



CERTIFICATION TEST REPORT

Report Number. : 13280103-E2V2

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

Model : A2453

FCC ID : BCGA2453

IC : 579C-A2453

EUT Description : Totally Wireless High-Performance Earphones

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

Date Of Issue:
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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	3/27/2020	Initial Issue	Francisco Guarnero
V2	3/31/2020	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: Totally Wireless High-Performance Earphones

MODEL: A2453

SERIAL NUMBER: CC2C902LPNC9 (Conducted) CC2C904HPNC9 (Radiated)

DATE TESTED: MARCH 11 – 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.

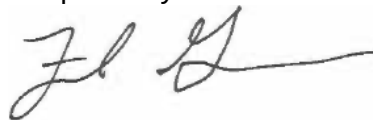
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This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

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 11.6.
See Comment	RSS-GEN 6.7	20dB BW/99% OBW	Reporting purposes only	ANSI C63.10 Sections 6.9.2 and 6.9.3
15.247 (a)(1)	RSS-247 (5.1) (b)	Hopping Frequency Separation		None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Number of Hopping Channels		None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Average Time of Occupancy		None.
15.247 (b)(1)	RSS-247 (5.4) (b)	Output Power		None.
See Comment		Average Power	Reporting purposes only	Per ANSI C63.10, Section 11.9.2.3.2.
15.247 (d)	RSS-247 (5.5)	Conducted Spurious Emissions		None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions		None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions		None.

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, KDB 414788 D01 Radiated Test Site v01r01 RSS-GEN Issue 5, and RSS-247 Issue 2.

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

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

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

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.

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 to 0.15 MHz	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 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%.

5.4. 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, model A2453 is a totally wireless high performance earphones. It has an integral battery, microphone and antenna. It can charge via bottom contacts with charging case.

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	Basic GFSK	12.67	18.49
2402 - 2480	Enhanced DQPSK	11.88	15.42
2402 - 2480	Enhanced 8PSK	12.22	16.67

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes to showing compliance. For average power data please refer to section 9.7.

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)
2.4	-5.40

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 1A610

6.5. WORST-CASE CONFIGURATION AND MODE

Radiated emissions 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 with and without charging case and AC/DC adapter, and it was determined that Z (portrait) orientation was the worst-case orientation with EUT only on below and above 1GHz configuration.; therefore, all final radiated testing was performed with the EUT only in Z (portrait) orientation.

AC line conducted emission was investigated on the following configuration: EUT with charging case and AC/DC adapter and EUT with charging case and Laptop. Below 30 MHz was tested with charging case and AC/DC adapter as the worst case.

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

Worst-case data rates as provided by the client were:

GFSK mode: DH5

8PSK mode: 3-DH5

6.6. 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
AC/DC Adapter	Apple	A1385	D292365CDYADHLHC3	NA
Charger Case	Apple	A2078	CC2C903GPNJH	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 / Power Meter

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						

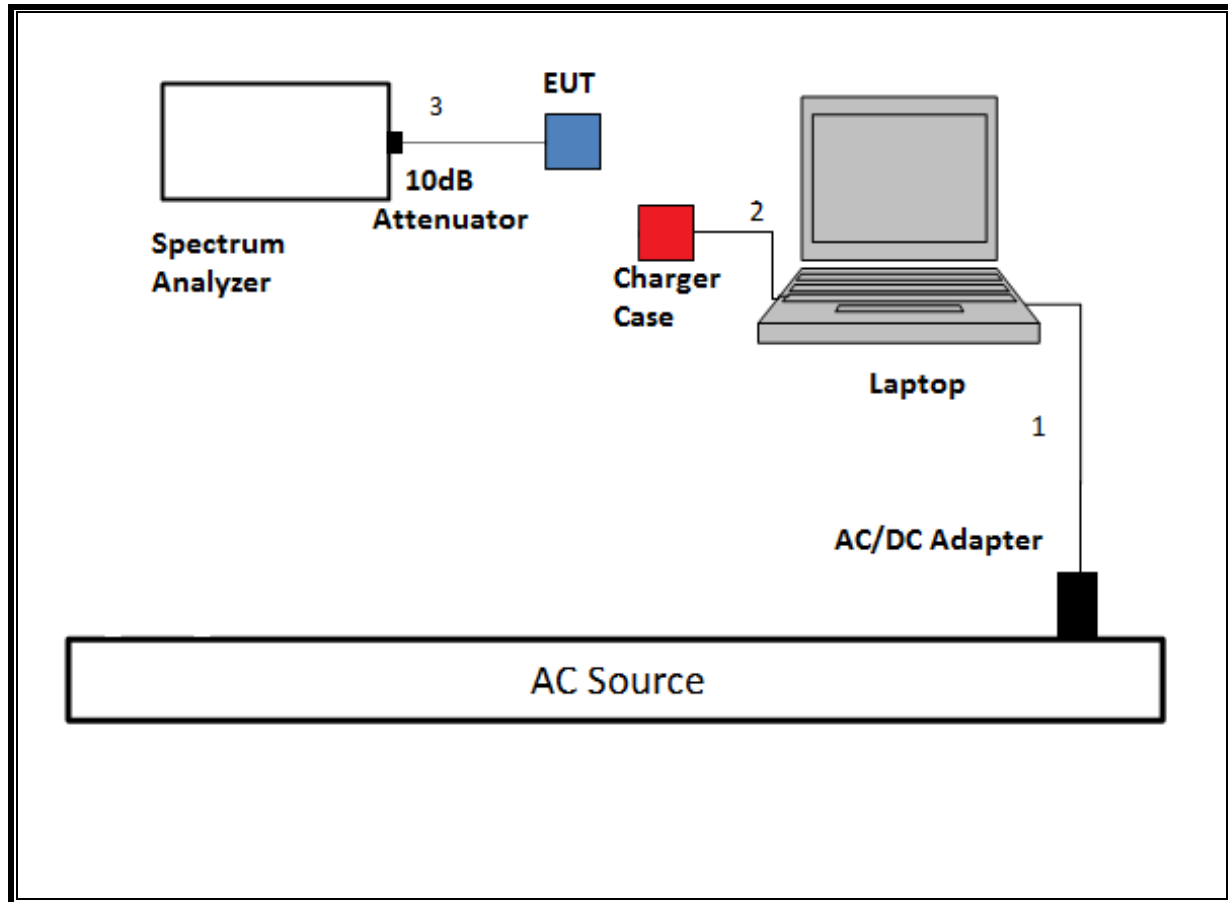
I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

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

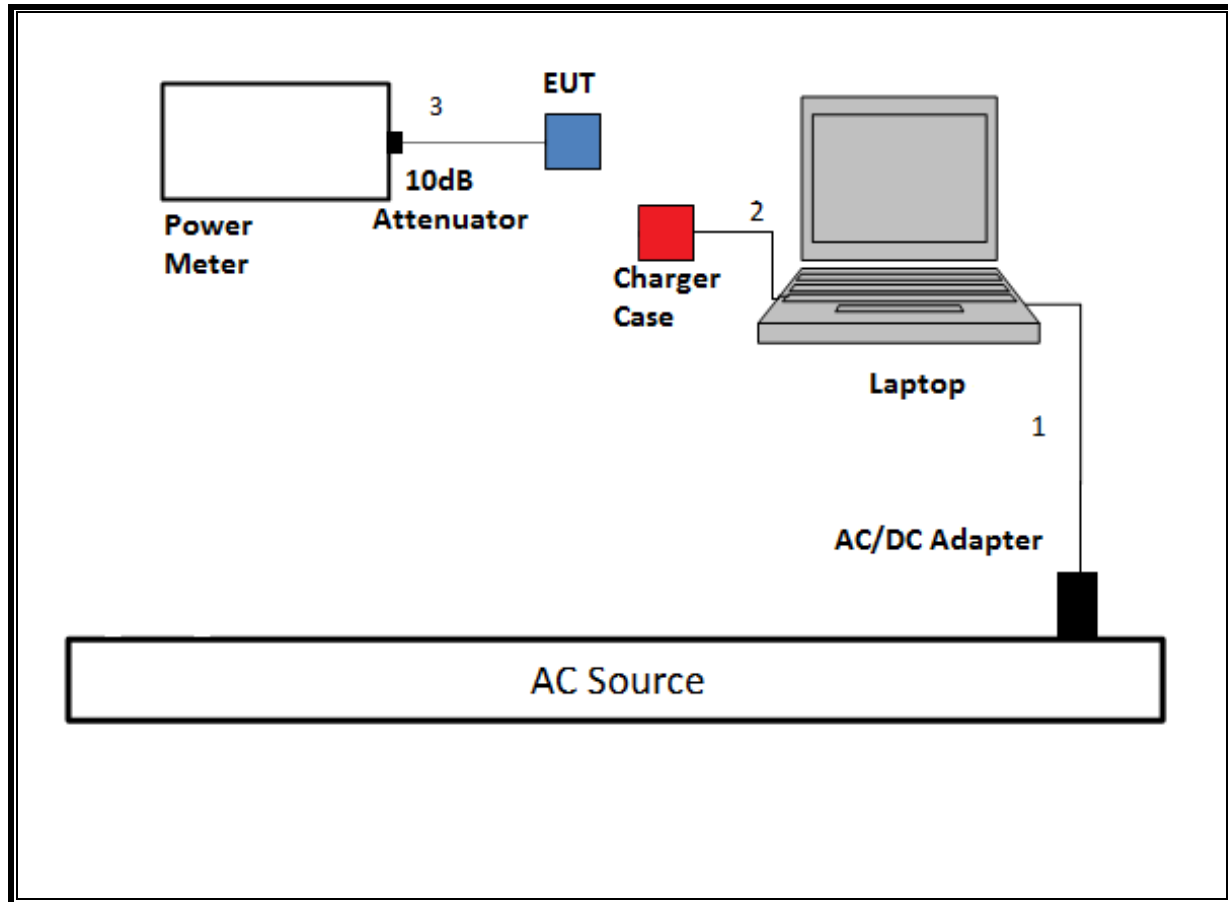
TEST SETUP

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

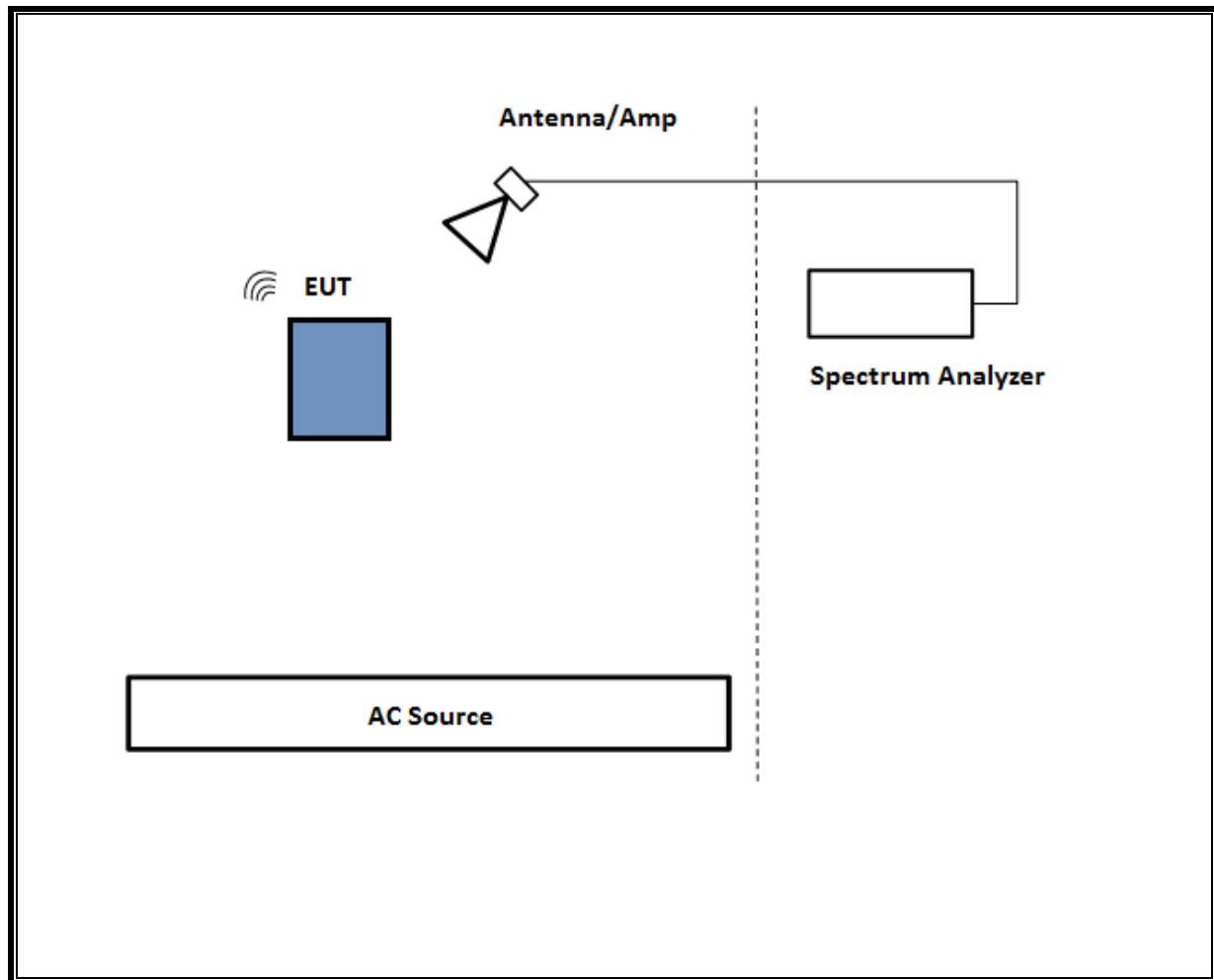
SETUP DIAGRAM FOR CONDUCTED TESTS

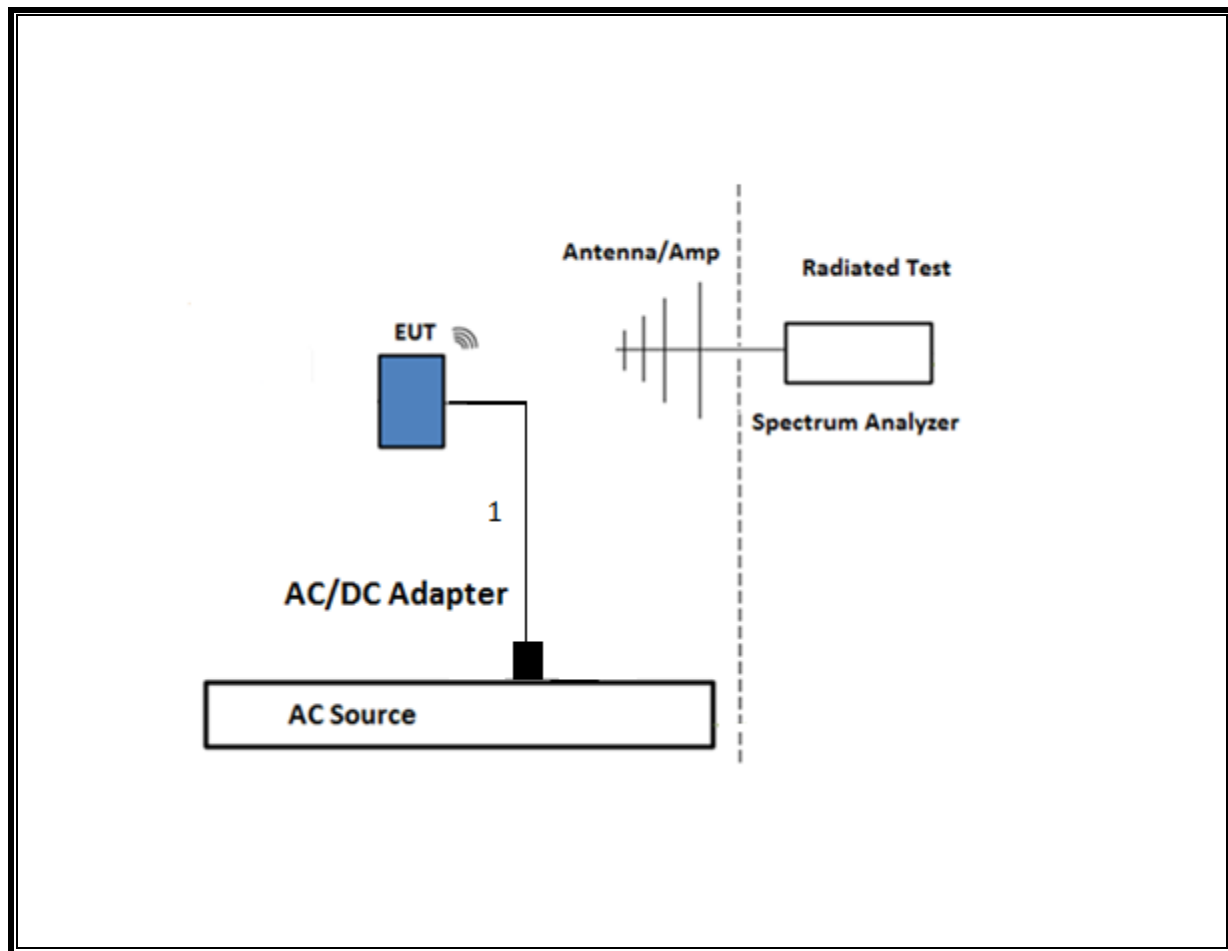


SETUP DIAGRAM FOR CONDUCTED TESTS: POWER METER CONFIGURATION

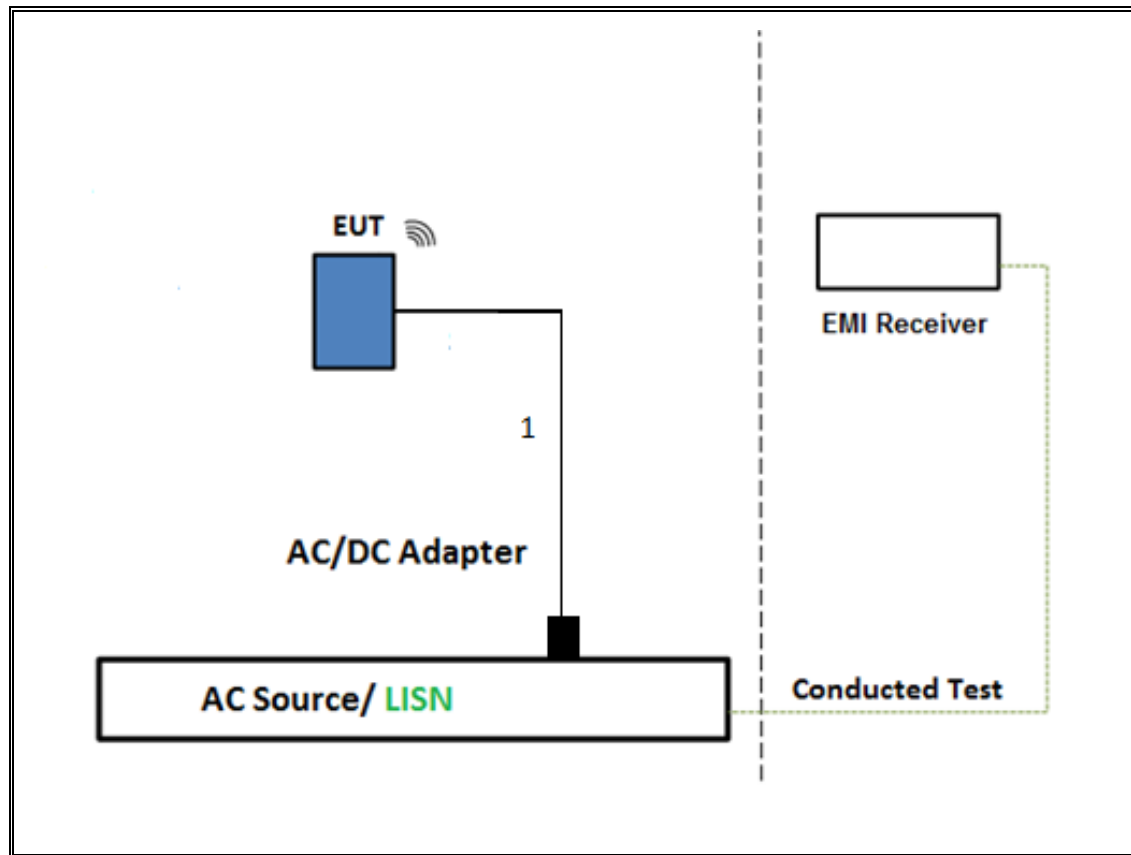


SETUP DIAGRAM FOR RADIATED TESTS ABOVE 1GHz

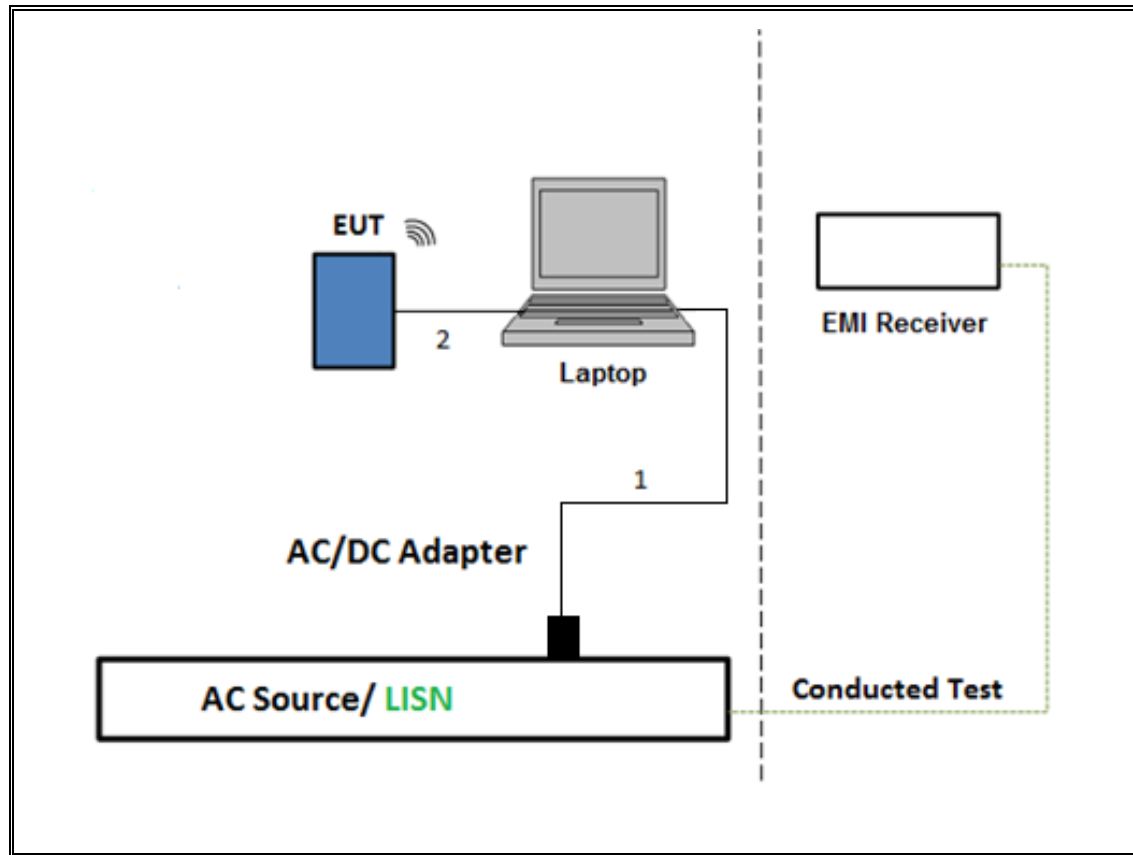


SETUP DIAGRAM FOR BELOW 1GHz

TEST SETUP- AC LINE CONDUCTED: CHARGER CONFIGURATION



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



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	310N	T477	06/06/2020	06/06/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T408	08/23/2020	08/23/2019
Antenna, Double Ridge Guide Horn Antenna 700MHz to 18GHz	A.H. SYSTEMS, INC.	SAS-571	T962	01/26/2021	01/26/2020
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T119	03/22/2021	03/22/2020
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	T740	07/31/2020	07/31/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T906	01/23/2021	01/23/2020
Antenna Horn, 18 to 26GHz	ARA	MWH-1826	T447	06/16/2020	06/16/2019
Pre-Amp 18-26GHz	Agilent Technology	8449B	T404	03/23/2021	03/23/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T342	01/23/2021	01/23/2020
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1683	06/06/2020	06/06/2019
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T136	06/14/2020	06/14/2019
Amplifier, 1 to 8GHz, 35dB	Miteq Inc.	AMF-4D-01000800-30-29P	T1156	05/11/2020	06/11/2019
Power Meter, P-series single channel	Keysight	N1911A	PRE0177682	01/21/2021	01/21/2020
Power Sensor	Keysight	N1921A	T1226	02/13/2021	02/13/2020
Antenna, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1683	06/06/2020	06/06/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T1454	01/23/2021	01/23/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	T339	01/22/2021	01/22/2020

AC Line Conducted					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESC17	T1436	04/10/2020	04/10/2019
Power Cable, Line Conducted Emissions	UL	PG1	T861	10/27/2020	10/27/2019
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	01/23/2021	01/23/2020
UL AUTOMATION SOFTWARE					
Radiated Software	UL	UL EMC	Ver 9.5, Mar 6, 2020		
Conducted Software	UL	UL EMC	2020.2.26		
AC Line Conducted Software	UL	UL EMC	Ver 9.5, February 21, 2020		

8. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Occupied BW (20dB): ANSI C63.10-2013 Section 6.9.2

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

Carrier Frequency Separation: ANSI C63.10-2013 Section 7.8.2

Number of Hopping Frequencies: ANSI C63.10-2013 Section 7.8.3

Time of Occupancy (Dwell Time): ANSI C63.10-2013 Section 7.8.4

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

Conducted Spurious Emissions: ANSI C63.10-2013 Section 7.8.8

Conducted Band-Edge: ANSI C63.10-2013 Section 6.10.4

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

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3 and 6.5

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3 and 6.6

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5

AC Power-line conducted emissions: ANSI C63.10-2013, Section 6.2.

9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

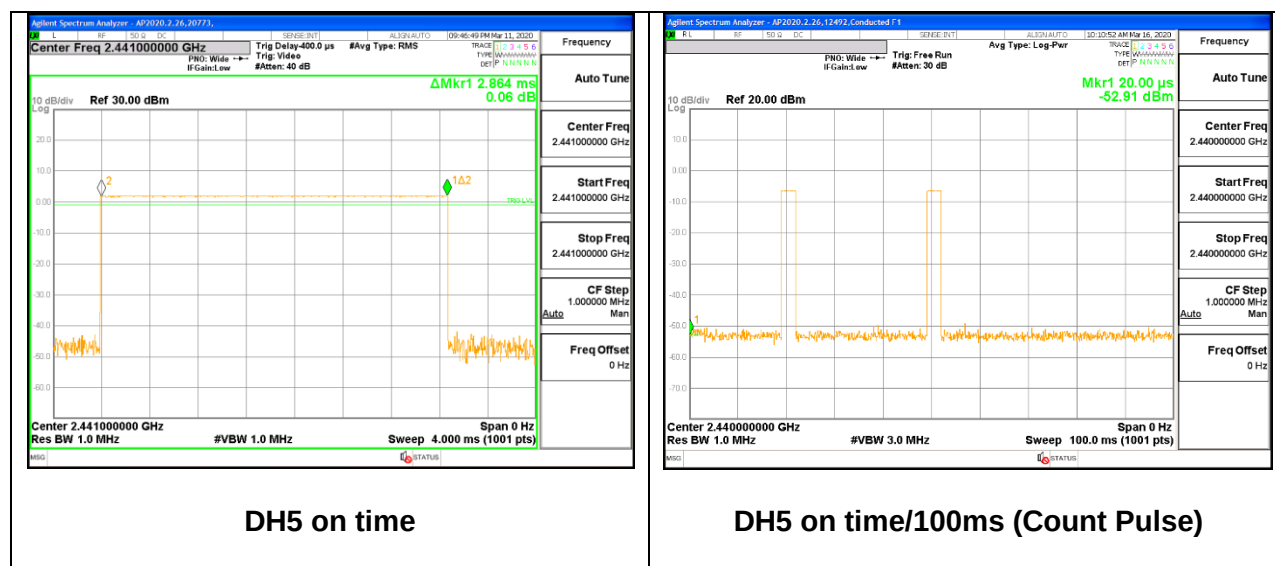
ON TIME AND DUTY CYCLE RESULTS

Duty cycle correction factor(dB) = $20\log(\text{duty cycle})$

Duty cycle=on time/100 milliseconds

On time = dwell time * hopping number in 100ms

DUTY CYCLE PLOTS



Note: Duty Cycle = on time/100 milliseconds = $2 \times 2.864 / 100 = 5.73\%$

Duty cycle correction factor = $20 \times \log(\text{Duty cycle}) = -24.8 \text{ dB}$

9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

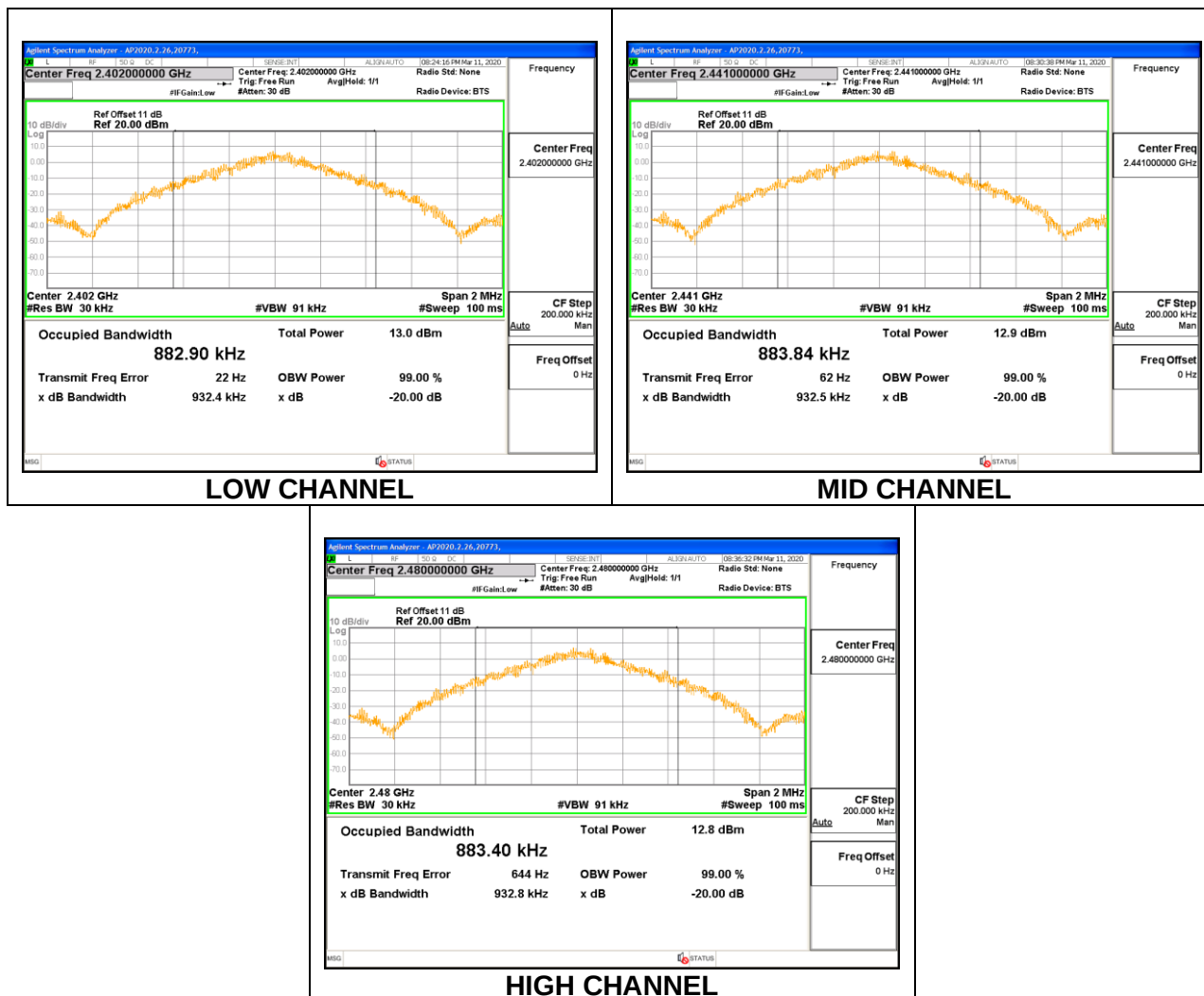
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq 3 \times$ RBW. The sweep time is coupled.

RESULTS

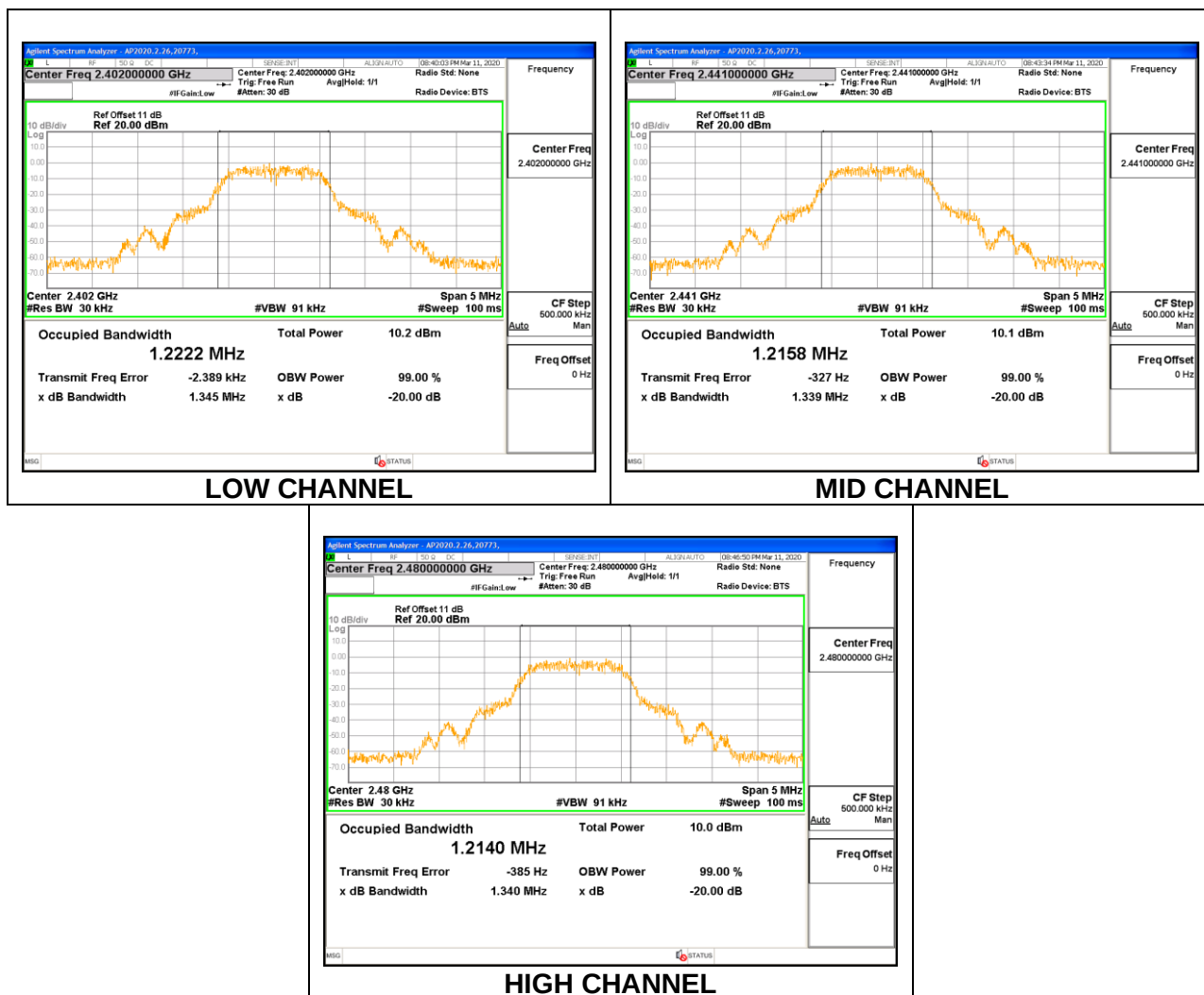
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.932	0.883
Mid	2441	0.933	0.884
High	2480	0.933	0.883



9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.345	1.222
Mid	2441	1.339	1.216
High	2480	1.340	1.214



9.3. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

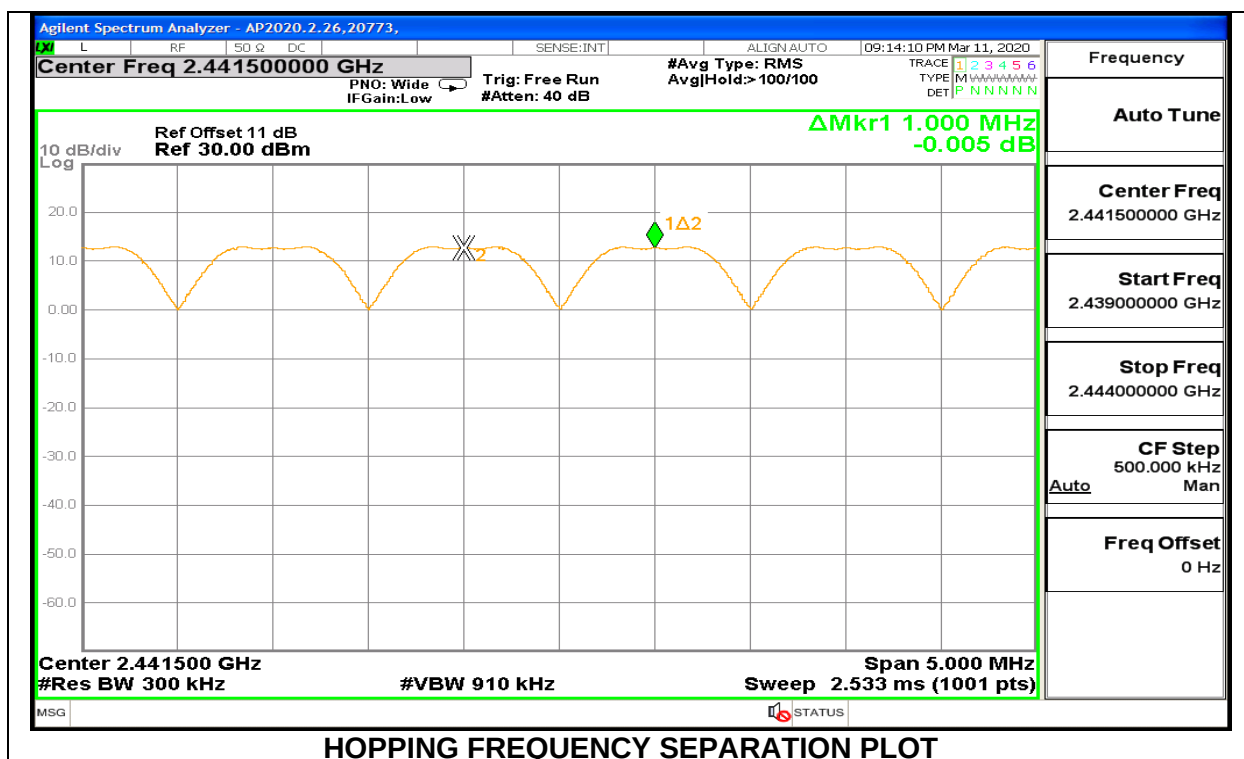
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

TEST PROCEDURE

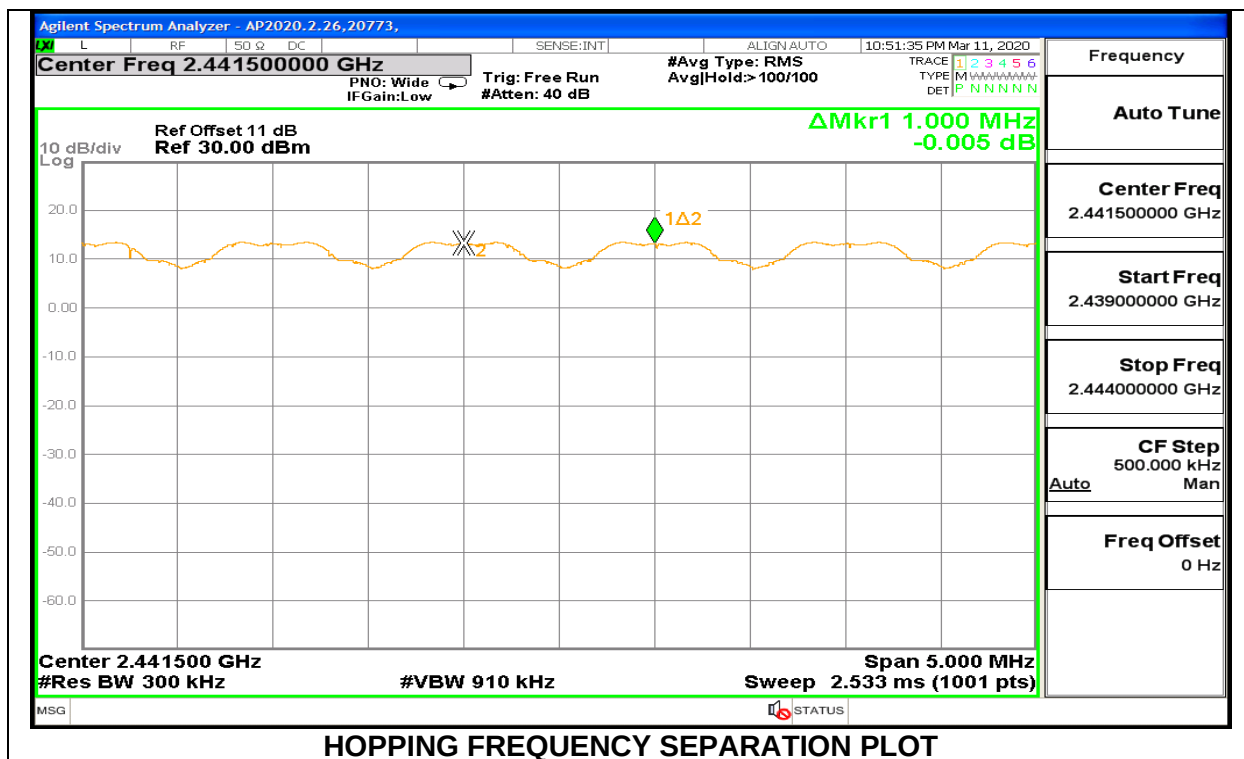
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq 3 \times RBW$. The sweep time is coupled.

RESULTS:

9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



9.4. NUMBER OF HOPPING CHANNELS

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

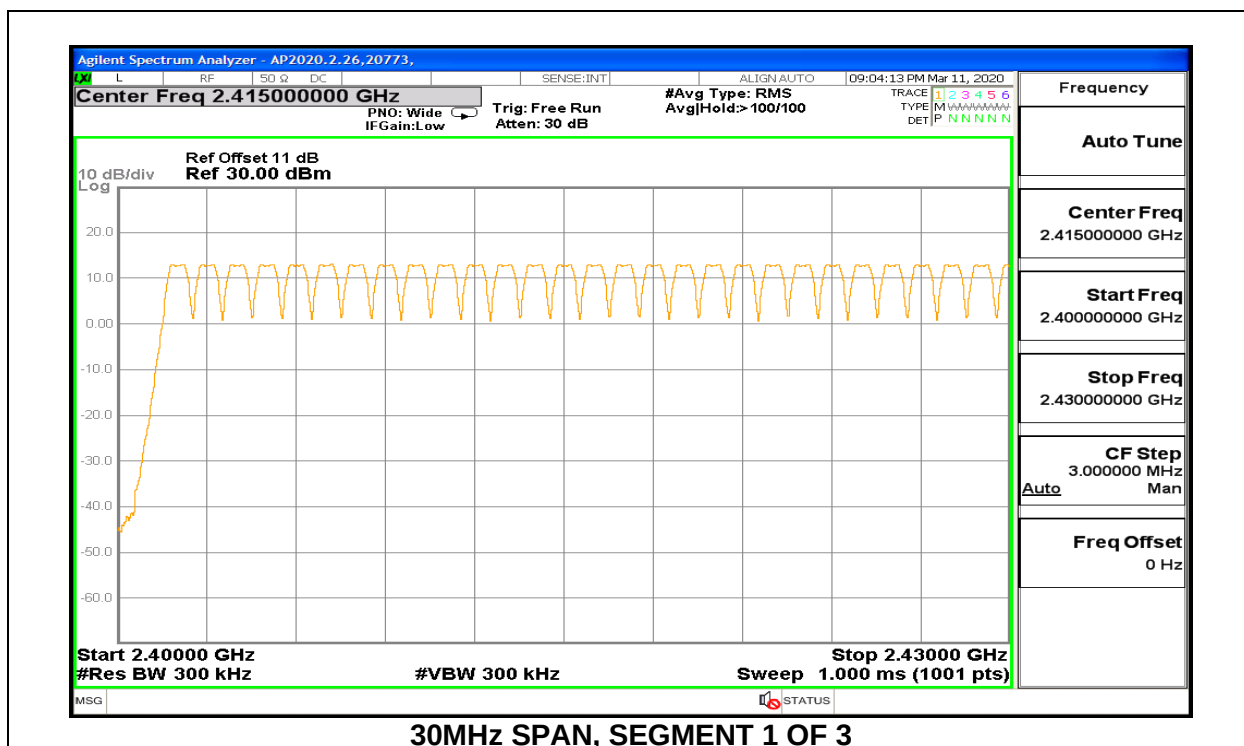
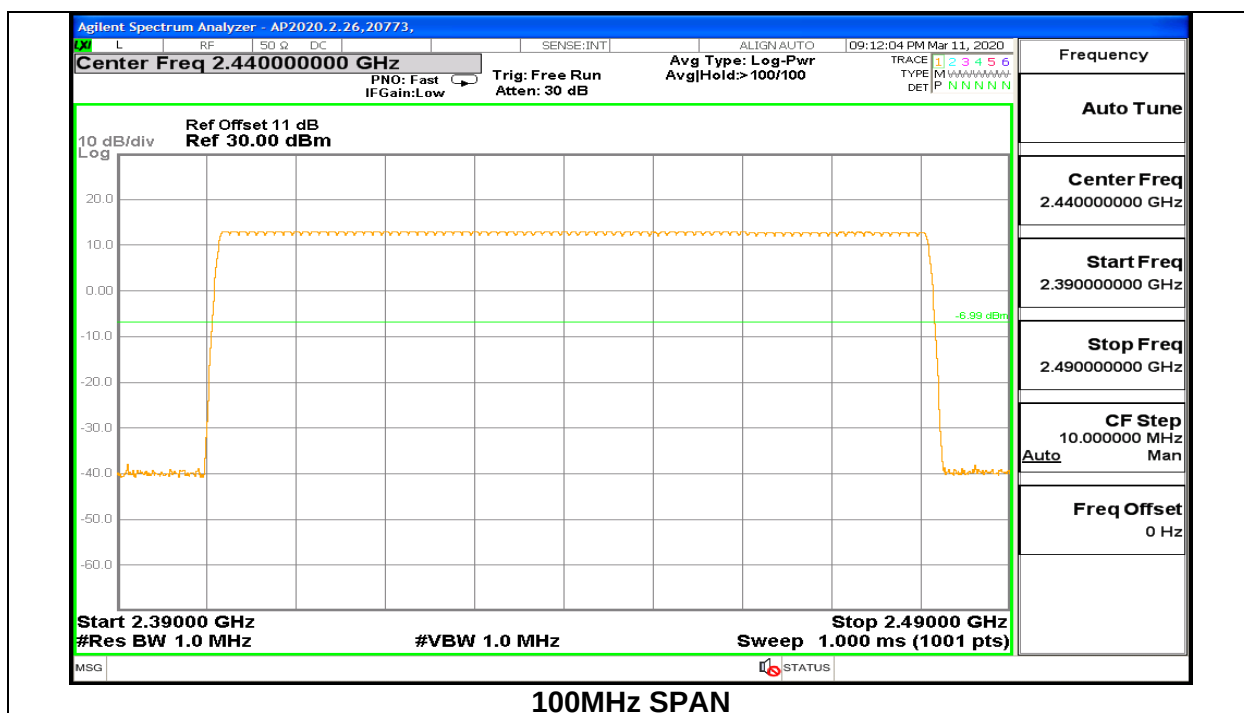
TEST PROCEDURE

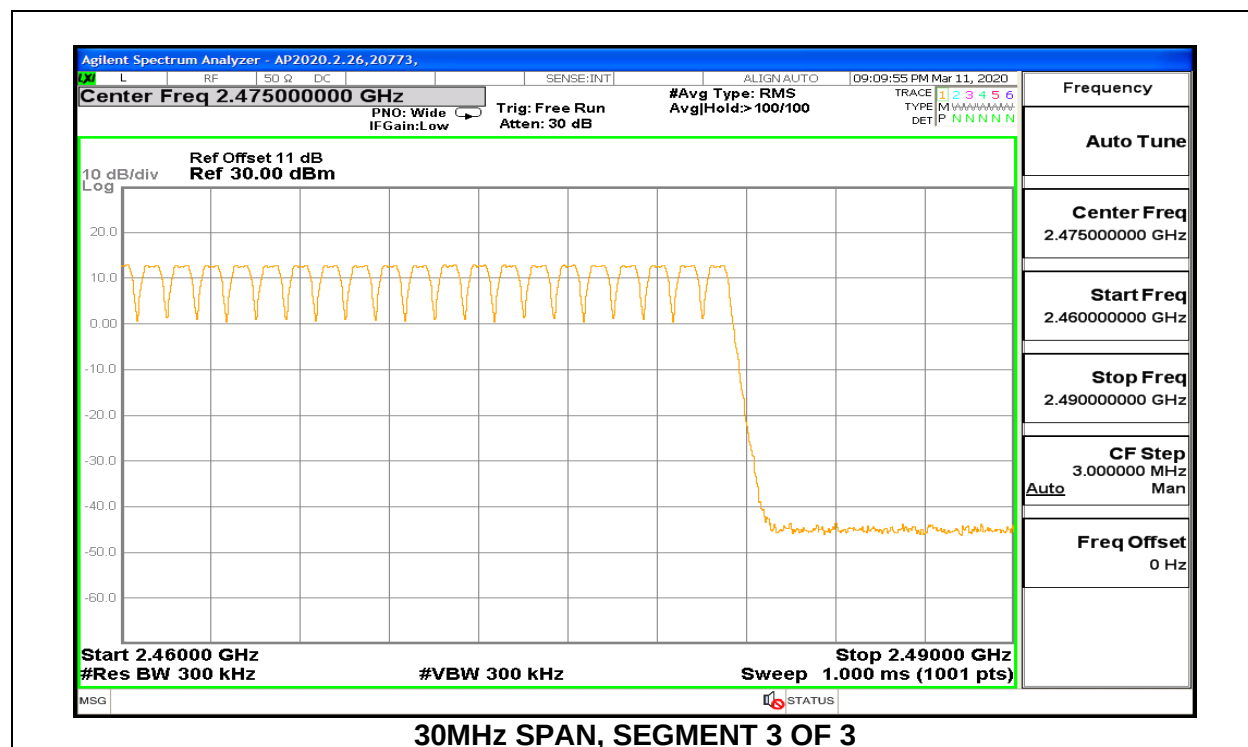
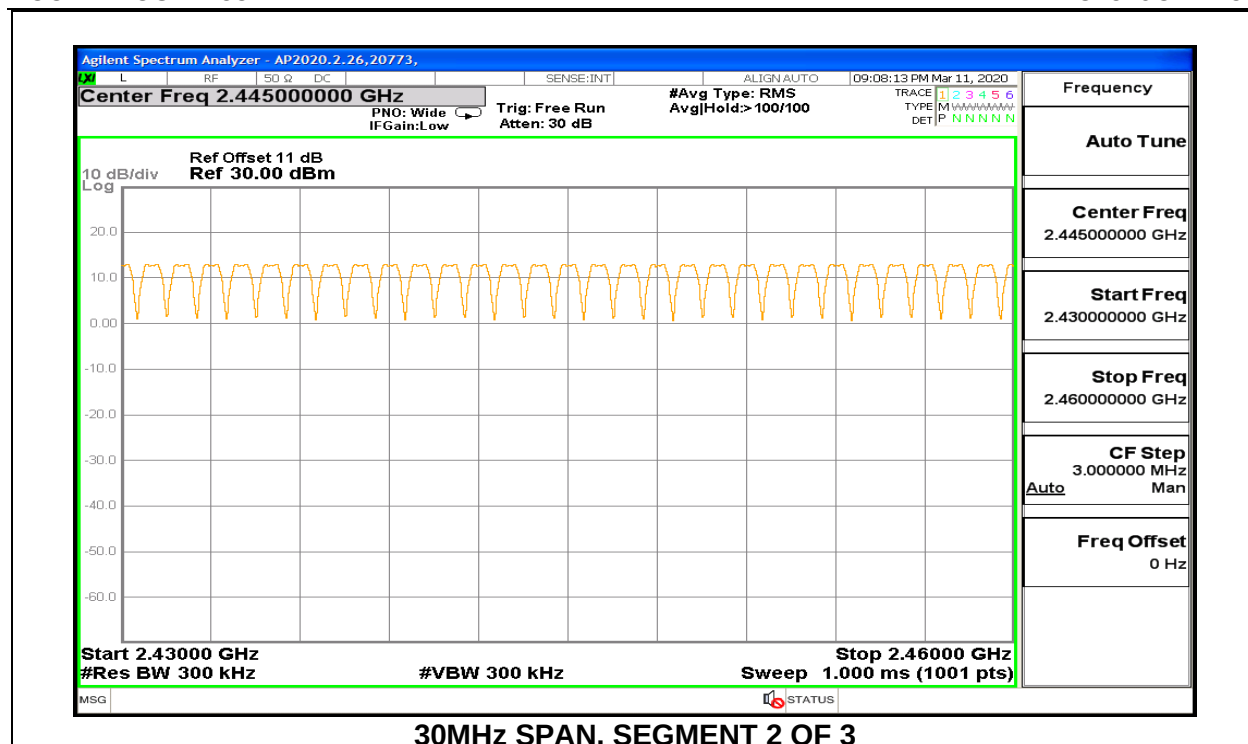
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

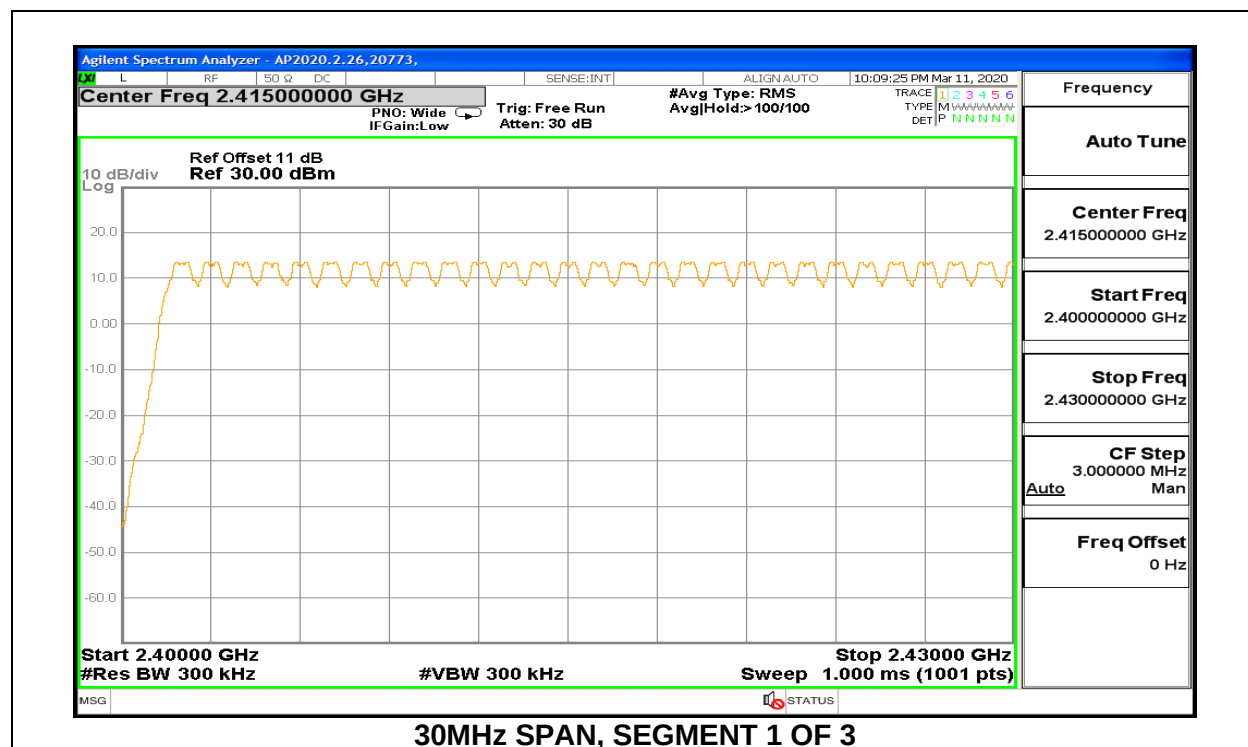
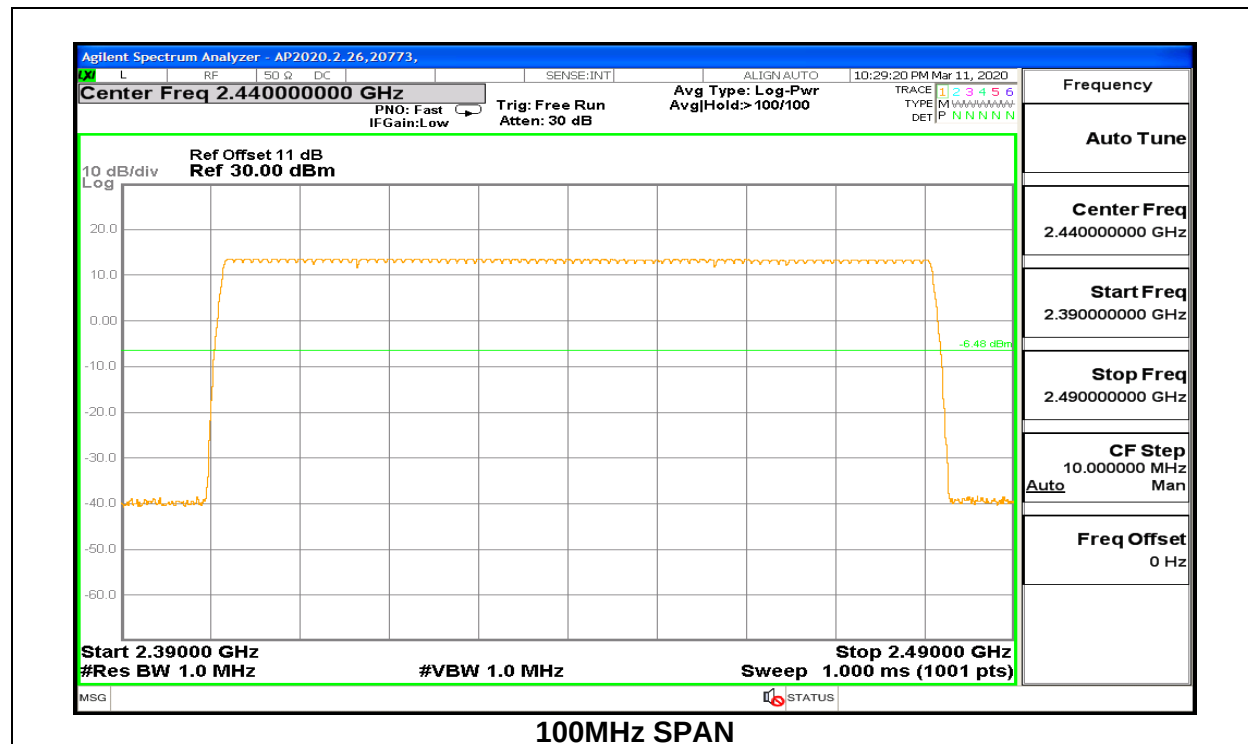
Normal Mode: 79 Channels Observed

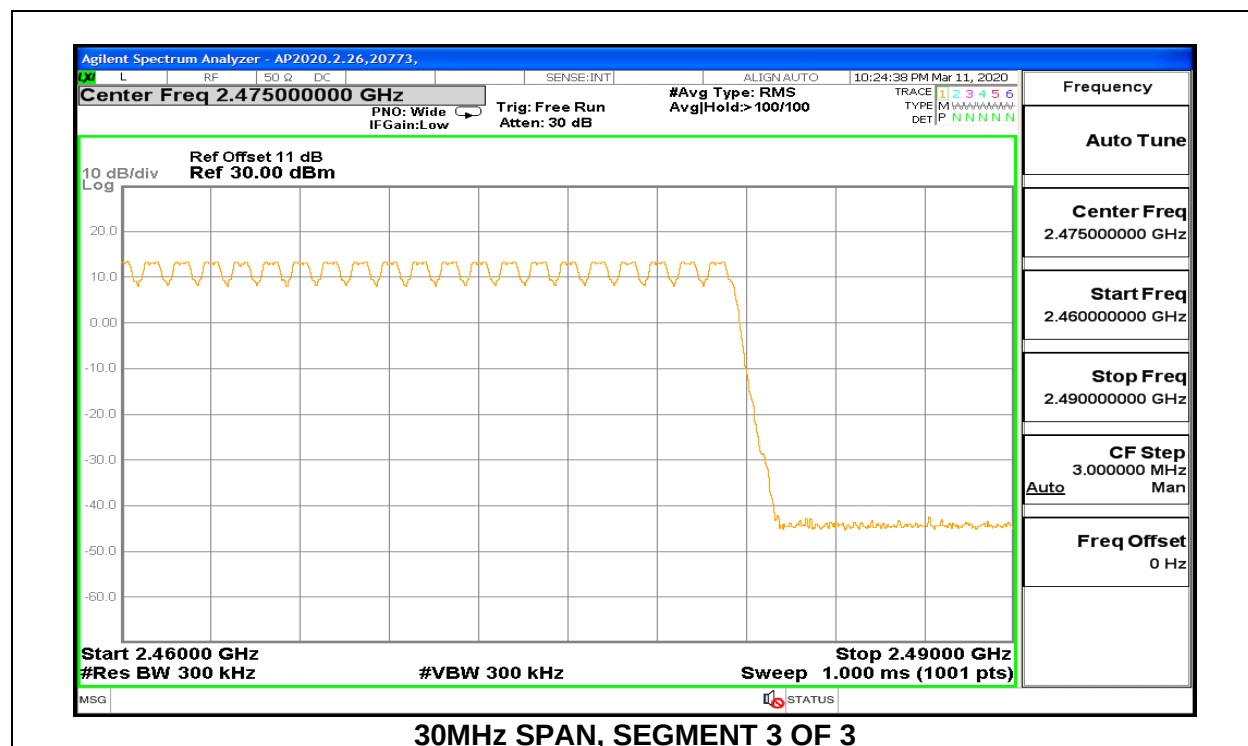
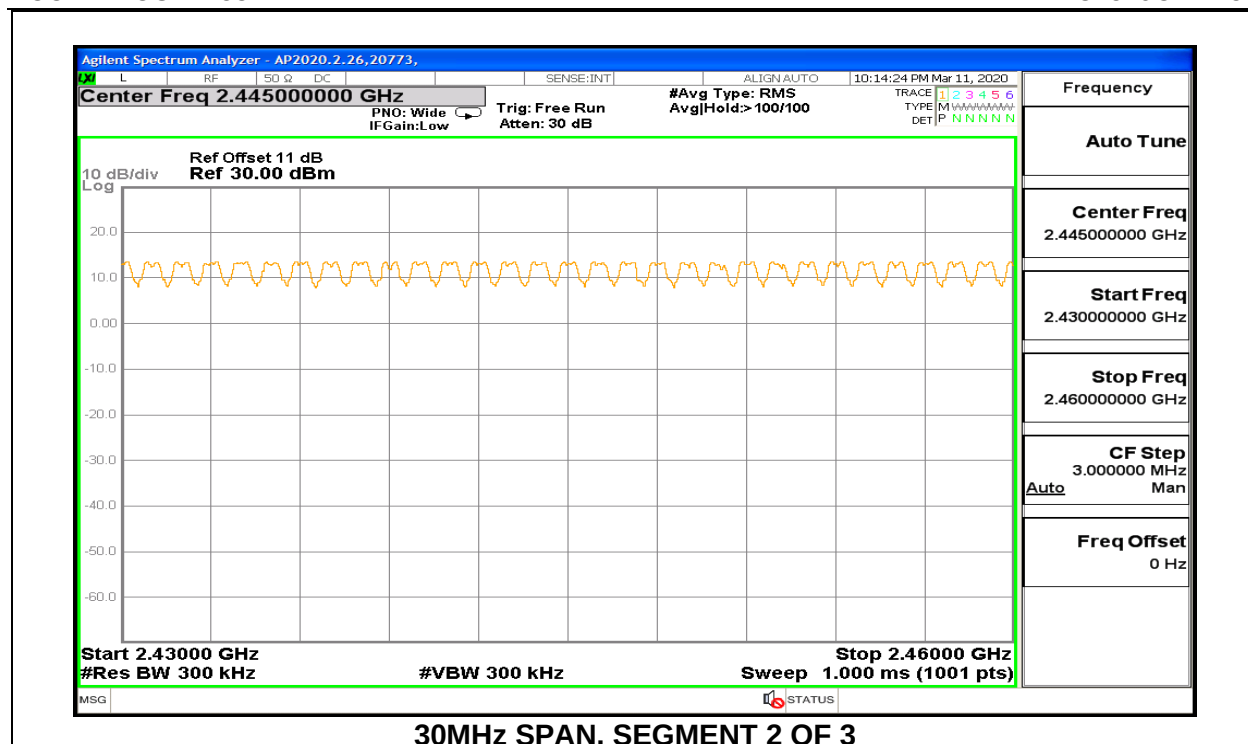
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION





9.5. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

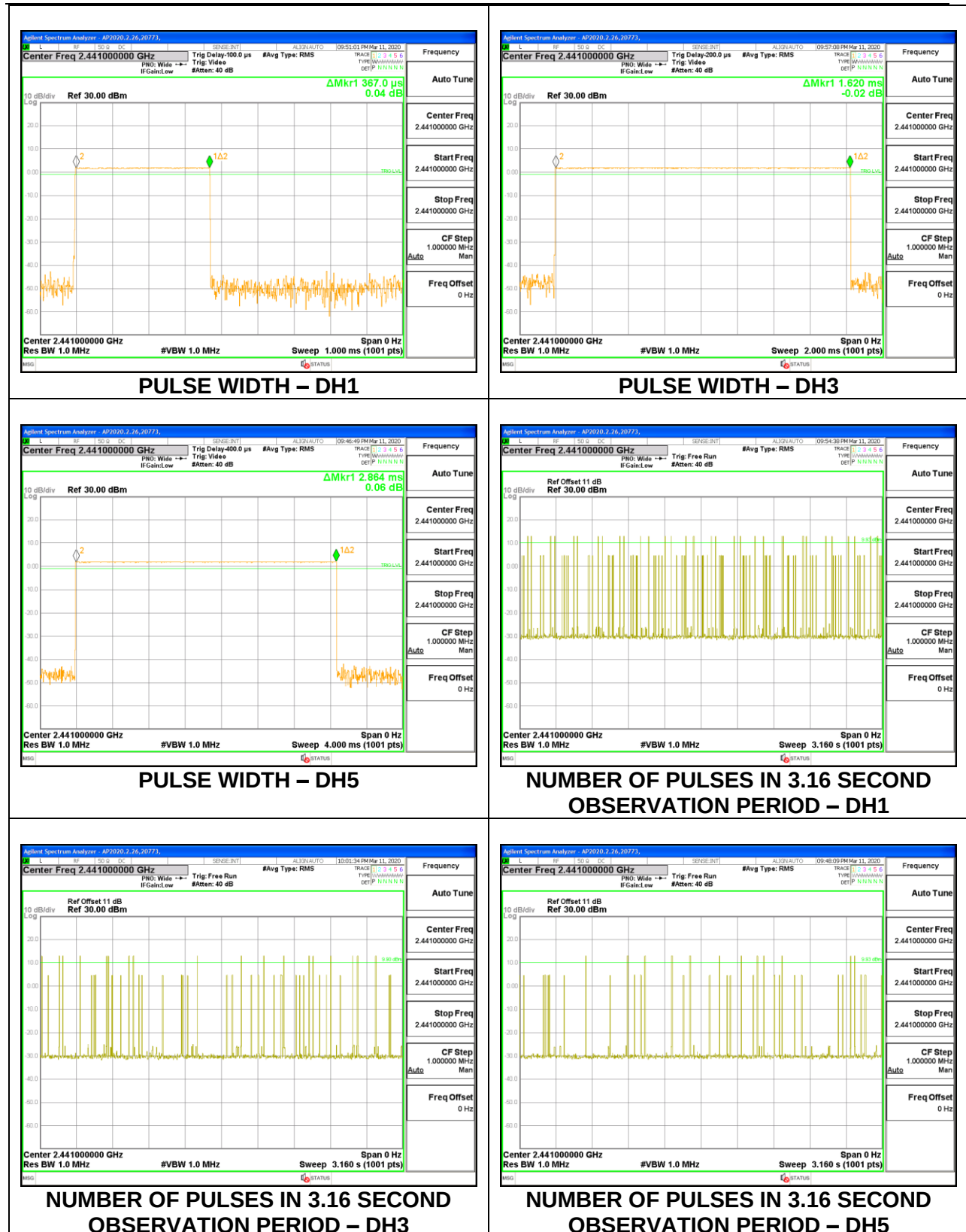
The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{pulse width}$.

RESULTS

9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.367	31	0.1138	0.4	-0.2862
DH3	1.62	18	0.2916	0.4	-0.1084
DH5	2.864	12	0.3437	0.4	-0.0563
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.367	7.75	0.02844	0.4	-0.3716
DH3	1.62	4.5	0.07290	0.4	-0.3271
DH5	2.864	3	0.08592	0.4	-0.3141



9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Normal Mode					
3DH1	0.37	30	0.111	0.4	-0.289
3DH3	1.62	15	0.243	0.4	-0.157
3DH5	2.864	13	0.37232	0.4	-0.0277

Note: for AFH (8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.



9.6. OUTPUT POWER

LIMITS

§15.247 (b) (1)

RSS-247 (5.4) (b)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

TEST PROCEDURE

Measurements perform using a wideband gated RF 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

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20773
Date:	3/14/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.67	21	-8.33
Middle	2441	12.51	21	-8.49
High	2480	12.45	21	-8.55

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20773
Date:	3/14/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.88	21	-9.12
Middle	2441	11.72	21	-9.28
High	2480	11.71	21	-9.29

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20773
Date:	3/14/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.22	21	-8.78
Middle	2441	12.02	21	-8.98
High	2480	11.96	21	-9.04

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.5 dB (including 11 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

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20773
Date	3/14/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.43
Middle	2441	12.30
High	2480	12.25

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20773
Date	3/14/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.08
Middle	2441	9.02
High	2480	9.01

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20773
Date	3/14/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.22
Middle	2441	9.18
High	2480	9.12

9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

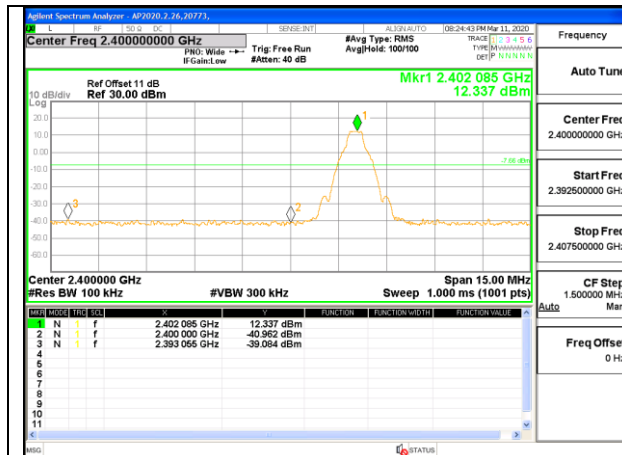
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

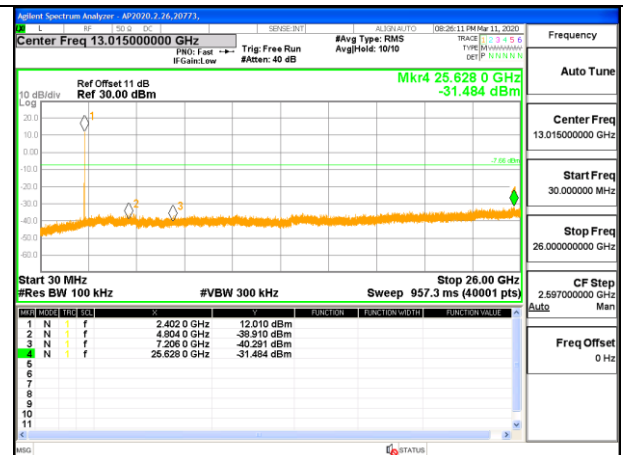
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

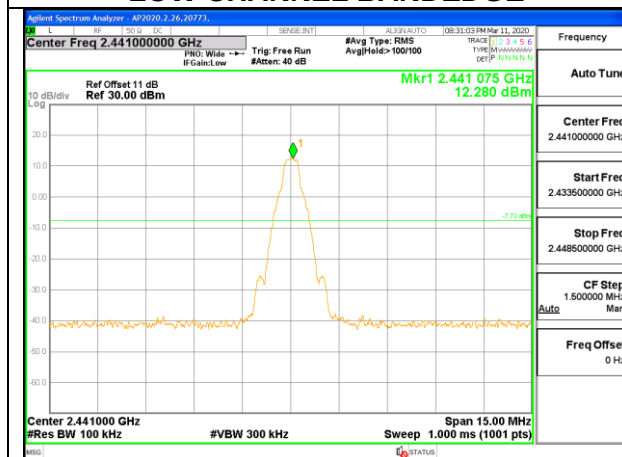
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



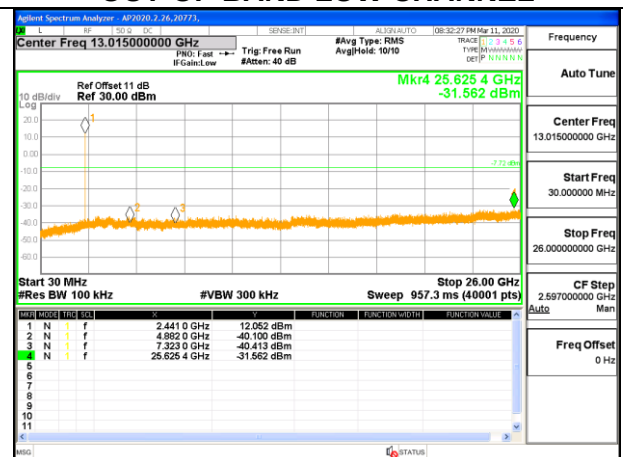
LOW CHANNEL BANDEDGE



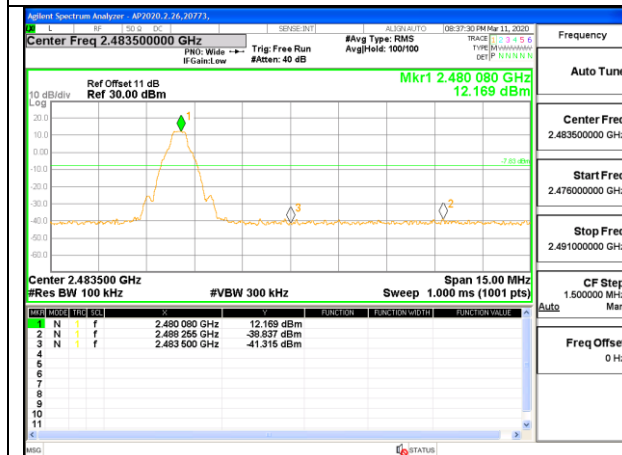
OUT-OF-BAND LOW CHANNEL



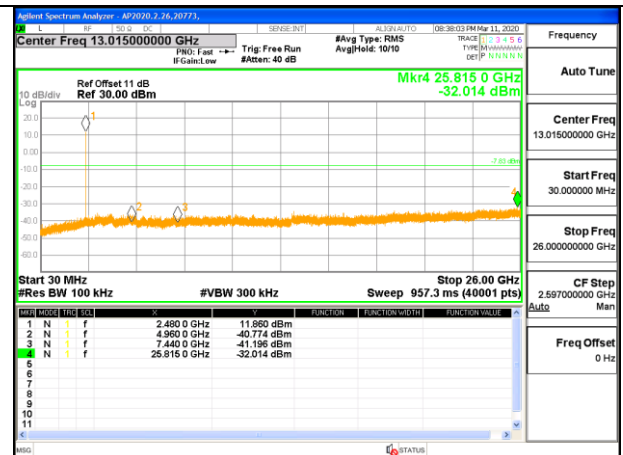
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

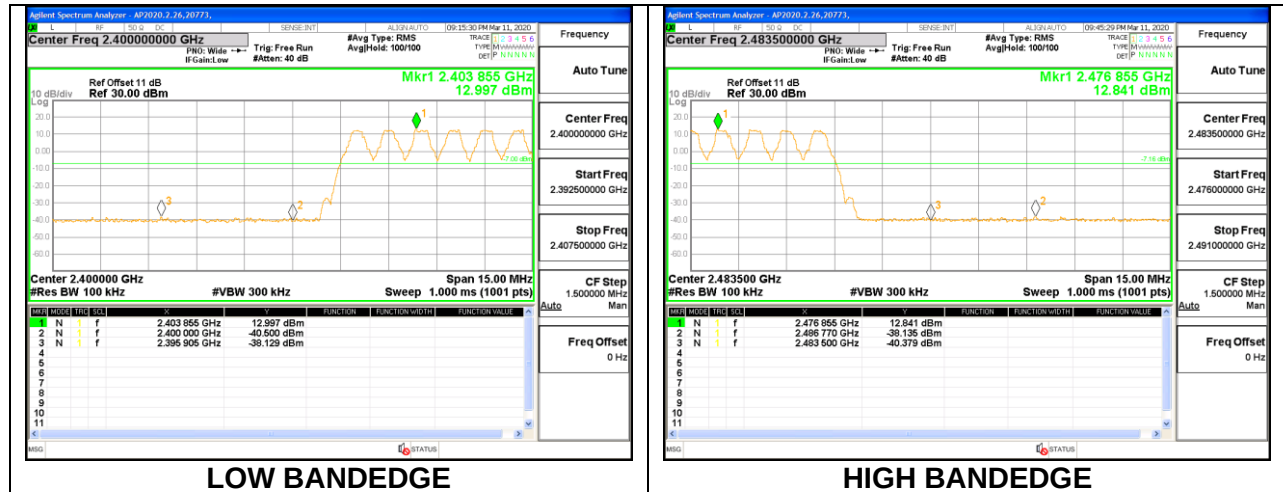


HIGH CHANNEL BANDEDGE



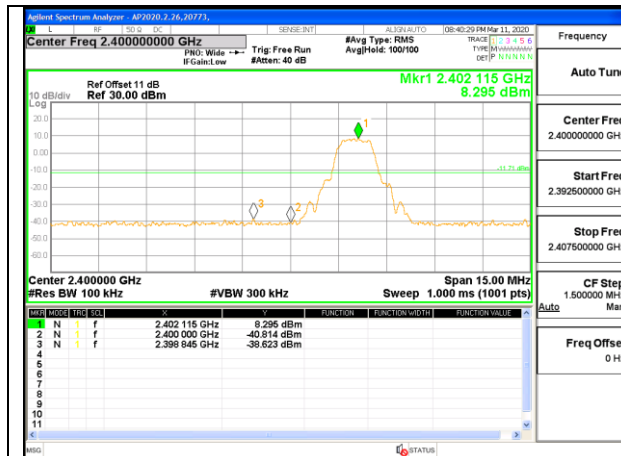
OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

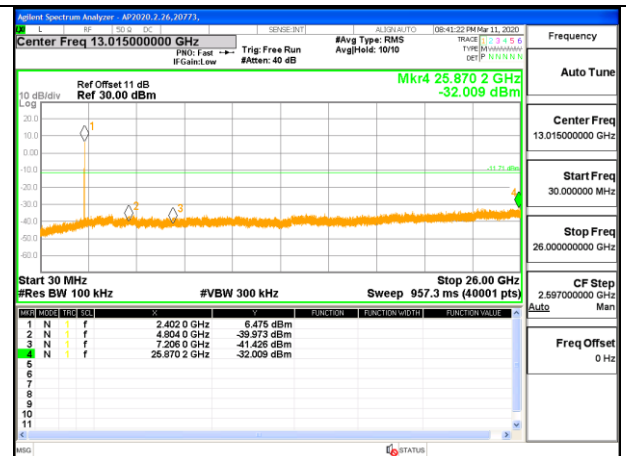


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

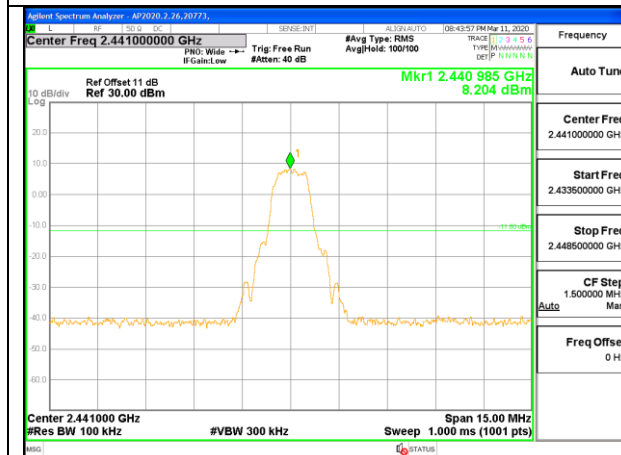
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



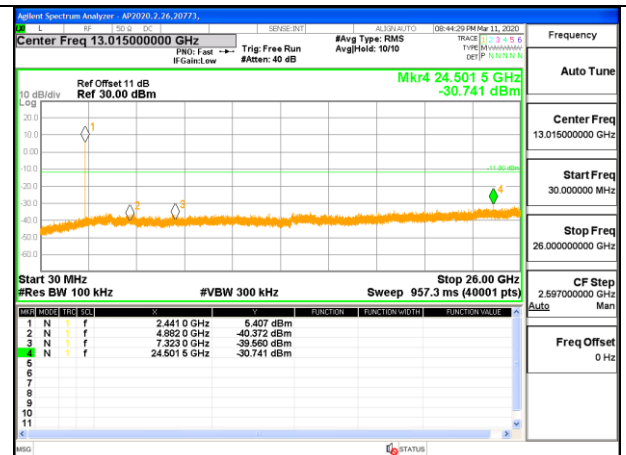
LOW CHANNEL BANDEDGE



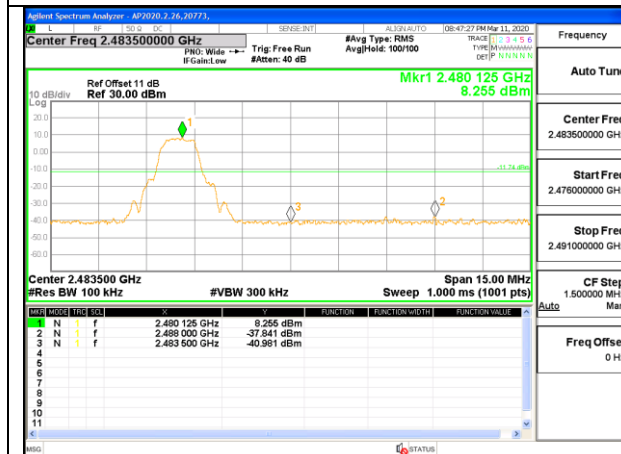
OUT-OF-BAND LOW CHANNEL



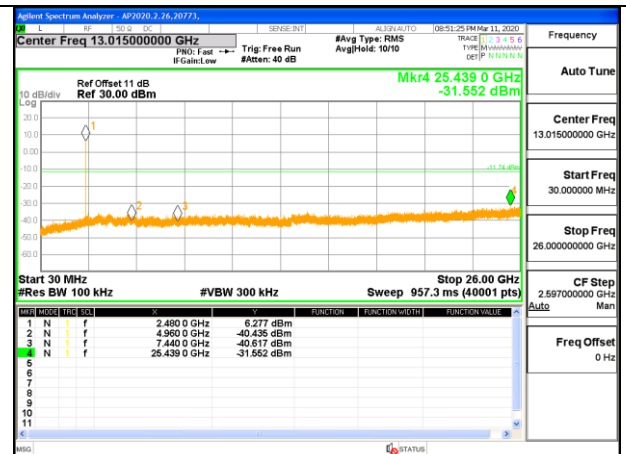
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



10. RADIATED TEST RESULTS

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 .

For the final measurements above 1GHz radiated spurious harmonics and band edge measurement, there is no need for the average reading since the peak reading passed with the peak limit. The average reading = peak reading – duty cycle Correction Factor (DCCF) which is $20 \log(\text{ON time}/100 \text{ milliseconds})$ and greater than 20dB.

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.

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.

KDB 558074 D01 15.247 Meas Guidance v05r02

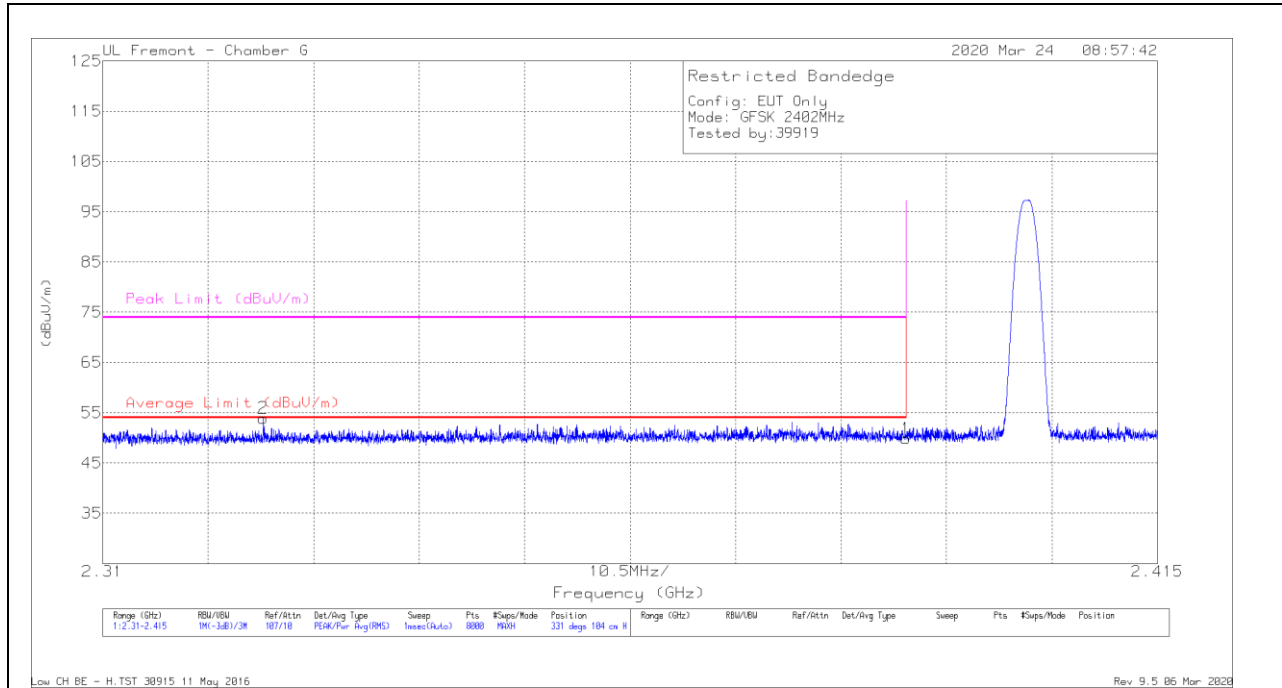
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

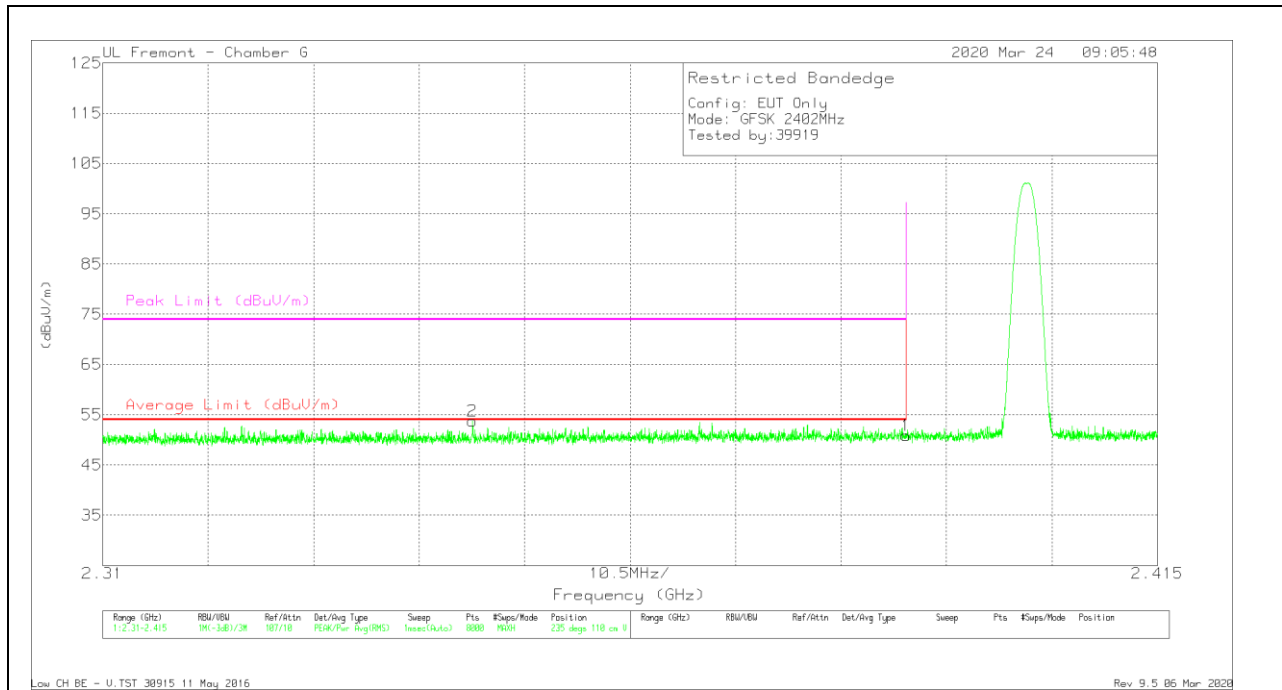
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Ampl/Cbll/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.2	Pk	31.9	-22.2	49.9	74	-24.1	331	104	H
2	* 2.32596	44.63	Pk	31.6	-22.3	53.93	74	-20.07	331	104	H

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

VERTICAL RESULT

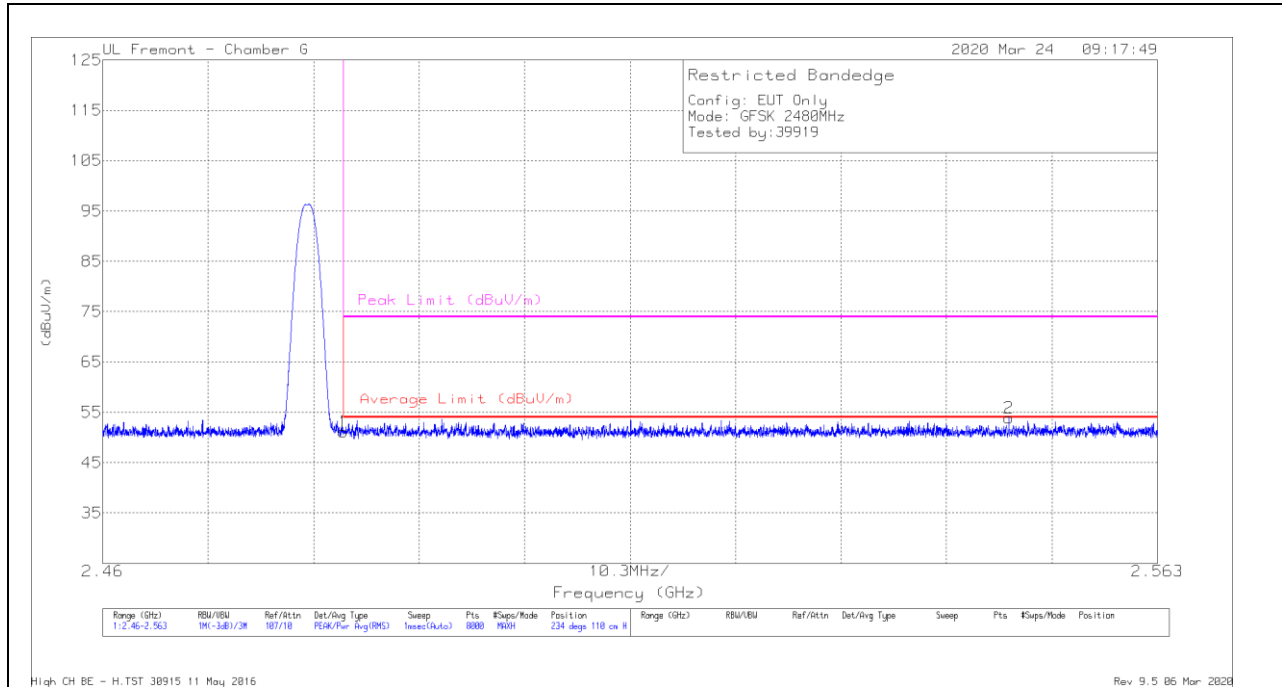


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.18	Pk	31.9	-22.2	50.88	74	-23.12	235	110	V
2	* 2.34682	44.25	Pk	31.7	-22.2	53.75	74	-20.25	235	110	V

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

BANDEDGE (HIGH CHANNEL)

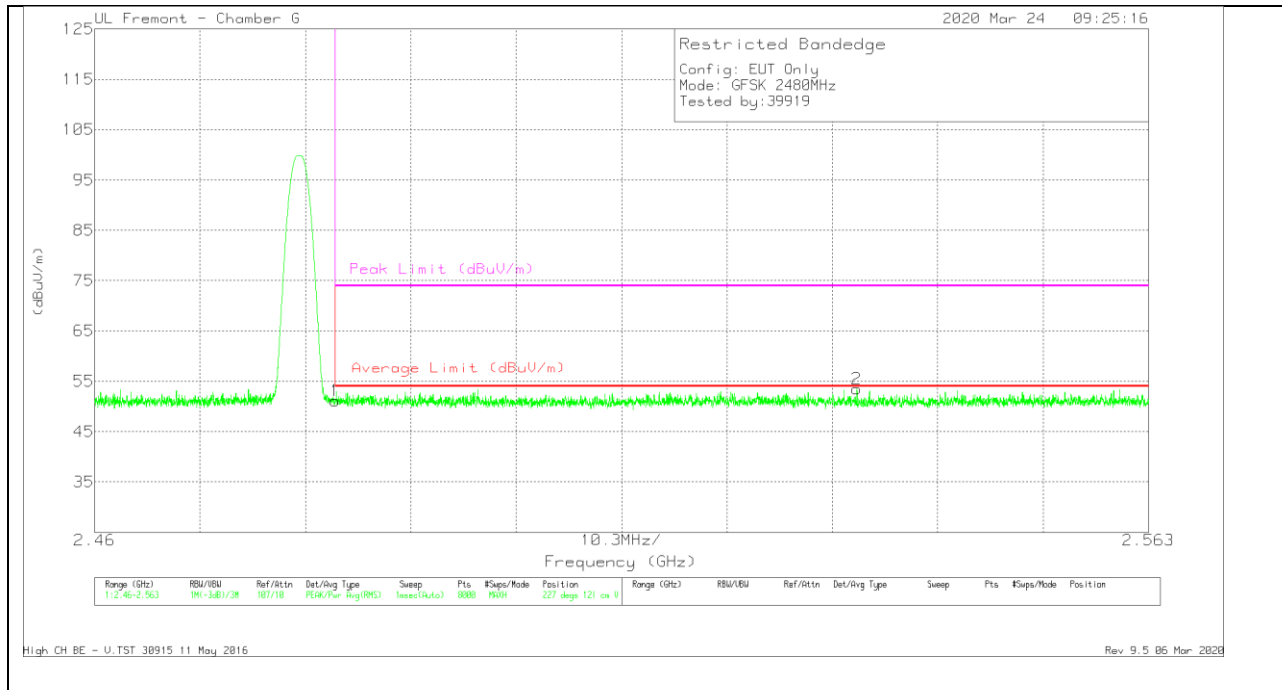
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.73	Pk	32.5	-22.1	51.13	74	-22.87	234	110	H
2	2.54849	43.71	Pk	32.4	-22.2	53.91	74	-20.09	234	110	H

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

VERTICAL RESULT

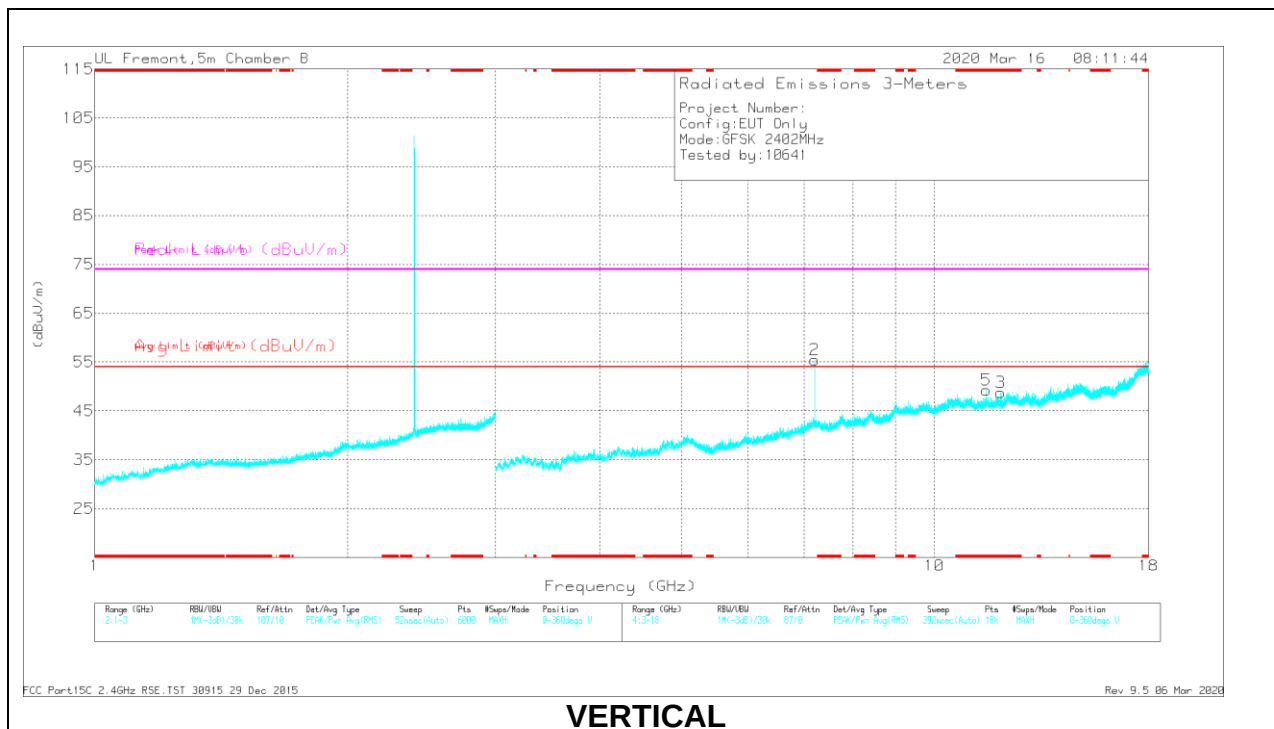
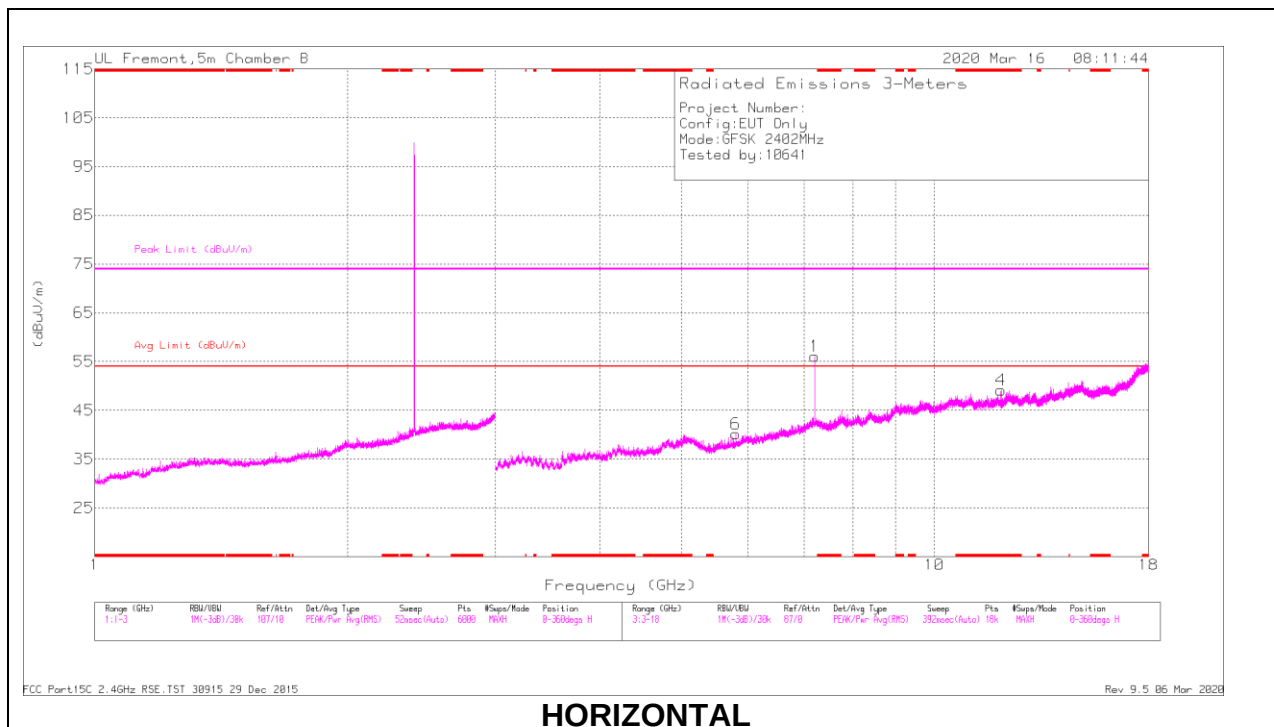


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dBm)	Amp/CbI/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.76	Pk	32.5	-22.1	51.16	74	-22.84	227	121	V
2	2.53449	43.32	Pk	32.4	-22.2	53.52	74	-20.48	227	121	V

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS

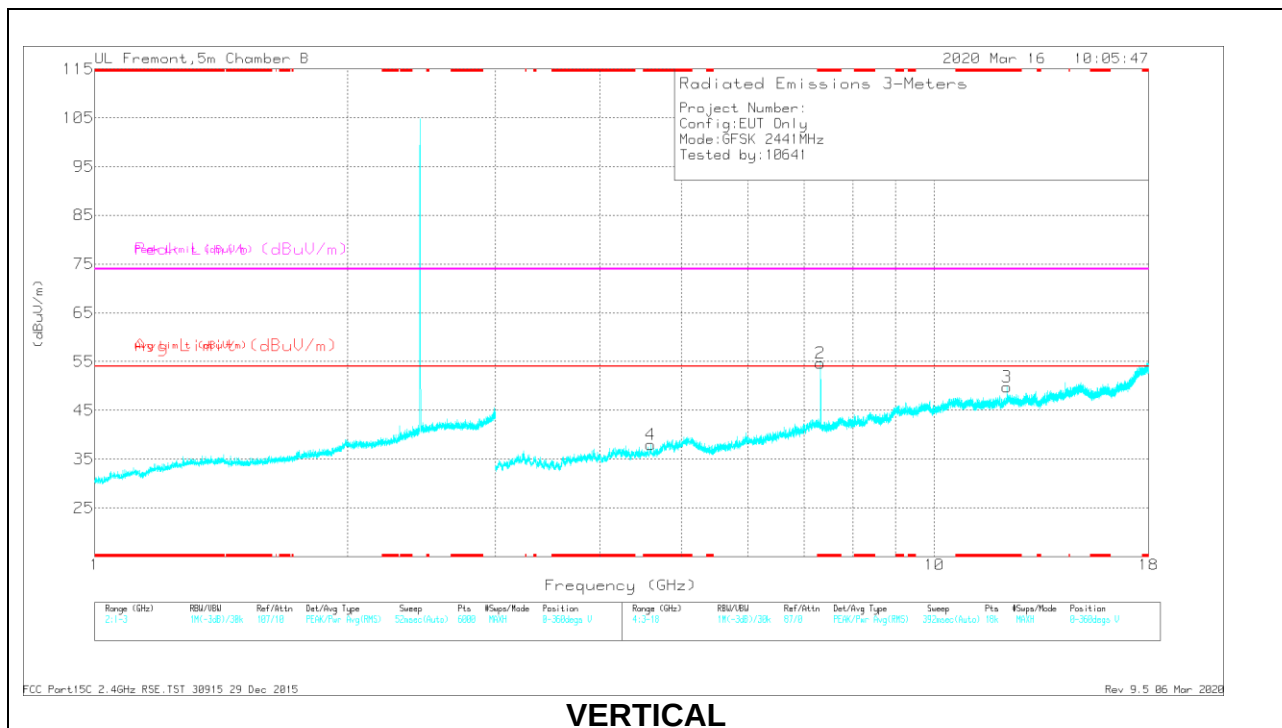
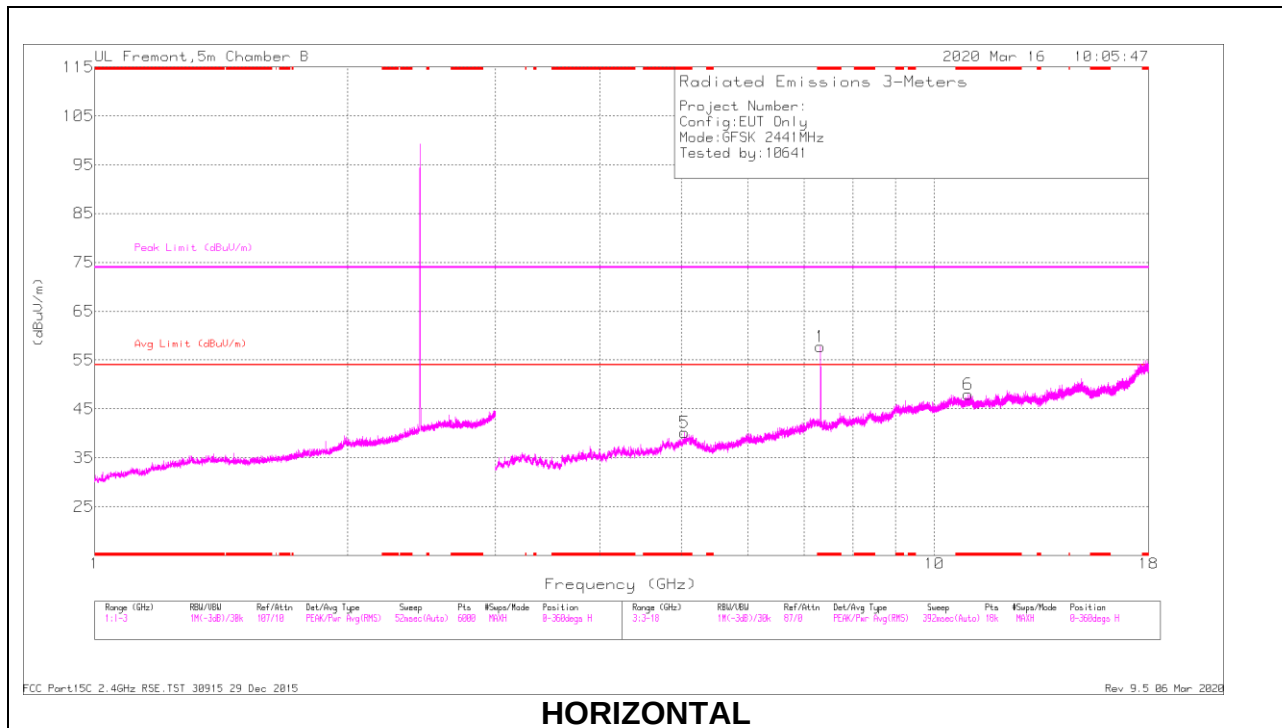


RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T962 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	7.20558	43.64	PKFH	37	-21.7	58.94	74	-15.06	334	101	H
2	7.20626	45.25	PKFH	37	-21.7	60.55	74	-13.45	192	395	V
3	* 12.01046	34.74	PKFH	39.6	-18.2	56.14	74	-17.86	338	364	V
4	* 12.00918	34.28	PKFH	39.6	-18.2	55.68	74	-18.32	325	101	H
5	* 11.54145	32.98	PKFH	39.2	-17.6	54.58	74	-19.42	293	161	V
6	5.80759	37.05	PKFH	33.4	-24.3	46.15	74	-27.85	312	134	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

MID CHANNEL RESULTS

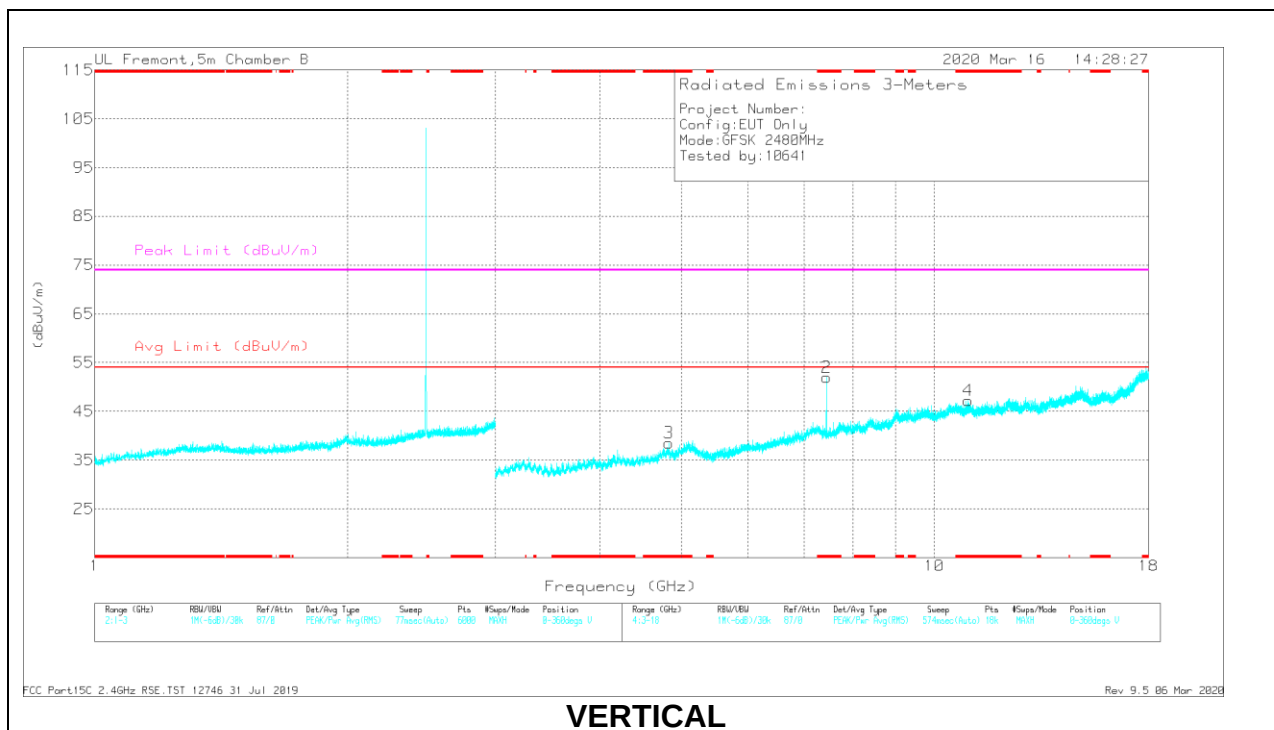
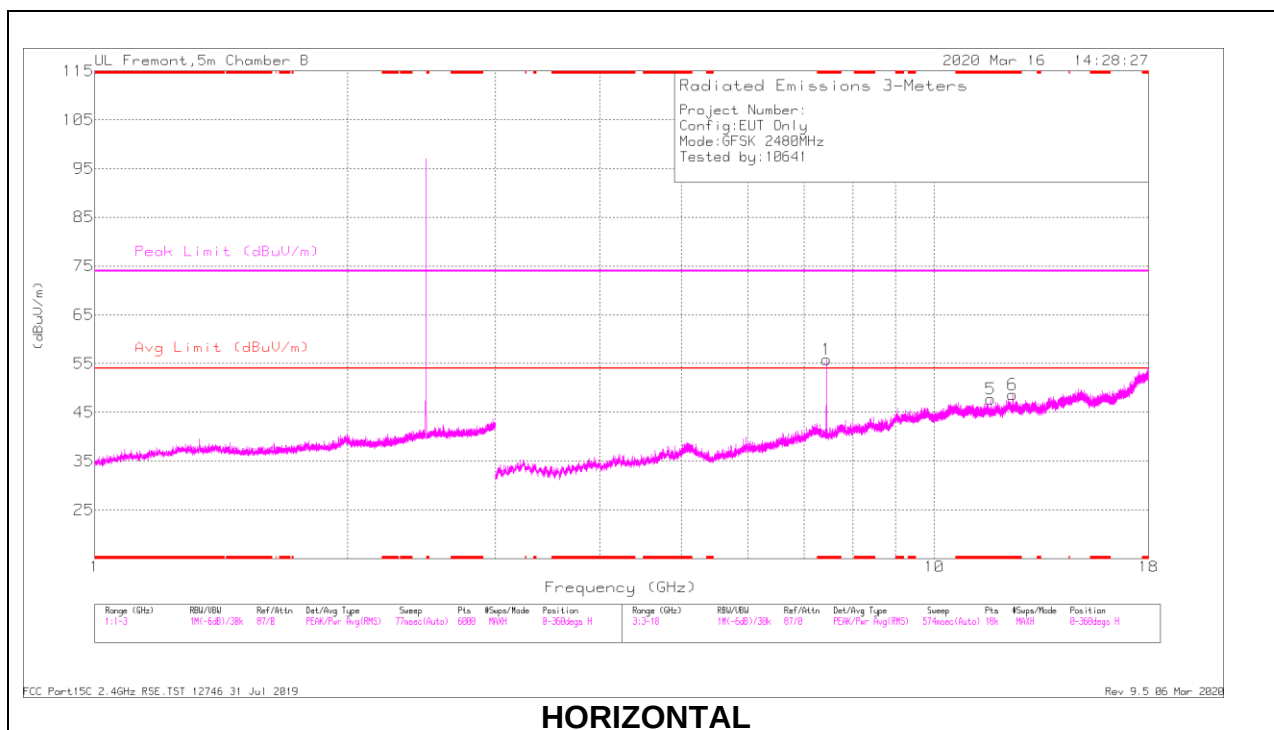


RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T962 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 7.32234	45.98	PKFH	37	-22.7	60.28	74	-13.72	207	105	H
2	* 7.32271	43.49	PKFH	37	-22.7	57.79	74	-16.21	75	243	V
3	* 12.20528	33.5	PKFH	40.1	-18	55.6	74	-18.4	208	101	V
4	* 4.59393	36.35	PKFH	32	-25.4	42.95	74	-31.05	187	228	V
5	* 5.04284	35.94	PKFH	33.7	-24.2	45.44	74	-28.56	94	256	H
6	* 10.97155	31.53	PKFH	39.4	-18	52.93	74	-21.07	103	275	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

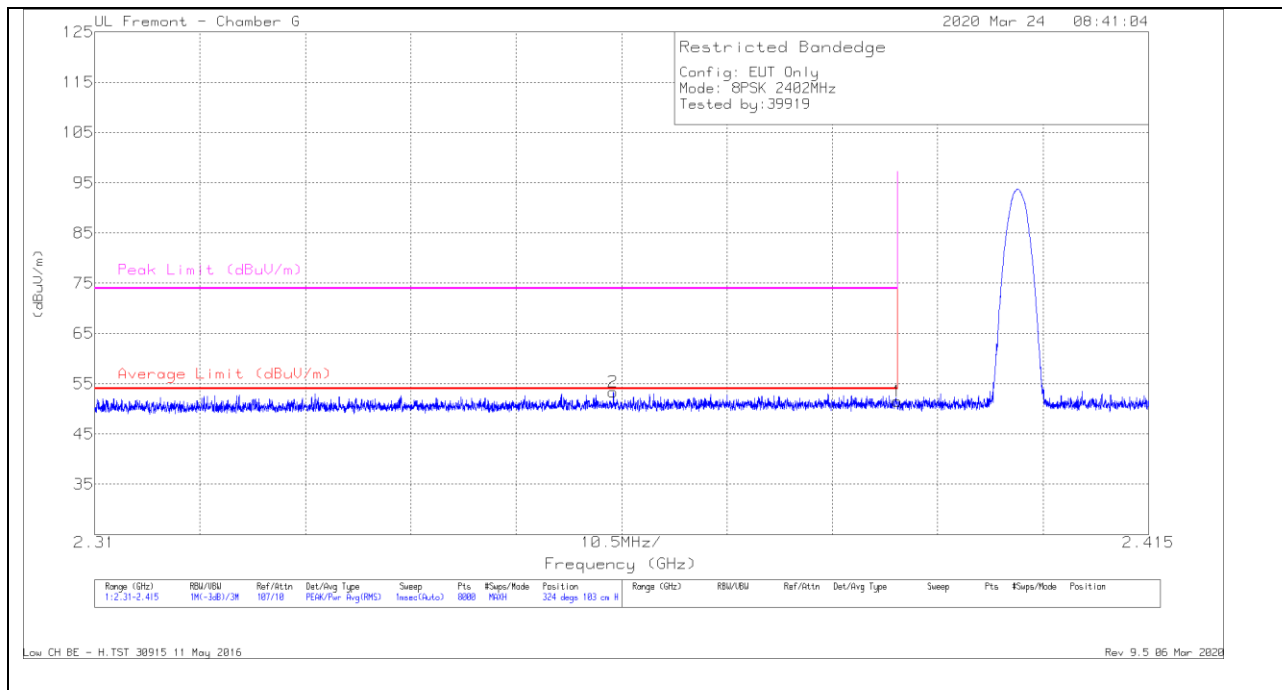
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T962 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 7.44044	44.1	PKFH	36.9	-22	59	74	-15	29	101	H
2	* 7.43947	41.37	PKFH	36.9	-22	56.27	74	-17.73	281	393	V
3	* 4.8312	35.02	PKFH	33.1	-24.8	43.32	74	-30.68	145	302	V
4	* 10.97264	31.02	PKFH	39.5	-18	52.52	74	-21.48	162	253	V
5	* 11.67977	29.98	PKFH	39.4	-17.9	51.48	74	-22.52	214	356	H
6	* 12.40083	32.02	PKFH	40.2	-18.8	53.42	74	-20.58	128	381	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

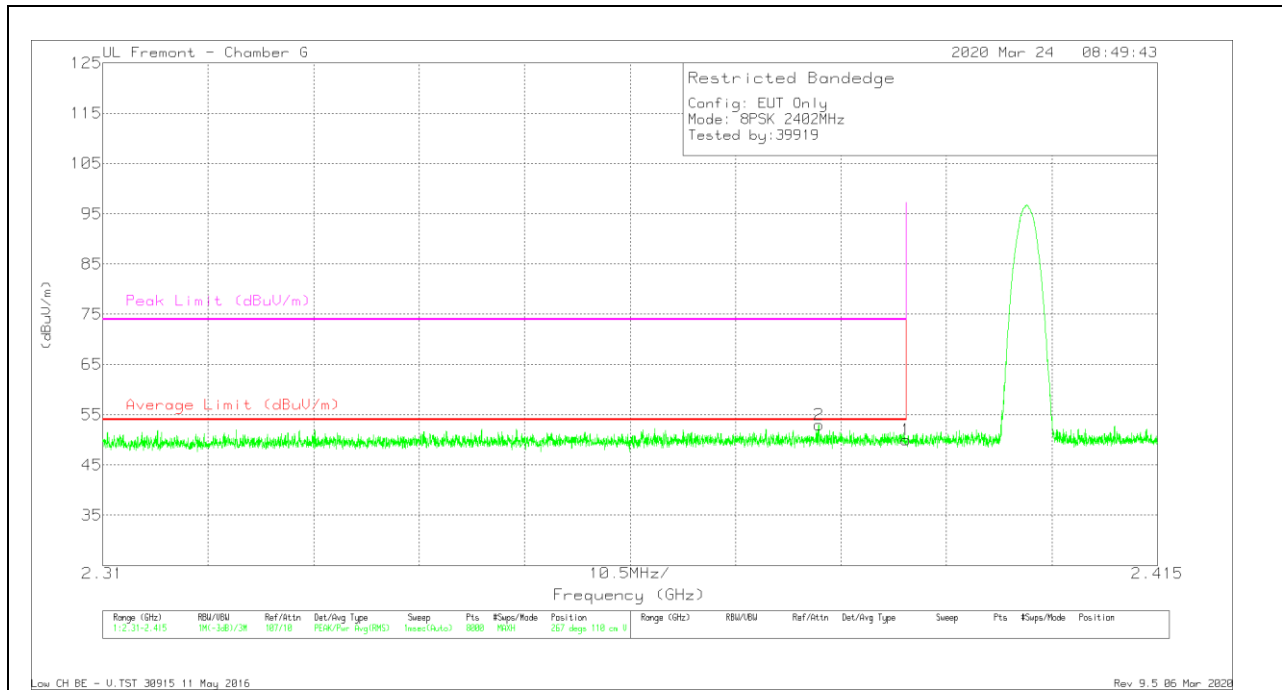
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dBm)	AmplCbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.76	Pk	31.9	-22.2	51.46	74	-22.54	324	103	H
2	* 2.36168	43.76	Pk	31.8	-22.2	53.36	74	-20.64	324	103	H

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

VERTICAL RESULT

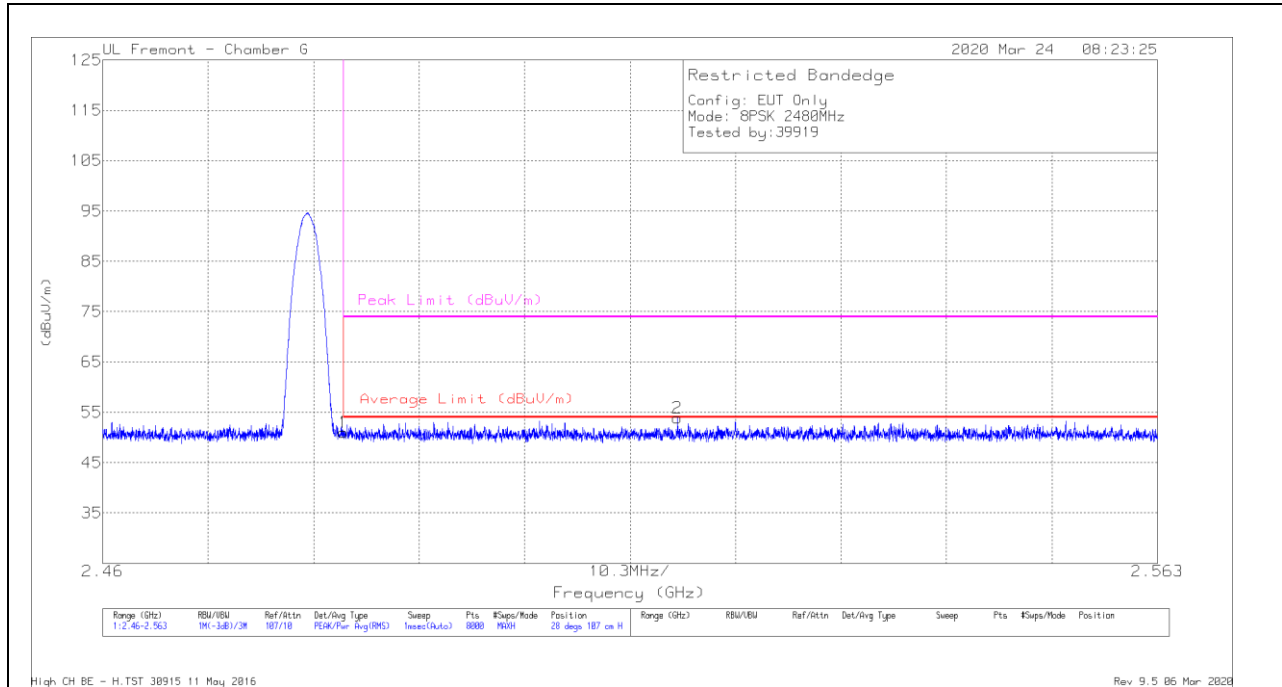


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT136 (dBm)	Amp/Cbl/Filtz/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.31	Pk	31.9	-22.2	50.01	74	-23.99	267	110	V
2	* 2.38128	43.33	Pk	31.9	-22.2	53.03	74	-20.97	267	110	V

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT

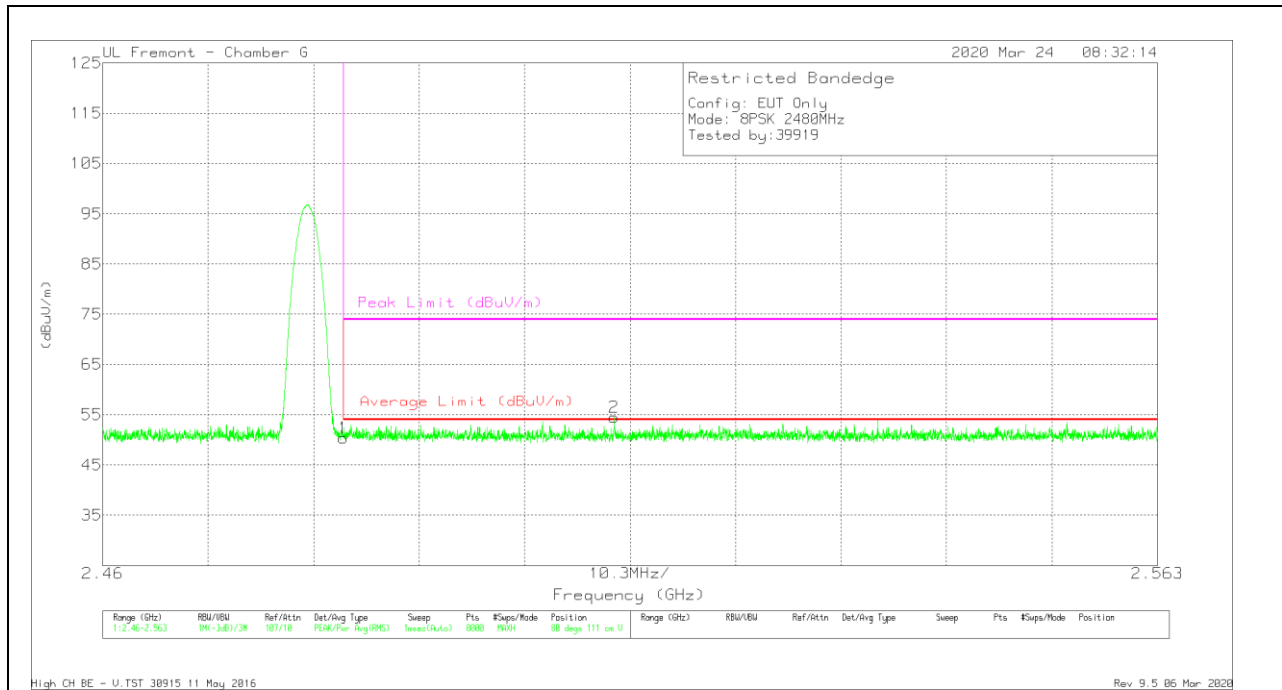


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dBm)	Amp/Cbl/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.56	Pk	32.5	-22.1	50.96	74	-23.04	28	107	H
2	2.51613	43.62	Pk	32.4	-22.1	53.92	74	-20.08	28	107	H

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

PK - Peak detector

VERTICAL RESULT

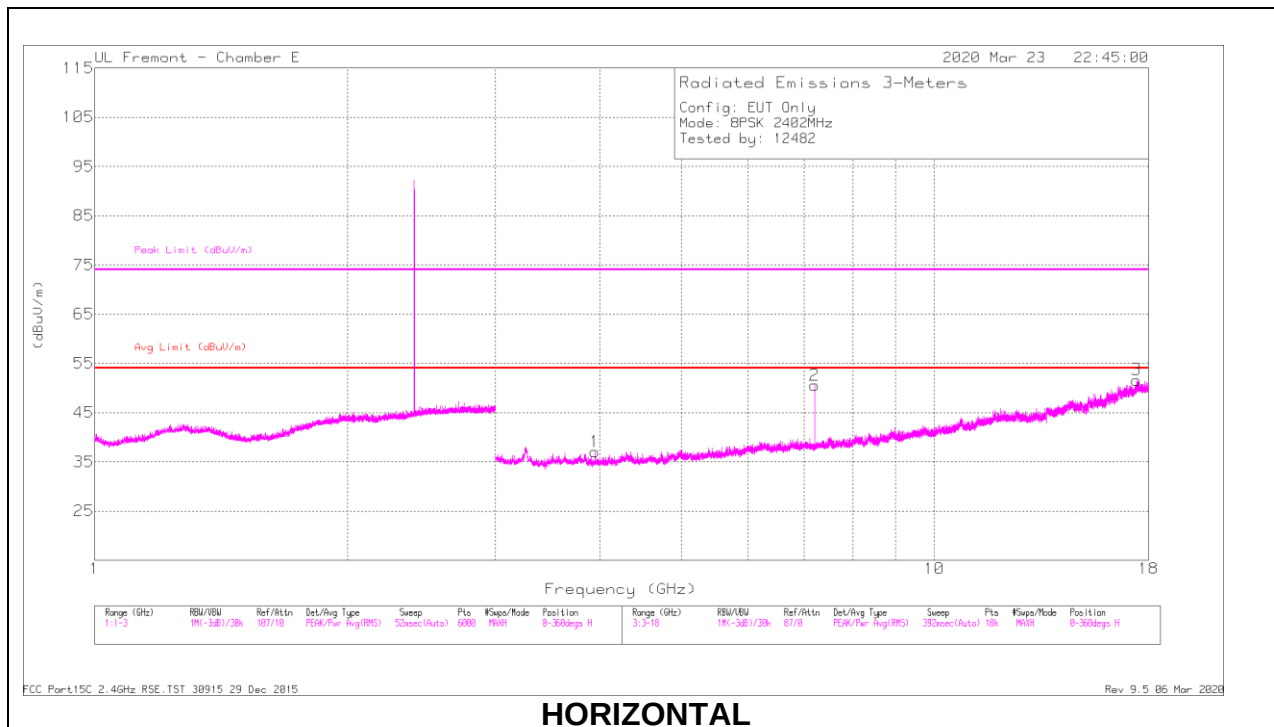


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Ampl/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.03	Pk	32.5	-22.1	50.43	74	-23.57	80	111	V
2	2.50994	44.26	Pk	32.4	-22.2	54.46	74	-19.54	80	111	V

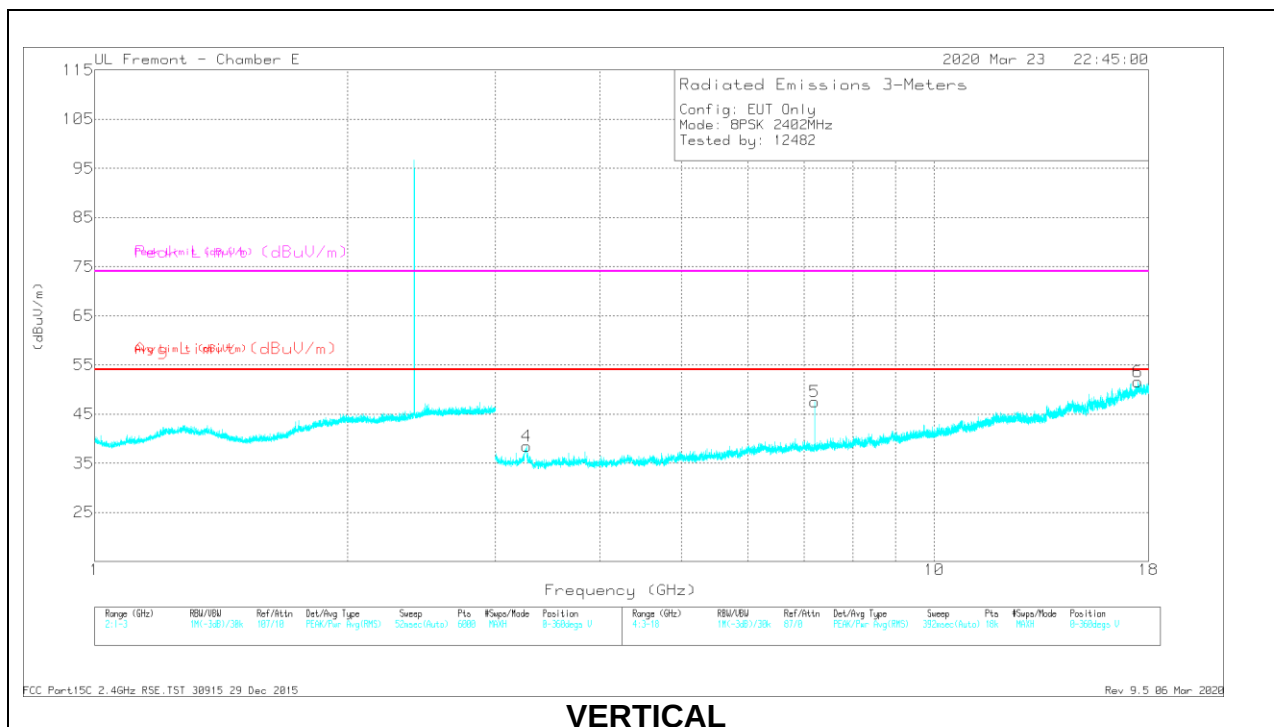
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



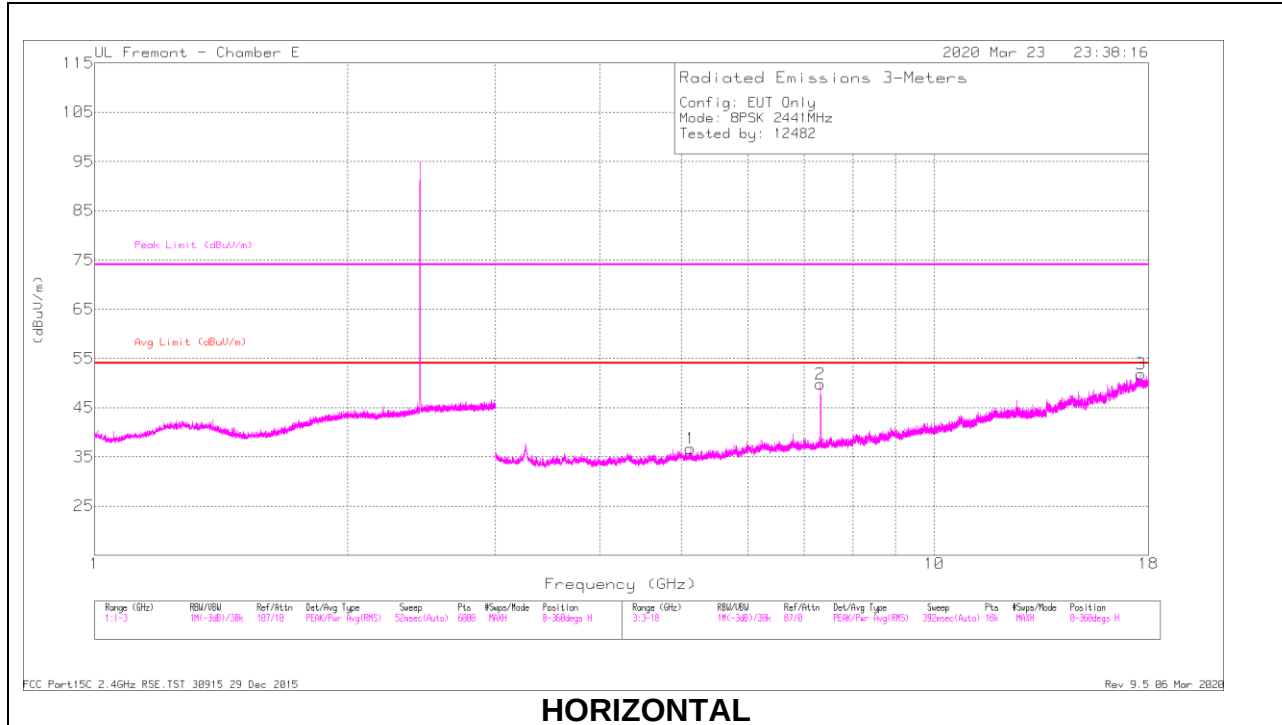
VERTICAL

RADIATED EMISSIONS

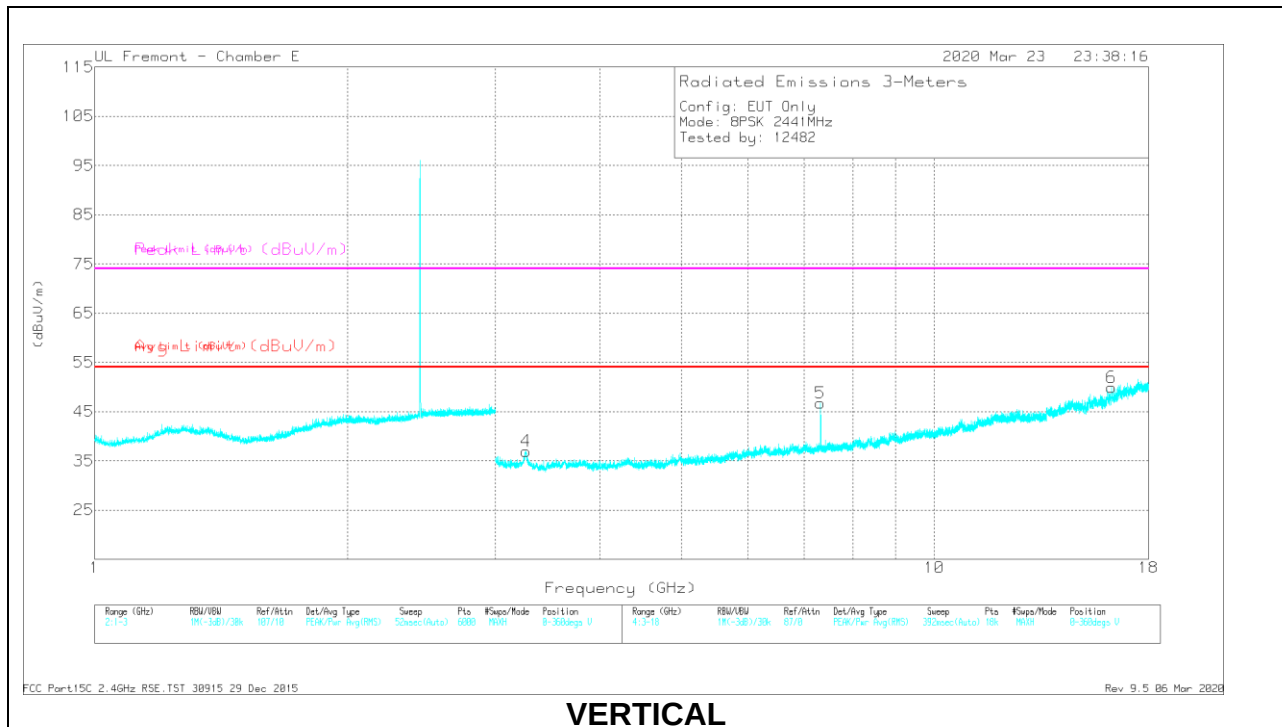
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.94464	40.58	PKFH	33.4	-33	40.98	74	-33.02	196	235	H
4	3.27021	42.37	PKFH	34.8	-34.5	42.67	74	-31.33	96	121	V
2	7.20577	46.35	PKFH	35.6	-28.4	53.55	74	-20.45	272	101	H
5	7.20594	43.98	PKFH	35.6	-28.4	51.18	74	-22.82	276	106	V
3	17.42722	35.39	PKFH	41.5	-19.6	57.29	74	-16.71	185	180	H
6	17.4743	35.82	PKFH	41.5	-19.1	58.22	74	-15.78	162	193	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

MID CHANNEL RESULTS



HORIZONTAL



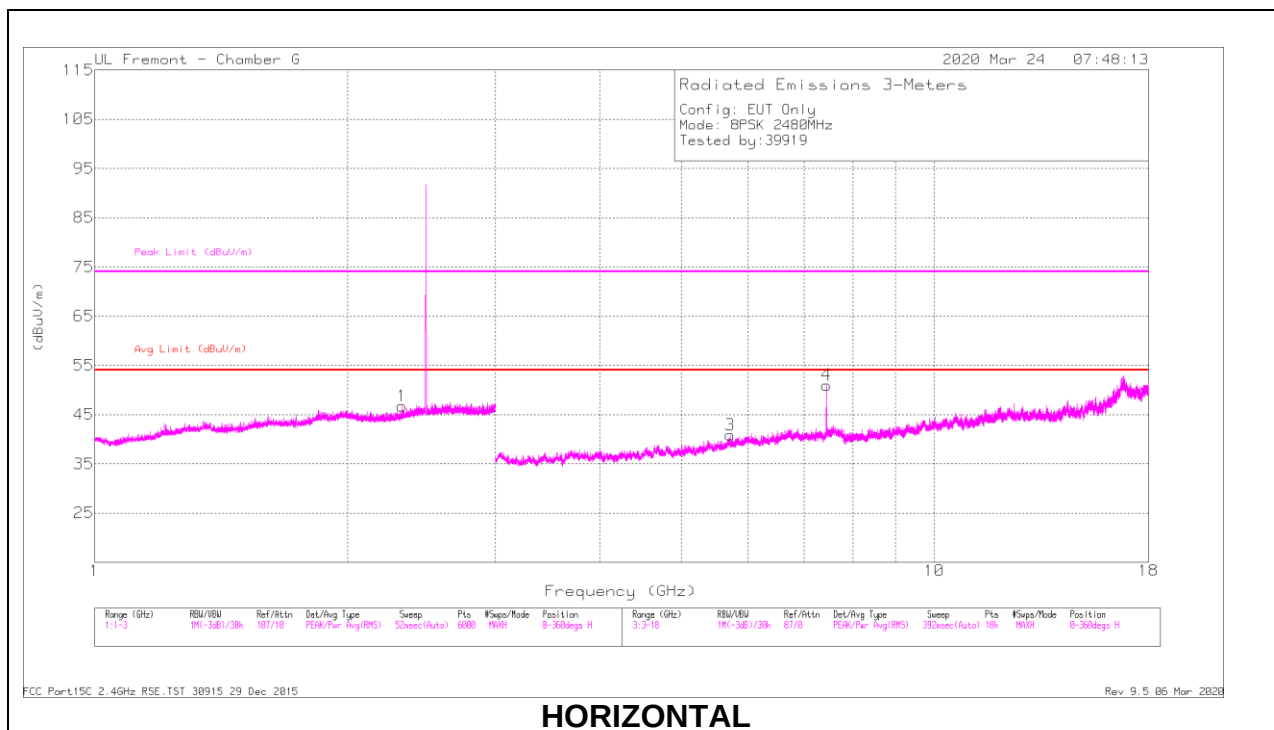
VERTICAL

RADIATED EMISSIONS

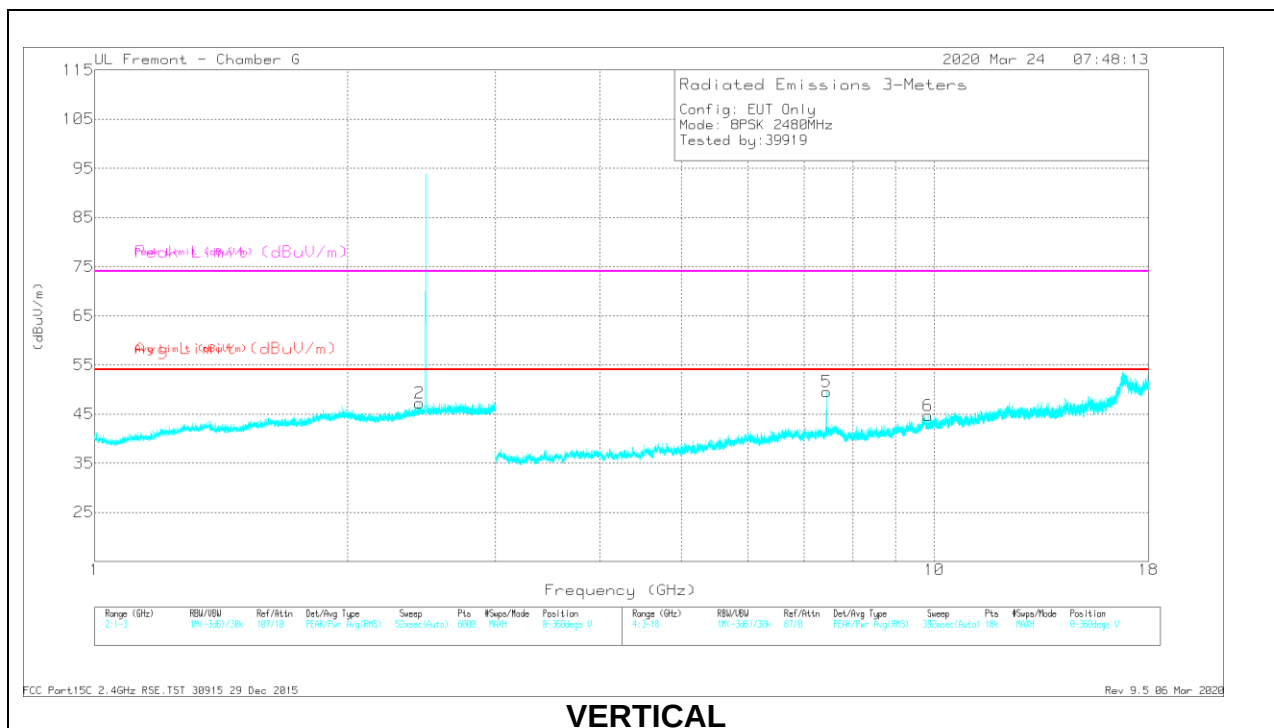
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 5.12096	40.09	PKFH	34.3	-31.5	42.89	74	-31.11	165	348	H
2	* 7.32322	46.64	PKFH	35.7	-28.2	54.14	74	-19.86	317	102	H
3	17.62403	34.1	PKFH	41.6	-19.1	56.6	74	-17.40	35	263	H
4	* 3.26468	43.17	PKFH	35.1	-34.5	43.77	74	-30.23	265	329	V
5	* 7.32243	43.43	PKFH	35.7	-28.2	50.93	74	-23.07	120	102	V
6	16.26615	34.05	PKFH	40.5	-19.3	55.25	74	-18.75	64	145	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

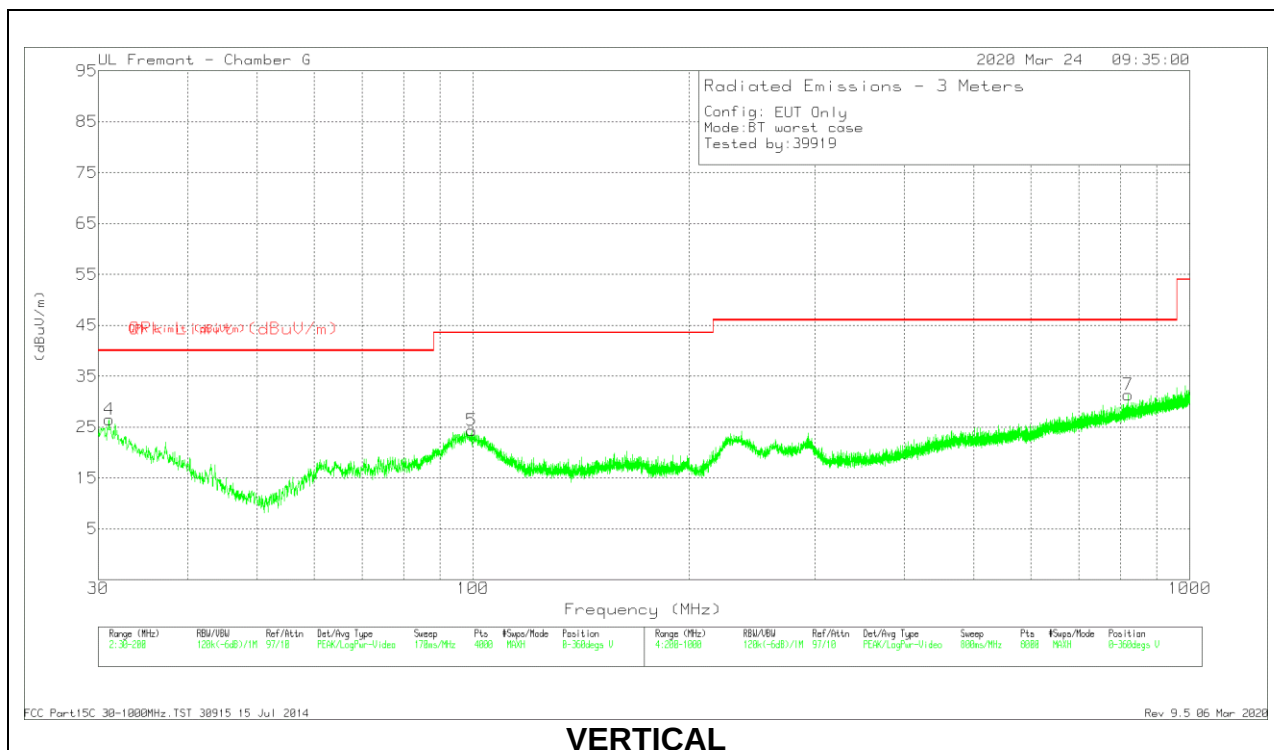
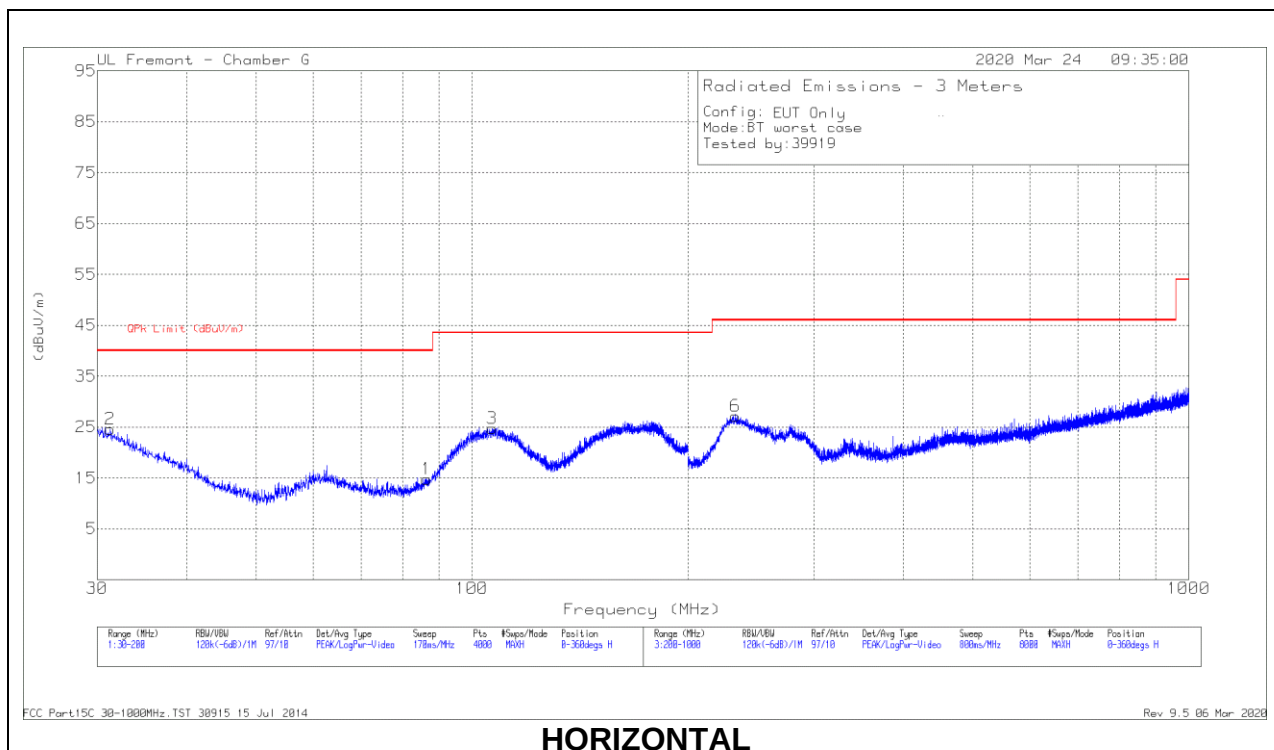
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.32423	41.89	PKFH	31.6	-22.3	51.19	74	-22.81	100	125	H
4	* 7.43996	46.54	PKFH	36.5	-27.8	55.24	74	-18.76	230	101	H
5	* 7.4404	45.17	PKFH	36.5	-27.8	53.87	74	-20.13	87	197	V
2	2.43922	41.82	PKFH	32.3	-22.1	52.02	74	-21.98	39	183	V
3	5.71	39.4	PKFH	35.1	-28.5	46	74	-28.00	186	115	H
6	9.82684	37.29	PKFH	37.1	-25.5	48.89	74	-25.11	78	106	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH FHSS/BT RB=100k for Frequencies <1GHz / RB=1MHz for Frequencies >1GHz, VB=3 x RB, Peak.

10.2. WORST CASE BELOW 1 GHz

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



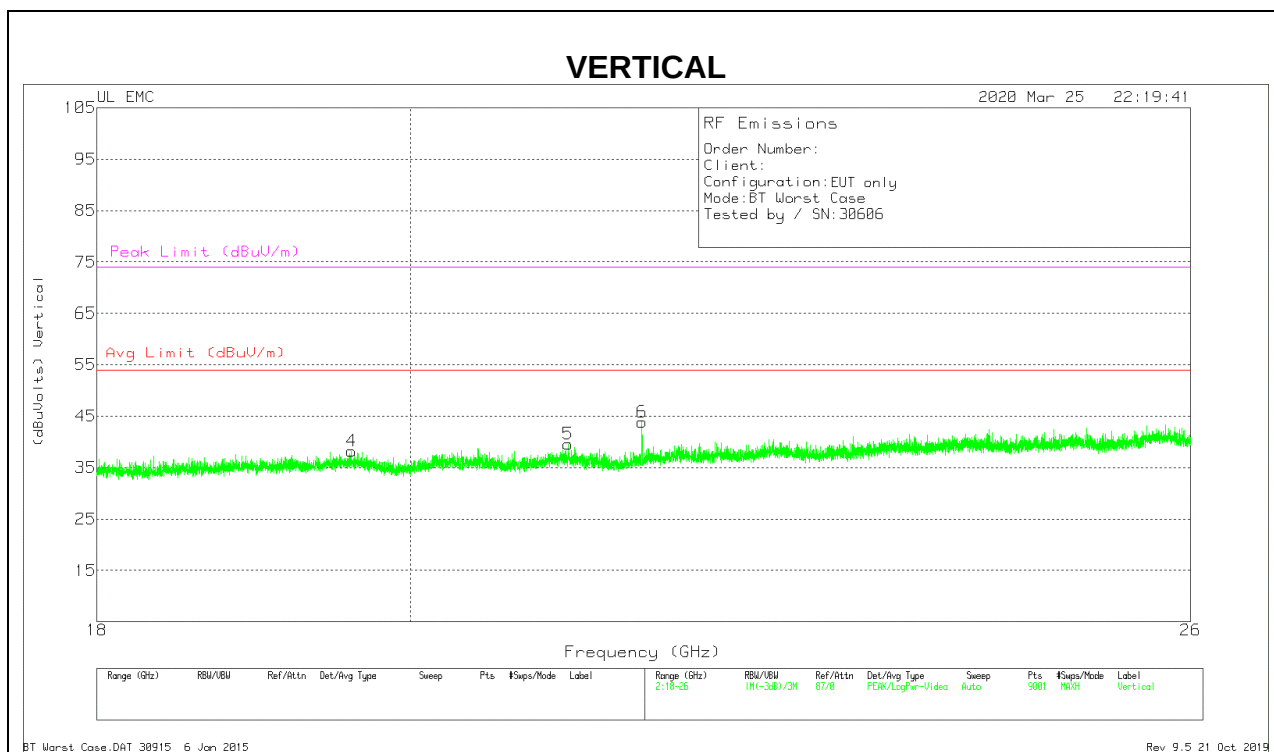
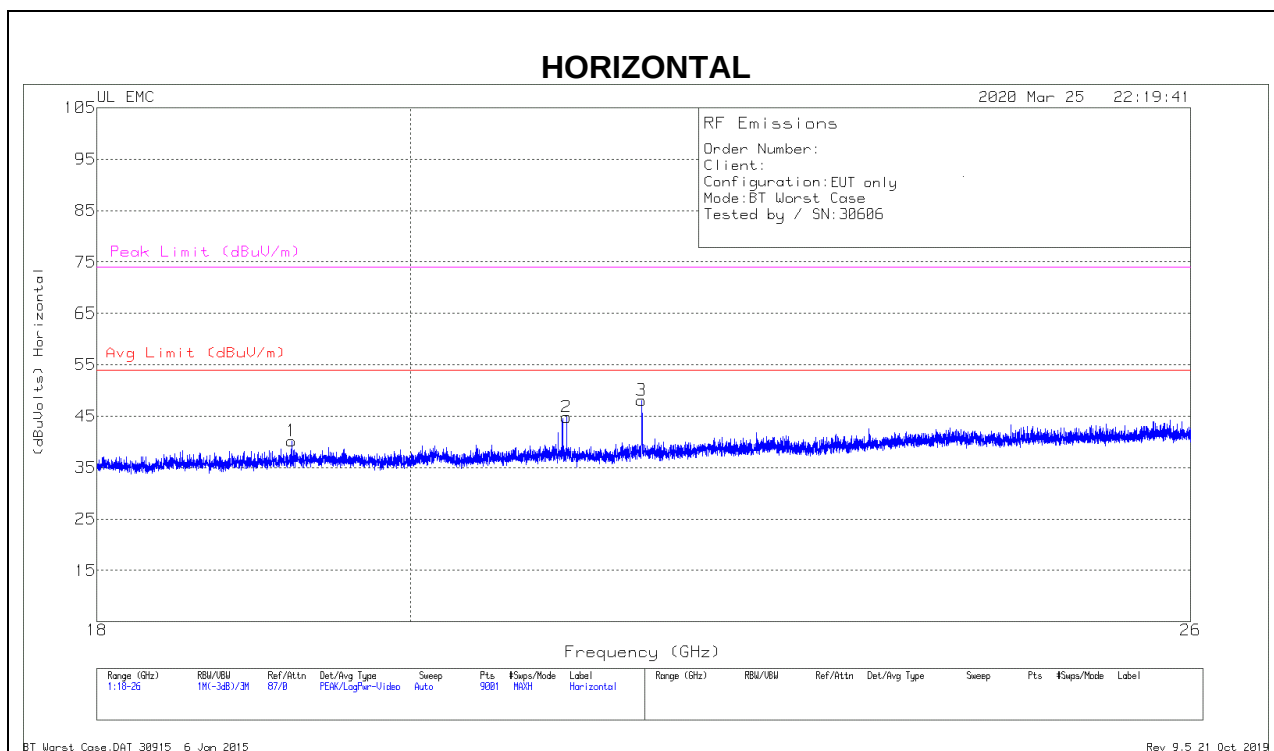
Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	31.0628	30.93	Pk	26.6	-31	26.53	40	-13.47	0-360	100	V
2	31.2753	29.03	Pk	26.5	-31	24.53	40	-15.47	0-360	99	H
1	86.4121	31.84	Pk	13.3	-30.4	14.74	40	-25.26	0-360	301	H
5	99.5055	38.36	Pk	16.2	-30.3	24.26	43.52	-19.26	0-360	100	V
3	106.6898	36.84	Pk	18.1	-30.3	24.64	43.52	-18.88	0-360	301	H
6	233.2043	39.07	Pk	17.3	-29.3	27.07	46.02	-18.95	0-360	99	H
7	820.7807	30.19	Pk	27.8	-26.7	31.29	46.02	-14.73	0-360	201	V

Pk - Peak detector

10.3. 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)	Peak Limit (dBuV/m)	PK Margin (dB)
1	19.21778	38.58	Pk	32.7	-21.6	-9.5	40.18	74	-33.82
2	21.08	42.12	Pk	33.1	-20.9	-9.5	44.82	74	-29.18
3	21.61689	45.35	Pk	33.1	-20.9	-9.5	48.05	74	-25.95
4	19.608	36.57	Pk	32.8	-21.7	-9.5	38.17	74	-35.83
5	21.08978	36.77	Pk	33.1	-20.8	-9.5	39.57	74	-34.43
6	21.61956	41.16	Pk	33.1	-20.9	-9.5	43.86	74	-30.14

Pk - Peak detector

11. 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

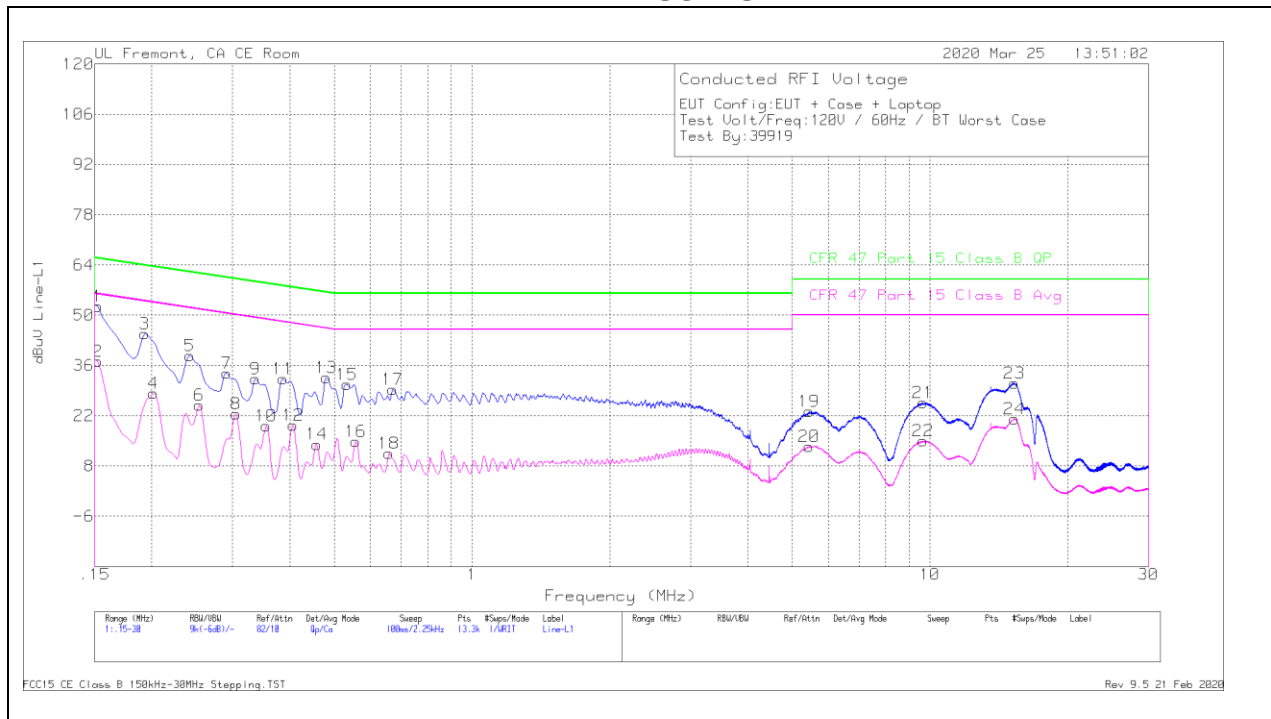
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

11.1.1. AC Power Line Host

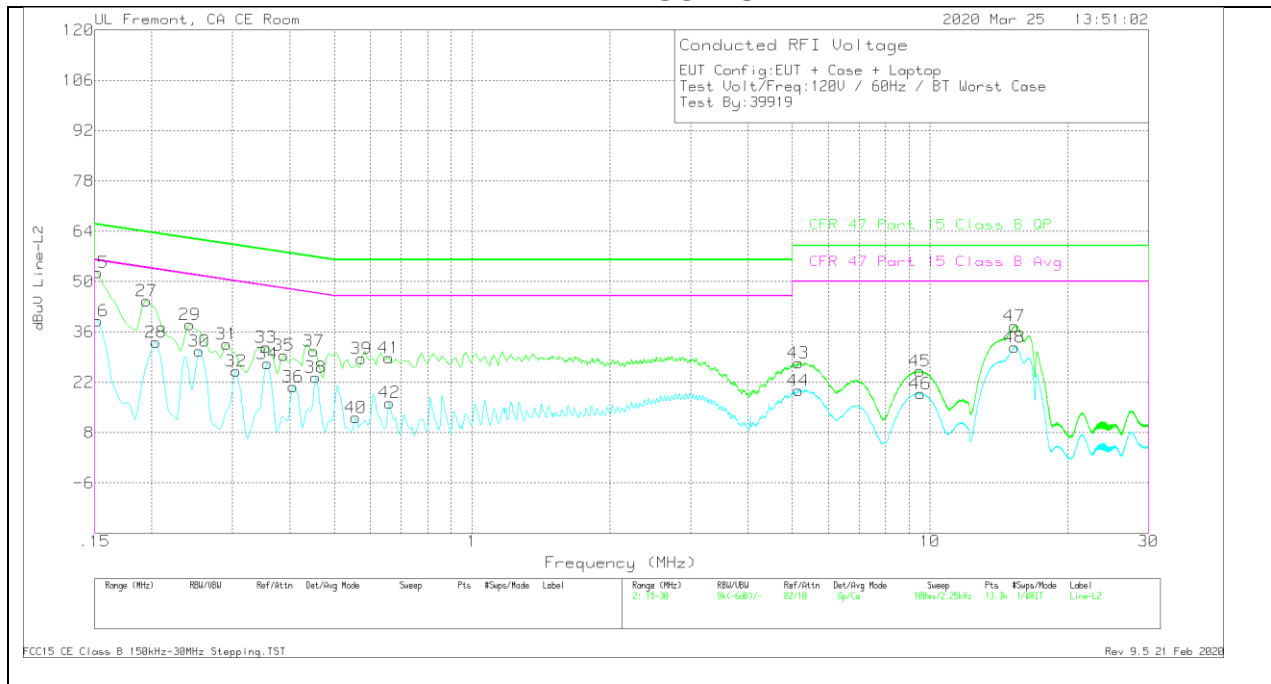
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1 (dB)	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)M argin (dB)
1	.15225	42.34	Qp	.1	0	10	52.44	65.88	-13.44	-	-
2	.15225	27.03	Ca	.1	0	10	37.13	-	-	55.88	-18.75
3	.19275	34.82	Qp	0	0	10	44.82	63.92	-19.1	-	-
4	.20175	18.29	Ca	0	0	10	28.29	-	-	53.54	-25.25
5	.24225	28.8	Qp	0	0	10	38.8	62.02	-23.22	-	-
6	.2535	14.94	Ca	0	0	10	24.94	-	-	51.64	-26.7
7	.29175	23.9	Qp	0	0	10	33.9	60.47	-26.57	-	-
8	.30525	12.58	Ca	0	0	10	22.58	-	-	50.1	-27.52
9	.33675	22.24	Qp	0	0	10	32.24	59.28	-27.04	-	-
10	.35475	9.16	Ca	0	0	10	19.16	-	-	48.85	-29.69
11	.38625	22.21	Qp	0	0	10	32.21	58.14	-25.93	-	-
12	.4065	9.31	Ca	0	0	10	19.31	-	-	47.72	-28.41
13	.48075	22.67	Qp	0	0	10	32.67	56.33	-23.66	-	-
14	.45825	4.05	Ca	0	0	10	14.05	-	-	46.72	-32.67
15	.5325	20.74	Qp	0	0	10	30.74	56	-25.26	-	-
16	.55725	4.87	Ca	0	0	10	14.87	-	-	46	-31.13
17	.672	19.25	Qp	0	0	10	29.25	56	-26.75	-	-
18	.6585	1.58	Ca	0	0	10	11.58	-	-	46	-34.42
19	5.4465	12.95	Qp	0	.1	10.1	23.15	60	-36.85	-	-
20	5.4465	3.18	Ca	0	.1	10.1	13.38	-	-	50	-36.62
21	9.65625	15.28	Qp	0	.2	10.1	25.58	60	-34.42	-	-
22	9.65738	4.65	Ca	0	.2	10.1	14.95	-	-	50	-35.05
23	15.30375	20.55	Qp	0	.3	10.2	31.05	60	-28.95	-	-
24	15.3015	10.67	Ca	0	.3	10.2	21.17	-	-	50	-28.83

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS

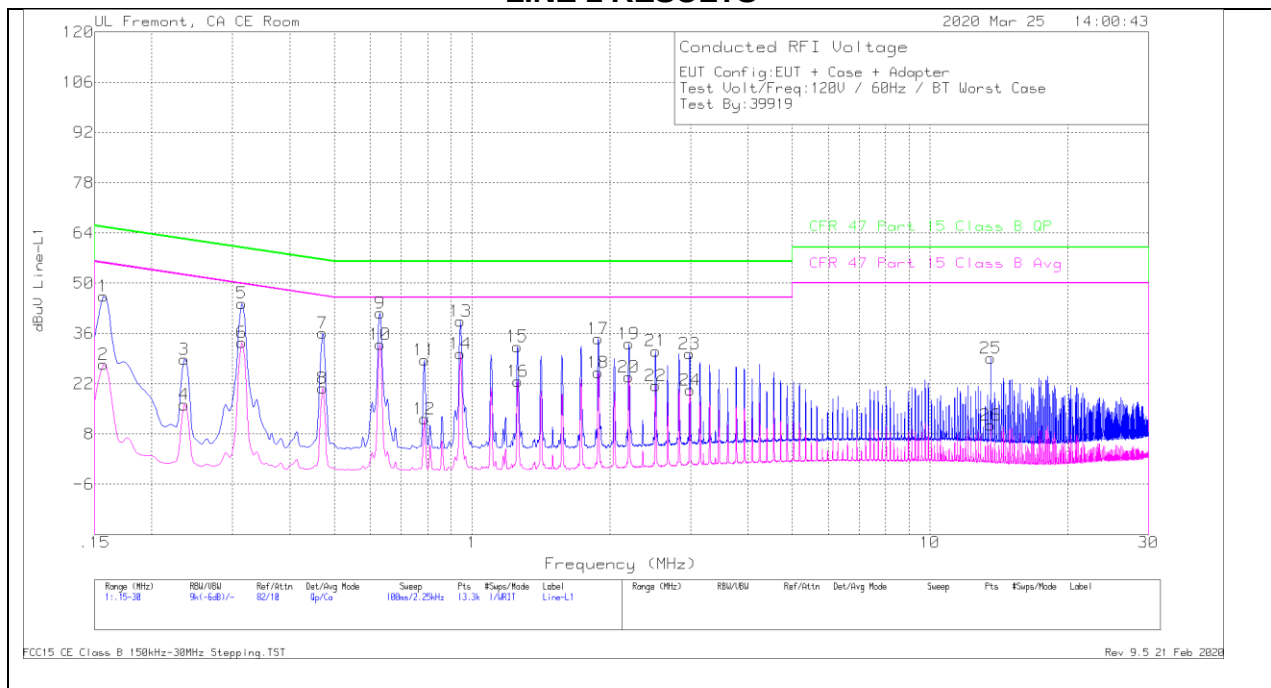


Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2 (dB)	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
25	.15225	42.44	Qp	.1	0	10	52.54	65.88	-13.34	-	-
26	.15225	28.94	Ca	.1	0	10	39.04	-	-	55.88	-16.84
27	.195	34.71	Qp	0	0	10	44.71	63.82	-19.11	-	-
28	.204	23.1	Ca	0	0	10	33.1	-	-	53.45	-20.35
29	.24225	28.07	Qp	0	0	10	38.07	62.02	-23.95	-	-
30	.2535	20.64	Ca	0	0	10	30.64	-	-	51.64	-21
31	.29175	22.68	Qp	0	0	10	32.68	60.47	-27.79	-	-
32	.30525	15.09	Ca	0	0	10	25.09	-	-	50.1	-25.01
33	.35475	21.81	Qp	0	0	10	31.81	58.85	-27.04	-	-
34	.357	17.22	Ca	0	0	10	27.22	-	-	48.8	-21.58
35	.3885	19.44	Qp	0	0	10	29.44	58.1	-28.66	-	-
36	.4065	10.75	Ca	0	0	10	20.75	-	-	47.72	-26.97
37	.4515	20.7	Qp	0	0	10	30.7	56.85	-26.15	-	-
38	.456	13.31	Ca	0	0	10	23.31	-	-	46.77	-23.46
39	.573	18.59	Qp	0	0	10	28.59	56	-27.41	-	-
40	.55725	2.15	Ca	0	0	10	12.15	-	-	46	-33.85
41	.6585	18.79	Qp	0	0	10	28.79	56	-27.21	-	-
42	.66075	6.32	Ca	0	0	10	16.32	-	-	46	-29.68
43	5.1585	17.27	Qp	0	.1	10.1	27.47	60	-32.53	-	-
44	5.16075	9.56	Ca	0	.1	10.1	19.76	-	-	50	-30.24
45	9.50325	14.77	Qp	0	.2	10.1	25.07	60	-34.93	-	-
46	9.52238	8.56	Ca	0	.2	10.1	18.86	-	-	50	-31.14
47	15.30375	27.11	Qp	0	.3	10.2	37.61	60	-22.39	-	-
48	15.29925	21.3	Ca	0	.3	10.2	31.8	-	-	50	-18.2

Qp - Quasi-Peak detector
Ca - CISPR average detection

11.1.2. AC Power Line Norm

LINE 1 RESULTS



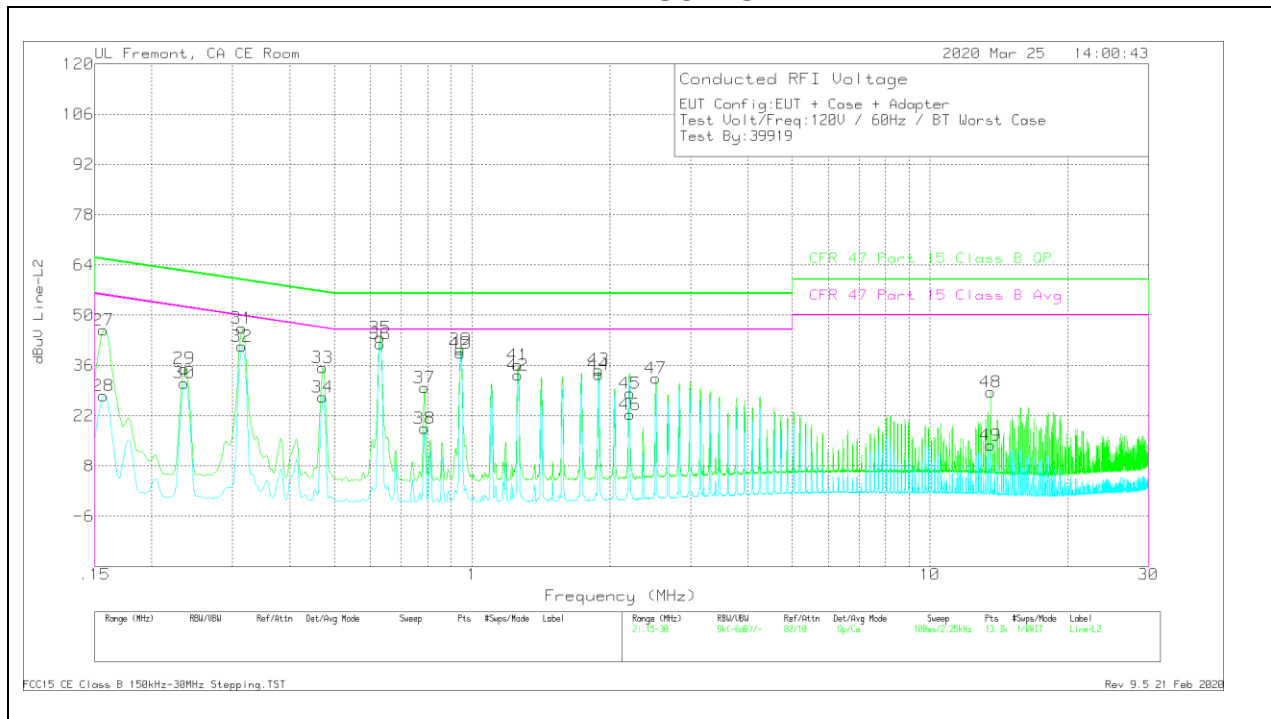
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1 (dB)	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.15675	36.32	Qp	.1	0	10	46.42	65.63	-19.21	-	-
2	.15675	17.28	Ca	.1	0	10	27.38	-	-	55.63	-28.25
3	.2355	18.78	Qp	0	0	10	28.78	62.25	-33.47	-	-
4	.2355	6.15	Ca	0	0	10	16.15	-	-	52.25	-36.1
5	.31425	34.41	Qp	0	0	10	44.41	59.86	-15.45	-	-
6	.31425	23.43	Ca	0	0	10	33.43	-	-	49.86	-16.43
7	.47175	26.13	Qp	0	0	10	36.13	56.48	-20.35	-	-
8	.47175	10.78	Ca	0	0	10	20.78	-	-	46.48	-25.7
9	.62925	31.63	Qp	0	0	10	41.63	56	-14.37	-	-
10	.62925	22.94	Ca	0	0	10	32.94	-	-	46	-13.06
11	.78675	18.63	Qp	0	0	10	28.63	56	-27.37	-	-
12	.78675	2.2	Ca	0	0	10	12.2	-	-	46	-33.8
13	.94425	29.36	Qp	0	.1	10	39.46	56	-16.54	-	-
14	.94425	20.3	Ca	0	.1	10	30.4	-	-	46	-15.6
15	1.257	22.27	Qp	0	.1	10	32.37	56	-23.63	-	-
16	1.25925	12.53	Ca	0	.1	10	22.63	-	-	46	-23.37
17	1.887	24.46	Qp	0	.1	10	34.56	56	-21.44	-	-
18	1.887	15.03	Ca	0	.1	10	25.13	-	-	46	-20.87
19	2.202	23.01	Qp	0	.1	10	33.11	56	-22.89	-	-
20	2.202	13.77	Ca	0	.1	10	23.87	-	-	46	-22.13
21	2.51475	21.05	Qp	0	.1	10	31.15	56	-24.85	-	-
22	2.517	11.37	Ca	0	.1	10	21.47	-	-	46	-24.53
23	2.98725	20.32	Qp	0	.1	10	30.42	56	-25.58	-	-
24	2.9895	10.09	Ca	0	.1	10	20.19	-	-	46	-25.81
25	*13.56	18.77	Qp	.1	.2	10.1	29.17	60	-30.83	-	-
26	*13.56	.07	Ca	.1	.2	10.1	10.47	-	-	50	-39.53

Qp - Quasi-Peak detector

Ca - CISPR average detection

*Indicates UL RFID signal. Not from device.

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2 (dB)	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)M argin (dB)
27	.15675	35.79	Qp	.1	0	10	45.89	65.63	-19.74	-	-
28	.15675	17.44	Ca	.1	0	10	27.54	-	-	55.63	-28.09
29	.2355	25.16	Qp	0	0	10	35.16	62.25	-27.09	-	-
30	.2355	21.15	Ca	0	0	10	31.15	-	-	52.25	-21.1
31	.31425	36.48	Qp	0	0	10	46.48	59.86	-13.38	-	-
32	.31425	31.4	Ca	0	0	10	41.4	-	-	49.86	-8.46
33	.47175	25.45	Qp	0	0	10	35.45	56.48	-21.03	-	-
34	.47175	17.23	Ca	0	0	10	27.23	-	-	46.48	-19.25
35	.62925	33.87	Qp	0	0	10	43.87	56	-12.13	-	-
36	.62925	32.04	Ca	0	0	10	42.04	-	-	46	-3.96
37	.78675	19.86	Qp	0	0	10	29.86	56	-26.14	-	-
38	.78675	8.46	Ca	0	0	10	18.46	-	-	46	-27.54
39	.94425	30.43	Qp	0	.1	10	40.53	56	-15.47	-	-
40	.94425	29.29	Ca	0	.1	10	39.39	-	-	46	-6.61
41	1.25925	26.01	Qp	0	.1	10	36.11	56	-19.89	-	-
42	1.25925	23.27	Ca	0	.1	10	33.37	-	-	46	-12.63
43	1.8915	24.71	Qp	0	.1	10	34.81	56	-21.19	-	-
44	1.88925	23.33	Ca	0	.1	10	33.43	-	-	46	-12.57
45	2.211	18.19	Qp	0	.1	10	28.29	56	-27.71	-	-
46	2.211	12.31	Ca	0	.1	10	22.41	-	-	46	-23.59
47	2.5215	22.39	Qp	0	.1	10	32.49	56	-23.51	-	-
48	*13.56	18.25	Qp	.1	.2	10.1	28.65	60	-31.35	-	-
49	*13.56	3.38	Ca	.1	.2	10.1	13.78	-	-	50	-36.22

Qp - Quasi-Peak detector

Ca - CISPR average detection

*Indicates UL RFID signal. Not from device.

12. SETUP PHOTOS

Please refer to 13280103-EP1V1 for setup photos

END OF TEST REPORT