



CERTIFICATION TEST REPORT

Report Number. : 12162294-E11V2

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

Model : A1984, A2107 AND A2108

FCC ID : BCG-E3220A

IC : 579C-E3220A

EUT Description : SMARTPHONE

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

Date Of Issue:
August 23, 2018

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Revision History

Rev.	Issue Date	Revisions	Revised By
V1	08/17/2018	Initial Issue	Chin Pang
V2	08/23/2018	Address TCB's Questions	Chin pang

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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: A1984, A2107, A2108

SERIAL NUMBER: C7CWN03JK3MN

DATE TESTED: MAY 24 – 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.

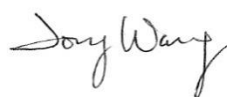
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section.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



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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

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. DIFFERENCE IN MODEL NUMBER

Model A2107, A2108 is electrically identical to Model A1984. Three model numbers are allocated for marketing and logistic purposes only. A1984 was used to perform all final tests.

5.3. 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	26.98
		Reader	27.38

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.

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 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	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

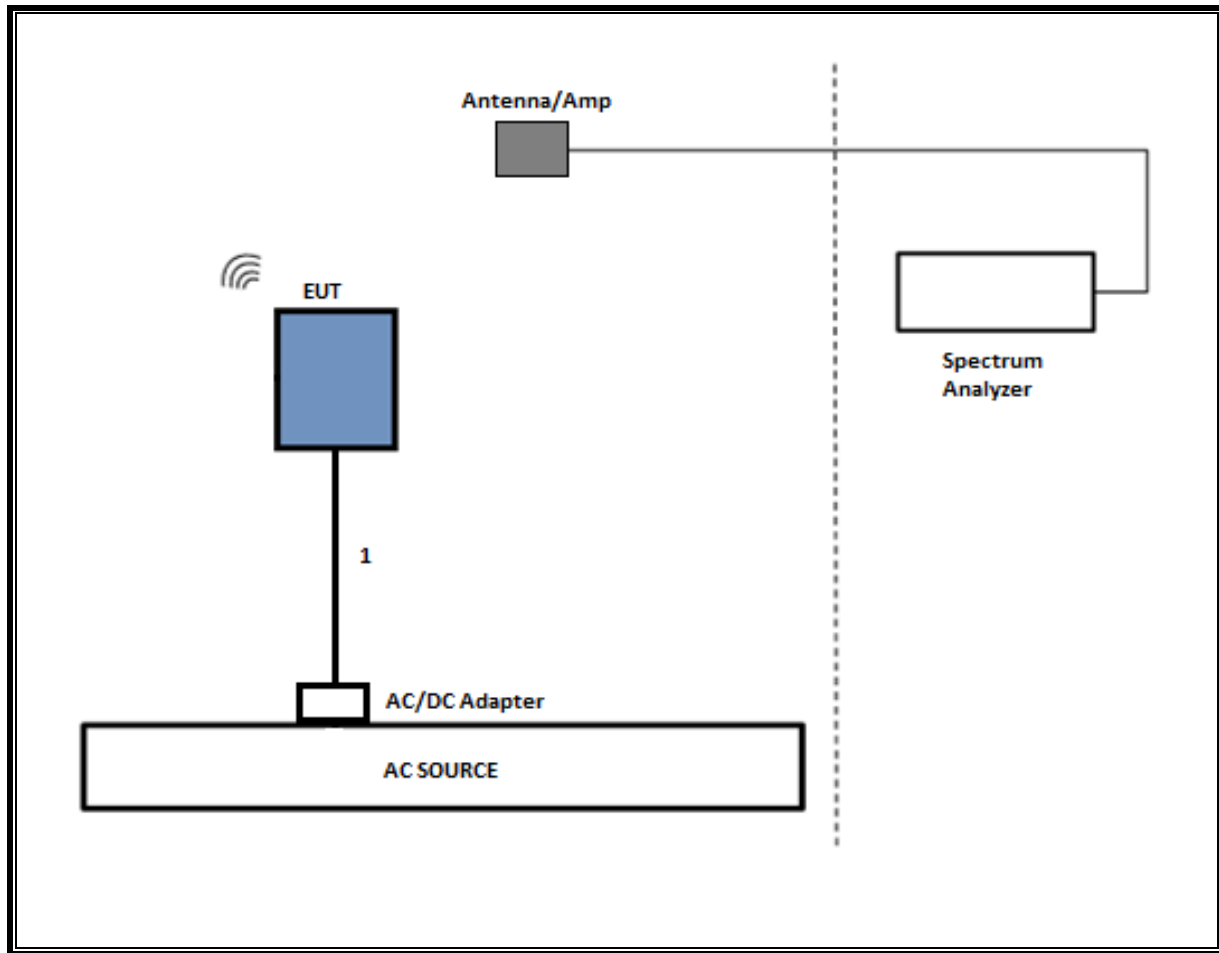
I/O CABLES

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

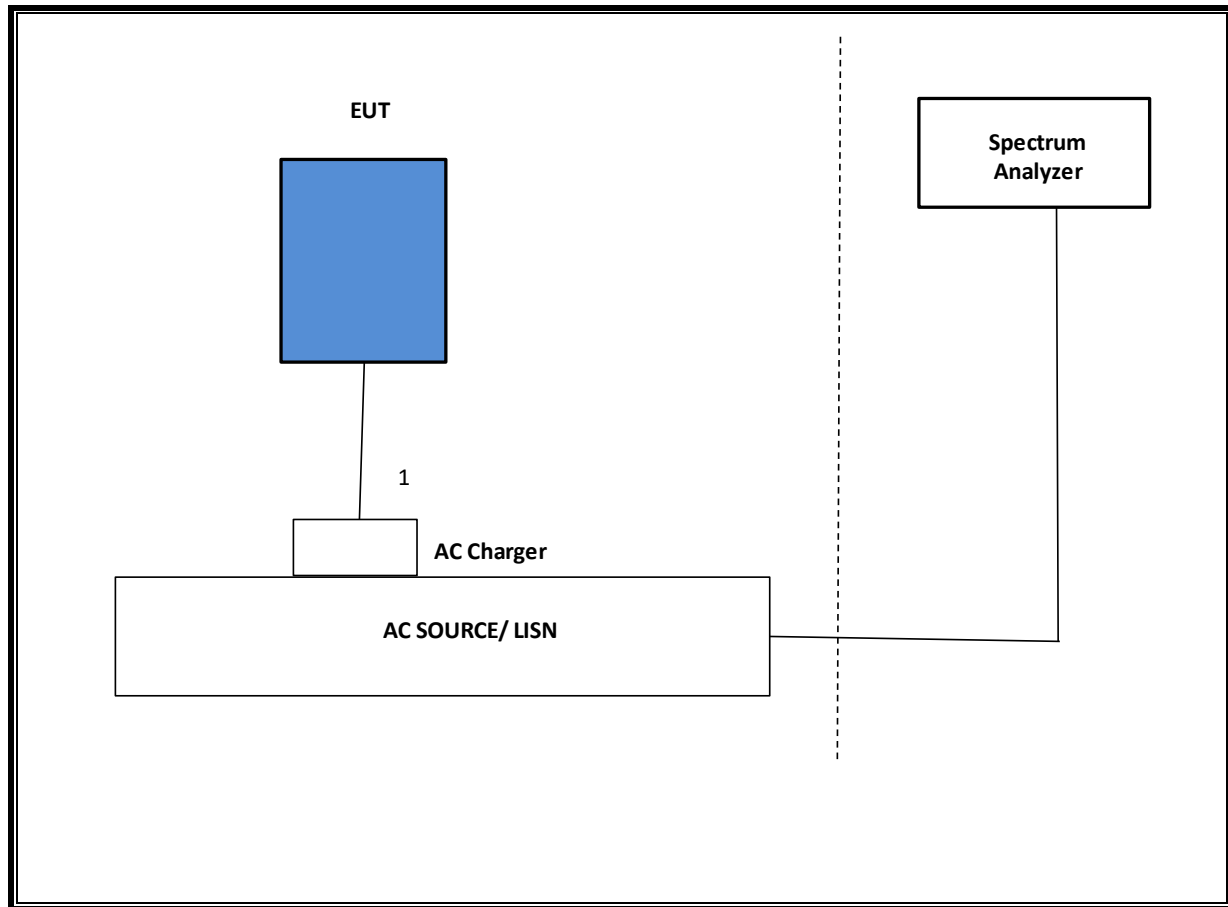
TEST SETUP

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

SETUP DIAGRAM 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, 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, PSA, 3Hz to 44GHz	Agilent (Keysight) Technologies	E4446A	T177	04/12/2019
Chamber, Environmental	Cincinnati Sub Zero	ZPHS-8-3.5-SCT/WC	T754	09/05/2018
Antenna, Active Loop 9KHz to 30MHz	EMCO	6502	T35	12/15/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T341	11/12/2018
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	06/15/2018
**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	

Note:

*Testing is completed before equipment expiration date.

**Testing began after calibration date.

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)

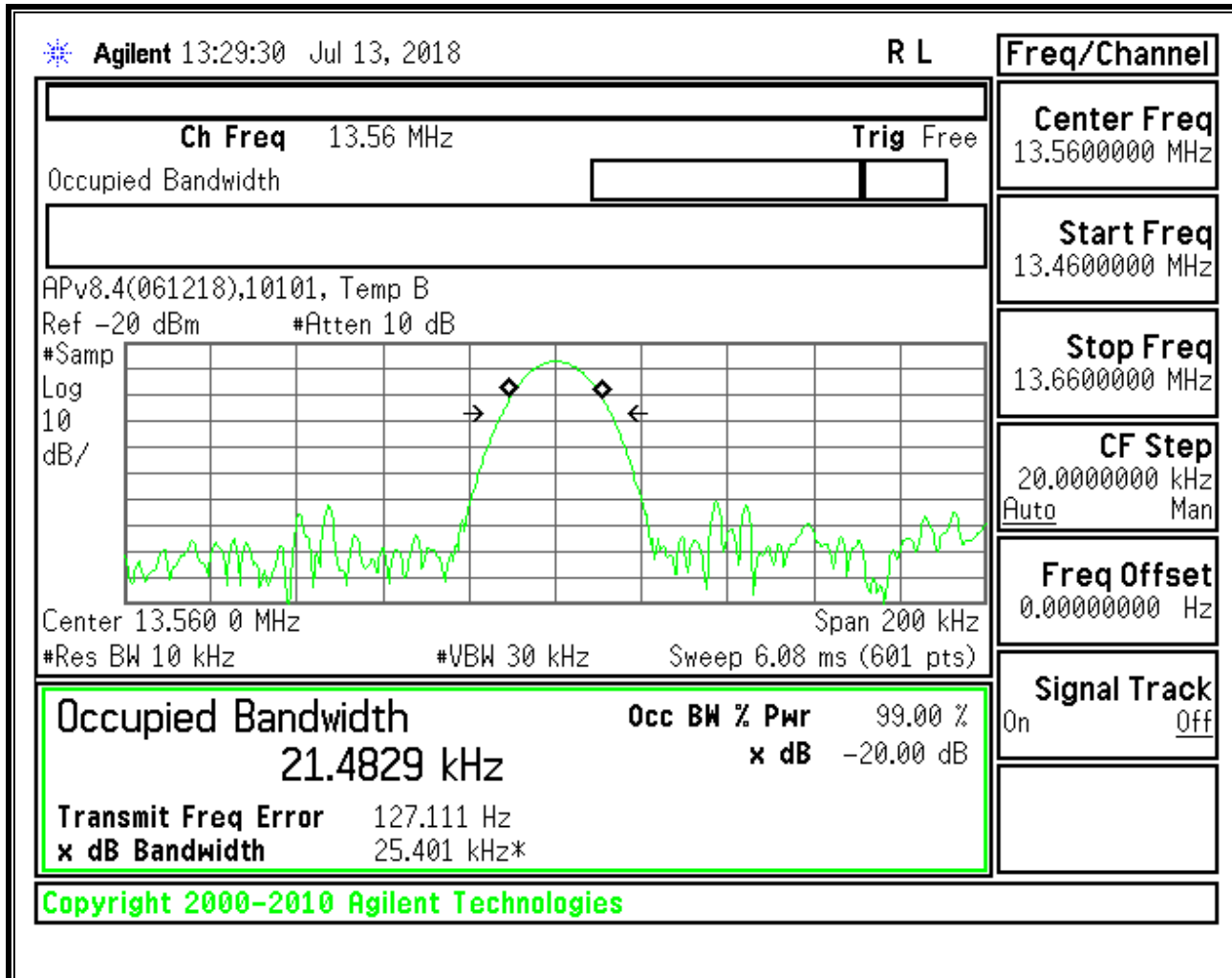
Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.4829	25.401

TYPE A (READER MODE)

Mode Kbps	Frequency (MHz)	99% Bandwidth (KHz)	20dB Bandwidth (KHz)
848	13.56	21.6098	25.658

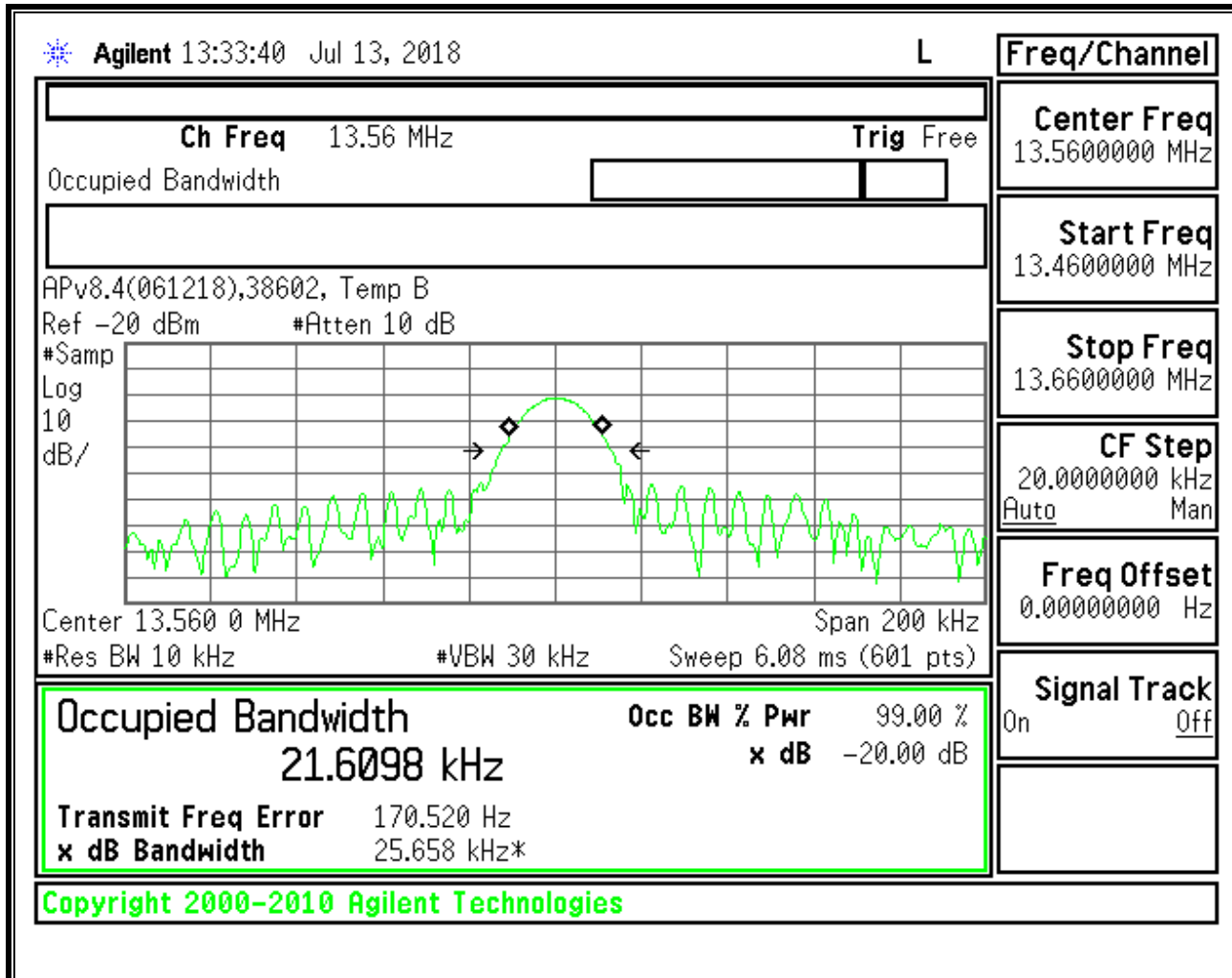
7.1. CE MODE

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 dBµV/m is:

Limit (dBµV/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

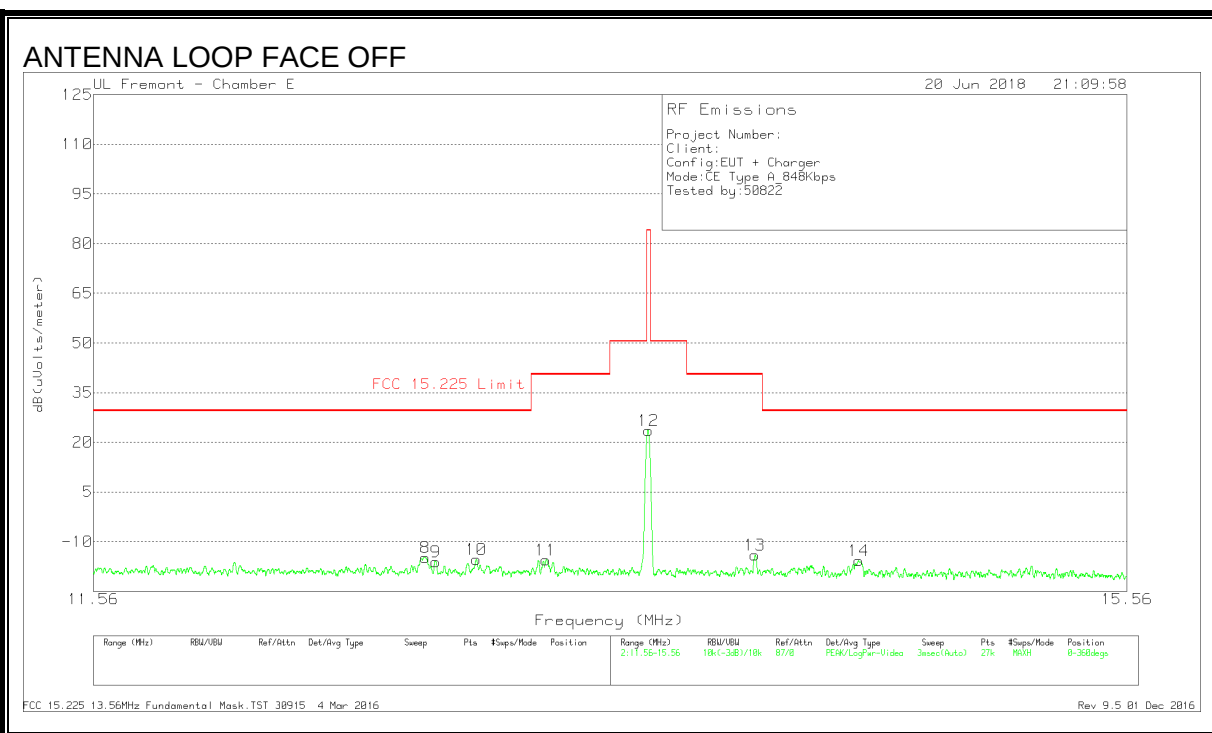
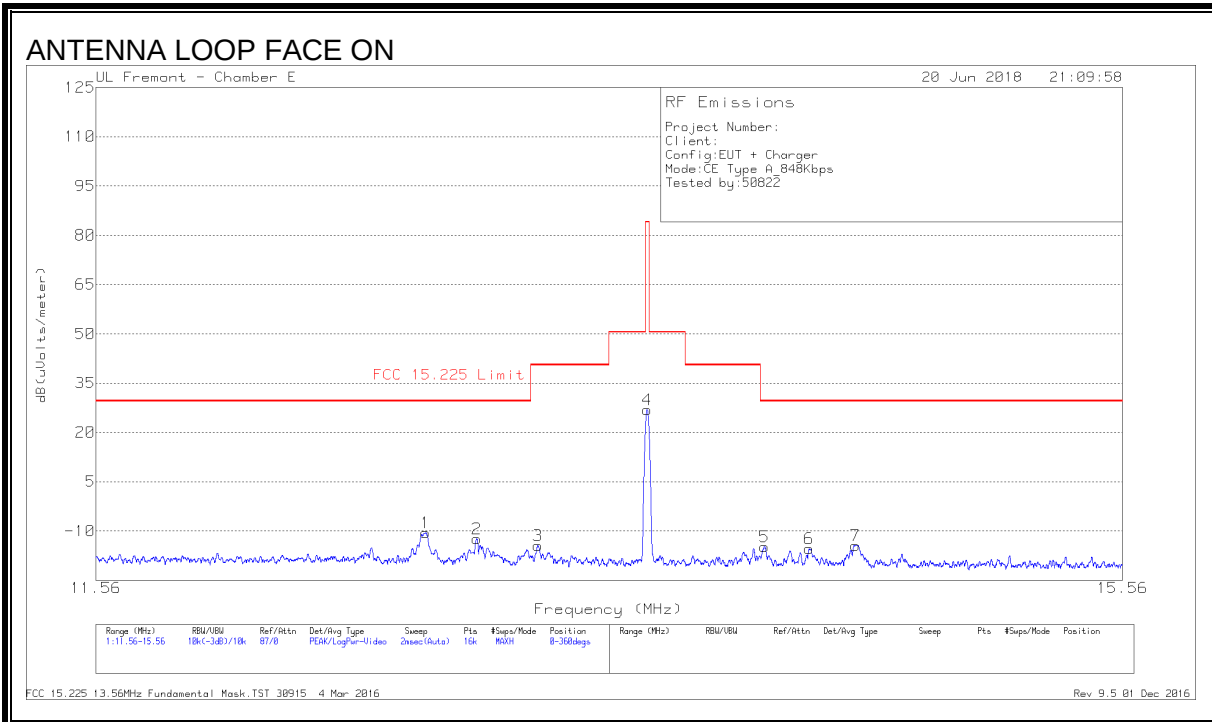
The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 13.56 MHz; therefore, the frequency range was investigated from 0.15 MHz to the 10th harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater.

RESULTS

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

8.2.1. CE MODE

FUNDAMENTAL 848Kbps

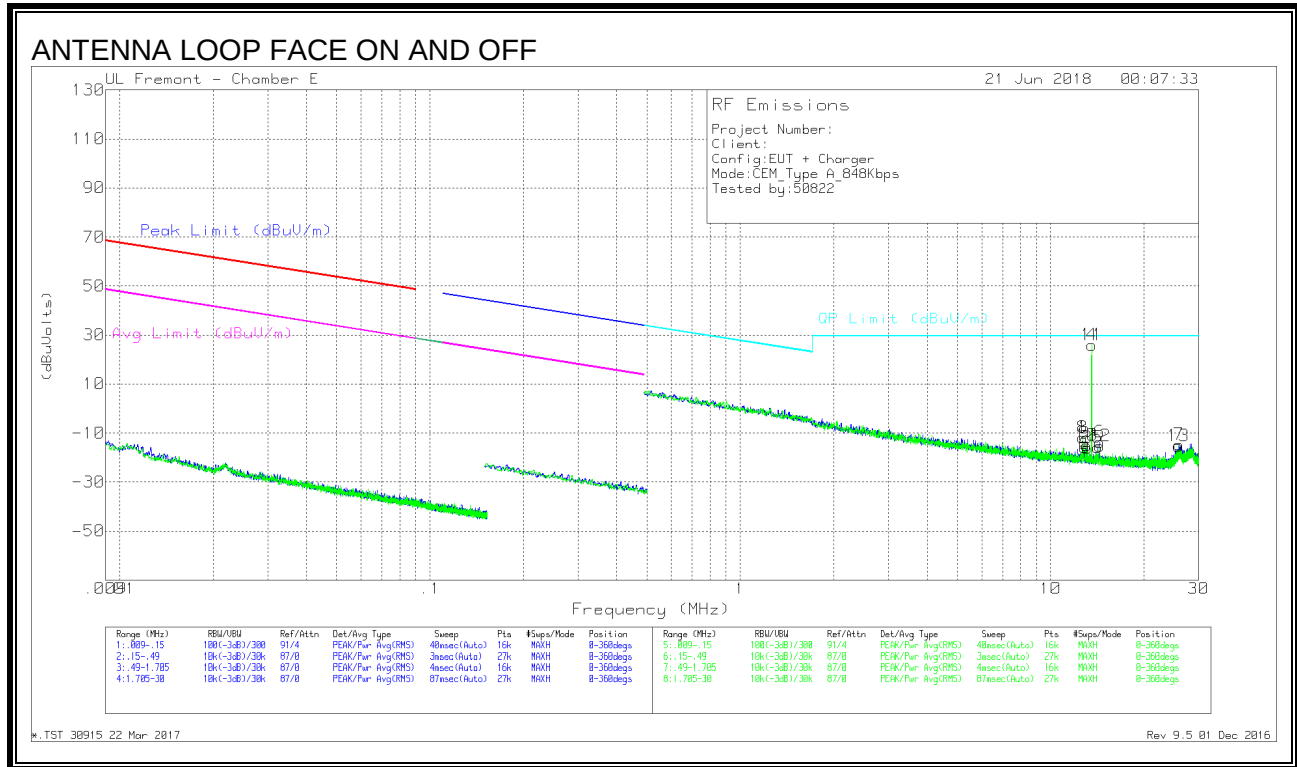


DATA

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)
8	12.71684	14	Pk	10.7	.5	-40	-14.8	29.54	-44.34	0-360
1	12.71863	18.22	Pk	10.7	.5	-40	-10.58	29.54	-40.12	0-360
9	12.75673	12.76	Pk	10.7	.5	-40	-16.04	29.54	-45.58	0-360
10	12.90473	13.39	Pk	10.7	.5	-40	-15.41	29.54	-44.95	0-360
2	12.90713	16.48	Pk	10.7	.5	-40	-12.32	29.54	-41.86	0-360
3	13.13763	14.35	Pk	10.7	.5	-40	-14.45	40.51	-54.96	0-360
11	13.16669	13.17	Pk	10.7	.5	-40	-15.63	40.51	-56.14	0-360
12	13.55948	52.44	Pk	10.6	.5	-40	23.54	84	-60.46	0-360
4	13.55975	55.88	Pk	10.6	.5	-40	26.98	84	-57.02	0-360
13	13.98254	14.79	Pk	10.6	.5	-40	-14.11	40.51	-54.62	0-360
5	14.02888	14.11	Pk	10.6	.5	-40	-14.79	29.54	-44.33	0-360
6	14.21113	13.45	Pk	10.6	.5	-40	-15.45	29.54	-44.99	0-360
7	14.40213	14.54	Pk	10.6	.5	-40	-14.36	29.54	-43.9	0-360
14	14.40449	13.1	Pk	10.6	.5	-40	-15.8	29.54	-45.34	0-360

Pk - Peak detector

SPURIOUS EMISSION 848Kbps



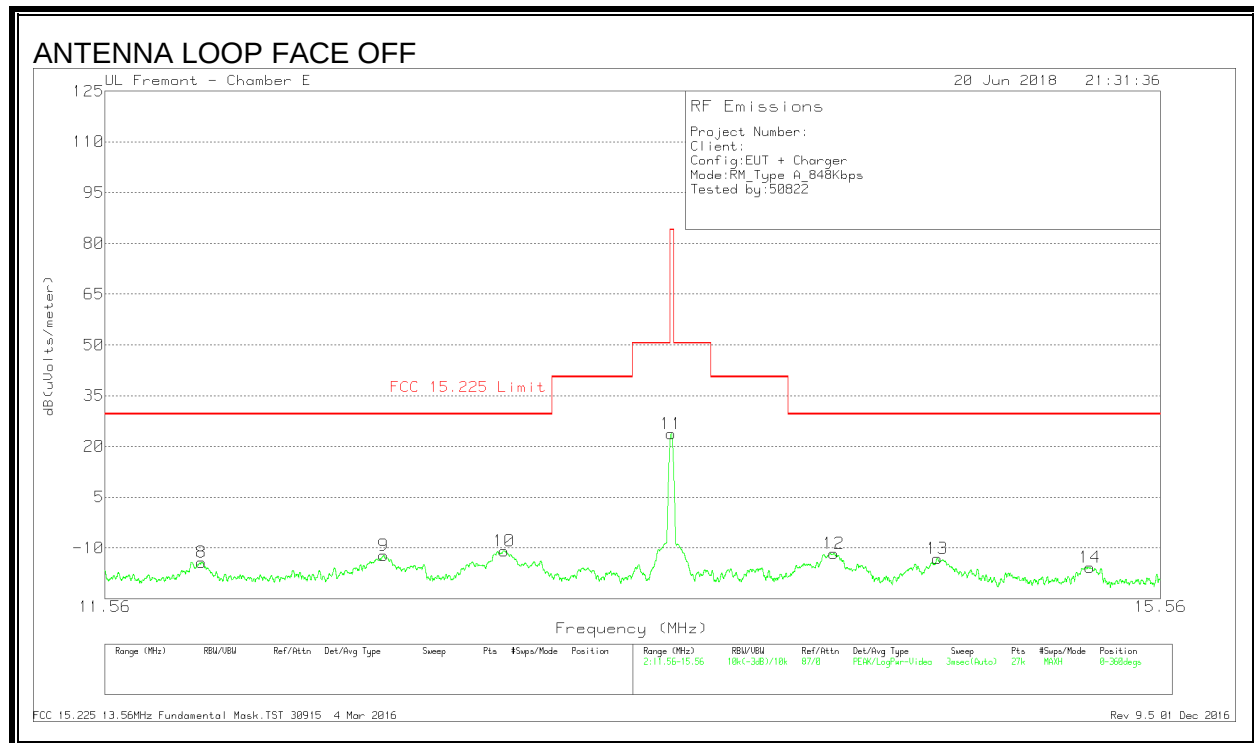
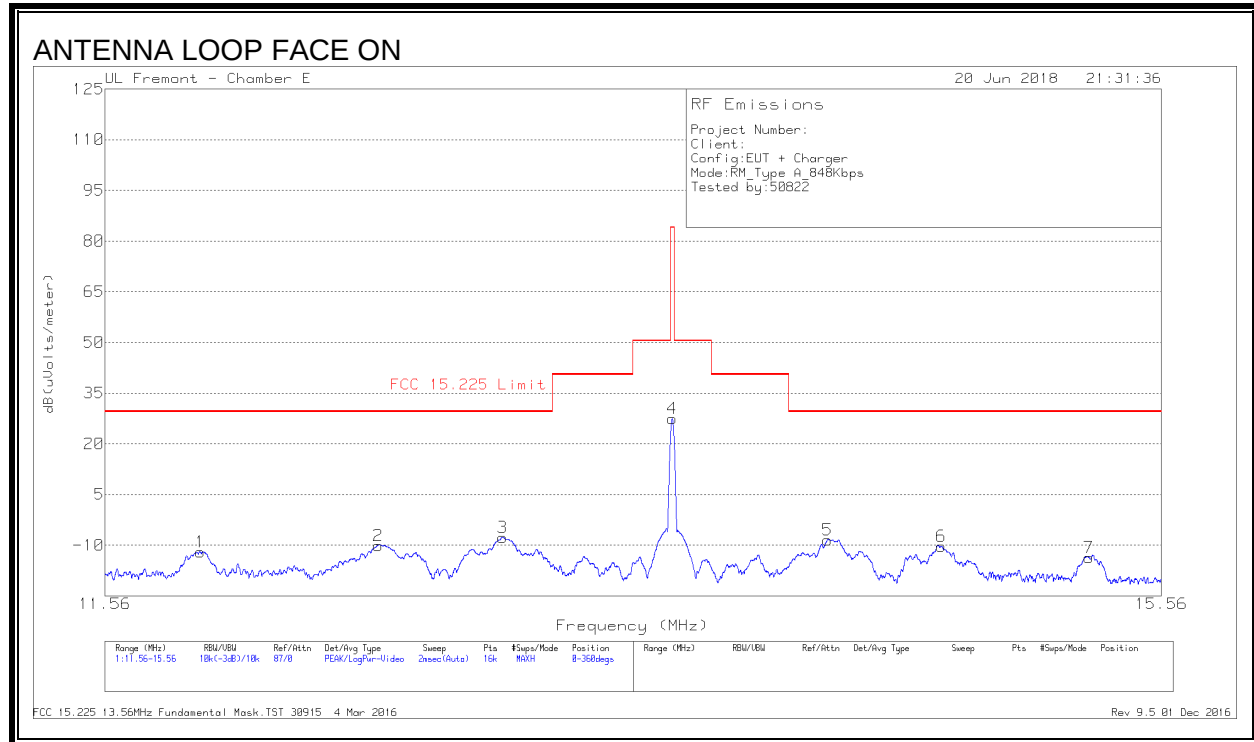
DATA

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	12.70062	16.6	Pk	11	.5	-40	-11.9	29.5	-41.4	0-360
8	12.71214	16.63	Pk	11	.5	-40	-11.87	29.5	-41.37	0-360
2	12.90445	12.59	Pk	11	.5	-40	-15.91	29.5	-45.41	0-360
9	12.90812	14.26	Pk	11	.5	-40	-14.24	29.5	-43.74	0-360
10	13.08785	13.5	Pk	11	.5	-40	-15	29.5	-44.5	0-360
3	13.11405	12.51	Pk	11	.5	-40	-15.99	29.5	-45.49	0-360
5	14.2155	12.55	Pk	11	.5	-40	-15.95	29.5	-45.45	0-360
6	14.40362	14.87	Pk	11	.5	-40	-13.63	29.5	-43.13	0-360
12	14.40833	13.09	Pk	11	.5	-40	-15.41	29.5	-44.91	0-360
13	25.76603	13.79	Pk	10.2	.7	-40	-15.31	29.5	-44.81	0-360
7	25.89284	14.23	Pk	10.2	.7	-40	-14.87	29.5	-44.37	0-360

Note: Marker 4 and 11 are the fundamental signal.

8.2.2. READER MODE

FUNDAMENTAL 848Kbps

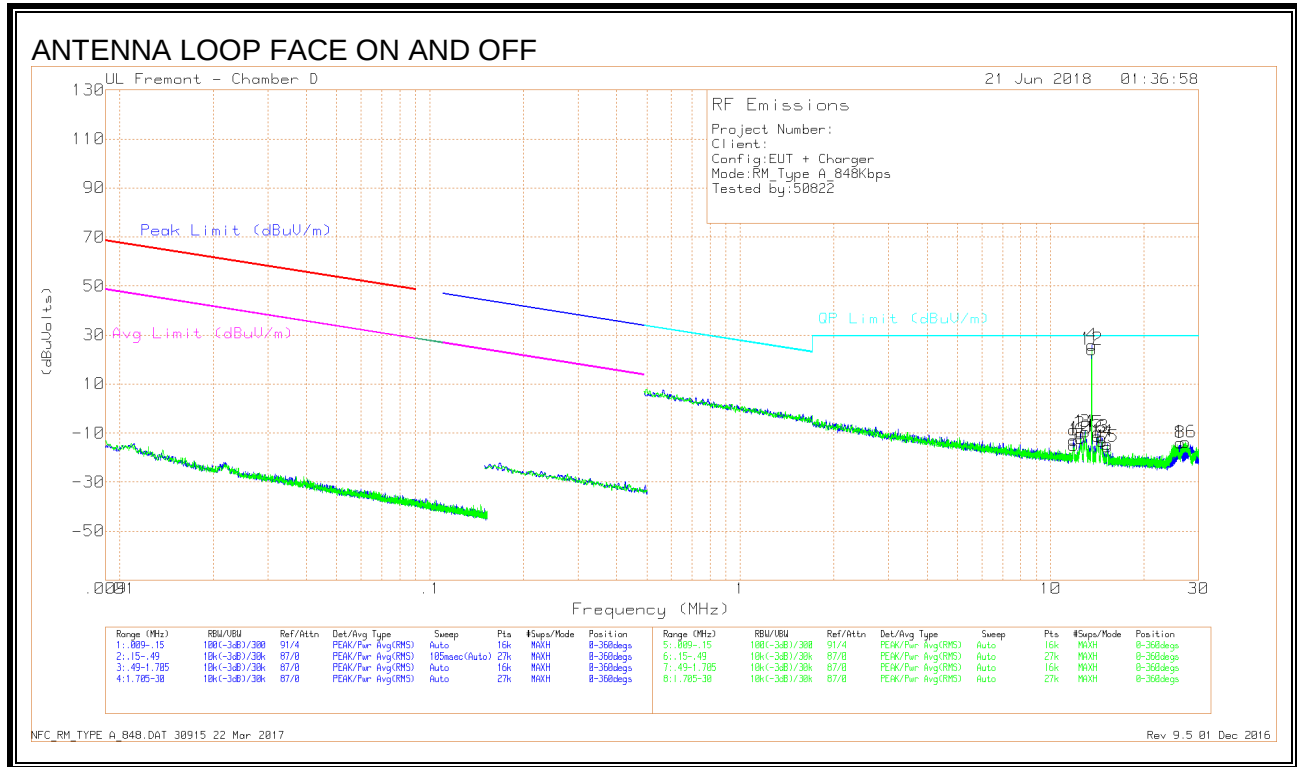


DATA

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)
1	11.87425	16.67	Pk	10.8	.5	-40	-12.03	29.54	-41.57	0-360
8	11.87924	14.43	Pk	10.8	.5	-40	-14.27	29.54	-43.81	0-360
2	12.484	18.59	Pk	10.8	.5	-40	-10.11	29.54	-39.65	0-360
9	12.50417	16.54	Pk	10.7	.5	-40	-12.26	29.54	-41.8	0-360
3	12.92863	21.11	Pk	10.7	.5	-40	-7.69	29.54	-37.23	0-360
10	12.9361	17.91	Pk	10.7	.5	-40	-10.89	29.54	-40.43	0-360
11	13.55807	52.7	Pk	10.6	.5	-40	23.8	84	-60.2	0-360
4	13.55975	56.28	Pk	10.6	.5	-40	27.38	84	-56.62	0-360
5	14.1655	20.48	Pk	10.6	.5	-40	-8.42	29.54	-37.96	0-360
12	14.19203	17.25	Pk	10.6	.5	-40	-11.65	29.54	-41.19	0-360
13	14.61302	15.91	Pk	10.5	.5	-40	-13.09	29.54	-42.63	0-360
6	14.62663	18.73	Pk	10.5	.5	-40	-10.27	29.54	-39.81	0-360
7	15.24675	15.26	Pk	10.5	.6	-40	-13.64	29.54	-43.18	0-360
14	15.25334	13.18	Pk	10.5	.5	-40	-15.82	29.54	-45.36	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)
9	11.86641	13.56	Pk	11	.5	-40	-14.94	29.5	-44.44	0-360
1	11.87374	15.57	Pk	11	.5	-40	-12.93	29.5	-42.43	0-360
2	12.48001	18.21	Pk	11	.5	-40	-10.29	29.5	-39.79	0-360
10	12.49311	16.49	Pk	11	.5	-40	-12.01	29.5	-41.51	0-360
3	12.92279	19.13	Pk	11	.5	-40	-9.37	29.5	-38.87	0-360
11	12.93904	19.02	Pk	11	.5	-40	-9.48	29.5	-38.98	0-360
13	14.1872	17.16	Pk	11	.5	-40	-11.34	29.5	-40.84	0-360
5	14.20921	18.77	Pk	11	.5	-40	-9.73	29.5	-39.23	0-360
6	14.63732	16.53	Pk	11.1	.5	-40	-11.87	29.5	-41.37	0-360
14	14.6478	14.9	Pk	11.1	.5	-40	-13.5	29.5	-43	0-360
15	15.23206	12.77	Pk	11.1	.6	-40	-15.53	29.5	-45.03	0-360
7	15.25826	13.97	Pk	11.1	.5	-40	-14.43	29.5	-43.93	0-360
8	26.12864	15.22	Pk	10.2	.7	-40	-13.88	29.5	-43.38	0-360
16	27.17926	15.43	Pk	10.1	.7	-40	-13.77	29.5	-43.27	0-360

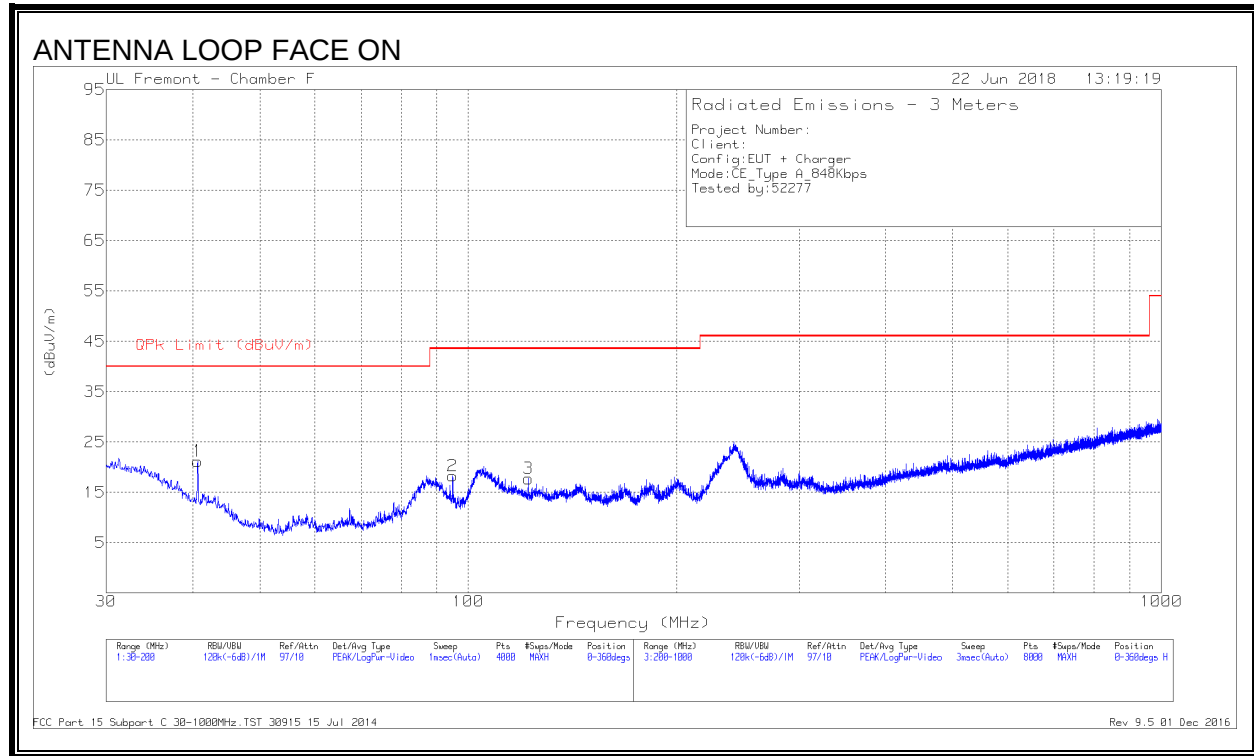
Pk - Peak detector

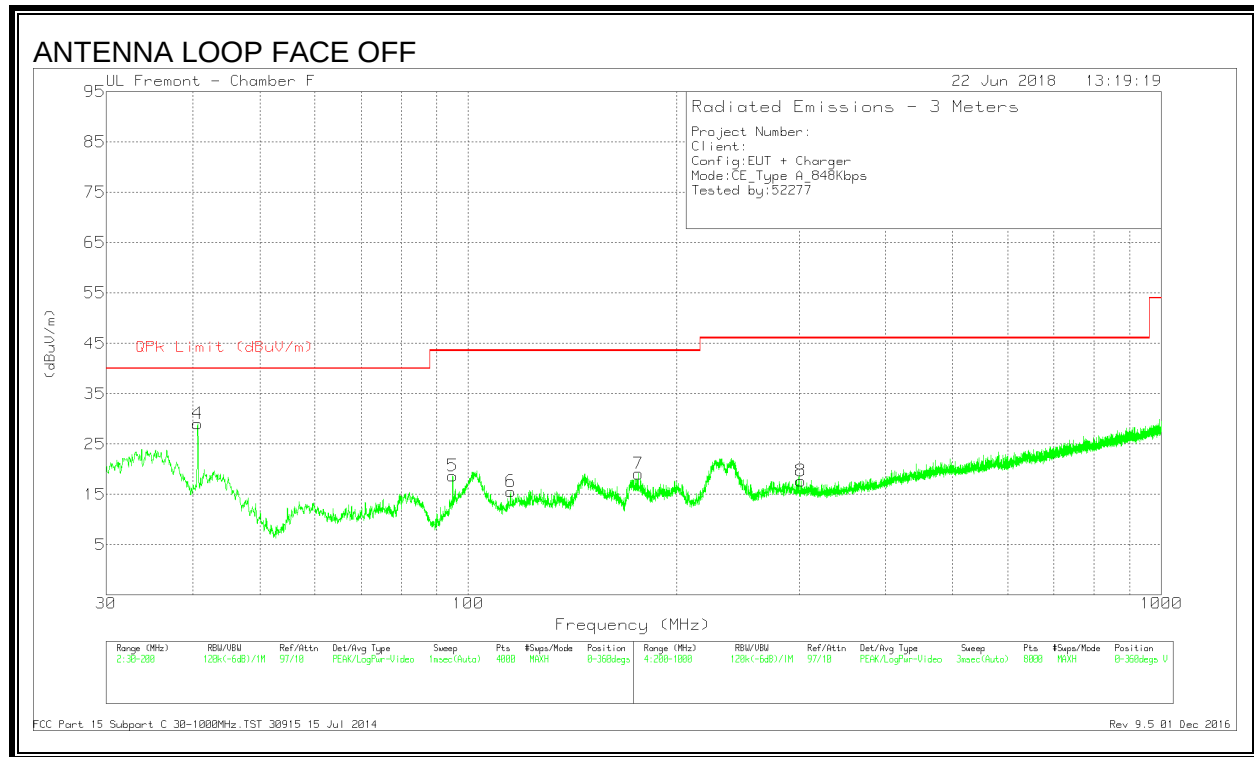
Note: Marker 4 and 12 are the fundamental signal.

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

8.3.1. CE MODE

SPURIOUS EMISSION 848Kbps





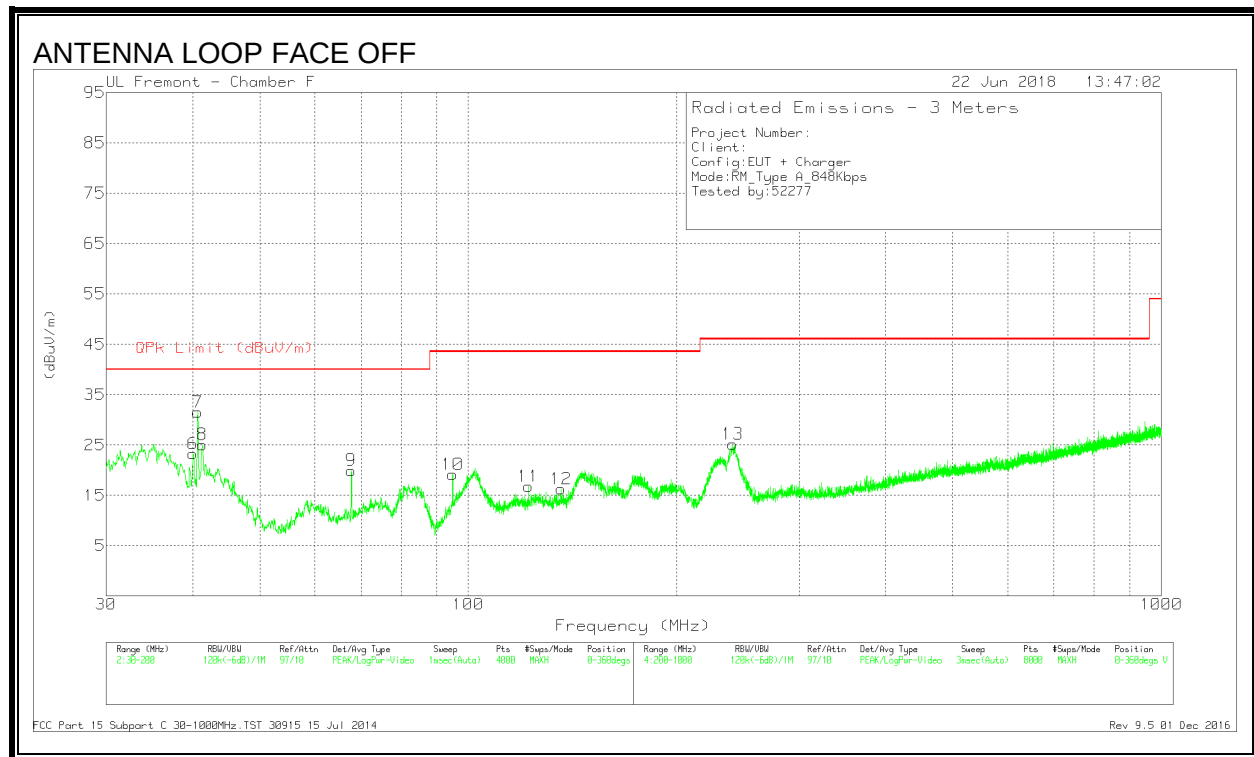
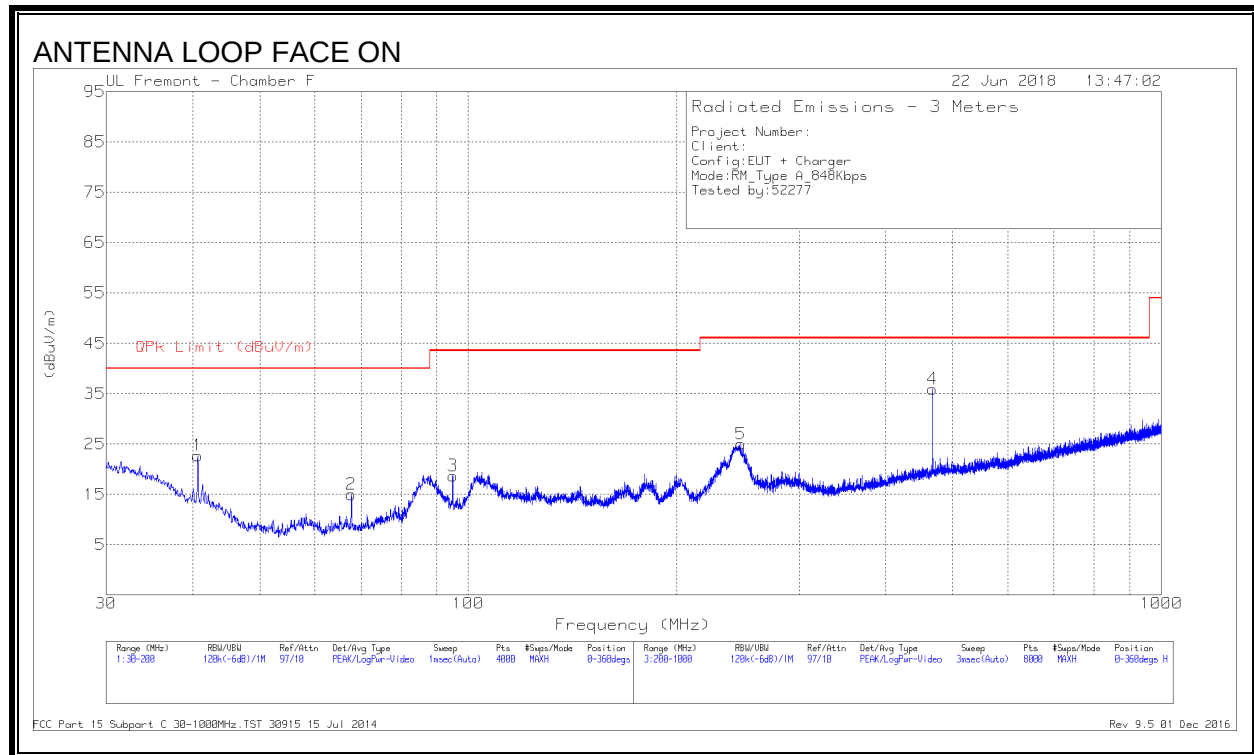
DATA

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	40.6703	35.58	Pk	17.4	-31.8	21.18	40	-18.82	0-360	399	H
2	94.9143	36.86	Pk	12.7	-31.3	18.26	43.52	-25.26	0-360	299	H
3	* 122.0363	31.14	Pk	17.7	-31.1	17.74	43.52	-25.78	0-360	199	H
4	40.6703	43.47	Pk	17.4	-31.8	29.07	40	-10.93	0-360	100	V
5	94.9143	37.3	Pk	12.7	-31.3	18.7	43.52	-24.82	0-360	100	V
6	* 115.0645	29.47	Pk	17.2	-31.1	15.57	43.52	-27.95	0-360	100	V
7	176.0678	34.41	Pk	15.3	-30.6	19.11	43.52	-24.41	0-360	100	V
8	301.9132	30.3	Pk	17.4	-30	17.7	46.02	-28.32	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	37.11	Pk	17.4	-31.8	22.71	40	-17.29	0-360	299	H
2	67.7923	34.58	Pk	11.9	-31.5	14.98	40	-25.02	0-360	199	H
3	94.9568	37.29	Pk	12.7	-31.3	18.69	43.52	-24.83	0-360	299	H
6	40.0326	37.15	Pk	17.9	-31.8	23.25	40	-16.75	0-360	100	V
7	40.6703	45.92	Pk	17.4	-31.8	31.52	40	-8.48	0-360	100	V
8	41.3079	39.87	Pk	17	-31.8	25.07	40	-14.93	0-360	100	V
9	67.7923	39.54	Pk	11.9	-31.5	19.94	40	-20.06	0-360	100	V
10	94.9143	37.76	Pk	12.7	-31.3	19.16	43.52	-24.36	0-360	100	V
11	* 122.0788	30.17	Pk	17.7	-31.1	16.77	43.52	-26.75	0-360	100	V
12	* 136.0224	29.98	Pk	17.3	-31	16.28	43.52	-27.24	0-360	100	V
4	467.8348	43.81	Pk	21.3	-29.2	35.91	46.02	-10.11	0-360	199	H
5	* 247.1061	39.8	Pk	15.5	-30.3	25	46.02	-21.02	0-360	100	H
13	* 240.7053	39.87	Pk	15.6	-30.3	25.17	46.02	-20.85	0-360	199	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:	6/23/18
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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 (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5600575	-1.722	13.5600613	-2.001	13.5600658	-2.331	13.5600708	-2.699	± 100
	40	13.5600355	-0.095	13.5600365	-0.168	13.5600379	-0.272	13.5600396	-0.401	± 100
	30	13.5600386	-0.326	13.5600372	-0.222	13.5600366	-0.178	13.5600350	-0.059	± 100
	20	13.5600342	0.000	13.5600355	-0.099	13.5600379	-0.273	13.5600407	-0.484	± 100
	10	13.5600492	-1.108	13.5600525	-1.352	13.5600563	-1.633	13.5600602	-1.917	± 100
	0	13.5600722	-2.805	13.5600761	-3.089	13.5600801	-3.384	13.5600836	-3.644	± 100
	-10	13.5600970	-4.630	13.5601000	-4.854	13.5601028	-5.061	13.5601049	-5.213	± 100
	-20	13.5600777	-3.212	13.5600947	-4.466	13.5601097	-5.572	13.5601193	-6.275	± 100
3.23	20	13.5600403	-0.451	13.5600410	-0.503	13.5600414	-0.532	13.5600418	-0.562	± 100
4.37	20	13.5600434	-0.680	13.5600428	-0.636	13.5600428	-0.636	13.5600423	-0.599	± 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 (MHz)	Delta (ppm)	@ 2 mins (MHz)	Delta (ppm)	@ 5 mins (MHz)	Delta (ppm)	@ 10 mins (MHz)	Delta (ppm)	Limit (ppm)
3.80	50	13.5600475	-0.501	13.5600497	-0.664	13.5600524	-0.863	13.5600556	-1.099	± 100
	40	13.5600322	0.627	13.5600326	0.597	13.5600331	0.560	13.2600338	0.221	± 100
	30	13.5600329	0.575	13.5600331	0.560	13.5600338	0.509	13.5600343	0.472	± 100
	20	13.5600407	0.000	13.5600385	0.162	13.5600392	0.108	13.5600402	0.034	± 100
	10	13.5600472	-0.482	13.5600502	-0.701	13.5600537	-0.960	13.5600574	-1.235	± 100
	0	13.5600691	-2.092	13.5600730	-2.384	13.5600773	-2.696	13.5600812	-2.990	± 100
	-10	13.5600870	-3.414	13.5600919	-3.776	13.5600970	-4.152	13.5601025	-4.558	± 100
	-20	13.5601183	-5.723	13.5601193	-5.796	13.5601202	-5.863	13.5601210	-5.922	± 100
3.23	20	13.5600420	-0.096	13.5600421	-0.103	13.5600423	-0.118	13.5600426	-0.140	± 100
4.37	20	13.5600418	-0.081	13.5600419	-0.088	13.5600420	-0.096	13.5600420	-0.096	± 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

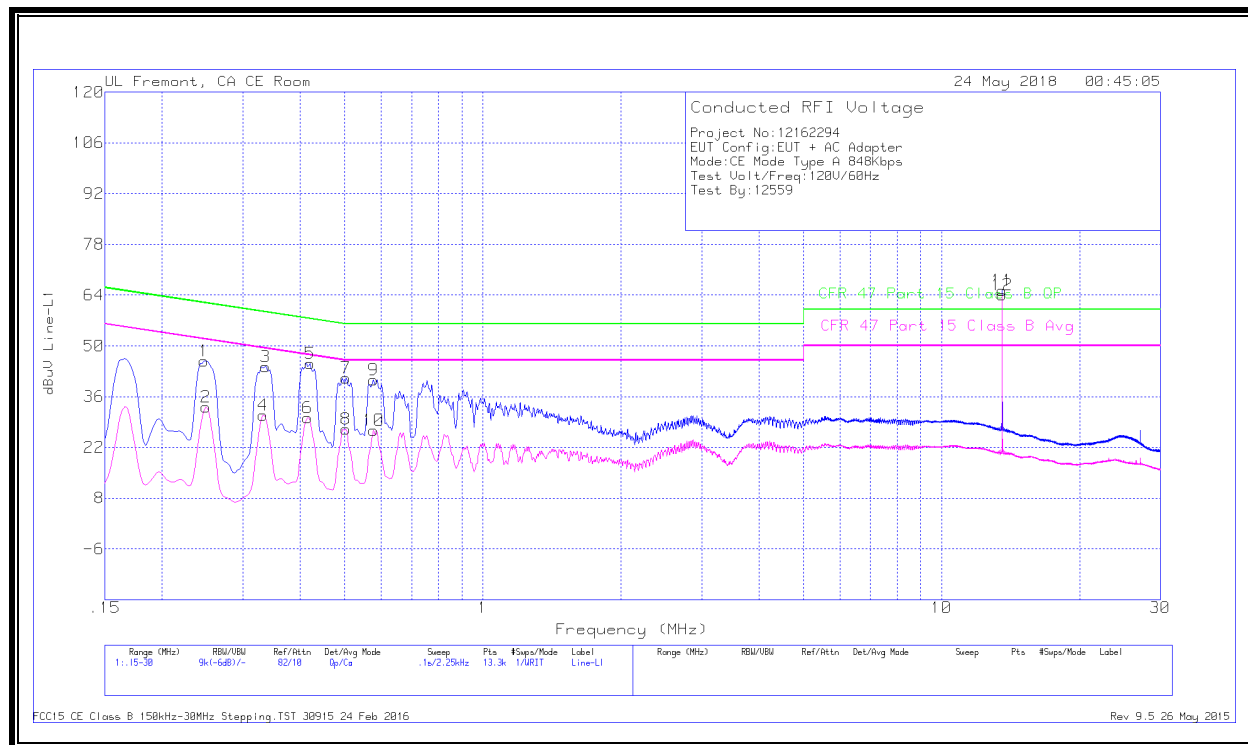
RESULTS

No non-compliance noted:

10.1. CE MODE

10.1.1. NORMAL OPERATION, 848Kbps

LINE 1 RESULTS



WORST EMISSIONS

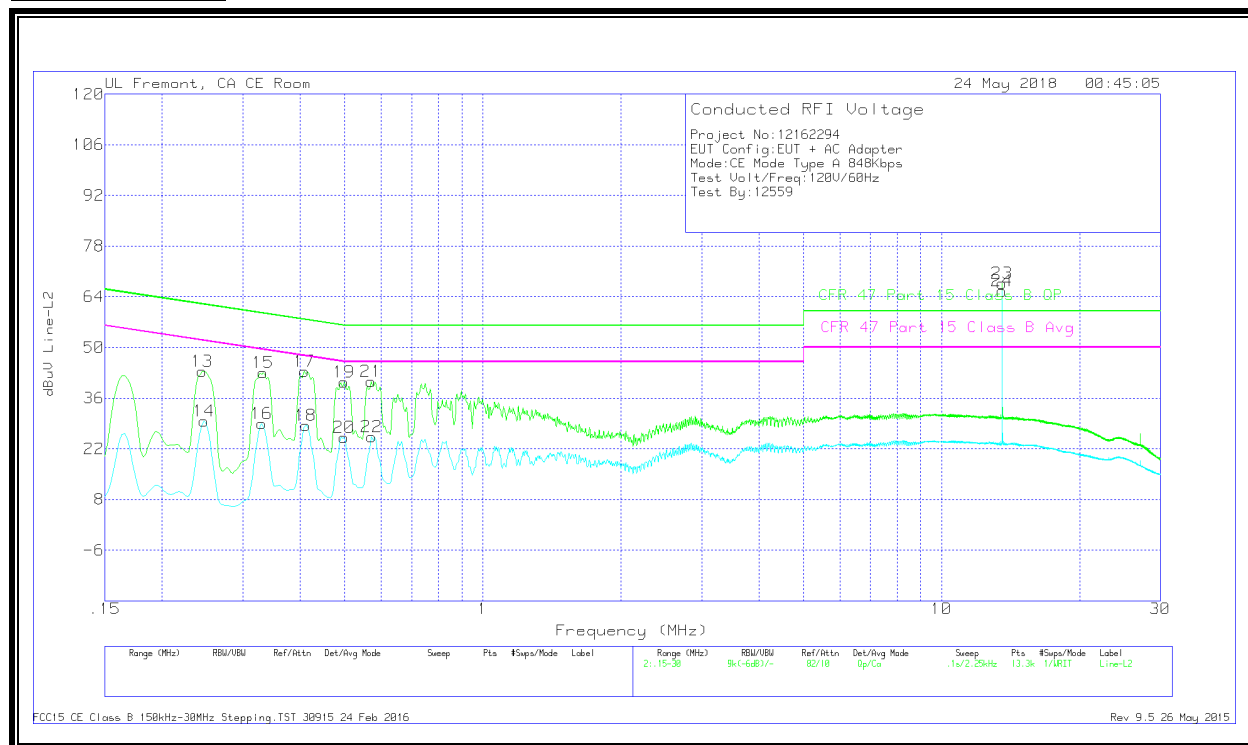
Range 1: Line-L1 15 - 30MHz

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	.24675	35.8	Qp	0	0	10.1	45.9	61.87	-15.97	-	-
2	.249	23.01	Ca	0	0	10.1	33.11	-	-	51.79	-18.68
3	.33562	34.2	Qp	0	0	10.1	44.3	59.31	-15.01	-	-
4	.33225	20.83	Ca	0	0	10.1	30.93	-	-	49.39	-18.46
5	.42	35.04	Qp	0	0	10.1	45.14	57.45	-12.31	-	-
6	.4155	20.02	Ca	0	0	10.1	30.12	-	-	47.54	-17.42
7	.50325	31.1	Qp	0	0	10.1	41.2	56	-14.8	-	-
8	.50325	16.91	Ca	0	0	10.1	27.01	-	-	46	-18.99
9	.5775	30.53	Qp	0	0	10.1	40.63	56	-15.37	-	-
10	.5775	16.54	Ca	0	0	10.1	26.64	-	-	46	-19.36
11	13.56	54.77	Qp	.1	.2	10.2	65.27	60	5.27	-	-
12	13.56	53.57	Ca	.1	.2	10.2	64.07	-	-	50	14.07

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

LINE 2 RESULTS



WORST EMISSIONS

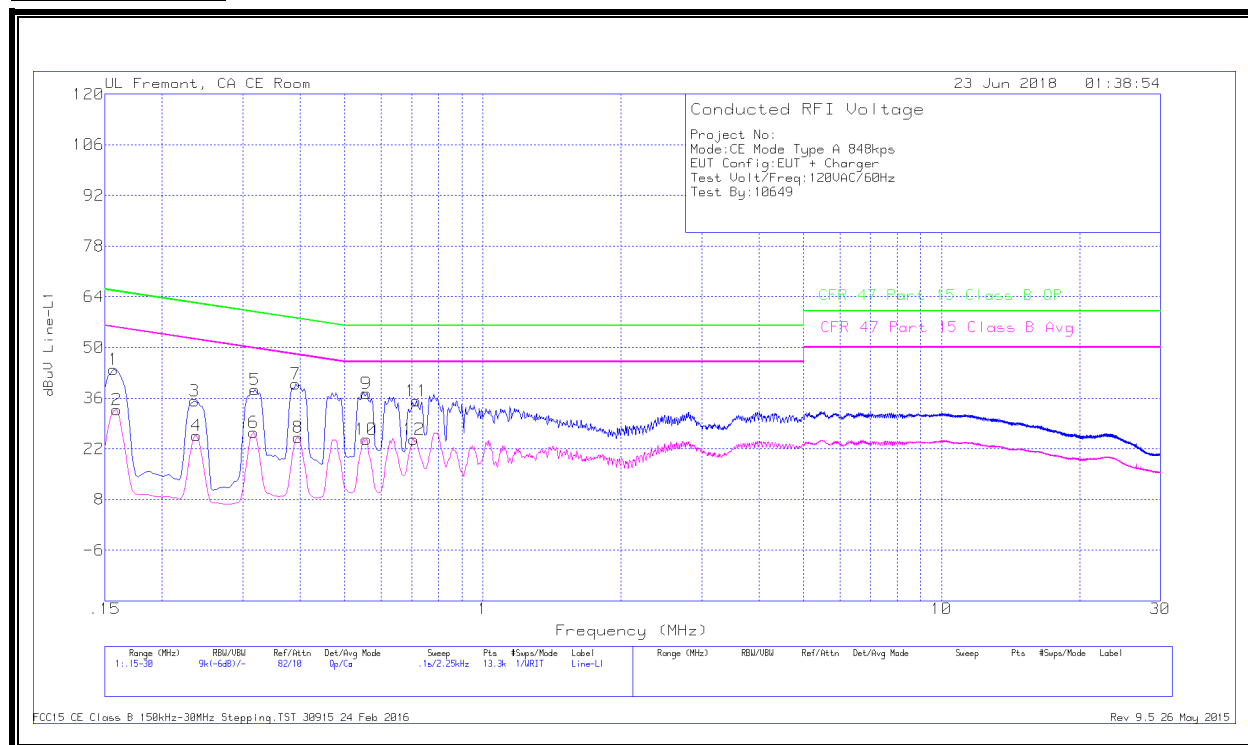
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B OP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.2445	33.3	Qp	0	0	10.1	43.4	61.94	-18.54	-	-
14	.24675	19.59	Ca	0	0	10.1	29.69	-	-	51.87	-22.18
15	.33225	32.88	Qp	0	0	10.1	42.98	59.39	-16.41	-	-
16	.33	18.81	Ca	0	0	10.1	28.91	-	-	49.45	-20.54
17	.40875	33.36	Qp	0	0	10.1	43.46	57.67	-14.21	-	-
18	.411	18.35	Ca	0	0	10.1	28.45	-	-	47.63	-19.18
19	.49875	30.33	Qp	0	0	10.1	40.43	56.02	-15.59	-	-
20	.49875	15.11	Ca	0	0	10.1	25.21	-	-	46.02	-20.81
21	.57075	30.47	Qp	0	0	10.1	40.57	56	-15.43	-	-
22	.573	15.2	Ca	0	0	10.1	25.3	-	-	46	-20.7
23	13.56	57.24	Qp	.1	.2	10.2	67.74	60	7.74	-	-
24	13.56	55.06	Ca	.1	.2	10.2	65.56	-	-	50	15.56

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

10.1.2. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS

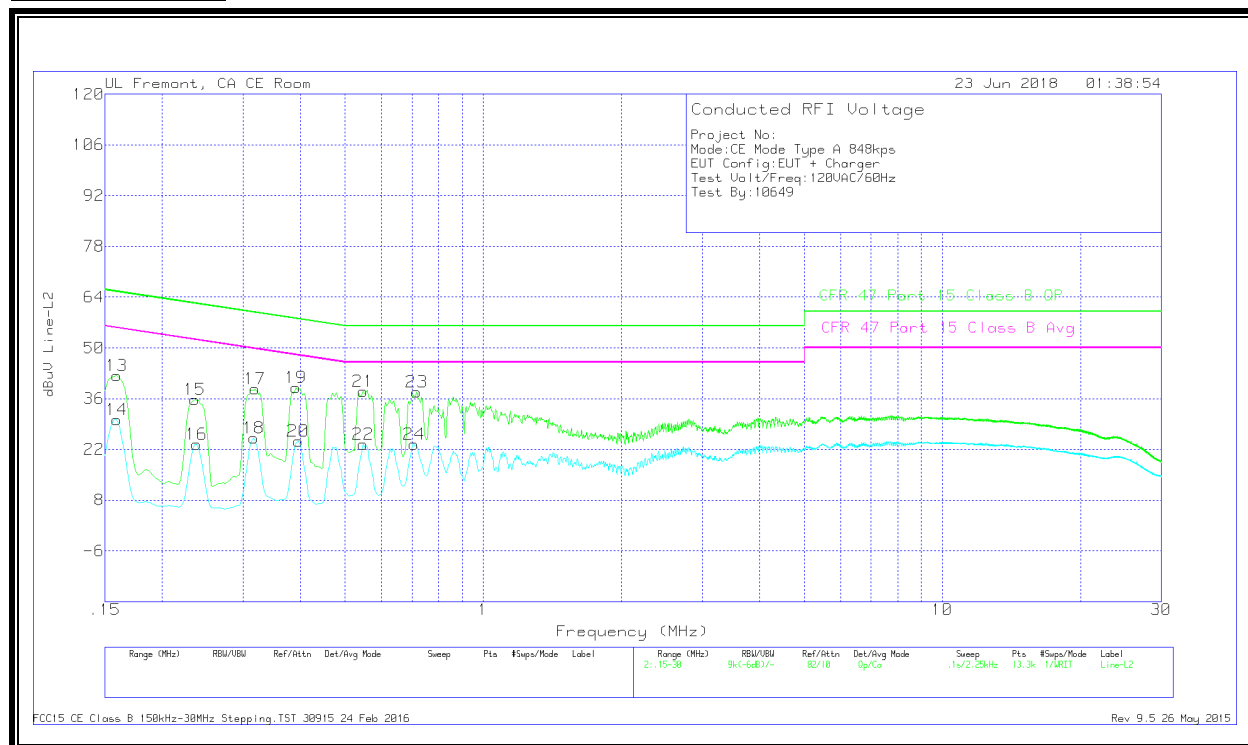


WORST EMISSIONS

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	33.05	Qp	.7	0	10.1	43.85	65.63	-21.78	-	-
2	.159	22	Ca	.7	0	10.1	32.8	-	-	55.52	-22.72
3	.2355	24.55	Qp	.5	0	10.1	35.15	62.25	-27.1	-	-
4	.23775	15.24	Ca	.4	0	10.1	25.74	-	-	52.17	-26.43
5	.31875	27.84	Qp	.4	0	10.1	38.34	59.74	-21.4	-	-
6	.3165	15.98	Ca	.4	0	10.1	26.48	-	-	49.8	-23.32
7	.39075	29.54	Qp	.2	0	10.1	39.84	58.05	-18.21	-	-
8	.39525	14.91	Ca	.2	0	10.1	25.21	-	-	47.95	-22.74
9	.55725	27.11	Qp	.1	0	10.1	37.31	56	-18.69	-	-
10	.55725	14.46	Ca	.1	0	10.1	24.66	-	-	46	-21.34
11	.717	25.09	Qp	.1	0	10.1	35.29	56	-20.71	-	-
12	.708	14.35	Ca	.1	0	10.1	24.55	-	-	46	-21.45

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



WORST EMISSIONS

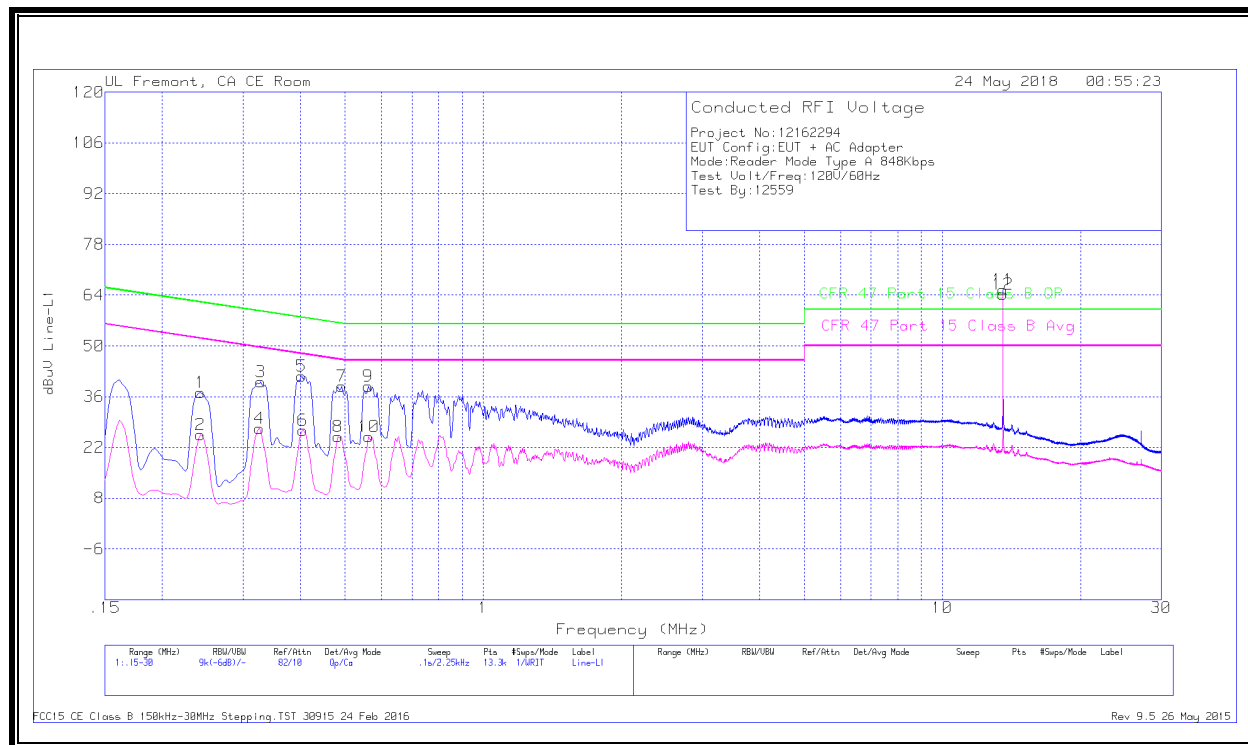
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.159	32.09	Qp	.1	0	10.1	42.29	65.52	-23.23	-	-
14	.159	20.01	Ca	.1	0	10.1	30.21	-	-	55.52	-25.31
15	.2355	25.54	Qp	.1	0	10.1	35.74	62.25	-26.51	-	-
16	.23775	13.27	Ca	.1	0	10.1	23.47	-	-	52.17	-28.7
17	.31875	28.47	Qp	.1	0	10.1	38.67	59.74	-21.07	-	-
18	.3165	14.91	Ca	.1	0	10.1	25.11	-	-	49.8	-24.69
19	.39075	28.77	Qp	.1	0	10.1	38.97	58.05	-19.08	-	-
20	.39525	14.04	Ca	.1	0	10.1	24.24	-	-	47.95	-23.71
21	.54825	27.86	Qp	.1	0	10.1	38.06	56	-17.94	-	-
22	.54825	13.2	Ca	.1	0	10.1	23.4	-	-	46	-22.6
23	.717	27.59	Qp	.1	0	10.1	37.79	56	-18.21	-	-
24	.708	13.17	Ca	.1	0	10.1	23.37	-	-	46	-22.63

Qp - Quasi-Peak detector
Ca - CISPR average detection

10.2. READER MODE

10.2.1. NORMAL OPERATION, 848Kbps

LINE 1 RESULTS



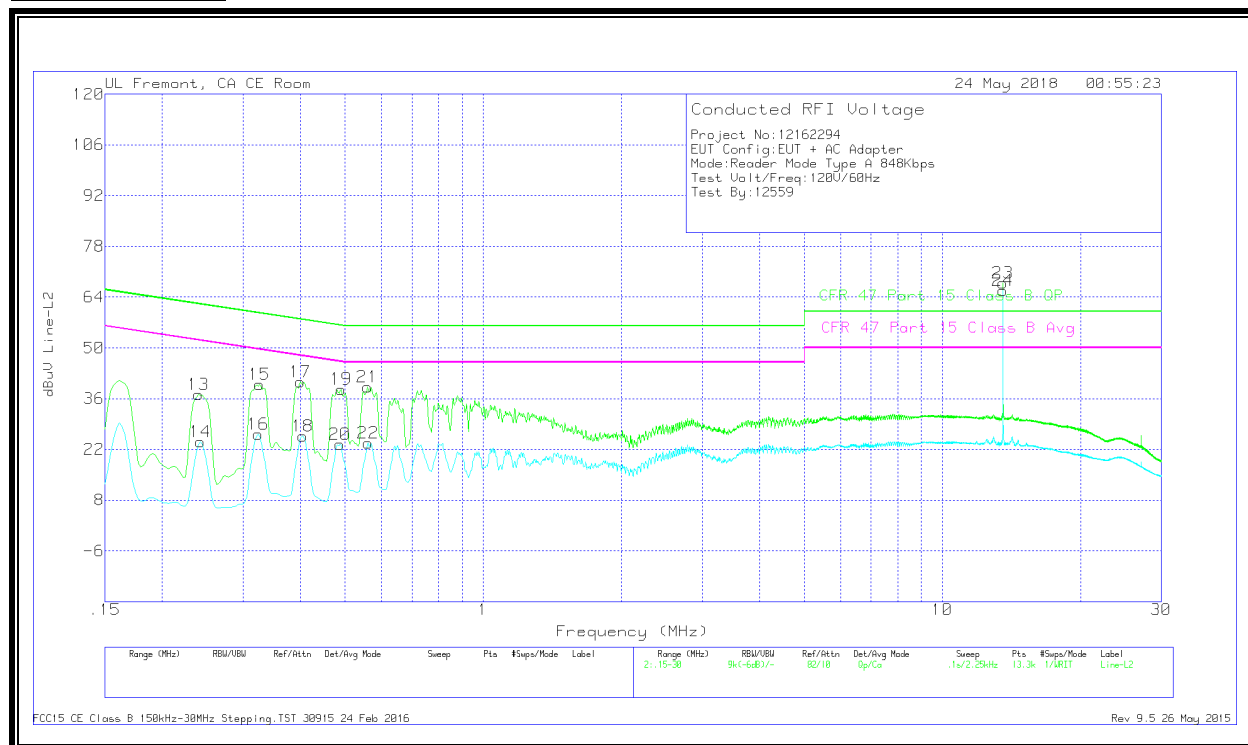
WORST EMISSIONS

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	.24225	27.05	Qp	0	0	10.1	37.15	62.02	-24.87	-	-
2	.24225	15.41	Ca	0	0	10.1	25.51	-	-	52.02	-26.51
3	.32775	29.99	Qp	0	0	10.1	40.09	59.51	-19.42	-	-
4	.3255	17.1	Ca	0	0	10.1	27.2	-	-	49.57	-22.37
5	.402	31.62	Qp	0	0	10.1	41.72	57.81	-16.09	-	-
6	.40425	16.57	Ca	0	0	10.1	26.67	-	-	47.77	-21.1
7	.492	28.7	Qp	0	0	10.1	38.8	56.13	-17.33	-	-
8	.483	14.85	Ca	0	0	10.1	24.95	-	-	46.29	-21.34
9	.56175	28.72	Qp	0	0	10.1	38.82	56	-17.18	-	-
10	.564	14.87	Ca	0	0	10.1	24.97	-	-	46	-21.03
11	13.56	55.03	Qp	.1	.2	10.2	65.53	60	5.53	-	-
12	13.56	53.81	Ca	.1	.2	10.2	64.31	-	-	50	14.31

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

LINE 2 RESULTS



WORST EMISSIONS

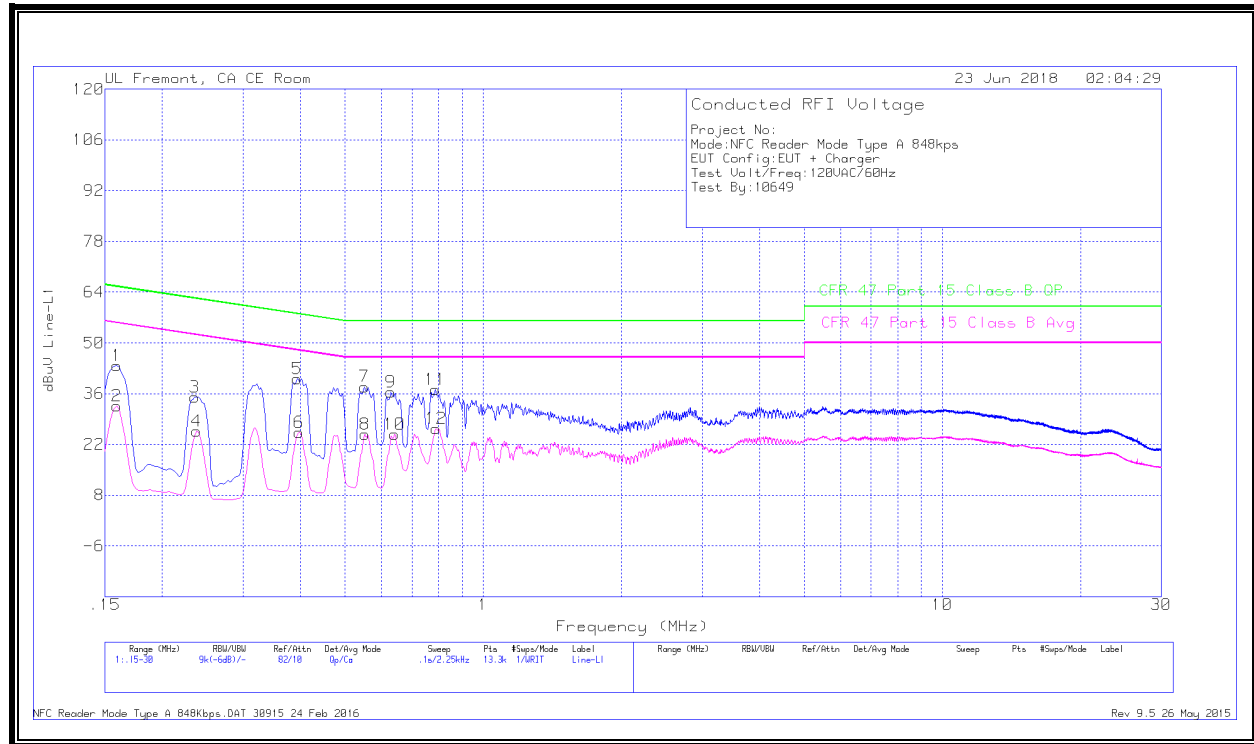
Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.24	27.05	Qp	0	0	10.1	37.15	62.1	-24.95	-	-
14	.24225	13.95	Ca	0	0	10.1	24.05	-	-	52.02	-27.97
15	.3255	29.84	Qp	0	0	10.1	39.94	59.57	-19.63	-	-
16	.32325	16.16	Ca	0	0	10.1	26.26	-	-	49.62	-23.36
17	.39975	30.46	Qp	0	0	10.1	40.56	57.86	-17.3	-	-
18	.40425	15.56	Ca	0	0	10.1	25.66	-	-	47.77	-22.11
19	.48975	28.51	Qp	0	0	10.1	38.61	56.17	-17.56	-	-
20	.4875	13.32	Ca	0	0	10.1	23.42	-	-	46.21	-22.79
21	.5595	29.08	Qp	0	0	10.1	39.18	56	-16.82	-	-
22	.56175	13.58	Ca	0	0	10.1	23.68	-	-	46	-22.32
23	13.56	57.45	Qp	.1	.2	10.2	67.95	60	7.95	-	-
24	13.56	55.25	Ca	.1	.2	10.2	65.75	-	-	50	15.75

Qp - Quasi-Peak detector
Ca - CISPR average detection

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

10.2.2. NORMAL OPERATION WITH ANTENNA PORT TERMINATED, 848Kbps

LINE 1 RESULTS

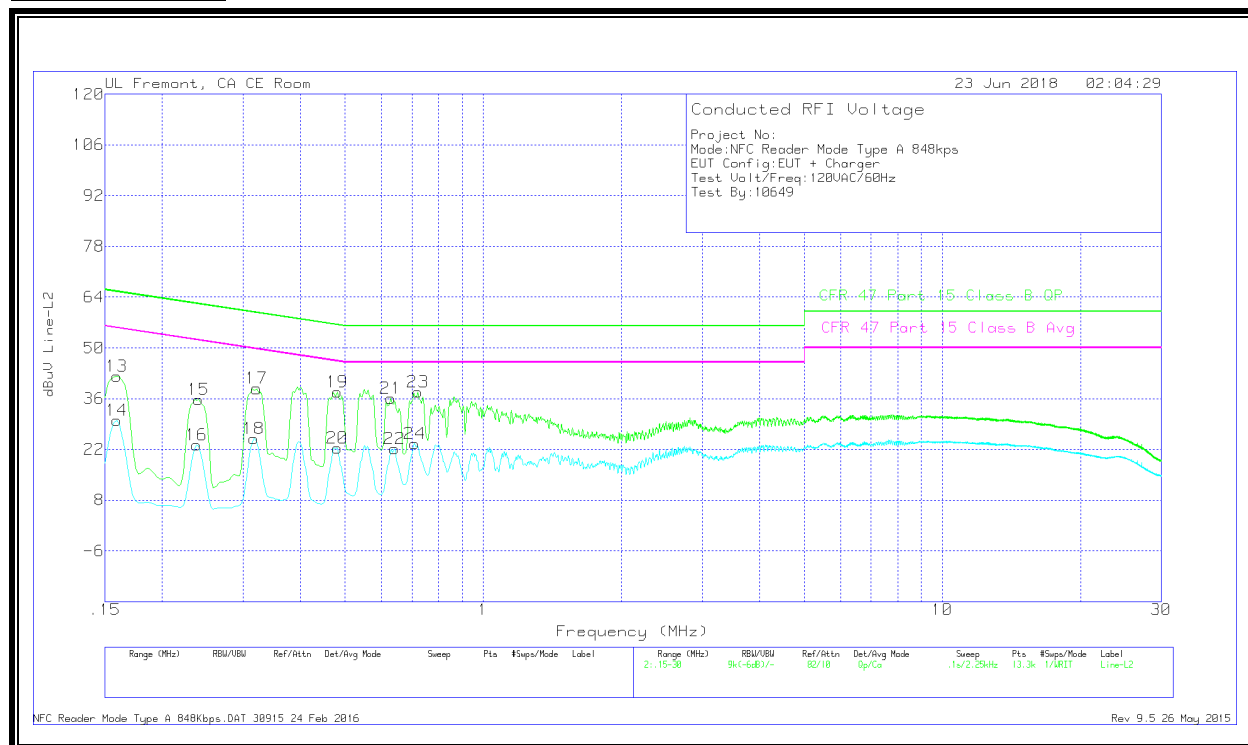


WORST EMISSIONS

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	32.89	Qp	.7	0	10.1	43.69	65.52	-21.83	-	-
2	.159	21.89	Ca	.7	0	10.1	32.69	-	-	55.52	-22.83
3	.2355	24.39	Qp	.5	0	10.1	34.99	62.25	-27.26	-	-
4	.23775	15.1	Ca	.4	0	10.1	25.6	-	-	52.17	-26.57
5	.393	29.8	Qp	.2	0	10.1	40.1	58	-17.9	-	-
6	.3975	15.01	Ca	.2	0	10.1	25.31	-	-	47.91	-22.6
7	.5505	27.72	Qp	.1	0	10.1	37.92	56	-18.08	-	-
8	.55275	14.57	Ca	.1	0	10.1	24.77	-	-	46	-21.23
9	.62925	26.2	Qp	.1	0	10.1	36.4	56	-19.6	-	-
10	.6405	14.63	Ca	.1	0	10.1	24.83	-	-	46	-21.17
11	.78675	26.86	Qp	.1	0	10.1	37.06	56	-18.94	-	-
12	.789	16.11	Ca	.1	0	10.1	26.31	-	-	46	-19.69

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	31.98	Qp	.1	0	10.1	42.18	65.52	-23.34	-	-
14	.159	19.87	Ca	.1	0	10.1	30.07	-	-	55.52	-25.45
15	.24	25.51	Qp	.1	0	10.1	35.71	62.1	-26.39	-	-
16	.23775	13.07	Ca	.1	0	10.1	23.27	-	-	52.17	-28.9
17	.321	28.59	Qp	.1	0	10.1	38.79	59.68	-20.89	-	-
18	.3165	14.72	Ca	.1	0	10.1	24.92	-	-	49.8	-24.88
19	.48075	27.6	Qp	.1	0	10.1	37.8	56.33	-18.53	-	-
20	.48075	12.12	Ca	.1	0	10.1	22.32	-	-	46.33	-24.01
21	.62925	25.84	Qp	.1	0	10.1	36.04	56	-19.96	-	-
22	.6405	11.94	Ca	.1	0	10.1	22.14	-	-	46	-23.86
23	.7215	27.63	Qp	.1	0	10.1	37.83	56	-18.17	-	-
24	.71025	13.35	Ca	.1	0	10.1	23.55	-	-	46	-22.45

Qp - Quasi-Peak detector
Ca - CISPR average detection

END OF REPORT

11. SETUP PHOTOS

Please refer to 12162294-EP1V1 for setup photos