



CERTIFICATION TEST REPORT

Report Number. : 12258201-E11V2

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

Model : A2106

FCC ID : BCG-E3238A

IC : 579C-E3238A

EUT Description : SMARTPHONE

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

Date Of Issue:
August 27, 2018

Prepared by:
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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	08/22/2018	Initial Issue	Chin Pang
V2	08/27/2018	Address TCB Question	Joe Vang

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: SMARTPHONE

MODEL: A2106

SERIAL NUMBER: C7CWN025K3MW

DATE TESTED: JUNE 21 – JULY 13, 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.

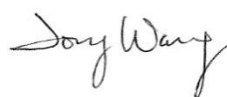
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. 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:



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, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd
☐ Chamber A (ISED:2324B-1)	☒ Chamber D (ISED:22541-1)	☐ Chamber K (ISED:2324A-1)
☐ Chamber B (ISED:2324B-2)	☒ Chamber E (ISED:22541-2)	☐ Chamber L (ISED:2324A-3)
☐ 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 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. Chambers K and L are covered under ISED company address code 2324A with site numbers 2324A-1 and 2324A-3, respectively.

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:

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

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	25.67
		Reader	848	26.52

5.3. WORST-CASE CONFIGURATION AND MODE

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

EUT was investigated with RX antenna Face-on, Face-off and horizontal(parallel to ground). 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 on RX antenna Face-on and Face-off; 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 area 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.

5.4. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	Mac Book Pro	C02PM012G3QD	FCC DoC
Laptop AC/DC Adapter	Apple	85W MagSAfe Power adapter	A1286	N/A
EUT AC/DC Adapter	Apple	A1385	N/A	N/A

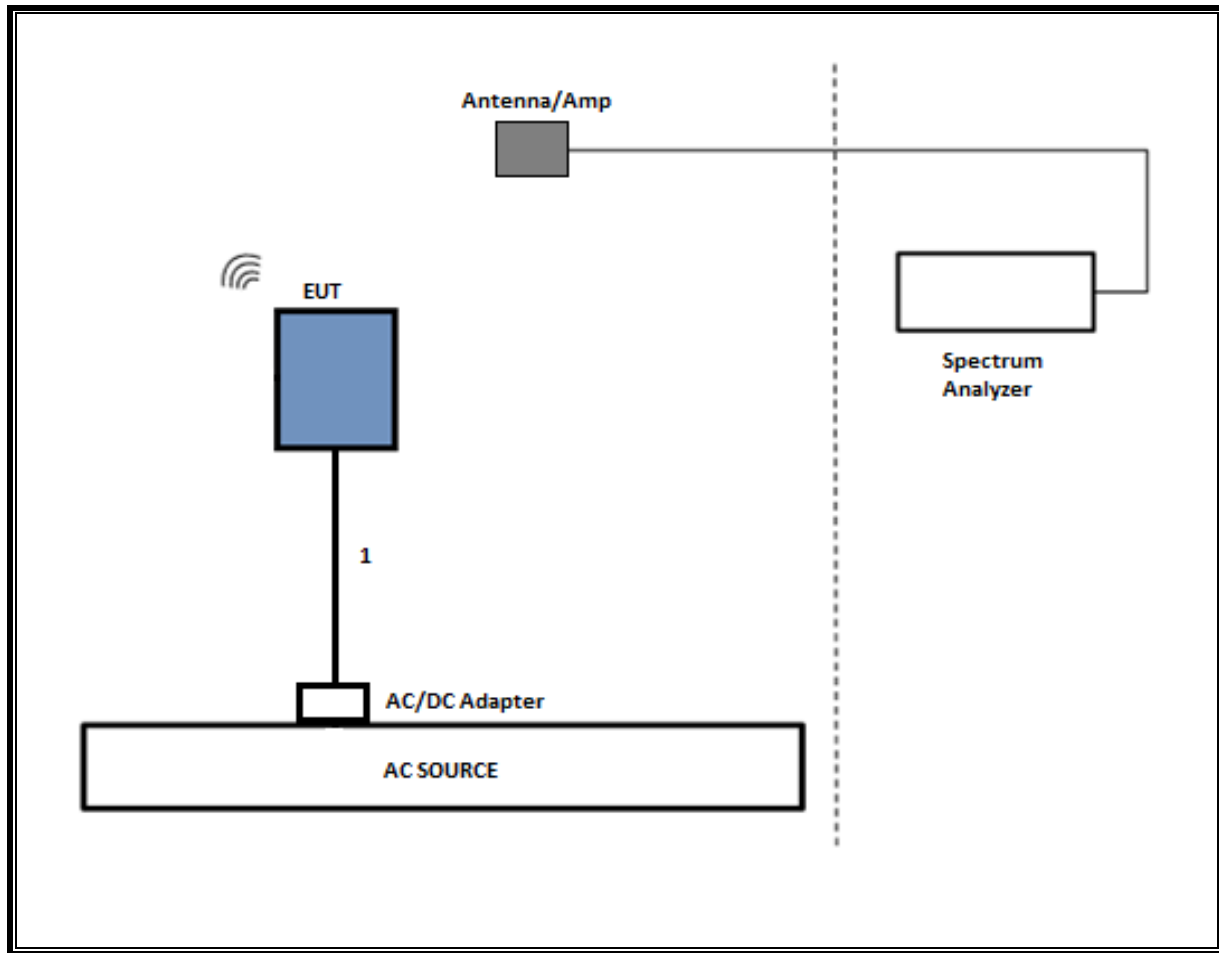
I/O CABLES

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

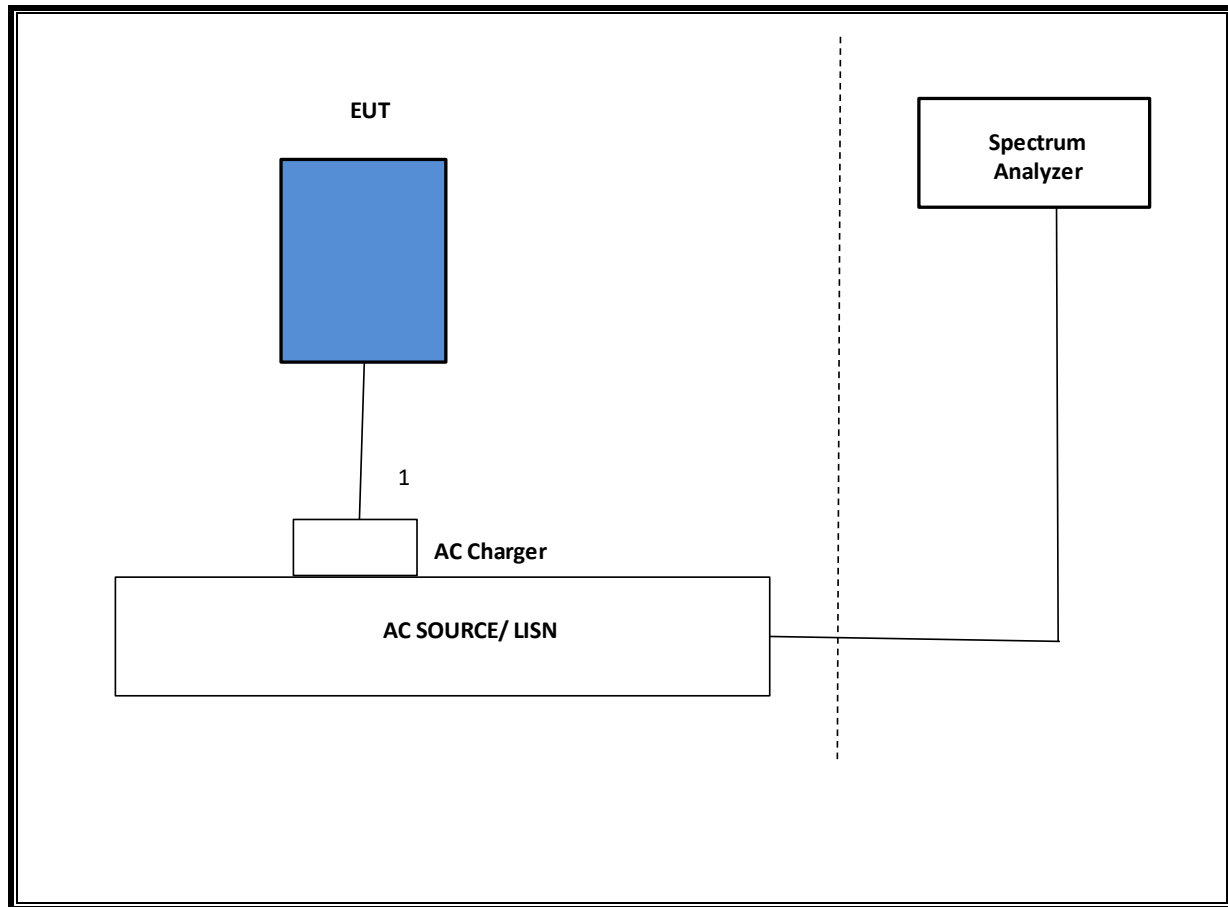
TEST SETUP

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

SETUP DIAGRAM



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, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB3	T408	12/15/2018
*Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	06/24/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T342	02/22/2019
Spectrum Analyzer, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	04/12/2019
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T340	12/15/2018
Antenna, Active Loop 9KHz to 30MHz	EMCO	6502	T35	12/15/2018
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	T1154	09/05/2018
Antenna, Active Loop 9KHz to 30MHz	EMCO	6502	T1616	09/14/2018
Spectrum Analyzer, PXA 3Hz to 44GHz	Keysight	N9030A	T906	02/16/2019

AC Line Conducted				
EMI Test Receiver 9KHz-7GHz	Rohde & Schwarz	ESCI7	T1436	01/25/2019
Power Cable, Line Conducted Emissions	UL	PG1	T861	08/31/2018
**LISN for Conducted Emissions CISPR-16	Fischer	50/250-25-2-01	T1310	06/19/2018
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	

Note: *Testing is completed before equipment expiration date

**Testing is completed after calibration was done

7. OCCUPIED BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

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

TYPE A (CE MODE)

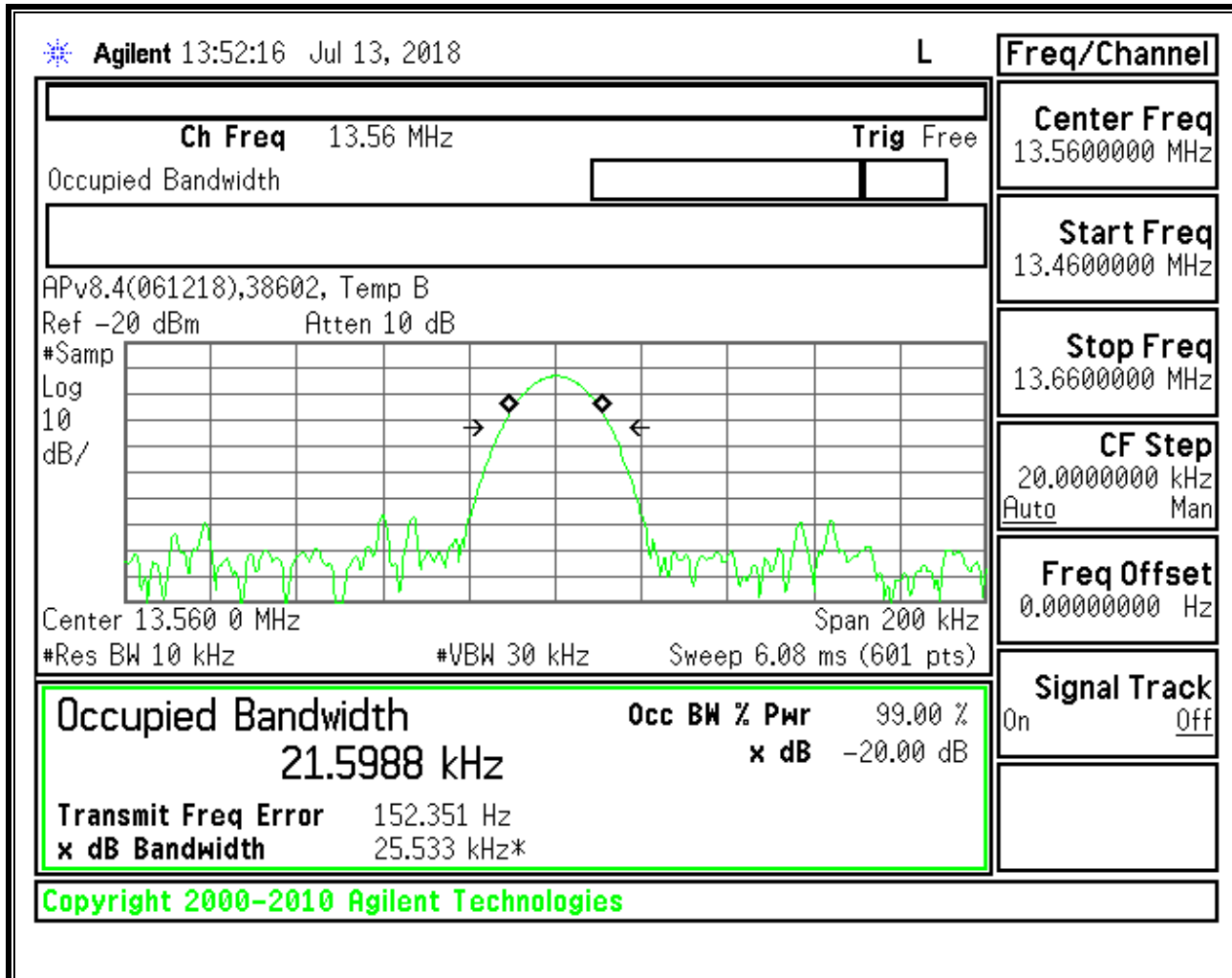
Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.5988	25.533

TYPE A (READER MODE)

Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.6214	25.584

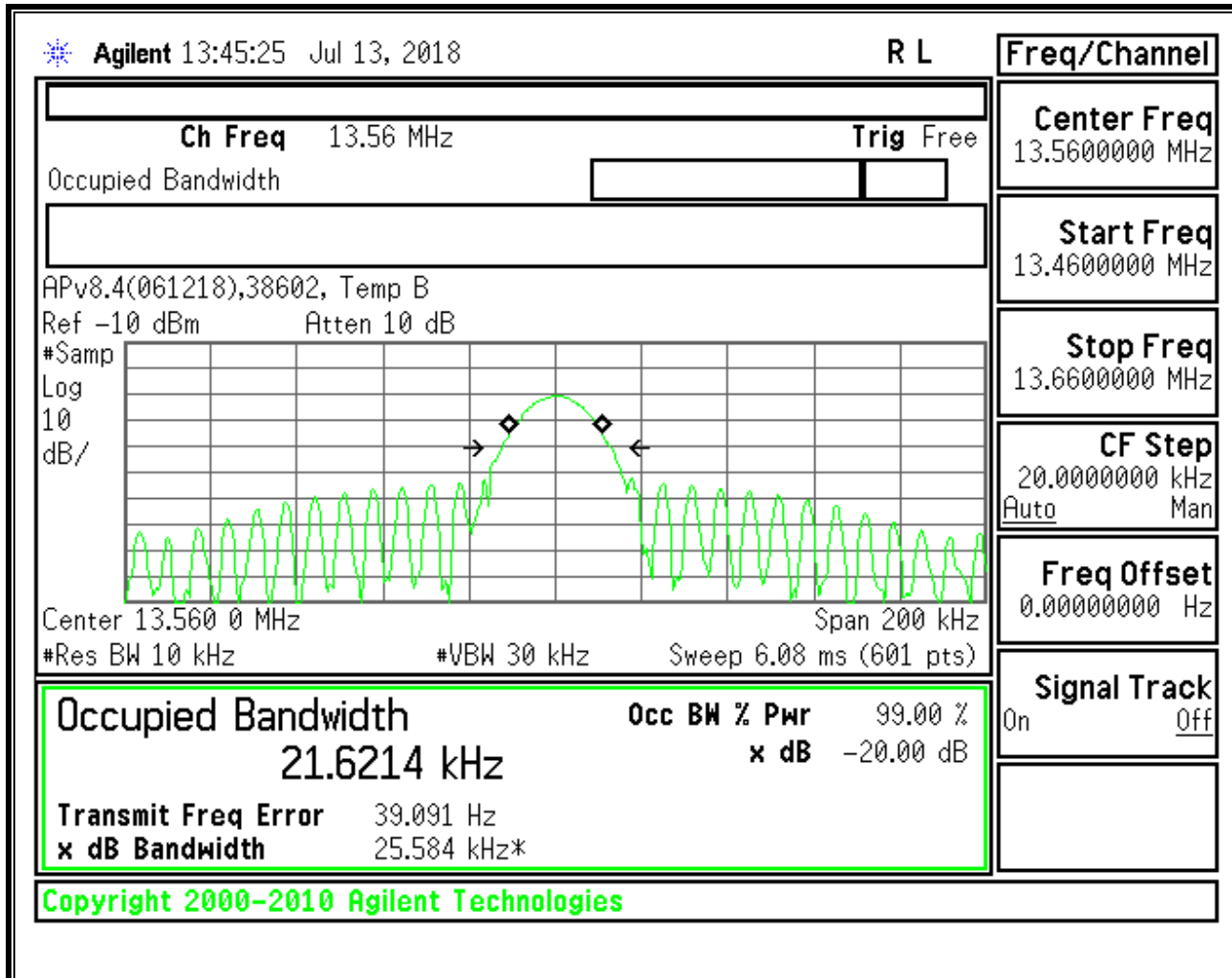
7.1. CE MODE

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 µV/m to dBuV/m is:

Limit (dBuV/m) = 20 log limit (µV/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

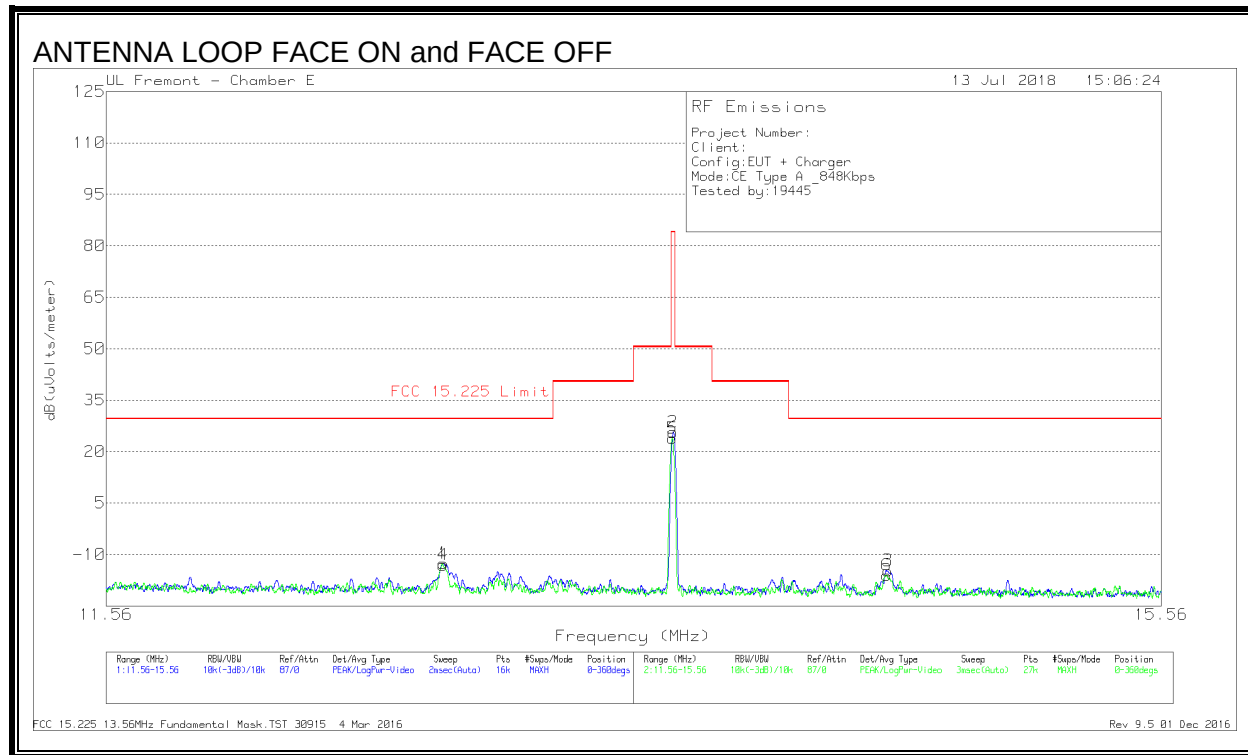
The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 13.56 MHz; therefore, the frequency range was investigated from 0.15 MHz to the 10th harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater.

RESULTS

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

8.2.1. CE MODE

FUNDAMENTAL 848Kbps



DATA

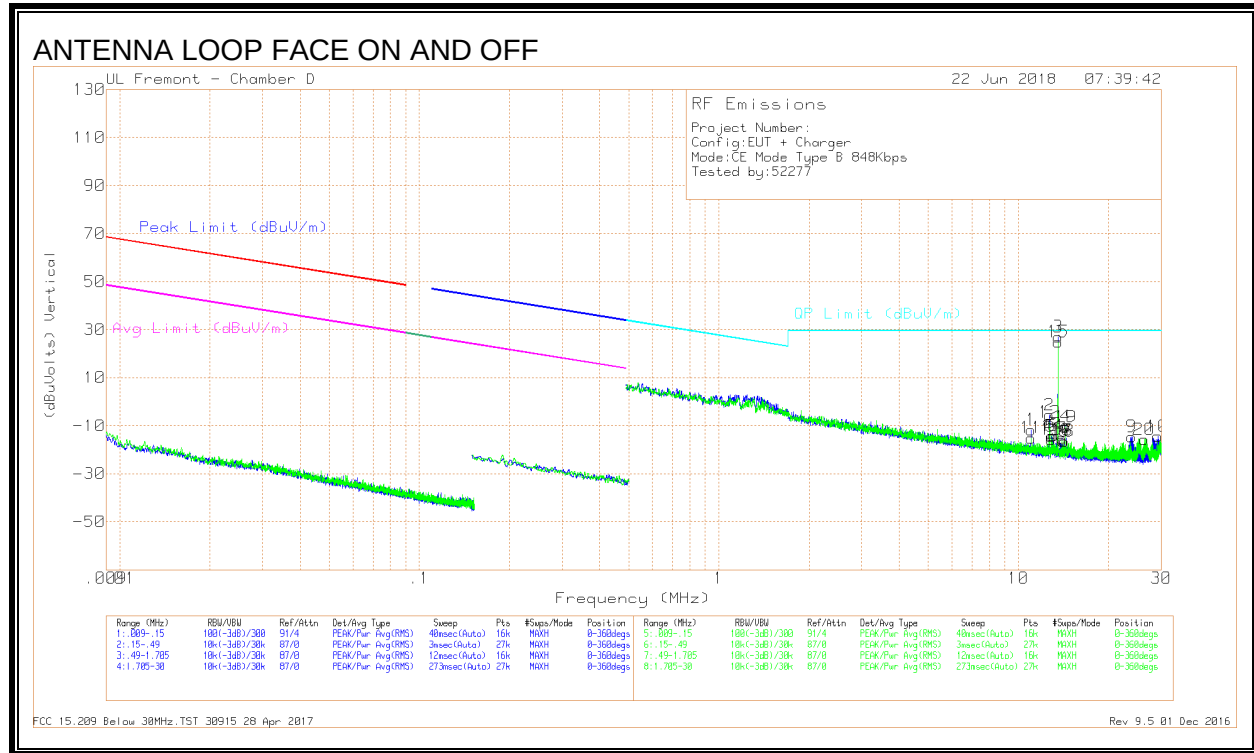
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr (dB) 40Log	Corrected Reading dB(uVolts/meter)	FCC 15.225 Limit	PK Margin (dB)	Azimuth (Degs)
4	12.70996	15.78	Pk	10.7	.5	-40	-13.02	29.54	-42.56	0-360
1	12.71138	16.23	Pk	10.7	.5	-40	-12.57	29.54	-42.11	0-360
5	13.55807	52.76	Pk	10.6	.5	-40	23.86	84	-60.14	0-360
2	13.561	54.57	Pk	10.6	.5	-40	25.67	84	-58.33	0-360
6	14.40153	12.91	Pk	10.6	.5	-40	-15.99	29.54	-45.53	0-360
3	14.40638	14.16	Pk	10.6	.5	-40	-14.74	29.54	-44.28	0-360

Pk - Peak detector

FCC 15.225 13.56MHz Fundamental Mask.TST 30915 4 Mar 2016

Rev 9.5 01 Dec 2016

SPURIOUS EMISSION 848Kbps



DATA

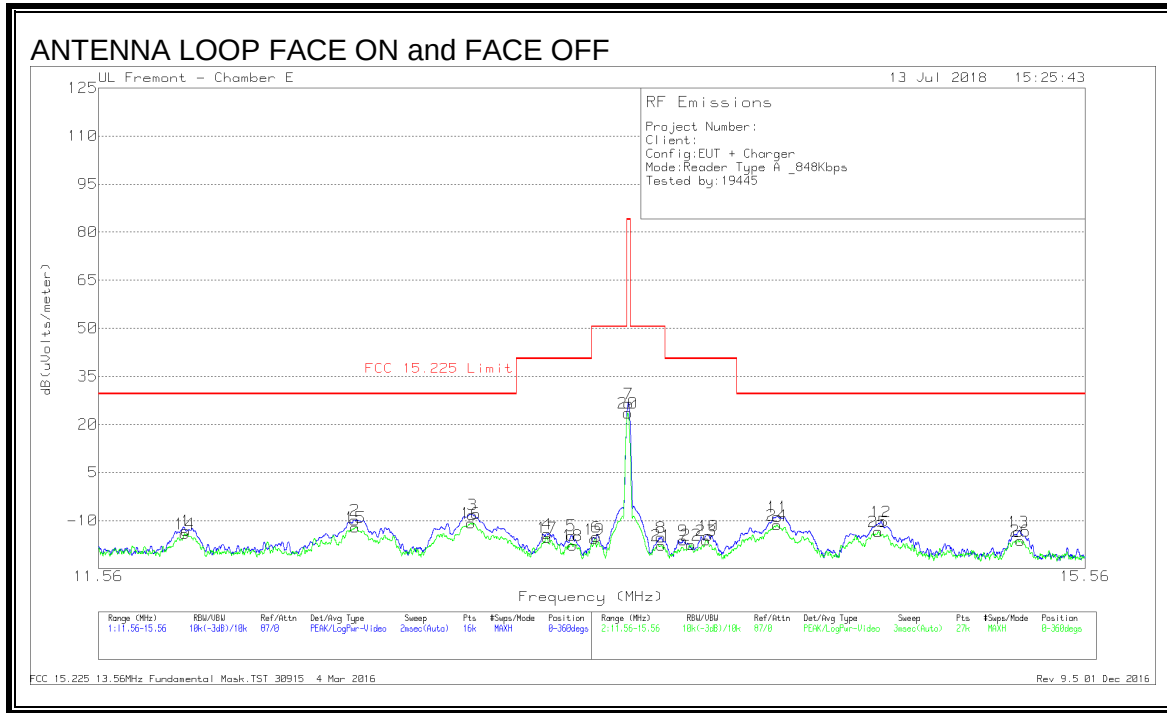
Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	Loop Antenna (dBm)	Cables (dB)	Dist Corr 30m	Corrected Reading (dBUVolts)	QP Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)
11	11.01543	13.65	Pk	10.9	.4	-40	-15.05	29.5	-44.55	0-360
1	11.017	16.99	Pk	10.9	.4	-40	-11.71	29.5	-41.21	0-360
2	12.71319	23.27	Pk	10.8	.4	-40	-5.53	29.5	-35.03	0-360
12	12.71529	20.2	Pk	10.8	.4	-40	-8.6	29.5	-38.1	0-360
5	12.88192	14.44	Pk	10.8	.4	-40	-14.36	29.5	-43.86	0-360
13	12.88716	13.07	Pk	10.8	.4	-40	-15.73	29.5	-45.23	0-360
14	12.96419	14.63	Pk	10.8	.4	-40	-14.17	29.5	-43.67	0-360
6	13.13554	14.69	Pk	10.8	.4	-40	-14.11	29.5	-43.61	0-360
16	13.98651	12.89	Pk	10.7	.4	-40	-16.01	29.5	-45.51	0-360
17	13.98651	12.89	Pk	10.7	.4	-40	-16.01	29.5	-45.51	0-360
7	13.98966	13.71	Pk	10.7	.4	-40	-15.19	29.5	-44.69	0-360
18	14.14843	12.46	Pk	10.7	.4	-40	-16.44	29.5	-45.94	0-360
8	14.23489	12.34	Pk	10.7	.4	-40	-16.56	29.5	-46.06	0-360
19	14.40676	18.31	Pk	10.7	.4	-40	-10.59	29.5	-40.09	0-360
4	14.40833	18.66	Pk	10.7	.4	-40	-10.24	29.5	-39.74	0-360
9	23.86077	15.33	Pk	9.6	.5	-40	-14.57	29.5	-44.07	0-360
20	26.27536	14.62	Pk	9.1	.5	-40	-15.78	29.5	-45.28	0-360
10	29.20871	16.62	Pk	8.5	.5	-40	-14.38	29.5	-43.88	0-360

Pk - Peak detector

Note: Marker 3 & 15 are the fundamental signal.

8.2.2. READER MODE

FUNDAMENTAL 848Kbps



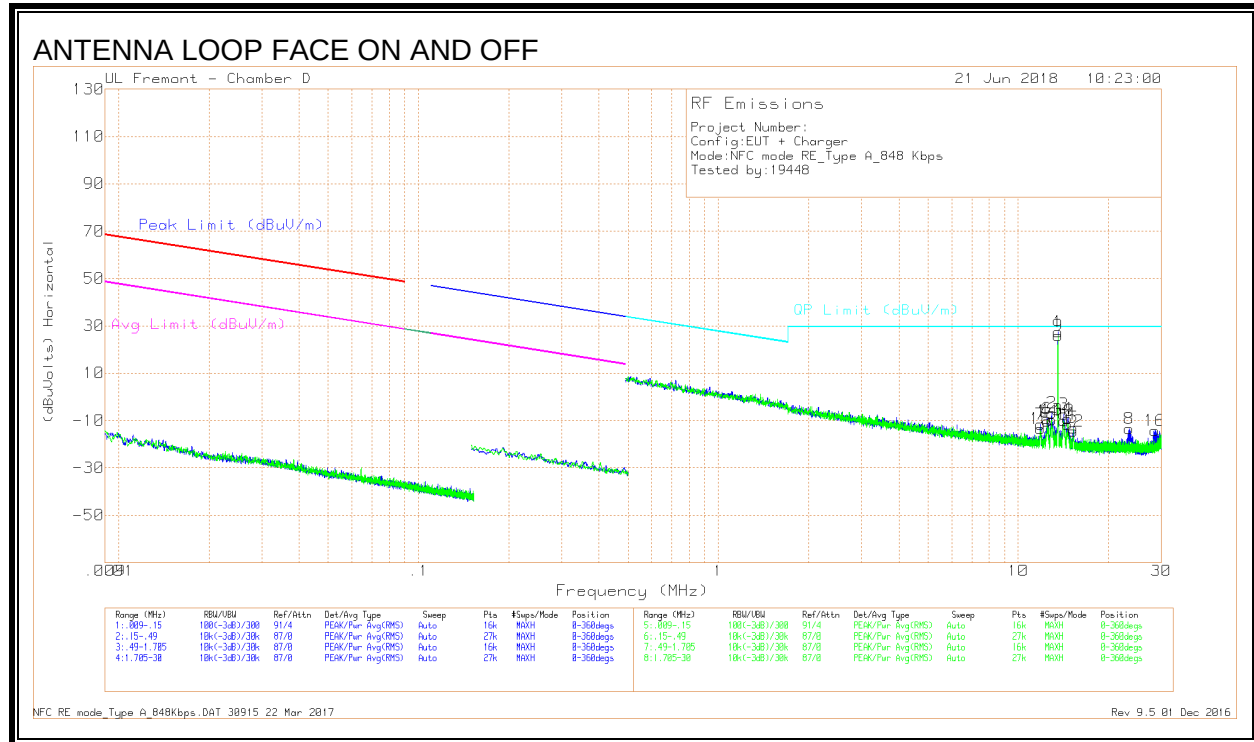
DATA

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)
14	11.86451	14.59	Pk	10.8	.5	-40	-14.11	29.54	-43.65	0-360
1	11.86863	15.58	Pk	10.8	.5	-40	-13.12	29.54	-42.66	0-360
2	12.4885	18.83	Pk	10.8	.5	-40	-9.87	29.54	-39.41	0-360
15	12.49048	16.61	Pk	10.8	.5	-40	-12.09	29.54	-41.63	0-360
16	12.93218	18.01	Pk	10.7	.5	-40	-10.79	29.54	-40.33	0-360
3	12.9385	20.63	Pk	10.7	.5	-40	-8.17	29.54	-37.71	0-360
4	13.2325	14.64	Pk	10.7	.5	-40	-14.16	40.51	-54.67	0-360
17	13.23299	13.48	Pk	10.7	.5	-40	-15.32	40.51	-55.83	0-360
5	13.33038	14.16	Pk	10.7	.5	-40	-14.64	40.51	-55.15	0-360
18	13.33408	11.03	Pk	10.7	.5	-40	-17.77	40.51	-58.28	0-360
19	13.42295	12.97	Pk	10.7	.5	-40	-15.83	50.5	-66.33	0-360
6	13.43075	13.72	Pk	10.7	.5	-40	-15.08	50.5	-65.58	0-360
20	13.55807	52.45	Pk	10.6	.5	-40	23.55	84	-60.45	0-360
7	13.562	55.42	Pk	10.6	.5	-40	26.52	84	-57.48	0-360
8	13.69488	13.69	Pk	10.6	.5	-40	-15.21	50.5	-65.71	0-360
21	13.69616	11.18	Pk	10.6	.5	-40	-17.72	50.5	-68.22	0-360
9	13.78638	12.74	Pk	10.6	.5	-40	-16.16	40.51	-56.67	0-360
22	13.82003	11.32	Pk	10.6	.5	-40	-17.58	40.51	-58.09	0-360
23	13.88205	12.76	Pk	10.6	.5	-40	-16.14	40.51	-56.65	0-360
10	13.89113	14.23	Pk	10.6	.5	-40	-14.67	40.51	-55.18	0-360
24	14.18101	17.5	Pk	10.6	.5	-40	-11.4	29.54	-40.94	0-360
11	14.183	20.11	Pk	10.6	.5	-40	-8.79	29.54	-38.33	0-360
25	14.62071	15.53	Pk	10.5	.5	-40	-13.47	29.54	-43.01	0-360
12	14.63175	18.7	Pk	10.5	.5	-40	-10.3	29.54	-39.84	0-360
13	15.25025	15.47	Pk	10.5	.5	-40	-13.53	29.54	-43.07	0-360
26	15.25919	12.72	Pk	10.5	.5	-40	-16.28	29.54	-45.82	0-360

Pk - Peak detector

FCC 15.225 13.56MHz Fundamental Mask.TST 30915 4 Mar 2016
Rev 9.5 01 Dec 2016

SPURIOUS EMISSION 848Kbps



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Cables (dB)	Dist Corr 30m	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
7	11.86222	17.13	Pk	11	.4	-40	-11.47	29.5	-40.97	0-360
15	11.8858	15.2	Pk	11	.4	-40	-13.4	29.5	-42.9	0-360
6	12.48368	19.3	Pk	11	.4	-40	-9.3	29.5	-38.8	0-360
14	12.50988	18.36	Pk	11	.4	-40	-10.24	29.5	-39.74	0-360
2	12.92174	21.69	Pk	11	.4	-40	-6.91	29.5	-36.41	0-360
13	12.93118	18.8	Pk	11	.4	-40	-9.8	29.5	-39.3	0-360
3	14.17515	21.23	Pk	11	.4	-40	-7.37	29.5	-36.87	0-360
10	14.18406	18.65	Pk	11	.4	-40	-9.95	29.5	-39.45	0-360
11	14.61846	16.97	Pk	11.1	.4	-40	-11.53	29.5	-41.03	0-360
4	14.62474	19.29	Pk	11.1	.4	-40	-9.21	29.5	-38.71	0-360
12	15.23363	14.08	Pk	11.1	.4	-40	-14.42	29.5	-43.92	0-360
5	15.24883	15.46	Pk	11.1	.4	-40	-13.04	29.5	-42.54	0-360
8	23.41327	15.49	Pk	10.6	.5	-40	-13.41	29.5	-42.91	0-360
16	28.5055	15.55	Pk	9.8	.5	-40	-14.15	29.5	-43.65	0-360

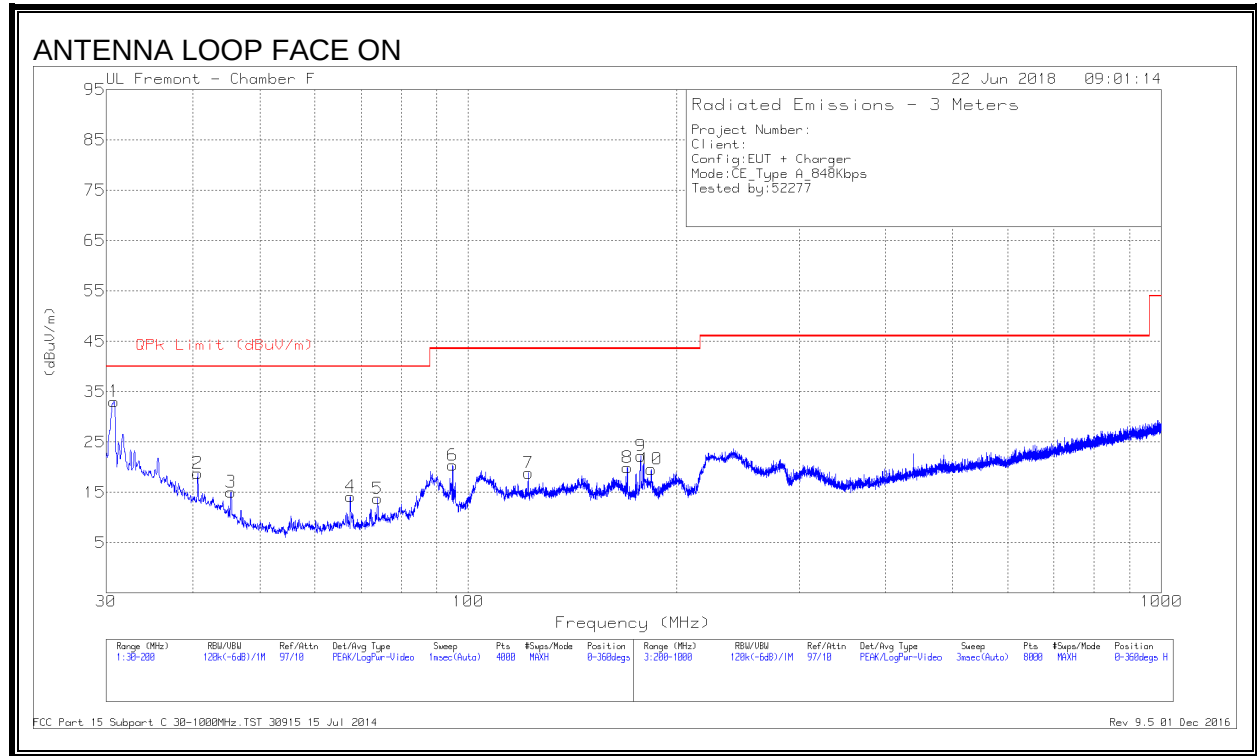
Pk - Peak detector

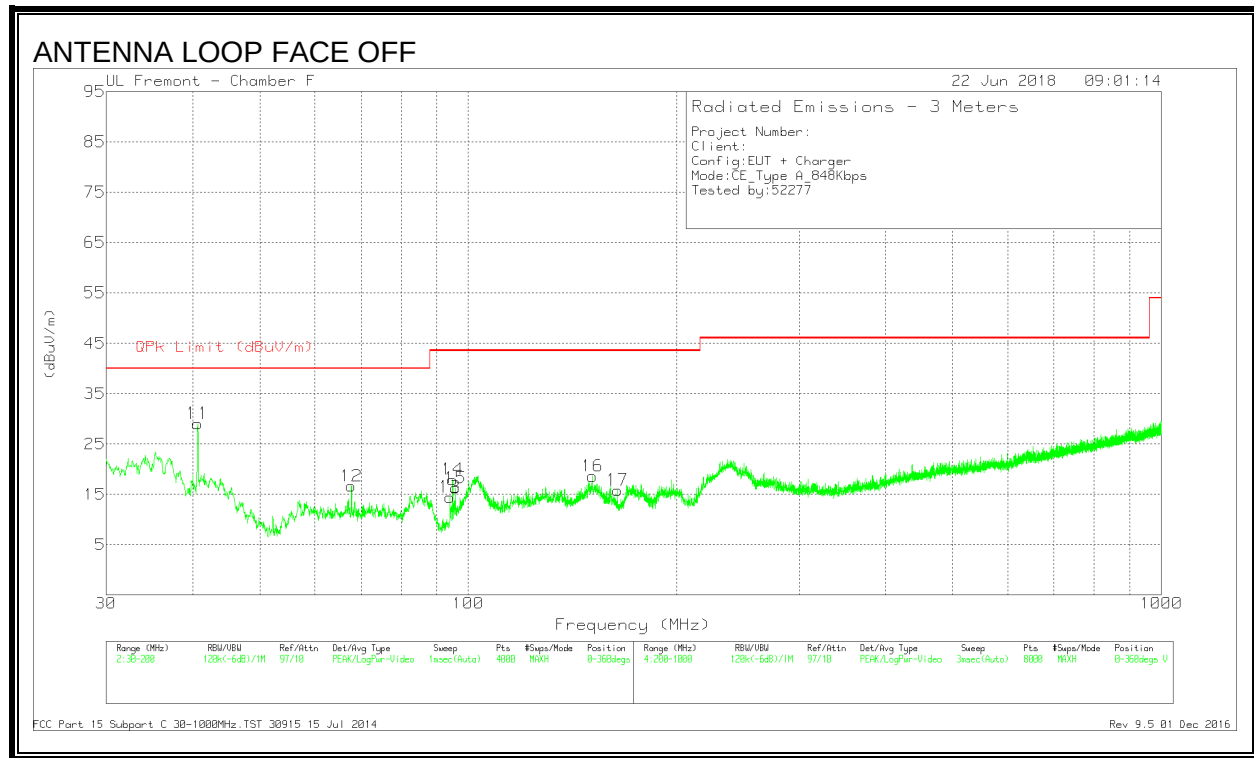
Note: Marker 1 & 9 are the fundamental signal.

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

8.3.1. CE MODE

SPURIOUS EMISSION 848Kbps





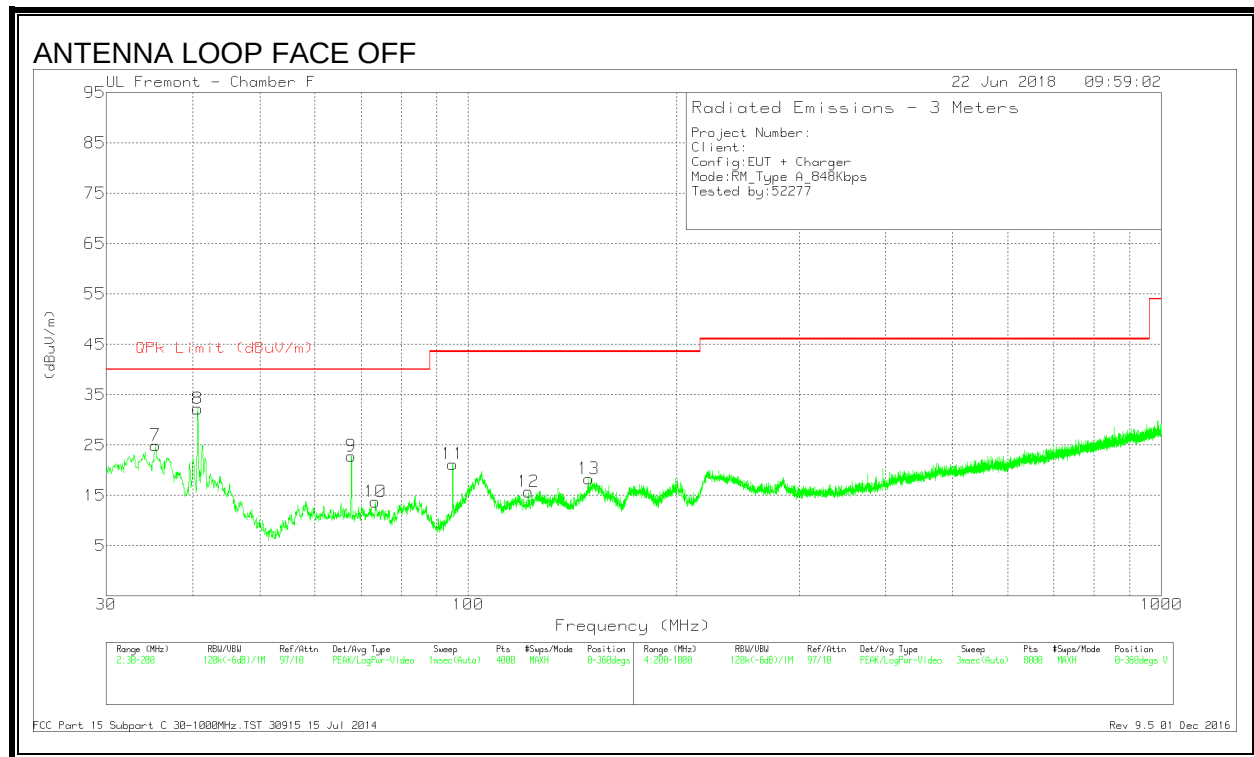
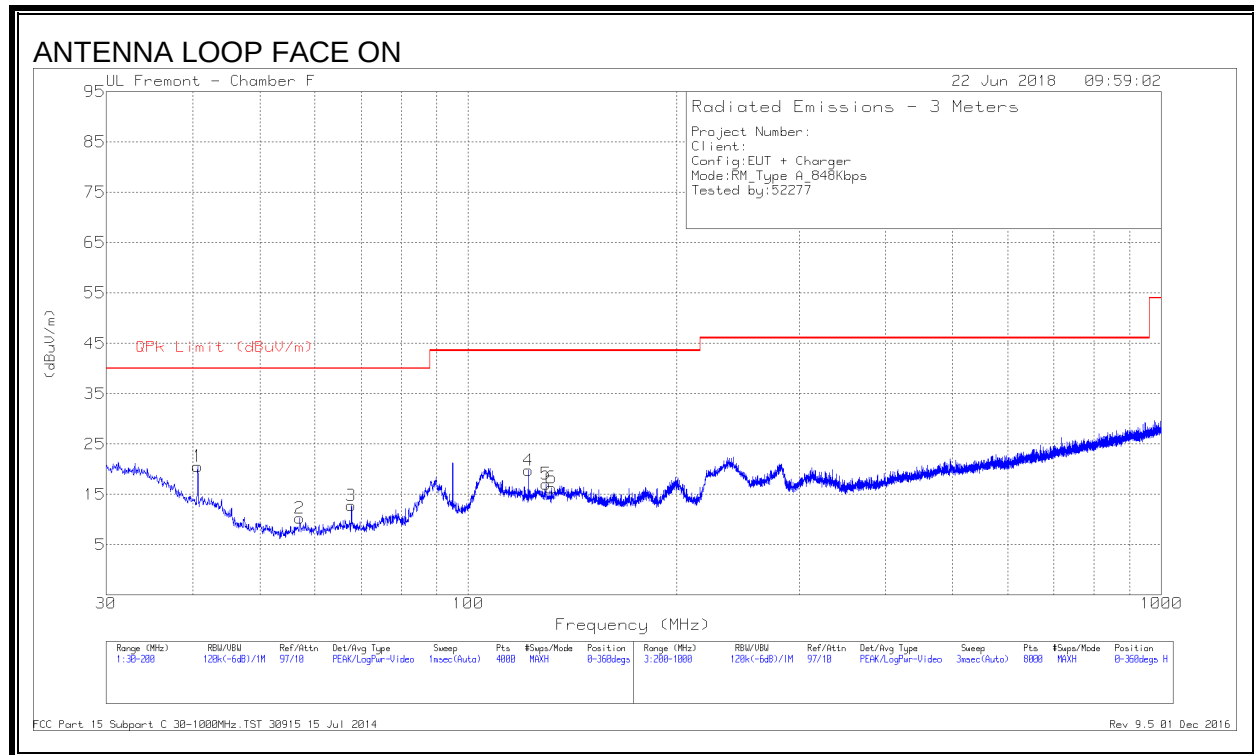
DATA

Marker	Frequency (MHz)	Meter Reading (dBUV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBUV/m)	QPk Limit (dBUV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.8077	40.06	Pk	24.9	-31.9	33.06	40	-6.94	0-360	299	H
2	40.6703	33.21	Pk	17.4	-31.8	18.81	40	-21.19	0-360	299	H
3	45.4315	32.88	Pk	14	-31.8	15.08	40	-24.92	0-360	299	H
4	67.5797	33.79	Pk	11.9	-31.5	14.19	40	-25.81	0-360	299	H
5	* 73.9564	33.39	Pk	11.9	-31.5	13.79	40	-26.21	0-360	299	H
6	94.9143	38.99	Pk	12.7	-31.3	20.39	43.52	-23.13	0-360	299	H
7	* 122.0363	32.27	Pk	17.7	-31.1	18.87	43.52	-24.65	0-360	199	H
8	* 169.6486	34.93	Pk	15.7	-30.7	19.93	43.52	-23.59	0-360	299	H
9	177.3431	37.54	Pk	15.3	-30.6	22.24	43.52	-21.28	0-360	299	H
10	183.656	35.1	Pk	15.1	-30.6	19.6	43.52	-23.92	0-360	299	H
11	40.6703	43.46	Pk	17.4	-31.8	29.06	40	-10.94	0-360	100	V
12	67.7923	36.26	Pk	11.9	-31.5	16.66	40	-23.34	0-360	100	V
13	94.0641	33.35	Pk	12.4	-31.3	14.45	43.52	-29.07	0-360	100	V
14	94.9143	36.57	Pk	12.7	-31.3	17.97	43.52	-25.55	0-360	100	V
15	95.7645	34.66	Pk	12.9	-31.3	16.26	43.52	-27.26	0-360	100	V
16	151.0288	33.01	Pk	16.4	-30.8	18.61	43.52	-24.91	0-360	100	V
17	* 164.1222	30.63	Pk	16	-30.8	15.83	43.52	-27.69	0-360	100	V

Pk - Peak detector

8.3.2. READER MODE

SPURIOUS EMISSION 848Kbps



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	40.6703	34.98	Pk	17.4	-31.8	20.58	40	-19.42	0-360	399	H
2	57.0795	30.9	Pk	11.1	-31.7	10.3	40	-29.7	0-360	399	H
3	67.7923	32.37	Pk	11.9	-31.5	12.77	40	-27.23	0-360	399	H
4	* 122.0788	33.15	Pk	17.7	-31.1	19.75	43.52	-23.77	0-360	199	H
5	* 129.412	30.36	Pk	17.7	-31	17.06	43.52	-26.46	0-360	399	H
6	* 131.7713	29.82	Pk	17.5	-31	16.32	43.52	-27.2	0-360	199	H
7	35.3564	35.22	Pk	21.5	-31.8	24.92	40	-15.08	0-360	100	V
8	40.6703	46.62	Pk	17.4	-31.8	32.22	40	-7.78	0-360	100	V
9	67.7923	42.43	Pk	11.9	-31.5	22.83	40	-17.17	0-360	100	V
10	* 73.4037	33.35	Pk	11.9	-31.5	13.75	40	-26.25	0-360	100	V
11	94.9143	39.81	Pk	12.7	-31.3	21.21	43.52	-22.31	0-360	100	V
12	* 122.0363	29.13	Pk	17.7	-31.1	15.73	43.52	-27.79	0-360	100	V
13	149.1583	32.81	Pk	16.4	-30.9	18.31	43.52	-25.21	0-360	100	V

Pk - Peak detector

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:	07/12/2018
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9.1. CE MODE

848Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C Limit: ± 100 ppm = 1.356 kHz										
Power Supply	Envir. Temp	Frequency Deviation Measured with Time Elapse								
(Vdc)	(°C)	Startup (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5601262	-2.162	13.5601293	-2.384	13.5601329	-2.651	13.5601375	-2.993	± 100
3.80	40	13.5601002	-0.241	13.5601019	-0.368	13.5601036	-0.488	13.5601049	-0.587	± 100
3.80	30	13.5600934	0.257	13.5600933	0.271	13.5600932	0.276	13.5600934	0.264	± 100
3.80	20	13.5600969	0.000	13.5601020	-0.377	13.5600959	0.073	13.5600957	0.088	± 100
3.80	10	13.5600938	0.235	13.5600947	0.162	13.5600963	0.048	13.5600988	-0.140	± 100
3.80	0	13.5601033	-0.467	13.5601062	-0.680	13.5601097	-0.945	13.5601145	-1.292	± 100
3.80	-10	13.5601231	-1.928	13.5601271	-2.222	13.5601310	-2.509	13.5601351	-2.812	± 100
3.80	-20	13.5601444	-3.498	13.5601464	-3.646	13.5601482	-3.782	13.5601500	-3.910	± 100
3.23	20	13.5600954	0.113	13.5600943	0.194	13.5600957	0.091	13.5600964	0.039	± 100
4.37	20	13.5600985	-0.116	13.5600982	-0.093	13.5600972	-0.020	13.5600970	-0.005	± 100

9.2. READER MODE

848Kbps

Reference Frequency: EUT Channel 13.56 MHz @ 20°C Limit: ± 100 ppm = 1.356 kHz										
Power Supply	Envir. Temp	Frequency Deviation Measured with Time Elapse								
(Vdc)	(°C)	Startup (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5601210	-0.991	13.5601262	-1.374	13.5601332	-1.890	13.5601429	-2.607	± 100
3.80	40	13.5600977	0.725	13.5600995	0.593	13.5601022	0.392	13.5601063	0.094	± 100
3.80	30	13.5600953	0.906	13.5600942	0.987	13.5600935	1.039	13.5600933	1.049	± 100
3.80	20	13.5601076	0.000	13.5601058	0.133	13.5601034	0.310	13.5600995	0.597	± 100
3.80	10	13.5600976	0.737	13.5600986	0.659	13.5601001	0.547	13.5601014	0.451	± 100
3.80	0	13.5601074	0.014	13.5601095	-0.146	13.5601121	-0.332	13.5601149	-0.541	± 100
3.80	-10	13.5601251	-1.295	13.5601277	-1.486	13.5601296	-1.623	13.5601336	-1.917	± 100
3.80	-20	13.5601442	-2.704	13.5601459	-2.828	13.5601479	-2.975	13.5601490	-3.055	± 100
3.23	20	13.5600982	0.690	13.5600988	0.646	13.5600997	0.580	13.5601005	0.521	± 100
4.37	20	13.5600947	0.946	13.5600951	0.918	13.5600955	0.890	13.5600961	0.845	± 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

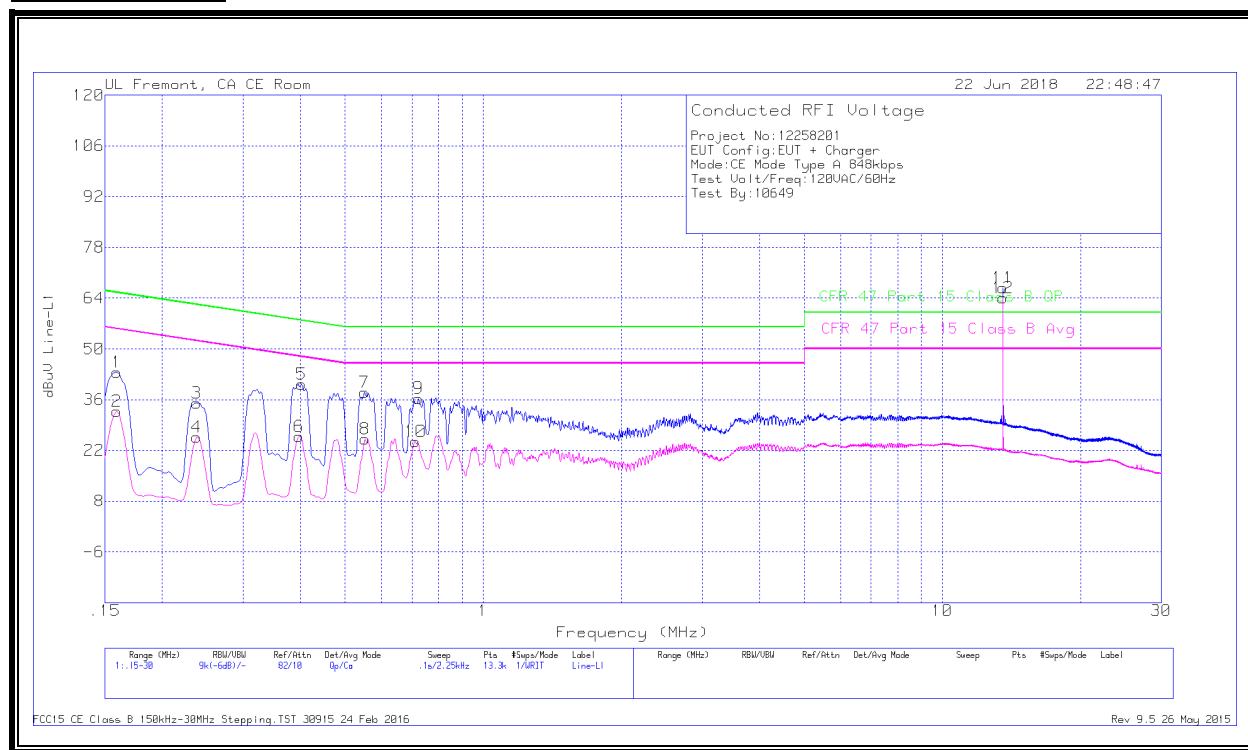
RESULTS

No non-compliance noted:

10.1. CE MODE

10.1.1. NORMAL OPERATION, 848Kbps

LINE 1 RESULTS



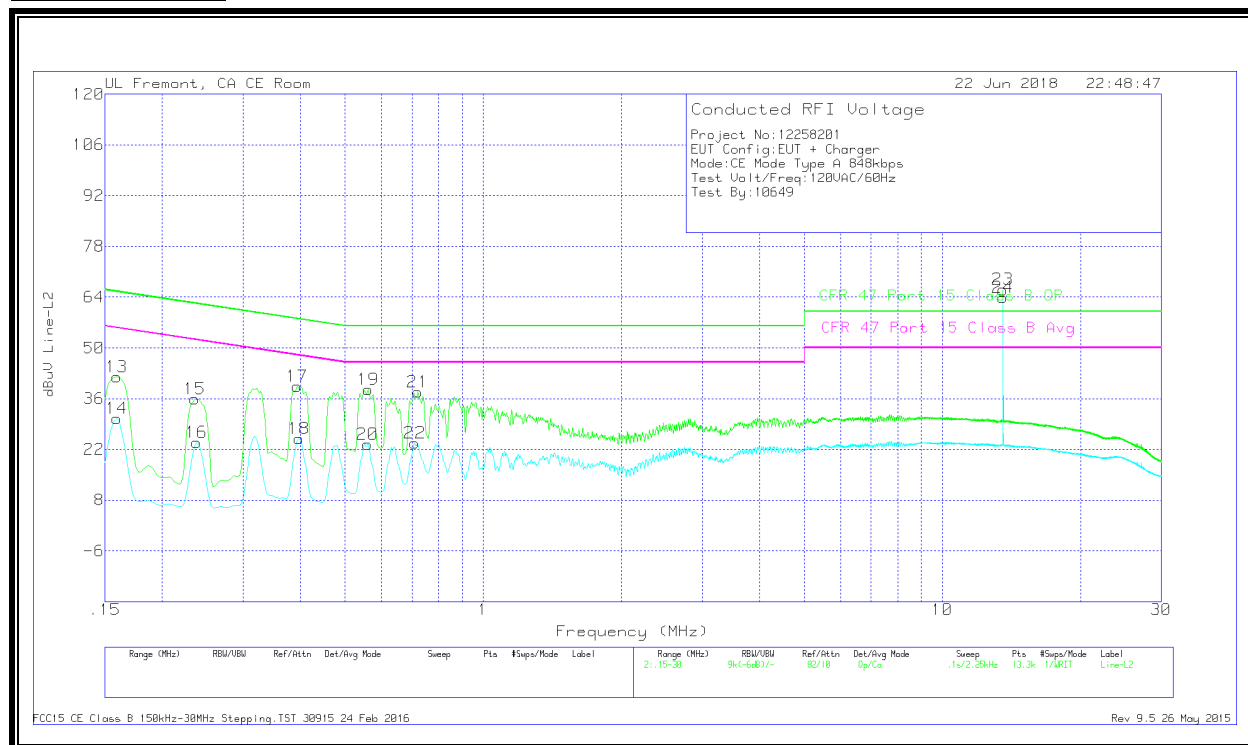
WORST EMISSIONS

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	32.71	Qp	.7	0	10.1	43.51	65.52	-22.01	-	-
2	.159	22.01	Ca	.7	0	10.1	32.81	-	-	55.52	-22.71
3	.23775	24.6	Qp	.4	0	10.1	35.1	62.17	-27.07	-	-
4	.23775	15.15	Ca	.4	0	10.1	25.65	-	-	52.17	-26.52
5	.402	30.02	Qp	.2	0	10.1	40.32	57.81	-17.49	-	-
6	.3975	15.57	Ca	.2	0	10.1	25.87	-	-	47.91	-22.04
7	.5505	27.74	Qp	.1	0	10.1	37.94	56	-18.06	-	-
8	.55275	14.88	Ca	.1	0	10.1	25.08	-	-	46	-20.92
9	.72375	26.15	Qp	.1	0	10.1	36.35	56	-19.65	-	-
10	.7125	14.22	Ca	.1	0	10.1	24.42	-	-	46	-21.58
11	13.56	56.31	Qp	.1	.2	10.2	66.81	60	6.81	-	-
12	13.56	53.56	Ca	.1	.2	10.2	64.06	-	-	50	14.06

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

LINE 2 RESULTS



WORST EMISSIONS

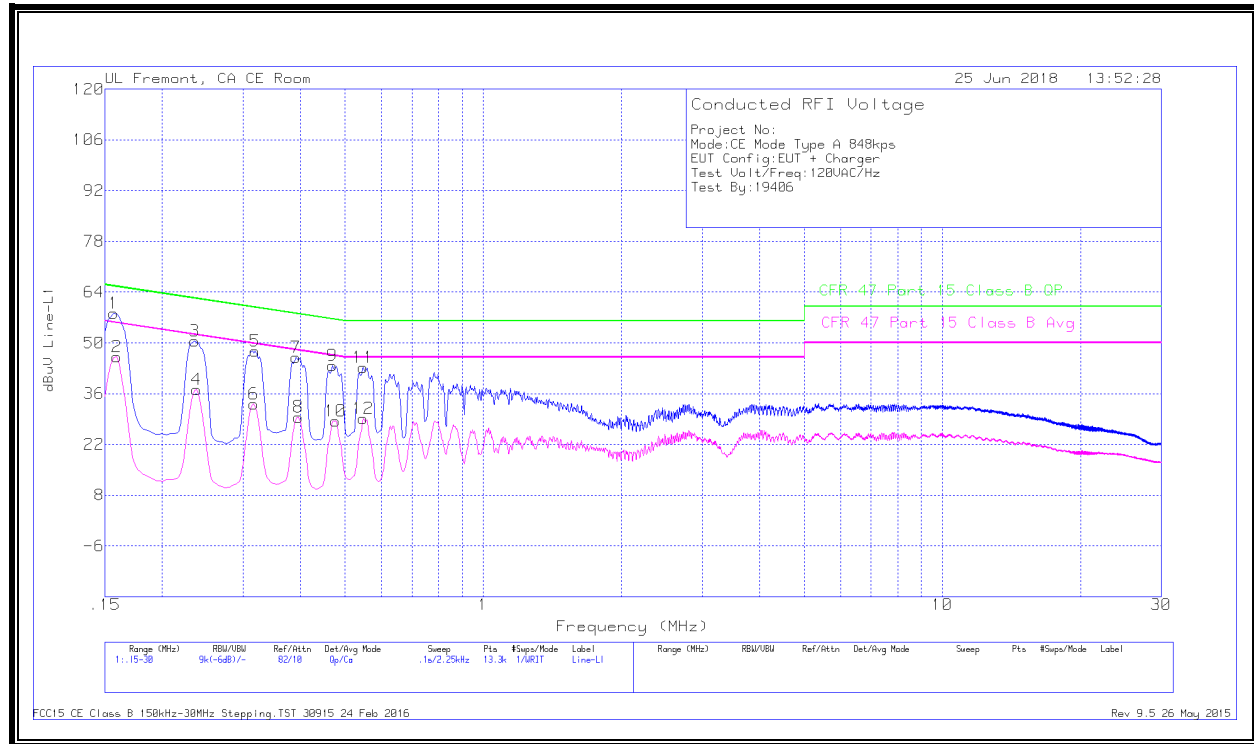
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.159	31.79	Qp	.1	0	10.1	41.99	65.52	-23.53	-	-
14	.159	20.38	Ca	.1	0	10.1	30.58	-	-	55.52	-24.94
15	.2355	25.64	Qp	.1	0	10.1	35.84	62.25	-26.41	-	-
16	.23775	13.75	Ca	.1	0	10.1	23.95	-	-	52.17	-28.22
17	.393	29.22	Qp	.1	0	10.1	39.42	58	-18.58	-	-
18	.3975	14.7	Ca	.1	0	10.1	24.9	-	-	47.91	-23.01
19	.56175	28.3	Qp	.1	0	10.1	38.5	56	-17.5	-	-
20	.5595	13.26	Ca	.1	0	10.1	23.46	-	-	46	-22.54
21	.7215	27.57	Qp	.1	0	10.1	37.77	56	-18.23	-	-
22	.71025	13.5	Ca	.1	0	10.1	23.7	-	-	46	-22.3
23	13.56	55.68	Qp	0	.2	10.2	66.08	60	6.08	-	-
24	13.56	53.57	Ca	0	.2	10.2	63.97	-	-	50	13.97

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

10.1.2. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS

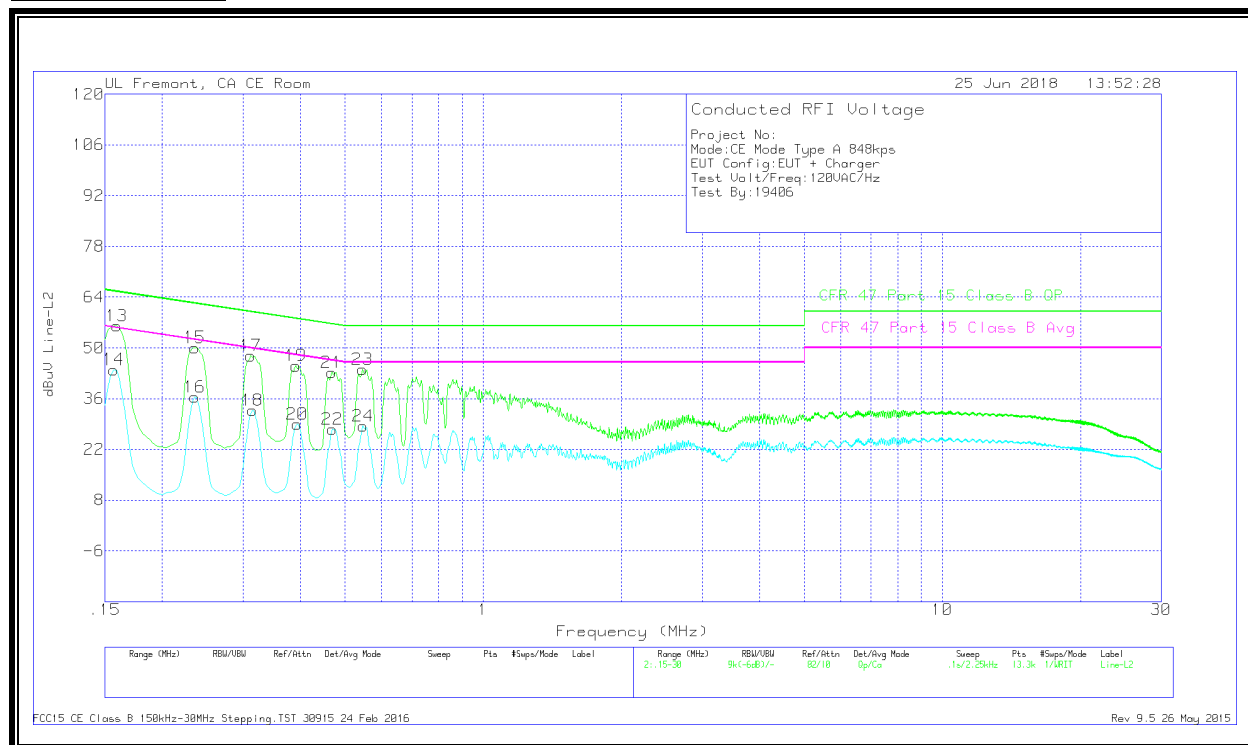


WORST EMISSIONS

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	.15675	47.33	Qp	.7	0	10.1	58.13	65.63	-7.5	-	-
2	.159	35.3	Ca	.7	0	10.1	46.1	-	-	55.52	-9.42
3	.2355	39.85	Qp	.5	0	10.1	50.45	62.25	-11.8	-	-
4	.23775	26.57	Ca	.4	0	10.1	37.07	-	-	52.17	-15.1
5	.31875	37.29	Qp	.4	0	10.1	47.79	59.74	-11.95	-	-
6	.3165	22.7	Ca	.4	0	10.1	33.2	-	-	49.8	-16.6
7	.39075	35.64	Qp	.2	0	10.1	45.94	58.05	-12.11	-	-
8	.39525	19.27	Ca	.2	0	10.1	29.57	-	-	47.95	-18.38
9	.4695	33.52	Qp	.1	0	10.1	43.72	56.52	-12.8	-	-
10	.47625	18.22	Ca	.1	0	10.1	28.42	-	-	46.4	-17.98
11	.54825	33.01	Qp	.1	0	10.1	43.21	56	-12.79	-	-
12	.54825	18.95	Ca	.1	0	10.1	29.15	-	-	46	-16.85

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

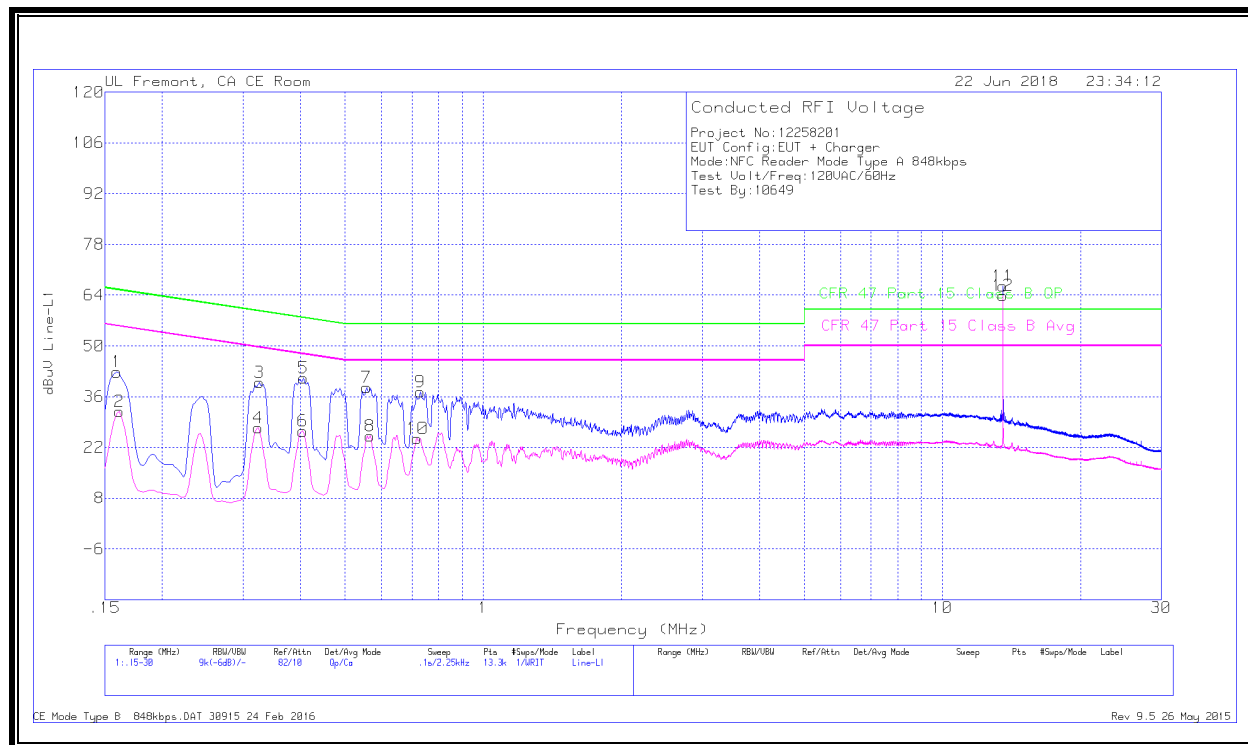
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.159	45.84	Qp	.1	0	10.1	56.04	65.52	-9.48	-	-
14	.15675	33.8	Ca	.1	0	10.1	44	-	-	55.63	-11.63
15	.2355	39.88	Qp	.1	0	10.1	50.08	62.25	-12.17	-	-
16	.2355	26.29	Ca	.1	0	10.1	36.49	-	-	52.25	-15.76
17	.312	37.63	Qp	.1	0	10.1	47.83	59.92	-12.09	-	-
18	.31425	22.55	Ca	.1	0	10.1	32.75	-	-	49.86	-17.11
19	.39075	34.85	Qp	.1	0	10.1	45.05	58.05	-13	-	-
20	.393	18.74	Ca	.1	0	10.1	28.94	-	-	48	-19.06
21	.46725	33.08	Qp	.1	0	10.1	43.28	56.56	-13.28	-	-
22	.4695	17.34	Ca	.1	0	10.1	27.54	-	-	46.52	-18.98
23	.546	33.88	Qp	.1	0	10.1	44.08	56	-11.92	-	-
24	.54825	18.31	Ca	.1	0	10.1	28.51	-	-	46	-17.49

Qp - Quasi-Peak detector
Ca - CISPR average detection

10.2. READER MODE

10.2.1. NORMAL OPERATION, 848Kbps

LINE 1 RESULTS



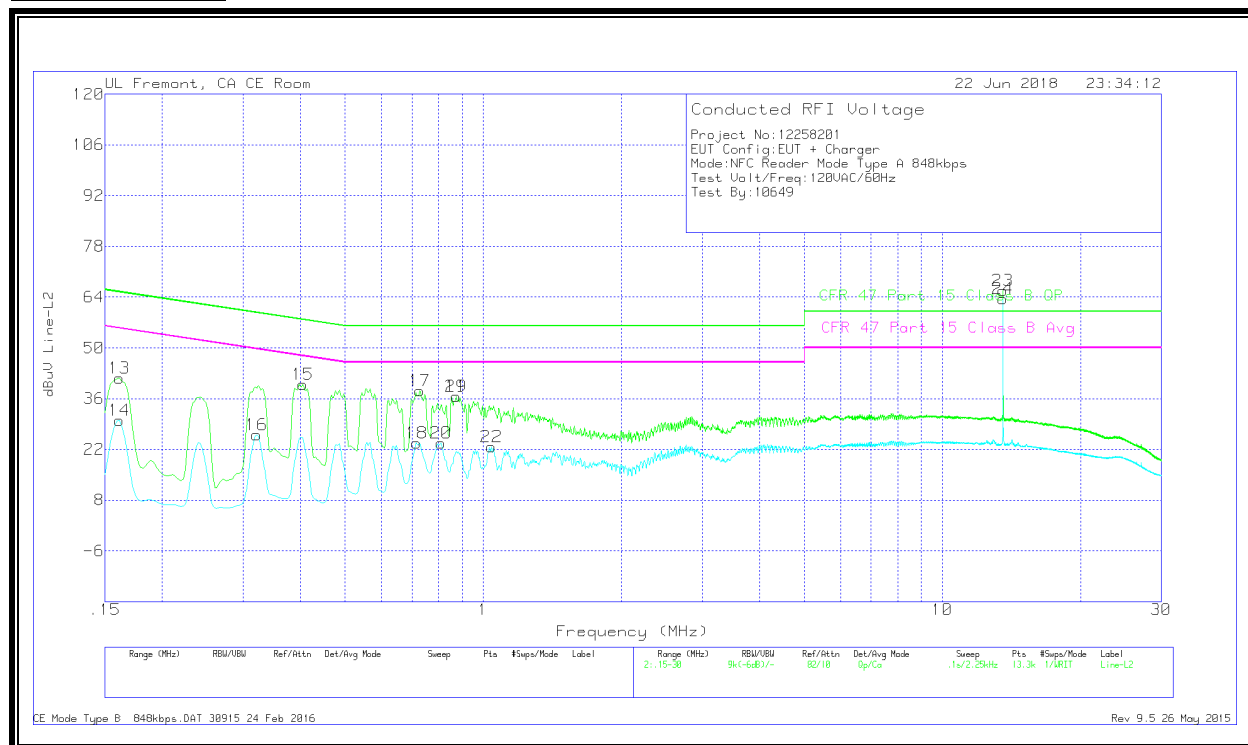
WORST EMISSIONS

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	31.99	Qp	.7	0	10.1	42.79	65.52	-22.73	-	-
2	.16125	21.06	Ca	.7	0	10.1	31.86	-	-	55.4	-23.54
3	.3255	29.52	Qp	.3	0	10.1	39.92	59.57	-19.65	-	-
4	.32325	16.85	Ca	.4	0	10.1	27.35	-	-	49.62	-22.27
5	.4065	30.83	Qp	.2	0	10.1	41.13	57.72	-16.59	-	-
6	.40425	16.15	Ca	.2	0	10.1	26.45	-	-	47.77	-21.32
7	.55725	28.29	Qp	.1	0	10.1	38.49	56	-17.51	-	-
8	.56737	14.92	Ca	.1	0	10.1	25.12	-	-	46	-20.88
9	.7305	27.04	Qp	.1	0	10.1	37.24	56	-18.76	-	-
10	.71925	14.22	Ca	.1	0	10.1	24.42	-	-	46	-21.58
11	13.56	56.07	Qp	.1	.2	10.2	66.57	60	6.57	-	-
12	13.56	53.33	Ca	.1	.2	10.2	63.83	-	-	50	13.83

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

LINE 2 RESULTS



WORST EMISSIONS

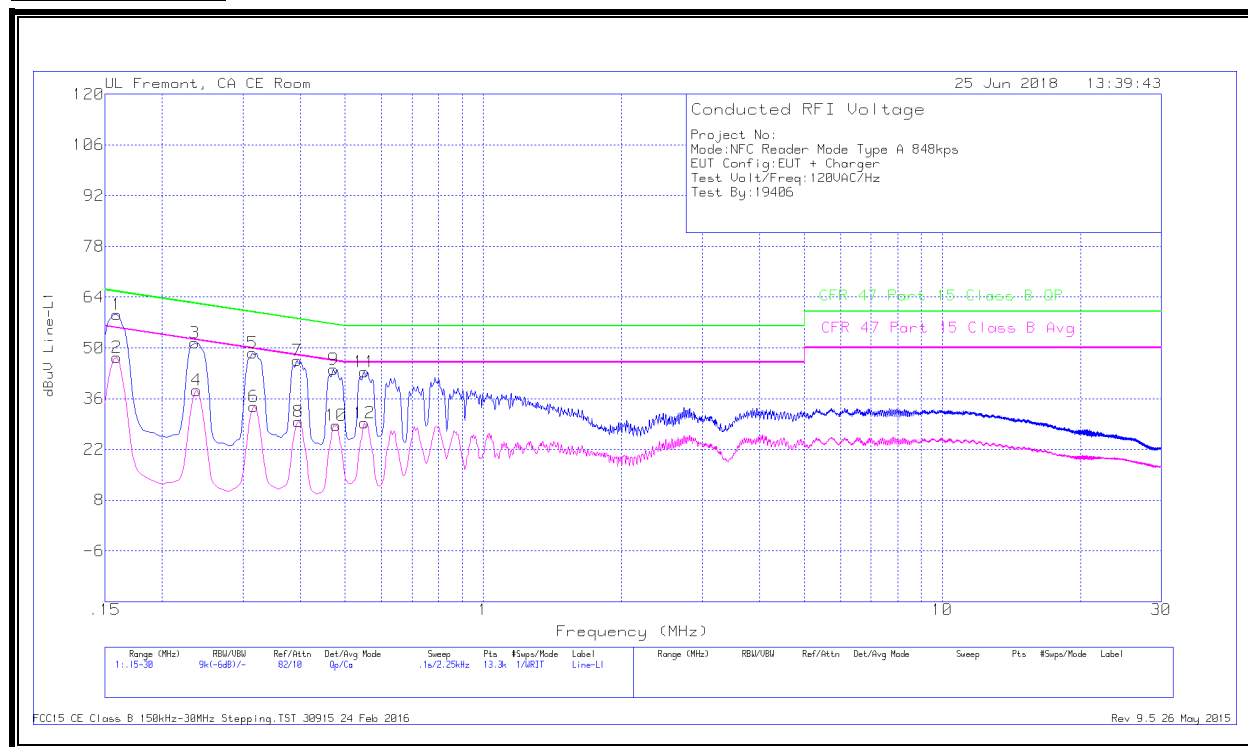
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.16125	31.38	Qp	.1	0	10.1	41.58	65.4	-23.82	-	-
14	.16125	19.86	Ca	.1	0	10.1	30.06	-	-	55.4	-25.34
15	.40425	29.78	Qp	.1	0	10.1	39.98	57.77	-17.79	-	-
16	.321	15.89	Ca	.1	0	10.1	26.09	-	-	49.68	-23.59
17	.72825	28.03	Qp	.1	0	10.1	38.23	56	-17.77	-	-
18	.717	13.63	Ca	.1	0	10.1	23.83	-	-	46	-22.17
19	.87225	26.35	Qp	.1	0	10.1	36.55	56	-19.45	-	-
20	.80925	13.5	Ca	.1	0	10.1	23.7	-	-	46	-22.3
21	.87225	26.35	Qp	.1	0	10.1	36.55	56	-19.45	-	-
22	1.04325	12.44	Ca	0	.1	10.1	22.64	-	-	46	-23.36
23	13.56	55.36	Qp	0	.2	10.2	65.76	60	5.76	-	-
24	13.56	53.21	Ca	0	.2	10.2	63.61	-	-	50	13.61

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

10.2.2. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS



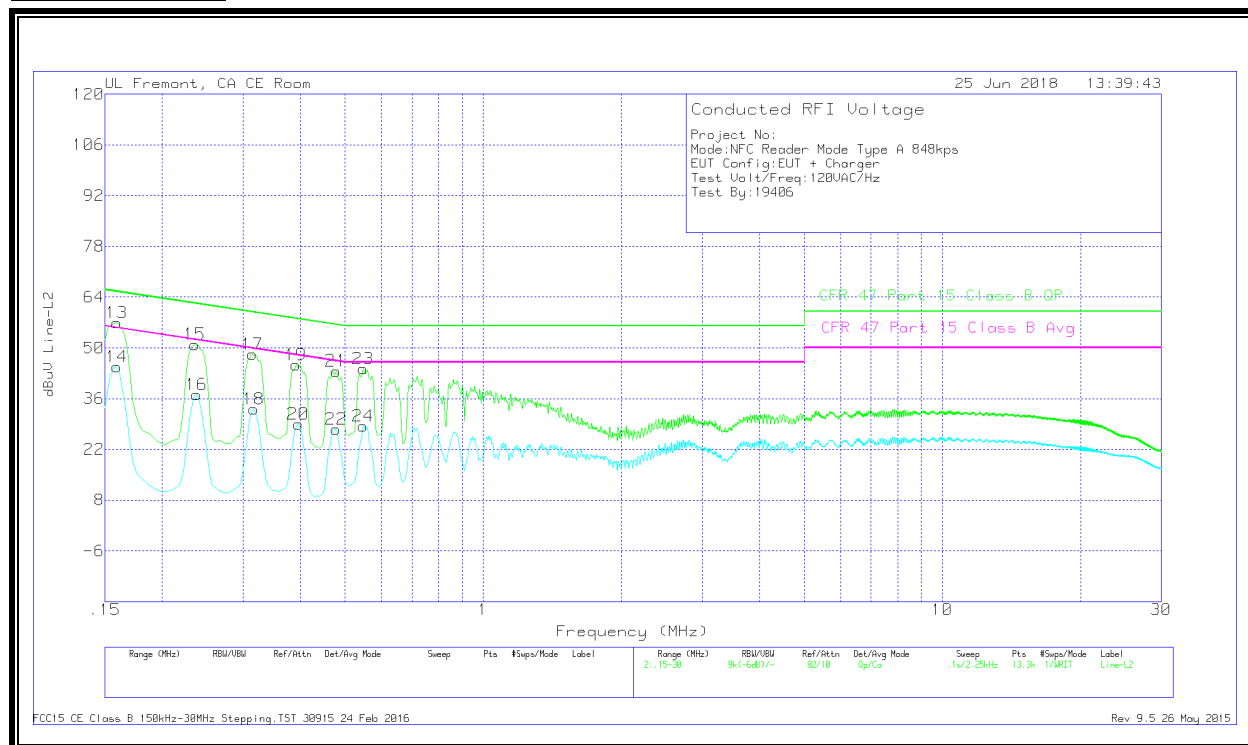
WORST EMISSIONS

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	.159	48.36	Qp	.7	0	10.1	59.16	65.52	-6.36	-	-
2	.159	36.63	Ca	.7	0	10.1	47.43	-	-	55.52	-8.09
3	.2355	40.82	Qp	.5	0	10.1	51.42	62.25	-10.83	-	-
4	.23775	27.77	Ca	.4	0	10.1	38.27	-	-	52.17	-13.9
5	.31425	38.04	Qp	.4	0	10.1	48.54	59.86	-11.32	-	-
6	.3165	23.4	Ca	.4	0	10.1	33.9	-	-	49.8	-15.9
7	.393	36.15	Qp	.2	0	10.1	46.45	58	-11.55	-	-
8	.39525	19.42	Ca	.2	0	10.1	29.72	-	-	47.95	-18.23
9	.47175	33.83	Qp	.1	0	10.1	44.03	56.48	-12.45	-	-
10	.4785	18.42	Ca	.1	0	10.1	28.62	-	-	46.37	-17.75
11	.5505	33.2	Qp	.1	0	10.1	43.4	56	-12.6	-	-
12	.5505	19.04	Ca	.1	0	10.1	29.24	-	-	46	-16.76

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	.159	46.72	Qp	.1	0	10.1	56.92	65.52	-8.6	-	-
14	.159	34.6	Ca	.1	0	10.1	44.8	-	-	55.52	-10.72
15	.2355	40.75	Qp	.1	0	10.1	50.95	62.25	-11.3	-	-
16	.23775	27	Ca	.1	0	10.1	37.2	-	-	52.17	-14.97
17	.31425	38.09	Qp	.1	0	10.1	48.29	59.86	-11.57	-	-
18	.3165	22.96	Ca	.1	0	10.1	33.16	-	-	49.8	-16.64
19	.39075	35.05	Qp	.1	0	10.1	45.25	58.05	-12.8	-	-
20	.39525	18.75	Ca	.1	0	10.1	28.95	-	-	47.95	-19
21	.4785	33.45	Qp	.1	0	10.1	43.65	56.37	-12.72	-	-
22	.4785	17.37	Ca	.1	0	10.1	27.57	-	-	46.37	-18.8
23	.54825	33.99	Qp	.1	0	10.1	44.19	56	-11.81	-	-
24	.54825	18.18	Ca	.1	0	10.1	28.38	-	-	46	-17.62

Qp - Quasi-Peak detector
Ca - CISPR average detection

END OF REPORT

11. SETUP PHOTOS

Please refer to 12258201-EP1V1 for setup photos