TEST REPORT

Report Number. : 13214419-E2V4

Applicant	:	Microsoft Corporation One Microsoft Way Redmond, WA 98052-6399 USA
Model	:	1873
FCC ID	:	C3K1873
IC	:	3048A-1873
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:
April 22, 2020

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

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	4/13/2020	Initial Issue	--
V2	4/16/2020	Section 9.2 updated	Henry Lau
V3	4/21/2020	Section 6.2 updated	Henry Lau
V4	4/22/2020	Section 6.2 updated	Henry Lau

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399
USA

EUT DESCRIPTION: Portable Computing Device

MODEL: 1873

SERIAL NUMBER: 030239493757

DATE TESTED: January 24, 2020 – February 4, 2020

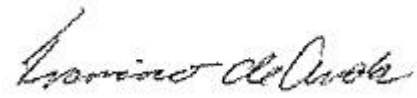
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

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:



FRANCISCO DE ANDA
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Consumer Technology Division
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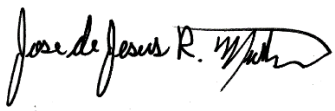
Prepared By:



JOSE MARTINEZ
TEST ENGINEER
Consumer Technology Division
UL Verification Services Inc.

Reviewed By:

HENRY LAU
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. REFERENCE DOCUMENTS

Measurements of original parameters as referenced in this report are documented in UL Verification Services report number 12857633-E2.

4. 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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5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. 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

5.3. 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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6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a portable computing device.

6.2. PERMISSIVE CHANGE SCOPE

Purpose for C2PC permissive change is to introduce a version that has a fabric keyboard. There are no rf changes or changes to the antenna but at a system level, the antenna peak gains have changed.

Radiated Spurious Emissions was performed due to changes of antenna gain.

Results for all other tests, Duty Cycle, Output Power, PSD, Bandwidth, conducted emissions, BE, and AC line conducted emissions from the original report (12857633-E2) remain representative as worst case.

Radiated Band Edge was omitted due to the original filing having margins greater than 10dB.

6.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	3.70	2.34
2402 - 2480	Enhanced DQPSK	5.42	3.48
2402 - 2480	Enhanced 8PSK	5.80	3.80

Note: Above maximum output power levels remain are same as the original filing.

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of -0.7 dBi.

6.5. SOFTWARE AND FIRMWARE

The operating system installed on the EUT is Windows 10 Home build 18362.418.

The Driver installed on the EUT is version 12.0.0.916.

The test utility software used during testing was QRCT v4.0.00123.

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6.6. WORST-CASE CONFIGURATION AND MODE

Radiated emissions between 9kHz and 26GHz were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The EUT has one intended orientations, X; 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

6.7. DESCRIPTION OF TEST SETUP

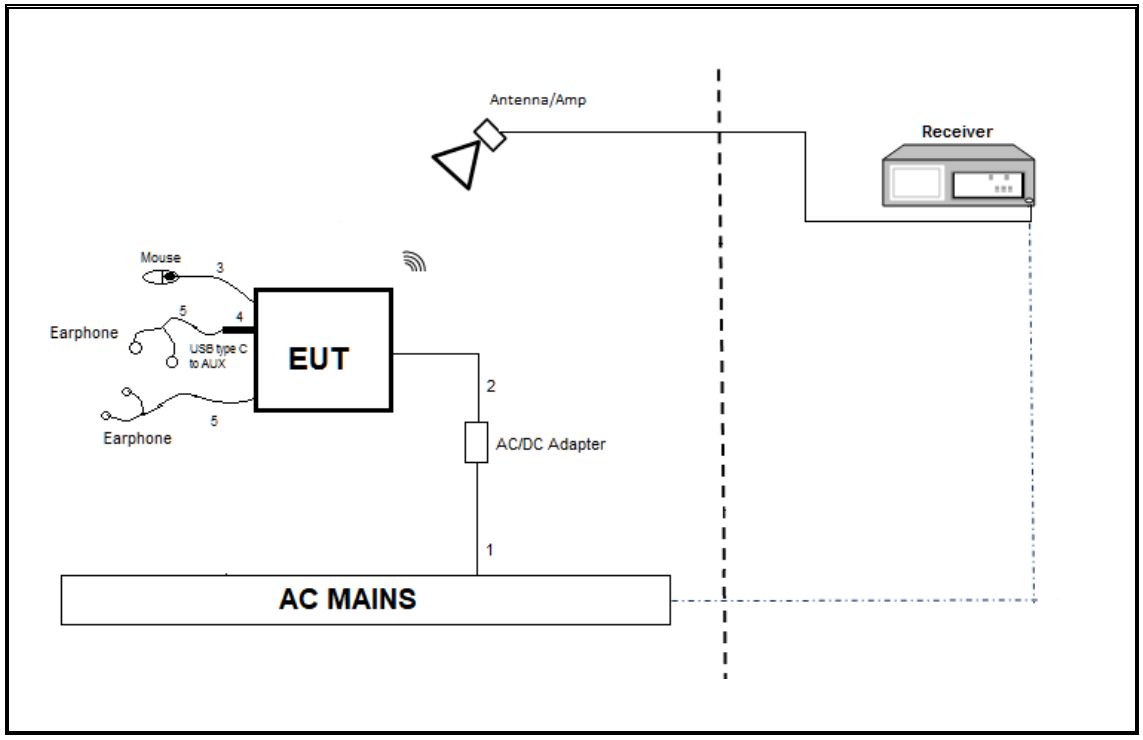
SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC DC Adapter	Microsoft	1706	0D130POEUBG9A	DoC
AC DC Adapter	Lenovo	ADLX45NCC2A	8SSA10E75794C1SG85N27C8	DoC
Laptop	Lenovo	Yoga 11e	R9-0R7JR3	PD99260NG
Mouse	Microsoft	1113	X821908-017	DoC
USB 3.0 Gigabit Ethernet Adapter	Linksys	USB3GIGV1	15710S08406234	DoC
USB Type C to Audio Jack	SONY	1310-9798	N/A	DoC
Earphone	SONY	AG-0501	N/A	DoC
Earphone	SONY	AG-1100	N/A	DoC

I/O CABLES (RADIATED EMISSIONS)

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	AC	1	AC	Un-shielded	1	to AC/DC Adapter
2	DC	1	DC	Shielded	1.2	to EUT
3	USB	1	TYPE A	Shielded	1.5	EUT to Mouse
4	USB	1	Type C	Shielded	0.1	USB-C to Audio Jack converter
5	Earphone	2	3.5mm	Un-shielded	1	EUT to earphone

RADIATED EMISSIONS SETUP DIAGRAM



TEST SETUP

For radiated: EUT is connected to all support equipment. The test software exercises the radio. Support laptop was removed after EUT was configured.

7. MEASUREMENT METHOD

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

8. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179367	05/16/2020	05/16/2019
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T344	05/07/2020	05/07/2019
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1571	05/28/2020	05/28/2019
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	PRE0179465	05/31/2020	05/31/2019
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	PRE0179467	05/31/2020	05/31/2019
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	175953	01/23/2021	01/23/2020
Antenna, BroadBand Hybrid, 30MHz to 3GHz	Sunol Sciences Corp.	JB3	PRE0181574	10/14/2020	10/14/2019
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	T447	08/13/2020	08/13/2019
Rf Amplifier, 18-26.5GHz, 60dB gain	AMPLICAL	AMP18G26.5-60	171590	05/01/2020	05/01/2019
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179372	02/16/2020	02/16/2019

TEST SOFTWARE LIST			
Description	**Manufacturer**	**Model**	**Version**
Radiated Software	UL	UL EMC	Ver 9.5, Oct 20, 2019
Radiated Software	UL	UL EMC	Ver 9.5, Sep 24, 2019
Radiated Software	UL	UL EMC	Ver 9.5, Oct 21, 2019

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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 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 9kHz to 26 GHz is investigated with the transmitter set to the channel with the highest output power.

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.

The limits in CFR 47, Part 15, Subpart C, paragraph 15.209(a), are identical to those in RSS-Gen section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table), using the free space impdedance of 377 Ohms. For example the measurement at frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to Y – 51.5 = Z dBuA/m, which has the same margin, W dB, to the corresponding RSS-Gen Table 6 limit as it has to 15.209(a) limit.

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KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

KDB 558074 D01 15.247 Meas Guidance v05r02

Use of a duty cycle correction factor (DCCF) is permitted for calculating average radiated field strength emission levels for an FHSS device in 15.247. This DCCF can be applied when the field strength limit (e.g., within a Government Restricted band) and the conditions specified in Section 15.35(c) can be satisfied. The average radiated field strength is calculated by subtracting the DCCF from the maximum radiated field strength level as determined through measurement. The maximum radiated field strength level represents the worst-case (maximum amplitude) RMS measurement of the emission(s) during continuous transmission (i.e., not including any time intervals during which the transmitter is off or is transmitting at a reduced power level). It is also acceptable to apply the DCCF to a measurement performed with a peak detector instead of the specified RMS power averaging detector. Note that Section 15.35(c) specifies that the DCCF shall represent the worst-case (greatest duty cycle) over any 100 msec transmission period.

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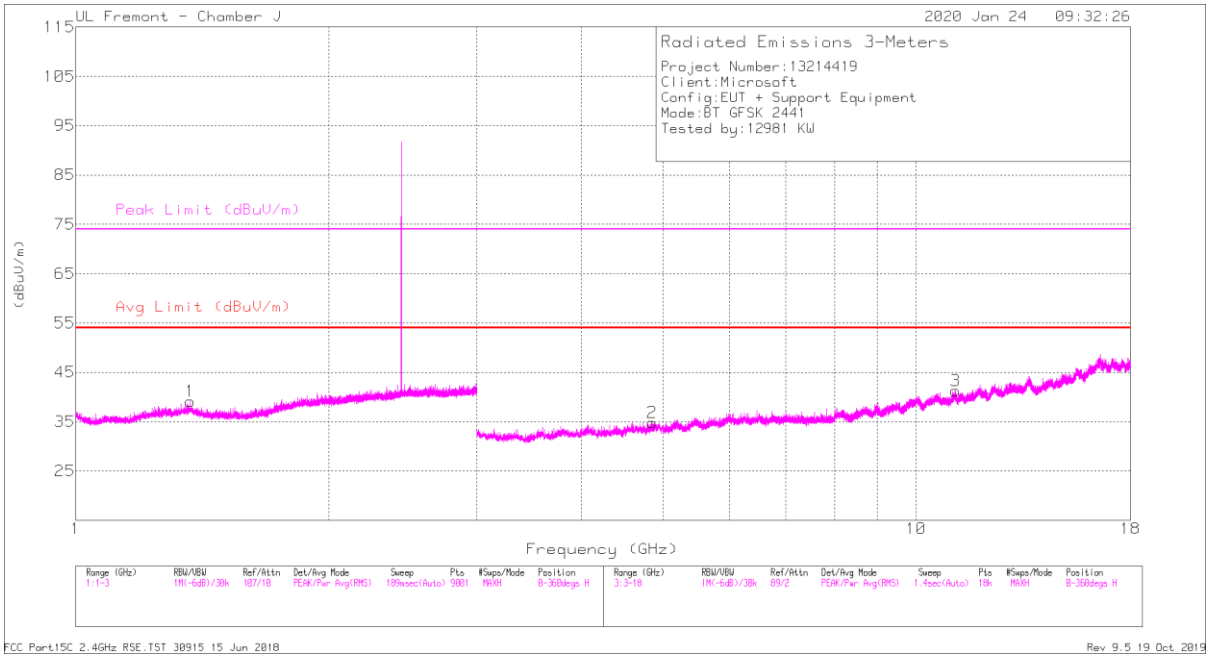
9.1. TRANSMITTER ABOVE 1 GHz

9.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL RESULTS



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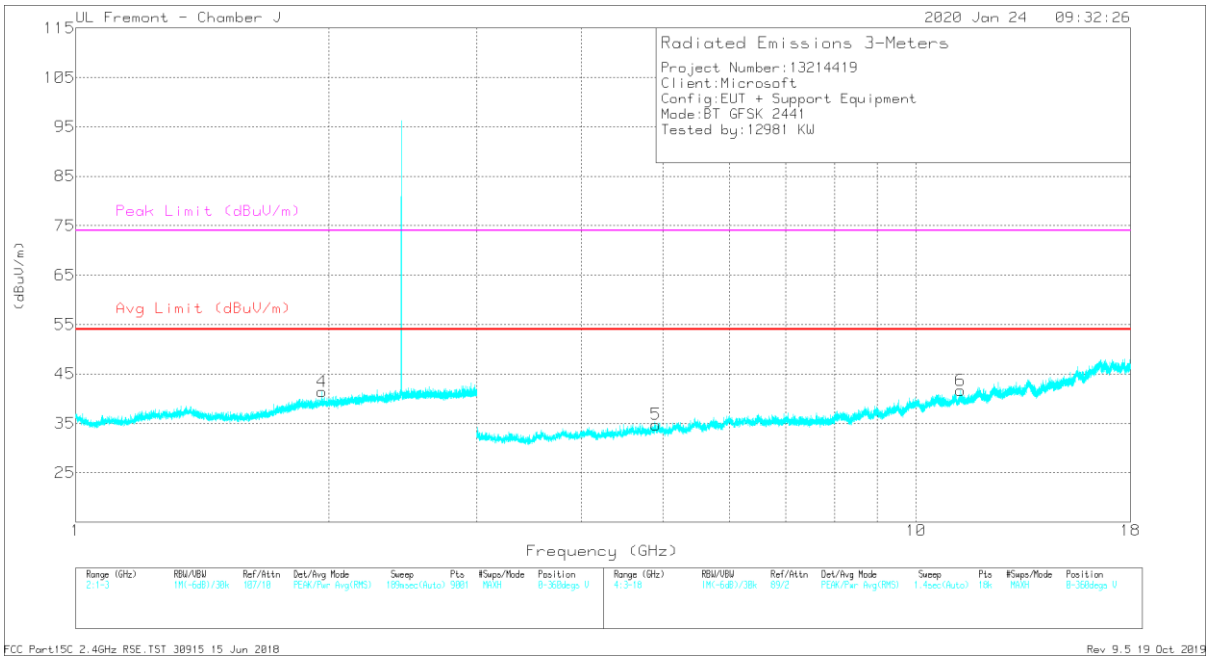

VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.36772	43.1	PKFH	29.4	-25.8	46.7	-	-	74	-27.3	318	179	H
	* 1.37019	29.78	VA1T	29.4	-25.9	33.28	54	-20.72	-	-	318	179	H
4	1.96277	43.09	PKFH	31	-25.7	48.39	-	-	-	-	61	400	V
2	* 4.85338	39.14	PKFH	34.2	-31.1	42.24	-	-	74	-31.76	57	166	H
	* 4.85171	26.34	VA1T	34.2	-31.1	29.44	54	-24.56	-	-	57	166	H
3	* 11.15057	33.1	PKFH	38	-23	48.1	-	-	74	-25.9	144	240	H
	* 11.15089	20.56	VA1T	38	-23	35.56	54	-18.44	-	-	144	240	H
5	* 4.89959	39.67	PKFH	34.1	-30.7	43.07	-	-	74	-30.93	144	298	V
	* 4.9016	26.16	VA1T	34.1	-30.7	29.56	54	-24.44	-	-	144	298	V
6	* 11.29307	32.7	PKFH	38	-22.5	48.2	-	-	74	-25.8	84	140	V
	* 11.29404	20.3	VA1T	38	-22.5	35.8	54	-18.2	-	-	84	140	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

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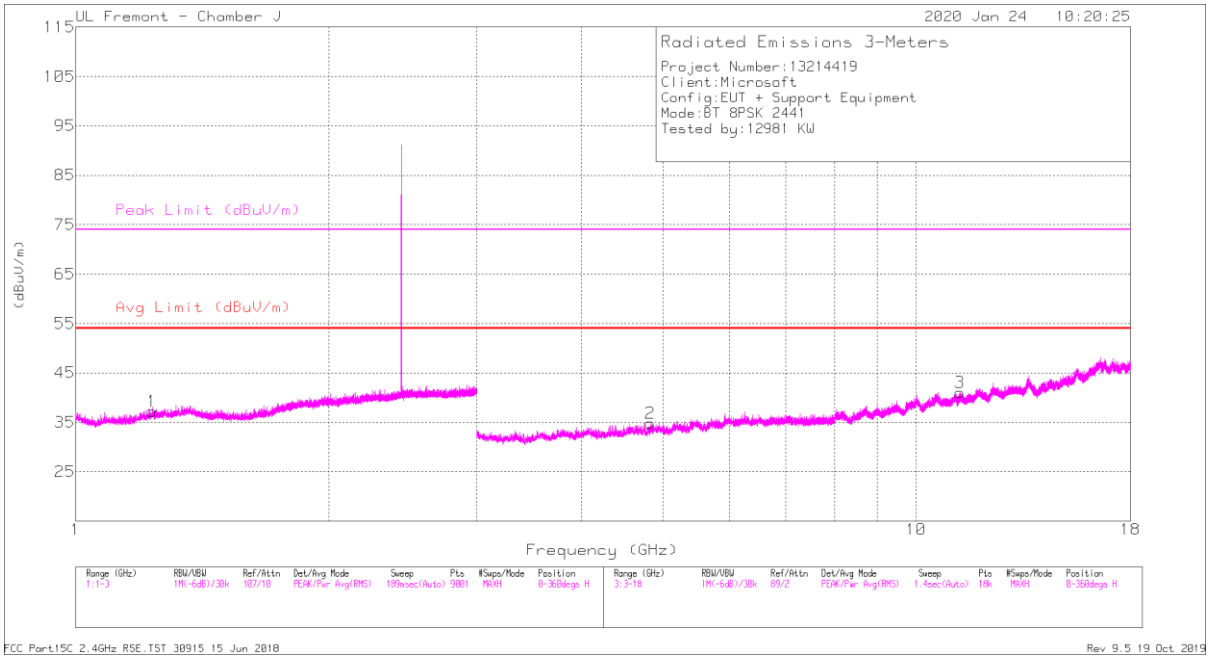
9.1.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL RESULTS



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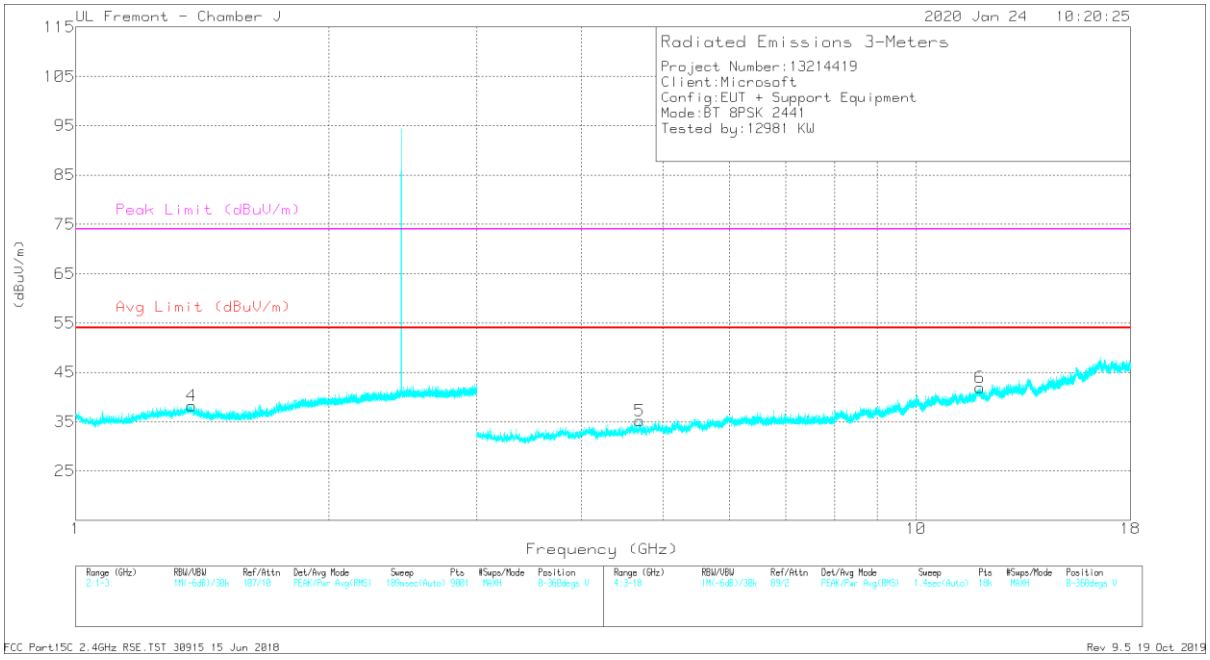

VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T344 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.23144	42.11	PKFH	28.6	-25.8	44.91	-	-	74	-29.09	107	290	H
	* 1.23316	29.56	VA1T	28.6	-25.8	32.36	54	-21.64	-	-	107	290	H
4	* 1.37067	43.09	PKFH	29.4	-25.9	46.59	-	-	74	-27.41	168	220	V
	* 1.37146	29.57	VA1T	29.3	-25.9	32.97	54	-21.03	-	-	168	220	V
2	* 4.82669	38.9	PKFH	34.3	-31.1	42.1	-	-	74	-31.9	103	128	H
	* 4.82711	25.87	VA1T	34.3	-31.1	29.07	54	-24.93	-	-	103	128	H
3	* 11.29228	32.86	PKFH	38	-22.5	48.36	-	-	74	-25.64	288	121	H
	* 11.29138	20.2	VA1T	38	-22.5	35.7	54	-18.3	-	-	288	121	H
5	* 4.69366	39.01	PKFH	34.1	-30.7	42.41	-	-	74	-31.59	189	356	V
	* 4.69433	25.87	VA1T	34.1	-30.7	29.27	54	-24.73	-	-	189	356	V
6	* 11.91108	31.93	PKFH	38.6	-21.9	48.63	-	-	74	-25.37	214	212	V
	* 11.91204	19.66	VA1T	38.6	-21.9	36.36	54	-17.64	-	-	214	212	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

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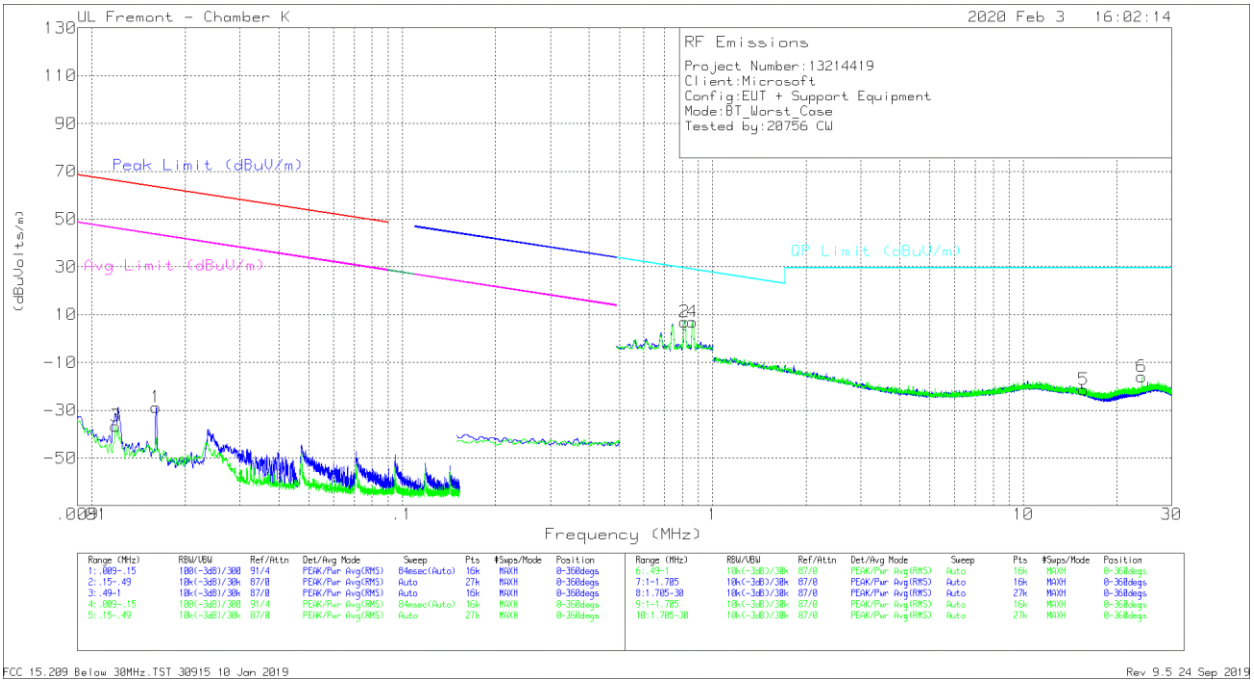
9.2. WORST CASE BELOW 30MHZ

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)	Cables w/ PRE0186650	Dist Corr 300m	Corrected Reading (dBuVolts/m)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.01615	23.82	Pk	59.3	-31.9	-80	-28.78	63.42	-92.2	43.42	-72.2	0-360
3	.01195	15.32	Pk	59.9	-31.8	-80	-36.58	66.04	-102.62	46.04	-82.62	0-360

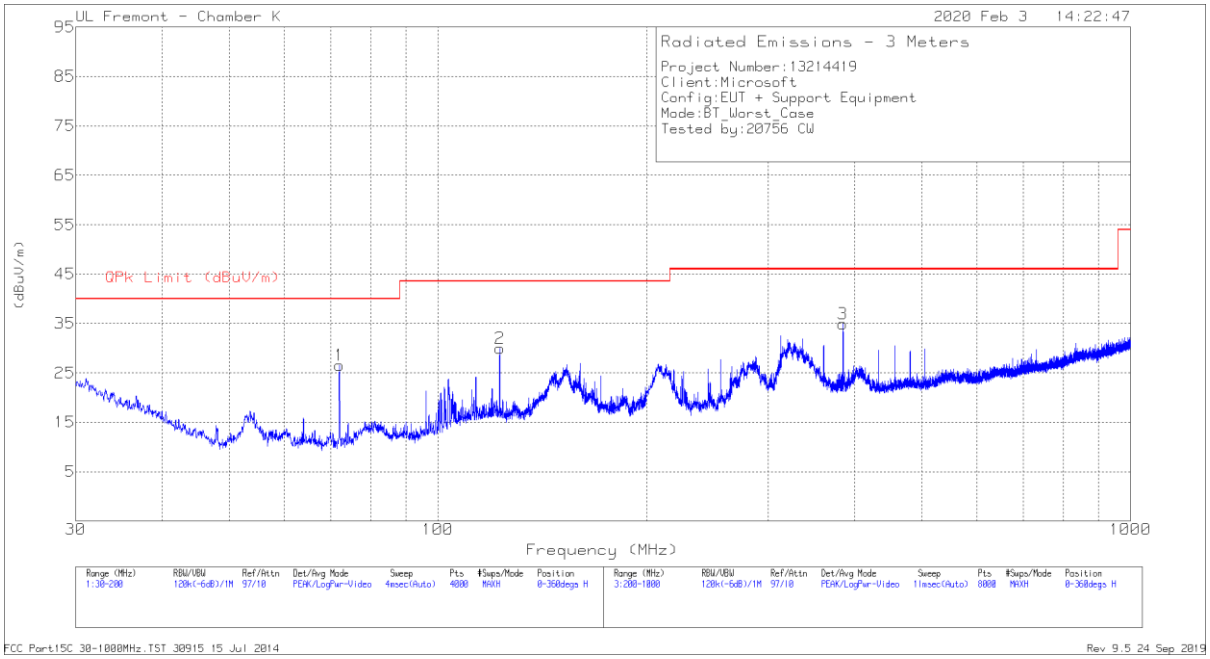
Pk - Peak detector

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Cables w/ PRE0186650	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts/m)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
2	.8121	22.88	Pk	56.1	-32.1	-40	6.88	29.42	-22.54	0-360
4	.86166	22.88	Pk	56.1	-32.1	-40	6.88	28.91	-22.03	0-360
5	15.63187	16.04	Pk	34.2	-31.7	-40	-21.46	29.5	-50.96	0-360
6	24.04207	21.76	Pk	33.8	-31.5	-40	-15.94	29.5	-45.44	0-360

Pk - Peak detector

9.3. WORST CASE BELOW 1 GHZ

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



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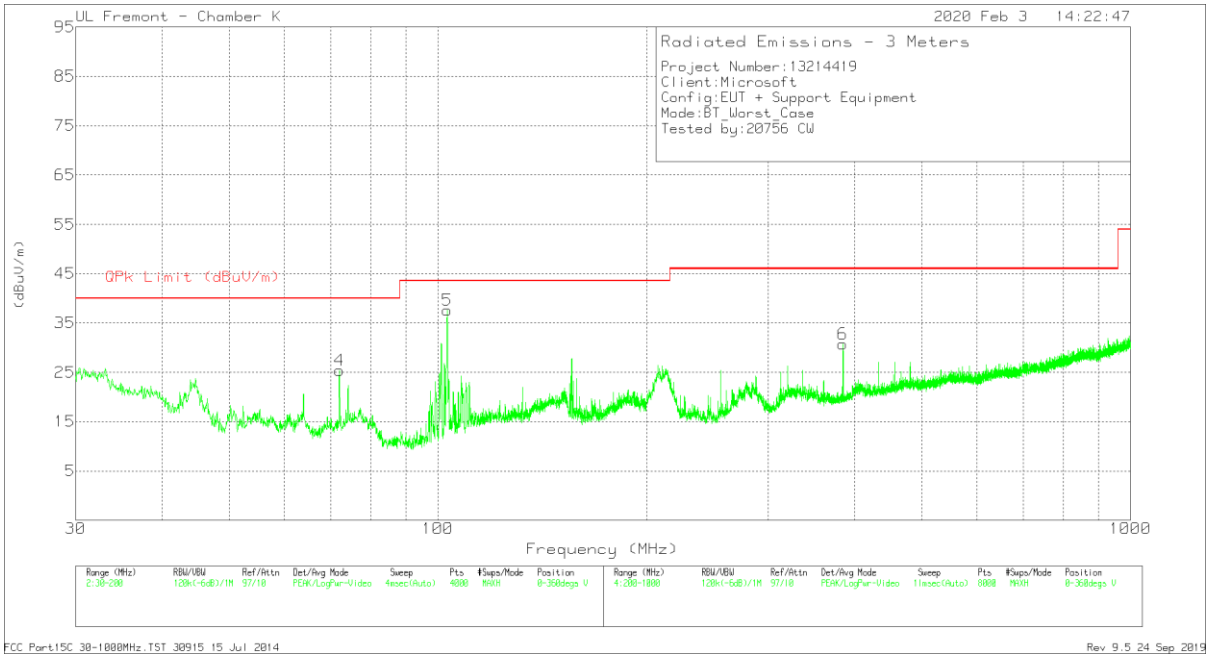

VERTICAL

Below 1GHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181574 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	72.0859	43.6	Pk	14.1	-31.2	26.5	40	-13.5	0-360	299	H
2	* 122.8865	40.92	Pk	19.9	-30.8	30.02	43.52	-13.5	0-360	199	H
4	72.0859	42.54	Pk	14.1	-31.2	25.44	40	-14.56	0-360	100	V
5	103.2696	29.39	Pk	17.1	-30.9	15.59	43.52	-27.93	358	122	V
	103.1123	22.21	Qp	17	-30.9	8.31	43.52	-35.21	358	122	V
3	384.624	43.52	Pk	20.9	-29.5	34.92	46.02	-11.1	0-360	100	H
6	384.624	39.37	Pk	20.9	-29.5	30.77	46.02	-15.25	0-360	99	V

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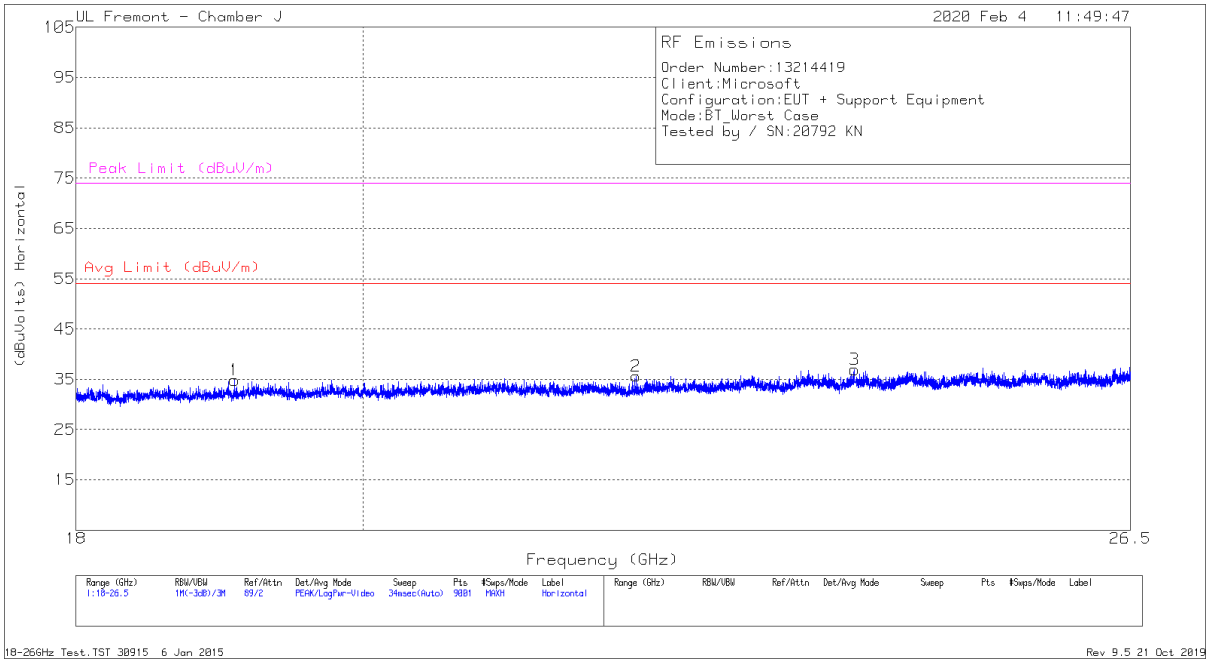
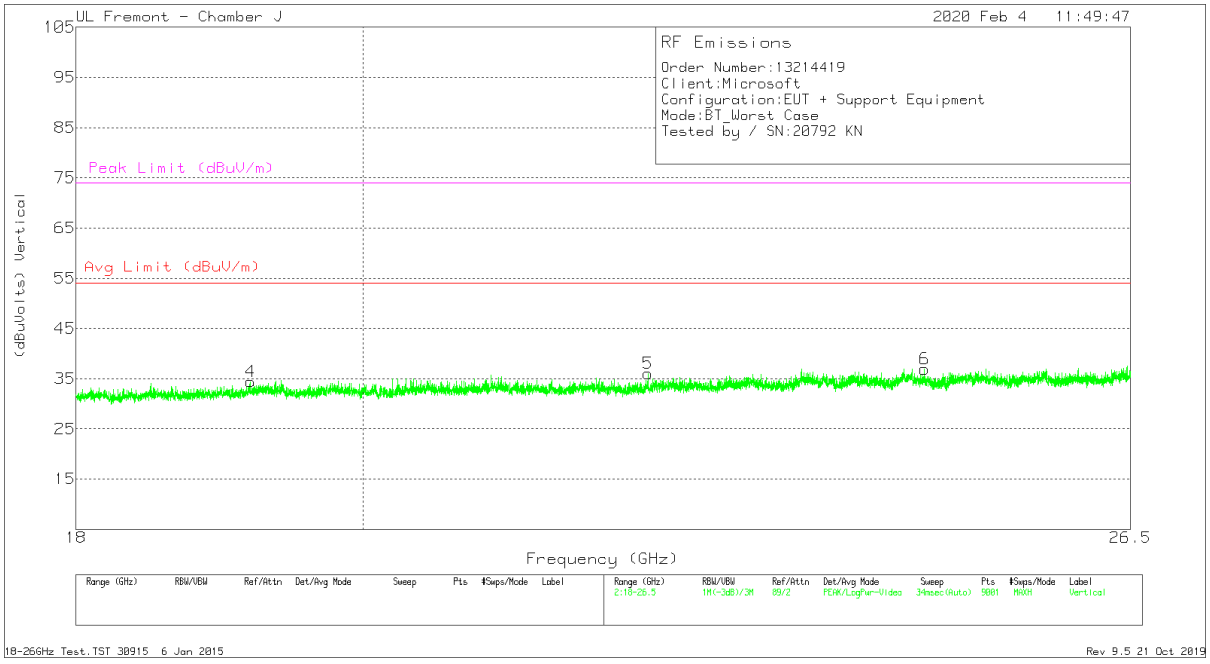
9.4. WORST CASE 18-26 GHZ

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	19.07761	69.43	Pk	32.6	-57.7	-9.5	34.83	54	-19.17	74	-39.17
2	22.1055	69.21	Pk	33.5	-57.6	-9.5	35.61	54	-18.39	74	-38.39
3	23.94811	68.9	Pk	34.3	-56.8	-9.5	36.9	54	-17.1	74	-37.1
4	19.18906	68.71	Pk	32.7	-57.5	-9.5	34.41	54	-19.59	74	-39.59
5	22.20089	69.3	Pk	33.5	-57.3	-9.5	36	54	-18	74	-38
6	24.57144	68.33	Pk	34.4	-56.3	-9.5	36.93	54	-17.07	74	-37.07

Pk - Peak detector

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