



CERTIFICATION TEST REPORT

Report Number. : 13685813-E4V2

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

Model : A2565

Brand : Apple

FCC ID : BCG-A2565

IC : 579C-A2565

EUT Description : Bluetooth Earbud

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:
September 29, 2021

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	9/2/2021	Initial Issue	Tri Pham
V2	9/29/2021	Updated Power	Tri Pham

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	10
6.6. DESCRIPTION OF TEST SETUP	12
7. MEASUREMENT METHODS	18
8. TEST AND MEASUREMENT EQUIPMENT	19
9. ANTENNA PORT TEST RESULTS	20
9.1. ON TIME AND DUTY CYCLE	20
9.2. 20 dB AND 99% BANDWIDTH	21
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	22
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION	23
9.3. HOPPING FREQUENCY SEPARATION	24
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	25
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION	26
9.4. NUMBER OF HOPPING CHANNELS	27
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	28
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION	32
9.5. AVERAGE TIME OF OCCUPANCY	36
9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION	37

9.5.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	38
9.6.	OUTPUT POWER.....	39
9.6.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION	40
9.6.2.	BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION	40
9.6.3.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	40
9.7.	AVERAGE POWER.....	41
9.7.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION	42
9.7.2.	BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION	42
9.7.3.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	42
9.8.	CONDUCTED SPURIOUS EMISSIONS.....	43
9.8.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION	44
9.8.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION.....	46
10.	RADIATED TEST RESULTS	48
10.1.	TRANSMITTER ABOVE 1 GHz.....	50
10.1.1.	BLUETOOTH BASIC DATA RATE GFSK MODULATION.....	50
10.1.2.	BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION	60
10.2.	WORST CASE BELOW 1 GHZ.....	70
10.3.	WORST CASE 18-26 GHZ.....	72
10.4.	WORST CASE BELOW 30MHz	74
11.	AC POWER LINE CONDUCTED EMISSIONS	76
11.1.	AC Power Line With Laptop.....	77
11.2.	AC Power Line With AC/DC Adapter.....	79
12.	SETUP PHOTOS	81

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: BLUETOOTH EARBUD

MODEL: A2565

BRAND: Apple

SERIAL NUMBER: H5R123600K6036030; H5R1262004Q03603N

SAMPLE RECEIPT DATE: 6/26/202; 7/23/2021

DATE TESTED: 7/22/2021 – 8/10/2021

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:



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

Prepared By:



Gerardo Abrego
Lab 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.

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	Complies	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Number of Hopping Channels	Complies	None.
15.247 (a)(1)(iii)	RSS-247 (5.1) (d)	Average Time of Occupancy	Complies	None.
15.247 (b)(1)	RSS-247 (5.4) (b)	Output Power	Complies	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	Complies	None.
15.209, 15.205	RSS-GEN 8.9, 8.10	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	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
- FCC KDB 662911 D01 v02r01
- KDB 558074 D01 15.247 Meas Guidance v05r02
- ANSI C63.10-2013
- RSS-GEN Issue 5 + A1 + A2
- RSS-247 Issue 2
- KDB 414788 D01 Radiated Test Site v01r01

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, certification #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
☐	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	208313
☒	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA	US0104	22541	208313
☒	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA	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	2.84 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 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 a Bluetooth earbud for right ear with an integral battery, microphone, and antenna.

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	12.74	18.79
2402 - 2480	Enhanced DQPSK	11.89	15.45
2402 - 2480	Enhanced 8PSK	12.40	17.38

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

The radio utilizes an LDS antenna, with a maximum gain of -3.6 dBi.

6.4. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was B4B20

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, it was determined that Y (Landscape) orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Y (Landscape) orientation.

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

For below 1GHz and above 1GHz tests were performed with EUT only. For AC power line conducted emission, tests were investigated with AC power adapter and with laptop.

GFSK, DQPSK, 8PSK average power are all investigated, The GFSK & 8PSK power are the worst case. For average power data please refer to section 9.7.

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

GFSK mode: DH5
8PSK mode: 3-DH5

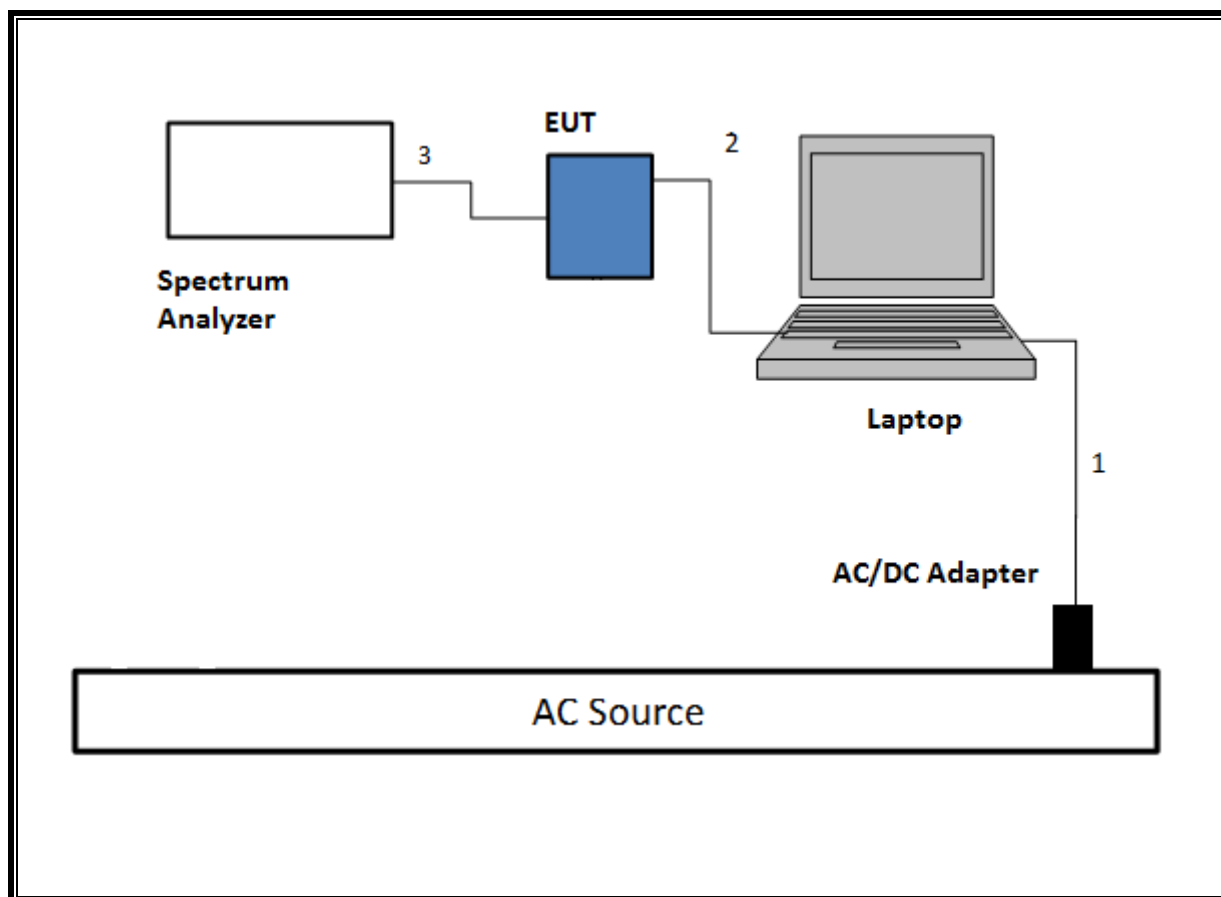
6.6. DESCRIPTION OF TEST SETUP

SUPPORT TEST EQUIPMENT						
Description		Manufacturer	Model	Serial Number		FCC ID/ DoC
Laptop		Apple	Macbook Pro	C02YL3ZMJHC8		BCGA1989
Laptop AC/DC adapter		Liteon Technology	A1424	NSW25679		DoC
EUT AC/DC adapter			Apple	A1720	C3D8417A7R93KVPA8	
I/O CABLES (RF CONDUCTED TEST)						
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-A	1	Lightning	Shielded	1.0	N/A
3	Antenna	1	SMA	Un-shielded	0.2	To spectrum Analyzer
I/O CABLES (RF RADIATED TEST)						
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-A	1	Lightning	Un-shielded	1	N/A

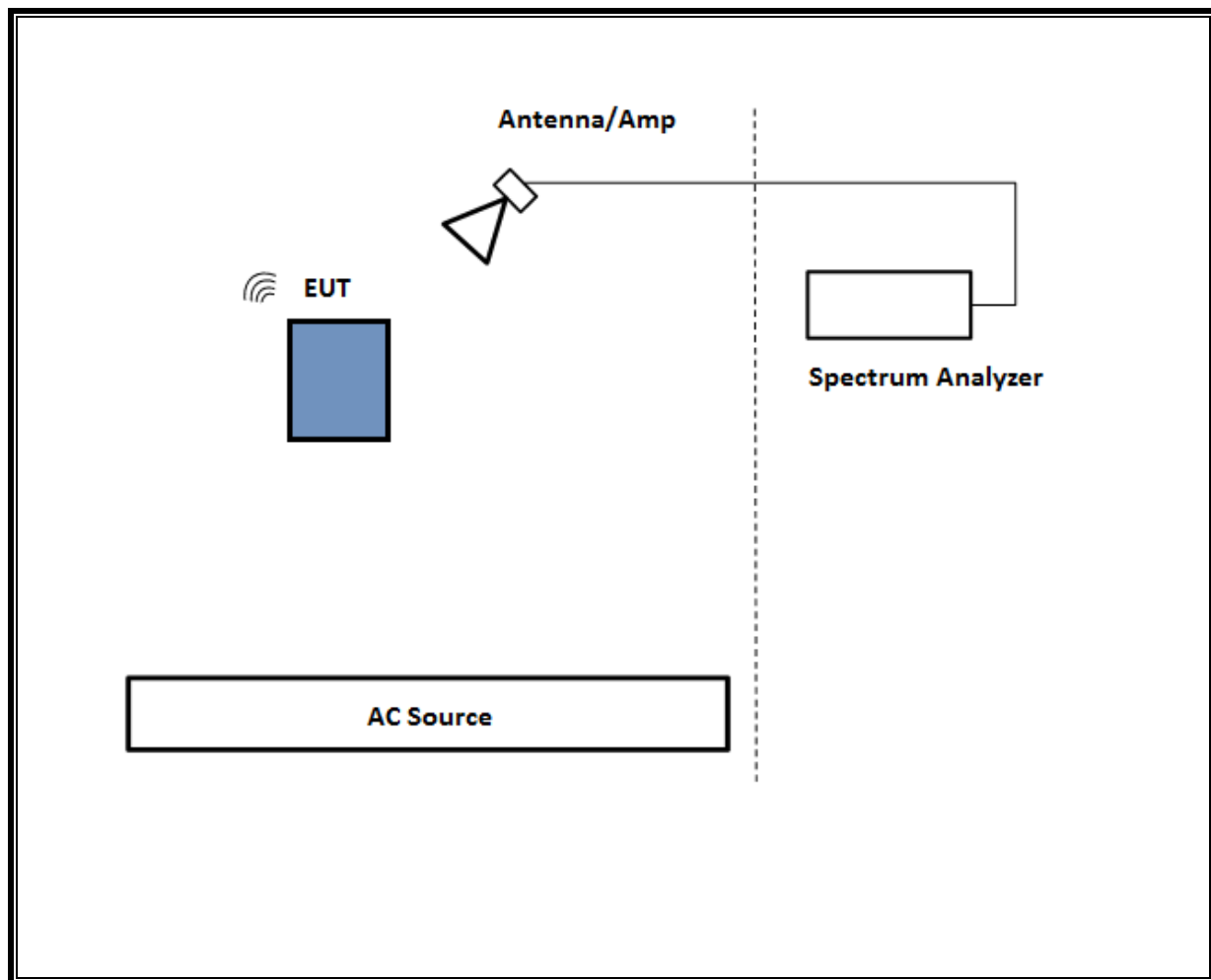
TEST SETUP

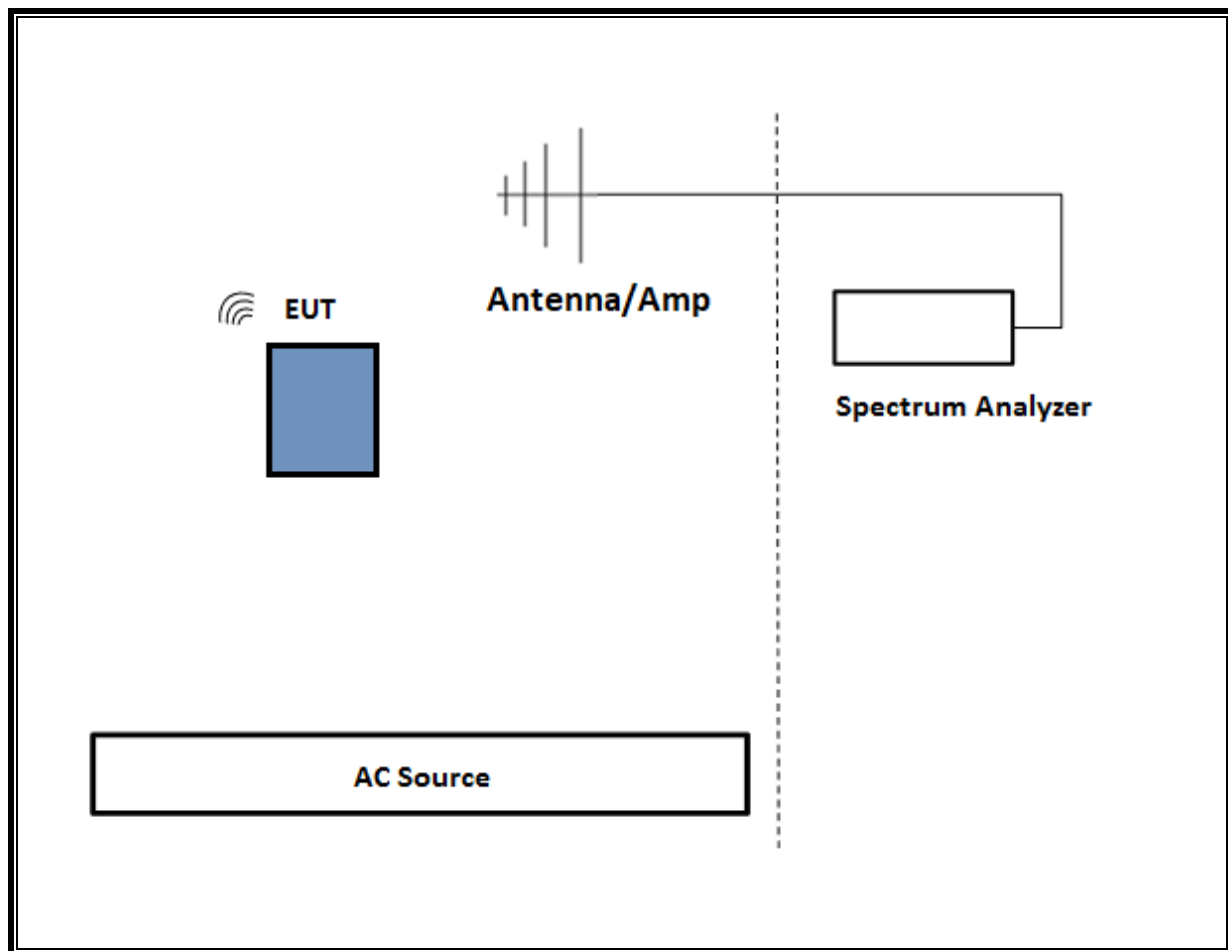
The EUT is connected to a test laptop during the tests. Test software exercised the radio card.

SETUP DIAGRAM FOR CONDUCTED TESTS

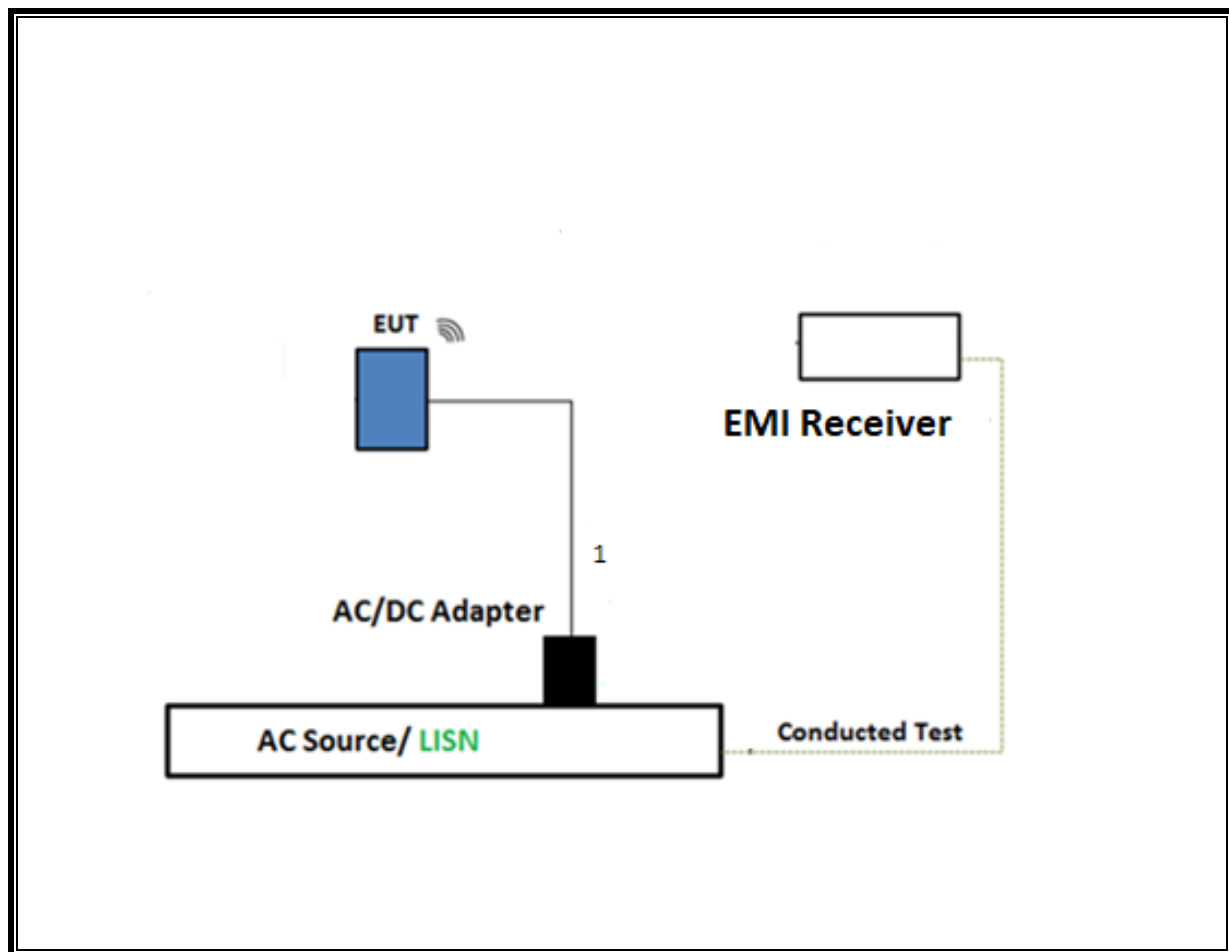


SETUP DIAGRAM FOR RADIATED TESTS Above 1GHz

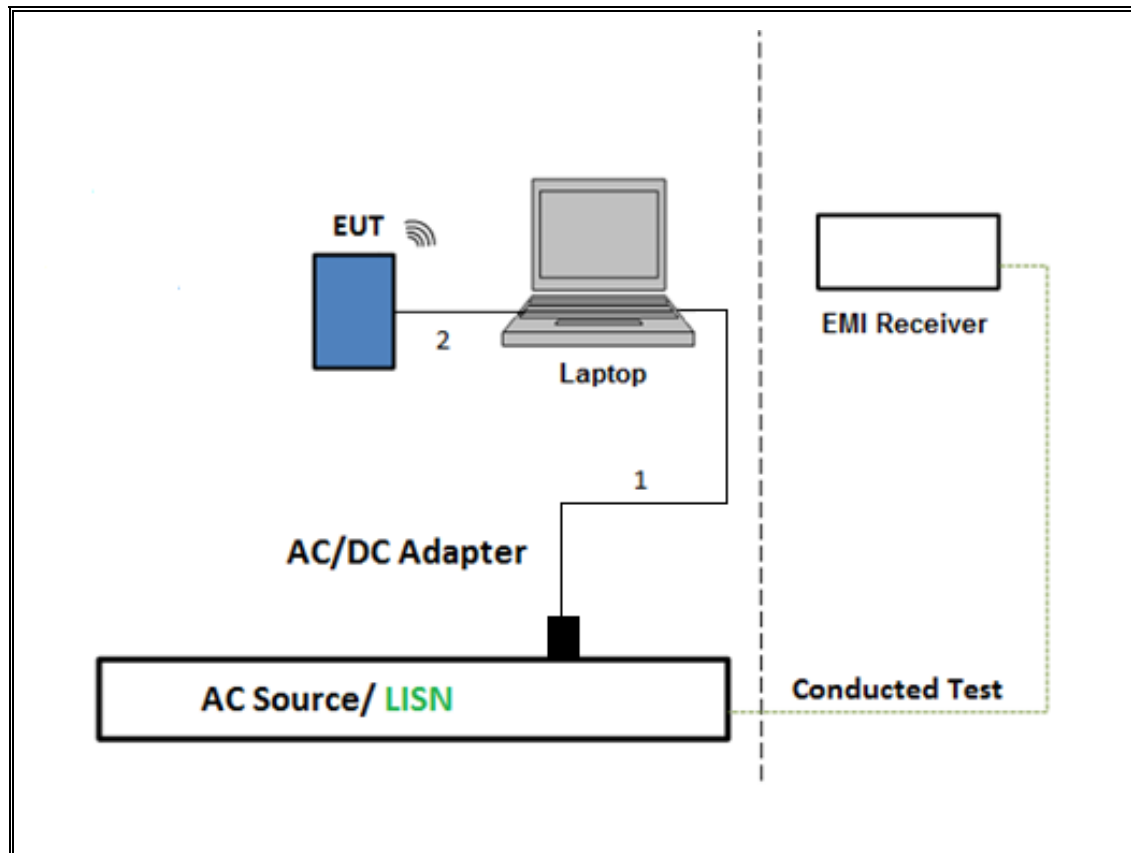


SETUP DIAGRAM FOR Below 1GHz

SETUP DIAGRAM FOR AC LINE CONDUCTED TEST



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



7. 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 & 13

Radiated Spurious Emissions 30-1000MHz: ANSI C63.10-2013 Section 6.3, 6.5 & 13

Radiated Spurious Emissions above 1GHz: ANSI C63.10-2013 Section 6.3, 6.6 & 13

Radiated Band-edge: ANSI C63.10-2013 Section 6.10.5 & 13

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

8. 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	Local ID	Cal Date	Cal Due
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0203383	2/24/2021	2/24/2022
Horn Antenna, 1-18 GHz	ETS Lindgren	3117	T120	4/7/2021	4/7/2022
Preamp, 1-18 GHz	Miteq	AFS42-00101800-25-S-42	PRE0183207	4/27/2021	4/27/2022
PXA Signal Analyzer	Agilent	N9030A	T906	1/27/2021	1/27/2022
Hybrid Antenna, 30-2000 MHz	SunAR	JB3	T900	2/24/2021	2/24/2022
Preamp, 0.1-1300 MHz	Sonoma Inst.	310	T173	7/22/2021	7/22/2022
Horn Antenna, 1-18 GHz	ETS Lindgren	3117	T712	3/22/2021	3/22/2022
*Preamp, 1-18 GHz	Miteq	AFS42-00101800-25-S-42	PRE0183530	8/27/2020	8/27/2021
Antenna, Active Loop 9kHz-30MHz	ETS Lindgren	6502	T1616	12/2/2020	12/2/2021
PXA Signal Analyzer	Agilent	N9030A	T1454	1/27/2021	1/27/2022
Preamplifier, 1-26.5GHz	Agilent	8449B	T404	4/19/2021	4/19/2022
Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	T449	4/22/2021	4/22/2022
Preamplifier, 26-40 GHz	Miteq	NSTTA2640-35-HG	T1864	4/19/2021	4/19/2022
PXA Signal Analyzer	Agilent	N9030A	206415	3/12/2021	3/12/2022
Horn Antenna, 26-40 GHz	ARA	MWH-2640/B	PRE0183142	4/22/2021	4/22/2022
PXA Signal Analyzer	Agilent	N9030A	T908	1/28/2021	1/28/2022
Power Meter, P-series single channel	Keysight	N1912A	T1245	1/21/2021	1/21/2022
Power Sensor	Keysight	N1912A	90392	1/28/2021	1/28/2022
PXA Signal Analyzer	Agilent	N9030A	T341	1/28/2021	1/28/2022
Power Meter, P-series single channel	Keysight	N1911A	PRE0177682	1/21/2021	1/21/2022
Power Meter, P-series single channel	Keysight	N1911A	T1264	1/26/2021	1/26/2022
Power Sensor	Keysight	N1921A	T1226	2/19/2021	2/19/2022
Power Sensor	Keysight	N1921A	T1227	3/16/2021	3/16/2022
EMI Test Receiver 9kHz-7GHz	Rohde & Schwarz	ESR	T1436	2/19/2021	2/19/2022
Power Cable, Line Conducted Emissions	Pasternack Enterprises	RG233/U	202327	10/16/2020	10/16/2021
LISN for Conducted Emissions CISPR-16	FISCHER CUSTOM COMMUNICATIONS	FCC-LISN-50/250-25-2-01	PRE0186446	1/20/2021	1/20/2022

Test Software List			
Description	Manufacturer	Model	Version
Radiated Software	UL	UL EMC	Ver 9.5, June 15, 2019
Antenna Port Software	UL	UL RF	Ver 2021.1.19
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015

Note: *Testing is completed before equipment expiration date.

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	2.00	2	1.000	100.0%	0.00	0.010
Bluetooth 8PSK	2.00	2	1.000	100.0%	0.00	0.010

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 3x RBW. The sweep time is coupled.

RESULTS

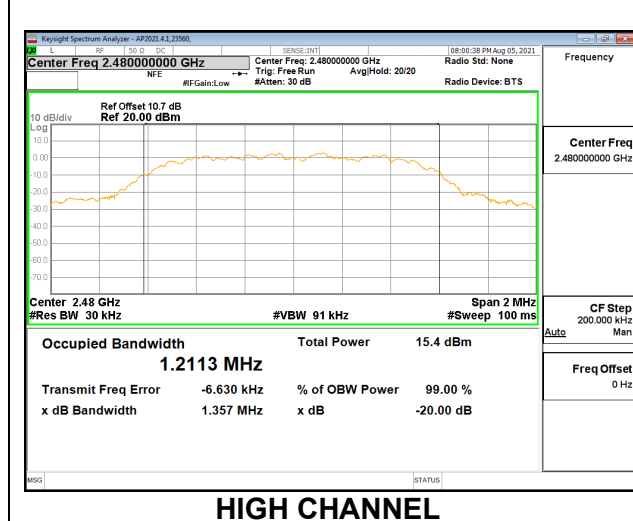
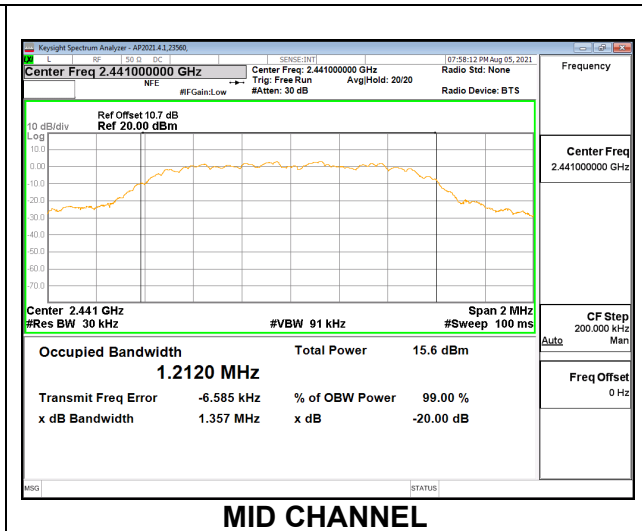
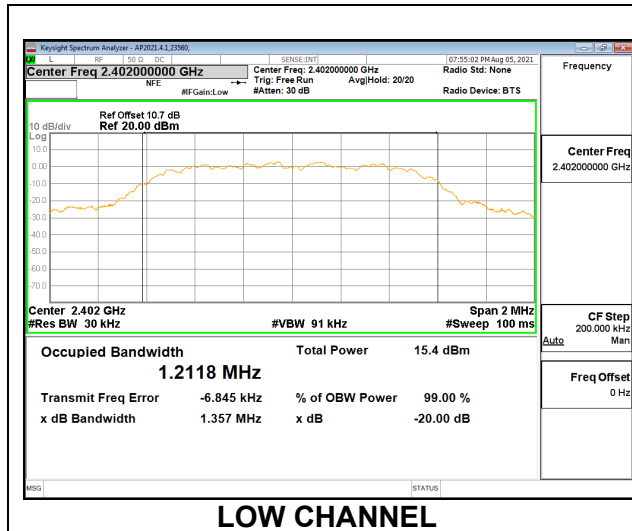
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.956	0.89647
Mid	2441	0.9671	0.89903
High	2480	0.9578	0.90066



9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.357	1.2118
Mid	2441	1.357	1.2120
High	2480	1.357	1.2113



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.

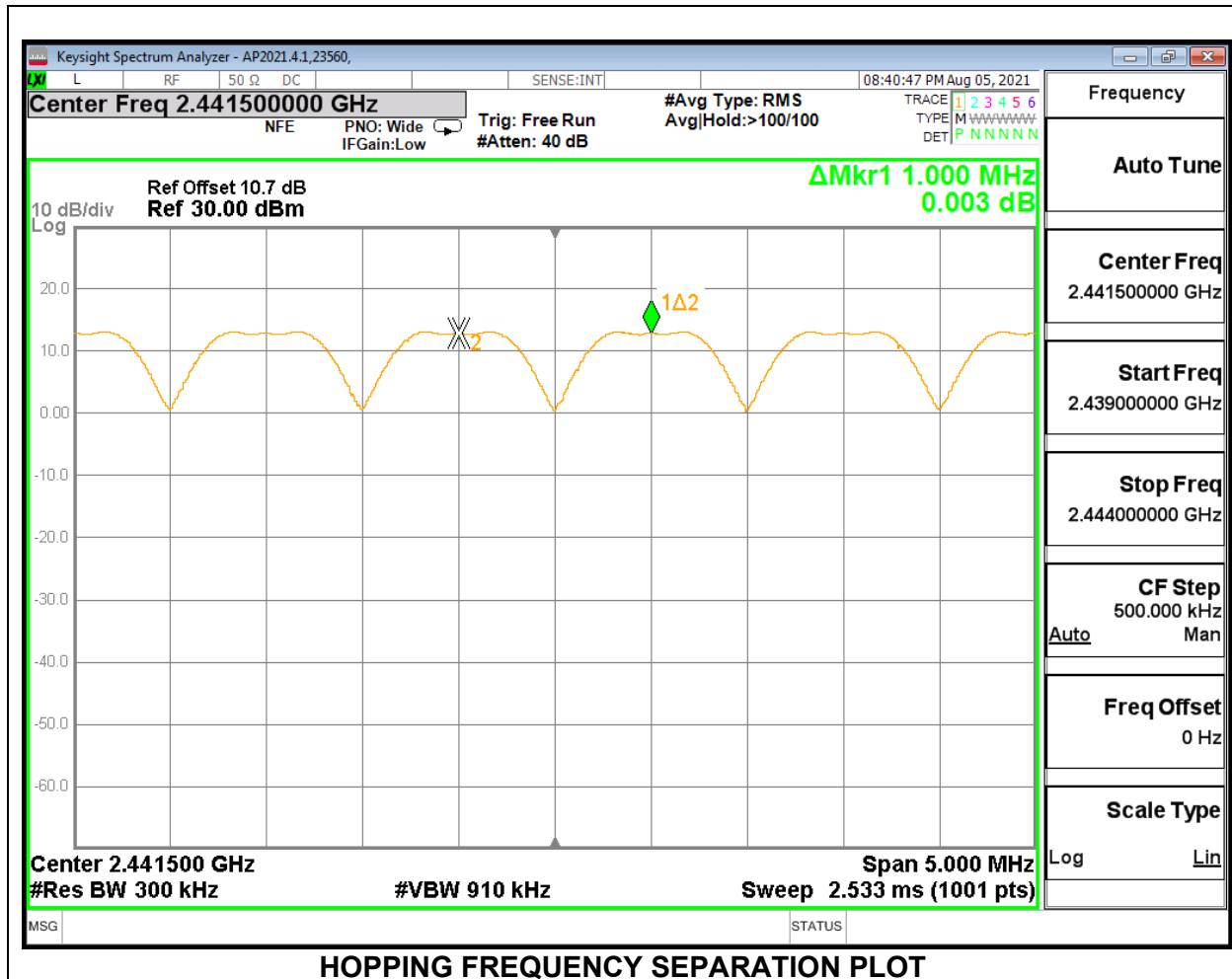
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

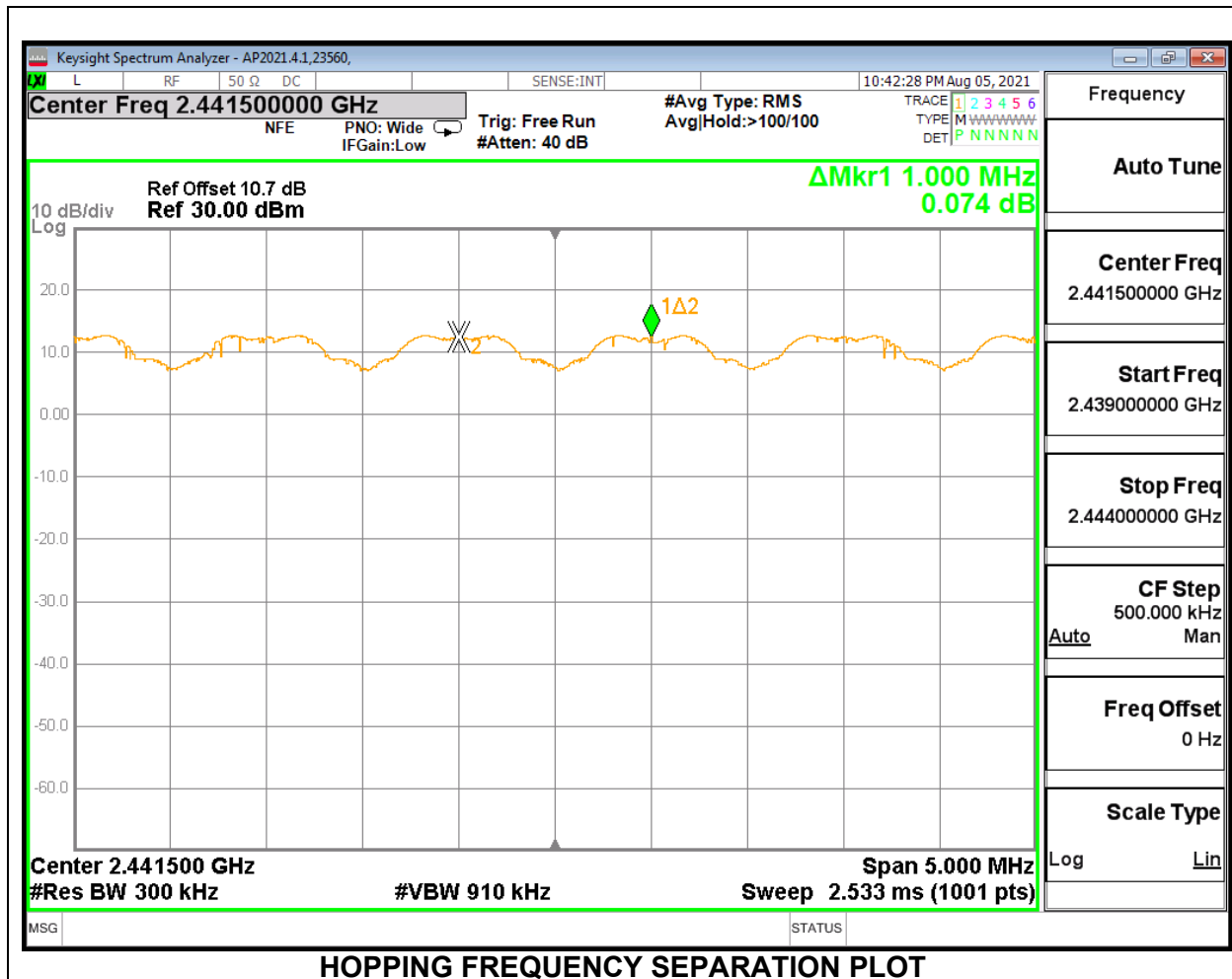
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq RBW$. The sweep time is coupled.

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.

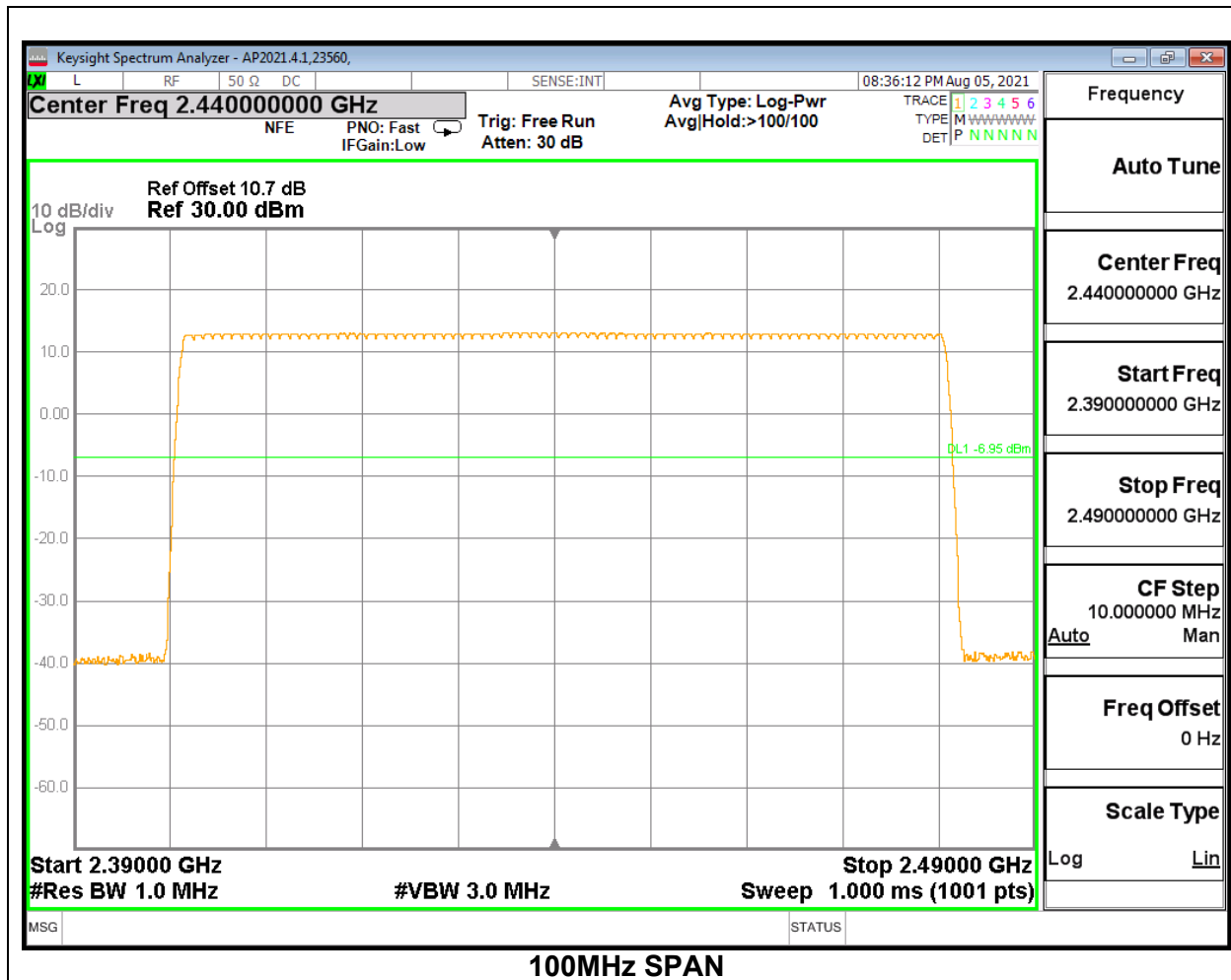
TEST PROCEDURE

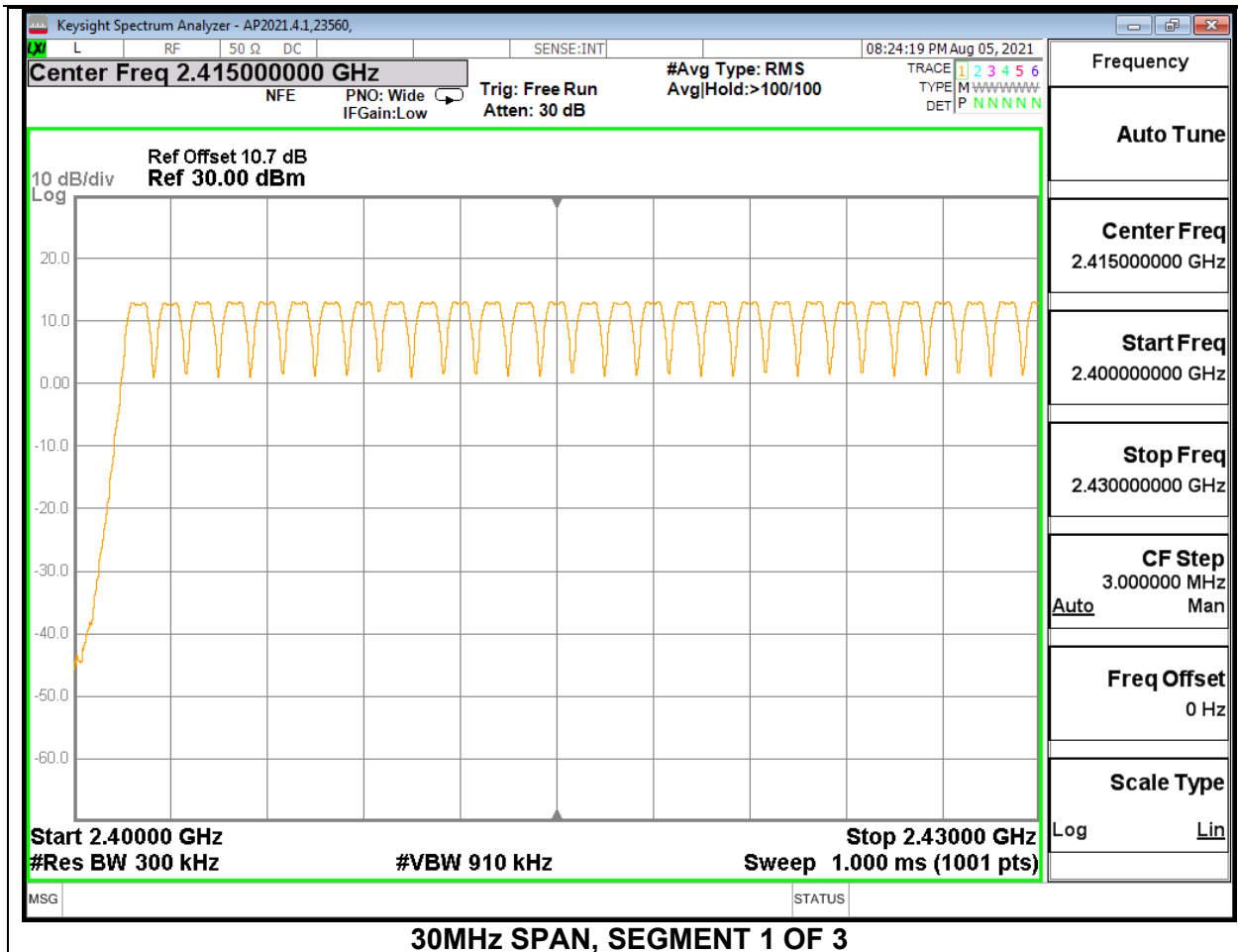
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

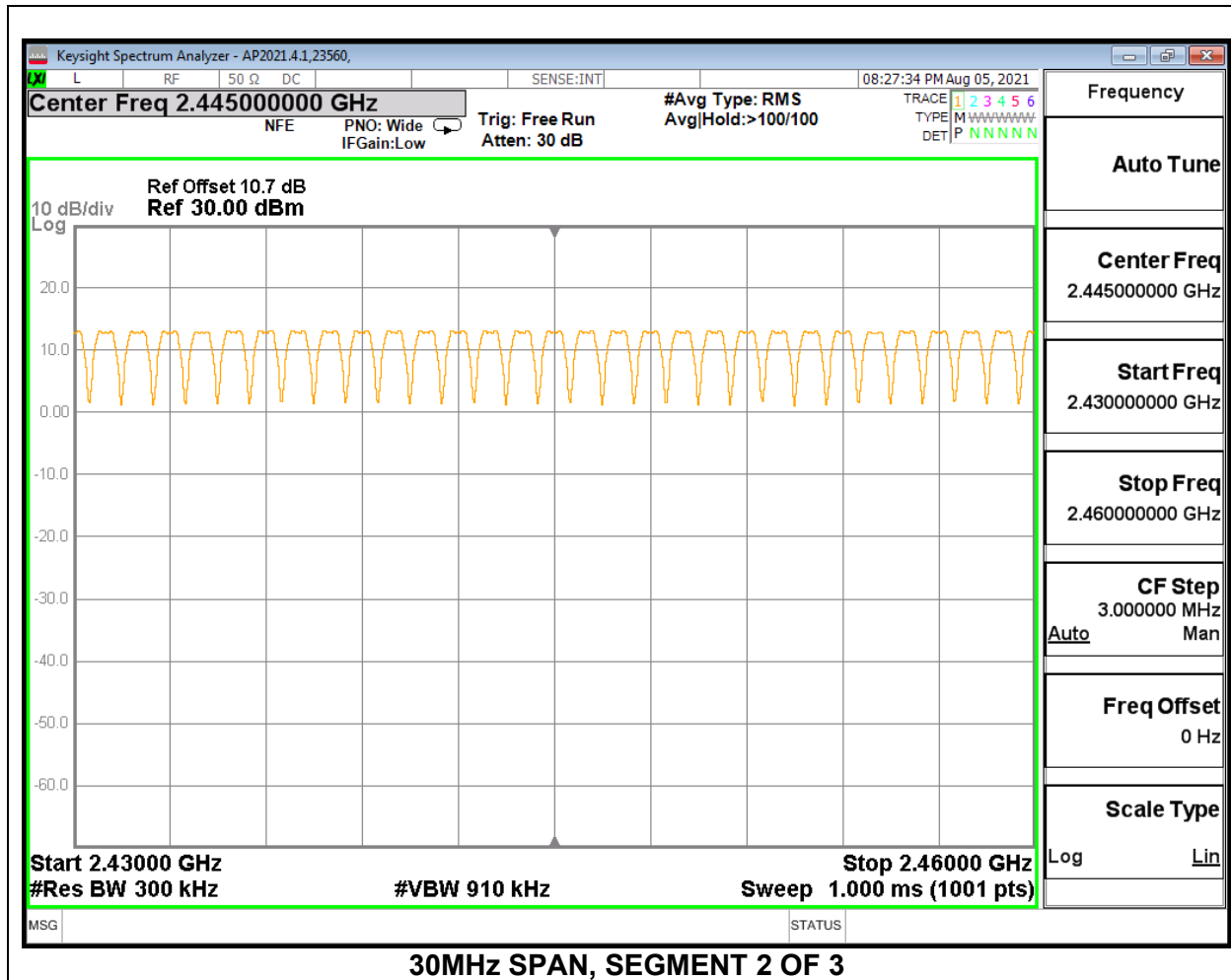
RESULTS

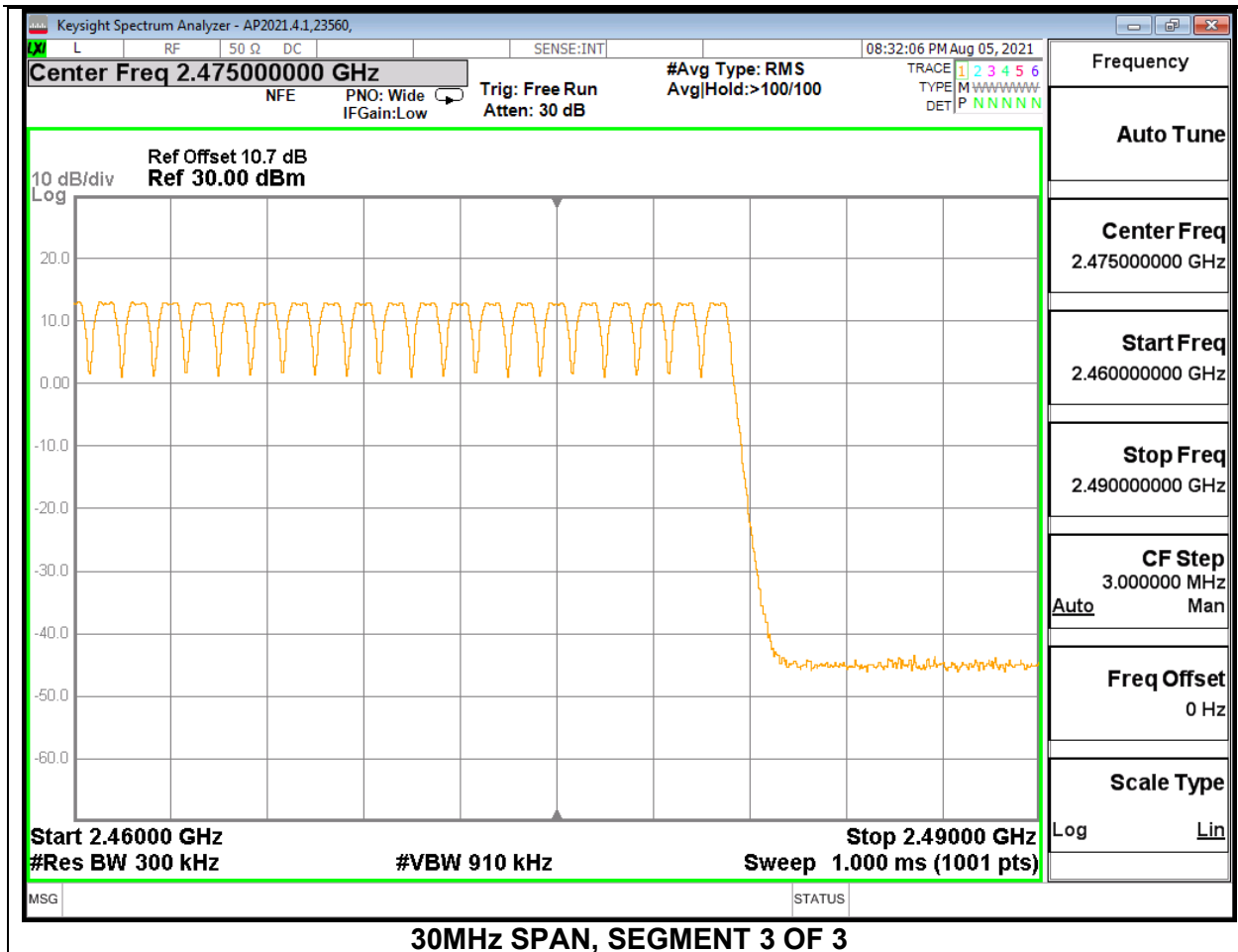
Normal Mode: 79 Channels Observed

9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

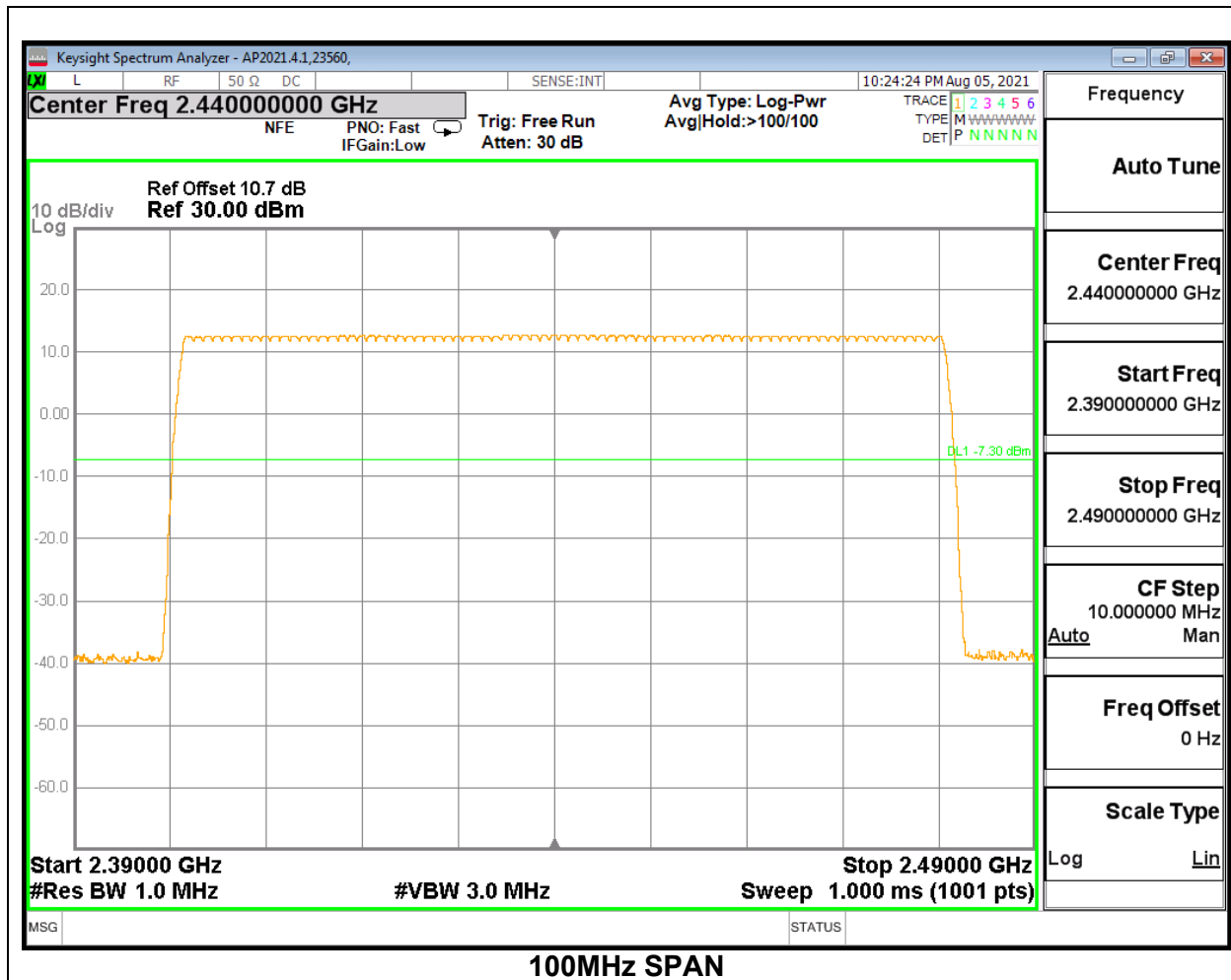


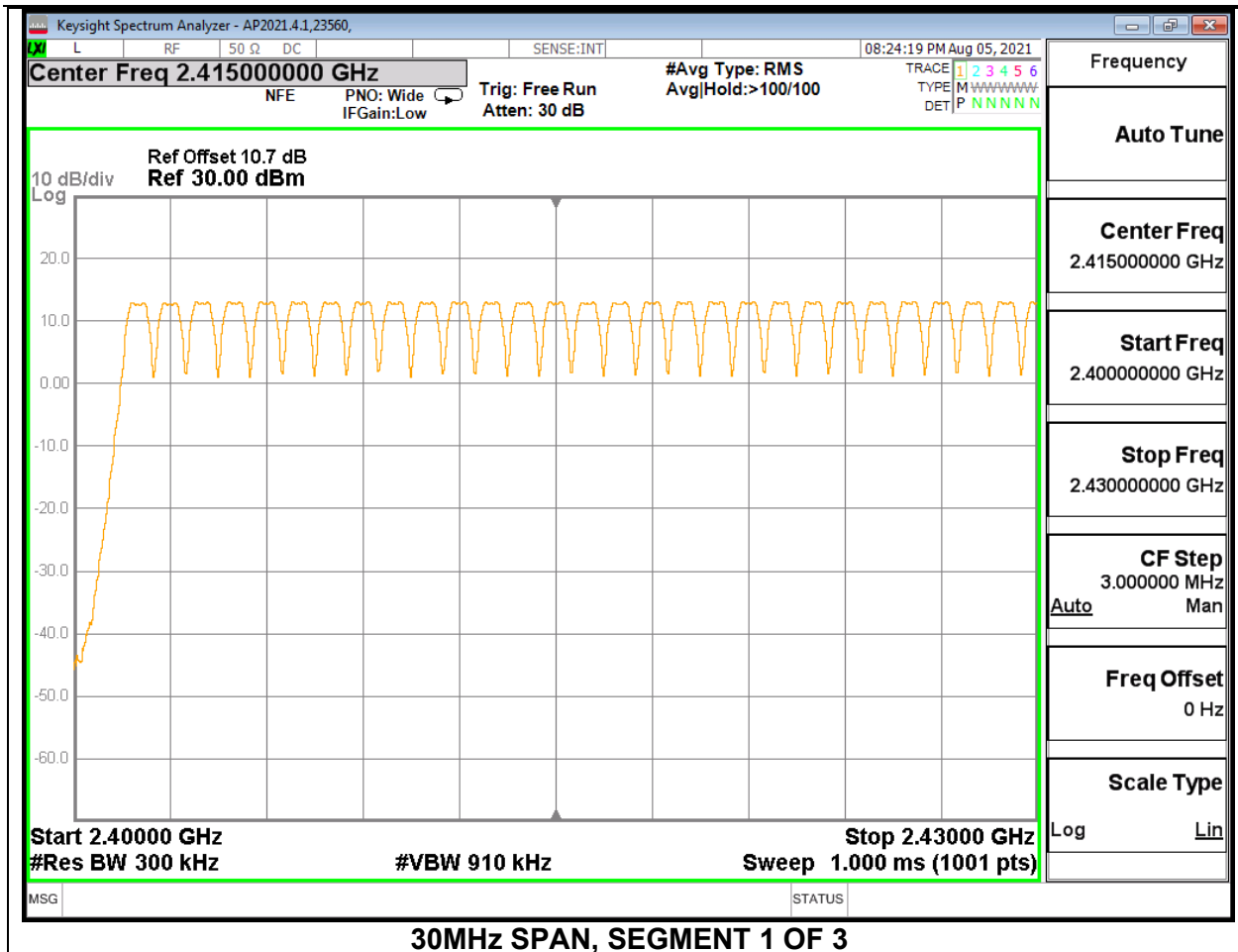


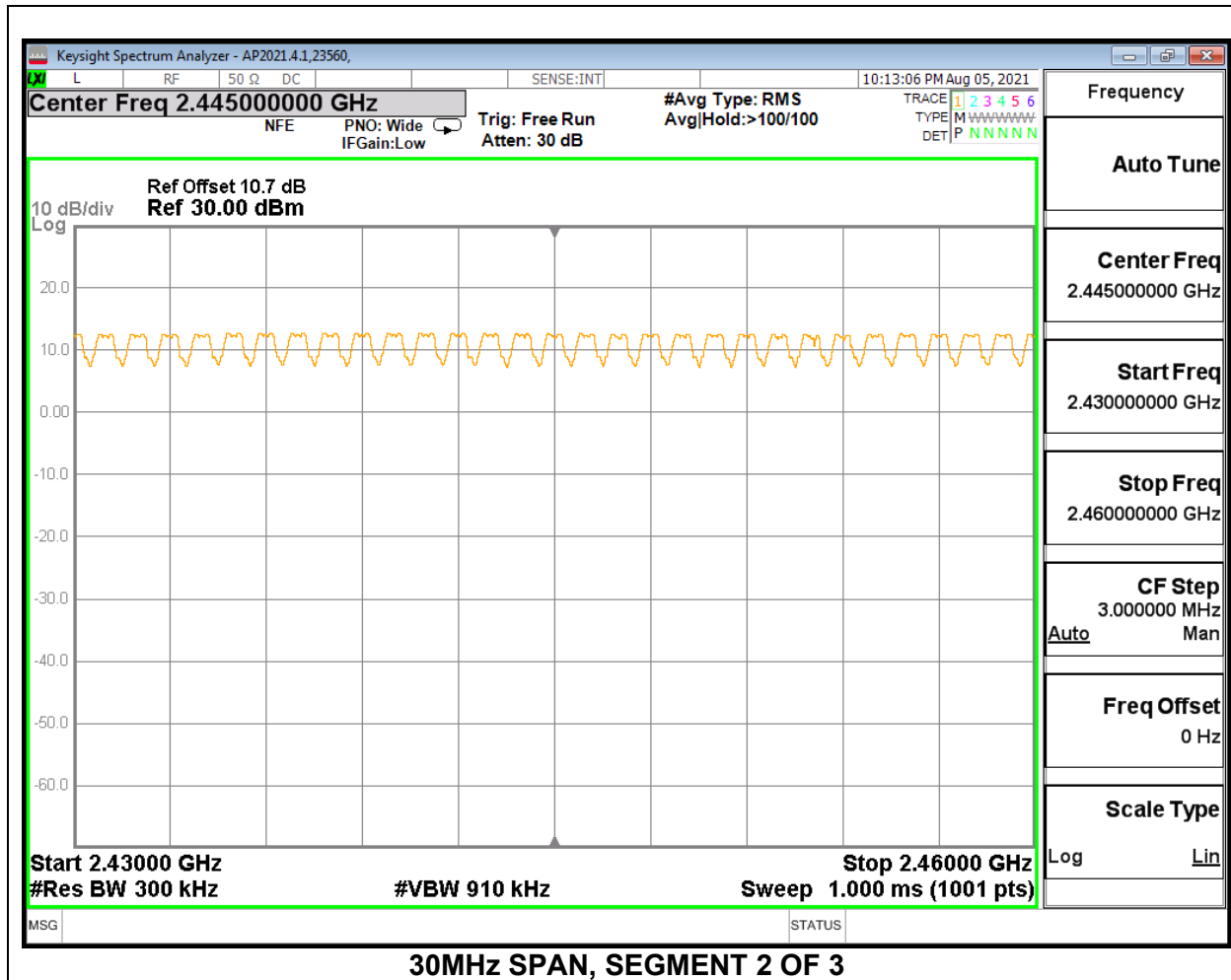


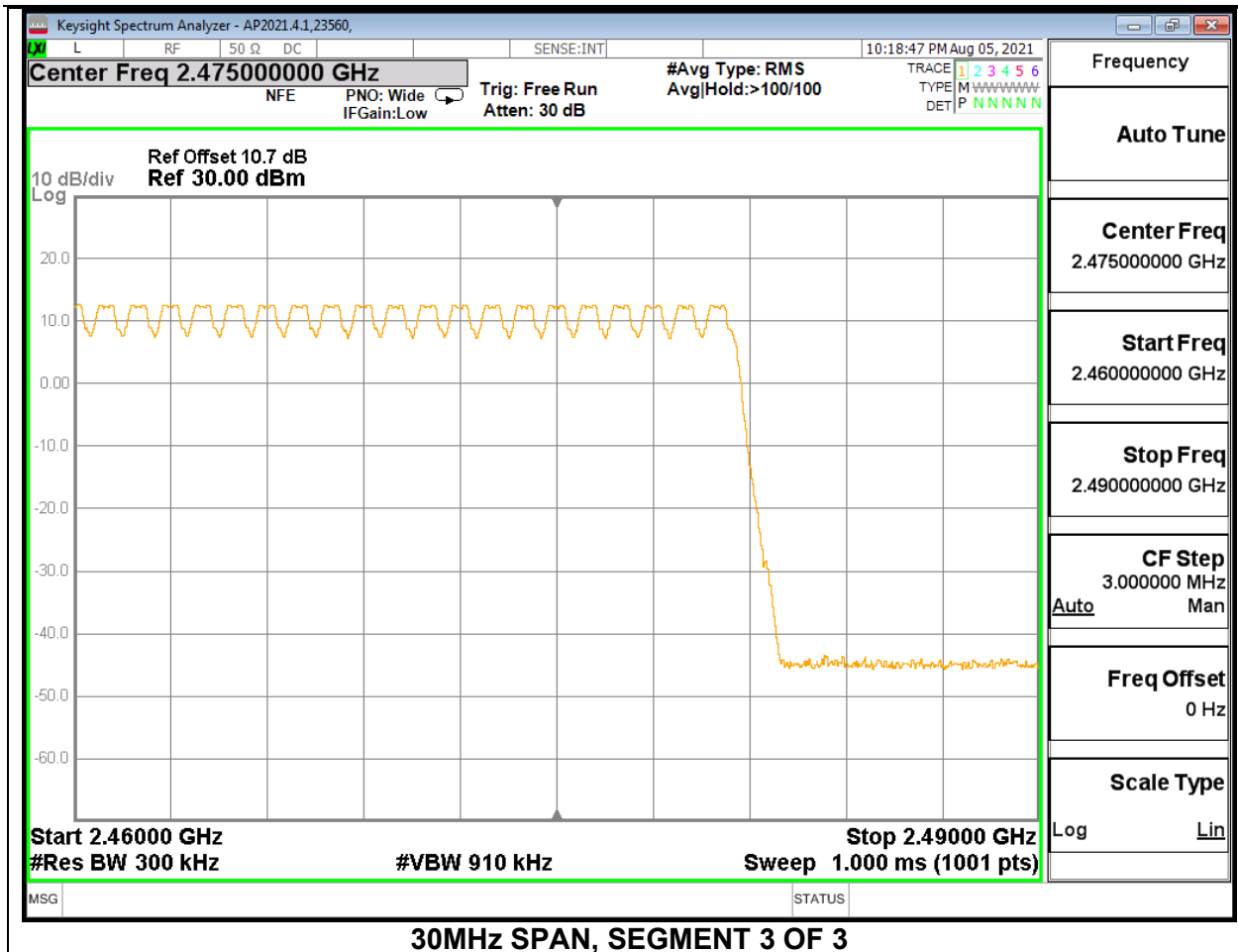


9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION









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.

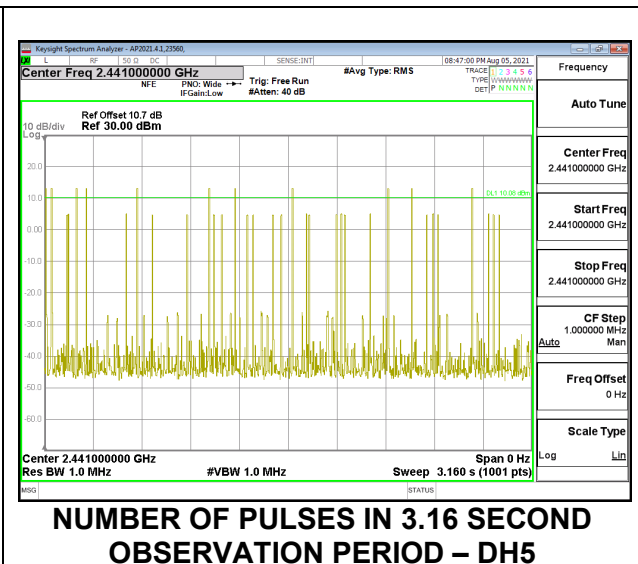
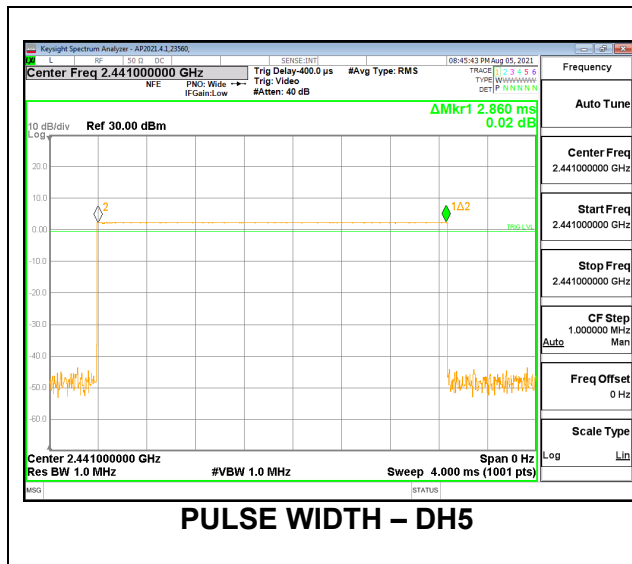
The average time of occupancy in the specified 3.16 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

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

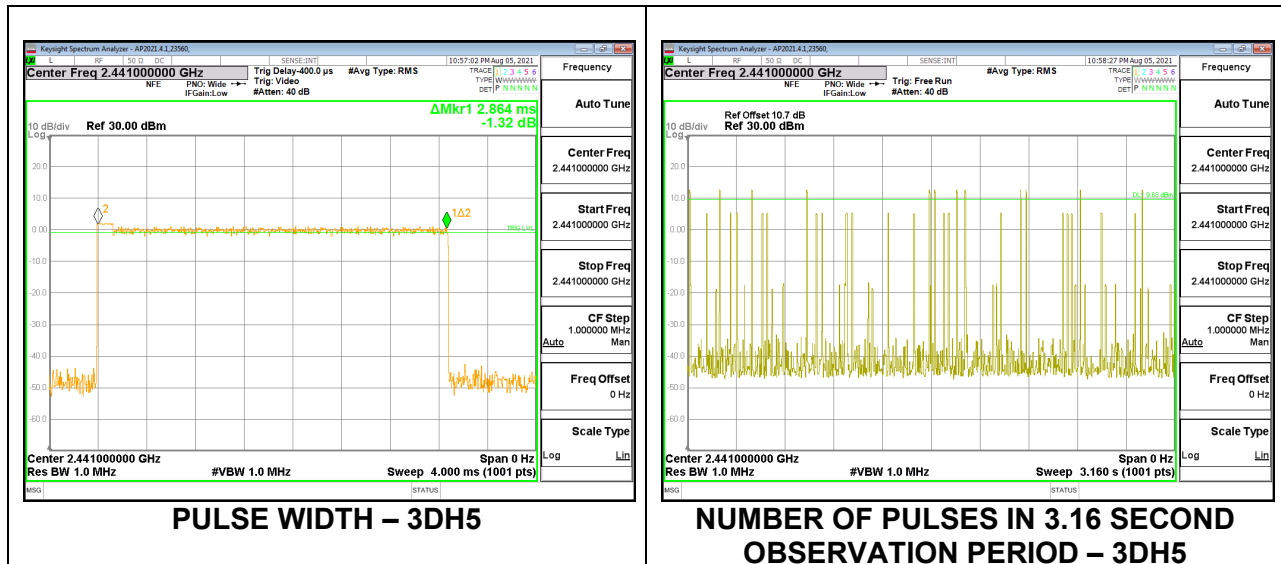
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH5	2.86	11	0.3146	0.4	-0.0854
GFSK AFH Mode					
DH5	2.86	2.75	0.07865	0.4	-0.3214



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				
3DH5	2.864	12	0.34368	0.4	-0.05632

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 was perform using a power meter with wideband peak power sensor.

RESULTS

9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	23560
Date:	8/5/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.65	21	-8.35
Middle	2441	12.73	21	-8.27
High	2480	12.74	21	-8.26

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	23560
Date:	8/5/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.79	21	-9.21
Middle	2441	11.89	21	-9.11
High	2480	11.71	21	-9.29

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	23560
Date:	8/5/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.31	21	-8.69
Middle	2441	12.4	21	-8.6
High	2480	12.4	21	-8.6

9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements was performed using a power meter with wideband average power sensor

RESULTS

9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	23560
Date	8/5/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.36
Middle	2441	12.46
High	2480	12.48

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	23560
Date	8/5/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.92
Middle	2441	9.05
High	2480	8.99

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	23560
Date	8/5/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.97
Middle	2441	9.08
High	2480	9.02

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.

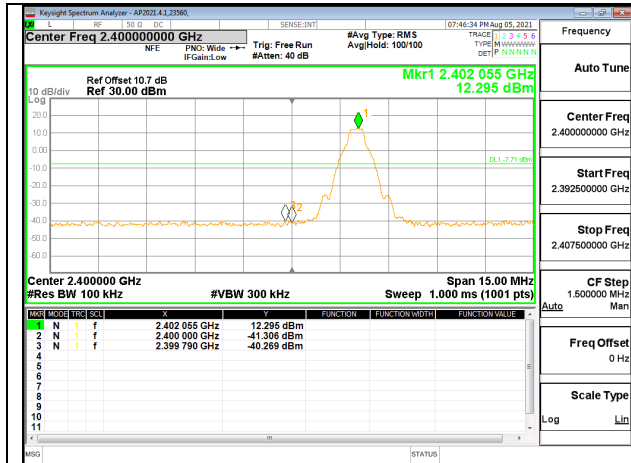
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

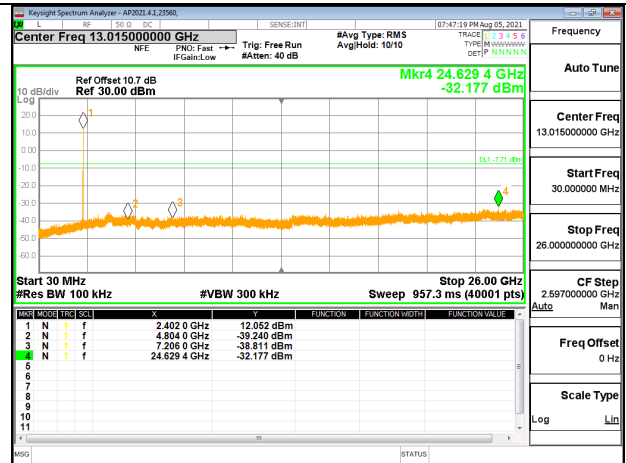
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

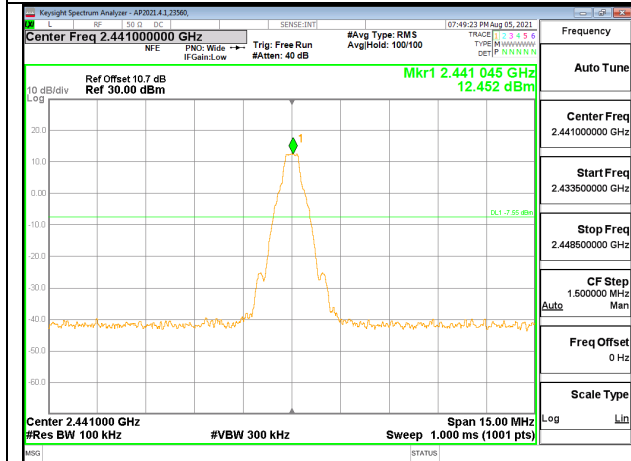
SPURIOUS EMISSIONS, NON-HOPPING



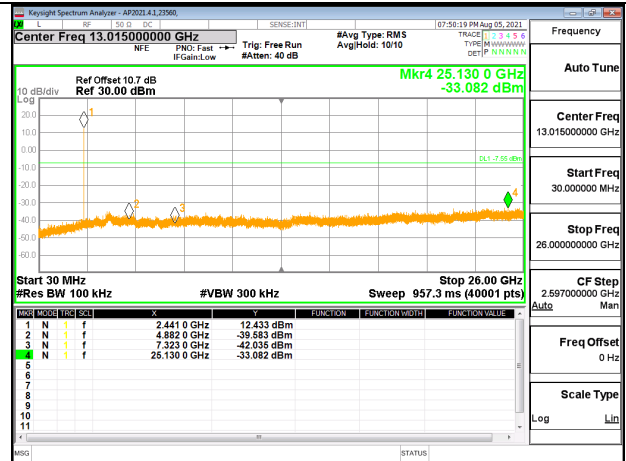
LOW CHANNEL BANDEDGE



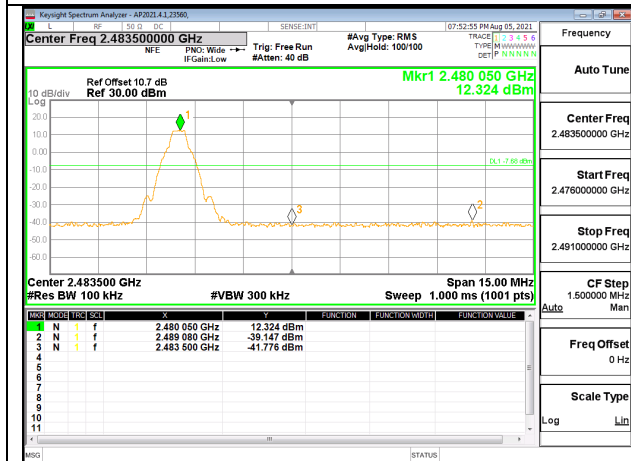
OUT-OF-BAND LOW CHANNEL



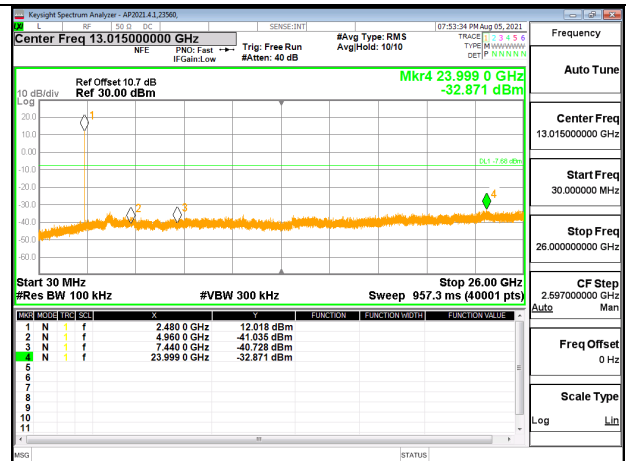
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

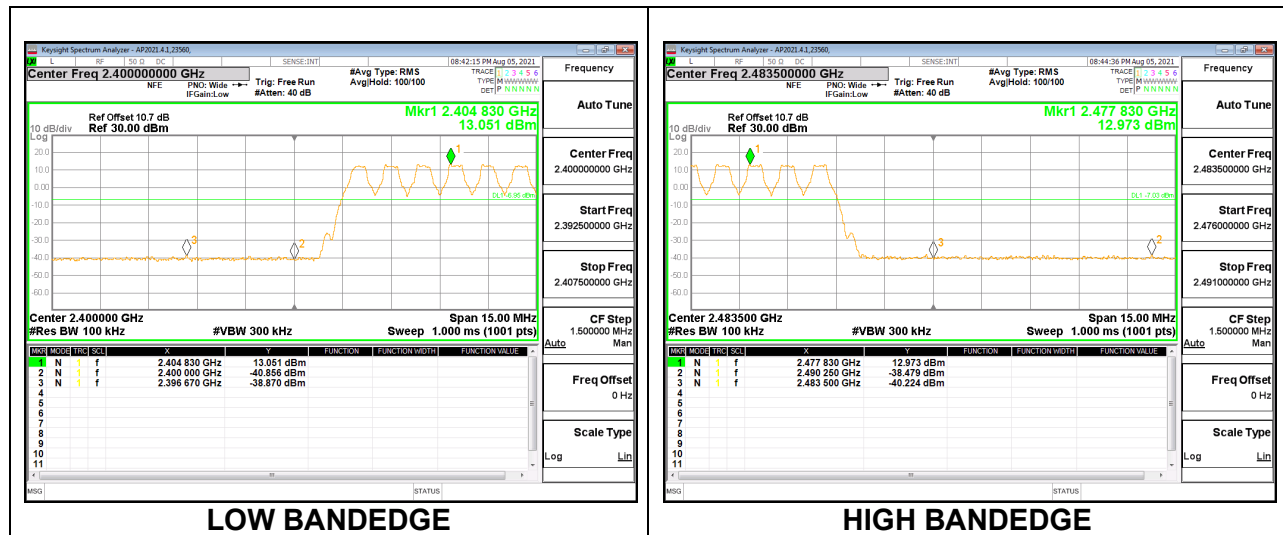


HIGH CHANNEL BANDEDGE



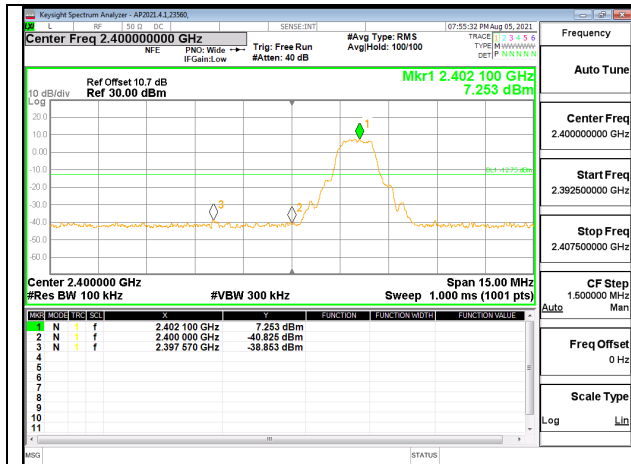
OUT-OF-BAND HIGH CHANNEL

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

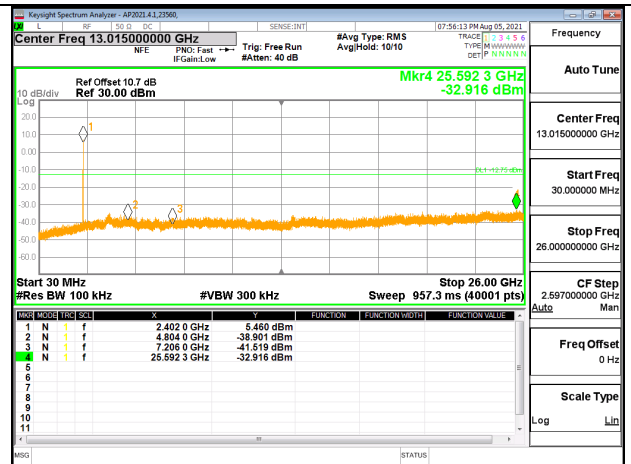


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

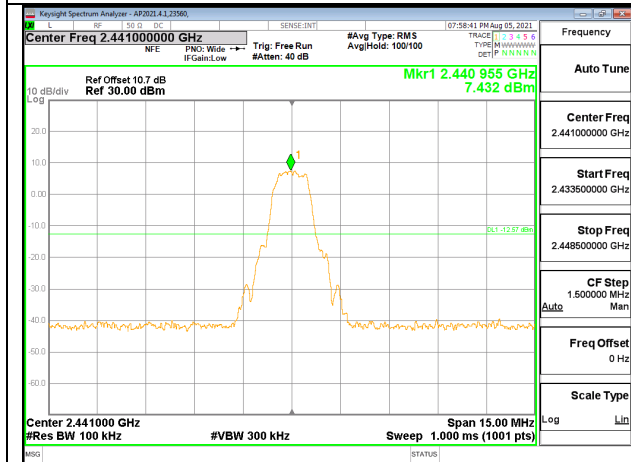
SPURIOUS EMISSIONS, NON-HOPPING



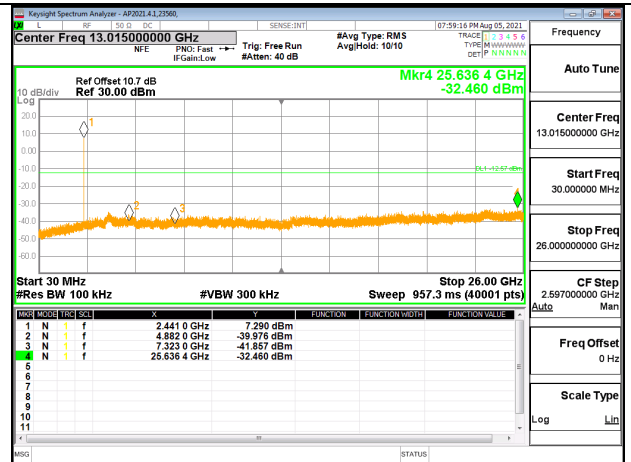
LOW CHANNEL BANDEDGE



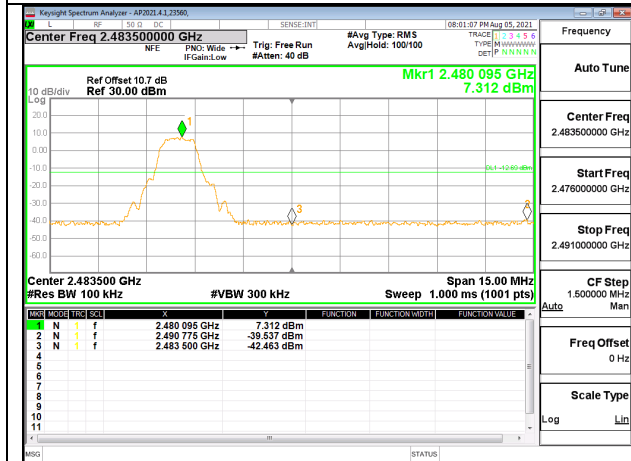
OUT-OF-BAND LOW CHANNEL



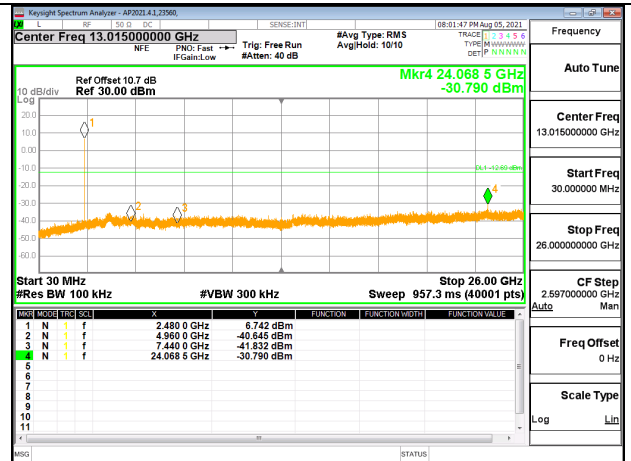
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

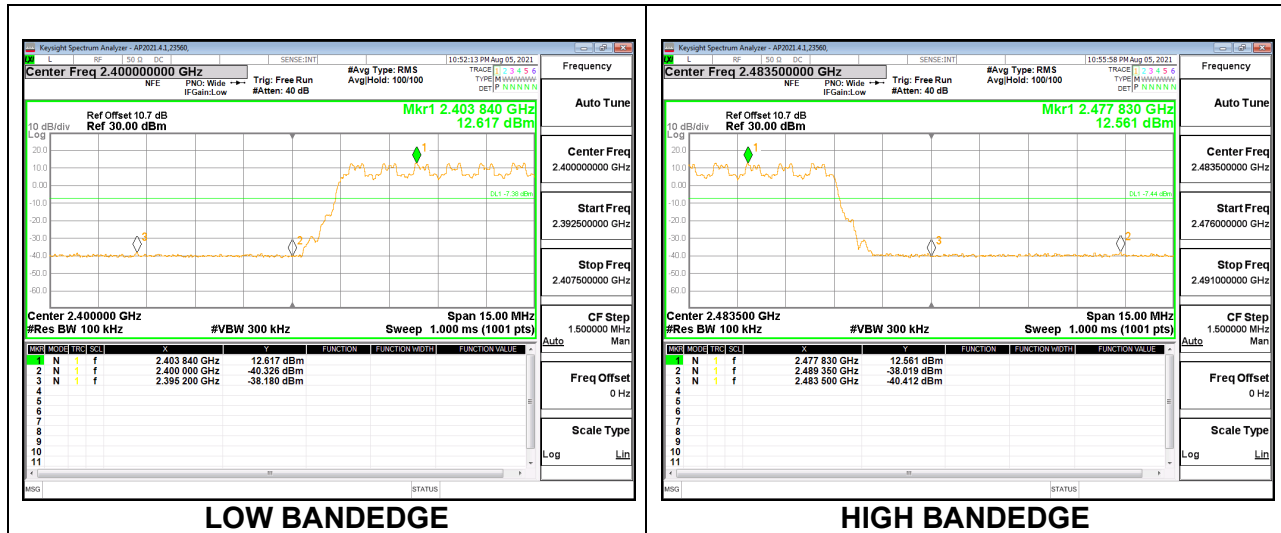


HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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 and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for average measurements.

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

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

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

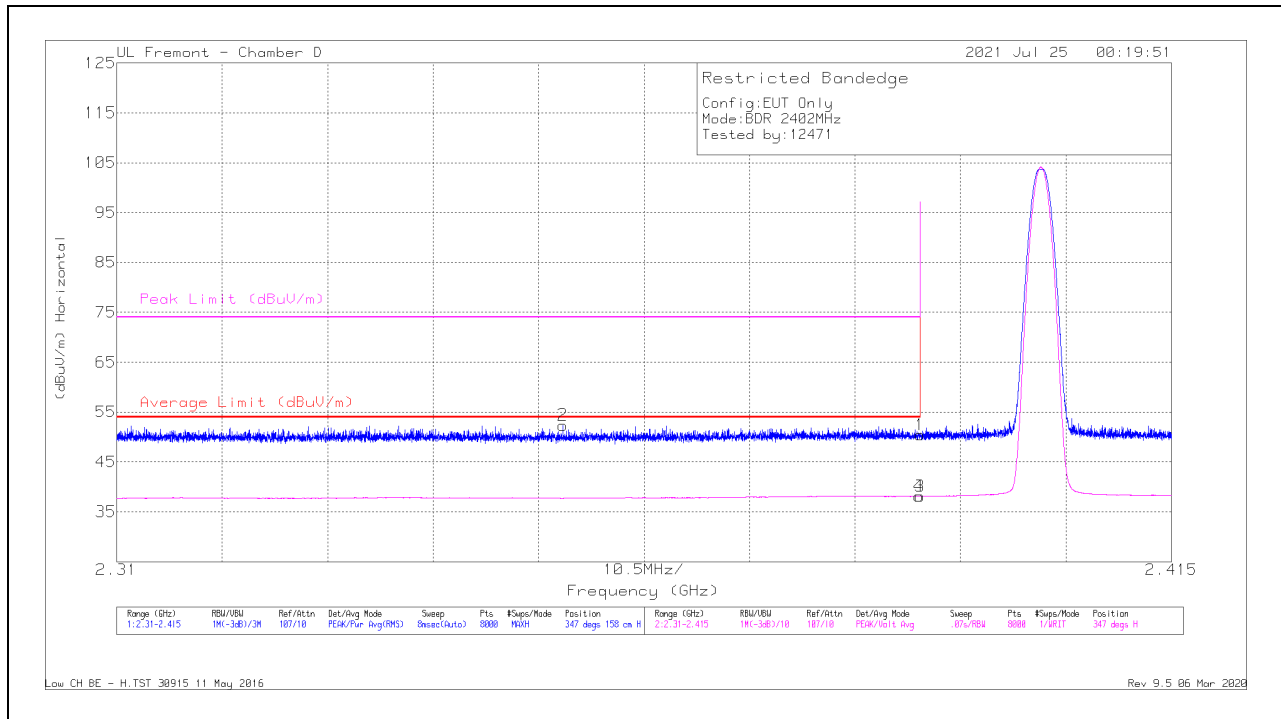
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can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



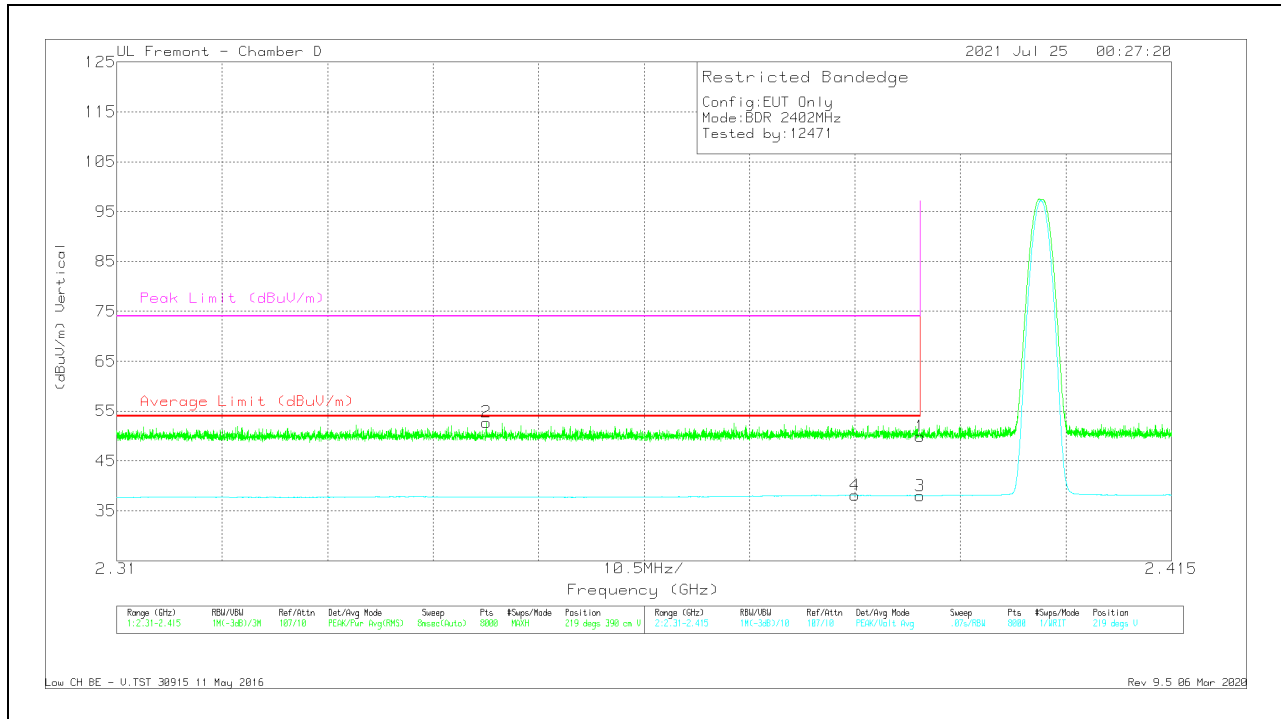
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.58	Pk	32.1	-20.3	50.38	-	-	74	-23.62	347	158	H
2	* 2.35442	41.08	Pk	31.8	-20.5	52.38	-	-	74	-21.62	347	158	H
3	* 2.39	26.31	VA1T	32.1	-20.3	38.11	54	-15.89	-	-	347	158	H
4	* 2.38988	26.36	VA1T	32.1	-20.3	38.16	54	-15.84	-	-	347	158	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 transmit duration

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbll/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.19	Pk	32.1	-20.3	49.99	-	-	74	-24.01	219	390	V
2	* 2.3468	41.26	Pk	31.9	-20.4	52.76	-	-	74	-21.24	219	390	V
3	* 2.39	26.2	VA1T	32.1	-20.3	38	54	-16	-	-	219	390	V
4	* 2.38348	26.42	VA1T	32.1	-20.4	38.12	54	-15.88	-	-	219	390	V

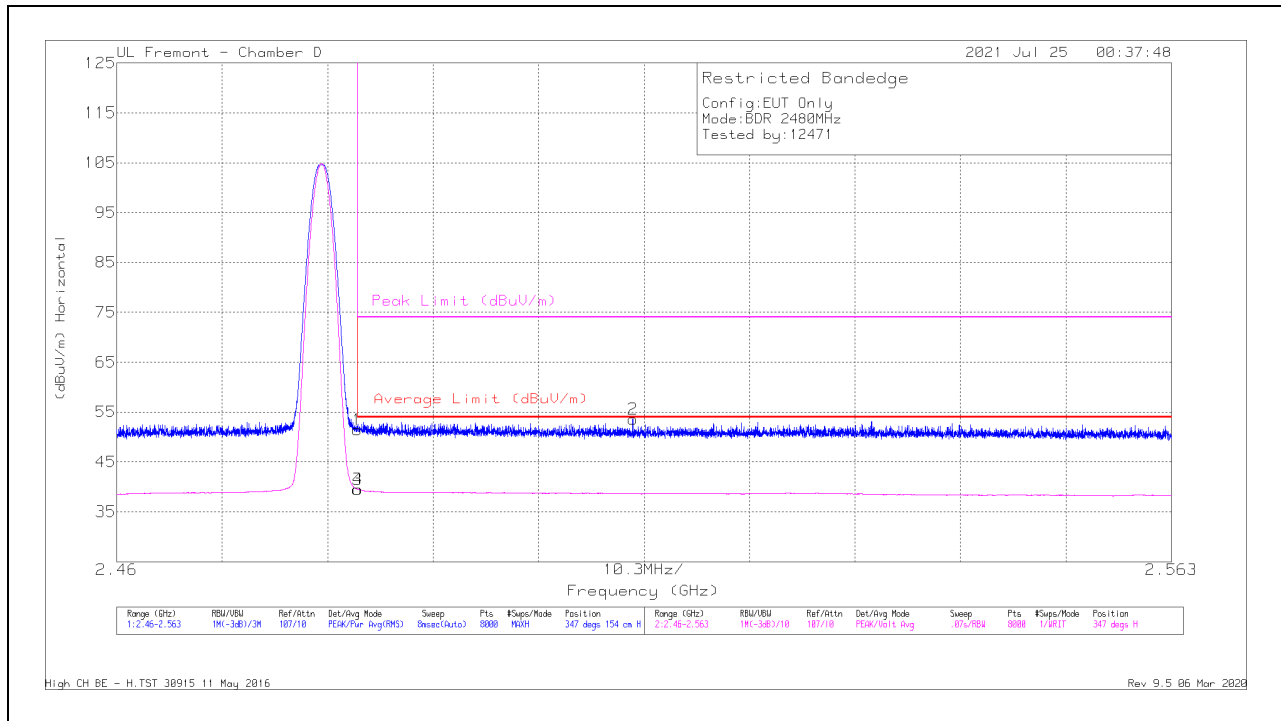
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



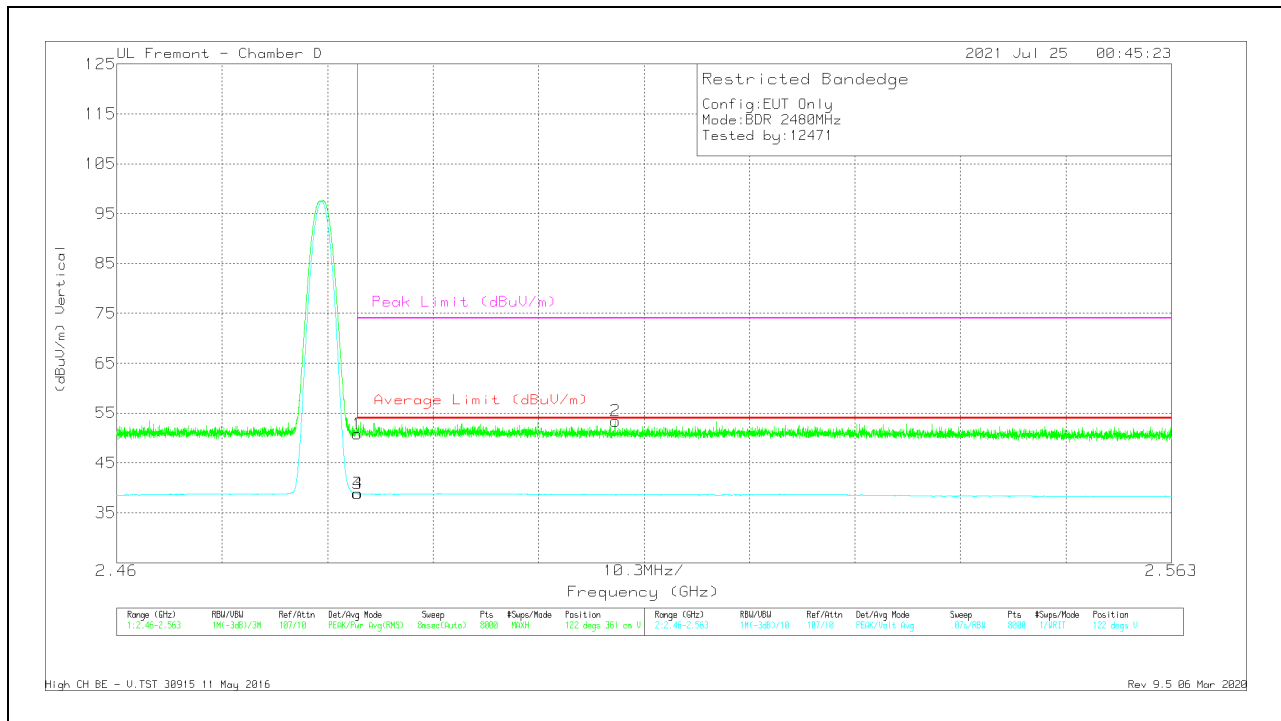
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filt/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	39.02	Pk	32.7	-20.3	51.42	-	-	74	-22.58	347	154	H
3	* 2.4835	27.15	VA1T	32.7	-20.3	39.55	54	-14.45	-	-	347	154	H
4	* 2.48356	27.11	VA1T	32.7	-20.3	39.51	54	-14.49	-	-	347	154	H
2	2.5104	41.15	Pk	32.7	-20.3	53.55	-	-	74	-20.45	347	154	H

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

Pk - Peak detector

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

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbll/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	38.36	Pk	32.7	-20.3	50.76	-	-	74	-23.24	122	361	V
3	* 2.4835	26.43	VA1T	32.7	-20.3	38.83	54	-15.17	-	-	122	361	V
4	* 2.48354	26.44	VA1T	32.7	-20.3	38.84	54	-15.16	-	-	122	361	V
2	2.50871	40.99	Pk	32.7	-20.3	53.39	-	-	74	-20.61	122	361	V

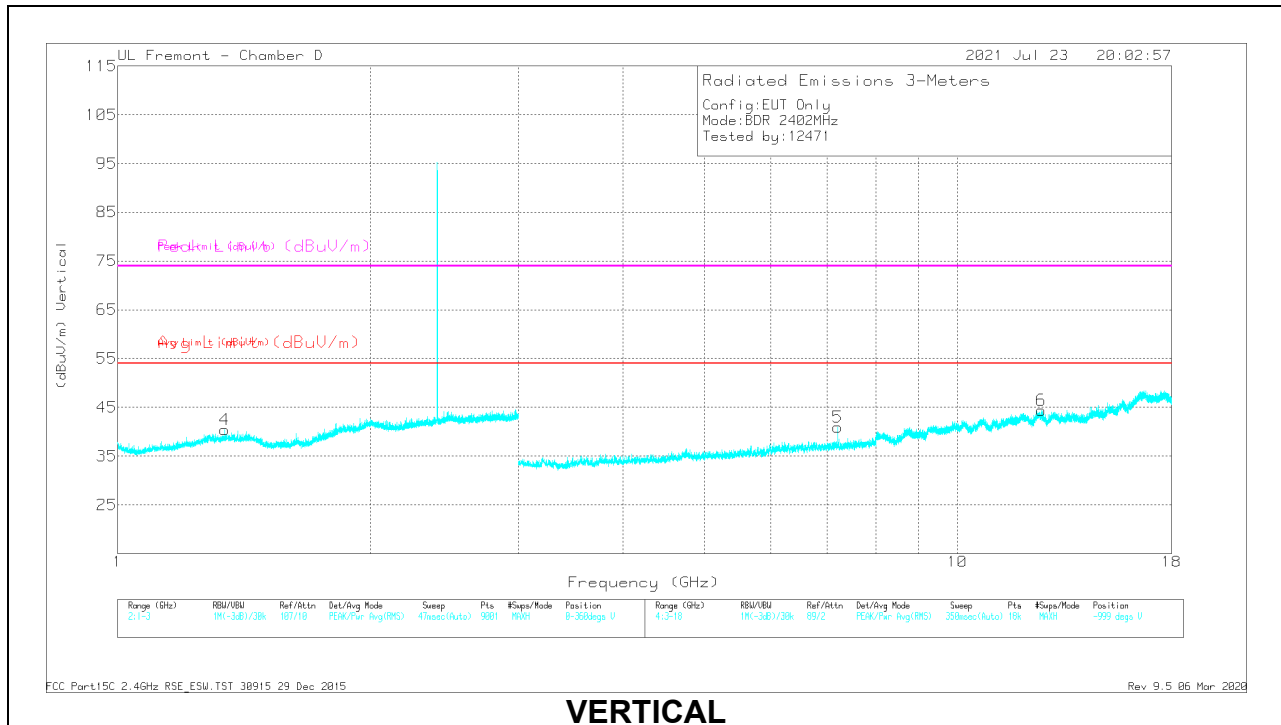
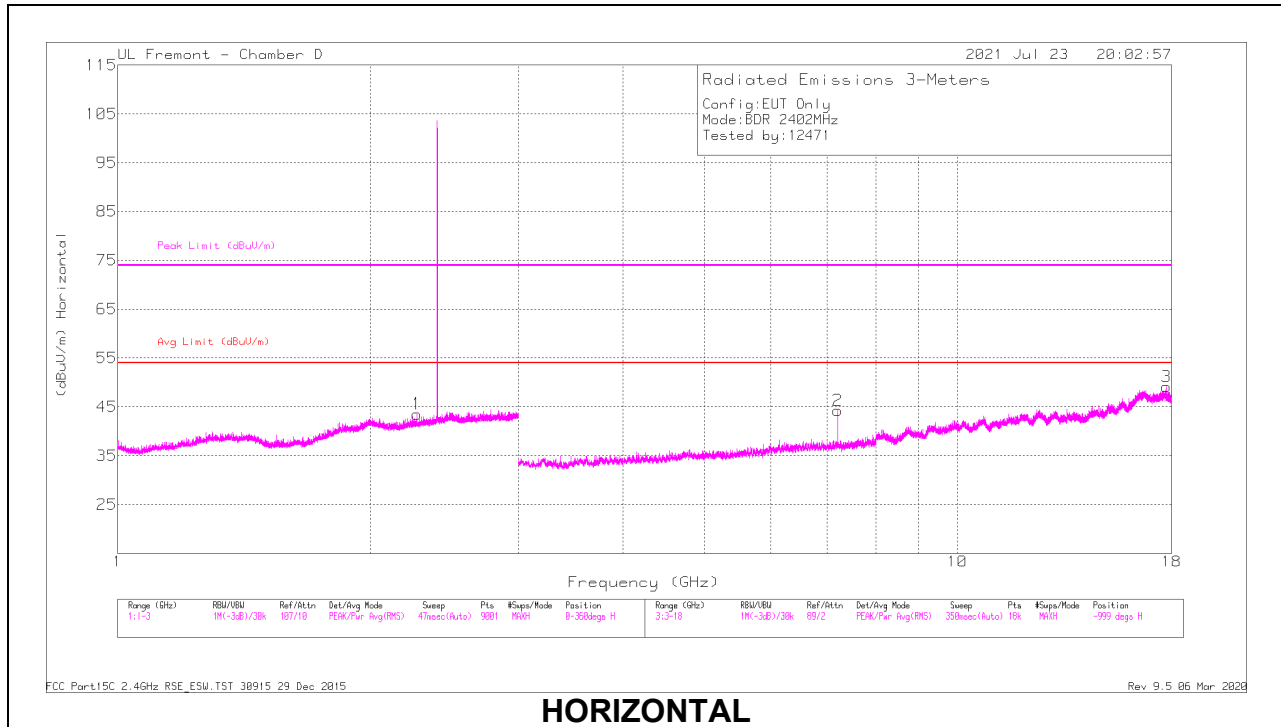
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

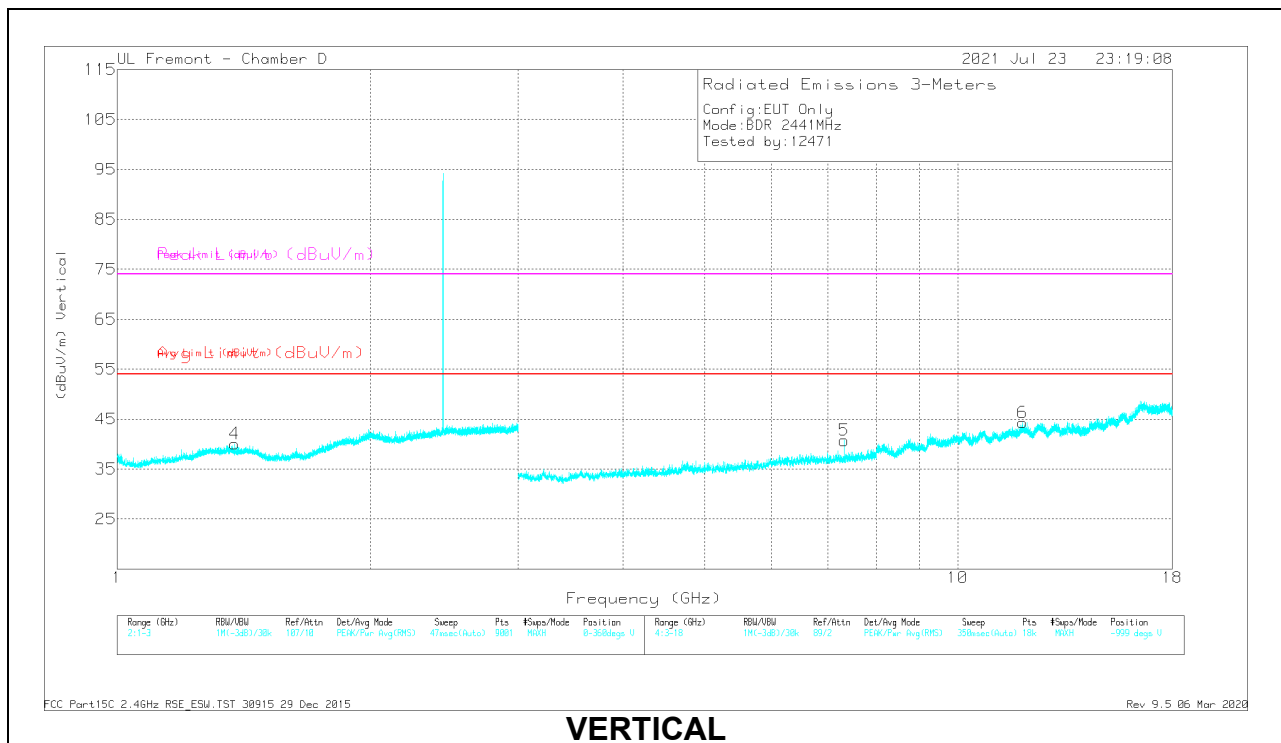
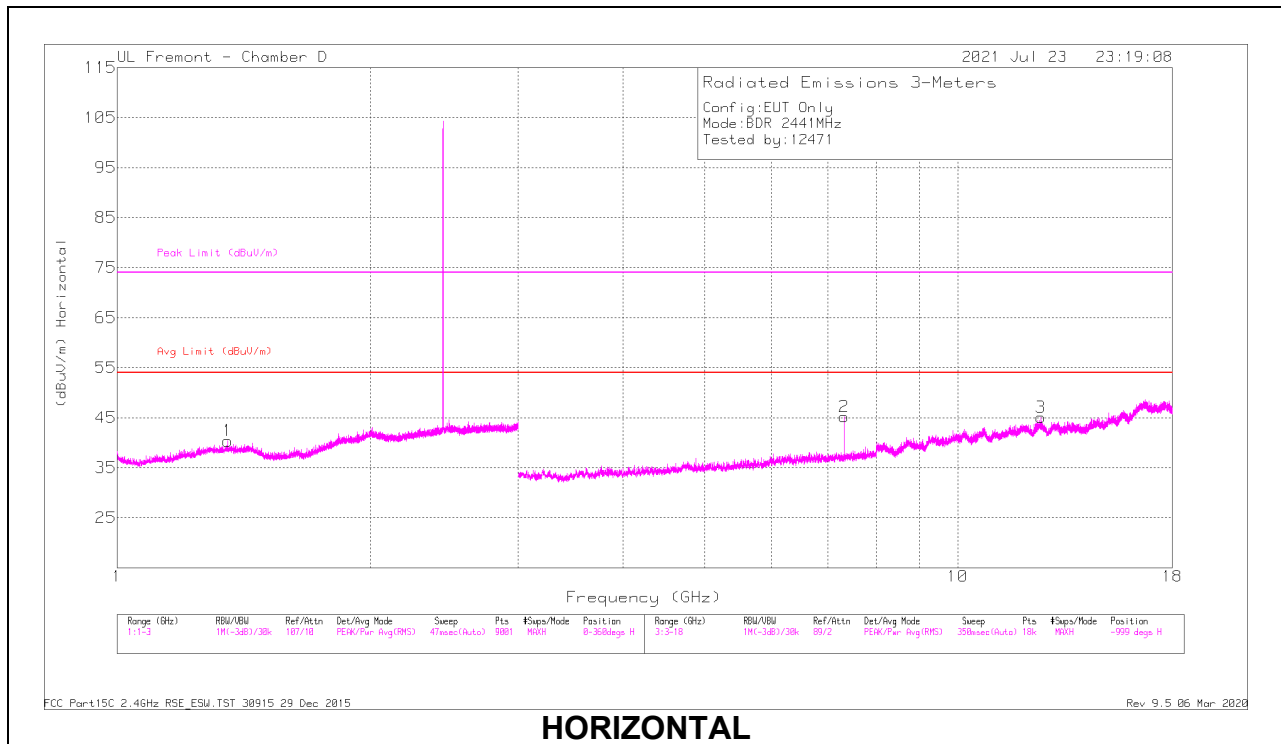
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.27164	39.65	PKFH	31.8	-20.5	50.95	-	-	74	-23.05	0	101	H
	* 2.27013	25.91	VA1T	31.8	-20.5	37.21	54	-16.79	-	-	0	101	H
4	* 1.33969	39.42	PKFH	29.4	-21.8	47.02	-	-	74	-26.98	7	200	V
	* 1.34099	26.42	VA1T	29.4	-21.8	34.02	54	-19.98	-	-	7	200	V
3	* 17.74701	31.16	PKFH	41.4	-17.9	54.66	-	-	74	-19.34	0	200	H
	* 17.74573	18.3	VA1T	41.5	-17.9	41.9	54	-12.1	-	-	0	200	H
6	* 12.58887	34.86	PKFH	39	-21.5	52.36	-	-	74	-21.64	0	200	V
	* 12.59159	21.11	VA1T	39	-21.4	38.71	54	-15.29	-	-	0	200	V
5	7.2055	36.93	PKFH	35.6	-24.7	47.83	-	-	-	-	167	247	V
2	7.20617	39.14	PKFH	35.6	-24.7	50.04	-	-	-	-	167	102	H

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

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

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

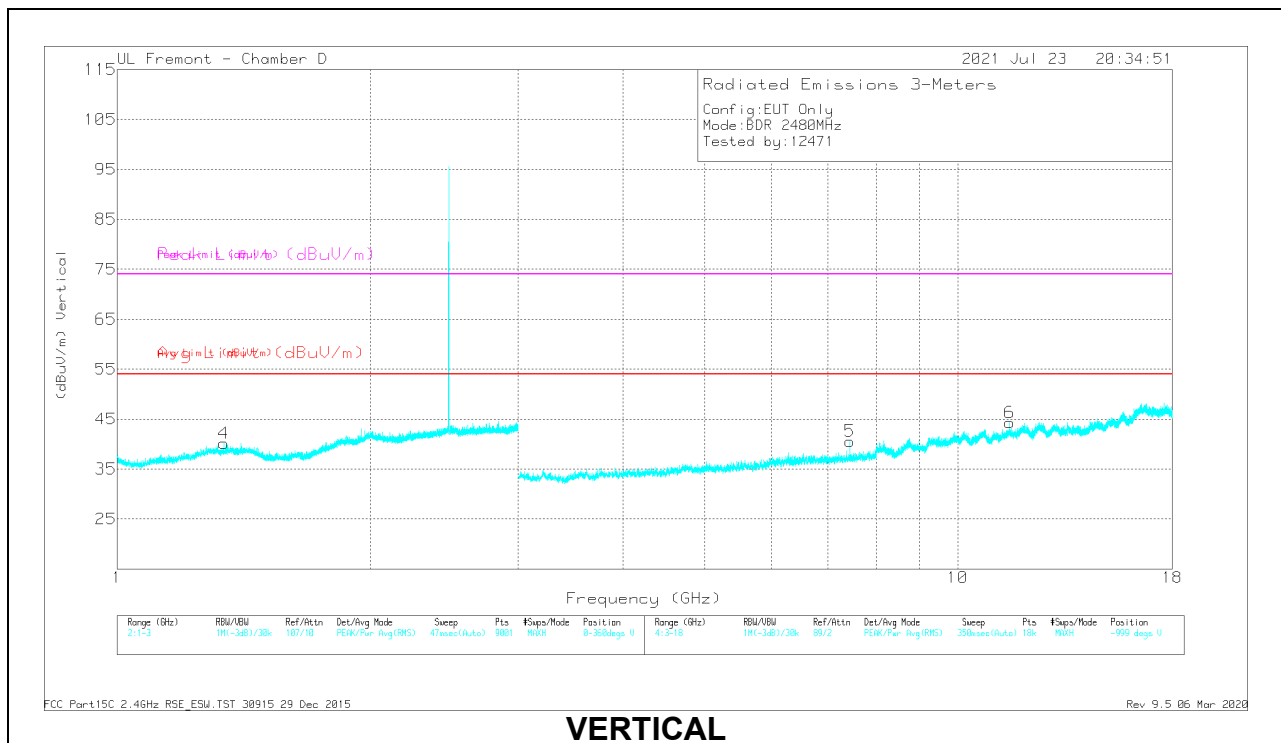
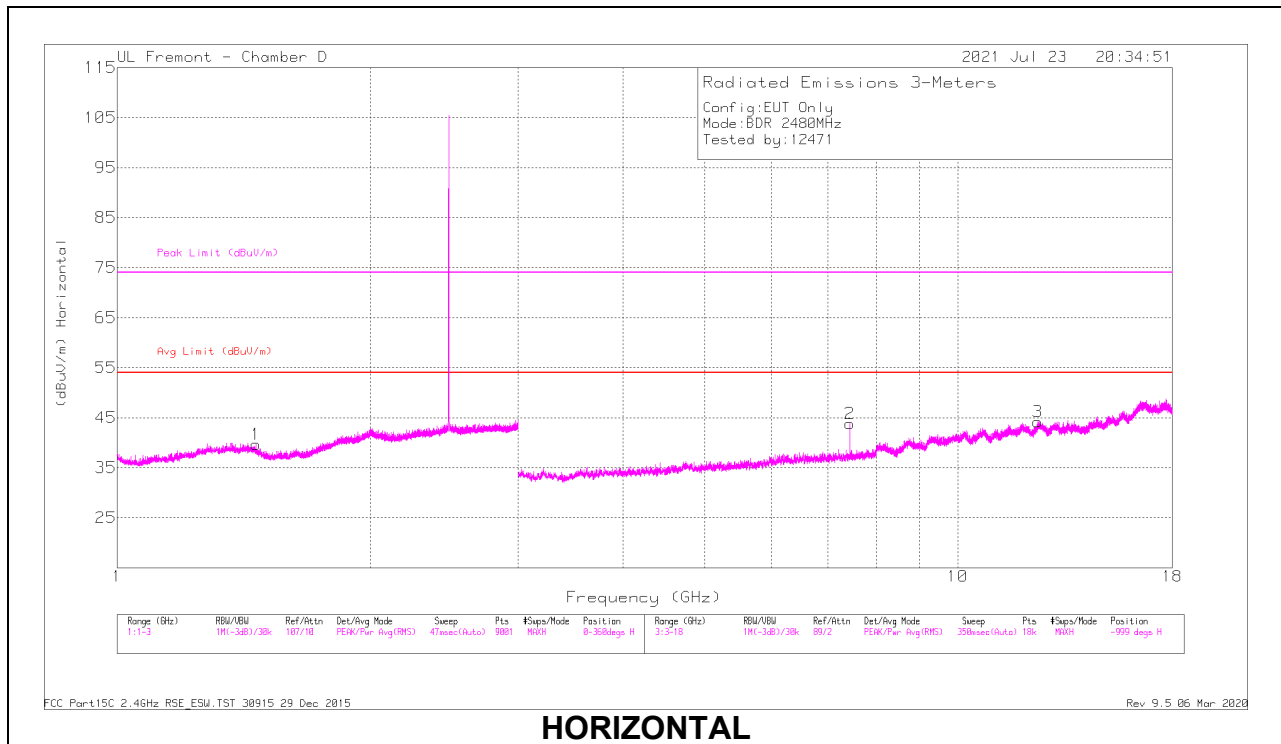
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.35147	40.06	PKFH	29.6	-21.7	47.96	-	-	74	-26.04	0	101	H
	* 1.35339	26.44	VA1T	29.6	-21.7	34.34	54	-19.66	-	-	0	101	H
4	* 1.37802	39.56	PKFH	29.4	-21.7	47.26	-	-	74	-26.74	0	101	V
	* 1.38085	26.35	VA1T	29.4	-21.7	34.05	54	-19.95	-	-	0	101	V
2	* 7.32259	39.43	PKFH	35.6	-24.8	50.23	-	-	74	-23.77	125	104	H
	* 7.32301	30.77	VA1T	35.6	-24.8	41.57	54	-12.43	-	-	125	104	H
3	* 12.56729	34.97	PKFH	39	-21.5	52.47	-	-	74	-21.53	0	101	H
	* 12.56735	21.15	VA1T	39	-21.5	38.65	54	-15.35	-	-	0	101	H
5	* 7.32263	36.66	PKFH	35.6	-24.8	47.46	-	-	74	-26.54	151	109	V
	* 7.32301	25.93	VA1T	35.6	-24.8	36.73	54	-17.27	-	-	151	109	V
6	* 11.94959	35.68	PKFH	38.7	-21	53.38	-	-	74	-20.62	0	101	V
	* 11.95128	20.31	VA1T	38.7	-21	38.01	54	-15.99	-	-	0	101	V

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

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

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.46225	39.63	PKFH	28.9	-21.6	46.93	-	-	74	-27.07	0	101	H
	* 1.4642	26.45	VA1T	28.9	-21.6	33.75	54	-20.25	-	-	0	101	H
4	* 1.33694	39.54	PKFH	29.4	-21.8	47.14	-	-	74	-26.86	5	101	V
	* 1.34058	26.42	VA1T	29.4	-21.8	34.02	54	-19.98	-	-	5	101	V
2	* 7.43957	38.79	PKFH	35.7	-24.4	50.09	-	-	74	-23.91	120	116	H
	* 7.43999	30.27	VA1T	35.7	-24.4	41.57	54	-12.43	-	-	120	116	H
3	* 12.44413	33.18	PKFH	39	-20.8	51.38	-	-	74	-22.62	0	101	H
	* 12.44635	19.93	VA1T	39	-20.8	38.13	54	-15.87	-	-	0	101	H
5	* 7.44035	37.48	PKFH	35.7	-24.4	48.78	-	-	74	-25.22	147	249	V
	* 7.43996	25.74	VA1T	35.7	-24.4	37.04	54	-16.96	-	-	147	249	V
6	* 11.53128	33.04	PKFH	38.2	-19.9	51.34	-	-	74	-22.66	0	101	V
	* 11.53221	19.42	VA1T	38.2	-19.9	37.72	54	-16.28	-	-	0	101	V

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

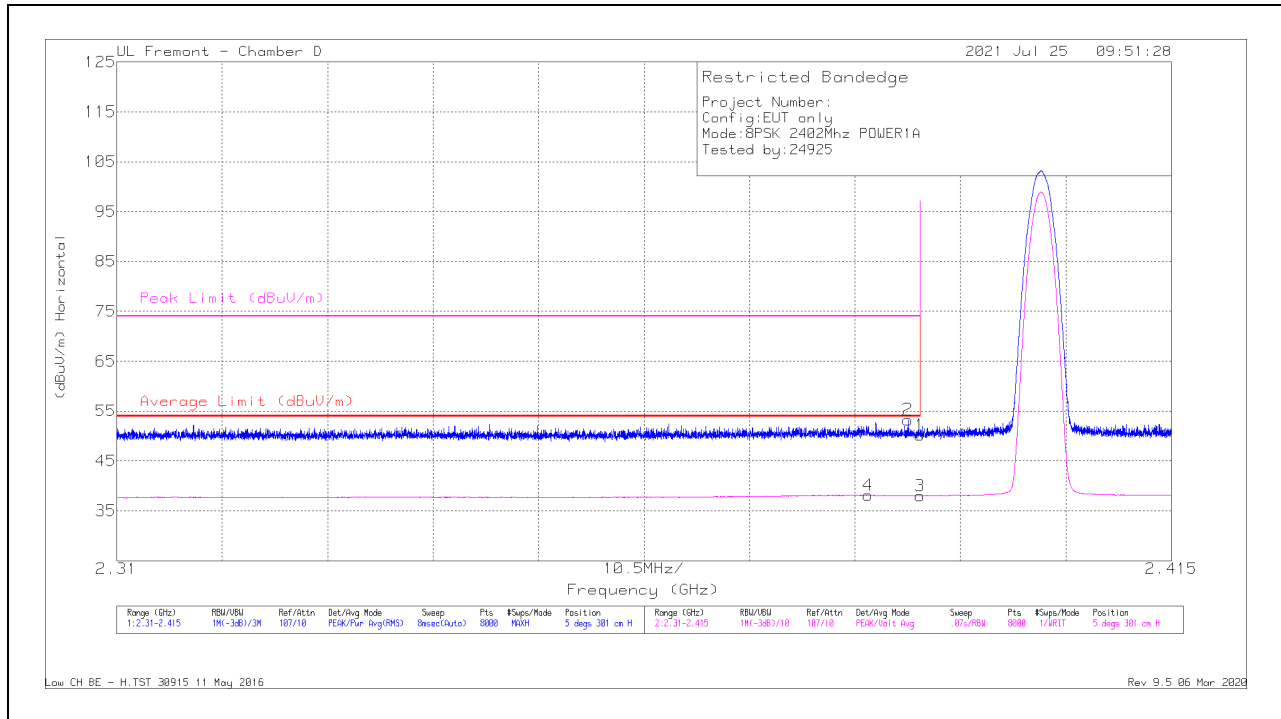
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak

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

10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



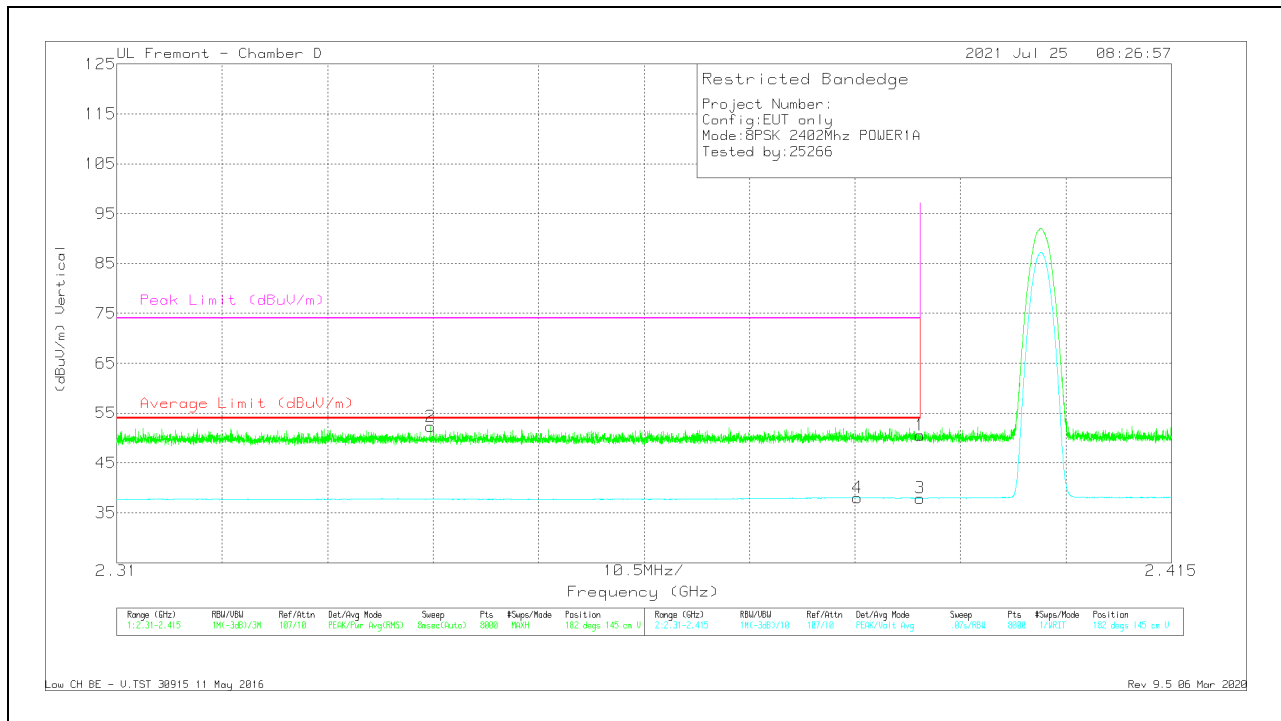
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	38.35	Pk	32.1	-20.3	50.15	-	-	74	-23.85	5	301	H
2	* 2.38876	41.56	Pk	32.1	-20.4	53.26	-	-	74	-20.74	5	301	H
3	* 2.39	26.22	VA1T	32.1	-20.3	38.02	54	-15.98	-	-	5	301	H
4	* 2.38482	26.44	VA1T	32.1	-20.4	38.14	54	-15.86	-	-	5	301	H

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

Pk - Peak detector

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

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dBm)	Amp/Cbll/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
2	* 2.34126	40.96	Pk	31.9	-20.5	52.36	-	-	74	-21.64	182	145	V
4	* 2.38372	26.36	VA1T	32.1	-20.4	38.06	54	-15.94	-	-	182	145	V
1	* 2.39	38.75	Pk	32.1	-20.3	50.55	-	-	74	-23.45	182	145	V
3	* 2.39	26.14	VA1T	32.1	-20.3	37.94	54	-16.06	-	-	182	145	V

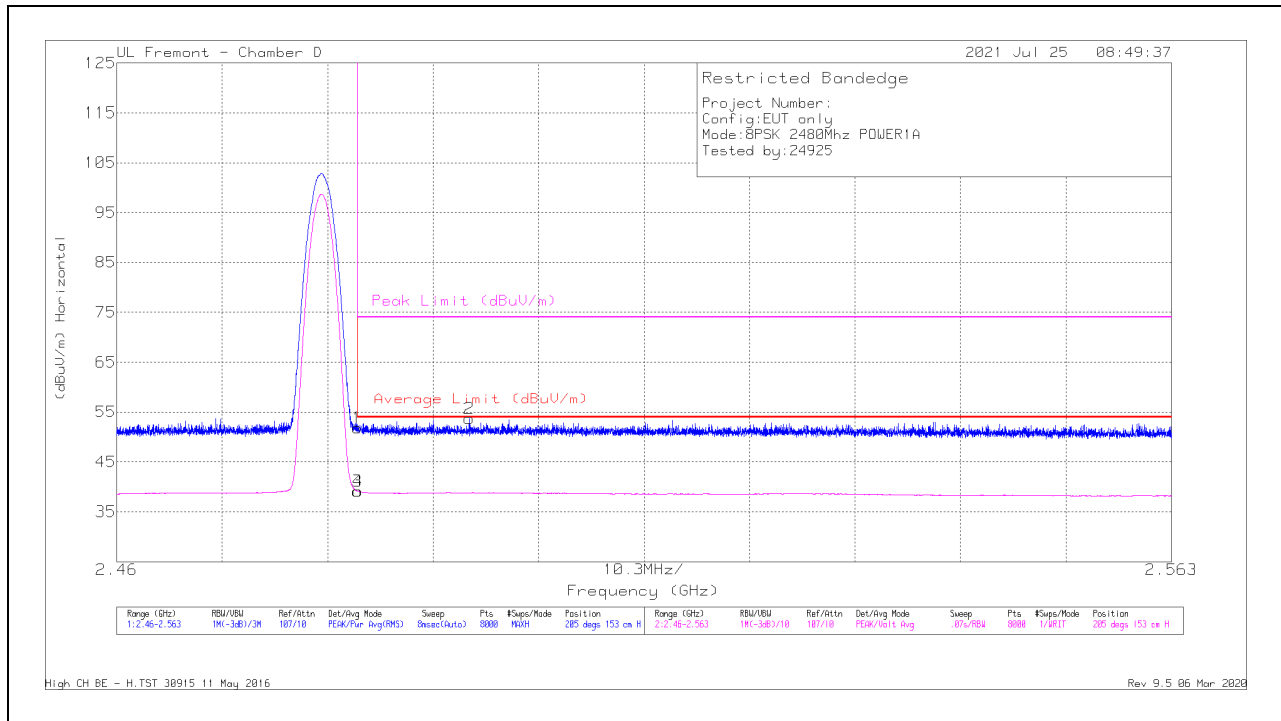
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



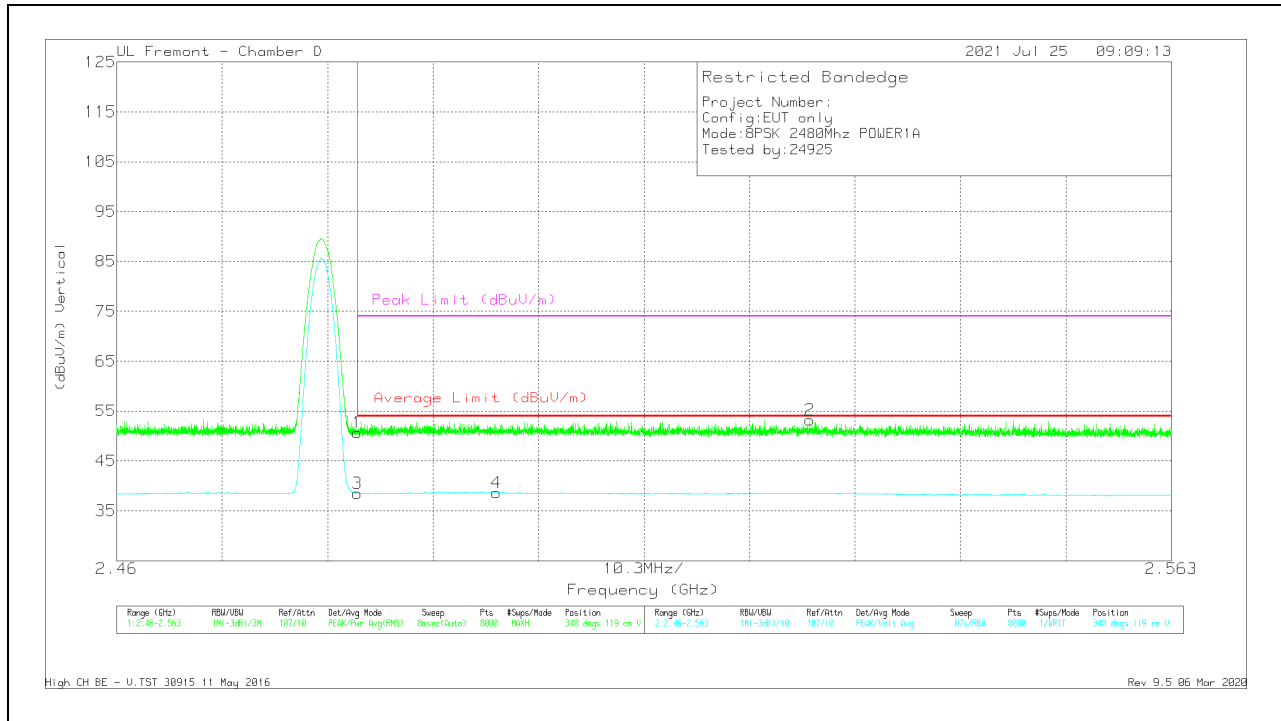
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	39.43	Pk	32.7	-20.3	51.83	-	-	74	-22.17	205	153	H
2	* 2.49442	41.09	Pk	32.8	-20.2	53.69	-	-	74	-20.31	205	153	H
3	* 2.4835	26.76	VA1T	32.7	-20.3	39.16	54	-14.84	-	-	205	153	H
4	* 2.48358	26.71	VA1T	32.7	-20.3	39.11	54	-14.89	-	-	205	153	H

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

Pk - Peak detector

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

VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fitr/ Pad (dB)	Corrected/Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin/Margin (dB)	Peak Limit (dBuV/m)	PK Margin/PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.4835	38.32	Pk	32.7	-20.3	50.72	-	-	74	-23.28	348	119	V
3	* 2.4835	26.12	VA1T	32.7	-20.3	38.52	54	-15.48	-	-	348	119	V
4	* 2.4971	26.06	VA1T	32.8	-20.2	38.66	54	-15.34	-	-	348	119	V
2	2.52767	40.72	Pk	32.6	-20.1	53.22	-	-	74	-20.78	348	119	V

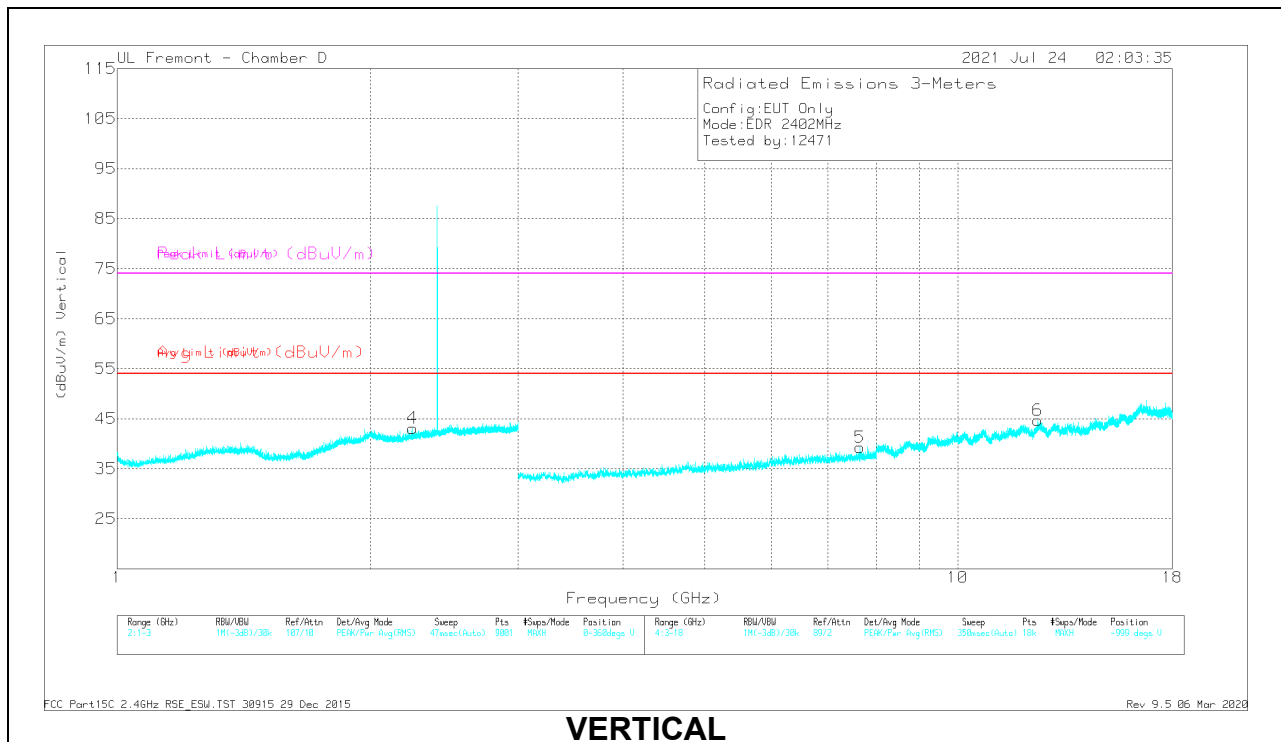
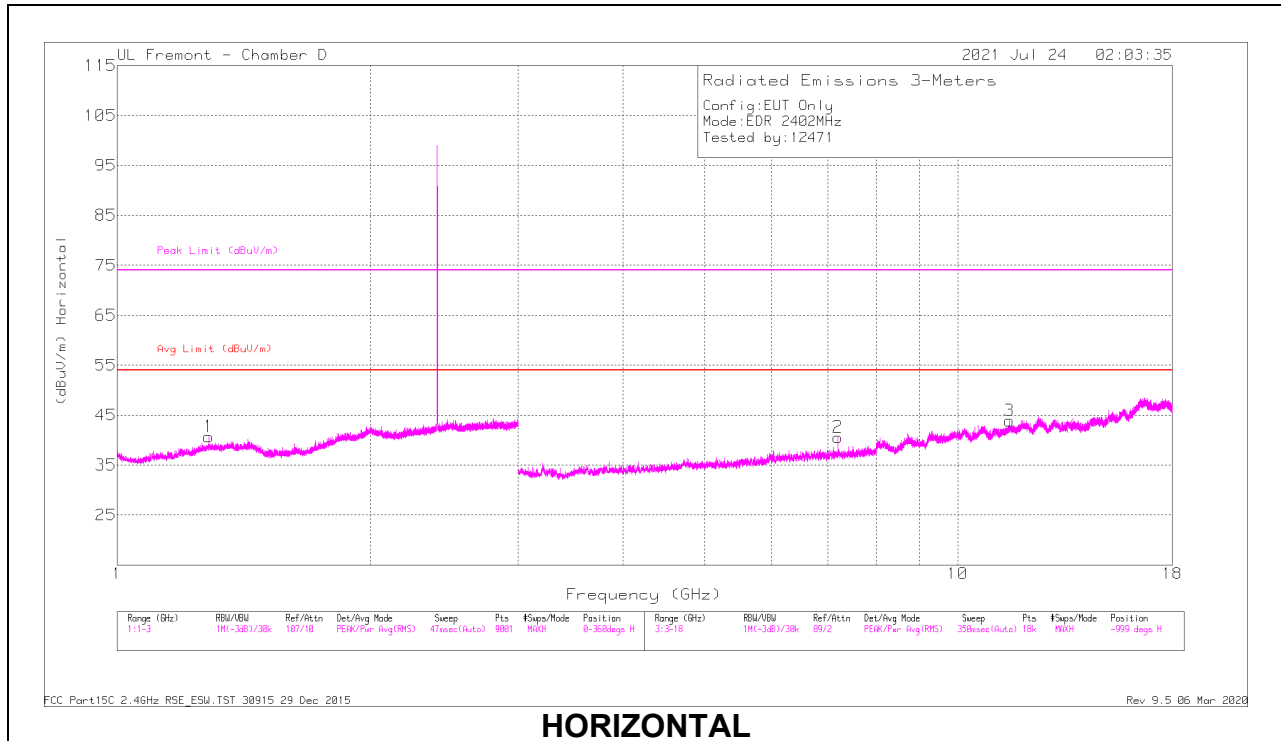
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

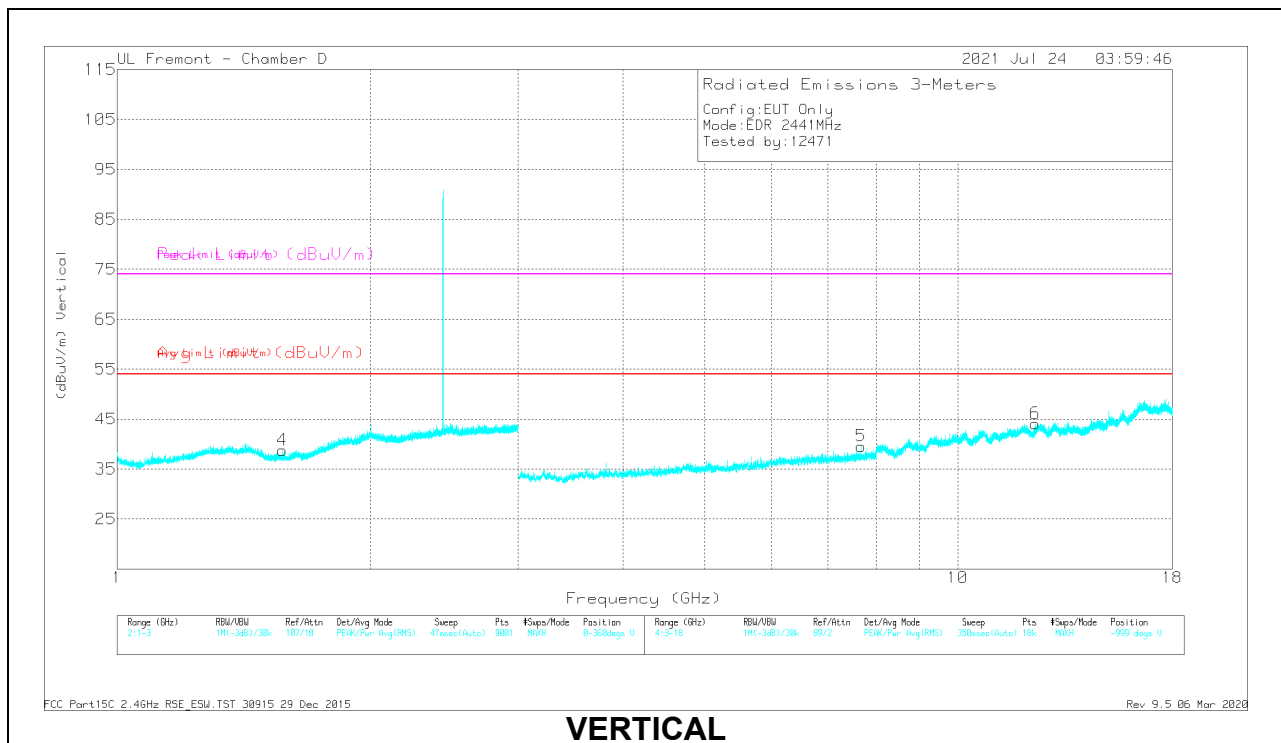
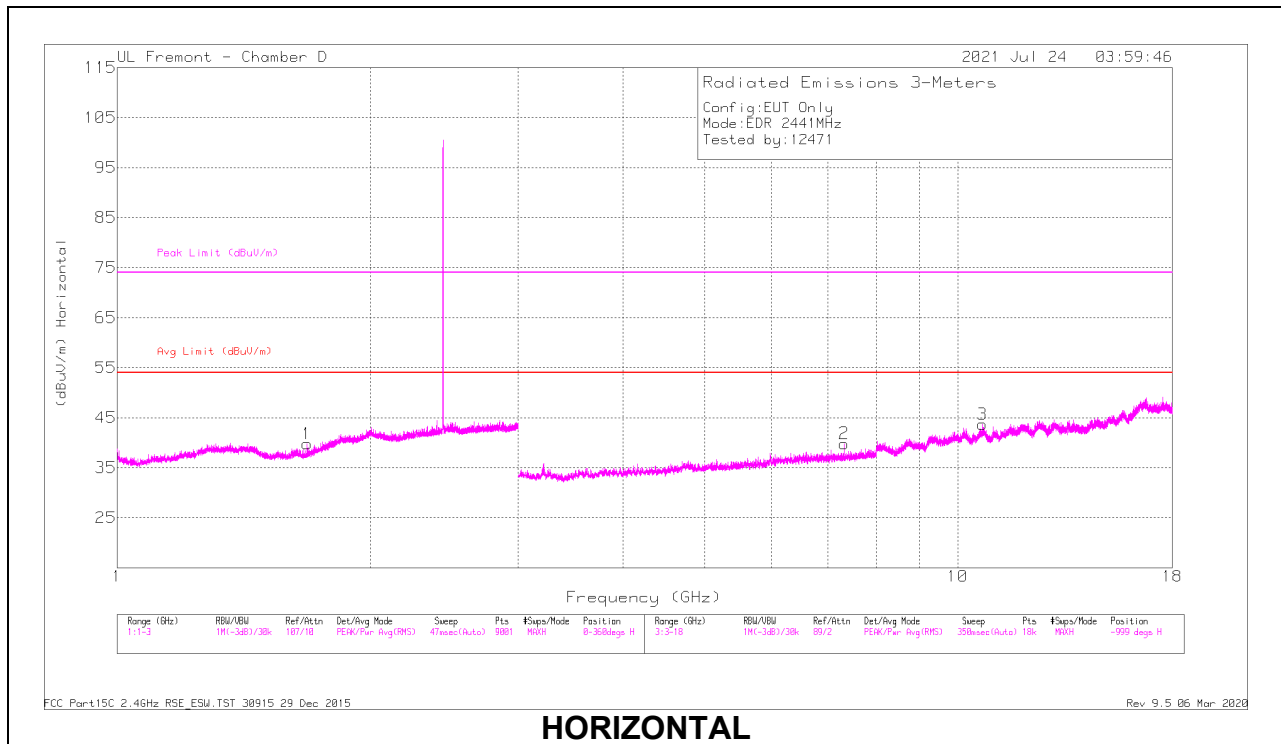
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.28644	40.57	PKFH	29.5	-21.9	48.17	-	-	74	-25.83	0	101	H
	* 1.28567	26.5	VA1T	29.5	-21.9	34.1	54	-19.9	-	-	0	101	H
4	* 2.24705	39.22	PKFH	31.6	-20.5	50.32	-	-	74	-23.68	2	200	V
	* 2.2465	25.9	VA1T	31.6	-20.5	37	54	-17	-	-	2	200	V
3	* 11.52699	33.03	PKFH	38.2	-20.2	51.03	-	-	74	-22.97	0	200	H
	* 11.52841	19.5	VA1T	38.2	-20.1	37.6	-	-	-	-	0	200	H
5	* 7.65451	34.78	PKFH	35.7	-24.2	46.28	-	-16.4	74	-27.72	297	101	V
	* 7.65416	21.36	VA1T	35.7	-24.3	32.76	-	-21.24	-	-	297	101	V
6	* 12.45211	33.27	PKFH	39	-20.7	51.57	-	-	74	-22.43	0	200	V
	* 12.45295	19.95	VA1T	39	-20.7	38.25	54	-15.75	-	-	0	200	V
2	7.20668	37.19	PKFH	35.6	-24.7	48.09	-	-	-	-	314	112	H

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

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

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

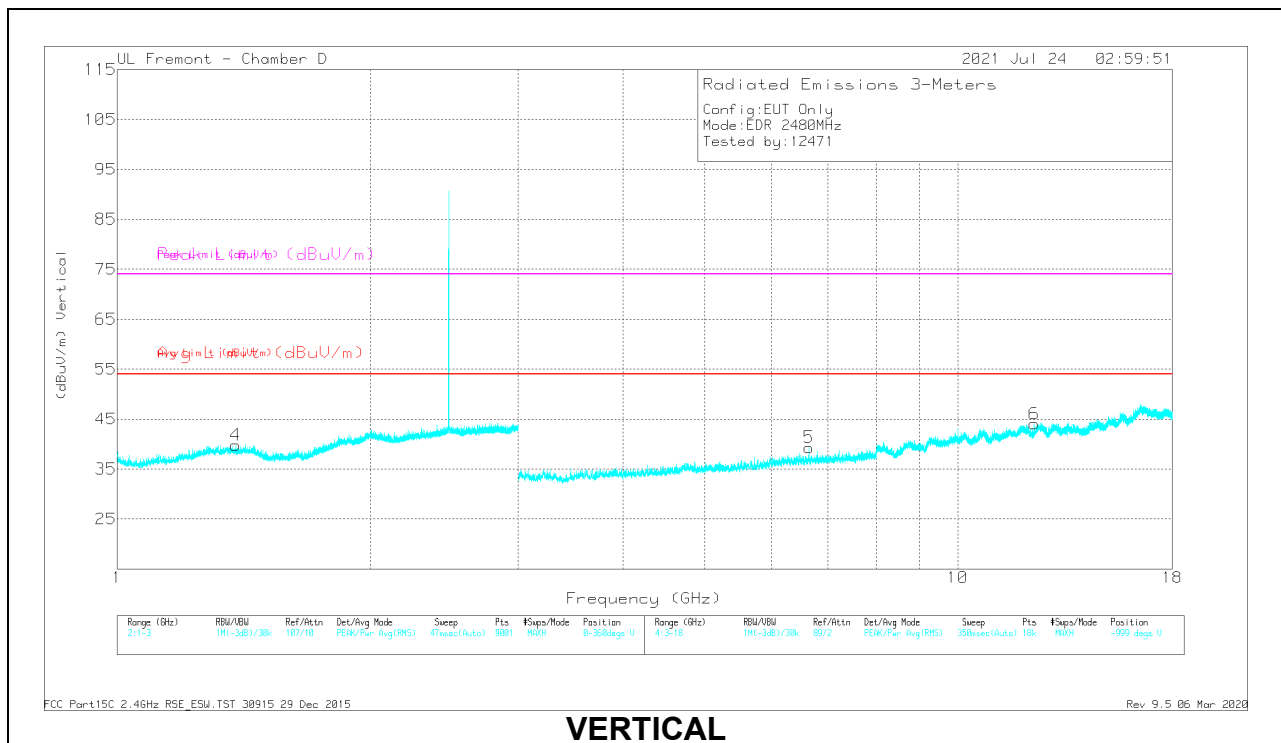
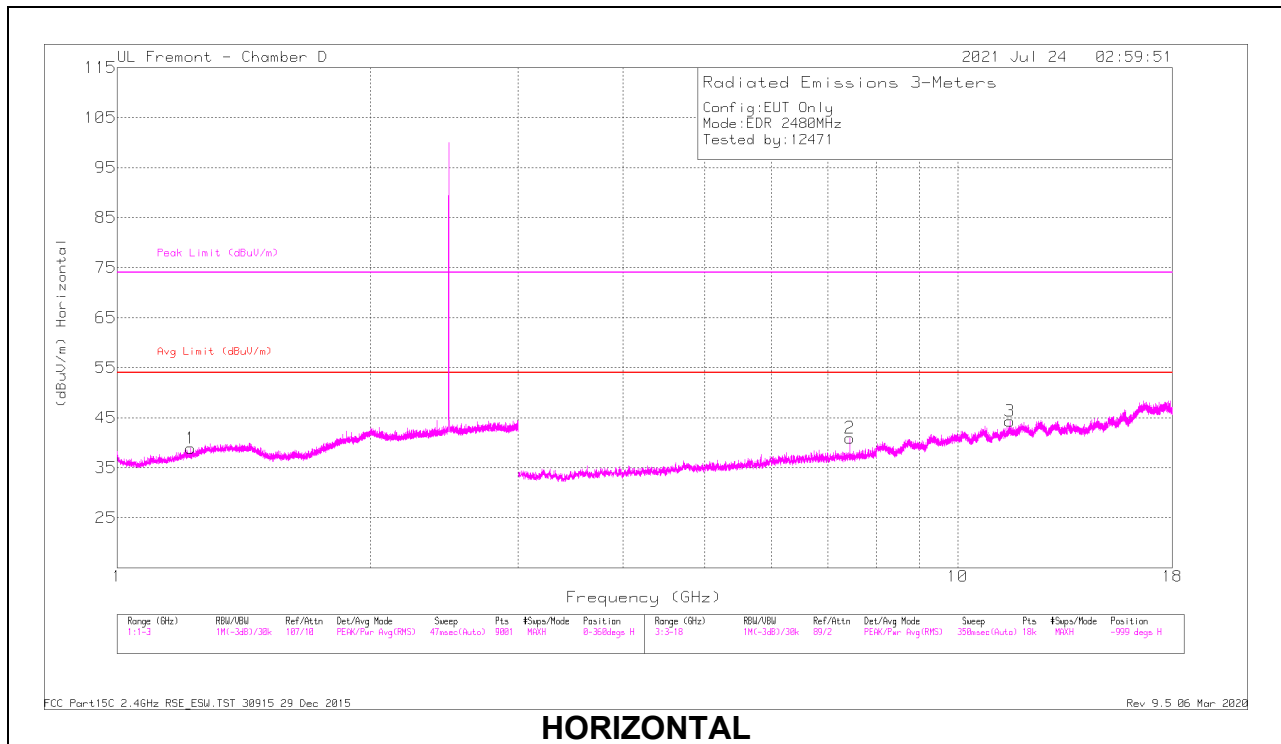
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.68162	39.24	PKFH	28.2	-21.3	46.14	-	-	74	-27.86	2	101	H
	* 1.68231	26.14	VA1T	28.2	-21.3	33.04	54	-20.96	-	-	2	101	H
4	* 1.572	39.15	PKFH	27.9	-21.4	45.65	-	-	74	-28.35	2	200	V
	* 1.57244	26.33	VA1T	27.9	-21.4	32.83	54	-21.17	-	-	2	200	V
2	* 7.32297	37.25	PKFH	35.6	-24.8	48.05	-	-	74	-25.95	305	105	H
	* 7.32301	26.54	VA1T	35.6	-24.8	37.34	54	-16.66	-	-	305	105	H
3	* 10.69333	33.29	PKFH	37.8	-20.7	50.39	-	-	74	-23.61	0	200	H
	* 10.69617	20.24	VA1T	37.9	-20.7	37.44	54	-16.56	-	-	0	200	H
5	* 7.68222	35.12	PKFH	35.7	-24.4	46.42	-	-	74	-27.58	72	112	V
	* 7.68036	21.75	VA1T	35.7	-24.4	33.05	54	-20.95	-	-	72	112	V
6	* 12.36409	32.63	PKFH	38.9	-20.6	50.93	-	-	74	-23.07	0	200	V
	* 12.3675	19.14	VA1T	38.9	-20.7	37.34	54	-16.66	-	-	0	200	V

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

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

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.22058	40.15	PKFH	28.4	-21.9	46.65	-	-	74	-27.35	0	101	H
	* 1.22173	26.4	VA1T	28.5	-21.9	33	54	-21	-	-	0	101	H
4	* 1.38357	39.63	PKFH	29.4	-21.7	47.33	-	-	74	-26.67	0	101	V
	* 1.38207	26.37	VA1T	29.4	-21.7	34.07	54	-19.93	-	-	0	101	V
2	* 7.43935	37.51	PKFH	35.7	-24.4	48.81	-	-	74	-25.19	126	106	H
	* 7.43996	26.24	VA1T	35.7	-24.4	37.54	54	-16.46	-	-	126	106	H
3	* 11.53578	32.7	PKFH	38.2	-20	50.9	-	-	74	-23.1	0	101	H
	* 11.53664	19.43	VA1T	38.2	-20.1	37.53	54	-16.47	-	-	0	101	H
6	* 12.3332	32.72	PKFH	38.9	-20.8	50.82	-	-	74	-23.18	0	101	V
	* 12.33385	19.3	VA1T	38.9	-20.8	37.4	54	-16.6	-	-	0	101	V
5	6.65547	35.74	PKFH	35.7	-25.6	45.84	-	-	-	-	262	361	V

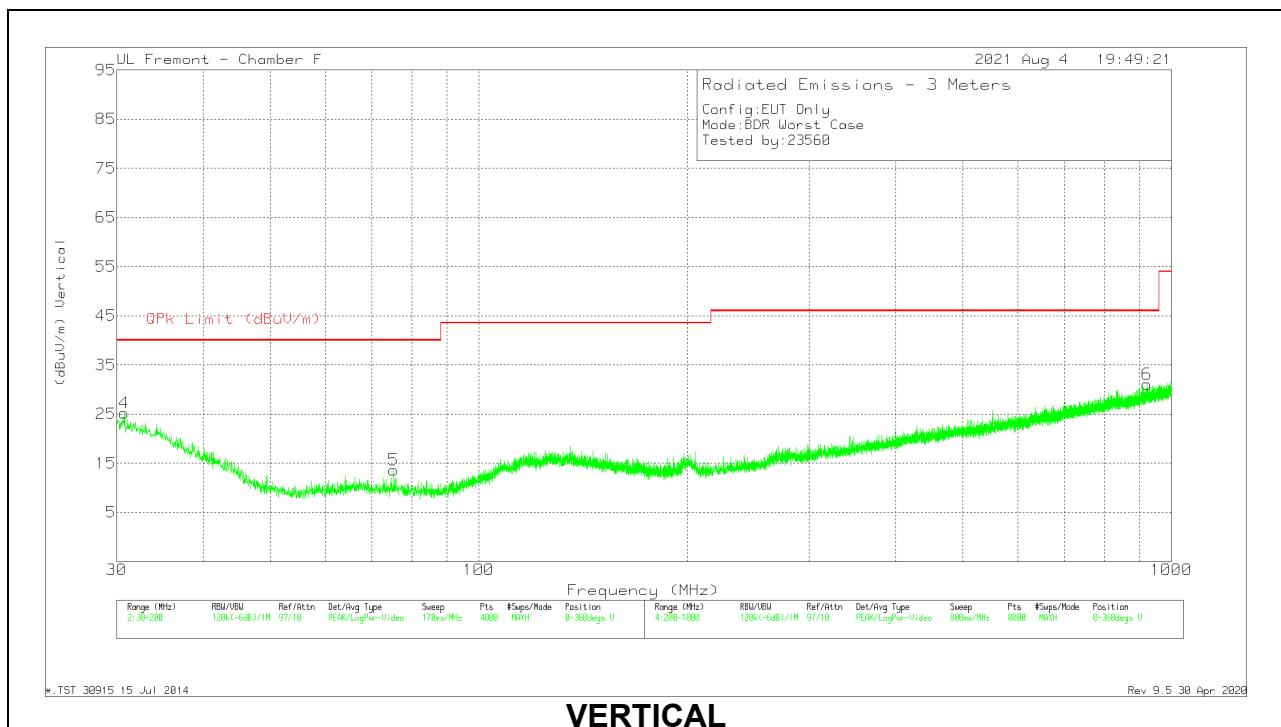
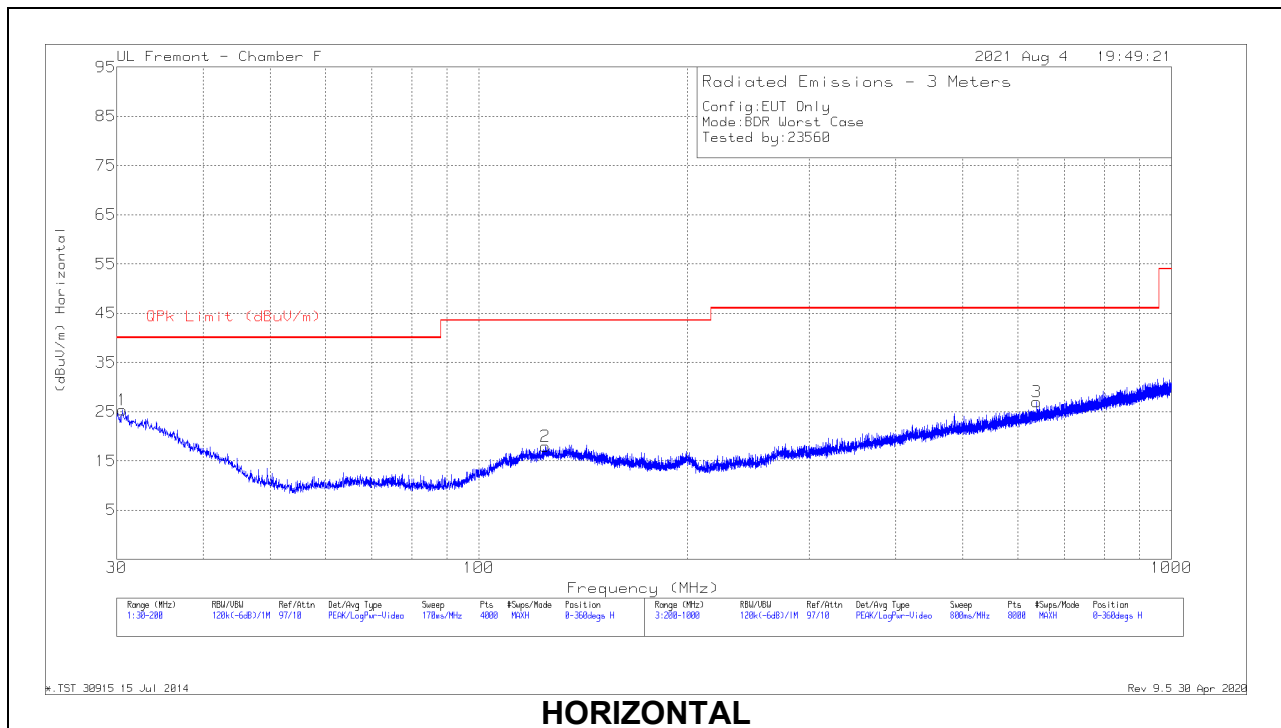
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

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

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

10.2. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

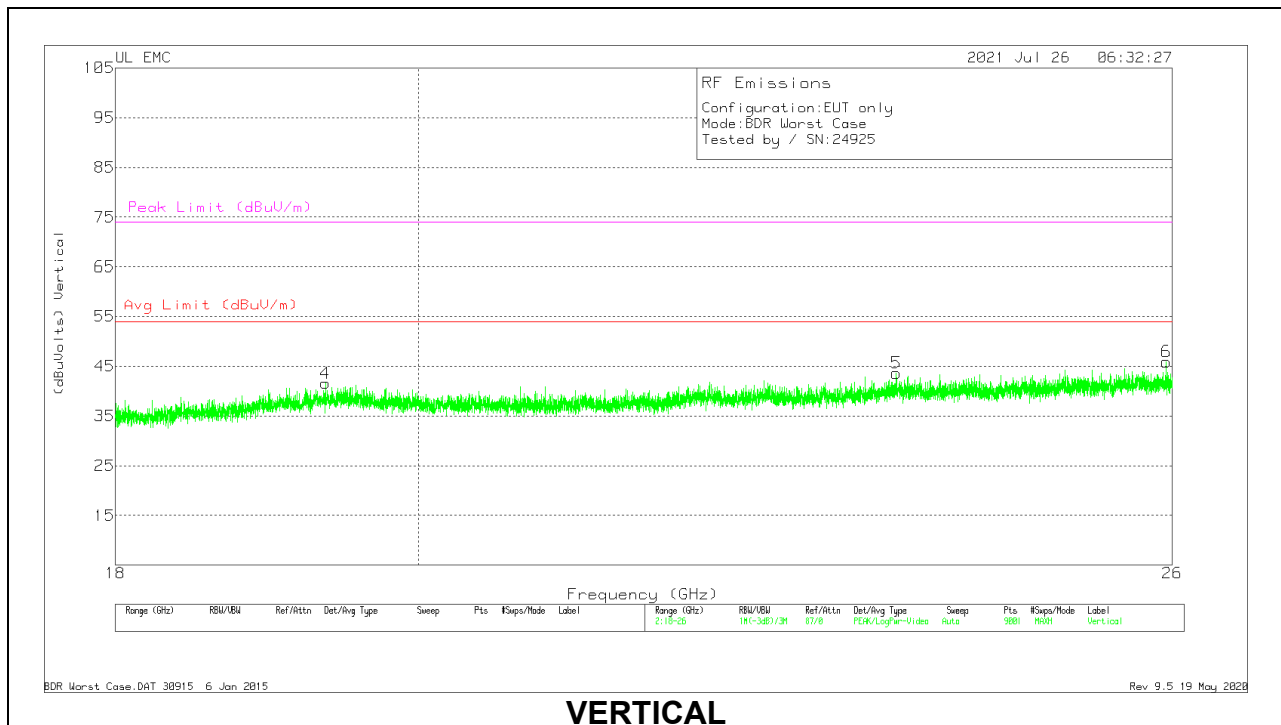
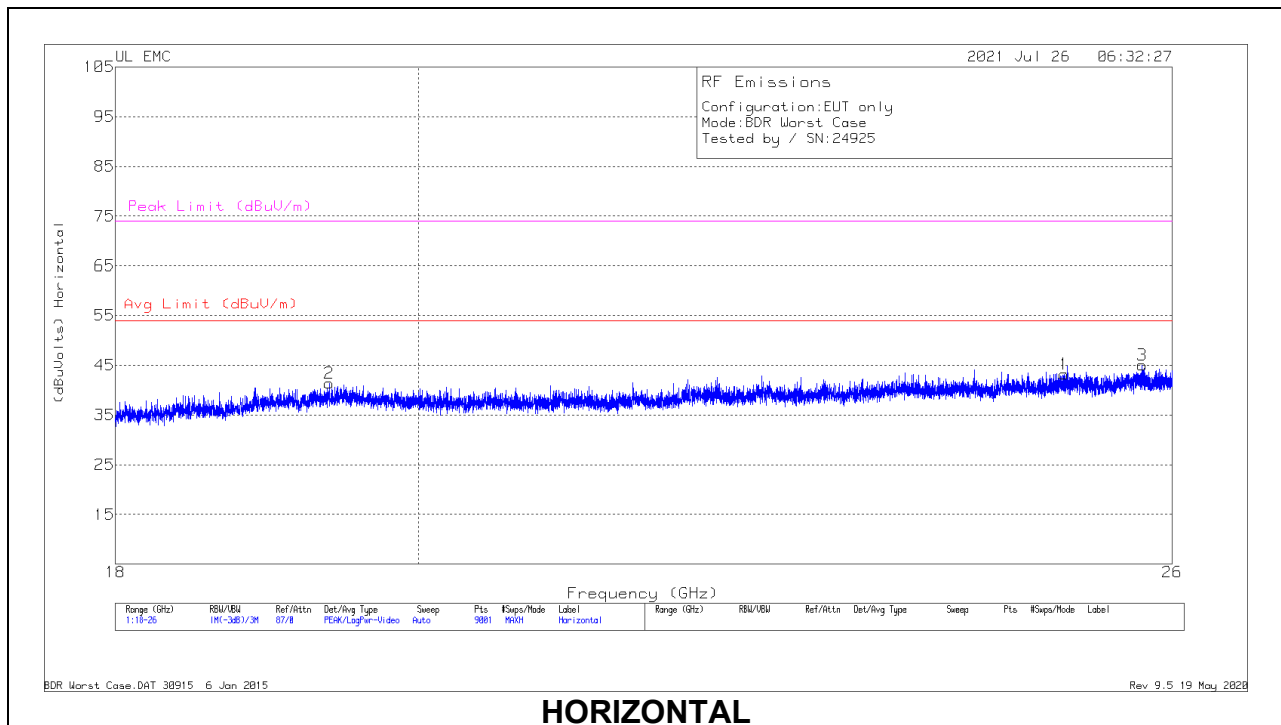
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T900 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	31.6667	21.71	Qp	26.9	-31.9	16.71	40	-23.29	224	203	H
2	* 123.5245	21.32	Qp	19.5	-31	9.82	43.52	-33.7	70	305	H
3	31.3387	21.59	Qp	27.2	-31.9	16.89	40	-23.11	7	110	V
4	76.9392	21.61	Qp	13.8	-31.4	4.01	40	-35.99	169	198	V
5	637.8771	20.42	Qp	25.3	-28.4	17.32	46.02	-28.7	65	133	H
6	921.549	19.83	Qp	28.5	-26.6	21.73	46.02	-24.29	116	371	V

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

Qp - Quasi-Peak detector

10.3. WORST CASE 18-26 GHZ

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



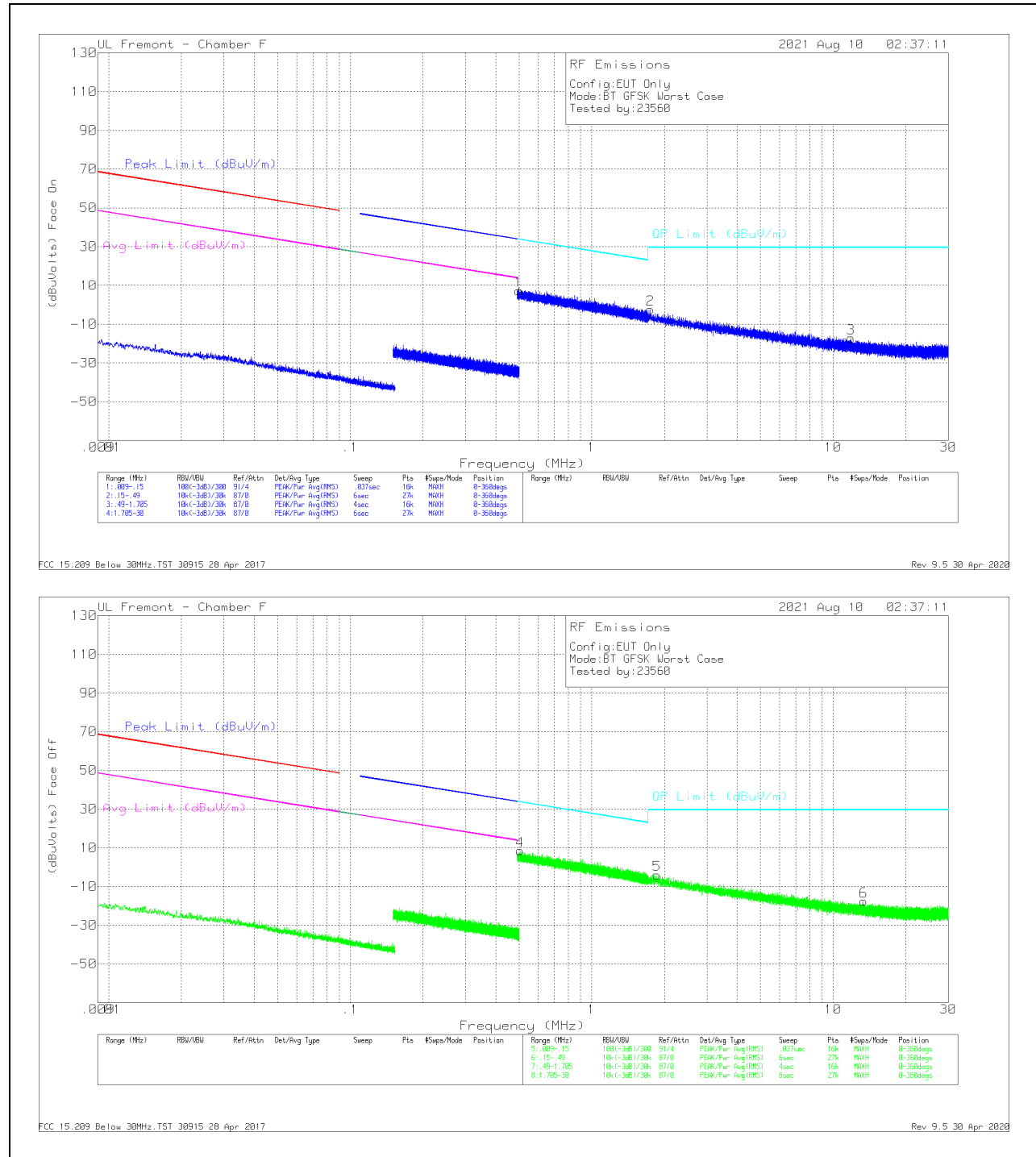
18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T449 AF	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Polarity
1	25.0418	36.5	Pk	34.1	-17.6	-9.5	43.5	54	-10.5	74	-30.5	H
2	19.39022	36.47	Pk	32.6	-18.2	-9.5	41.37	54	-12.63	74	-32.63	H
3	25.72889	38.52	Pk	34.1	-18.1	-9.5	45.02	54	-8.98	74	-28.98	H
4	19.36444	36.51	Pk	32.7	-18.1	-9.5	41.61	54	-12.39	74	-32.39	V
5	23.61778	37.82	Pk	33.7	-18.4	-9.5	43.62	54	-10.38	74	-30.38	V
6	25.94578	39.7	Pk	34.3	-18.6	-9.5	45.9	54	-8.1	74	-28.1	V

Pk - Peak detector

10.4. WORST CASE BELOW 30MHz

FACE-ON & FACE-OFF



Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Antenna Orientation
1	.4995	36.12	Pk	11.1	.1	-40	7.32	33.63	-26.31	0-360	Face on
2	1.75216	26.14	Pk	11.4	.1	-40	-2.36	29.5	-31.86	0-360	Face on
3	11.87479	11.54	Pk	10.8	.4	-40	-17.26	29.5	-46.76	0-360	Face on
4	.50657	37.3	Pk	11.1	.1	-40	8.5	33.51	-25.01	0-360	Face off
5	1.8643	24.47	Pk	11.4	.2	-40	-3.93	29.5	-33.43	0-360	Face off
6	13.37762	11.16	Pk	10.8	.4	-40	-17.64	29.5	-47.14	0-360	Face off

Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 28 Apr 2017
Rev 9.5 30 Apr 2020

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.

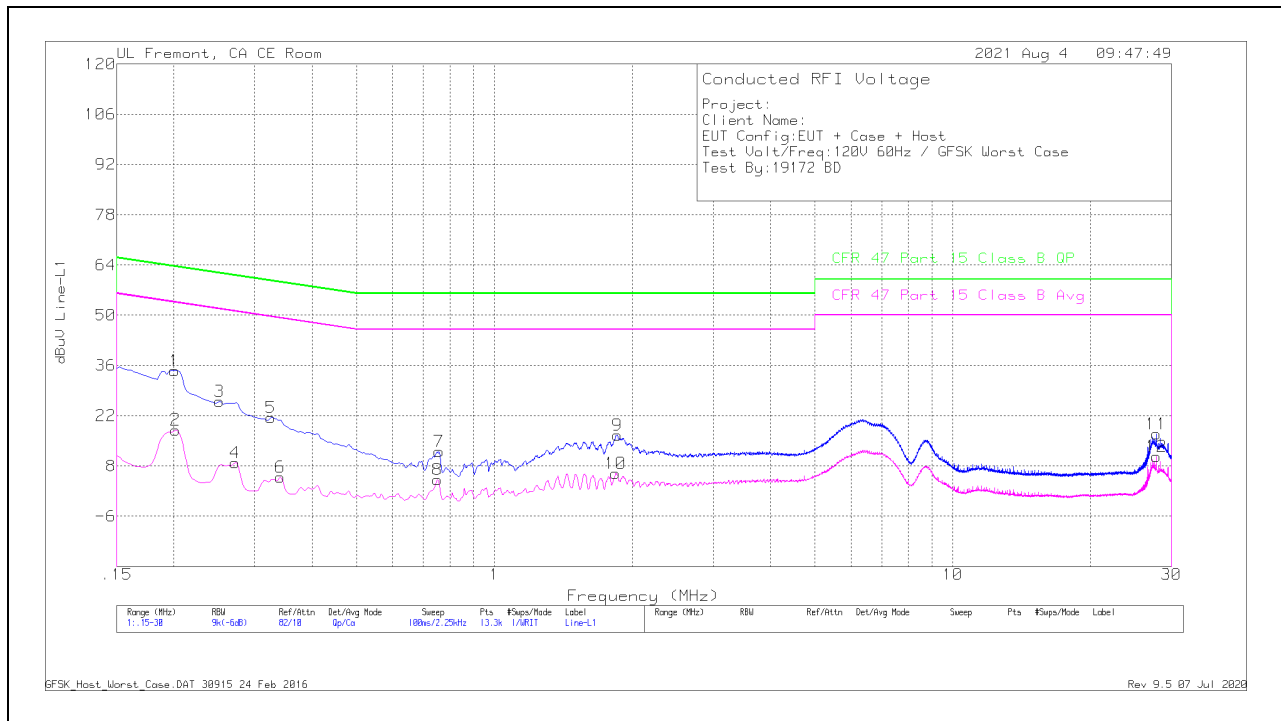
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

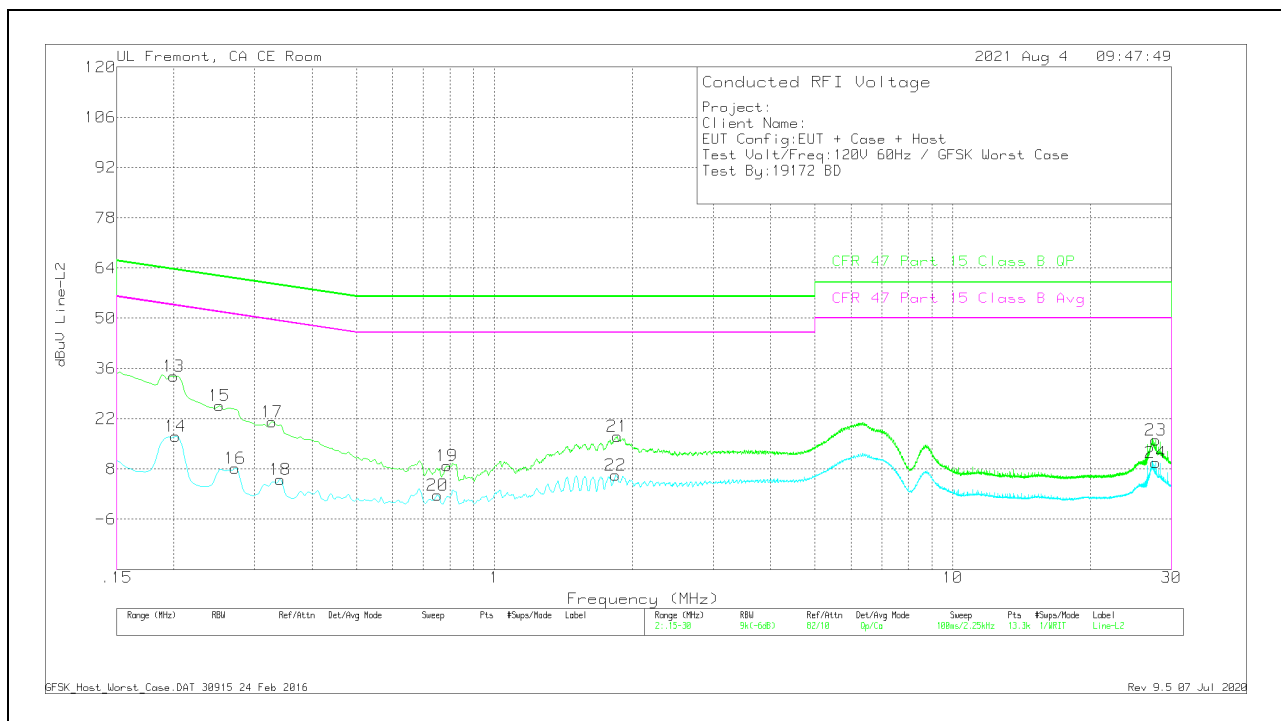
RESULTS

11.1. AC Power Line With Laptop

LINE 1 RESULTS



LINE 2 RESULTS



AC LINE DATA

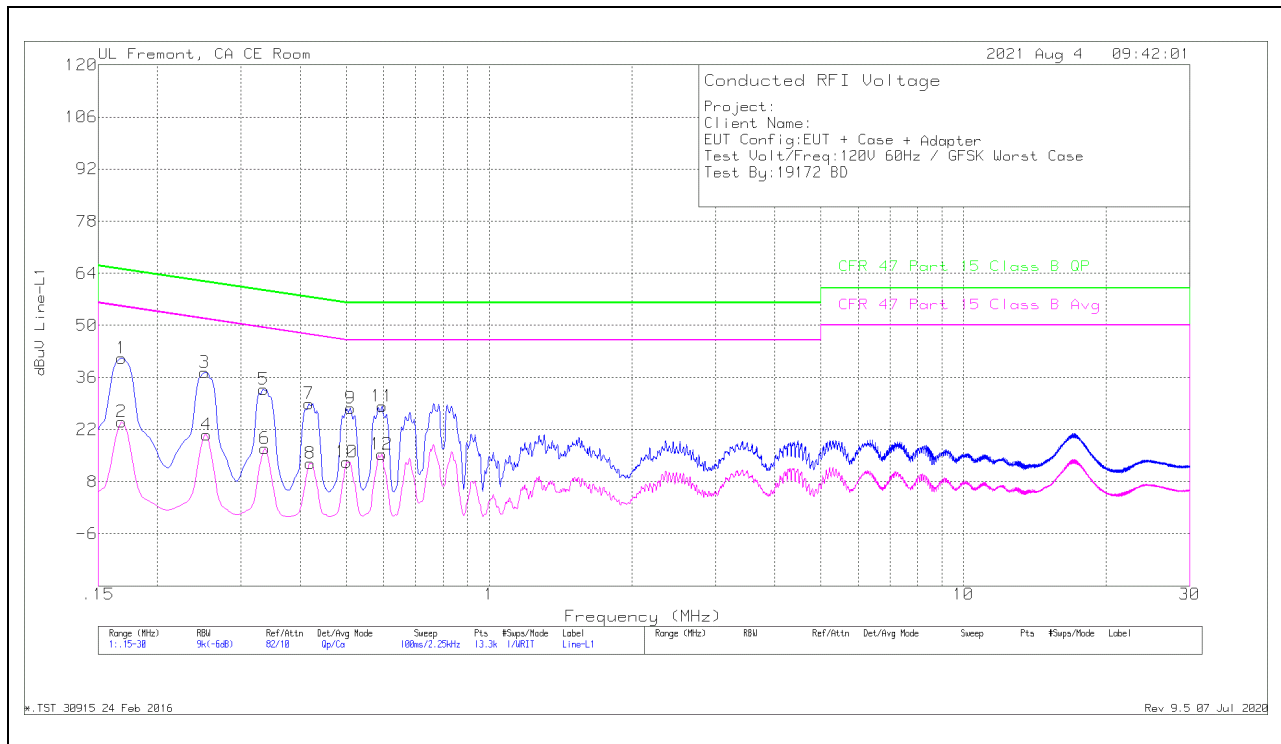
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L1	LC Cables C1&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)M argin (dB)
2	.20175	8.76	Ca	0	0	9.3	18.06	-	-	53.54	-35.48
4	.2715	-3.39	Ca	0	0	9.3	8.91	-	-	51.07	-42.16
6	.34125	-4.42	Ca	0	0	9.3	4.88	-	-	49.17	-44.29
8	.75075	-5.28	Ca	0	.1	9.3	4.12	-	-	46	-41.88
10	1.83975	-3.5	Ca	0	.1	9.3	5.9	-	-	46	-40.1
12	27.7845	.93	Ca	0	.3	9.4	10.63	-	-	50	-39.37
1	.20063	25.31	Qp	0	0	9.3	34.61	63.58	-28.97	-	-
3	.25125	16.71	Qp	0	0	9.3	26.01	61.72	-35.71	-	-
5	.3255	12.11	Qp	0	0	9.3	21.41	59.57	-38.16	-	-
7	.7575	2.62	Qp	0	.1	9.3	12.02	56	-43.98	-	-
9	1.8555	7.12	Qp	0	.1	9.3	16.52	56	-39.48	-	-
11	27.78225	7.15	Qp	0	.3	9.4	16.85	60	-43.15	-	-

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L2	LC Cables C2&C3 dB	TekBox Limiter TBFL1 Model 207	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)
14	.20175	7.88	Ca	0	0	9.3	17.18	-	-	53.54	-36.36
16	.2715	-1.04	Ca	0	0	9.3	8.26	-	-	51.07	-42.81
18	.34125	-4.17	Ca	0	0	9.3	5.13	-	-	49.17	-44.04
20	.75075	-8.55	Ca	0	0	9.3	.75	-	-	46	-45.25
22	1.83975	-3.13	Ca	0	.1	9.3	6.27	-	-	46	-39.73
24	27.75525	.04	Ca	.1	.3	9.4	9.84	-	-	50	-40.16
13	.1995	24.54	Qp	0	0	9.3	33.84	63.63	-29.79	-	-
15	.25125	16.39	Qp	0	0	9.3	25.69	61.72	-36.03	-	-
17	.32775	11.79	Qp	0	0	9.3	21.09	59.51	-38.42	-	-
19	.789	-3.8	Qp	0	0	9.3	8.92	56	-47.08	-	-
21	1.8555	7.66	Qp	0	.1	9.3	17.06	56	-38.94	-	-
23	27.75525	6.18	Qp	.1	.3	9.4	15.98	60	-44.02	-	-

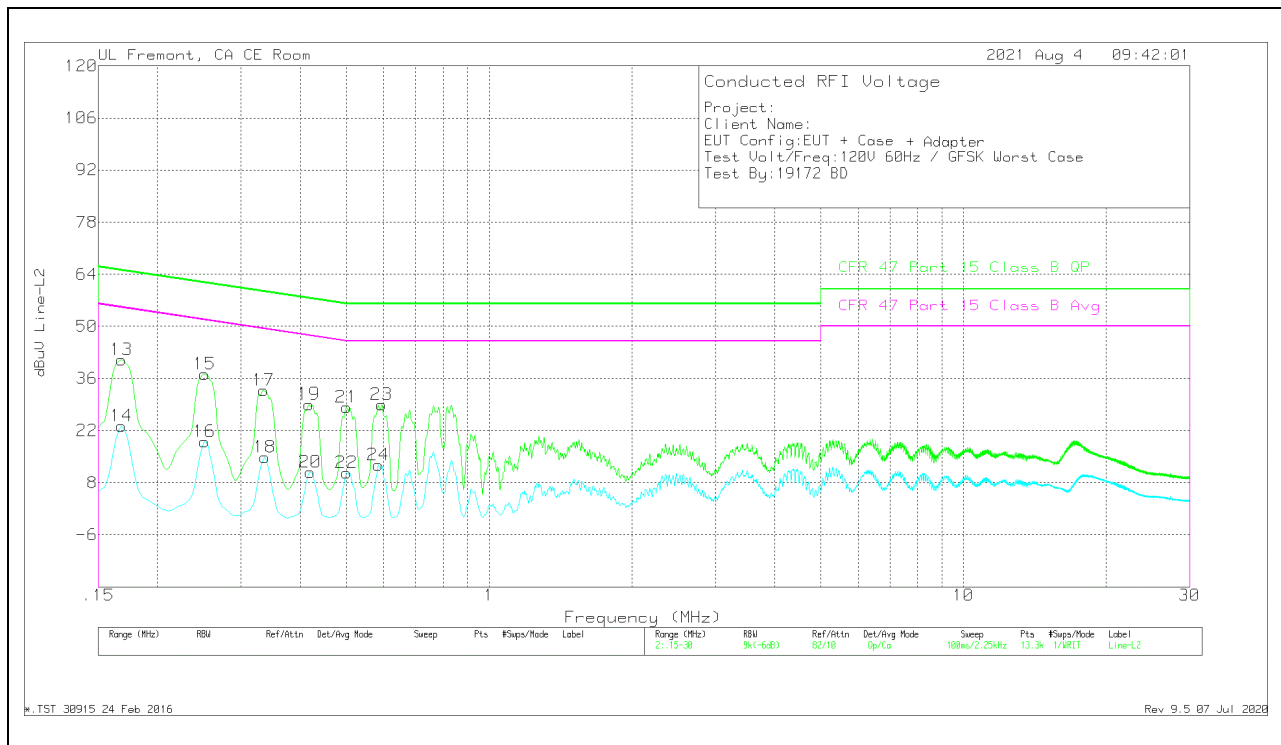
Qp - Quasi-Peak detector
Ca - CISPR average detection

11.2. AC Power Line With AC/DC Adapter

LINE 1 RESULTS



LINE 2 RESULTS



AC LINE DATA

Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L1	LC Cables C1&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
2	.168	14.61	Ca	0	0	9.4	24.01	-	-	55.06	-31.05
4	.2535	11.26	Ca	0	0	9.3	20.56	-	-	51.64	-31.08
6	.33675	7.63	Ca	0	0	9.3	16.93	-	-	49.28	-32.35
8	.42	3.68	Ca	0	0	9.3	12.98	-	-	47.45	-34.47
10	.501	3.98	Ca	0	0	9.3	13.28	-	-	46	-32.72
12	.59325	6.11	Ca	0	0	9.3	15.41	-	-	46	-30.59
1	.168	31.8	Qp	0	0	9.4	41.2	65.06	-23.86	-	-
3	.25125	28.01	Qp	0	0	9.3	37.31	61.72	-24.41	-	-
5	.3345	23.58	Qp	0	0	9.3	32.88	59.34	-26.46	-	-
7	.41775	19.7	Qp	0	0	9.3	29	57.49	-28.49	-	-
9	.51	18.43	Qp	0	0	9.3	27.73	56	-28.27	-	-
11	.5955	18.99	Qp	0	0	9.3	28.29	56	-27.71	-	-

Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	PRE018644 6 L2	LC Cables C2&C3 dB	TekBox Limiter TBFL1 Model 207	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
14	.168	13.84	Ca	0	0	9.4	23.24	-	-	55.06	-31.82
16	.25125	9.72	Ca	0	0	9.3	19.02	-	-	51.72	-32.7
18	.33675	5.53	Ca	0	0	9.3	14.83	-	-	49.28	-34.45
20	.42	1.51	Ca	0	0	9.3	10.81	-	-	47.45	-36.64
22	.501	1.42	Ca	0	0	9.3	10.72	-	-	46	-35.28
24	.58425	3.38	Ca	0	0	9.3	12.68	-	-	46	-33.32
13	.168	31.61	Qp	0	0	9.4	41.01	65.06	-24.05	-	-
15	.25125	27.87	Qp	0	0	9.3	37.17	61.72	-24.55	-	-
17	.3345	23.53	Qp	0	0	9.3	32.83	59.34	-26.51	-	-
19	.41775	19.75	Qp	0	0	9.3	29.05	57.49	-28.44	-	-
21	.501	18.93	Qp	0	0	9.3	28.23	56	-27.77	-	-
23	.59325	19.65	Qp	0	0	9.3	28.95	56	-27.05	-	-

Qp - Quasi-Peak detector

Ca - CISPR average detection

12. SETUP PHOTOS

Please refer to 13685813-EP2V1 for setup photos

END OF TEST REPORT