

## Electromagnetic Compatibility

### Test Report

#### FCC CFR47 Part 15 Subpart C 15.207, 15.209, 15.215 & 15.225

**Report Number:** EJ0089 RJC-650 FCC15.225  
**Issue:** Release version 2.0  
**Date of Issue:** January 27, 2017  
**Number of Pages:** 34

**Testing laboratory:** QAI Laboratories, Inc.  
**Address:** 834 80TH Street SW, Suite 200, Everett, WA 98203-7008  
**Phone:** +1-425-512-8419

#### Laboratory Accreditations (per ISO/IEC 17025:2005):



**American Association for Laboratory Accreditation Certificate Number: 3657.02**

This report has been completed in accordance with the requirements of ISO/IEC 17025. Test results contained in this report are within QAI Laboratories ISO/IEC 17025 accreditation. QAI Laboratories authorizes the applicant to reproduce this report, provided it is reproduced in its entirety and for the use by the company's employees only.

**Test Standard**.....: FCC CFR47 Part 15 Subpart C 15.207, 15.209, 15.215 & 15.225

**Applicant's name** .....: RJC Enterprises, LLC.  
**Address**.....: 11711 N. Creek Pky S, Suite D-103 Bothell, WA 98011  
**Phone**.....: 425-481-3281 X12



**Test item description**.....: RJC Enterprises Model 650 Fiber Optic Measuring System  
**Model Number**.....: 650-01, 650-02, 650-03, and 650-04  
**FCC ID**.....: O5F065003

## Revision History

Date	Report Number	Rev #	Details	Authors Initials
June 6, 2016	EJ0089 RJC-650 FCC15.225	0.0	Draft report	JQ
Oct. 19, 2016	EJ0089 RJC-650 FCC15.225	0.1	Draft report	HZ
Nov. 7, 2016	EJ0089 RJC-650 FCC15.225	1.0	Final Report	HZ
Jan. 27, 2017	EJ0089 RJC-650 FCC15.225	2.0	Final Report	HZ
All previous versions of this Report have been superseded by the latest dated Revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.				

---

## **Table of Contents**

Summary of Test Results .....	4
General Information .....	5
Part 1: Antenna requirement .....	9
Part 2: AC conducted emission .....	10
Part 3: Radiated Spurious Emissions .....	19
Part 4: 20 dB bandwidth .....	24
Part 5: Field strength of emissions .....	27
Part 6: Frequency tolerance .....	28
Appendix A Test Setup Photographs .....	31
End of Test Report .....	34

## Summary of Test Results

The following tests demonstrate the testimony to "FCC & IC" Mark Electromagnetic compatibility testing for "Model 650 Fiber Optic Measurement System" manufactured by RJC Enterprises, LLC. The testing was performed on this unit pursuant to 47 CFR (FCC) Part 15 Subpart C while being operated within the band 13.110-14.010 MHz

	Test	47 CFR (FCC) Part 15 Subpart C	Description	Result
Part 1	Antenna requirement	FCC 47 CFR Part 15.203 RSS-Gen Issue4 (7.1.2)	Soldered, non-replaceable antenna	Complies
Part 2	AC conducted emission	15.207	Class B Limits	Complies
Part 3	Radiated Emission	15.209	Radiated emission limits; general requirements.	Complies
Part 4	20 dB bandwidth	15.215 (c)	20 dB bandwidth is contained within the frequency band	Complies
Part 5	Field strength of emissions	15.225	within the band 13.553–13.567 MHz shall not exceed 15,848 uv/m at 30 meters.	Complies
Part 6	Frequency tolerance	15.225(e)	within $\pm 0.01\%$ of the operating frequency	Complies

Tests were conducted on a sample of the equipment as requested by RJC Enterprises, LLC for the purpose of demonstrating compliance with FCC CFR47 Part 15 Subpart C 15.207, 15.209, 15.215 & 15.225. RJC Enterprises, LLC is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products, as required. Please note that this list of tests may only comprise a partial list of the tests that are required before a FCC label can be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

X 

**Written by Jack Qin**  
RF/EMC Test Engineer/Technical Writer

X 

**Reviewed by Aman Jathaul,**  
EMC Project Manager




**Tested by Bruce Balston**  
EMC Test Engineer



**Approved by Parminder Singh**  
Director for the EMC Department

## General Information

### Equipment Under Test Information:

<b>Manufacturer</b>	RJC Enterprises
<b>Product Name</b>	Fiber Optic Measuring System
<b>Model Number</b>	650-01, 650-02, 650-03, and 650-04
<b>Photograph</b>	
<b>Modifications</b>	There were no modifications made to the EUT.

### Cable Descriptions:

Number	Description	Connectors (at EUT-end)	Length	Shielded	Ferrite
1	AC power Input	Three prong plug	1 m	No	No

### EUT Test Configuration:

The EUT was powered via a 3-conductor cable providing 120 VAC / 60 Hz.

### Environmental Conditions:

INDOORS, Temperature: 22-28°C, R.H.: 39.7 - 54.4%

## Test Equipment Used

Frequency Stability equipment list for units 650-01,02,04

Asset #	Equipment	Manufacturer	Model #	Serial #	Cal Due
1575	Temperature Chamber	Ransco	925D-1-4	4341	Conditional
1579	Thermometer	Fluke	52	28270224WS	8/25/2016
1583	Thermocouple	Fluke	J-Type	None	8/25/2016
1146	Spectrum Analyzer	Rohde & Schwarz	1164.4391.K40	100184	11/3/2016
1061	Multimeter	Fluke	73-II	6831444	8/29/2017
1253	Near Field Probe	Electrometrics	EM-6993	6CM H Field	Conditional
None	Variable Autotransformer	Staco	3PN1010B	120V/10A	Conditional

Frequency Stability equipment list for unit 650-03

Asset #	Equipment	Manufacturer	Model #	Serial #	Cal Due
1575	Temperature Chamber	Thermotron	SII-4S Minimax	25-1324-S	
1579	Thermometer	Fluke	52	28270224WS	8/25/2016
1583	Thermocouple	Fluke	J-Type	None	8/25/2016
1146	Spectrum Analyzer	Rohde & Schwarz	1164.4391.K40	100184	11/3/2016
1061	Multimeter	Fluke	73-II	6831444	8/29/2017
1253	Near Field Probe	Electrometrics	EM-6993	6CM H Field	Conditional
None	Variable Autotransformer	Staco	3PN1010B	120V/10A	Conditional

Radiated Emissions test Equipment list for units 650-01,02,03,04

Asset #	Description	Model	Manufacturer	Cal date	Cal Due
00001008	QP Adapter	85650A	HP	2/5/2016	2/5/2017
00001181	SA Display Unit	85662A	HP	2/5/2016	2/5/2017
00001182	Spectrum Analyzer	85660B	HP	2/5/2016	2/5/2017
00001011	RF Preselector	85650A	HP	2/5/2016	2/5/2017
00001156	Multi Device Controller	2090	ETS-EMCO	NCR	NCR
00001157	System Controller	SC99V	Sunol	NCR	NCR
00001238	Amplifier 0.1-1000MHz	8447F	HP	3/6/2016	6/6/2016
00001110	Biconical Antenna	93110B	EMCO	5/7/2014	5/7/2016
00001116	Log Periodic Antenna	LPA-25	Electrometrics	9/8/2014	9/8/2017

Conducted Emissions Test equipment List for units 650-01,02,03,04

Asset #	Description	Model	Manufacturer	Cal date	Cal Due
00001008	QP Adapter	85650A	HP	2/5/2016	2/5/2017
00001181	SA Display Unit	85662A	HP	2/5/2016	2/5/2017
00001182	Spectrum Analyzer	85660B	HP	2/5/2016	2/5/2017
00001011	RF Preselector	85650A	HP	2/5/2016	2/5/2017
00001288	RF Fuse	7930-8.0	Solar	10/16/2014	10/16/2016
00001286	HP Filter	FCC-450B-2.4N	Fischer	10/16/2014	10/16/2016
00001057	LISN	FCC-LISN-50-25-2-08	Fischer	11/19/2015	11/19/2017

### Relevant Site Registrations and Accreditations:

<b>USA EMC Test Laboratory:</b>	QAI Laboratories Inc.
Location/Address	834 80 <sup>TH</sup> Street SW, Suite 200, Everett, WA 98203-7008
Tel:	+1-425-512-8419
Fax:	+1-425-322-3011
3 m Semi-Anechoic Chamber Test Site and AC Line Conduction Site FCC Test Site Address: Same as above.	
3 m Semi-Anechoic Chamber Test Site Industry Canada Test Site # 11876A-1 Address: Same as above.	
3 m Semi-Anechoic Chamber Test Site and AC Line Conduction Site FCC Test Site Registration Number: 307482	
3 m Semi-Anechoic Chamber Test Site Industry Canada Test Site Registration File Number: 46405-11876	

### Measurement Uncertainties:

Test	Frequency Range / Polarization	Measurement Uncertainty
Conducted Emissions	0.150 – 30 MHz	2.5540
Radiated Emissions	30 – 200 MHz (H-pol)	2.7171
Radiated Emissions	30 – 200 MHz (V-pol)	3.8957
Radiated Emissions	200 – 1000 MHz (H-pol)	5.2340
Radiated Emissions	200 – 1000 MHz (V-pol)	4.6578

## Sample Calculations – Radiated Emissions and Conducted Emissions:

### Radiated Emissions:

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading.

$$\text{Field Strength (dB}\mu\text{V)} = \text{RAW} - \text{AMP} + \text{CL} + \text{ACF}$$

Where:

**RAW** = Measured level (dB $\mu$ V)

**AMP** = Amplifier Gain (dB)

**CBL** = Cable Loss (dB)

**ACF** = Antenna Correction Factor (dB/m)

Sample Radiated Emissions Calculation:

$$\text{Measurement} + \text{Antenna Correction Factor} - \text{Amplifier Gain} + \text{Cable Loss} = \text{Adjusted Radiated Emissions Value (dB}\mu\text{V/m)}$$

$$25.3 \text{ dB}\mu\text{V} + 19.7 \text{ dB} - 23.0 \text{ dB} + 3.7 \text{ dB} = 25.7 \text{ dB}\mu\text{V/m}$$

### Conducted Emissions:

The measured RF Voltage that is applied to the conducted limits is calculated by subtracting the Amplifier Gain (if any) and adding the Cable Loss, LISN Correction Factor, High Pass Filter Loss, and the RF Fuse Loss to the measured reading.

$$\text{Adjusted RF Voltage (dB}\mu\text{V)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{LCF} + \text{HPF} + \text{RFF}$$

Where:

**RAW** = Measured level (dB $\mu$ V)

**AMP** = Amplifier Gain (dB)

**CBL** = Cable Loss (dB)

**LCF** = LISN Correction Factor (dB/m)

**HPF** = High Pass Filter (dB)

**RFF** = RF Fuse (dB)

Sample Conducted Emissions Calculation:

$$\text{Measurement} + \text{LISN Factor} - \text{Amplifier Gain} + \text{Cable Loss} + \text{HPF Loss} + \text{RFF Loss} = \text{Adjusted Conducted RF Voltage Emissions Value (dB}\mu\text{V/m)}$$

$$47.3 \text{ dB}\mu\text{V} + 0.7 \text{ dB} - 21.0 \text{ dB} + 0.9 \text{ dB} + 0.5 \text{ dB} + 0.1 \text{ dB} = 28.5 \text{ dB}\mu\text{V/m}$$



---

## Part 1: Antenna requirement

DATE: June 16, 2017

TEST STANDARD: FCC 47 CFR Part 15.203 and IC RSS-Gen Section 7.1.2

APPLICABLE REGULATIONS: - "An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited." ... "the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded."

RESULT: A Soldered, non-replaceable antenna is installed inside of the EUT.

This unit meets antenna requirement.

## Part 2: AC conducted emission

DATE: March 14, 2016

TEST STANDARDS: 47 CFR (FCC) Part 15 Subpart C 15.207

MINIMUM STANDARD: Class B Limits

Frequency (MHz)	Conducted Limit (dB $\mu$ V)	
	Quasi-Peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 – 5	56	46
5-30	60	50
Note 1 The lower limit shall apply at the transition frequencies.		
Note 2 The limit decreases linearly with the logarithm of the frequency in the 0.15 to 0.50 MHz		

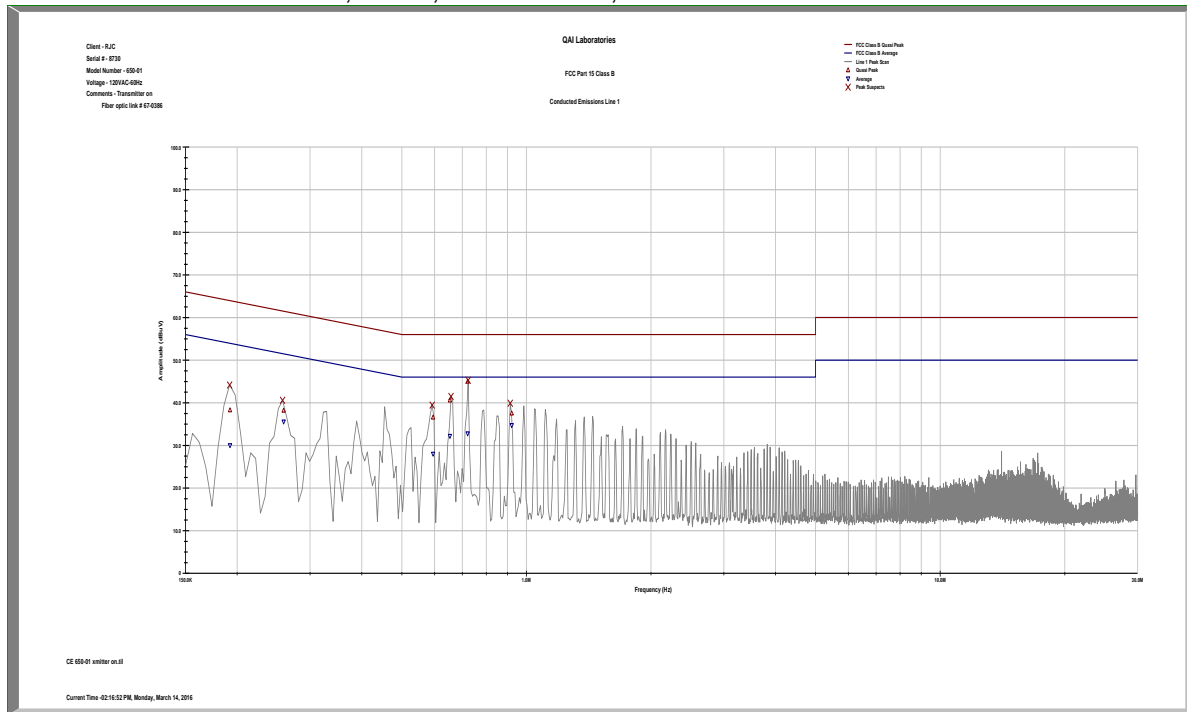
TEST SETUP: The EUT was connected to the conducted emissions LISN apparatus.

METHOD OF MEASUREMENT: Measurements were made using a test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector.

PERFORMANCE: Complies with the test standards above

## DATA & PLOT:

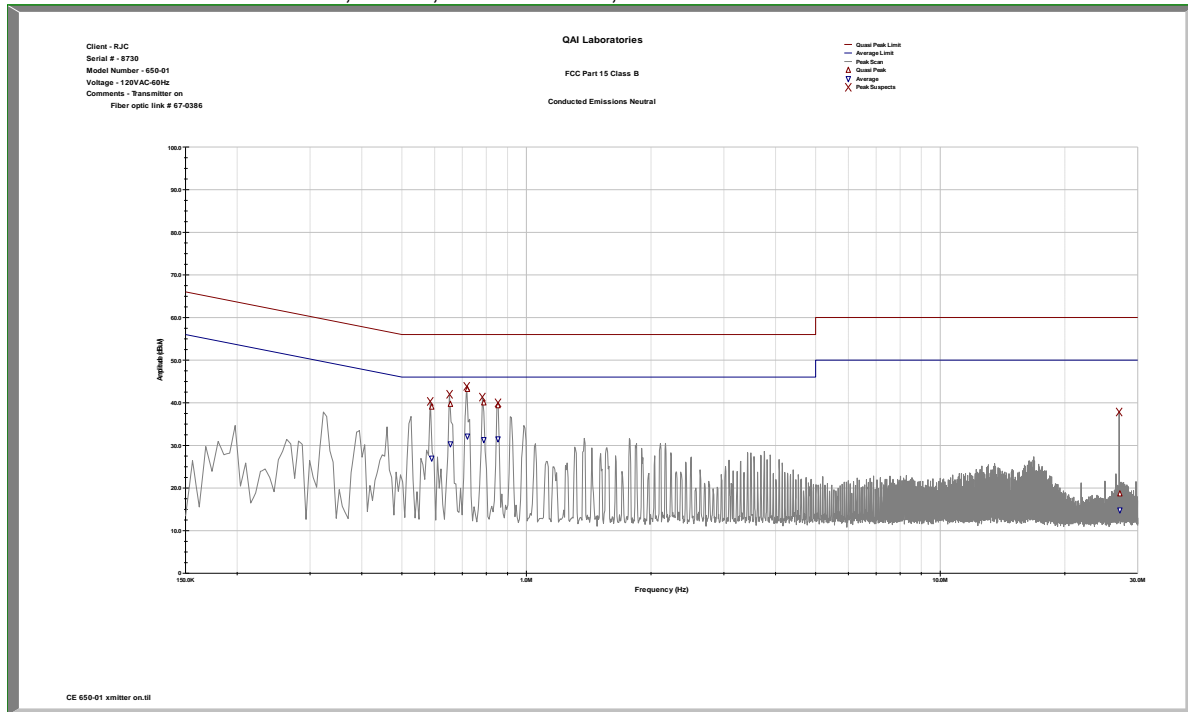
### Plot of AC Mains Conducted Emissions, Line 1, Model 650-01, TX-on



### Data of AC Mains Conducted Emissions, Line 1, Model 650-01, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.192	38.42	30.15	0.02	38.27	63.94	-25.67	30	53.94	-23.94
0.259	38.3	35.64	0	38.19	61.46	-23.27	35.54	51.46	-15.92
0.595	36.6	28.02	0	36.55	56	-19.45	27.97	46	-18.03
0.653	40.74	32.36	-0.14	40.56	56	-15.44	32.18	46	-13.82
0.721	45.24	33.02	-0.2	45	56	-11	32.77	46	-13.23
0.921	37.72	34.89	-0.15	37.53	56	-18.47	34.71	46	-11.29

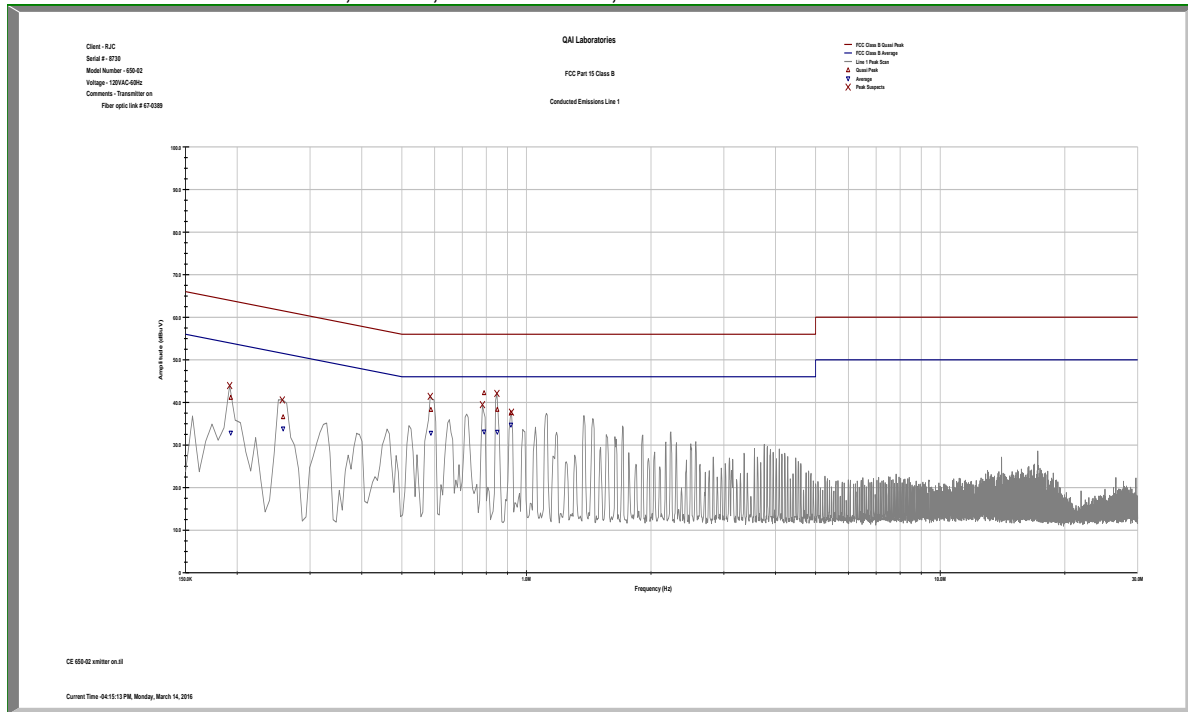
Plot of AC Mains Conducted Emissions, Line 2, Model 650-01, TX-on



Data of AC Mains Conducted Emissions, Line 2, Model 650-01, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.591	39.06	27.10	0.00	39.02	56.00	-16.98	27.06	46.00	-18.94
0.656	39.90	30.47	-0.17	39.70	56.00	-16.30	30.27	46.00	-15.73
0.721	43.44	32.37	-0.20	43.20	56.00	-12.80	32.13	46.00	-13.87
0.788	40.01	31.28	0.00	39.98	56.00	-16.02	31.25	46.00	-14.75
0.854	39.49	31.67	-0.19	39.27	56.00	-16.73	31.45	46.00	-14.55
27.134	19.26	15.42	-0.44	18.72	60.00	-41.28	14.88	50.00	-35.12

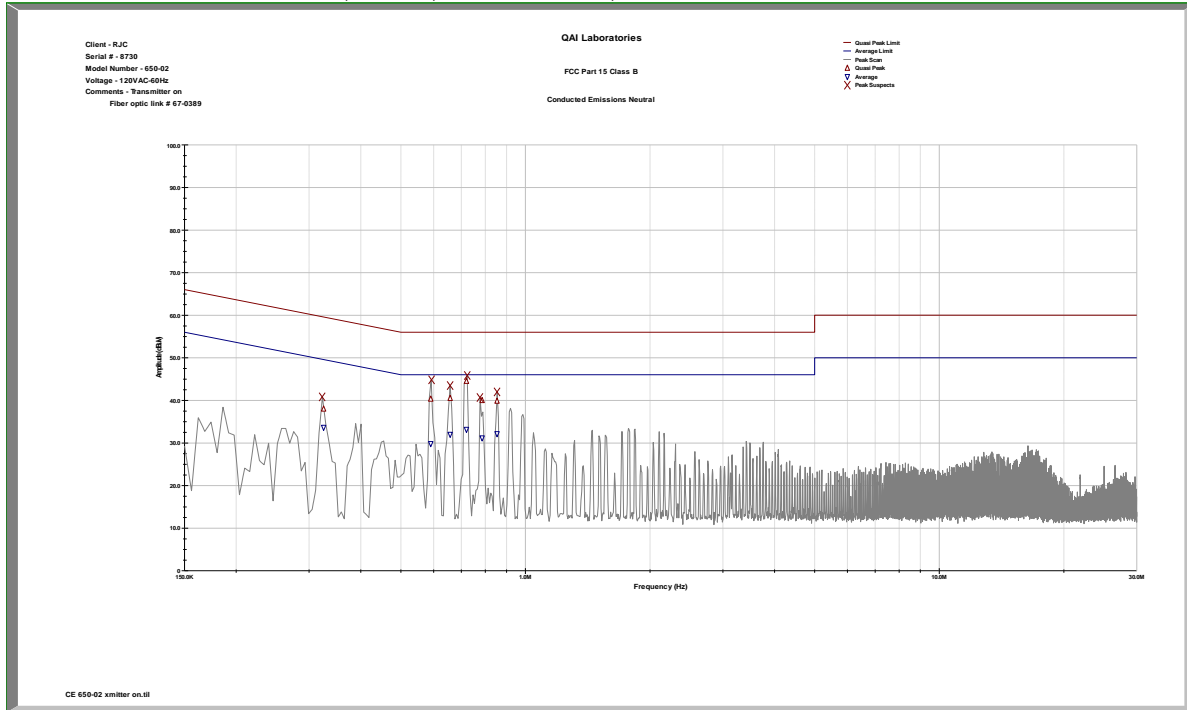
Plot of AC Mains Conducted Emissions, Line 1, Model 650-02, TX-on



Data of AC Mains Conducted Emissions, Line 1, Model 650-02, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.193	41.27	33.01	0.01	41.1	63.91	-22.8	32.84	53.91	-21.06
0.258	36.69	33.94	0	36.58	61.49	-24.91	33.83	51.49	-17.66
0.588	38.31	32.85	0	38.26	56	-17.74	32.8	46	-13.2
0.79	42.26	33.13	0	42.22	56	-13.78	33.09	46	-12.91
0.85	38.52	33.24	-0.17	38.31	56	-17.69	33.03	46	-12.97
0.917	37.71	34.92	-0.16	37.51	56	-18.49	34.72	46	-11.28

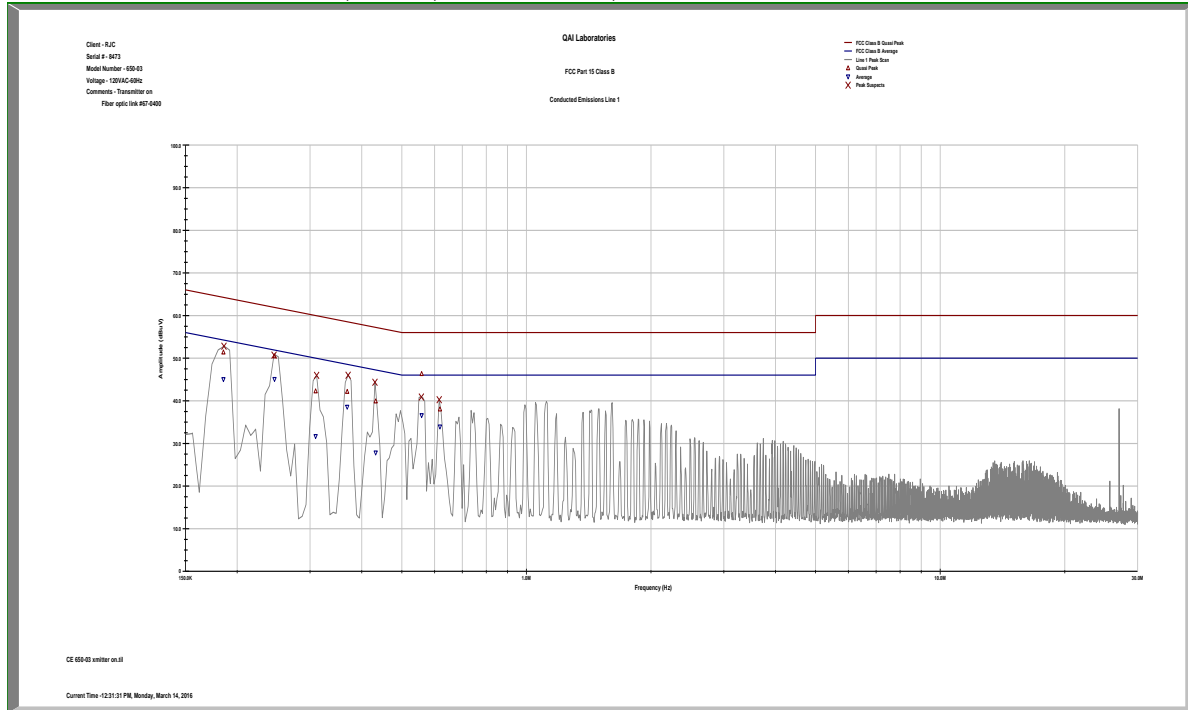
Plot of AC Mains Conducted Emissions, Line 2, Model 650-02, TX-on



Data of AC Mains Conducted Emissions, Line 2, Model 650-02, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.325	38.01	33.72	-0.03	37.90	59.57	-21.67	33.61	49.57	-15.96
0.590	40.44	29.79	0.00	40.40	56.00	-15.60	29.75	46.00	-16.25
0.658	40.72	32.13	-0.18	40.50	56.00	-15.50	31.90	46.00	-14.10
0.721	44.74	33.34	-0.20	44.50	56.00	-11.50	33.10	46.00	-12.90
0.785	39.99	31.10	0.00	39.96	56.00	-16.04	31.07	46.00	-14.93
0.855	40.00	32.34	-0.19	39.77	56.00	-16.23	32.11	46.00	-13.89

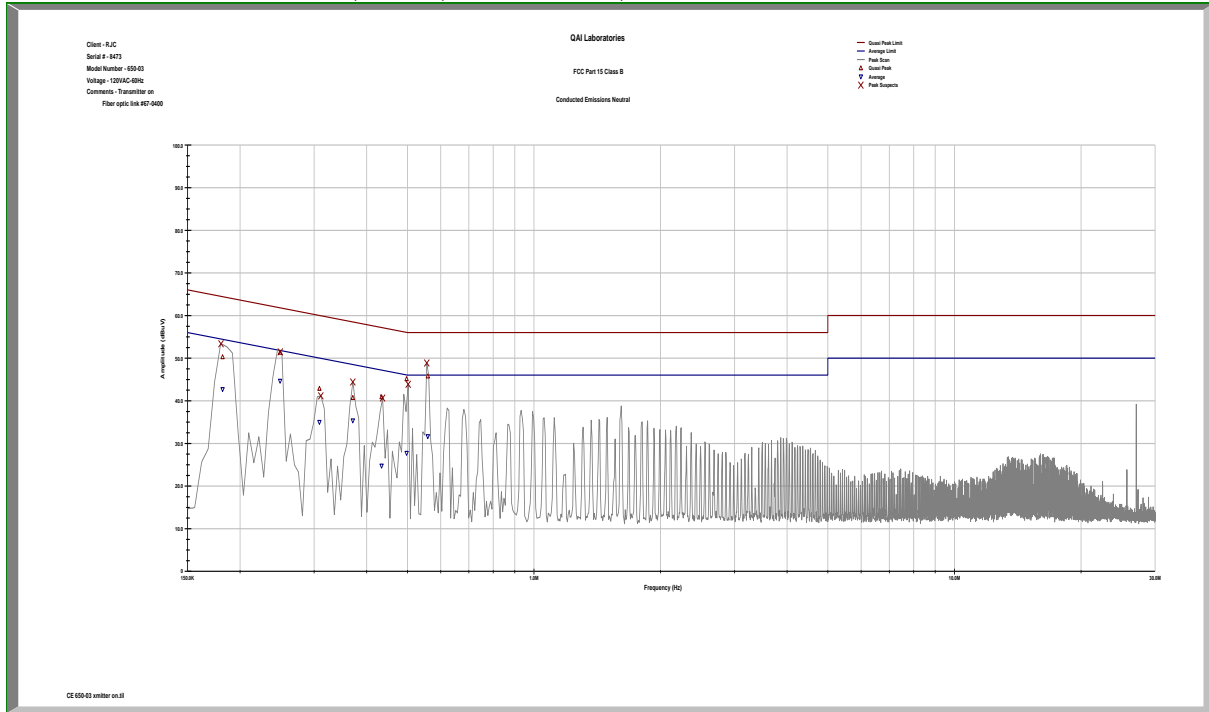
Plot of AC Mains Conducted Emissions, Line 1, Model 650-03, TX-on



Data of AC Mains Conducted Emissions, Line 1, Model 650-03, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.185	51.47	45.16	0.06	51.35	64.25	-12.9	45.04	54.25	-9.21
0.246	50.48	45.06	0.11	50.47	61.89	-11.42	45.05	51.89	-6.84
0.31	42.41	31.83	-0.08	42.24	59.98	-17.74	31.66	49.98	-18.32
0.369	42.06	38.48	0.13	42.12	58.52	-16.41	38.54	48.52	-9.99
0.432	39.85	27.76	0.1	39.89	57.21	-17.32	27.81	47.21	-19.4
0.558	46.28	36.53	0.08	46.31	56	-9.69	36.56	46	-9.44
0.618	38.03	33.96	0	37.99	56	-18.01	33.91	46	-12.09

Plot of AC Mains Conducted Emissions, Line 2, Model 650-03, TX-on

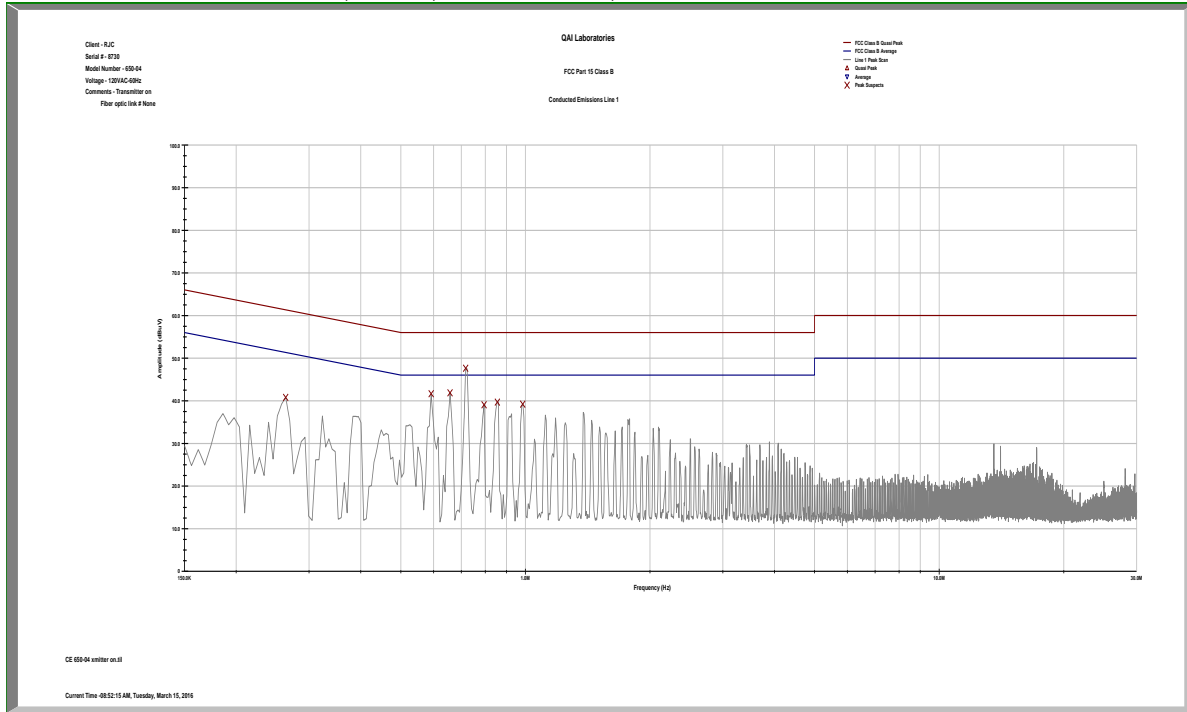


Data of AC Mains Conducted Emissions, Line 2, Model 650-03, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.182	50.43	42.86	0.02	50.26	64.41	-14.14	42.69	54.41	-11.71
0.249	51.34	44.69	0.06	51.29	61.79	-10.5	44.64	51.79	-7.15
0.309	43.02	35.15	-0.09	42.85	60	-17.15	34.98	50	-15.02
0.371	40.59	35.26	0.16	40.68	58.48	-17.8	35.35	48.48	-13.13
0.434	40.87	24.72	0.06	40.88	57.18	-16.3	24.73	47.18	-22.45
0.498	45.35	27.95	-0.19	45.12	56.04	-10.92	27.71	46.04	-18.33
0.559	45.7	31.6	0.07	45.73	56	-10.27	31.63	46	-14.37



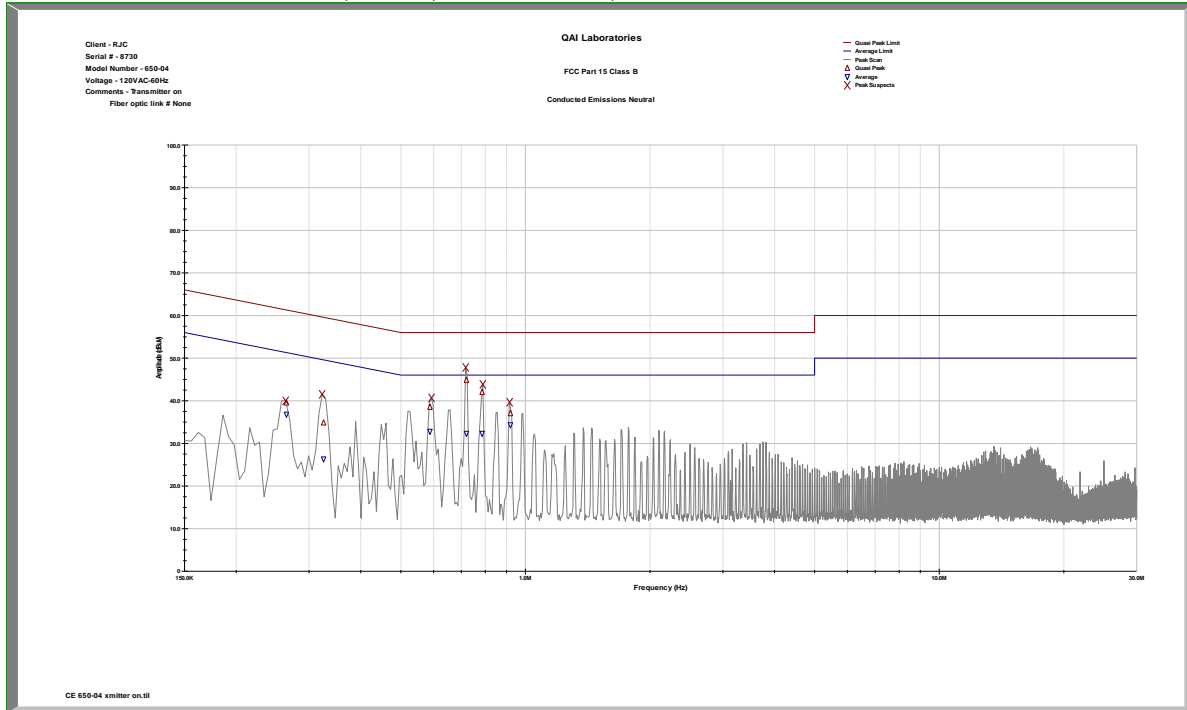
Plot of AC Mains Conducted Emissions, Line 1, Model 650-04, TX-on



Data of AC Mains Conducted Emissions, Line 1, Model 650-04, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.264	41.4	36.61	0	41.29	61.3	-20.01	36.5	51.3	-14.8
0.722	45.49	33.08	-0.19	45.26	56	-10.74	32.84	46	-13.16
0.787	42.48	33.09	0	42.44	56	-13.56	33.05	46	-12.95
0.854	39.51	34.25	-0.19	39.28	56	-16.72	34.03	46	-11.97
0.985	40.22	34.5	-0.01	40.17	56	-15.83	34.45	46	-11.55
1.053	39.09	32.63	-0.08	38.98	56	-17.02	32.52	46	-13.48

Plot of AC Mains Conducted Emissions, Line 2, Model 650-04, TX-on



Data of AC Mains Conducted Emissions, Line 2, Model 650-04, TX-on

Freq (MHz)	QP Meas (dBuV)	AVG Meas (dBuV)	Total Corr (dB)	QP Actual (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AVG Actual (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
0.265	39.63	36.89	0.00	39.53	61.27	-21.74	36.79	51.27	-14.48
0.325	34.99	26.46	-0.04	34.88	59.57	-24.69	26.35	49.57	-23.22
0.589	38.57	32.91	0.00	38.53	56.00	-17.47	32.87	46.00	-13.13
0.721	45.06	32.62	-0.20	44.82	56.00	-11.18	32.38	46.00	-13.62
0.786	41.94	32.38	0.00	41.91	56.00	-14.09	32.34	46.00	-13.66
0.919	37.13	34.49	-0.16	36.94	56.00	-19.06	34.30	46.00	-11.70

### Part 3: Radiated Spurious Emissions

DATE: March 14, 2016

TEST STANDARDS: 47 CFR (FCC) Part 15 Subpart C 15.209

MINIMUM STANDARD: 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:

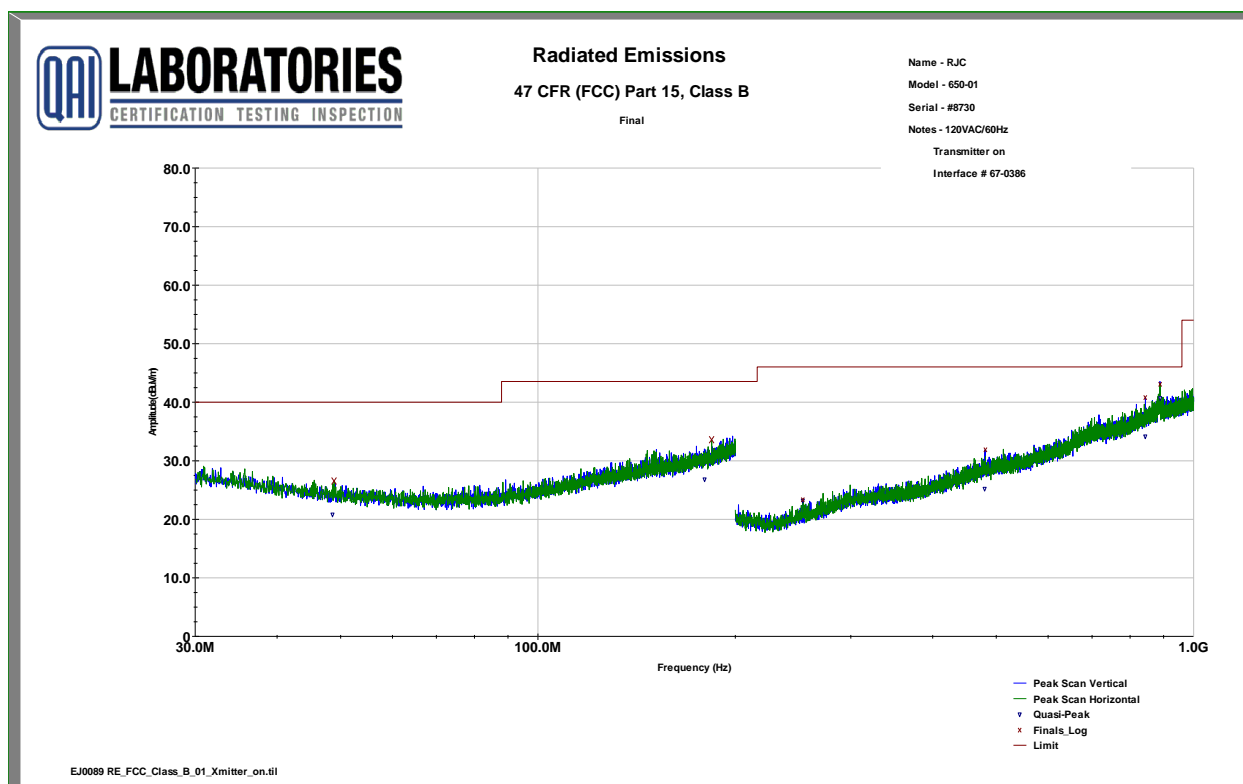
Frequency MHz	Limit of Field strength		distance
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	m
0.009-0.49	$2400/F(\text{kHz})$	$67.6-20\text{Log}F(\text{kHz})$	300
0.49-1.705	$24000/F(\text{kHz})$	$87.6-20\text{Log}F(\text{kHz})$	30
1.705-30	30	29.5	30
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
above 960	500	54.0	3

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

PERFORMANCE: Complies with the test standards above

DATA & PLOT:

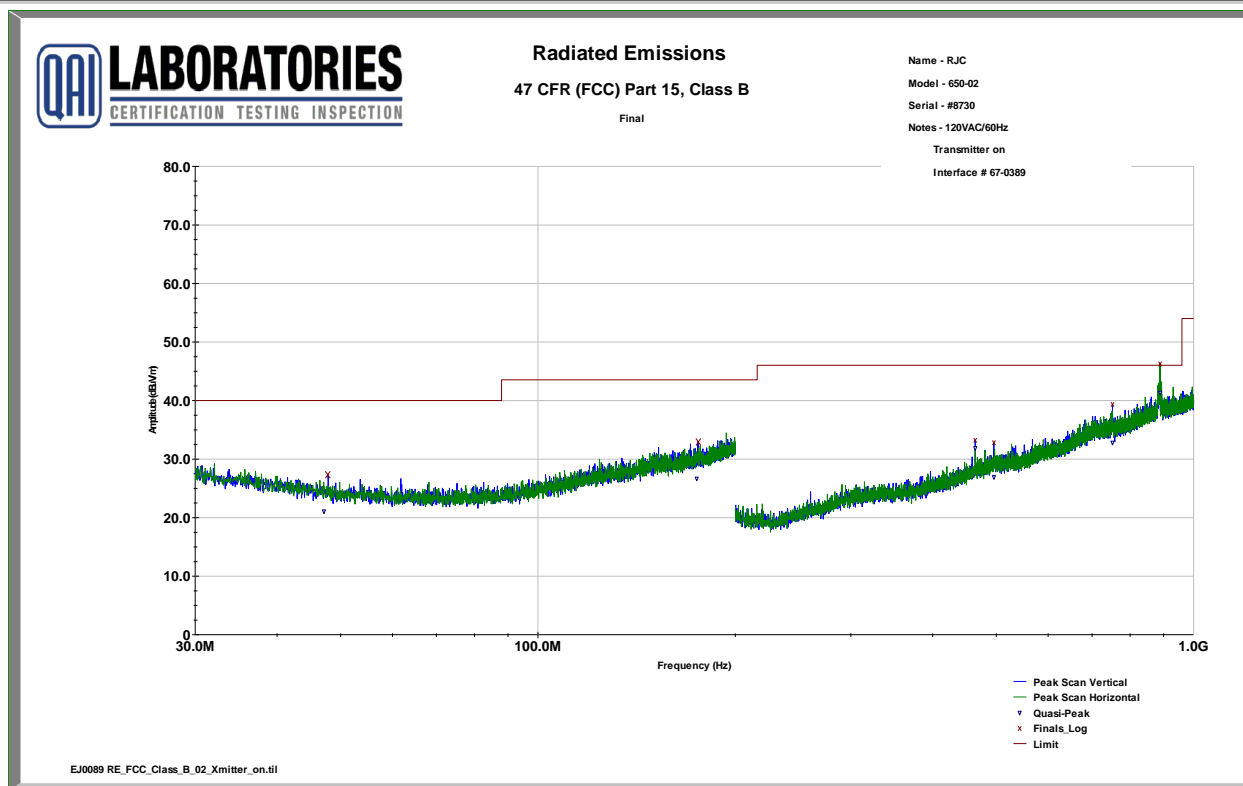
Note: The test of the radiated emissions was also performed on the frequency range between 9KHz and 30MHz, however there was no emissions detected.



Plot of Radiated Emissions, 30MHz – 1GHz, Model 650-01, TX-on

Data of Radiated Emissions, Model 650-01, TX-on

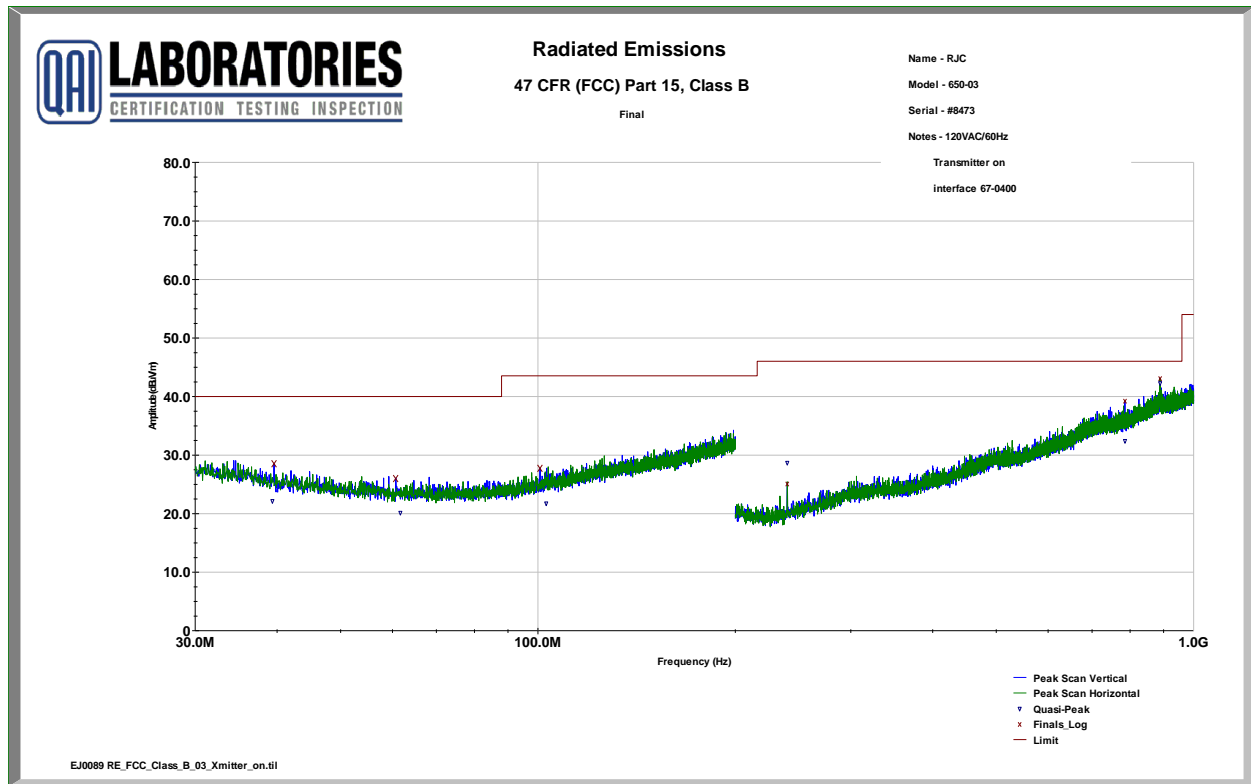
Frequency (MHz)	QP Meas (dBuV/m)	Corr (dB)	Limit (dBuV/m)	Polarity	Height (cm)	Azimuth (deg)	Margin (dB)
48.628	35.500	-14.70	40.0	V	229	266	-19.2
179.671	35.520	-8.68	43.5	V	208	211	-16.7
253.592	27.080	-3.93	46.0	H	277	209	-22.9
480.332	26.740	-1.56	46.0	V	296	0	-20.8
844.566	26.180	7.87	46.0	V	172	231	-12.0
889.455	31.790	8.83	46.0	H	248	188	-5.4



Plot of Radiated Emissions, 30MHz – 1GHz, Model 650-02, TX-on

Data of Radiated Emissions, Model 650-02, TX-on

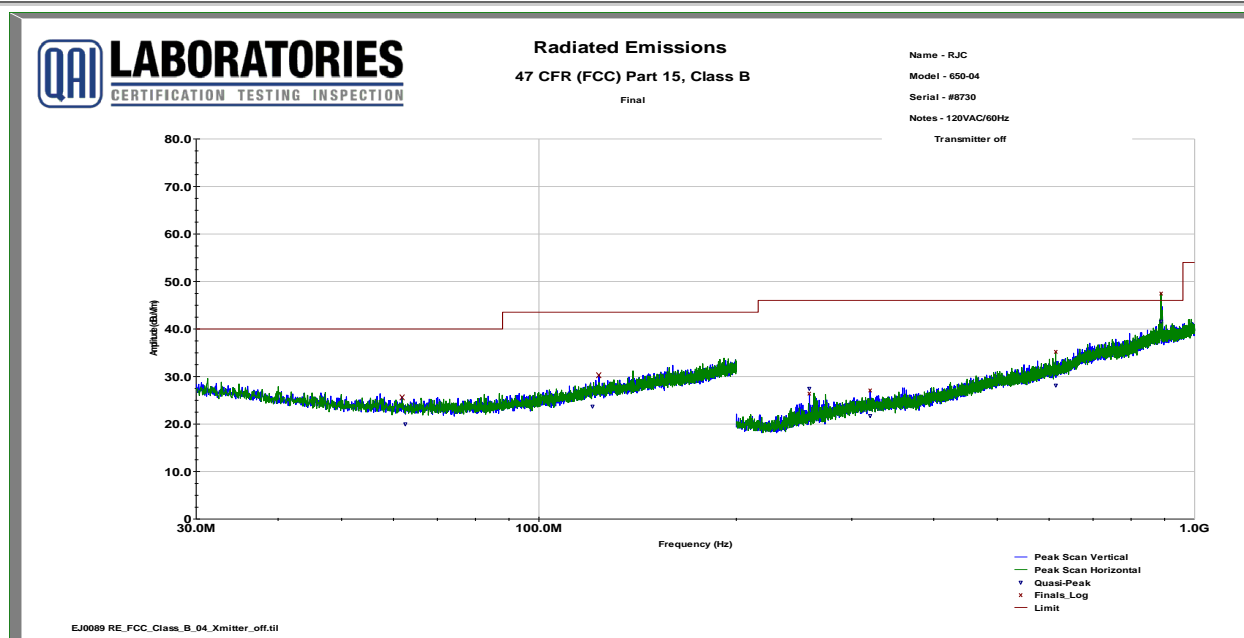
Frequency (MHz)	QP Meas (dBuV/m)	Corr (dB)	Limit (dBuV/m)	Polarity	Height (cm)	Azimuth (deg)	Margin (dB)
47.147	35.520	-14.45	40.0	V	162	4	-18.9
174.576	35.590	-9.00	43.5	V	161	170	-16.9
464.008	33.990	-2.18	46.0	H	294	68	-14.2
495.994	28.000	-1.01	46.0	H	174	146	-19.0
751.773	27.240	5.53	46.0	V	342	358	-13.2
888.780	32.480	8.82	46.0	H	185	293	-4.7



Plot of Radiated Emissions, 30MHz – 1GHz, Model 650-03, TX-on

Data of Radiated Emissions, Model 650-03, TX-on

Frequency (MHz)	QP Meas (dBuV/m)	Corr (dB)	Limit (dBuV/m)	Polarity	Height (cm)	Azimuth (deg)	Margin (dB)
39.394	35.500	-13.33	40.0	H	334	0	-17.8
61.654	35.550	-15.44	40.0	H	236	33	-19.9
102.996	35.460	-13.75	43.5	H	203	159	-21.8
240.018	33.540	-4.93	46.0	V	103	260	-17.4
785.340	26.200	6.14	46.0	V	290	11	-13.7
888.625	33.390	8.82	46.0	H	346	197	-3.8



Plot of Radiated Emissions, 30MHz – 1GHz, Model 650-04, TX-on

Data of Radiated Emissions, Model 650-04, TX-on

Frequency (MHz)	QP Meas (dBuV/m)	Corr (dB)	Limit (dBuV/m)	Polarity	Height (cm)	Azimuth (deg)	Margin (dB)
62.461	35.470	-15.45	40.0	V	343	41	-20.0
120.805	35.680	-11.98	43.5	V	107	77	-19.8
258.514	30.950	-3.54	46.0	V	135	33	-18.6
320.061	28.260	-6.49	46.0	H	105	140	-24.2
614.096	26.460	1.68	46.0	V	161	189	-17.9
888.387	32.810	8.82	46.0	V	277	174	-4.4

---

## Part 4: 20 dB bandwidth

DATE: March 15, 2016

TEST STANDARDS: 47 CFR (FCC) Part 15 Subpart C 15.215 (c)

MINIMUM STANDARD: (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

DATA:

Frequency Unit: MHz

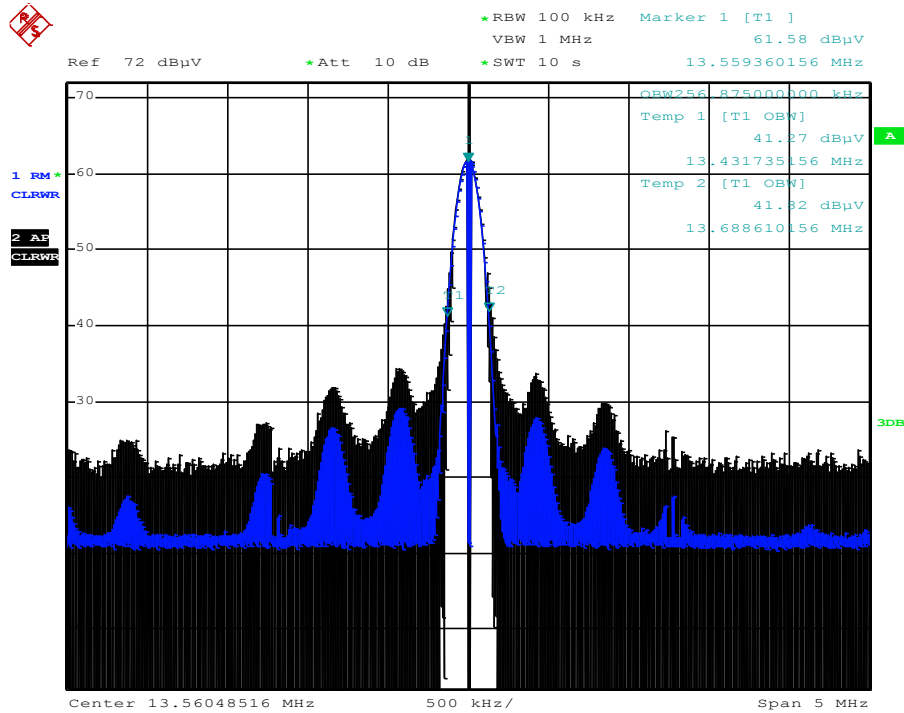
EUT #	Centre Frequency	Low side, 20 dB BW	High side, 20 dB BW	20dB BW (kHz)
650-01	13.55936	13.43173	13.68861	256.88
650-02	13.55936	13.42861	13.69298	264.37
650-03	13.55936	13.52148	13.59698	75.5
650-04	13.55936	13.43423	13.67361	239.38

PERFORMANCE: Complies with the test standards above

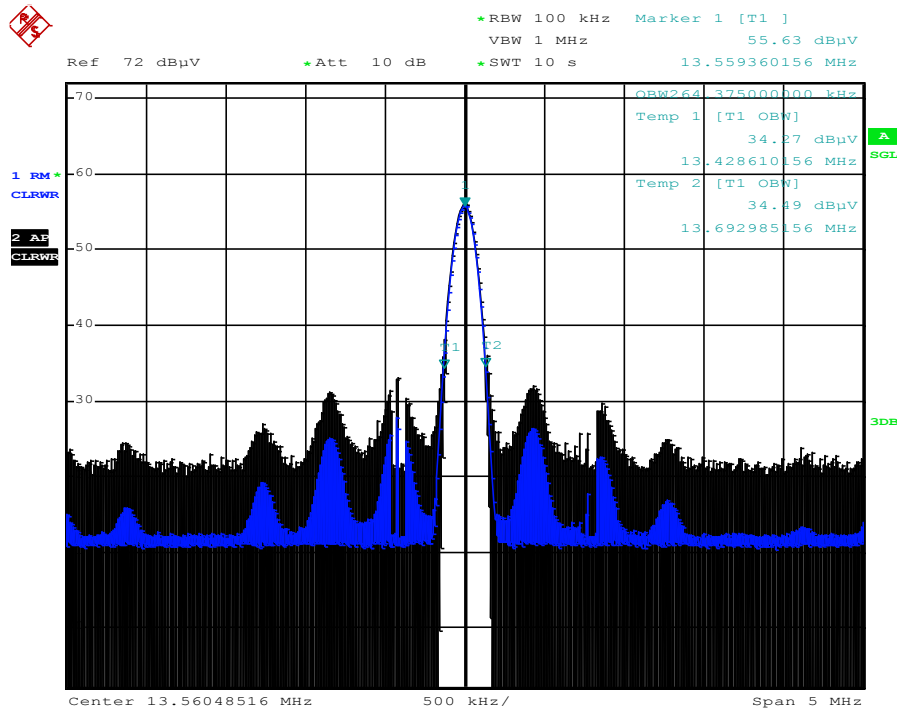


PLOT:

Plot of 20 dB BW of the unit 650-01

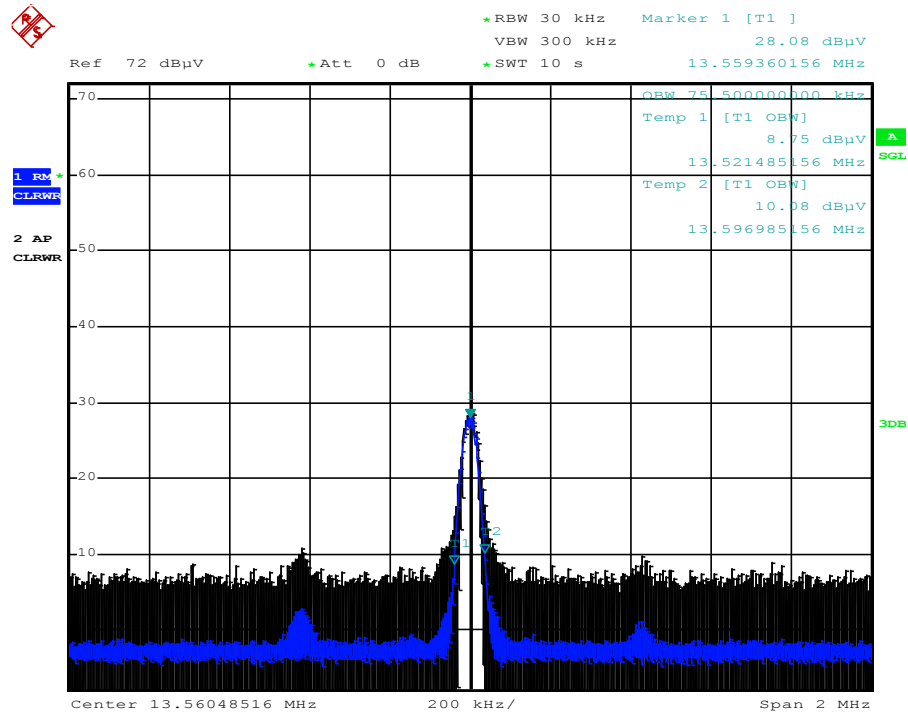


Plot of 20 dB BW of the unit 650-02

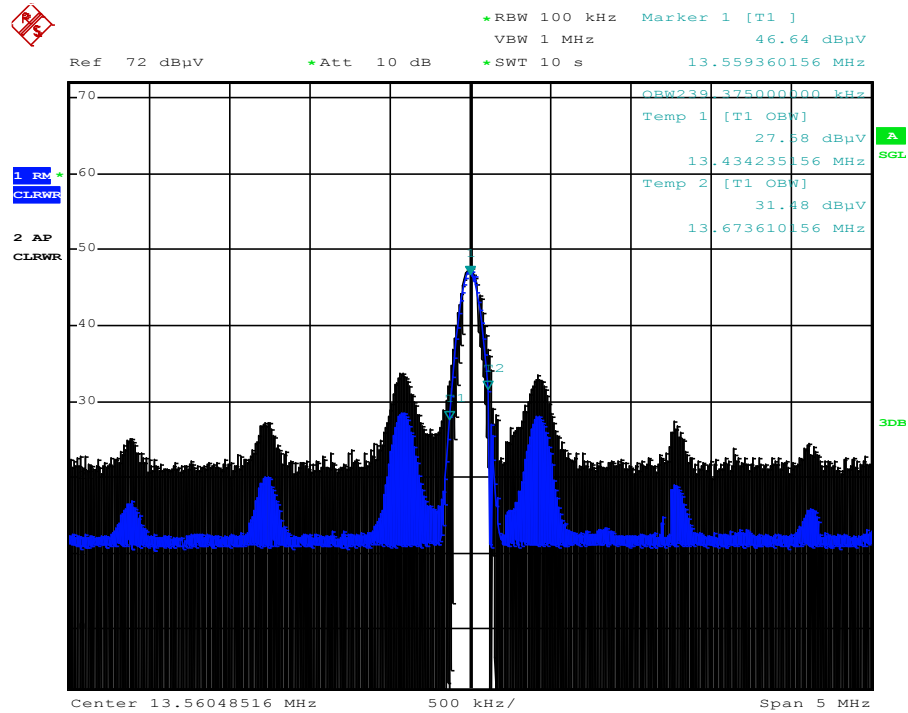


THIS REPORT IS THE CONFIDENTIAL PROPERTY OF THE CLIENT ADDRESSED. THE REPORT MAY ONLY BE REPRODUCED IN FULL. PUBLICATION OF EXTRACTS FROM THIS REPORT IS NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM QAI. ANY LIABILITY ATTACHED THERETO IS LIMITED TO THE FEE CHARGED FOR THE INDIVIDUAL PROJECT FILE REFERENCED. THE RESULTS OF THIS REPORT PERTAIN ONLY TO THE SPECIFIC SAMPLE(S) EVALUATED.

Plot of 20 dB BW of the unit 650-03



Plot of 20 dB BW of the unit 650-04



THIS REPORT IS THE CONFIDENTIAL PROPERTY OF THE CLIENT ADDRESSED. THE REPORT MAY ONLY BE REPRODUCED IN FULL. PUBLICATION OF EXTRACTS FROM THIS REPORT IS NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM QAI. ANY LIABILITY ATTACHED THERETO IS LIMITED TO THE FEE CHARGED FOR THE INDIVIDUAL PROJECT FILE REFERENCED. THE RESULTS OF THIS REPORT PERTAIN ONLY TO THE SPECIFIC SAMPLE(S) EVALUATED.

## Part 5: Field strength of emissions

DATE: March 15, 2016

TEST STANDARDS: 47 CFR (FCC) Part 15 Subpart C 15.225

MINIMUM STANDARD: (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 uV/m or 84 dBuV/m at 30 meters

DATA & PLOT:

Unit	Freq.		LIM @3m	MEAS @1m	dist 1m-3m	BW 1M/100K	MEAS @3m	Total Corr	cMEAS @3m	Margin
	MHz		dBuV/m	dBuV			dBuV	dBuV/m	dBuV/m	dB
650-04	13.56	PARA	104.0	53.6	-9.54	-10.0	34.1	-16.0	18.1	85.9
650-04	13.56	PERP	104.0	53.0	-9.54	-10.0	33.5	-16.0	17.5	86.5
650-03	13.56	PARA	104.0	50.6	-9.54	-10.0	31.1	-16.0	15.1	88.9
650-03	13.56	PERP	104.0	49.5	-9.54	-10.0	30.0	-16.0	14.0	90.0
650-02	13.56	PARA	104.0	55.9	-9.54	-10.0	36.4	-16.0	20.4	83.6
650-02	13.56	PERP	104.0	52.3	-9.54	-10.0	32.8	-16.0	16.8	87.2
650-01	13.56	PARA	104.0	52.6	-9.54	-10.0	33.1	-16.0	17.1	86.9
650-01	13.56	PERP	104.0	55.8	-9.54	-10.0	36.3	-16.0	20.3	83.7

Note: 1) The limit at 3m = limit at 30 m + 20Log (30/3)

$$=84\text{dBuV/m} + 20 \text{ dB}$$

$$=104 \text{ dBuV/m}$$

2) the measurement distance between the EUT and the receiver is 1 m

PERFORMANCE: Complies with the test standards above

---

## Part 6: Frequency tolerance

DATE: March 17, 2016

TEST STANDARDS: 47 CFR (FCC) Part 15 Subpart C 15.225(e)

MINIMUM STANDARD: 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.

PERFORMANCE: Complies with the test standards above.

DATA:

Unit 650-01, Frequency Vs. Voltage at 20° C

Voltage	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
120 VAC	13.56048015	Reference	NA	NA
102 VAC	13.56048015	0	0.001356048	PASS
138 VAC	13.56048015	0	0.001356048	PASS

Unit 650-01, Frequency Vs Temperature

Temperature (°C)	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
-30	13.5604241	-0.00005600	0.001356048	PASS
-20	13.5604581	-0.00002200	0.001356048	PASS
-10	13.5607461	-0.00000400	0.001356048	PASS
0	13.5604828	+0.00000275	0.001356048	PASS
10	13.5604828	+0.00000275	0.001356048	PASS
20	13.56048015	Reference	NA	PASS
30	13.5604869	-0.0000032	0.001356048	PASS
40	13.5604869	-0.0000032	0.001356048	PASS
50	13.5604869	-0.0000032	0.001356048	PASS

Unit 650-02, Frequency Vs. Voltage at 20° C

Voltage	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
120 VAC	13.560500150	Reference	NA	NA
102 VAC	13.560500150	0	0.0013560500	PASS
138 VAC	13.560500150	0	0.0013560500	PASS

Unit 650-02, Frequency Vs Temperature

Temperature (°C)	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
-30	13.5605198	+0.00001965	0.0013560500	PASS
-20	13.5605318	+0.00003165	0.0013560500	PASS
-10	13.5605357	+0.00003556	0.0013560500	PASS
0	13.5605338	+0.00003365	0.0013560500	PASS
10	13.5605198	+0.00001965	0.0013560500	PASS
20	13.560500150	Reference	NA	PASS
30	13.5604818	-0.00001834	0.0013560500	PASS
40	13.5604678	-0.00003234	0.0013560500	PASS
50	13.5604618	-0.00003834	0.0013560500	PASS

Unit 650-03, Frequency Vs. Voltage at 20° C

Voltage	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
120 VAC	13.5605021	Reference	NA	NA
102 VAC	13.5605021	0	0.00135605	PASS
138 VAC	13.5605021	0	0.00135605	PASS

Unit 650-03, Frequency Vs Temperature

Temperature (°C)	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
-30	13.5605329	-0.000011875	0.00135605	PASS
-20	13.5605280	-0.000025875	0.00135605	PASS
-10	13.5605300	-0.000027875	0.00135605	PASS
0	13.5605220	-0.000019875	0.00135605	PASS
10	13.5605110	-0.000008875	0.00135605	PASS
20	13.5605021	Reference	NA	PASS
30	13.5604910	-0.000011125	0.00135605	PASS
40	13.5604896	-0.000017125	0.00135605	PASS
50	13.5604830	-0.000019125	0.00135605	PASS

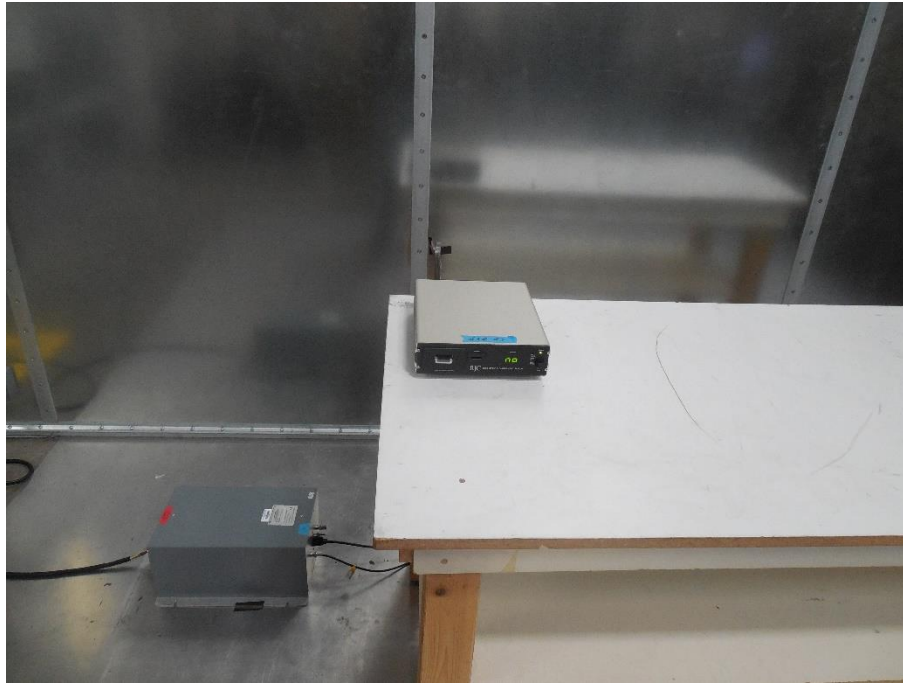
Unit 650-04, Frequency Vs. Voltage at 20° C

Voltage	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
120 VAC	13.5604869	Reference	NA	NA
102 VAC	13.5604869	0	0.00135605	
138 VAC	13.5604869	0	0.00135605	

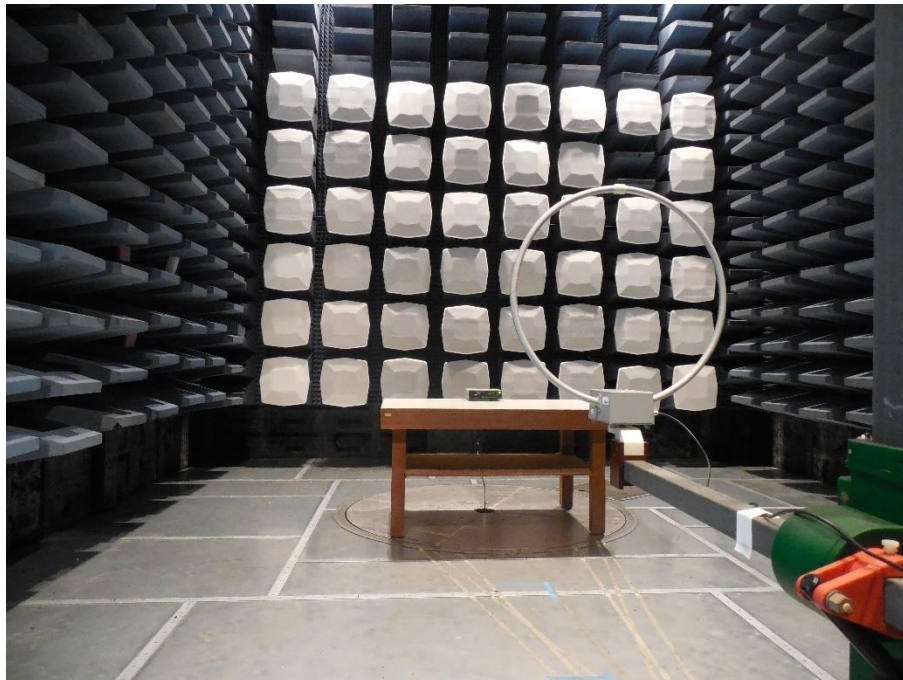
Unit 650-04, Frequency Vs Temperature

Temperature (°C)	Frequency (MHz)	Frequency Shift (MHz)	Maximum Allowed Frequency Shift (MHz)	Results
-30	13.5604269	-0.000060	0.00135605	
-20	13.5604489	-0.000038	0.00135605	
-10	13.5604689	-0.000018	0.00135605	
0	13.5604829	-0.000004	0.00135605	
10	13.5604849	-0.000002	0.00135605	
20	13.5604869	Reference	0	NA
30	13.5604829	-0.000004	0.00135605	
40	13.5604829	-0.000004	0.00135605	
50	13.5604849	-0.000002	0.00135605	

## Appendix A Test Setup Photographs



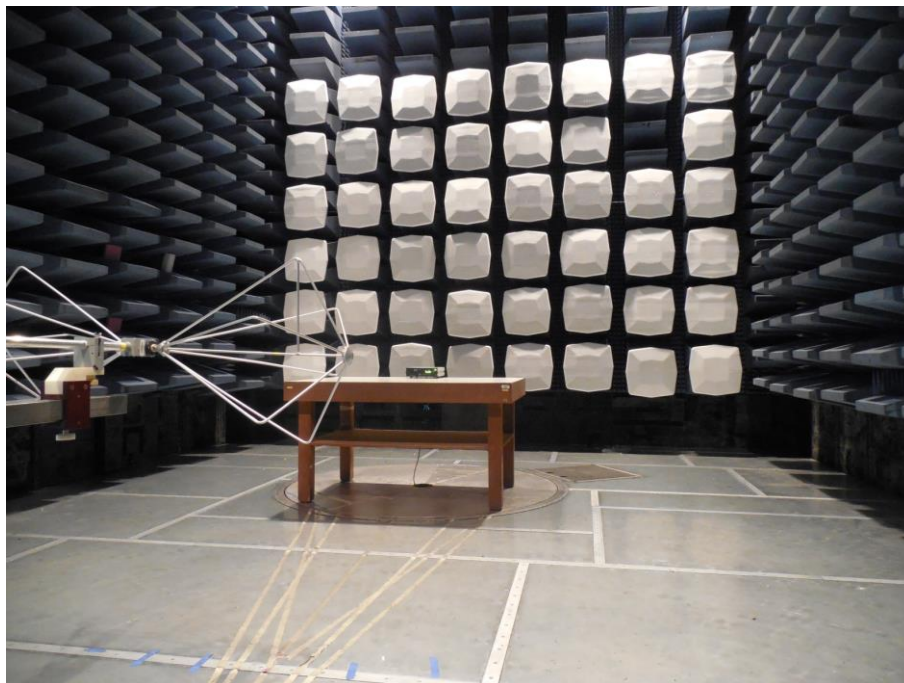
Conducted Emission Test Setup, below 30MHz



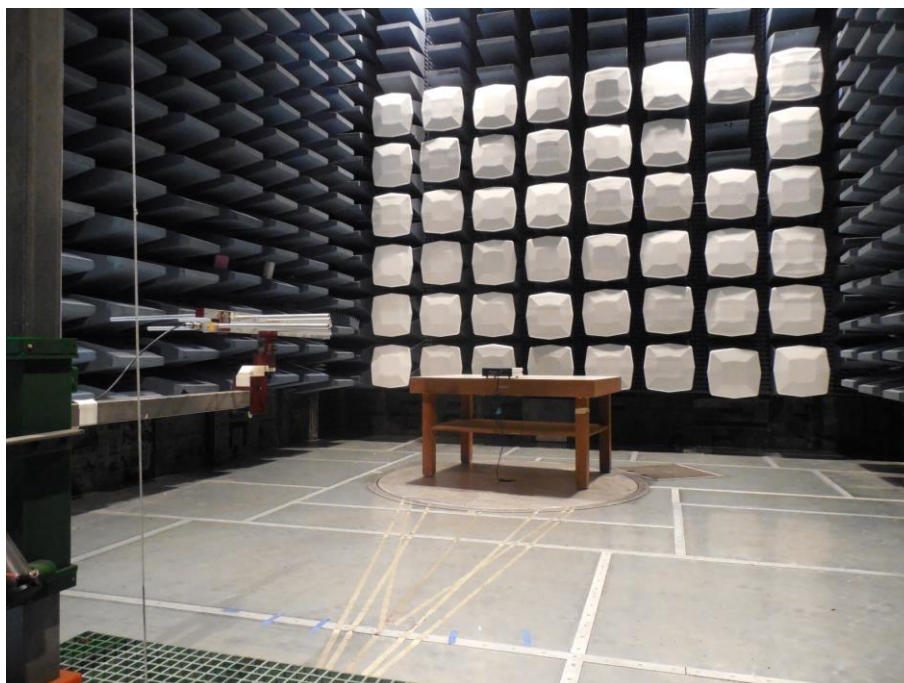
Radiated Emission Test Setup, below 30MHz

THIS REPORT IS THE CONFIDENTIAL PROPERTY OF THE CLIENT ADDRESSED. THE REPORT MAY ONLY BE REPRODUCED IN FULL. PUBLICATION OF EXTRACTS FROM THIS REPORT IS NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM QAI. ANY LIABILITY ATTACHED THERETO IS LIMITED TO THE FEE CHARGED FOR THE INDIVIDUAL PROJECT FILE REFERENCED. THE RESULTS OF THIS REPORT PERTAIN ONLY TO THE SPECIFIC SAMPLE(S) EVALUATED.





Radiated Emission Test Setup, 30MHz -200MHz



Radiated Emission Test Setup, above 200MHz

THIS REPORT IS THE CONFIDENTIAL PROPERTY OF THE CLIENT ADDRESSED. THE REPORT MAY ONLY BE REPRODUCED IN FULL. PUBLICATION OF EXTRACTS FROM THIS REPORT IS NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM QAI. ANY LIABILITY ATTACHED THERETO IS LIMITED TO THE FEE CHARGED FOR THE INDIVIDUAL PROJECT FILE REFERENCED. THE RESULTS OF THIS REPORT PERTAIN ONLY TO THE SPECIFIC SAMPLE(S) EVALUATED.





Radiated Emission (close-up view) Test Setup

## End of Test Report

THIS REPORT IS THE CONFIDENTIAL PROPERTY OF THE CLIENT ADDRESSED. THE REPORT MAY ONLY BE REPRODUCED IN FULL. PUBLICATION OF EXTRACTS FROM THIS REPORT IS NOT PERMITTED WITHOUT WRITTEN APPROVAL FROM QAI. ANY LIABILITY ATTACHED THERETO IS LIMITED TO THE FEE CHARGED FOR THE INDIVIDUAL PROJECT FILE REFERENCED. THE RESULTS OF THIS REPORT PERTAIN ONLY TO THE SPECIFIC SAMPLE(S) EVALUATED.