CERTIFICATION TEST REPORT

Report Number. : 12790786-E1V3

Applicant : PLANTRONICS INC.
345 ENCINAL ST
SANTA CRUZ, CA 95060 U.S.A.

Model : CB4222 D, CB4222 CD, CB4222-M CD, CB5232 D, CB5232 CD, CB5232-M CD

FCC ID : AL8-CBX2X2

IC : 457A-CBX2X2

EUT Description : BLUETOOTH BASE

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

Date Of Issue:
July 19, 2019

Prepared by:
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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	7/2/2019	Initial Issue	
V2	7/8/2019	Updated number of pulses	Tri Pham
V3	7/19/2019	Updated worst case config	Tri Pham

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: PLANTRONICS INC.
345 ENCINAL ST
SANTA CRUZ, CA 95060 U.S.A.

EUT DESCRIPTION: BLUETOOTH BASE

MODEL: CB4222 D, CB4222 CD, CB4222-M CD, CB5232 D, CB5232 CD, CB5232-M CD

SERIAL NUMBER: 143P29 (CB4222-CD conducted)
143PD5 (CB4222-CD Radiated)

DATE TESTED: May 30, 2019 – June 24, 2019

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

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r01, RSS-GEN Issue 5, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd
☐ Chamber A	☐ Chamber D	☒ Chamber I
☐ Chamber B	☐ Chamber E	☐ Chamber J
☐ Chamber C	☐ Chamber F	☐ Chamber K
	☐ Chamber G	☐ Chamber L
	☐ Chamber H	☐ Chamber M

The above test sites and facilities are covered under FCC Test Firm Registration # 208313 and Industry Canada ISED Site Code: 2324A.

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

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. 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

4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a Bluetooth Base.

5.2. DESCRIPTION OF MODELS DIFFERENCES

Client specified all models in the product family are electrically identical. Power measurements were performed on both CB5200-CD and CB4222-CD and it was determined that the CB4222-CD was worst case. Therefore testing was performed on the CB4222-CD to represent the family.

5.3. 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	15.45	35.08
2402 - 2480	Enhanced DQPSK	10.53	11.30
2402 - 2480	Enhanced 8PSK	10.68	11.69

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an omni directional monopole antenna, with a maximum gain of 2.85 dBi.

5.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was V204.

The test utility software used during testing was HIDTWidller Version 1.0.01 and BlueSuite 2.6.8.

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5.6. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 30MHz, 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.

Pretesting was performed for standalone and with accessories attached. It was found that standalone was worst case, therefore all tests were performed as standalone.

The fundamental of the EUT is a desktop device and was tested in normal operating conditions.

Worst-case data rates as provided by the client were:
GFSK mode: DH5 (1 Mbps)
8PSK mode: 3-DH5 (3 Mbps)

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC/DC Adapter	Plantronics	SSC-090100	N/A	N/A
BT Headset	Plantronics	203-JN0508	163CTW	N/A
Laptop	Lenovo	TP000p6A	PF1H0N1K	N/A

I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	DC	1	DC	Unshielded	1	AC/DC Adapter to Base Plug
2	Antenna	1	SMA	Unshielded	.08	To spectrum Analyzer

TEST SETUP

The EUT was tested as standalone. Test software exercised the radio card.

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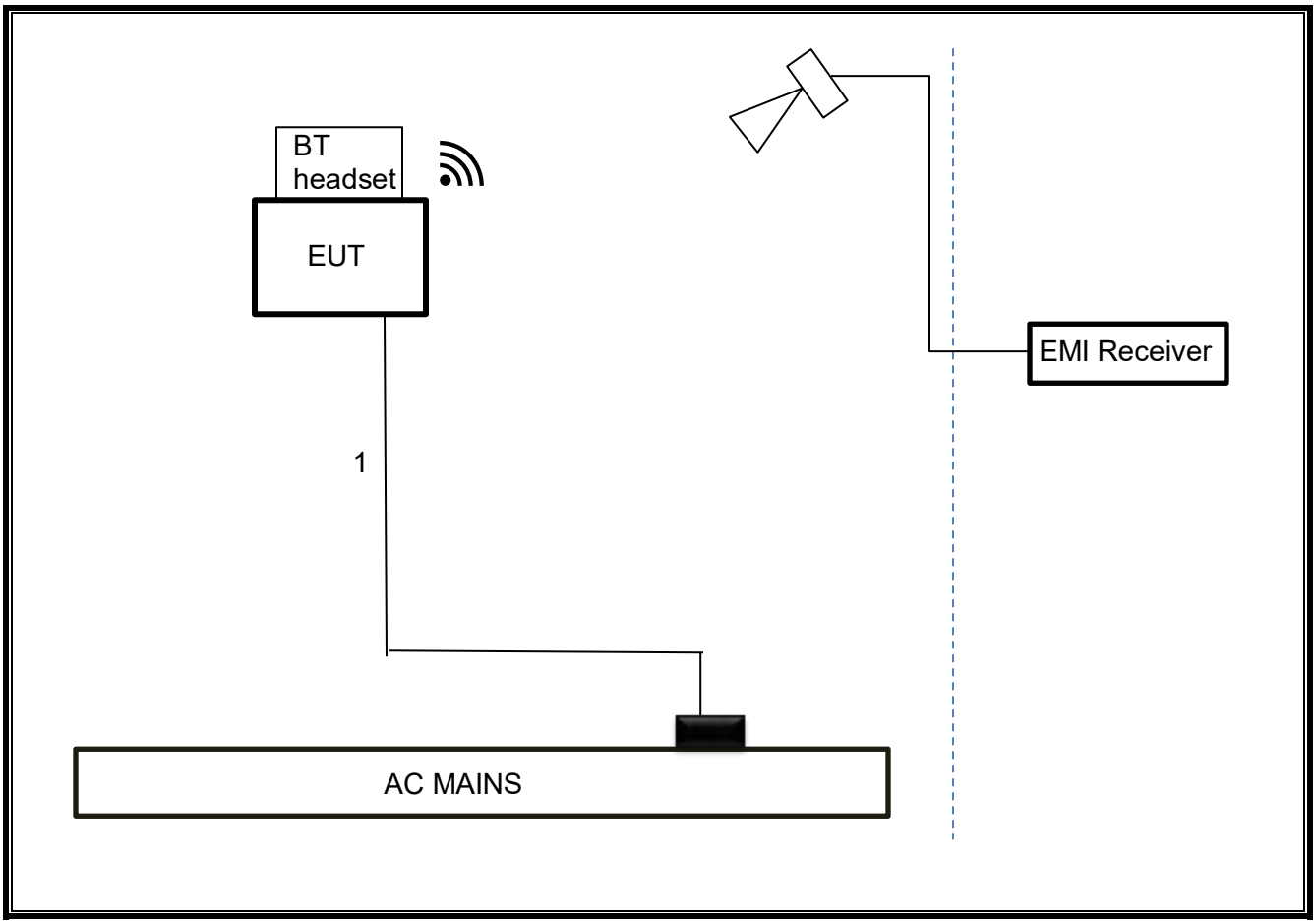
SETUP DIAGRAM: RADIATED TESTS



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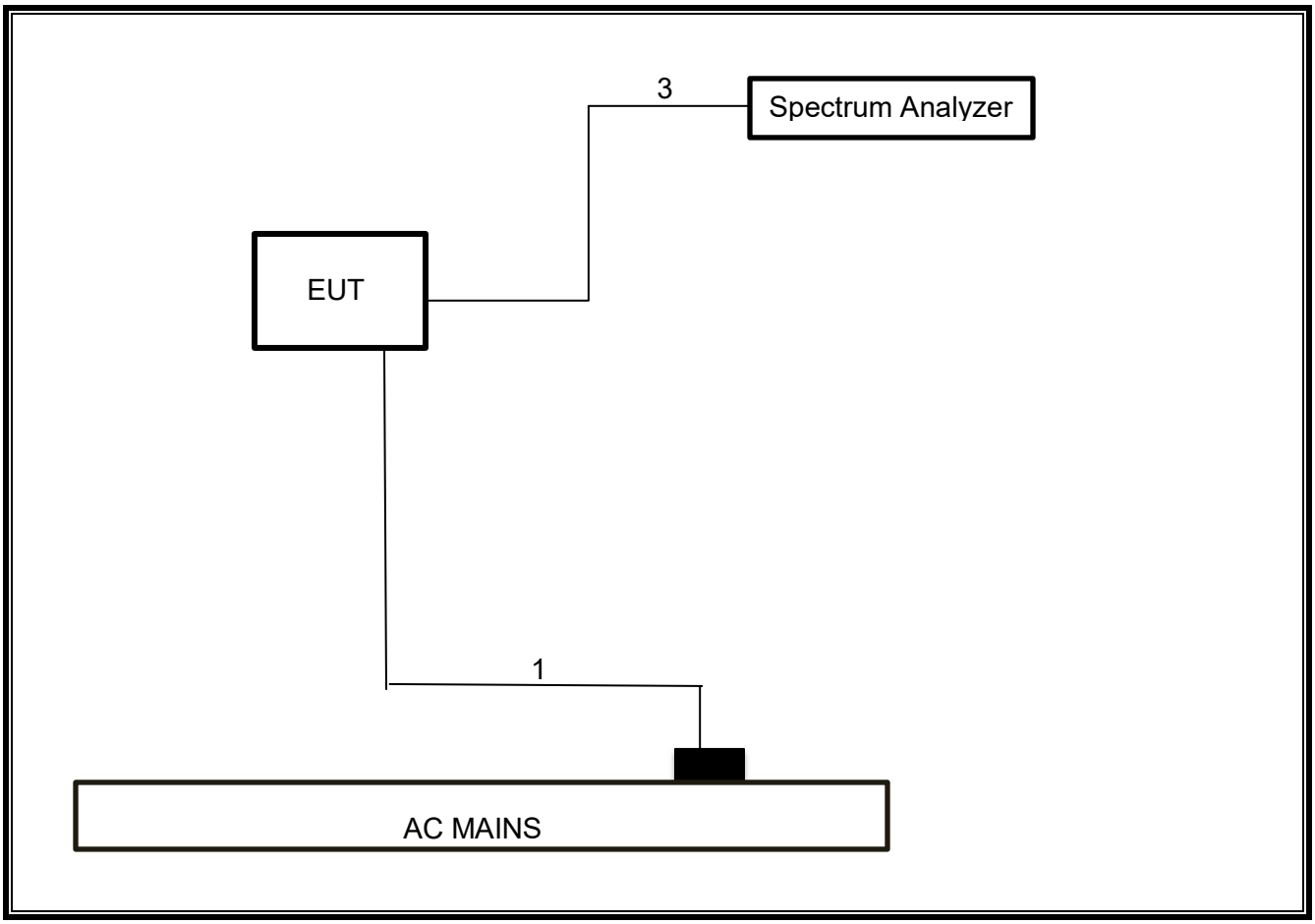
SETUP DIAGRAM: CONDUCTED TESTS



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6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179465	05/31/2020	05/31/2019
Antenna, Passive Loop 100kHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179467	05/31/2020	05/31/2019
Antenna, Double Ridge Guide Horn Antenna 700MHz to 18GHz	A.H. SYSTEMS, INC.	SAS-571	PRE0190810	07/10/2019	07/10/2017
RF Amplifier, 1-18GHz	MITEQ	AFS42-00101800-25-S-42	PRE0181078	08/01/2019	08/01/2018
Hybrid Antenna, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0184971	11/13/2019	11/13/2018
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180175	07/09/2019	07/09/2018
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	PRE0182188	08/29/2019	08/29/2018
Rf Amplifier, 18-26.5GHz, 60dB gain	Amplical	AMP18G26.5-60	PRE0181238	05/01/2020	05/01/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179376	02/14/2020	02/14/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T908	01/23/2020	01/23/2019
AC Line Conducted					
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020	02/14/2019
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020	01/24/2019
Test Software List					
Radiated Software	UL	UL EMC		Ver 9.5, June 22, 2018	
Antenna Port Software	UL	UL RF		Ver 9.6, April 18, 2019	
AC Line Conducted Software	UL	UL EMC		Ver 9.5, May 26, 2015	

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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

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

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

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

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

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

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	2.89	3.75	0.771	77.1%	1.13	0.346
Bluetooth 8PSK	2.90	3.75	0.773	77.3%	1.12	0.345

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DUTY CYCLE PLOTS

BLUETOOTH GFSK

BLUETOOTH 8PSK

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8.2. 20 dB AND 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

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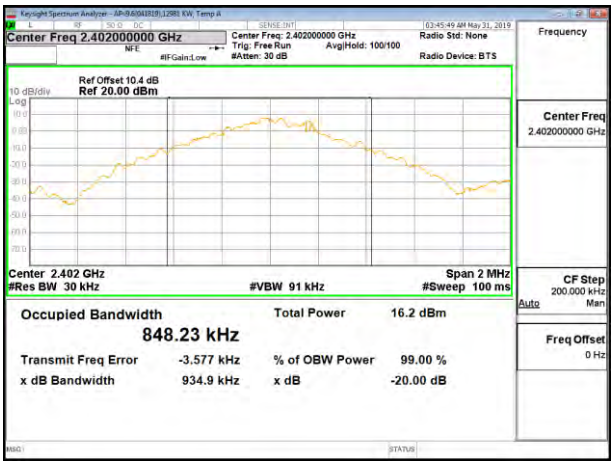
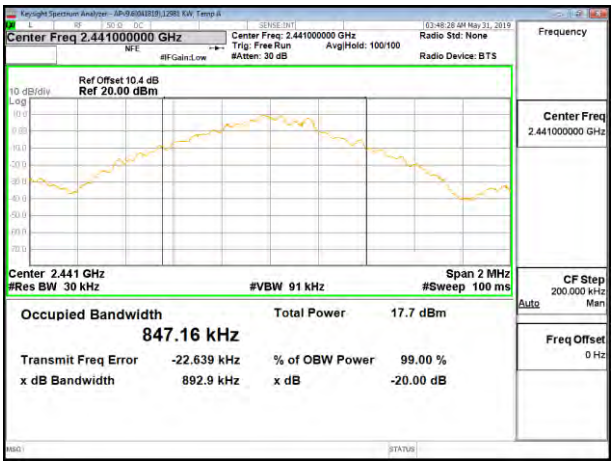
RESULTS

8.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

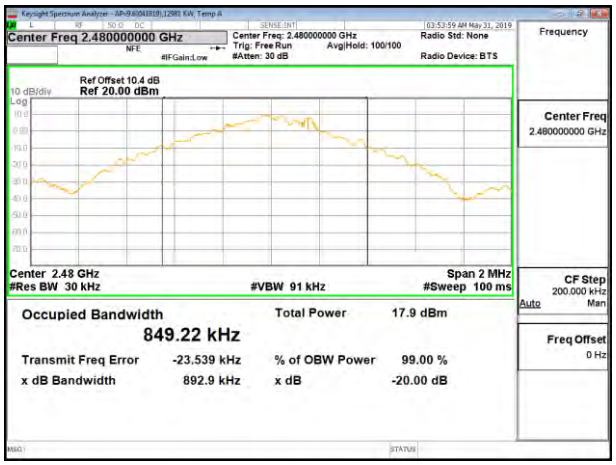
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.935	0.848
Mid	2441	0.893	0.847
High	2480	0.893	0.849



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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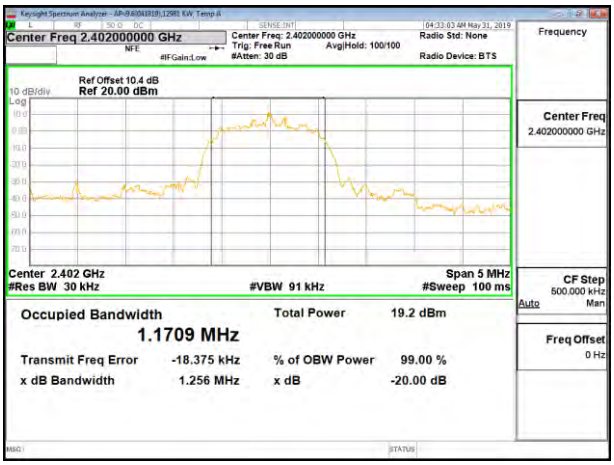
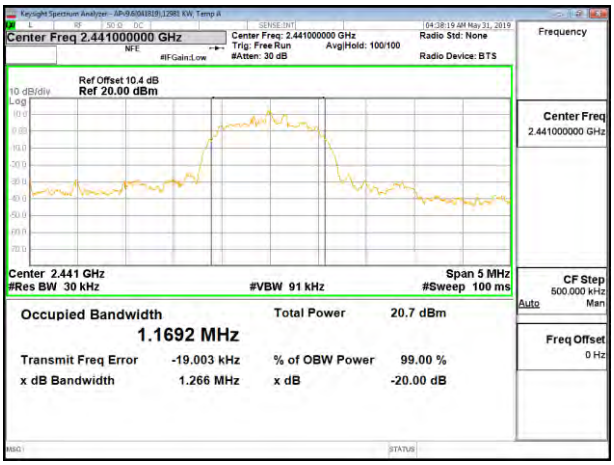
8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

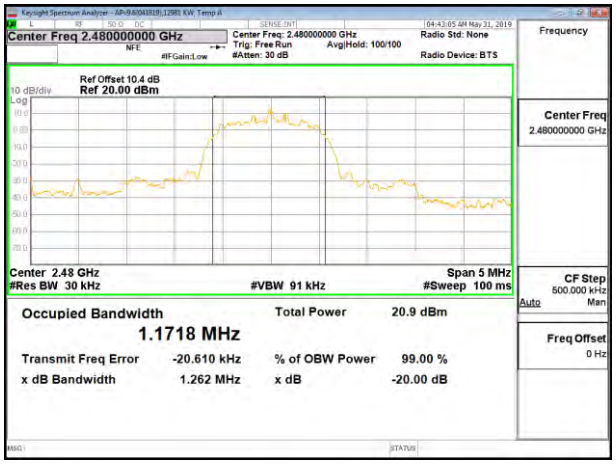
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.256	1.171
Mid	2441	1.266	1.169
High	2480	1.262	1.172



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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8.3. 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.

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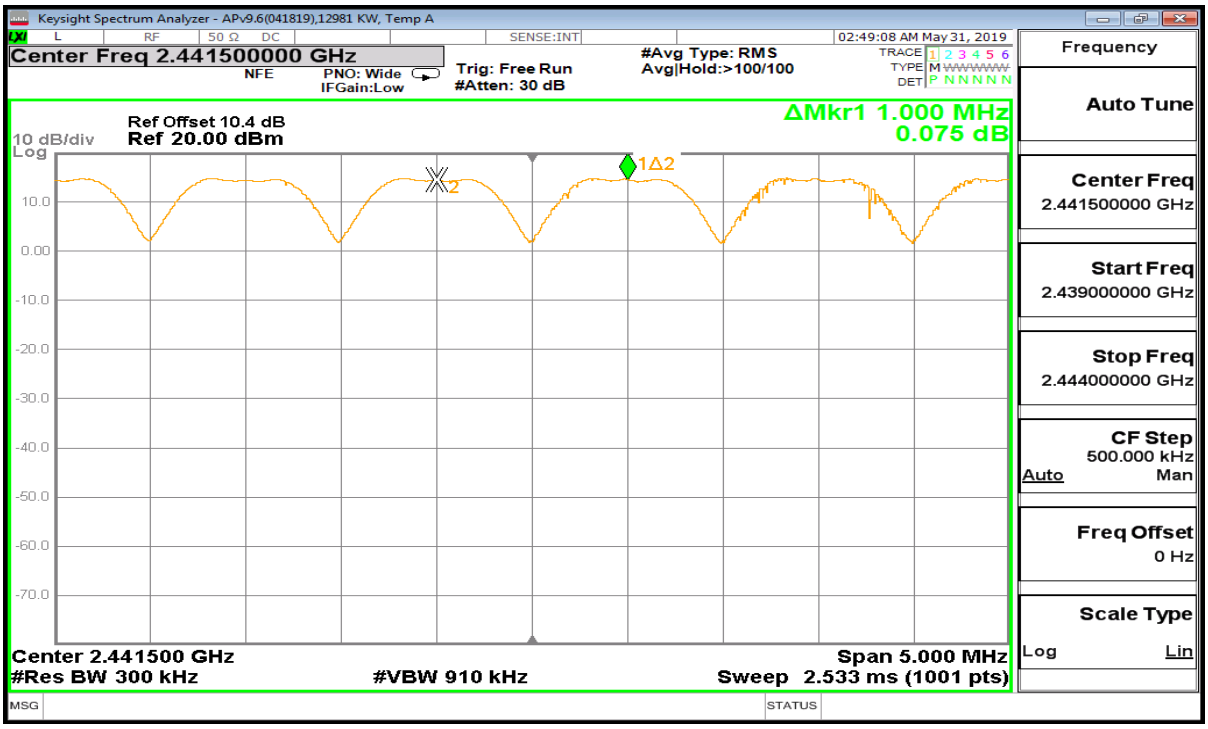
RESULTS

8.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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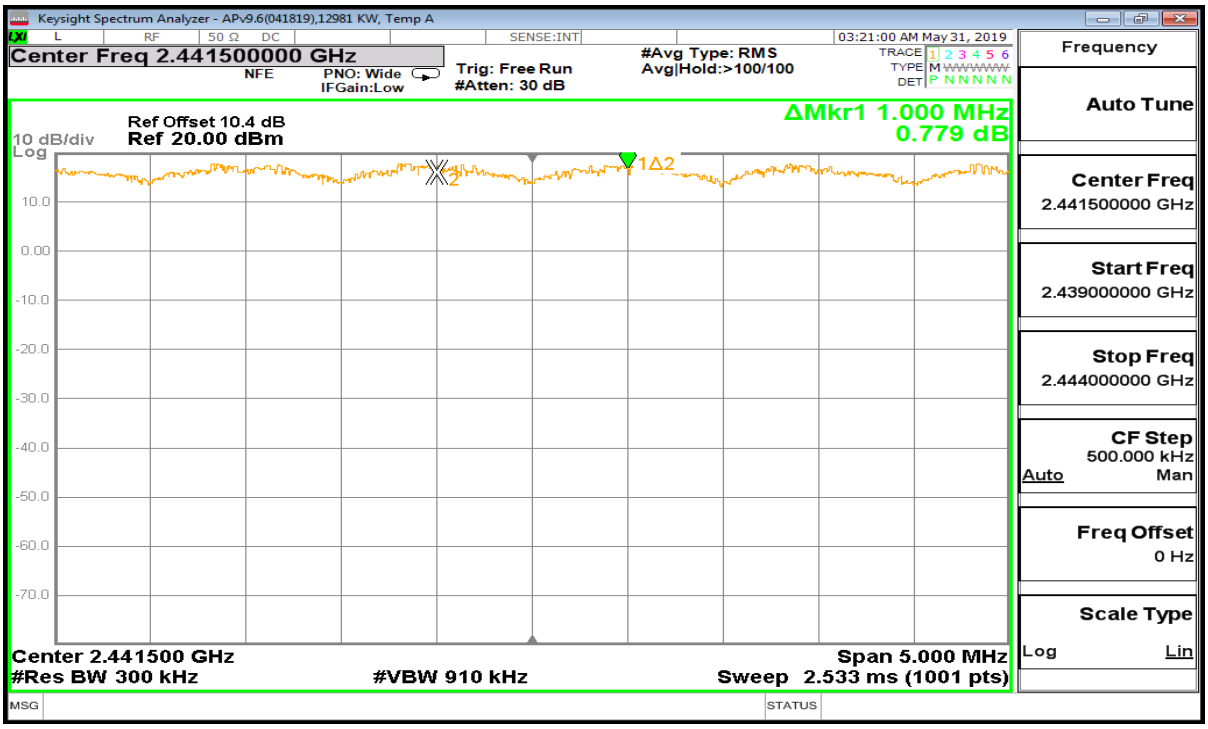
8.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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8.4. 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.

RESULTS

Normal Mode: 79 Channels Observed

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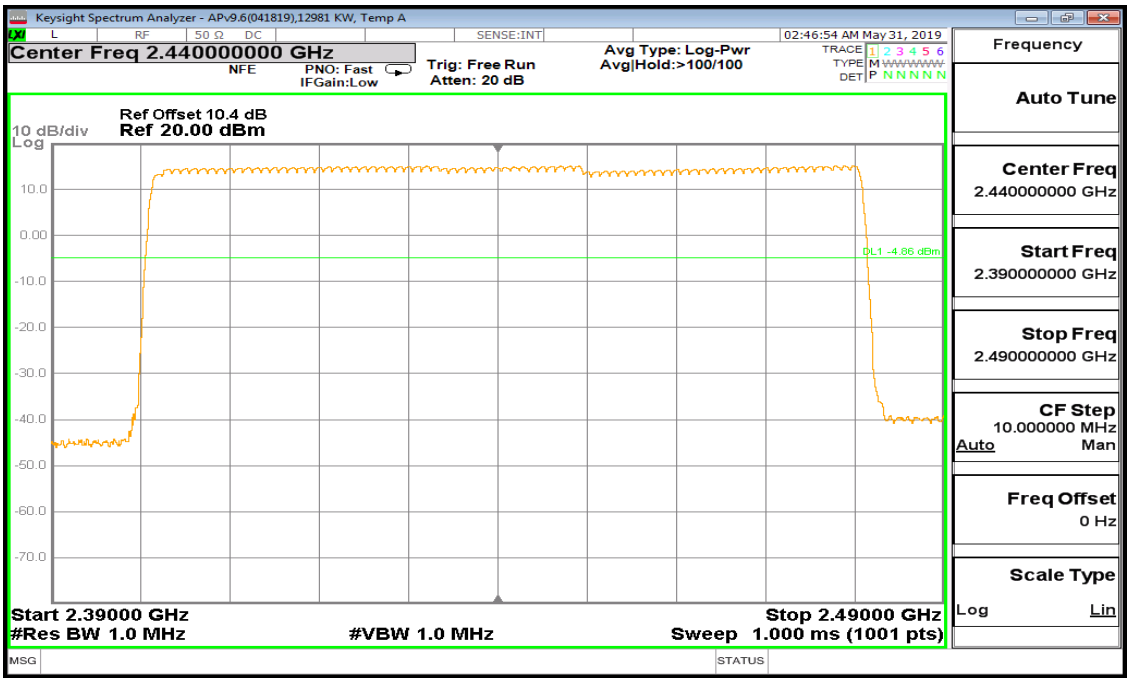
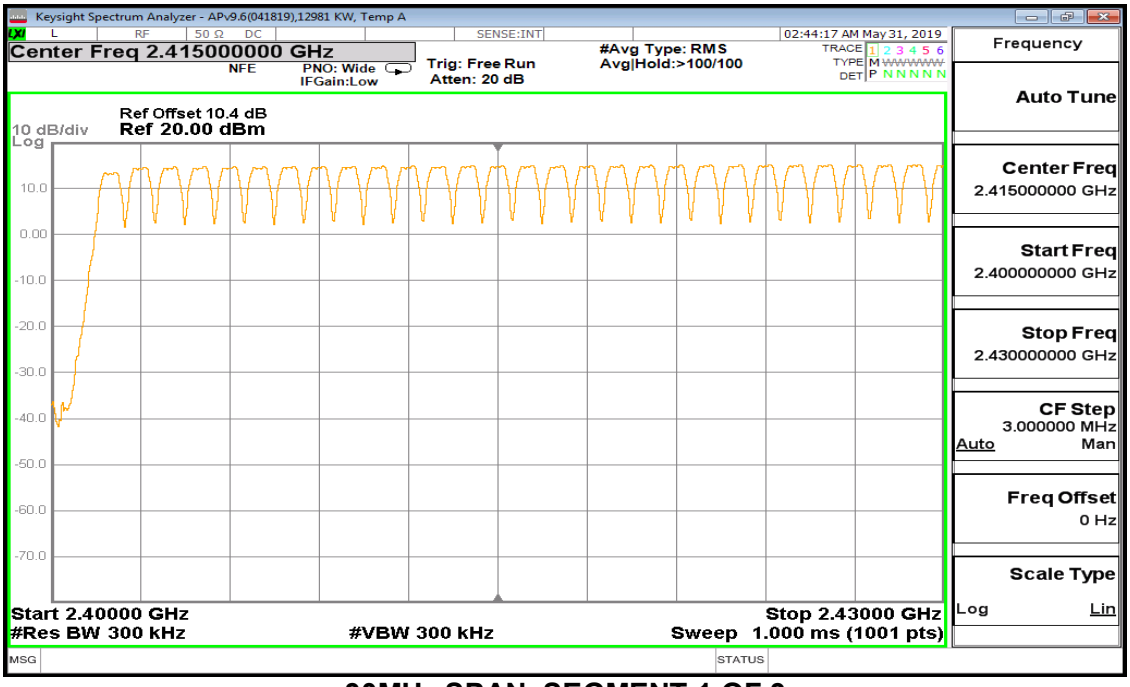
8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

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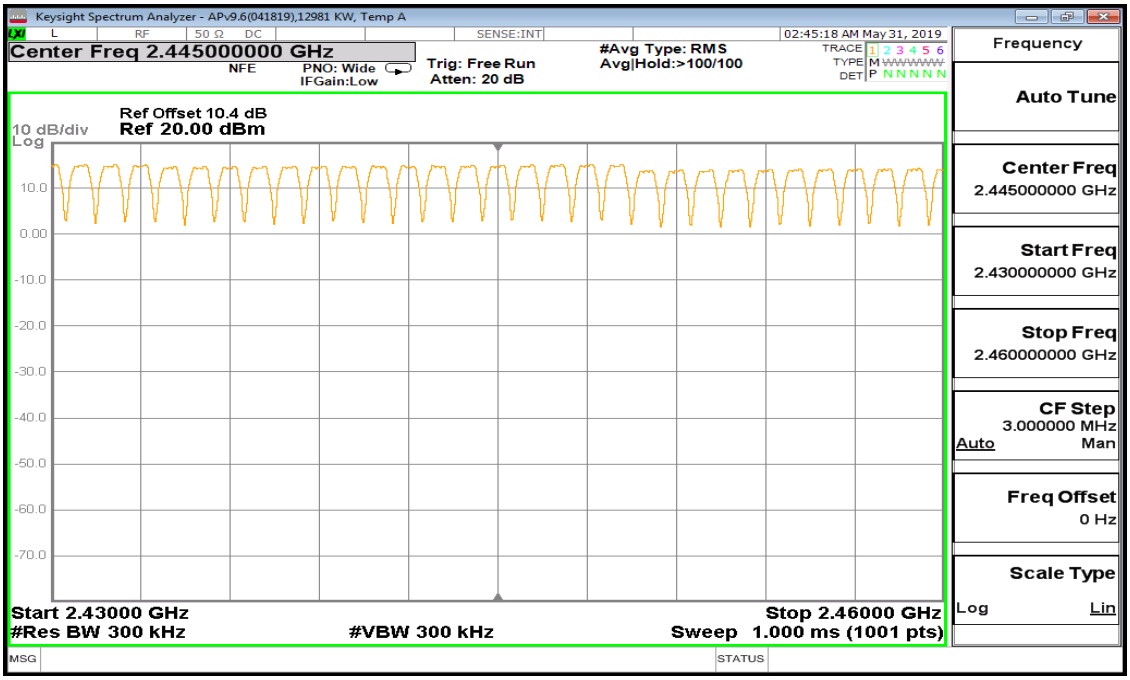
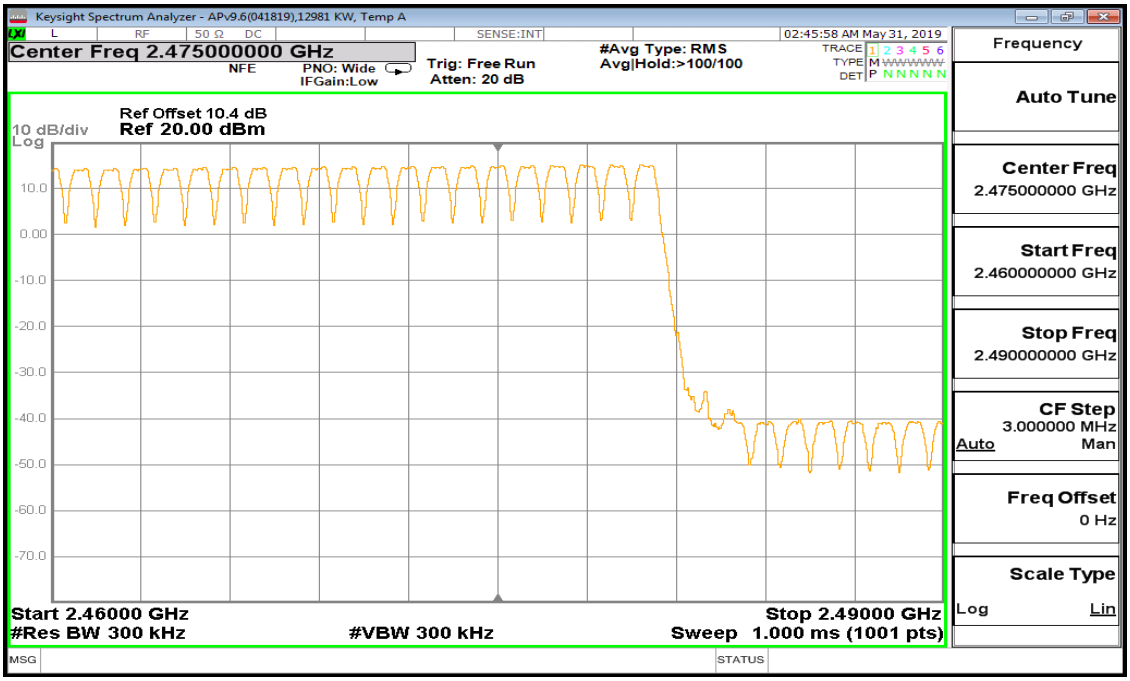


30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

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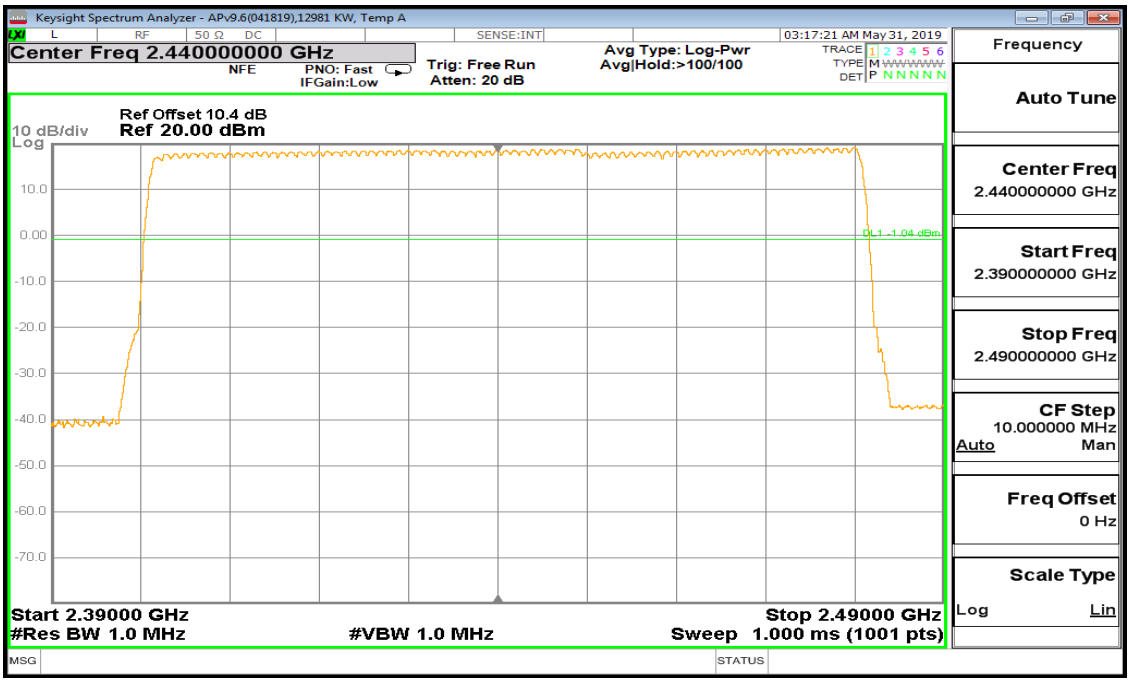
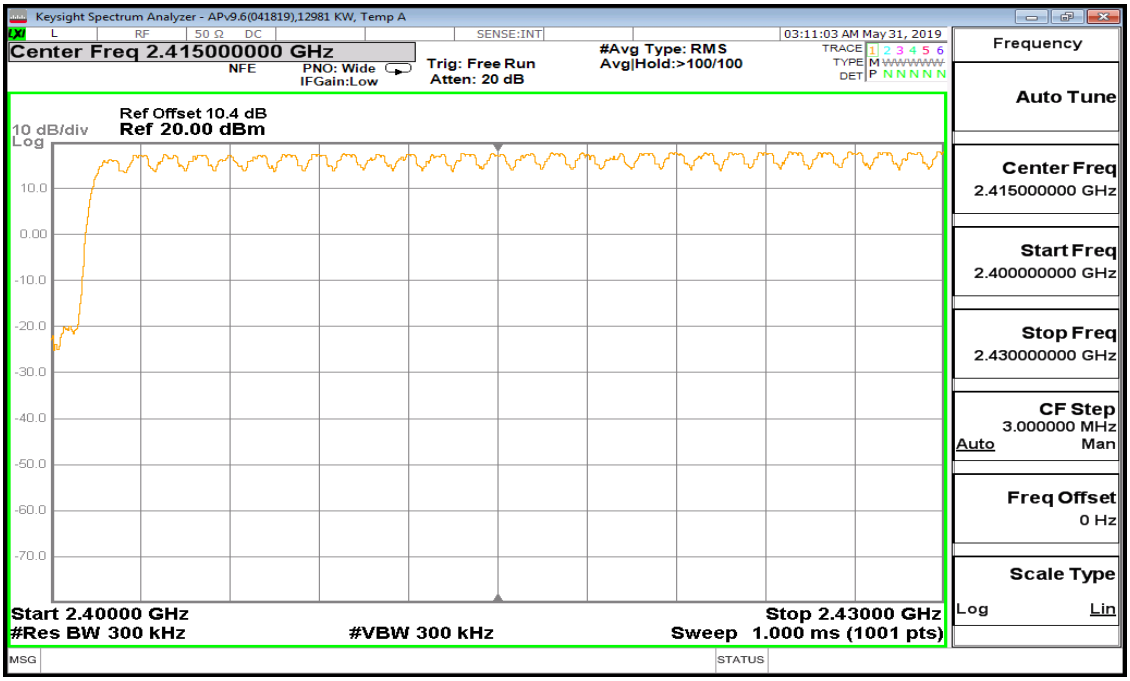
8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

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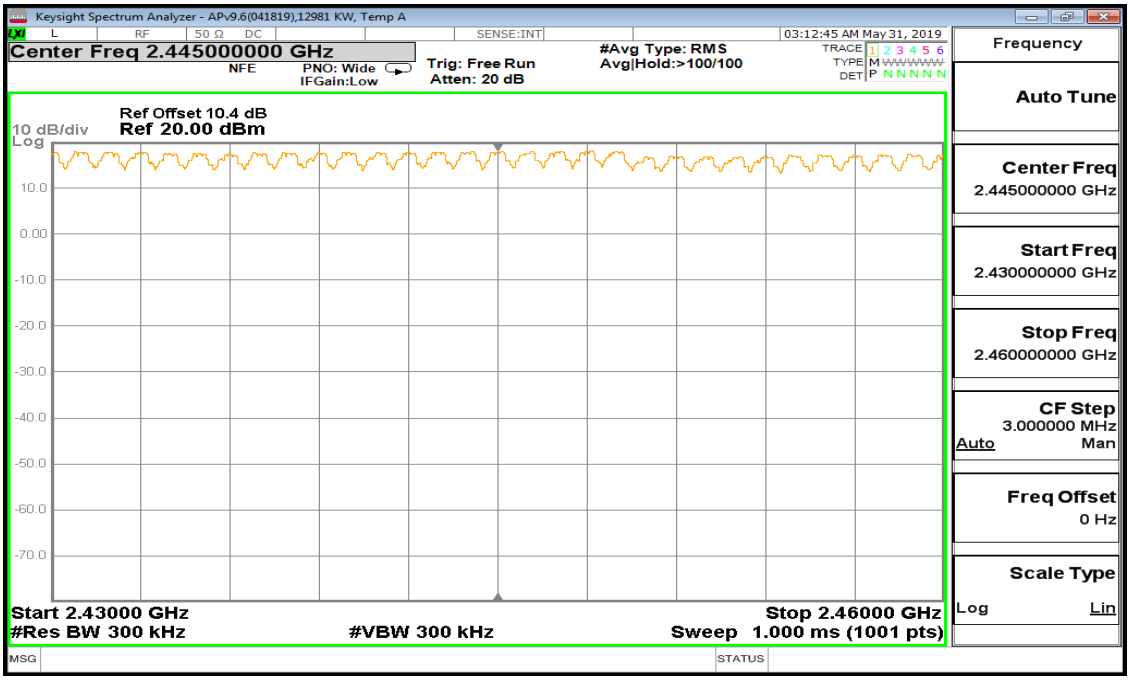
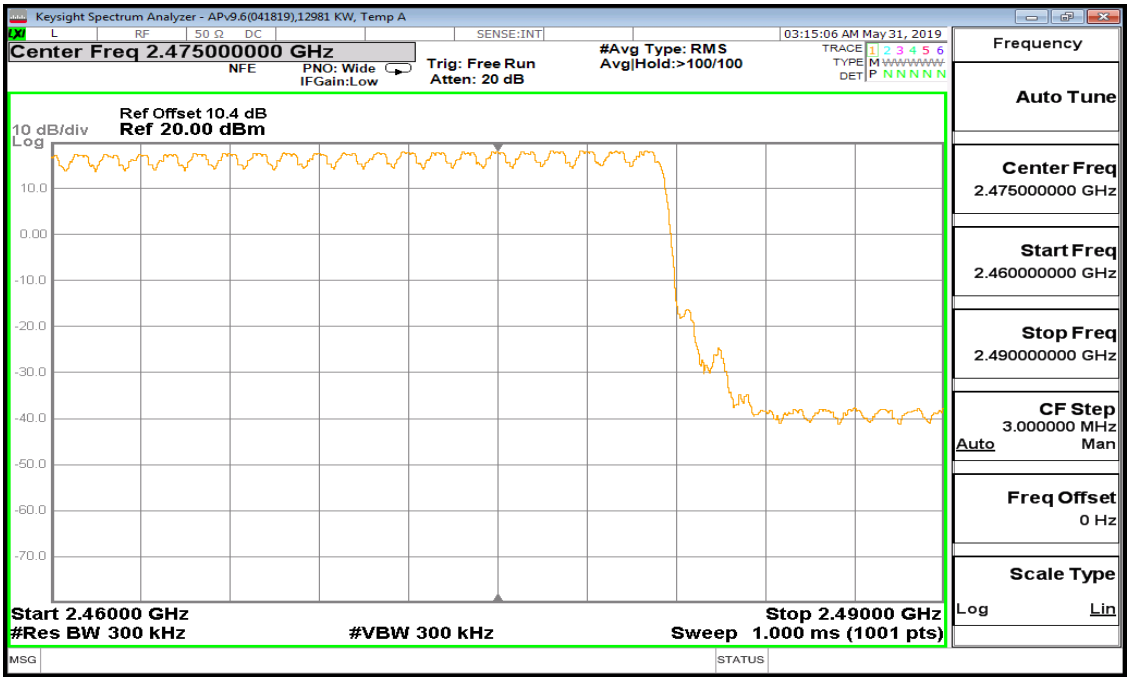


30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

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8.5. 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.

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RESULTS

8.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.4	32	0.1280	0.4	-0.2720
DH3	1.652	16	0.2643	0.4	-0.1357
DH5	2.892	10	0.2892	0.4	-0.1108
DH Packet	Pulse Width (sec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.4	8	0.03200	0.4	-0.3680
DH3	1.652	4	0.06608	0.4	-0.3339
DH5	2.892	2.5	0.07230	0.4	-0.3277

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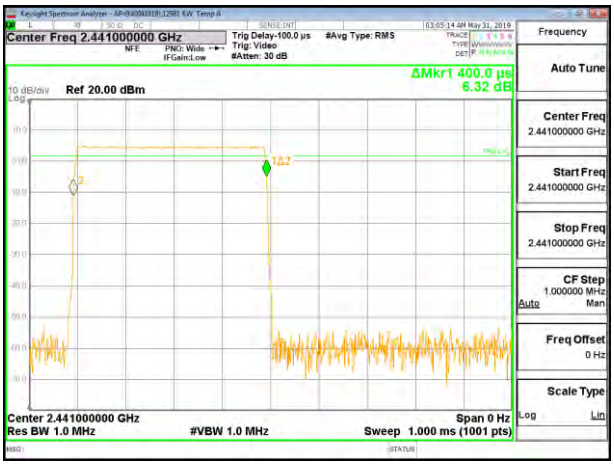
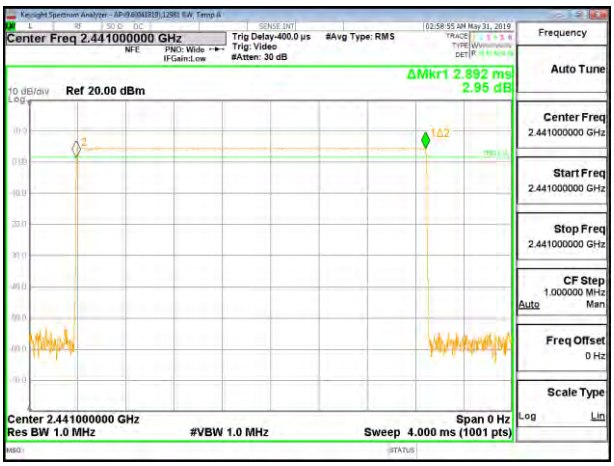
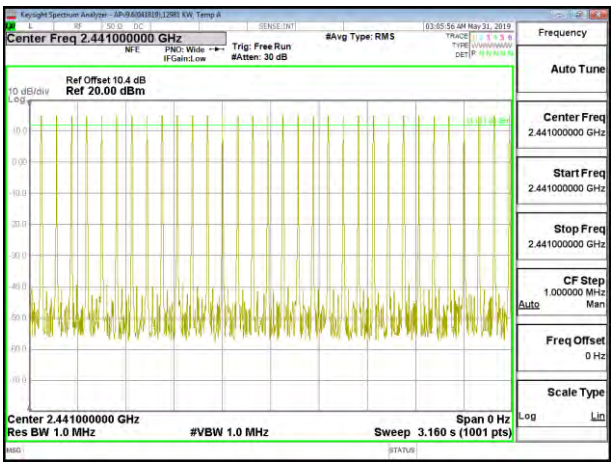


PULSE WIDTH – DH1

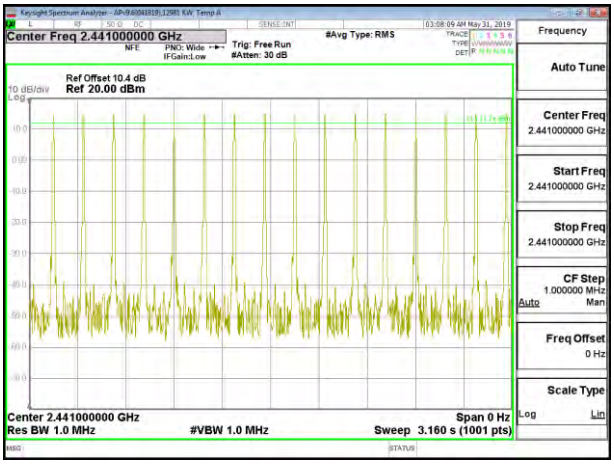
PULSE WIDTH – DH3



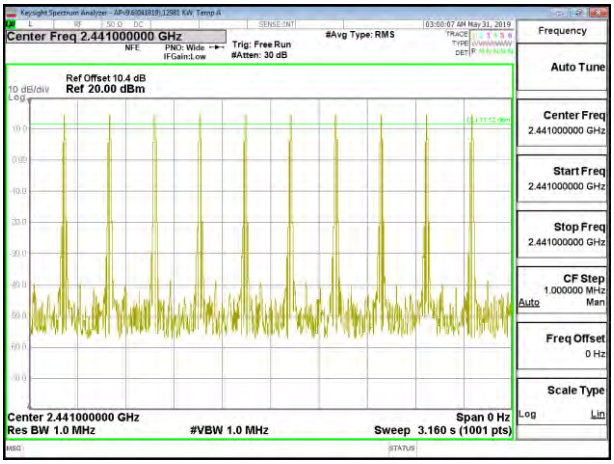
PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

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8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Normal Mode					
3DH1	0.397	32	0.12704	0.4	-0.27296
3DH3	1.656	16	0.26496	0.4	-0.13504
3DH5	2.904	11	0.31944	0.4	-0.08056

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.

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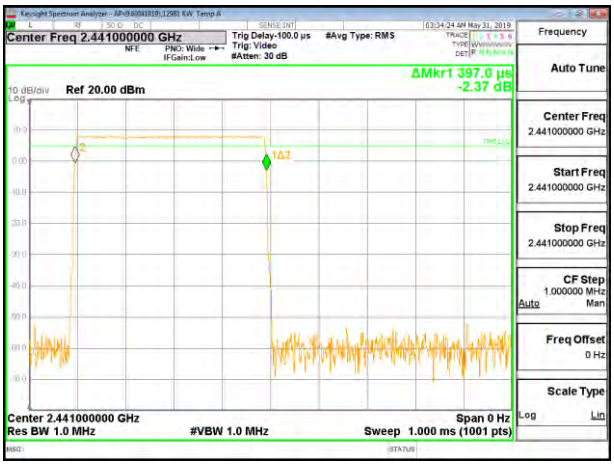
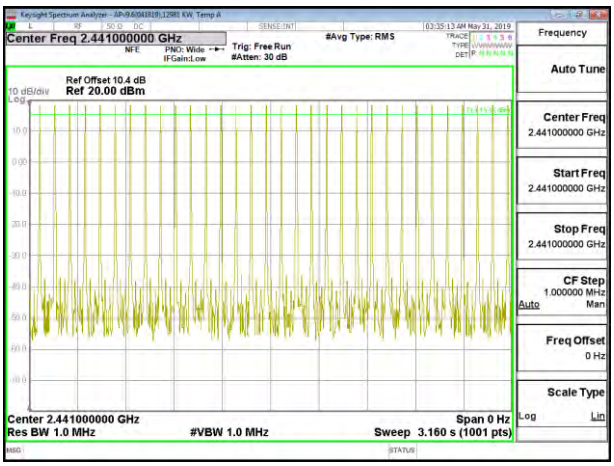


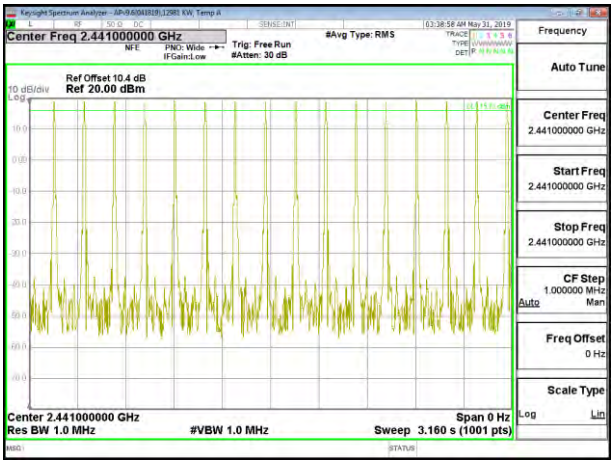
PULSE WIDTH – 3DH1

PULSE WIDTH – 3DH3

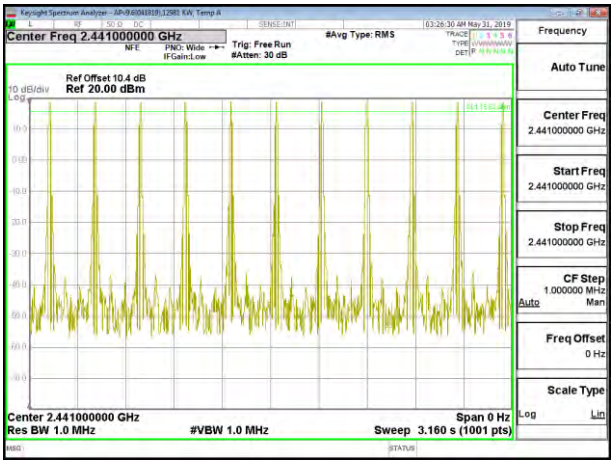
PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

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8.6. 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.

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RESULTS

8.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	12981 KW
Date:	6/24/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	13.62	30	-16.38
Middle	2441	15.20	30	-14.8
High	2480	15.45	30	-14.55

8.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	12981 KW
Date:	6/24/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.02	21	-11.98
Middle	2441	10.06	21	-10.94
High	2480	10.53	21	-10.47

8.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	12981 KW
Date:	6/24/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.20	21	-11.8
Middle	2441	10.20	21	-10.8
High	2480	10.68	21	-10.32

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8.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss of 10.4 dB (including 10 dB pad and 0.4 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

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RESULTS

8.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	12981 KW
Date	6/24/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	13.40
Middle	2441	14.91
High	2480	15.19

8.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	12981 KW
Date	6/24/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.74
Middle	2441	9.81
High	2480	10.18

8.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	12981 KW
Date	6/24/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	8.90
Middle	2441	9.95
High	2480	10.28

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8.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Limit = -20 dBc

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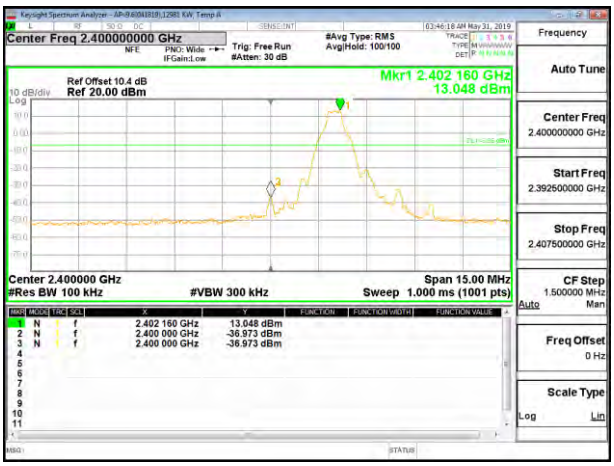
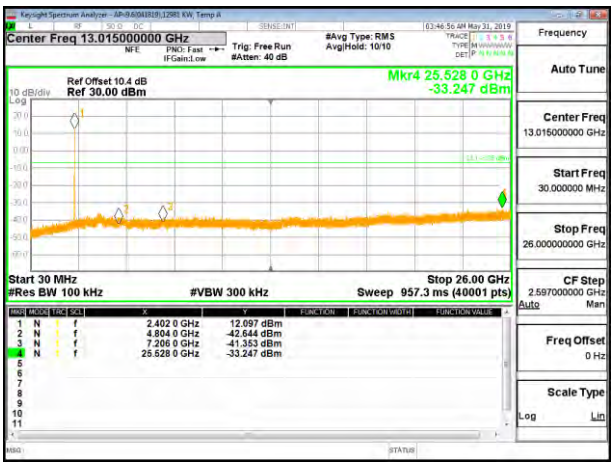
RESULTS

8.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING

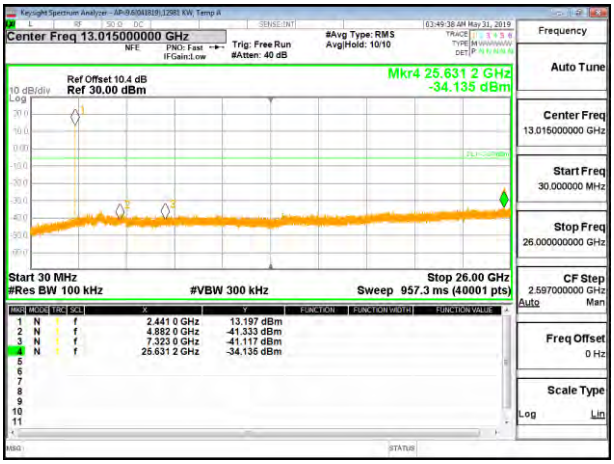


LOW CHANNEL BANDEDGE

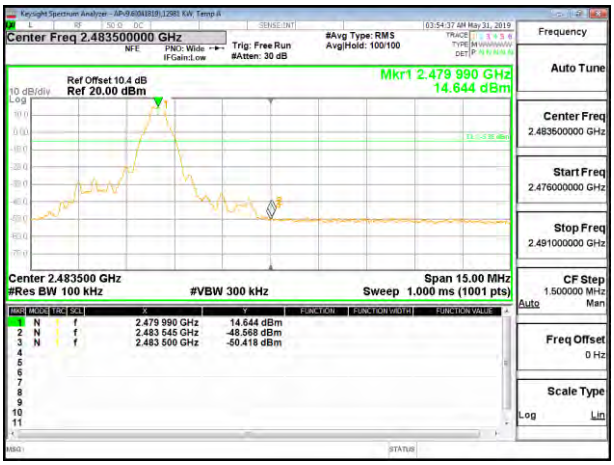


OUT-OF-BAND LOW CHANNEL

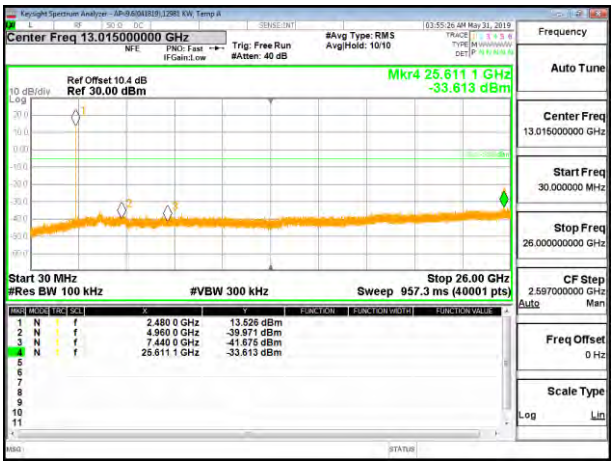
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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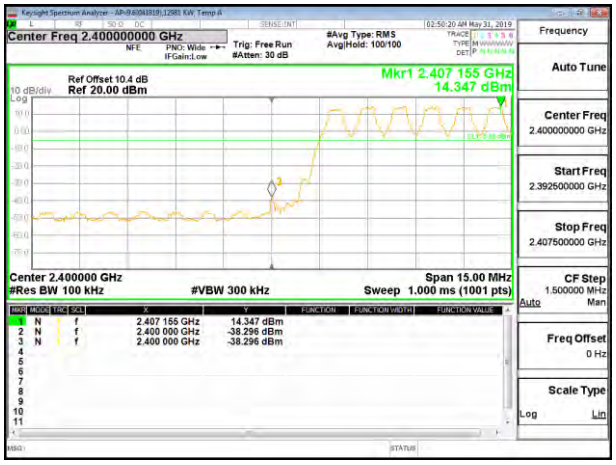
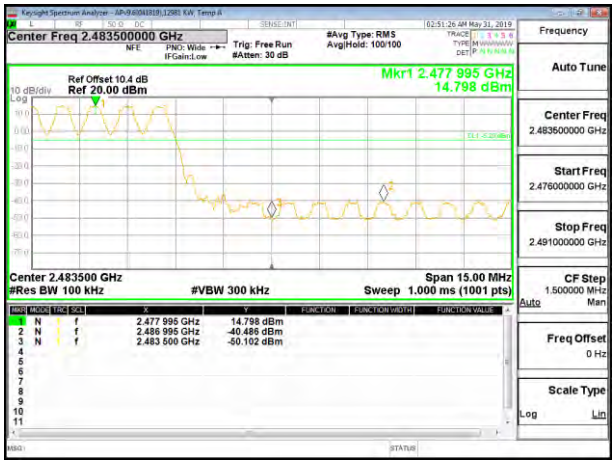
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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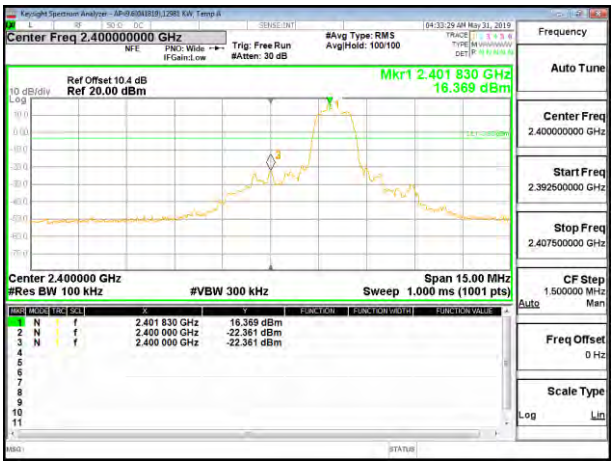
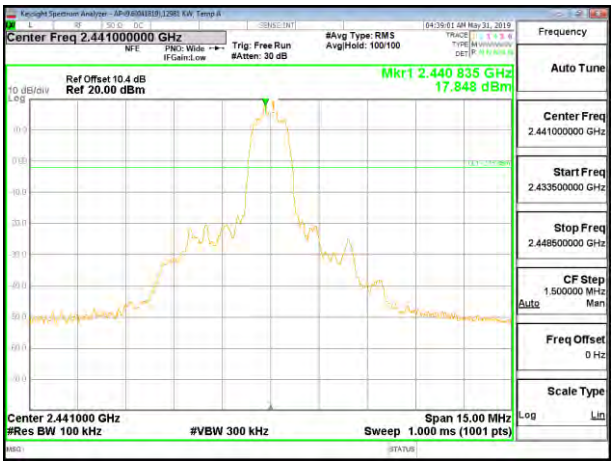
8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



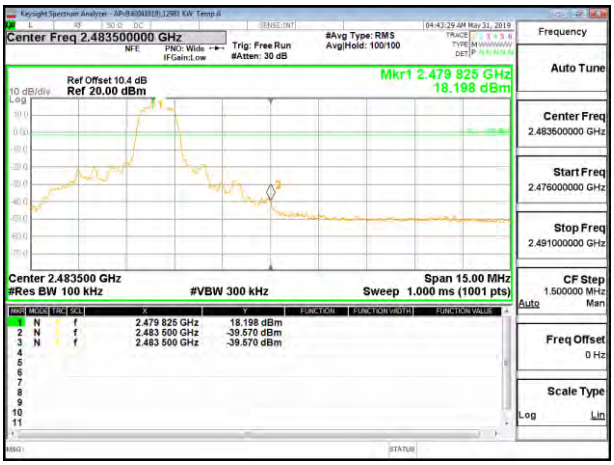
LOW CHANNEL BANDEDGE

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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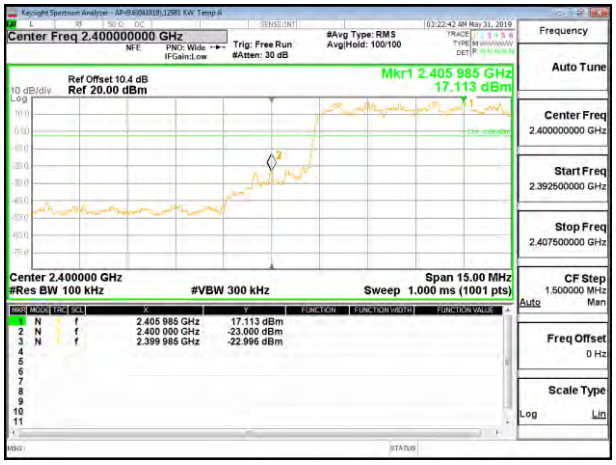
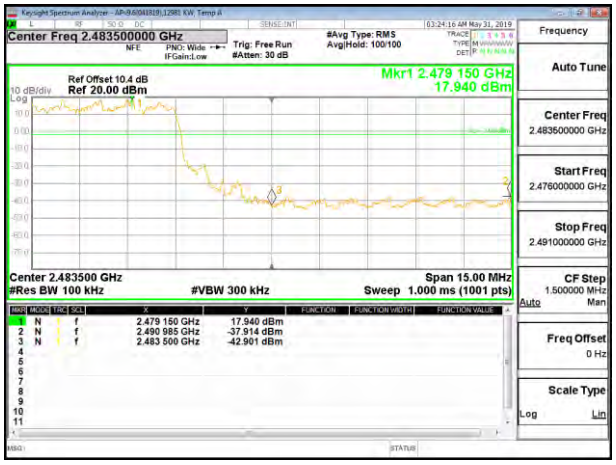
Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

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9. RADIATED EMISSIONS 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

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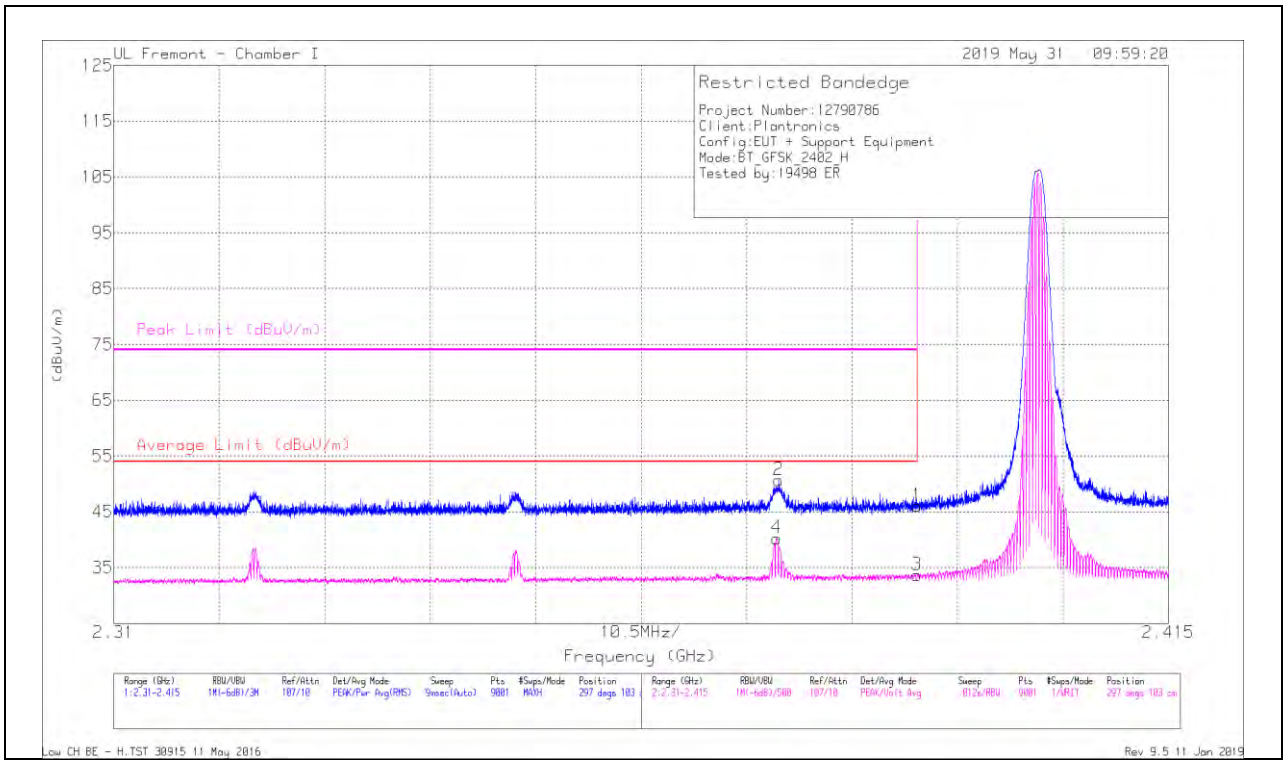
9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE019081 0 (dB/m)	Amp/Cbl/Flt r/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	38.79	Pk	28.9	-21.6	46.09	-	-	74	-27.91	297	103	H
2	2.376	43.31	Pk	28.8	-21.5	50.61	-	-	74	-23.39	297	103	H
3	2.39	26.31	VA1T	28.9	-21.6	33.61	54	-20.39	-	-	297	103	H
4	2.376	33.02	VA1T	28.8	-21.6	40.22	54	-13.78	-	-	297	103	H

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

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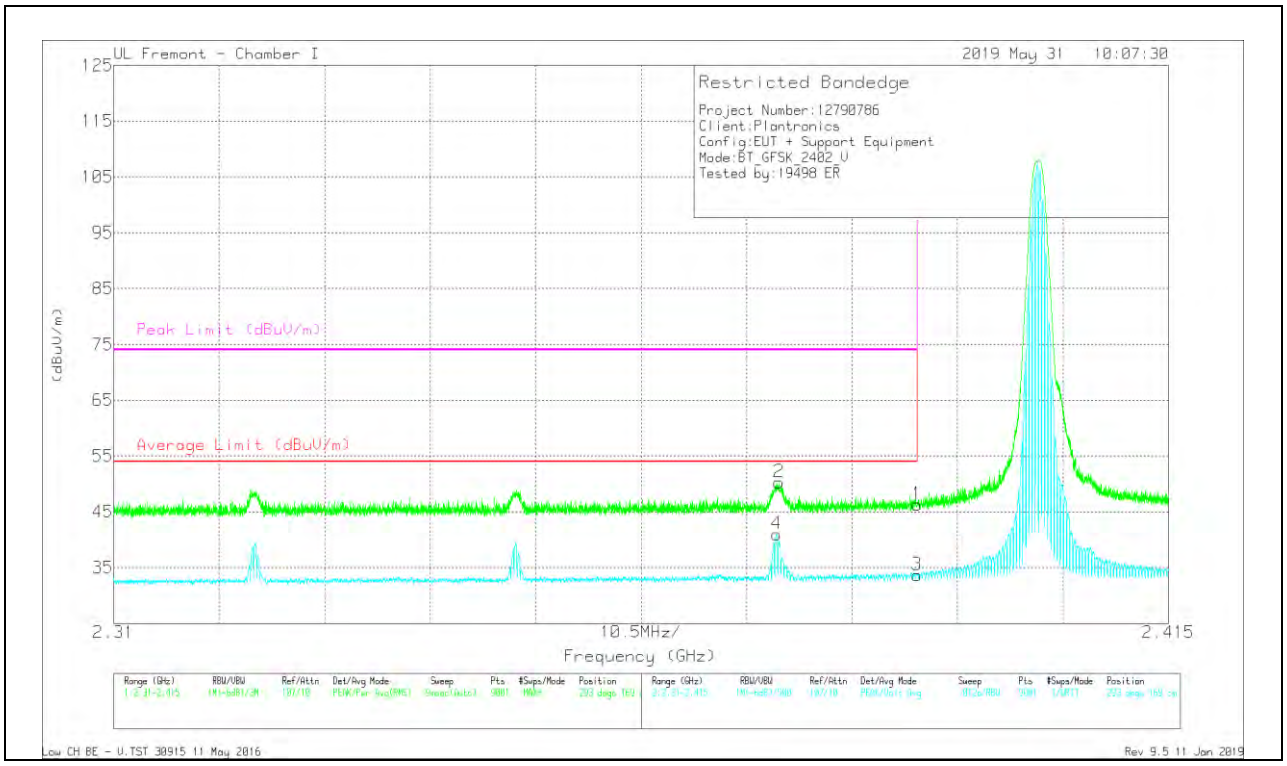
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE019081 0 (dB/m)	Amp/Cbl/Flt r/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	38.97	Pk	28.9	-21.6	46.27	-	-	74	-27.73	293	169	V
2	2.376	43	Pk	28.8	-21.5	50.3	-	-	74	-23.7	293	169	V
3	2.39	26.33	VA1T	28.9	-21.6	33.63	54	-20.37	-	-	293	169	V
4	2.376	33.76	VA1T	28.8	-21.6	40.96	54	-13.04	-	-	293	169	V

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

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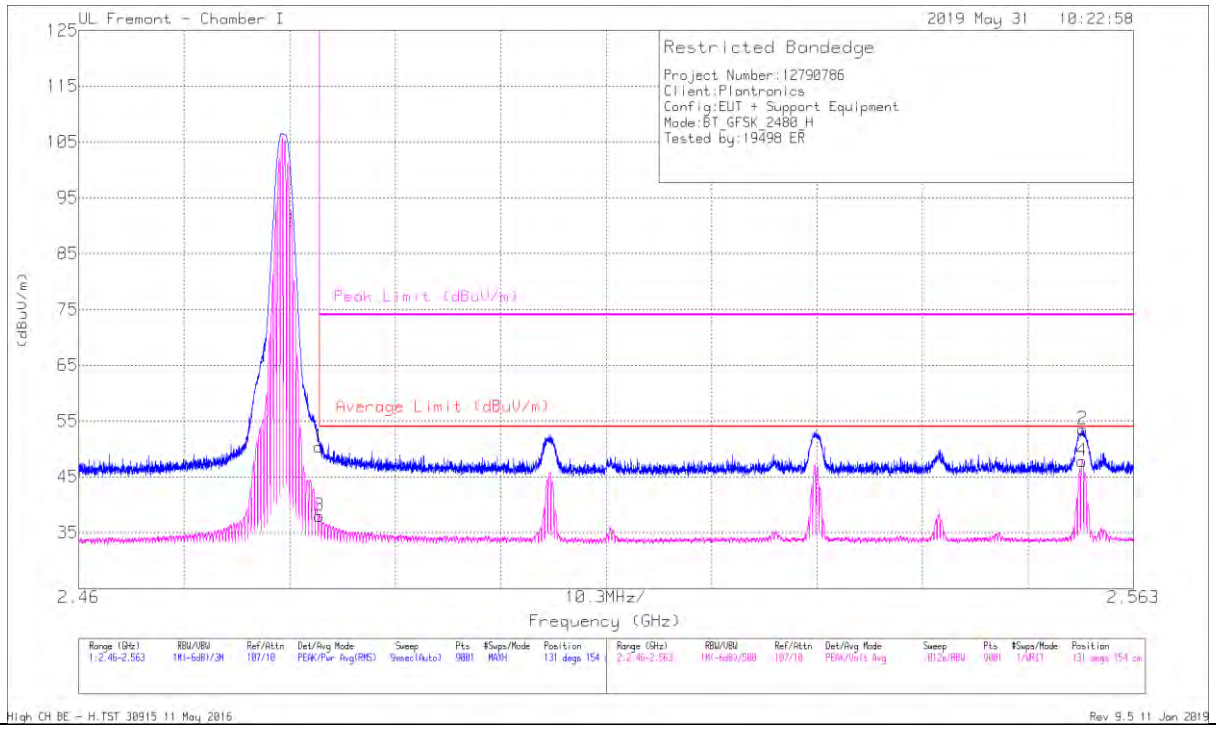
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	42.71	Pk	29.4	-21.7	50.41	-	-	74	-23.59	131	154	H
2	2.558	45.54	Pk	29.6	-21.6	53.54	-	-	74	-20.46	131	154	H
3	2.484	30.27	VA1T	29.4	-21.7	37.97	54	-16.03	-	-	131	154	H
4	2.558	39.78	VA1T	29.6	-21.6	47.78	54	-6.22	-	-	131	154	H

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

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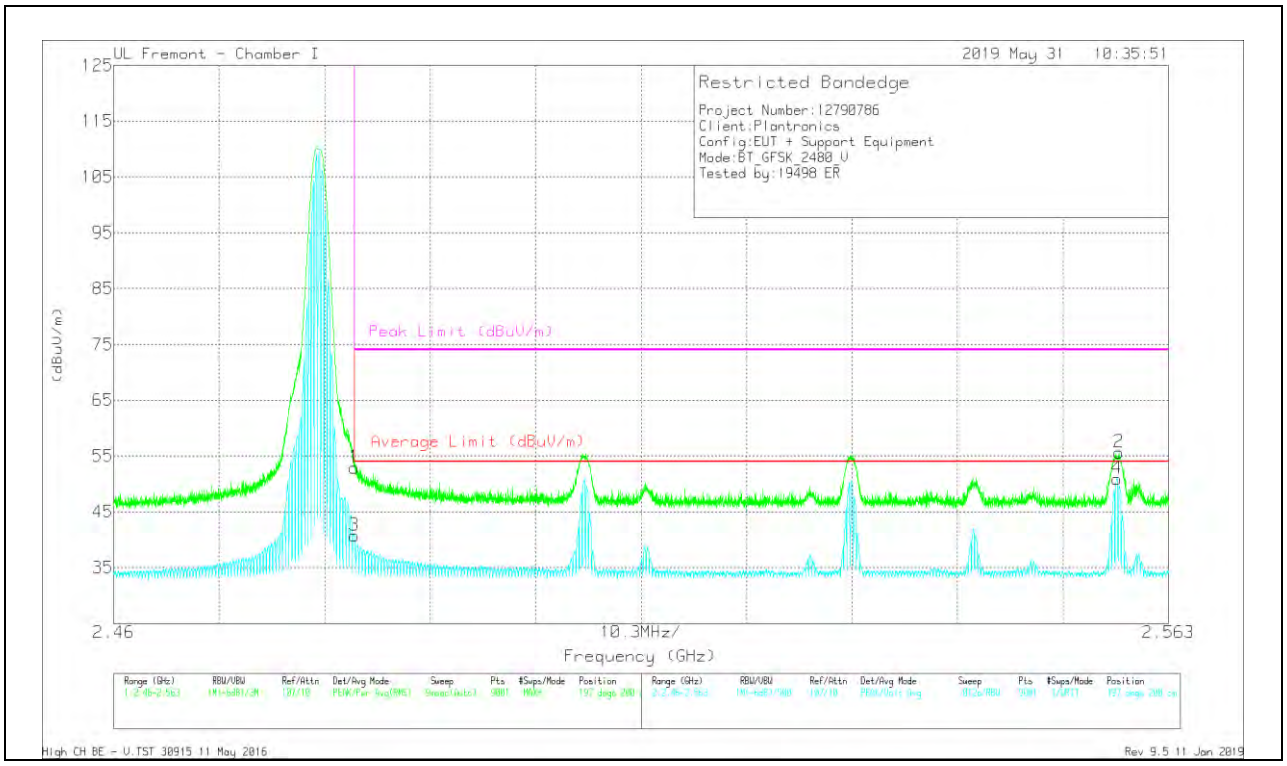
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (dB/m)	Amp/Cbl/Flt r/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	2.484	45.17	Pk	29.4	-21.7	52.87	-	-	74	-21.13	197	200	V
2	2.558	47.6	Pk	29.6	-21.6	55.6	-	-	74	-18.4	197	200	V
3	2.484	33	VA1T	29.4	-21.7	40.7	54	-13.3	-	-	197	200	V
4	2.558	42.86	VA1T	29.6	-21.6	50.86	54	-3.14	-	-	197	200	V

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

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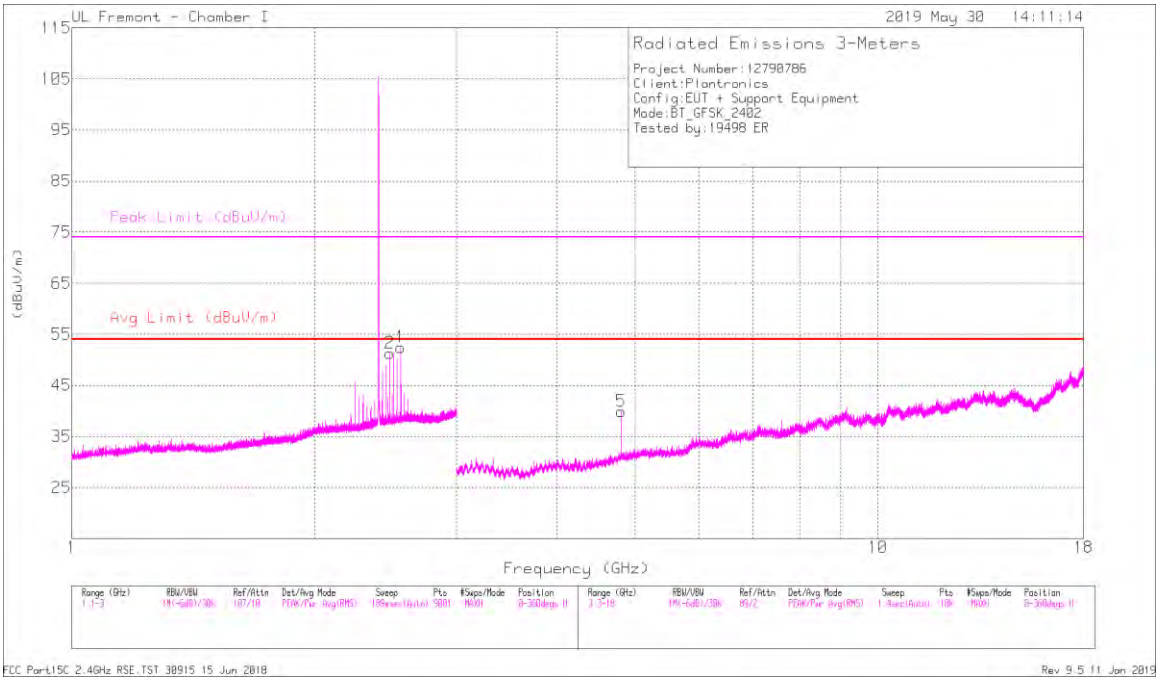
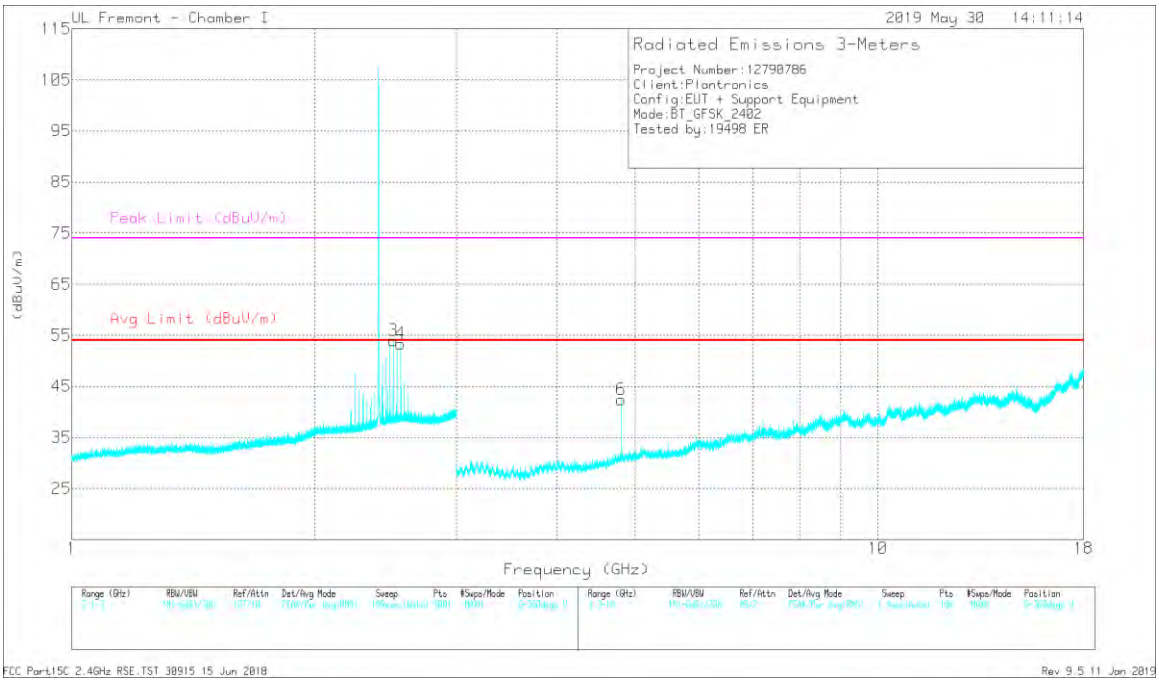
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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
2.558	46.95	PKFH	29.6	-21.6	54.95	-	-	-	-	86	244	H
2.48	46.92	PKFH	29.4	-21.7	54.62	-	-	-	-	246	184	H
2.506	48.5	PKFH	29.5	-21.8	56.2	-	-	-	-	200	136	V
2.558	48.44	PKFH	29.6	-21.6	56.44	-	-	-	-	200	126	V
* 4.804	39.63	PKFH	33.1	-28	44.73	-	-	74	-29.27	89	103	H
* 4.804	33.48	VA1T	33.1	-28	38.58	54	-15.42	-	-	89	103	H
* 4.804	41.29	PKFH	33.1	-28	46.39	-	-	74	-27.61	327	103	V
* 4.804	35.42	VA1T	33.1	-28	40.52	54	-13.48	-	-	327	103	V

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

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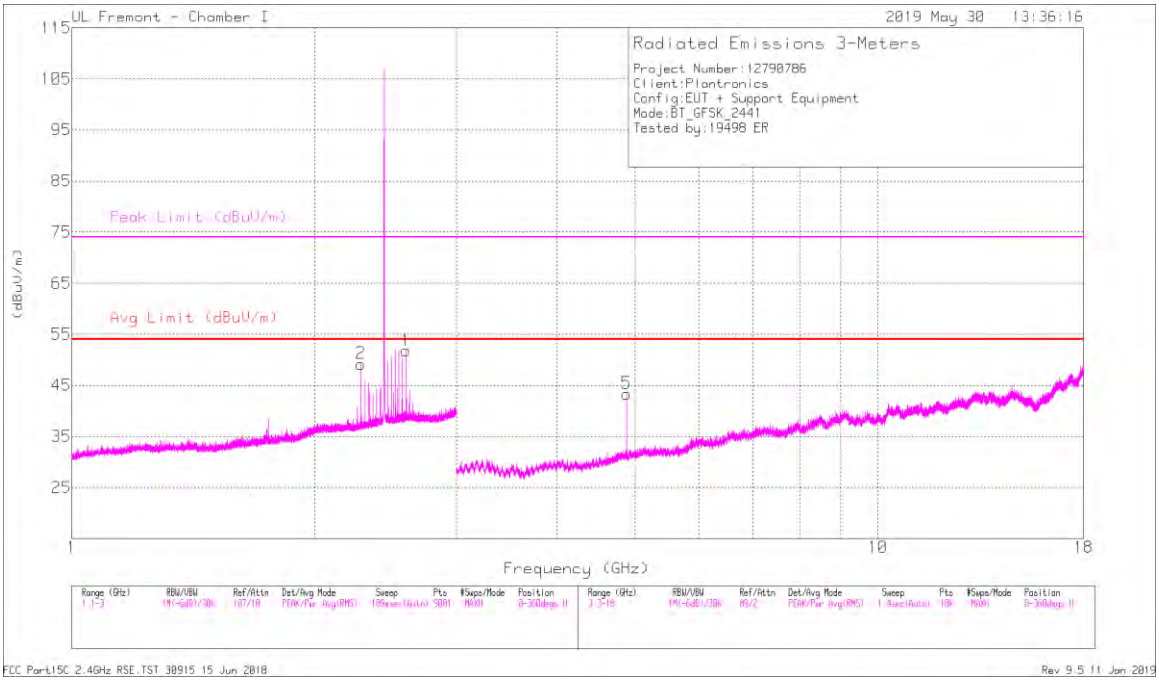
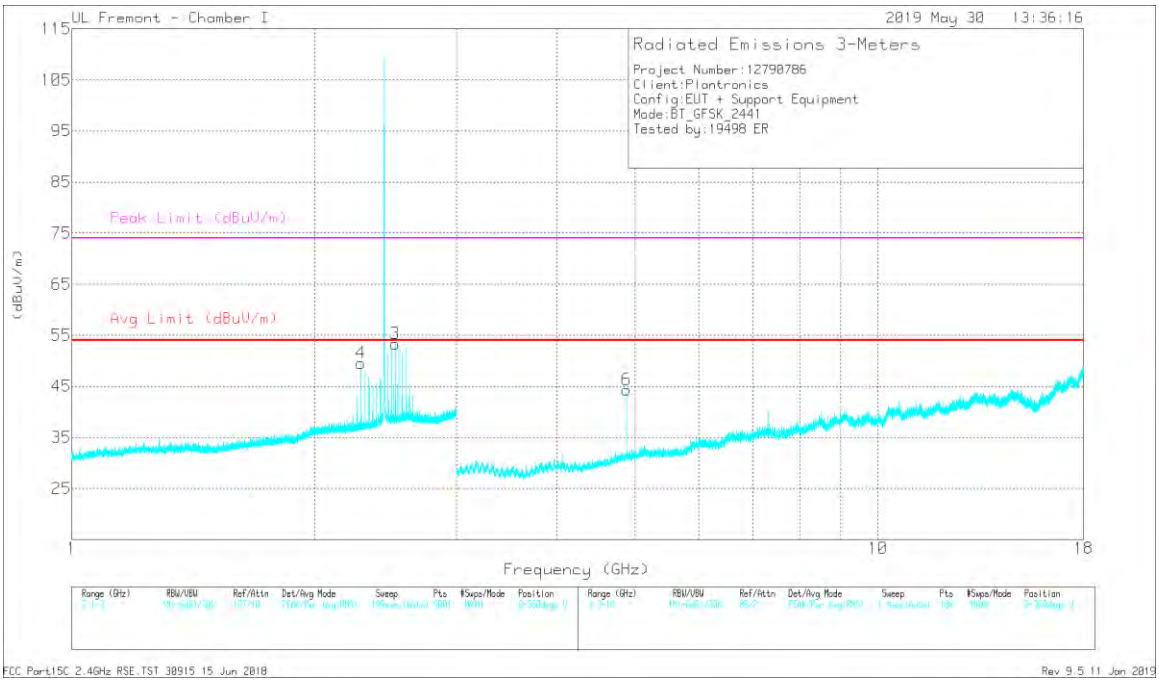
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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
* 2.285	45.19	PKFH	28.2	-21.5	51.89	-	-	74	-22.11	131	104	H
* 2.285	40.7	VA1T	28.2	-21.5	47.4	54	-6.6	-	-	131	104	H
2.597	46.42	PKFH	29.8	-21.6	54.62	-	-	-	-	289	100	H
* 2.285	45.75	PKFH	28.2	-21.5	52.45	-	-	74	-21.55	316	167	V
* 2.285	41.43	VA1T	28.2	-21.5	48.13	54	-5.87	-	-	316	167	V
2.519	48.63	PKFH	29.5	-21.7	56.43	-	-	-	-	174	219	V
* 4.882	41.04	PKFH	33.3	-28.8	45.54	-	-	74	-28.46	76	107	H
* 4.882	34.78	VA1T	33.3	-28.8	39.28	54	-14.72	-	-	76	107	H
* 4.882	42.34	PKFH	33.3	-28.8	46.84	-	-	74	-27.16	303	113	V
* 4.882	37.38	VA1T	33.3	-28.8	41.88	54	-12.12	-	-	303	113	V

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

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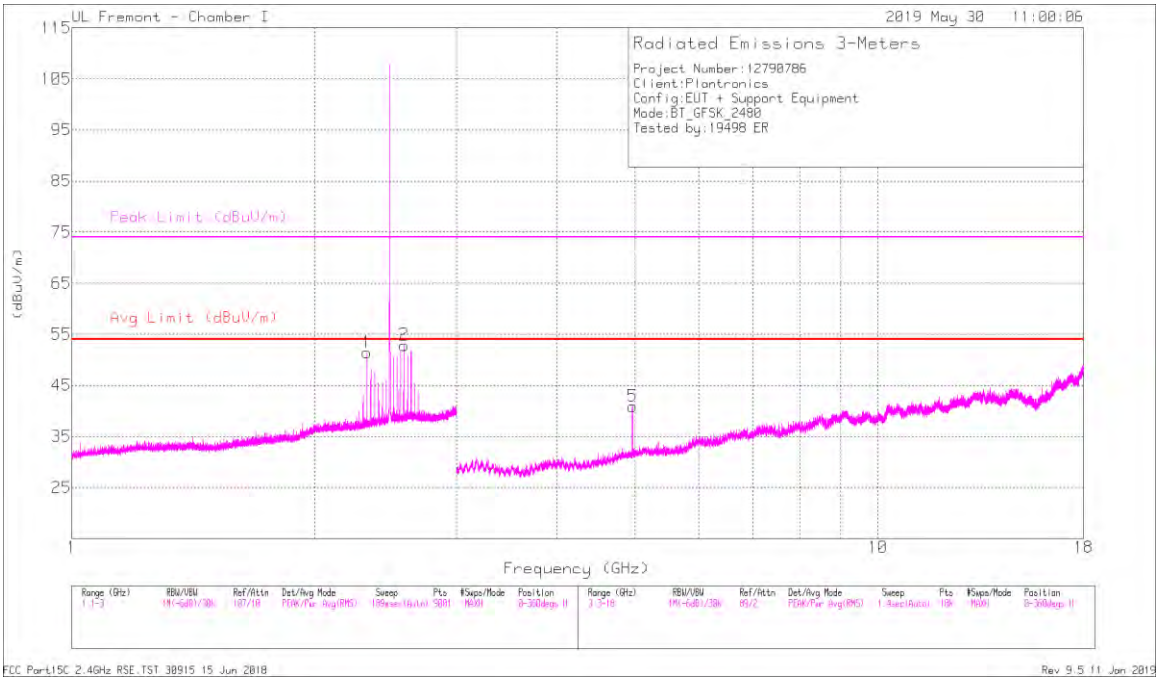
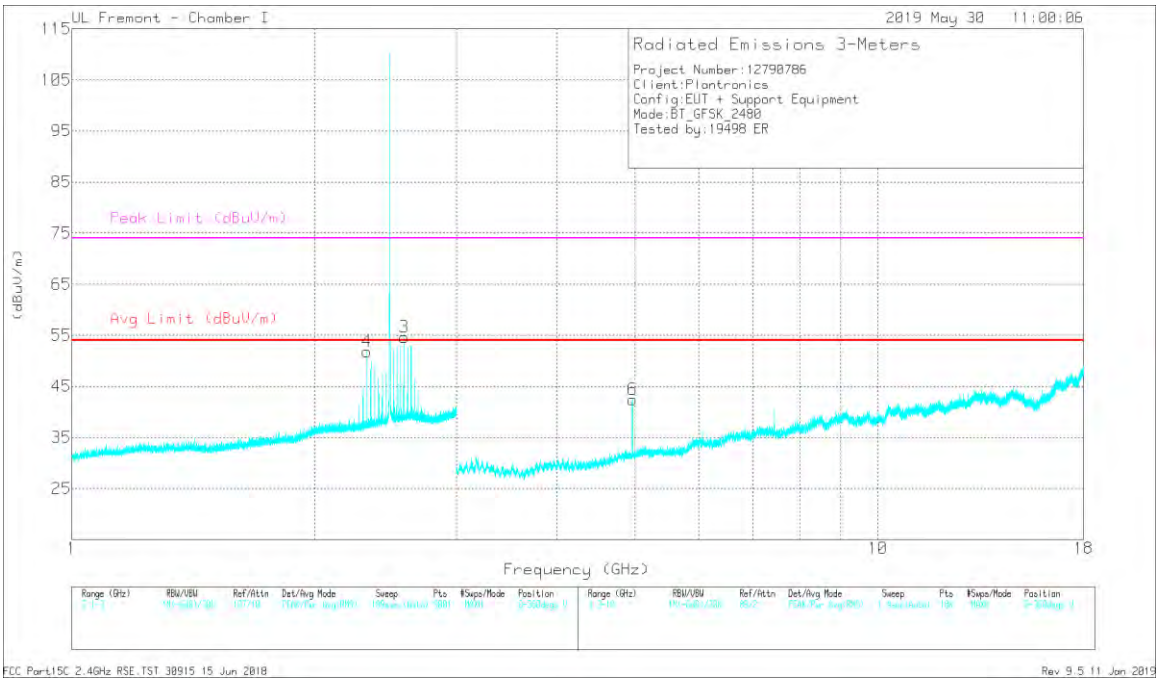
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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
* 2.324	47.01	PKFH	28.4	-21.5	53.91	-	-	74	-20.09	251	204	H
* 2.324	43.92	VA1T	28.4	-21.5	50.82	54	-3.18	-	-	251	204	H
2.584	48.08	PKFH	29.8	-21.6	56.28	-	-	-	-	277	100	H
* 2.324	47.99	PKFH	28.4	-21.5	54.89	-	-	74	-19.11	314	127	V
* 2.324	44.55	VA1T	28.4	-21.5	51.45	54	-2.55	-	-	314	127	V
2.584	48.9	PKFH	29.8	-21.6	57.1	-	-	-	-	176	151	V
* 4.96	42.05	PKFH	33.5	-29	46.55	-	-	74	-27.45	198	104	H
* 4.96	36.15	VA1T	33.5	-29	40.65	54	-13.35	-	-	198	104	H
* 4.96	42.25	PKFH	33.5	-29	46.75	-	-	74	-27.25	304	101	V
* 4.96	35.7	VA1T	33.5	-29	40.2	54	-13.8	-	-	304	101	V

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

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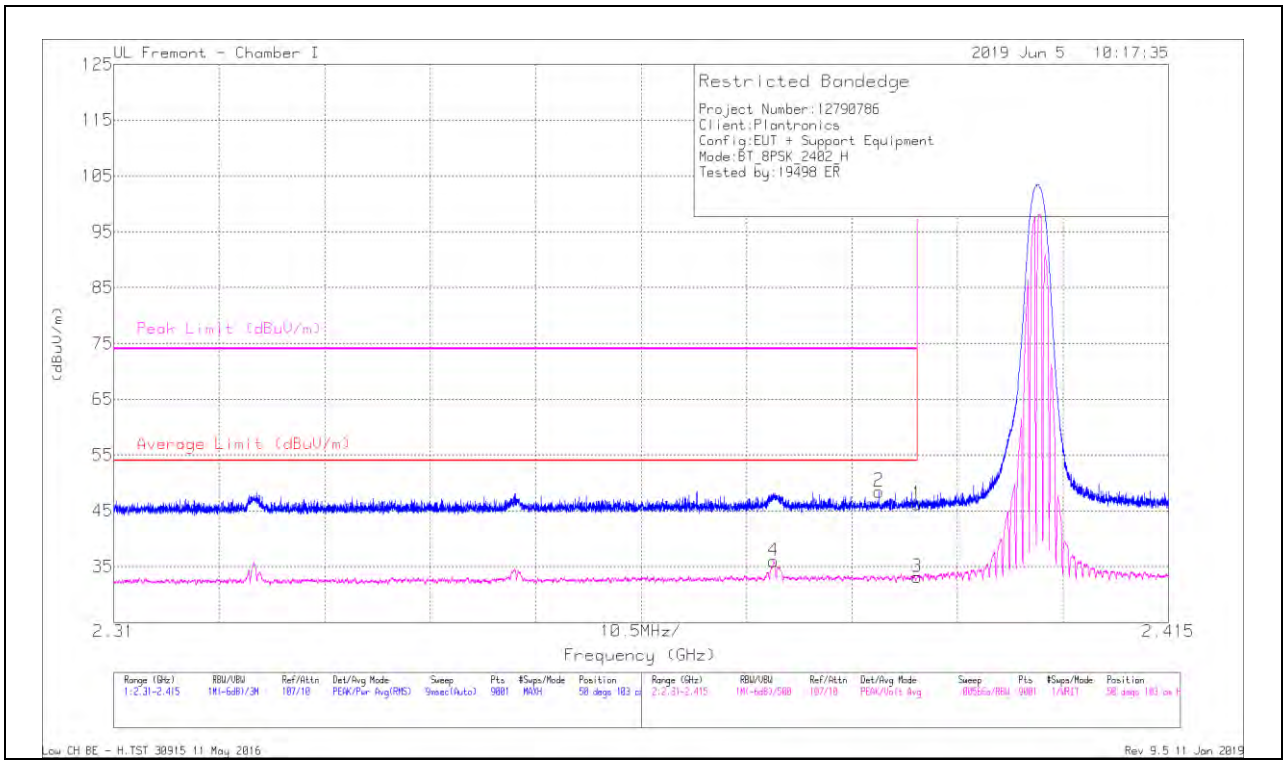
9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE019081 0 (dB/m)	Amp/Cbl/Flt r/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	38.87	Pk	28.9	-21.6	46.17	-	-	74	-27.83	50	103	H
2	2.386	41.19	Pk	28.9	-21.6	48.49	-	-	74	-25.51	50	103	H
3	2.39	25.82	VA1T	28.9	-21.6	33.12	54	-20.88	-	-	50	103	H
4	2.376	28.69	VA1T	28.8	-21.5	35.99	54	-18.01	-	-	50	103	H

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

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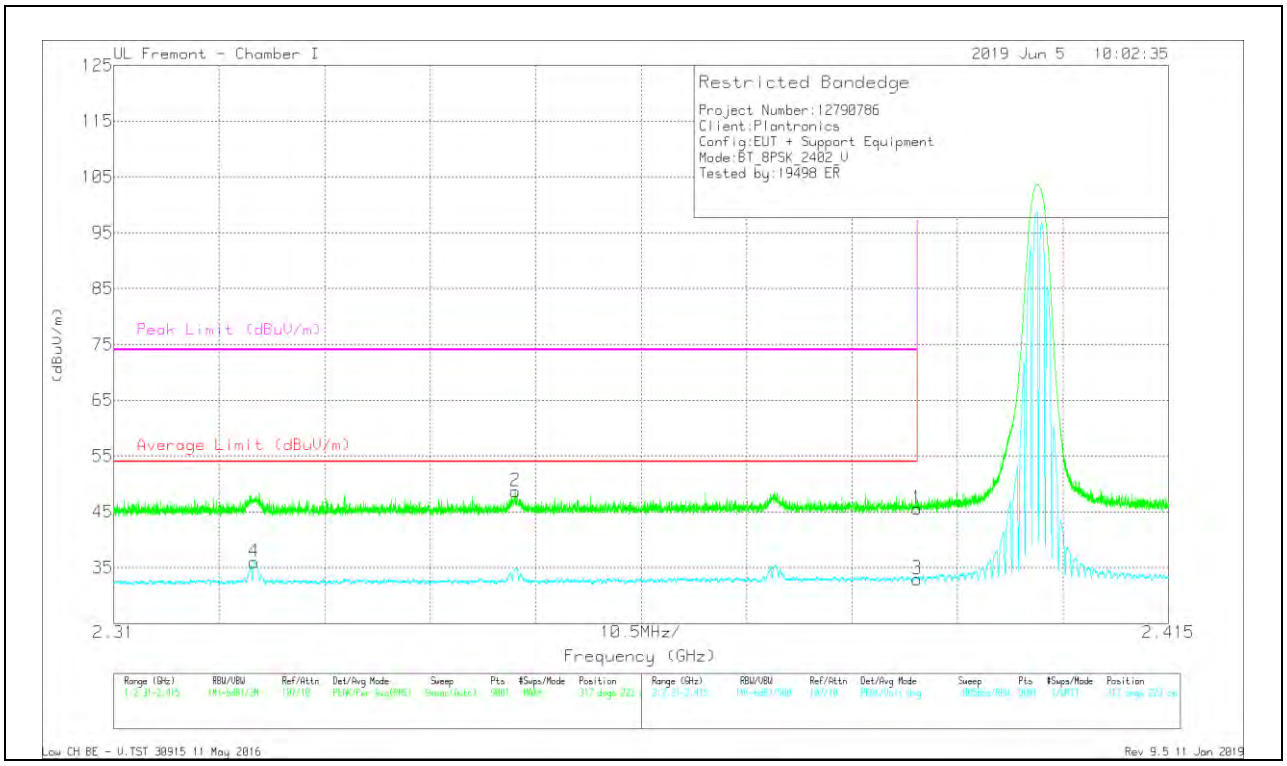
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (dB/m)	Amp/Cbl/Flt r/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	38.33	Pk	28.9	-21.6	45.63	-	-	74	-28.37	317	223	V
2	2.35	41.54	Pk	28.6	-21.5	48.64	-	-	74	-25.36	317	223	V
3	2.39	25.67	VA1T	28.9	-21.6	32.97	54	-21.03	-	-	317	223	V
4	2.324	29.17	VA1T	28.4	-21.5	36.07	54	-17.93	-	-	317	223	V

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

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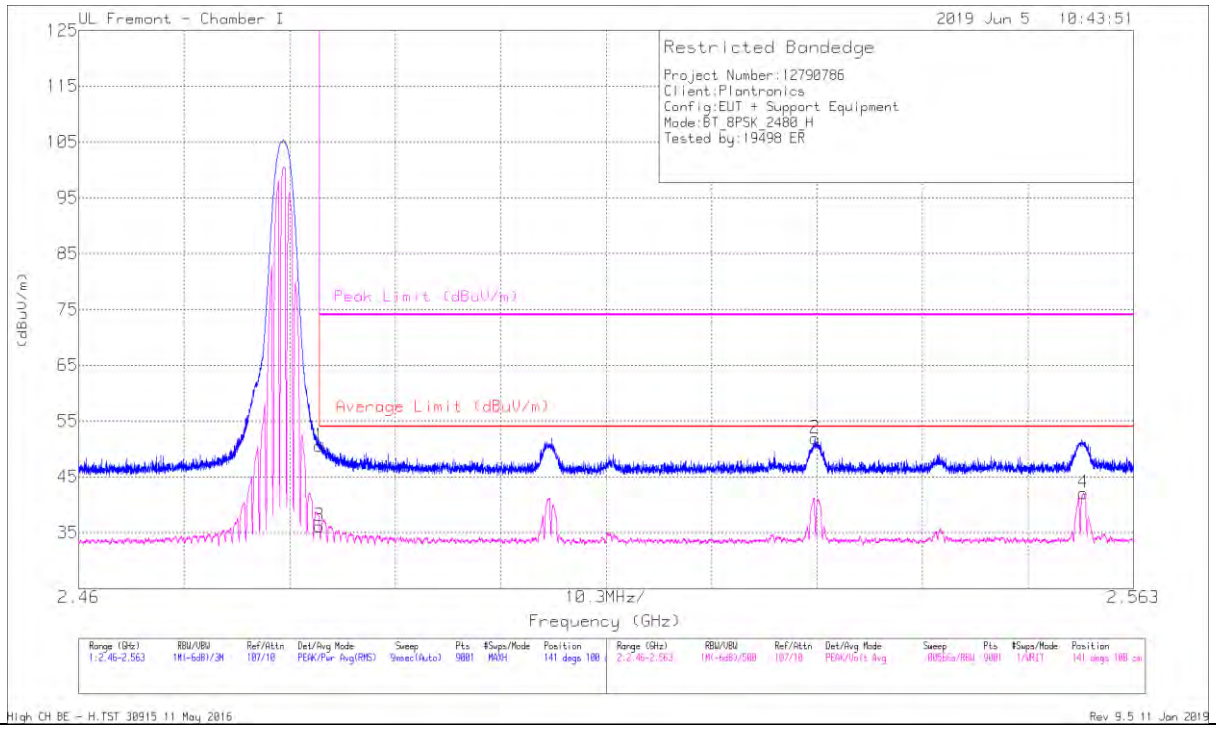
BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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	2.484	42.8	Pk	29.4	-21.7	50.5	-	-	74	-23.5	141	100	H
2	2.532	44.02	Pk	29.6	-21.7	51.92	-	-	74	-22.08	141	100	H
3	2.484	28.48	VA1T	29.4	-21.7	36.18	54	-17.82	-	-	141	100	H
4	2.558	34.1	VA1T	29.6	-21.6	42.1	54	-11.9	-	-	141	100	H

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

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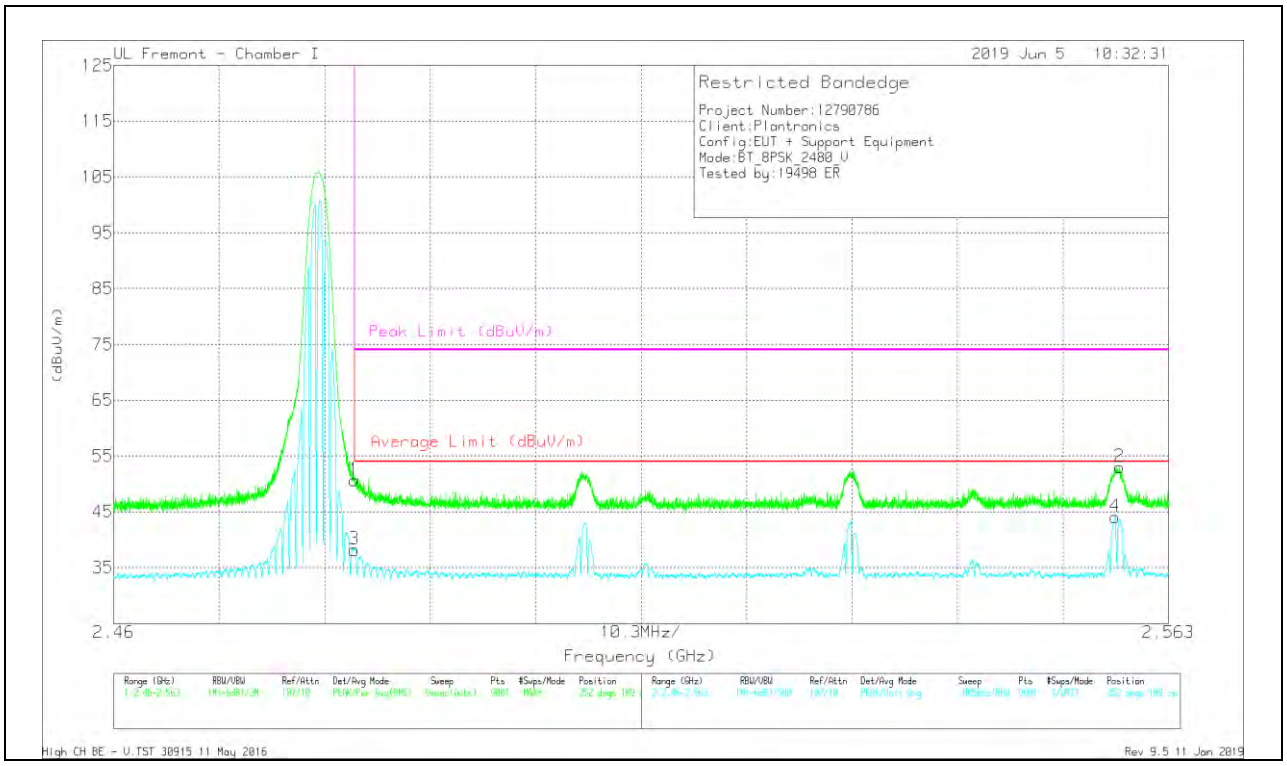
VERTICAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (dB/m)	Amp/Cbl/Flt r/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	2.484	43.01	Pk	29.4	-21.7	50.71	-	-	74	-23.29	352	189	V
2	2.558	44.99	Pk	29.6	-21.6	52.99	-	-	74	-21.01	352	189	V
3	2.484	30.49	VA1T	29.4	-21.7	38.19	54	-15.81	-	-	352	189	V
4	2.558	36.07	VA1T	29.6	-21.6	44.07	54	-9.93	-	-	352	189	V

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

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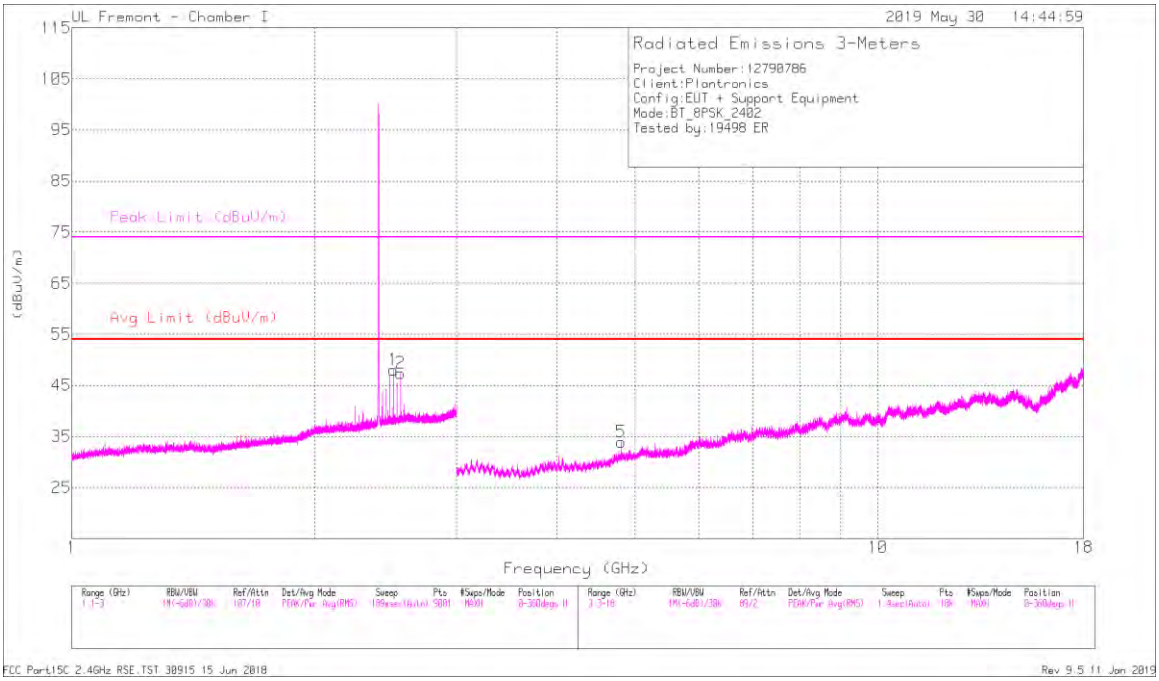
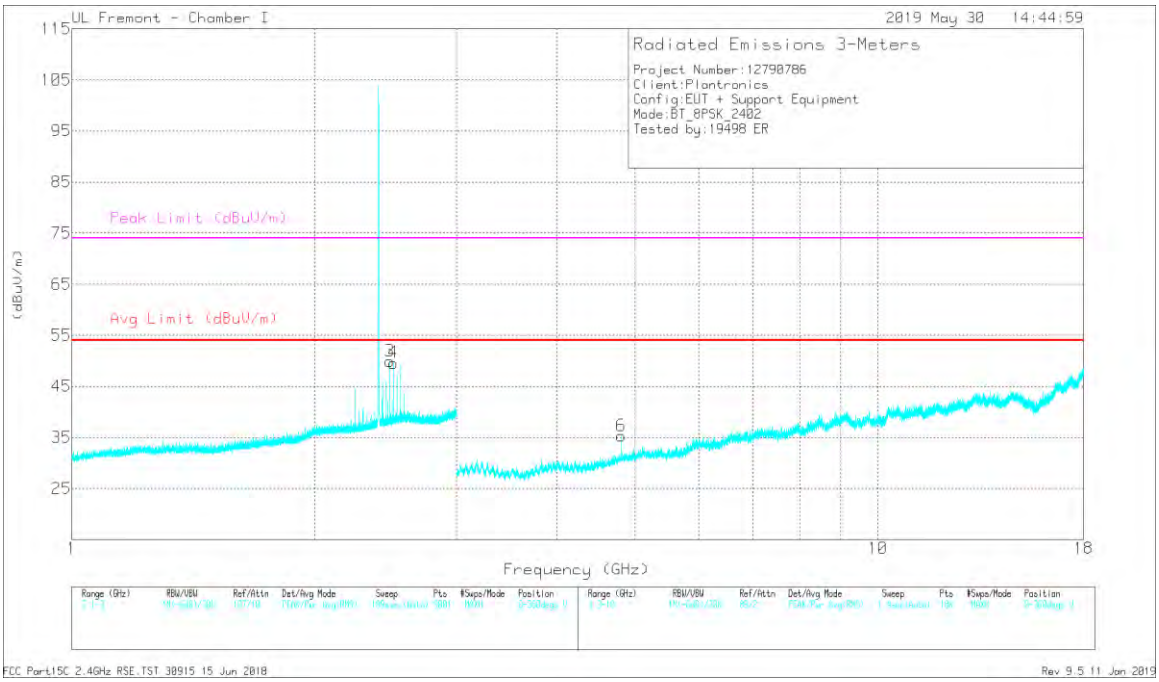
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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
2.506	44.43	PKFH	29.5	-21.8	52.13	-	-	-	-	287	112	H
2.558	44.8	PKFH	29.6	-21.6	52.8	-	-	-	-	286	100	H
2.48	45.35	PKFH	29.4	-21.7	53.05	-	-	-	-	182	206	V
2.506	46.34	PKFH	29.5	-21.8	54.04	-	-	-	-	178	146	V
* 4.804	36.61	PKFH	33.1	-28	41.71	-	-	74	-32.29	190	102	H
* 4.804	25.89	VA1T	33.1	-28	30.99	54	-23.01	-	-	190	102	H
* 4.804	37.89	PKFH	33.1	-28	42.99	-	-	74	-31.01	319	100	V
* 4.804	27.36	VA1T	33.1	-28	32.46	54	-21.54	-	-	319	100	V

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

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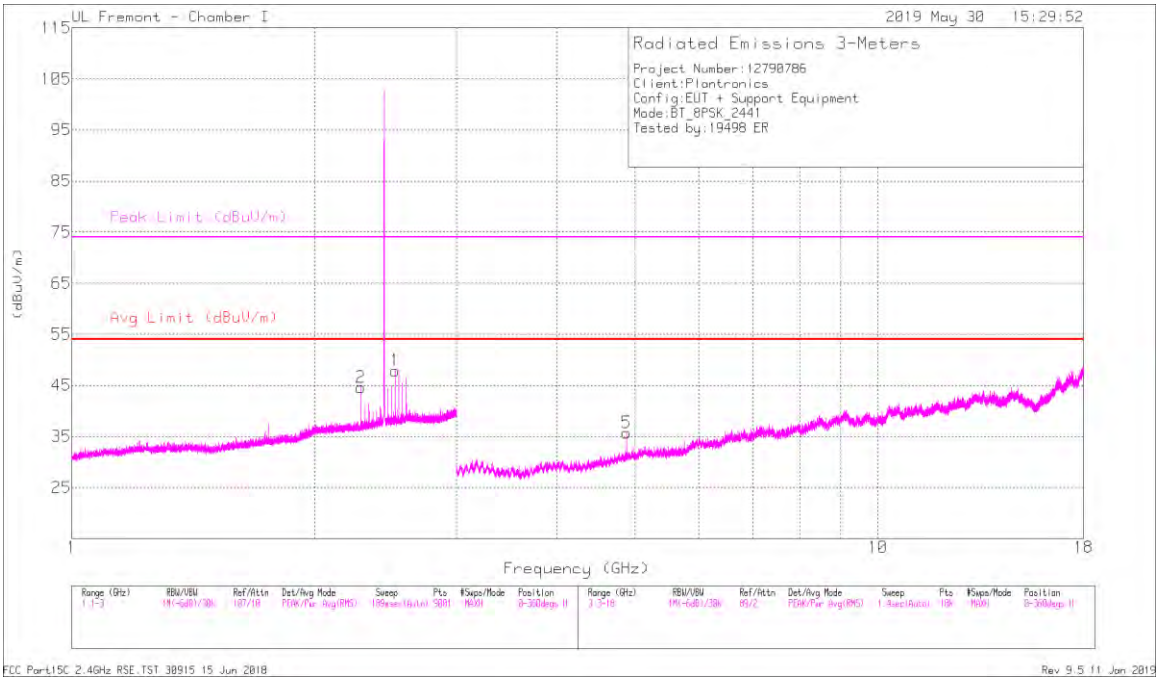
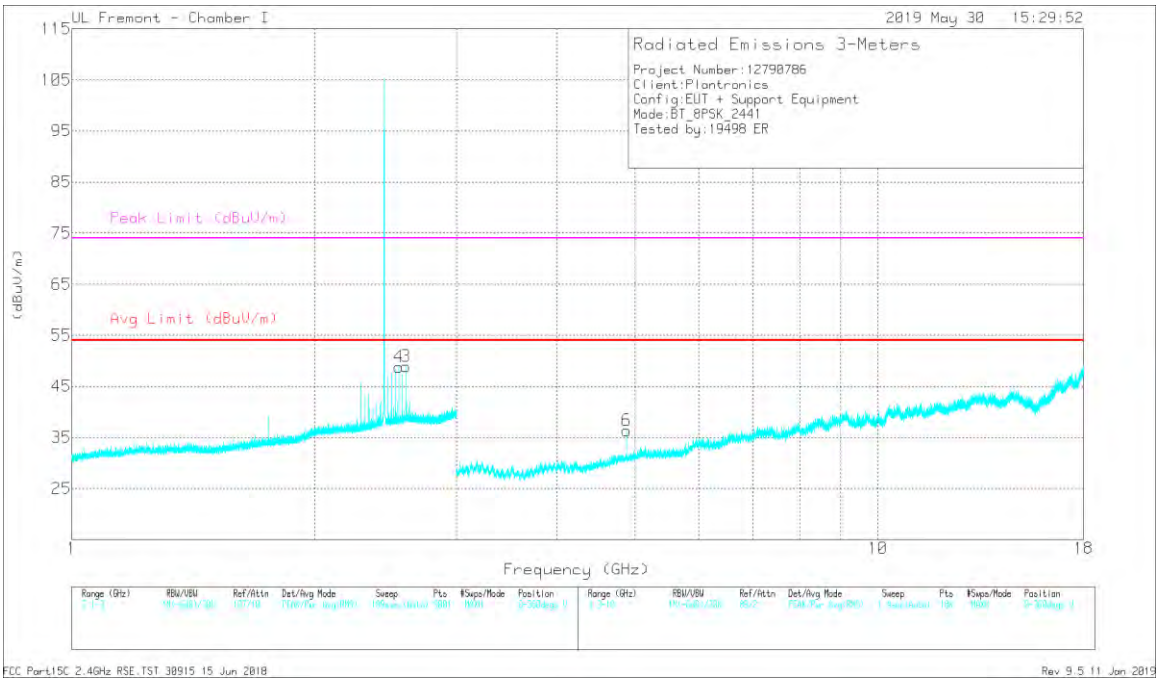
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE019081 0 (dB/m)	Amp/Cbl/Fl tr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 2.285	43.39	PKFH	28.2	-21.5	50.09	-	-	74	-23.91	233	212	H
* 2.285	35.31	VA1T	28.2	-21.5	42.01	54	-11.99	-	-	233	212	H
2.519	44.33	PKFH	29.5	-21.7	52.13	-	-	-	-	295	103	H
2.597	44.97	PKFH	29.8	-21.6	53.17	-	-	-	-	96	124	V
2.545	45.06	PKFH	29.6	-21.7	52.96	-	-	-	-	185	132	V
* 4.882	39.37	PKFH	33.3	-28.8	43.87	-	-	74	-30.13	196	106	H
* 4.882	29.53	VA1T	33.3	-28.8	34.03	54	-19.97	-	-	196	106	H
* 4.882	38.98	PKFH	33.3	-28.8	43.48	-	-	74	-30.52	301	100	V
* 4.882	29.1	VA1T	33.3	-28.8	33.6	54	-20.4	-	-	301	100	V

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

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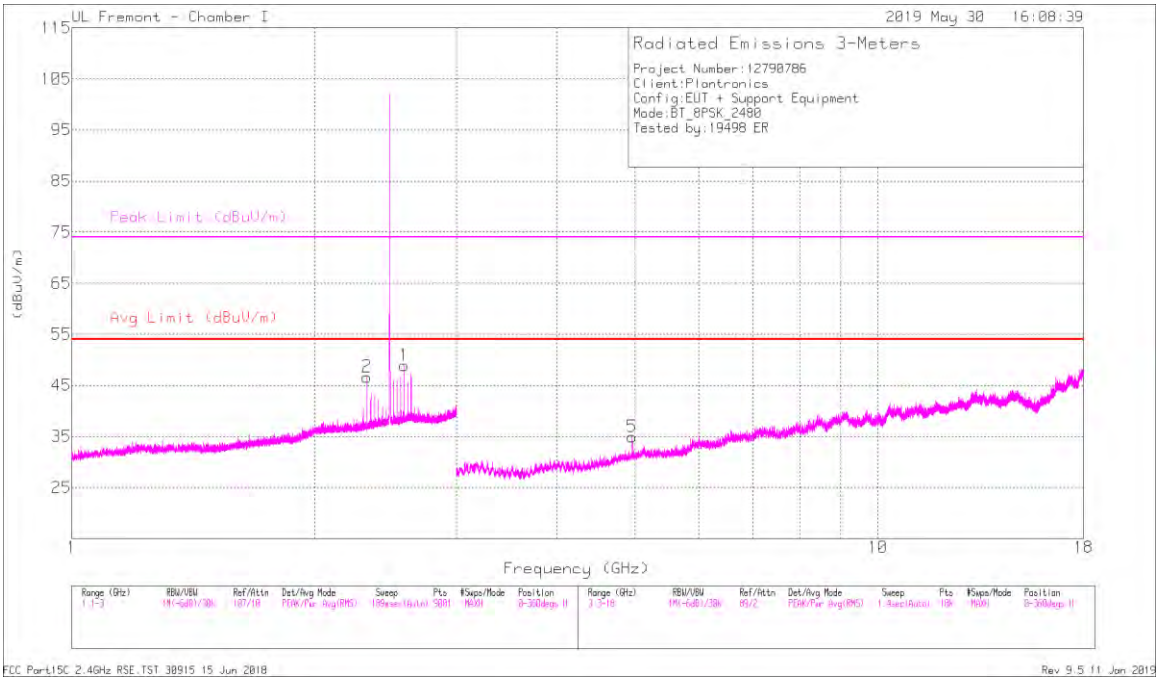
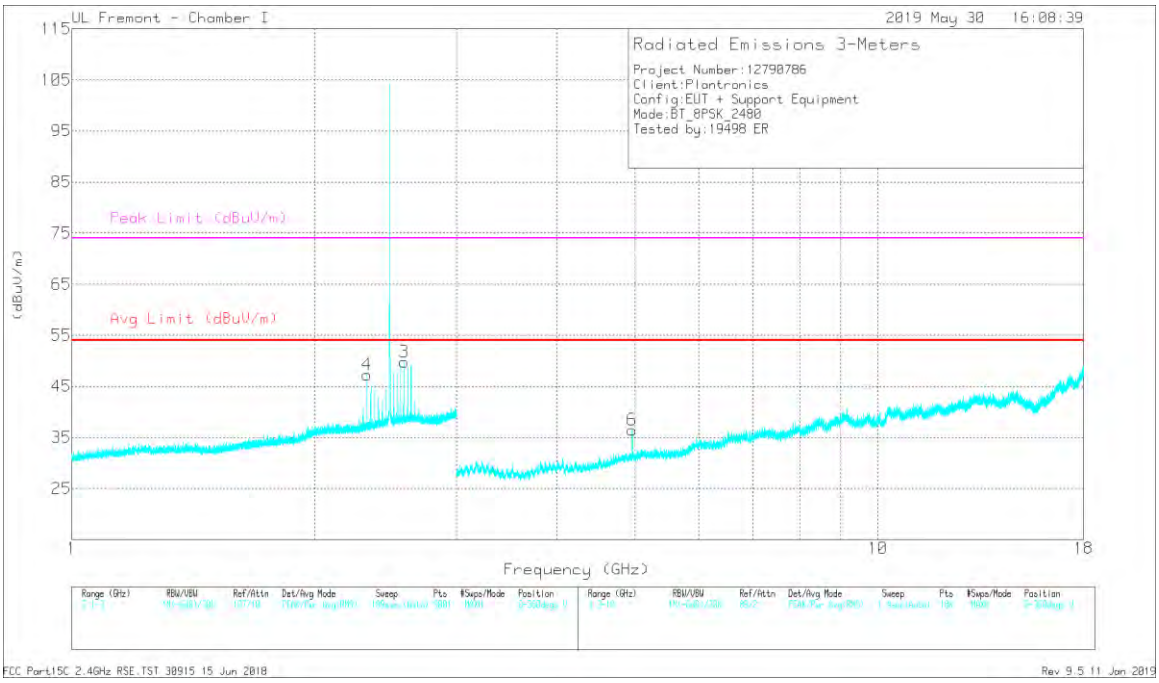
HIGH CHANNEL RESULTS



HORIZONTAL



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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0190810 (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
* 2.324	43.48	PKFH	28.4	-21.5	50.38	-	-	74	-23.62	247	196	H
* 2.324	35.7	VA1T	28.4	-21.5	42.6	54	-11.4	-	-	247	196	H
2.584	44.99	PKFH	29.8	-21.6	53.19	-	-	-	-	290	119	H
* 2.324	43.8	PKFH	28.4	-21.5	50.7	-	-	74	-23.3	314	170	V
* 2.324	36.62	VA1T	28.4	-21.5	43.52	54	-10.48	-	-	314	170	V
2.584	45.13	PKFH	29.8	-21.6	53.33	-	-	-	-	198	123	V
* 4.96	38.37	PKFH	33.5	-29	42.87	-	-	74	-31.13	207	102	H
* 4.96	27.2	VA1T	33.5	-29	31.7	54	-22.3	-	-	207	102	H
* 4.96	38.62	PKFH	33.5	-29	43.12	-	-	74	-30.88	317	156	V
* 4.96	27.59	VA1T	33.5	-29	32.09	54	-21.91	-	-	317	156	V

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

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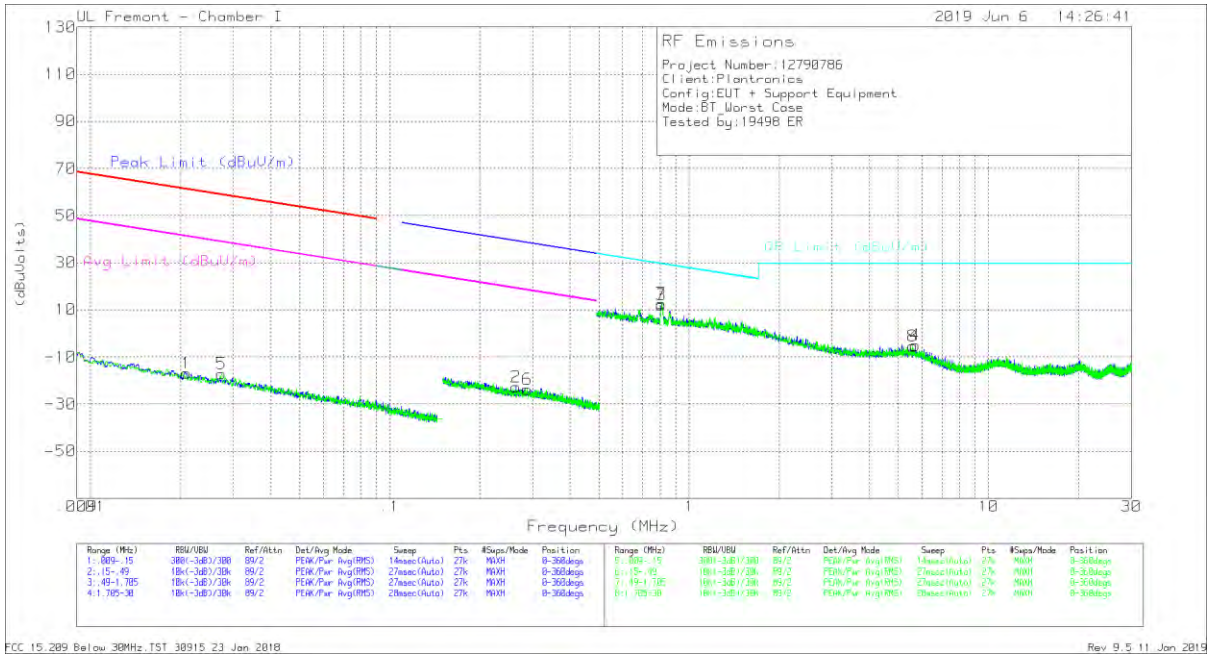
9.2. WORST CASE BELOW 30MHZ

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

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Below 30MHz Data

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.02091	48.61	Pk	14.6	0	-80	-16.79	61.18	-77.97	41.18	-57.97	0-360
2	.26398	43.43	Pk	13.7	.1	-80	-22.77	39.18	-61.95	19.18	-41.95	0-360
5	.02741	47.7	Pk	15.1	0	-80	-17.2	58.83	-76.03	38.83	-56.03	0-360
6	.28824	42.31	Pk	13.7	.1	-80	-23.89	38.42	-62.31	18.42	-42.31	0-360

Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.80871	38.17	Pk	13.9	.1	-40	12.17	29.46	-17.29	0-360
4	5.6895	20.34	Pk	14.3	.3	-40	-5.06	29.5	-34.56	0-360
7	.80716	38.51	Pk	13.9	.1	-40	12.51	29.48	-16.97	0-360
8	5.56793	19.92	Pk	14.3	.3	-40	-5.48	29.5	-34.98	0-360

Pk - Peak detector

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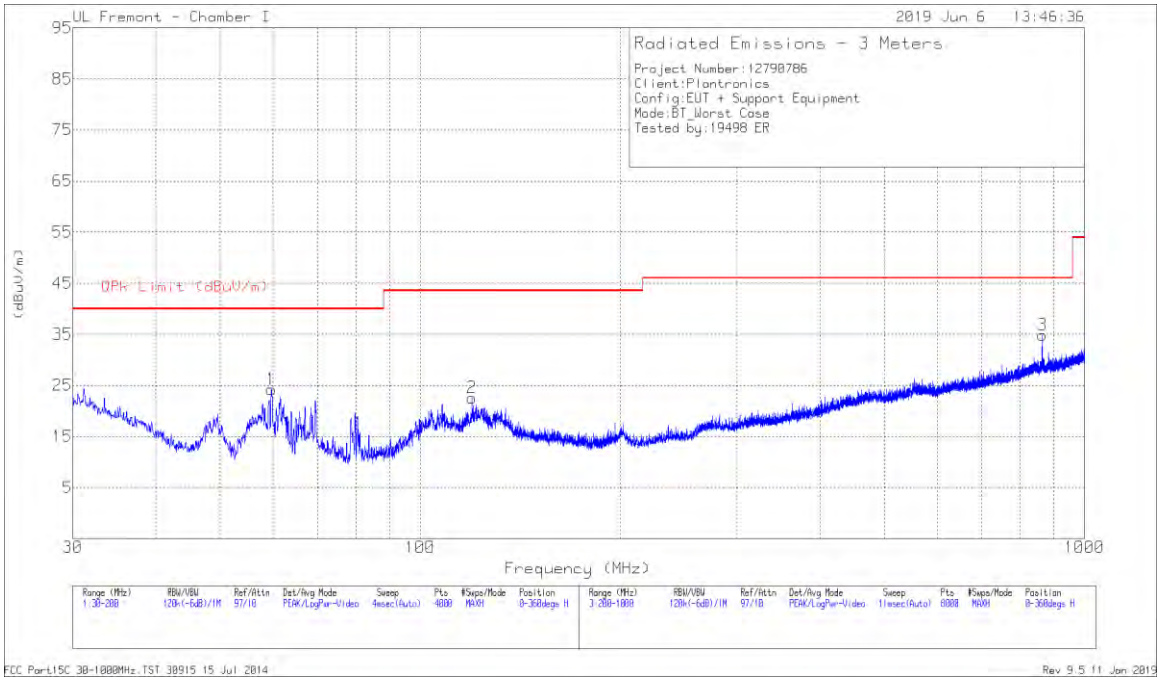
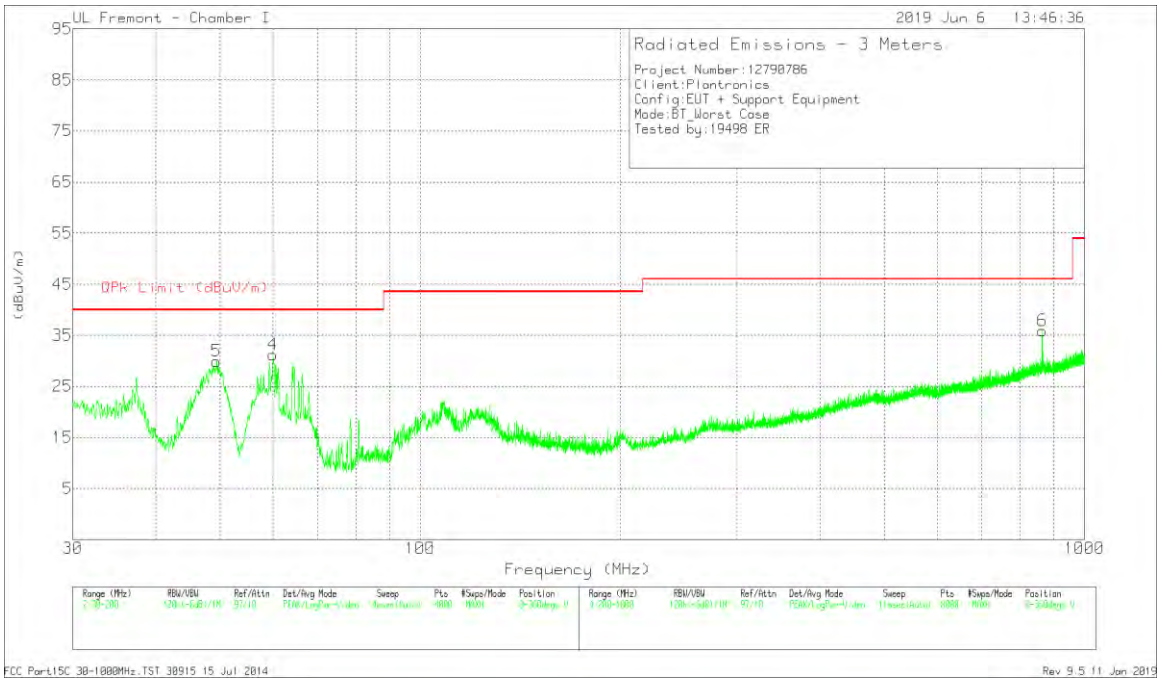
9.3. WORST CASE BELOW 1 GHZ

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 PRE0184971 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	59.7152	41.95	Pk	13.2	-31	24.15	40	-15.85	0-360	300	H
2	* 119.6132	33.59	Pk	19.6	-30.6	22.59	43.52	-20.93	0-360	200	H
4	60.0128	49	Pk	13.2	-31	31.2	40	-8.8	0-360	101	V
5	49.385	47.38	Pk	13.7	-31.2	29.88	40	-10.12	0-360	101	V
3	864.6864	34.88	Pk	27.7	-27.7	34.88	46.02	-11.14	0-360	101	H
6	863.4862	35.88	Pk	27.7	-27.7	35.88	46.02	-10.14	0-360	101	V

Pk - Peak detector

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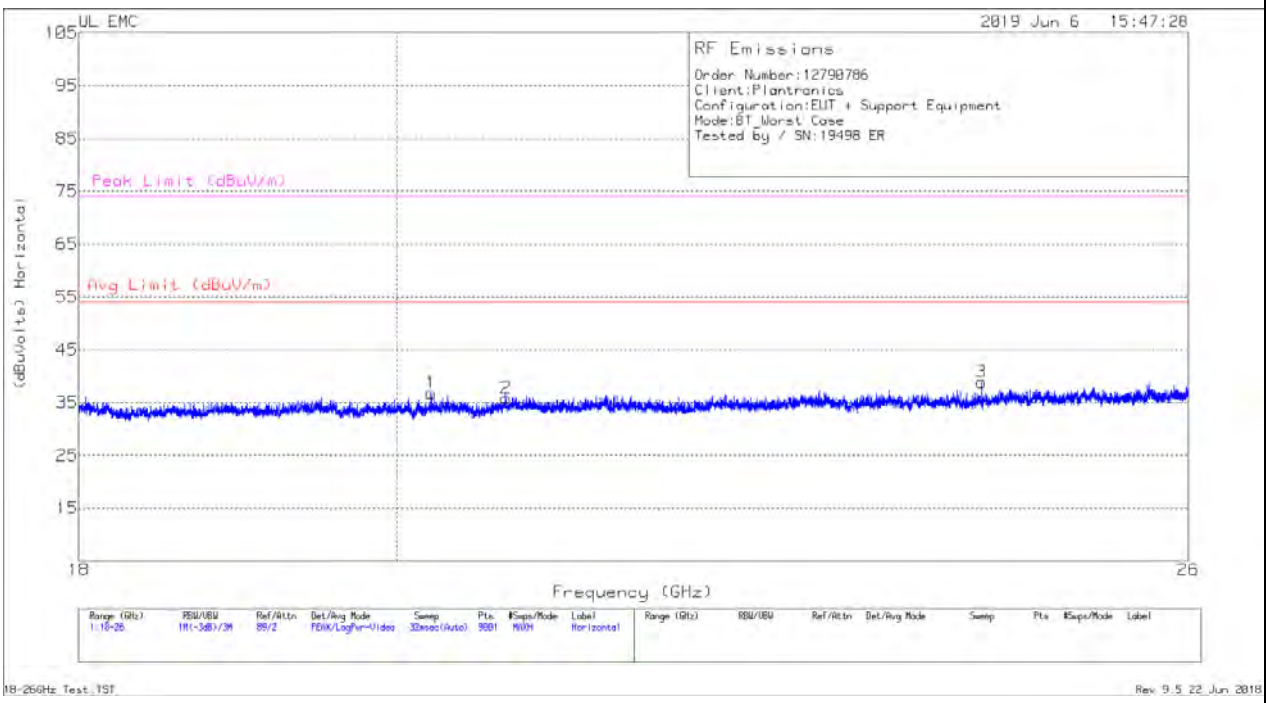
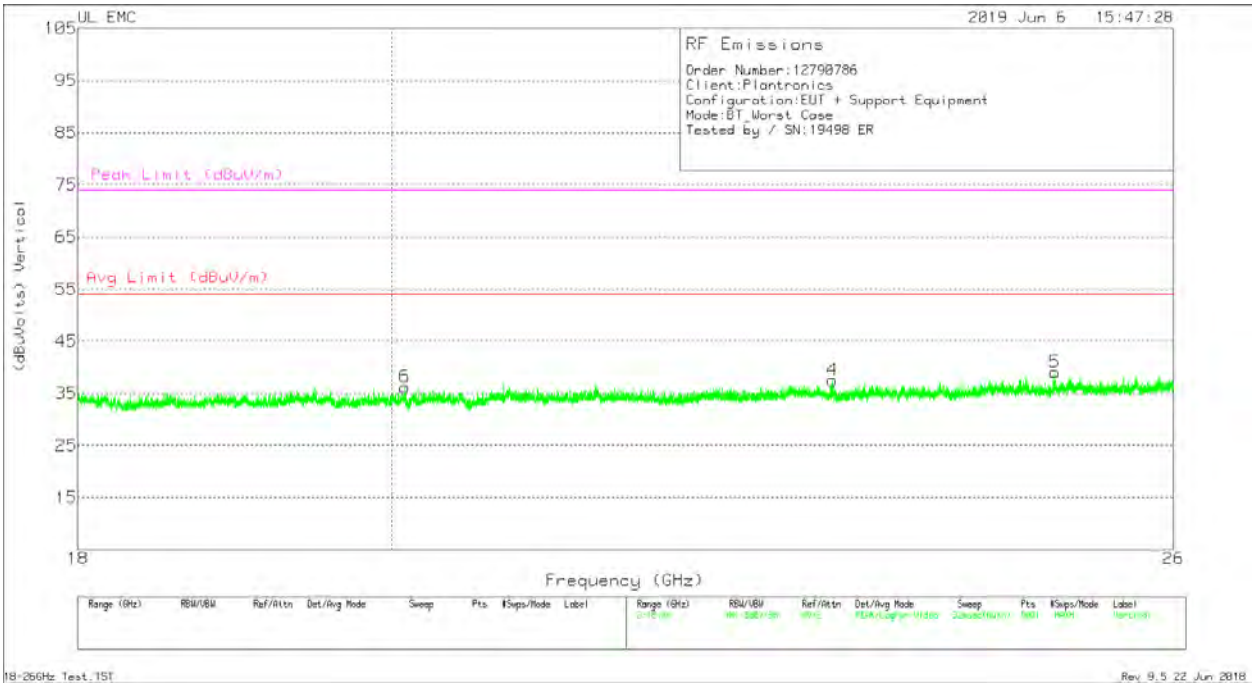
9.4. WORST CASE 18-26 GHZ

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



HORIZONTAL



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18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0182188 (dB/m)	Amp/Cbl (dB)	Dist Corr (dB)	Corrected Reading (dBuVolts)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)
1	20.14	68.85	Pk	33.5	-56.8	-9.5	36.05	54	-17.95	74	-37.95
2	21.275	70.52	Pk	33.5	-57.3	-9.5	37.22	54	-16.78	74	-36.78
3	24.048	68.65	Pk	34.6	-56.5	-9.5	37.25	54	-16.75	74	-36.75
4	19.472	69.86	Pk	33.4	-57.2	-9.5	36.56	54	-17.44	74	-37.44
5	21.678	70.46	Pk	33.9	-57.6	-9.5	37.26	54	-16.74	74	-36.74
6	22.757	70.34	Pk	34.2	-57.7	-9.5	37.34	54	-16.66	74	-36.66

Pk - Peak detector

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10. 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.

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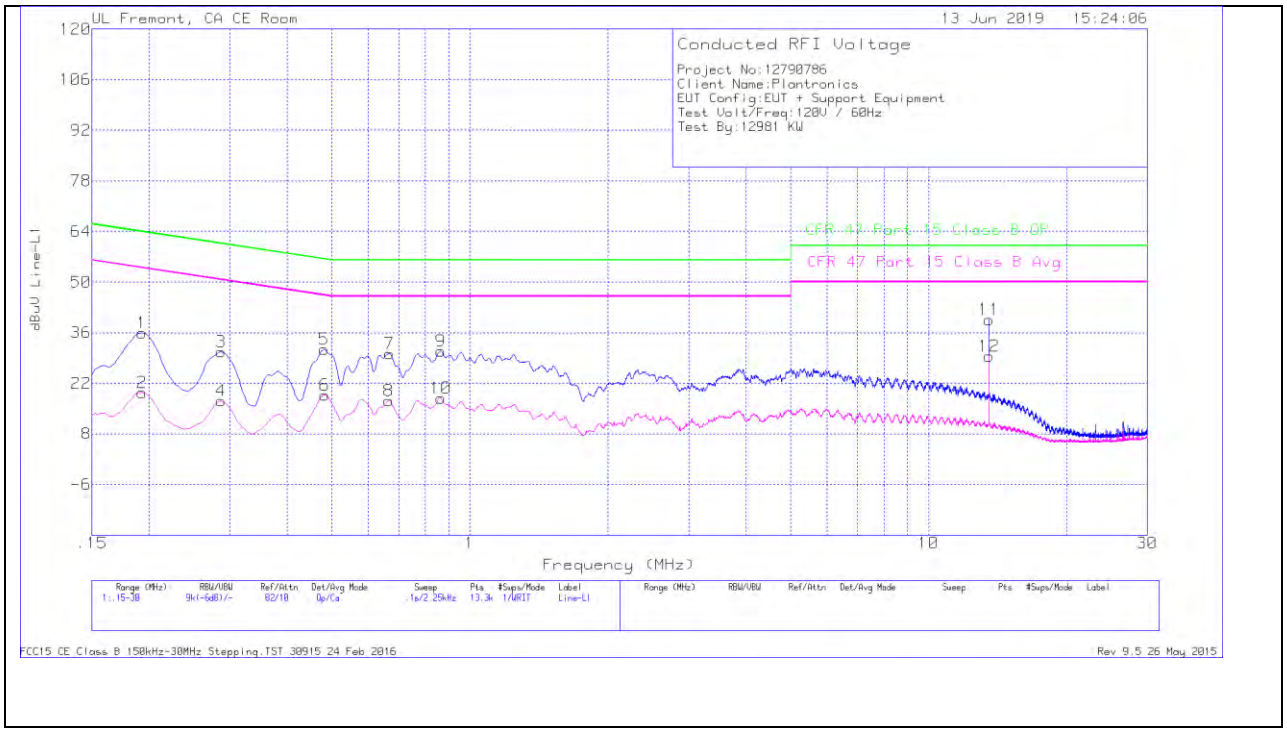
RESULTS

LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.19275	25.79	Qp	0	0	10.1	35.89	63.92	-28.03	-	-
2	.19275	9.37	Ca	0	0	10.1	19.47	-	-	53.92	-34.45
3	.28725	20.67	Qp	0	0	10.1	30.77	60.6	-29.83	-	-
4	.28725	6.98	Ca	0	0	10.1	17.08	-	-	50.6	-33.52
5	.48075	21.24	Qp	0	0	10.1	31.34	56.33	-24.99	-	-
6	.483	8.68	Ca	0	0	10.1	18.78	-	-	46.29	-27.51
7	.6675	20.06	Qp	0	0	10.1	30.16	56	-25.84	-	-
8	.66525	7.07	Ca	0	0	10.1	17.17	-	-	46	-28.83
9	.8655	20.77	Qp	0	0	10.1	30.87	56	-25.13	-	-
10	.8655	7.7	Ca	0	0	10.1	17.8	-	-	46	-28.2
11	13.56225	29.15	Qp	.1	.2	10.2	39.65	60	-20.35	-	-
12	13.56	18.97	Ca	.1	.2	10.2	29.47	-	-	50	-20.53

Qp - Quasi-Peak detector

Ca - CISPR average detection

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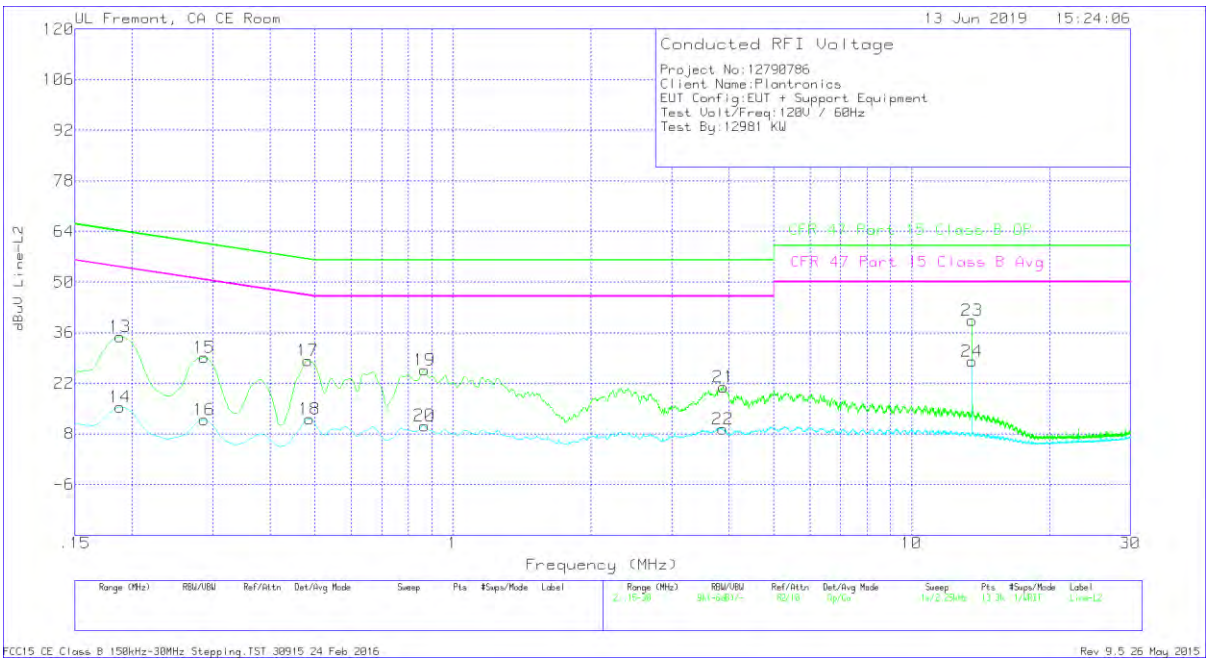
LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
13	.18825	24.72	Qp	0	0	10.1	34.82	64.11	-29.29	-	-
14	.18825	5.29	Ca	0	0	10.1	15.39	-	-	54.11	-38.72
15	.28725	19.04	Qp	0	0	10.1	29.14	60.6	-31.46	-	-
16	.28725	1.84	Ca	0	0	10.1	11.94	-	-	50.6	-38.66
17	.483	18.2	Qp	0	0	10.1	28.3	56.29	-27.99	-	-
18	.4875	2.02	Ca	0	0	10.1	12.12	-	-	46.21	-34.09
19	.86775	15.52	Qp	0	0	10.1	25.62	56	-30.38	-	-
20	.86775	.18	Ca	0	0	10.1	10.28	-	-	46	-35.72
21	3.88725	10.8	Qp	0	.1	10.1	21	56	-35	-	-
22	3.8805	-.83	Ca	0	.1	10.1	9.37	-	-	46	-36.63
23	13.56	28.88	Qp	.1	.2	10.2	39.38	60	-20.62	-	-
24	13.56	17.53	Ca	.1	.2	10.2	28.03	-	-	50	-21.97

Qp - Quasi-Peak detector

Ca - CISPR average detection

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