



CERTIFICATION TEST REPORT

Report Number. : 12204447-E11V3

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

Model : A2097

FCC ID : BCG-E3232A

IC : 579C-E3232A

EUT Description : SMARTPHONE

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

Date Of Issue:

August 10, 2018

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	7/13/2018	Initial Issue	Chin Pang
V2	7/16/2018	Address TCB's Questions	Chin Pang
V3	8/10/2018	Address TCB's Questions	Jingang 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. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY.....	7
5. EQUIPMENT UNDER TEST	8
5.1. DESCRIPTION OF EUT	8
5.2. MAXIMUM OUTPUT POWER.....	8
5.3. SOFTWARE AND FIRMWARE.....	8
5.4. WORST-CASE CONFIGURATION AND MODE.....	8
5.5. DESCRIPTION OF TEST SETUP.....	9
6. TEST AND MEASUREMENT EQUIPMENT	12
7. OCCUPIED BANDWIDTH	13
7.1. CE MODE.....	14
7.2. READER MODE	15
8. RADIATED EMISSION TEST RESULTS.....	16
8.1. LIMITS AND PROCEDURE	16
8.2. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 - 30 MHz), EUT WITH AC/DC ADAPTER	18
8.2.1. CE MODE.....	18
8.2.2. READER MODE	20
8.3. TX SPURIOUS EMISSION 30 TO 1000 MHz, EUT WITH AC/DC ADAPTER.....	22
8.3.1. CE MODE.....	22
8.3.2. READER MODE	24
9. FREQUENCY STABILITY	26
9.1. CE MODE.....	27
9.2. READER MODE	27
10. AC MAINS LINE CONDUCTED EMISSIONS	28
10.1. CE MODE	29
10.1.1. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps.....	29
10.1.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps	

10.2.	READER MODE.....	33
10.2.1.	NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps.....	33
10.2.2.	NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps	35
11.	SETUP PHOTOS	37

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: SMARTPHONE

MODEL: A2097

SERIAL NUMBER: C39WP04UK95F

DATE TESTED: March 26, 2018 – May 18, 2018

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:



Chin Pang
Senior Test Engineer
UL VERIFICATION SERVICES INC.

Prepared By:



Jingang Li
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
☐ Chamber A (ISED:2324B-1)	☒ Chamber D (ISED:22541-1)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)
	☐ Chamber G (ISED:22541-4)
	☒ Chamber H (ISED:22541-5)

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through C is 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 Apple iPhone, 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, Bluetooth, GPS and NFC. All models support at least one UICC based SIM. The second SIM is either UICC based, electronic SIM (e-SIM), or second SIM is not present. The device has a built-in inductive charging receiver which is not user accessible. The rechargeable battery is not user accessible.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode		Kbps	E Field at 30m distance (dBuV/m)
13.56	Type A	CE	848	20.79
		Reader	848	21.01

5.3. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was v16.30.67.7

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.

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 A was determined to be the worst case and therefore Type A was selected for all final tests.

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	Mac Book Pro	HRP007154	FCC Doc
Laptop AC/DC Adapter	Apple	A1343	ADP-85EBT V85	n/a
EUT AC/DC Adapter	Apple	A1385	D292365B2FQDHLHC7	n/a

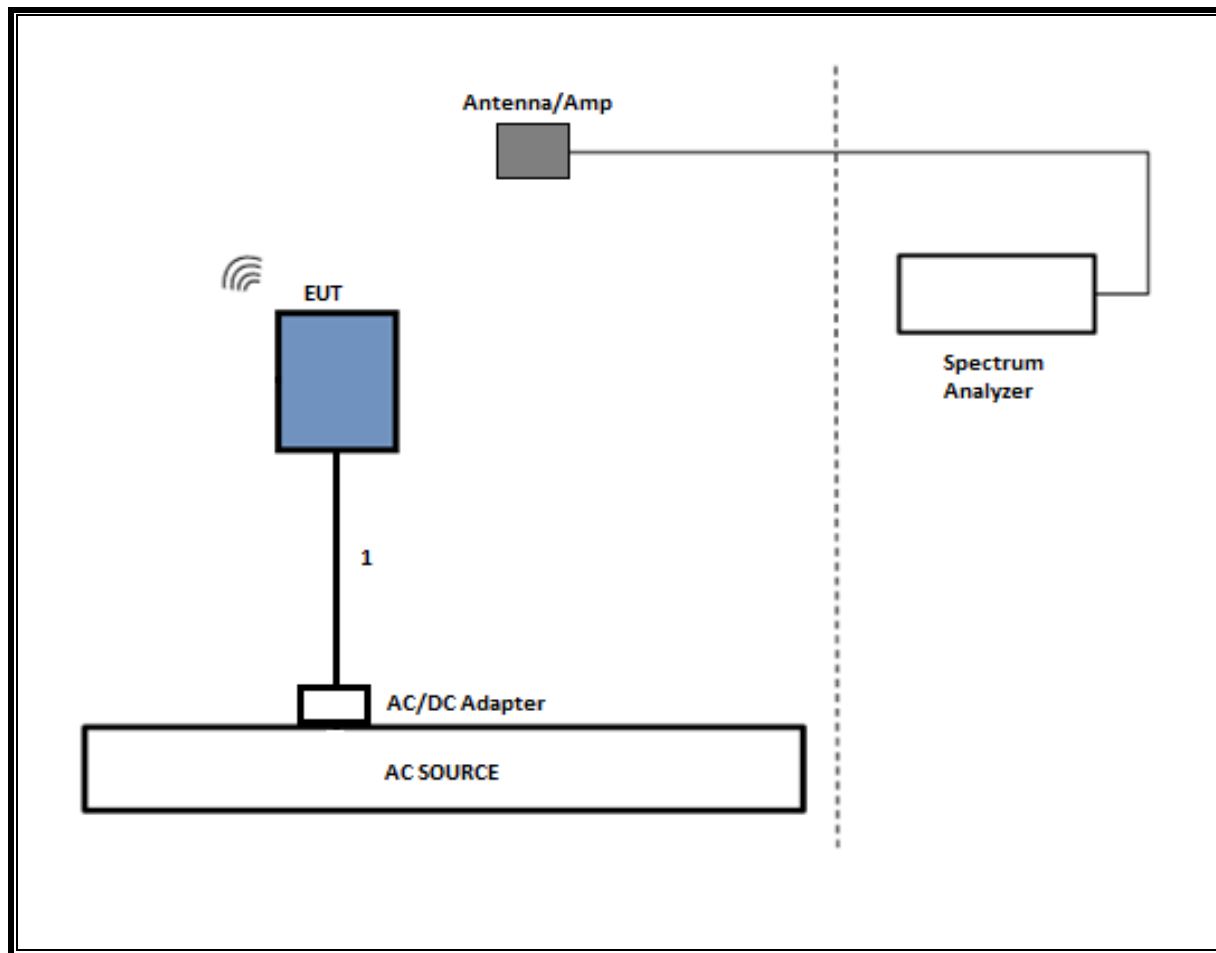
I/O CABLES

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

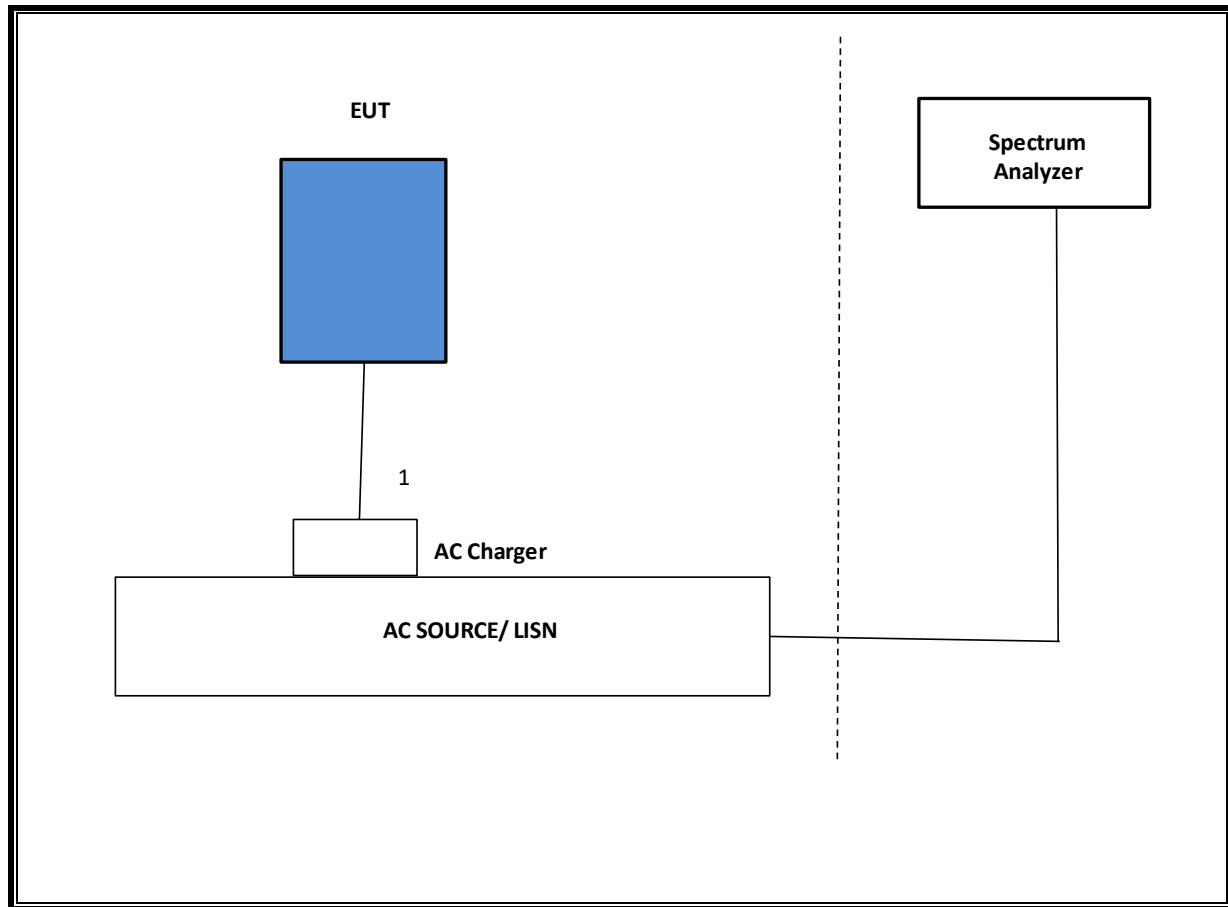
TEST SETUP

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 AC 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, Active Loop 9KHz to 30MHz	ETS-Lindgren	6502	T1683	02/21/2019
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	T122	03/08/2019
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T835	06/24/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A-544	T341	11/12/2018
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	T754	09/05/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T341	11/12/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T342	02/22/2019

AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	T1436	01/25/2019
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2018
LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/15/2018
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	

7. OCCUPIED BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

Type A with the 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

ID:	38602	Date:	4/12/18
------------	-------	--------------	---------

99% and 20dB BW

CE MODE

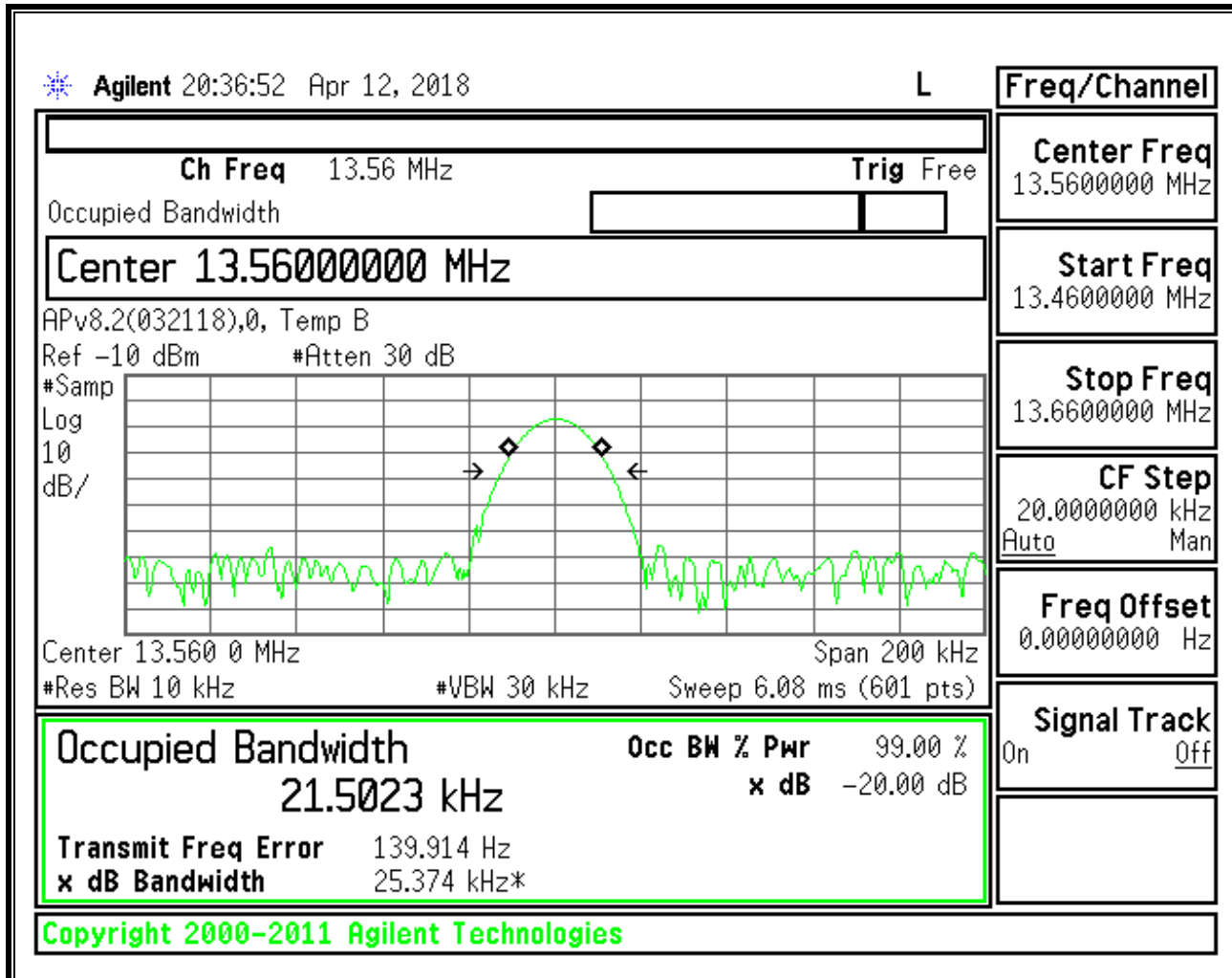
Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.5023	25.374

READER MODE

Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.7312	25.032

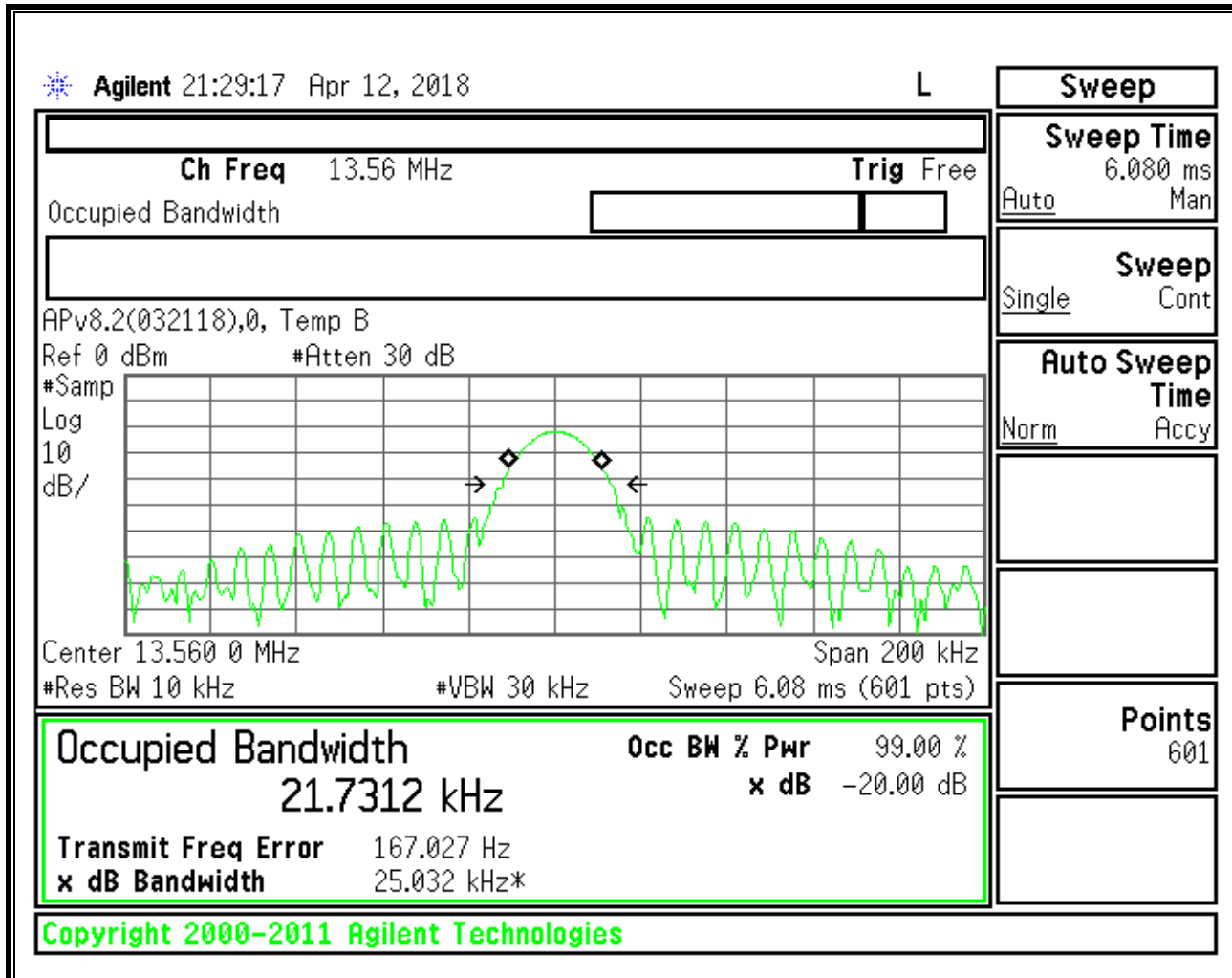
7.1. CE MODE

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 (µV/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

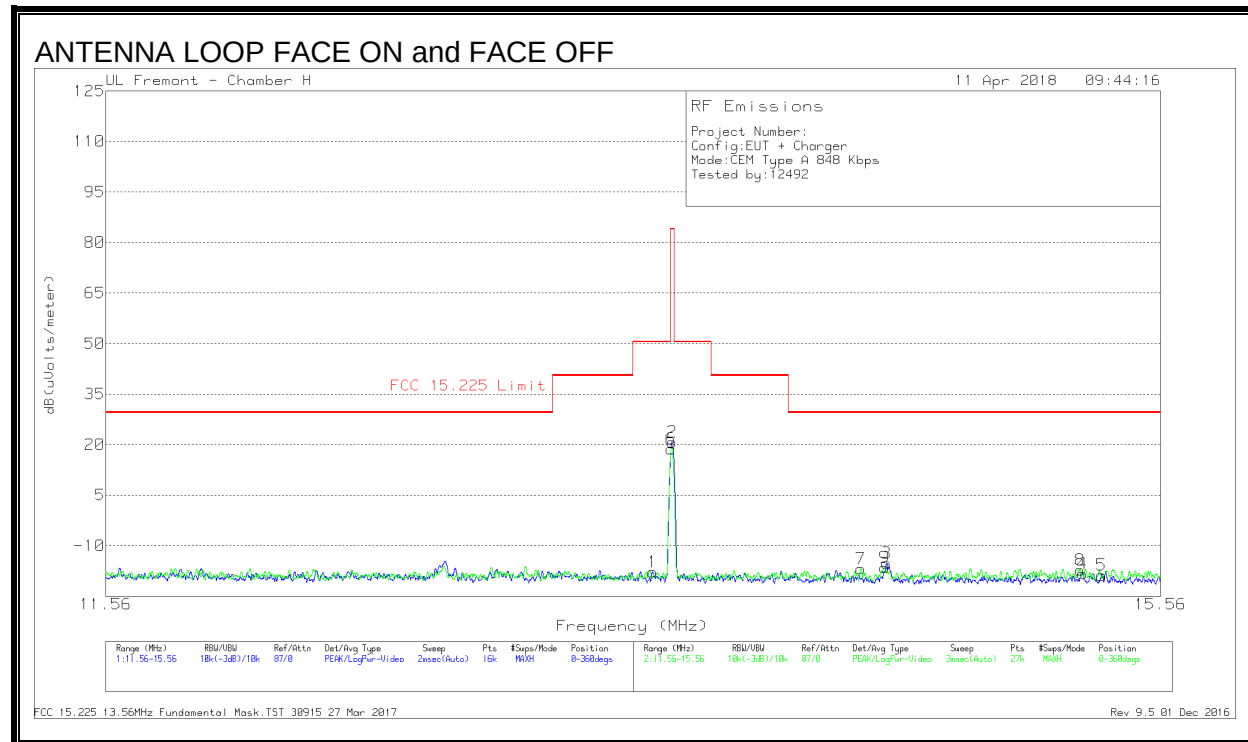
The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 13.56 MHz; therefore, the frequency range was investigated from 0.15 MHz to the 10th harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater.

RESULTS

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

8.2.1. CE MODE

FUNDAMENTAL 848Kbps

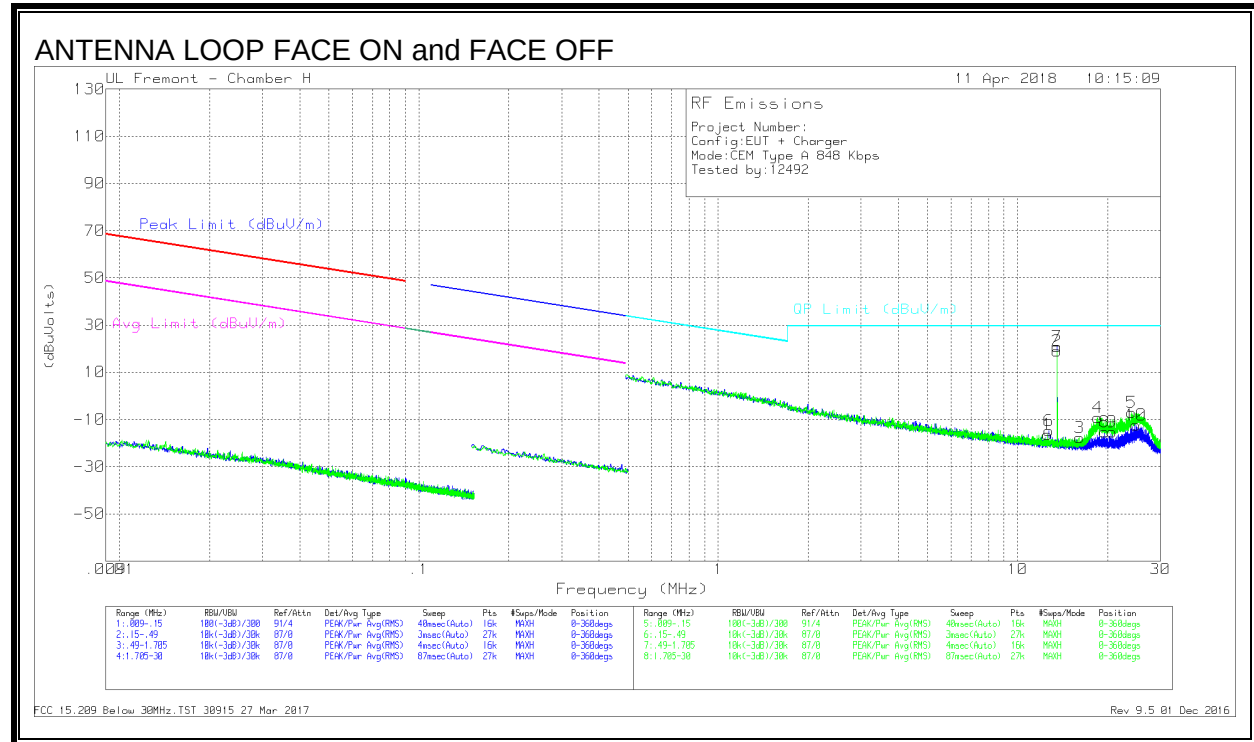


DATA

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	13.48563	10.95	Pk	10.8	.4	-40	-17.85	50.5	-68.35	0-360
6	13.55652	47.69	Pk	10.7	.4	-40	18.79	84	-65.21	0-360
2	13.55988	49.69	Pk	10.7	.4	-40	20.79	84	-63.21	0-360
7	14.30155	12.01	Pk	10.7	.4	-40	-16.89	29.54	-46.43	0-360
9	14.39679	12.45	Pk	10.7	.4	-40	-16.45	29.54	-45.99	0-360
3	14.40538	13.66	Pk	10.7	.4	-40	-15.24	29.54	-44.78	0-360
8	15.21338	11.66	Pk	10.7	.4	-40	-17.24	29.54	-46.78	0-360
4	15.22363	10.62	Pk	10.7	.4	-40	-18.28	29.54	-47.82	0-360
5	15.3035	10.09	Pk	10.7	.4	-40	-18.81	29.54	-48.35	0-360

Pk - Peak detector

SPURIOUS EMISSION 848Kbps



DATA

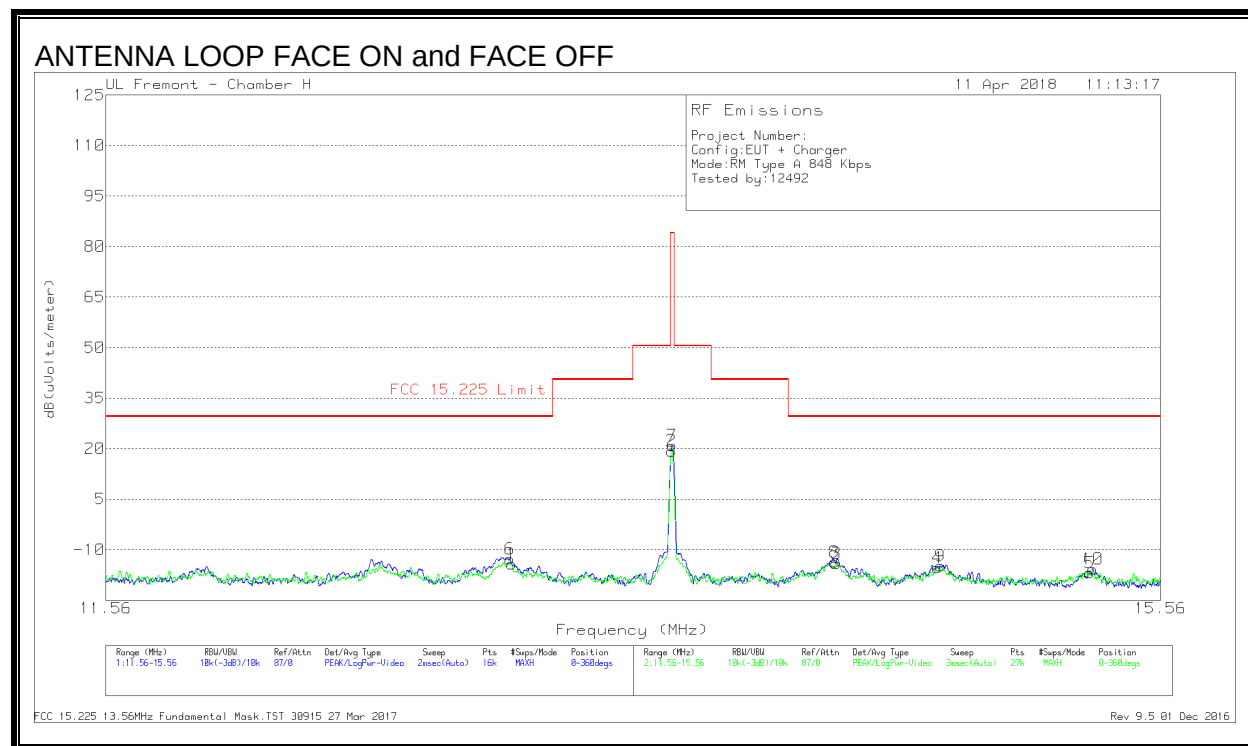
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	12.61258	12.32	Pk	10.8	.4	-40	-16.48	29.5	-45.98	0-360
6	12.71057	14.06	Pk	10.8	.4	-40	-14.74	29.5	-44.24	0-360
3	16.10138	11.4	Pk	10.6	.4	-40	-17.6	29.5	-47.1	0-360
4	18.5013	19.91	Pk	10.3	.5	-40	-9.29	29.5	-38.79	0-360
8	19.49952	14.01	Pk	10.3	.5	-40	-15.19	29.5	-44.69	0-360
9	20.67537	14.11	Pk	10.1	.5	-40	-15.29	29.5	-44.79	0-360
5	24.03998	23.12	Pk	9.4	.5	-40	-6.98	29.5	-36.48	0-360
10	24.87733	17.89	Pk	9.2	.6	-40	-12.31	29.5	-41.81	0-360

Pk - Peak detector

Note: marker 2 and 7 are the fundamental signal.

8.2.2. READER MODE

FUNDAMENTAL 848Kbps

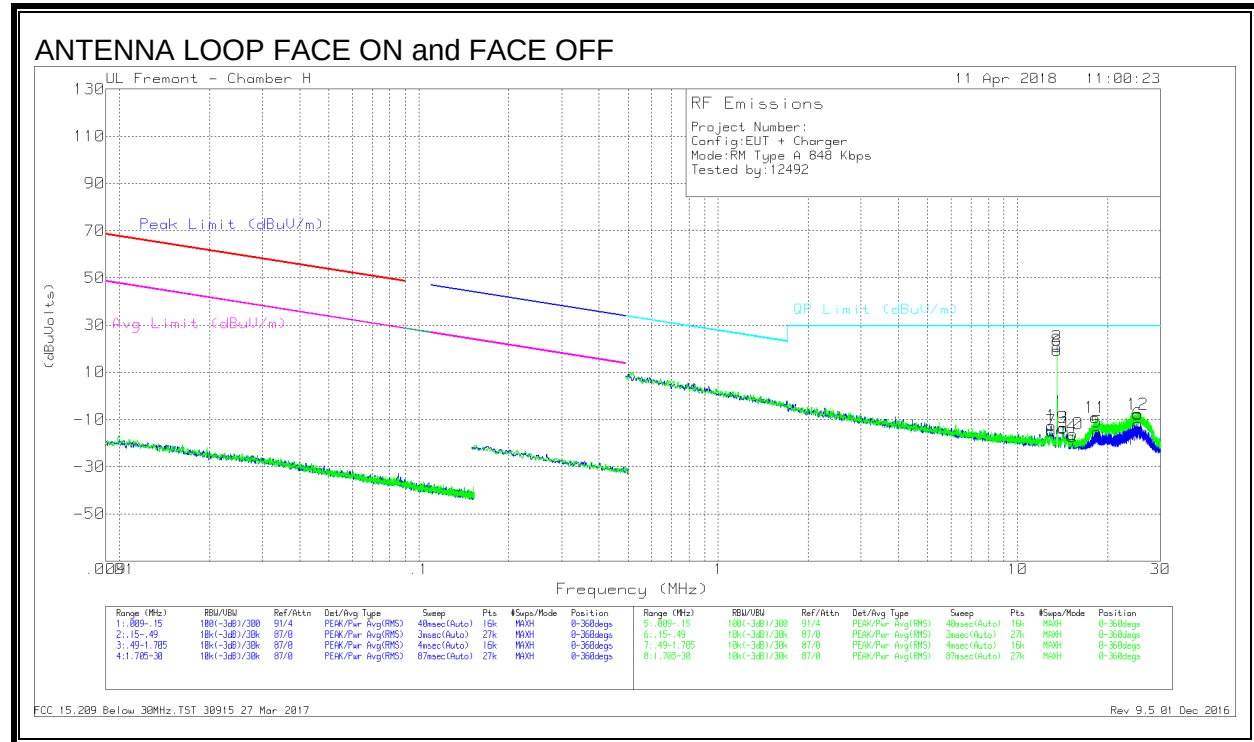


DATA

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)
6	12.95313	15.99	Pk	10.8	.4	-40	-12.81	29.54	-42.35	0-360
1	12.96038	14.61	Pk	10.8	.4	-40	-14.19	29.54	-43.73	0-360
2	13.55822	48.26	Pk	10.7	.4	-40	19.36	84	-64.64	0-360
7	13.55975	49.91	Pk	10.7	.4	-40	21.01	84	-62.99	0-360
8	14.19575	15.22	Pk	10.7	.4	-40	-13.68	29.54	-43.22	0-360
3	14.20113	14.87	Pk	10.7	.4	-40	-14.03	29.54	-43.57	0-360
4	14.6108	13.56	Pk	10.7	.4	-40	-15.34	29.54	-44.88	0-360
9	14.62363	14.09	Pk	10.7	.4	-40	-14.81	29.54	-44.35	0-360
5	15.25127	11.99	Pk	10.7	.4	-40	-16.91	29.54	-46.45	0-360
10	15.26525	13.22	Pk	10.7	.4	-40	-15.68	29.54	-45.22	0-360

Pk - Peak detector

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)
7	12.94585	14.07	Pk	10.8	.4	-40	-14.73	29.5	-44.23	0-360
1	12.94847	16.15	Pk	10.8	.4	-40	-12.65	29.5	-42.15	0-360
9	14.16153	15.33	Pk	10.7	.4	-40	-13.57	29.5	-43.07	0-360
3	14.1914	15.53	Pk	10.7	.4	-40	-13.37	29.5	-42.87	0-360
4	15.23363	11.64	Pk	10.7	.4	-40	-17.26	29.5	-46.76	0-360
10	15.27188	12.68	Pk	10.7	.4	-40	-16.22	29.5	-45.72	0-360
11	18.16908	19.95	Pk	10.4	.5	-40	-9.15	29.5	-38.65	0-360
5	18.40802	13.87	Pk	10.4	.5	-40	-15.23	29.5	-44.73	0-360
6	25.20326	18.31	Pk	9.2	.6	-40	-11.89	29.5	-41.39	0-360
12	25.26352	22.34	Pk	9.1	.6	-40	-7.96	29.5	-37.46	0-360

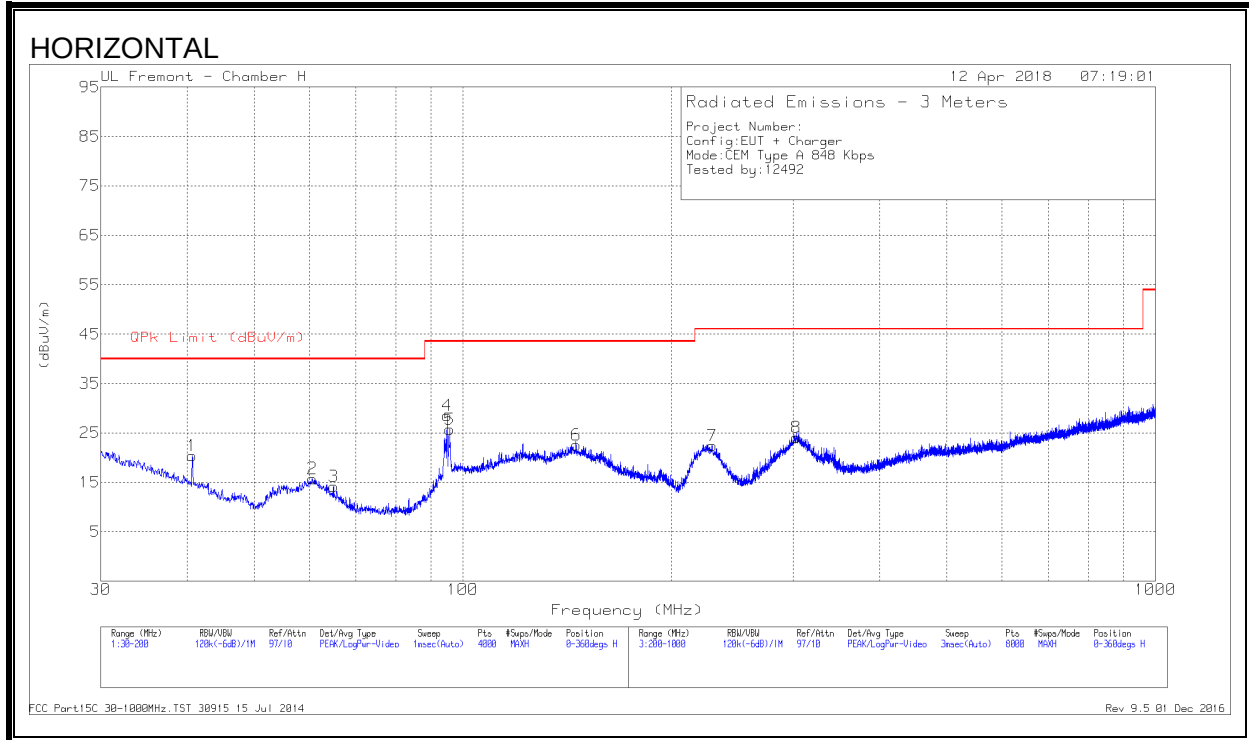
Pk - Peak detector

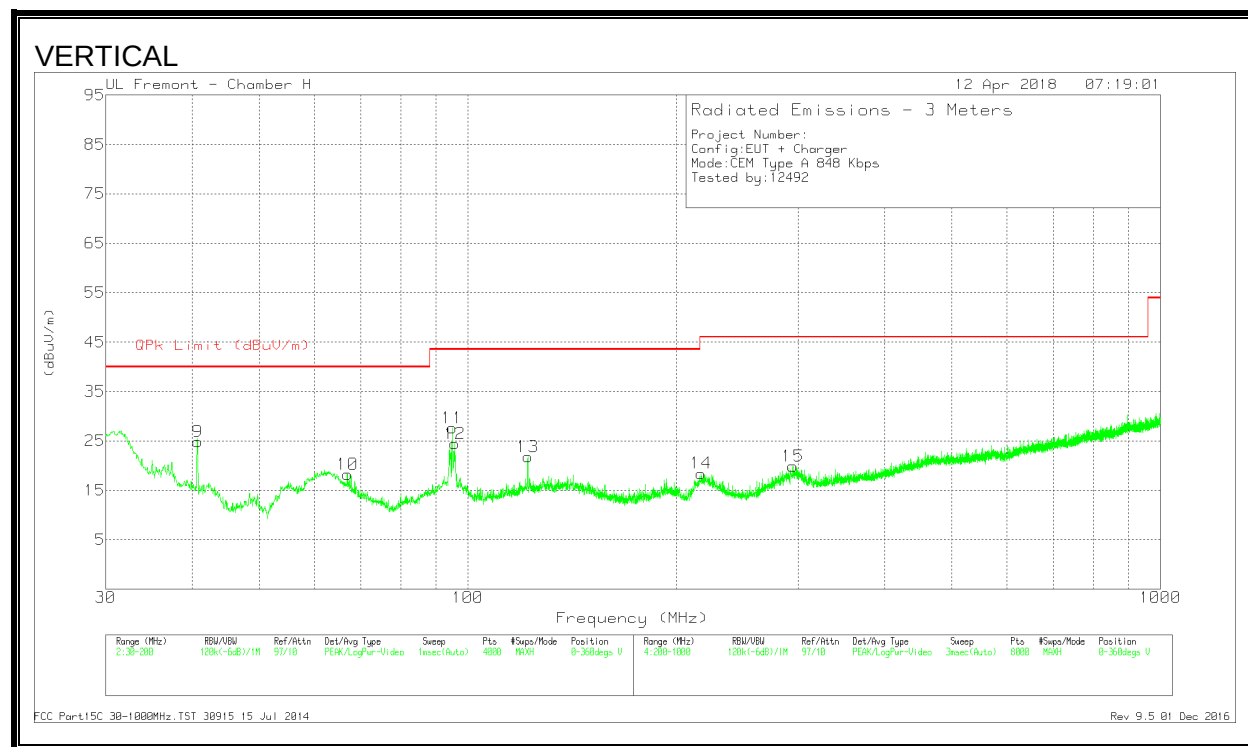
Note: Marker 2 and 8 are the fundamental signal.

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

8.3.1. CE MODE

SPURIOUS EMISSION 848Kbps





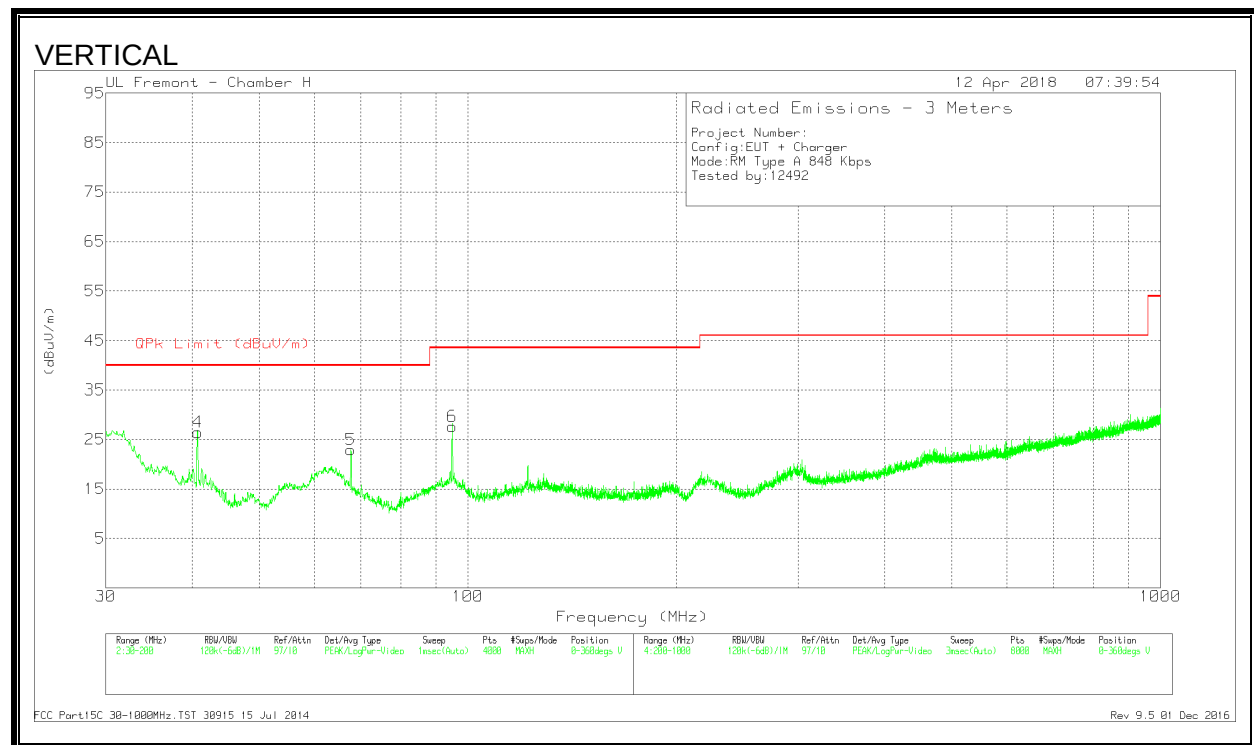
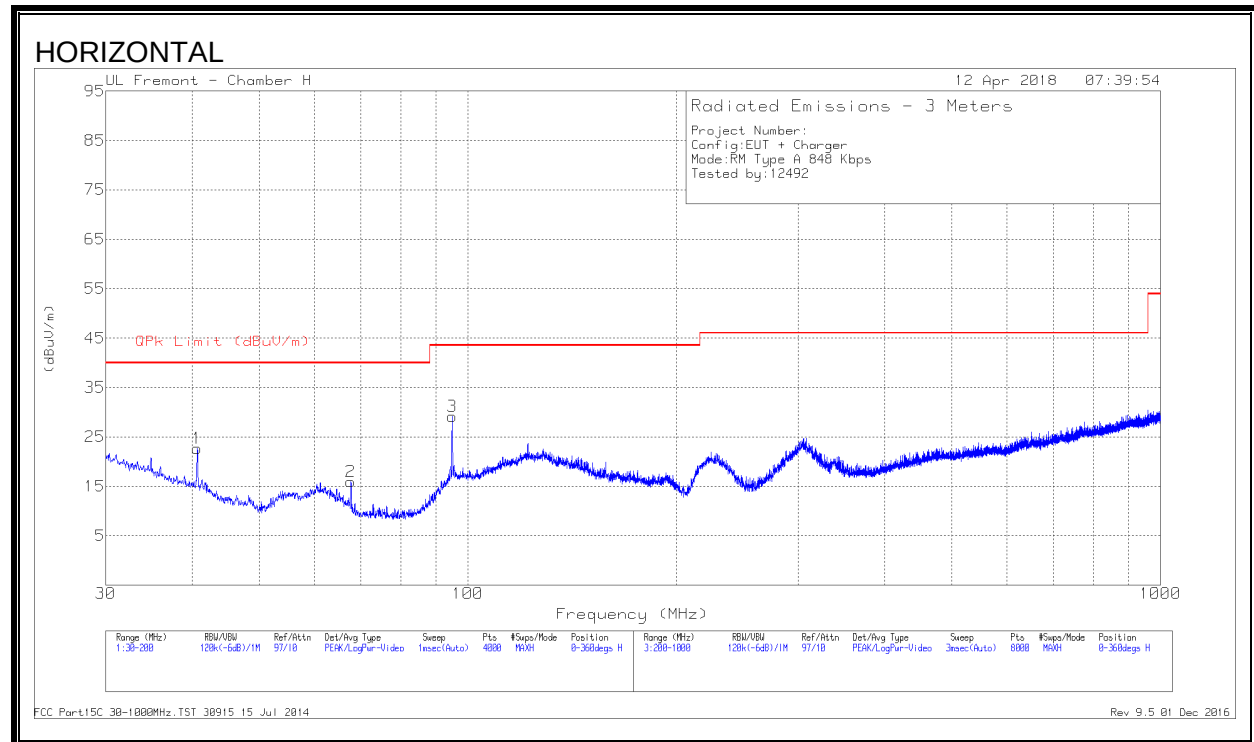
DATA

Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	AFT122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBUV/m)	QPk Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
13	* 122.0363	34.35	Pk	17.7	-30.3	21.75	43.52	-21.77	0-360	100	V
1	40.6703	33.99	Pk	17.6	-31.2	20.39	40	-19.61	0-360	399	H
9	40.7128	38.42	Pk	17.6	-31.2	24.82	40	-15.18	0-360	100	V
2	60.6504	35.36	Pk	11.3	-30.9	15.76	40	-24.24	0-360	399	H
3	65.0716	33.34	Pk	11.6	-30.8	14.14	40	-25.86	0-360	199	H
10	66.9846	37.35	Pk	11.7	-30.8	18.25	40	-21.75	0-360	100	V
4	94.9143	46.29	Pk	12.8	-30.6	28.49	43.52	-15.03	0-360	199	H
11	94.9143	45.39	Pk	12.8	-30.6	27.59	43.52	-15.93	0-360	100	V
5	95.7645	43.28	Pk	13	-30.6	25.68	43.52	-17.84	0-360	199	H
12	95.7645	42.03	Pk	13	-30.6	24.43	43.52	-19.09	0-360	100	V
6	145.885	36.11	Pk	16.6	-30.1	22.61	43.52	-20.91	0-360	199	H
14	217.2022	33.53	Pk	14.5	-29.6	18.43	46.02	-27.59	0-360	101	V
7	229.1038	36.98	Pk	15	-29.6	22.38	46.02	-23.64	0-360	100	H
15	294.6123	31.76	Pk	17.2	-29.1	19.86	46.02	-26.16	0-360	199	V
8	302.9134	35.89	Pk	17.3	-29.1	24.09	46.02	-21.93	0-360	100	H

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

8.3.2. READER MODE

SPURIOUS EMISSION 848Kbps



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	40.6703	36.33	Pk	17.6	-31.2	22.73	40	-17.27	0-360	399	H
4	40.7128	40.03	Pk	17.6	-31.2	26.43	40	-13.57	0-360	100	V
2	67.7923	34.96	Pk	11.8	-30.8	15.96	40	-24.04	0-360	199	H
5	67.7923	41.94	Pk	11.8	-30.8	22.94	40	-17.06	0-360	100	V
3	94.9143	47	Pk	12.8	-30.6	29.2	43.52	-14.32	0-360	299	H
6	94.9568	45.46	Pk	12.8	-30.6	27.66	43.52	-15.86	0-360	100	V

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

ID:	38602	Date:	3/26/18
------------	-------	--------------	---------

No non-compliance noted.

9.1. CE MODE

848Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C										
Limit: ± 100 ppm = 1.35600 KHz										
Power Supply	Envir. Temp	Frequency Deviation Measured with Time Elapse								
(VAC)	(°C)	Startup (KHz)	Delta (ppm)	@ 2 mins (KHz)	Delta (ppm)	@ 5 mins (KHz)	Delta (ppm)	@ 10 mins (KHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5601193	-1.581	13.5601239	-1.915	13.5601292	-2.311	13.5601350	-2.739	± 100
	40	13.5600940	0.287	13.5600952	0.201	13.5600968	0.081	13.5600988	-0.064	± 100
	30	13.5600925	0.398	13.5600920	0.437	13.5600915	0.468	13.5600913	0.483	± 100
	20	13.5600979	0.000	13.5600978	0.007	13.5600977	0.012	13.5600977	0.012	± 100
	10	13.5600939	0.291	13.5600972	0.052	13.5601007	-0.206	13.5601027	-0.353	± 100
	0	13.5601048	-0.509	13.5601068	-0.658	13.5601094	-0.851	13.5601122	-1.055	± 100
	-10	13.5601222	-1.792	13.5601238	-1.912	13.5601253	-2.024	13.5601265	-2.114	± 100
	-20	13.5601292	-2.310	13.5601288	-2.280	13.5601281	-2.231	13.5601273	-2.169	± 100
3.23	20	13.5601030	-0.374	13.5601030	-0.377	13.5601031	-0.387	13.5601032	-0.394	± 100
4.37	20	13.5601029	-0.371	13.5601024	-0.334	13.5601019	-0.293	13.5601011	-0.240	± 100

9.2. READER MODE

848Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C										
Limit: ± 100 ppm = 1.35600 KHz										
Power Supply	Envir. Temp	Frequency Deviation Measured with Time Elapse								
(VAC)	(°C)	Startup (KHz)	Delta (ppm)	@ 2 mins (KHz)	Delta (ppm)	@ 5 mins (KHz)	Delta (ppm)	@ 10 mins (KHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5601087	-0.532	13.5601127	-0.832	13.5601177	-1.195	13.5601231	-1.596	± 100
	40	13.5601127	-0.828	13.5601082	-0.497	13.5601041	-0.194	13.5601007	0.054	± 100
	30	13.5600929	0.628	13.5600918	0.710	13.5600911	0.767	13.5600908	0.783	± 100
	20	13.5601015	0.000	13.5601011	0.028	13.5601008	0.046	13.5601004	0.079	± 100
	10	13.5601030	-0.113	13.5601032	-0.132	13.5601033	-0.135	13.5601035	-0.154	± 100
	0	13.5601089	-0.548	13.5601110	-0.701	13.5601135	-0.889	13.5601159	-1.066	± 100
	-10	13.5601293	-2.052	13.5601289	-2.026	13.5601286	-1.999	13.5601280	-1.955	± 100
	-20	13.5601235	-1.627	13.5601252	-1.752	13.5601267	-1.862	13.5601279	-1.948	± 100
3.23	20	13.5601028	-0.099	13.5601036	-0.160	13.5601040	-0.188	13.5601040	-0.188	± 100
4.37	20	13.5601012	0.016	13.5601001	0.103	13.5600996	0.138	13.5600992	0.167	± 100

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

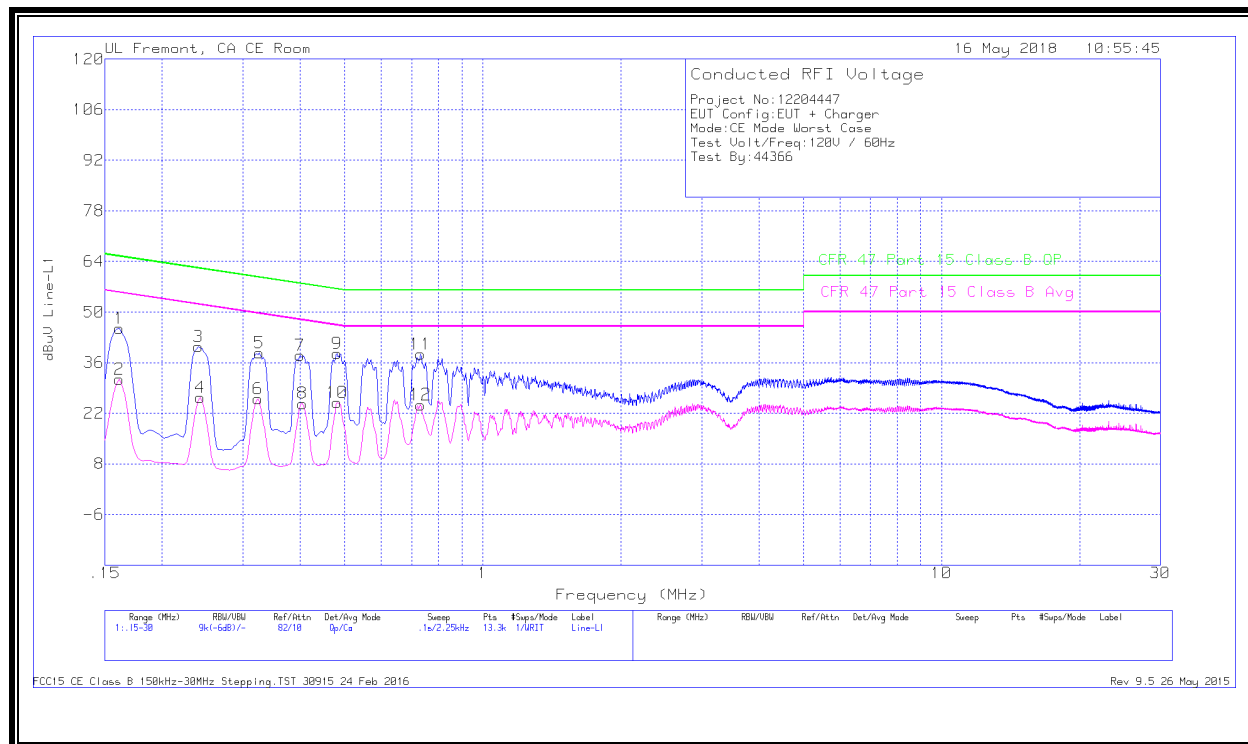
RESULTS

No non-compliance noted:

10.1. CE MODE

10.1.1. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



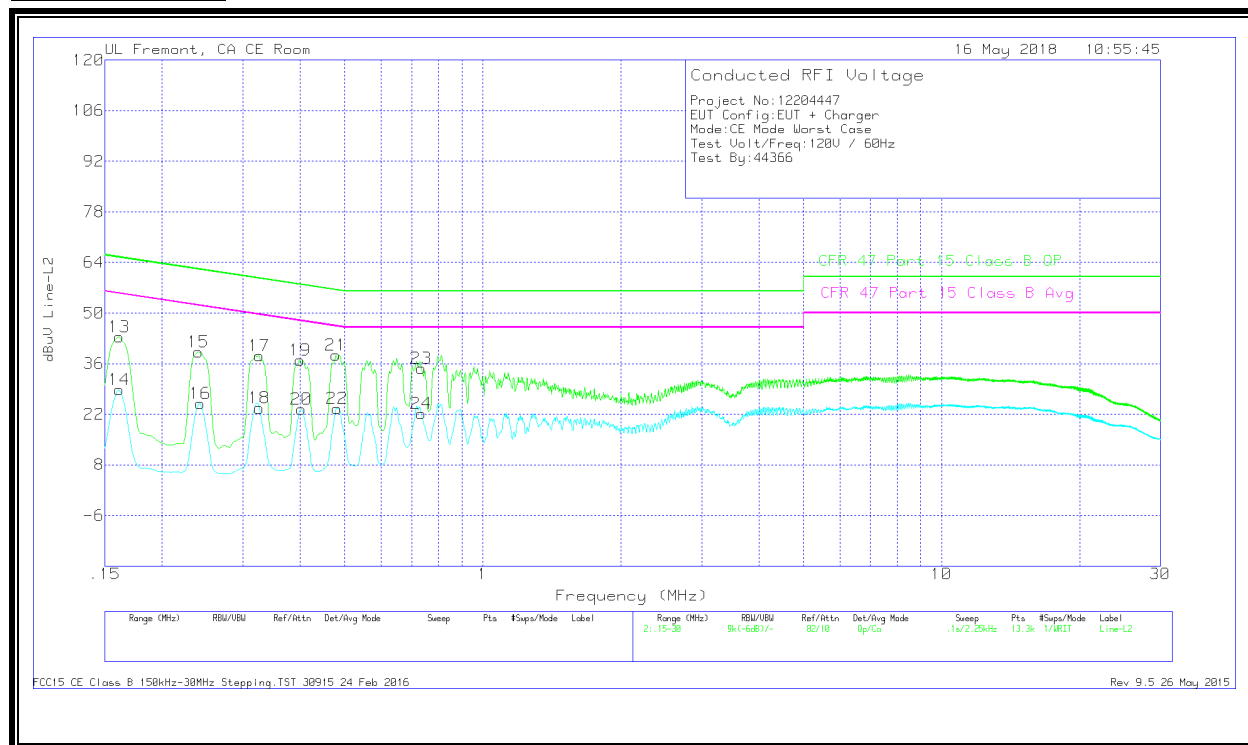
WORST EMISSIONS

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	35.27	Qp	.1	0	10.1	45.47	65.4	-19.93	-	-
2	.16125	21.18	Ca	.1	0	10.1	31.38	-	-	55.4	-24.02
3	.24	30.26	Qp	0	0	10.1	40.36	62.1	-21.74	-	-
4	.24225	16.21	Ca	0	0	10.1	26.31	-	-	52.02	-25.71
5	.3255	28.62	Qp	0	0	10.1	38.72	59.57	-20.85	-	-
6	.32325	15.91	Ca	0	0	10.1	26.01	-	-	49.62	-23.61
7	.39975	27.98	Qp	0	0	10.1	38.08	57.86	-19.78	-	-
8	.40425	14.61	Ca	0	0	10.1	24.71	-	-	47.77	-23.06
9	.48075	28.42	Qp	0	0	10.1	38.52	56.33	-17.81	-	-
10	.48075	14.82	Ca	0	0	10.1	24.92	-	-	46.33	-21.41
11	.73275	28.21	Qp	0	0	10.1	38.31	56	-17.69	-	-
12	.73275	14.26	Ca	0	0	10.1	24.36	-	-	46	-21.64

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	.16125	33.24	Qp	0	0	10.1	43.34	65.4	-22.06	-	-
14	.16125	18.74	Ca	0	0	10.1	28.84	-	-	55.4	-26.56
15	.24	29.17	Qp	0	0	10.1	39.27	62.1	-22.83	-	-
16	.24225	14.85	Ca	0	0	10.1	24.95	-	-	52.02	-27.07
17	.3255	28	Qp	0	0	10.1	38.1	59.57	-21.47	-	-
18	.3255	13.57	Ca	0	0	10.1	23.67	-	-	49.57	-25.9
19	.39975	26.85	Qp	0	0	10.1	36.95	57.86	-20.91	-	-
20	.402	13.29	Ca	0	0	10.1	23.39	-	-	47.81	-24.42
21	.4785	28.28	Qp	0	0	10.1	38.38	56.37	-17.99	-	-
22	.48075	13.44	Ca	0	0	10.1	23.54	-	-	46.33	-22.79
23	.735	24.62	Qp	0	0	10.1	34.72	56	-21.28	-	-
24	.735	12.04	Ca	0	0	10.1	22.14	-	-	46	-23.86

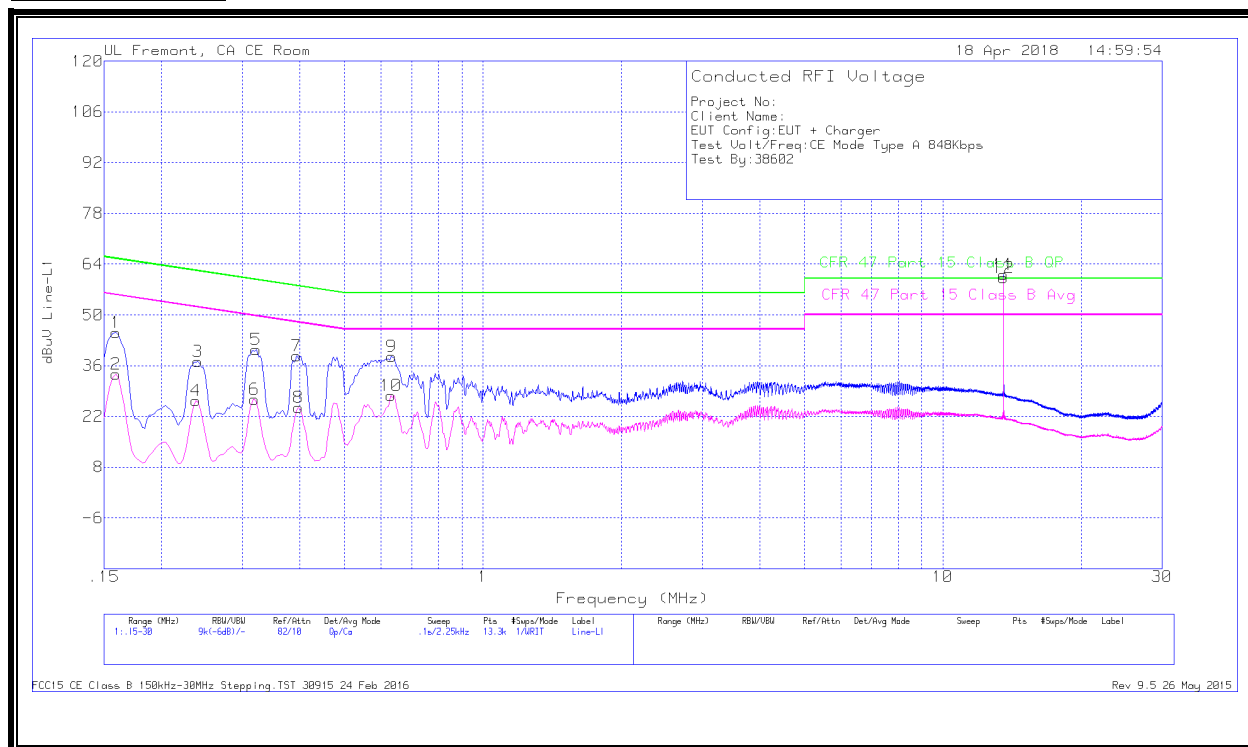
Qp - Quasi-Peak detector

Ca - CISPR average detection

FCC15 CE Class B 150kHz-30MHz Stepping.TST 30915 24 Feb 2016
Rev 9.5 26 May 2015

10.1.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



WORST EMISSIONS

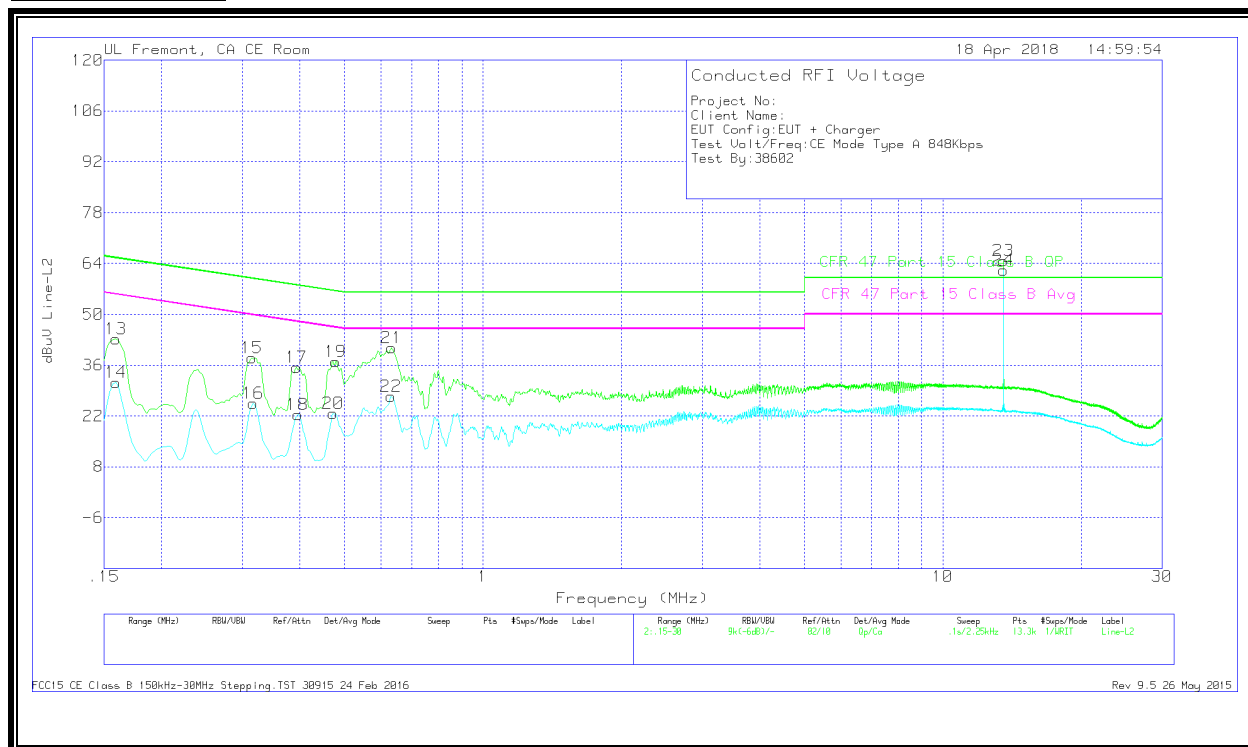
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.159	34.97	Qp	.1	0	10.1	45.17	65.52	-20.35	-	-
2	.159	23.45	Ca	.1	0	10.1	33.65	-	-	55.52	-21.87
3	.24	27.03	Qp	0	0	10.1	37.13	62.1	-24.97	-	-
4	.23775	16.18	Ca	0	0	10.1	26.28	-	-	52.17	-25.89
5	.321	30.26	Qp	0	0	10.1	40.36	59.68	-19.32	-	-
6	.31875	16.66	Ca	0	0	10.1	26.76	-	-	49.74	-22.98
7	.393	28.59	Qp	0	0	10.1	38.69	58	-19.31	-	-
8	.3975	14.32	Ca	0	0	10.1	24.42	-	-	47.91	-23.49
9	.63262	28.39	Qp	0	0	10.1	38.49	56	-17.51	-	-
10	.6315	17.71	Ca	0	0	10.1	27.81	-	-	46	-18.19
11	13.56	50.68	Qp	.1	.2	10.2	61.18	60	1.18	-	-
12	13.56	49.81	Ca	.1	.2	10.2	60.31	-	-	50	10.31

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	33.16	Qp	0	0	10.1	43.26	65.52	-22.26	-	-
14	.159	21.18	Ca	0	0	10.1	31.28	-	-	55.52	-24.24
15	.31425	27.97	Qp	0	0	10.1	38.07	59.86	-21.79	-	-
16	.3165	15.46	Ca	0	0	10.1	25.56	-	-	49.8	-24.24
17	.393	25.28	Qp	0	0	10.1	35.38	58	-22.62	-	-
18	.39525	12.34	Ca	0	0	10.1	22.44	-	-	47.95	-25.51
19	.4785	26.94	Qp	0	0	10.1	37.04	56.37	-19.33	-	-
20	.47175	12.62	Ca	0	0	10.1	22.72	-	-	46.48	-23.76
21	.63375	30.72	Qp	0	0	10.1	40.82	56	-15.18	-	-
22	.6315	17.3	Ca	0	0	10.1	27.4	-	-	46	-18.6
23	13.56	54.29	Qp	.1	.2	10.2	64.79	60	4.79	-	-
24	13.56	51.69	Ca	.1	.2	10.2	62.19	-	-	50	12.19

Qp - Quasi-Peak detector

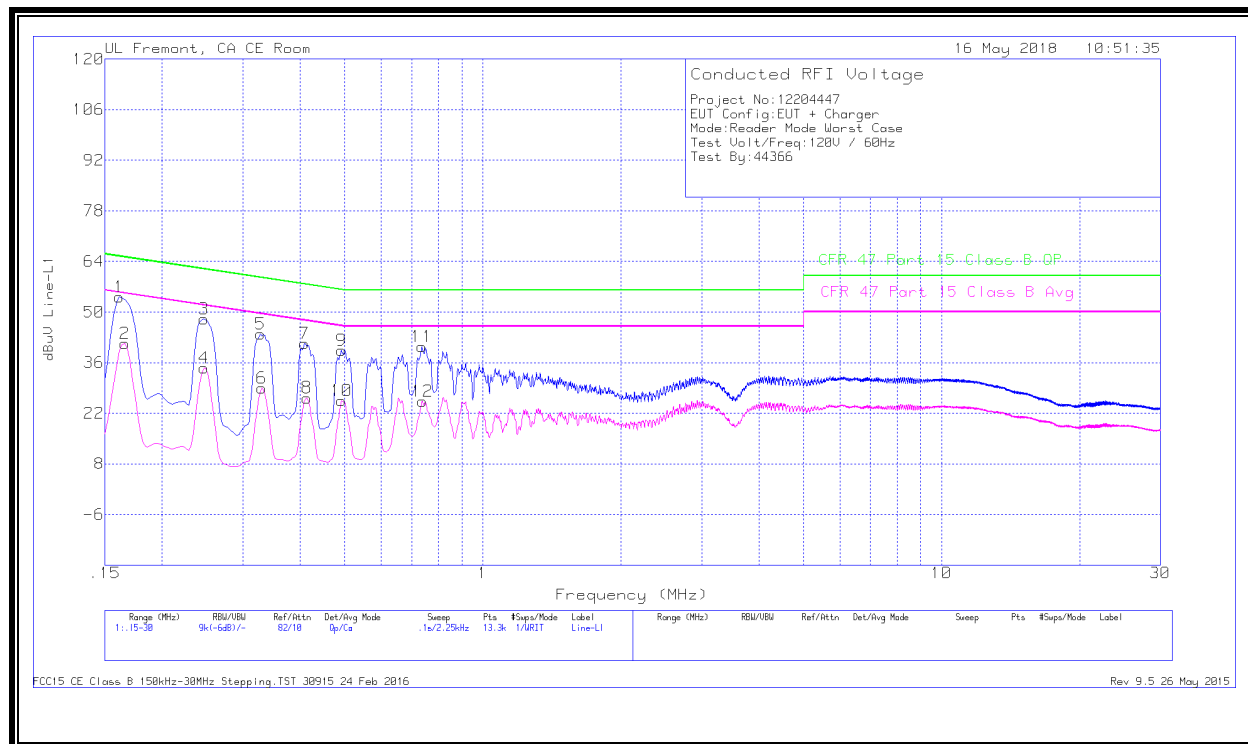
Ca - CISPR average detection

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



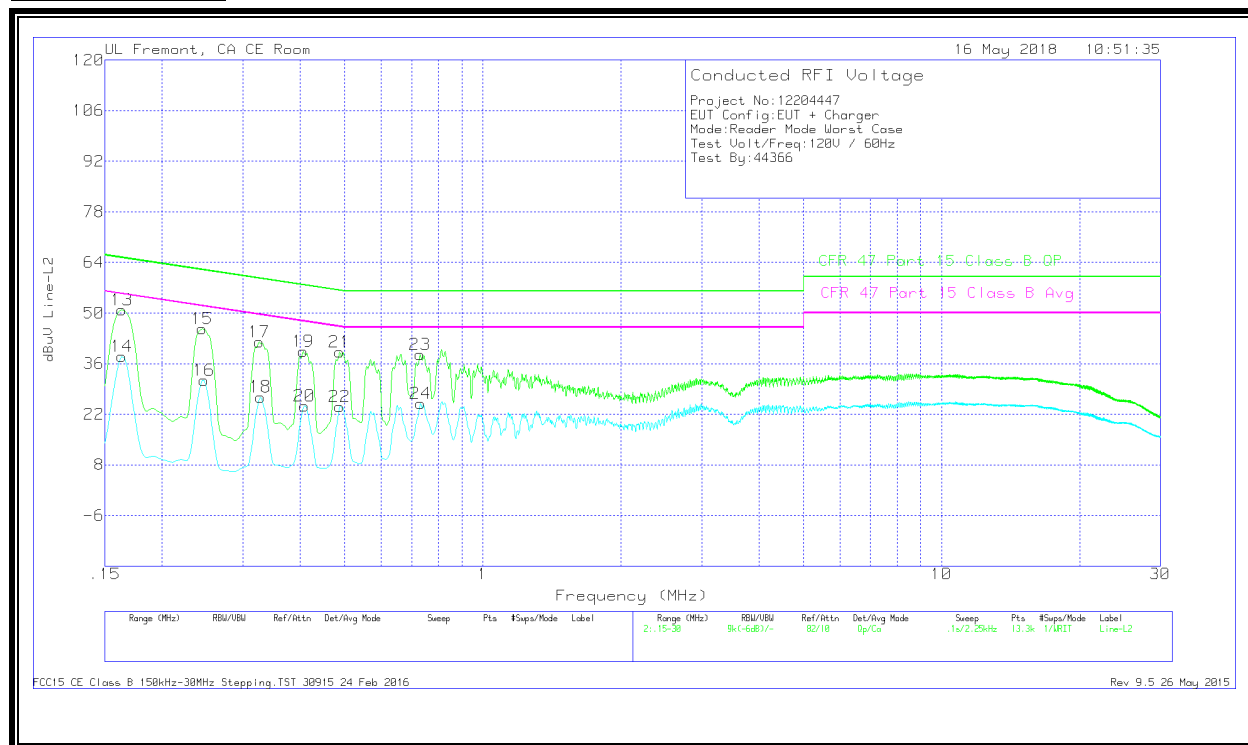
WORST EMISSIONS

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	.16125	43.93	Qp	.1	0	10.1	54.13	65.4	-11.27	-	-
2	.16575	31.16	Ca	.1	0	10.1	41.36	-	-	55.17	-13.81
3	.24675	37.96	Qp	0	0	10.1	48.06	61.87	-13.81	-	-
4	.24675	24.46	Ca	0	0	10.1	34.56	-	-	51.87	-17.31
5	.32775	33.84	Qp	0	0	10.1	43.94	59.51	-15.57	-	-
6	.33	18.85	Ca	0	0	10.1	28.95	-	-	49.45	-20.5
7	.40875	31.22	Qp	0	0	10.1	41.32	57.67	-16.35	-	-
8	.41325	16.17	Ca	0	0	10.1	26.27	-	-	47.58	-21.31
9	.492	29.23	Qp	0	0	10.1	39.33	56.13	-16.8	-	-
10	.492	15.36	Ca	0	0	10.1	25.46	-	-	46.13	-20.67
11	.73725	30.26	Qp	0	0	10.1	40.36	56	-15.64	-	-
12	.7395	15.22	Ca	0	0	10.1	25.32	-	-	46	-20.68

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	40.7	Qp	0	0	10.1	50.8	65.28	-14.48	-	-
14	.1635	27.83	Ca	0	0	10.1	37.93	-	-	55.28	-17.35
15	.2445	35.54	Qp	0	0	10.1	45.64	61.94	-16.3	-	-
16	.24675	21.27	Ca	0	0	10.1	31.37	-	-	51.87	-20.5
17	.3255	31.84	Qp	0	0	10.1	41.94	59.57	-17.63	-	-
18	.32775	16.69	Ca	0	0	10.1	26.79	-	-	49.51	-22.72
19	.4065	29.29	Qp	0	0	10.1	39.39	57.72	-18.33	-	-
20	.40875	14.22	Ca	0	0	10.1	24.32	-	-	47.67	-23.35
21	.4875	29.07	Qp	0	0	10.1	39.17	56.21	-17.04	-	-
22	.4875	14.01	Ca	0	0	10.1	24.11	-	-	46.21	-22.1
23	.7305	28.48	Qp	0	0	10.1	38.58	56	-17.42	-	-
24	.73275	14.88	Ca	0	0	10.1	24.98	-	-	46	-21.02

Qp - Quasi-Peak detector

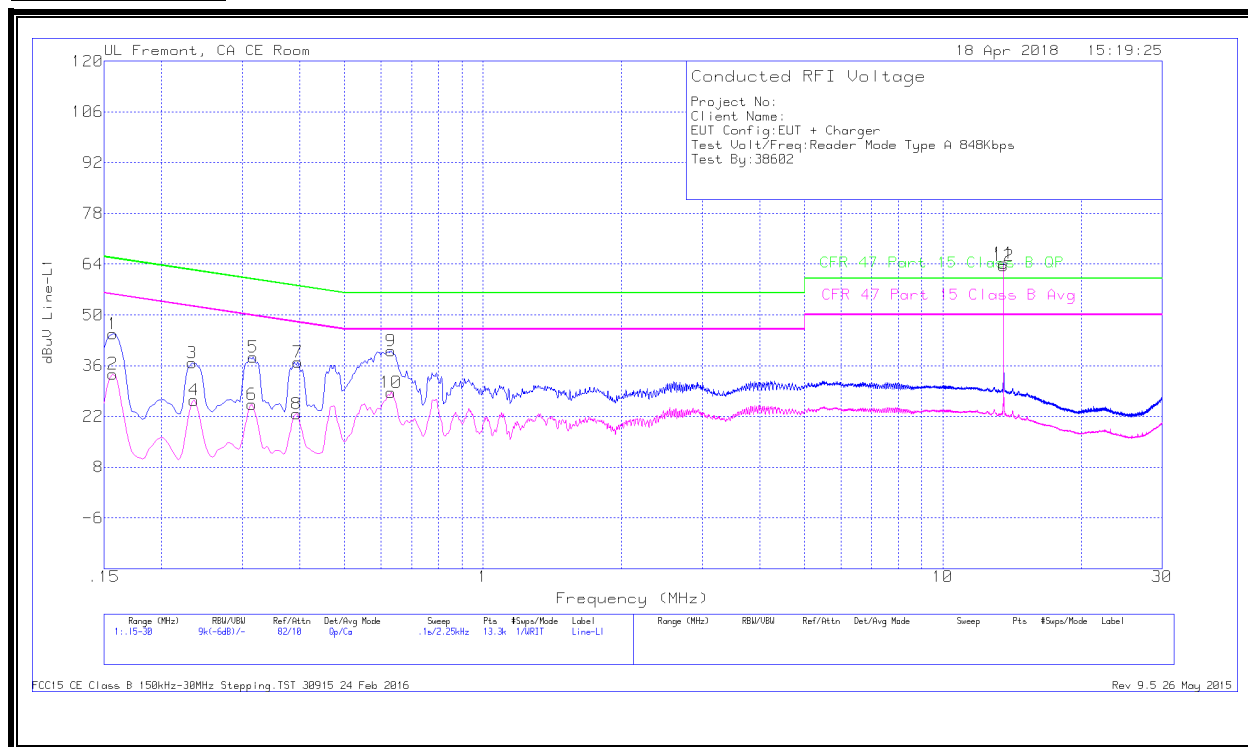
Ca - CISPR average detection

FCC15 CE Class B 150kHz-30MHz Stepping.TST 30915 24 Feb 2016

Rev 9.5 26 May 2015

10.2.2. NORMAL OPERATION WITHOUT ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



WORST EMISSIONS

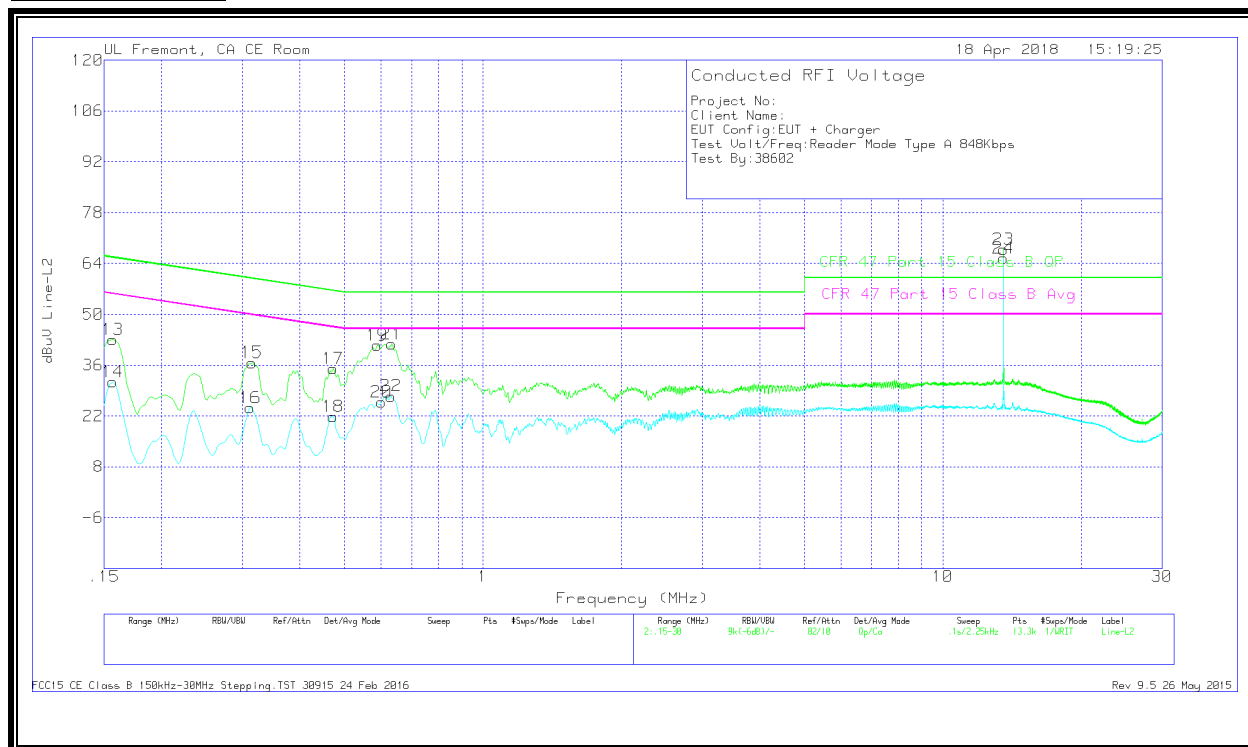
Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR) Margin (dB)
1	.15675	34.65	Qp	.1	0	10.1	44.85	65.63	-20.78	-	-
2	.15675	23.54	Ca	.1	0	10.1	33.74	-	-	55.63	-21.89
3	.23325	26.68	Qp	0	0	10.1	36.78	62.33	-25.55	-	-
4	.2355	16.35	Ca	0	0	10.1	26.45	-	-	52.25	-25.8
5	.3165	28.25	Qp	0	0	10.1	38.35	59.8	-21.45	-	-
6	.31425	15.18	Ca	0	0	10.1	25.28	-	-	49.86	-24.58
7	.39525	26.85	Qp	0	0	10.1	36.95	57.95	-21	-	-
8	.393	12.66	Ca	0	0	10.1	22.76	-	-	48	-25.24
9	.6315	29.96	Qp	0	0	10.1	40.06	56	-15.94	-	-
10	.6315	18.5	Ca	0	0	10.1	28.6	-	-	46	-17.4
11	13.56	53.72	Qp	.1	.2	10.2	64.22	60	4.22	-	-
12	13.56	53.12	Ca	.1	.2	10.2	63.62	-	-	50	13.62

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	33	Qp	0	0	10.1	43.1	65.63	-22.53	-	-
14	.15675	21.26	Ca	0	0	10.1	31.36	-	-	55.63	-24.27
15	.31425	26.6	Qp	0	0	10.1	36.7	59.86	-23.16	-	-
16	.312	14.2	Ca	0	0	10.1	24.3	-	-	49.92	-25.62
17	.47175	24.87	Qp	0	0	10.1	34.97	56.48	-21.51	-	-
18	.47175	11.8	Ca	0	0	10.1	21.9	-	-	46.48	-24.58
19	.58875	31.42	Qp	0	0	10.1	41.52	56	-14.48	-	-
20	.60225	15.78	Ca	0	0	10.1	25.88	-	-	46	-20.12
21	.63375	31.68	Qp	0	0	10.1	41.78	56	-14.22	-	-
22	.6315	17.39	Ca	0	0	10.1	27.49	-	-	46	-18.51
23	13.56	57.36	Qp	.1	.2	10.2	67.86	60	7.86	-	-
24	13.56	54.89	Ca	.1	.2	10.2	65.39	-	-	50	15.39

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 12204447-EP1V1 for setup photos