

TEST REPORT

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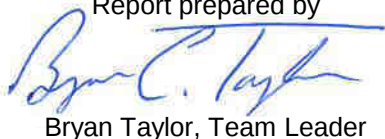
Product Name: WCAT Module
Model Number: WCATA002
FCCID: ZKJ-WCATA002

FCC Standards: Title 47 CFR Part 15 Subpart B and C

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510

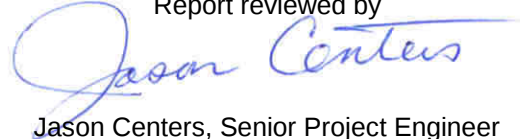
Client:
GE Digital Energy
AP6-1NW Appliance Park
Louisville, KY 40225

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TABLE OF CONTENTS

1	<i>Introduction and Conclusion</i>	<i>3</i>
2	<i>Test Summary</i>	<i>3</i>
3	<i>Description of Equipment Under Test</i>	<i>4</i>
4	<i>Peak Conducted Power</i>	<i>6</i>
5	<i>Occupied Bandwidth</i>	<i>8</i>
6	<i>Conducted Spurious Emissions.....</i>	<i>15</i>
7	<i>Power Spectral Density</i>	<i>19</i>
8	<i>Radiated Spurious Emissions (Transmitter).....</i>	<i>25</i>
9	<i>Radiated Spurious Emissions (Receiver).....</i>	<i>31</i>
10	<i>AC Powerline Conducted Emissions</i>	<i>34</i>
11	<i>Antenna Requirement per FCC Part 15.203.....</i>	<i>37</i>
12	<i>Measurement Uncertainty.....</i>	<i>38</i>
13	<i>Revision History</i>	<i>39</i>

1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Peak Conducted Power	§ 15.247(b)(3)(4)	RSS-210 (A8.4)	Pass
8	Occupied Bandwidth	§ 15.247(a)(2)	RSS-210 (A8.2), RSS-GEN (4.6.1)	Pass
15	Conducted Spurious Emissions	§ 15.247(d)	RSS-210 (A8.5)	Pass
19	Power Spectral Density	§ 15.247(e)	RSS-210 (A8.2b)	Pass
25	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (2.2) (A8.5)	Pass
31	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (6.1)	Pass
34	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
37	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	GE Digital Energy
Model Number	WCATA002
Serial Number	Test Sample 2
FCC Identifier	ZKJ-WCATA002
Receive Date	4/22/2014
Test Start Date	4/22/2014
Test End Date	5/8/2014
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2412MHz – 2462MHz
Mode(s) of Operation	802.11b/g/n
Modulation Type	BPSK, QPSK, CCK, OFDM
Duty Cycle	100%
Transmission Control	Test Commands
Test Channels	1, 6, 11
Antenna Type (15.203)	Internal
Power Supply	USB

Description of Equipment Under Test

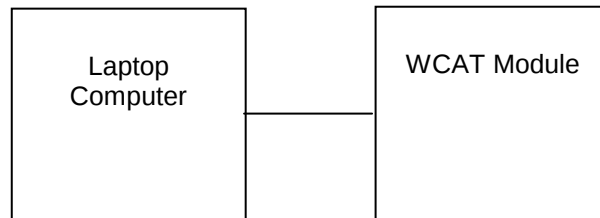
The equipment under test was a WiFi Transceiver module.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting 802.11 b, g, or n (HT-20) on low mid or high channels
2	Receive / idle mode

3.1 System setup including cable interconnection details, support equipment and simplified block diagram

3.2 EUT Block Diagram:



3.3 Cables:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
USB Power Cable	4 ft	None	Yes	AC/DC Power Adapter	DC Input to Test Jig
Ethernet Cable	6 ft	Yes	None	Test Sample	Laptop

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	Gateway	LT28002u	Not labeled

4 Peak Conducted Power

4.1 Test Limits

§ 15.247(b)(3): For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 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.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247). The peak output power was measured using the channel power function of the spectrum analyzer.

4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/10/2013	9/10/2014

4.4 Results:

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	19.86	19.99	21.39	22.67
	2437	6	19.65	19.75	21.11	22.65
	2462	11	19.49	19.73	21.09	22.49

Peak

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	16.63	16.68	17.65	17.72
	2437	6	16.53	16.55	17.64	17.77
	2462	11	16.19	16.36	17.51	17.66

Average

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	20.95	21.07	21.31	21.33	21.81	21.85	21.85	21.93
	2437	6	20.94	21.04	21.46	21.42	21.83	21.87	21.86	22.17
	2462	11	20.92	21.05	21.38	21.4	21.79	21.88	21.87	22.09

Peak

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	13.88	13.89	13.89	14.08	14.42	14.51	14.52	14.67
	2437	6	13.82	13.85	13.91	14.09	14.52	14.62	14.68	14.71
	2462	11	13.86	13.86	13.91	14.03	14.47	14.52	14.55	14.68

Average

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n (20MHz)	2412	1	20.21	20.24	20.46	20.63	20.74	20.88	21.01	21.12
	2437	6	20.13	20.31	20.38	20.42	20.56	20.91	20.98	21.08
	2462	11	20.09	20.28	20.36	20.45	20.54	20.89	21.05	21.11

Peak

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7
802.11n (20MHz)	2412	1	13.11	13.21	13.36	13.58	13.61	13.65	13.67	13.72
	2437	6	13.13	13.26	13.41	13.54	13.62	13.67	13.69	13.78
	2462	11	13.29	13.33	13.42	13.48	13.53	13.53	13.54	13.57

Average

5 Occupied Bandwidth

5.1 Test Limits

§ 15.247(a)(2): For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz.

5.2 Test Procedure

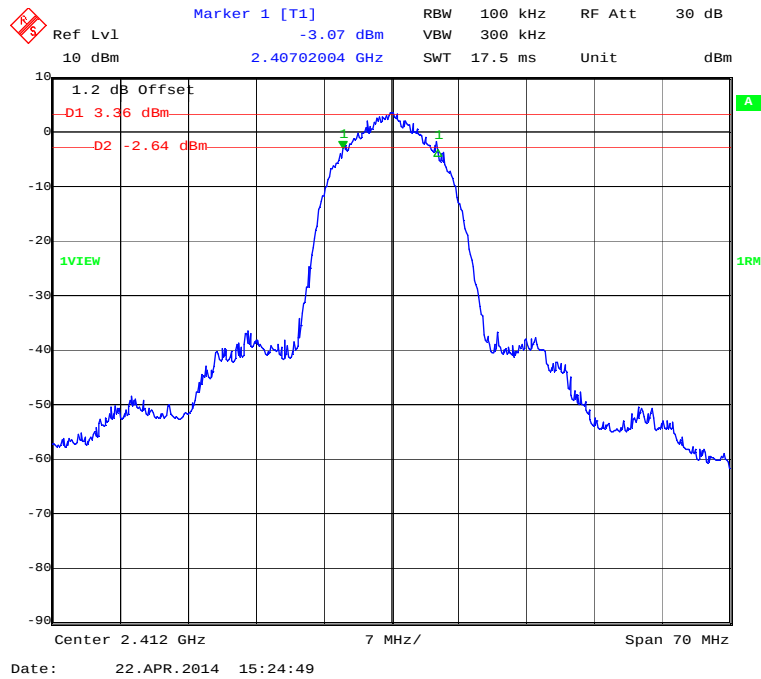
ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

5.3 Test Equipment Used:

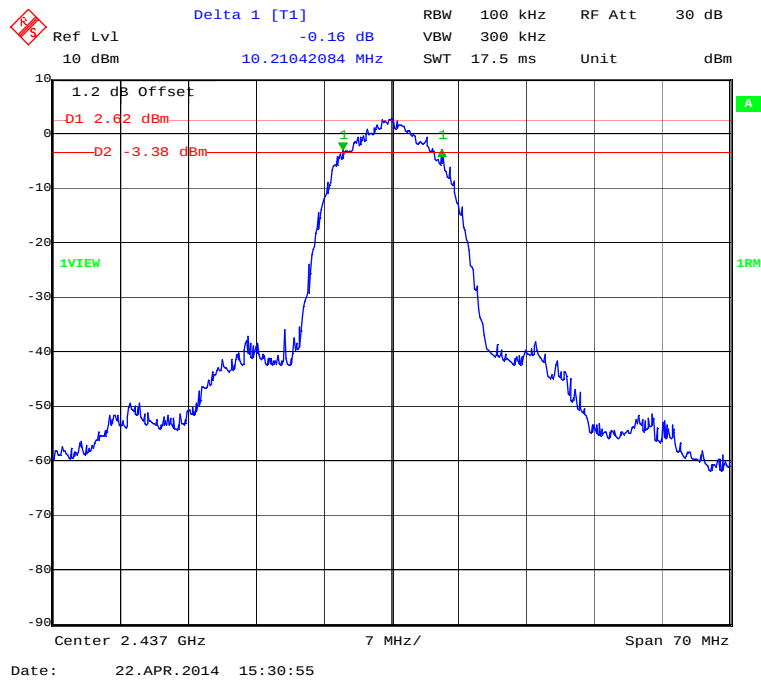
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/10/2013	9/10/2014

5.4 Results:

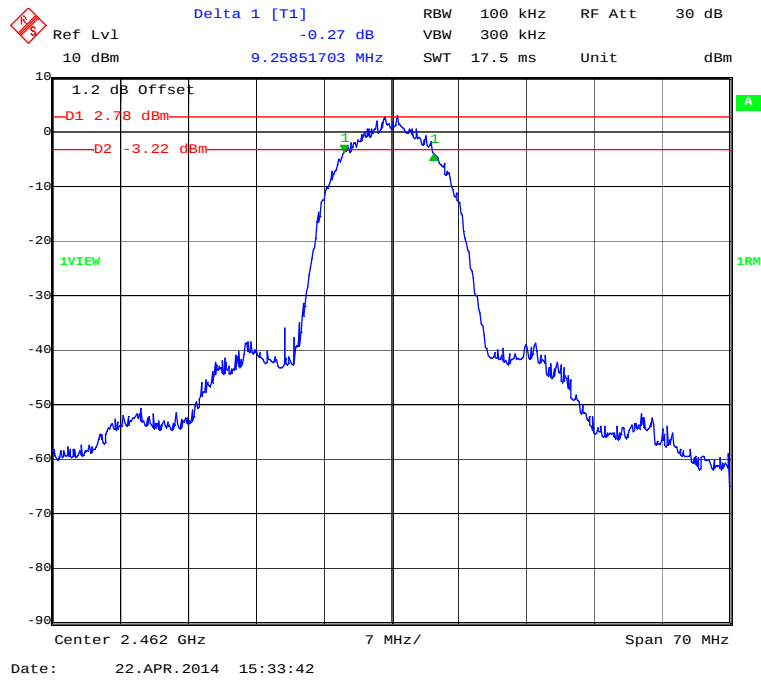
Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
802.11b	1	2412	9.81MHz	---	Pass
802.11b	6	2437	10.21MHz	13.32MHz	Pass
802.11b	11	2462	9.25MHz	---	Pass
802.11g	1	2412	16.4MHz	---	Pass
802.11g	6	2437	16.27MHz	16.41MHz	Pass
802.11g	11	2462	16.27MHz	---	Pass
802.11n (20MHz)	1	2412	17.25MHz	---	Pass
802.11n (20MHz)	6	2437	17.39MHz	17.53MHz	Pass
802.11n (20MHz)	11	2462	17.11MHz	---	Pass



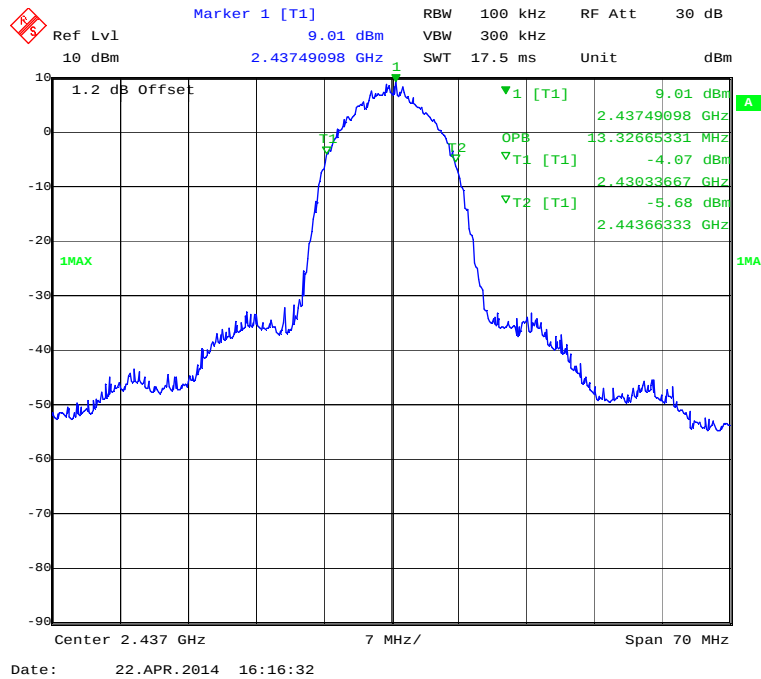
6dB Bandwidth Plot (Channel 1) – 802.11b mode



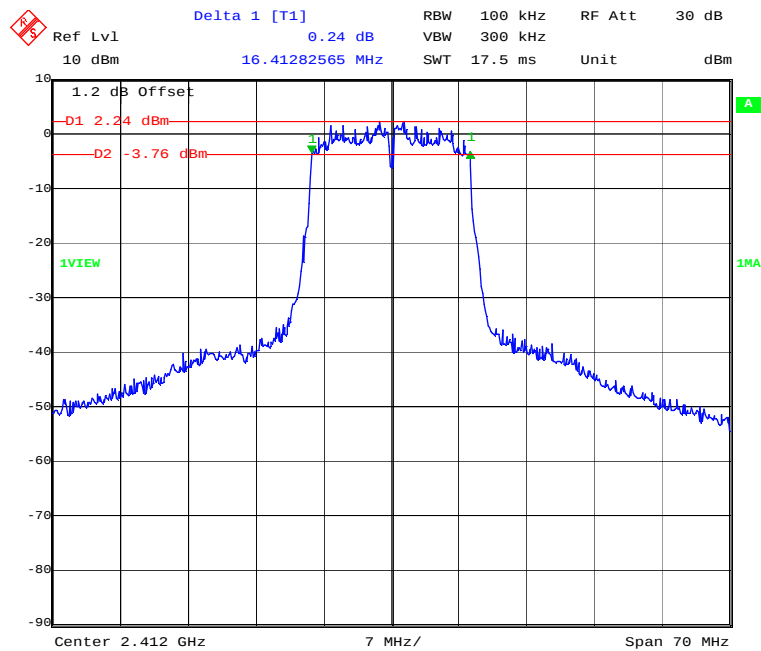
6dB Bandwidth Plot (Channel 6) – 802.11b mode



6dB Bandwidth Plot (Channel 11) – 802.11b mode

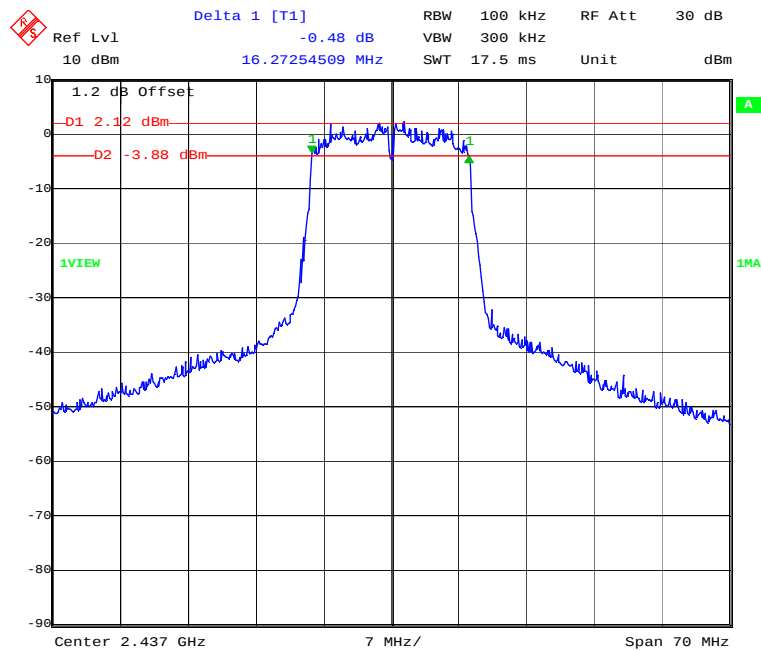


99% Power Bandwidth Plot (Channel 6) – 802.11b mode



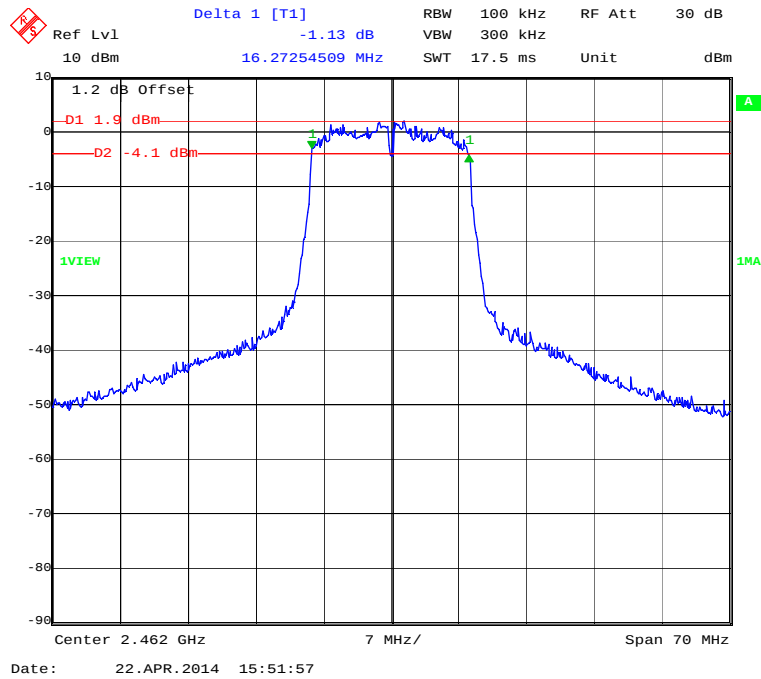
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6dB Bandwidth Plot (Channel 1) – 802.11g mode

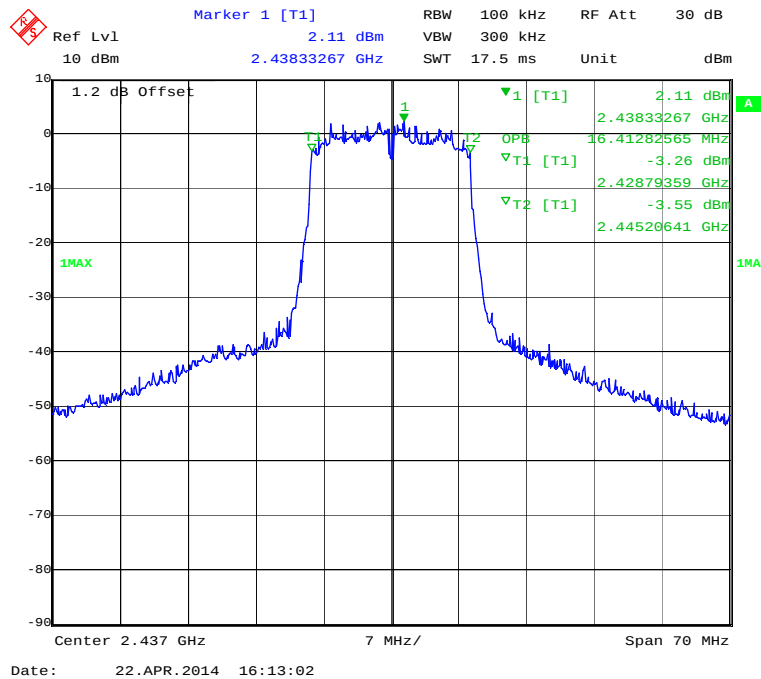


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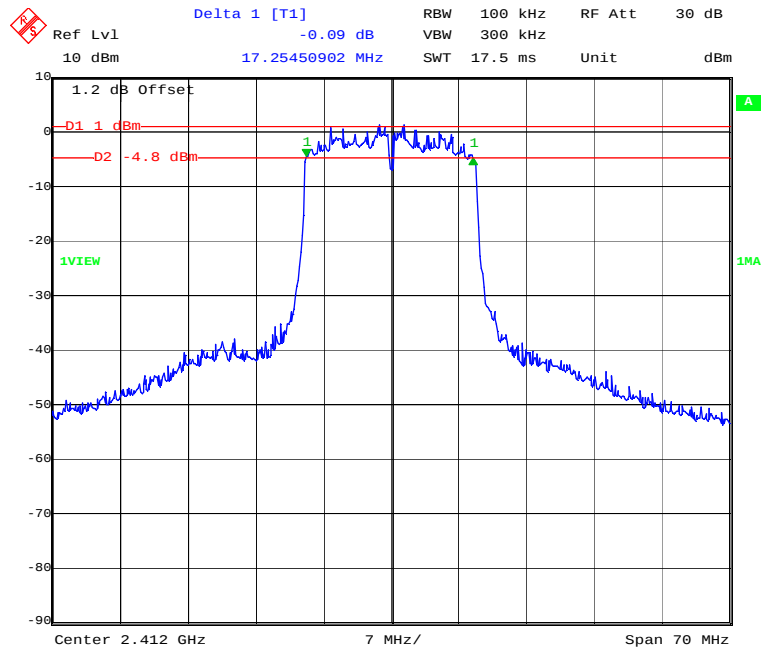
6dB Bandwidth Plot (Channel 6) – 802.11g mode



6dB Bandwidth Plot (Channel 11) – 802.11g mode

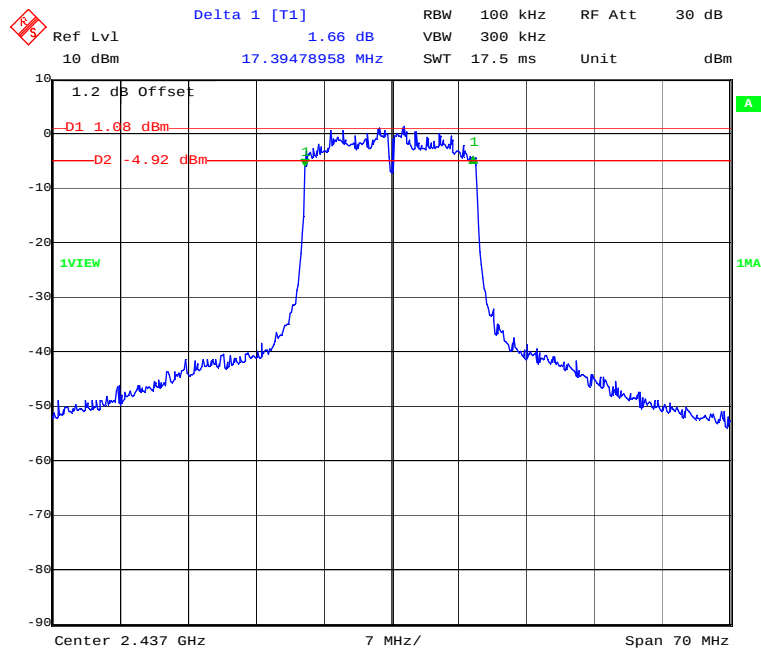


99% Power Bandwidth Plot (Channel 6) – 802.11g mode



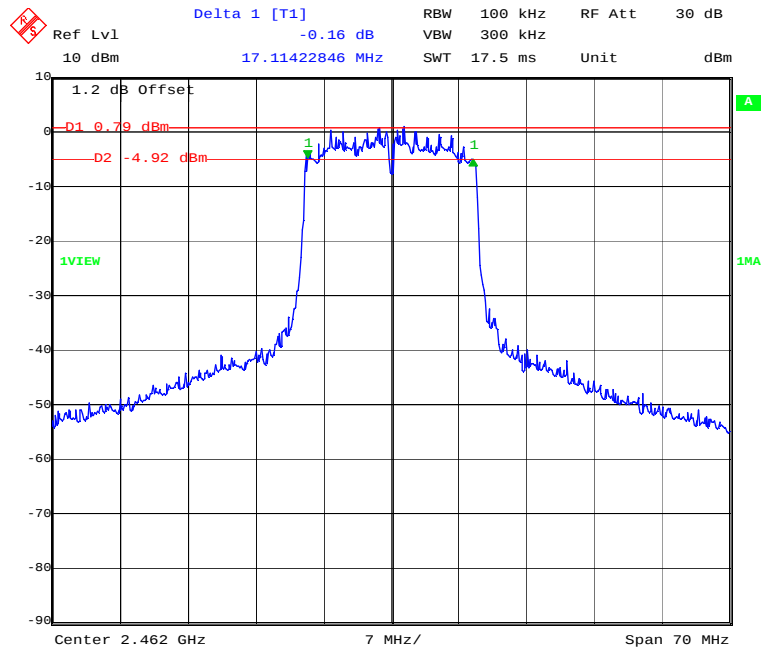
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6dB Bandwidth Plot (Channel 1) – 802.11n mode (20MHz)



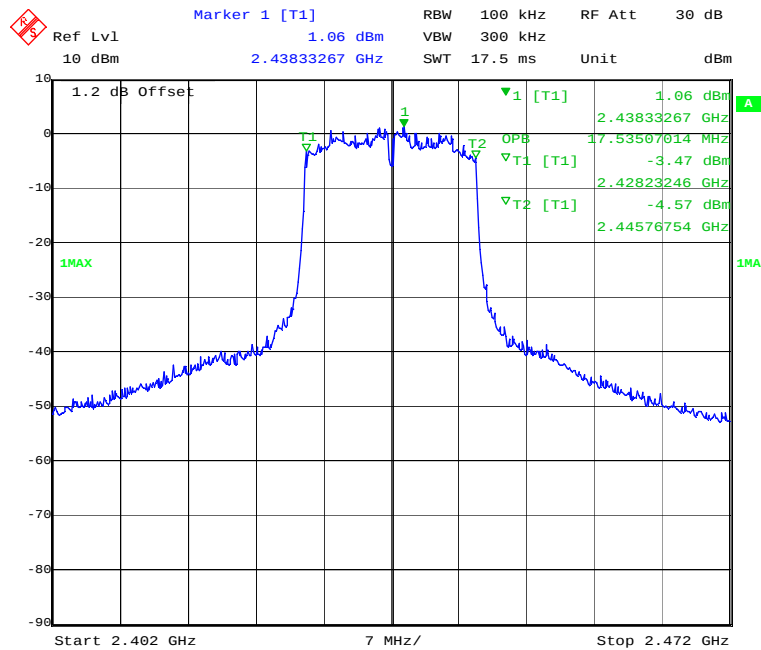
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6dB Bandwidth Plot (Channel 6) – 802.11n mode (20MHz)



Date: 22.APR.2014 16:07:04

6dB Bandwidth Plot (Channel 11) – 802.11n mode (20MHz)



Date: 22.APR.2014 16:11:34

99% Power Bandwidth Plot (Channel 6) – 802.11n mode (20MHz)

6 Conducted Spurious Emissions

6.1 Test Limits

§ 15.247(d): In any 100 kHz 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 the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

6.2 Test Procedure

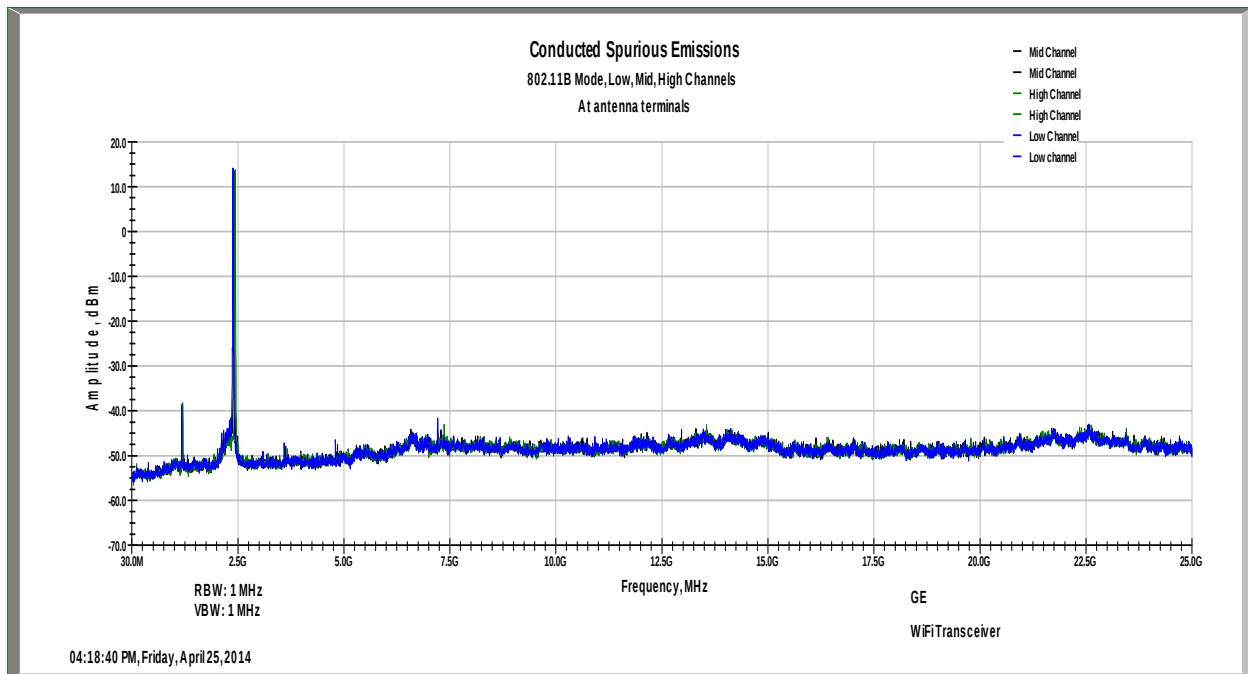
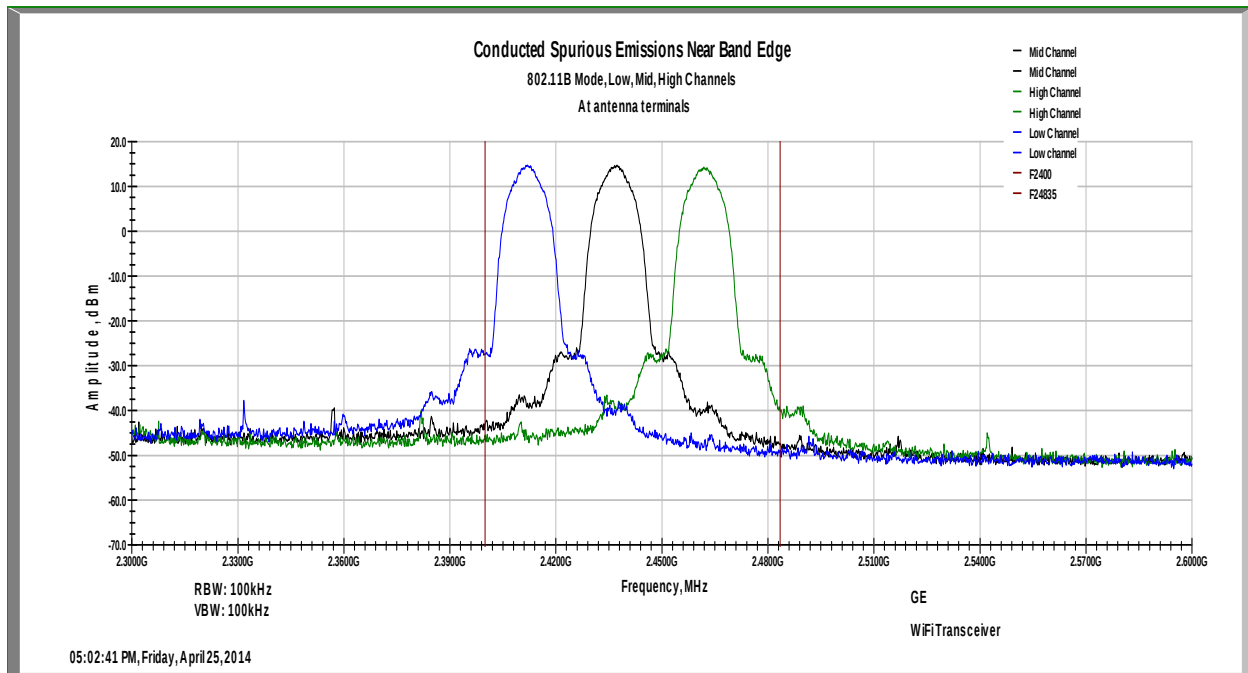
ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

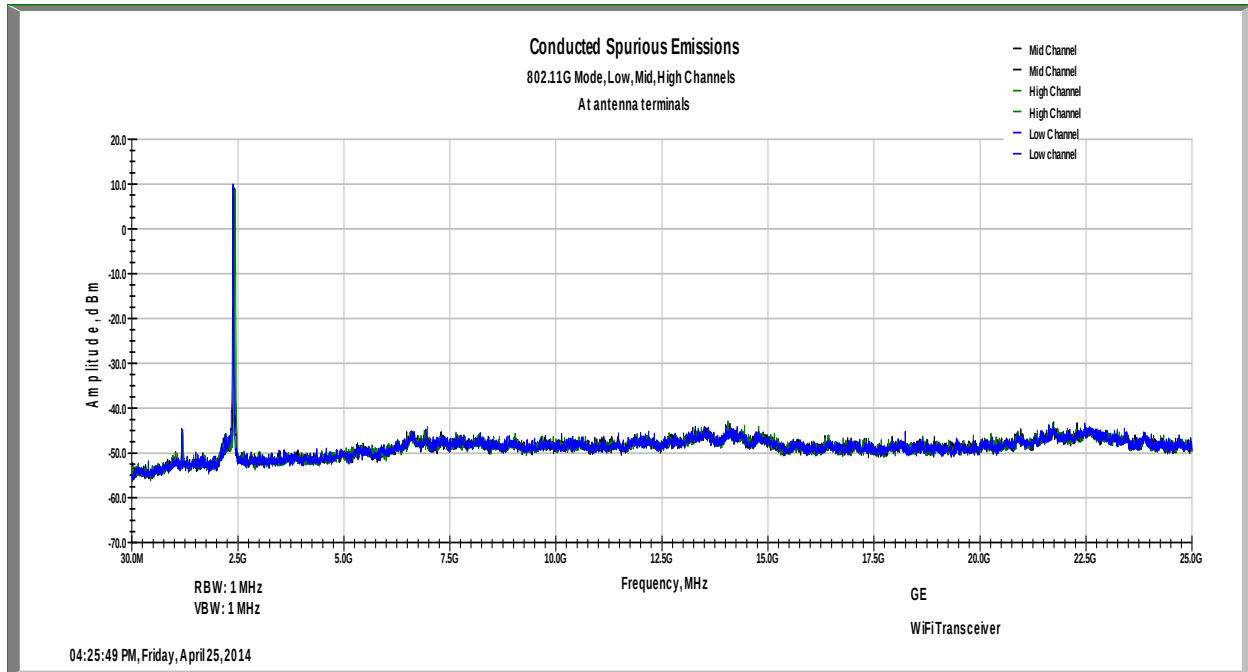
6.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/10/2013	9/10/2014

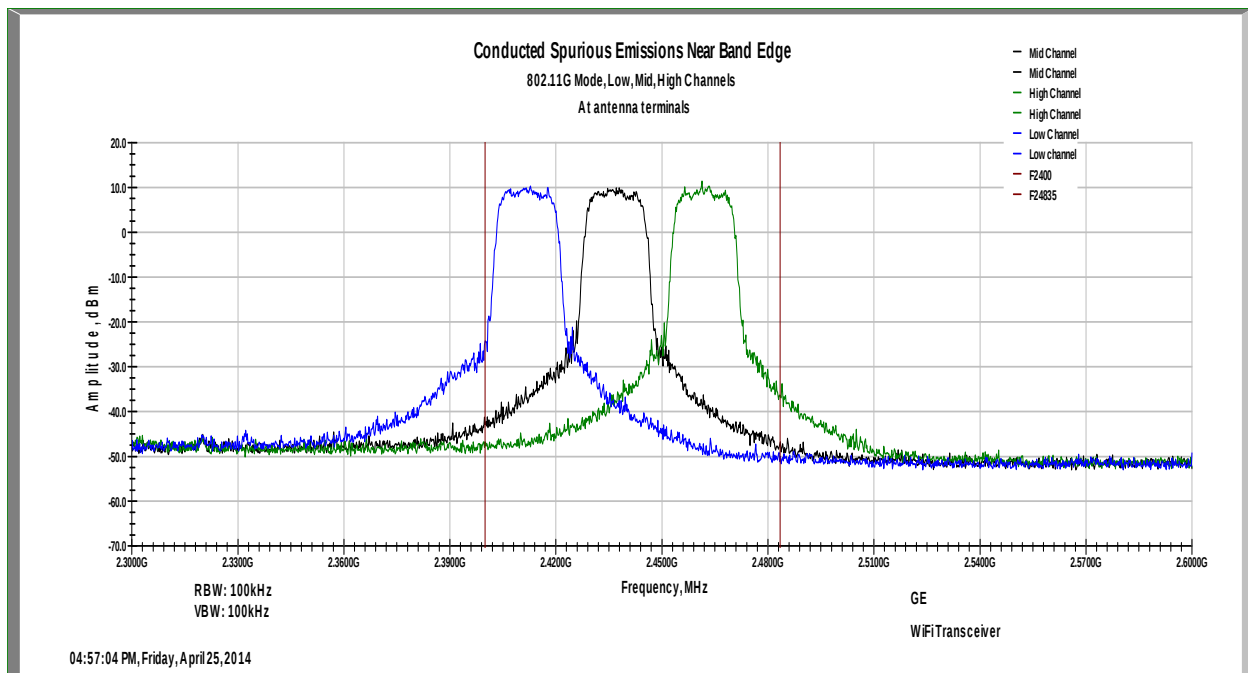
6.4 Results:

The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.

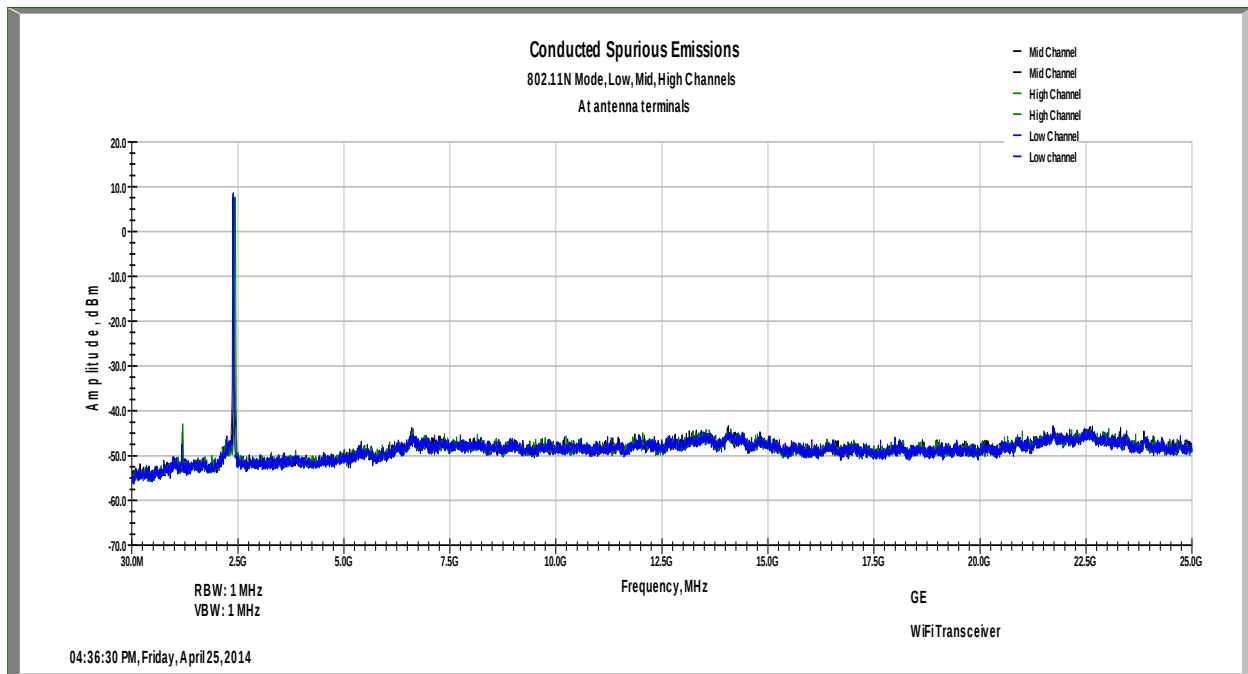
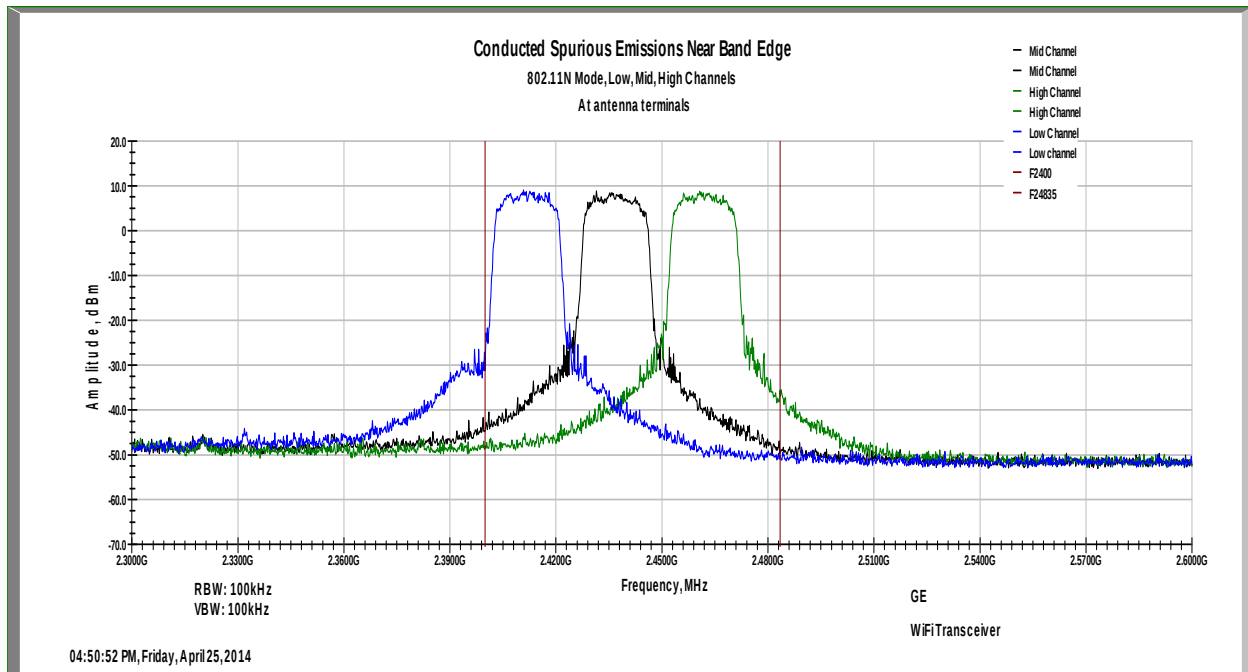
**Conducted Spurious Emissions - 802.11b Mode Low, Mid, High Channels****Emissions Close to Band Edge - 802.11b Mode (20MHz) Low, Mid, and High Channel**



Conducted Spurious Emissions - 802.11g Mode Low, Mid, High Channels



Emissions Close to Band Edge - 802.11g Mode (20MHz) Low, Mid, and High Channel

**Conducted Spurious Emissions - 802.11n Mode (20MHz) Low, Mid, High Channels****Emissions Close to Band Edge - 802.11n Mode (20MHz) Low, Mid, and High Channel**

7 Power Spectral Density

7.1 Test Limits

§ 15.247(e): For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

7.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

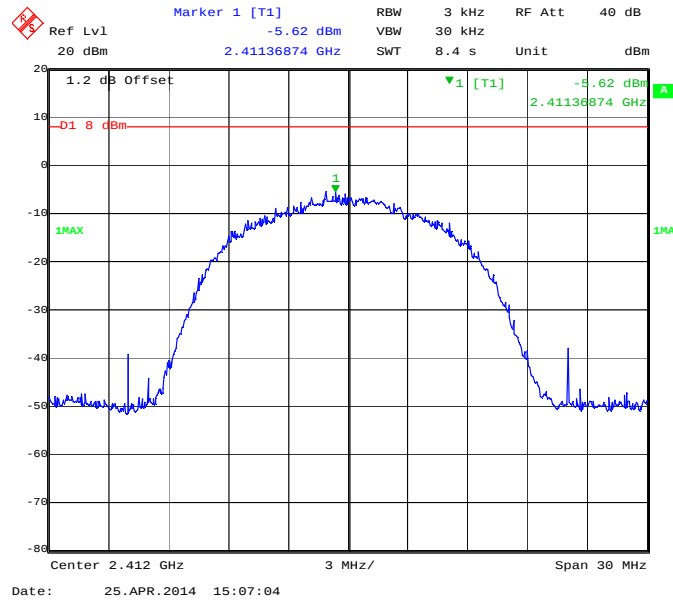
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/10/2013	9/10/2014

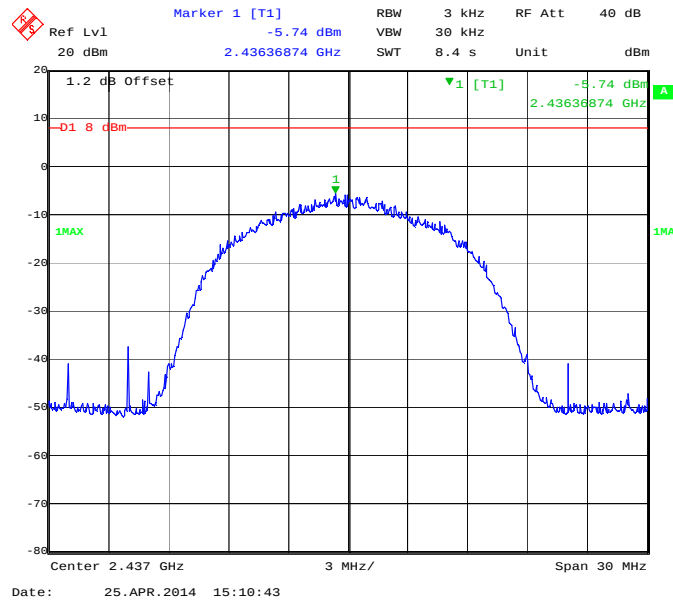
7.4 Results:

*PSD Option 1 Method

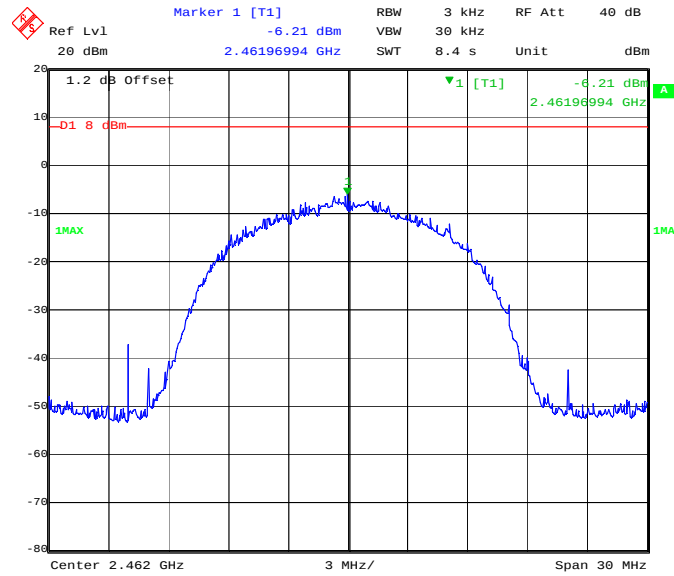
Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Result
802.11b	1	2412	-5.62	8.0	Pass
802.11b	6	2437	-5.74	8.0	Pass
802.11b	11	2462	-6.21	8.0	Pass
802.11g	1	2412	-12.42	8.0	Pass
802.11g	6	2437	-11.61	8.0	Pass
802.11g	11	2462	-11.17	8.0	Pass
802.11n (20MHz)	1	2412	-13.17	8.0	Pass
802.11n (20MHz)	6	2437	-12.24	8.0	Pass
802.11n (20MHz)	11	2462	-13.58	8.0	Pass



Power Spectral Density – Channel 1 802.11b mode

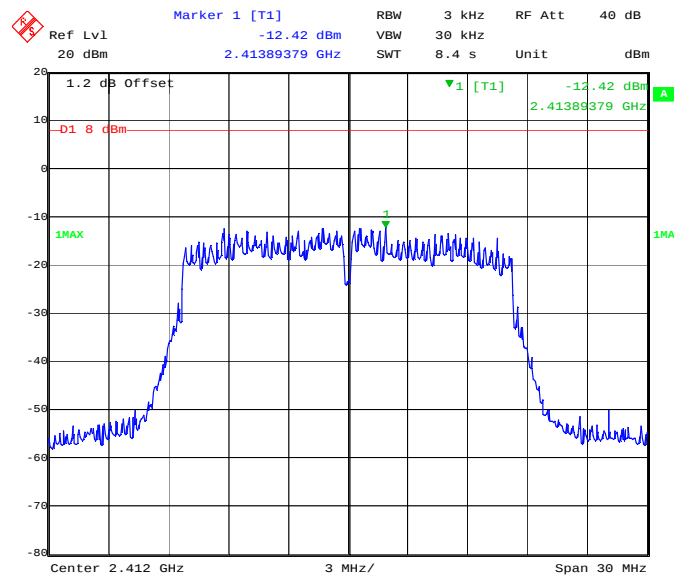


Power Spectral Density – Channel 6 802.11b mode



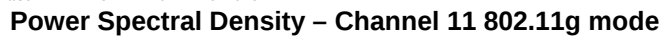
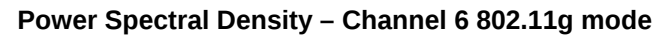
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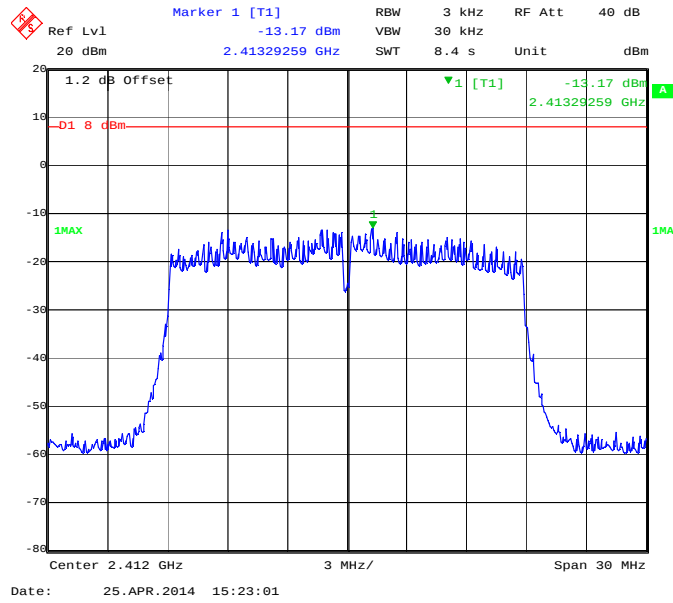
Power Spectral Density – Channel 11 802.11b mode



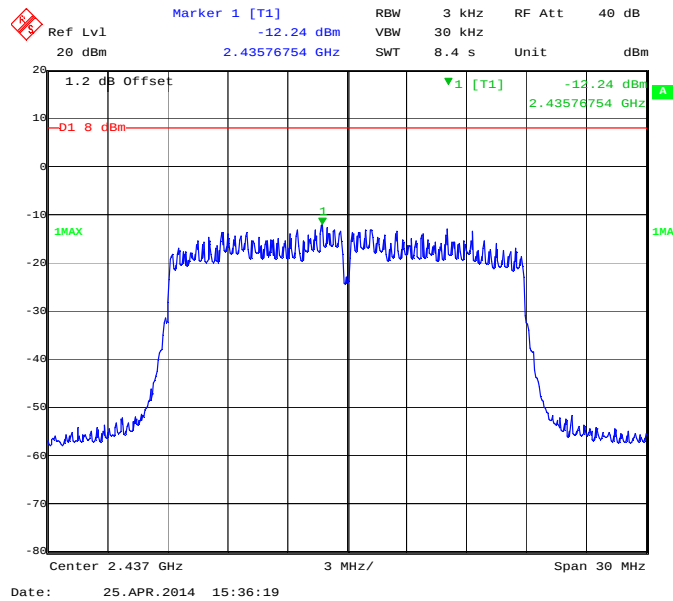
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Power Spectral Density – Channel 1 802.11g mode

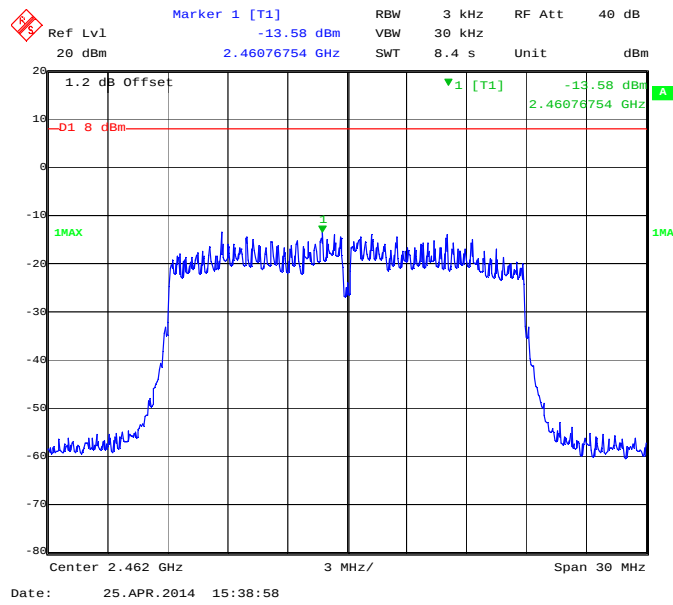




Power Spectral Density – Channel 1 802.11n mode (20MHz)



Power Spectral Density – Channel 6 802.11n mode (20MHz)



Power Spectral Density – Channel 11 802.11n mode (20MHz)

8 Radiated Spurious Emissions (Transmitter)

8.1 Test Limits

§ 15.247(d): In any 100 kHz 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 the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
10.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	(²)
13.36–13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

² Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

8.2 Test Procedure

ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

8.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:

$$FS = RA + AF + CF$$

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dB μ V

AF = 18.52 dB

CF = 0.78 dB

$FS = 19.48 + 18.52 + 0.78 = 38.78$ dB μ V/m

Level in μ V/m = Common Antilogarithm $[(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$

8.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/11/2013	9/11/2014
Bilog Antenna	00051864	ETS	3142C	12/17/2013	12/17/2014
Horn Antenna	00154521	ETS	3117	10/10/2013	10/10/2014
Horn Antenna (18 – 26.5GHz)	LM8621	ETS	3160-09	10/9/2013	10/9/2014
Preamplifier	122005	Rohde&Schwarz	TS-PR18	9/19/2013	9/19/2014
Preamplifier	100050	Rohde&Schwarz	TS-PR26	9/19/2013	9/19/2014
System Controller	3957	Sunol Sciences	SC110V	Time of Use	Time of Use

8.5 Results:

All spurious emissions were attenuated by at least 20dB below the level of the fundamental as required by Part 15.247(d). Additionally, all emissions falling within restricted bands of operation and at the band edges were found to be below the limit specified in Part 15.209(a). The spurious emissions listed in the following tables are the worst case emissions. Emissions not reported were at or below the measurement noise floor. The test sample was evaluated on three orthogonal axes since it was a module and could be used in any orientation.

Worst Case Spurious Measurements (802.11b Mode, Low Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	5/8/2014		End Date:	5/8/2014			
Temperature:	23.3C		Humidity:	43.50%		Pressure:	988.9mBar			
Specification:	FCC Part 15B		Test Limit:	Class B						
Notes:	802.11 B Mode. Low Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.824 GHz	V	43.59	-29.594	34.7	48.696	74	-25.304	1MHz / Pk	3m	Compliant
4.824 GHz	V	34.71	-29.594	34.7	39.816	54	-14.184	1MHz / Av	3m	Compliant
4.824 GHz	H	40.86	-29.594	34.7	45.966	74	-28.034	1MHz / Pk	3m	Compliant
4.824 GHz	H	34.42	-29.594	34.7	39.526	54	-14.474	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.39 GHz	V	22.87	4.673	32.944	60.487	74	-13.513	1MHz / Pk	3m	Compliant
2.39 GHz	V	13.09	4.673	32.944	50.707	54	-3.293	1MHz / Av	3m	Compliant
2.39 GHz	H	21.13	4.673	32.944	58.747	74	-15.253	1MHz / Pk	3m	Compliant
2.39 GHz	H	13.1	4.673	32.944	50.717	54	-3.283	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11b Mode, Mid Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	5/8/2014		End Date:	5/8/2014			
Temperature:	23.3C		Humidity:	43.50%		Pressure:	988.9mBar			
Specification:	FCC Part 15B		Test Limit:	Class B						
Notes:	802.11 B Mode. Middle Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.874 GHz	V	45.01	-29.521	34.7	50.189	74	-23.811	1MHz / Pk	3m	Compliant
4.874 GHz	V	37.15	-29.521	34.7	42.329	54	-11.671	1MHz / Av	3m	Compliant
4.874 GHz	H	45.04	-29.521	34.7	50.219	74	-23.781	1MHz / Pk	3m	Compliant
4.874 GHz	H	33.88	-29.521	34.7	39.059	54	-14.941	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11b Mode, High Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 B Mode. High Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.924 GHz	V	42.56	-29.449	34.7	47.811	74	-26.189	1MHz / Pk	3m	Compliant
4.924 GHz	V	37.47	-29.449	34.7	42.721	54	-11.279	1MHz / Av	3m	Compliant
4.924 GHz	H	40.8	-29.449	34.7	46.051	74	-27.949	1MHz / Pk	3m	Compliant
4.924 GHz	H	33.38	-29.449	34.7	38.631	54	-15.369	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.4835 GHz	V	22.9	4.773	32.907	60.58	74	-13.42	1MHz / Pk	3m	Compliant
2.4835 GHz	V	13.78	4.773	32.907	51.46	54	-2.54	1MHz / Av	3m	Compliant
2.4835 GHz	H	24.03	4.773	32.907	61.71	74	-12.29	1MHz / Pk	3m	Compliant
2.4835 GHz	H	13.78	4.773	32.907	51.46	54	-2.54	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11g Mode, Low Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 G Mode. Low Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.8224 GHz	V	38.06	-29.596	34.7	43.164	74	-30.836	1MHz / Pk	3m	Compliant
4.8224 GHz	V	29.38	-29.596	34.7	34.484	54	-19.516	1MHz / Av	3m	Compliant
4.8226 GHz	H	37.7	-29.596	34.7	42.804	74	-31.196	1MHz / Pk	3m	Compliant
4.8226 GHz	H	25.63	-29.596	34.7	30.734	54	-23.266	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.39 GHz	V	22.67	4.673	32.944	60.287	74	-13.713	1MHz / Pk	3m	Compliant
2.39 GHz	V	13.25	4.673	32.944	50.867	54	-3.133	1MHz / Av	3m	Compliant
2.39 GHz	H	22.94	4.673	32.944	60.557	74	-13.443	1MHz / Pk	3m	Compliant
2.39 GHz	H	13.14	4.673	32.944	50.757	54	-3.243	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11g Mode, Mid Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 G Mode. Middle Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.8738 GHz	V	43.47	-29.521	34.7	48.649	74	-25.351	1MHz / Pk	3m	Compliant
4.8738 GHz	V	30.68	-29.521	34.7	35.859	54	-18.141	1MHz / Av	3m	Compliant
4.8704 GHz	H	39.16	-29.526	34.7	44.334	74	-29.666	1MHz / Pk	3m	Compliant
4.8704 GHz	H	28.54	-29.526	34.7	33.714	54	-20.286	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11g Mode, High Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 G Mode. High Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.9246 GHz	V	36.76	-29.448	34.7	42.012	74	-31.988	1MHz / Pk	3m	Compliant
4.9246 GHz	V	27.23	-29.448	34.7	32.482	54	-21.518	1MHz / Av	3m	Compliant
4.9246 GHz	H	37.79	-29.448	34.7	43.042	74	-30.958	1MHz / Pk	3m	Compliant
4.9246 GHz	H	27.94	-29.448	34.7	33.192	54	-20.808	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.4835 GHz	V	24.06	4.773	32.907	61.74	74	-12.26	1MHz / Pk	3m	Compliant
2.4835 GHz	V	13.81	4.773	32.907	51.49	54	-2.51	1MHz / Av	3m	Compliant
2.4835 GHz	H	24.36	4.773	32.907	62.04	74	-11.96	1MHz / Pk	3m	Compliant
2.4835 GHz	V	13.81	4.773	32.907	51.49	54	-2.51	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11n (20MHz) Mode, Low Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 N Mode. Low Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.824 GHz	V	38.3	-29.594	34.7	43.406	74	-30.594	1MHz / Pk	3m	Compliant
4.824 GHz	V	28.5	-29.594	34.7	33.606	54	-20.394	1MHz / Av	3m	Compliant
4.824 GHz	H	36.57	-29.594	34.7	41.676	74	-32.324	1MHz / Pk	3m	Compliant
4.824 GHz	H	26.81	-29.594	34.7	31.916	54	-22.084	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.39 GHz	V	23.04	4.673	32.944	60.657	74	-13.343	1MHz / Pk	3m	Compliant
2.39 GHz	V	13.22	4.673	32.944	50.837	54	-3.163	1MHz / Av	3m	Compliant
2.39 GHz	H	21.27	4.673	32.944	58.887	74	-15.113	1MHz / Pk	3m	Compliant
2.39 GHz	H	13.13	4.673	32.944	50.747	54	-3.253	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11n (20MHz) Mode, Mid Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 N Mode. Middle Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.874 GHz	V	34.64	-29.521	34.7	39.819	74	-34.181	1MHz / Pk	3m	Compliant
4.874 GHz	V	28.23	-29.521	34.7	33.409	54	-20.591	1MHz / Av	3m	Compliant
4.8743 GHz	H	37.64	-29.521	34.7	42.819	74	-31.181	1MHz / Pk	3m	Compliant
4.8743 GHz	H	26.99	-29.521	34.7	32.169	54	-21.831	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Worst Case Spurious Measurements (802.11n (20MHz) Mode, High Channel)

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	5/8/2014	End Date:	5/8/2014					
Temperature:	23.3C	Humidity:	43.50%	Pressure:	988.9mBar					
Specification:	FCC Part 15B	Test Limit:	Class B							
Notes:	802.11 N Mode. High Channel									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
4.9221 GHz	V	38.11	-29.451	34.7	43.359	74	-30.641	1MHz / Pk	3m	Compliant
4.9221 GHz	V	27	-29.451	34.7	32.249	54	-21.751	1MHz / Av	3m	Compliant
4.924 GHz	H	35.5	-29.449	34.7	40.751	74	-33.249	1MHz / Pk	3m	Compliant
4.924 GHz	H	25.71	-29.449	34.7	30.961	54	-23.039	1MHz / Av	3m	Compliant
Band Edge Measurements										
2.4835 GHz	V	24.61	4.773	32.907	62.29	74	-11.71	1MHz / Pk	3m	Compliant
2.4835 GHz	V	13.78	4.773	32.907	51.46	54	-2.54	1MHz / Av	3m	Compliant
2.4835 GHz	H	23.85	4.773	32.907	61.53	74	-12.47	1MHz / Pk	3m	Compliant
2.4835 GHz	H	13.8	4.773	32.907	51.48	54	-2.52	1MHz / Av	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

9 Radiated Spurious Emissions (Receiver)

9.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

These limits are identical to those in RSS-GEN

9.2 Test Procedure

ANSI C63.4: 2009

9.3 Example of Field Strength Calculation Method:

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:

$$FS = RA + AF + CF$$

FS = Field Strength in dBμV/m

RA = Receiver Amplitude in dBμV

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV

AF = 18.52 dB

CF = 0.78 dB

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	9/11/2013	9/11/2014
Bilog Antenna	00051864	ETS	3142C	12/17/2013	12/17/2014
Horn Antenna	00154521	ETS	3117	10/10/2013	10/10/2014
Preamplifier	122005	Rohde&Schwarz	TS-PR18	9/19/2013	9/19/2014
System Controller	3957	Sunol Sciences	SC110V	Time of Use	Time of Use

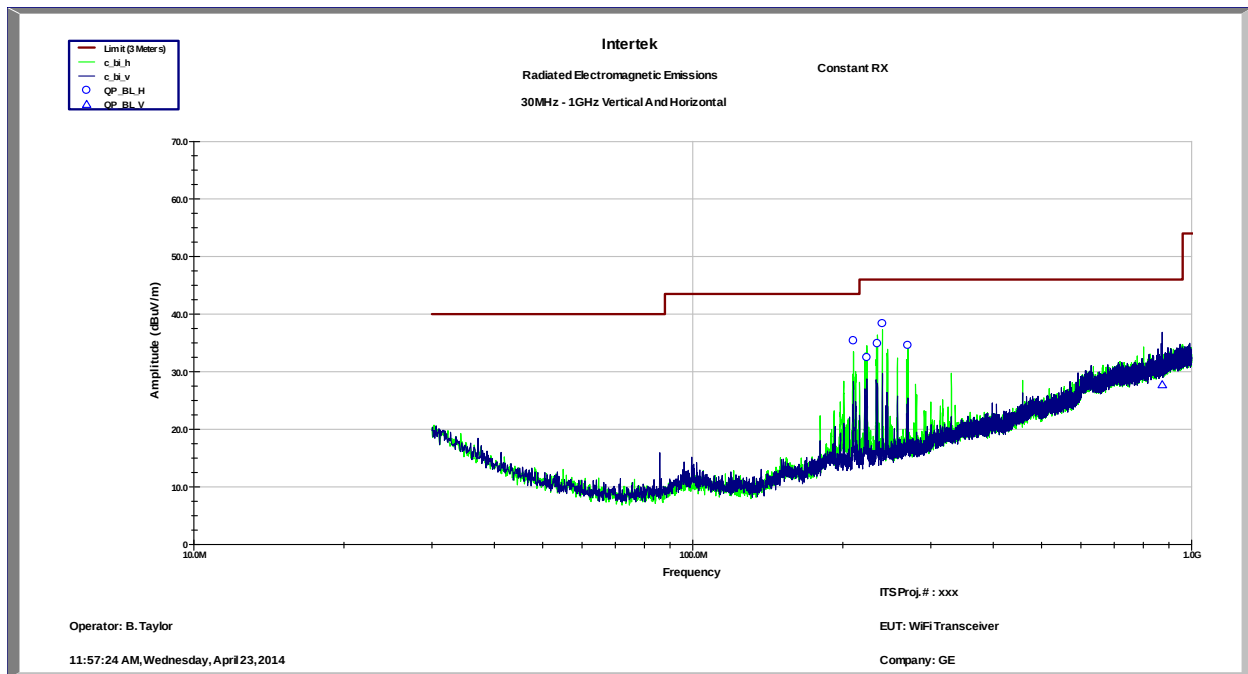
9.5 Results:

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1.

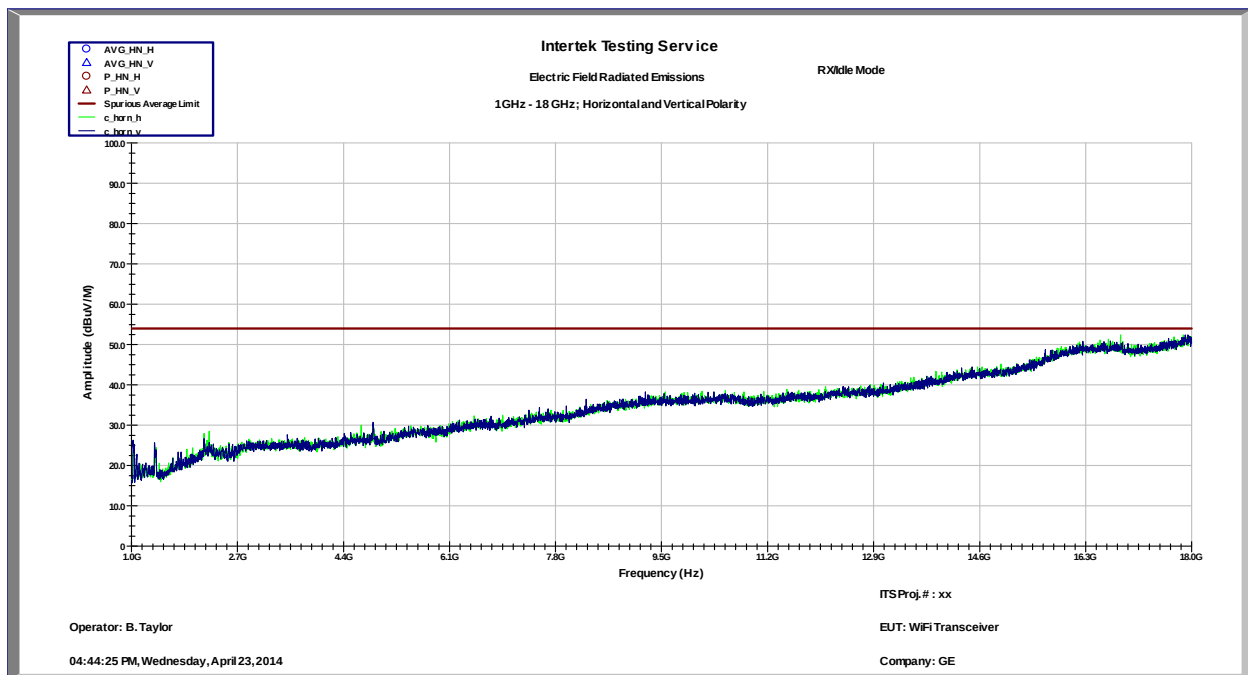
9.6 Test Data:

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	4/23/2014		End Date:	4/23/2014			
Temperature:	23.3C		Humidity:	43.50%		Pressure:	988.9mBar			
Specification:	FCC Part 15B		Test Limit:	Class B						
Notes:	RX / Idle Mode									
A	B	C	D	E	F	G	H	I	J	K
Frequency	Polarity (H/V)	Raw Reading (dBuV)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	RBW / Detector	Test Distance	Results
873.3 MHz	H	0.15	4.8	22.8	27.75	46	-18.25	120kHz / QP	3m	Compliant
210.0 MHz	H	22.18	2.3	10.9	35.38	43.52	-8.14	120kHz / QP	3m	Compliant
223.39 MHz	H	18.72	2.3	11.44	32.46	46	-13.54	120kHz / QP	3m	Compliant
234.51 MHz	H	20.41	2.5	11.97	34.88	46	-11.12	120kHz / QP	3m	Compliant
240.0 MHz	H	23.76	2.4	12.2	38.36	46	-7.64	120kHz / QP	3m	Compliant
270.0 MHz	H	18.88	2.6	13.1	34.58	46	-11.42	120kHz / QP	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

Deviations, Additions, or Exclusions: None



Bilog Prescan



Horn Prescan

10 AC Powerline Conducted Emissions

10.1 Test Limits

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

10.2 Test Procedure

ANSI C63.4: 2009

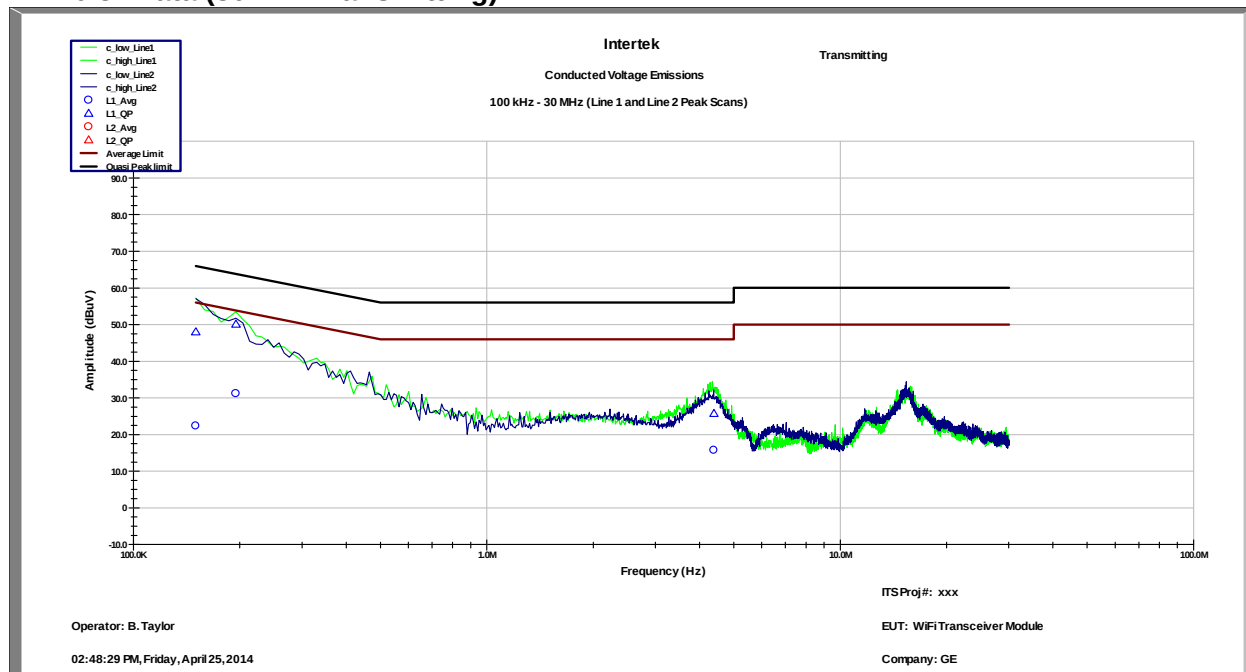
10.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESi26	9/11/2013	9/11/2014
LISN	3333	Teseq	NNB52	3/12/2014	3/12/2015

10.4 Results:

The sample tested was found to Comply.

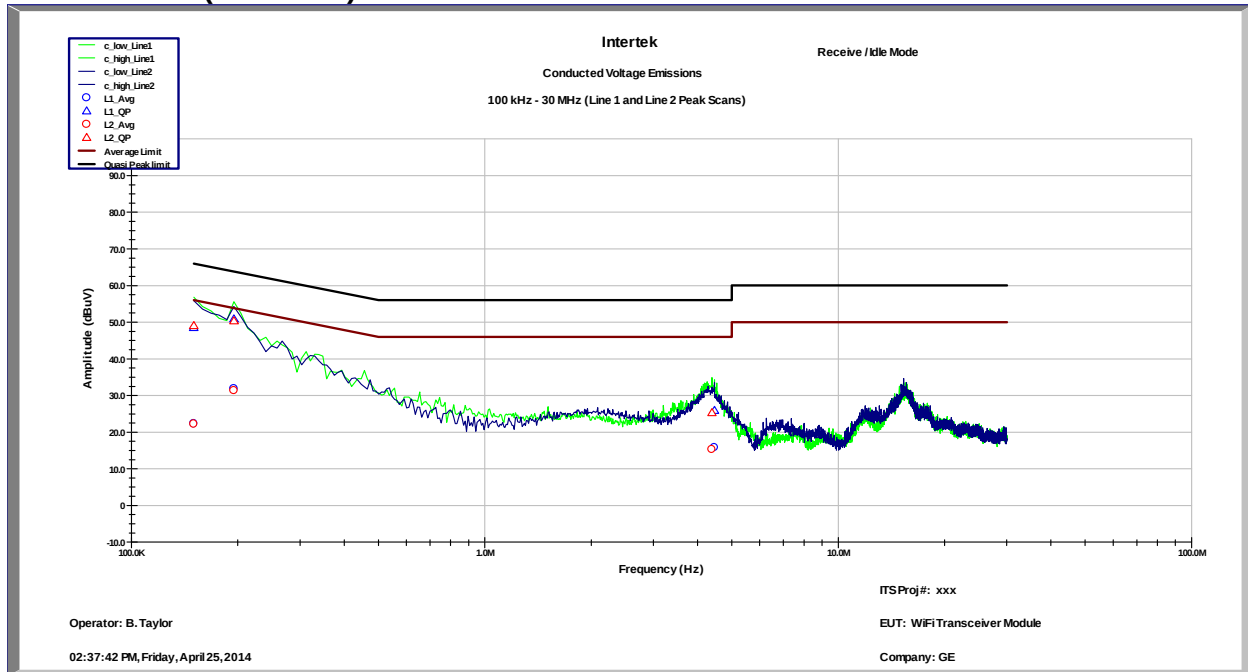
10.5 Data (802.11 Transmitting):



Conducted Voltage Emissions on Power Lines								
Test Engineer:	Bryan Taylor		Start Date:	4/25/2014		End Date:	4/25/2014	
Temperature:	23.6C		Humidity:	36.30%		Pressure:	988.9mBar	
Specification:	FCC Part 15		Test Limit:	Class B		RBW:	9kHz	
Notes:	Transmitting							
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.0 KHz	47.98	66	-18.02	22.35	56	-33.65	Compliant
Line 1	195.0 KHz	50.12	63.82	-13.7	31.15	53.82	-22.67	Compliant
Line 1	4.389 MHz	25.78	56	-30.22	15.72	46	-30.28	Compliant
Line 2	150.0 KHz	48.49	66	-17.51	21.97	56	-34.03	Compliant
Line 2	195.0 KHz	49.98	63.82	-13.84	30.76	53.82	-23.06	Compliant
Line 2	4.344 MHz	22.41	56	-33.59	12.61	46	-33.39	Compliant

Deviations, Additions, or Exclusions: None

10.6 Data (Idle Mode):



Conducted Voltage Emissions on Power Lines								
Test Engineer:	Bryan Taylor		Start Date:	4/25/2014		End Date:	4/25/2014	
Temperature:	23.6C		Humidity:	36.30%		Pressure:	988.9mBar	
Specification:	FCC Part 15		Test Limit:	Class B		RBW:	9kHz	
Notes:	Receive / Idle Mode							
Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.0 KHz	48.5	66	-17.5	22.3	56	-33.7	Compliant
Line 1	195.0 KHz	50.89	63.82	-12.93	31.83	53.82	-21.99	Compliant
Line 1	4.461 MHz	25.93	56	-30.07	15.82	46	-30.18	Compliant
Line 2	150.0 KHz	49.05	66	-16.95	22.22	56	-33.78	Compliant
Line 2	195.0 KHz	50.35	63.82	-13.47	31.32	53.82	-22.5	Compliant
Line 2	4.389 MHz	25.3	56	-30.7	15.27	46	-30.73	Compliant

Deviations, Additions, or Exclusions: None

11 Antenna Requirement per FCC Part 15.203

11.1 Test Limits

§ 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

11.2 Results:

The sample tested met the antenna requirement. The antenna used was permanently attached and integral to the PCB.

12 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of $k = 2$, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	+3.9dB	
Radiated emissions, 1 to 18 GHz	+4.2dB	
Radiated emissions, 18 to 40 GHz	+4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	+2.8dB	

13 Revision History

Revision Level	Date	Report Number	Notes
0	5/15/2014	101570486LEX-001	Original Issue