



CERTIFICATION TEST REPORT

Report Number. : 12901678 - E11V2

Applicant : APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA. 95014, U.S.A.

Model : A2161, A2219, AND A2220

FCC ID : BCG-E3306A

IC : 579C-E3306A

EUT Description : SMARTPHONE

Test Standard(s) : FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 9

Date Of Issue:
AUGUST 22, 2019

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	08/16/2019	Initial Issue	Chin Pang
V2	08/22/2019	Addressed TCB Feedback for section 5 and 11 and 5.3	Tony Li

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>7</i>
5. EQUIPMENT UNDER TEST	8
5.1. <i>DESCRIPTION OF EUT</i>	<i>8</i>
5.2. <i>DIFFERENCE IN MODEL NUMBER.....</i>	<i>8</i>
5.3. <i>MAXIMUM OUTPUT POWER.....</i>	<i>8</i>
5.4. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>9</i>
5.5. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>10</i>
6. TEST AND MEASUREMENT EQUIPMENT	13
7. OCCUPIED BANDWIDTH	14
7.1. <i>CE MODE.....</i>	<i>15</i>
7.2. <i>READER MODE</i>	<i>16</i>
8. RADIATED EMISSION TEST RESULTS.....	17
8.1. <i>LIMITS AND PROCEDURE</i>	<i>17</i>
8.2. <i>FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 - 30 MHz), EUT WITH AC/DC ADAPTER</i>	<i>19</i>
8.2.1. <i>CE MODE.....</i>	<i>19</i>
8.2.2. <i>READER MODE</i>	<i>21</i>
8.3. <i>TX SPURIOUS EMISSION 30 TO 1000 MHz, EUT WITH AC/DC ADAPTER.....</i>	<i>24</i>
8.3.1. <i>CE MODE</i>	<i>24</i>
8.3.2. <i>READER MODE</i>	<i>26</i>
9. FREQUENCY STABILITY	28
9.1. <i>CE MODE.....</i>	<i>29</i>
9.2. <i>READER MODE</i>	<i>29</i>
10. AC MAINS LINE CONDUCTED EMISSIONS	30
10.1. <i>CE MODE</i>	<i>31</i>
10.1.1. <i>NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps.....</i>	<i>31</i>
10.1.2. <i>NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps</i>	<i>33</i>

10.2. READER MODE.....	35
10.2.1. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps.....	35
10.2.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps	
37	
11. SETUP PHOTOS	39

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 APPLE PARK WAY
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: SMARTPHONE

MODEL: A2161, A2219, AND A2220

SERIAL NUMBER: G6TYW034N395

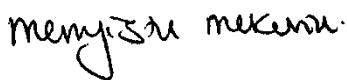
DATE TESTED: JUNE 01, 2019 – JUNE 22, 2019

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	Complies
ISED RSS-210 Issue 9, Annex B	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. 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:



Mengistu Mekuria
Senior Test Engineer
UL VERIFICATION SERVICES INC.

Prepared By:



Tony Wang
LAB ENGINEER
UL VERIFICATION SERVICES INC.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5, and RSS-210 Issue 9.

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
<input type="checkbox"/> Chamber A (ISED:2324B-1)	<input type="checkbox"/> Chamber D (ISED:22541-1)
<input checked="" type="checkbox"/> Chamber B (ISED:2324B-2)	<input type="checkbox"/> Chamber E (ISED:22541-2)
<input type="checkbox"/> Chamber C (ISED:2324B-3)	<input type="checkbox"/> Chamber F (ISED:22541-3)
	<input type="checkbox"/> Chamber G (ISED:22541-4)
	<input type="checkbox"/> Chamber H (ISED:22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through C are covered under ISED company address code 2324B with site numbers 2324B -1 through 2324B-3, respectively. Chambers D through H are covered under ISED Canada company address code 22541 with site numbers 22541 -1 through 22541-5, respectively.

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at [NVLAP Lab Search](#).

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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

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%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a smartphone with multimedia functions (music, application support, and video), cellular GSM, GPRS, EGPRS, UMTS, LTE, TD-SCDMA, CDMA, IEEE 802.11a/b/g/n/ac/ax, Bluetooth, Ultra-Wide band, GPS and NFC. All models support at least one UICC based SIM. The second SIM, if present, is either UICC based pSIM (physical SIM) or e-SIM (electronic SIM). The device has a built-in inductive charging receiver. The rechargeable battery is also not user accessible

5.2. DIFFERENCE IN MODEL NUMBER

Model A2161, A2219 and A2220 is electrically identical to Model A2161. Three model numbers are allocated for marketing and logistic purposes only. A2161 was used to perform all final tests.

5.3. MAXIMUM FIELD STRENGTH

The transmitter has a maximum peak radiated field strength as follows:

Frequency Range (MHz)	Mode		Kbps	E Field at 30m distance (dBuV/m)
13.56	Type B	CE	848	19.00
		Reader	848	21.05

5.4. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated under three orthogonal orientations X (Flatbed), Y (Landscape), and Z (Portrait). The Y (Landscape) orientation was determined to be the worst-case orientation for CE mode and Z (.Portrait) orientation was the worst case for reader mode.

The worst case position of the EUT was investigated under two configurations: EUT with power supply, EUT with earphones. The EUT with power supply configuration was determined to be worst-case configurations; therefore, all final tests were performed on the EUT with power supply.

In addition, Type A, B and F with CE mode and Reader mode data rates and ISO 15693 were investigated to determine the worst case based on the highest power and spurious emissions. Type B was determined to be the worst case and therefore Type B was selected for all final tests.

For below 30MHz testing, investigation was done on three antenna orientations: RX antenna Face-on, Face-off and horizontal (parallel to ground). The worst-case configurations were determined on RX antenna Face-on and Face-off; therefore, all final tests were performed using these two orientations.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
laptop	Apple	Macbook Pro	C02V90P8G8WL	QDS-BRCM1069
Laptop AC/DC adapter	Liteon Technology	PA-1450-BA1	B123	NA
EUT AC Adapter	Apple	A1385	D292365CDYADHLHC3	NA

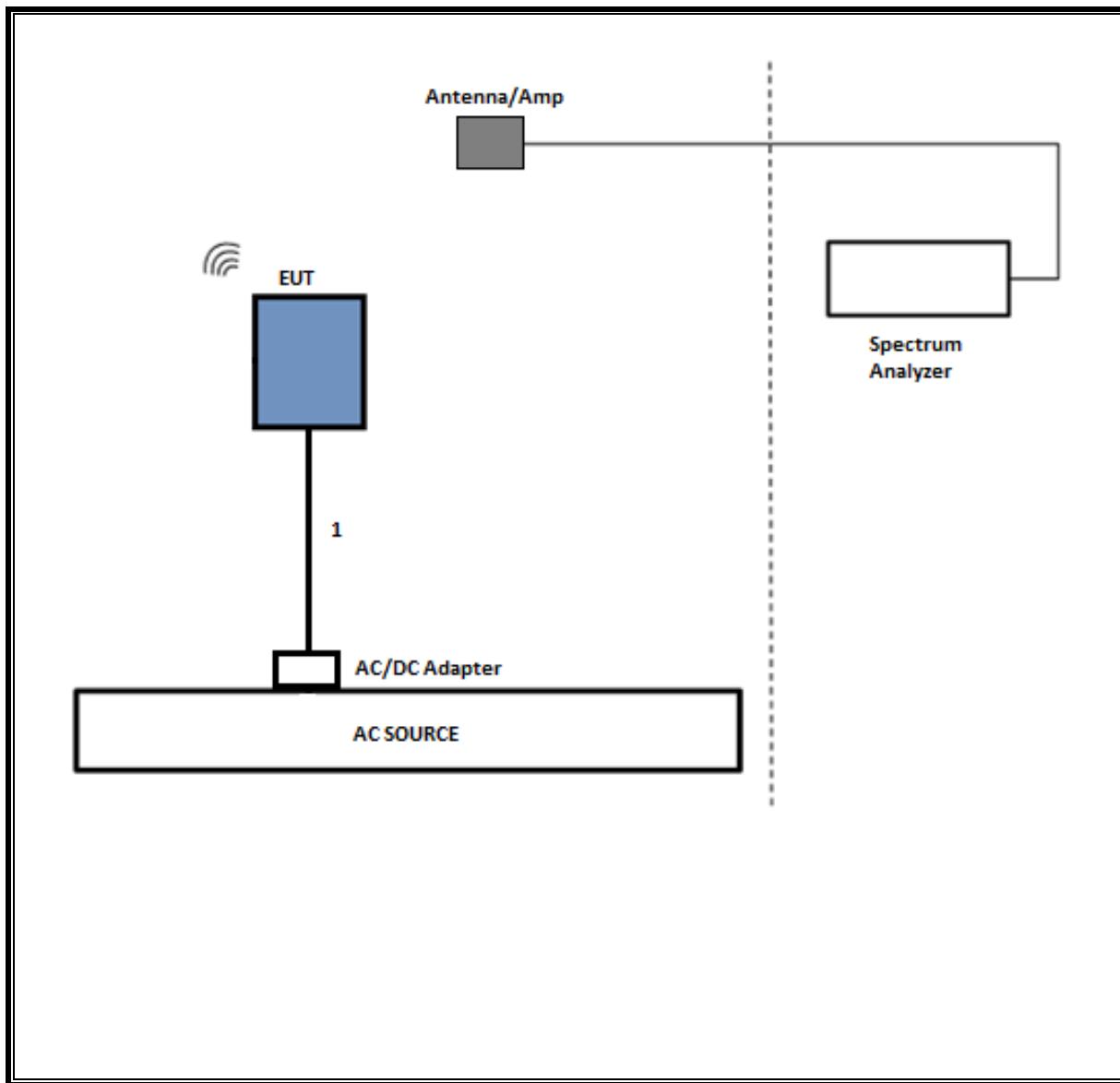
I/O CABLES

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	N/A

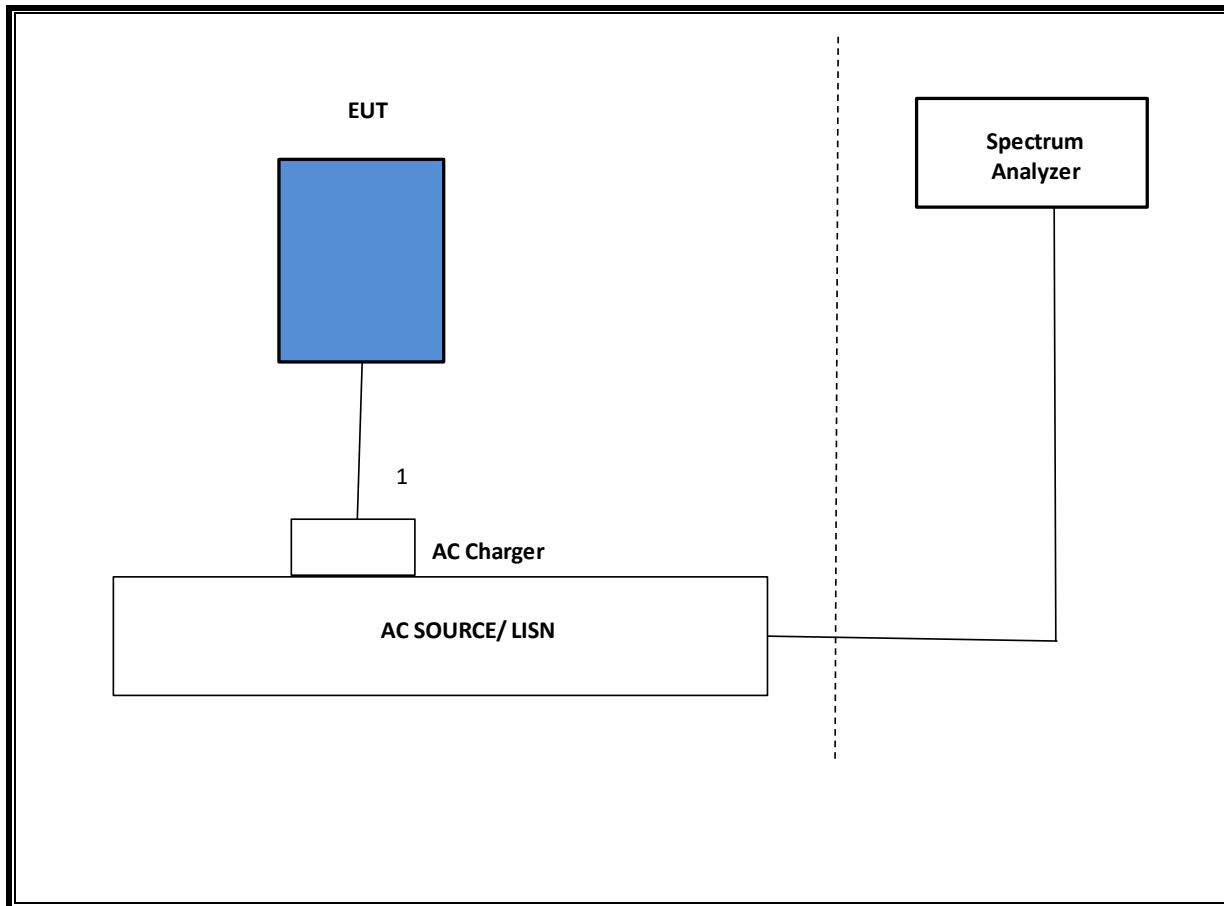
TEST SETUP

The EUT is installed in a host laptop computer during the tests. Test software exercised the EUT.

SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR LINE CONDUCTED TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

Description	Manufacturer	Model	ID Num	Cal Due
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	T243	02/13/2020
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T286	06/06/2020
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T905	01/24/2020
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	T754	08/15/2019
Antenna, Active Loop 9KHz to 30MHz	EMCO	6502	T35	06/06/2020
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T1450	01/23/2020
AC Line Conducted				
EMI Test Receiver 9Khz-7GHz	Rohde & Schwarz	ESCI7	T1436	02/14/2020
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2019
*LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/19/2019
UL AUTOMATION SOFTWARE				
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016	
Conducted Software	UL	UL EMC	Ver 5.4, October 13, 2016	
AC Line Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015	

*Testing is completed before equipment expiration date.

7. OCCUPIED BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Type A with highest data rate. The transmitter output is connected to the spectrum analyzer. The RBW is set to 10kHz. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

Note: Because the measured signal is CW or CW-like adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW

RESULTS

99% and 20dB BW

CE MODE

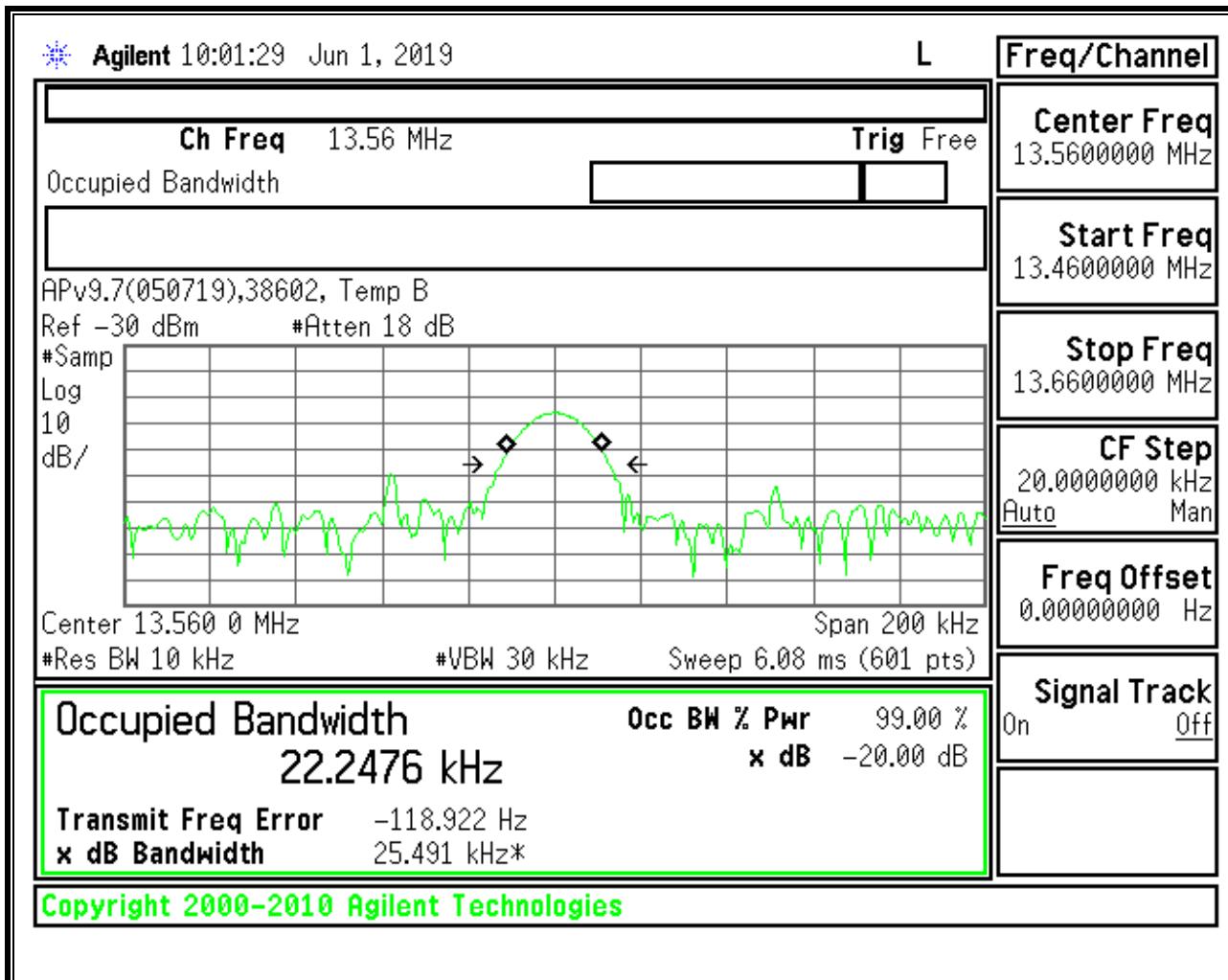
Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	22.2476	25.491

READER MODE

Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.9784	25.589

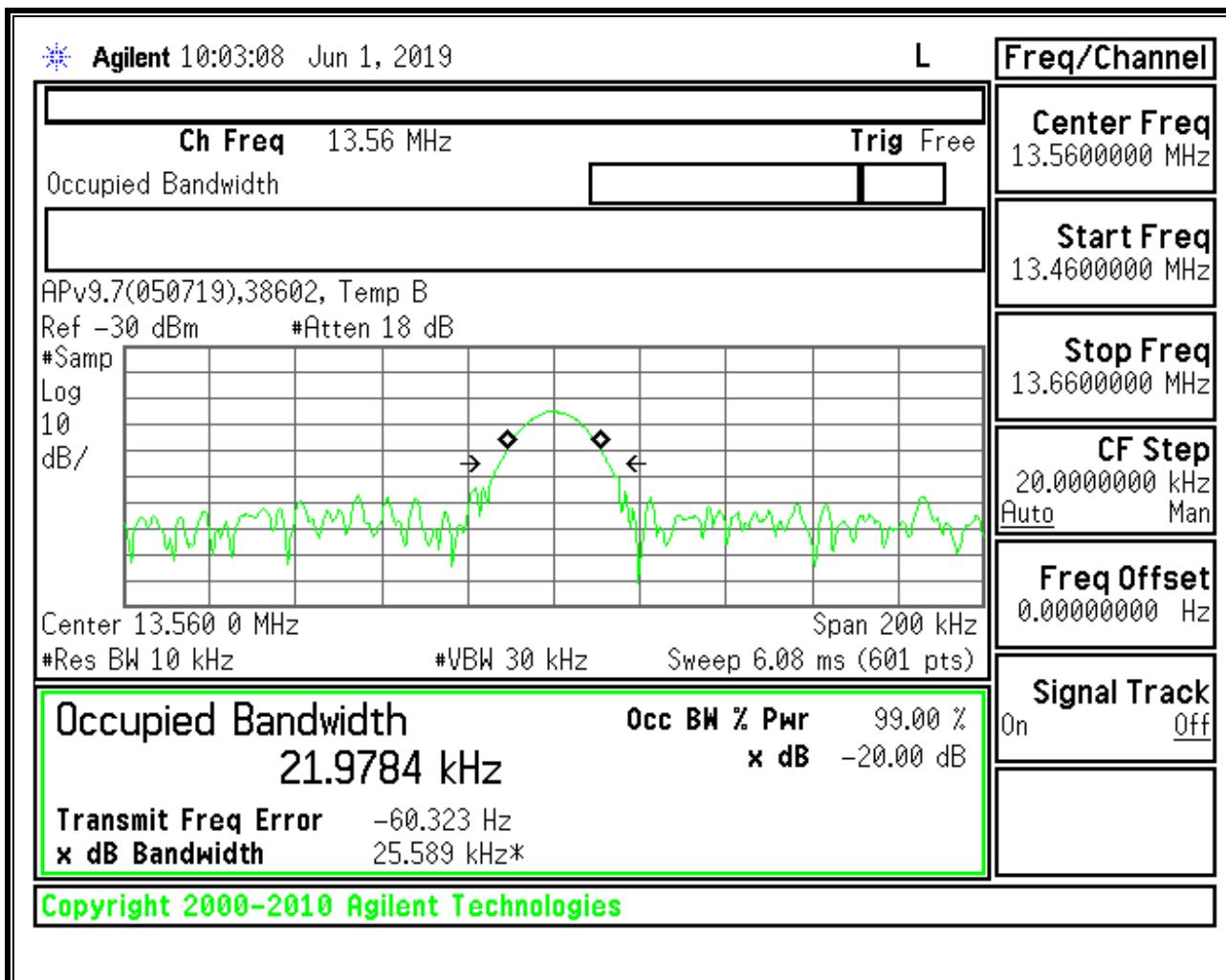
7.1. CE MODE

848Kbps



7.2. READER MODE

848Kbps



8. RADIATED EMISSION TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMIT

§15.225

IC RSS-210, Annex B.6

IC RSS-GEN, Section 8.9 (Transmitter)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/ meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz and shall not exceed the general radiated emission limits in § 15.209 as follows:

§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (μ V/m)	Measurement Distance (m)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100**	3
88 - 216	150**	3
216 – 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

Formula for converting the field strength from uV/m to dBuV/m is:

Limit (dBuV/m) = 20 log limit (uV/m)

In addition:

§15.209 (d) The emission limits shown the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

§15.209 (d) The provisions in §§ 15.225, measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

TEST PROCEDURE

ANSI C63.10, 2013

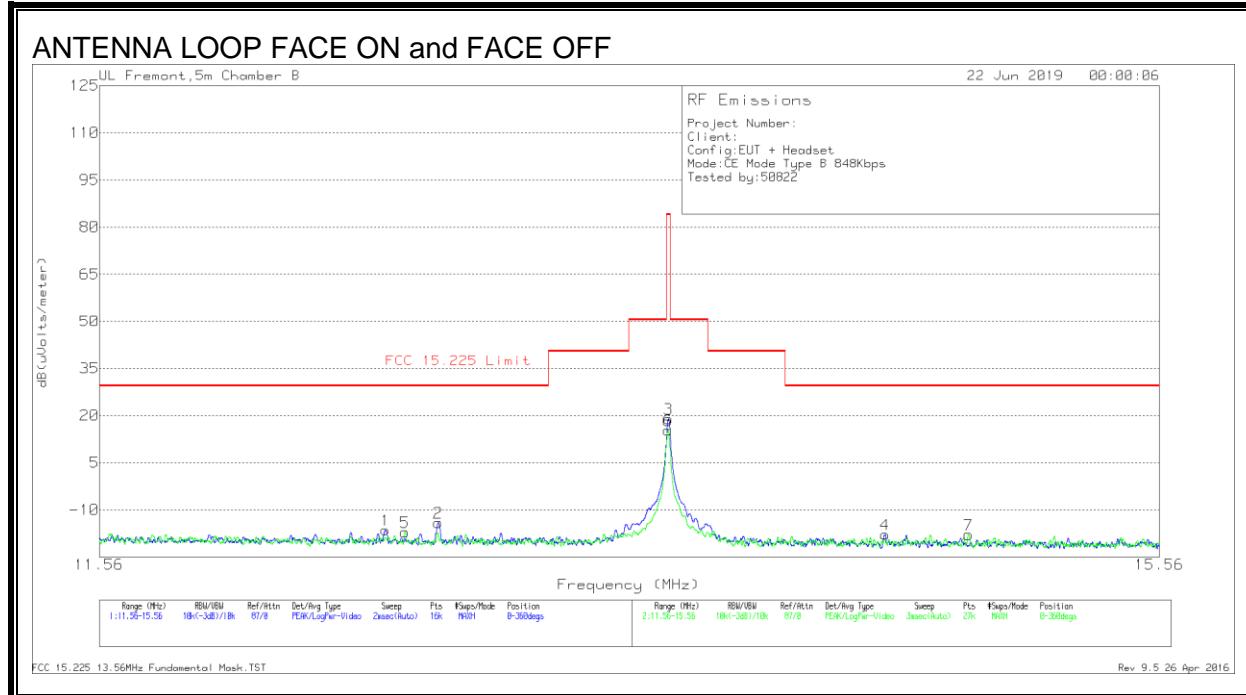
The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 13.56 MHz; therefore, the frequency range was investigated from 0.15 MHz to the 10th harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater.

RESULTS

8.2. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 - 30 MHz), EUT WITH AC/DC ADAPTER

8.2.1. CE MODE

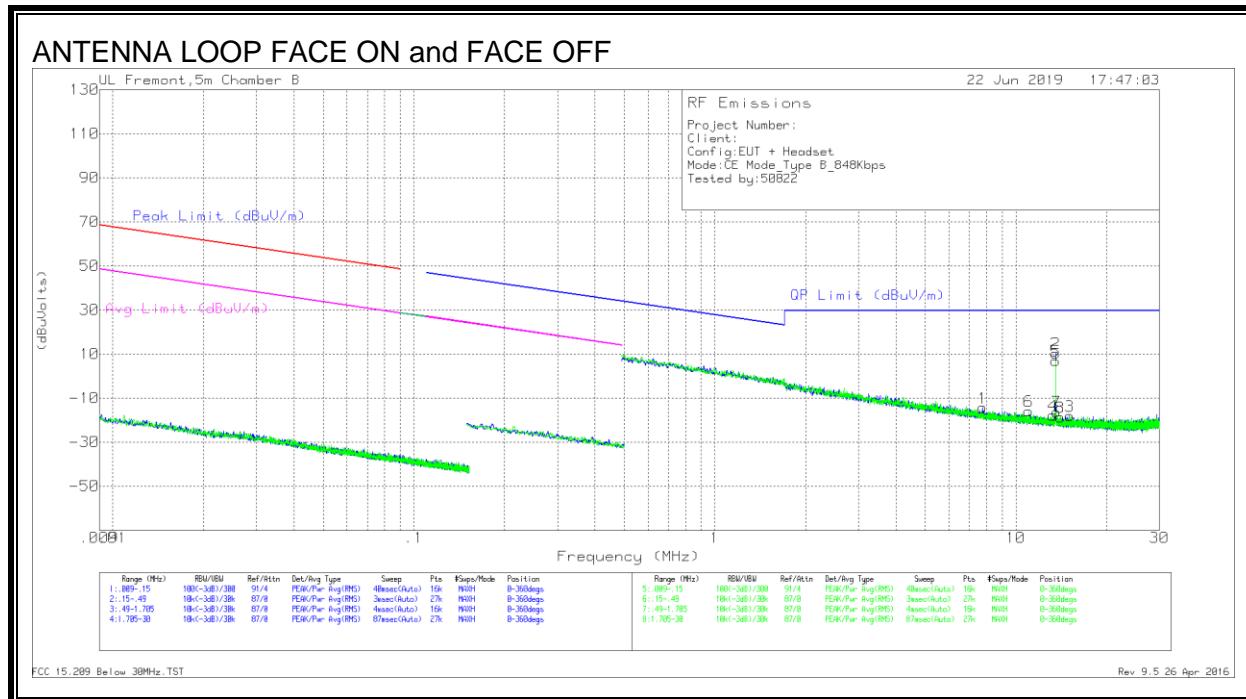
FUNDAMENTAL 848Kbps



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	PK Margin (dB)	Azimuth (Degs)
1	12.52588	12.41	Pk	10.7	.5	-40	-16.39	29.54	-45.93	0-360
5	12.59474	11.72	Pk	10.7	.5	-40	-17.08	29.54	-46.62	0-360
2	12.71263	14.78	Pk	10.7	.5	-40	-14.02	29.54	-43.56	0-360
6	13.55822	44.24	Pk	10.6	.5	-40	15.34	84	-68.66	0-360
3	13.56025	47.9	Pk	10.6	.5	-40	19	84	-65	0-360
4	14.40838	11.09	Pk	10.6	.5	-40	-17.81	29.54	-47.35	0-360
7	14.74903	11.15	Pk	10.5	.5	-40	-17.85	29.54	-47.39	0-360

Pk - Peak detector

SPURIOUS EMISSION 848Kbps



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolt s)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	7.75458	14.24	Pk	10.9	.4	-40	-14.46	29.5	-43.96	0-360
6	11.02906	12.77	Pk	10.8	.4	-40	-16.03	29.5	-45.53	0-360
4	13.28226	10.78	Pk	10.8	.5	-40	-17.92	29.5	-47.42	0-360
2	13.5605	39.08	Pk	10.7	.5	-40	10.28	29.5	-19.22	0-360
5	13.5605	35.68	Pk	10.7	.5	-40	6.88	29.5	-22.62	0-360
7	13.64067	12.54	Pk	10.7	.5	-40	-16.26	29.5	-45.76	0-360
8	14.0583	10.11	Pk	10.7	.5	-40	-18.69	29.5	-48.19	0-360
3	15.09949	10.54	Pk	10.8	.5	-40	-18.16	29.5	-47.66	0-360

Pk - Peak detector

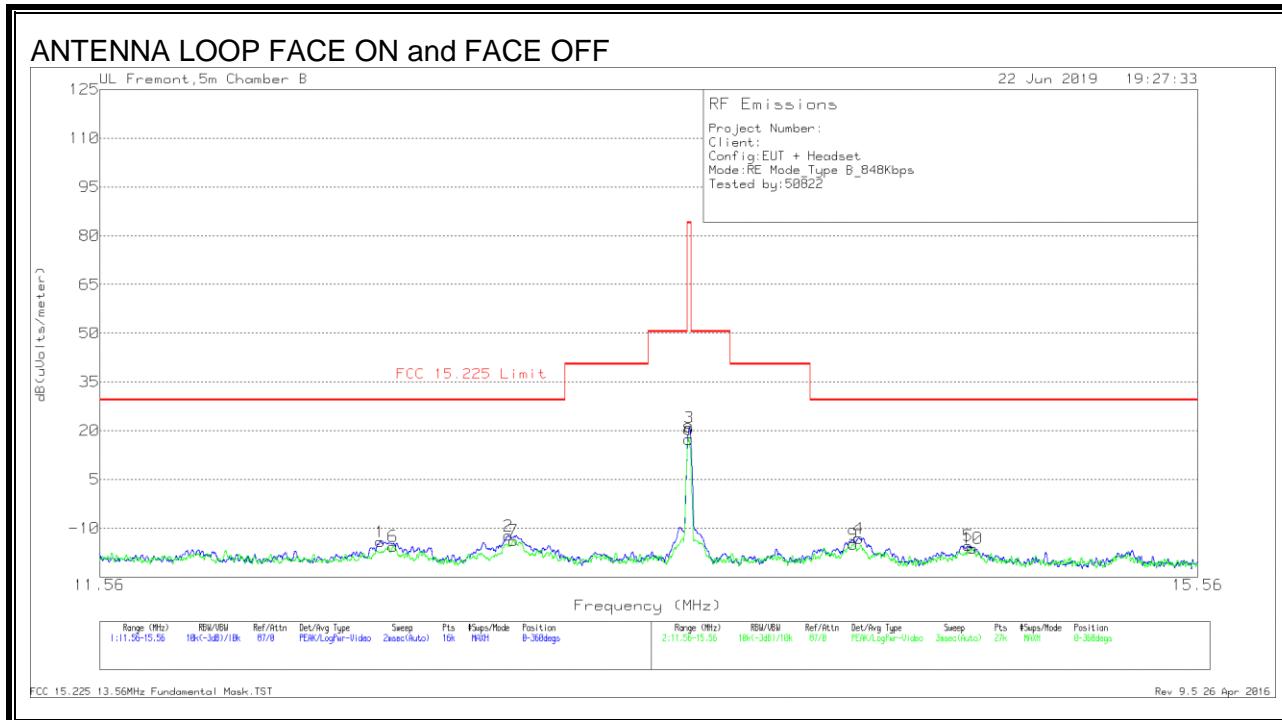
FCC 15.209 Below 30MHz.TST 30915 28 Apr 2017

Rev 9.5 01 Dec 2016

Note: Marker 1 and 5 are the fundamental signal.

8.2.2. READER MODE

FUNDAMENTAL 848Kbps



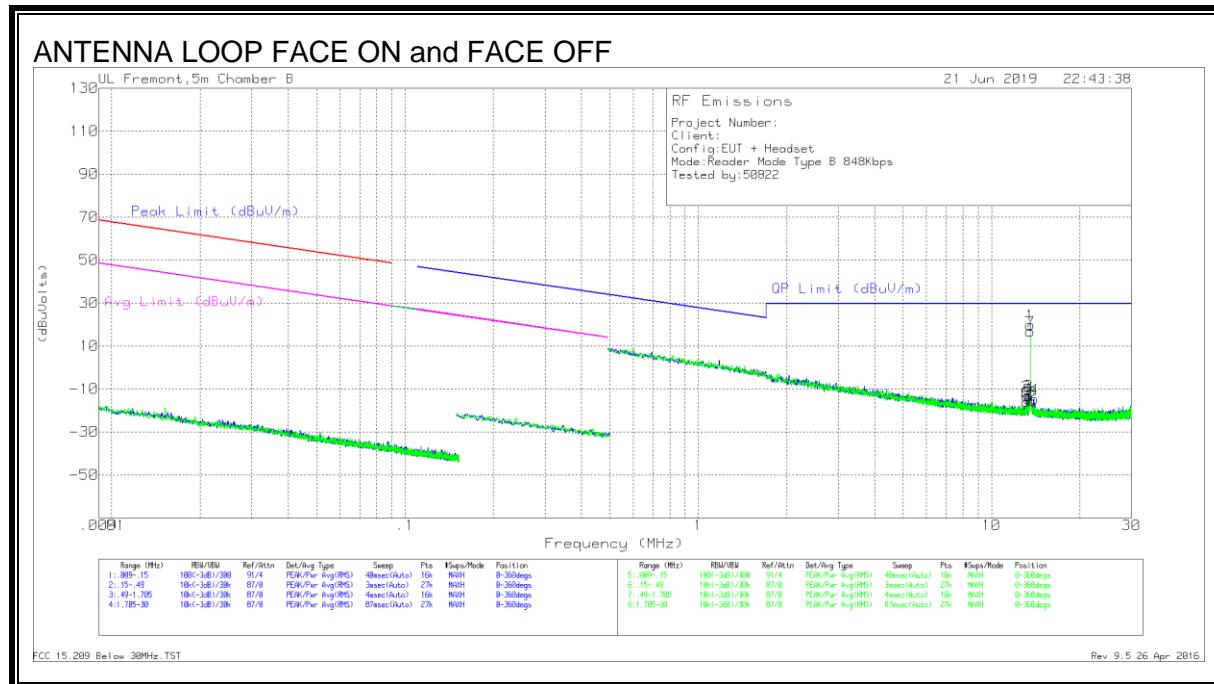
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	PK Margin (dB)	Azimuth (Degs)
1	12.47263	14.6	Pk	10.8	.5	-40	-14.1	29.54	-43.64	0-360
6	12.51571	13.23	Pk	10.7	.5	-40	-15.57	29.54	-45.11	0-360
2	12.91263	16.59	Pk	10.7	.5	-40	-12.21	29.54	-41.75	0-360
7	12.93011	15.03	Pk	10.7	.5	-40	-13.77	29.54	-43.31	0-360
8	13.55822	46.31	Pk	10.6	.5	-40	17.41	84	-66.59	0-360
3	13.56025	49.95	Pk	10.6	.5	-40	21.05	84	-62.95	0-360
9	14.17464	14.04	Pk	10.6	.5	-40	-14.86	29.54	-44.4	0-360
4	14.19613	15.86	Pk	10.6	.5	-40	-13.04	29.54	-42.58	0-360
5	14.62288	13.66	Pk	10.5	.5	-40	-15.34	29.54	-44.88	0-360
10	14.63981	12.9	Pk	10.5	.5	-40	-16.1	29.54	-45.64	0-360

Pk - Peak detector

FCC 15.225 13.56MHz Fundamental Mask.TST

Rev 9.5 26 Apr 2016

SPURIOUS EMISSION 848Kbps



Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
6	13.13658	12.68	Pk	10.8	.5	-40	-16.02	29.5	-45.52	0-360
2	13.1392	15.24	Pk	10.8	.5	-40	-13.46	29.5	-42.96	0-360
5	13.40435	13.86	Pk	10.8	.5	-40	-14.84	29.5	-44.34	0-360
3	13.40697	15.71	Pk	10.8	.5	-40	-12.99	29.5	-42.49	0-360
1	13.55788	48.7	Pk	10.7	.5	-40	19.9	29.5	-9.6	0-360
7	13.5605	45.55	Pk	10.7	.5	-40	16.75	29.5	-12.75	0-360
8	13.7156	13.02	Pk	10.7	.5	-40	-15.78	29.5	-45.28	0-360
4	13.98494	14.06	Pk	10.7	.5	-40	-14.74	29.5	-44.24	0-360

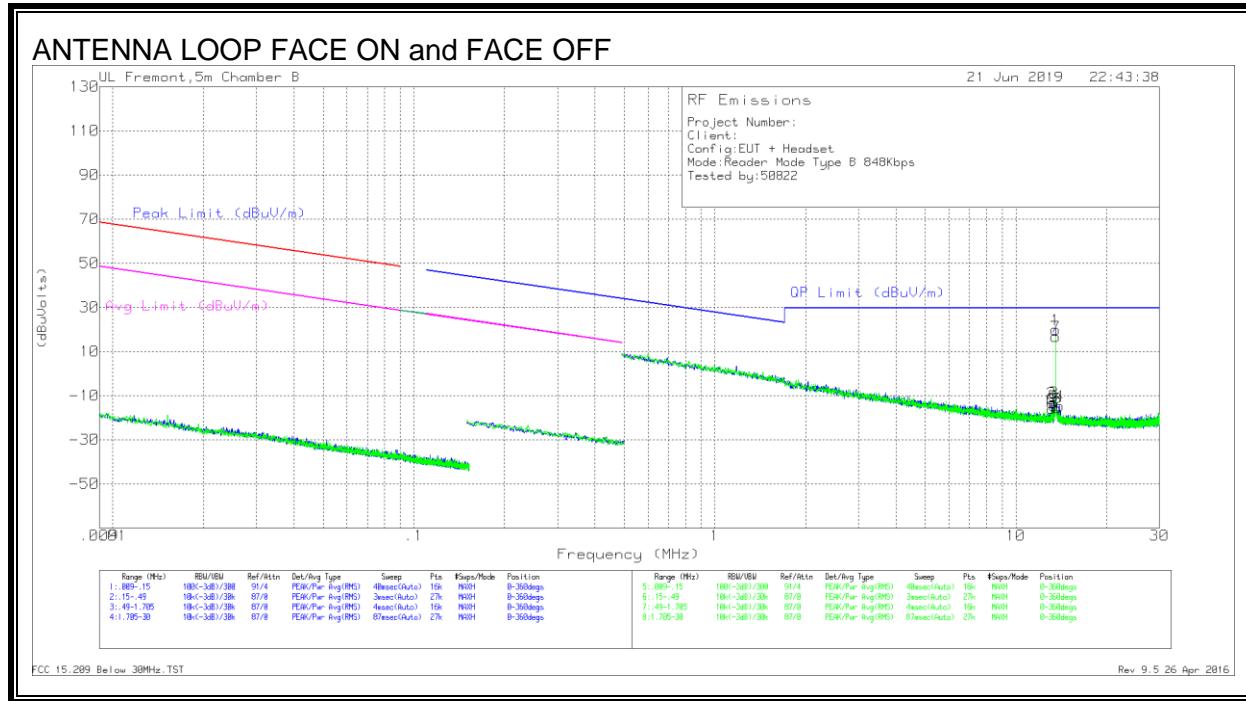
Pk - Peak detector

FCC 15.209 Below 30MHz.TST 30915 28 Apr 2017

Rev 9.5 01 Dec 2016

Note: Marker 1 and 7 are the fundamental signal

SPURIOUS EMISSION 848Kbps



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
6	13.13658	12.68	Pk	10.8	.5	-40	-16.02	29.5	-45.52	0-360
2	13.1392	15.24	Pk	10.8	.5	-40	-13.46	29.5	-42.96	0-360
5	13.40435	13.86	Pk	10.8	.5	-40	-14.84	29.5	-44.34	0-360
3	13.40697	15.71	Pk	10.8	.5	-40	-12.99	29.5	-42.49	0-360
1	13.55788	48.7	Pk	10.7	.5	-40	19.9	29.5	-9.6	0-360
7	13.5605	45.55	Pk	10.7	.5	-40	16.75	29.5	-12.75	0-360
8	13.7156	13.02	Pk	10.7	.5	-40	-15.78	29.5	-45.28	0-360
4	13.98494	14.06	Pk	10.7	.5	-40	-14.74	29.5	-44.24	0-360
6	13.13658	12.68	Pk	10.8	.5	-40	-16.02	29.5	-45.52	0-360

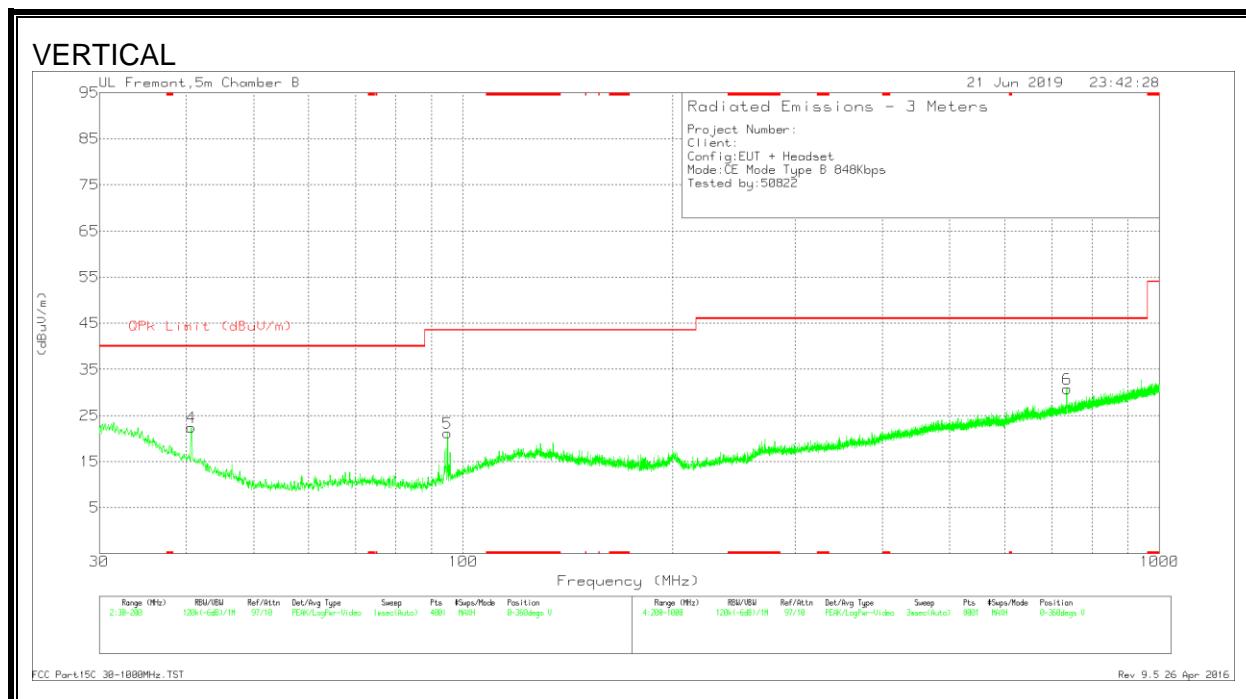
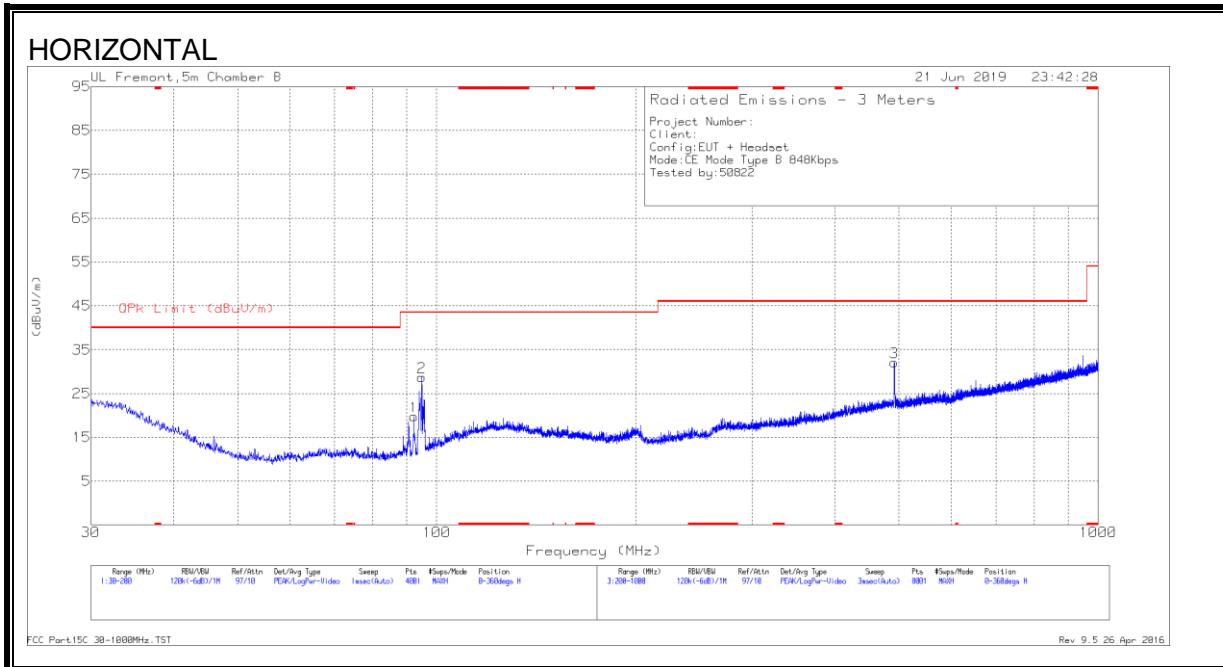
Pk - Peak detector

FCC 15.209 Below 30MHz.TST
Rev 9.5 26 Apr 2016

8.3. TX SPURIOUS EMISSION 30 TO 1000 MHz, EUT WITH AC/DC ADAPTER

8.3.1. CE MODE

SPURIOUS EMISSION 848Kbps



Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPK Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	40.6675	34.52	Pk	19.2	-31.3	22.42	40	-17.58	0-360	101	V
1	92.39	36.38	Pk	14.1	-30.7	19.78	43.52	-23.74	0-360	199	H
2	94.8975	44.71	Pk	14.7	-30.7	28.71	43.52	-14.81	0-360	299	H
5	94.8975	37.19	Pk	14.7	-30.7	21.19	43.52	-22.33	0-360	101	V
3	491.7	37.49	Pk	23.6	-29	32.09	46.02	-13.93	0-360	299	H
6	736.8	32.36	Pk	26.5	-28.1	30.76	46.02	-15.26	0-360	302	V

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

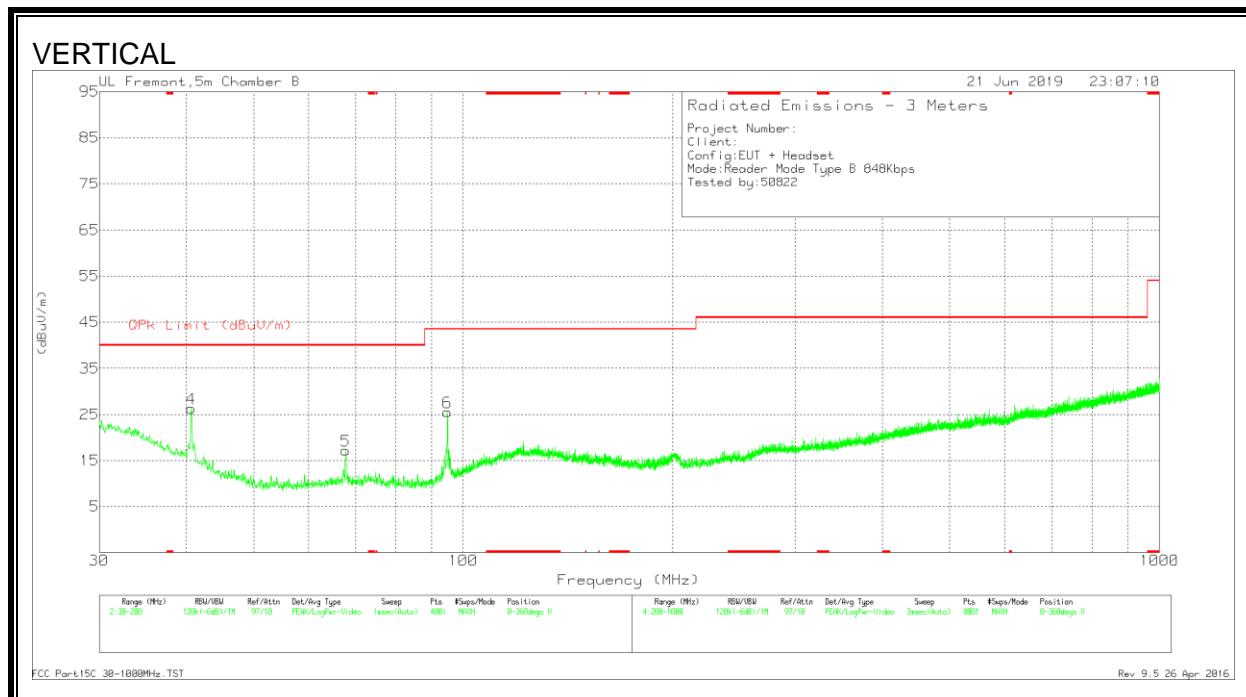
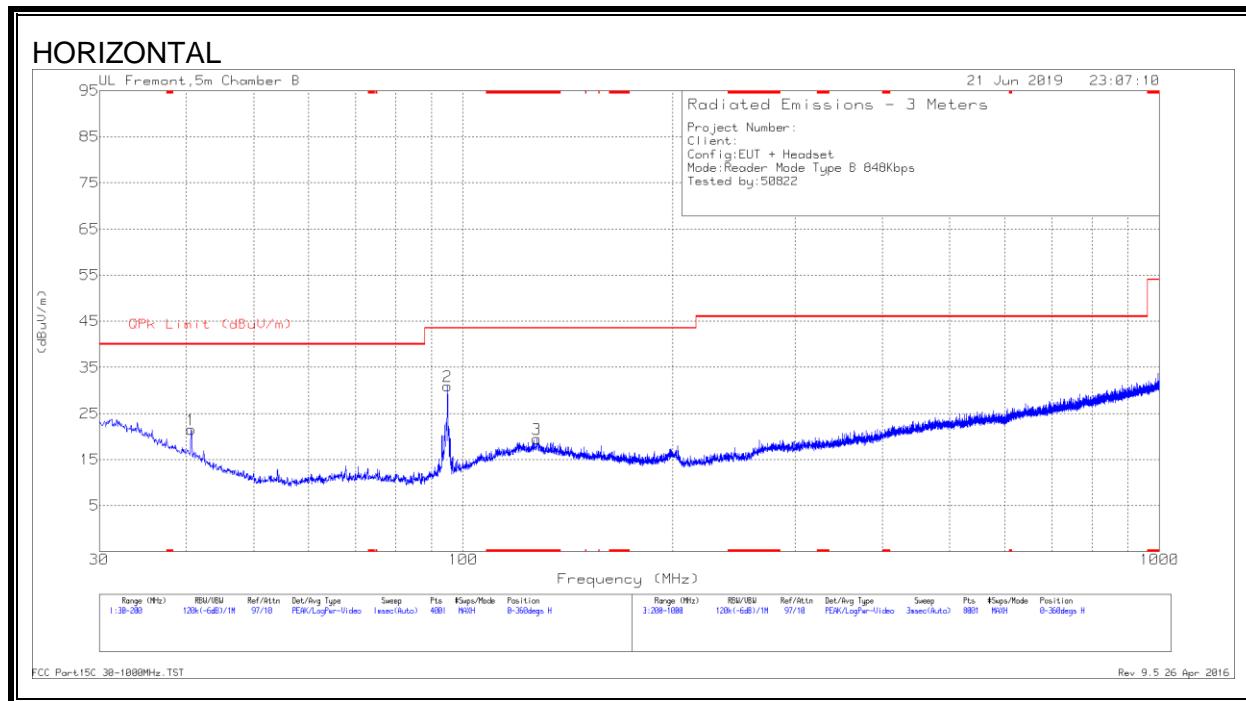
Pk - Peak detector

FCC Part15C 30-1000MHz.TST 30915 15 Jul 2014

Rev 9.5 01 Dec 2016

8.3.2. READER MODE

SPURIOUS EMISSION 848Kbps



DATA

Marker	Frequenc y (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl (dB)	Correcte d Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	* 127.58	29.97	Pk	19.9	-30.4	19.47	43.52	-24.05	0-360	299	H
1	40.6675	33.62	Pk	19.2	-31.3	21.52	40	-18.48	0-360	299	H
4	40.6675	38.4	Pk	19.2	-31.3	26.3	40	-13.7	0-360	102	V
5	67.7825	34.07	Pk	14.1	-31	17.17	40	-22.83	0-360	102	V
2	94.8975	46.9	Pk	14.7	-30.7	30.9	43.52	-12.62	0-360	299	H
6	94.8975	41.5	Pk	14.7	-30.7	25.5	43.52	-18.02	0-360	102	V

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

Pk - Peak detector

NFC_RM_TYPE A_848.DAT 30915 15 Jul 2014

Rev 9.5 01 Dec 2016

9. FREQUENCY STABILITY

LIMIT

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency, over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

IC RSS-210, Annex B.6

Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

TEST PROCEDURE

ANSI C63.10-2013 Clause 6.8

RESULTS

No non-compliance noted.

ID:	38602	Date:	6/14/19
-----	-------	-------	---------

9.1. CE MODE

848Kbps

CE MODE TYPE B 848 Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C										
		Limit: ± 100 ppm = 1.35600 KHz								
Power Supply (VAC)	Envir. Temp (°C)	Frequency Deviation Measured with Time Elapse								
		Startup (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	
3.80	50	13.5598785	0.450	13.5597983	6.363	13.5598014	6.135	13.5598018	6.107	
	40	13.5597821	7.559	13.5597789	7.798	13.5597560	9.488	13.5597704	8.421	
	30	13.5599934	-8.020	13.5597916	6.857	13.5597982	6.370	13.5598352	3.644	
	20	13.5598846	0.000	13.5598496	2.586	13.5598941	-0.698	13.5598904	-0.425	
	10	13.5597460	10.219	13.5598090	5.579	13.5598014	6.135	13.5598033	6.000	
	0	13.5597714	8.349	13.5598337	3.754	13.5598677	1.244	13.5598404	3.263	
	-10	13.5600811	10.281	13.5600953	-15.536	13.5601078	-16.457	13.5601176	-17.179	
	-20	13.5599530	-5.041	13.5600985	-15.773	13.5600953	-15.538	13.5600813	-14.503	
	3.23	20	13.5598154	5.101	13.5598346	3.689	13.5598011	6.157	13.5598129	5.286
	4.37	20	13.5598194	4.811	13.5598867	-0.154	13.5598809	0.272	13.5599019	-1.271

9.2. READER MODE

848Kbps

READER MODE TYPE B 848Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C										
		Limit: ± 100 ppm = 1.35600 KHz								
Power Supply (VAC)	Envir. Temp (°C)	Frequency Deviation Measured with Time Elapse								
		Startup (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	
3.80	50	13.5597920	5.287	13.5597905	5.396	13.5597893	5.486	13.5597878	5.595	
	40	13.5598142	3.654	13.5598111	3.877	13.5598081	4.100	13.5598050	4.333	
	30	13.5598444	1.426	13.5598414	1.644	13.5598377	1.916	13.5598341	2.187	
	20	13.5598637	0.000	13.5598638	-0.007	13.5598645	-0.056	13.5598651	-0.105	
	10	13.5598458	1.319	13.5598568	0.513	13.5598689	-0.385	13.5598821	-1.353	
	0	13.5599137	-3.686	13.5599186	-4.048	13.5599235	-4.411	13.5599288	-4.800	
	-10	13.5599435	-5.886	13.5599468	-6.129	13.5599497	-6.342	13.5599526	-6.554	
	-20	13.5599582	-6.969	13.5599581	-6.964	13.5599579	-6.944	13.5599568	-6.862	
	3.23	20	13.5599380	-5.476	13.5599323	-5.056	13.5599257	-4.570	13.5599180	-4.006
	4.37	20	13.5598546	0.676	13.5598500	1.008	13.5598450	1.378	13.5598393	1.804

10. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207
IC RSS-GEN, Section 8.8

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Notes:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

TEST PROCEDURE

ANSI C63.10:2013

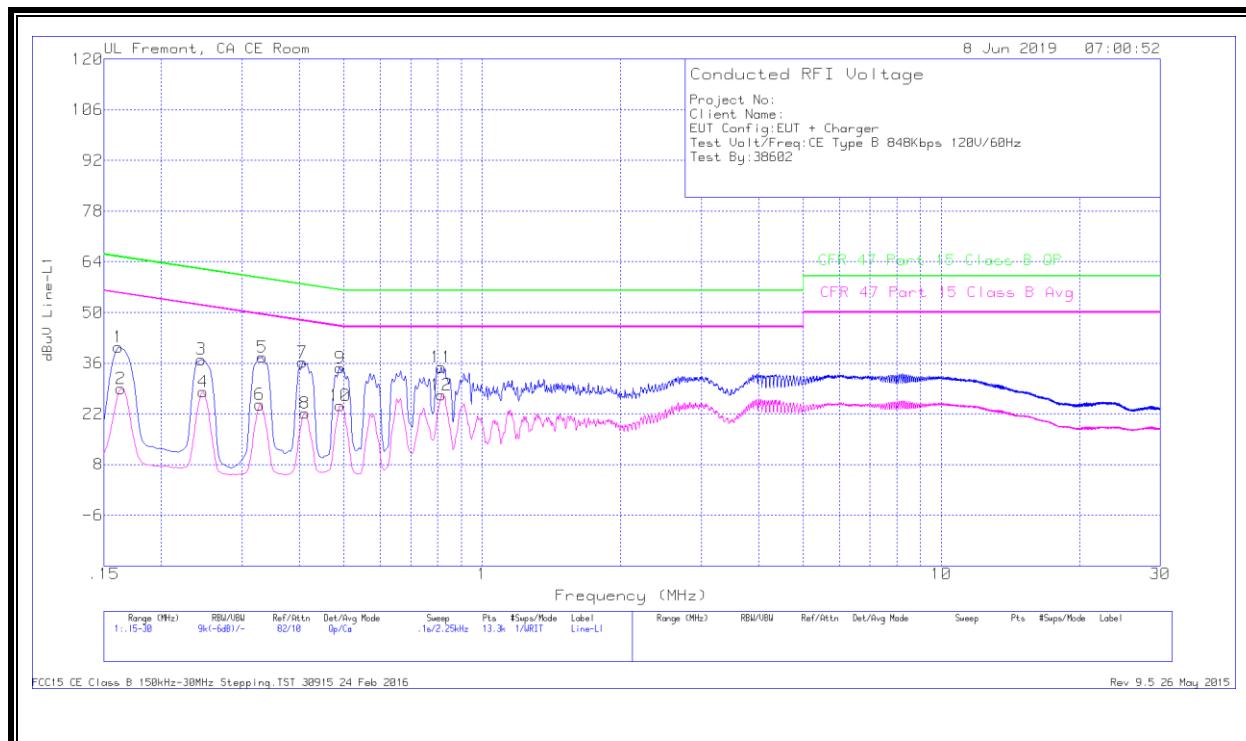
RESULTS

No non-compliance noted:

10.1. CE MODE

10.1.1. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



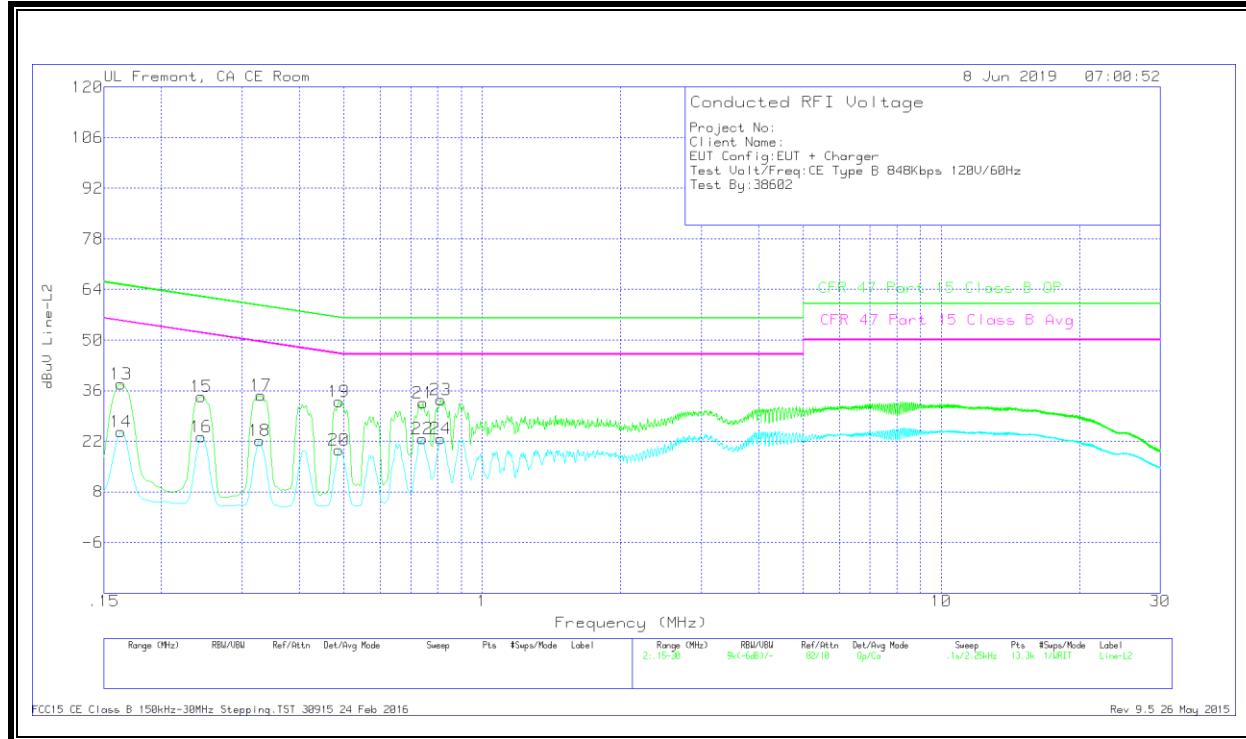
WORST EMISSIONS

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	.16125	30.18	Qp	.1	0	10.1	40.38	65.4	-25.02	-	-
2	.1635	18.83	Ca	.1	0	10.1	29.03	-	-	55.28	-26.25
3	.2445	26.95	Qp	0	0	10.1	37.05	61.94	-24.89	-	-
4	.24675	17.93	Ca	0	0	10.1	28.03	-	-	51.87	-23.84
5	.33225	27.6	Qp	0	0	10.1	37.7	59.39	-21.69	-	-
6	.32775	14.44	Ca	0	0	10.1	24.54	-	-	49.51	-24.97
7	.4065	26.12	Qp	0	0	10.1	36.22	57.72	-21.5	-	-
8	.411	12.05	Ca	0	0	10.1	22.15	-	-	47.63	-25.48
9	.48975	24.61	Qp	0	0	10.1	34.71	56.17	-21.46	-	-
10	.48975	14.15	Ca	0	0	10.1	24.25	-	-	46.17	-21.92
11	.81375	24.77	Qp	0	0	10.1	34.87	56	-21.13	-	-
12	.81487	17.06	Ca	0	0	10.1	27.16	-	-	46	-18.84

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

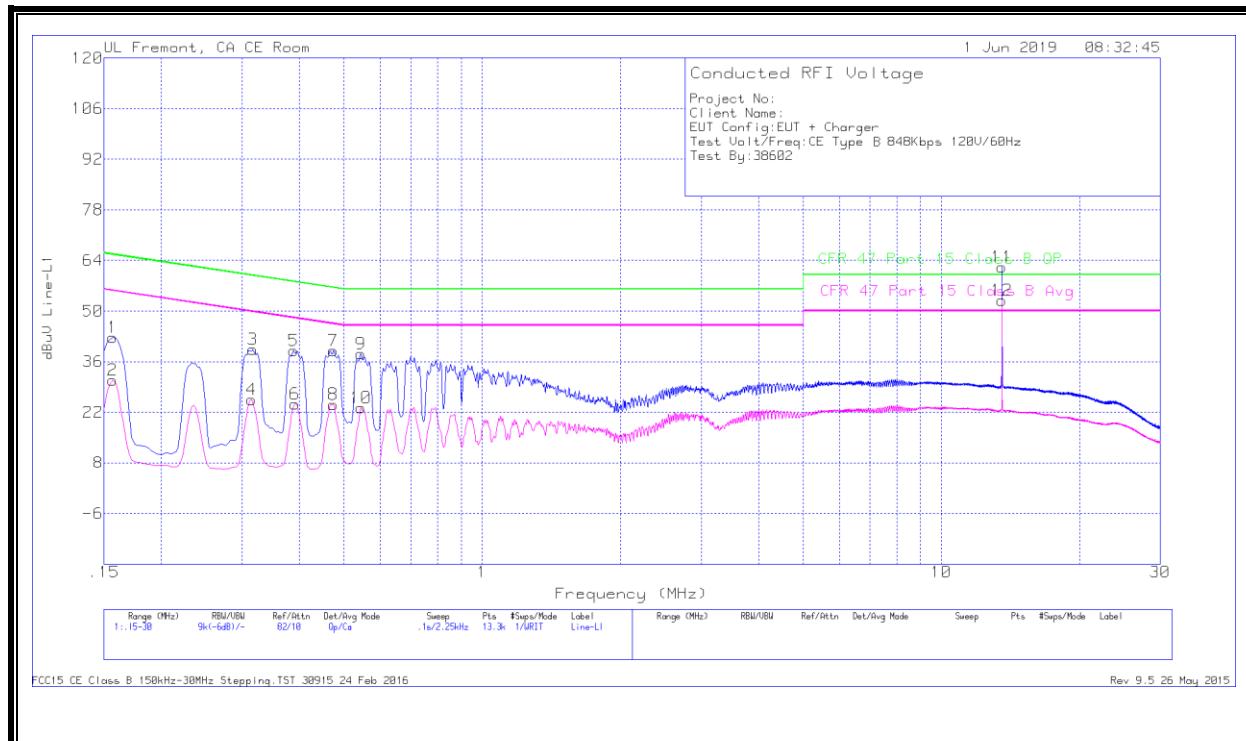
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.1635	27.61	Qp	.1	0	10.1	37.81	65.28	-27.47	-	-
14	.1635	14.41	Ca	.1	0	10.1	24.61	-	-	55.28	-30.67
15	.2445	24.22	Qp	0	0	10.1	34.32	61.94	-27.62	-	-
16	.2445	13.12	Ca	0	0	10.1	23.22	-	-	51.94	-28.72
17	.33	24.64	Qp	0	0	10.1	34.74	59.45	-24.71	-	-
18	.32775	12.07	Ca	0	0	10.1	22.17	-	-	49.51	-27.34
19	.4875	22.82	Qp	0	0	10.1	32.92	56.21	-23.29	-	-
20	.4875	9.44	Ca	0	0	10.1	19.54	-	-	46.21	-26.67
21	.744	22.51	Qp	0	0	10.1	32.61	56	-23.39	-	-
22	.74175	12.65	Ca	0	0	10.1	22.75	-	-	46	-23.25
23	.8115	23.33	Qp	0	0	10.1	33.43	56	-22.57	-	-
24	.8115	12.58	Ca	0	0	10.1	22.68	-	-	46	-23.32

Qp - Quasi-Peak detector

Ca - CISPR average detection

10.1.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



WORST EMISSIONS

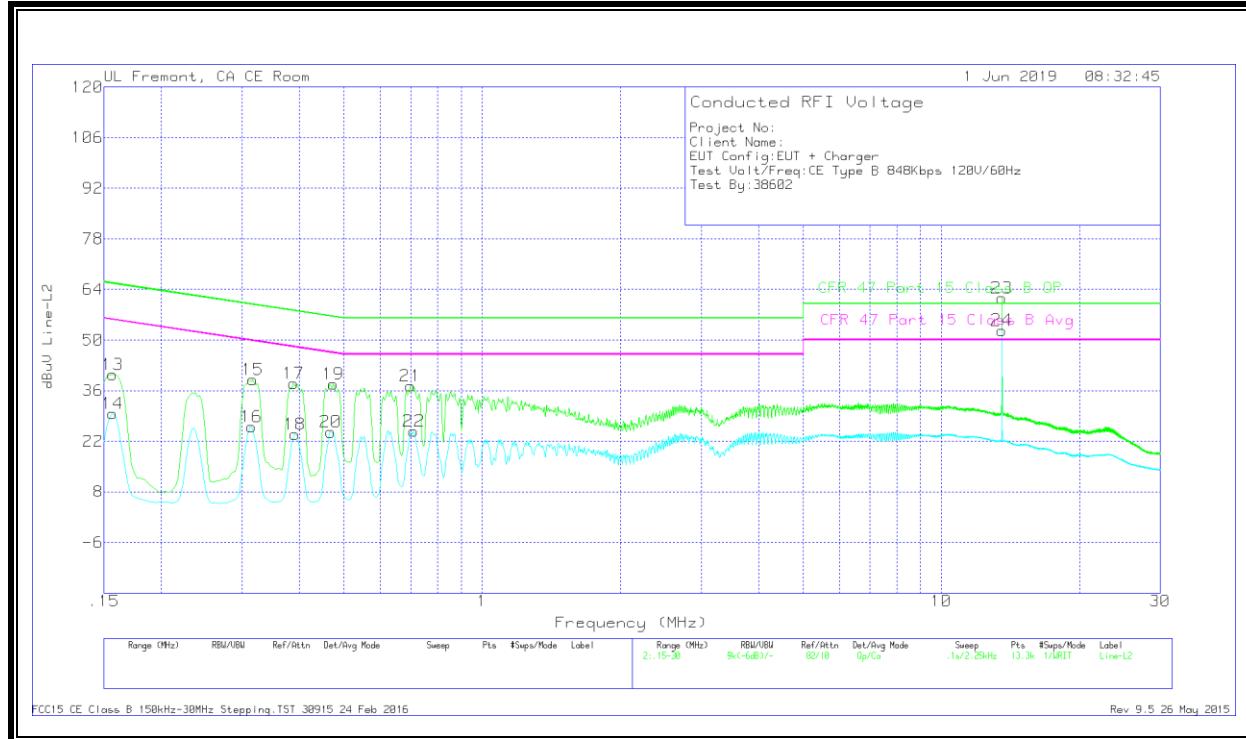
Range 2: Line-L2 .15 - 30MHz												
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)	
13	.15675	30.31	Qp	.1	0	10.1	40.51	65.63	-25.12	-	-	
14	.15675	19.39	Ca	.1	0	10.1	29.59	-	-	55.63	-26.04	
15	.3165	29	Qp	0	0	10.1	39.1	59.8	-20.7	-	-	
16	.31425	15.89	Ca	0	0	10.1	25.99	-	-	49.86	-23.87	
17	.3885	27.86	Qp	0	0	10.1	37.96	58.1	-20.14	-	-	
18	.39075	13.82	Ca	0	0	10.1	23.92	-	-	48.05	-24.13	
19	.474	27.74	Qp	0	0	10.1	37.84	56.44	-18.6	-	-	
20	.46725	14.44	Ca	0	0	10.1	24.54	-	-	46.56	-22.02	
21	.699	27.17	Qp	0	0	10.1	37.27	56	-18.73	-	-	
22	.71025	14.74	Ca	0	0	10.1	24.84	-	-	46	-21.16	
23	13.56	51.1	Qp	.1	.2	10.2	61.6	60	1.6	-	-	
24	13.56	42.19	Ca	.1	.2	10.2	52.69	-	-	50	2.69	

Qp - Quasi-Peak detector

Ca - CISPR average detection

Note: 13.56MHz is a fundamental frequency of the EUT. Data documented in above section, indicate that when the antenna terminal is terminated the fundamental amplitude is lowering below the limit line

LINE 2 RESULTS



WORST EMISSIONS

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	.15675	30.31	Qp	.1	0	10.1	40.51	65.63	-25.12	-	-
14	.15675	19.39	Ca	.1	0	10.1	29.59	-	-	55.63	-26.04
15	.3165	29	Qp	0	0	10.1	39.1	59.8	-20.7	-	-
16	.31425	15.89	Ca	0	0	10.1	25.99	-	-	49.86	-23.87
17	.3885	27.86	Qp	0	0	10.1	37.96	58.1	-20.14	-	-
18	.39075	13.82	Ca	0	0	10.1	23.92	-	-	48.05	-24.13
19	.474	27.74	Qp	0	0	10.1	37.84	56.44	-18.6	-	-
20	.46725	14.44	Ca	0	0	10.1	24.54	-	-	46.56	-22.02
21	.699	27.17	Qp	0	0	10.1	37.27	56	-18.73	-	-
22	.71025	14.74	Ca	0	0	10.1	24.84	-	-	46	-21.16
23	13.56	51.1	Qp	.1	.2	10.2	61.6	60	1.6	-	-
24	13.56	42.19	Ca	.1	.2	10.2	52.69	-	-	50	2.69

Qp - Quasi-Peak detector

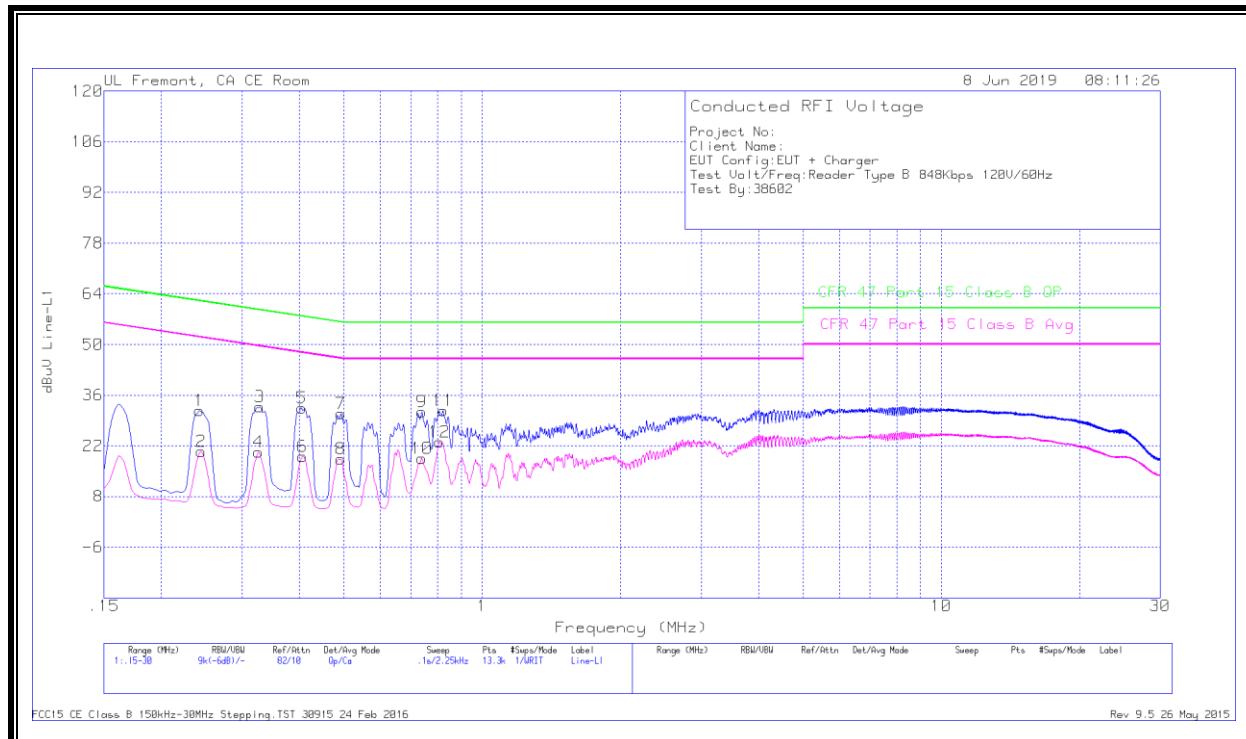
Ca - CISPR average detection

Note: 13.56MHz is a fundamental frequency of the EUT. Data documented in above section, indicate that when the antenna terminal is terminated the fundamental amplitude is lowering below the limit line

10.2. READER MODE

10.2.1. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



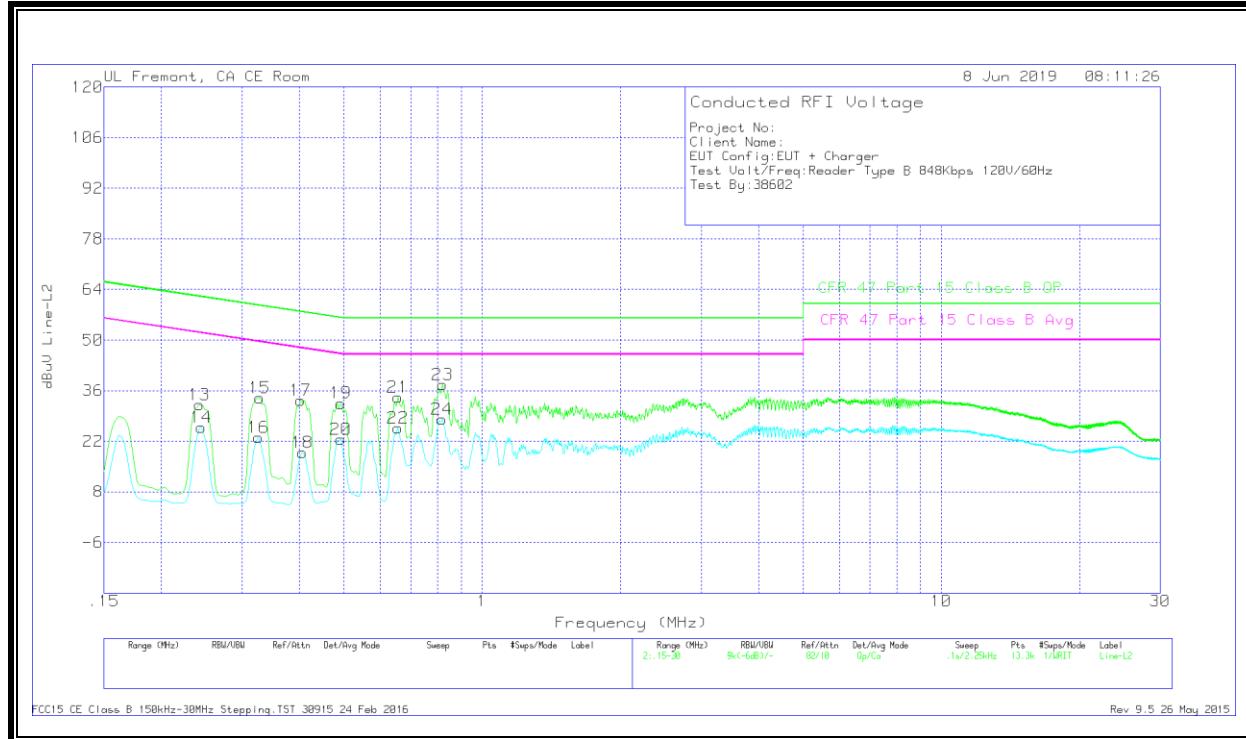
WORST EMISSIONS

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	.24225	21.57	Qp	0	0	10.1	31.67	62.02	-30.35	-	-
2	.2445	10.33	Ca	0	0	10.1	20.43	-	-	51.94	-31.51
3	.32775	22.67	Qp	0	0	10.1	32.77	59.51	-26.74	-	-
4	.3255	10.16	Ca	0	0	10.1	20.26	-	-	49.57	-29.31
5	.40425	22.36	Qp	0	0	10.1	32.46	57.77	-25.31	-	-
6	.4065	9	Ca	0	0	10.1	19.1	-	-	47.72	-28.62
7	.492	20.7	Qp	0	0	10.1	30.8	56.13	-25.33	-	-
8	.492	8.31	Ca	0	0	10.1	18.41	-	-	46.13	-27.72
9	.7395	21.36	Qp	0	0	10.1	31.46	56	-24.54	-	-
10	.7395	8.51	Ca	0	0	10.1	18.61	-	-	46	-27.39
11	.82275	21.69	Qp	0	0	10.1	31.79	56	-24.21	-	-
12	.807	13.01	Ca	0	0	10.1	23.11	-	-	46	-22.89

Qp - Quasi-Peak detector

Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

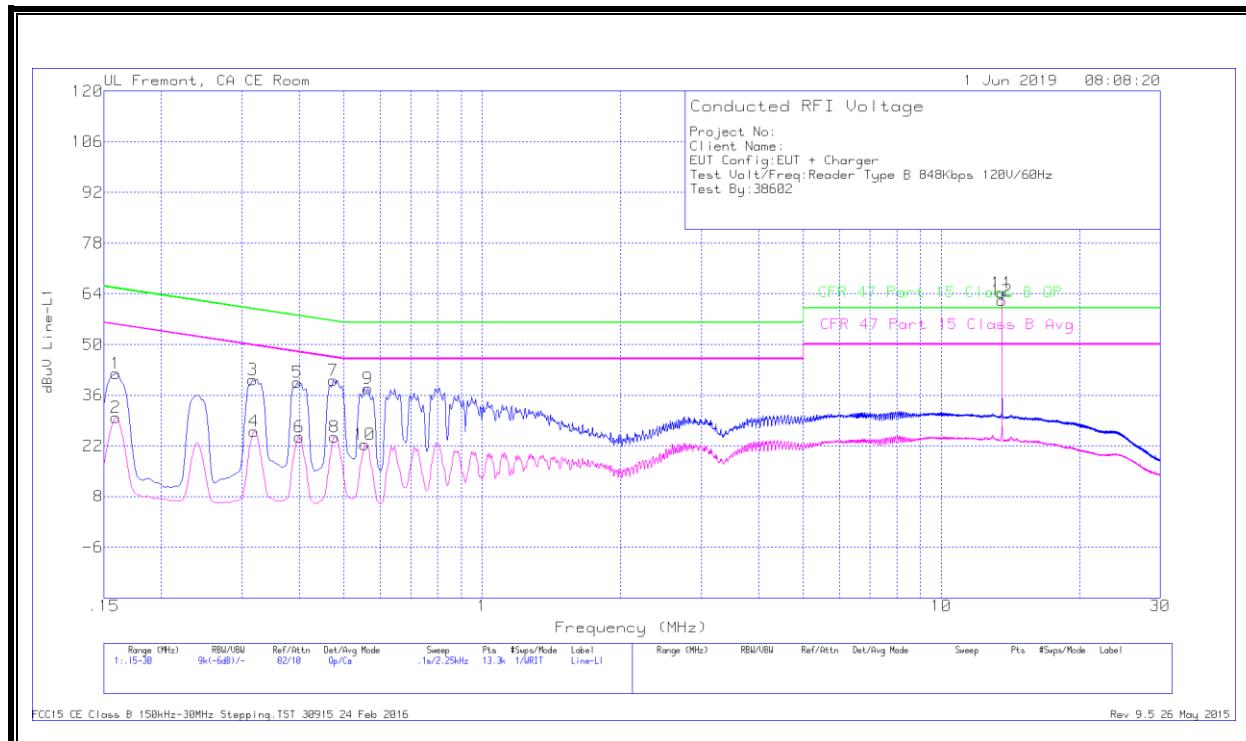
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.24225	21.92	Qp	0	0	10.1	32.02	62.02	-30	-	-
14	.2445	15.76	Ca	0	0	10.1	25.86	-	-	51.94	-26.08
15	.32775	23.97	Qp	0	0	10.1	34.07	59.51	-25.44	-	-
16	.3255	12.99	Ca	0	0	10.1	23.09	-	-	49.57	-26.48
17	.402	23.22	Qp	0	0	10.1	33.32	57.81	-24.49	-	-
18	.4065	8.81	Ca	0	0	10.1	18.91	-	-	47.72	-28.81
19	.492	22.43	Qp	0	0	10.1	32.53	56.13	-23.6	-	-
20	.492	12.38	Ca	0	0	10.1	22.48	-	-	46.13	-23.65
21	.65625	24.16	Qp	0	0	10.1	34.26	56	-21.74	-	-
22	.65625	15.49	Ca	0	0	10.1	25.59	-	-	46	-20.41
23	.8205	27.49	Qp	0	0	10.1	37.59	56	-18.41	-	-
24	.81825	18.07	Ca	0	0	10.1	28.17	-	-	46	-17.83

Qp - Quasi-Peak detector

Ca - CISPR average detection

10.2.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



WORST EMISSIONS

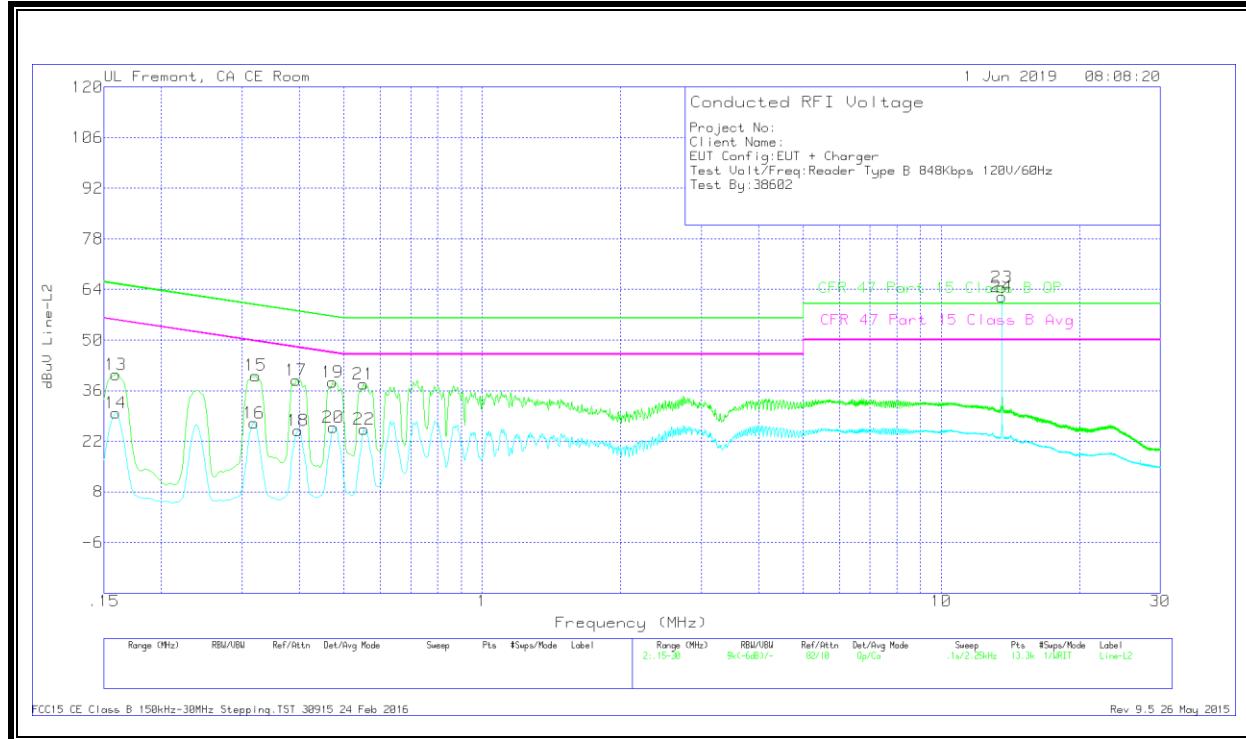
Range 1: Line-L1 .15 - 30MHz												
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)	
1	.159	31.8	Qp	.1	0	10.1	42	65.52	-23.52	-	-	
2	.159	19.65	Ca	.1	0	10.1	29.85	-	-	55.52	-25.67	
3	.3165	30.19	Qp	0	0	10.1	40.29	59.8	-19.51	-	-	
4	.31875	15.99	Ca	0	0	10.1	26.09	-	-	49.74	-23.65	
5	.39525	29.43	Qp	0	0	10.1	39.53	57.95	-18.42	-	-	
6	.39975	14.36	Ca	0	0	10.1	24.46	-	-	47.86	-23.4	
7	.474	30.05	Qp	0	0	10.1	40.15	56.44	-16.29	-	-	
8	.47625	14.37	Ca	0	0	10.1	24.47	-	-	46.4	-21.93	
9	.564	27.75	Qp	0	0	10.1	37.85	56	-18.15	-	-	
10	.555	12.32	Ca	0	0	10.1	22.42	-	-	46	-23.58	
11	13.56	53.72	Qp	.1	.2	10.2	64.22	60	4.22	-	-	
12	13.56	51.66	Ca	.1	.2	10.2	62.16	-	-	50	12.16	

Qp - Quasi-Peak detector

Ca - CISPR average detection

Note: 13.56MHz is a fundamental frequency of the EUT. Data documented in above section, indicate that when the antenna terminal is terminated the fundamental amplitude is lowering below the limit line

LINE 2 RESULTS



WORST EMISSIONS

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	.159	30.29	Qp	.1	0	10.1	40.49	65.52	-25.03	-	-
14	.159	19.6	Ca	.1	0	10.1	29.8	-	-	55.52	-25.72
15	.321	30.08	Qp	0	0	10.1	40.18	59.68	-19.5	-	-
16	.31875	16.98	Ca	0	0	10.1	27.08	-	-	49.74	-22.66
17	.393	28.84	Qp	0	0	10.1	38.94	58	-19.06	-	-
18	.3975	14.82	Ca	0	0	10.1	24.92	-	-	47.91	-22.99
19	.47175	28.21	Qp	0	0	10.1	38.31	56.48	-18.17	-	-
20	.474	15.77	Ca	0	0	10.1	25.87	-	-	46.44	-20.57
21	.5505	27.76	Qp	0	0	10.1	37.86	56	-18.14	-	-
22	.55275	15.23	Ca	0	0	10.1	25.33	-	-	46	-20.67
23	13.56	54.15	Qp	.1	.2	10.2	64.65	60	4.65	-	-
24	13.56	51.55	Ca	.1	.2	10.2	62.05	-	-	50	12.05

Qp - Quasi-Peak detector

Ca - CISPR average detection

Note: 13.56MHz is a fundamental frequency of the EUT. Data documented in above section, indicate that when the antenna terminal is terminated the fundamental amplitude is lowering below the limit line

END OF REPORT

11. SETUP PHOTOS

Please refer to 12901678-EP1V1 Setup Photos_Report for setup photos