LS Research, LLC
W66 N220 Commerce Court ● Cedarburg, WI 53012 ● USA
Phone: 262.375.4400 ● Fax: 262.375.4248
www.lsr.com

ENGINEERING TEST REPORT # 310376 Rx PIFA
LSR Job #: C-1086

Compliance Testing of:

ProFLEX01-SOC

Test Date(s):
May 31st to June 8th 2011

Prepared For:
LS Research, LLC
W66 N220 Commerce Ct.
Cedarburg, WI. 53012

In accordance with:
RSS-GEN
&
CFR 47 15.109

This Test Report is issued under the Authority of: Thomas T. Smith

Signature: Thomas T. Smith Date: 9/20/2011

Test Report Reviewed by:	**Project Engineer:**
Signature: Thomas T. Smith Date:	Khairul Aidi Zainal, Senior EMC Engineer
	Signature: Date: 9/20/11

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EXHIBIT 1. INTRODUCTION

1.1 SCOPE

References:	RSS-GEN Section 6 CFR 47 15.109
Title:	General Requirements and Information for the Certification of Radiocommunication Equipment
Purpose of Test:	To gain IC and FCC Certification Authorization for a Digital Device operated in Receive Mode
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	• Commercial, Industrial or Business • Residential

1.2 NORMATIVE REFERENCES

Publication	Title
RSS-Gen Issue2,	Spectrum Management and Telecommunications Radio Standards Specification
CFR 47 Part 15	Radio Frequency devices
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
CISPR 16-1-1	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus.

1.3 LS Research, LLC TEST FACILITY

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

1.4 LOCATION OF TESTING

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

List of Facilities Located at LS Research, LLC:

- Compact Chamber
- Semi-Anechoic Chamber
- Open Area Test Site (OATS)

1.5 TEST EQUIPMENT UTILIZED

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated in accordance with A2LA standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 CLIENT INFORMATION

Manufacturer Name:	**LS Research, LLC**
Address:	**W66N220 Commerce Ct. Cedarburg, WI**
Contact Name:	**Josh Bablitch**

2.2 EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information has been supplied by the applicant.

Product Name:	ProFLEX01-SOC
Model Number:	ProFLEX01-SOC
Serial Number:	15A (Low Chan) 16A (Mid Chan) 17A (High Chan)

2.3 ASSOCIATED ANTENNA DESCRIPTION

Antenna used with this module is a PCB trace PIFA.

2.4 EUT'S TECHNICAL SPECIFICATIONS

Additional Information:

Frequency Range (in MHz)	2405MHz - 2475MHz
Operating Voltage	3.6 VDC
Receiver Bandwidth	5 MHz
Receiver Sensitivity	-98 dBm
Highest Frequency on Board	4950 MHz
Receiver Spurious (worst case at 3 m)	46.46dBµV/m at 4950MHz
Microprocessor Model # (if applicable)	TI CC2530F256
EUT will be operated under FCC part(s) and IC Rule	IC: RSS-GEN FCC: CFR 47 part 15
Portable/Mobile	☐ Portable ☒ Mobile
Modular Filing	☒ Yes ☐ No

2.5 PRODUCT DESCRIPTION

This radio module is used to add a 2.4GHz band 802.15.4 radio into any suitable product.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 CLIMATE TEST CONDITIONS

Temperature:	70° Fahrenheit
Humidity:	40%
Pressure:	728mmHg

3.2 APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

RSS Paragraph	Test Requirements	Compliance (yes/no)
7.2.2	Power Line Conducted Emissions Measurements	Yes
6	Un-Intentional Radiated Emissions	Yes

CFR 47 Part 15 section	Test Requirements	Compliance (yes/no)
107	Power Line Conducted Emissions Measurements	Yes
109	Un-Intentional Radiated Emissions	Yes

3.3 MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

☒ **None** ☐ **Yes (explain below)**

3.4 DEVIATIONS & EXCLUSIONS FROM TEST SPECIFICATIONS

☒ **None** ☐ **Yes (explain below)**

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of Industry Canada RSS-Gen and RSS-210, Issue 7 (2007), Section 7 for non-intentional radiators.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

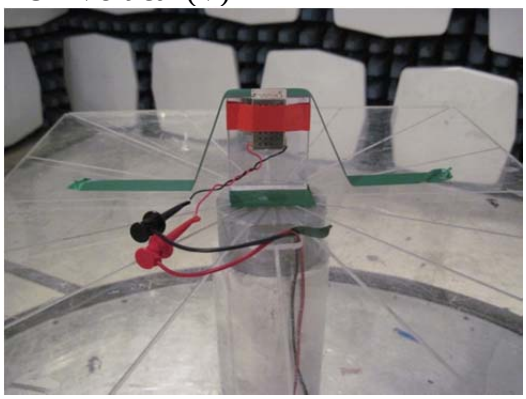
5.1 Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS GEN and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous transmit mode for final testing using power as provided by bench DC power supply.

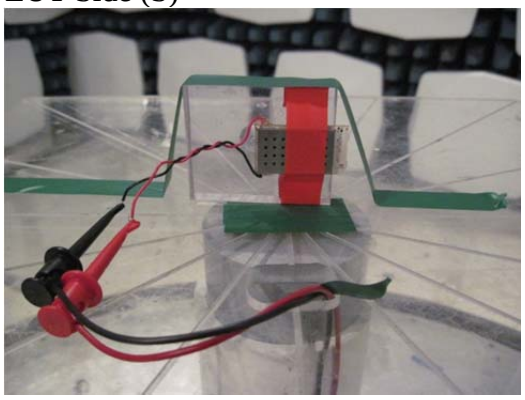
The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2405MHz), middle (2440MHz) and high (2475MHz) to comply with FCC Part 15.31(m). There were three units programmed to continuously receive at the respective frequencies.

5.2 Test Setup Photo(s) – Radiated Emissions Test

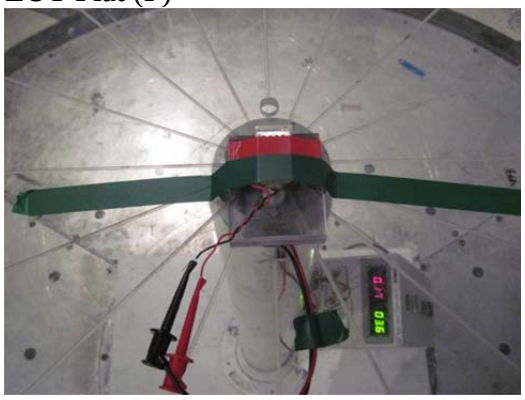
EUT Vertical (V)



EUT Side (S)



EUT Flat (F)



5.3 Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. From 18 GHz to 25 GHz, the EUT was measured using a standard gain Horn Antenna and pre-amplifier.

In the frequency range of 30 MHz to 4 GHz, the maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height while for the range of 4 GHz to 25 GHz the antenna was raised and lowered between 1 and 1.8 meters in height. In addition, the polarity of the antenna was switched between horizontal and vertical polarity.

The EUT was positioned in three orthogonal orientations with the dipole antenna either straight or bent.

Measurement above 1 GHz were performed with RBW = 1MHz with VBW = 1MHz (peak) and VBW=10 Hz (average).

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5.4 Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with resolution bandwidths as prescribed in ANSI C63.4.

5.5 Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Canada RSS GEN, RSS-210 and CFR 47 Part 15 sections 109. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.6 CALCULATION OF RADIATED EMISSIONS LIMITS

The following table depicts the Class B limits for an unintentional radiator. These limits are obtained from RSS-Gen Section 6, Table 1, for radiated emissions measurements.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion from field strength μV/m to dBμV/m:
$dB\mu V/m = 20 \log_{10} (100)$
= 40 dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

For measurements made at 0.3 meter, a 20 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 20 = 74 dB/μV/m at 0.3 meters

Reported data:

For both fundamental and spurious emissions measurement, the data reported includes all necessary correction factors. These correction factors are loaded onto the EMI receiver when measurements are performed.

Reported Measurement data = Raw receiver measurement (dBμV/m) + Antenna correction Factor + Cable factor (dB) + Miscellaneous factors when applicable (dB) – amplification factor when applicable (dB).

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) = 35.45 (dBμV/m).

5.7 DATA CHART – RADIATED EMISSIONS TEST

Measurements of Electromagnetic Radiated Emissions
Frequency Range Inspected: 30 MHz to 25000MHz

Manufacturer:	LS Research, LLC						
Date(s) of Test:	May 31st to June 8th 2011						
Project Engineer:	Khairul Aidi Zainal						
Test Engineer(s):	Khairul Aidi Zainal						
Voltage:	3.6 VDC						
Operation Mode:	continuous receive						
Environmental Conditions in the Lab:	Temperature: 70° F Relative Humidity: 40 %						
EUT Power:		Single Phase 120 VAC		3 Phase ___VAC			
		Battery	X	Other: Bench DC Supply			
EUT Placement:		80cm non-conductive table		10cm Spacers			
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS			
Measurements:		Pre-Compliance		Preliminary	X	Final	
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average	

The following table depicts the level of significant spurious radiated RF emissions found:

FREQ (MHz)	ANT	EUT	HEIGHT (m)	AZIMUTH (°)	PEAK (dBuV/m)	Q.PEAK (dBuV/m)	AVG (dBuV/m)	LIMIT (dBuV/m)	MARGIN (db)
971.4	H	V	1.00	0	33.9	27.8	21.2	54.0	26.2
663.9	V	V	1.00	0	29.4	23.7	17.0	46.0	22.3
141.4	V	V	1.00	0	30.8	25.4	15.5	43.0	17.6
4810.0	V	S	1.00	118	56.2	N/A	51.5	63.5	12.0
4880.0	V	F	1.08	347	57.2	N/A	54.5	63.5	9.0
4950.0	V	S	1.22	274	58.0	N/A	56.0	63.5	7.5

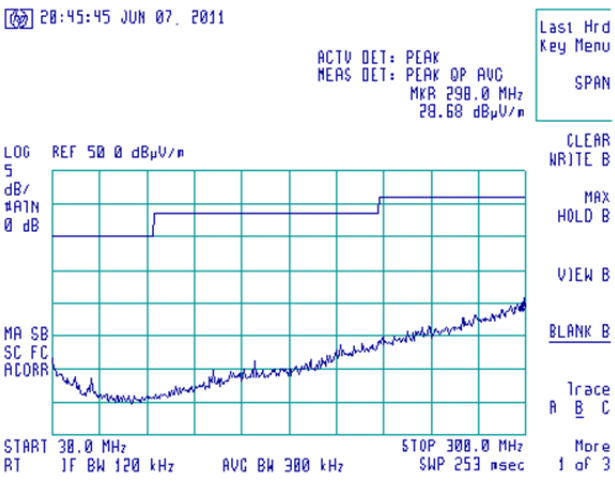
Notes:
1. H: Horizontal; V:Vertical; S: Side

5.8 Screen Captures - Radiated Emissions Testing

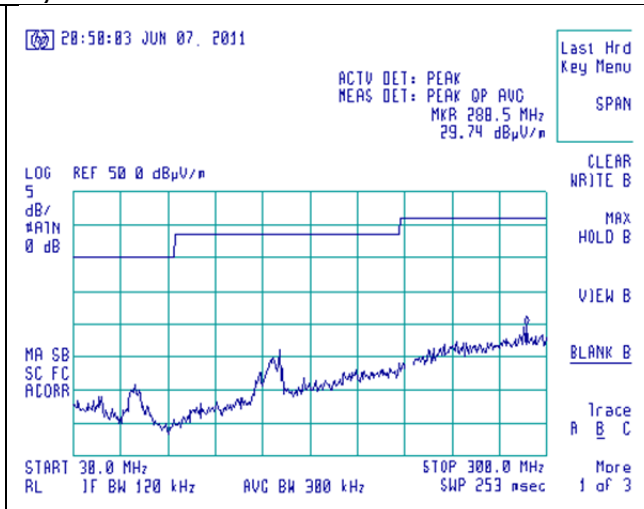
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a peak detector with video averaging is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, as measured on channels 2405 MHz, 2445 MHz and 2475 MHz.

30-300 MHz, at 3m

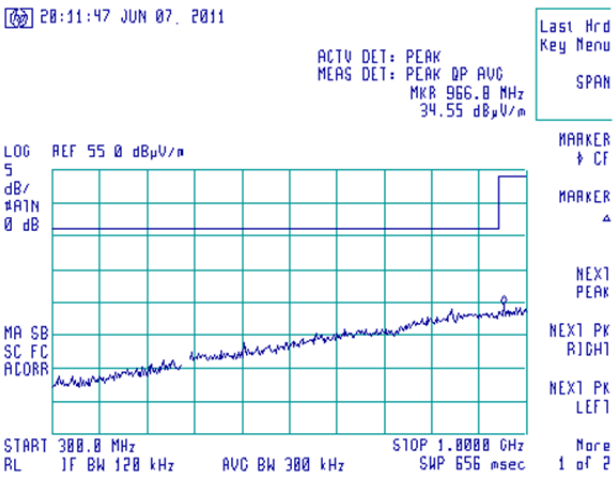


Horizontal

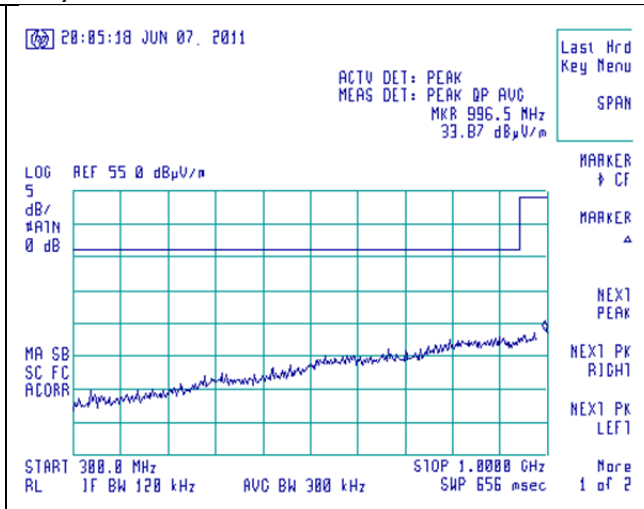


Vertical

300-1000 MHz, at 3m



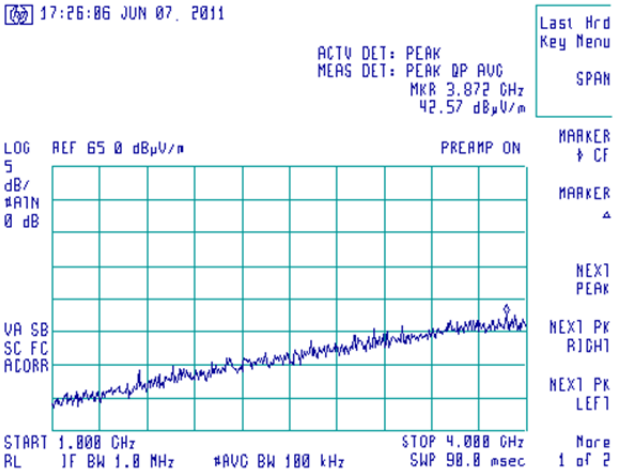
Horizontal



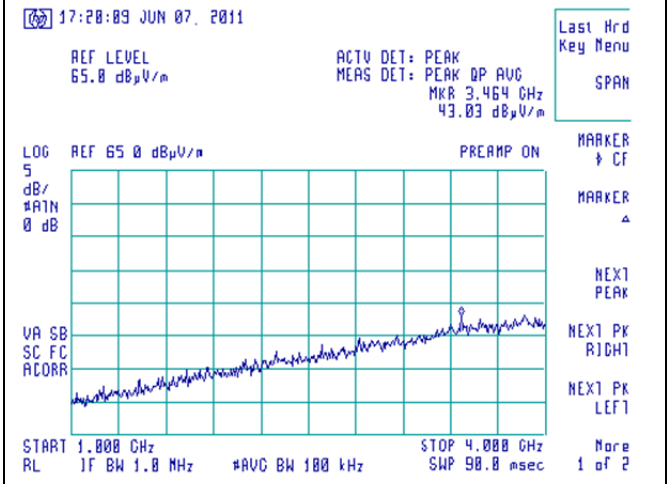
Vertical

Screen Captures - Radiated Emissions Testing *(continued)*

1000-4000 MHz, at 3m

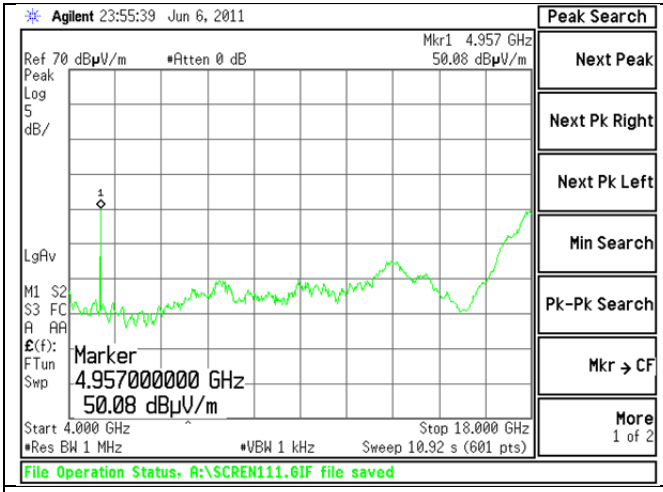


Horizontal

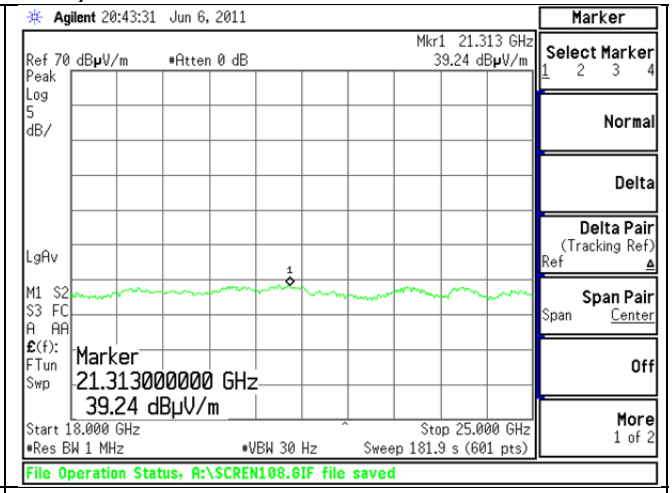


Vertical

4000-25000 MHz, at 1m



4 GHz to 18 GHz



18 GHz to 25 GHz

EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE: 7.2.2

6.1 Test Setup

The test area and setup are in accordance with ANSI C63.4 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to EMI receiver System. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 Test Procedure

The EUT was investigated in continuous modulated transmit mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

6.3 Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to the SI standard. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI System, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC Part 15.207 and RSS GEN 7.2.2 for Conducted Emissions for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

6.5 FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBµV)		Measuring Bandwidth
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6 CONDUCTED EMISSIONS TEST DATA CHART

Frequency Range inspected: 150 KHz to 30 MHz

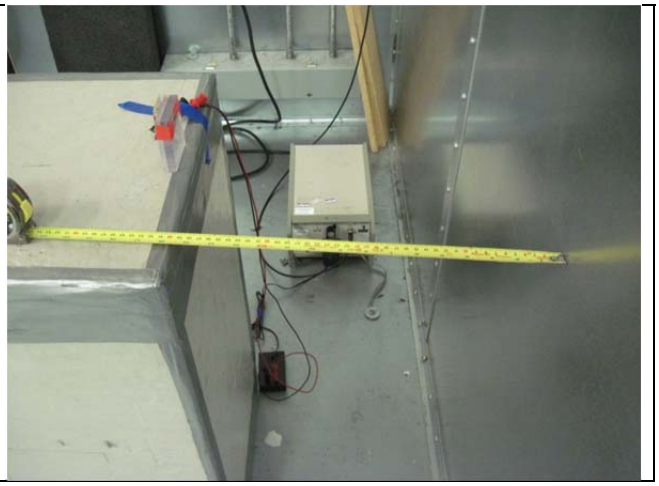
Manufacturer:	LS Research, LLC					
Date(s) of Test:	June 7th 2011					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Khairul Aidi Zainal					
Voltage:	120 VAC					
Operation Mode:	continuous receive					
Environmental Conditions in the Lab:	Temperature: 23° C Relative Humidity: 48 %					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

		QUASI-PEAK			AVERAGE		
Frequency (MHz)	**Line**	**Q-Peak Reading (dBµV)**	**Q-Peak Limit (dBµ V)**	**Quasi-Peak Margin (dB)**	**Average Reading (dBµV)**	**Average Limit (dBµ V)**	**Average Margin (dB)**
0.154	1.0	32.5	65.8	33.3	5.8	55.8	50.0
0.186	1.0	31.8	64.2	32.4	3.8	54.2	50.4
1.129	1.0	25.9	56.0	30.1	2.1	46.0	43.9
0.157	2.0	31.2	65.6	34.4	3.7	55.6	51.9
0.272	2.0	27.1	61.1	34.0	2.2	51.1	48.9
0.958	2.0	26.3	56.0	29.7	2.1	46.0	43.9

Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

6.7 Test Setup Photo(s) – Conducted Emissions Test

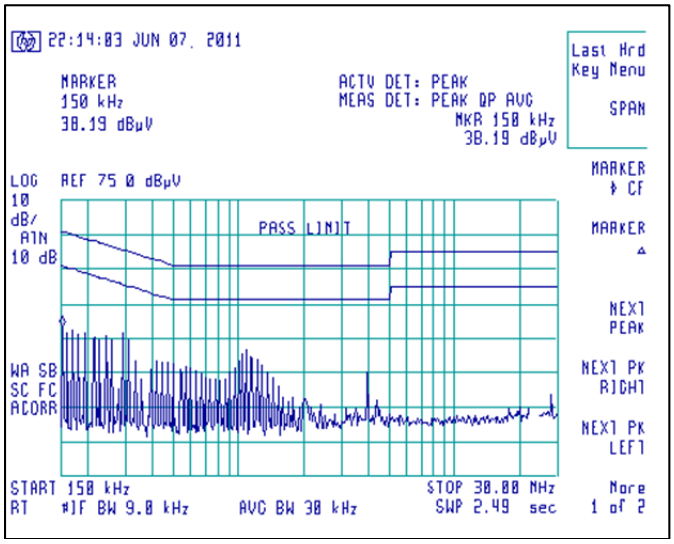


6.8 Screen Captures – Conducted Emissions Test

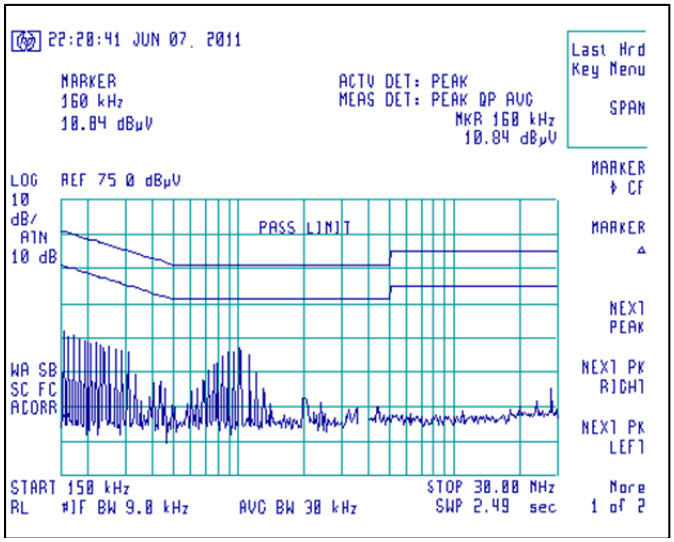
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.107 and RSS GEN.

The signature scans shown here are from channel 2445 MHz, chosen as being a good representative of channels.

Line 1



Line 2



APPENDIX A: Test Equipment List

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 29-Dec-2010 Type Test: Radiated Emissions Job #: C-1086

Prepared By: AIDI Customer: LSR Quote #: 310376

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	10/29/2010	10/29/2011	Active Calibration
2	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	4/27/2011	4/27/2012	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	10/19/2010	10/19/2011	Active Calibration
4	AA 960150	Bicon Antenna	EIS	31100	0003-3346	10/19/2010	10/19/2011	Active Calibration
5	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	10/29/2010	10/29/2011	Active Calibration
6	EE 960073	SpectrumAnalyzer	Agilent	E4446A	US45300564	9/22/2010	9/22/2011	Active Calibration
7	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	1/4/2011	1/4/2012	Active Calibration
8	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro	WLA622-4	123001	10/13/2010	10/13/2011	Active Calibration
9	AA 960143	Phaseflex	Gore	EKDD1001048.0	5546519	9/22/2011	9/22/2012	Active Calibration
10	AA 960142	Phaseflex	Gore	EMOCJOCJO36.0	4943263	9/23/2010	9/23/2011	Active Calibration
11	AA 960144	Phaseflex	Gore	EKDD1001010720	5800373	6/1/2011	6/1/2012	Active Calibration

Project Engineer: Aidi Quality Assurance: Peter

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date: 29-Dec-2010 Type Test: AC Mains Job #: C-1086

Prepared By: AIDI Customer: LSR Quote #: 310376

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	10/29/2010	10/29/2011	Active Calibration
2	AA 960072	Transient Limiter	HP	11947A	3107A02515	10/8/2010	10/8/2011	Active Calibration
3	AA 960008	LISN	EMCO	3816/2NM	9701-1057	1/4/2011	1/4/2012	Active Calibration
4	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	10/29/2010	10/29/2011	Active Calibration

Project Engineer: AIDI Quality Assurance: PETER

APPENDIX B: TEST STANDARDS – CURRENT PUBLICATION DATES RADIO

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2009		
ANSI C63.10	2009		
CISPR 11	2009-05	2009-12 P	
CISPR 12	2007-05		
CISPR 14-1	2005-11	2008-11	
CISPR 14-2	2001-11	2001-11	2008-05
CISPR 16-1-1 Note 1	2010-01		
CISPR 16-1-2 Note 1	2003	2004-04	2006-07
CISPR 22	2008-09		
CISPR 24	1997-09	2001-07	2002-10
EN 55011	2007-05		
EN 55014-1	2006		
EN 55014-2	1997		
EN 55022	2006	2007	
EN 60601-1-2	2007-03		
EN 61000-3-2	2006-05		
EN 61000-3-3	2008-12		
EN 61000-4-2	2009-05		
EN 61000-4-3	2006-07	2008-05	
EN 61000-4-4	2004		
EN 61000-4-5	2006-12		
EN 61000-4-6	2009-05		
EN 61000-4-8	1994	2001	
EN 61000-4-11	2004-10		
EN 61000-6-1	2007-02		
EN 61000-6-2	2005-12		
EN 61000-6-3	2007-02		
EN 61000-6-4	2007-02		
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IEC 61000-4-4	2004-07	2010-10	
IEC 61000-4-5	2005-11		
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IEC 61000-6-1	2005-03		
IEC 61326-1	2006-06		
ISO 14982	1998-07		
MIL Std. 461E	1999-08		
RSS GEN	2007-06		
RSS 119	2007-06		
RSS 123	1999-11		
RSS 125	2000-03		
RSS 131	2003-07		
RSS 136	2002-10		
RSS 137	2009-02		
RSS 210	2007-06		
RSS 213	2005-12		
RSS 243	2005-11		
RSS 310	2007-06		

Note 1: Test not on LSR Scope of Accreditation.

Updated on 02-03-10

P=Project FD= Final Draft

Appendix C: Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.8 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	1.128 Volts/Meter
Conducted Immunity	3 Volts level	1.0 V