FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-247 ISSUE 1

B-MODE RADIATED EMISSION
TEST REPORT

FOR

CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS

MODEL NUMBER: A1779

FCC ID: BCG-E3086A
IC: 579C-E3086A

REPORT NUMBER: 16U23310-E2V2

ISSUE DATE: JULY 29, 2016

Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	07/22/2016	Initial Issue	Chin Pang
V2	07/29/2016	Revised Section 5.3, and 8.3 to address TCB's questions	Tina Chu

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: CELLULAR PHONE WITH BLUETOOTH AND WLAN RADIOS

MODEL: A1779

SERIAL NUMBER: C39RW01HHFML (RADIATED)

DATE TESTED: JULY 21-29, 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

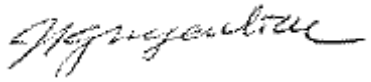
UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement 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, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

CHIN PANG
SENIOR ENGINEER
UL VERIFICATION SERVICES INC.

Prepared By:



LIEU NGUYEN
EMC 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, KDB 558074 D01 v03r05, 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 47266 Benicia Street, Fremont, California, USA. 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
Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Radiated Disturbance, 9KHz to 30 MHz	3.15 dB
Radiated Disturbance, 30 to 1000 MHz	5.36 dB
Radiated Disturbance,1000 to 18000 MHz	4.32 dB
Radiated Disturbance,18000 to 26000 MHz	4.45 dB
Radiated Disturbance,26000 to 40000 MHz	5.24 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT Model A1779 is a mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/CDMA/WCDMA/HSPA+/DC-HSDPA/LTE-radio, IEEE 802.11a/b/g/n/ac, NFC and Bluetooth radio. The rechargeable battery is not user accessible.

5.2. MAXIMUM OUTPUT POWER

Please refer to project number: UL-RPT-RP11241886JD07E, FCC ID: BCG-E3086A

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

Frequency Band (GHz)	Antenna Gain (dBi)	
	Chain 0	Chain 1
2.4	-1.87	-1.25

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 9.44.11.27.

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X/Y/Z, it was determined that (X) Flatbed orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in (X) Flatbed orientation.

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

802.11b mode: 1 Mbps

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	MacBook Pro	W885200F70K	NA
Laptop Power Supply	Apple	A1343	C0420640G9KDJ92BD	NA

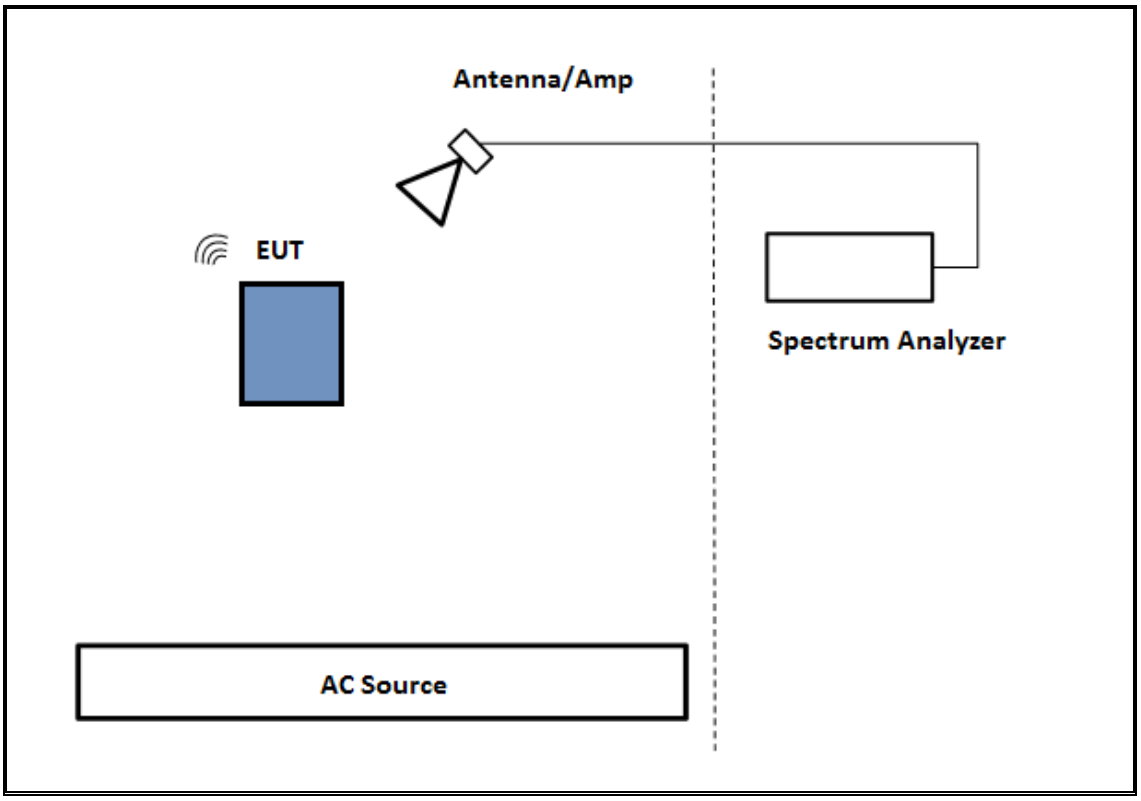
I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None Used						

TEST SETUP- RADIATED-ABOVE 1 GHZ

The battery powered EUT was tested as a standalone unit. Test software exercised the EUT.

SETUP DIAGRAM



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**
Amplifier, 1 - 18GHz	Miteq	AFS42-00101800-25-S-42	1782158	1/25/2017
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	MY52350675	11/15/2016
Power Meter, P-series single channel	Agilent	N1911A	GB45100212	9/25/2016
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent	N1921A	MY53260010	7/8/2016
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826	209336	5/26/2017
Spectrum Analyzer, 40 GHz	Agilent	8564E	3943A01643	8/14/2016
Amplifier, 1 to 26.5GHz, 23.5dB Gain minimum	Keysight	8449B	3008A04710	7/5/2017
UL SOFTWARE				
* Radiated Software	UL	UL EMC	Ver 9.5, June 24, 2015	

Note: * indicates automation software version used in the compliance certification testing

7. MEASUREMENT METHODS

Output Power: KDB 558074 D01 v03r05, Section 9.1.2.

Radiated Spurious Emission: KDB 558074 D01 v03r05, Section 12.1

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

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 1.5m 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 as applicable for average measurements.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

For 2.4 GHz band, the spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

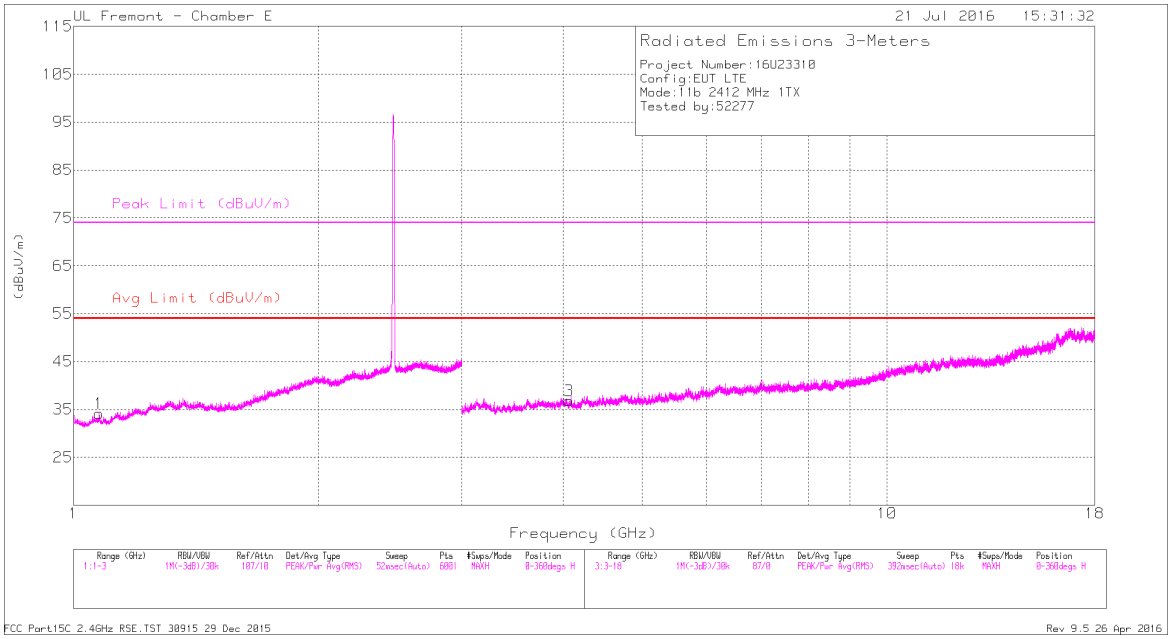
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

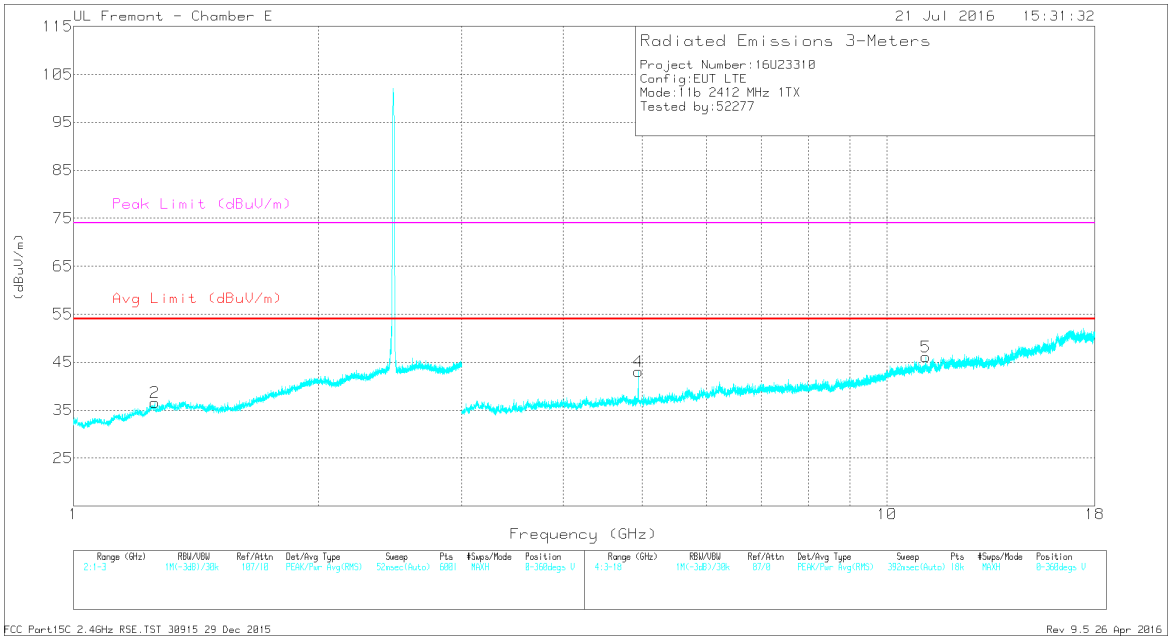
8.2.1. 802.11b 1Tx MODE IN THE 2.4 GHz BAND CHAIN 0

HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



DATA

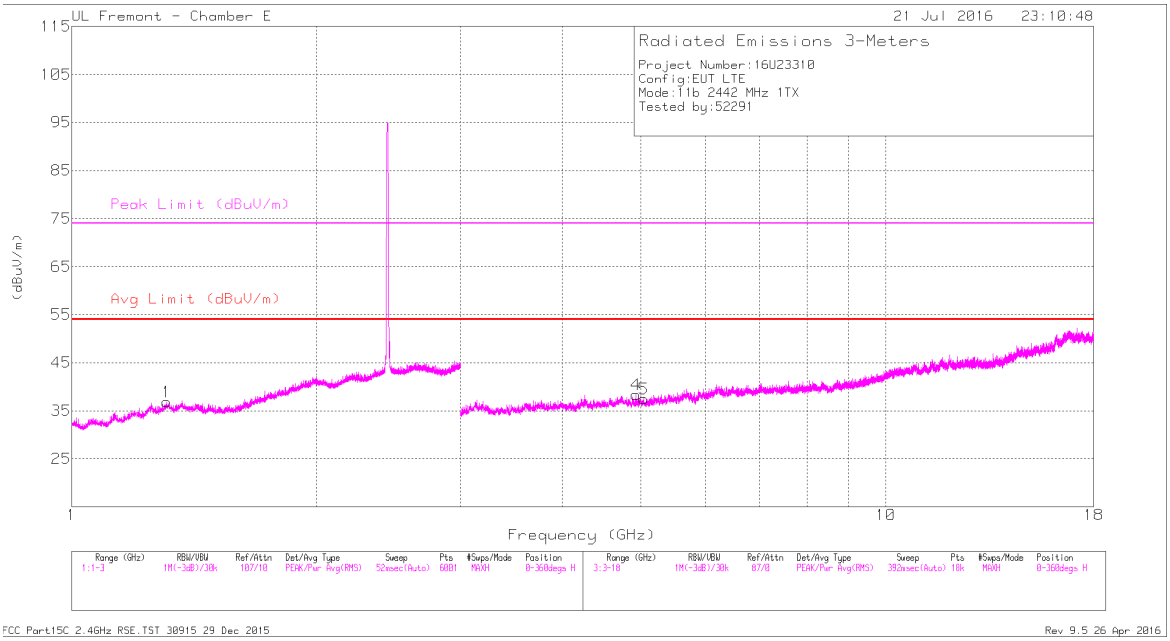
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (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	* 1.075	30.49	Pk	27.6	-23.9	34.19	-	-	74	-39.81	0-360	200	H
2	* 1.259	30.28	Pk	29	-22.7	36.58	-	-	74	-37.42	0-360	100	V
3	* 4.063	34.38	Pk	33.3	-30.8	36.88	-	-	74	-37.12	0-360	200	H
4	* 4.944	39.53	Pk	34	-30.5	43.03	-	-	74	-30.97	0-360	200	V
5	* 11.161	31.24	Pk	38.1	-23.2	46.14	-	-	74	-27.86	0-360	200	V

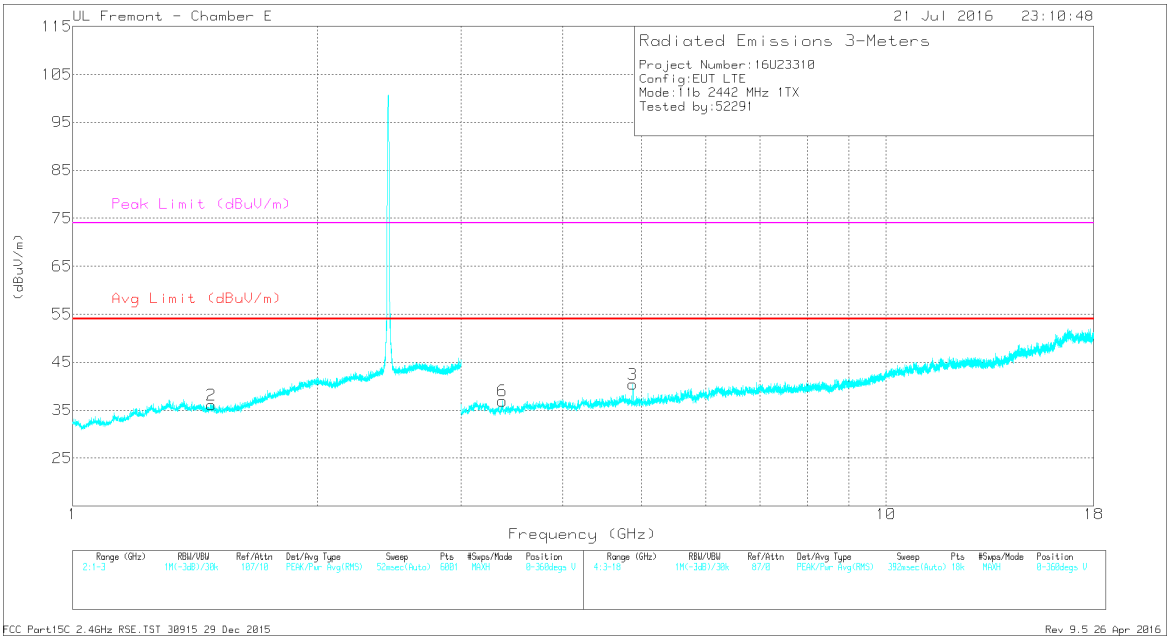
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS MID CHANNEL,

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



DATA

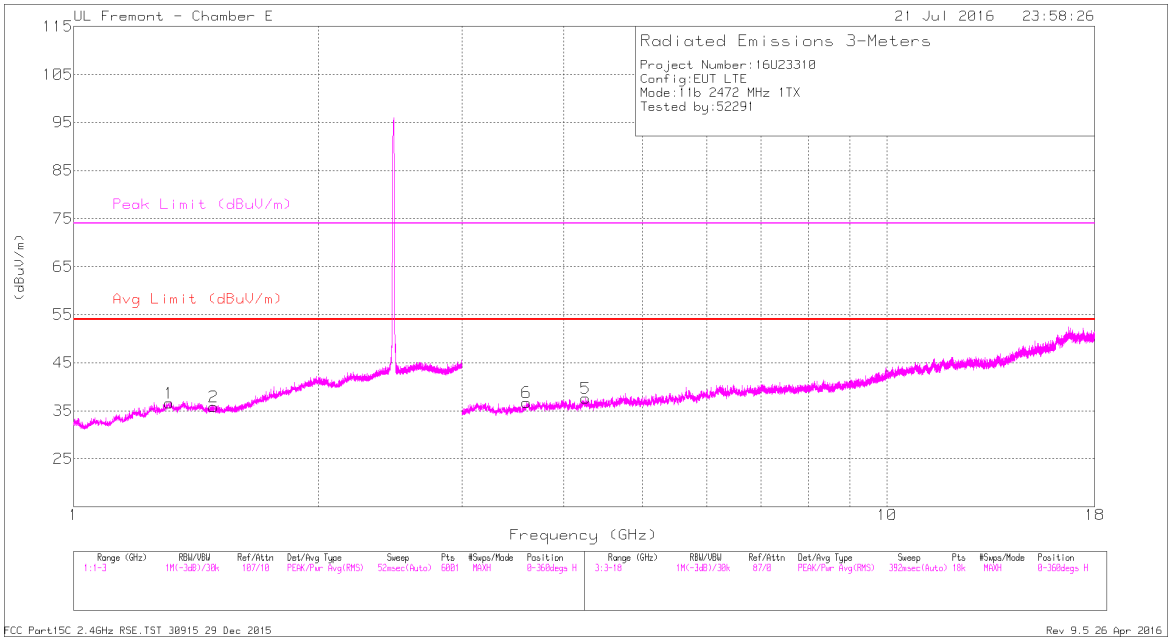
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.309	30	Pk	29.3	-22.4	0	36.9	-	-	74	-37.1	0-360	100	H
2	* 1.481	29.65	Pk	28	-21.6	0	36.05	-	-	74	-37.95	0-360	200	V
4	* 4.934	34.94	Pk	34	-30.6	0	38.34	-	-	74	-35.66	0-360	100	H
5	* 5.045	33.25	Pk	34	-29.8	0	37.45	-	-	74	-36.55	0-360	199	H
3	* 4.884	36.69	Pk	34	-30.3	0	40.39	-	-	74	-33.61	0-360	199	V
6	3.373	34.71	Pk	32.8	-30.6	0	36.91	-	-	-	-	0-360	199	V

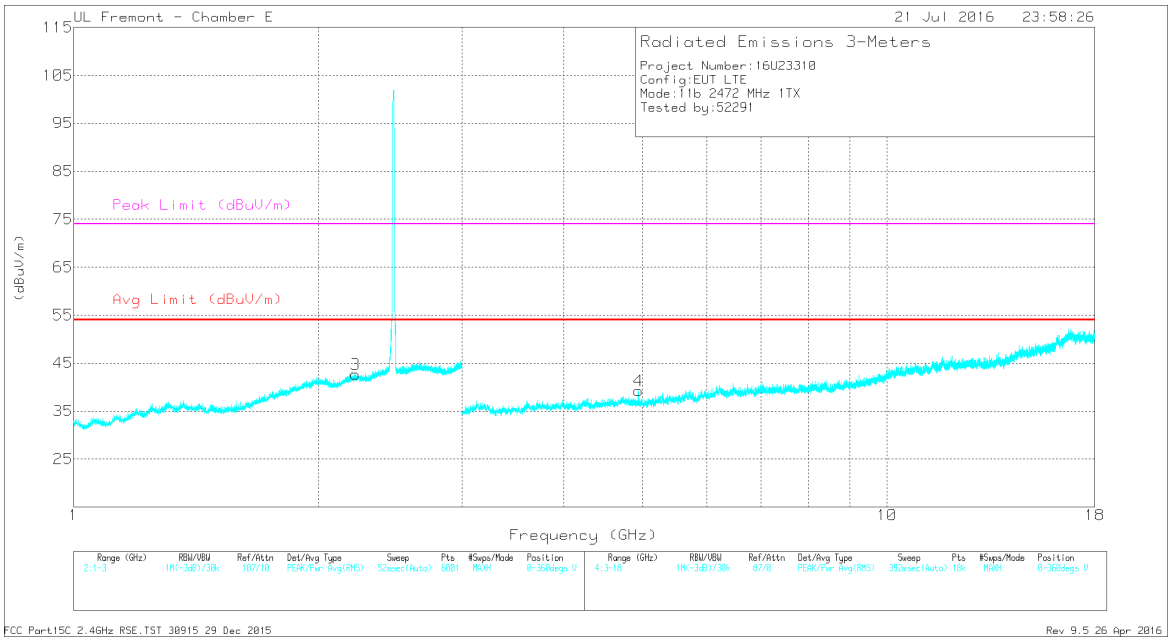
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

HARMONICS AND SPURIOUS EMISSIONS HIGH CHANNEL

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



DATA

Trace Markers

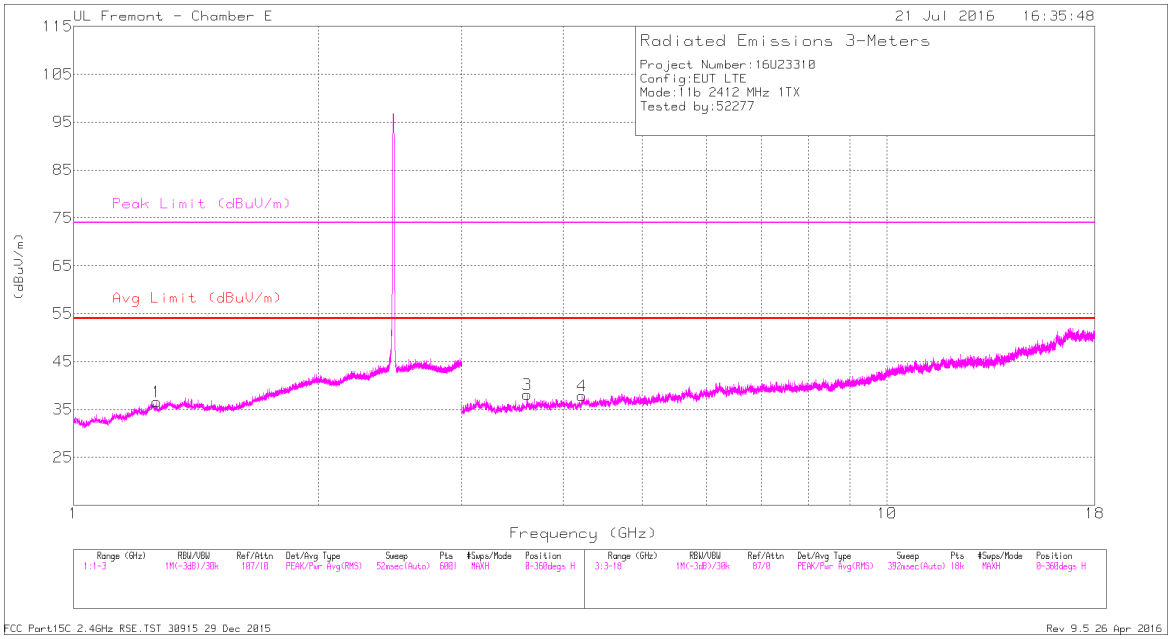
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.311	29.64	Pk	29.3	-22.4	0	36.54	-	-	74	-37.46	0-360	100	H
2	* 1.485	29.47	Pk	27.9	-21.6	0	35.77	-	-	74	-38.23	0-360	200	H
3	* 2.221	31.03	Pk	31.8	-20.1	0	42.73	-	-	74	-31.27	0-360	100	V
5	* 4.259	33.27	Pk	33.3	-29	0	37.57	-	-	74	-36.43	0-360	100	H
6	* 3.605	34.33	Pk	33	-30.6	0	36.73	-	-	74	-37.27	0-360	100	H
4	* 4.944	35.7	Pk	34	-30.5	0	39.2	-	-	74	-34.8	0-360	200	V

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

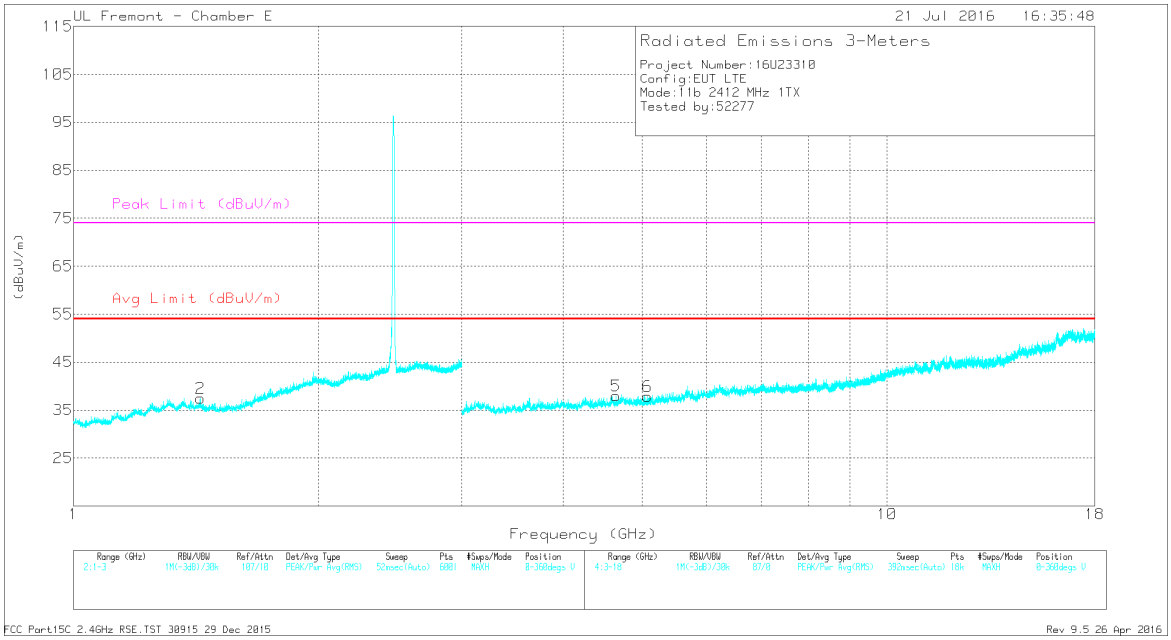
8.2.2. 802.11b 1Tx MODE IN THE 2.4 GHz BAND CHAIN 1

HARMONICS AND SPURIOUS EMISSIONS LOW CHANNEL

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (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	* 1.266	30.23	Pk	29.1	-22.7	36.63	-	-	74	-37.37	0-360	200	H
3	* 3.612	35.66	Pk	33	-30.5	38.16	-	-	74	-35.84	0-360	200	H
4	* 4.216	33.72	Pk	33.3	-29.2	37.82	-	-	74	-36.18	0-360	200	H
5	* 4.644	34.63	Pk	33.9	-30.6	37.93	-	-	74	-36.07	0-360	200	V
6	* 5.079	33.53	Pk	34	-29.7	37.83	-	-	74	-36.17	0-360	100	V
2	1.432	30.66	Pk	28.6	-21.8	37.46	-	-	-	-	0-360	200	V

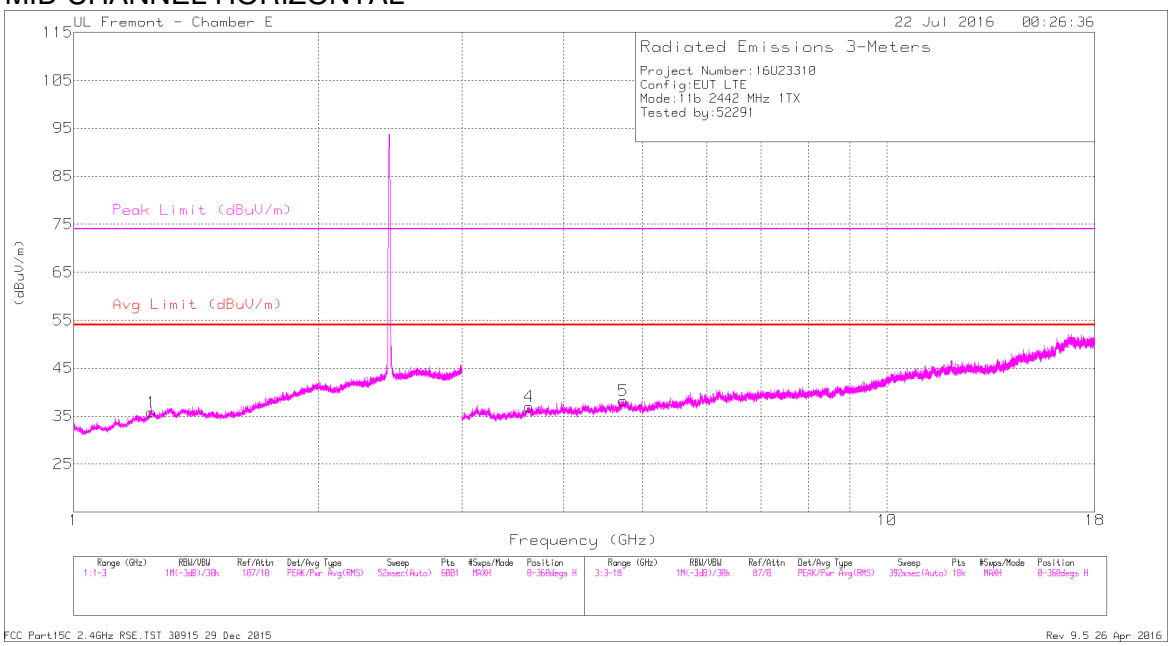
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

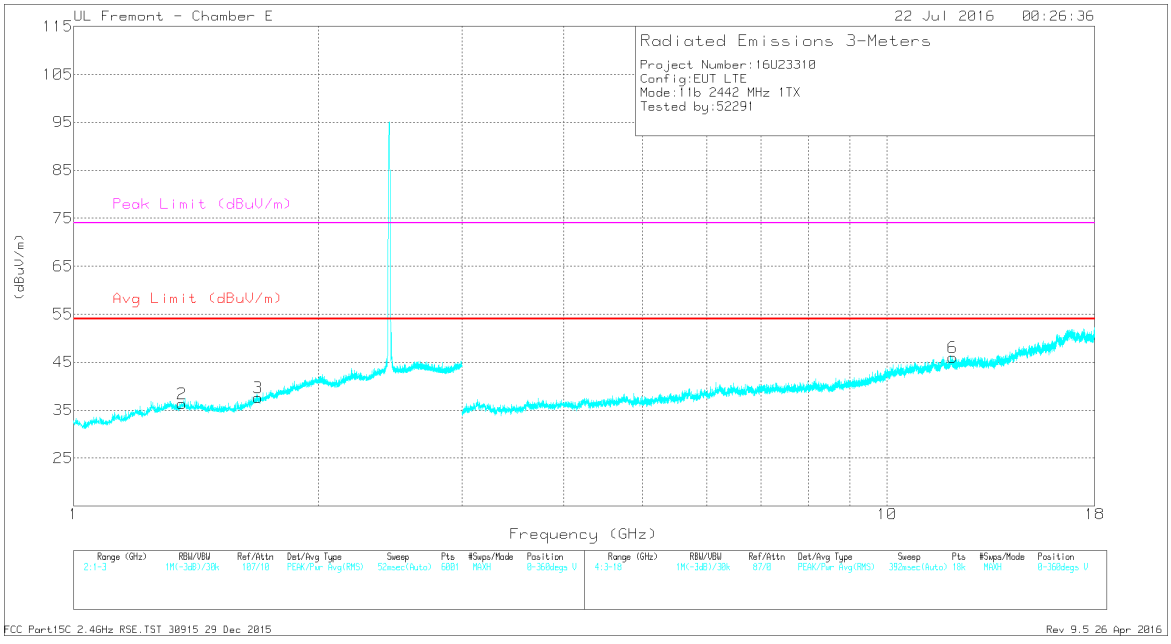
FCC Part15C 2.4GHz RSE.TST 30915 29 Dec 2015
Rev 9.5 26 Apr 2016

HARMONICS AND SPURIOUS EMISSIONS MID CHANNEL

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



DATA

Trace Markers

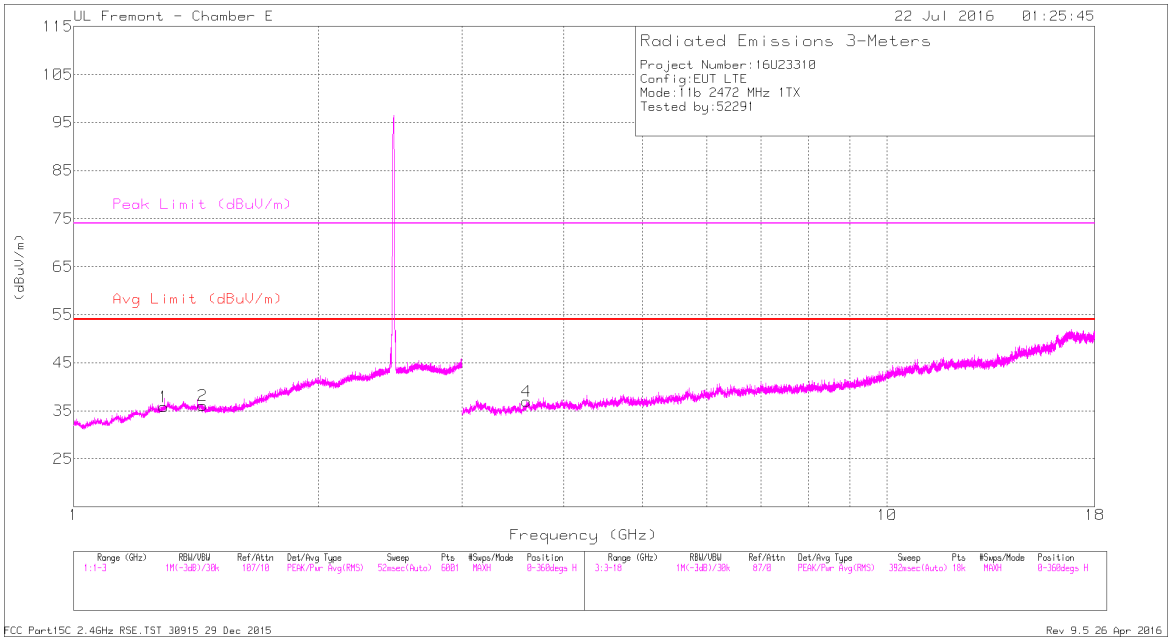
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.247	29.46	Pk	28.9	-22.5	0	35.86	-	-	74	-38.14	0-360	200	H
2	* 1.359	29.28	Pk	29.2	-22.1	0	36.38	-	-	74	-37.62	0-360	100	V
3	* 1.686	29.72	Pk	29	-21.1	0	37.62	-	-	74	-36.38	0-360	200	V
4	* 3.627	34.43	Pk	33	-30.4	0	37.03	-	-	74	-36.97	0-360	100	H
5	* 4.742	33.38	Pk	34	-29.1	0	38.28	-	-	74	-35.72	0-360	100	H
6	* 12.04	31.18	Pk	38.9	-24.1	0	45.98	-	-	74	-28.02	0-360	200	V

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

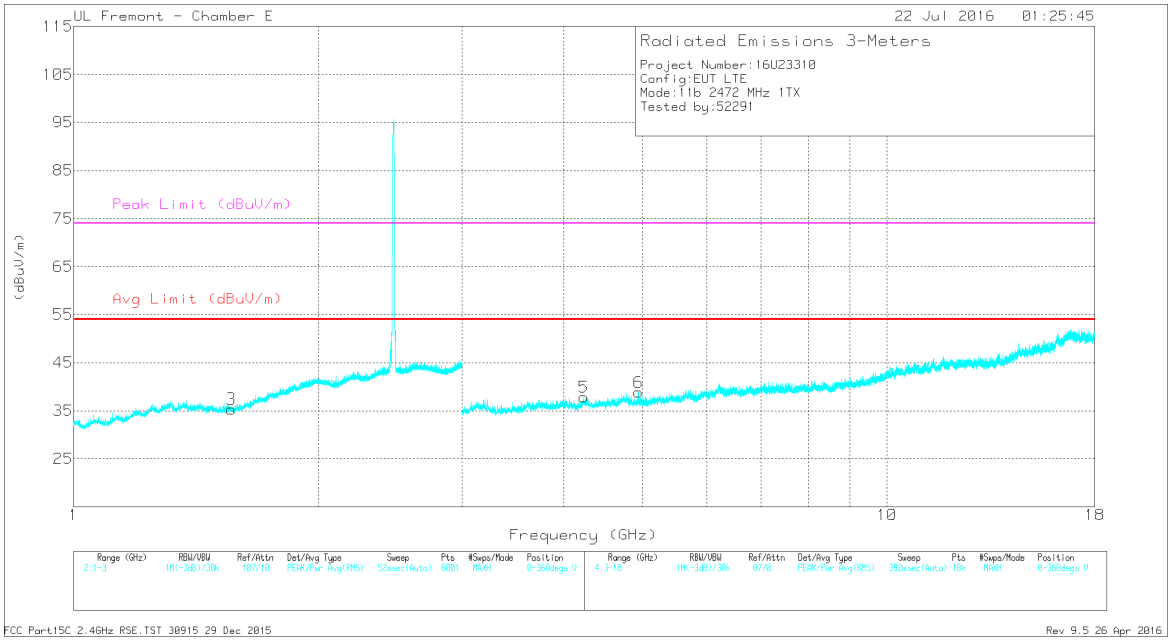
Pk - Peak detecto

HARMONICS AND SPURIOUS EMISSIONS HIGH CHANNEL

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



DATA

Trace Markers

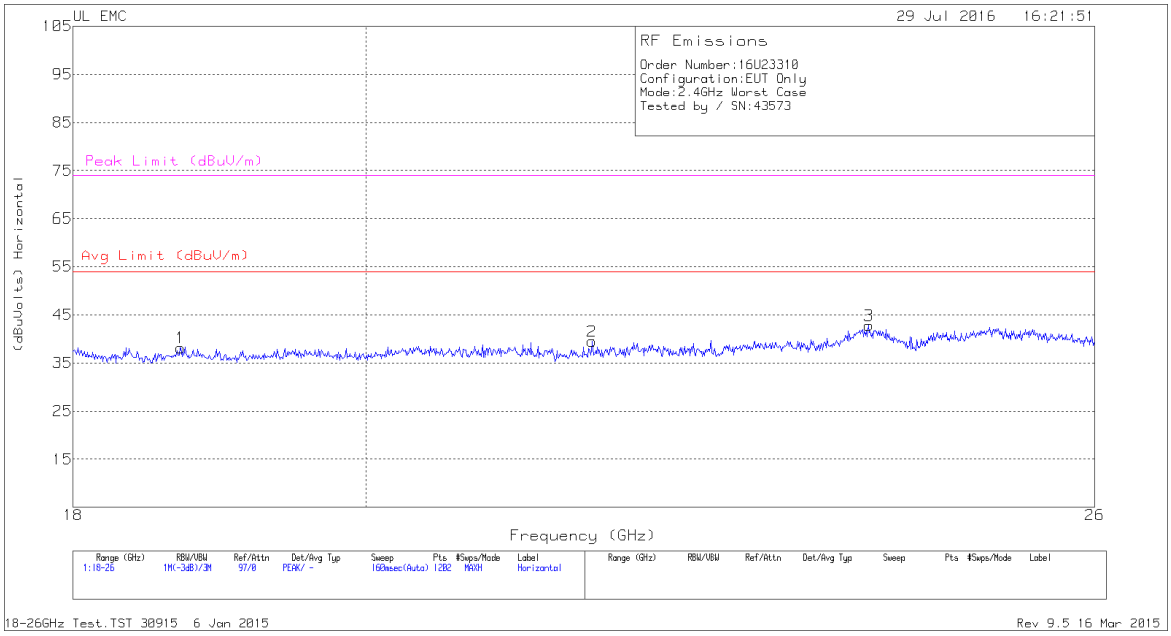
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T711 (dB/m)	Amp/Cbl /Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.291	28.98	Pk	29.3	-22.5	35.78	-	-	74	-38.22	0-360	200	H
2	* 1.44	29.32	Pk	28.5	-21.7	36.12	-	-	74	-37.88	0-360	200	H
3	* 1.561	29.08	Pk	27.8	-21.5	35.38	-	-	74	-38.62	0-360	200	V
4	* 3.603	34.72	Pk	33	-30.7	37.02	-	-	74	-36.98	0-360	200	H
5	* 4.235	33.55	Pk	33.3	-29	37.85	-	-	74	-36.15	0-360	100	V
6	* 4.944	35.42	Pk	34	-30.5	38.92	-	-	74	-35.08	0-360	200	V

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

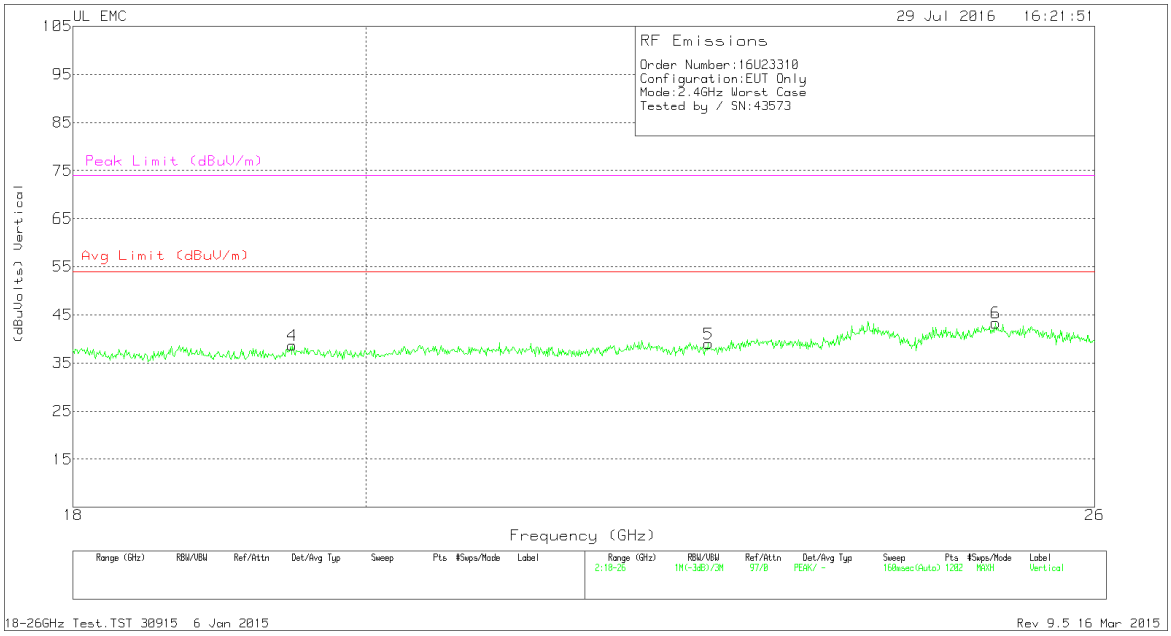
8.3. WORST-CASE 18 to 26 GHz

SPURIOUS EMISSIONS 18 to 26 GHz

HORIZONTAL



VERTICAL



DATA

Trace Markers

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	18.709	39.67	Pk	32.4	-24.4	-9.5	38.17	54	-15.83	74	-35.83
2	21.697	40.4	Pk	33.2	-24.6	-9.5	39.5	54	-14.5	74	-34.5
3	23.968	42.53	Pk	34	-24.2	-9.5	42.83	54	-11.17	74	-31.17
4	19.479	40.47	Pk	32.7	-25	-9.5	38. 67	54	-15.33	74	-35.33
5	22.623	40.1	Pk	33.4	-25	-9.5	39	54	-15	74	-35
6	25.087	43.03	Pk	34.3	-24.5	-9.5	43.33	54	-10.67	74	-30.67

Pk - Peak detector

Class B 18-26GHz.TST 30915 14 Aug 2014

Rev 9.5 16 Mar 2015