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Report On

Application for Grant of Equipment Authorization of the
NantWorks
HBox Access Point for Medical Devices

FCC Part 15 Subpart C §15.247
IC RSS-210 Issue 8 December 2010

Report No. SC1311091A

January 2014



REPORT ON Radio Testing of the
NantWorks
Access Point for Medical Devices

TEST REPORT NUMBER SC1311091A

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DATED January 10, 2014



Revision History

SC1311091A NantWorks HBox Access Point for Medical Devices					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
01/10/2014	Initial Release				Chip R. Fleury



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SECTION 1

REPORT SUMMARY

Radio Testing of the
NantWorks
Access Point for Medical Devices



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the NantWorks HBox Access Point for Medical Devices to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-210 Issue 8 December 2010.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	NantWorks
Model Number(s)	200-HBX-PDL
FCC ID Number	IFU1001008
IC Number	N/A (Manufacturer not seeking IC Certification at the time of verification)
Serial Number(s)	N/A (Sample #1) Conducted antenna service port testing sample, serial number not available due to temporary addition of an antenna port for testing / 34008112 (Radiated testing - Sample #2) 34008096 (Radiated testing - Sample #3)
Number of Samples Tested	3
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2012). • RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 3, December 2010). • 558074 D01 DTS Meas Guidance v03r01,(April 09,2013) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • 662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013) Emissions Testing of Transmitters with Multiple Outputs in the Same Band
Start of Test	November 26, 2013
Finish of Test	December 24, 2013
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	None. Supporting documents for EUT certification are separate exhibits.



1.2 BRIEF SUMMARY OF RESULTS

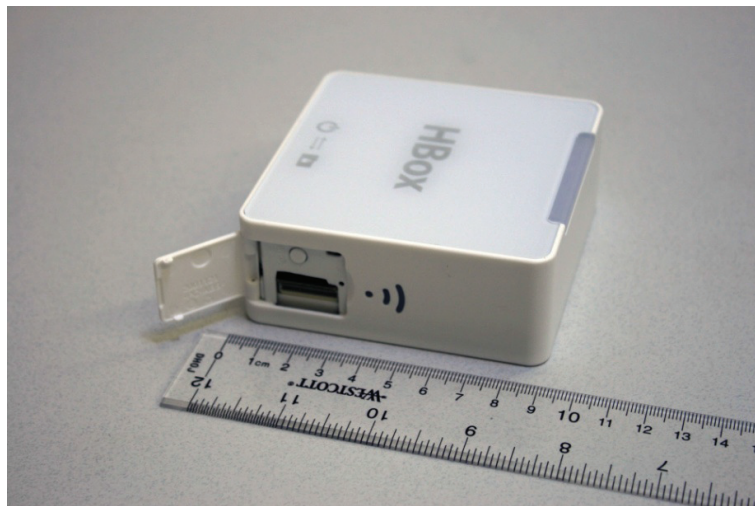
A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 with cross-reference to the corresponding IC RSS standard is shown below.

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
2.1	§15.247(b)(3)	RSS-210 A8.4 (4)	Peak Output Power	Compliant	
2.2	§15.207(a)	RSS-Gen 7.2.4	Conducted Emissions	Compliant	
2.3		RSS-Gen 4.6.1	99% Emission Bandwidth	Compliant	
2.4	§15.247(a)(2)	RSS-210 A8.2(a)	Minimum 6 dB RF Bandwidth	Compliant	
2.5	§15.247(d)	RSS-210 A8.5	Out-of-Band Emissions - Conducted	Compliant	
2.6	§15.247(d)	RSS-210 A8.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	§15.247(d)	RSS-210 A8.5	Spurious Radiated Emissions	Compliant	
2.7		RSS-Gen 4.10	Receiver Spurious Emissions	Compliant	
2.8	§15.247(d)	RSS-210 A8.5	Radiated Band Edge Measurements	Compliant	
2.9	§15.247(e)	RSS-210 A8.2(b)	Power Spectral Density for Digitally Modulated Device	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a NantWorks HBox Access Point for Medical Devices as shown in the photograph below. The EUT can connect to a network through Ethernet port or Wi-Fi. In normal operation, the EUT collects user data via USB, Bluetooth or Wi-Fi and upload the information back to a data server. The NFC function is for quick Bluetooth pairing by obtaining the device info when within NFC range of the EUT. Only the 802.11 a, b, g, n and Bluetooth LE functions verified in this test report.



Equipment Under Test



1.3.2 EUT General Description

EUT Description	Access Point for Medical Devices
Model Name	HBox
Model Number(s)	200-HBX-PDL
Rated Voltage	Internal 3.7VDC Li-Ion Battery (Gold Peak Industries 130801-00), AC adapter/charger is Hon-Kwang Switching Power Supply Model: HK-AB-050A400-US, output is 5.0VDC 4.0A
Mode Verified	802.11 a/b/g/n and BT LE
Capability	802.11 a/b/g/n WLAN (DTS/U-NII), Bluetooth 2.0 + EDR, Bluetooth 4.0 and NFC
Primary Unit (EUT)	☒ Production ☐ Pre-Production ☐ Engineering
Antenna Type	Integral PIFA type (Ant #1 and 2)
MIMO Signal Type	Completely uncorrelated (Manufacturer declared)
Antenna Gain Ant #1 (Main, WiFi +BT)	2400MHz = 2.9dBi 5000MHz = 2.3dBi
Antenna Gain Ant #2 (MIMO 802.11 n ht20 2.4 GHz only)	2400MHz = 5.5dBi

1.3.3 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
802.11a	5745-5825	10.18	10.42
802.11b	2412-2462	14.85	30.55
802.11g	2412-2462	13.09	20.37
802.11 n (ht20)	2412-2462	13.13	20.56
802.11 n (ht40)	2422-2452	12.54	17.95
802.11 n (ht20)	5745-5825	10.05	10.12
802.11 n (ht40)	5745-5825	6.53	4.45
802.11 n (ht20 MIMO)	2412-2462	15.66	36.82
Bluetooth LE	2402-2480	8.46	7.00



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna conducted port test configuration. All measurements were performed on the main antenna (Ant.#1) except when in MIMO configuration where both antenna (Ant #1 and 2) were verified. MIMO function is limited to 802.11 n ht20 2.4GHz only. Antenna #1 is for both Wi-Fi and Bluetooth functions while Antenna #2 is for MIMO function only. The EUT is programmed using a generic JTAG debug board connected via USB. Radio commands are programmed using Tera Term SSH2 (Secure Shell) client software.
B	Radiated emissions test configuration. The EUT is programmed using PuTTY SSH2 (Secure Shell) client software. The EUT is connected to a support broadband router where the support laptop used to program the EUT is also connected. Client provided radio commands to modify modes, channel number and data rates. TX power is set to max power as a default setting.

1.4.2 EUT Exercise Software

HBOX Function Tester. This is built-in within the firmware. Radio commands are executed via Ethernet or USB via a JTAG debug board using Tera Term or Putty from a support PC.

1.4.3 Support Equipment and I/O cables

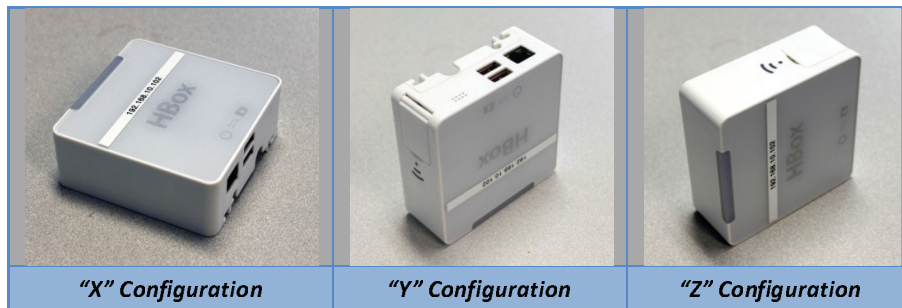
Manufacturer	Equipment/Cable	Description
Sony	Personal Computer (Y Series Laptop)	Model PCG-31311L
Sony	AC Adapter	Model PCGA-AC19V9 S/N:147839091 0023259
Hon-Kwang	I.T.E. Power Supply for EUT	Model HK-AB-050A400-US 5VDC @ 4A
Trendnet	Broadband Router	Model TW100S4W1CA S/N: RA1332S400789
DVE	Switching Adapter for Broadband Router	Model DSA-6PFE-05 FUS 050100 5VDC @ 1A
Lorom	CAT5E Patch Cable (2X)	Unshielded, 1.5 meters Ethernet cables
-	Debug board	Generic JTAG (Joint Test Action Group)/IEEE 1149.1 Standard Test Access Port and
	USB cable	Shielded, 1.7m generic USB cable

1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per maximum conducted output power measurements:

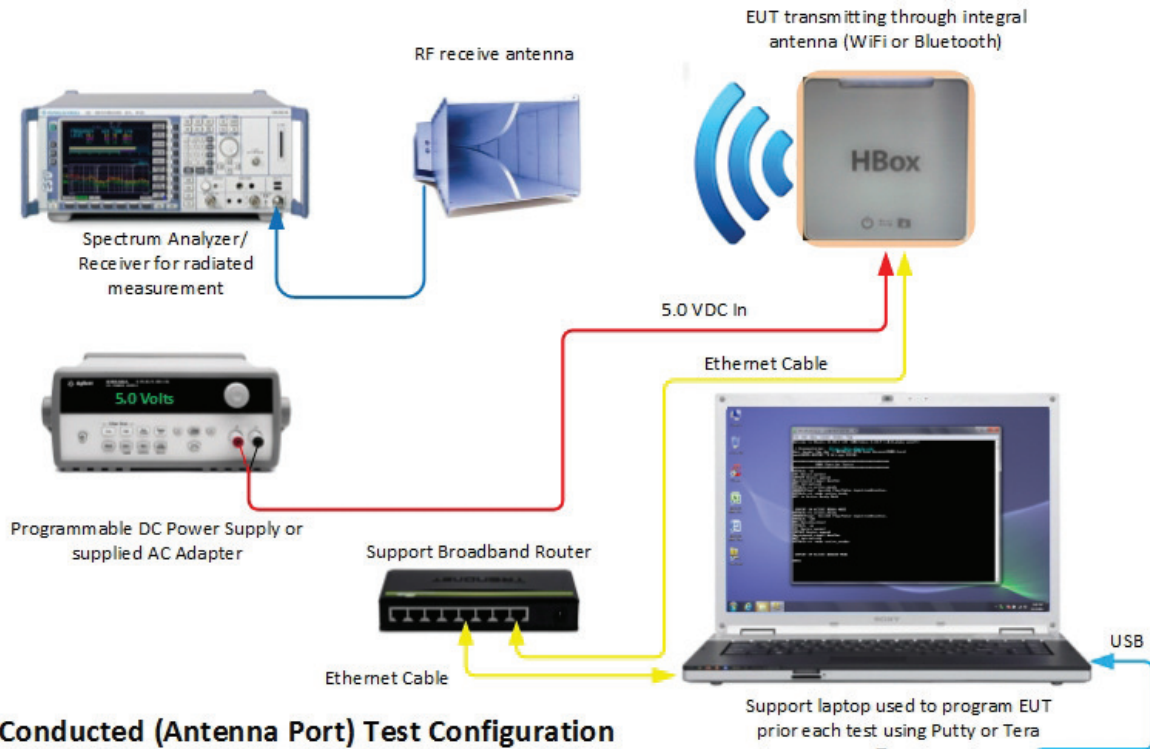
Mode	Channel	Data Rate
802.11a	157 (MidChannel)	6Mbps
802.11b	6 (Mid Channel)	5.5Mbps
802.11g	6 (Mid Channel)	6Mbps
802.11 n (ht20)	6 (Mid Channel)	6.5Mbps (mcs 0)
802.11 n (ht40)	6 (Mid Channel)	13Mbps (mcs 1)
802.11 n (ht20)	165 (High Channel)	6.5Mbps (mcs 0)
802.11 n (ht40)	157 (Mid Channel)	58.5Mbps (mcs 6)
802.11 n (ht20 MIMO)	6 (Mid Channel)	13Mbps (mcs 8)
Bluetooth LE	17 (Mid Channel)	1Mbps

EUT is a mobile device. For radiated measurements X, Y and Z orientations were verified. Worst case position is "X".

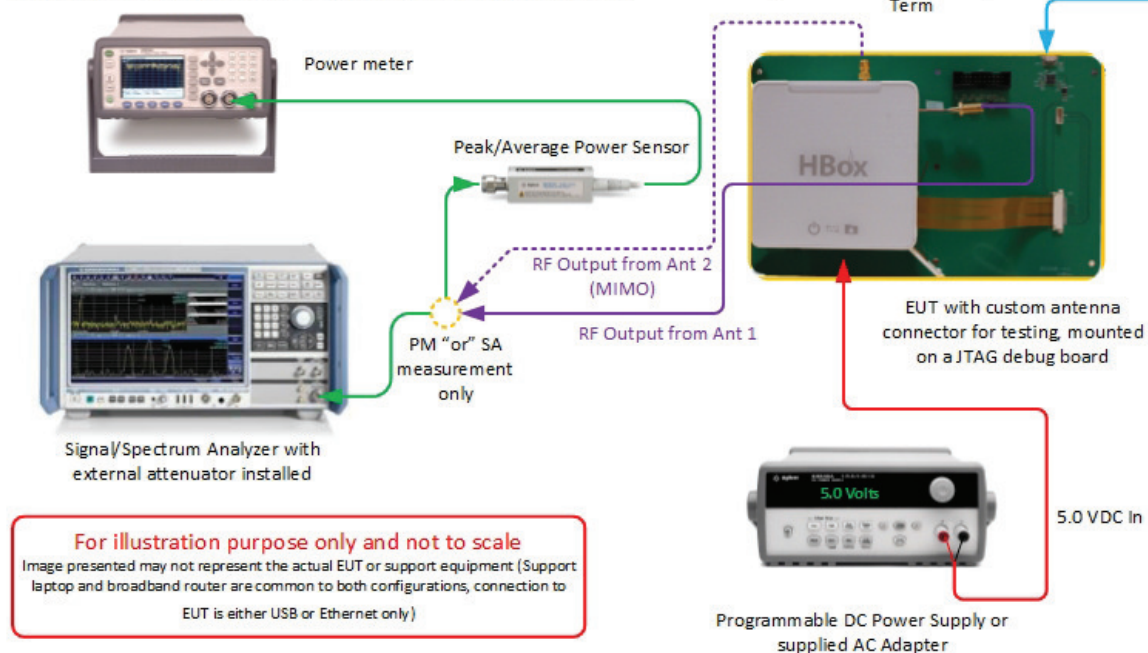


1.4.5 Simplified Test Configuration Diagram

Radiated Test Configuration



Conducted (Antenna Port) Test Configuration





1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number N/A (Sample #1) Antenna port conducted sample/34008112 (Sample #2)/34008096 (Sample #3)		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2009, 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.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY

1.8.1 FCC – Registration No.: US5296

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.498 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US5296.

1.8.2 Industry Canada (IC) Registration No.: 3067A

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.



SECTION 2

TEST DETAILS

Radio Testing of the
NantWorks
Access Point for Medical Devices



2.1 PEAK OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3)

2.1.2 Standard Applicable

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

2.1.3 Equipment Under Test and Modification State

Serial No: N/A (Sample #1) / Test Configuration A

2.1.4 Date of Test/Initial of test personnel who performed the test

November 26, 2013/FSC

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions

Ambient Temperature	24.1°C
Relative Humidity	34.6%
ATM Pressure	99.3 kPa

2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- An offset of 21.25dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- Test methodology is per Clause 9.2.3.1 of KDB 558074 D01 (DTS Meas Guidance v03r01, April 09, 2013). All conditions under this Clause are satisfied.
- Both Peak and Average measurements were recorded.

2.1.8 Test Results

WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11a (5745MHz to 5825MHz)	149 (5745 MHz)	6	8.97	15.20
		9	8.42	15.17
		12	8.06	14.98
		18	8.22	15.23
		24	7.16	15.25
		36	7.97	16.43
		48	7.03	16.47
		54	6.93	16.54
	157 (5785 MHz)	6	10.18	16.47
		9	10.00	15.40
		12	9.67	15.61
		18	8.78	15.51
		24	8.09	15.51
		36	8.31	15.98
		48	8.22	16.92
		54	9.08	16.87
	165 (5825 MHz)	6	9.37	15.01
		9	9.31	15.04
		12	9.27	15.17
		18	7.85	14.87
		24	7.10	15.09
		36	7.80	16.69
		48	7.28	16.64
		54	6.94	16.52



WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11b	1 (2412 MHz)	1	12.11	14.24
		2	12.09	14.22
		5.5	12.15	14.36
		11	12.00	14.33
	6 (2437 MHz)	1	14.47	18.89
		2	13.83	18.89
		5.5	14.85	18.84
		11	13.84	18.36
	11 (2462 MHz)	1	13.26	14.64
		2	12.48	14.65
		5.5	12.40	14.73
		11	12.41	14.75
802.11g	1 (2412 MHz)	6	12.14	19.08
		9	11.54	19.07
		12	11.83	19.06
		18	10.98	19.09
		24	10.60	19.20
		36	10.15	19.19
		48	9.58	19.20
		54	9.18	19.15
	6 (2437 MHz)	6	13.09	19.67
		9	12.81	19.84
		12	12.82	19.93
		18	12.29	19.76
		24	12.35	19.94
		36	12.09	19.87
		48	11.66	19.72

WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11g	6 (2437 MHz)	54	11.06	19.80
	11 (2462 MHz)	6	12.15	19.47
		9	12.23	19.51
		12	11.73	19.55
		18	11.76	19.58
		24	10.79	19.42
		36	10.79	19.48
		48	10.08	19.55
		54	10.91	19.61
802.11n (ht20)	1 (2412 MHz)	mcs 0 (6.50 Mbps)	11.99	19.10
		mcs 1(13.0 Mbps)	11.66	19.10
		mcs 2(19.5 Mbps)	11.22	19.00
		mcs 3 (26.0 Mbps)	11.53	19.22
		mcs 4 (39.0 Mbps)	10.56	19.08
		mcs 5 (52.0 Mbps)	9.35	19.26
		mcs 6 (58.5 Mbps)	9.54	19.16
		mcs 7 (65.0 Mbps)	9.57	19.07
	6 (2437 MHz)	mcs 0 (6.50 Mbps)	13.13	19.58
		mcs 1(13.0 Mbps)	12.88	19.86
		mcs 2(19.5 Mbps)	12.31	19.75
		mcs 3 (26.0 Mbps)	11.68	19.84
		mcs 4 (39.0 Mbps)	12.10	19.62
		mcs 5 (52.0 Mbps)	11.40	19.73
		mcs 6 (58.5 Mbps)	10.52	19.74
		mcs 7 (65.0 Mbps)	9.54	19.63

WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11n (ht20)	11 (2462 MHz)	mcs 0 (6.50 Mbps)	12.28	19.55
		mcs 1(13.0 Mbps)	12.05	19.47
		mcs 2(19.5 Mbps)	12.06	19.60
		mcs 3 (26.0 Mbps)	11.30	19.63
		mcs 4 (39.0 Mbps)	10.93	19.56
		mcs 5 (52.0 Mbps)	10.85	19.55
		mcs 6 (58.5 Mbps)	10.13	19.58
		mcs 7 (65.0 Mbps)	8.88	19.56
802.11n (ht40)	3 (2422 MHz)	mcs 0 (6.50 Mbps)	6.20	18.47
		mcs 1(13.0 Mbps)	5.80	18.47
		mcs 2(19.5 Mbps)	5.36	17.94
		mcs 3 (26.0 Mbps)	4.77	18.09
		mcs 4 (39.0 Mbps)	3.71	18.26
		mcs 5 (52.0 Mbps)	3.57	17.71
		mcs 6 (58.5 Mbps)	7.73	19.72
		mcs 7 (65.0 Mbps)	6.92	19.80
	6 (2437 MHz)	mcs 0 (6.50 Mbps)	11.82	18.43
		mcs 1(13.0 Mbps)	12.54	18.46
		mcs 2(19.5 Mbps)	11.06	18.64
		mcs 3 (26.0 Mbps)	7.11	13.69
		mcs 4 (39.0 Mbps)	10.62	18.46
		mcs 5 (52.0 Mbps)	10.62	18.57
		mcs 6 (58.5 Mbps)	7.19	13.90
		mcs 7 (65.0 Mbps)	10.07	19.84
	9 (2452 MHz)	mcs 0 (6.50 Mbps)	7.92	19.06
		mcs 1(13.0 Mbps)	6.56	18.85



WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11n (ht40)	9 (2452 MHz)	mcs 2(19.5 Mbps)	5.67	18.57
		mcs 3 (26.0 Mbps)	5.64	19.14
		mcs 4 (39.0 Mbps)	4.32	18.70
		mcs 5 (52.0 Mbps)	4.05	19.37
		mcs 6 (58.5 Mbps)	7.62	20.14
		mcs 7 (65.0 Mbps)	7.64	20.12
802.11n (ht20 5745MHz to 5825MHz)	149 (5745 MHz)	mcs 0 (6.50 Mbps)	7.65	14.85
		mcs 1(13.0 Mbps)	8.66	15.23
		mcs 2(19.5 Mbps)	8.39	15.01
		mcs 3 (26.0 Mbps)	8.92	15.54
		mcs 4 (39.0 Mbps)	8.24	14.82
		mcs 5 (52.0 Mbps)	5.52	15.28
		mcs 6 (58.5 Mbps)	7.20	16.38
		mcs 7 (65.0 Mbps)	7.15	16.28
	157 (5785 MHz)	mcs 0 (6.50 Mbps)	9.88	15.42
		mcs 1(13.0 Mbps)	9.71	15.65
		mcs 2(19.5 Mbps)	8.99	15.46
		mcs 3 (26.0 Mbps)	8.87	15.52
		mcs 4 (39.0 Mbps)	7.98	15.44
		mcs 5 (52.0 Mbps)	9.10	16.90
		mcs 6 (58.5 Mbps)	8.38	16.87
		mcs 7 (65.0 Mbps)	8.30	17.02
	165 (5825 MHz)	mcs 0 (6.50 Mbps)	10.05	15.19
		mcs 1(13.0 Mbps)	9.31	15.11
		mcs 2(19.5 Mbps)	8.31	14.75
		mcs 3 (26.0 Mbps)	7.62	14.65

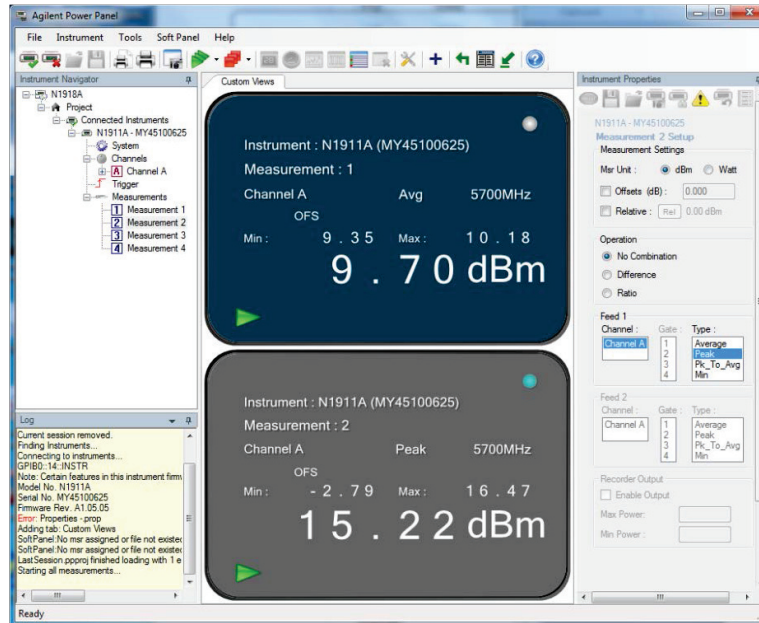


WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11n (ht20 5745MHz to 5825MHz)	165 (5825 MHz)	mcs 4 (39.0 Mbps)	7.75	16.50
		mcs 5 (52.0 Mbps)	7.17	16.64
		mcs 6 (58.5 Mbps)	6.85	16.46
		mcs 7 (65.0 Mbps)	7.35	16.47
802.11n (ht40 5745MHz to 5825MHz)	149 (5745 MHz)	mcs 0 (6.50 Mbps)	4.75	14.76
		mcs 1(13.0 Mbps)	4.08	14.70
		mcs 2(19.5 Mbps)	3.43	14.75
		mcs 3 (26.0 Mbps)	2.92	14.61
		mcs 4 (39.0 Mbps)	2.15	14.57
		mcs 5 (52.0 Mbps)	1.96	14.32
		mcs 6 (58.5 Mbps)	4.61	15.39
		mcs 7 (65.0 Mbps)	4.09	15.77
	157 (5785 MHz)	mcs 0 (6.50 Mbps)	3.94	13.95
		mcs 1(13.0 Mbps)	2.54	14.84
		mcs 2(19.5 Mbps)	5.75	15.70
		mcs 3 (26.0 Mbps)	4.09	14.37
		mcs 4 (39.0 Mbps)	1.67	15.10
		mcs 5 (52.0 Mbps)	2.51	15.48
		mcs 6 (58.5 Mbps)	6.53	16.14
		mcs 7 (65.0 Mbps)	4.99	16.19
	165 (5825 MHz)	mcs 0 (6.50 Mbps)	4.69	14.16
		mcs 1(13.0 Mbps)	3.99	14.91
		mcs 2(19.5 Mbps)	2.67	14.52
		mcs 3 (26.0 Mbps)	4.16	14.50
		mcs 4 (39.0 Mbps)	3.51	13.27
		mcs 5 (52.0 Mbps)	3.76	14.57

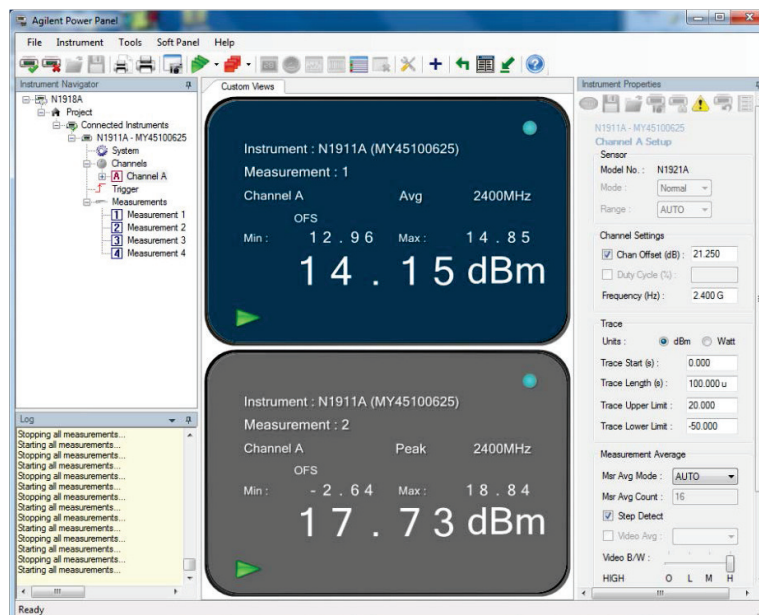
WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11n (ht40 5745MHz to 5825MHz)	165 (5825 MHz)	mcs 6 (58.5 Mbps)	3.98	15.04
		mcs 7 (65.0 Mbps)	6.34	16.65
802.11n (ht20 MIMO on antenna #1)	6 (2437 MHz)	mcs 8 (13.00 Mbps)	12.10	19.48
		mcs 9 (26.00 Mbps)	11.82	19.62
		mcs 10 (39.00 Mbps)	11.77	19.59
		mcs 11 (52.00 Mbps)	10.52	19.69
		mcs 12 (78.0 Mbps)	10.99	19.82
		mcs 13 (104.0 Mbps)	10.50	19.86
		mcs 14 (117.0 Mbps)	7.37	19.43
		mcs 15 (130.0 Mbps)	5.45	19.27
802.11n (ht20 MIMO on antenna #2)	6 (2437 MHz)	mcs 8 (13.00 Mbps)	13.14	20.62
		mcs 9 (26.00 Mbps)	12.61	20.67
		mcs 10 (39.00 Mbps)	12.66	20.44
		mcs 11 (52.00 Mbps)	12.45	20.49
		mcs 12 (78.0 Mbps)	8.13	18.13
		mcs 13 (104.0 Mbps)	10.77	21.09
		mcs 14 (117.0 Mbps)	8.84	20.61
		mcs 15 (130.0 Mbps)	6.93	20.67

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Average Power (dBm)	Measured Peak Power (dBm)
	37 (2402 MHz)	GFSK @ 1Mbps	7.40	8.02
	17 (2440 MHz)		8.46	8.94
	39 (2480 MHz)		8.05	8.53

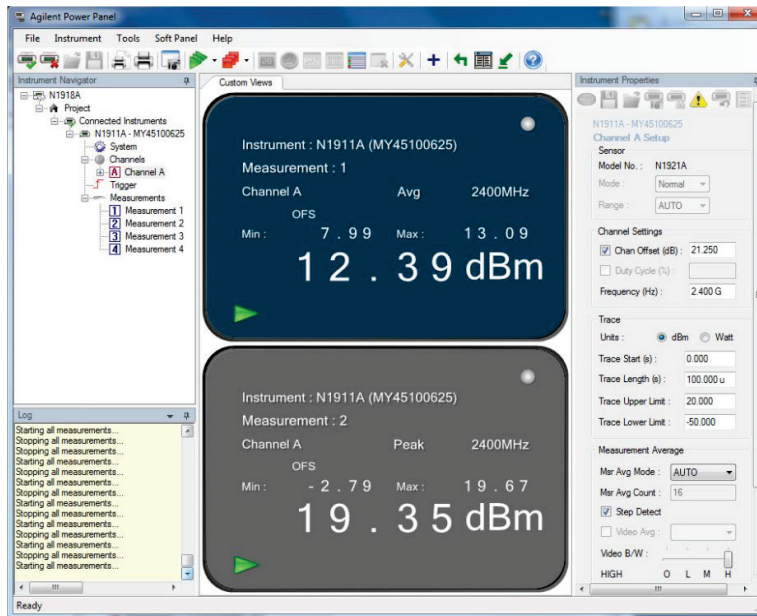
2.1.9 Sample Test Display



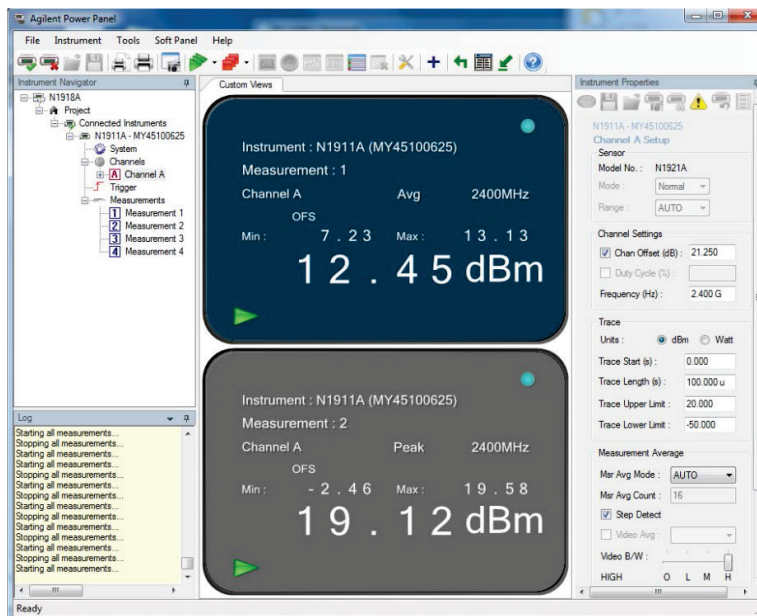
802.11 "a" mode. Mid Channel 6Mbps



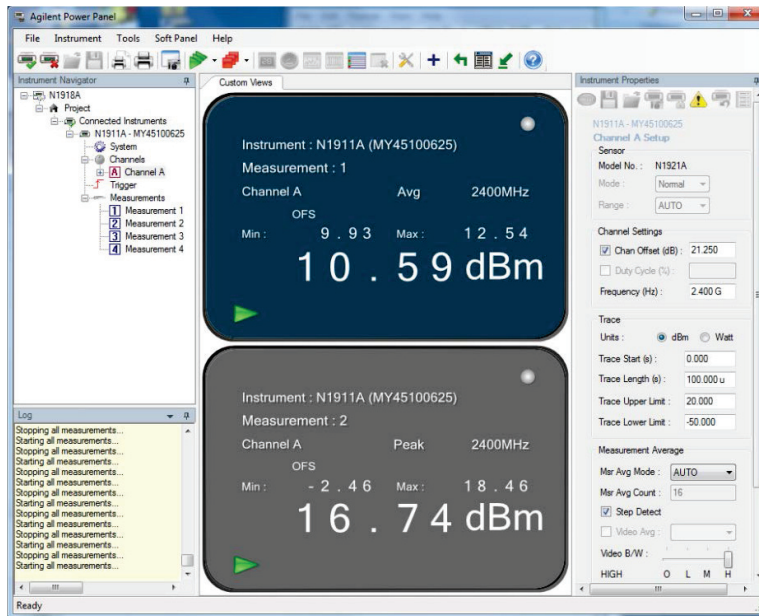
802.11 "b" mode. Mid Channel 5.5Mbps



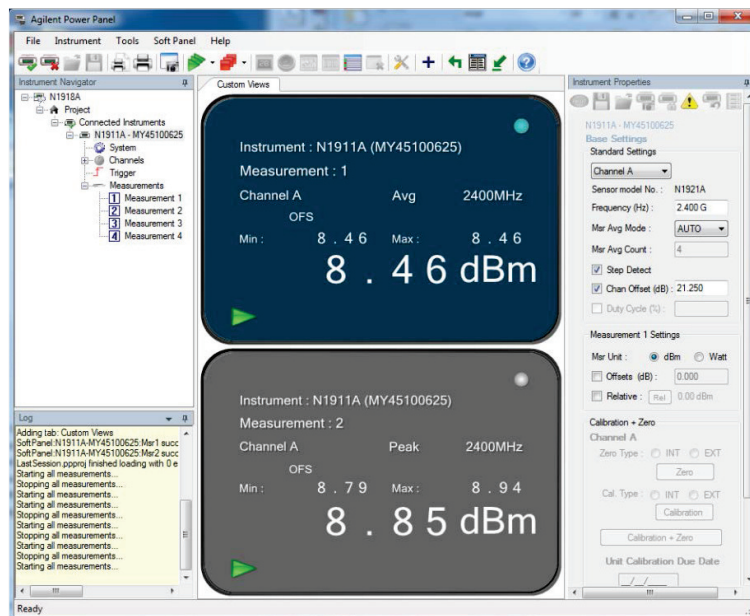
802.11 "g" mode. Mid Channel 6Mbps



802.11 "n" mode ht20. Mid Channel 6.5Mbps



802.11 "n" mode ht40. Mid Channel 13Mbps



Bluetooth LE. Mid Channel 1Mbps

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.2.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

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

*Decreases with the logarithm of the frequency.

2.2.3 Equipment Under Test and Modification State

Serial No: 34008112 / Test Configuration B

2.2.4 Date of Test/Initial of test personnel who performed the test

December 13, 2013/FSC

2.2.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.6 Environmental Conditions

Ambient Temperature 17.9°C
Relative Humidity 30.0.%
ATM Pressure 99.8 kPa

2.2.7 Additional Observations

- The EUT was verified using AC adapter supplied by the manufacturer..
- EUT verified using input voltage of 120VAC 60Hz.
- There are no significant variations in test results between each operating modes. Only the worst case observed configuration is presented (802.11n HT20 MIMO mode).
- Receive mode is also presented for comparison.



- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.8 for sample computation.

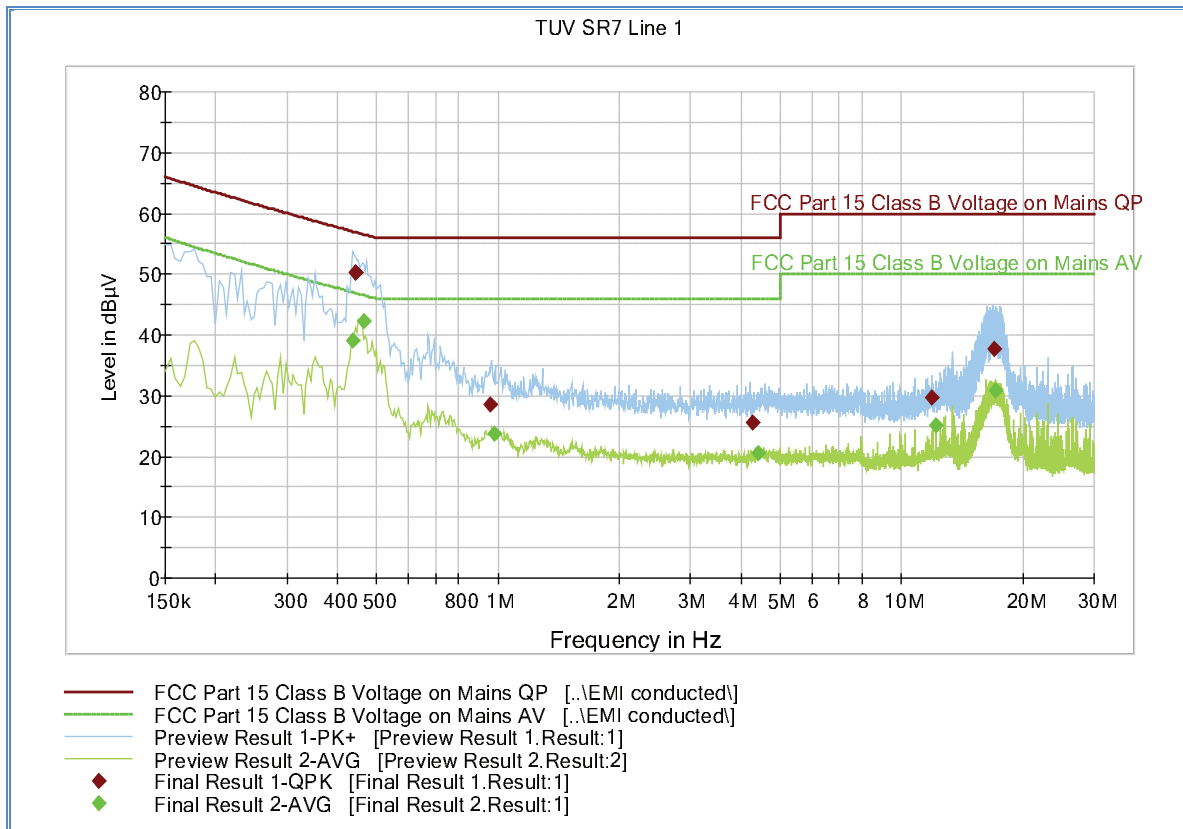
2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbμV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbμV) @ 150kHz			26.2

2.2.9 Test Results

Compliant. See attached plots and tables.

2.2.10 FCC Conducted Emissions Line 1 – Hot (Worst Case Transmit Mode)



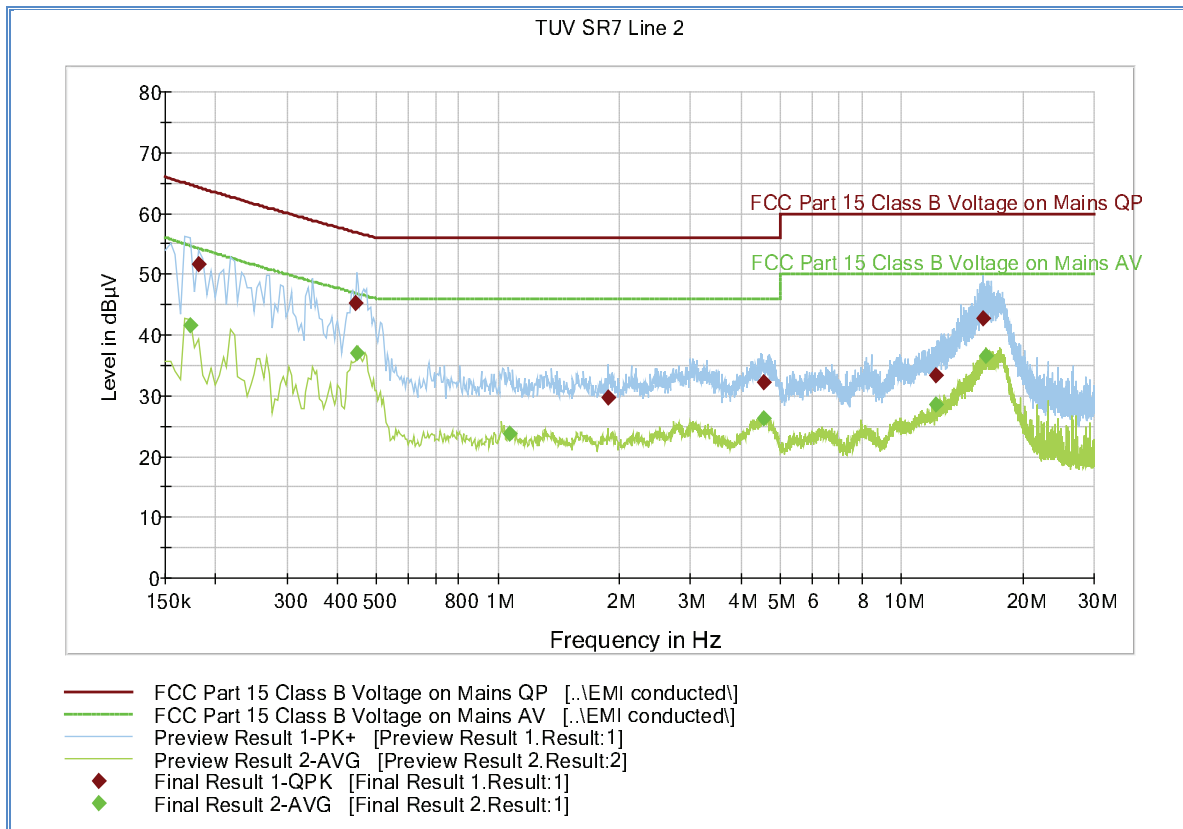
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.442500	50.3	1000.0	9.000	Off	L1	20.2	6.6	56.9
0.442500	50.3	1000.0	9.000	Off	L1	20.2	6.6	56.9
0.960000	28.6	1000.0	9.000	Off	L1	20.2	27.4	56.0
4.281000	25.6	1000.0	9.000	Off	L1	20.4	30.4	56.0
11.890500	29.8	1000.0	9.000	Off	L1	20.5	30.2	60.0
16.908000	37.7	1000.0	9.000	Off	L1	20.8	22.3	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.438000	39.1	1000.0	9.000	Off	L1	20.2	7.9	47.0
0.465000	42.4	1000.0	9.000	Off	L1	20.2	4.2	46.5
0.978000	23.7	1000.0	9.000	Off	L1	20.2	22.3	46.0
4.411500	20.6	1000.0	9.000	Off	L1	20.4	25.4	46.0
12.196500	25.2	1000.0	9.000	Off	L1	20.5	24.8	50.0
17.083500	30.8	1000.0	9.000	Off	L1	20.8	19.2	50.0

2.2.1 FCC Conducted Emissions Line 2 – Neutral (Worst Case Transmit Mode)



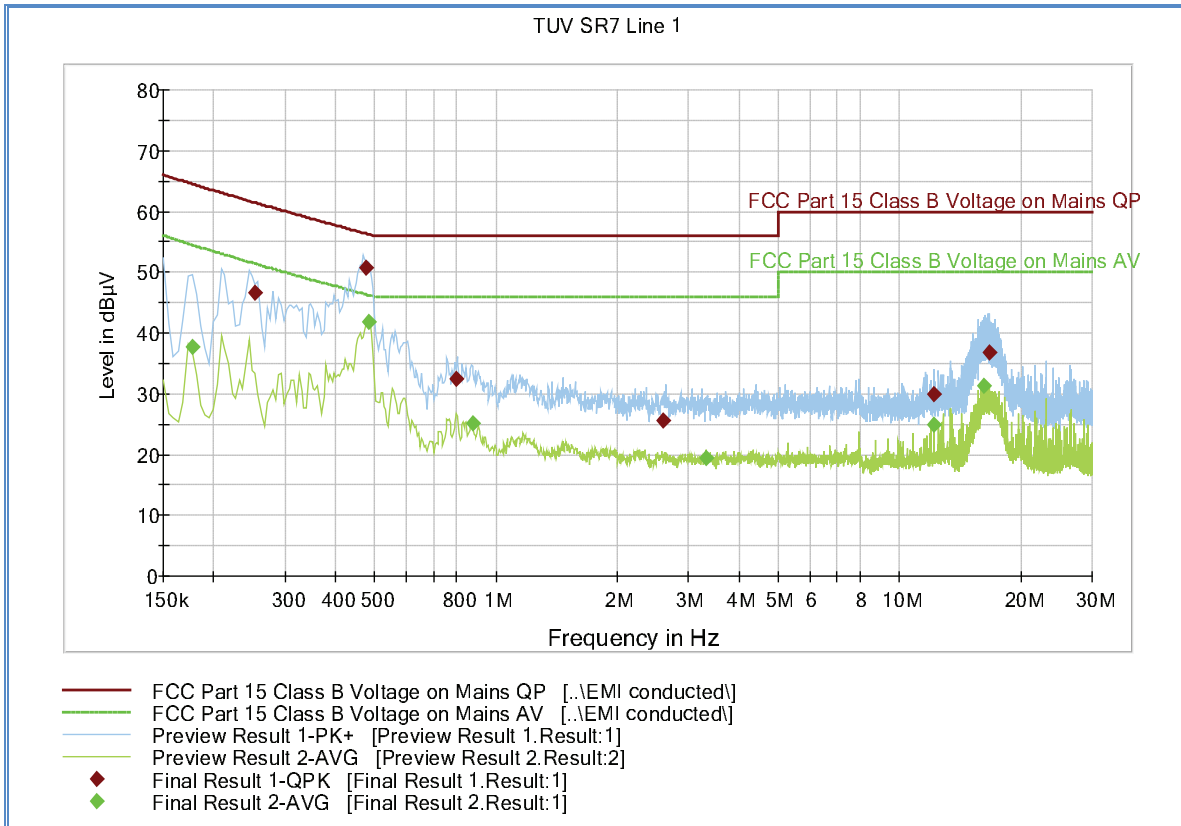
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.181500	51.6	1000.0	9.000	Off	N	21.2	12.7	64.3
0.442500	45.2	1000.0	9.000	Off	N	21.1	11.7	56.9
1.873500	29.8	1000.0	9.000	Off	N	21.1	26.2	56.0
4.542000	32.3	1000.0	9.000	Off	N	21.2	23.7	56.0
12.142500	33.3	1000.0	9.000	Off	N	21.3	26.7	60.0
15.859500	42.6	1000.0	9.000	Off	N	21.5	17.4	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.172500	41.7	1000.0	9.000	Off	N	21.2	13.0	54.7
0.447000	37.1	1000.0	9.000	Off	N	21.1	9.7	46.8
1.072500	23.8	1000.0	9.000	Off	N	21.1	22.2	46.0
4.555500	26.2	1000.0	9.000	Off	N	21.2	19.8	46.0
12.196500	28.5	1000.0	9.000	Off	N	21.3	21.5	50.0
16.228500	36.7	1000.0	9.000	Off	N	21.5	13.3	50.0

2.2.2 FCC Conducted Emissions Line 1 – Hot (Receive Mode)



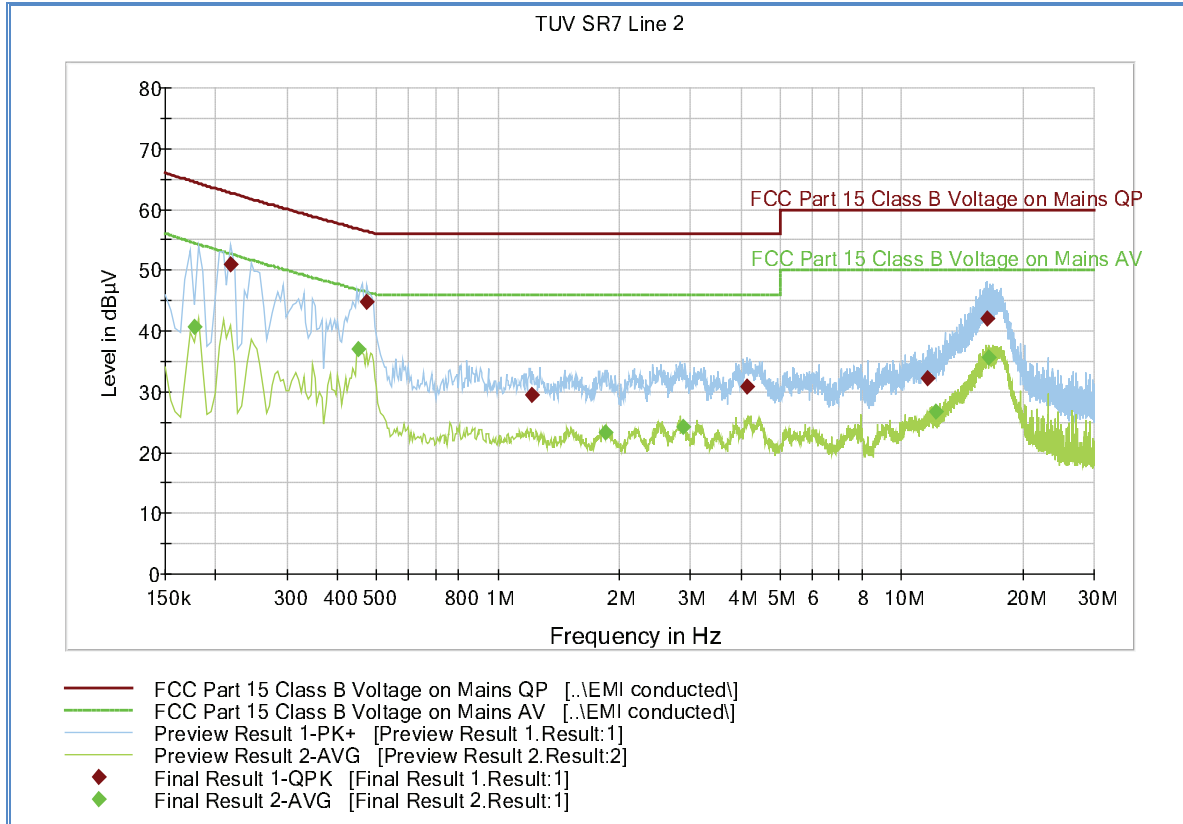
Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.253500	46.7	1000.0	9.000	Off	L1	20.3	14.7	61.4
0.478500	50.7	1000.0	9.000	Off	L1	20.2	5.6	56.3
0.798000	32.5	1000.0	9.000	Off	L1	20.2	23.5	56.0
2.598000	25.7	1000.0	9.000	Off	L1	20.3	30.3	56.0
12.138000	30.0	1000.0	9.000	Off	L1	20.5	30.0	60.0
16.746000	36.9	1000.0	9.000	Off	L1	20.8	23.1	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.177000	37.6	1000.0	9.000	Off	L1	20.4	16.9	54.5
0.483000	41.9	1000.0	9.000	Off	L1	20.2	4.4	46.3
0.874500	25.2	1000.0	9.000	Off	L1	20.2	20.8	46.0
3.318000	19.5	1000.0	9.000	Off	L1	20.3	26.5	46.0
12.196500	25.0	1000.0	9.000	Off	L1	20.5	25.0	50.0
16.228500	31.4	1000.0	9.000	Off	L1	20.8	18.6	50.0

2.2.3 FCC Conducted Emissions Line 2 – Neutral (Receive Mode)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)
0.217500	50.9	1000.0	9.000	Off	N	21.1	11.9	62.7
0.474000	44.8	1000.0	9.000	Off	N	21.1	11.6	56.4
1.216500	29.5	1000.0	9.000	Off	N	21.1	26.5	56.0
4.137000	30.8	1000.0	9.000	Off	N	21.2	25.2	56.0
11.589000	32.3	1000.0	9.000	Off	N	21.3	27.7	60.0
16.309500	42.0	1000.0	9.000	Off	N	21.6	18.0	60.0

Average

Frequency (MHz)	Average (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBμV)
0.177000	40.8	1000.0	9.000	Off	N	21.2	13.8	54.5
0.451500	37.1	1000.0	9.000	Off	N	21.1	9.7	46.8
1.851000	23.3	1000.0	9.000	Off	N	21.1	22.7	46.0
2.868000	24.3	1000.0	9.000	Off	N	21.1	21.7	46.0
12.196500	26.7	1000.0	9.000	Off	N	21.3	23.3	50.0
16.467000	35.6	1000.0	9.000	Off	N	21.6	14.4	50.0



2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 4.6.1

2.3.2 Standard Applicable

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

2.3.3 Equipment Under Test and Modification State

Serial No: N/A (Sample #1) / Test Configuration A

2.3.4 Date of Test/Initial of test personnel who performed the test

December 11, 2013/FSC

2.3.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.6 Environmental Conditions

Ambient Temperature	19.4°C
Relative Humidity	19.3%
ATM Pressure	99.6 kPa

2.3.7 Additional Observations

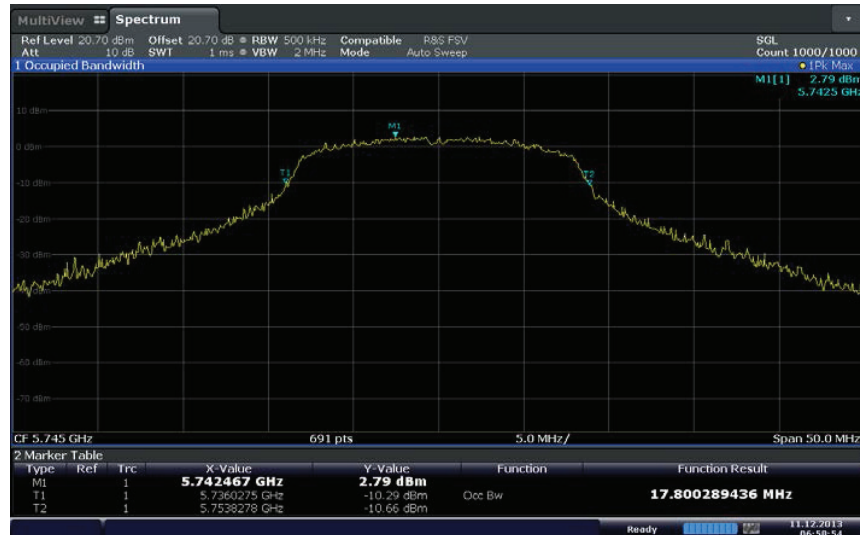
- This is a conducted test.
- An offset of 20.7dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.

- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

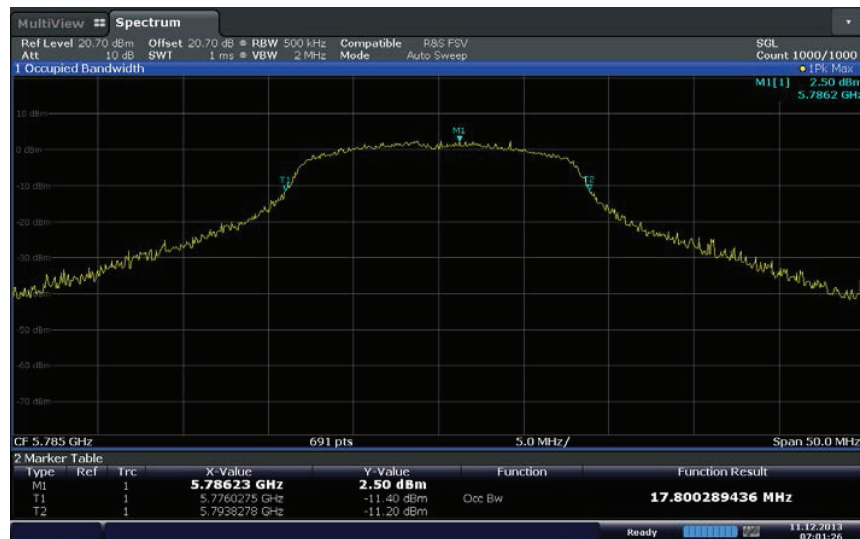
2.3.8 Test Results (For reporting purposes only)

Mode	Channel	Measured 99% Bandwidth (MHz)
802.11a	149 (5745 MHz)	17.800
	157 (5785 MHz)	18.740
	165 (5825 MHz)	17.728
802.11b	1 (2412 MHz)	14.689
	6 (2437 MHz)	14.689
	11 (2462 MHz)	14.616
802.11g	1 (2412 MHz)	18.162
	6 (2437 MHz)	18.017
	11 (2462 MHz)	17.945
802.11n HT20	1 (2412 MHz)	19.247
	6 (2437 MHz)	19.103
	11 (2462 MHz)	18.958
802.11n HT20	149 (5745 MHz)	18.886
	157 (5785 MHz)	19.030
	165 (5825 MHz)	18.958
802.11n HT40	3 (2422 MHz)	35.962
	6 (2437 MHz)	35.962
	9 (2452 MHz)	35.856
802.11n HT40	149 (5745 MHz)	36.190
	157 (5785 MHz)	36.273
	165 (5825 MHz)	36.273
Bluetooth LE	37 (2402 MHz)	1.042
	17 (2440 MHz)	1.042
	39 (2480 MHz)	1.042

2.3.9 Test Results Plots



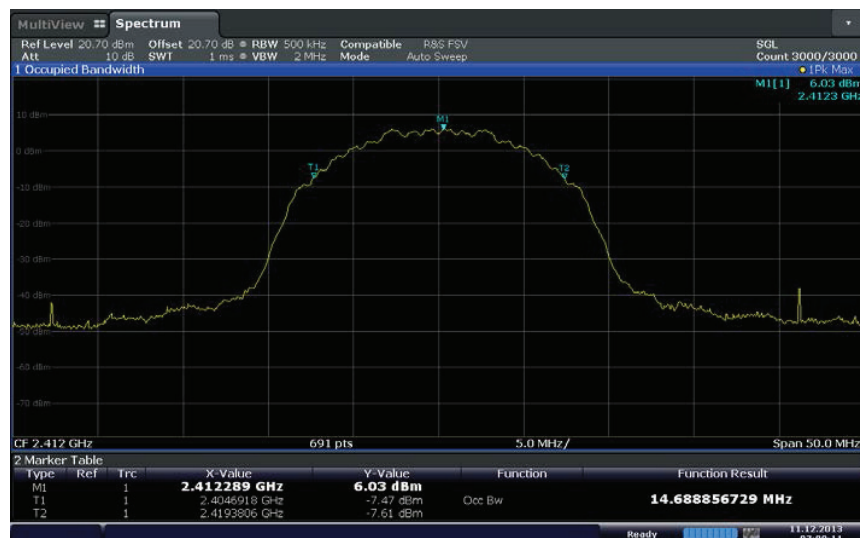
802.11a Low Channel



802.11a Mid Channel



802.11a High Channel



802.11b Low Channel