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TEST REPORT

Report Number: G101112064LEX-001.2
Project Number: G101112064

Report Issue Date: 1/2/2014


Product Name: Machinery Health Analyzer
Model Number: CSI 2140
FCCID: NL5-CSI2410M1
ICID: 3434A-CSI2140M1

Standards: FCC Part 15C and RSS-210 Issue 8

Radios Under Test: 802.11b, and 802.11g

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

Client:
Computational systems Inc.
835 Innovation Drive
Knoxville, TN 37932

Report prepared by

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TABLE OF CONTENTS

1 Introduction and Conclusion..... 3

2 Test Summary 3

3 Description of Equipment Under Test 4

4 Peak Conducted Power 6

5 Occupied Bandwidth 8

6 Conducted Spurious Emissions..... 13

7 Power Spectral Density..... 19

8 Radiated Spurious Emissions (Transmitter)..... 23

9 AC Powerline Conducted Emissions 31

10 Antenna Requirement per FCC Part 15.203..... 35

11 Measurement Uncertainty..... 36

12 Revision History 37

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
13	Conducted Spurious Emissions	§ 15.247(d)	RSS-210 (A8.5)	Pass
19	Power Spectral Density	§ 15.247(e)	RSS-210 (A8.2b)	Pass
23	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (2.2) (A8.5)	Pass
31	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
35	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	Computational systems Inc.
Model Number	CSI 2140
Serial Number	BETA 001020
FCC Identifier	NL5-CSI2410M1
IC Identifier	3434A-CSI2140M1
Receive Date	10/31/2013
Test Start Date	11/4/2013
Test End Date	11/20/2013
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2412MHz – 2462MHz
Mode(s) of Operation	802.11b/g
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	115VAC/60Hz (Via AC / DC Power Adapter)

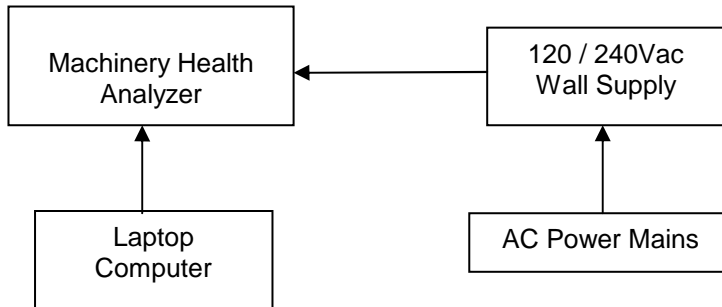
Description of Equipment Under Test
The CSI 2140 is a ruggedized machinery health analyzer

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting 802.11 b or g 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
DC Power Cable	5ft	None	None	DC Power Adapter	DC Power Input
AC Power Cable	5ft	None	None	AC Power Source	DC Power Adapter
Ethernet Cable	50ft	None	None	Ethernet Port	Laptop Computer

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop Computer	HP	EliteBook 8470p	None

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	18.29	19.3	20.45	21.84
	2437	6	19.28	20.05	20.87	21.74
	2462	11	17.17	18.37	20.07	20.85

Peak

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)			
			Data Rate (Mbps)			
			1	2	5.5	11
802.11b	2412	1	15.14	16.25	16.52	17.11
	2437	6	16.2	17.02	16.88	16.94
	2462	11	14.1	15.33	16.12	16.14

Average

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	23.33	23.37	22.42	22.57	22.83	22.33	22.4	22.65
	2437	6	22.15	22.27	21.37	21.43	22.2	22.04	22.18	22.45
	2462	11	21.2	21.1	20.23	21.14	21.53	21.03	21.14	21.79

Peak

Mode	Frequency (MHz)	Channel Number	Conducted Power (dBm)							
			Data Rate (Mbps)							
			6	9	12	18	24	36	48	54
802.11g	2412	1	17.07	17.13	16.88	16.85	17.43	16.57	16.83	16.8
	2437	6	15.86	15.92	15.65	15.45	16.72	16.45	16.69	16.71
	2462	11	14.63	14.82	14.92	15.26	15.91	15.33	15.54	15.92

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

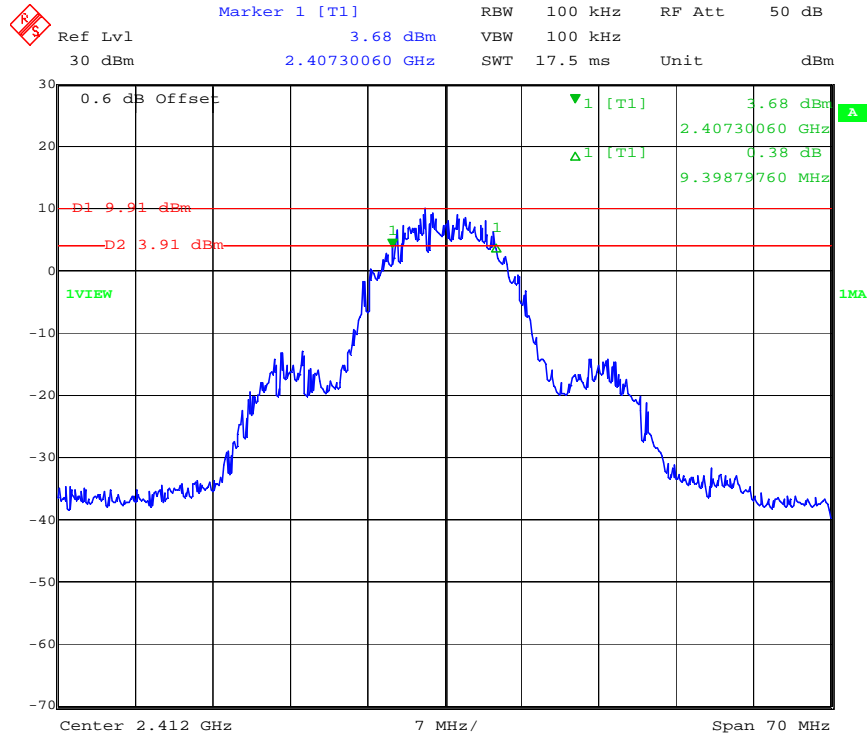
ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

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

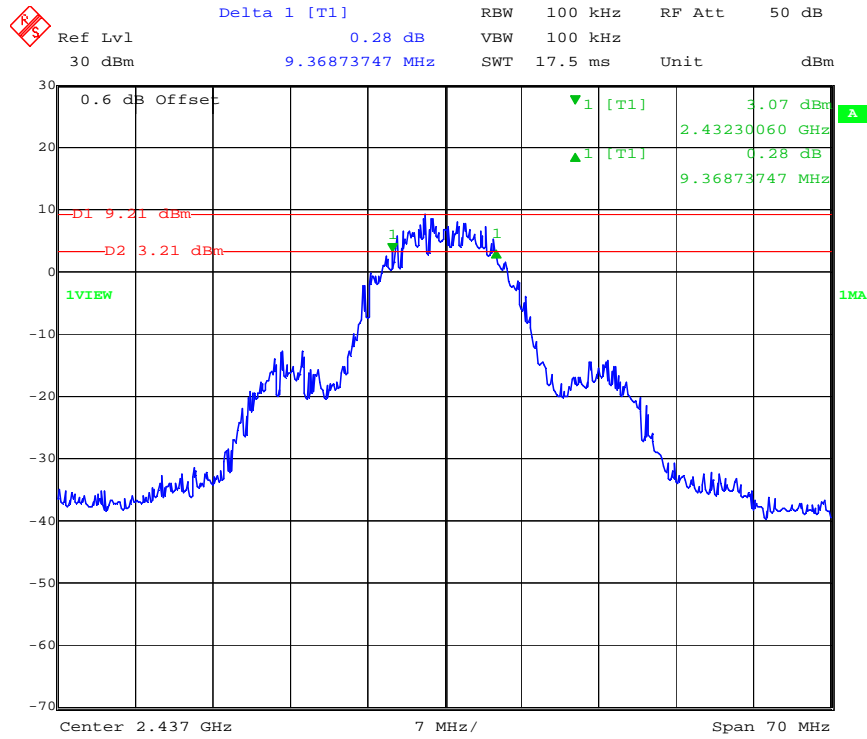
5.4 Results:

Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
802.11b	1	2412	9.39MHz	---	Pass
802.11b	6	2437	9.36MHz	16.69MHz	Pass
802.11b	11	2462	9.39MHz	---	Pass
802.11g	1	2412	16.69MHz	---	Pass
802.11g	6	2437	16.69MHz	24.96MHz	Pass
802.11g	11	2462	16.69MHz	---	Pass



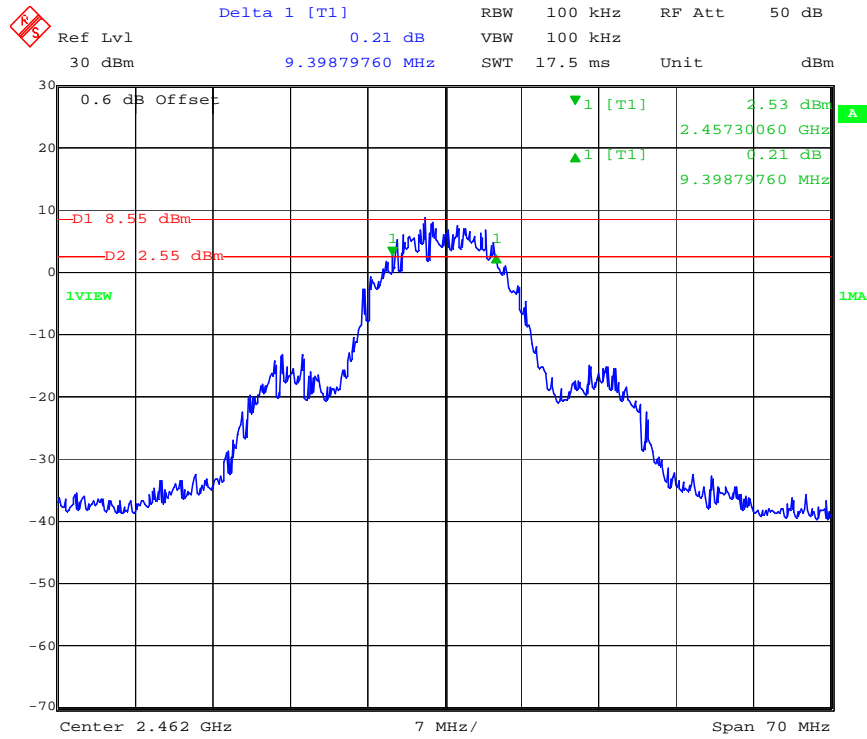
Date: 4.NOV.2013 11:14:40

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



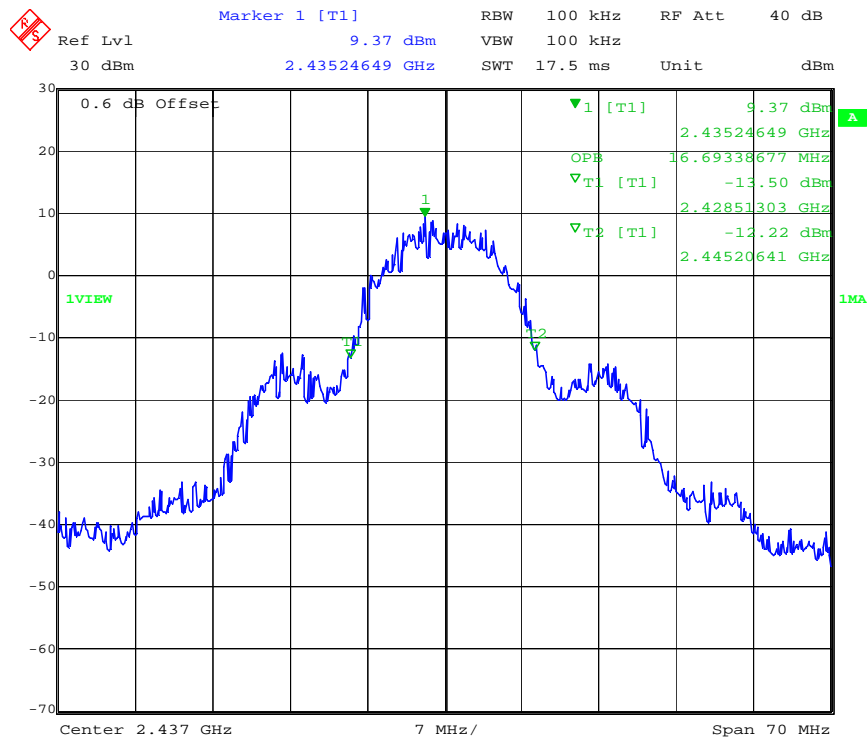
Date: 4.NOV.2013 11:16:43

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



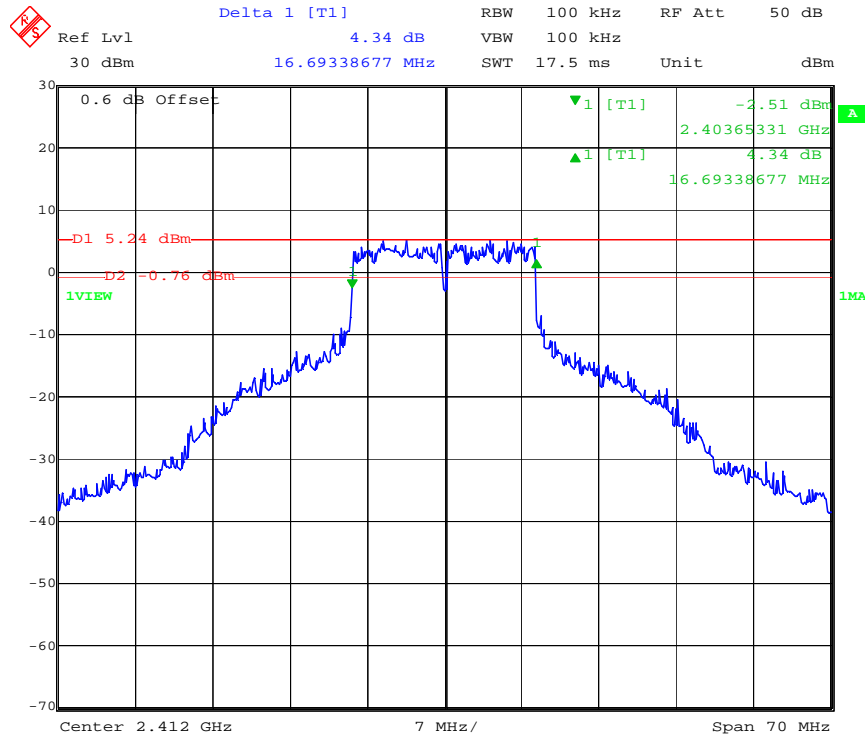
Date: 4.NOV.2013 11:18:46

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



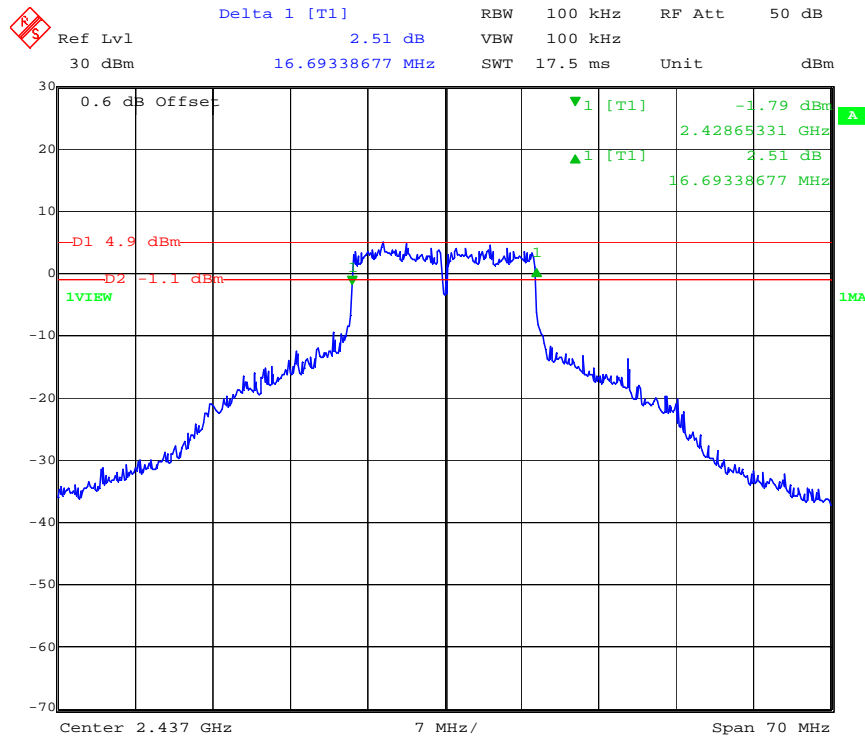
Date: 4.NOV.2013 11:41:38

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



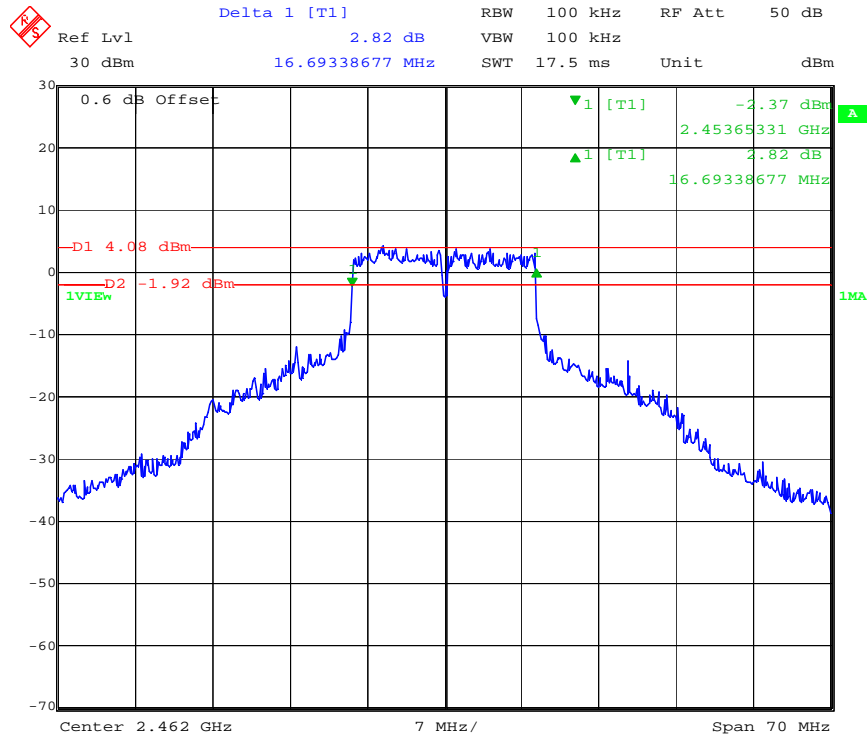
Date: 4.NOV.2013 11:28:58

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



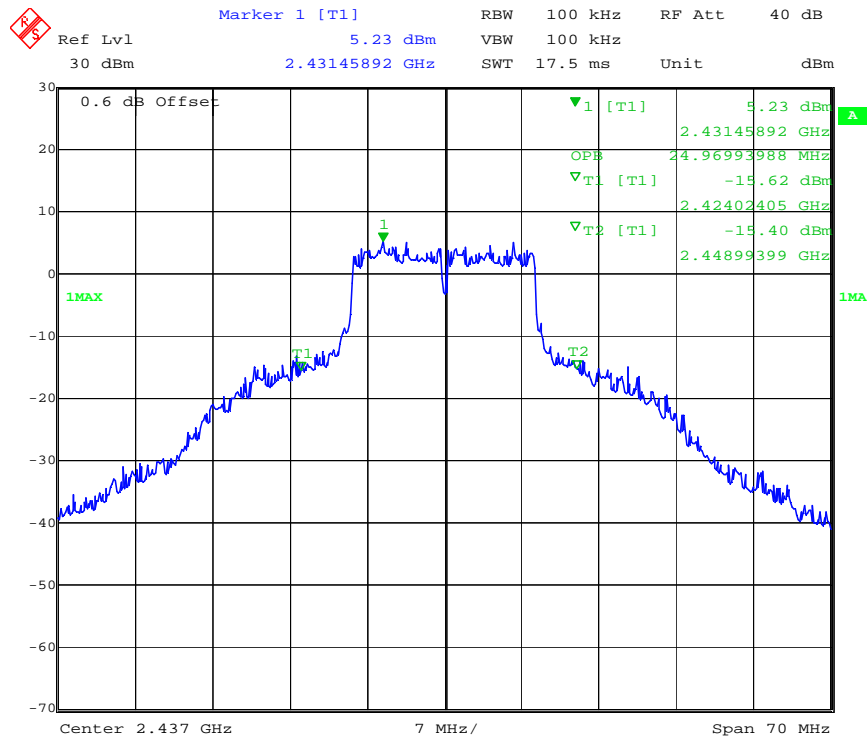
Date: 4.NOV.2013 11:31:30

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



Date: 4.NOV.2013 11:34:13

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



Date: 4.NOV.2013 11:39:57

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

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

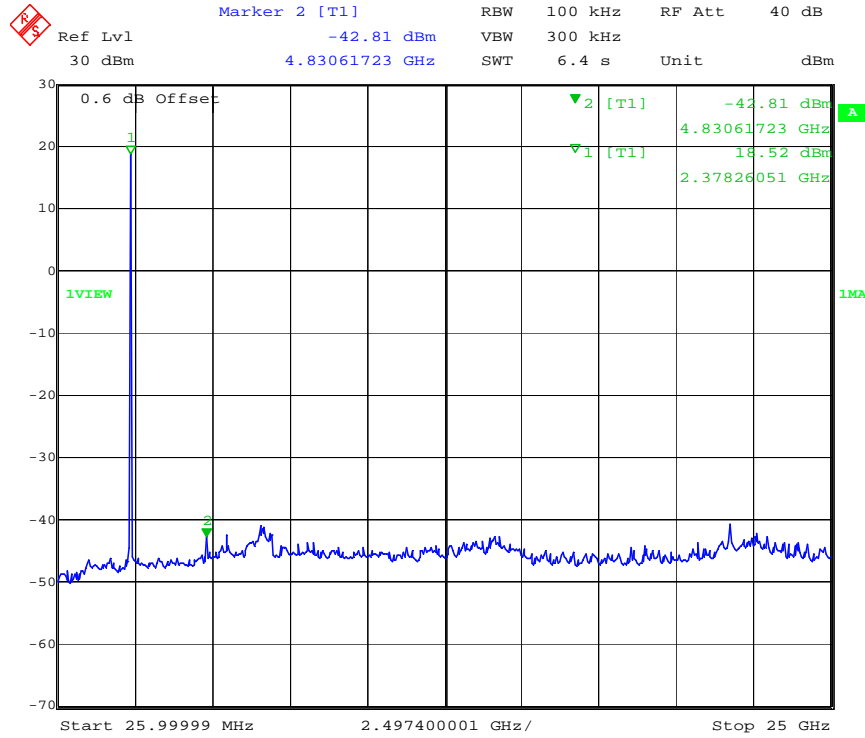
ANSI C63.10: 2009 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

6.3 Test Equipment Used:

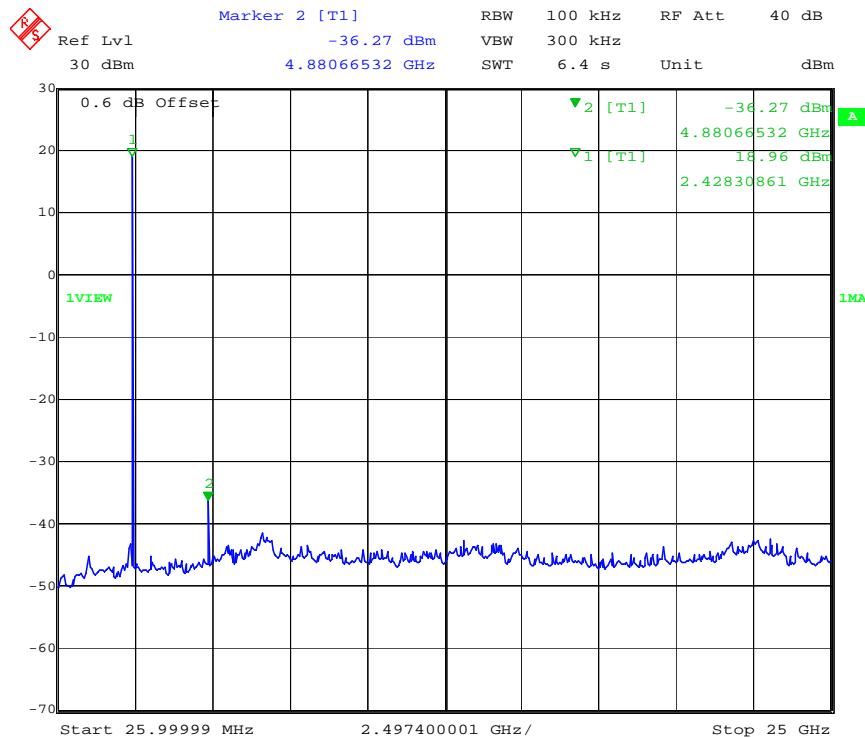
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/10/2013	9/10/2014

6.4 Results:

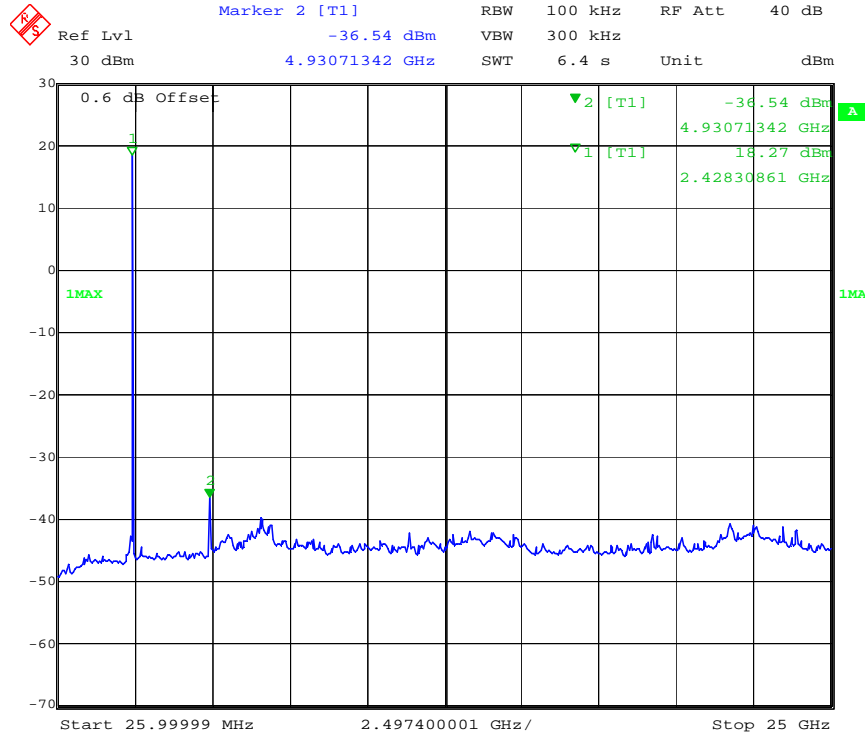
The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.



Conducted Spurious Emissions - 802.11b Mode Low Channel

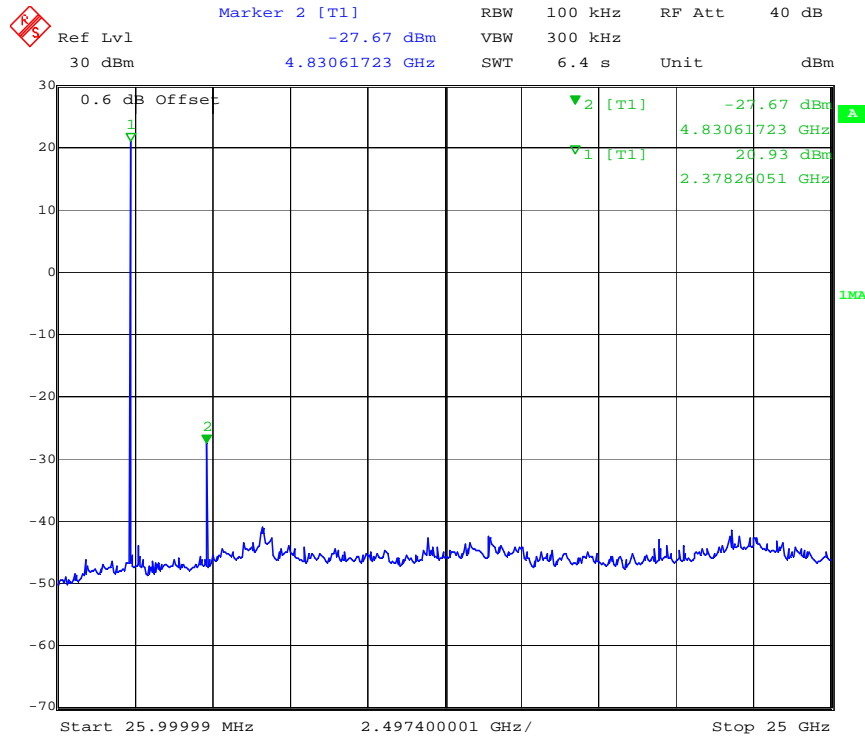


Conducted Spurious Emissions - 802.11b Mode Mid Channel



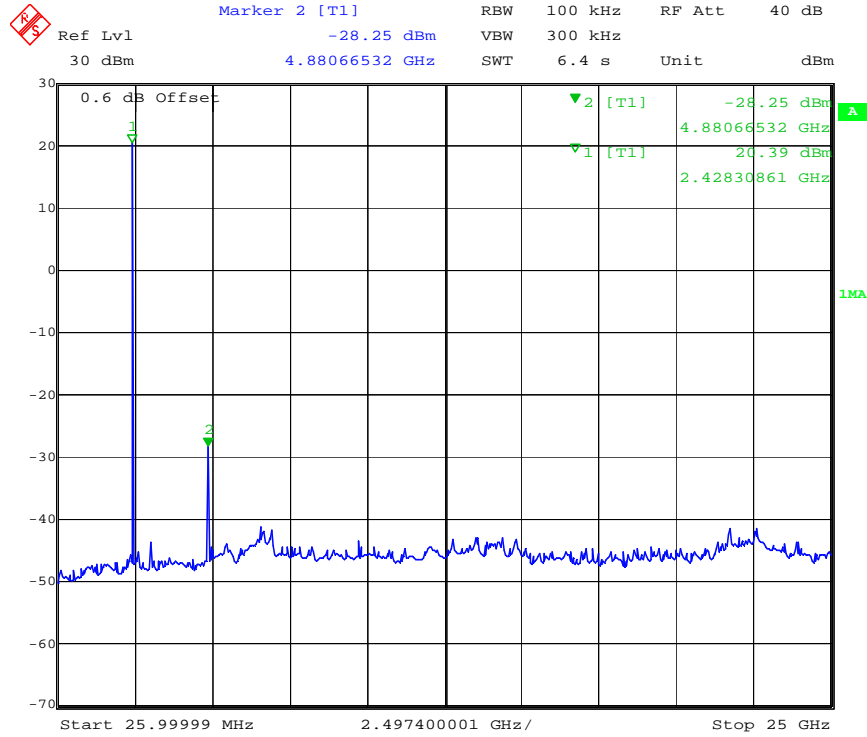
Date: 4.NOV.2013 14:07:54

Conducted Spurious Emissions - 802.11b Mode High Channel



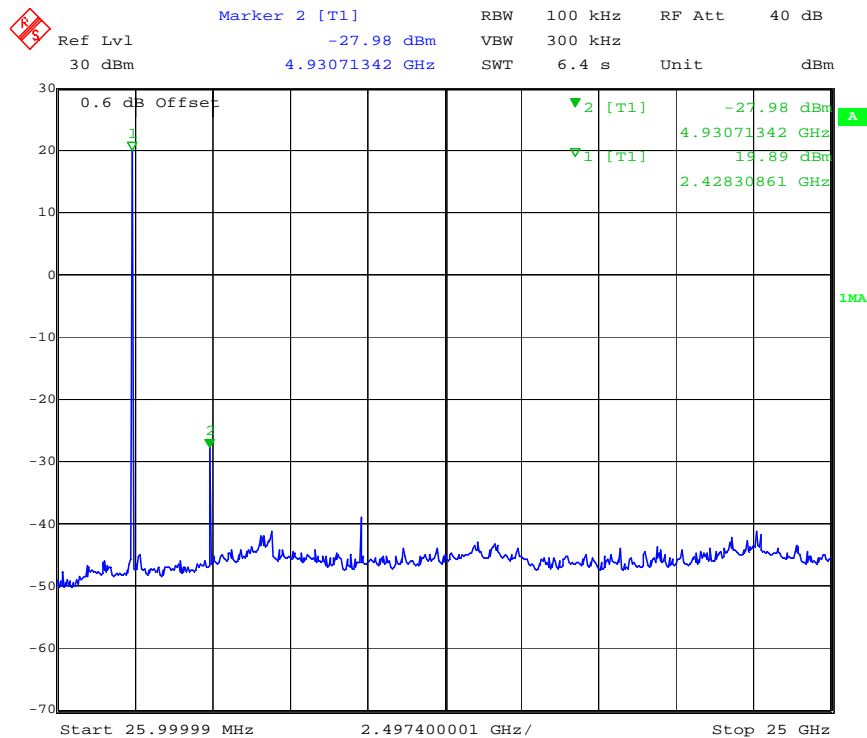
Date: 4.NOV.2013 14:09:49

Conducted Spurious Emissions - 802.11g Mode Low Channel



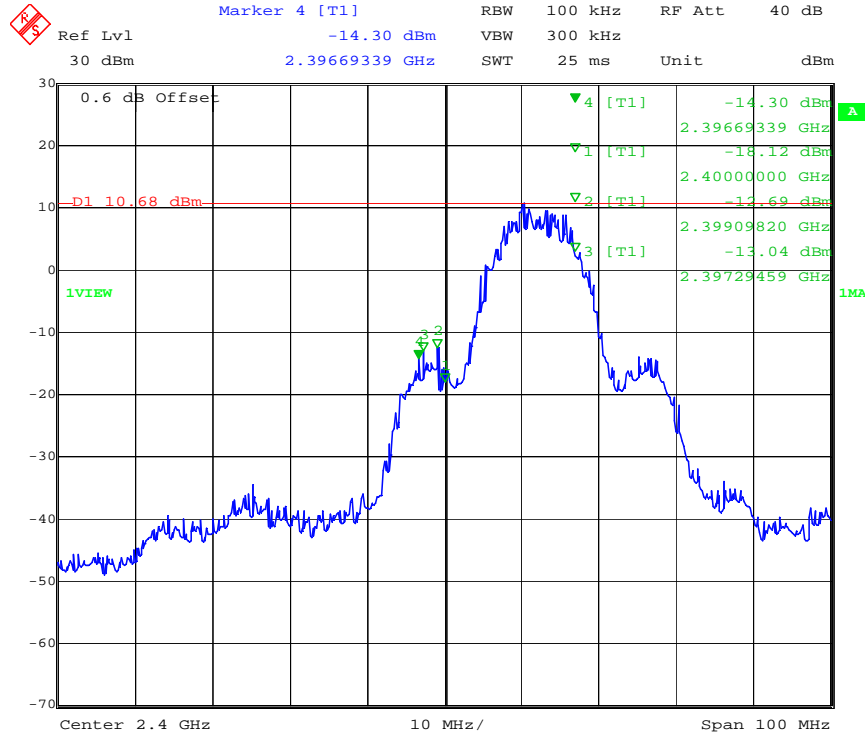
Date: 4.NOV.2013 14:10:45

Conducted Spurious Emissions - 802.11g Mode Mid Channel



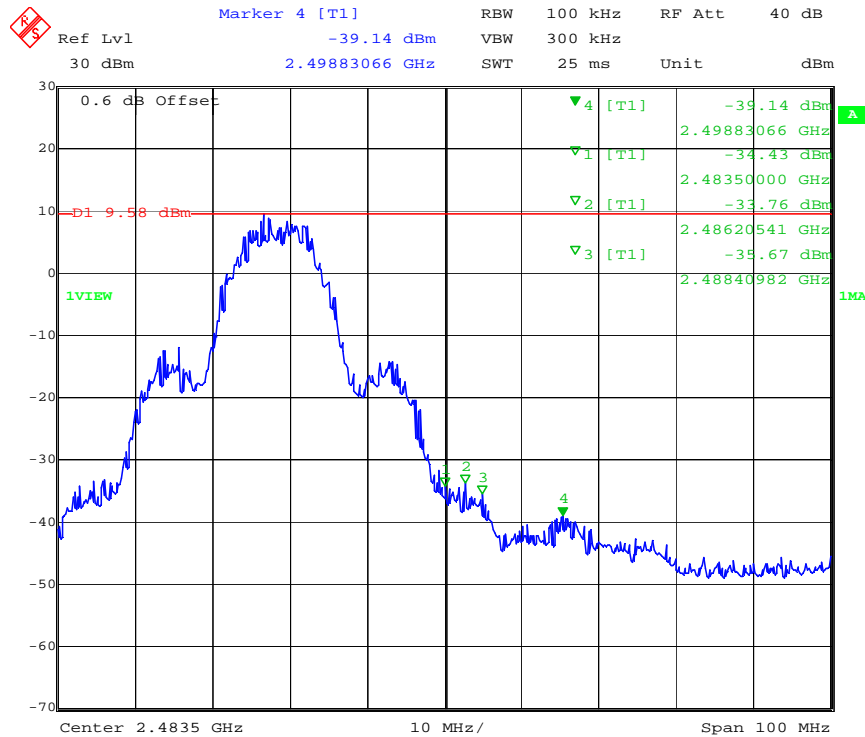
Date: 4.NOV.2013 14:11:35

Conducted Spurious Emissions - 802.11g Mode High Channel



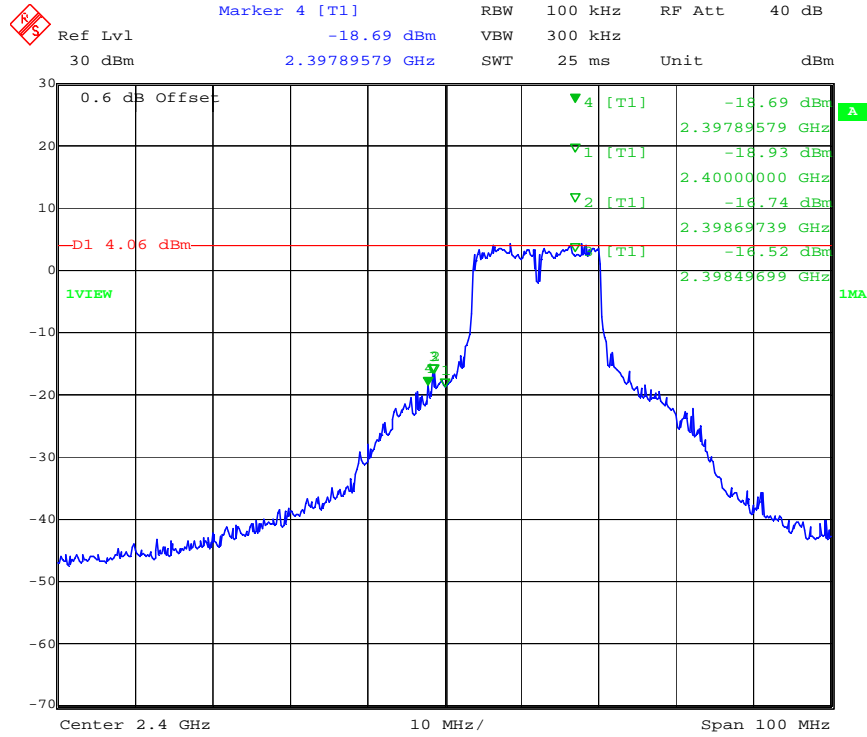
Date: 4.NOV.2013 12:11:13

Emissions Close to Band Edge - 802.11b Mode Low Channel



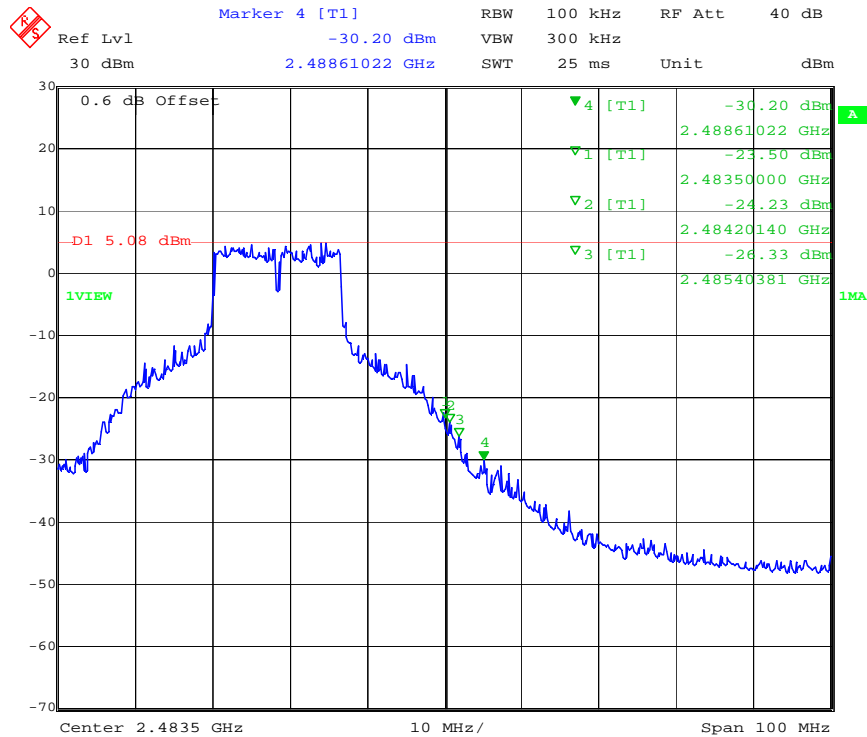
Date: 4.NOV.2013 12:13:17

Emissions Close to Band Edge - 802.11b Mode High Channel



Date: 4.NOV.2013 13:08:55

Emissions Close to Band Edge - 802.11g Mode Low Channel



Date: 4.NOV.2013 12:15:42

Emissions Close to Band Edge - 802.11g Mode 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)

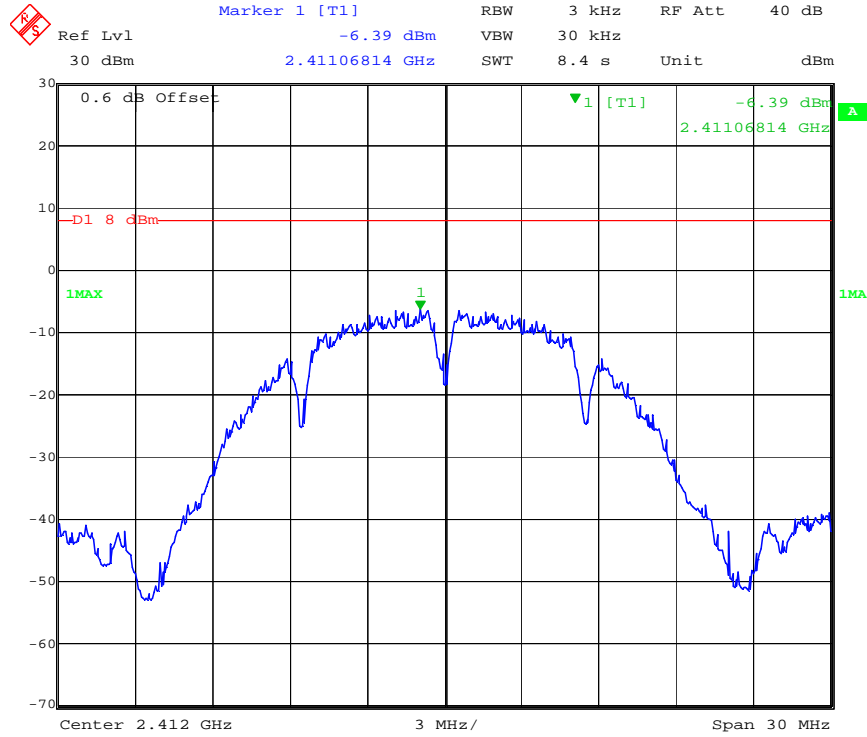
7.3 Test Equipment Used:

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

7.4 Results:

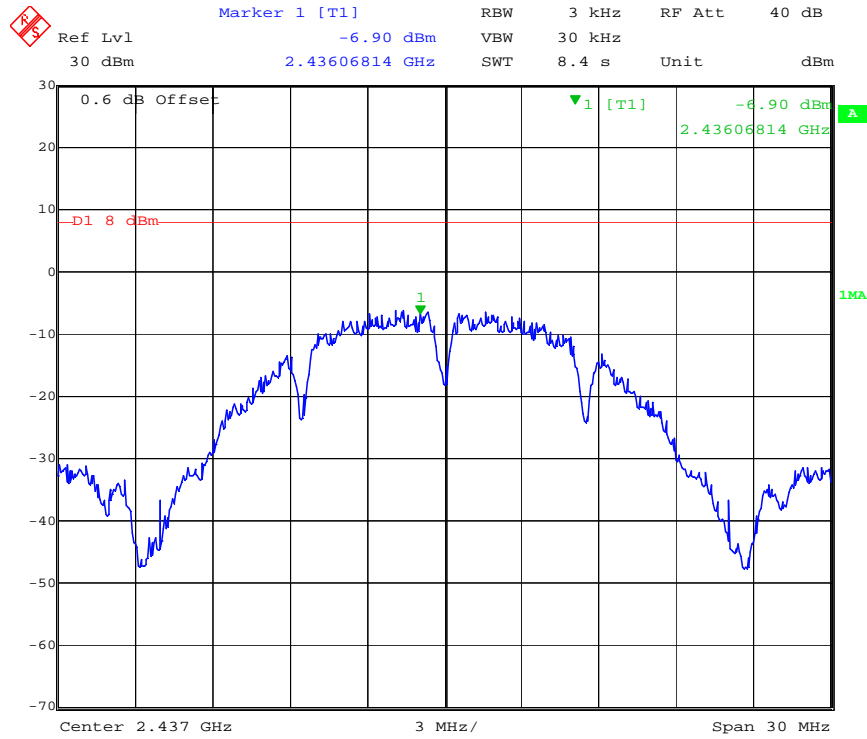
*PSD Option 1 Method

Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Result
802.11b	1	2412	-6.39dBm	8.0	Pass
802.11b	6	2437	-6.47dBm	8.0	Pass
802.11b	11	2462	-6.73dBm	8.0	Pass
802.11g	1	2412	-8.71dBm	8.0	Pass
802.11g	6	2437	-9.25dBm	8.0	Pass
802.11g	11	2462	-9.75dBm	8.0	Pass



Date: 4.NOV.2013 14:27:57

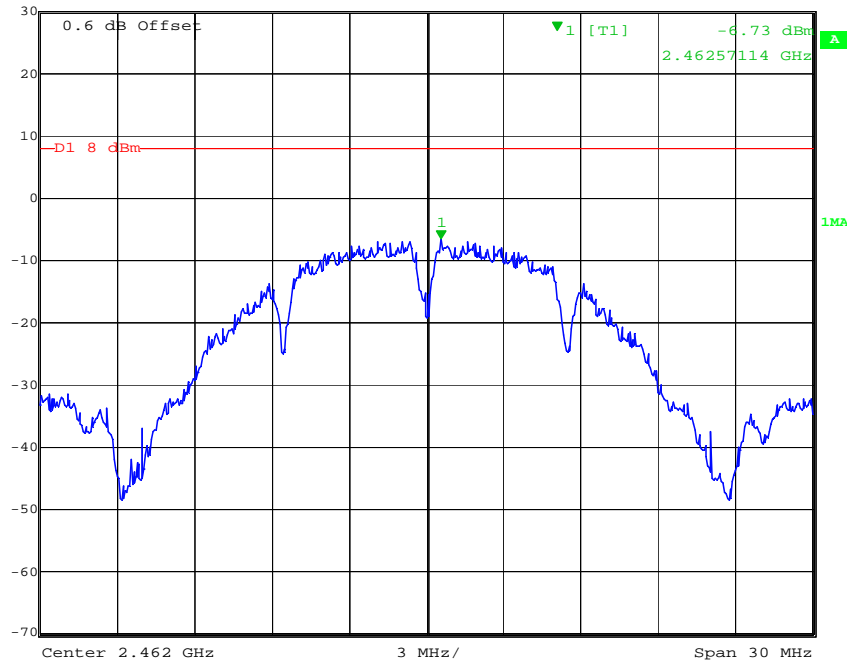
Power Spectral Density – Channel 1 802.11b mode



Date: 4.NOV.2013 14:30:58

Power Spectral Density – Channel 6 802.11b mode

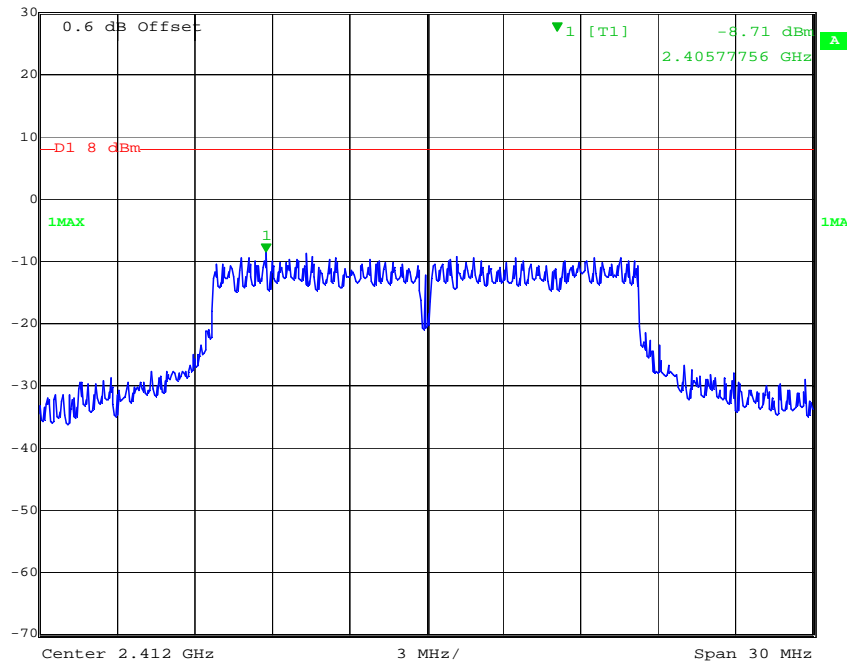
Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -6.73 dBm VBW 30 kHz
30 dBm 2.46257114 GHz SWT 8.4 s Unit dBm



Date: 4.NOV.2013 14:32:24

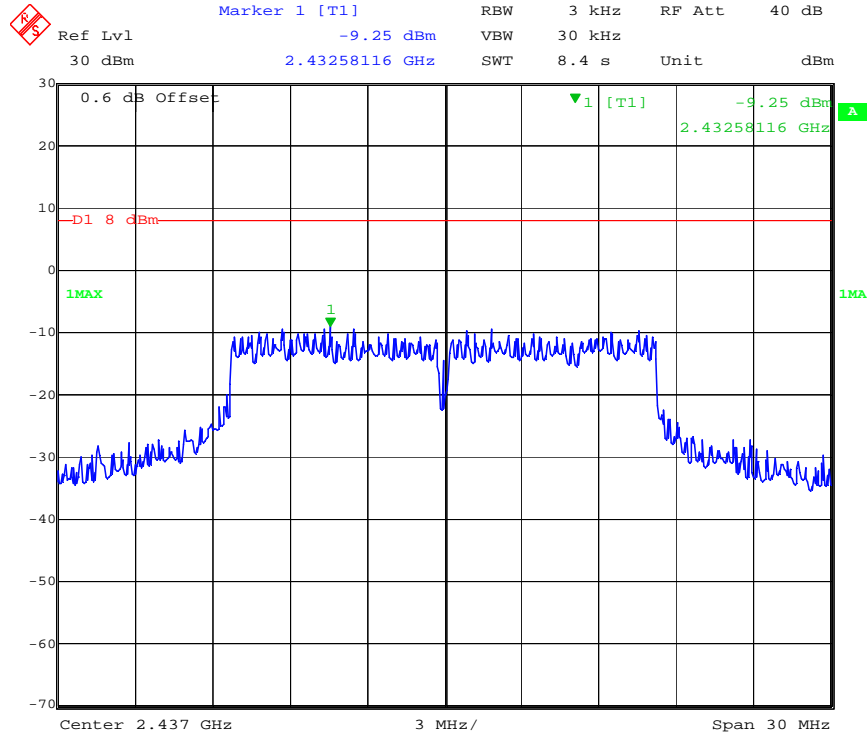
Power Spectral Density – Channel 11 802.11b mode

Marker 1 [T1] RBW 3 kHz RF Att 40 dB
Ref Lvl -8.71 dBm VBW 30 kHz
30 dBm 2.40577756 GHz SWT 8.4 s Unit dBm



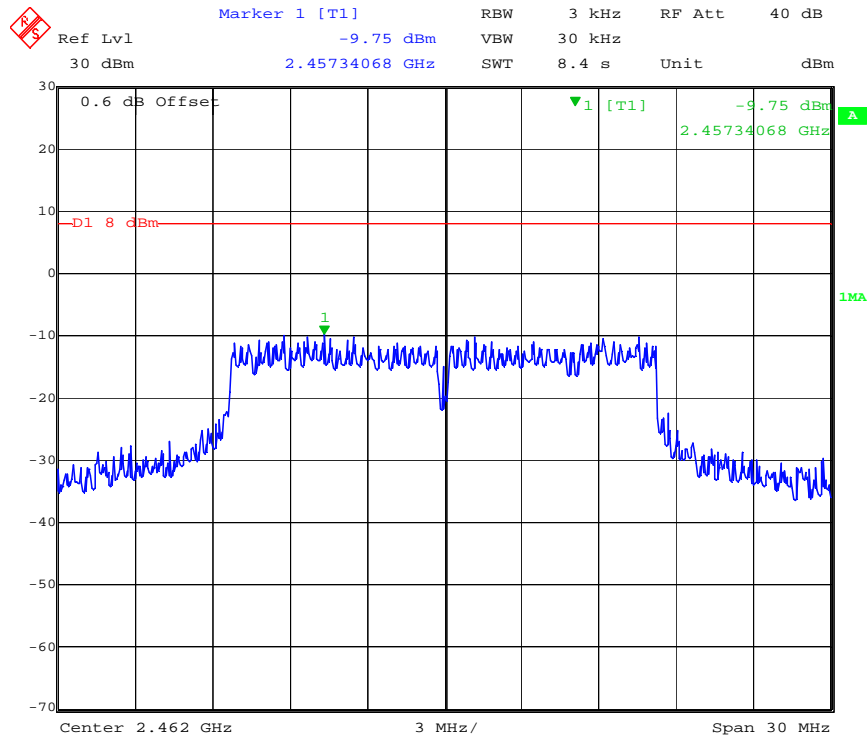
Date: 4.NOV.2013 14:36:11

Power Spectral Density – Channel 1 802.11g mode



Date: 4.NOV.2013 14:37:22

Power Spectral Density – Channel 6 802.11g mode



Date: 4.NOV.2013 14:38:24

Power Spectral Density – Channel 11 802.11g mode

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
Preamplifier	987410	Miteq	AFS44-00102000-30-10P-44	9/11/2013	9/11/2014
Preamplifier	SF456200904	Mini-Circuits	ZX60-3018G-S+	9/11/2013	9/11/2014
Biconnilog Antenna	00051864	ETS	3142C	12/14/2012	12/14/2013
Horn Antenna	00156319	ETS	3117	4/24/2013	4/24/2014
Horn Antenna	00117798	ETS	3116C	4/24/2013	4/24/2014
System Controller	121701-1	Sunol Sciences	SC99V	Calibration Not Required	Calibration Not Required
High Pass Filter	3986-01 DC0408	Microwave Circuits, Inc.	H3G020G2	Calibrate at Time Of Use	Calibrate at Time Of Use
Band Reject filter	155	Micro-Tronics	BRM50702	Calibrate at Time Of Use	Calibrate at 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 hand held device and could be used in any orientation. There were no significant emissions in any of the restricted bands below 1GHz.

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

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	11/6/2013		End Date:	11/15/2013			
Temperature:	23.9C		Humidity:	52.10%		Pressure:	989.7mBar			
Specification:	FCC Part 15C		Test Limit:	Class B						
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11B, Low Channel. Output Power Adjusted to 17dBm on Test Tool									
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	42.36	-31.121	34.7	45.939	74	-28.061	1MHz / Pk	3m	Compliant
7.236 GHz	V	36.54	-26.696	35.911	45.755	74	-28.245	1MHz / Pk	3m	Compliant
9.648 GHz	V	30.77	-22.459	37.337	45.648	74	-28.352	1MHz / Pk	3m	Compliant
12.06 GHz	V	31.42	-22.799	39.552	48.173	74	-25.827	1MHz / Pk	3m	Compliant
4.824 GHz	V	43.99	-31.121	34.7	47.569	54	-6.411	1MHz / Avg	3m	Compliant
7.236 GHz	V	31.12	-26.696	35.911	40.335	54	-13.645	1MHz / Avg	3m	Compliant
9.648 GHz	V	29.39	-22.459	37.337	44.268	54	-9.712	1MHz / Avg	3m	Compliant
12.06 GHz	V	18.48	-22.799	39.552	35.233	54	-18.747	1MHz / Avg	3m	Compliant
4.824 GHz	H	47.45	-31.121	34.7	51.029	74	-22.971	1MHz / Pk	3m	Compliant
7.2358 GHz	H	35.09	-26.697	35.911	44.305	74	-29.695	1MHz / Pk	3m	Compliant
9.6479 GHz	H	36.67	-22.459	37.337	51.548	74	-22.452	1MHz / Pk	3m	Compliant
12.065 GHz	H	31.81	-22.81	39.548	48.548	74	-25.452	1MHz / Pk	3m	Compliant
4.824 GHz	H	44.85	-31.121	34.7	48.429	54	-5.551	1MHz / Avg	3m	Compliant
7.2358 GHz	H	22.66	-26.697	35.911	31.875	54	-22.105	1MHz / Avg	3m	Compliant
9.6479 GHz	H	30.08	-22.459	37.337	44.958	54	-9.022	1MHz / Avg	3m	Compliant
12.065 GHz	H	18.58	-22.81	39.548	35.318	54	-18.662	1MHz / Avg	3m	Compliant
Restricted Band Edge Measurements Below										
2390 GHz	V	29.42	4.8	32.946	67.166	74	-6.834	1MHz / Pk	3m	Compliant
2390 GHz	V	14.5	4.8	32.946	52.246	54	-1.754	1MHz / Avg	3m	Compliant
2390 GHz	H	29.93	4.8	32.946	67.676	74	-6.324	1MHz / Pk	3m	Compliant
2390 GHz	H	14.76	4.8	32.946	52.506	54	-1.494	1MHz / Avg	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

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

Radiated Emissions										
Test Engineer:	Bryan Taylor	Start Date:	11/6/2013	End Date:	11/6/2013					
Temperature:	23.9C	Humidity:	52.10%	Pressure:	989.7mBar					
Specification:	FCC Part 15C	Test Limit:	Class B							
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11B, Middle Channel. Output Power Adjusted to 17dBm on Test Tool									
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
4.8741 GHz	V	42.75	-31.111	34.7	46.339	74	-27.661	1MHz / Pk	3m	Compliant
7.311 GHz	V	32.81	-26.539	35.9	42.171	74	-31.829	1MHz / Pk	3m	Compliant
9.7479 GHz	V	28.99	-22.519	37.497	43.968	74	-30.032	1MHz / Pk	3m	Compliant
12.185 GHz	V	26.61	-22.623	39.452	43.439	74	-30.561	1MHz / Pk	3m	Compliant
4.8741 GHz	V	39.08	-31.111	34.7	42.669	54	-11.311	1MHz / Avg	3m	Compliant
7.311 GHz	V	25.98	-26.539	35.9	35.341	54	-18.639	1MHz / Avg	3m	Compliant
9.7479 GHz	V	30.7	-22.519	37.497	45.678	54	-8.302	1MHz / Avg	3m	Compliant
12.185 GHz	V	23.52	-22.623	39.452	40.349	54	-13.631	1MHz / Avg	3m	Compliant
4.8741 GHz	H	40.48	-31.111	34.7	44.069	74	-29.931	1MHz / Pk	3m	Compliant
7.311 GHz	H	28.99	-26.539	35.9	38.351	74	-35.649	1MHz / Pk	3m	Compliant
9.748 GHz	H	33.35	-22.519	37.497	48.328	74	-25.672	1MHz / Pk	3m	Compliant
12.185 GHz	H	26.09	-22.623	39.452	42.919	74	-31.081	1MHz / Pk	3m	Compliant
4.8741 GHz	H	44.59	-31.111	34.7	48.179	54	-5.801	1MHz / Avg	3m	Compliant
7.311 GHz	H	25.94	-26.539	35.9	35.301	54	-18.679	1MHz / Avg	3m	Compliant
9.748 GHz	H	15.89	-22.519	37.497	30.868	54	-23.112	1MHz / Avg	3m	Compliant
12.185 GHz	H	18.41	-22.623	39.452	35.239	54	-18.741	1MHz / Avg	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:	11/7/2013	End Date:	11/15/2013					
Temperature:	23.9C	Humidity:	52.10%	Pressure:	989.7mBar					
Specification:	FCC Part 15C	Test Limit:	Class B							
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11B, High Channel. Output Power Adjusted to 17dBm on Test Tool									
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	48.08	-31.096	34.7	51.684	74	-22.316	1MHz / Pk	3m	Compliant
7.3858 GHz	V	40.48	-26.442	35.9	49.938	74	-24.062	1MHz / Pk	3m	Compliant
9.8479 GHz	V	39.87	-22.556	37.657	54.97	74	-19.03	1MHz / Pk	3m	Compliant
12.309 GHz	V	31.68	-22.27	39.377	48.786	74	-25.214	1MHz / Pk	3m	Compliant
4.924 GHz	V	45.82	-31.096	34.7	49.424	54	-4.556	1MHz / Avg	3m	Compliant
7.3858 GHz	V	35.18	-26.442	35.9	44.638	54	-9.342	1MHz / Avg	3m	Compliant
9.8479 GHz	V	35.23	-22.556	37.657	50.33	54	-3.65	1MHz / Avg	3m	Compliant
12.309 GHz	V	18.1	-22.27	39.377	35.206	54	-18.774	1MHz / Avg	3m	Compliant
4.924 GHz	H	37.57	-31.096	34.7	41.174	74	-32.826	1MHz / Pk	3m	Compliant
7.386 GHz	H	41.1	-26.442	35.9	50.558	74	-23.442	1MHz / Pk	3m	Compliant
9.8479 GHz	H	31.42	-22.556	37.657	46.52	74	-27.48	1MHz / Pk	3m	Compliant
12.31 GHz	H	34.95	-22.271	39.376	52.055	74	-21.945	1MHz / Pk	3m	Compliant
4.924 GHz	H	35.17	-31.096	34.7	38.774	54	-15.206	1MHz / Avg	3m	Compliant
7.386 GHz	H	36.27	-26.442	35.9	45.728	54	-8.252	1MHz / Avg	3m	Compliant
9.8479 GHz	H	21.9	-22.556	37.657	37	54	-16.98	1MHz / Avg	3m	Compliant
12.31 GHz	H	27.16	-22.271	39.376	44.265	54	-9.715	1MHz / Avg	3m	Compliant
Restricted Band Edge Measurements Below										
2.4835 GHz	V	18.39	4.8	32.907	56.097	74	-17.903	1MHz / Pk	3m	Compliant
2.4835 GHz	V	9.96	4.8	32.907	47.667	54	-6.333	1MHz / Avg	3m	Compliant
2.4835 GHz	H	19.15	4.8	32.907	56.857	74	-17.143	1MHz / Pk	3m	Compliant
2.4835 GHz	H	12.13	4.8	32.907	49.837	54	-4.163	1MHz / Avg	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:	11/8/2013	End Date:	11/15/2013					
Temperature:	23.9C	Humidity:	52.10%	Pressure:	989.7mBar					
Specification:	FCC Part 15C	Test Limit:	Class B							
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11G, Low Channel. Output Power Adjusted to 17dBm on Test Tool									
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	41.35	-31.121	34.7	44.929	74	-29.071	1MHz / Pk	3m	Compliant
7.236 GHz	V	32.37	-26.696	35.911	41.585	74	-32.415	1MHz / Pk	3m	Compliant
9.648 GHz	V	29.12	-22.459	37.337	43.998	74	-30.002	1MHz / Pk	3m	Compliant
12.06 GHz	V	29.5	-22.8	39.552	46.253	74	-27.747	1MHz / Pk	3m	Compliant
4.824 GHz	V	33.88	-31.121	34.7	37.459	54	-16.521	1MHz / Avg	3m	Compliant
7.236 GHz	V	22.99	-26.696	35.911	32.205	54	-21.775	1MHz / Avg	3m	Compliant
9.648 GHz	V	19.74	-22.459	37.337	34.618	54	-19.362	1MHz / Avg	3m	Compliant
12.06 GHz	V	19.75	-22.8	39.552	36.503	54	-17.477	1MHz / Avg	3m	Compliant
4.8239 GHz	H	37.95	-31.121	34.7	41.529	74	-32.471	1MHz / Pk	3m	Compliant
7.2358 GHz	H	32.95	-26.697	35.911	42.165	74	-31.835	1MHz / Pk	3m	Compliant
9.6479 GHz	H	28.87	-22.459	37.337	43.748	74	-30.252	1MHz / Pk	3m	Compliant
12.065 GHz	H	30.52	-22.81	39.548	47.258	74	-26.742	1MHz / Pk	3m	Compliant
4.8239 GHz	H	28.55	-31.121	34.7	32.129	54	-21.851	1MHz / Avg	3m	Compliant
7.2358 GHz	H	23.06	-26.697	35.911	32.275	54	-21.705	1MHz / Avg	3m	Compliant
9.6479 GHz	H	19.36	-22.459	37.337	34.238	54	-19.742	1MHz / Avg	3m	Compliant
12.065 GHz	H	19.95	-22.81	39.548	36.688	54	-17.292	1MHz / Avg	3m	Compliant
Restricted Band Edge Measurements Below										
2.39 GHz	V	29.35	4.8	32.944	67.094	74	-6.906	1MHz / Pk	3m	Compliant
2.39 GHz	V	15.37	4.8	32.944	53.114	54	-0.886	1MHz / Avg	3m	Compliant
2.39 GHz	H	28.43	4.8	32.944	66.174	74	-7.826	1MHz / Pk	3m	Compliant
2.39 GHz	H	15.46	4.8	32.944	53.204	54	-0.796	1MHz / Avg	3m	Compliant
Calculations:					F = C + D + E		H = F - G			

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

Radiated Emissions										
Test Engineer:	Bryan Taylor		Start Date:	11/8/2013		End Date:	11/8/2013			
Temperature:	23.9C		Humidity:	52.10%		Pressure:	989.7mBar			
Specification:	FCC Part 15C		Test Limit:	Class B						
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11G, Middle Channel. Output Power Adjusted to 17dBm on Test Tool									
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
4.8741 GHz	V	40.97	-31.111	34.7	44.559	74	-29.441	1MHz / Pk	3m	Compliant
7.3111 GHz	V	34.41	-26.539	35.9	43.771	74	-30.229	1MHz / Pk	3m	Compliant
9.748 GHz	V	29.24	-22.519	37.497	44.218	74	-29.782	1MHz / Pk	3m	Compliant
12.185 GHz	V	29.89	-22.623	39.452	46.719	74	-27.281	1MHz / Pk	3m	Compliant
4.8741 GHz	V	29.25	-31.111	34.7	32.839	54	-21.141	1MHz / Avg	3m	Compliant
7.3111 GHz	V	22.24	-26.539	35.9	31.601	54	-22.379	1MHz / Avg	3m	Compliant
9.748 GHz	V	19.64	-22.519	37.497	34.618	54	-19.362	1MHz / Avg	3m	Compliant
12.185 GHz	V	19.87	-22.623	39.452	36.699	54	-17.281	1MHz / Avg	3m	Compliant
4.8741 GHz	H	37.44	-31.111	34.7	41.029	74	-32.971	1MHz / Pk	3m	Compliant
7.311 GHz	H	32.08	-26.539	35.9	41.441	74	-32.559	1MHz / Pk	3m	Compliant
9.748 GHz	H	30.9	-22.519	37.497	45.878	74	-28.122	1MHz / Pk	3m	Compliant
12.185 GHz	H	29.5	-22.623	39.452	46.329	74	-27.671	1MHz / Pk	3m	Compliant
4.8741 GHz	H	37.03	-31.111	34.7	40.619	54	-13.361	1MHz / Avg	3m	Compliant
7.311 GHz	H	22.77	-26.539	35.9	32.131	54	-21.849	1MHz / Avg	3m	Compliant
9.748 GHz	H	21.76	-22.519	37.497	36.738	54	-17.242	1MHz / Avg	3m	Compliant
12.185 GHz	H	20.29	-22.623	39.452	37.119	54	-16.861	1MHz / Avg	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:	11/8/2013		End Date:	11/15/2013				
Temperature:	23.9C		Humidity:	52.10%		Pressure:	989.7mBar				
Specification:	FCC Part 15C		Test Limit:	Class B							
Notes:	Emissions Above 1GHz Falling in Restricted Bands. 802.11G, High Channel. Output Power Adjusted to 17dBm on Test Tool										
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	34.82	-31.096	34.7	38.424	74	-35.576	1MHz / Pk	3m	Compliant	
7.3858 GHz	V	33.09	-26.442	35.9	42.548	74	-31.452	1MHz / Pk	3m	Compliant	
9.848 GHz	V	30.52	-22.556	37.657	45.62	74	-28.38	1MHz / Pk	3m	Compliant	
12.309 GHz	V	29.89	-22.27	39.377	46.996	74	-27.004	1MHz / Pk	3m	Compliant	
4.924 GHz	V	26.52	-31.096	34.7	30.124	54	-23.856	1MHz / Avg	3m	Compliant	
7.3858 GHz	V	22.1	-26.442	35.9	31.558	54	-22.422	1MHz / Avg	3m	Compliant	
9.848 GHz	V	20.58	-22.556	37.657	35.68	54	-18.3	1MHz / Avg	3m	Compliant	
12.309 GHz	V	19.64	-22.27	39.377	36.746	54	-17.234	1MHz / Avg	3m	Compliant	
4.924 GHz	H	34.55	-31.096	34.7	38.154	74	-35.846	1MHz / Pk	3m	Compliant	
7.386 GHz	H	32.08	-26.442	35.9	41.538	74	-32.462	1MHz / Pk	3m	Compliant	
9.8479 GHz	H	30.02	-22.556	37.657	45.12	74	-28.88	1MHz / Pk	3m	Compliant	
12.31 GHz	H	28.74	-22.271	39.376	45.845	74	-28.155	1MHz / Pk	3m	Compliant	
4.924 GHz	H	29.03	-31.096	34.7	32.634	54	-21.346	1MHz / Avg	3m	Compliant	
7.386 GHz	H	22.66	-26.442	35.9	32.118	54	-21.862	1MHz / Avg	3m	Compliant	
9.8479 GHz	H	20.31	-22.556	37.657	35.41	54	-18.57	1MHz / Avg	3m	Compliant	
12.31 GHz	H	19.76	-22.271	39.376	36.865	54	-17.115	1MHz / Avg	3m	Compliant	
Restricted Band Edge Measurements Below											
2.4835 GHz	V	25.72	4.8	32.907	63.427	74	-10.573	1MHz / Pk	3m	Compliant	
2.4835 GHz	V	13.6	4.8	32.907	51.307	54	-2.693	1MHz / Avg	3m	Compliant	
2.4835 GHz	H	28.88	4.8	32.907	66.587	74	-7.413	1MHz / Pk	3m	Compliant	
2.4835 GHz	H	15.46	4.8	32.907	53.167	54	-0.833	1MHz / Avg	3m	Compliant	
Calculations:					F = C + D + E		H = F - G				

9 AC Powerline Conducted Emissions

9.1 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.

9.2 Test Procedure

ANSI C63.4: 2009

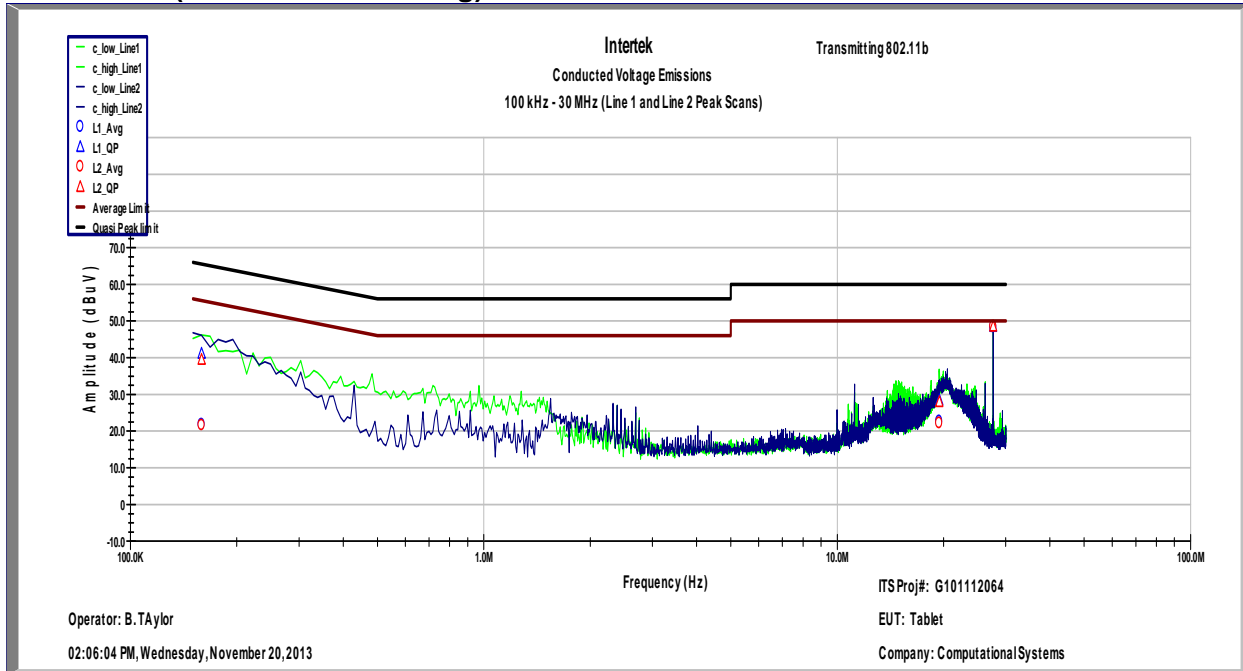
9.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ES126	9/11/2013	9/11/2014
LISN	3333	Teseq	NNB52	3/11/2013	3/11/2014

9.4 Results:

The sample tested was found to Comply.

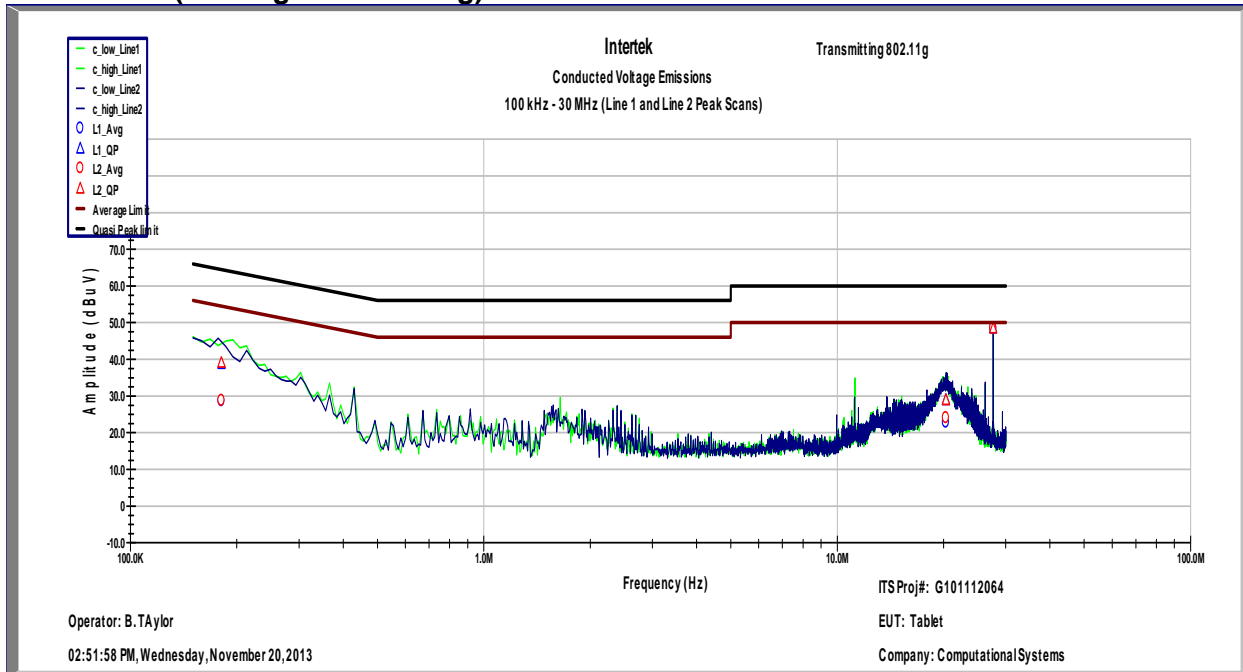
9.5 Data (802.11b Transmitting):



Conducted Voltage Emissions on Power Lines								
Test Engineer:	Bryan Taylor	Start Date:	11/20/2013	End Date:	11/20/2013			
Temperature:	23.6C	Humidity:	45.20%	Pressure:	988.9mBar			
Specification:	FCC Part 15C	Test Limit:	Class B	RBW:	9kHz			
Notes:	802.11b 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	159.0 KHz	41.08	65.52	-24.43	21.71	55.52	-33.8	Compliant
Line 1	19.44 MHz	28.38	60	-31.62	22.51	50	-27.49	Compliant
Line 1	27.636 MHz	48.39	60	-11.61	48.32	50	-1.68	Compliant
Line 2	159.0 KHz	39.44	65.52	-26.07	21.58	55.52	-33.93	Compliant
Line 2	19.44 MHz	27.89	60	-32.11	22.08	50	-27.92	Compliant
Line 2	27.636 MHz	48.49	60	-11.51	48.42	50	-1.58	Compliant

Deviations, Additions, or Exclusions: None

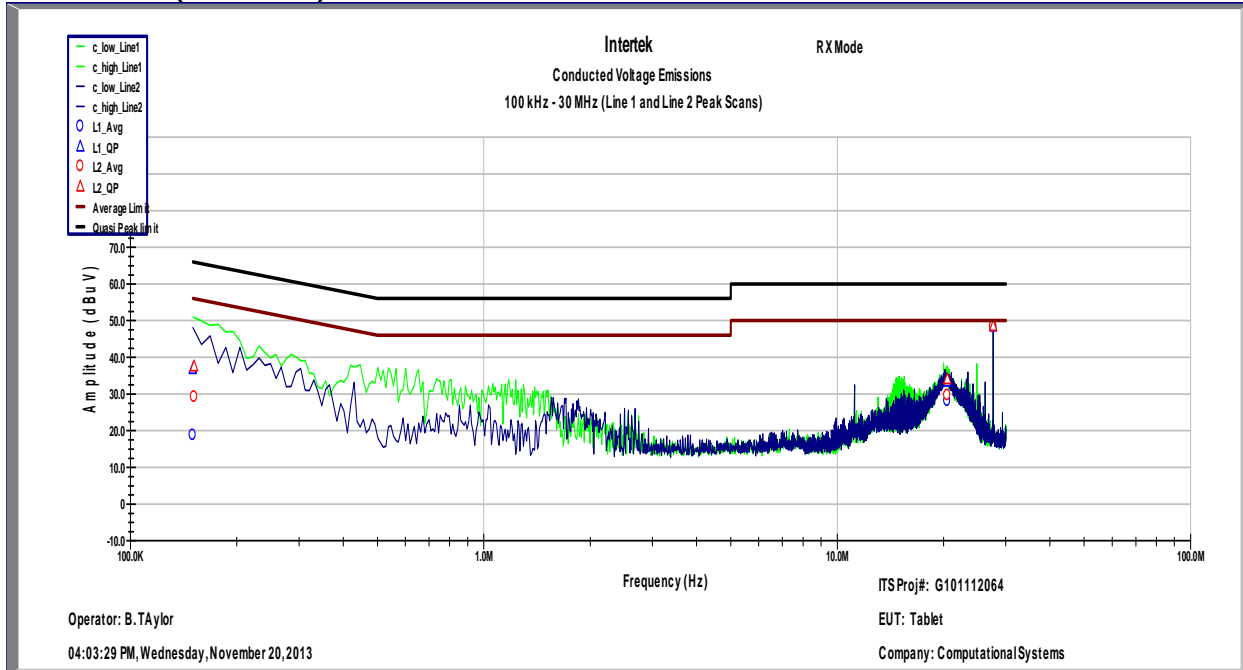
9.1 Data (802.11g Transmitting):



Conducted Voltage Emissions on Power Lines								
Test Engineer:	Bryan Taylor	Start Date:	11/20/2013	End Date:	11/20/2013			
Temperature:	23.6C	Humidity:	45.20%	Pressure:	988.9mBar			
Specification:	FCC Part 15C	Test Limit:	Class B	RBW:	9kHz			
Notes:	802.11g 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	180.9 KHz	38.73	64.44	-25.71	28.58	54.44	-25.86	Compliant
Line 1	20.3 MHz	28.92	60	-31.08	22.71	50	-27.29	Compliant
Line 1	27.637 MHz	48.45	60	-11.55	48.39	50	-1.61	Compliant
Line 2	180.9 KHz	39.06	64.44	-25.38	28.71	54.44	-25.73	Compliant
Line 2	20.3 MHz	28.92	60	-31.08	23.97	50	-26.03	Compliant
Line 2	27.637 MHz	48.42	60	-11.58	48.43	50	-1.57	Compliant

Deviations, Additions, or Exclusions: None

9.2 Data (Idle Mode):



Conducted Voltage Emissions on Power Lines								
Test Engineer:	Bryan Taylor	Start Date:	11/20/2013	End Date:	11/20/2013			
Temperature:	23.6C	Humidity:	45.20%	Pressure:	988.9mBar			
Specification:	FCC Part 15C	Test Limit:	Class B	RBW:	9kHz			
Notes:	RX							
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	36.81	66	-29.19	18.76	56	-37.24	Compliant
Line 1	20.49 MHz	33.45	60	-26.55	28.09	50	-21.91	Compliant
Line 1	27.636 MHz	48.41	60	-11.59	48.34	50	-1.66	Compliant
Line 2	151.3 KHz	37.5	65.93	-28.43	29.13	55.93	-26.8	Compliant
Line 2	20.49 MHz	34.03	60	-25.97	29.56	50	-20.44	Compliant
Line 2	27.636 MHz	48.51	60	-11.49	48.45	50	-1.55	Compliant

Deviations, Additions, or Exclusions: None

10 Antenna Requirement per FCC Part 15.203**10.1 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.

10.2 Results:

The sample tested met the antenna requirement. The antenna utilized a U.fl connector for connection to the PCB antenna.

11 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	

12 Revision History

Revision Level	Date	Report Number	Notes
1	12/1/2013	G101112064LEX-001	Original Issue
2	1/2/2014	G101112064LEX-001.2	FCCID and ICID were swapped.