



CERTIFICATION TEST REPORT

Report Number. : 12802195-E2V2

Applicant : Microsoft Corp.
One Microsoft Way
Redmond, WA 98052

Model : 1876

FCC ID : C3K1876

IC : 3048A-1876

EUT Description : Portable Computing Device

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

Date Of Issue:
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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	8/20/2019	Initial Issue	--
V2	9/5/2019	Section 8.2.1: 99% updated	Henry Lau

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corp.
One Microsoft Way
Redmond, WA 98052

EUT DESCRIPTION: Portable Computing Device

MODEL: 1876

SERIAL NUMBER: Conducted: 005764692553
Radiated: 024269592753

DATE TESTED: July 03 – August 05, 2019

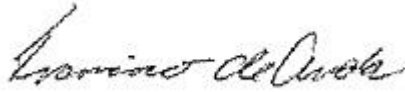
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

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 v05r02, 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

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

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
 $36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$

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%.

5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a Portable Computing Device.

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	5.63	3.66
2402 - 2480	Enhanced DQPSK	4.78	3.01
2402 - 2480	Enhanced 8PSK	4.81	3.03

Note: GFSK, DQPSK, 8PSK average Power are all investigated, The GFSK & 8PSK Power are the worst case. Testing is based on these modes to show compliance. For average power data please refer to section 8.7.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an PIFA antenna, with a maximum gain of 0.6 dBi.

5.4. SOFTWARE AND FIRMWARE

The operating system installed on the EUT is Windows 10 Pro build 18362.19h1_release.190318-1202.

The Bluetooth Driver installed on the EUT is version 3000.0.630.0.

The test utility software used during testing was QRCT v4.0.00108

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, and four configurations with a keyboard at 45 degrees, 90 degrees, 180 degrees, and portrait, it was determined that 90 degrees with keyboard orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in 90 degrees with keyboard orientation.

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

GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest output power.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Keyboard	Microsoft	EV2BB01A	E2XEV2BB01A00042	DoC
AC/DC Adapter	Microsoft	1706	0C130J02JT396	DoC
Laptop	Lenovo	80S6	YD03NTTF	DoC
AC/DC Adapter	Lenovo	ADLX45NCC3A	N/A	DoC
Ethernet to USB Adapter	Linksys	USB3GIGV1	15710S08405610	DoC
USB Type C to USB Type A Adapter	Amazon Basics	L6LUC021-CS-R	N/A	N/A
USB Type C to Audio Jack	Sony	A1-0231	N/A	N/A
Earphone	Sony	AG1100	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	AC	1	AC	Un-Shielded	0.2	to AC/DC Adapter
2	DC	1	DC	Shielded	1	to Laptop, to EUT
3	USB	1	Type C	Un-Shielded	0.2	USB-C to USB-A Adapter
4	USB	1	Type A	Un-shielded	0.1	USB-A to RJ45 converter
5	Ethernet	1	RJ45	Un-shielded	>3m	Laptop to EUT
6	Antenna	1	SMA	Un-Shielded	0.2	to Analyzer

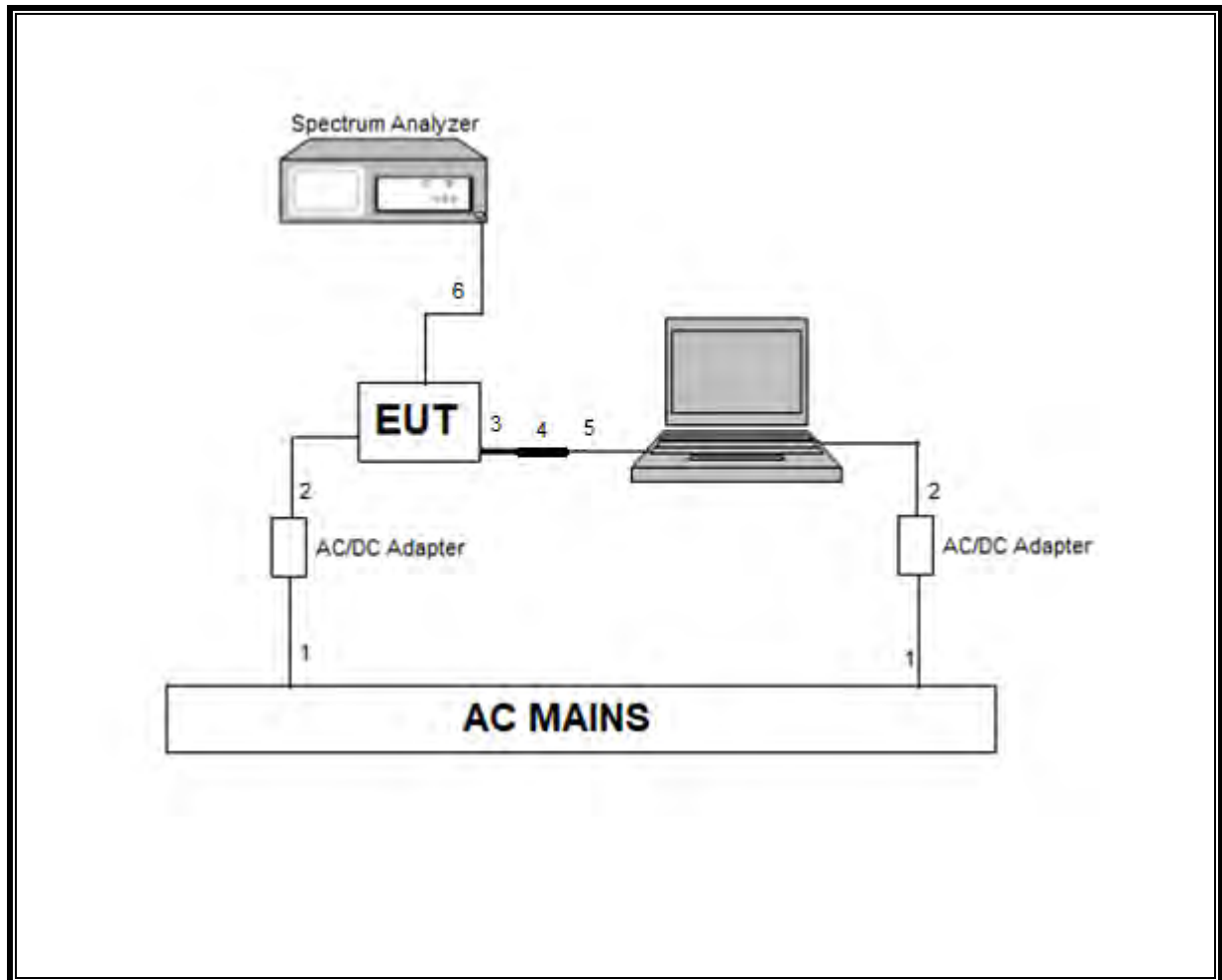
I/O CABLES (RADIATED AND CONDUCTED EMISSIONS)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	Type C	Un-shielded	0.2	to AC/DC Adapter
2	DC	1	DC	Shielded	1	to Laptop, to EUT
3	USB	1	Type C	Un-shielded	0.2	USB-C to USB-A Adapter
4	USB	1	Type A	Un-shielded	0.1	USB-A to RJ45 converter
5	Ethernet	1	RJ45	Un-shielded	>3	Laptop to EUT
6	USB	1	Type C	Un-shielded	0.1	USB-C to Audio Jack converter
7	Earphone	1	3.5mm	Un-shielded	1	EUT to earphone

TEST SETUP

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

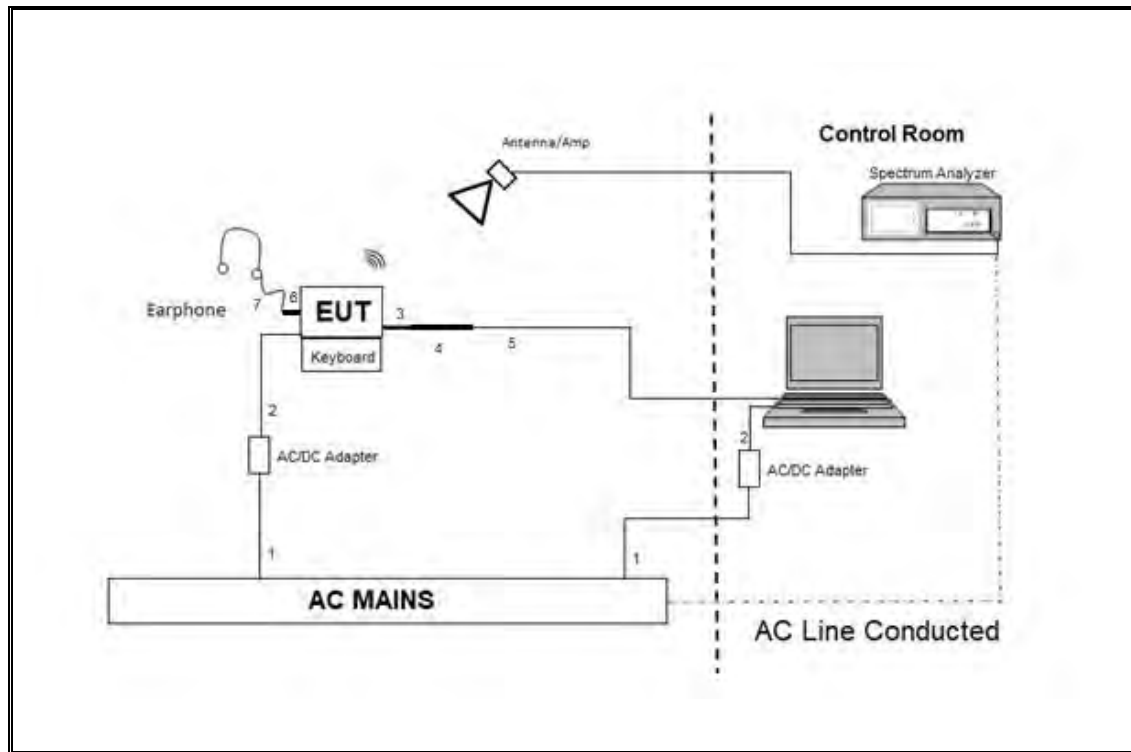
CONDUCTED TEST SETUP DIAGRAM



TEST SETUP

For conducted tests, the EUT was connected to a laptop. The test software exercises the radio.

RADIATED AND AC LINE CONDUCTED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated tests: EUT is connected to all support equipment. 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	ID Num	Cal Due	Last Cal
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1265	01/29/2020	01/29/2019
Power Sensor, P-series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T1227	02/05/2020	02/05/2019
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, Horn 1-18GHz	AR	AMPL-ATH1G18	PRE0189055	04/20/2020	04/20/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	EMC4294	06/14/2020	06/14/2019
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1571	05/28/2020	05/28/2019
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1569	05/04/2020	05/04/2019
Hybrid Antenna, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0181575	08/01/2019	08/01/2018
Hybrid Antenna, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0184052	10/24/2019	10/24/2018
Amplifier, 9kHz to 1GHz, 32 dB	SONOMA INSTRUMENT	310	PRE0180174	06/01/2020	06/01/2019
Amplifier, 9kHz to 1GHz, 32 dB	SONOMA INSTRUMENT	310	175953	12/13/2019	12/13/2018
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	PRE0182188	08/29/2019	08/29/2018
Pre-Amp, 18-26.5GHz	Amplical	AMP18G26.5-60	PRE0181238	05/01/2020	05/01/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179367	05/16/2020	05/16/2019
EMI Test Receiver	Rohde & Schwarz	ESW44	PRE0179372	02/16/2020	02/16/2019
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4440A	T200	01/28/2020	01/28/2019
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T917	01/24/2020	01/24/2019
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 9.9, June 05, 2019		
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015		

NOTES:

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

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.

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

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
Bluetooth GFSK	2.880	3.750	0.768	76.8%	1.15	0.347
Bluetooth 8PSK	2.890	3.750	0.771	77.1%	1.13	0.346

DUTY CYCLE PLOTS



Bluetooth GFSK



Bluetooth 8PSK

8.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

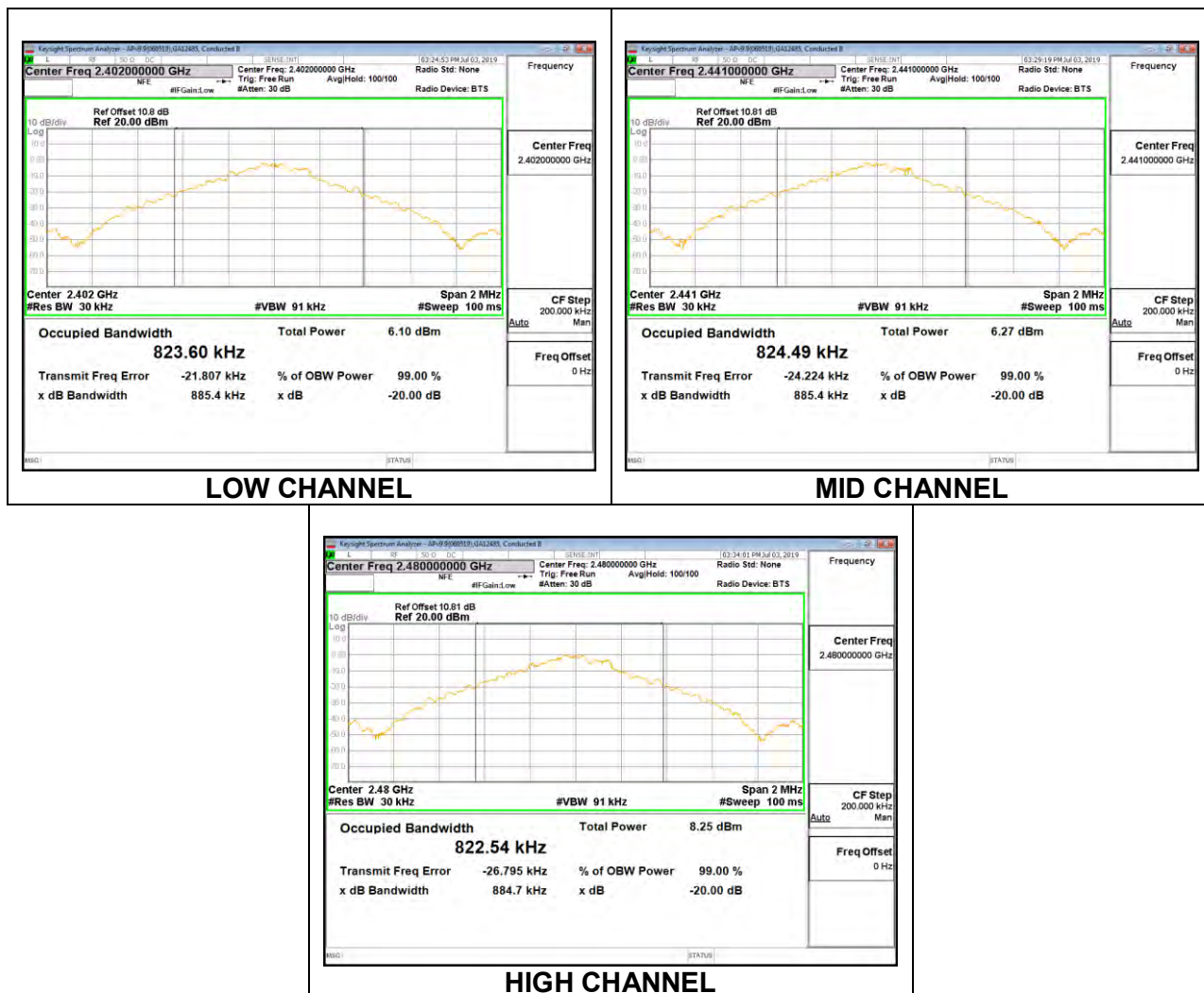
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

8.2.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	0.82360
Mid	2441	0.82449
High	2480	0.82254



8.2.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.1757
Mid	2441	1.1755
High	2480	1.1765



8.3. 20 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

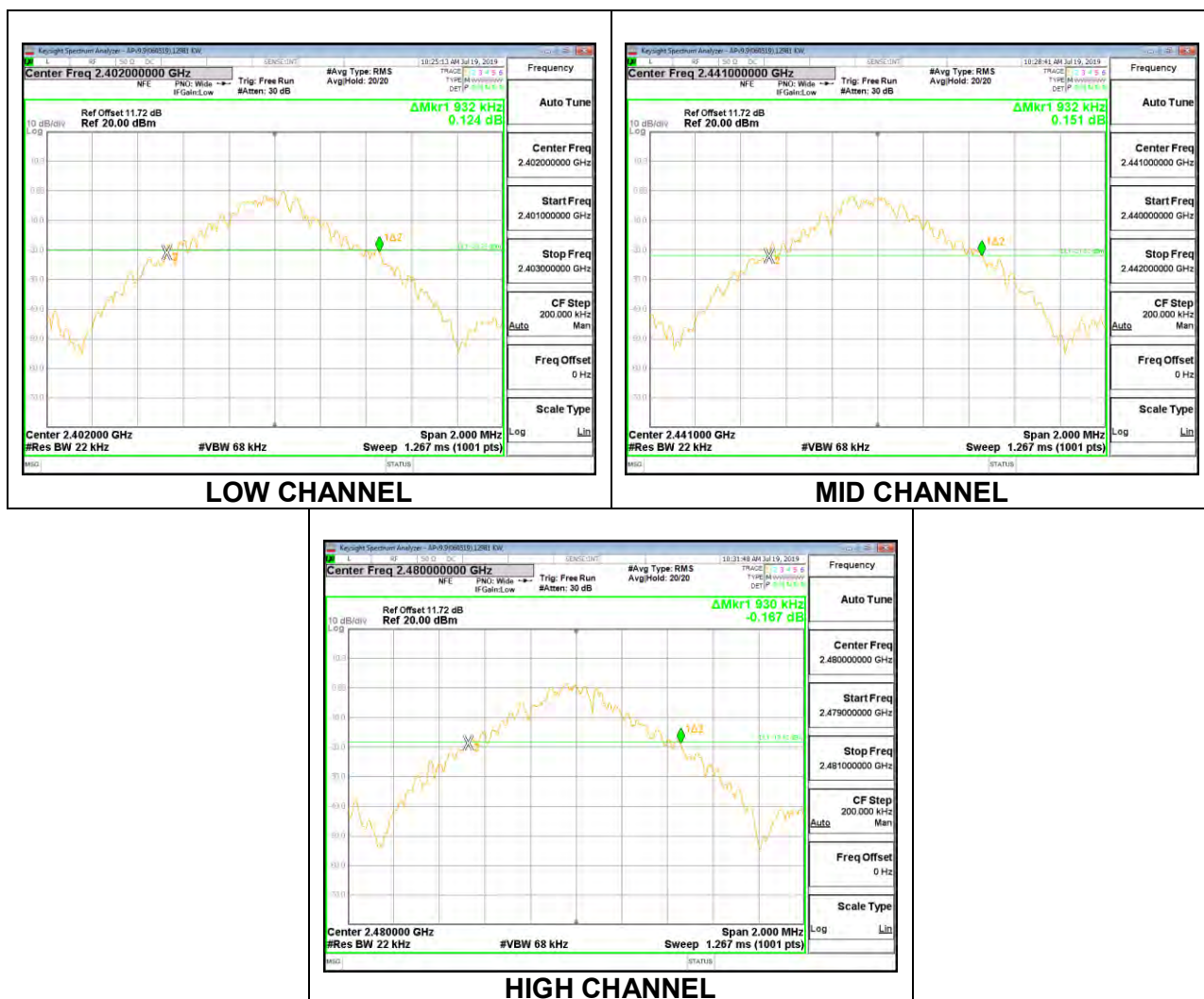
TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

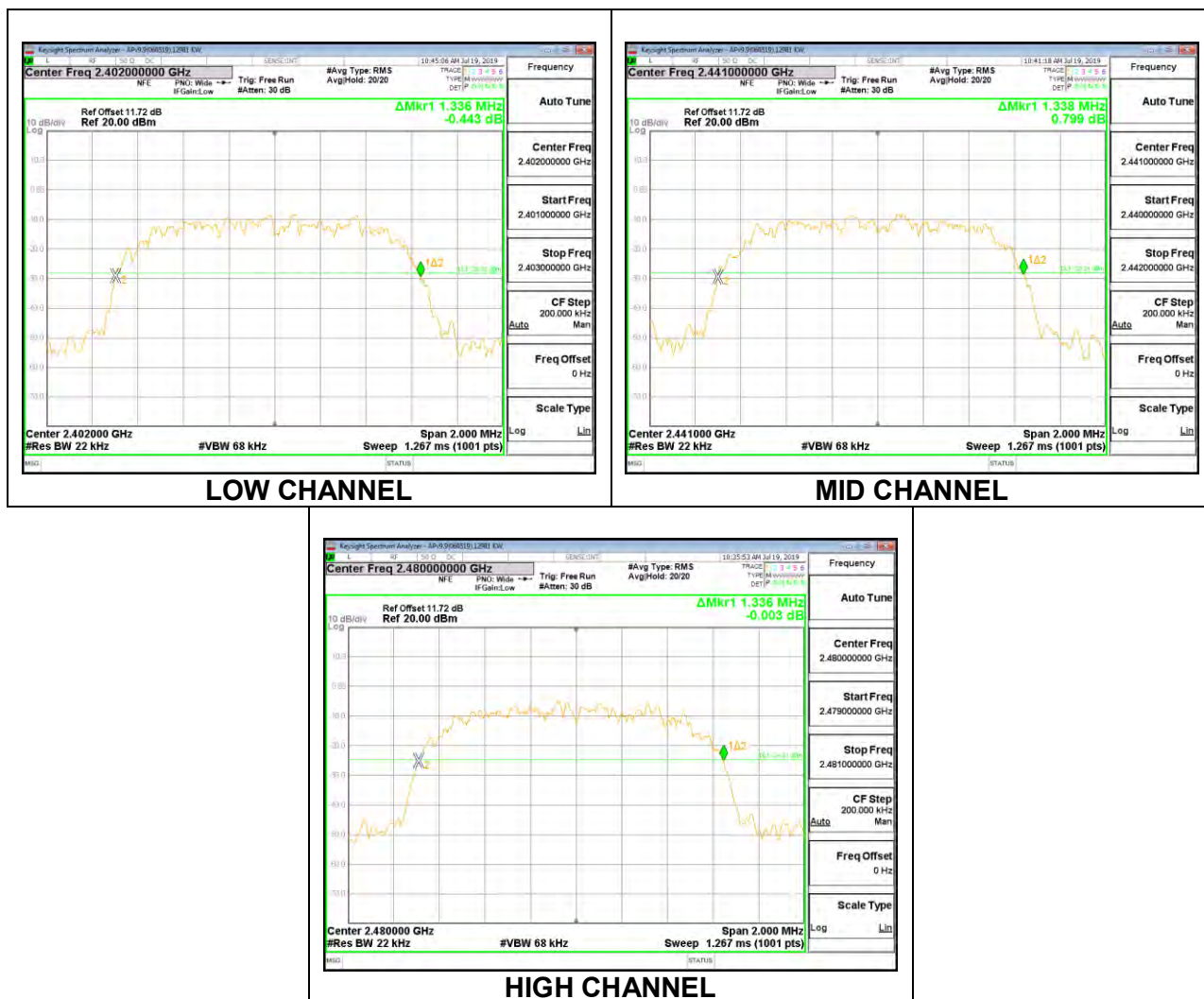
8.3.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	0.932
Mid	2441	0.932
High	2480	0.930



8.3.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
Low	2402	1.336
Mid	2441	1.338
High	2480	1.336



8.4. HOPPING FREQUENCY SEPARATION

LIMITS

FCC §15.247 (a) (1)

RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

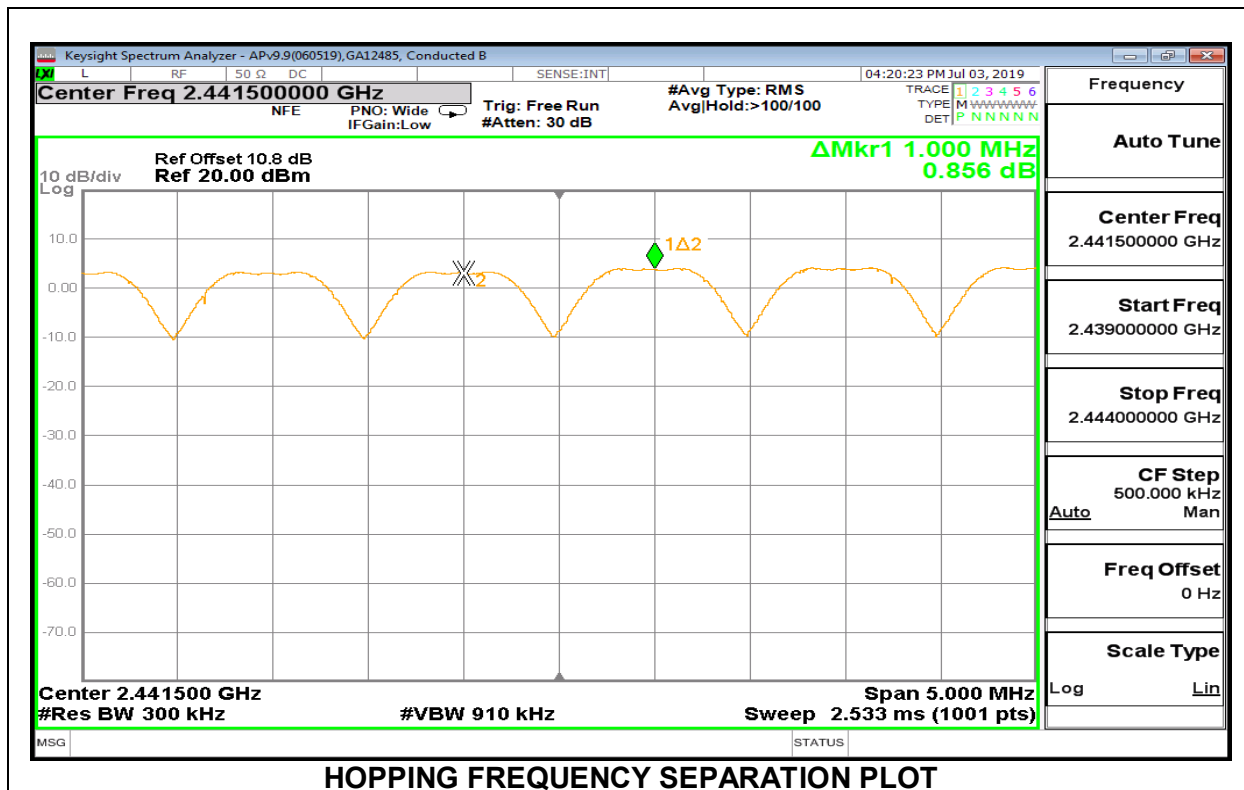
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

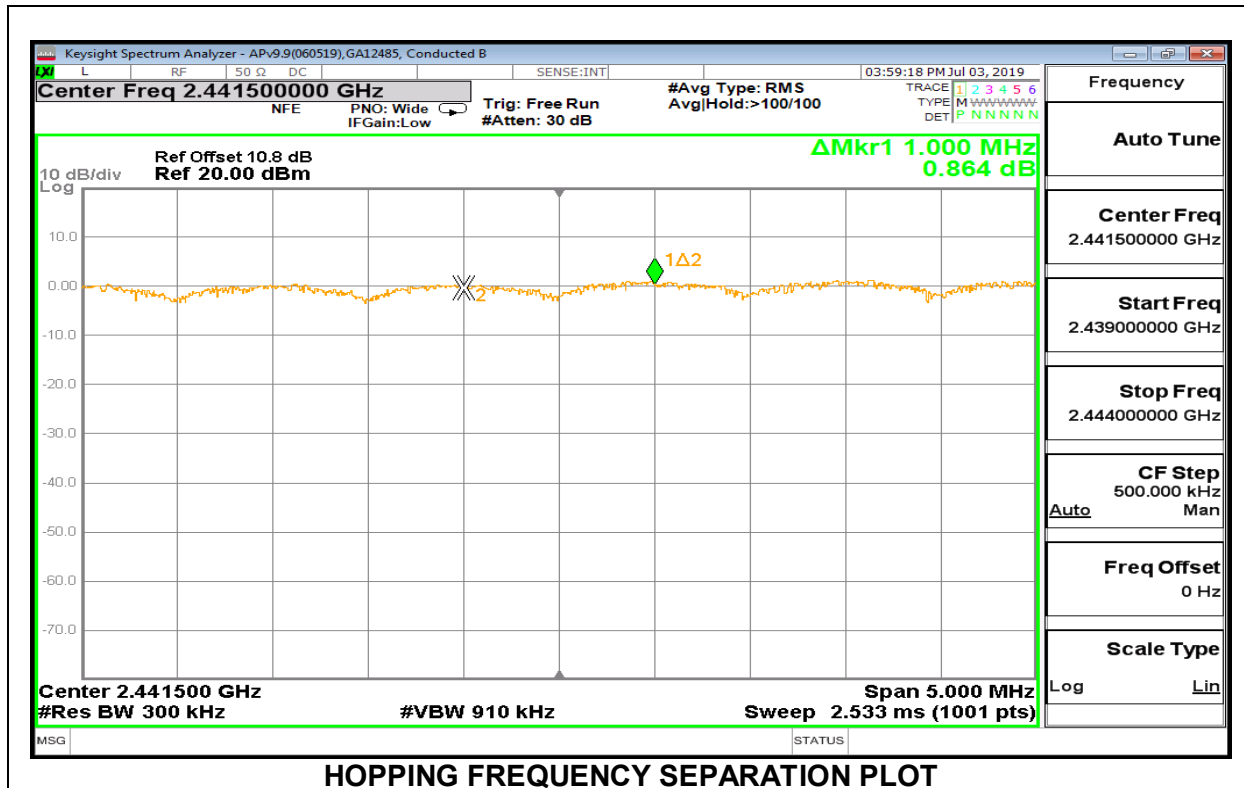
The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to $VBW \geq RBW$. The sweep time is coupled.

RESULTS

8.4.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



8.4.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION



8.5. 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.

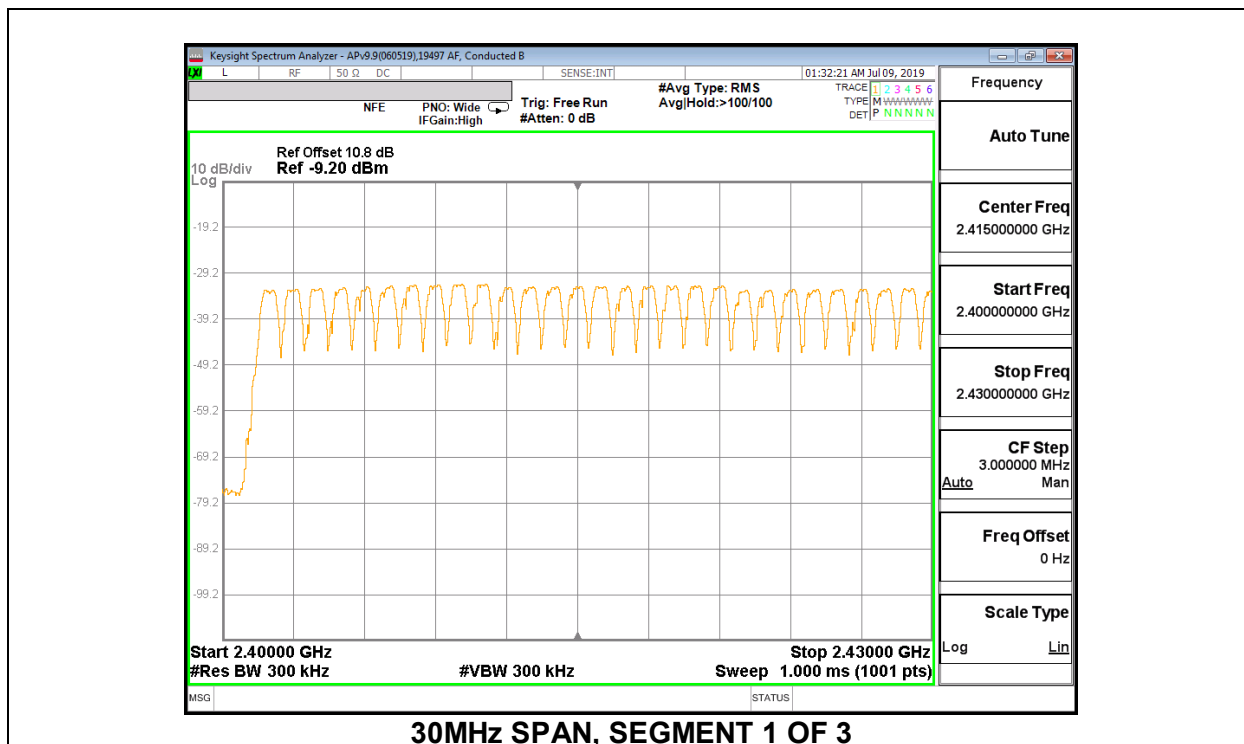
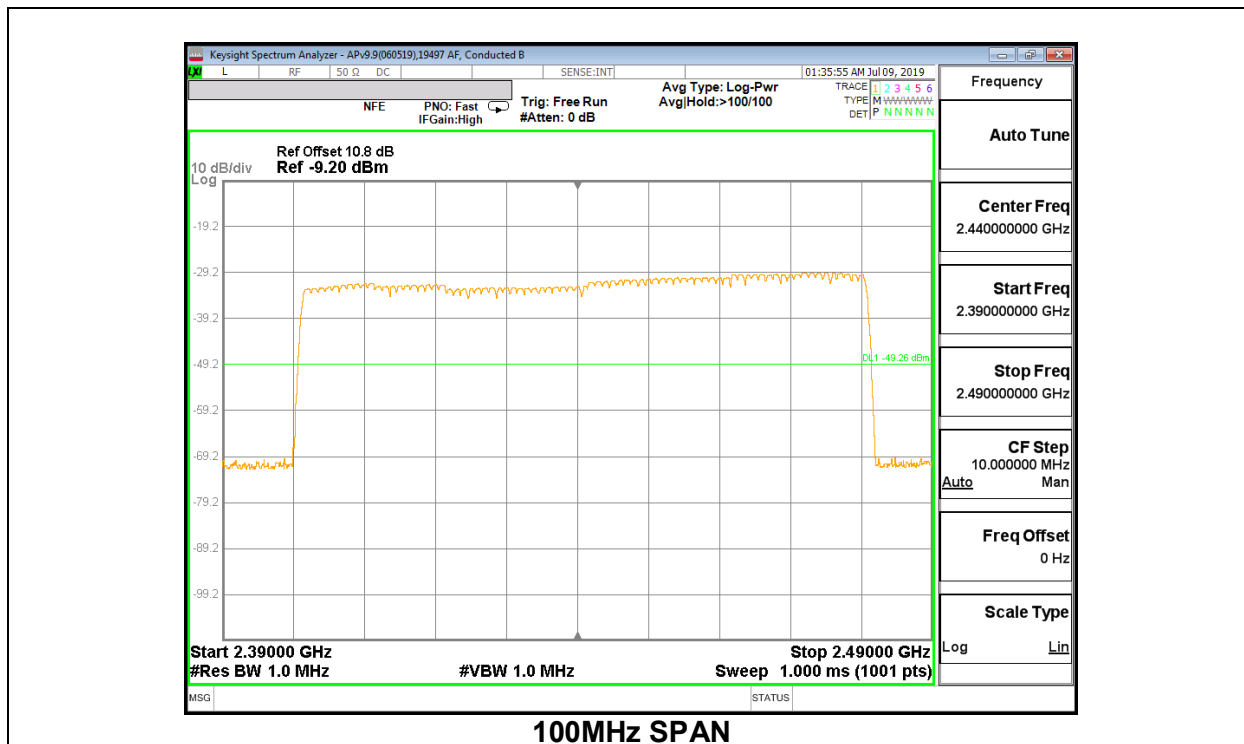
TEST PROCEDURE

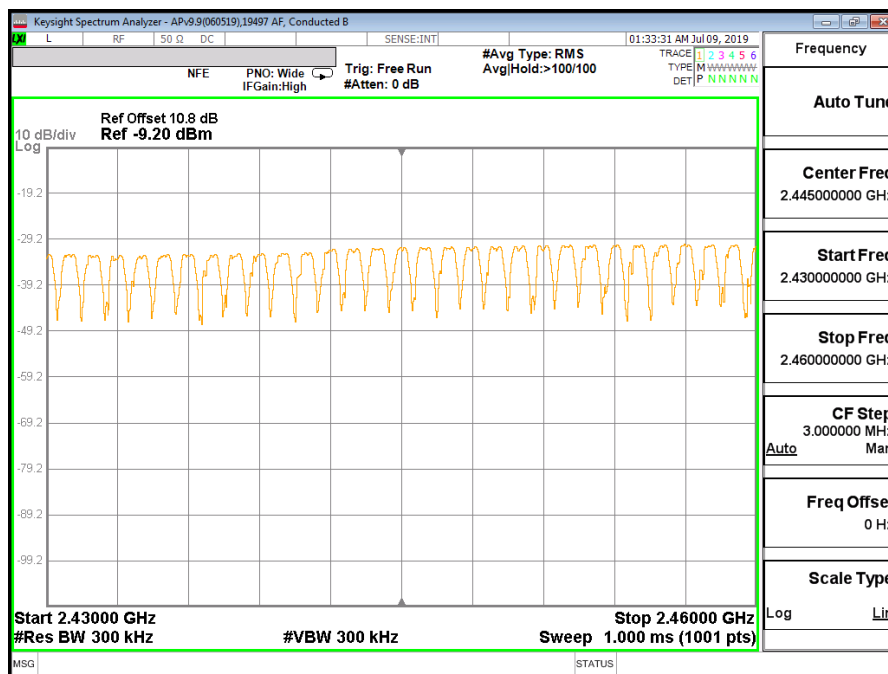
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

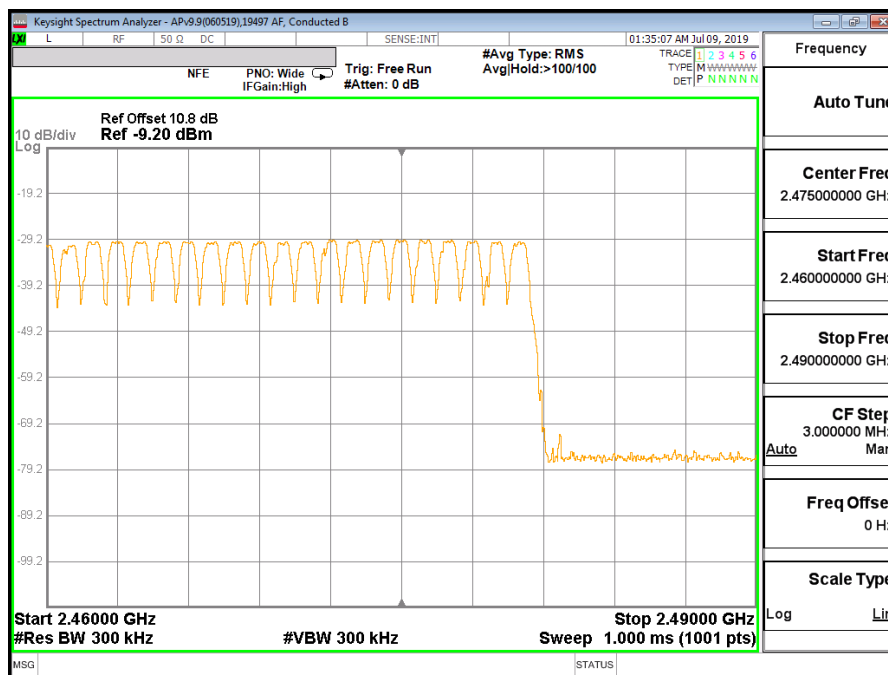
Normal Mode: 79 Channels Observed

8.5.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION



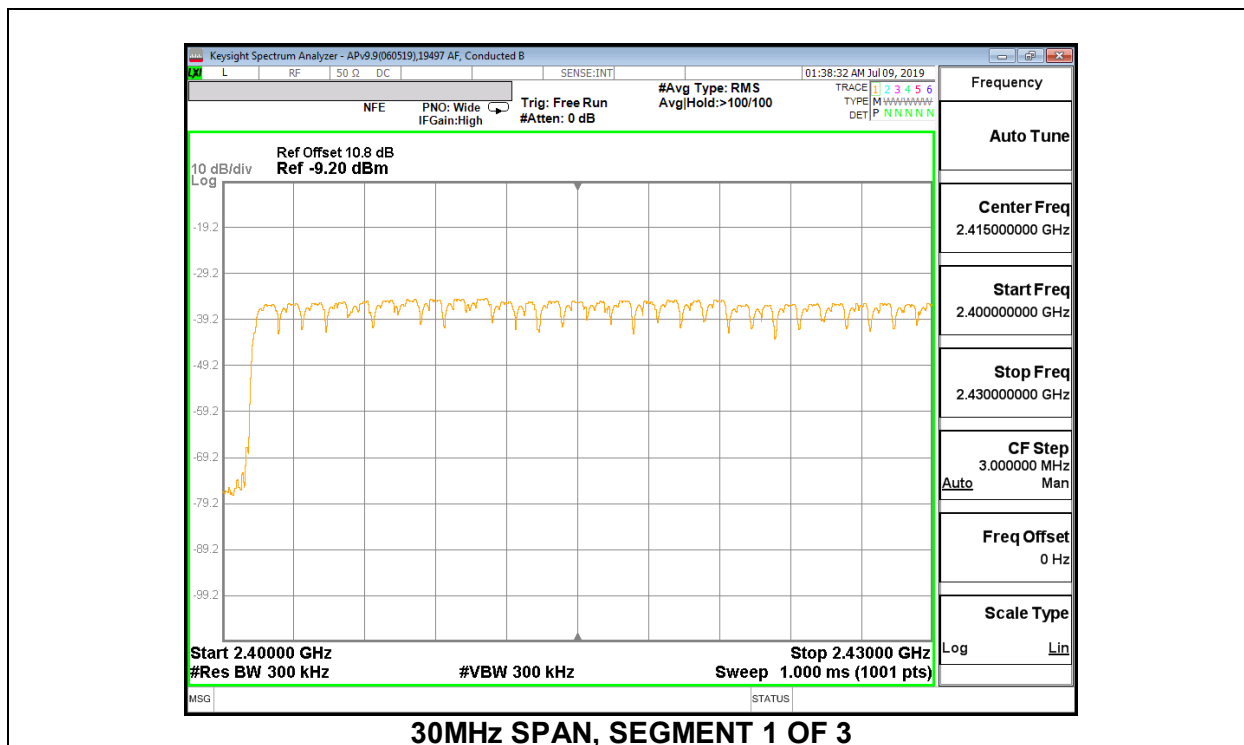
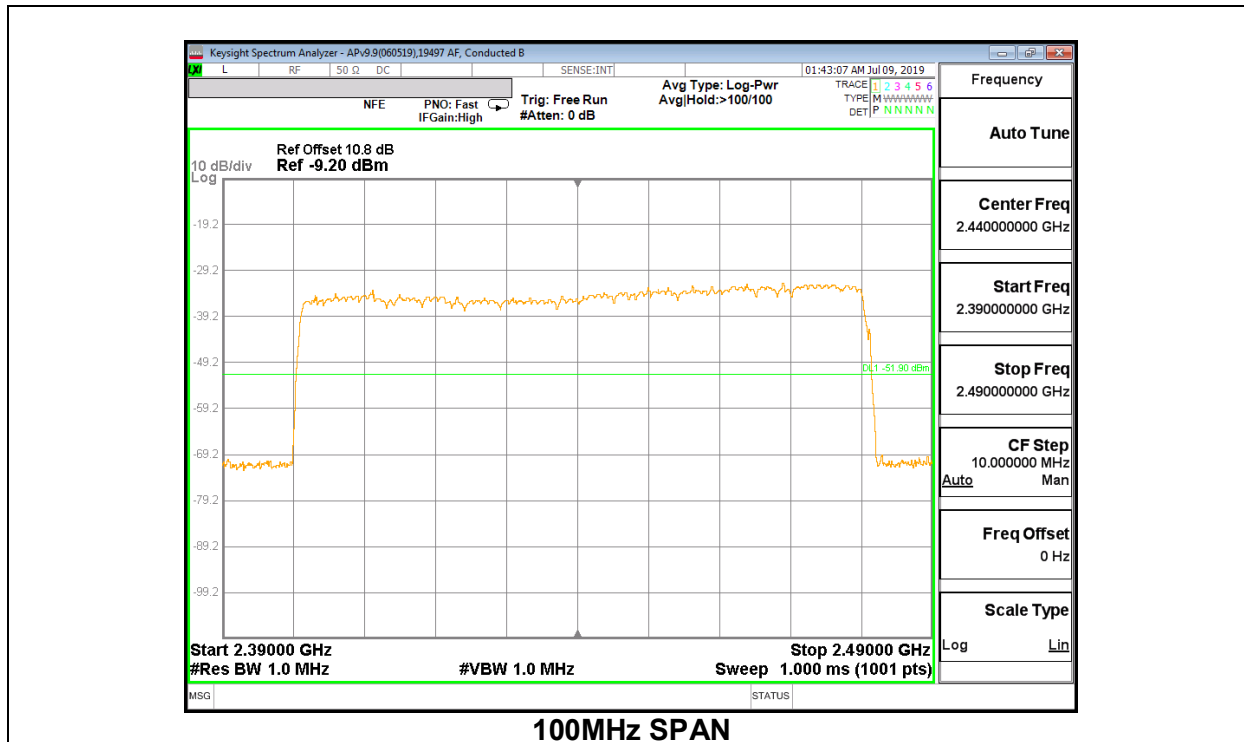


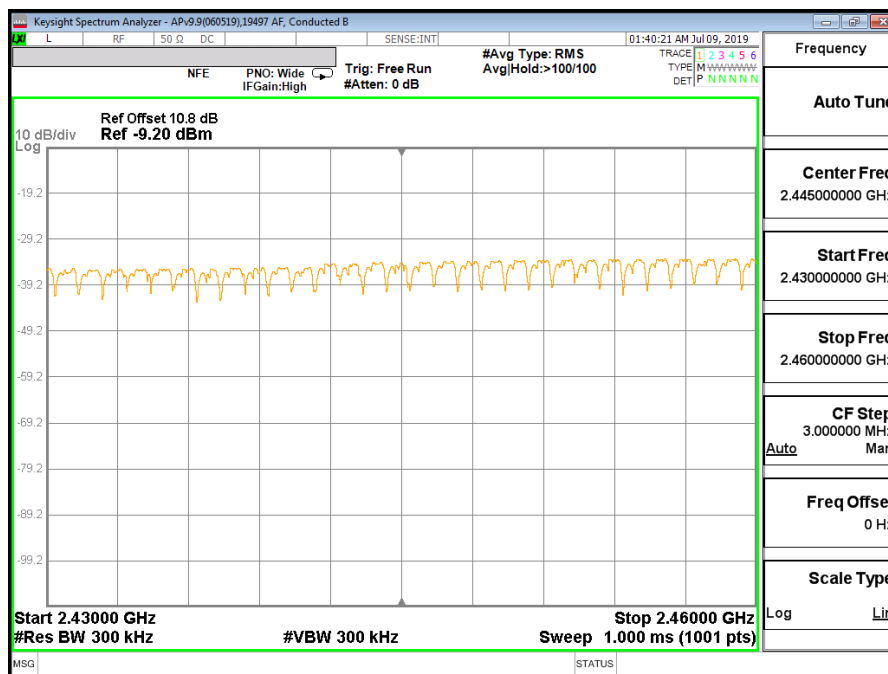
30MHz SPAN, SEGMENT 2 OF 3



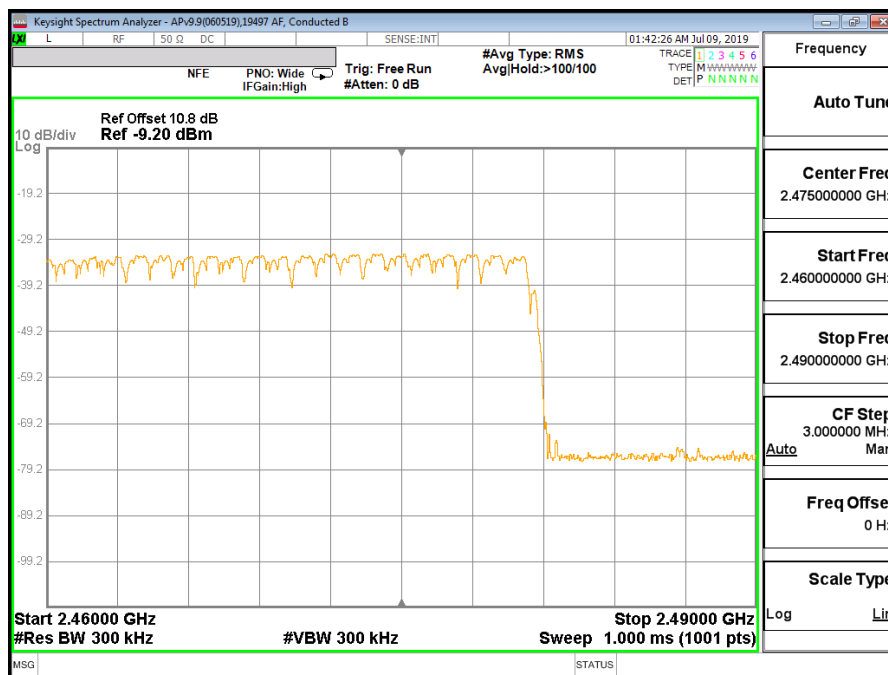
30MHz SPAN, SEGMENT 3 OF 3

8.5.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION





30MHz SPAN, SEGMENT 2 OF 3



30MHz SPAN, SEGMENT 3 OF 3

8.6. AVERAGE TIME OF OCCUPANCY

LIMITS

FCC §15.247 (a) (1) (iii)

RSS-247 (5.1) (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

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

RESULTS

8.6.1. 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	0.381	30	0.1143	0.4	-0.2857
DH3	1.638	11	0.1802	0.4	-0.2198
DH5	2.884	7	0.2019	0.4	-0.1981
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	0.381	7.5	0.02858	0.4	-0.3714
DH3	1.638	2.75	0.04505	0.4	-0.3550
DH5	2.884	1.75	0.05047	0.4	-0.3495



8.6.2. 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	0.387	31	0.11997	0.4	-0.28003
3DH3	1.146	13	0.14898	0.4	-0.25102
3DH5	2.888	10	0.2888	0.4	-0.1112

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.



8.7. 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 peak reading of power.

RESULTS

8.7.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	GA12485
Date:	7/3/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.4	21	-17.6
Middle	2441	3.74	21	-17.26
High	2480	5.63	21	-15.37

8.7.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	GA12485
Date:	7/3/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.46	21	-18.54
Middle	2441	2.8	21	-18.2
High	2480	4.81	21	-16.19

8.7.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	GA12485
Date:	7/3/2019

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	2.43	21	-18.57
Middle	2441	2.78	21	-18.22
High	2480	4.78	21	-16.22

8.8. 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

8.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

Tested By:	GA12485
Date	7/3/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	3.13
Middle	2441	3.48
High	2480	5.32

8.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

Tested By:	GA12485
Date	7/3/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	0.3
Middle	2441	0.59
High	2480	2.84

8.8.3. BLUETOOTH ENHANCED DATA RATE DQPSK MODULATION

Tested By:	GA12485
Date	7/3/2019

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	0.28
Middle	2441	0.59
High	2480	2.83

8.9. 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.

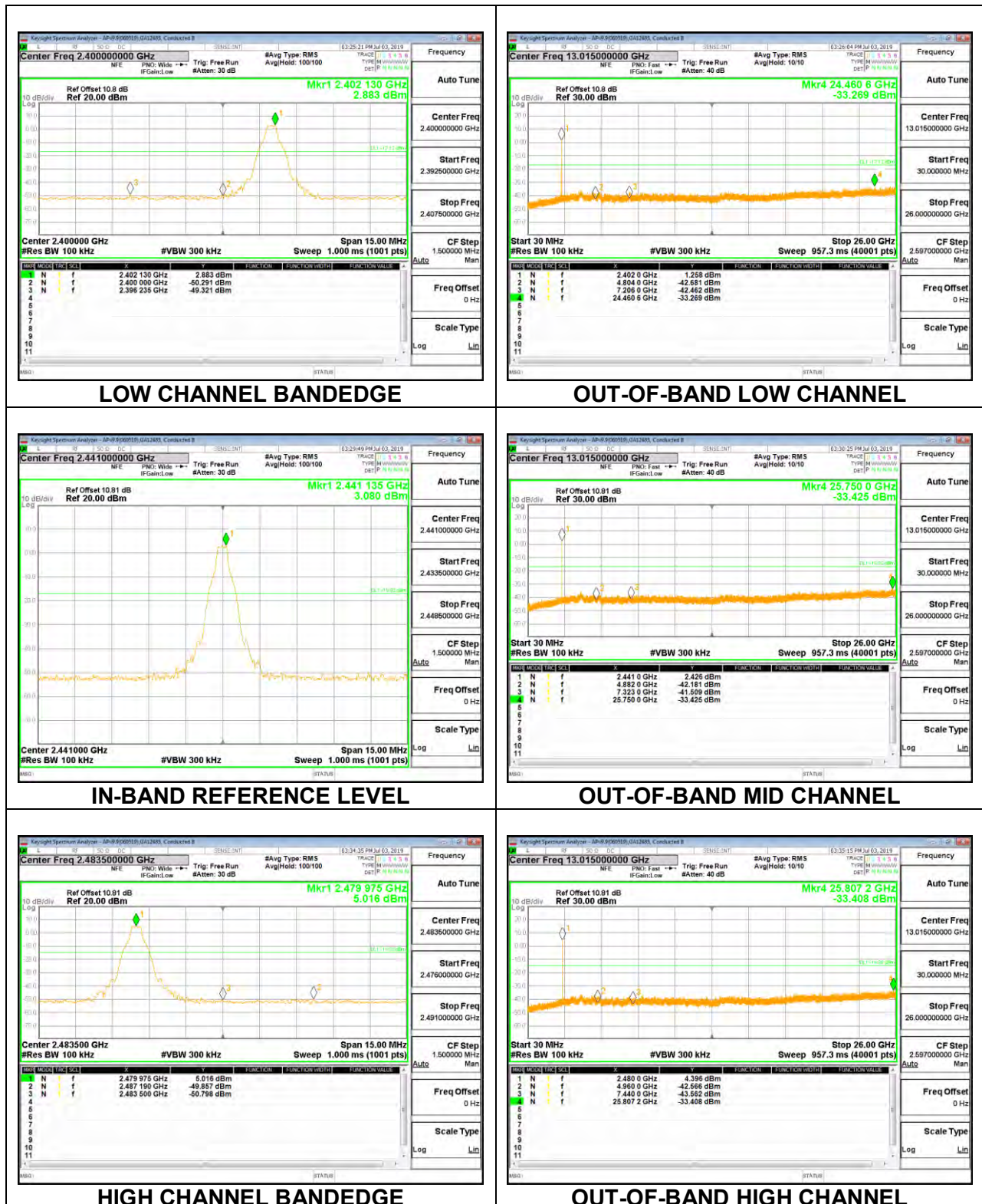
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

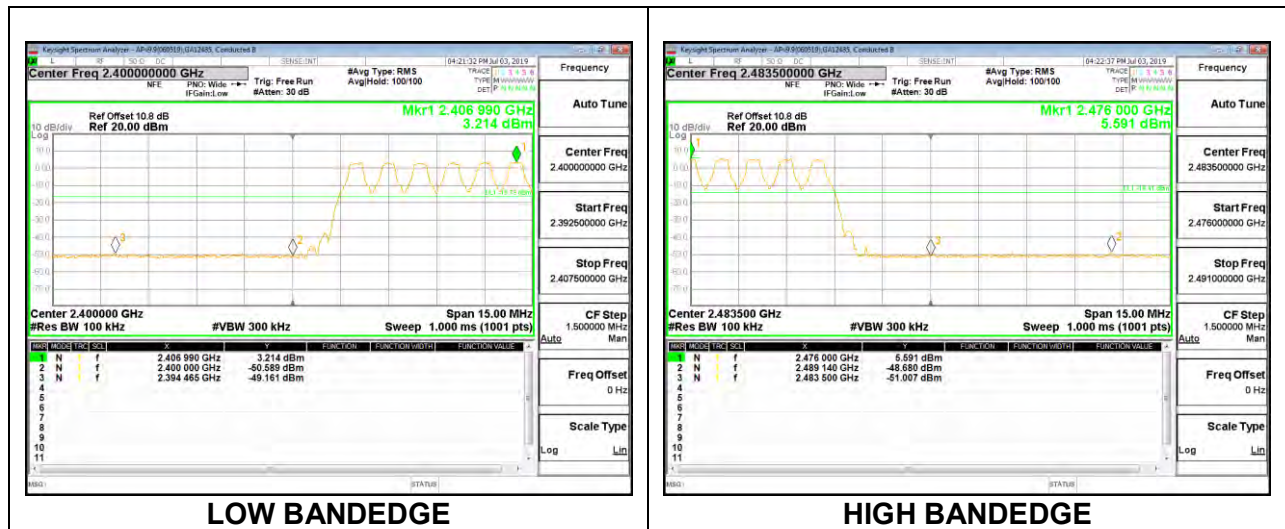
RESULTS

8.9.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

SPURIOUS EMISSIONS, NON-HOPPING

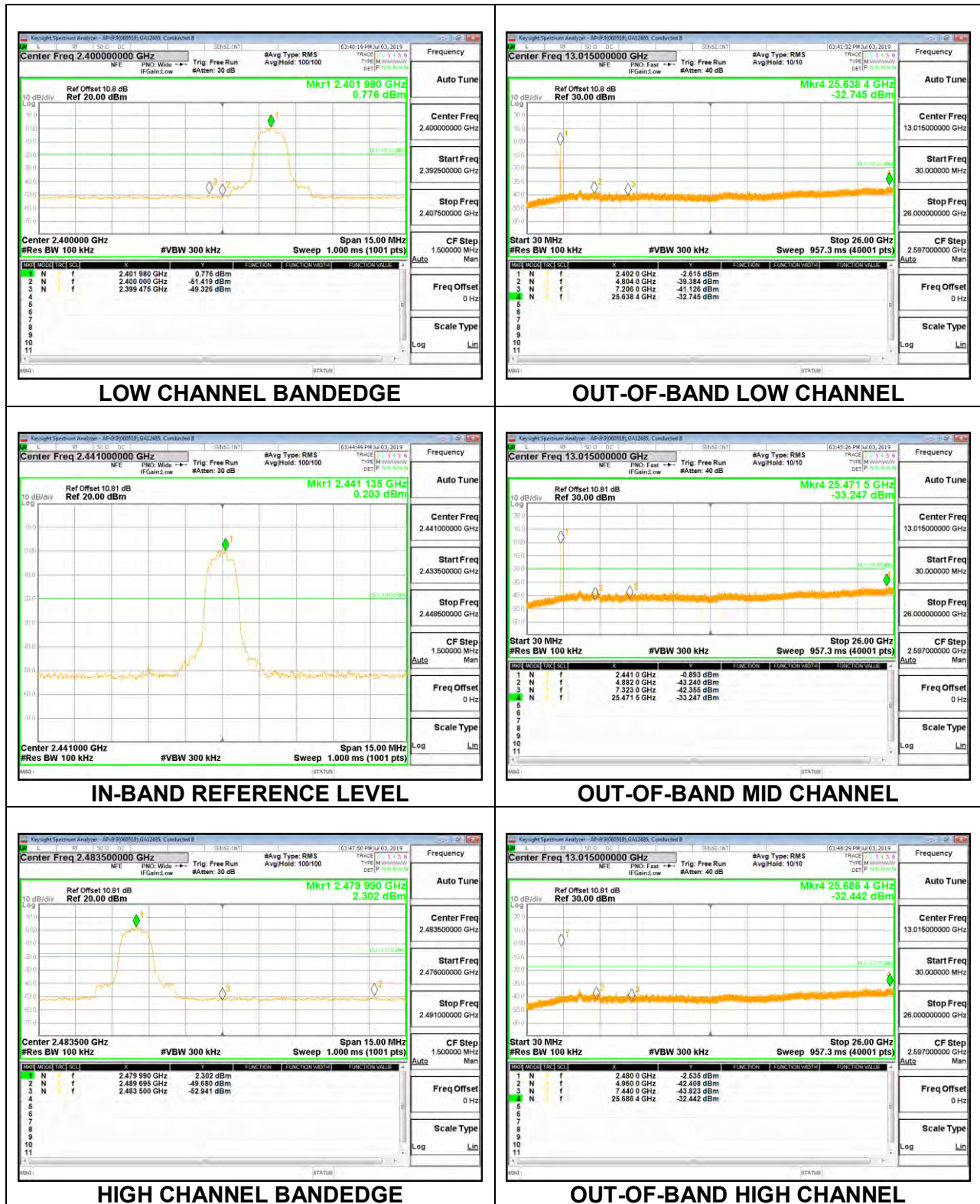


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



8.9.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

SPURIOUS EMISSIONS, NON-HOPPING



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



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 30MHz, below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

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

2D antenna use - For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

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

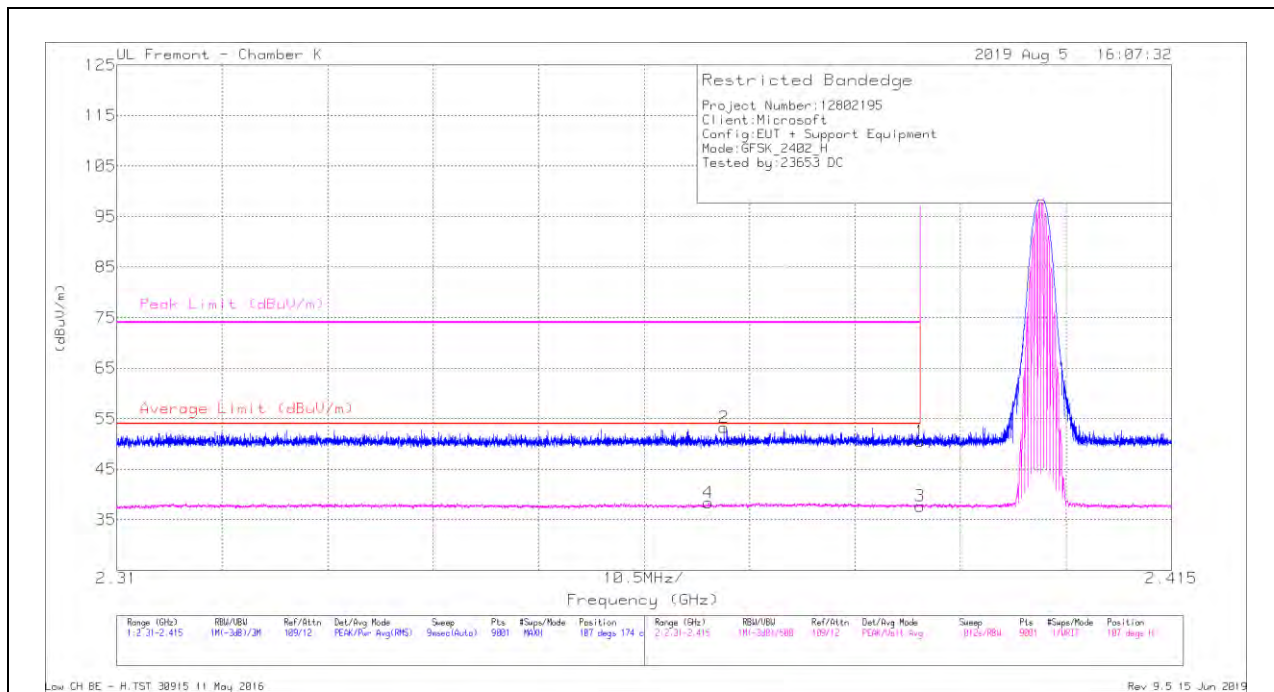
Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can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

9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.38999	32.75	Pk	31.9	-14.1	50.55	-	-	74	-23.45	107	174	H
2	2.37044	35.55	Pk	31.9	-14.2	53.25	-	-	74	-20.75	107	174	H
3	2.38999	19.89	VA1T	31.9	-14.1	37.69	54	-16.31	-	-	107	174	H
4	2.36892	20.69	VA1T	31.9	-14.2	38.39	54	-15.61	-	-	107	174	H

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

Pk - Peak detector

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

UL Fremont - Chamber K

2019 Aug 5 16:18:19

Restricted Bandedge

Project Number: 12882195
 Client: Microsoft
 Config: EUT + Support Equipment
 Mode: GFSK_2482_U
 Tested by: 23653 DC

Peak Limit (dBuV/m)

Average Limit (dBuV/m)

(dBuV/m)

Frequency (GHz)

2.31 2.415

10.5MHz/

Range (GHz) 1.915 RBW/VBW 100/10 Ref/Att 100/10 Det/Avg Mode ENVELOPE Sweep 100/10 Pls 1000 #Sigs/Mode 1 Position 1.915

Range (GHz) 1.915 RBW/VBW 100/10 Ref/Att 100/10 Det/Avg Mode ENVELOPE Sweep 100/10 Pls 1000 #Sigs/Mode 1 Position 1.915

Low CH BE - U.TST 30915 11 May 2016

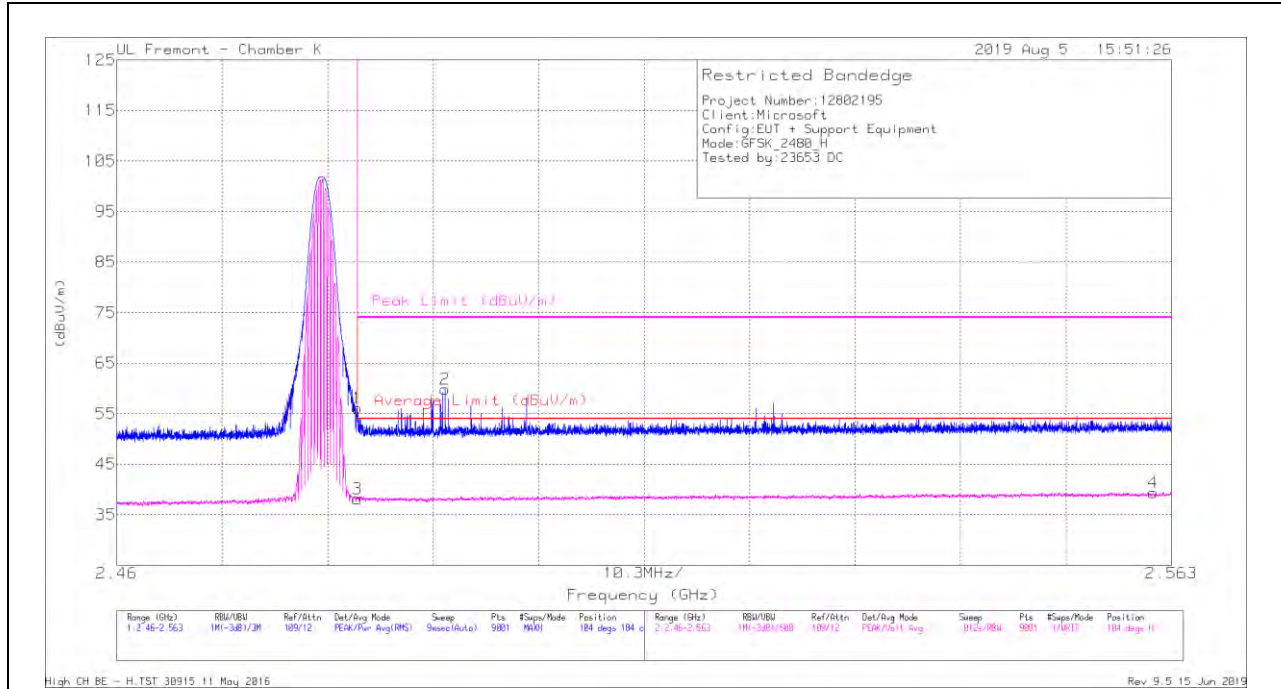
Rev 9.5 15 Jun 2019

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/CbI/Filt/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	2.38999	32.93	Pk	31.9	-14.1	50.73	-	-	74	-23.27	144	149	V
2	2.32443	37.58	Pk	31.6	-14.5	54.68	-	-	74	-19.32	144	149	V
3	2.38999	19.93	VA1T	31.9	-14.1	37.73	54	-16.27	-	-	144	149	V
4	2.317	22.43	VA1T	31.6	-14.4	39.63	54	-14.37	-	-	144	149	V

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

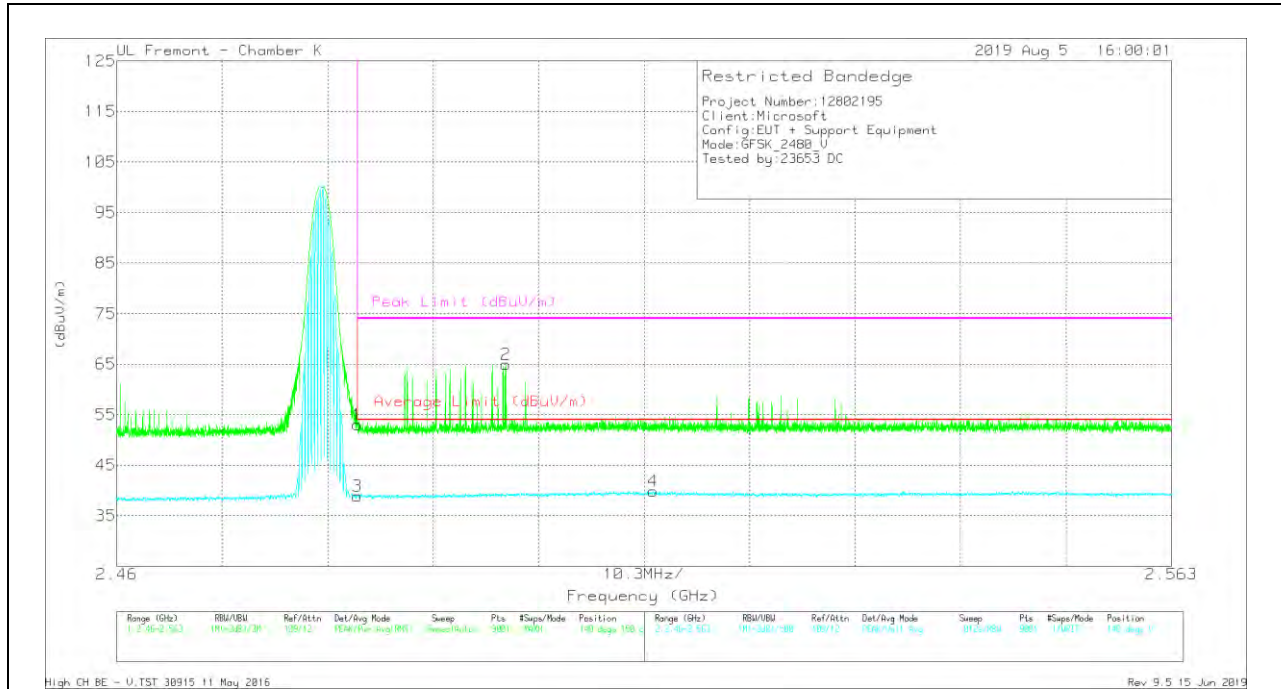
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cb/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.48351	37.78	Pk	32.5	-14.1	56.18	-	-	74	-17.82	104	184	H
2	2.49208	41.4	Pk	32.5	-14	59.9	-	-	74	-14.1	104	184	H
3	2.48351	19.77	VA1T	32.5	-14.1	38.17	54	-15.83	-	-	104	183	H
4	2.56122	20.42	VA1T	32.5	-13.6	39.32	54	-14.68	-	-	104	183	H

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

Pk - Peak detector

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

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.48351	34.65	Pk	32.5	-14.1	53.05	-	-	74	-20.95	140	150	V
2	2.49801	46.44	Pk	32.4	-13.9	64.94	-	-	74	-9.06	140	150	V
3	2.48351	20.44	VA1T	32.5	-14.1	38.84	54	-15.16	-	-	140	150	V
4	2.51238	21.38	VA1T	32.4	-13.9	39.88	54	-14.12	-	-	140	150	V

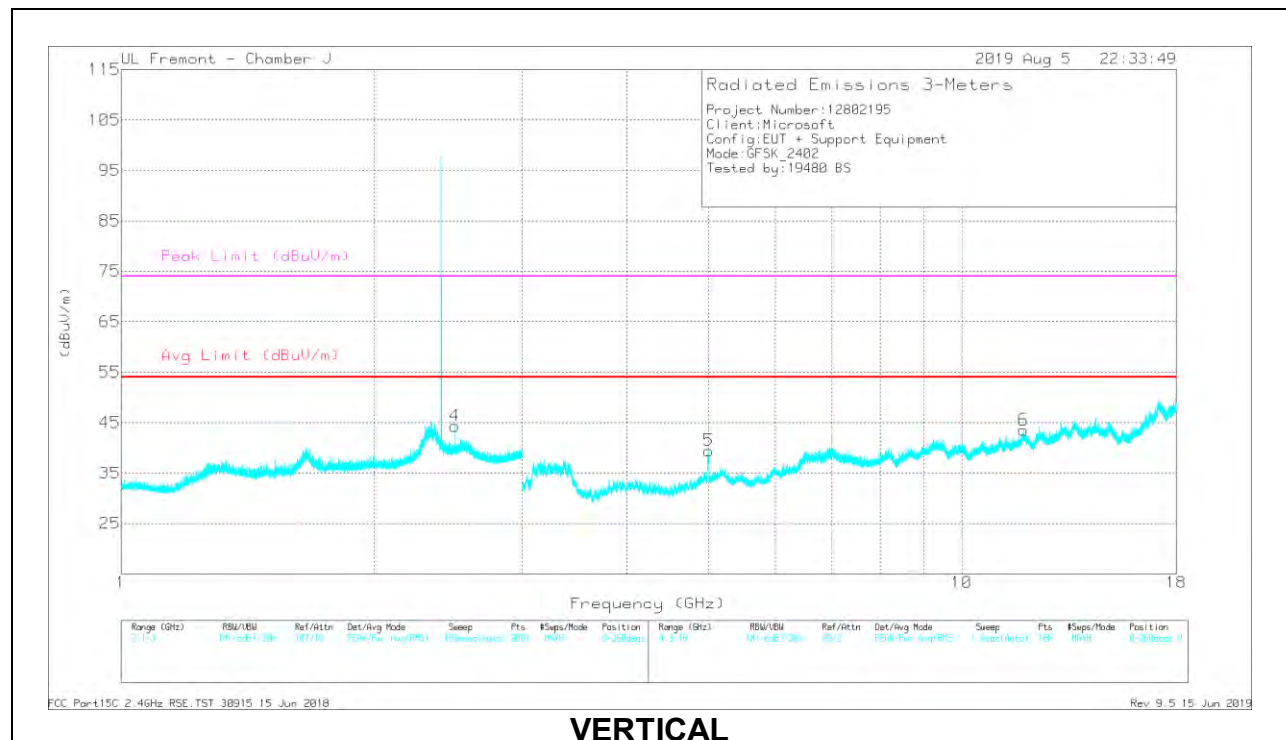
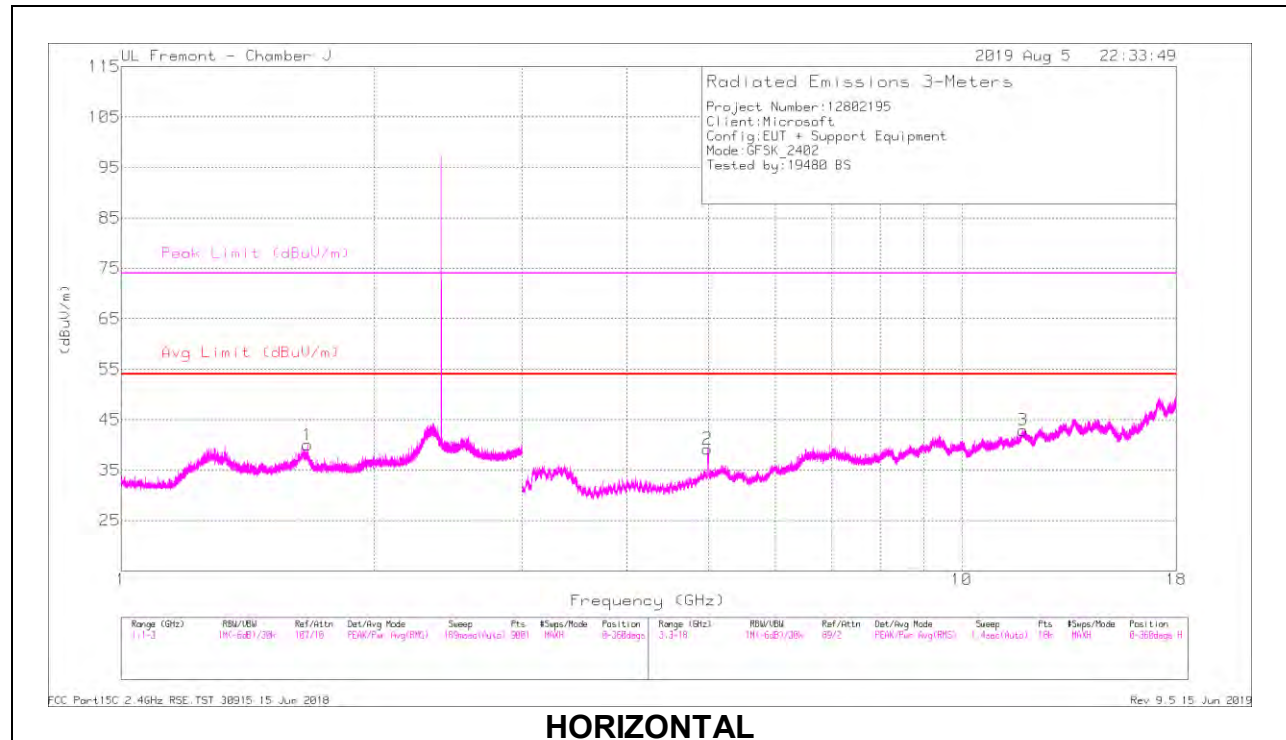
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

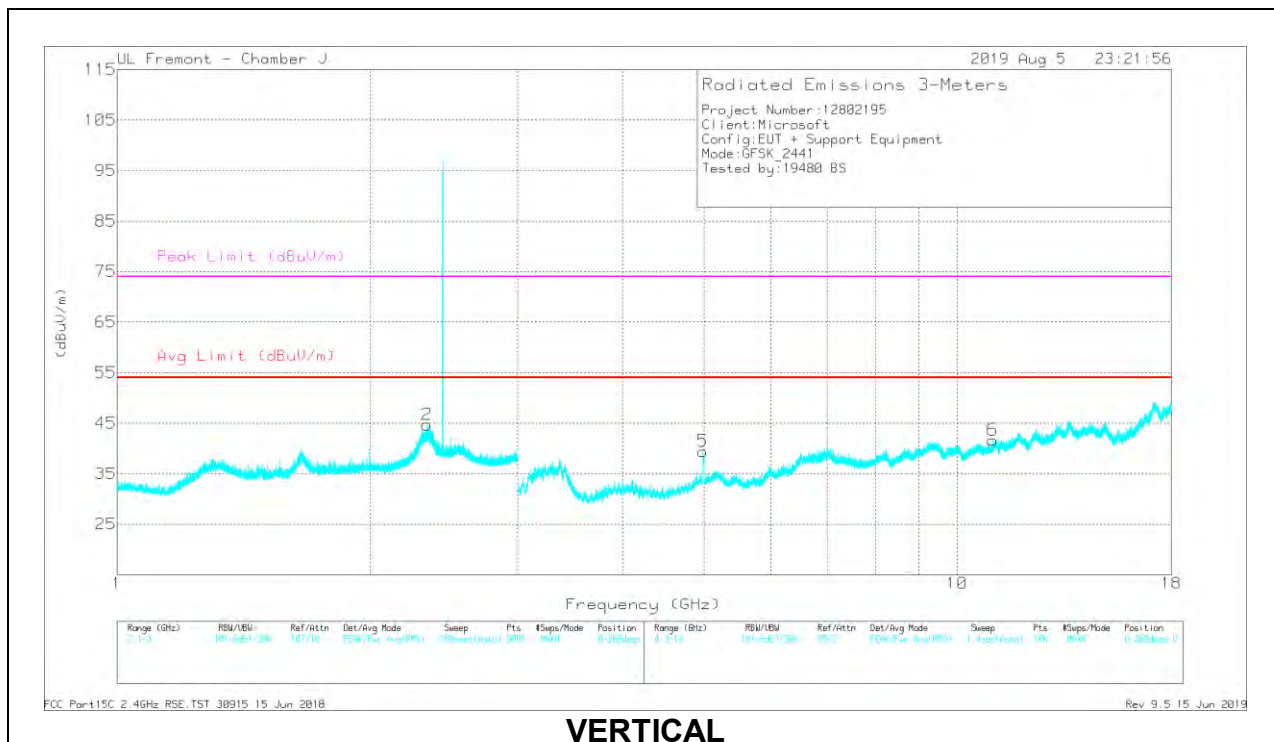
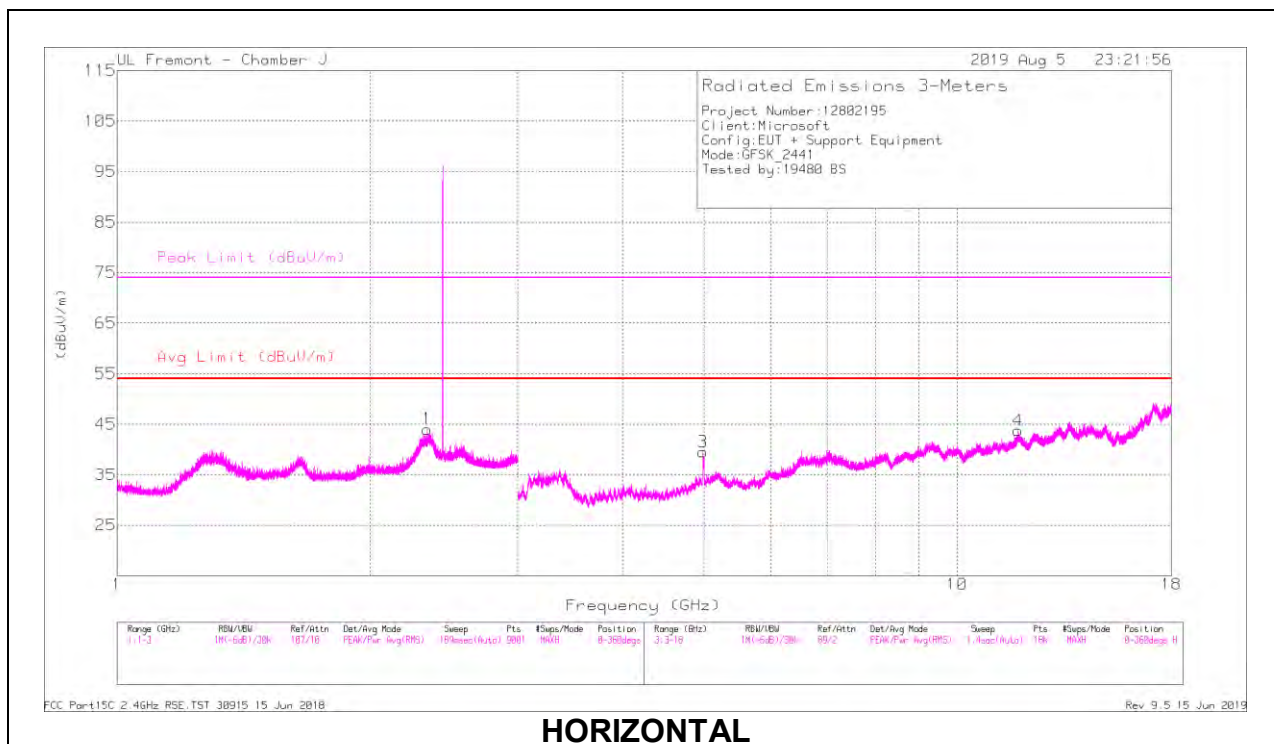
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dBm)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.66381	48	PKFH	25.8	-25.8	48	-	-	74	-26	185	190	H
	* 1.66416	35.05	VA1T	25.8	-25.8	35.05	54	-18.95	-	-	185	190	H
4	* 2.4963	53.98	PKFH	30	-25.5	58.48	-	-	74	-15.52	160	184	V
	* 2.49582	32.15	VA1T	30	-25.5	36.65	54	-17.35	-	-	160	184	V
2	* 4.98228	49.1	PKFH	35	-30.2	53.9	-	-	74	-20.1	102	215	H
	* 4.98513	27.94	VA1T	35	-30.2	32.74	54	-21.26	-	-	102	215	H
3	* 11.82271	31.74	PKFH	40	-21.7	50.04	-	-	74	-23.96	186	124	H
	* 11.82434	19.28	VA1T	40	-21.7	37.58	54	-16.42	-	-	186	124	H
5	* 4.99839	48.57	PKFH	35.1	-30	53.67	-	-	74	-20.33	16	218	V
	* 4.99498	28.07	VA1T	35	-30	33.07	54	-20.93	-	-	16	218	V
6	* 11.85084	32.08	PKFH	39.9	-21.7	50.28	-	-	74	-23.72	313	171	V
	* 11.8523	19.39	VA1T	39.9	-21.7	37.59	54	-16.41	-	-	313	171	V

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

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

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

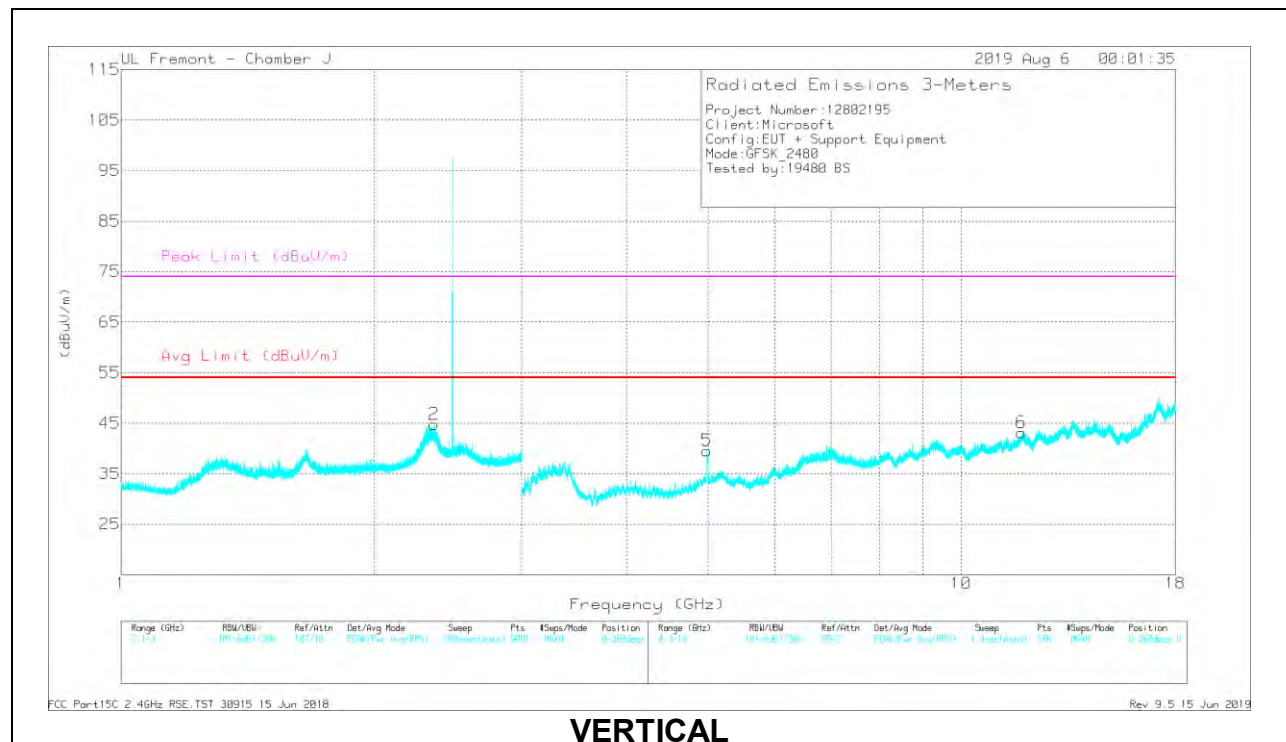
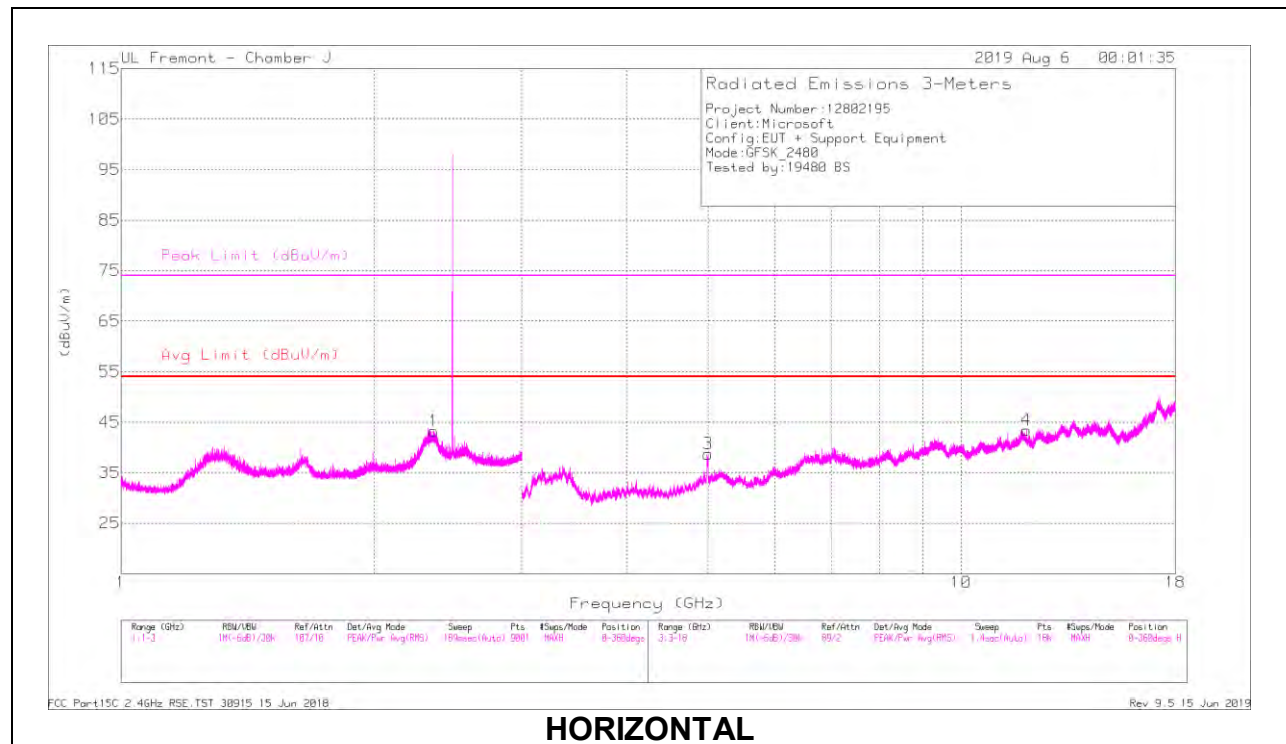
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.34078	49.52	PKFH	29	-25.6	52.92	-	-	74	-21.08	92	251	H
	* 2.33991	36.24	VA1T	29	-25.6	39.64	54	-14.36	-	-	92	251	H
2	* 2.33659	50.03	PKFH	29	-25.6	53.43	-	-	74	-20.57	128	108	V
	* 2.33942	37.73	VA1T	29	-25.6	41.13	54	-12.87	-	-	128	108	V
3	* 4.98331	47.24	PKFH	35	-30.2	52.04	-	-	74	-21.96	103	235	H
	* 4.98387	27.33	VA1T	35	-30.2	32.13	54	-21.87	-	-	103	235	H
4	* 11.82219	32.22	PKFH	40	-21.7	50.52	-	-	74	-23.48	50	249	H
	* 11.82497	19.1	VA1T	40	-21.7	37.4	54	-16.6	-	-	50	249	H
5	* 4.9833	48.13	PKFH	35	-30.2	52.93	-	-	74	-21.07	124	221	V
	* 4.98322	27.54	VA1T	35	-30.2	32.34	54	-21.66	-	-	124	221	V
6	* 11.03112	33.53	PKFH	39.1	-23.1	49.53	-	-	74	-24.47	234	197	V
	* 11.02948	19.94	VA1T	39.1	-23.1	35.94	54	-18.06	-	-	234	197	V

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

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

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dBm)	Amp/Cbl/Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.35836	50.09	PKFH	29.2	-25.5	53.79	-	-	74	-20.21	118	344	H
	* 2.35491	36.92	VA1T	29.2	-25.6	40.52	54	-13.48	-	-	118	344	H
2	* 2.35835	49.76	PKFH	29.2	-25.5	53.46	-	-	74	-20.54	130	109	V
	* 2.35836	37.2	VA1T	29.2	-25.5	40.9	54	-13.1	-	-	130	109	V
3	* 4.99998	48.24	PKFH	35.1	-29.9	53.44	-	-	74	-20.56	100	178	H
	* 4.99713	27.48	VA1T	35.1	-30	32.58	54	-21.42	-	-	100	178	H
4	* 11.97022	31.51	PKFH	39.9	-22.1	49.31	-	-	74	-24.69	195	121	H
	* 11.96845	19.28	VA1T	39.9	-22.1	37.08	54	-16.92	-	-	195	121	H
5	* 4.98307	48.11	PKFH	35	-30.2	52.91	-	-	74	-21.09	123	221	V
	* 4.9844	27.6	VA1T	35	-30.2	32.4	54	-21.6	-	-	123	221	V
6	* 11.80073	32.13	PKFH	40	-21.8	50.33	-	-	74	-23.67	17	103	V
	* 11.80288	19.02	VA1T	40	-21.8	37.22	54	-16.78	-	-	17	103	V

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

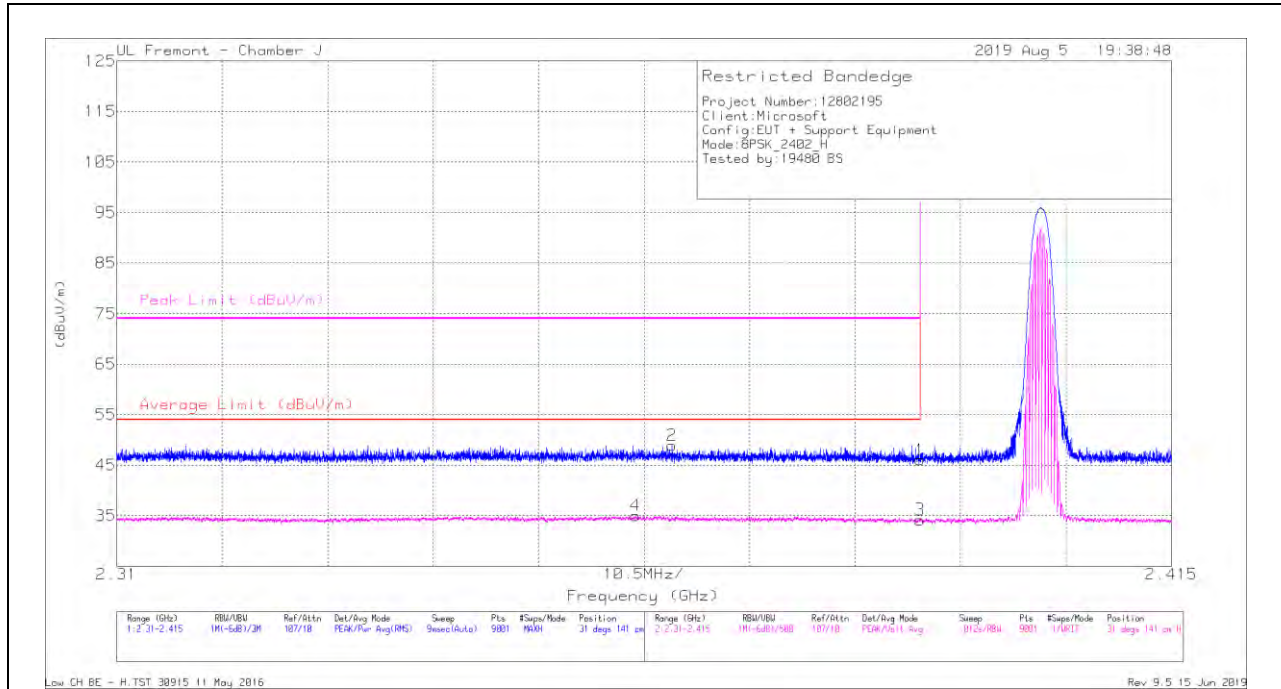
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

BANDEDGE (LOW CHANNEL)

HORIZONTAL RESULT



Trace Markers

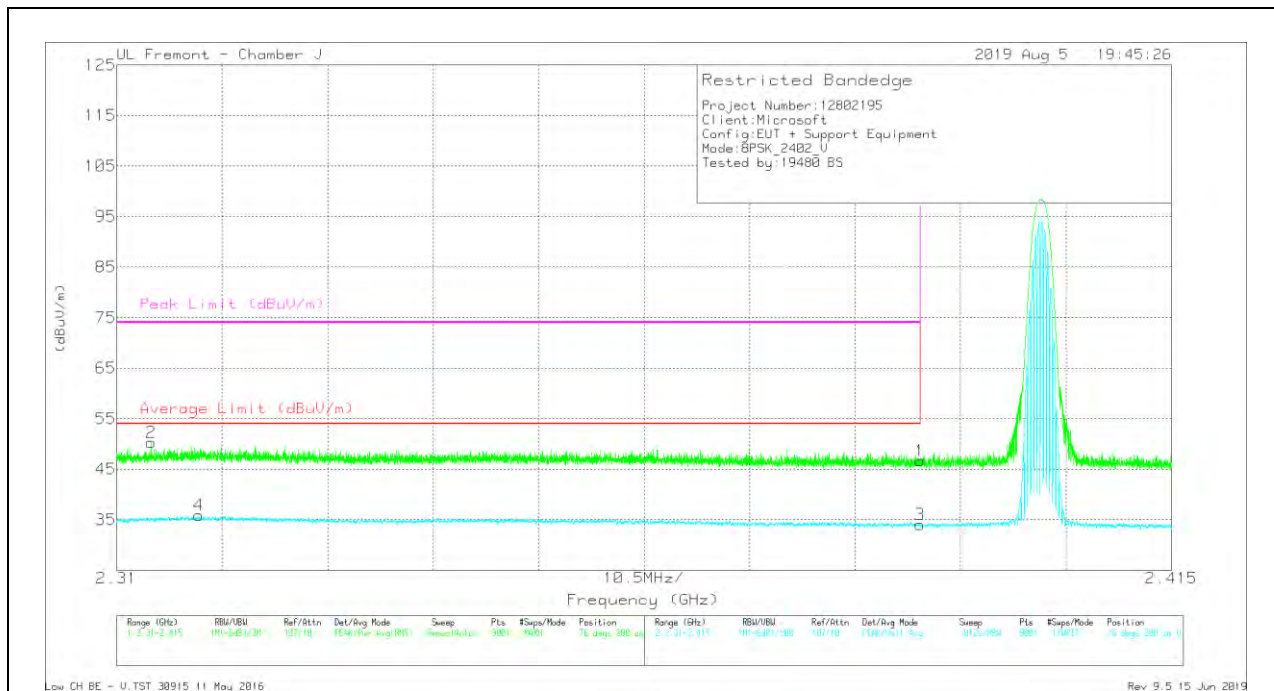
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.38999	42.09	Pk	29.5	-25.5	46.09	-	-	74	-27.91	31	141	H
2	* 2.36529	45.14	Pk	29.3	-25.5	48.94	-	-	74	-25.06	31	141	H
3	* 2.38999	30.21	VA1T	29.5	-25.5	34.21	54	-19.79	-	-	31	141	H
4	* 2.36165	31.3	VA1T	29.2	-25.5	35	54	-	-	-	31	141	H

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

Pk - Peak detector

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

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Ftr/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	42.69	Pk	29.5	-25.5	46.69	-	-	74	-27.31	76	280	V
2	* 2.31344	47.19	Pk	28.7	-25.6	50.29	-	-	74	-23.71	76	280	V
3	* 2.38999	30	VA1T	29.5	-25.5	34	54	-20	-	-	76	280	V
4	* 2.31817	32.54	VA1T	28.8	-25.5	35.84	54	-18.16	-	-	76	280	V

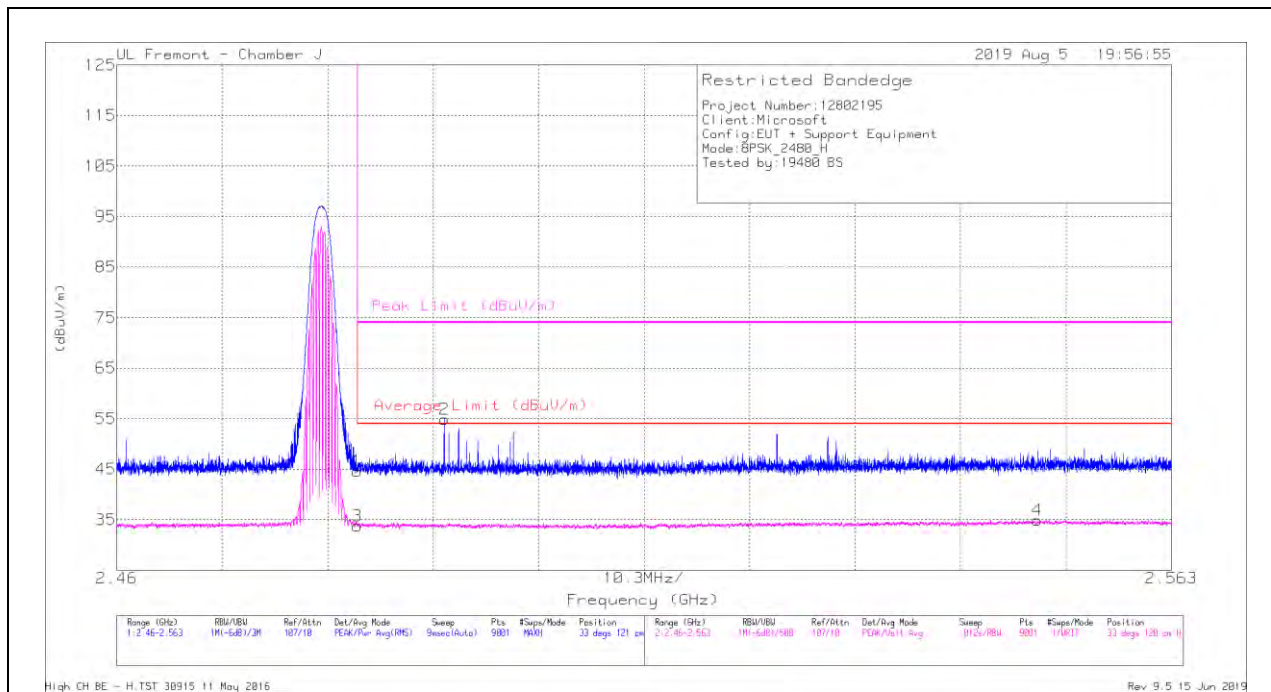
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

BANDEDGE (HIGH CHANNEL)

HORIZONTAL RESULT



Trace Markers

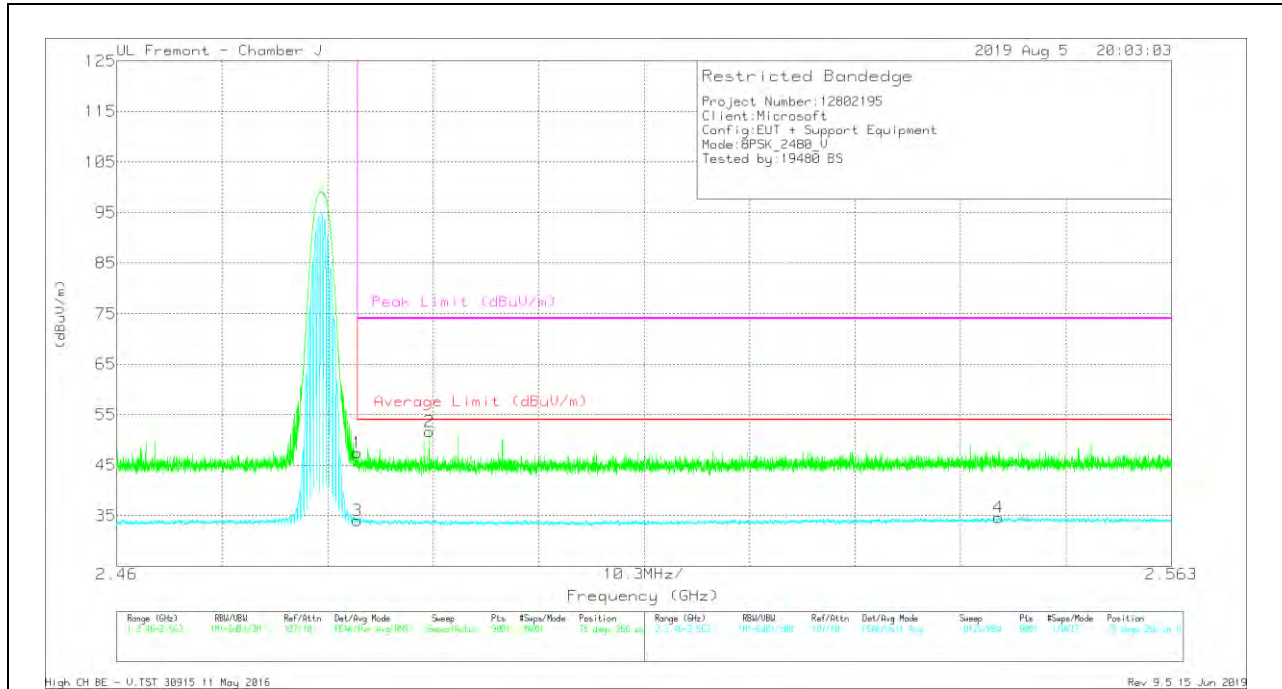
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/CbI/Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	40.24	Pk	29.9	-25.5	44.64	-	-	74	-29.36	33	121	H
2	* 2.49198	50.53	Pk	29.9	-25.5	54.93	-	-	74	-19.07	33	121	H
3	* 2.48351	29.4	VA1T	29.9	-25.5	33.8	54	-20.2	-	-	33	120	H
4	2.54989	29.99	VA1T	30.3	-25.4	34.89	54	-19.11	-	-	33	120	H

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

Pk - Peak detector

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

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Ftr/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	43.02	Pk	29.9	-25.5	47.42	-	-	74	-26.58	75	266	V
2	* 2.49052	47.26	Pk	29.9	-25.5	51.66	-	-	74	-22.34	75	266	V
3	* 2.48351	29.57	VA1T	29.9	-25.5	33.97	54	-20.03	-	-	75	266	V
4	2.54608	29.79	VA1T	30.3	-25.4	34.69	54	-19.31	-	-	75	266	V

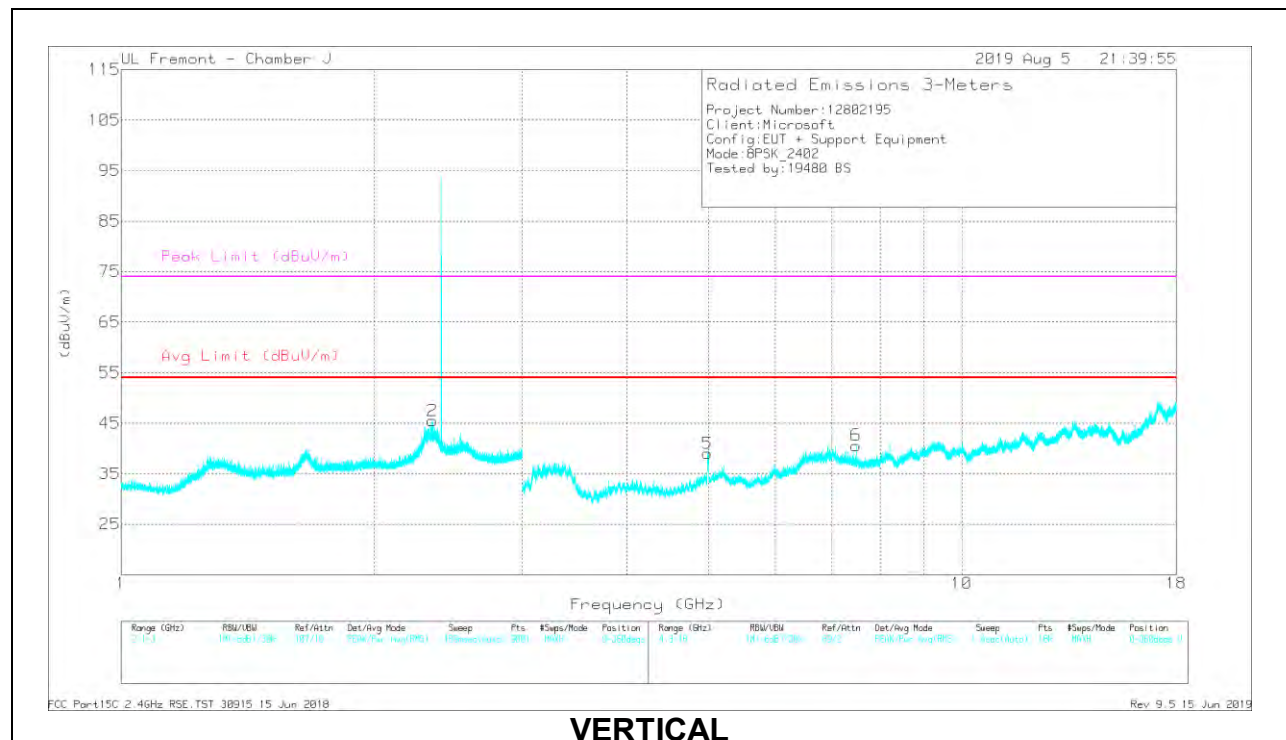
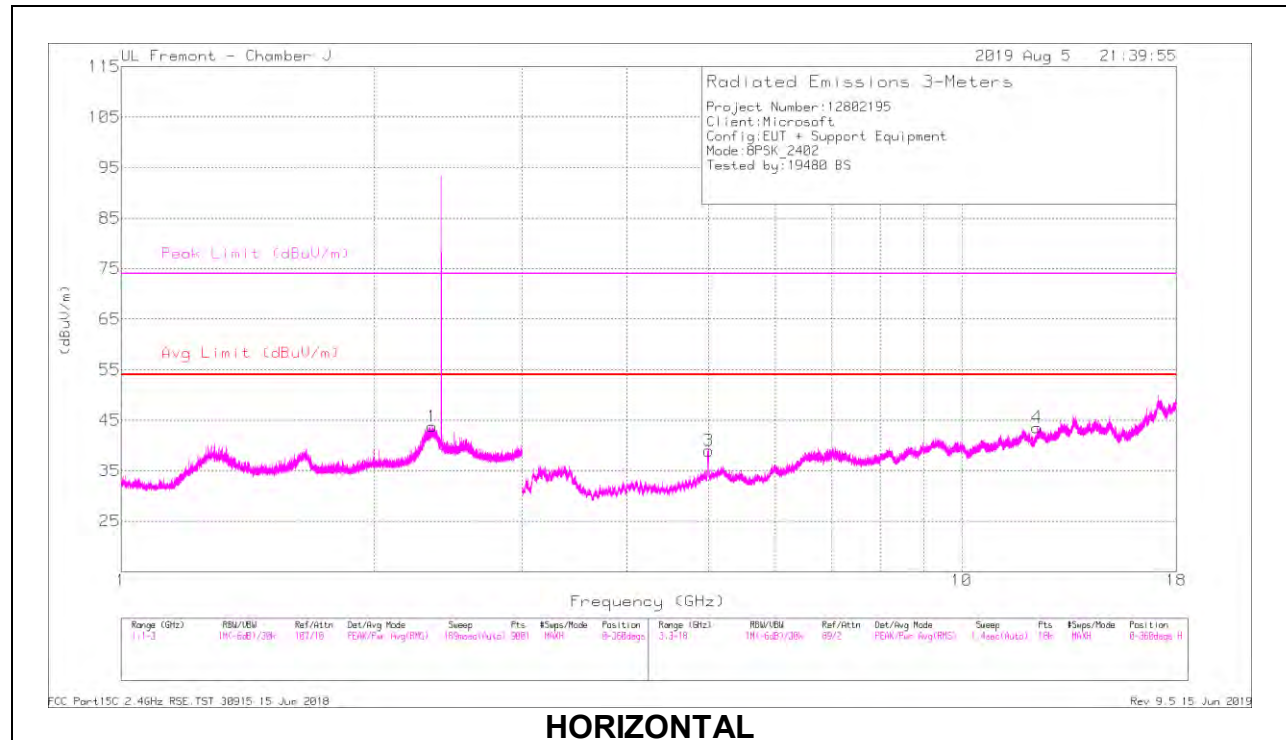
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

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

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



RADIATED EMISSIONS

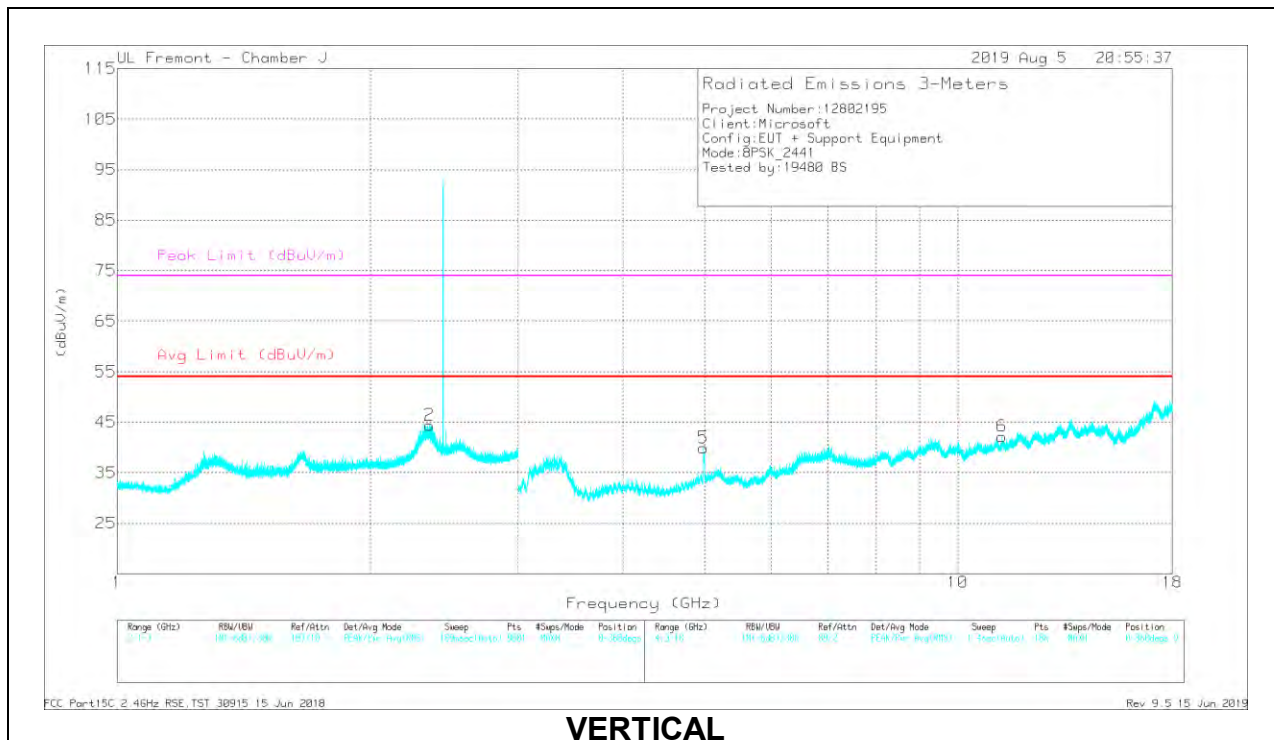
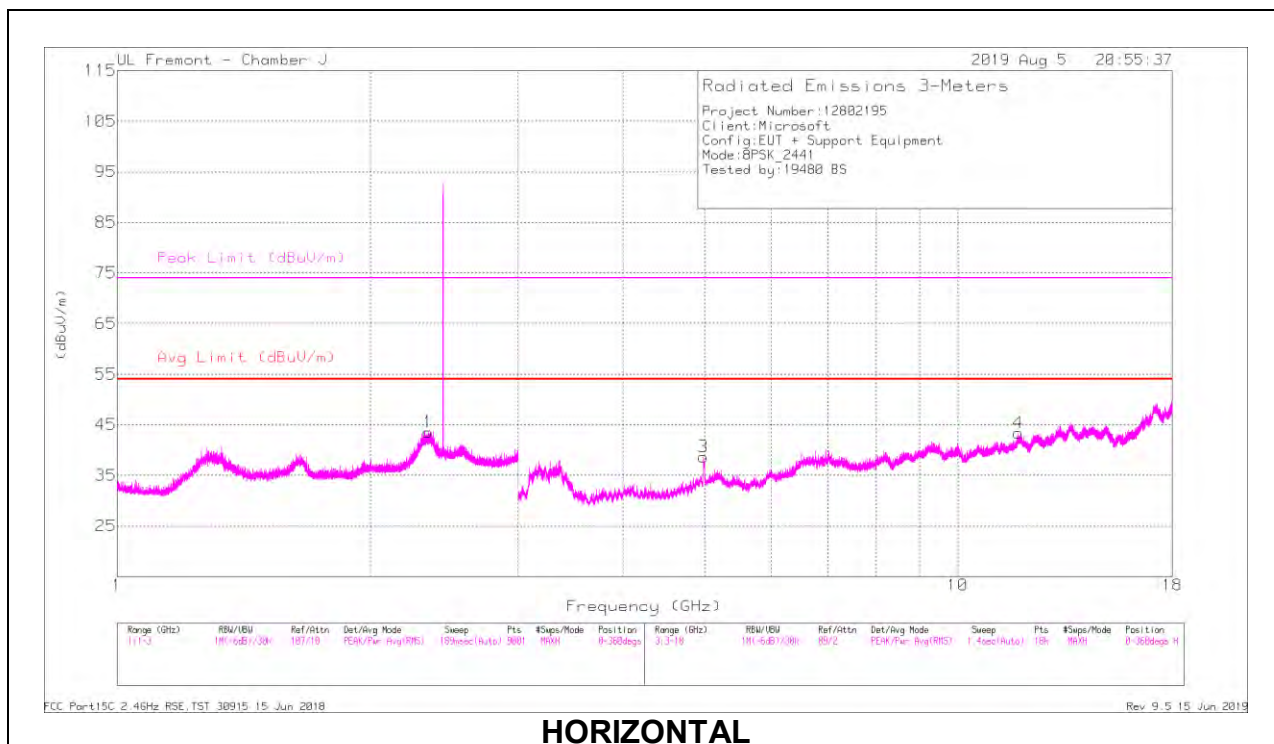
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.34437	49.69	PKFH	29.1	-25.6	53.19	-	-	74	-20.81	91	279	H
	* 2.34269	36.98	VA1T	29	-25.6	40.38	54	-13.62	-	-	91	279	H
2	* 2.34469	50.45	PKFH	29.1	-25.6	53.95	-	-	74	-20.05	129	108	V
	* 2.34596	37.98	VA1T	29.1	-25.6	41.48	54	-12.52	-	-	129	108	V
3	* 4.98678	47.75	PKFH	35.1	-30	52.85	-	-	74	-21.15	102	222	H
	* 4.98622	27.72	VA1T	35	-30	32.72	54	-21.28	-	-	102	222	H
4	* 12.29415	31.87	PKFH	40.2	-21.7	50.37	-	-	74	-23.63	205	290	H
	* 12.29503	18.97	VA1T	40.2	-21.7	37.47	54	-16.53	-	-	205	290	H
5	* 4.98456	48.6	PKFH	35	-30.2	53.4	-	-	74	-20.6	15	214	V
	* 4.98494	27.86	VA1T	35	-30.2	32.66	54	-21.34	-	-	15	214	V
6	* 7.48782	35.44	PKFH	37.5	-27.2	45.74	-	-	74	-28.26	168	105	V
	* 7.48712	23.44	VA1T	37.5	-27.2	33.74	54	-20.26	-	-	168	105	V

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

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

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

MID CHANNEL RESULTS



RADIATED EMISSIONS

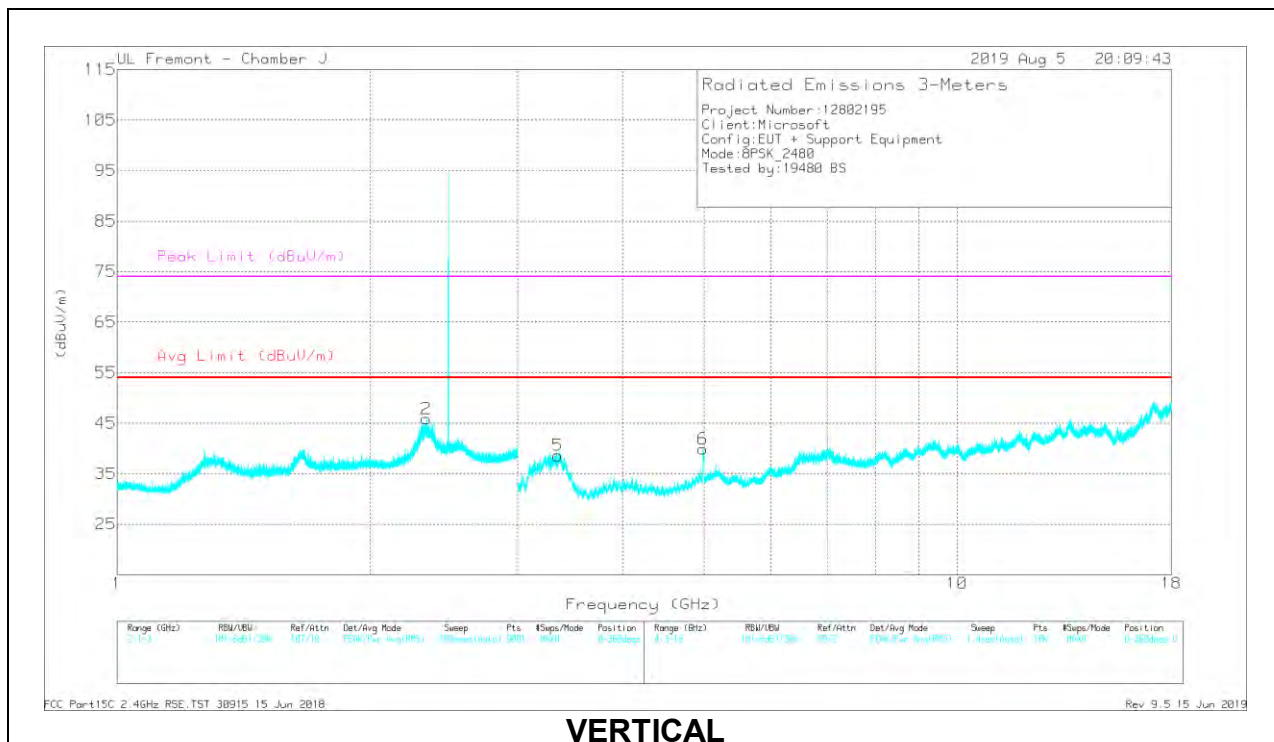
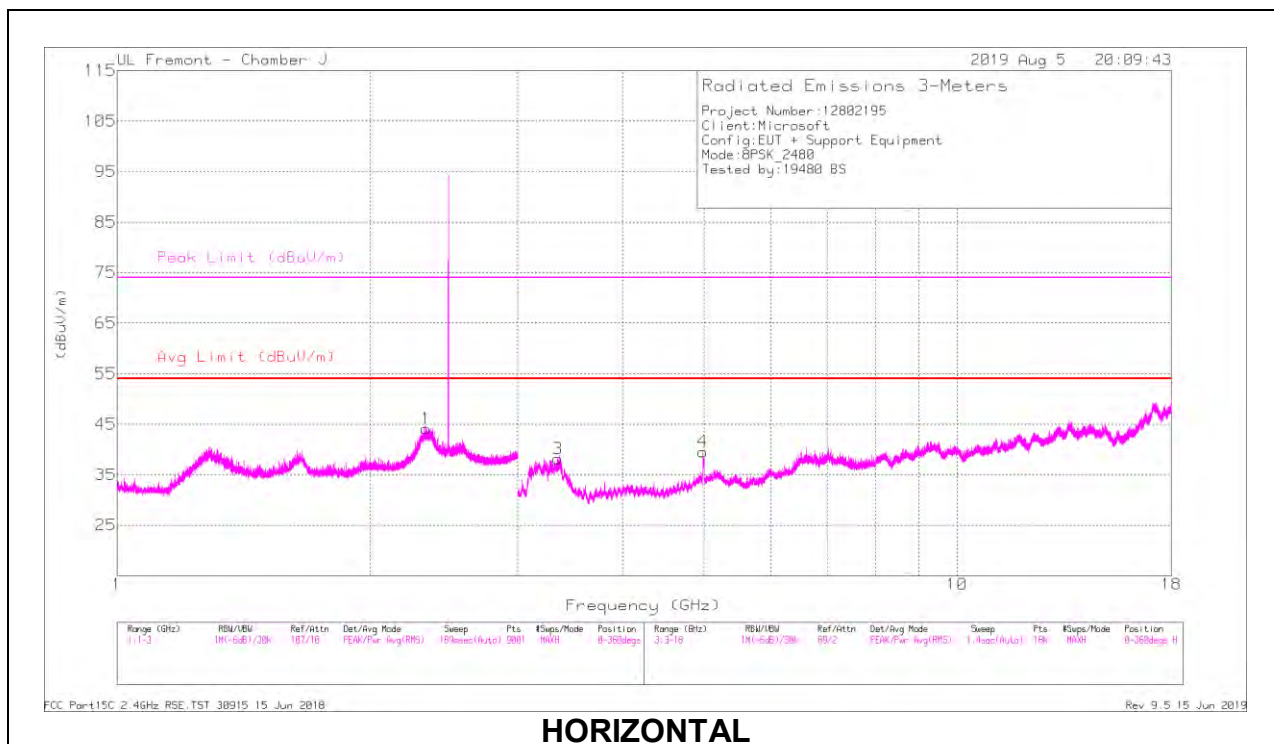
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.34508	48.93	PKFH	29.1	-25.6	52.43	-	-	74	-21.57	95	191	H
	* 2.34436	36.49	VA1T	29.1	-25.6	39.99	54	-14.01	-	-	95	191	H
2	* 2.35168	50.01	PKFH	29.1	-25.5	53.51	-	-	74	-20.39	130	104	V
	* 2.35191	37.65	VA1T	29.1	-25.5	41.25	54	-12.75	-	-	130	104	V
3	* 4.98473	48.23	PKFH	35	-30.2	53.03	-	-	74	-20.97	101	200	H
	* 4.98598	27.86	VA1T	35	-30.2	32.66	54	-21.34	-	-	101	200	H
4	* 11.81231	31.42	PKFH	40	-21.8	49.82	-	-	74	-24.38	241	180	H
	* 11.81213	18.98	VA1T	40	-21.8	37.18	54	-16.82	-	-	241	180	H
5	* 4.97994	46.01	PKFH	34.9	-30.2	50.71	-	-	74	-23.29	104	115	V
	* 4.98316	27.12	VA1T	35	-30.2	31.92	54	-22.08	-	-	104	115	V
6	* 11.28892	32.14	PKFH	39.1	-22.6	48.64	-	-	74	-25.36	334	214	V
	* 11.28671	19.76	VA1T	39.1	-22.6	36.26	54	-17.74	-	-	334	214	V

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

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

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

HIGH CHANNEL RESULTS



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/Filr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.33444	49.54	PKFH	28.9	-25.6	52.84	-	-	74	-21.16	95	223	H
	* 2.33517	36.69	VA1T	29	-25.6	40.09	54	-13.91	-	-	95	223	H
2	* 2.33544	51.09	PKFH	29	-25.6	54.49	-	-	74	-19.51	130	110	V
	* 2.33234	37.87	VA1T	28.9	-25.6	41.17	-	-	-	-	130	110	V
4	* 4.99402	47.43	PKFH	35	-30	52.43	-	-	74	-21.57	101	190	H
	* 4.99583	27.5	VA1T	35.1	-30	32.6	54	-21.4	-	-	101	190	H
3	* 3.34807	49.14	PKFH	31.2	-33.5	46.84	-	-	74	-27.16	100	117	H
	* 3.34829	36.23	VA1T	31.2	-33.5	33.93	54	-20.07	-	-	100	117	H
6	* 4.9801	47.86	PKFH	34.9	-30.2	52.56	-	-	74	-21.44	132	108	V
	* 4.98325	27.56	VA1T	35	-30.2	32.36	54	-21.64	-	-	132	108	V
5	* 3.34738	49.4	PKFH	31.2	-33.6	47	-	-	74	-27	28	195	V
	* 3.34861	37.15	VA1T	31.2	-33.5	34.85	54	-19.15	-	-	28	195	V

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

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

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

9.2. SPURIOUS EMISSIONS FOR COLLOCATION

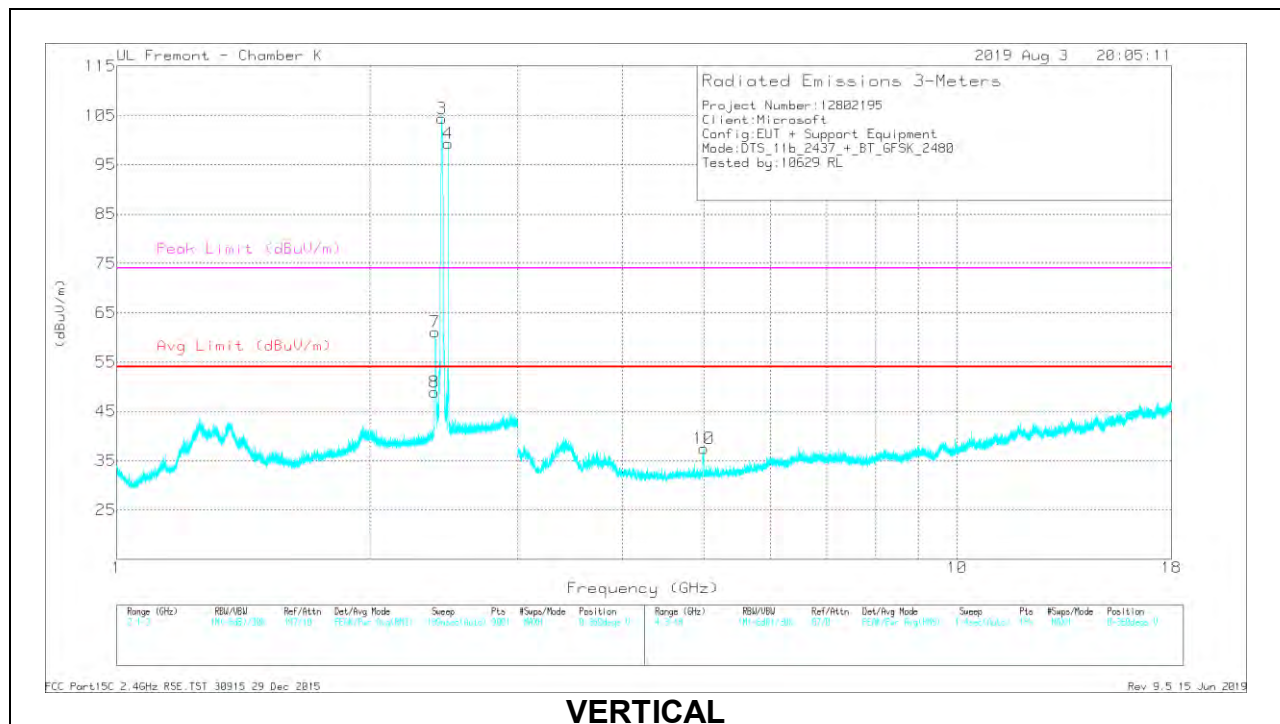
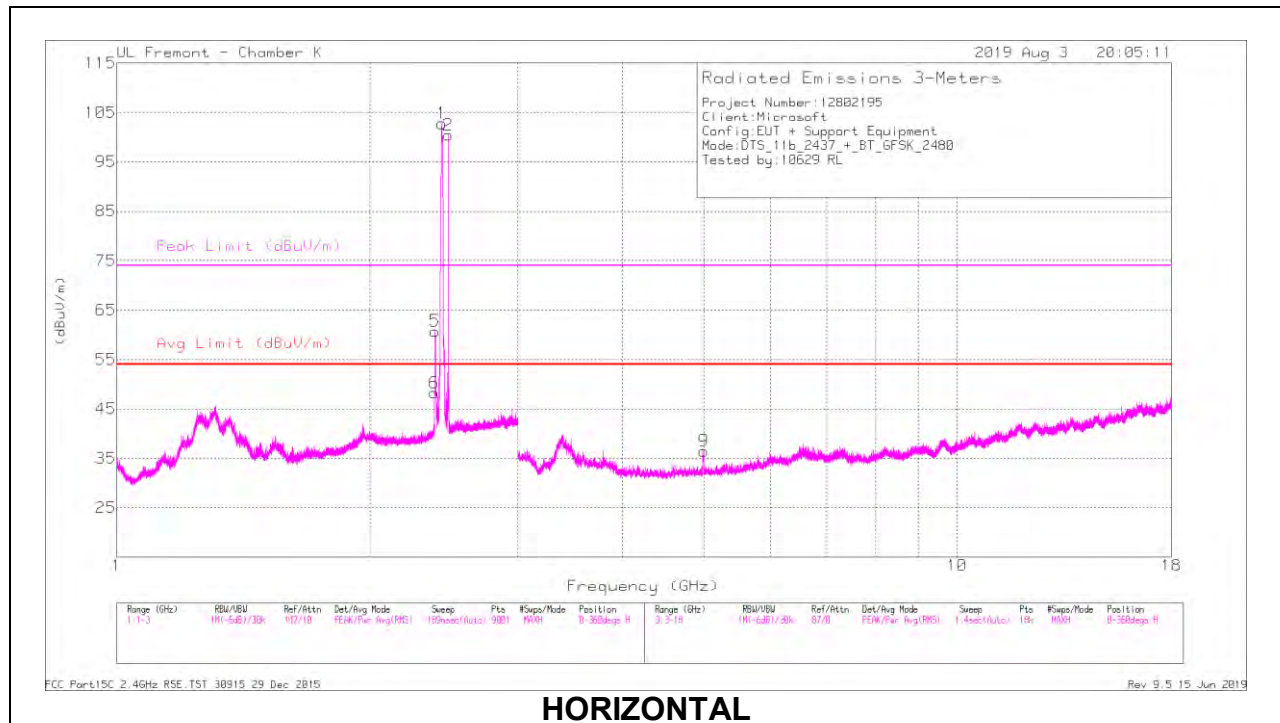
TEST-CASE CONDITIONS

Testcase #	Antenna	Mode	Frequency (MHz)
1	Chain 1	BT GFSK	2480
	WWAN	LTE Band 7, QPSK (20MHz), 1RB	2510
2	Chain 1	BT GFSK	2480
	WWAN	LTE Band 5, QPSK (10MHz), 1RB	836.5
3	Chain 1	BT GFSK	2480
	Chain 2	WLAN 2.4GHz, 11b	2437
4	Chain 1	BT GFSK	2480
	Chain 2	WLAN 5GHz, 11n HT20	5260

For simultaneous transmission of any BT (2.4GHz) and WWAN bands, investigation has been performed and no noticeable new emission was found.

9.2.1. TEST CASE 3

Chain 1 BT GFSK 2480MHz + Chain 2 WLAN 2.4GHz 802.11b 2437MHz



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Filtr/ Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	**2.438	84.59	Pk	32.3	-14.1	102.79	-	-	-	-	0-360	101	H
2	***2.48022	81.98	Pk	32.5	-14.1	100.38	-	-	-	-	0-360	200	H
3	**2.43644	86.14	Pk	32.3	-14.1	104.34	-	-	-	-	0-360	101	V
4	***2.48022	80.86	Pk	32.5	-14.1	99.26	-	-	-	-	0-360	101	V
5	2.39402	46.56	PKFH	31.9	-14.2	64.26	-	-	-	-	120	122	H
	2.39399	43.52	VA1T	31.9	-14.2	61.22	-	-	-	-	120	122	H
6	* 2.39	35.81	PKFH	31.9	-14.1	53.61	-	-	74	-20.39	113	171	H
	* 2.38953	28.01	VA1T	31.9	-14.1	45.81	54	-8.19	-	-	113	171	H
7	2.3941	48.03	PKFH	31.9	-14.2	65.73	-	-	-	-	186	158	V
	2.39407	44.48	VA1T	31.9	-14.2	62.18	-	-	-	-	186	158	V
8	* 2.38984	37.07	PKFH	31.9	-14.1	54.87	-	-	74	-19.13	184	131	V
	* 2.38988	30.43	VA1T	31.9	-14.1	48.23	54	-5.77	-	-	184	131	V
9	* 4.99559	46.55	PKFH	34.1	-30.4	50.25	-	-	74	-23.75	197	104	H
	* 4.99497	29.6	VA1T	34.1	-30.4	33.3	54	-20.7	-	-	197	104	H
10	* 4.97987	48.66	PKFH	34	-30.5	52.16	-	-	74	-21.84	5	103	V
	* 4.98379	30.77	VA1T	34.1	-30.4	34.47	54	-19.53	-	-	5	103	V

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

** - fundamental frequency of WLAN 11b 2437MHz Channel

*** - fundamental frequency of BT GFSK 2480MHz Channel

Pk - Peak detector

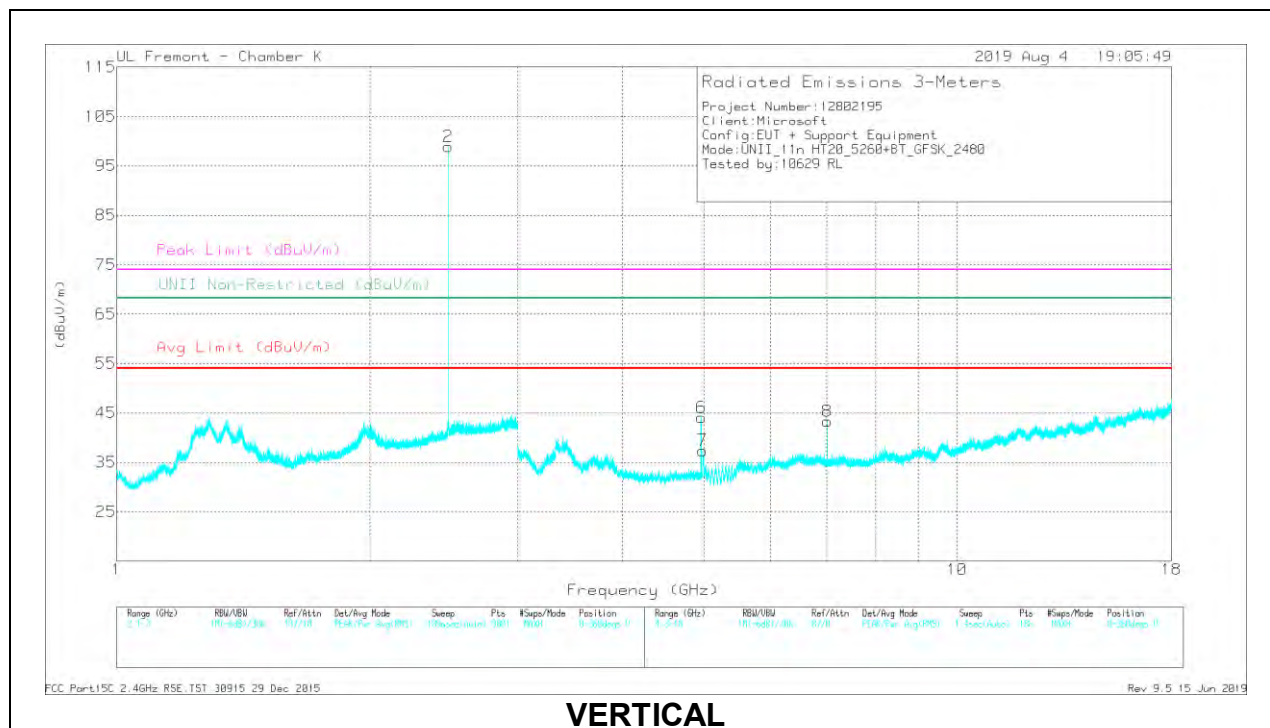
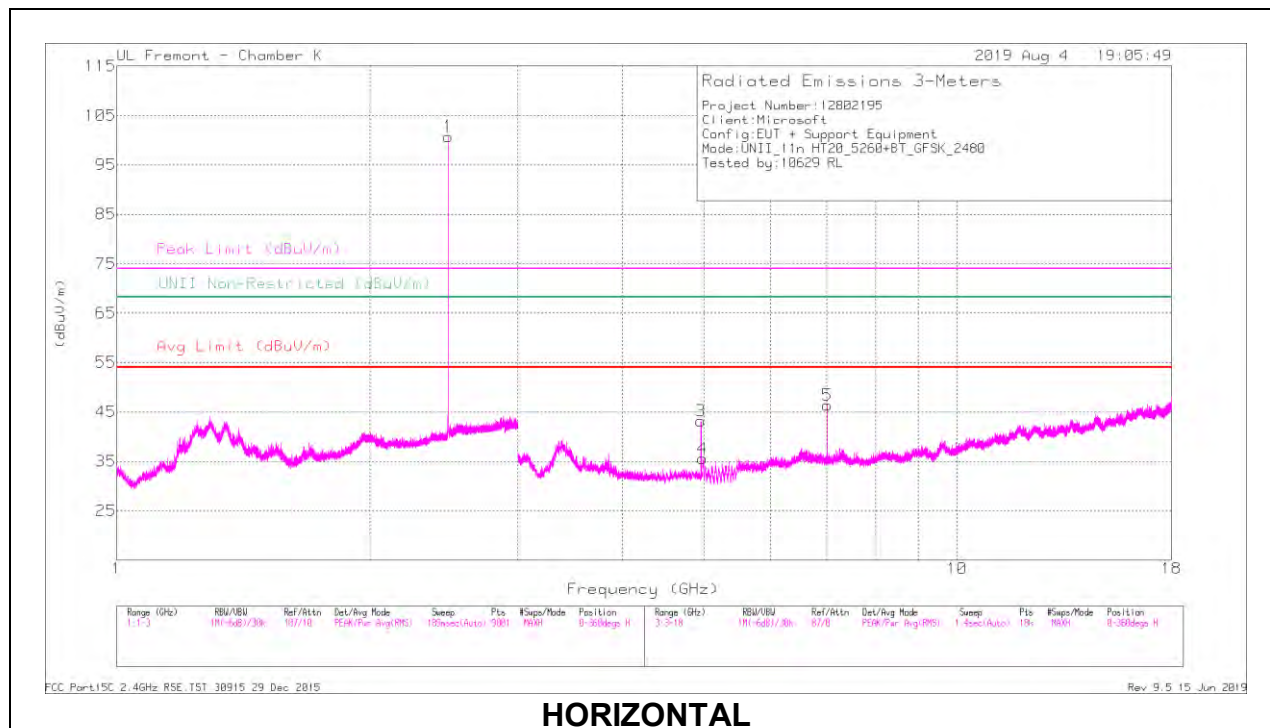
PKFH FHSS/BT RB=100k for Frequencies<1GHz / RB=1MHz for Frequencies>1GHz, VB=3 x RB, Peak

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

9.2.2. TEST CASE 4

Chain 1 BT GFSK 2480MHz + Chain 2 WLAN 5GHz, 802.11n HT20 5260 MHz

A 5150 – 5350MHz Band Reject filter was utilized for this test.



RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF EMC4294 (dB/m)	Amp/Cbl/Filtr/Pa d (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	UNII Non-Restricted (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	**2.48	82.35	Pk	32.5	-12.1	102.75	-	-	-	-	-	-	0-360	200	H
2	**2.48022	80.48	Pk	32.5	-12.1	100.88	-	-	-	-	-	-	0-360	200	V
3	* 4.95963	45.28	PKFH	34.1	-28.6	50.78	-	-	74	-23.22	-	-	213	116	H
	* 4.96	40.85	VA1T	34.1	-28.6	46.35	54	-7.65	-	-	-	-	213	116	H
4	* 4.99349	45.99	PKFH	34.1	-28.4	51.69	-	-	74	-22.31	-	-	201	104	H
	* 4.98894	29.4	VA1T	34.1	-28.4	35.1	54	-18.9	-	-	-	-	201	104	H
5	7.01329	41.64	PKFH	35.7	-24.8	52.54	-	-	-	-	68.2	-15.66	139	345	H
	7.01334	37.75	VA1T	35.7	-24.8	48.65	-	-	-	-	-	-	139	345	H
6	* 4.96017	45.65	PKFH	34.1	-28.6	51.15	-	-	74	-22.85	-	-	173	102	V
	* 4.96003	41.25	VA1T	34.1	-28.6	46.75	54	-7.25	-	-	-	-	173	102	V
7	* 4.97965	47.42	PKFH	34	-28.5	52.92	-	-	74	-21.08	-	-	5	102	V
	* 4.98392	30.57	VA1T	34.1	-28.4	36.27	54	-17.73	-	-	-	-	5	102	V
8	7.01331	40.21	PKFH	35.7	-24.8	51.11	-	-	-	-	68.2	-17.09	75	294	V
	7.01339	34.59	VA1T	35.7	-24.8	45.49	-	-	-	-	-	-	75	294	V

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

** - fundamental frequency of BT GFSK 2480MHz Channel

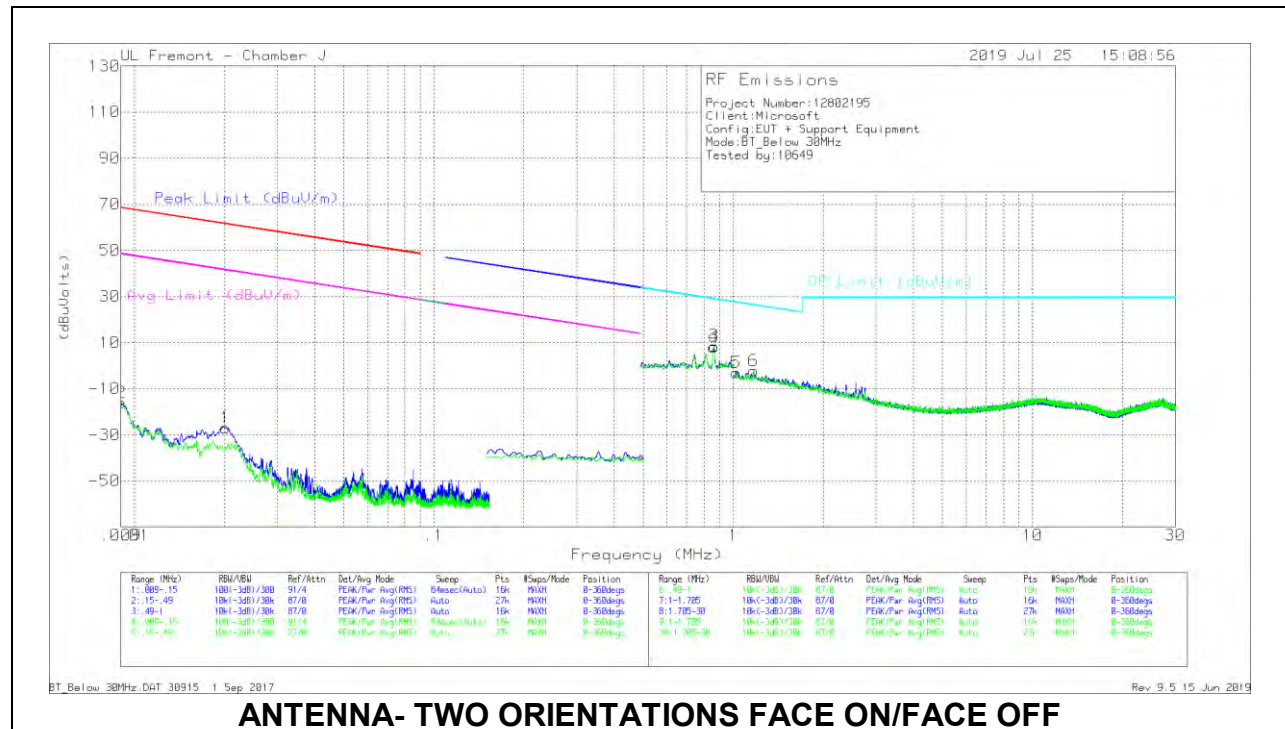
Pk - Peak detector

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

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

9.3. 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)	Azimuth (Degs)
1	.02013	22.83	Pk	58.8	-28.5	-80	-26.87	61.51	-88.38	41.51	-68.38	0-360
2	.00905	31.37	Pk	61.1	-28.5	-80	-16.03	68.45	-84.48	48.45	-64.48	0-360

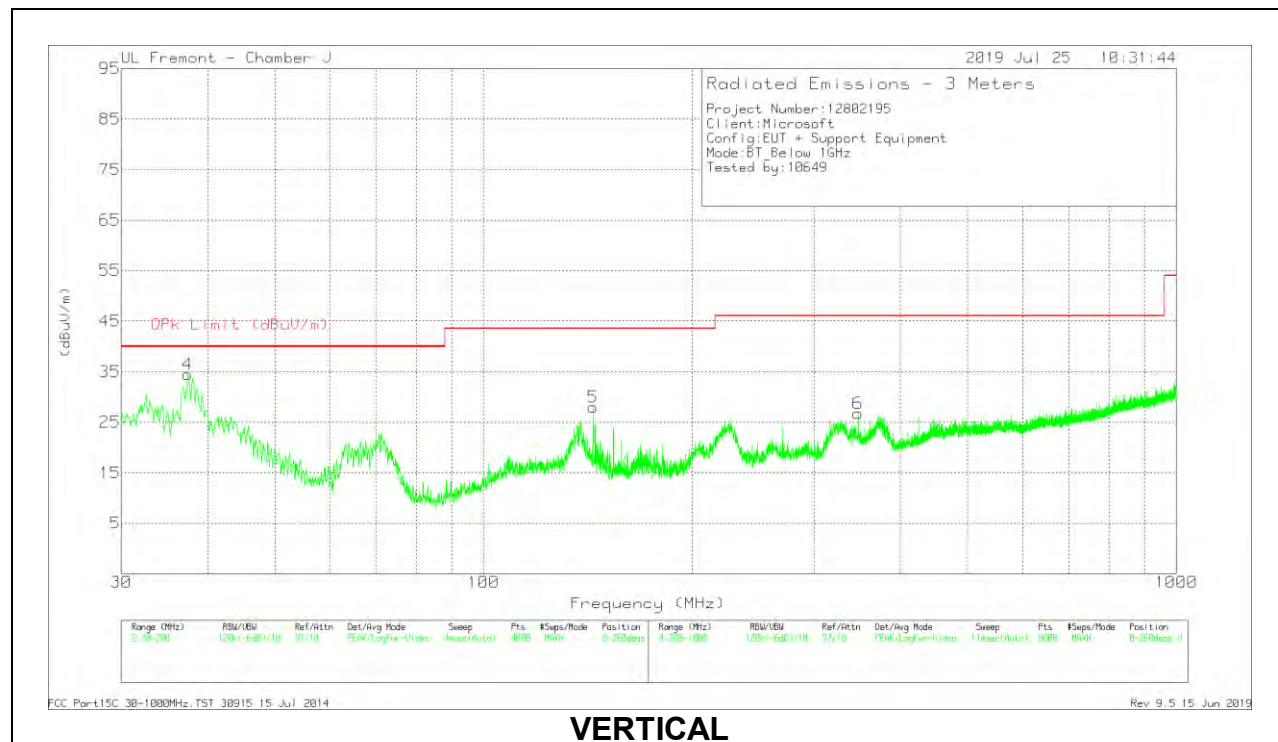
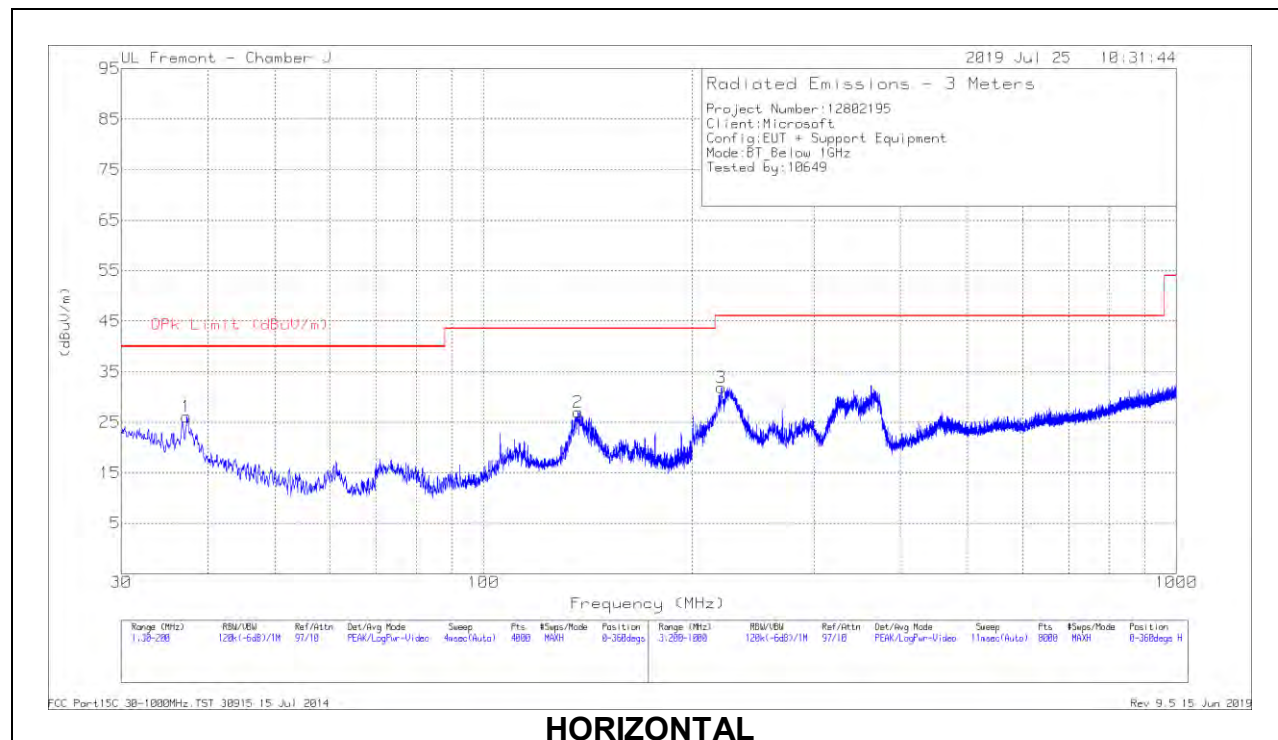
Pk - Peak detector

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)
4	.86166	20.34	Pk	56.1	-28.4	-40	8.04	28.91	-20.87	0-360
3	.86398	20.86	Pk	56.1	-28.4	-40	8.56	28.89	-20.33	0-360
5	1.02394	18.59	Pk	46.7	-28.4	-40	-3.11	27.42	-30.53	0-360
6	1.17032	20.39	Pk	45.9	-28.4	-40	-2.11	26.26	-28.37	0-360

Pk - Peak detector

9.4. WORST CASE BELOW 1 GHZ

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



Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	37.2694	36.17	Pk	21.4	-31.5	26.07	40	-13.93	0-360	298	H
2	* 136.9364	38.69	Pk	19.1	-30.8	26.99	43.52	-16.53	0-360	298	H
4	37.4394	44.65	Pk	21.3	-31.5	34.45	40	-5.55	156	101	V
	37.465	39.91	Qp	21.3	-31.5	29.71	40	-10.29	156	101	V
5	143.9295	40.08	Pk	18.6	-30.7	27.98	43.52	-15.54	0-360	101	V
3	220.5027	45.63	Pk	16.6	-30.4	31.83	46.02	-14.19	0-360	101	H
6	347.2191	36.63	Pk	20	-29.9	26.73	46.02	-19.29	0-360	198	V

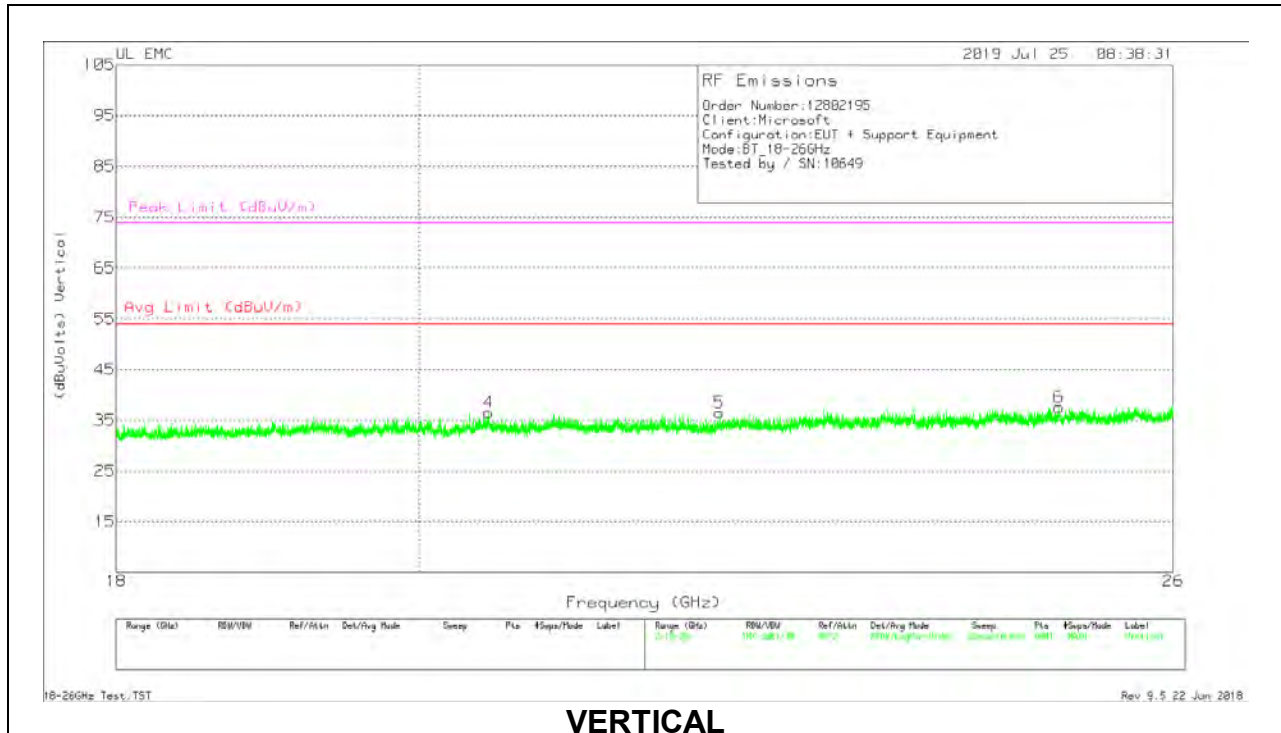
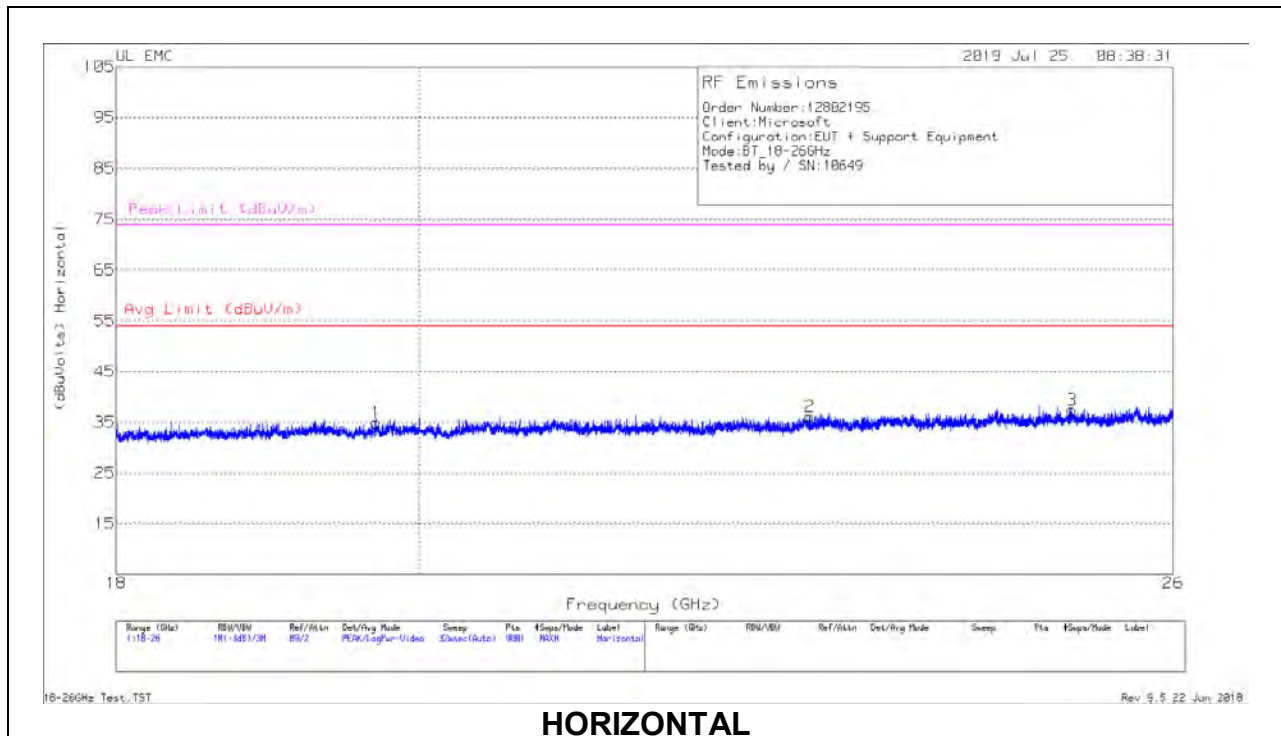
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

Qp - Quasi-Peak detector

9.5. WORST CASE 18-26 GHZ

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



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	19.703	67.51	Pk	33.4	-56.5	-9.5	34.91	54	-19.09	74	-39.09
2	22.912	69.13	Pk	34.1	-57.6	-9.5	36.13	54	-17.87	74	-37.87
3	25.101	66.99	Pk	35	-55.1	-9.5	37.39	54	-16.61	74	-36.61
4	20.491	69	Pk	33.7	-56.7	-9.5	36.5	54	-17.5	74	-37.5
5	22.204	69.28	Pk	34.2	-57.5	-9.5	36.48	54	-17.52	74	-37.52
6	24.988	67.17	Pk	35	-55.1	-9.5	37.57	54	-16.43	74	-36.43

Pk - Peak detector

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.

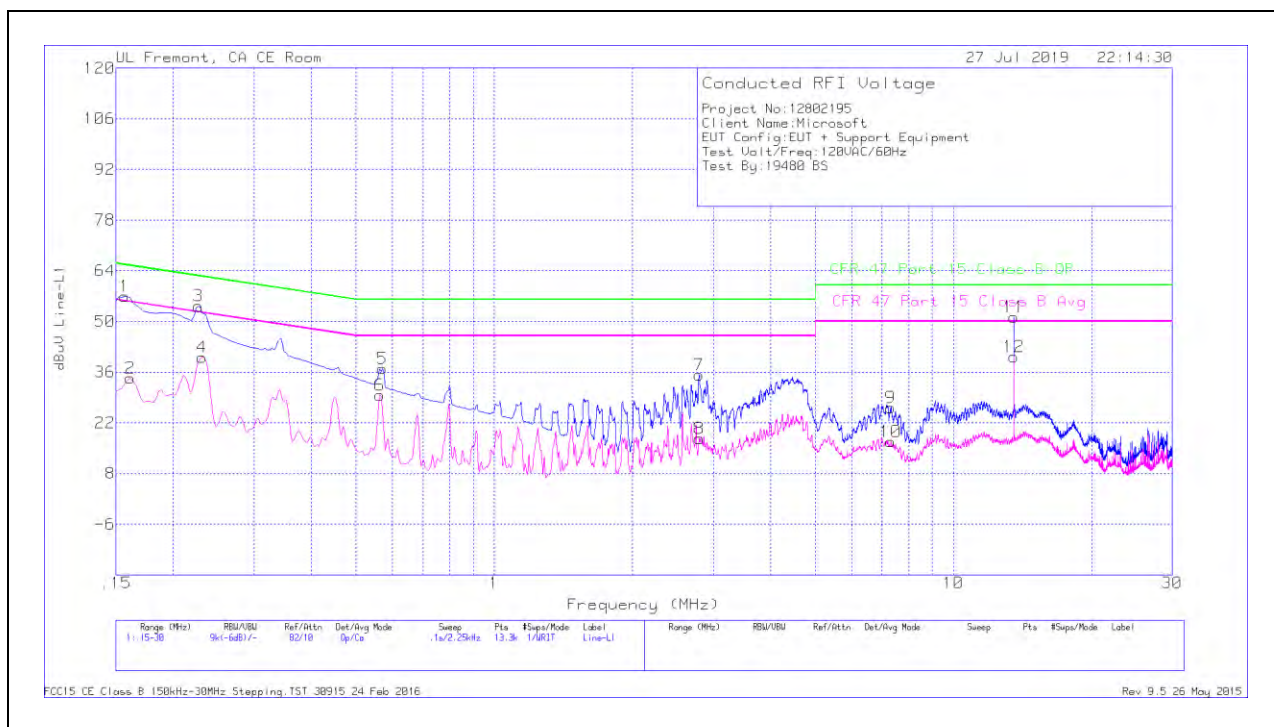
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

10.1.1. AC Power Line Norm

LINE 1 RESULTS



Trace Markers

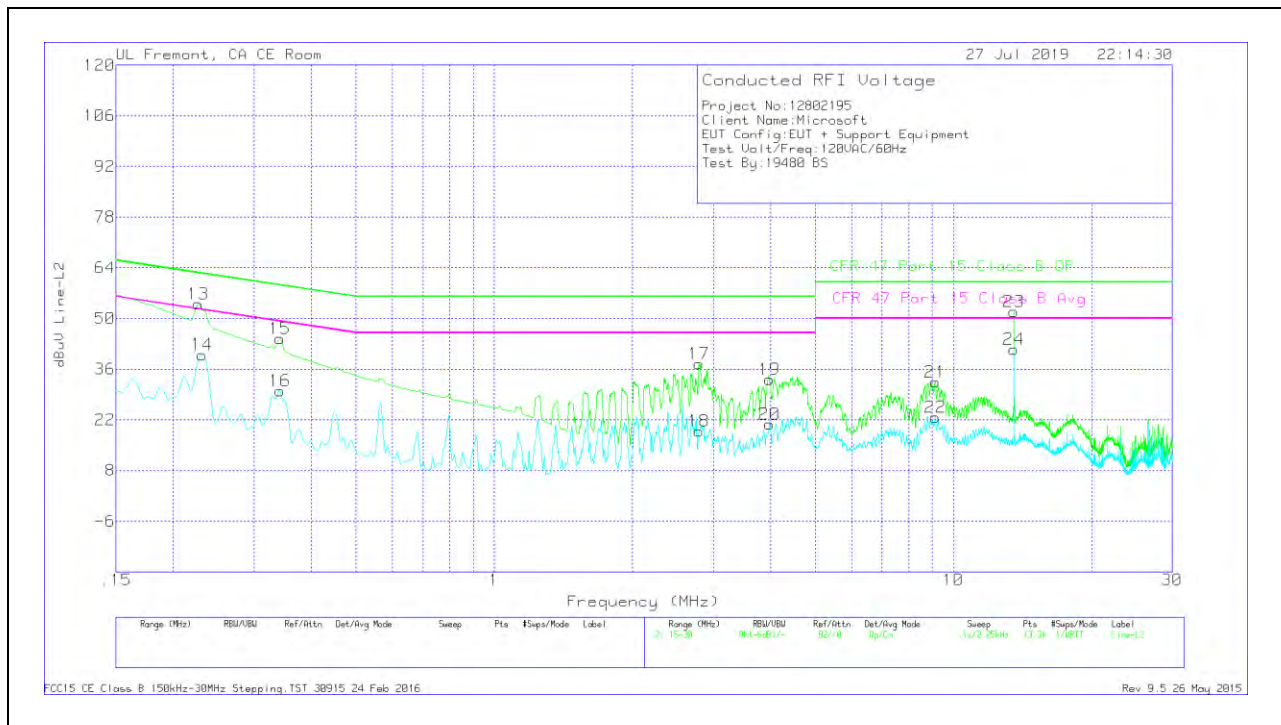
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.15675	46.69	Qp	.1	0	10.1	56.89	65.63	-8.74	-	-
2	.16125	24.12	Ca	.1	0	10.1	34.32	-	-	55.4	-21.08
3	.2265	44.16	Qp	0	0	10.1	54.26	62.58	-8.32	-	-
4	.231	30.05	Ca	0	0	10.1	40.15	-	-	52.41	-12.26
5	.57075	26.83	Qp	0	0	10.1	36.93	56	-19.07	-	-
6	.564	19.63	Ca	0	0	10.1	29.73	-	-	46	-16.27
7	2.796	24.96	Qp	0	.1	10.1	35.16	56	-20.84	-	-
8	2.79825	7.5	Ca	0	.1	10.1	17.7	-	-	46	-28.3
9	7.31625	15.71	Qp	0	.2	10.2	26.11	60	-33.89	-	-
10	7.314	6.39	Ca	0	.2	10.2	16.79	-	-	50	-33.21
11	13.56	40.66	Qp	.1	.2	10.2	51.16	60	-8.84	-	-
12	13.56	29.73	Ca	.1	.2	10.2	40.23	-	-	50	-9.77

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



Trace Markers

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	.2265	43.83	Qp	0	0	10.1	53.93	62.58	-8.65	-	-
14	.231	29.9	Ca	0	0	10.1	40	-	-	52.41	-12.41
15	.34125	34.27	Qp	0	0	10.1	44.37	59.17	-14.8	-	-
16	.34125	19.96	Ca	0	0	10.1	30.06	-	-	49.17	-19.11
17	2.79375	27.21	Qp	0	.1	10.1	37.41	56	-18.59	-	-
18	2.796	8.63	Ca	0	.1	10.1	18.83	-	-	46	-27.17
19	3.97725	22.93	Qp	0	.1	10.1	33.13	56	-22.87	-	-
20	3.98175	10.56	Ca	0	.1	10.1	20.76	-	-	46	-25.24
21	9.1455	22.02	Qp	0	.2	10.2	32.42	60	-27.58	-	-
22	9.13763	12.35	Ca	0	.2	10.2	22.75	-	-	50	-27.25
23	13.56	41.38	Qp	.1	.2	10.2	51.88	60	-8.12	-	-
24	13.56	30.96	Ca	.1	.2	10.2	41.46	-	-	50	-8.54

Qp - Quasi-Peak detector

Ca - CISPR average detection

NOTE: Markers 23 and 24, 13.56MHz is an external NFC signal unrelated to the EUT.