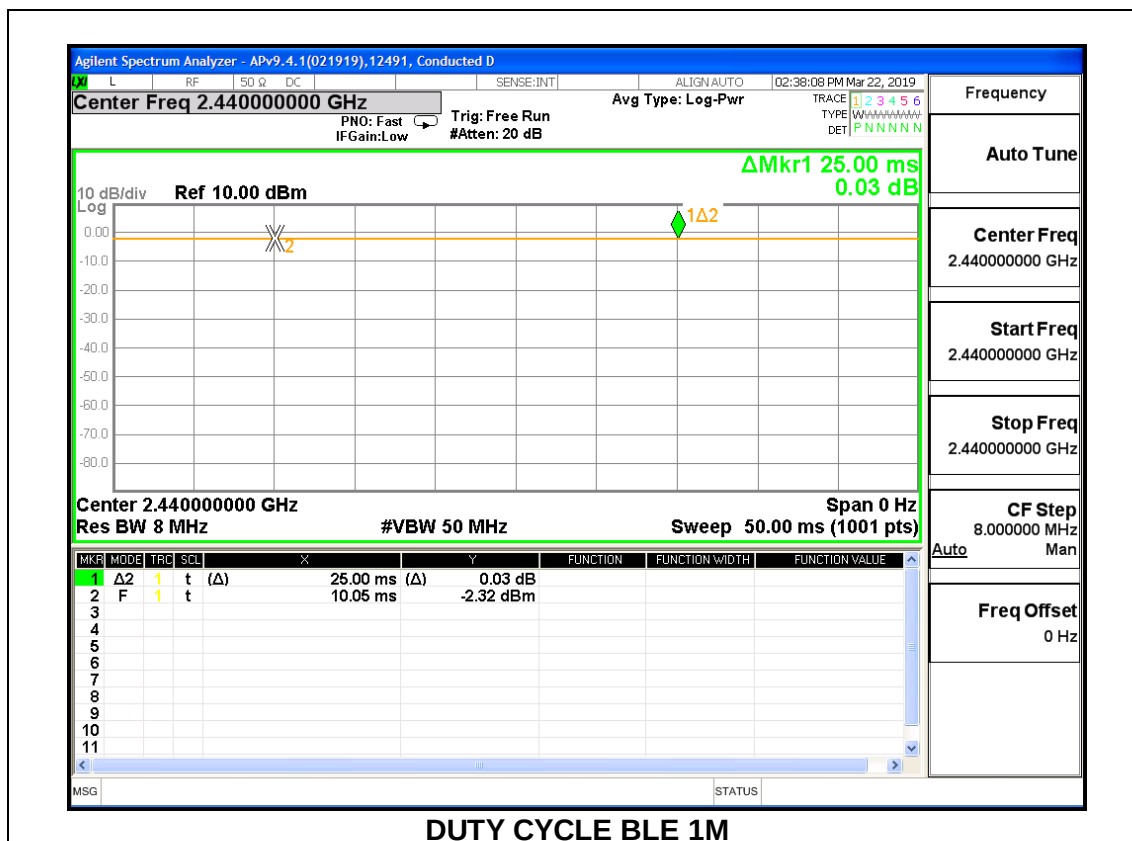
None; for reporting purposes only.

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 1M	1.000	1.000	1.000	100.00%	0.00	0.010
BLE 2M	1.000	1.000	1.000	100.00%	0.00	0.010



8.2. 99% BANDWIDTH

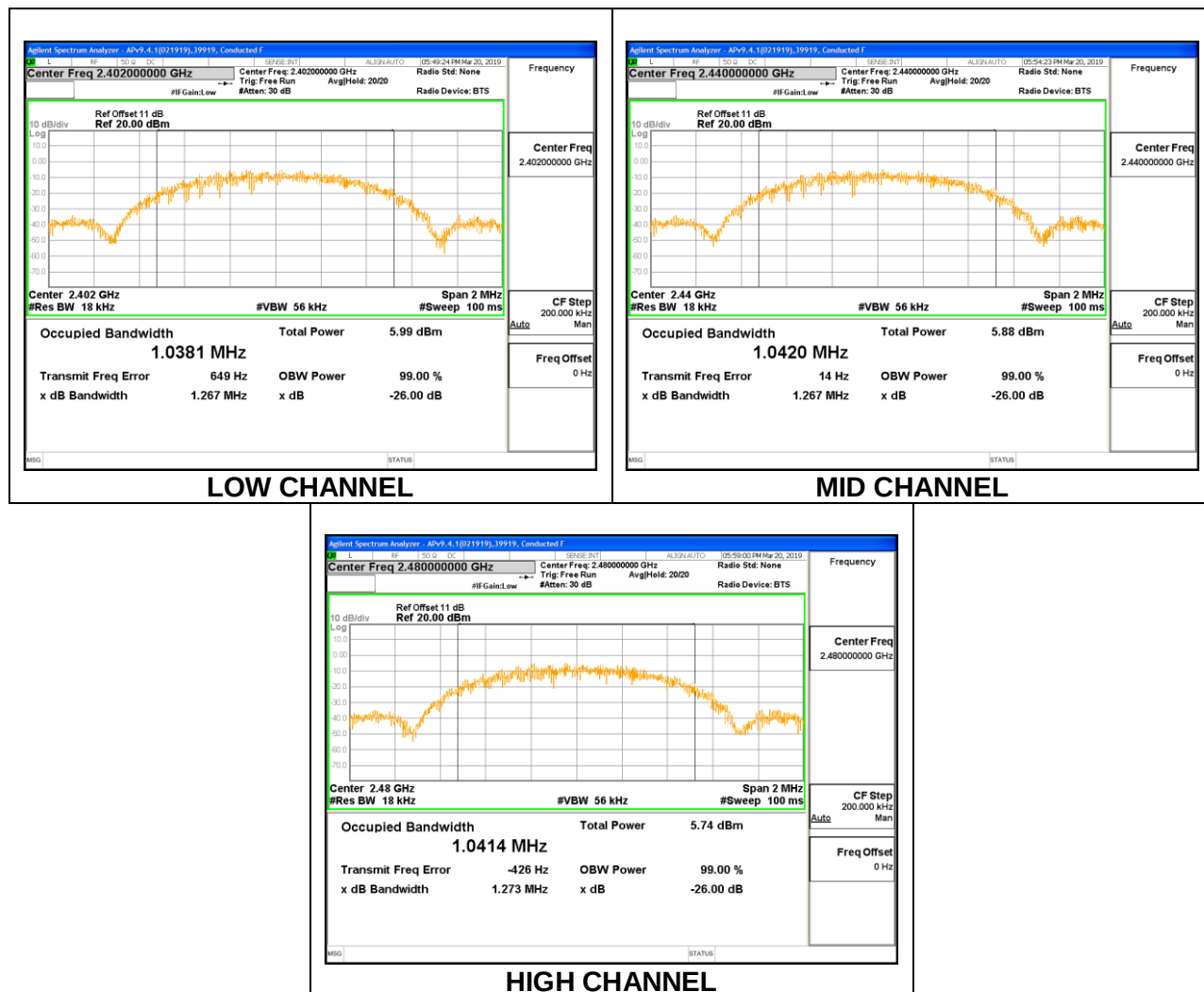
LIMITS

None; for reporting purposes only.

RESULTS

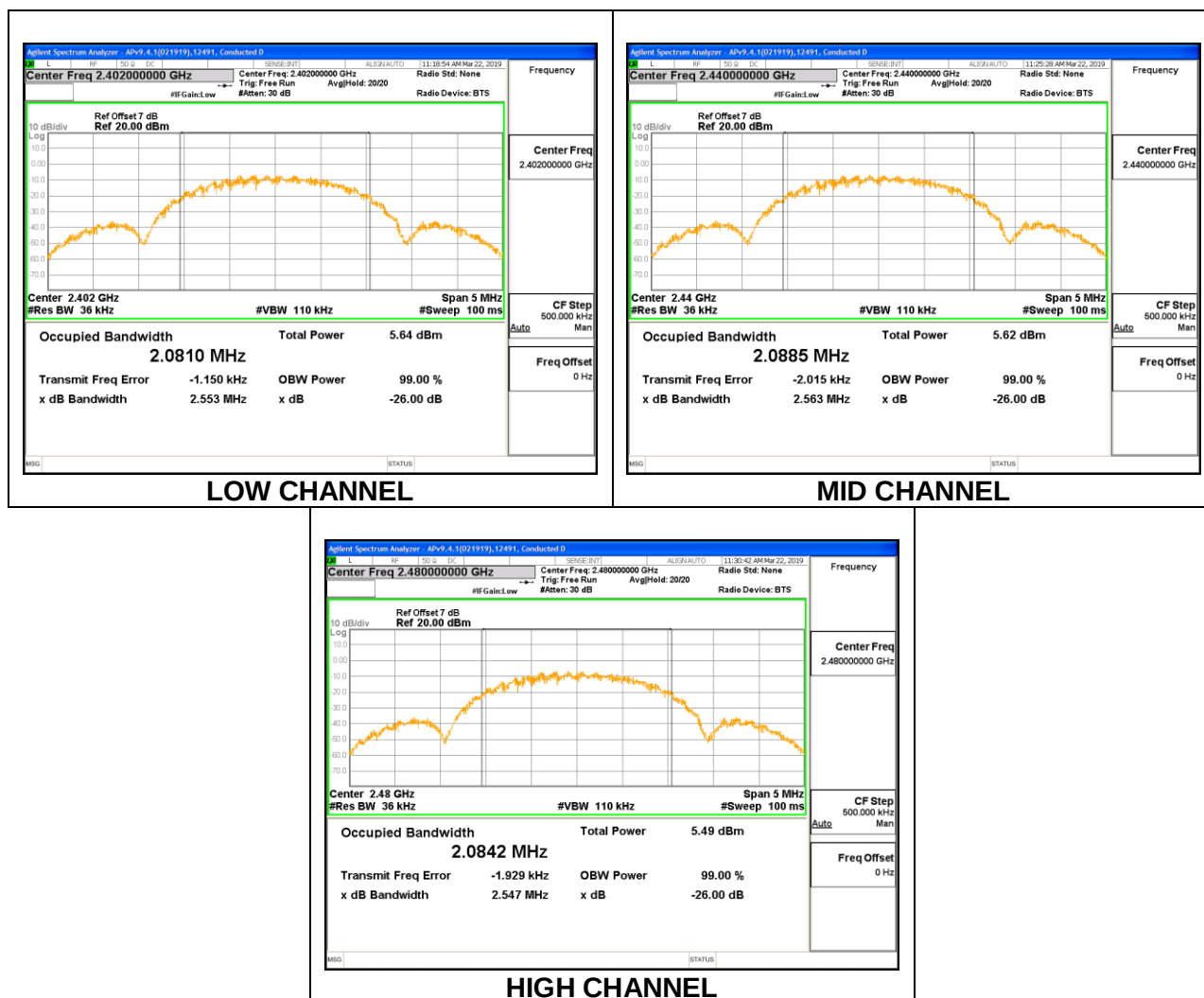
8.2.1. BLE (1Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0380
Middle	2440	1.0420
High	2480	1.0410



8.2.2. BLE (2Mbps)

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	2.0810
Middle	2440	2.0885
High	2480	2.0842



8.3. 6 dB BANDWIDTH

LIMITS

FCC §15.407 (e)

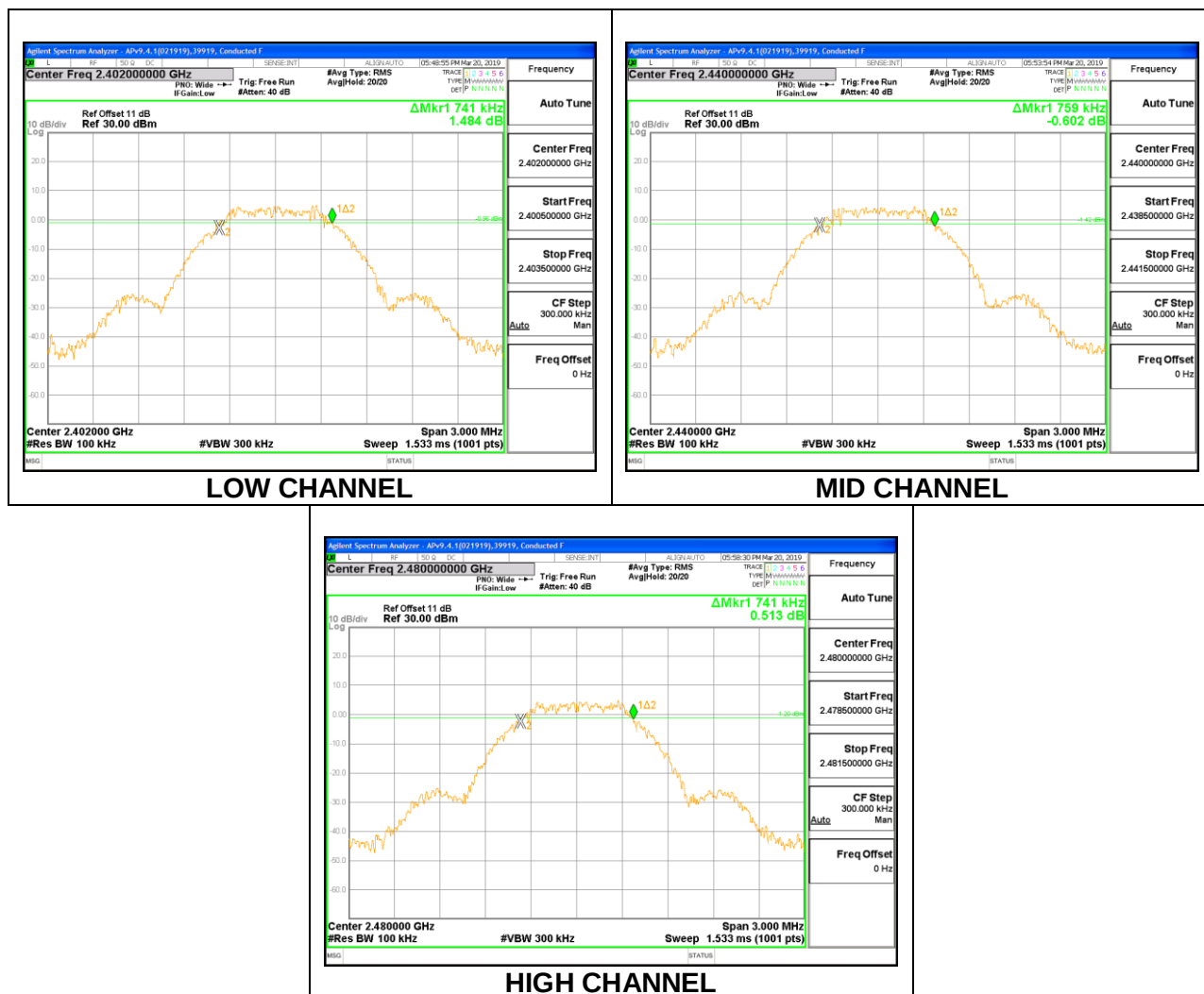
RSS-247 5.2 (a)

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

RESULTS

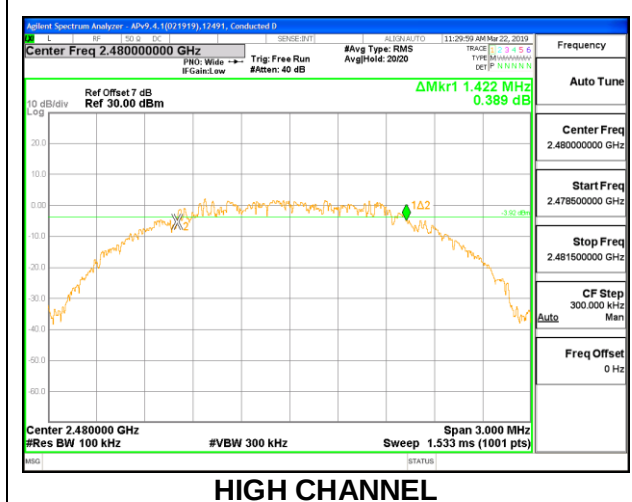
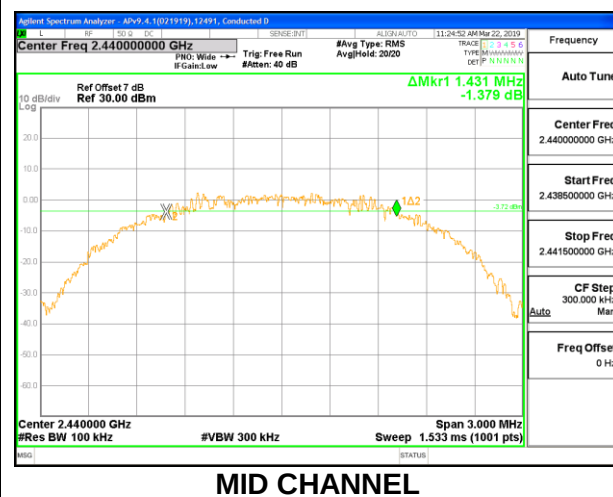
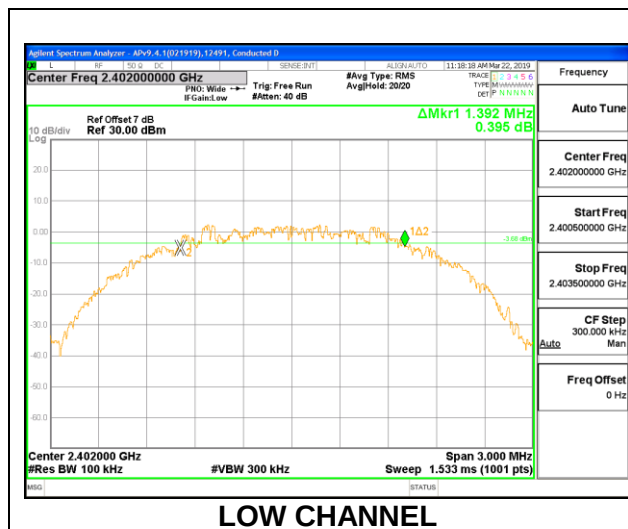
8.3.1. BLE (1Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7410	0.5
Middle	2440	0.7590	0.5
High	2480	0.7410	0.5



8.3.2. BLE (2Mbps)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	1.392	0.5
Middle	2440	1.431	0.5
High	2480	1.422	0.5



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:	12491
Date:	3/22/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.05	30	-24.95
Middle	2440	5.06	30	-24.94
High	2480	4.86	30	-25.14

8.4.2. BLE (2Mbps)

Tested By:	12491
Date:	3/22/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	5.06	30	-24.94
Middle	2440	4.96	30	-25.04
High	2480	4.85	30	-25.15

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 11 dB (including 10 dB pad and 1 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:	12491
Date:	3/22/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	4.94
Middle	2440	4.95
High	2480	4.72

8.5.2. BLE (2Mbps)

Tested By:	12491
Date:	3/22/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	4.94
Middle	2440	4.84
High	2480	4.72

8.6. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

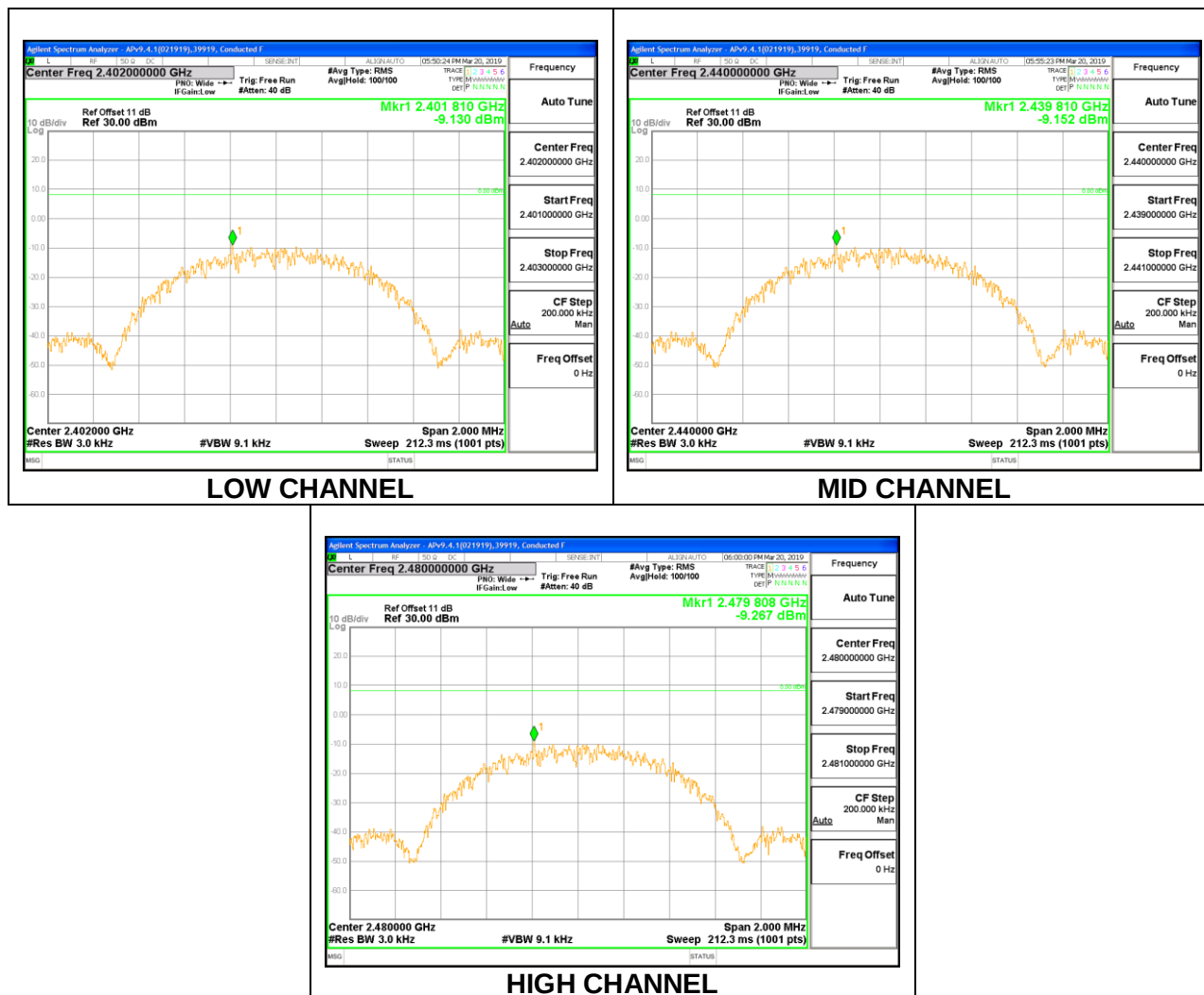
RSS-247 (5.2) (b)

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

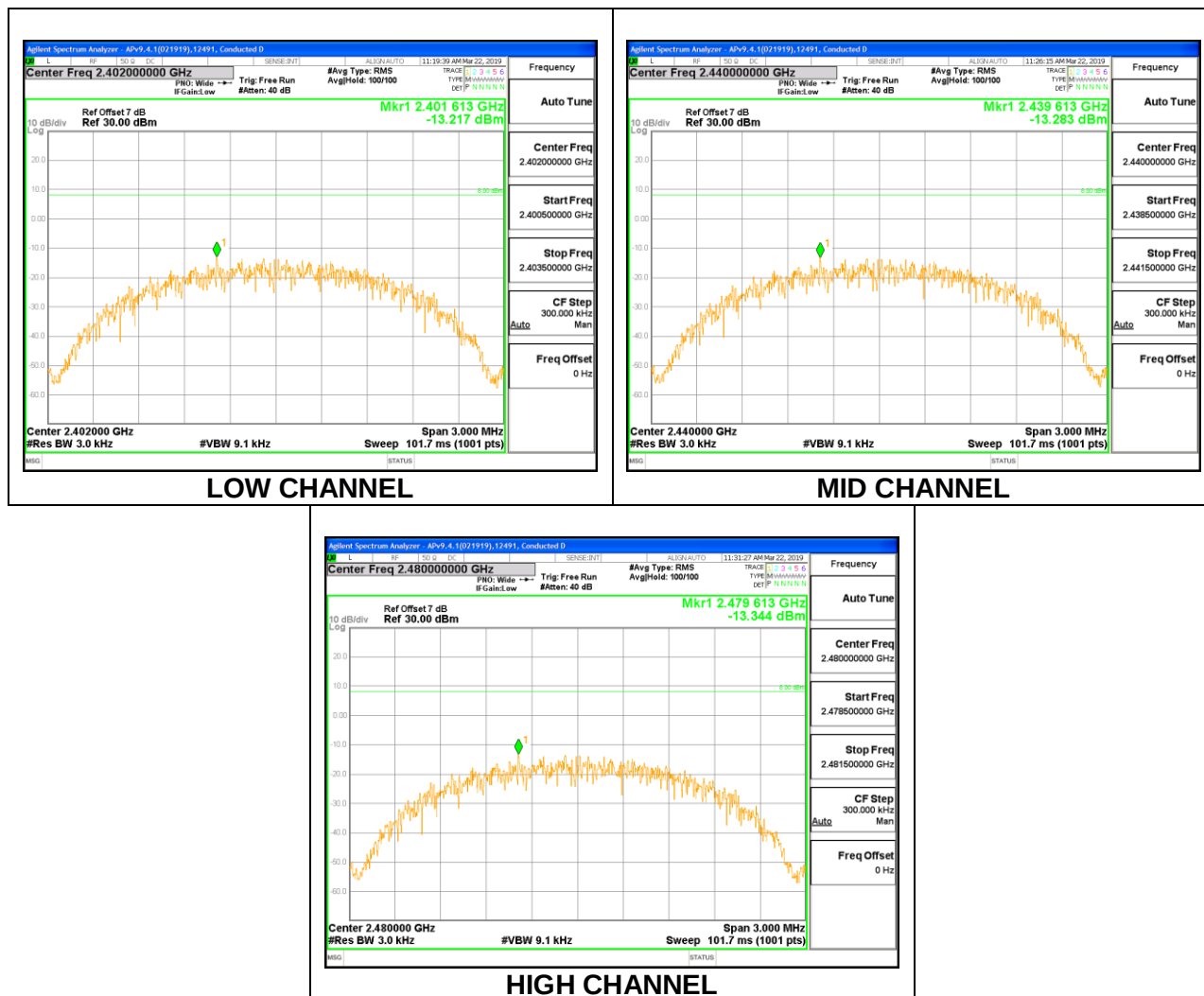
8.6.1. BLE (1Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-9.13	8	-17.13
Middle	2440	-9.15	8	-17.15
High	2480	-9.27	8	-17.27



8.6.2. BLE (2Mbps)

Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	2402	-13.217	8	-21.217
Middle	2440	-13.283	8	-21.283
High	2480	-13.344	8	-21.344



8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

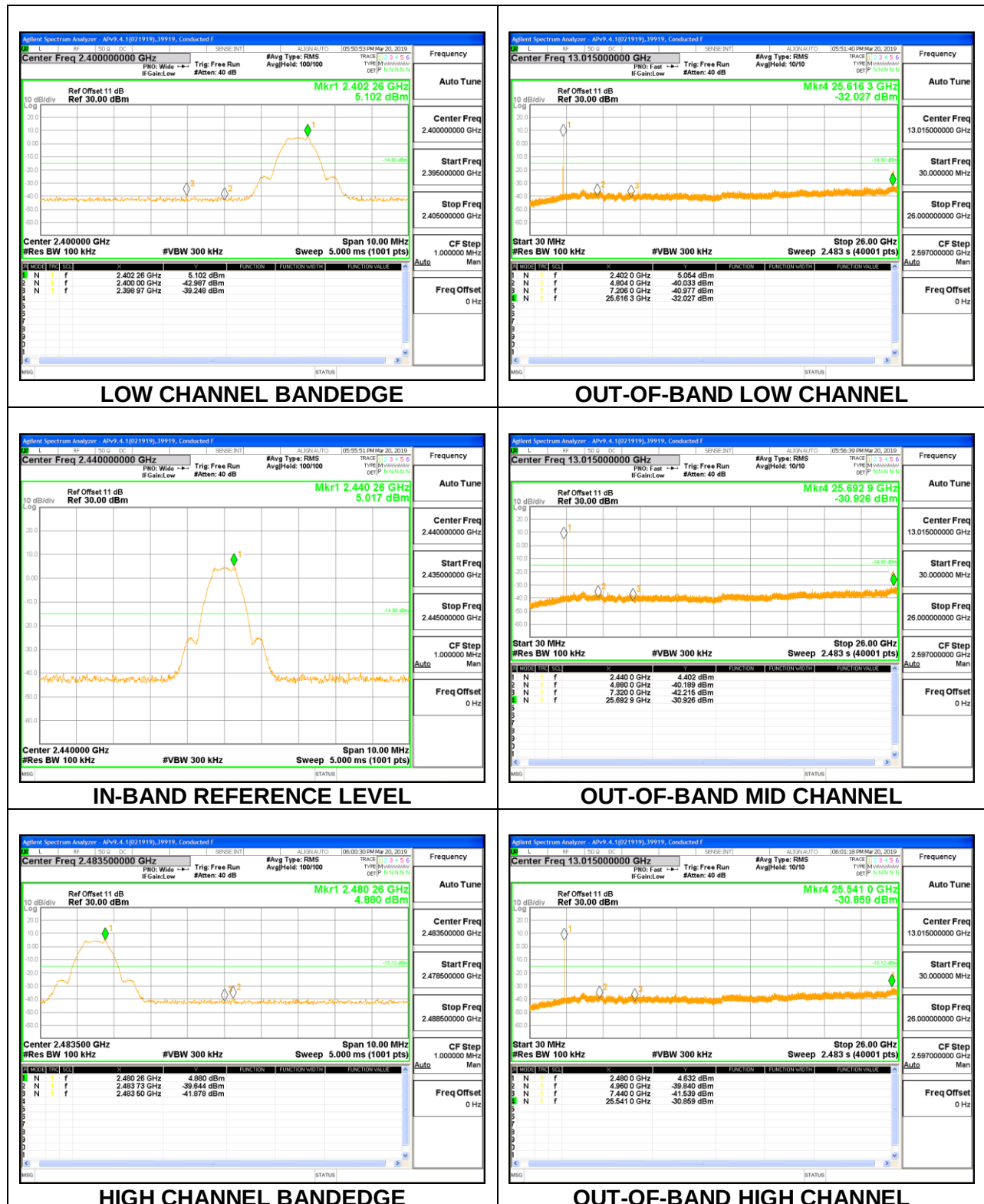
FCC §15.247 (d)

RSS-247 5.5

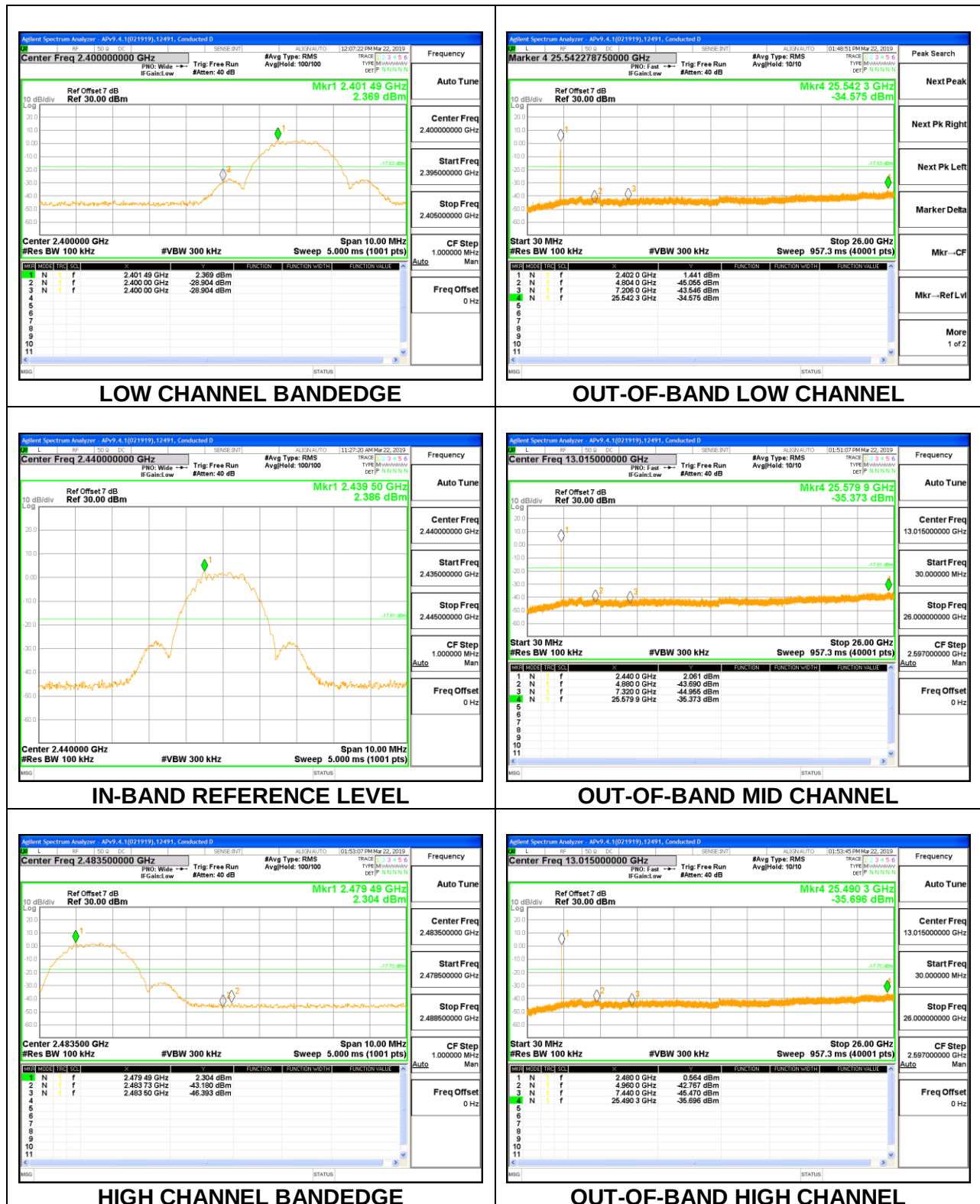
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

8.7.1. BLE (1Mbps)



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 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.

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.

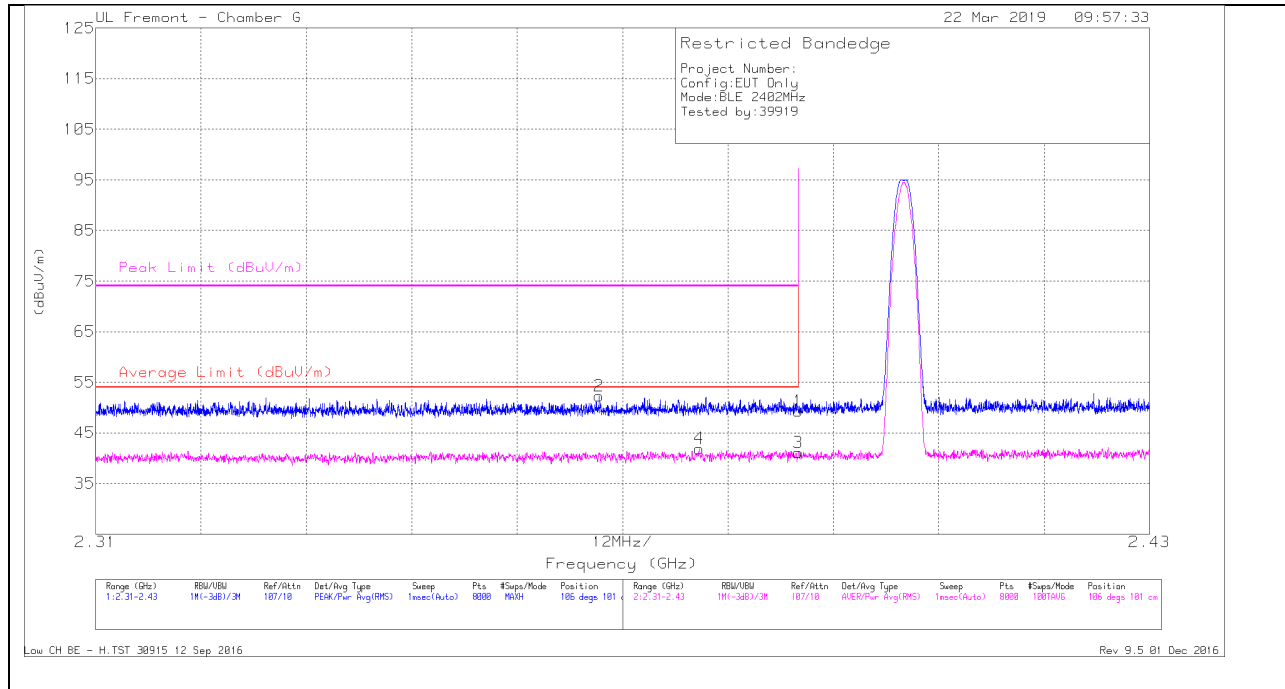
For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BLE (1Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



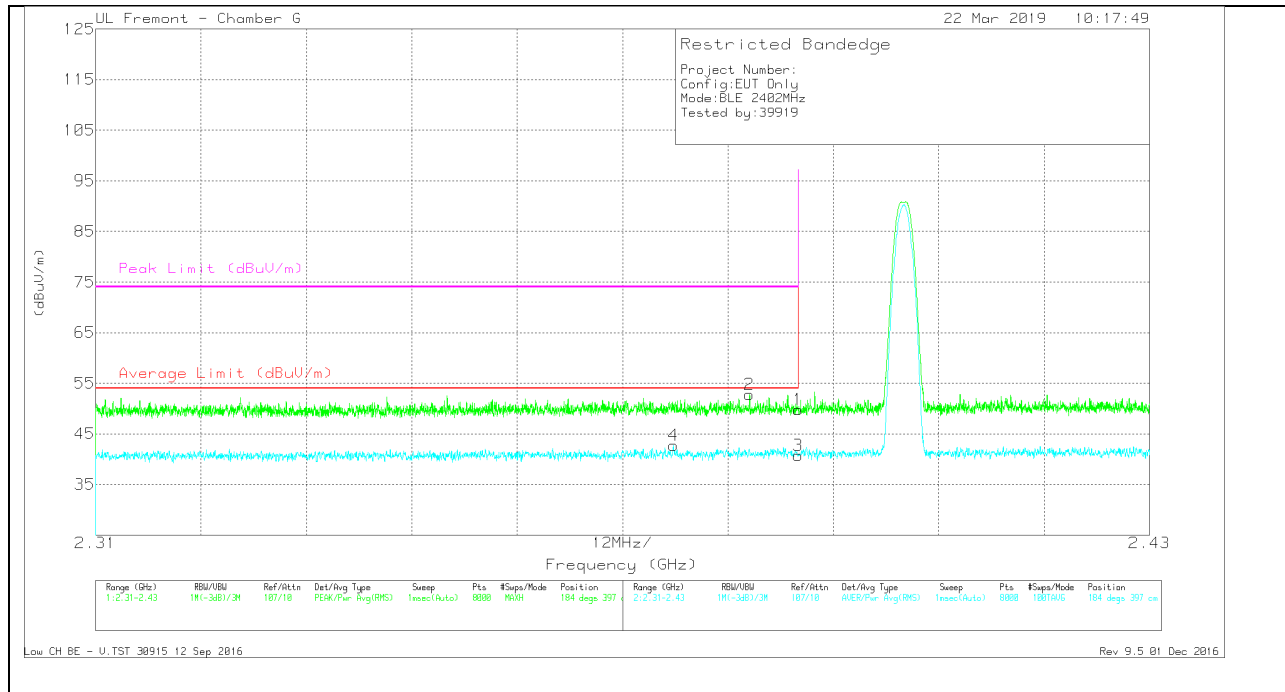
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT120 (dB/m)	Amp/Cbl/Filtr/Par d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	39.69	Pk	31.9	-22.3	49.29	-	-	74	-24.71	106	101	H
2	* 2.367	42.83	Pk	31.8	-22.3	52.33	-	-	74	-21.67	106	101	H
3	* 2.39	31.52	RMS	31.9	-22.3	41.12	54	-12.88	-	-	106	101	H
4	* 2.379	32.41	RMS	31.8	-22.3	41.91	54	-12.09	-	-	106	101	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.39	40.19	Pk	31.9	-22.3	49.79	-	-	74	-24.21	184	397	V
2	* 2.384	43.17	Pk	31.9	-22.3	52.77	-	-	74	-21.23	184	397	V
3	* 2.39	31.13	RMS	31.9	-22.3	40.73	54	-13.27	-	-	184	397	V
4	* 2.376	33.25	RMS	31.8	-22.3	42.75	54	-11.25	-	-	184	397	V

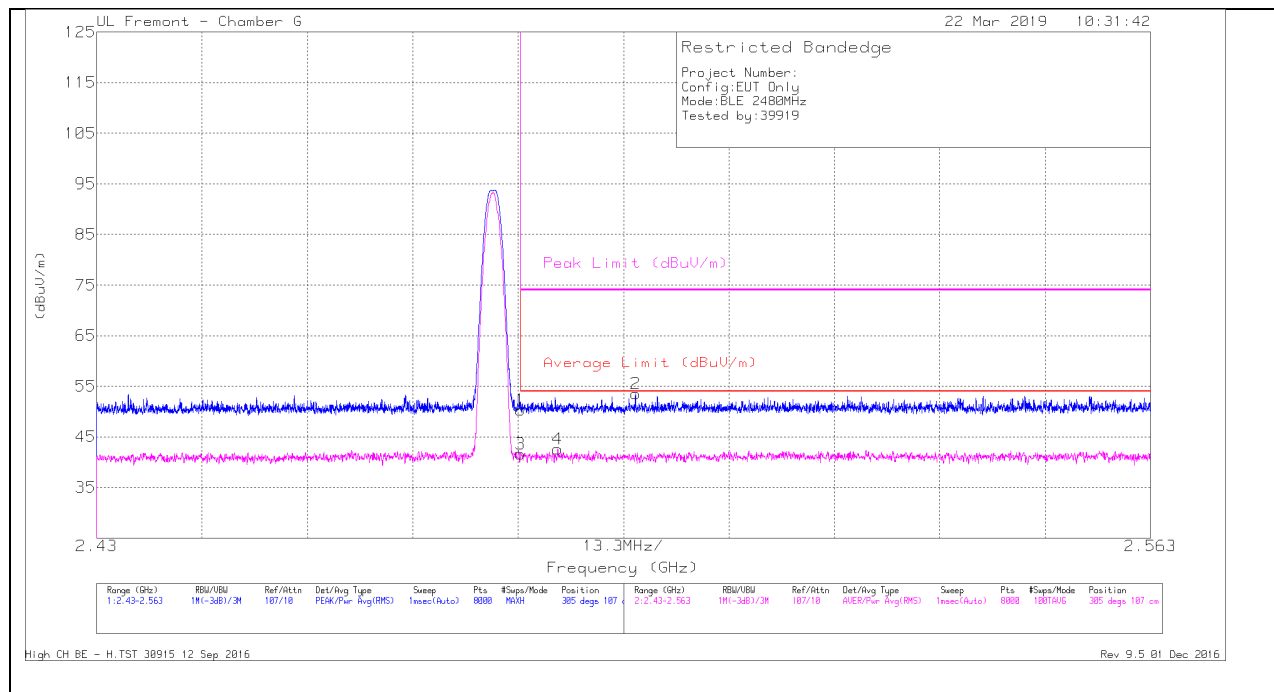
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

BANDEGE (HIGH CHANNEL)

HORIZONTAL RESULT



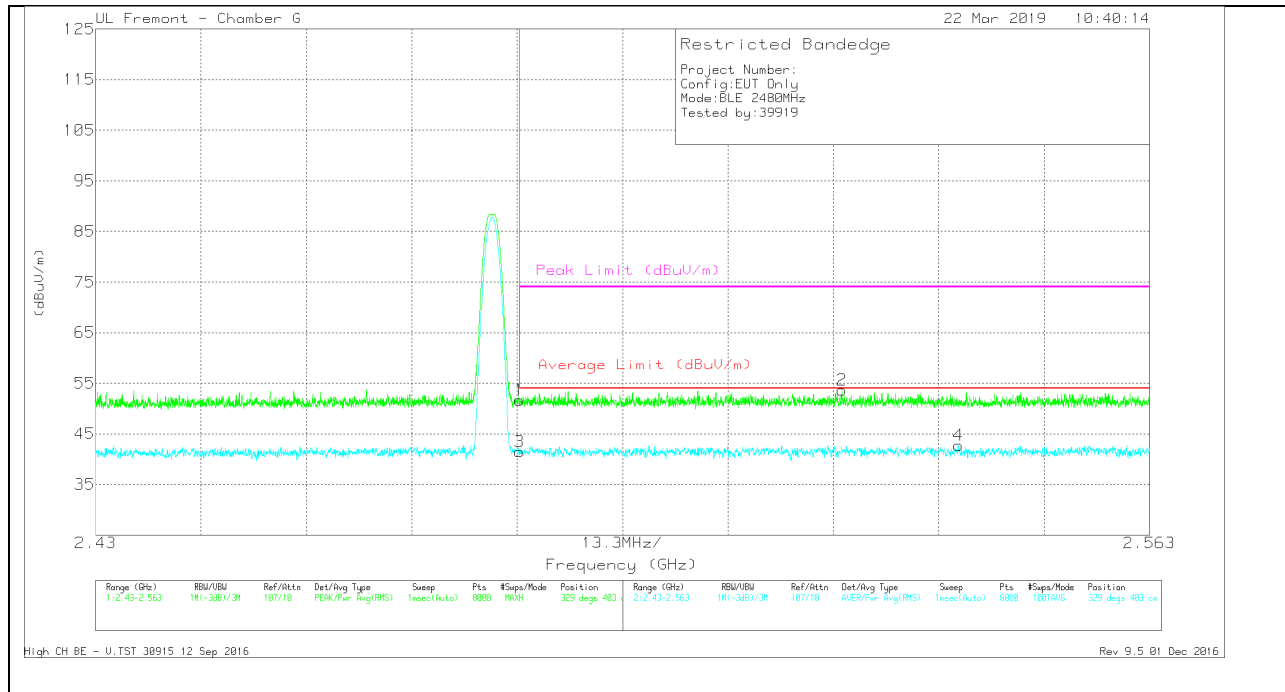
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.15	Pk	32.4	-22.3	50.25	-	-	74	-23.75	305	107	H
2	* 2.498	43.46	Pk	32.4	-22.3	53.56	-	-	74	-20.44	305	107	H
3	* 2.484	31.49	RMS	32.4	-22.3	41.59	54	-12.41	-	-	305	107	H
4	* 2.488	32.55	RMS	32.4	-22.3	42.65	54	-11.35	-	-	305	107	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Ftr/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	* 2.484	41.58	Pk	32.4	-22.3	51.68	-	-	74	-22.32	329	403	V
3	* 2.484	31.38	RMS	32.4	-22.3	41.48	54	-12.52	-	-	329	403	V
2	2.524	43.6	Pk	32.4	-22.3	53.7	-	-	74	-20.3	329	403	V
4	2.539	32.63	RMS	32.4	-22.3	42.73	54	-11.27	-	-	329	403	V

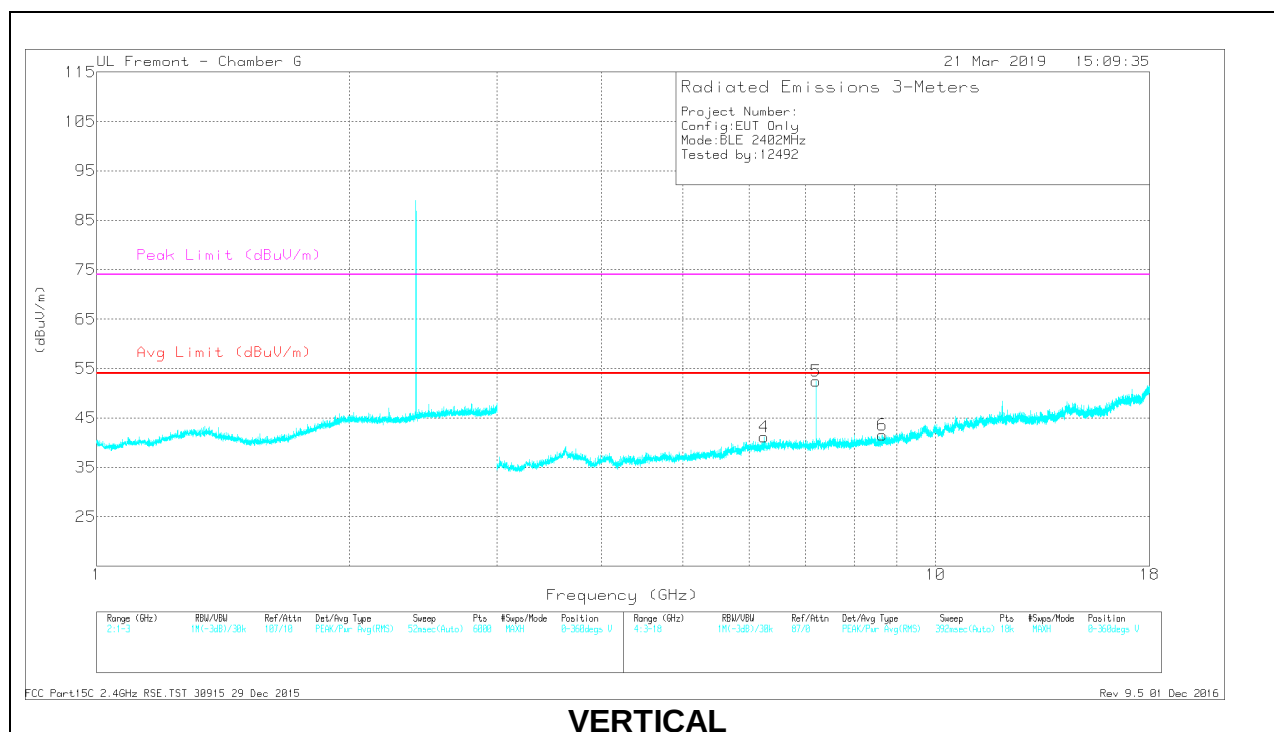
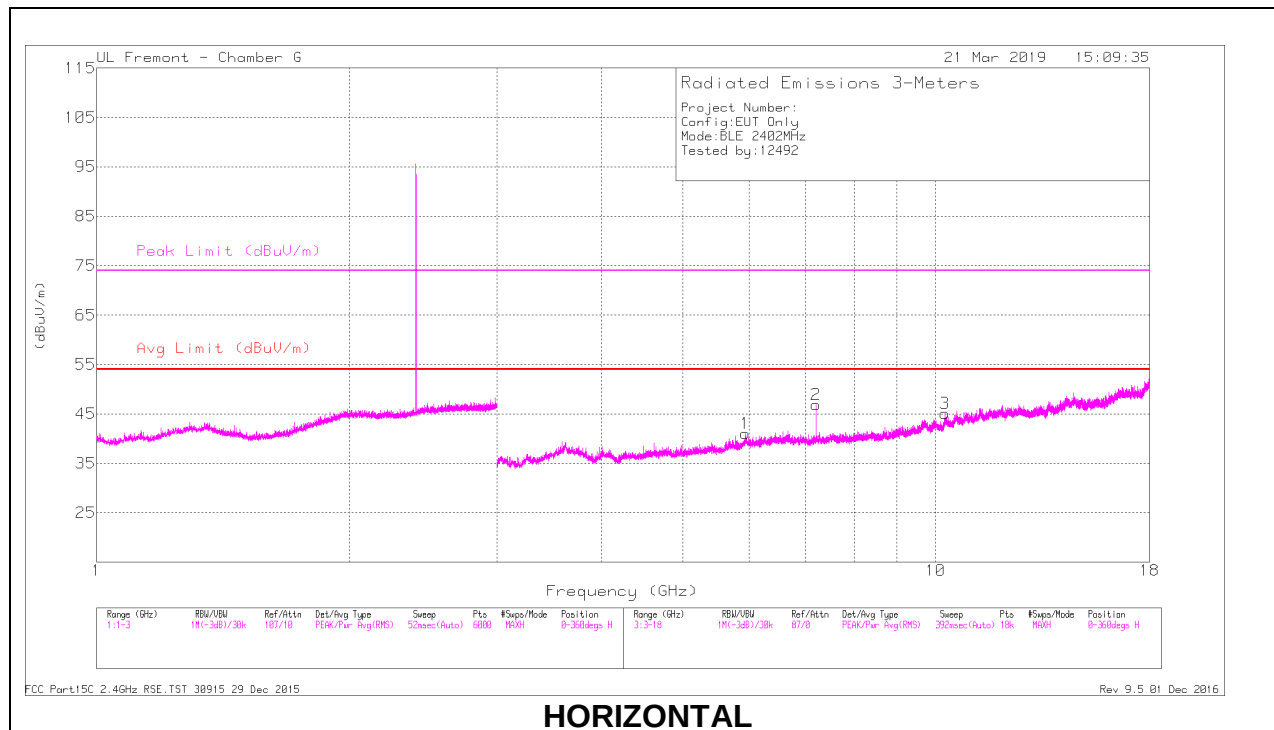
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS

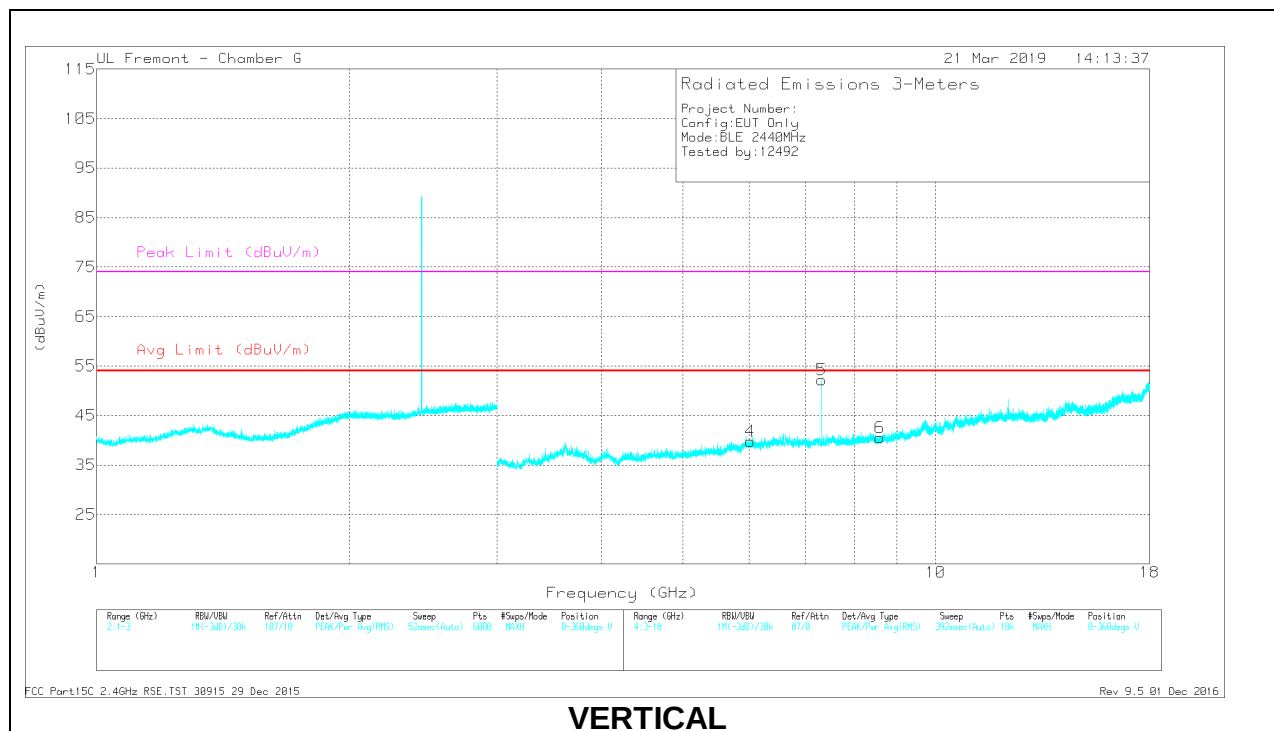
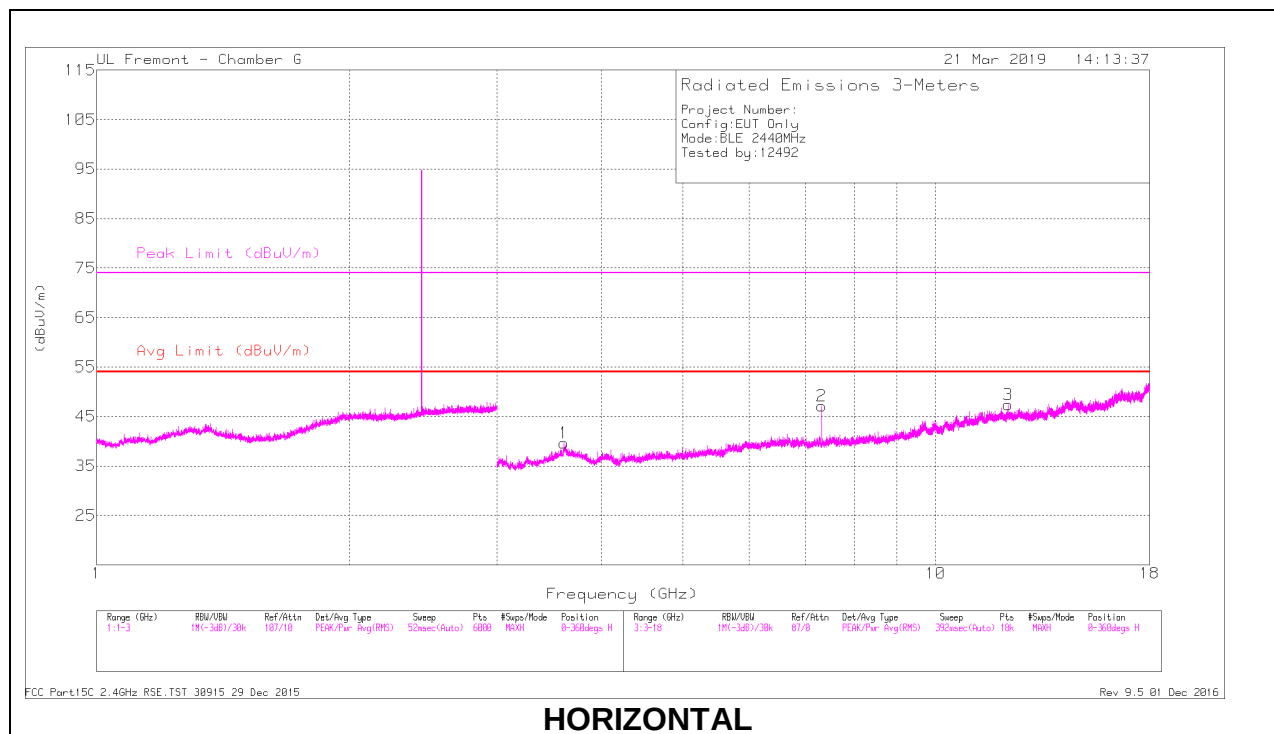


RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Filtr/Path (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	5.939	39.88	PK2	35.5	-28.6	46.78	-	-	-	-	341	183	H
4	6.253	39.95	PK2	35.8	-28.4	47.35	-	-	-	-	229	187	V
5	7.205	44.13	PK2	35.8	-27.9	52.03	-	-	-	-	291	104	H
2	7.205	47.75	PK2	35.8	-27.9	55.65	-	-	-	-	322	169	V
6	8.644	38.15	PK2	36.2	-26.6	47.75	-	-	-	-	311	228	V
3	10.259	37.15	PK2	37.6	-23.6	51.15	-	-	-	-	318	173	H

PK2 - KDB558074 Method: Maximum Peak

MID CHANNEL RESULTS



RADIATED EMISSIONS

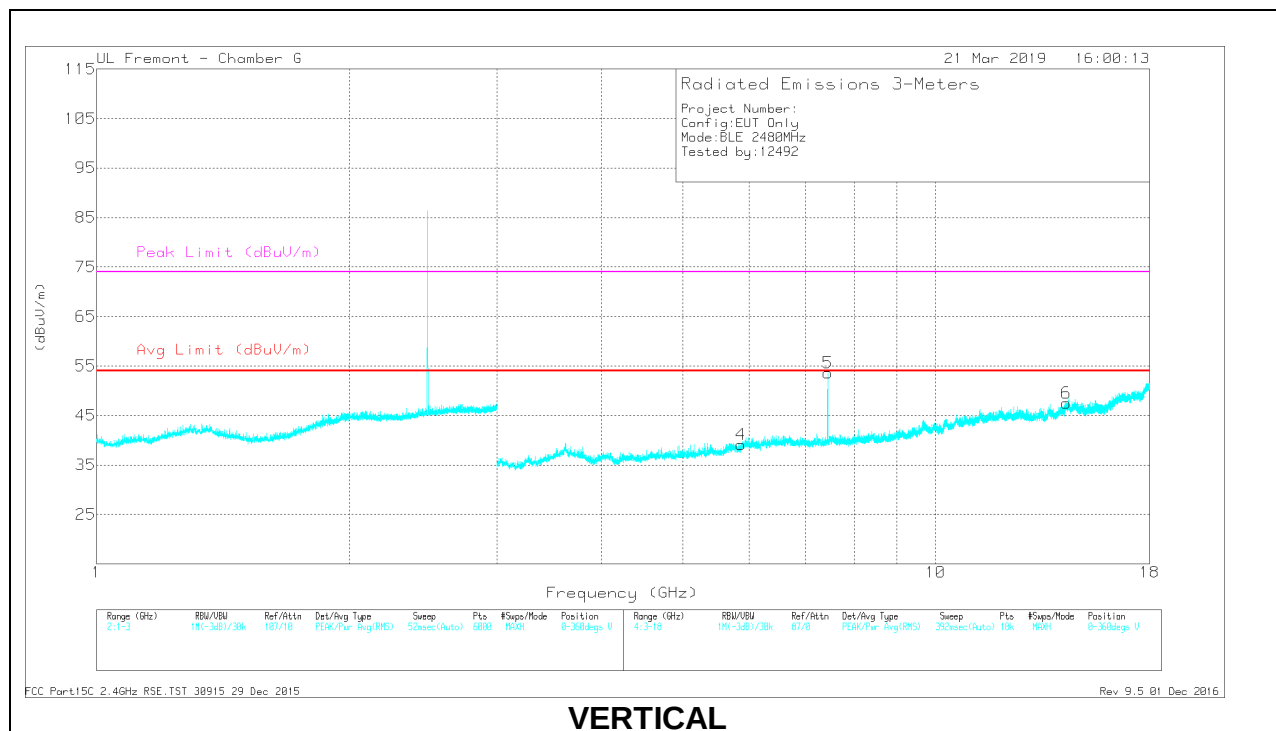
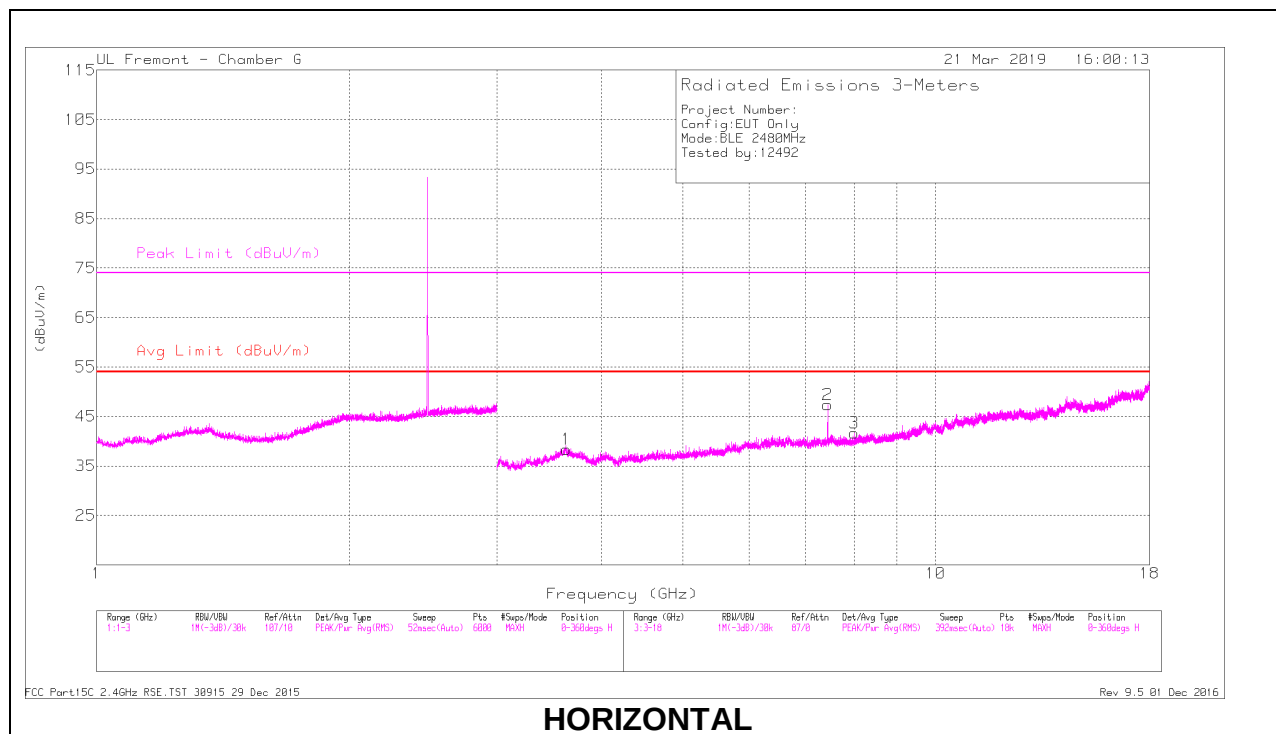
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.605	40.85	PK2	35	-30.6	45.25	-	-	74	-28.75	226	235	H
	* 3.607	29.62	MAv1	35	-30.5	34.12	54	-19.88	-	-	226	235	H
2	* 7.321	44.04	PK2	35.9	-27.6	52.34	-	-	74	-21.66	90	101	H
	* 7.321	35.92	MAv1	35.9	-27.6	44.22	54	-9.78	-	-	90	101	H
3	* 12.201	37.42	PK2	39.5	-22.9	54.02	-	-	74	-19.98	216	216	H
	* 12.201	26.21	MAv1	39.5	-22.9	42.81	54	-11.19	-	-	216	216	H
5	* 7.32	47.41	PK2	35.9	-27.6	55.71	-	-	74	-18.29	138	224	V
	* 7.319	41.59	MAv1	35.9	-27.6	49.89	54	-4.11	-	-	138	224	V
4	6.018	40.57	PK2	35.6	-28.3	47.87	-	-	-	-	266	213	V
6	8.581	38.07	PK2	36.1	-26.7	47.47	-	-	-	-	138	120	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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
2	* 7.441	42.88	PK2	36	-27.9	50.98	-	-	74	-23.02	283	213	H
	* 7.439	34.64	MAv1	36	-27.9	42.74	54	-11.26	-	-	283	213	H
1	* 3.632	40.76	PK2	35	-29.8	45.96	-	-	74	-28.04	263	223	H
	* 3.635	29.79	MAv1	34.8	-29.8	34.79	54	-19.21	-	-	263	223	H
5	* 7.44	40.25	PK2	36	-27.9	48.35	-	-	74	-25.65	202	171	V
	* 7.44	29.02	MAv1	36	-27.9	37.12	54	-16.88	-	-	202	171	V
4	5.866	40.3	PK2	35.4	-29.7	46	-	-	-	-	164	139	V
3	8.003	38.96	PK2	36.1	-27.3	47.76	-	-	-	-	123	123	H
6	14.328	37.44	PK2	40	-22.3	55.14	-	-	-	-	187	213	V

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

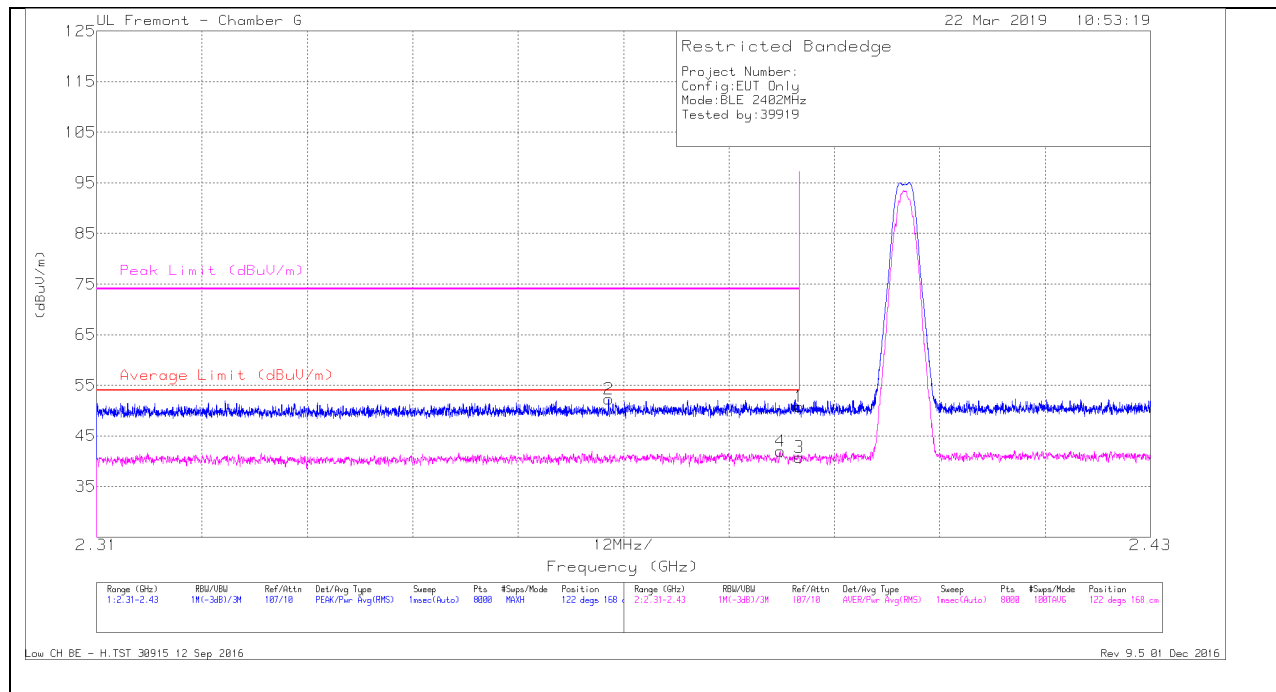
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

9.2.2. BLE (2Mbps)

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



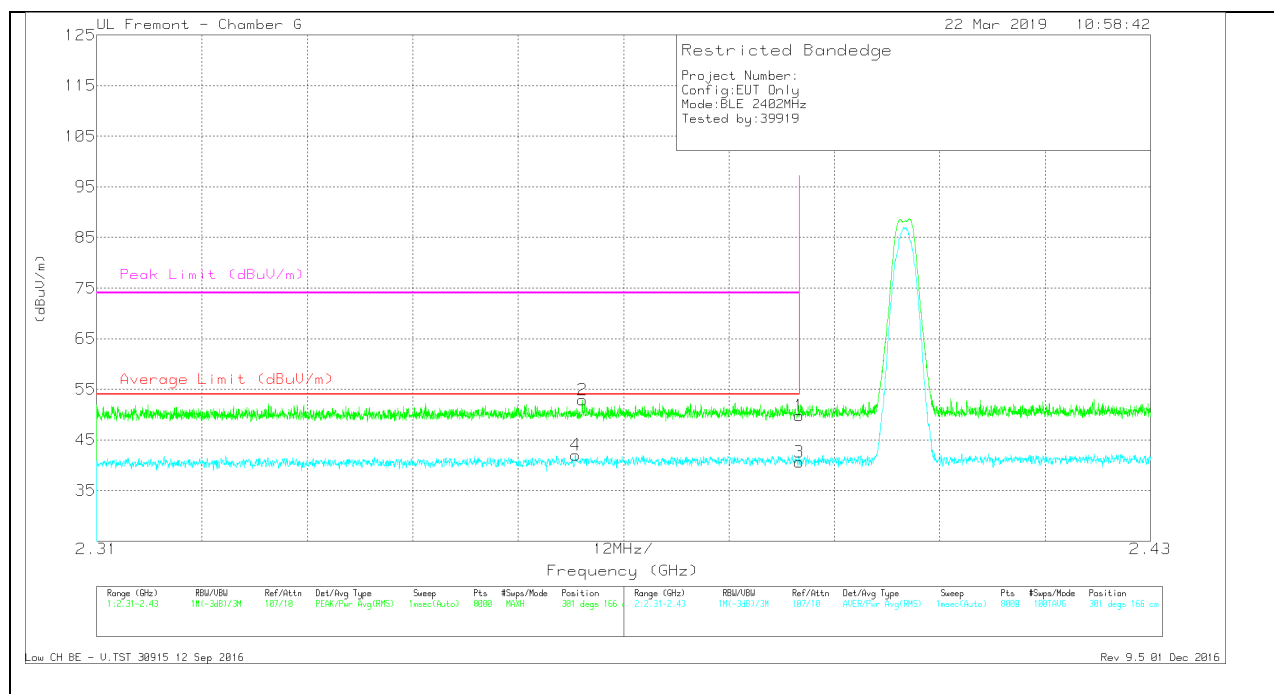
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.14	Pk	31.9	-22.3	50.74	-	-	74	-23.26	122	168	H
2	* 2.368	42.73	Pk	31.8	-22.3	52.23	-	-	74	-21.77	122	168	H
3	* 2.39	31.19	RMS	31.9	-22.3	40.79	54	-13.21	-	-	122	168	H
4	* 2.388	32.32	RMS	31.9	-22.2	42.02	54	-11.98	-	-	122	168	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	40.2	Pk	31.9	-22.3	49.8	-	-	74	-24.2	301	166	V
2	* 2.365	43.46	Pk	31.7	-22.3	52.86	-	-	74	-21.14	301	166	V
3	* 2.39	31.01	RMS	31.9	-22.3	40.61	54	-13.39	-	-	301	166	V
4	* 2.365	32.63	RMS	31.7	-22.3	42.03	54	-11.97	-	-	301	166	V

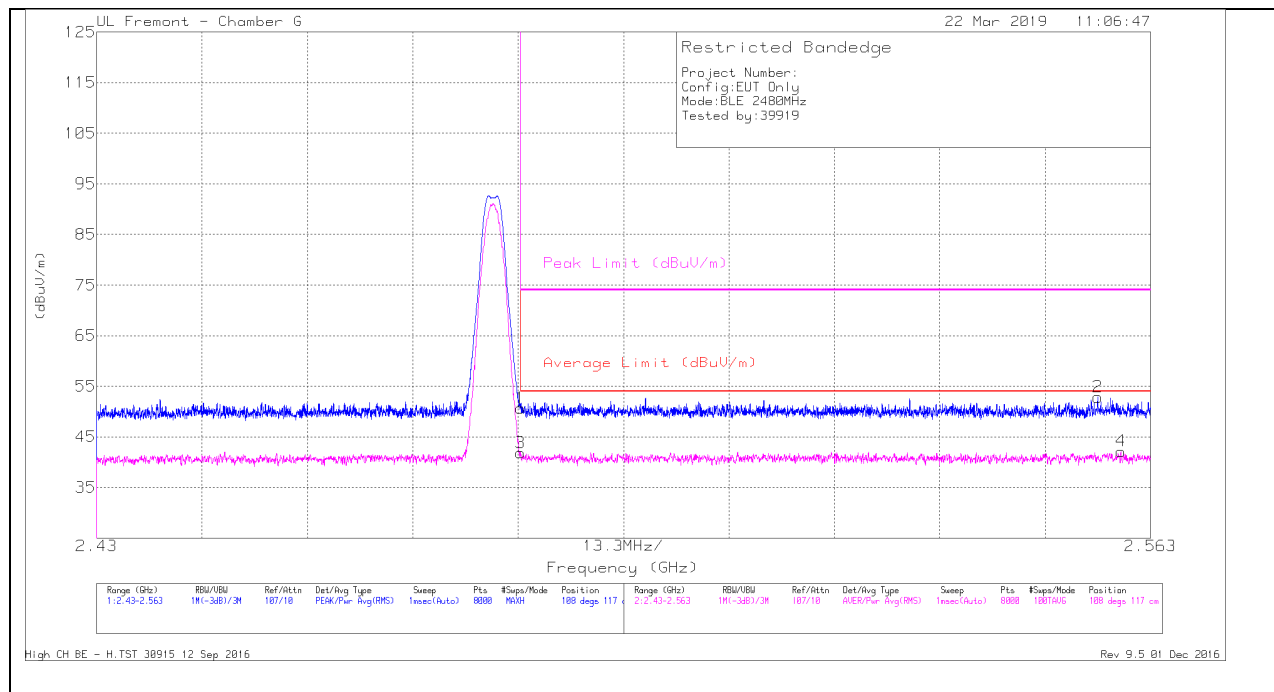
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

BANEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



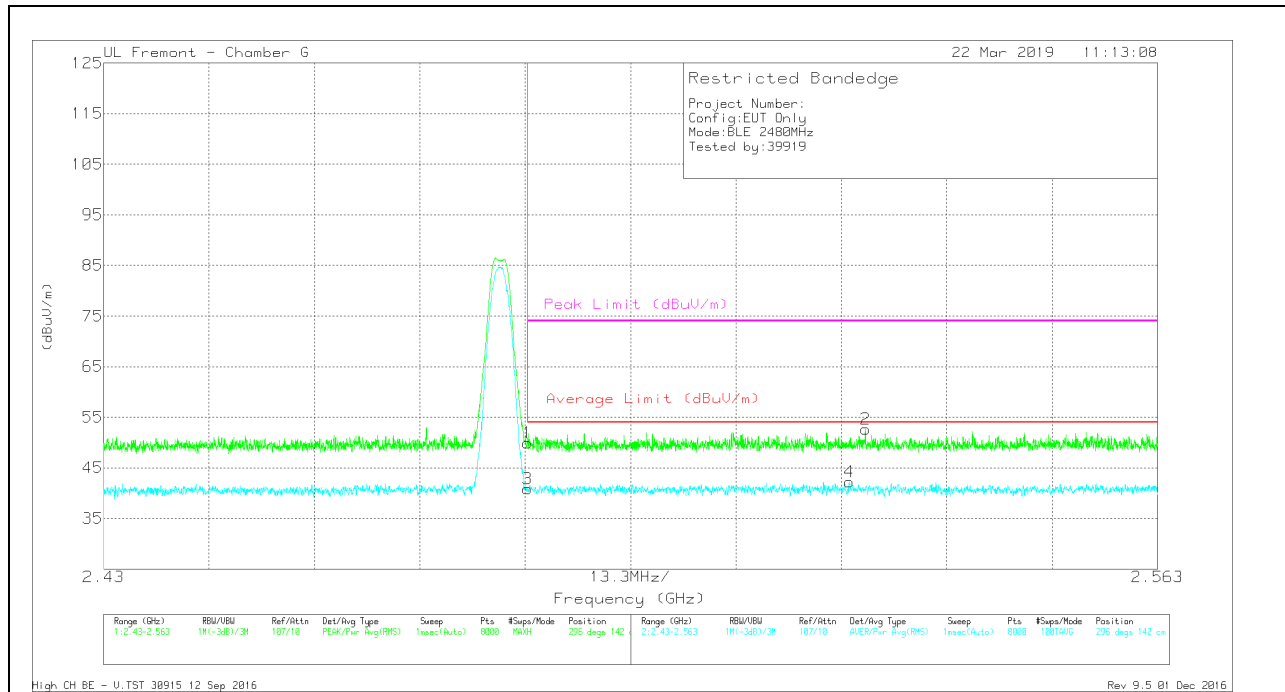
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.57	Pk	32.4	-22.3	50.67	-	-	74	-23.33	108	117	H
3	* 2.484	31.76	RMS	32.4	-22.3	41.86	54	-12.14	-	-	108	117	H
2	2.556	42.54	Pk	32.4	-22.1	52.84	-	-	74	-21.16	108	117	H
4	2.559	31.96	RMS	32.4	-22.2	42.16	54	-11.84	-	-	108	117	H

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

Pk - Peak detector

RMS - RMS detection

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 2.484	39.82	Pk	32.4	-22.3	49.92	-	-	74	-24.08	296	142	V
3	* 2.484	30.76	RMS	32.4	-22.3	40.86	54	-13.14	-	-	296	142	V
4	2.524	32.16	RMS	32.4	-22.3	42.26	54	-11.74	-	-	296	142	V
2	2.526	42.54	Pk	32.4	-22.3	52.64	-	-	74	-21.36	296	142	V

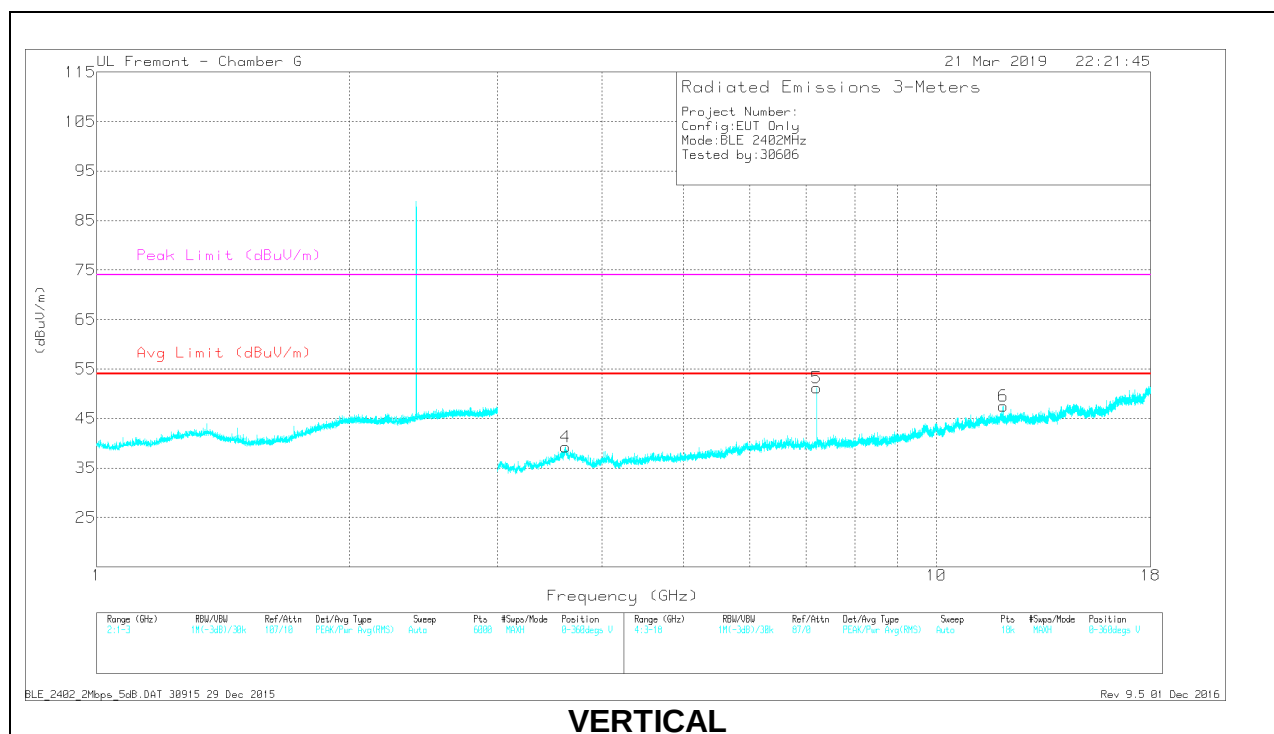
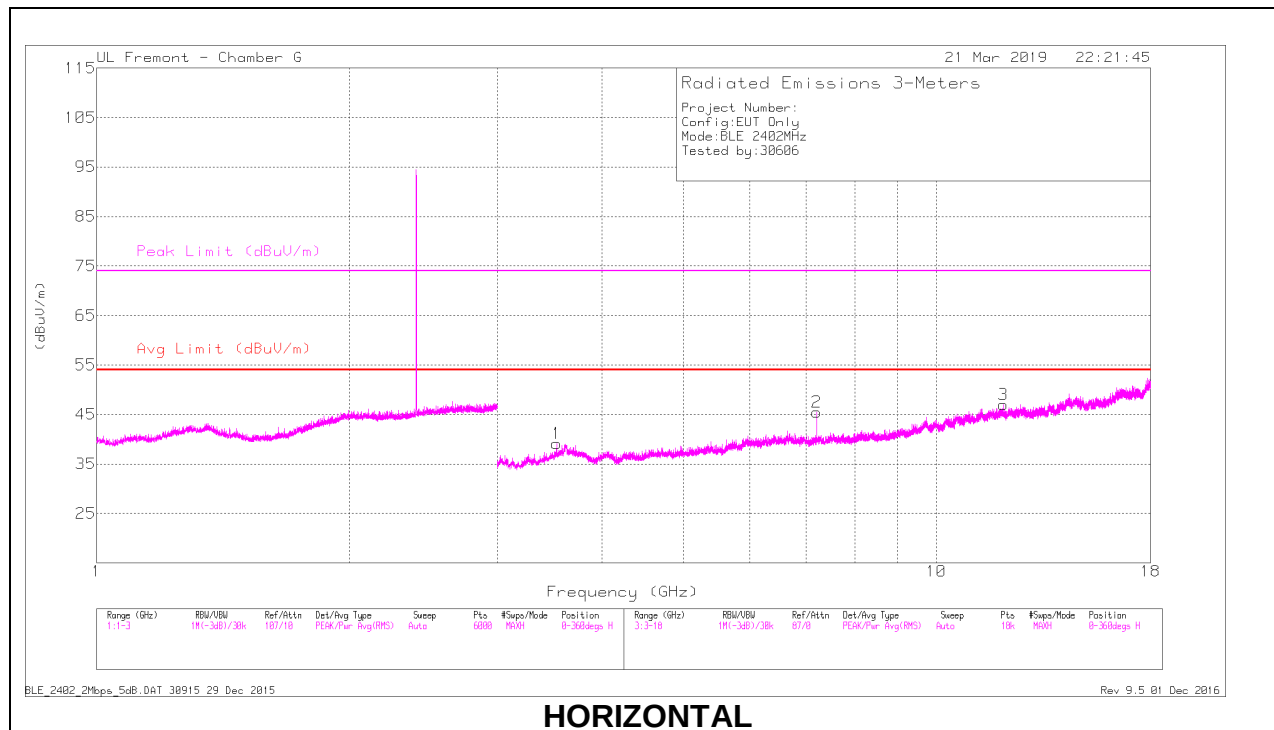
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

RMS - RMS detection

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

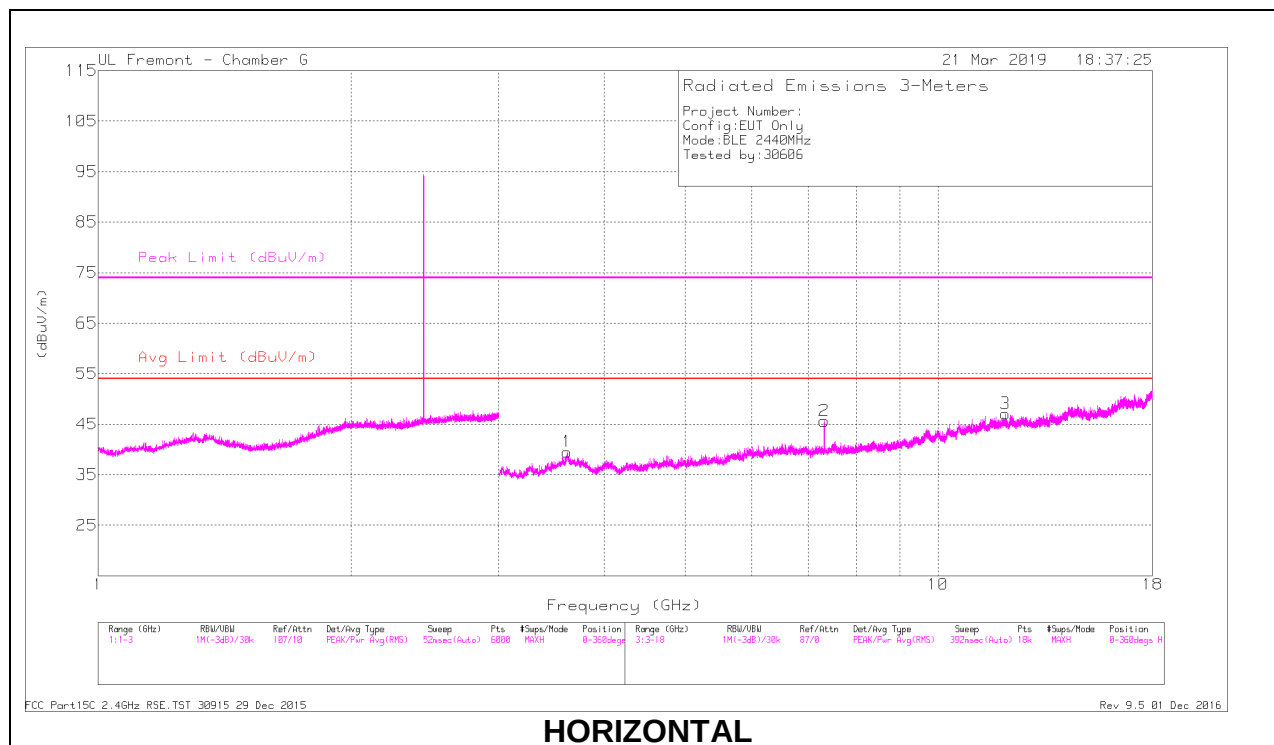
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.529	41.18	PK2	35	-30.8	45.38	-	-	74	-28.62	316	360	H
	* 3.529	29.18	MAv1	35	-30.8	33.38	54	-20.62	-	-	316	360	H
3	* 12.013	37.75	PK2	39.5	-23	54.25	-	-	74	-19.75	17	105	H
	* 12.013	27.07	MAv1	39.5	-23	43.57	54	-10.43	-	-	17	105	H
4	* 3.621	41.68	PK2	35.7	-30.2	47.18	-	-	74	-26.82	233	378	V
	* 3.621	29.29	MAv1	35.7	-30.2	34.79	54	-19.21	-	-	233	378	V
6	* 12.012	39.08	PK2	39.5	-23	55.58	-	-	74	-18.42	46	119	V
	* 12.013	27.91	MAv1	39.5	-23	44.41	54	-9.59	-	-	46	119	V
2	7.208	43.67	PK2	35.8	-27.8	51.67	-	-	-	-	96	108	H
5	7.208	48.13	PK2	35.8	-27.8	56.13	-	-	-	-	124	143	V

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

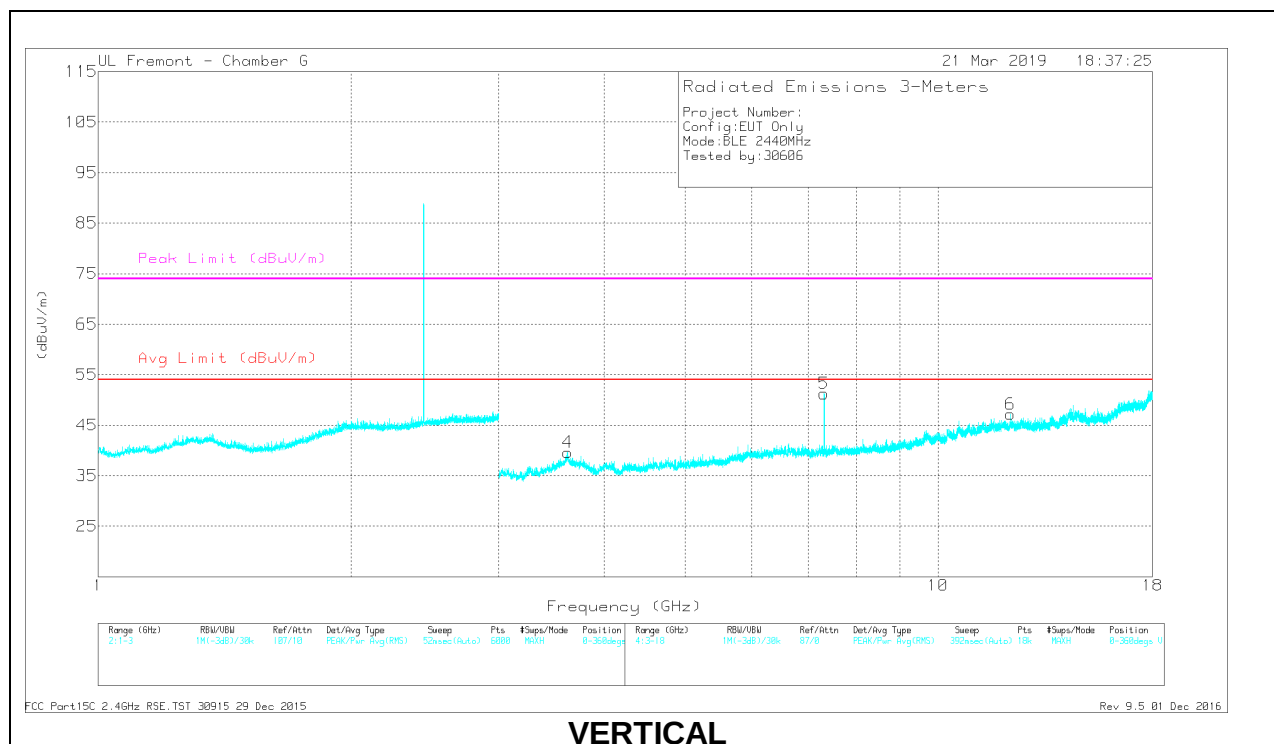
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

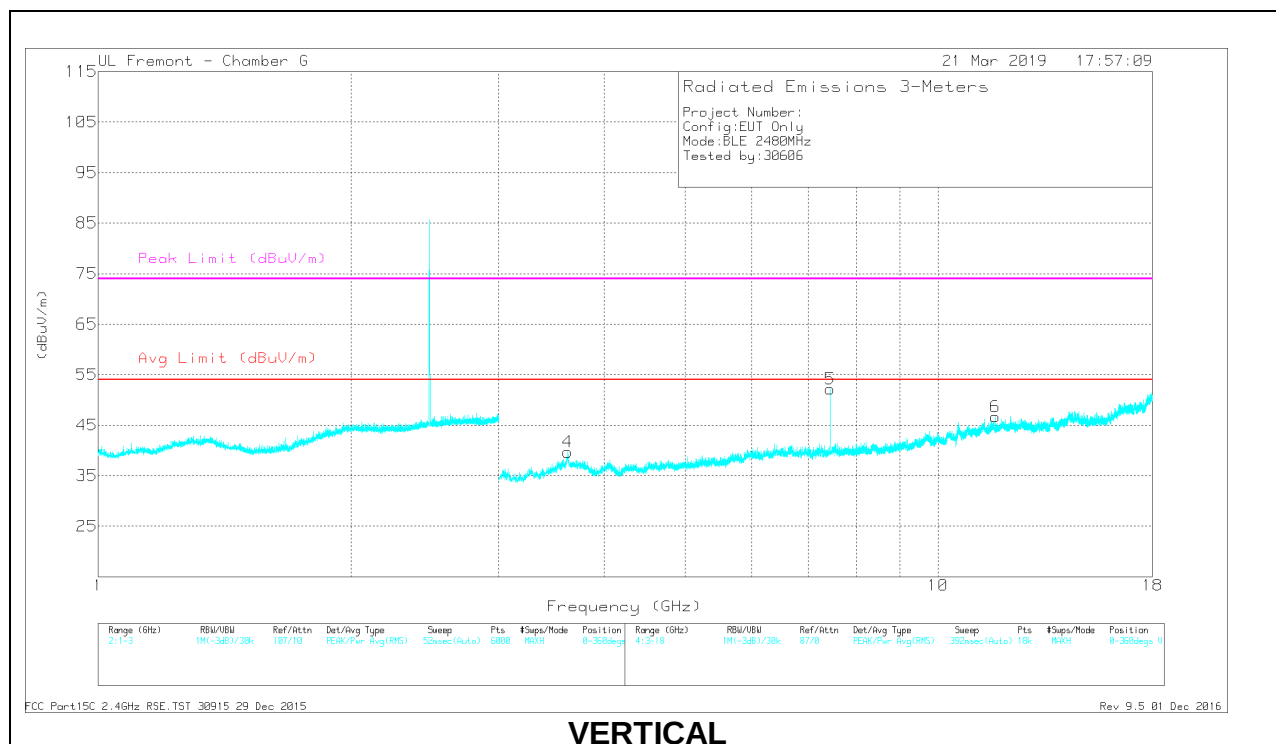
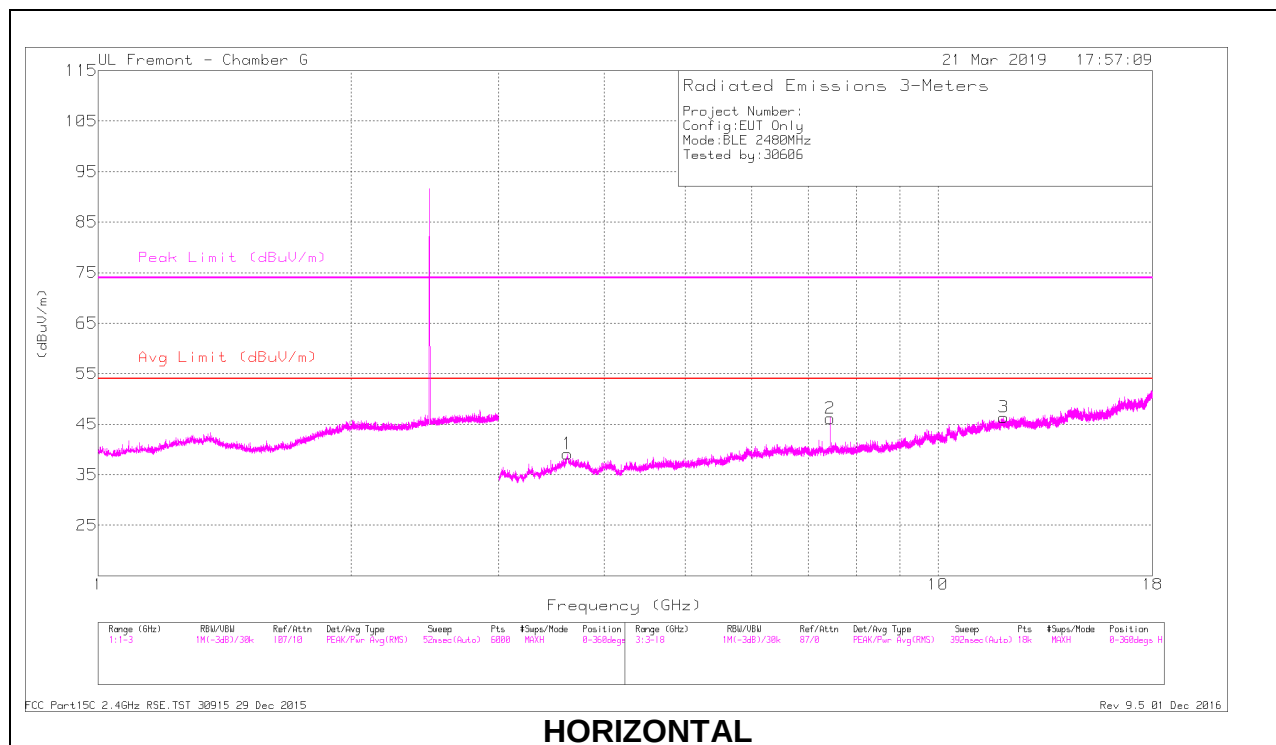
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.616	41.28	PK2	35.6	-30.3	46.58	-	-	74	-27.42	113	229	H
	* 3.617	29.37	MAv1	35.7	-30.3	34.77	54	-19.23	-	-	113	229	H
2	* 7.321	42.86	PK2	35.9	-27.6	51.16	-	-	74	-22.84	278	128	H
	* 7.321	33.63	MAv1	35.9	-27.6	41.93	54	-12.07	-	-	278	128	H
3	* 12.025	36.15	PK2	39.5	-23.2	52.45	-	-	74	-21.55	357	321	H
	* 12.024	24.76	MAv1	39.5	-23.2	41.06	54	-12.94	-	-	357	321	H
4	* 3.626	40.94	PK2	35.4	-30	46.34	-	-	74	-27.66	7	295	V
	* 3.625	29.28	MAv1	35.5	-30.1	34.68	54	-19.32	-	-	7	295	V
5	* 7.318	47.75	PK2	35.8	-27.6	55.95	-	-	74	-18.05	288	253	V
	* 7.319	40.56	MAv1	35.8	-27.6	48.76	54	-5.24	-	-	288	253	V
6	* 12.198	37.91	PK2	39.5	-22.9	54.51	-	-	74	-19.49	210	140	V
	* 12.198	26.69	MAv1	39.5	-22.9	43.29	54	-10.71	-	-	210	140	V

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

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (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	* 3.619	40.9	PK2	35.7	-30.2	46.4	-	-	74	-27.6	237	191	H
	* 3.62	29.18	MAv1	35.7	-30.2	34.68	54	-19.32	-	-	237	191	H
2	* 7.438	44.93	PK2	36	-27.9	53.03	-	-	74	-20.97	84	111	H
	* 7.439	36.18	MAv1	36	-27.9	44.28	54	-9.72	-	-	84	111	H
3	* 11.975	36.72	PK2	39.5	-22.4	53.82	-	-	74	-20.18	173	326	H
	* 11.975	24.43	MAv1	39.5	-22.4	41.53	54	-12.47	-	-	173	326	H
4	* 3.623	40.94	PK2	35.6	-30.1	46.44	-	-	74	-27.56	131	378	V
	* 3.624	29.4	MAv1	35.6	-30.1	34.9	54	-19.1	-	-	131	378	V
5	* 7.438	49.14	PK2	36	-27.9	57.24	-	-	74	-16.76	158	144	V
	* 7.439	41.76	MAv1	36	-27.9	49.86	54	-4.14	-	-	158	144	V
6	* 11.706	36.7	PK2	39.3	-23.4	52.6	-	-	74	-21.4	96	277	V
	* 11.71	24.95	MAv1	39.3	-23.4	40.85	54	-13.15	-	-	96	277	V

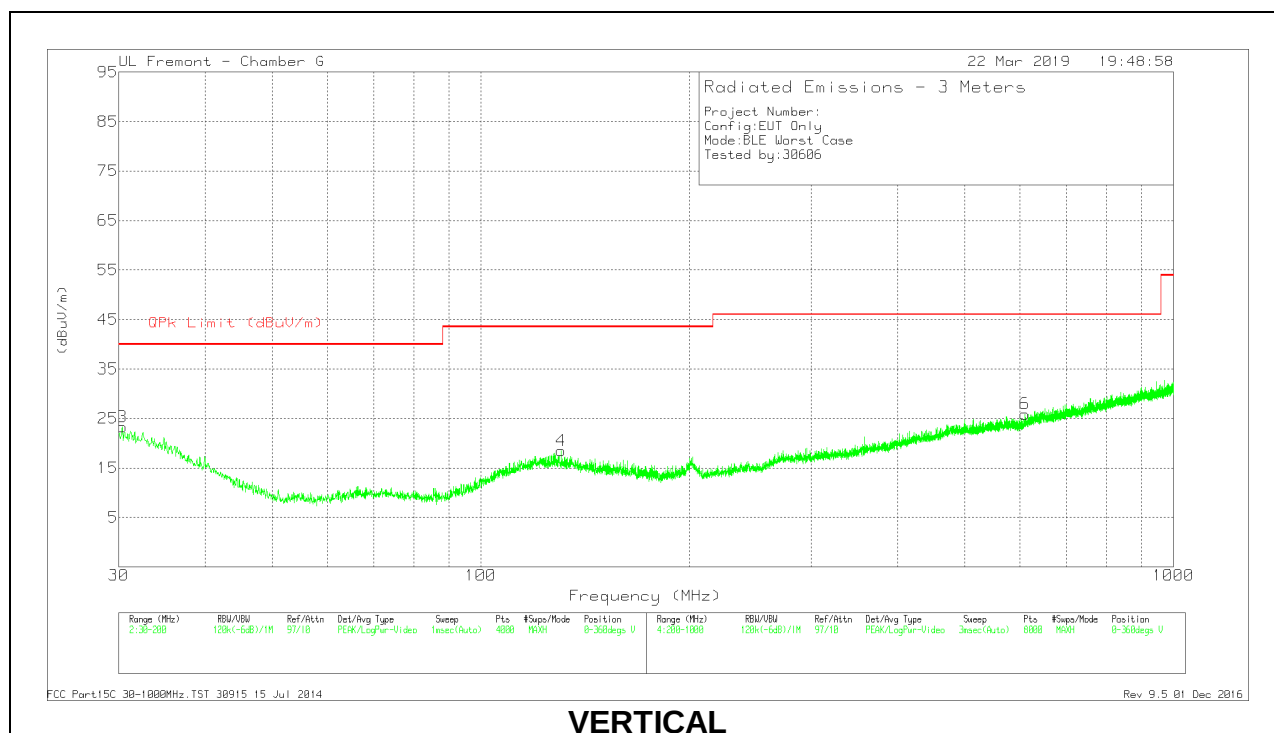
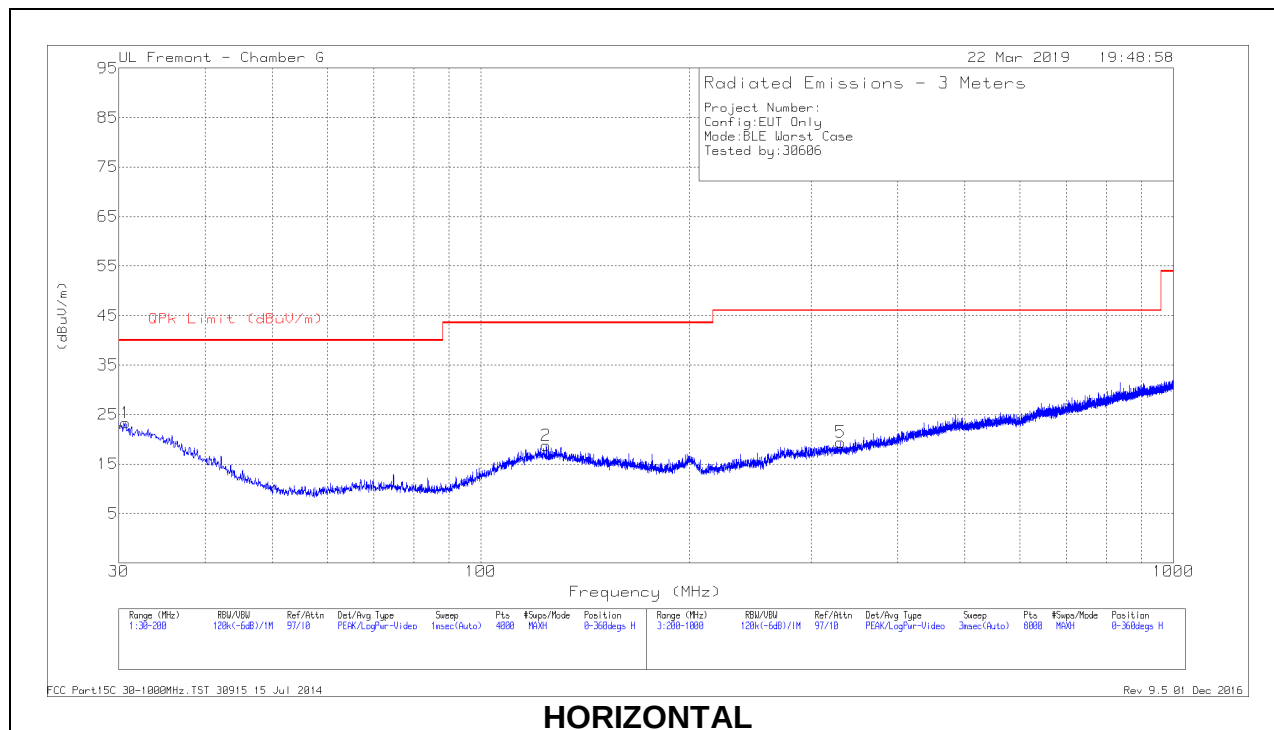
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

9.3. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

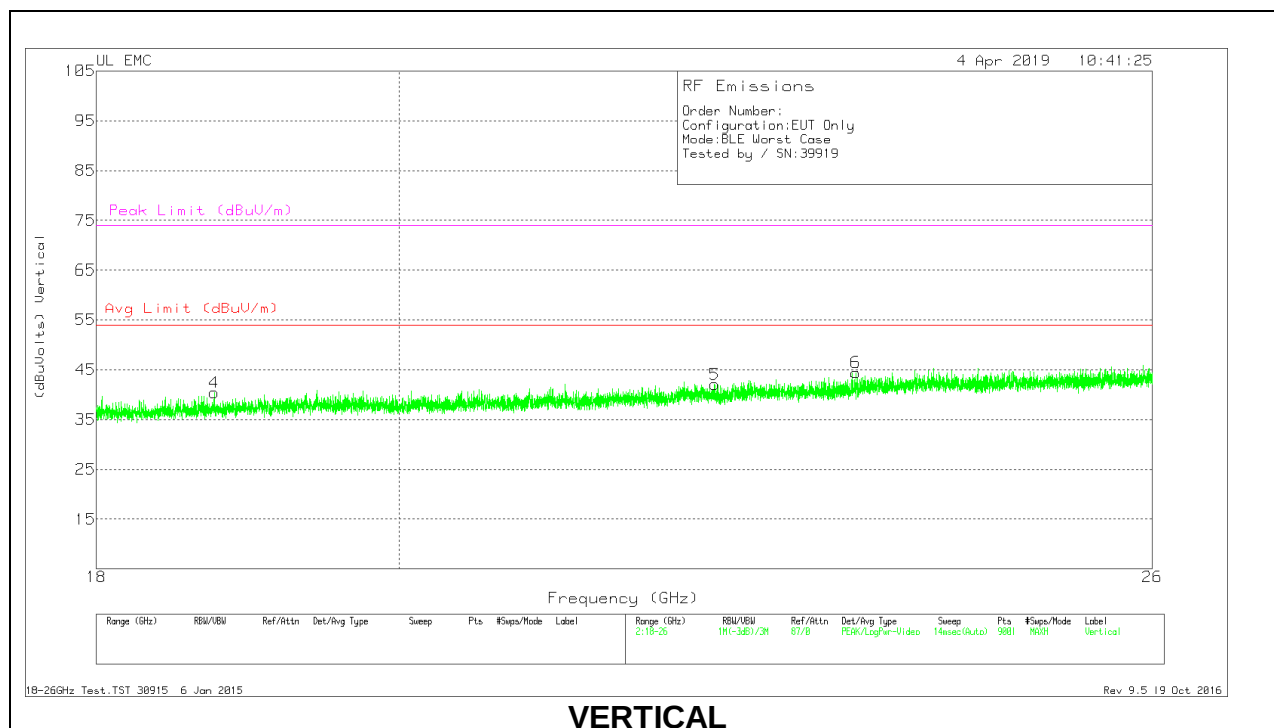
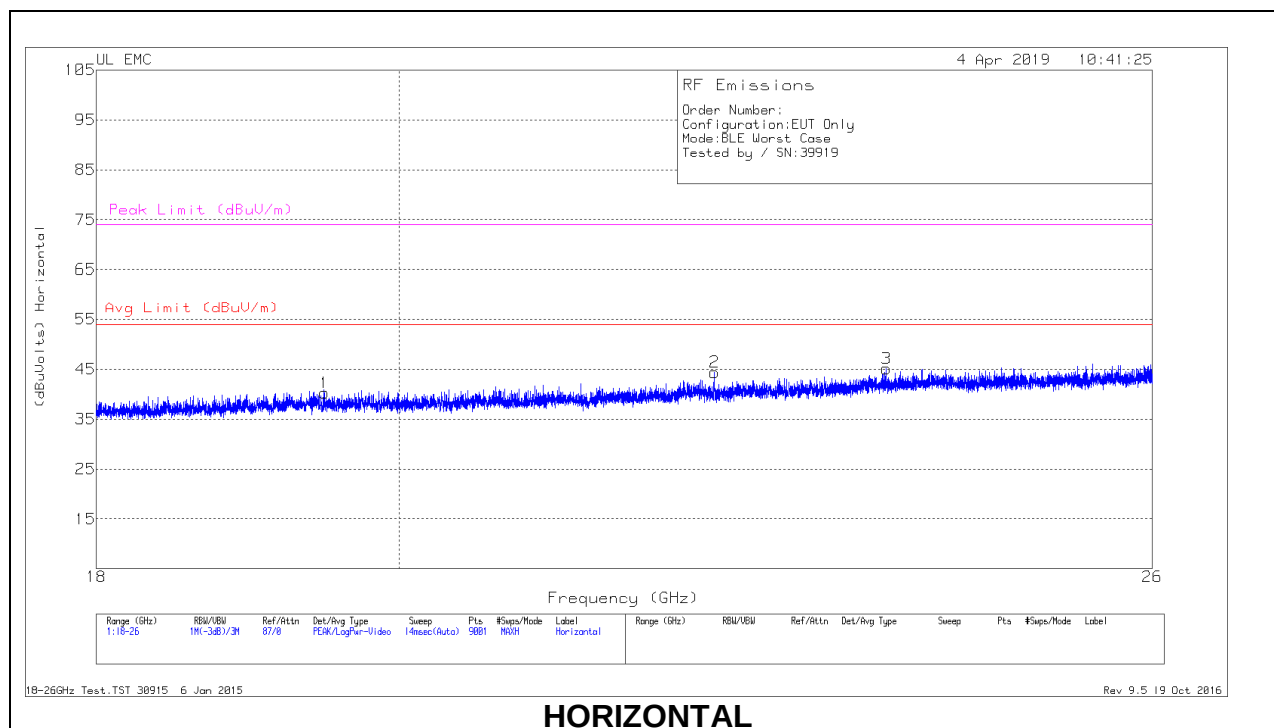
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 124.3319	28.96	Pk	20	-30.2	18.76	43.52	-24.76	0-360	200	H
4	* 130.6235	28.82	Pk	19.8	-30.1	18.52	43.52	-25	0-360	100	V
5	* 331.017	28.24	Pk	19.9	-28.7	19.44	46.02	-26.58	0-360	400	H
6	* 610.5534	28.72	Pk	24.6	-27.4	25.92	46.02	-20.1	0-360	201	V
3	30.3401	27.81	Pk	26.7	-31.2	23.31	40	-16.69	0-360	100	V
1	30.6802	28.23	Pk	26.3	-31.2	23.33	40	-16.67	0-360	400	H

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

Pk - Peak detector

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	19.489	38.36	Pk	32.8	-21.4	-9.5	40.26	54	-13.74	74	-33.74
2	22.323	40.79	Pk	33.5	-20.4	-9.5	44.39	54	-9.61	74	-29.61
3	23.699	40.22	Pk	34.1	-19.7	-9.5	45.12	54	-8.88	74	-28.88
4	18.755	39.11	Pk	32.4	-21.6	-9.5	40.41	54	-13.59	74	-33.59
5	22.324	38.48	Pk	33.5	-20.4	-9.5	42.08	54	-11.92	74	-31.92
6	23.449	40.03	Pk	34	-20.1	-9.5	44.43	54	-9.57	74	-29.57

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 ^a	56 to 46 ^a
0.5-5	56	46
5-30	60	50

^a Decreases with the logarithm of the frequency.

TEST PROCEDURE

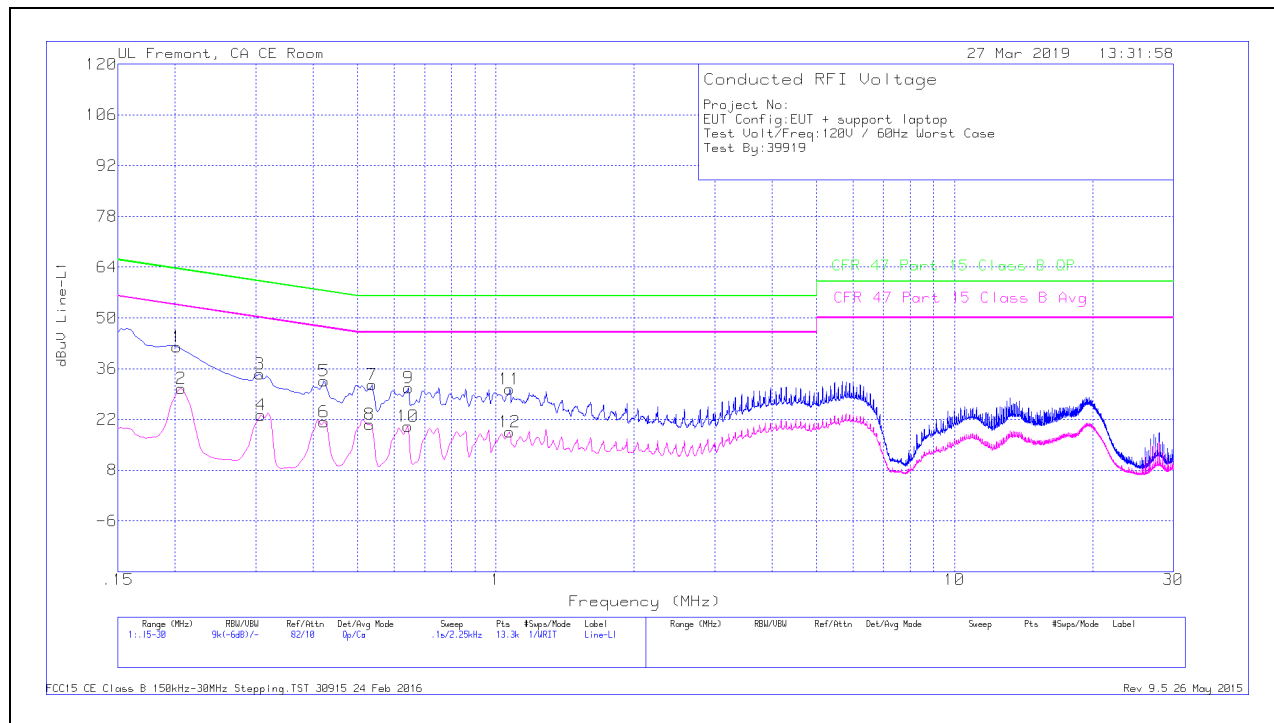
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

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

RESULTS

10.1.1. AC Power Line Host

LINE 1 RESULTS



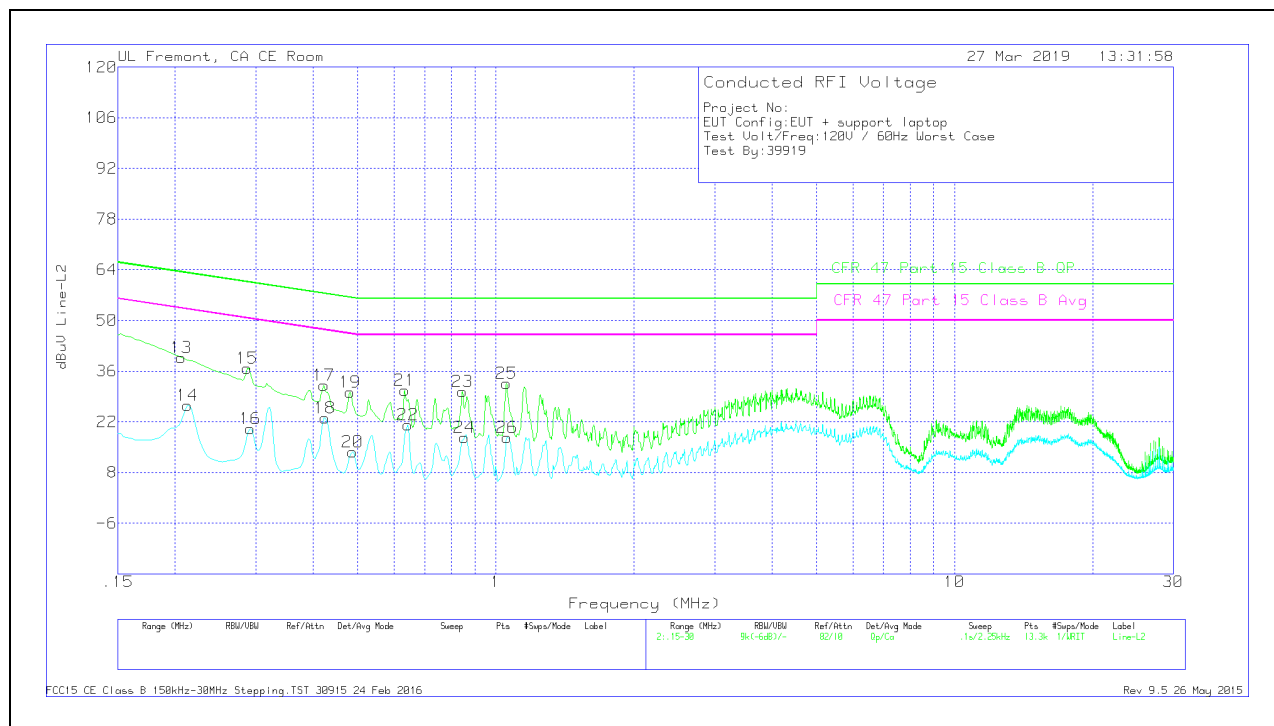
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.20175	31.9	Qp	0	0	10.1	42	63.54	-21.54	-	-
2	.20625	20.41	Ca	0	0	10.1	30.51	-	-	53.35	-22.84
3	.30525	24.43	Qp	0	0	10.1	34.53	60.1	-25.57	-	-
4	.3075	13.05	Ca	0	0	10.1	23.15	-	-	50.04	-26.89
5	.42225	22.44	Qp	0	0	10.1	32.54	57.4	-24.86	-	-
6	.42225	11.17	Ca	0	0	10.1	21.27	-	-	47.4	-26.13
7	.537	21.48	Qp	0	0	10.1	31.58	56	-24.42	-	-
8	.53025	10.5	Ca	0	0	10.1	20.6	-	-	46	-25.4
9	.645	20.56	Qp	0	0	10.1	30.66	56	-25.34	-	-
10	.64275	10.04	Ca	0	0	10.1	20.14	-	-	46	-25.86
11	1.0725	20.2	Qp	0	.1	10.1	30.4	56	-25.6	-	-
12	1.07025	8.38	Ca	0	.1	10.1	18.58	-	-	46	-27.42

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

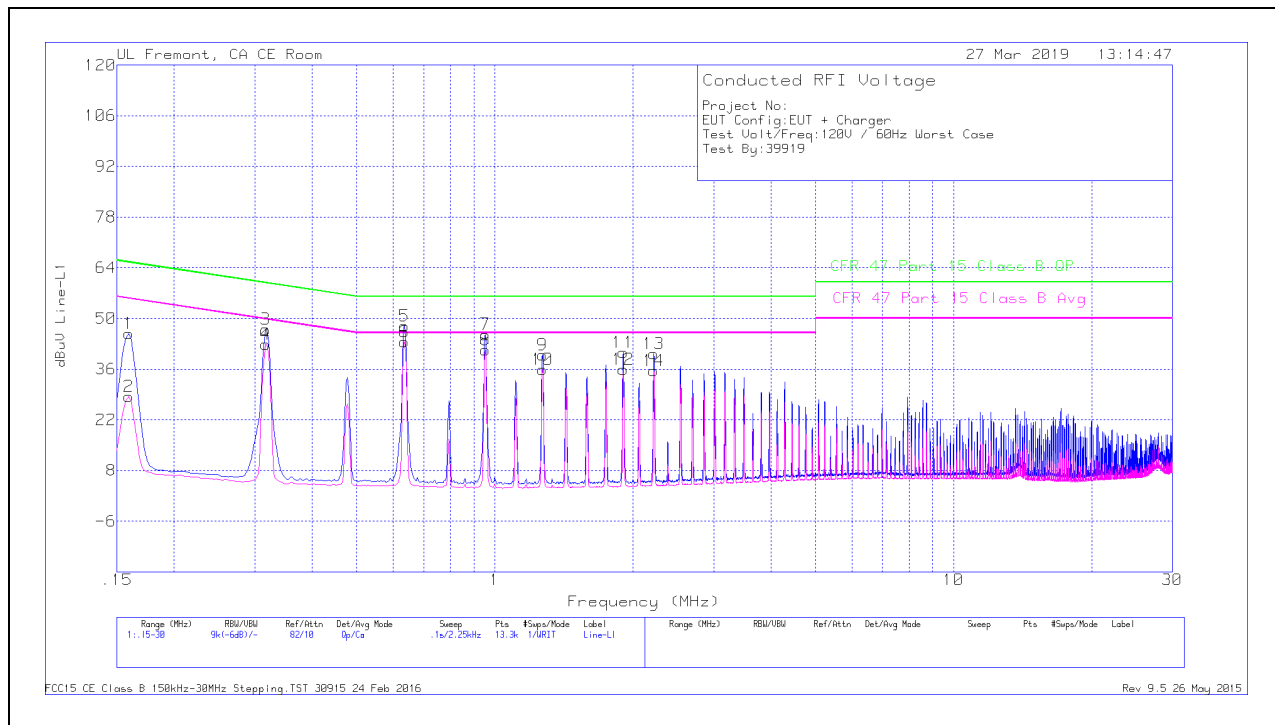
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.20625	29.7	Qp	0	0	10.1	39.8	63.35	-23.55	-	-
14	.213	16.45	Ca	0	0	10.1	26.55	-	-	53.09	-26.54
15	.28725	26.65	Qp	0	0	10.1	36.75	60.6	-23.85	-	-
16	.29175	10.07	Ca	0	0	10.1	20.17	-	-	50.47	-30.3
17	.42225	21.96	Qp	0	0	10.1	32.06	57.4	-25.34	-	-
18	.4245	12.99	Ca	0	0	10.1	23.09	-	-	47.36	-24.27
19	.48075	20.16	Qp	0	0	10.1	30.26	56.33	-26.07	-	-
20	.4875	3.57	Ca	0	0	10.1	13.67	-	-	46.21	-32.54
21	.63375	20.53	Qp	0	0	10.1	30.63	56	-25.37	-	-
22	.64275	11.01	Ca	0	0	10.1	21.11	-	-	46	-24.89
23	.84525	20.23	Qp	0	0	10.1	30.33	56	-25.67	-	-
24	.85425	7.51	Ca	0	0	10.1	17.61	-	-	46	-28.39
25	1.0545	22.47	Qp	0	.1	10.1	32.67	56	-23.33	-	-
26	1.059	7.45	Ca	0	.1	10.1	17.65	-	-	46	-28.35

Qp - Quasi-Peak detector

Ca - CISPR average detection

10.1.2. AC Power Line Norm

LINE 1 RESULTS



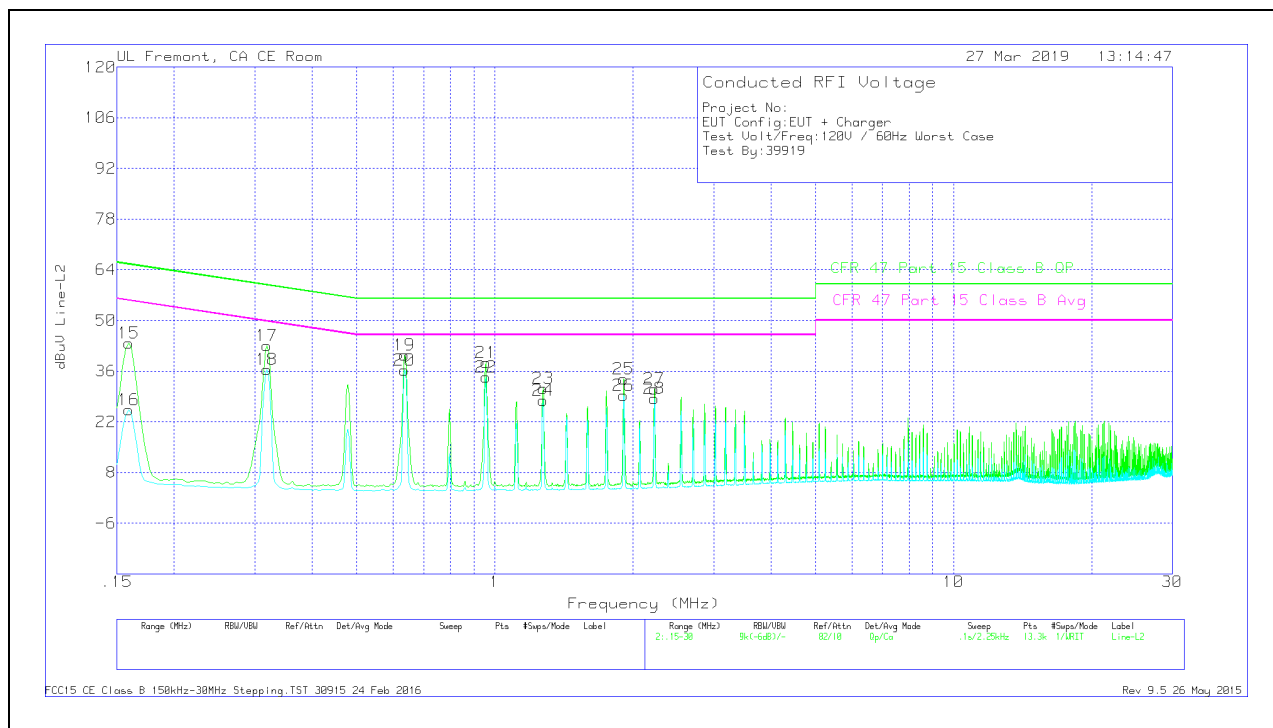
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.159	35.57	Qp	.1	0	10.1	45.77	65.52	-19.75	-	-
2	.159	18.29	Ca	.1	0	10.1	28.49	-	-	55.52	-27.03
3	.3165	36.86	Qp	0	0	10.1	46.96	59.8	-12.84	-	-
4	.3165	32.72	Ca	0	0	10.1	42.82	-	-	49.8	-6.98
5	.636	37.75	Qp	0	0	10.1	47.85	56	-8.15	-	-
6	.636	33.54	Ca	0	0	10.1	43.64	-	-	46	-2.36
7	.95325	35.36	Qp	0	.1	10.1	45.56	56	-10.44	-	-
8	.95325	31.14	Ca	0	.1	10.1	41.34	-	-	46	-4.66
9	1.2705	29.74	Qp	0	.1	10.1	39.94	56	-16.06	-	-
10	1.2705	25.64	Ca	0	.1	10.1	35.84	-	-	46	-10.16
11	1.905	30.48	Qp	0	.1	10.1	40.68	56	-15.32	-	-
12	1.905	25.71	Ca	0	.1	10.1	35.91	-	-	46	-10.09
13	2.22225	30.06	Qp	0	.1	10.1	40.26	56	-15.74	-	-
14	2.22225	25.3	Ca	0	.1	10.1	35.5	-	-	46	-10.5

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
15	.159	33.56	Qp	.1	0	10.1	43.76	65.52	-21.76	-	-
16	.159	15.15	Ca	.1	0	10.1	25.35	-	-	55.52	-30.17
17	.31875	32.96	Qp	0	0	10.1	43.06	59.74	-16.68	-	-
18	.31875	26.35	Ca	0	0	10.1	36.45	-	-	49.74	-13.29
19	.636	30.32	Qp	0	0	10.1	40.42	56	-15.58	-	-
20	.636	26.22	Ca	0	0	10.1	36.32	-	-	46	-9.68
21	.9555	28.23	Qp	0	.1	10.1	38.43	56	-17.57	-	-
22	.9555	24.17	Ca	0	.1	10.1	34.37	-	-	46	-11.63
23	1.275	21.1	Qp	0	.1	10.1	31.3	56	-24.7	-	-
24	1.275	17.65	Ca	0	.1	10.1	27.85	-	-	46	-18.15
25	1.9095	23.64	Qp	0	.1	10.1	33.84	56	-22.16	-	-
26	1.9095	19.05	Ca	0	.1	10.1	29.25	-	-	46	-16.75
27	2.229	20.8	Qp	0	.1	10.1	31	56	-25	-	-
28	2.229	18.24	Ca	0	.1	10.1	28.44	-	-	46	-17.56

Qp - Quasi-Peak detector

Ca - CISPR average detection

11. SETUP PHOTOS

Please refer to 12742033-EP2V1 for setup photos

END OF TEST REPORT