LS RESEARCH, LLC
Wireless Product Development

W66 N220 Commerce Court ● Cedarburg, WI 53012 USA ● Phone: 262.375.4400 ● Fax: 262.375.4248 ● www.lsr.com

ENGINEERING TEST REPORT # 313033 B
LSR Job #: C-1694

Compliance Testing of:
TiWi5

Test Date(s):
February 7, 8, 16, March 26-28, and April 1-2 2013

Prepared For:
LS Research
W66 N220 Commerce Court
Cedarburg, WI 53012

This Test Report is issued under the Authority of: Adam Alger, EMC Engineer

Signature: Date: 5-16-13

Test Report Reviewed by:	**Report by:**
Khairul Aidi Zainal, Senior EMC Engineer	Adam Alger, EMC Engineer
Signature: Date: 5-13-13	Signature: Date: 5-13-13

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LS Research, LLC in Review

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

TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

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

Federal Communications Commission (FCC) – USA

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

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1
File Number: IC 3088-A
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1
File Number: IC 3088

U. S. Conformity Assessment Body (CAB) Validation

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

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

1.0 Summary of Test Report

The purpose of these tests is to request a Class II permissive change to FCC ID: TFB-TIWI501 and IC: 5969A-TIWI501, to add an antenna. See permissive change request letter for full description of changes.

In 2013 the EUT TiWi5 was tested and MEETS the following requirements:

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.207 IC : RSS GEN sect. 7.2.2	Power Line Conducted Emissions Measurements	Yes
FCC : 15.247 (a)(1) IC : RSS 210 A8.1 (a)	20 dB Bandwidth	Yes
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(d) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 210 A8.2 (a)	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (d) IC: RSS 210 A8.2 (b)	Power Spectral Density of a Digital Modulation System	Yes
FCC : 15.247(c), 15.209 & 15.205 IC : RSS 210 A8.2(b), section 2.2, 2.6 and 2.7	Transmitter Radiated Emissions	Yes

2.0 Test Facilities

All testing was performed at:

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

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.
LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

3.0 Client Information

Manufacturer Name:	LS Research
Address:	W66 N220 Commerce Court Cedarburg, WI 53012
Contact Person:	Josh Bablitch

3.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	TIWI5
Model Number:	TIWI5
Serial Number:	Synapse XBRV4
FCC ID	TFB-TIWI501
IC Number	5969A-TIWI501

3.2 Product Description

The TIWI5 module is a multi-standard module with support for WLAN (802.11 a/b/g/n), Bluetooth 2.1+EDR and Bluetooth 4.0 (LE).

3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test.

3.4 Deviations & Exclusions from Test Specifications

None noted at time of test.

4.0 Conditions of Test

Environmental:

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

Mains Voltage: 120VAC 60 Hz

5.0 Additional Information

The EUT was programmed from a laptop computer with a HyperTerminal type program sending commands via Ethernet cable connected to PoE injector. EUT powered via PoE.

6.0 Test Equipment

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

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

7.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.407, and Industry Canada RSS-210, Issue 8 (2010), Annex 9.

If some emissions are seen to be within 3 dB of their respective limits:
As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

Appendix A – Test Equipment

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 26-Mar-2013 Type Test : Radiated Measurments Job # : C-1694

Prepared By: Adam Customer : LSR Quote #: 313033

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration
2	EE 960147	Pre-Amp	Adv. Micro	WLA612	123101	2/1/2013	2/1/2014	Active Calibration
3	EE 960146	Std. Gain Horn Ant. w/preamp	Adv. Micro / EMC	WLA622-4 / 3160-09	123001	9/26/2012	9/26/2013	Active Calibration
4	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	6/30/2012	6/30/2013	Active Calibration
5	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/29/2012	6/29/2013	Active Calibration
6	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/29/2012	6/29/2013	Active Calibration
7	EE 960161	26.5-40GHz LNA	Ducommun Tech	ALN-33144030	1103717-01	9/17/2012	9/17/2013	Active Calibration
8	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/1/2011	6/1/2013	Active Calibration
9	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/26/2012	6/26/2013	Active Calibration
10	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	12/10/2012	12/10/2013	Active Calibration
11	AA 960081	Double Ridge Horn Antenna	EMCO	3115	6907	1/29/2013	1/29/2014	Active Calibration
12	AA 960137	Standard Gain Horn Ant.	EMCO	3160-10	69259	10/4/2011	10/4/2014	Active Calibration
13	AA 960160	UTiFLEX Cable	Micro-Coax	UFC142A-0-0720-20(	218652-001	9/13/2012	9/13/2013	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 26-Mar-2013 Type Test : RF Conducted Job # : C-1694

Prepared By: Adam Customer : LSR Quote #: 313033

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/1/2011	6/1/2013	Active Calibration
2	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration

Project Engineer: Quality Assurance:

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 20-Dec-2011 Type Test : AC mains Job # : C-1371

Prepared By: Aidi Customer : LSR Quote #: 311362

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	11/22/2011	11/22/2012	Active Calibration
2	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	11/22/2011	11/22/2012	Active Calibration
3	AA 960072	Transient Limiter	HP	11947A	3107A02515	11/2/2011	11/2/2012	Active Calibration
4	AA 960075	LISN	EMCO	3810/2NM	9612-1710	9/19/2011	9/19/2012	Active Calibration

Project Engineer: Aidi Quality Assurance: Mike Hintzke

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

Manufacturer	LS Research
Test Location	LS Research, LLC – Bench Measurements
Rule Part	FCC Part 15.247 / RSS-210 Annex 8
General Measurement Procedure	FCC KDB 558074 D01 DTS Meas Guidance v02 ANSI C63.10-2009 Section 6.7
General Description of Measurement	A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source.

B.1.1 – RF Conducted - Fundamental

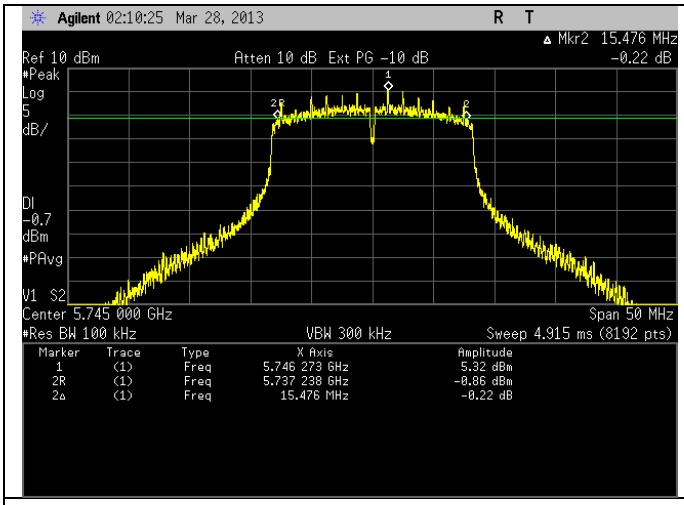
Manufacturer	LS Research
Date	3-28 and 4-1 2013
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	FCC Part 15.247 / RSS-210 A8
Specific Measurement Procedure	FCC KDB 558074 Section 7 Option 1 (DTS 6 dB BW) FCC KDB 558074 Section 8.1.2 Option 2 (Peak Output Power channel integration method) FCC KDB 558074 Section 9.1 Option 1 (DTS Peak PSD)
Additional Description of Measurement	For PSD limit in 3 kHz compliance is shown in 100 kHz bandwidth
Additional Notes	1) EUT transmitting at maximum duty cycle with no correction needed because peak measurements made. 2) Sample Calculations: Power Margin(dB) = Power Limit(dBm) – Power (dBm) Peak PSD Margin(dB) = PSD 3kHz Limit(dBm) – Peak PSD 100kHz (dBm)

Table

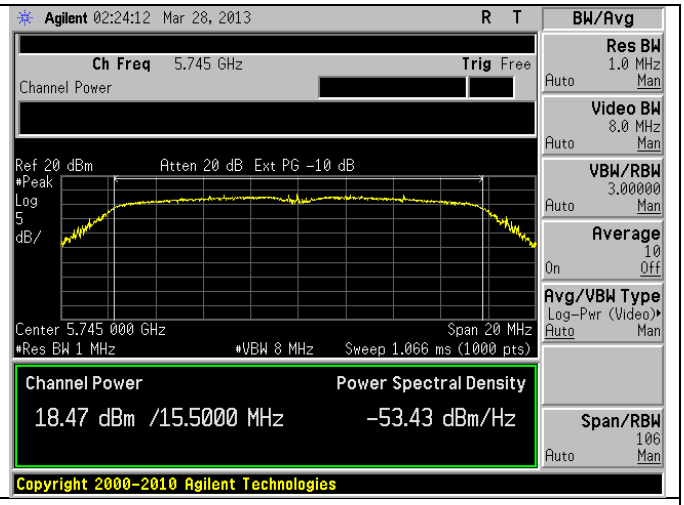
Data Rate	Channel	Frequency (MHz)	DTS 6dB (MHz)	Power (dBm)	Power Limit (dBm)	Power Margin (dB)	PSD in 100 kHz(dBm)	3 kHz PSD Limit (dBm)	PKPSD Margin (dB)
6 Mbps	149	5745	15.5	18.5	30	11.5	5.3	8	2.7
	157	5785	15.5	18.1	30	11.9	5.0	8	3.0
	165	5825	15.5	18.2	30	11.8	5.2	8	2.8
12 Mbps	149	5745	16.3	18.5	30	11.5	4.8	8	3.2
	157	5785	15.4	18.2	30	11.8	4.5	8	3.5
	165	5825	16.3	18.4	30	11.6	4.2	8	3.8
24 Mbps	149	5745	16.4	18.6	30	11.4	4.7	8	3.4
	157	5785	16.1	18.3	30	11.7	5.1	8	2.9
	165	5825	16.4	18.4	30	11.6	4.5	8	3.5
MCS7	149	5745	17.2	15.6	30	14.5	2.0	8	6.0
	157	5785	17.3	15.3	30	14.7	1.8	8	6.2
	165	5825	17.2	15.4	30	14.6	2.0	8	6.0

Plots – 6 Mbps

Channel 149 - 5745 MHz

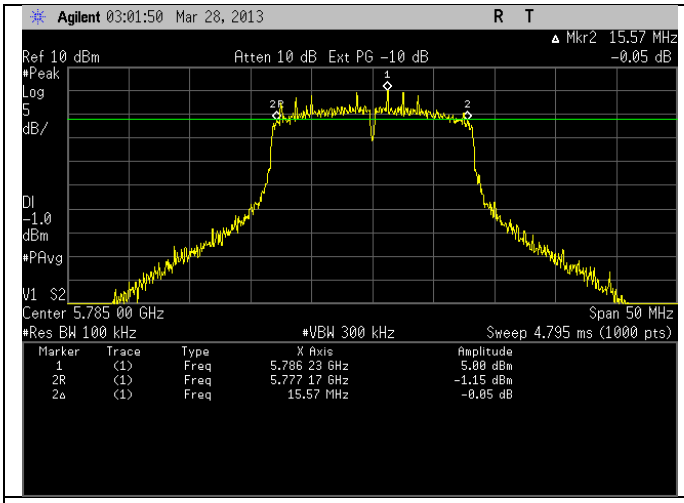


DTS BW and PSD



Power and PPSD

Channel 157 - 5785 MHz



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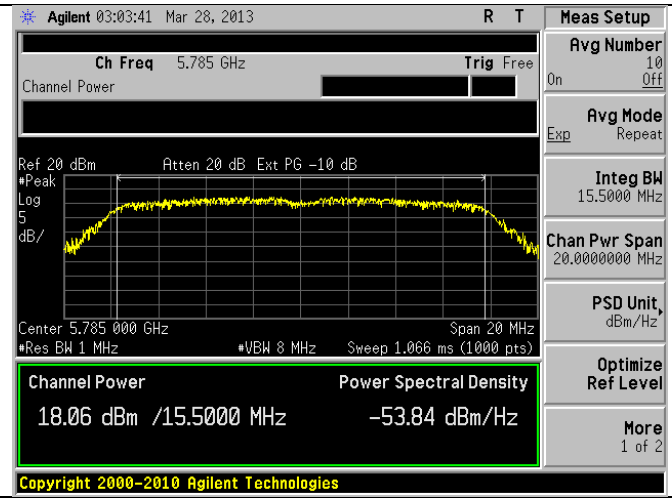
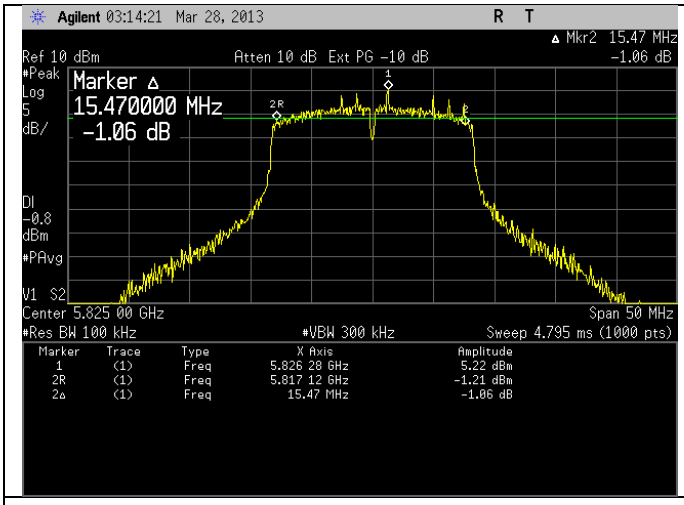


Power and PPSD

Channel 165 - 5825 MHz



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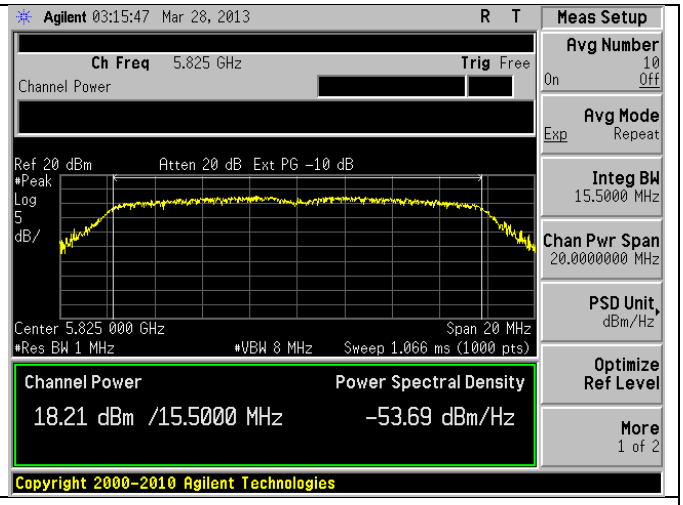
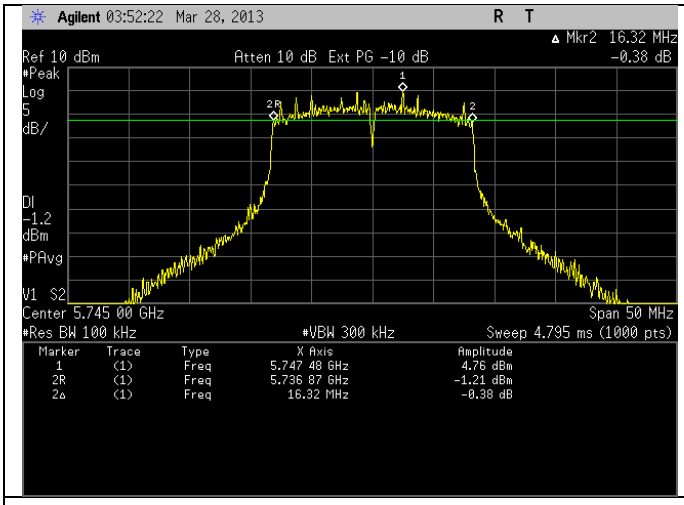


Power

Plots – 12 Mbps

Channel 149 - 5745 MHz



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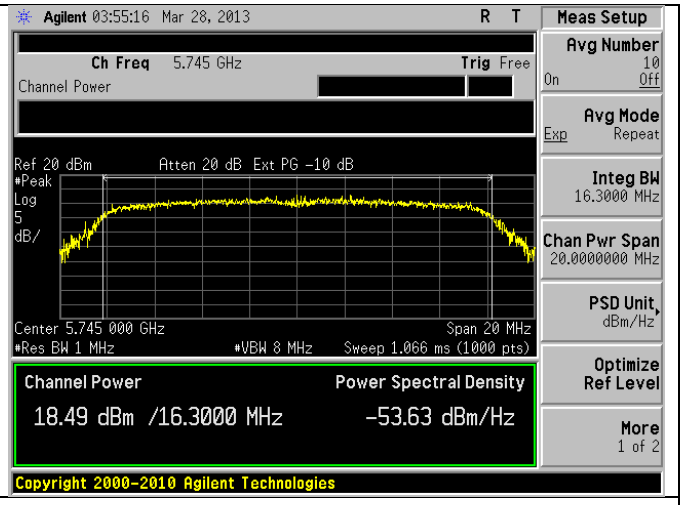
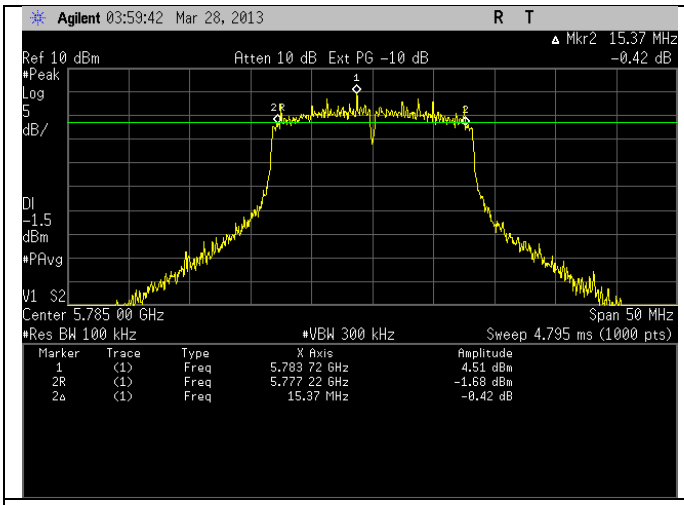


Power

Channel 157 - 5785 MHz



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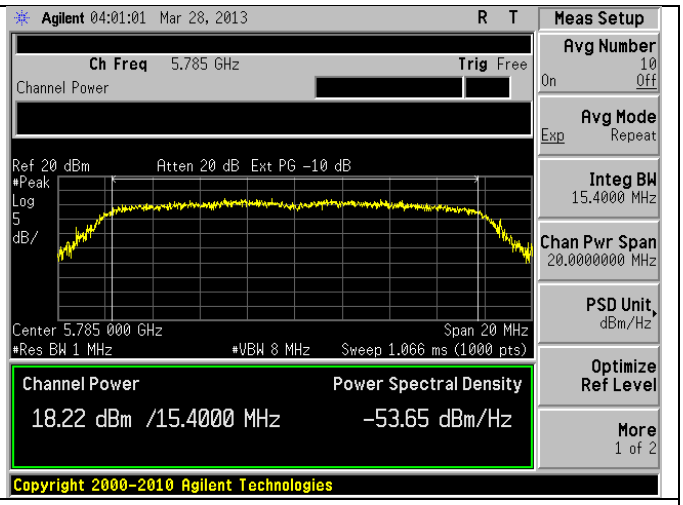
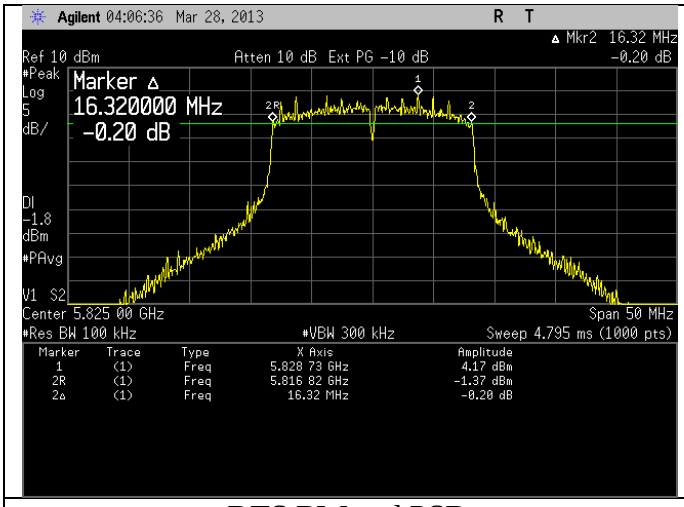


Power

Channel 165 - 5825 MHz



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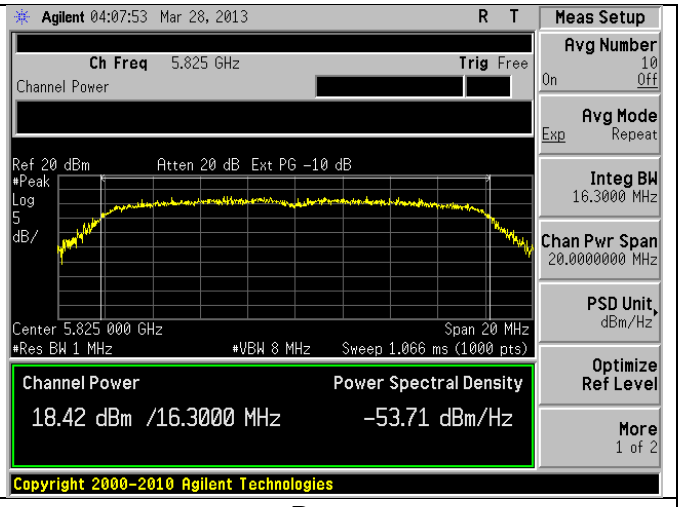
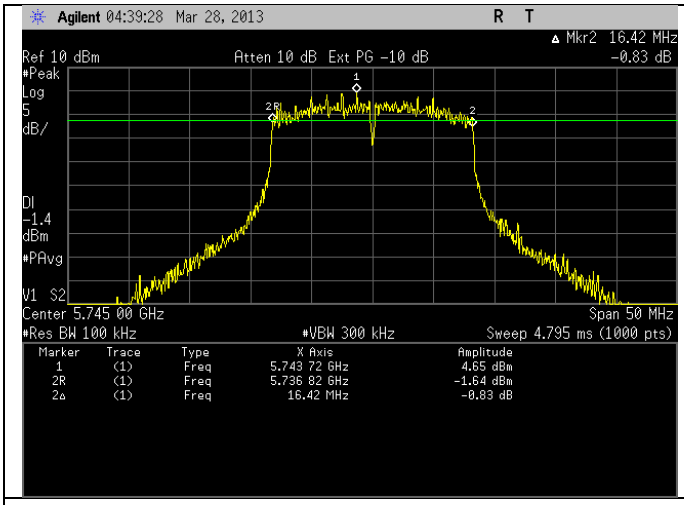


Power

Plots – 24 Mbps

Channel 149 - 5745 MHz



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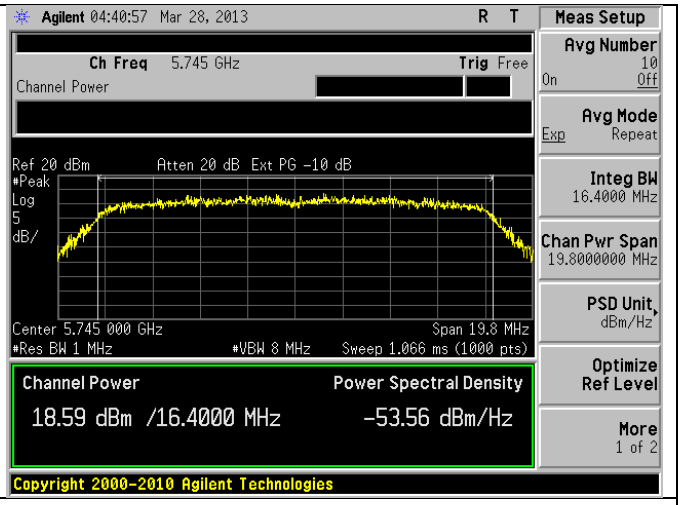
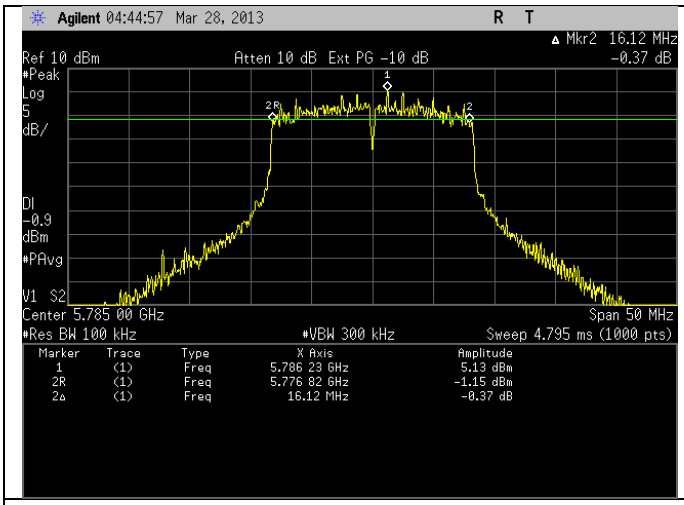


Power

Channel 157 - 5785 MHz



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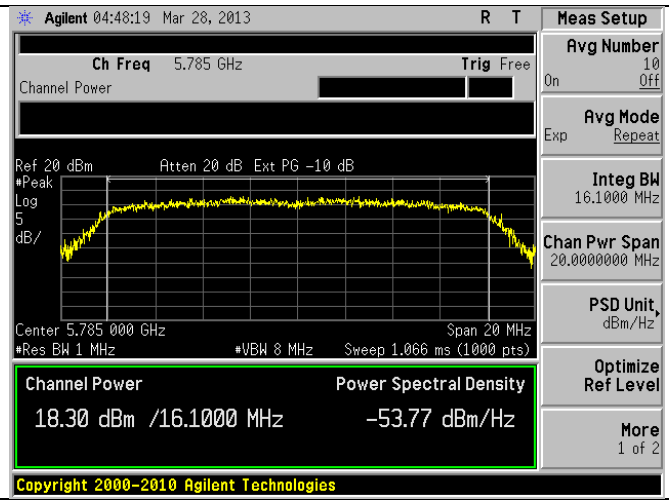
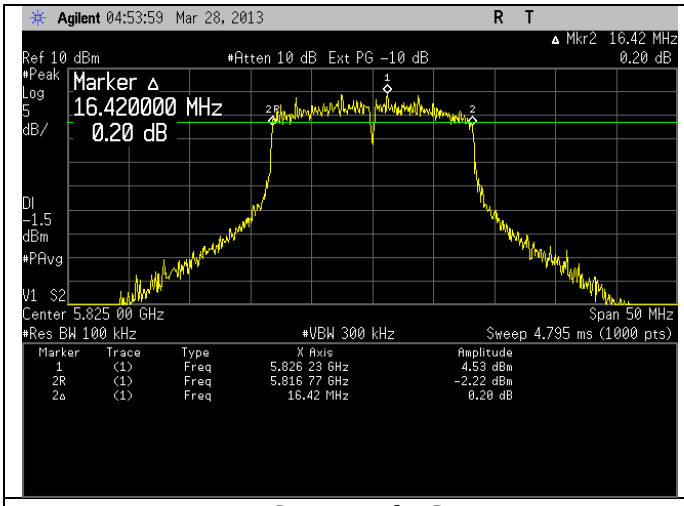


Power

Channel 165 - 5825 MHz



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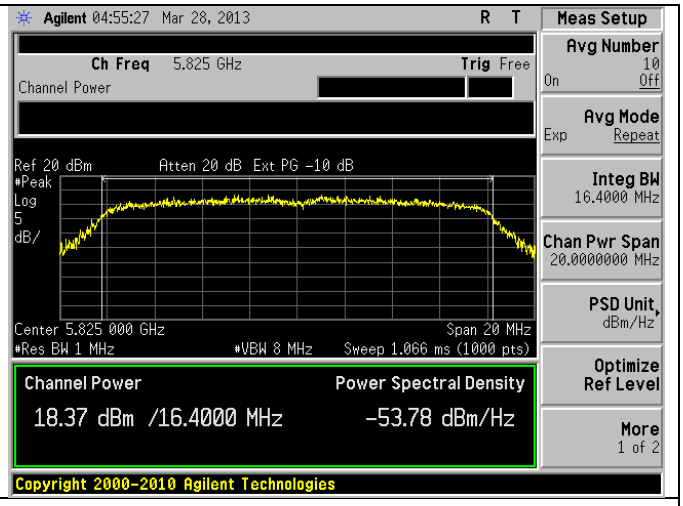
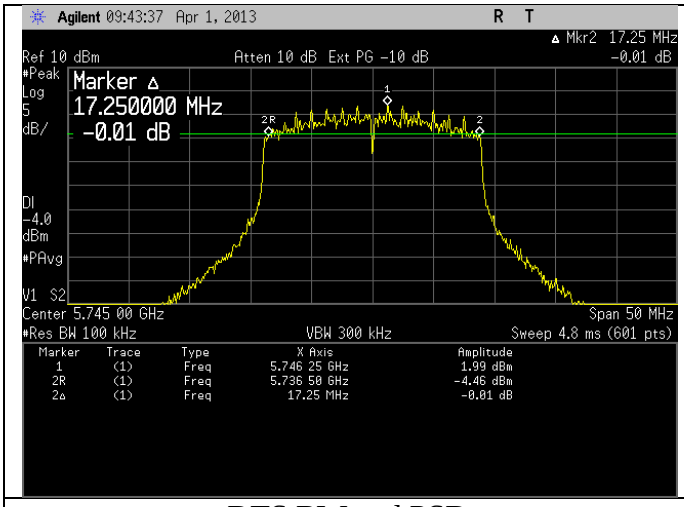


Power

Plots – MCS7

Channel 149 - 5745 MHz



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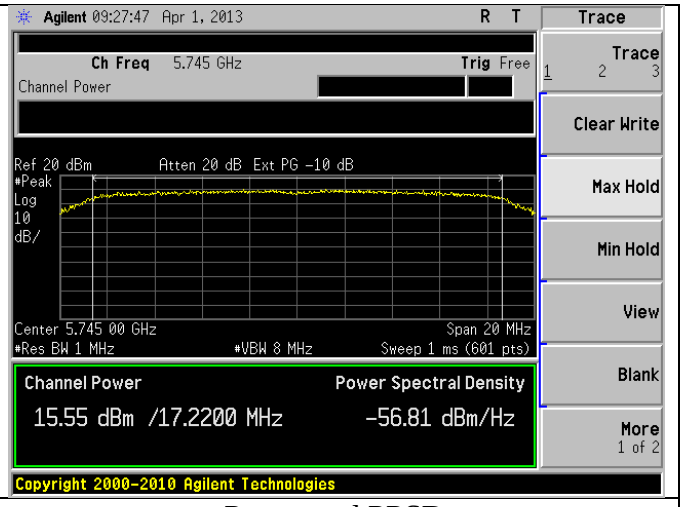
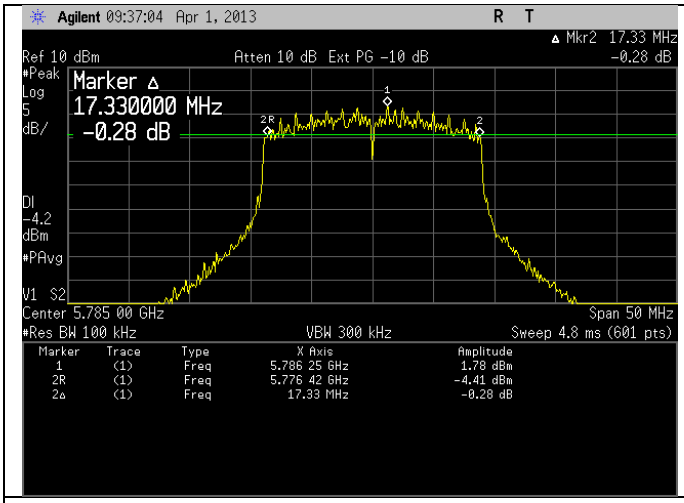


Power and PPSD

Channel 157 - 5785 MHz



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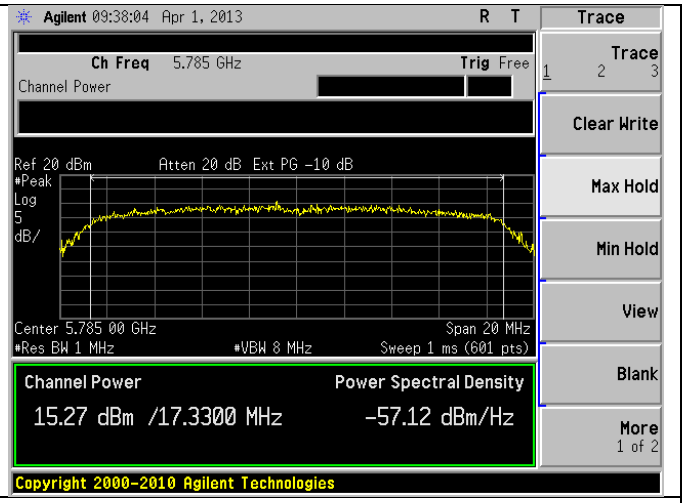
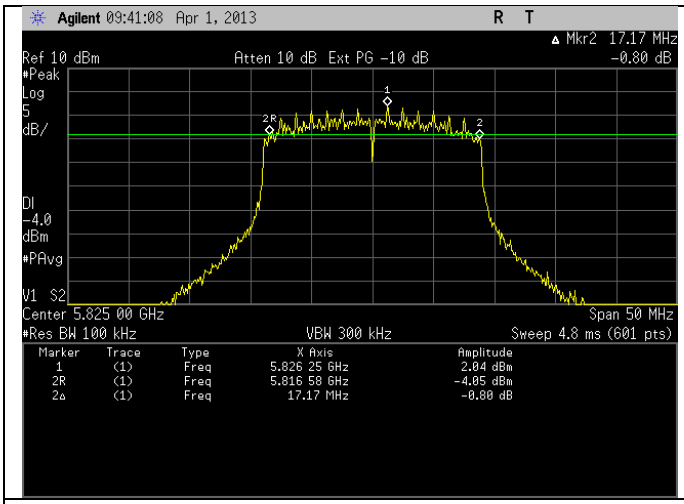


Power

Channel 165 - 5825 MHz



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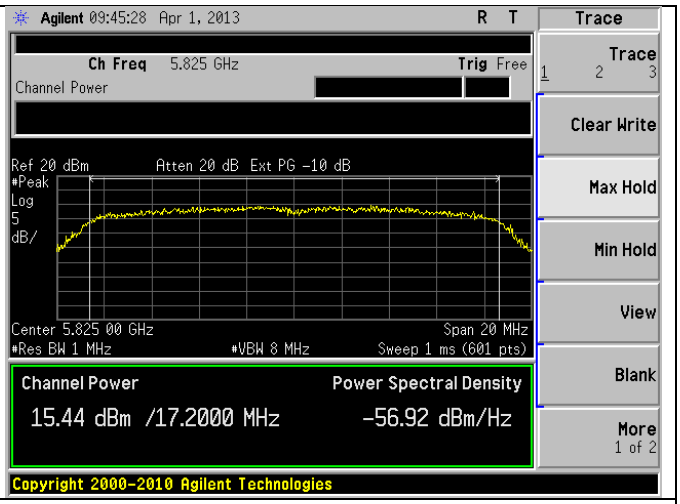


Power

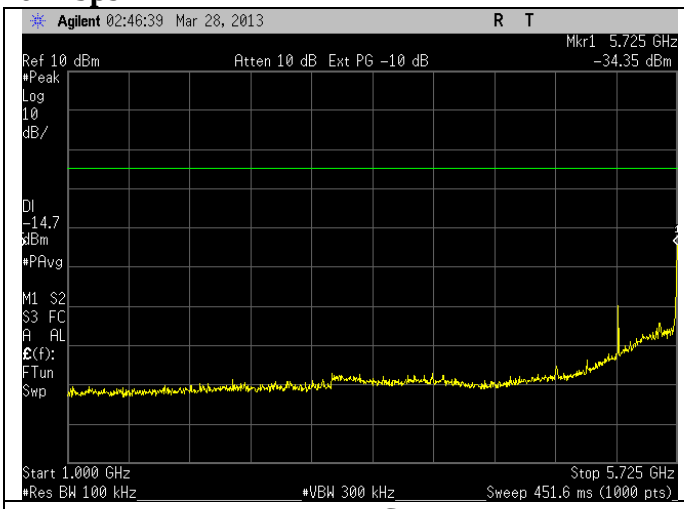
B.1.2.1 – RF Conducted – Spurious

Manufacturer	LS Research
Date	3-28, 4-1 2013
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.247 / RSS-210 A8
Specific Measurement Procedure	FCC KDB 558074 Section 10 – Unwanted Emissions
Additional Description of Measurement	RF Conducted Measurement
Additional Notes	1) 30-1000 MHz, 10-26 GHz, and 26-40 GHz no emissions found with all channels and data rates. Noise floor plots provided. 2) No emissions within 15 dB of limit.

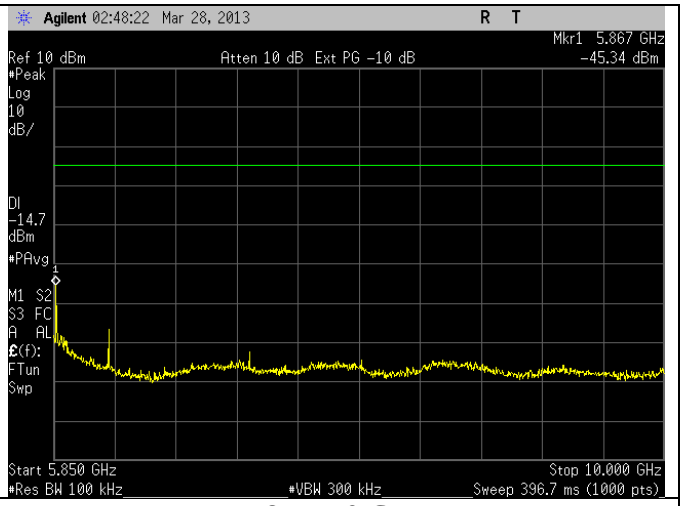
Plots start next page

Plots

Channel 149
6 Mbps

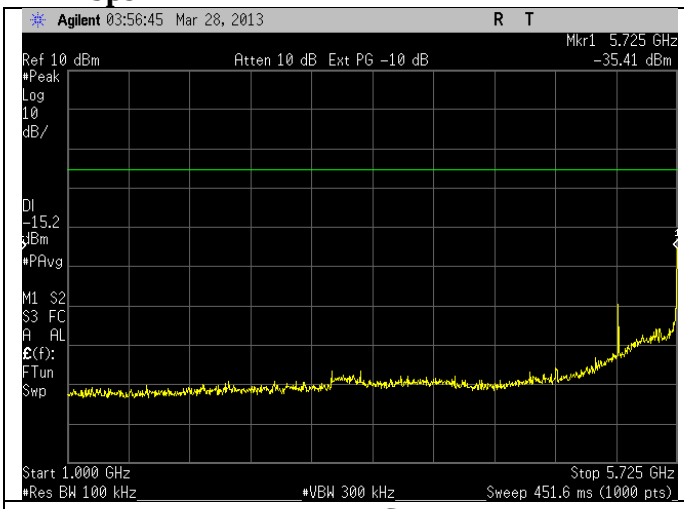


1 - 5.725 GHz

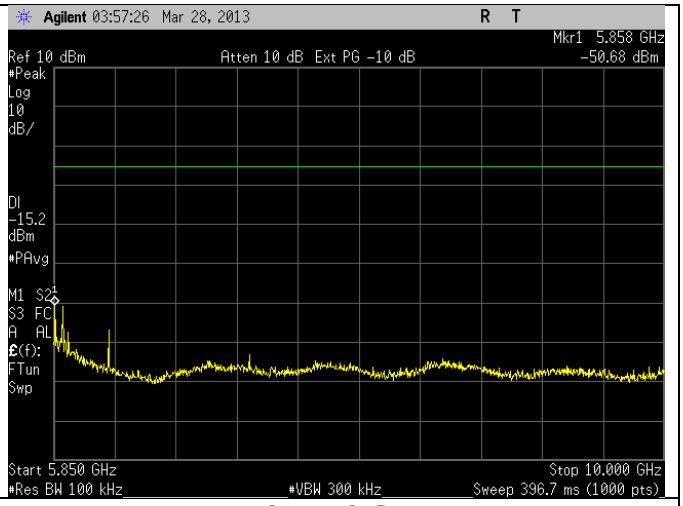


5.85 – 10 GHz

12 Mbps

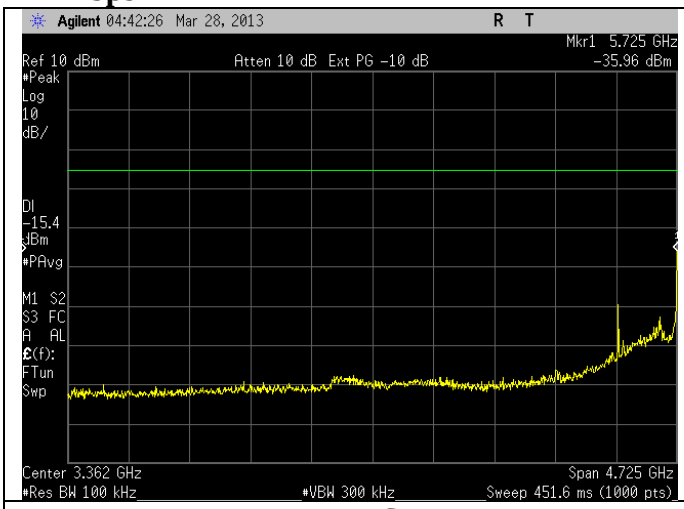


1 - 5.725 GHz

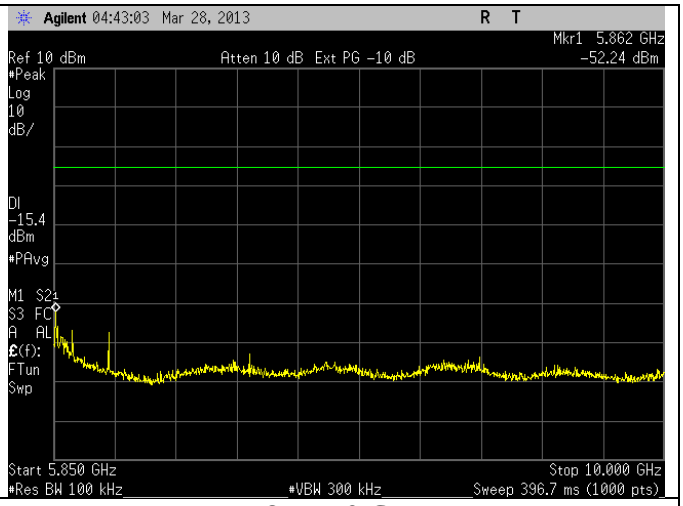


5.85 – 10 GHz

24 Mbps

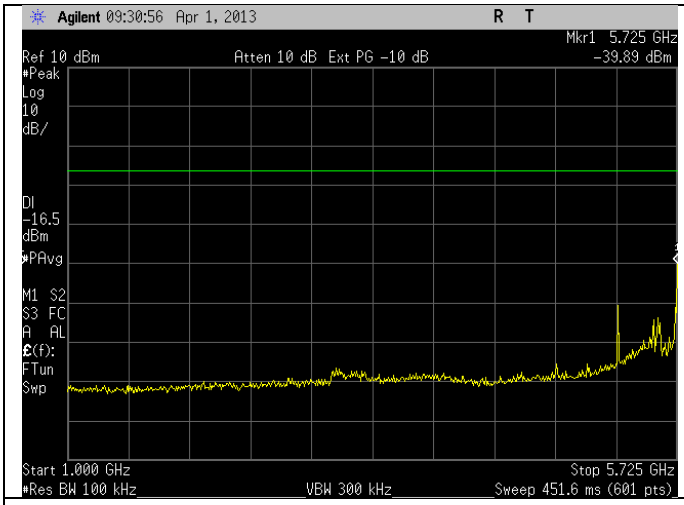


1 - 5.725 GHz

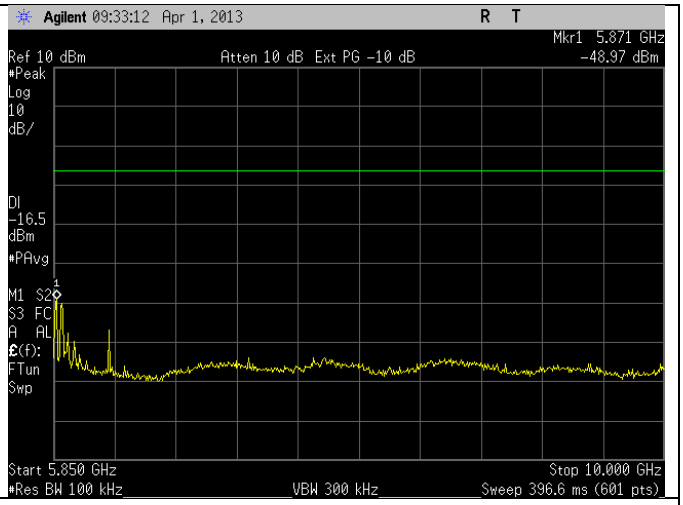


5.85 – 10 GHz

MCS7

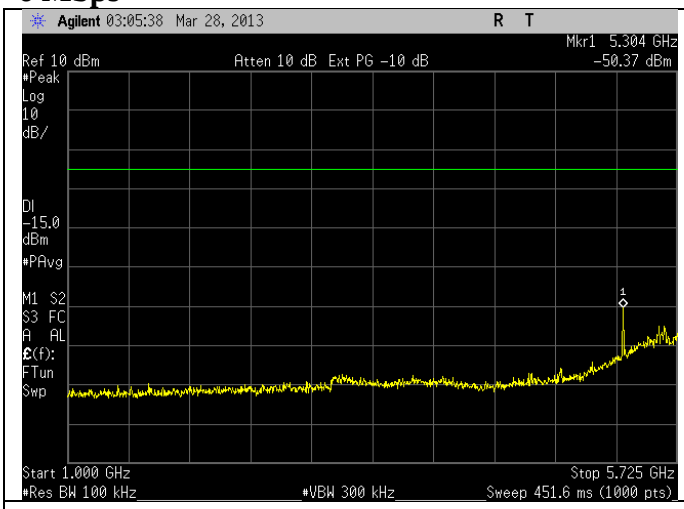


1 - 5.725 GHz

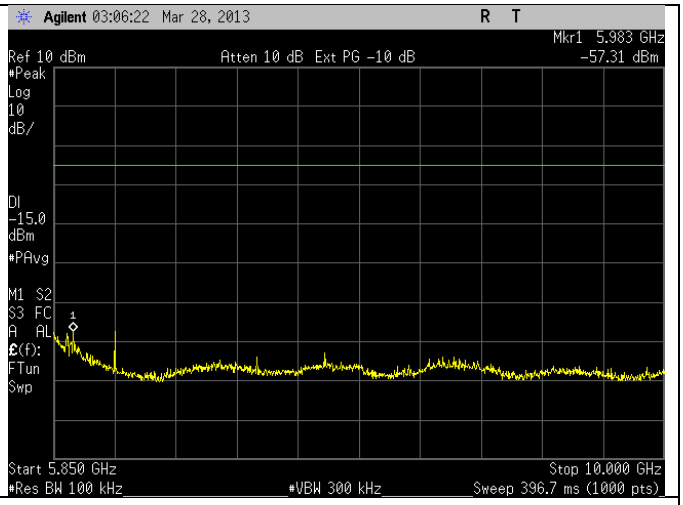


5.85 – 10 GHz

Channel 157
6 Mbps

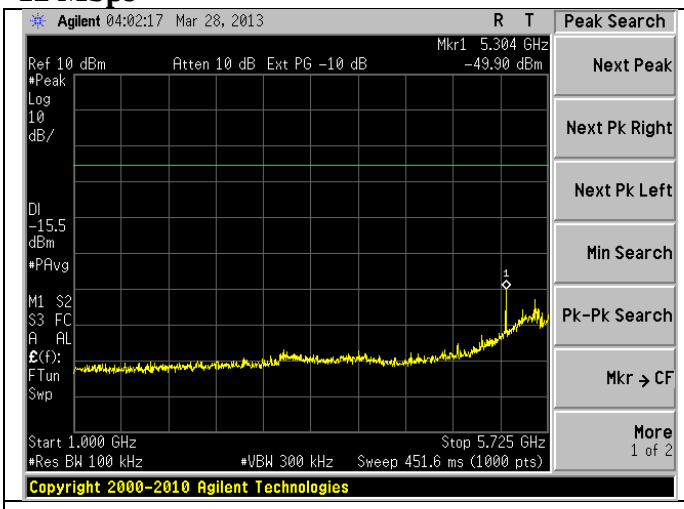


1 - 5.725 GHz

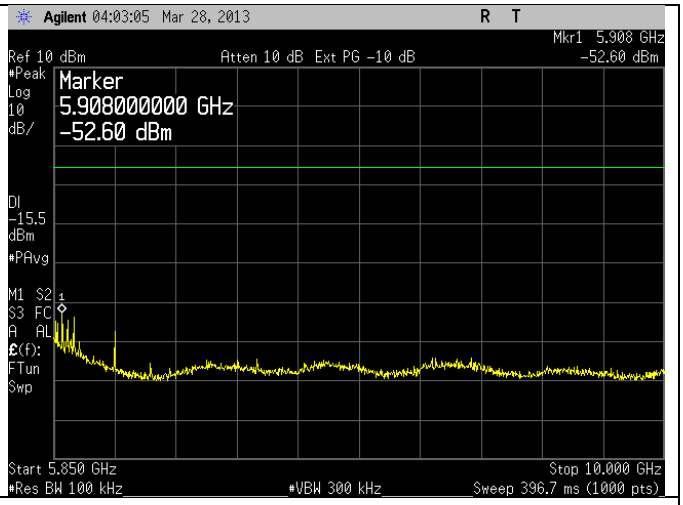


5.85 – 10 GHz

12 Mbps

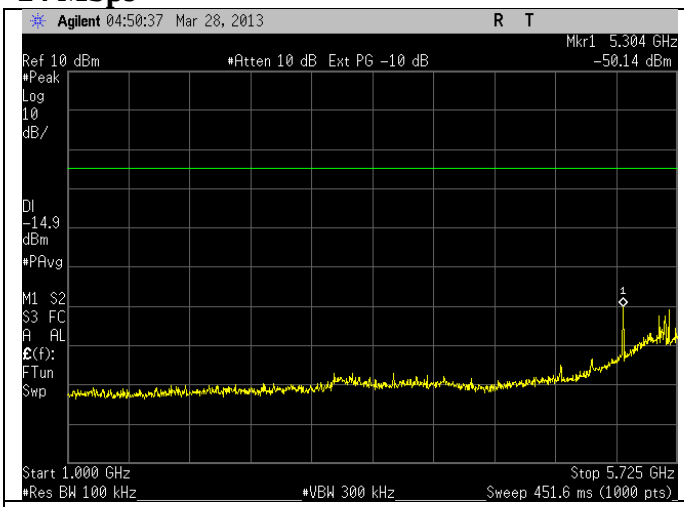


1 - 5.725 GHz

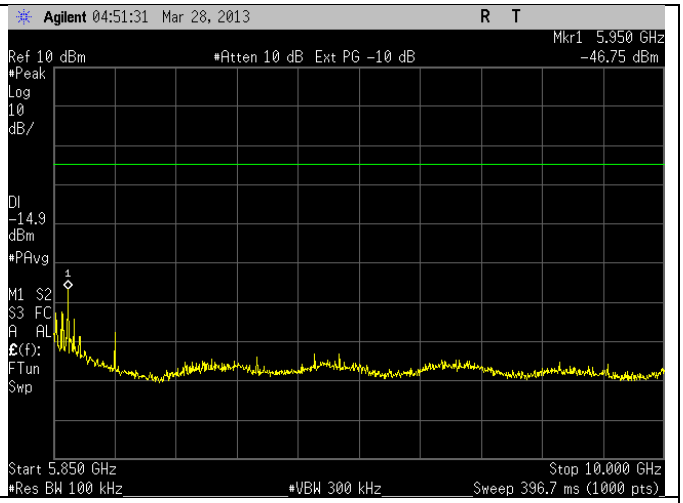


5.85 – 10 GHz

24 Mbps

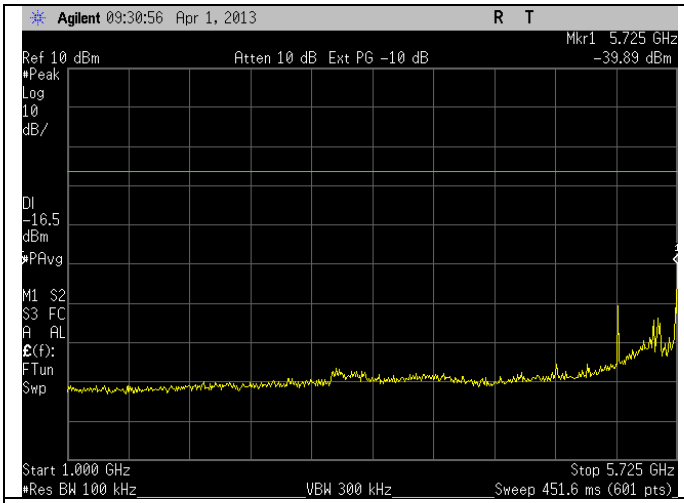


1 - 5.725 GHz

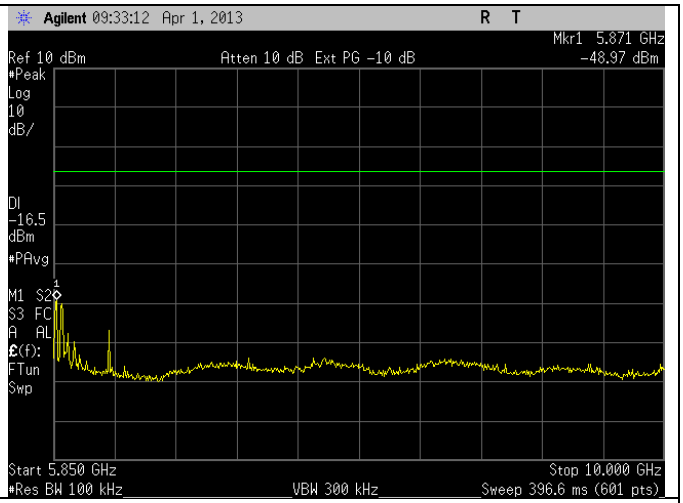


5.85 – 10 GHz

MCS7

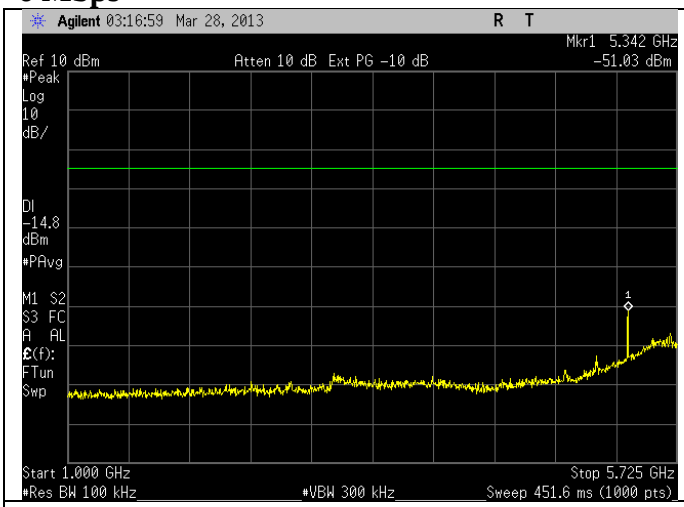


1 - 5.725 GHz

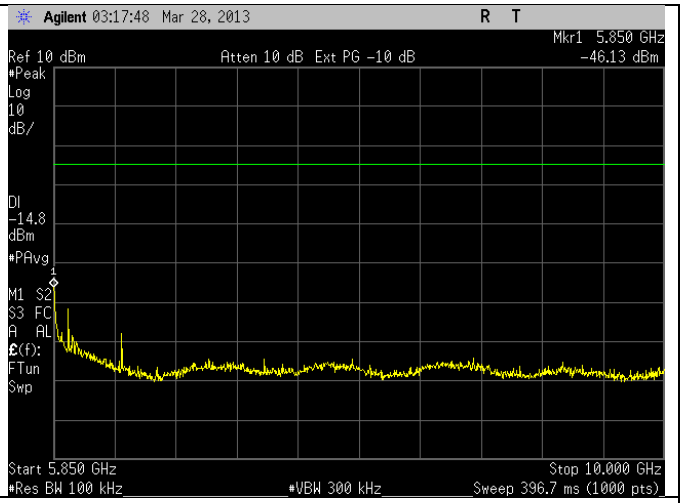


5.85 – 10 GHz

Channel 165
6 Mbps

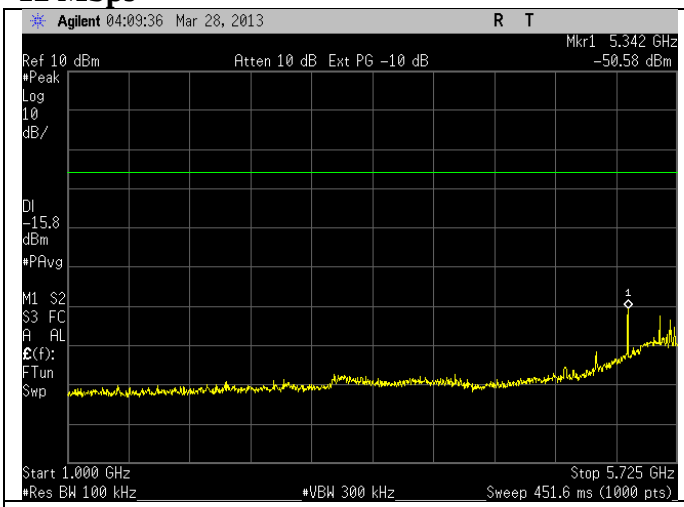


1 - 5.725 GHz

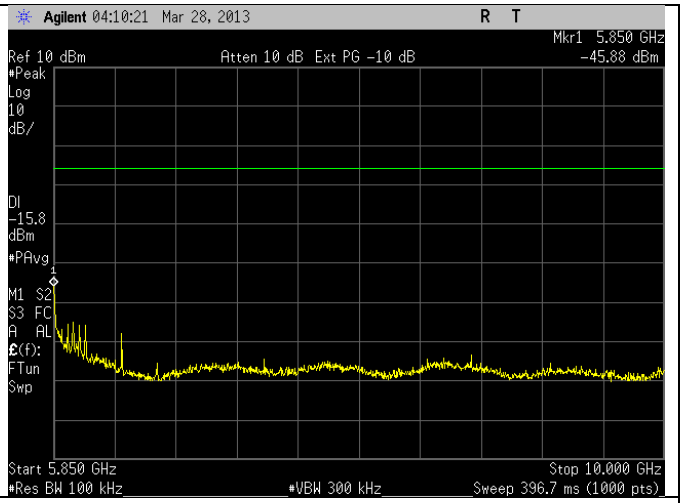


5.85 – 10 GHz

12 Mbps

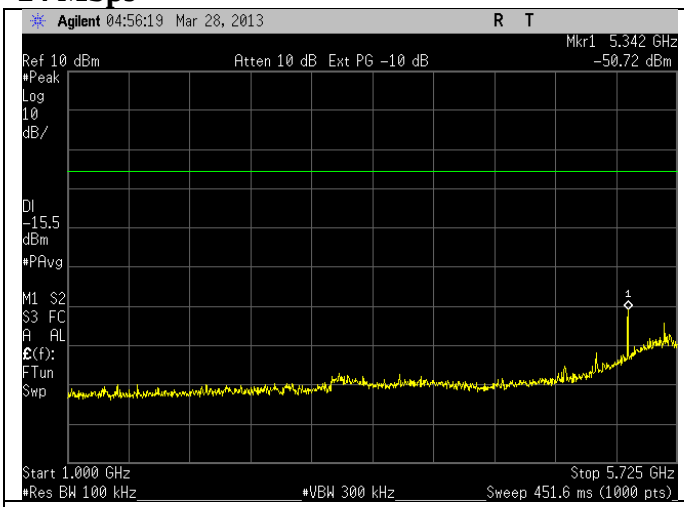


1 - 5.725 GHz

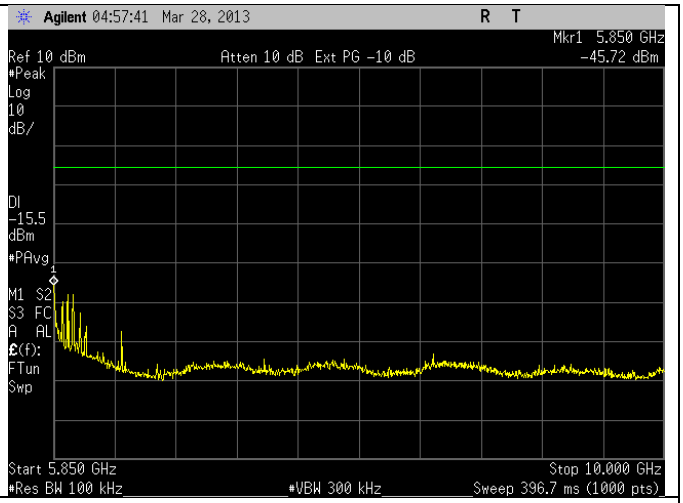


5.85 – 10 GHz

24 Mbps

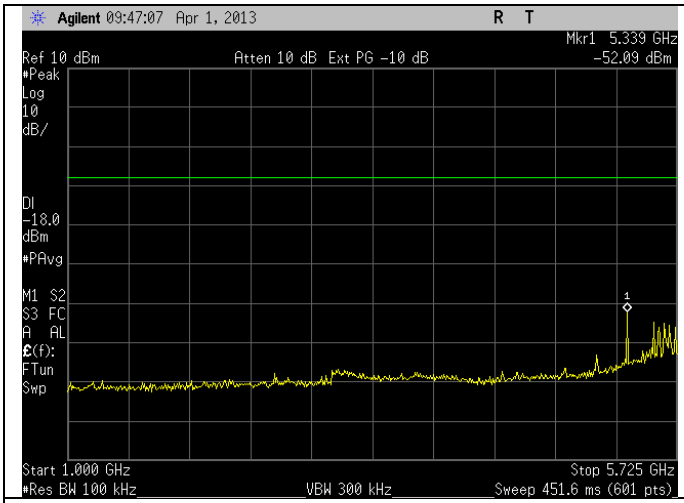


1 - 5.725 GHz

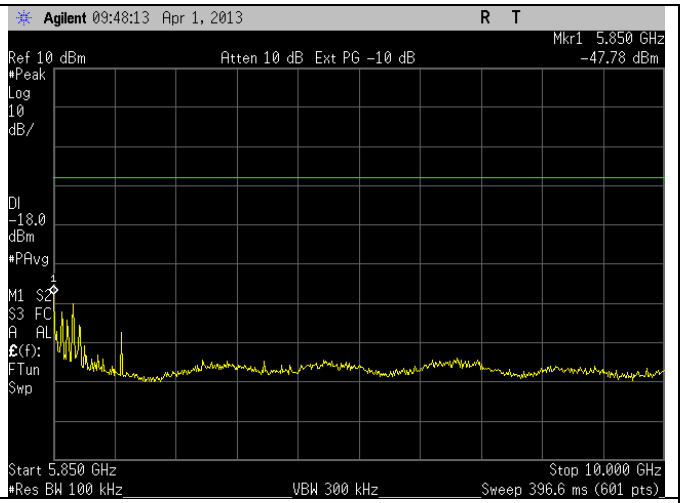


5.85 – 10 GHz

MCS7

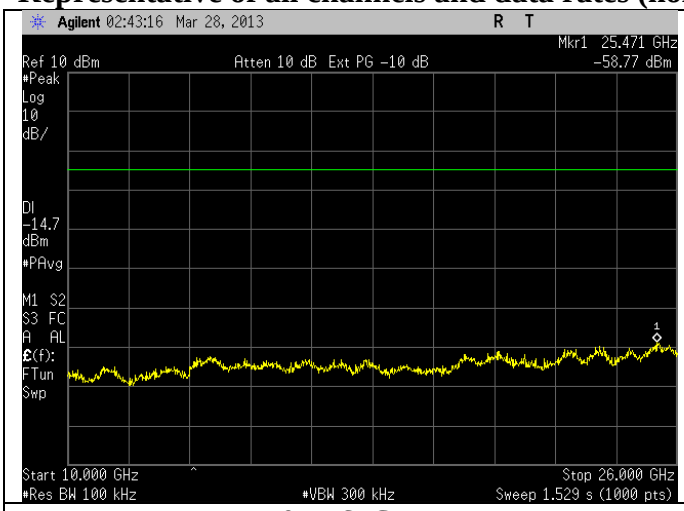


1 - 5.725 GHz

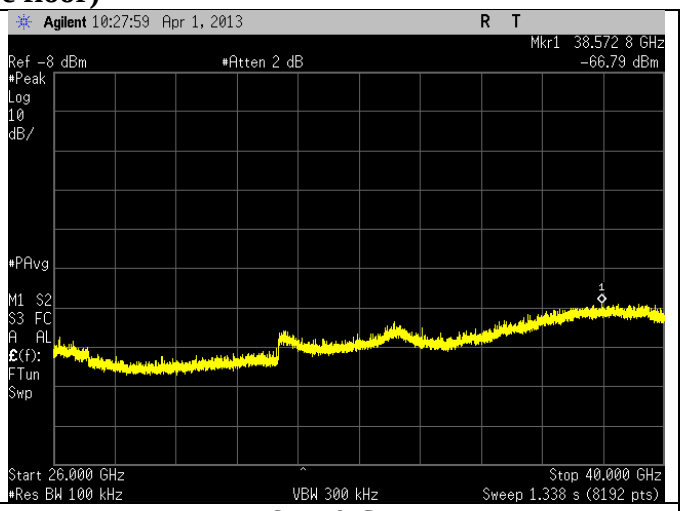


5.85 – 10 GHz

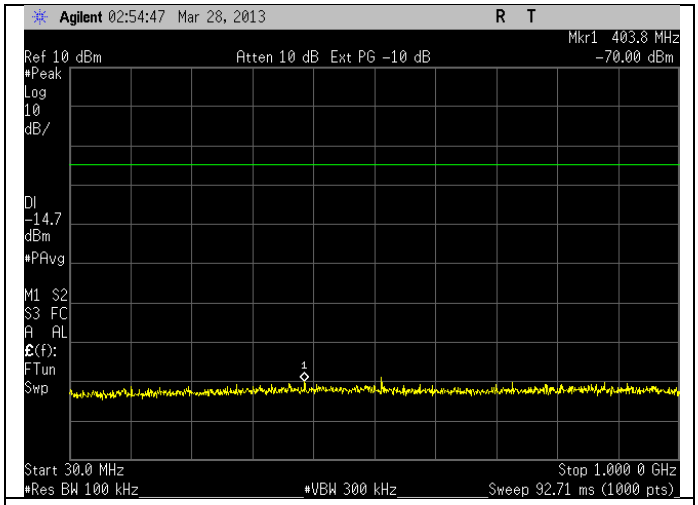
Representative of all channels and data rates (noise floor)



10 - 26 GHz



26 – 40 GHz



30 - 1000 MHz

B.2 – Radiated Emissions

Rule Part(s)	FCC: 15.247 / 15.205 / 15.209 IC: RSS-210 A8 / RSS-210 Section 2.2			
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10 – 2009 FCC KDB 558074 D01 DTS Meas Guidance v02			
Test Location	LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber			
Test Distance	See data section			
EUT Placement	80 cm height non-conductive table above reference ground plane			
Frequency Range of Measurement	Biconical: 30-300 MHz	Log Periodic Dipole Array: 300-1000 MHz	Double-Ridged Waveguide Horn: 1-18 GHz	(2) Standard Gain Horn: 18-26GHz 26-40 GHz
Measurement Detectors	30-1000MHz RBW: 120 kHz VBW: As specified		1 - 40 GHz: RBW : 1MHz VBW: As specified	
Description of Measurement	1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values. 2) The EUT is placed on a non-conductive pedestal centered on a turn-table in the test location with the antenna at the test distance from the EUT 3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height.			
Example Calculations	Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)			

FCC Part 15.209 / IC RSS-210 Section 2.7 Limits:

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

B.2.1 – Radiated Harmonics in Restricted Bands

Manufacturer	LS Research
Date	2-6 and 4-2-2013
Operator	Adam A
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.247/ 15.205 / 15.209
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10 - 2009 FCC KDB 558074
Test Distance	1 meter (8-40 GHz)
EUT Placement	80 cm height non-conductive table centered on turn-table
Detectors	Peak; RBW 1MHz
Additional Notes	1) Tested in the worst case of continuous transmit 6 Mbps (WLAN) modulated mode for radiated harmonics with EUT Antenna in three orthogonal positions at maximum power. Maximum results reported. 2) Peak measurements meet average restricted band limits as reported in data table. 3) Plots show reduced VBW(average) for identifying emissions 4) Tested at 1 meter test distance so a distance correction factor of 9.5 added to 3 meter limit.

Example Calculation:
FCC 15.209 Average Limit @ 1 meter (dBµV/m) – Peak Reading (dBµV/m) = Margin

Data Table

Channel 149

Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Limit (dBµV/m)	Average Margin (dB)	Antenna Polarity	EUT orientation
11490	1.00	335	55.66	63.5	7.84	Vertical	Vertical
22980	1.00	126	55.9	63.5	7.6	Horizontal	Flat

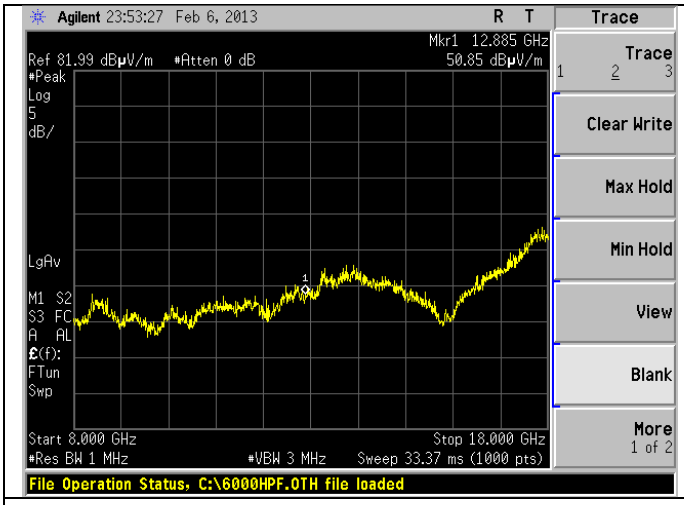
Channel 157

Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Limit (dBµV/m)	Average Margin (dB)	Antenna Polarity	EUT orientation
11570	1.21	15	56	63.5	7.5	Horizontal	Vertical
23140	1.01	67	57.1	63.5	6.4	Vertical	Vertical

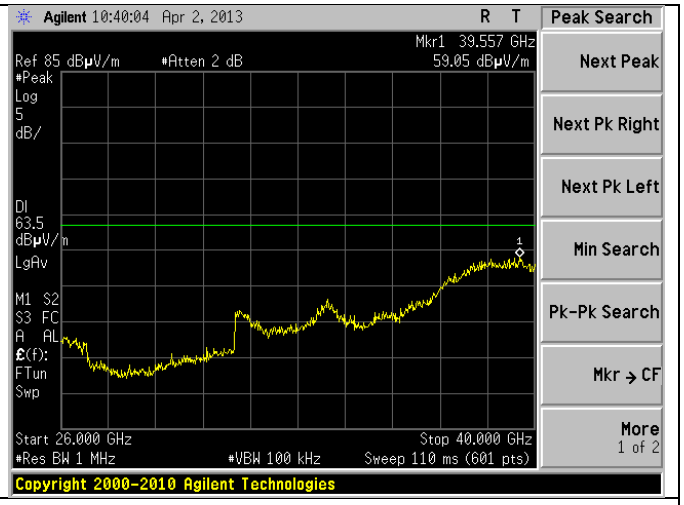
Channel 165

Frequency (MHz)	Height (cm)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Limit (dBµV/m)	Average Margin (dB)	Antenna Polarity	EUT orientation
11650	1.00	347	55.37	63.5	8.13	Vertical	Vertical

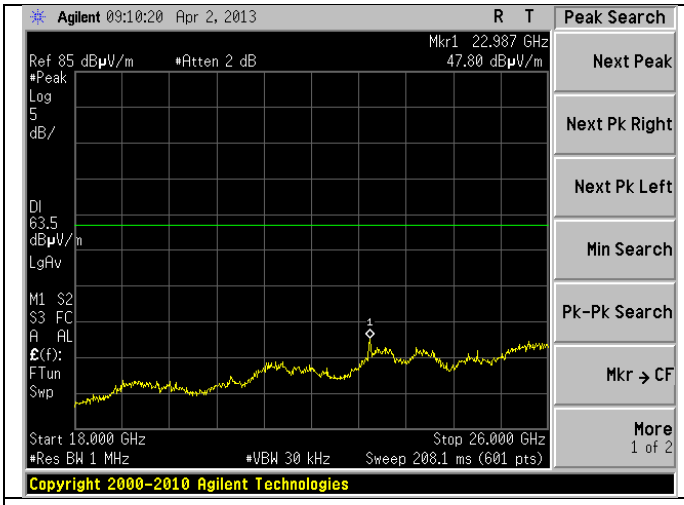
Plots



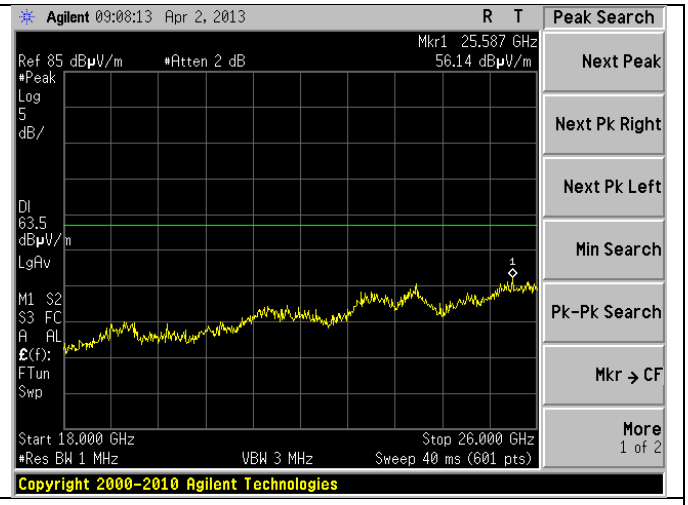
8 – 18 GHz Peak



26 – 40 GHz (Reduced VBW)



18 - 26 GHz Average



18 - 26 GHz Peak

B.2.1 – Radiated Emissions

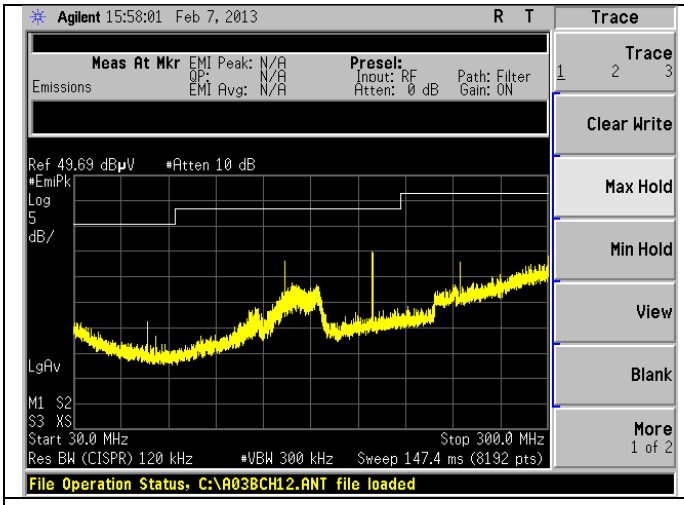
Manufacturer	LS Research
Date	2-7-13
Operator	Shane R.
Temp. / R.H.	20 - 25º C / 30-60% R.H.
Rule Part	15.247/ 15.205 / 15.209
Measurement Procedure	ANSI C63.4 - 2003 ANSI C63.10 - 2009
Test Distance	3 meter 30-1000 MHz
EUT Placement	80 cm height non-conductive table centered on turn-table
Detectors	Quasi-Peak, Peak; RBW 120kHz
Additional Notes	1) Tested in the worst case of continuous transmit 6 Mbps (WLAN) modulated mode with EUT Antenna in three orthogonal positions at maximum power. Maximum results reported. 2) ALL EMISSIONS FOUND DETERMINED NOT ASSOCIATED WITH RADIO

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

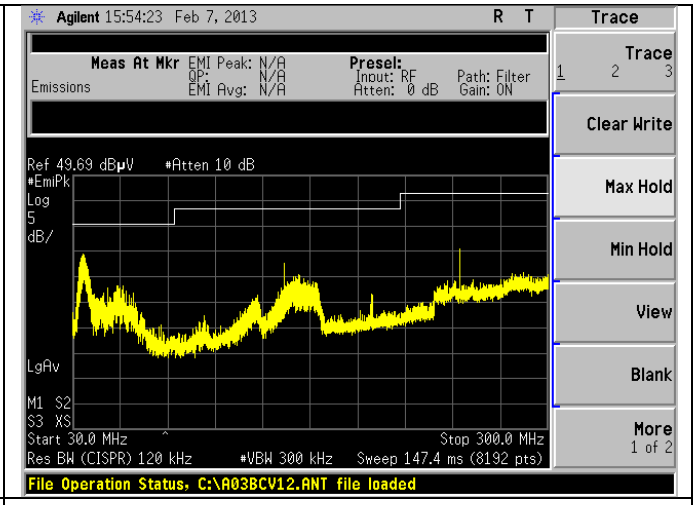
Data Table

Frequency (MHz)	Height (m)	Azimuth (degree)	Quasi Peak Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
147.9	2.11	180	41.89	43.5	1.6	H	F
250.0	1.37	0	42.04	46.0	4.0	H	F
150.0	2.15	359	32.7	43.5	10.8	V	F
200.0	1.67	103	36.7	43.5	6.8	H	F
800.0	1.07	212	44.19	46.0	1.8	H	F
600.0	1.49	163	43.18	46.0	2.8	H	F
800.0	1.50	180	41.19	46.0	4.8	V	F

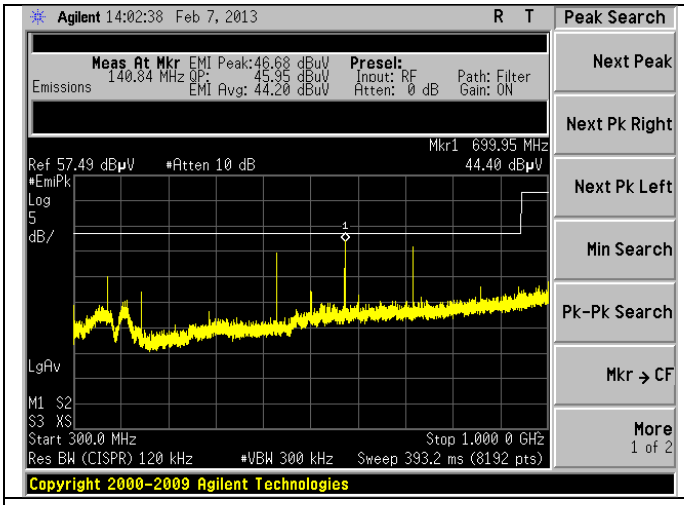
Plots



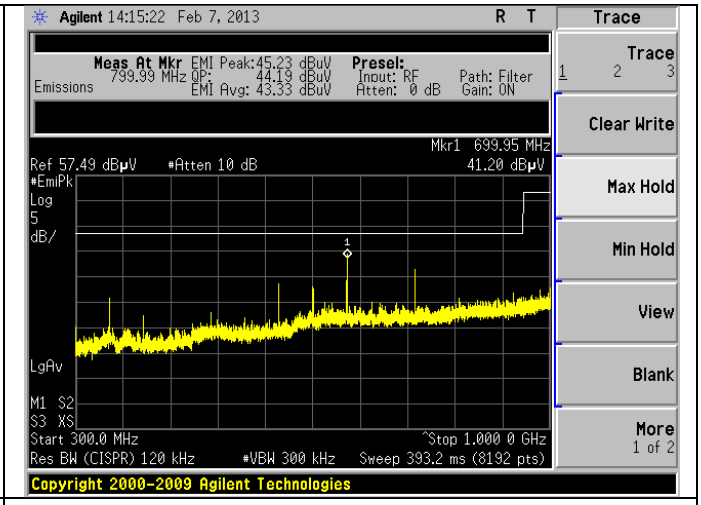
30 - 300 MHz Horizontal



30 - 300 MHz Vertical



300 – 1000 MHz Horizontal



300 – 1000 MHz Vertical

B3 – Frequency Stability

Manufacturer	LS Research
Operator	Khairul Aidi Zainal
Additional Notes	The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied ±15% from the nominal. The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.

WLAN 5.7 GHZ

	3.06 VDC		3.60 VDC		4.14 VDC			
	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	POWER (dBm)	FREQUENCY (Hz)	FREQ DRIFT (Hz)	Pout DRIFT (dBm)
LOW CHANNEL	3.8	5745002200	4.0	5745002300	4.0	5745002340	140	0.3
MID CHANNEL	2.7	5785002280	3.0	5785002360	3.2	5785002280	80	0.5
HIGH CHANNEL	2.1	5825002160	2.4	5825002220	2.6	5825002320	160	0.4

B4 – AC Mains Conducted Emissions

Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15, Industry Canada RSS-210 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

Test Procedure

The EUT was investigated in continuous modulated transmit mode and continuous receive mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

An off-the-shelf DC power supply was used during the test to supply the EUT with the appropriate DC voltage.

Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	**Class B Limits (dBμV)**		**Measuring Bandwidth**
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

Test Data

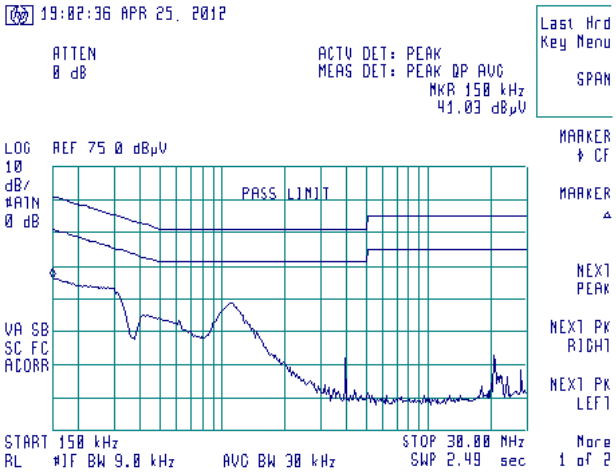
Manufacturer:	LS Research					
Date(s) of Test:	April 25th 2012					
Project Engineer:	Khairul Aidi Zainal					
Test Engineer:	Mike Hintzke					
Voltage:	120 VAC					
Operation Mode:	Continuous transmit, modulated					
Environmental Conditions in the Lab:	Temperature: 71° F Relative Humidity: 40%					
Test Location:	X	AC Mains Test area				Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:		Peak	X	Quasi-Peak	X	Average

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.150	L1	35.2	66.0	30.8	5.2	56.0	50.8
0.302	L1	32.2	60.2	28.0	10.7	50.2	39.5
1.106	L1	27.2	56.0	28.8	-2.7	46.0	48.7
0.150	L2	34.6	66.0	31.4	4.9	56.0	51.1
0.416	L2	20.0	57.5	37.5	-7.0	47.5	54.5
0.295	L2	30.0	60.4	30.4	0.6	50.4	49.8
1.025	L2	27.6	56.0	28.4	-2.4	46.0	48.4
0.618	L2	22.1	56.0	33.9	17.7	46.0	28.3

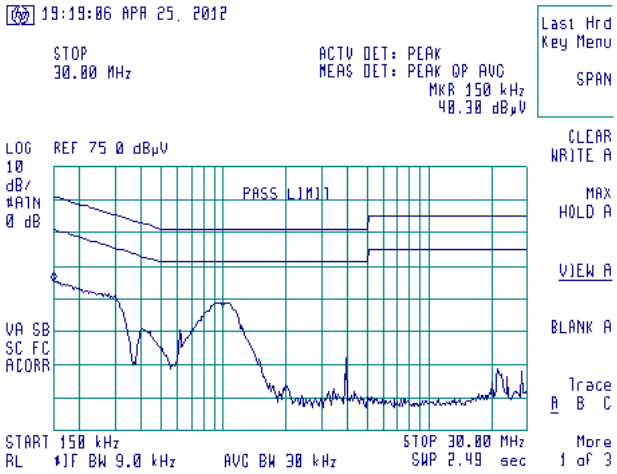
Notes:

1) The emissions listed are characteristic of the power supply used, and did not change by the EUT.

These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207 and RSS GEN 7.2.2 (Table 2).



Line 1



Line 2

Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	3 – Meter chamber, Biconical Antenna	4.82 dB
Radiated Emissions	3-Meter Chamber, Log Periodic Antenna	4.88 dB
Radiated Emissions	3-Meter Chamber, Horn Antenna	4.85 dB
Radiated Emissions	10-Meter OATS, Biconical Antenna	4.32 dB
Radiated Emissions	10-Meter OATS, Log Periodic Antenna	3.63 dB
Absolute Conducted Emissions	Agilent PSA/ESA Series	1.38 dB
AC Line Conducted Emissions	Shielded Room/EMCO LISN	3.20 dB
Radiated Immunity	3 Volts/Meter in 3-Meter Chamber	2.05 Volts/Meter
Conducted Immunity	3 Volts level	2.33 V
EFT Burst, Surge, VDI	230 VAC	54.4 V
ESD Immunity	Discharge at 15kV	3200 V
Temperature/Humidity	Thermo-hygrometer	0.64°/ 2.88 %RH

Appendix D - References

Publication	Year	Title
FCC CFR Parts 0-15	2013	Code of Federal Regulations – Telecommunications
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
RSS-210 Annex 8	2010	Low-power License-exempt Radio communication Devices (All Frequency Bands): Category I Equipment
RSS-GEN Issue 3	2010	General Requirements and Information for the Certification of Radio Apparatus
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
FCC KDB 558074 D01 DTS Meas Guidance v02	2012	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

END OF REPORT

Date	Version	Comments	Person
5-13-13	V0	Initial Draft Release	Adam A
5-16-13	V1	Final Release	Adam A