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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.
MIFI7730L Wireless Hotspot Modem

FCC Part 15 Subpart C §15.247 (DTS)
RSS-247 Issue 1 May 2015

Report No. SD72118338-0716G **September 2016**

REPORT ON	Radio Testing of the Novatel Wireless Inc. MIFI7730L Wireless Hotspot Modem
TEST REPORT NUMBER	SD72118338-0716G
PREPARED FOR	Novatel Wireless Inc. 9645 Scranton Road, Suite 205 San Diego, CA 92121 USA
CONTACT PERSON	Roman Olmos Senior Regulatory Engineer (858) 812-3400 rolmos@nvtl.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Juan Manuel Gonzalez Name Authorized Signatory Title: EMC SL Manager West Region
DATED	September 15, 2016

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Revision History

SD72118338-0716G Novatel Wireless Inc. MiFi 7730L Wireless Hotspot Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
09/15/2016	Initial Release				Juan Manuel Gonzalez

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TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
MIFI7730L Wireless Hotspot Modem

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MiFi 7730L Wireless Hotspot Modem to the requirements of FCC Part 15 Subpart C §15.247 and RSS-247 Issue 1 May 2015.

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	Novatel Wireless Inc.
Product Marketing Name	MiFi 7730L
Model Number(s)	MIFI7730L
FCC ID Number	PKRNVWMIFI7730
IC Number	3229A-MIFI7730
Serial Number(s)	SZ170616900012 and SZ160616900005
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2015). • RSS-247 Issue 1 May 2015 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices. • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014). • 558074 D01 DTS Meas Guidance v03r05, (April 08, 2016) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Start of Test	August 01, 2016
Finish of Test	August 19, 2016
Name of Engineer(s)	Ferdinand Custodio Xiaoying Zhang
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-247 5.4(4)	Peak Output Power	Compliant	
2.2	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	Compliant	
2.3		RSS-Gen 6.6	99% Emission Bandwidth	Compliant	
2.4	§15.247(a)(2)	RSS-247 5.2(1)	Minimum 6 dB RF Bandwidth	Compliant	
2.5	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
2.6	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	KDB558074 Clause 12.2.7		Spurious Radiated Emissions	Compliant	
2.8	§15.247(e)	RSS-247 5.2(2)	Power Spectral Density for Digitally Modulated Device	Compliant	

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. MIFI7730L Wireless Hotspot Modem. The EUT supports LTE, WCDMA/HSPA, GPRS, EDGE, 802.11a, 802.11b, 802.11g, 802.11n and 802.11ac. WLAN supports both SISO and MIMO mode. Bands supported for WIFI are 2.4GHz, U-NII 1 and U-NII 3.

1.3.2 EUT General Description

EUT Description	Wireless Hotspot Modem
Product Marketing Name	MiFi 7730L
Model Number(s)	MIFI7730L
Rated Voltage	5VDC via USB or internal rechargeable Li-Ion Battery 3.8V 4500mAh 17.1Wh (PN 40123117.01)
Mode Verified	802.11b, 802.11g and 802.11n in 2.4GHz band
Capability	LTE, WCDMA/HSPA, GPRS, EDGE, 802.11a, 802.11b, 802.11g, 802.11n and 802.11ac
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering
Antenna Type	RF Ceramic Chip antenna
Antenna Manufacturer	Novatel Wireless Inc.
Antenna Model Number	12023210.01

Antenna Gain

2412 MHz to 2462 MHz	0.8 dBi
5170 MHz to 5250 MHz	3.6 dBi
5735 MHz to 5835 MHz	2.1 dBi

1.3.3 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
802.11b SISO	2412-2462	17.77	59.841
802.11g MIMO	2412-2462	18.60	72.444
802.11 n MIMO	2412-2462	18.54	71.450

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Power measurements using antenna conducted port test setup. Two power meters were used simultaneously to measure power from both WLAN antenna (RF0 and RF1). SISO mode and MIMO mode verified.
B	Antenna Conducted Port Test Setup. Antenna port (RF0 or RF1) connected directly to the Spectrum Analyser with 20dB external attenuator.
C	AC Conducted Emissions Test Setup. The EUT was programmed initially to transmit worst case configuration, the USB then was replaced with the provided AC Adapter during tests.
D	Radiated Test Setup (Cabinet Spurious Emissions). Antenna port terminated with 50Ω load.

1.4.2 EUT Exercise Software

The EUT is connected to the support laptop via USB. Tera Term was used to communicate with the EUT. The manufacturer provided different macros to load that configures the RF settings of the EUT. Parameters that could be updated using the macros are 802.11 mode, channel, modulation, bandwidth, TX port and TX power.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Lenovo	Support Laptop (T410S)	P/N 0A31972 S/N R9-92MH0 10/11
Salom	USB (EUT to Support Laptop)	Type A to Type C USB Cable. Sample DCP-1P4P

1.4.4 Worst Case Configuration

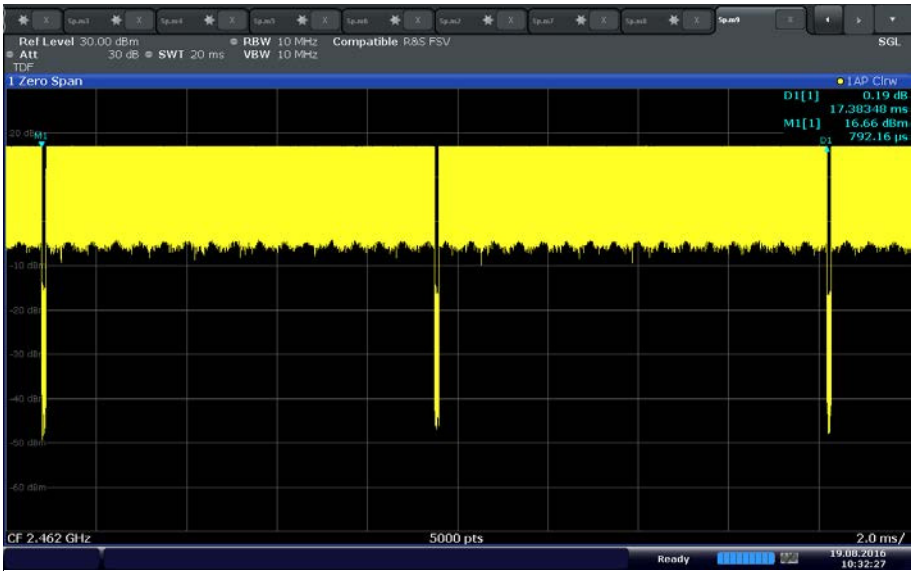
Worst-case configuration used in this test report as per maximum conducted output power measurements (averaged across all three channels and data rate available):

Mode	Channel	Data Rate
802.11b	1 (Low Channel)	1Mbps
802.11g	1 (Low Channel)	6 Mbps
802.11n 20MHz	6 (Mid Channel)	MCS 7

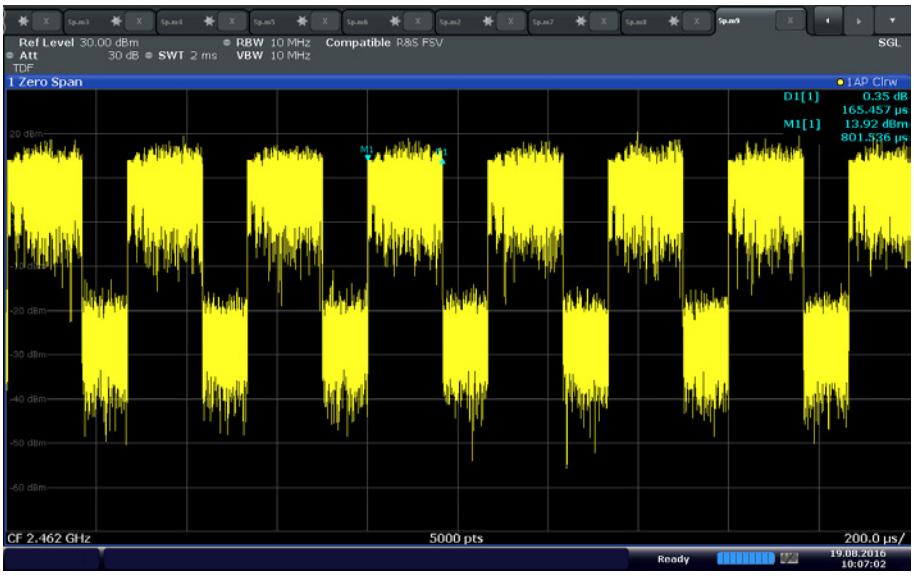
The EUT is a portable device. For radiated measurements, X, Y and Z orientations were verified during initial prescan to verify the worst axis. No major variation in emissions observed between the three (3) orientations for cabinet spurious emissions. Verifications performed using “X” configuration. The photos presented here are for reference only and not the actual EUT.

1.4.5 Duty Cycle and Transmission Duration Used (Worst Case Configuration)

Mode	*T (μs)*	Duty Cycle (x)	DCCF
802.11b	8597.7	0.9892	N/A (Duty Cycle ≥ 98%)
802.11g	1420.0	0.9342	0.30 dB
802.11n	165.46	0.6122	2.13 dB

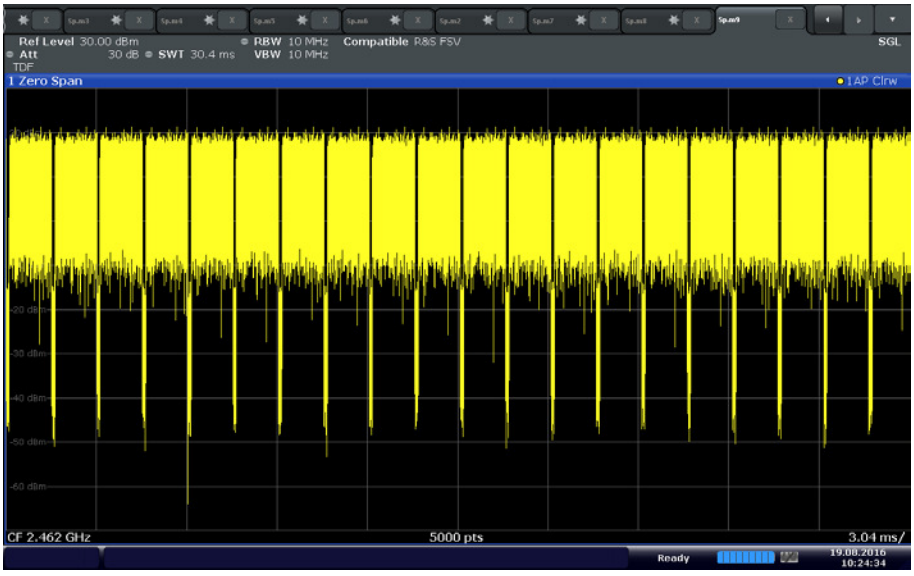


Sample Duty Cycle Calculation (802.11b) 2 Tx /17.383 ms



Date: 19.AUG.2016 10:07:02

Sample *T* Verification (802.11n)



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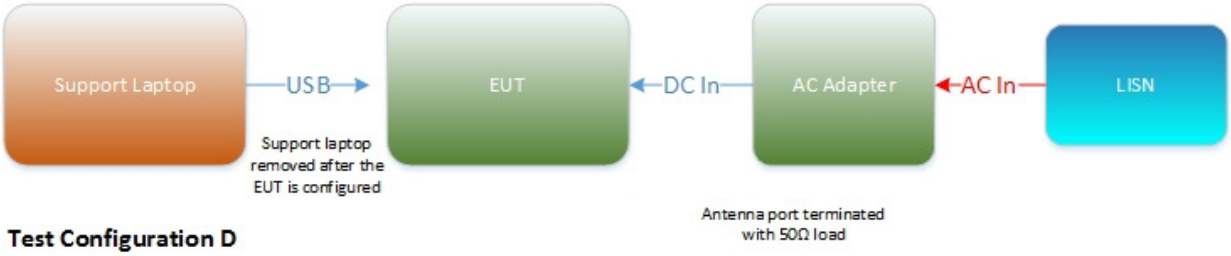
Sample Duty Cycle Calculation (802.11g) 20 Tx /30.4 ms

1.4.6 Simplified Test Configuration Diagram

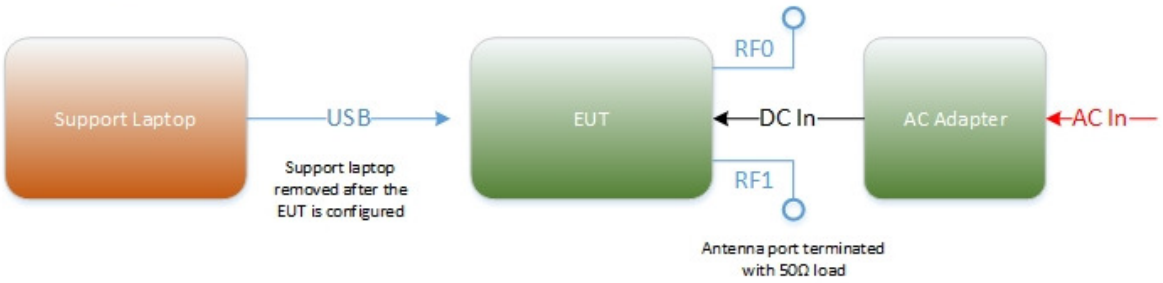
Test Configuration A

Test Configuration B

Test Configuration C



Test Configuration D



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 SZ170616900012 and SZ160616900005		
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 C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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 C63.4-2014. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

16936 Via Del Campo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

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 §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 Innovation, Science and Economic Development Canada Registration No.: 3067A

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

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 2

TEST DETAILS

Radio Testing of the
Novatel Wireless Inc.
MIFI7730L Wireless Hotspot Modem

2.1 MAXIMUM CONDUCTED OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(4)

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: SZ160616900005 / Test Configuration A

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

August 02 and 03, 2016/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

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4 °C
Relative Humidity	47.4 %
ATM Pressure	99.2 kPa

2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [average] output power) using direct connection to power meters. Both antenna ports were monitored even in SISO mode.
- An offset of 20.40dB 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 v03r05, April 08, 2016). All conditions under this Clause are satisfied.
- The EUT transmits continuously. Burst Mode of the power meter was used wherein the captured burst were analysed and presented. Captured bursts includes the average power and timing data.
- EUT complies with the 30dBm limit (worst case MIMO test mode (802.11g and 802.11n, 802.11b does not support MIMO)).

2.1.8 Test Results

WLAN Mode	Channel	Data Rates (Mbps)	Maximum Conducted Output Power (dBm)	
			Worst Case TX Chain	MIMO
802.11b	1 (2412 MHz)	1	16.77	Not Supported
		2	17.40	
		5.5	16.21	
		11	16.35	
	6 (2437 MHz)	1	17.47	
		2	17.77	
		5.5	16.76	
		11	16.88	
	11 (2462 MHz)	1	16.86	
		2	17.32	
		5.5	16.19	
		11	16.52	

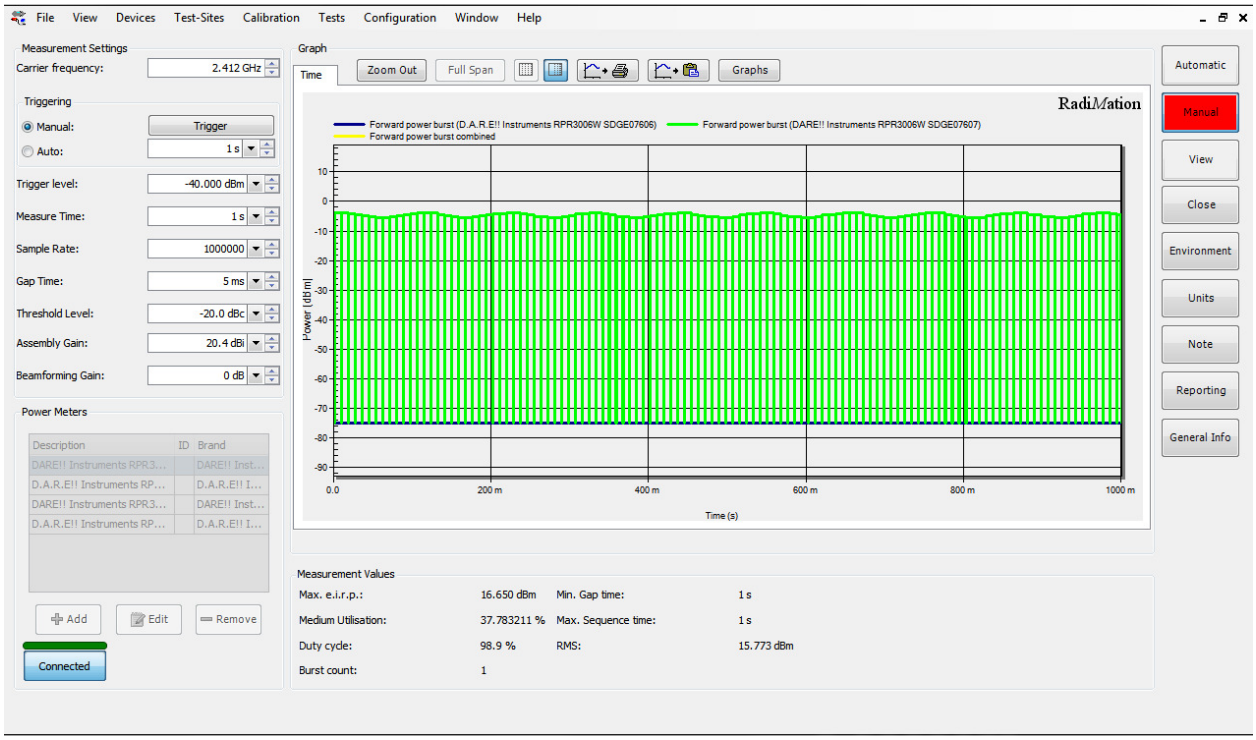
WLAN Mode	Channel	Data Rates (Mbps)	Maximum Conducted Output Power (dBm)	
			Worst Case TX Chain	MIMO
802.11g	1 (2412 MHz)	6	15.07	18.08
		9	15.16	18.17
		12	15.03	18.04
		18	14.97	17.98
		24	14.82	17.83
		36	14.84	17.85
		48	15.15	18.16
		54	15.03	18.04
	6 (2437 MHz)	6	15.51	18.52
		9	15.59	18.60
		12	15.53	18.54
		18	15.34	18.35
		24	15.39	18.40

802.11g	6 (2437 MHz)	36	15.42	18.43
		48	15.41	18.42
		54	15.24	18.25
	11 (2462 MHz)	6	15.20	18.21
		9	15.40	18.41
		12	15.32	18.33
		18	15.33	18.34
		24	15.23	18.24
		36	15.24	18.25
		48	15.30	18.31
		54	14.88	17.89

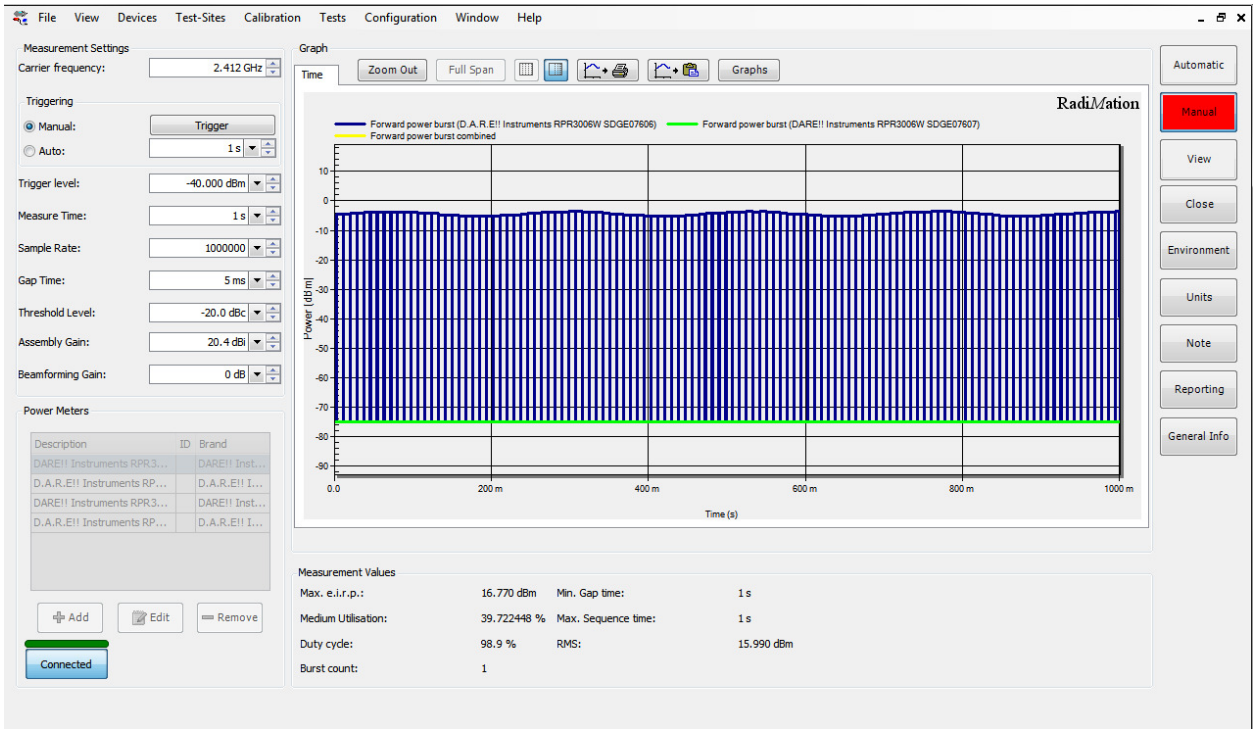
WLAN Mode	Channel	Modulation and Coding Scheme	Maximum Conducted Output Power (dBm)	
			Worst Case TX Chain	MIMO
802.11n 20MHz BW	1 (2412 MHz)	mcs 0	15.27	18.28
		mcs 1	15.36	18.37
		mcs 2	15.14	18.15
		mcs 3	15.23	18.24
		mcs 4	15.06	18.07
		mcs 5	15.12	18.13
		mcs 6	15.24	18.25
		mcs 7	15.00	18.01
	6 (2437 MHz)	mcs 0	15.41	18.42
		mcs 1	15.44	18.45
		mcs 2	15.51	18.52
		mcs 3	15.52	18.53
		mcs 4	15.53	18.54
		mcs 5	15.34	18.35
		mcs 6	15.40	18.41
		mcs 7	15.35	18.36
	11 (2462 MHz)	mcs 0	15.18	18.19
		mcs 1	15.10	18.11
		mcs 2	14.96	17.97
		mcs 3	15.00	18.01

802.11n 20MHz BW	11 (2462 MHz)	mcs 4	14.94	17.95
		mcs 5	14.90	17.91
		mcs 6	14.81	17.82
		mcs 7	14.84	17.85

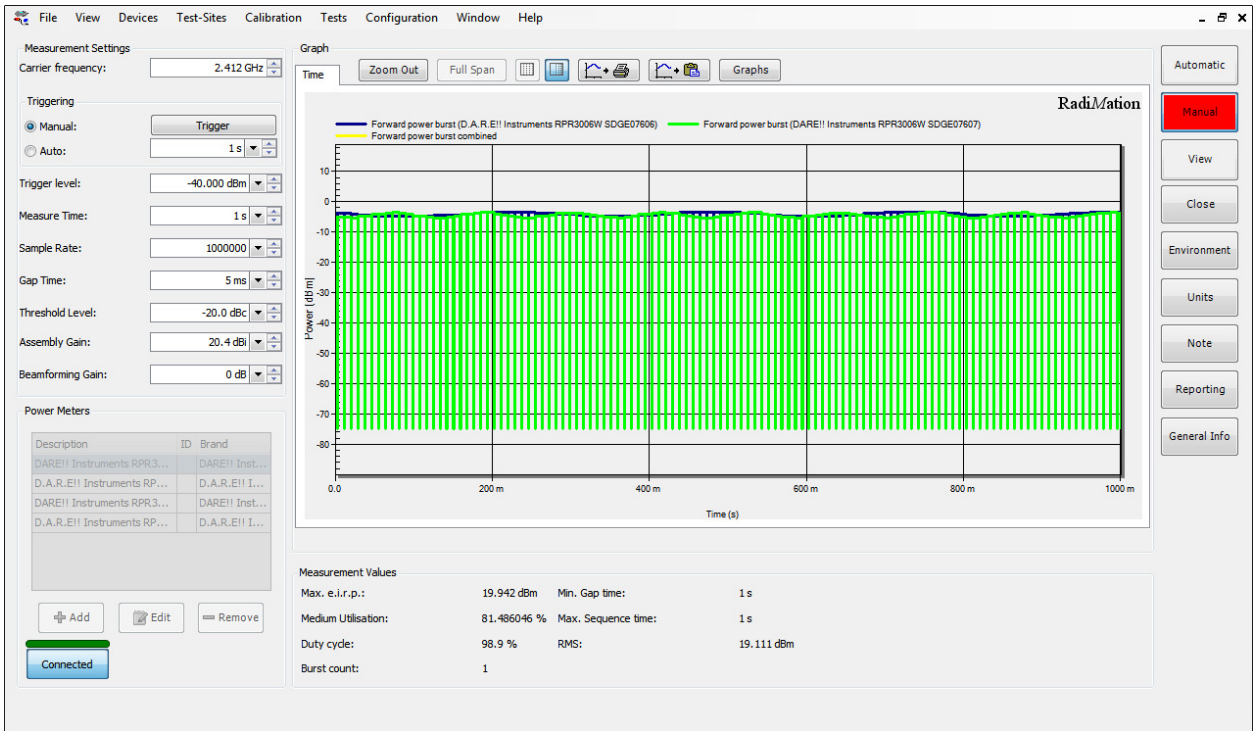
2.1.9 Sample Test Plots



Low Channel 802.11b 1Mbps SISO RF0



Low Channel 802.11b 1Mbps SISO RF1



Low Channel 802.11b 1Mbps MIMO

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a) and RSS-Gen 8.8

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 µH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBµV)	
	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: SZ170616900012/Test Configuration C

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

August 08, 2016/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	28.3 °C
Relative Humidity	48.8 %
ATM Pressure	98.5 kPa

2.2.7 Additional Observations

Measurement was done using EMC32 V8.53 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.

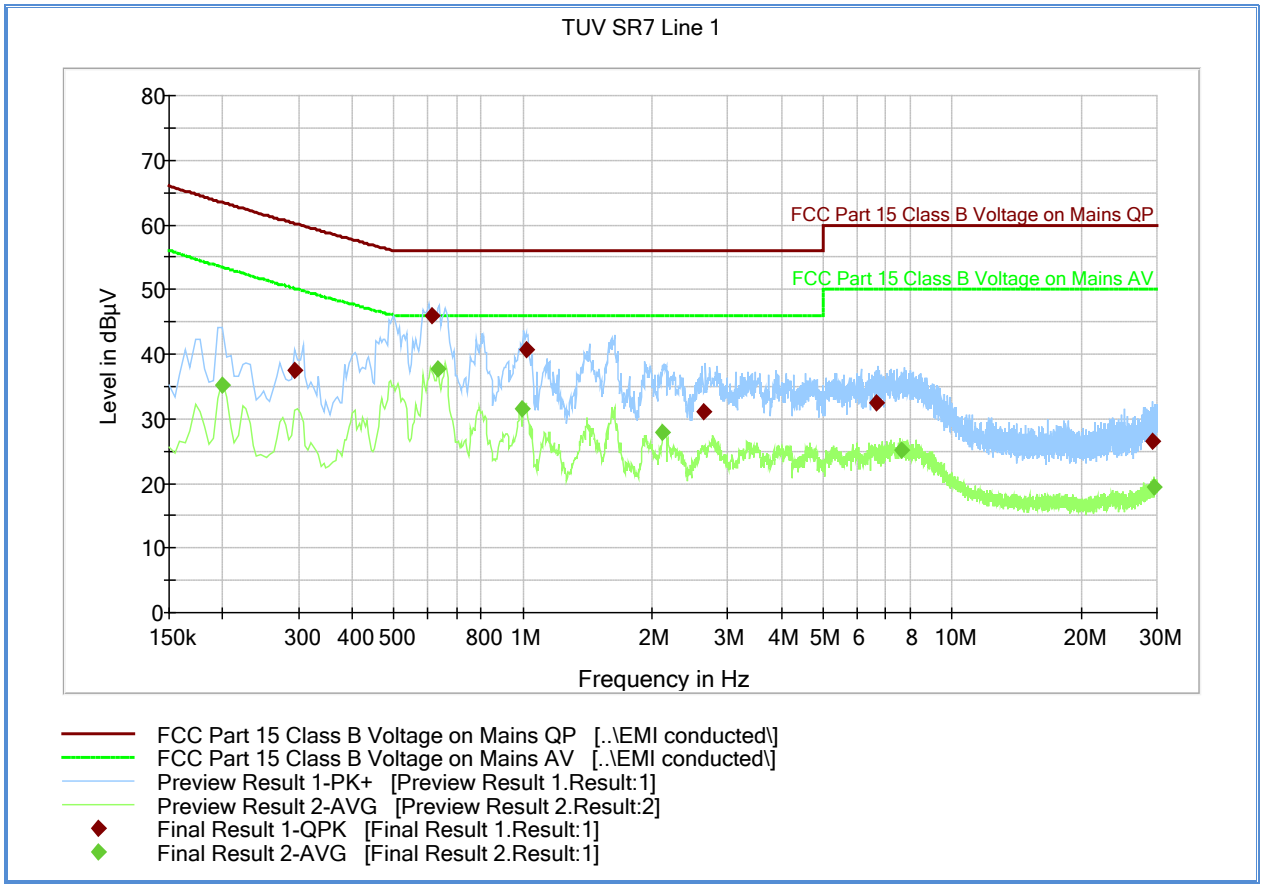
2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

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# 7568 (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 MIFI7000 120VAC 60Hz (Line 1)



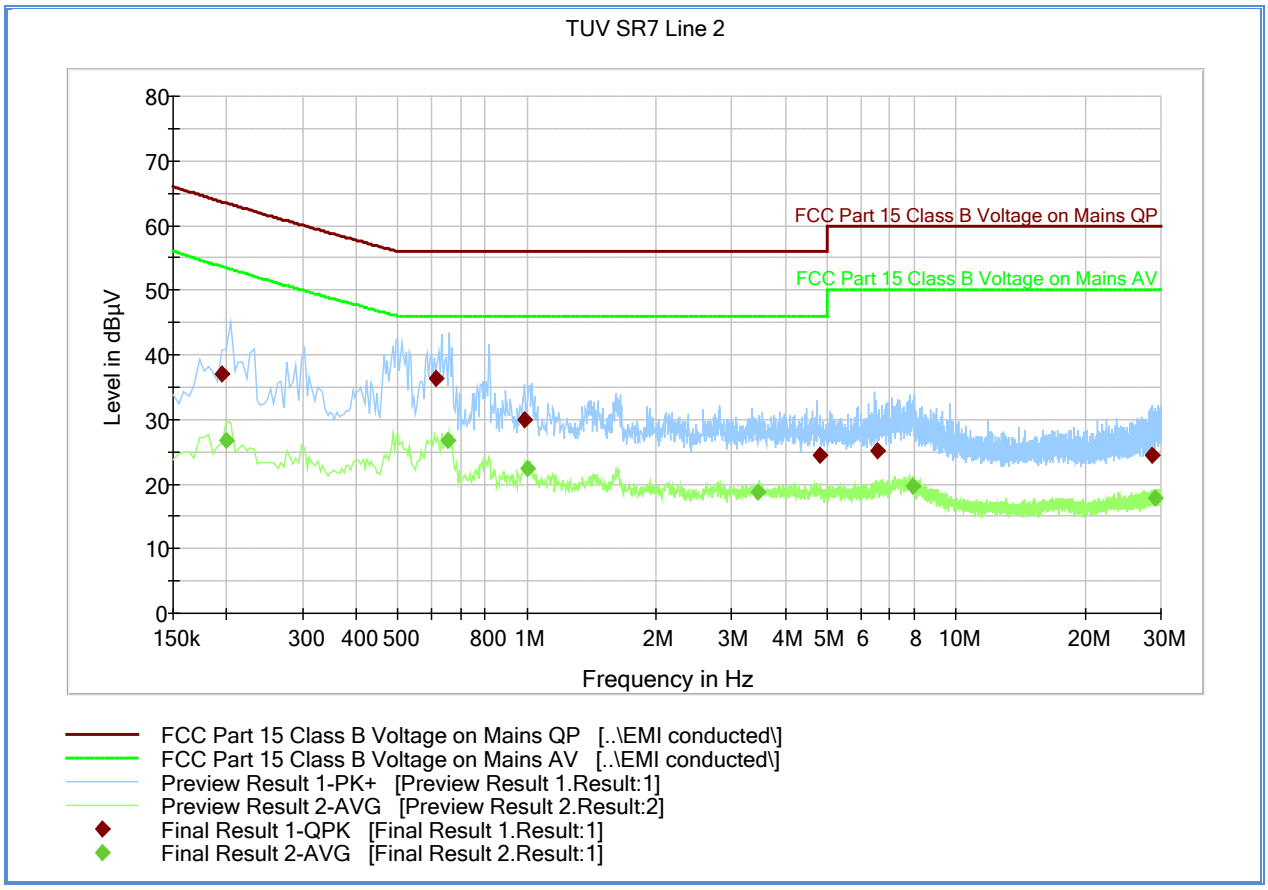
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.294000	37.5	1000.0	9.000	Off	L1	20.0	22.7	60.2
0.613500	46.0	1000.0	9.000	Off	L1	20.0	10.0	56.0
1.023000	40.8	1000.0	9.000	Off	L1	20.0	15.2	56.0
2.638500	31.0	1000.0	9.000	Off	L1	20.1	25.0	56.0
6.679500	32.4	1000.0	9.000	Off	L1	20.1	27.6	60.0
29.355000	26.5	1000.0	9.000	Off	L1	20.5	33.5	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.199500	35.1	1000.0	9.000	Off	L1	20.1	18.4	53.5
0.636000	37.6	1000.0	9.000	Off	L1	20.0	8.4	46.0
0.996000	31.5	1000.0	9.000	Off	L1	20.0	14.5	46.0
2.121000	27.9	1000.0	9.000	Off	L1	20.0	18.1	46.0
7.597500	25.1	1000.0	9.000	Off	L1	20.1	24.9	50.0
29.521500	19.3	1000.0	9.000	Off	L1	20.5	30.7	50.0

2.2.11 MIFI7000 120VAC 60Hz (Line 2)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.172500	48.7	1000.0	9.000	Off	N	20.1	16.1	64.8
0.469500	47.0	1000.0	9.000	Off	N	20.0	9.5	56.5
0.978000	35.6	1000.0	9.000	Off	N	20.0	20.4	56.0
4.677000	35.7	1000.0	9.000	Off	N	20.1	20.3	56.0
12.340500	37.7	1000.0	9.000	Off	N	20.2	22.3	60.0
14.833500	43.4	1000.0	9.000	Off	N	20.3	16.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.172500	38.5	1000.0	9.000	Off	N	20.1	16.3	54.7
0.469500	42.5	1000.0	9.000	Off	N	20.0	4.0	46.5
0.942000	29.6	1000.0	9.000	Off	N	20.0	16.4	46.0
3.565500	29.6	1000.0	9.000	Off	N	20.1	16.4	46.0
12.453000	31.7	1000.0	9.000	Off	N	20.2	18.3	50.0
14.752500	37.2	1000.0	9.000	Off	N	20.3	12.8	50.0

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.6

2.3.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.
When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 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 (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.
The trace data points are recovered and are directly summed in linear power level 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 (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.
The difference between the two recorded frequencies is the 99% occupied bandwidth.

2.3.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

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

August 08, 2016/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/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	28.3 °C
Relative Humidity	48.8 %
ATM Pressure	98.5 kPa

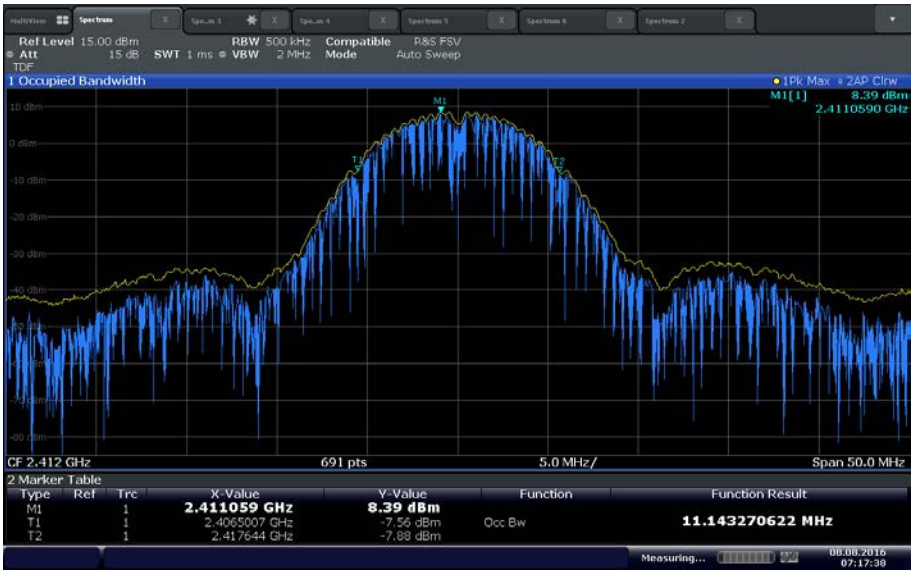
2.3.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used 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 analyser was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyser was used for this test.

2.3.8 Test Results (For reporting purposes only)

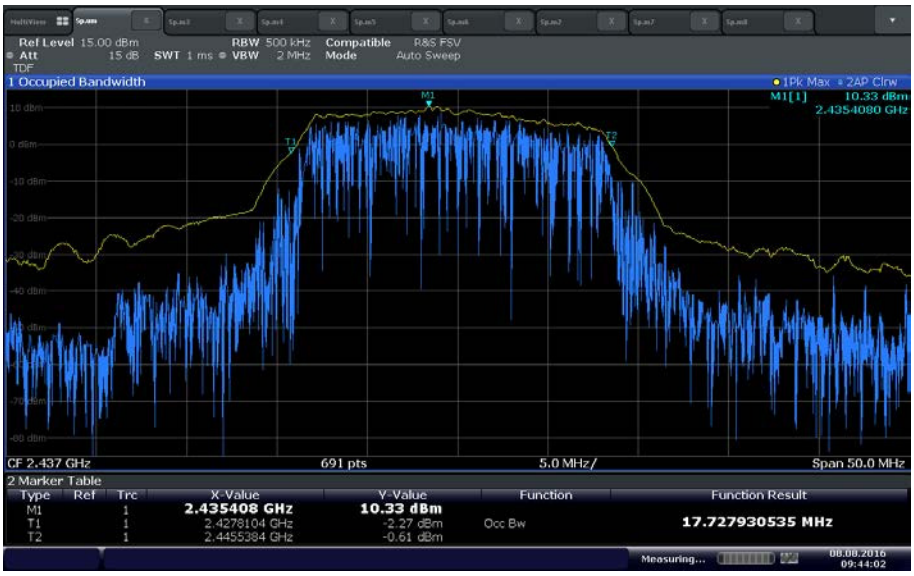
Mode	Channel	Measured 99% Bandwidth (MHz)
802.11b	1 (2412 MHz)	11.143
	6 (2437 MHz)	10.998
	11 (2462 MHz)	11.070
802.11g	1 (2412 MHz)	17.872
	6 (2437 MHz)	17.727
	11 (2462 MHz)	17.800
802.11n 20MHz BW	1 (2412 MHz)	18.596
	6 (2437 MHz)	18.451
	11 (2462 MHz)	18.451

2.3.9 Sample Test Results Plots



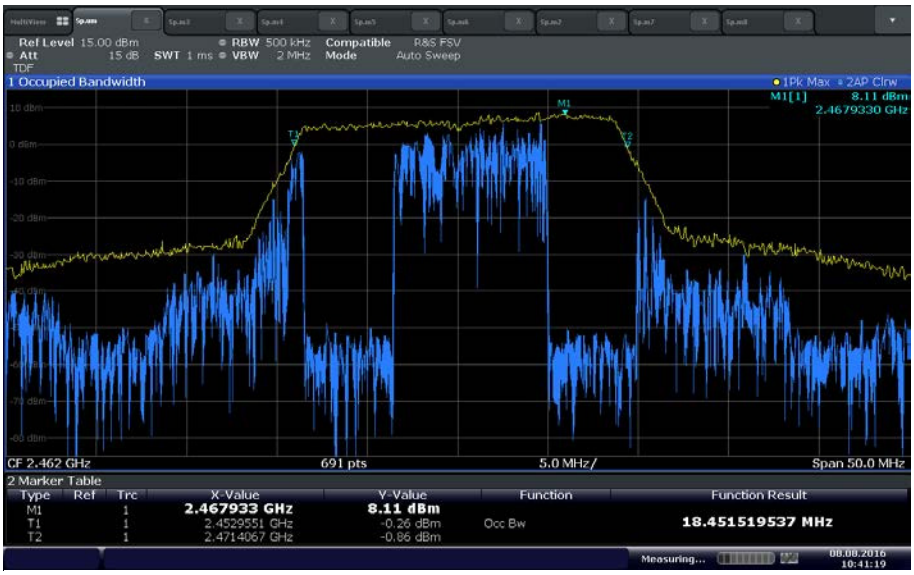
Date: 8.AUG.2016 07:17:38

802.11b Low Channel



Date: 8.AUG.2016 09:44:02

802.11g Mid Channel



Date: 8.AUG.2016 10:41:19

802.11n High Channel (20 MHz BW)

2.4 MINIMUM 6 DB RF BANDWIDTH

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(1)

2.4.2 Standard Applicable

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.4.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

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

August 08, 2016/FSC

2.4.5 Test Equipment Used

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

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	28.3 °C
Relative Humidity	48.8 %
ATM Pressure	98.5 kPa

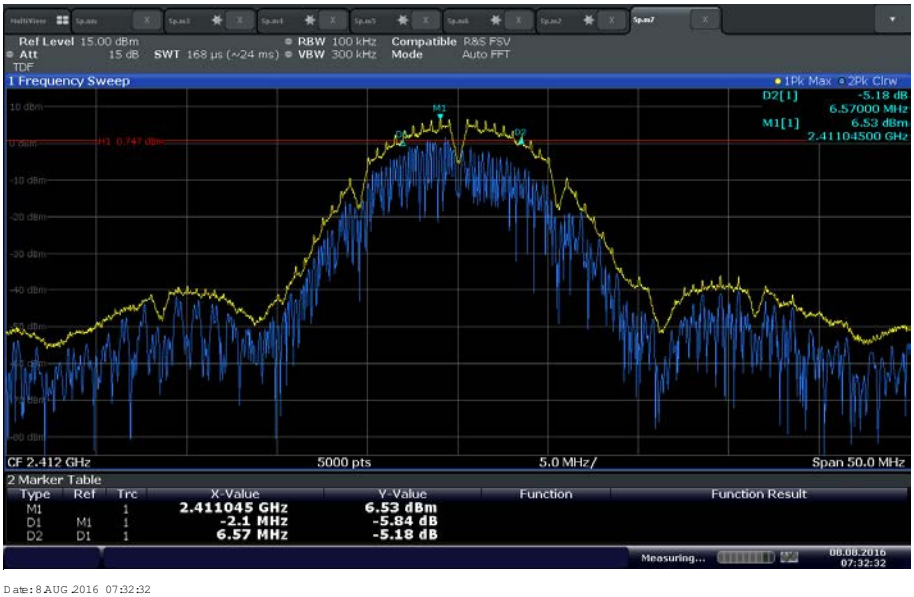
2.4.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW was set to 100 kHz while VBW is ≥3X RBW.
- Sweep is auto while Detector used is peak.
- If the "n" dB down marker function of the spectrum analyser is not appropriate for the type of signal being measured, then a horizontal line will be drawn where the signal is 6 dB down from the peak measurement. The BW will be measured using the outermost points where the signal intersects the line.

2.4.8 Test Results

Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
802.11b	1 (2412 MHz)	6.570	0.500	Complies
	6 (2437 MHz)	7.260	0.500	Complies
	11 (2462 MHz)	7.090	0.500	Complies
802.11g	1 (2412 MHz)	16.26	0.500	Complies
	6 (2437 MHz)	16.17	0.500	Complies
	11 (2462 MHz)	16.44	0.500	Complies
802.11n 20MHz BW	1 (2412 MHz)	17.81	0.500	Complies
	6 (2437 MHz)	17.65	0.500	Complies
	11 (2462 MHz)	17.74	0.500	Complies

2.4.9 Sample Test Results Plots

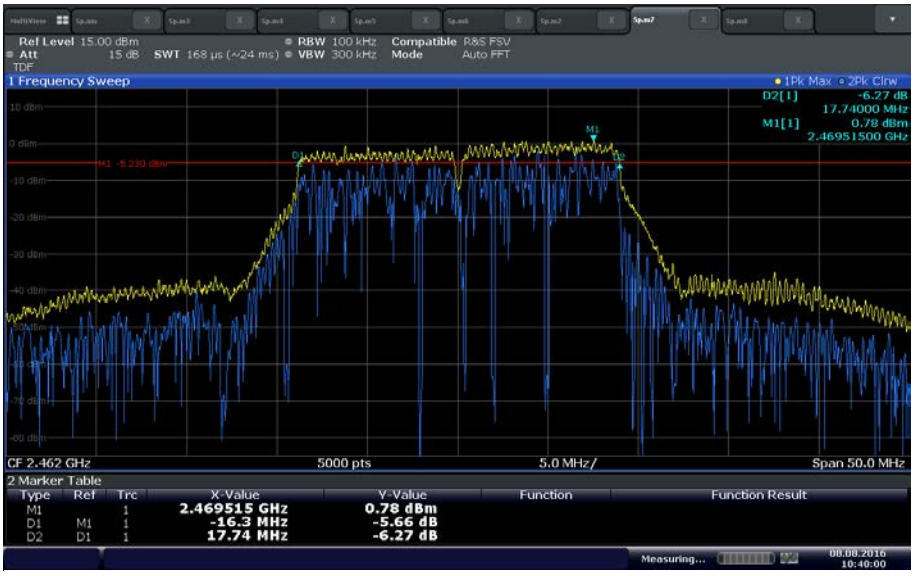


Date: 8.AUG.2016 07:32:32

802.11b Low Channel

Date: 8.AUG.2016 09:42:41

802.11g Mid Channel



Date: 8.AUG.2016 10:40:01

802.11n High Channel (20 MHz BW)

2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

2.5.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-247 5.5

2.5.2 Standard Applicable

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.5.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

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

August 08, 2016/FSC

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions/ Test Location

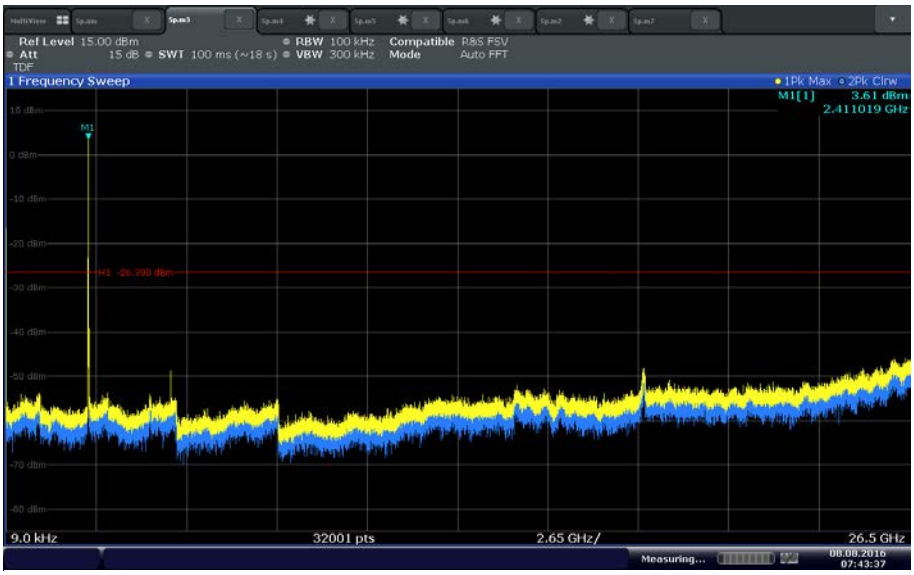
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	28.3 °C
Relative Humidity	48.8 %
ATM Pressure	98.5 kPa

2.5.7 Additional Observations

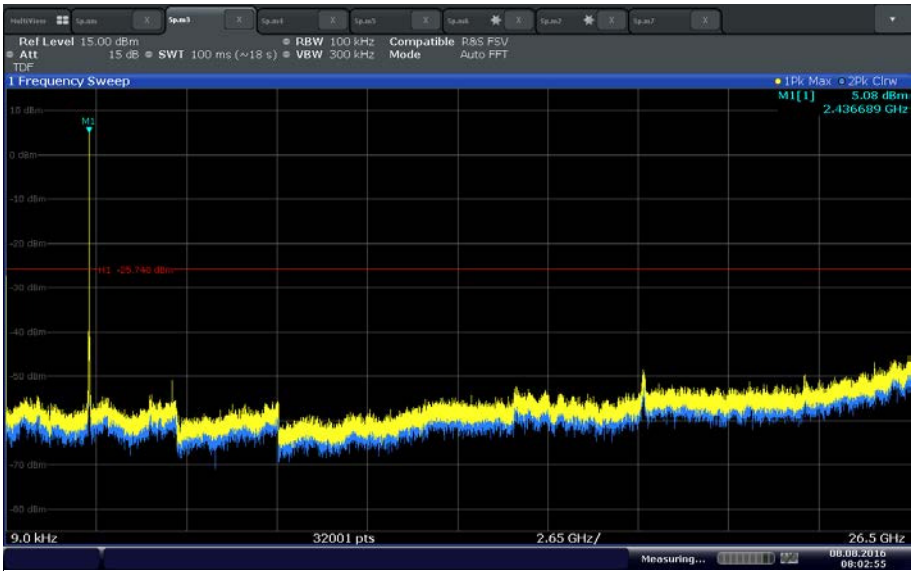
- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level (worst case).
- Spectrum was searched from 9 kHz up to 26.5GHz.
- Test performed on the worst case antenna port, there were no spurious emissions observed within 10dB of the limit so EUT complies even MIMO mode considered (limit used -3dB).

2.5.8 Test Results Plots



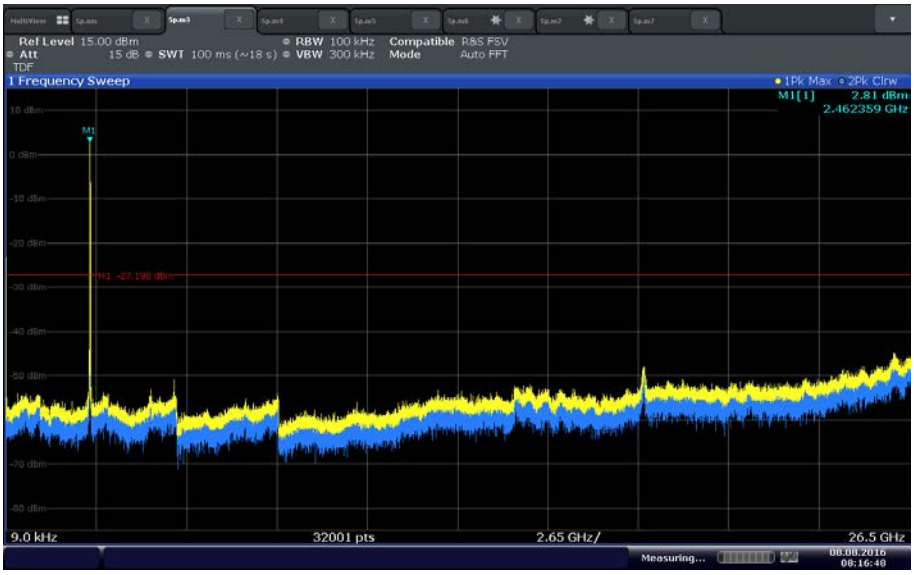
Date: 8.AUG.2016 07:43:37

802.11b Low Channel



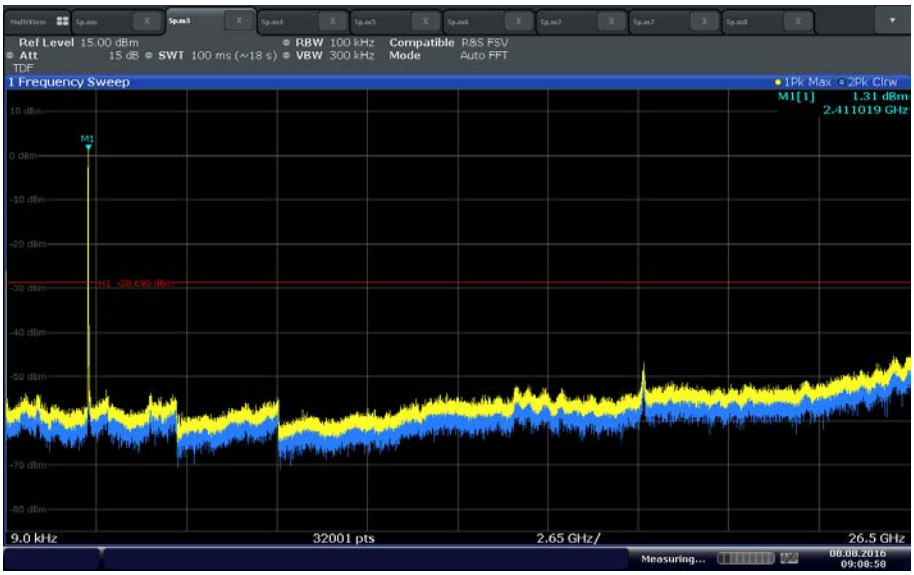
Date: 8.AUG.2016 08:02:55

802.11b Mid Channel



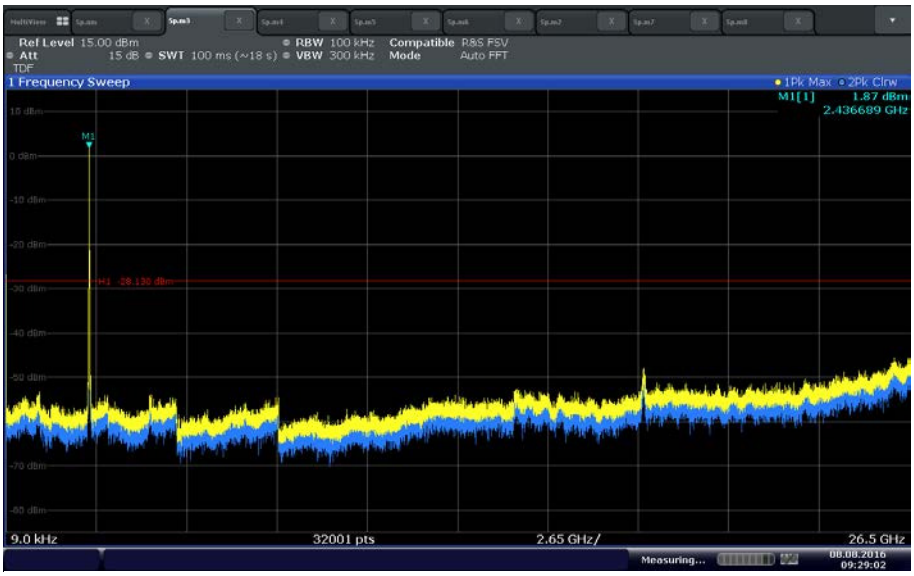
Date: 8.AUG.2016 08:16:48

802.11b High Channel



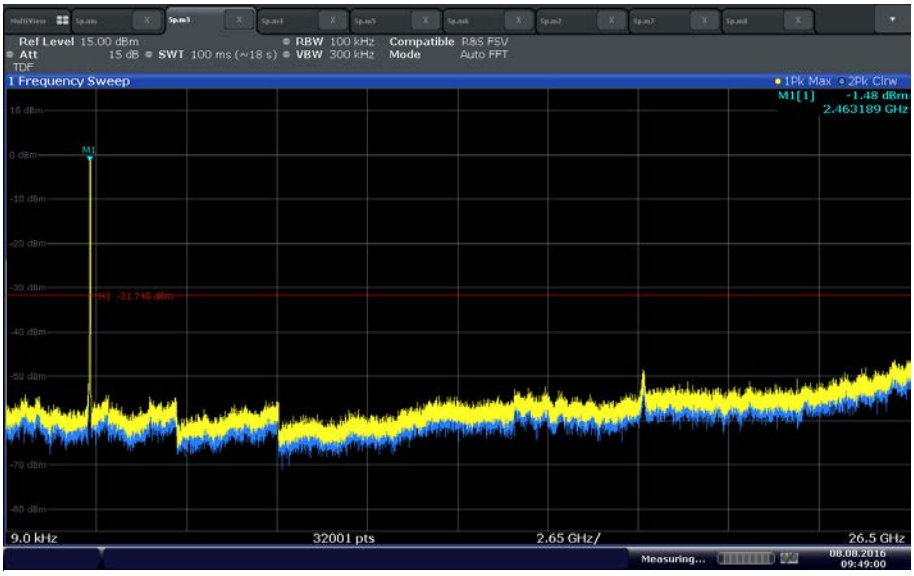
Date: 8.AUG.2016 09:08:58

802.11g Low Channel



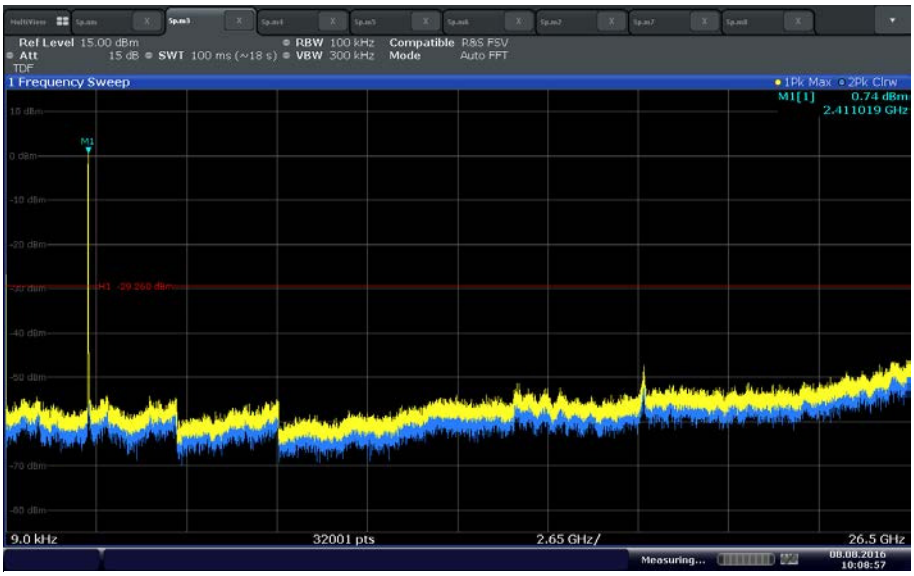
Date: 8.AUG.2016 09:29:03

802.11g Mid Channel



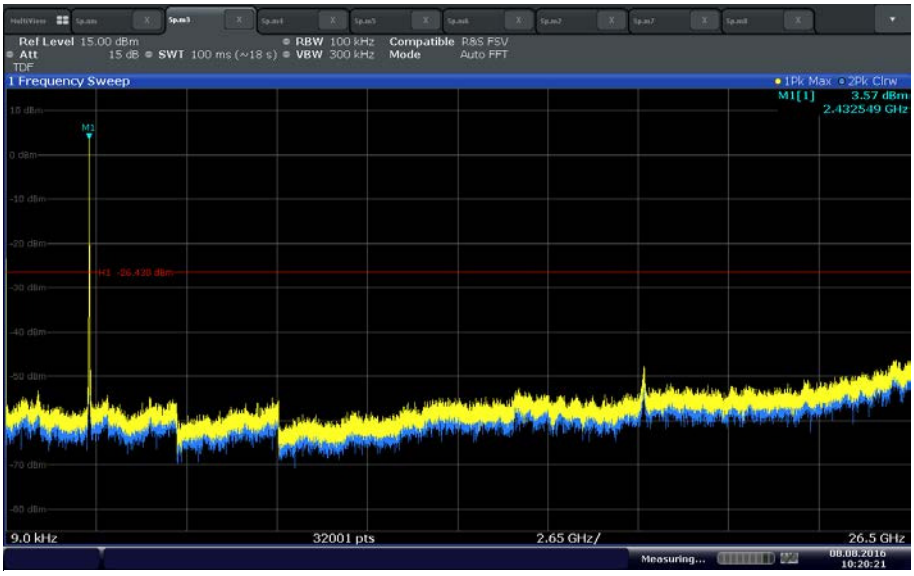
Date: 8.AUG.2016 09:49:00

802.11g High Channel



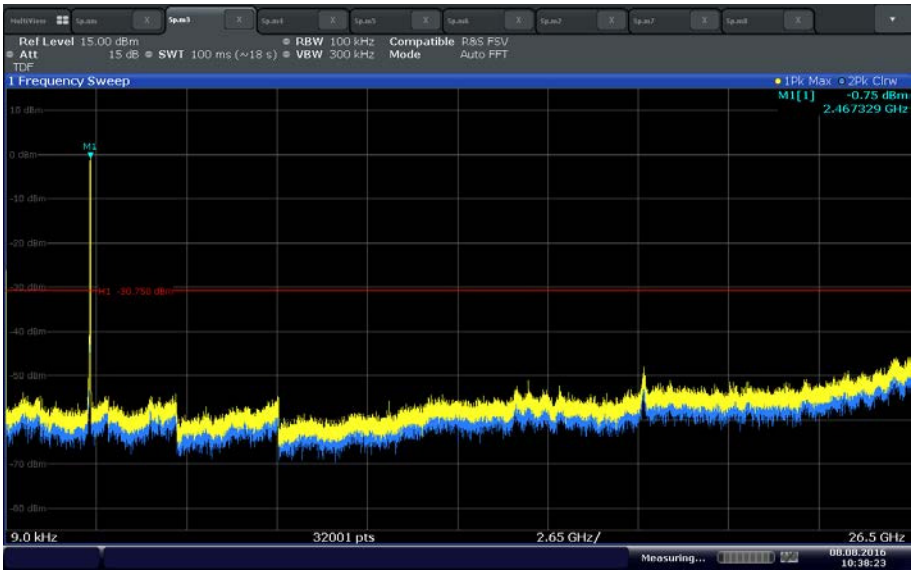
Date: 8.AUG.2016 10:08:58

802.11n Low Channel (20MHz BW)



Date: 8.AUG.2016 10:20:20

802.11n Mid Channel (20MHz BW)



Date: 8.AUG.2016 10:38:23

802.11n High Channel (20MHz BW)

2.6 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-247 5.5

2.6.2 Standard Applicable

See previous test.

2.6.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

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

August 08 and 19, 2016/FSC

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.0 - 28.3 °C
Relative Humidity	48.8 – 53.4 %
ATM Pressure	98.5 – 98.9 kPa

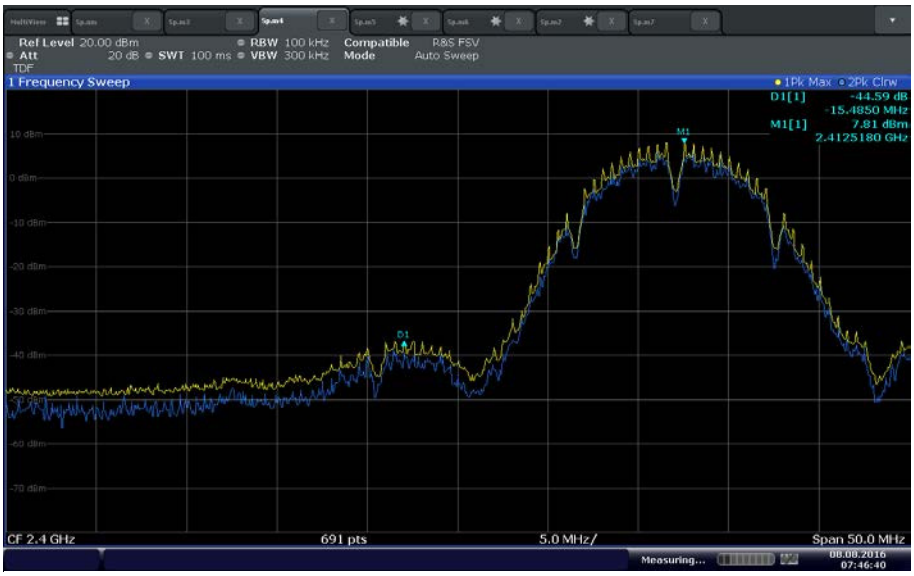
2.6.7 Additional Observations

- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- Procedure is per Clause 12.2.4, 12.2.5.1, 12.2.5.2 and 13.3.2 of KDB558074.

WLAN Mode	Peak Verification	Average Verification
802.11b	Clause 12.2.4	Clause 12.2.5.1
802.11g	Clause 12.2.4	Clause 12.2.5.2
802.11n	Clause 12.2.4	Clause 13.3.2

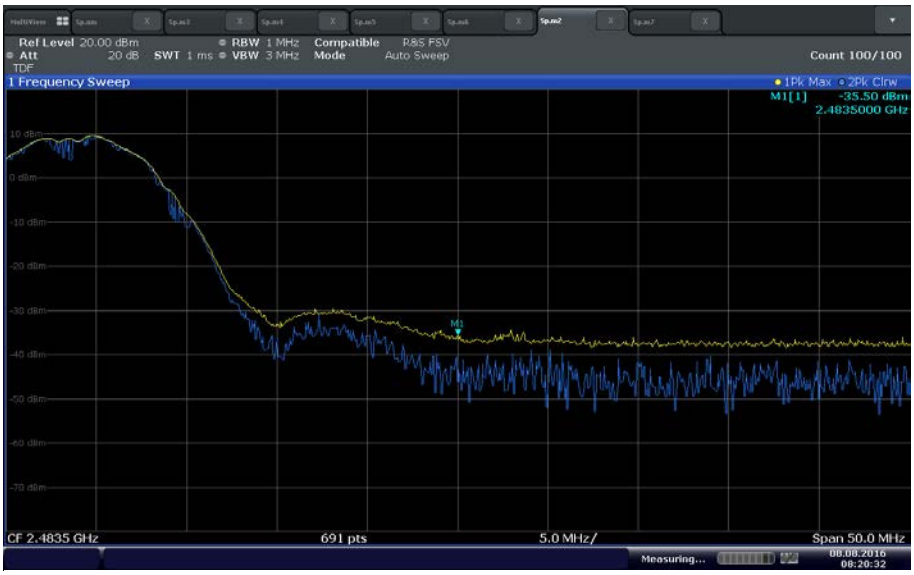
2.6.8 Test Results

Complies. See attached plots.



Date: 8.AUG.2016 07:46:40

802.11b Low Channel (2412 MHz)



Date: 8.AUG.2016 08:20:33

802.11b High Channel (2462 MHz Peak)

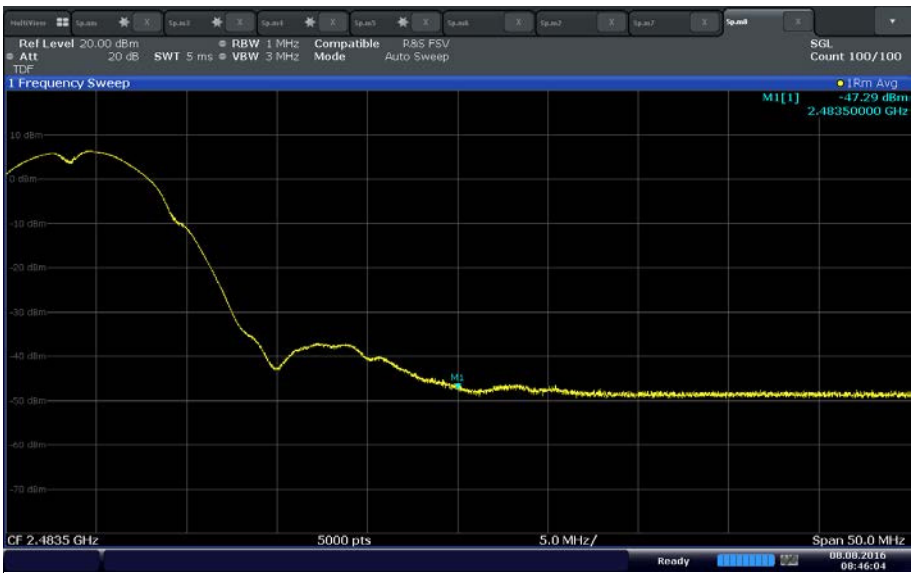
Upper Band Edge (in Restricted Band) measurement using Peak Power measurement procedure as per Clause 12.2.4 of KDB558074

Measured Peak = -35.50 dBm, since antenna gain is 0.8 dBi then EIRP is -34.7 dBm. Electric field strength in dBµV/m is then calculated using the formula:

$$E = EIRP - 20\log D + 104.8$$

Where: E = electric field strength in dBµV/m
EIRP = equivalent isotropic radiated power in dBm
D = specific measurement distance in meters

E is therefore =(-35.50 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3dB (MIMO)
= 63.56 dBµV/m @ 3 meters (complies with 74 dBµV/m Peak limits)

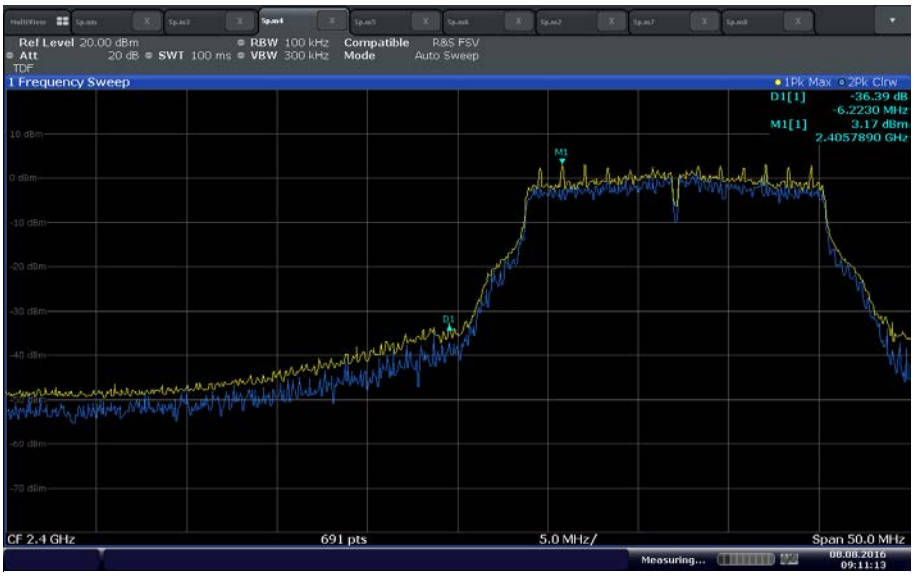


Date: 8.AUG.2016 08:46:04

802.11b High Channel (2462 MHz Average)

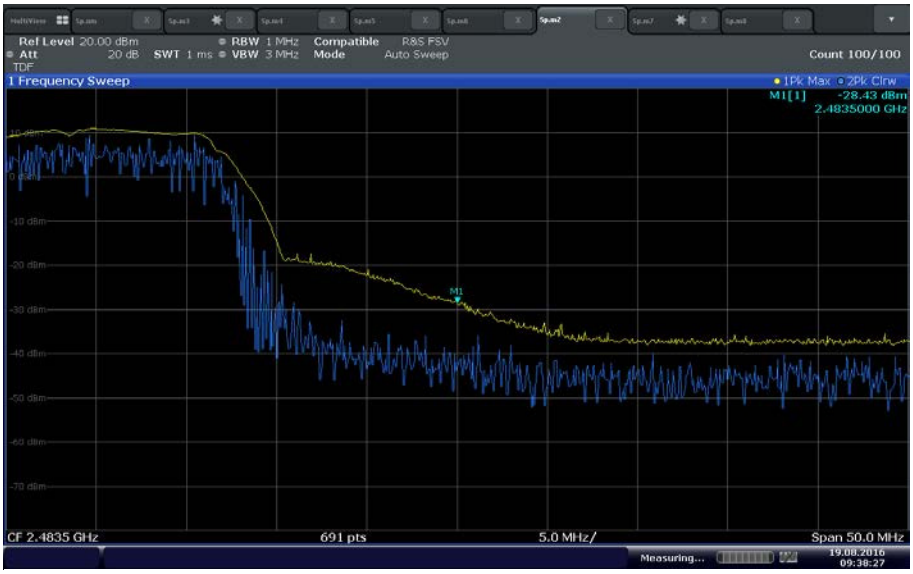
Upper Band Edge (in Restricted Band) measurement using Trace averaging with continuous EUT transmission at full power as per Clause 12.2.5.1 of KDB558074

E is therefore =(-47.29 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3 dB (MIMO)
= 51.04 dBµV/m @ 3 meters (complies with 54 dBµV/m Average limits)



Date: 8.AUG.2016 09:11:13

802.11g Low Channel (2412 MHz)



Date: 19.AUG.2016 09:38:27

802.11g High Channel (2462 MHz Peak)

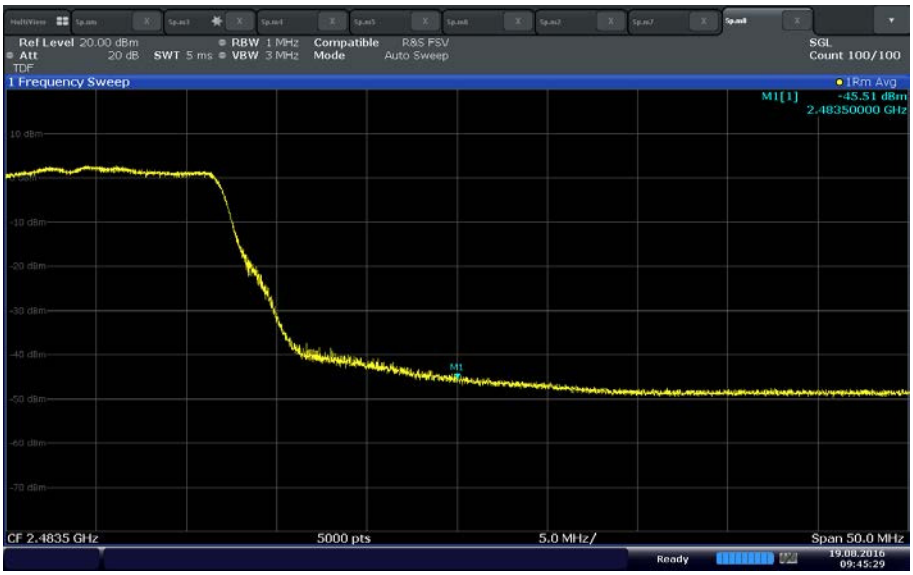
Upper Band Edge (in Restricted Band) measurement using Peak Power measurement procedure as per Clause 12.2.4 of KDB558074

Measured Peak = -28.43 dBm, since antenna gain is 0.8 dBi then EIRP is -27.63 dBm. Electric field strength in dBµV/m is then calculated using the formula:

$$E = EIRP - 20\log D + 104.8$$

Where:	E	= electric field strength in dBµV/m
	EIRP	= equivalent isotropic radiated power in dBm
	D	= specific measurement distance in meters

E is therefore =(-28.43 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3dB (MIMO)
= 70.63 dBµV/m @ 3 meters (complies with 74 dBµV/m Peak limits)

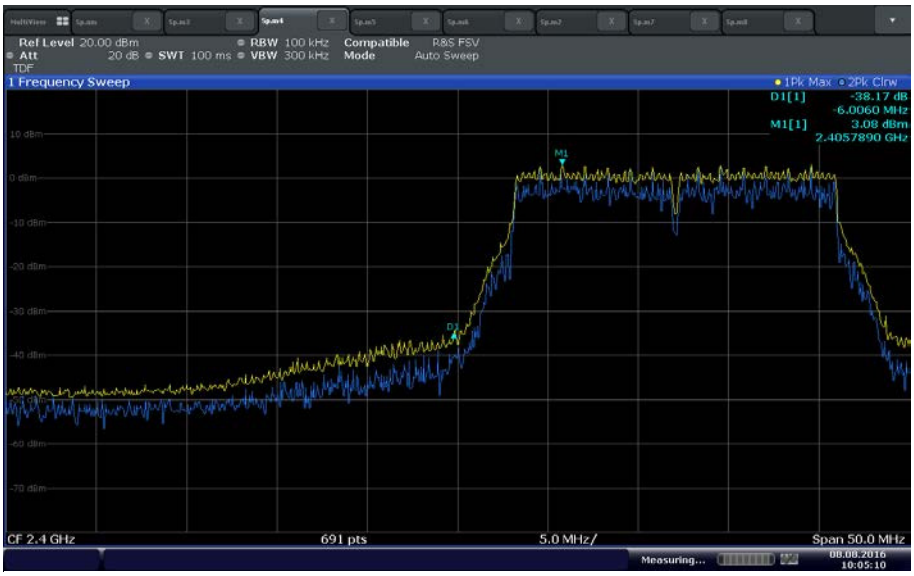


Date: 19.AUG.2016 09:45:29

802.11g High Channel (2462 MHz Average)

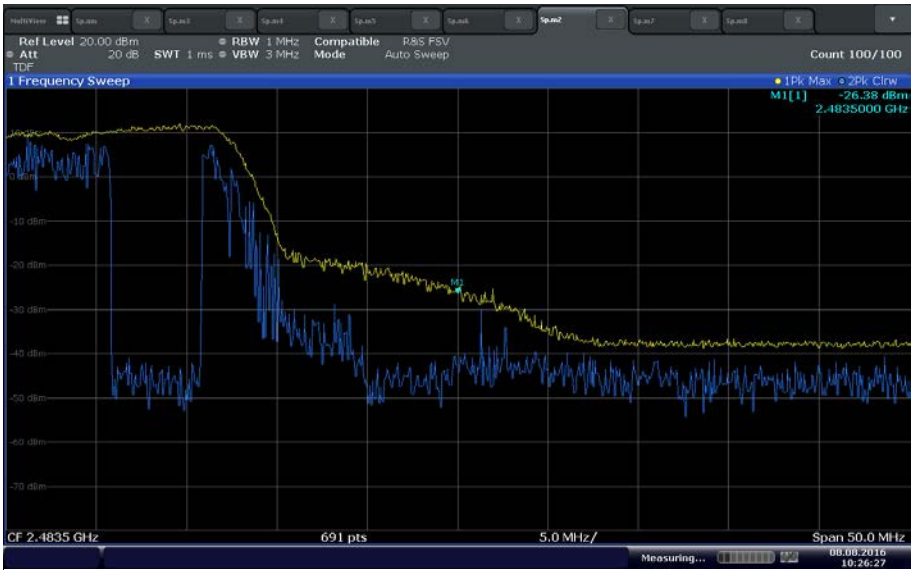
Upper Band Edge (in Restricted Band) measurement using Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction as per Clause 12.2.5.2 of KDB558074

E is therefore =(-45.51 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3dB (MIMO) + 0.3dB (DCCF)
= 53.84dBµV/m @ 3 meters (complies with 54 dBµV/m Average limits)



Date: 8.AUG.2016 10:05:11

802.11n Low Channel (2412 MHz)



Date: 8.AUG.2016 10:26:27

802.11n High Channel (2462 MHz Peak)

Upper Band Edge (in Restricted Band) measurement using Peak Power measurement procedure as per Clause 12.2.4 of KDB558074

Measured Peak = -26.38dBm, since antenna gain is 0.8 dBi then EIRP is -25.58 dBm. Electric field strength in dBµV/m is then calculated using the formula:

$$E = EIRP - 20\log D + 104.8$$

Where: E = electric field strength in dBµV/m
EIRP = equivalent isotropic radiated power in dBm
D = specific measurement distance in meters

E is therefore =(-26.38 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3dB (MIMO)
= 72.68 dBµV/m @ 3 meters (complies with 74 dBµV/m Peak limits)

Date: 19.AUG.2016 10:55:04

802.11n High Channel (2462 MHz Average)

Upper Band Edge (in Restricted Band) measurement using Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction as per Clause 13.3.2 of KDB558074

E is therefore =(-47.21 + 0.8 dbi) dBm – (20log 3 meters) + 104.8 + 3dB (MIMO) + 2.13 dB (DCCF)
= 53.98 dBµV/m @ 3 meters (complies with 54 dBµV/m Average limits)

2.7 SPURIOUS RADIATED EMISSIONS

2.7.1 Specification Reference

KDB558074 D01 DTS Meas Guidance v03r05 Clause 12.2.7

2.7.2 Standard Applicable

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

2.7.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration D

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

August 12, 2016/XYZ

2.7.5 Test Equipment Used

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

2.7.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.1 °C
Relative Humidity	52.6 %
ATM Pressure	98.9 kPa

2.7.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- Test Methodology is per Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v03r05.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case channel and data rate/MCS presented.
- Only noise floor measurements observed above 18GHz.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

- 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 2.7.8 for sample computation.

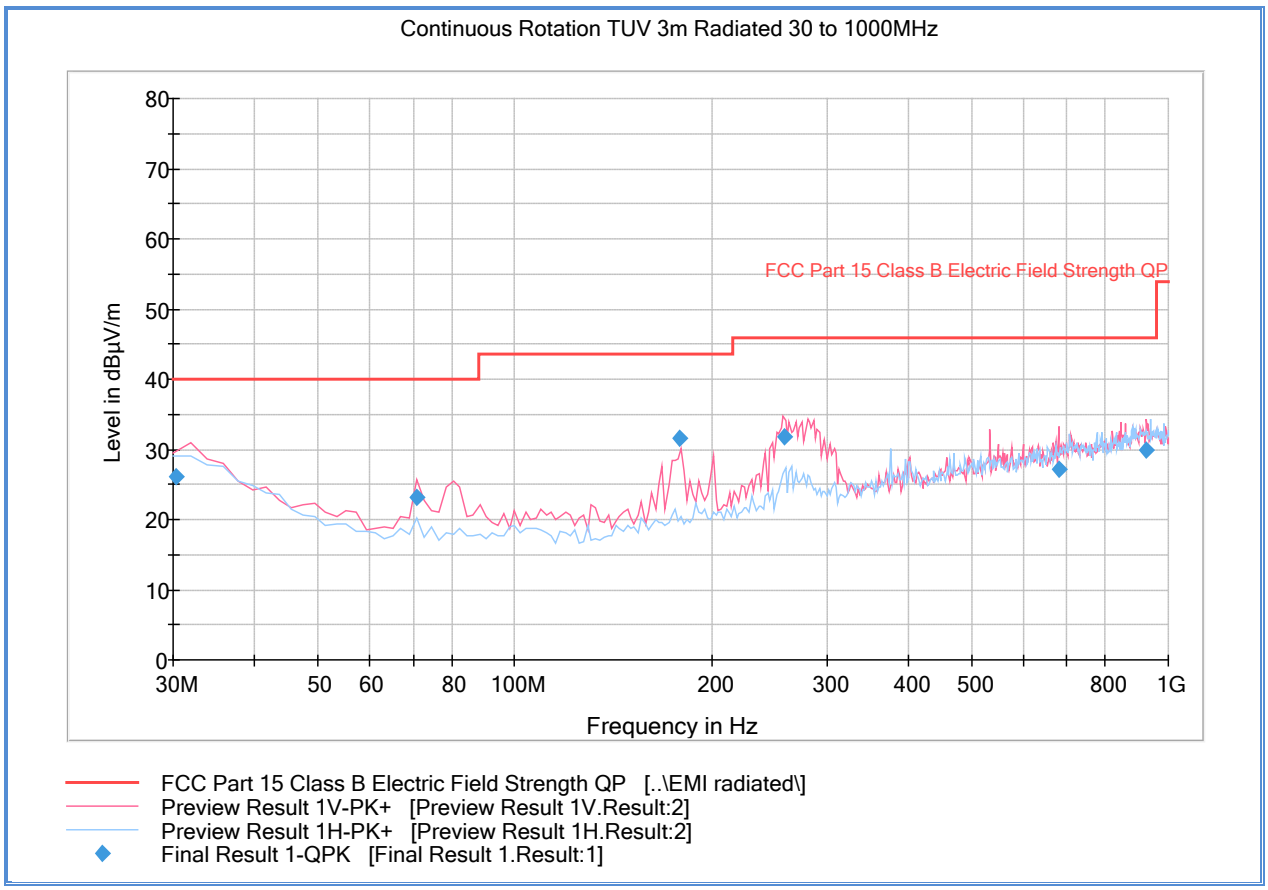
2.7.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.7.9 Test Results

See attached plots.

2.7.10 Test Results Below 1GHz (Worst Case Configuration – 802.11b)

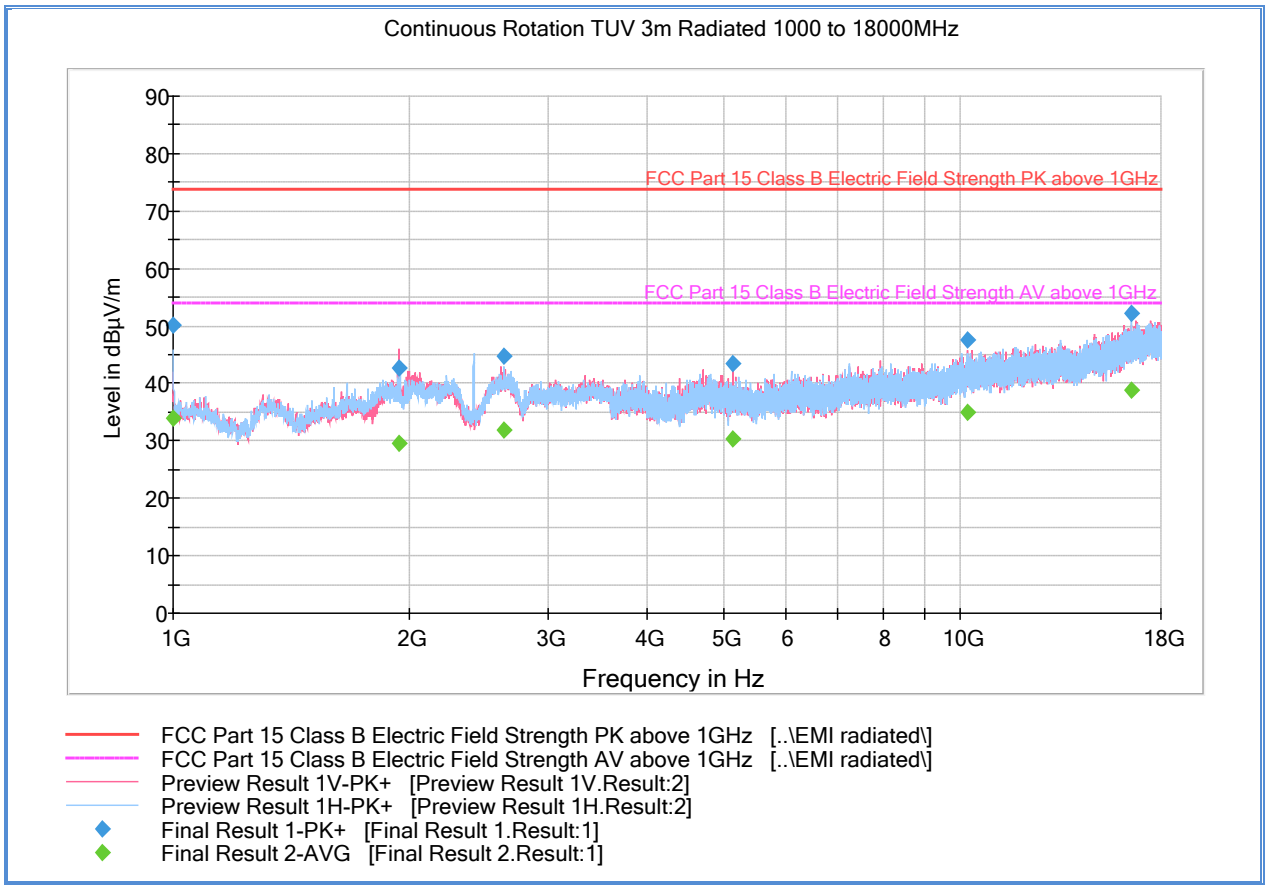


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.360000	26.0	1000.0	120.000	105.0	V	3.0	-6.0	14.0	40.0
70.741643	23.2	1000.0	120.000	105.0	V	346.0	-16.8	16.8	40.0
178.559359	31.5	1000.0	120.000	105.0	V	9.0	-12.5	12.0	43.5
258.514870	31.8	1000.0	120.000	100.0	V	15.0	-9.0	14.2	46.0
680.138517	27.2	1000.0	120.000	106.0	V	15.0	2.2	18.8	46.0
924.972265	29.8	1000.0	120.000	165.0	V	15.0	6.3	16.2	46.0

Test Notes: Only worst case channel presented for cabinet spurious emissions.

2.7.11 Test Results Above 1GHz (Worst Case Configuration – 802.11b)



Peak Data

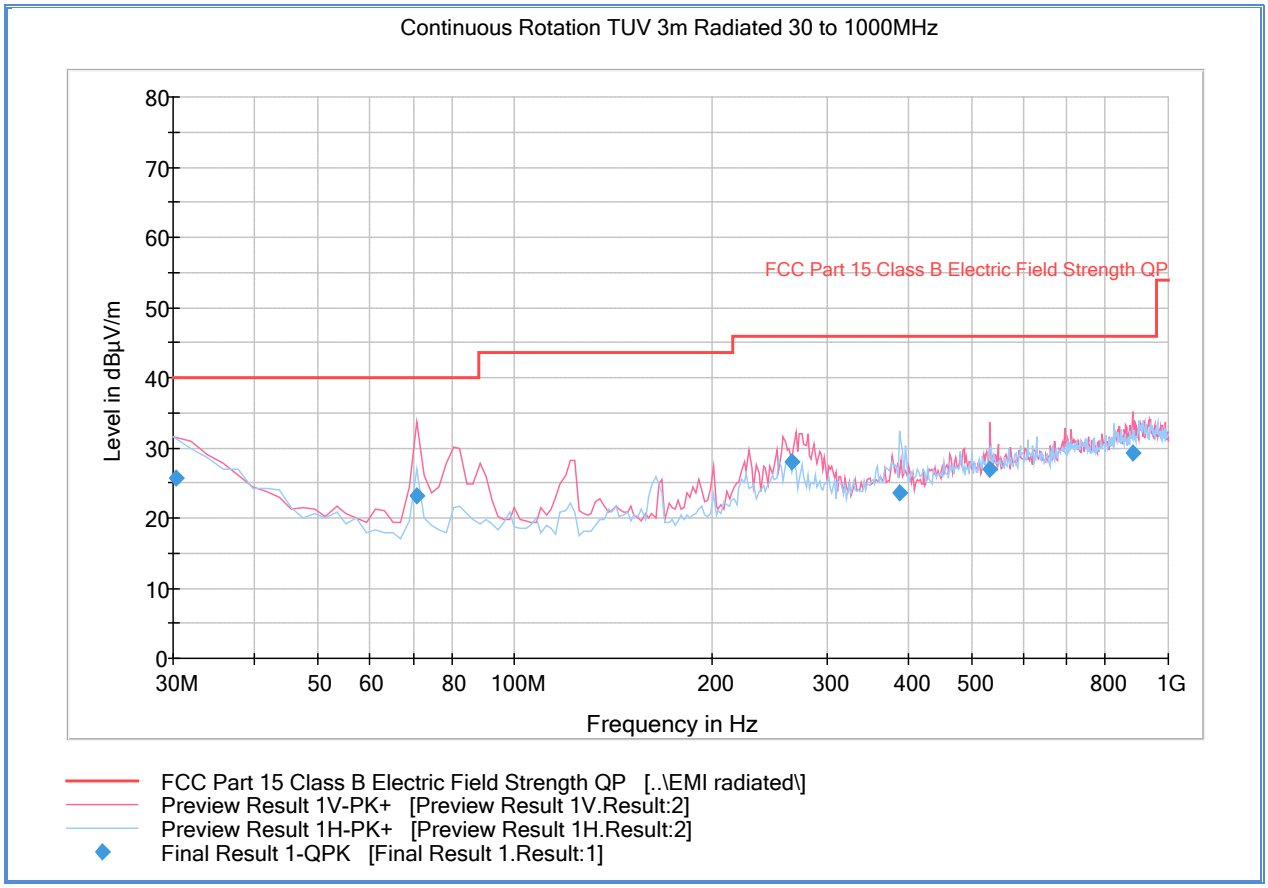
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.900000	50.0	1000.0	1000.000	124.7	H	340.0	-7.7	23.9	73.9
1935.933333	42.6	1000.0	1000.000	284.2	V	20.0	-0.7	31.3	73.9
2628.633333	44.9	1000.0	1000.000	281.3	H	20.0	-0.9	29.0	73.9
5143.466667	43.4	1000.0	1000.000	138.7	V	4.0	3.5	30.5	73.9
10218.333333	47.7	1000.0	1000.000	159.6	V	0.0	11.4	26.2	73.9
16528.033333	52.1	1000.0	1000.000	146.7	H	5.0	19.2	21.8	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.900000	33.9	1000.0	1000.000	124.7	H	340.0	-7.7	20.0	53.9
1935.933333	29.7	1000.0	1000.000	284.2	V	20.0	-0.7	24.2	53.9
2628.633333	31.8	1000.0	1000.000	281.3	H	20.0	-0.9	22.1	53.9
5143.466667	30.5	1000.0	1000.000	138.7	V	4.0	3.5	23.4	53.9
10218.333333	34.9	1000.0	1000.000	159.6	V	0.0	11.4	19.0	53.9
16528.033333	38.9	1000.0	1000.000	146.7	H	5.0	19.2	15.0	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.7.12 Test Results Below 1GHz (Worst Case Configuration – 802.11g)

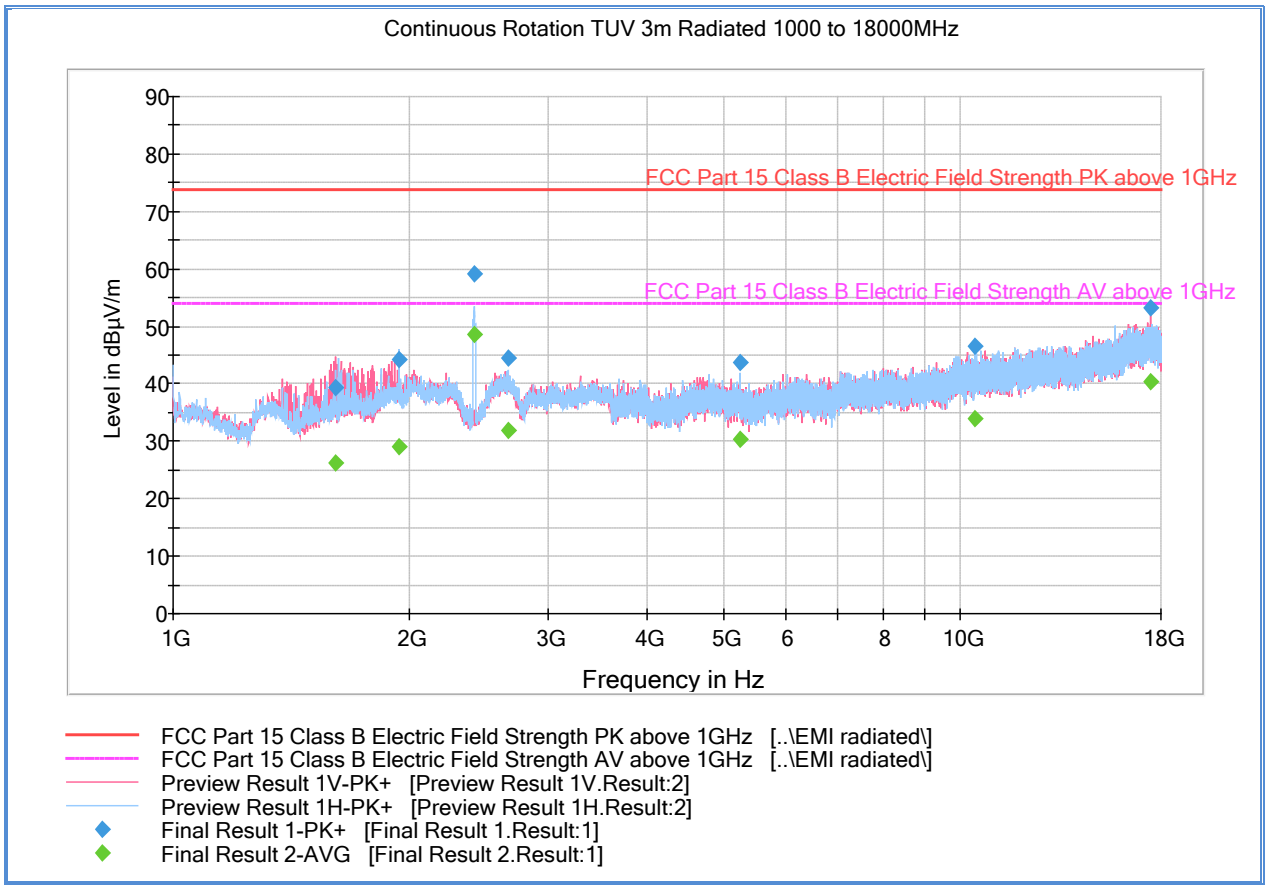


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.360000	25.6	1000.0	120.000	400.0	H	15.0	-6.0	14.4	40.0
70.861643	23.2	1000.0	120.000	115.0	V	345.0	-16.8	16.8	40.0
265.818196	28.0	1000.0	120.000	100.0	V	15.0	-8.4	18.0	46.0
387.675351	23.5	1000.0	120.000	250.0	H	15.0	-4.5	22.5	46.0
533.146934	27.0	1000.0	120.000	208.0	V	357.0	-0.9	19.0	46.0
882.822846	29.4	1000.0	120.000	200.0	V	352.0	5.5	16.6	46.0

Test Notes: Only worst case channel presented for cabinet spurious emissions.

2.7.13 Test Results Above 1GHz (Worst Case Configuration – 802.11g)



Peak Data

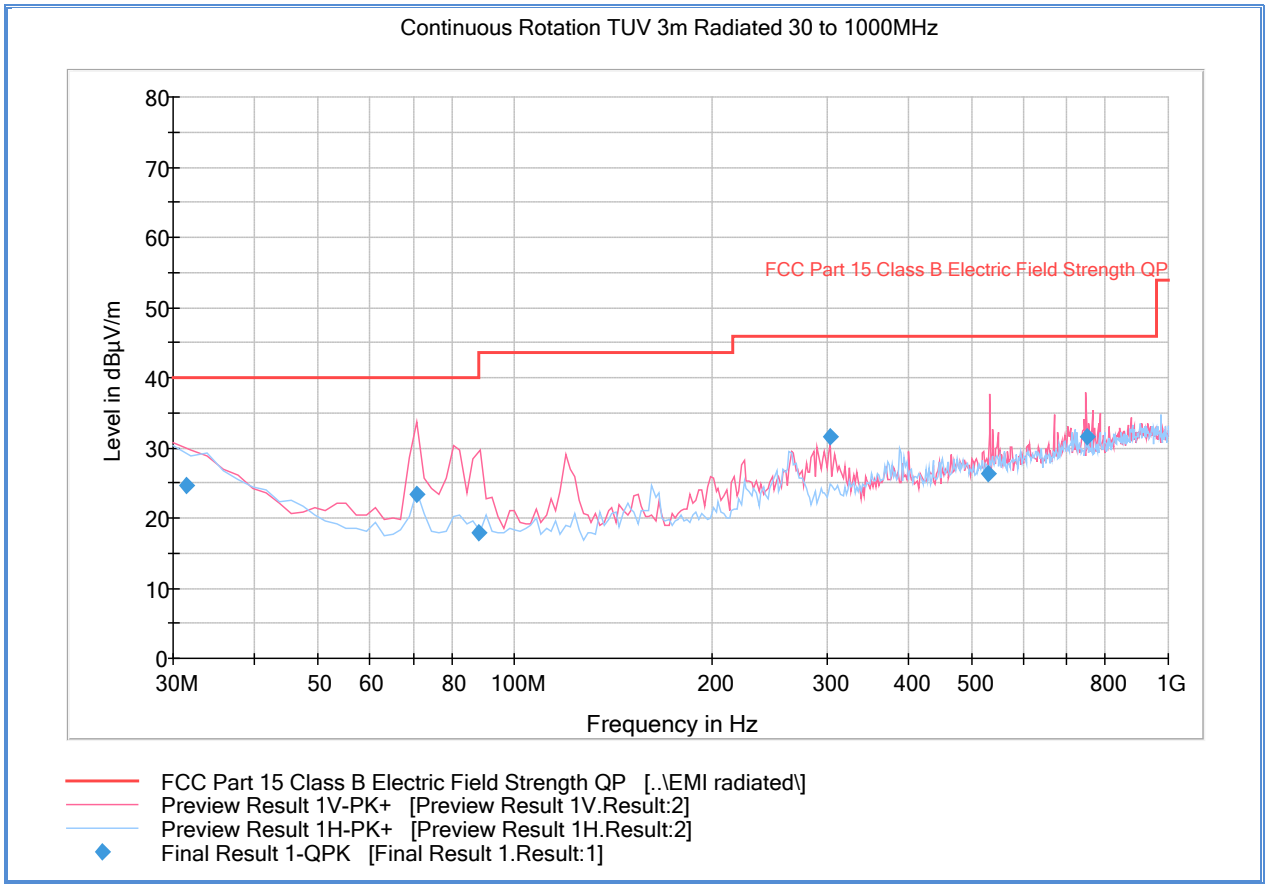
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1606.900000	39.2	1000.0	1000.000	241.3	V	341.0	-5.8	34.7	73.9
1939.200000	44.2	1000.0	1000.000	208.5	H	340.0	-0.7	29.7	73.9
2413.466667	59.2	1000.0	1000.000	102.7	H	342.0	-1.1	14.7	73.9
2667.333333	44.6	1000.0	1000.000	131.7	H	20.0	-0.8	29.3	73.9
5246.633333	43.6	1000.0	1000.000	151.2	H	353.0	3.9	30.3	73.9
10431.733333	46.6	1000.0	1000.000	186.5	H	5.0	12.0	27.3	73.9
17469.966667	53.4	1000.0	1000.000	195.5	V	354.0	20.1	20.5	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1606.900000	26.3	1000.0	1000.000	241.3	V	341.0	-5.8	27.6	53.9
1939.200000	29.0	1000.0	1000.000	208.5	H	340.0	-0.7	24.9	53.9
2413.466667	48.5	1000.0	1000.000	102.7	H	342.0	-1.1	5.4	53.9
2667.333333	31.8	1000.0	1000.000	131.7	H	20.0	-0.8	22.1	53.9
5246.633333	30.3	1000.0	1000.000	151.2	H	353.0	3.9	23.6	53.9
10431.733333	34.1	1000.0	1000.000	186.5	H	5.0	12.0	19.8	53.9
17469.966667	40.3	1000.0	1000.000	195.5	V	354.0	20.1	13.6	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures. 2.4GHz notch filter used for this test.

2.7.14 Test Results Below 1GHz (Worst Case Configuration – 802.11n)



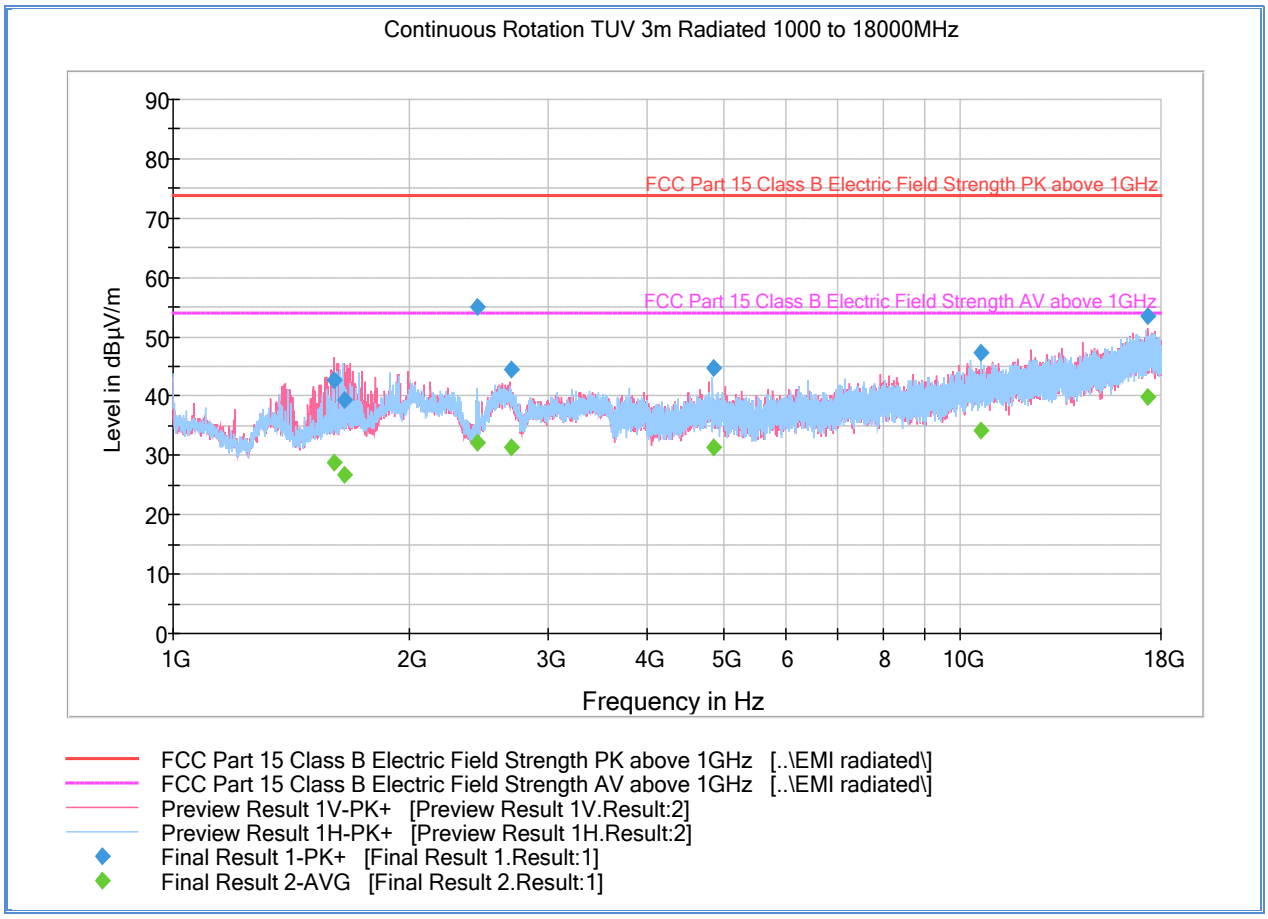
Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.400000	24.7	1000.0	120.000	284.0	V	15.0	-6.6	15.3	40.0
70.701643	23.4	1000.0	120.000	106.0	V	347.0	-16.8	16.6	40.0
88.292745	18.0	1000.0	120.000	105.0	V	352.0	-15.7	25.5	43.5
303.888176	31.5	1000.0	120.000	100.0	V	15.0	-6.8	14.5	46.0
531.346934	26.3	1000.0	120.000	150.0	V	346.0	-0.9	19.7	46.0
750.334589	31.6	1000.0	120.000	106.0	V	358.0	3.3	14.4	46.0

Test Notes: Only worst case channel presented for cabinet spurious emissions.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.7.15 Test Results Above 1GHz (Worst Case Configuration – 802.11n)



Peak Data

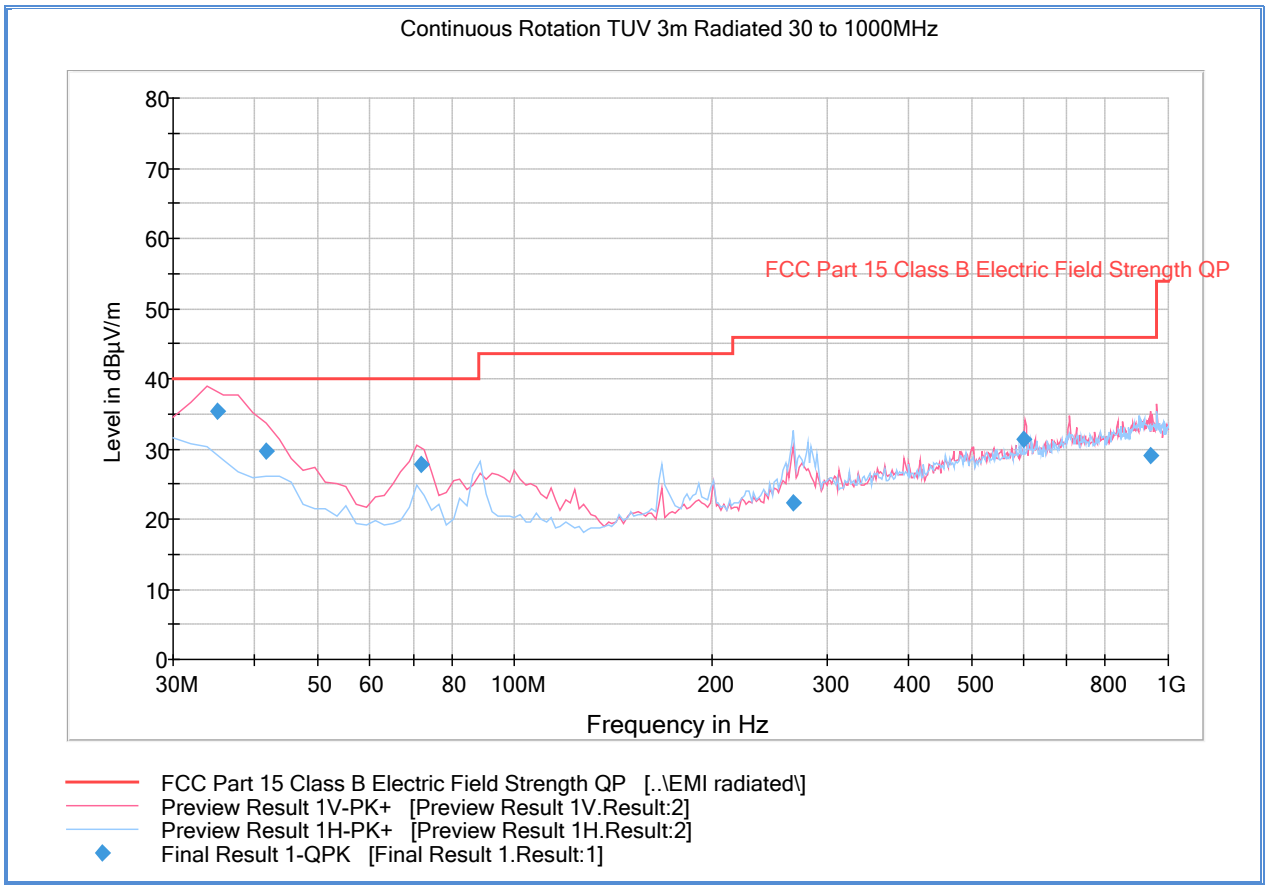
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1599.533333	42.6	1000.0	1000.000	218.4	V	341.0	-5.9	31.3	73.9
1650.766667	39.3	1000.0	1000.000	250.5	V	341.0	-5.0	34.6	73.9
2435.933333	55.0	1000.0	1000.000	182.6	H	341.0	-1.0	18.9	73.9
2684.366667	44.6	1000.0	1000.000	103.7	V	4.0	-0.6	29.3	73.9
4851.300000	44.8	1000.0	1000.000	138.7	H	347.0	3.4	29.1	73.9
10622.400000	47.2	1000.0	1000.000	217.4	H	20.0	12.0	26.7	73.9
17324.333333	53.6	1000.0	1000.000	208.5	V	4.0	19.8	20.3	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1599.533333	28.7	1000.0	1000.000	218.4	V	341.0	-5.9	25.2	53.9
1650.766667	26.7	1000.0	1000.000	250.5	V	341.0	-5.0	27.2	53.9
2435.933333	32.2	1000.0	1000.000	182.6	H	341.0	-1.0	21.7	53.9
2684.366667	31.3	1000.0	1000.000	103.7	V	4.0	-0.6	22.6	53.9
4851.300000	31.5	1000.0	1000.000	138.7	H	347.0	3.4	22.4	53.9
10622.400000	34.3	1000.0	1000.000	217.4	H	20.0	12.0	19.6	53.9
17324.333333	39.8	1000.0	1000.000	208.5	V	4.0	19.8	14.1	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures. 2.4GHz notch filter used for this test.

2.7.16 Test Results Below 1GHz (Co-located TX, both WLAN and Cell radio are active)

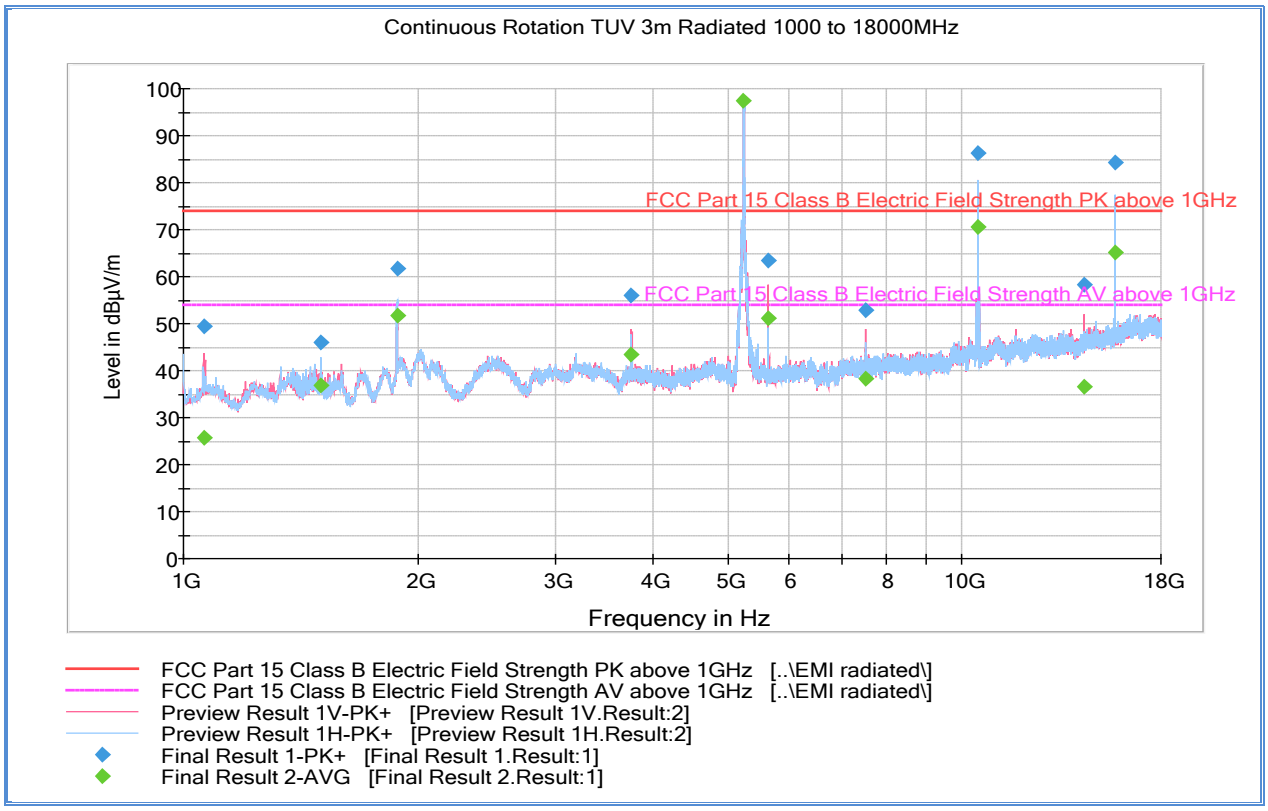


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
35.047776	35.3	1000.0	120.000	100.0	V	277.0	-8.5	4.7	40.0
41.647214	29.7	1000.0	120.000	100.0	V	154.0	-11.7	10.3	40.0
71.861643	27.8	1000.0	120.000	100.0	V	67.0	-16.8	12.2	40.0
266.354309	22.4	1000.0	120.000	100.0	H	114.0	-8.3	23.6	46.0
601.686894	31.3	1000.0	120.000	203.0	V	155.0	0.7	14.7	46.0
939.059479	29.0	1000.0	120.000	231.0	V	83.0	6.3	17.0	46.0

Test Notes: Only worst case WLAN and licensed test configuration presented.

2.7.17 Test Results Above 1GHz (Co-located TX, both WLAN and Cell radio are active)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1062.866667	49.5	1000.0	1000.000	103.7	V	270.0	-7.5	24.4	73.9
1500.000000	46.1	1000.0	1000.000	102.7	H	132.0	-6.2	27.8	73.9
1881.133333	61.6	1000.0	1000.000	111.7	H	73.0	-1.8	12.3	73.9
3762.133333	56.0	1000.0	1000.000	194.5	V	241.0	1.5	17.9	73.9
5237.933333	107.6	1000.0	1000.000	128.7	H	215.0	3.9	Downlink harmonic	
5640.000000	63.5	1000.0	1000.000	184.5	V	216.0	4.4	10.4	73.9
7520.300000	53.0	1000.0	1000.000	103.7	V	323.0	7.5	20.9	73.9
10478.666667	86.2	1000.0	1000.000	220.4	V	287.0	12.0	Downlink harmonic	
14327.433333	58.2	1000.0	1000.000	115.7	V	74.0	15.5	15.7	73.9
15721.966667	84.3	1000.0	1000.000	127.7	H	210.0	17.5	Downlink harmonic	

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1062.866667	25.8	1000.0	1000.000	103.7	V	270.0	-7.5	28.1	53.9
1500.000000	36.9	1000.0	1000.000	102.7	H	132.0	-6.2	17.0	53.9
1881.133333	51.8	1000.0	1000.000	111.7	H	73.0	-1.8	2.1	53.9
3762.133333	43.3	1000.0	1000.000	194.5	V	241.0	1.5	10.6	53.9
5237.933333	97.3	1000.0	1000.000	128.7	H	215.0	3.9	Downlink harmonic	
5640.000000	51.0	1000.0	1000.000	184.5	V	216.0	4.4	2.9	53.9
7520.300000	38.4	1000.0	1000.000	103.7	V	323.0	7.5	15.5	53.9
10478.666667	70.5	1000.0	1000.000	220.4	V	287.0	12.0	Downlink harmonic	
14327.433333	36.6	1000.0	1000.000	115.7	V	74.0	15.5	17.3	53.9
15721.966667	65.3	1000.0	1000.000	127.7	H	210.0	17.5	Downlink harmonic	

Test Notes: Only worst case WLAN and licensed test configuration presented.

2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

Part 15 Subpart C §15.247(e) and RSS-247 5.2(2)

2.8.2 Standard Applicable

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

2.8.3 Equipment Under Test and Modification State

Serial No: SZ170616900012 / Test Configuration B

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

August 08, 2016/FSC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	28.3 °C
Relative Humidity	48.8 %
ATM Pressure	98.5 kPa

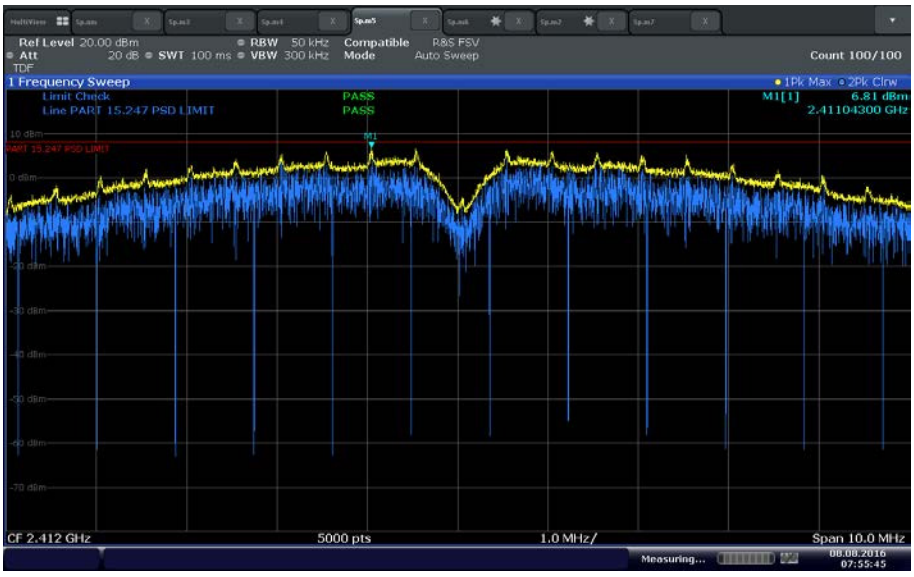
2.8.7 Additional Observations

- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074 (April 08, 2016).
- Span is 1.5 times the DTS bandwidth.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz
- Set the VBW ≥ 3 x RBW
- Detector is Peak
- Sweep time is Auto Couple.
- Trace mode is max hold
- Trace allowed to fully stabilize.
- The RBW used during testing shall be reported.

2.8.8 Test Results Summary

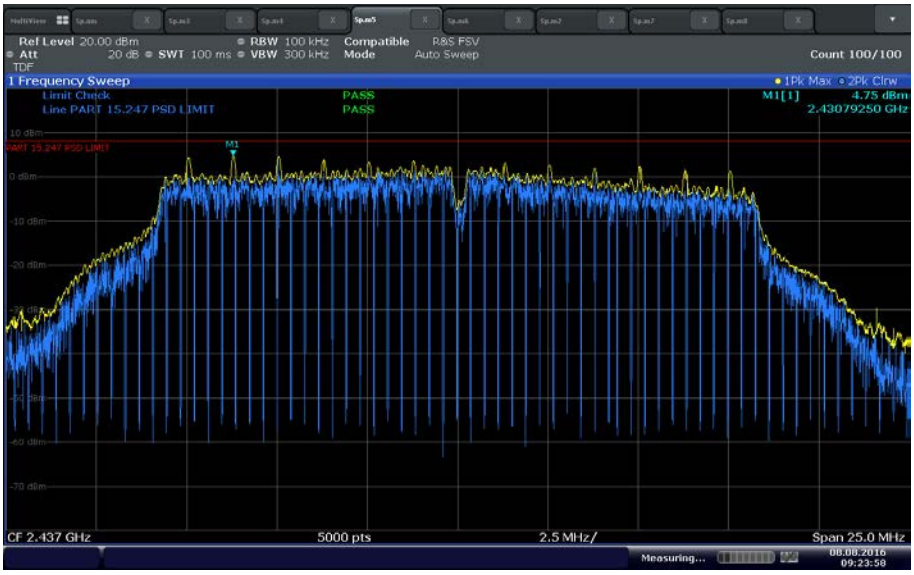
Mode	Channel	Marker Reading (dBm)/RBW used	PSD Limit (dBm)	Margin (dB)	Compliance
802.11b	1 (2412 MHz)	6.81/50kHz	8	1.19	Complies
	6 (2437 MHz)	6.61/30kHz	8	1.39	Complies
	11 (2462 MHz)	6.09/100kHz	8	1.91	Complies
802.11g	1 (2412 MHz)	3.14/100kHz	8	4.86	Complies
	6 (2437 MHz)	4.75/100kHz	8	3.25	Complies
	11 (2462 MHz)	2.81/100kHz	8	5.19	Complies
802.11n 20MHz BW	1 (2412 MHz)	3.10/100kHz	8	4.90	Complies
	6 (2437 MHz)	4.85/100kHz	8	3.15	Complies
	11 (2462 MHz)	2.85/100kHz	8	5.15	Complies

2.8.9 Test Results Plots



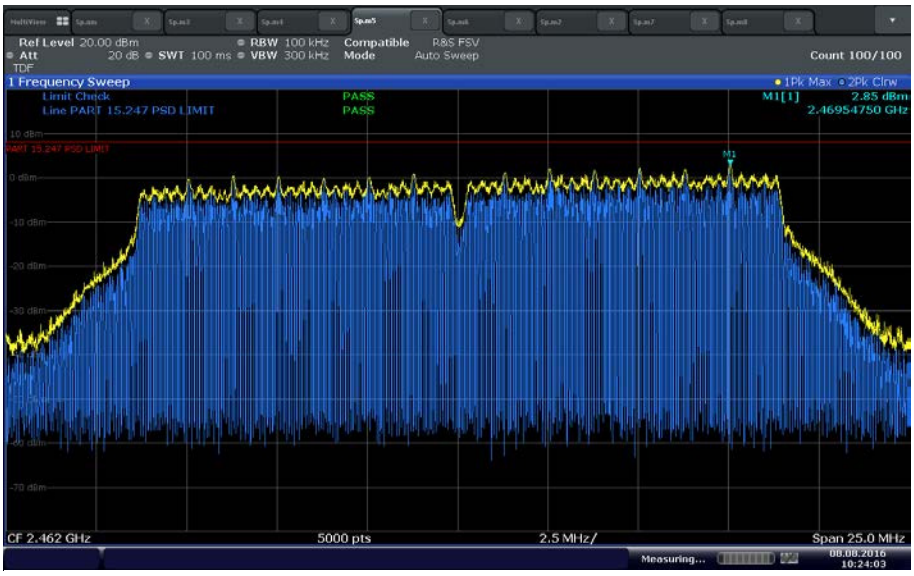
Date: 8.AUG.2016 07:55:46

802.11b Low Channel



Date: 8.AUG.2016 09:23:58

802.11g Mid Channel



Date: 8.AUG.2016 10:24:03

802.11n High Channel

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Antenna Conducted Port Setup						
7606	USB RF Power Sensor	RadiPower RPR3006W	14I00048SNO048	DARE!! Instruments	09/24/15	09/24/16
7607	USB RF Power Sensor	RadiPower RPR3006W	14I00048SNO047	DARE!! Instruments	11/18/15	11/18/16
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	10/05/15	10/05/16
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/16/16	05/16/17
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7611	
8832	20dB Attenuator	34-20-34	BP4150	MCE/Weinschel	Verified by 1003 and 7611	
AC Conducted Emissions Test Setup						
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	09/03/15	09/03/16
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	10/28/15	10/28/16
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/29/16	02/28/17
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	05/12/16	05/12/17
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1003 and 7611	
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	01/11/16	01/11/17
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 1003 and 7611	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7611	
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
7560	Barometer/Temperature/Humidity Transmitter	iBTHX-W	1240476	Omega	10/19/15	10/19/16
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Measurements (Below 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyser	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.57

3.2.2 Radiated Emission Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.78
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.56

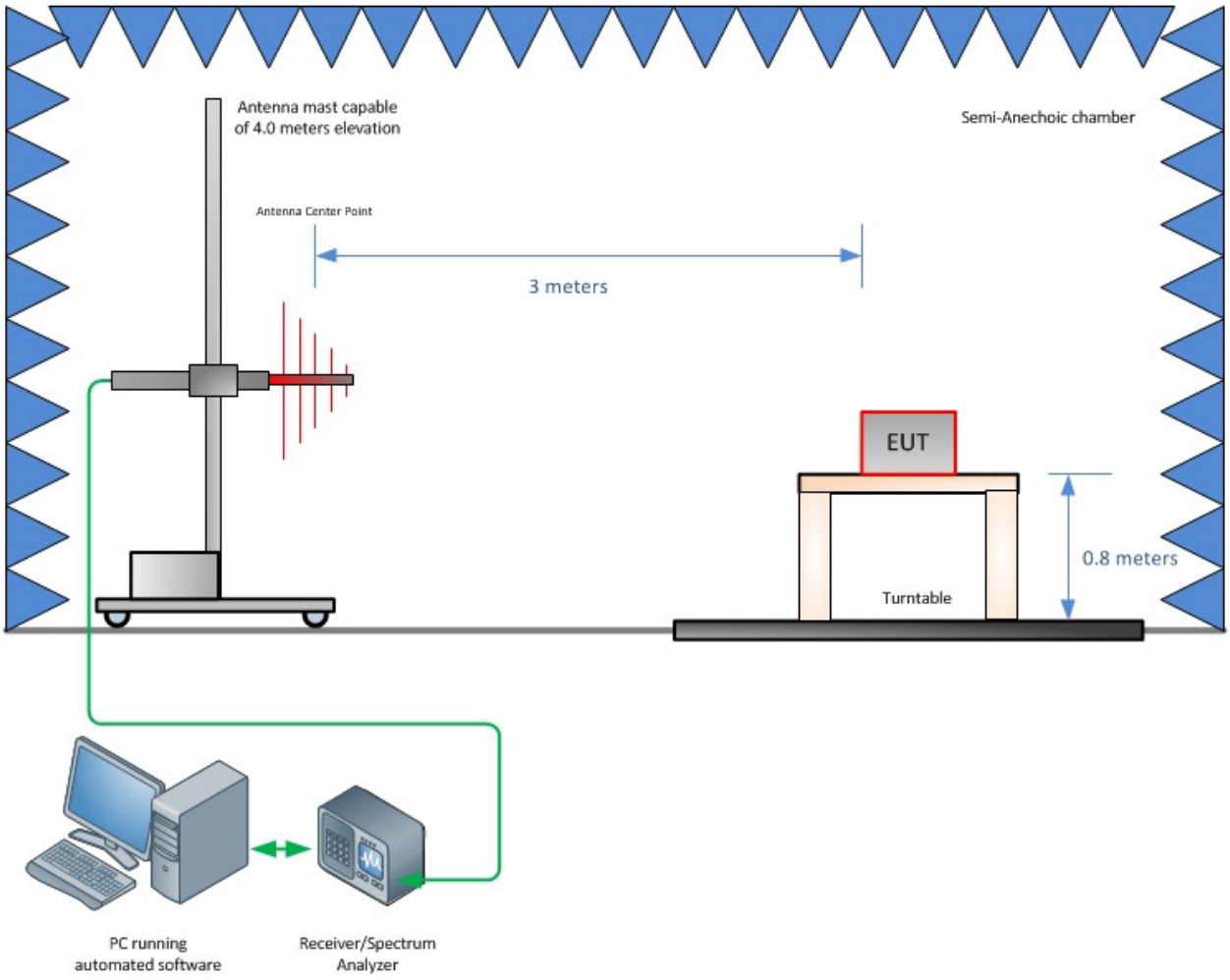
3.2.3 Conducted Antenna Port Measurement

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.72
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.45

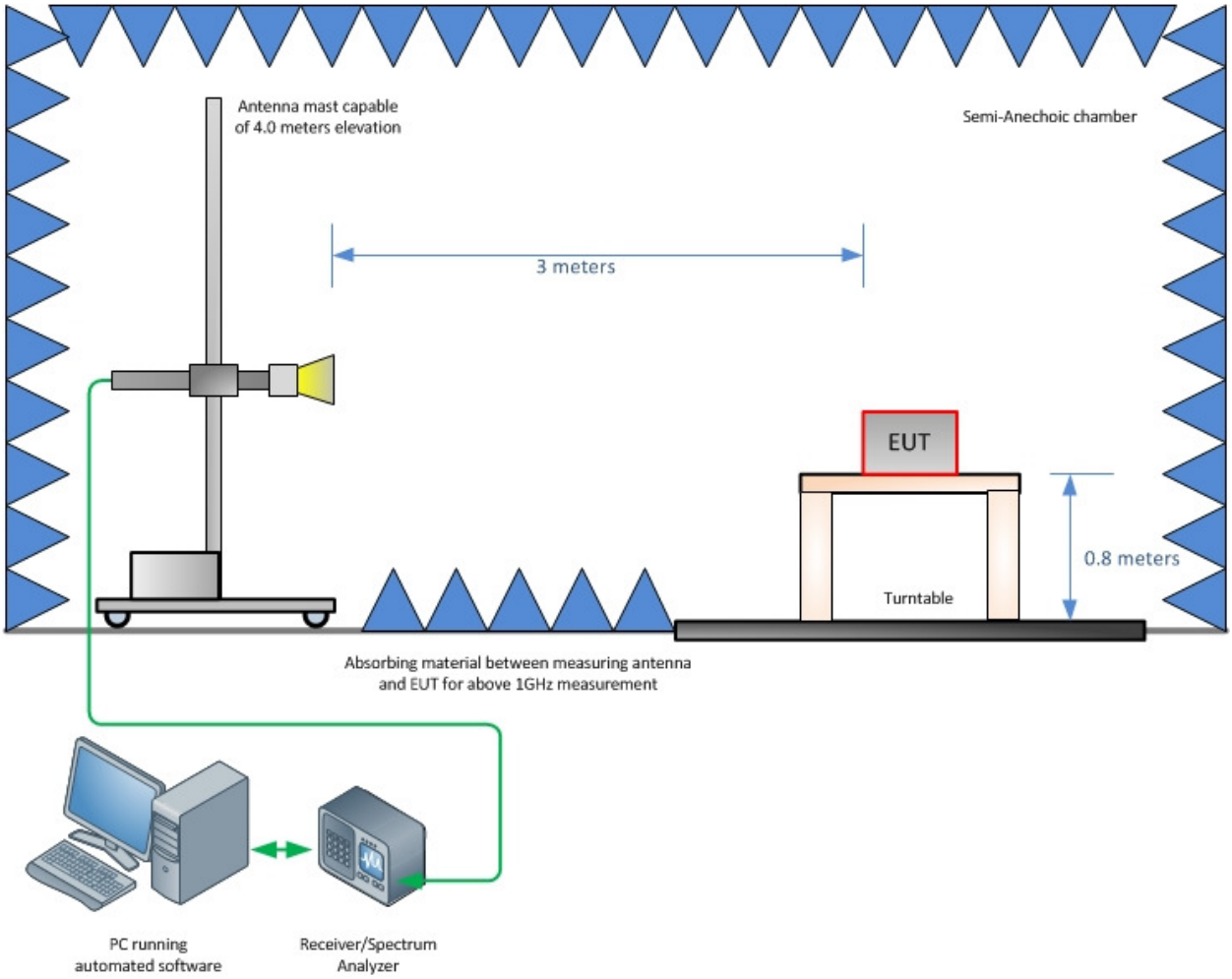
SECTION 4

DIAGRAM OF TEST SETUP

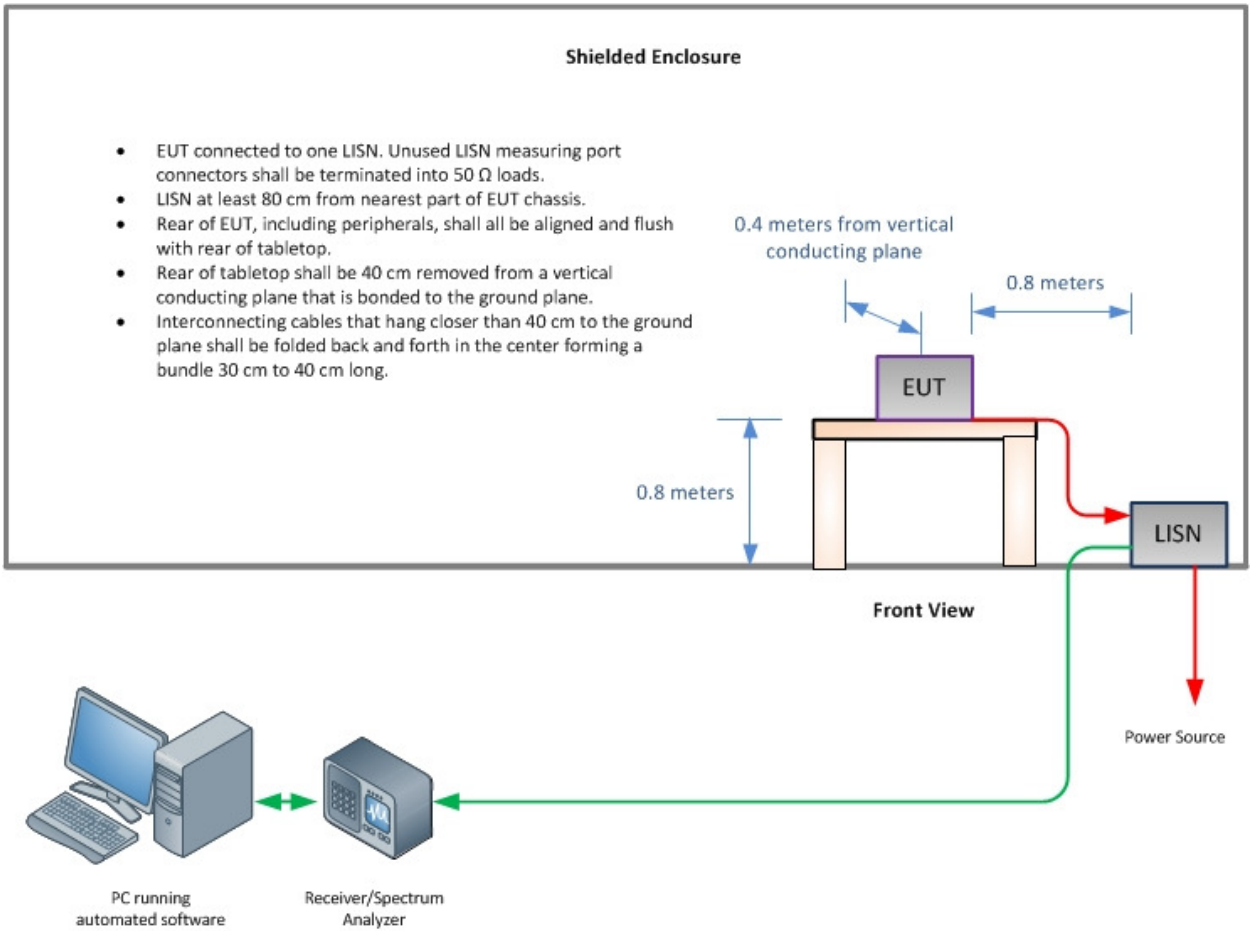
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup

SECTION 5

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5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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