CLASS II PERMISSIVE CHANGE TEST REPORT

Report Number. : 11460738-E3V3

Applicant	:	Microsoft Corporation One Microsoft Way Redmond, WA, 98052, USA
Model	:	1708
FCC ID	:	C3K1708
IC	:	3048A-1708
EUT Description	:	Wireless Input Device
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C INDUSTRY CANADA RSS - 247 ISSUE 1

Date Of Issue:
December 16, 2016

Prepared by:
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	11/30/2016	Initial Review	---
V2	12/14/2016	Updated section 5.2	Francisco de Anda
V3	12/16/2016	Revised section 5.2	Francisco de Anda

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UL VERIFICATION SERVICES INC.
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Microsoft Corporation
One Microsoft Way
Redmond, WA 98052

EUT DESCRIPTION: Wireless Input Device

MODEL: 1708

SERIAL NUMBER: 02600010964642 (Conducted), 02600009024642 (Radiated)

DATE TESTED: November 18th 2016 – November 23rd, 2016

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-247 Issue 1	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. 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, or any agency of the U.S. Government.

Approved & Released For
UL Verification Services Inc. By:

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Prepared By:

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Engineer
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, RSS-GEN Issue 4, and RSS-247 Issue 1.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, 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
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☒ Chamber C	☐ Chamber F
	☐ Chamber G
	☒ Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

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

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

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	3.15 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.32 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.45 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.24 dB

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Model 1708 is a wireless input device that contains an 802.11a/g/n and Bluetooth transceiver.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The purpose of this C2PC is to upgrade the device described under section 5.1 of this report to include the following two configuration changes that will be manufactured;

Configuration C

-Removal of RF shield.

Configuration F

-Change of PCB layout due to re-sizing the PCB and consequent relocation of some non-RF relevant components and removal of RF shield

Radiated tests were performed. Conducted test are leveraged from the original report, number R11040094-E3V5. Conducted power data included in this report is used to verify the output power.

5.3. MAXIMUM OUTPUT POWER

The measured output power values were verified to be less or equal than the original values. Refer to original report number “R11040094-E3V5” for original output power values and for all antenna port conducted results.

The EUT has peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	7.35	5.43
2402 - 2480	DQPSK	7.11	5.14
2402 - 2480	Enhanced 8PSK	7.34	5.42

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5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integral antenna, with a maximum gain of 0 dBi.

5.5. SOFTWARE AND FIRMWARE

The controller firmware used with the EUT during testing was 3.1.703.0 and Radio Firmware was 1.0.107.0.

The test utility software used during testing was WCN Combo Tool v2.1509.00

5.6. WORST-CASE CONFIGURATION AND MODE

An investigation on two EUT configurations (C and F, described in section 5.2) was performed, it was determined that configuration F was worst-case. Therefore, all final radiated testing was performed on configuration F.

For below 1G radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

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 were:

GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	Lenovo	X220	R9-EVC3X	DoC
Laptop AC Adapter	Lenovo	42T4434	11S42T4434Z1ZF3K0CV0A3	DoC
Interface Board	Microsoft	X930837-001	None	None
AC/DC Adapter	Samsung	ETA0U61JWE	SC2F422AS/A-E	DoC

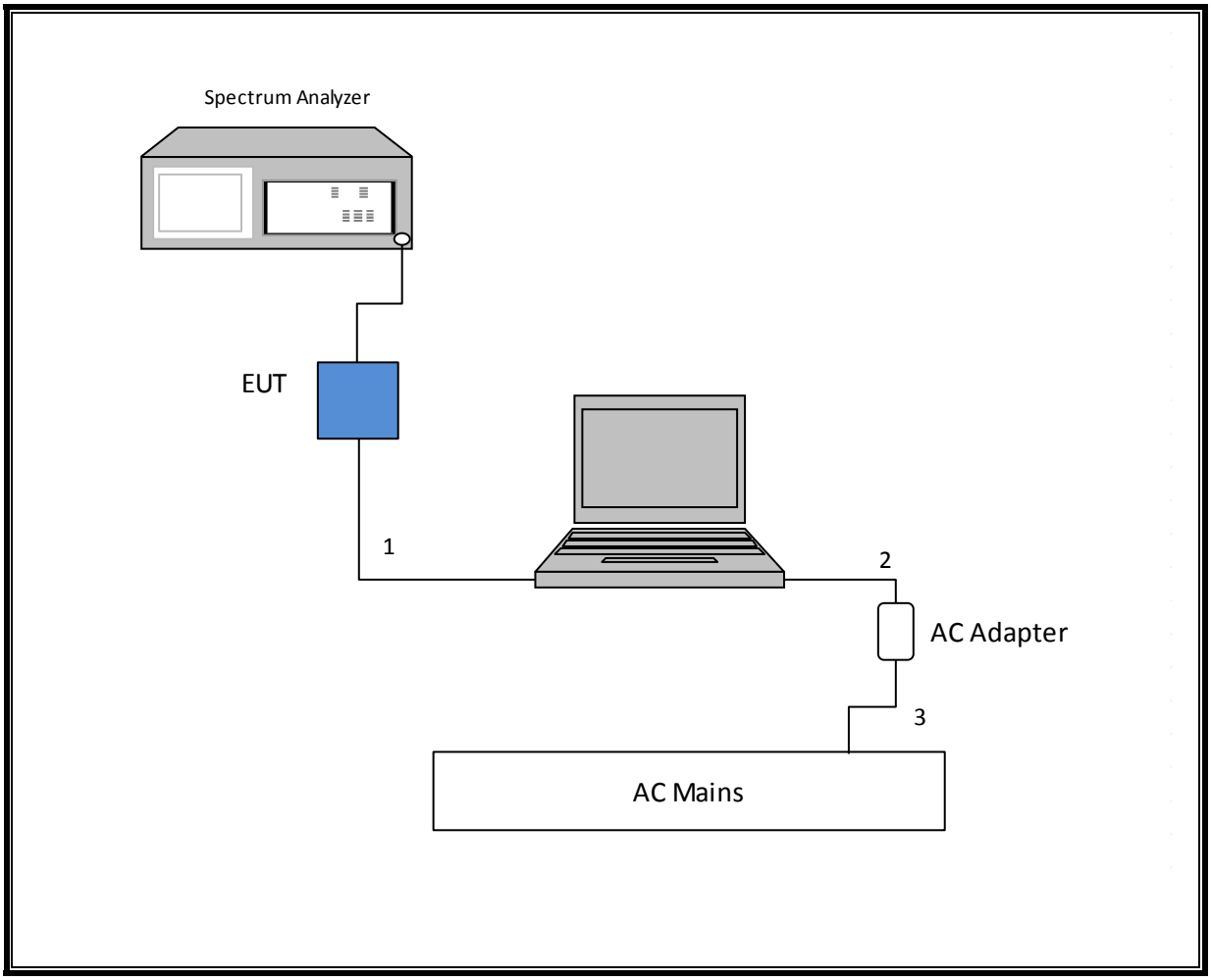
I/O CABLES

I/O Cable List						
Cable No	**Port**	**# of identical ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	USB	1	USB	unshielded	1	
2	DC	1	barrel	unshielded	0.8	
3	AC	1	2 prong	unshielded	1.5	

TEST SETUP - CONDUCTED TESTS

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

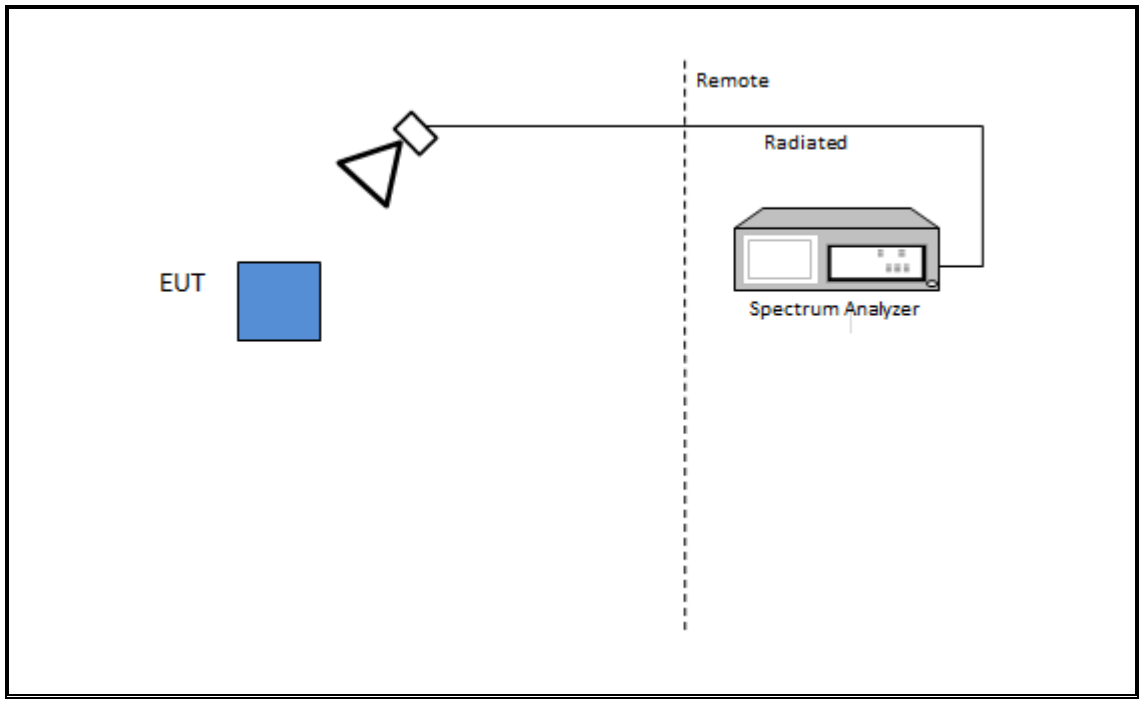
SETUP DIAGRAM - CONDUCTED TESTS



TEST SETUP - RADIATED TESTS

An interface board between EUT and laptop was used to program the EUT. Once programmed the EUT was tested standalone powered by batteries. Test software exercised the EUT.

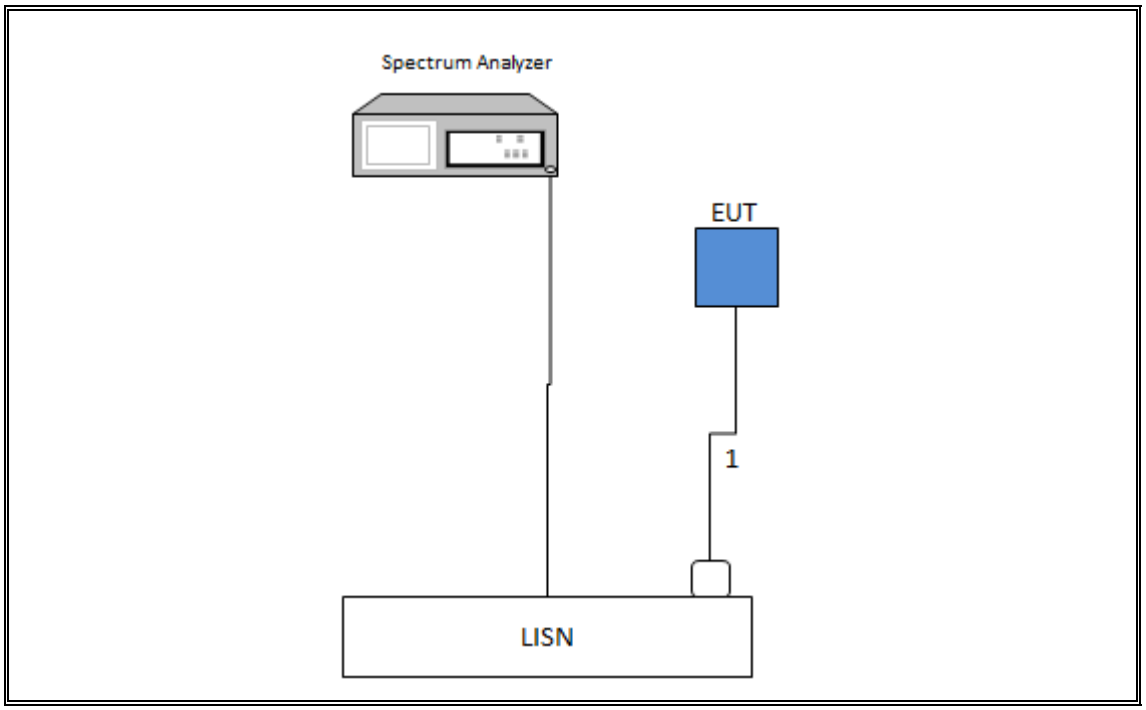
SETUP DIAGRAM - RADIATED TESTS



TEST SETUP- AC LINE CONDUCTED: AC/DC ADAPTER

The EUT was powered by AC/DC adapter via USB cable. Test software exercised the EUT.

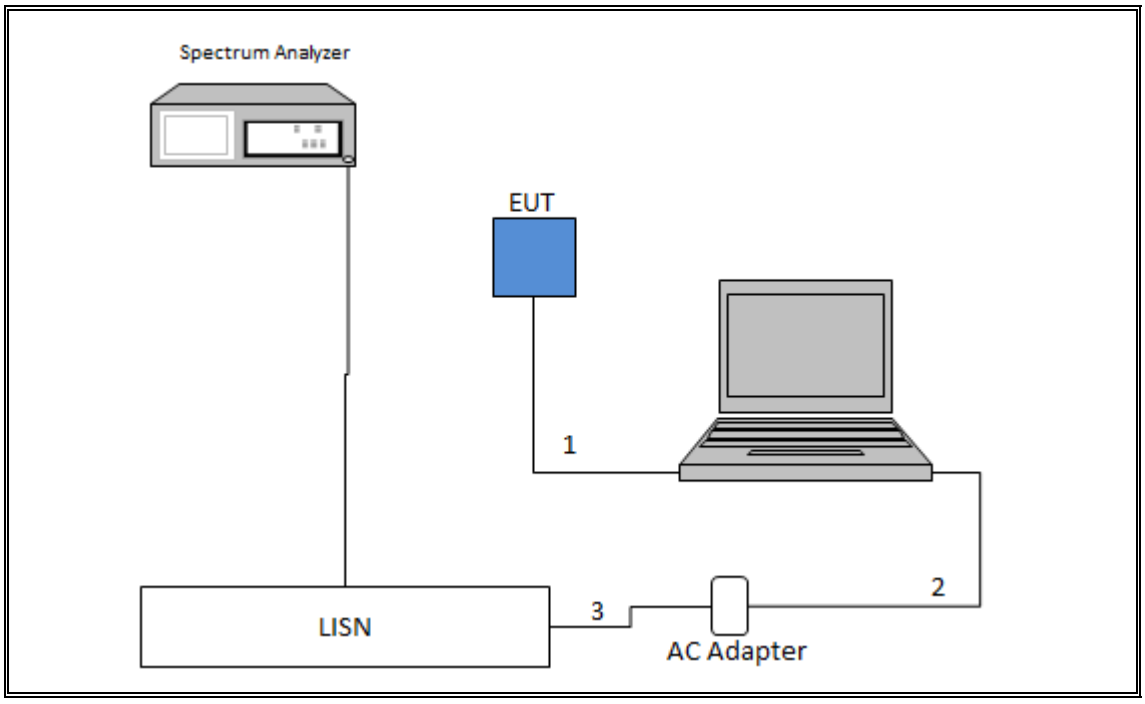
SETUP DIAGRAM - AC LINE CONDUCTED: AC/DC ADAPTER



TEST SETUP- AC LINE CONDUCTED: LAPTOP CONFIGURATION

The EUT was powered by host PC via USB cable. Test software exercised the EUT.

SETUP DIAGRAM – AC LINE CONDUCTED: LAPTOP CONFIGURATION



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, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences Corp.	JB3	T130	09/23/17
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T119	01/04/2017
Antenna, Horn 1-18GHz	ETS-Lindgren	3117	T346	02/22/2017
Antenna, Active Loop 9kHz to 30MHz	ETS-Lindgren	6502	T757	05/31/2017
RF Amplifier	MITEQ	AFS42-00101800-25-S-42	T931	08/26/2017
RF Amplifier	MITEQ	AFS42-00101800-25-S-42	T1165	08/01/2017
RF Preamplifier, 1 - 7GHz	Amplical	AMP1G6-10-27	T1370	04/15/2017
RF Preamplifier, 1 - 8GHz	MITEQ	AMF-4D-01000800-30-29P	T1574	08/26/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T1450	12/21/2016
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T908	04/13/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight	N9030A	T906	02/03/2017
High Pass Filter 3GHz	Micro-Tronics	HPM17543	T486	08/01/2017
High Pass Filter 3GHz	Micro-Tronics	HPM17543	T896	08/26/2017
Antenna, Horn, 18-26 GHz	ARA	MWH-1826/B	T449	05/26/2017
RF Preamplifier, 1 - 26GHz	Agilent	8449B	T404	07/05/2017
Spectrum Analyzer, 40 GHz	HP	8564E	T106	09/07/2017
LISN	Fischer Custom Communication, Inc.	FCC-LISN-50/250-25-2-01-CISPR16	T1310	06/08/2017
EMI Test Receiver, 10 Hz - 7 GHz	Rohde & Schwarz	ESCR 7	T1436	12/19/2016
Transient Limiter	Com-Power	LIT-930	T1457	02/10/2017
Power Meter	Keysight	N1912A	T1244	05/03/2017
Power Sensor	Keysight	N1921A	T1224	03/22/2017
Radiated Software	UL	UL EMC	Rev. 9.5, April 26, 2016	

7. MEASUREMENT METHODS

On Time and Duty Cycle: ANSI C63.10-2013 Section 11.6

Peak Output Power: ANSI C63.10-2013 Section 7.8.5

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

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

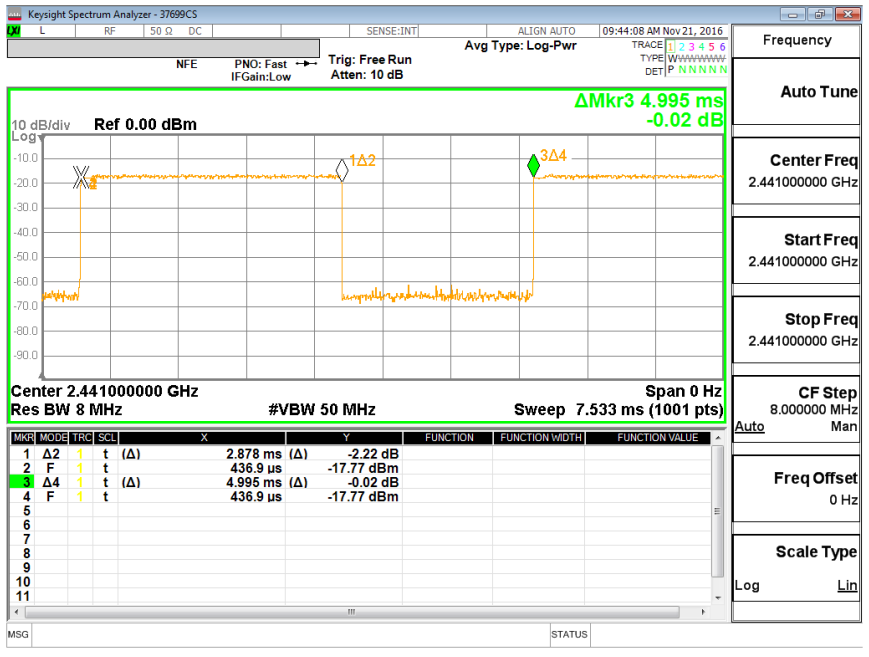
Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
Bluetooth GFSK	2.870	5.000	0.574	57.40%	2.41	0.348
Bluetooth 8PSK	2.878	4.995	0.576	57.62%	2.39	0.347

DUTY CYCLE PLOTS

HOPPING OFF

DUTY CYCLE GFSK MODE

DUTY CYCLE 8PSK MODE



8.1. BASIC DATA RATE GFSK MODULATION

8.1.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.15	30	-22.85
Middle	2441	7.35	30	-22.65
High	2480	7.22	30	-22.78

8.1.2. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	6.68
Middle	2441	7.01
High	2480	6.87

8.2. ENHANCED DATA RATE QPSK MODULATION

8.2.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	6.81	21	-14.16
Middle	2441	7.11	21	-13.86
High	2480	7.05	21	-13.92

8.2.2. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	3.48
Middle	2441	3.78
High	2480	3.66

8.3. ENHANCED DATA RATE 8PSK MODULATION

8.3.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-247 (5.4) (2)

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.

TEST PROCEDURE

The transmitter output is connected to a wideband peak and average power meter.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.05	21	-13.92
Middle	2441	7.34	21	-13.63
High	2480	7.23	21	-13.74

8.3.2. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	3.47
Middle	2441	3.76
High	2480	3.65

9. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

IC 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
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 scans above 1 GHz the resolution bandwidth is set to 1 MHz, then 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.

PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak→ this is a note from Radiated automation software. When the frequency is below 1G, software is using RB=100kHz; when the frequency is above 1G, software is using RB=1MHz.

The spectrum from 9KHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

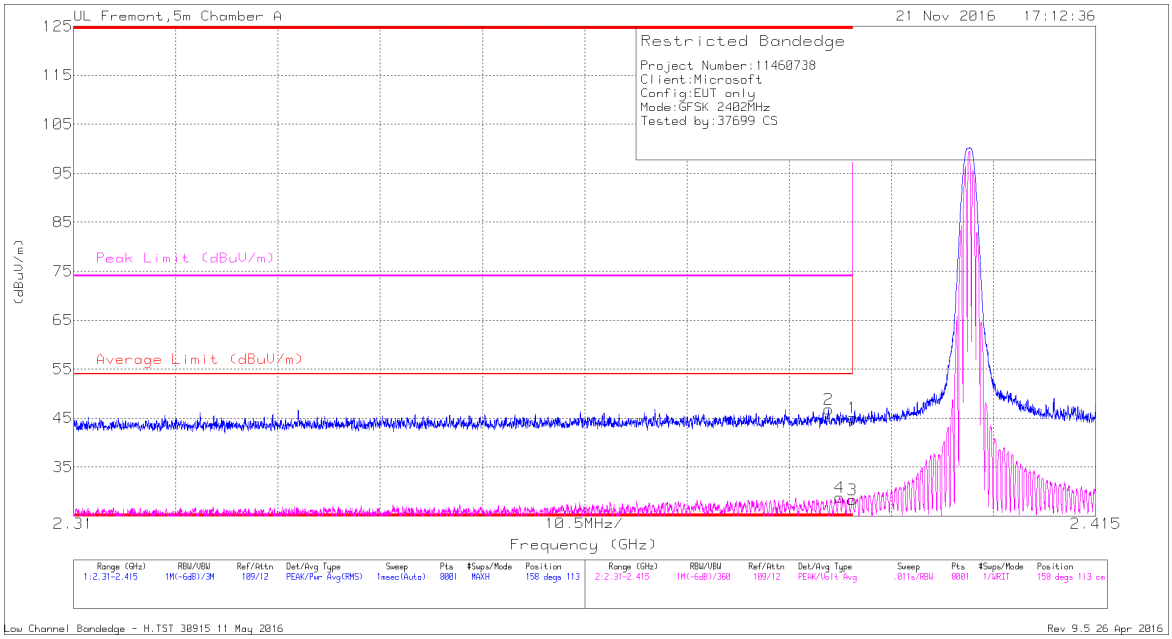
RESULTS

9.1. ABOVE 1 GHz

9.1.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL HORIZONTAL PLOT



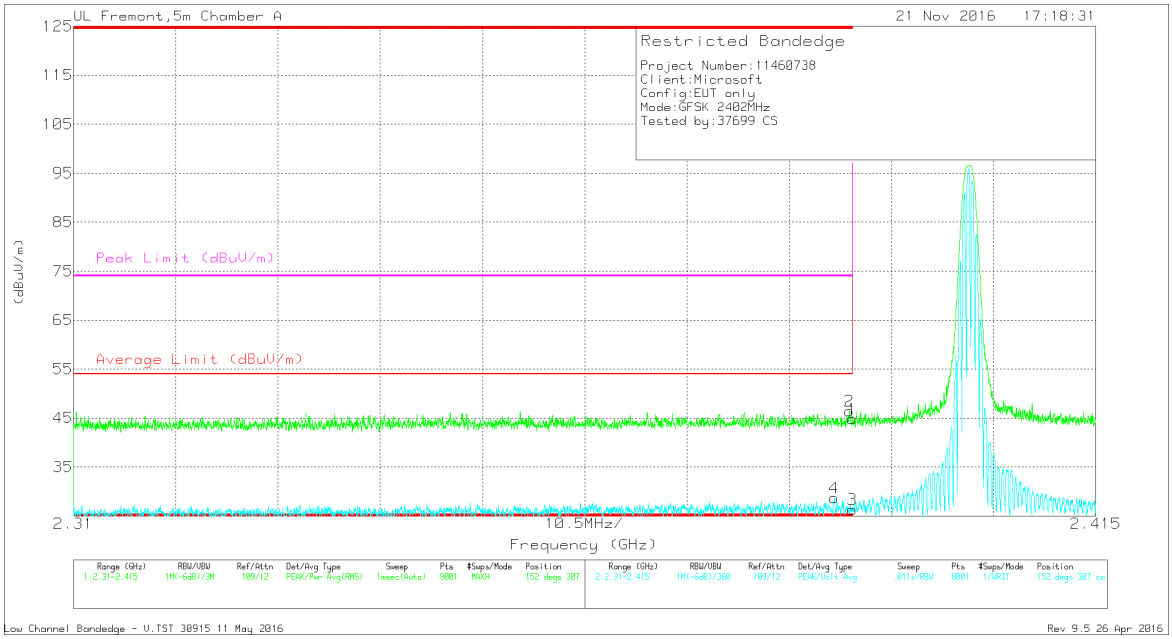
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	36.42	Pk	32.3	-23.7	45.02	-	-	74	-28.98	158	113	H
2	* 2.388	38.16	Pk	32.3	-23.7	46.76	-	-	74	-27.24	158	113	H
3	* 2.39	19.71	VA1T	32.3	-23.7	28.31	54	-25.69	-	-	158	113	H
4	* 2.389	20.25	VA1T	32.3	-23.7	28.85	54	-25.15	-	-	158	113	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

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL VERTICAL PLOT



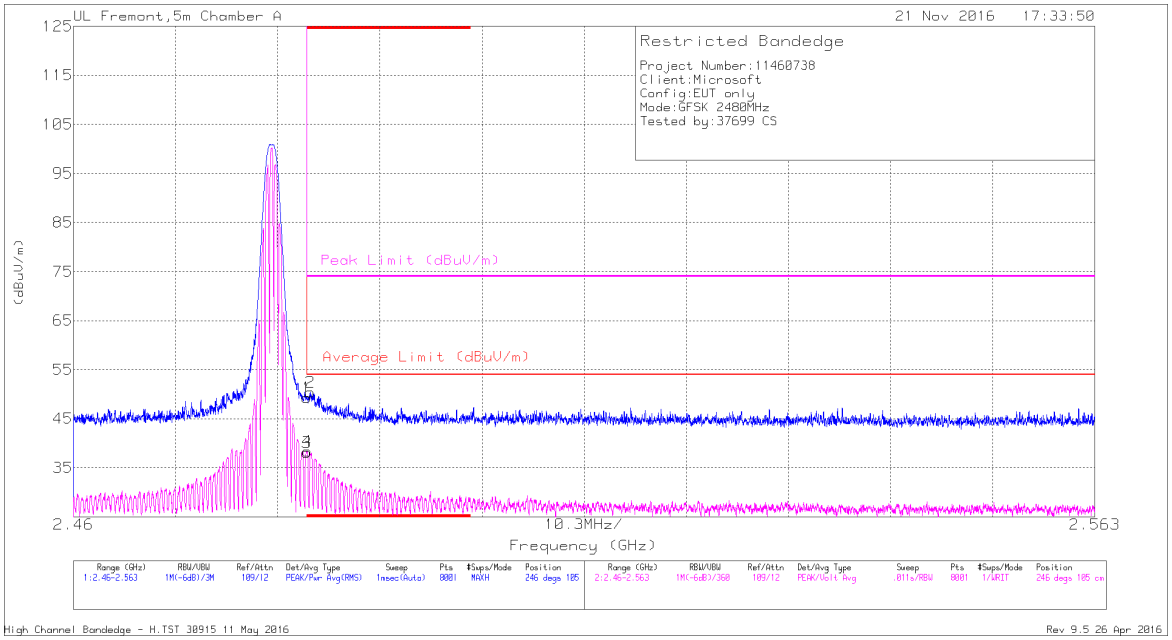
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	36.18	Pk	32.3	-23.7	44.78	-	-	74	-29.22	152	307	V
2	* 2.39	37.87	Pk	32.3	-23.7	46.47	-	-	74	-27.53	152	307	V
3	* 2.39	17.69	VA1T	32.3	-23.7	26.29	54	-27.71	-	-	152	307	V
4	* 2.388	20.11	VA1T	32.3	-23.7	28.71	54	-25.29	-	-	152	307	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

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL HORIZONTAL PLOT



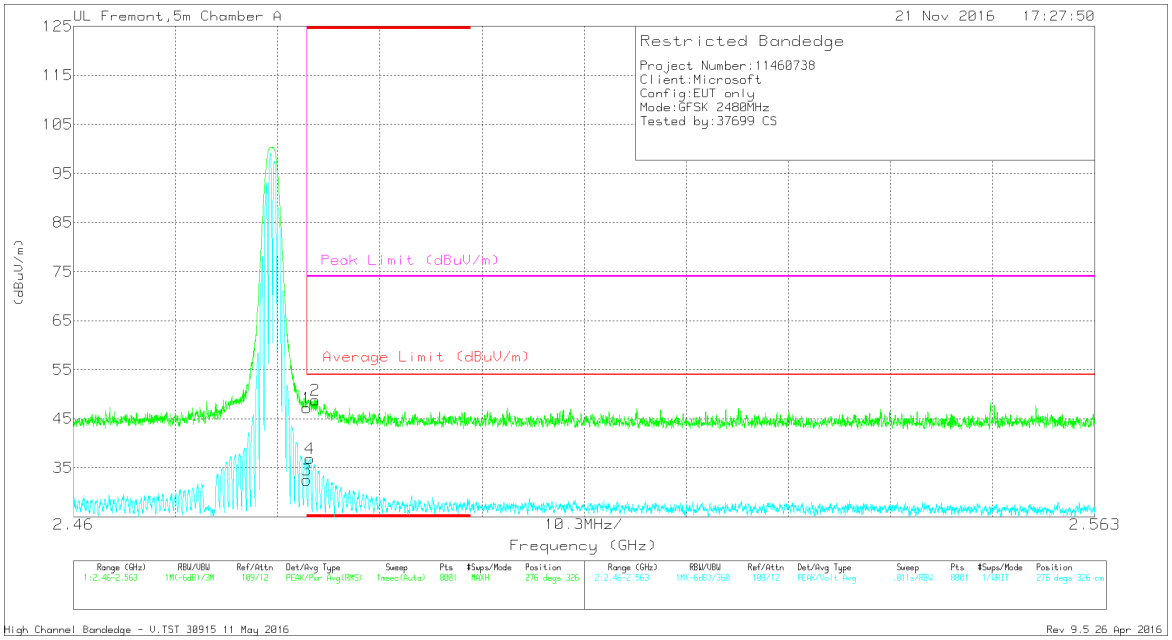
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	40.54	Pk	32.4	-23.6	49.34	-	-	74	-24.66	246	105	H
2	* 2.484	41.59	Pk	32.4	-23.6	50.39	-	-	74	-23.61	246	105	H
3	* 2.484	29.3	VA1T	32.4	-23.6	38.1	54	-15.9	-	-	246	105	H
4	* 2.484	29.6	VA1T	32.4	-23.6	38.4	54	-15.6	-	-	246	105	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

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL VERTICAL PLOT



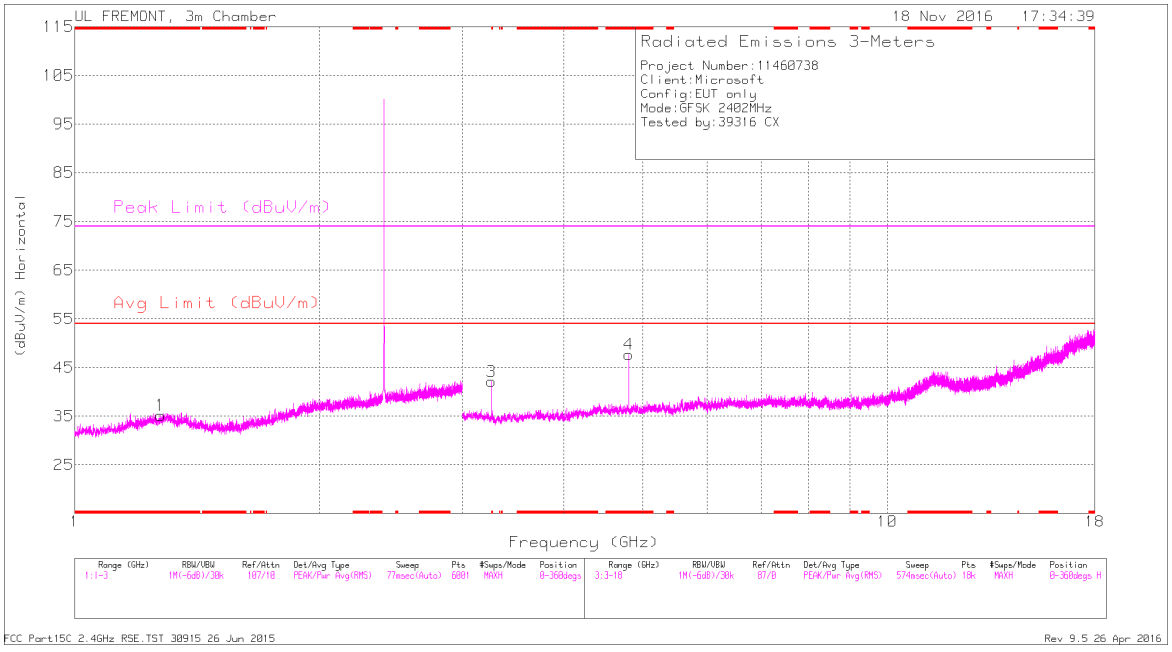
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.39	Pk	32.4	-23.6	47.19	-	-	74	-26.81	276	326	V
2	* 2.484	40.03	Pk	32.4	-23.6	48.83	-	-	74	-25.17	276	326	V
3	* 2.484	23.68	VA1T	32.4	-23.6	32.48	54	-21.52	-	-	276	326	V
4	* 2.484	28.06	VA1T	32.4	-23.6	36.86	54	-17.14	-	-	276	326	V

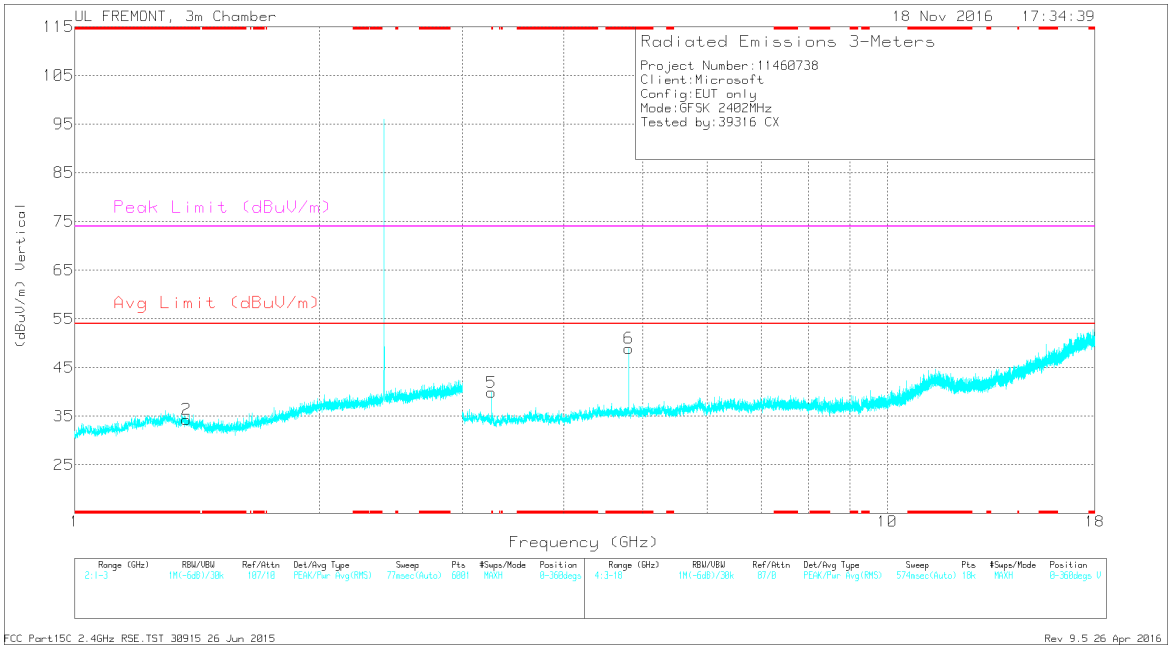
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (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	* 1.277	33.16	PKFH	29.7	-22.6	40.26	-	-	74	-33.74	209	154	H
	* 1.275	16.69	VA1T	29.7	-22.6	23.79	54	-30.21	-	-	209	154	H
2	* 1.374	32.93	PKFH	29.1	-22.8	39.23	-	-	74	-34.77	173	133	V
	* 1.374	17.99	VA1T	29.1	-22.8	24.29	54	-29.71	-	-	173	133	V
4	* 4.804	43.54	PKFH	34.2	-27.6	50.14	-	-	74	-23.86	268	135	H
	* 4.804	40.72	VA1T	34.2	-27.6	47.32	54	-6.68	-	-	268	135	H
6	* 4.804	44.84	PKFH	34.2	-27.6	51.44	-	-	74	-22.56	100	101	V
	* 4.804	41.14	VA1T	34.2	-27.6	47.74	54	-6.26	-	-	100	101	V
3	3.256	38.82	PKFH	32.7	-29.4	42.12	-	-	-	-	232	104	H
5	3.256	36.59	PKFH	32.7	-29.4	39.89	-	-	-	-	156	113	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

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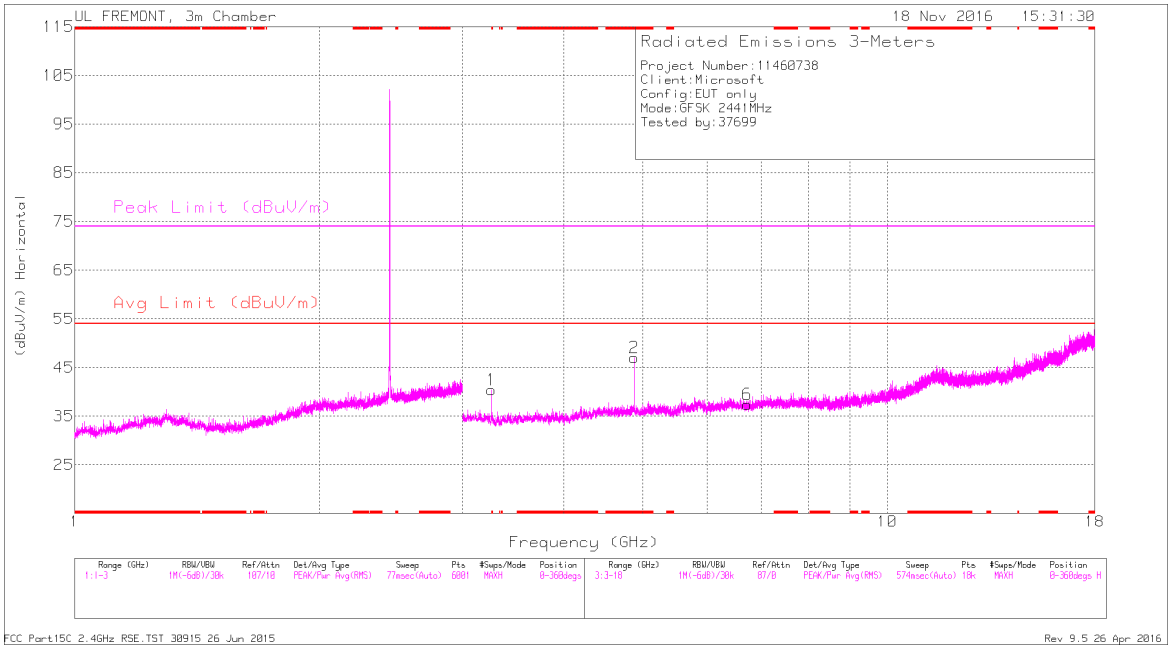
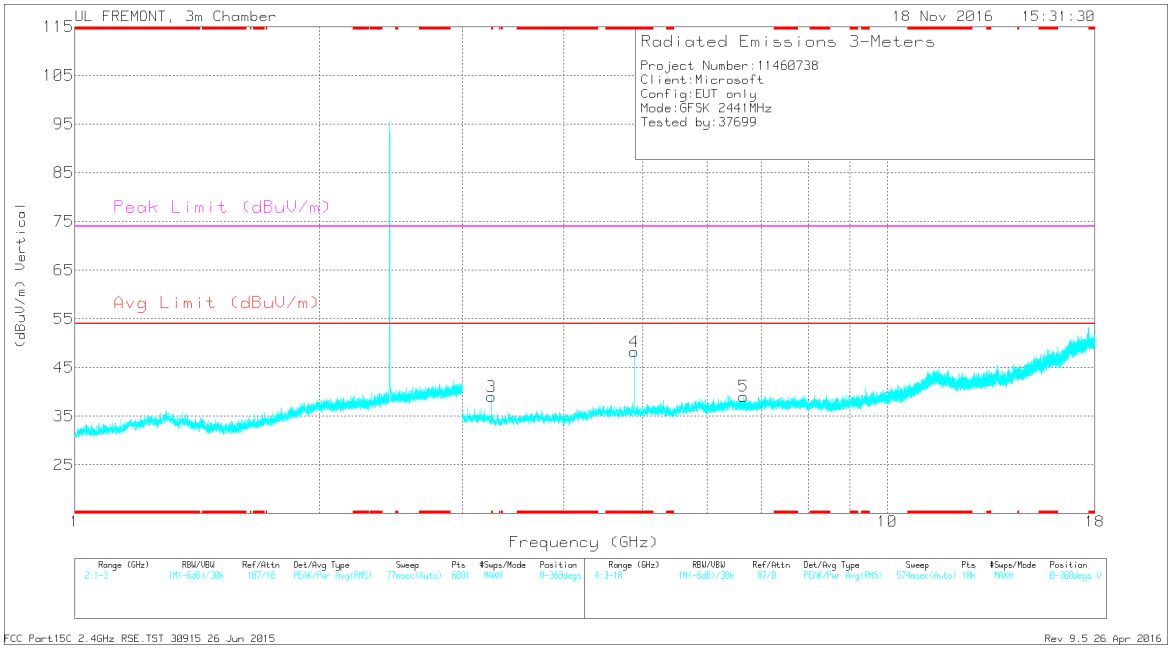
HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



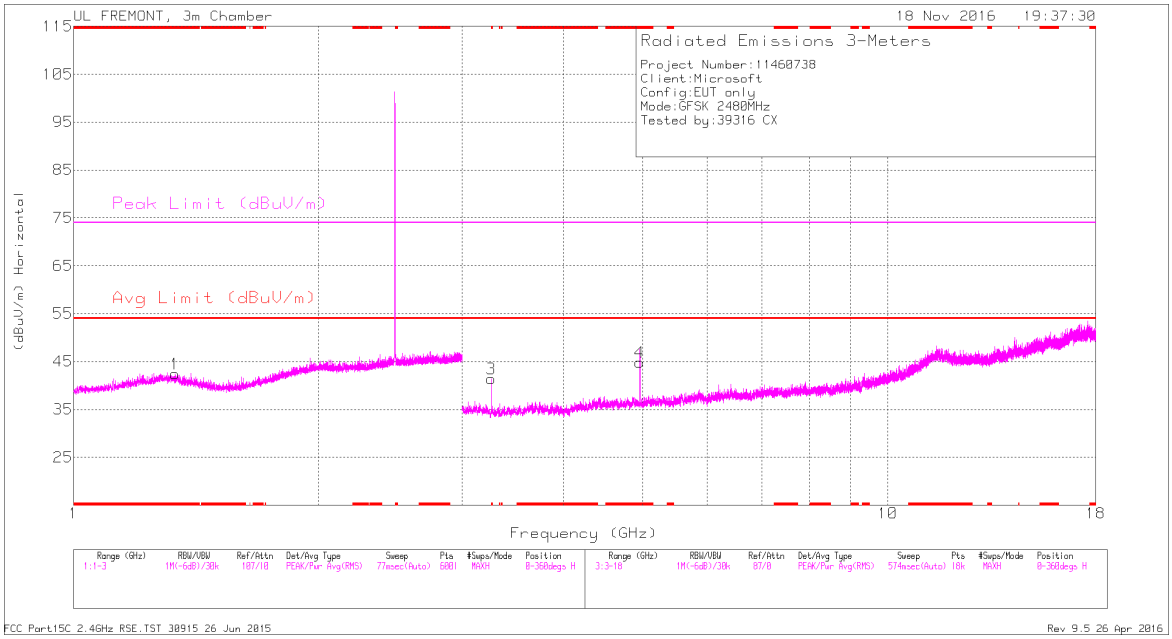
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (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	* 4.882	42.59	PKFH	34.2	-27.6	49.19	-	-	74	-24.81	272	116	H
	* 4.882	38.1	VA1T	34.2	-27.6	44.7	54	-9.3	-	-	272	116	H
4	* 4.882	44.38	PKFH	34.2	-27.6	50.98	-	-	74	-23.02	233	200	V
	* 4.882	40.13	VA1T	34.2	-27.6	46.73	54	-7.27	-	-	233	200	V
1	3.256	37.14	PkFH	32.7	-29.4	40.44	-	-	-	-	231	108	H
3	3.256	35.73	PkFH	32.7	-29.4	39.03	-	-	-	-	248	202	V
5	6.657	29.89	PkFH	35.6	-26.4	39.09	-	-	-	-	107	187	V
6	6.721	27.55	PkFH	35.6	-25.7	37.45	-	-	-	-	26	132	H

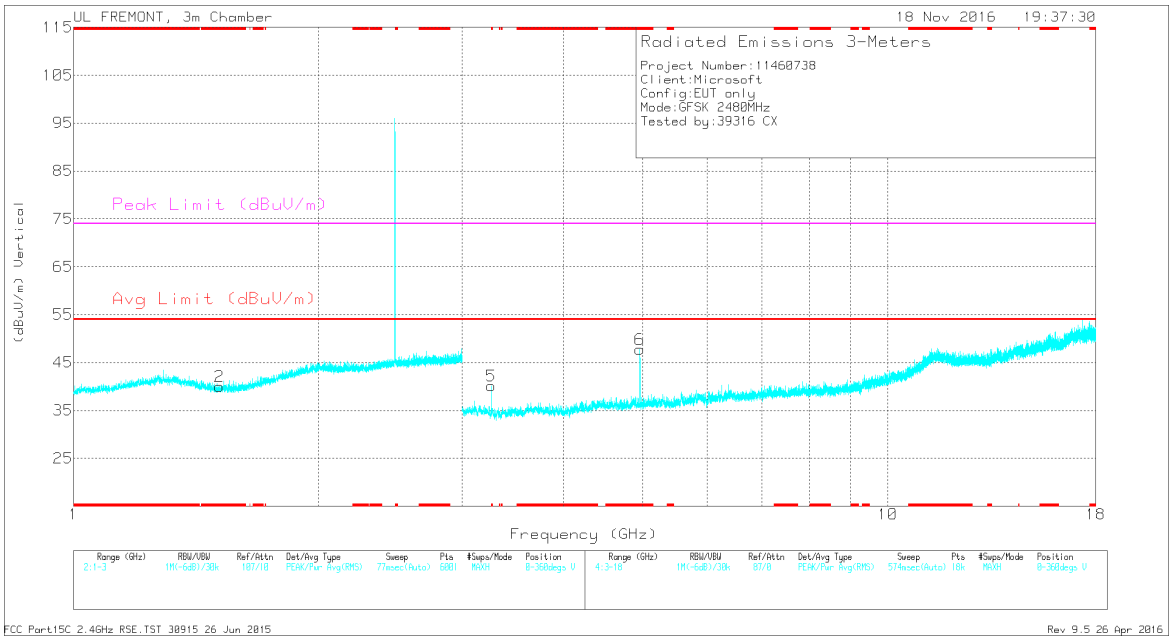
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

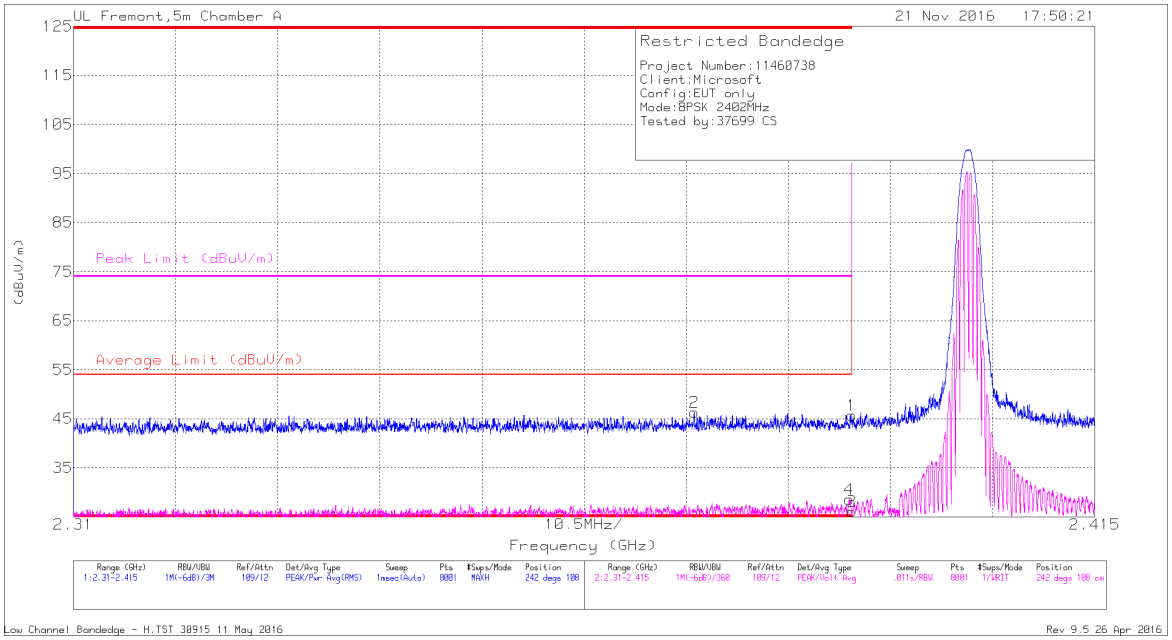
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.333	39.65	PKFH	29.6	-21.9	47.35	-	-	74	-26.65	213	141	H
	* 1.332	27.73	VA1T	29.6	-21.9	35.43	54	-18.57	-	-	213	141	H
2	* 1.512	39.96	PKFH	27.8	-21.7	46.06	-	-	74	-27.94	179	155	V
	* 1.51	27.21	VA1T	27.8	-21.7	33.31	54	-20.69	-	-	179	155	V
4	* 4.96	45.52	PKFH	34.2	-28.5	51.22	-	-	74	-22.78	270	103	H
	* 4.96	41.99	VA1T	34.2	-28.5	47.69	54	-6.31	-	-	270	103	H
6	* 4.96	44.85	PKFH	34.2	-28.5	50.55	-	-	74	-23.45	37	101	V
	* 4.96	41.04	VA1T	34.2	-28.5	46.74	54	-7.26	-	-	37	101	V
3	3.256	39.39	PKFH	32.7	-29.4	42.69	-	-	-	-	231	189	H
5	3.256	40.55	PKFH	32.7	-29.4	43.85	-	-	-	-	314	127	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

9.1.2. ENHANCED DATA RATE 8PSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL HORIZONTAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (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
2	* 2.374	37.81	Pk	32.2	-23.7	46.31	-	-	74	-27.69	242	108	H
1	* 2.39	37.14	Pk	32.3	-23.7	45.74	-	-	74	-28.26	242	108	H
3	* 2.39	17.46	VA1T	32.3	-23.7	26.06	54	-27.94	-	-	242	108	H
4	* 2.39	19.92	VA1T	32.3	-23.7	28.52	54	-25.48	-	-	242	108	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

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL VERTICAL PLOT

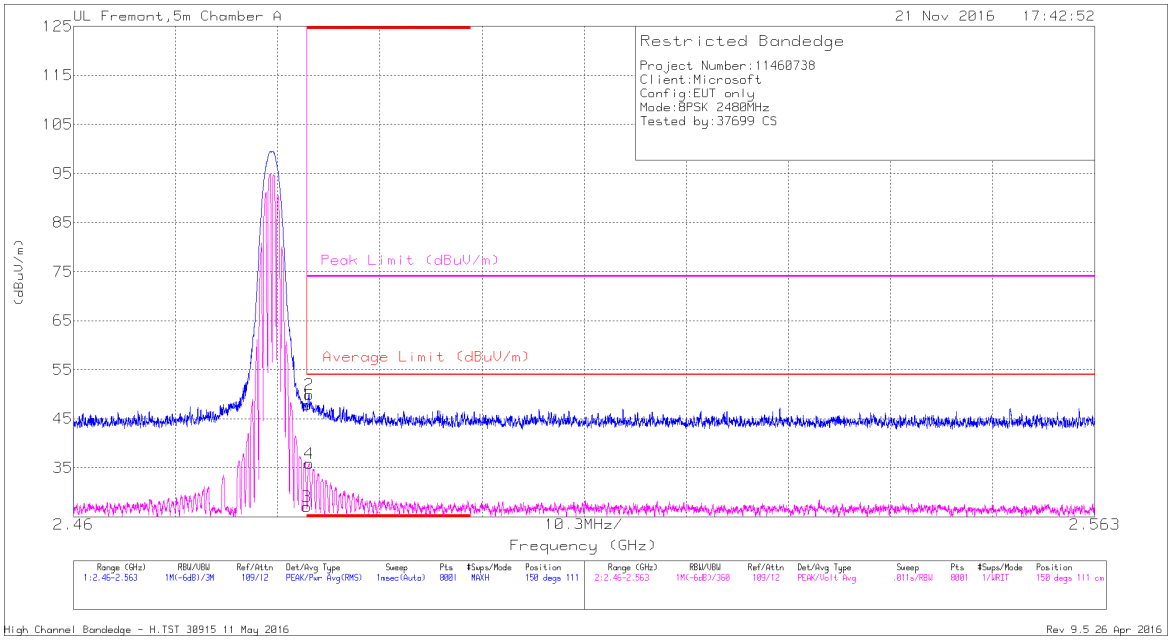
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (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
4	* 2.345	19.19	VA1T	32	-23.7	27.49	54	-26.51	-	-	45	193	V
2	* 2.388	38.19	Pk	32.3	-23.7	46.79	-	-	74	-27.21	45	193	V
1	* 2.39	35.24	Pk	32.3	-23.7	43.84	-	-	74	-30.16	45	193	V
3	* 2.39	17.73	VA1T	32.3	-23.7	26.33	54	-27.67	-	-	45	193	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

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL HORIZONTAL PLOT



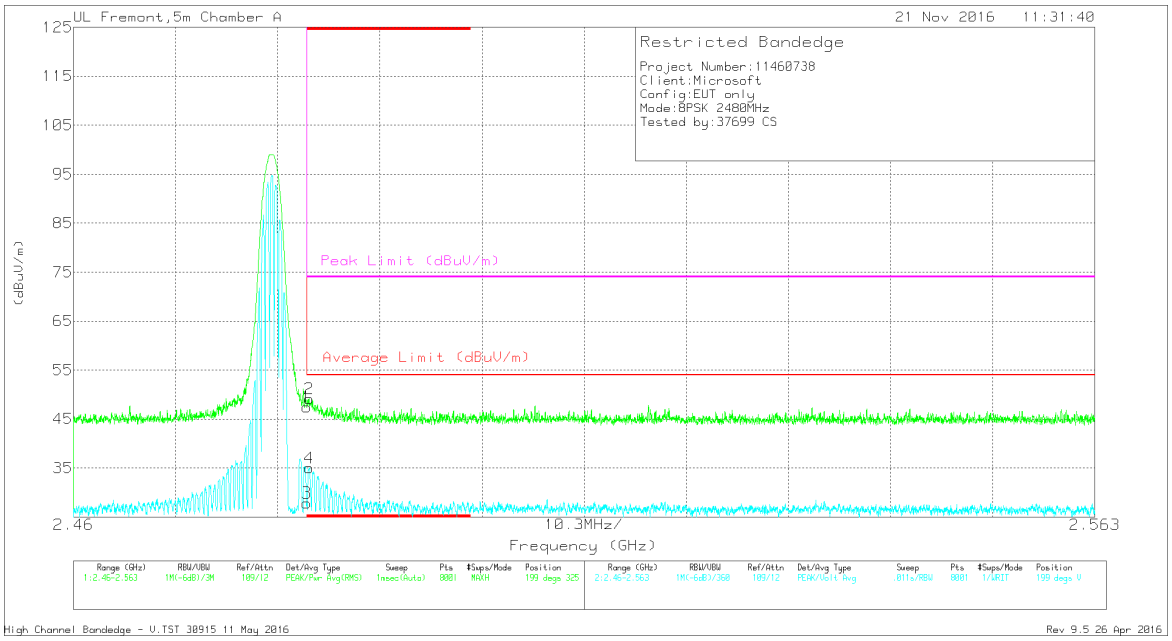
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	39.03	Pk	32.4	-23.6	47.83	-	-	74	-26.17	150	111	H
2	* 2.484	41.1	Pk	32.4	-23.6	49.9	-	-	74	-24.1	150	111	H
3	* 2.484	18.25	VA1T	32.4	-23.6	27.05	54	-26.95	-	-	150	111	H
4	* 2.484	27.1	VA1T	32.4	-23.6	35.9	54	-18.1	-	-	150	111	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

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL VERTICAL PLOT



DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.484	38.69	Pk	32.4	-23.6	47.49	-	-	74	-26.51	199	325	V
2	* 2.484	40.43	Pk	32.4	-23.6	49.23	-	-	74	-24.77	199	325	V
3	* 2.484	19.08	VA1T	32.4	-23.6	27.88	54	-26.12	-	-	199	325	V
4	* 2.484	26.24	VA1T	32.4	-23.6	35.04	54	-18.96	-	-	199	325	V

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

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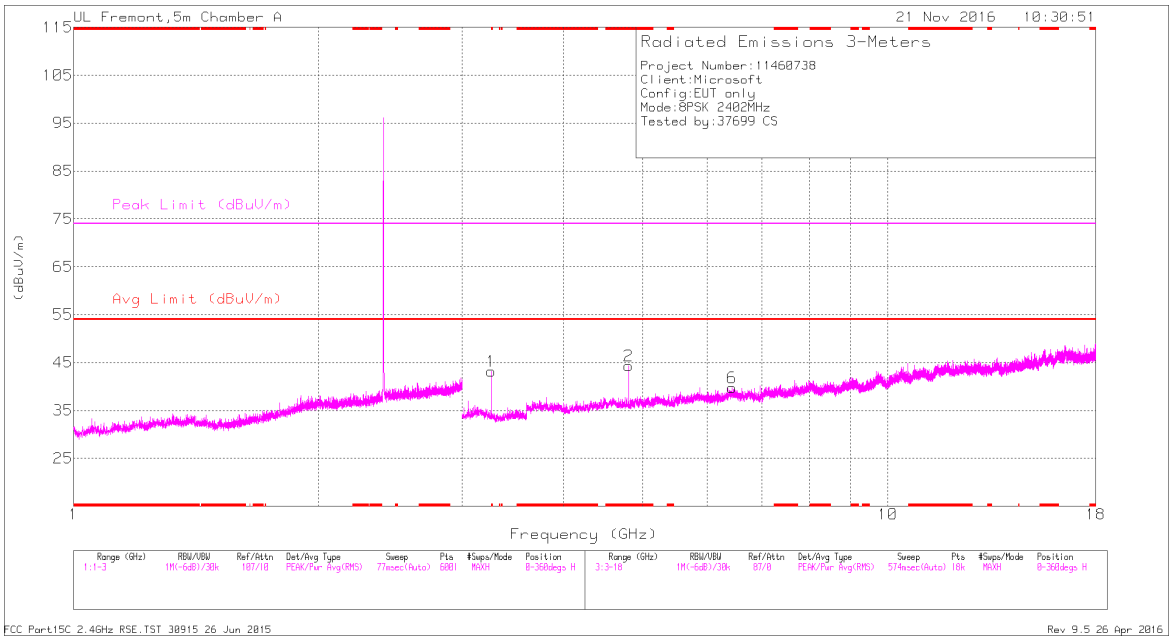
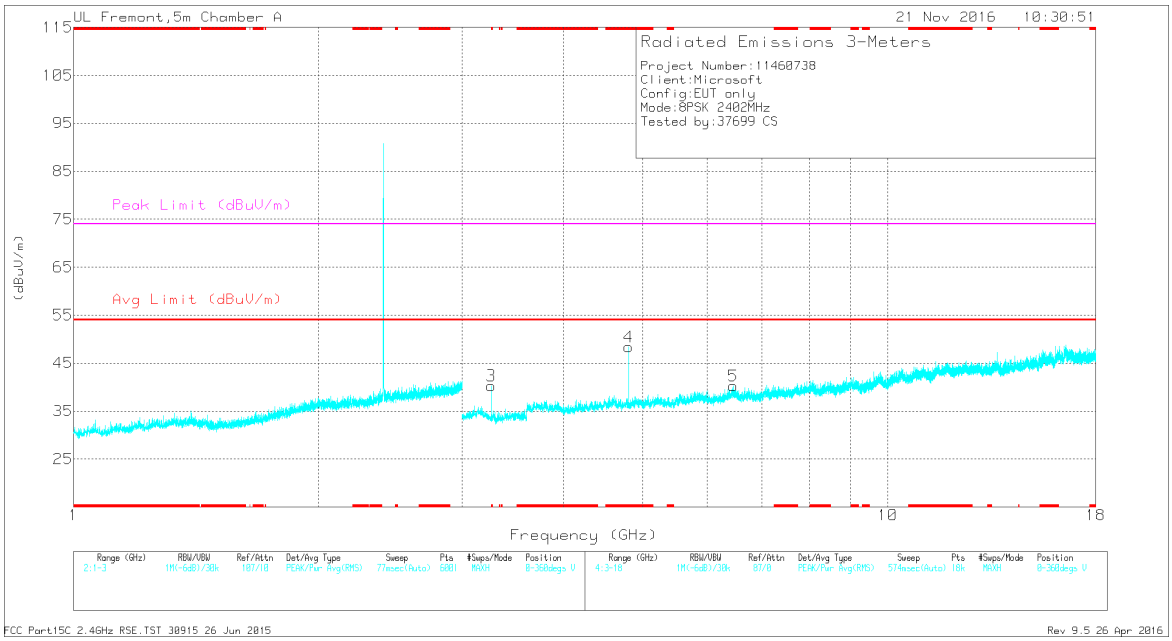
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



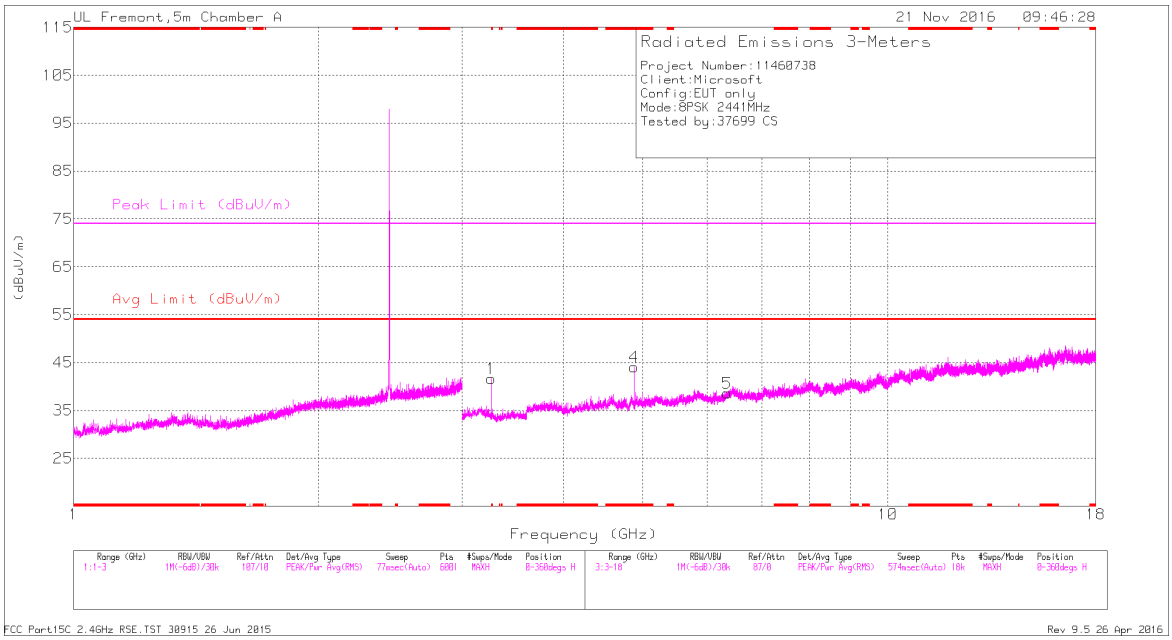
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (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	* 4.804	42.84	PKFH	34.3	-28.6	48.54	-	-	74	-25.46	57	103	H
	* 4.804	34.84	VA1T	34.3	-28.6	40.54	54	-13.46	-	-	57	103	H
4	* 4.804	43.63	PKFH	34.3	-28.6	49.33	-	-	74	-24.67	75	113	V
	* 4.804	35.59	VA1T	34.3	-28.6	41.29	54	-12.71	-	-	75	113	V
1	3.256	41.4	PKFH	32.9	-31.1	43.2	-	-	-	-	156	101	H
3	3.256	38.53	PKFH	32.9	-31.1	40.33	-	-	-	-	203	207	V
6	6.436	29.34	PKFH	35.6	-25.2	39.74	-	-	-	-	382	215	H
5	6.453	29.89	PKFH	35.6	-25.2	40.29	-	-	-	-	145	123	V

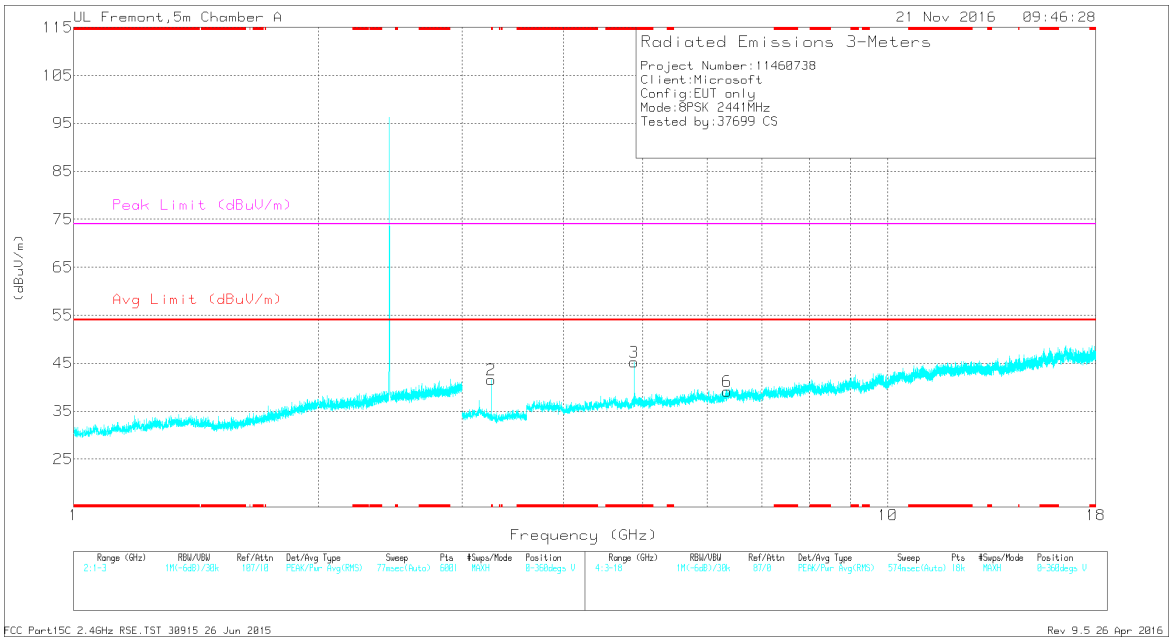
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



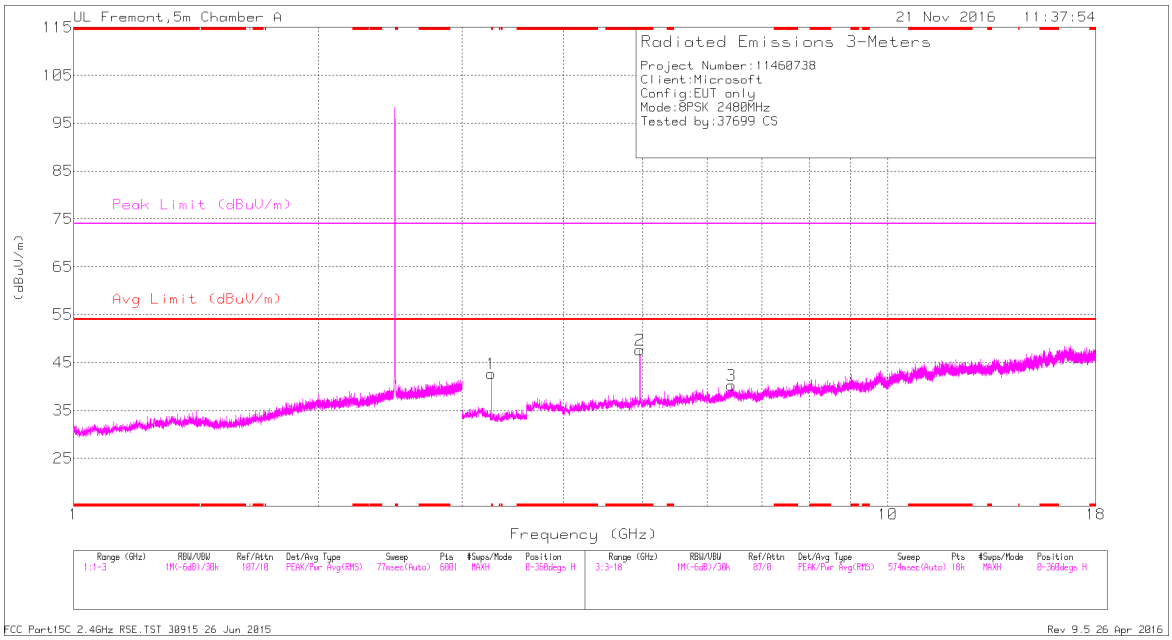
DATA

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (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
4	* 4.882	42.74	PKFH	34.3	-27.8	49.24	-	-	74	-24.76	97	241	H
	* 4.882	34.89	VA1T	34.3	-27.8	41.39	54	-12.61	-	-	97	241	H
3	* 4.882	43.02	PKFH	34.3	-27.8	49.52	-	-	74	-24.48	268	109	V
	* 4.882	34.85	VA1T	34.3	-27.8	41.35	54	-12.65	-	-	268	109	V
1	3.256	39.83	PKFH	32.9	-31.1	41.63	-	-	-	-	323	110	H
2	3.256	39.79	PKFH	32.9	-31.1	41.59	-	-	-	-	108	127	V
5	6.346	29.29	PKFH	35.6	-26.3	38.59	-	-	-	-	247	153	H
6	6.349	29.96	PKFH	35.6	-26.4	39.16	-	-	-	-	23	101	V

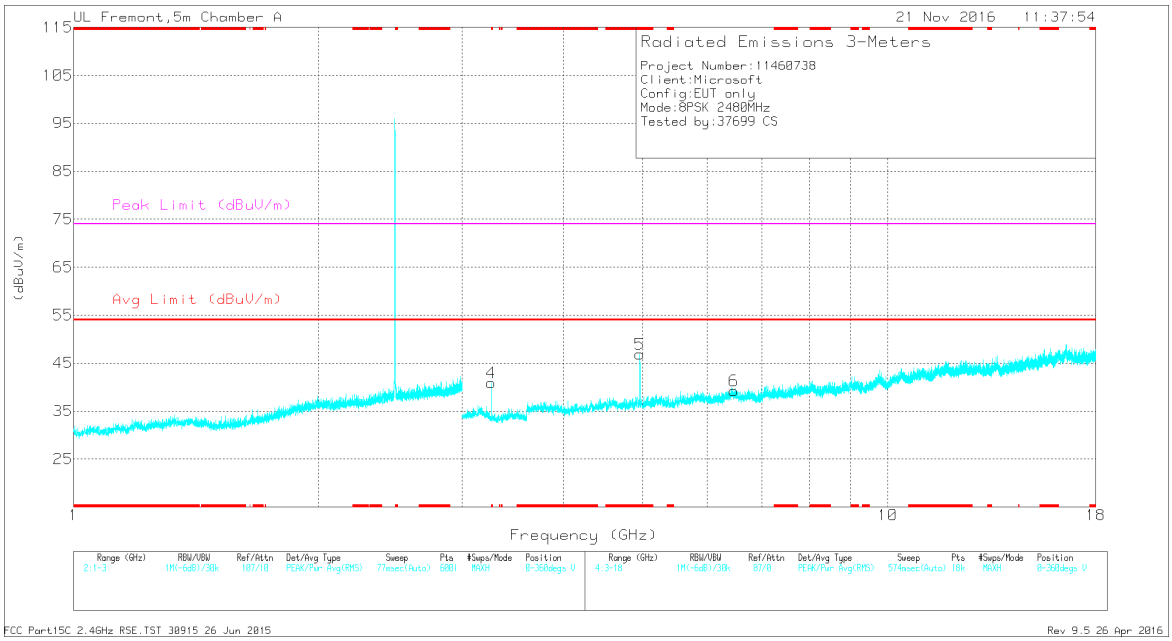
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

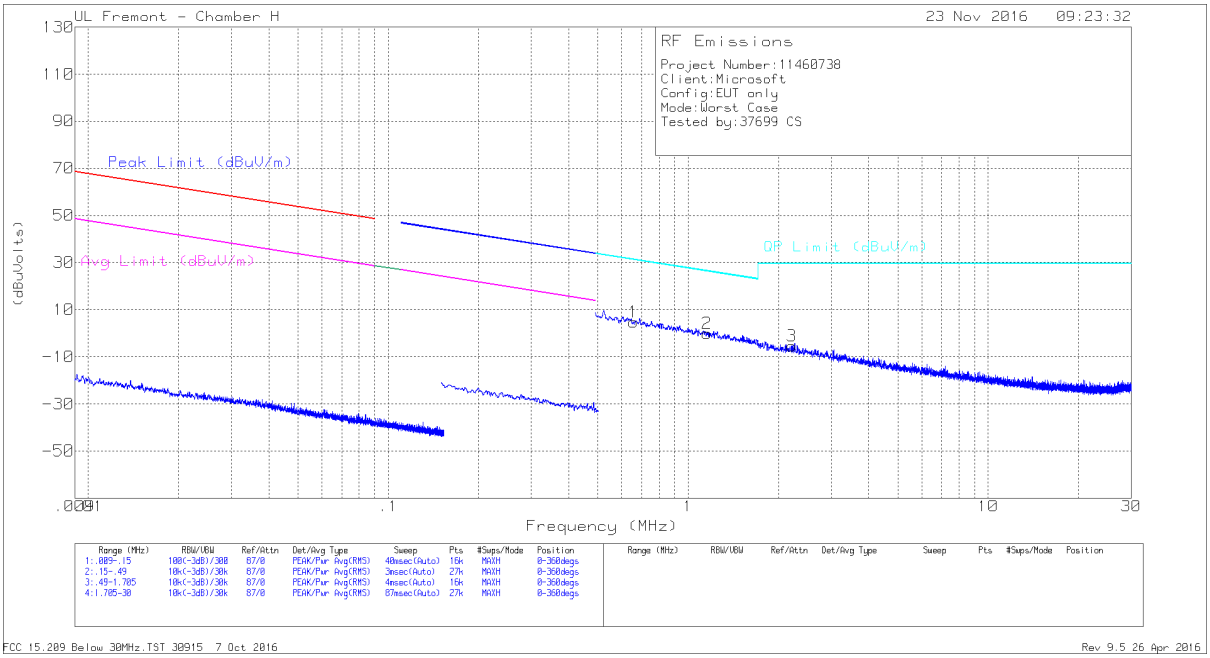
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (db/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	* 4.96	43.06	PKFH	34.3	-28.2	49.16	-	-	74	-24.84	86	107	H
	* 4.96	34.9	VA1T	34.3	-28.2	41	54	-13	-	-	86	107	H
5	* 4.96	42.68	PKFH	34.3	-28.2	48.78	-	-	74	-25.22	128	107	V
	* 4.96	35.4	VA1T	34.3	-28.2	41.5	54	-12.5	-	-	128	107	V
1	3.256	40.87	PKFH	32.9	-31.1	42.67	-	-	-	-	147	101	H
4	3.256	39.13	PKFH	32.9	-31.1	40.93	-	-	-	-	197	105	V
3	6.43	29.9	PKFH	35.6	-25.2	40.3	-	-	-	-	312	213	H
6	6.466	28.69	PKFH	35.6	-25	39.29	-	-	-	-	48	207	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PKFH - FHSS: RB=100k/1MHz VB=3 x RB, Peak
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

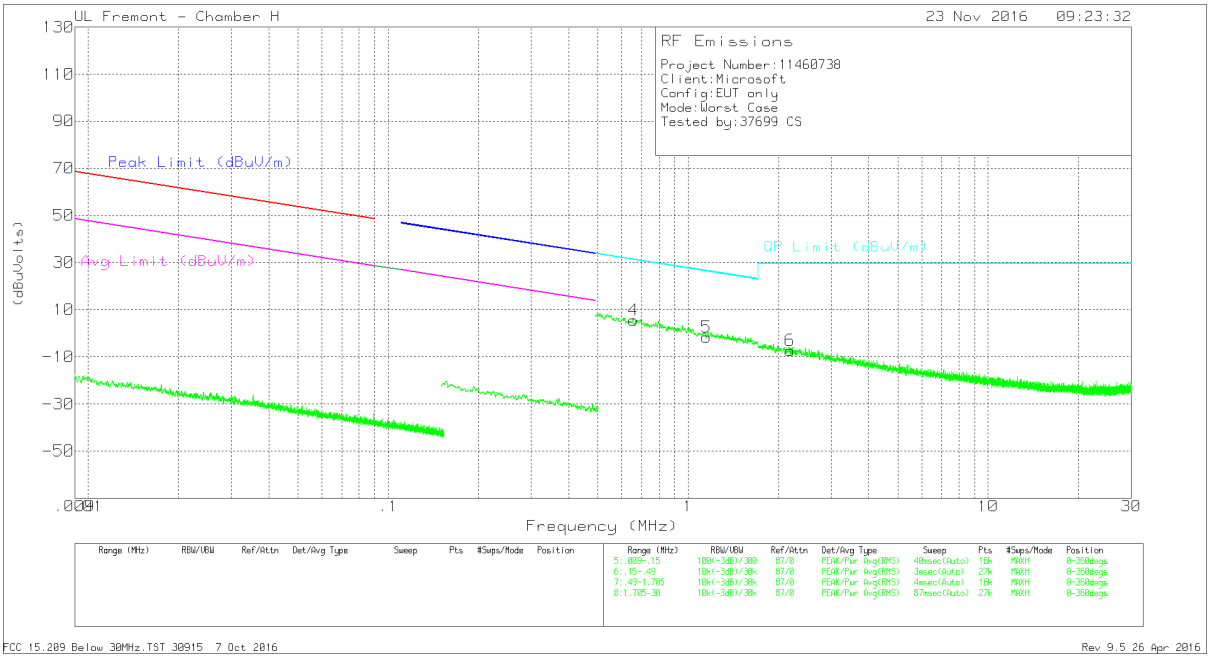
9.2. WORST-CASE BELOW 1 GHz

SPURIOUS EMISSIONS 9KHz TO 30 MHz (WORST-CASE CONFIGURATION)

HORIZONTAL PLOT



VERTICAL PLOT



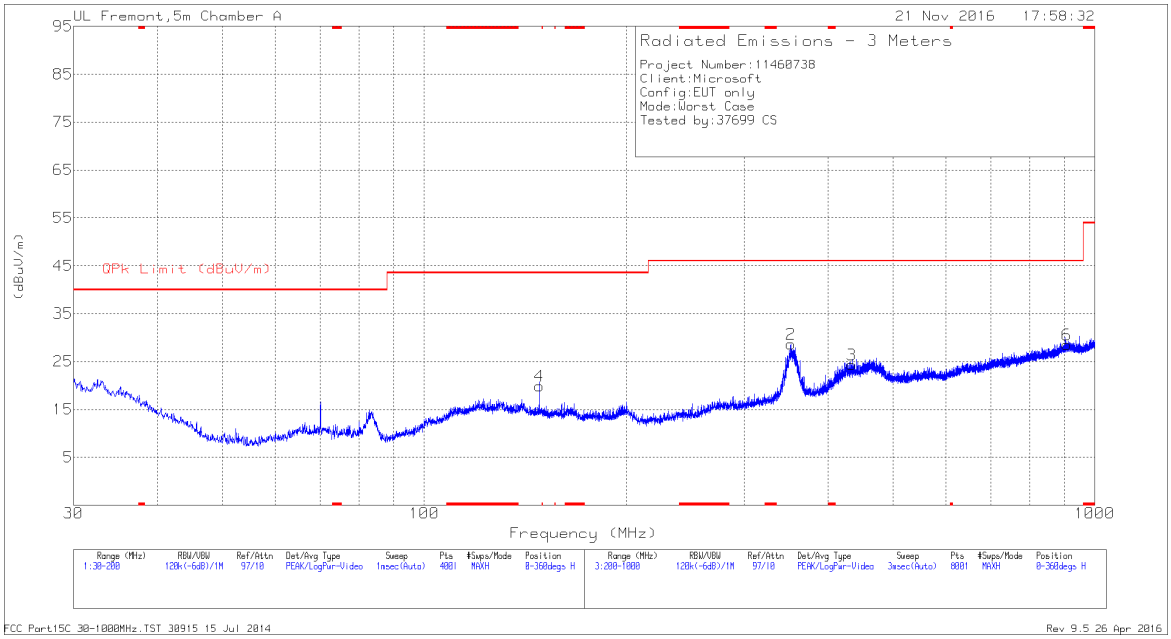
DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cbl (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
4	.65682	33.68	Pk	11.8	.1	-40	5.58	31.26	-25.68	0-360
1	.65686	32.79	Pk	11.8	.1	-40	4.69	31.26	-26.57	0-360
5	1.14862	26.37	Pk	11.8	.2	-40	-1.63	26.42	-28.05	0-360
2	1.15333	27.96	Pk	11.8	.2	-40	-.04	26.39	-26.43	0-360
6	2.17922	20.61	Pk	11.9	.2	-40	-7.29	29.5	-36.79	0-360
3	2.21118	22.46	Pk	11.9	.2	-40	-5.44	29.5	-34.94	0-360

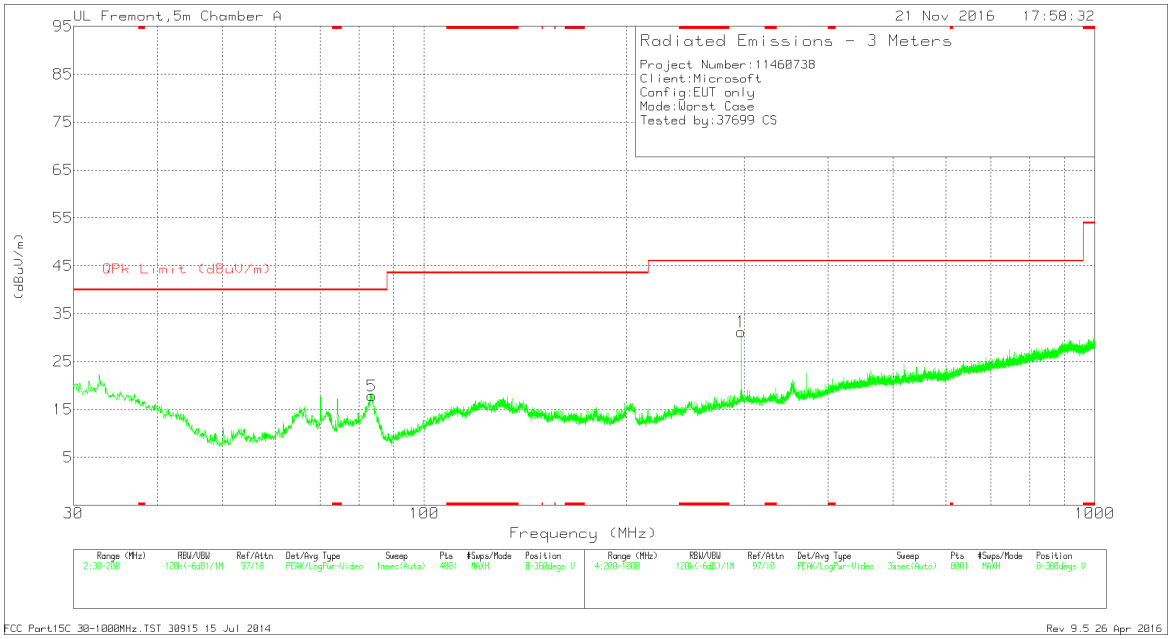
Pk - Peak detector

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

HORIZONTAL PLOT



VERTICAL PLOT



Data

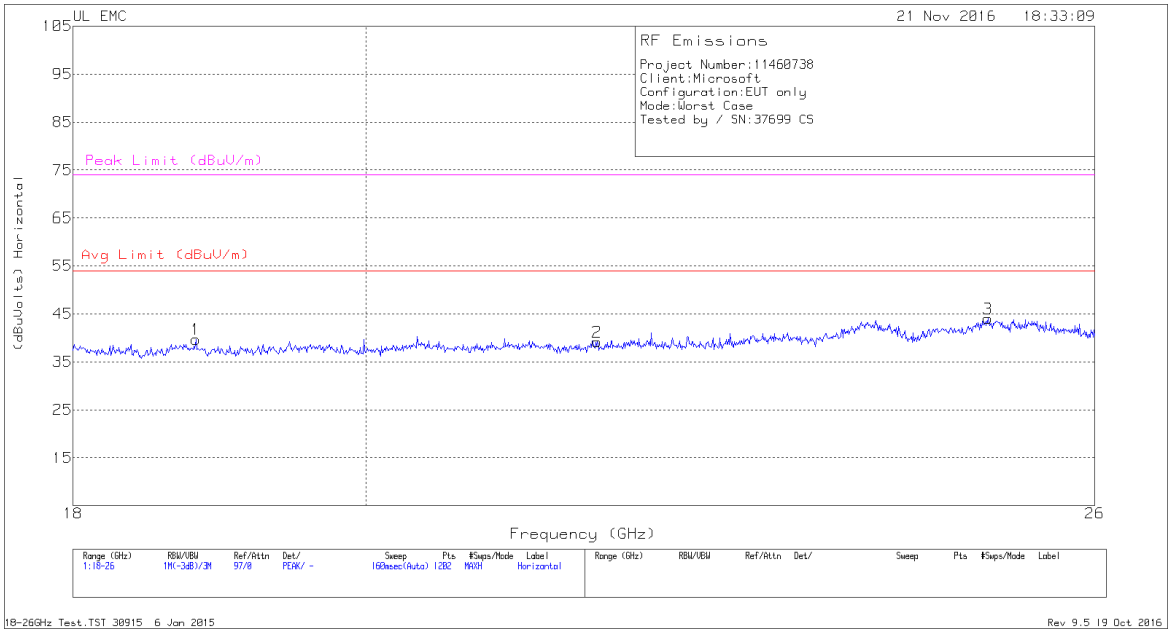
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T130 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
5	83.5925	37.2	Pk	11.4	-30.7	17.9	40	-22.1	0-360	100	V
4	148.4475	33.38	Pk	16.7	-30.2	19.88	43.52	-23.64	0-360	100	H
1	297	43.35	Pk	17.3	-29.4	31.25	46.02	-14.77	0-360	300	V
2	352	39.42	Pk	18.4	-29.2	28.62	46.02	-17.4	0-360	100	H
3	434	32.56	Pk	20.7	-28.9	24.36	46.02	-21.66	0-360	100	H
6	908.7	28.88	Pk	26.9	-27.3	28.48	46.02	-17.54	0-360	100	H

Pk - Peak detector

9.3. WORST-CASE ABOVE 18 GHz

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

HORIZONTAL PLOT



HORIZONTAL PLOT

Data

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T449 (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	18.813	41.67	Pk	32.4	-24.9	-9.5	39.67	54	-14.33	74	-34.33
2	21.737	40.27	Pk	33.2	-24.8	-9.5	39.17	54	-14.83	74	-34.83
3	25.021	43.7	Pk	34.2	-24.4	-9.5	44	54	-10	74	-30
4	18.806	40.73	Pk	32.4	-24.8	-9.5	38.83	54	-15.17	74	-35.17
5	21.73	40.27	Pk	33.2	-24.8	-9.5	39.17	54	-14.83	74	-34.83
6	25.061	44.37	Pk	34.3	-25	-9.5	44.17	54	-9.83	74	-29.83

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

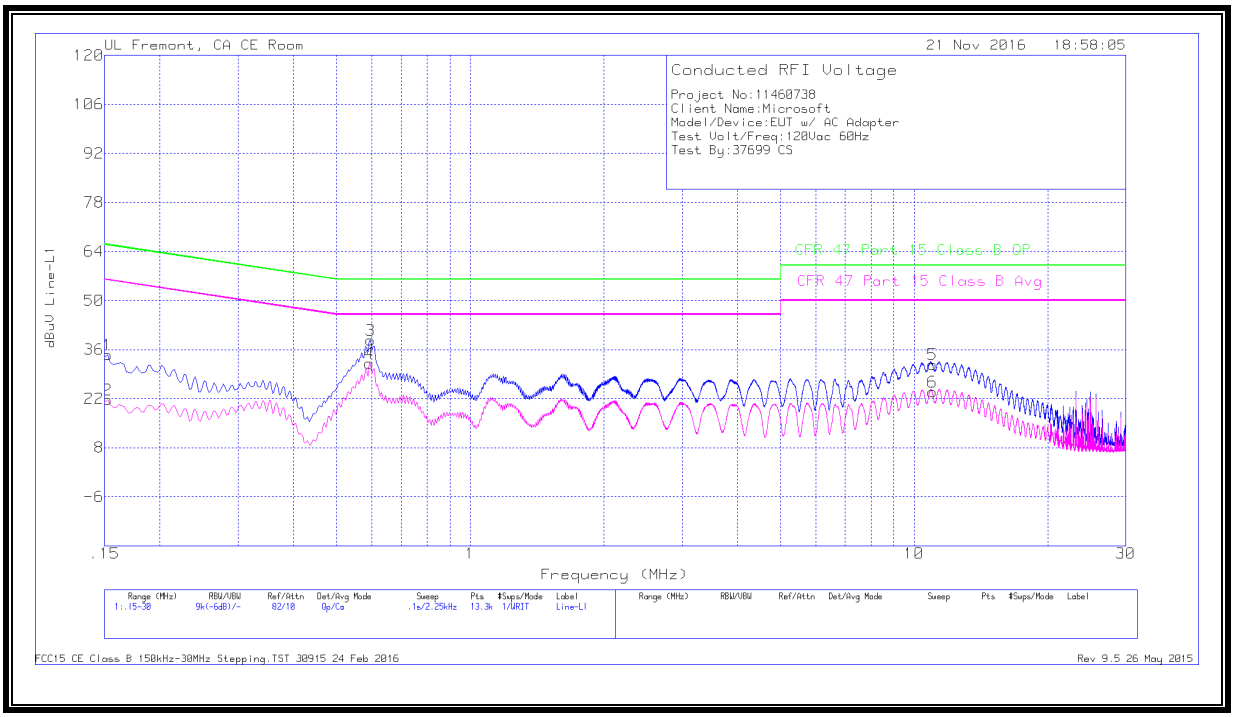
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

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

RESULTS

10.1. EUT POWERED BY AC/DC ADAPTER VIA USB CABLE

LINE 1 RESULTS

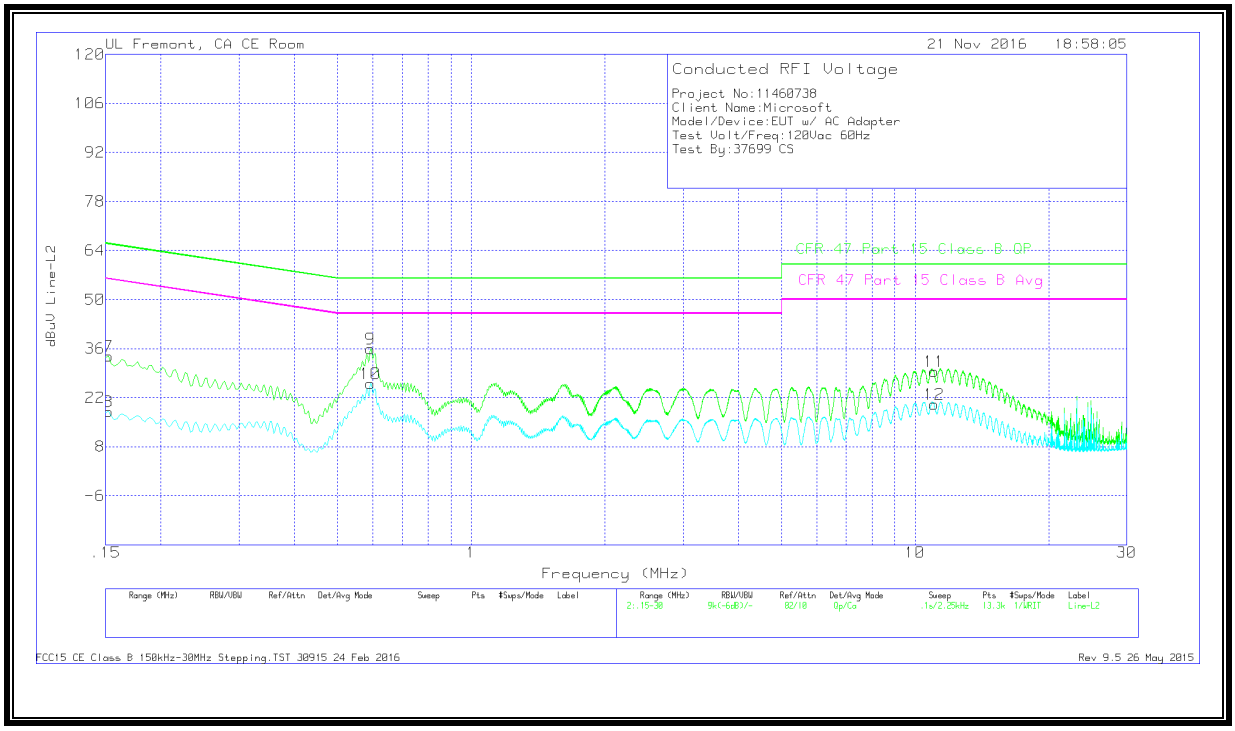


WORST EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables 1&3	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	24.32	Qp	.1	0	10.1	34.52	65.88	-31.36	-	-
2	.15225	11.43	Ca	.1	0	10.1	21.63	-	-	55.88	-34.25
3	.5955	28.66	Qp	0	0	10.1	38.76	56	-17.24	-	-
4	.59325	22.06	Ca	0	0	10.1	32.16	-	-	46	-13.84
5	10.99613	21.38	Qp	0	.2	10.2	31.78	60	-28.22	-	-
6	10.995	13.46	Ca	0	.2	10.2	23.86	-	-	50	-26.14

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



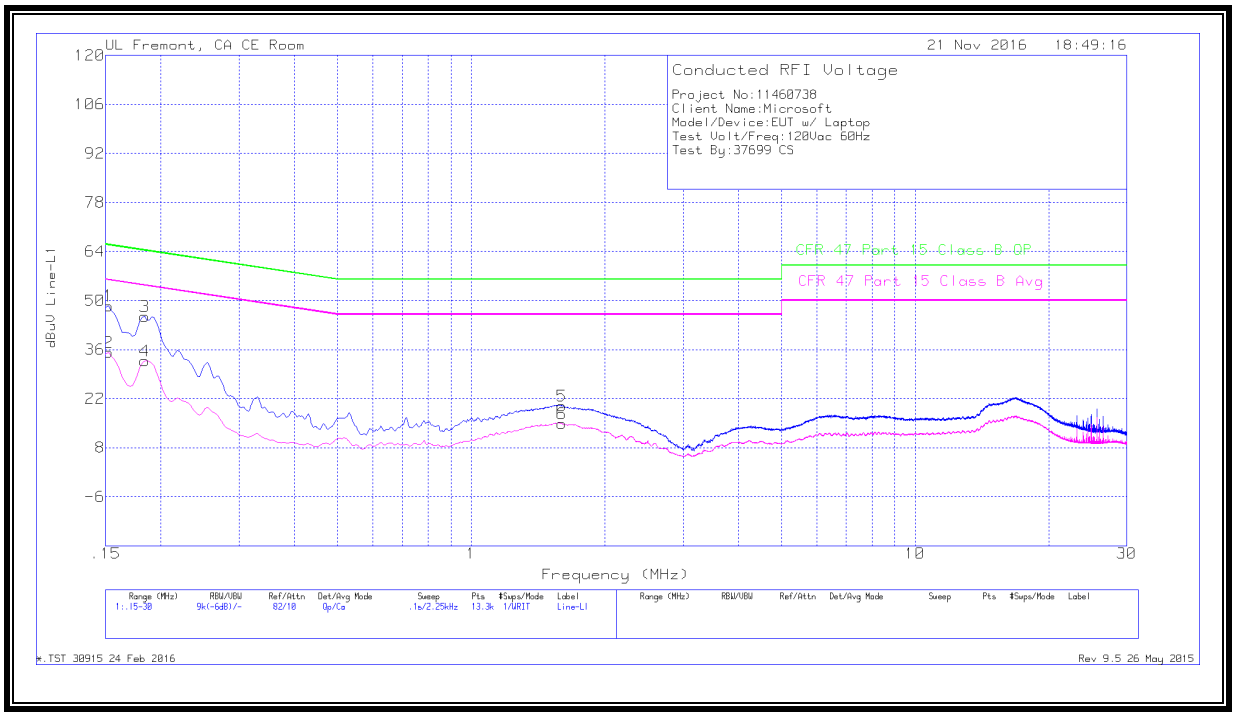
WORST EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables 2&3	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)
7	.15225	23.71	Qp	0	0	10.1	33.81	65.88	-32.07	-	-
8	.15225	7.97	Ca	0	0	10.1	18.07	-	-	55.88	-37.81
9	.59325	25.84	Qp	0	0	10.1	35.94	56	-20.06	-	-
10	.59325	15.97	Ca	0	0	10.1	26.07	-	-	46	-19.93
11	11.0355	19.02	Qp	0	.2	10.2	29.42	60	-30.58	-	-
12	11.02875	9.73	Ca	0	.2	10.2	20.13	-	-	50	-29.87

Qp - Quasi-Peak detector
Ca - CISPR average detection

10.2. EUT POWERED BY HOST PC VIA USB CABLE

LINE 1 RESULTS

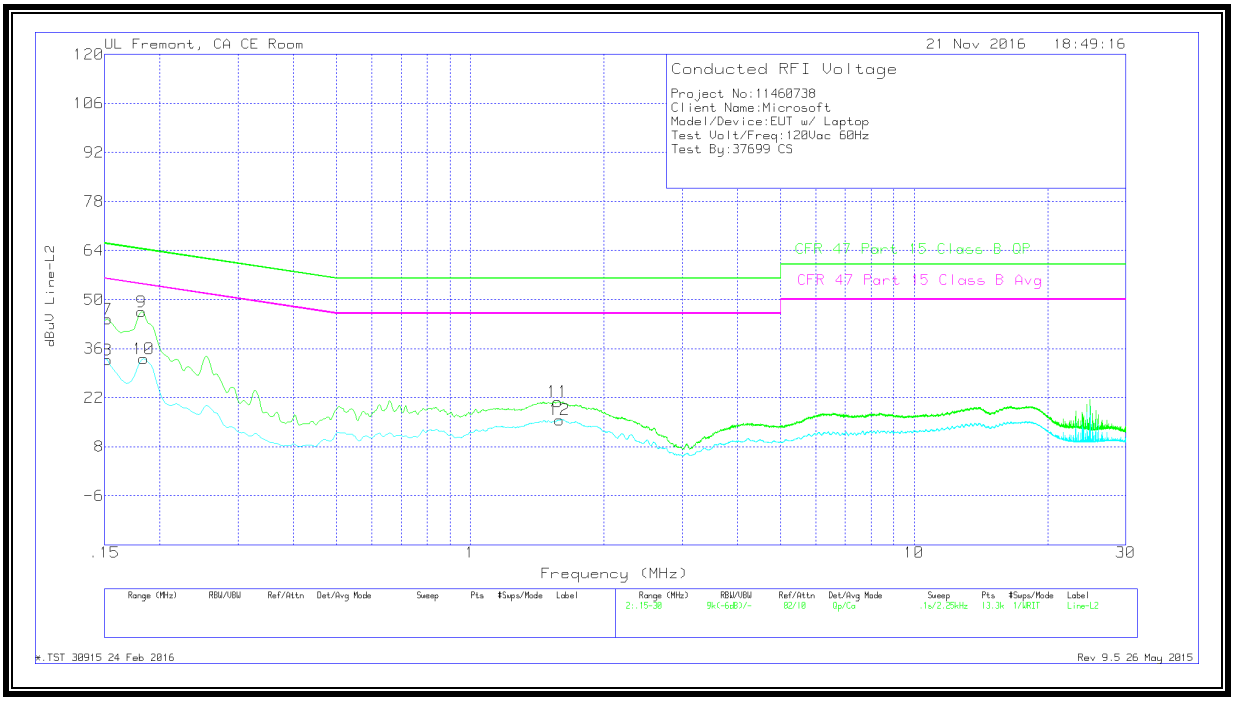


WORST EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables 1&3	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	38.32	Qp	.1	0	10.1	48.52	65.88	-17.36	-	-
2	.15225	25.1	Ca	.1	0	10.1	35.3	-	-	55.88	-20.58
3	.18375	35.32	Qp	0	0	10.1	45.42	64.31	-18.89	-	-
4	.18375	22.69	Ca	0	0	10.1	32.79	-	-	54.31	-21.52
5	1.599	9.77	Qp	0	.1	10.1	19.97	56	-36.03	-	-
6	1.59788	4.72	Ca	0	.1	10.1	14.92	-	-	46	-31.08

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables 2&3	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)
7	.15225	34.4	Qp	0	0	10.1	44.5	65.88	-21.38	-	-
8	.15225	22.72	Ca	0	0	10.1	32.82	-	-	55.88	-23.06
9	.1815	36.38	Qp	0	0	10.1	46.48	64.42	-17.94	-	-
10	.18375	23.04	Ca	0	0	10.1	33.14	-	-	54.31	-21.17
11	1.572	10.68	Qp	0	.1	10.1	20.88	56	-35.12	-	-
12	1.59	5.47	Ca	0	.1	10.1	15.67	-	-	46	-30.33

Qp - Quasi-Peak detector
Ca - CISPR average detection

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