

TEST REPORT

Report Number.: 14093500-E1V2

Applicant : SONOS INC.
614 CHAPALA ST.
SANTA BARBARA, CA, 93101, U.S.A.

Model : S41

Brand : SONOS

FCC ID : SBVRM041

IC : 5373A-RM041

EUT Description : 802.11 a/b/g/n/ac/ax 2x2 Client Device with BT and BLE

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 ISSUE 2
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:
2022-10-24

Prepared by:
UL VERIFICATION SERVICES
47173 Benicia Street
Fremont, CA 94538 U.S.A.
TEL: (510) 319-4000
FAX: (510) 661-0888



REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2022-10-13	Initial Issue	---
V2	2022-10-24	Updated Section 1 and 7	K.Kedida

TABLE OF CONTENTS

REPORT REVISION HISTORY	2
TABLE OF CONTENTS	3
1. ATTESTATION OF TEST RESULTS	5
2. TEST RESULTS SUMMARY	7
3. TEST METHODOLOGY	8
4. FACILITIES AND ACCREDITATION	8
5. DECISION RULES AND MEASUREMENT UNCERTAINTY	9
5.1. METROLOGICAL TRACEABILITY	9
5.2. DECISION RULES.....	9
5.3. MEASUREMENT UNCERTAINTY.....	9
5.4. SAMPLE CALCULATION	9
6. EQUIPMENT UNDER TEST	10
6.1. EUT DESCRIPTION	10
6.2. MAXIMUM OUTPUT POWER.....	10
6.3. DESCRIPTION OF AVAILABLE ANTENNAS	10
6.4. SOFTWARE AND FIRMWARE.....	10
6.5. WORST-CASE CONFIGURATION AND MODE.....	11
6.6. DESCRIPTION OF TEST SETUP.....	12
7. TEST AND MEASUREMENT EQUIPMENT	14
8. MEASUREMENT METHODS	15
9. ANTENNA PORT TEST RESULTS	16
9.1. ON TIME AND DUTY CYCLE.....	16
9.2. 20 dB AND 99% BANDWIDTH	17
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	18
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	19
9.3. HOPPING FREQUENCY SEPARATION	20
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	21
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	21
9.4. NUMBER OF HOPPING CHANNELS.....	22
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	23
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	25
9.5. AVERAGE TIME OF OCCUPANCY.....	27
9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	28

9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....30

9.6. *OUTPUT POWER*.....32

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION33

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION33

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....33

9.7. *AVERAGE POWER*.....34

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION35

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION35

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....35

9.8. *CONDUCTED SPURIOUS EMISSIONS*.....36

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION37

9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....39

10. RADIATED TEST RESULTS41

10.1. *TRANSMITTER ABOVE 1 GHz*.....43

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION.....43

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION53

10.2. *WORST CASE BELOW 30MHz*63

10.3. *WORST CASE BELOW 1 GHz*64

10.4. *WORST CASE 18-26 GHz*.....66

11. AC POWER LINE CONDUCTED EMISSIONS68

12. SETUP PHOTOS71

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Sonos Inc.
614 Chapala St.
Santa Barbara, CA, 93101, U.S.A.

EUT DESCRIPTION: 802.11 a/b/g/n/ac/ax 2x2 Client Device with BT and BLE

MODEL: S41

BRAND: SONOS

SERIAL NUMBER: Radiated Sample: 528B4 and 6B90A
Conducted Sample: 4304F

SAMPLE RECEIPT DATE: 2022-04-11

DATE TESTED: 2022-04-12 to 2022-06-21

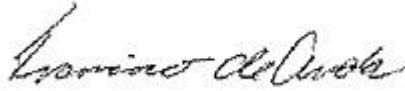
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5 + A1 +A2	Complies

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 A2LA, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



Francisco de Anda
Staff Engineer
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Glenn Escano
Senior Test Engineer
Consumer Technology Division
UL Verification Services Inc.

1st Reviewed By:



Vien Tran
Senior Laboratory Engineer
Consumer Technology Division
UL Verification Services Inc.

2nd Reviewed By:



Kiya Kedida
Senior Project Engineer
Consumer Technology Division
UL Verification Services Inc.

2. TEST RESULTS SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

Below is a list of the data provided by the customer:

1. Antenna gain and type (see section 6.3)

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	Compliant	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Number of Hopping Channels	Compliant	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Average Time of Occupancy	Compliant	None.
15.247 (b)(1)	RSS-247 (5.4) (b)	Output Power	Compliant	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	Compliant	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Compliant	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Compliant	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 + A1 + A2, and RSS-247 Issue 2.

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number #0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building 1: 47173 Benicia Street Fremont, CA 94538, U.S.A	US0104	2324A	208313
<input type="checkbox"/>	Building 2: 47266 Benicia Street Fremont, CA 94538, U.S.A	US0104	22541	208313
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd Fremont, CA 94538, U.S.A	US0104	2324B	208313

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U _{Lab}
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 db
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 db
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 db
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 db
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 db
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 db
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 db

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

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

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

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is an 802.11 a/b/g/n/ac/ax 2x2 Client Device with BT and BLE.

This report covers BT radio

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	14.35	27.23
2402 - 2480	Enhanced DQPSK	14.23	26.49
2402 - 2480	Enhanced 8PSK	14.24	26.55

6.3. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna gain and type as provided by the manufacturer are as follows:

The radio utilizes a PCB antenna, with maximum gain of 4 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 69.1-26251-diag.

The test utility software used during testing was GUI 20220422_V4.

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 EUT can only be setup in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

GFSK, DQPSK, 8PSK average power are all investigated, The GFSK and 8PSK power are the worst case. Testing is based on these modes to showing compliance.

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

GFSK mode: DH5

8PSK mode: 3-DH5

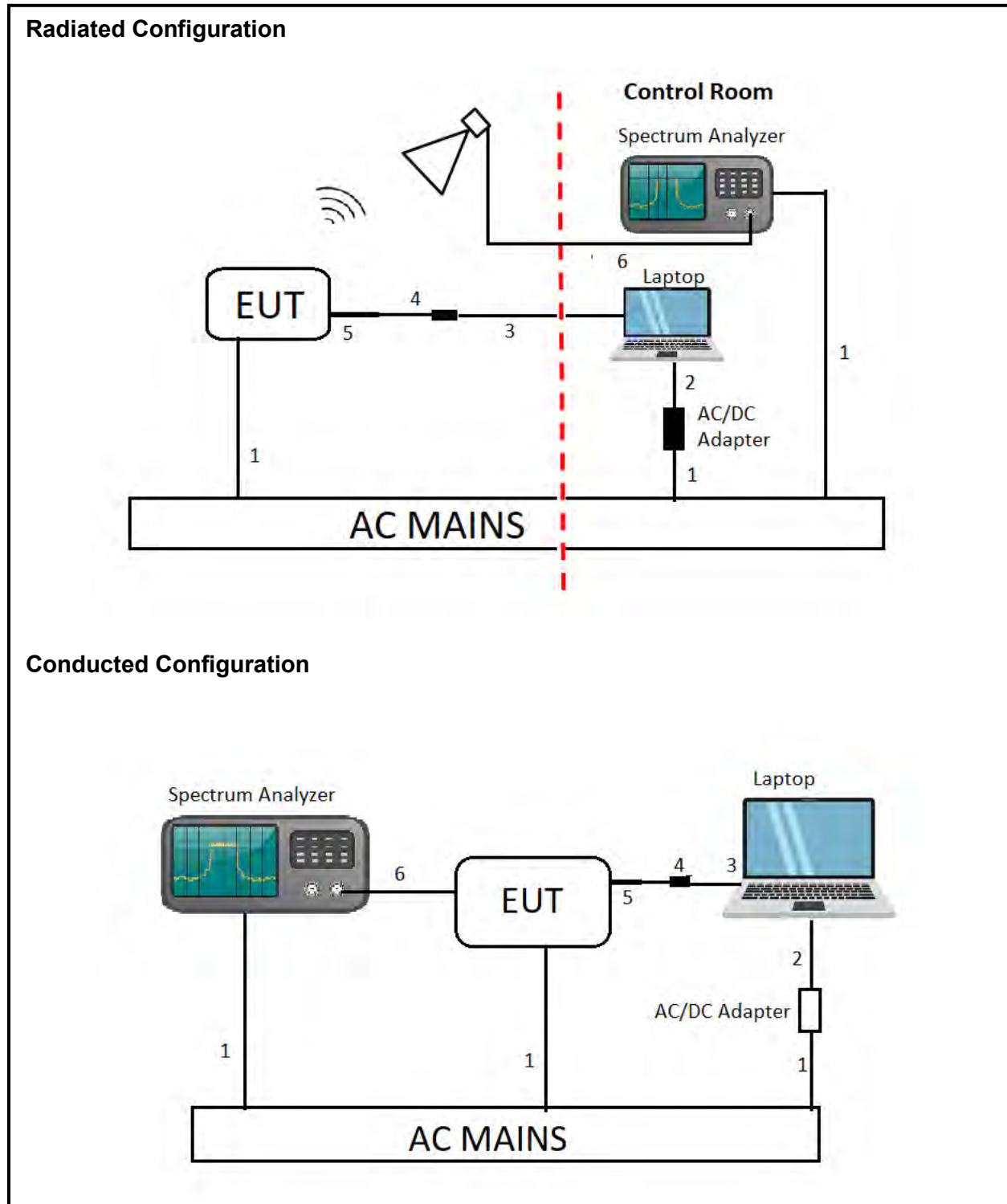
6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	Lenovo	T460s	PC0JMBF8	Doc		
Laptop AC/DC Adapter	Lenovo	ADLX90NLC2A	11S45N0247Z1ZSHH448JEY	Doc		
USB-A to Ethernet Adapter	Plugable	USB2-E100	8CAE4CE46AFA	Doc		
USB-C to USB-A Female Adapter	Amazon Basics	L6LUC160-CS-R	N/A	Doc		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to EUT/Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Un-shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	1.5	Laptop to USB Ethernet Adapter
4	USB-A	1	USB-A	Shielded	0.05	USB Ethernet Adapter to USB
5	USB-C	1	USB-C	Shielded	0.05	EUT to USB-C/USB-A Female Adapter
6	SMA Cable	1	SMA	Un-Shielded	0.1	EUT to Spectrum Analyzer
I/O CABLES (RADIATED TEST)						
Cable No.	Port	# Of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to EUT/Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Un-shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	10	Laptop to USB Ethernet Adapter
4	USB-A	1	USB-A	Shielded	0.05	USB Ethernet Adapter to USB
5	USB-C	1	USB-C	Shielded	0.05	EUT to USB-C/USB-A Female Adapter
6	SMA Cable	1	SMA	Un-Shielded	10	EUT to Horn Antenna

TEST SETUP

The EUT is a stand-alone unit, and the radio is exercised remotely by Sonos Compliance GUI test utility software via ethernet.

SETUP DIAGRAM



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
Antenna, Broadband Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	171862	2022-09-28	2021-09-28
Amplifier, 10KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310N	29654	2023-04-24	2022-04-24
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	T119	2022-05-07*	2021-05-07
RF Filter Box, 1-18GHz	FREMONT	SAC-L1	171013	2023-03-09	2022-03-09
EMI TEST RECEIVER, with B8 option	Rohde & Schwarz	ESW44	PRE0179377	2023-02-20	2022-02-20
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	201499	2023-02-17	2022-02-17
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	172363	2022-12-07	2021-12-07
Amplifier 18-26.5GHz, +5Vdc, -54dBm P1dB	AMPLICAL	AMP18G26.5-60	171583	2023-01-27	2022-01-27
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	SC-8015	2022-05-24*	2021-05-24
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	SC-8014	2022-05-24*	2021-05-24
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent Technologies	N9030A	80396	2023-01-02	2022-01-02
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	T1268	2023-02-03	2022-02-03
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90419	2023-03-02	2022-03-02
AC Line Conducted					
LISN	Fischer Custom Communications, Inc	FCC-LISN-50/250-25-2-01-480V	175765	2023-01-25	2022-01-25
EMI TEST RECEIVER	Rohde & Schwarz	ESR	93091	2023-02-21	2022-02-21
Transient Limiter	TE	TBFL1	207996	2022-06-01	2021-06-01
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Ver 2022-07-06		
Antenna Port Software	UL	UL RF	Ver 2022.5.31		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, 2022-02-17		

*Test performed before calibration expired.

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, 6.5

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

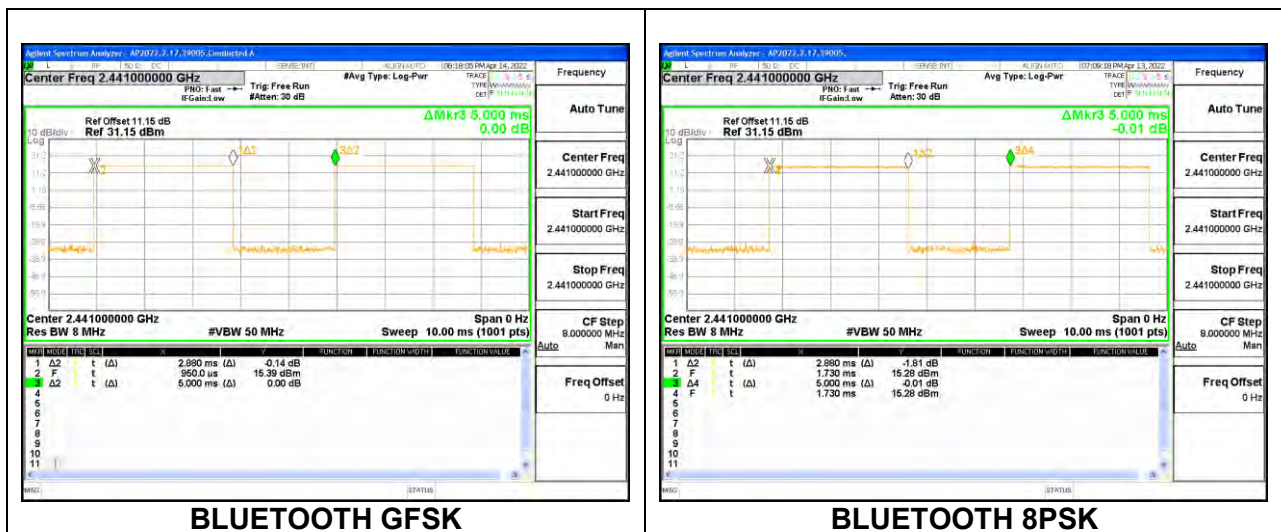
PROCEDURE

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

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
Bluetooth GFSK	2.880	5.000	0.576	57.6	2.40	0.347
Bluetooth 8PSK	2.880	5.000	0.576	57.6	2.40	0.347

DUTY CYCLE PLOTS



9.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

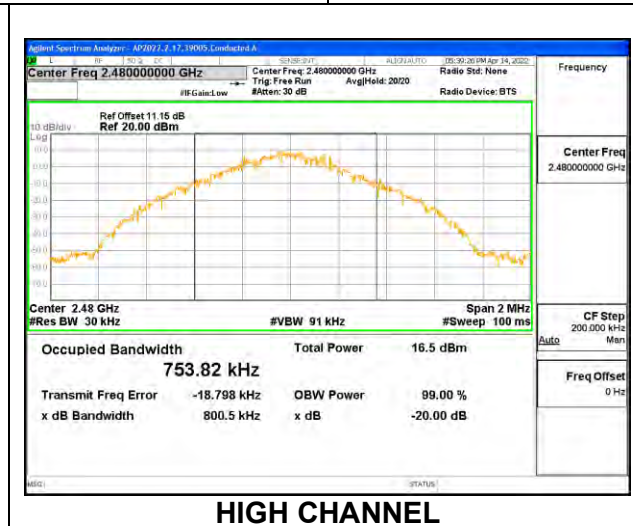
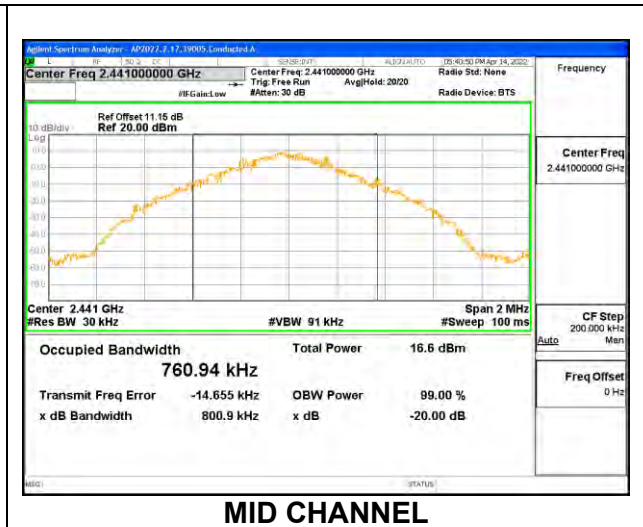
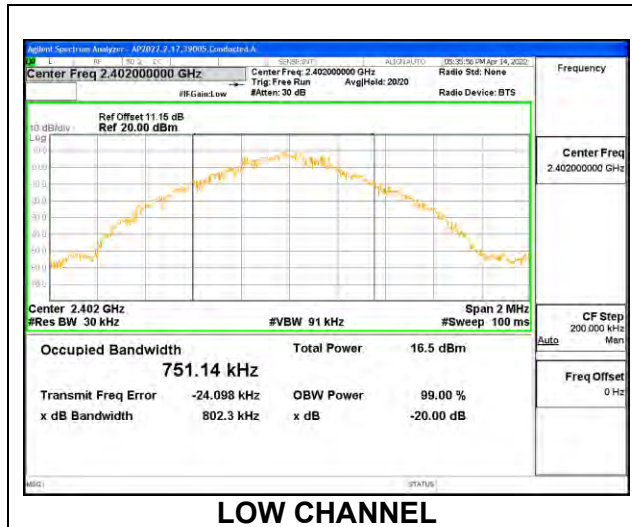
TEST PROCEDURE

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 RBW. The sweep time is coupled.

RESULTS

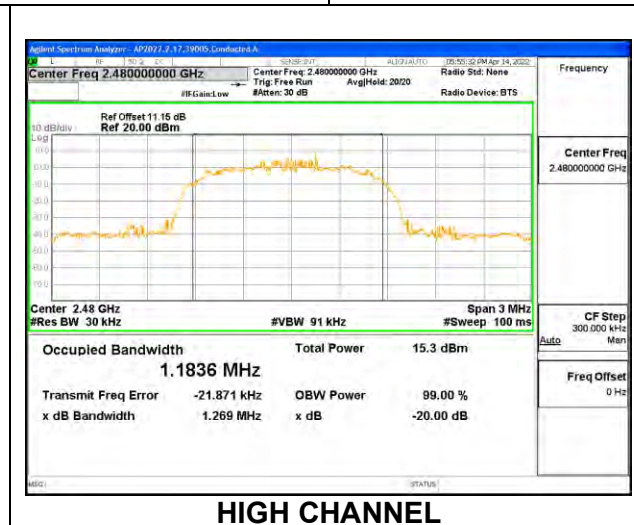
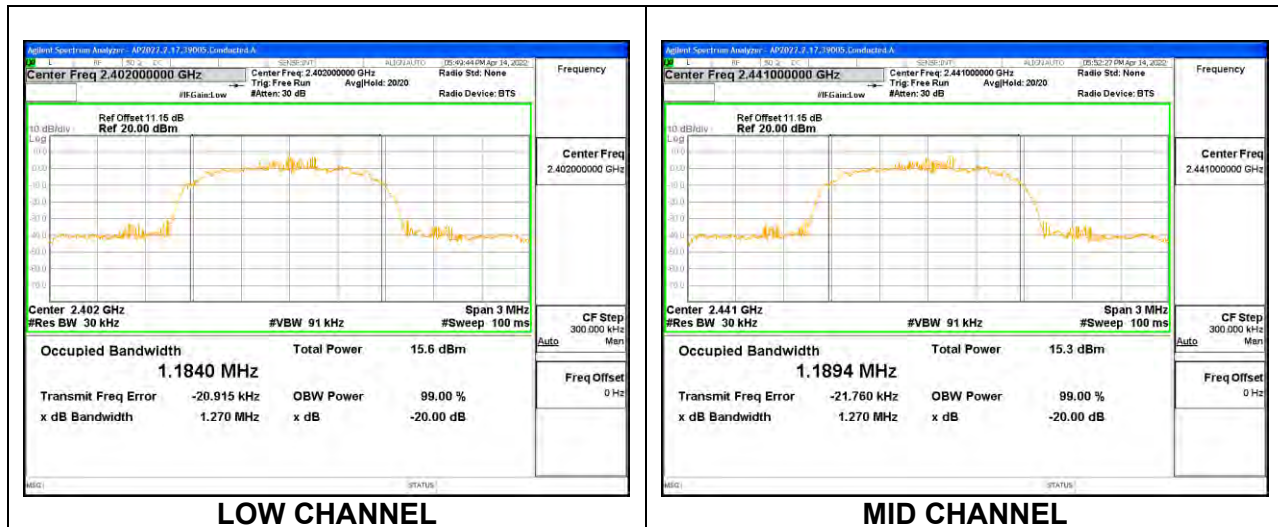
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	802.3	751.14
Mid	2441	800.9	760.94
High	2480	800.5	753.82



9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.270	1.1840
Mid	2441	1.270	1.1894
High	2480	1.269	1.1836



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.

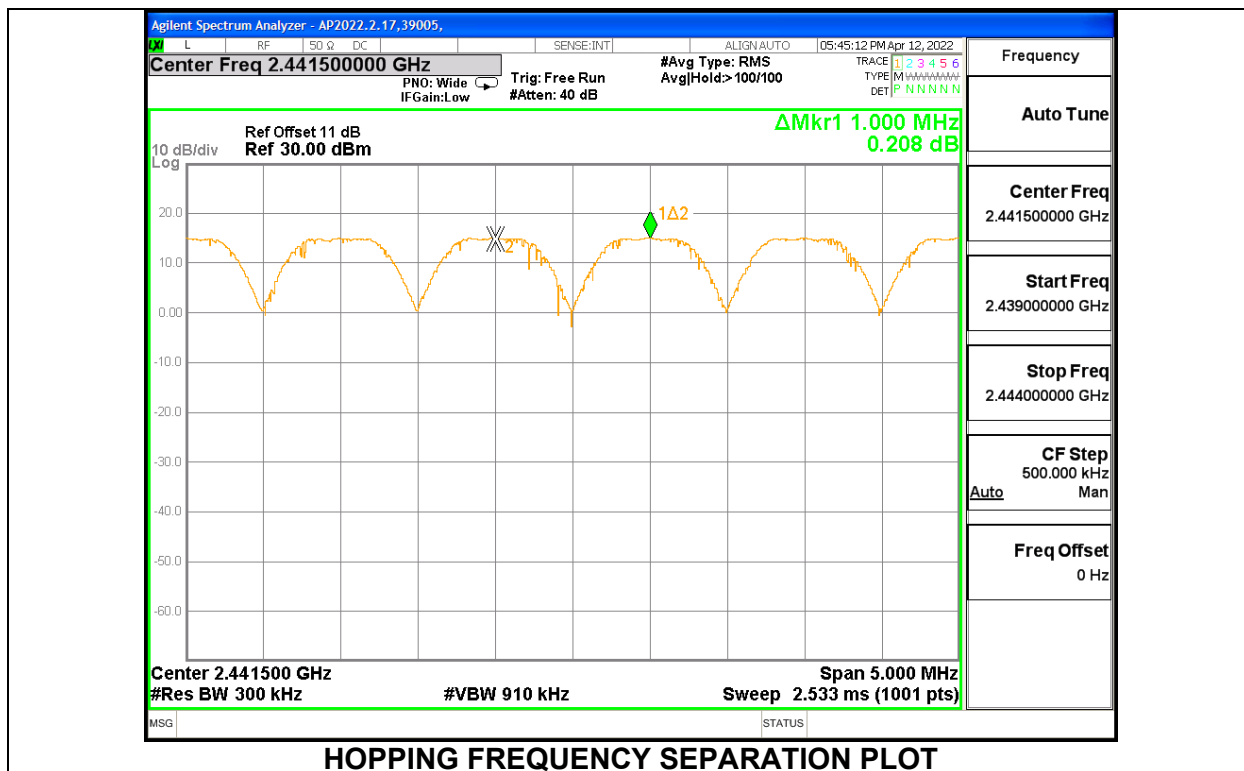
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

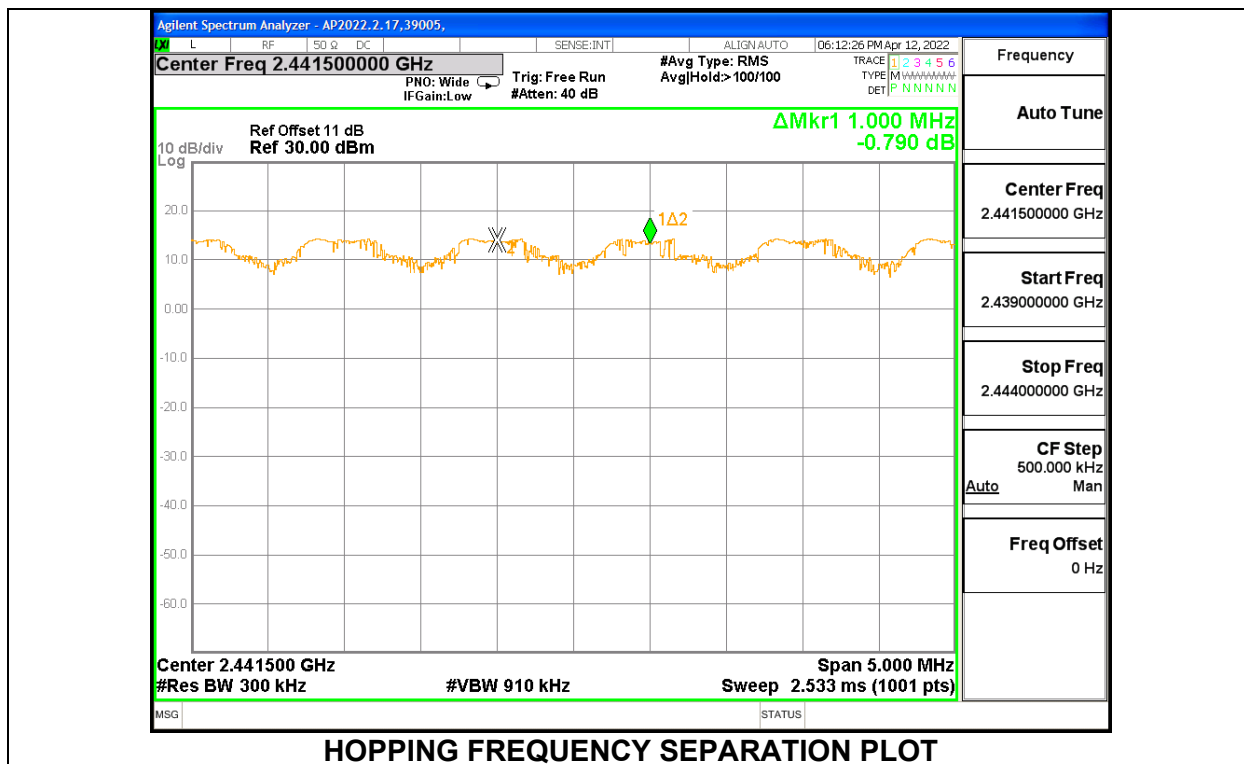
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq RBW$. The sweep time is coupled.

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.

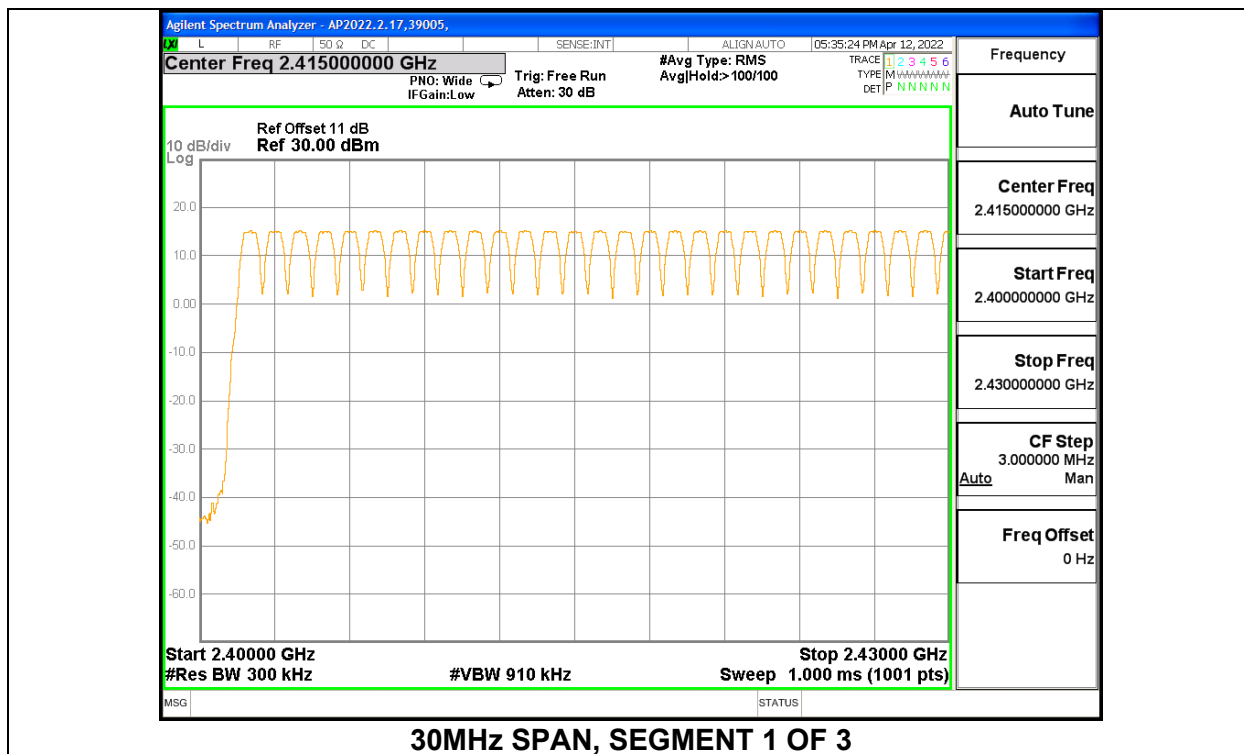
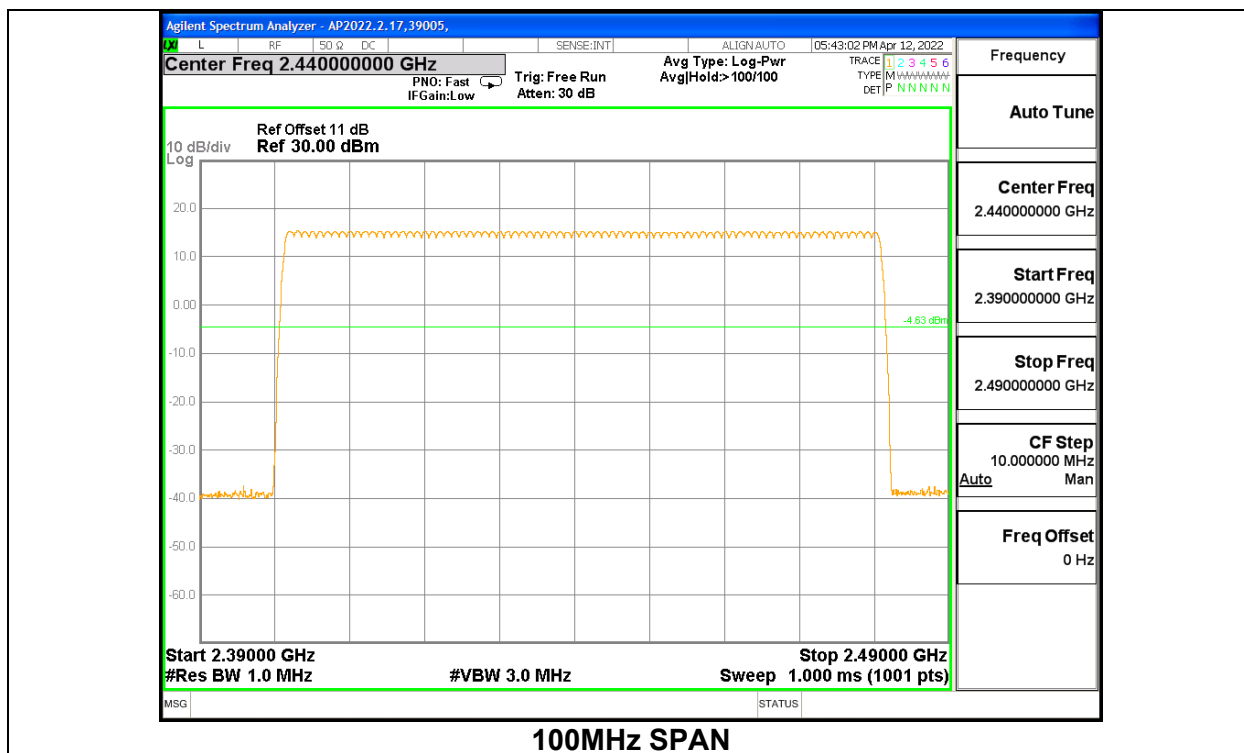
TEST PROCEDURE

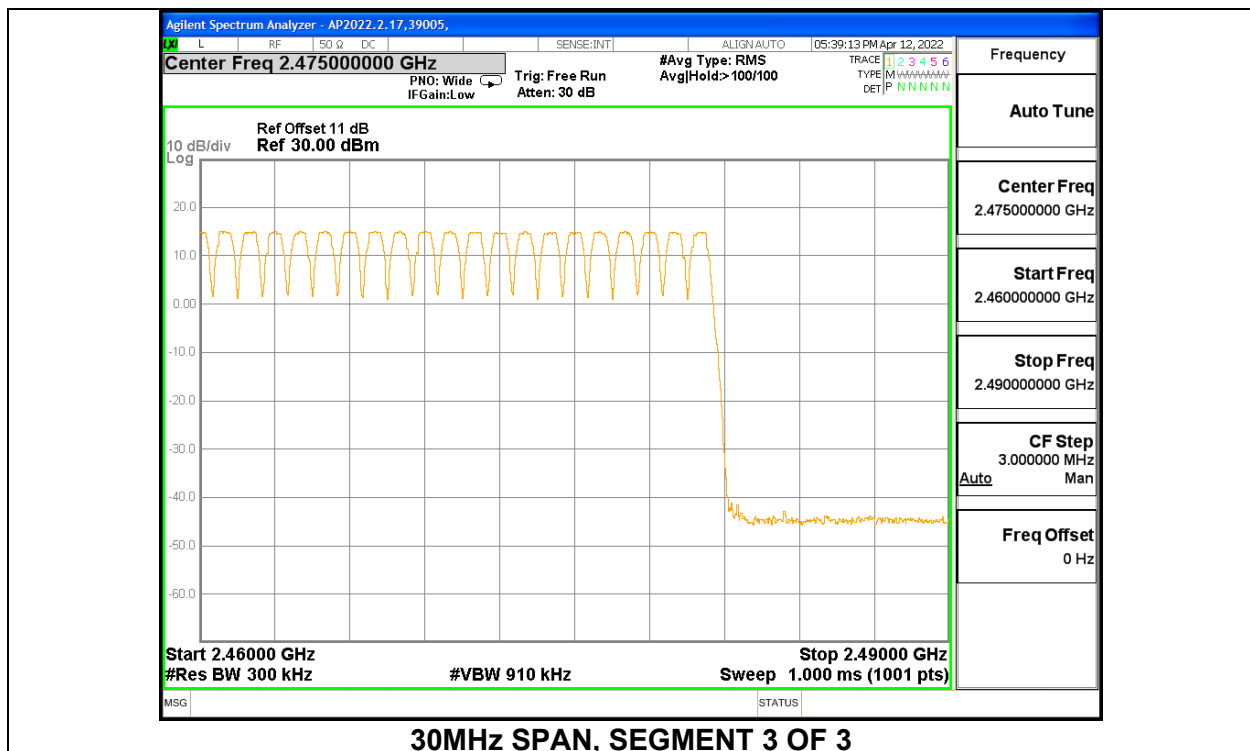
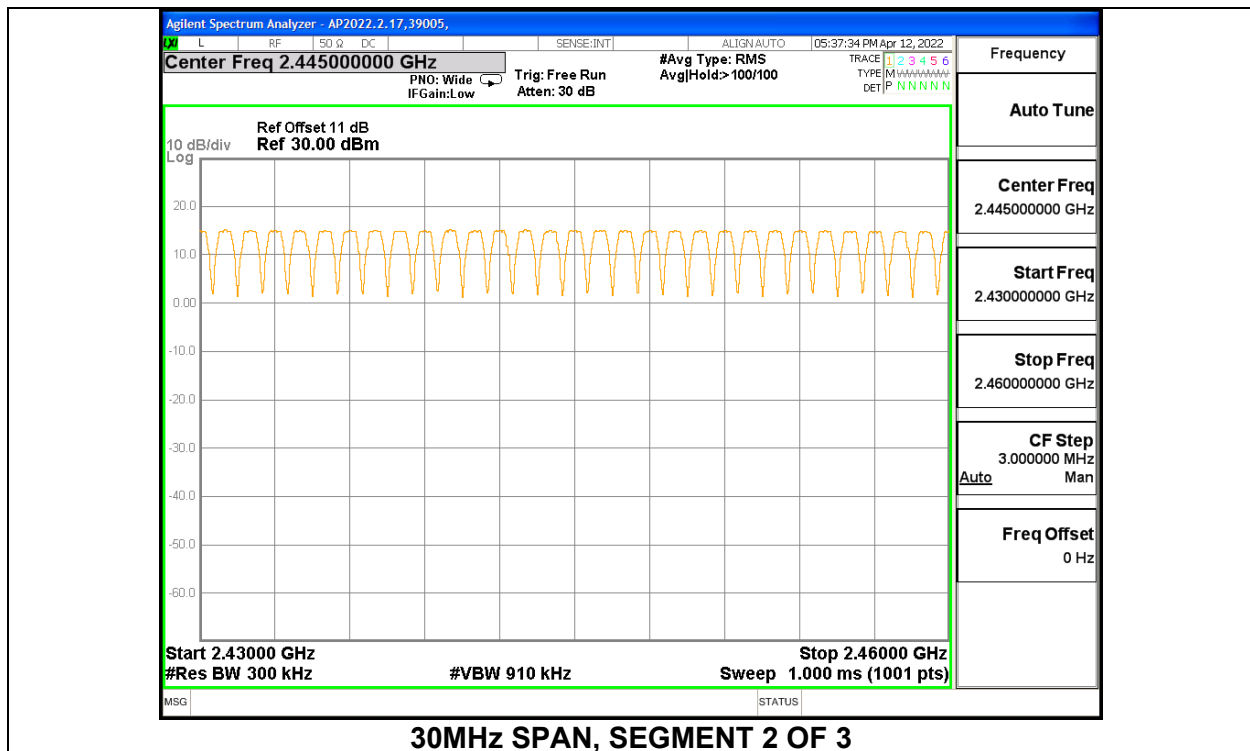
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

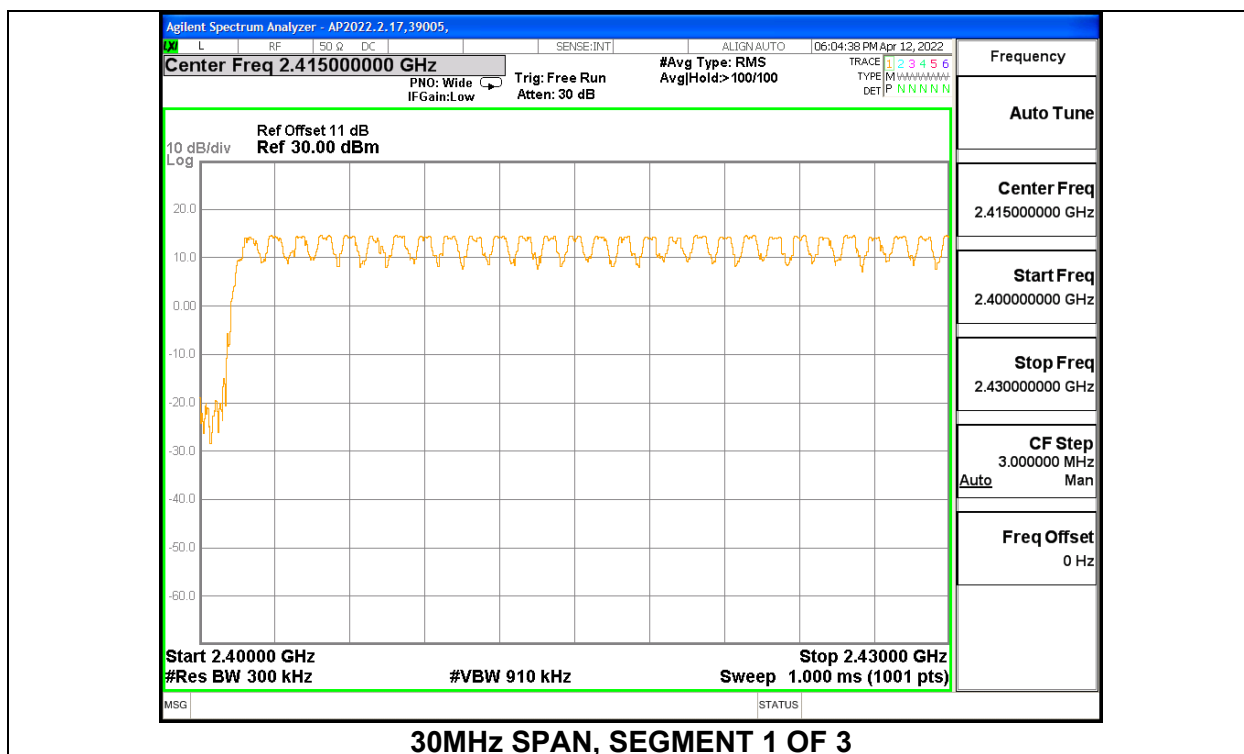
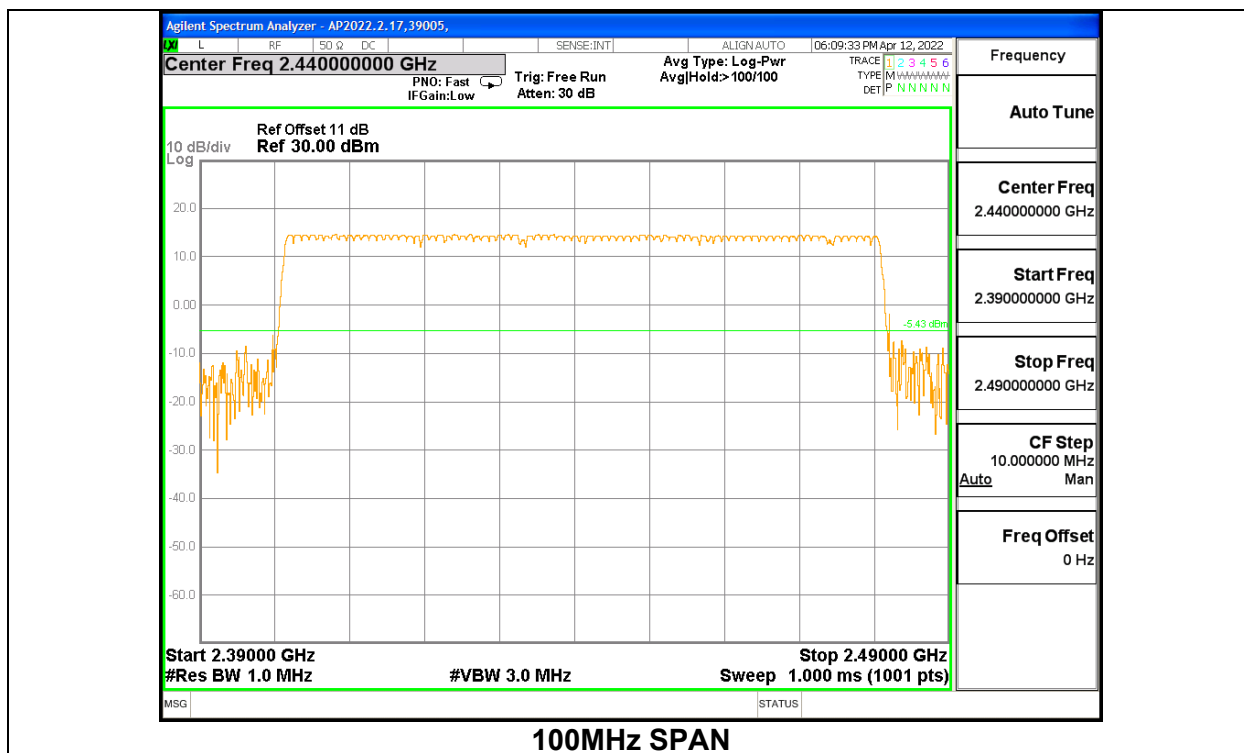
Normal Mode: 79 Channels Observed

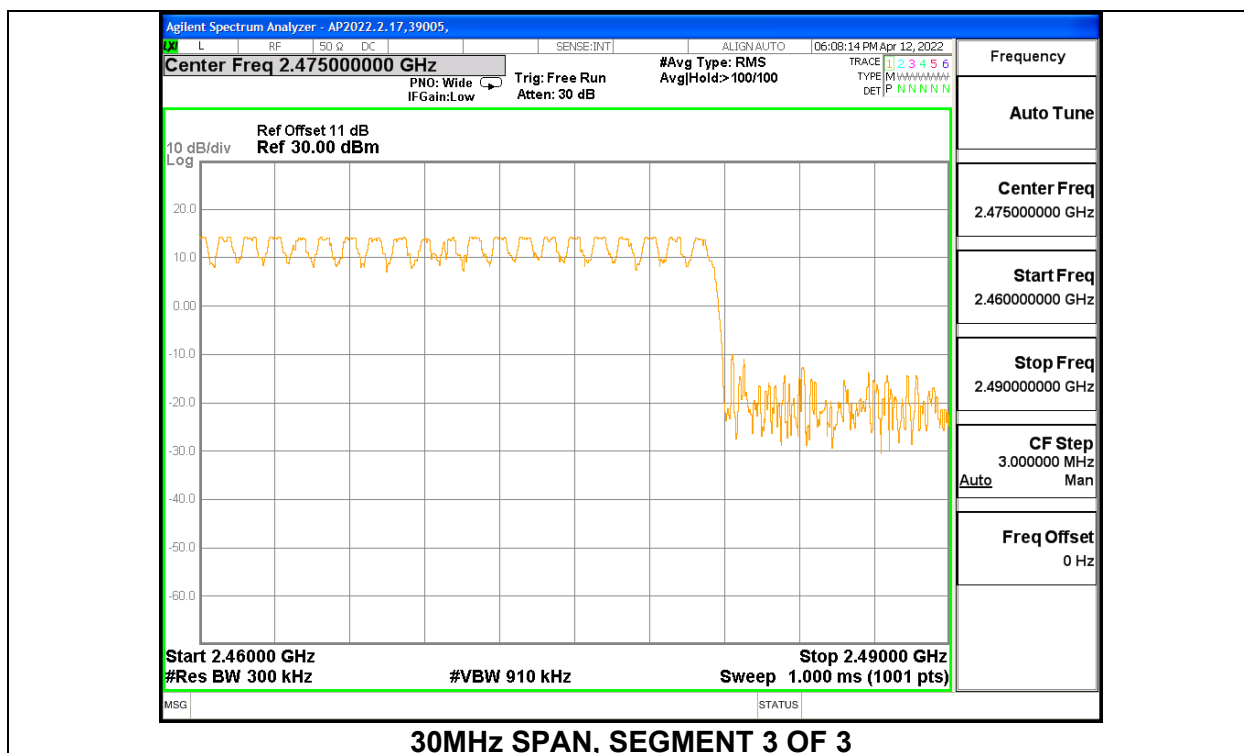
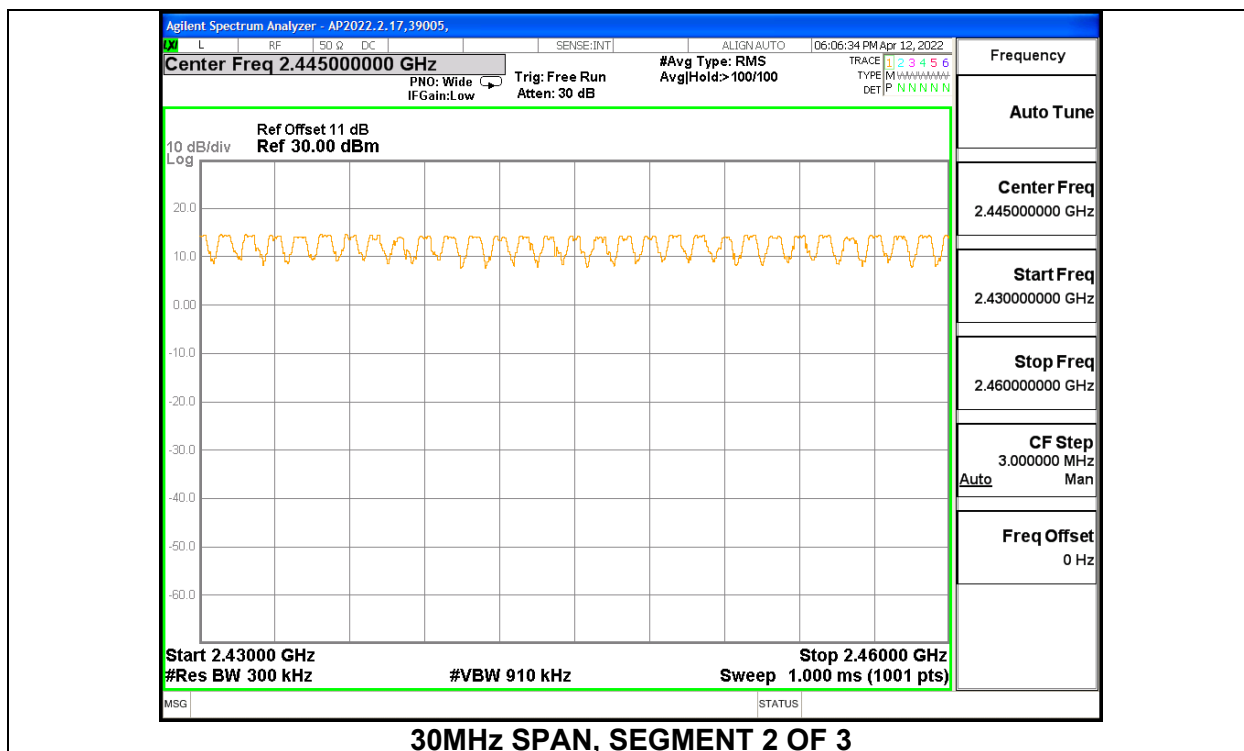
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION





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.

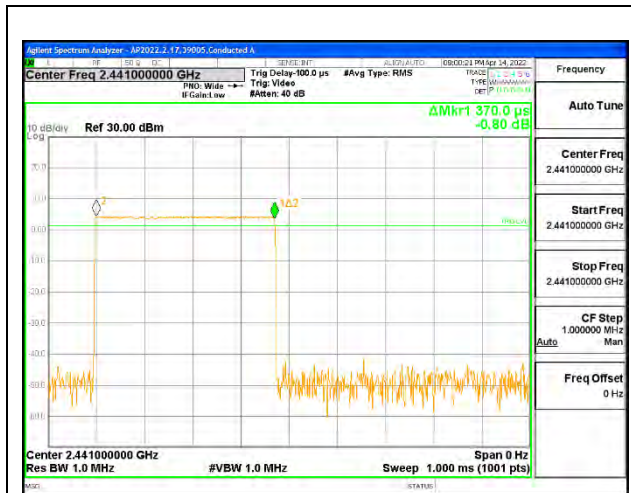
The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

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

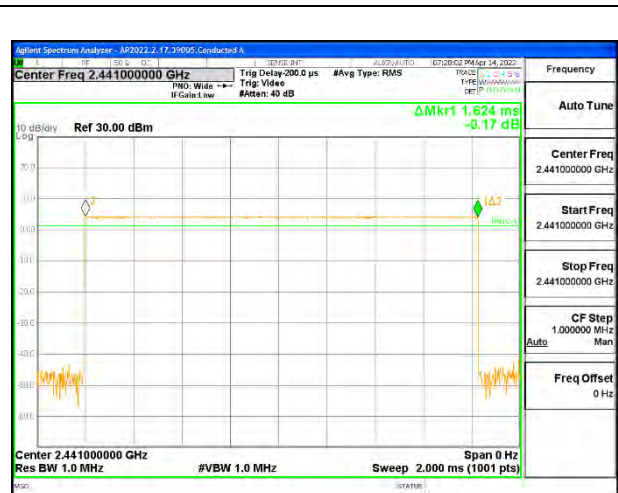
RESULTS

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	0.37	16	0.0592	0.4	-0.3408
DH3	1.624	14	0.2274	0.4	-0.1726
DH5	2.864	8	0.2291	0.4	-0.1709
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	0.37	4	0.01480	0.4	-0.3852
DH3	1.624	3.5	0.05684	0.4	-0.3432
DH5	2.864	2	0.05728	0.4	-0.3427



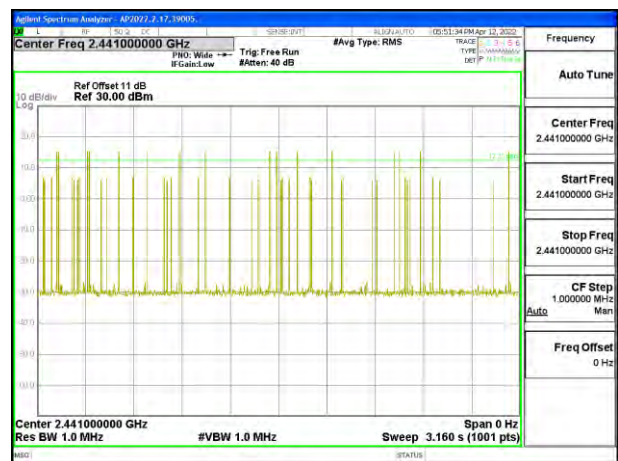
PULSE WIDTH – DH1



PULSE WIDTH – DH3



PULSE WIDTH – DH5



**NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – DH1**



**NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – DH3**

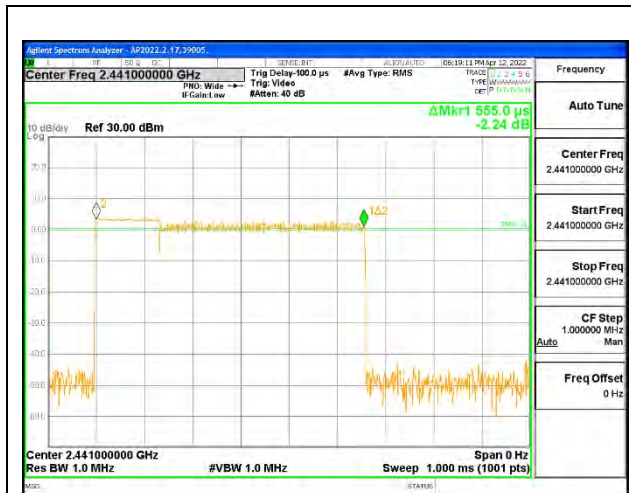


**NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – DH5**

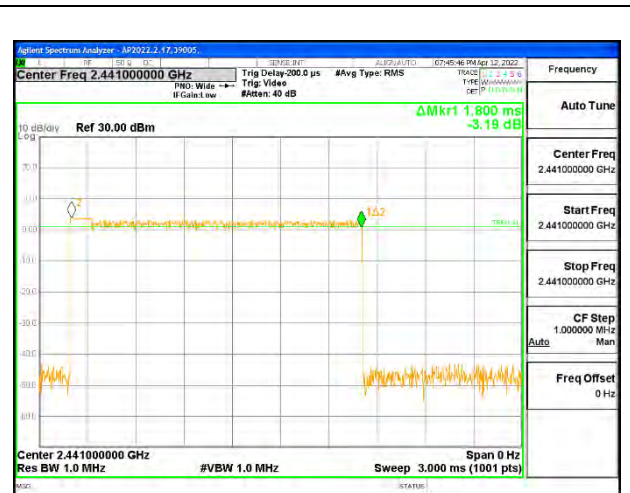
9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

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	0.555	15	0.08325	0.4	-0.31675
3DH3	1.8	9	0.162	0.4	-0.238
3DH5	2.868	8	0.22944	0.4	-0.17056

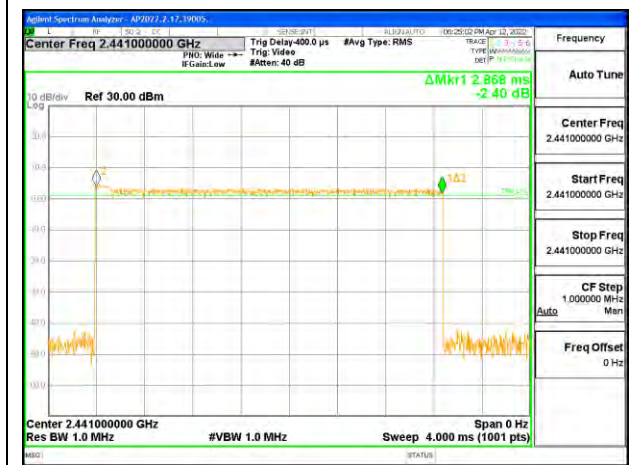
Note: for AFH(8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.



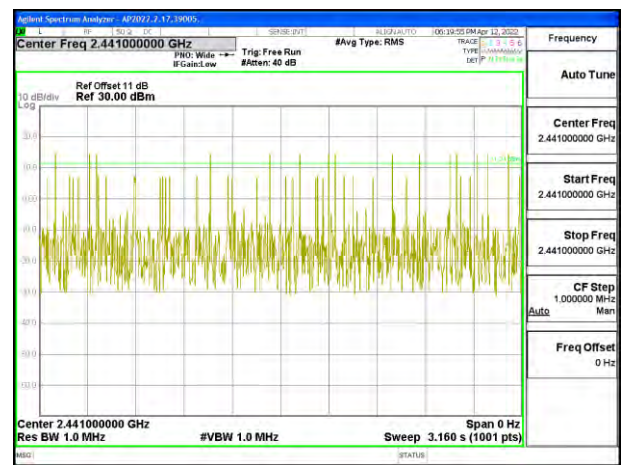
PULSE WIDTH – 3DH1



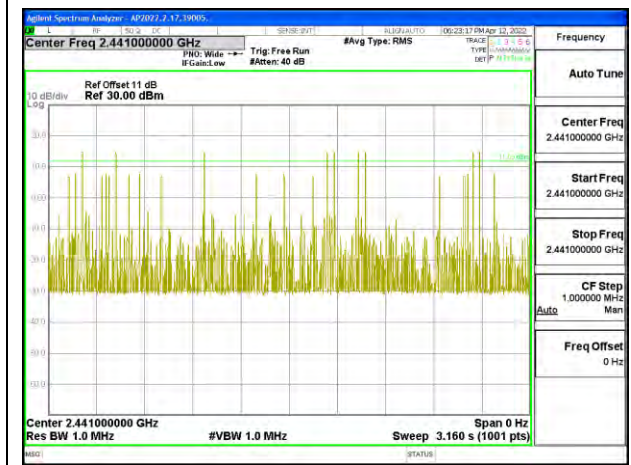
PULSE WIDTH – 3DH3



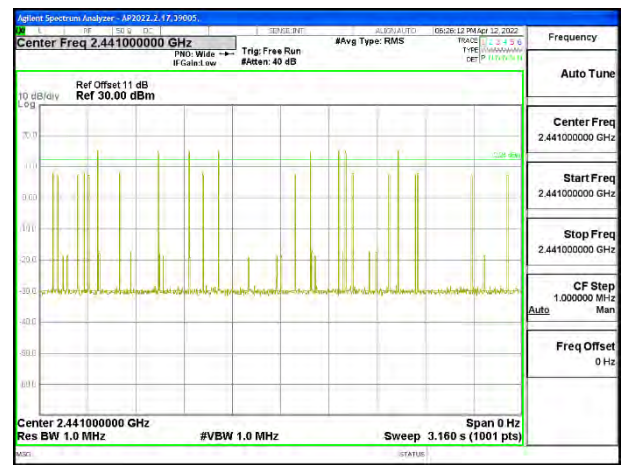
PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

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

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband power sensor. Peak output power was read directly from power meter.

RESULTS

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	RA 39005
Date:	6/21/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.34	21	-6.66
Middle	2441	14.35	21	-6.65
High	2480	14.29	21	-6.71

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	RA 39005
Date:	6/21/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.23	21	-6.77
Middle	2441	14.22	21	-6.78
High	2480	14.21	21	-6.79

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	RA 39005
Date:	6/21/2022

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	14.24	21	-6.76
Middle	2441	14.23	21	-6.77
High	2480	14.22	21	-6.78

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

The transmitter output is connected to a power meter.

The power output was measured on the EUT antenna port using SMA cable with 10dB attenuator connected to a power meter via wideband power sensor. Gated average output power was read directly from power meter.

RESULTS

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	RA 39005
Date	6/21/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	14.07
Middle	2441	14.03
High	2480	13.97

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	RA 39005
Date	6/21/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.50
Middle	2441	11.50
High	2480	11.50

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	RA 39005
Date	6/21/2022

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.51
Middle	2441	11.50
High	2480	11.50

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.

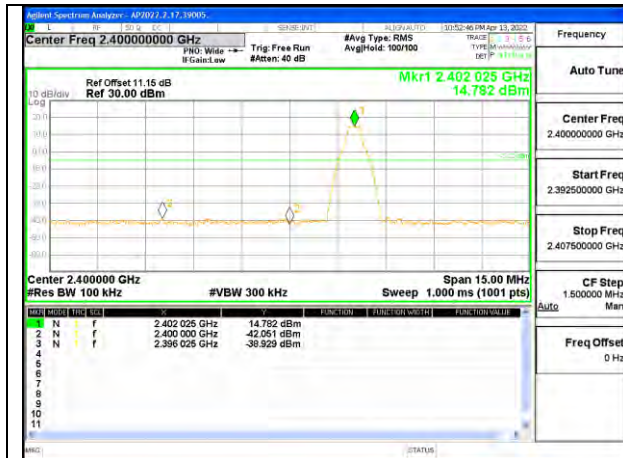
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

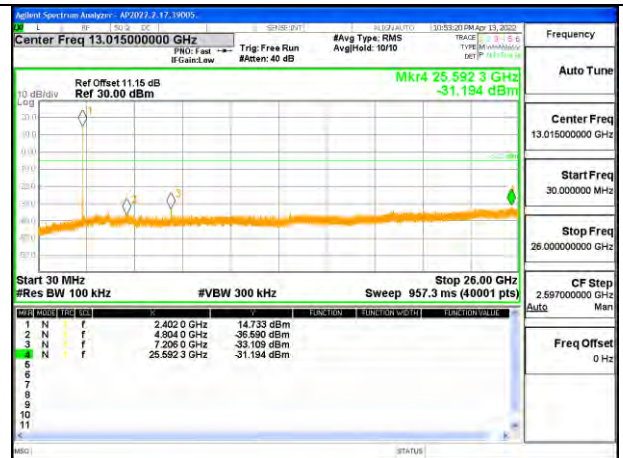
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

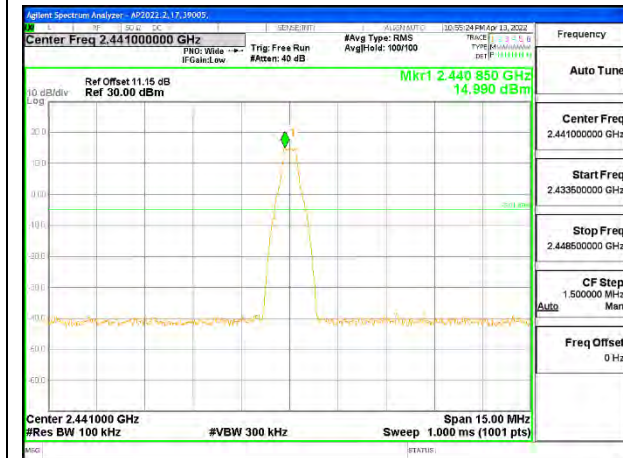
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



LOW CHANNEL BANDEDGE



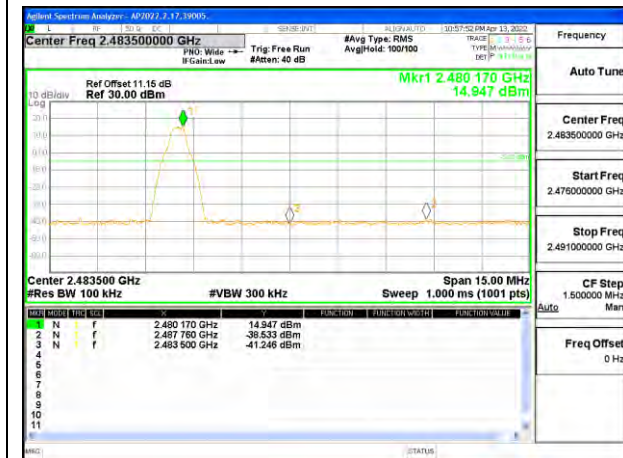
OUT-OF-BAND LOW CHANNEL



IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

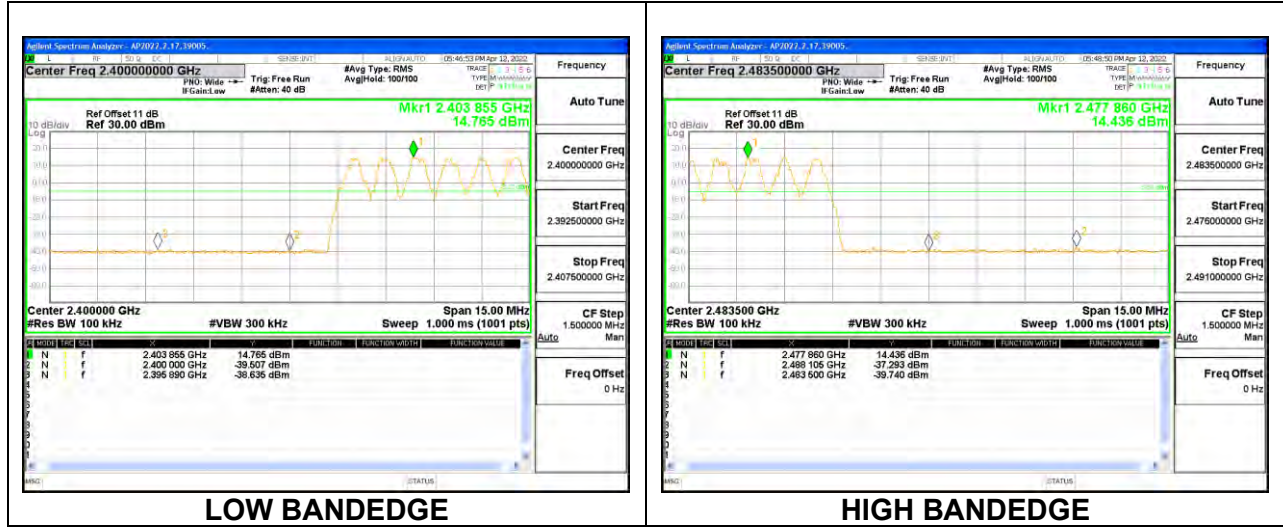


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

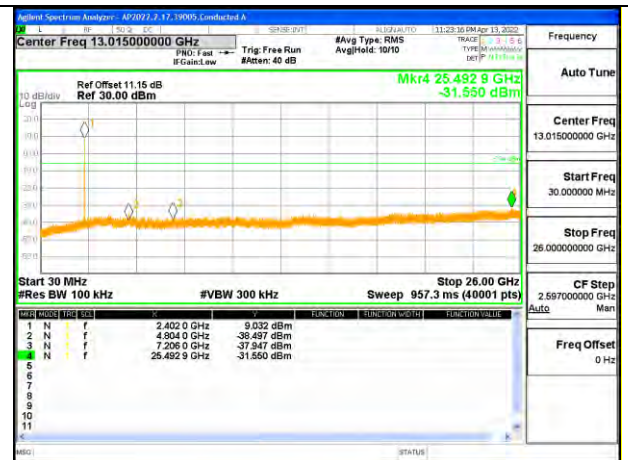


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

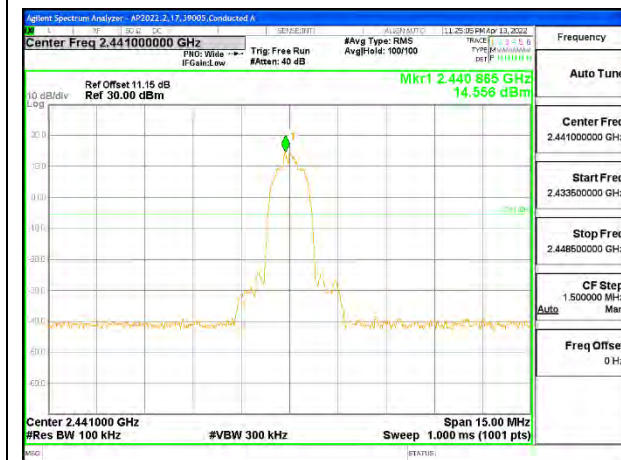
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



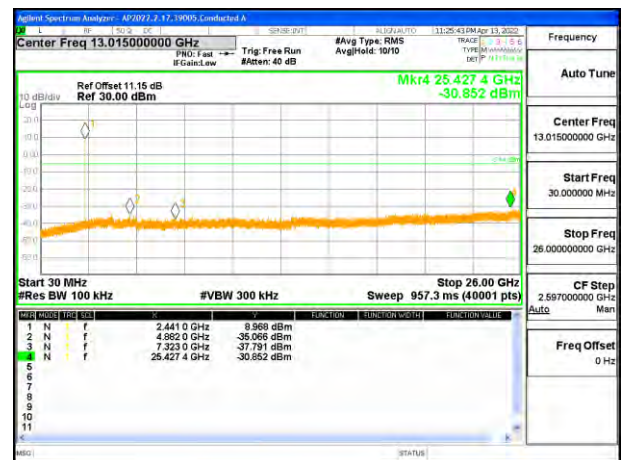
LOW CHANNEL BANDEDGE



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 in the 30-1000MHz range, 9kHz for peak and/or quasi-peak detection measurements in the 0.15-30MHz range and 200Hz for peak and/or quasi-peak detection measurements in the 9 to 150kHz range. Peak detection is used unless otherwise noted as quasi-peak or average (9-90kHz and 110-490kHz).

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

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

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

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

2D antenna use - 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.

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

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

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

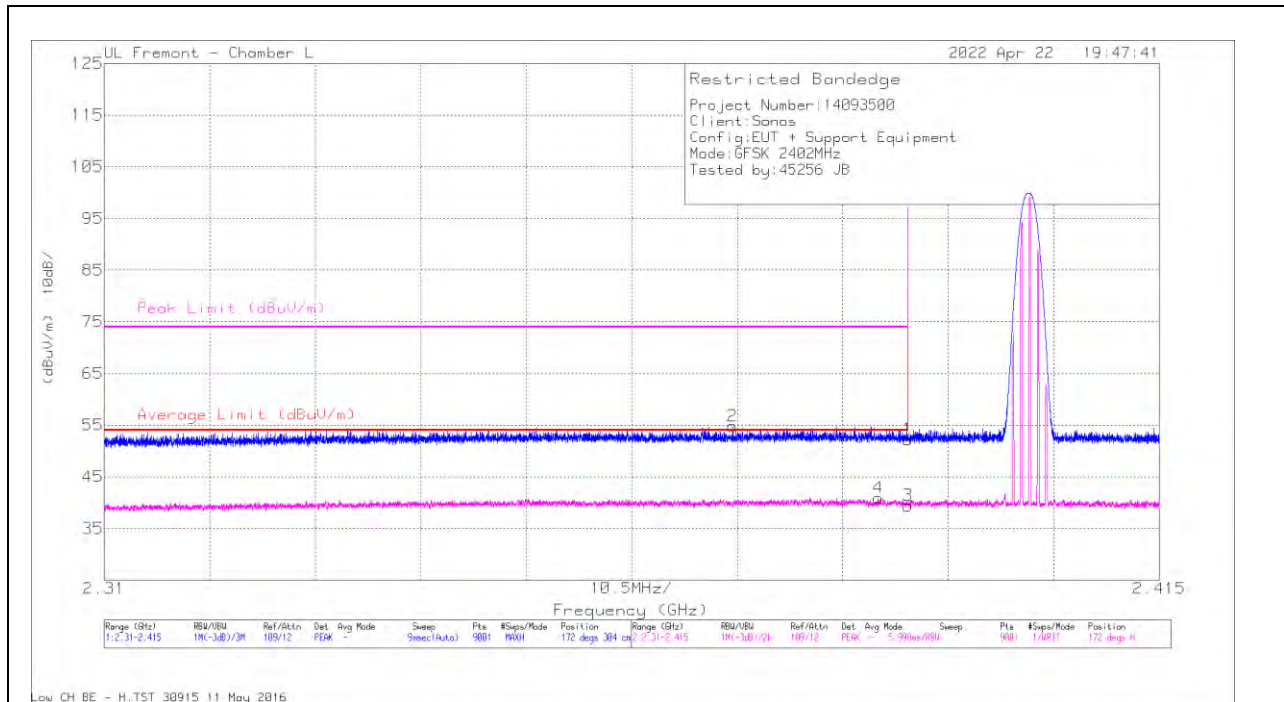
Note: The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table), using the free space impedance of 377 Ohms. For example, the measurement at frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to $Y - 51.5 = Z$ dBuA/m, which has the same margin, W dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Trace Markers

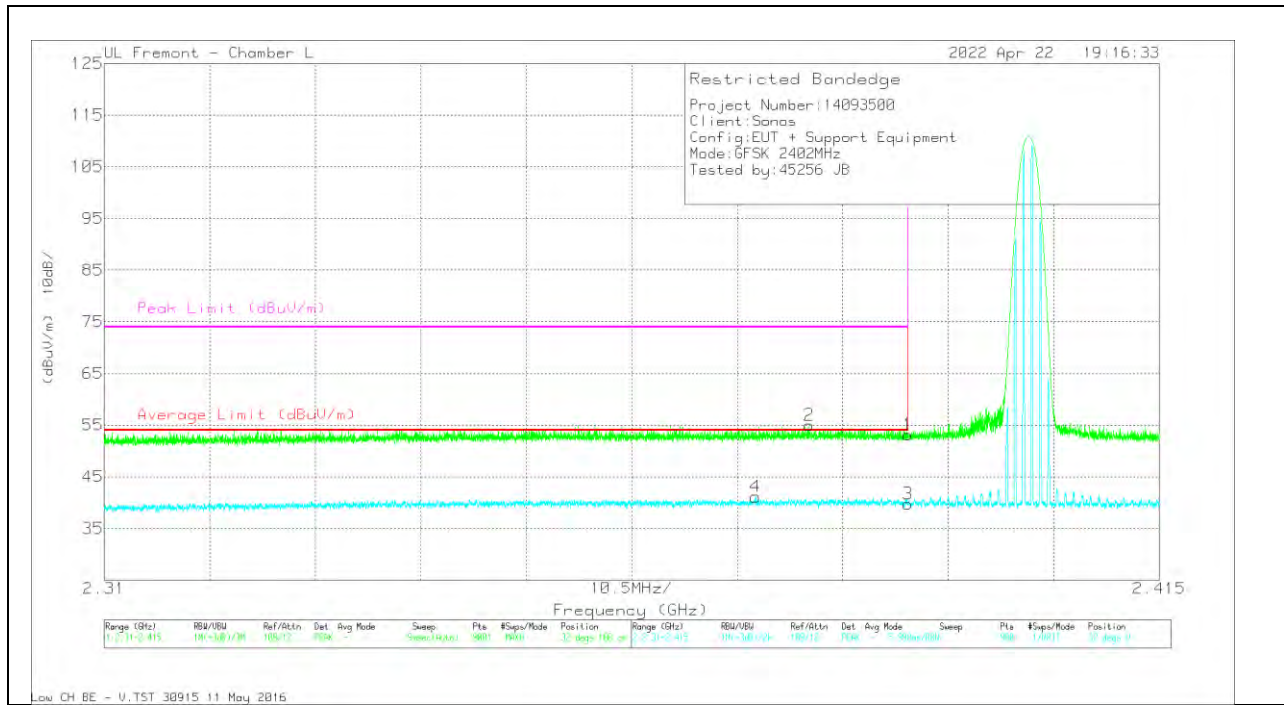
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	31.67	Pk	32	-11.5	52.17	-	-	74	-21.83	172	304	H
2	* 2.372535	34.17	PK	32.1	-11.5	54.77	-	-	74	-19.23	172	304	H
3	* 2.39	18.93	VA1T	32	-11.5	39.43	54	-14.57	-	-	172	304	H
4	* 2.387026	20.31	VA1T	32.1	-11.5	40.91	54	-13.09	-	-	172	304	H

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

Pk - Peak detector

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

VERTICAL RESULT



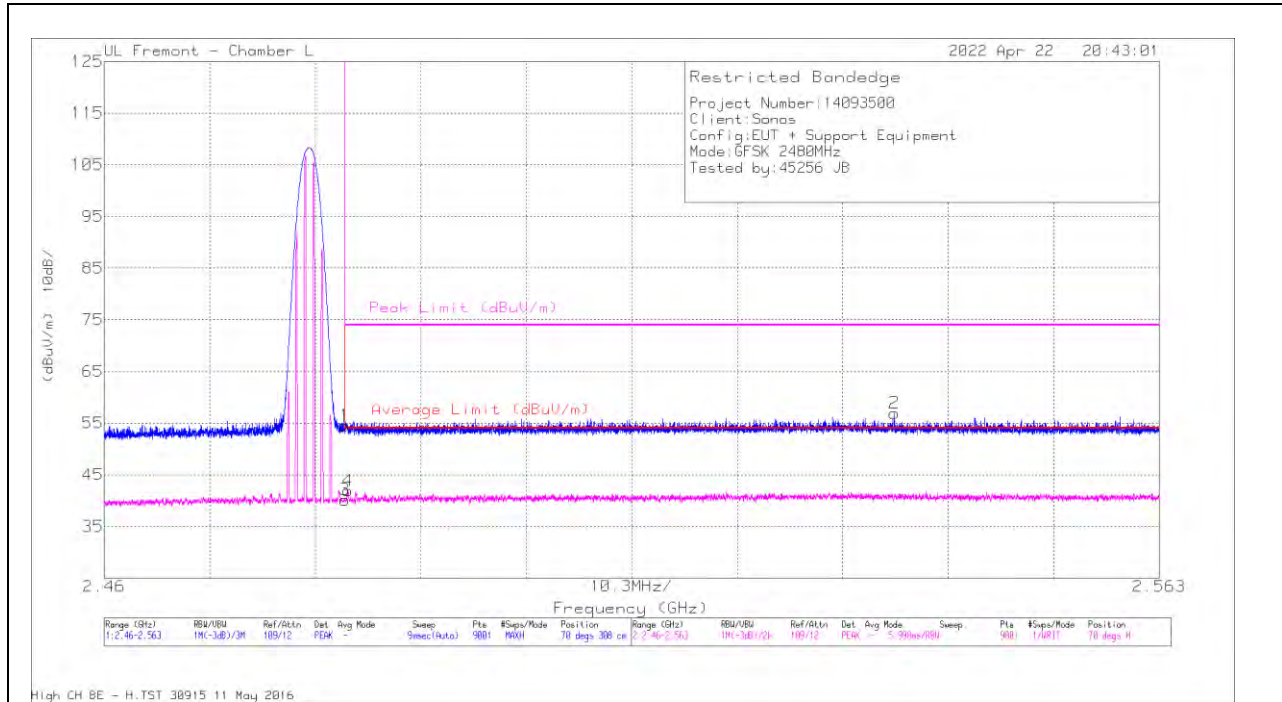
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	32.63	Pk	32	-11.5	53.13	-	-	74	-20.87	32	160	V
2	* 2.380154	34.36	Pk	32.1	-11.5	54.96	-	-	74	-19.04	32	160	V
3	* 2.39	19.24	VA1T	32	-11.5	39.74	54	-14.26	-	-	32	160	V
4	* 2.37481	20.53	VA1T	32.1	-11.5	41.13	54	-12.87	-	-	32	160	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmitted duration

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT

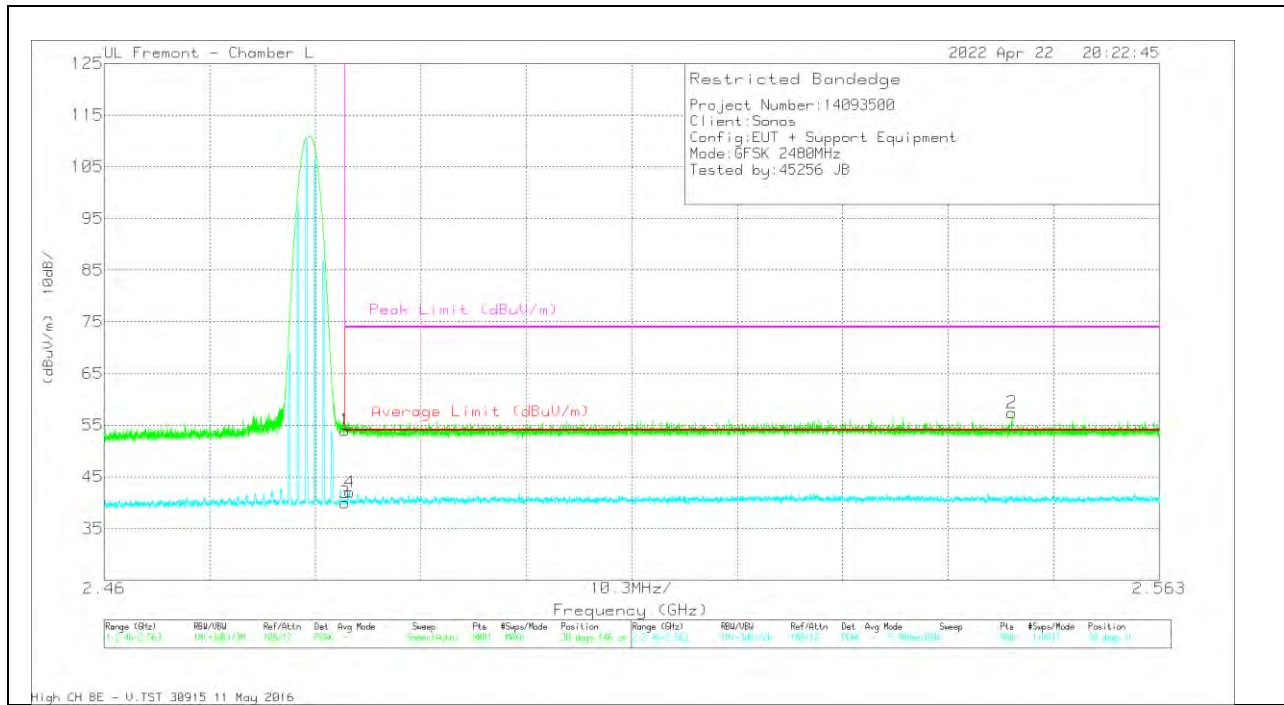


Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/CbI/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	33.3	Pk	32.3	-11.1	54.5	-	-	74	-19.5	70	308	H
2	2.537133	35.54	Pk	32.4	-11	56.94	-	-	74	-17.06	70	308	H
3	* 2.4835	18.96	VA1T	32.3	-11.1	40.16	54	-13.84	-	-	70	308	H
4	* 2.483804	20.69	VA1T	32.3	-11.1	41.89	54	-12.11	-	-	70	308	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmitted duration

VERTICAL RESULT



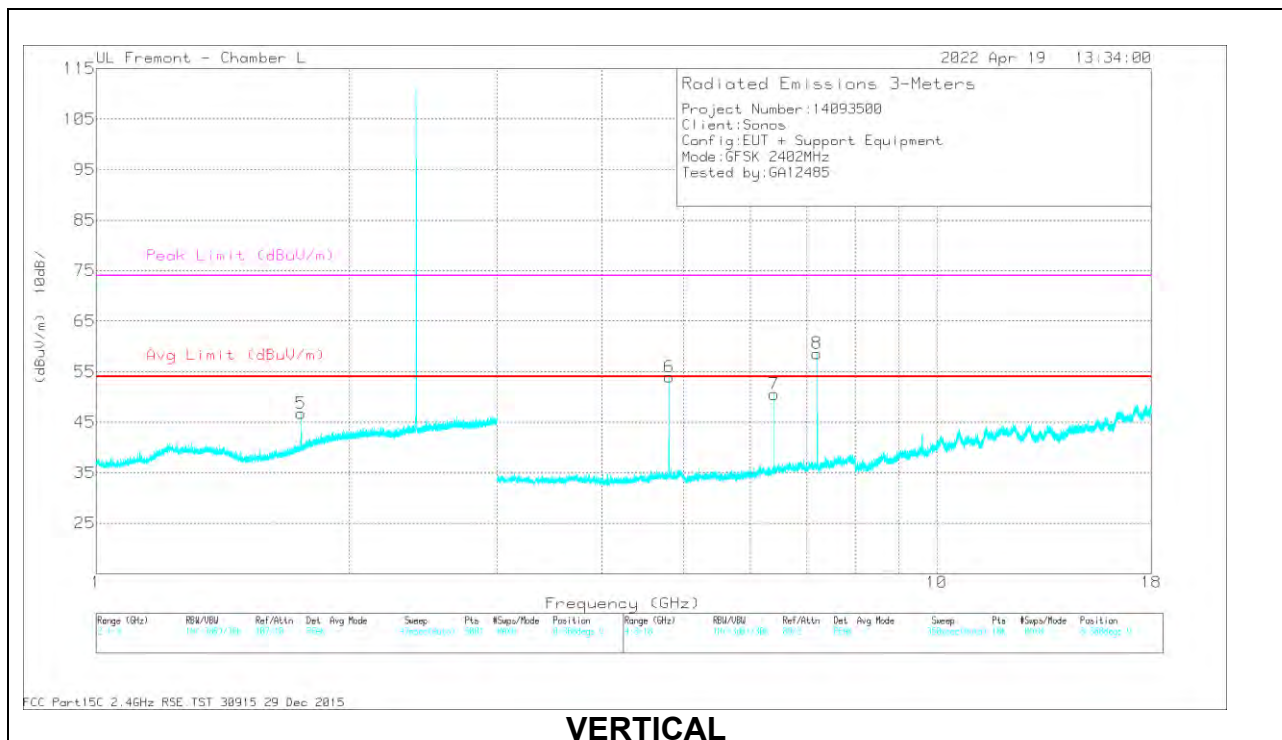
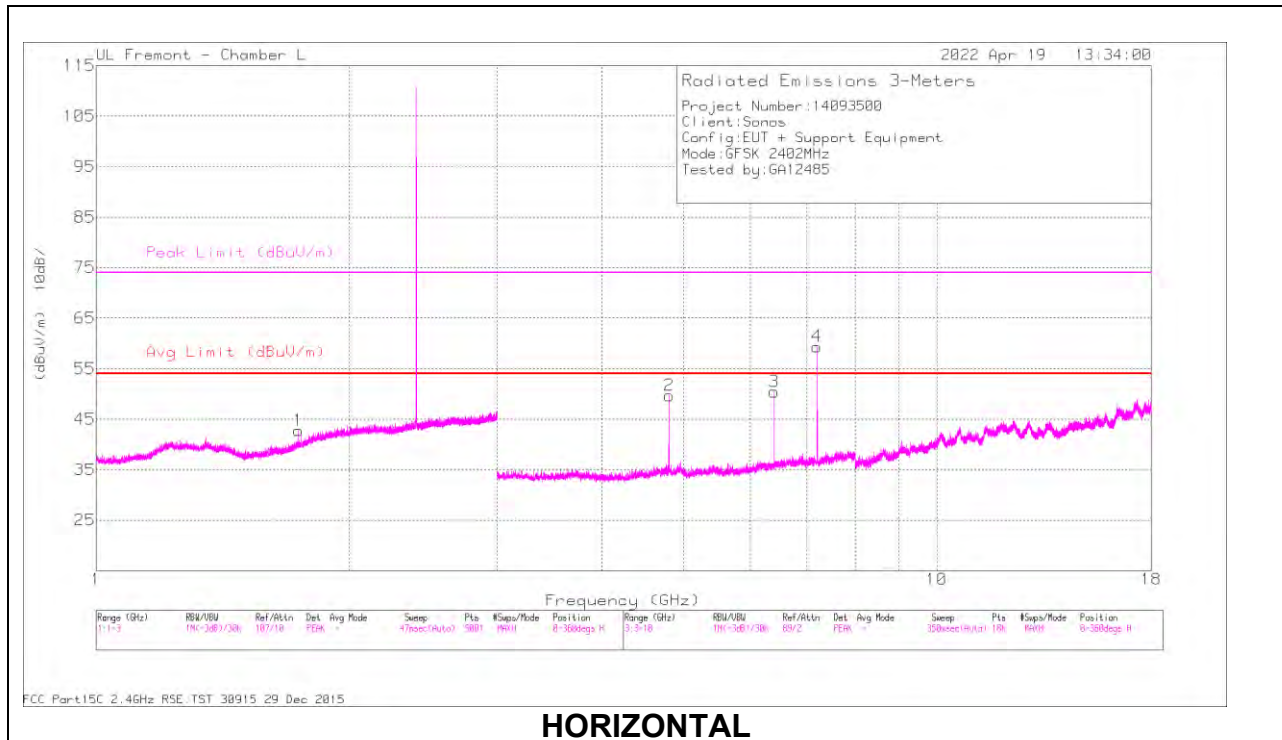
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	32.82	Pk	32.3	-11.1	54.02	-	-	74	-19.98	30	146	V
2	2.548611	36.2	Pk	32.2	-11	57.4	-	-	74	-16.6	30	146	V
3	* 2.4835	18.8	VA1T	32.3	-11.1	40	54	-14	-	-	30	146	V
4	* 2.483964	20.82	VA1T	32.3	-11.1	42.02	54	-11.98	-	-	30	146	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmitted duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

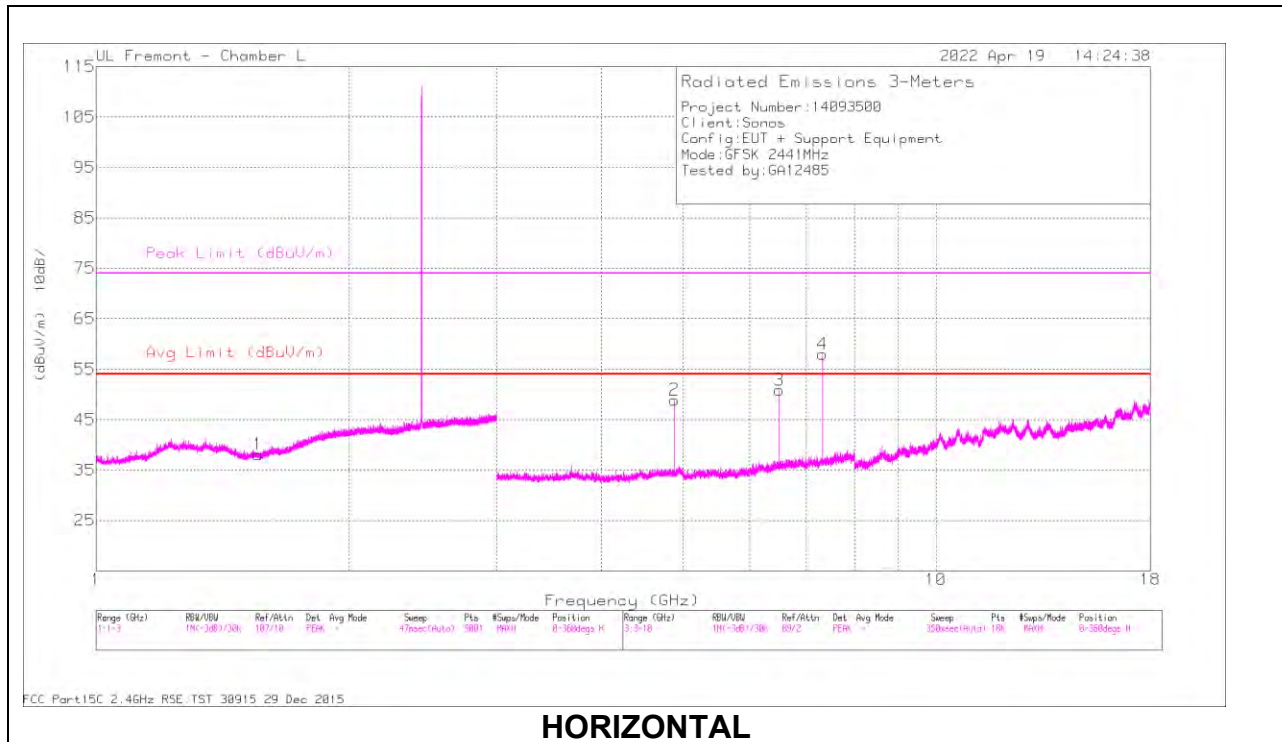
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.738521	40.78	PKFH	29.5	-21.3	48.98	-	-	-	-	198	273	H
	1.740735	27.47	VA1T	29.5	-21.3	35.67	-	-	-	-	198	273	H
5	1.751474	40.98	PKFH	29.6	-21.3	49.28	-	-	-	-	77	188	V
	1.751889	27.16	VA1T	29.6	-21.3	35.46	-	-	-	-	77	188	V
4	7.205997	45.58	PKFH	35.6	-20.2	60.98	-	-	-	-	353	101	H
	7.205861	28.21	VA1T	35.6	-20.1	43.71	-	-	-	-	353	101	H
2	* 4.803718	47.14	PKFH	34.1	-24.5	56.74	-	-	74	-17.26	49	117	H
	* 4.803846	32.58	VA1T	34.1	-24.5	42.18	54	-11.82	-	-	49	117	H
3	6.405271	40.41	PKFH	35.7	-21.4	54.71	-	-	-	-	4	106	H
	6.405354	27.28	VA1T	35.7	-21.4	41.58	-	-	-	-	4	106	H
8	7.205917	47.38	PKFH	35.6	-20.1	62.88	-	-	-	-	187	115	V
	7.205889	30	VA1T	35.6	-20.1	45.5	-	-	-	-	187	115	V
6	* 4.803838	47.2	PKFH	34.1	-24.5	56.8	-	-	74	-17.2	128	108	V
	* 4.803914	32.15	VA1T	34.1	-24.5	41.75	54	-12.25	-	-	128	108	V
7	6.405339	42.82	PKFH	35.7	-21.4	57.12	-	-	-	-	129	399	V
	6.405354	28.25	VA1T	35.7	-21.4	42.55	-	-	-	-	129	399	V

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

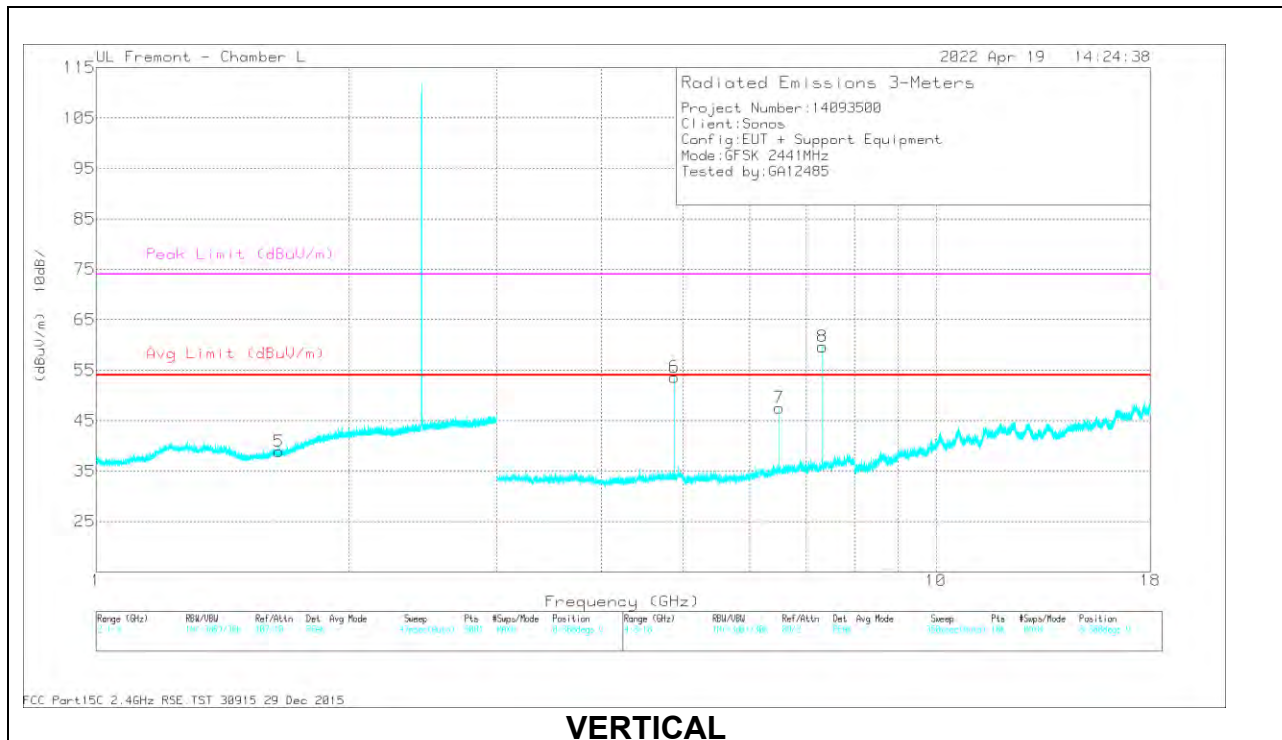
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

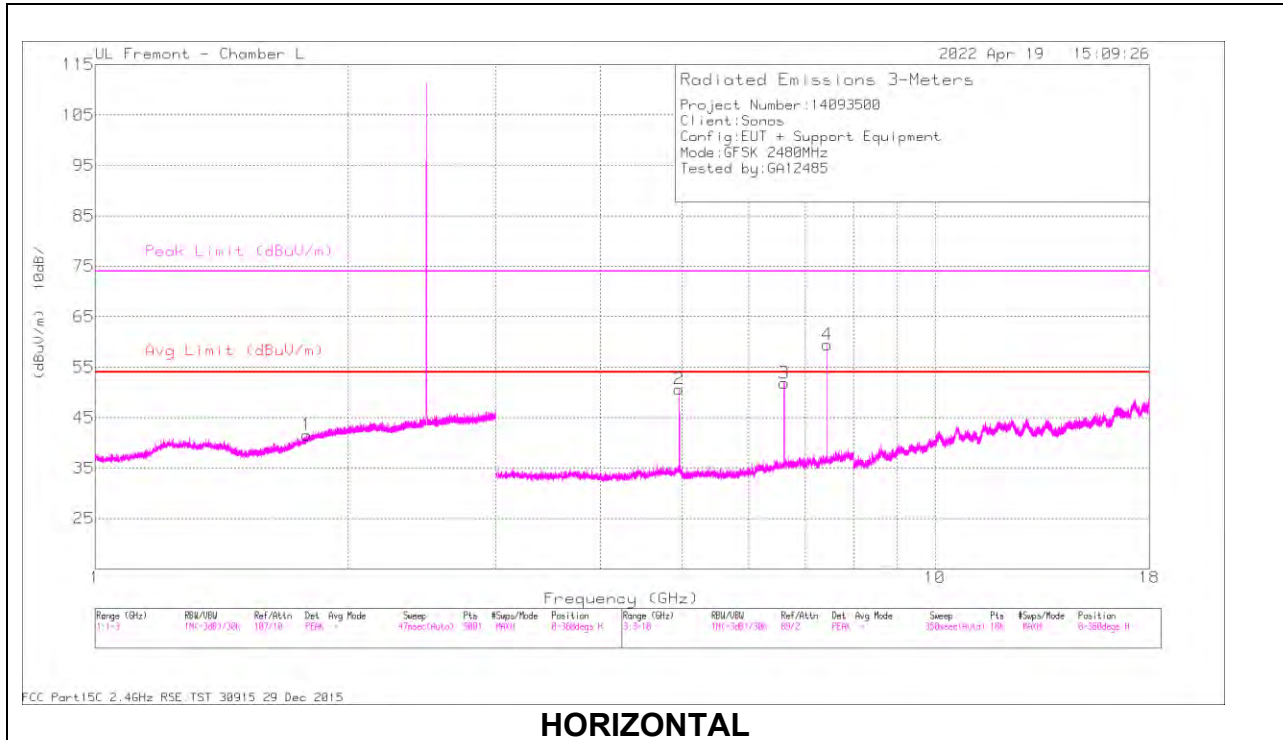
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.558769	41.45	PKFH	27.8	-22	47.25	-	-	74	-26.75	268	159	H
	* 1.557003	27.69	VA1T	27.8	-22	33.49	54	-20.51	-	-	268	159	H
5	1.652058	41.11	PKFH	28.4	-21.7	47.81	-	-	-	-	287	219	V
	1.650307	27.21	VA1T	28.4	-21.7	33.91	-	-	-	-	287	219	V
2	* 4.88174	47.38	PKFH	34.2	-24.3	57.28	-	-	74	-16.72	49	112	H
	* 4.882048	32.21	VA1T	34.2	-24.3	42.11	54	-11.89	-	-	49	112	H
3	6.509335	40.15	PKFH	35.8	-21.6	54.35	-	-	-	-	10	109	H
	6.509367	27.18	VA1T	35.8	-21.6	41.38	-	-	-	-	10	109	H
4	* 7.323042	50.55	PKFH	35.6	-20.1	66.05	-	-	74	-7.95	44	113	H
	* 7.32281	31.81	VA1T	35.6	-20.1	47.31	54	-6.69	-	-	44	113	H
8	* 7.322994	50.92	PKFH	35.6	-20.1	66.42	-	-	74	-7.58	187	113	V
	* 7.32293	32.17	VA1T	35.6	-20.1	47.67	54	-6.33	-	-	187	113	V
6	* 4.882012	45.49	PKFH	34.2	-24.3	55.39	-	-	74	-18.61	357	102	V
	* 4.881936	29.87	VA1T	34.2	-24.3	39.77	54	-14.23	-	-	357	102	V
7	6.509251	36.1	PKFH	35.8	-21.6	50.3	-	-	-	-	10	102	V
	6.509267	23.95	VA1T	35.8	-21.6	38.15	-	-	-	-	10	102	V

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

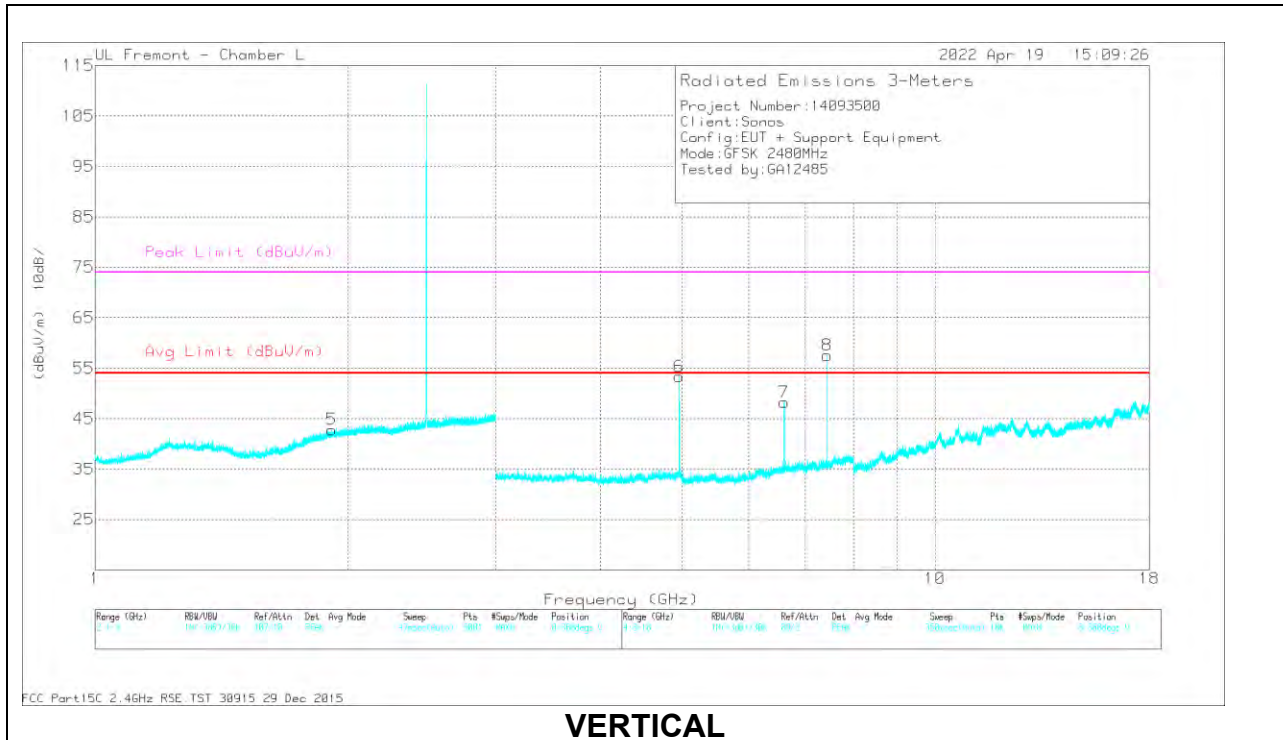
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

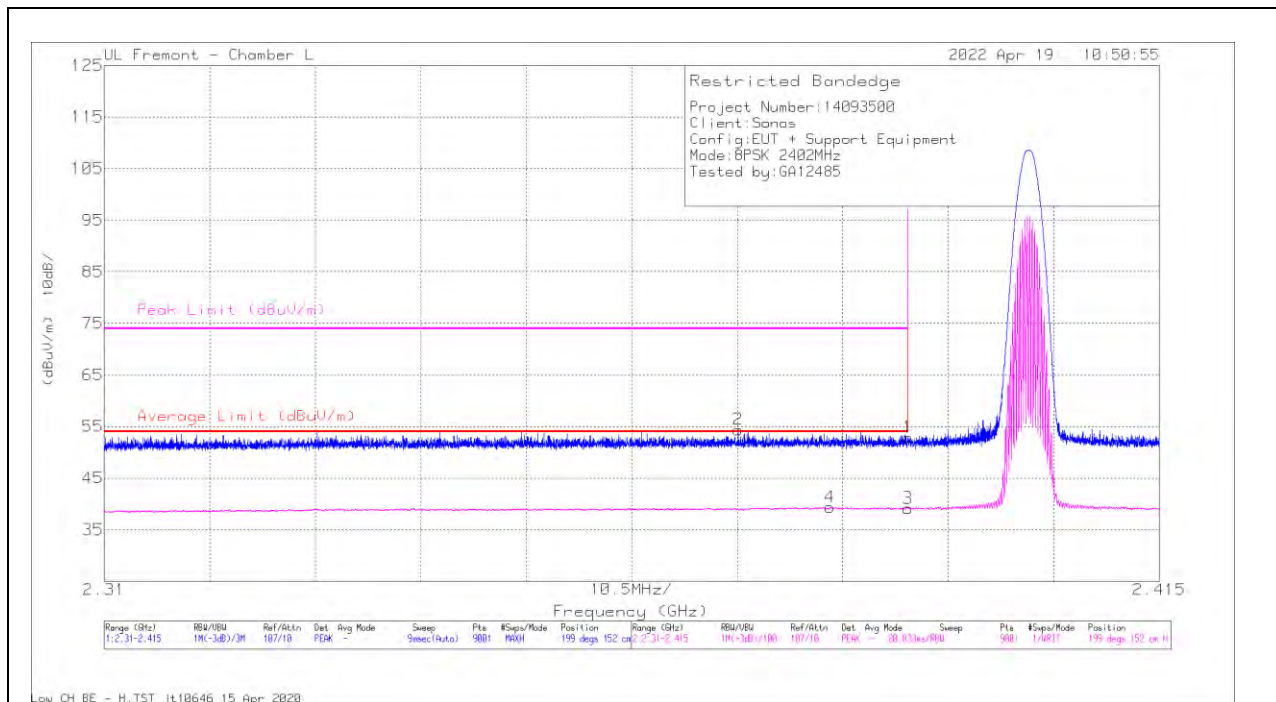
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.786248	41.01	PKFH	30	-21.2	49.81	-	-	-	-	13	193	H
	1.784486	27.3	VA1T	30	-21.2	36.1	-	-	-	-	13	193	H
5	1.91385	40.72	PKFH	31.2	-20.8	51.12	-	-	-	-	80	156	V
	1.912719	27.11	VA1T	31.2	-20.8	37.51	-	-	-	-	80	156	V
2	* 4.959912	44.21	PKFH	34.2	-23.2	55.21	-	-	74	-18.79	48	106	H
	* 4.959988	29.59	VA1T	34.2	-23.2	40.59	54	-13.41	-	-	48	106	H
3	6.613174	41.81	PKFH	35.7	-21	56.51	-	-	-	-	41	110	H
	6.613286	28.16	VA1T	35.7	-21	42.86	-	-	-	-	41	110	H
4	* 7.440154	46.49	PKFH	35.7	-20	62.19	-	-	74	-11.81	47	102	H
	* 7.439974	28.06	VA1T	35.7	-20	43.76	54	-10.24	-	-	47	102	H
6	* 4.960012	47.25	PKFH	34.2	-23.2	58.25	-	-	74	-15.75	352	112	V
	* 4.960036	31.67	VA1T	34.2	-23.2	42.67	54	-11.33	-	-	352	112	V
7	6.613272	40.08	PKFH	35.7	-21	54.78	-	-	-	-	185	111	V
	6.61323	27.39	VA1T	35.7	-21	42.09	-	-	-	-	185	111	V
8	* 7.439841	50.32	PKFH	35.7	-20	66.02	-	-	74	-7.98	188	110	V
	* 7.439973	31.28	VA1T	35.7	-20	46.98	54	-7.02	-	-	188	110	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 transmitted duration

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Trace Markers

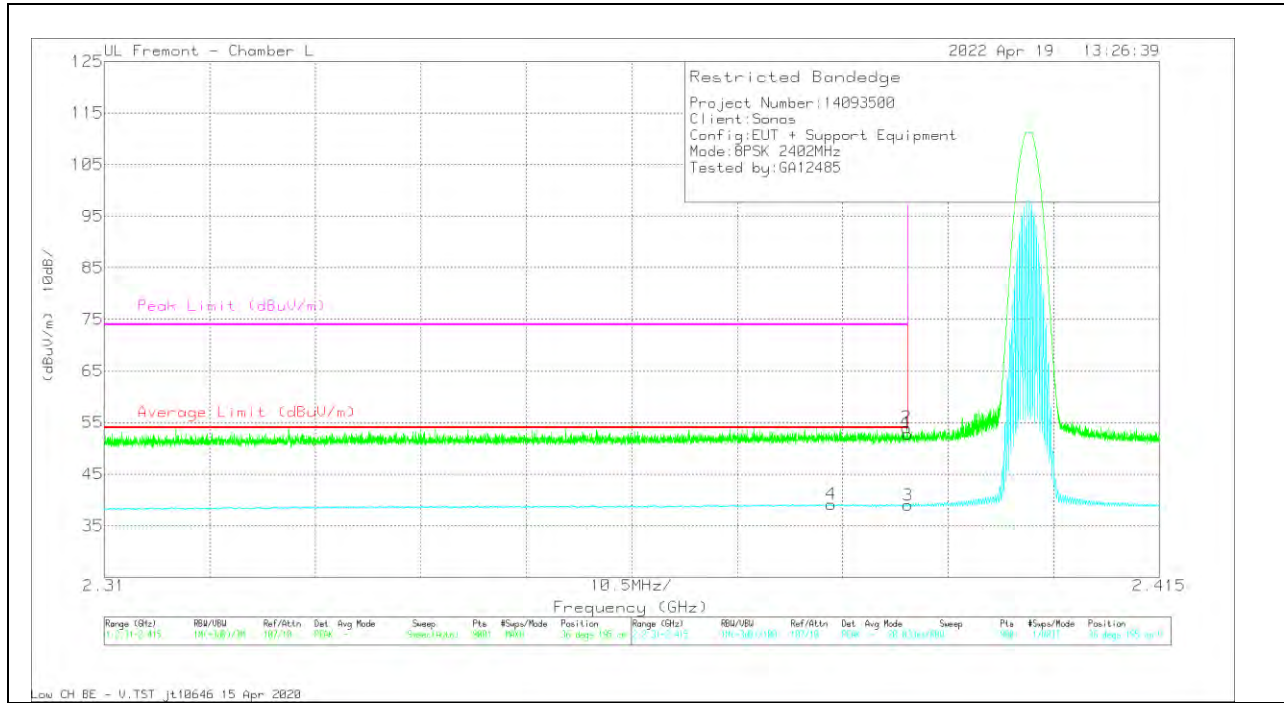
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.22	Pk	32	-19.3	52.92	-	-	74	-21.08	199	152	H
2	* 2.373072	41.69	Pk	32.1	-19.4	54.39	-	-	74	-19.61	199	152	H
3	* 2.39	26.42	VA1T	32	-19.3	39.12	54	-14.88	-	-	199	152	H
4	* 2.38223	26.66	VA1T	32.1	-19.4	39.36	54	-14.64	-	-	199	152	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmitted duration

VERTICAL RESULT



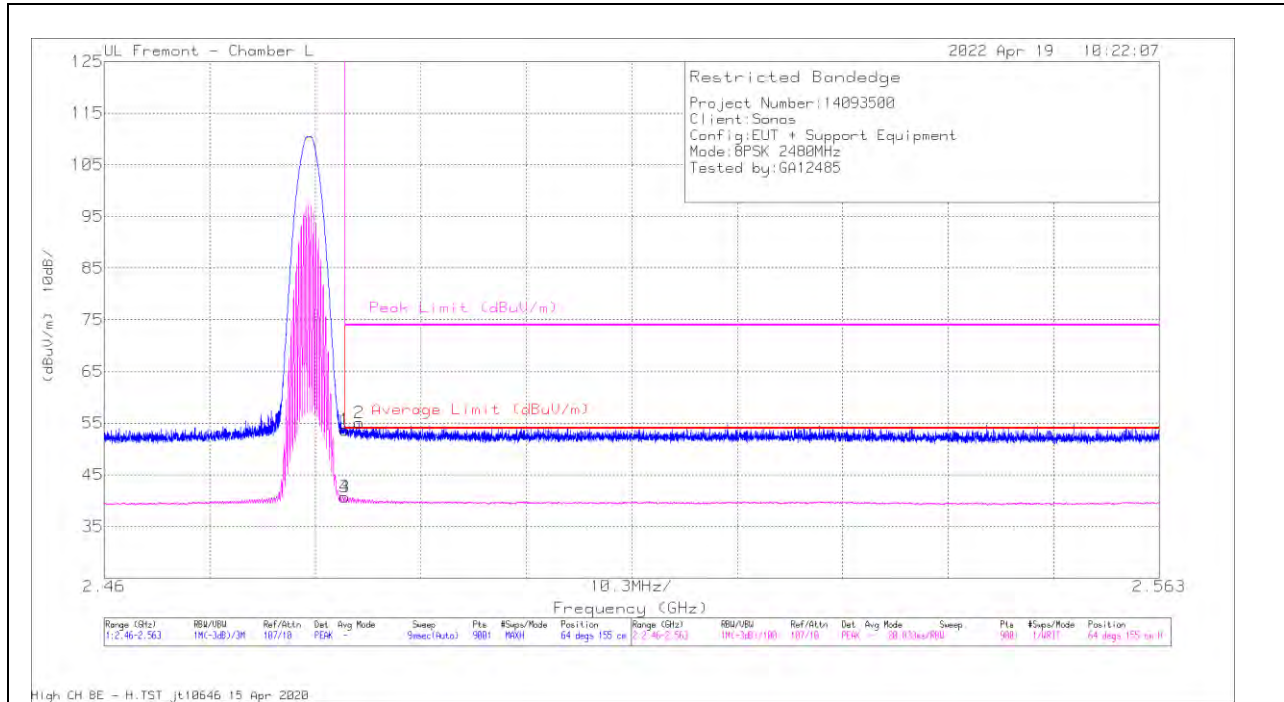
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.08	Pk	32	-19.3	52.78	-	-	74	-21.22	36	195	V
2	* 2.389861	41.3	Pk	32	-19.3	54	-	-	74	-20	36	195	V
3	* 2.39	26.28	VA1T	32	-19.3	38.98	54	-15.02	-	-	36	195	V
4	* 2.382359	26.45	VA1T	32.1	-19.4	39.15	54	-14.85	-	-	36	195	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmitted duration

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

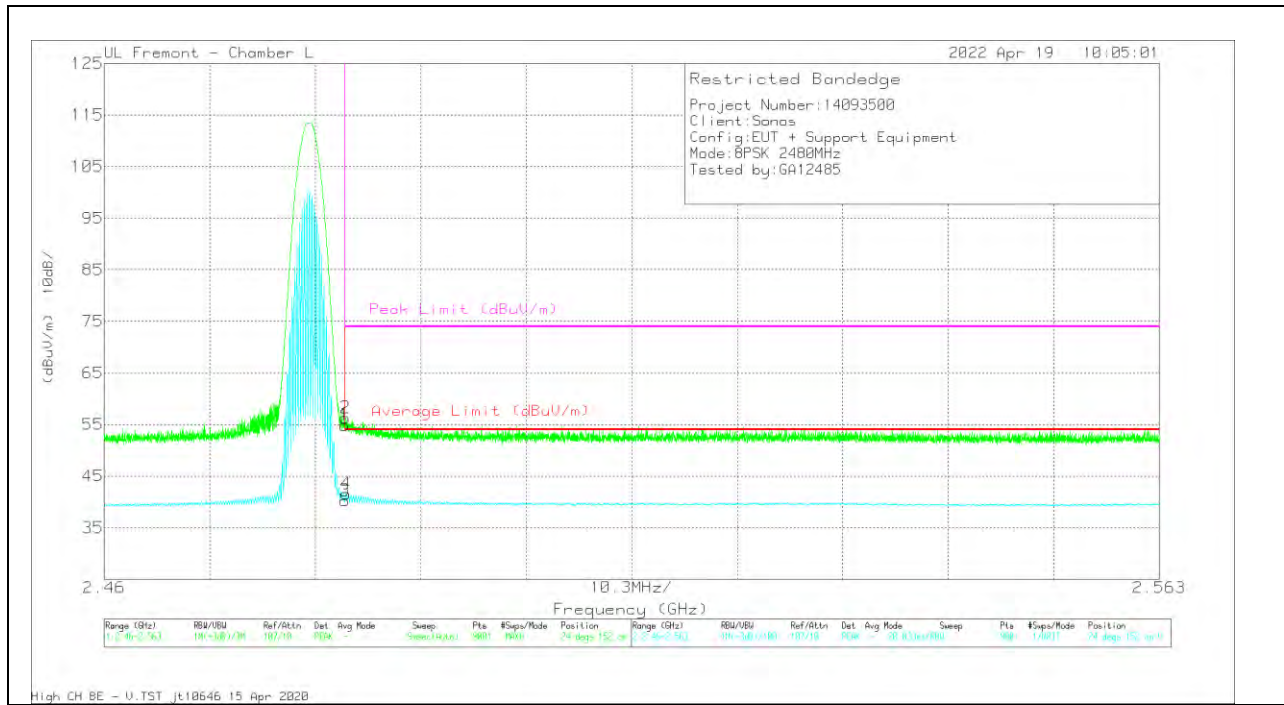
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cb1/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	40.4	Pk	32.3	-19	53.7	-	-	74	-20.3	64	155	H
2	* 2.484914	41.77	Pk	32.3	-19	55.07	-	-	74	-18.93	64	155	H
3	* 2.4835	27.4	VA1T	32.3	-19	40.7	54	-13.3	-	-	64	155	H
4	* 2.483506	27.42	VA1T	32.3	-19	40.72	54	-13.28	-	-	64	155	H

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

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmitted duration

VERTICAL RESULT



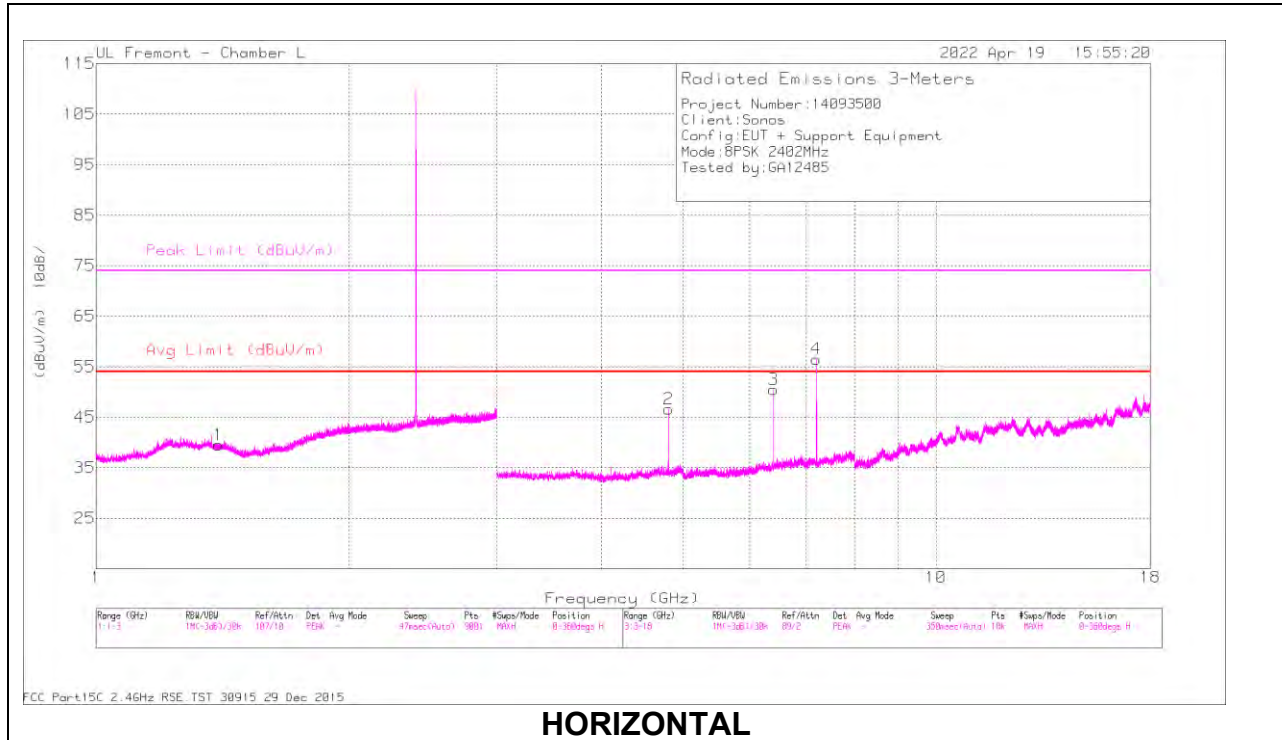
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	41.59	Pk	32.3	-19	54.89	-	-	74	-19.11	24	152	V
2	* 2.48354	43	Pk	32.3	-19	56.3	-	-	74	-17.7	24	152	V
3	* 2.4835	26.96	VA1T	32.3	-19	40.26	54	-13.74	-	-	24	152	V
4	* 2.48362	28.27	VA1T	32.3	-19	41.57	54	-12.43	-	-	24	152	V

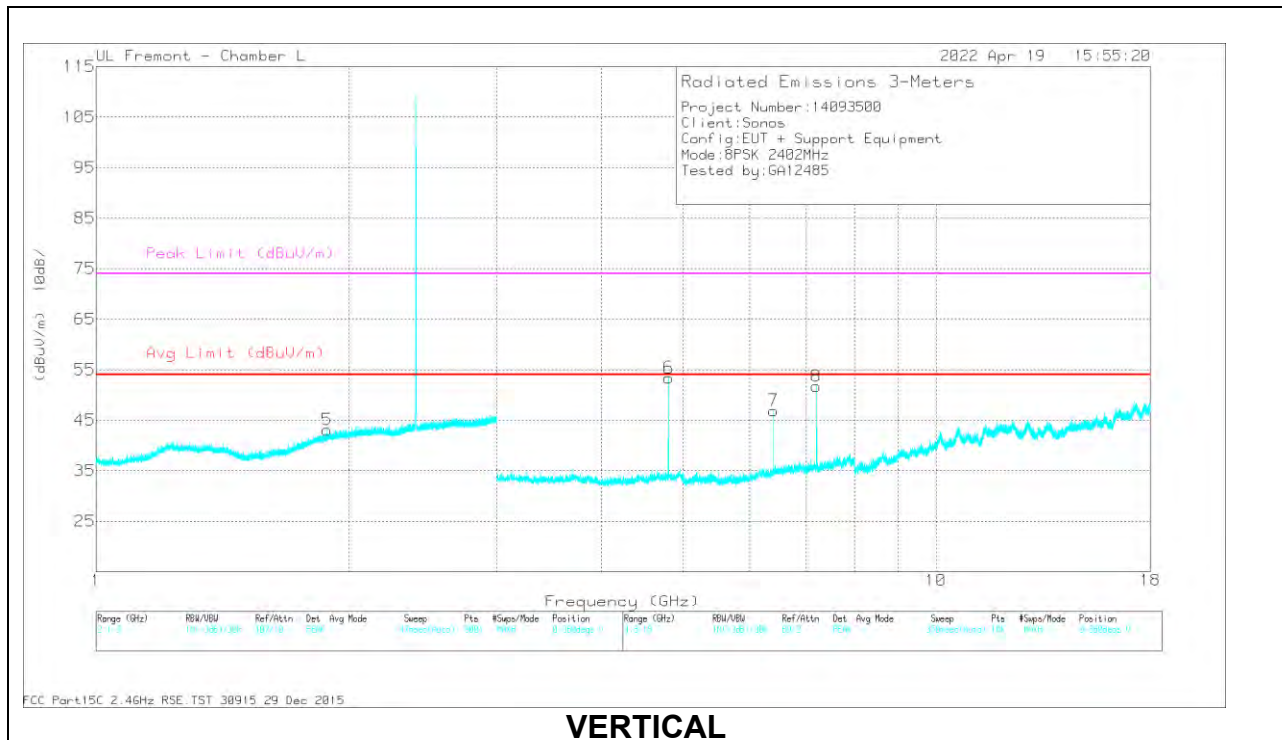
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 Pk - Peak detector
 VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmitted duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



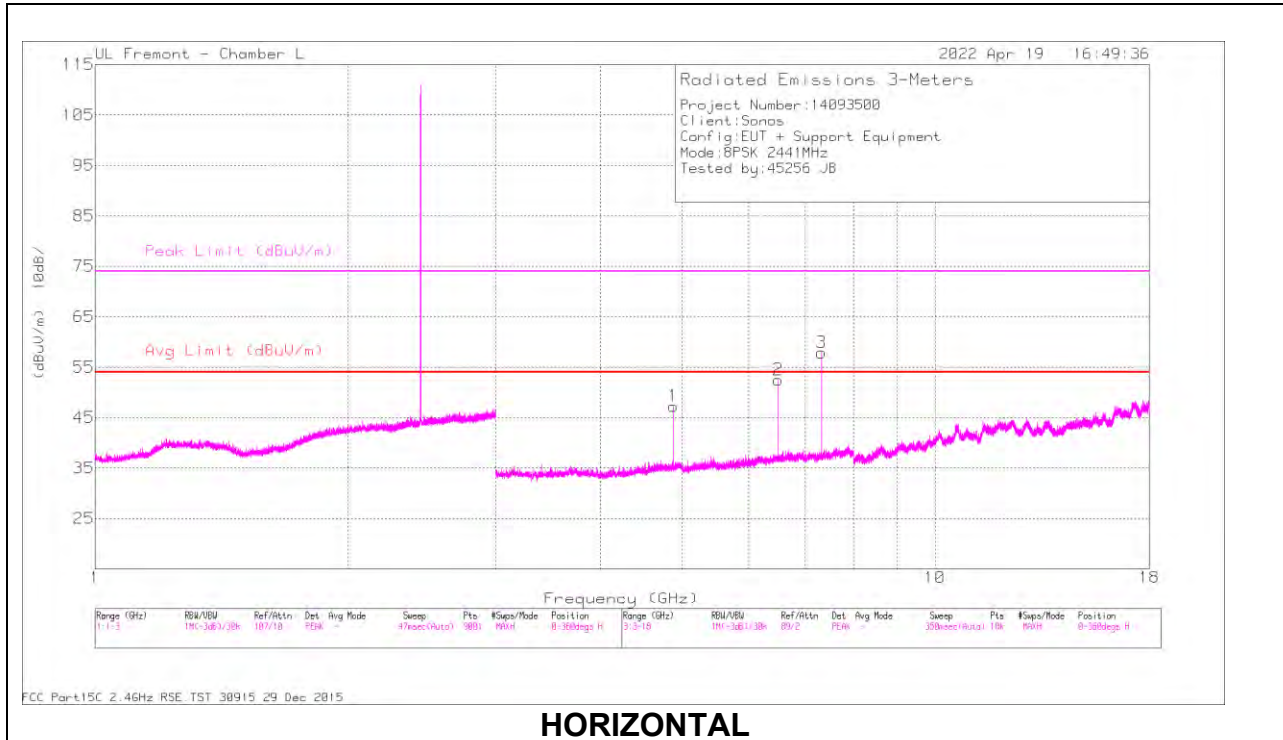
VERTICAL

RADIATED EMISSIONS

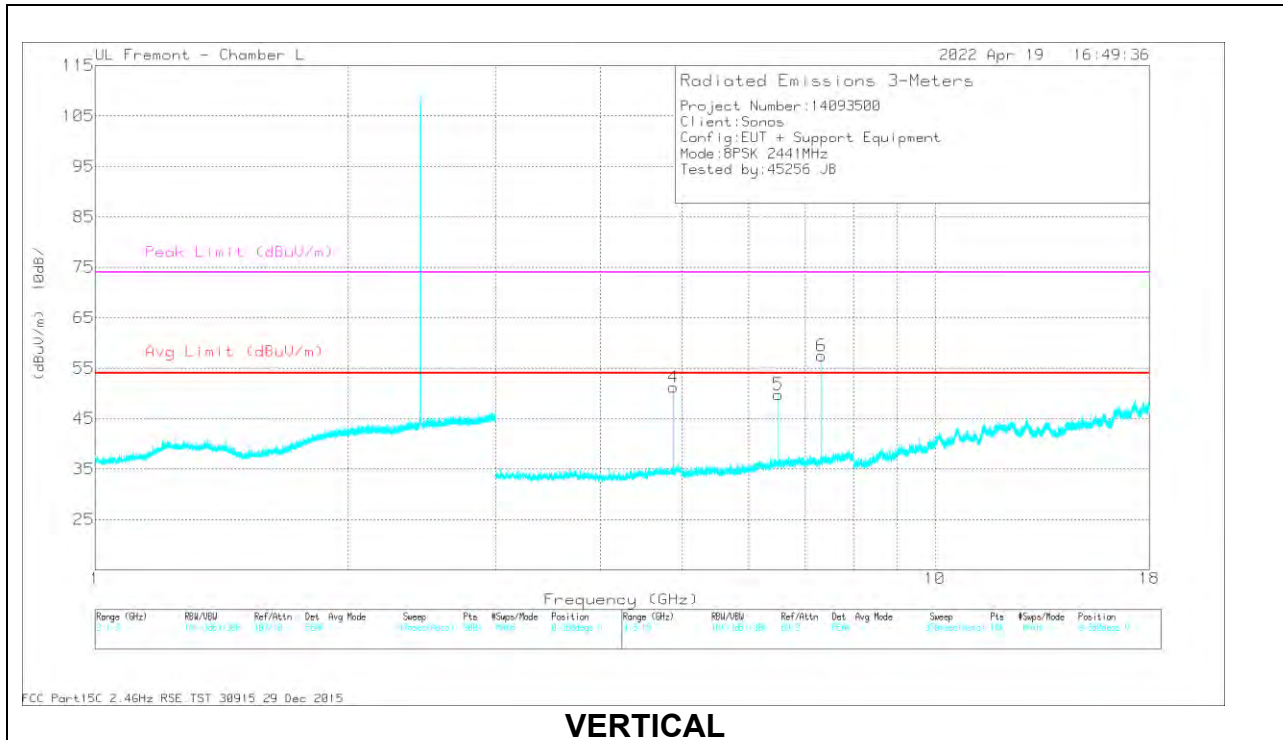
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.399666	41.32	PKFH	29.2	-22.4	48.12	-	-	74	-25.88	246	125	H
	* 1.400954	27.91	VA1T	29.2	-22.5	34.61	54	-19.39	-	-	246	125	H
5	1.885388	41.02	PKFH	31.1	-20.8	51.32	-	-	-	-	286	133	V
	1.884137	26.9	VA1T	31.1	-20.8	37.2	-	-	-	-	286	133	V
2	* 4.80357	46	PKFH	34.1	-24.5	55.6	-	-	74	-18.4	52	115	H
	* 4.804066	35.77	VA1T	34.1	-24.5	45.37	54	-8.63	-	-	52	115	H
3	6.405522	42.32	PKFH	35.7	-21.4	56.62	-	-	-	-	7	112	H
	6.405243	37.12	VA1T	35.7	-21.4	51.42	-	-	-	-	7	112	H
4	7.205953	46.57	PKFH	35.6	-20.2	61.97	-	-	-	-	349	101	H
	7.206025	31.87	VA1T	35.6	-20.2	47.27	-	-	-	-	349	101	H
6	* 4.8036	48.35	PKFH	34.1	-24.5	57.95	-	-	74	-16.05	359	110	V
	* 4.803884	35.94	VA1T	34.1	-24.5	45.54	54	-8.46	-	-	359	110	V
7	6.405406	41.1	PKFH	35.7	-21.4	55.4	-	-	-	-	12	110	V
	6.405303	35.48	VA1T	35.7	-21.4	49.78	-	-	-	-	12	110	V
8	7.206297	49.14	PKFH	35.6	-20.2	64.54	-	-	-	-	186	113	V
	7.205969	34.33	VA1T	35.6	-20.2	49.73	-	-	-	-	186	113	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 transmitted duration

MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

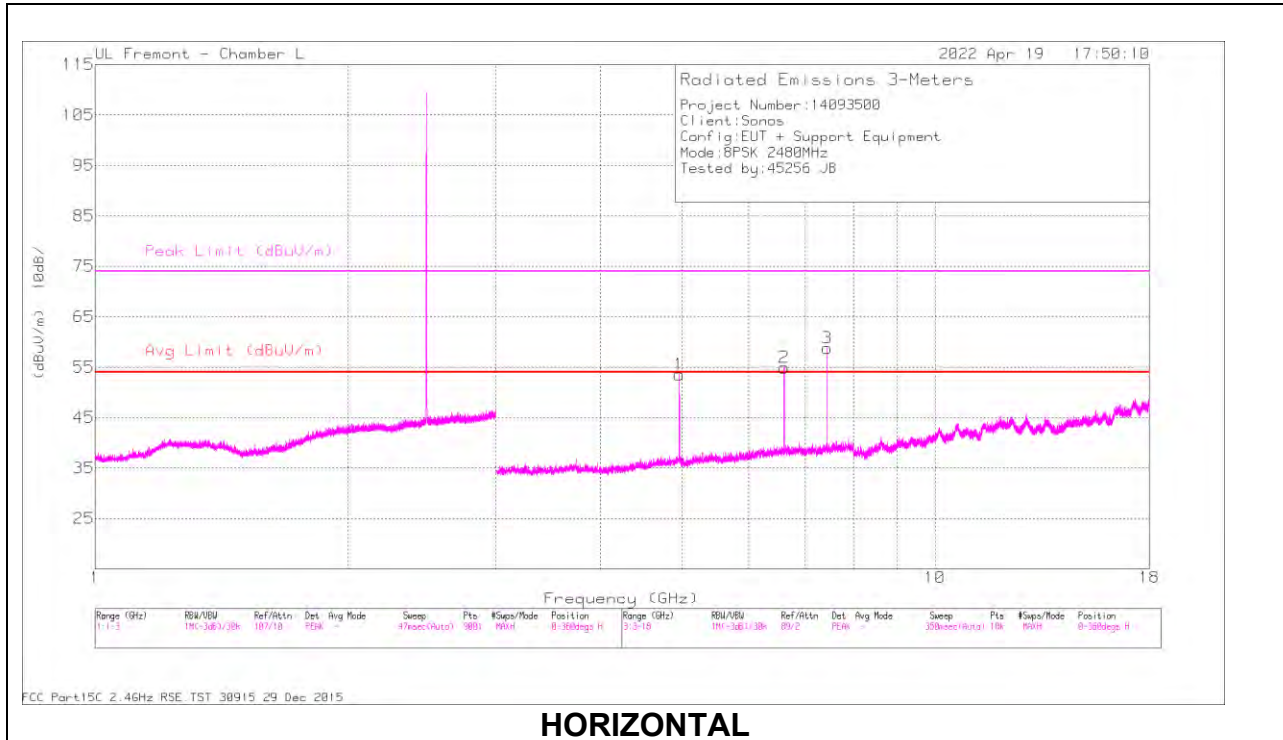
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.88151	48.38	PKFH	34.2	-24.3	58.28	-	-	74	-15.72	50	110	H
	* 4.88189	38.02	VA1T	34.2	-24.3	47.92	54	-6.08	-	-	50	110	H
3	* 7.322988	51.91	PKFH	35.6	-20.1	67.41	-	-	74	-6.59	43	112	H
	* 7.323076	36.73	VA1T	35.6	-20.1	52.23	54	-1.77	-	-	43	112	H
2	6.509351	39.66	PKFH	35.8	-21.6	53.86	-	-	-	-	39	112	H
	6.509235	34.34	VA1T	35.8	-21.6	48.54	-	-	-	-	39	112	H
4	* 4.882383	49.4	PKFH	34.2	-24.3	59.3	-	-	74	-14.7	119	113	V
	* 4.881984	37.83	VA1T	34.2	-24.3	47.73	54	-6.27	-	-	119	113	V
6	* 7.323218	50.23	PKFH	35.6	-20.1	65.73	-	-	74	-8.27	178	112	V
	* 7.322938	36.14	VA1T	35.6	-20.1	51.64	54	-2.36	-	-	178	112	V
5	6.509419	38.6	PKFH	35.8	-21.6	52.8	-	-	-	-	184	112	V
	6.509347	32.47	VA1T	35.8	-21.6	46.67	-	-	-	-	184	112	V

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

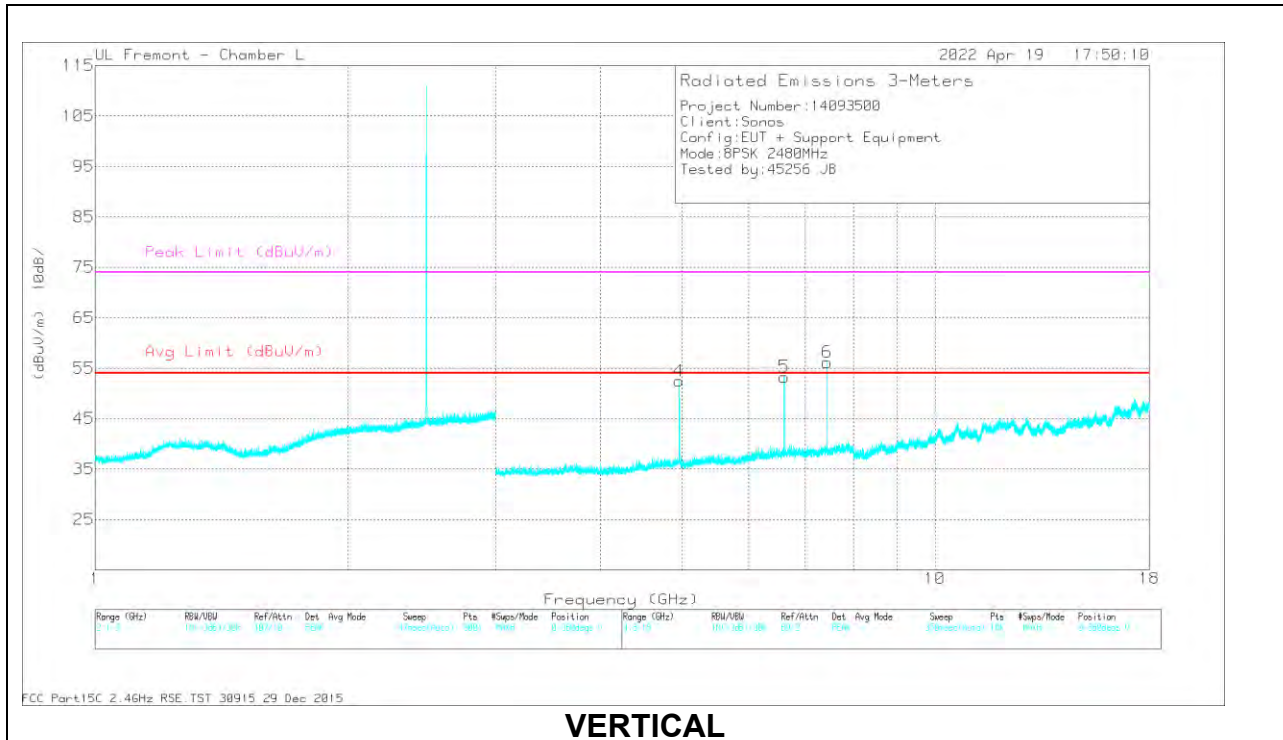
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

HIGH 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)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 4.959566	44.12	PKFH	34.2	-23.2	55.12	-	-	74	-18.88	67	102	H
	* 4.959914	34.89	VA1T	34.2	-23.2	45.89	54	-8.11	-	-	67	102	H
2	6.613454	40.98	PKFH	35.7	-21	55.68	-	-	-	-	43	112	H
	6.613186	36.06	VA1T	35.7	-21	50.76	-	-	-	-	43	112	H
3	* 7.439789	50.32	PKFH	35.7	-20	66.02	-	-	74	-7.98	43	111	H
	* 7.439921	35.39	VA1T	35.7	-20	51.09	54	-2.91	-	-	43	111	H
4	* 4.960383	46.71	PKFH	34.2	-23.2	57.71	-	-	74	-16.29	352	104	V
	* 4.959888	36.82	VA1T	34.2	-23.2	47.82	54	-6.18	-	-	352	104	V
5	6.61314	39.24	PKFH	35.7	-21	53.94	-	-	-	-	184	112	V
	6.613324	34.15	VA1T	35.7	-21	48.85	-	-	-	-	184	112	V
6	* 7.440389	51.05	PKFH	35.7	-20	66.75	-	-	74	-7.25	189	112	V
	* 7.440229	36.41	VA1T	35.7	-20	52.11	54	-1.89	-	-	189	112	V

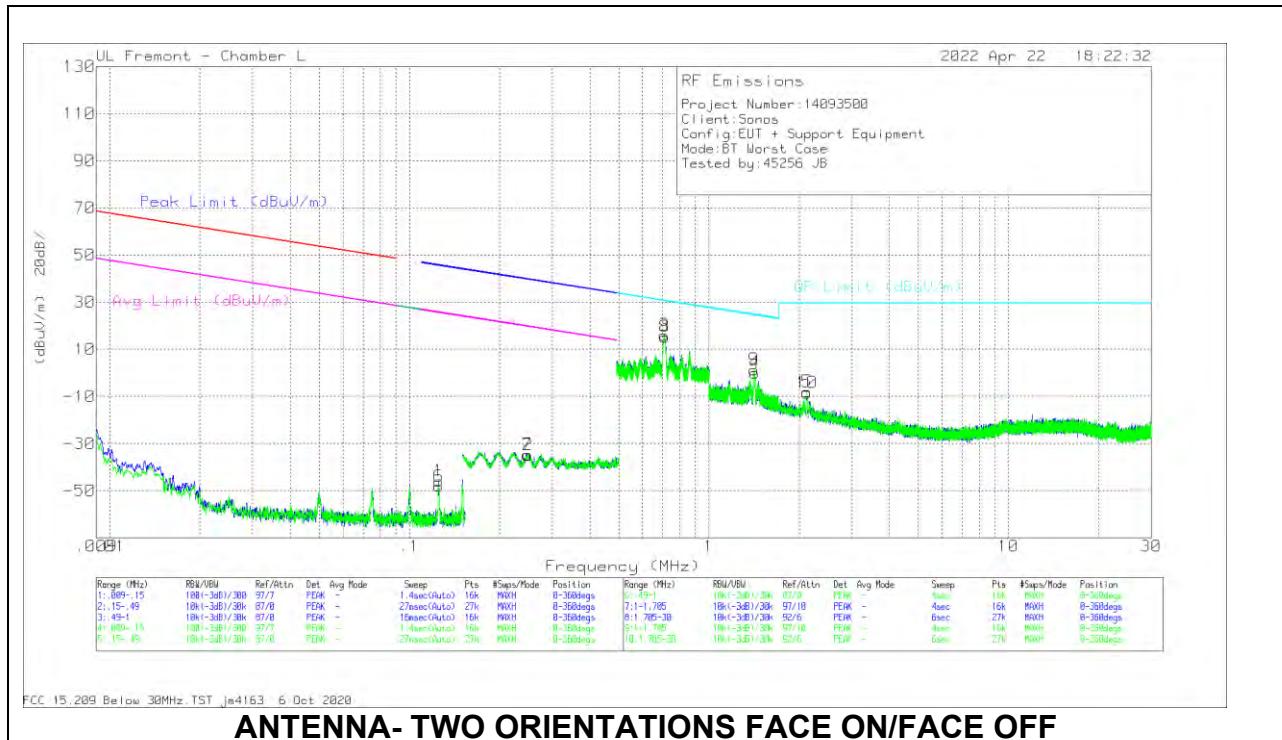
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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 transmitted duration

10.2. WORST CASE BELOW 30MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Polarity
1	.1251	10.35	Pk	55.8	-32	-80	-45.85	45.68	-91.53	25.68	-71.53	0-360	Face-On
2	.2486	20.88	Pk	56.3	-32	-80	-34.82	39.71	-74.53	19.71	-54.53	0-360	Face-On
6	.1252	8.1	Pk	55.8	-32	-80	-48.1	45.68	-93.78	25.68	-73.78	0-360	Face-Off
7	.2472	21.08	Pk	56.3	-32	-80	-34.62	39.75	-74.37	19.75	-54.37	0-360	Face-Off

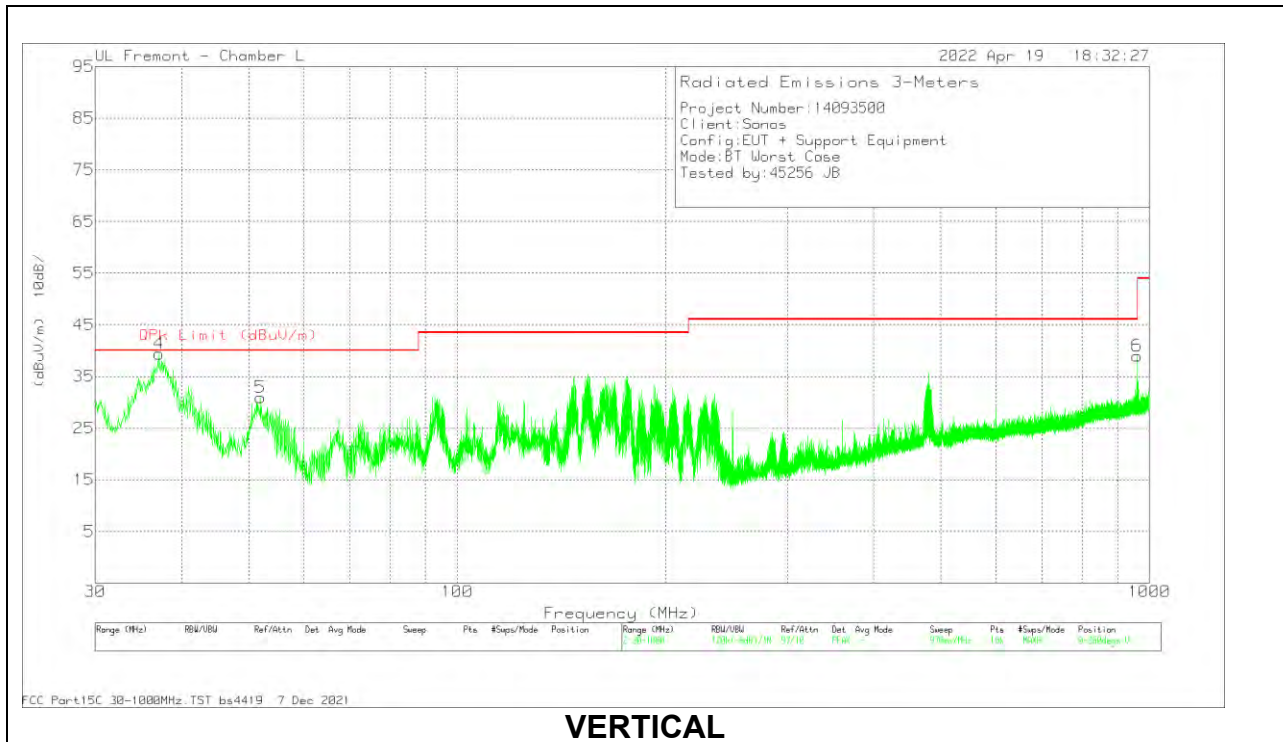
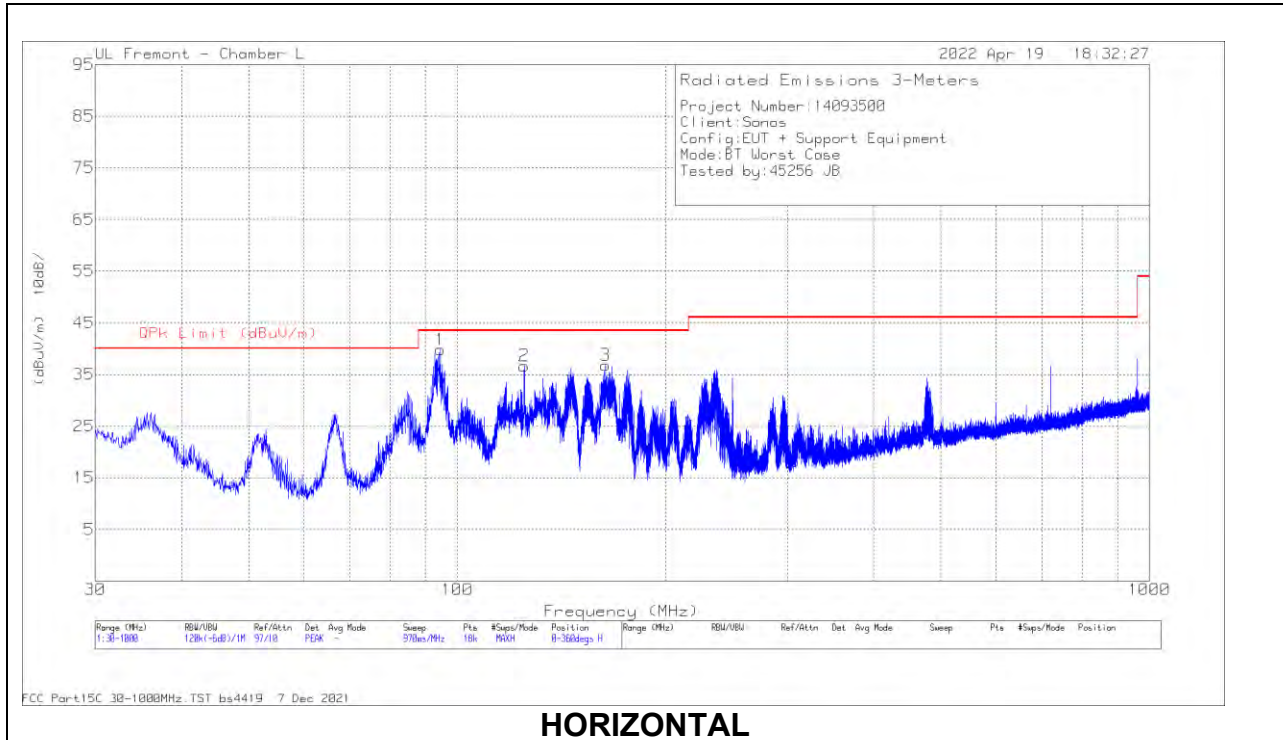
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Polarity
3	.7087	31.78	Pk	56.2	-31.9	-40	16.08	30.6	-14.52	0-360	Face-On
8	.7123	31	Pk	56.2	-31.9	-40	15.3	30.56	-15.26	0-360	Face-Off
4	1.4215	27.26	Pk	44.7	-31.9	-40	.06	24.58	-24.52	0-360	Face-On
5	2.1221	22.47	Pk	41.3	-31.8	-40	-8.03	29.5	-37.53	0-360	Face-On
9	1.4153	28.57	Pk	44.7	-31.9	-40	1.37	24.61	-23.24	0-360	Face-Off
10	2.1232	22.07	Pk	41.3	-31.8	-40	-8.43	29.5	-37.93	0-360	Face-Off

Pk - Peak detector

10.3. WORST CASE BELOW 1 GHz

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



Below 1GHz Data

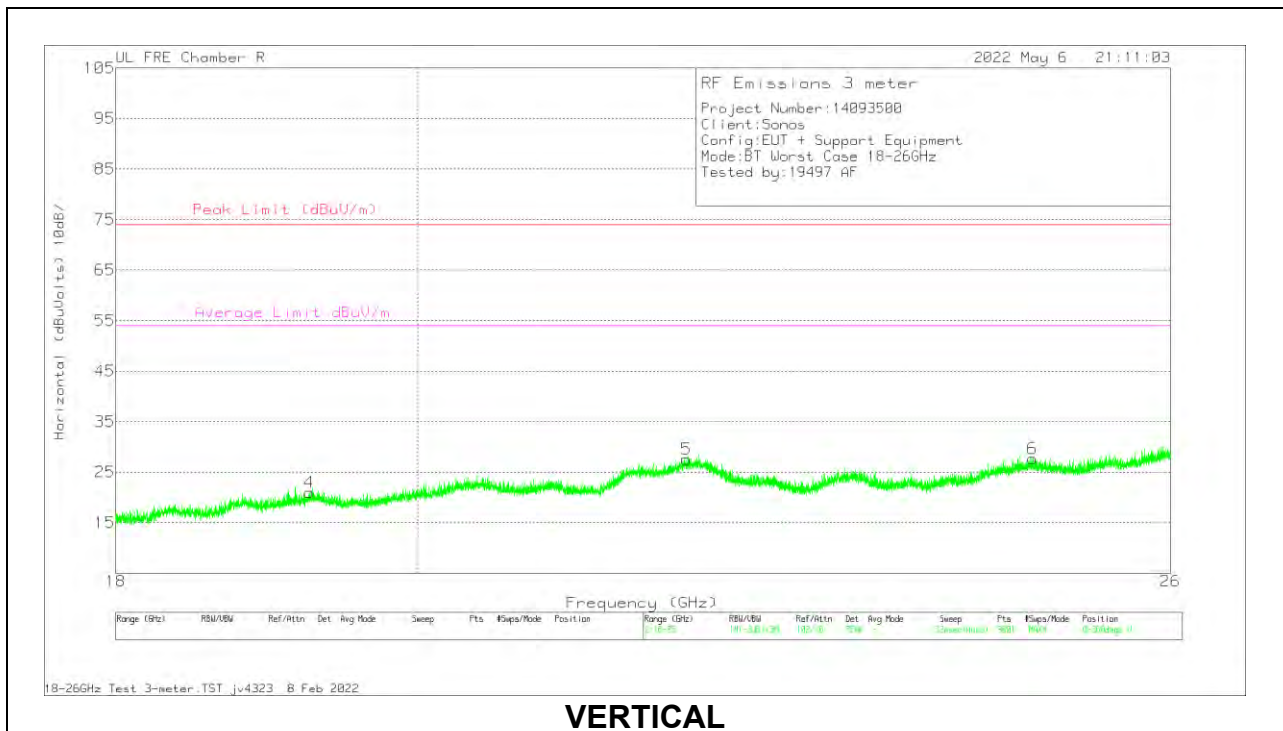
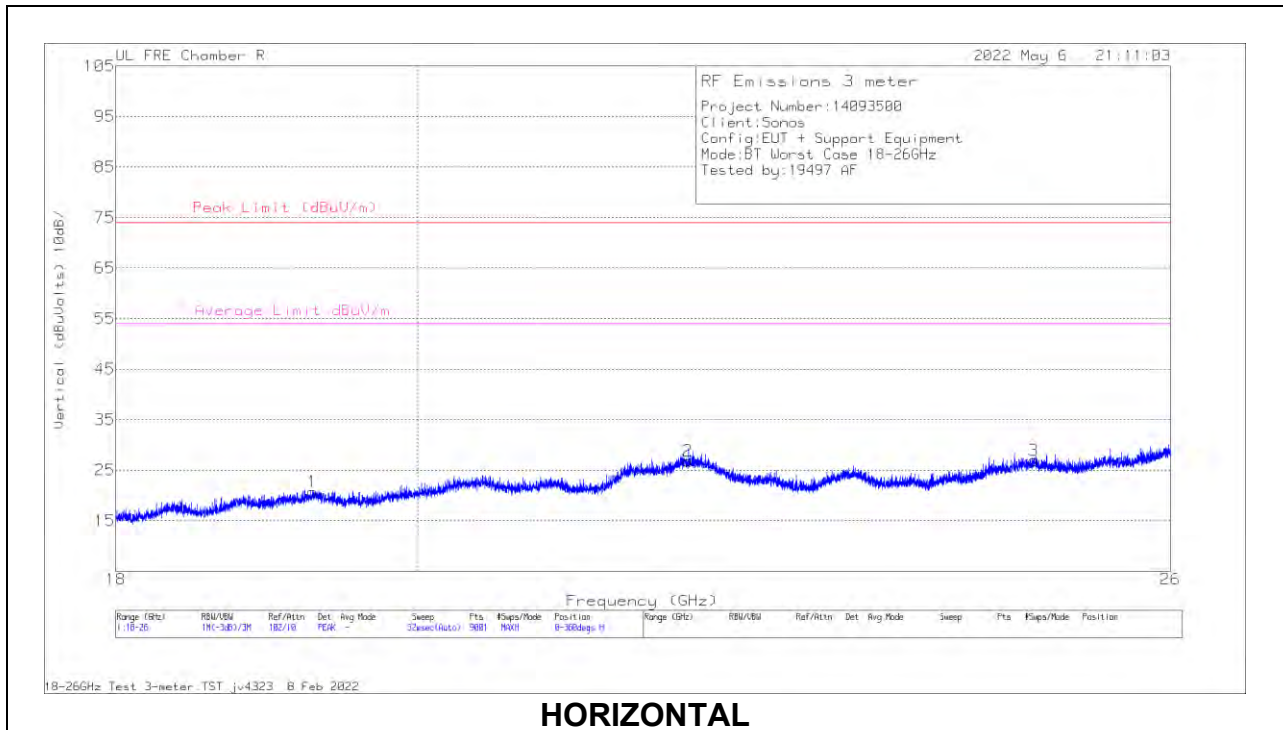
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	171862 ACF (dB)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	94.559	56	Pk	14.6	-30.8	39.8	43.52	-3.72	0-360	199	H
	94.582	51.99	Qp	14.6	-30.8	35.79	43.52	-7.73	252	215	H
2	125.006	47.59	Pk	19.7	-30.6	36.69	43.52	-6.83	0-360	299	H
	163.914	49.19	Pk	17.9	-30.3	36.79	43.52	-6.73	0-360	199	H
4	37.1134	49.1	Pk	21.6	-31.3	39.4	40	-6	0-360	99	V
	37.4179	46.57	Qp	21.4	-31.3	36.67	40	-3.33	91	102	V
5	51.9867	48.93	Pk	13.2	-31.2	30.93	40	-9.07	0-360	99	V
6	960.016	37.1	Pk	28.8	-26.9	39	53.97	-14.97	0-360	99	V

Pk - Peak detector

Qp - Quasi-Peak detector

10.4. WORST CASE 18-26 GHz

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



18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBUV)	Det	172363 AF (dB/m)	171583 Amp (dB)	Cables (dB)	Corrected Reading (dBUVolts)	Peak Limit (dBUV/m)	PK Margin (dB)	Average Limit dBUV/m	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 19.278222	38.91	Pk	32.9	-65.5	14.4	20.71	74	-53.29	54	-33.29	0-360	99	H
4	* 19.255111	39.27	Pk	32.8	-65.5	14.4	20.97	74	-53.03	54	-33.03	0-360	99	V
5	21.965334	43.64	Pk	33.5	-65	15.4	27.54	74	-46.46	54	-26.46	0-360	99	V
2	21.972445	42.93	Pk	33.5	-65	15.4	26.83	74	-47.17	54	-27.17	0-360	99	H
6	24.780445	40.98	Pk	34.6	-64.2	16.3	27.68	74	-46.32	54	-26.32	0-360	99	V
3	24.788445	40.29	Pk	34.6	-64.2	16.3	26.99	74	-47.01	54	-27.01	0-360	99	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
 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 C63.4.

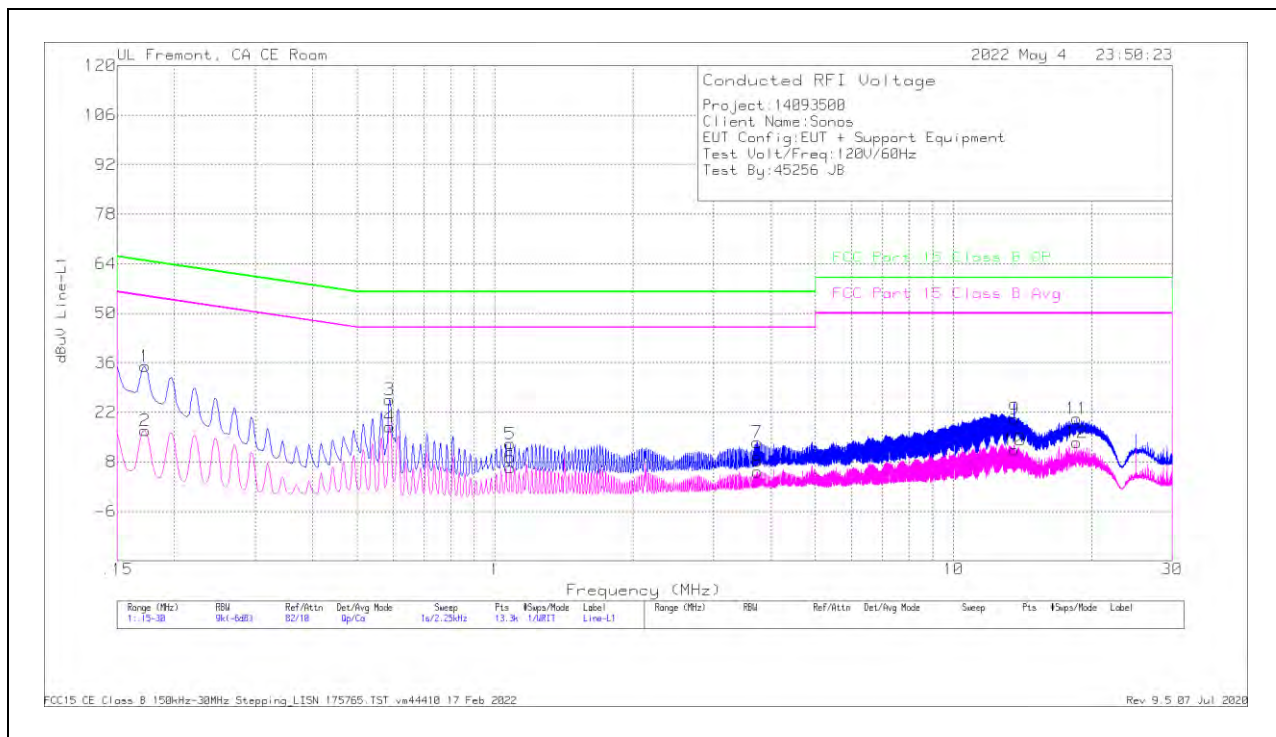
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

11.1. AC POWER LINE

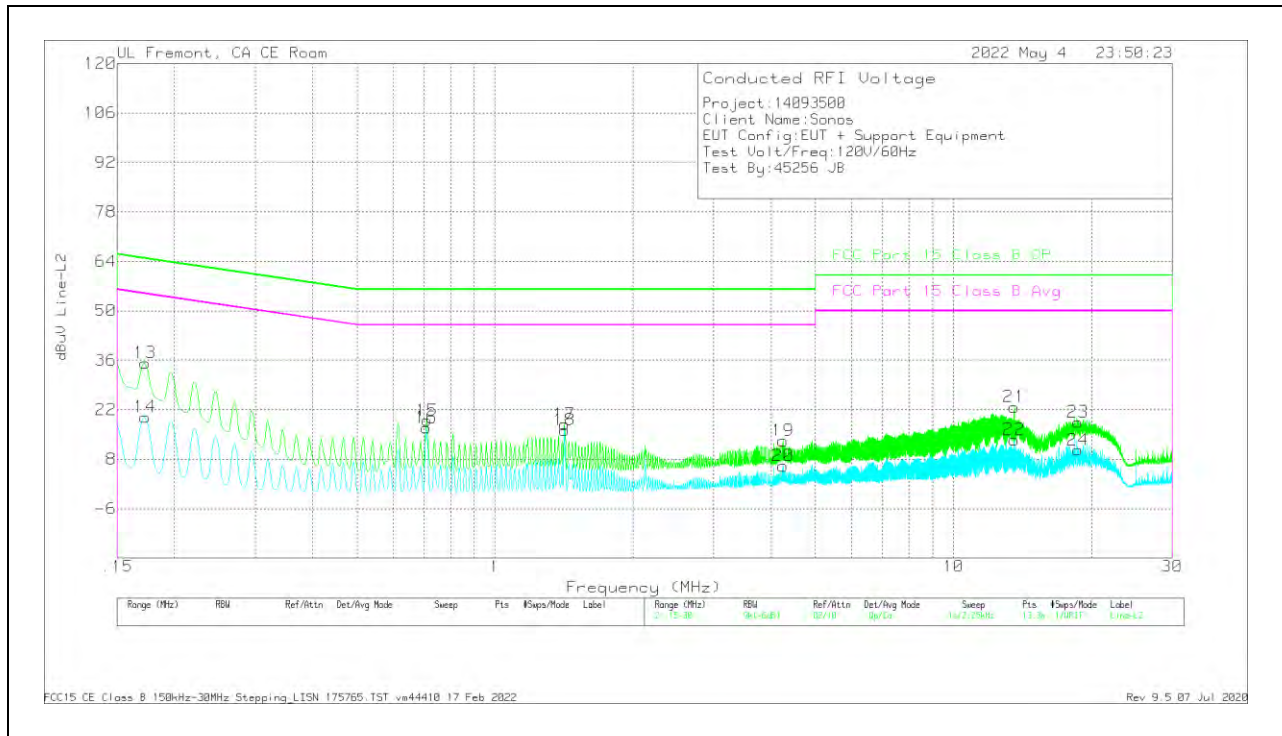
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L1	C1&C3 cable	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	FCC Part 15 Class B QP	QP Margin (dB)	FCC Part 15 Class B Avg	Av(CISPR)M argin (dB)
2	.1725	7.34	Ca	.1	0	9.4	16.84	-	-	54.84	-38
4	.58875	8.56	Ca	0	.1	9.3	17.96	-	-	46	-28.04
6	1.07925	-2.99	Ca	0	.1	9.3	6.41	-	-	46	-39.59
8	3.732	-4.19	Ca	0	.1	9.3	5.21	-	-	46	-40.79
10	13.59825	1.74	Ca	.1	.2	9.3	11.34	-	-	50	-38.66
12	18.582	3.85	Ca	.1	.2	9.3	13.45	-	-	50	-36.55
1	.1725	25.48	Qp	.1	0	9.4	34.98	64.84	-29.86	-	-
3	.58875	16.2	Qp	0	.1	9.3	25.6	56	-30.4	-	-
5	1.07925	3.68	Qp	0	.1	9.3	13.08	56	-42.92	-	-
7	3.72975	4.12	Qp	0	.1	9.3	13.52	56	-42.48	-	-
9	13.59375	10.48	Qp	.1	.2	9.3	20.08	60	-39.92	-	-
11	18.582	10.59	Qp	.1	.2	9.3	20.19	60	-39.81	-	-

Qp - Quasi-Peak detector
 Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	175765 LISN L2	C2&C3 cable	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	FCC Part 15 Class B QP	QP Margin (dB)	FCC Part 15 Class B Avg	Av(CISPR)Margin (dB)
14	.1725	10.42	Ca	.1	0	9.4	19.92	-	-	54.84	-34.92
16	.708	7.51	Ca	0	.1	9.3	16.91	-	-	46	-29.09
18	1.41675	6.85	Ca	0	.1	9.3	16.25	-	-	46	-29.75
20	4.24725	-3.3	Ca	0	.1	9.3	6.1	-	-	46	-39.9
22	13.56	3.92	Ca	.1	.2	9.3	13.52	-	-	50	-36.48
24	18.68775	1.01	Ca	.1	.2	9.3	10.61	-	-	50	-39.39
13	.1725	25.75	Qp	.1	0	9.4	35.25	64.84	-29.59	-	-
15	.71025	9.57	Qp	0	.1	9.3	18.97	56	-37.03	-	-
17	1.41675	8.45	Qp	0	.1	9.3	17.85	56	-38.15	-	-
19	4.24725	3.82	Qp	0	.1	9.3	13.22	56	-42.78	-	-
21	13.56	13.19	Qp	.1	.2	9.3	22.79	60	-37.21	-	-
23	18.68775	8.86	Qp	.1	.2	9.3	18.46	60	-41.54	-	-

Qp - Quasi-Peak detector
 Ca - CISPR average detection