



CERTIFICATION TEST REPORT

Report Number. : 13280103-E3V2

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

Model : A2454

FCC ID : BCGA2454

IC : 579C-A2454

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:
March 31, 2020

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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	3/27/2020	Initial Issue	Jingang Li
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: A2454

SERIAL NUMBER: CC2C9062PNCC (Conducted) CC2C902APNCC (Radiated)

DATE TESTED: MARCH 12 – 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.

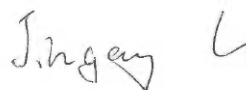
This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This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



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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, 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 A2454 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	12.66	18.45
2402 - 2480	Enhanced DQPSK	12.00	15.85
2402 - 2480	Enhanced 8PSK	12.54	17.95

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	-4.90

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	CC2C904GPNJH	
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						

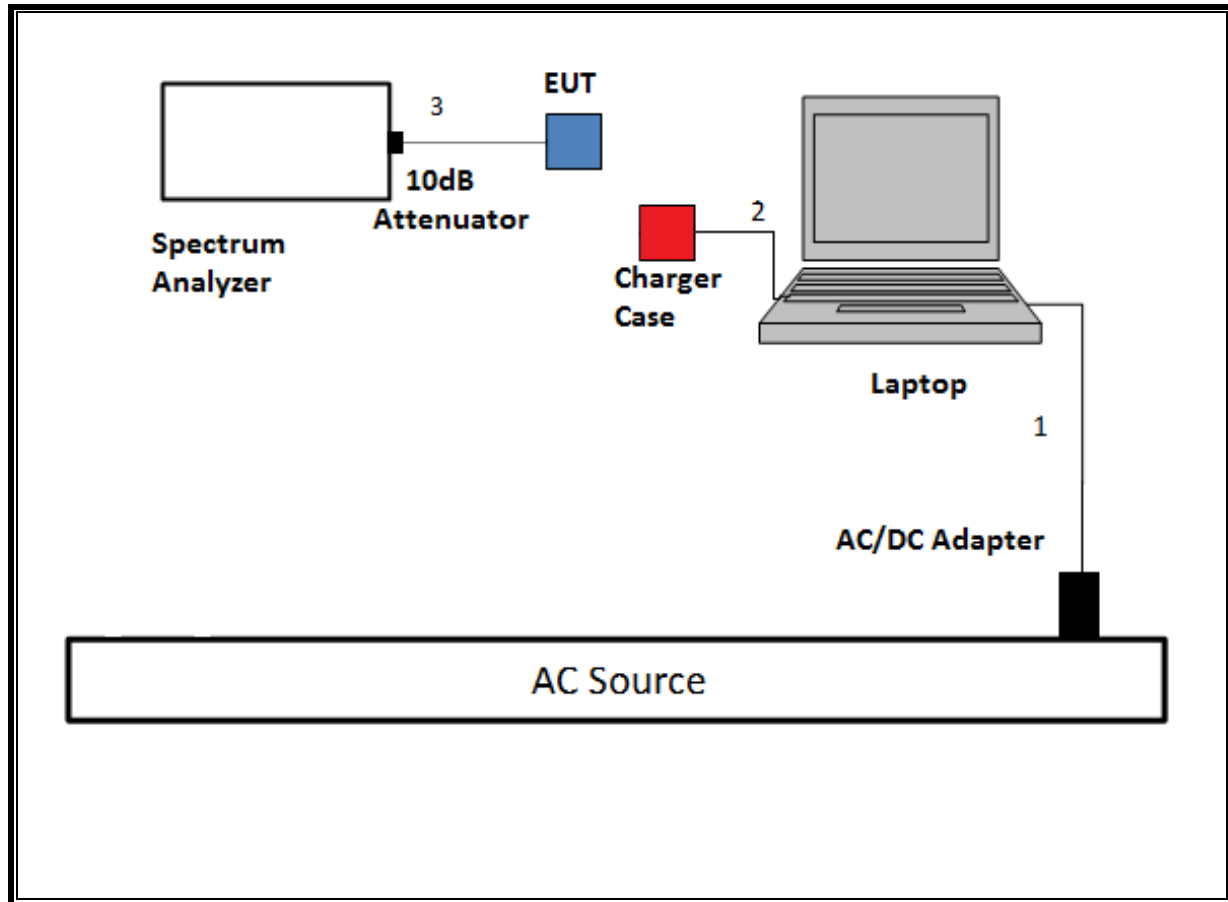
I/O CABLES (BELOW 1GHz AND AC POWER LINE TEST WITH ADAPTER AND LAPTOP)

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

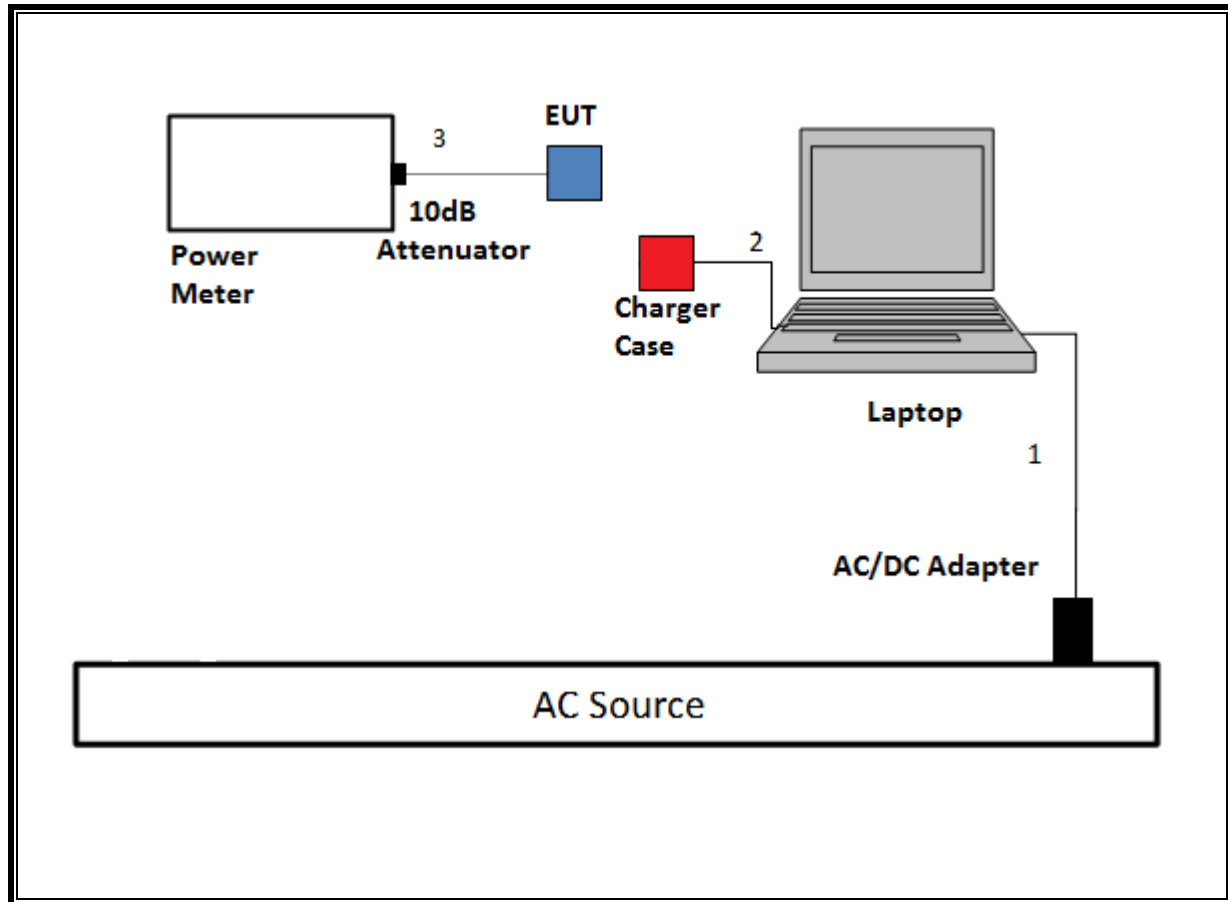
TEST SETUP

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

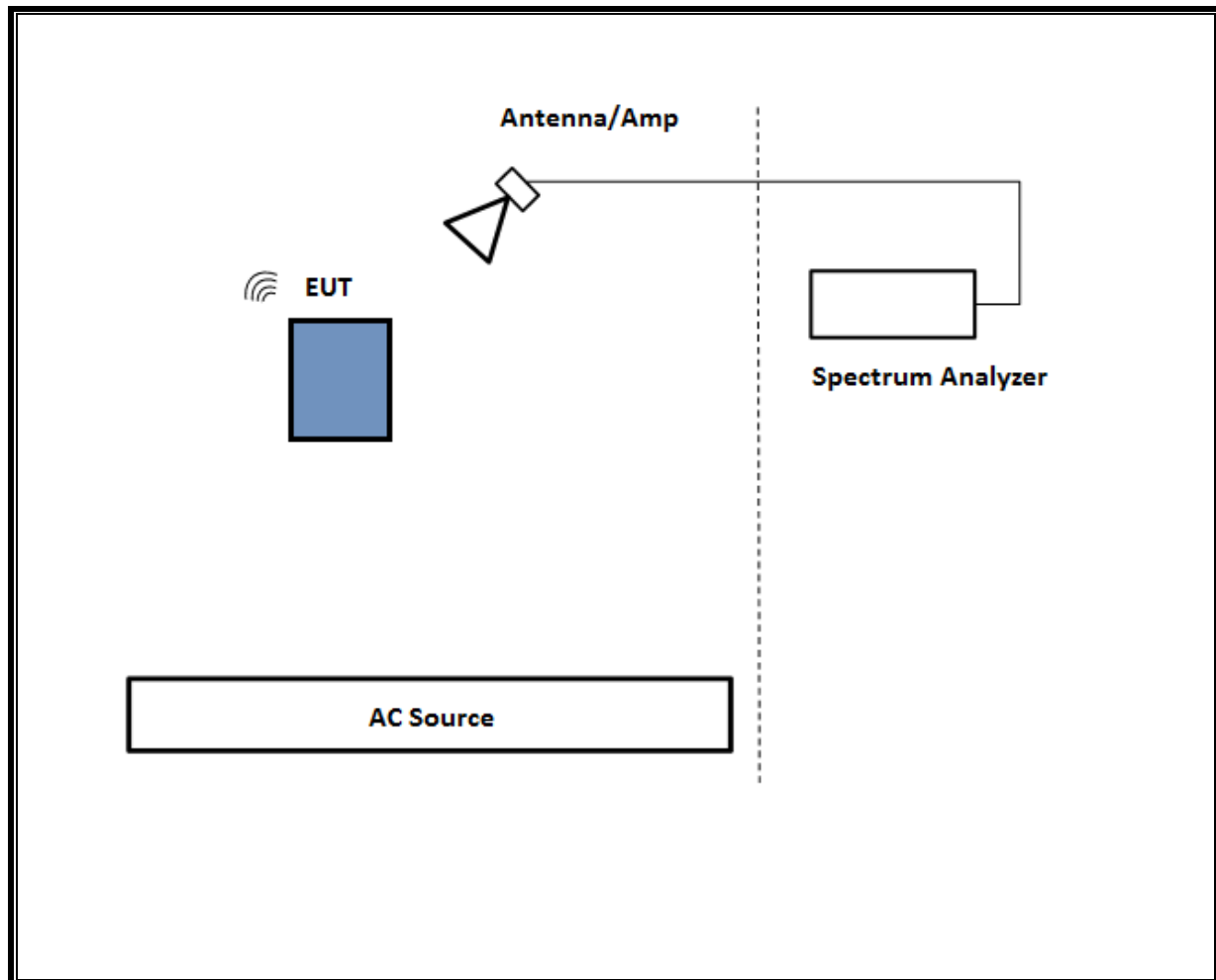
SETUP DIAGRAM FOR CONDUCTED TESTS

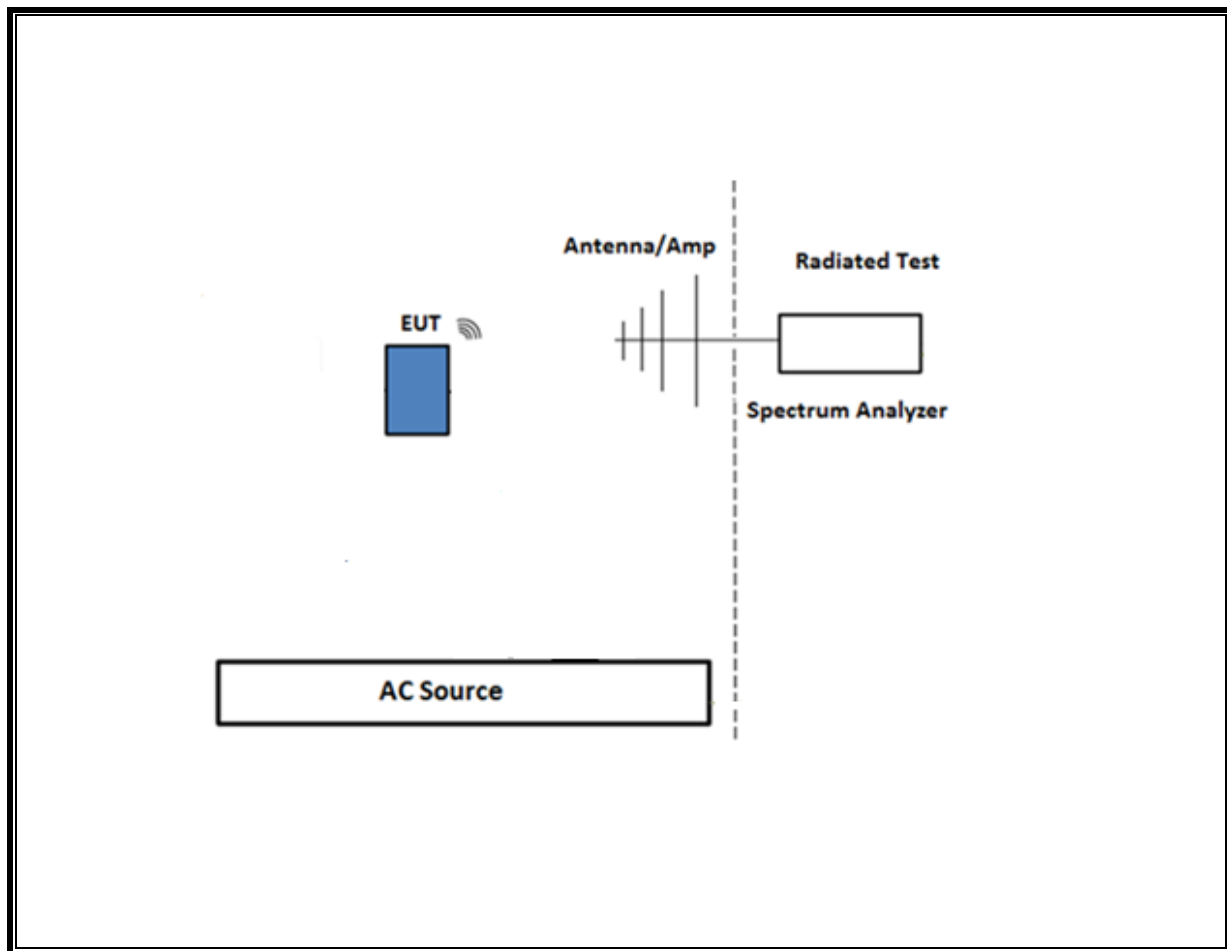


SETUP DIAGRAM FOR CONDUCTED TESTS: POWER METER CONFIGURATION

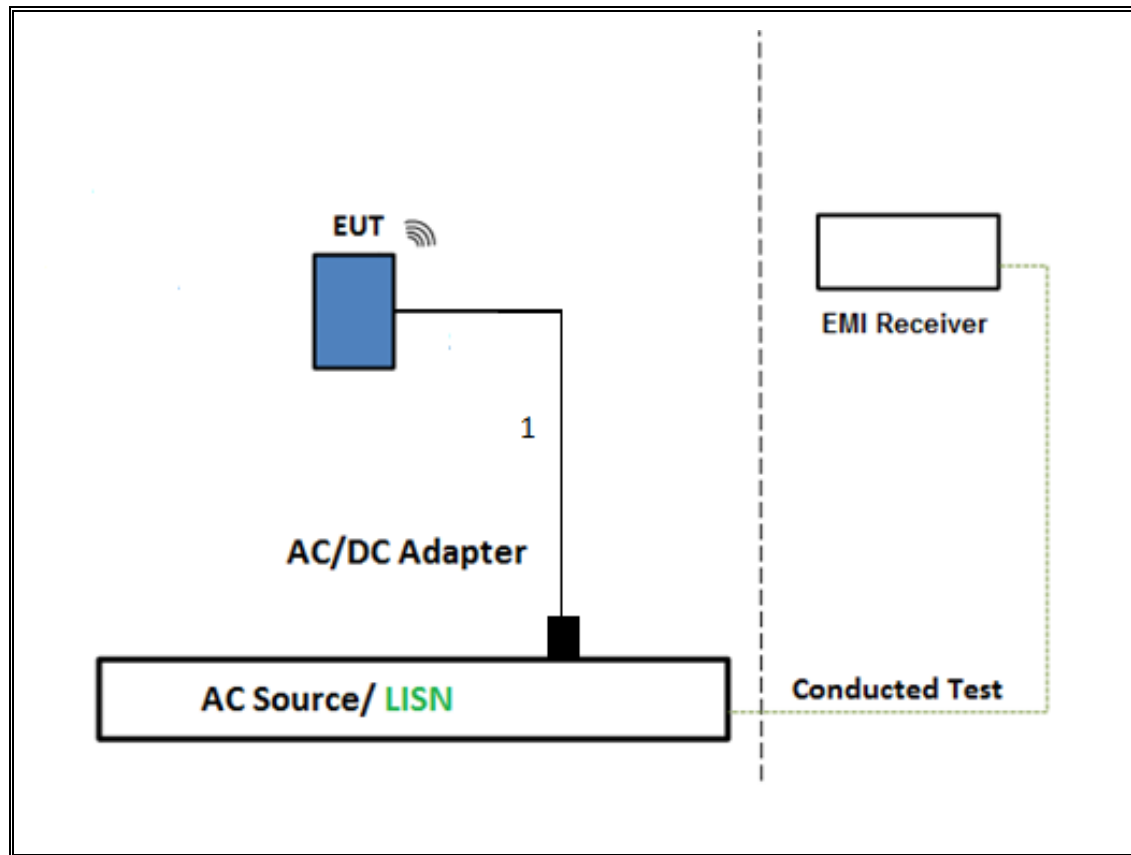


SETUP DIAGRAM FOR RADIATED TESTS ABOVE 1GHz

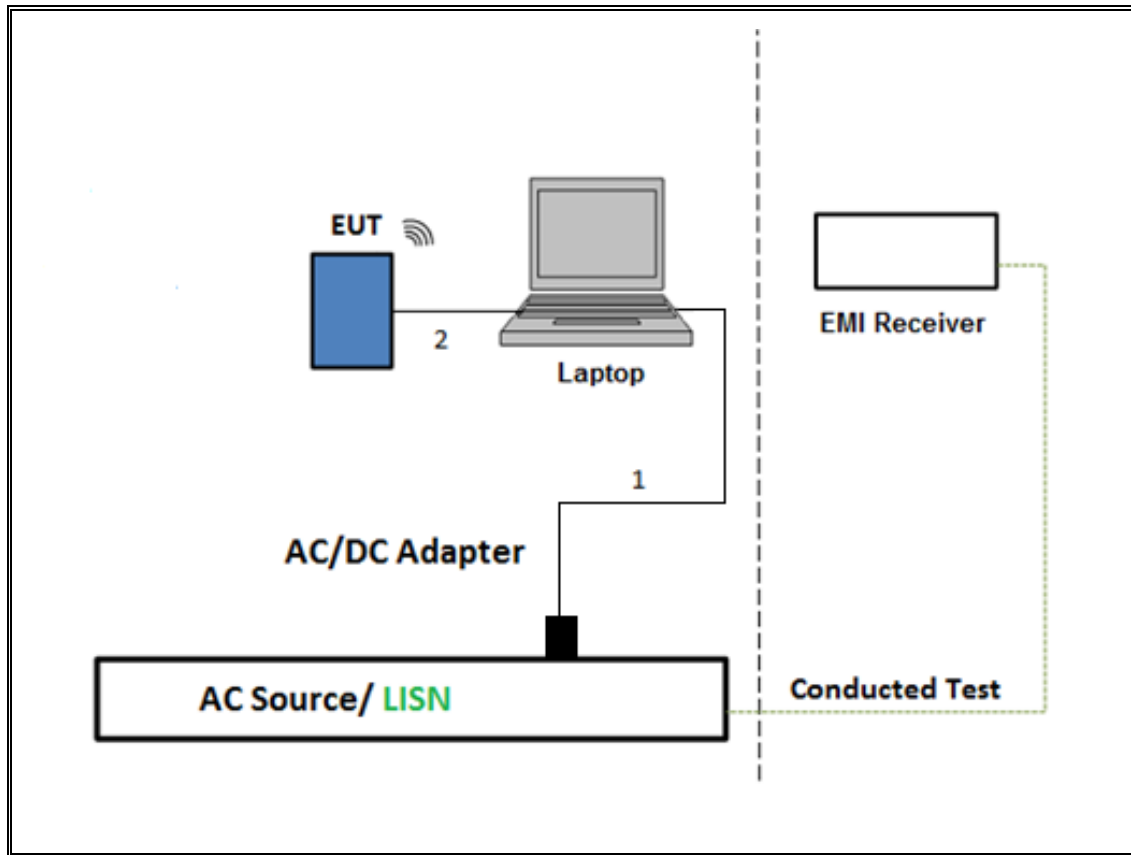


SETUP DIAGRAM FOR BELOW 1GHz

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
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	02/14/2020	02/14/2019
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

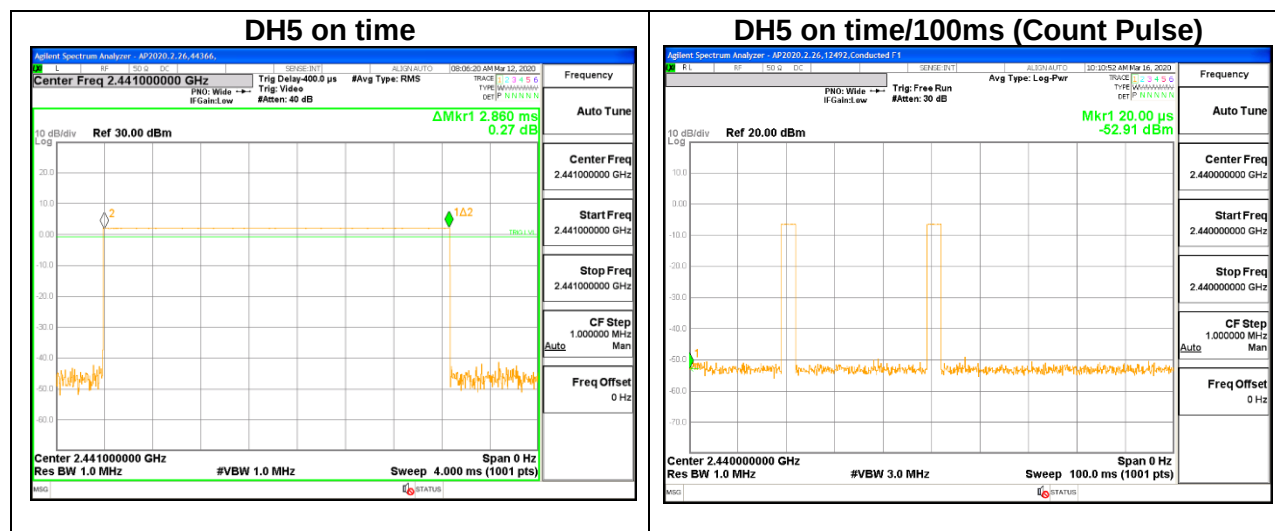
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

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



Note: Duty Cycle = on time/100 milliseconds = $2 \times 2.86 / 100 = 5.72\%$

Duty cycle correction factor = $20 \times \log(\text{Duty cycle}) = -24.85 \text{ dB}$

9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

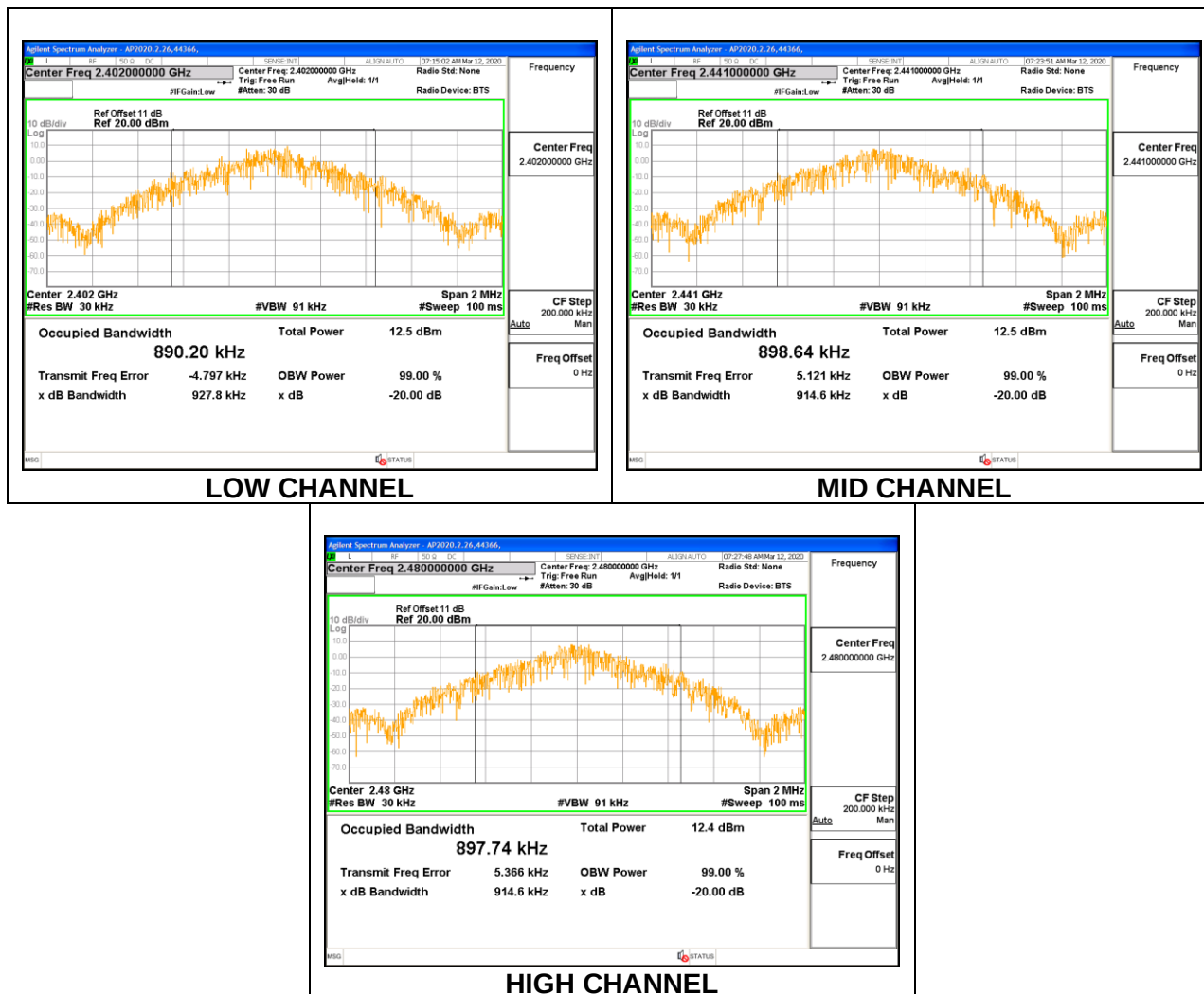
TEST PROCEDURE

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

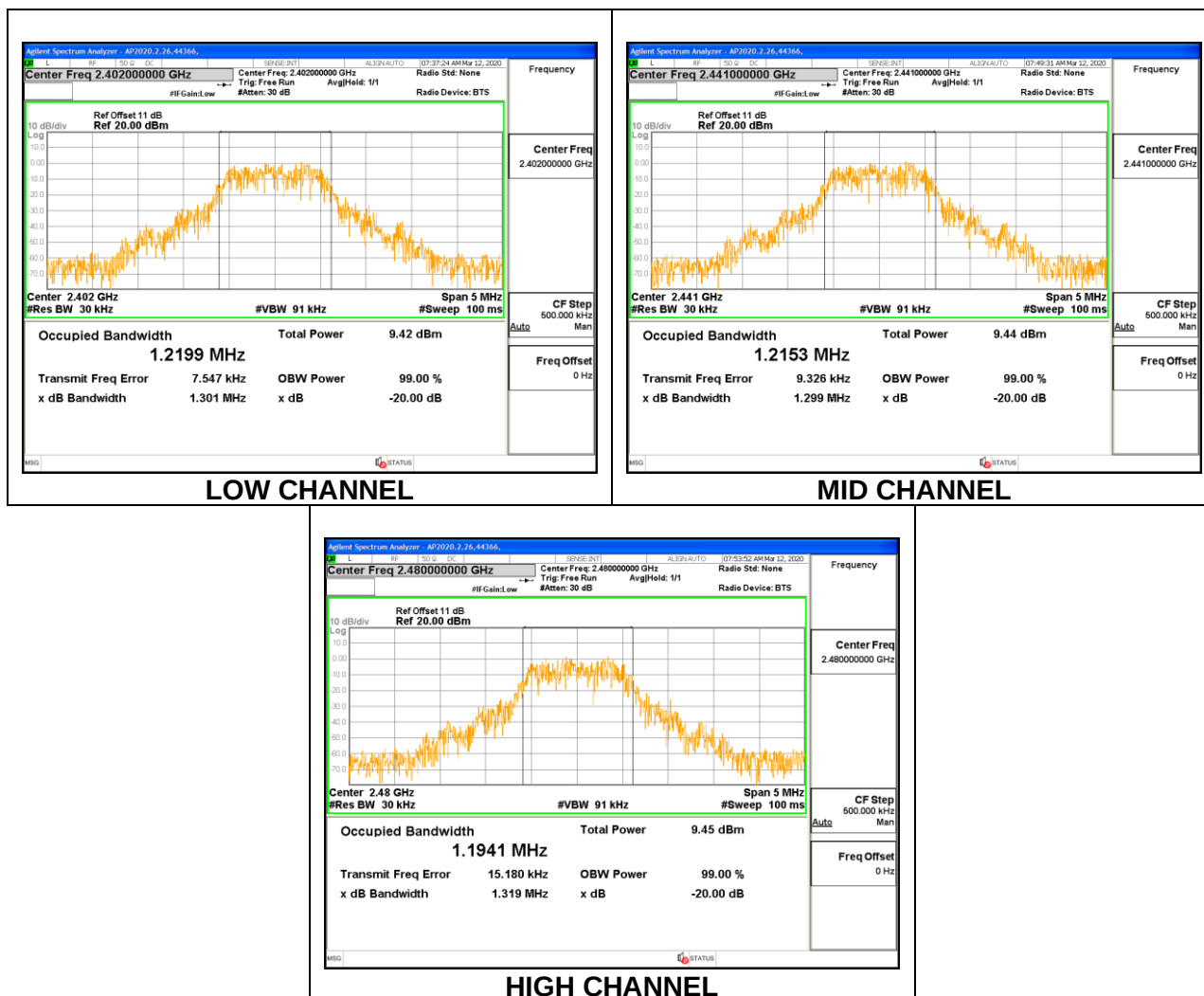
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
2402	0.928	0.890
2441	0.915	0.899
2480	0.915	0.898



9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.301	1.220
Mid	2441	1.299	1.215
High	2480	1.319	1.194



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.

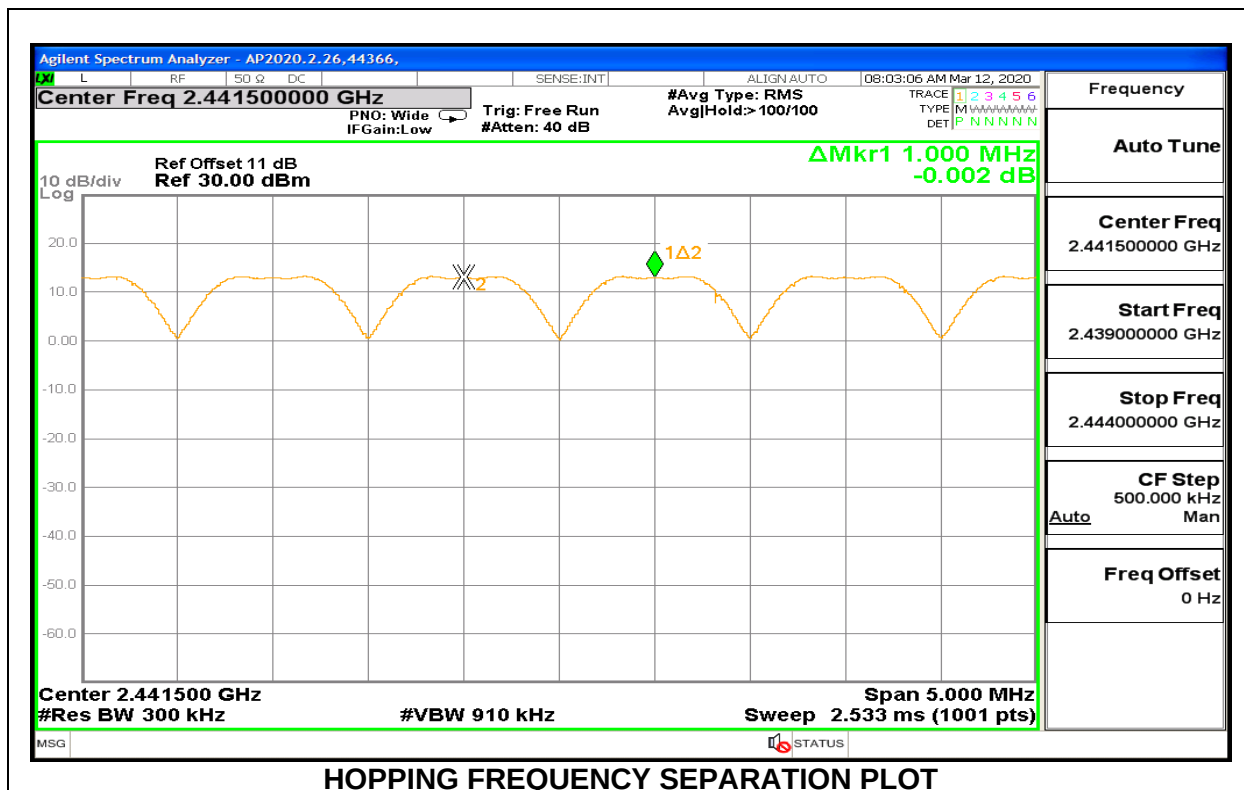
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

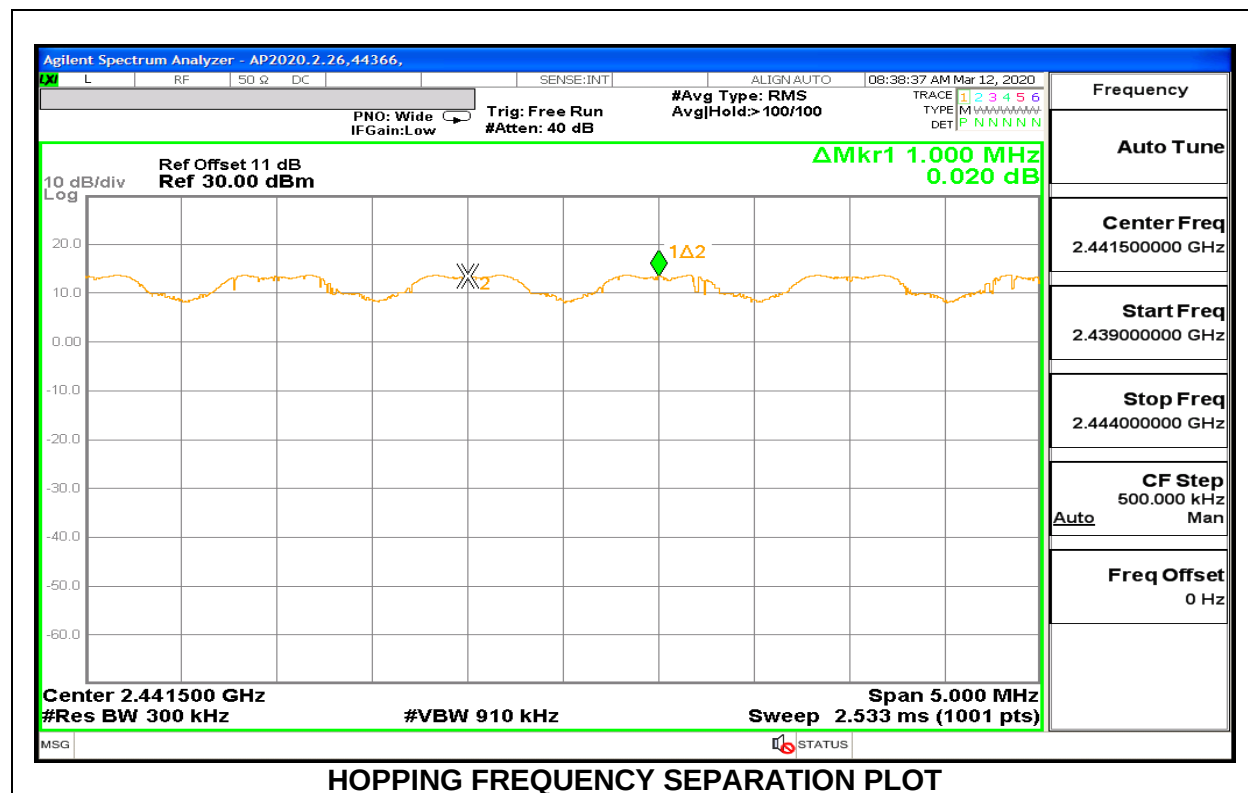
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq 3 \times RBW$. The sweep time is coupled.

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.

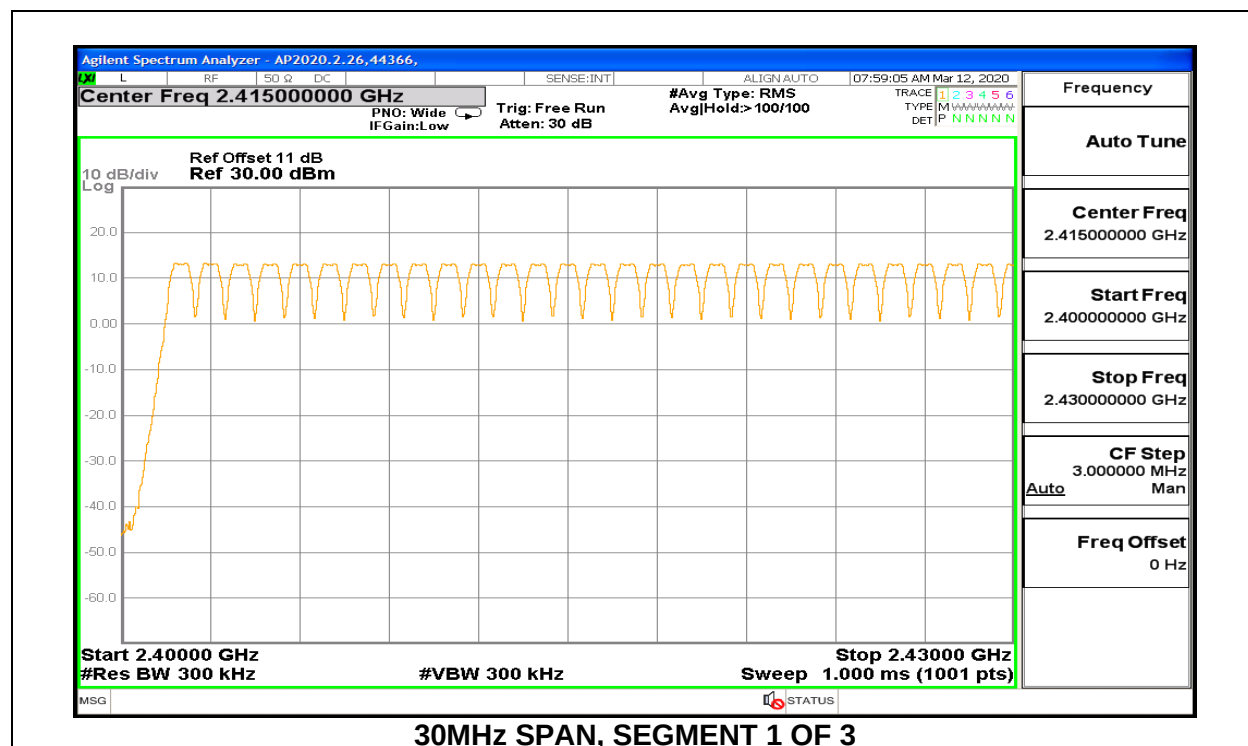
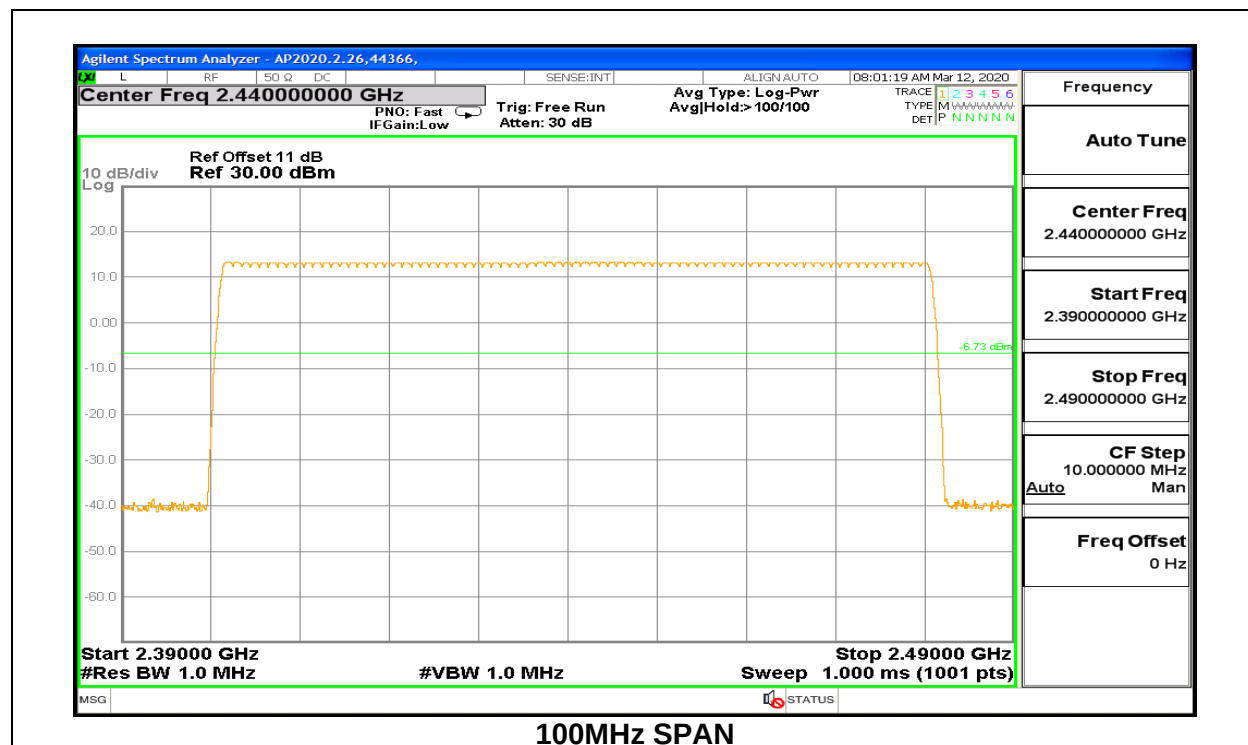
TEST PROCEDURE

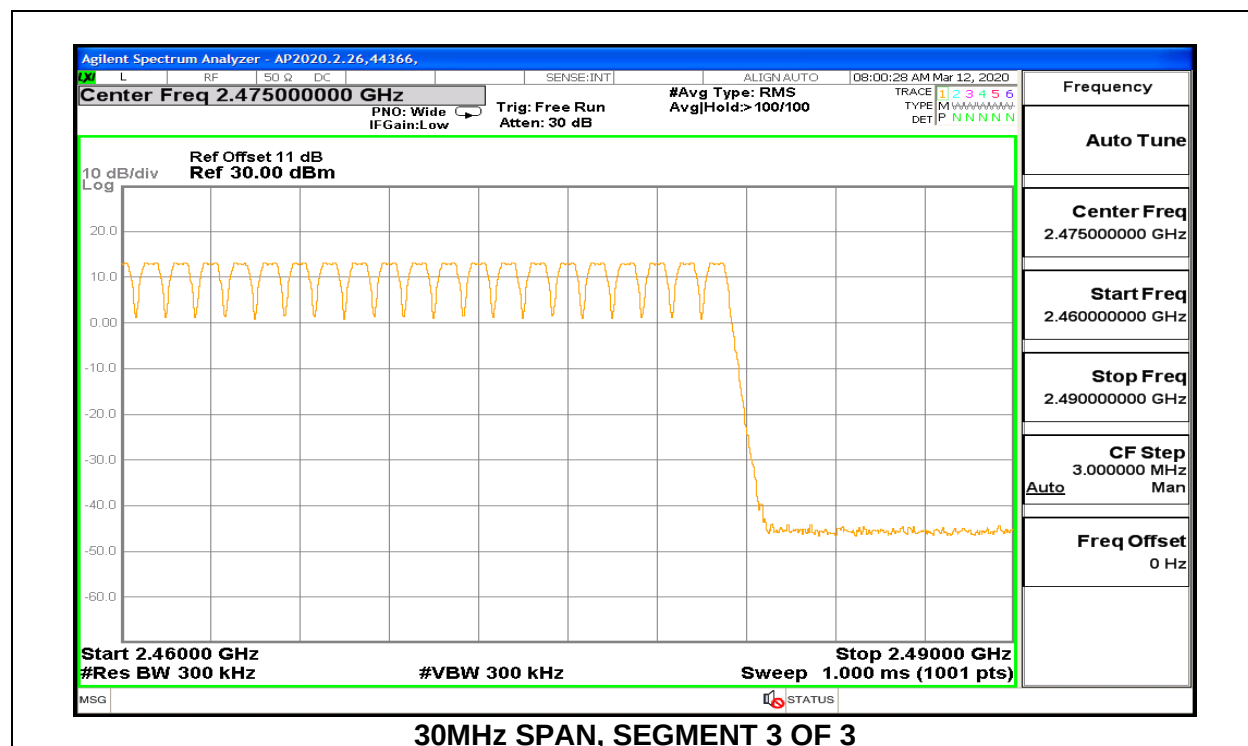
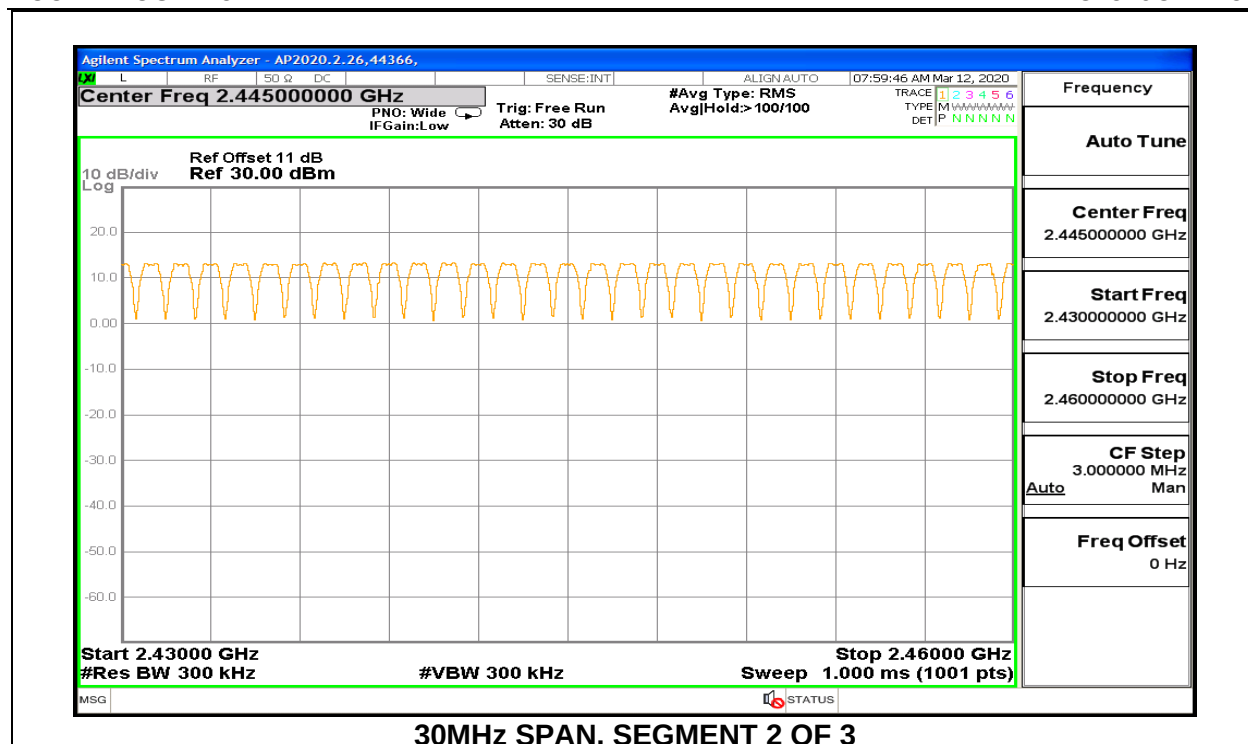
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

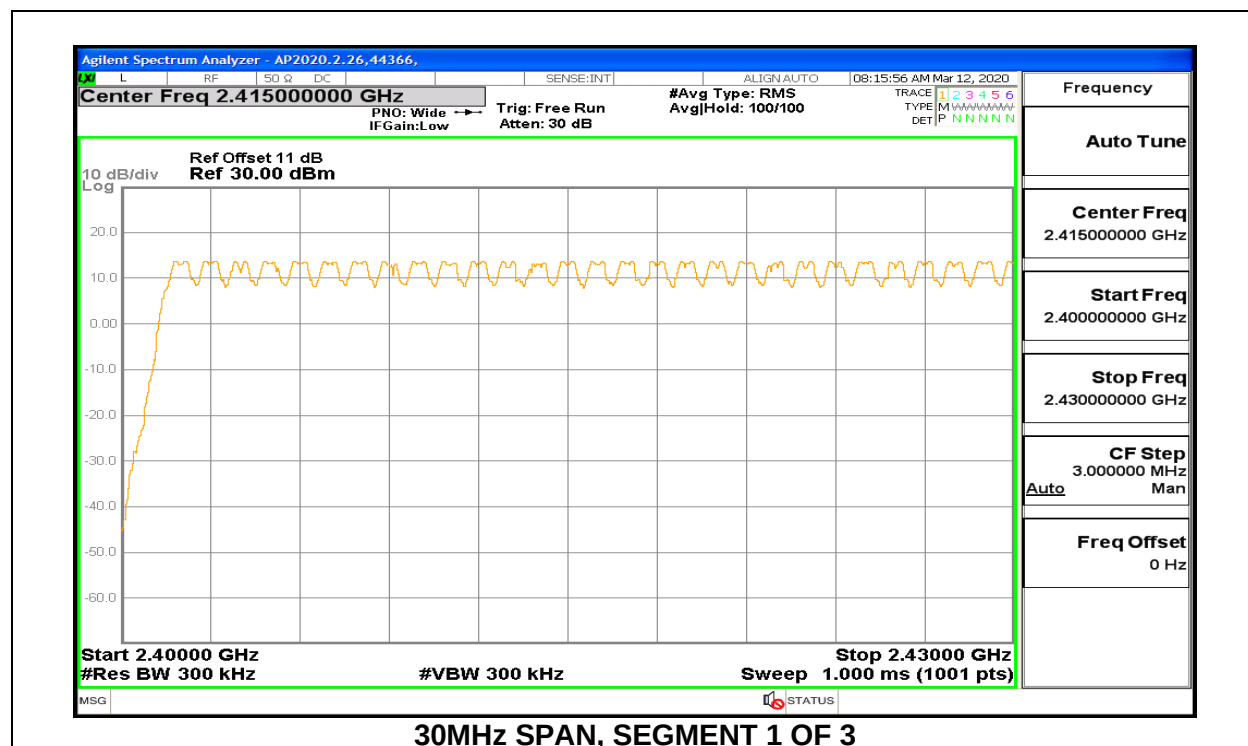
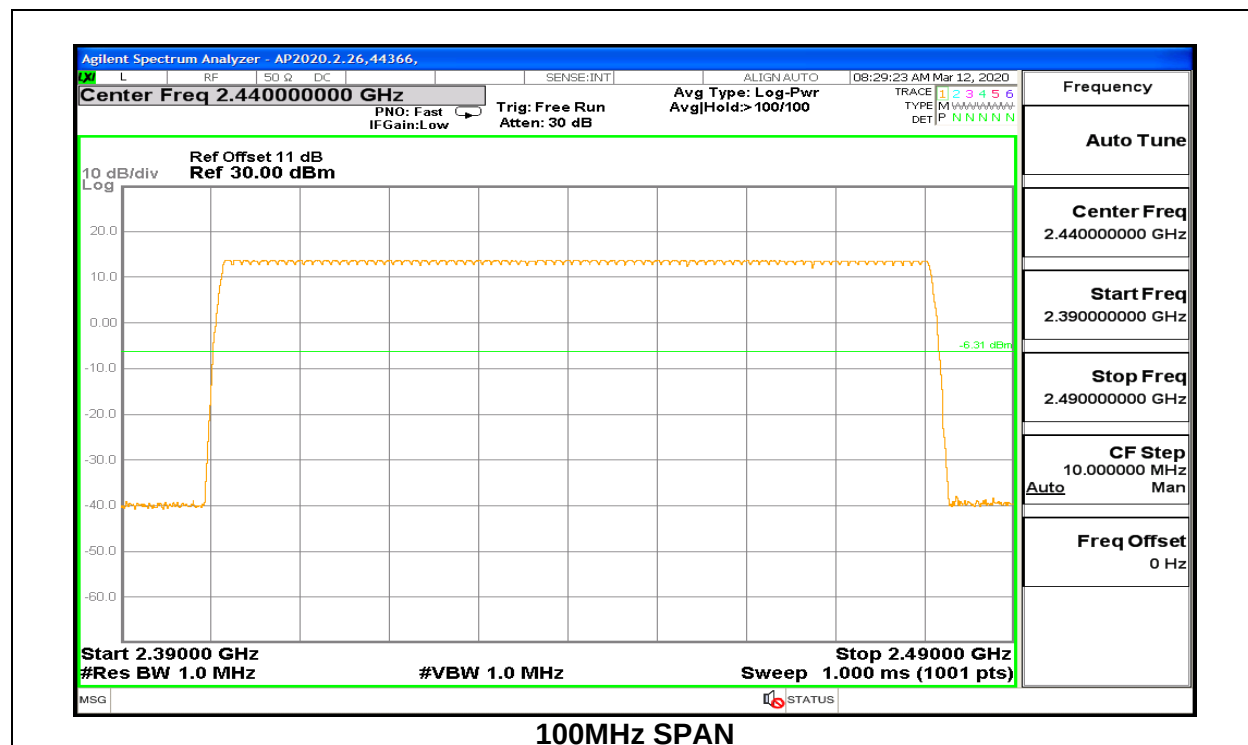
Normal Mode: 79 Channels Observed

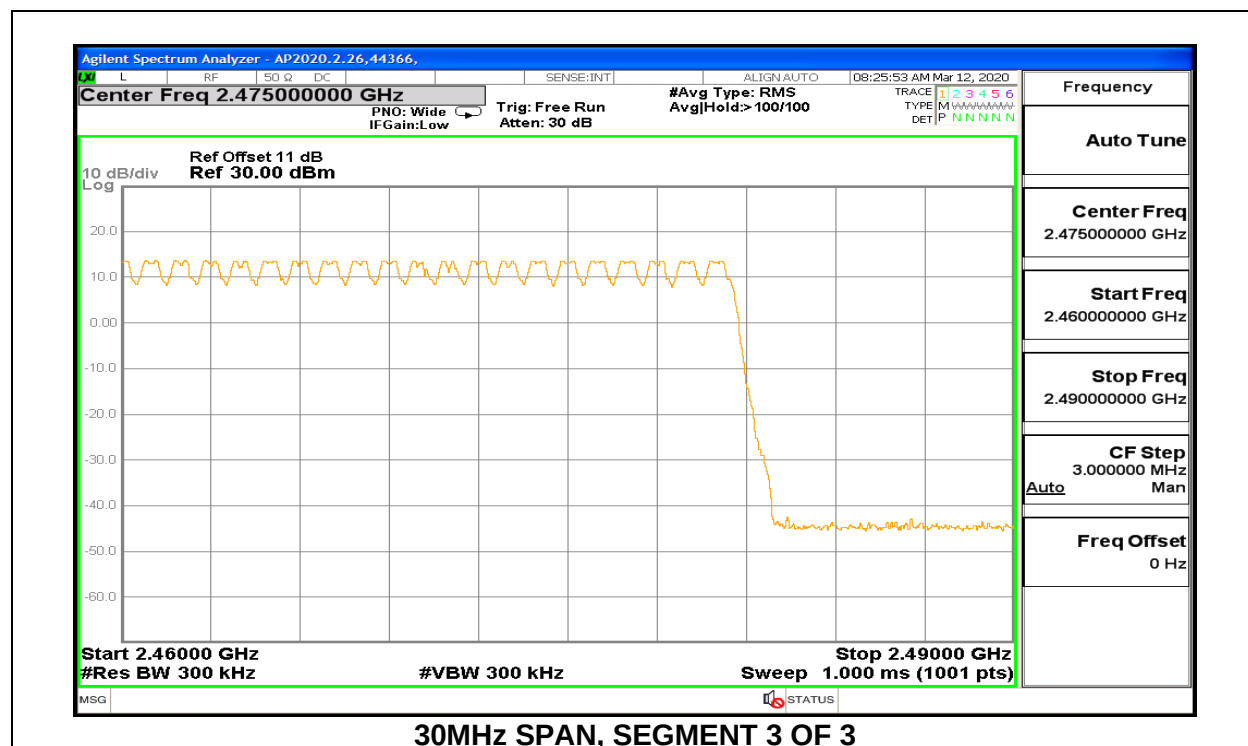
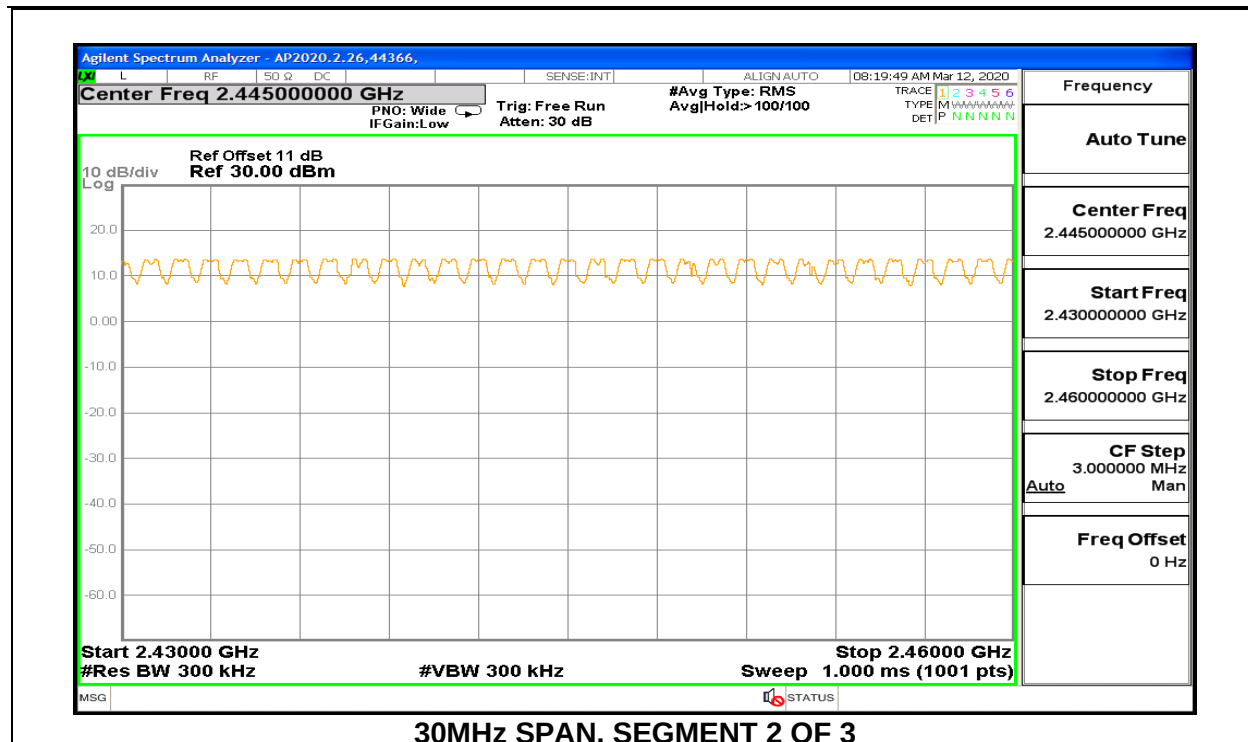
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





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	32	0.1174	0.4	-0.2826
DH3	1.620	15	0.2430	0.4	-0.1570
DH5	2.860	11	0.3146	0.4	-0.0854
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	8	0.02936	0.4	-0.3706
DH3	1.62	3.75	0.06075	0.4	-0.3393
DH5	2.86	2.75	0.07865	0.4	-0.3214



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	0.370	31	0.1147	0.4	-0.2853
3DH3	1.624	15	0.2436	0.4	-0.1564
3DH5	2.864	11	0.31504	0.4	-0.085

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 1.0 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:	44366
Date:	3/13/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.66	21	-8.34
Middle	2441	12.44	21	-8.56
High	2480	12.51	21	-8.49

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	44366
Date:	3/13/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.00	21	-9
Middle	2441	11.81	21	-9.19
High	2480	11.90	21	-9.1

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	44366
Date:	3/13/2020

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.54	21	-8.46
Middle	2441	12.40	21	-8.6
High	2480	12.48	21	-8.52

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 11 dB (including 10 dB pad and 1.0 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:	44366
Date	3/13/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.46
Middle	2441	12.23
High	2480	12.29

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	44366
Date	3/13/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.32
Middle	2441	9.17
High	2480	9.24

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	44366
Date	3/13/2020

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.44
Middle	2441	9.22
High	2480	9.28

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.

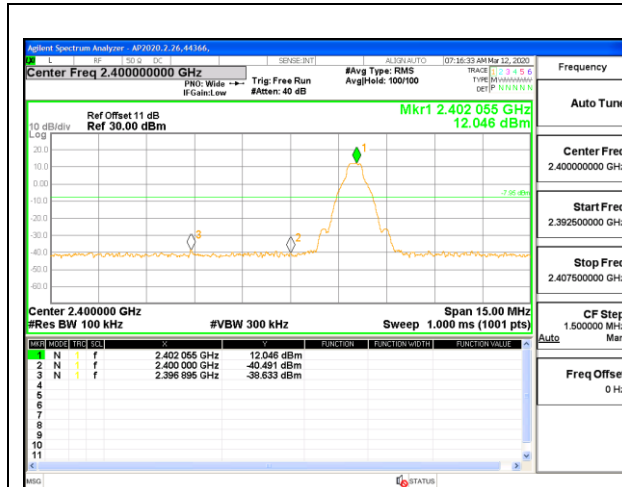
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

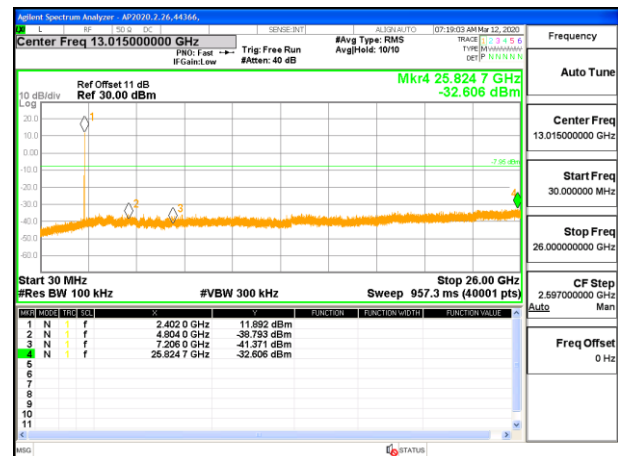
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

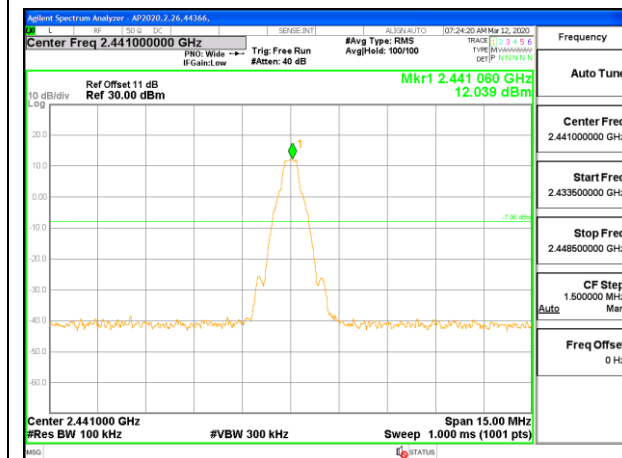
SPURIOUS EMISSIONS, NON-HOPPING



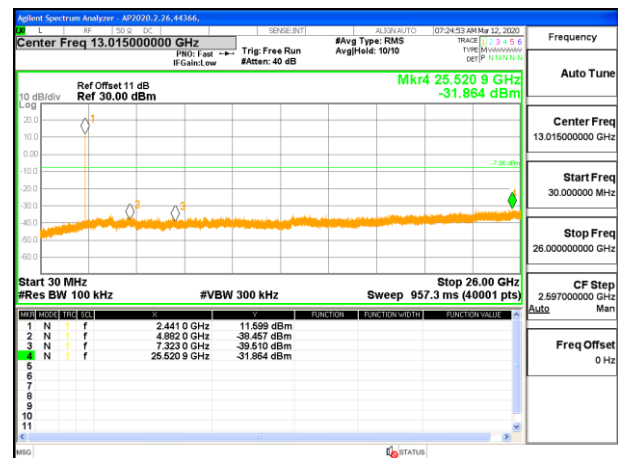
LOW CHANNEL BANDEDGE



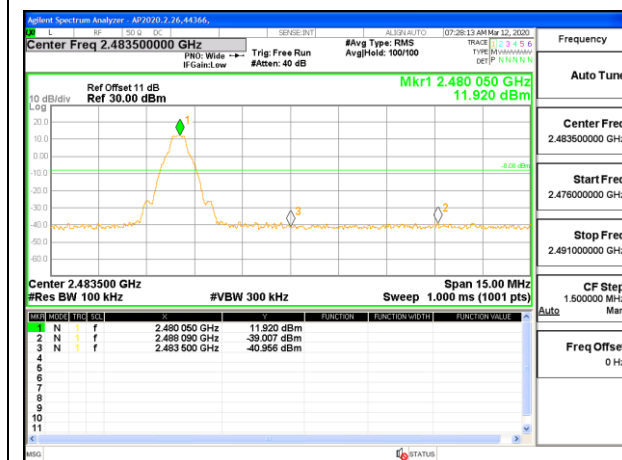
OUT-OF-BAND LOW CHANNEL



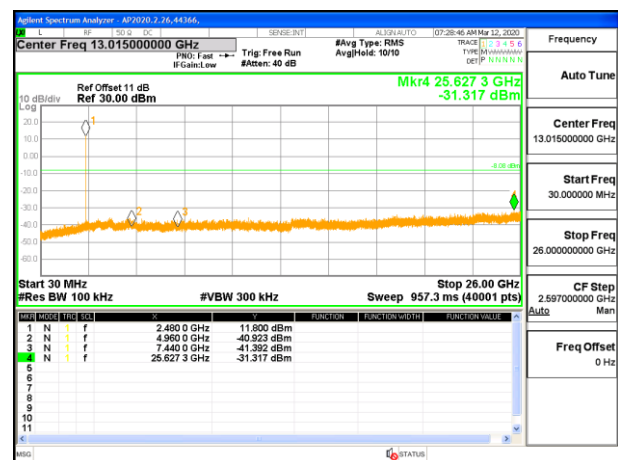
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

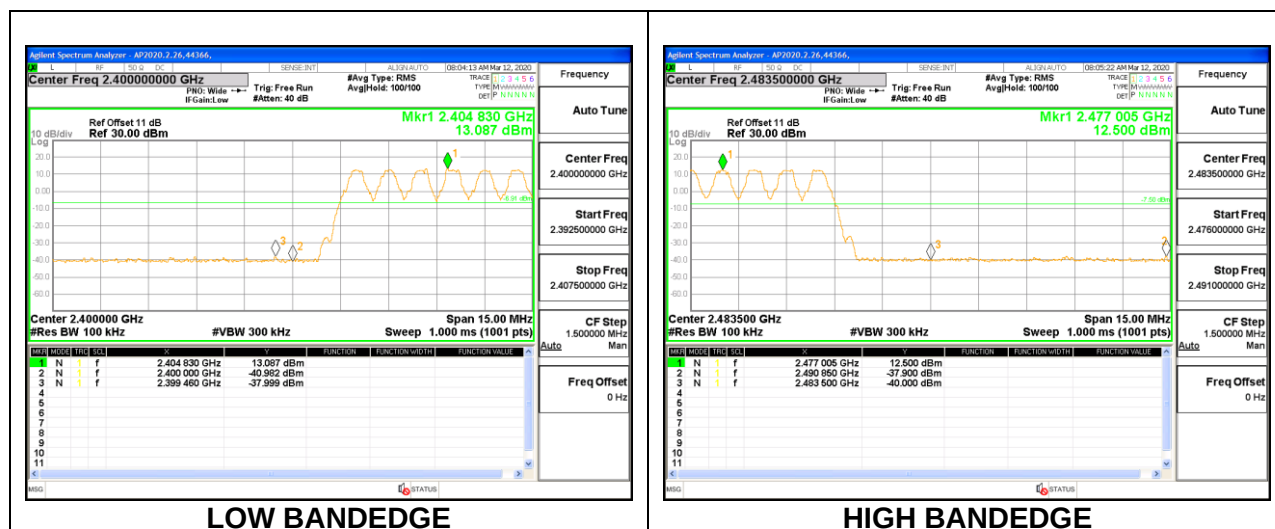


HIGH CHANNEL BANDEDGE



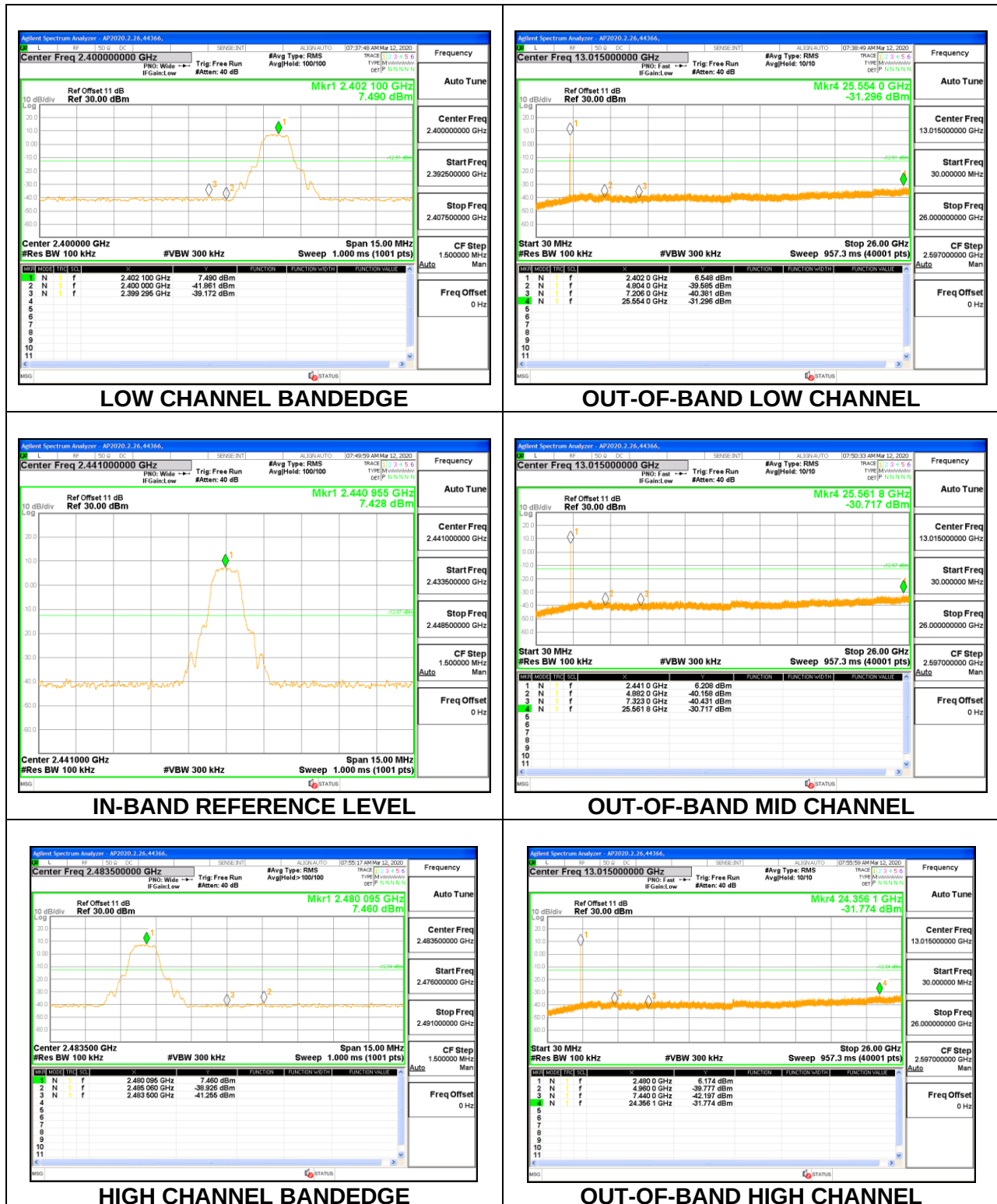
OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

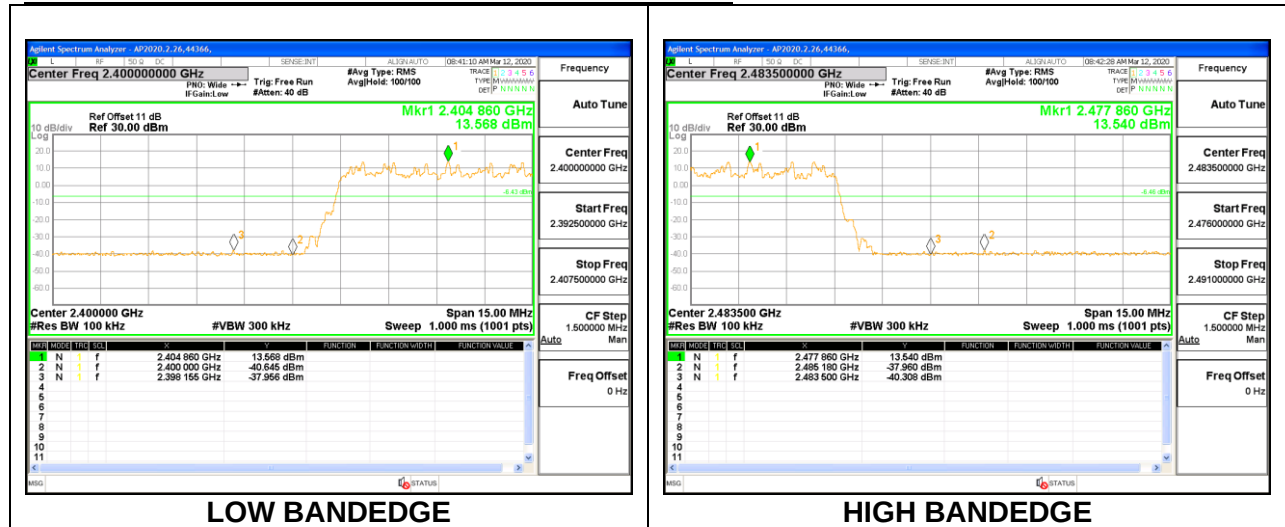


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

SPURIOUS EMISSIONS, NON-HOPPING



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.

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.

For the 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 – 20*log (1/duty cycle), and the 20*log (1/duty cycle) is greater than 20dB

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

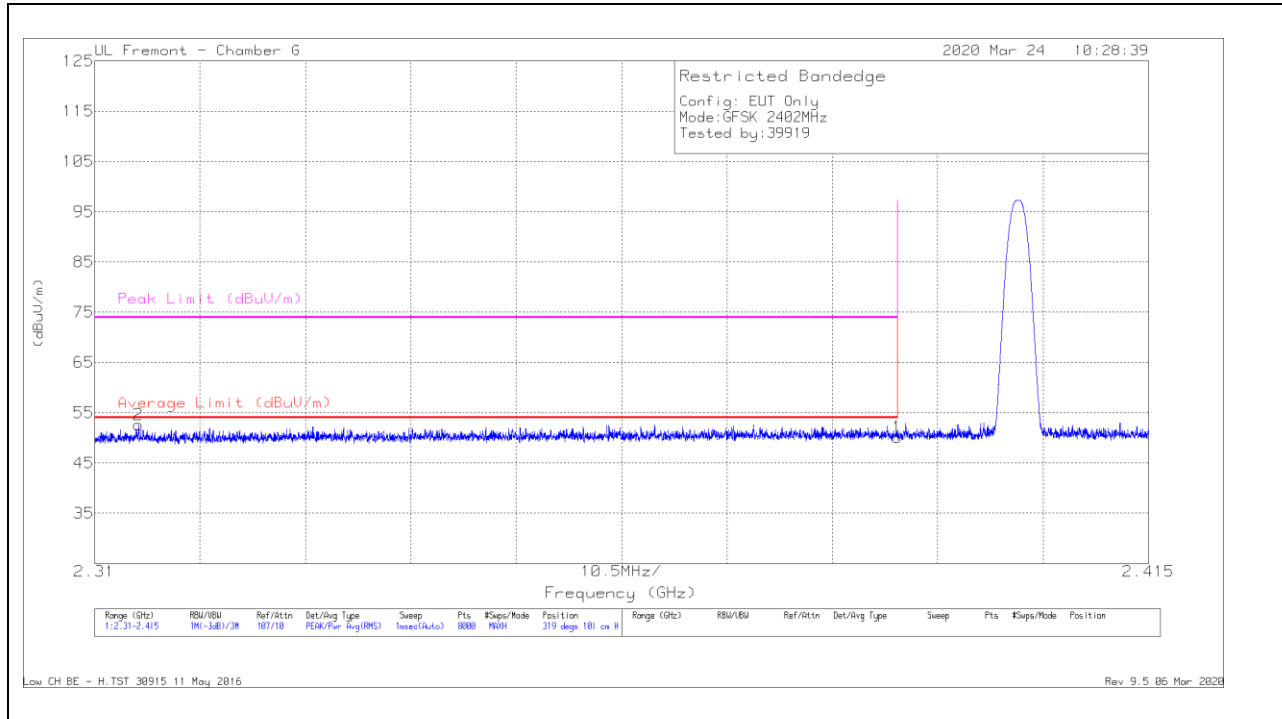
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can 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)

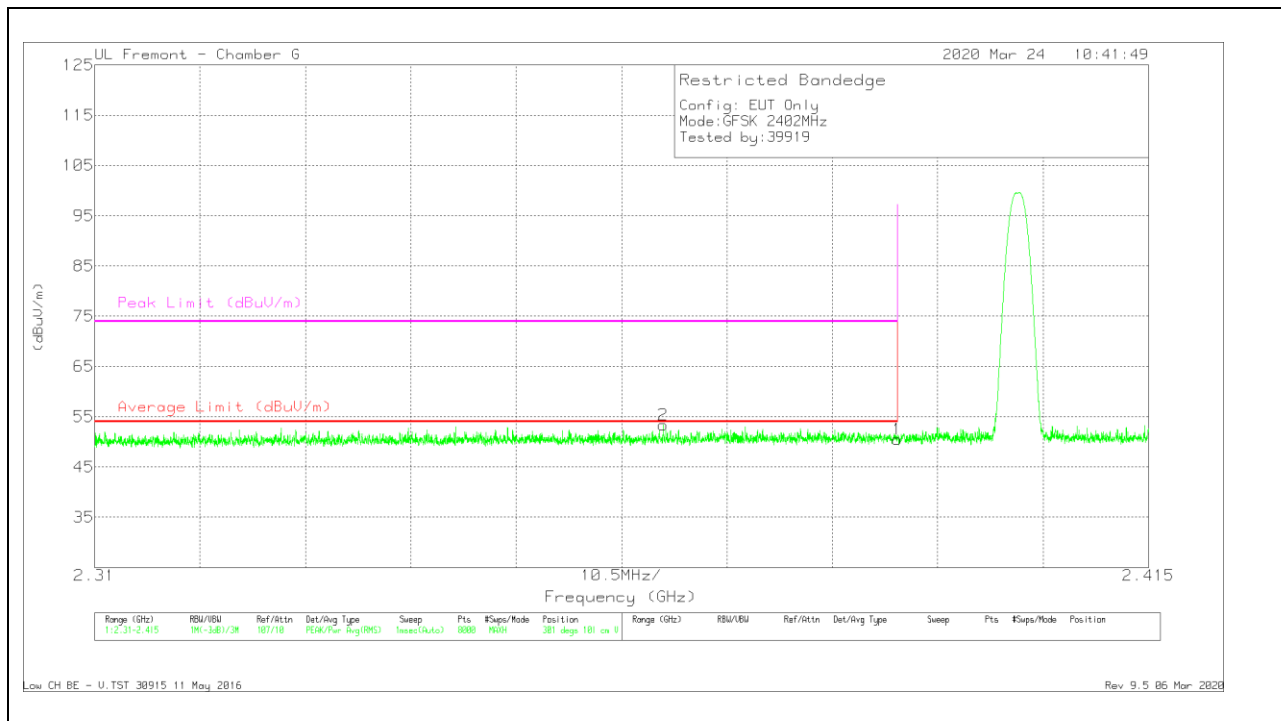
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.39	Pk	31.9	-22.2	50.09	74	-23.91	319	101	H
2	* 2.31437	43.48	Pk	31.5	-22.3	52.68	74	-21.32	319	101	H

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

VERTICAL RESULT

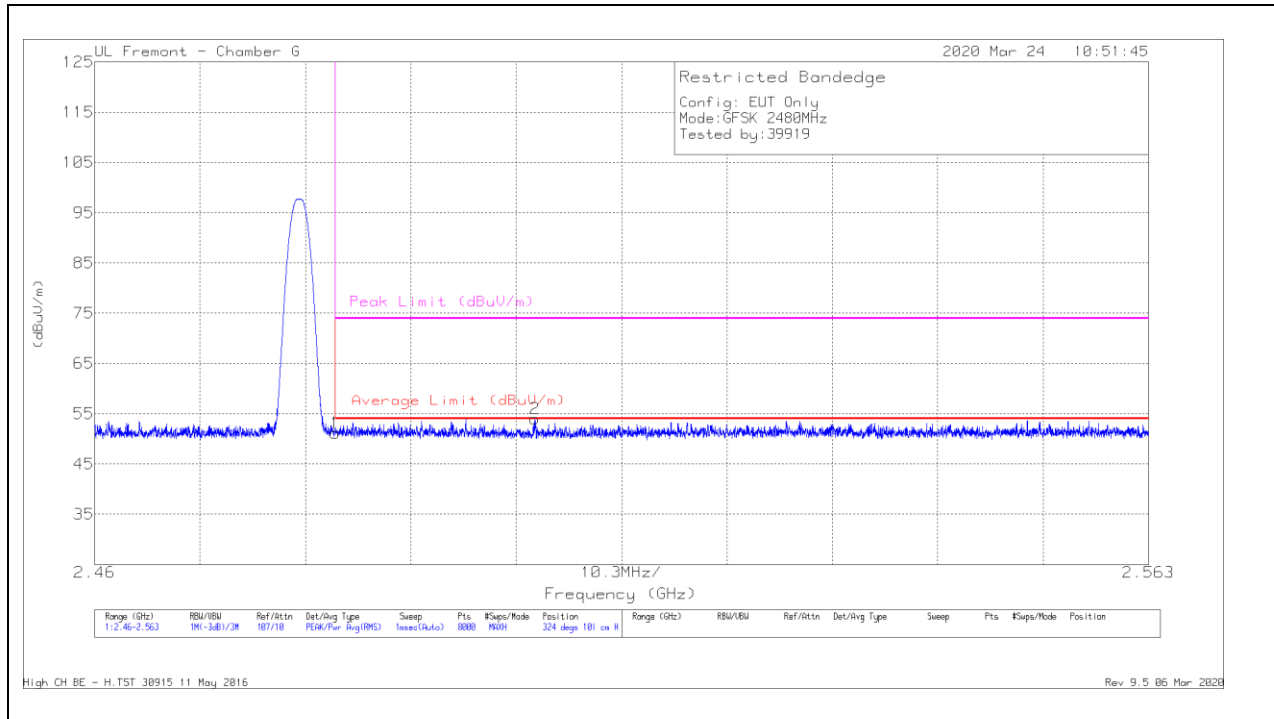


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/CbI/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.77	Pk	31.9	-22.2	50.47	74	-23.53	301	101	V
2	* 2.36664	43.82	Pk	31.8	-22.2	53.42	74	-20.58	301	101	V

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

BANDEDGE (HIGH CHANNEL)

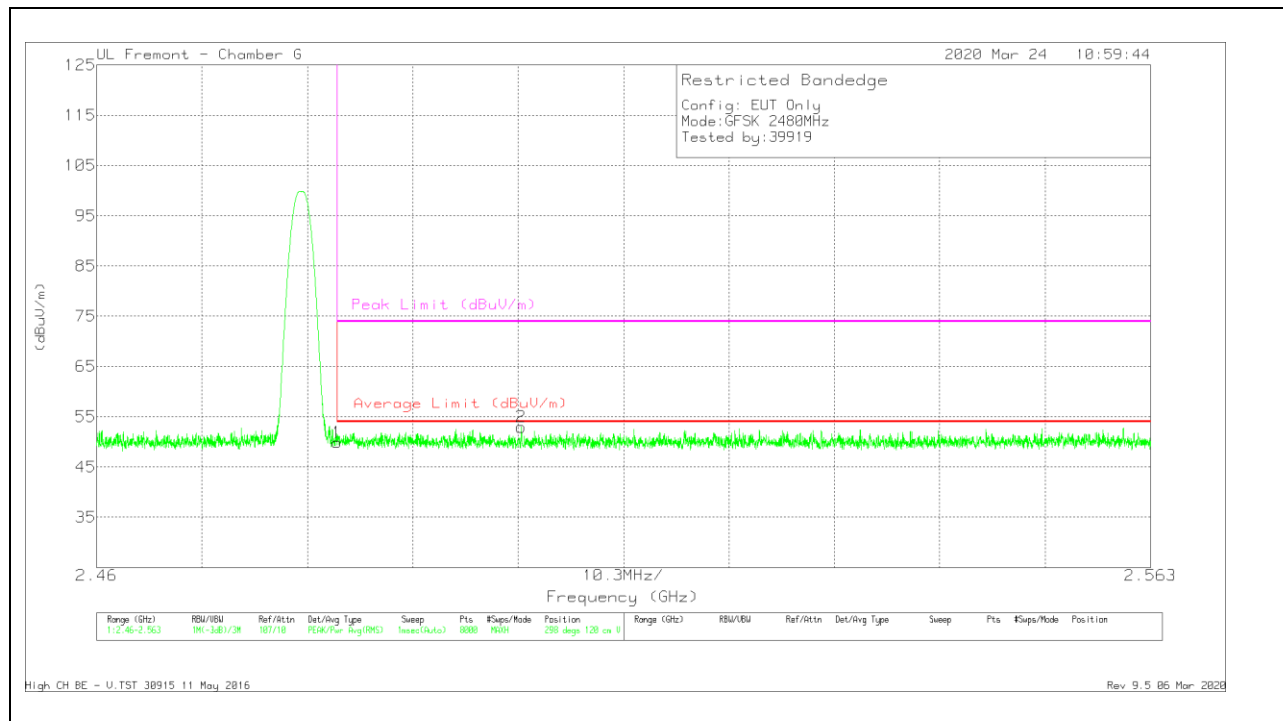
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Ampl/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.75	Pk	32.5	-22.1	51.15	74	-22.85	324	101	H
2	2.50301	43.74	Pk	32.4	-22.2	53.94	74	-20.06	324	101	H

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

VERTICAL RESULT

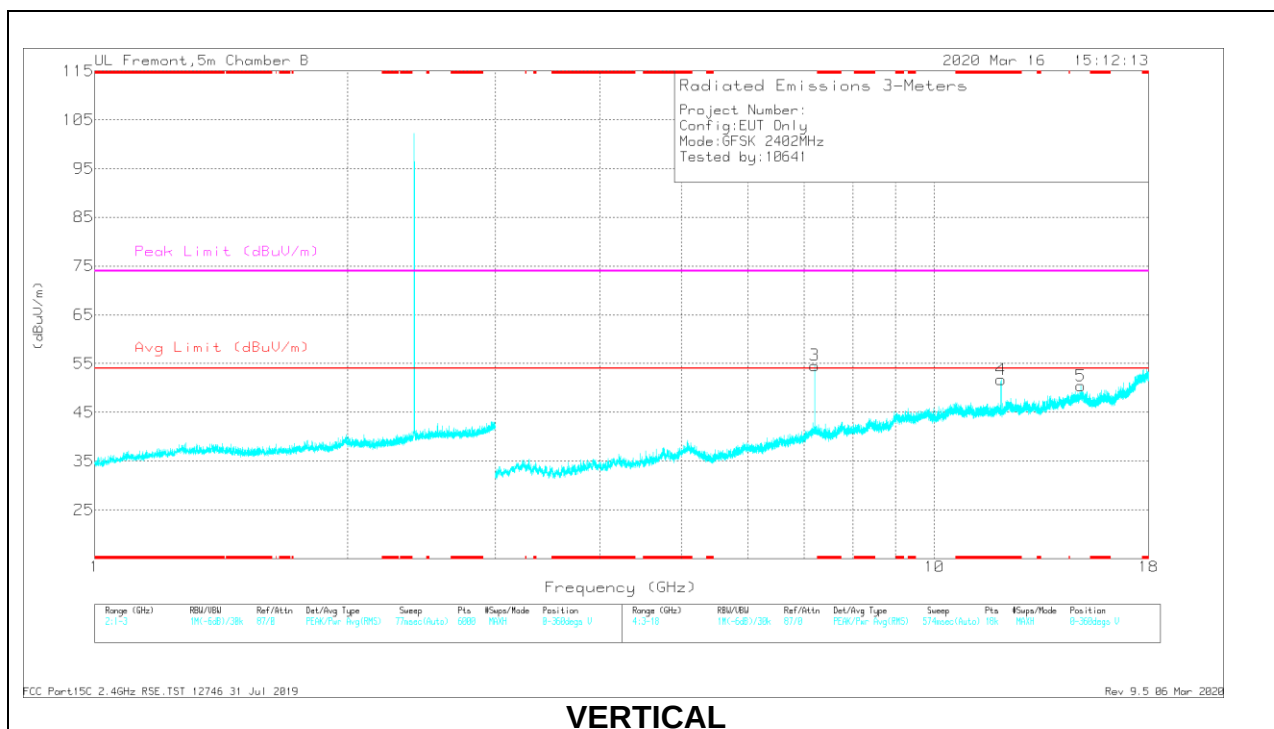
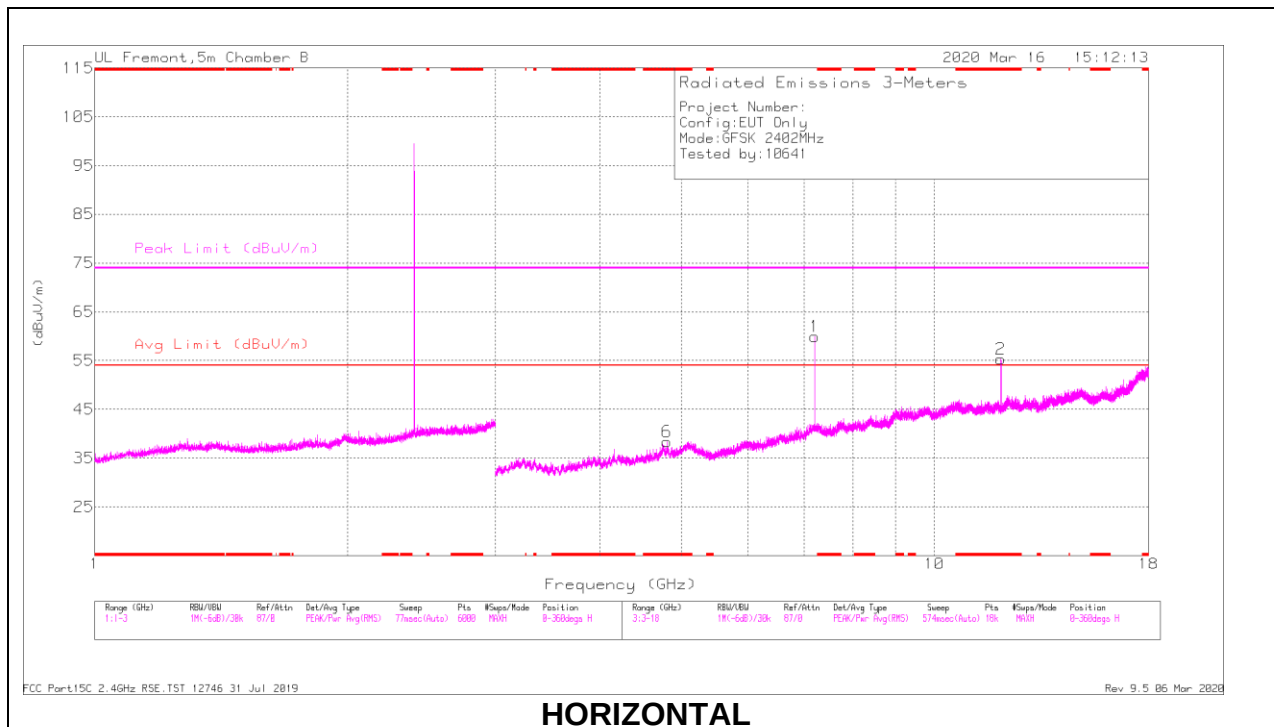


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	39.46	Pk	32.5	-22.1	49.86	74	-24.14	298	120	V
2	2.5015	42.74	Pk	32.4	-22.2	52.94	74	-21.06	298	120	V

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

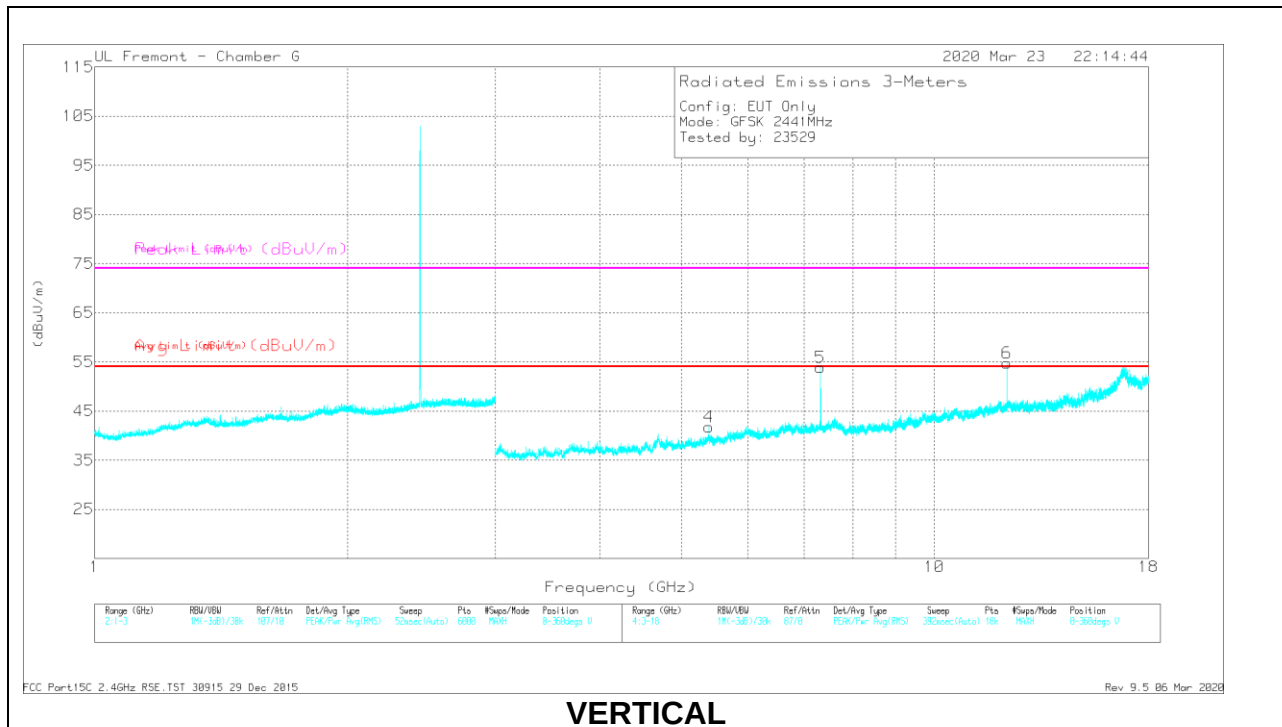
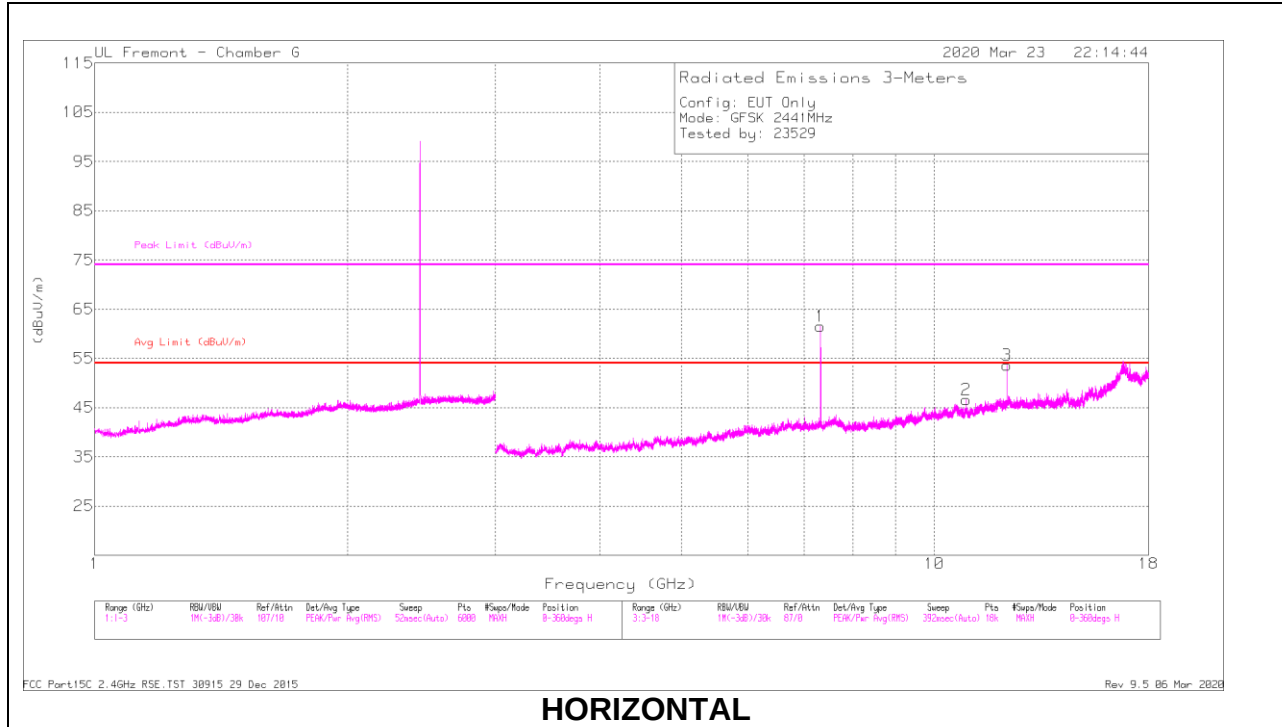
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T962 (dB/m)	Amp/Cbl/Fitr/Pa d (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 12.0108	37.82	PKFH	39.6	-18.2	59.22	74	-14.78	133	101	H
6	* 4.80362	34.58	PKFH	33	-24.5	43.08	74	-30.92	142	213	H
4	* 12.01075	35.54	PKFH	39.6	-18.2	56.94	74	-17.06	3	198	V
3	7.20545	43.09	PKFH	37	-21.7	58.39	74	-15.61	101	398	V
1	7.20558	46.94	PKFH	37	-21.7	62.24	74	-11.74	126	105	H
5	14.95206	31.13	PKFH	42.4	-19.3	54.23	74	-19.77	0	213	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

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

MID CHANNEL RESULTS



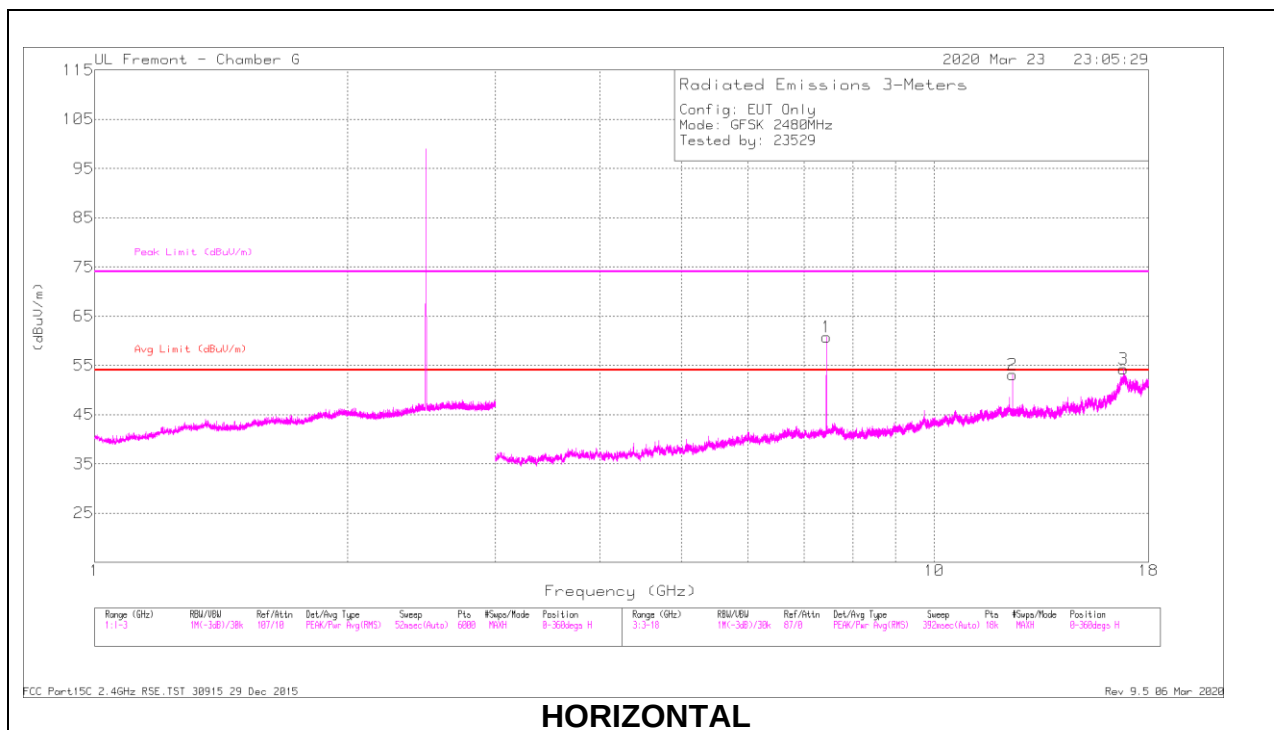
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 7.32339	53.43	PKFH	36.3	-27.6	62.13	74	-11.87	310	110	H
* 10.91571	37.43	PKFH	37.6	-23.1	51.93	74	-22.07	282	200	H
* 12.20577	42.08	PKFH	39	-22.7	58.38	74	-15.62	326	102	H
* 5.39114	39.79	PKFH	34.6	-29	45.39	74	-28.61	278	163	V
* 7.32283	46.87	PKFH	36.3	-27.6	55.57	74	-18.43	0	101	V
* 12.20428	42.33	PKFH	39	-22.8	58.53	74	-15.47	21	105	V

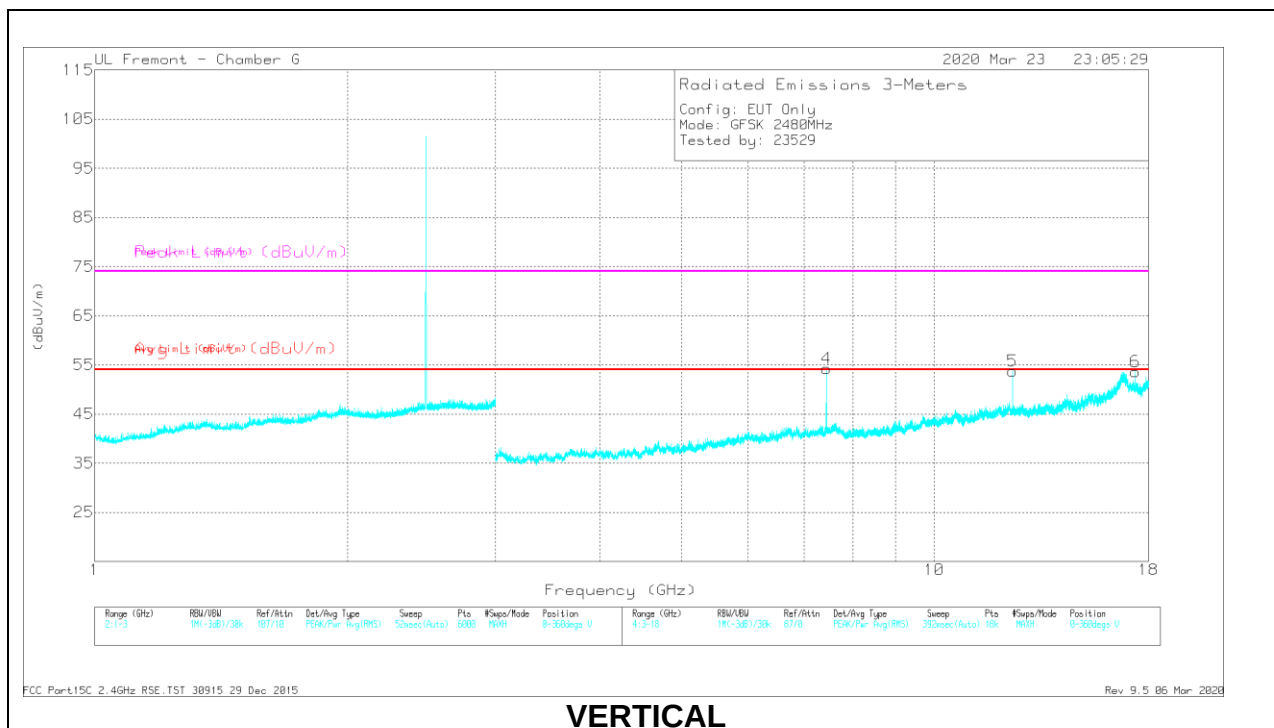
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

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
* 7.44045	53.06	PKFH	36.5	-27.8	61.76	74	-12.24	311	111	H
* 12.40073	42.28	PKFH	39	-23.3	57.98	74	-16.02	329	101	H
* 7.44029	49.09	PKFH	36.5	-27.8	57.79	74	-16.21	246	285	V
* 12.399	42.74	PKFH	39	-23.3	58.44	74	-15.56	15	101	V
16.79675	34.87	PKFH	41.8	-17.5	59.17	-	-	247	178	H
17.36165	34.81	PKFH	41.6	-19.3	57.11	-	-	62	232	V

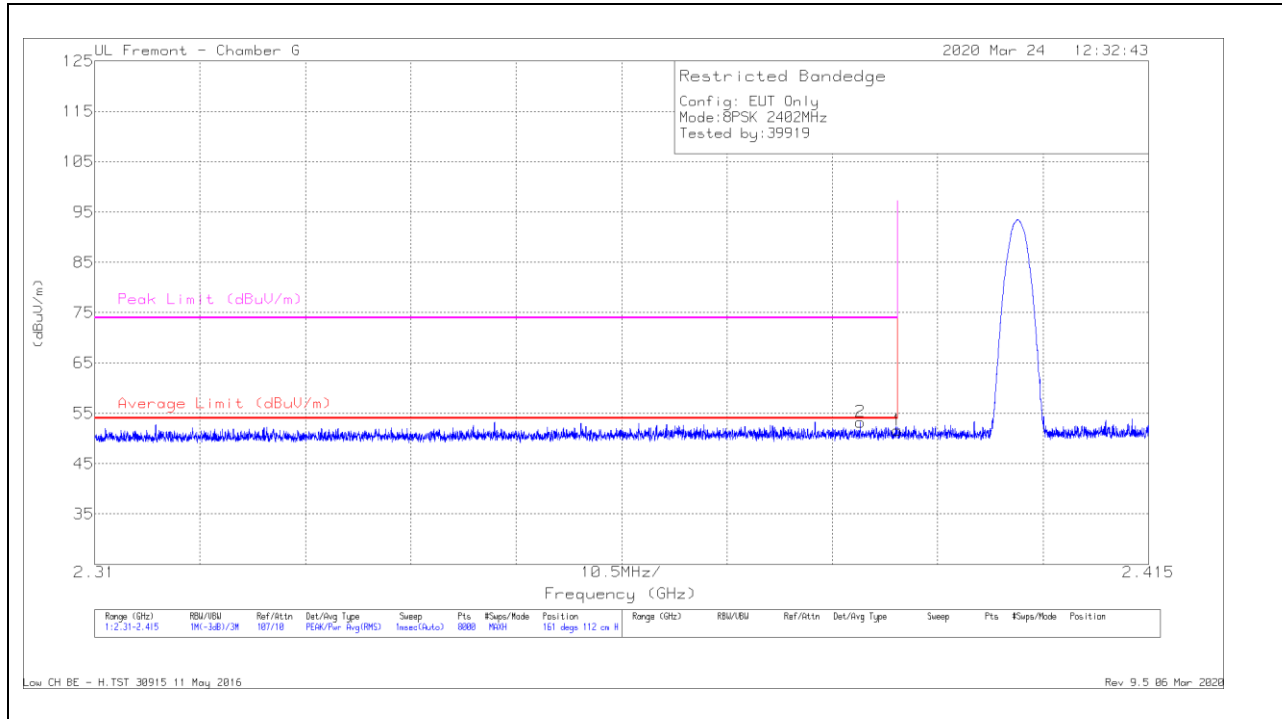
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

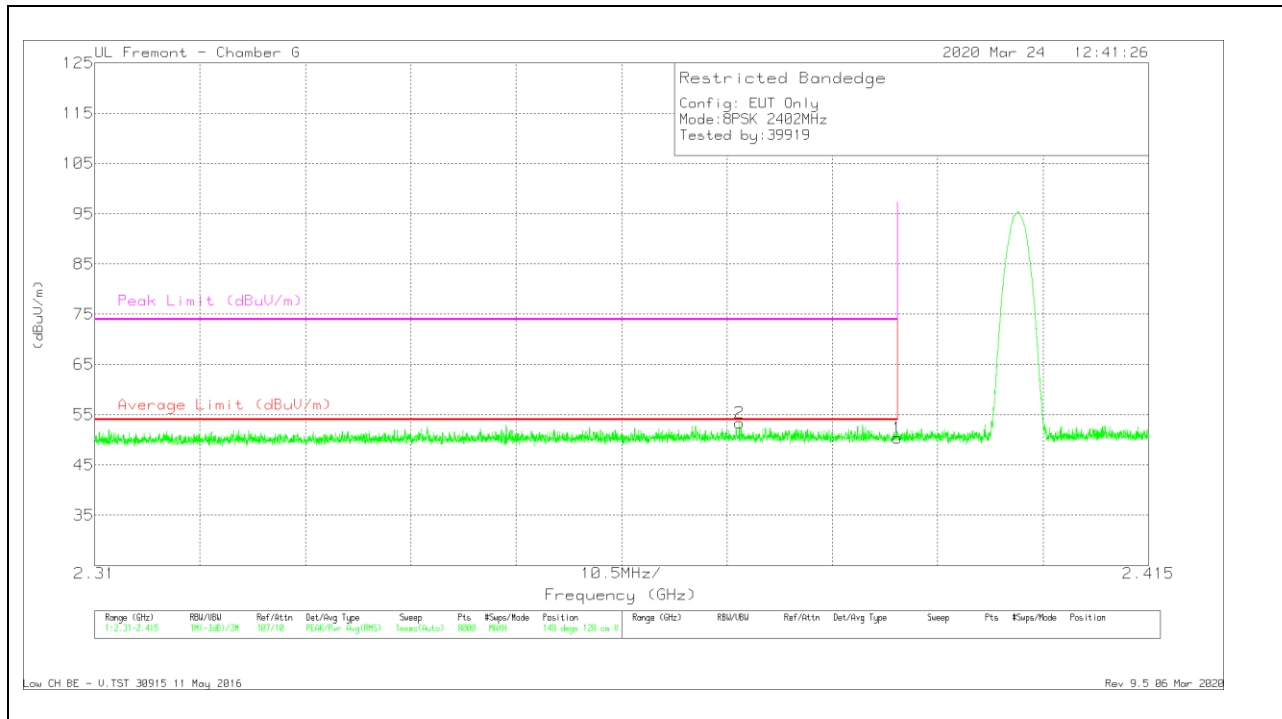
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/CBI/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.91	Pk	31.9	-22.2	51.61	74	-22.39	161	112	H
2	* 2.38629	43.61	Pk	31.9	-22.2	53.31	74	-20.69	161	112	H

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

VERTICAL RESULT

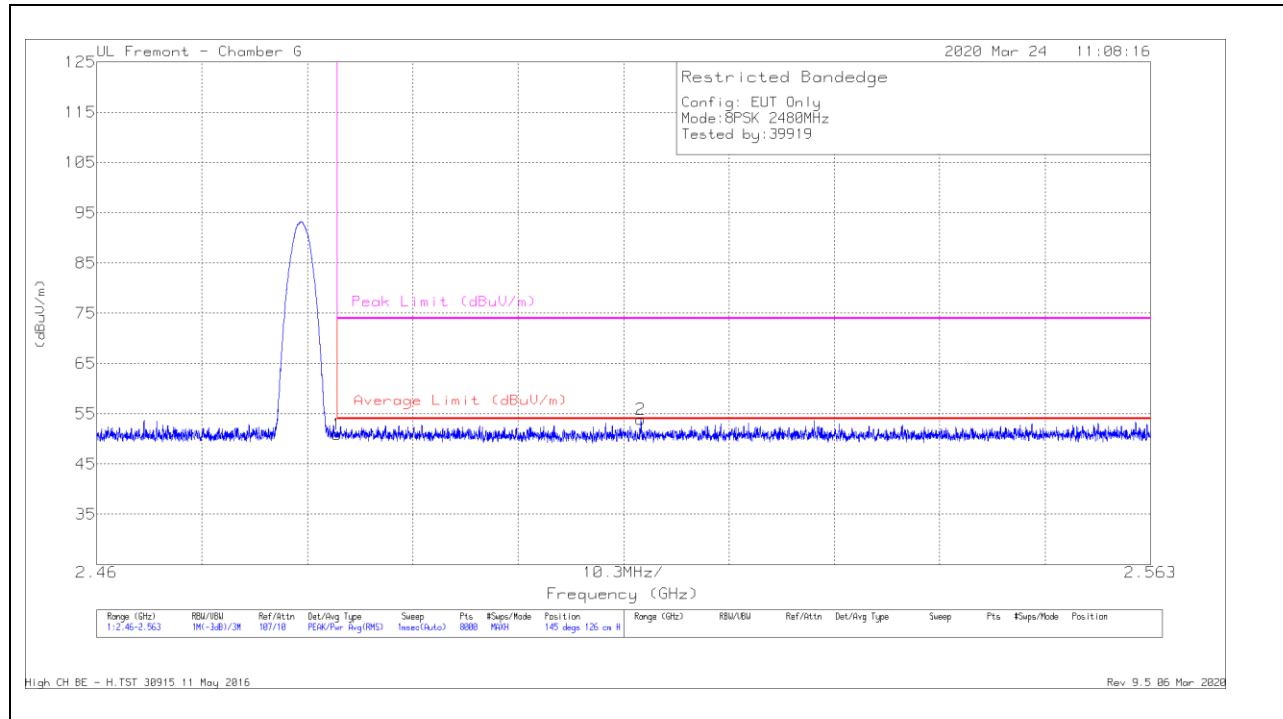


Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	AF T136 (dB/m)	Amp/CbI/Filt/Pad (dB)	Corrected Reading (dBUV/m)	Peak Limit (dBUV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.72	Pk	31.9	-22.2	50.42	74	-23.58	148	128	V
2	* 2.37424	43.62	Pk	31.9	-22.2	53.32	74	-20.68	148	128	V

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

BANDEDGE (HIGH CHANNEL)

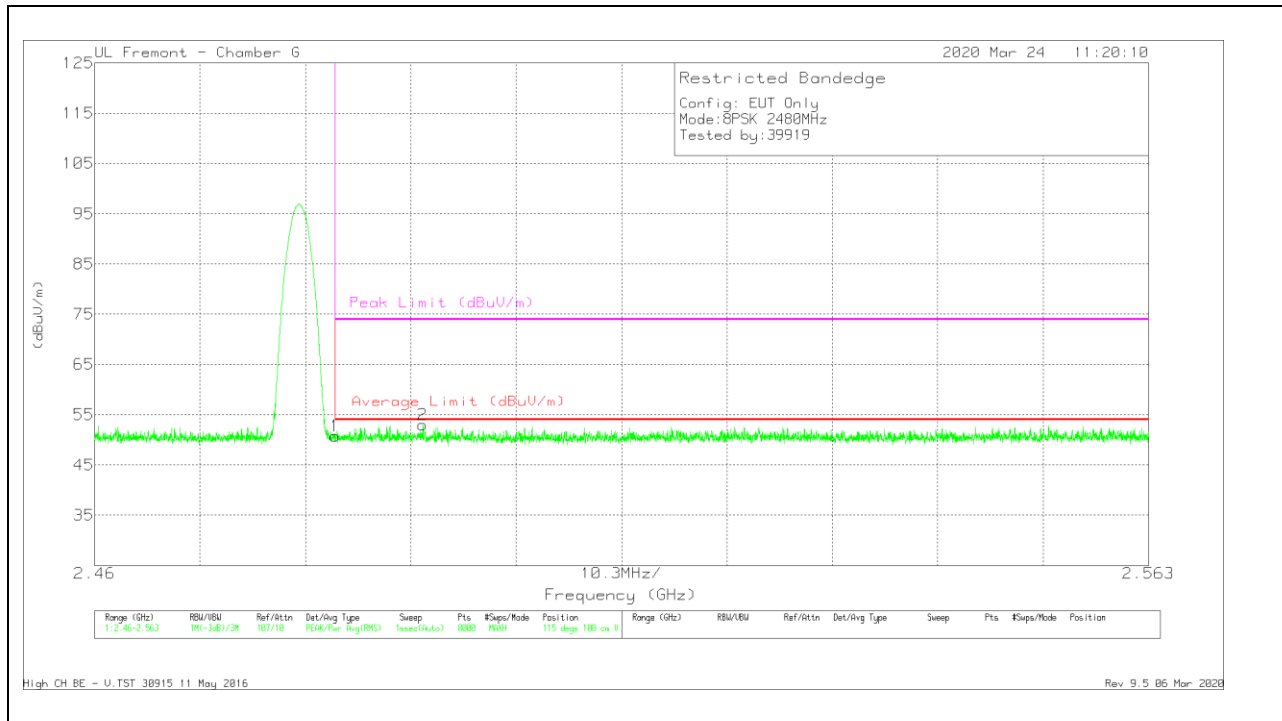
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.46	Pk	32.5	-22.1	50.86	74	-23.14	145	126	H
2	2.51319	43.7	Pk	32.4	-22.2	53.9	74	-20.1	145	126	H

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

VERTICAL RESULT

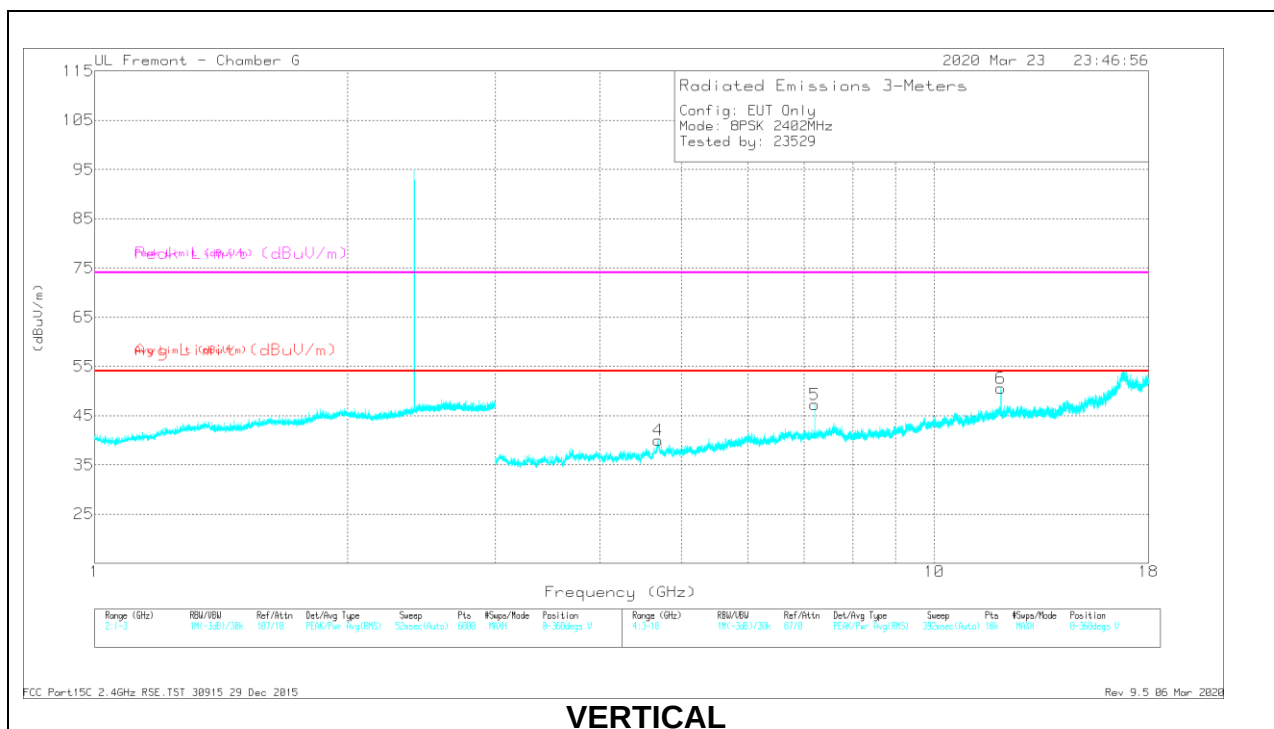
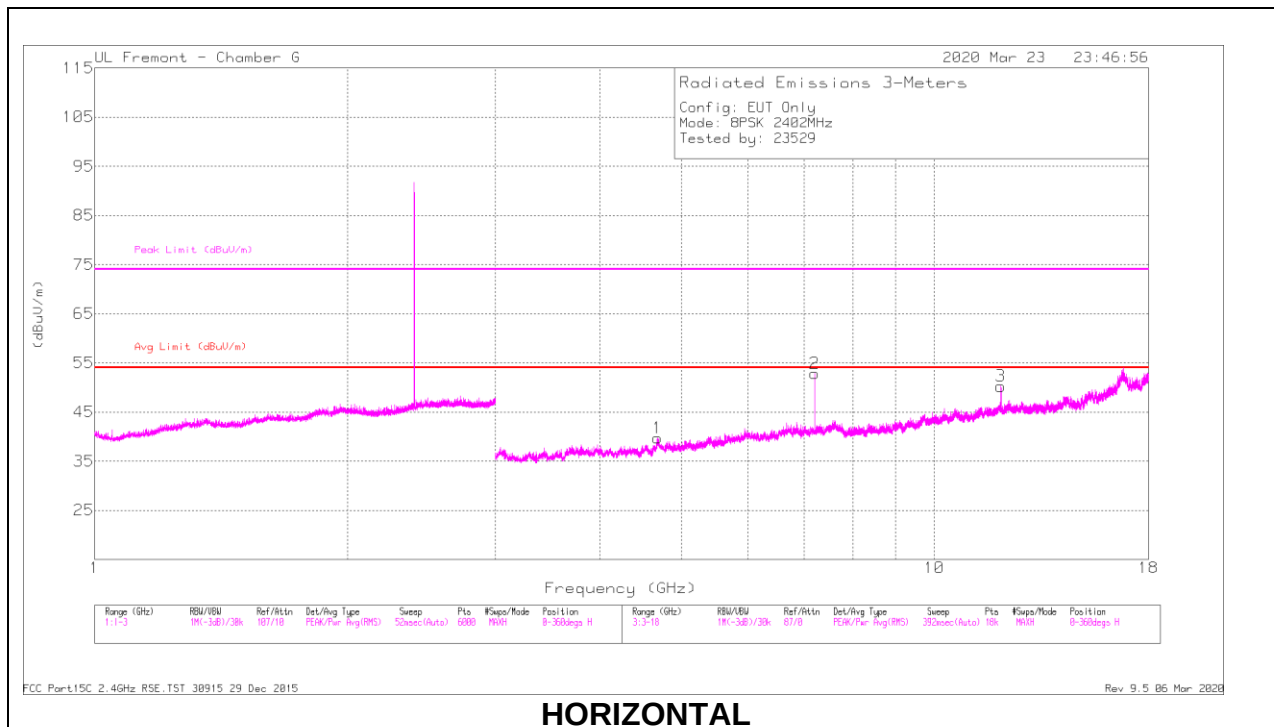


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dBm)	Amp/CbI/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.34	Pk	32.5	-22.1	50.74	74	-23.26	115	108	V
2	* 2.49209	42.69	Pk	32.5	-22.2	52.99	74	-21.01	115	108	V

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



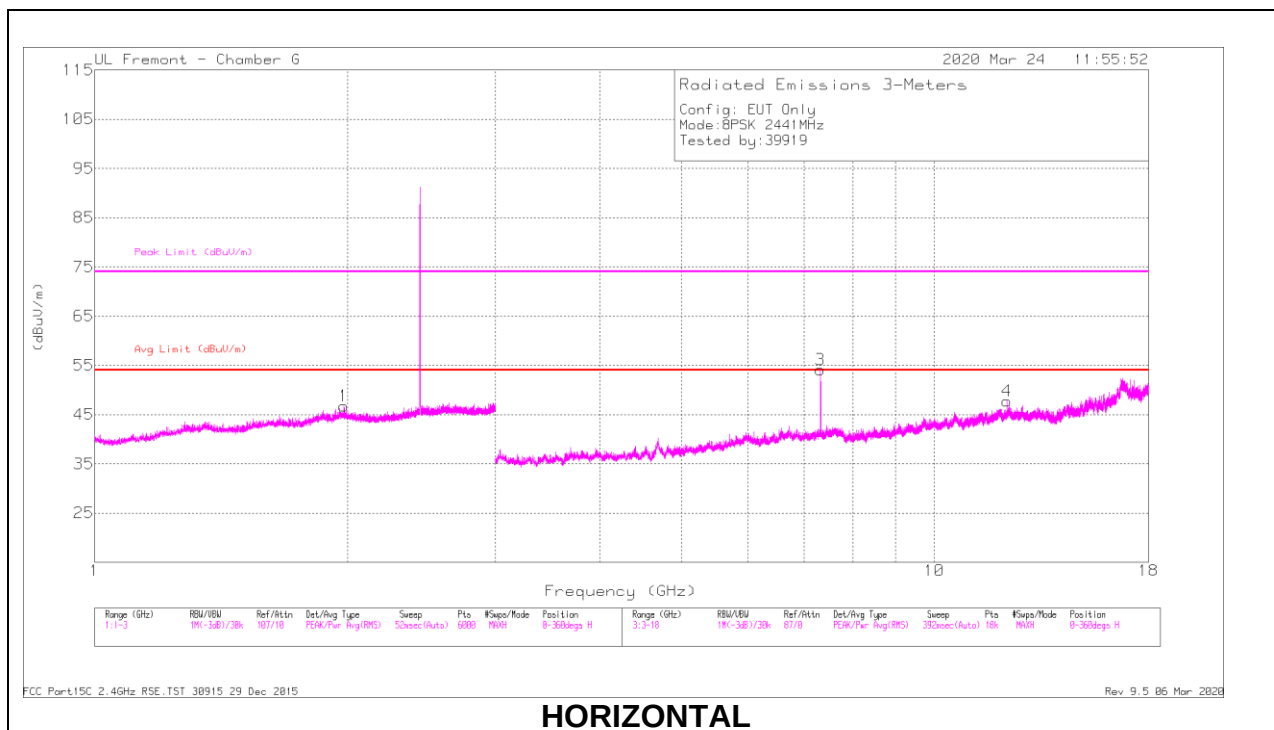
RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 4.68784	40.56	PKFH	34	-29.6	44.96	74	-29.04	133	240	H
* 12.00947	40.66	PKFH	38.8	-22.4	57.06	74	-16.94	328	107	H
* 4.69085	40.65	PKFH	34	-29.6	45.05	74	-28.95	246	209	V
* 12.00951	41.11	PKFH	38.8	-22.4	57.51	74	-16.49	29	101	V
7.206	48.51	PKFH	36.3	-27.7	57.11	-	-	291	121	H
7.20616	43.86	PKFH	36.3	-27.7	52.46	-	-	0	111	V

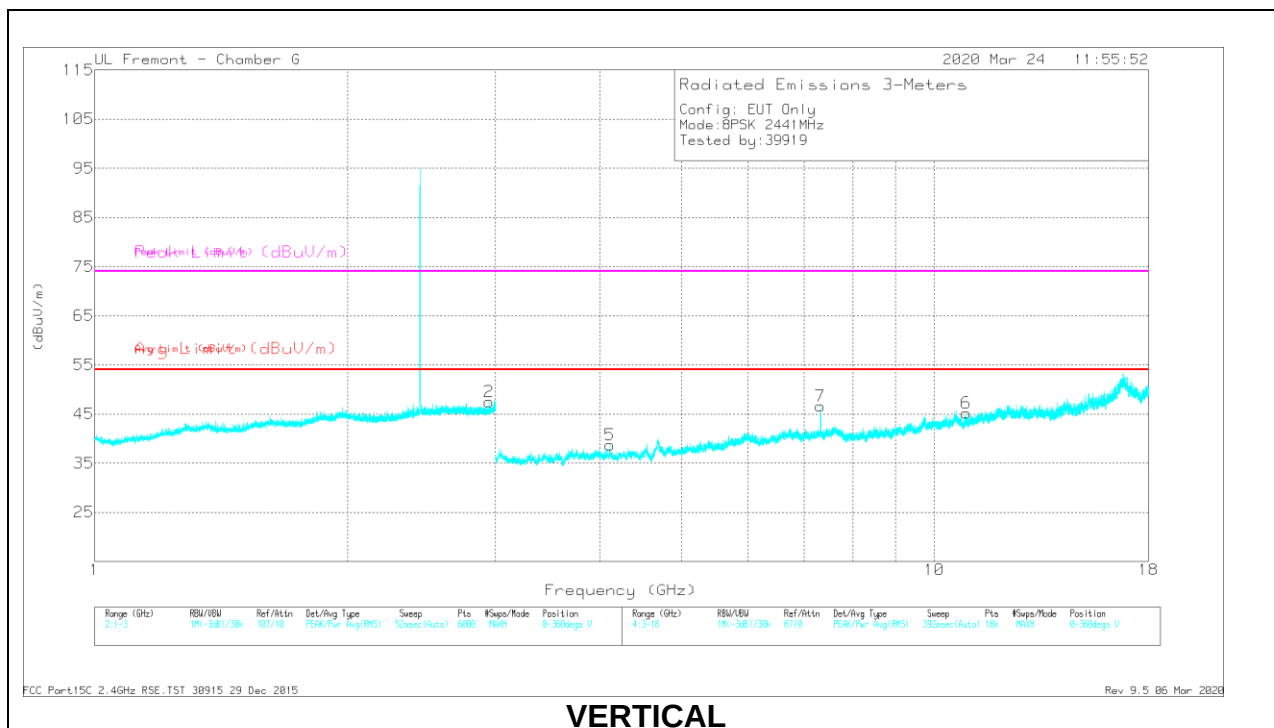
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

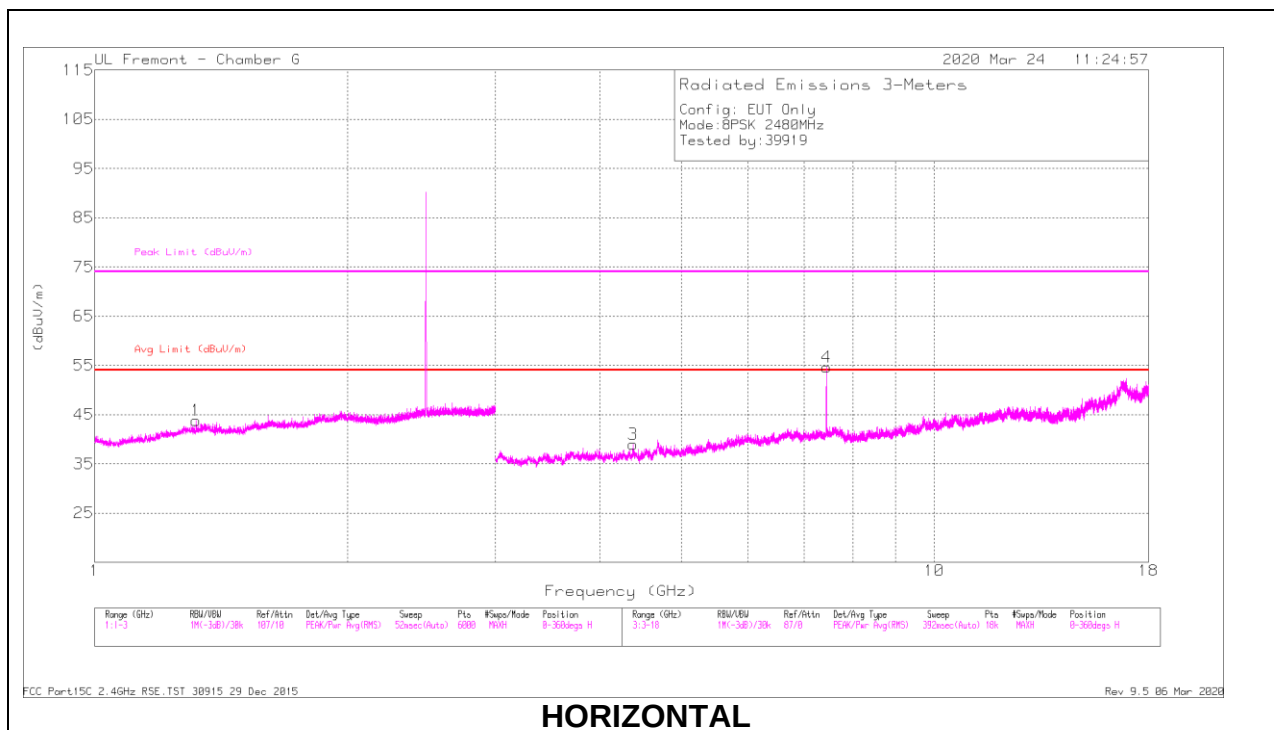
RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 7.32299	49.34	PKFH	36.3	-27.6	58.04	74	-15.96	287	229	H
4	* 12.20494	39.47	PKFH	39	-22.7	55.77	74	-18.23	302	182	H
5	* 4.11045	40.08	PKFH	33.1	-30.1	43.08	74	-30.92	282	122	V
6	* 10.91057	36.44	PKFH	37.6	-23	51.04	74	-22.96	252	183	V
7	* 7.32262	43.25	PKFH	36.3	-27.6	51.95	74	-22.05	260	393	V
1	1.97841	42.77	PKFH	32	-22.7	52.07	74	-21.93	46	108	H
2	2.95074	42.33	PKFH	32.4	-21.6	53.13	74	-20.87	145	208	V

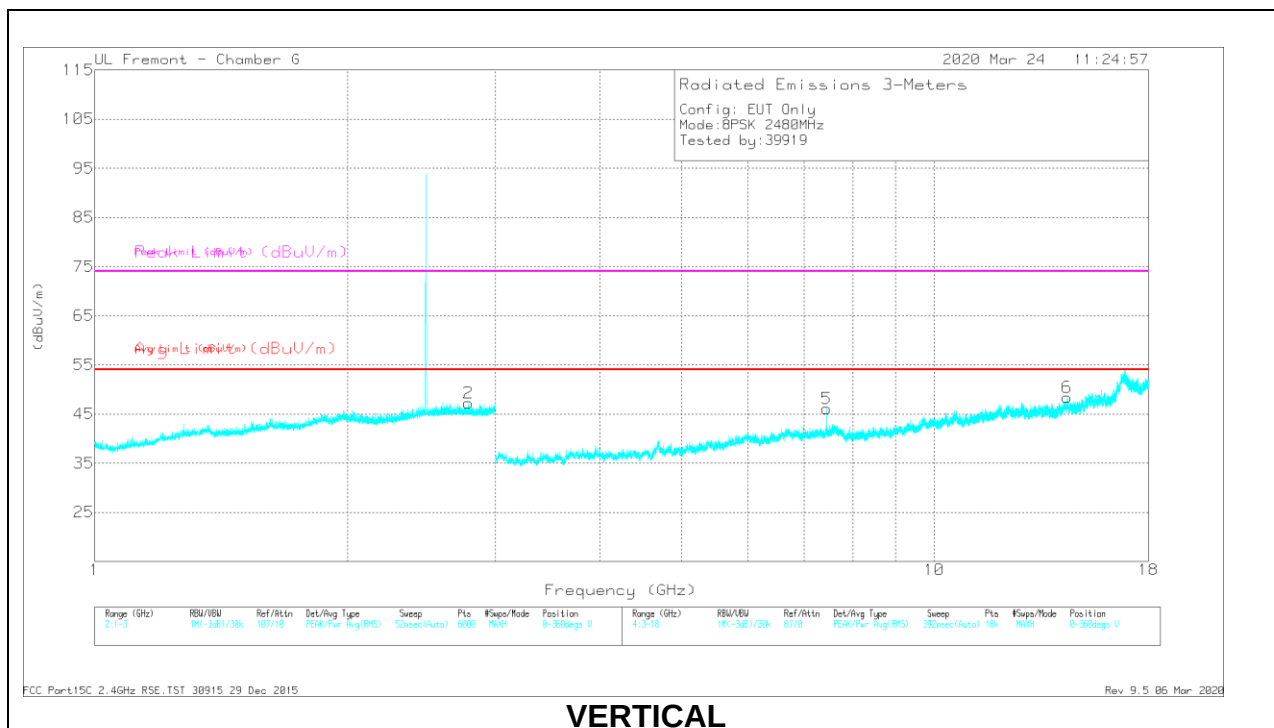
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

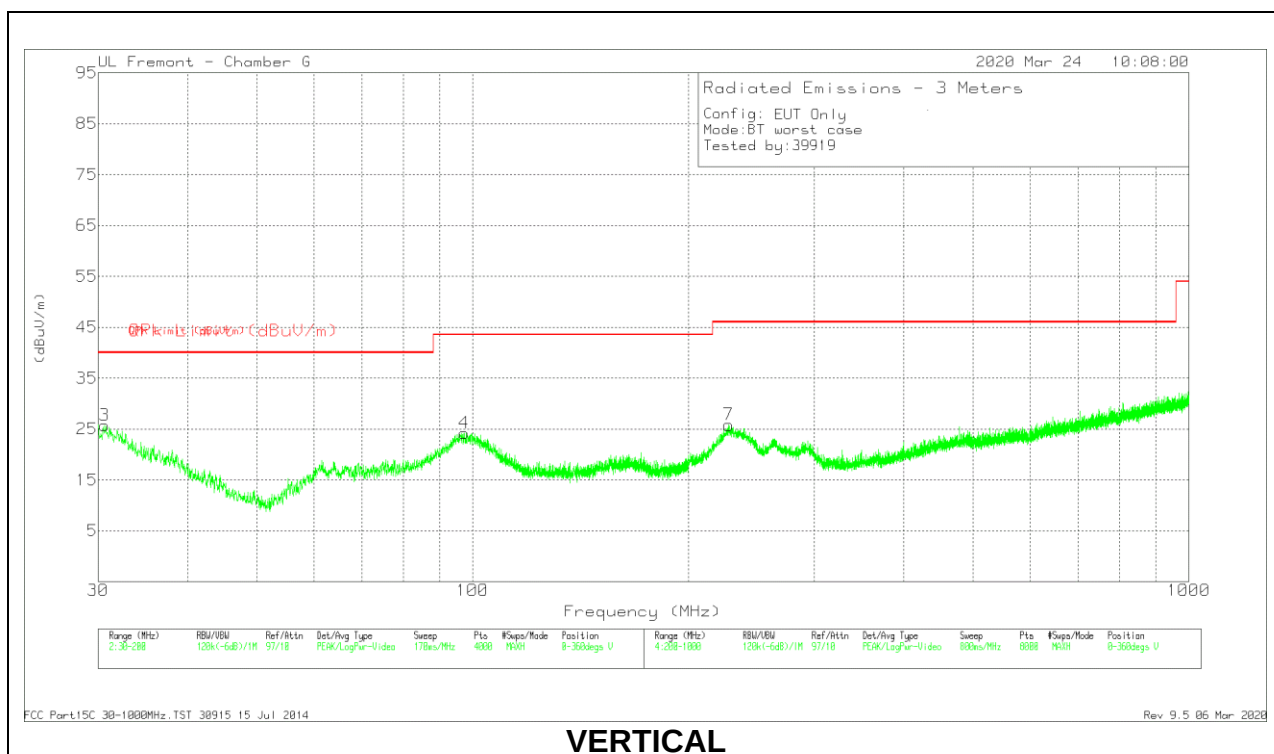
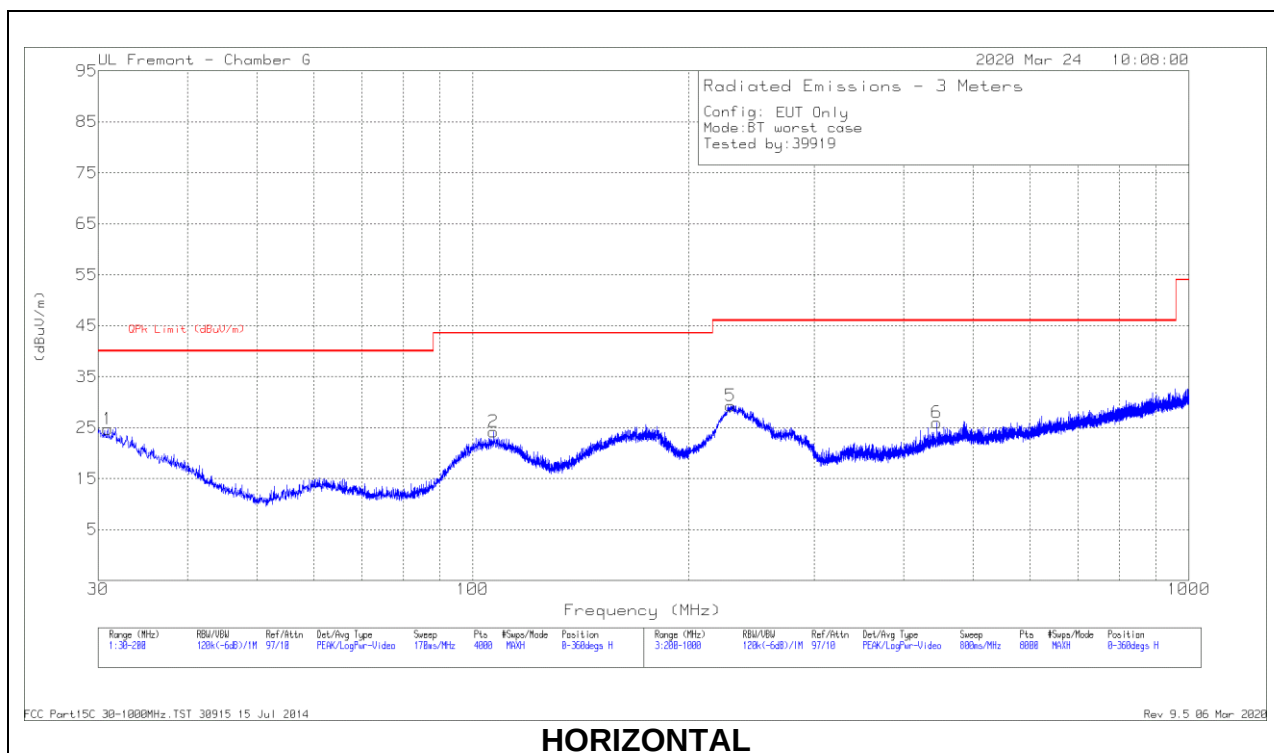
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T136 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.32143	42.93	PKFH	29.5	-23.5	48.93	74	-25.07	69	116	H
2	* 2.78961	42.42	PKFH	32.4	-22	52.82	74	-21.18	117	162	V
3	* 4.38115	39.86	PKFH	33.6	-29.7	43.76	74	-30.24	84	220	H
4	* 7.43999	49.97	PKFH	36.5	-27.8	58.67	74	-15.33	293	218	H
5	* 7.44095	41.7	PKFH	36.5	-27.8	50.4	74	-23.6	3	102	V
6	14.39759	36.01	PKFH	39.6	-22.9	52.71	74	-21.29	51	125	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)



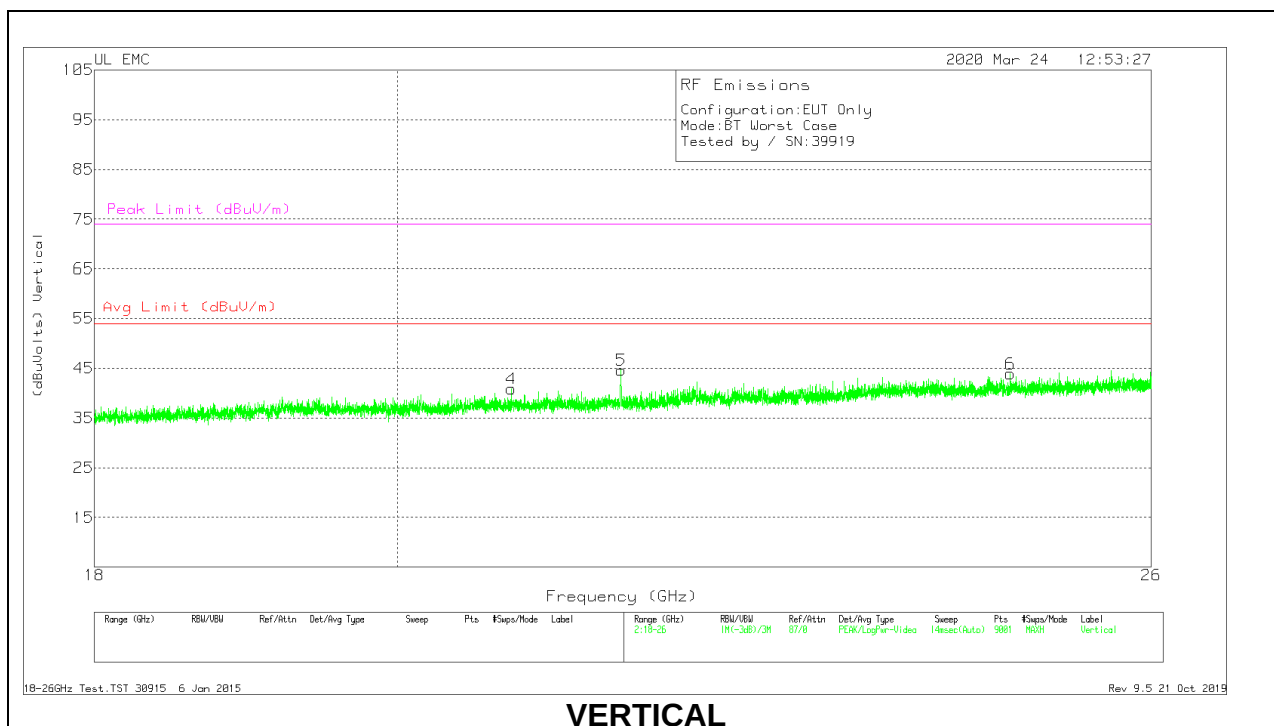
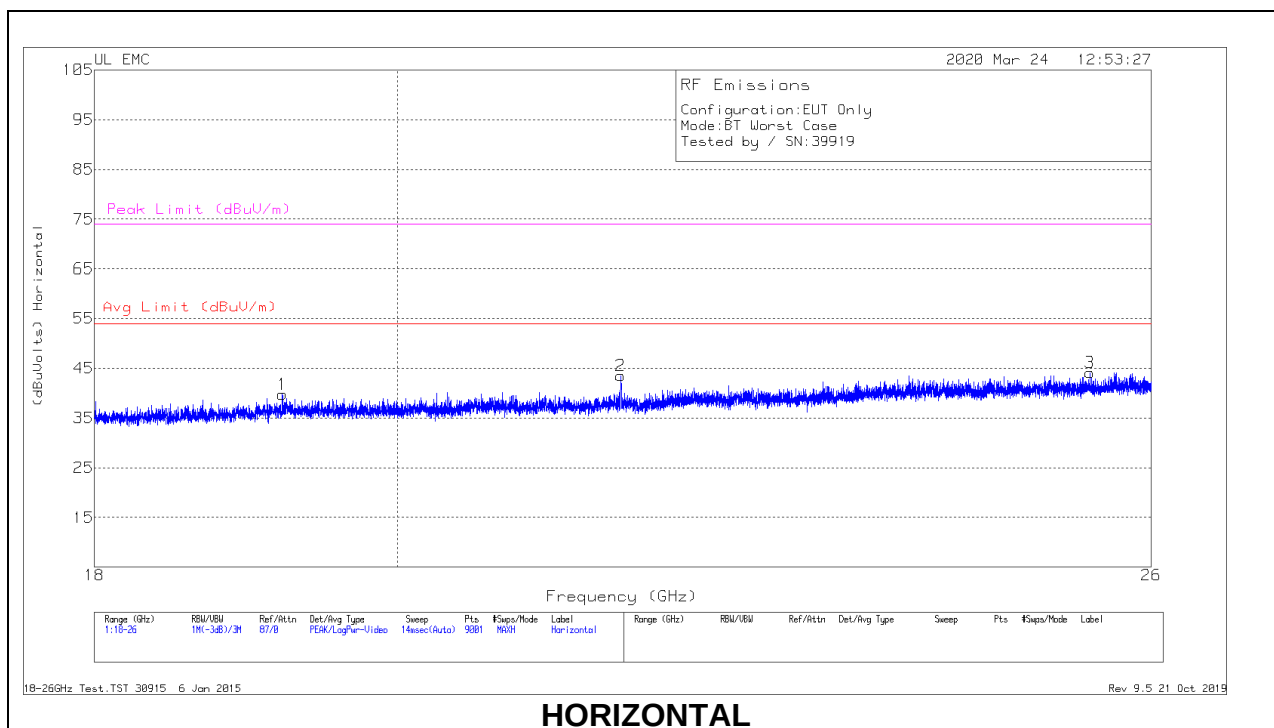
Below 1GHz Data

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
3	30.6377	29.84	Pk	26.9	-31	25.74	40	-14.26	0-360	100	V
1	30.9352	28.94	Pk	26.7	-31	24.64	40	-15.36	0-360	301	H
4	97.4224	38.85	Pk	15.6	-30.3	24.15	43.52	-19.37	0-360	100	V
2	106.8599	36.25	Pk	18.2	-30.3	24.15	43.52	-19.37	0-360	301	H
7	227.8036	38.08	Pk	17	-29.3	25.78	46.02	-20.24	0-360	201	V
5	229.1038	41.62	Pk	17.1	-29.4	29.32	46.02	-16.7	0-360	99	H
6	444.4318	31.44	Pk	22.8	-28.3	25.94	46.02	-20.08	0-360	99	H

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	19.216	38.19	Pk	32.7	-21.6	-9.5	39.79	74	-34.21
2	21.61778	40.8	Pk	33.1	-20.9	-9.5	43.5	74	-30.5
3	25.44978	38.91	Pk	34.5	-19.8	-9.5	44.11	74	-29.89
4	20.81067	38.67	Pk	33	-21.3	-9.5	40.87	74	-33.13
5	21.61867	41.95	Pk	33.1	-20.9	-9.5	44.65	74	-29.35
6	24.75378	38.5	Pk	34.4	-19.5	-9.5	43.9	74	-30.1

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.

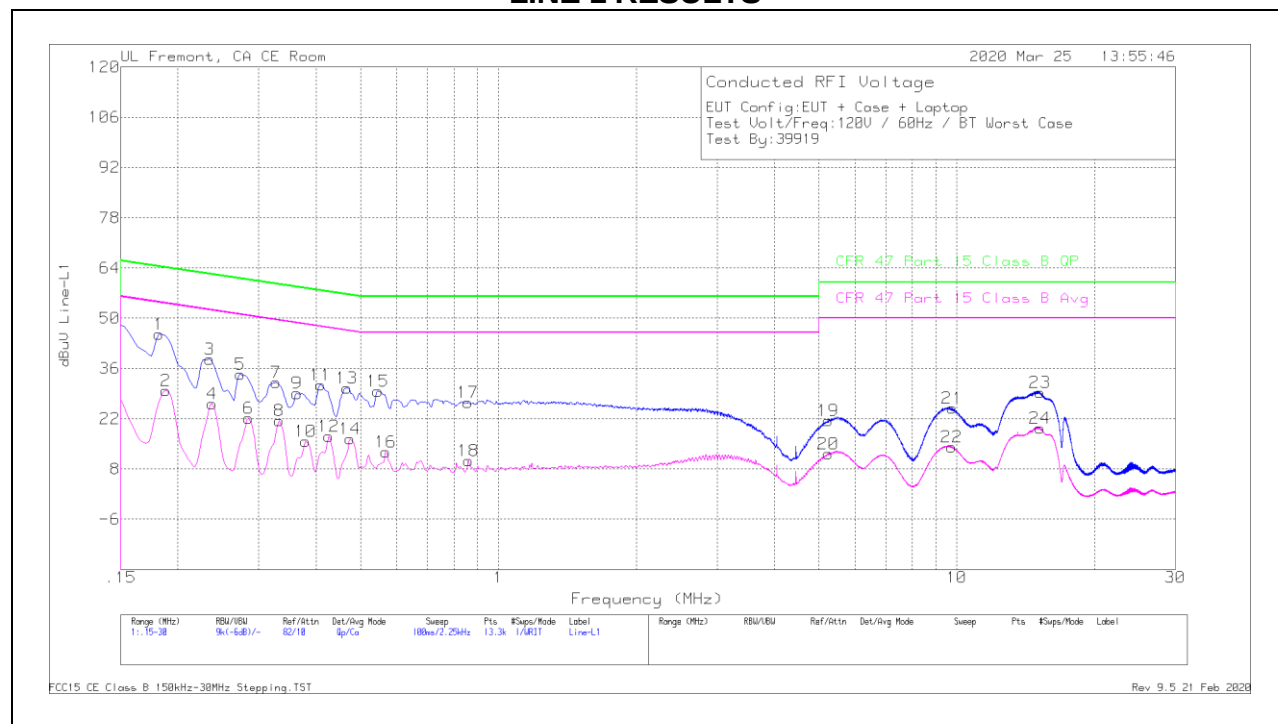
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

11.1.1. AC Power Line Host

LINE 1 RESULTS

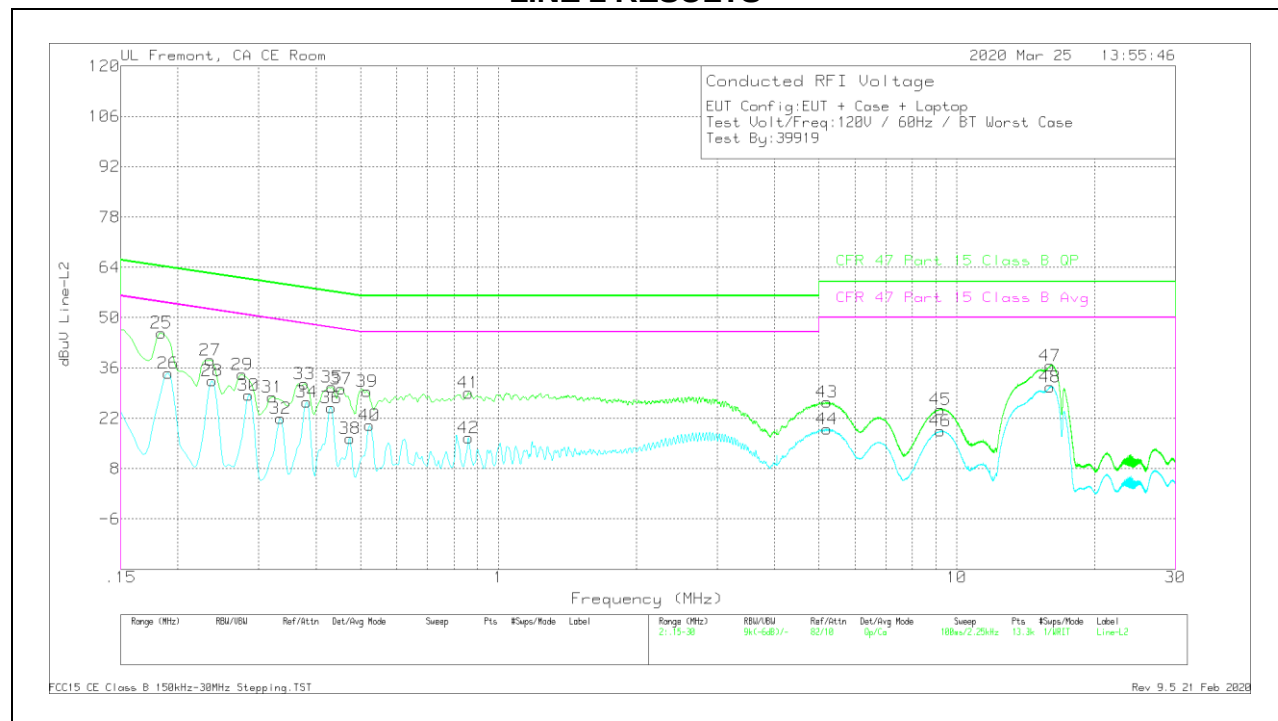


Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1 (dB)	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.1815	35.62	Qp	0	0	10	45.62	64.42	-18.8	-	-
2	.18825	19.92	Ca	0	0	10	29.92	-	-	54.11	-24.19
3	.23438	28.55	Qp	0	0	10	38.55	62.29	-23.74	-	-
4	.23775	16.16	Ca	0	0	10	26.16	-	-	52.17	-26.01
5	.27375	24.31	Qp	0	0	10	34.31	61	-26.69	-	-
6	.285	12.2	Ca	0	0	10	22.2	-	-	50.67	-28.47
7	.32775	22.07	Qp	0	0	10	32.07	59.51	-27.44	-	-
8	.33225	11.39	Ca	0	0	10	21.39	-	-	49.39	-28
9	.36375	19.06	Qp	0	0	10	29.06	58.64	-29.58	-	-
10	.3795	5.69	Ca	0	0	10	15.69	-	-	48.29	-32.6
11	.40875	21.4	Qp	0	0	10	31.4	57.67	-26.27	-	-
12	.42675	7.18	Ca	0	0	10	17.18	-	-	47.32	-30.14
13	.46725	20.5	Qp	0	0	10	30.5	56.56	-26.06	-	-
14	.474	6.39	Ca	0	0	10	16.39	-	-	46.44	-30.05
15	.546	19.69	Qp	0	0	10	29.69	56	-26.31	-	-
16	.5685	2.79	Ca	0	0	10	12.79	-	-	46	-33.21
17	.85875	16.5	Qp	0	0	10	26.5	56	-29.5	-	-
18	.861	.31	Ca	0	0	10	10.31	-	-	46	-35.69
19	5.24625	11.29	Qp	0	.1	10.1	21.49	60	-38.51	-	-
20	5.2485	1.97	Ca	0	.1	10.1	12.17	-	-	50	-37.83
21	9.7665	14.62	Qp	0	.2	10.1	24.92	60	-35.08	-	-
22	9.762	3.83	Ca	0	.2	10.1	14.13	-	-	50	-35.87
23	15.2115	18.83	Qp	0	.3	10.2	29.33	60	-30.67	-	-
24	15.18113	8.89	Ca	0	.3	10.2	19.39	-	-	50	-30.61

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



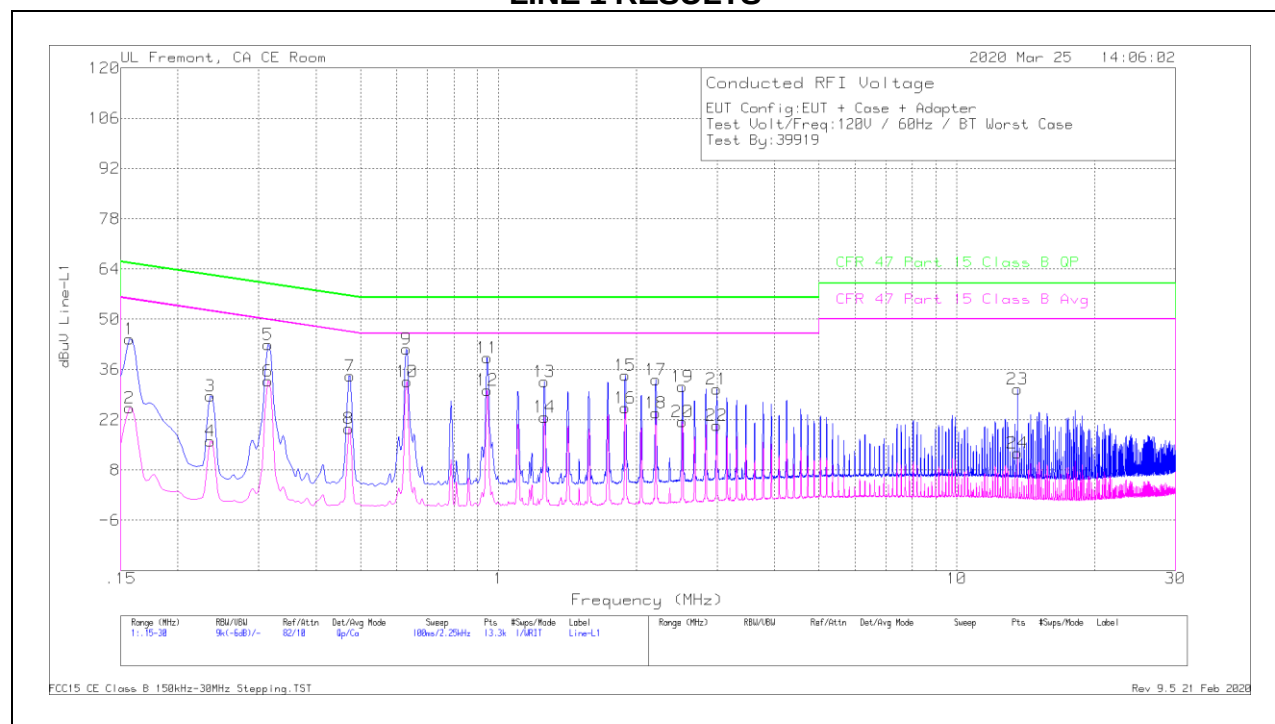
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2 (dB)	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
25	.18375	35.8	Qp	0	0	10	45.8	64.31	-18.51	-	-
26	.1905	24.63	Ca	0	0	10	34.63	-	-	54.01	-19.38
27	.2355	28.22	Qp	0	0	10	38.22	62.25	-24.03	-	-
28	.23775	22.42	Ca	0	0	10	32.42	-	-	52.17	-19.75
29	.276	24.22	Qp	0	0	10	34.22	60.94	-26.72	-	-
30	.285	18.44	Ca	0	0	10	28.44	-	-	50.67	-22.23
31	.321	17.93	Qp	0	0	10	27.93	59.68	-31.75	-	-
32	.3345	12.04	Ca	0	0	10	22.04	-	-	49.34	-27.3
33	.37725	21.62	Qp	0	0	10	31.62	58.34	-26.72	-	-
34	.38175	16.47	Ca	0	0	10	26.47	-	-	48.24	-21.77
35	.4335	20.75	Qp	0	0	10	30.75	57.19	-26.44	-	-
36	.43125	15.02	Ca	0	0	10	25.02	-	-	47.23	-22.21
37	.45375	20.21	Qp	0	0	10	30.21	56.81	-26.6	-	-
38	.474	6.36	Ca	0	0	10	16.36	-	-	46.44	-30.08
39	.51675	19.56	Qp	0	0	10	29.56	56	-26.44	-	-
40	.5235	9.99	Ca	0	0	10	19.99	-	-	46	-26.01
41	.861	19.06	Qp	0	0	10	29.06	56	-26.94	-	-
42	.861	6.54	Ca	0	0	10	16.54	-	-	46	-29.46
43	5.208	16.39	Qp	0	.1	10.1	26.59	60	-33.41	-	-
44	5.20575	8.82	Ca	0	.1	10.1	19.02	-	-	50	-30.98
45	9.1995	14.21	Qp	0	.2	10.1	24.51	60	-35.49	-	-
46	9.20625	8.14	Ca	0	.2	10.1	18.44	-	-	50	-31.56
47	15.9675	26.2	Qp	0	.3	10.2	36.7	60	-23.3	-	-
48	15.9675	20.27	Ca	0	.3	10.2	30.77	-	-	50	-19.23

Qp - Quasi-Peak detector

Ca - CISPR average detection

11.1.2. AC Power Line Norm

LINE 1 RESULTS



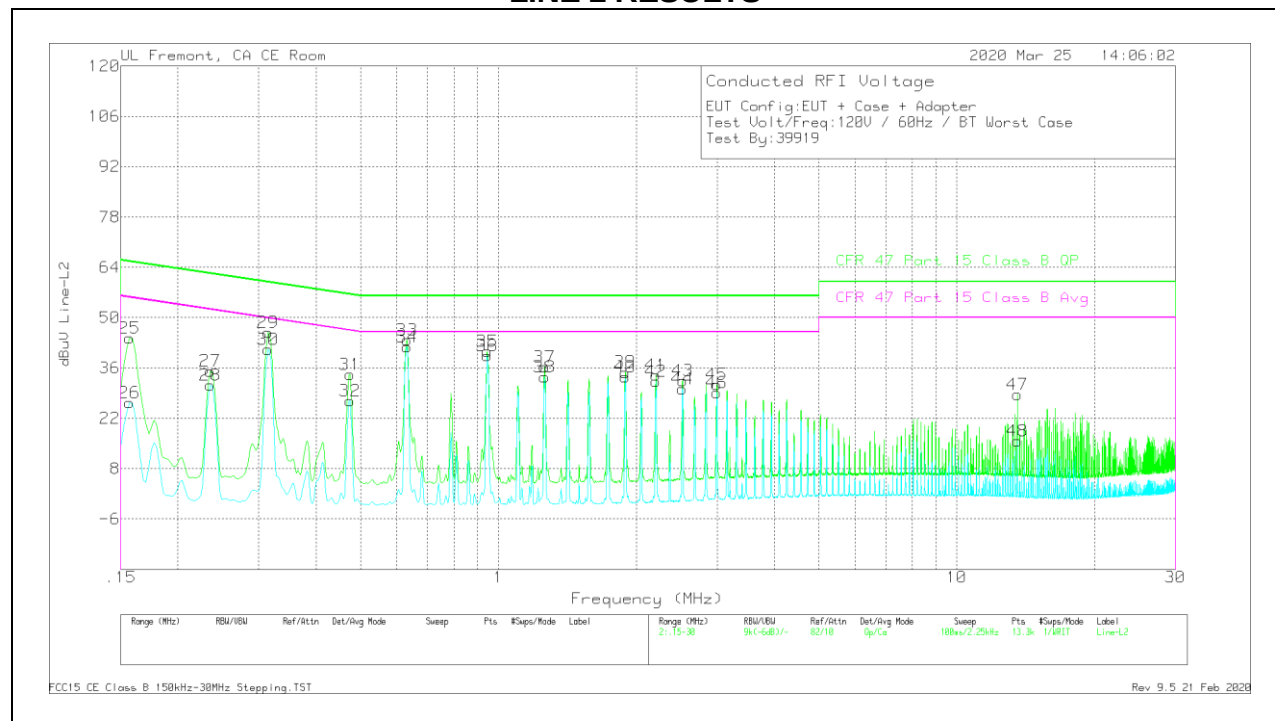
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1 (dB)	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.15675	34.36	Qp	.1	0	10	44.46	65.63	-21.17	-	-
2	.15675	15.18	Ca	.1	0	10	25.28	-	-	55.63	-30.35
3	.2355	18.63	Qp	0	0	10	28.63	62.25	-33.62	-	-
4	.2355	6.08	Ca	0	0	10	16.08	-	-	52.25	-36.17
5	.31425	32.91	Qp	0	0	10	42.91	59.86	-16.95	-	-
6	.31425	22.83	Ca	0	0	10	32.83	-	-	49.86	-17.03
7	.474	24.21	Qp	0	0	10	34.21	56.44	-22.23	-	-
8	.47175	9.49	Ca	0	0	10	19.49	-	-	46.48	-26.99
9	.62925	31.7	Qp	0	0	10	41.7	56	-14.3	-	-
10	.6315	22.62	Ca	0	0	10	32.62	-	-	46	-13.38
11	.9465	29.21	Qp	0	.1	10	39.31	56	-16.69	-	-
12	.9465	20.17	Ca	0	.1	10	30.27	-	-	46	-15.73
13	1.25925	22.49	Qp	0	.1	10	32.59	56	-23.41	-	-
14	1.2615	12.67	Ca	0	.1	10	22.77	-	-	46	-23.23
15	1.8915	24.34	Qp	0	.1	10	34.44	56	-21.56	-	-
16	1.8915	15.21	Ca	0	.1	10	25.31	-	-	46	-20.69
17	2.2065	23.1	Qp	0	.1	10	33.2	56	-22.8	-	-
18	2.2065	13.86	Ca	0	.1	10	23.96	-	-	46	-22.04
19	2.5215	21.12	Qp	0	.1	10	31.22	56	-24.78	-	-
20	2.5215	11.4	Ca	0	.1	10	21.5	-	-	46	-24.5
21	2.994	20.45	Qp	0	.1	10	30.55	56	-25.45	-	-
22	2.994	10.38	Ca	0	.1	10	20.48	-	-	46	-25.52
23	*13.56	20.08	Qp	.1	.2	10.1	30.48	60	-29.52	-	-
24	*13.56	2.34	Ca	.1	.2	10.1	12.74	-	-	50	-37.26

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)
25	.15675	34.29	Qp	.1	0	10	44.39	65.63	-21.24	-	-
26	.15675	16.22	Ca	.1	0	10	26.32	-	-	55.63	-29.31
27	.2355	25.16	Qp	0	0	10	35.16	62.25	-27.09	-	-
28	.2355	21.17	Ca	0	0	10	31.17	-	-	52.25	-21.08
29	.31425	35.84	Qp	0	0	10	45.84	59.86	-14.02	-	-
30	.31425	31.16	Ca	0	0	10	41.16	-	-	49.86	-8.7
31	.474	24.15	Qp	0	0	10	34.15	56.44	-22.29	-	-
32	.474	16.8	Ca	0	0	10	26.8	-	-	46.44	-19.64
33	.6315	33.85	Qp	0	0	10	43.85	56	-12.15	-	-
34	.6315	31.95	Ca	0	0	10	41.95	-	-	46	-4.05
35	.9465	30.59	Qp	0	.1	10	40.69	56	-15.31	-	-
36	.9465	29.31	Ca	0	.1	10	39.41	-	-	46	-6.59
37	1.2615	26.16	Qp	0	.1	10	36.26	56	-19.74	-	-
38	1.2615	23.33	Ca	0	.1	10	33.43	-	-	46	-12.57
39	1.8915	24.71	Qp	0	.1	10	34.81	56	-21.19	-	-
40	1.8915	23.46	Ca	0	.1	10	33.56	-	-	46	-12.44
41	2.20875	23.85	Qp	0	.1	10	33.95	56	-22.05	-	-
42	2.2065	22.17	Ca	0	.1	10	32.27	-	-	46	-13.73
43	2.52375	22.35	Qp	0	.1	10	32.45	56	-23.55	-	-
44	2.5215	20.14	Ca	0	.1	10	30.24	-	-	46	-15.76
45	2.99625	21.35	Qp	0	.1	10	31.45	56	-24.55	-	-
46	2.99625	19.01	Ca	0	.1	10	29.11	-	-	46	-16.89
47	*13.56	18.25	Qp	.1	.2	10.1	28.65	60	-31.35	-	-
48	*13.56	5.37	Ca	.1	.2	10.1	15.77	-	-	50	-34.23

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