CERTIFICATION TEST REPORT

Report Number. : 13685813-E2V2

Applicant	:	APPLE INC. 1 APPLE PARK WAY CUPERTINO, CA 95014, U.S.A
Model	:	A2564
Brand	:	Apple
FCC ID	:	BCG-A2564
IC	:	579C-A2564
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.
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NVLAP TESTING
ilac-MRA
NVLAP Lab code: 200065-0

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

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: BLUETOOTH EARBUD

MODEL: A2564

BRAND: Apple

SERIAL NUMBER: H5R1262005N035Y3S; H5R1237002S035Y31

SAMPLE RECEIPT DATE: 6/26/2021

DATE TESTED: 7/23/2021 – 8/11/2021

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.

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Approved & Released For
UL Verification Services Inc. By:

Prepared By:

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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.

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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

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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 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 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 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a Bluetooth earbud for left 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	12.76	18.88
2402 - 2480	Enhanced DQPSK	12.53	17.91
2402 - 2480	Enhanced 8PSK	12.62	18.28

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 -4.5 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.

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Worst-case data rates 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	DoC

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.

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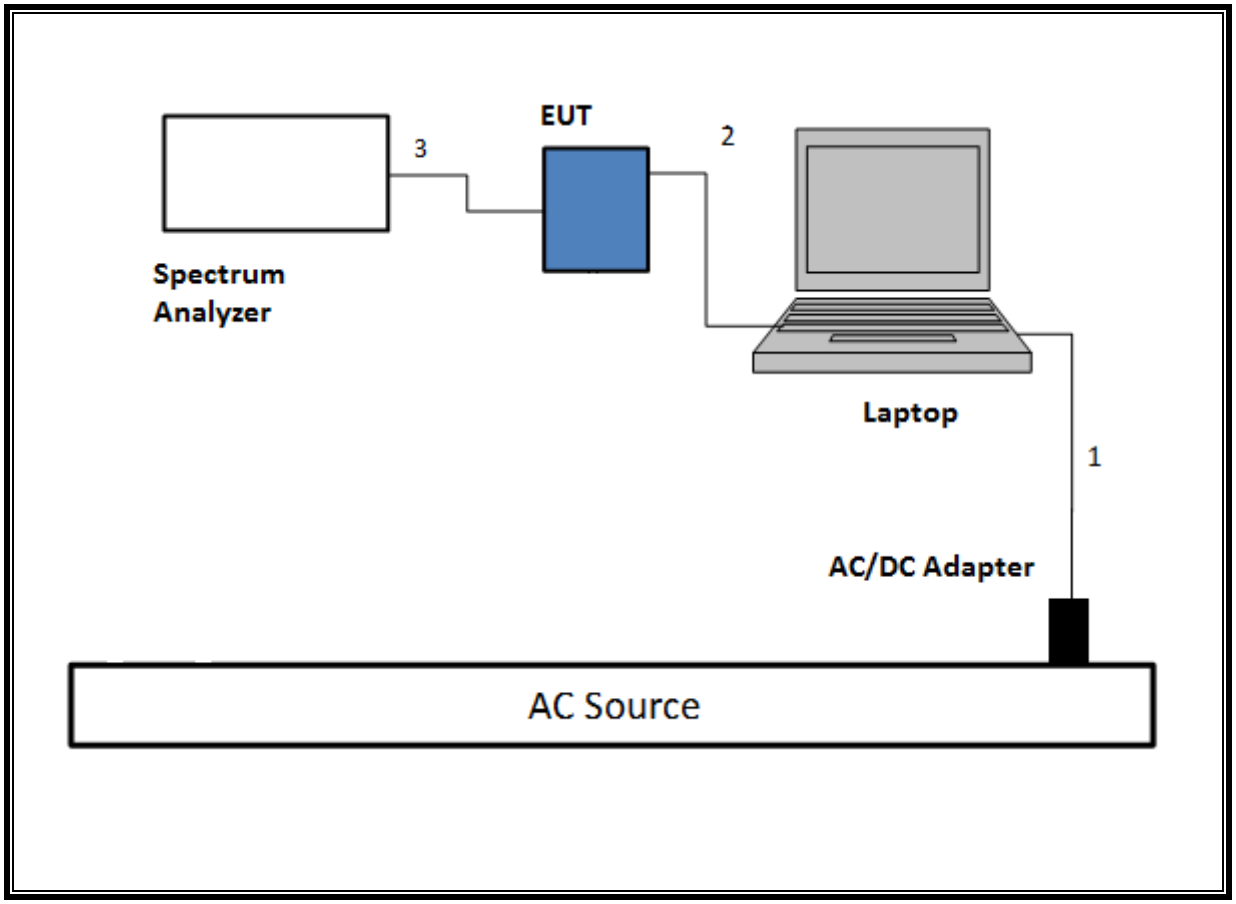
SETUP DIAGRAM FOR CONDUCTED TESTS



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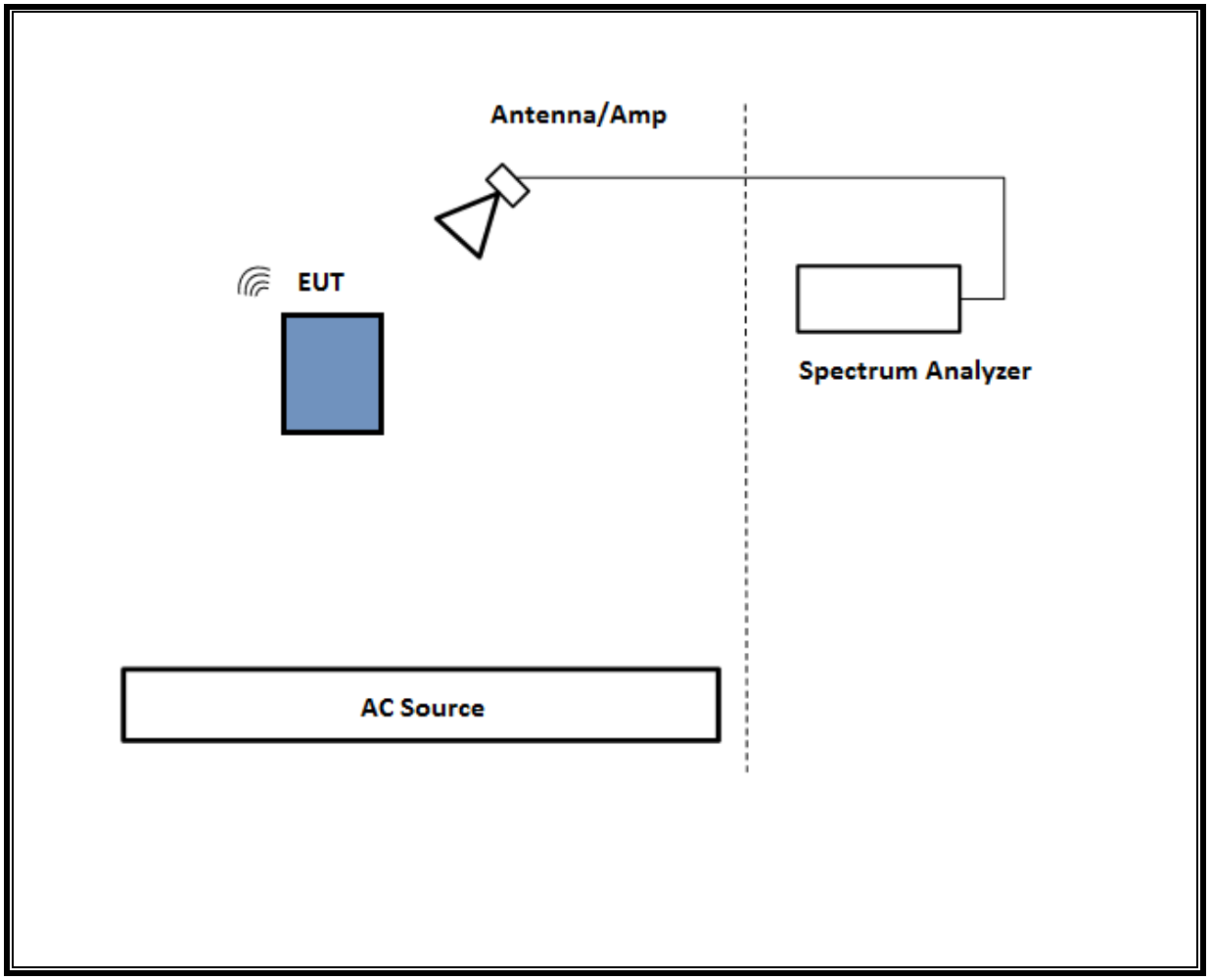
SETUP DIAGRAM FOR RADIATED TESTS Above 1GHz



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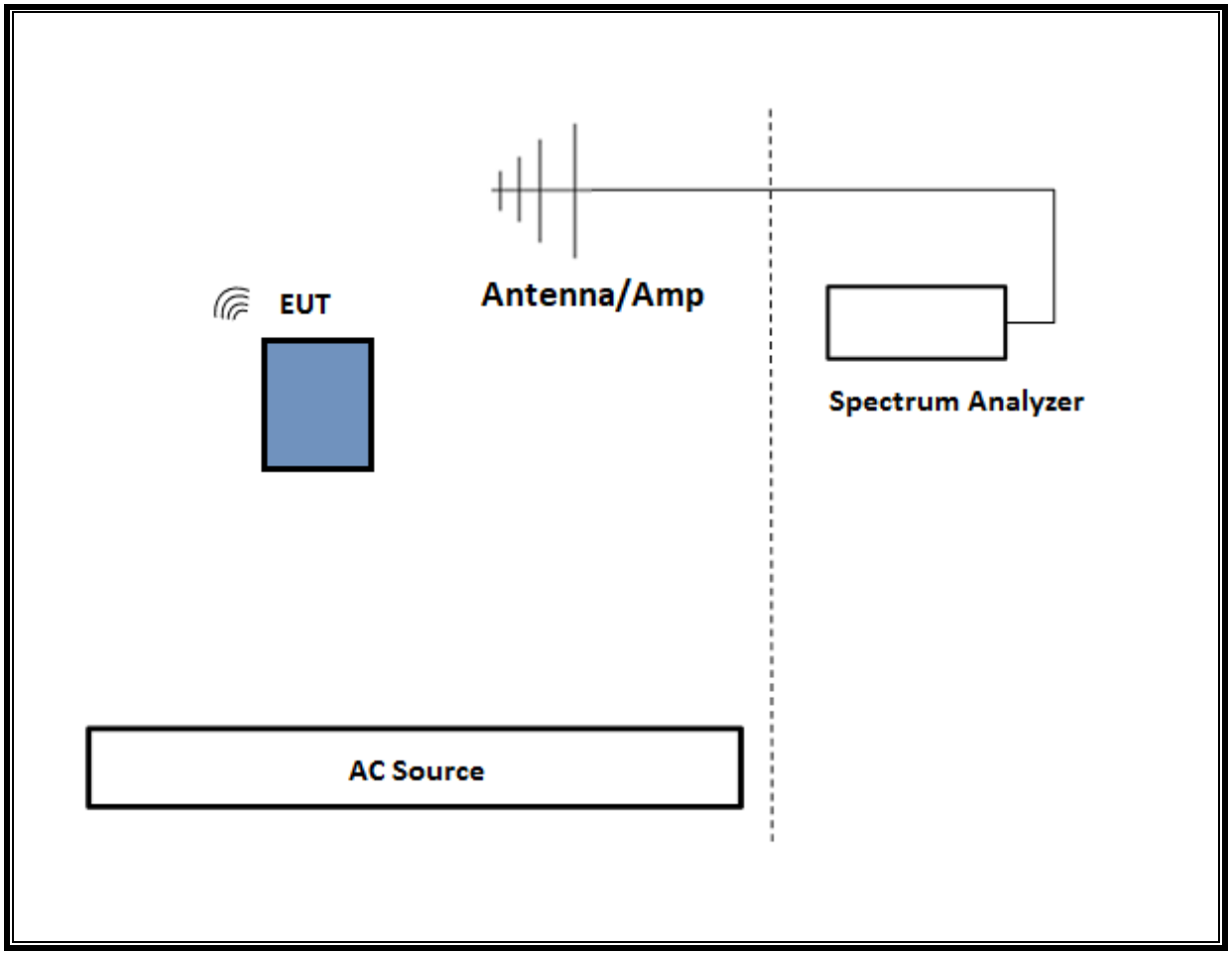
SETUP DIAGRAM FOR Below 1GHz



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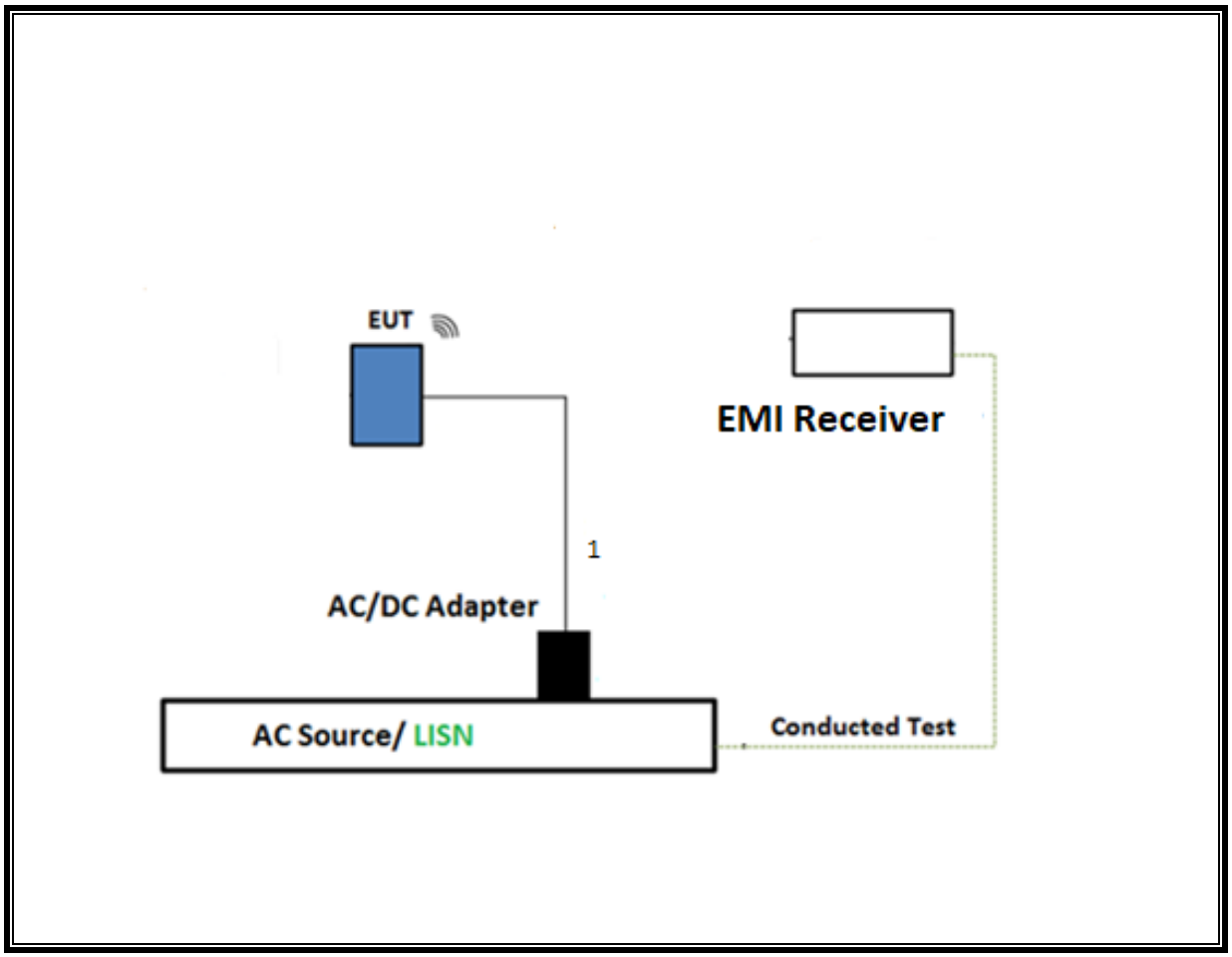
SETUP DIAGRAM FOR AC LINE CONDUCTED TEST



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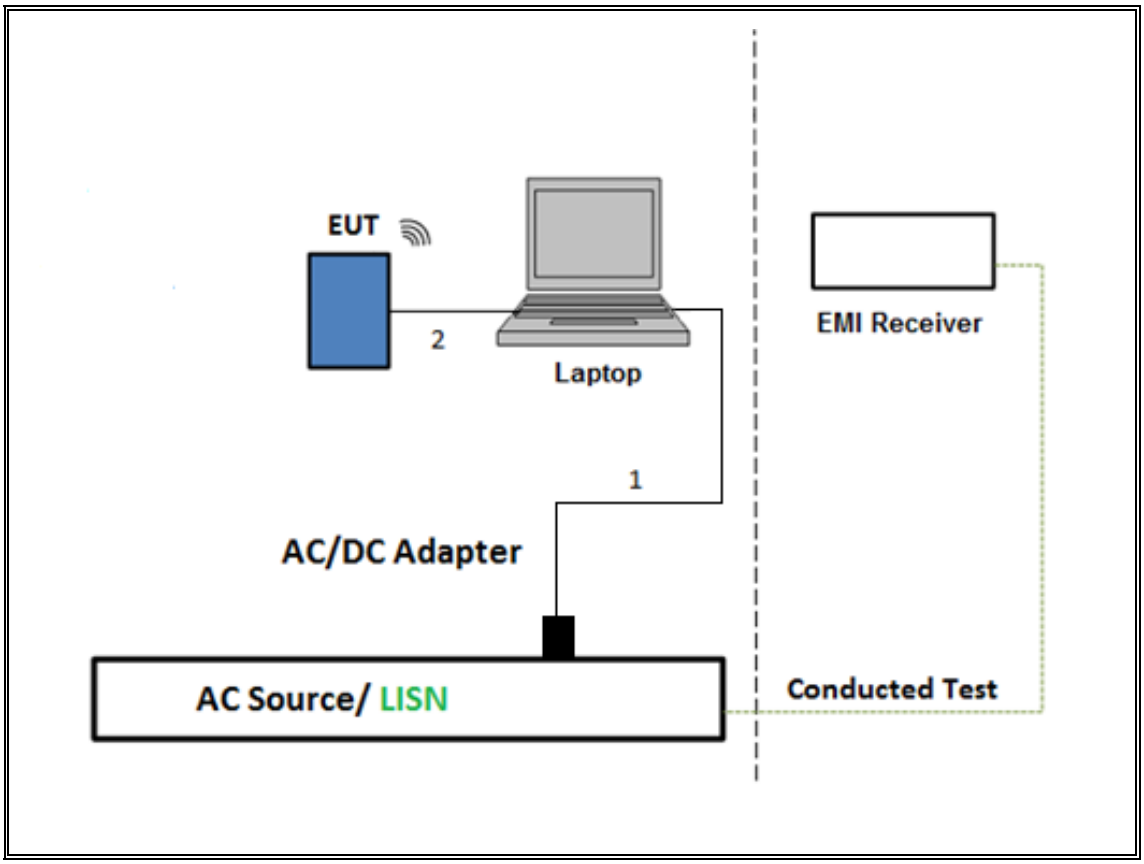
TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION



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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.

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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	Aglilent	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
Radiated Software	UL	UL EMC	Ver 9.5.07, July 2020		
AC Line Conducted Software	UL	UL EMC	Ver 9.5.07, July 2020		

Test Software List			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5.07, July 2020
AC Line Conducted Software	UL	UL RF	Ver 9.5.07, July 2020
Antenna Port Software	UL	UL RF	Ver 2021.5.13

Note: *Testing is completed before equipment expiration date

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9. ANTENNA PORT TEST RESULTS

9.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

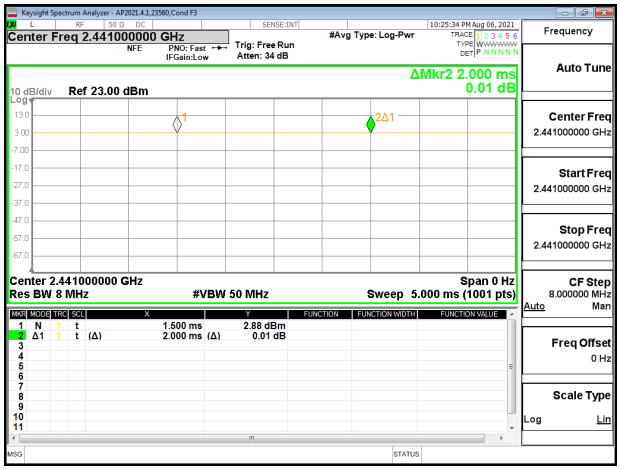
PROCEDURE

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	2.000	2.000	1.000	100.0%	0.00	0.010
Bluetooth 8PSK	2.000	2.000	1.000	100.0%	0.00	0.010

DUTY CYCLE PLOTS



BLUETOOTH GFSK

BLUETOOTH 8PSK

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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 ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ 3xRBW. The sweep time is coupled.

RESULTS

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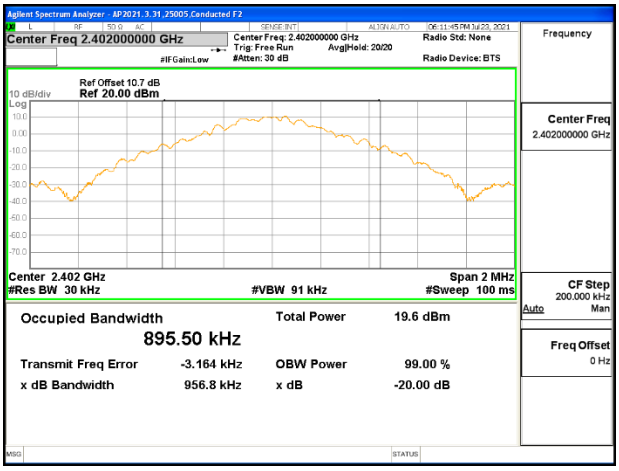
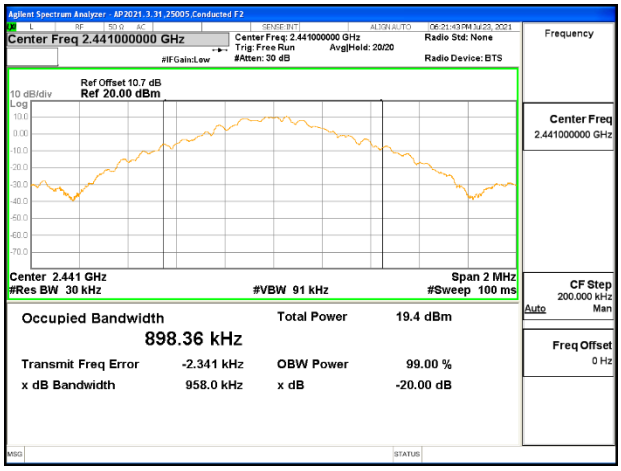
9.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

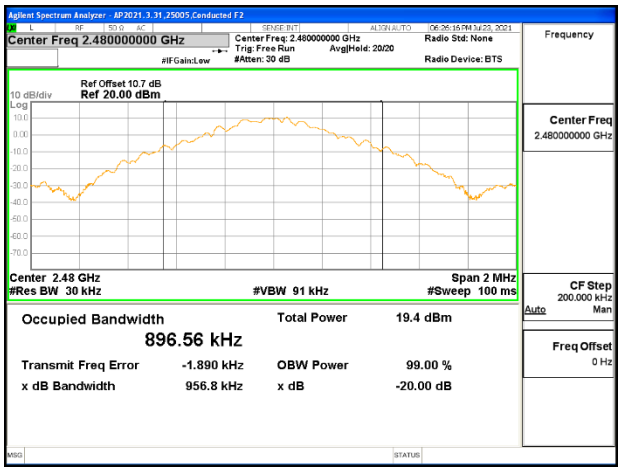
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.9568	0.89550
Mid	2441	0.9580	0.98936
High	2480	0.9568	0.89656



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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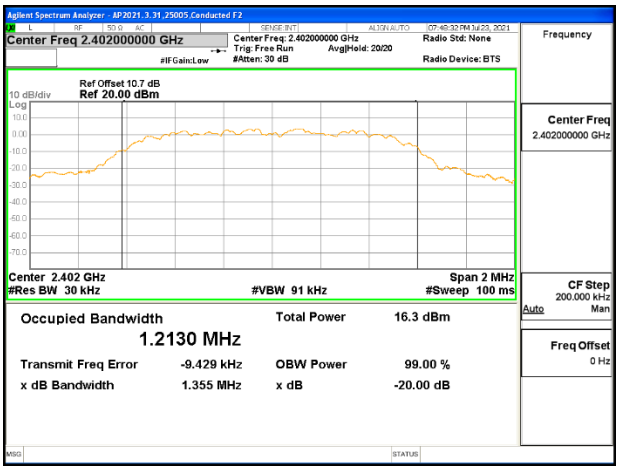
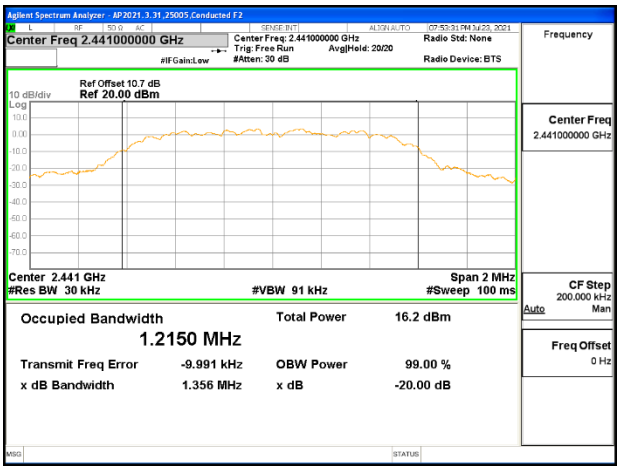
9.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

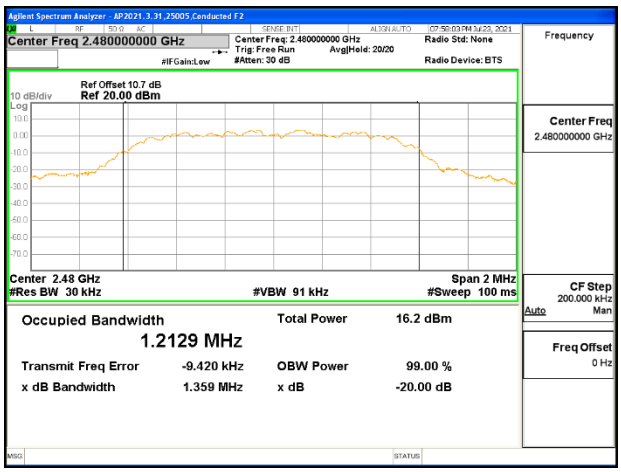
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.355	1.2130
Mid	2441	1.356	1.2150
High	2480	1.359	1.2129



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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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 hoping 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 >= 3xRBW. The sweep time is coupled.

RESULTS

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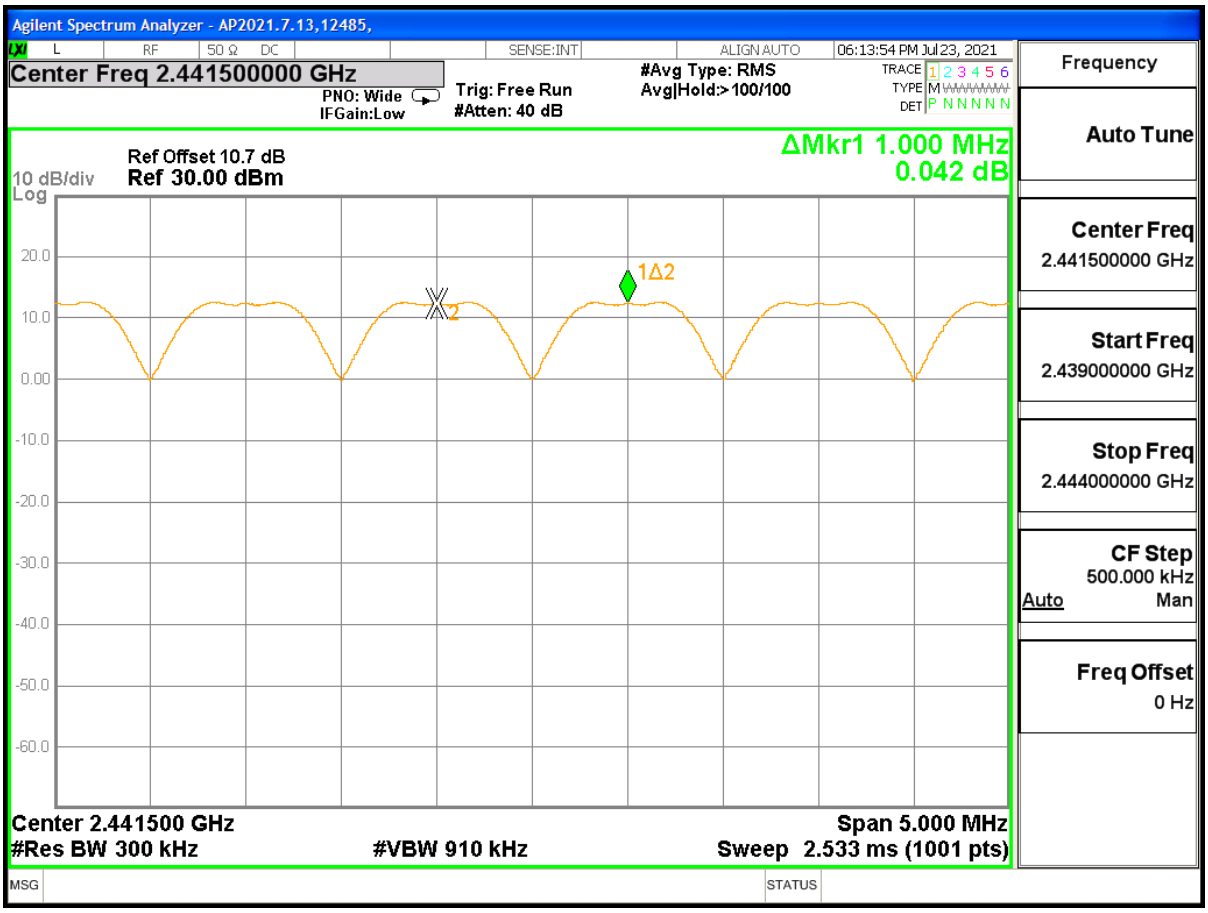
9.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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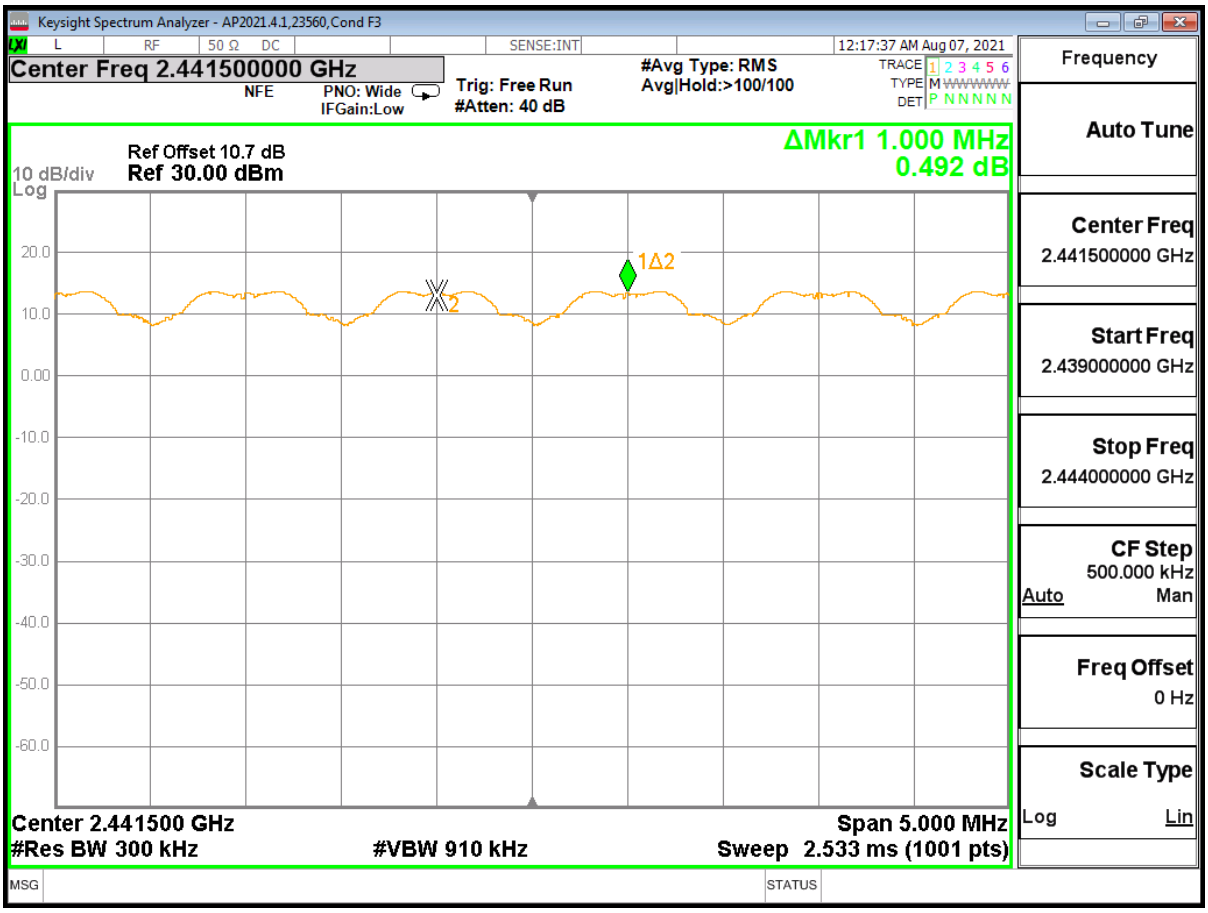
9.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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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

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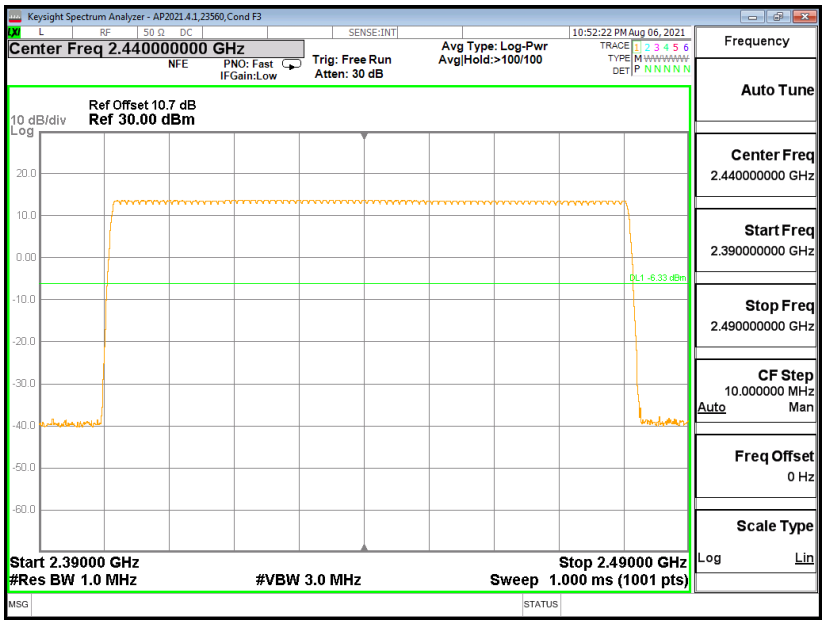
9.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



100MHz SPAN

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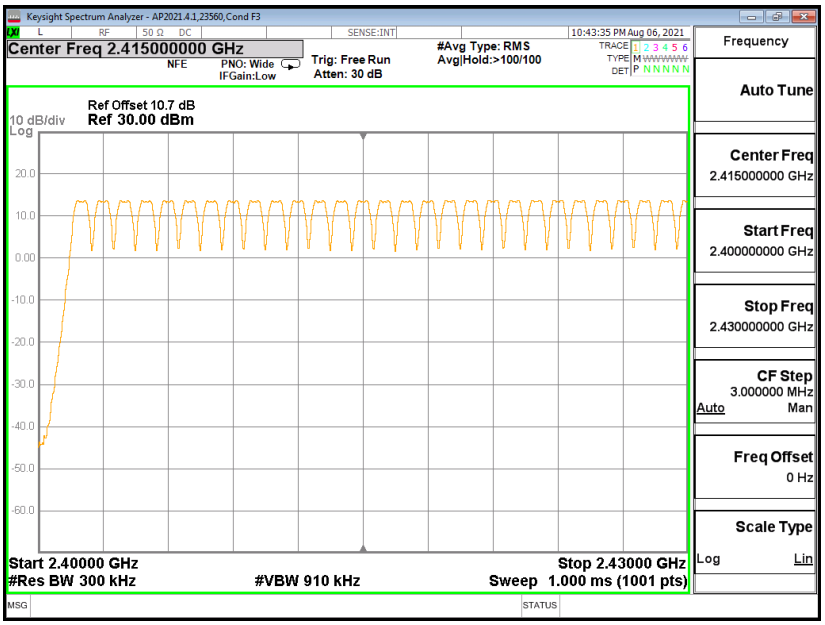

30MHz SPAN, SEGMENT 1 OF 3

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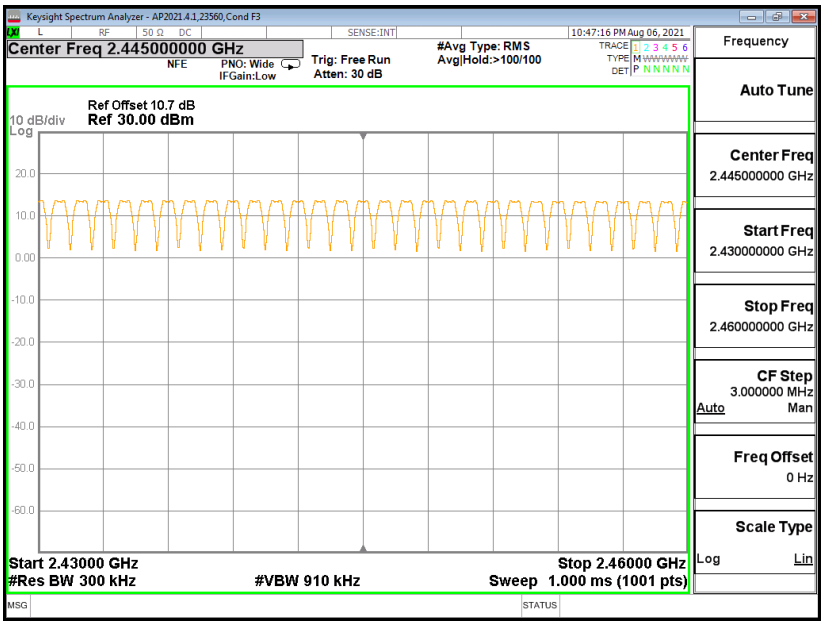

30MHz SPAN, SEGMENT 2 OF 3

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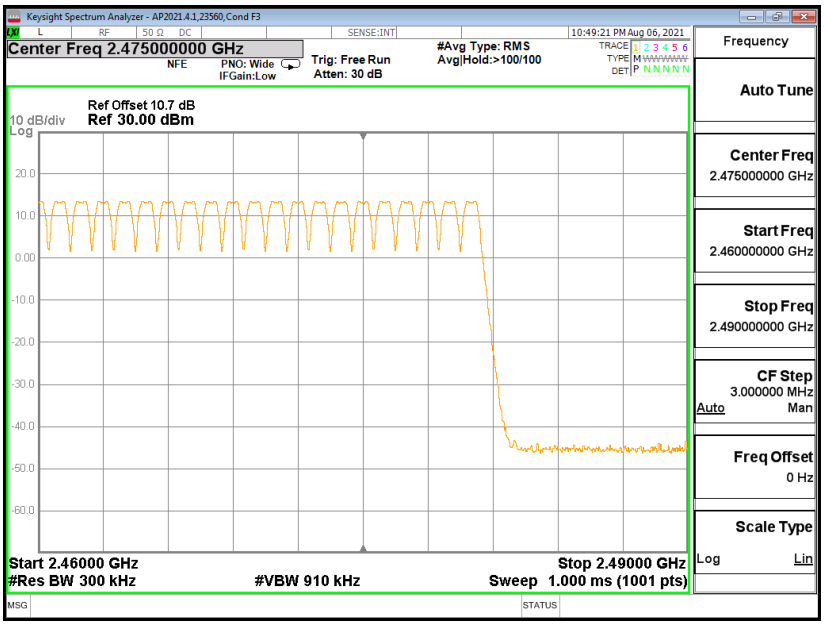

30MHz SPAN, SEGMENT 3 OF 3

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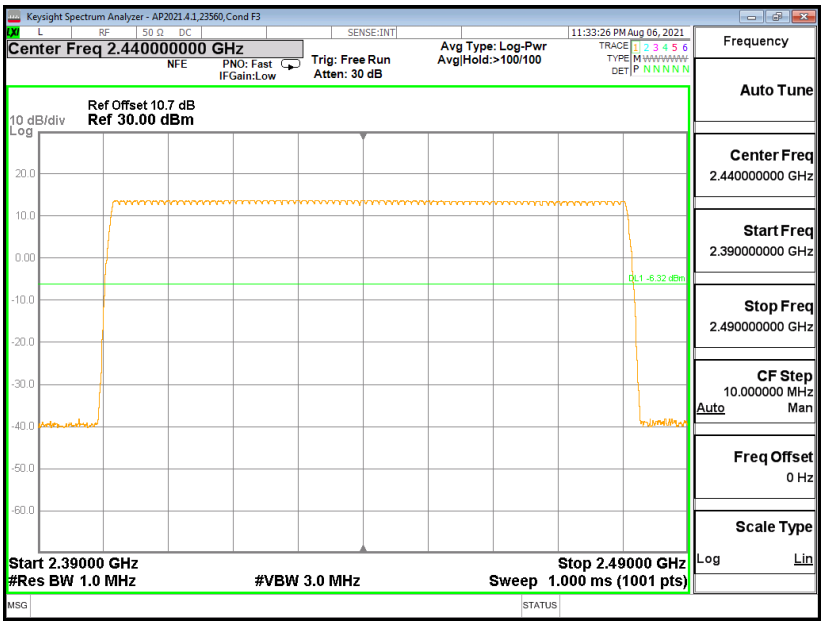
9.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



100MHz SPAN

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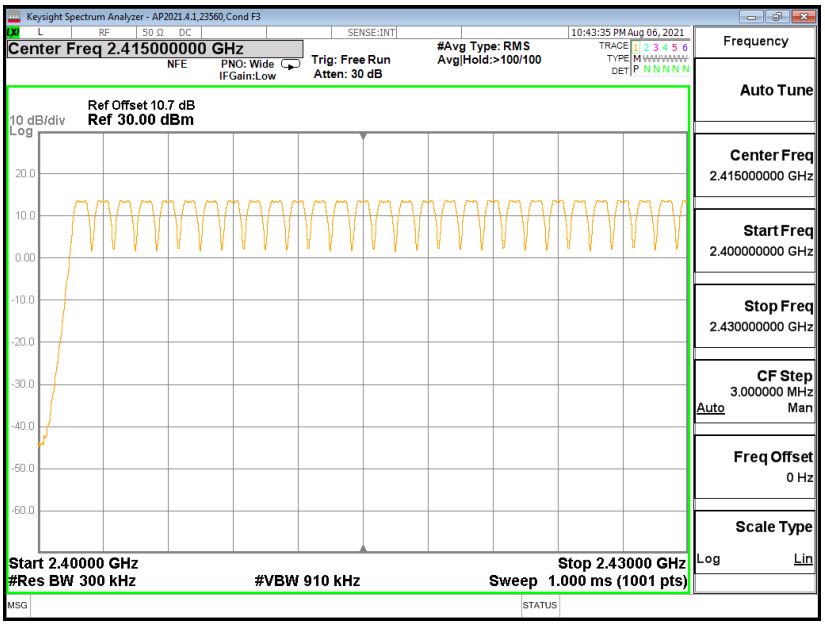

30MHz SPAN, SEGMENT 1 OF 3

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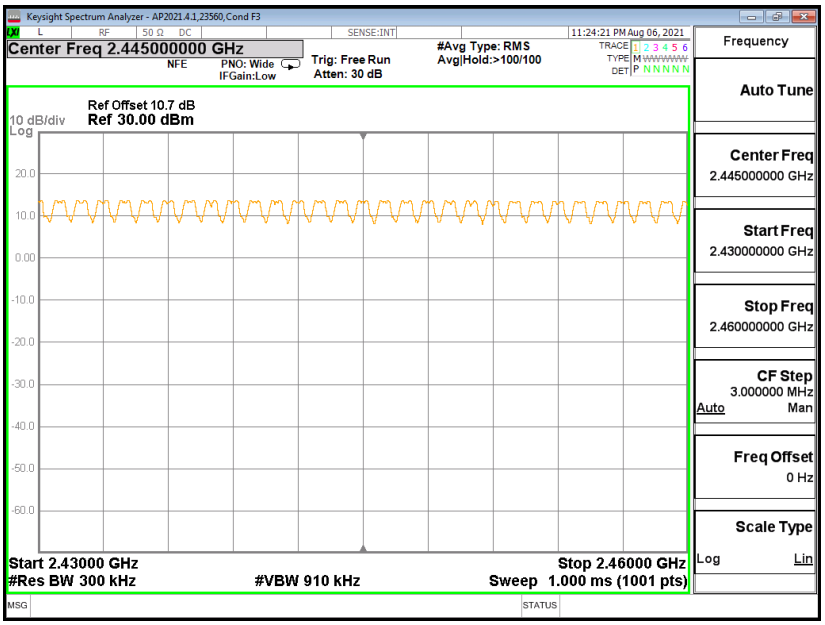

30MHz SPAN, SEGMENT 2 OF 3

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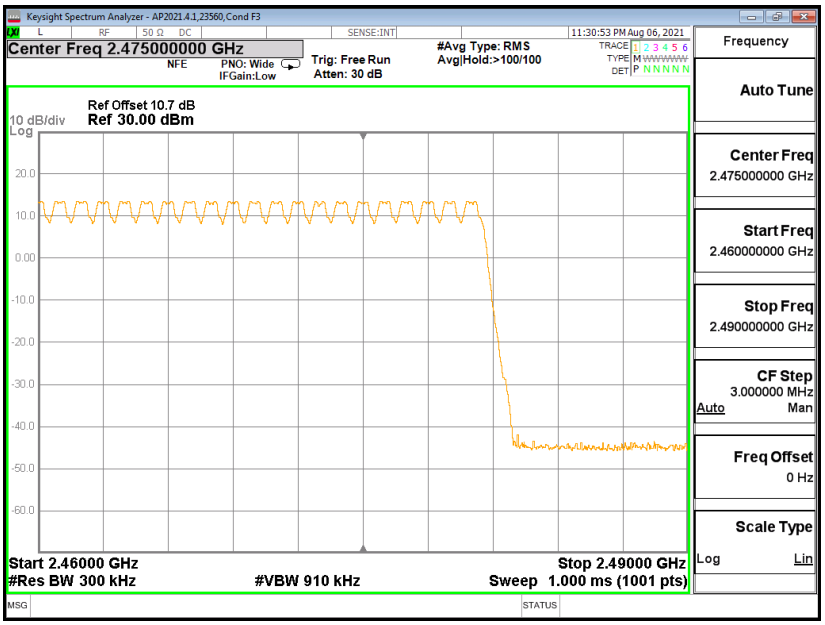

30MHz SPAN, SEGMENT 3 OF 3

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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 * (# of pulses in 3.16 s) * 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 * (# of pulses in 0.8 s) * pulse width.

RESULTS

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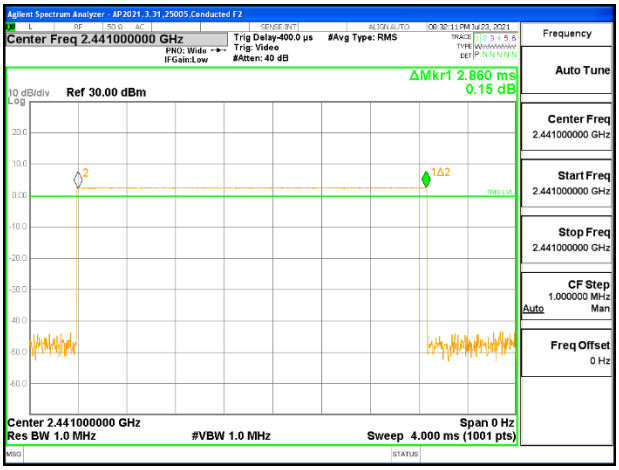
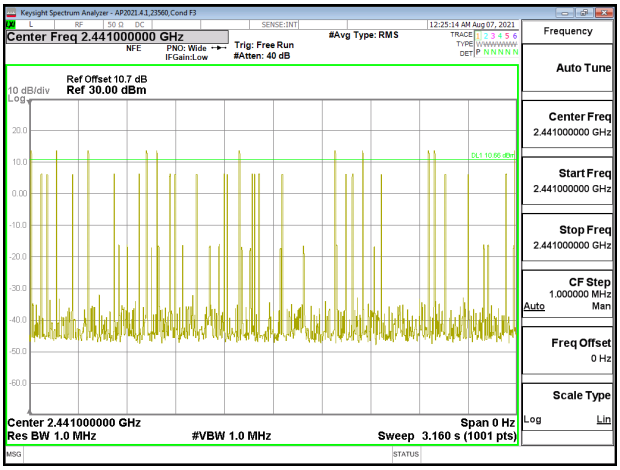
9.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

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
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH5	2.86	2.75	0.07865	0.4	-0.3214



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

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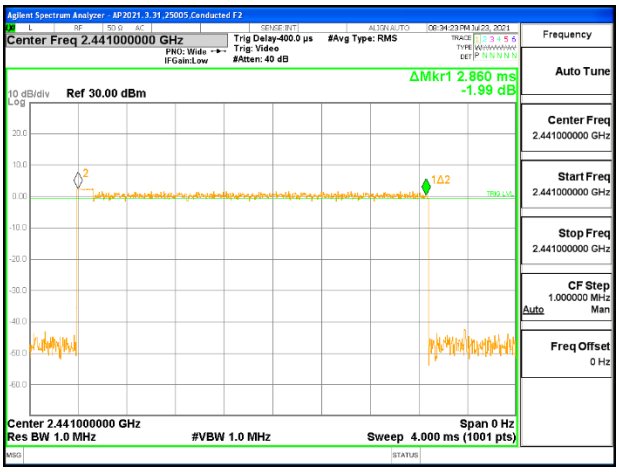
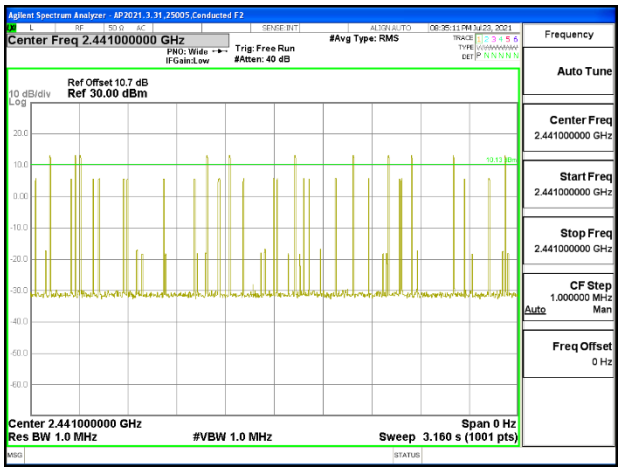
9.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

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	2.86	11	0.3146	0.4	-0.0854

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 – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

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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

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9.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	19232
Date:	7/23/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.76	21	-8.24
Middle	2441	12.67	21	-8.33
High	2480	12.74	21	-8.26

9.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	19232
Date:	7/23/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.53	21	-8.47
Middle	2441	12.46	21	-8.54
High	2480	12.44	21	-8.56

9.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	19232
Date:	7/23/2021

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.62	21	-8.38
Middle	2441	12.52	21	-8.48
High	2480	12.61	21	-8.39

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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

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9.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	19232
Date	7/23/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.43
Middle	2441	12.39
High	2480	12.45

9.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	19232
Date	7/23/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.32
Middle	2441	9.27
High	2480	9.34

9.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	19232
Date	7/23/2021

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.38
Middle	2441	9.33
High	2480	9.42

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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

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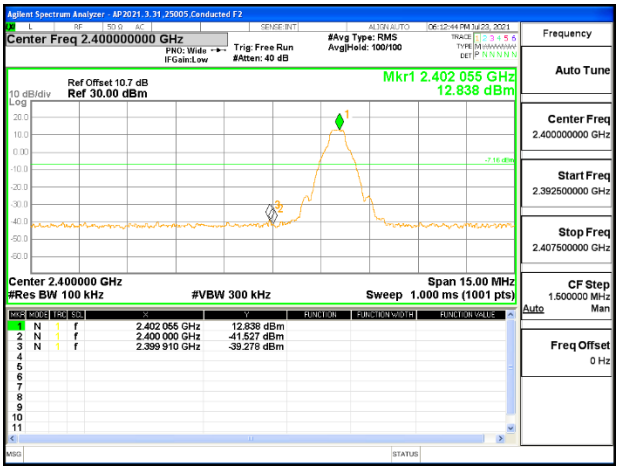
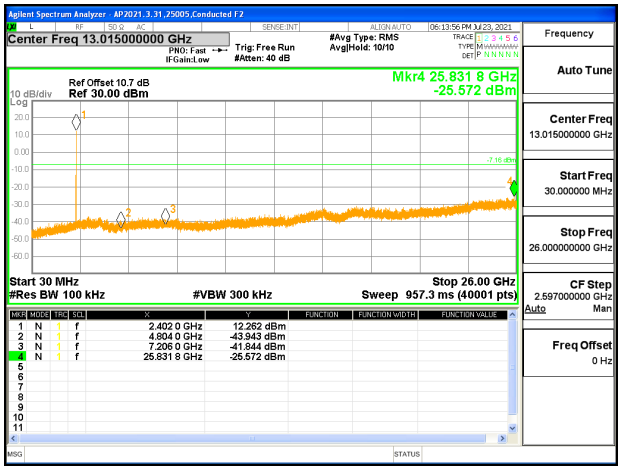
9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

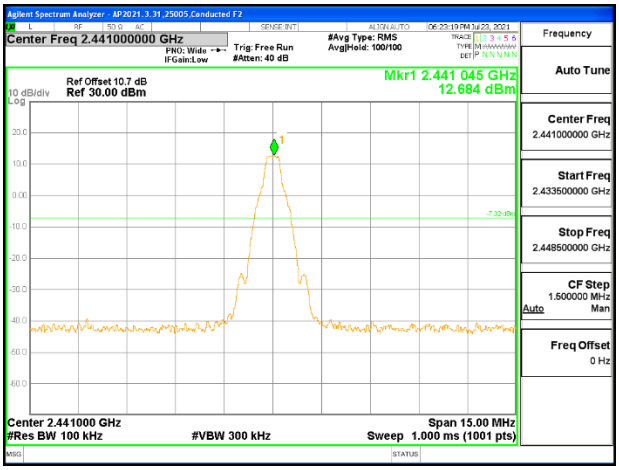
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



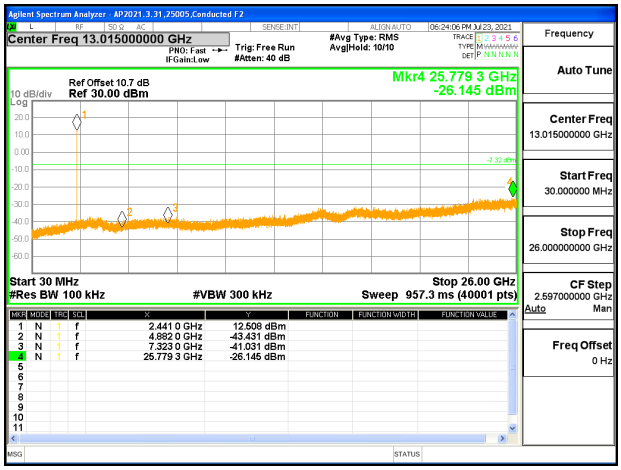
LOW CHANNEL BANDEDGE



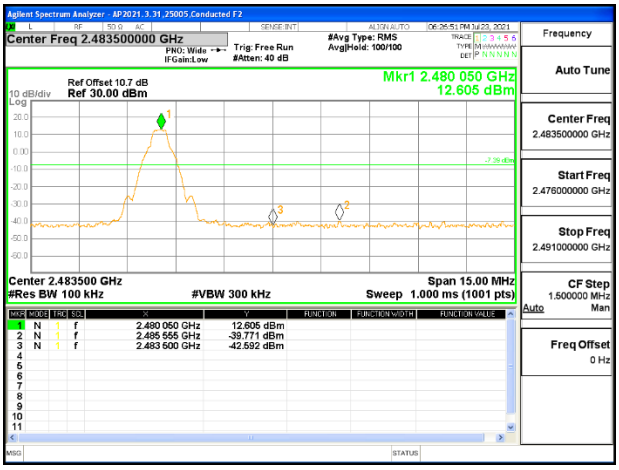
OUT-OF-BAND LOW CHANNEL



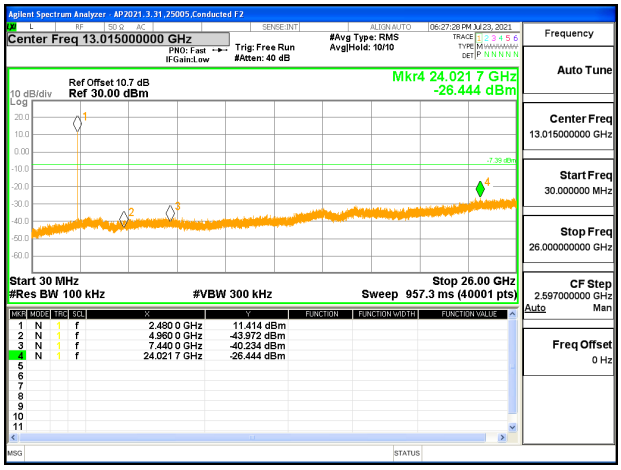
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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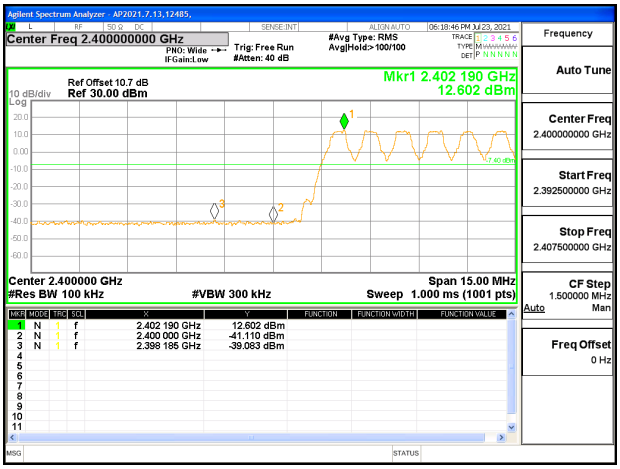
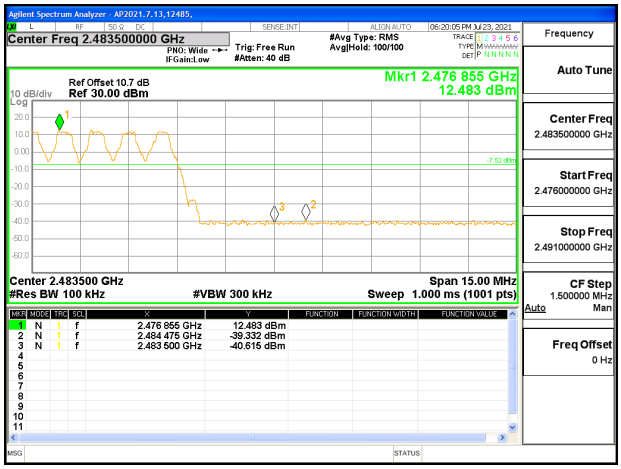
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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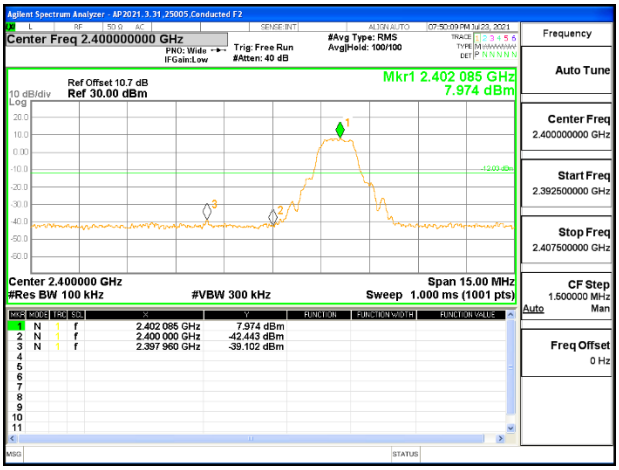
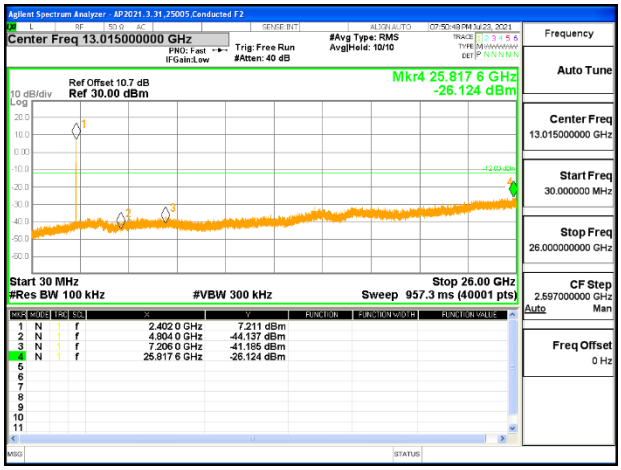
9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

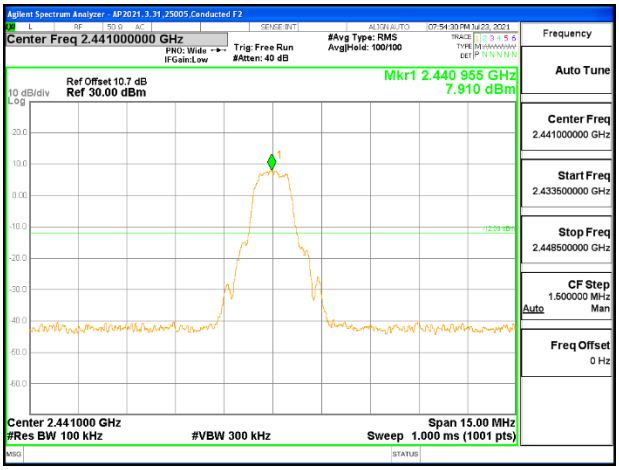
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



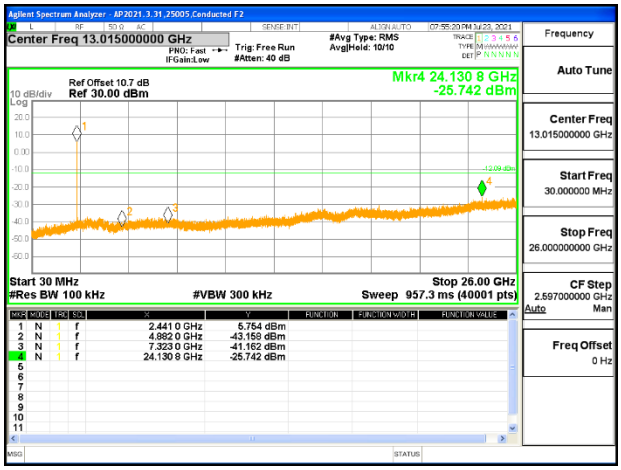
LOW CHANNEL BANDEDGE



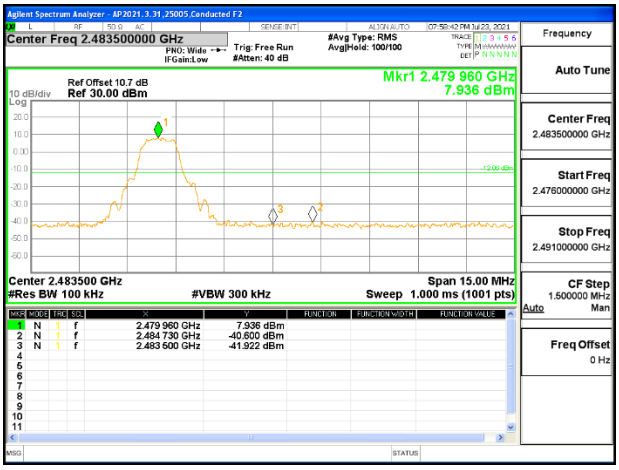
OUT-OF-BAND LOW CHANNEL



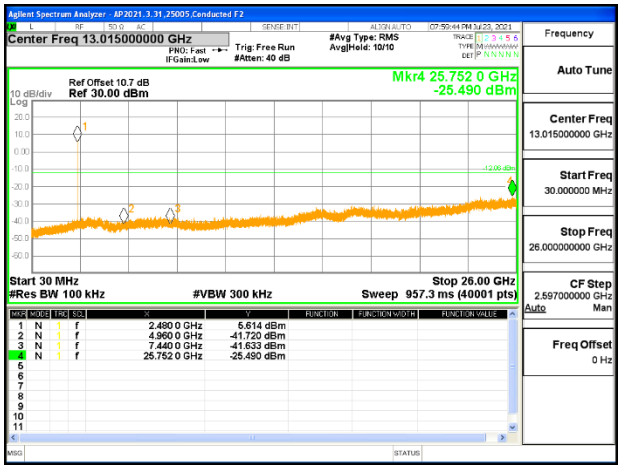
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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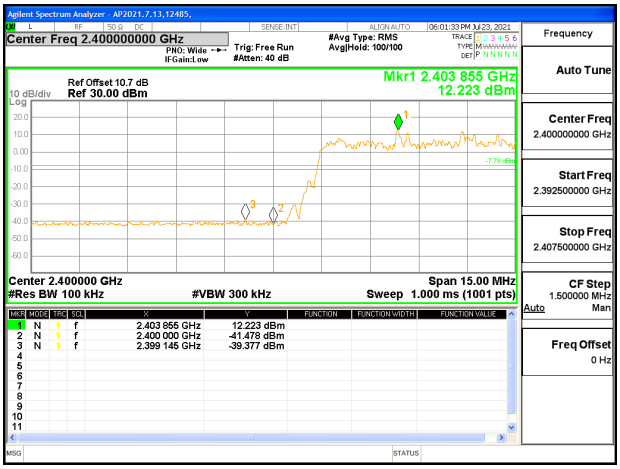
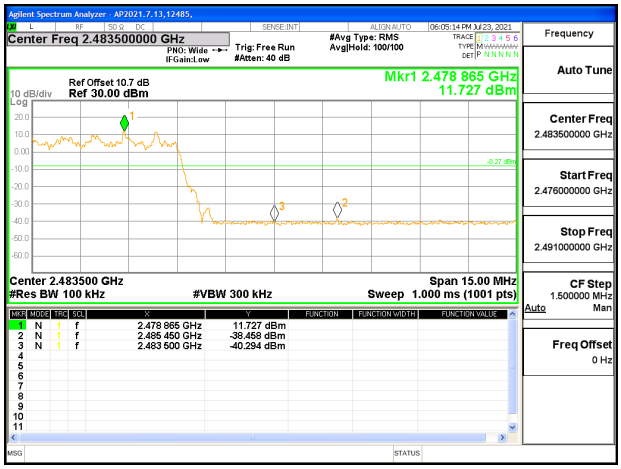
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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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.

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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.

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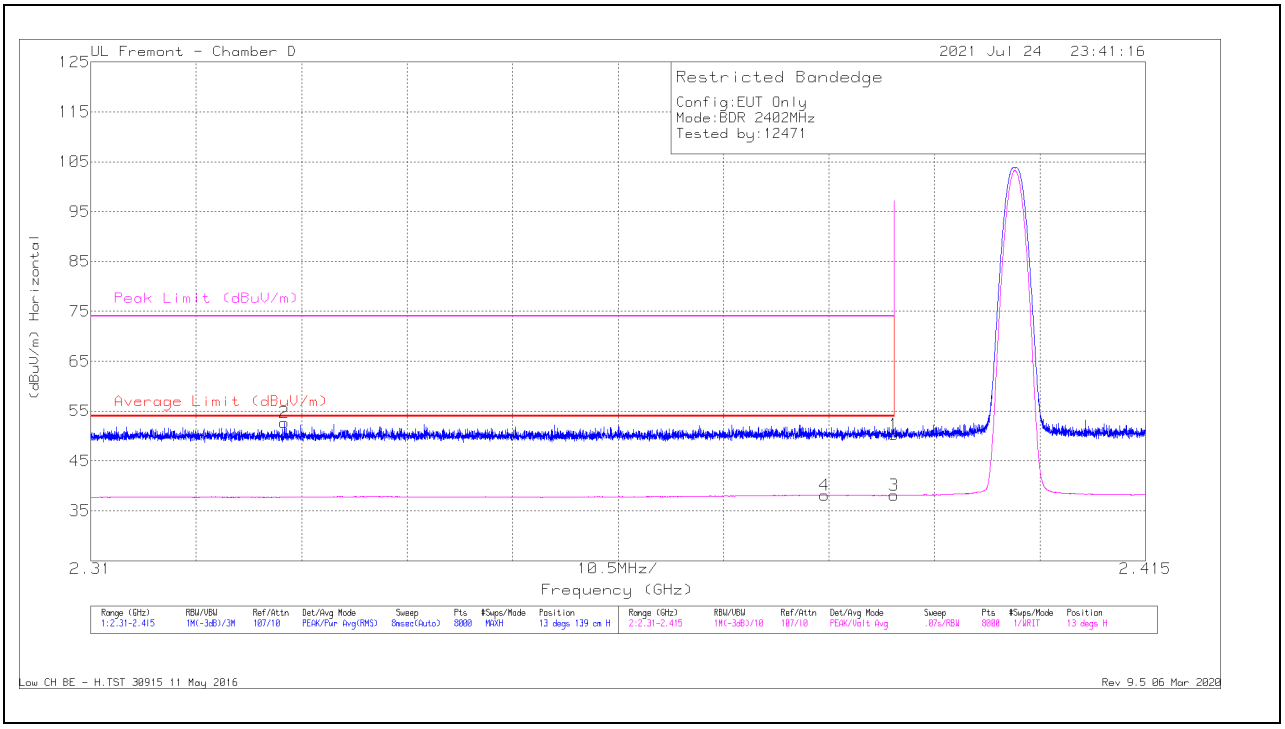
10.1. TRANSMITTER ABOVE 1 GHz

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/Fltr/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	38.48	Pk	32.1	-20.3	50.28	-	-	74	-23.72	13	139	H
2	* 2.32928	41.41	Pk	31.8	-20.5	52.71	-	-	74	-21.29	13	139	H
3	* 2.39	26.29	VA1T	32.1	-20.3	38.09	54	-15.91	-	-	13	139	H
4	* 2.38306	26.37	VA1T	32.2	-20.4	38.17	54	-15.83	-	-	13	139	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

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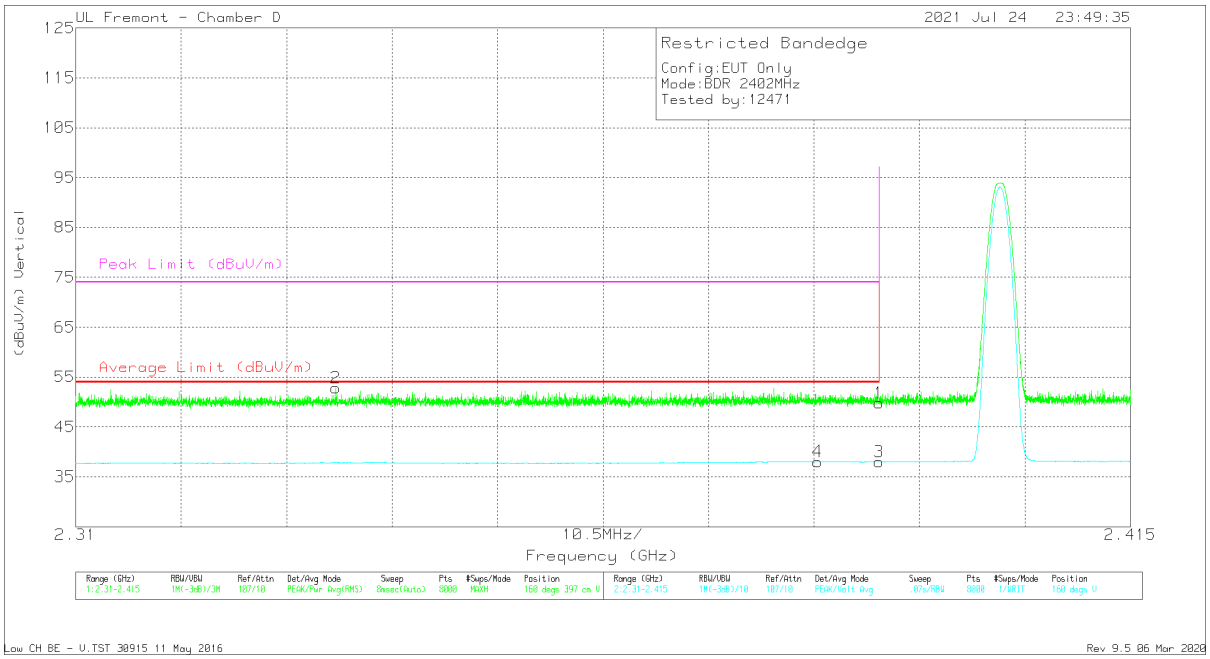
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	37.97	Pk	32.1	-20.3	49.77	-	-	74	-24.23	160	397	V
2	* 2.33587	41.31	Pk	31.9	-20.4	52.81	-	-	74	-21.19	160	397	V
3	* 2.39	26.17	VA1T	32.1	-20.3	37.97	54	-16.03	-	-	160	396	V
4	* 2.38384	26.36	VA1T	32.1	-20.4	38.06	54	-15.94	-	-	160	396	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
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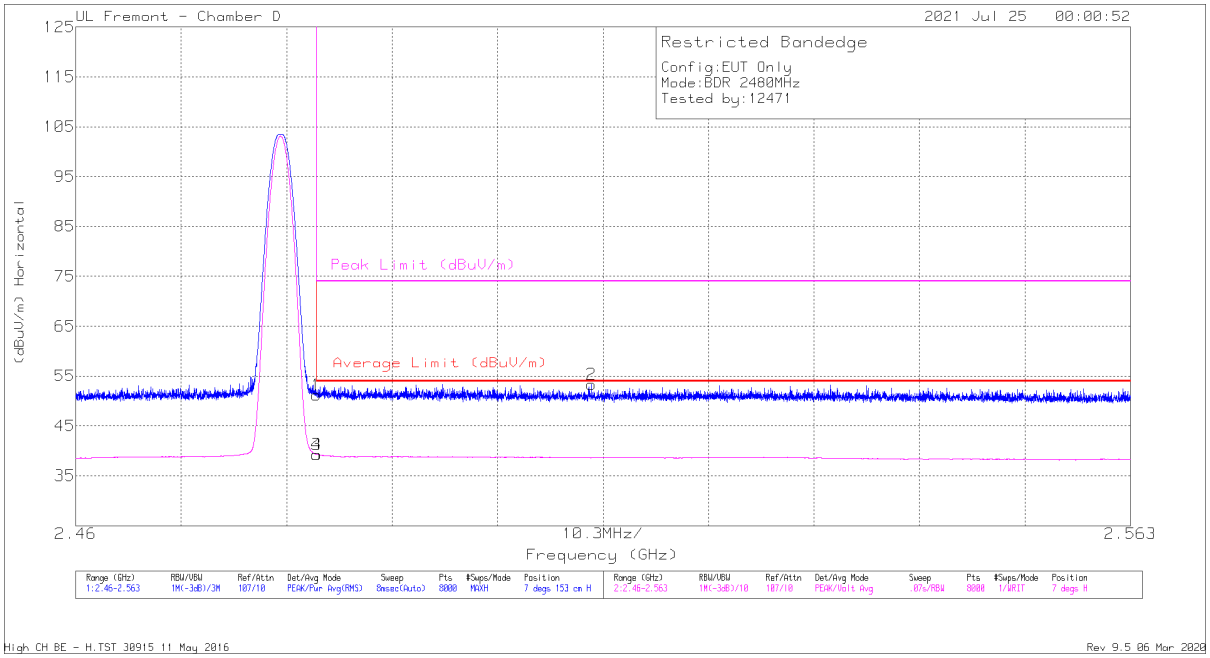
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	38.78	Pk	32.7	-20.3	51.18	-	-	74	-22.82	7	153	H
3	* 2.4835	26.9	VA1T	32.7	-20.3	39.3	54	-14.7	-	-	7	153	H
4	* 2.48353	26.89	VA1T	32.7	-20.3	39.29	54	-14.71	-	-	7	153	H
2	2.51036	40.95	Pk	32.7	-20.3	53.35	-	-	74	-20.65	7	153	H

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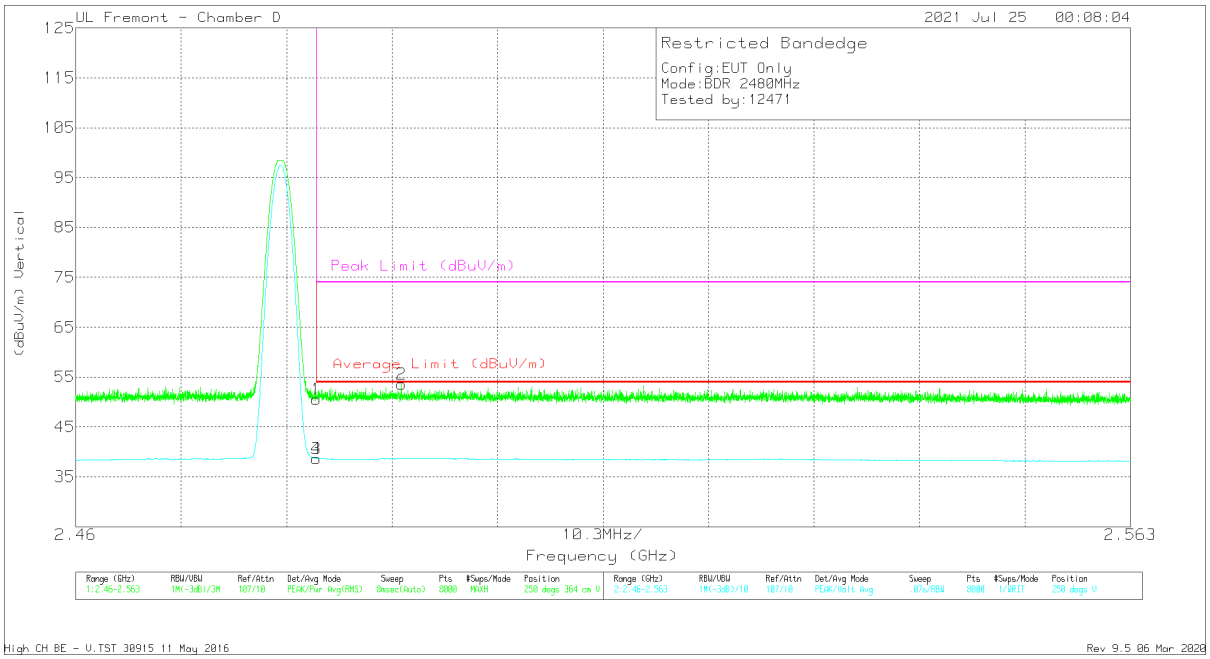
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	38.16	Pk	32.7	-20.3	50.56	-	-	74	-23.44	250	364	V
2	* 2.49181	40.94	Pk	32.8	-20.2	53.54	-	-	74	-20.46	250	364	V
3	* 2.4835	26.28	VA1T	32.7	-20.3	38.68	54	-15.32	-	-	250	364	V
4	* 2.48351	26.28	VA1T	32.7	-20.3	38.68	54	-15.32	-	-	250	364	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

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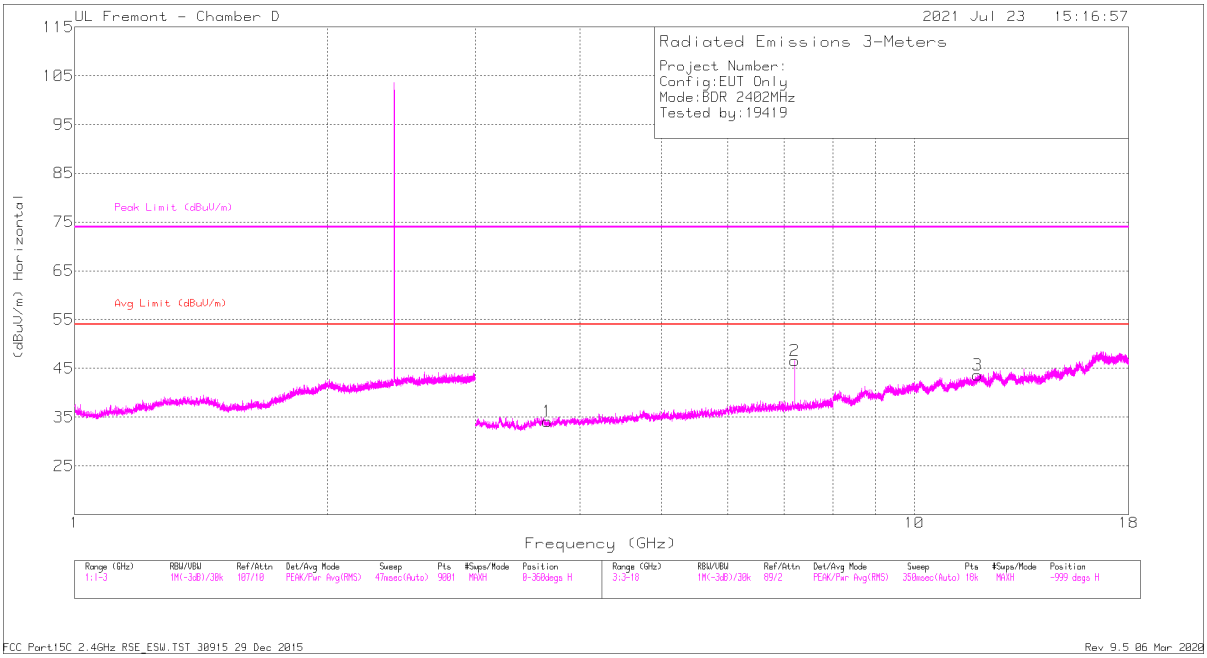
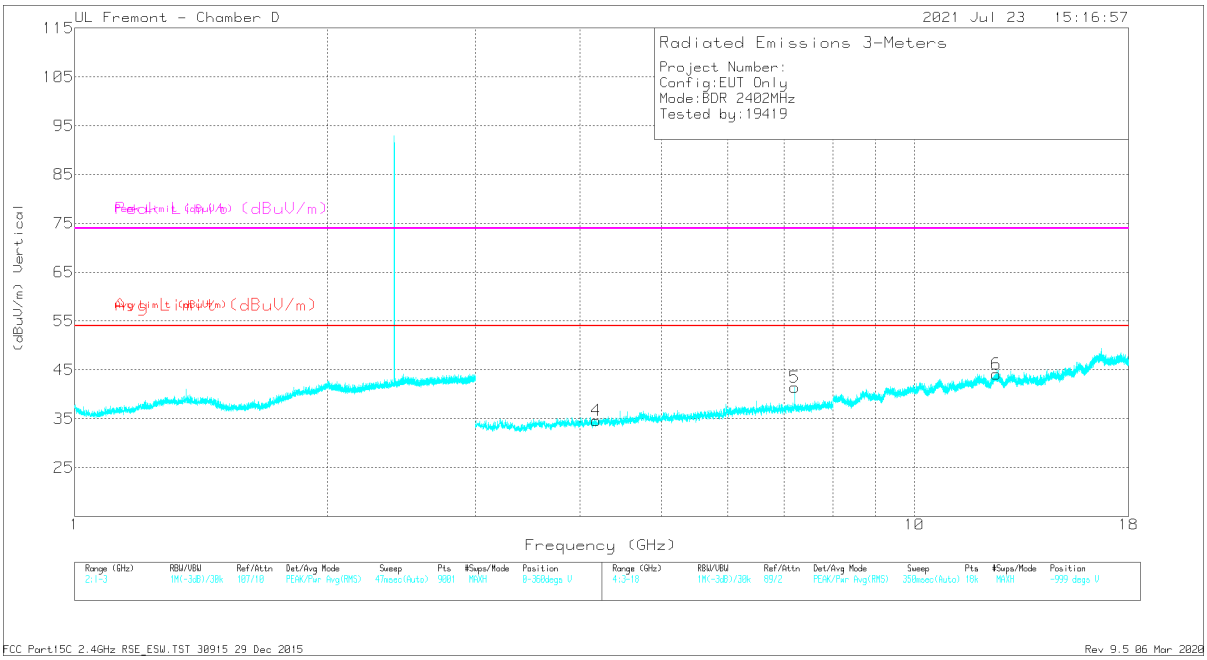
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 3.65826	37.37	PKFH	33.1	-28.5	41.97	-	-	74	-32.03	283	205	H
	* 3.65738	24.44	VA1T	33.1	-28.5	29.04	54	-24.96	-	-	283	205	H
3	* 11.90557	32.53	PKFH	38.6	-20.3	50.83	-	-	74	-23.17	354	143	H
	* 11.90779	19.78	VA1T	38.6	-20.3	38.08	54	-15.92	-	-	354	143	H
4	* 4.18116	36.87	PKFH	33.5	-27.3	43.07	-	-	74	-30.93	203	148	V
	* 4.18024	23.39	VA1T	33.5	-27.3	29.59	54	-24.41	-	-	203	148	V
6	* 12.52143	34.41	PKFH	39	-21	52.41	-	-	74	-21.59	241	339	V
	* 12.5239	20.72	VA1T	39	-21	38.72	54	-15.28	-	-	241	339	V
2	7.20595	40.37	PKFH	35.6	-24.7	51.27	-	-	-	-	47	104	H
5	7.20597	26.72	VA1T	35.6	-24.7	37.62	-	-	-	-	250	104	V
2	7.20598	33.95	VA1T	35.6	-24.7	44.85	-	-	-	-	47	104	H
5	7.20666	37.14	PKFH	35.6	-24.7	48.04	-	-	-	-	250	104	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

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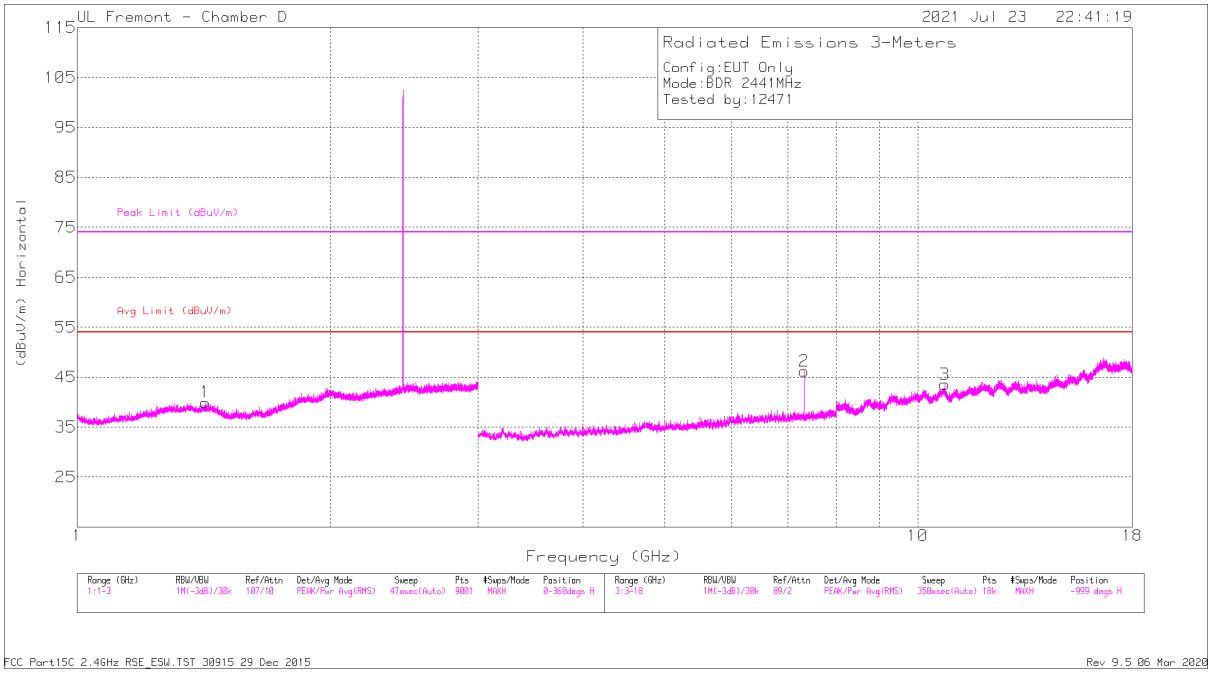
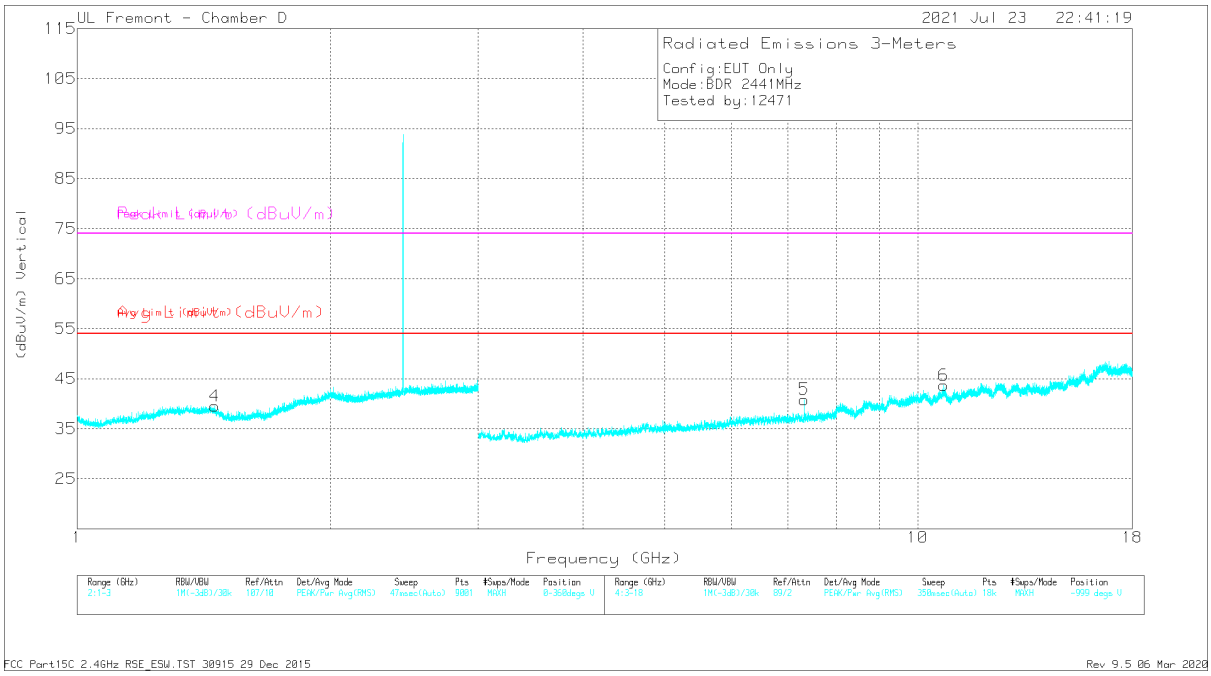
MID CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	* 1.42042	39.38	PKFH	29.4	-21.6	47.18	-	-	74	-26.82	0	200	H
	* 1.41798	26.42	VA1T	29.4	-21.6	34.22	54	-19.78	-	-	0	200	H
4	* 1.45587	40.51	PKFH	29.1	-21.5	48.11	-	-	74	-25.89	0	200	V
	* 1.45916	26.42	VA1T	29	-21.6	33.82	54	-20.18	-	-	0	200	V
2	* 7.3224	40.02	PKFH	35.6	-24.8	50.82	-	-	74	-23.18	232	118	H
	* 7.32299	33.76	VA1T	35.6	-24.8	44.56	54	-9.44	-	-	232	118	H
3	* 10.76459	32.98	PKFH	37.8	-20.1	50.68	-	-	74	-23.32	0	200	H
	* 10.76584	19.65	VA1T	37.8	-20.1	37.35	54	-16.65	-	-	0	200	H
5	* 7.32207	36.82	PKFH	35.7	-24.8	47.72	-	-	74	-26.28	186	104	V
	* 7.32299	26.17	VA1T	35.6	-24.8	36.97	54	-17.03	-	-	186	104	V
6	* 10.74278	33.05	PKFH	37.9	-20.1	50.85	-	-	74	-23.15	0	200	V
	* 10.74279	19.9	VA1T	37.9	-20.1	37.7	54	-16.3	-	-	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

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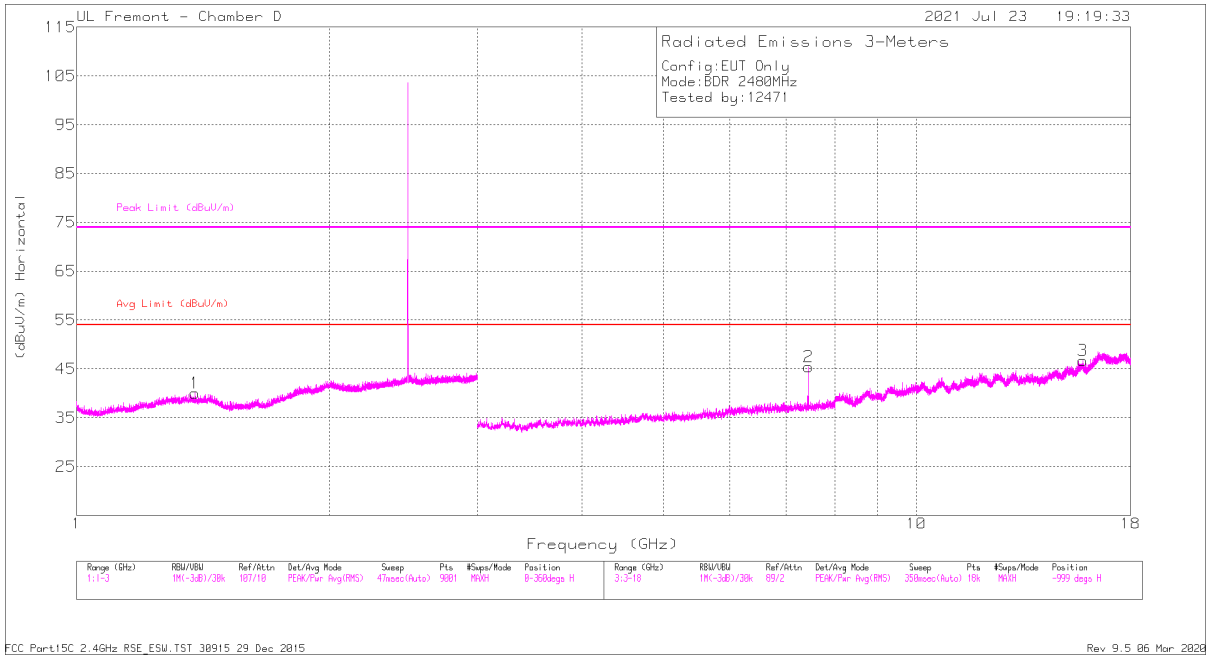
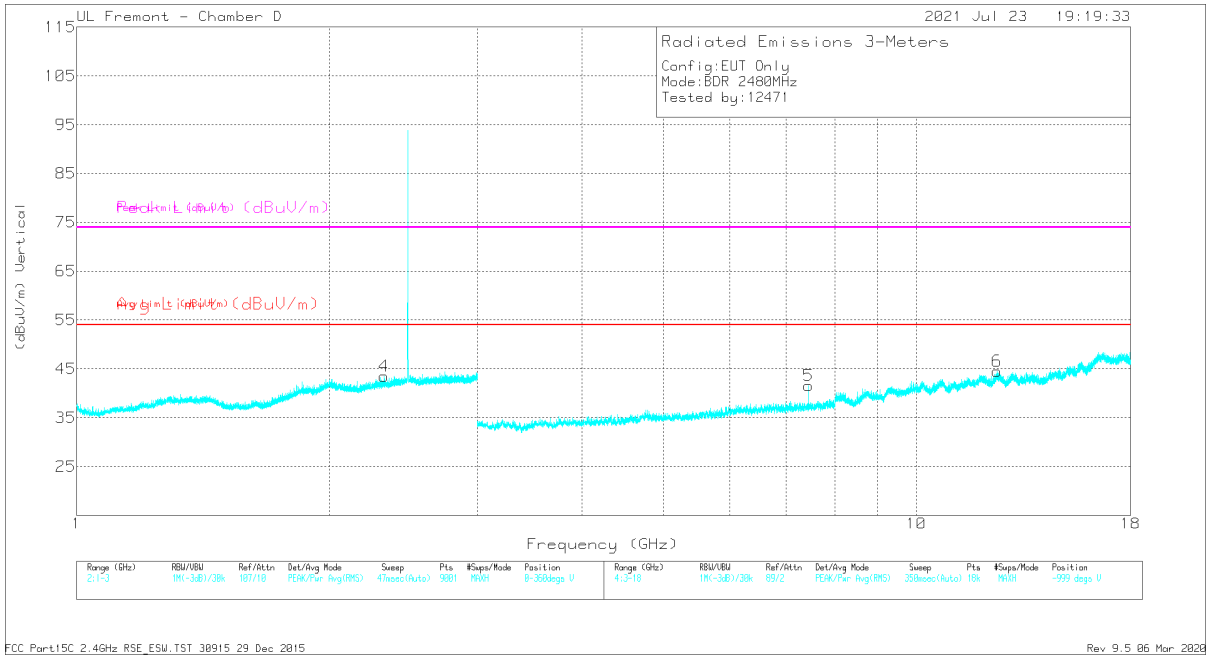
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	* 1.38441	39.53	PKFH	29.4	-21.7	47.23	-	-	74	-26.77	360	101	H
	* 1.38323	26.32	VA1T	29.4	-21.7	34.02	54	-19.98	-	-	360	101	H
4	* 2.32358	39.75	PKFH	31.8	-20.4	51.15	-	-	74	-22.85	360	101	V
	* 2.32555	25.86	VA1T	31.8	-20.4	37.26	54	-16.74	-	-	360	101	V
2	* 7.44069	40.6	PKFH	35.7	-24.4	51.9	-	-	74	-22.1	47	102	H
	* 7.43999	32.82	VA1T	35.7	-24.4	44.12	54	-9.88	-	-	47	102	H
3	* 15.78385	33	PKFH	40.3	-19.5	53.8	-	-	74	-20.2	0	102	H
	* 15.78289	19.7	VA1T	40.3	-19.5	40.5	54	-13.5	-	-	0	102	H
5	* 7.43941	36.57	PKFH	35.7	-24.4	47.87	-	-	74	-26.13	47	110	V
	* 7.43997	26.83	VA1T	35.7	-24.4	38.13	54	-15.87	-	-	47	110	V
6	* 12.48148	33.35	PKFH	39	-20.8	51.55	-	-	74	-22.45	0	200	V
	* 12.48306	20.25	VA1T	39	-20.7	38.55	54	-15.45	-	-	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

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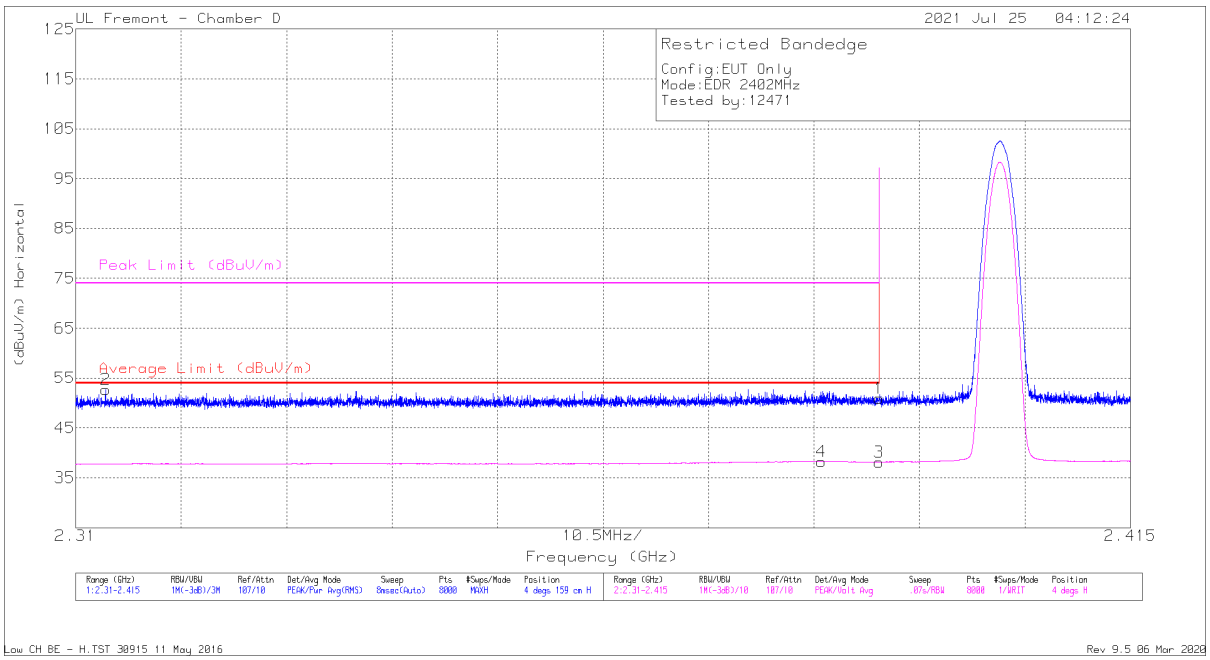
10.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	39.19	Pk	32.1	-20.3	50.99	-	-	74	-23.01	4	159	H
2	* 2.31297	41.45	Pk	31.8	-20.5	52.75	-	-	74	-21.25	4	159	H
3	* 2.39	26.37	VA1T	32.1	-20.3	38.17	54	-15.83	-	-	4	159	H
4	* 2.38423	26.59	VA1T	32.1	-20.4	38.29	54	-15.71	-	-	4	159	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

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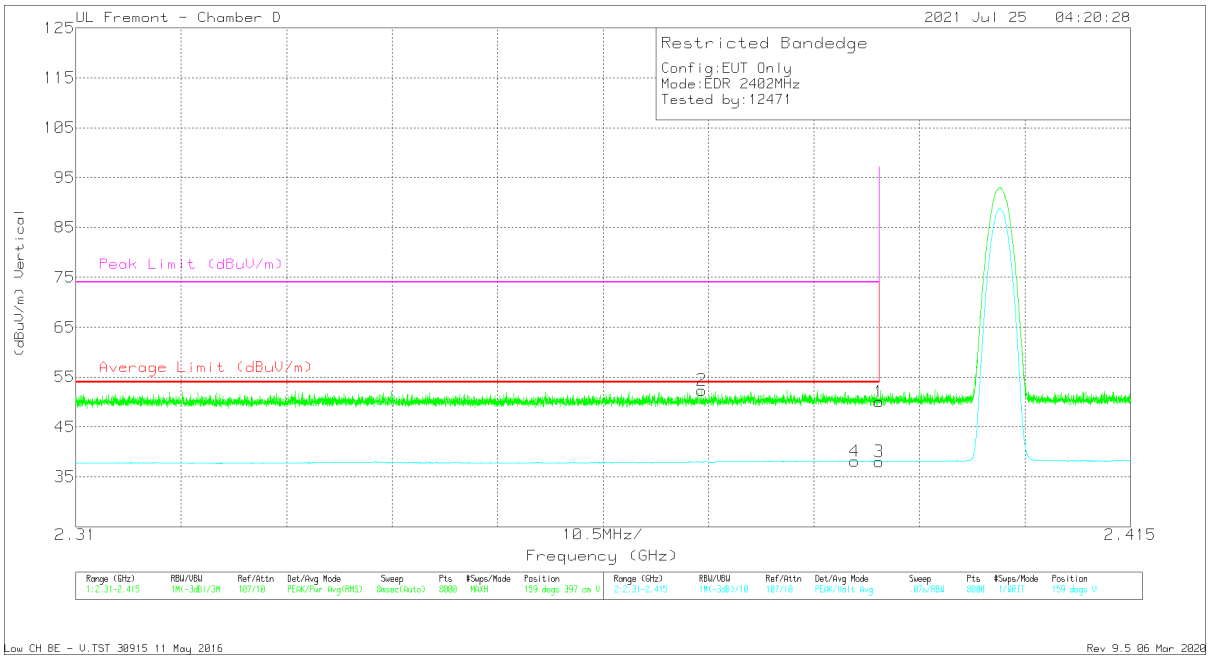
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	38.28	Pk	32.1	-20.3	50.08	-	-	74	-23.92	159	397	V
2	* 2.37233	40.78	Pk	32	-20.4	52.38	-	-	74	-21.62	159	397	V
3	* 2.39	26.26	VA1T	32.1	-20.3	38.06	54	-15.94	-	-	159	397	V
4	* 2.38755	26.47	VA1T	32.1	-20.4	38.17	54	-15.83	-	-	159	397	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

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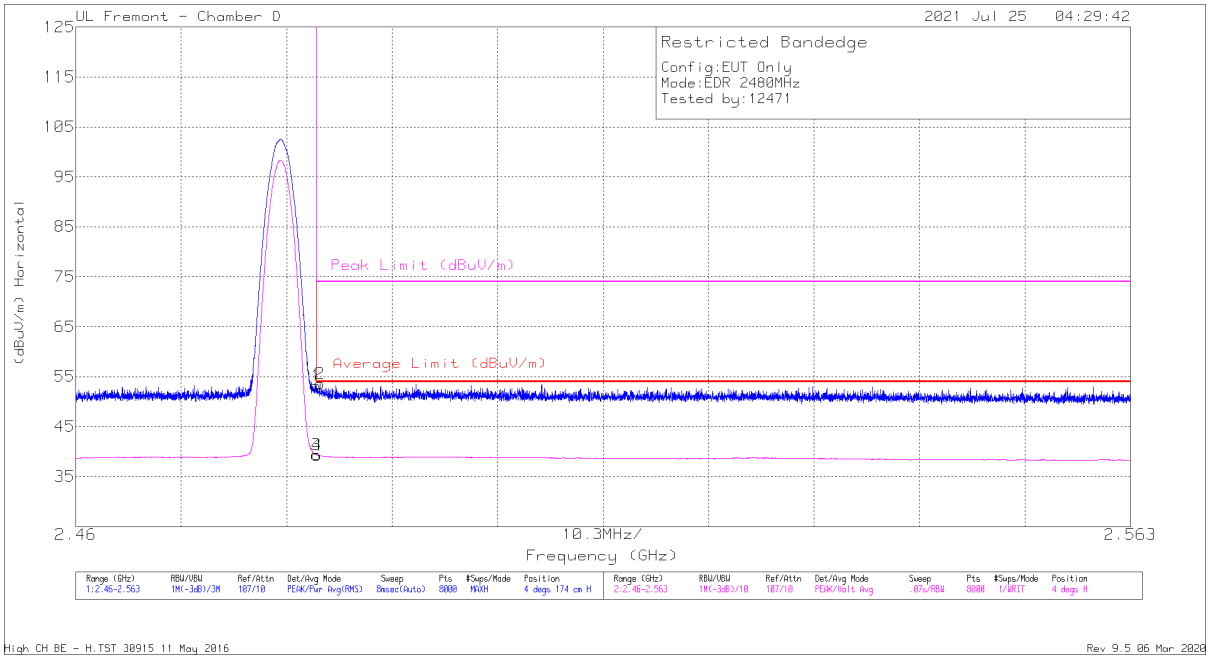
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	40.82	Pk	32.7	-20.3	53.22	-	-	74	-20.78	4	174	H
2	* 2.48384	41.12	Pk	32.7	-20.3	53.52	-	-	74	-20.48	4	174	H
3	* 2.4835	26.94	VA1T	32.7	-20.3	39.34	54	-14.66	-	-	4	174	H
4	* 2.48355	26.9	VA1T	32.7	-20.3	39.3	54	-14.7	-	-	4	174	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

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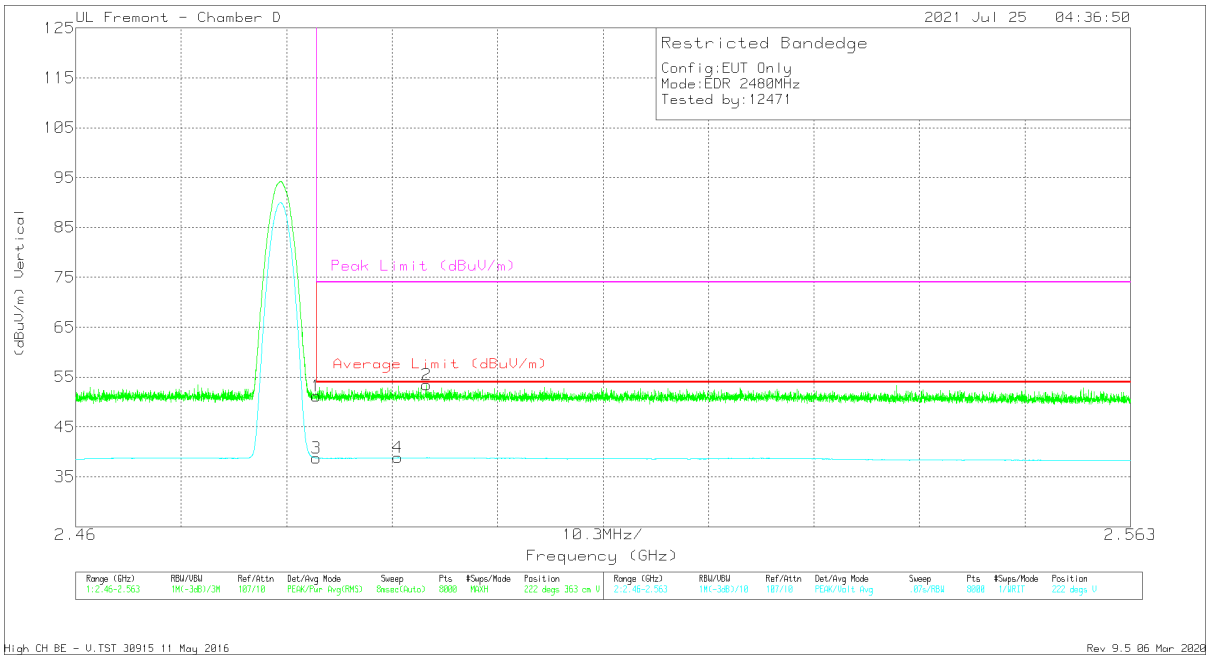
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	38.8	Pk	32.7	-20.3	51.2	-	-	74	-22.8	222	363	V
2	* 2.49429	40.85	Pk	32.8	-20.2	53.45	-	-	74	-20.55	222	363	V
3	* 2.4835	26.4	VA1T	32.7	-20.3	38.8	54	-15.2	-	-	222	363	V
4	* 2.49146	26.24	VA1T	32.8	-20.2	38.84	54	-15.16	-	-	222	363	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

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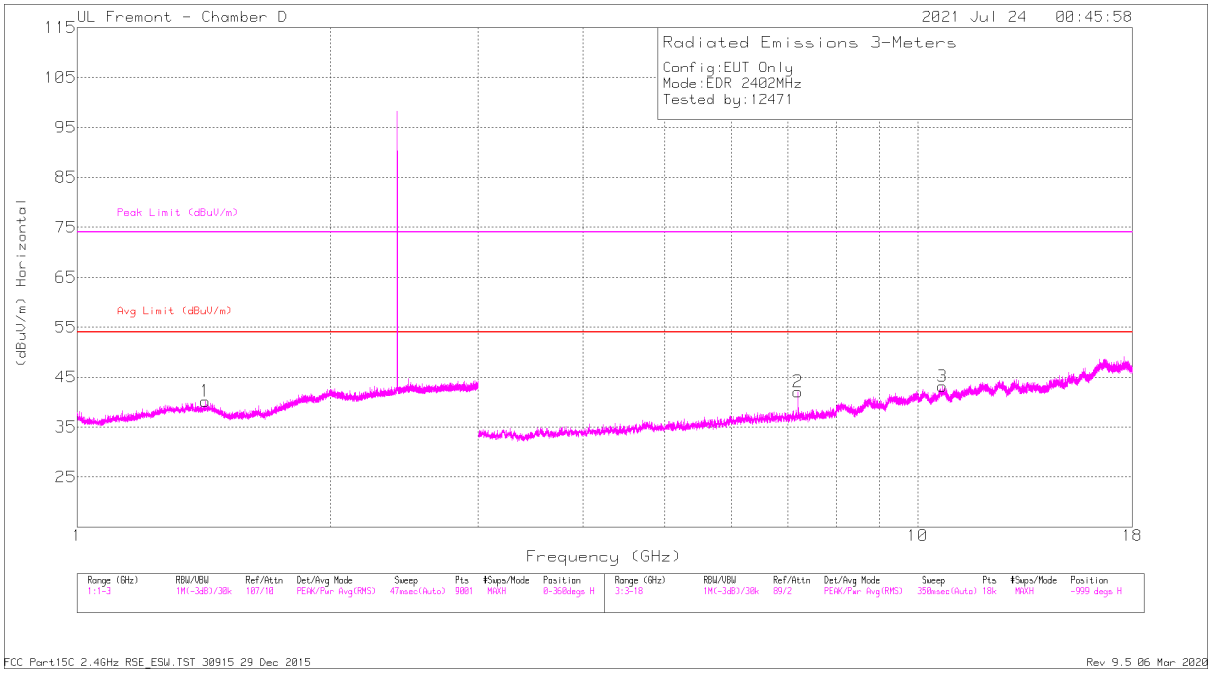
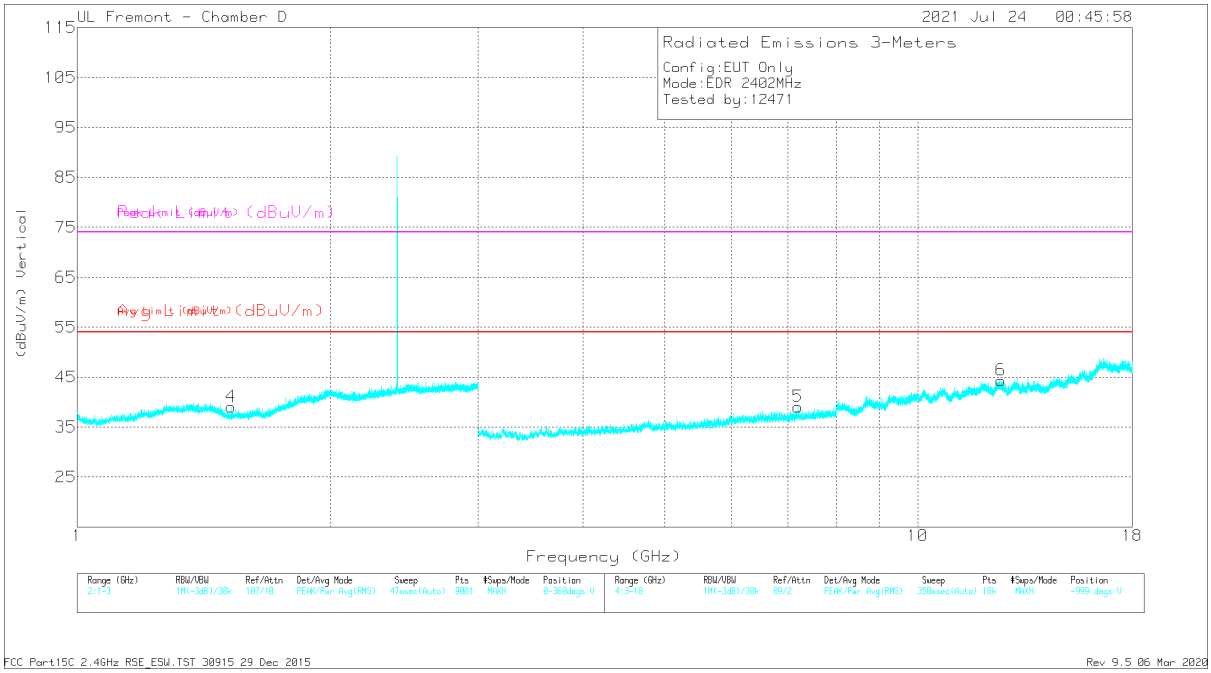
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	* 1.42044	39.83	PKFH	29.4	-21.6	47.63	-	-	74	-26.37	356	200	H
	* 1.41929	26.45	VA1T	29.4	-21.6	34.25	54	-19.75	-	-	356	200	H
4	* 1.52641	40.68	PKFH	27.9	-21.5	47.08	-	-	74	-26.92	360	200	V
	* 1.52474	26.32	VA1T	27.9	-21.5	32.72	54	-21.28	-	-	360	200	V
3	* 10.70202	33.82	PKFH	37.9	-20.6	51.12	-	-	74	-22.88	0	101	H
	* 10.70465	20.08	VA1T	37.9	-20.5	37.48	54	-16.52	-	-	0	101	H
6	* 12.56199	34.99	PKFH	39	-21.5	52.49	-	-	74	-21.51	0	101	V
	* 12.56503	21.1	VA1T	39	-21.5	38.6	54	-15.4	-	-	0	101	V
2	7.20565	39.34	PKFH	35.6	-24.7	50.24	-	-	-	-	224	104	H
5	7.20632	37.52	PKFH	35.6	-24.7	48.42	-	-	-	-	195	103	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

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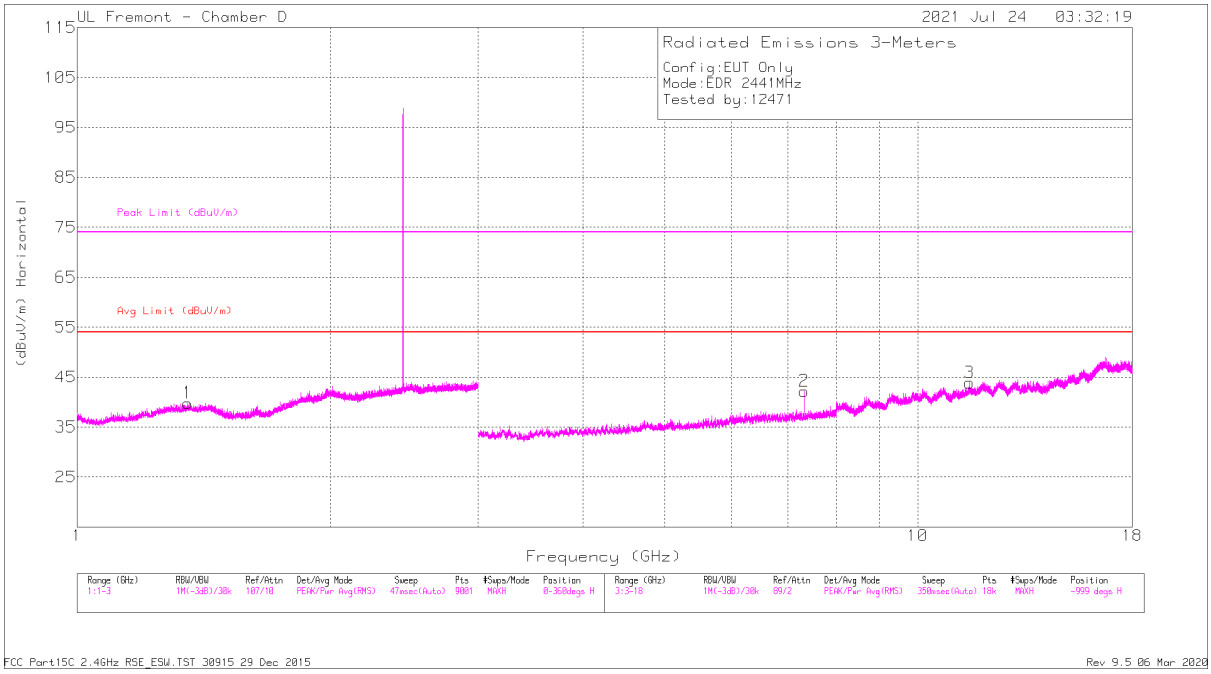
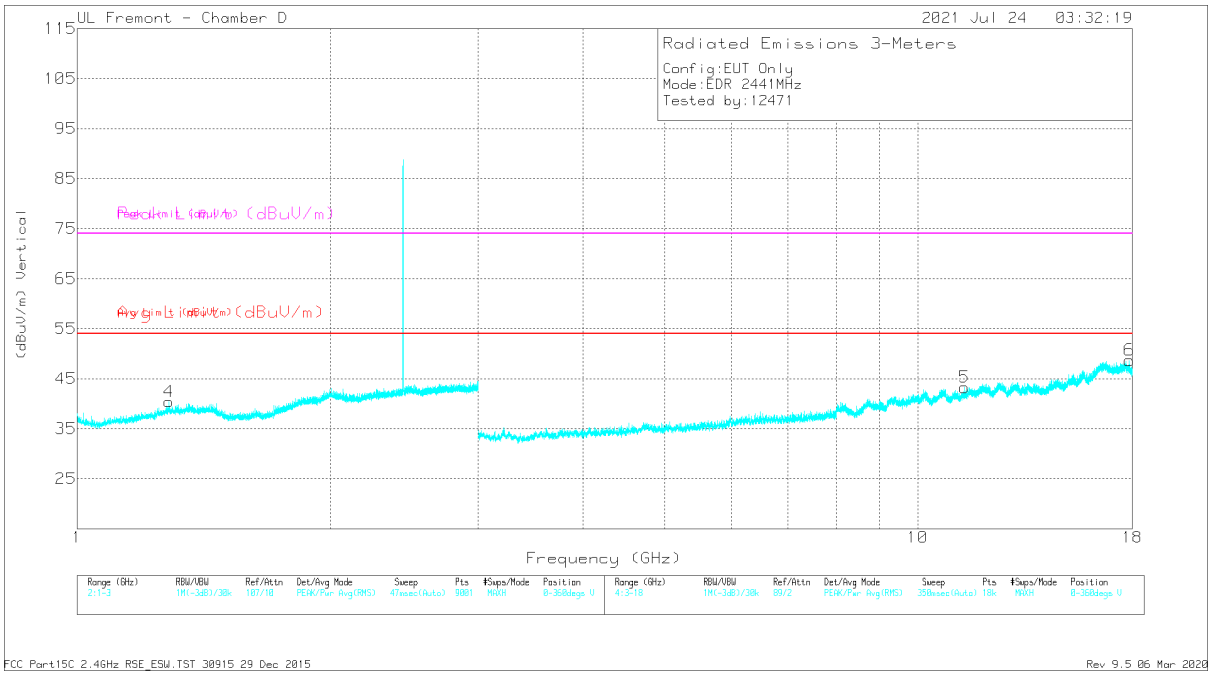
MID CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	* 1.35361	39.8	PKFH	29.6	-21.7	47.7	-	-	74	-26.3	0	200	H
	* 1.35462	26.5	VA1T	29.6	-21.8	34.3	54	-19.7	-	-	0	200	H
4	* 1.28601	40.52	PKFH	29.5	-21.9	48.12	-	-	74	-25.88	0	101	V
	* 1.28659	26.52	VA1T	29.5	-21.9	34.12	54	-19.88	-	-	0	101	V
2	* 7.32335	39.04	PKFH	35.6	-24.8	49.84	-	-	74	-24.16	230	117	H
	* 7.32303	28.59	VA1T	35.6	-24.8	39.39	54	-14.61	-	-	230	117	H
3	* 11.52732	32.9	PKFH	38.2	-20.1	51	-	-	74	-23	0	200	H
	* 11.52886	19.59	VA1T	38.2	-20	37.79	54	-16.21	-	-	0	200	H
5	* 11.36731	32.93	PKFH	38	-20.8	50.13	-	-	74	-23.87	0	200	V
	* 11.36744	19.78	VA1T	38	-20.8	36.98	54	-17.02	-	-	0	200	V
6	* 17.85486	31.37	PKFH	41.3	-17	55.67	-	-	74	-18.33	0	200	V
	* 17.85523	18.1	VA1T	41.3	-17	42.4	54	-11.6	-	-	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

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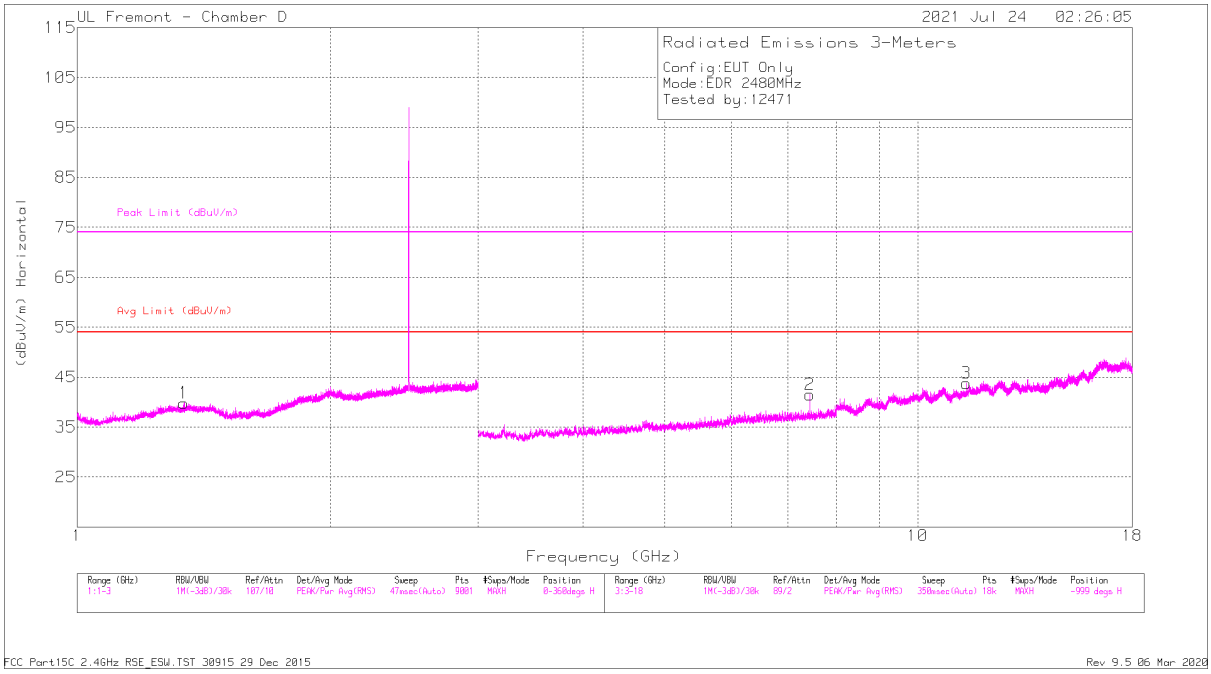
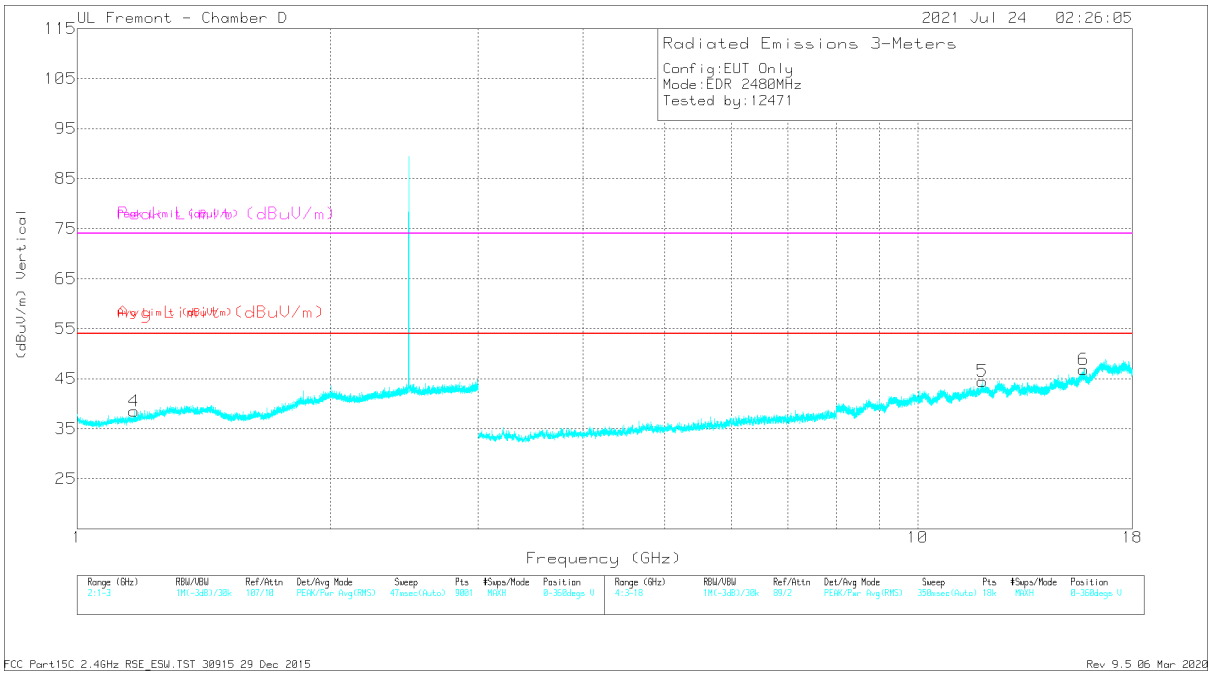
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T712 (dB/m)	Amp/Cbl/Fltr/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	* 1.33942	40.02	PKFH	29.4	-21.8	47.62	-	-	74	-26.38	0	101	H
	* 1.3403	26.44	VA1T	29.4	-21.8	34.04	54	-19.96	-	-	0	101	H
4	* 1.16865	40.14	PKFH	27.8	-22	45.94	-	-	74	-28.06	0	101	V
	* 1.16756	26.49	VA1T	27.8	-22	32.29	54	-21.71	-	-	0	101	V
2	* 7.44053	38.74	PKFH	35.7	-24.4	50.04	-	-	74	-23.96	231	117	H
	* 7.44002	27.58	VA1T	35.7	-24.4	38.88	54	-15.12	-	-	231	117	H
3	* 11.42223	33.43	PKFH	38	-20.6	50.83	-	-	74	-23.17	0	200	H
	* 11.4233	19.67	VA1T	38	-20.7	36.97	54	-17.03	-	-	0	200	H
5	* 11.93514	34.85	PKFH	38.7	-20.8	52.75	-	-	74	-21.25	0	101	V
	* 11.93823	20.16	VA1T	38.7	-20.8	38.06	54	-15.94	-	-	0	101	V
6	* 15.749	33	PKFH	40.2	-19.7	53.5	-	-	74	-20.5	0	101	V
	* 15.74648	19.79	VA1T	40.2	-19.6	40.39	54	-13.61	-	-	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

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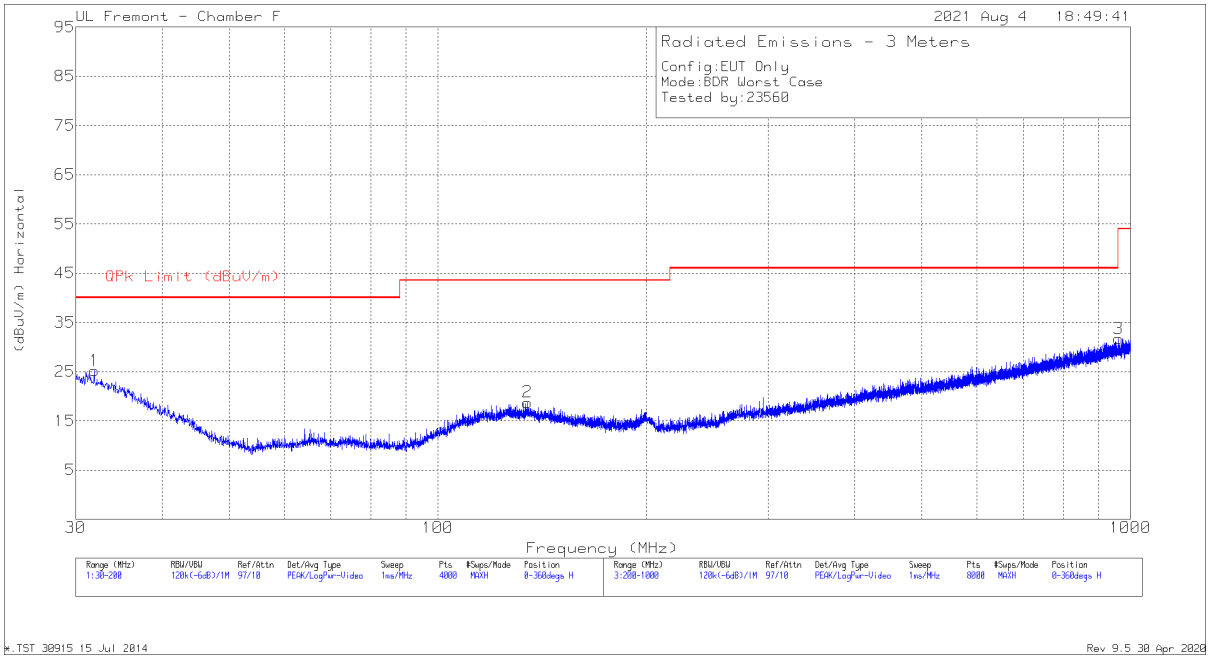
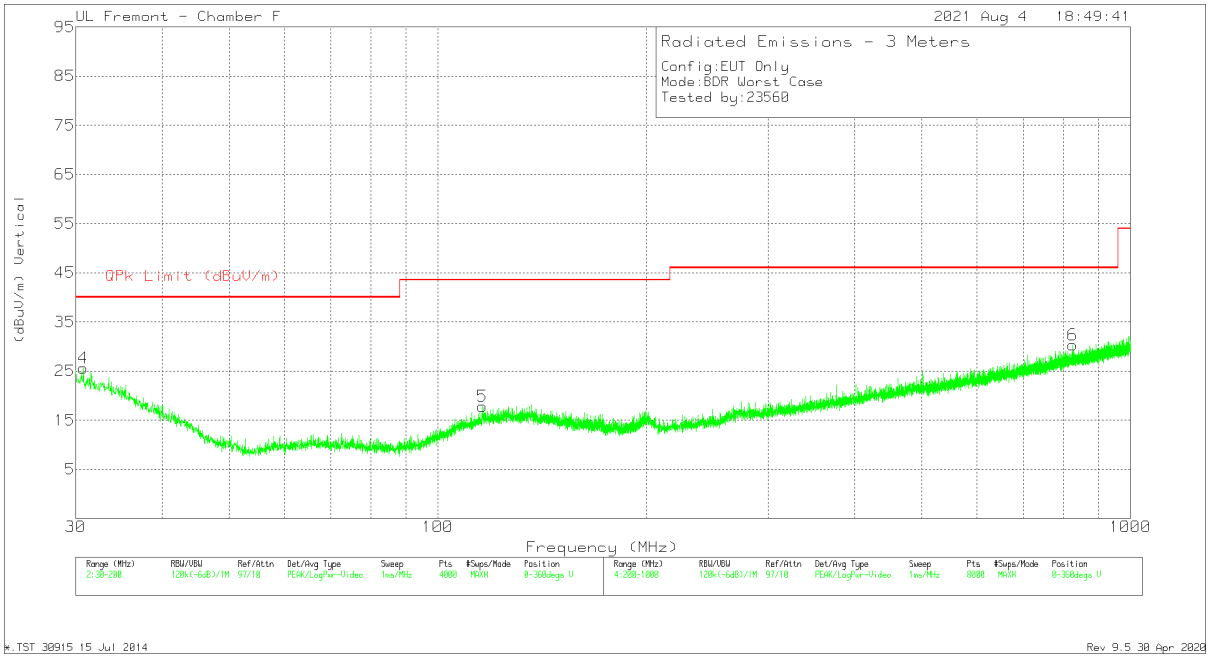
10.2. WORST CASE BELOW 1 GHZ

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



HORIZONTAL



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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	33.104	22.2	Qp	25.9	-31.9	16.2	40	-23.8	312	302	H
2	* 134.5777	21.71	Qp	19.6	-30.9	10.41	43.52	-33.11	338	201	H
4	32.6252	22.01	Qp	26.3	-31.9	16.41	40	-23.59	170	161	V
5	* 116.5147	21.88	Qp	19.1	-31	9.98	43.52	-33.54	9	313	V
3	* 960.3739	19.62	Qp	28.8	-26.1	22.32	53.97	-31.65	279	115	H
6	826.1212	20.45	Qp	27.5	-27.5	20.45	46.02	-25.57	192	275	V

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

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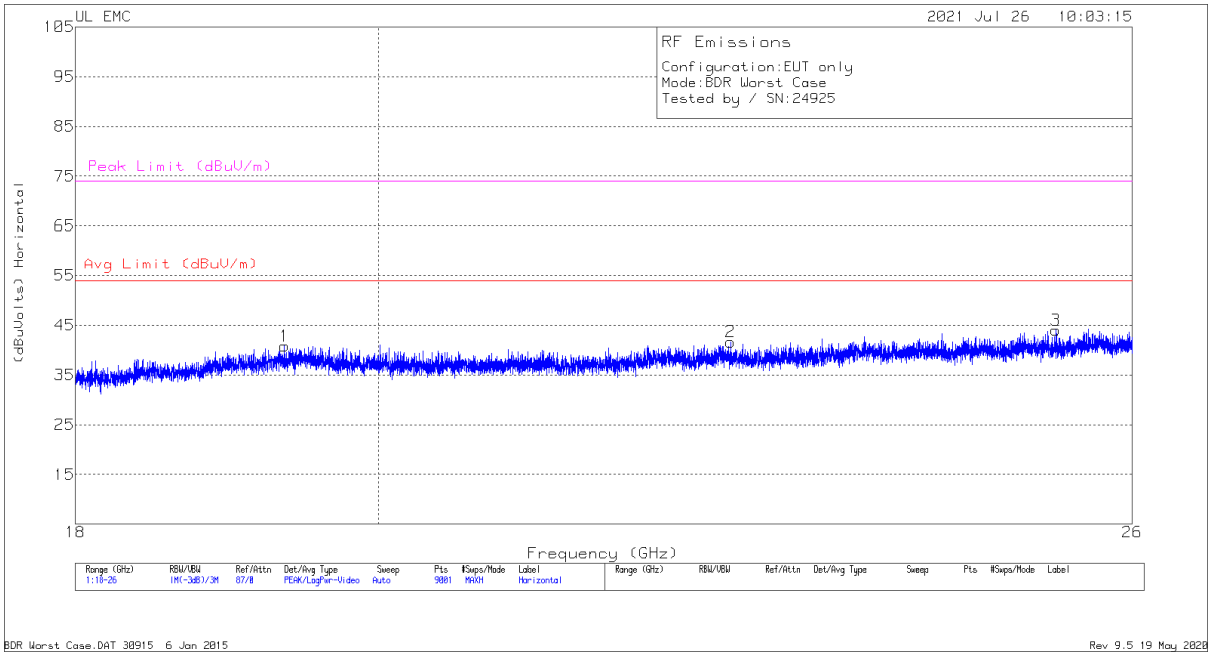
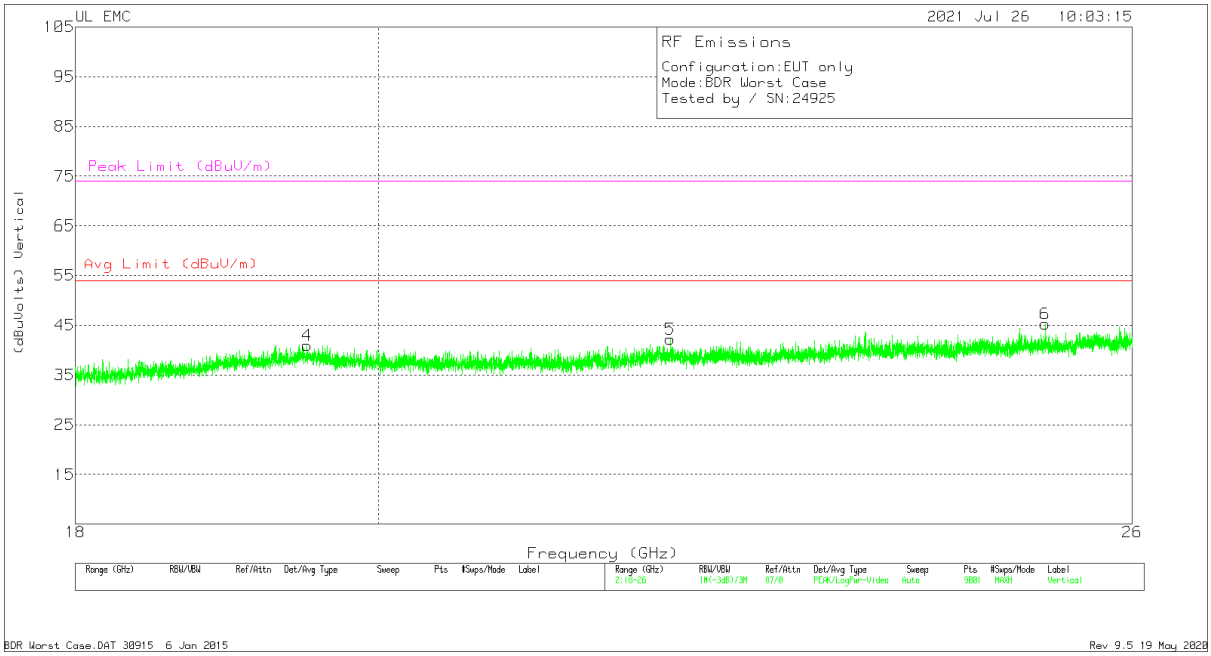
10.3. WORST CASE 18-26 GHZ

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



HORIZONTAL



VERTICAL

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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	19.35733	35.85	Pk	32.7	-18.2	-9.5	40.85	54	-13.15	74	-33.15	H
2	22.608	36.55	Pk	33.4	-18.8	-9.5	41.65	54	-12.35	74	-32.35	H
3	25.31822	37.35	Pk	34.1	-17.9	-9.5	44.05	54	-9.95	74	-29.95	H
4	19.51111	35.96	Pk	32.6	-18.1	-9.5	40.96	54	-13.04	74	-33.04	V
5	22.13867	37.11	Pk	33.3	-18.7	-9.5	42.21	54	-11.79	74	-31.79	V
6	25.22311	38.28	Pk	34.2	-17.7	-9.5	45.28	54	-8.72	74	-28.72	V

Pk - Peak detector

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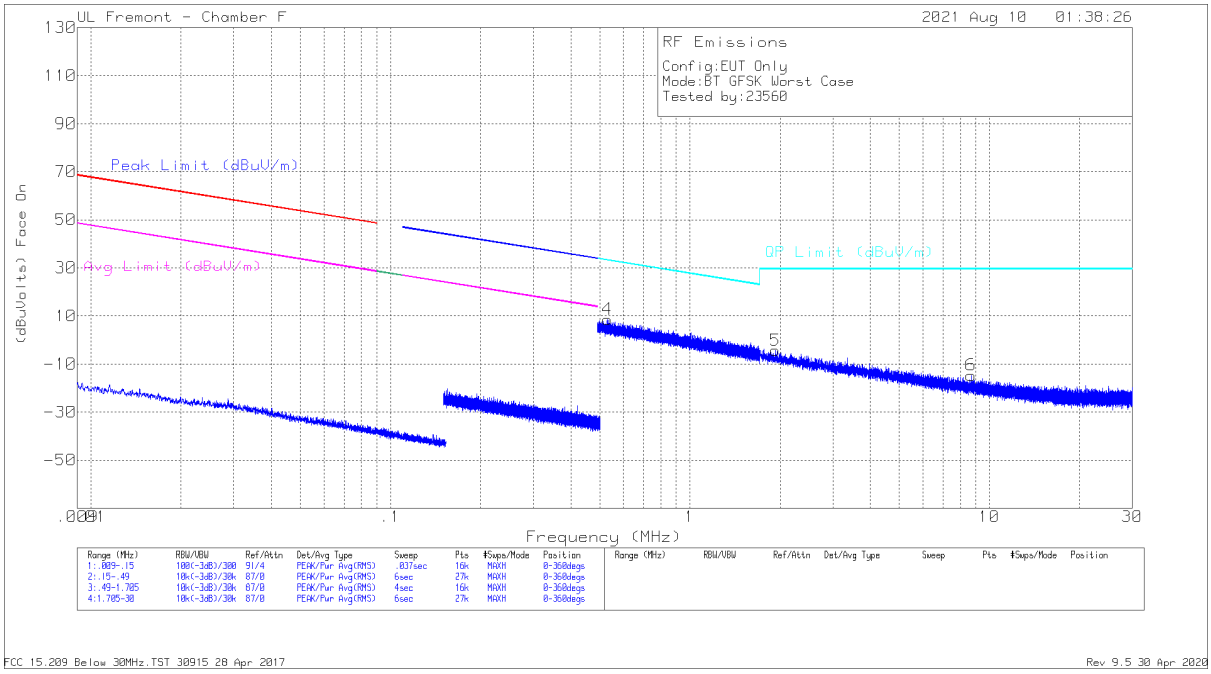
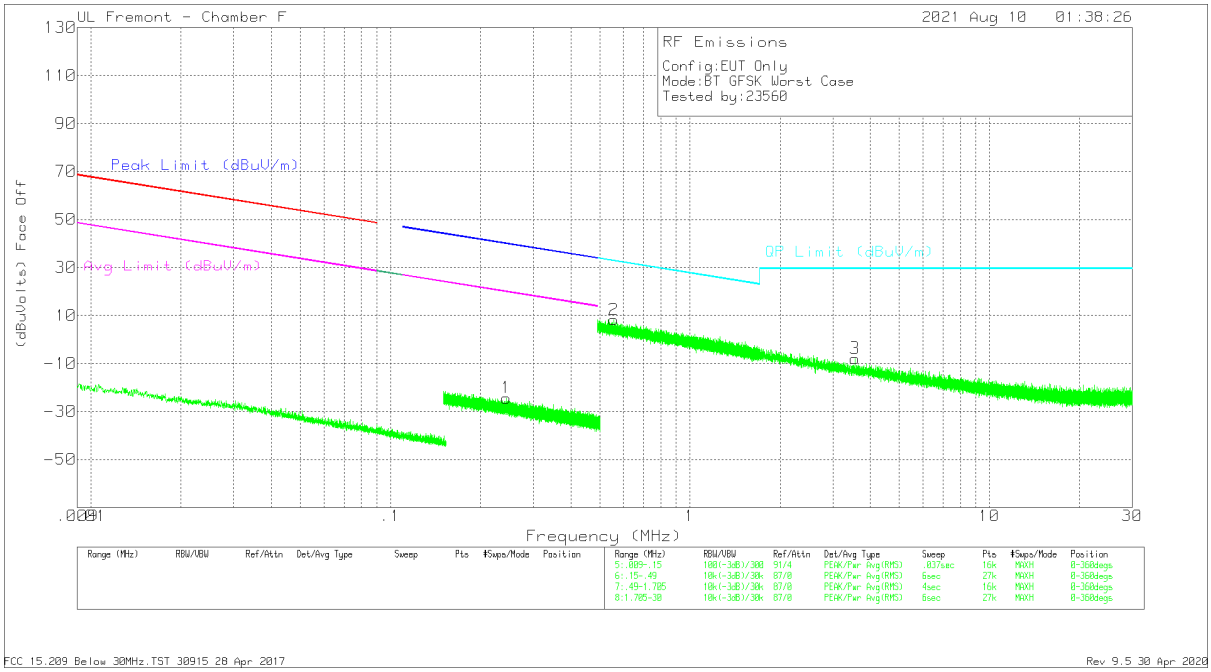
10.4. WORST CASE BELOW 30MHz

Parallel and Perpendicular





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Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr 300 m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Antenna Orientation
1	.24368	44.16	Pk	11.4	.1	-80	-24.34	39.88	-64.22	19.88	-44.22	0-360	Face off

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
4	.53127	37.28	Pk	11.2	.1	-40	8.58	33.1	-24.52	0-360	Face on
5	1.92718	24.03	Pk	11.4	.2	-40	-4.37	29.5	-33.87	0-360	Face on
6	8.68887	14.15	Pk	10.9	.3	-40	-14.65	29.5	-44.15	0-360	Face on
2	.55734	36.89	Pk	11.2	.1	-40	8.19	32.68	-24.49	0-360	Face off
3	3.56206	20.37	Pk	11.5	.2	-40	-7.93	29.5	-37.43	0-360	Face off

Pk - Peak detector

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

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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

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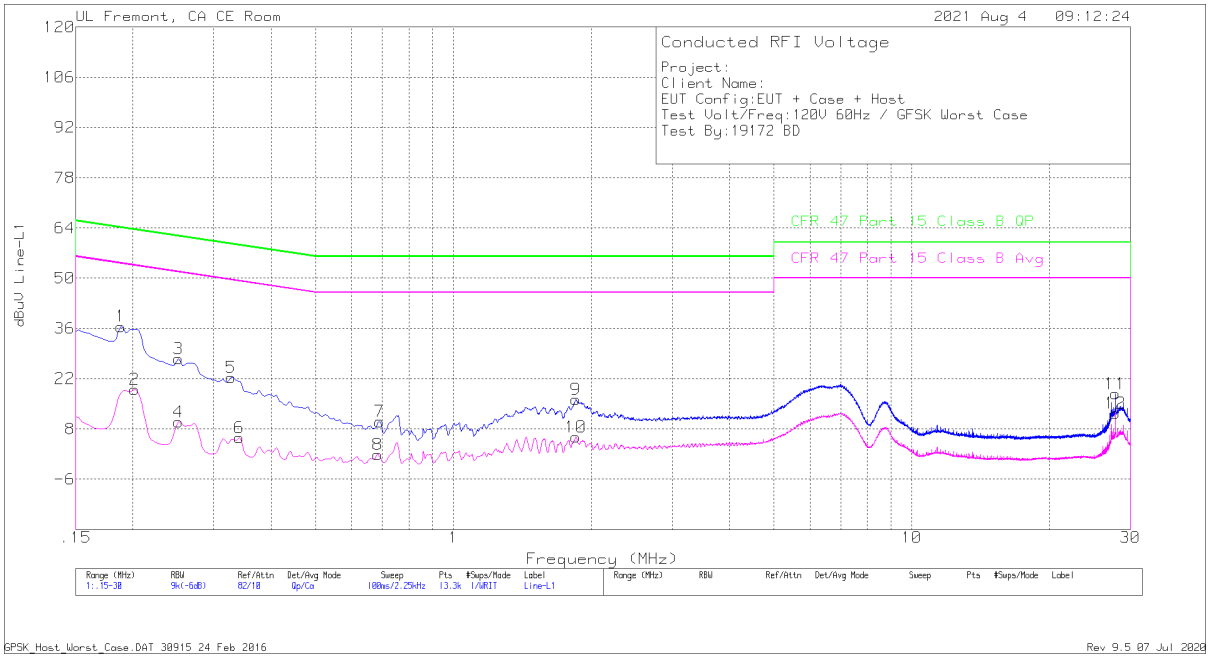
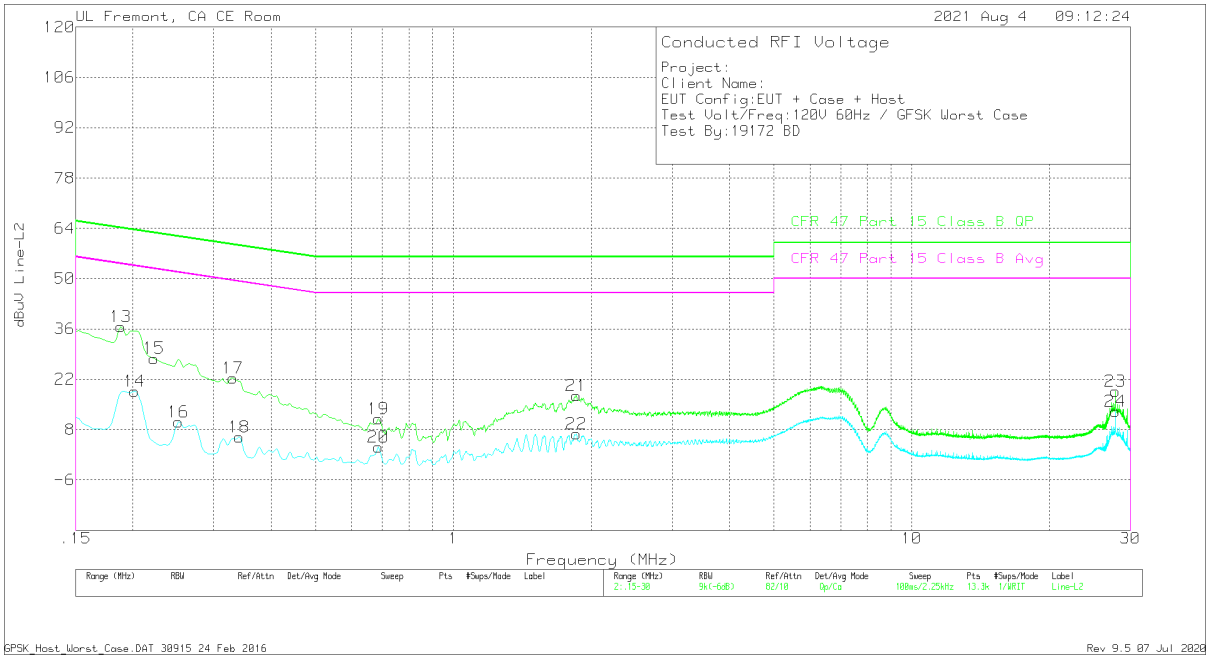
11.1. AC Power Line With Laptop

LINE 1 RESULTS



LINE 2 RESULTS



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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	.20175	9.74	Ca	0	0	9.3	19.04	-	-	53.54	-34.5
4	.25125	.6	Ca	0	0	9.3	9.9	-	-	51.72	-41.82
6	.34125	-3.74	Ca	0	0	9.3	5.56	-	-	49.17	-43.61
8	.68325	-8.42	Ca	0	0	9.3	.88	-	-	46	-45.12
10	1.84875	-3.7	Ca	0	.1	9.3	5.7	-	-	46	-40.3
12	27.82275	2.67	Ca	0	.3	9.4	12.37	-	-	50	-37.63
1	.18825	27.16	Qp	0	0	9.4	36.56	64.11	-27.55	-	-
3	.25125	18.28	Qp	0	0	9.3	27.58	61.72	-34.14	-	-
5	.32775	12.98	Qp	0	0	9.3	22.28	59.51	-37.23	-	-
7	.69	.74	Qp	0	0	9.3	10.04	56	-45.96	-	-
9	1.851	6.76	Qp	0	.1	9.3	16.16	56	-39.84	-	-
11	27.8205	8.13	Qp	0	.3	9.4	17.83	60	-42.17	-	-

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	.20175	9.44	Ca	0	0	9.3	18.74	-	-	53.54	-34.8
16	.25125	.84	Ca	0	0	9.3	10.14	-	-	51.72	-41.58
18	.34125	-3.35	Ca	0	0	9.3	5.95	-	-	49.17	-43.22
20	.6855	-6.1	Ca	0	0	9.3	3.2	-	-	46	-42.8
22	1.8555	-2.66	Ca	0	.1	9.3	6.74	-	-	46	-39.26
24	27.7935	3.29	Ca	.1	.3	9.4	13.09	-	-	50	-36.91
13	.18825	27.17	Qp	0	0	9.4	36.57	64.11	-27.54	-	-
15	.222	18.53	Qp	0	0	9.3	27.83	62.74	-34.91	-	-
17	.33	13.1	Qp	0	0	9.3	22.4	59.45	-37.05	-	-
19	.6855	1.64	Qp	0	0	9.3	10.94	56	-45.06	-	-
21	1.85325	8.1	Qp	0	.1	9.3	17.5	56	-38.5	-	-
23	27.79125	8.91	Qp	.1	.3	9.4	18.71	60	-41.29	-	-

Qp - Quasi-Peak detector
Ca - CISPR average detection

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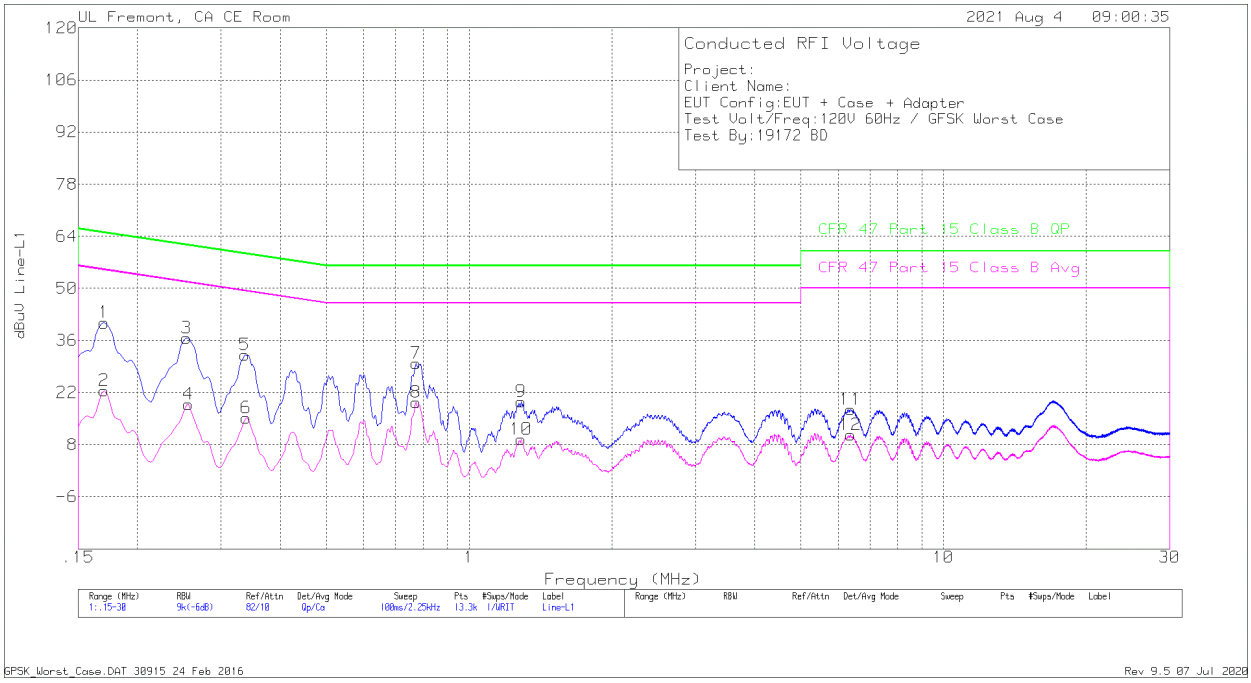
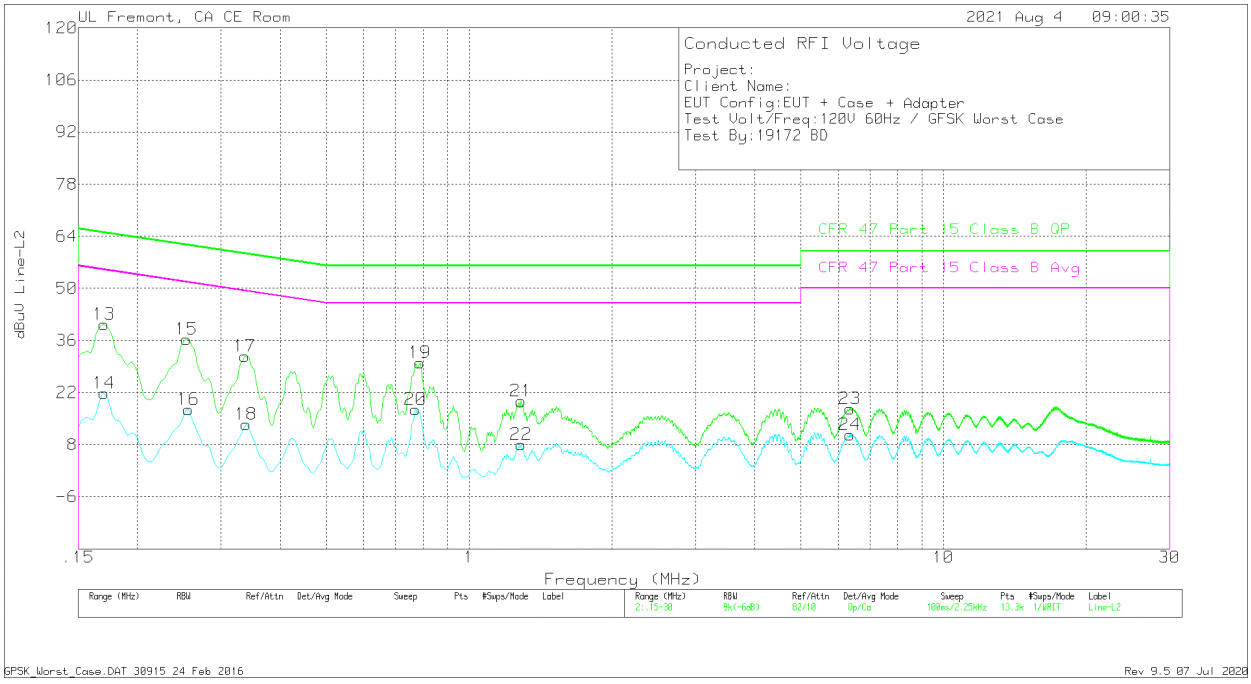
11.2. AC Power Line with AC/DC Adapter

LINE 1 RESULTS



LINE 2 RESULTS



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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	.17025	13.12	Ca	0	0	9.4	22.52	-	-	54.95	-32.43
4	.25575	9.59	Ca	0	0	9.3	18.89	-	-	51.57	-32.68
6	.339	5.83	Ca	0	0	9.3	15.13	-	-	49.23	-34.1
8	.77325	9.98	Ca	0	.1	9.3	19.38	-	-	46	-26.62
10	1.2885	.05	Ca	0	.1	9.3	9.45	-	-	46	-36.55
12	6.37575	1.19	Ca	0	.1	9.3	10.59	-	-	50	-39.41
1	.17025	31.35	Qp	0	0	9.4	40.75	64.95	-24.2	-	-
3	.2535	27.4	Qp	0	0	9.3	36.7	61.64	-24.94	-	-
5	.33675	22.86	Qp	0	0	9.3	32.16	59.28	-27.12	-	-
7	.77325	20.47	Qp	0	.1	9.3	29.87	56	-26.13	-	-
9	1.2885	10.15	Qp	0	.1	9.3	19.55	56	-36.45	-	-
11	6.37575	8.12	Qp	0	.1	9.3	17.52	60	-42.48	-	-

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	.17025	12.39	Ca	0	0	9.4	21.79	-	-	54.95	-33.16
16	.25575	8.19	Ca	0	0	9.3	17.49	-	-	51.57	-34.08
18	.339	4.07	Ca	0	0	9.3	13.37	-	-	49.23	-35.86
20	.771	8.14	Ca	0	0	9.3	17.44	-	-	46	-28.56
22	1.28625	-1.31	Ca	0	.1	9.3	8.09	-	-	46	-37.91
24	6.3555	1.2	Ca	0	.1	9.3	10.6	-	-	50	-39.4
13	.17025	30.96	Qp	0	0	9.4	40.36	64.95	-24.59	-	-
15	.2535	27.01	Qp	0	0	9.3	36.31	61.64	-25.33	-	-
17	.33675	22.5	Qp	0	0	9.3	31.8	59.28	-27.48	-	-
19	.789	20.78	Qp	0	0	9.3	30.08	56	-25.92	-	-
21	1.28625	10.24	Qp	0	.1	9.3	19.64	56	-36.36	-	-
23	6.35325	8.26	Qp	0	.1	9.3	17.66	60	-42.34	-	-

Qp - Quasi-Peak detector
Ca - CISPR average detection

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12. SETUP PHOTOS

Please refer to 13685813-EP1V1 for setup photos

END OF TEST REPORT

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