Electromagnetic Compatibility Test Report

Prepared in accordance with

CFR47-15C and RSS-210, Issue 8

(Multiple Parts)

On

EVSE Charging Station

EV230PDRACG

Schneider Electric USA Inc.

1415 S. Roselle Road

Palatine, IL 60067 USA

Prepared by:

TUV Rheinland of North America, Inc.

Manufacturer's statement - attestation

The manufacturer; Schneider Electric USA Inc. as the responsible party for the equipment tested, hereby affirms:

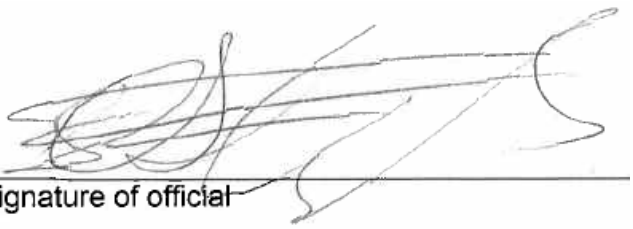
a) That he has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;

b) That the device in this test report will be representative of production units;

c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.

d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

Konstantin Filippenko
Printed name of official


Signature of official

Schneider Electric USA Inc
1415 S. Roselle Rd
Palatine, IL 60067
Address

19 October 2012
Date

919-266-8806
Telephone number

Konstantin.Filippenko@schneider-electric.com
Email address of official

Client:	Schneider Electric	Schneider Electric USA Inc. 1415 S. Roselle Road Palatine, IL 60067 USA	Konstantin Filippenko 919-266-8806 / 919-266-8397 Konstantin.Filippenko@schneider-electric.com
Identification:	EVSE Charging Station	***Serial No.:***	PRODUCTION SAMPLE
Test item:	EV230PDRACG	***Date tested:***	21 September 2012
Testing location:	TUV Rheinland of North America 762 Park Avenue Youngsville, NC 27596-9470 U.S.A.	Tel: (919) 554-3668 Fax: (919) 554-3542	
Test specification:	**Emissions: FCC Part 15C, RSS-210 Issue 8:** FCC Parts 15.207(a) and RSS-GEN 7.2.4 FCC Parts 15.205, 15.209, 15.215(c), RSS-210 **FCC Part 15.247 and RSS-210 Annex 8:** FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 FCC Part 15.247(a)(2) and RSS-210 A1.1.3, FCC Part 15.247(b)(3) and RSS-210 A8.4(4), FCC Part 15.247(d) and RSS-210 2.2,		
Test Result	**The above product was found to be Compliant to the above test standard(s)**		

tested by: Mark Ryan	***reviewed by:*** Robert Richards
16 October 2010 *Signature*	30 October 2012 *Date* *Signature*
Other Aspects:	**None**

Abbreviations: OK, Pass, Compliant, Complies = passed
Fail, Not Compliant, Does Not Comply = failed
N/A = not applicable

FC	ilac-MRA A2LA ACCREDITED	**Industry Canada**
90552 and 100881	**Testing Cert #3331.05**	**2932H-1 and 2932H-2**

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1 General Information

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR47-15C and RSS-210, Issue 8 based on the results of testing performed on 21 September 2012 on the EVSE Charging Station, Model No. EV230PDRACG, manufactured by Schneider Electric USA Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All ancillary documentation will be included as a supplements.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT (Equipment Under Test) in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

1.3 Revision History

Revision	Date	Description of Revision
--	30 Oct 2012	Initial Release

1.4 Summary of Test Results

Applicant	Schneider Electric USA Inc. 1415 S. Roselle Road Palatine, IL 60067 USA	**Tel**	919-266-8806	**Contact**	Konstantin Filippenko
		Fax	919-266-8397	**e-mail**	Konstantin.Filippenko@schneider-electric.com

Description	EVSE Charging Station	**Model Number**	EV230PDRACG
Serial Number	PRODUCTION SAMPLE	**Test Voltage/Freq.**	240 VAC / 60Hz
Test Date Completed:	21 September 2012	**Test Engineer**	Mark Ryan

Standards	Description	Severity Level or Limit	Worst Case	Test Result
FCC Part 15, Subpart C Standard	Radio Frequency Devices-Subpart C: Intentional Radiators	See called out basic standards below	See Below	**Complies**
RSS-210 Issue 8 Standard	Low-Power Licence-exempt Radiocommunication Devices Category I Equipment	See called out basic standards below	See Below	**Complies**
FCC Part 15.247 and RSS-210 Issue 8, Annex 8				
FCC Part 15.247 and RSS-210 Annex 8	Operation within the band 2400 to 2483.5 MHz	See called out parts below	See Below	Complies
FCC Parts 15.247(d), 15.205, 15.209, 15.215(c) and RSS-210 A8.5 and RSS-GEN 7.2.1	Out-of-Band Spurious and Harmonic Emissions (EUT in Transmit Mode)	Below the applicable limits	39.64 dBµV/m at 3m, 320 MHz	Complies
FCC Part 15.207(a) and RSS-GEN	Conducted Emissions on AC Mains	150kHz - 30MHz	46.34 dBµV at 200 kHz	Complies
FCC Part 15.247(d) and RSS-210 2.2	Band Edge Radiated Emission	Per requirements of the standard	Below Limits	Complies
FCC Part 15.247(b)(3) and RSS-210 A8.4(4)	Conducted Output Power	Shall not exceed 1.0 Watts (30dBm)	-4.30 dBm	Complies
FCC Part 15.247(a)(2) and RSS-210 A1.1.3	Occupied Bandwidth	6 dB ≥ 500 kHz 20 dB 99% BW ≤ 0.5% of freq. (12 MHz)	1.54 MHz 2.59 MHz 2.41 MHz	Complies
FCC Part 15.247(e) and RSS-210, Section A8.2(b)	Peak Power Spectrial Denesity	≤ 8 dBm in any 3 kHz	-16.02 dBm	Complies
FCC Part 15.209 and RSS-210 Issue 8				
FCC Part 15.209 and RSS-210 i8 2.5.1	Transmitters with Wanted Emissions that are within the General Field Strength Limits	The General Field Strength Limits	11.19 dBµV/m at 30m, 13.56 MHz	Complies
RSS-GEN	Occupied Bandwidth	99% BW ≤ 0.5% of center freq.	100 Hz	Complies
RF Exposure				
FCC Part 2.1093 and RSS-102, Issue 4	RF Exposure	SAR or MPE Requirements	0.0002 mW/cm^2 0.000002 W/m^2	Complies

2 Laboratory Information

2.1 Laboratory Certifications

2.1.1 US Federal Communications Commission

TUV Rheinland of North America located at 762 Park Avenue, Youngsville, NC 27596-9470 is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, and 18. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Standard 17025:2005 (Certificate Number: 3331.05, Master Code: 134288). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Industry Canada

Registration No.: 2932H-1 The OATS has been accepted by Industry Canada to perform testing to 3 and to 10 meters, based on the test procedures described in ANSI C63.4-2009.

Registration No.: 2932H-2 The 5 meter chamber has been accepted by Industry Canada to perform testing to 3 meters, based on the test procedures described in ANSI C63.4-2009.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Laboratory Registration No: A-0034).

2.1.5 Sample Calculation – radiated & conducted emissions

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

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

2.1.6 Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.2 Expanded Measurement Uncertainty Emissions

	U_{lab}	U_{cispr}
Radiated Disturbance @ 3m		
30 MHz – 1,000 MHz	4.52 dB	5.2 dB
Radiated Disturbance @ 10m		
30 MHz – 1,000 MHz	4.51 dB	5.2 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	3.33 dB	3.6 dB
Disturbance Power		
30 MHz – 300 MHz	4.00 dB	4.5 dB

2.2.1 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 2.50 %
The estimated combined standard uncertainty for ESD immunity measurements is 4.10 %
The estimated combined standard uncertainty for radiated immunity measurements is ± 2.05 dB
The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for surge immunity measurements is ± 2.92 %
The estimated combined standard uncertainty for conducted immunity measurements is ± 1.83 dB
The estimated combined standard uncertainty for power frequency magnetic field immunity measurements is ± 5.80 %
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 1.74 %

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.3 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

2.4 Software Used

Manufacturer	Name	Version
Quantum Change/EMC Systems LLC.	Tile	3.2U
TopRudder	RadCon RF Immunity	1.1.13
TUV	Alt "R"	1
TUV	Alt "C"	1
VolTech Instruments	IEC61000-3 for PM6000	1.24.12
California Intruments	AC Source GUI 32	1.19
CTS	CTS 3.0	3.2.0.32
KeyTek ECAT	Surgeware	V5.31
KeyTek ECAT	Burstware	V5.31
Rohde & Schwarz	Click Rate Analyzer	1.7.0

2.5 Measurement Equipment Used

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
Radiated Emissions (5 Meter Chamber)					
Receiver, EMI	Rohde & Schwarz	ESIB40	100043	04-Sep-12	04-Sep-13
Receiver, EMI	Rohde & Schwarz	ESCI 7	100917	05-Sep-12	05-Sep-13
Amplifier, preamp	Agilent Technologies	8449B	3008A01480	01-Sep-12	01-Sep-13
Ant. BiconiLog	Chase	CBL6140A	1108	24-Aug-11	24-Aug-13
Antenna Horn 1-18GHz	EMCO	3115	2236	13-Dec10	13-Dec-12
Cable, Coax	MicroCaox	MKR300C-0-0-1200-500500	002	01-Sep-12	01-Sep-13
Cable, Coax	MicroCaox	MKR300C-0-1968-500310	005	01-Sep-12	01-Sep-13
Cable, Coax	MicroCaox	UFB29C-1-5905-50U-50U	009	01-Sep-12	01-Sep-13
Cable, Coax	Andrew	FSJ1-50A	045	01-Sep-12	01-Sep-13
1.5 GHz High Pass Filter	Bonn Electronik	BHF 1500	025155	01-Sep-12	01-Sep-13
Antenna/Amp/Cable	ATM/Miteq/Microcoax	28-442-6/cal, JS42-26004000-28-5A, MKR300C-0-1968-500310	G047702-01	31-Aug-11	31-Aug-13
General Laboratory Equipment					
Meter, Multi	Fluke	179	90580752	06-Sep-12	06-Sep-13
Meter, Temp/Humid/Barom	Davis	7400	PB00205A13	09-May-12	09-May-13
Meter, Temp/Humid/Barom	Davis	7400	PB00205A05	09-May-12	09-May-13

3 Product Information

3.1 Product Description

The model used for testing is a EV230PDRACG. It is a US specific, 208V - 240V AC, pedestal mount, dual output, 3R NEMA enclosure, advanced features, ChargePoint gateway electric vehicle charging station that allows an end user to replenish the batteries of their Electric Vehicle or Plug-in Hybrid Electric Vehicle. It has a Licensed and certified Multi-Tech cellular modem (gateway) that provides for connection to a ChargePoint network. It has a ZigBee radio, based on 802.15.4, that allows networking to non-gateway charging stations. The non-gateway models do not have cellular modems and are suffixed with " NG " instead of " G ". The Canadian specific model adds a " C " suffix and is identical in every way to the US specific except the SIM card installed in the modem is for a Canadian cellular service provider. The specific cellular modem (gateway) ID's will be included on the label, and will be using the manufacturer's certification(s).

The models in the family of EVSE Charging Stations that will be deemed compliant by this report are as follows:

EV230G (with Cellular Modem)
FCC ID: Q6H-EV230G
IC ID: 9193B-EV230G
Contains FCCID: AU792U07A31817
Contains IC ID: 125A-0027

Models
EV230PDRACG
EV230PDRACGC
EV230PSRACG
EV230PSRACGC
EV230WDRACG
EV230WDRACGC

EV230NG (w/o Cellular Modem)
FCC ID: Q6H-EV230G
IC ID: 9193B-EV230G

Models
EV230PDRACNG
EV230PSRACNG
EV230WDRACNG

3.2 Equipment Modifications

No modifications were needed to bring product into compliance.

3.3 Purpose of this Test Report

This test report is intended to be a new certification

3.3.1 Photo of EUT

Figure 1 – Photo of EUT

4 Intentional Radiators

FCC Part 15.247 and RSS-210 Issue 8, Annex 8

4.1 External Antenna used

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on e ither RF conducted or radiated measurements. C onducted antenna port measurements are provided in Section 6.

4.1.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	25 September 2012	
Standard	FCC Parts 15.205, 15.209, 15.215(c), 15.247(d), RSS-210 A8.5, and RSS-GEN 7.2.1						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table. See test plans for details						
EUT Powered By	240 VAC / 60Hz	**Temp**	75º F	**Humidity**	43%	**Pressure**	1012 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.1.2 Test Procedure

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for the radiated emission test.

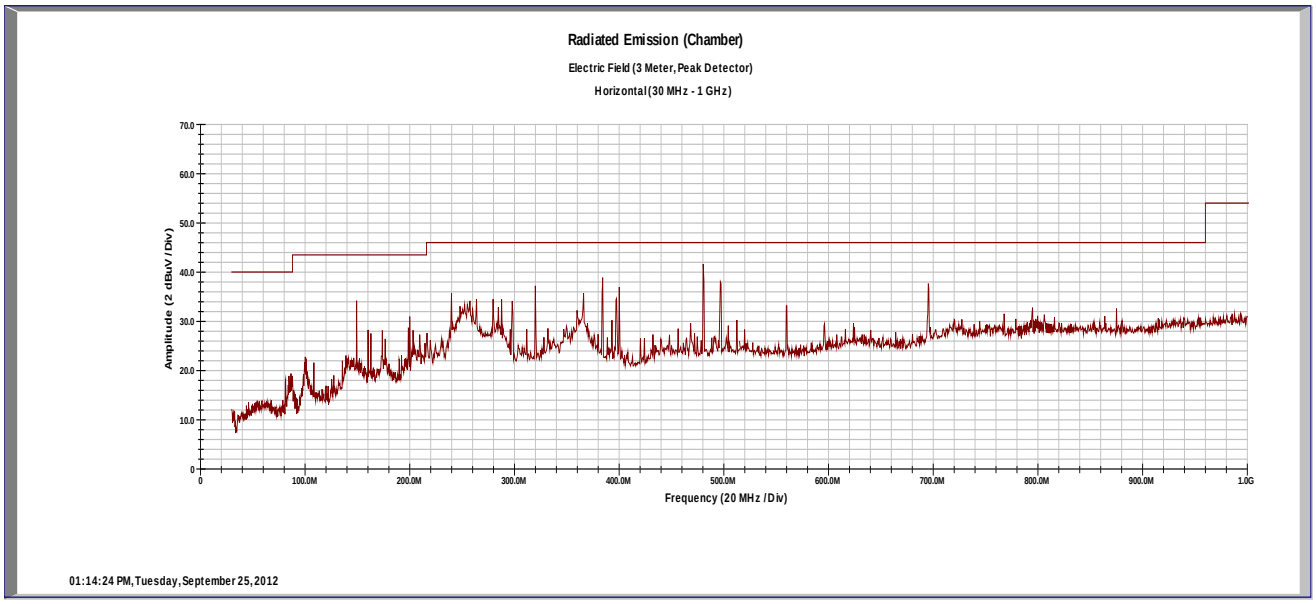
4.1.4 Final Test

All final radiated spurious emissions measurements were below (in compliance) the limits.

The worst –case emissions are shown below. All other emissions are on file at TUV Rheinland.

4.1.4.1 Emissions Outside the Frequency Band

Radiated Emissions Ch. 11, 30 – 1000 MHz (Worst Case)
Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
149.23	H	1.4	290	23.66	0.00	1.34	7.88	32.88	43.50	-10.62
240.08	H	1	0	18.65	0.00	1.70	11.72	32.07	46.00	-13.93
320.00	H	1.6	174	24.17	0.00	1.97	13.50	39.64	46.00	-6.36
384.00	H	1.6	174	22.05	0.00	2.15	14.80	39.00	46.00	-7.00
479.96	H	1.9	265	19.78	0.00	2.42	16.90	39.10	46.00	-6.90
695.29	H	1.7	148	12.52	0.00	2.92	20.31	35.74	46.00	-10.26

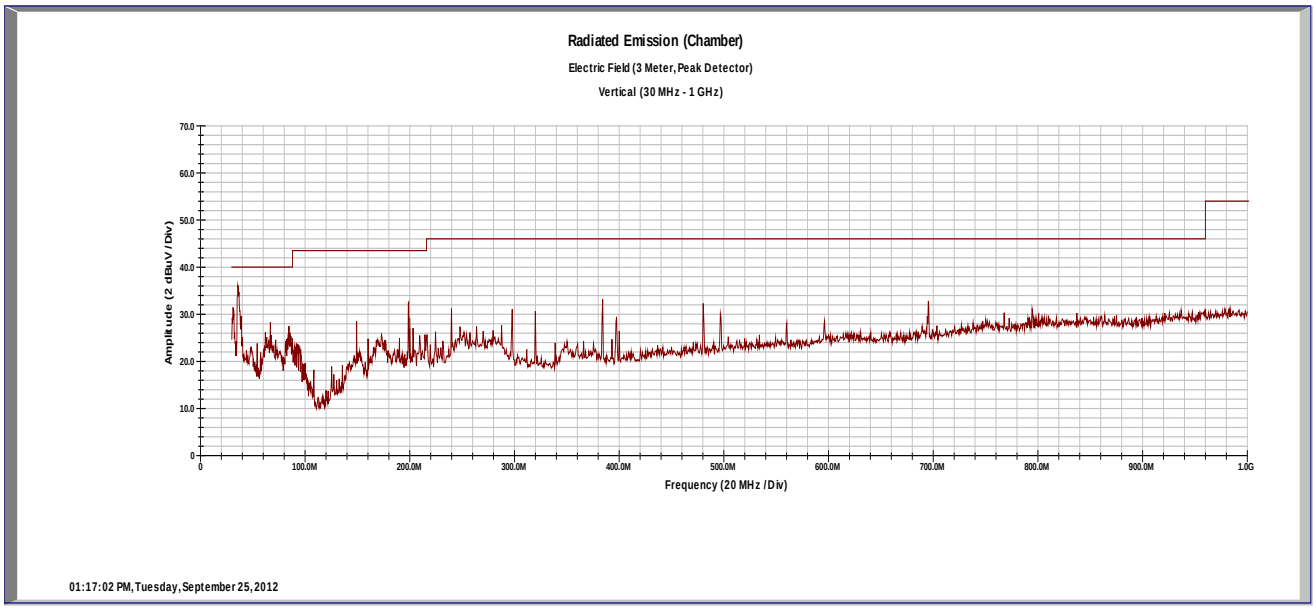
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All transmitters were on during this test.

Radiated Emissions – Ch.11, 30 – 1000 MHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
35.79	V	1	78	26.04	0.00	0.66	7.75	34.45	40.00	-5.55

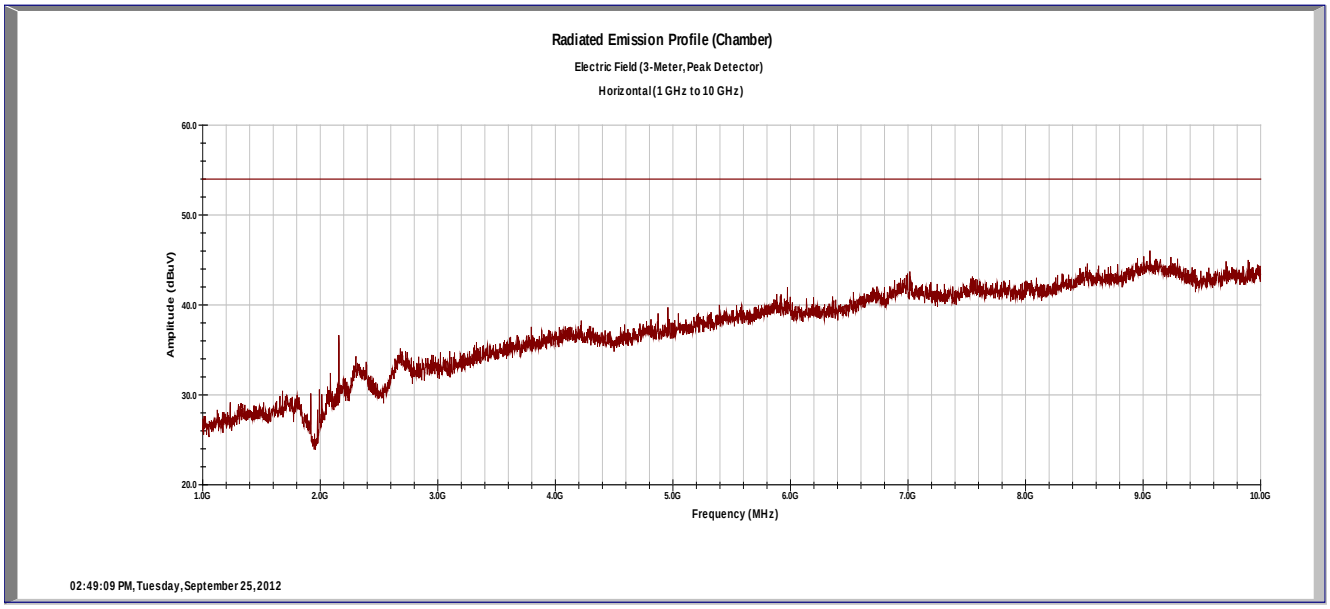
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All transmitters were on during this test.

Radiated Emissions Ch11, 1-10GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

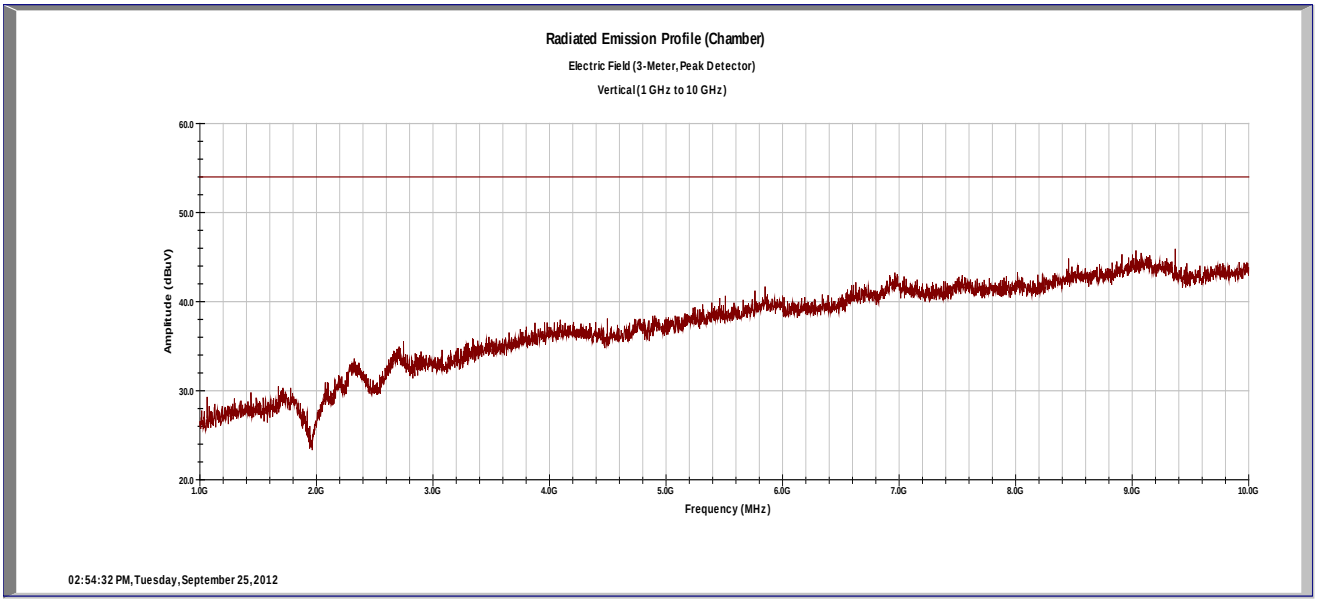
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: A band –notch filter was used to keep from overdriving the measurement receiver.
All emissions were either not detectable or more than 20 dB below the limit.
The three test channels gave similar results
All transmitters were on during this test.

Radiated Emissions – Ch11, 1-10GHz

Vertical



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

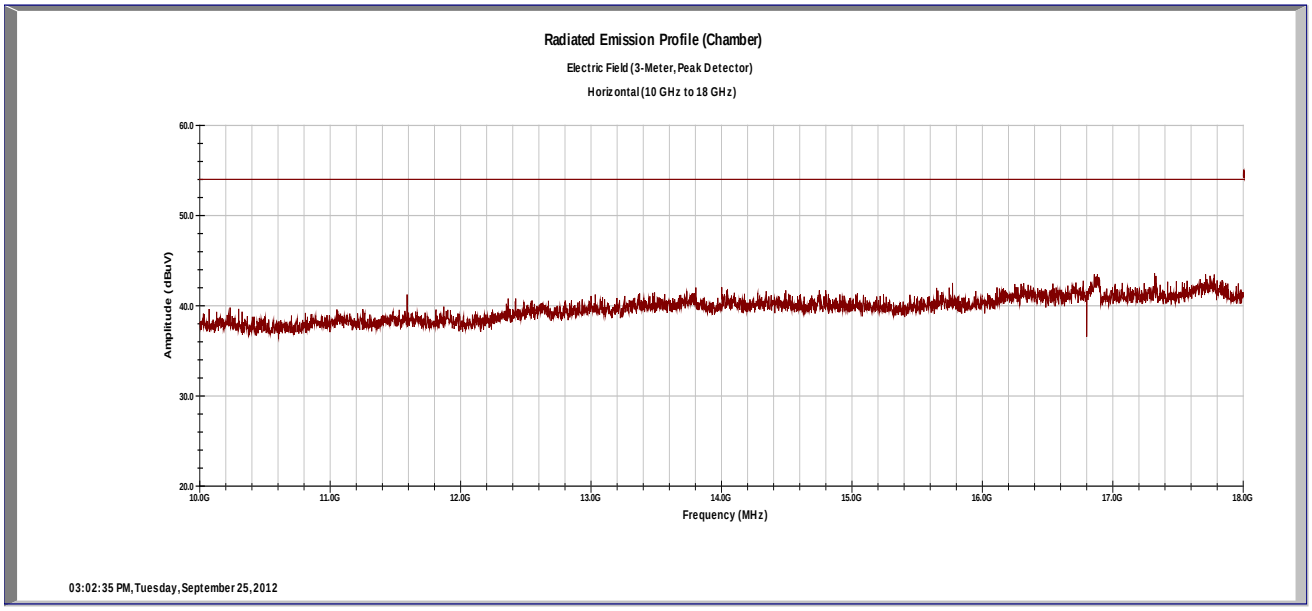
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: A band –notch filter was used to keep from overdriving the measurement receiver.
All emissions were either not detectable or more than 20 dB below the limit.
The three test channels gave similar results
All transmitters were on during this test.

Radiated Emissions Ch17, 10-18 GHz

Horizontal



Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

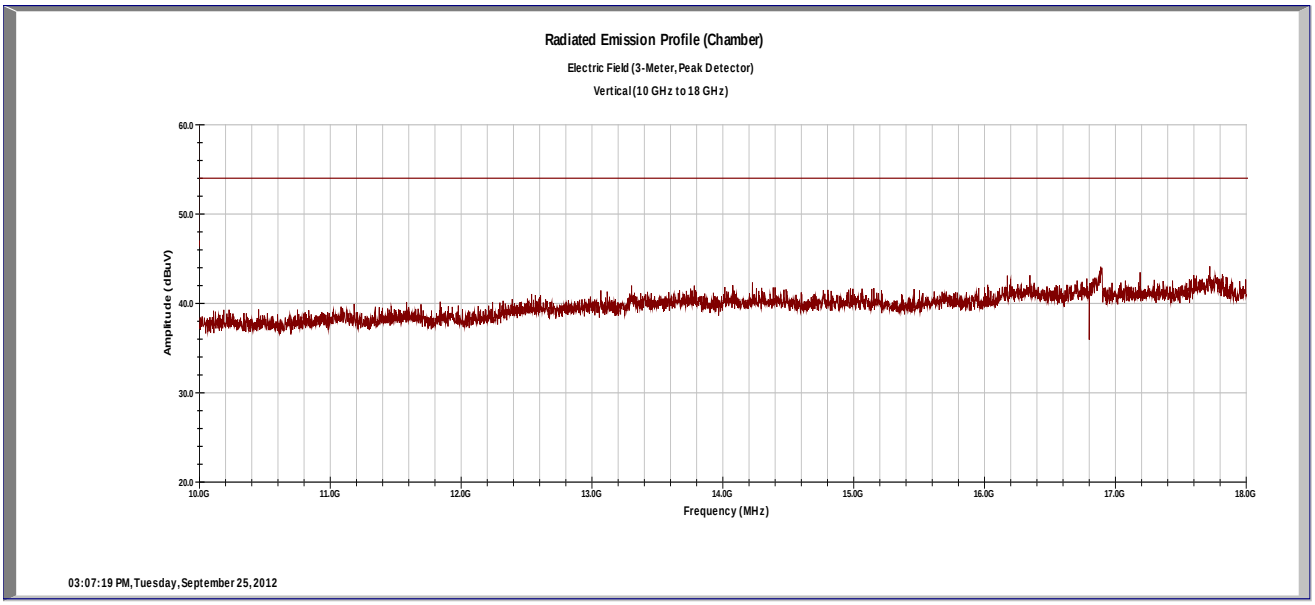
Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: A band –notch filter was used to keep from overdriving the measurement receiver.
All emissions were either not detectable or more than 20 dB below the limit.
The three test channels gave similar results
All transmitters were on during this test.

Radiated Emissions – Ch11, 10-18 GHz

Vertical

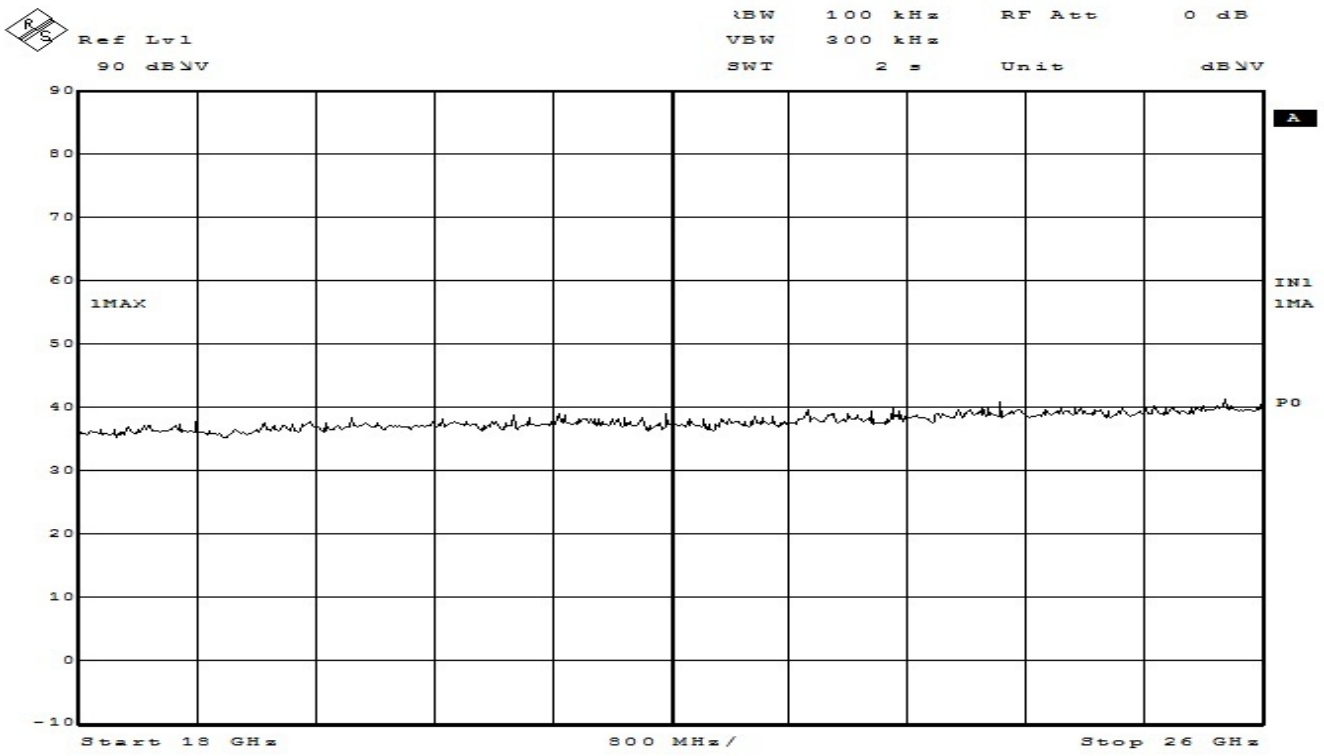


Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: A band –notch filter was used to keep from overdriving the measurement receiver.
All emissions were either not detectable, or more than 20 dB below the limit.
All transmitters were on during this test.



18-15 GHz scan, all transmitters were on during this test.

No emissions detected.

4.2 Conducted Emissions on AC Mains in Transmit mode

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other nearby electronic equipment.

4.2.1 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	26 September 2012	
Standard	FCC Part 15.207(a), and RSS-GEN						
Product Model	EV230PDRACG		Serial#	Production Prototype			
Configuration	See test plan for details						
Test Set-up	Tested in shielded room EUT placed on table see test plans for details						
EUT Powered By	240 VAC / 60Hz	**Temp**	75º F	**Humidity**	43%	**Pressure**	1012 mbar
Frequency Range	150KHz – 30MHz						
Mod. to EUT	None		**Test Performed By**	Mark Ryan			

4.2.2 Test Procedure

Conducted and FCC emissions tests were performed using the procedures of ANSI C63.4 including methods for signal maximizations and EUT configuration. The photos included with the report show the EUT in its maximized configuration.

The frequency range from 150kHz – 30MHz was investigated for conducted emissions.

Conducted Emissions measurements were performed in either the shielded room or ground plane location (with attached vertical ground plane) using procedures specified in the test plan and standard.

4.2.3 Deviations

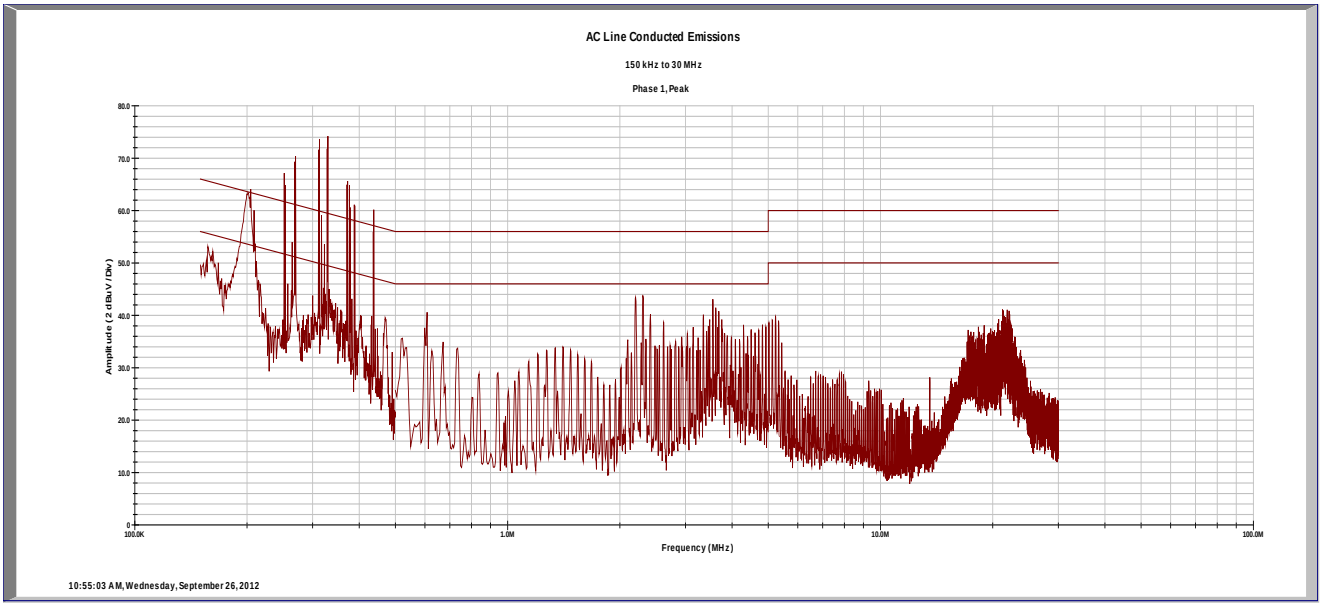
There were no deviations from the test methodology listed in the test plan for the conducted emission test.

4.2.4 Final Test

All final conducted emissions measurements were below (in compliance) the limits. It lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories.

4.2.5 Final Graphs and Tabulated Data

Conducted Emissions @ 240V/60Hz
Line 1



Freq 0.00	ID N	Quasi 0.00	Ave 0.00	Loss (dB)	T Limiter 0.00	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.15	1	41.32	27.05	0.03	9.92	65.78	55.78	-14.52	-18.79
0.27	1	36.37	9.70	0.04	9.93	61.00	51.00	-14.66	-31.33
0.38	1	31.66	2.00	0.04	9.93	58.32	48.32	-16.69	-36.35
0.63	1	18.30	17.31	0.05	9.94	56.00	46.00	-27.71	-18.70
2.30	1	34.10	34.19	0.10	10.03	56.00	46.00	-11.77	-1.68
5.23	1	28.35	27.25	0.15	10.18	60.00	50.00	-21.32	-12.42
18.72	1	24.04	14.10	0.29	10.50	60.00	50.00	-25.17	-25.11
21.25	1	26.33	19.25	0.31	10.54	60.00	50.00	-22.82	-19.90

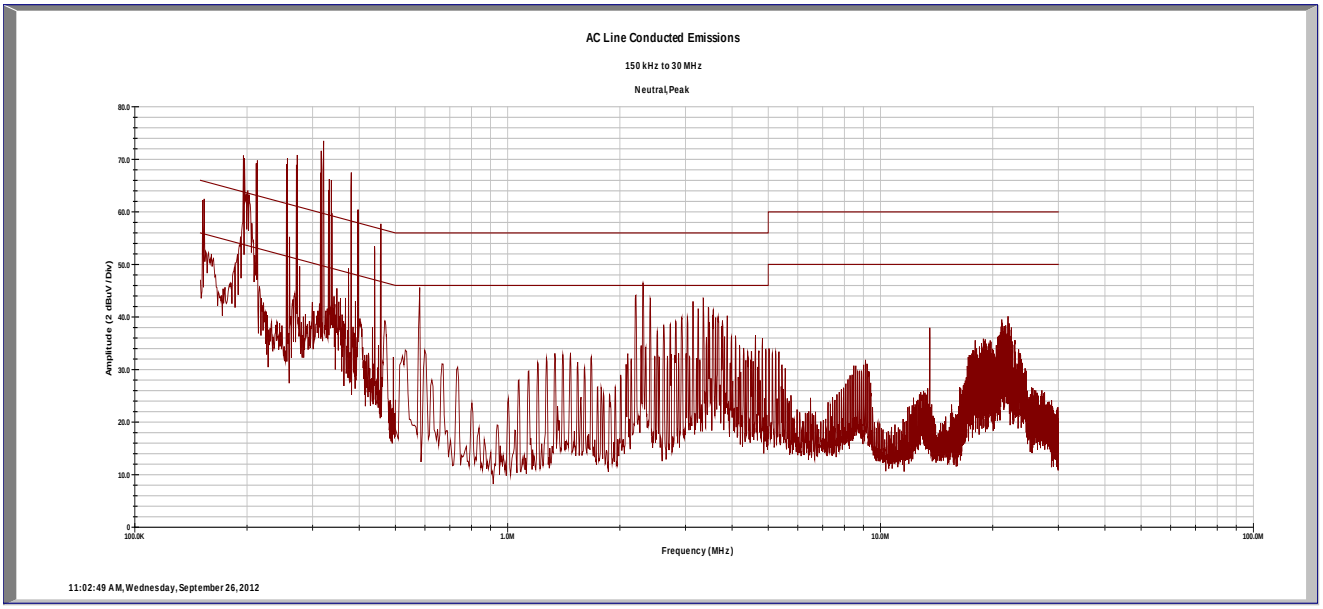
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.66dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Peak detector shown in plot
The highest signals shown in plot are transients, and are not measureable

Conducted Emissions @ 240V/60Hz

Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.17	N	37.34	12.69	0.03	9.92	64.77	54.77	-17.49	-32.14
0.20	N	51.94	36.40	0.03	9.91	63.53	53.53	-1.64	-7.18
0.35	N	35.04	3.79	0.04	9.92	58.87	48.87	-13.87	-35.12
2.30	N	35.77	34.50	0.10	10.04	56.00	46.00	-10.10	-1.37
13.56	N	26.99	26.15	0.24	10.42	60.00	50.00	-22.34	-13.18
21.46	N	24.50	16.20	0.31	10.34	60.00	50.00	-24.84	-23.14

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.66dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: Peak detector shown in plot
The highest signals shown in plot are transients, and are not measureable

4.3 Band Edge

4.3.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	12 September 2012	
Standard	FCC Part 15.247(d), RSS 210, 2.2						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240 VAC / 60Hz	**Temp**	73º F	**Humidity**	36%	**Pressure**	1010 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.3.2 Test Procedure

Intentional radiators operating under the alternative provisions to the general emission limits 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. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

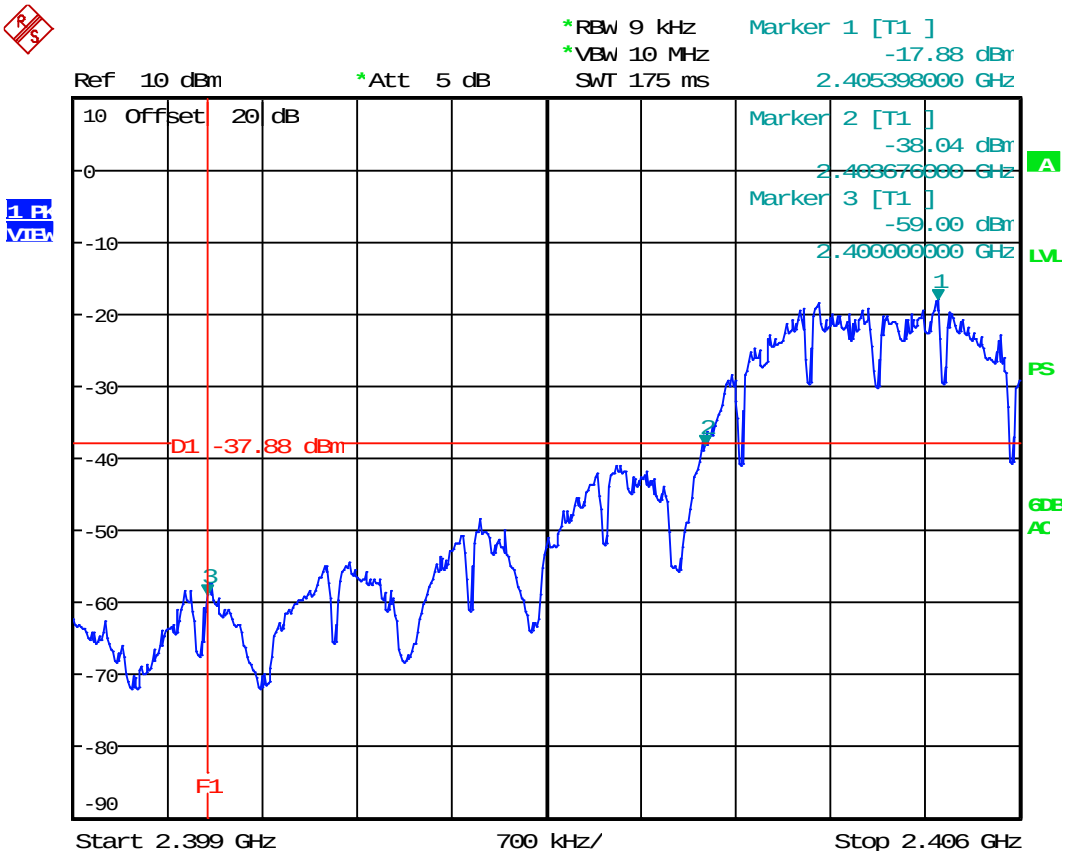
4.3.1 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

4.3.2 Final Test

The EUT met the performance criteria requirement as specified in the standards.

4.3.3 Final Data



Date: 26.SEP.2012 15:05:00

Notes: Measured using the Peak detector. Band Edge is at 2.4 GHz (Marker 3).

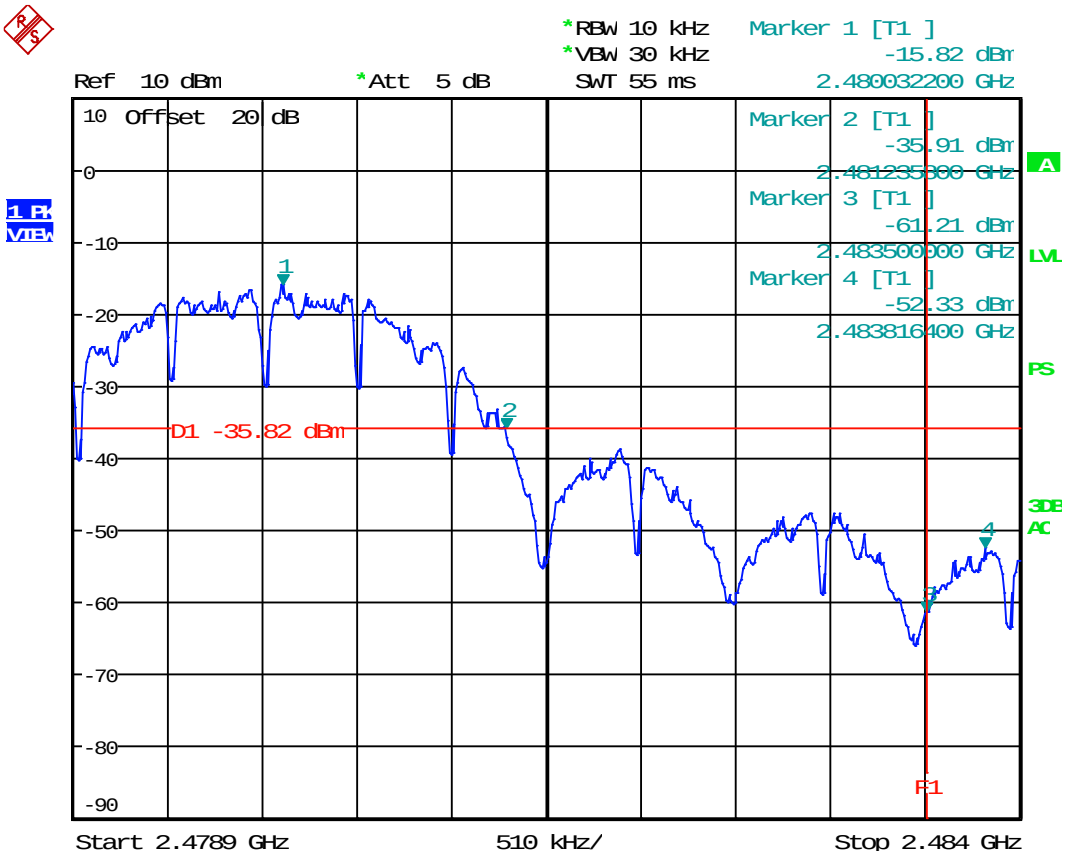
The nearest restricted band (2390MHz) is 10 MHz below the band edge

At the lowest channel, the -20dBc point is at 2403.68 MHz.

The band edge (Line F1) is at 2400 MHz

Figure 2: Channel Separation = 400 kHz

The EUT is compliant with the rules.



Date: 26.SEP.2012 14:57:34

Band edge (Line F1) at 2483.5 MHz is also the start of a restricted band, so the rules of 15.205 apply.

The -20dBc point is inside the band at 2476.69MHz.
The highest peak above the band edge is at 2.483.82 MHz:

Figure 3: Upper Band Edge Measurement (Radiated Emission)

The EUT is compliant with the rules.

4.1 Conducted Output Power, FCC 15.247(b)(3) and RSS-210 A8.4(4)

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

4.1.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	26 September 2012	
Standard	FCC Part 15.247(a)(1)(i) and RSS-210, A8.1						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240 VAC / 60Hz	**Temp**	73º F	**Humidity**	36%	**Pressure**	1010 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

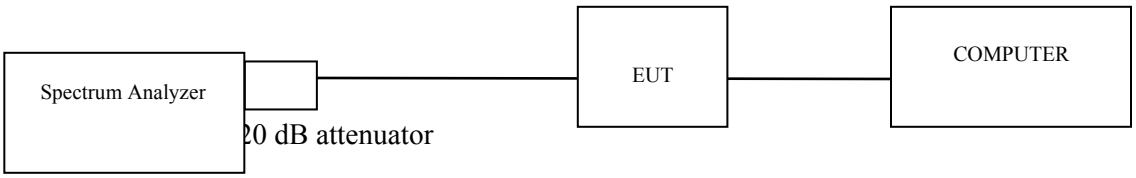
4.1.2 Test Procedure

The channel bandwidth for this system is greater than 250 kHz. Therefore the system must use at least 25 channels that are selected at the system hopping rate, from a pseudo-randomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

In constant transmit mode, the EUT would send a packet every 97.3 ms with a delay of 8 to 16 ms between packets. Each packet is sent on the next channel determined by the pseudo-random hop sequence, as defined in the operation description document.

4.1.3 Deviations

There were no deviations from the test methodology listed in the test plan for this test.



4.1.1 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

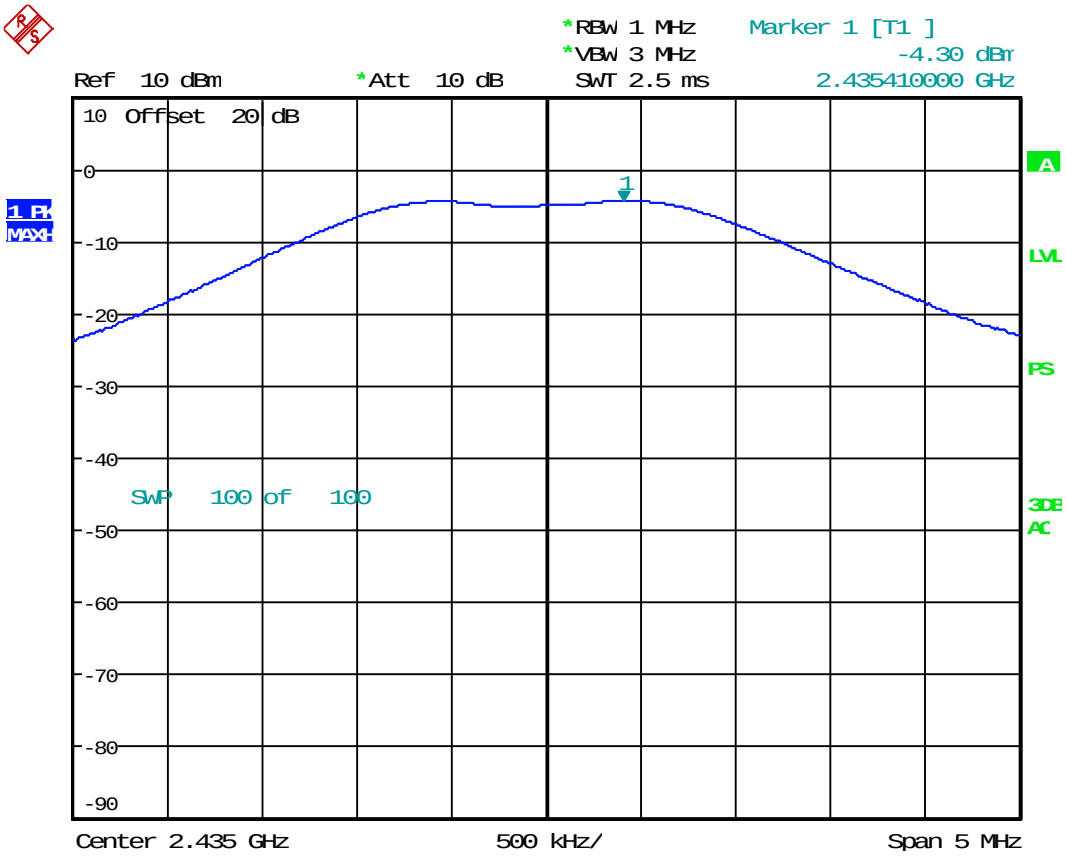
Test Setup:

4.1.1 Peak Power Output

Peak Output Conducted Power Measurements

Emission Freq (MHz)	Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.00 (f_L)	-5.81	30	-35.81
2435.00 (f_M)	**-4.30**	**30**	**-34.30**
2480.00 (f_H)	-6.26	30	--36.26

4.1.1 Final Data



Date: 26.SEP.2012 14:31:21

Figure 4 – Highest Peak Conducted Power Output for EUT.

Graphs of the other frequencies are on file with the manufacturer and at TUV.

Antenna Gain

The Antenna used has a maximum gain of 3.0 dBi. The antenna is below 6dBi gain, It complies with FCC Part 15.247(b)(4)

Results

As tested, the EUT was found to be compliant to the requirements of the test standard.

4.2 Peak Power Spectral Density

4.2.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	26 September 2012
Standard	FCC Part 15.247(e) and RSS 210 A8.2(b)						
Product Model	EVSE Charging Station			**Serial#**	Production Prototype		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240VAC / 60 Hz	**Temp**	74º F	**Humidity**	32%	**Pressure**	1010mbar
Perf. Criteria	Below Limit (10dBm)		**Perf. Verification**		≤8 dBm in any 3 kHz		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.2.2 Test Procedure

The methods of ANSI C63.10:2009, section 6.11.2.3 were used.

4.2.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Radiated Immunity test.

4.2.4 Final Test

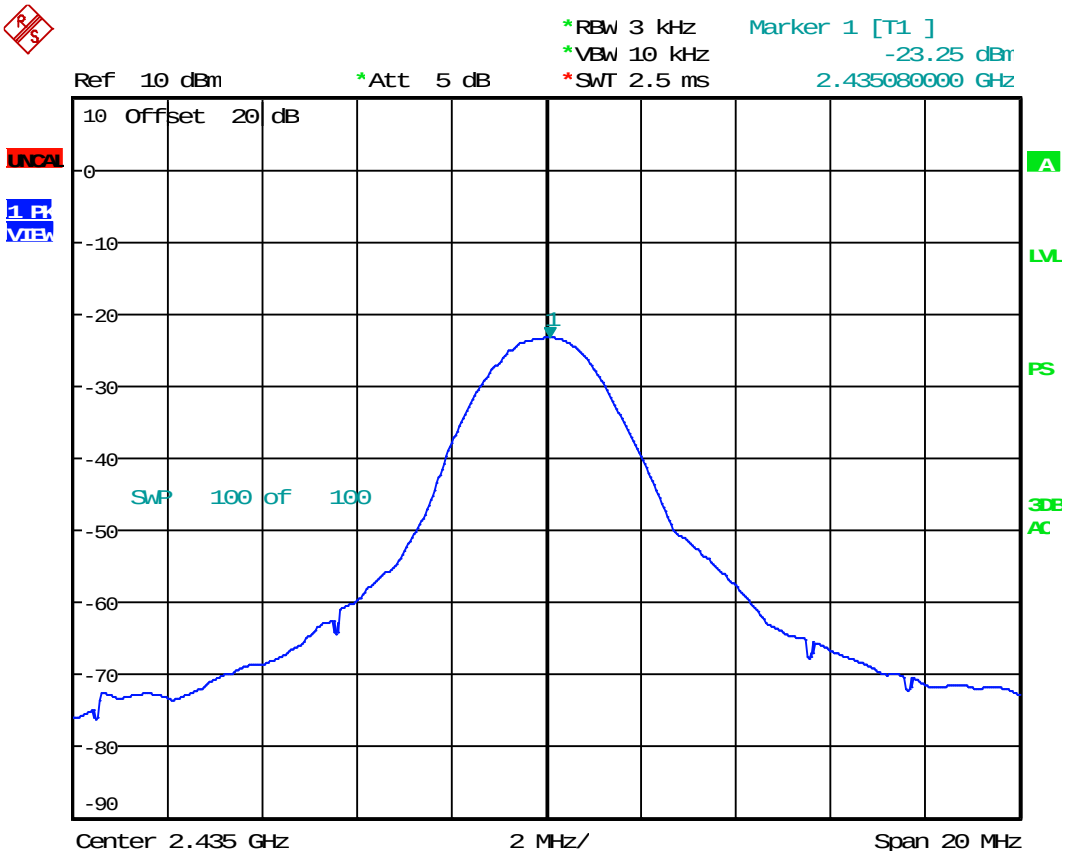
The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

Power Spectral Density Measurements

Emission Freq (MHz)	Measured Value (dBm)	Antenna Gain (dBi)	Corrected Value (dBm)	Spec Limit (dBm)	Spec Margin (dB)
2405.00 (f_L)	-21.31	3	-18.31	8	-26.31
2440.00 (f_M)	**-19.02**	**3**	-16.02	**8**	-24.02
2480.00 (f_H)	-21.43	3	-18.43	8	-26.43

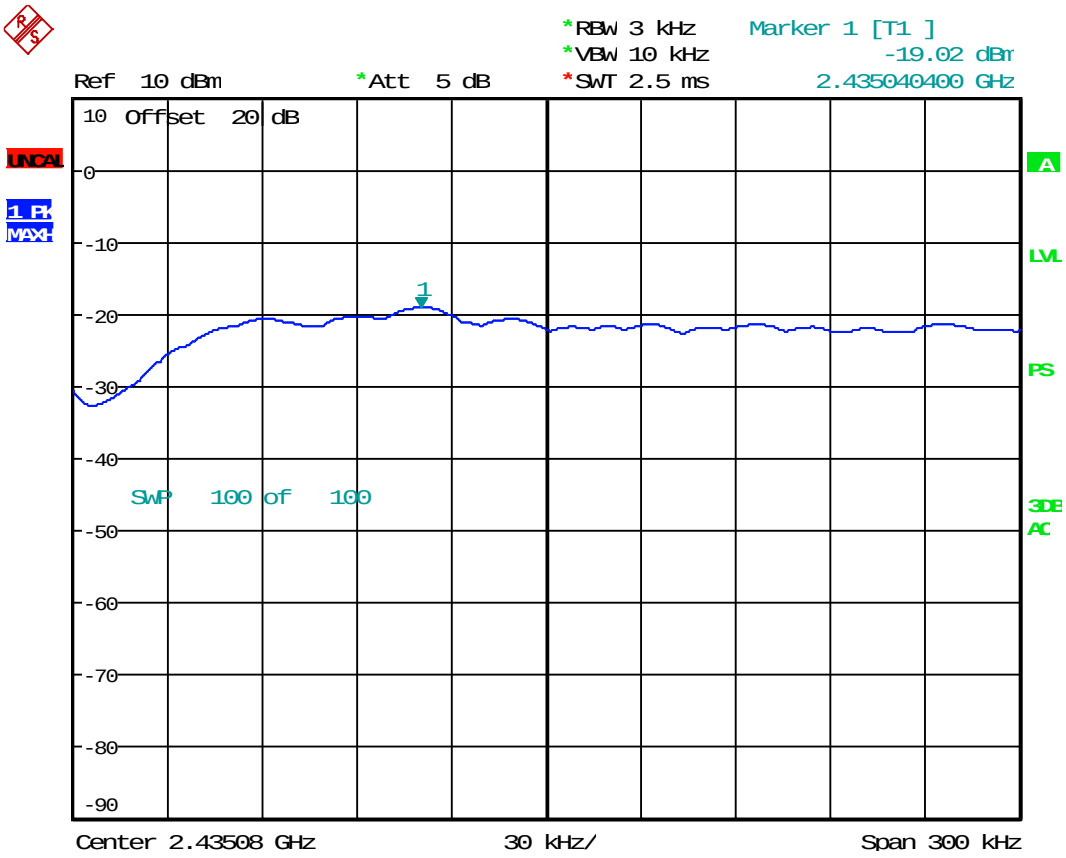
Note: worst Case PSD measurement plots are shown below; the other plots are on file at TUV Rheinland.

4.2.5 Final Data



Date: 26.SEP.2012 14:47:28

Figure 5: Peak Reference Frequency



Date: 26.SEP.2012 14:48:18

Corrected Spectral Density = -19.02dBm + 3dBi (antenna gain) = -16.03 dBm

Figure 6: Worst Case Power Spectral Density measurement

Note: worst Case PSD measurement plots are shown; the other plots are on file at TUV Rheinland.

4.3 Occupied Bandwidth

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.3.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	26 September 2012	
Standard	FCC Part 15.247(a)(1)(i)						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240 VAC / 60Hz	**Temp**	73º F	**Humidity**	36%	**Pressure**	1010 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.3.2 Test Procedure

Minimum allowed 6dB Bandwidth = 500 kHz

4.3.3 Deviations

There were no deviations from the test methodology listed in the test plan for this test.

4.3.4 Final Test

The EUT met requirements of this section as no 6 dB bandwidth less than 500 kHz.

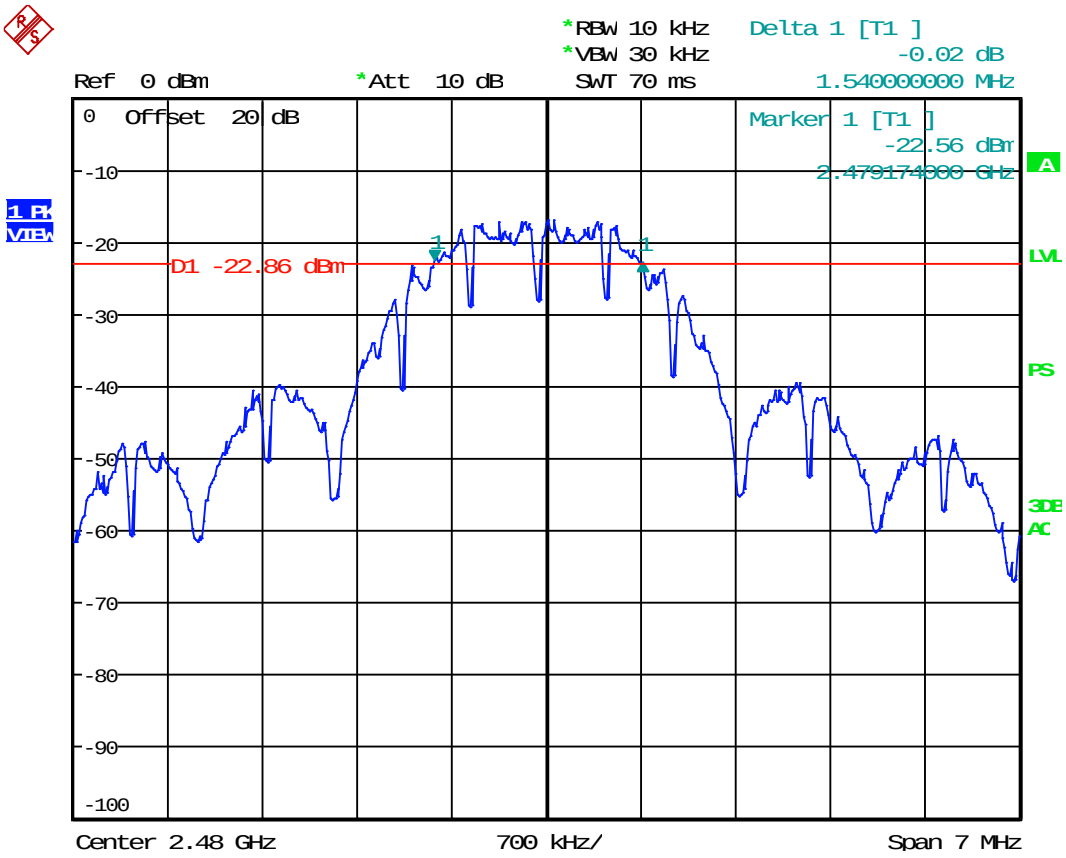
4.3.5 Final Data

Minimum 6dB Band width is 1.54 MHz which is much greater than 500 kHz

The EUT met the performance criteria requirement as specified in the standards.

Channel	6 dB BW (MHz)	20 dB BW (MHz)
Low	1.554	2.576
Mid	1.568	2.548
High	1.54	2.59

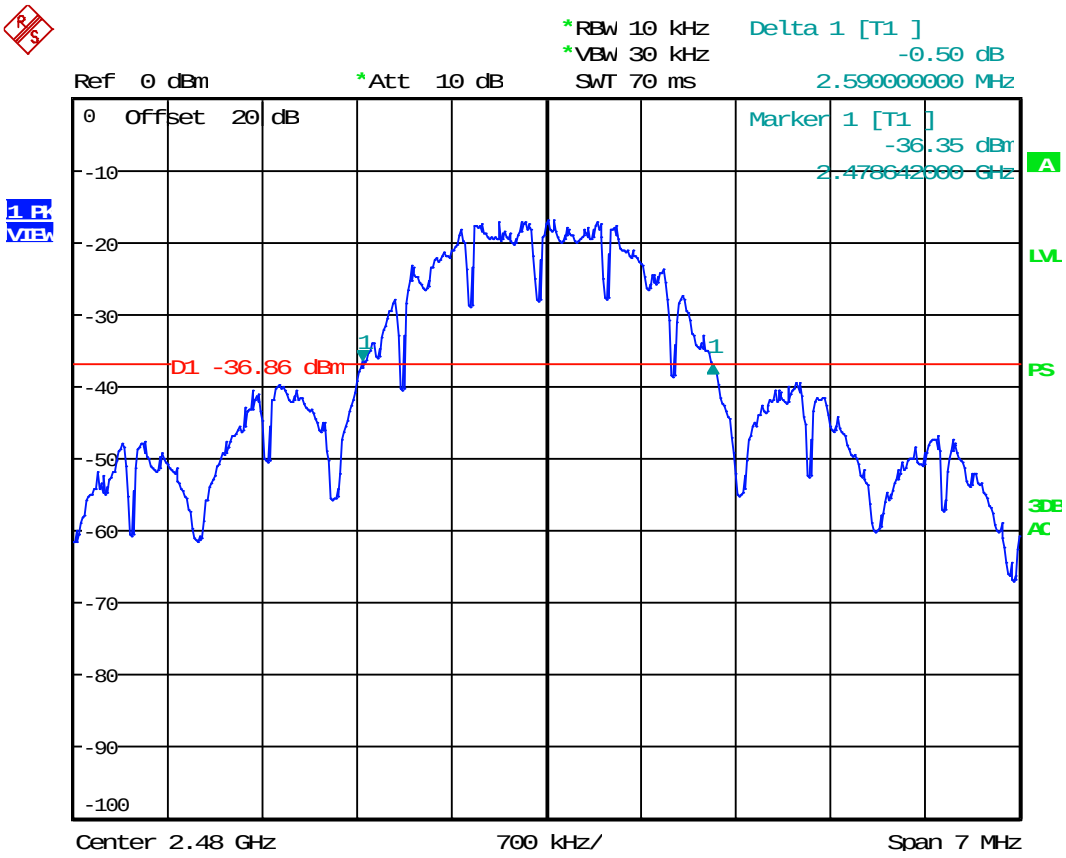
Note: Highlighted data is worst-case.



Date: 26.SEP.2012 14:20:46

***BW = 286.3 KHZ**

Figure 7: Minimum 6 dB Occupied Bandwidth



Date: 26.SEP.2012 14:21:49

***BW = 470 KHZ**

Figure 8: Worst Case 20 dB Occupied Bandwidth

Note: Plots of other channels and data rates are on file at TUV Rheinland.

4.4 99% Power Bandwidth

For the purpose of Section A1.1, the 99% bandwidth shall be no wider than .25% of the center frequency for devices operating between 70-900MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

4.4.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	26 September 2012
Standard	RSS-210 Section A1.1.3						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240 VAC / 60Hz	**Temp**	73º F	**Humidity**	36%	**Pressure**	1010 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.4.2 Test Procedure

The Video bandwidth is 3 times that of the resolution bandwidth.

The limit of the bandwidth would be 0.5% of 2.405 GHz is 12.03 MHz. The measured 99% bandwidth is 2.408 MHz.

4.4.3 Deviations

There were no deviations from the test methodology listed in the test plan for this test.

4.4.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

4.4.1 Final Tabulated Data

Channel	99% BW (MHz)
Low	2.408
Mid	2.38
High	2.234

Note: Highlighted data highest 99% Band Width.

4.4.2 Final Graphic Data

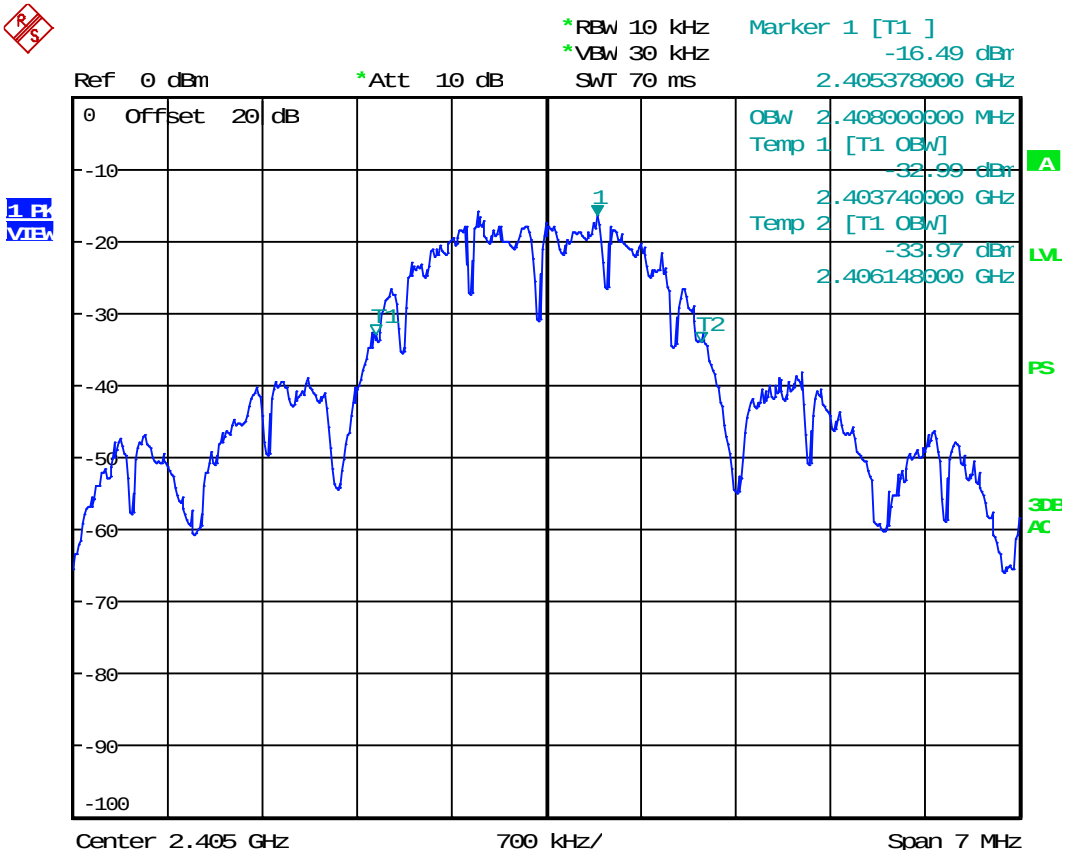


Figure 9 – 99% Power Bandwidth = 472 kHz

Spectrum Analyzer Parameters:
RBW=9kHz
Span=1MHz
VBW= 30kHz
LOG dB/div.= 10dB
Sweep = Auto
Detector = sample detector, max hold

The EUT is compliant to the requirements of RSS-210 A1.1.3

4.5 Band Edge

4.5.1 Test Over View

Results	**Complies** (as tested per this report)				**Date**	12 September 2012	
Standard	FCC Part 15.247(e), RSS 210 A8.1(c)						
Product Model	EV230PDRACG			**Serial#**	Production Sample		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240 VAC / 60Hz	**Temp**	73º F	**Humidity**	36%	**Pressure**	1010 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.5.2 Test Procedure

Intentional radiators operating under the alternative provisions to the general emission limits 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. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.5.3 Deviations

There were no deviations from the test methodology listed in the test plan for this test.

4.5.4 Final Test

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

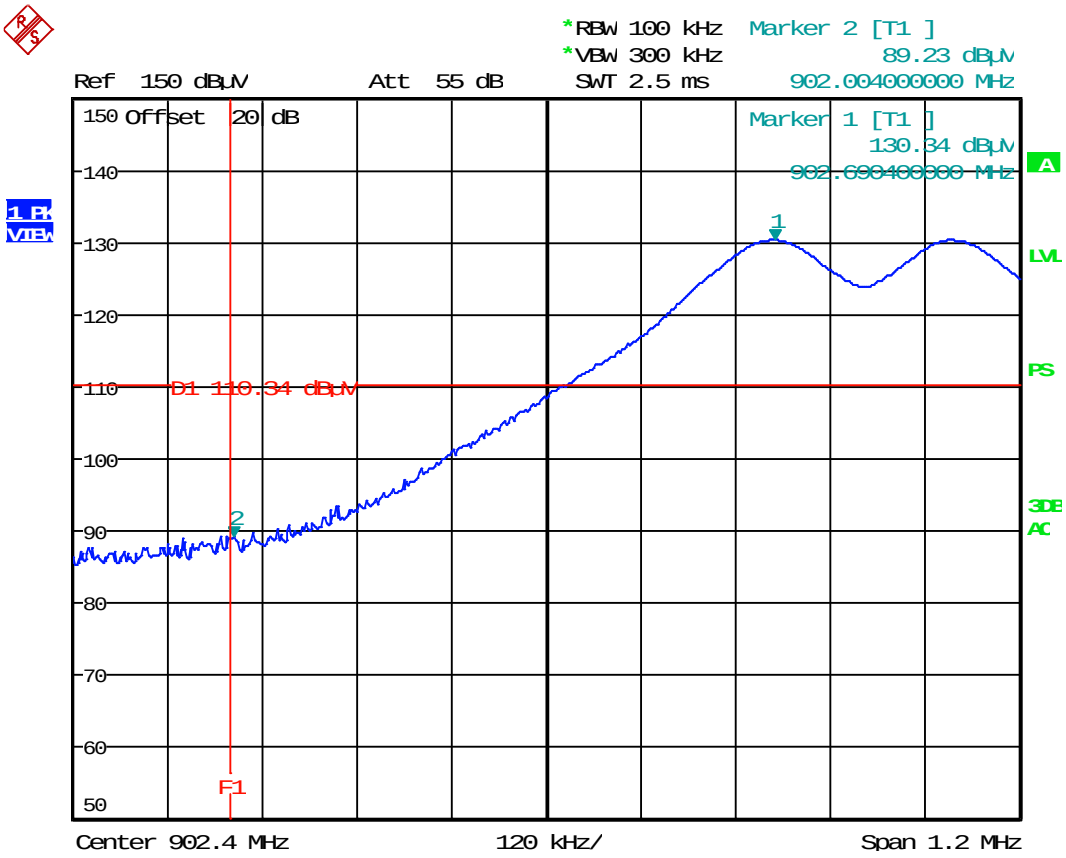


Figure 10: Lower Band Edge Measurement

Note: Band Edge (F1) is at 902 MHz

Channel Frequency is 902.8 MHz, The level at the band edge is -41.11dBc.

This is well below the -20dBc requirement.

The EUT is compliant with the rules.

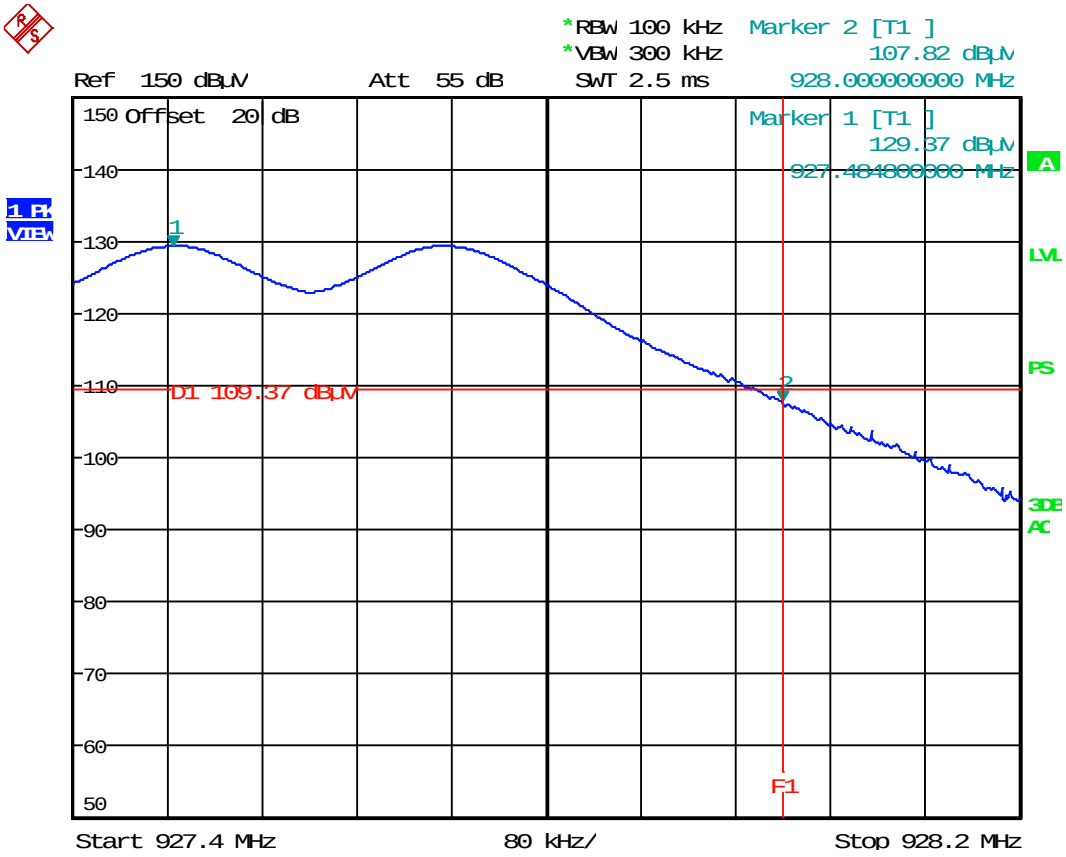


Figure 11: Upper Band Edge Measurement

Note: Band Edge (F1) is at 928 MHz

Channel Frequency is 927.6 MHz, The level at the band edge is -21.55 dBc.

This is below the -20dBc requirement.

The EUT is compliant with the rules.

4.6 Antenna Gain

The EUT cannot utilize an antenna with a gain higher than 6 dBi.

External Antenna gain:

The antenna used is a **Laird Technologies Phantom Antenna # TRA24003P**

The antenna gain is provided by the manufacturer:

Freq. (GHz)	Peak (dBi)	Gain (Numeric)
2.4 – 2.4835	3	2

Note: Highlighted data is worst-case.

Final Data:

The gain of the antennas is below 6 dBi.

The Transmitter output power does not need to be reduced.

FCC Part 15.209(a) and RSS-210 Issue 8

(a) The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Limit for 13.56 MHz:

Frequency (MHz)	Field strength (µV/m)	Equivalent to (dBµV/m)	Measurement distance (meters)
1.705–30.0	30	29.54	30

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the instances 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.

4.7 Over View of Test

Results	**Complies** (as tested per this report)				**Date**	26 September 2012	
Standard	FCC Part 15.209 and RSS-210						
Product Model	ProxPad			**Serial#**	11081514		
Test Set-up	Tested in a 5m Semi Anechoic chamber, placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane on a turn-table.						
EUT Powered By	240 VAC /50 Hz	**Temp**	72º F	**Humidity**	40%	**Pressure**	997 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.7.1 Test Procedure

All testing was performed in accordance with 47 CFR Part 15, ANSI C63.10:2009, RSS-GEN Issue 2. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.7.2 Deviations

None.

4.7.3 Final Test

All final radiated and spurious emissions measurements were below (in compliance) the limits.

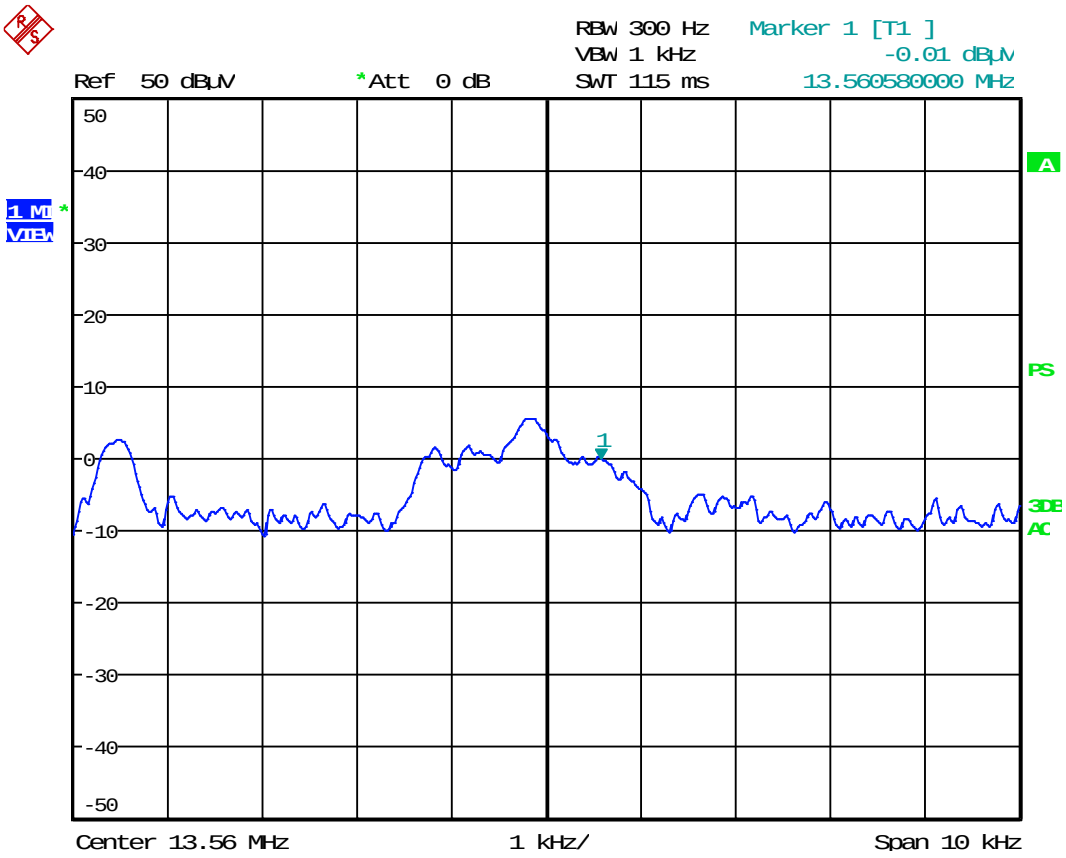
The worst –case emissions are shown below.

4.7.4 Final Graphs and Tabulated Data

	Raw Data (dBµV)	ANT & Cable CF	Corrected Data (dBµV)	Limit dBµV	Margin
Distance (m)	QP	dB	QP	(Peak)	dB
30.00	-0.01	11.2	11.19	29.54	-18.35

Figure 12 – Signal Strength at 30m

Note: the 30 uV/m at 30 meters limit is equivalent to 29.54 dBµV/m at 30 meters



Date: 26.SEP.2012 10:27:43

Figure 13 – Graph of Signal Strength of fundamental frequency at 30m in OATS

Note: The marker is on the fundamental frequency. It was verified by turning the transmitter on and off

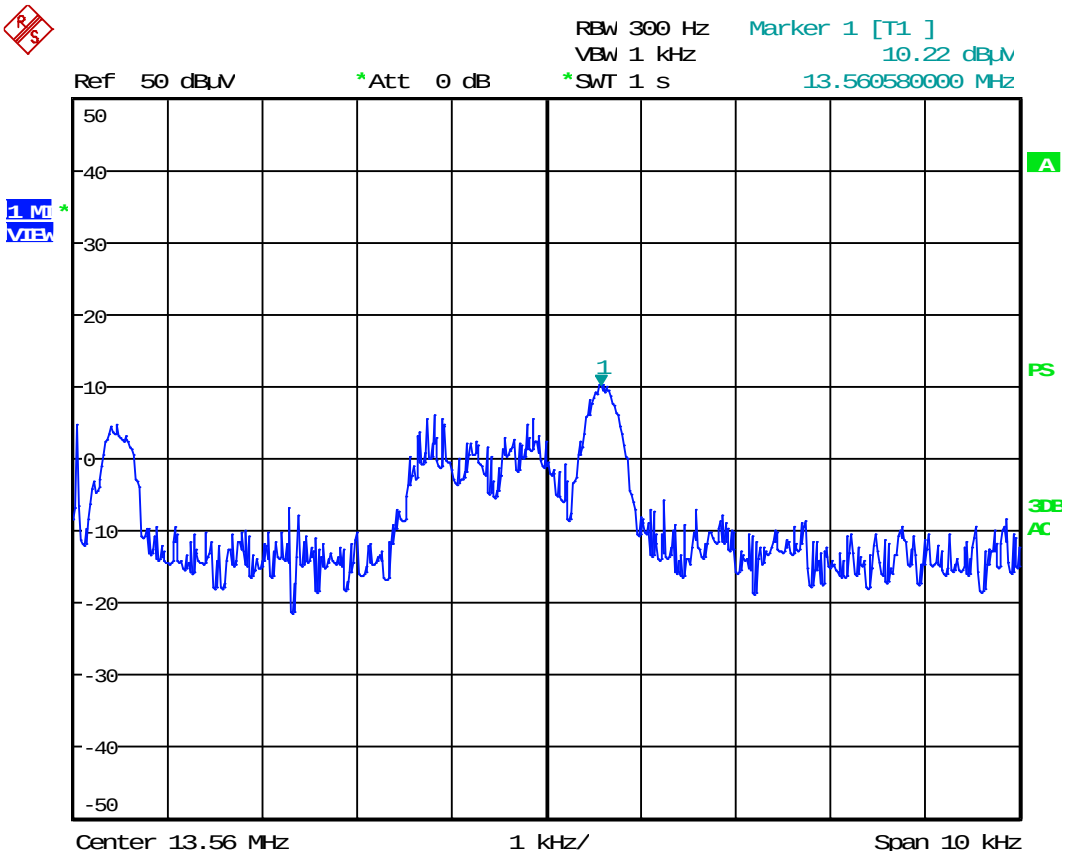
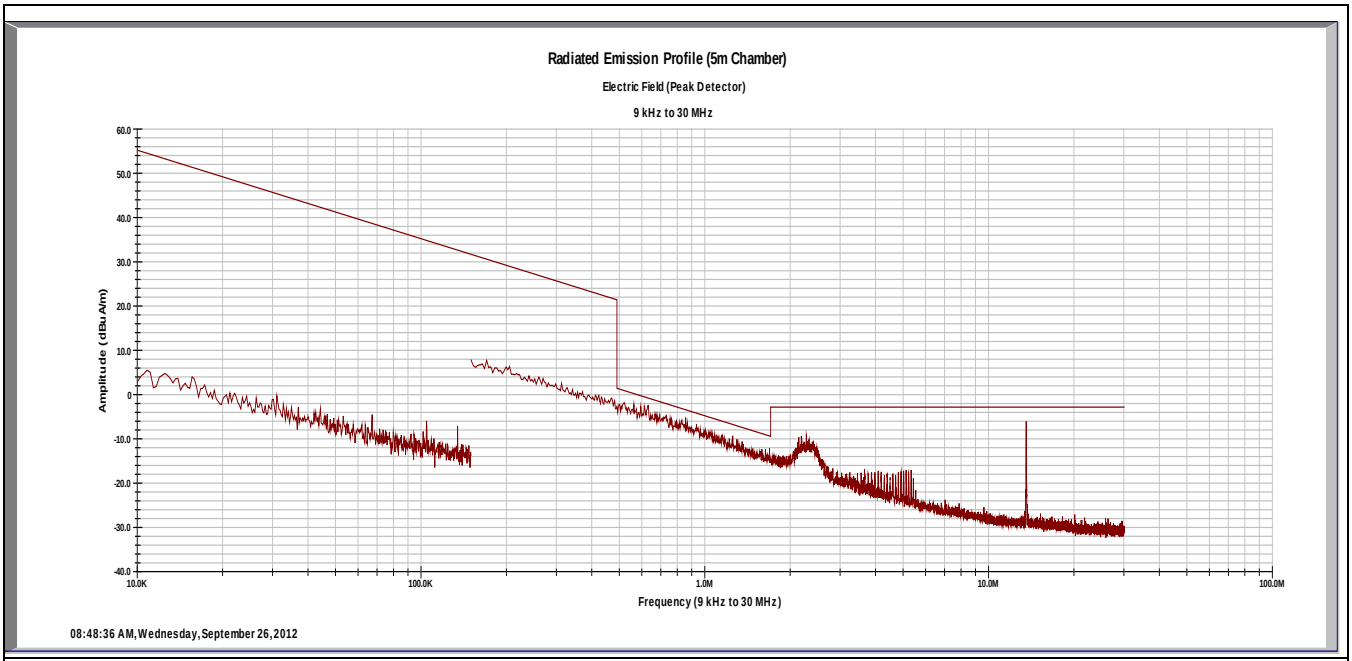


Figure 14 – Verification plot of fundamental frequency at 10m in OATS

Note: The marker is on the fundamental frequency. It was verified by turning the transmitter on and off and further verified by making a measurement at 10 m.

Radiated Emissions 10kHz-30MHz

Parallel



Emission Freq (MHz)	ANT Polar (P/p)	ANT Pos (m)	Table Pos (deg)	QP FIM Value (dBuA)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuA/m)	Spec Limit (dBuA/m)	Spec Margin (dB)
2.27	P	1	40	27.40	0.00	0.17	-40.52	-12.95	-1.00	-11.95
5.23	P	1	40	23.28	0.00	0.26	-41.25	-17.71	-1.00	-16.71
13.56	P	1	40	34.81	0.00	0.42	-43.97	-8.75	-1.00	-7.75

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 2.29dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: All emissions, including the fundamental are below the basic limits (FCC Part 15.209).
Due to the ambient levels in the OATS, The measurements were made in the 5m semi-anechoic chamber.
The Limit lines are adjusted to 3m measurement, using the dBuA/m scale.

Figure 15 – Spurious emissions from 10 kHz to 30 MHz

Note: the emission shown at 13.56 MHz is the fundamental frequency of the EUT.

4.8 99% Power Bandwidth

For the purpose of RSS-GEN, Section 4.6.1; When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be 99% emission, as calculated or measured.

4.8.1 Test Over View

Results	**Complies** (as tested per this report)					**Date**	26 September 2012
Standard	RSS-210 Section A1.1.3						
Product Model	SPEECH AUGMENTATION DEVICE			**Serial#**	11081514		
Test Set-up	Direct Measurement from antenna port						
EUT Powered By	240VAC / 60 Hz	**Temp**	78º F	**Humidity**	36%	**Pressure**	993 mbar
Perf. Criteria	(Below Limit)		**Perf. Verification**		Readings Under Limit		
Mod. to EUT	None		**Test Performed By**		Mark Ryan		

4.8.2 Test Procedure

Using the procedures of RSS-GEN section 4.6.1, the 10 Hz resolution bandwidth is 1% of the 1 kHz span. The 30 Hz video bandwidth is 3 times that of the resolution bandwidth.

4.8.3 Deviations

There were no deviations from the test methodology listed in the test plan for the Electrical Fast transients (EFT) Immunity test.

4.8.4 Final Results

The measured 99% bandwidth is: 96.2 Hz.

To allow for minor variances, the Designation of Necessary Bandwidth per TRC-43 would be: 100H

The EUT met the performance criteria requirement as specified in the test plan of this report and in the standards.

The EUT is compliant to the requirements of RSS-210 A1.1.3

FCC Part 15.207(a) and RSS-210 Issue 8

(RSS-GEN table 6?)

4.9 FCC 207(a) and RSS-GEN 7.2.4 – Conducted Emissions on AC Mains

This test measures the electromagnet levels of spurious signals generated by the EUT on the AC power line that may affect the performance of other nearby electronic equipment.

4.9.1 Over View of Test

Results	**Complies**				**Date**	26 September 2012	
Standard	FCC Part 15.207(a) and RSS-210						
Product Model	ProxPad			**Serial#**	NA		
Test Set-up	Tested in shielded room. EUT placed on table, see test plans for details						
EUT Powered By	240VAC / 60Hz	**Temp**	74º F	**Humidity**	39%	**Pressure**	996 mbar
Frequency Range	150 kHz – 30 MHz						
Perf. Criteria	(Below Limit)	**Perf. Verification**	Readings Under Limit for L1 & Neutral				
Mod. to EUT	None	**Test Performed By**	Mark Ryan				

4.9.1 Test Procedure

Conducted and FCC emissions tests were performed using the procedures of ANSI C63.4:2009 including methods for signal maximizations and EUT configuration. The frequency range from 150 kHz to 30 MHz was investigated for conducted emissions.

EUT was placed 80cm above a ground plane, using procedures specified in ANSI C63.4.

Worst-case emissions shown; EUT in transmit mode with AC power module.

4.9.2 Deviations

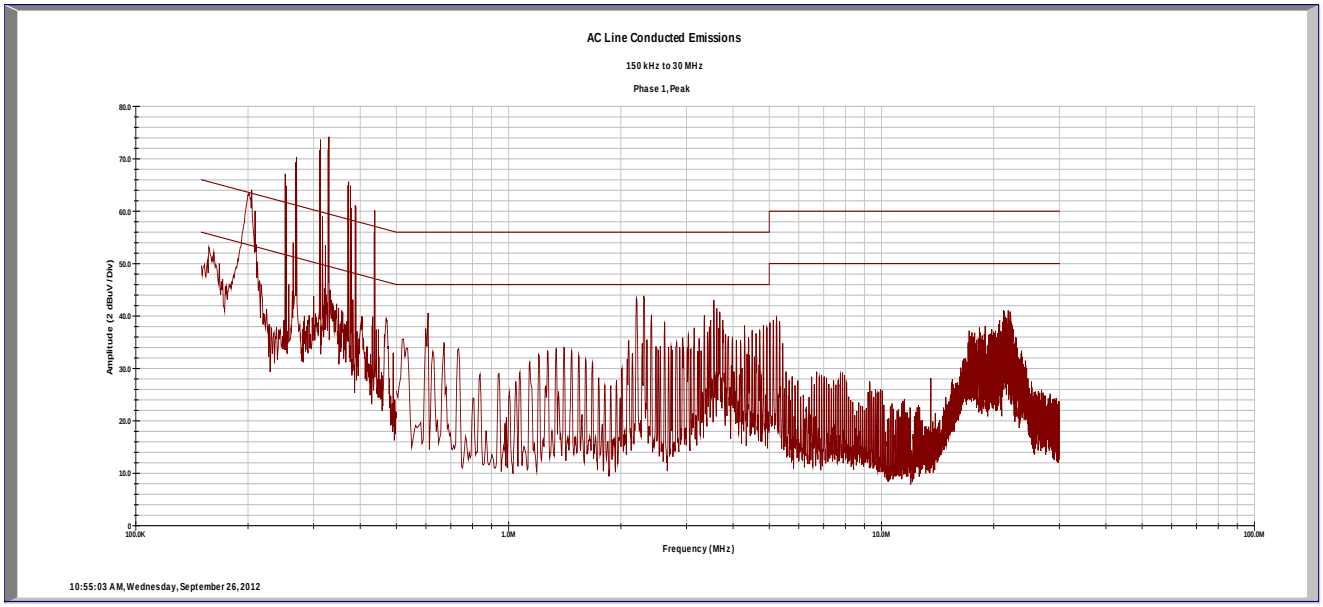
There were no deviations from the test methodology listed in the test plan for the conducted emission test.

4.9.3 Final Test

All final conducted emissions measurements were below (in compliance) the limits.

4.9.4 Final data and Graphs

Conducted Emissions @ 240V/60Hz
Line 1



Freq 0.00	ID N	Quasi 0.00	Ave 0.00	Loss (dB)	T Limiter 0.00	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.15	1	41.32	27.05	0.03	9.92	65.78	55.78	-14.52	-18.79
0.27	1	36.37	9.70	0.04	9.93	61.00	51.00	-14.66	-31.33
0.38	1	31.66	2.00	0.04	9.93	58.32	48.32	-16.69	-36.35
0.63	1	18.30	17.31	0.05	9.94	56.00	46.00	-27.71	-18.70
2.30	1	34.10	34.19	0.10	10.03	56.00	46.00	-11.77	-1.68
5.23	1	28.35	27.25	0.15	10.18	60.00	50.00	-21.32	-12.42
18.72	1	24.04	14.10	0.29	10.50	60.00	50.00	-25.17	-25.11
21.25	1	26.33	19.25	0.31	10.54	60.00	50.00	-22.82	-19.90

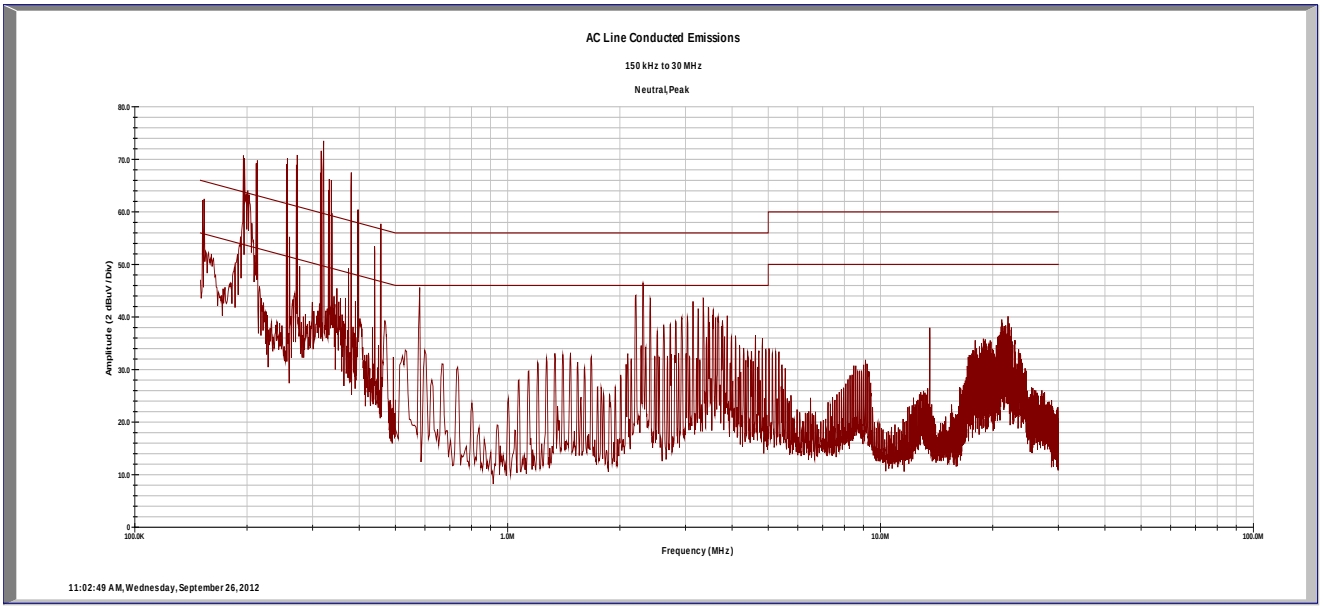
Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.66dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No dummy load used.
The spikes shown are transients and are not measurable.

Conducted Emissions @ 240V/60Hz

Neutral



Freq (MHz)	ID (1,2,3,N)	Quasi (dBuV)	Ave (dBuV)	Loss (dB)	T Limiter (dB)	Limit (dBuV)	Limit (dBuV)	Margin (dB)	Margin (dB)
0.17	N	37.34	12.69	0.03	9.92	64.77	54.77	-17.49	-32.14
0.20	N	51.94	36.40	0.03	9.91	63.53	53.53	-1.64	-7.18
0.35	N	35.04	3.79	0.04	9.92	58.87	48.87	-13.87	-35.12
2.30	N	35.77	34.50	0.10	10.04	56.00	46.00	-10.10	-1.37
13.56	N	26.99	26.15	0.24	10.42	60.00	50.00	-22.34	-13.18
21.46	N	24.50	16.20	0.31	10.34	60.00	50.00	-24.84	-23.14

Quasi Spec Margin = Quasi FIM + Cable Loss + LISN CF - Quasi Limit ± Uncertainty
Ave Spec Margin = Ave FIM + Cable Loss + LISN CF - Ave Limit ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.66dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: No dummy load used.
The spikes shown are transients and are not measurable.

The emission at 13.56MHz is the fundamental frequency of the RFID device.

5 RF Exposure – Zigbee Transmitter

5.1 Exposure Requirements – FCC Parts 2.1091, 15.247(d), and RSS-102 Issue 4

FCC Part 15.247(d) states that SAR evaluation in not required if "Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. *See* §1.1307(b)(1) of CFR 47."

RSS-102 section 2.5.1 states that a device is exempt from SAR evaluation if the frequency is "above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use…".

5.1.1 Test Procedure:

If the antenna is located > 20cm from the user, then an MPE calculation is acceptable.

If the antenna is located < 20cm (portable / mobile / hand-held device) from the user, then SAR evaluation is required.

5.1.2 Evaluation

The EUT is a Zigbee - Device and is intended to be separated from human contact by more than 20cm. Therefore the MPE calculation will be used.

5.2 MPE Calculation for FCC

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula (see section 4.9.6) and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

5.2.1 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	…	…	F/300	6
1500-100,000	…	…	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	…	…	f /1500	6
1500-100,000	…	…	1.0	30

f = Frequency in MHz

5.2.2 EUT operating condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

5.2.3 Classification

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm or more separation distance with the antenna should be included in user's manual.

5.2.4 Test Results

5.2.4.1 Antenna Gain

The maximum published Gain of antenna is 3.0 dBi or 2.0 (numeric).

5.2.4.2 Output Power into Antenna & RF Exposure value at distance 20cm:

Calculations for this report are based on highest power measurement and the highest gain of the antenna. Limit for MPE (from FCC part 1.1310 table 1) is **1.0 mW/cm^2**

Highest Pout is -4.3 dBm = 0.4 mW, highest antenna gain (in linear scale) is 2.0, R is 20cm, and f = 2400 MHz

Pd = (0.4*2.0) / (1600π) = **0.0002 mW/cm^2**, which is well below to the 1 mW/cm^2 limit.

The Exposure time of 30 Minutes was not included nor required for this calculation.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

5.2.5 Sample Calculation

The Friis transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm2
Pout = output power to antenna in mW
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

5.3 MPE Calculation for Industry Canada

5.3.1 Test Methodology

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in RSS-102 section 4.2 is followed. The Gain of the antenna used in this product is measured in a Semi-Anechoic Chamber, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

5.3.2 RF Exposure Limit

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in Section 4.2 of RSS-102.

RF Field Strength Limits for Devices used by the General Public.

Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	$280/f$	$2.19/f$	-	6
10-30	28	$2.19/f$	-	6
30-300	28	0.073	2*	6
300-1500	$1.585\ f^{0.5}$	$0.0042\ f^{0.5}$	$f/150$	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158\ f^{0.5}$	$4.21 \times 10^{-4}\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000/f^{1.2}$

Note: f is frequency in MHz
*Power density limit is applicable at frequencies greater than 100 MHz.

5.3.3 EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

5.3.4 Classification

The antenna of the product, under normal use condition, is at least 0.2 m away from the body of the user. Warning statement to the user for keeping at least 0.2m or more separation distance with the antenna should be included in users manual. Therefore, this device is classified as a **Mobile Device**.

5.3.5 Test Results

5.3.5.1 Antenna Gain

The maximum Published Gain of antenna is 3.0 dBi or 2.0 (numeric).

5.3.5.2 Output Power into Antenna & RF Exposure value at distance of 0.2 m:

Calculations for this report are based on highest power measurement and the highest gain of the antenna. Per the table in section 4.2 of RSS-102, the RF Field Exposure Limit is **10.0 W/m^2**

Highest Pout is -4.3 dBm = 0.0004 W, highest antenna gain (linear scale) is 2.0, R is 0.2m, and f = 2400 MHz

Pd = (0.0004*2.0) / (0.16π) = **0.000002 W/m^2**, which is well below to the 10 W/m^2 limit.

The Exposure time of 6 Minutes was not included nor required for this calculation.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

5.3.6 Sample Calculation

The Friis transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in W/m^2
Pout = output power to antenna in W
G = gain of antenna in linear scale
$\pi \approx 3.1416$
R = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

6 RF Exposure for 13.56 MHz RFID devices

6.1 Exposure Requirements – FCC KDB # 447498 DO1 and RSS-102 Issue 4

FCC KDB # 447498 DO1 - Mobile and Portable Device RF Exposure and Procedures and Equipment Authorization Policies section 1) c) states that unless excluded by *specific FCC test procedures*, portable devices with output power > $60/f_{(GHz)}$ mW shall include SAR data for equipment approval.

RSS-102 section 2.5.1 states that a device is exempt from SAR evaluation if the frequency is "from 3 kHz up to 1 GHz inclusively, and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use…".

6.1.1 Test Procedure

If the antenna is located > 20cm from the user, then an MPE calculation is acceptable.

If the antenna is located < 20cm (portable / mobile / hand-held device) from the user, then SAR evaluation is required.

6.1.2 Evaluation

The EUT is an card-reading RFID device, where the antenna can be located less than 20cm from the user, therefore SAR evaluation is required.

6.2 Evaluation for FCC

FCC 447498 D01 Mobile Portable RF Exposure v04, Paragraph 2) section a) i) states:
"A device may be used in portable exposure conditions with no restrictions on host platforms when either the source-based time-averaged output power is ≤ $60/f_{(GHz)}$ mW or all measured 1-g SAR are < 0.4 W/kg."

The EUT operates below 100 MHz and has a peak power output that is below the levels of Part 15.209. As such, this device is exempt from SAR testing.

6.3 Evaluation for Industry Canada

The maximum EIRP peak power output of the EUT is: 11.19 dBµV/m at 30m. Using the standard field strength calculation, this is equivalent to a power output of 0.39 nW eirp. See section 6.1.4 of this report.

The EUT is well below the 200mW power level that SAR testing would be required for this frequency range.

6.3.1 Conclusion

SAR data is not required for either FCC or Industry Canada.

Note: the 0.39 nW eirp power level has not been time-averaged and it is considered the absolute worst case.

6.3.2 Calculated EIRP Level for the RFID Device

Note: The EUT does not have a means to make direct measurements. Therefore the EIRP is calculated.

Per the equation in section 5.4.2 of FCC Document # 558074 D01 Measurement Guidance v01;

EIRP = E + 20Log(d) -104.8, where:

EIRP = the equivalent isotropic radiated power in dBm,

E = electric field strength in dBµV /m; E = 11.19 (see section 4.7 of this report),

d = measurement distance in meters; d = 30,

EIRP = 11.19 + 20Log(30) – 104.8 = 11.19 + 29.54 - 104.8 = **-64.07 dBm** which is equivalent to: 0.39 nW