

ELECTROMAGNETIC COMPATIBILITY TEST REPORT

PREPARED FOR OCE DISPLAY GRAPHICS SYSTEMS
BY QAI LABORATORIES



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EMC Test Laboratory: **QAI Laboratories Inc.**

Address: 3980 North Fraser Way, Burnaby, BC, V5J 5K5 Canada

Phone: (604) 527-8378

Fax: (604) 527-8368

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



American Association for Laboratory Accreditation Certificate Number: 3657.02

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EMC Client:

Address: Oce Display Graphics Systems

Phone: Suite 406 – 13251 Delf Place, Richmond, BC, Canada | V6V 2A2

(604) 232-2345

Applicable Test Standards:

47 CFR Part 15, Subpart C – 15.209, 15.225

RSS-210 Issue 9 – Annex A2.6

RSS-Gen Issue 4

Equipment Tested

RFID2 Radio Module

Model Number:

3010120604

FCC ID:

U2P-3010120604

IC Certification Number:

6947A-3010120604

Manufacturer:

Oce Display Graphics Systems

REVISION HISTORY

Date	Report Number	Rev #	Details	Author's Initials
October 27, 2016	E10440-1601_ODGS-RFID2	0.0	Draft Test Report	HZ
Nov. 9, 2016	E10440-1601_ODGS-RFID2	1.0	Final Test Report	HZ
Nov. 29, 2016	E10440-1601_ODGS-RFID2	2.0	<ul style="list-style-type: none"> - Test Equipment List Update (pg. 10) - Note added regarding conducted emissions (pg. 6) - Test method added (pgs. 11, 15, 18, and 19) 	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All previous versions of this report have been superseded by the latest dated revision as listed in the above table.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.

REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by Oce Display Graphics Systems. Tests were conducted on the sample equipment as requested by Oce Display Graphics Systems for the purpose of demonstrating compliance with 47 CFR Part 15: Subpart C – 15.209, 15.225, RSS-210 Issue 9 – Annex A2.6, and RSS-Gen Issue 4 as agreed upon by Oce Display Graphics Systems as per Quote 16SH08295R2.

Oce Display Graphics Systems is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC or IC Declaration of Conformity and can only be produced by the manufacturer.

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



Written by HP Enriquez
EMC Technical Writer



Reviewed by Aman Jathaul
EMC Engineering Manager



Reviewed by Parminder Singh
Director for the EMC Department

QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

British Columbia

QAI Laboratories Inc.
Main Laboratory/Headquarters
3980 North Fraser Way,
Burnaby, BC V5J Canada

Ontario

QAI Laboratories Inc.
1081 Meyerside Drive, Unit #14
Mississauga, ON L5T 1M4 Canada

Washington

QAI Laboratories Ltd.
834 80TH Street SW, Suite 200,
Everett, WA 98203-7008 USA

Virginia

QAI Laboratories Ltd.
1047 Zachary Taylor Hwy,
Suite A Huntly, VA 22640 USA

California

QAI Laboratories Ltd.
8385 White Oak Avenue Rancho
Cucamonga, CA 91730 USA

Oklahoma

QAI Laboratories Ltd.
108th East Avenue,
Tulsa, OK 74116 USA

QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

EMC Laboratory Location	FCC Designation (3m SAC)	IC Registration (3m SAC)	A2LA Certificate
Burnaby, BC Canada	CA9543	21146-1	3657.02
Everett, Washington USA	307482	11876A-1	3657.02



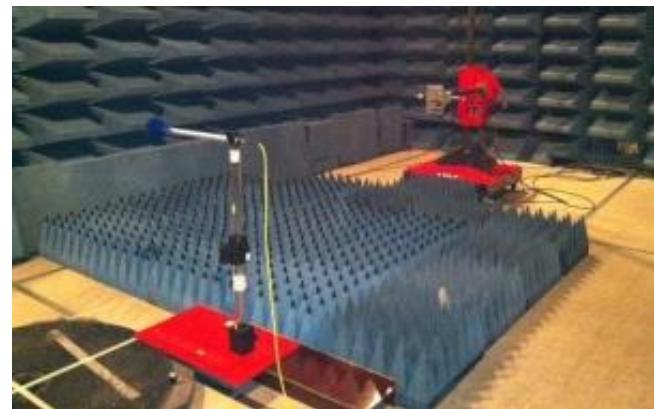
Headquarters & EMC Laboratory in Burnaby, BC



EMC Laboratory in Everett, Washington



3 m Semi-Anechoic Chamber (SAC) in Burnaby, BC



3 m Semi-Anechoic Chamber (SAC) in Burnaby, BC



10 m Open Area Test Site (OATS) in British Columbia, Canada



5 m Semi-Anechoic Chamber (SAC) in Everett, Washington



5 m Semi-Anechoic Chamber (SAC) in Everett, Washington

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Section I: EXECUTIVE SUMMARY

1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of “RFID2 Radio Module” as per Sections 1.2 & 1.3.

1.2 Scope

The information documented in this report is based on the test methods and levels as per Quote 16SH08295R2:

- **47 CFR Part 15** – Radio Frequency Devices, Subpart C – Intentional Radiator
 - o 15.209: Radiated emission limits; general requirements
 - o 15.225: Operation within the band 13.110-14.010 MHz
- **RSS-210 Issue 9** – License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
 - o Annex A2.6: Band 13.110-14010 MHz
- **RSS-Gen Issue 4** – General Requirements and Information for the Certification of Radio Apparatus

1.3 Summary of Results

The following tests demonstrate the testimony to “FCC and IC” Mark Electromagnetic compatibility testing for “RFID2 Radio Module” manufactured by Oce Display Graphics Systems.

The following testing was performed pursuant to the FCC and IC Radio and RF Emissions Standards:

Test or Measurement	Applicable FCC Rule Parts	Description	Performance Criteria
Main Power Line Conducted Emissions	47 CFR Part 15, Subpart B: 15.107 RSS-Gen Issue 4	The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range.	Complies
Radiated E-Field Emissions	47 CFR Part 15, Subpart C: 15.209 RSS-210 Issue 9	The radiated E-field spurious emissions were measured from 30 to 1000 MHz frequency range.	Complies
Radiated H-Field Emissions	47 CFR Part 15, Subpart C: 15.225, 15.209 RSS-210 Issue 9: Annex A2.6	The radiated H-field spurious emissions were measured from 9 kHz to 30 MHz frequency range.	Complies
99% Occupied Bandwidth	RSS-Gen Issue 4: Section 6.6	The difference between the two recorded frequencies is the 99% occupied bandwidth.	Complies
Frequency Stability	47 CFR Part 15, Subpart C: 15.225 RSS-210 Issue 9: Annex A2.6	Ensure the normal functionality despite temperature fluctuations	Complies

Section II: GENERAL INFORMATION

2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as complete system.

Equipment Under Test (EUT) Information

EUT	RFID2 Radio Module
Description	Modular Intentional Radiator, Short Range Device, operating at 13.56 MHz Powered by a 24 Vdc AC/DC DCPCS for EMC testing
FRN	0016079253
FCC ID	U2P-3010120604
IC Certification Number	6947A-3010120604
Manufacturer	Oce Display Graphics Systems
Model No.	3010120604
Serial No.	ENG 003E

Auxiliary Equipment Information

Equipment	Manufacturer	Product Description	Model No.
Auxiliary 1	LG	LCD Monitor	W2242TQT
Auxiliary 2	(Property of ODGS)	CPU - XP Embedded Edition - Only use dedicated USB stick for data exchange	CARWNT156
Auxiliary 3	Mouse	Microsoft Corp.	1094

2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

Parameter	Conditions
Location	Indoors
Temperature	22-28°C
Relative Humidity	39.7 - 54.4%

2.3 Measurement Uncertainty

Parameter	Uncertainty
Radiated Emissions, 30MHz-1GHz	± 2.40 dB
Radiated Emissions, 1GHz-40GHz	± 2.48 dB
Radio Frequency	±1,5 x 10-5 MHz
Total RF Power Conducted	±1.36 dB
Spurious Emissions, Conducted	±1.36 dB
RF Power Density, Conducted	±1.36 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

Frequency (MHz)	Quasi-Peak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
42.663900	33.0	1000.000	120.000	100.0	H	70.0	13.2	7.5	40.5

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable loss}$$

Or

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable Loss} - \text{Amp gain (if pre-amplifier was used)}$$

The final Quasi peak reading shown in the data is calculated by the software using following equation:

$$\text{Corrected Quasi Peak(dB}\mu\text{V/m)} = \text{Raw Quasi Peak Reading} + \text{Antenna factor} + \text{Cable loss}$$

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150	44.3	1000.000	9.000	0.6	21.7	66.0

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150	27.2	1000.000	9.000	0.6	28.8	56.0

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

$$\text{Corr.(dB)} = \text{Antenna factor} + \text{Cable loss}$$

The final Quasi peak or Average reading shown in the data is calculated by the software using following equation:

$$\text{Corr. Quasi Peak/Average Reading (dB}\mu\text{V)} = \text{Raw Quasi Peak/Average Reading} + \text{Antenna factor} + \text{Cable loss}$$

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

$$\text{Margin(dB)} = \text{Limit} - \text{Quasi-Peak or Average reading}$$

2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

Emissions Test Equipment

Manufacturer	Model	Description	Serial No.	Calibration Due Date
Sunol Sciences	SM46C	Turntable	051204-2	N/A
Sunol Sciences	TWR95	Mast	TREML0001	N/A
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A120106	24-Sep-2017
ETS Lindgren	6502	Active Loop Antenna 10kHz – 30MHz	2178	21-Aug-2017
ETS Lindgren	2165	Turntable	00043677	N/A
ETS Lindgren	2125	Mast	00077487	N/A
Rohde & Schwarz	ESU40	EMI Receiver	100011	20-Nov-2017
Fischer	FCC-LISN-50-25-2-08	LISN (150kHz-30MHz)	2041	19-Nov-2018
ETS Lindgren	S201	5-meter Semi-Anechoic Chamber	1030	N/A
AH Systems	PAM118	Amplifier 10KHz-18GHz	189	Conditional Use
California Instruments	PACS-1	Harmonics and flicker analyzer	72569	18 July 2018
California Instruments	OMNI 1-18 I	Programmable Impedance Flicker test	-	18 July 2018
California Instruments	3001ix	Power supply	HK52117	18 July 2018

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software

Section III: REQUIREMENTS FOR THE US MARKET (FCC) & THE CANADIAN MARKET (IC) - Exigences pour le Marché Canadien

3.1 Main Power Line Conducted Emissions

Date Performed:

November 25, 2016

Test Standard:

- 47 CFR Part 15, Subpart B Section 15.107
- RSS-Gen Issue 4

Test Method:

- ANSI C63.10 2013

Minimum Requirement:

47 CFR Part 15, Subpart B (Section § 15.107) – 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:

Frequency (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15 – 0.50	79	66
0.50 – 30.0	73	60

Note 1: The lower limit shall apply at the transition frequencies.

Method of Measurement:

The Line Impedance Stabilizing Network (LISN) was used to make conducted emissions measurements. The equipment was operated and tested at 120Vac/60Hz while in “Continuous Mode” of operation. Measurements were made by using an EMI test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector capabilities. Test receiver requirements, including the bandwidths used, for the test receiver are those specified in CISPR 16-1-1.

Modifications:

No modification was required to comply for this test.

Performance:

Complies with the applicable standard.

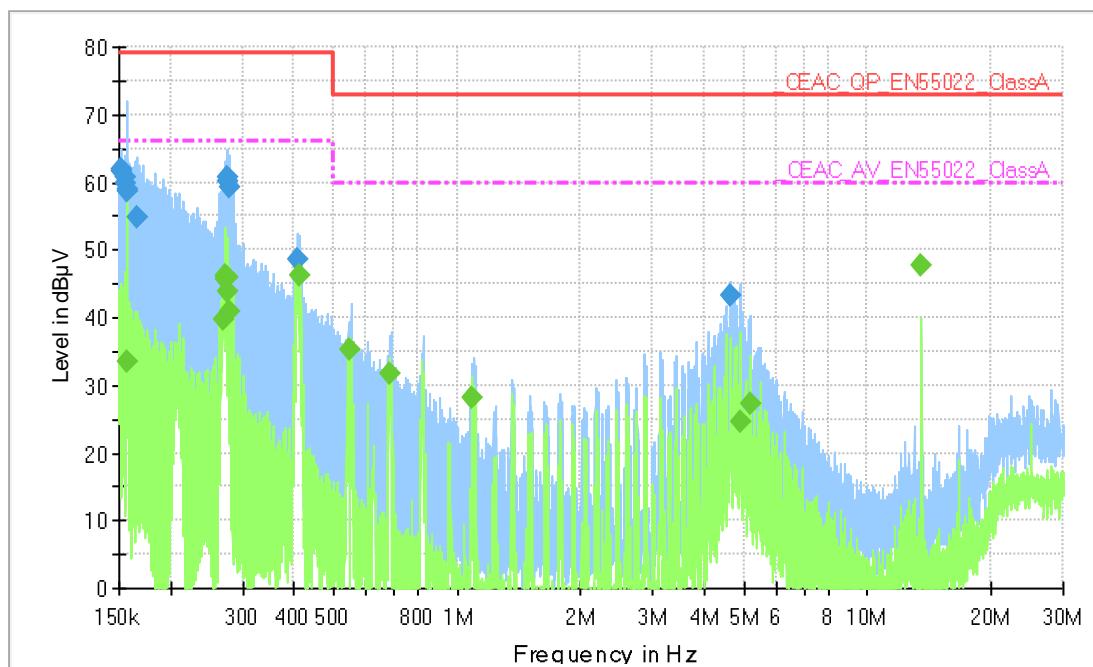
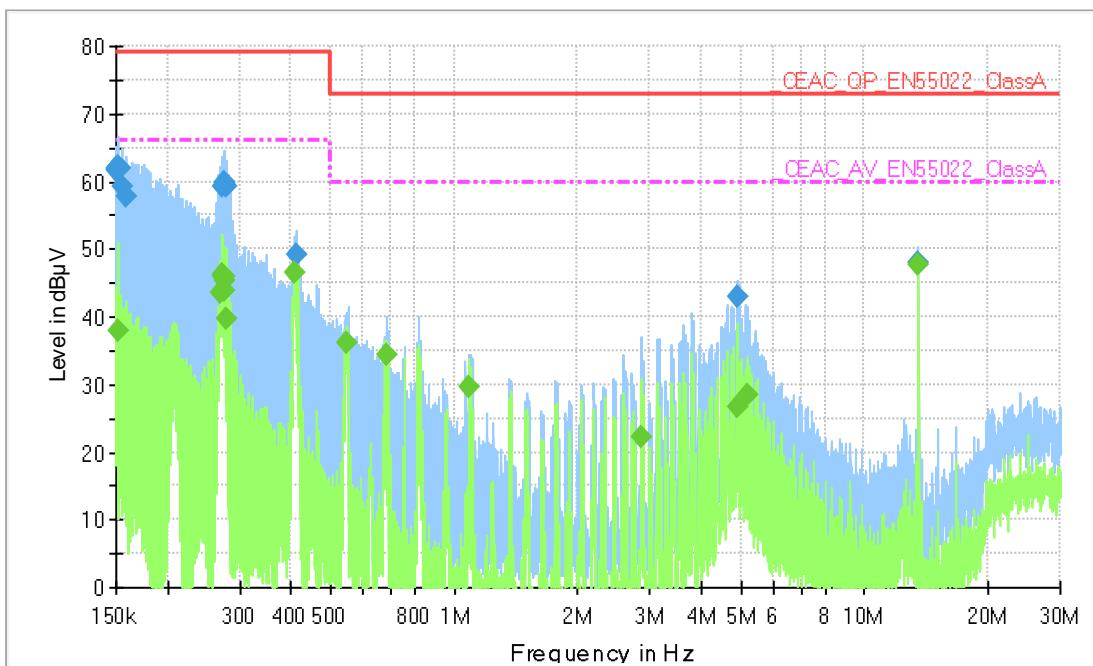
Measurement Data and Plot:**Plot 1: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 120Vac/60Hz – Line 1**

Table 1: Quasi-peak data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 1

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.151810	62.0	1000.000	9.000	GND	10.5	17.0	79.0
0.152266	61.8	1000.000	9.000	GND	10.5	17.2	79.0
0.155030	60.8	1000.000	9.000	GND	10.5	18.2	79.0
0.155963	60.0	1000.000	9.000	GND	10.5	19.0	79.0
0.156744	59.0	1000.000	9.000	GND	10.5	20.0	79.0
0.157058	58.7	1000.000	9.000	GND	10.5	20.3	79.0
0.165933	54.9	1000.000	9.000	GND	10.5	24.1	79.0
0.274056	60.1	1000.000	9.000	GND	10.4	18.9	79.0
0.275981	60.7	1000.000	9.000	GND	10.4	18.3	79.0
0.277918	59.3	1000.000	9.000	GND	10.4	19.7	79.0
0.409171	48.7	1000.000	9.000	GND	10.4	30.3	79.0
4.644696	43.1	1000.000	9.000	GND	10.5	29.9	73.0

Table 2: Average data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 1

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.157058	33.6	1000.000	9.000	GND	10.5	32.4	66.0
0.268364	39.8	1000.000	9.000	GND	10.4	26.2	66.0
0.271874	45.7	1000.000	9.000	GND	10.4	20.3	66.0
0.272690	46.1	1000.000	9.000	GND	10.4	19.9	66.0
0.273236	45.8	1000.000	9.000	GND	10.4	20.2	66.0
0.274056	46.0	1000.000	9.000	GND	10.4	20.0	66.0
0.275154	45.9	1000.000	9.000	GND	10.4	20.1	66.0
0.276809	43.8	1000.000	9.000	GND	10.4	22.2	66.0
0.277918	40.8	1000.000	9.000	GND	10.4	25.2	66.0
0.410810	46.2	1000.000	9.000	GND	10.4	19.8	66.0
0.546202	35.3	1000.000	9.000	GND	10.4	24.7	60.0
0.683945	31.8	1000.000	9.000	GND	10.4	28.2	60.0
1.091865	28.1	1000.000	9.000	GND	10.4	31.9	60.0
4.877835	24.5	1000.000	9.000	GND	10.5	35.5	60.0
5.194862	27.3	1000.000	9.000	GND	10.5	32.7	60.0



Plot 2: Main Power Line Conducted Emissions 150 kHz to 30 MHz at 120Vac/60Hz – Line 2

Table 3: Quasi-peak data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 2

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.150300	61.6	1000.000	9.000	GND	10.6	17.4	79.0
0.150752	61.9	1000.000	9.000	GND	10.5	17.1	79.0
0.151658	62.2	1000.000	9.000	GND	10.5	16.8	79.0
0.153335	61.9	1000.000	9.000	GND	10.5	17.1	79.0
0.155963	59.1	1000.000	9.000	GND	10.5	19.9	79.0
0.158160	57.7	1000.000	9.000	GND	10.5	21.3	79.0
0.272690	59.4	1000.000	9.000	GND	10.4	19.6	79.0
0.274056	59.9	1000.000	9.000	GND	10.4	19.1	79.0
0.275981	60.0	1000.000	9.000	GND	10.4	19.0	79.0
0.277641	59.3	1000.000	9.000	GND	10.4	19.7	79.0
0.412456	49.1	1000.000	9.000	GND	10.4	30.0	79.0
4.877835	42.9	1000.000	9.000	GND	10.5	30.1	73.0

Table 4: Average data Main Power Line Conducted Emissions at 120Vac/60Hz – Line 2

Frequency (MHz)	Average (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	PE	Corr. (dB)	Margin (dB)	Limit (dB μ V)
0.151658	37.9	1000.000	9.000	GND	10.5	28.1	66.0
0.269978	43.4	1000.000	9.000	GND	10.4	22.6	66.0
0.271874	46.0	1000.000	9.000	GND	10.4	20.0	66.0
0.272690	46.3	1000.000	9.000	GND	10.4	19.7	66.0
0.273236	46.3	1000.000	9.000	GND	10.4	19.7	66.0
0.274056	45.9	1000.000	9.000	GND	10.4	20.1	66.0
0.275154	45.2	1000.000	9.000	GND	10.4	20.8	66.0
0.276809	43.9	1000.000	9.000	GND	10.4	22.1	66.0
0.278753	39.6	1000.000	9.000	GND	10.4	26.4	66.0
0.408354	46.5	1000.000	9.000	GND	10.4	19.5	66.0
0.547295	36.2	1000.000	9.000	GND	10.4	23.8	60.0
0.681216	34.4	1000.000	9.000	GND	10.4	25.6	60.0
1.089685	29.6	1000.000	9.000	GND	10.4	30.4	60.0
2.866143	22.3	1000.000	9.000	GND	10.5	37.7	60.0
4.877835	26.8	1000.000	9.000	GND	10.5	33.2	60.0

3.2 Radiated Spurious Emissions (E Field – 30 to 1000 MHz)

Date Performed:

October 12, 2016

Test Standard:

- 47 CFR Part 15, Subpart C: 15.209
- RSS-210 Issue 9

Test Method:

- ANSI C63.10 2013

Minimum Requirement:

If measurements above tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emissions limits as shown below:

Frequency (MHz)	Field Strength dB μ V/m @ 3m
30 – 88	40.0
88 – 216	43.5
216 – 960	46.0
above 960	54.0

Note: The tighter limit applies at the band edges.

§ 15.205 Restricted bands of operation:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41.			

At frequencies, equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions.

Test Setup:

The EUT was placed on a turntable, which is 0.8m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4m high to maximize the emissions signal strength. The equipment was setup in a 3m Semi-Anechoic Chamber for preliminary measurements and finals were completed in 3m and 10m Open Air Test Site at 3m.

During pre-compliance test, worst-case orientation was determined by rotating the EUT on three axes and final radiated emissions tests were performed in that orientation.

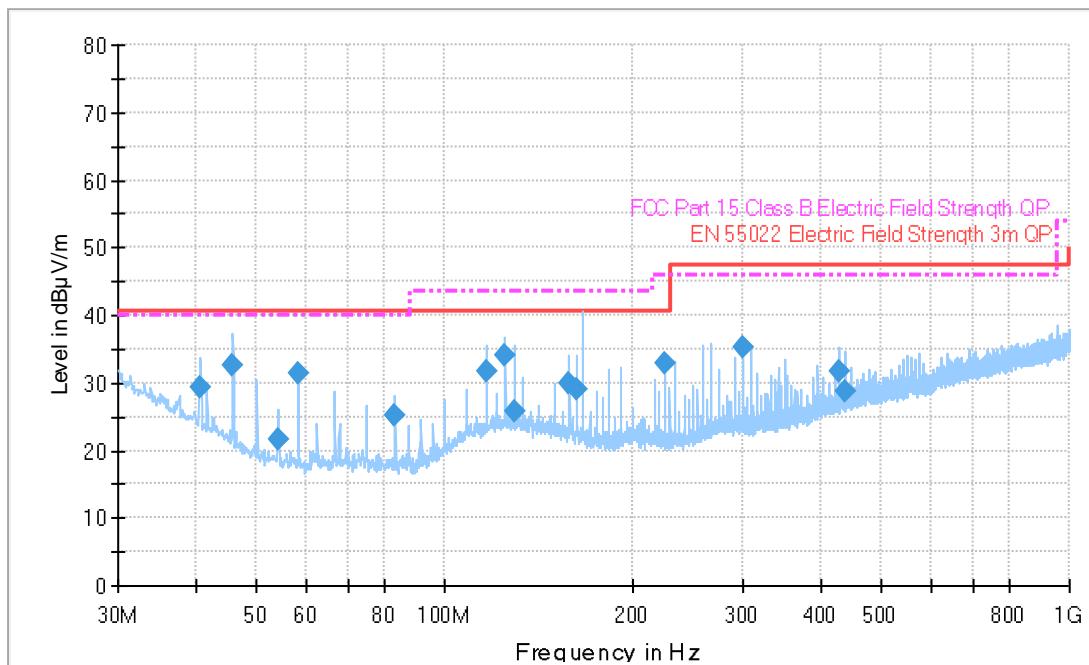
Modifications:

No modification was required to comply for this test.

Performance:

The highest emission measured was 35.1 dB μ V/m at 299.99 MHz. It has 10.9 dB margin to the FCC 15.209 limit. The unit complies with the applicable standard.

Measurement Data and Plot:



Plot 3: Radiated Emissions FCC/IC 30MHz - 1GHz at 3m

Table 5: Data of Radiated Emissions, 30MHz - 1GHz at 3m

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
40.676000	29.4	1000.000	120.000	145.0	V	294.0	20.4	10.6	40.0
45.839900	32.5	1000.000	120.000	100.0	V	6.0	17.6	7.5	40.0
54.178250	21.5	1000.000	120.000	100.0	V	270.0	14.9	18.5	40.0
58.329300	31.3	1000.000	120.000	100.0	V	45.0	14.3	8.7	40.0
83.319700	25.1	1000.000	120.000	132.0	V	118.0	14.6	14.9	40.0
116.667050	31.7	1000.000	120.000	100.0	V	157.0	20.5	11.8	43.5
125.007750	34.0	1000.000	120.000	100.0	V	0.0	20.8	9.5	43.5
129.165400	25.9	1000.000	120.000	206.0	H	306.0	20.8	17.6	43.5
158.343400	29.9	1000.000	120.000	100.0	V	162.0	19.6	13.6	43.5
162.506150	29.1	1000.000	120.000	100.0	V	180.0	19.4	14.4	43.5
224.989500	32.9	1000.000	120.000	297.0	V	240.0	18.3	13.1	46.0
299.994050	35.1	1000.000	120.000	100.0	H	180.0	20.8	10.9	46.0
429.173000	31.6	1000.000	120.000	100.0	V	150.0	24.3	14.4	46.0
437.454050	28.7	1000.000	120.000	100.0	V	249.0	24.5	17.3	46.0

Table 6: Data of Radiated Emissions of Harmonics Frequency

Frequency (MHz)	Correction factor (dB)	Corrected peak (dBuV/m)	Corrected Quasi-peak (dBuV/m)	Polarity (V/H)	Antenna height (cm)	Angle (degree)	FCC limit (dBuV/m)	Margin (dB)
27.1	19.6	19.6	19.6	V	100.0	15.1	69.5	49.9
40.7	20.0	29.4	28.3	V	150.0	260.0	40.0	11.7
40.7	20.0	23.5	18.8	H	254.9	340.7	40.0	21.2
54.2	14.1	29.6	24.8	V	100.0	156.0	40.0	15.2
54.2	14.1	17.6	13.1	H	100.0	221.0	40.0	26.9
67.8	14.4	21.0	19.7	V	100.0	46.8	40.0	20.3
81.4	15.2	19.7	11.9	V	100.0	54.4	40.0	28.1
94.9	16.4	19.1	15.1	V	100.0	50.3	43.5	28.4
108.5	19.1	33.7	32.2	V	100.0	5.6	43.5	11.3
122.0	21.0	23.8	16.8	V	100.0	16.7	43.5	26.7
135.6	20.7	23.7	19.0	V	100.0	164.8	43.5	24.5

3.3 Radiated Spurious Emissions (H Field – 9 kHz to 30 MHz)

Date Performed:

October 12, 2016

Test Standard:

- 47 CFR Part 15, Subpart C: 15.225, 15.209
- RSS-210 Issue 9: Annex A2.6

Test Method:

- ANSI C63.10 2013

Minimum Requirement:

As per the standard 47 CFR Part 15, Subpart C: 15.225 and RSS-210 Issue 9: Annex A2.6 – The field strength of any emissions operating at 13.110-14.010 MHz range shall not exceed the following limits:

Band Frequency (MHz)	Field Strength (dB μ V/m) at 30m	Field Strength (dB μ V/m) at 3m
13.553-13.567	84	124.0
13.410-13.553	50.5	90.5
13.110-13.410	40.5	80.5
13.710-14.010	40.5	80.5
13.110-14.010	29.5	69.5

Band Frequency (MHz)	Field Strength (μ V/m)	Measurement Distance (meters)	Field Strength (dB μ V/m) at 3m
0.009 – 0.490	2400/F(kHz)	300	128.5 – 93.8
0.490 – 1.705	24000/F(kHz)	30	73.8 – 63.0
1.705 – 30.0	30	30	69.5

Note: Limit is extrapolated from 300m and 30m to 3m by adding 80dB and 40dB respectively as per FCC Part 15.31(f)(2).

Test Setup:

The EUT was placed on a turntable, which is 0.8m above ground plane. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable and moving the receiving antenna from 1m to 4m high to maximize the emissions signal strength. The equipment was setup in a 3m Semi-Anechoic Chamber for preliminary measurements and finals were completed in 3m and 10m Open Air Test Site at 3m. Measurements were also performed from 9 kHz to 30 MHz with an active loop antenna, but no emissions were found in that range.

During pre-compliance test, worst-case orientation was determined by rotating the EUT on three axes and final radiated emissions tests were performed in that orientation.

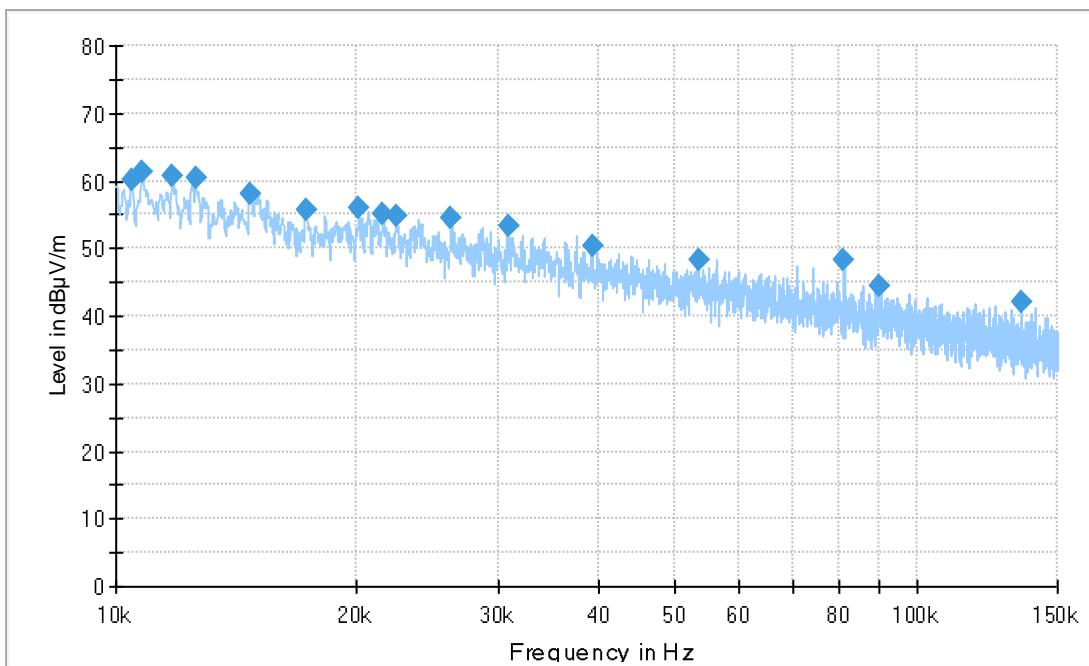
Modifications:

No modification was required to comply for this test.

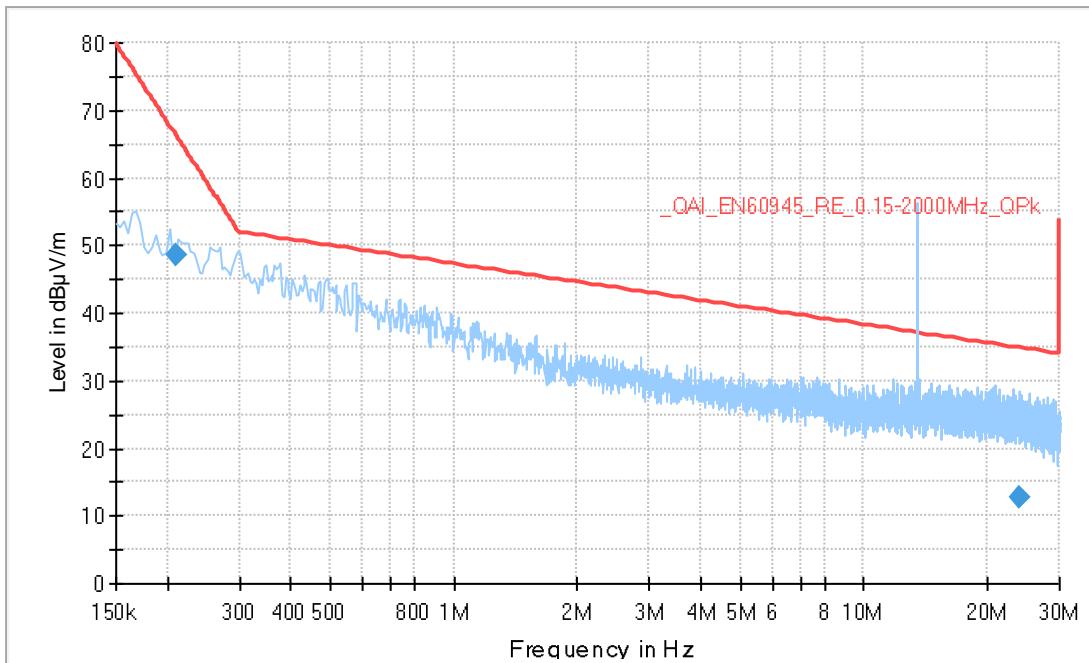
Performance:

Complies with the applicable standard.

Measurement Data and Plot:

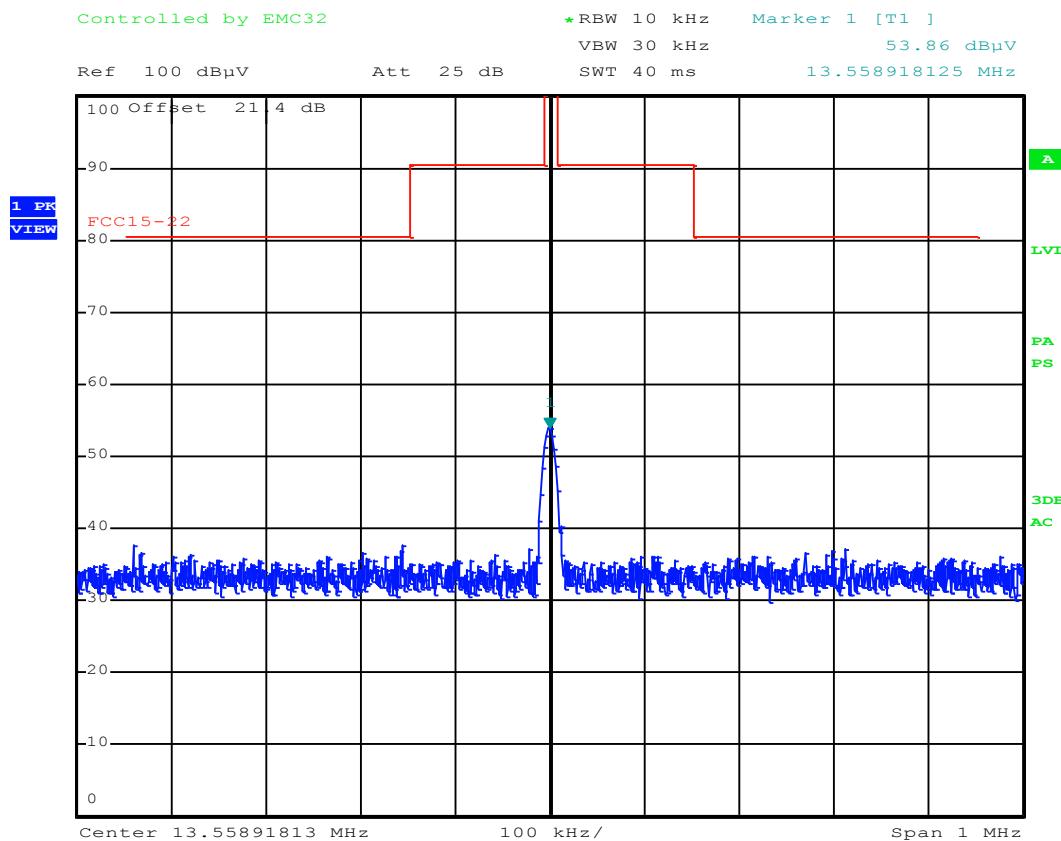


Plot 4: Radiated Emissions FCC/IC using an Active Loop Antenna at 10kHz-150kHz 3m (SAC)



Plot 5: Radiated Emissions FCC/IC using an Active Loop Antenna at 150kHz-30MHz 3m (SAC)

Note: Limit line in this plot is not the limit applied.



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Plot 6: Radiated Emissions 13.06 MHz – 14.06 MHz

Table 7: Data of Radiated Emissions for the Fundamental Frequency

Frequency (MHz)	Raw pk (dB μ V)	Antenna Factor (dB/m)	Attenuation (dB)	Corrected peak (dB μ V/m)	Angle (degree)	Antenna orientation	Antenna height (cm)	FCC limit (dB μ V/m)	Margin (dB)
13.558	36.1	10.8	10.6	57.5	0	Parallel	100	123.99	66.49
13.558	34.5	10.8	10.6	55.9	291	Perpendicular	100	123.99	68.09
13.558	31.7	10.8	10.6	53.1	29	Parallel to GND	164	123.99	70.89

Note: All other radiated emissions at frequency range 10kHz to 30MHz are at least 20db below the limit required by the above standards.

3.4 Frequency Stability

Date Performed:

October 14, 2016

Test Standard:

- 47 CFR Part 15, Subpart C: 15.225
- RSS-210 Issue 9: Annex A2.6

Test Method:

- ANSI C63.10 2013

Test Setup:

The test was conducted as defined by the test methods in 47 CFR Part 15, Subpart C: 15.225 and RSS-210 Issue 9: A2.6. The EUT was bench tested in the temperature chamber. Measurements were made using a Spectrum Analyzer with 120kHz RBW Average detector while directly connected to the EUT through the antenna port. The carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

Modifications:

No modification was required to comply for this test.

Performance:

Complies with the applicable standard.

Measurement Data and Plot:

Table 8: Frequency Stability Test Data

Temperature (°C)	Frequency (MHz)	Delta (kHz)	ppm
-20	13.5612	-0.9	-0.07
-10	13.5619	-0.2	-0.01
0	13.5623	0.2	0.01
10	13.5618	-0.3	-0.02
23	13.5621	0	0.00
30	13.5622	0.1	0.01
40	13.5623	0.2	0.01
50	13.5628	0.7	0.05

3.5 99% Occupied Bandwidth

Date Performed:

October 12, 2016

Test Standard:

- RSS-Gen Issue 4: Section 6.6

Test Method:

- ANSI C63.10 2013

Test Setup:

RSS-Gen Issue 4: Section 6.6 – A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

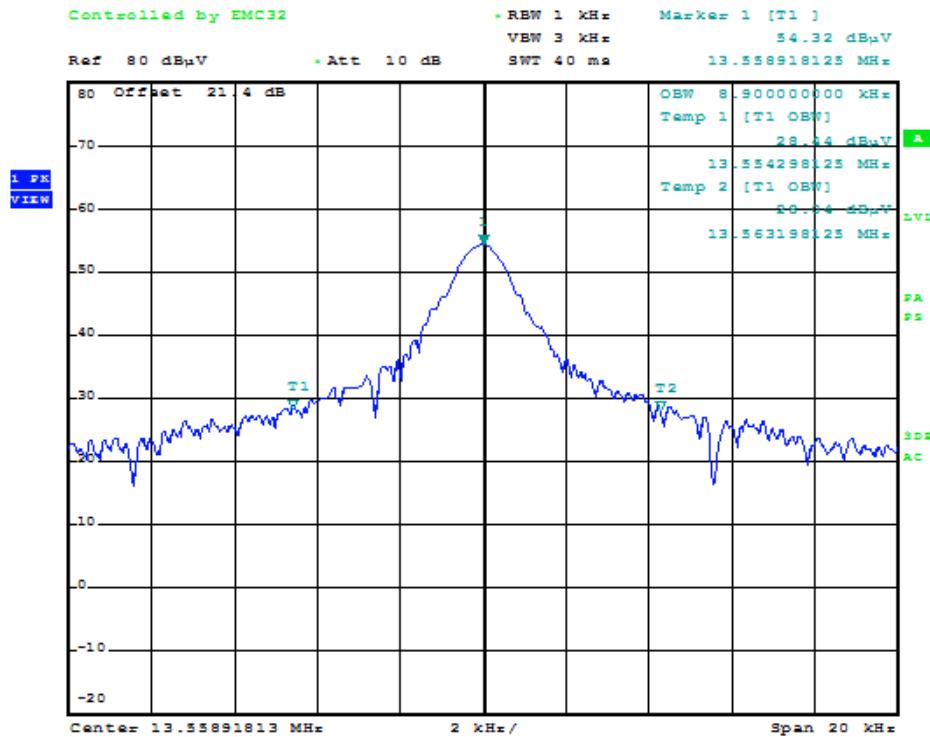
Modifications:

No modification was required to comply for this test.

Performance:

The 99% occupied bandwidth is 8.9 kHz. Complies with the applicable standard.

Measurement Data and Plot:



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Plot 7: 99% Occupied Bandwidth Data Plot

Appendix A: TEST SETUP PICTURES



Figure 1: Radiated Emissions (30 MHz – 1 GHz) Test Setup



Figure 2: Radiated Emissions (below 30 MHz) Test Setup

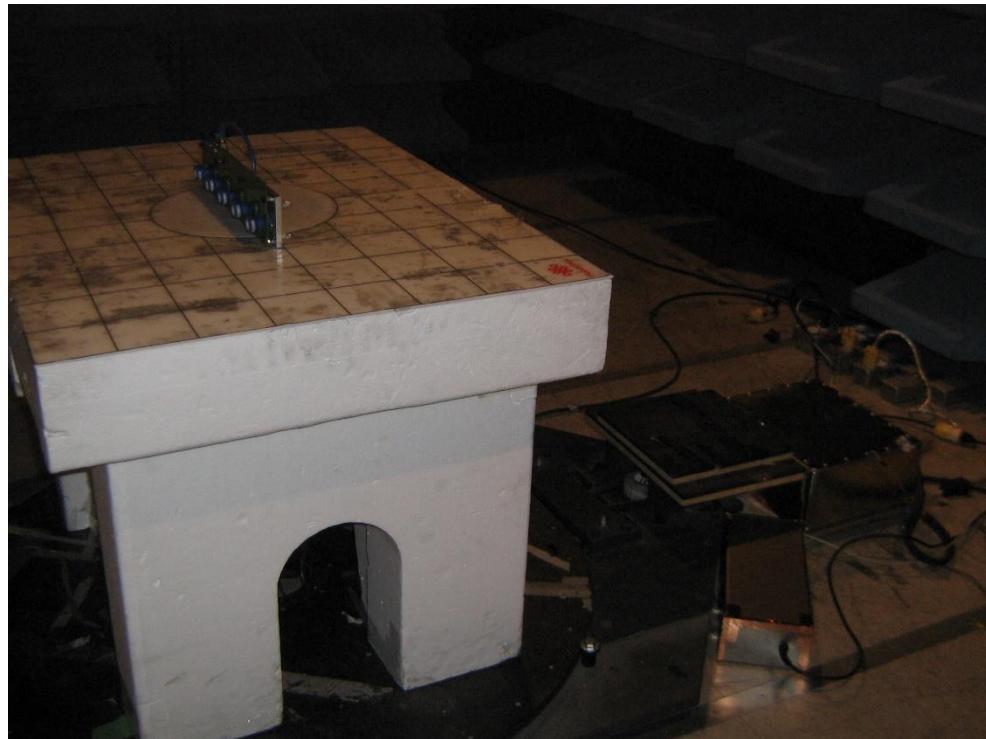


Figure 3: Radiated Emissions Test Setup

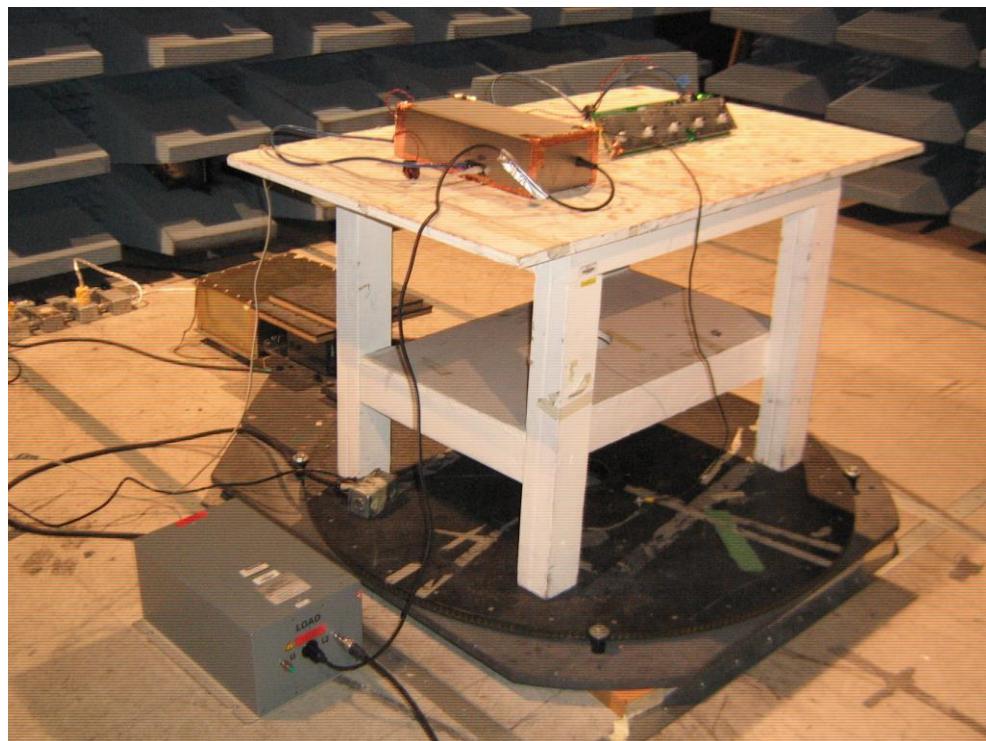


Figure 4: Conducted Emissions Test Setup

Appendix B: ABBREVIATIONS

Abbreviation	Definition
AC	Alternating Current
DC	Direct Current
E.I.R.P.	Equivalent Isotropically Radiated Power
EMC	ElectroMagnetic Compatibility
EMI	ElectroMagnetic Interference
EUT	Equipment Under Test
FCC	Federal Communications Commission
IC	Industry Canada
ICES	Interference-Causing Equipment Standard
LISN	Line Impedance Stabilizing Network
OATS	Open Area Test Site
RF	Radio Frequency
RMS	Root-Mean-Square
RSS	Radio Standards Specifications
SAC	Semi-Anechoic Chamber

END OF REPORT