a Laird Business

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ENGINEERING TEST REPORT # TR 315202 A
LSR Job #: C-2323

Compliance Testing of:
CSE Cisco Communication Module

Test Date(s):
November-December 2015

Prepared For:
Corporate Systems Engineering, LLC
1215 Brookville Way
Indianapolis, IN 46239

This Test Report issued:

Signature: Date: 3-14-16

Quality Assurance by:	**Report by:**
Khairul Aidi Zainal, Engineering Manager	Adam Alger, EMC Engineer
Signature: Date: 3-14-16	Signature: Date: 1-6-16

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LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: 1255.01

Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948
FCC Registration Number: 90756

Industrie Canada Industry Canada

Canada

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088-2
On file, 3 Meter Semi-Anechoic Chamber based on RSS-GEN – Issue 4
File Number: IC 3088-3

U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.
Date of Validation: November 20, 2002
Notified Body Identification Number: 1243

1.0 Summary of Test Report

In November – December 2015 the EUT, CSE Cisco Communication Module, as provided by Corporate Systems Engineering, LCC was tested and MEETS the following requirements:

FCC Requirement	IC Requirement	Test Requirements	Measurement Procedure	Compliance (Yes/No)
15.247 (a)(1)(i)	RSS-247 Section 5.1 (3)	Occupied Bandwidth	ANSI C63.10-2013 Section 7.8.7	Yes
15.247(b)(2)	RSS-247 Section 5.4 (1)	Maximum Output Power	ANSI C63.10-2013 Section 7.8.5	Yes
15.247 (a)(1)(i)	RSS-247 Section 5.1	Frequency-hopping device parameters	ANSI C63.10-2013 Section 7.8	Yes
15.247(d)	RSS-247 Section 5.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	ANSI C63.10-2013 Section 7.8.8	Yes
15.247(d), 15.209 & 15.205	RSS-GEN Section 8.9, 8.10	Transmitter Radiated Emissions in Restricted Bands	ANSI C63.10-2013 Section (6.3,6.5,6.6)	Yes
2.1055 (d)	RSS-GEN Section 6.11	Frequency Stability	ANSI C63.10-2013 Section 6.8	Yes
15.207 15.107	RSS-GEN Section 8.8	Power Line Conducted Emissions Measurements	ANSI C63.10-2013 Section 6.2	Yes
15.109	RSS-GEN Section 7	Receive Mode (Digital Device) Radiated Emissions	ANSI C63.4-2014 Section 8	Yes

2.0 Test Facilities

All testing was performed at:

LS Research, LLC
W66 N220 Commerce Court
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of 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.

3.0 Client Information

Manufacturer Name:	Corporate Systems Engineering, LLC
Address:	1215 Brookville Way Indianapolis, IN 46239
Contact Person:	Charles W. Kile

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	CSE Cisco Communication Module
Model Number:	3130-0117-00A
Serial Number:	Engineering Sample (1 with u.fl port for RF Conducted measurements, 1 with antenna attached)
FCC:	0016848673
IC:	20780-3130011700A

3.2 Product Information

900 MHz FHSS with integral antenna

3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

3.5 Additional Information

EUT programmed for continuous transmit, normal (hopping) mode transmit, and continuous receive mode via USB cable connected to computer running proprietary software.

4.0 Conditions of Test

Environmental:

Temperature: 20-25º C
Relative Humidity: 30-60%
Atmospheric Pressure: 86-106 kPa

Mains Voltage: 5 VDC

5.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

Frequency Range	Resolution Bandwidth
9 kHz – 150 kHz	200 Hz
150 kHz – 30 MHz	9 kHz
30 MHz – 1000 MHz	120 kHz
Above 1000 MHz	1 MHz

6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.207, Industry Canada RSS-247, Issue 1 (2015), Annex 8, RSS-GEN Issue 4 (2014).

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.

Appendix A – Test Equipment

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 16-Oct-2015 Type Test : Emissions Job # : C-2323

Prepared By: Adam Alger Customer : Corporate Systems Engineering Quote #: 315202

No	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	8/6/2015	8/6/2016	Active Calibration
2	AA 960163	Log Periodic Antenna	A.H. Systems, In	SAS-512-2	500	3/16/2015	3/16/2016	Active Calibration
3	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	7/9/2015	7/9/2016	Active Calibration
4	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-S+	40201429	7/9/2015	7/9/2016	Active Calibration
5	EE 960089	LISN - 15A	COM-POWER	LI-215A	191943	3/2/2015	3/2/2016	Active Calibration
6	EE 960085	N9038A MXE 26.5GHz Receiver	Agilent	N9038A	MY51210148	5/6/2015	5/6/2016	Active Calibration

Project Engineer: Quality Assurance:

Appendix B – Test Data
B.1 – RF Conducted Emissions

Manufacturer	Corporate Systems Engineering
Test Location	LS Research, LLC
Rule Part	FCC 15.247 IC RSS-247
General Measurement Procedure	ANSI C63.10 Section 6.7
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

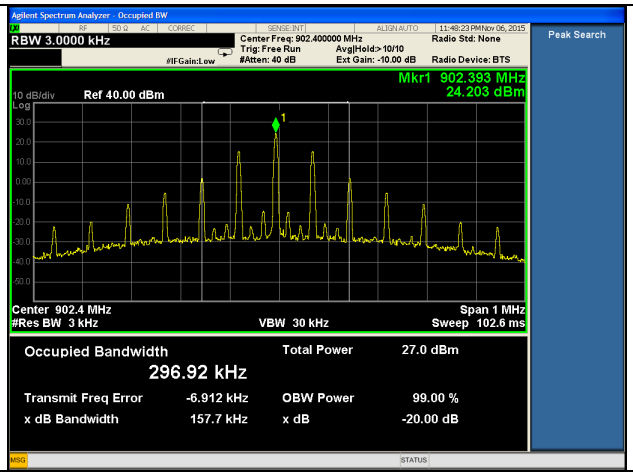
B.1.1 – RF Conducted – Occupied Bandwidth

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1)(i) IC RSS-247 Section 5.1(3)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8.7
Additional Description of Measurement	Peak detector used
Additional Notes	Continuous transmit modulated used for this test.

Table

Frequency (MHz)	20 dB OBW (kHz)	99 % BW (kHz)
902.4	157.7	296.9
914.8	157.7	296.3
927.6	157.6	296.2

Plots



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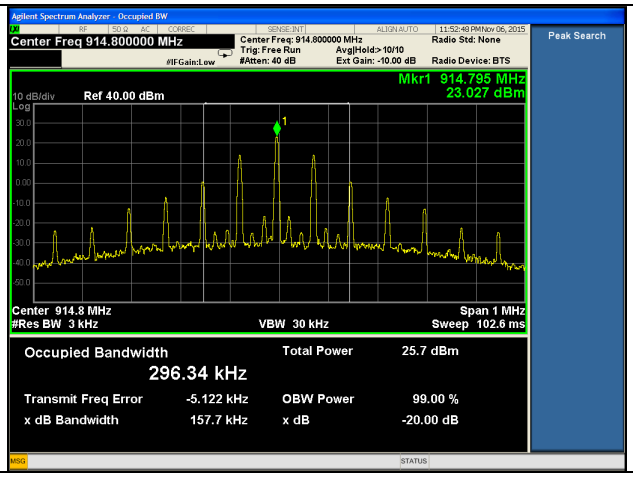

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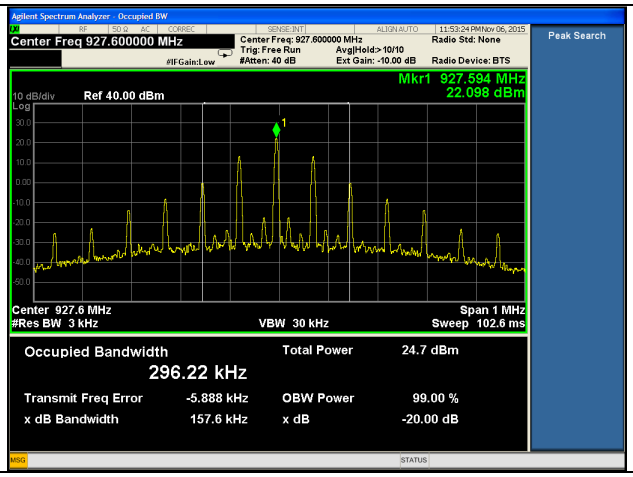


High

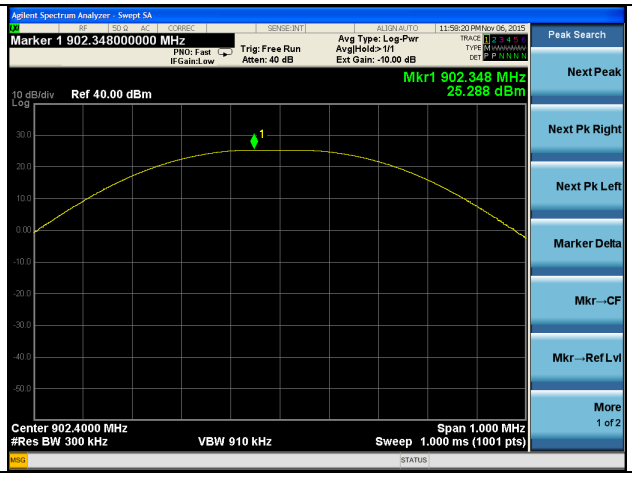
B.1.2 – RF Conducted – Maximum Output Power

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (b) (2) IC RSS-247 Section 5.4 (1)
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8.5
Additional Description of Measurement	RBW greater than the 20 dB bandwidth of signal
Additional Notes	Continuous transmit modulated used for this test. Sample Calculation: Margin (dB) = Limit – Measured level

Table

Frequency (MHz)	20 dB OBW (kHz)	99 % BW (kHz)	Power (dBm)	Power Limit (dBm)	Margin (dB)
902.4	157.7	296.9	25.29	30	4.71
914.8	157.7	296.3	24.28	30	5.72
927.6	157.6	296.2	23.30	30	6.70

Plots



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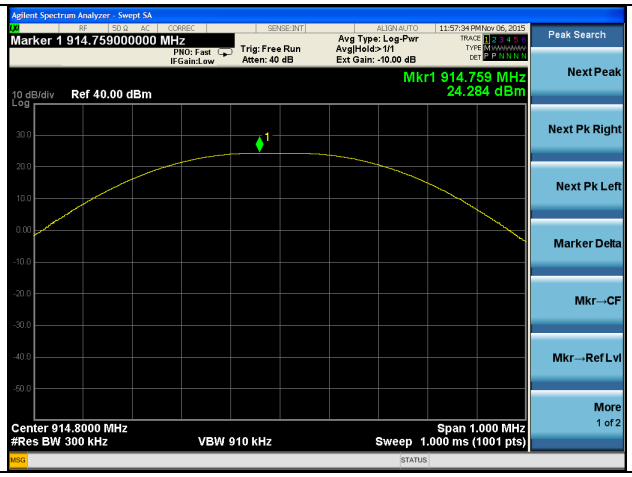

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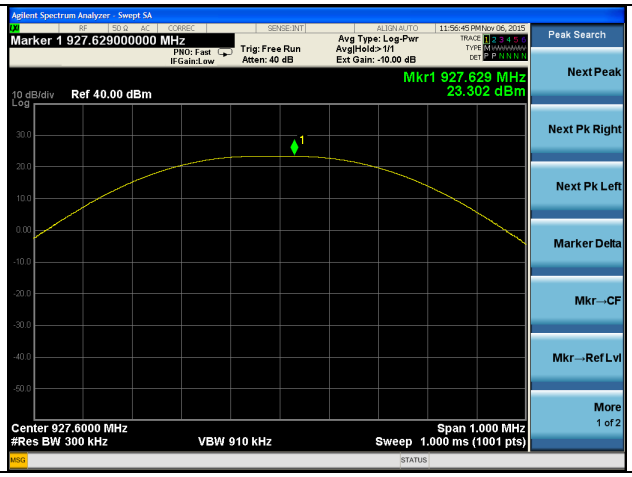
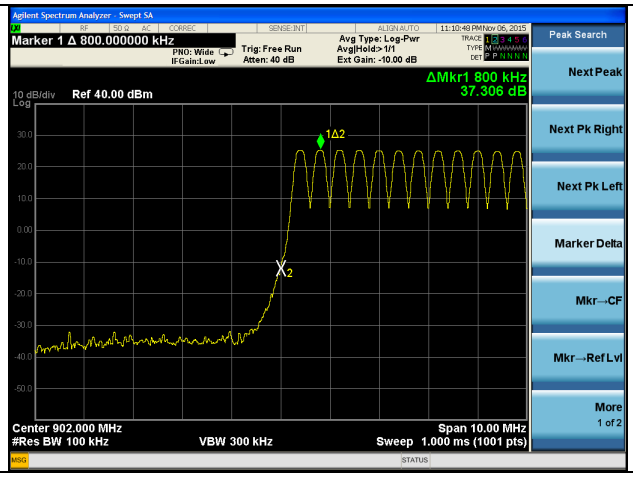


High

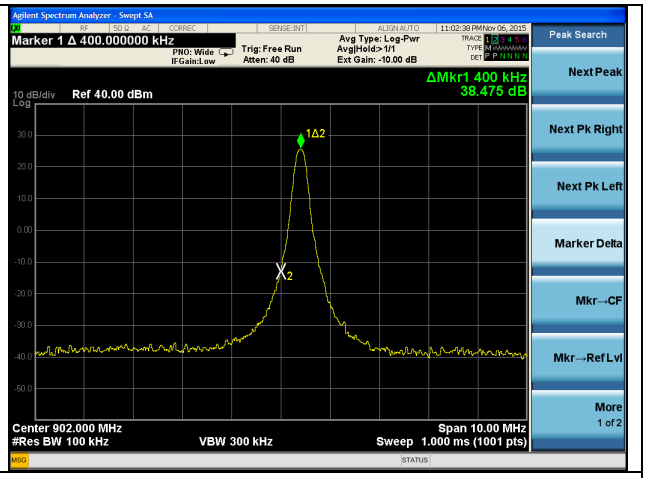
B.1.3 – RF Conducted – Transmitter Spurious Emissions

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (d) IC RSS-247 Section 5.5
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8.6 (6.10)
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	1. Plots show emissions outside of authorized band attenuated greater than 20 dB when compared to in-band emissions within 100 kHz RBW. 2. Band-edge measurements tested with EUT in single channel continuous transmit modulated and in normal hopping mode.

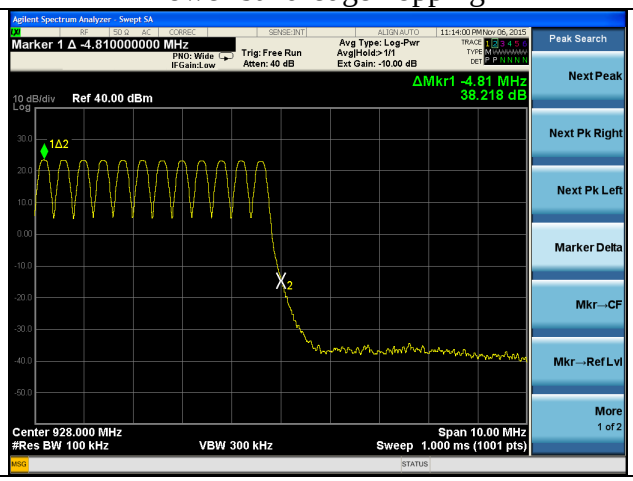
Plots – Band-edge



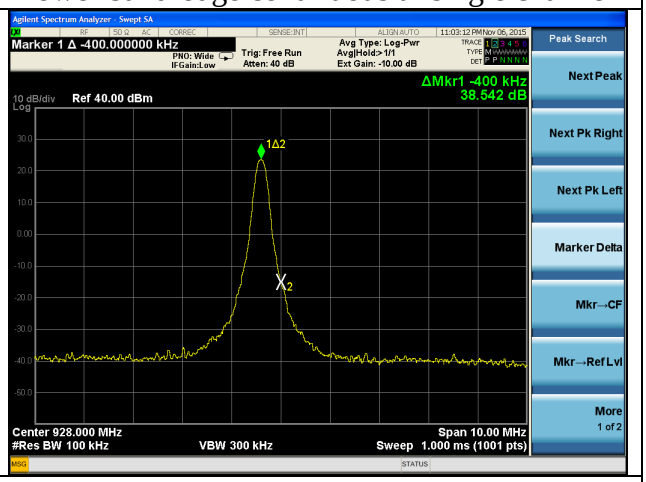
Lower band-edge hopping



Lower band-edge continuous tx single channel

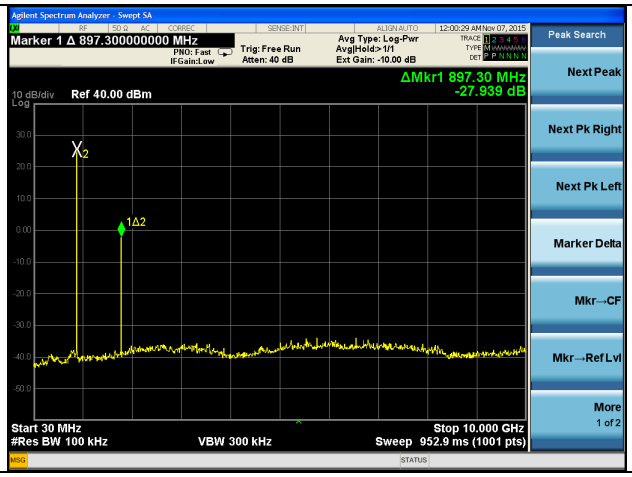


Upper band-edge hopping



Upper band-edge continuous tx single channel

Plots



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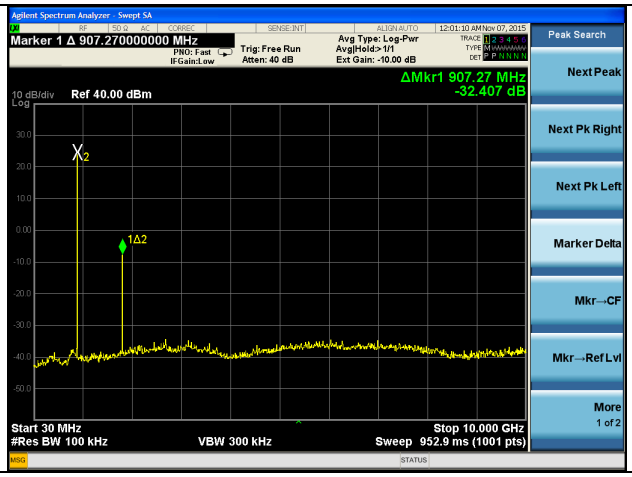

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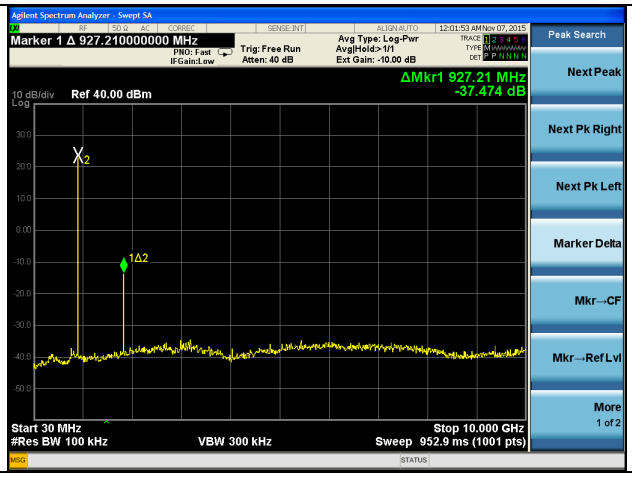


High

B.1.4 – RF Conducted – Frequency Stability

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 2.1055 RSS-GEN Section 6.11
Specific Measurement Procedure	ANSI C63.10-2013 Section 6.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by a variable DC supply. Below is data showing stability of the fundamental frequency. Continuous transmit un-modulated used for this test. EUT operates at 5.0 VDC nominal

	5.00	4.25	5.75	
	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQ DRIFT (Hz)
LOW CHANNEL	902393459	902393745	902393642	286
MID CHANNEL	914793285	914793255	914793266	30
HIGH CHANNEL	927593020	927592993	927593107	114

B.1.5 – RF Conducted – Hopping Requirements

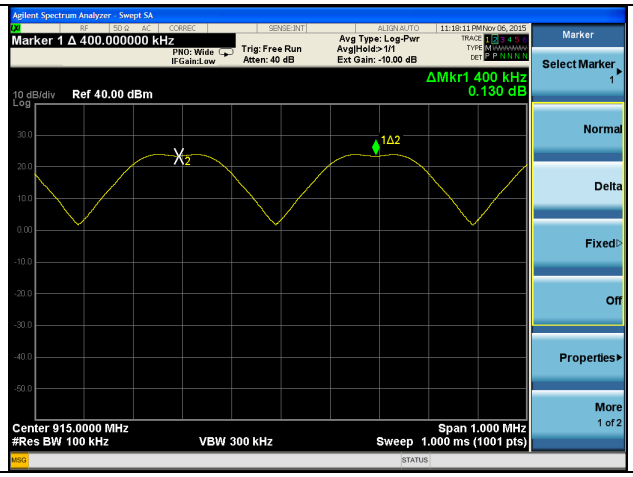
Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247 (a)(1)(i) RSS-GEN Section 5.1
Specific Measurement Procedure	ANSI C63.10-2013 Section 7.8
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	Hopping mode used for this test

Requirement:
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

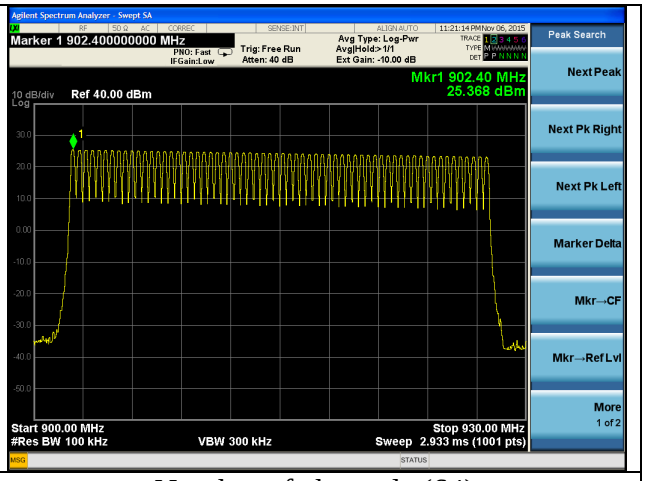
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period

1. Hopping separation > 20 dB (400 kHz > 157 kHz)
2. 20 dB BW < 250 kHz (157 kHz < 250 kHz)
3. Number of channels = 64 > 50
4. Average time of occupancy = 52.2 ms * 7 = .3654 seconds < 0.4 seconds

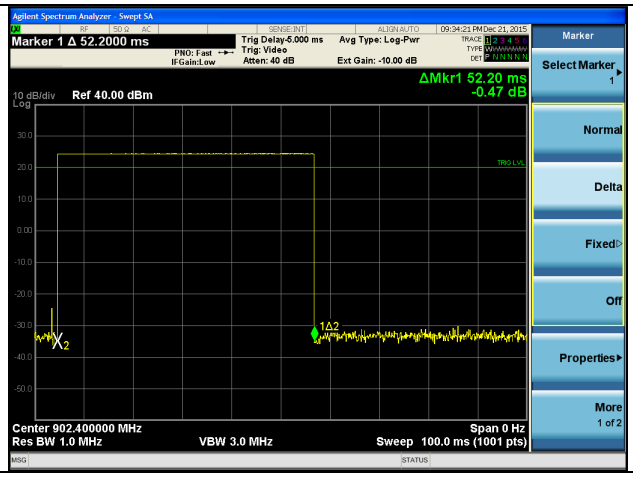
Plots



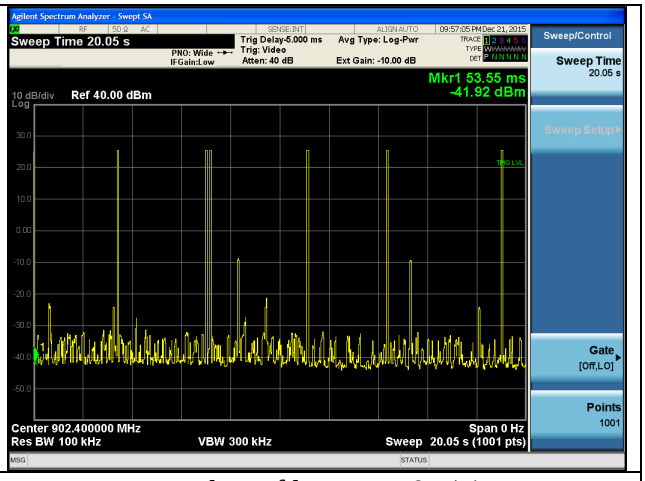
Channel separation (400 kHz)



Number of channels (64)



Length of pulse (52.2 ms)



Number of hops in 20s (7)

B.2 – Transmitter Radiated Emissions in Restricted Bands

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-GEN Section 8.9,8.10			
Measurement Procedure	ANSI C63.10 – 2013 Section (6.3,6.5,6.6)			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.2.1 – Radiated Emissions in Restricted Bands

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.247/ 15.205 / 15.209 IC RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.10-2013 Section 6.6
Test Distance	3 meter
EUT Placement	150 cm height non-conductive table centered on turn-table , absorbers covering ground plane
Detectors	Below 1 GHz: Quasi-Peak, RBW 120 kHz Above 1 GHz: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz
Additional Notes	1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported.

Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin (dB)

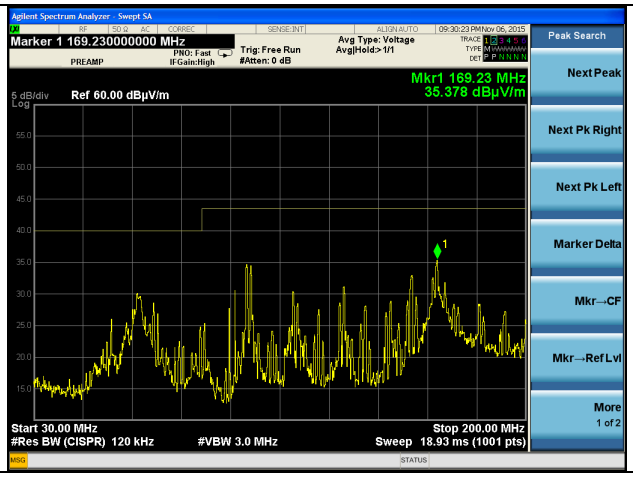
Table – Emissions 30-1000 MHz in Restricted bands

Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
169.2	H	214	147	36.27	43.5	7.2
169.2	V	187	100	35.13	43.5	8.4
960.0	H	324	150	41.31	46.0	4.7
960.0	H	331	150	42.20	46.0	3.8
960.0	H	334	142	44.10	46.0	1.9

Table – Emissions 1-10 GHz in Restricted bands

Channel	Frequency (MHz)	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Average Reading (dBµV/m)	Peak Reading (dBµV/m)	Average Margin (dB)	Peak Margin (dB)
Low	2707.2	Vertical	Vertical	141	5	52.82	54.75	1.2	19.3
			Horizontal	229	241	50.98	53.26	3.0	20.7
		Horizontal	Vertical	179	9	49.11	51.95	4.9	22.1
			Horizontal	230	346	51.67	54.03	2.3	20.0
		Flat	Vertical	145	293	49.02	51.78	5.0	22.2
			Horizontal	113	308	49.61	52.15	4.4	21.9
Mid	2744.4	Vertical	Vertical	116	13	48.14	51.26	5.9	22.7
			Horizontal	218	32	46.72	50.54	7.3	23.5
		Horizontal	Vertical	215	342	45.21	49.44	8.8	24.6
			Horizontal	180	328	47.21	50.73	6.8	23.3
		Flat	Vertical	100	165	47.70	51.01	6.3	23.0
			Horizontal	165	155	44.77	48.75	9.2	25.3
High	2782.8	Vertical	Vertical	154	249	42.63	48.23	11.4	25.8
			Horizontal	199	209	42.21	47.29	11.8	26.7
		Horizontal	Vertical	148	233	39.22	46.53	14.8	27.5
			Horizontal	143	67	41.84	47.12	12.2	26.9
		Flat	Vertical	128	196	44.16	48.36	9.8	25.6
			Horizontal	108	82	43.10	47.87	10.9	26.1

Plots – 30-800 MHz



30-200 MHz Vertical

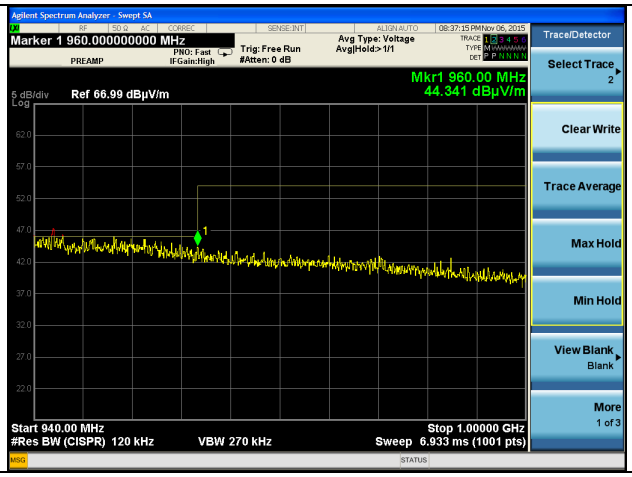
30-200 MHz Horizontal

200-800 MHz Vertical

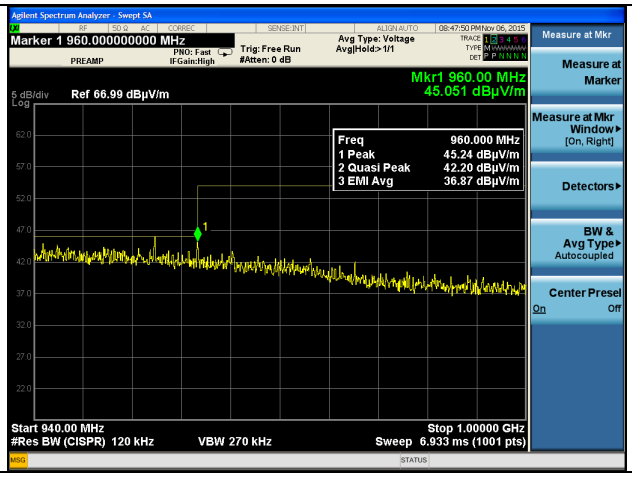
200-800 MHz Horizontal

Note: No restricted bands between 614 and 960 MHz

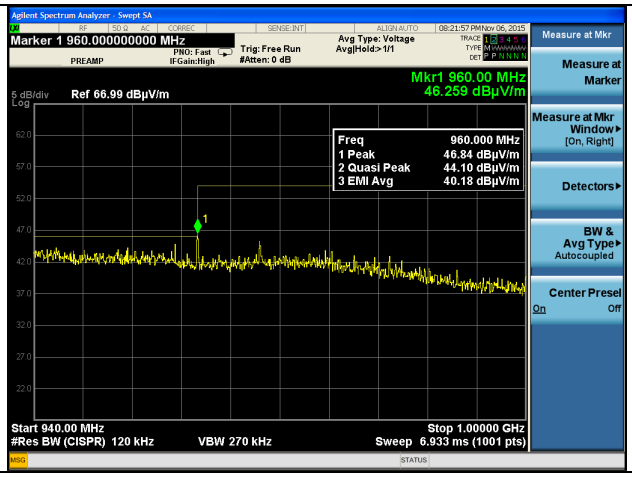
Plots – Restricted band 960-1000 MHz



Low

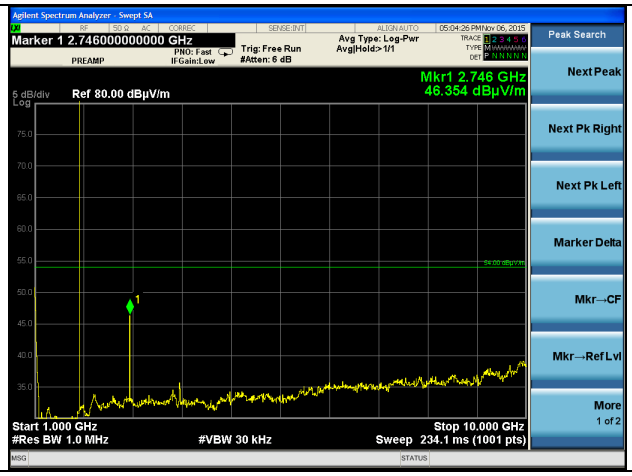


Mid

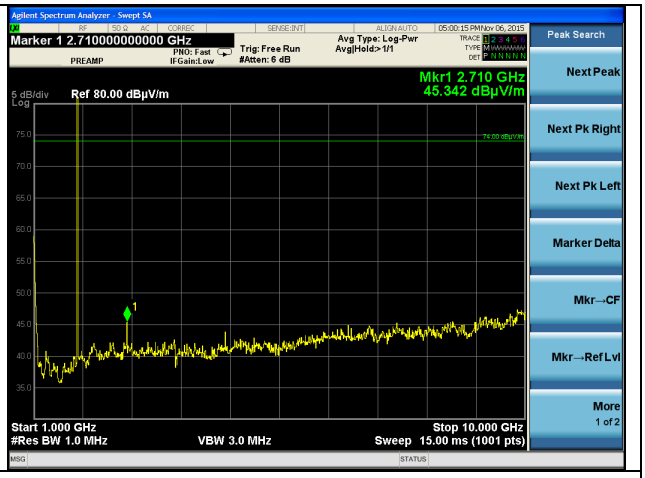


High

Plots – Restricted bands in the 1-10 GHz range



Reduced VBW



Peak

B.3 – Radiated Emissions in Receive Mode

Rule Part(s)	FCC: 15.109 IC: RSS-GEN Section 7			
Measurement Procedure	ANSI C63.4-2014 Section 8			
Test Location	LS Research, LLC – FCC/IC Listed 3 meter Chamber			
Test Distance	See data section			
EUT Placement	Above 1 GHz: 80 cm height non-conductive table above reference ground plane covered with absorbers Below 1 GHz: 80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-200 MHz	Log Periodic Dipole Array: 200-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	Standard Gain Horn: 18-26GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: At least 300 kHz		1 - 40 GHz: RBW : 1MHz VBW: At least 3 MHz Peak VBW: 30 Hz Average	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

Limits:

Frequency (MHz)	3 m Limit (µV/m)	3 m Limit (dBµV/m)	Type
30-88	100	40.0	Quasi-Peak
88-216	150	43.5	Quasi-Peak
216-960	200	46.0	Quasi-Peak
Above 960	500	54.0	Average (>1 GHz)

B.3.1 – Radiated Spurious Emissions Receive Mode (30-1000 MHz)

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table (no absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel

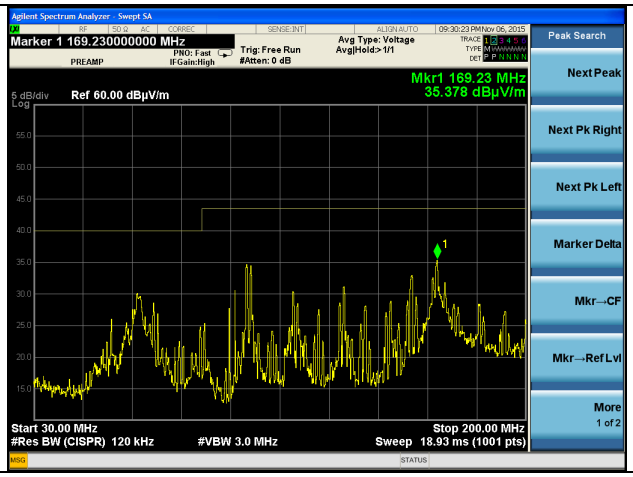
Example Calculation:

Limit (dBµV/m) – Reading (dBµV/m) = Margin

Table

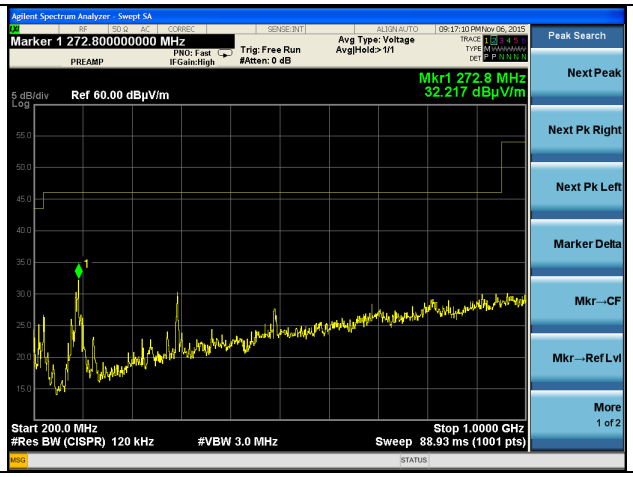
Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Margin (dB)
169.23	H	214	147	36.27	43.5	7.2
169.23	V	187	100	35.13	43.5	8.4
103.61	V	13	100	35.01	43.5	8.5
272.8	V	237	143	30.35	46.0	15.7
272.8	H	346	208	26.97	46.0	19.0

Plots



30-200 MHz Vertical

30-200 MHz Horizontal



200-1000 MHz Vertical

200-1000 MHz Horizontal

B.3.2 – Radiated Spurious Emissions Receive Mode (1-10 GHz)

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC 15.109 IC RSS-GEN
Measurement Procedure	ANSI C63.4-2013 Section 8
Test Distance	3 meter 1-10 GHz
EUT Placement	80 cm height non-conductive table centered on turn-table (absorbers on ground plane)
Detectors	Peak; RBW 120 kHz
Additional Notes	1) Tested in continuous receive mode with EUT in three orientations 2) Emissions not effected by channel

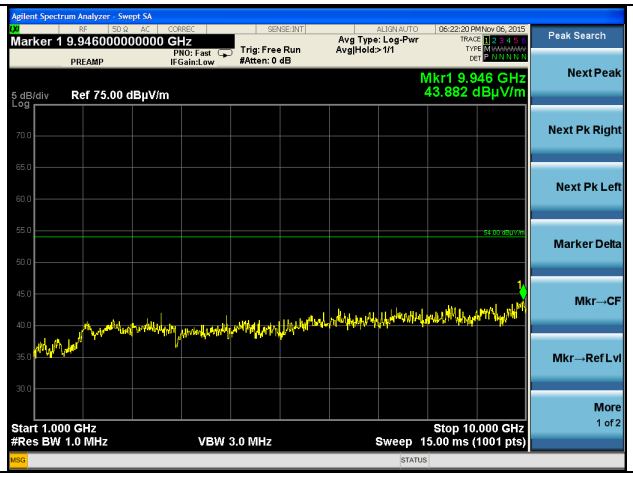
Example Calculation:
Limit (dBµV/m) – Reading (dBµV/m) = Margin

Table

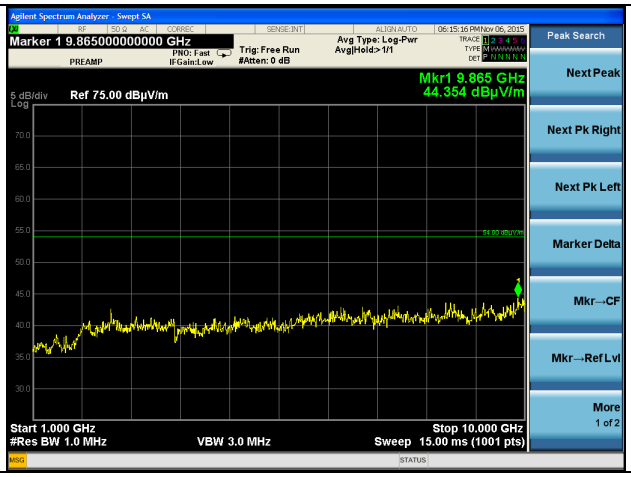
Frequency (MHz)	Antenna Polarity	Azimuth (degree)	Height (cm)	Peak Reading (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)
9946	H	0	100	43.88	54	10.1
9865	V	0	100	44.35	54	9.7
9946	H	0	100	42.87	54	11.1
9910	V	0	100	44.17	54	9.8
9901	H	0	100	43.96	54	10.0
9928	V	0	100	44.83	54	9.2

Note: Measurements of system noise floor. No emissions found above system noise floor. Peak meets average limits.

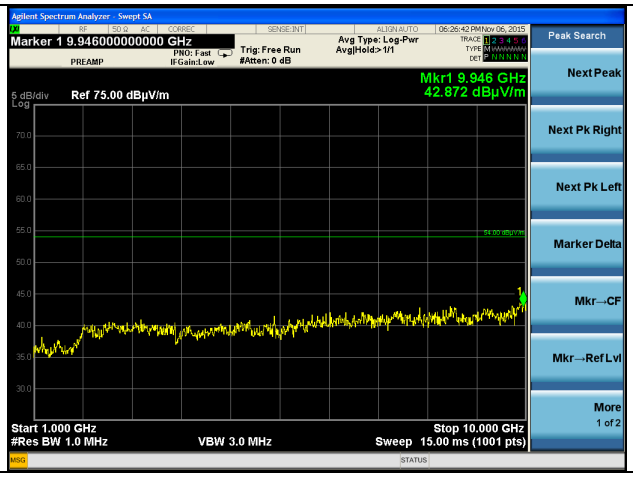
Plots



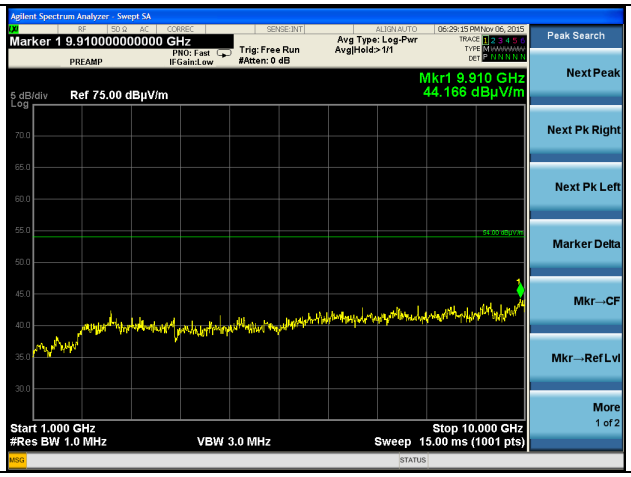
Low Ch – Horizontal



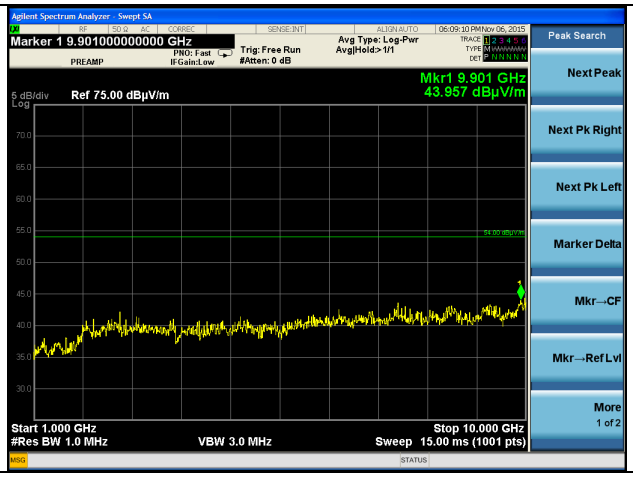
Low Ch – Vertical



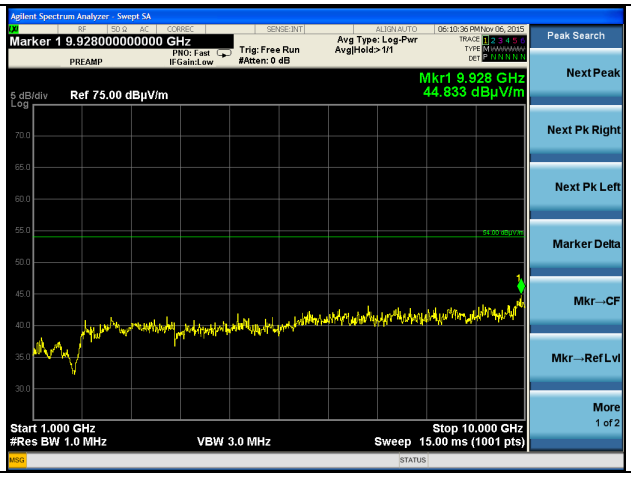
Mid Ch – Horizontal



Mid Ch – Vertical



High Ch – Horizontal



High Ch – Vertical

B.4 – AC Mains Conducted Emissions

Rule Part(s)	FCC: 15.207 / 15.107 IC: RSS-247 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 – 2013
Test Location	LS Research, LLC – Conducted Emissions Area
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table above reference ground plane
Frequency Range of Measurement	150 kHz – 30 MHz
Measurement Detectors	Peak, Quasi-Peak, Average RBW: 9 kHz VBW: At least 27 kHz
Description of Measurement	1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral). 3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit.
Example Calculations	Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)

Limits of Conducted Emissions at the AC Mains Ports:

Frequency Range (MHz)	Class B Limits (dBµV)	
	Quasi-Peak	Average
0.150 -0.50 *	66-56	56-46
0.5 – 5.0	56	46
5.0 – 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

B.4.1 – AC Mains Conducted Emissions

Manufacturer	Corporate Systems Engineering
Date	11-06-15
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.207 / 15.107 / RSS-GEN
Measurement Procedure	ANSI C63.4 - 2014 ANSI C63.10 - 2013 Section 6.2
Test Voltage	120 VAC 60 Hz
EUT Placement	80 cm height non-conductive table, 40 cm from vertical ground plane
Detectors	Peak; RBW 9 kHz Quasi-Peak and Average
Additional Notes	1) Tested in continuous transmit and receive with no significant difference between operating channels.

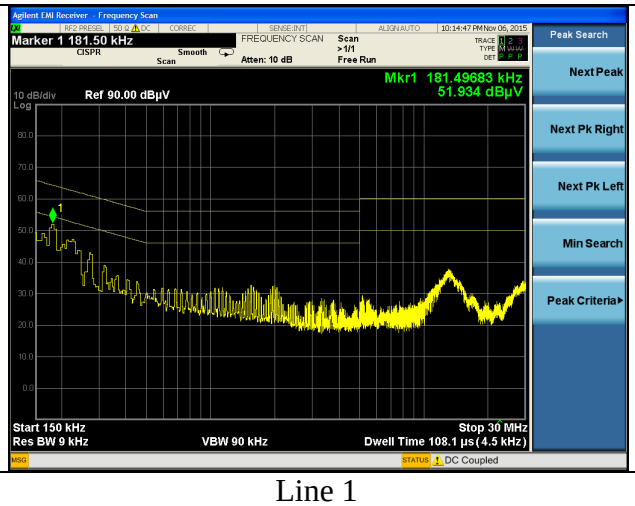
Example Calculation:

Margin (dB) = Limit (dBµV) – Reading (dBµV)

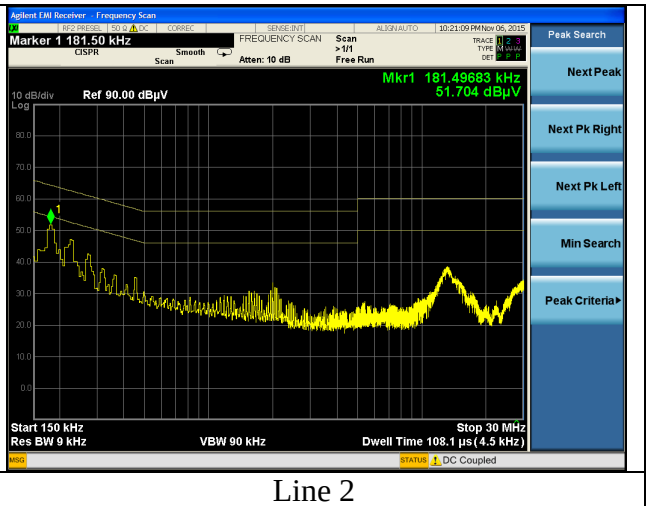
Table

Frequency (MHz)	Line	Peak Reading (dBµV)	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.181	1	52.0	50.8	64.4	13.6	40.2	54.4	14.2
0.271	1	43.4	40.9	61.1	20.2	31.7	51.1	19.4
0.316	1	39.5	36.6	59.8	23.2	28.5	49.8	21.3
0.181	2	51.9	50.4	64.4	14.0	37.5	54.4	16.9
0.226	2	47.0	45.5	62.6	17.1	33.3	52.6	19.3
0.271	2	43.4	40.8	61.1	20.3	30.1	51.1	21.0

Plots



Line 1



Line 2

Appendix C - Uncertainty Summary

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	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64°/ 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2016	Code of Federal Regulations – Telecommunications
RSS-247 Issue 1	2015	Digital Transmissions Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
RSS-GEN Issue 4	2014	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.4	2014	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.
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices

END OF REPORT

Date	Version	Comments	Person
1-6-16	V0	Initial Draft Release	Adam A
3-14-16	V1	Final Release	Adam A