

CLASS II PERMISSIVE CHANGE TEST REPORT

Report Number: 102358168LAX-013

Project Number: G102358168

March 31, 2016

**Testing performed on the
Radio Module**

**Part Number: 150-00020 with 160-00011
to**

**FCC Part 15 Subpart C (15.247)
Industry Canada RSS-247, Issue 1**

For

Juicero

Test Performed by:

Intertek

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Test Authorized by:

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Prepared by:



Grace Lin

Date: March 31, 2016

Reviewed by:



Krishna Vemuri

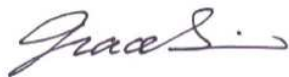
Date: March 31, 2016

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Report No. 102358168LAX-013

Equipment Under Test:	Radio Module
Trade Name:	Juicero
Part Number Tested:	150-00020 with 160-00011
Serial Number:	503M20309A1
Applicant:	Juicero
Contact:	Paul Katz
Address:	Juicero 2001 Bryant Street San Francisco, CA 94110
Country	USA
Tel. Number:	(201) 694-5161
Email:	paul@juicero.com
Applicable Regulation:	FCC Part 15 Subpart C (15.247) Industry Canada RSS-247, Issue 1
Dates of Test:	March 3 to March 8, 2016

We attest to the accuracy of this report:



Grace Lin
EMC Staff Engineer



Krishna Vemuri
EMC Engineering Team Lead

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1.0 Summary of Tests

Test	Reference FCC	Reference Industry Canada	Result
RF Output Power	15.247(b)(3)	RSS-247, 5.4	Complies
Out of Band Antenna Conducted Emission	15.247(d)	RSS-247, 5.5	Complies
Transmitter Radiated Emissions	15.247(d), 15.209, 15.205	RSS-247, 5.5	Complies
Antenna Requirement	15.203	RSS-GEN	Complies
RF Exposure	15.247(i), 2.1093(d)	RSS-102	Complies

EUT receive date: February 25, 2016

EUT receive condition: The pre-production version of the EUT was received in good condition with no apparent damage. As declared by the Applicant, it is identical to the production units.

Test start date: March 3, 2016

Test completion date: March 8, 2016

The test results in this report pertain only to the item tested.

2.0 General Information

2.1 Product Description

The Equipment Under Test (EUT), part number: 150-00020 with 160-00011, is an IEEE 802.11 b/g/n WiFi transmitter module.

The EUT supports a wide range of data rates in the 2.4GHz band:

IEEE 802.11b: 1, 2, 5.5, 11Mbps

IEEE 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps

IEEE 802.11n: MCS0, MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7

Applicant	Juicero Inc
Part Number	150-00020 with 160-00011
Modulation Technique	DSSS (BPSK, QPSK, CCK), OFDM (BPSK, QPSK, 16QAM, 64QAM)
Rated RF Output	802.11b: 12.17dBm (16.48mW) 802.11g: 12.75dBm (18.84mW) 802.11n: 12.65dBm (18.41mW)
Frequency Range	2412 – 2462 MHz
Type of modulation	BPSK, QPSK, 16QAM, 64QAM
Number of Channel(s)	11
Antenna(s) & Gain	PCB antenna, 3.95 dBi peak gain
Manufacturer Name & Address	Juicero 2001 Bryant Street San Francisco, CA 94110, USA

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Antenna conducted measurements were performed according to the FCC documents “Guidance for Performing Compliance Measurement on Digital Transmission Systems (DTS) Operating under §15.247” (KDB 558074), and RSS-247, RSS-GEN, and

Radiated emissions and AC mains conducted emissions measurements were performed according to the procedures in ANSI C63.10. Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "Data Sheet" of this report.

2.4 Test Facility

The test site used to collect the radiated data is a 3 meter semi-anechoic chamber. This test facility and site measurement data have been fully placed on file with the FCC, IC and A2LA accredited.

2.5 Measurement Uncertainty

Compliance with the limits was based on the results of the measurements and doesn't take into account the measurement uncertainty.

Estimated Measurement Uncertainty

Measurement	Expanded Uncertainty (k=2)		
	0.15 MHz – 1 GHz	1 GHz – 2.5 GHz	> 2.5 GHz
RF Power and Power Density – antenna conducted	-	0.7 dB	-
Unwanted emissions - antenna conducted	1.1 dB	1.3 dB	1.9 dB
Bandwidth – antenna conducted	-	30 Hz	-
Radiated emissions	4.2 dB	3.4 dB	4.4 dB
AC mains conducted emissions	2.4 dB	-	-

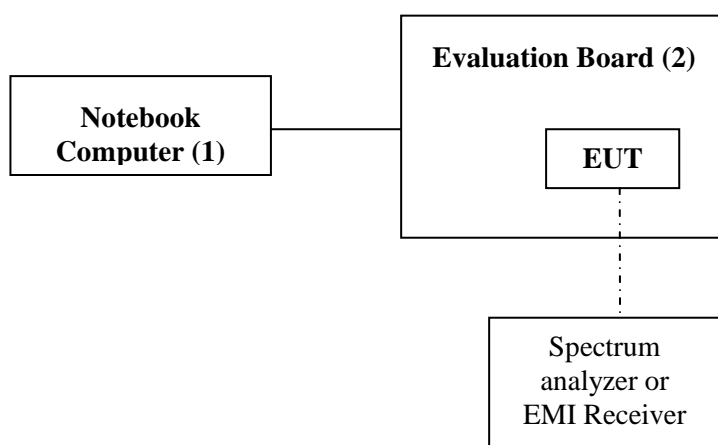
3.0 System Test Configuration

3.1 Support Equipment and description

Item #	Description	Model No./ Part No.	Serial No.
1	HP Notebook Computer	Pavilion 14-v062US	5CD4411DFR
2	Juicero Evaluation Board	830-00001 Main Controller PCB	A 00056

3.2 Block Diagram of Test Setup

Antenna was removed and co-axial connector with a cable was installed for Conducted Measurements.
External PCB antenna was used for Radiated Measurements.



Note: The EUT was powered through USB port of the notebook computer.

S = Shielded	F = With Ferrite
U = Unshielded	M = Meter

3.3 Justification

Preliminary testing was performed for all modulation/data rate modes. The worse-case data rate with highest power and widest spectrum were selected for final measurements:

- CCK 5.5 Mbps – for 802.11b
- OFDM 9 Mbps – for 802.11g
- OFDM MCS0 – for 802.11n HT20

The RF power setting used for all tests in the report is 4.

3.4 Mode of Operation during Test

During transmitter testing, the transmitter was setup to transmit continuously at maximum RF power on low, middle and high channels.

3.5 Modifications Required for Compliance

Intertek installed no modifications during compliance testing in order to bring the product into compliance.

3.6 Additions, Deviations and Exclusions from Standards

No additions, deviations or exclusions from the standard were made.

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals FCC Rule 15.247(b)(3)

4.1.1 Requirement

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm).
For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.1.2 Procedure

The antenna port of the EUT was connected to the input of a spectrum analyzer/power meter to measure the Maximum Conducted Transmitter Output Power.

The procedure described in FCC Publication 558074 D01 DTS Meas Guidance v03r04 January 07, 2016 was used. Specifically, section 9.2.2.2 Method AVGSA-1.

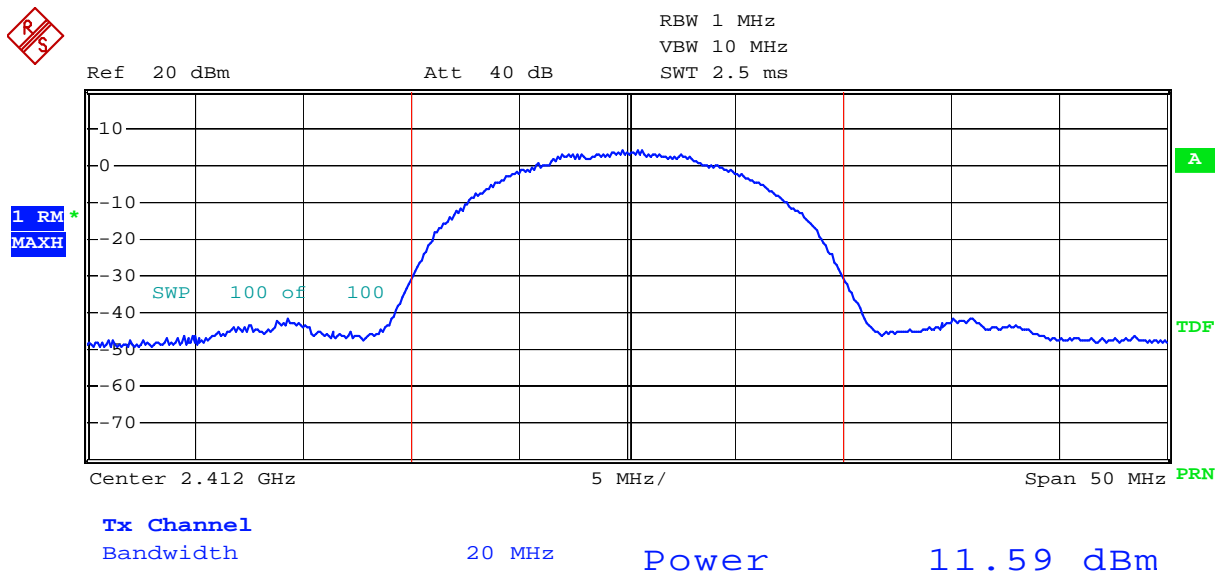
1. Set the RBW = 1-5% of the OBW, not to exceed 1MHz.
2. Set the VBW $\geq 3 \times$ RBW
3. Set the span $\geq 1.5 \times$ OBW.
4. Detector = RMS.
5. Sweep time = auto couple.
6. Trace mode = power averaging (100 traces)
7. Number of points in sweep $\geq 2 \times$ span/RBW.
8. Use the instrument's band/channel power measurement function with the band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels at intervals equal to the RBW extending across the entire OBW of the spectrum.

4.1.3 Test Result

Refer to the following plots for the test result:

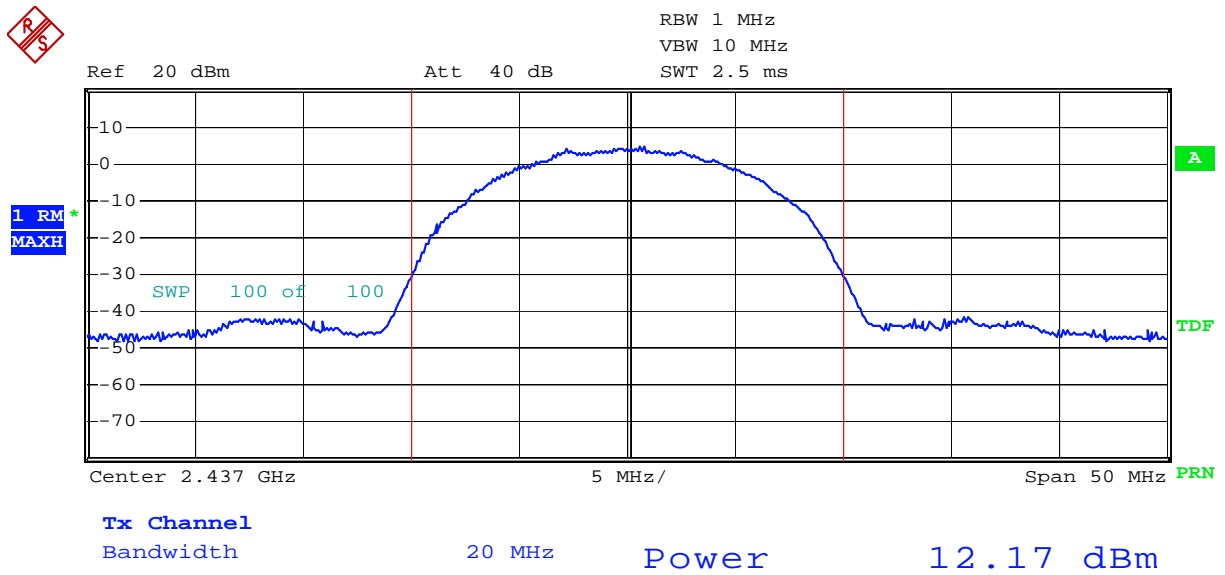
Standard	Data Rate	Channel	Frequency MHz	Conducted Power dBm	Conducted Power mW	Plot #
802.11b	5.5 Mbps	1	2412	11.59	14.42	2.1
		6	2437	12.17	16.48	2.2
		11	2462	11.25	13.34	2.3
802.11g	9 Mbps	1	2412	11.76	15.00	2.4
		6	2437	12.75	18.84	2.5
		11	2462	10.90	12.30	2.6
802.11n HT20	MCS 0	1	2412	10.98	12.53	2.7
		6	2437	12.65	18.41	2.8
		11	2462	10.04	10.09	2.9

Plot 2.1



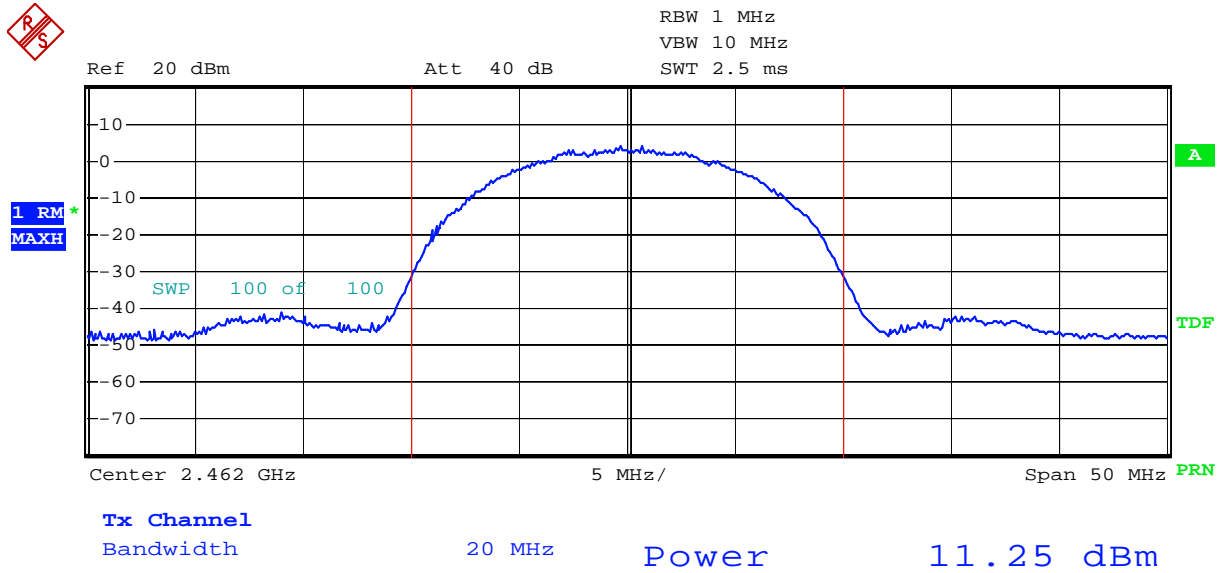
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Plot 2.2



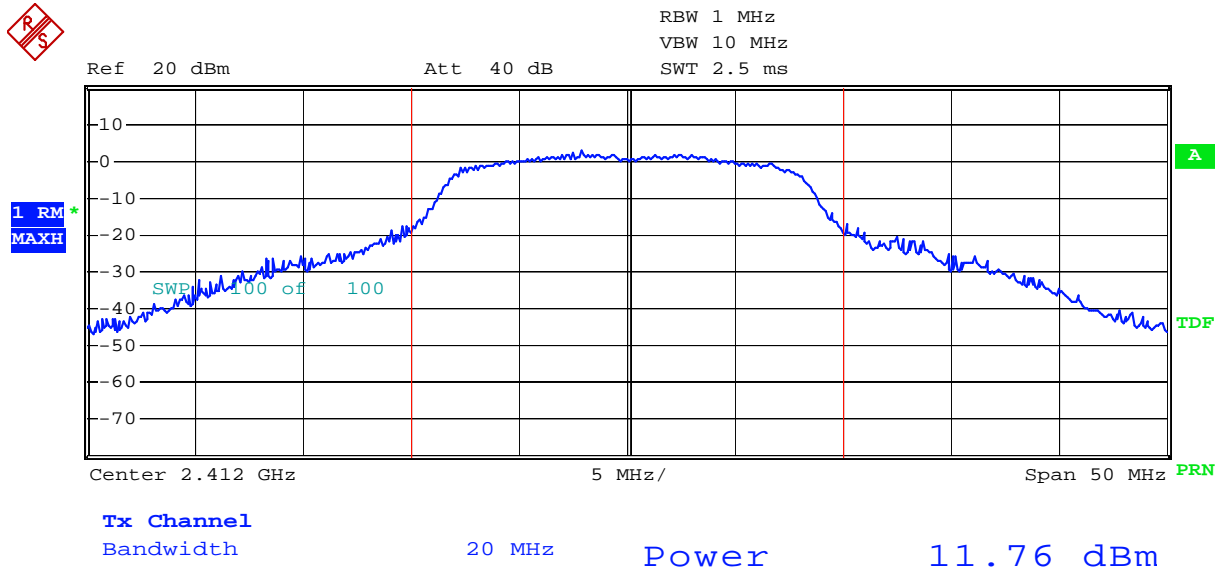
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Plot 2.3



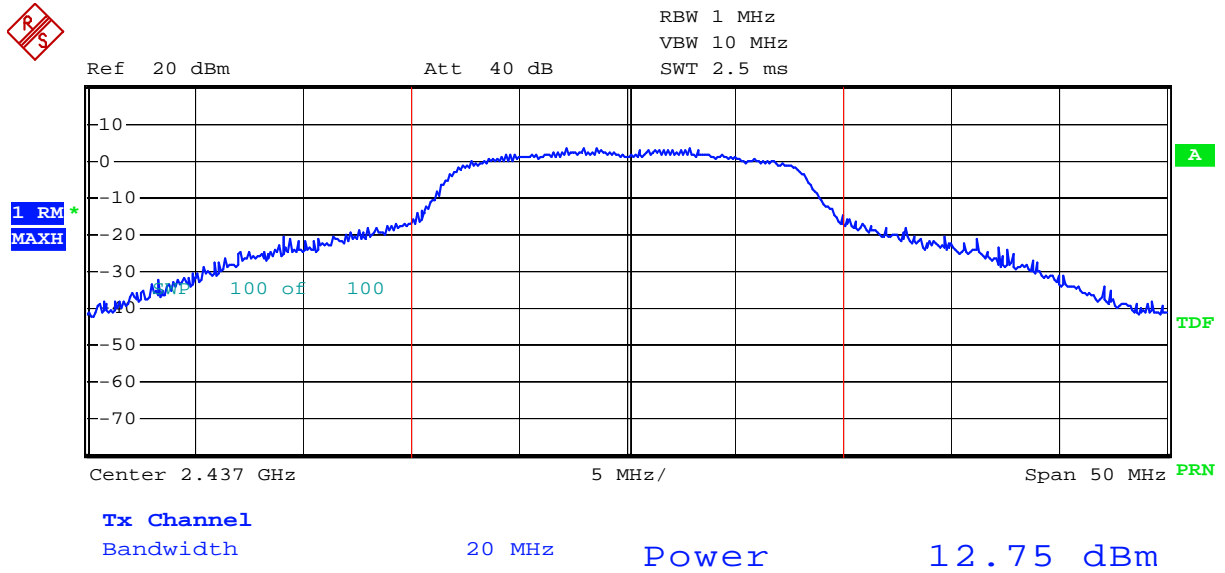
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Plot 2.4



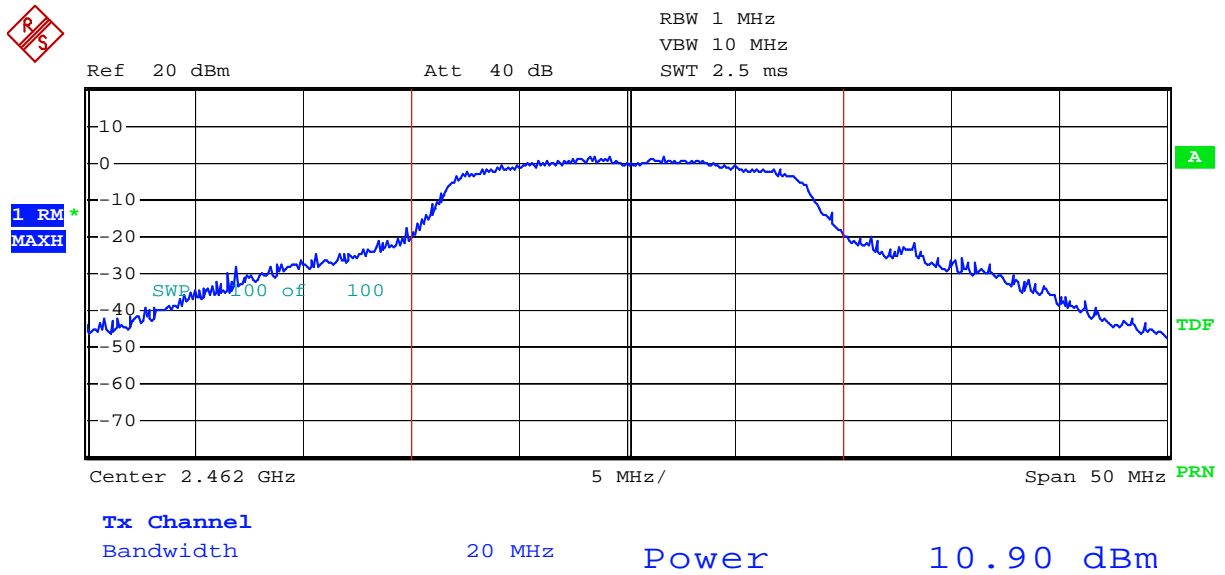
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Plot 2.5



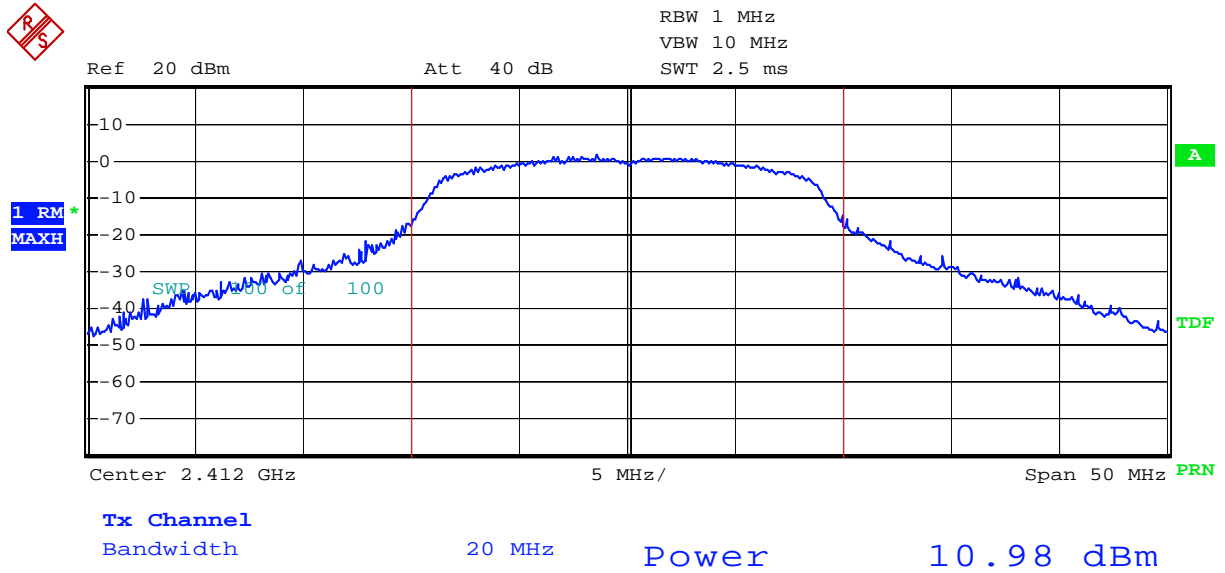
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Plot 2.6



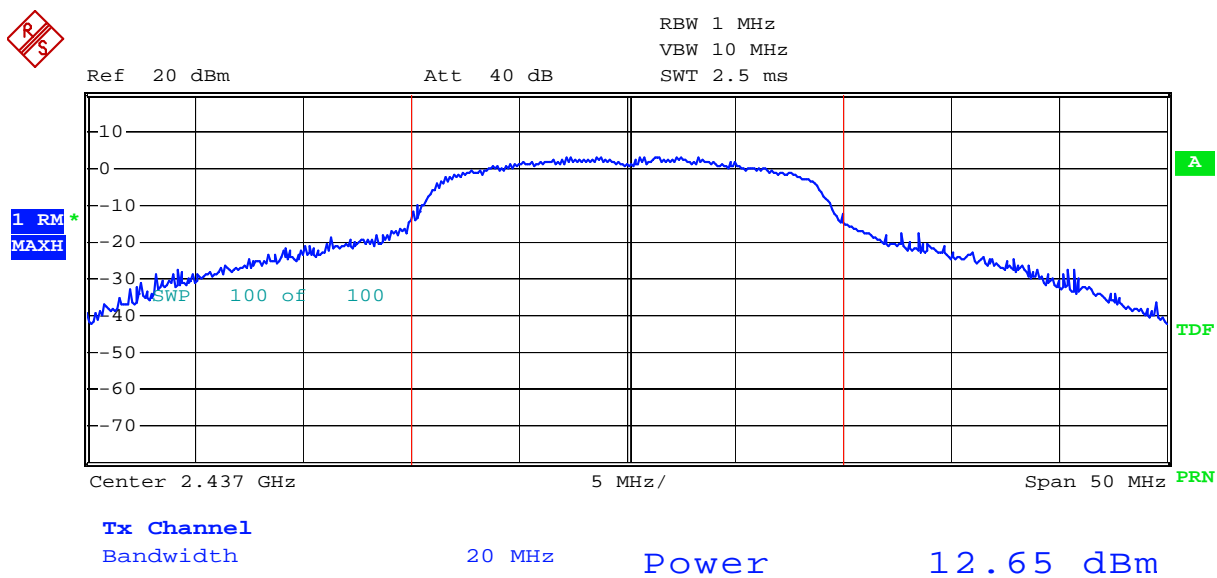
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Plot 2.7



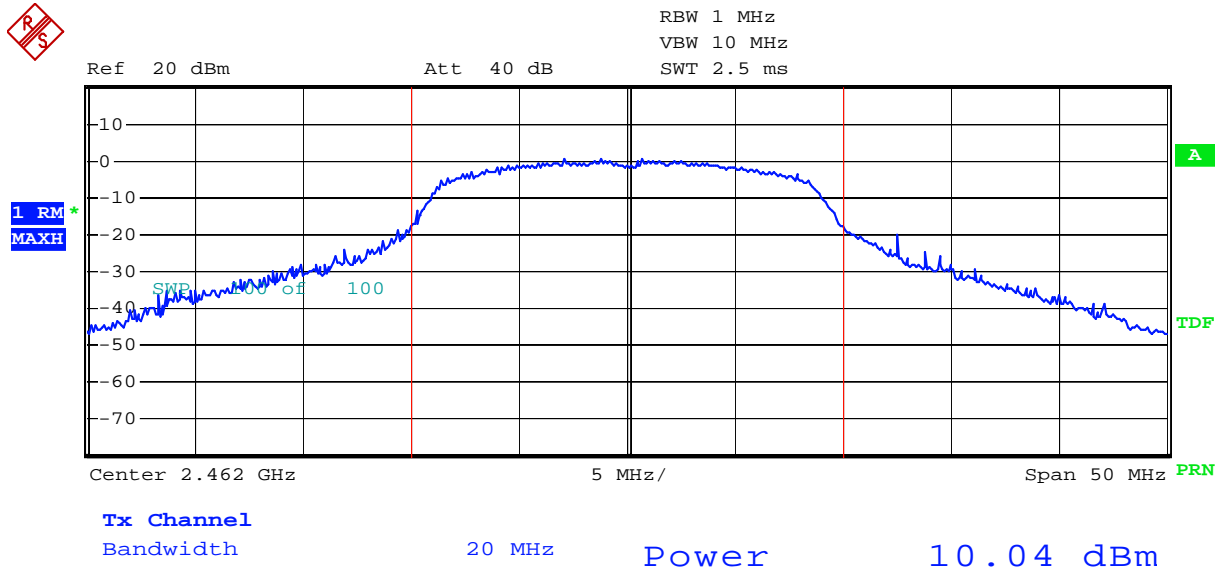
Date: 8.MAR.2016 17:04:45

Plot 2.8



Date: 8.MAR.2016 17:05:54

Plot 2.9



Date: 8.MAR.2016 17:10:31

4.2 Out-of-Band Conducted Emissions FCC 15.247(d)

4.2.1 Requirement

In any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.2.2 Procedure

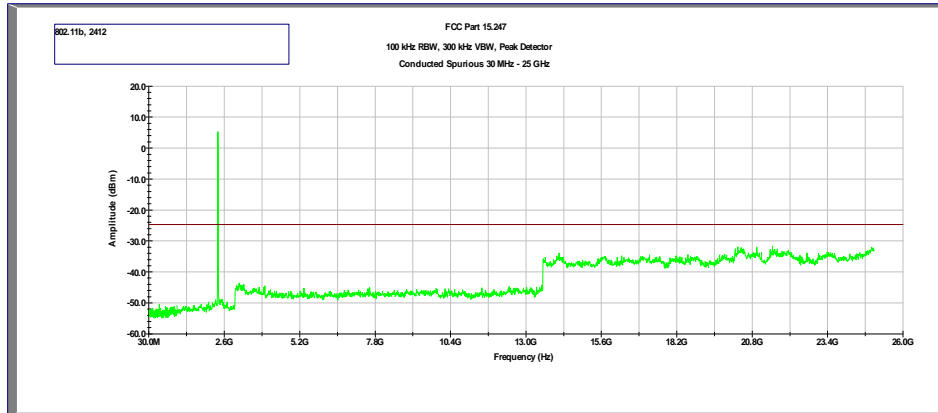
A spectrum analyzer was connected to the antenna port of the transmitter. Analyzer Resolution Bandwidth was set to 100 kHz. For each channel investigated, the in-band and out-of-band emission measurements were performed. The out-of-band emissions were measured from 30 MHz to 25 GHz.

4.2.3 Test Result

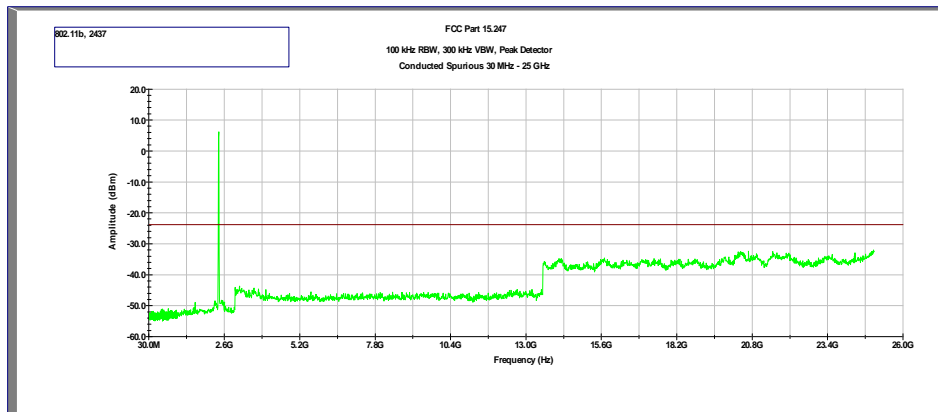
Refer to the following plots 4.1 – 4.9 for unwanted conducted emissions. The plot shows -30dB attenuation limit line.

Results	Complies
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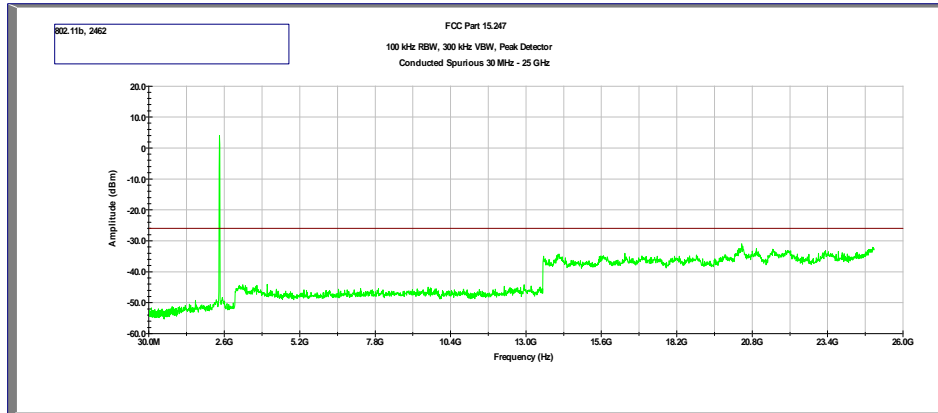
Plot 4.1
Tx @ 2412MHz 802.11b



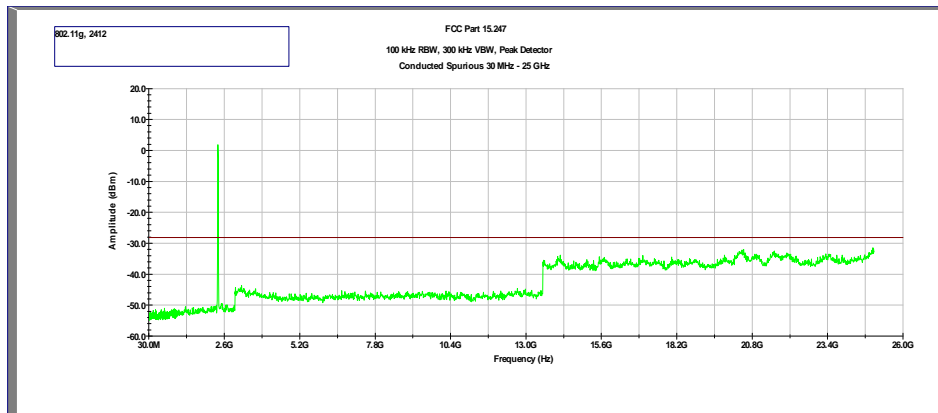
Plot 4.2
Tx @ 2437MHz 802.11b



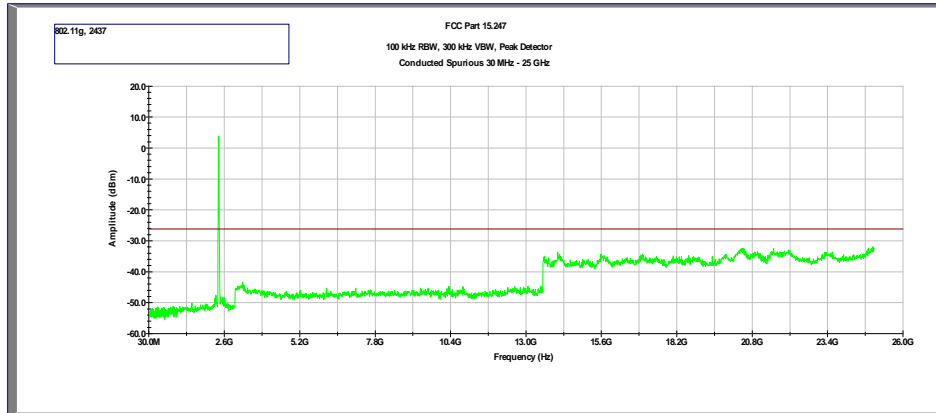
Plot 4.3
Tx @ 2462MHz 802.11b



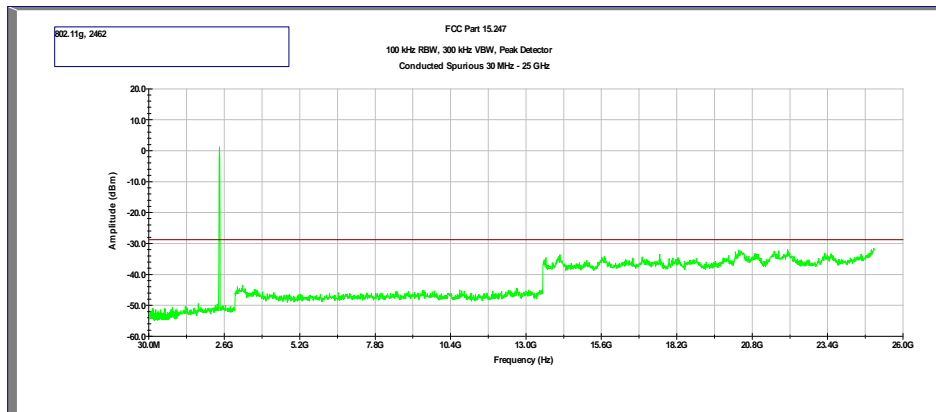
Plot 4.4
Tx @ 2412MHz 802.11g



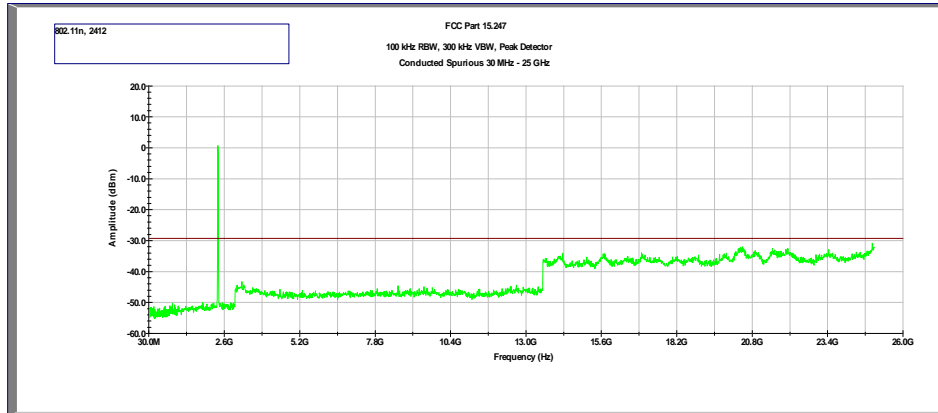
Plot 4.5
Tx @ 2437MHz 802.11g



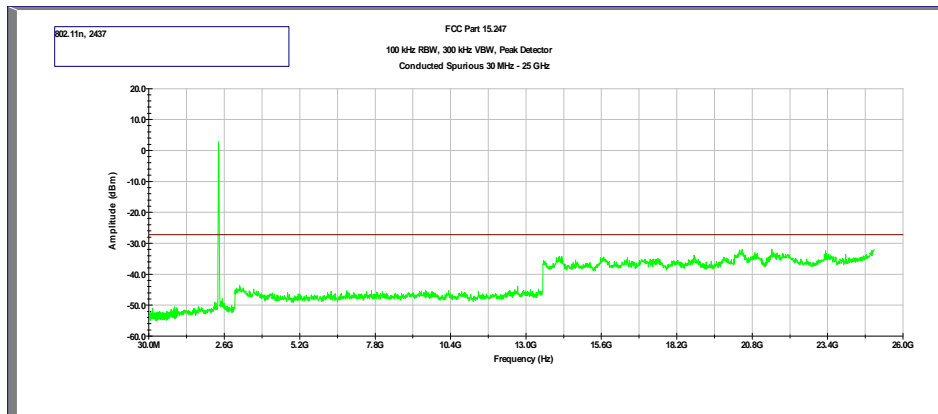
Plot 4.6
Tx @ 2462MHz 802.11g



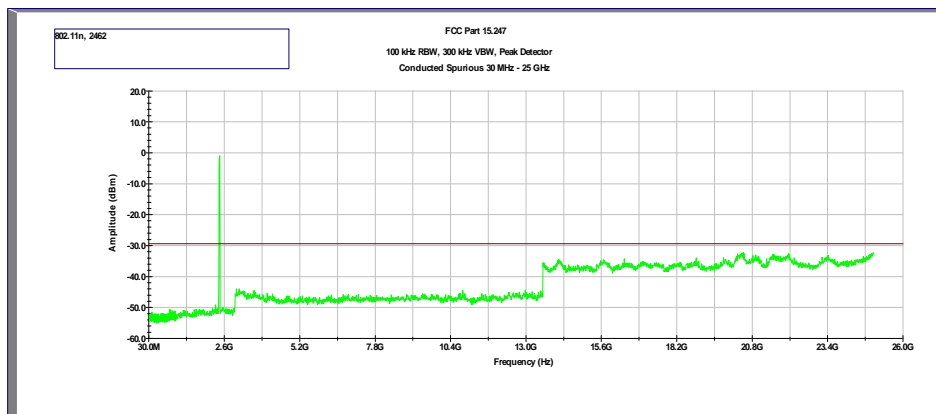
Plot 4.7
Tx @ 2412MHz 802.11n, HT20



Plot 4.8
Tx @ 2437MHz 802.11n, HT20



Plot 4.9
Tx @ 2462MHz 802.11n, HT20



4.3 Transmitter Radiated Emissions FCC Rule 15.247(d), 15.209, 15.205; RSS-247

4.3.1 Requirement

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)).

For out of band radiated emissions (except for frequencies in restricted bands), in any 100 kHz bandwidths outside the EUT pass-band, the RF power shall be at least 20dB (peak) or 30 dB (average) below that of the maximum in-band 100 kHz emissions.

4.3.2 Procedure

Radiated emission measurements were performed from 30 MHz to 25 GHz according to the procedure described in ANSI C64.10. Spectrum Analyzer Resolution Bandwidth is 100 kHz or greater for frequencies 30 MHz to 1000 MHz, 1 MHz for frequencies above 1000 MHz. Above 1000 MHz Peak and Average measurements were performed.

The EUT is placed on a plastic/Styrofoam table that is 80 cm in height for below 1000MHz and 1.5m in height for above 1GHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters. A preamp was used from 30MHz to 26GHz. All measurements were made with a Peak Detector and compared to QP limits for 30MHz – 1GHz and Average limits for 1GHz – 26GHz.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels).

4.3.3 Field Strength Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$FS = RA + AF + CF - AG$; if measurement is performed at a distance other than specified in the rule, a Distance Correction Factor (DCF) shall be added.

Where FS = Field Strength in $dB(\mu V/m)$

RA = Receiver Amplitude (including preamplifier) in $dB(\mu V)$; AF = Antenna Factor in $dB(1/m)$

CF = Cable Attenuation Factor in dB ; AG = Amplifier Gain in dB

Assume a receiver reading of $52.0\text{ dB}(\mu V)$ is obtained. The antennas factor of $7.4\text{ dB}(1/m)$ and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving field strength of $32\text{ dB}(\mu V/m)$. This value in $dB(\mu V/m)$ was converted to its corresponding level in $\mu V/m$.

$RA = 52.0\text{ dB}(\mu V)$

$AF = 7.4\text{ dB}(1/m)$

$CF = 1.6\text{ dB}$

$AG = 29.0\text{ dB}$

$FS = 52.0 + 7.4 + 1.6 - 29.0 = 32\text{ dB}(\mu V/m)$.

Level in $\mu V/m$ = Common Antilogarithm $[(32\text{ dB}\mu V/m)/20] = 39.8\text{ }\mu V/m$.

4.3.4 Test Results

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

The EUT passed the test by 2.42 dB

Test Results: 15.209/15.205 Restricted Band Emissions

Out-of-Band Radiated spurious emissions at the Band-edge

Protocol	Antenna Polarization	Channel Frequency (MHz)	Frequency (MHz)	EUT Orientation	EUT Ant Orientation	EUT Power Setting	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
802.11b	H	2412	2390.00	YZ	V	4	27.71	54	-26.29	182.0	117.0	Ave
	H	2412	2390.00	YZ	V	4	49.11	74	-24.89	182.0	117.0	Peak
	H	2462	2483.50	YZ	V	4	27.49	54	-26.51	48.0	191.0	Ave
802.11g	H	2462	2483.50	YZ	V	4	44.50	74	-29.50	48.0	191.0	Peak
	H	2412	2390.00	YZ	V	4	32.24	54	-21.76	182.0	117.0	Ave
	H	2412	2390.00	YZ	V	4	68.14	74	-5.86	182.0	117.0	Peak
	H	2462	2483.50	YZ	V	4	27.51	54	-26.49	48.0	191.0	Ave
	H	2462	2483.50	YZ	V	4	65.45	74	-8.55	48.0	191.0	Peak
802.11n	H	2412	2390.00	YZ	V	4	33.98	54	-20.02	182.0	117.0	Ave
	H	2412	2390.00	YZ	V	4	71.58	74	-2.42	182.0	117.0	Peak
	H	2462	2483.50	YZ	V	4	29.85	54	-24.15	48.0	191.0	Ave
	H	2462	2483.50	YZ	V	4	67.47	74	-6.53	48.0	191.0	Peak

Date of Test: March 7, 2016

Radiated Spurious Emissions

802.11b										
Antenna Polarization	Channel Frequency	Frequency (MHz)	EUT Orientation	EUT Ant Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	2412	4019.38	YZ	V	37.17	54	-16.83	104.0	100.0	Ave
H	2412	4019.38	YZ	V	54.00	74	-20.00	104.0	100.0	Peak
H	2412	4824.00	YZ	V	36.64	54	-17.36	218.0	123.0	Ave
H	2412	4824.00	YZ	V	51.56	74	-22.44	218.0	123.0	Peak
H	2412	6431.94	YZ	V	46.15	54	-7.85	38.0	216.0	Ave
H	2412	6431.94	YZ	V	59.51	74	-14.49	38.0	216.0	Peak
H	2437	4061.70	YZ	V	37.39	54	-16.61	36.0	192.0	Ave
H	2437	4061.70	YZ	V	54.49	74	-19.51	36.0	192.0	Peak
H	2437	4874.00	YZ	V	36.19	54	-17.81	314.0	169.0	Ave
H	2437	4874.00	YZ	V	53.25	74	-20.75	314.0	169.0	Peak
H	2437	6498.61	YZ	V	46.67	54	-7.33	129.0	195.0	Ave
H	2437	6498.61	YZ	V	57.26	74	-16.74	129.0	195.0	Peak
H	2462	4103.20	YZ	V	38.81	54	-15.19	37.0	125.0	Ave
H	2462	4103.20	YZ	V	55.89	74	-18.11	37.0	125.0	Peak
H	2462	4924.00	YZ	V	37.53	54	-16.47	201.0	186.0	Ave
H	2462	4924.00	YZ	V	54.83	74	-19.17	201.0	186.0	Peak
H	2462	6565.30	YZ	V	46.36	54	-7.64	125.0	170.0	Ave
H	2462	6565.30	YZ	V	58.14	74	-15.86	125.0	170.0	Peak
								Date of Test: March 5-7, 2016		

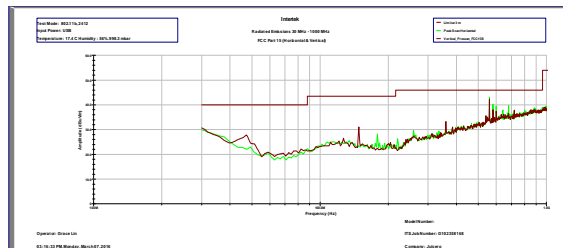
802.11g										
Antenna Polarization	Channel Frequency	Frequency (MHz)	EUT Orientation	EUT Ant Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	2412	6431.94	YZ	V	40.94	54	-13.06	129.0	199.0	Ave
H	2412	6431.94	YZ	V	54.32	74	-19.68	129.0	199.0	Peak
H	2437	6498.61	YZ	V	41.30	54	-12.70	132.0	200.0	Ave
H	2437	6498.61	YZ	V	56.61	74	-17.39	132.0	200.0	Peak
H	2462	6565.35	YZ	V	40.62	54	-13.38	127.0	200.0	Ave
H	2462	6565.35	YZ	V	57.32	74	-16.68	127.0	200.0	Peak
								Date of Test: March 5-7, 2016		

802.11n										
Antenna Polarization	Channel Frequency	Frequency (MHz)	EUT Orientation	EUT Ant Orientation	Measured Data (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Turntable Degree	Antenna Height (cm)	Detector
H	2412	6431.94	YZ	V	41.49	54	-12.51	123.0	201.0	Ave
H	2412	6431.94	YZ	V	53.15	74	-20.85	123.0	201.0	Peak
H	2437	6498.61	YZ	V	43.14	54	-10.86	127.0	202.0	Ave
H	2437	6498.61	YZ	V	56.89	74	-17.11	127.0	202.0	Peak
H	2462	6565.30	YZ	V	40.52	54	-13.48	73.0	200.0	Ave
H	2462	6565.30	YZ	V	54.63	74	-19.37	73.0	200.0	Peak
H	2462	13130.51	YZ	V	43.70	54	-10.30	110.0	186.0	Ave
H	2462	13130.51	YZ	V	58.62	74	-15.38	110.0	186.0	Peak
								Date of Test: March 5-7, 2016		

Tx @ 2412MHz 802.11b

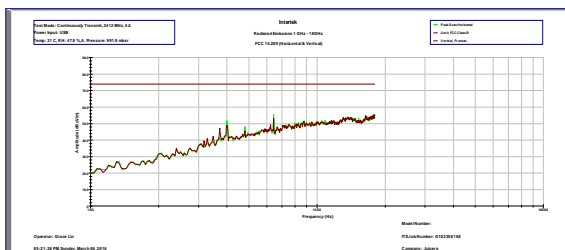
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

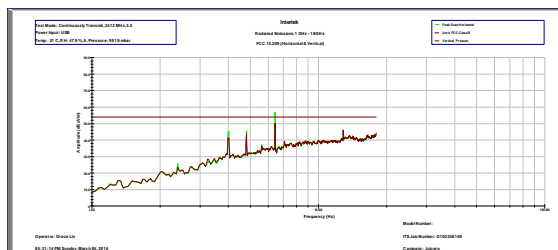


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



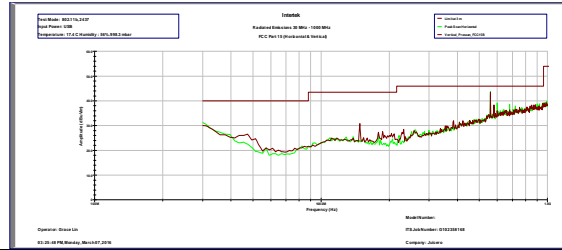
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2437MHz 802.11b

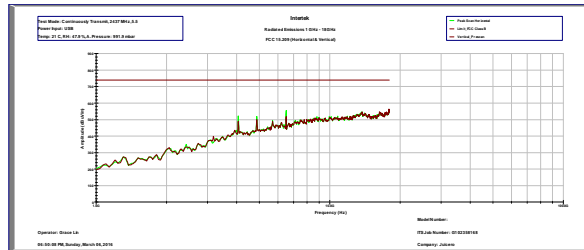
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

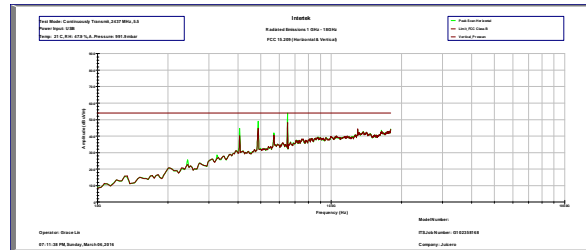


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



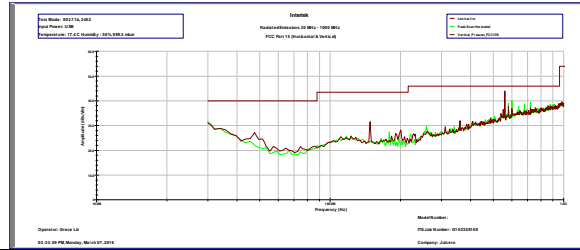
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2462MHz 802.11b

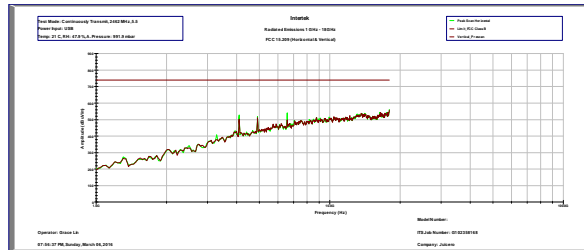
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

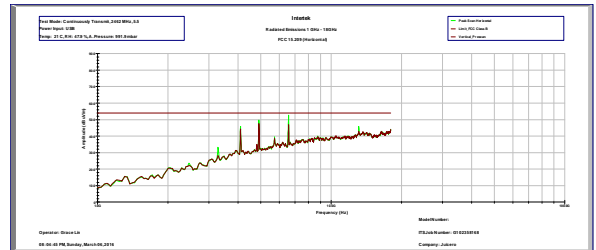


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



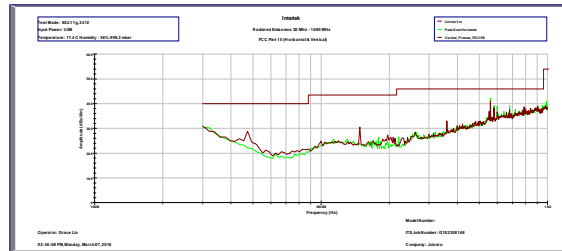
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2412MHz 802.11g

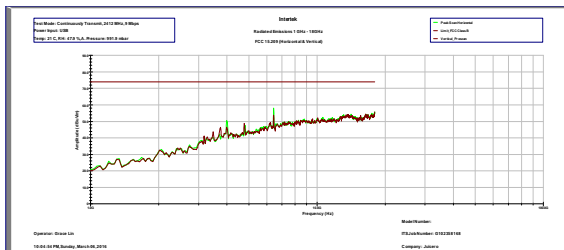
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

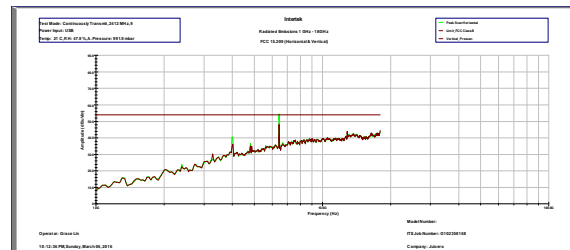


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



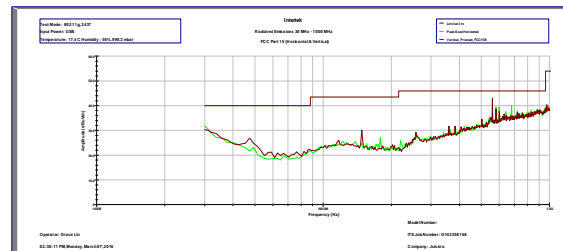
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2437MHz 802.11g

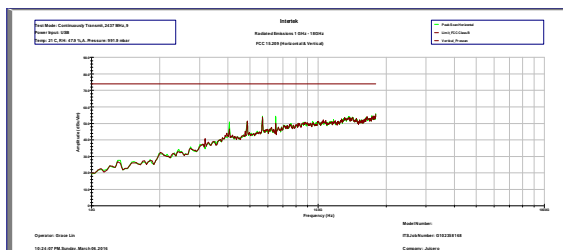
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

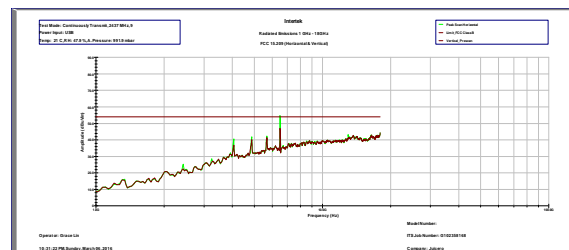


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



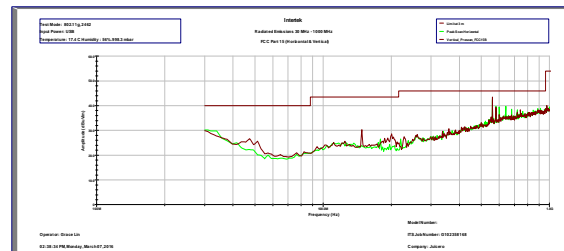
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2462MHz 802.11g

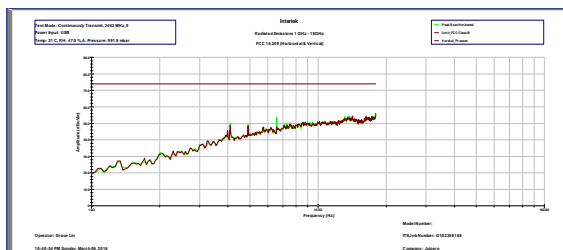
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

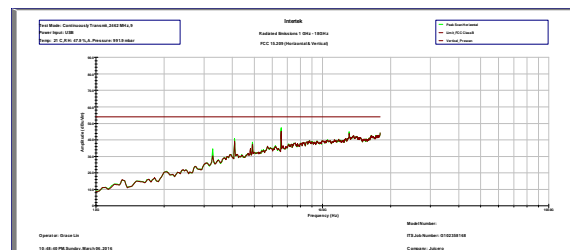


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



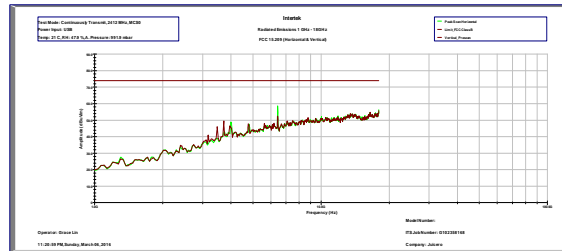
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2412MHz 802.11n, HT20

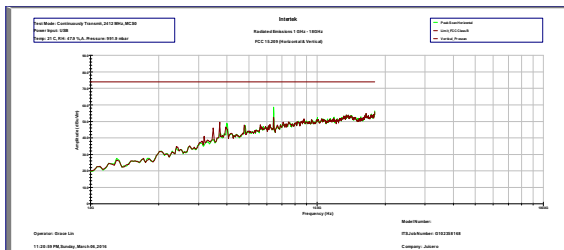
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

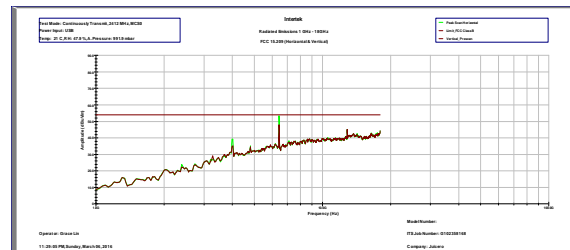


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



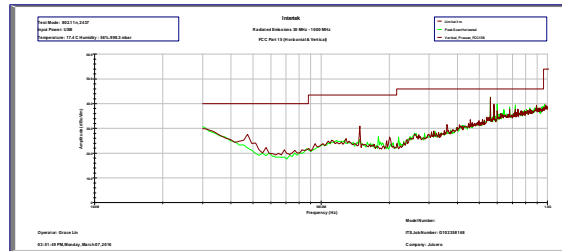
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2437MHz 802.11n, HT20

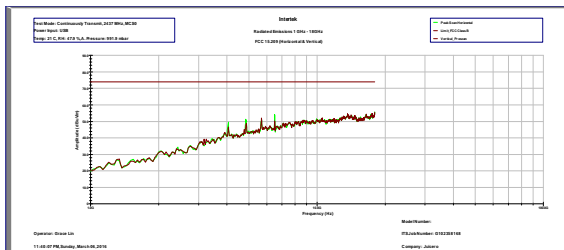
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

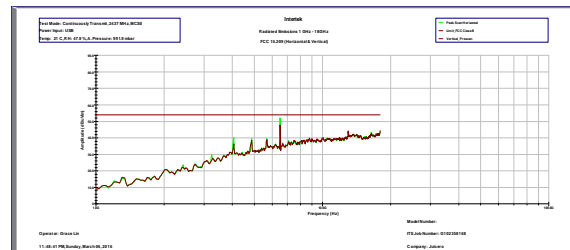


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



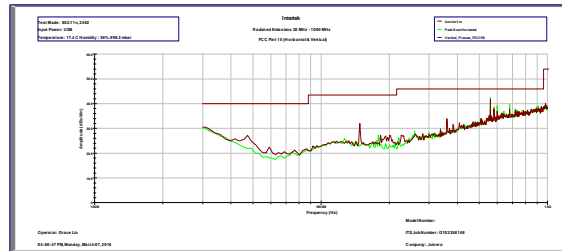
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

Tx @ 2462MHz 802.11n, HT20

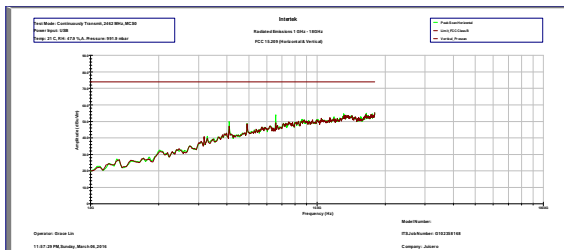
Radiated Spurious 30 MHz to 1 GHz

Quasi-Peak

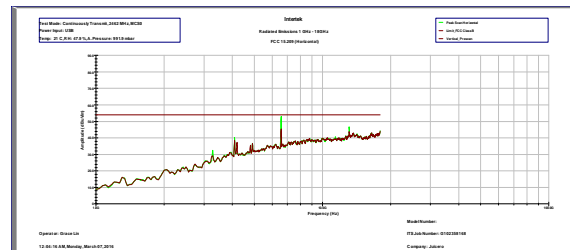


Radiated Spurious 1 GHz to 18 GHz

Peak



Average



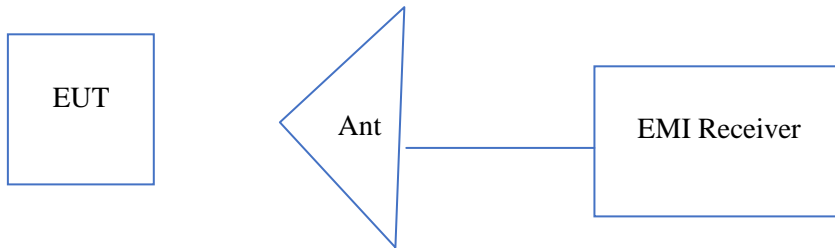
Note: All other emissions not reported are noise floor which is at least 10 dB below the limit.

Note: Radiated emission measurements were performed up to 25GHz. No Emissions were identified when scanned from 18-25 GHz.

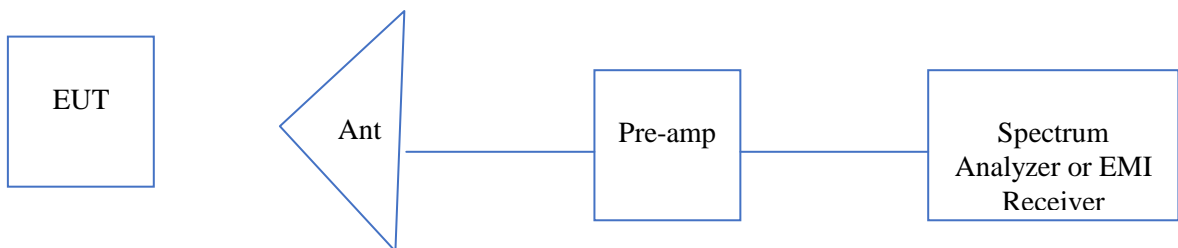
4.3.4 Test Setup Diagram

The following diagrams show the testing configurations used.

Below 1 GHz:



Above 1 GHz:



5.0 List of Test Equipment

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Asset #	Cal Int	Cal Due
Spectrum Analyzer	Rohde and Schwarz	FSP	000690	12	01/11/17
EMI Receiver	Rohde and Schwarz	ESCI	001140	12	02/22/17
BI-Log Antenna	Teseq	CBL 6111D	001147	12	10/28/16
Horn Antenna	ETS-Lindgren	3115	001515	12	11/05/16
Pre-Amplifier (1-18GHz)	Miteq	AMF-4D-001180-24-10P	ITS 00526	12	10/06/16
Horn Antenna w Preamplifier	ETS Lindgren	3116C-PA	s/n: 00117568	12	01/06/17

6.0 Document History

Revision/ Job Number	Writer Initials	Reviewers Initials	Date	Change
1.0 / G102358168	GL	KV	March 31, 2016	Original document