



FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

FOR

Wireless Charger

MODEL NUMBER: BEX4814-XX

REPORT NUMBER: 11436518A

FCC ID: 2AJX5-BEX4814

ISSUE DATE: November 7, 2016

Prepared for
Byrne Electrical Specialists Inc.
320 Byrne Industrial Dr.
Rockford, MI 49341
USA

Prepared by
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NVLAP Lab code: 100414-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--		Initial Issue	

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Byrne Electrical Specialists Inc.
320 Byrne Industrial Dr.
Rockford, MI 49341
USA

EUT DESCRIPTION: Wireless Charger

MODEL: BEX4814-XX

SERIAL NUMBER: non-serialized

DATE TESTED: September 26, 2016 – November 7, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	Pass

UL LLC 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 LLC 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 LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC 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 LLC By:



Bob DeLisi
WiSE Principal Engineer
UL LLC

Tested By:



Bart Mucha
WiSE Staff Engineer
UL LLC

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.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 333 Pfingsten Road, Northbrook, IL 60062 USA.

UL NBK is accredited by NVLAP, Laboratory Code 100414-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/>

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

Sample Calculations

Radiated Field Strength and Conducted Emissions data contained within this report is calculated on the following basis:

Field Strength (dBuV/m) = Meter Reading (dBuV) + AF (dB/m) - Gain (dB) + Cable Loss (dB)

Conducted Voltage (dBuV) = Meter Reading (dBuV) + Cable Loss (dB) + LISN IL (dB)

Conducted Current (dBuA) = Meter Reading (dBuV) + Cable Loss (dB) - Transducer Factor (dBohms)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test	Range	Equipment	Uncertainty k=2
Conducted Emissions	9k-150kHz	LISN	3.84dB
Conducted Emissions	150k-30MHz	LISN	3.65dB
Radiated Emissions	9k-30MHz	H-Field Loop	3.15dB
Radiated Emissions	30-200MHz	Bicon 10m Horz	4.48dB
Radiated Emissions	30-200MHz	Bicon 10m Vert	4.49dB
Radiated Emissions	200-1000MHz	LogP 10m Horz	3.79dB
Radiated Emissions	200-1000MHz	LogP 10m Vert	3.84dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Wireless Qi Charger with three separate charging coils and two USB 5V outputs (maximum 1A each). Device is installed in single orientation only as part of a desk / table.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Field Strength dBuV/m	Measurement Distnace (meters)
0.110 - 0.205	Charging	82.05	3.00

* the maximum output field strength is recorded at 3m distance. The Maximum level is for single coil only (reporting the highest emission). During testing all three coils were active, and each operated as slightly different frequency. See section 7.1 for test data.

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The device utilizes an coil antenna

5.4. TEST CONFIGURATIONS

The following configurations were investigated:

EUT Configuration	Description
1	EUT with wireless loads (receiving coils with resistors and maximum power) and with USB loads (1A each).
2	EUT without loads

5.5. MODE(S) OF OPERATION

Mode	Description
1	EUT putting out full maximum power to wireless loads and resistors on USB ports
2	EUT powered but not charging (no loads)

5.6. SOFTWARE AND FIRMWARE

none

5.7. WORST-CASE CONFIGURATION AND MODE

EUT was tested with receiving coil terminated into resistors providing maximum load. Based on some preliminary measurements with different devices using the same coil it was determined that there is not significant difference in emissions when a single or two coils are used.

5.8. MODIFICATIONS

No modifications were made during testing.

5.9. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Qi Loads	Byrne Electrical Specialists.	None	none	none
Resistive Loads - 50Hm resistor	-	-	-	-

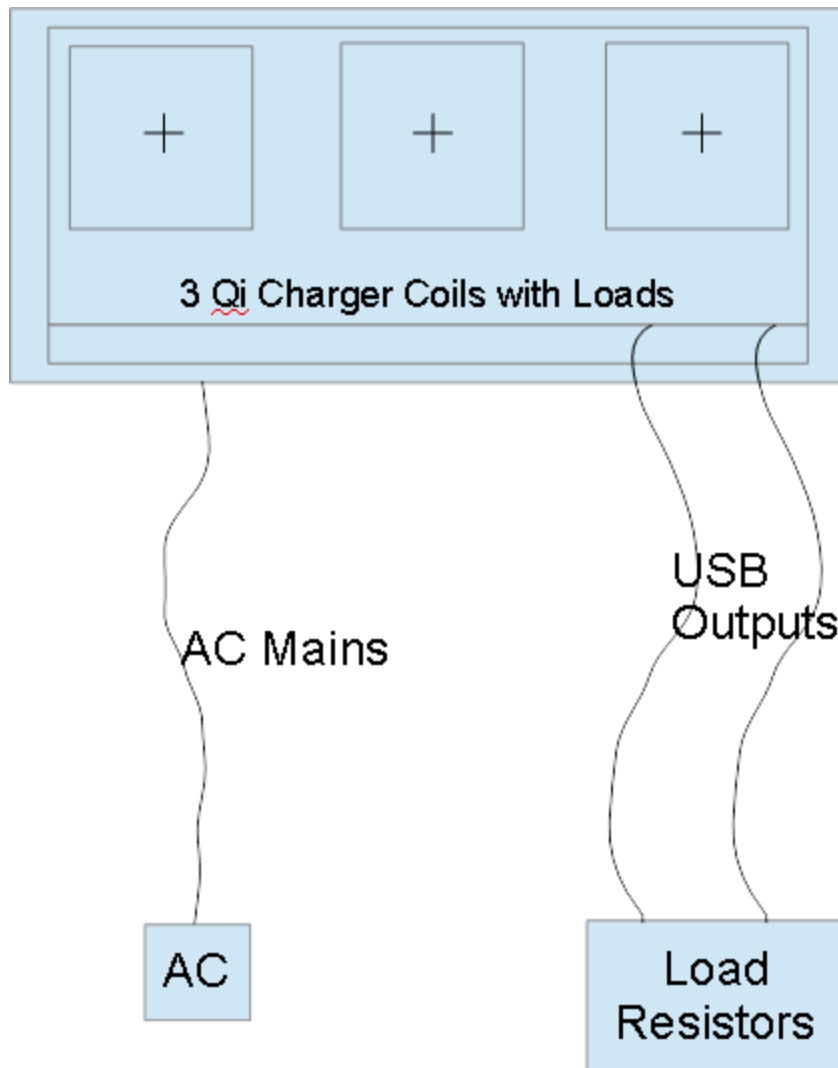
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC Input	1	-	3-wire	1.5m	none
2	AC Outputs	3	-	-	-	none
3	USB Outputs	2	SUB	USB	-	Terminated with resistors

TEST SETUP

The EUT was installed in a typical configuration. Refer to the following diagram.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	Manufacturer	Model	Eq. No.	Cal Date	Cal Due
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014		
Conducted Software	UL	UL EMC	Ver 9.5, May 17 2012		
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC4328	20151118	20161118
Bicon Antenna	Chase	VBA6106A	EMC4078	20151228	20161231
Log-P Antenna	Chase	UPA6109	EMC4313	20160122	20170131
Loop Antenna	EMCO	6502/1	EMC4026	20160722	20170731
EMI Test Receiver	Rohde & Schwarz	ESR	EMC4377	20160426	20170426
Transient Limiter	Electro-Metrics	EM7600-2	EMC4224	N/A	N/A
HighPass Filter	Solar Electronics	2803-150	885551	N/A	N/A
Attenuator	HP	8494B	2831A00838	N/A	N/A
LISN - L1	Solar	8602-50-TS-50-N	EMC4052	20160216	20170228
LISN - L2	Solar	8602-50-TS-50-N	EMC4064	20160216	20170228

7. RADIATED EMISSION TEST RESULTS

7.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.209 (a)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (m)	Limit dBuV/m
0.009–0.490	2400/F(kHz)	300	128.5 – 93.8 @3m
0.490–1.705	24000/F(kHz)	30	73.8 – 63.0 @ 3m
1.705–30.0	30	30	69.5 – 69.5 @ 3m
30–88	100	3	40.0 @ 3m
88 to 216	150	3	43.5 @ 3m
216 to 960	200	3	46.0 @ 3m
Above 960 MHz	500	3	54.0 @ 3m
Note: The lower limit shall apply at the transition frequency.			

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz measurements. The antenna to EUT distance is 3 meters.

For measurements below 1 GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements for the 30-1000 MHz range, 9 kHz for peak detection measurements or 9 kHz for quasi-peak detection measurements for the 0.15-30 MHz range and 200 Hz for peak detection measurements or 200 Hz for quasi-peak detection measurements for the 9 to 150 kHz range. Peak detection is used unless otherwise noted as quasi-peak.

The spectrum from 9kHz to 1 GHz is investigated with the transmitter constantly transmitting into a fixed load to ensure maximum current draw from the charger.

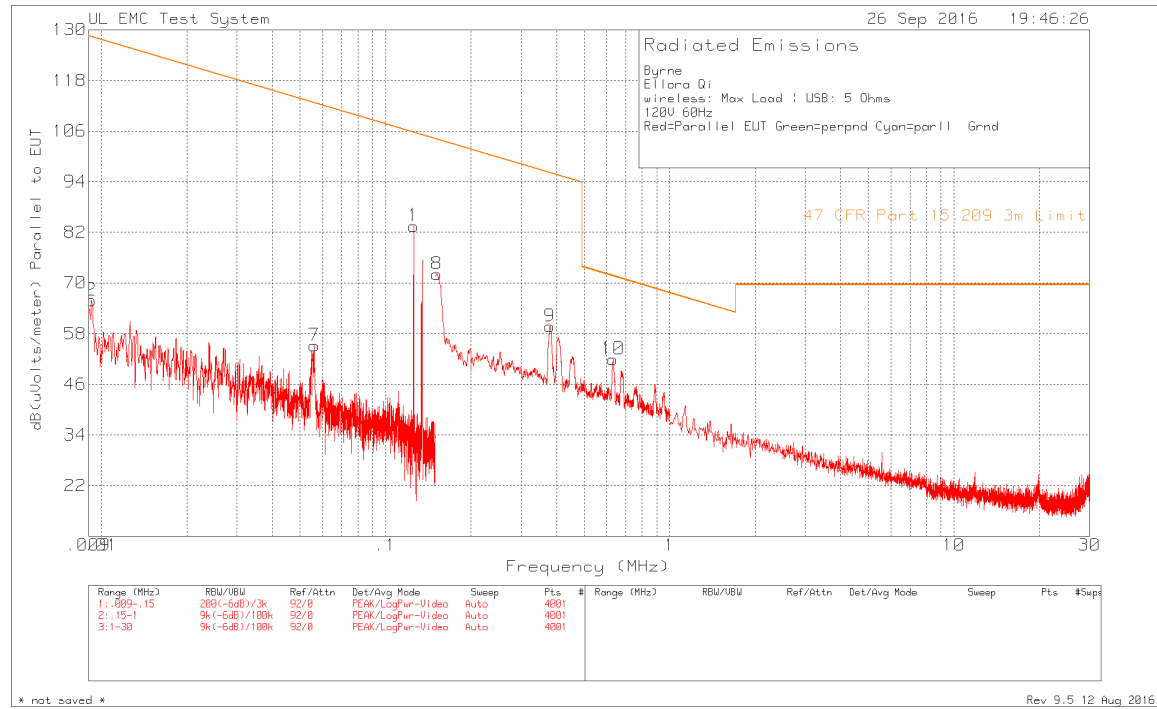
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. Measurements are made with the antenna positioned at 0° and 90° in vertical polarization and in a horizontal polarization to the ground plane.

Although measurements were made on a test site other than an open area site, comparisons between an open area site and the chamber have been made to show that measurements in the chamber correlate to those on an open area site.

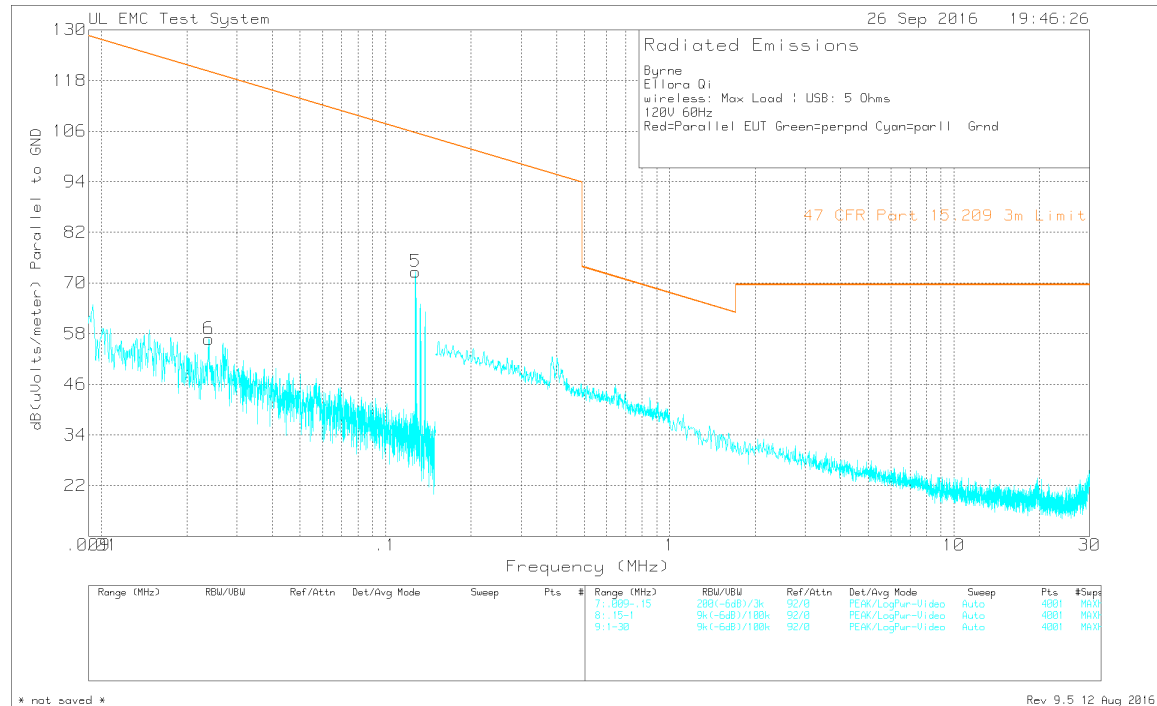
RESULTS

TX FUNDAMENTAL AND SPURIOUS EMISSIONS 0.009kHz TO 30 MHz Charging Mode

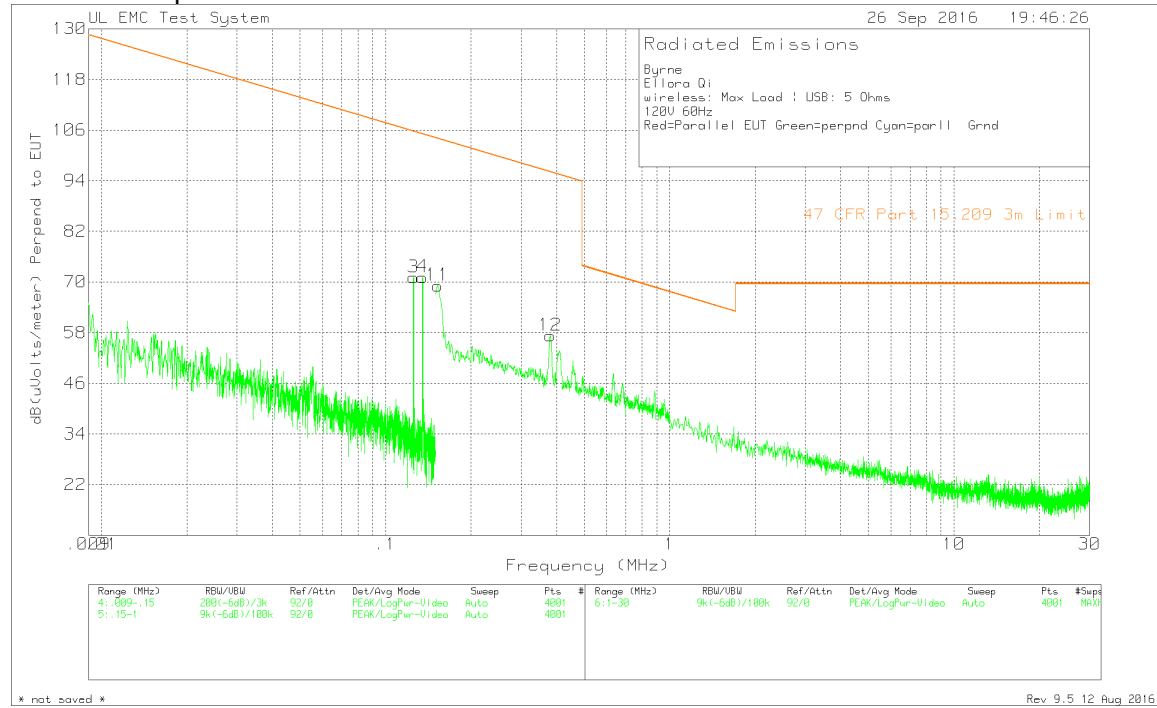
Antenna Parallel to EUT



Antenna Parallel to Ground



Antenna Perpendicular to EUT



Byrne
Ellora Qi
wireless: Max Load | USB: 5 Ohms
120V 60Hz
Red=Parallel EUT Green=perpnd Cyan=par11 Grnd

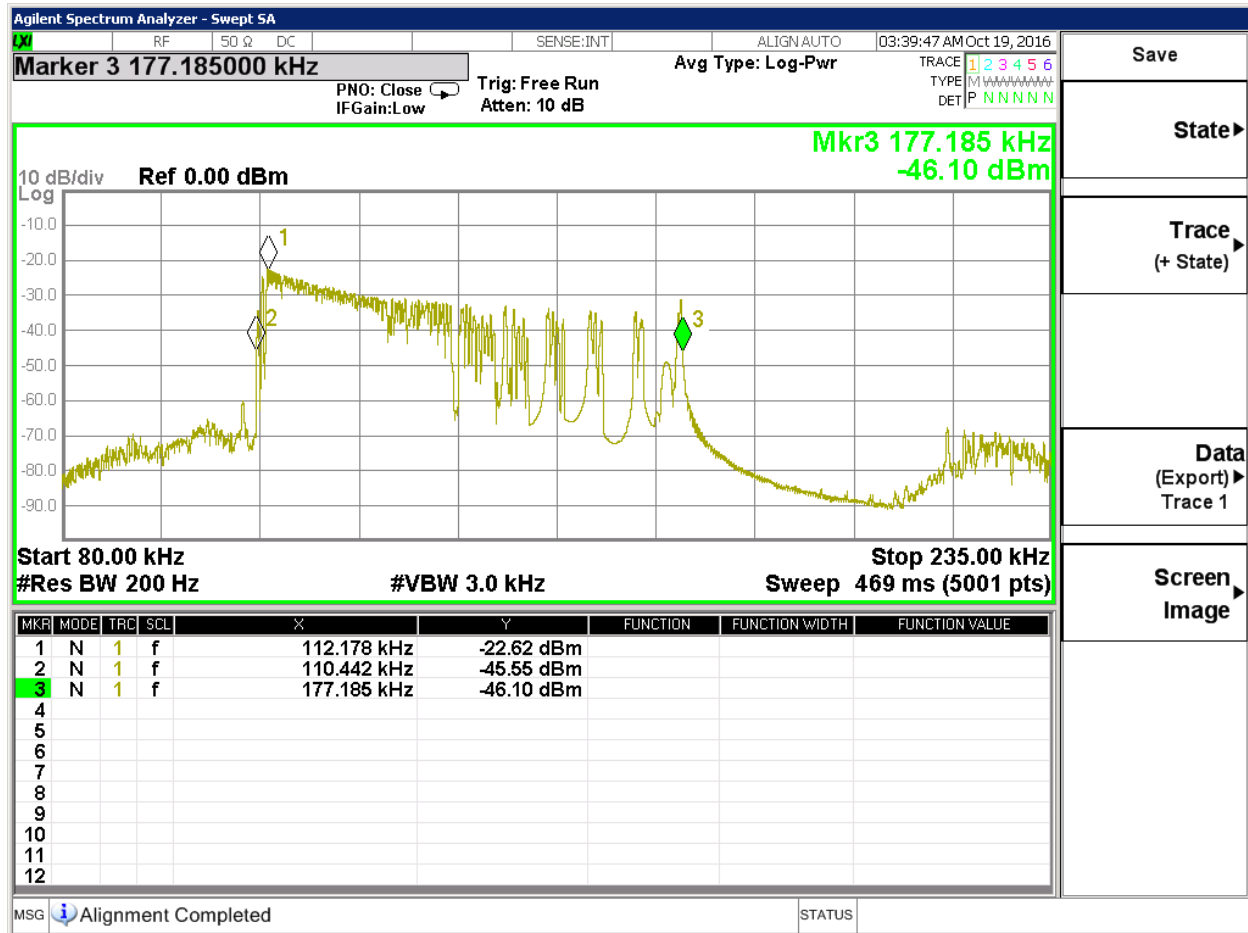
Trace Markers

Test No.	Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB(uVolts/meter)	Limit:1
=====						
Parallel to EUT						
1	.12562	72.12dBuV Pk	11.4	0	83.52	105.62 -
		Azimuth:0-360	Height:101		Margin (dB)	-22.1 -
2	.00921	43.7dBuV Pk	22.2	0	65.9	128.3 -
		Azimuth:0-360	Height:101		Margin (dB)	-62.4 -
7	.05615	42.83dBuV Pk	12.3	0	55.13	112.61 -
		Azimuth:0-360	Height:101		Margin (dB)	-57.48 -
8	.1517	60.81dBuV Pk	11.3	0	72.11	103.98 -
		Azimuth:0-360	Height:101		Margin (dB)	-31.87 -
9	.37898	48.41dBuV Pk	11.3	0	59.71	96.03 -
		Azimuth:0-360	Height:101		Margin (dB)	-36.32 -
10	.63159	40.54dBuV Pk	11.4	0	51.94	71.6 -
		Azimuth:0-360	Height:101		Margin (dB)	-19.66 -
Perpend to EUT						
3	.12548	59.69dBuV Pk	11.4	0	71.09	105.63 -
		Azimuth:0-360	Height:101		Margin (dB)	-34.54 -
4	.13493	59.74dBuV Pk	11.4	0	71.14	105 -
		Azimuth:0-360	Height:101		Margin (dB)	-33.86 -
11	.15256	57.85dBuV Pk	11.3	0	69.15	103.93 -
		Azimuth:0-360	Height:101		Margin (dB)	-34.78 -
12	.37961	45.99dBuV Pk	11.3	0	57.29	96.02 -
		Azimuth:0-360	Height:101		Margin (dB)	-38.73 -
Parallel to GND						
5	.12737	61.23dBuV Pk	11.4	0	72.63	105.5 -
		Azimuth:0-360	Height:101		Margin (dB)	-32.87 -
6	.02388	40.85dBuV Pk	15.9	0	56.75	120.03 -
		Azimuth:0-360	Height:101		Margin (dB)	-63.28 -

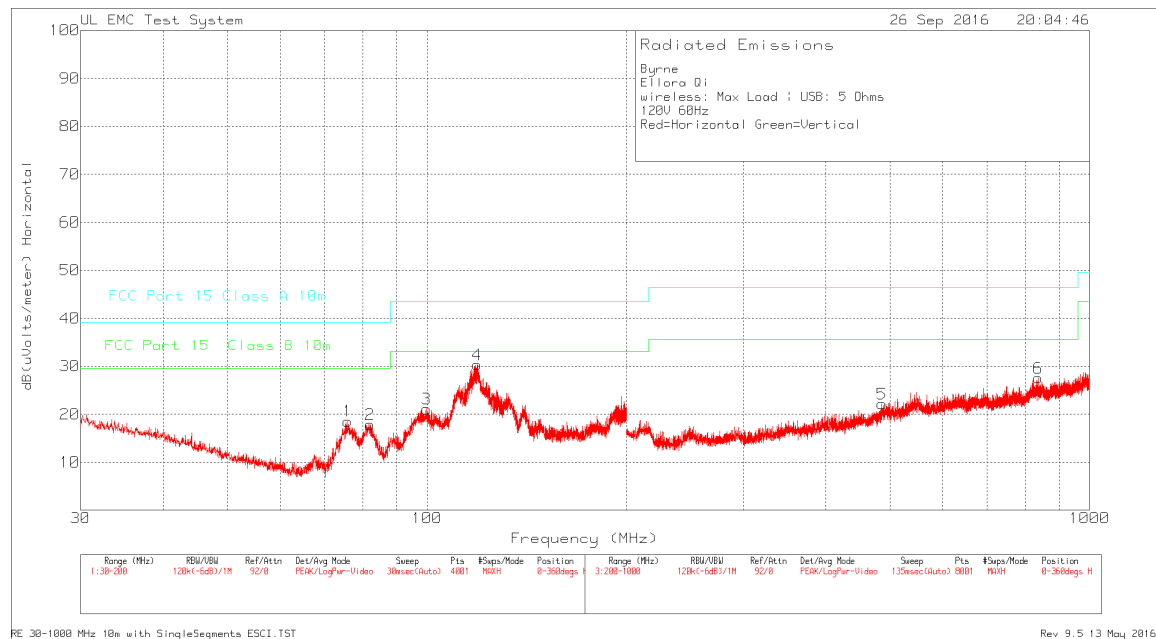
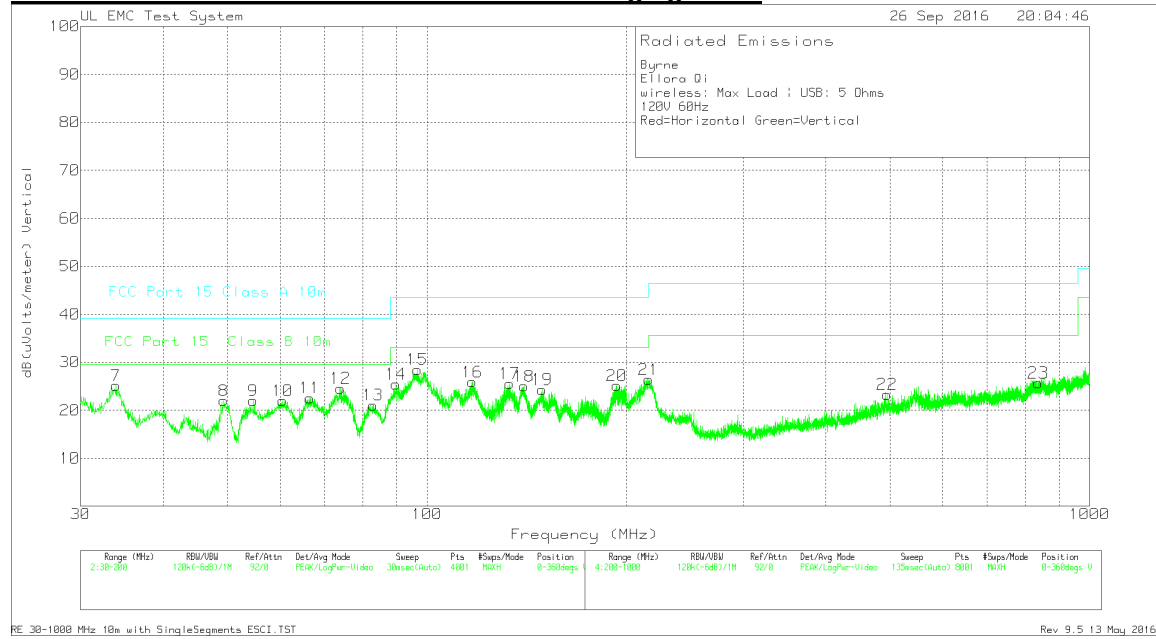
LIMIT 1: 47 CFR Part 15.209 3m Limit
Pk - Peak detector

RESTRICTED BANDEDGE EMISSIONS

Bandedge measurements were conducted using radiated field strength and 20dBc points. Attempt was made to move the device up and down and around the charging pad. This caused the impedance of the load to change and maximum range of frequencies was used. Special Attention was paid to 110kHz.



TX SPURIOUS EMISSIONS 30MHz TO 1GHz Charging Mode



Byrne
Ellora Qi
wireless: Max Load | USB: 5 Ohms
120V 60Hz
Red=Horizontal Green=Vertical

Trace Markers

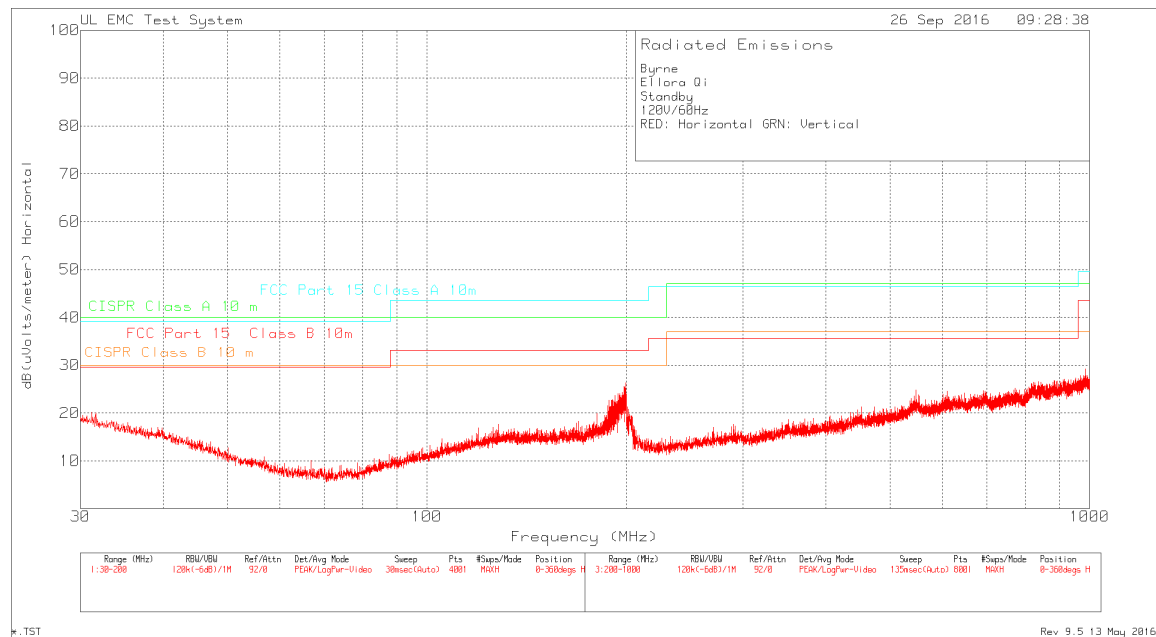
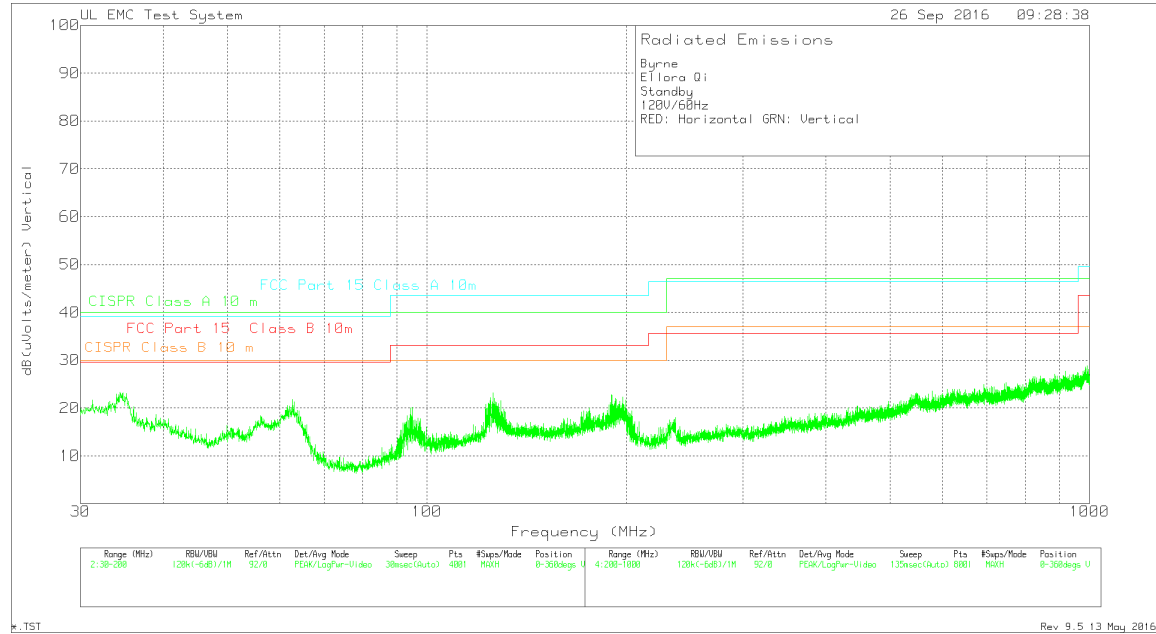
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB (uVolts/meter)	Limit:1	2
1	75.9425	41.68dBuV Pk Azimuth:0-360	6.8 Height:248	-29.9 Horz	18.58 Margin (dB)	39.08	29.55
2	81.9775	40.02dBuV Pk Azimuth:0-360	7.8 Height:248	-29.9 Horz	17.92 Margin (dB)	39.08	29.55
3	99.9125	40.21dBuV Pk Azimuth:0-360	10.7 Height:248	-29.8 Horz	21.11 Margin (dB)	43.52	33.07
4	118.995	46.75dBuV Pk Azimuth:0-360	13.3 Height:399	-29.7 Horz	30.35 Margin (dB)	43.52	33.07
7	33.9525	38.6dBuV Pk Azimuth:0-360	16.6 Height:102	-30 Vert	25.2 Margin (dB)	39.08	29.55
8	49.38	41.43dBuV Pk Azimuth:0-360	10.6 Height:102	-30 Vert	22.03 Margin (dB)	39.08	29.55
9	54.65	43.44dBuV Pk Azimuth:0-360	8.6 Height:102	-30 Vert	22.04 Margin (dB)	39.08	29.55
10	60.5575	44.93dBuV Pk Azimuth:0-360	7 Height:251	-29.9 Vert	22.03 Margin (dB)	39.08	29.55
11	66.55	46.11dBuV Pk Azimuth:0-360	6.5 Height:251	-30 Vert	22.61 Margin (dB)	39.08	29.55
12	74.0725	48dBuV Pk Azimuth:0-360	6.6 Height:399	-30 Vert	24.6 Margin (dB)	39.08	29.55
13	82.8275	43dBuV Pk Azimuth:0-360	8 Height:399	-29.9 Vert	21.1 Margin (dB)	39.08	29.55
14	89.7975	46.08dBuV Pk Azimuth:0-360	9.3 Height:251	-29.9 Vert	25.48 Margin (dB)	43.52	33.07
15	96.6825	48.11dBuV Pk Azimuth:0-360	10.2 Height:102	-29.8 Vert	28.51 Margin (dB)	43.52	33.07
16	116.9975	42.62dBuV Pk Azimuth:0-360	13.1 Height:102	-29.8 Vert	25.92 Margin (dB)	43.52	33.07
17	133.275	41.11dBuV Pk Azimuth:0-360	14.2 Height:102	-29.7 Vert	25.61 Margin (dB)	43.52	33.07
18	140.075	40.46dBuV Pk Azimuth:0-360	14.2 Height:102	-29.6 Vert	25.06 Margin (dB)	43.52	33.07
19	149.2125	39.75dBuV Pk Azimuth:0-360	14.2 Height:102	-29.6 Vert	24.35 Margin (dB)	43.52	33.07
20	193.37	37.94dBuV Pk Azimuth:0-360	16 Height:102	-28.8 Vert	25.14 Margin (dB)	43.52	33.07
5	486	32.86dBuV Pk Azimuth:0-360	17.3 Height:299	-28 Horz	22.16 Margin (dB)	46.44	35.57
6	835.8	32.73dBuV Pk Azimuth:0-360	22.4 Height:299	-27.6 Horz	27.53 Margin (dB)	46.44	35.57
21	216	44.4dBuV Pk Azimuth:0-360	11.4 Height:102	-29.4 Vert	26.4 Margin (dB)	43.52	33.07
22	495	33.55dBuV Pk Azimuth:0-360	17.7 Height:302	-27.9 Vert	23.35 Margin (dB)	46.44	35.57
23	837	31.03dBuV Pk Azimuth:0-360	22.4 Height:302	-27.7 Vert	25.73 Margin (dB)	46.44	35.57

No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading dB (uVolts/meter)	Limit:1	2
117.895		43.1dBuV Qp Azimuth: 0	13.2 Height:381	-29.8 Horz	26.5 Margin (dB)	43.52	33.07
33.9275		33.86dBuV Qp Azimuth: 94	16.6 Height:101	-30 Vert	20.46 Margin (dB)	39.08	29.55
72.135		42.43dBuV Qp Azimuth: 267	6.5 Height:171	-29.9 Vert	19.03 Margin (dB)	39.08	29.55
98.06		45.26dBuV Qp Azimuth: 210	10.4 Height:102	-29.8 Vert	25.86 Margin (dB)	43.52	33.07

LIMIT 1: FCC Part 15 Class A 10m
LIMIT 2: FCC Part 15 Class B 10m

Pk - Peak detector
Qp - Quasi-Peak detector

DIGITAL RADIATED EMISSIONS 30 MHz TO 1 GHz Standby Mode



* no emissions within 6dB from the limit, additional quasi-peak measurements not needed.

8. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207 (a)

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	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
* Decreases with the logarithm of the frequency.		

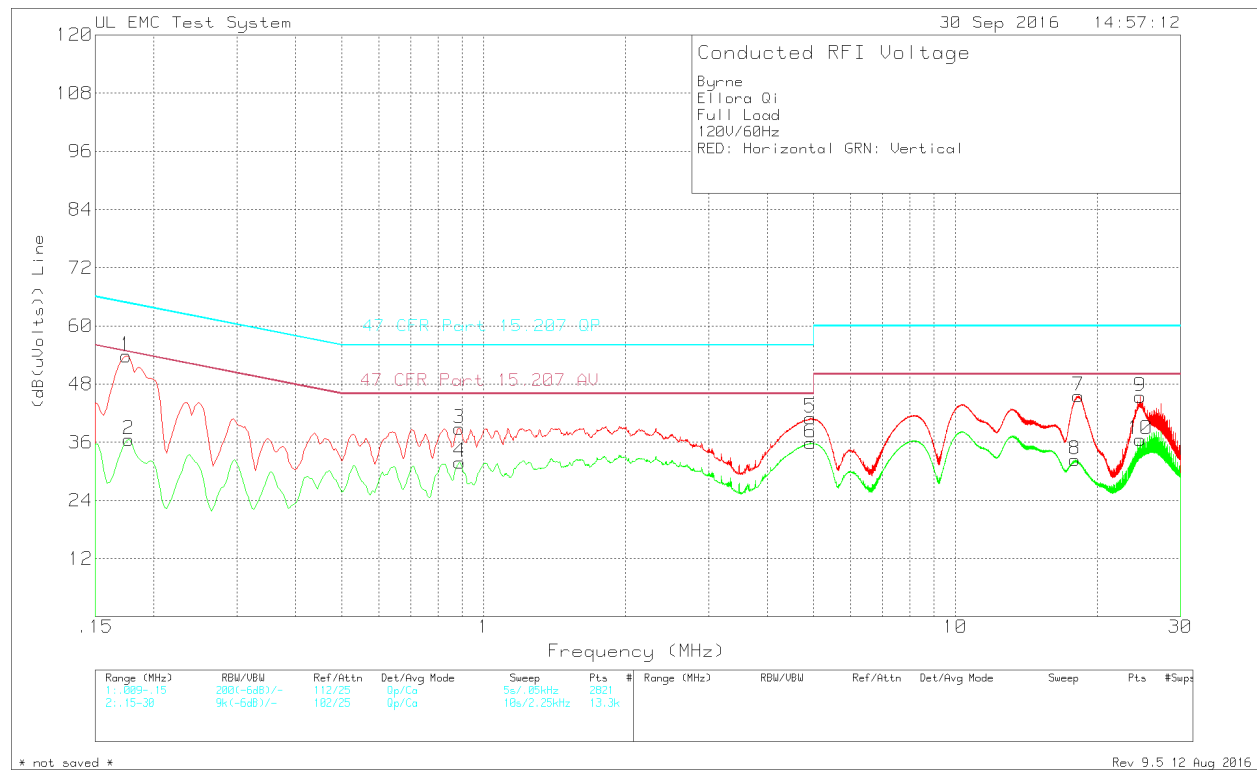
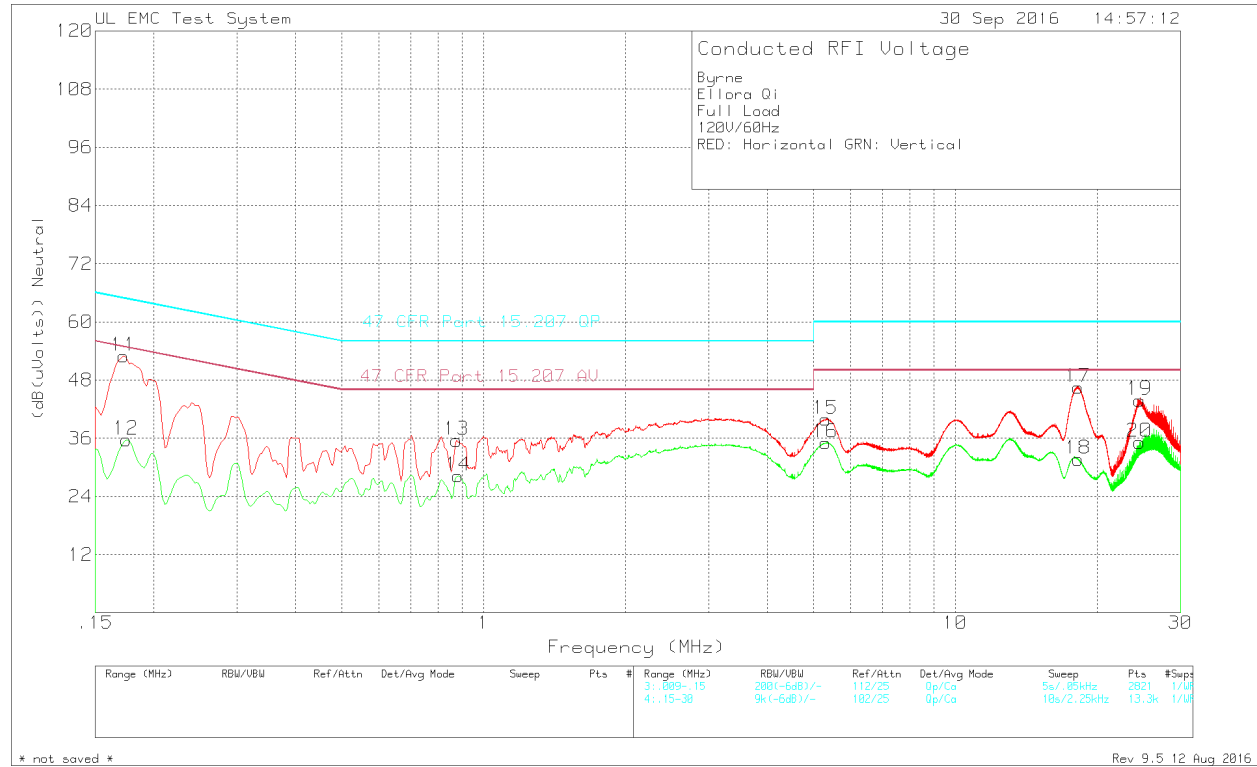
TEST PROCEDURE

ANSI C63.10

RESULTS

No non-compliance noted:

Line Conducted Emissions – Charging Mode



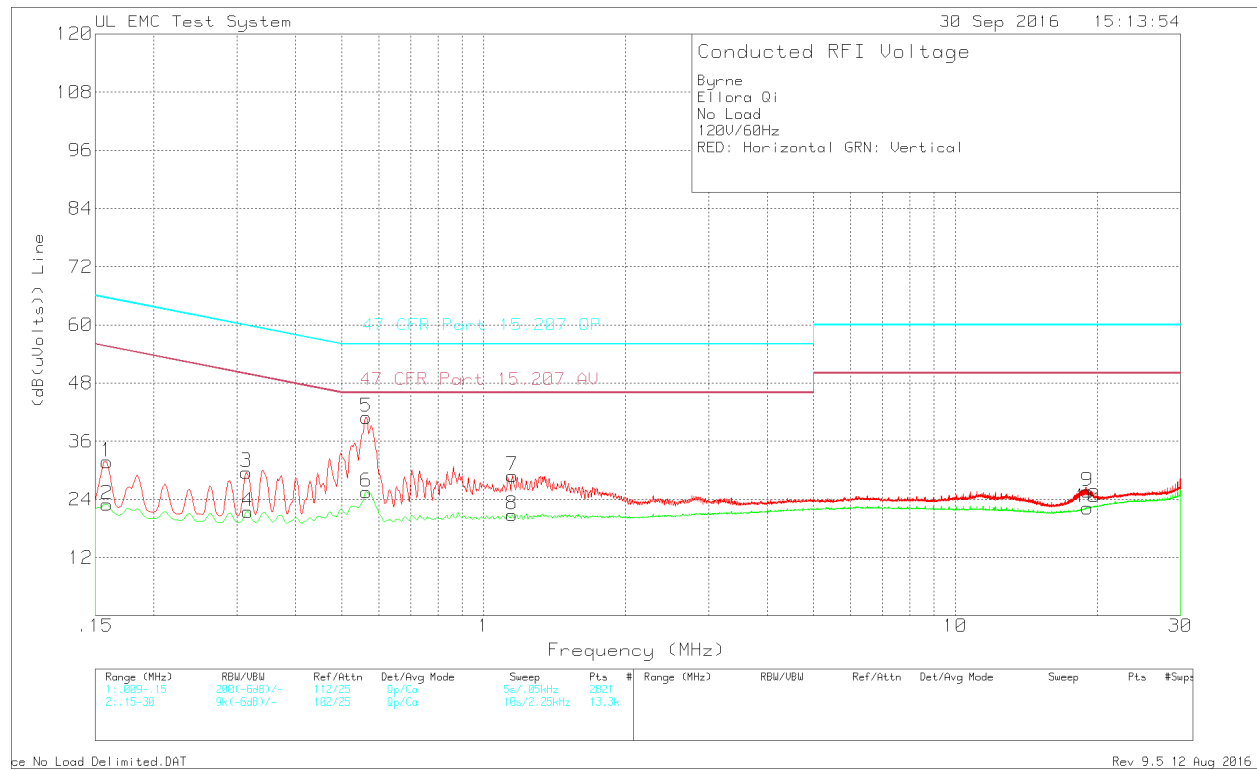
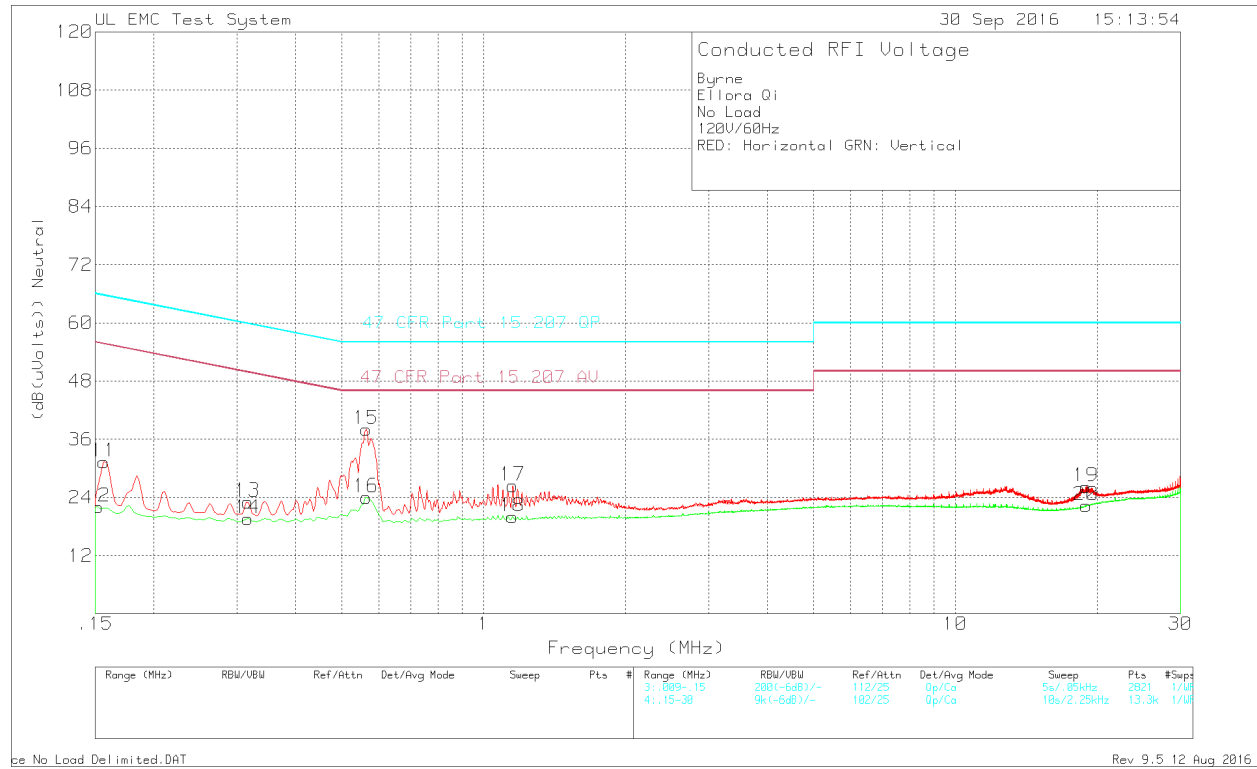
Byrne
Ellora Qi
Full Load
120V/60Hz
RED: Horizontal GRN: Vertical

Trace Markers						
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB(uVolts))	Limit:1 2
=====						
Line						
1	.17475	43.44dBuV Qp	.1	10.3	53.84	64.73 54.73
					Margin (dB)	-10.89 -.89
2	.177	26.16dBuV Ca	.1	10.3	36.56	64.63 54.63
					Margin (dB)	-28.07 -18.07
3	.888	28.56dBuV Qp	0	10.3	38.86	56 46
					Margin (dB)	-17.14 -7.14
4	.89025	21.61dBuV Ca	0	10.3	31.91	56 46
					Margin (dB)	-24.09 -14.09
5	4.93125	30.45dBuV Qp	0	10.6	41.05	56 46
					Margin (dB)	-14.95 -4.95
6	4.93125	25.32dBuV Ca	0	10.6	35.92	56 46
					Margin (dB)	-20.08 -10.08
7	18.24	34.19dBuV Qp	0	11.4	45.59	60 50
					Margin (dB)	-14.41 -4.41
8	17.94075	21dBuV Ca	0	11.4	32.4	60 50
					Margin (dB)	-27.6 -17.6
9	24.6525	33.55dBuV Qp	0	11.9	45.45	60 50
					Margin (dB)	-14.55 -4.55
10	24.6525	24.66dBuV Ca	0	11.9	36.56	60 50
					Margin (dB)	-23.44 -13.44
Neutral						
11	.1725	42.52dBuV Qp	.1	10.3	52.92	64.84 54.84
					Margin (dB)	-11.92 -1.92
12	.17475	25.29dBuV Ca	.1	10.3	35.69	64.73 54.73
					Margin (dB)	-29.04 -19.04
13	.87675	25.28dBuV Qp	0	10.3	35.58	56 46
					Margin (dB)	-20.42 -10.42
14	.8835	17.94dBuV Ca	0	10.3	28.24	56 46
					Margin (dB)	-27.76 -17.76
15	5.30925	29.33dBuV Qp	0	10.6	39.93	60 50
					Margin (dB)	-20.07 -10.07
16	5.30925	24.5dBuV Ca	0	10.6	35.1	60 50
					Margin (dB)	-24.9 -14.9
17	18.21975	35.1dBuV Qp	0	11.4	46.5	60 50
					Margin (dB)	-13.5 -3.5
18	18.22088	20.29dBuV Ca	0	11.4	31.69	60 50
					Margin (dB)	-28.31 -18.31
19	24.5805	31.86dBuV Qp	0	12	43.86	60 50
					Margin (dB)	-16.14 -6.14
20	24.5805	23.18dBuV Ca	0	12	35.18	60 50
					Margin (dB)	-24.82 -14.82

LIMIT 1: 47 CFR Part 15.207 QP
LIMIT 2: 47 CFR Part 15.207 AV

Qp - Quasi-Peak detector
Ca - CISPR Average detection

Line Conducted Emissions – Standby Mode



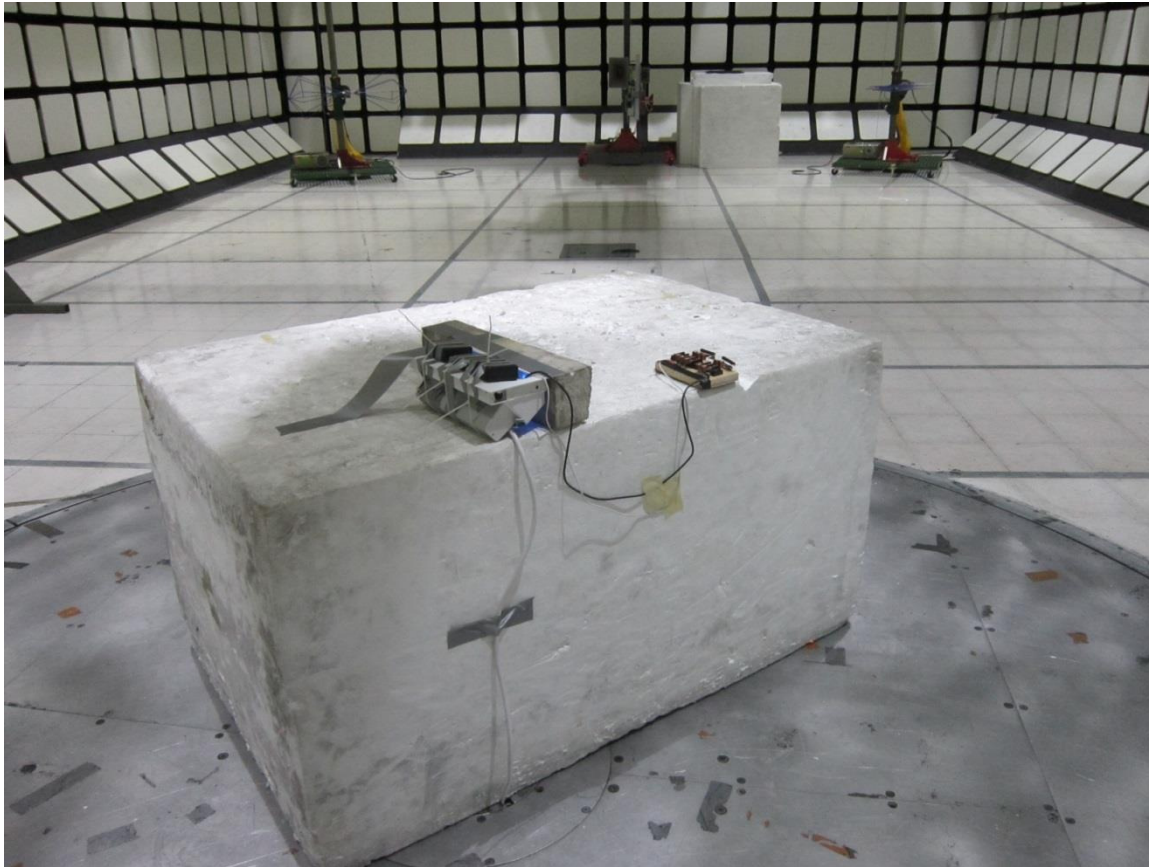
Byrne
Ellora Qi
No Load
120V/60Hz
RED: Horizontal GRN: Vertical

Trace Markers						
No.	Test Frequency (MHz)	Meter Reading	Transducer Factor (dB)	Gain/Loss Factor (dB)	Corrected Reading (dB(uVolts))	Limit:1 2
=====						
Line						
1	.159	21.39dBuV Qp	.1	10.3	31.79	65.52 55.52
					Margin (dB)	-33.73 -23.73
2	.159	12.61dBuV Ca	.1	10.3	23.01	65.52 55.52
					Margin (dB)	-42.51 -32.51
3	.31425	19.33dBuV Qp	0	10.3	29.63	59.86 49.86
					Margin (dB)	-30.23 -20.23
4	.3165	11.2dBuV Ca	0	10.3	21.5	59.8 49.8
					Margin (dB)	-38.3 -28.3
5	.564	30.65dBuV Qp	0	10.3	40.95	56 46
					Margin (dB)	-15.05 -5.05
6	.564	15.28dBuV Ca	0	10.3	25.58	56 46
					Margin (dB)	-30.42 -20.42
7	1.15125	18.61dBuV Qp	0	10.3	28.91	56 46
					Margin (dB)	-27.09 -17.09
8	1.149	10.58dBuV Ca	0	10.3	20.88	56 46
					Margin (dB)	-35.12 -25.12
9	19.06913	14.19dBuV Qp	0	11.5	25.69	60 50
					Margin (dB)	-34.31 -24.31
10	19.06688	10.79dBuV Ca	0	11.5	22.29	60 50
					Margin (dB)	-37.71 -27.71
Neutral						
11	.15675	20.92dBuV Qp	.1	10.3	31.32	65.63 55.63
					Margin (dB)	-34.31 -24.31
12	.15225	11.67dBuV Ca	.1	10.3	22.07	65.88 55.88
					Margin (dB)	-43.81 -33.81
13	.3165	12.78dBuV Qp	0	10.3	23.08	59.8 49.8
					Margin (dB)	-36.72 -26.72
14	.3165	9.37dBuV Ca	0	10.3	19.67	59.8 49.8
					Margin (dB)	-40.13 -30.13
15	.564	27.75dBuV Qp	0	10.3	38.05	56 46
					Margin (dB)	-17.95 -7.95
16	.564	13.72dBuV Ca	0	10.3	24.02	56 46
					Margin (dB)	-31.98 -21.98
17	1.1535	16.13dBuV Qp	0	10.3	26.43	56 46
					Margin (dB)	-29.57 -19.57
18	1.15125	9.72dBuV Ca	0	10.3	20.02	56 46
					Margin (dB)	-35.98 -25.98
19	18.92625	14.66dBuV Qp	0	11.6	26.26	60 50
					Margin (dB)	-33.74 -23.74
20	18.9465	10.7dBuV Ca	0	11.6	22.3	60 50
					Margin (dB)	-37.7 -27.7
LIMIT 1: 47 CFR Part 15.207 QP						
LIMIT 2: 47 CFR Part 15.207 AV						

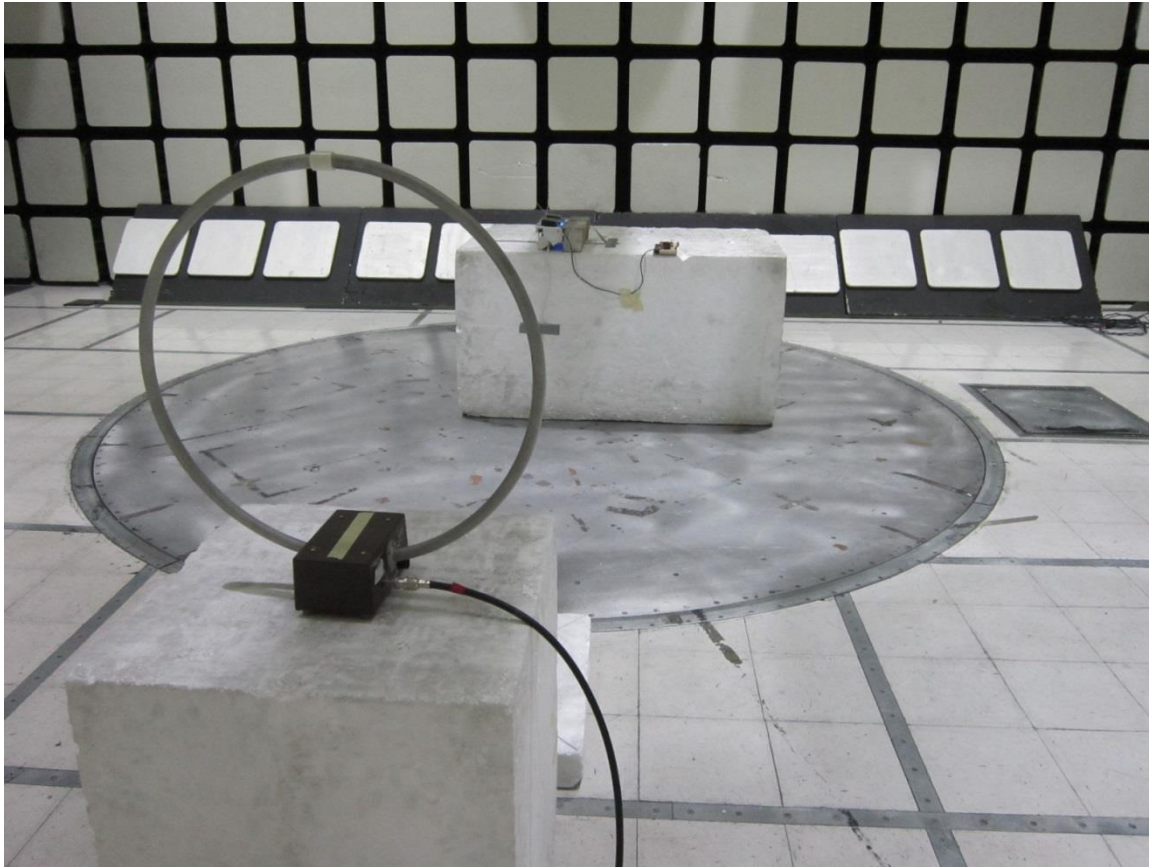
Qp - Quasi-Peak detector
Ca - CISPR Average detection

9. SETUP PHOTOS

RADIATED EMISSION Above 30 MHz



Radiated Emissions Below 30MHz



Line Conducted Emissions



END OF REPORT