



Test Report

Prepared for: **Garmin International Inc**

Model: A02777

Description: Camera

Serial Number: N/A

FCC ID: IPH-02777

IC: 1792A-02777

To

FCC Part 15.247 DTS

Date of Issue: August 3, 2016

On the behalf of the applicant:

**Garmin International Inc
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Olathe, KS 66062**

Attention of:

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Project No: p1660026**

**Kenneth Lee
Project Test Engineer**

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	June 27, 2016	Kenneth Lee	Original Document
2.0	July 23, 2016	Amanda Reed	Updated model & description
3.0	August 3, 2016	Kenneth Lee	Updated Band Edge Test Setup Diagram



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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to <http://www.compliancetesting.com/labscope.html> for current scope of accreditation.

Testing Certificate Number: **2152.01**



FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The applicant has been cautioned as to the following

15.21 - Information to User

The user's manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) - Special Accessories

Equipment marked to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.10-2013 and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
27.6	30.9	948.6

EUT Description

Model: A02777
Description: Camera
Firmware: N/A
Software: N/A
Serial Number: N/A
Additional Information: None

EUT Operation during Tests

The EUT was put into a test mode where the channel and modulation could be selected. The EUT was fully tested in the B, G and N modulations.

Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Switching Power Supply	Garmin	PSM10R-050	N/A

Cables: None

Modifications: None

15.203: Antenna Requirement:

- The antenna is permanently attached to the EUT
- The antenna uses a unique coupling
- The EUT must be professionally installed
- The antenna requirement does not apply



Test Results Summary

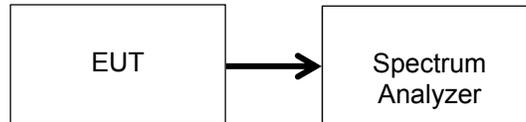
Specification	Test Name	Pass, Fail, N/A	Comments
15.247(b)	Peak Output Power	Pass	
15.247(b)	Conducted Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Radiated Spurious Emissions	Pass	
15.247(d), 15.209(a), 15.205	Emissions At Band Edges	Pass	
15.247(a)(2)	Occupied Bandwidth	Pass	
15.247(e)	Transmitter Power Spectral Density	Pass	
15.207	A/C Powerline Conducted Emissions	Pass	

Peak Output Power
Engineer: Kenneth Lee

Test Date: 06/22/2016

Test Procedure

The EUT was connected directly to a spectrum analyzer input. The peak readings were taken and the result was then compared to the limit.

Test Setup

Transmitter Peak Output Power
WiFi B

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2412	14.70	1 W (30 dBm)	Pass
2442	14.42	1 W (30 dBm)	Pass
2462	14.03	1 W (30 dBm)	Pass

WiFi G

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2412	12.06	1 W (30 dBm)	Pass
2442	13.41	1 W (30 dBm)	Pass
2462	10.78	1 W (30 dBm)	Pass

WiFi N

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
2412	5.76	1 W (30 dBm)	Pass
2442	5.58	1 W (30 dBm)	Pass
2462	5.28	1 W (30 dBm)	Pass

Conducted Spurious Emission

Engineer: Kenneth Lee

Test Date: 06/23/2016

Test Procedure

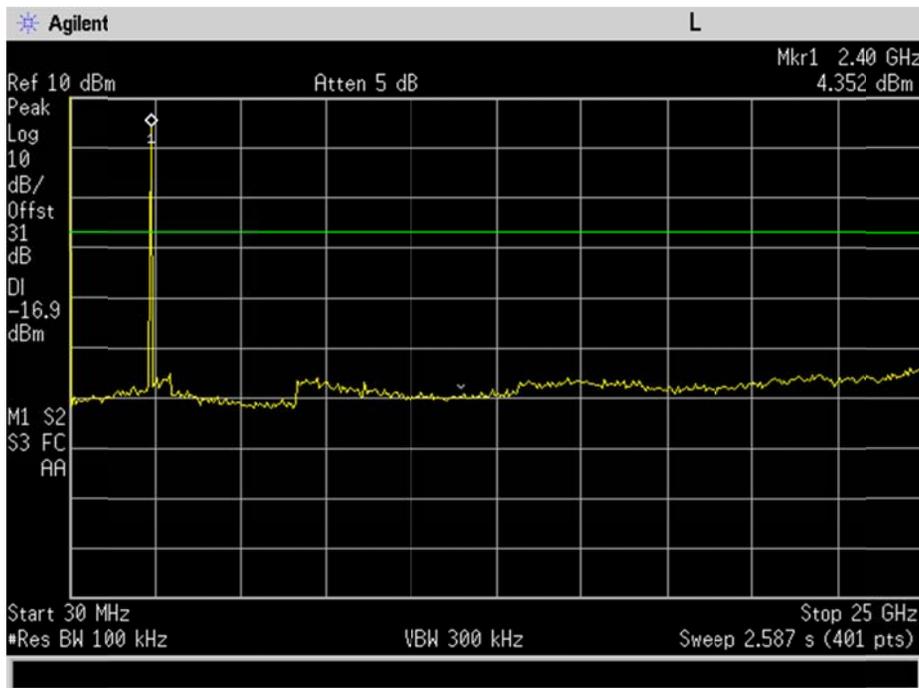
The EUT was connected to a spectrum analyzer to verify that the EUT met the requirements for spurious emissions. The frequency range from 30 MHz to the 10th harmonic of the fundamental transmitter was observed. Only detectable spurious emissions were recorded and plotted. The peak output power is added to the recorded measurement to provide the corrected spurious level dBc.

Test Setup



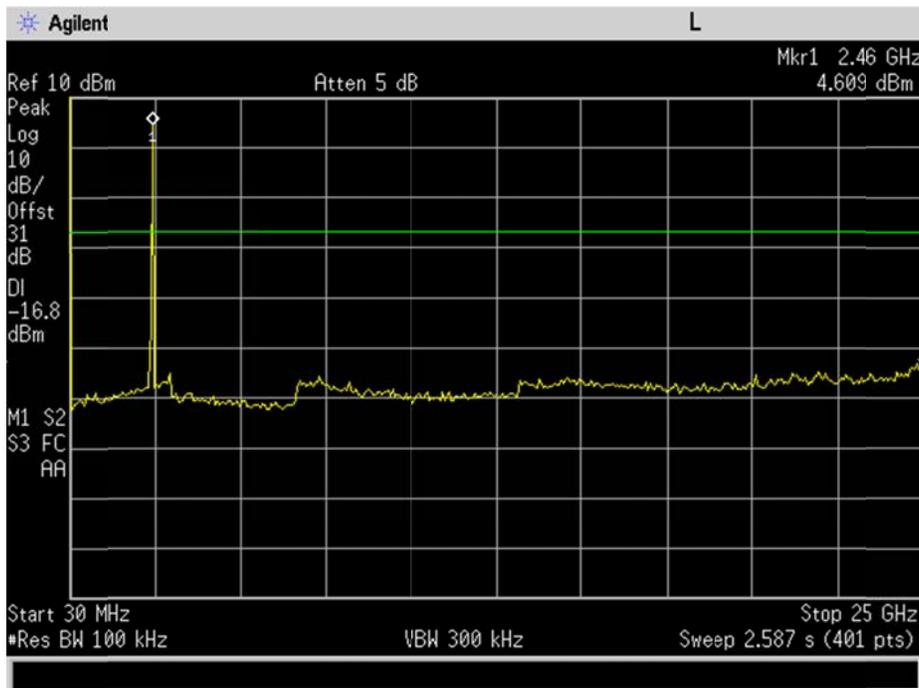
Conducted Spurious Emissions Summary Test Table

**Conducted Spurious Emissions
WiFi B - Tuned Freq=2012 MHz**

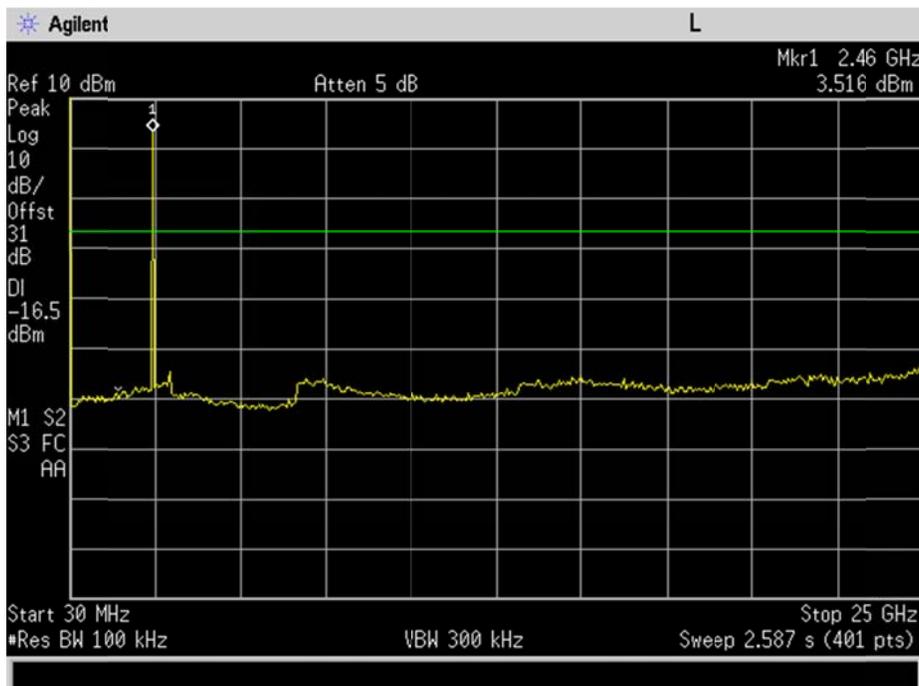




Conducted Spurious Emissions WiFi B - Tuned Freq=2442 MHz

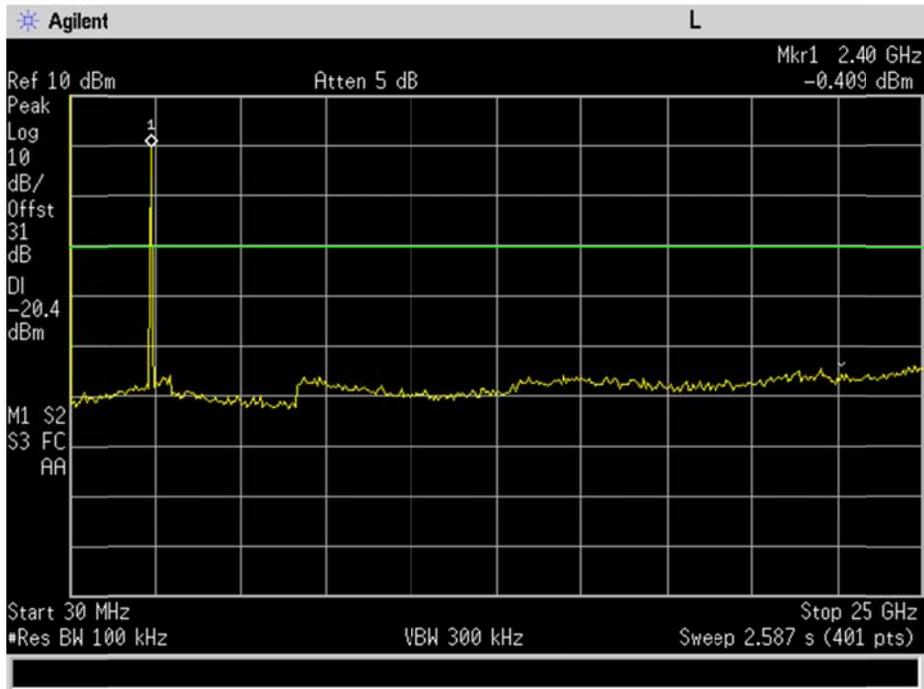


Conducted Spurious Emissions Tuned Freq=2462 MHz

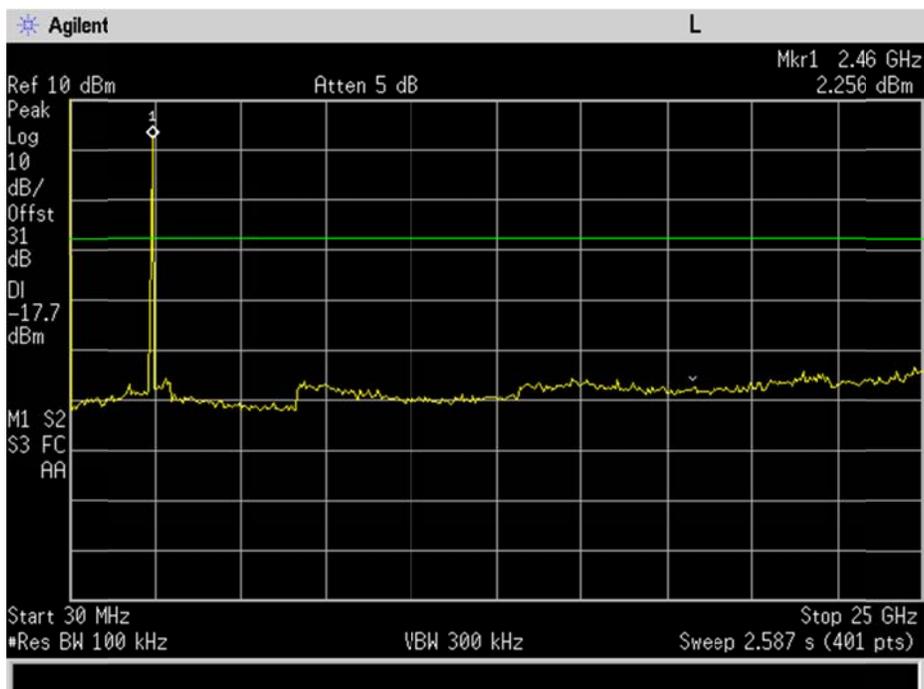




Conducted Spurious Emissions WiFi G - Tuned Freq=2012 MHz

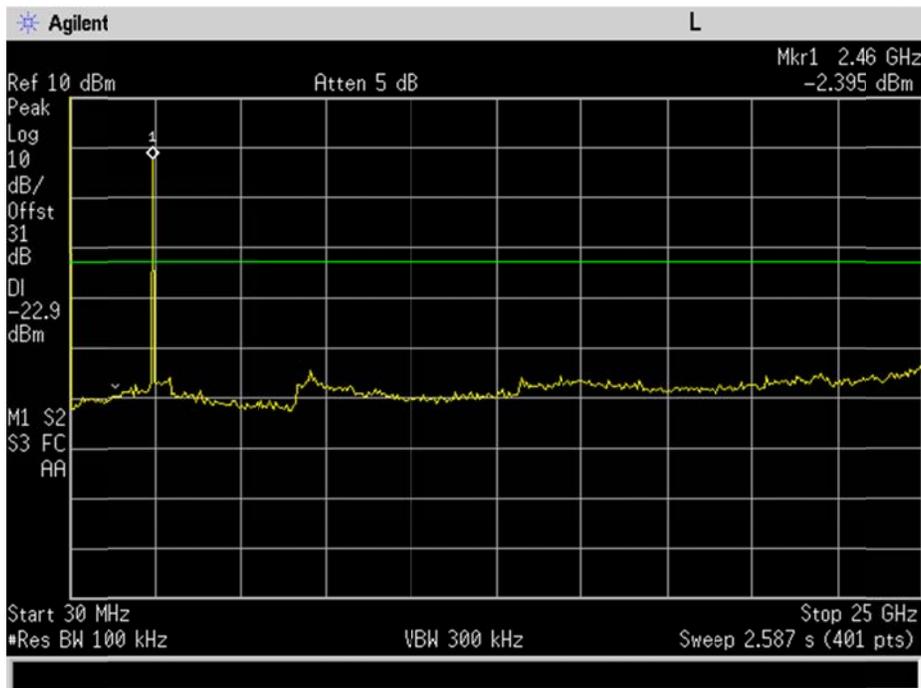


Conducted Spurious Emissions Tuned Freq=2442 MHz

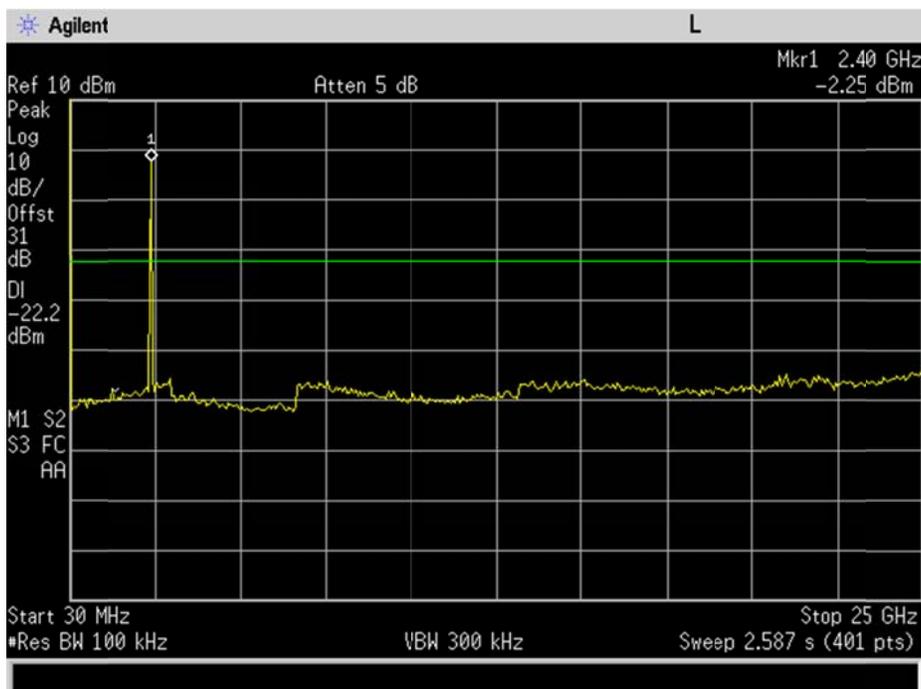




Conducted Spurious Emissions WiFi G - Tuned Freq=2462 MHz

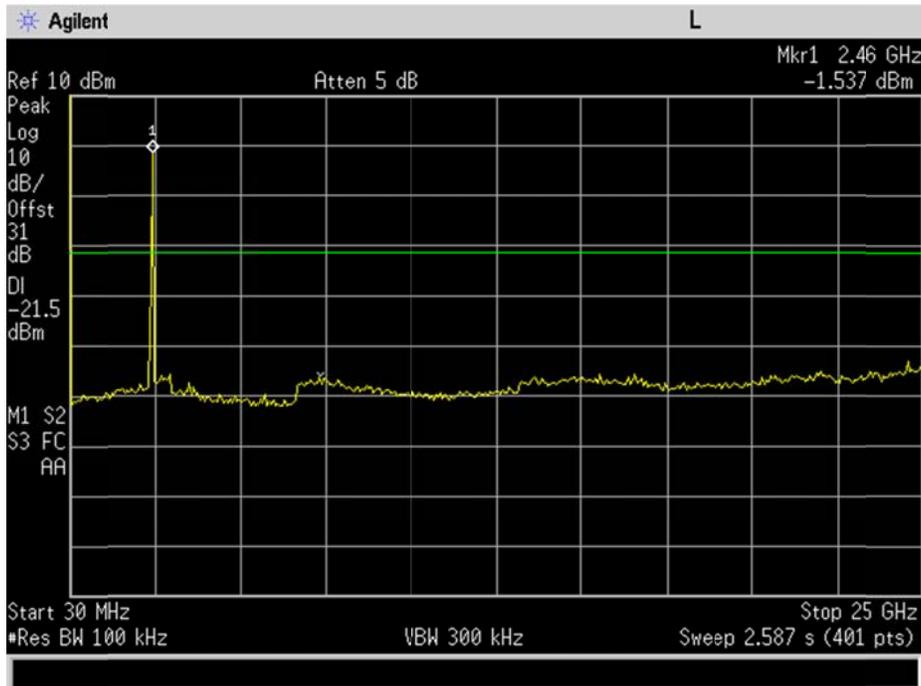


Conducted Spurious Emissions WiFi N - Tuned Freq=2012 MHz

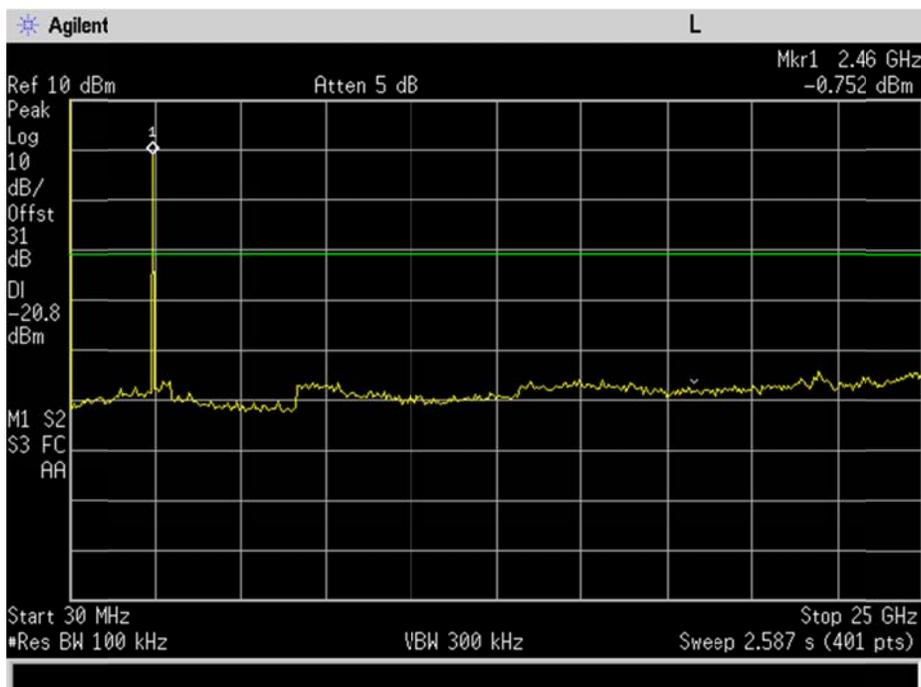




Conducted Spurious Emissions WiFi N - Tuned Freq=2442 MHz



Conducted Spurious Emissions WiFi N - Tuned Freq=2462 MHz



Radiated Spurious Emissions

Engineer: Kenneth Lee

Test Date: 06/28/2016

Test Procedure
Radiated Spurious Emissions: 30 – 1000 MHz

The EUT was tested in a semi-anechoic test chamber set 1m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360° with the antennas in both the vertical and horizontal orientation and was raised from 1 to 4 meters to ensure the TX signal levels were maximized.

All emissions from 30 MHz to 1 GHz were examined.

Measured Level includes antenna and receiver cable correction factors.

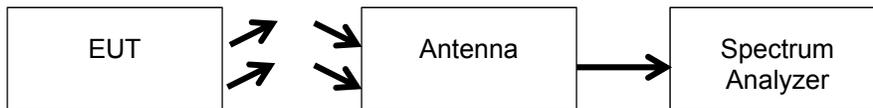
Correction factors were input into the spectrum analyzer before recording “Measured Level”.

RBW = 100 KHz

VBW = 300 KHz

Detector – Quasi Peak

Test Setup



Test Procedure for
Radiated Spurious Emissions above 1 GHz

The EUT was tested in a semi anechoic chamber set 1m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Spurious Emissions. The antenna, band reject filter, amplifier and cable correction factors were input into the spectrum analyzer before recording the Measured Level to ensure accurate readings. The spectrum for each tuned frequency was examined to the 10th harmonic.

Test Setup



See Annex A for test data

Emissions at Band Edges

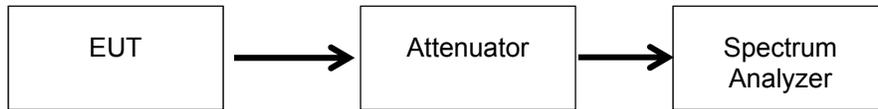
Engineer: Kenneth Lee

Test Date: 06/22/2016

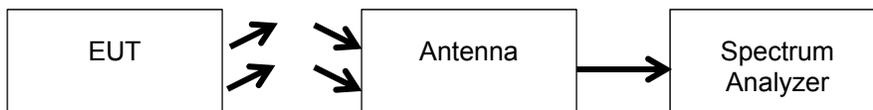
Test Procedure

A spectrum analyzer was used to verify that the EUT met the requirements for band edge and restricted band for both peak and average measurements. The cable and attenuator correction factors were input into the analyzer as a reference level offset to ensure accurate readings.

Band Edge Test Setup

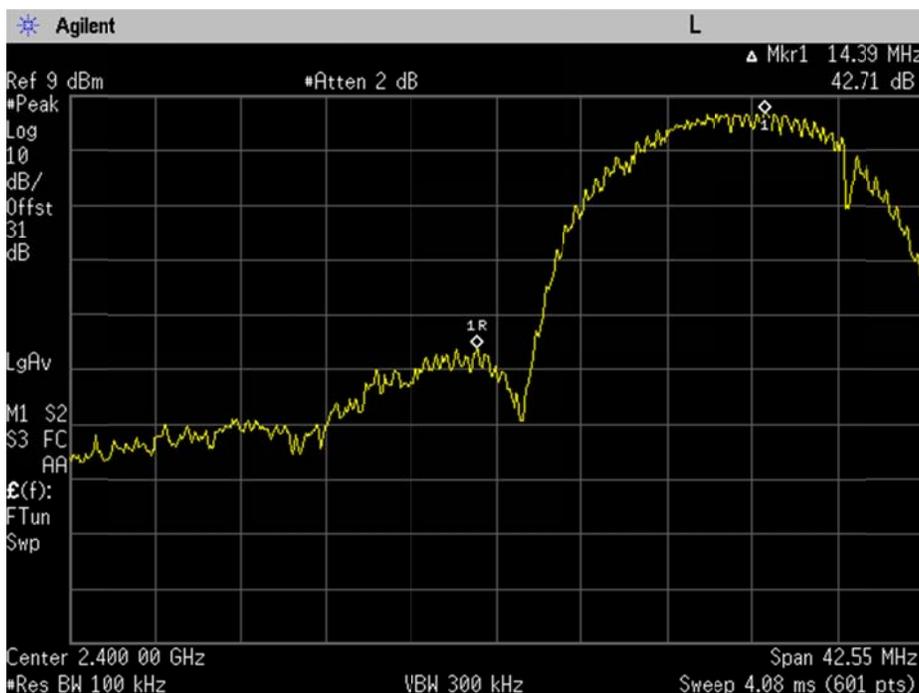


Restricted Band Edge Test Setup

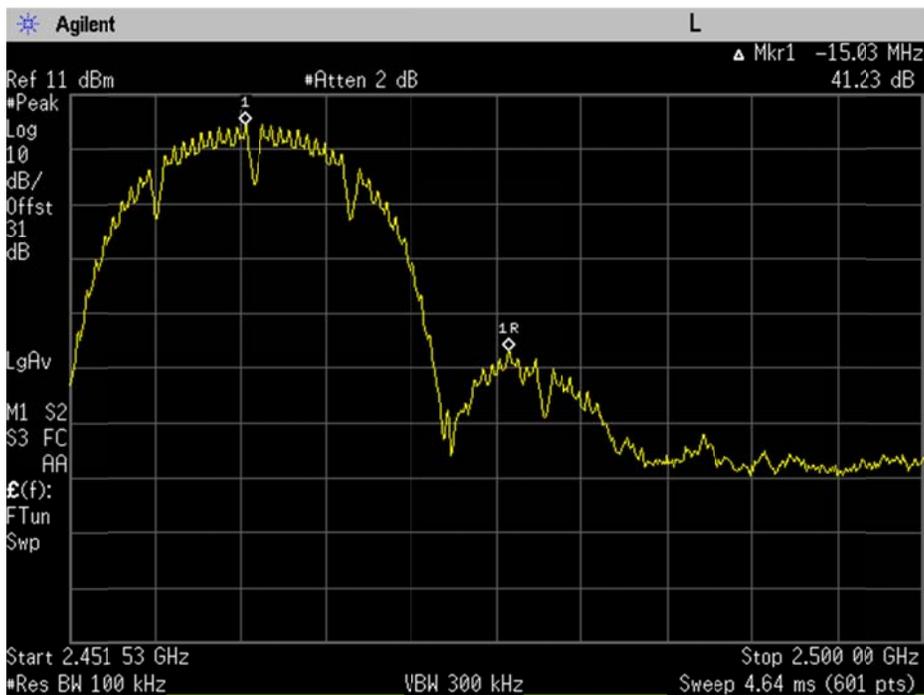




WiFi B - Band Edge 2400 MHz Tuned Freq = 2412 MHz

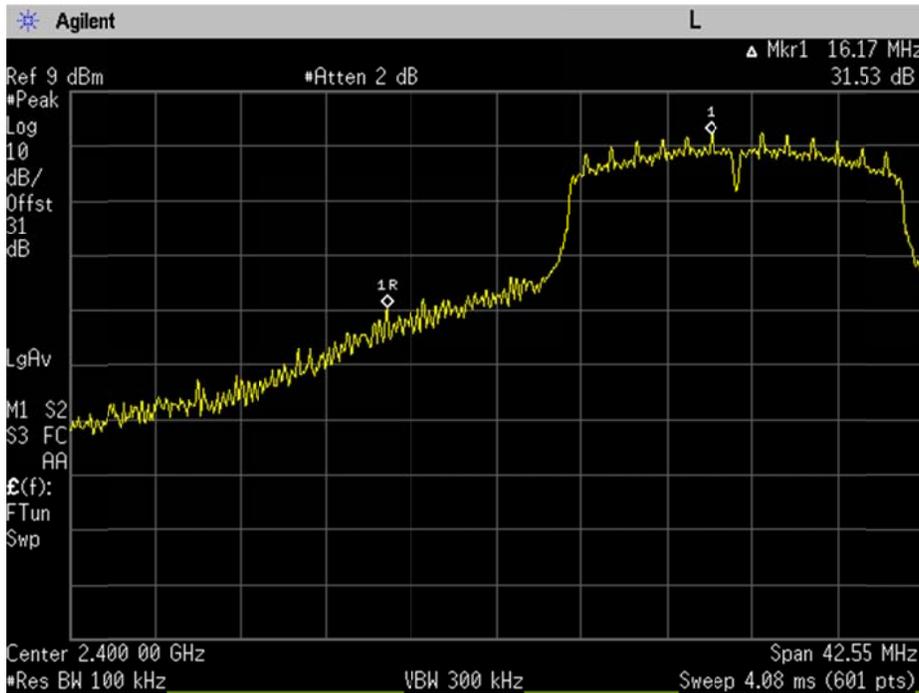


WiFi B - Band Edge 2483.5 MHz Tuned Freq = 2462 MHz

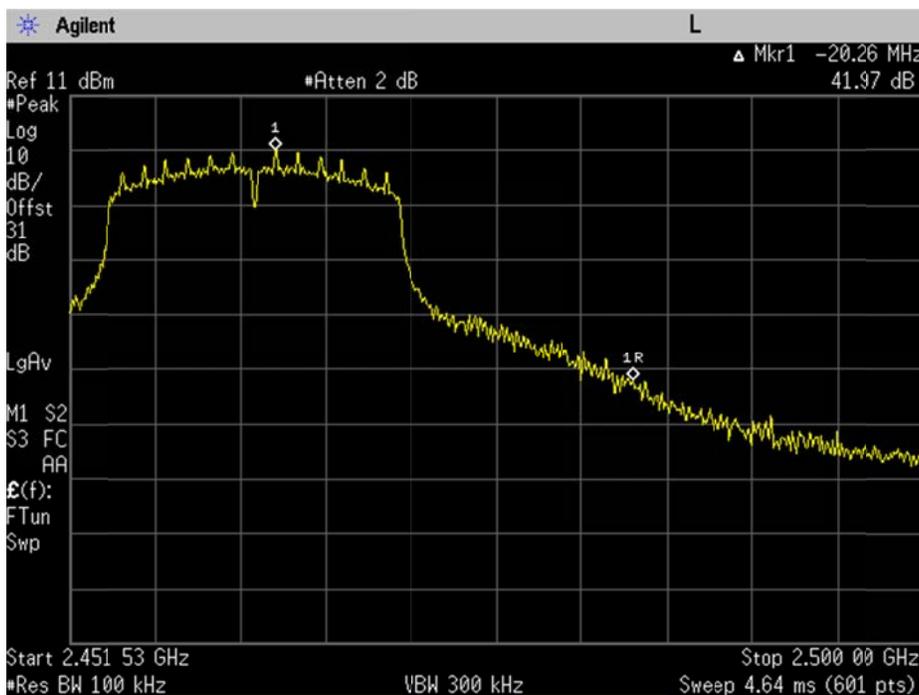




WiFi G - Band Edge 2400 MHz
Tuned Freq = 2412 MHz

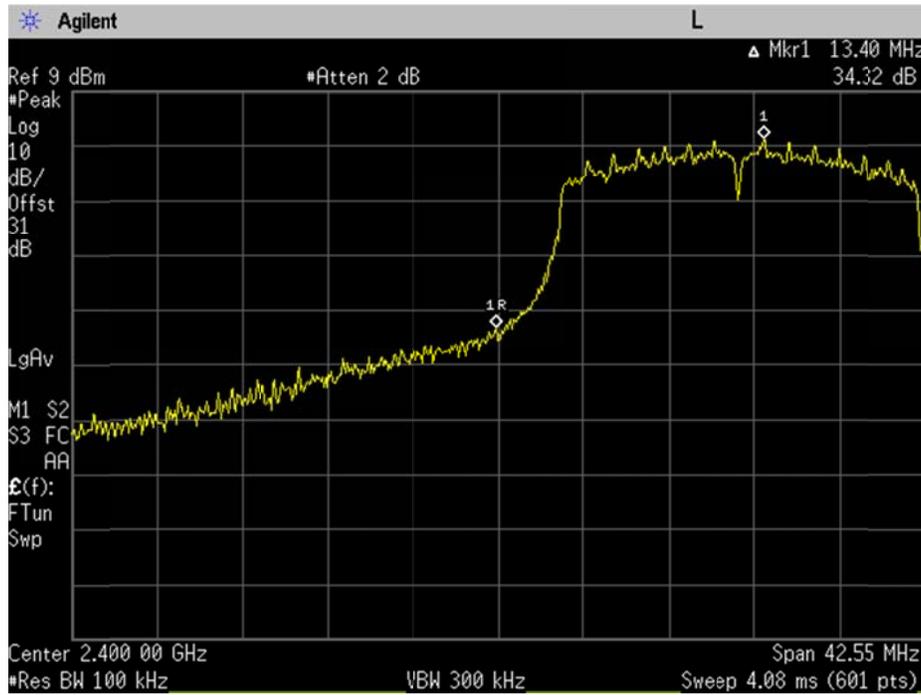


WiFi G - Band Edge 2483.5 MHz
Tuned Freq = 2462 MHz

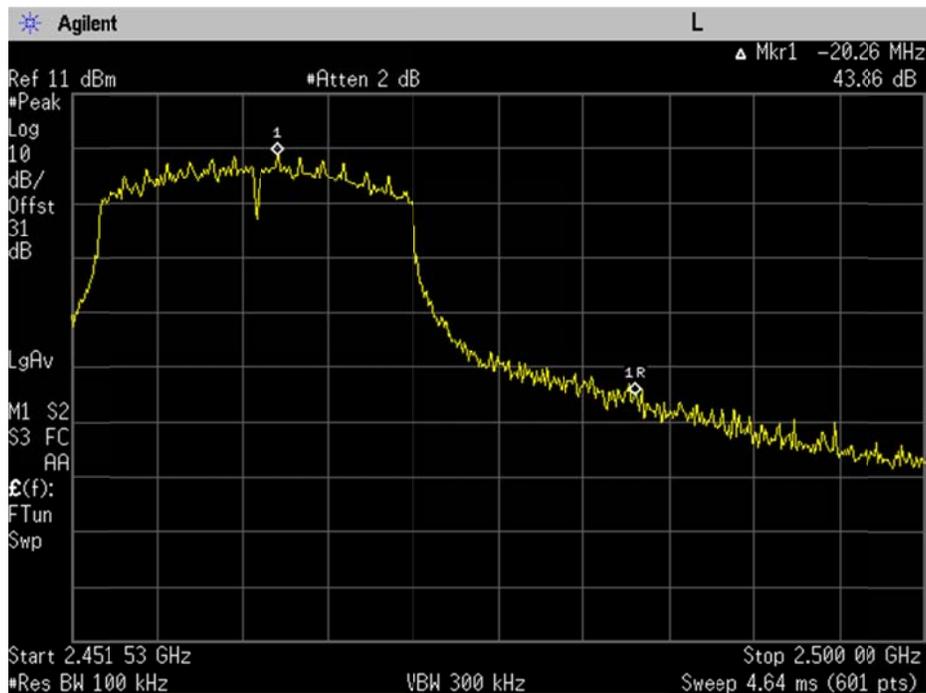




WiFi N - Band Edge 2400 MHz
Tuned Freq = 2412 MHz

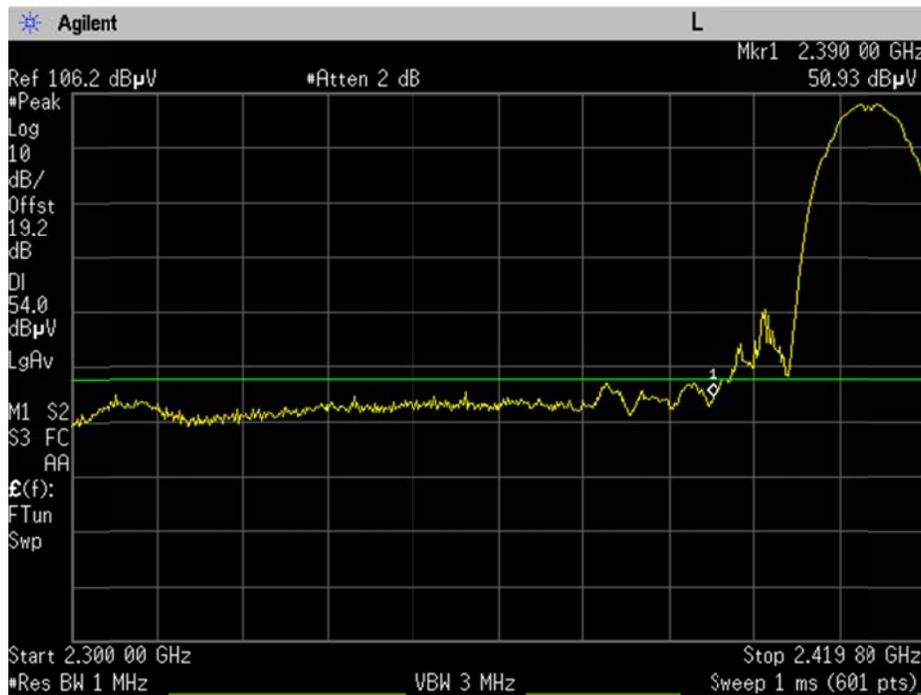


WiFi N - Band Edge 2483.5 MHz
Tuned Freq = 2462 MHz

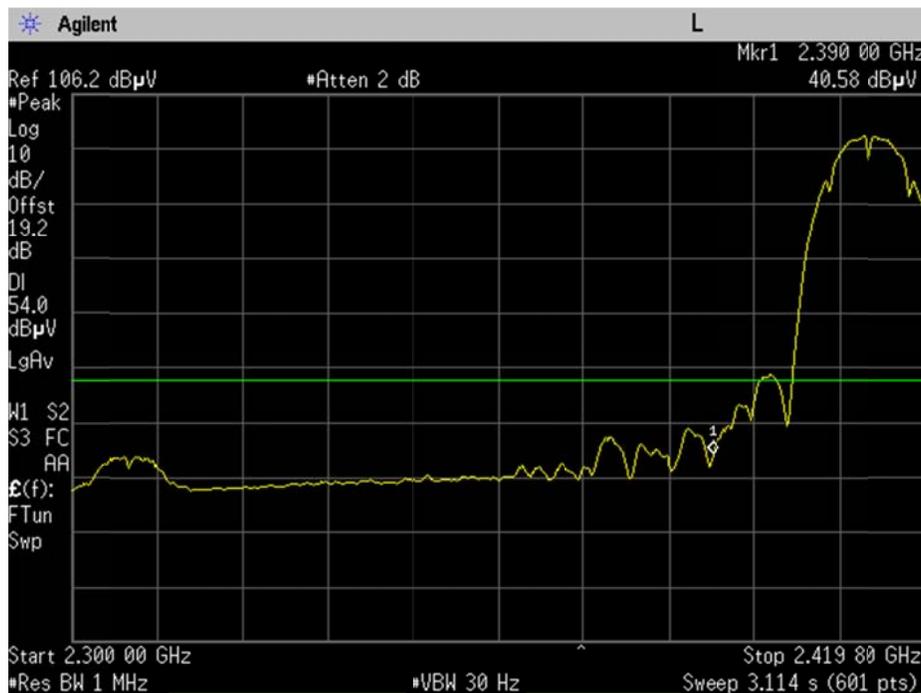




WiFi B - Restricted Band 2300 – 2390 MHz – Peak Tuned Freq = 2412 MHz

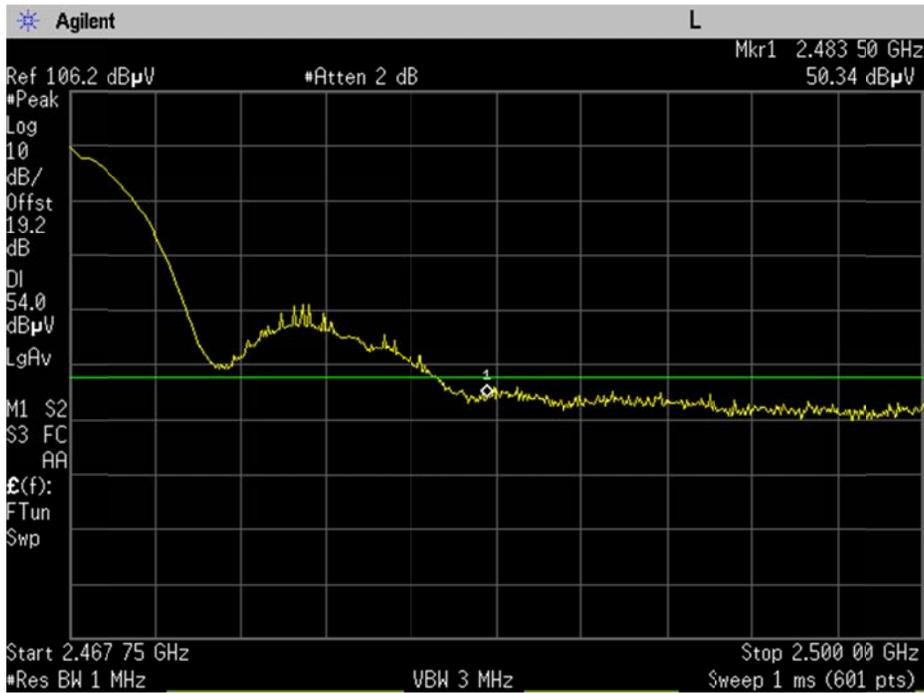


WiFi B - Restricted Band 2300 – 2390 MHz – Avg Tuned Freq = 2412 MHz

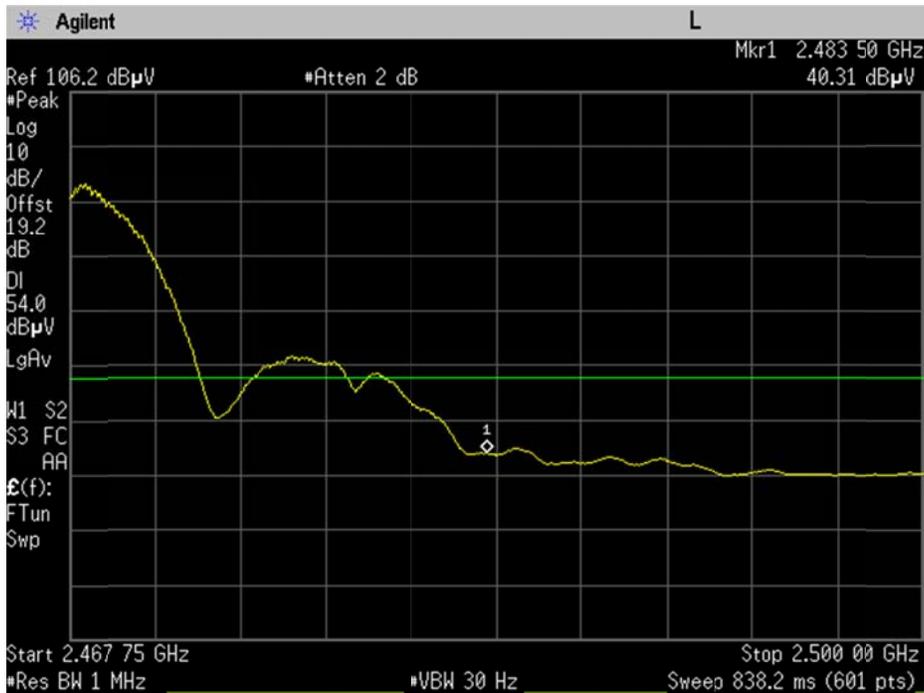




**WiFi B - Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2462 MHz**

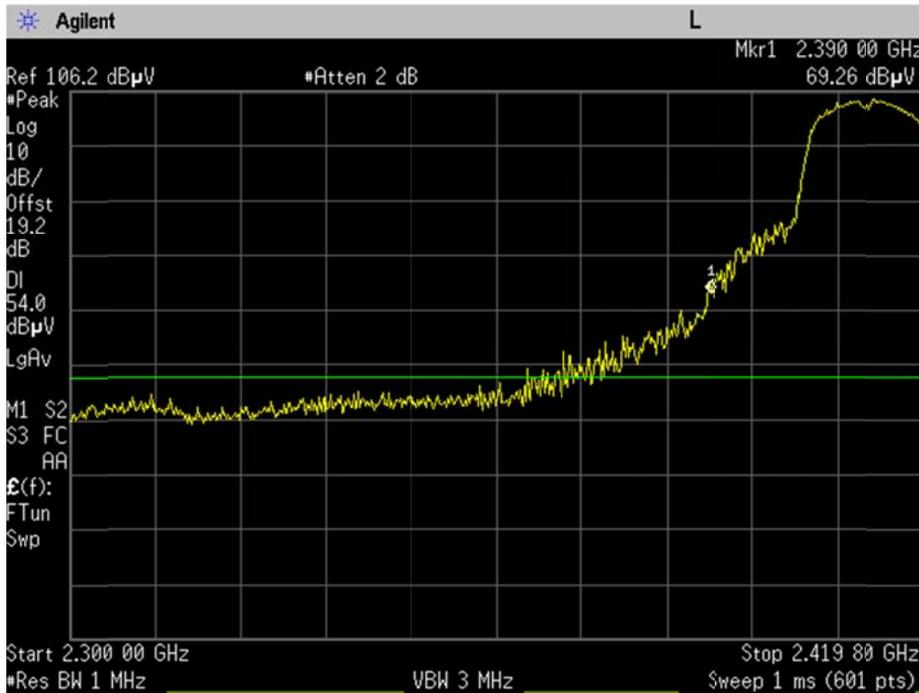


**WiFi B - Restricted Band 2483.5 – 2500 MHz – Avg
Tuned Freq = 2462 MHz**

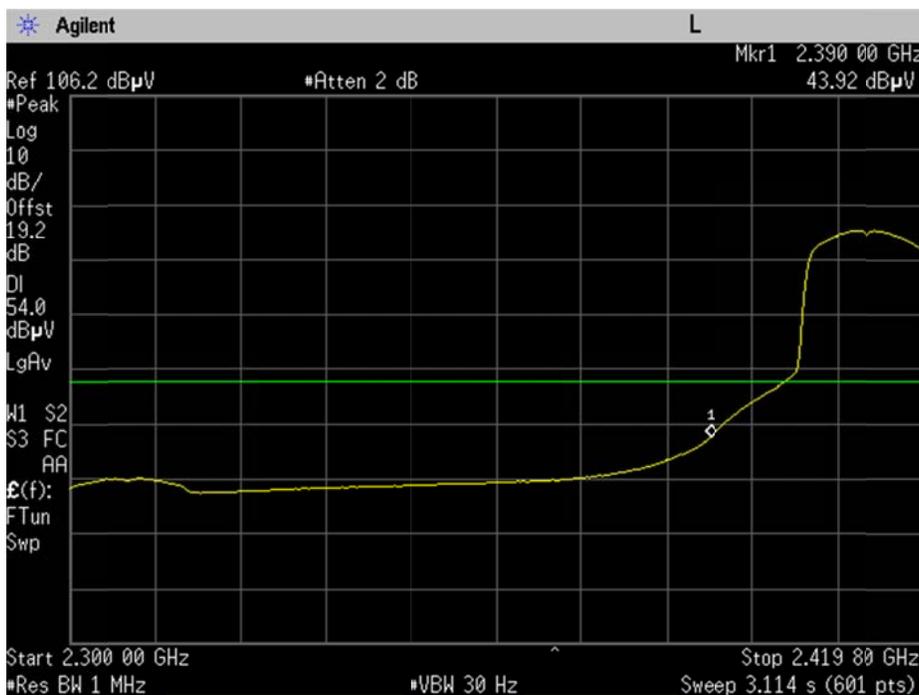




WiFi G - Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2412 MHz

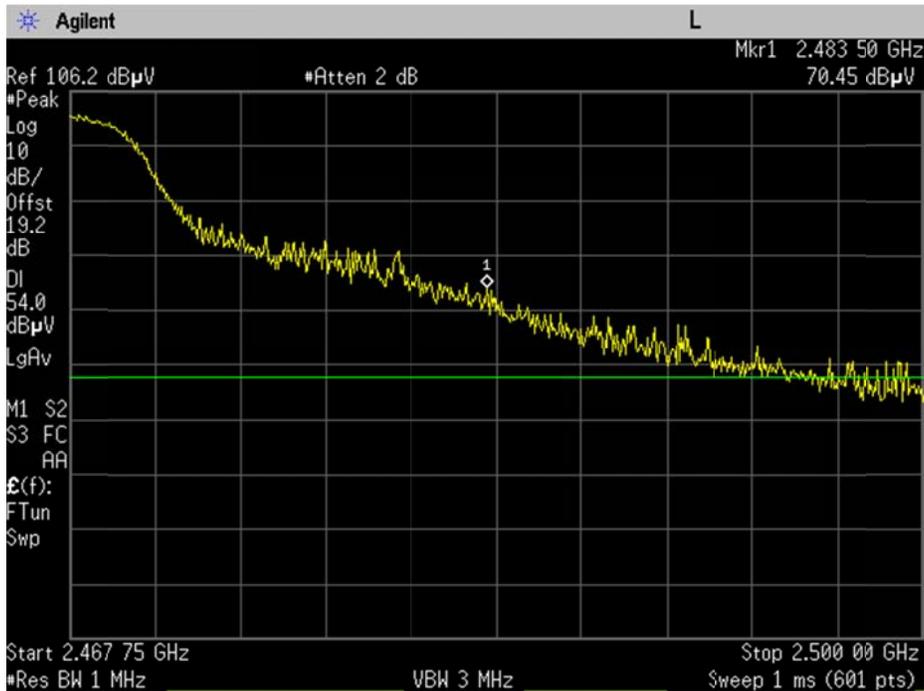


WiFi G - Restricted Band 2300 – 2390 MHz – Avg
Tuned Freq = 2412 MHz

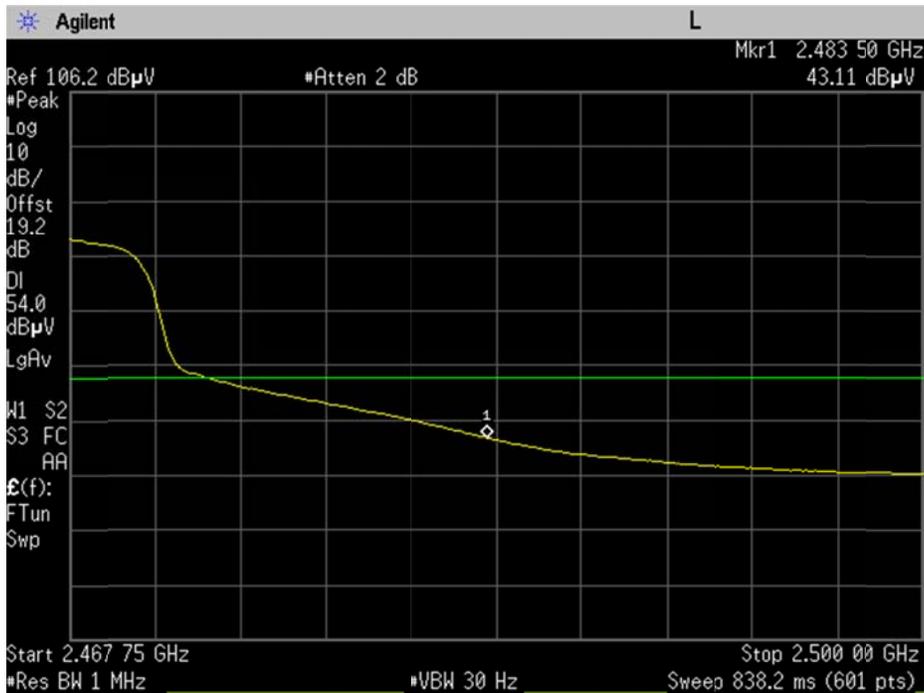




WiFi G - Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2462 MHz

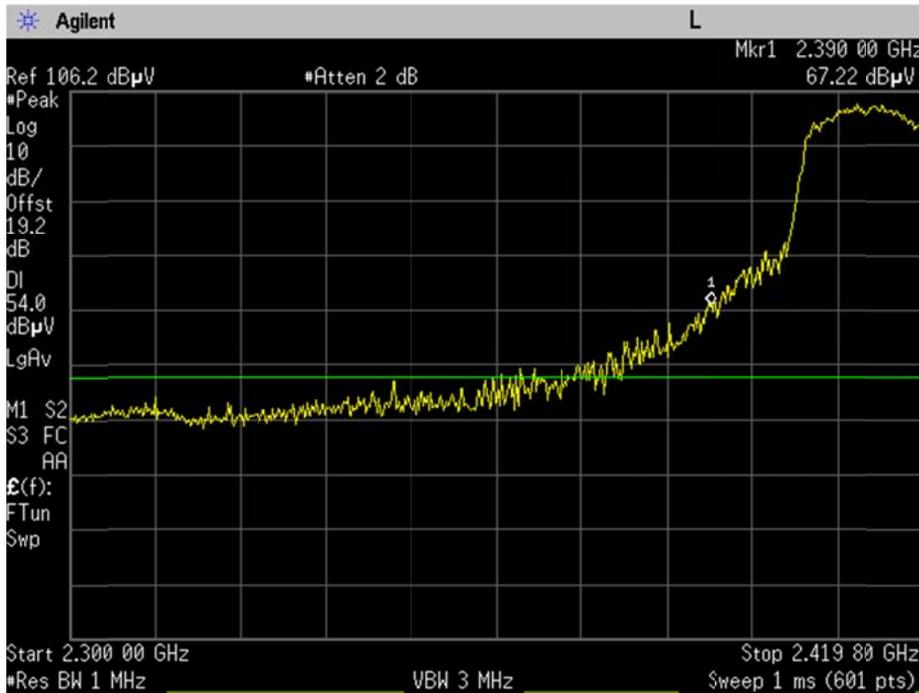


WiFi G - Restricted Band 2483.5 – 2500 MHz – Avg
Tuned Freq = 2462 MHz

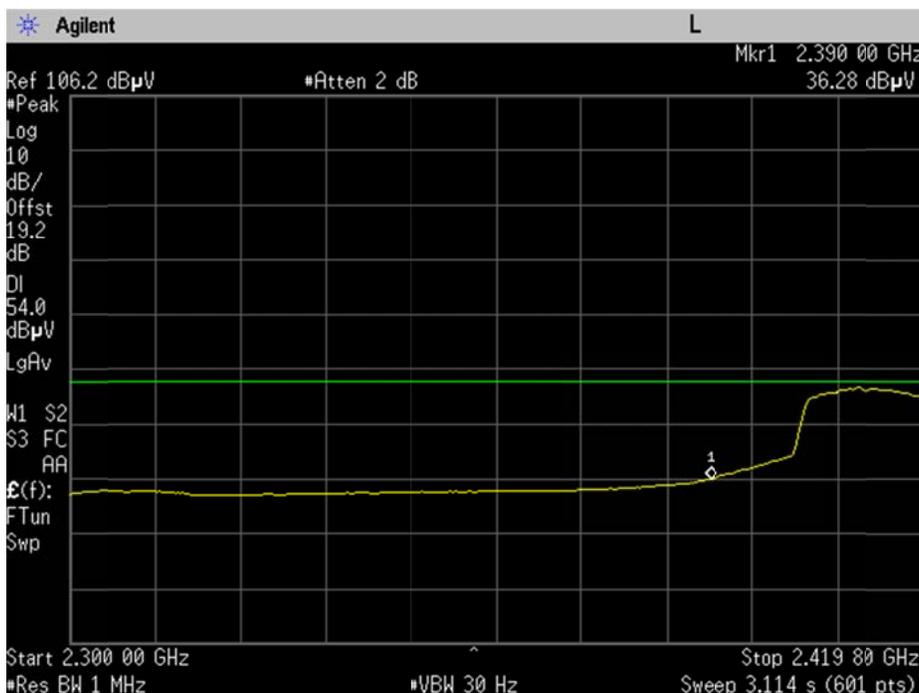




WiFi N - Restricted Band 2300 – 2390 MHz – Peak
Tuned Freq = 2412 MHz

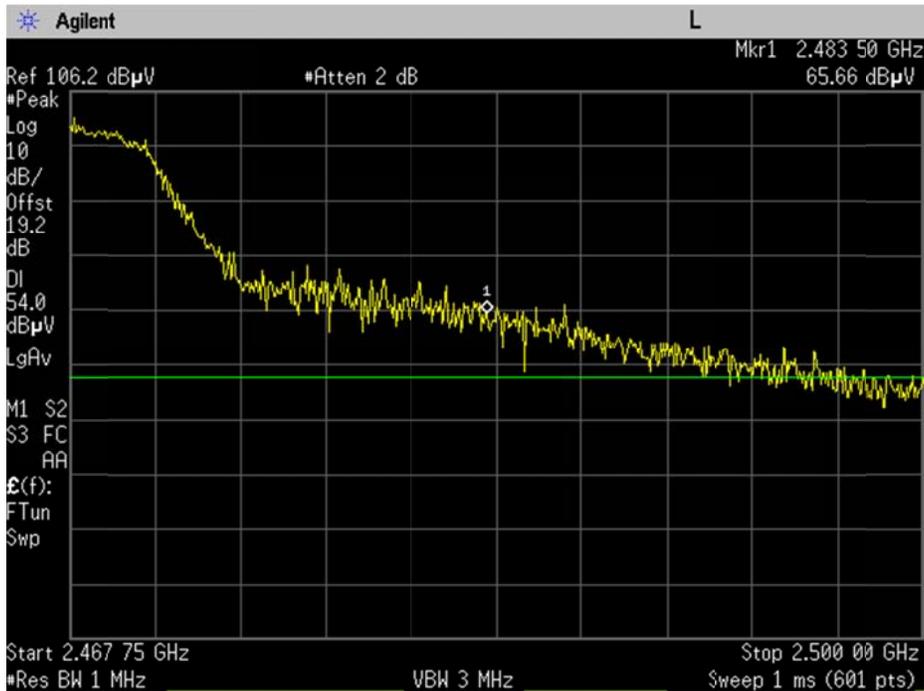


WiFi N - Restricted Band 2300 – 2390 MHz – Avg
Tuned Freq = 2412 MHz

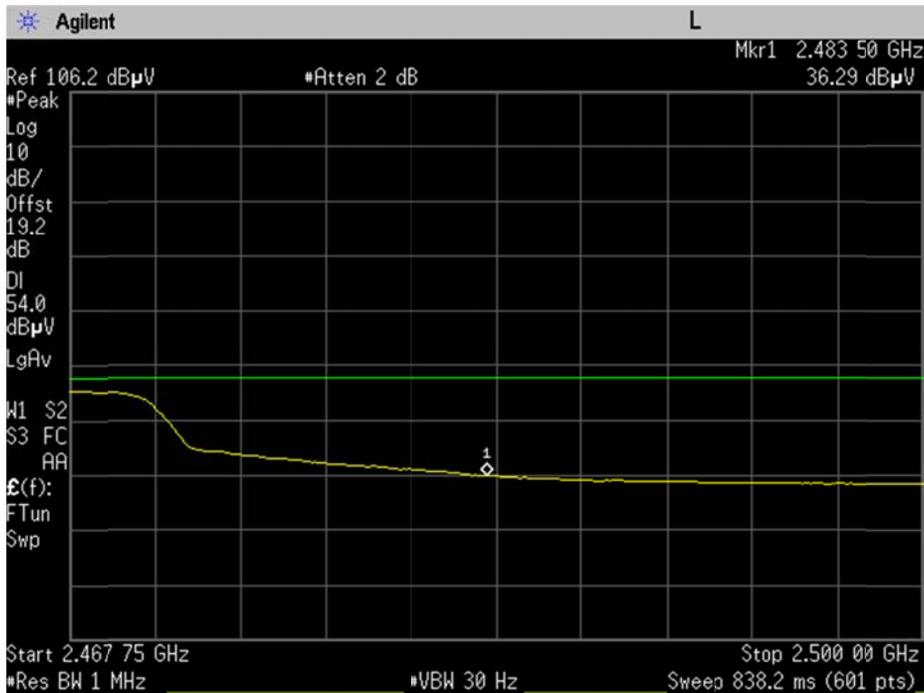




WiFi N - Restricted Band 2483.5 – 2500 MHz – Peak
Tuned Freq = 2462 MHz



WiFi N - Restricted Band 2483.5 – 2500 MHz – Avg
Tuned Freq = 2462 MHz





Occupied Bandwidth

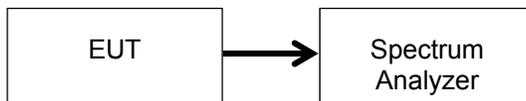
Engineer: Kenneth Lee

Test Date: 06/22/2016

Test Procedure

The EUT was connected directly to a spectrum analyzer. The Span was set wide enough to capture the entire transmit spectrum and the resolution bandwidth was set to at least 1% of the span. The analyzer was set to max hold and when the entire spectrum was captured the 6dB and 99% bandwidths were measured to verify the bandwidth met the specification.

Test Setup



WiFi B - 6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2412	10.099	≥ 500	Pass
2442	10.119	≥ 500	Pass
2462	10.009	≥ 500	Pass

WiFi B - 99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Result
2412	14.577	Pass
2442	14.545	Pass
2462	14.562	Pass



WiFi G - 6 dB Occupied Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2412	15.146	≥ 500	Pass
2428	15.138	≥ 500	Pass
2462	15.138	≥ 500	Pass

WiFi G - 99% Bandwidth Summary

Frequency (MHz)	Measured Bandwidth (MHz)	Result
2412	16.262	Pass
2428	17.129	Pass
2462	16.254	Pass

WiFi N - 6 dB Occupied Bandwidth Summary

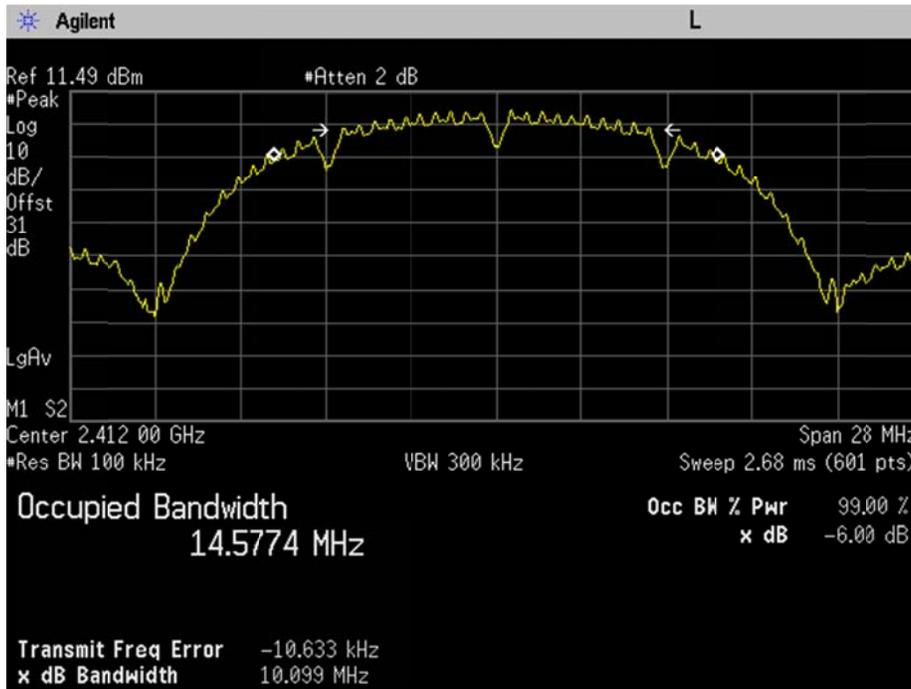
Frequency (MHz)	Measured Bandwidth (MHz)	Specification Limit (kHz)	Result
2412	15.156	≥ 500	Pass
2428	15.144	≥ 500	Pass
2462	15.160	≥ 500	Pass

WiFi N - 99% Bandwidth Summary

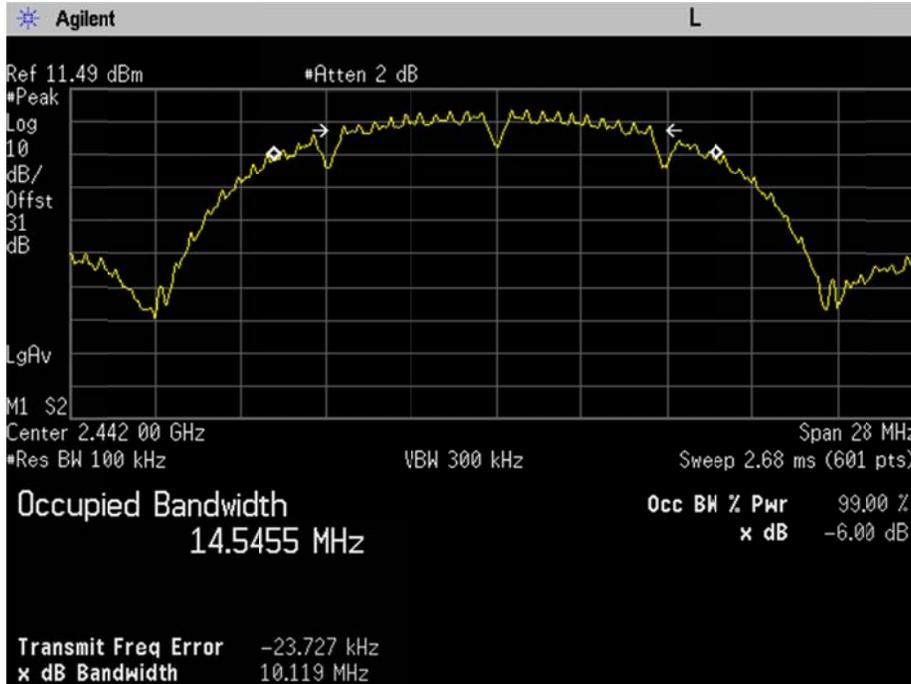
Frequency (MHz)	Measured Bandwidth (MHz)	Result
2412	17.367	Pass
2428	17.451	Pass
2462	17.433	Pass



WiFi B - 6dB and 99% Bandwidth 2412 MHz

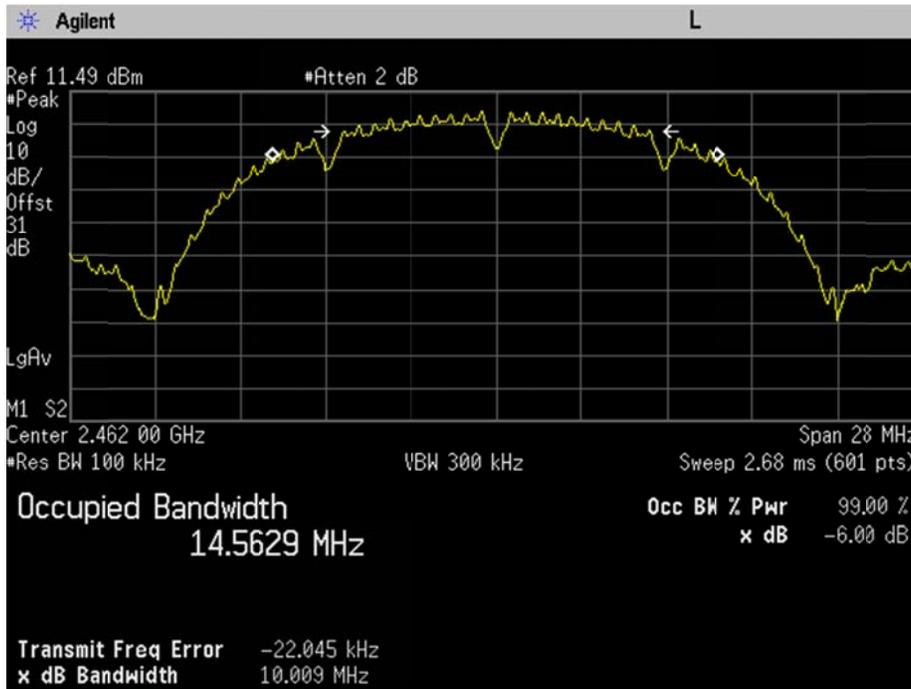


WiFi B - 6dB and 99% Bandwidth 2442 MHz

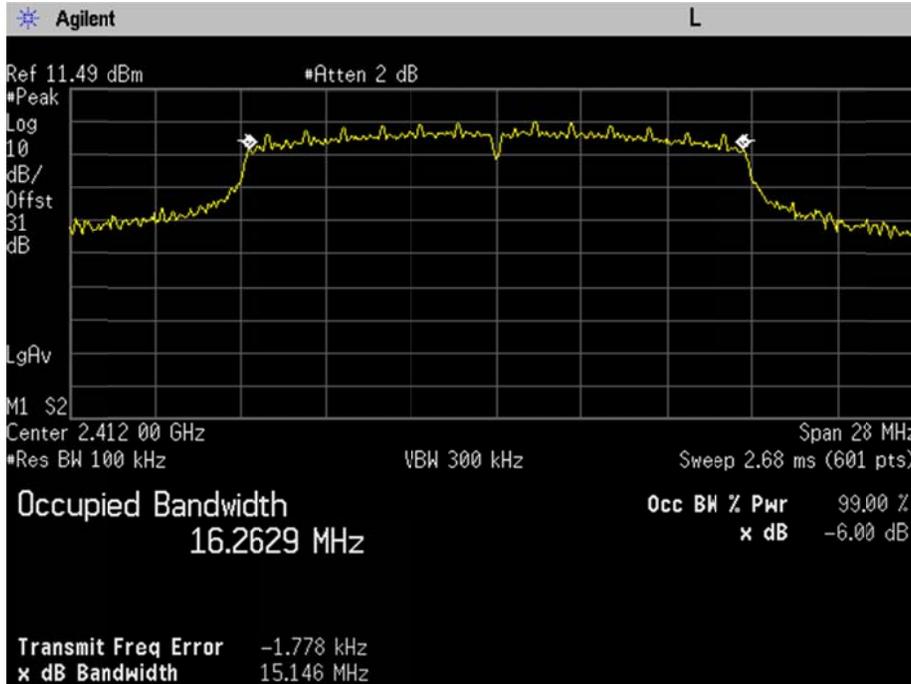




WiFi B - 6dB and 99% Bandwidth 2462 MHz

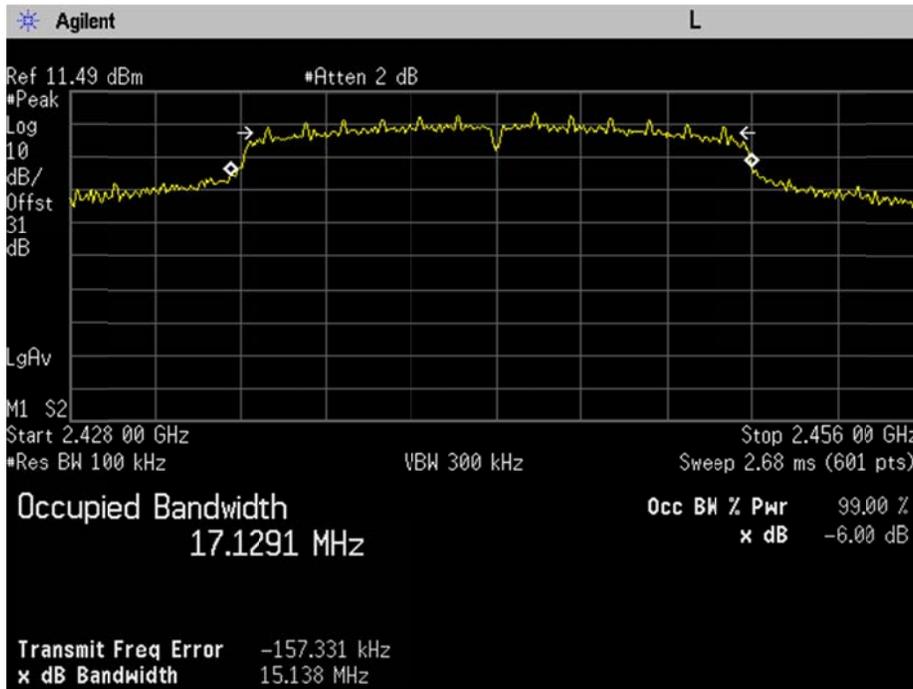


WiFi G - 6dB and 99% Bandwidth 2412 MHz

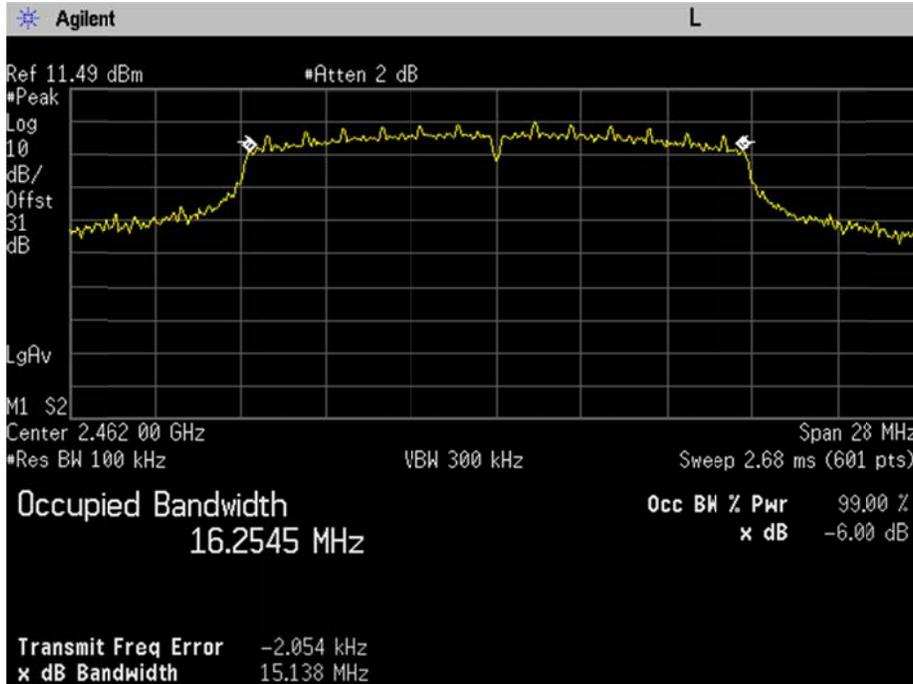




WiFi G - 6dB and 99% Bandwidth 2428 MHz

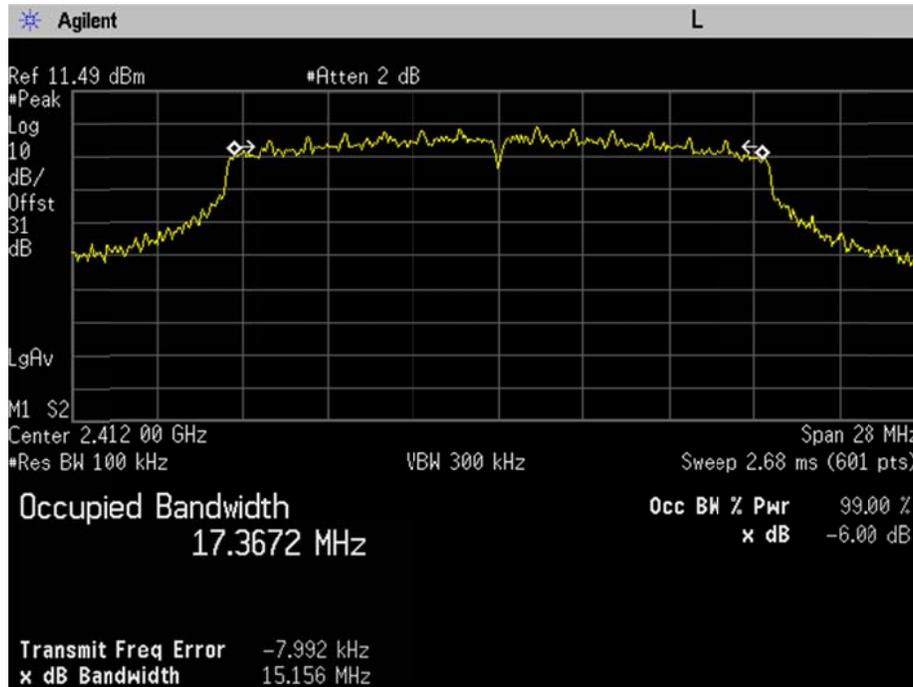


WiFi G - 6dB and 99% Bandwidth 2462 MHz

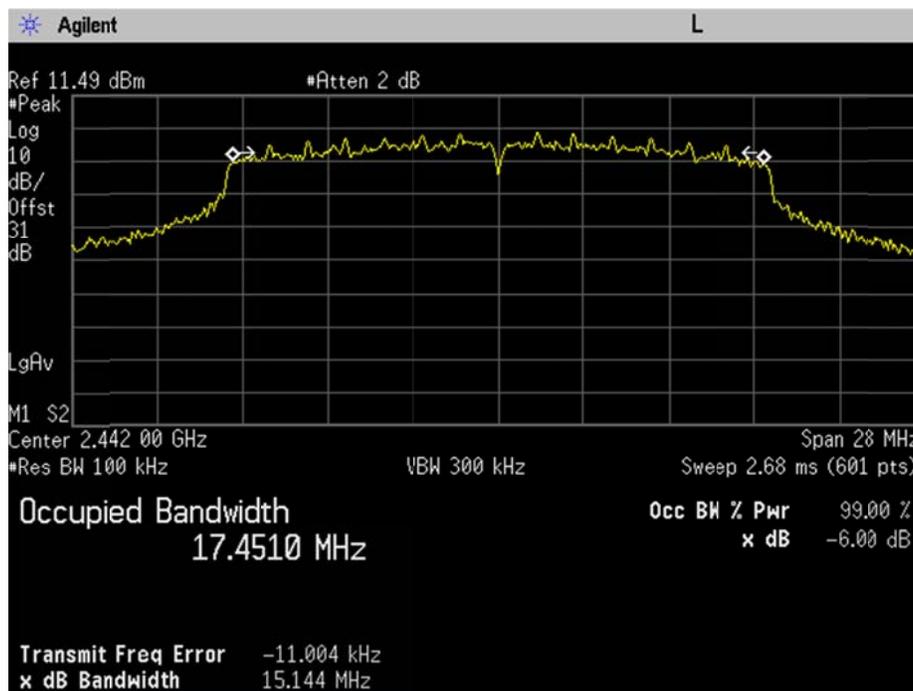




WiFi N - 6dB and 99% Bandwidth 2412 MHz

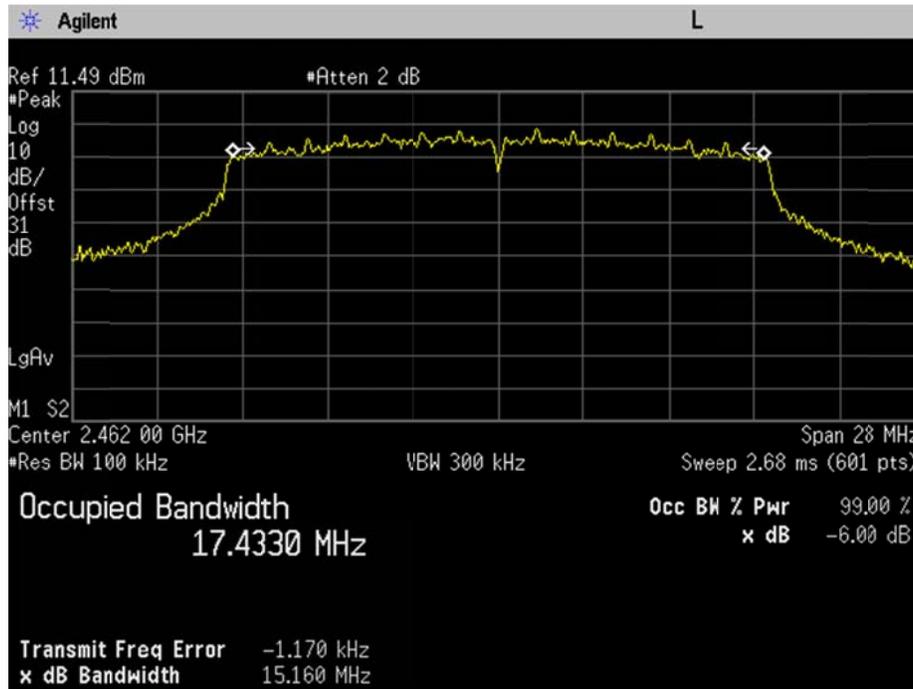


WiFi N - 6dB and 99% Bandwidth 2442 MHz





WiFi N - 6dB and 99% Bandwidth 2462 MHz

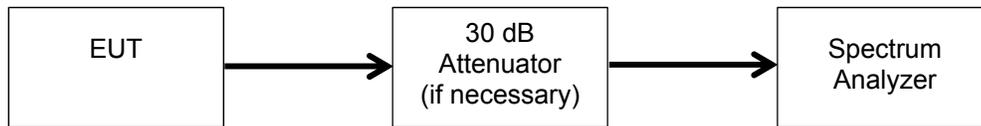


Transmitter Power Spectral Density (PSD)
Engineer: Kenneth Lee

Test Date: 06/22/2016

Test Procedure

The EUT was connected directly to a spectrum analyzer. The test was performed per section 6.11.2.3 of C63.10 - 2013 "Procedure for determining PSD for DTS devices".

Test Setup

PSD Summary
WiFi B

Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2412	-3.27	8	Pass
2442	-3.837	8	Pass
2462	-3.633	8	Pass

WiFi G

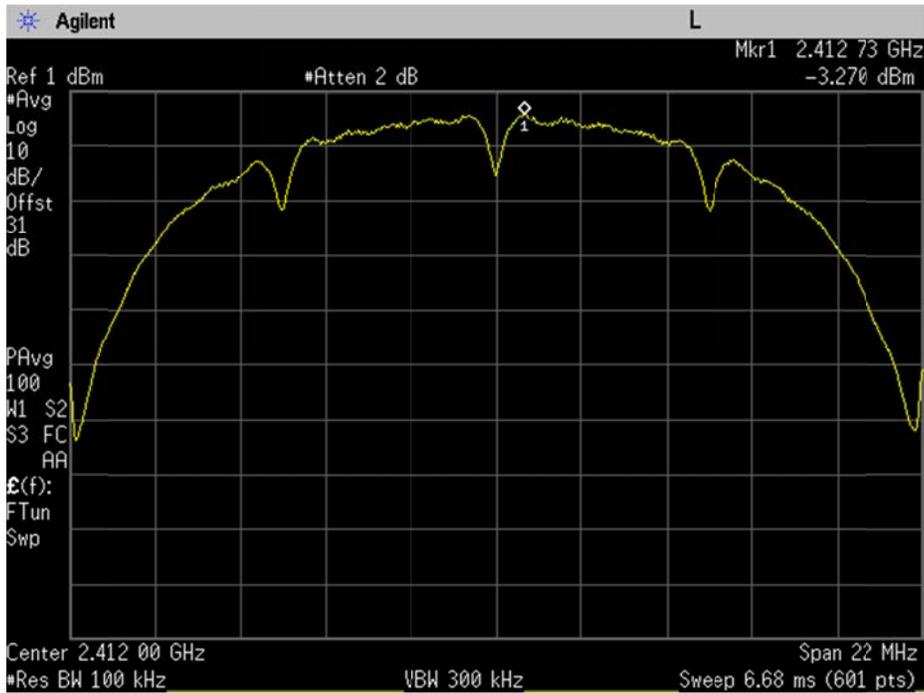
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2412	-8.555	8	Pass
2442	-6.506	8	Pass
2462	-9.179	8	Pass

WiFi N

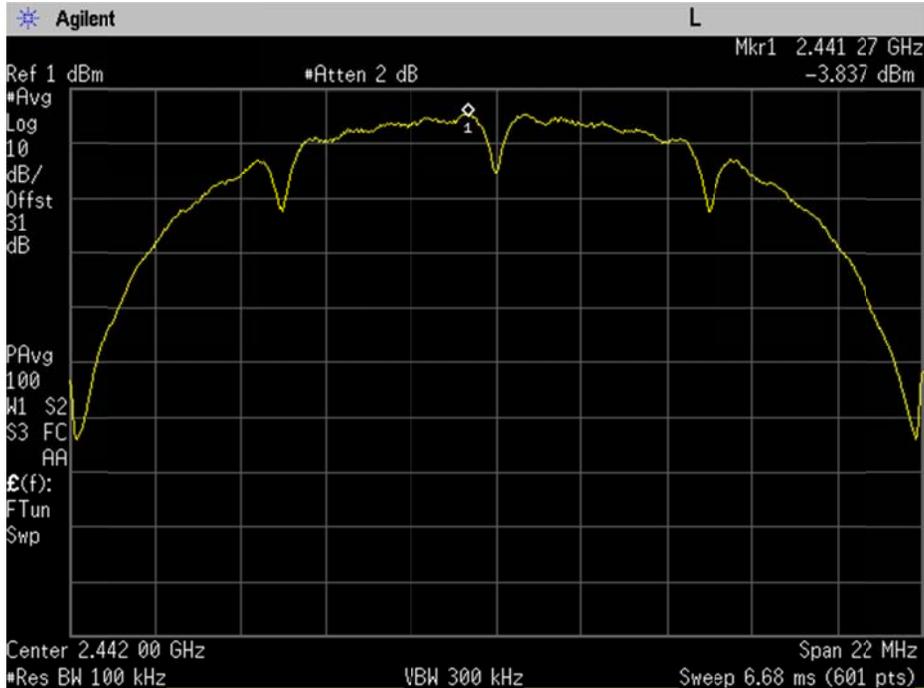
Frequency (MHz)	Measured Data (dBm)	Specification Limit (dBm)	Result
2412	-12.353	8	Pass
2428	-12.466	8	Pass
2462	-11.991	8	Pass



WiFi B - PSD 2412 MHz



WiFi B - PSD 2442 MHz

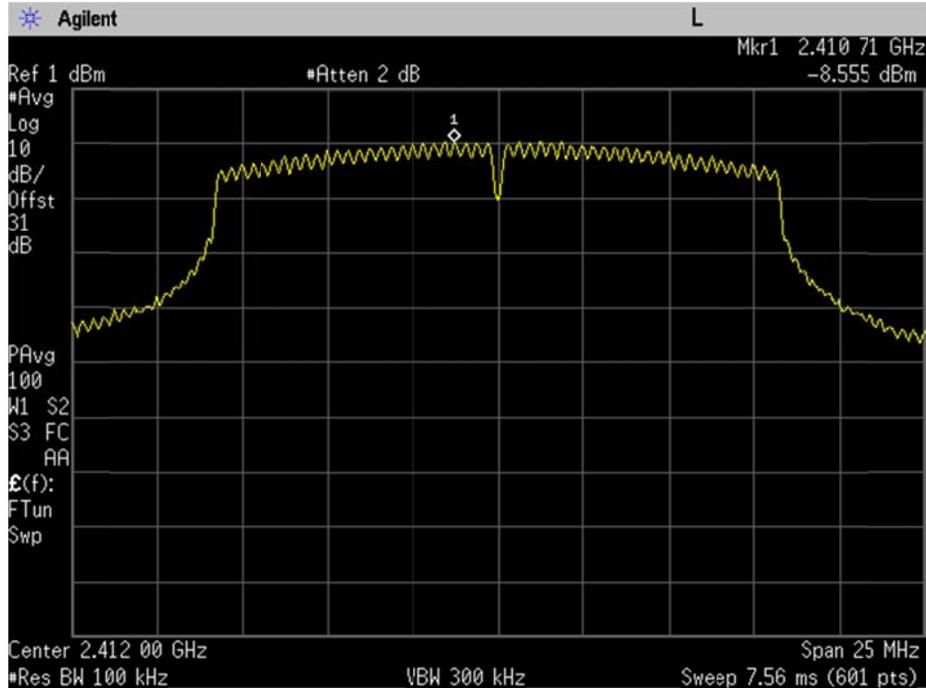




WiFi B - PSD 2462 MHz

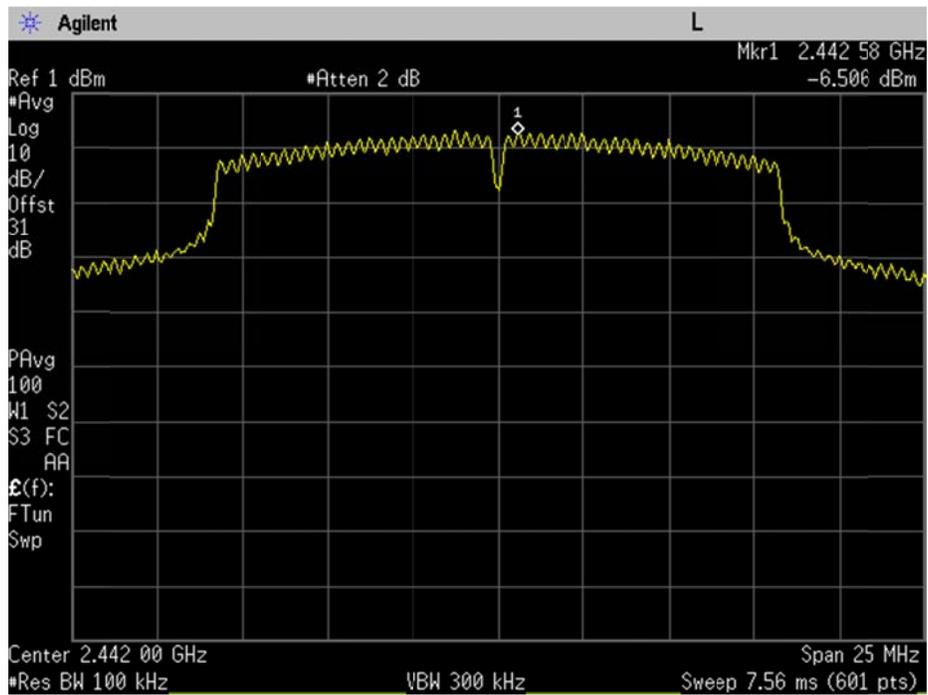


WiFi G - PSD 2412 MHz

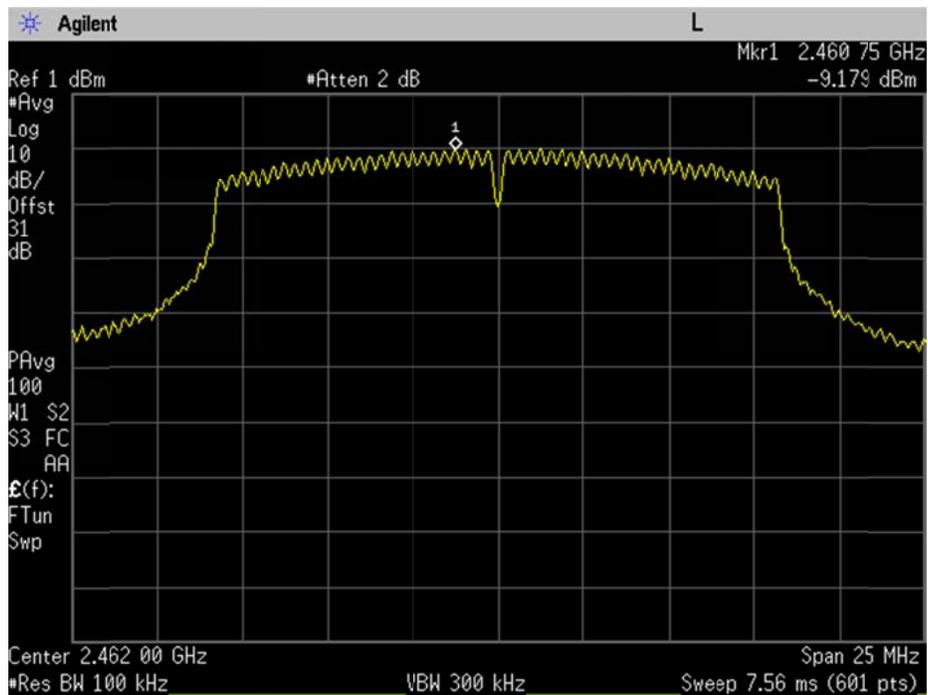




WiFi G - PSD 2442 MHz

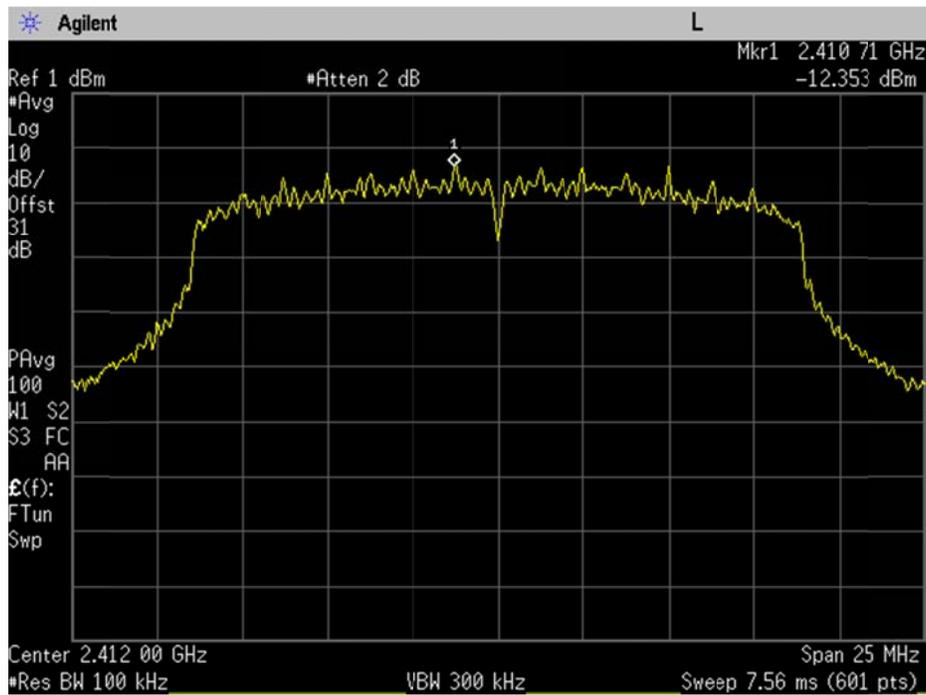


WiFi G - PSD 2462 MHz

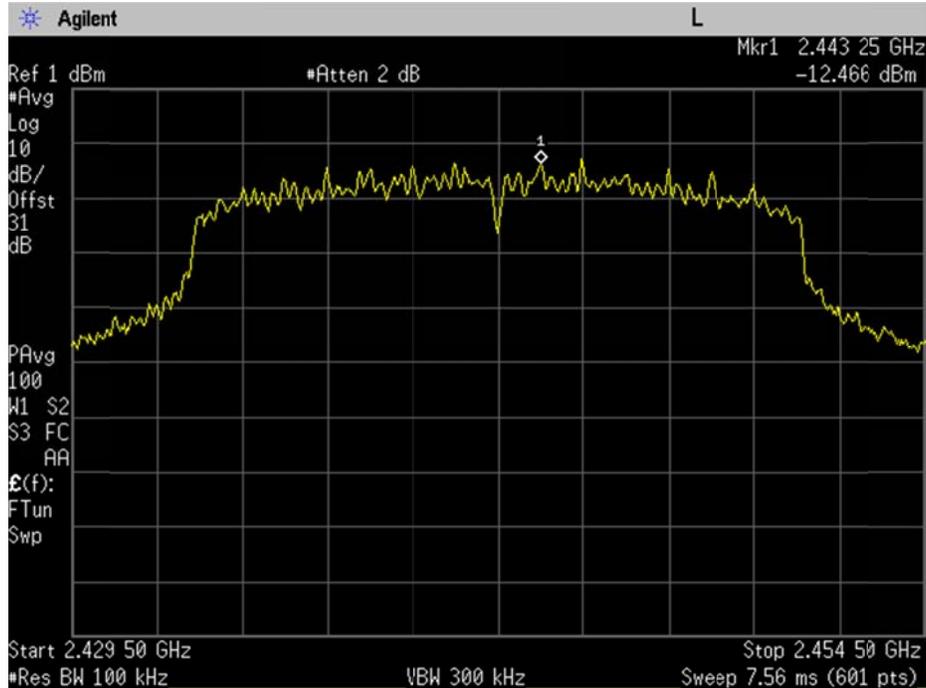




WiFi N - PSD 2412 MHz

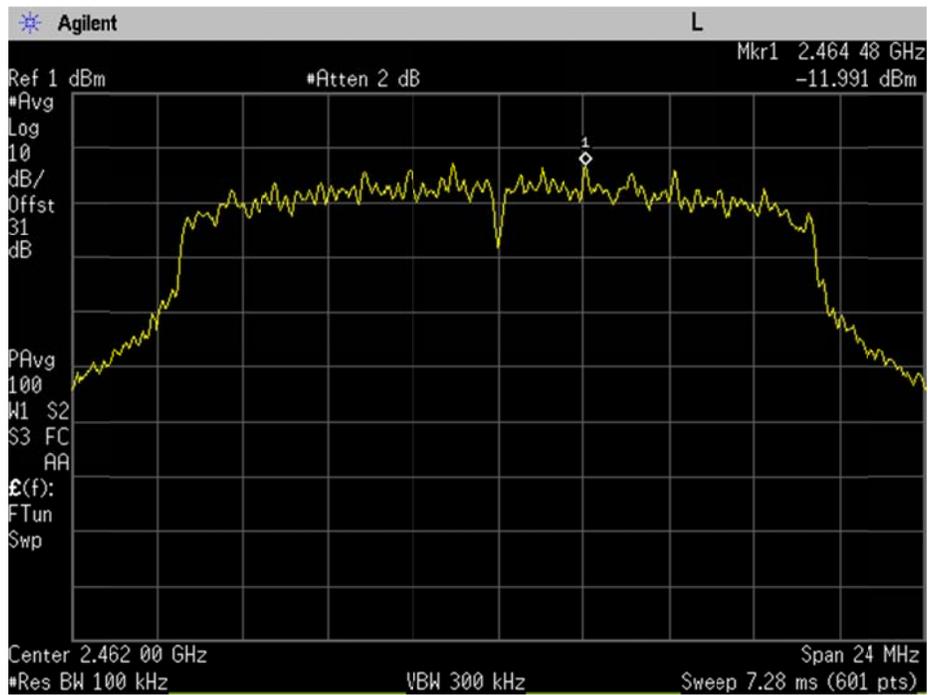


WiFi N - PSD 2442 MHz





WiFi N - PSD 2462 MHz



A/C Powerline Conducted Emission

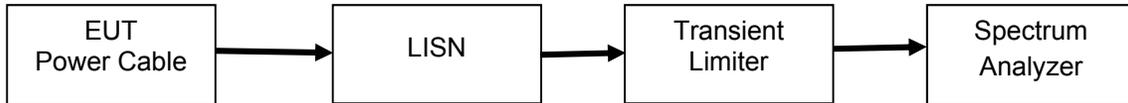
Engineer: Kenneth Lee

Test Date: 06/23/2016

Test Procedure

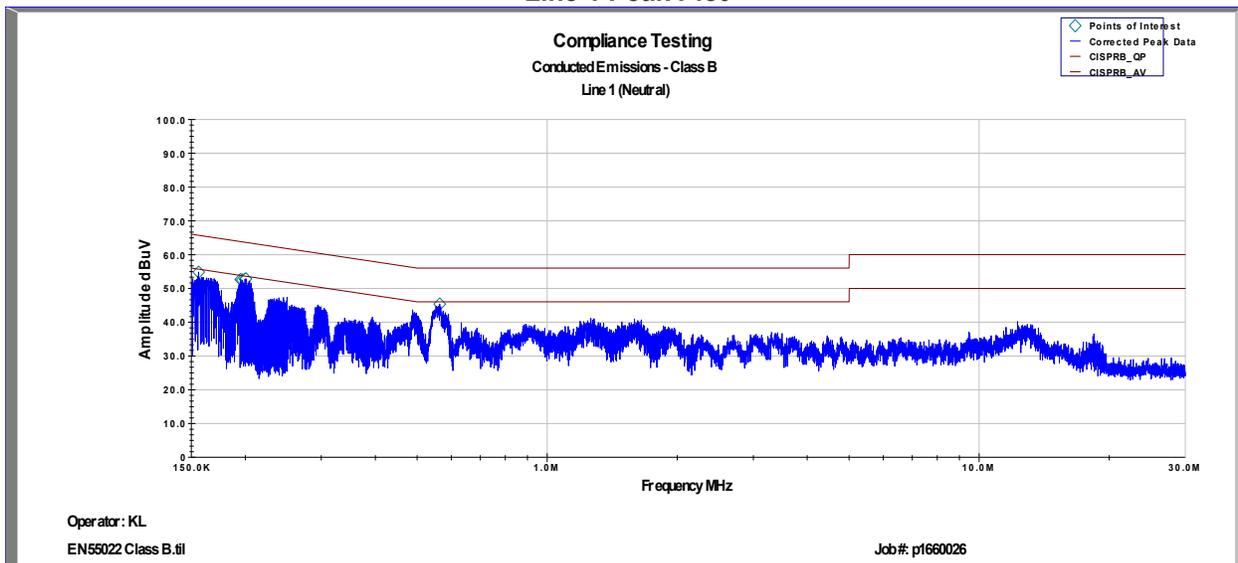
The EUT power cable was connected to a LISN and the monitored output of the LISN was connected to a transient limiter, which then connected directly to a spectrum analyzer. The conducted emissions from 150 kHz to 30 MHz were measured and compared to the specification limits.

Test Setup

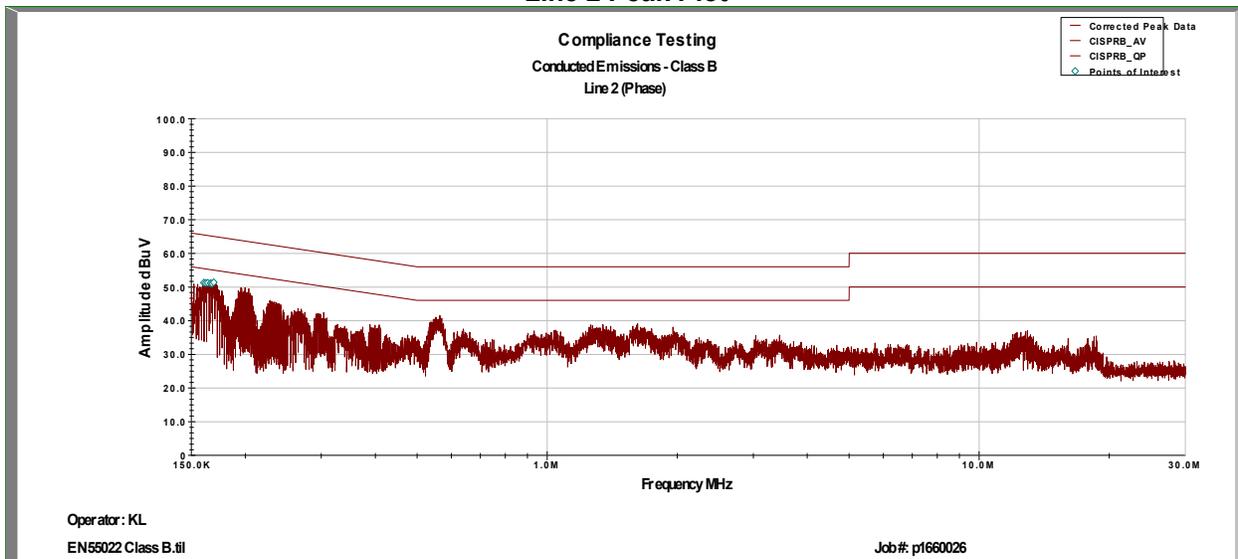


Conducted Emission Test Results

Line 1 Peak Plot



Line 2 Peak Plot





Line 1 Neutral Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
158.9 KHz	19.26	0.21	0.073	10.2	29.741	55.746	-26.005
196.55 KHz	20.98	0.2	0.075	10.1	31.358	54.67	-23.312
196.64 KHz	21.45	0.2	0.075	10.1	31.825	54.667	-22.843
197.4 KHz	22.15	0.2	0.075	10.1	32.521	54.646	-22.124
197.7 KHz	22.04	0.2	0.075	10.1	32.415	54.637	-22.222
559.03 KHz	18.58	0.1	0.071	10.1	28.854	46	-17.146

Line 2 Phase Avg Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	Avg Margin (dB)
150.5 KHz	16.83	0.3	0.073	10.2	27.394	55.986	-28.592
156.88 KHz	16.13	0.23	0.073	10.2	26.637	55.803	-29.166
160.43 KHz	17.87	0.2	0.073	10.196	28.339	55.702	-27.363
162.95 KHz	20.5	0.2	0.073	10.17	30.944	55.63	-24.686
165.7 KHz	17.93	0.2	0.073	10.143	28.35	55.551	-27.202
167.52 KHz	20.91	0.2	0.073	10.125	31.308	55.499	-24.191

Line 1 Neutral QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
158.9 KHz	39.1	0.211	0.073	10.2	49.584	65.746	-16.162
196.55 KHz	38.8	0.2	0.075	10.1	49.175	64.67	-15.495
196.64 KHz	38.79	0.2	0.075	10.1	49.165	64.667	-15.503
197.4 KHz	38.8	0.2	0.075	10.1	49.175	64.646	-15.471
197.7 KHz	38.48	0.2	0.075	10.1	48.855	64.637	-15.782
559.03 KHz	31.72	0.1	0.071	10.1	41.991	56	-14.009

Line 2 Phase QP Detector

Frequency	Measured Value (dBuV)	LISN Correction Factor (dB)	Cable Loss (dB)	Transient Limiter (dB)	Final Data (dBuV)	Limit (dBuV)	QP Margin (dB)
150.5 KHz	35.42	0.3	0.073	10.2	45.988	65.986	-19.998
156.88 KHz	36.09	0.23	0.073	10.2	46.594	65.803	-19.209
160.43 KHz	36.3	0.2	0.073	10.196	46.769	65.702	-18.933
162.95 KHz	38.46	0.2	0.073	10.17	48.904	65.63	-16.726
165.7 KHz	36.07	0.2	0.073	10.143	46.486	65.551	-19.065
167.52 KHz	38	0.2	0.073	10.125	48.398	65.499	-17.101

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
EMI Receiver	HP	8546A	i00033	3/29/16	3/29/17
Transient Limiter	Com-Power	LIT-153	i00123	Verified on: 06/23/2016	
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/22/15	4/22/18
Spectrum Analyzer	Agilent	E4407B	i00331	9/18/15	9/18/16
Horn Antenna	EMCO	3115	i00103	1/20/15	1/20/17
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Preamplifier for 1-18GHz horn antenna	Miteq	AFS44 00101 400 23-10P-44	i00509	Verified on: 06/28/16	
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/19/15	10/19/17
EMI Analyzer	Agilent	E7405A	i00379	2/11/16	2/11/17
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	7/27/14	7/27/16
LISN	COM-Power	LI-125A	i00447	7/25/14	7/25/16
LISN	COM-Power	LI-125A	i00449	8/28/15	8/28/17
PSA Spectrum Analyzer	Agilent	E4445A	i00471	8/26/15	8/26/16

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT