TEST REPORT

Report Number. : 13171837-E2V2

Applicant	:	Samsung Electronics Co., Ltd. 129 Samsung-Ro, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 16677, Korea
Model	:	SM-A515U, SM-A515U1, SM-A515W and SM-S515DL
FCC ID	:	A3LSMA515U
ISED	:	649E-SMA515W
EUT Description	:	GSM/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
February 27, 2020

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	1/14/2020	Initial Issue	
V2	2/28/2020	Updated Table of Content	Steven Tran

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UL VERIFICATION SERVICES INC.
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	Samsung Electronics Co., Ltd. 129 Samsung-Ro, Yeongtong-Gu, Suwon-Si, Gyeonggi-Do, 16677, Korea
EUT DESCRIPTION:	GSM/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+
MODEL:	SM-A515U, SM-A515U1, SM-A515W and SM-S515DL
SERIAL NUMBER:	Radiated: R38MB0B5P8X Conducted: R38MB0B5QVN
DATE TESTED:	December 26, 2019 – January 06, 2020

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

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

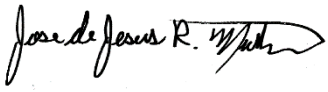
The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components.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

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

Approved & Released For
UL Verification Services Inc. By:

Operations Leader
Consumer Technology Division
UL Verification Services Inc.

Prepared By:



Jose Martinez
Test Engineer
Consumer Technology Division
UL Verification Services Inc.

Reviewed By:

Steven Tran
Project Engineer
Consumer Technology Division
UL Verification Services Inc.

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 v05r02, KDB 414788 D01 Radiated Test Site v01r01, 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. Chambers above are covered under Industry Canada company address and respective code: 2324A.

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

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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	3.39 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.07 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

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

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a GSM/CDMA/WCDMA/LTE Phablet with BT/BLE, DTS/UNII a/b/g/n/ac, NFC and ANT+. The model SM-A515U was used for final testing and is representative of the test results in this report.

5.2. 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	9.48	8.87
2402 - 2480	Enhanced DQPSK	9.22	8.36
2402 - 2480	Enhanced 8PSK	9.85	9.66

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.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an FPCB antenna, with a maximum gain of -1.1 dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was A515U.001.

5.5. 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 X orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in X orientation.

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

GFSK mode: DH5
8PSK mode: 3-DH5

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC Adapter	Samsung	EP-TA200	R37KBKLF1W1DK3	N/A
Earphone	Samsung	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	Antenna	1	RF	Shielded	0.2	To PSA and BT Tester
2	USB	1	USB	Un-shielded	1	EUT to AC Mains

I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB	Shielded	1	N/A
2	earphone	1	3.5mm	Un-shielded	1	N/A

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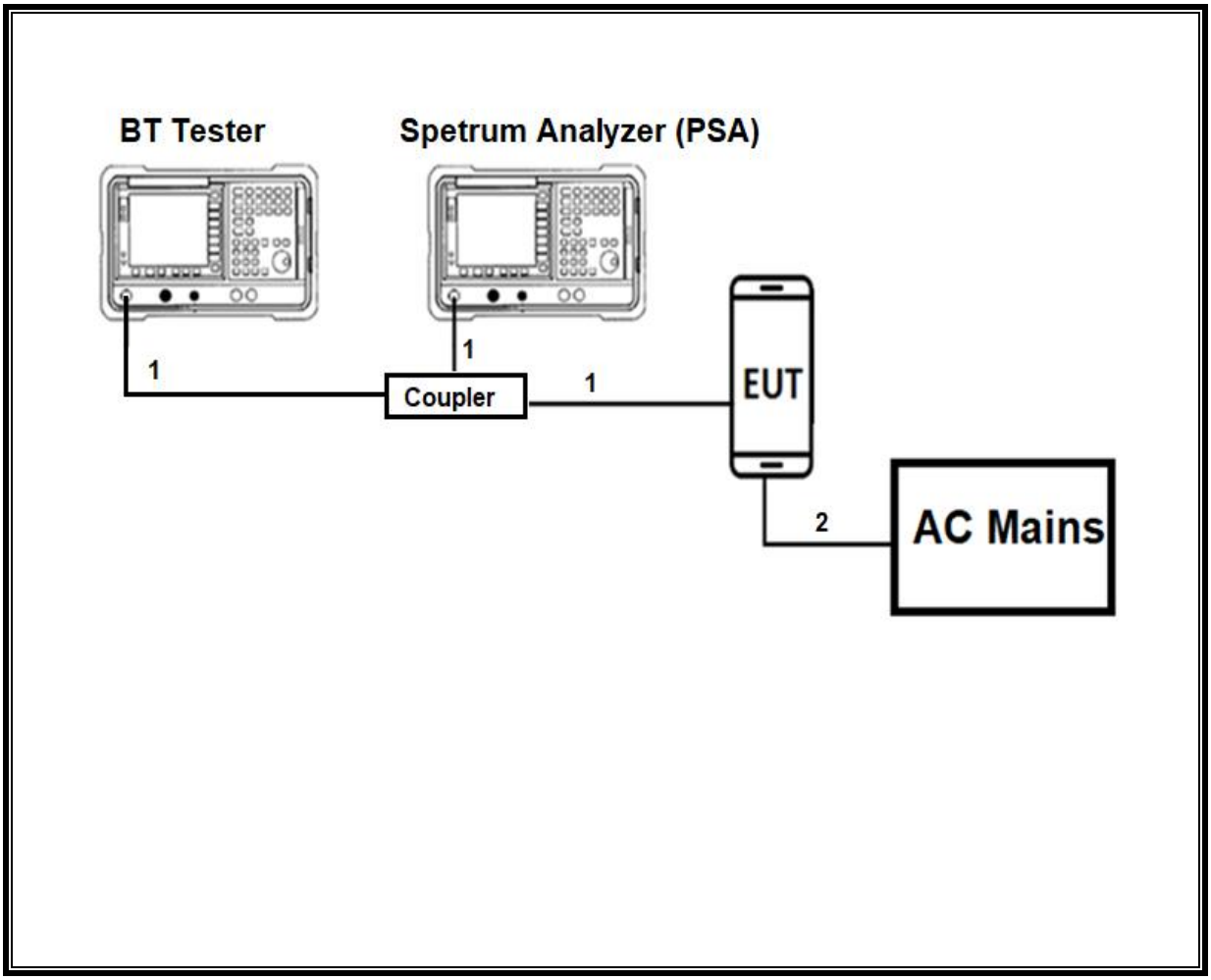
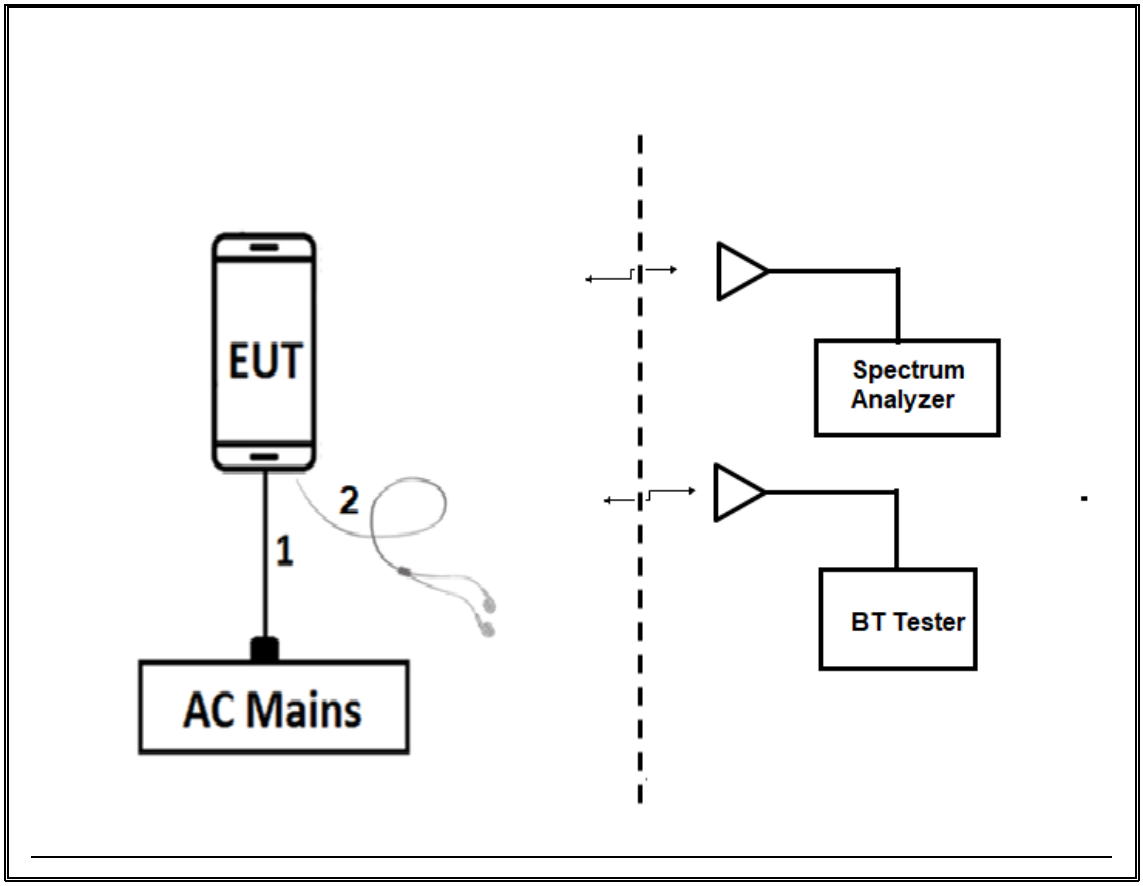
CONDUCTED TEST SETUP DIAGRAM



TEST SETUP

For conducted tests: the EUT was stand alone. The test software exercises the radio.

RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT is connected to earphone. The test software exercises the radio.

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**	**Asset**	**Cal Due**
Antenna, Passive Loop 30Hz to 1MHz	ELETRO METRICS	EM-6871	PRE0179466	05/31/2020
Antenna, Passive Loop 100KHz to 30MHz	ELETRO METRICS	EM-6872	PRE0179468	05/31/2020
Bluetooth Tester	Rohde&Schwarz	CBT	T258	02/14/2020
Antenna, Horn 1-18GHz	ETS Lindgren	3117	T862	06/05/2020
Amplifier, 1 to 18GHz	Miteq	AFS42-00101800-25-S-42	PRE0181078	08/24/2020
Antenna, Horn 1-18GHz	ETS Lindgren	3117	EMC4294	06/14/2020
Amplifier, 1 to 18GHz	Amplical	AMP1G18-35	T1569	05/04/2020
Antenna, Broadband Hybrid, 30MHz to 2GHz	Sunol Sciences	JB3	T899	08/23/2020
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	PRE0180174	06/01/2020
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	E9030A	T917	01/24/2020
Antenna Horn, 18 to 26.5GHz	ARA	MWH-1826/B	T447	08/13/2020
Pre-Amp 1-26.5 GHz	AMPLICAL	AMP18G26.5-60	PRE0181238	05/01/2020
EMI Test Receiver	Rohde&Schwarz	ESW44	PRE0179367	05/16/2020
EMI Test Receiver	Rohde&Schwarz	ESW44	PRE0179376	02/14/2020
EMI Test Receiver	Rohde&Schwarz	ESW44	PRE0179372	02/16/2020
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T229	01/31/2020
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T1226	02/06/2020
AC Line Conducted				
EMI Receiver	Rohde & Schwarz	ESR	T1436	02/14/2020
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	01/24/2020
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, Sep 24, 2019	
Antenna Port Software	UL	UL RF	Ver 2019.11.13	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

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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.

PROCEDURE

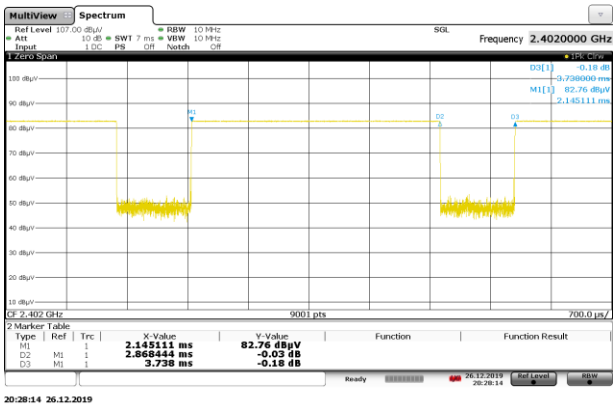
ANSI C63.10, Section 11.6 : Zero-Span Spectrum Analyzer Method.

ON TIME AND DUTY CYCLE RESULTS

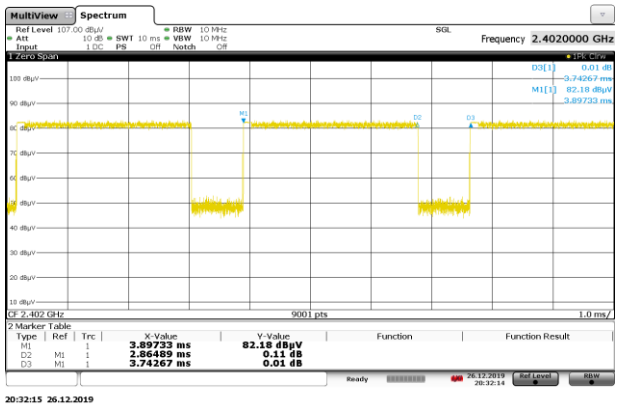
Tested By:	23653 DC

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	2.87	3.74	0.767	76.7	1.15	0.349
Bluetooth 8PSK	2.86	3.74	0.765	76.5	1.16	0.349

DUTY CYCLE PLOTS



BLUETOOTH GFSK



BLUETOOTH 8PSK

8.2. 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 ≥ RBW. The sweep time is coupled.

RESULTS

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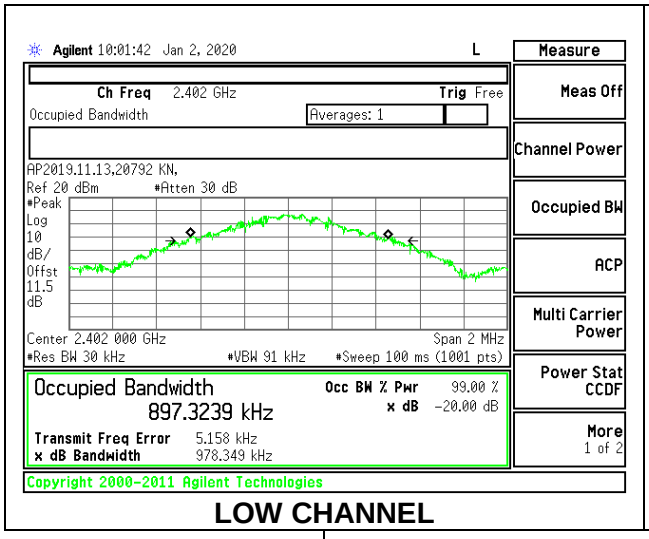
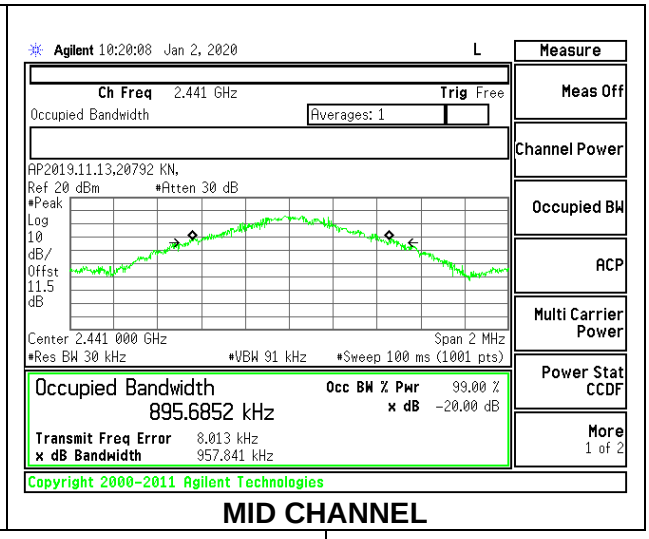
8.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

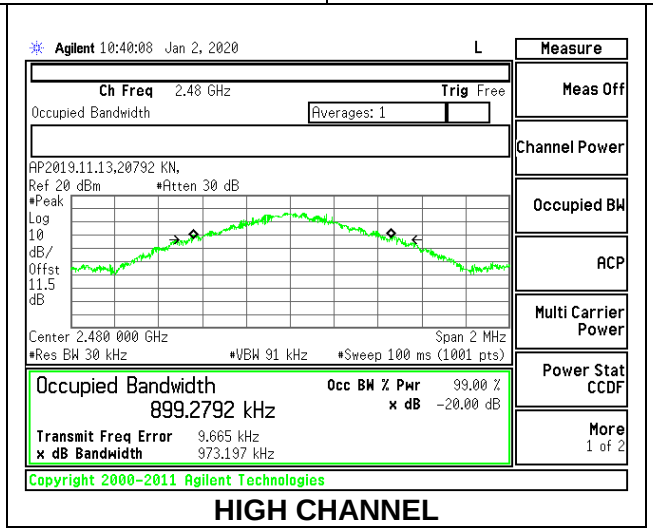
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	0.978	0.897
Mid	2441	0.958	0.896
High	2480	0.973	0.899



LOW CHANNEL



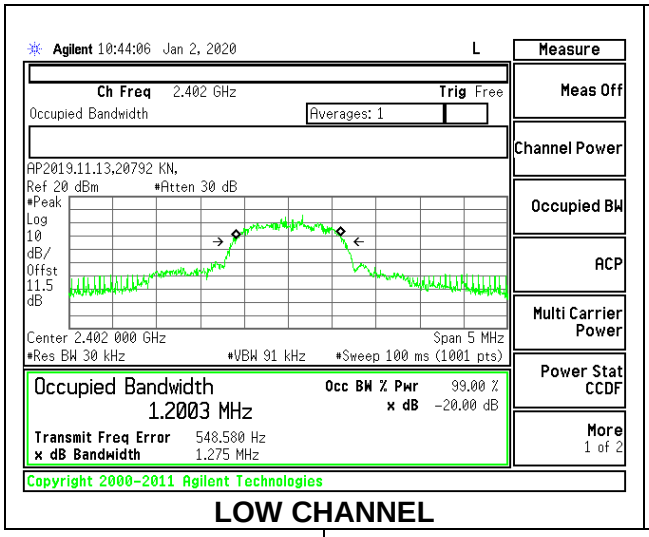
MID CHANNEL



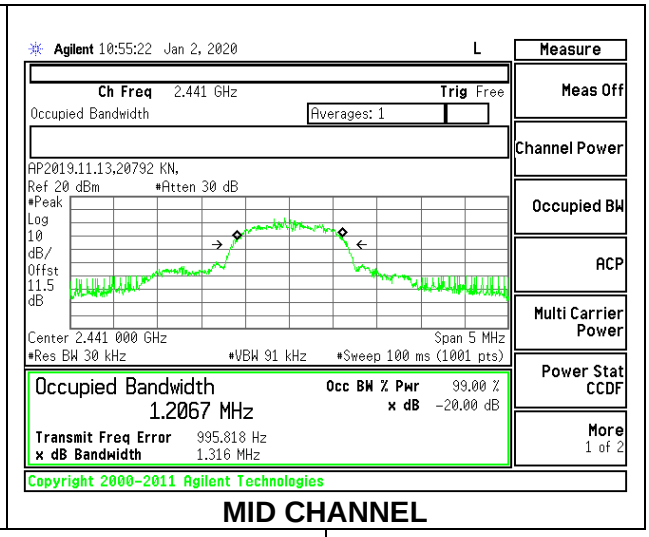
HIGH CHANNEL

8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

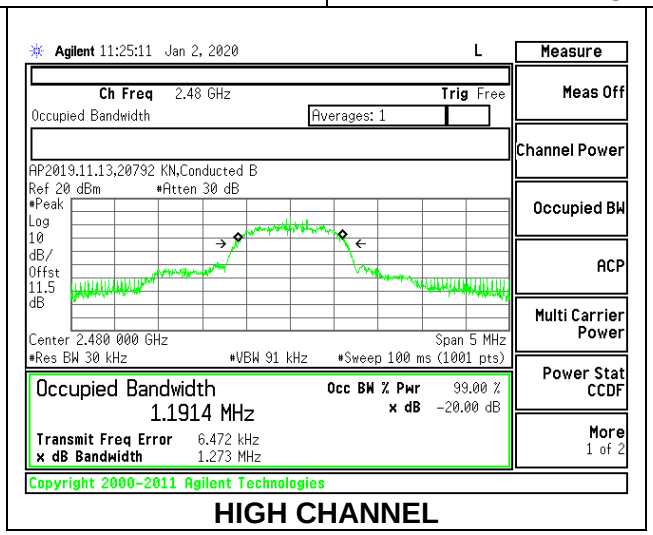
Channel	Frequency (MHz)	20dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	2402	1.275	1.200
Mid	2441	1.316	1.207
High	2480	1.273	1.191



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

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.

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 >= RBW. The sweep time is coupled.

RESULTS

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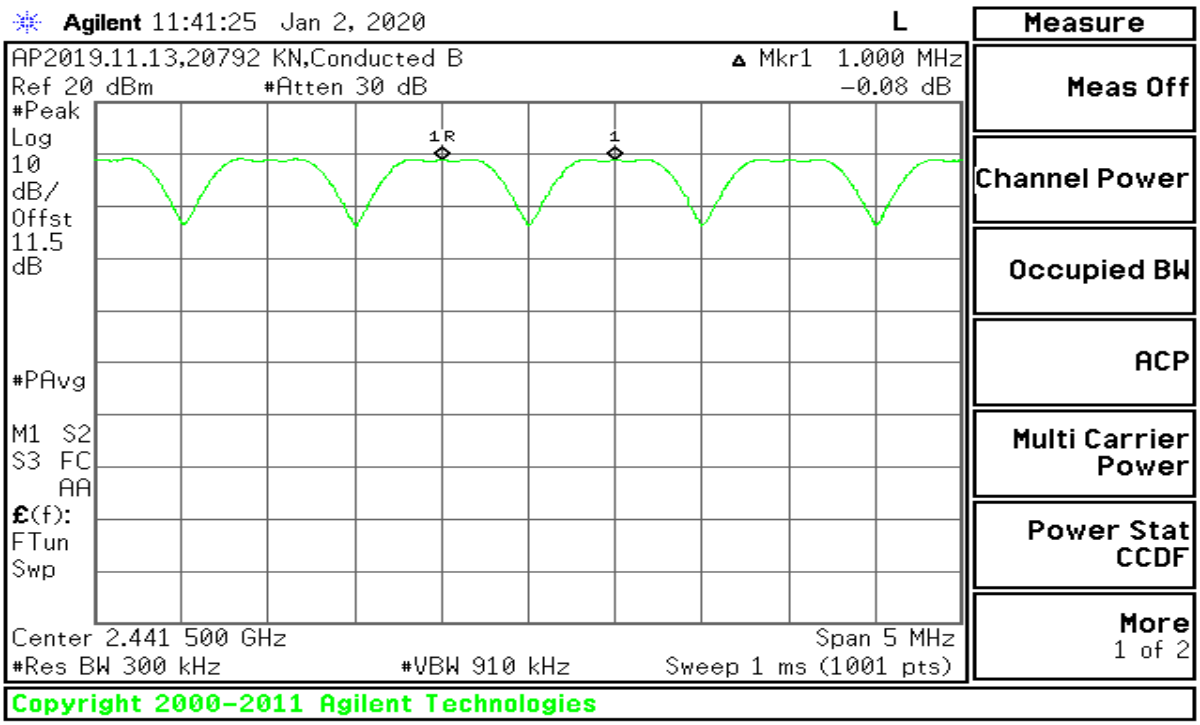
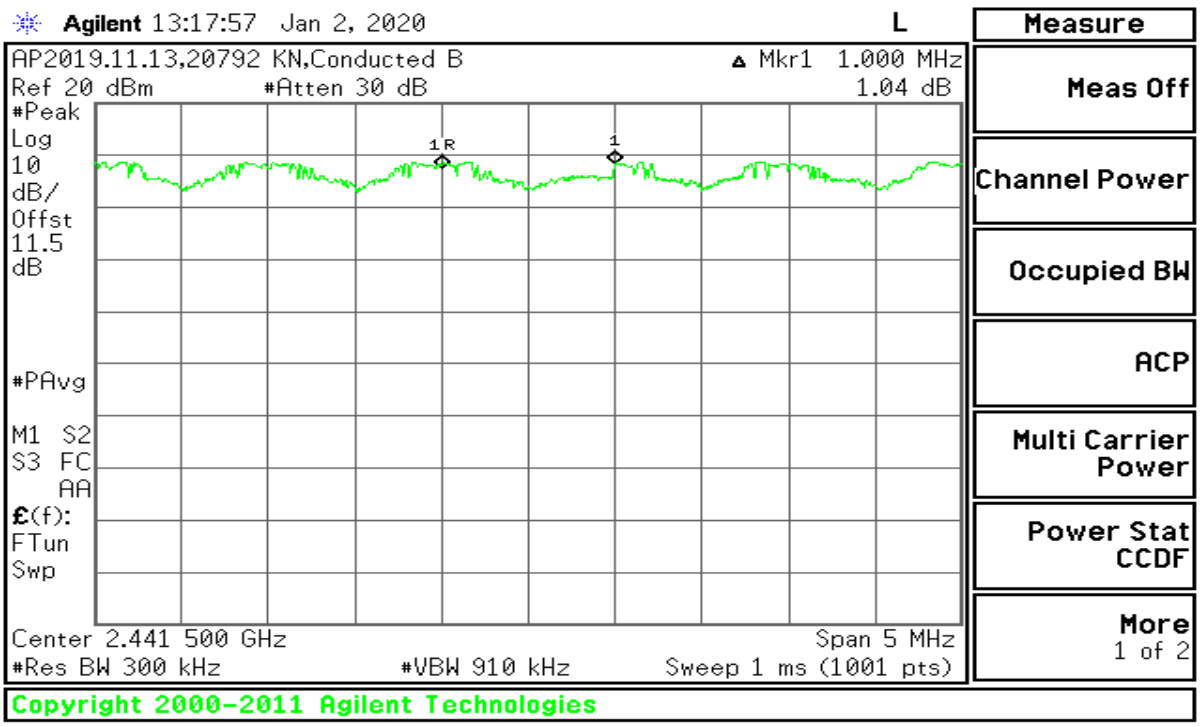
8.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

8.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



HOPPING FREQUENCY SEPARATION PLOT

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.

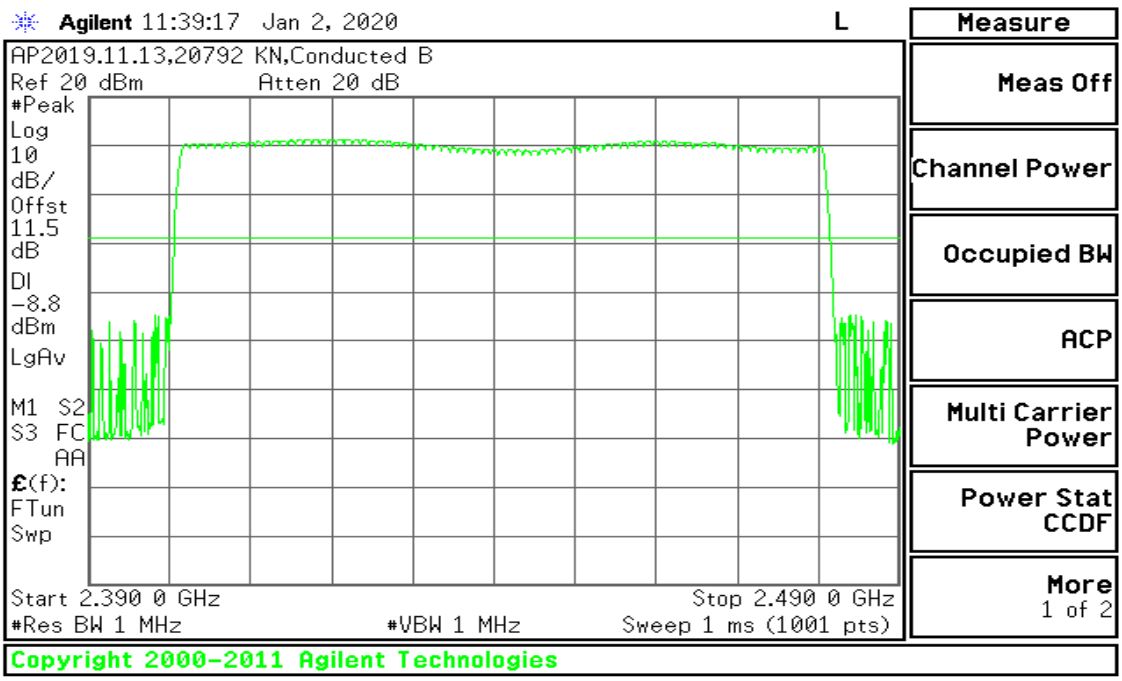
TEST PROCEDURE

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.

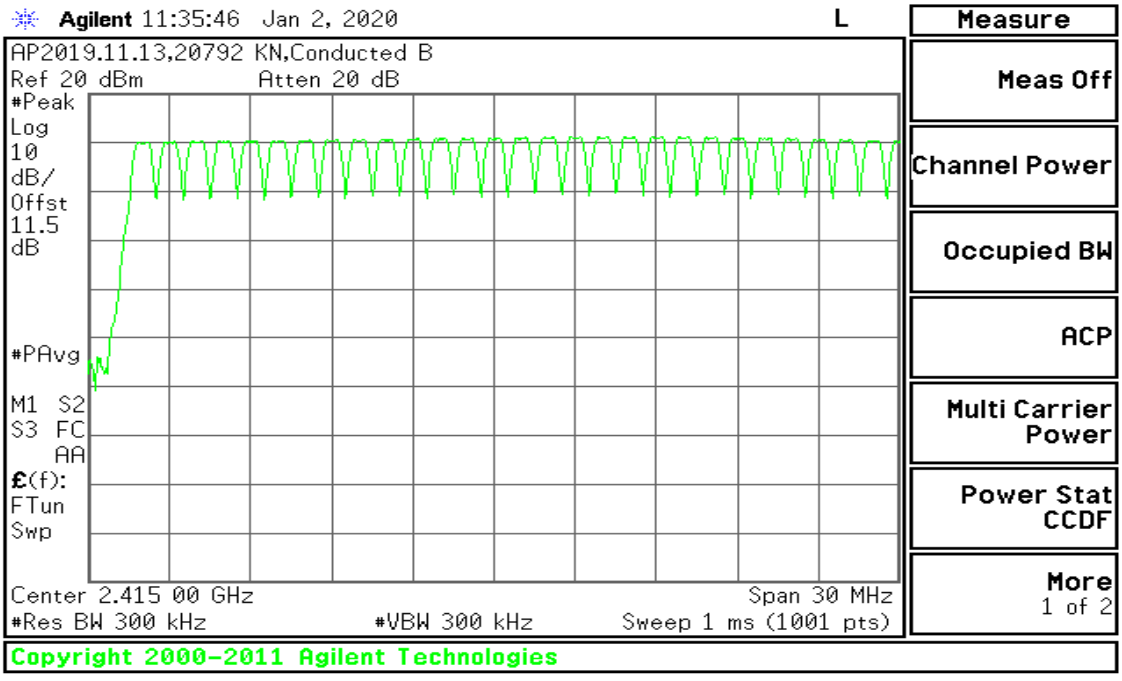
RESULTS

Normal Mode: 79 Channels Observed

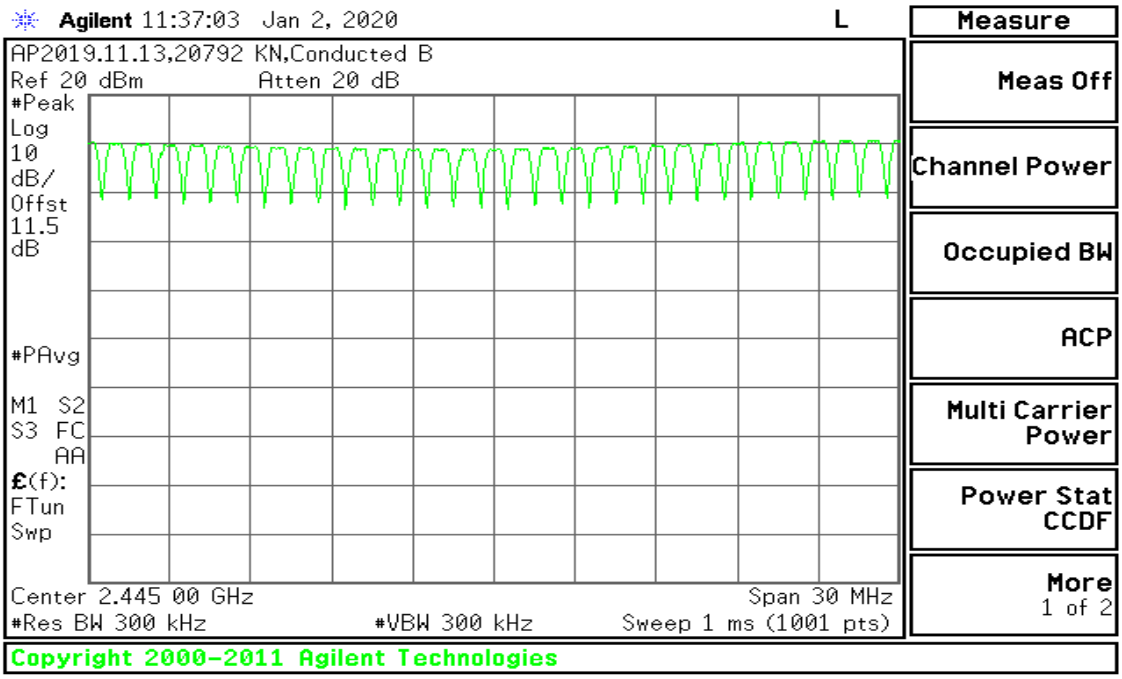
8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



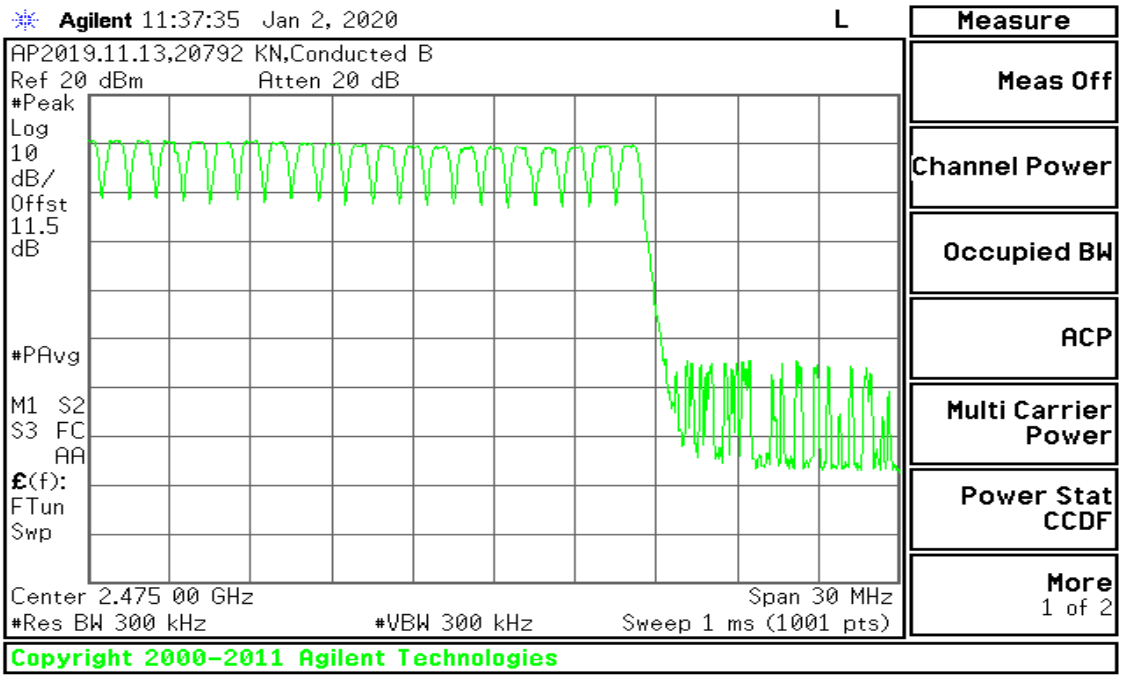
100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3

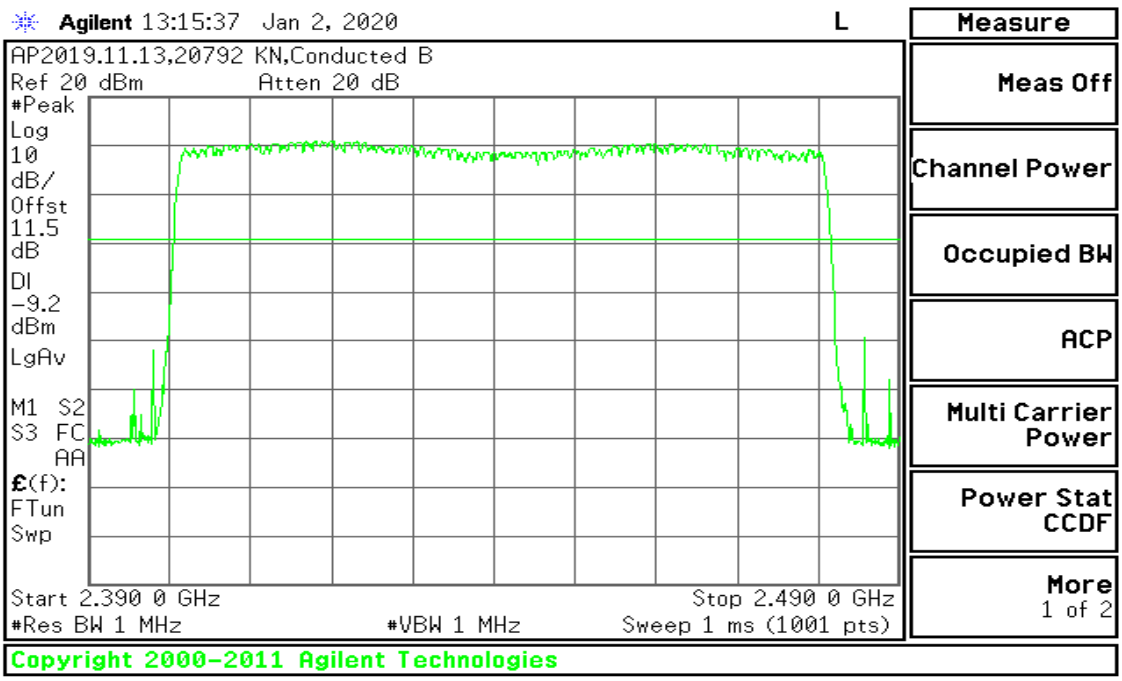


30MHz SPAN, SEGMENT 2 OF 3

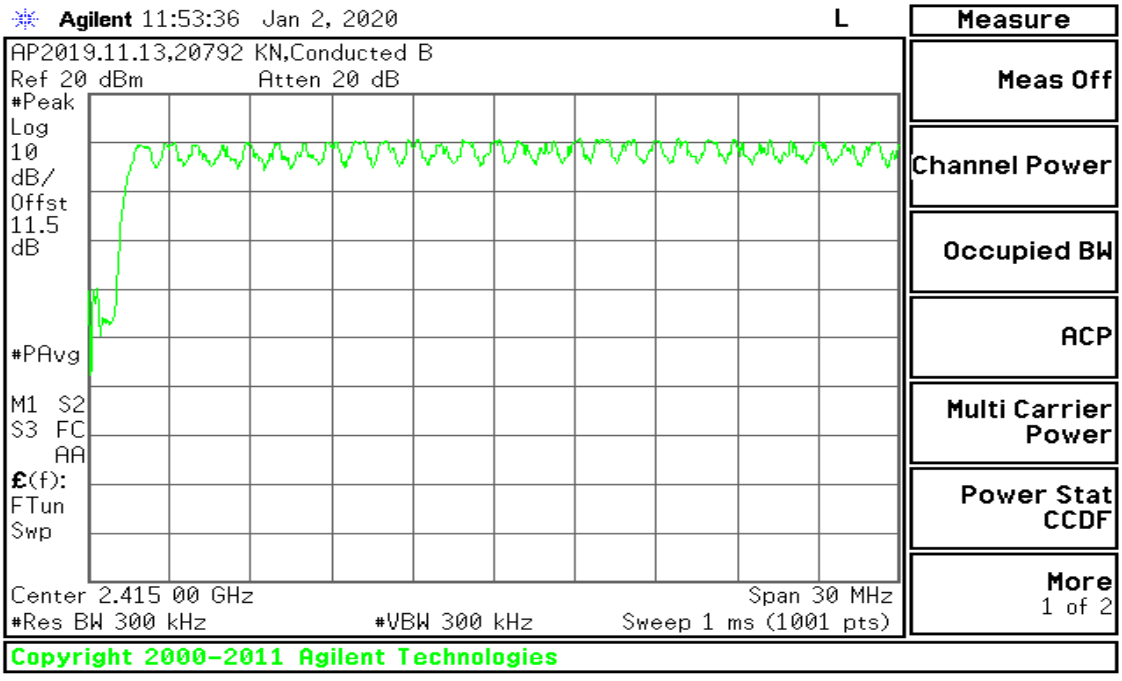


30MHz SPAN, SEGMENT 3 OF 3

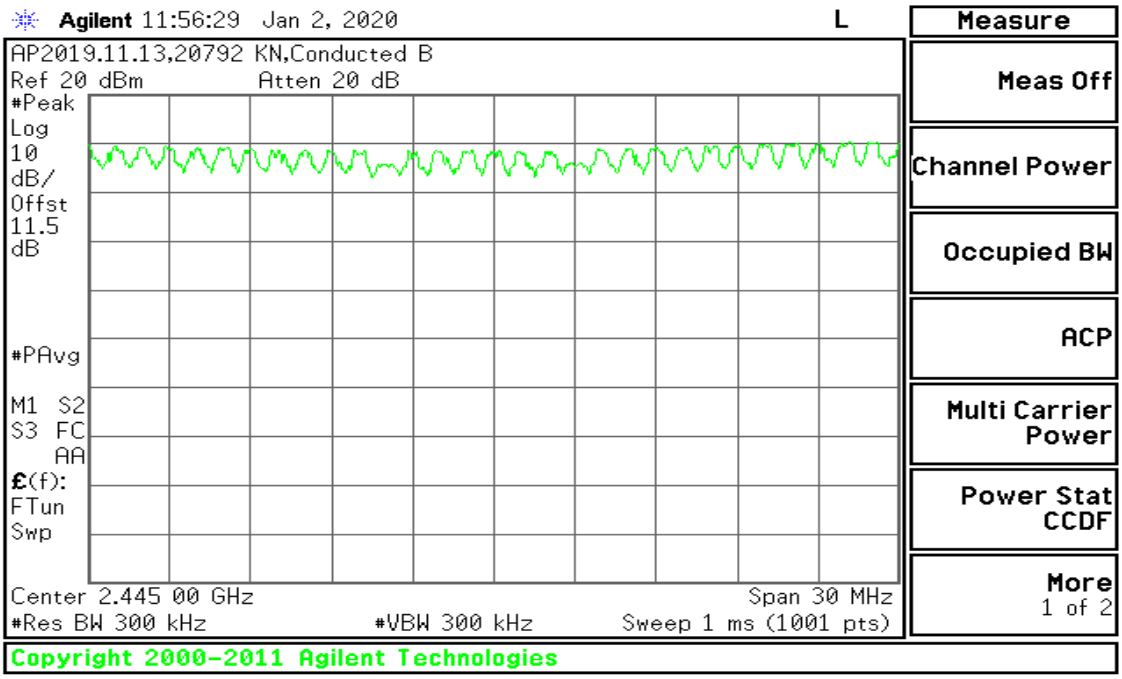
8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



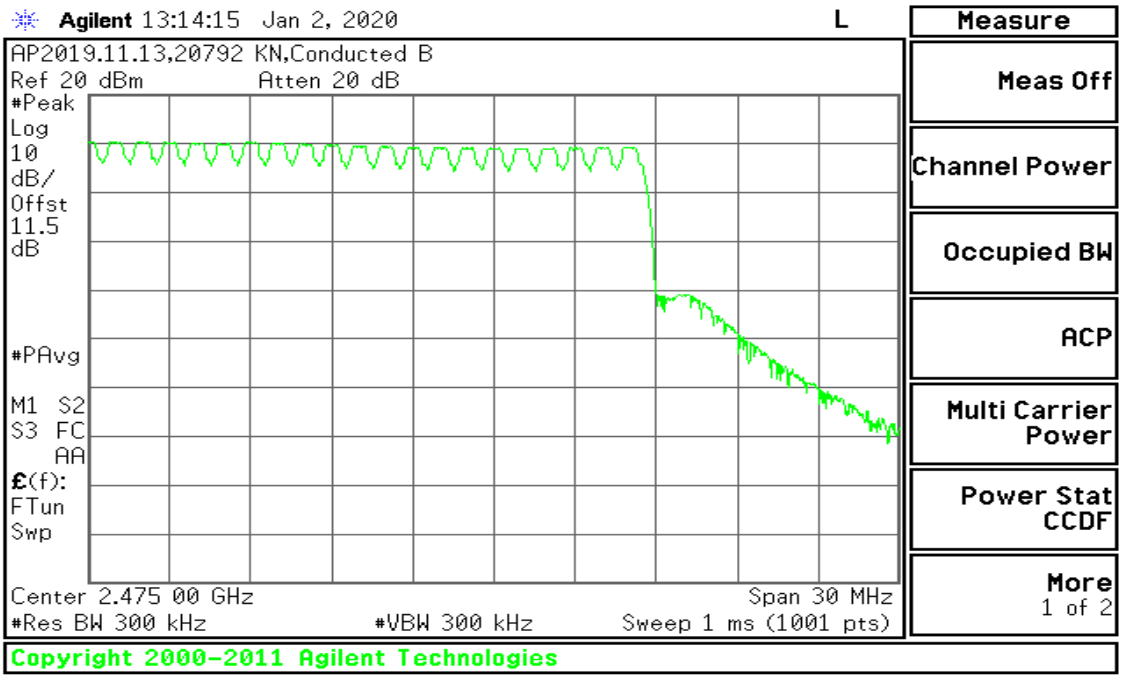
100MHz SPAN



30MHz SPAN, SEGMENT 1 OF 3



30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

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.

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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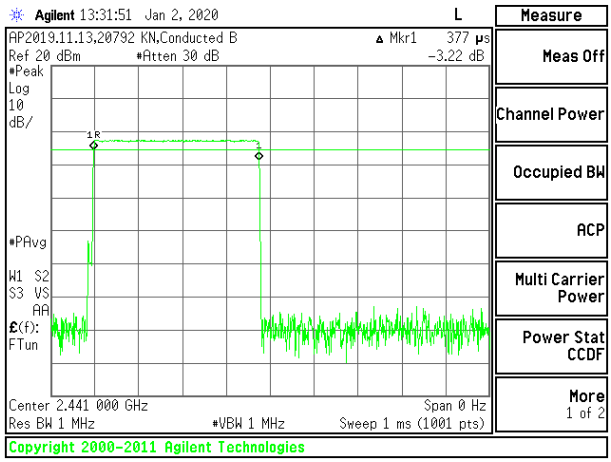
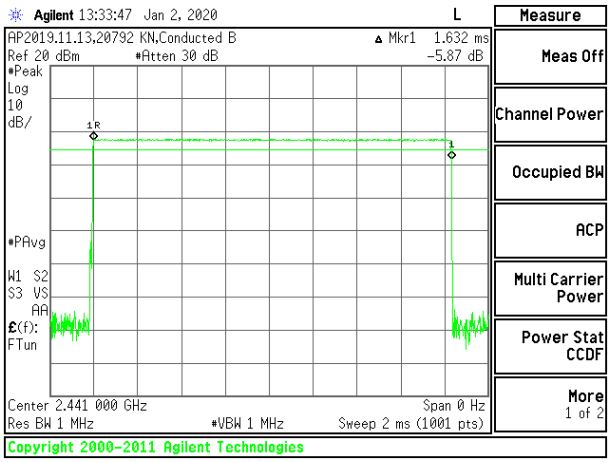
8.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

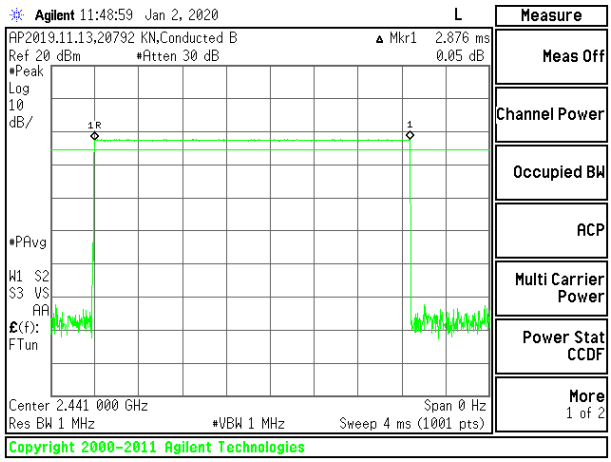
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.377	32	0.1206	0.4	-0.2794
DH3	1.632	14	0.2285	0.4	-0.1715
DH5	2.876	12	0.3451	0.4	-0.0549
DH Packet	Pulse Width (msec)	Number of Pulses in 0.8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK AFH Mode					
DH1	0.377	8	0.03016	0.4	-0.3698
DH3	1.632	3.5	0.05712	0.4	-0.3429
DH5	2.876	3	0.08628	0.4	-0.3137



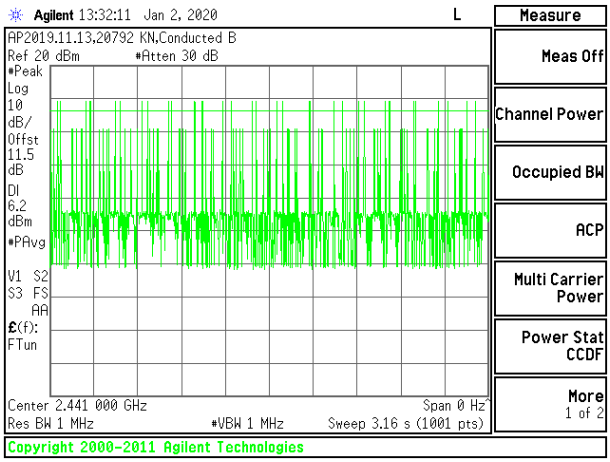
PULSE WIDTH – DH1



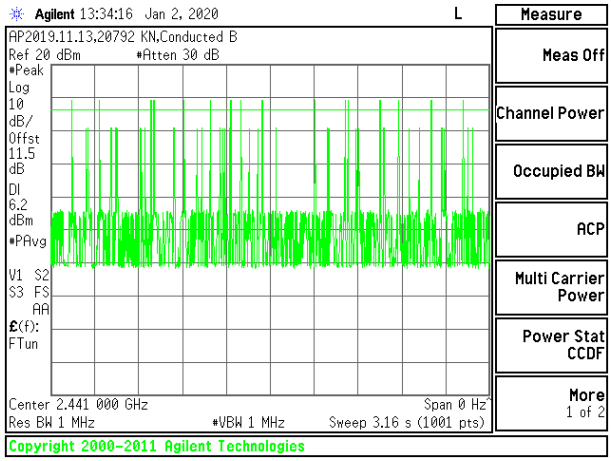
PULSE WIDTH – DH3



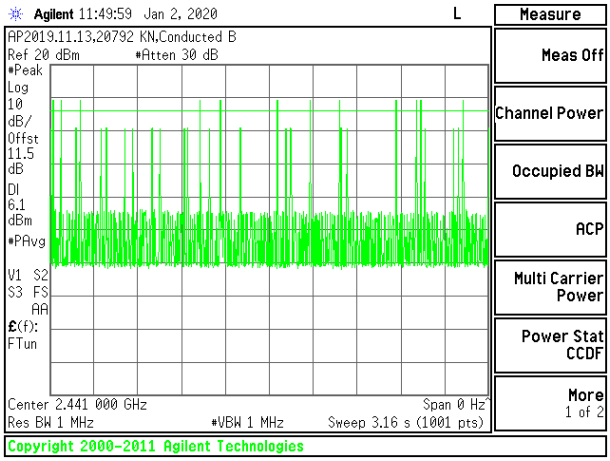
PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3

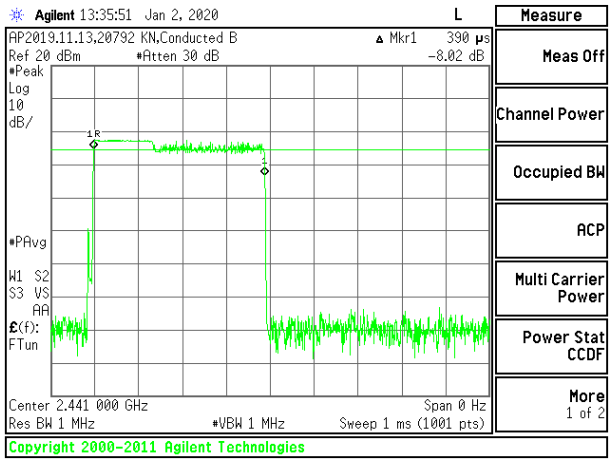


NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5

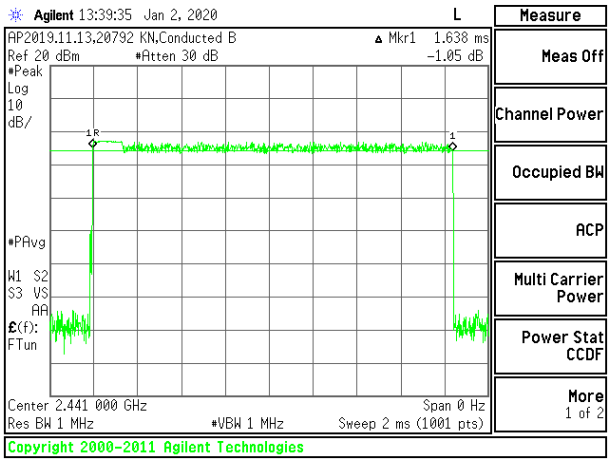
8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

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	0.39	32	0.1248	0.4	-0.2752
3DH3	1.638	14	0.22932	0.4	-0.17068
3DH5	2.888	13	0.37544	0.4	-0.02456

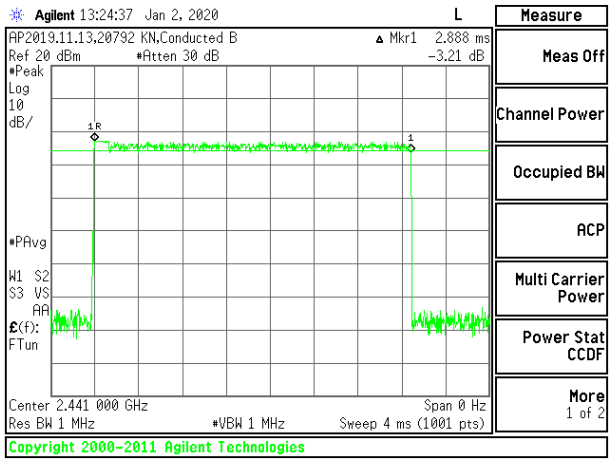
Note: for AFH(8PSK) mode, please refer to the results of AFH(GFSK) mode; the channel selection and hopping rate are the same for both EDR and Basic Rate operation, data for Basic Rate demonstrates compliance with channel occupancy when AFH is employed.



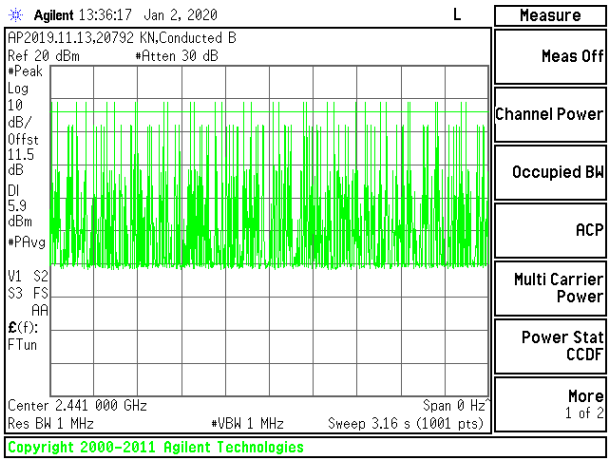
PULSE WIDTH – 3DH1



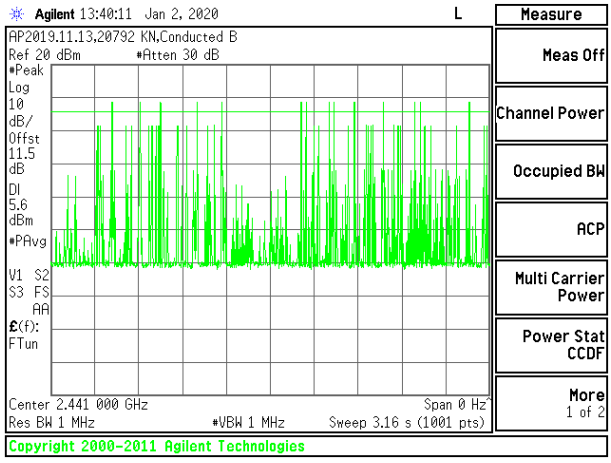
PULSE WIDTH – 3DH3



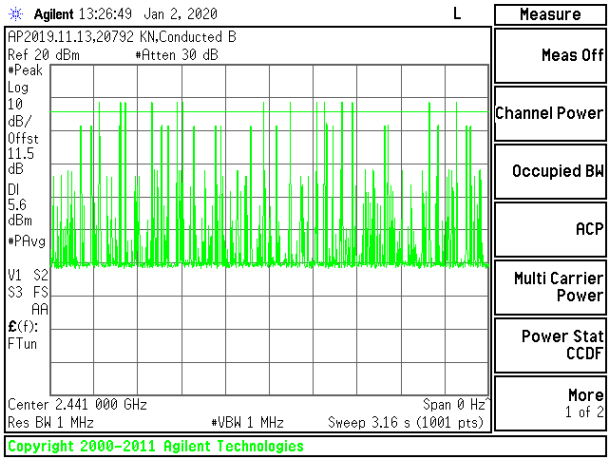
PULSE WIDTH – 3DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH1



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH3



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – 3DH5

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.

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.
The cable assembly insertion loss was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

8.6.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20792 KN
Date:	1/6/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.48	21	-11.52
Middle	2441	8.74	21	-12.26
High	2480	9.09	21	-11.91

8.6.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20792 KN
Date:	1/6/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.22	21	-11.78
Middle	2441	8.44	21	-12.56
High	2480	8.81	21	-12.19

8.6.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20792 KN
Date:	1/6/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	9.85	21	-11.15
Middle	2441	9.15	21	-11.85
High	2480	9.57	21	-11.43

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 was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

UL VERIFICATION SERVICES INC.
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8.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	20792 KN
Date	1/6/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.19
Middle	2441	8.47
High	2480	8.80

8.7.2. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	20792 KN
Date	1/6/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	6.47
Middle	2441	5.72
High	2480	5.94

8.7.3. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	20792 KN
Date	1/6/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	6.48
Middle	2441	5.74
High	2480	5.96

8.8. 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

UL VERIFICATION SERVICES INC.
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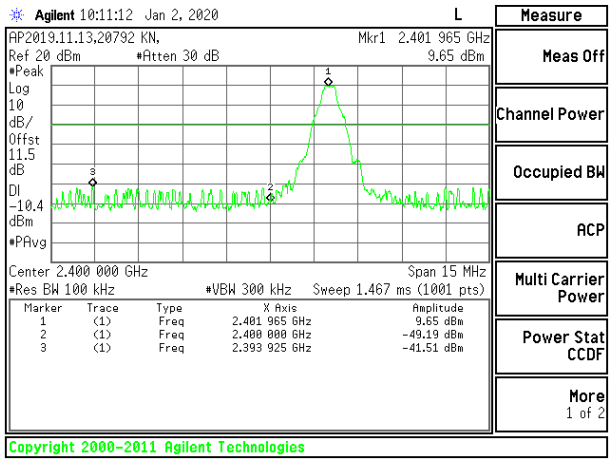
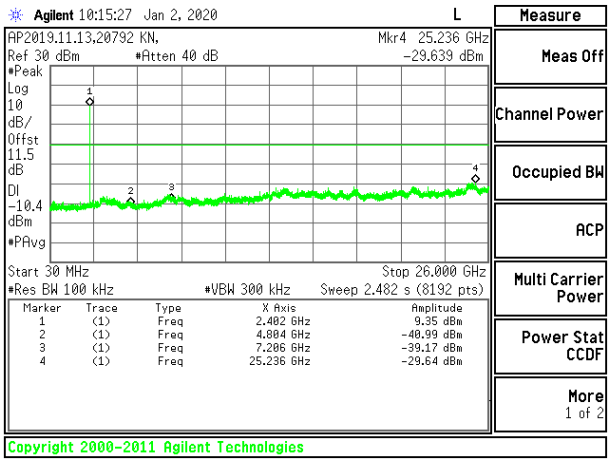
8.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

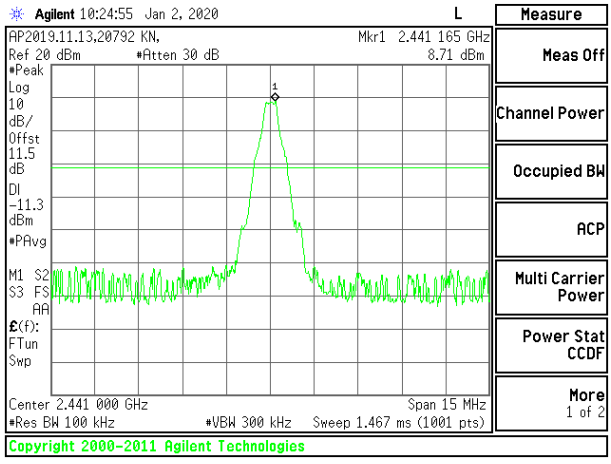
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



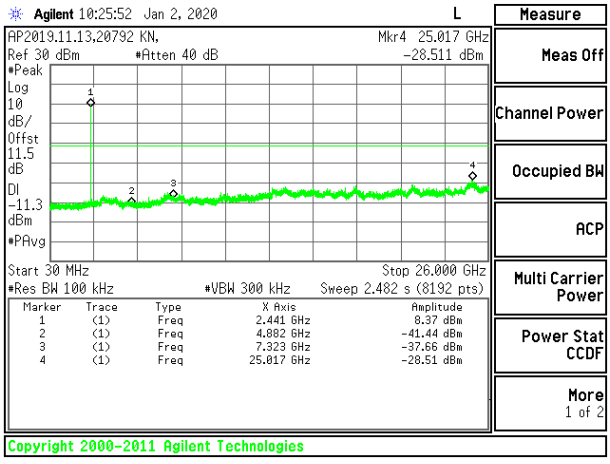
LOW CHANNEL BANDEDGE



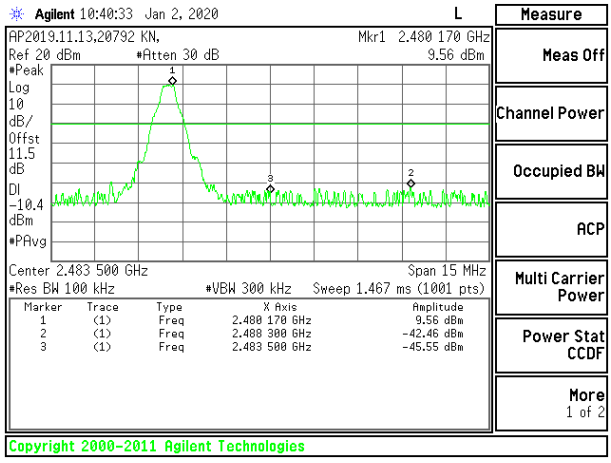
OUT-OF-BAND LOW CHANNEL



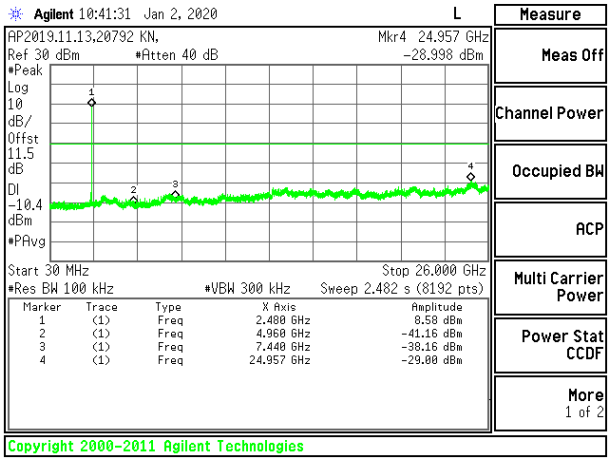
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

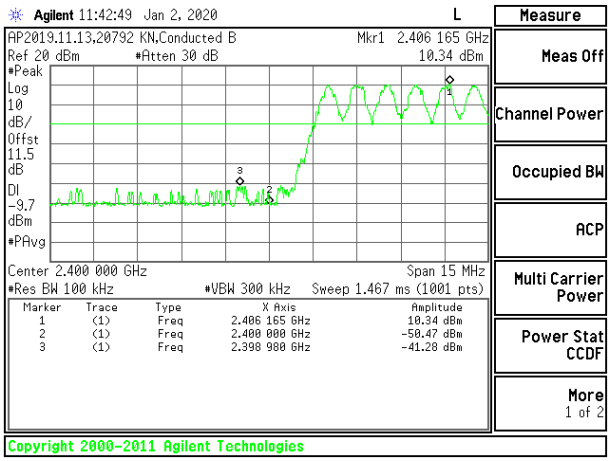


HIGH CHANNEL BANDEDGE

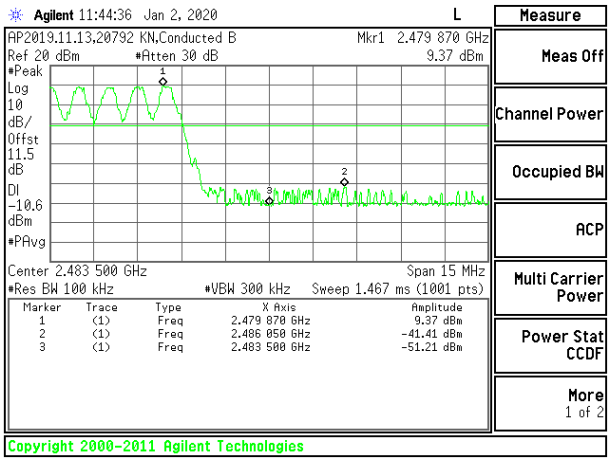


OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



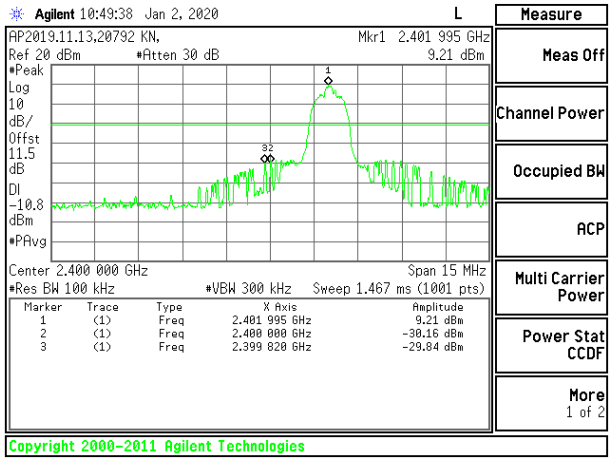
LOW BANDEDGE



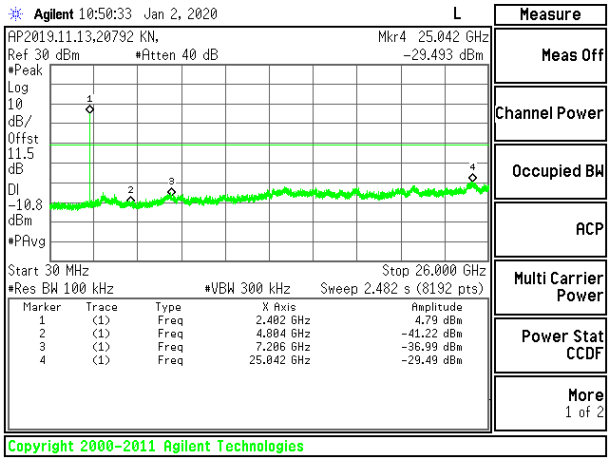
HIGH BANDEDGE

8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

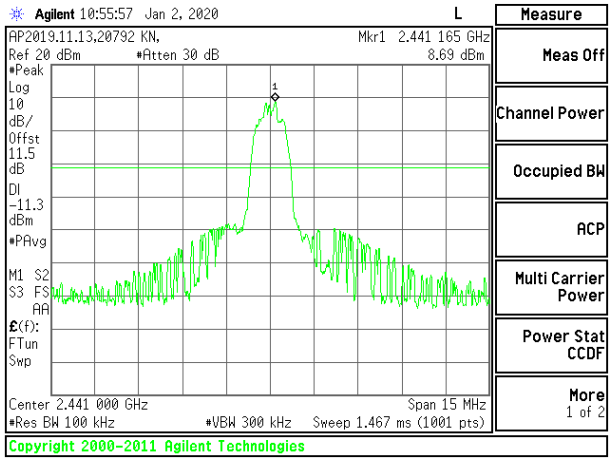
Antenna 1 SPURIOUS EMISSIONS, NON-HOPPING



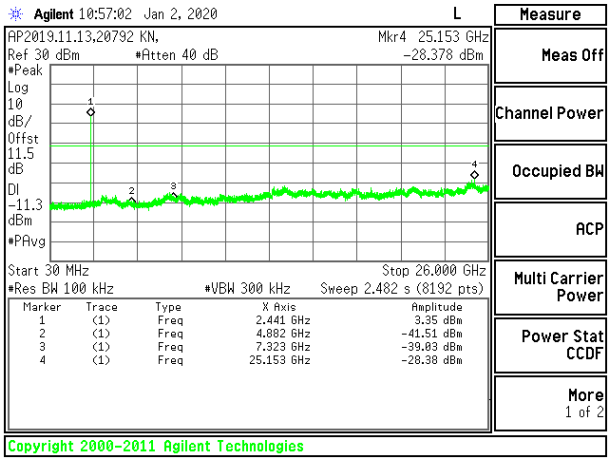
LOW CHANNEL BANDEDGE



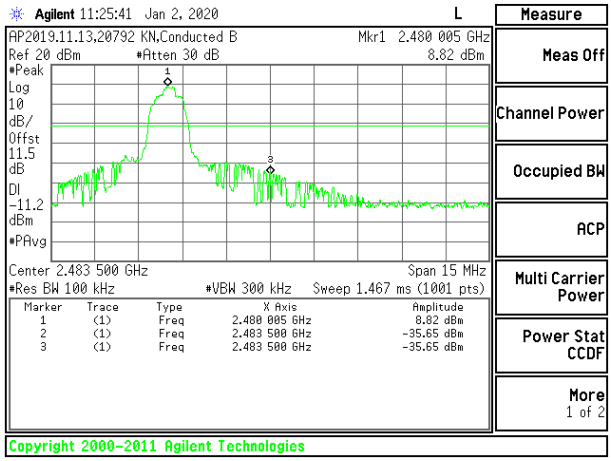
OUT-OF-BAND LOW CHANNEL



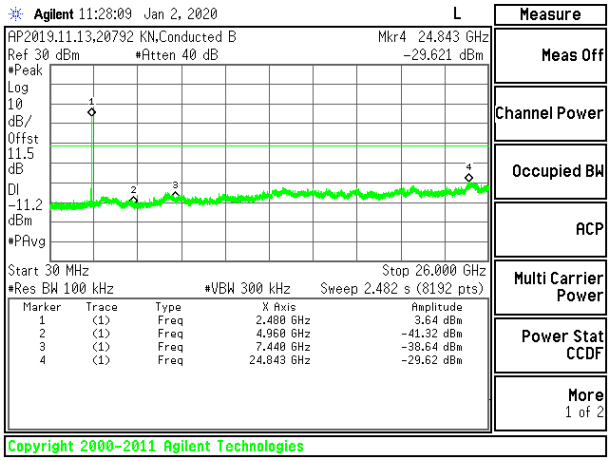
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL

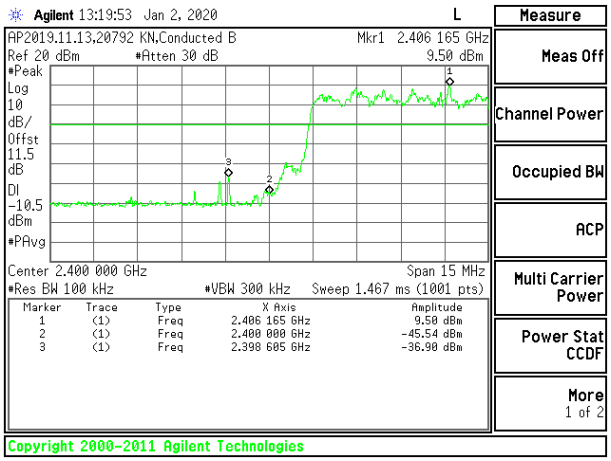


HIGH CHANNEL BANDEDGE

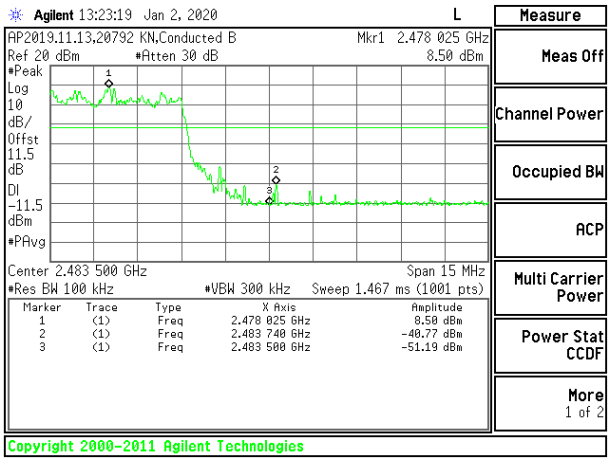


OUT-OF-BAND HIGH CHANNEL

Antenna 1 SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



LOW BANDEDGE



HIGH BANDEDGE

9. 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.

2D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel).

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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 v05r01

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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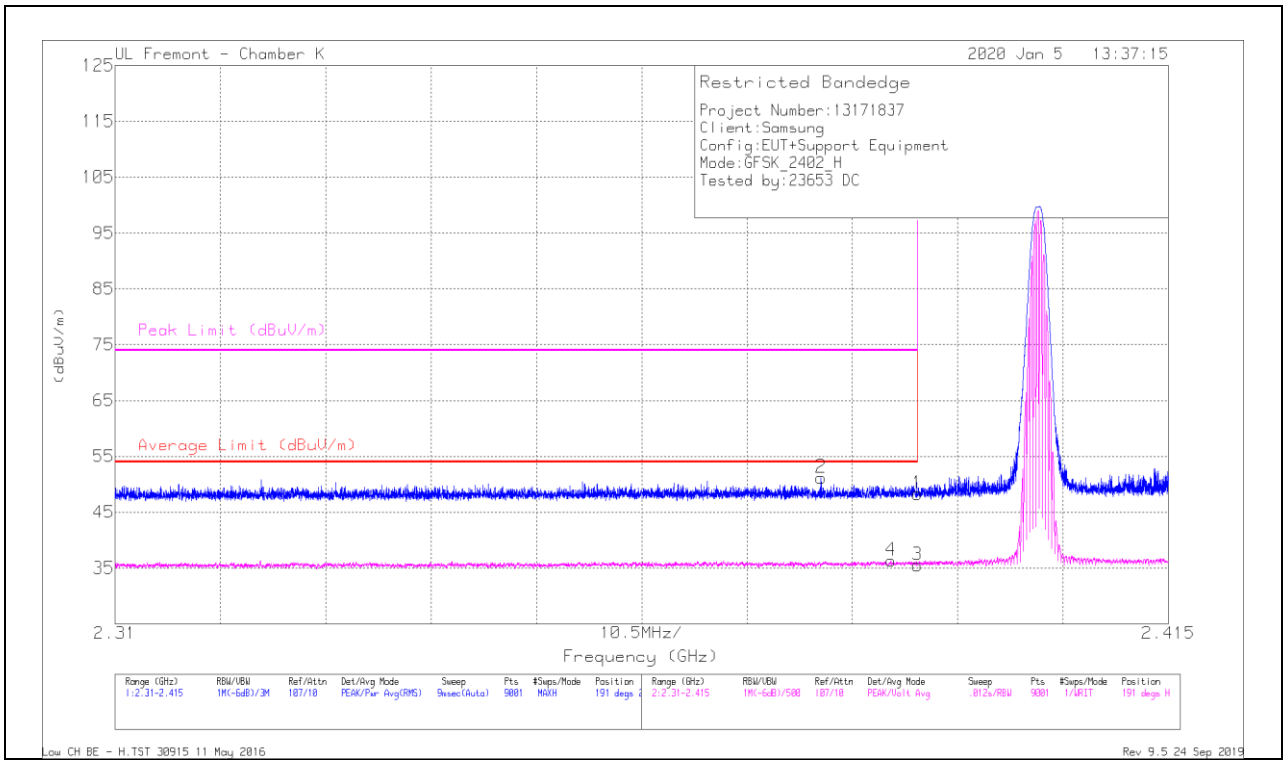
9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

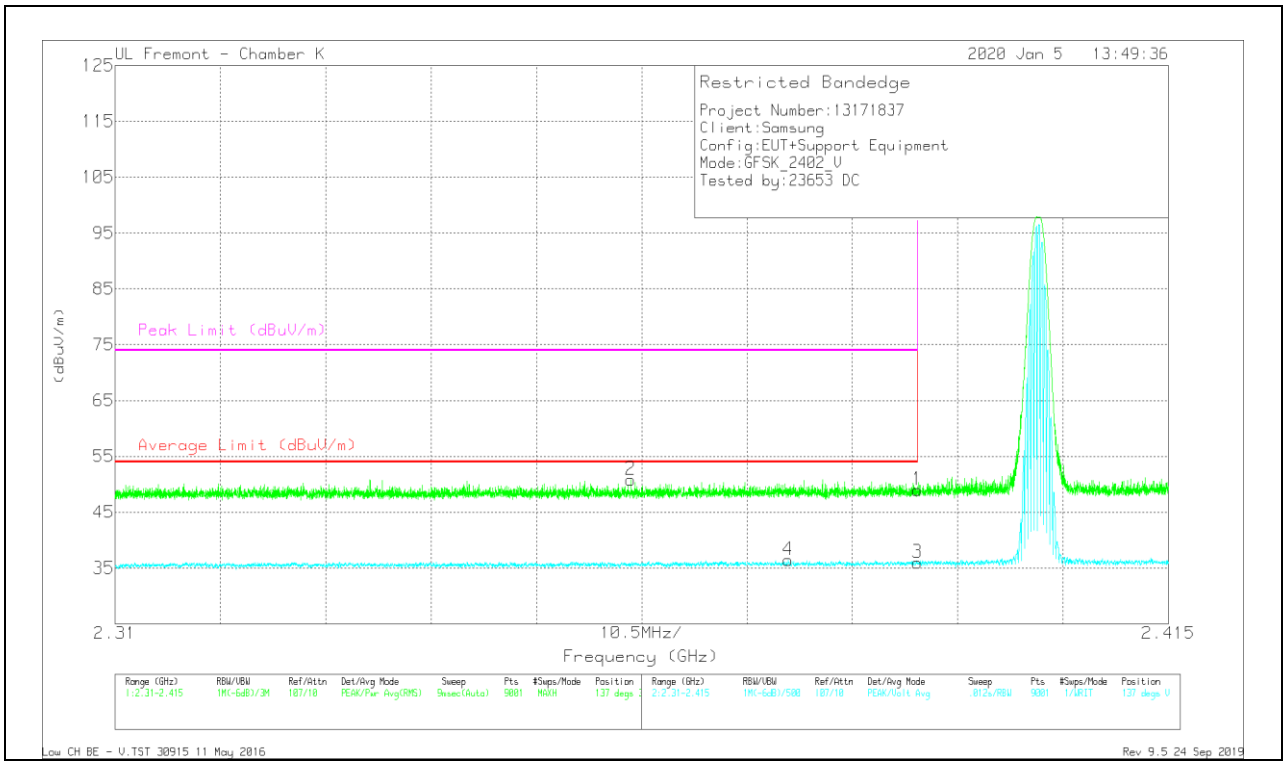
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.38999	41.12	Pk	31.9	-24.7	48.32	-	-	74	-25.68	191	288	H
2	* 2.38038	44	Pk	31.9	-24.7	51.2	-	-	74	-22.8	191	288	H
3	* 2.38999	28.34	VA1T	31.9	-24.7	35.54	54	-18.46	-	-	191	288	H
4	* 2.38733	29.06	VA1T	31.9	-24.6	36.36	54	-17.64	-	-	191	288	H

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

VERTICAL RESULT

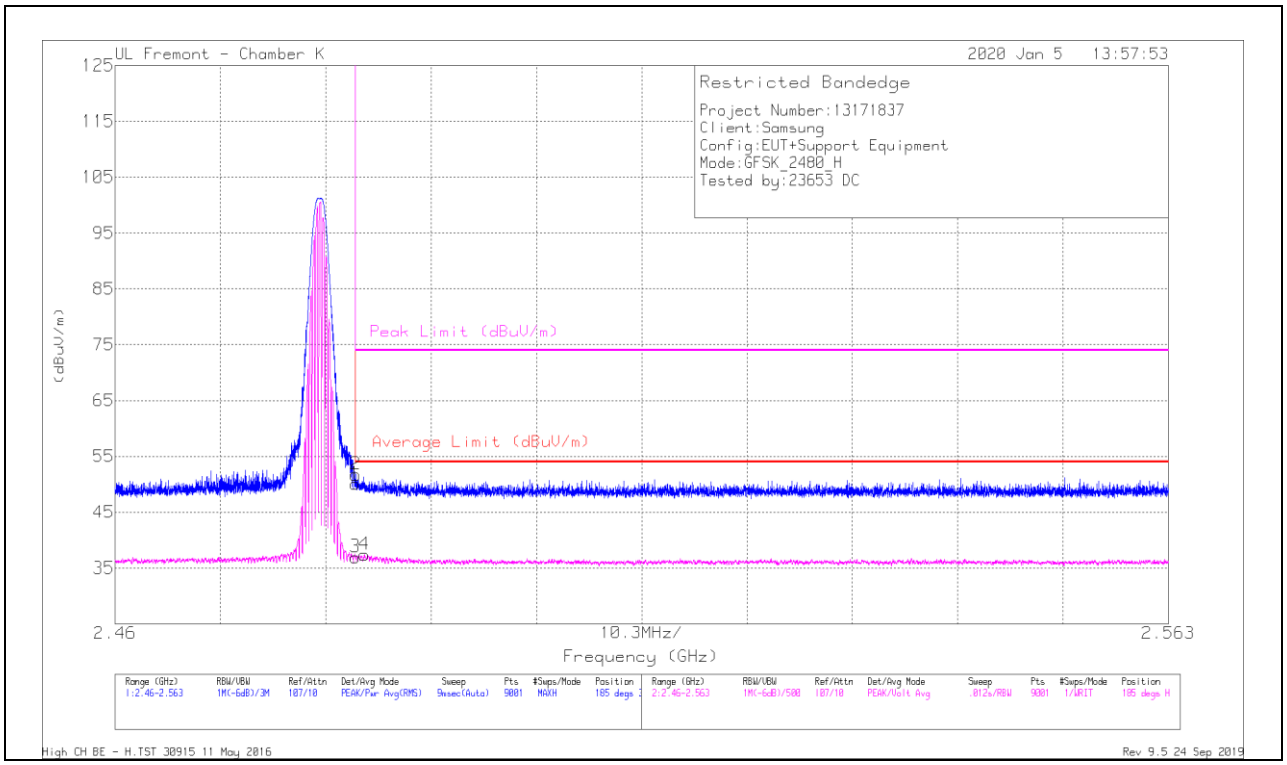


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	41.82	Pk	31.9	-24.7	49.02	-	-	74	-24.98	137	376	V
2	* 2.36138	43.64	Pk	31.8	-24.6	50.84	-	-	74	-23.16	137	376	V
3	* 2.38999	28.78	VA1T	31.9	-24.7	35.98	54	-18.02	-	-	137	376	V
4	* 2.37711	29.24	VA1T	31.9	-24.7	36.44	54	-17.56	-	-	137	376	V

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

BANDEDGE (HIGH CHANNEL)

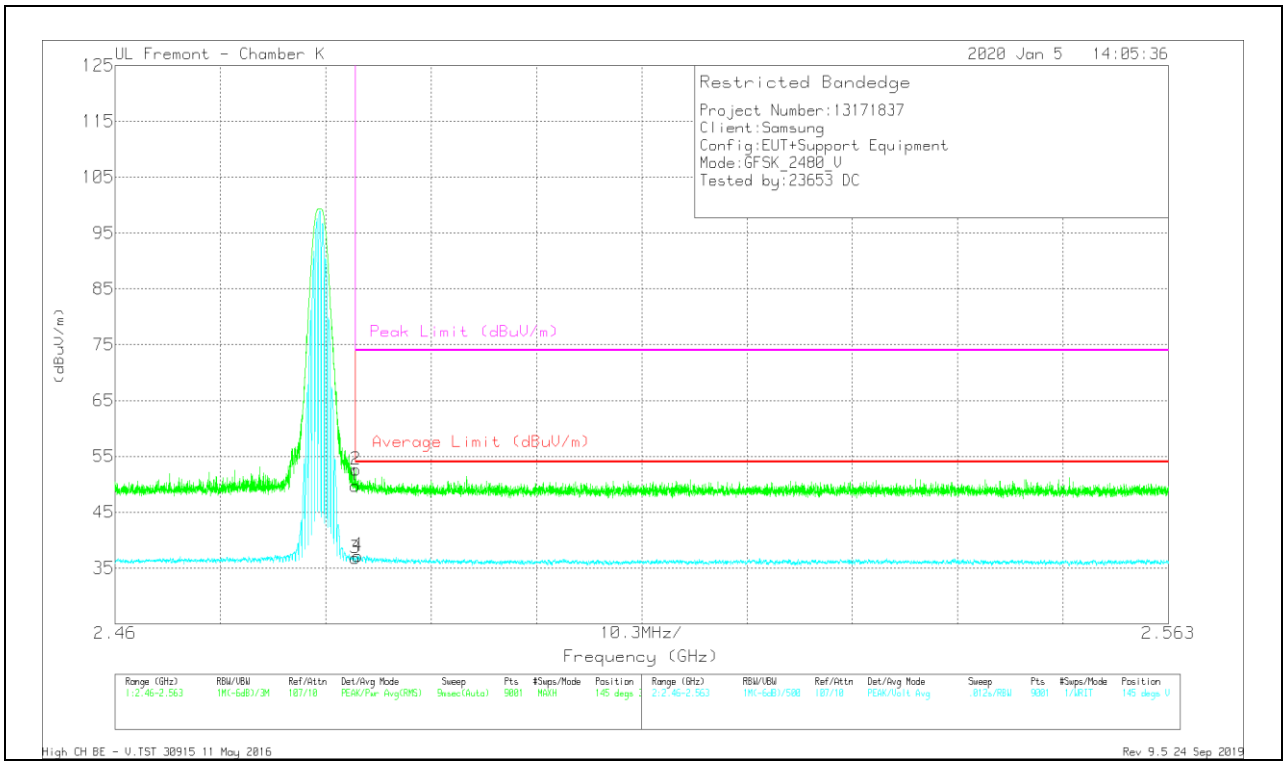
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.48351	42.35	Pk	32.5	-24.8	50.05	-	-	74	-23.95	185	308	H
2	* 2.48352	44.03	Pk	32.5	-24.8	51.73	-	-	74	-22.27	185	308	H
3	* 2.48351	29.24	VA1T	32.5	-24.8	36.94	54	-17.06	-	-	185	308	H
4	* 2.48438	29.7	VA1T	32.5	-24.8	37.4	54	-16.6	-	-	185	308	H

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

VERTICAL RESULT

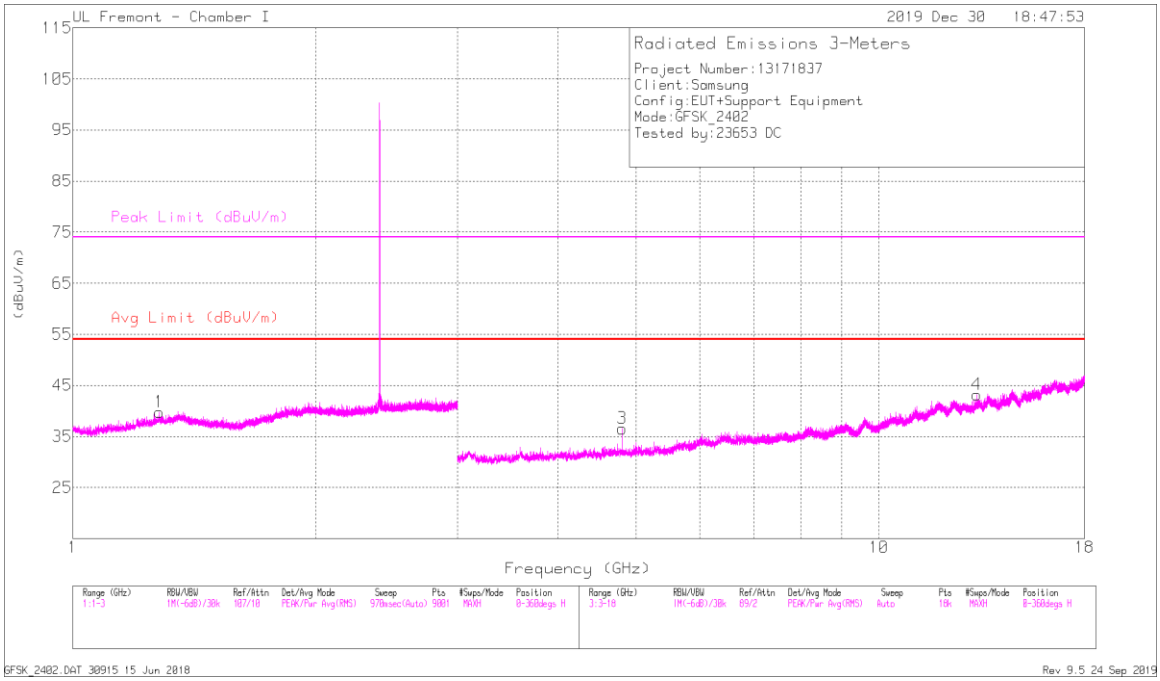


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	42.06	Pk	32.5	-24.8	49.76	-	-	74	-24.24	145	397	V
2	* 2.48354	44.92	Pk	32.5	-24.8	52.62	-	-	74	-21.38	145	397	V
3	* 2.48351	29.07	VA1T	32.5	-24.8	36.77	54	-17.23	-	-	145	397	V
4	* 2.48372	29.48	VA1T	32.5	-24.8	37.18	54	-16.82	-	-	145	397	V

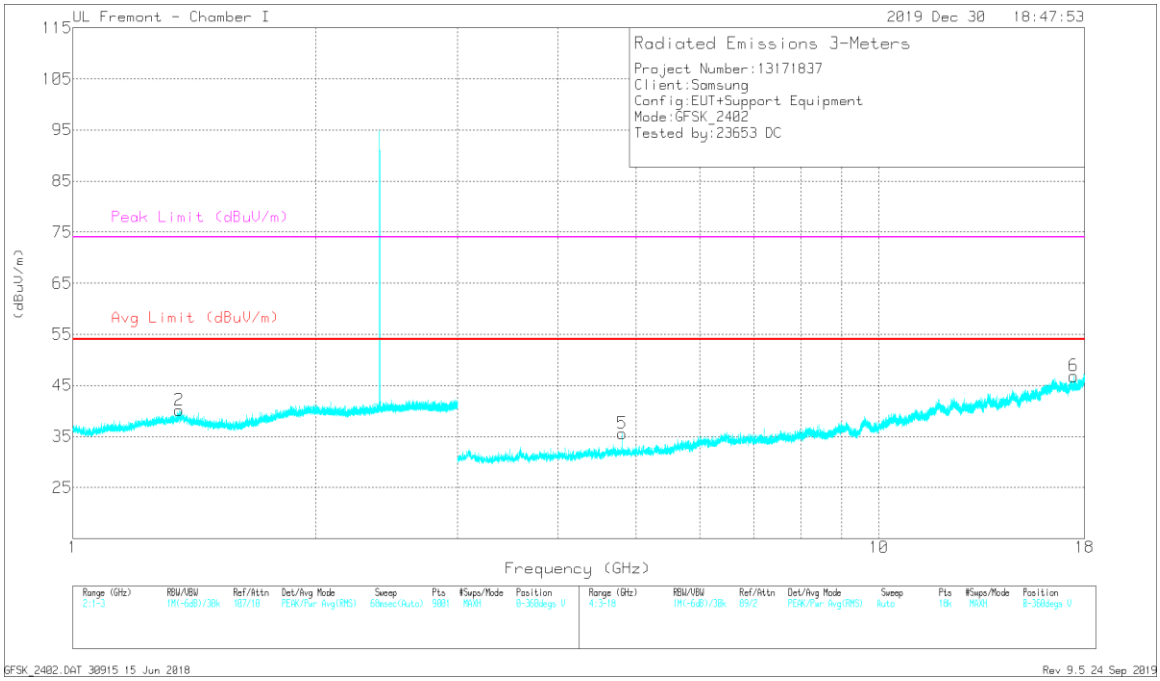
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton (in Hz) where Ton is the transmit duration.

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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
* 1.279	39.36	PKFH	29.4	-23.9	44.86	-	-	74	-29.14	111	173	H
* 1.2809	26.56	VA1T	29.4	-24	31.96	54	-22.04	-	-	111	173	H
* 1.35542	39.29	PKFH	29.6	-23.8	45.09	-	-	74	-28.91	345	137	V
* 1.35657	26.7	VA1T	29.6	-23.8	32.5	54	-21.5	-	-	345	137	V
13.22798	29.04	PKFH	39.1	-19.9	48.24	-	-	-	-	15	230	H
* 4.80418	35.09	PKFH	34.2	-30.3	38.99	-	-	74	-35.01	57	107	H
* 4.8041	23.82	VA1T	34.2	-30.3	27.72	54	-26.28	-	-	57	107	H
17.44722	28.28	PKFH	40.5	-15.8	52.98	-	-	-	-	93	312	V
* 4.80418	36.44	PKFH	34.2	-30.3	40.34	-	-	74	-33.66	68	108	V
* 4.80411	25.88	VA1T	34.2	-30.3	29.78	54	-24.22	-	-	68	108	V

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

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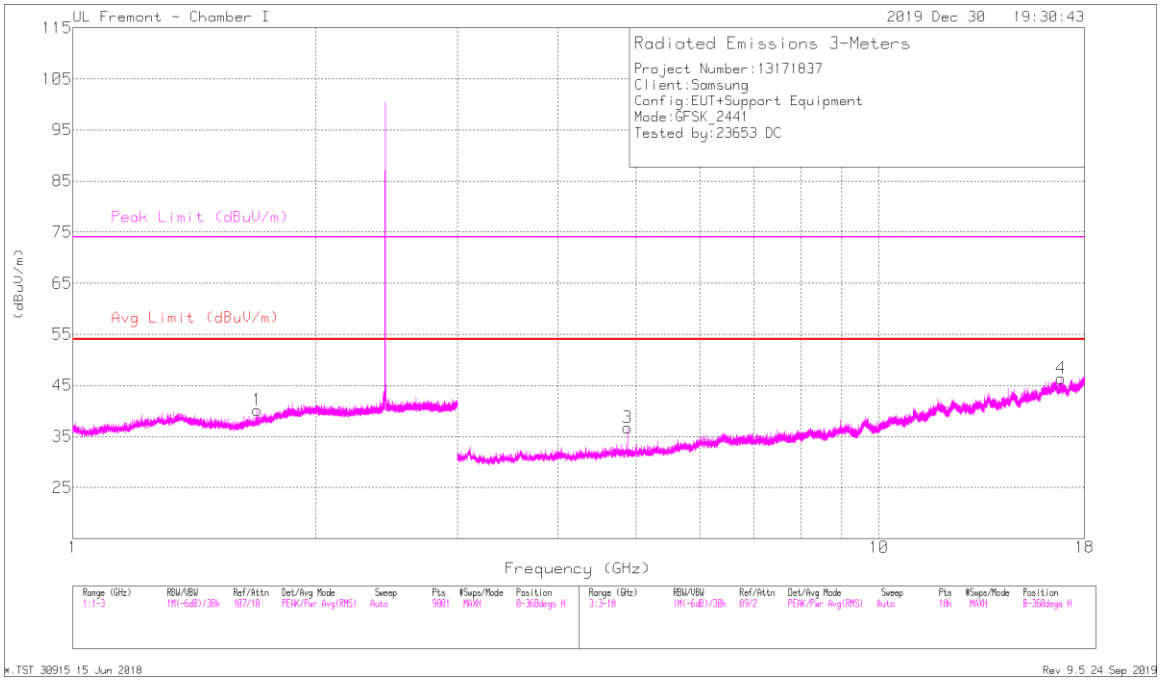
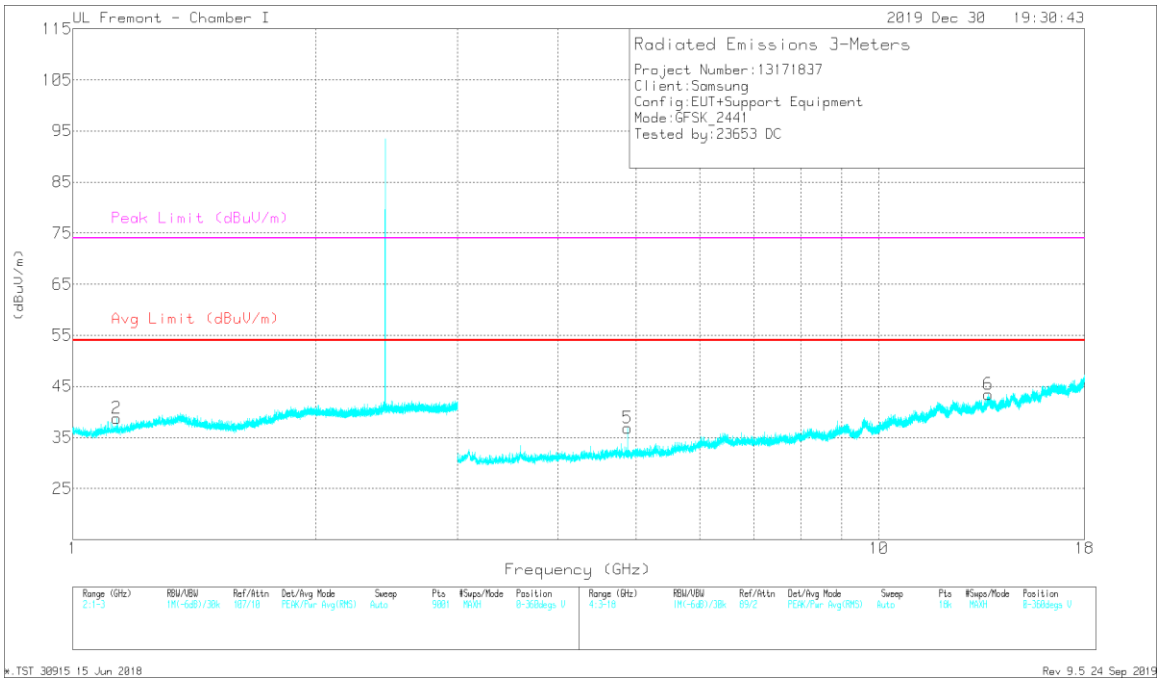
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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
* 1.69269	38.94	PKFH	29	-24.2	43.74	-	-	74	-30.26	76	194	H
* 1.69301	26.17	VA1T	29	-24.2	30.97	54	-23.03	-	-	76	194	H
* 1.13356	40.14	PKFH	27.6	-23.8	43.94	-	-	74	-30.06	302	171	V
* 1.13212	27.07	VA1T	27.6	-23.8	30.87	54	-23.13	-	-	302	171	V
16.82236	29.01	PKFH	40.9	-16.8	53.11	-	-	-	-	15	161	H
* 4.88184	36.92	PKFH	34.1	-30.5	40.52	-	-	74	-33.48	50	114	H
* 4.88203	27.08	VA1T	34.1	-30.5	30.68	54	-23.32	-	-	50	114	H
13.6778	29.69	PKFH	38.7	-18.8	49.59	-	-	-	-	76	353	V
* 4.8817	35.91	PKFH	34.1	-30.5	39.51	-	-	74	-34.49	73	120	V
* 4.88212	26.22	VA1T	34.1	-30.5	29.82	54	-24.18	-	-	73	120	V

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

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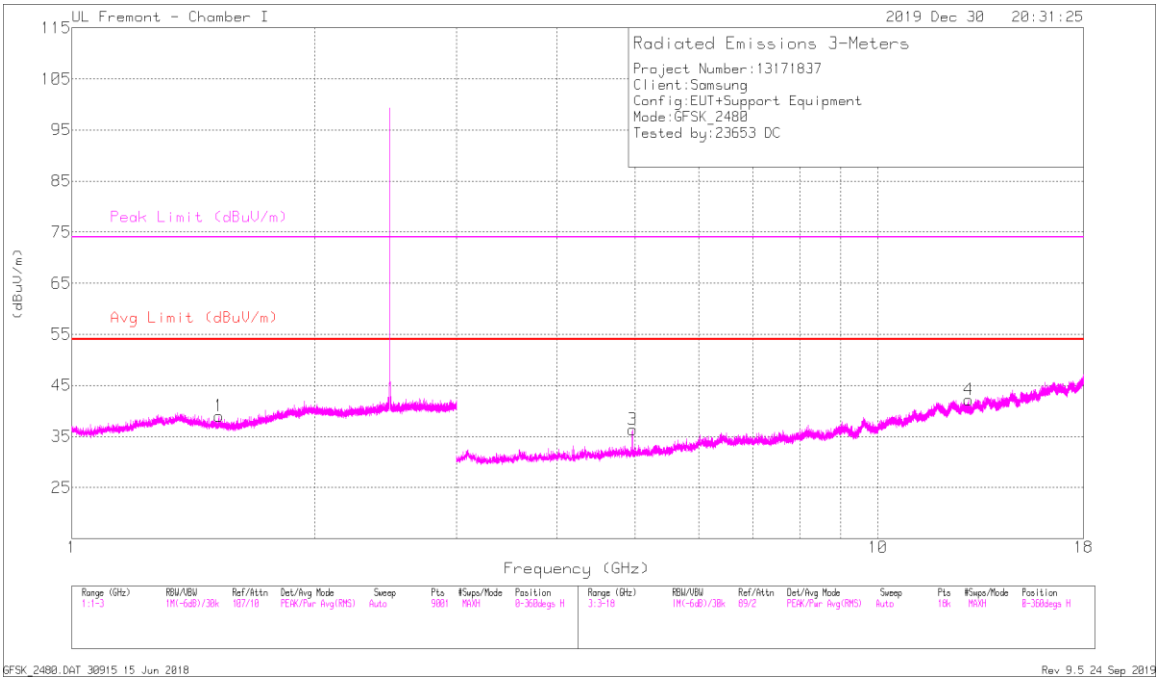
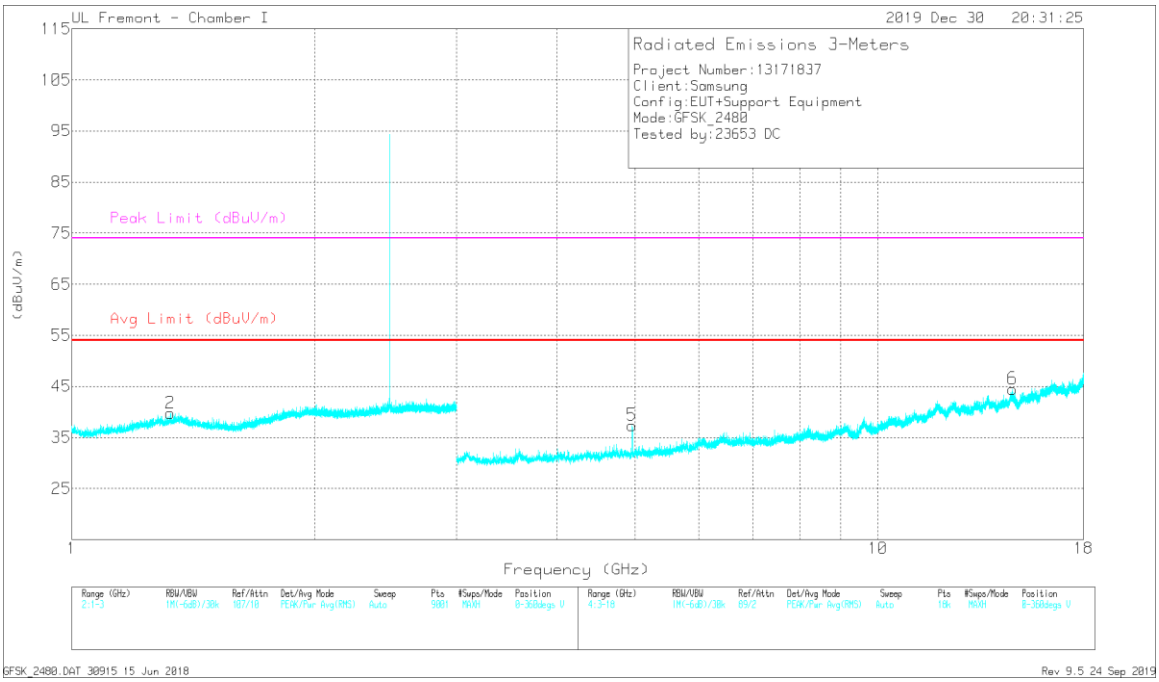
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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
* 1.52377	39.57	PKFH	28.1	-23.8	43.87	-	-	74	-30.13	254	117	H
* 1.52305	26.91	VA1T	28.1	-23.8	31.21	54	-22.79	-	-	254	117	H
* 1.32746	39.56	PKFH	29.2	-24	44.76	-	-	74	-29.24	209	154	V
* 1.32667	26.62	VA1T	29.2	-23.9	31.92	54	-22.08	-	-	209	154	V
12.97413	29.78	PKFH	39.1	-20	48.88	-	-	-	-	161	332	H
* 4.96025	36.61	PKFH	34.1	-30.6	40.11	-	-	74	-33.89	63	134	H
* 4.9601	26.81	VA1T	34.1	-30.6	30.31	54	-23.69	-	-	63	134	H
14.69337	28.92	PKFH	39.9	-18.6	50.22	-	-	-	-	278	148	V
* 4.95992	36.54	PKFH	34.1	-30.6	40.04	-	-	74	-33.96	58	107	V
* 4.96013	26.83	VA1T	34.1	-30.6	30.33	54	-23.67	-	-	58	107	V

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

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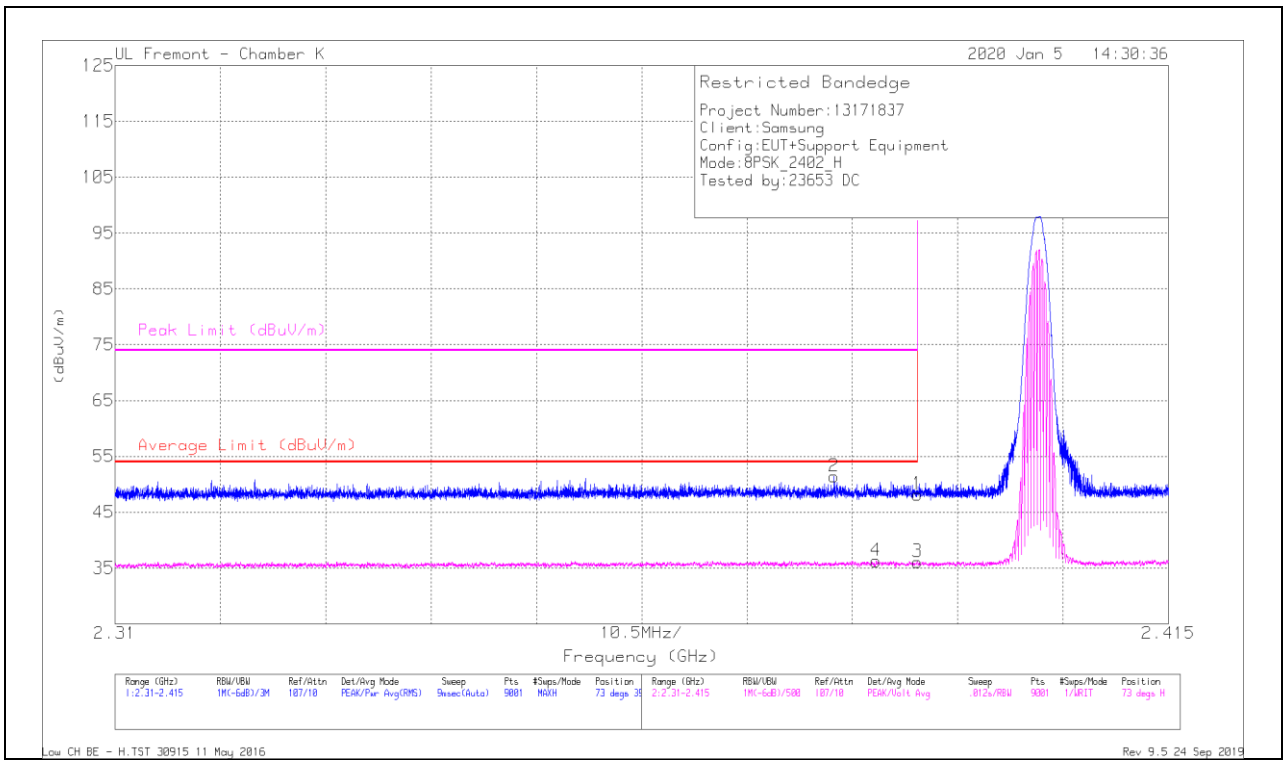
9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

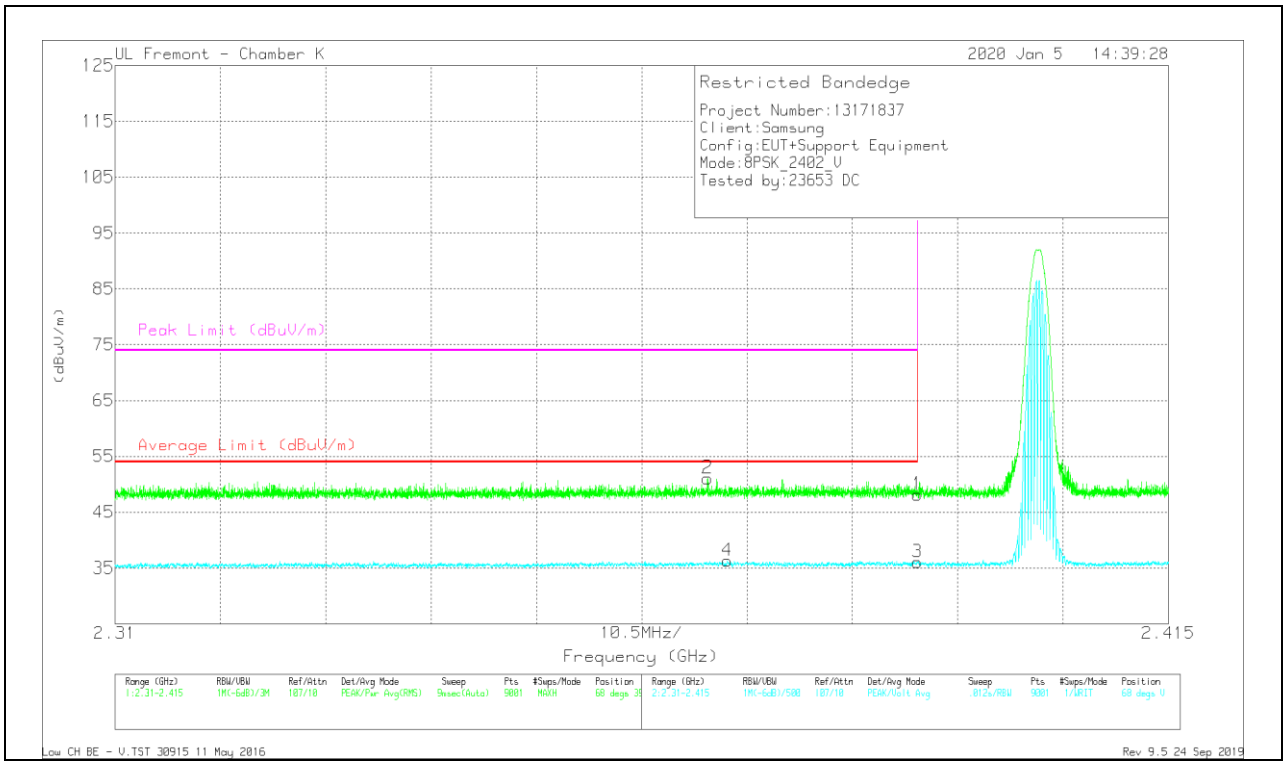
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.38999	40.95	Pk	31.9	-24.7	48.15	-	-	74	-25.85	73	397	H
2	* 2.38168	44.2	Pk	31.9	-24.7	51.4	-	-	74	-22.6	73	397	H
3	* 2.38999	28.91	VA1T	31.9	-24.7	36.11	54	-17.89	-	-	73	397	H
4	* 2.38587	28.97	VA1T	31.9	-24.6	36.27	54	-17.73	-	-	73	397	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 the transmit duration

VERTICAL RESULT

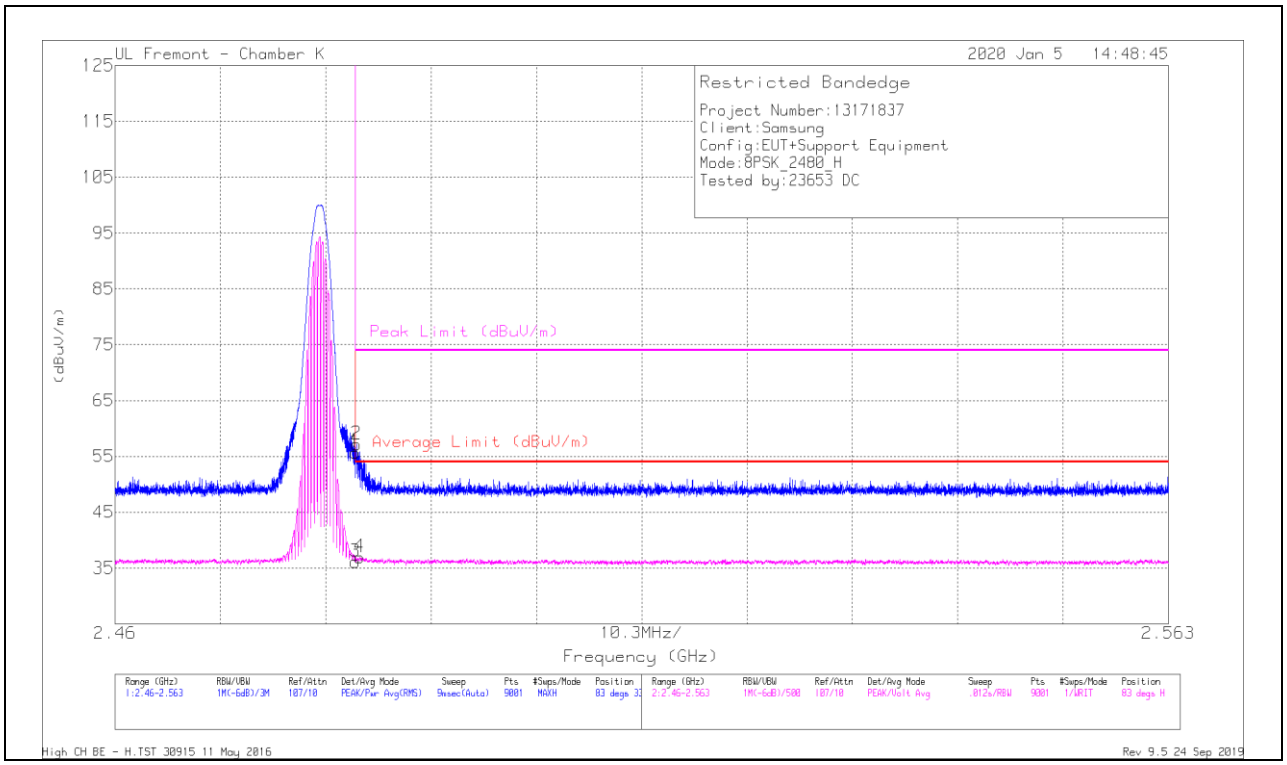


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	40.94	Pk	31.9	-24.7	48.14	-	-	74	-25.86	68	392	V
2	* 2.36906	43.77	Pk	31.9	-24.6	51.07	-	-	74	-22.93	68	392	V
3	* 2.38999	28.84	VA1T	31.9	-24.7	36.04	54	-17.96	-	-	68	392	V
4	* 2.37104	29	VA1T	31.9	-24.6	36.3	54	-17.7	-	-	68	392	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 the transmit duration

BANDEDGE (HIGH CHANNEL)

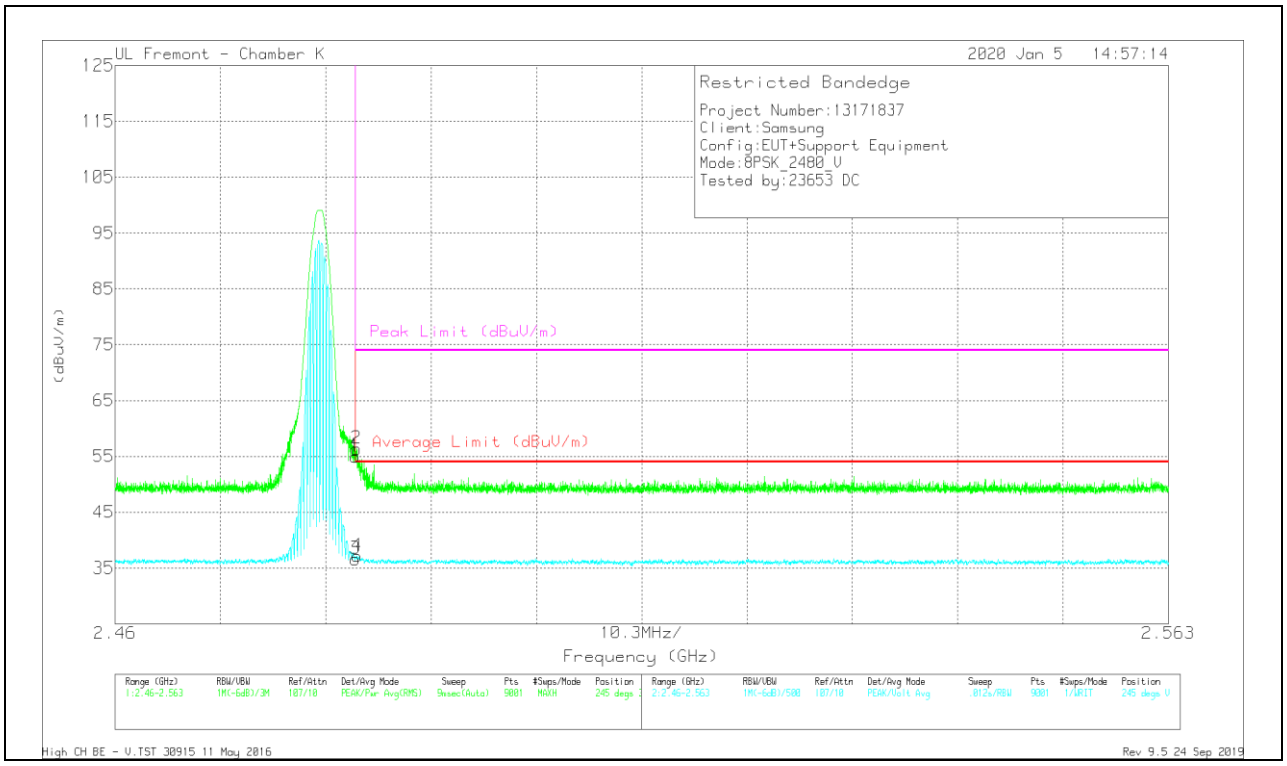
HORIZONTAL RESULT



Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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	* 2.48351	48.02	Pk	32.5	-24.8	55.72	-	-	74	-18.28	83	333	H
2	* 2.48361	49.48	Pk	32.5	-24.8	57.18	-	-	74	-16.82	83	333	H
3	* 2.48351	28.44	VA1T	32.5	-24.8	36.14	54	-17.86	-	-	83	333	H
4	* 2.48392	29.26	VA1T	32.5	-24.8	36.96	54	-17.04	-	-	83	333	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 the transmit duration

VERTICAL RESULT

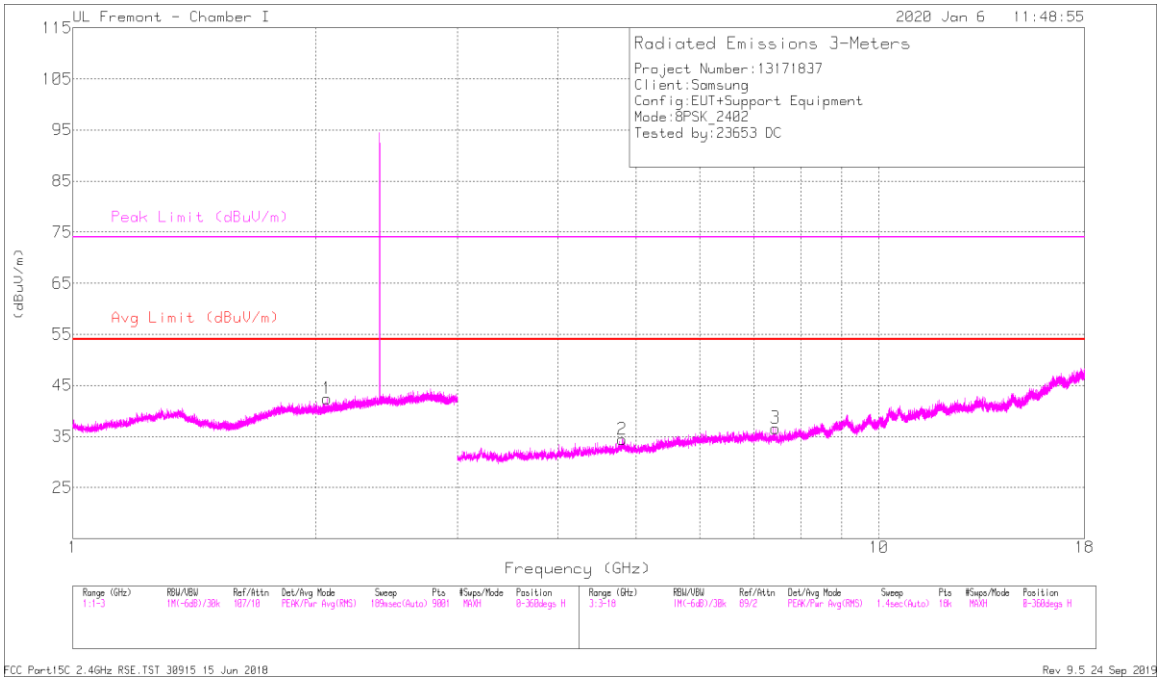


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	47.23	Pk	32.5	-24.8	54.93	-	-	74	-19.07	245	391	V
2	* 2.4836	48.67	Pk	32.5	-24.8	56.37	-	-	74	-17.63	245	391	V
3	* 2.48351	28.93	VA1T	32.5	-24.8	36.63	54	-17.37	-	-	245	391	V
4	* 2.48367	29.46	VA1T	32.5	-24.8	37.16	54	-16.84	-	-	245	391	V

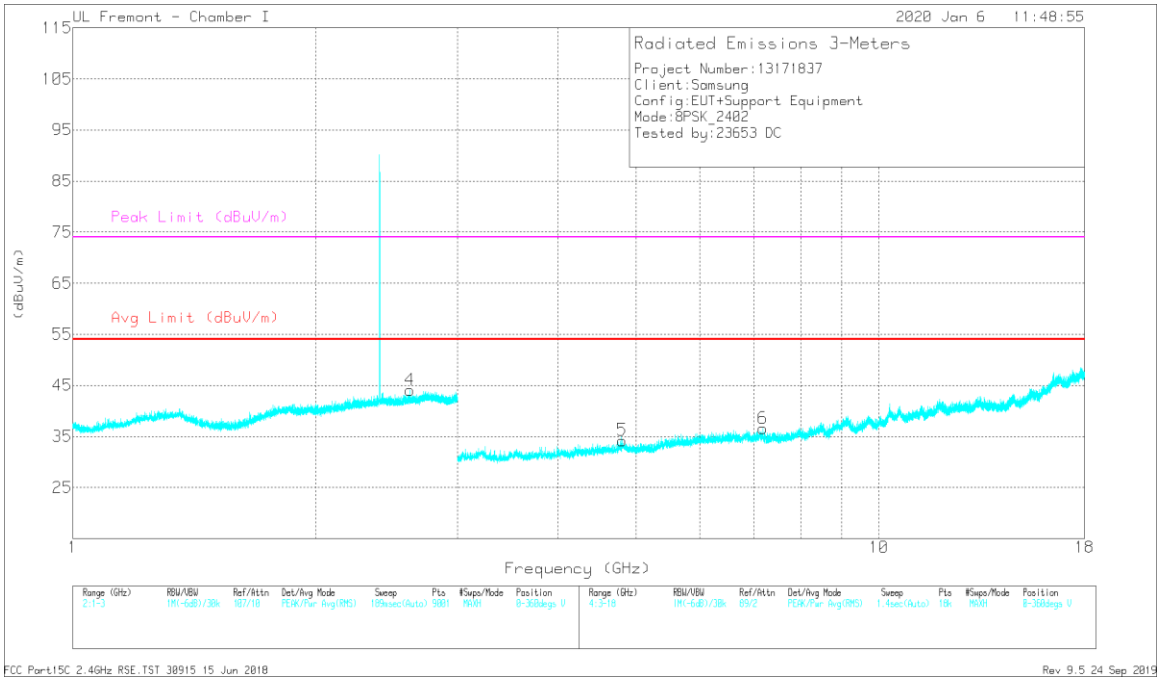
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where Ton is the transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



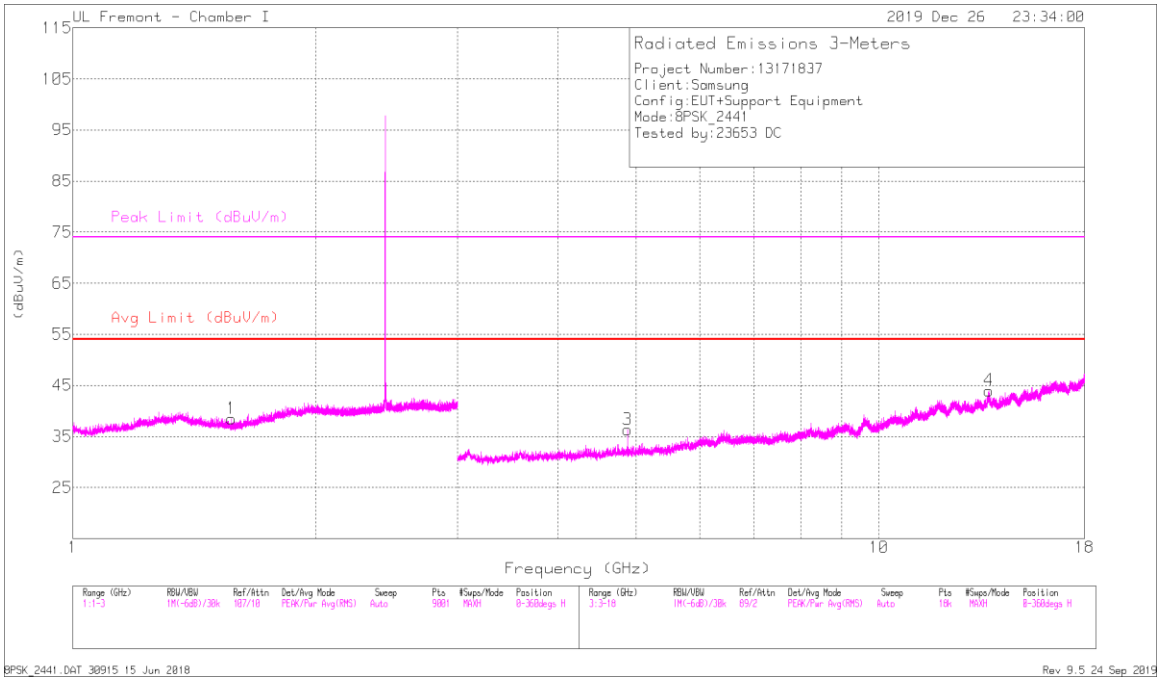
VERTICAL

RADIATED EMISSIONS

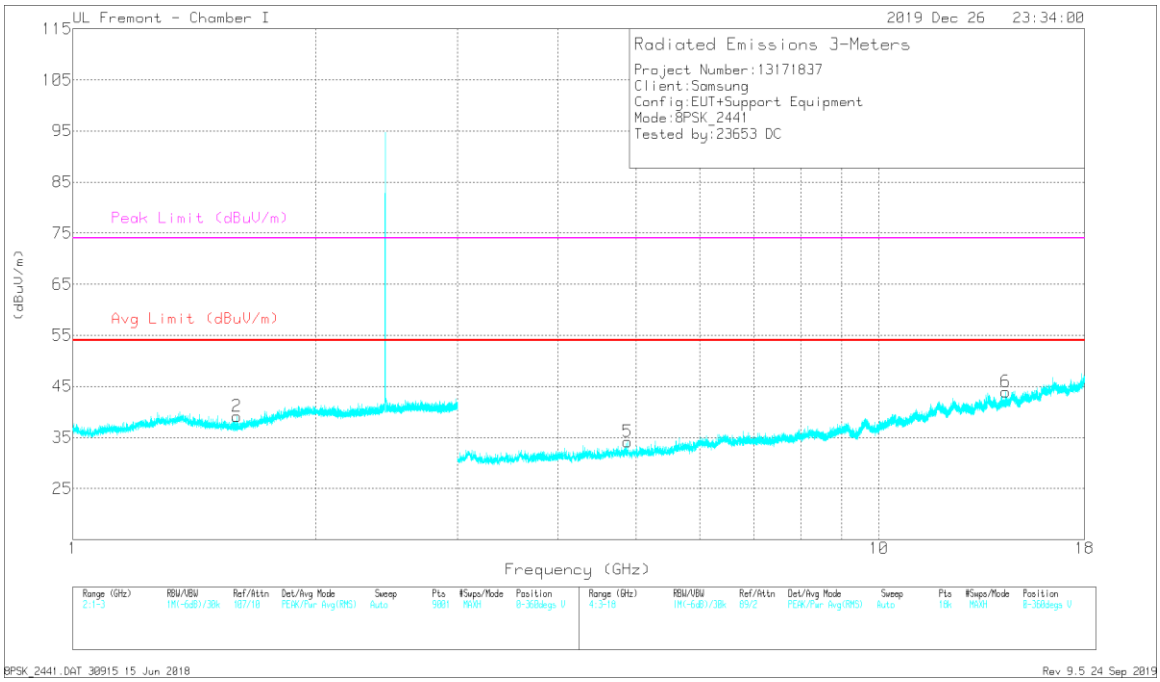
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T862 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.0651	38.14	PKFH	31.1	-20.9	48.34	-	-	-	-	297	277	H
2.62034	37.27	PKFH	32.5	-19.9	49.87	-	-	-	-	170	307	V
* 4.80382	34.51	PKFH	34.2	-25.8	42.91	-	-	74	-31.09	45	121	H
* 4.80412	22.48	VA1T	34.2	-25.8	30.88	54	-23.12	-	-	45	121	H
* 7.44067	30.61	PKFH	35.6	-23	43.21	-	-	74	-30.79	295	112	H
* 7.44096	18.35	VA1T	35.6	-23	30.95	54	-23.05	-	-	295	112	H
7.18205	32.58	PKFH	35.6	-23.7	44.48	-	-	-	-	171	143	V
* 4.8038	34.59	PKFH	34.2	-25.8	42.99	-	-	74	-31.01	232	225	V
* 4.80408	22.18	VA1T	34.2	-25.8	30.58	54	-23.42	-	-	232	225	V

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

MID CHANNEL RESULTS



HORIZONTAL



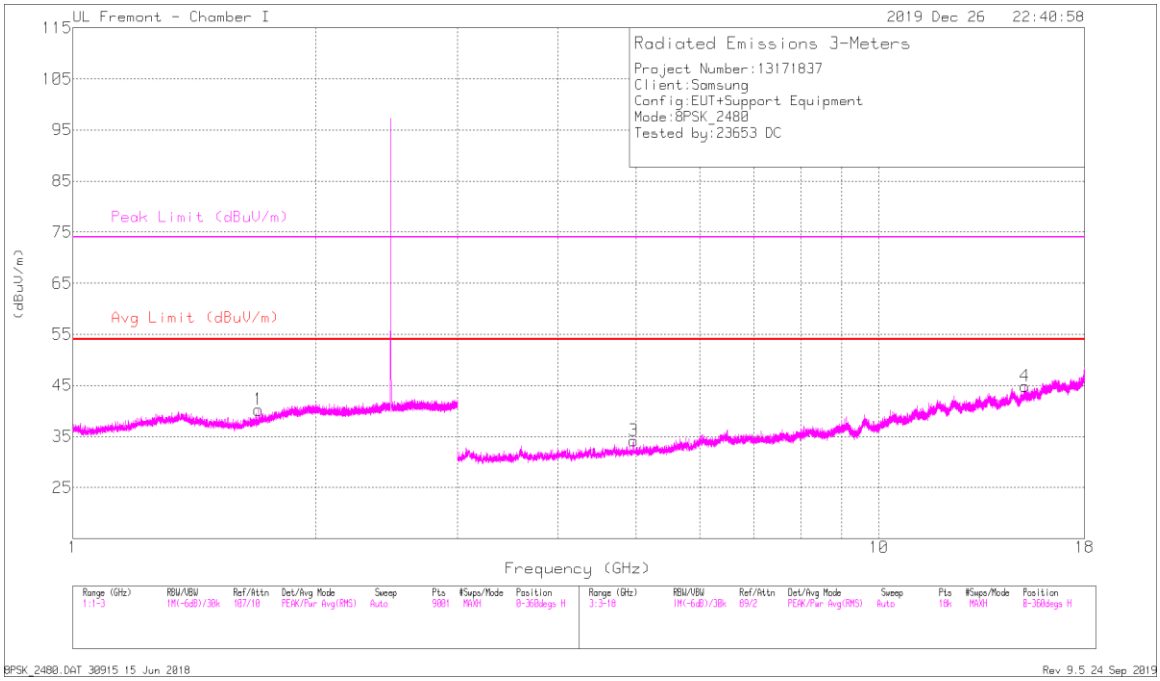
VERTICAL

RADIATED EMISSIONS

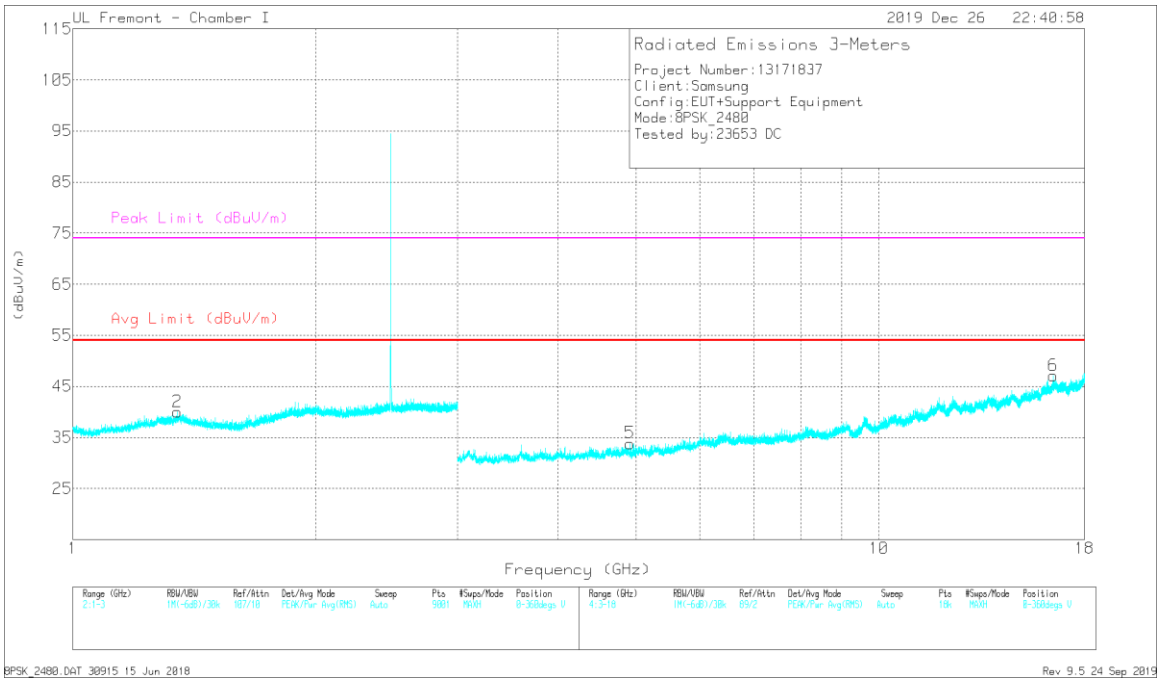
Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
* 1.57073	39.22	PKFH	27.9	-23.9	43.22	-	-	74	-30.78	35	133	H
* 1.57203	26.3	VA1T	27.9	-23.9	30.3	54	-23.7	-	-	35	133	H
* 1.59765	39.2	PKFH	28	-24	43.2	-	-	74	-30.8	133	124	V
* 1.59536	26.28	VA1T	27.9	-23.9	30.28	54	-23.72	-	-	133	124	V
13.69416	30.9	PKFH	38.7	-18.7	50.9	-	-	-	-	344	383	H
* 4.88214	35.02	PKFH	34.1	-30.5	38.62	-	-	74	-35.38	53	106	H
* 4.88215	23.8	VA1T	34.1	-30.5	27.4	54	-26.6	-	-	53	106	H
14.36773	28.83	PKFH	39.2	-18.1	49.93	-	-	-	-	116	244	V
* 4.88202	35.81	PKFH	34.1	-30.5	39.41	-	-	74	-34.59	220	251	V
* 4.88202	23.25	VA1T	34.1	-30.5	26.85	54	-27.15	-	-	220	251	V

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

HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (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
* 1.70011	38.42	PKFH	29.1	-24.2	43.32	-	-	74	-30.68	31	150	H
* 1.69952	25.89	VA1T	29.1	-24.2	30.79	54	-23.21	-	-	31	150	H
* 1.34832	39.77	PKFH	29.5	-23.9	45.37	-	-	74	-28.63	214	124	V
* 1.34663	26.67	VA1T	29.5	-23.9	32.27	54	-21.73	-	-	214	124	V
15.19132	28.64	PKFH	39.9	-18.4	50.14	-	-	-	-	78	371	H
* 4.9601	36.57	PKFH	34.1	-30.6	40.07	-	-	74	-33.93	55	135	H
* 4.95999	24.78	VA1T	34.1	-30.6	28.28	54	-25.72	-	-	55	135	H
16.46476	28.81	PKFH	40.9	-17	52.71	-	-	-	-	113	129	V
* 4.91194	33.92	PKFH	34.1	-30.6	37.42	-	-	74	-36.58	166	133	V
* 4.91054	21.22	VA1T	34.1	-30.6	24.72	54	-29.28	-	-	166	133	V

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

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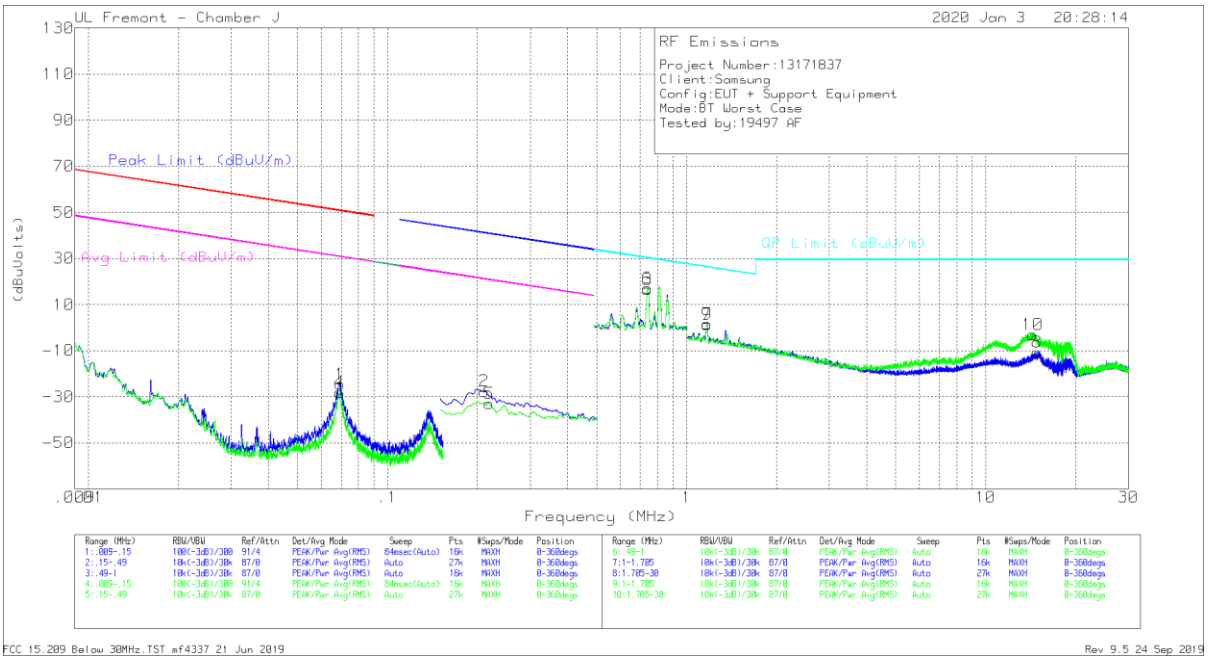
9.2. WORST CASE BELOW 30MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.06932	28.4	Pk	55.8	-28.6	-80	-24.4	50.77	-75.17	30.77	-55.17	-	-	-	-	0-360
2	.21074	24.87	Pk	56.1	-28.6	-80	-27.63	-	-	-	-	41.14	-68.77	21.14	-48.77	0-360
4	.06898	24.81	Pk	55.8	-28.6	-80	-27.99	50.81	-78.8	30.81	-58.8	-	-	-	-	0-360
5	.21841	19.63	Pk	56.1	-28.6	-80	-32.87	-	-	-	-	40.83	-73.7	20.83	-53.7	0-360

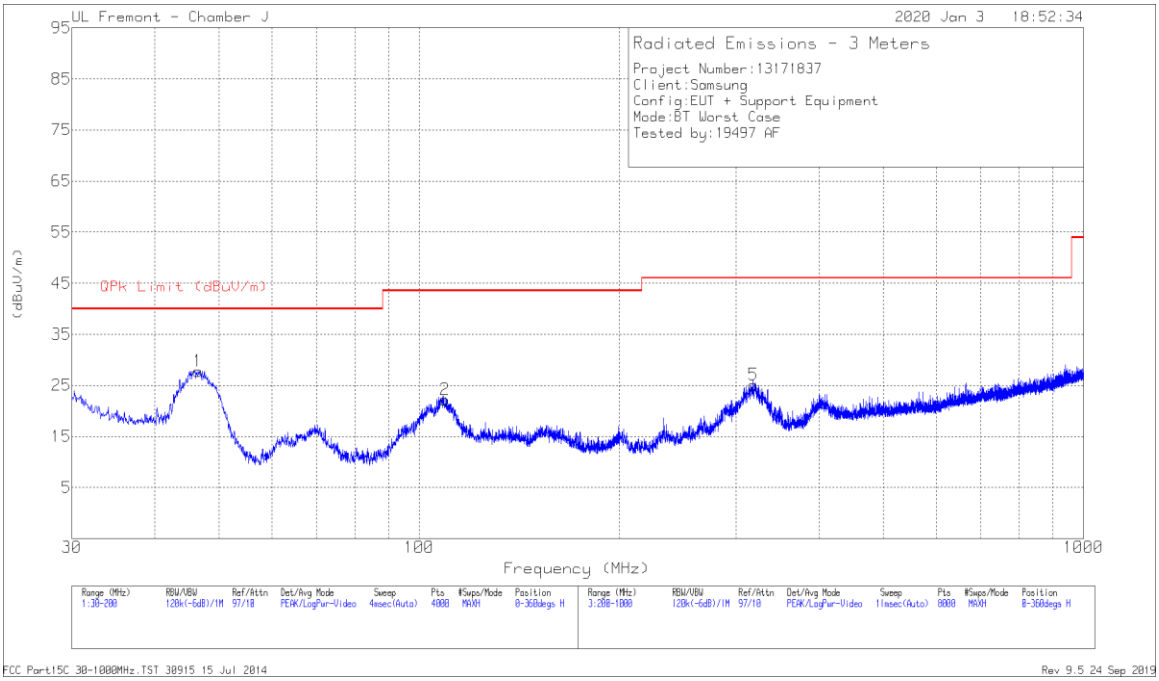
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.74077	29.05	Pk	56.1	-28.5	-40	16.65	30.22	-13.57	0-360
6	.74077	29.47	Pk	56.1	-28.5	-40	17.07	30.22	-13.15	0-360
7	1.17035	24.24	Pk	45.9	-28.4	-40	1.74	26.26	-24.52	0-360
8	14.85635	23.3	Pk	34.1	-27.9	-40	-10.5	29.5	-40	0-360
9	1.17052	23.81	Pk	45.9	-28.4	-40	1.31	26.26	-24.95	0-360
10	14.33026	30.8	Pk	34.1	-27.9	-40	-3	29.5	-32.5	0-360

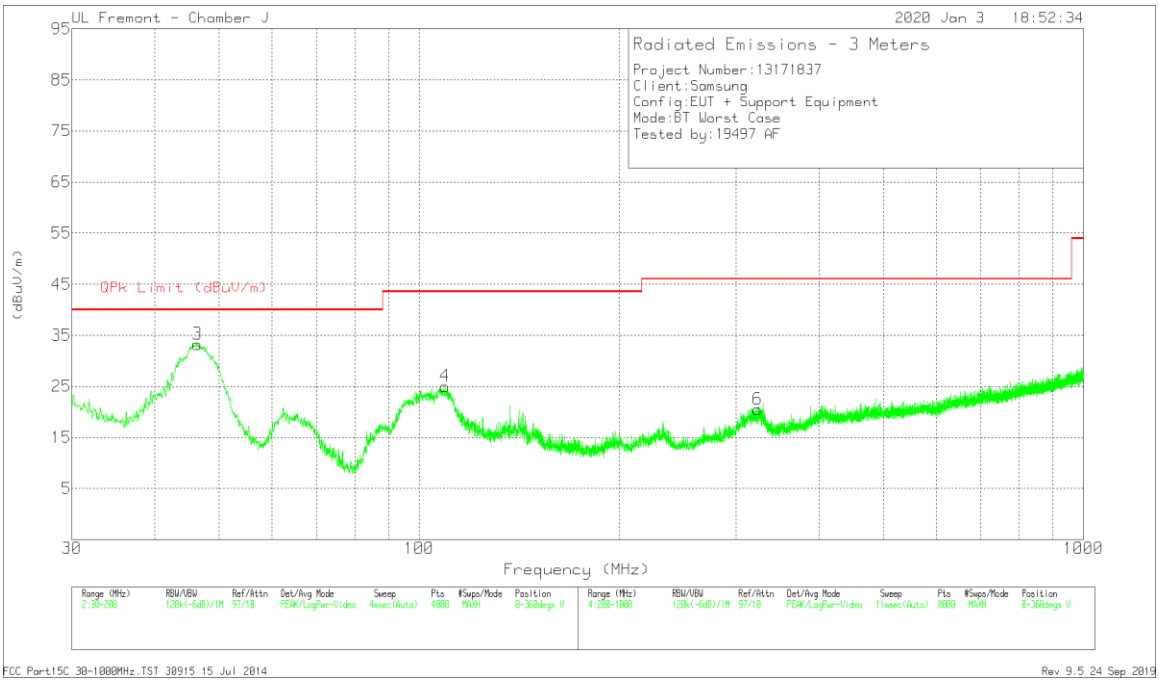
Pk - Peak detector

9.3. WORST CASE BELOW 1 GHz

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



HORIZONTAL



VERTICAL

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T899 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	46.4518	43.8	Pk	15.4	-31.4	27.8	40	-12.2	0-360	398	H
2	* 109.368	34.86	Pk	18.3	-31	22.16	43.52	-21.36	0-360	298	H
3	46.3242	49.18	Pk	15.5	-31.4	33.28	40	-6.72	0-360	101	V
	46.3247	40.28	Qp	15.5	-31.4	24.38	40	-15.62	333	390	V
4	* 109.3255	37.73	Pk	18.3	-31	25.03	43.52	-18.49	0-360	101	V
5	318.7154	35.27	Pk	19.8	-30	25.07	46.02	-20.95	0-360	101	H
6	* 323.016	30.74	Pk	19.8	-30	20.54	46.02	-25.48	0-360	101	V

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

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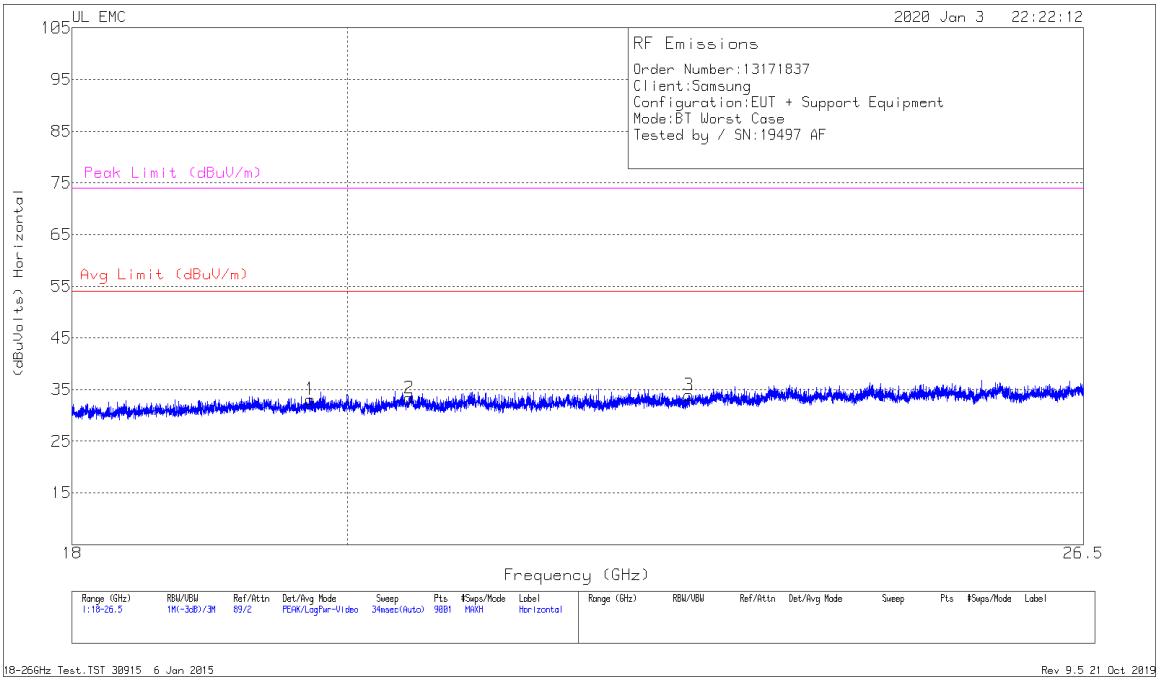
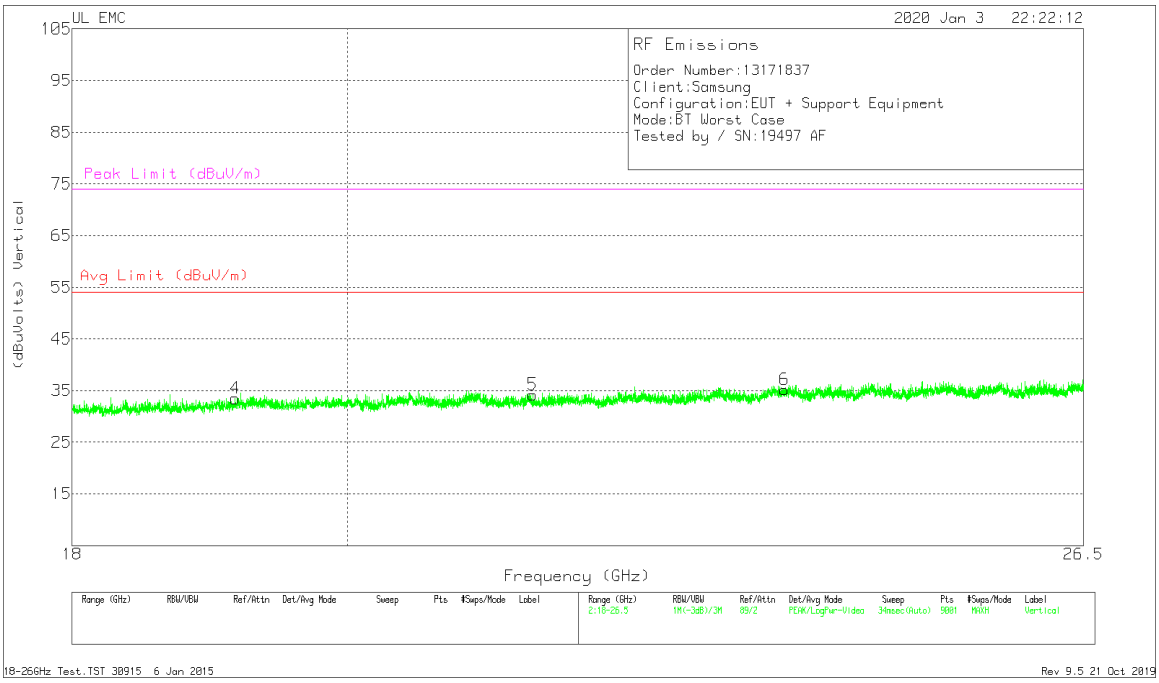
9.4. WORST CASE 18-26 GHz

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



HORIZONTAL



VERTICAL

18 – 26GHz DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	T447 AF (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	19.71605	66.63	Pk	32.8	-56.8	-9.5	33.13	54	-20.87	74	-40.87
2	20.47822	66.42	Pk	33.1	-56.6	-9.5	33.42	54	-20.58	74	-40.58
3	22.78739	67.5	Pk	33.6	-57.7	-9.5	33.9	54	-20.1	74	-40.1
4	19.15789	67.78	Pk	32.6	-57.4	-9.5	33.48	54	-20.52	74	-40.52
5	21.46611	67.68	Pk	33.2	-57.2	-9.5	34.18	54	-19.82	74	-39.82
6	23.63644	67.58	Pk	34.2	-57.1	-9.5	35.18	54	-18.82	74	-38.82

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.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

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

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

RESULTS

UL VERIFICATION SERVICES INC.
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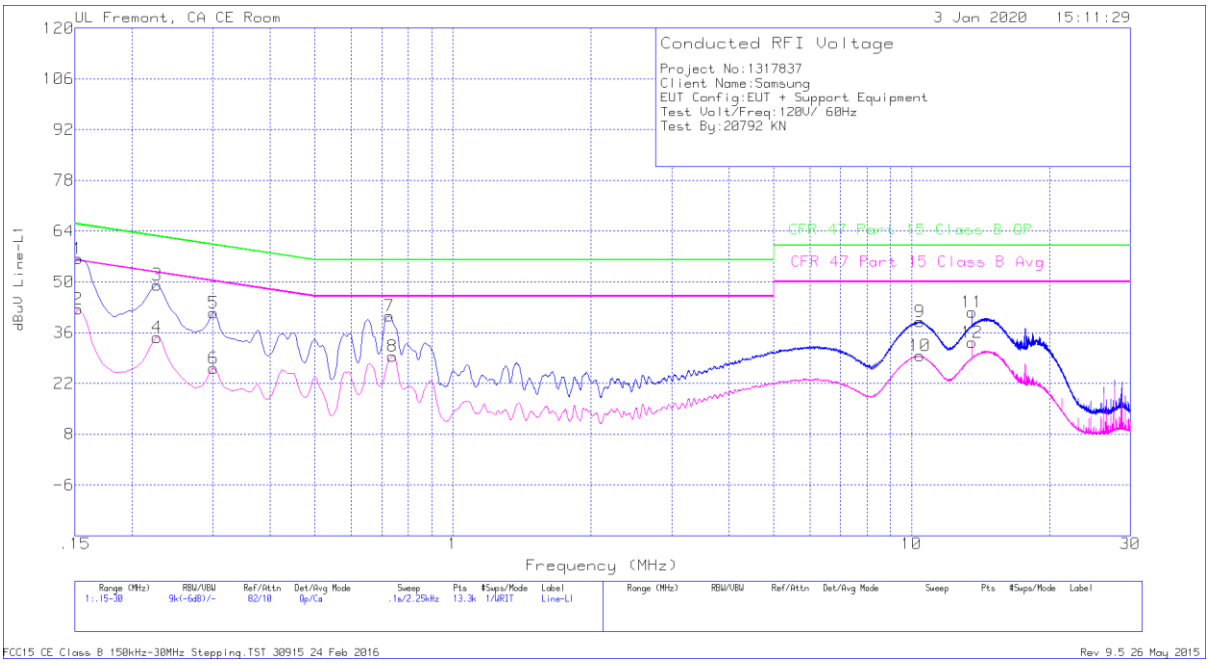
AC Power Line Norm

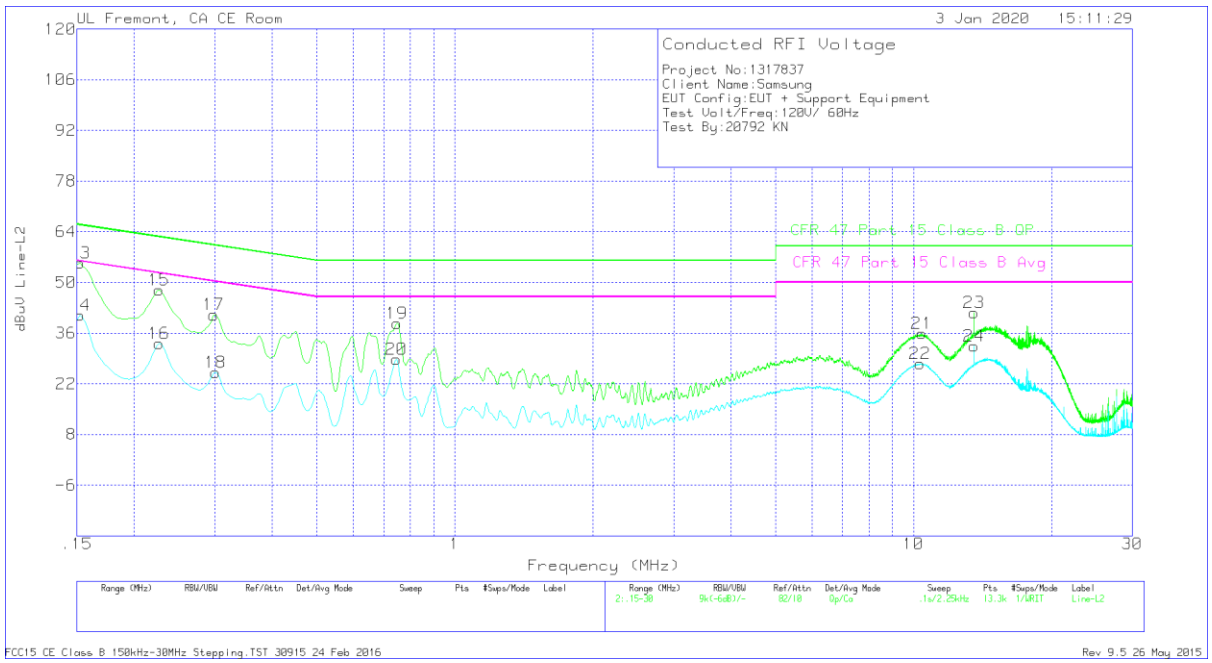
LINE 1 RESULTS



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	.15225	46.22	Qp	.1	0	10.1	56.42	65.88	-9.46	-	-
2	.15225	32.3	Ca	.1	0	10.1	42.5	-	-	55.88	-13.38
3	.2265	39.11	Qp	0	0	10.1	49.21	62.58	-13.37	-	-
4	.2265	24.62	Ca	0	0	10.1	34.72	-	-	52.58	-17.86
5	.30075	31.34	Qp	0	0	10.1	41.44	60.22	-18.78	-	-
6	.30075	16.1	Ca	0	0	10.1	26.2	-	-	50.22	-24.02
7	.72825	30.51	Qp	0	0	10.1	40.61	56	-15.39	-	-
8	.7395	19.34	Ca	0	0	10.1	29.44	-	-	46	-16.56
9	10.44375	28.67	Qp	0	.2	10.2	39.07	60	-20.93	-	-
10	10.43363	19.19	Ca	0	.2	10.2	29.59	-	-	50	-20.41
11	13.56	31.23	Qp	.1	.2	10.2	41.73	60	-18.27	-	-
12	13.56	22.88	Ca	.1	.2	10.2	33.38	-	-	50	-16.62

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE**:** Markers 11 and 12, 13.56MHz is an external NFC signal unrelated to the EUT.

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	.15225	45.15	Qp	.1	0	10.1	55.35	65.88	-10.53	-	-
14	.15225	30.72	Ca	.1	0	10.1	40.92	-	-	55.88	-14.96
15	.2265	37.8	Qp	0	0	10.1	47.9	62.58	-14.68	-	-
16	.2265	22.96	Ca	0	0	10.1	33.06	-	-	52.58	-19.52
17	.2985	30.95	Qp	0	0	10.1	41.05	60.28	-19.23	-	-
18	.30075	15.05	Ca	0	0	10.1	25.15	-	-	50.22	-25.07
19	.7485	28.63	Qp	0	0	10.1	38.73	56	-17.27	-	-
20	.74625	18.66	Ca	0	0	10.1	28.76	-	-	46	-17.24
21	10.43025	25.44	Qp	0	.2	10.2	35.84	60	-24.16	-	-
22	10.32225	17.14	Ca	0	.2	10.2	27.54	-	-	50	-22.46
23	13.56	31.1	Qp	.1	.2	10.2	41.6	60	-18.4	-	-
24	13.56	21.9	Ca	.1	.2	10.2	32.4	-	-	50	-17.6

Qp - Quasi-Peak detector
Ca - CISPR average detection
NOTE**:** Markers 23 and 24, 13.56MHz is an external NFC signal unrelated to the EUT.