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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.

MiFi 6620L Wireless Hotspot Modem

FCC Part 15 Subpart C §15.247

Report No. SC1403560D Rev.1

July 2014



REPORT ON Radio Testing of the
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem

TEST REPORT NUMBER SC1403560D Rev.1

PREPARED FOR Novatel Wireless Inc.
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DATED July, 17, 2014



Revision History

SC1403560D Rev.1 Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
07/17/2014	Initial Release				Ferdinand Custodio
07/18/2014	Initial Release	Rev. 1	Model name change from MiFi6620L to MiFi 6620L	2, 3, 5, 6, 8 and 15	Ferdinand Custodio



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SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem to the requirements of FCC Part 15 Subpart C §15.247

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.
Model Number(s)	MiFi 6620L
FCC ID Number	PKRNVWMIFI6620
IC Number	N/A
Serial Number(s)	SS220414800525
Number of Samples Tested	1
Start of Test	June 28, 2014
Finish of Test	July 03, 2014
Name of Engineer(s)	Alex Chang
Related Document(s)	<ul style="list-style-type: none">• RF Exposure Lab Certificate of Compliance SAR Evaluation Test Report Number: SAR.20140601 Revision D.• 558074 D01 DTS Meas Guidance v03r02 June 05, 2014 (Guidance for Performing Compliance Measurements on Digital Transmission System (DTS) Operating Under §15.247)• 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 is shown below.

Section	§15.247 Spec Clause	Test Description	Result	Comments/ Base Standard
2.1	§15.247(b)(3)	Peak Output Power	Compliant	
2.2	§15.207(a)	Conducted Emissions	Compliant	
2.3	§15.247(a)(2)	Minimum 6 dB RF Bandwidth	Compliant	
2.4	§15.247(d)	Out-of-Band Emissions - Conducted	Compliant	
2.5	§15.247(d)	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.6	§15.247(d)	Spurious Radiated Emissions	Compliant	
2.7	§15.247(e)	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. MiFi 6620L Wireless Hotspot Modem. The EUT creates a personal Wi-Fi cloud, capable of sharing high speed 4G LTE and 3G Mobile Broadband Internet connectivity with up to 15 Wi-Fi enable devices simultaneously. The EUT comes with an AC power adaptor Novatel Wireless, model: SSW-2597.

1.3.2 EUT General Description

EUT Description	Wireless Hotspot Modem
Model Number(s)	MiFi 6620L
Rated Voltage	Nominal 3.8VDC Li-Ion Battery AC Power Adaptor: Input: 100-240VAC/0.3A/50-60Hz Output: 5.0 VDC/2.0A
Mode Verified	802.11 a/b/g/n
Capability	GSM850/1900, CDMA2000 1xRTT, 1xEV-DO Release 0 and A, WCDMA850/1900, LTE Band 2, 4, and 13, WLAN 802.11 a/b/g/n
Frequency Range	2412 MHz to 2462 MHz in the 2400 MHz to 2483.5 MHz Band 5745 MHz to 5825 MHz in the 5725 MHz to 5850 MHz Band



Internal Antenna Details
(Client declaration, max. Antenna gain covered under this test report)

WWAN Antenna – CDMA/GPRS/EDGE/WCDMA/LTE

Manufacturer: NVTL
Part Number: NVTL DA-01020345

Type: Monopole

Antenna Gain:

- CDMA BC0 – 850MHz: -3.46dBi
- CDMA BC1 – 1900MHz: -0.97dBi
- GSM850 – 850MHz: -2.0dBi
- GSM1900 – 1900MHz: -1.64dBi
- WCDMA Band 5 – 850MHz: -2.0dBi
- WCDMA Band 2 – 1900MHz: -1.64dBi
- LTE Band 2 – 1900MHz: -1.64dBi
- LTE Band 4 – 1700MHz: -0.83dBi
- LTE Band 13 – 700MHz: -1.09dBi

WLAN – Antenna: 802.11 a/b/g/n

Manufacturer: NVTL
Part Number: NVTL 12023203

Type: CERAMIC CHIP

Antenna Tx0 Gain:

- 802.11 b/g/n 2.4GHz: -0.94dBi
- 802.11 a/n 5GHz: 1.72dBi

Antenna Tx1 Gain:

- 802.11 b/g/n 2.4GHz: -0.94dBi
- 802.11 a/n 5GHz: 1.72dBi



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configurations	Description
A	Conducted antenna port measurement. EUT Tx at a max power and connected to a programmable DC power supply via dummy battery pack.
B	Radiated test setup. EUT Tx through integral antenna and connected to supplied AC power adaptor.

1.4.2 EUT Exercise Software

Before each test, the EUT is configured using Qualcomm Radio Control Toolkit Version 3.0.28.0. The software allows configuration of channels, modes, data rate and power level. Power level is set according to manufacturer specification for each mode (802.11 b/g/n and 802.11 a/n).

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Dell	Support Laptop	Support Laptop for WiFi Test configuration, Model: Latitude XT2
Dell	Support Laptop Power Supply Adaptor	Model: PA-1900-02D
Novatel Wireless	USB Cable	Micro USB Type B to Standard USB Type B

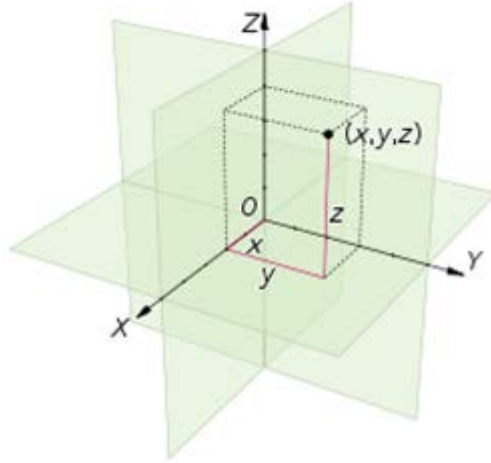
1.4.4 Worst Case Configuration

Worst-case configuration used in this test report based from Average Output Power measurements:

System Mode	Frequency Range (MHz)	Mode	Channel	Data Rate (Mbps)	Average Output Power (dBm)	Average Output Power (mW)
SISO	2412 – 2462	802.11b	1	1	6.99	5.00
	2412 – 2462	802.11g	1	6	11.96	15.70
	5745 – 5825	802.11a	157	6	7.96	6.25

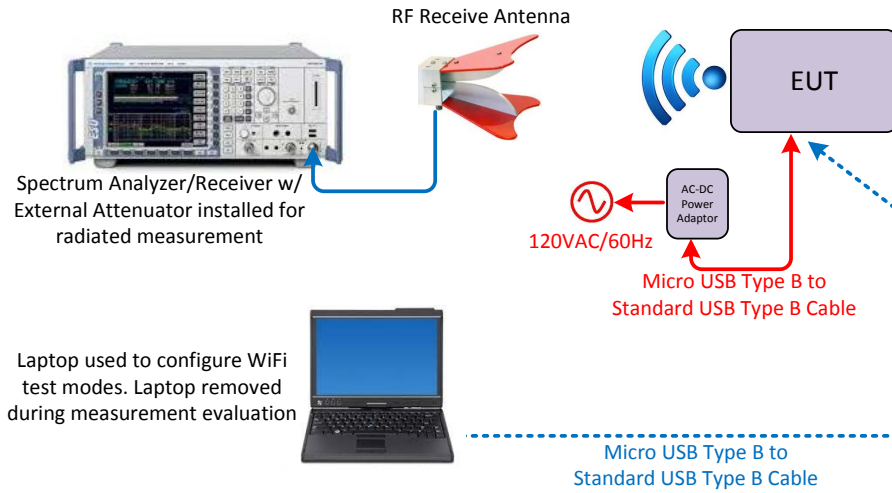
System Mode	Frequency Range (MHz)	Mode	Channel	Data Rate (Mbps)	Average Output Power (dBm)	Average Output Power (mW)
MIMO	2412 – 2462	802.11n (HT20)	6	6.5	12.99	19.91
	5745 – 5825	802.11n (HT20)	165	6.5	10.91	12.33
	5745 – 5825	802.11n (HT40)	157	13.5	10.79	11.99

For radiated measurements X, Y, and Z orientations were verified. The verification was determined “Y” as worst case configuration.

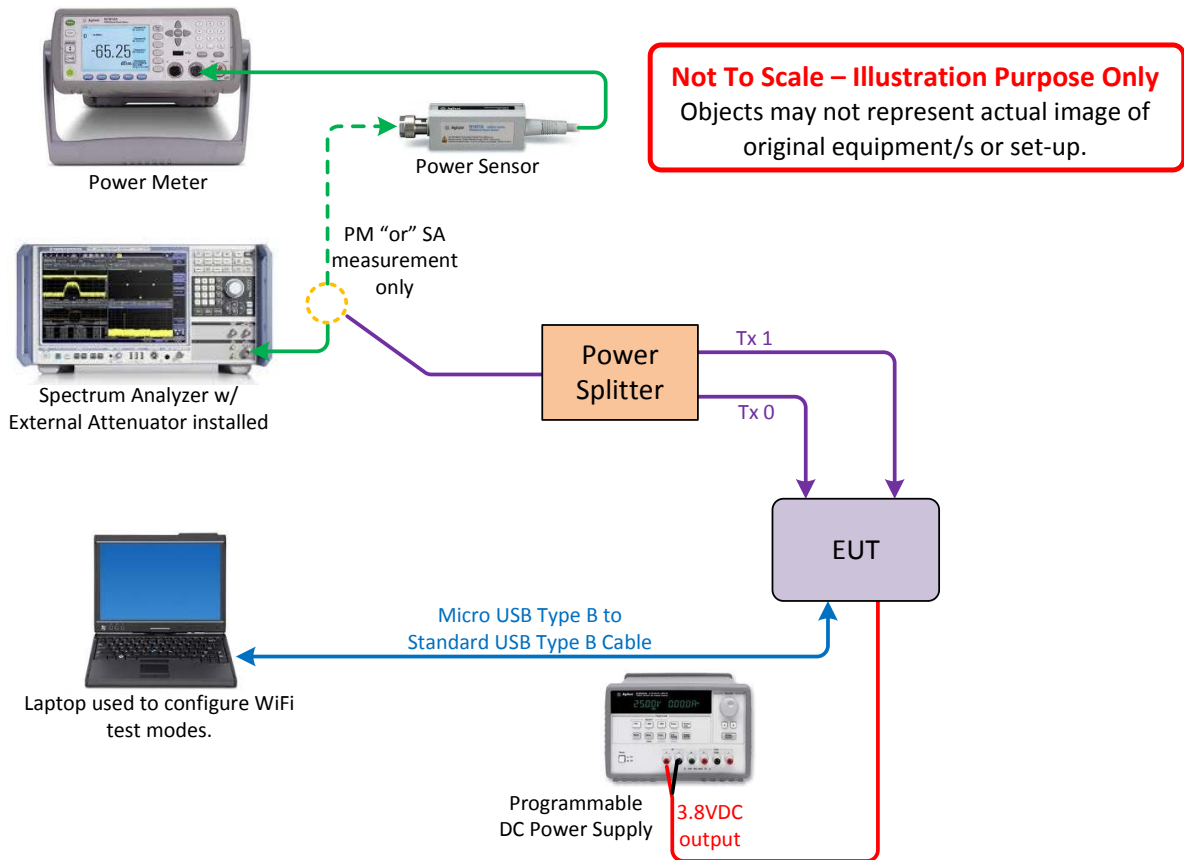


1.4.5 Simplified Test Configuration Diagram

Radiated/Conducted Emission Test Configuration via Conducted Port



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 SS220414800525		
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 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)

Sony Electronics Inc., Building #8, 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 Fax: 858 546 0364.

1.8.3 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.



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

The 10m Semi-anechoic chamber of TÜV SÜD 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
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem



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: SS220414800525 / Test Configuration A

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

*June 28, 2014 / AC

*The tables presented on this test report are from SAR Evaluation Test Report Number: SAR.20140601 Revision D ; TUV performed Verification on random channels and worst case conditions and did not find any significant differences.

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	21.7°C
Relative Humidity	42.7%
ATM Pressure	99.6 kPa

2.1.7 Additional Observations

- These are the Conducted port measurement provided by the RF exposure SAR laboratory. The data was used and help in determining worst case testing conditions for the remainder of the report.
- This is a conducted test using a peak/average power meter.
- This is a conducted test using Method A: Peak Power Meter Method discussed under KDB 558074 D01 DTS Measurement Guidance v03r02 (Compliance Measurement Guidance for 15.247 Digital Transmission Systems, June 05, 2014).



- TUV performed verification checks and compared the measurements to the data provided by RF Exposure Labs (SAR.20140601 Revision D) and the results were found to be similar and are used to show compliance in this test report.
- The offset table below to the power meter was used for the power splitter, external attenuator and cable used.

Channel (#)	Frequency (MHz)	Offset (dB)
1	2412	27.5
6	2437	27.6
11	2462	27.6
149	5745	31.2
157	5785	31.0
165	5825	31.7

- Conducted antenna port 0 and 1 were verified and found transmit port 1 was worst case scenario when in SISO mode. Therefore, only transmit port 1 was reported.
- All available modes and data rates were verified. The worst case data rate for each mode (marked bold and italic) will be verified for each test throughout this test report.



2.1.8 Test Results

See attached table.

802.11b (2.4GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	1	2412	1	6.99	9.72
			2	6.95	9.61
			5.5	6.92	9.74
			11	6.85	9.91
	6	2437	1	6.98	9.73
			2	6.94	9.70
			5.5	6.91	9.76
			11	6.83	9.68
	11	2462	1	6.92	9.70
			2	6.91	9.66
			5.5	6.87	9.68
			11	6.81	9.59



802.11g (2.4GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	1	2412	6	11.96	17.36
			9	11.92	17.32
			12	11.91	17.28
			18	11.93	17.26
			24	11.90	17.29
			36	11.89	17.11
			48	11.85	17.18
			54	11.81	17.10
	6	2437	6	11.92	17.21
			9	11.94	17.29
			12	11.90	17.23
			18	11.88	17.22
			24	11.89	17.19
			36	11.84	17.15
			48	11.83	17.13
	11	2462	54	11.86	17.20
			6	11.96	17.08
			9	11.94	17.03
			12	11.90	16.97
			18	11.89	17.05
			24	11.92	17.04
			36	11.85	16.93
			48	11.88	16.99
	54	11.84	16.94		



802.11n (HT20) (2.4GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	1	2412	MCS0_6.5	9.97	15.24
			MCS1_13	9.92	15.22
			MCS2_19.5	9.90	15.26
			MCS3_26	9.91	15.20
			MCS4_39	9.89	15.19
			MCS5_52	9.87	15.21
			MCS6_58.5	9.90	15.17
			MCS7_65	9.88	15.15
	6	2437	MCS0_6.5	9.98	15.34
			MCS1_13	9.92	15.31
			MCS2_19.5	9.94	15.28
			MCS3_26	9.90	15.29
			MCS4_39	9.88	15.26
			MCS5_52	9.86	15.22
			MCS6_58.5	9.90	15.27
			MCS7_65	9.87	15.20
	11	2462	MCS0_6.5	9.97	15.28
			MCS1_13	9.96	15.26
			MCS2_19.5	9.95	15.27
			MCS3_26	9.93	15.29
			MCS4_39	9.94	15.22
			MCS5_52	9.90	15.24
			MCS6_58.5	9.92	15.20
			MCS7_65	9.98	15.23



802.11n (HT20) (2.4GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
MIMO	1	2412	MCS0_6.5	12.98	18.25
			MCS1_13	12.93	18.23
			MCS2_19.5	12.91	18.27
			MCS3_26	12.92	18.21
			MCS4_39	12.90	18.20
			MCS5_52	12.88	18.22
			MCS6_58.5	12.91	18.18
			MCS7_65	12.89	18.16
	6	2437	MCS0_6.5	12.99	18.35
			MCS1_13	12.93	18.32
			MCS2_19.5	12.95	18.29
			MCS3_26	12.91	18.30
			MCS4_39	12.89	18.27
			MCS5_52	12.87	18.23
			MCS6_58.5	12.91	18.28
			MCS7_65	12.88	18.21
	11	2462	MCS0_6.5	12.98	18.29
			MCS1_13	12.97	18.27
			MCS2_19.5	12.96	18.28
			MCS3_26	12.94	18.30
			MCS4_39	12.95	18.23
			MCS5_52	12.91	18.25
			MCS6_58.5	12.93	18.21
			MCS7_65	12.99	18.24



802.11a (5GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	149	5745	6	7.92	12.64
			9	7.91	12.62
			12	7.89	13.58
			18	7.86	12.57
			24	7.85	12.53
			36	7.84	12.54
			48	7.86	12.59
			54	7.82	12.50
	157	5785	6	7.96	12.66
			9	7.94	12.61
			12	7.95	12.63
			18	7.92	12.59
			24	7.93	12.57
			36	7.85	12.54
			48	7.84	12.56
			54	7.80	12.58
	165	5825	6	7.90	12.67
			9	7.88	12.64
			12	7.87	12.63
			18	7.85	12.60
			24	7.86	12.54
			36	7.82	12.52
			48	7.81	12.50
			54	7.84	12.53



802.11n (HT20) (5GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	149	5745	MCS0_6.5	7.89	12.58
			MCS1_13	7.87	12.57
			MCS2_19.5	7.88	12.56
			MCS3_26	7.85	12.54
			MCS4_39	7.72	12.50
			MCS5_52	7.81	12.49
			MCS6_58.5	7.86	12.56
			MCS7_65	7.80	12.57
	157	5785	MCS0_6.5	7.87	12.58
			MCS1_13	7.86	12.53
			MCS2_19.5	7.88	12.60
			MCS3_26	7.72	12.51
			MCS4_39	7.79	12.47
			MCS5_52	7.75	12.45
			MCS6_58.5	7.81	12.52
			MCS7_65	7.84	12.53
	165	5825	MCS0_6.5	7.90	12.49
			MCS1_13	7.86	12.58
			MCS2_19.5	7.84	12.46
			MCS3_26	7.85	12.57
			MCS4_39	7.83	12.59
			MCS5_52	7.89	12.51
			MCS6_58.5	7.81	12.47
			MCS7_65	7.78	12.53



802.11n (HT20) (5GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
MIMO	149	5745	MCS0_6.5	10.90	15.59
			MCS1_13	10.88	15.58
			MCS2_19.5	10.89	15.57
			MCS3_26	10.86	15.55
			MCS4_39	10.73	15.51
			MCS5_52	10.82	15.50
			MCS6_58.5	10.87	15.57
	MCS7_65	10.81	15.58		
	157	5785	MCS0_6.5	10.88	15.59
			MCS1_13	10.87	15.54
			MCS2_19.5	10.89	15.61
			MCS3_26	10.73	15.52
			MCS4_39	10.80	15.48
			MCS5_52	10.76	15.46
			MCS6_58.5	10.82	15.53
	MCS7_65	10.85	15.54		
	165	5825	MCS0_6.5	10.91	15.50
			MCS1_13	10.87	15.59
			MCS2_19.5	10.85	15.47
			MCS3_26	10.86	15.58
			MCS4_39	10.84	15.60
MCS5_52			10.90	15.52	
MCS6_58.5			10.82	15.48	
MCS7_65	10.79	15.54			



802.11n (HT40) (5GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
SISO	151	5755	MCS0_13.5	7.76	12.23
			MCS1_27	7.72	12.29
			MCS2_40.5	7.70	12.24
			MCS3_54	7.68	12.27
			MCS4_81	7.66	12.20
			MCS5_108	7.71	12.18
			MCS6_121.5	7.69	12.16
			MCS7_135	7.63	12.17
	157	5785	MCS0_13.5	7.78	12.26
			MCS1_27	7.72	12.23
			MCS2_40.5	7.76	12.27
			MCS3_54	7.75	12.22
			MCS4_81	7.71	12.20
			MCS5_108	7.67	12.28
			MCS6_121.5	7.65	12.24
			MCS7_135	7.60	12.19
	163	5815	MCS0_13.5	7.73	12.29
			MCS1_27	7.71	12.31
			MCS2_40.5	7.70	12.24
			MCS3_54	7.66	12.27
			MCS4_81	7.69	12.22
MCS5_108			7.64	12.19	
MCS6_121.5			7.62	12.16	
MCS7_135	7.59	12.12			



802.11n (HT40) (5GHz)					
System Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Average Power (dBm)	Peak Power (dBm)
MIMO	151	5755	MCS0_13.5	10.77	15.24
			MCS1_27	10.73	15.30
			MCS2_40.5	10.71	15.25
			MCS3_54	10.69	15.28
			MCS4_81	10.67	15.21
			MCS5_108	10.72	15.19
			MCS6_121.5	10.70	15.17
			MCS7_135	10.64	15.18
	157	5785	MCS0_13.5	10.79	15.27
			MCS1_27	10.73	15.24
			MCS2_40.5	10.77	15.28
			MCS3_54	10.76	15.23
			MCS4_81	10.72	15.21
			MCS5_108	10.68	15.29
			MCS6_121.5	10.66	15.25
			MCS7_135	10.61	15.20
	163	5815	MCS0_13.5	10.74	15.30
			MCS1_27	10.72	15.32
			MCS2_40.5	10.71	15.25
			MCS3_54	10.67	15.28
			MCS4_81	10.70	15.23
			MCS5_108	10.65	15.20
			MCS6_121.5	10.63	15.17
			MCS7_135	10.60	15.13



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 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*
20.5–5	56	46
5–30	60	50

**Decreases with the logarithm of the frequency.*

2.2.3 Equipment Under Test and Modification State

Serial No: SS220414800525 / Test Configuration A

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

June 30, 2014 / AC

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 TUV SUD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8°C
 Relative Humidity 47.3%
 ATM Pressure 98.7 kPa

2.2.7 Additional Observations

- The EUT is connected to public AC mains via supplied AC power adaptor/charger.
- The EUT was verified using worst case configuration (worst case channel/mode). The EUT was set to transmit max power while plugged into the AC power adaptor.
- EUT verified using input voltage of 120VAC/60Hz.



- 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)

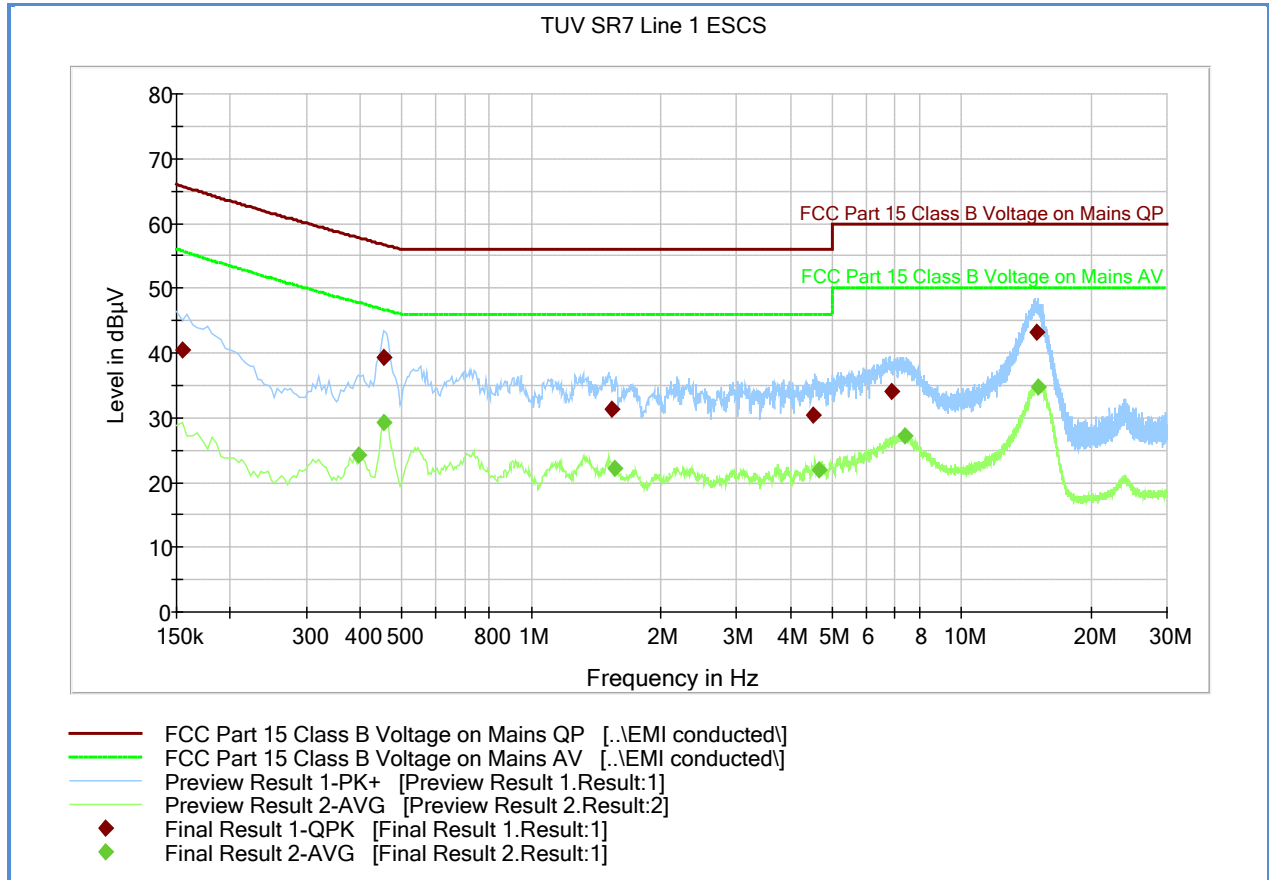
Measuring equipment raw measurement (db μ V) @ 150kHz		5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9
	Asset# 1177 (cable)	0.15
	Asset# 1176 (cable)	0.35
	Asset# 7567 (LISN)	0.30
Reported QuasiPeak Final Measurement (dbμV) @ 150kHz		26.2

2.2.9 Test Results

Compliant. See attached plots and tables.



2.2.10 120VAC/60Hz, Line 1_Worst Case Configuration_802.11n 2.4GHz(HT20)_Mid Channel Transmit mode



Quasi Peak

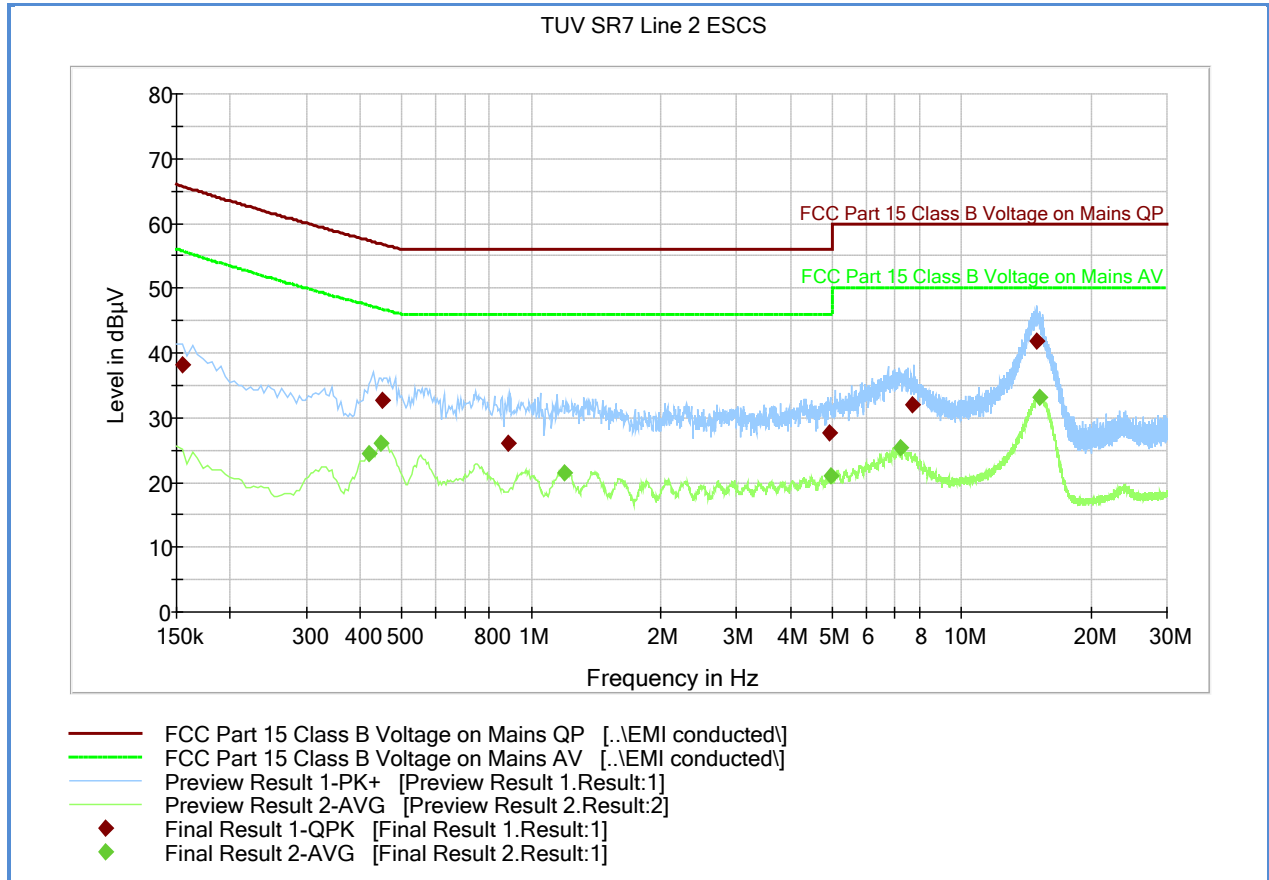
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	40.6	1000.0	9.000	Off	L1	20.1	25.2	65.7
0.456000	39.3	1000.0	9.000	Off	L1	20.0	17.4	56.7
1.536000	31.4	1000.0	9.000	Off	L1	20.0	24.6	56.0
4.524000	30.3	1000.0	9.000	Off	L1	20.5	25.7	56.0
6.882000	34.1	1000.0	9.000	Off	L1	20.6	25.9	60.0
14.995500	43.3	1000.0	9.000	Off	L1	20.8	16.7	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.397500	24.2	1000.0	9.000	Off	L1	20.1	23.6	47.8
0.456000	29.2	1000.0	9.000	Off	L1	20.0	17.5	46.7
1.567500	22.2	1000.0	9.000	Off	L1	20.1	23.8	46.0
4.654500	22.0	1000.0	9.000	Off	L1	20.5	24.0	46.0
7.363500	27.1	1000.0	9.000	Off	L1	20.5	22.9	50.0
15.076500	34.8	1000.0	9.000	Off	L1	20.8	15.2	50.0



2.2.11 120VAC/60Hz, Line 2_Worst Case Configuration_802.11n 2.4GHz(HT20)_Mid Channel Transmit mode



Quasi Peak

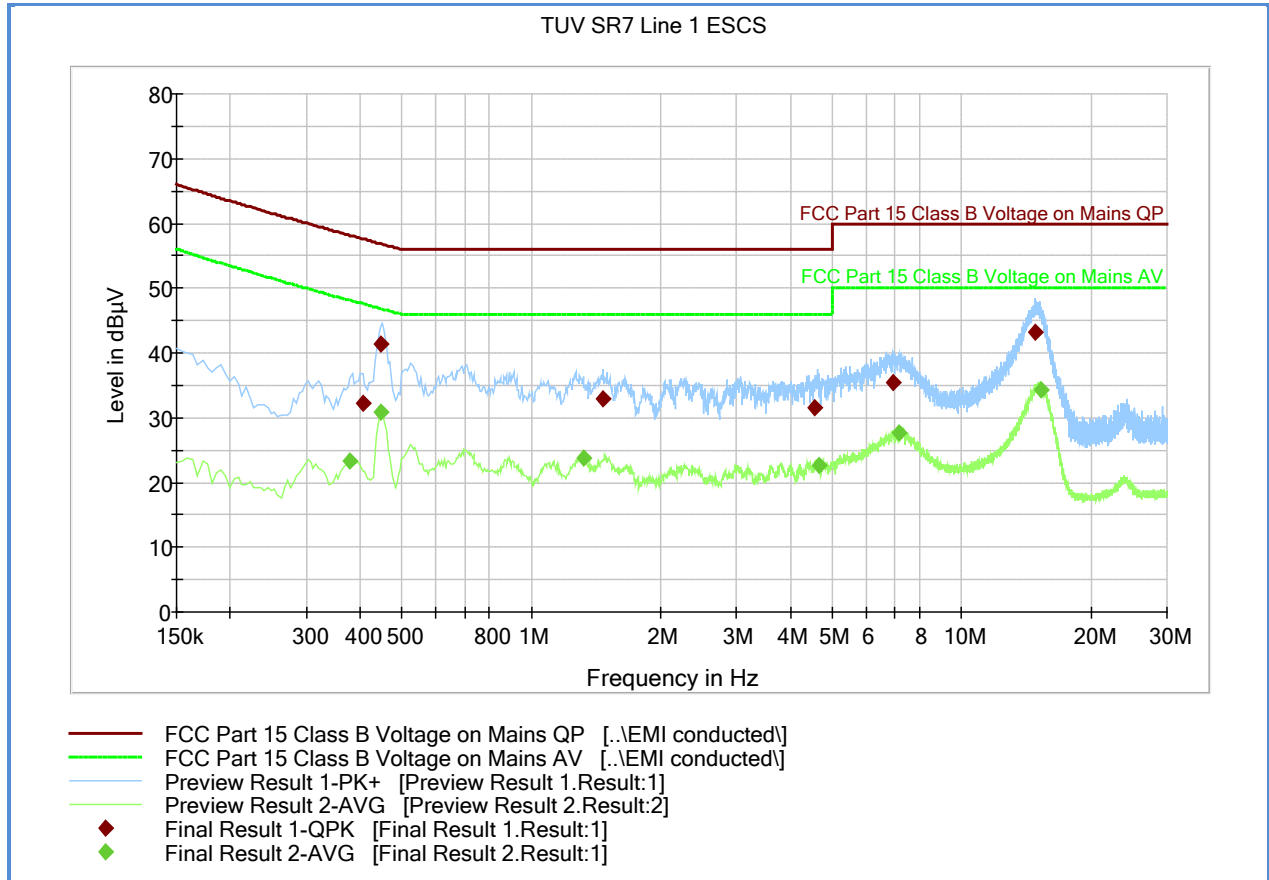
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	38.2	1000.0	9.000	Off	N	20.1	27.6	65.7
0.451500	32.6	1000.0	9.000	Off	N	20.0	24.2	56.8
0.883500	26.2	1000.0	9.000	Off	N	20.0	29.8	56.0
4.942500	27.7	1000.0	9.000	Off	N	20.4	28.3	56.0
7.665000	31.9	1000.0	9.000	Off	N	20.4	28.1	60.0
14.982000	41.9	1000.0	9.000	Off	N	20.7	18.1	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.420000	24.3	1000.0	9.000	Off	N	20.0	23.0	47.3
0.447000	26.1	1000.0	9.000	Off	N	20.0	20.8	46.8
1.198500	21.5	1000.0	9.000	Off	N	20.0	24.5	46.0
4.983000	21.0	1000.0	9.000	Off	N	20.4	25.0	46.0
7.183500	25.4	1000.0	9.000	Off	N	20.4	24.6	50.0
15.193500	33.2	1000.0	9.000	Off	N	20.8	16.8	50.0



2.2.12 120VAC/60Hz, Line 1_Worst Case Configuration_802.11n 5GHz(HT20)_High Channel Transmit mode



Quasi Peak

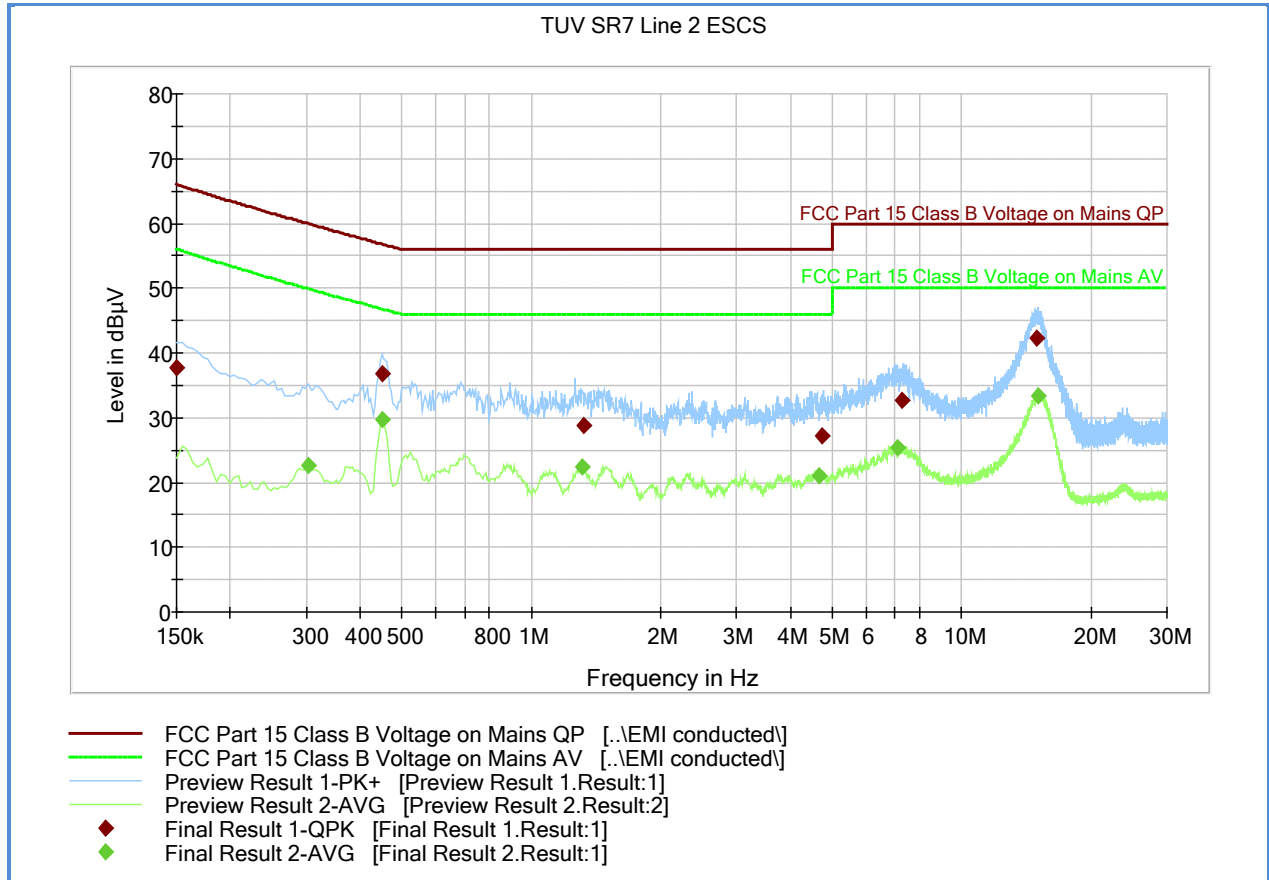
Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.406500	32.2	1000.0	9.000	Off	L1	20.1	25.4	57.6
0.447000	41.3	1000.0	9.000	Off	L1	20.0	15.6	56.9
1.464000	32.8	1000.0	9.000	Off	L1	20.0	23.2	56.0
4.560000	31.5	1000.0	9.000	Off	L1	20.5	24.5	56.0
6.945000	35.4	1000.0	9.000	Off	L1	20.6	24.6	60.0
14.883000	43.2	1000.0	9.000	Off	L1	20.8	16.8	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.379500	23.4	1000.0	9.000	Off	L1	20.0	24.7	48.1
0.447000	30.8	1000.0	9.000	Off	L1	20.0	16.1	46.8
1.324500	23.7	1000.0	9.000	Off	L1	20.2	22.3	46.0
4.654500	22.6	1000.0	9.000	Off	L1	20.5	23.4	46.0
7.156500	27.6	1000.0	9.000	Off	L1	20.5	22.4	50.0
15.288000	34.4	1000.0	9.000	Off	L1	20.9	15.6	50.0



2.2.13 120VAC/60Hz, Line 2_Worst Case Configuration_802.11n 5GHz(HT20)_High Channel Transmit mode



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	37.8	1000.0	9.000	Off	N	20.1	28.2	66.0
0.451500	36.9	1000.0	9.000	Off	N	20.0	19.9	56.8
1.324500	28.7	1000.0	9.000	Off	N	20.1	27.3	56.0
4.749000	27.2	1000.0	9.000	Off	N	20.4	28.8	56.0
7.273500	32.7	1000.0	9.000	Off	N	20.4	27.3	60.0
14.991000	42.3	1000.0	9.000	Off	N	20.7	17.7	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.303000	22.7	1000.0	9.000	Off	N	20.1	27.2	49.9
0.451500	29.7	1000.0	9.000	Off	N	20.0	17.0	46.8
1.315500	22.4	1000.0	9.000	Off	N	20.1	23.6	46.0
4.659000	21.1	1000.0	9.000	Off	N	20.4	24.9	46.0
7.071000	25.3	1000.0	9.000	Off	N	20.4	24.7	50.0
15.117000	33.4	1000.0	9.000	Off	N	20.8	16.6	50.0



2.3 MINIMUM 6 dB RF BANDWIDTH

2.3.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.3.2 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.

2.3.3 Equipment Under Test and Modification State

Serial No: SS220414800525 / Test Configuration A

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

June 30, 2014 / AC

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 TUV SUD America Inc. Rancho Bernardo facility

Ambient Temperature 25.8°C
 Relative Humidity 47.3%
 ATM Pressure 98.7 kPa

2.3.7 Additional Observations

- This is a conducted test as per section 8.0 DTS bandwidth guidance of KDB 558074 D01 DTS Meas Guidance v03r02 (Compliance Measurement Guidance for 15.247 Digital Transmission Systems, June 05, 2014).
- The offset table below to the power meter was used for the power splitter, external attenuator and cable used.

Channel (#)	Frequency (MHz)	Offset (dB)
1	2412	27.5
6	2437	27.6
11	2462	27.6
149	5745	31.2
157	5785	31.0
165	5825	31.7

- Conducted antenna port 0 and 1 were verified and found transmit port 1 was worst case scenario when in SISO mode. Therefore, only transmit port 1 was reported.
- Automatic bandwidth function of the spectrum analyzer was used for this test.
- Span is wide enough to capture the channel transmission.
- RBW is 1% to 5% of the fundamental bandwidth.

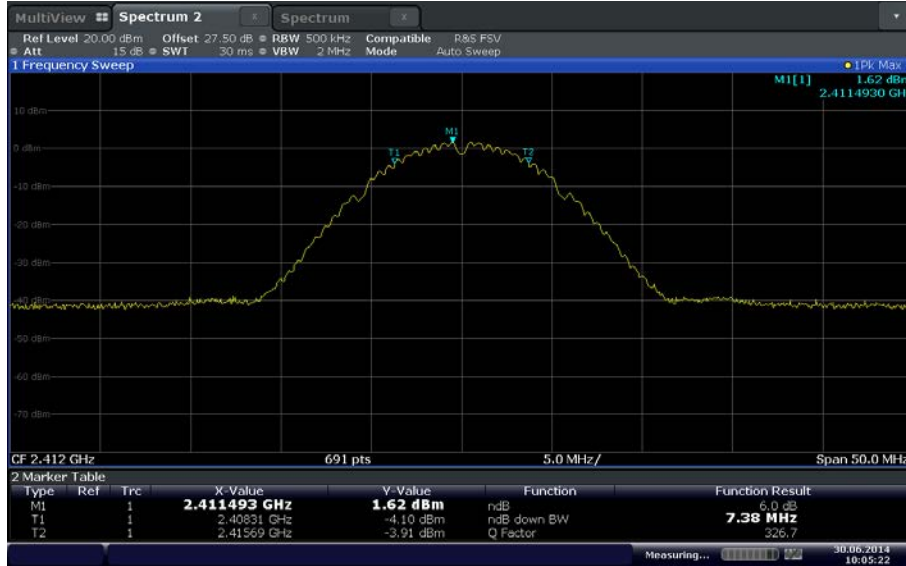


- VBW is 3X RBW.
- 100 kHz RBW setting not possible. Any RBW setting below 500 kHz will result in inaccurate measurement due to pronounced dip in the middle of the fundamental signal dividing the bandwidth by half when using automatic bandwidth function of the spectrum analyzer.
- Sweep is auto.
- Detector is peak.
- Trace is max hold.



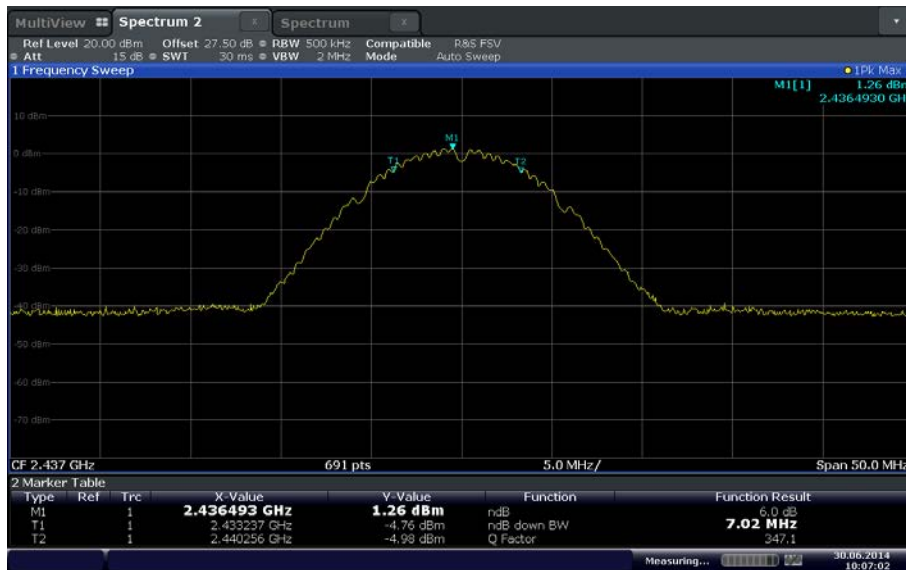
2.3.8 Test Results/Plots

802.11b_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11b	1 (2412 MHz)	7.38	0.500	Complies



Date: 30 JUN 2014 10:05:24

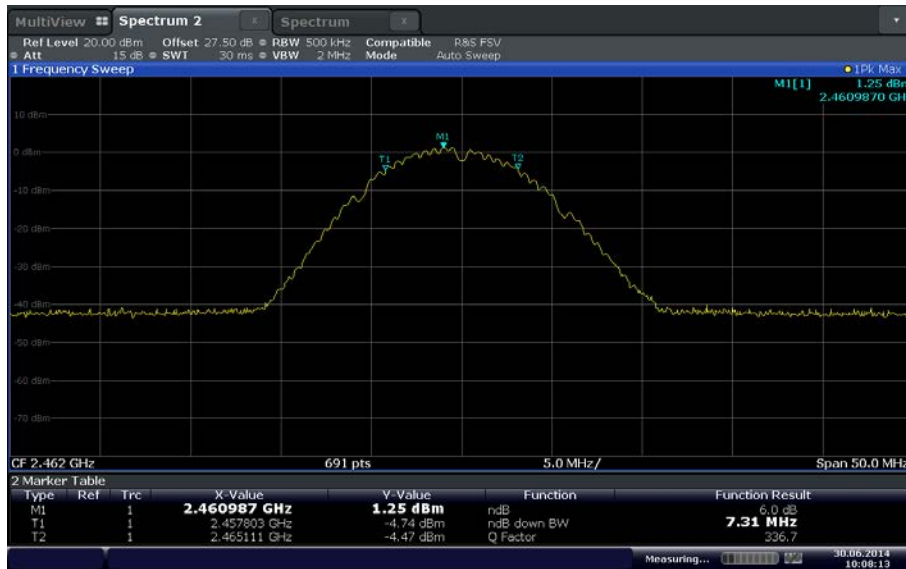
802.11b_Mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11b	6 (2437 MHz)	7.02	0.500	Complies



Date: 30 JUN 2014 10:07:02

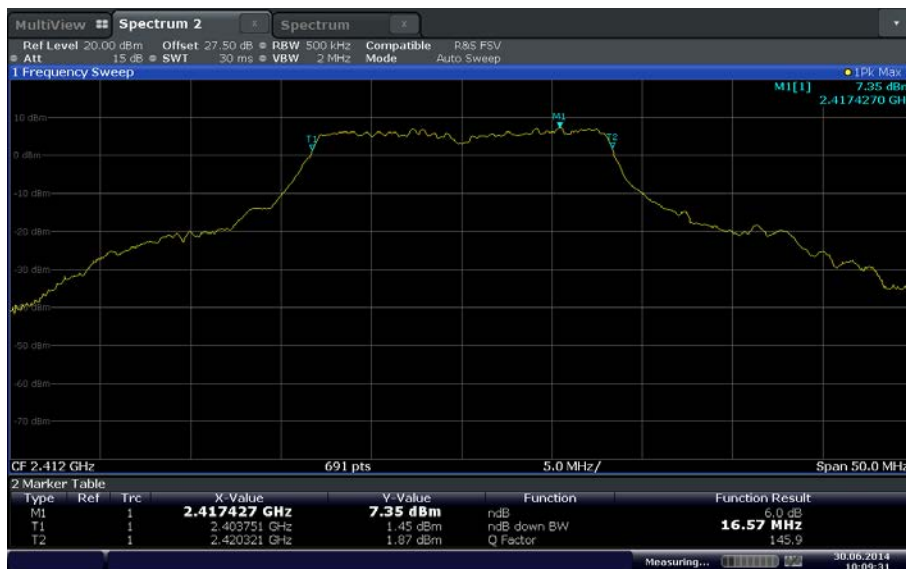


802.11b_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11b	11 (2462 MHz)	7.31	0.500	Complies



Date: 30 JUN 2014 10:08:13

802.11g_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11g	1 (2412 MHz)	16.57	0.500	Complies



Date: 30 JUN 2014 10:09:31

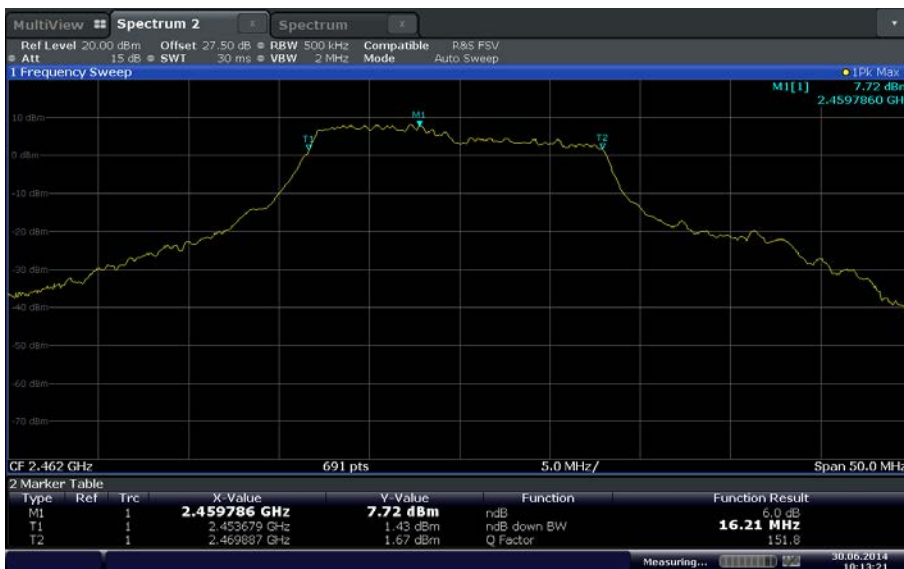


802.11g_Mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11g	6 (2437 MHz)	16.64	0.500	Complies



Date: 30 JUN 2014 10:10:31

802.11g_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11g	11 (2462 MHz)	16.21	0.500	Complies



Date: 30 JUN 2014 10:13:21



802.11n_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	1 (2412 MHz)	17.51	0.500	Complies



Date: 30 JUN 2014 10:14:41

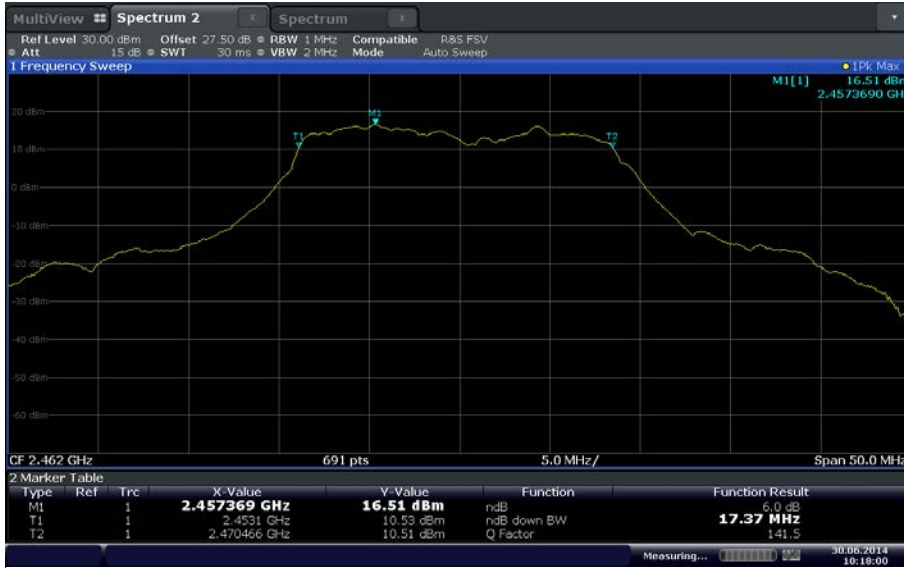
802.11n_mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	6 (2437 MHz)	17.44	0.500	Complies



Date: 30 JUN 2014 10:16:13

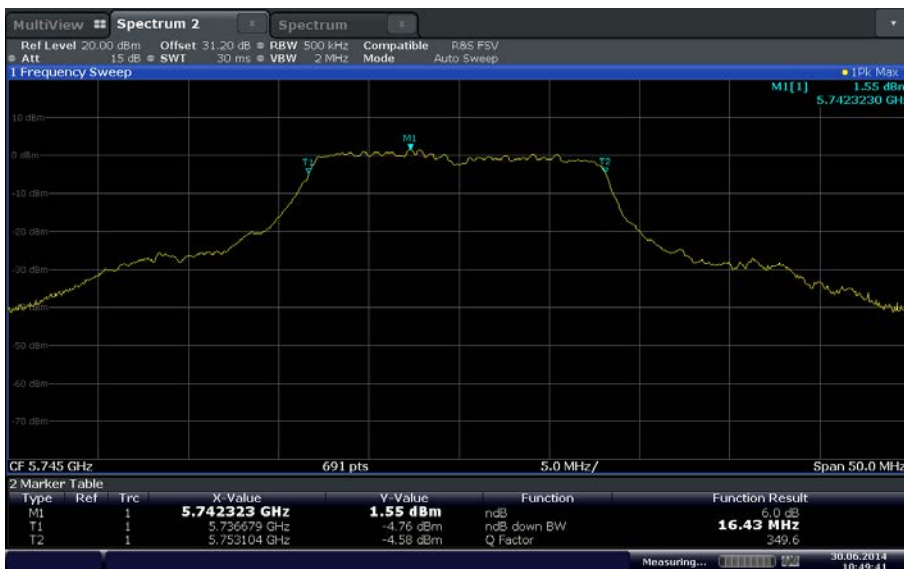


802.11n_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	11 (2462 MHz)	17.37	0.500	Complies



Date: 30 JUN 2014 10:18:00

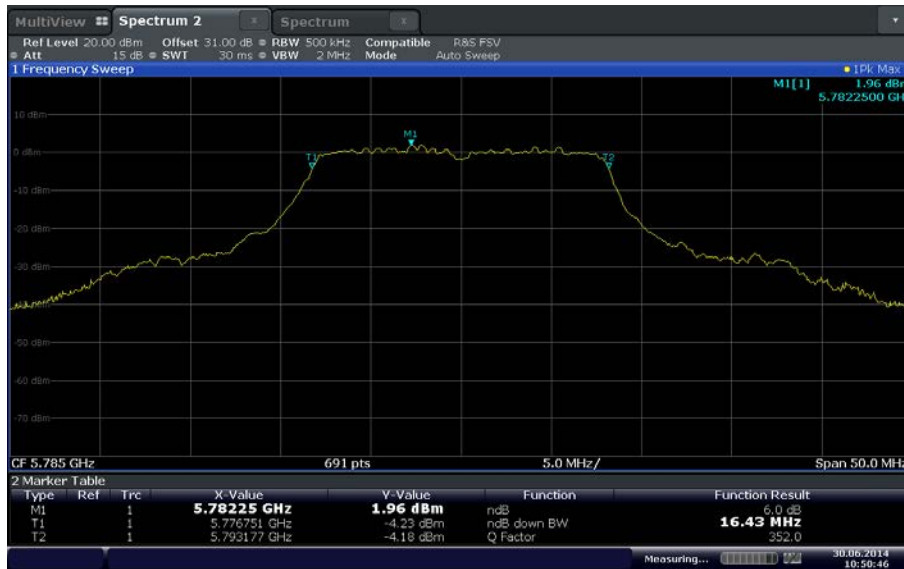
802.11a_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11a	149 (5745 MHz)	16.43	0.500	Complies



Date: 30 JUN 2014 10:49:41

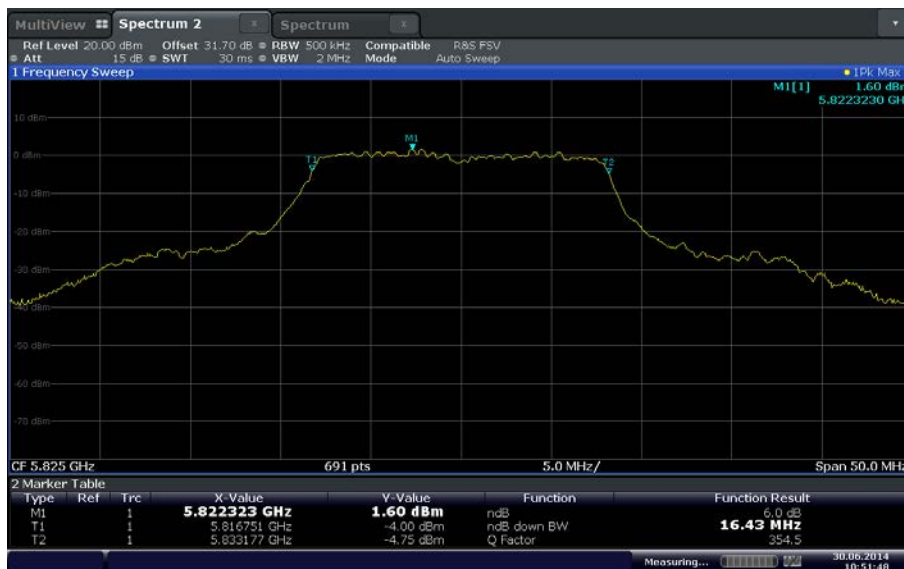


802.11a_Mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11a	157 (5785 MHz)	16.43	0.500	Complies



Date: 30 JUN 2014 10:50:46

802.11a_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Tx Port 1 / 802.11a	165 (5825 MHz)	16.43	0.500	Complies



Date: 30 JUN 2014 10:51:48



802.11n_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	149 (5745 MHz)	17.73	0.500	Complies



Date: 30 JUN 2014 10:43:21

802.11n_Mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	157 (5785 MHz)	17.58	0.500	Complies



Date: 30 JUN 2014 10:47:37



802.11n_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT20)	165 (5825 MHz)	17.73	0.500	Complies



Date: 30 JUN 2014 10:46:25

802.11n_Low Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT40)	151 (5755 MHz)	35.75	0.500	Complies



Date: 30 JUN 2014 10:46:32



802.11n_Mid Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT40)	157 (5785 MHz)	35.46	0.500	Complies



Date: 30 JUN 2014 10:59:05

802.11n_High Channel				
Antenna Port / Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
MIMO / 802.11n (HT40)	163 (5815 MHz)	34.01	0.500	Complies



Date: 30 JUN 2014 11:02:20



2.4 OUT-OF-BAND EMISSIONS - CONDUCTED

2.4.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.4.2 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)).

2.4.3 Equipment Under Test and Modification State

Serial No: SS220414800525 / Test Configuration A

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

June 30, 2014 / AC

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	25.8°C
Relative Humidity	47.3%
ATM Pressure	98.7 kPa

2.4.7 Additional Observations

- This is a conducted test.
- 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).
- Conducted antenna port 0 and 1 were verified and found transmit port 1 was worst case scenario when in SISO mode. Therefore, only transmit port 1 was reported.
- Spectrum was searched from 30MHz up to 26GHz (802.11 b/g/n) and up to 40GHz (802.11 a/n).



- The offset table below to the power meter was used for the power splitter, external attenuator and cable used.

Channel (#)	Frequency (MHz)	Offset (dB)
1	2412	27.5
6	2437	27.6
11	2462	27.6
149	5745	31.2
157	5785	31.0
165	5825	31.7



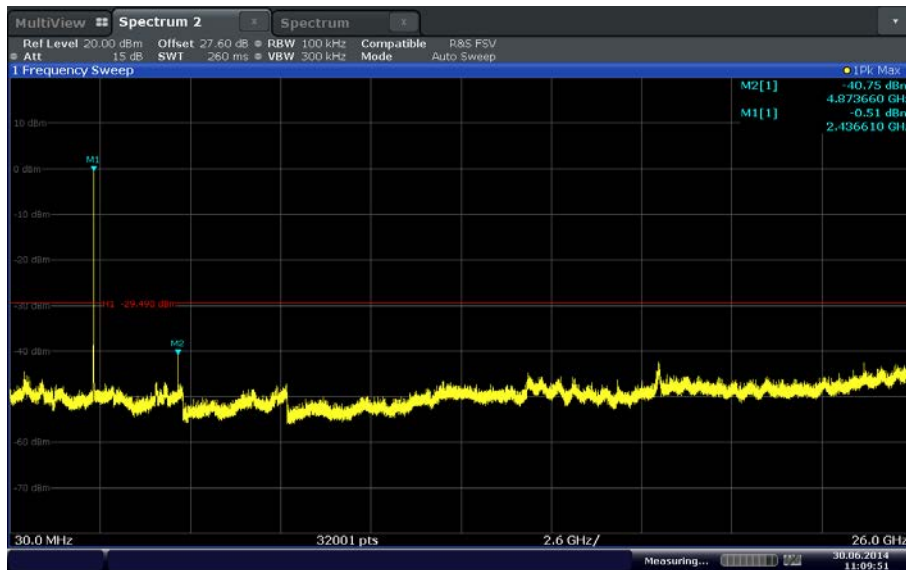
2.4.8 Test Results/Plots

802.11b_Low Channel (2412 MHz)



Date: 30 JUN 2014 11:07:21

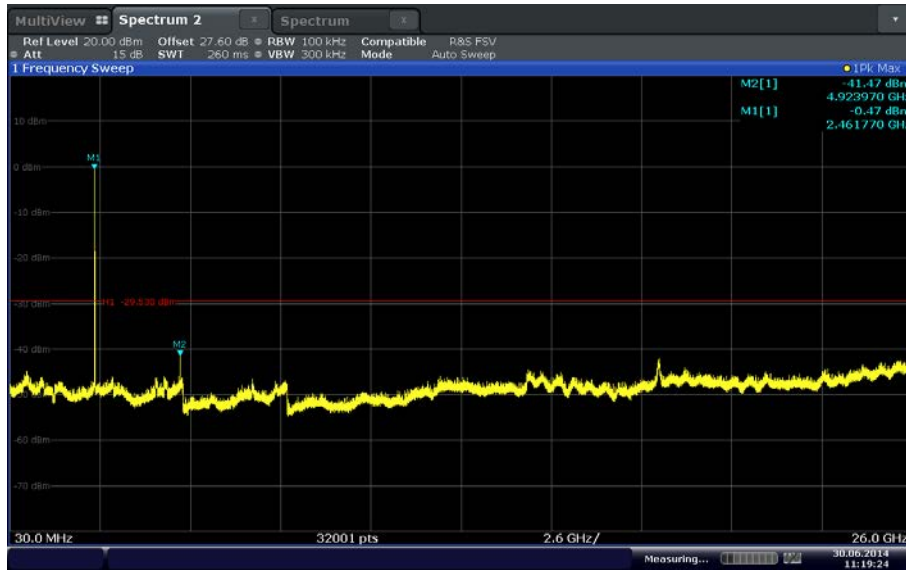
802.11b_Mid Channel (2437 MHz)



Date: 30 JUN 2014 11:09:51

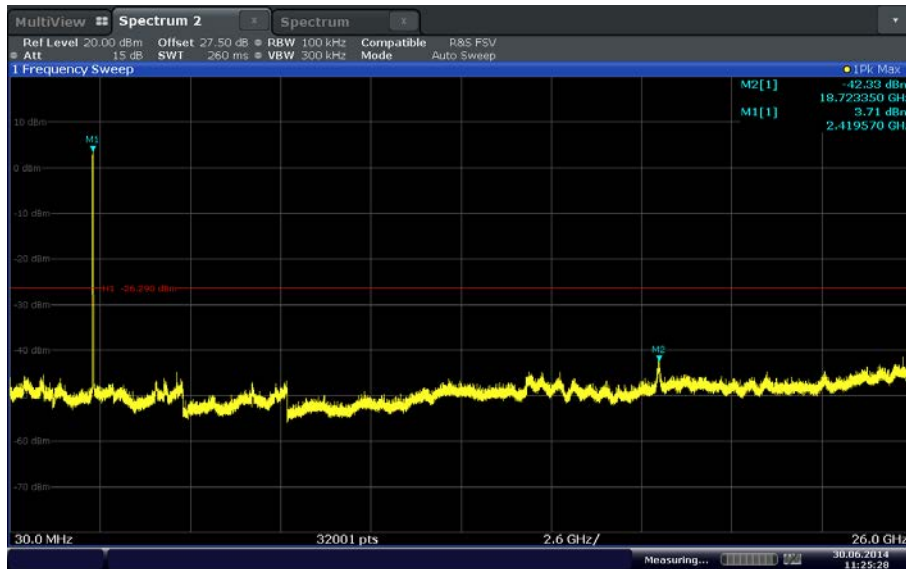


802.11b_High Channel (2462 MHz)



Date: 30 JUN 2014 11:19:24

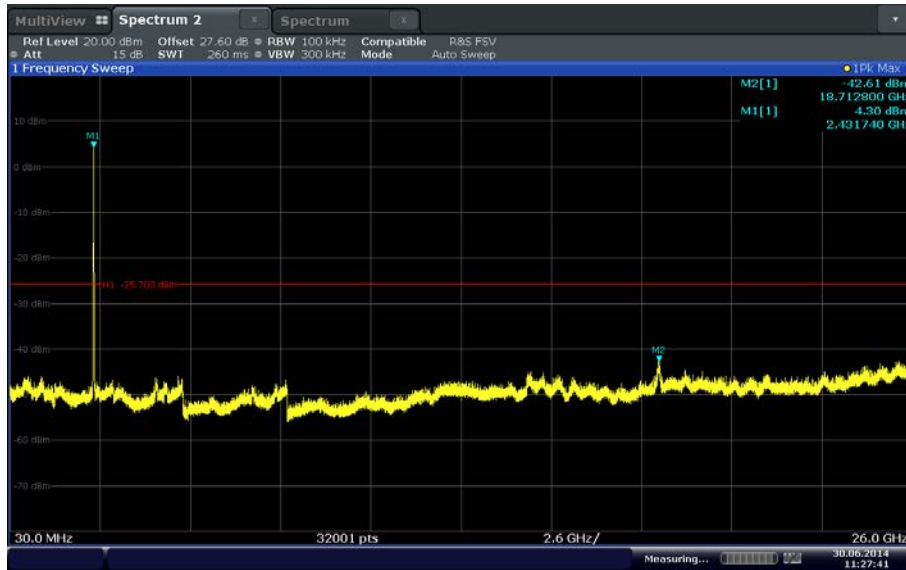
802.11g_Low Channel (2412 MHz)



Date: 30 JUN 2014 11:25:28

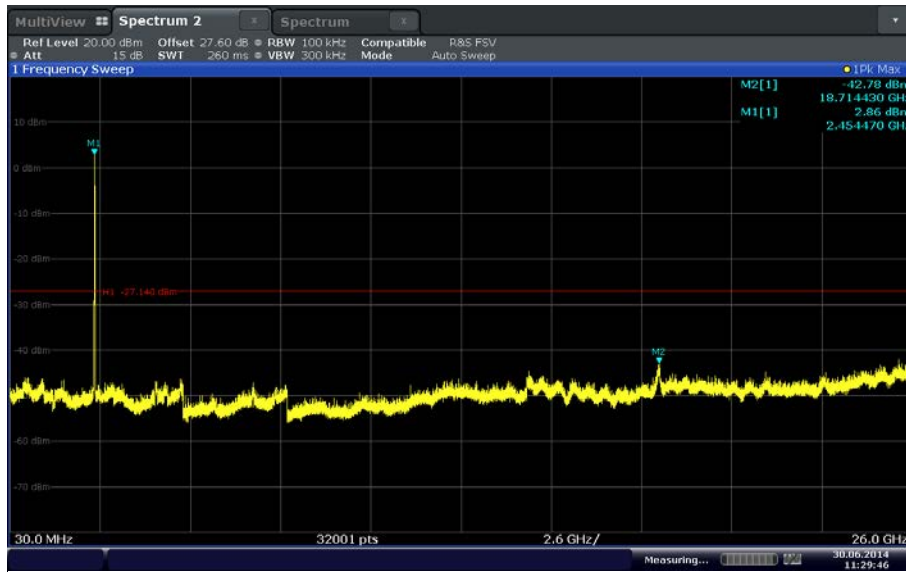


802.11g_Mid Channel (2437 MHz)



Date: 30 JUN 2014 11:27:41

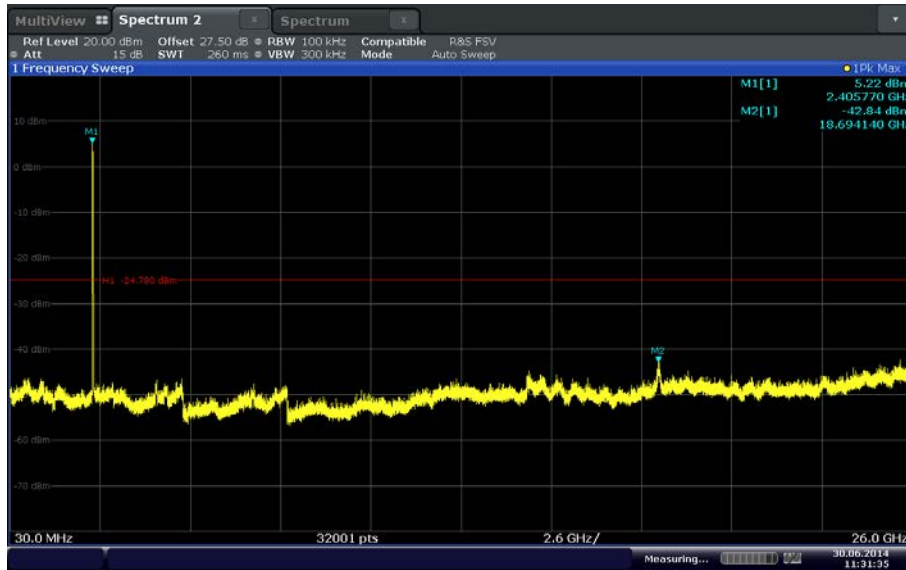
802.11g_High Channel (2462 MHz)



Date: 30 JUN 2014 11:29:47

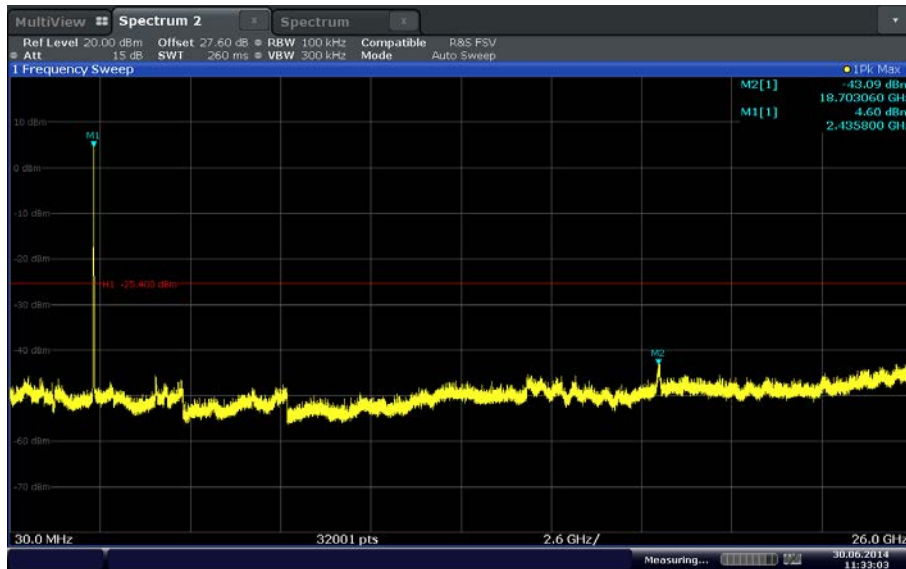


802.11n (HT20)_Low Channel (2412 MHz)



Date: 30 JUN 2014 11:31:35

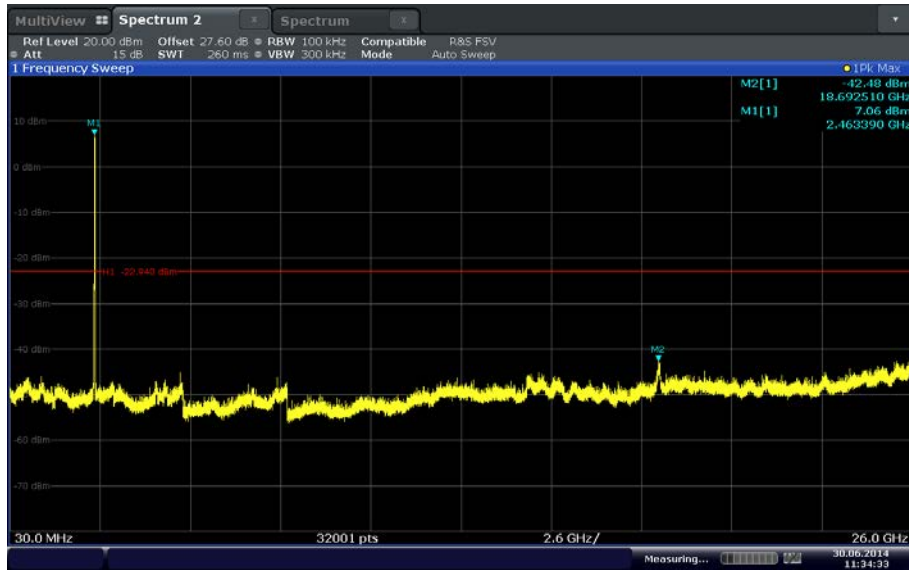
802.11n (HT20)_Mid Channel (2437 MHz)



Date: 30 JUN 2014 11:33:04

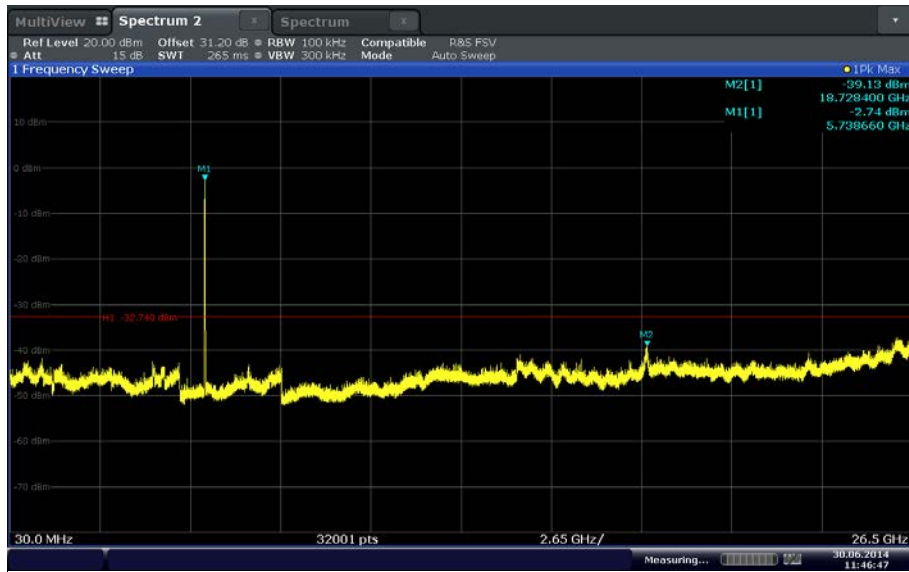


802.11n (HT20)_High Channel (2462 MHz)



Date: 30 JUN 2014 11:34:34

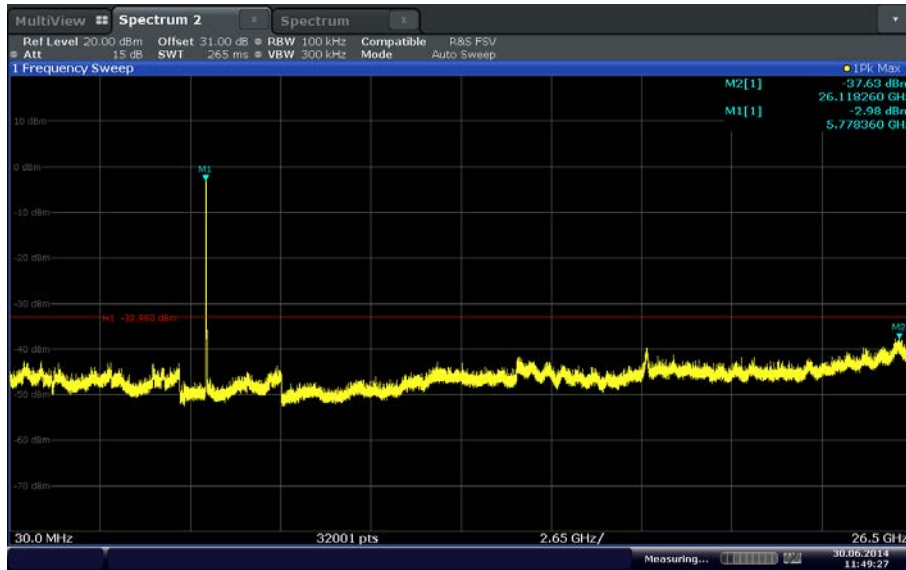
802.11a_Low Channel (5745 MHz)



Date: 30 JUN 2014 11:46:48

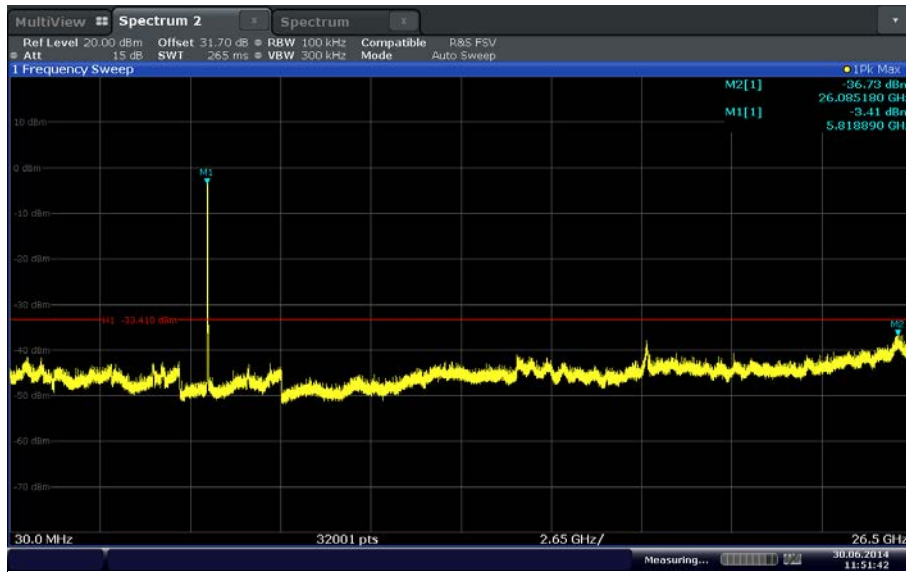


802.11a_Mid Channel (5785 MHz)



Date: 30 JUN 2014 11:49:27

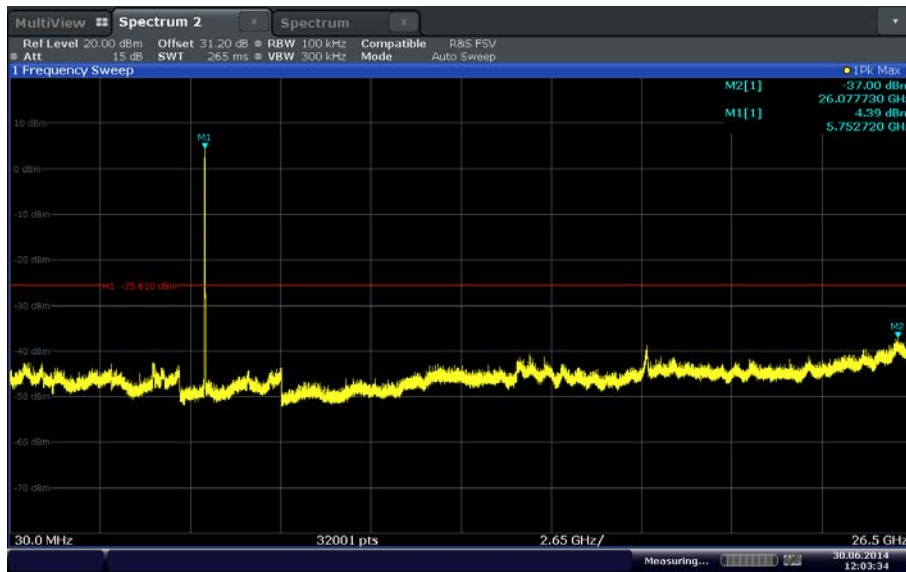
802.11a_High Channel (5825 MHz)



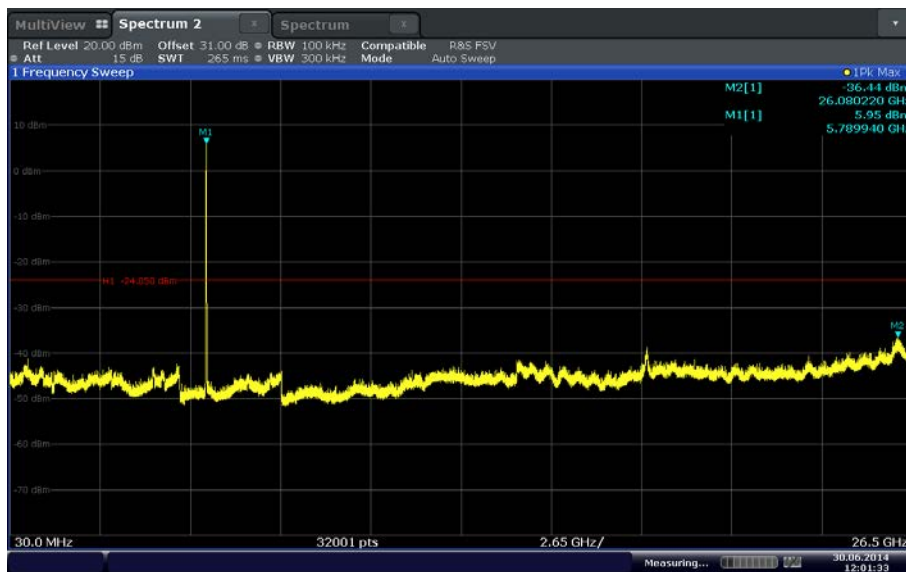
Date: 30 JUN 2014 11:51:42



802.11n (HT20)_Low Channel (5745 MHz)

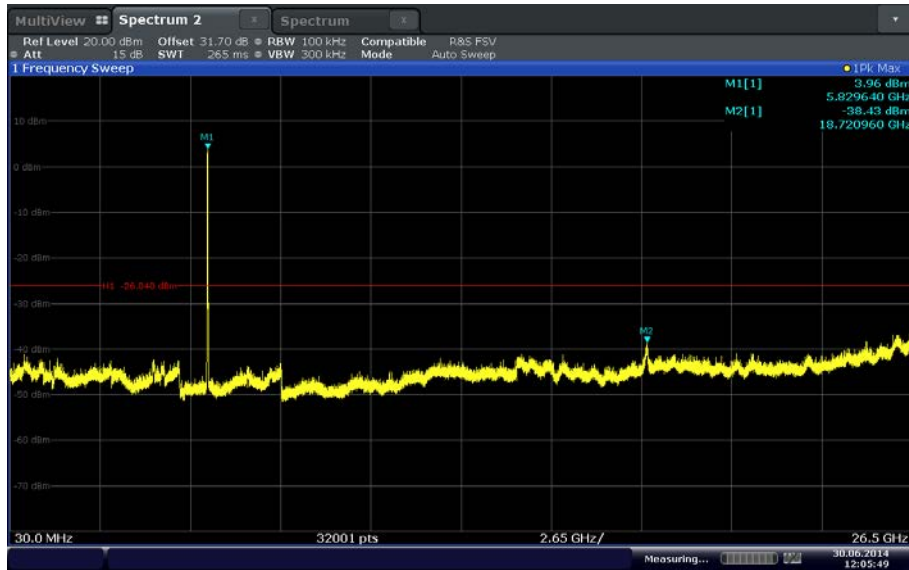


802.11n (HT20)_Mid Channel (5785 MHz)



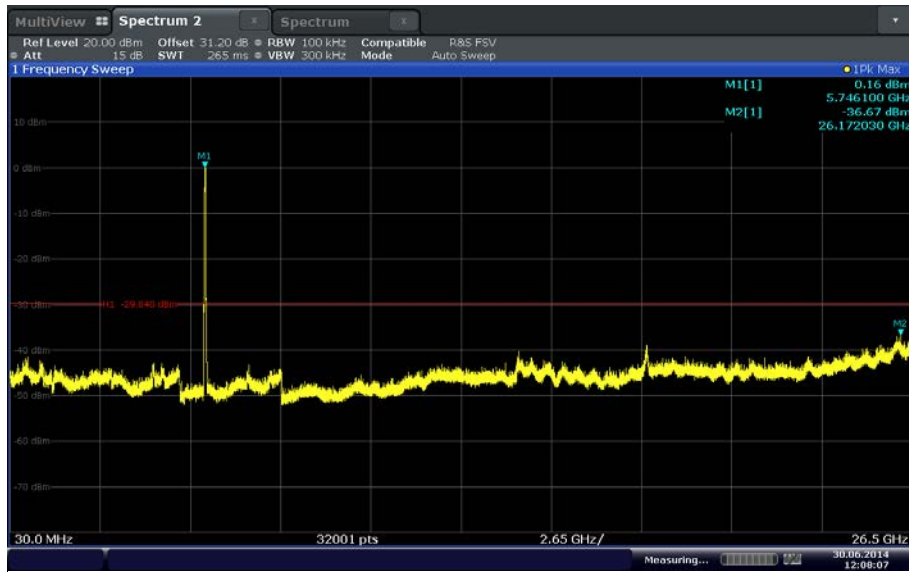


802.11n (HT20)_High Channel (5825 MHz)



Date: 30 JUN 2014 12:05:50

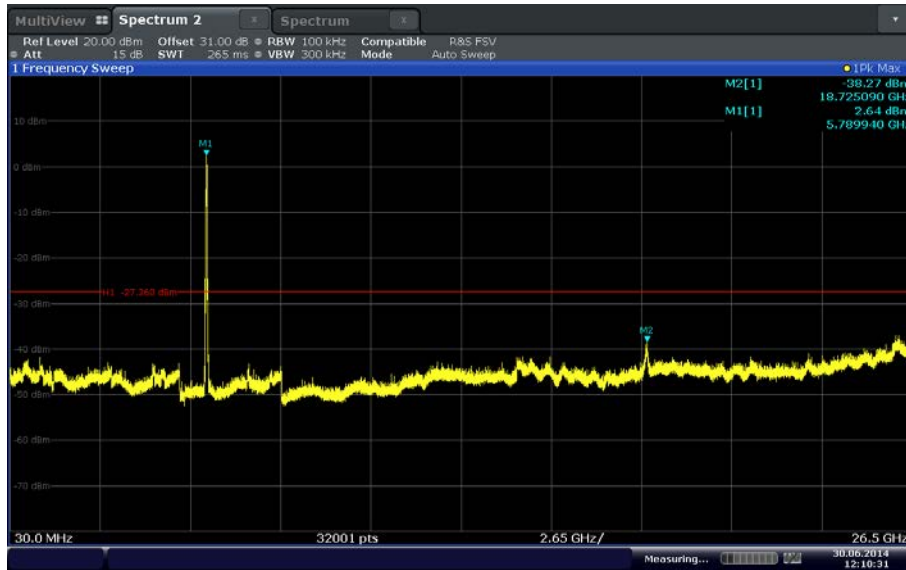
802.11n (HT40)_Low Channel (5755 MHz)



Date: 30 JUN 2014 12:08:07

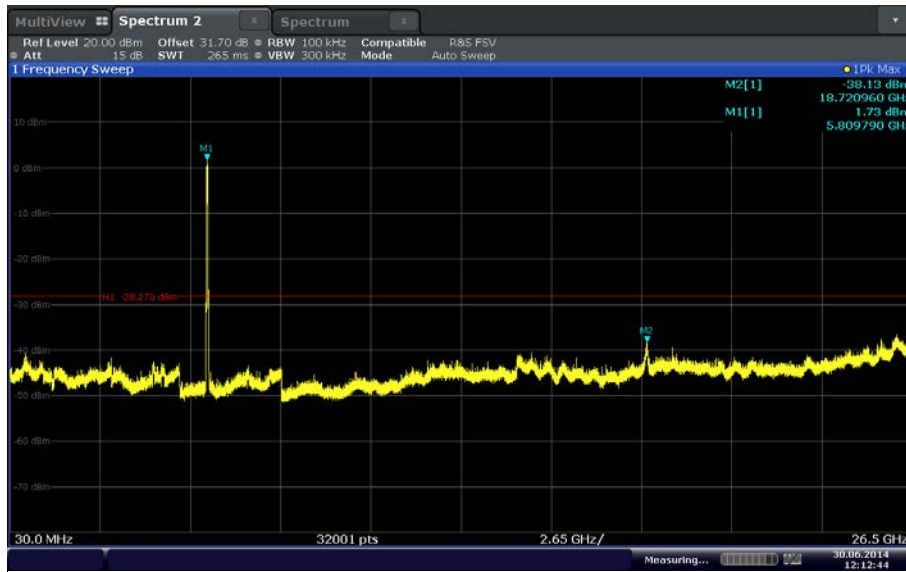


802.11n (HT40)_Mid Channel (5785 MHz)



Date: 30 JUN 2014 12:10:31

802.11n (HT40)_High Channel (5815 MHz)



Date: 30 JUN 2014 12:12:44



2.5 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.5.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.5.2 Standard Applicable

See previous test.

2.5.3 Equipment Under Test and Modification State

Serial No: SS220414800525/ Test Configuration A

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

June 30, 2014 / AC

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	25.8°C
Relative Humidity	47.3%
ATM Pressure	98.7 kPa

2.5.7 Additional Observations

- Setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
- Band-edge (2400MHz and 2483.5MHz/5725MHz and 5850MHz) emissions were verified in this test.
- The spectrum analyzer was centred on the band-edge frequency while setting the EUT to the corresponding transmit channel (i.e. Low Channel for lower band-edge).
- RBW setting used is 100 kHz.
- Limit used is 30dB which is relative to the in-band average output power in 100 kHz.
- The worst delta from the highest level of desired power to or beyond the band edge is presented in this test report.
- Conducted antenna port 0 and 1 were verified and found transmit port 1 was worst case scenario when in SISO mode. Therefore, only transmit port 1 was reported.
- Only some of test plots were performed based on Integration test method procedure per section 13.3 of KDB 558074 D01 DTS Meas Guidance v03r02 (Compliance Measurement Guidance for 15.247 Digital Transmission Systems, June 05, 2014). See attached plots for detail.

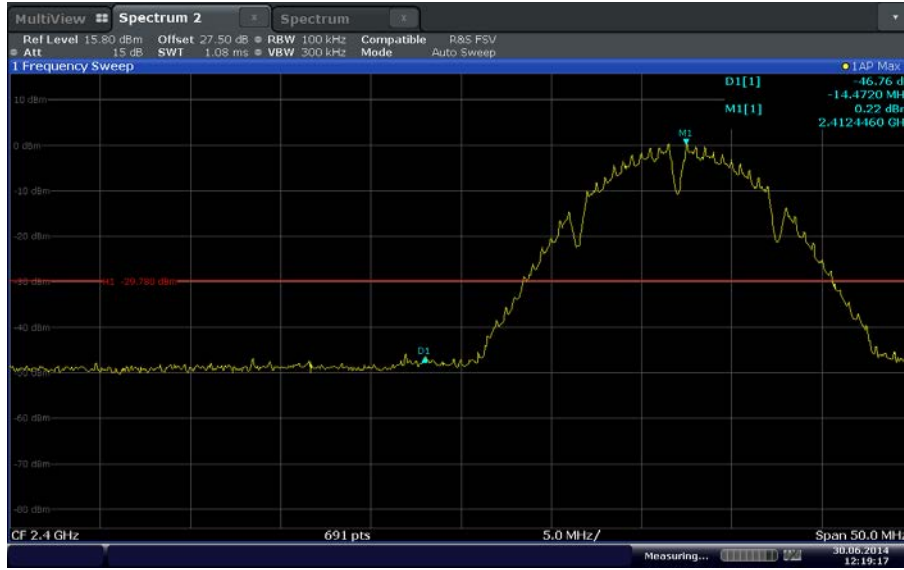


2.5.8 Test Results

Complies. See attached plots.

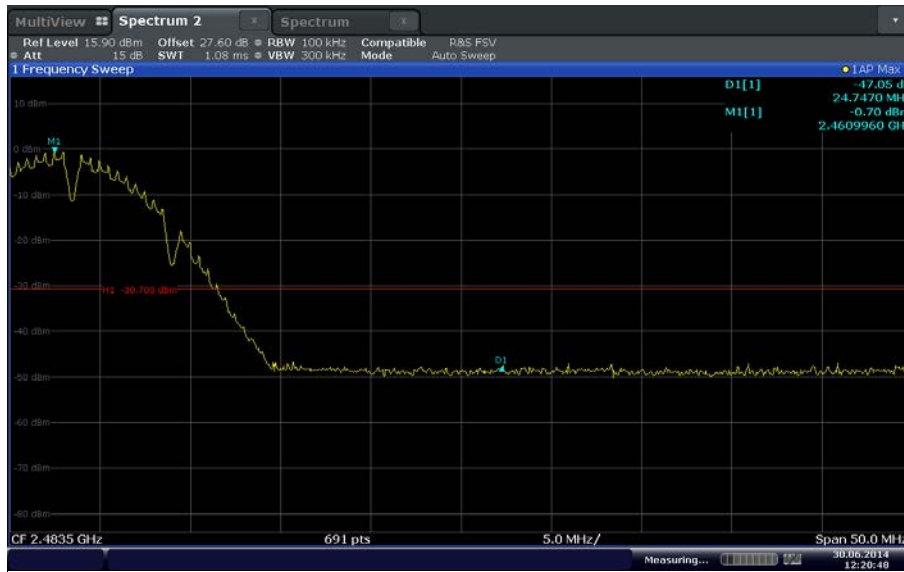


802.11b_Lower Band Edge of 2400 MHz Band



Date: 30 JUN 2014 12:19:18

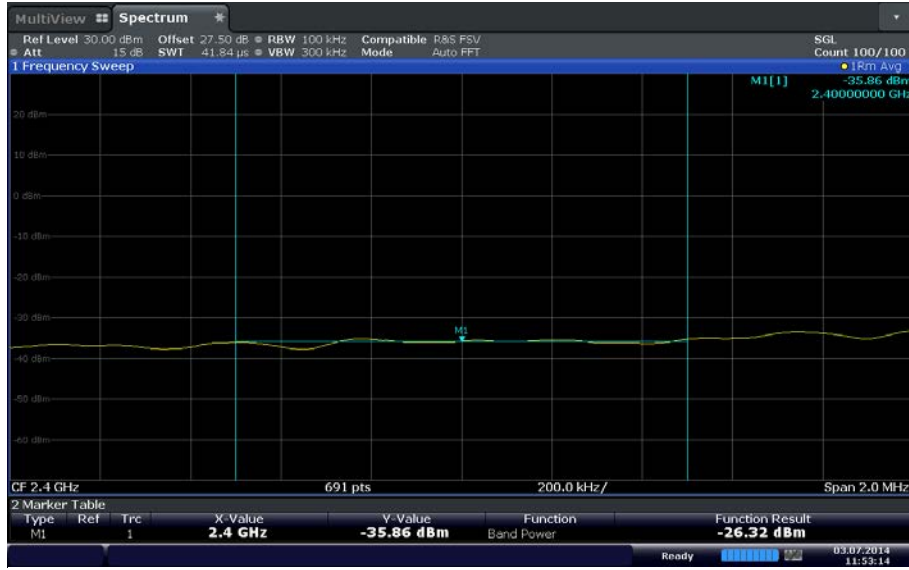
802.11b_Higher Band Edge of 2483.5 MHz Band



Date: 30 JUN 2014 12:20:47

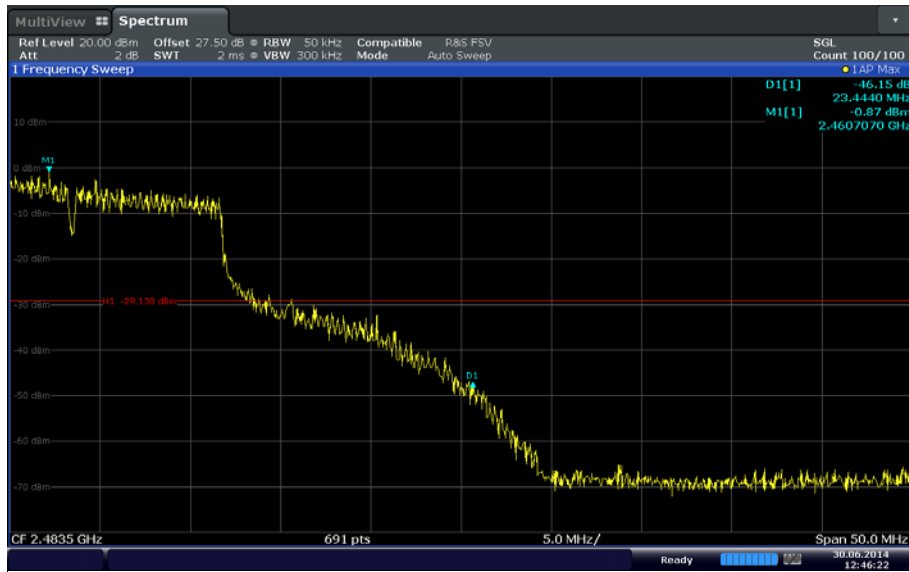


802.11g_Lower Band Edge of 2400 MHz Band (Integration test method)



Date: 3 JUL 2014 11:53:14

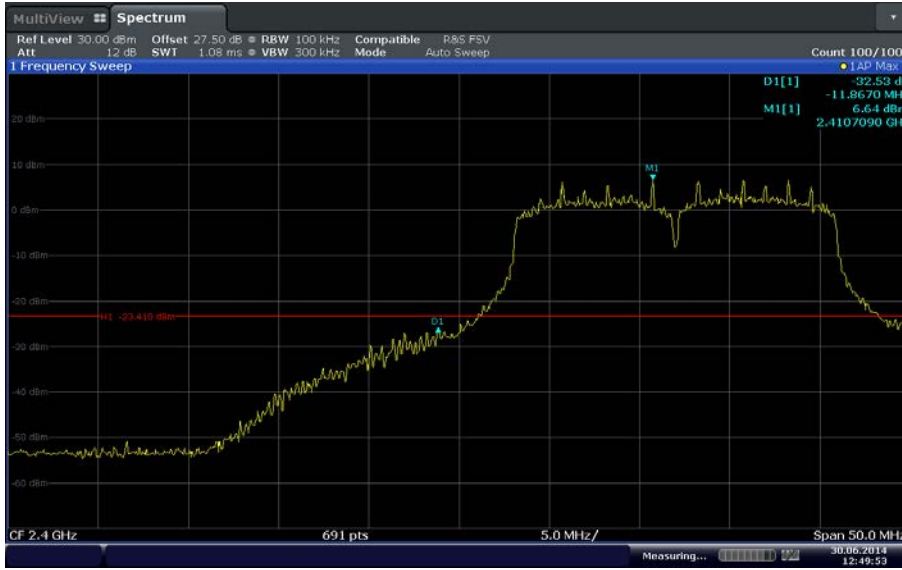
802.11g_Higher Band Edge of 2483.5 MHz Band



Date: 30 JUN 2014 12:46:22

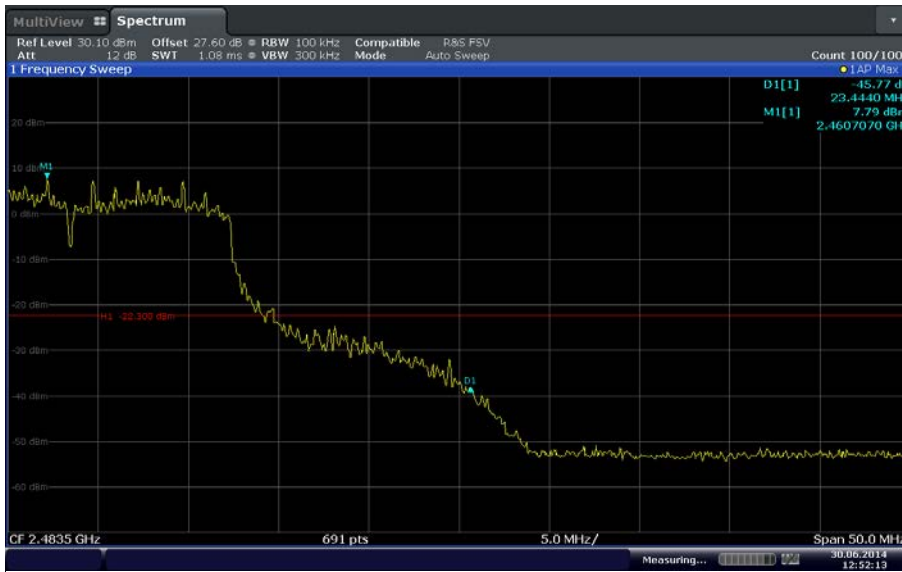


802.11n (HT20)_Lower Band Edge of 2400 MHz Band



Date: 30 JUN 2014 12:49:53

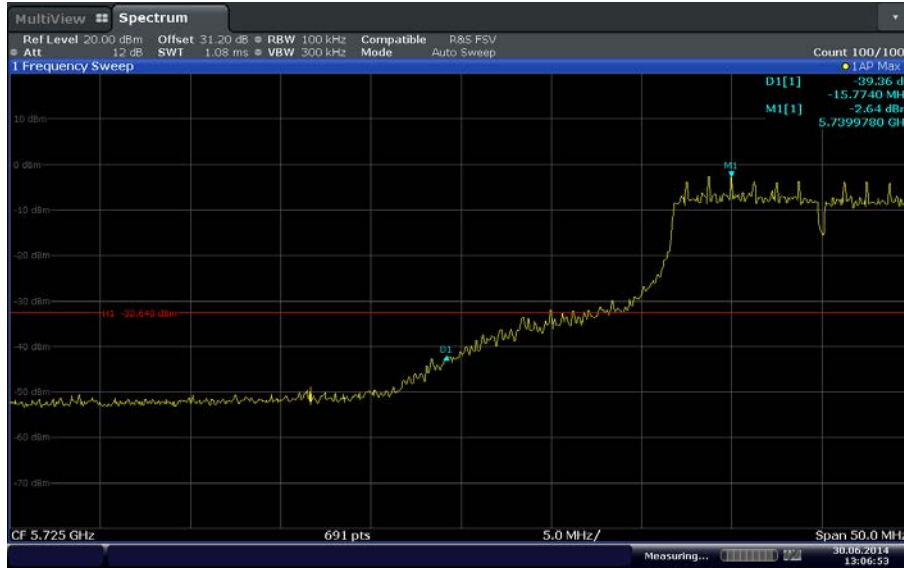
802.11n (HT20)_Higher Band Edge of 2483.5 MHz Band



Date: 30 JUN 2014 12:52:13

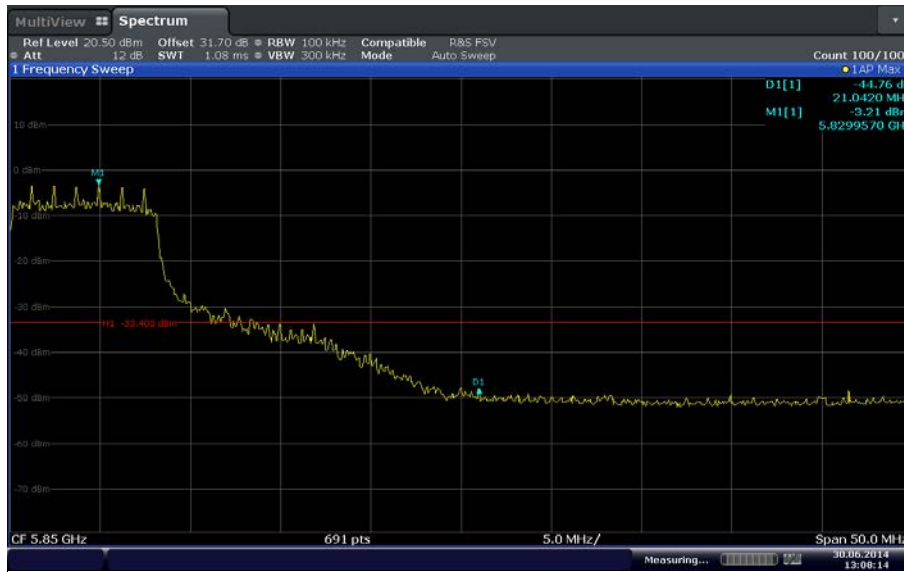


802.11a_Lower Band Edge of 5725 MHz Band



Date: 30 JUN 2014 13:06:53

802.11a_Higher Band Edge of 5850 MHz Band



Date: 30 JUN 2014 13:08:14