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Report On

Application for Grant of Equipment Authorization of the
Hughes Network Systems
9105 Thuraya WLAN Satellite Terminal
IP Voyager and Orion IP

FCC Part 15 Subpart C §15.247

Report No. SD72102234B

March 2015



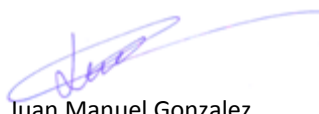
REPORT ON Radio Testing of the
Hughes Network Systems
9105 Thuraya WLAN Satellite Terminal IP Voyager and Orion IP

TEST REPORT NUMBER SD72102234B

PREPARED FOR Hughes Network Systems
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DATED March 09, 2015



Revision History

SD72102234B Hughes Network Systems 9105 Thuraya WLAN Satellite Terminal IP Voyager and Orion IP					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/09/2015	Initial Release				Juan M. Gonzalez

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Hughes Network Systems
9105 Thuraya WLAN Satellite Terminal
IP Voyager and Orion IP



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Hughes Network Systems 9105 Thuraya WLAN Satellite Terminal IP Voyager and Orion IP 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	Hughes Network Systems
Model Name(s)	IP Voyager and Orion IP
Model Number(s)	9105
FCC ID Number	K3YHNS9105
IC Number	N/A
Serial Number(s)	357932-01-020007-2
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2014). • 558074 D01 DTS Meas Guidance v03r02 June 05, 2014 (Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247)
Start of Test	February 02, 2015
Finish of Test	February 06, 2015
Name of Engineer(s)	Alex Chang
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 is shown below.

Section	§15.247 Spec Clause	Test Description	Result	Comments/ Base Standard
2.1	§15.247(b)(3)	Peak Output Power	Compliant	
—	§15.207(a)	Conducted Emissions	N/A *)	
2.2	§15.247(a)(2)	Minimum 6 dB RF Bandwidth	Compliant	
2.3	§15.247(d)	Out-of-Band Emissions - Conducted	Compliant	
2.4	§15.247(d)	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.5	§15.247(d)	Spurious Radiated Emissions	Compliant	
2.6	§15.247(d)	Radiated Band Edge Measurements	Compliant	
2.7	§15.247(e)	Power Spectral Density for Digitally Modulated Device	Compliant	

*) Not applicable, EUT is a DC powered device.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Hughes Network Systems Thuraya WLAN Satellite Terminal as shown in the photograph below. EUT is available in two configurations, IP Voyager (Land Mobile) and Orion IP (Maritime), the Thuraya WLAN Satellite Terminal, model 9105, allows the user to send and receive IP traffic via Ethernet and 802.11 b/g/n Wi-Fi interfaces over the Thuraya satellite network. The IP Voyager configuration is installed in a land mobile vehicle; the Orion IP configuration is installed in a maritime vessel, powered by 12/24VDC from the host vehicle or maritime vessel. The modem unit with WLAN antenna is common to both configurations, the difference being in the connected satellite antenna which is specific for the installed vehicle or maritime vessel purpose.



Equipment Under Test, model 9105



WLAN Antenna



HN221 – Land Mobile

For Land Mobile operation, the 9105 is provided with HN221 and designated Thuraya IP Voyager



HN321 – Maritime

For Maritime operation, the 9105 is provided with HN321 and designated Thuraya Orion IP



1.3.2 EUT General Description

EUT Description	Thuraya WLAN Satellite Terminal
Model Name(s)	IP Voyager and Orion IP
Model Number(s)	9105
Rated Voltage	12/24VDC from vehicle or maritime vessel battery
Mode Verified	802.11 b/g/n (20MHz/40MHz for 802.11n)
Capability	802.11 b/g/n WLAN (DTS) 2.4GHz band (20MHz/40MHz for 802.11n) and 1.6GHz Mobile Satellite Service
Frequency Range	2412 MHz to 2462 MHz in the 2400 MHz to 2483.5 MHz Band
Number of Operating Frequencies	11 (b, g, n HT20), 7 (n HT40)
Channels Verified (b, g, n HT20)	Channel 1 (Low Channel 2412 MHz) Channel 6(Mid Channel 2437 MHz) Channel 11 (High Channel 2462MHz)
Channels Verified(n HT40)	Channel 3 (Low Channel 2422 MHz) Channel 6(Mid Channel 2437 MHz) Channel 9 (High Channel 2452MHz)
Modulation Used	DSSS and OFDM

1.3.3 Antenna Details

Model	HG2403RD
Manufacturer	L-com Global Connectivity
Antenna Type	Rubber Duck Antenna
Antenna Gain	3 dBi
EUT Antenna Connector	Reverse Polarity SAM Plug (RP-SMA Plug)
Maximum Dimensions	137mm (Length) x 13mm (Diameter)

1.3.4 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
802.11b	2412-2462	12.55	17.99
802.11g	2412-2462	12.20	16.59
802.11n (HT20)	2412-2462	12.25	16.79
802.11n (HT40)	2422-2452	12.19	16.56



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Conducted port measurement configuration. The antenna was removed to gain access to the main antenna connector.
B	Radiated emission configuration. The EUT was set on continuous transmission at 100% duty cycle modulated in low, mid or high channel for evaluation.

1.4.2 EUT Exercise Software

“Perl Command” software provided by the client was used to program the EUT. A file containing commands to change channels and data rates. Specific channel/modulation combination is copied from this file and transferred to the test software, once executed the EUT will transmit at max power (default setting if TX) at that channel.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Toshiba	Laptop	Model: PA2722U, S/N: X9073402
Toshiba	Laptop External PSU	Model: PA2450U, S/N: 9903C2058923
Compaq	PS2 Mouse	Model: M-S48a
MG Electronics	EUT Support PSU	Model: ST242A
-	CAT5e (Laptop to EUT)	2.1m unshielded RJ45 connector
-	CAT5e x 3	2.1m unshielded RJ45 connector

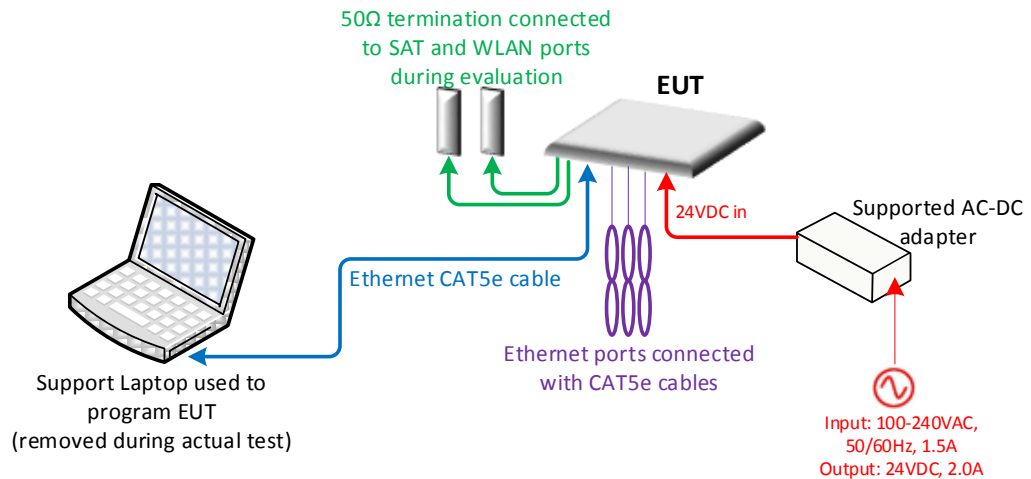
1.4.4 Worst Case Configuration

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

Mode	Channel	Data Rate
802.11b	1 (Low Channel)	5.5 Mbps
802.11g	6 (Mid Channel)	18 Mbps
802.11n (HT20)	6 (Mid Channel)	Mcs 0 (72.0 Mbps)
802.11n (HT40)	6 (Mid Channel)	Mcs 7 (150.0 Mbps)

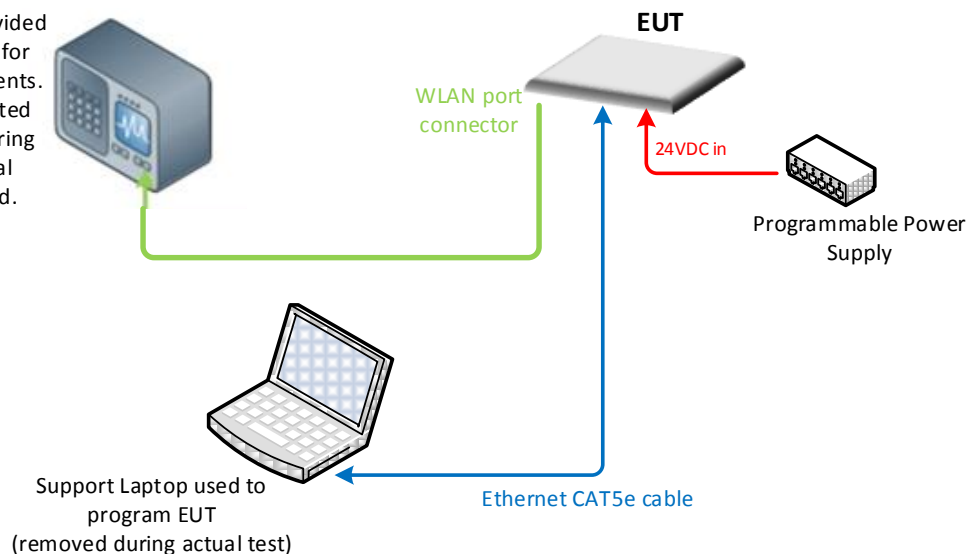
1.4.5 Simplified Test Configuration Diagram

Emission Test Setup



Conducted Port Measurement Test Setup

Antenna test port provided by the manufacturer for conducted measurements. The output is connected directly to the measuring equipment, external attenuators are used.



Not To Scale – Illustration Purpose Only
 Objects may not represent actual image of original equipment/s or set-up.



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 357932-01-020007-2		
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

1.9 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 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
Hughes Network Systems
9105 Thuraya WLAN Satellite Terminal
IP Voyager and Orion IP



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: 357932-01-020007-2 / Test Configuration A

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

June 17, 2014 / KAM

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	25.7°C
Relative Humidity	39.4%
ATM Pressure	98.9 kPa

2.1.7 Additional Observations

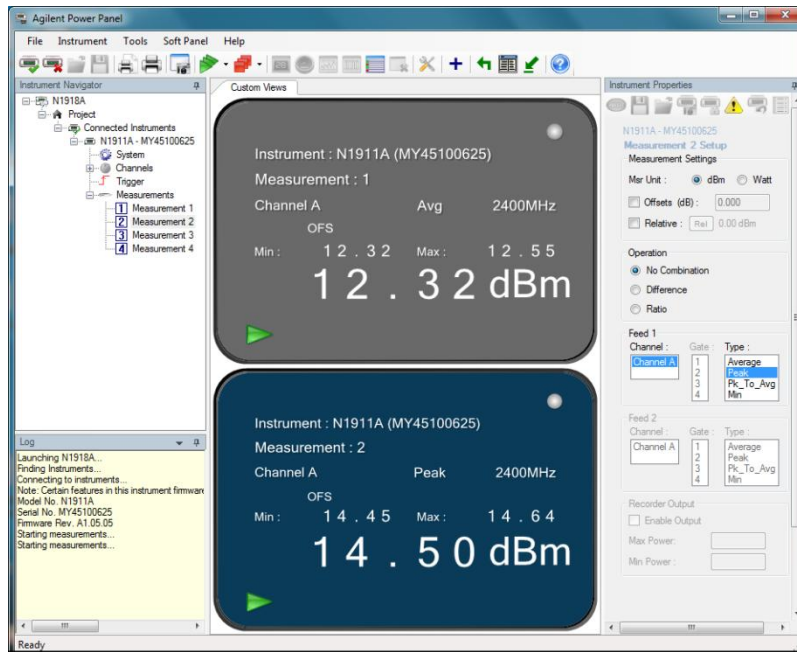
- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- This is a conducted test using Method A: Peak Power Meter Method per Section 9.2.3 under KDB 558074 D01 DTS Measurement Guidance v03r02 (Compliance Measurement Guidance for 15.247 Digital Transmission Systems, June 05, 2014).
- Both Peak and Average measurements were recorded.
- 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

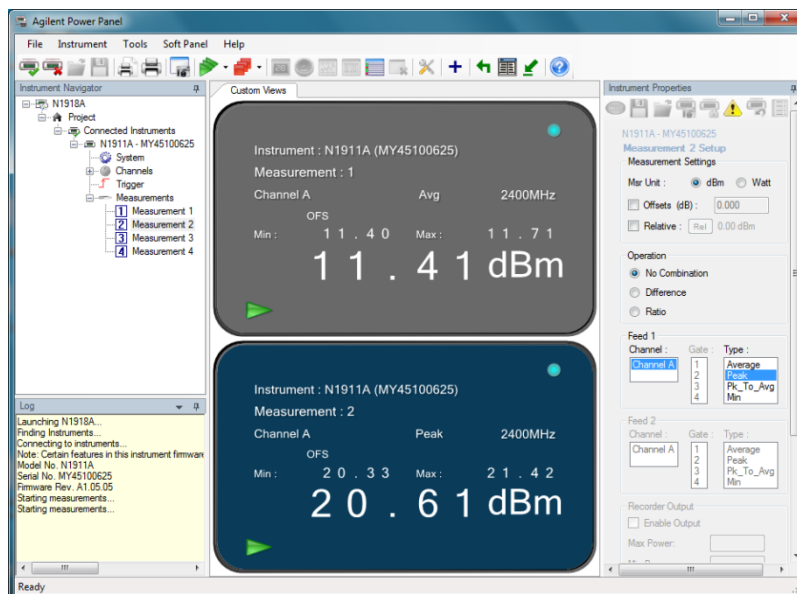
WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11b	1 (2412 MHz)	1	12.22	15.04
		2	12.52	15.27
		5.5	12.55	14.64
		11	12.49	15.28
	6 (2437 MHz)	1	12.37	15.12
		2	12.22	15.00
		5.5	12.29	14.41
		11	12.27	15.04
	11 (2462 MHz)	1	11.74	14.58
		2	11.87	14.61
		5.5	11.82	13.90
		11	11.84	14.64
802.11g	1 (2412 MHz)	6	11.98	21.51
		9	11.86	21.20
		12	11.88	21.34
		18	11.93	21.29
		24	11.85	21.83
		36	11.86	21.35
		48	11.79	21.38
		54	11.71	21.62
	6 (2437 MHz)	6	12.10	21.64
		9	12.11	21.40
		12	12.14	21.48
		18	12.20	21.49
		24	12.08	22.07
		36	12.00	21.50
		48	12.09	21.54

WLAN Mode	Channel	Data Rates (Mbps)	Measured Average Power (dBm)	Measured Peak Power (dBm)
802.11g	6 (2437 MHz)	54	12.06	21.85
	11 (2462 MHz)	6	11.71	21.42
		9	11.63	21.14
		12	11.65	21.22
		18	11.70	21.11
		24	11.63	21.74
		36	11.53	21.24
		48	11.59	21.26
		54	11.53	21.58
802.11n (20 MHz BW)	1 (2412 MHz)	mcs 0 (72.0 Mbps)	12.07	21.11
	6 (2437 MHz)	mcs 0 (72.0 Mbps)	12.25	21.29
	11 (2462 MHz)	mcs 0 (72.0 Mbps)	11.69	20.78
802.11n (40 MHz BW)	3 (2422 MHz)	mcs 7 (150.0 Mbps)	11.99	21.46
	6 (2437 MHz)	mcs 7 (150.0 Mbps)	12.19	21.55
	9 (2452 MHz)	mcs 7 (150.0 Mbps)	11.99	21.35

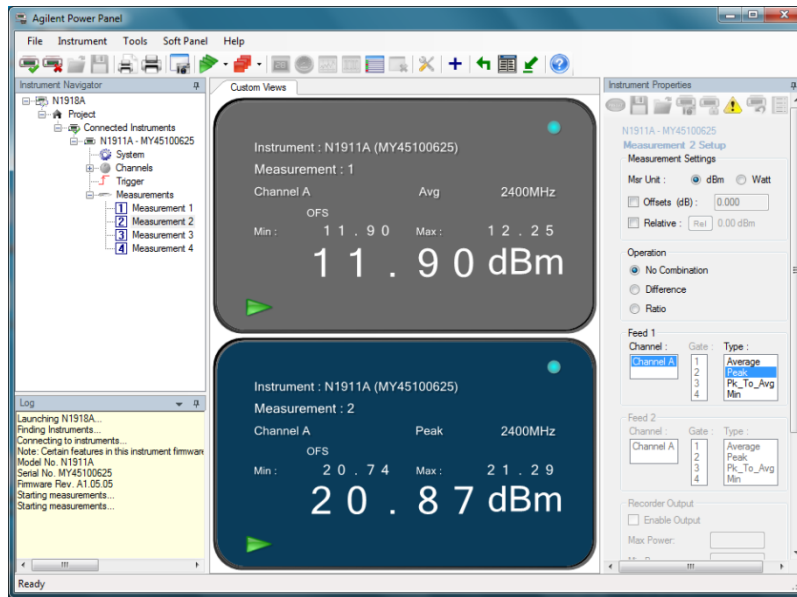
2.1.9 Sample Test Display



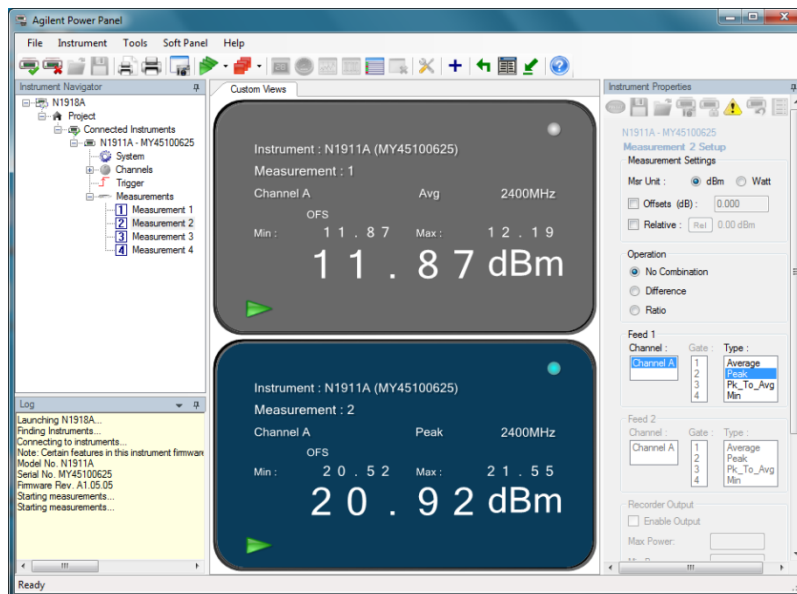
802.11 "b" mode. Low Channel 5.5Mbps



802.11 "g" mode. High Channel 6Mbps



802.11 "n" mode HT20. Mid Channel 72Mbps



802.11 "n" mode HT40. Mid Channel 150Mbps



2.2 MINIMUM 6 dB RF BANDWIDTH

2.2.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.2.2 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.

2.2.3 Equipment Under Test and Modification State

Serial No: 357932-01-020007-2 / Test Configuration A

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

June 18, 2014 / KAM

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	25.1 °C
Relative Humidity	44.1 %
ATM Pressure	98.9 kPa

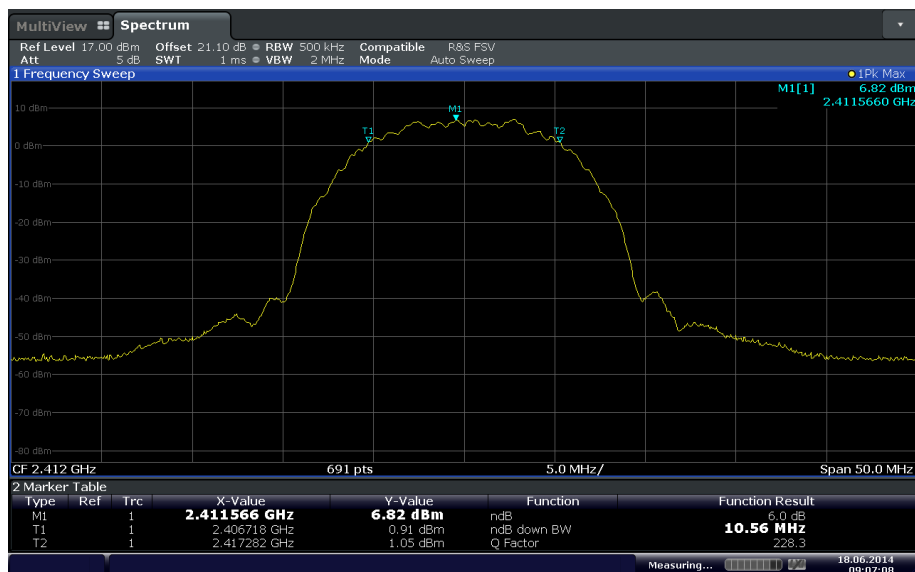
2.2.7 Additional Observations

- This is a conducted test.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- Span is wide enough to capture the channel transmission.
- RBW is set to 1% of the span.
- VBW is $\geq 3X$ RBW.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.2.8 Test Results

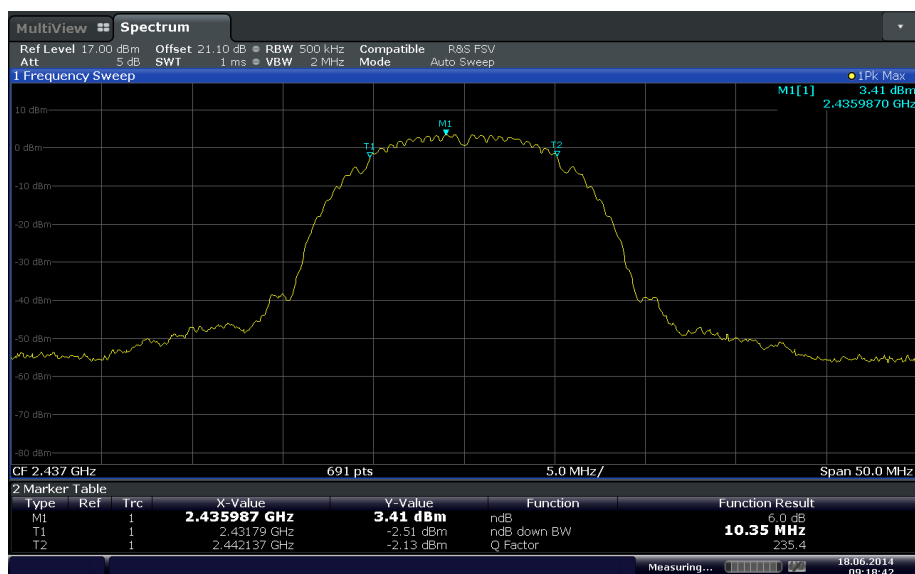
Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
802.11b	1 (2412 MHz)	10.56	0.500	Complies
	6 (2437 MHz)	10.35	0.500	Complies
	11 (2462 MHz)	10.20	0.500	Complies
802.11g	1 (2412 MHz)	16.71	0.500	Complies
	6 (2437 MHz)	16.79	0.500	Complies
	11 (2462 MHz)	16.71	0.500	Complies
802.11n HT20	1 (2412 MHz)	17.87	0.500	Complies
	6 (2437 MHz)	17.95	0.500	Complies
	11 (2462 MHz)	17.95	0.500	Complies
802.11n HT40	3 (2422 MHz)	36.90	0.500	Complies
	6 (2437 MHz)	36.90	0.500	Complies
	9 (2452 MHz)	36.90	0.500	Complies

2.2.9 Test Results Plots



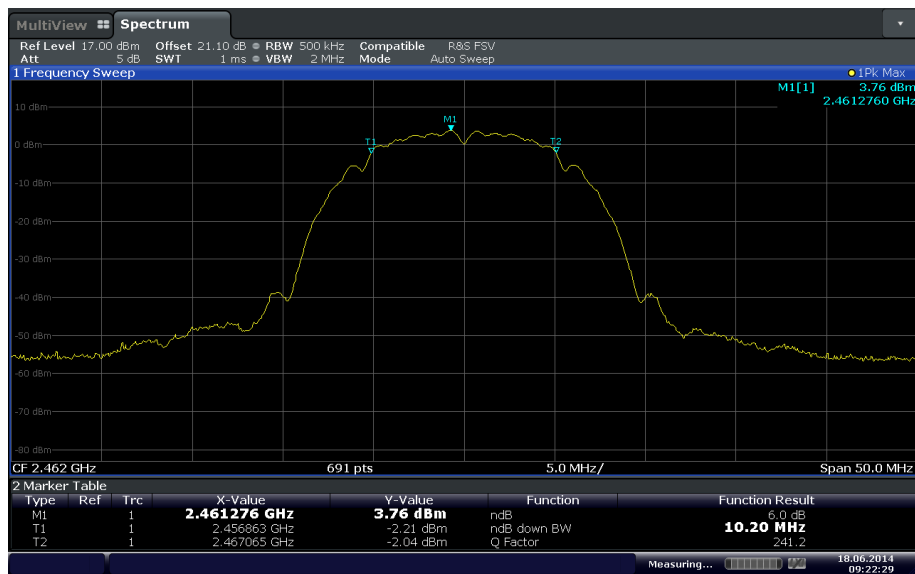
Date: 18 JUN 2014 09:07:08

802.11b mode_Low Channel



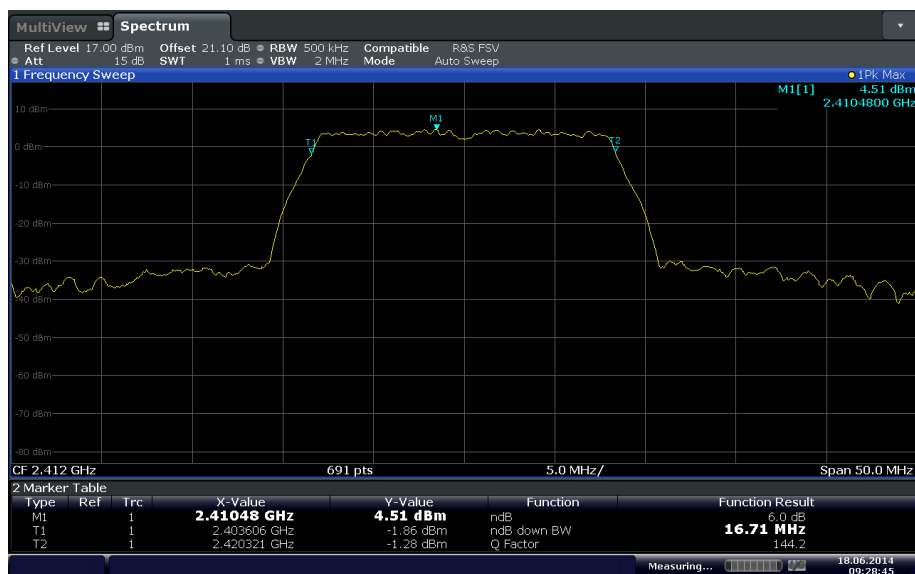
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802.11b mode_Mid Channel



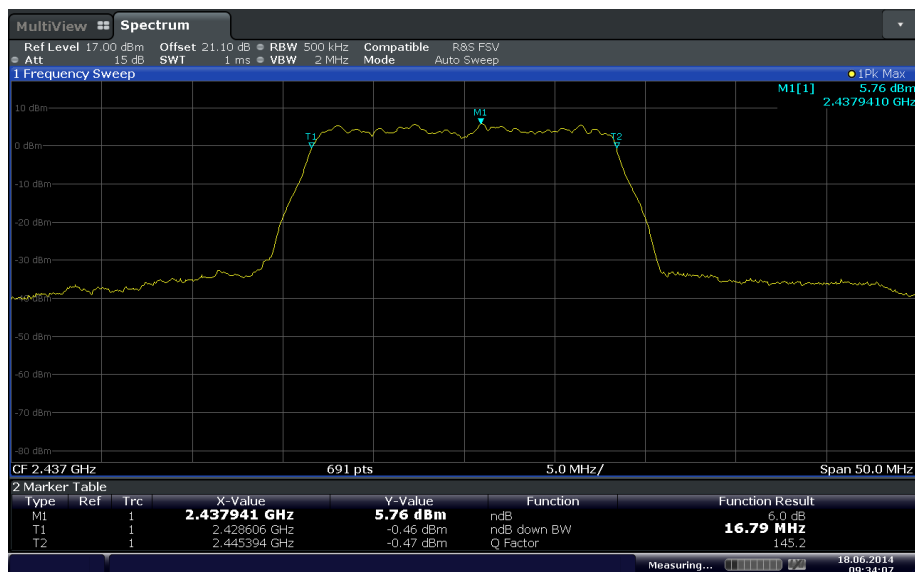
Date: 18 JUN 2014 09:22:29

802.11b mode_High Channel



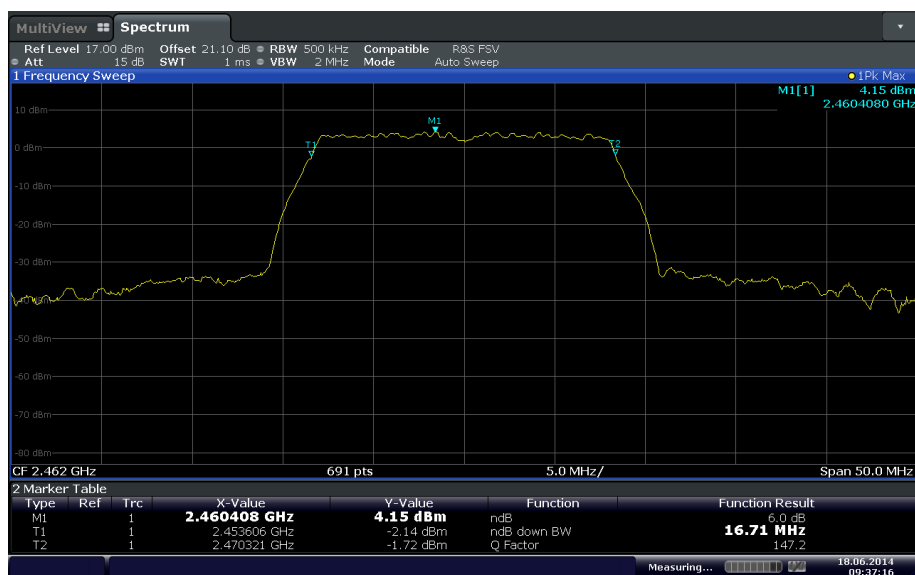
Date: 18 JUN 2014 09:28:45

802.11g mode_Low Channel



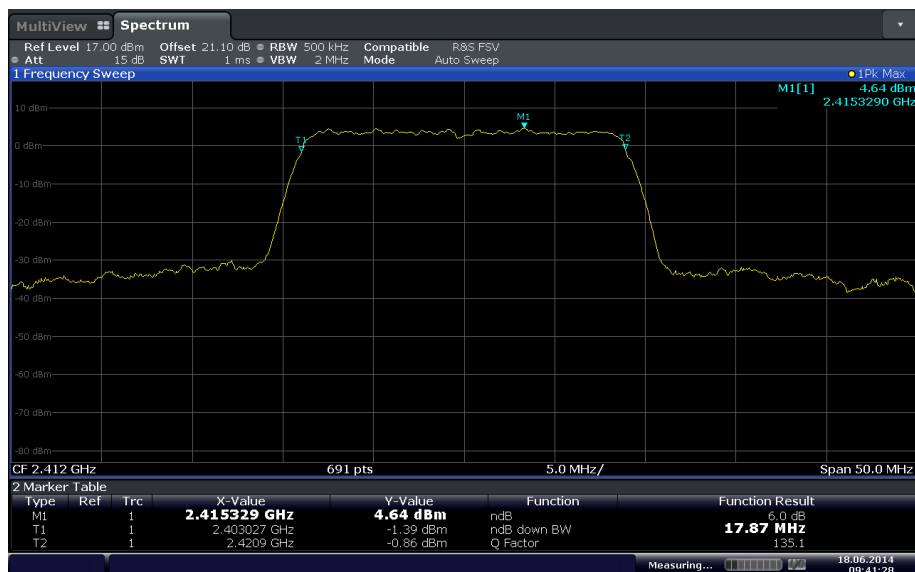
Date: 18 JUN 2014 09:34:07

802.11g mode_Mid Channel



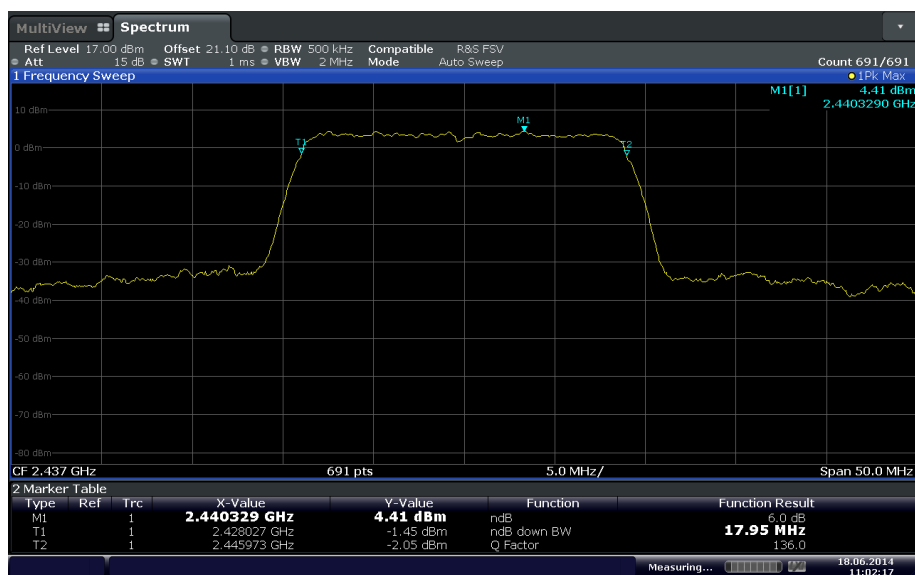
Date: 18 JUN 2014 09:37:16

802.11g mode_High Channel



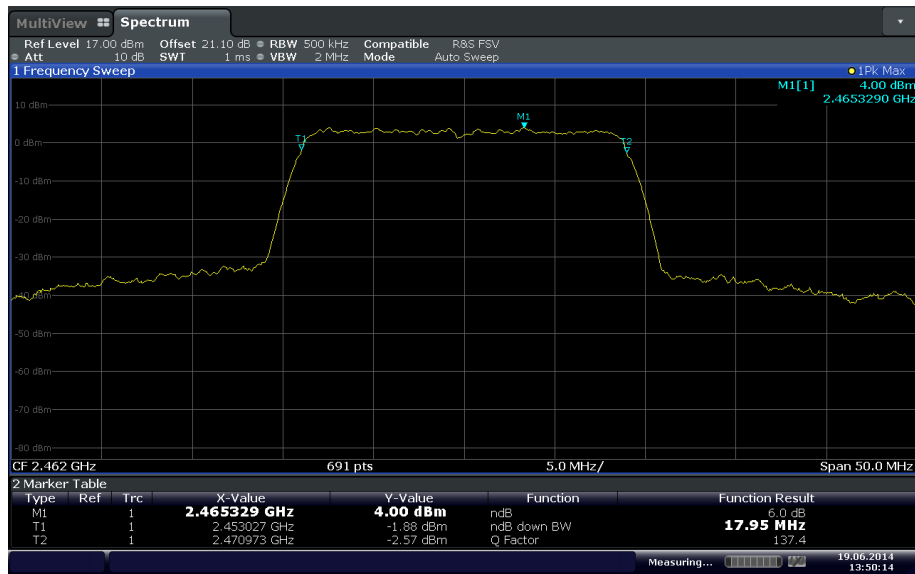
Date: 18 JUN 2014 09:41:28

802.11n mode HT20_Low Channel



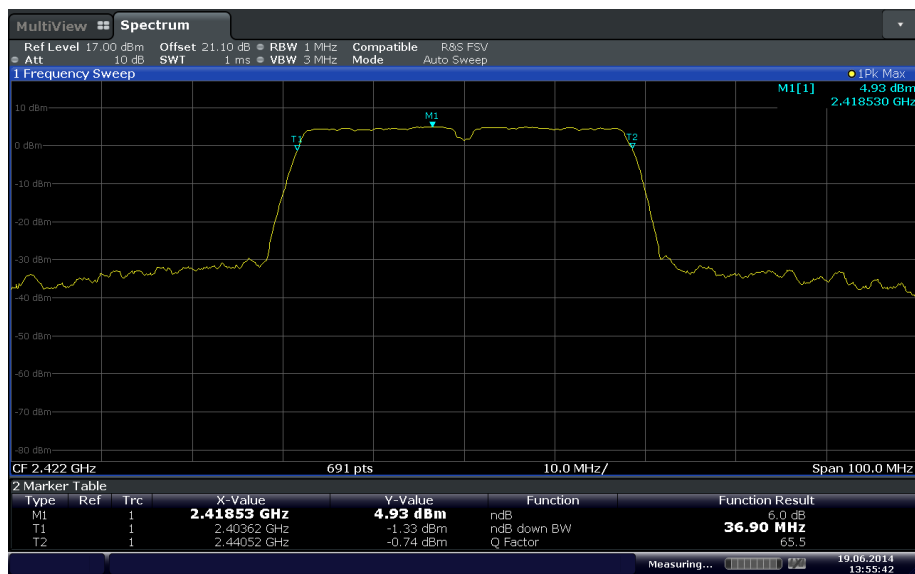
Date: 18 JUN 2014 11:02:17

802.11n mode HT20_Mid Channel



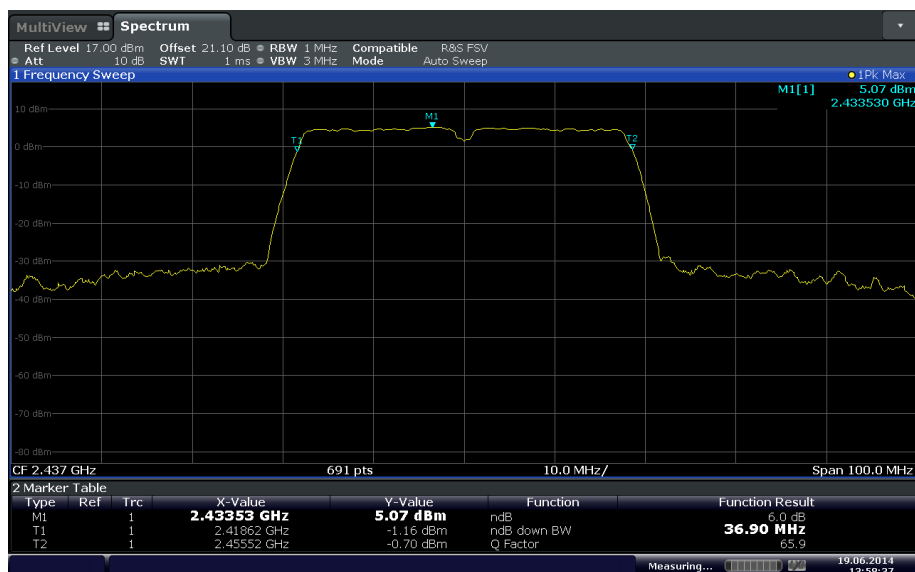
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802.11n mode HT20_High Channel



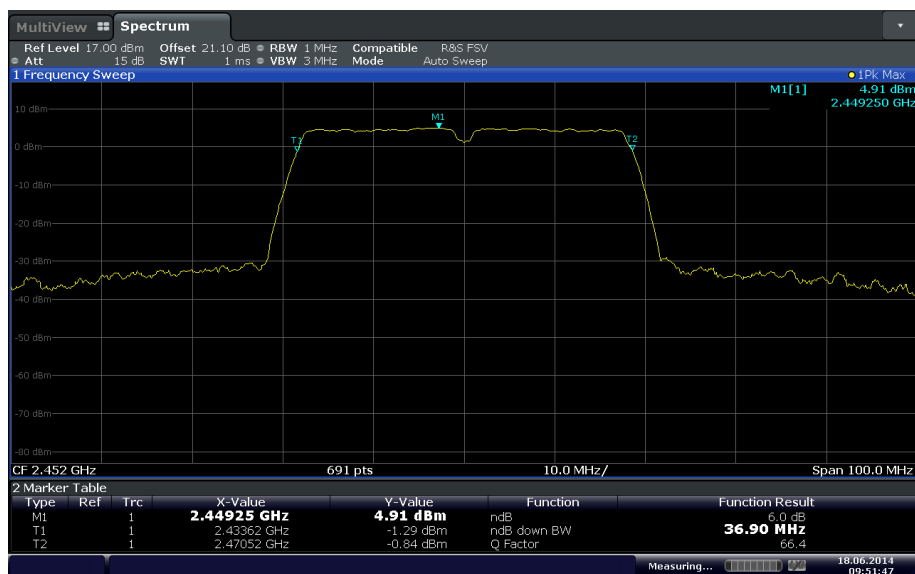
Date: 19 JUN 2014 13:55:43

802.11n mode HT40_Low Channel



Date: 19 JUN 2014 13:58:36

802.11n mode HT40_Mid Channel



Date: 18 JUN 2014 09:51:47

802.11n mode HT40_High Channel



2.3 OUT-OF-BAND EMISSIONS - CONDUCTED

2.3.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.3.2 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)).

2.3.3 Equipment Under Test and Modification State

Serial No: 357932-01-020007-2 / Test Configuration A

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

June 18, 2014 / KAM

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

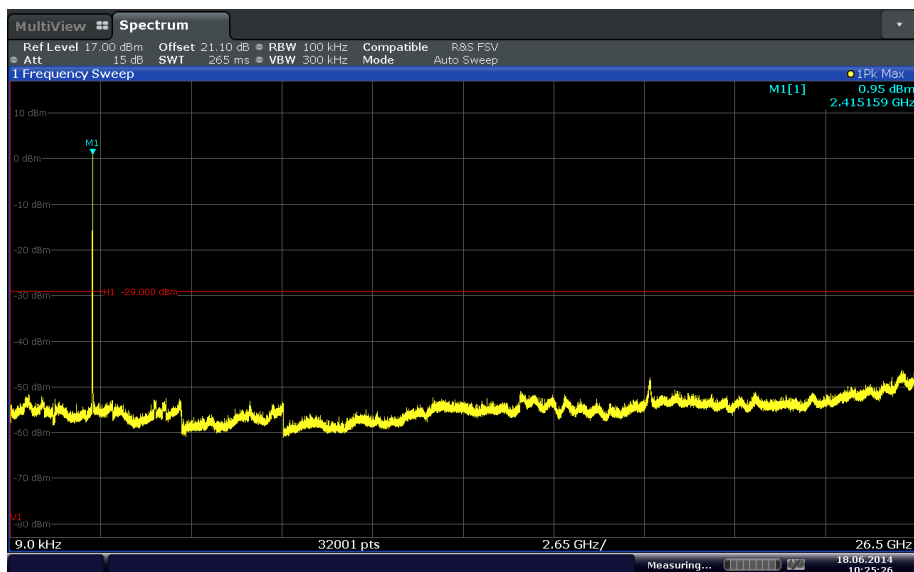
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.1 °C
Relative Humidity	44.1. %
ATM Pressure	98.9 kPa

2.3.7 Additional Observations

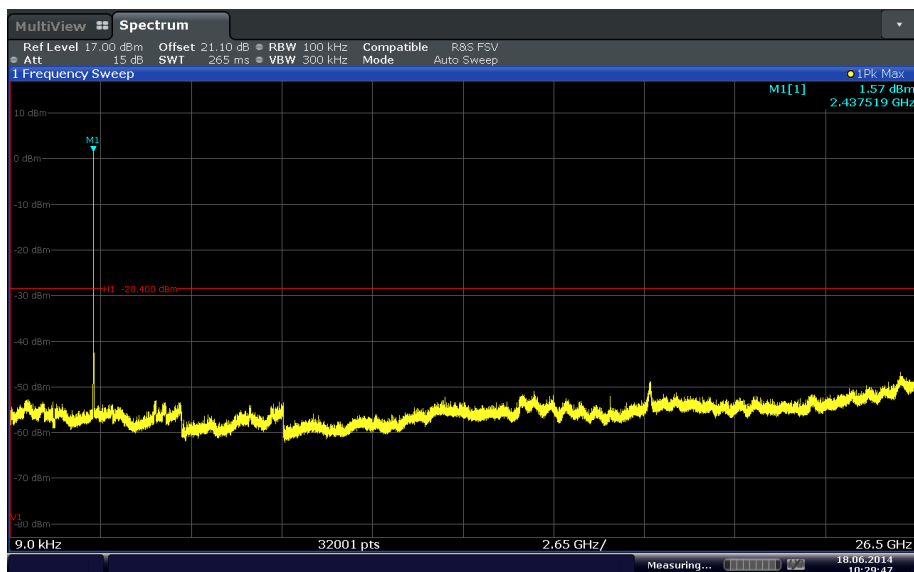
- This is a conducted test.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level.
- Spectrum was searched from 9 kHz up to 26.5GHz.

2.3.8 Test Results Plots



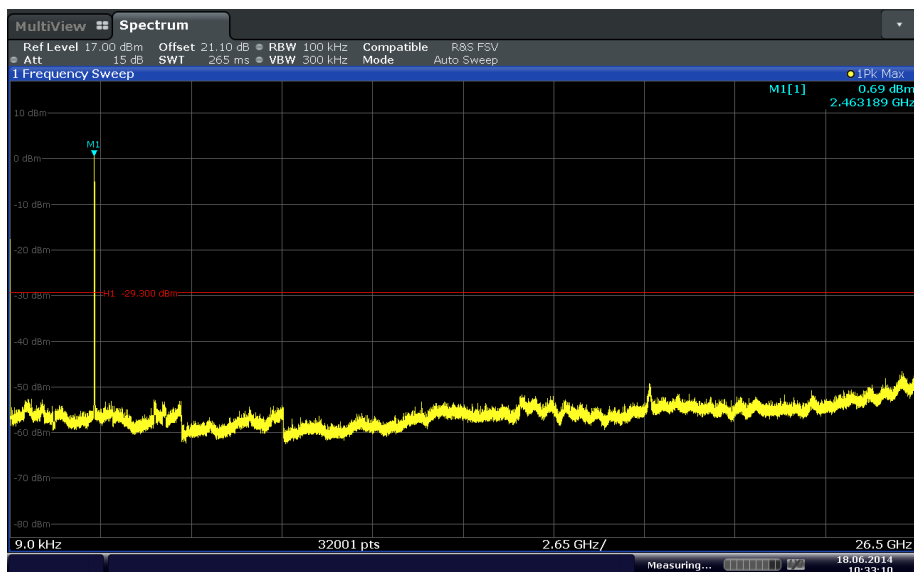
Date: 18 JUN 2014 10:25:26

802.11b mode_Low Channel



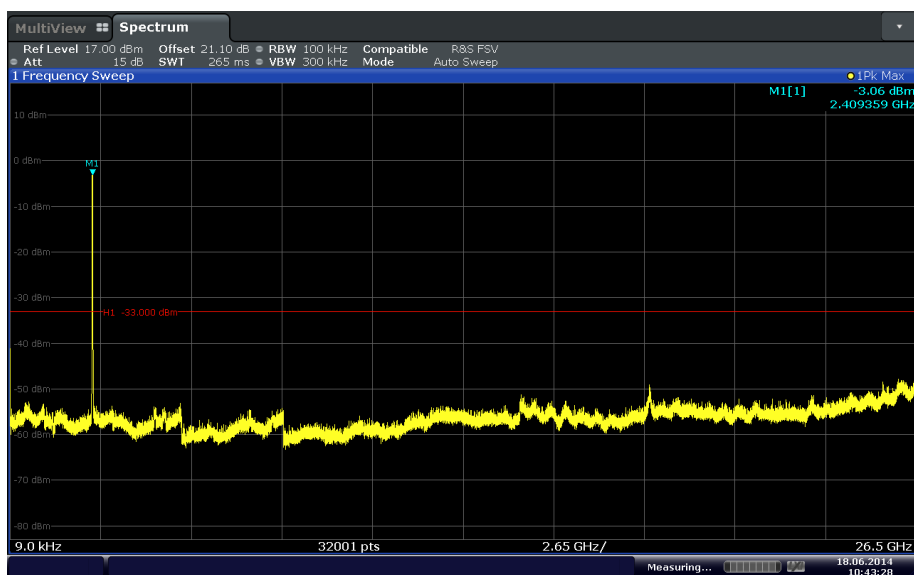
Date: 18 JUN 2014 10:29:47

802.11b mode_Mid Channel



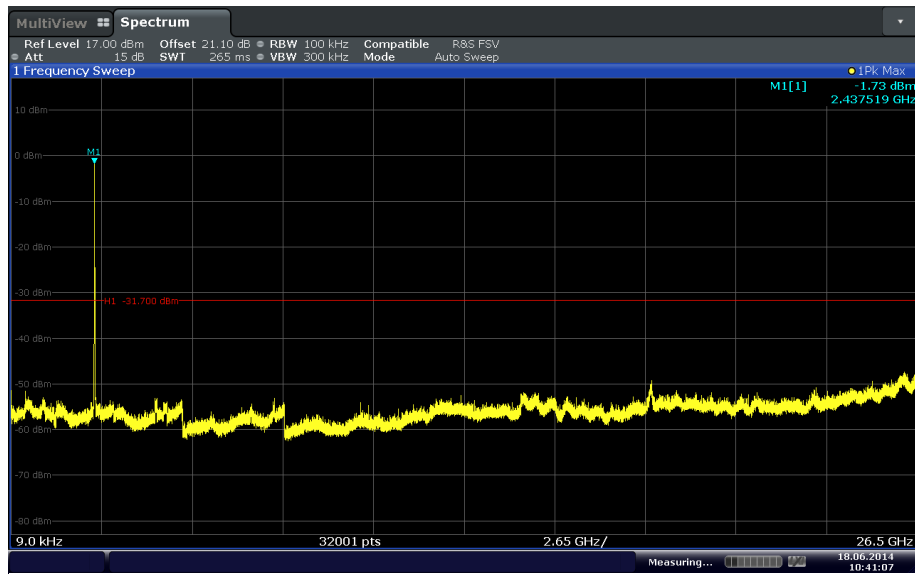
Date: 18 JUN 2014 10:33:09

802.11b mode_High Channel



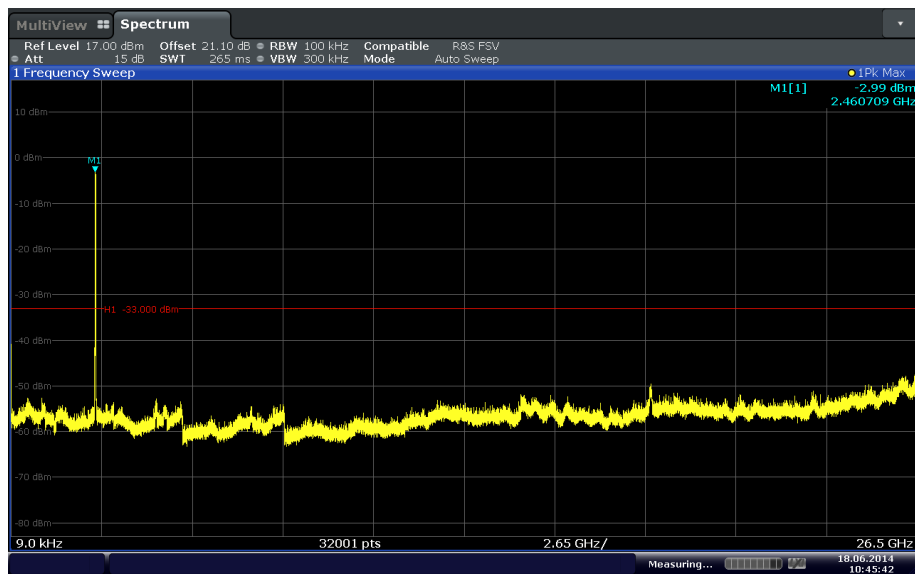
Date: 18 JUN 2014 10:43:28

802.11g mode_Low Channel



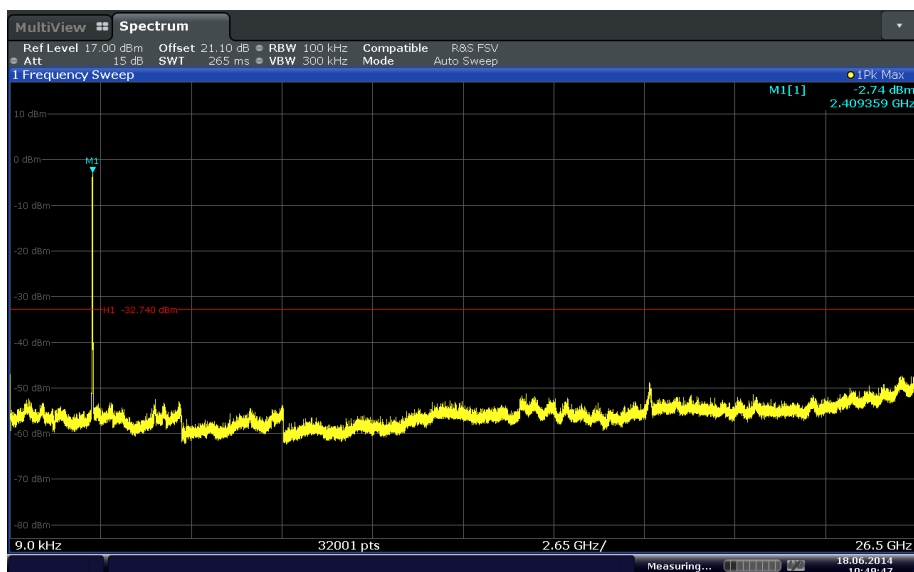
Date: 18 JUN 2014 10:41:08

802.11g mode_Mid Channel



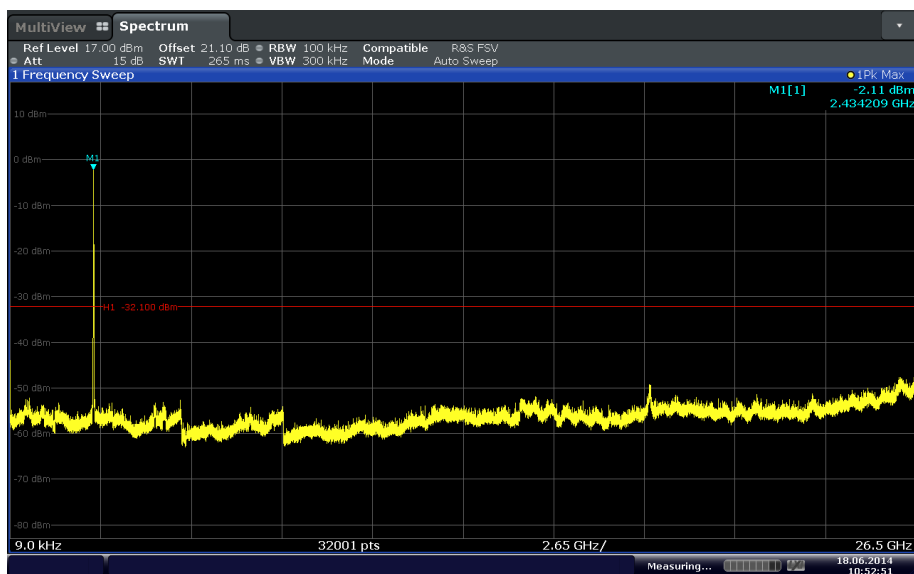
Date: 18 JUN 2014 10:45:42

802.11g mode_High Channel



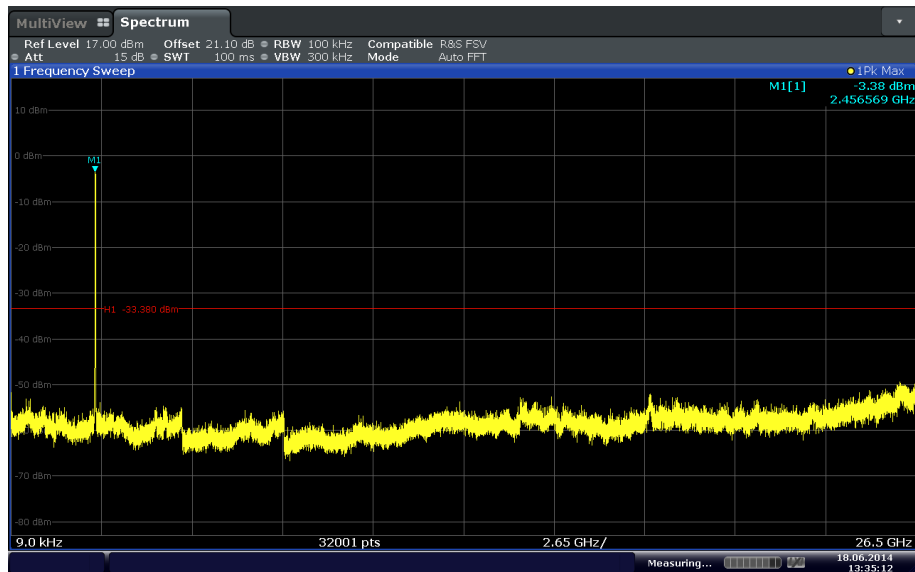
Date: 18 JUN 2014 10:49:48

802.11n mode HT20_Low Channel



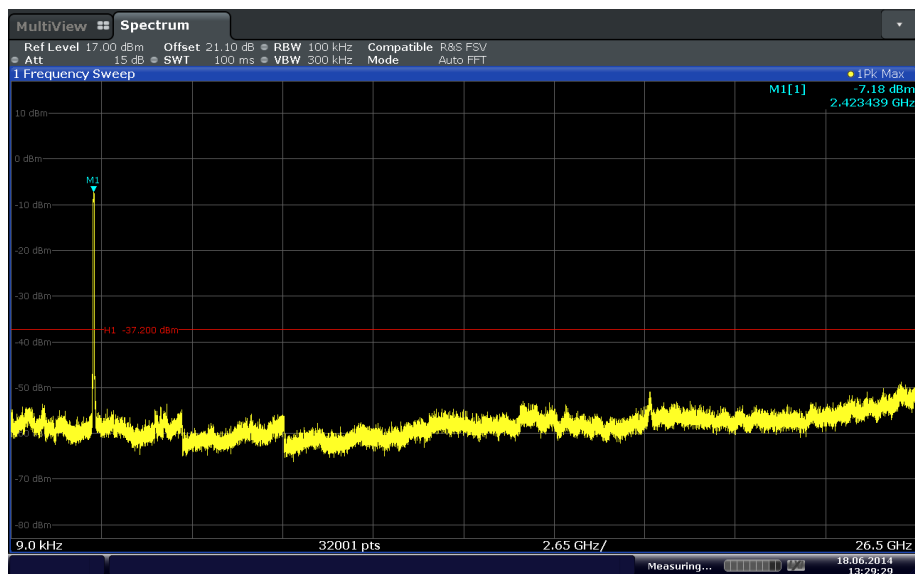
Date: 18 JUN 2014 10:52:51

802.11n mode HT20_Mid Channel



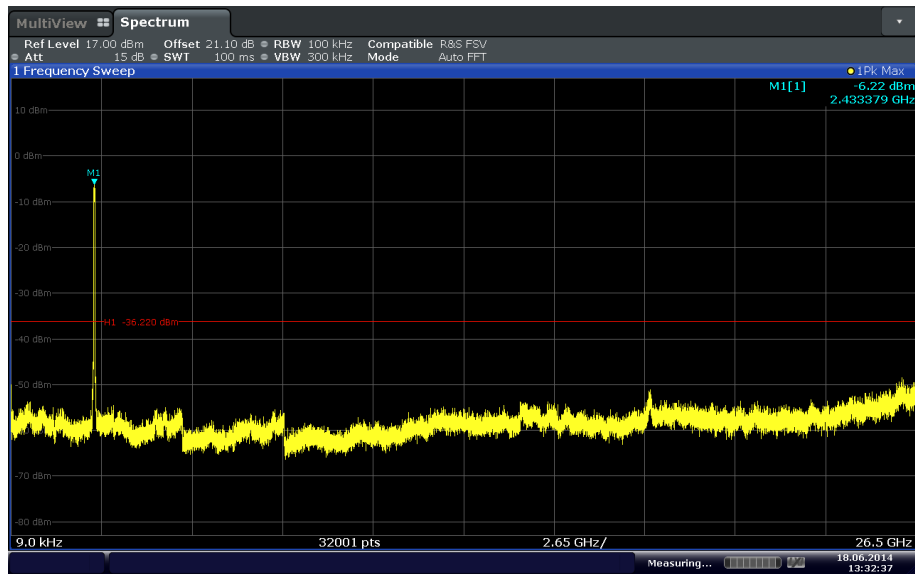
Date: 18 JUN 2014 13:35:13

802.11n mode HT20_High Channel



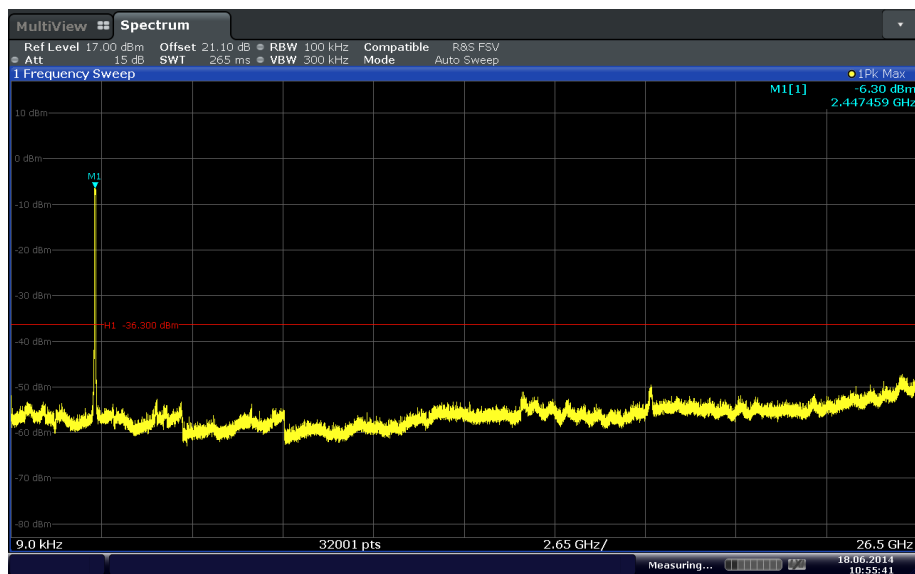
Date: 18 JUN 2014 13:29:28

802.11n mode HT40_Low Channel



Date: 18 JUN 2014 13:32:38

802.11n mode HT40_Mid Channel



Date: 18 JUN 2014 10:55:41

802.11n mode HT40_High Channel



2.4 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.4.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.4.2 Standard Applicable

See previous test.

2.4.3 Equipment Under Test and Modification State

Serial No: 357932-01-020007-2 / Test Configuration A

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

June 18, 2014 / KAM

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

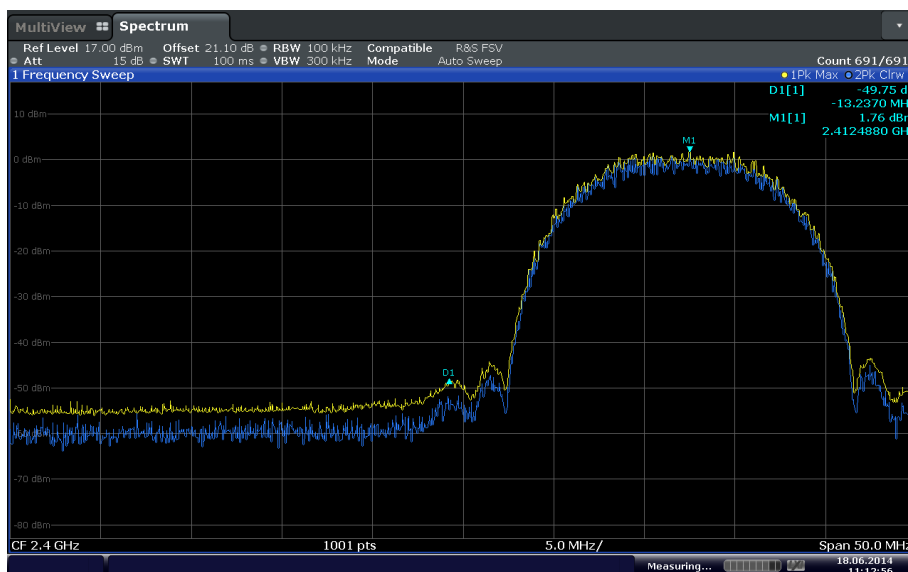
Ambient Temperature	25.1 °C
Relative Humidity	44.1 %
ATM Pressure	98.9 kPa

2.4.7 Additional Observations

- This is a conducted test.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Trace was centred on the band-edge frequency.
- Span was set to encompass the band-edge frequency and the peak of the emission.
- Using Marker function, peak of the emission was determined and the delta to the band-edge frequency measured.

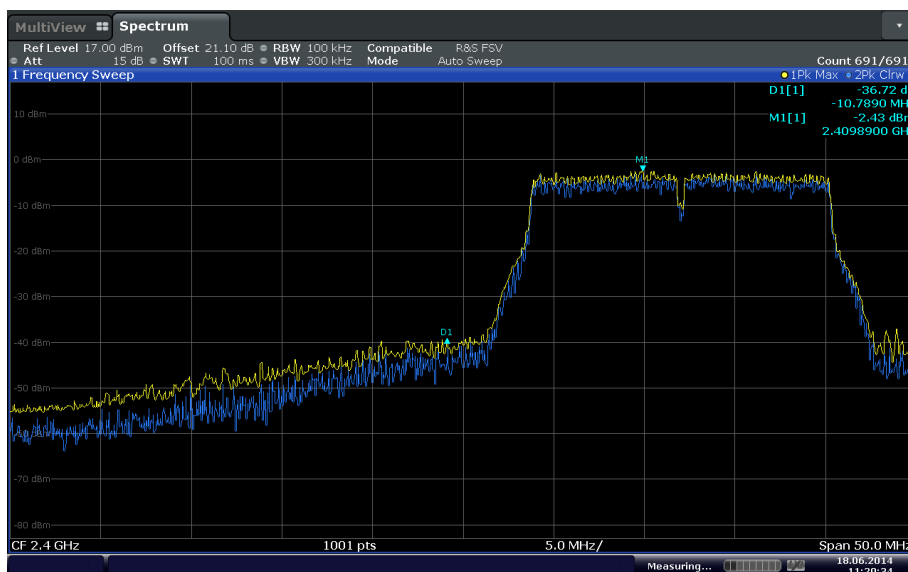
2.4.8 Test Results

Complies. See attached plots.



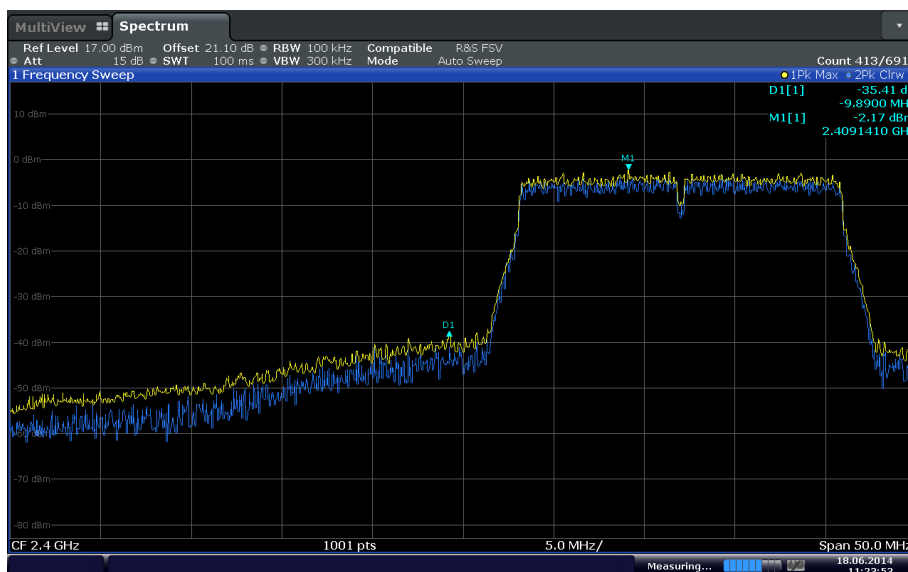
Date: 18 JUN 2014 11:12:57

802.11b mode_Low Channel (2412 MHz)



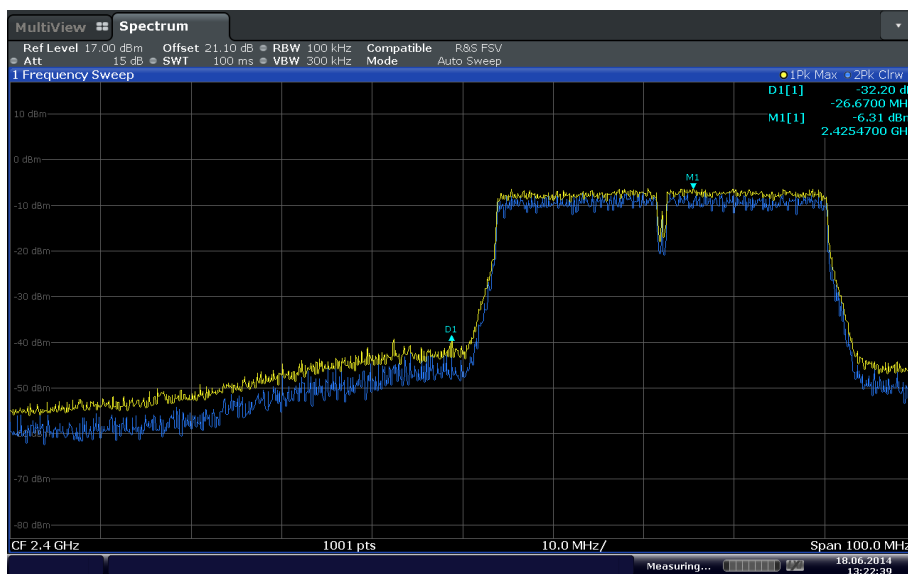
Date: 18 JUN 2014 11:20:34

802.11g mode_Low Channel (2412 MHz)



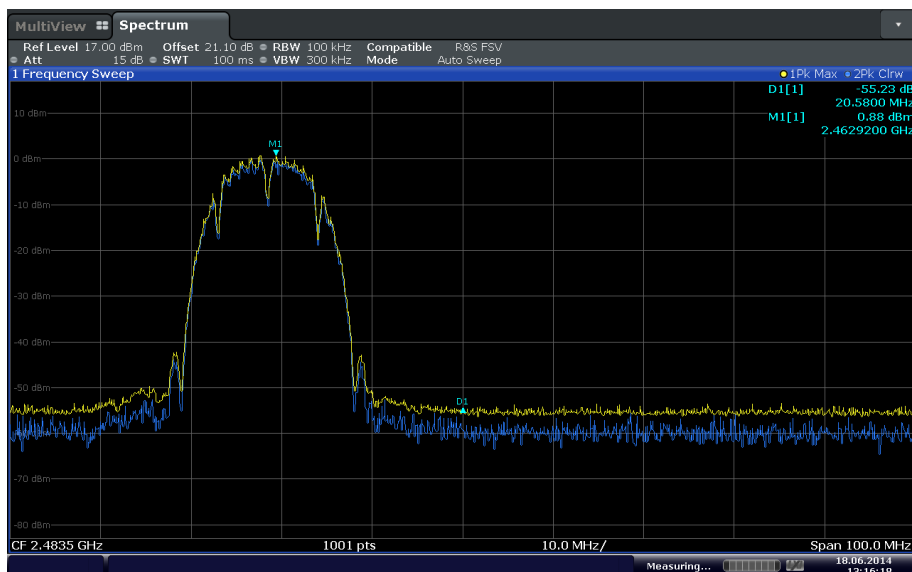
Date: 18 JUN 2014 11:23:53

802.11n mode HT20_Low Channel (2412 MHz)



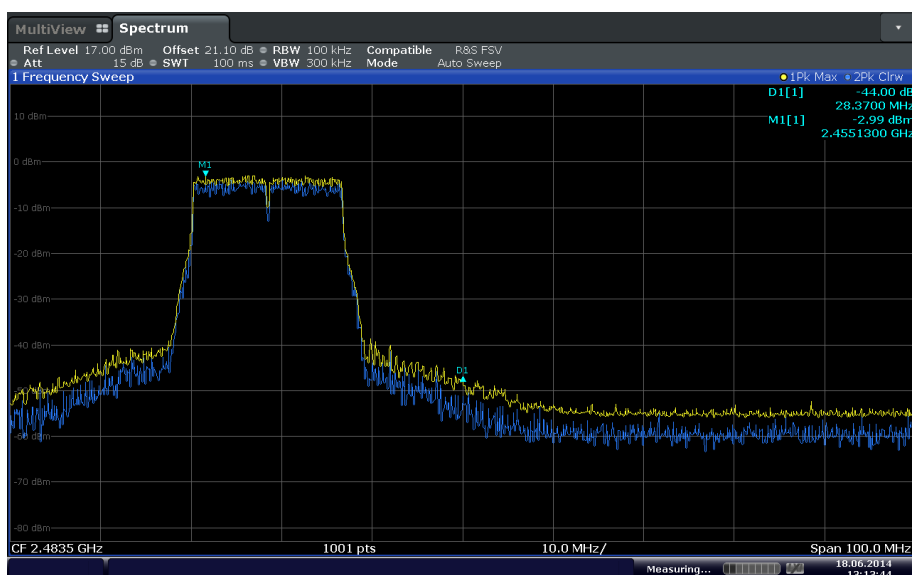
Date: 18 JUN 2014 13:22:39

802.11n mode HT40_Low Channel (2422 MHz)



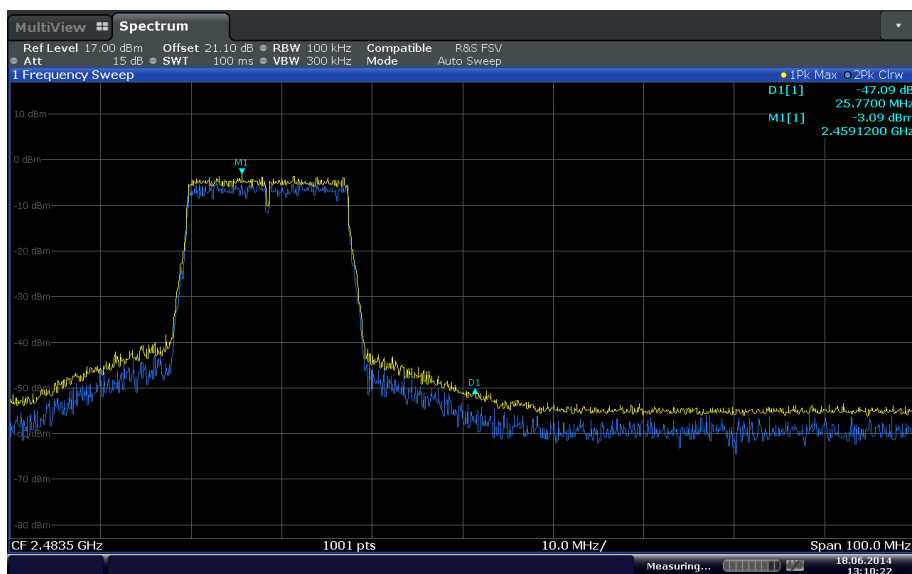
Date: 18 JUN 2014 13:16:18

802.11b mode_High Channel (2462 MHz)



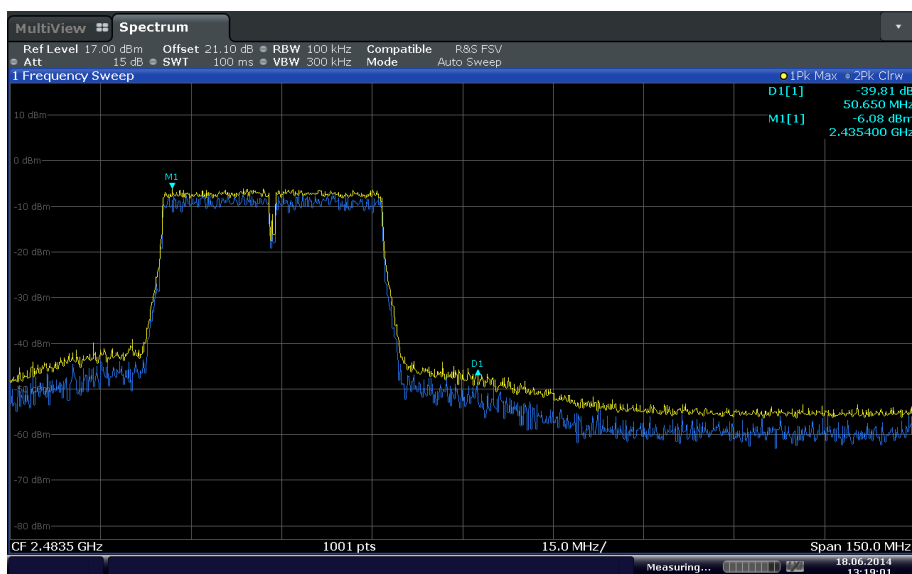
Date: 18 JUN 2014 13:13:44

802.11g mode_High Channel (2462 MHz)



Date: 18 JUN 2014 13:10:22

802.11n mode HT20_High Channel (2462 MHz)



Date: 18 JUN 2014 13:10:01

802.11n mode HT40_High Channel (2452 MHz)



2.5 SPURIOUS RADIATED EMISSIONS

2.5.1 Specification Reference

Part 15 Subpart C §15.247(d)

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: 357932-01-020007-2 / Test Configuration B

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

February 03 and 05, 2015 / 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	23.4°C
Relative Humidity	37.2%
ATM Pressure	99.4 kPa

2.5.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- 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 considered worst case WLAN configuration (802.11b, Low Channel, 5.5Mbps) presented for radiated emissions below 1GHz. There are no significant differences in emissions between all modes below 1GHz.



- Only noise floor measurements observed above 18GHz.
- 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.

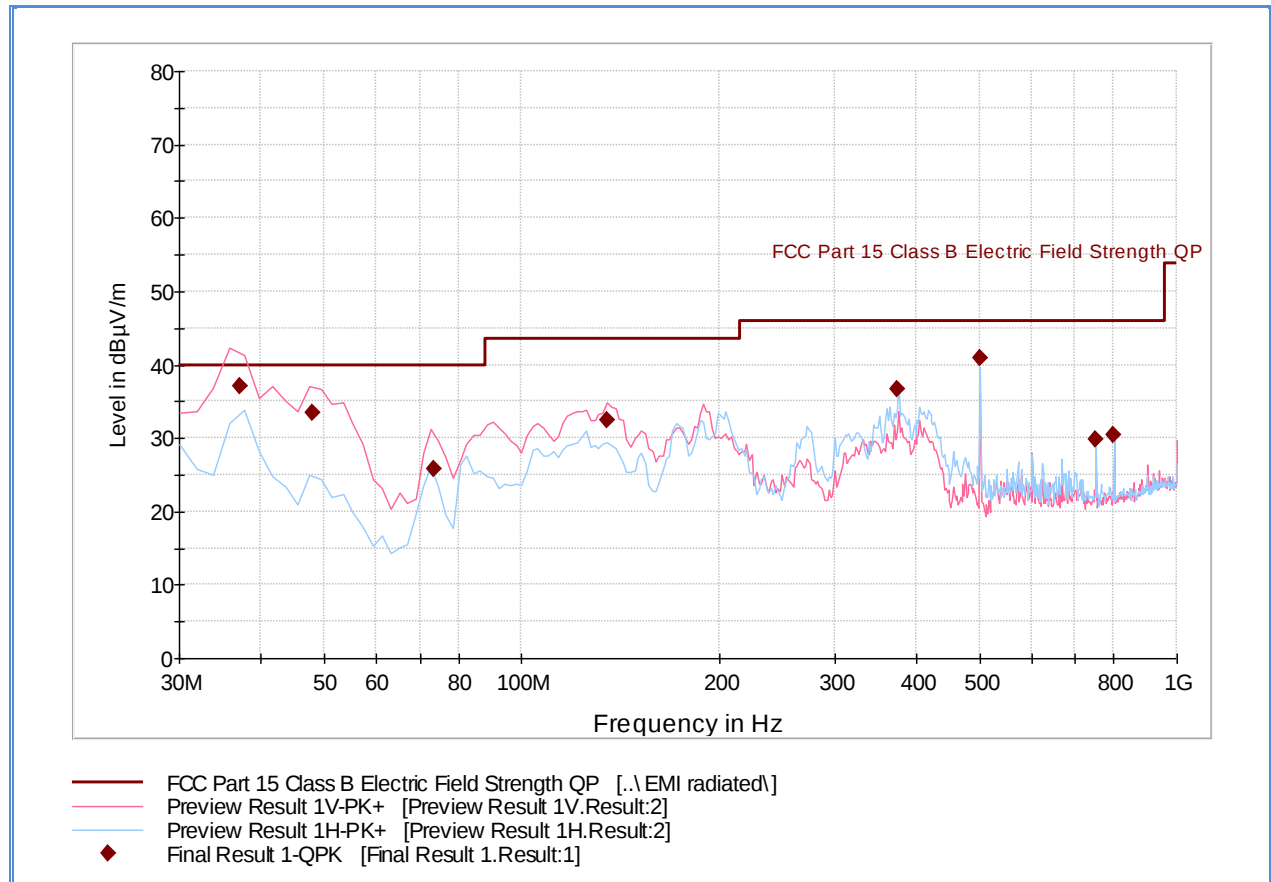
2.5.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 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 (db μ V/m) @ 30MHz			11.8

2.5.9 Test Results

See attached plots.

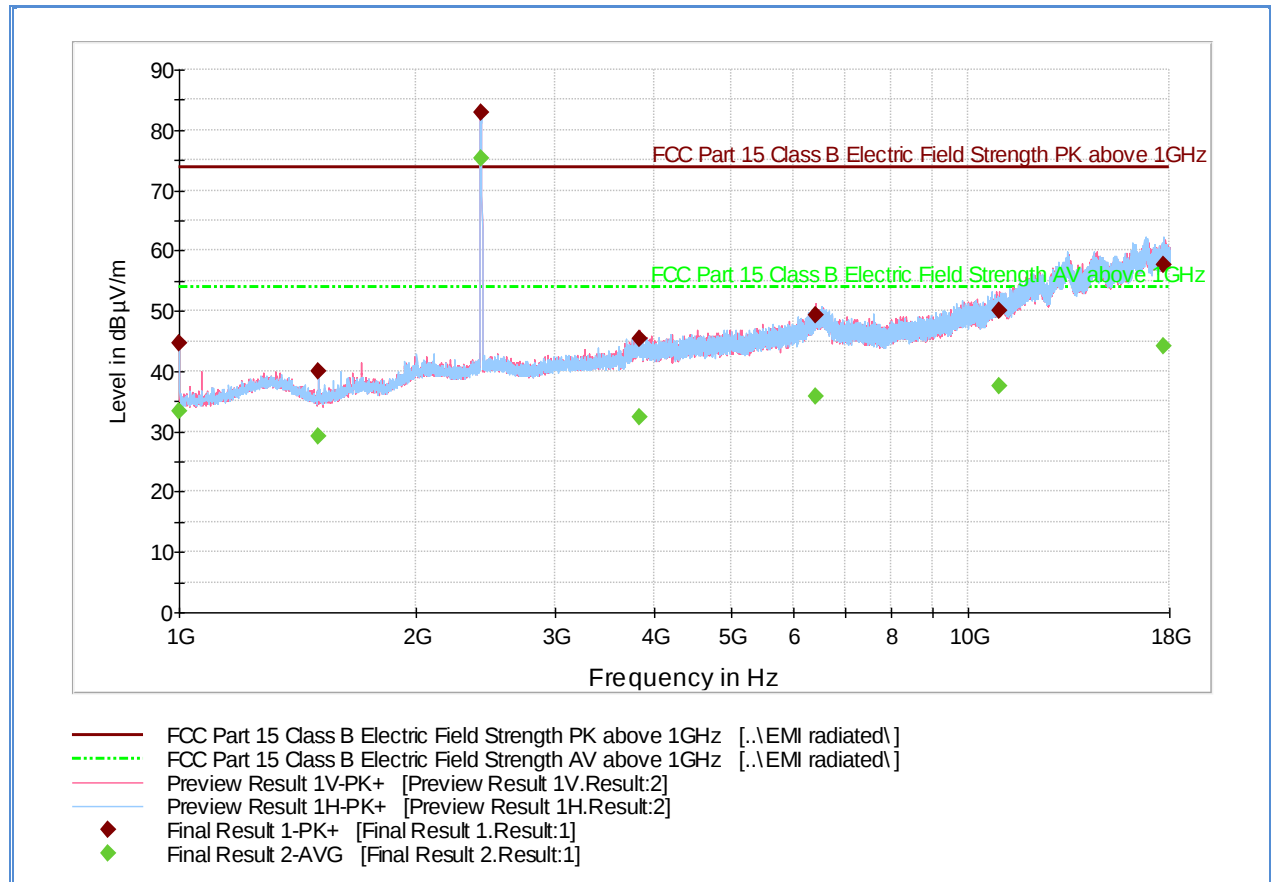
2.5.10 Test Results Below 1GHz (WLAN Worst Case Configuration)



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)
37.191663	37.1	1000.0	120.000	100.0	V	101.0	-14.7	2.9	40.0
48.014990	33.5	1000.0	120.000	100.0	V	33.0	-19.1	6.5	40.0
73.485531	25.8	1000.0	120.000	105.0	V	3.0	-21.9	14.2	40.0
135.169940	32.4	1000.0	120.000	100.0	V	28.0	-20.2	11.1	43.5
375.012024	36.6	1000.0	120.000	100.0	H	116.0	-9.1	9.4	46.0
500.020842	40.8	1000.0	120.000	116.0	H	199.0	-6.8	5.2	46.0
750.022365	29.8	1000.0	120.000	109.0	H	246.0	-1.8	16.2	46.0
800.003447	30.4	1000.0	120.000	105.0	H	208.0	-1.5	15.6	46.0

2.5.11 Test Results Above 1GHz (802.11b mode_Low Channel_5.5Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	44.7	1000.0	1000.000	202.3	H	300.0	-7.4	29.2	73.9
1500.200000	39.9	1000.0	1000.000	274.3	H	225.0	-5.7	34.0	73.9
2414.600000	82.8	1000.0	1000.000	103.7	V	37.0	-0.5	Fundamental *)	
3825.800000	45.3	1000.0	1000.000	202.3	V	20.0	4.9	28.6	73.9
6414.300000	49.3	1000.0	1000.000	101.7	V	300.0	11.2	24.6	73.9
10964.300000	50.1	1000.0	1000.000	112.7	V	195.0	14.8	23.8	73.9
17684.733333	57.7	1000.0	1000.000	343.1	H	250.0	23.0	16.2	73.9

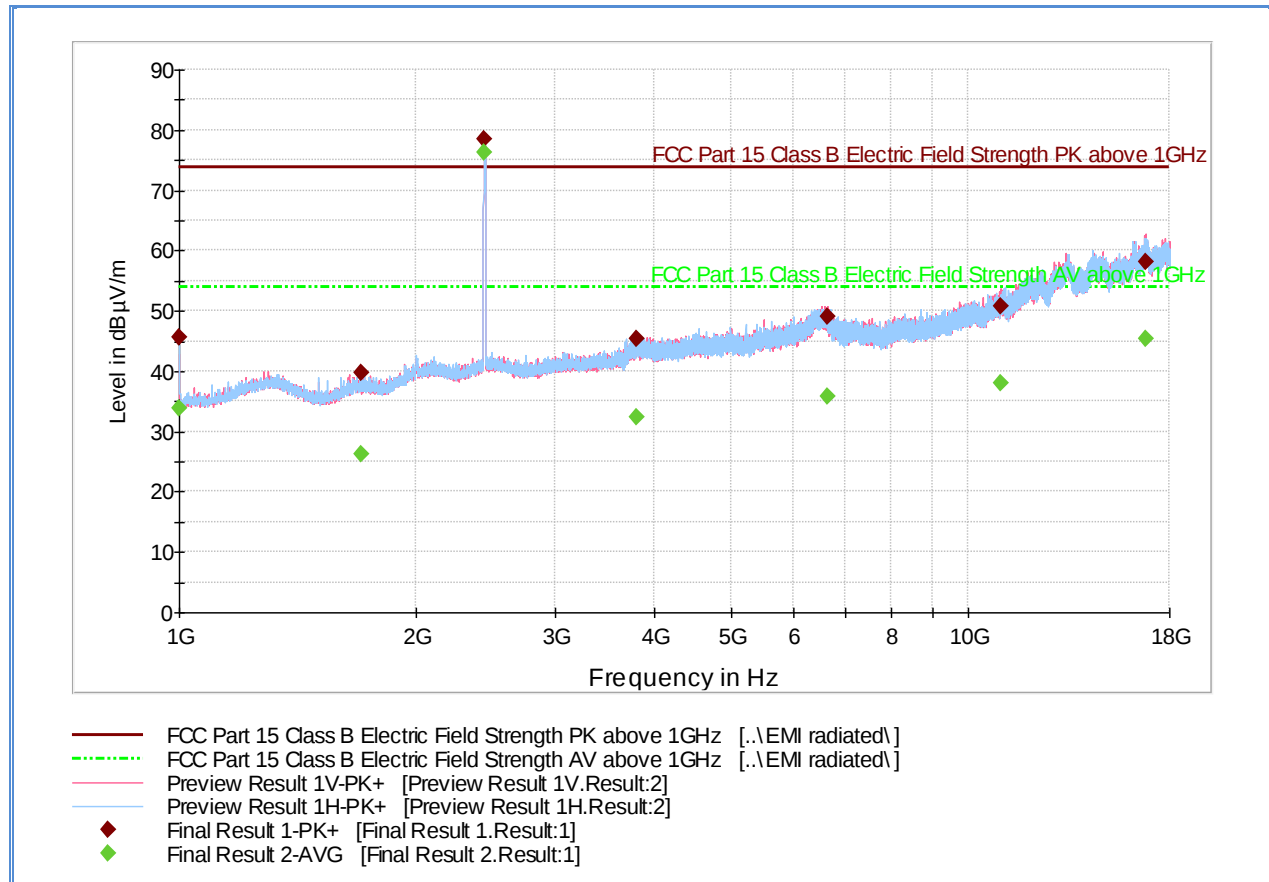
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	33.2	1000.0	1000.000	202.3	H	300.0	-7.4	20.7	53.9
1500.200000	29.2	1000.0	1000.000	274.3	H	225.0	-5.7	24.7	53.9
2414.600000	75.3	1000.0	1000.000	103.7	V	37.0	-0.5	Fundamental *)	
3825.800000	32.3	1000.0	1000.000	202.3	V	20.0	4.9	21.6	53.9
6414.300000	35.9	1000.0	1000.000	101.7	V	300.0	11.2	18.0	53.9
10964.300000	37.6	1000.0	1000.000	112.7	V	195.0	14.8	16.3	53.9
17684.733333	44.0	1000.0	1000.000	343.1	H	250.0	23.0	9.9	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.12 Test Results Above 1GHz (802.11b mode_Mid Channel_1Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	45.6	1000.0	1000.000	190.6	H	283.0	-7.4	28.3	73.9
1699.833333	39.6	1000.0	1000.000	255.3	V	107.0	-4.3	34.3	73.9
2435.733333	78.4	1000.0	1000.000	102.8	H	134.0	-0.4	Fundamental *)	
3807.633333	45.3	1000.0	1000.000	377.1	V	128.0	4.9	28.6	73.9
6640.833333	49.0	1000.0	1000.000	301.2	V	258.0	10.9	24.9	73.9
10994.533333	50.8	1000.0	1000.000	344.1	V	103.0	14.9	23.1	73.9
16768.633333	58.0	1000.0	1000.000	115.7	V	300.0	23.5	15.9	73.9

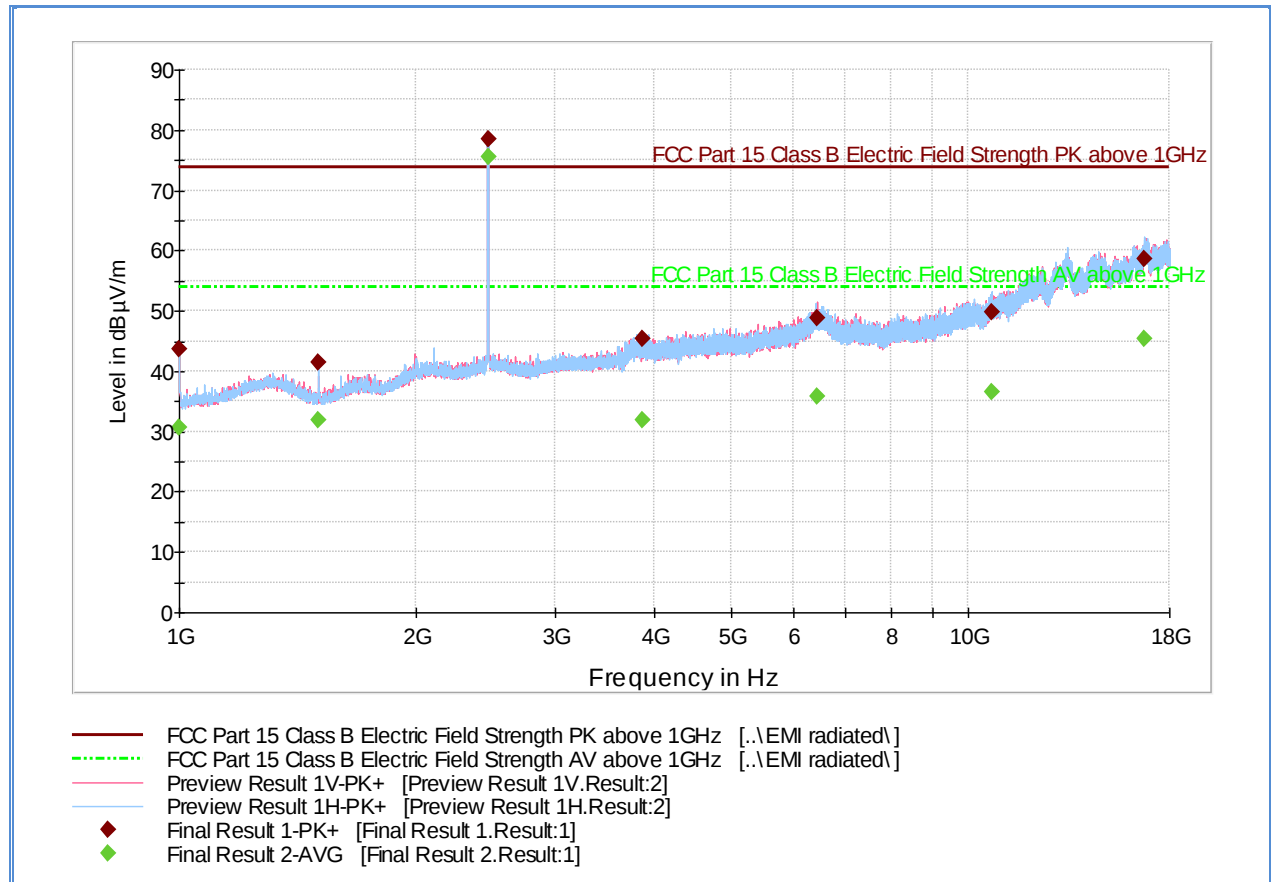
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	33.7	1000.0	1000.000	190.6	H	283.0	-7.4	20.2	53.9
1699.833333	26.3	1000.0	1000.000	255.3	V	107.0	-4.3	27.6	53.9
2435.733333	76.3	1000.0	1000.000	102.8	H	134.0	-0.4	Fundamental *)	
3807.633333	32.4	1000.0	1000.000	377.1	V	128.0	4.9	21.5	53.9
6640.833333	35.8	1000.0	1000.000	301.2	V	258.0	10.9	18.1	53.9
10994.533333	37.9	1000.0	1000.000	344.1	V	103.0	14.9	16.0	53.9
16768.633333	45.3	1000.0	1000.000	115.7	V	300.0	23.5	8.6	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.13 Test Results Above 1GHz (802.11b mode_High Channel_2Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	43.6	1000.0	1000.000	202.3	H	291.0	-7.4	30.3	73.9
1500.000000	41.4	1000.0	1000.000	163.6	H	133.0	-5.7	32.5	73.9
2463.566667	78.5	1000.0	1000.000	102.7	H	146.0	-0.2	Fundamental *)	
3866.033333	45.3	1000.0	1000.000	197.5	V	198.0	4.9	28.6	73.9
6432.466667	48.7	1000.0	1000.000	148.7	V	99.0	11.2	25.2	73.9
10741.033333	49.7	1000.0	1000.000	244.4	H	238.0	14.0	24.2	73.9
16759.766667	58.6	1000.0	1000.000	201.3	H	20.0	23.5	15.3	73.9

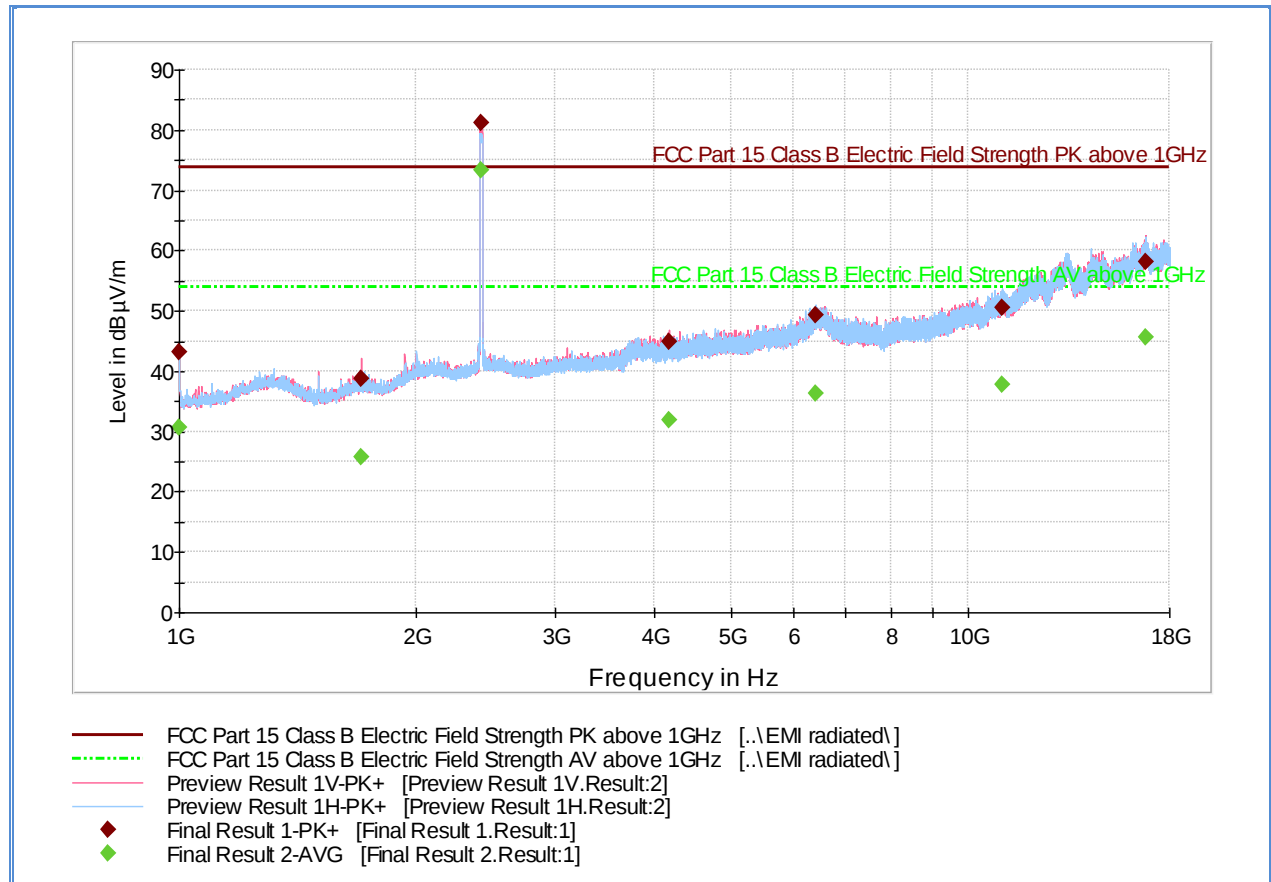
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	30.7	1000.0	1000.000	202.3	H	291.0	-7.4	23.2	53.9
1500.000000	31.8	1000.0	1000.000	163.6	H	133.0	-5.7	22.1	53.9
2463.566667	75.5	1000.0	1000.000	102.7	H	146.0	-0.2	Fundamental *)	
3866.033333	31.9	1000.0	1000.000	197.5	V	198.0	4.9	22.0	53.9
6432.466667	35.7	1000.0	1000.000	148.7	V	99.0	11.2	18.2	53.9
10741.033333	36.6	1000.0	1000.000	244.4	H	238.0	14.0	17.3	53.9
16759.766667	45.3	1000.0	1000.000	201.3	H	20.0	23.5	8.6	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.14 Test Results Above 1GHz (802.11g mode_Low Channel_6Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	43.2	1000.0	1000.000	202.3	H	296.0	-7.4	30.7	73.9
1700.400000	38.8	1000.0	1000.000	287.2	V	-16.0	-4.3	35.1	73.9
2413.633333	81.3	1000.0	1000.000	99.7	V	158.0	-0.5	Fundamental *)	
4178.566667	44.8	1000.0	1000.000	229.4	V	-16.0	5.0	29.1	73.9
6398.766667	49.4	1000.0	1000.000	321.1	H	234.0	11.2	24.5	73.9
11028.833333	50.6	1000.0	1000.000	378.1	H	223.0	14.8	23.3	73.9
16799.633333	58.1	1000.0	1000.000	200.5	V	316.0	23.7	15.8	73.9

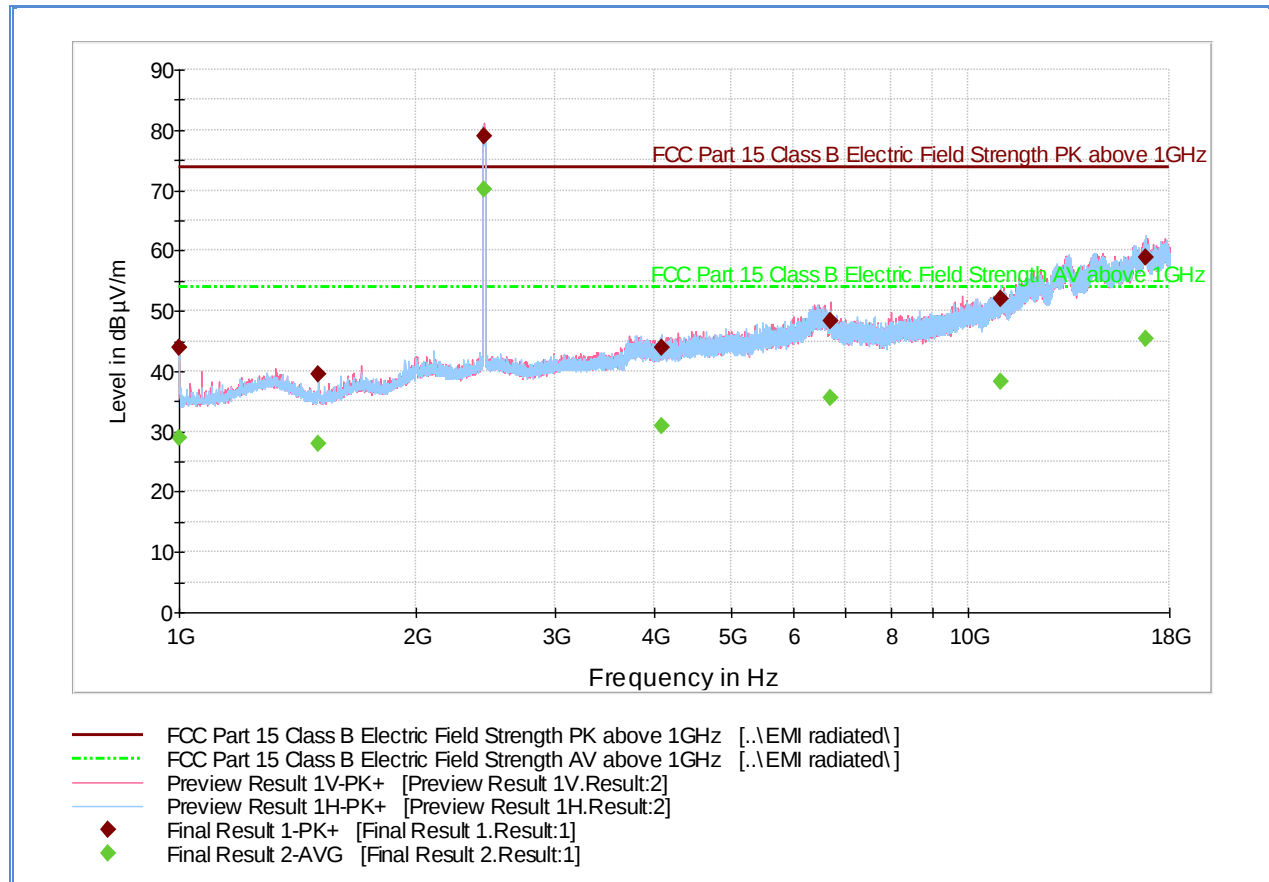
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	30.6	1000.0	1000.000	202.3	H	296.0	-7.4	23.3	53.9
1700.400000	25.8	1000.0	1000.000	287.2	V	-16.0	-4.3	28.1	53.9
2413.633333	73.3	1000.0	1000.000	99.7	V	158.0	-0.5	Fundamental *)	
4178.566667	31.9	1000.0	1000.000	229.4	V	-16.0	5.0	22.0	53.9
6398.766667	36.3	1000.0	1000.000	321.1	H	234.0	11.2	17.6	53.9
11028.833333	37.8	1000.0	1000.000	378.1	H	223.0	14.8	16.1	53.9
16799.633333	45.5	1000.0	1000.000	200.5	V	316.0	23.7	8.4	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.15 Test Results Above 1GHz (802.11g mode_Mid Channel_18Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	43.9	1000.0	1000.000	202.3	H	271.0	-7.4	30.0	73.9
1499.600000	39.6	1000.0	1000.000	276.3	H	236.0	-5.7	34.3	73.9
2438.966667	78.9	1000.0	1000.000	103.7	V	189.0	-0.4	Fundamental *)	
4088.733333	44.0	1000.0	1000.000	132.7	H	209.0	5.0	29.9	73.9
6697.066667	48.4	1000.0	1000.000	334.1	V	111.0	10.7	25.5	73.9
11009.433333	52.0	1000.0	1000.000	285.3	H	236.0	14.9	21.9	73.9
16790.700000	58.9	1000.0	1000.000	300.6	H	10.0	23.6	15.0	73.9

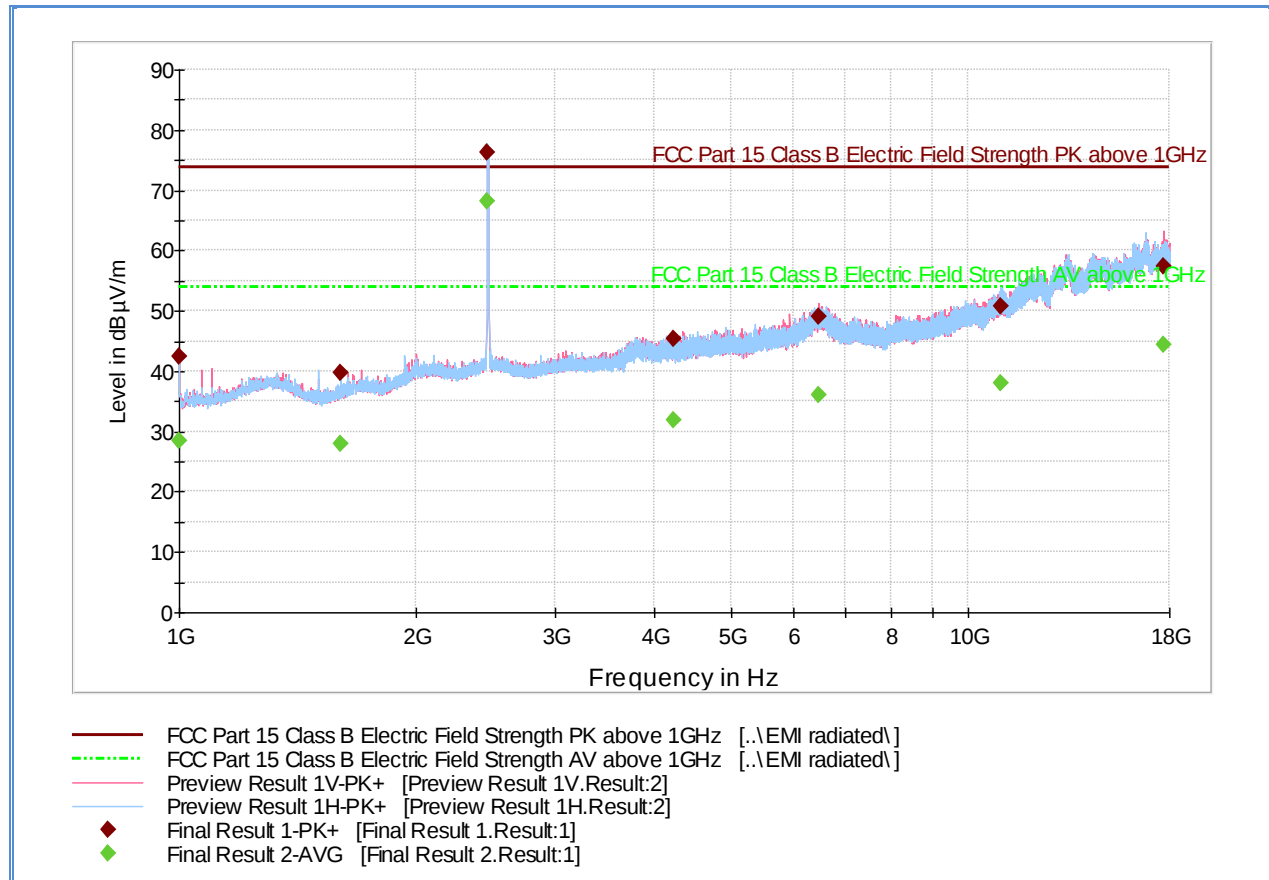
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	28.9	1000.0	1000.000	202.3	H	271.0	-7.4	25.0	53.9
1499.600000	28.0	1000.0	1000.000	276.3	H	236.0	-5.7	25.9	53.9
2438.966667	70.2	1000.0	1000.000	103.7	V	189.0	-0.4	Fundamental *)	
4088.733333	30.8	1000.0	1000.000	132.7	H	209.0	5.0	23.1	53.9
6697.066667	35.5	1000.0	1000.000	334.1	V	111.0	10.7	18.4	53.9
11009.433333	38.2	1000.0	1000.000	285.3	H	236.0	14.9	15.7	53.9
16790.700000	45.5	1000.0	1000.000	300.6	H	10.0	23.6	8.4	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.16 Test Results Above 1GHz (802.11g mode_High Channel_6Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	42.4	1000.0	1000.000	202.3	H	337.0	-7.4	31.5	73.9
1599.733333	39.7	1000.0	1000.000	191.5	V	23.0	-5.5	34.2	73.9
2455.566667	76.2	1000.0	1000.000	140.7	H	206.0	-0.3	Fundamental *)	
4229.233333	45.4	1000.0	1000.000	258.3	V	351.0	4.9	28.5	73.9
6453.966667	48.9	1000.0	1000.000	122.7	V	351.0	11.1	25.0	73.9
11012.066667	50.7	1000.0	1000.000	238.4	H	228.0	14.9	23.2	73.9
17715.766667	57.4	1000.0	1000.000	290.2	V	211.0	23.1	16.5	73.9

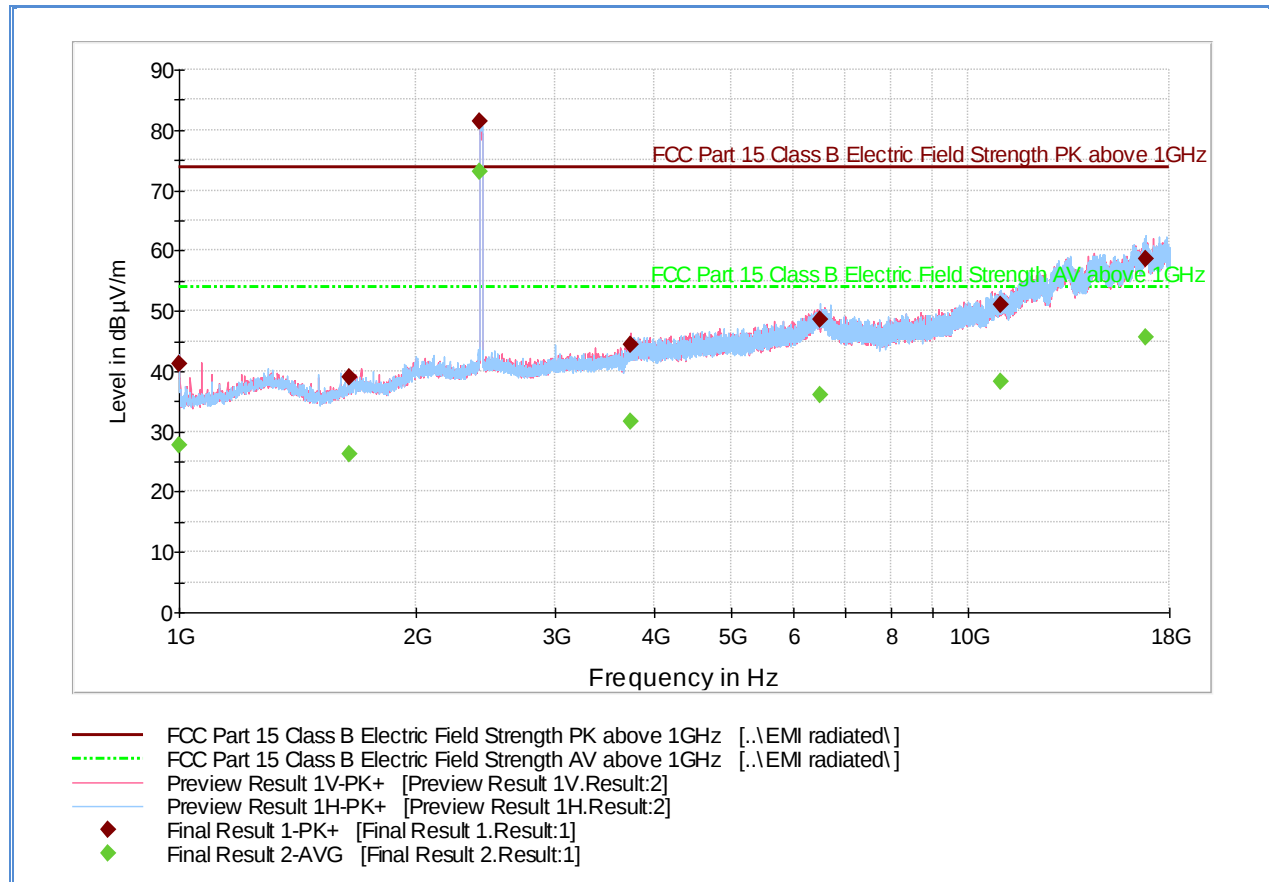
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	28.3	1000.0	1000.000	202.3	H	337.0	-7.4	25.6	53.9
1599.733333	28.0	1000.0	1000.000	191.5	V	23.0	-5.5	25.9	53.9
2455.566667	68.1	1000.0	1000.000	140.7	H	206.0	-0.3	Fundamental *)	
4229.233333	32.0	1000.0	1000.000	258.3	V	351.0	4.9	21.9	53.9
6453.966667	36.1	1000.0	1000.000	122.7	V	351.0	11.1	17.8	53.9
11012.066667	38.1	1000.0	1000.000	238.4	H	228.0	14.9	15.8	53.9
17715.766667	44.3	1000.0	1000.000	290.2	V	211.0	23.1	9.6	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.17 Test Results Above 1GHz (802.11n mode HT20_Low Channel_72Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	41.3	1000.0	1000.000	139.7	V	163.0	-7.4	32.6	73.9
1640.166667	39.1	1000.0	1000.000	227.4	V	69.0	-5.0	34.8	73.9
2408.366667	81.3	1000.0	1000.000	140.7	H	188.0	-0.5	Fundamental *)	
3735.866667	44.5	1000.0	1000.000	154.6	V	202.0	4.2	29.4	73.9
6498.366667	48.6	1000.0	1000.000	117.7	H	202.0	11.1	25.3	73.9
11006.966667	51.1	1000.0	1000.000	288.2	H	164.0	14.9	22.9	73.9
16802.466667	58.6	1000.0	1000.000	409.0	H	70.0	23.7	15.3	73.9

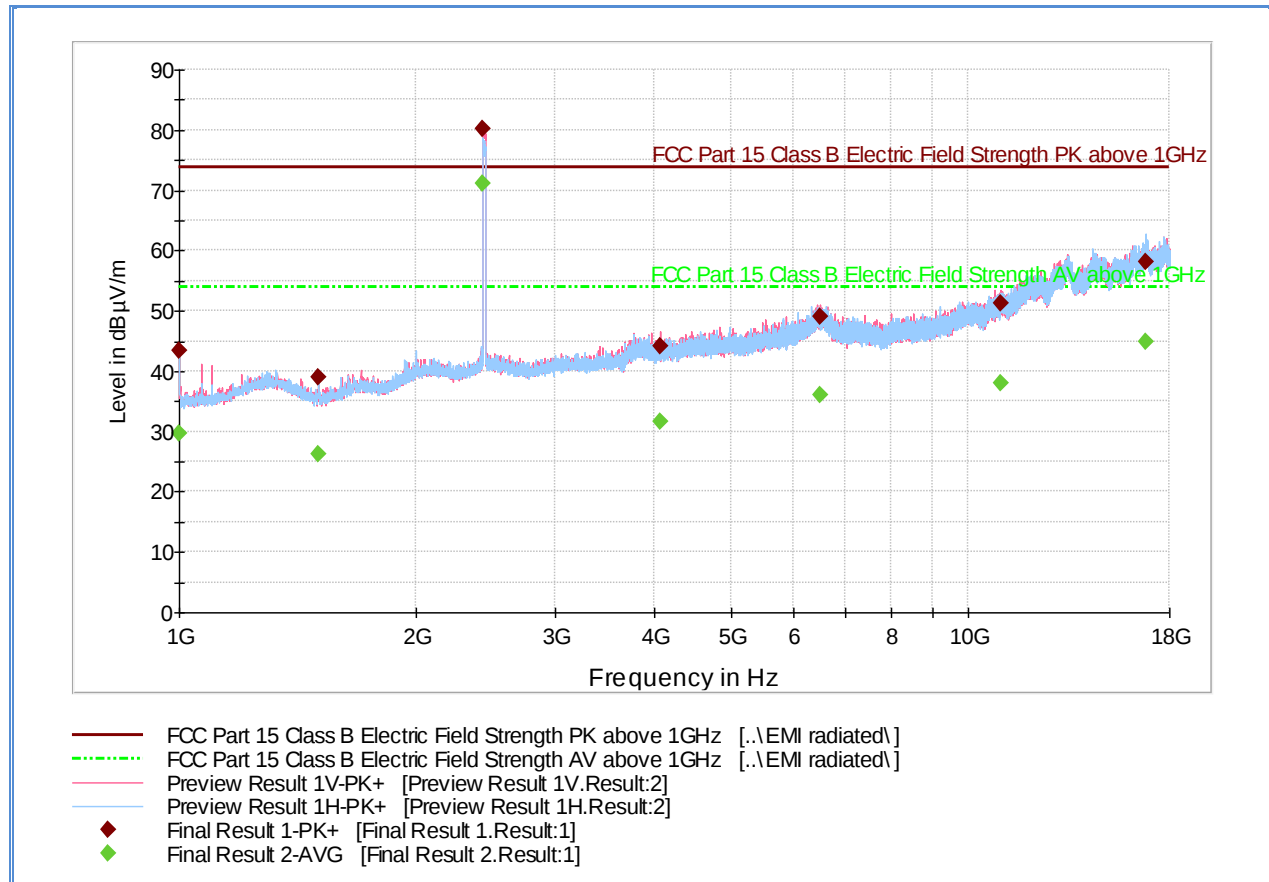
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	27.7	1000.0	1000.000	139.7	V	163.0	-7.4	26.2	53.9
1640.166667	26.2	1000.0	1000.000	227.4	V	69.0	-5.0	27.7	53.9
2408.366667	73.0	1000.0	1000.000	140.7	H	188.0	-0.5	Fundamental *)	
3735.866667	31.6	1000.0	1000.000	154.6	V	202.0	4.2	22.3	53.9
6498.366667	36.0	1000.0	1000.000	117.7	H	202.0	11.1	17.9	53.9
11006.966667	38.2	1000.0	1000.000	288.2	H	164.0	14.9	15.7	53.9
16802.466667	45.5	1000.0	1000.000	409.0	H	70.0	23.7	8.4	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.18 Test Results Above 1GHz (802.11n mode HT20_Mid Channel_72Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.000000	43.4	1000.0	1000.000	202.3	H	336.0	-7.4	30.5	73.9
1500.000000	39.0	1000.0	1000.000	248.3	H	213.0	-5.7	34.9	73.9
2429.500000	80.2	1000.0	1000.000	103.7	V	37.0	-0.4	Fundamental *)	
4072.600000	44.2	1000.0	1000.000	121.7	V	177.0	5.0	29.7	73.9
6503.666667	49.1	1000.0	1000.000	302.2	V	197.0	11.1	24.8	73.9
11006.566667	51.2	1000.0	1000.000	247.3	V	291.0	14.9	22.7	73.9
16827.433333	58.0	1000.0	1000.000	174.6	H	225.0	23.4	15.9	73.9

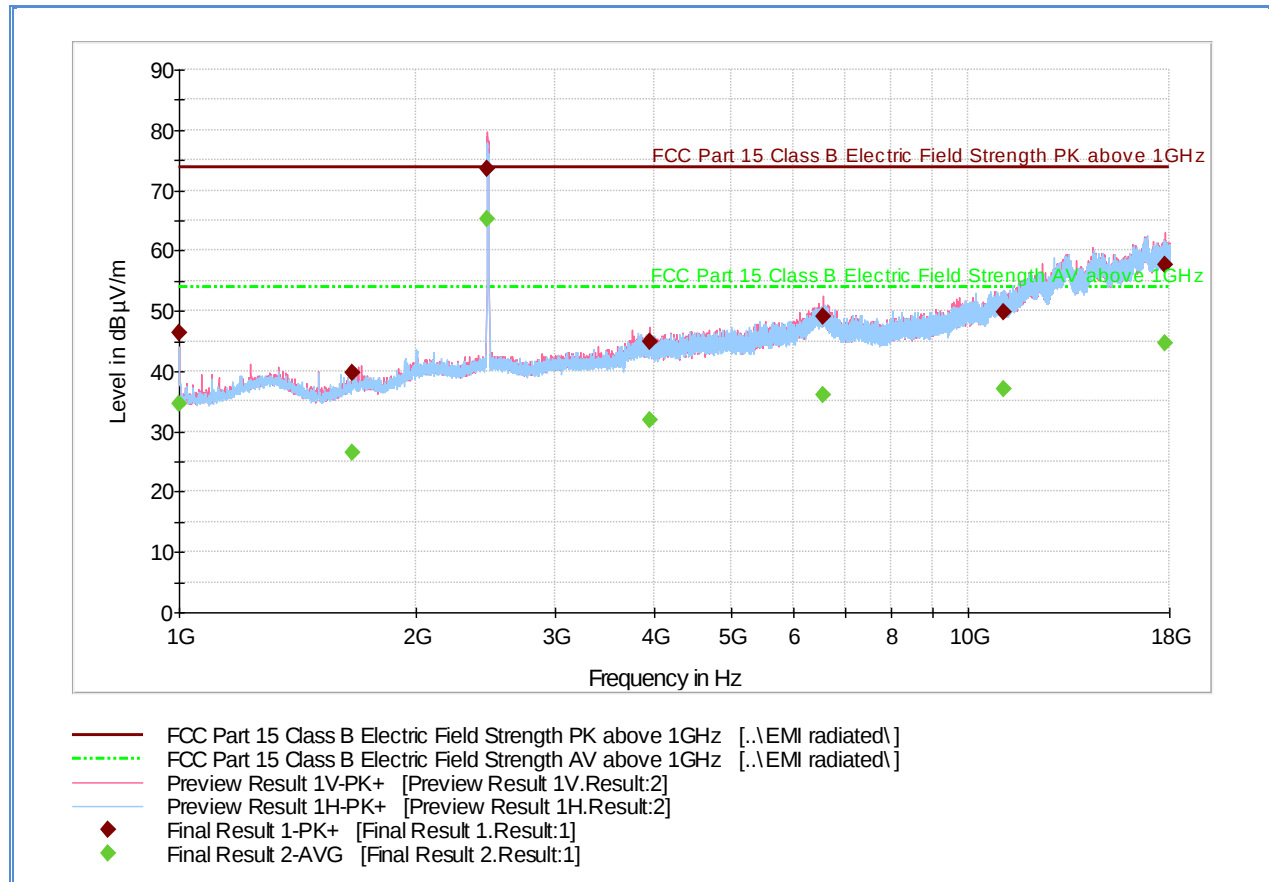
Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.000000	29.7	1000.0	1000.000	202.3	H	336.0	-7.4	24.2	53.9
1500.000000	26.2	1000.0	1000.000	248.3	H	213.0	-5.7	27.7	53.9
2429.500000	71.1	1000.0	1000.000	103.7	V	37.0	-0.4	Fundamental *)	
4072.600000	31.5	1000.0	1000.000	121.7	V	177.0	5.0	22.4	53.9
6503.666667	36.0	1000.0	1000.000	302.2	V	197.0	11.1	17.9	53.9
11006.566667	38.0	1000.0	1000.000	247.3	V	291.0	14.9	15.9	53.9
16827.433333	44.9	1000.0	1000.000	174.6	H	225.0	23.4	9.0	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.19 Test Results Above 1GHz (802.11n mode HT20_High Channel_72Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	46.5	1000.0	1000.000	156.7	V	157.0	-7.4	27.4	73.9
1660.000000	39.7	1000.0	1000.000	276.3	V	98.0	-4.7	34.2	73.9
2454.866667	73.7	1000.0	1000.000	124.7	V	231.0	-0.3	Fundamental *)	
3950.633333	45.0	1000.0	1000.000	296.3	V	23.0	4.9	28.9	73.9
6556.966667	49.0	1000.0	1000.000	216.5	V	98.0	11.3	24.9	73.9
11082.366667	49.9	1000.0	1000.000	123.7	H	188.0	14.6	24.0	73.9
17751.066667	57.7	1000.0	1000.000	406.7	V	10.0	23.2	16.2	73.9

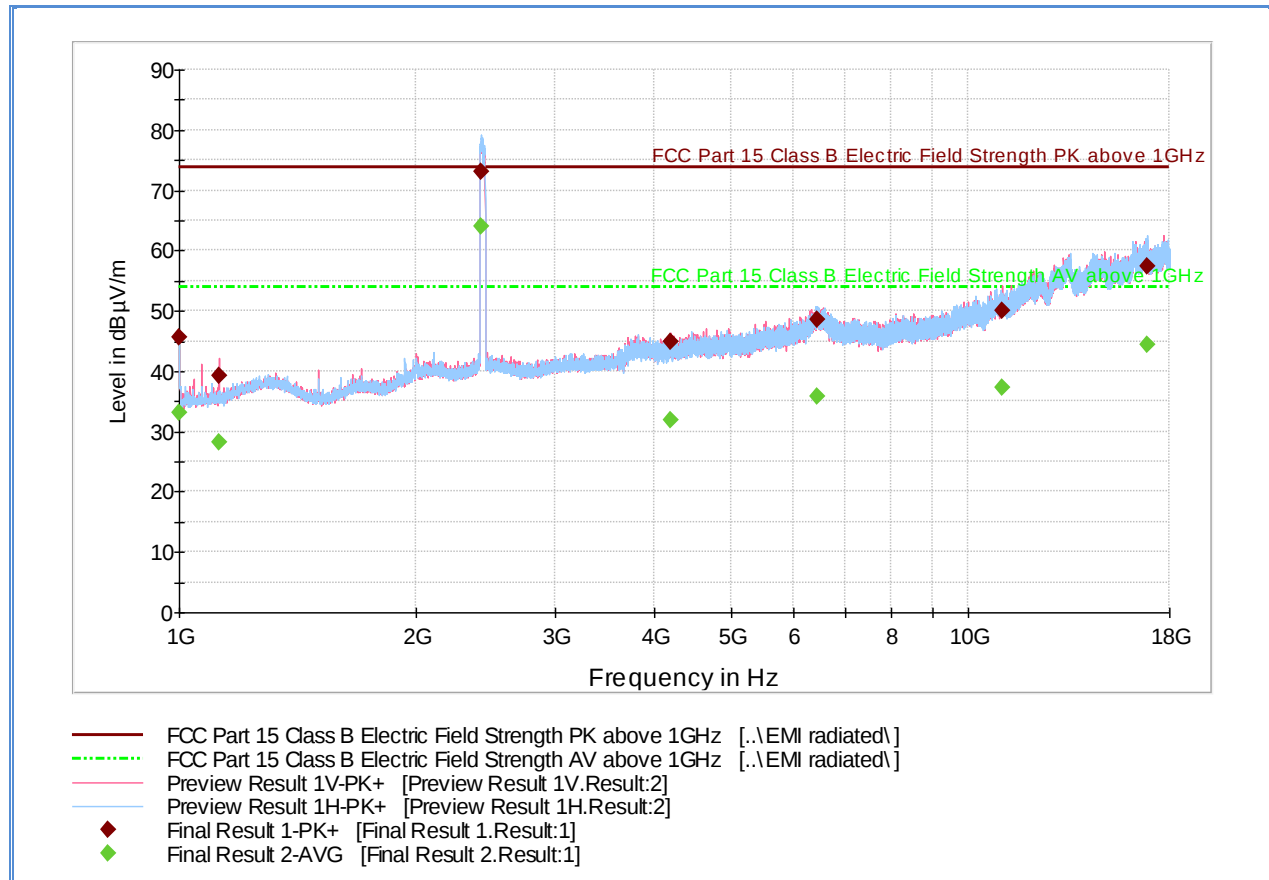
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	34.7	1000.0	1000.000	156.7	V	157.0	-7.4	19.2	53.9
1660.000000	26.4	1000.0	1000.000	276.3	V	98.0	-4.7	27.5	53.9
2454.866667	65.3	1000.0	1000.000	124.7	V	231.0	-0.3	Fundamental *)	
3950.633333	31.8	1000.0	1000.000	296.3	V	23.0	4.9	22.1	53.9
6556.966667	36.1	1000.0	1000.000	216.5	V	98.0	11.3	17.8	53.9
11082.366667	36.9	1000.0	1000.000	123.7	H	188.0	14.6	17.0	53.9
17751.066667	44.7	1000.0	1000.000	406.7	V	10.0	23.2	9.2	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.20 Test Results Above 1GHz (802.11n mode HT40_Low Channel_150Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.000000	45.7	1000.0	1000.000	218.4	H	36.0	-7.4	28.2	73.9
1122.600000	39.4	1000.0	1000.000	202.3	V	50.0	-6.9	34.5	73.9
2414.200000	73.0	1000.0	1000.000	116.7	H	206.0	-0.5	Fundamental *)	
4199.266667	44.9	1000.0	1000.000	188.5	V	26.0	5.0	29.0	73.9
6449.833333	48.5	1000.0	1000.000	217.4	H	241.0	11.1	25.4	73.9
11045.300000	50.0	1000.0	1000.000	162.6	V	342.0	14.7	23.9	73.9
16857.233333	57.3	1000.0	1000.000	302.6	H	82.0	23.1	16.6	73.9

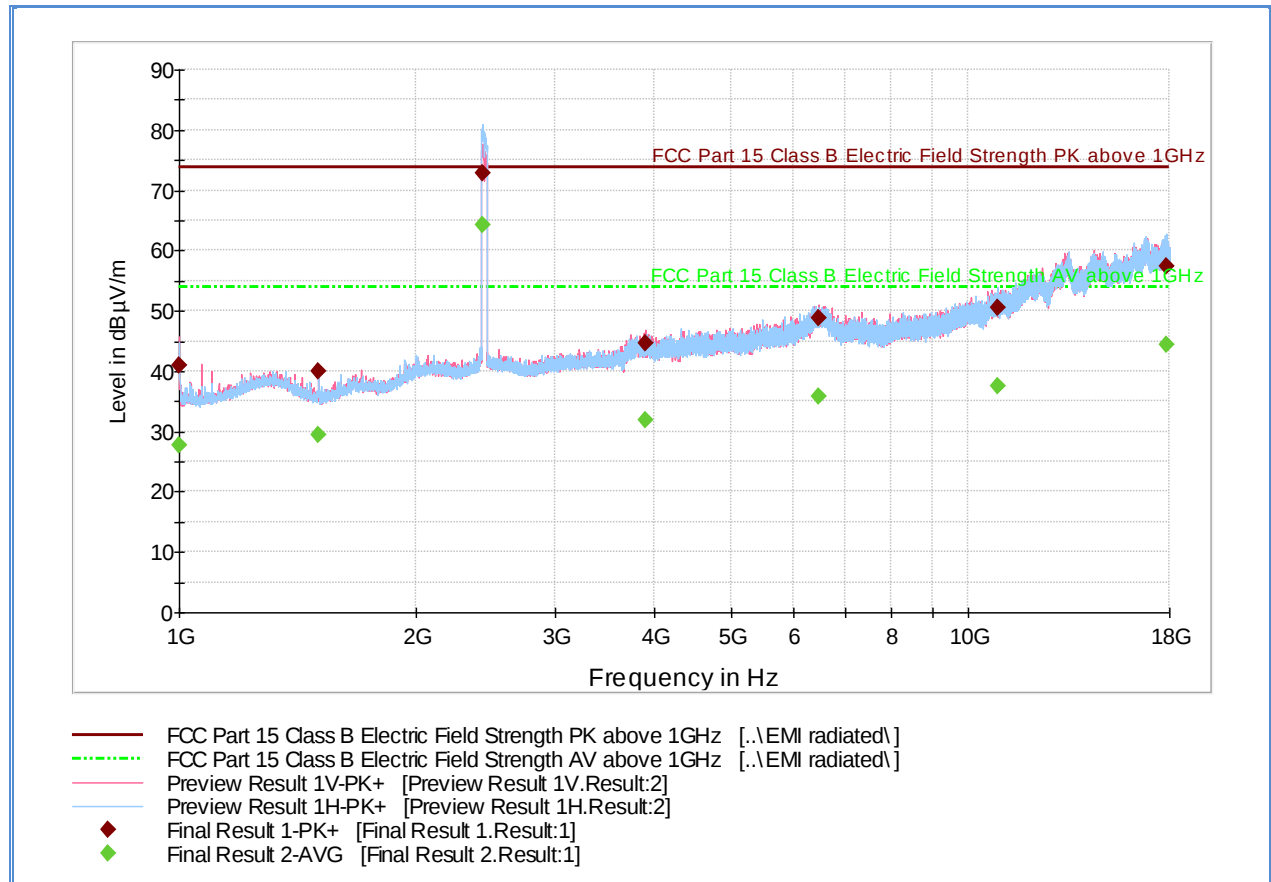
Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.000000	33.0	1000.0	1000.000	218.4	H	36.0	-7.4	20.9	53.9
1122.600000	28.2	1000.0	1000.000	202.3	V	50.0	-6.9	25.7	53.9
2414.200000	64.1	1000.0	1000.000	116.7	H	206.0	-0.5	Fundamental *)	
4199.266667	31.8	1000.0	1000.000	188.5	V	26.0	5.0	22.1	53.9
6449.833333	35.9	1000.0	1000.000	217.4	H	241.0	11.1	18.0	53.9
11045.300000	37.2	1000.0	1000.000	162.6	V	342.0	14.7	16.7	53.9
16857.233333	44.5	1000.0	1000.000	302.6	H	82.0	23.1	9.4	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.21 Test Results Above 1GHz (802.11n mode HT40_Mid Channel_159Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	40.9	1000.0	1000.000	137.7	V	71.0	-7.4	33.0	73.9
1500.000000	40.1	1000.0	1000.000	276.3	H	235.0	-5.7	33.8	73.9
2421.900000	72.9	1000.0	1000.000	116.7	H	210.0	-0.5	Fundamental *)	
3893.266667	44.7	1000.0	1000.000	278.3	V	195.0	5.0	29.2	73.9
6464.000000	48.9	1000.0	1000.000	103.7	V	23.0	11.1	25.0	73.9
10925.566667	50.5	1000.0	1000.000	403.1	H	0.0	14.7	23.4	73.9
17836.633333	57.5	1000.0	1000.000	408.6	H	130.0	23.2	16.4	73.9

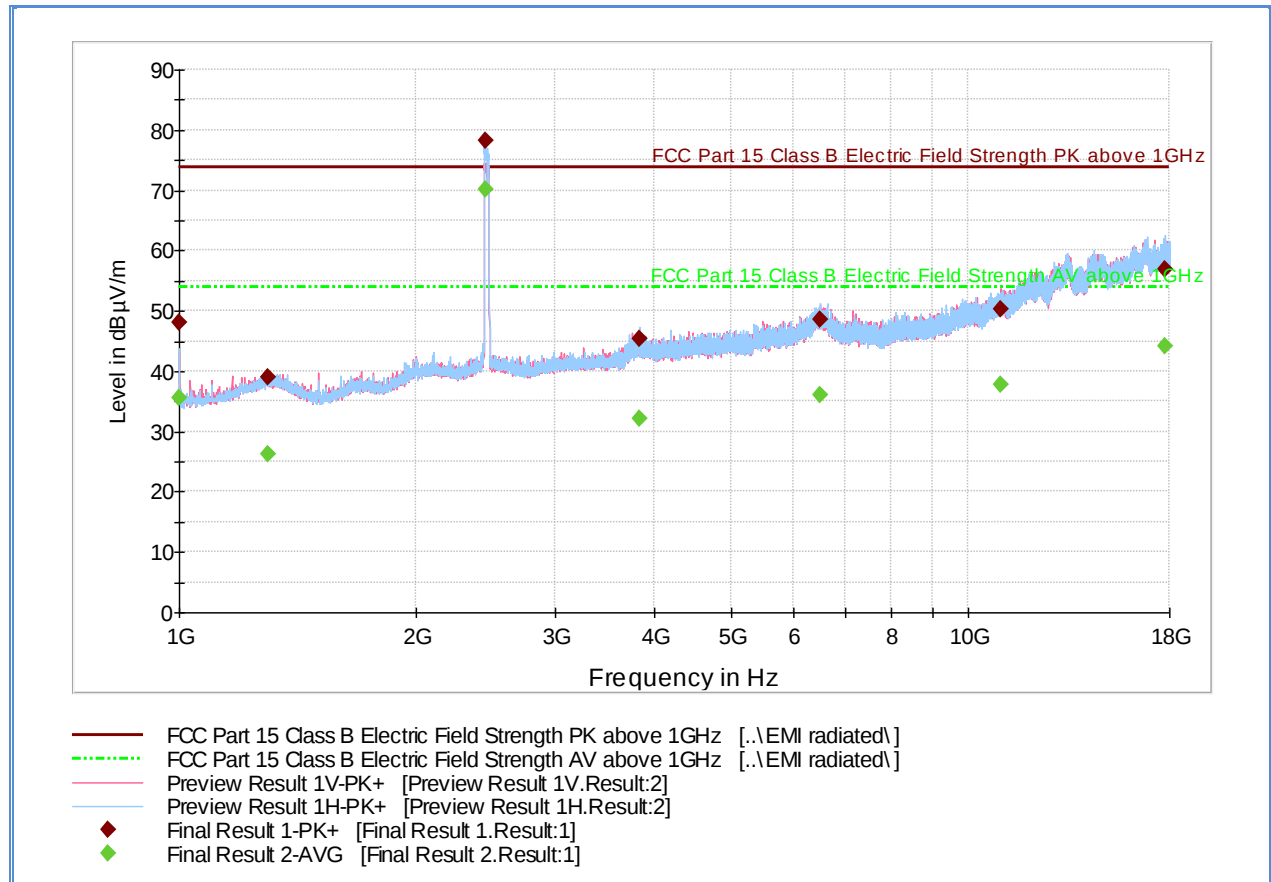
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	27.8	1000.0	1000.000	137.7	V	71.0	-7.4	26.1	53.9
1500.000000	29.5	1000.0	1000.000	276.3	H	235.0	-5.7	24.4	53.9
2421.900000	64.3	1000.0	1000.000	116.7	H	210.0	-0.5	Fundamental *)	
3893.266667	31.9	1000.0	1000.000	278.3	V	195.0	5.0	22.0	53.9
6464.000000	35.9	1000.0	1000.000	103.7	V	23.0	11.1	18.0	53.9
10925.566667	37.6	1000.0	1000.000	403.1	H	0.0	14.7	16.3	53.9
17836.633333	44.5	1000.0	1000.000	408.6	H	130.0	23.2	9.4	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.

2.5.22 Test Results Above 1GHz (802.11n mode HT40_High Channel_159Mbps)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.2	1000.0	1000.000	268.3	H	253.0	-7.4	25.7	73.9
1296.233333	38.9	1000.0	1000.000	173.6	H	187.0	-5.5	35.0	73.9
2448.533333	78.1	1000.0	1000.000	103.7	H	206.0	-0.3	Fundamental *)	
3839.966667	45.3	1000.0	1000.000	378.1	H	4.0	4.9	28.6	73.9
6496.233333	48.6	1000.0	1000.000	155.6	H	20.0	11.1	25.3	73.9
10985.833333	50.4	1000.0	1000.000	299.2	V	337.0	14.9	23.5	73.9
17757.866667	56.8	1000.0	1000.000	268.3	H	100.0	23.2	17.1	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)
1000.000000	35.6	1000.0	1000.000	268.3	H	253.0	-7.4	18.3	53.9
1296.233333	26.3	1000.0	1000.000	173.6	H	187.0	-5.5	27.6	53.9
2448.533333	70.1	1000.0	1000.000	103.7	H	206.0	-0.3	Fundamental *)	
3839.966667	32.1	1000.0	1000.000	378.1	H	4.0	4.9	21.8	53.9
6496.233333	36.0	1000.0	1000.000	155.6	H	20.0	11.1	17.9	53.9
10985.833333	37.8	1000.0	1000.000	299.2	V	337.0	14.9	16.1	53.9
17757.866667	44.3	1000.0	1000.000	268.3	H	100.0	23.2	9.6	53.9

*) This is fundamental frequency not part of spurious emission evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 3GHz. Measurements above 3GHz are noise floor figures.



2.6 RADIATED BAND EDGE MEASUREMENTS AND IMMEDIATE RESTRICTED BANDS

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.6.2 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)).

2.6.3 Equipment Under Test and Modification State

Serial No: 357932-01-020007-2 / Test Configuration B

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

February 05, 2015 / AC

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	23.3 °C
Relative Humidity	40.8.%
ATM Pressure	99.5 kPa

2.6.7 Additional Observations

- This is a radiated test. The spectrum was searched from 2310MHz to 2390MHz for lower immediate restricted band and 2483.5MHz to 2500MHz for the upper immediate restricted band.
- There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.



- 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 2.8.8 for sample computation.

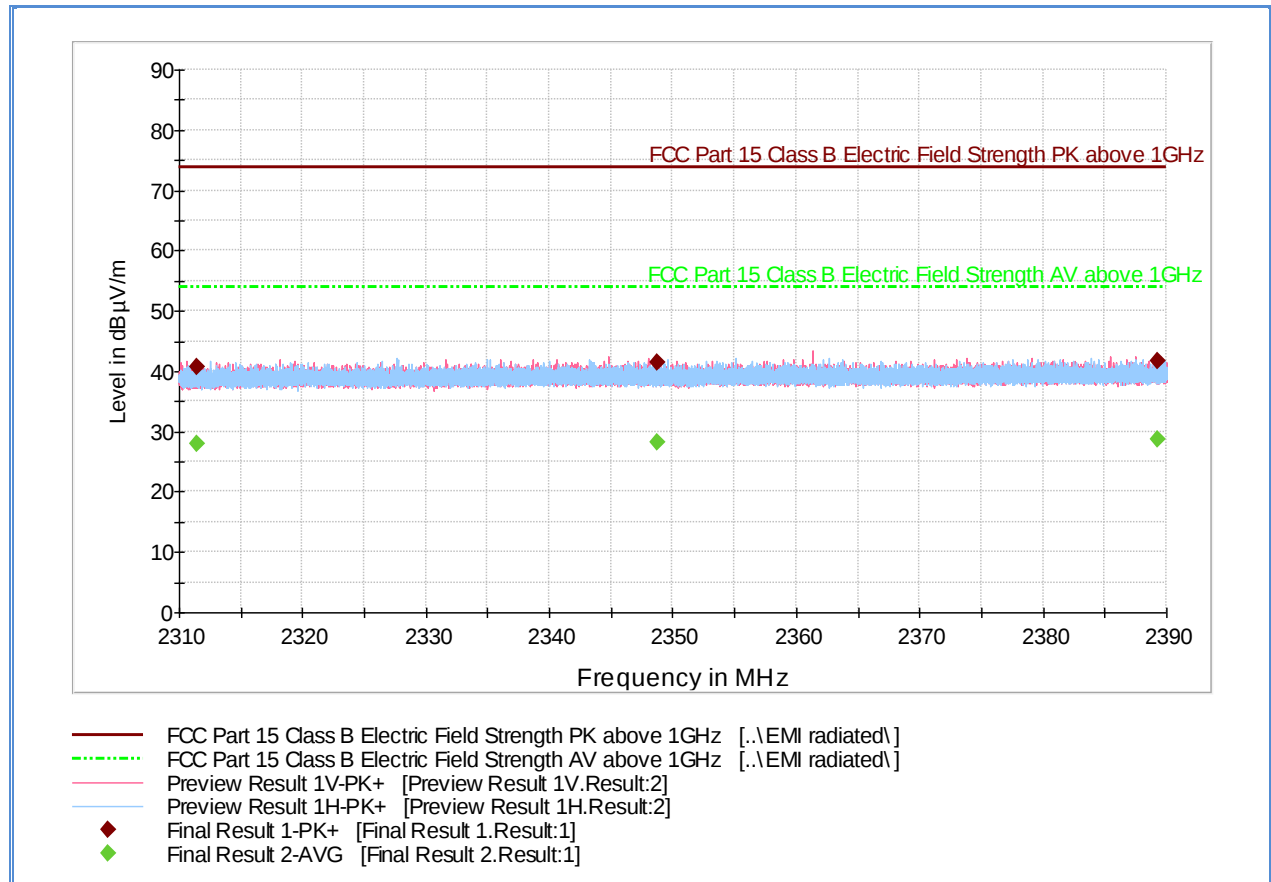
2.6.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (db μ V) @ 2400 MHz			53.9
Correction Factor (dB)	Asset# 1153 (cable)	3.4	-0.4
	Asset# 8628(preamplifier)	-36.5	
	Asset#7575 (antenna)	32.7	
Reported Max Peak Final Measurement (dbμV/m) @ 2400 MHz			53.5

2.6.9 Test Results

See attached plots.

2.6.10 Test Results Restricted Band 2310MHz to 2390MHz (802.11b mode Low Channel)



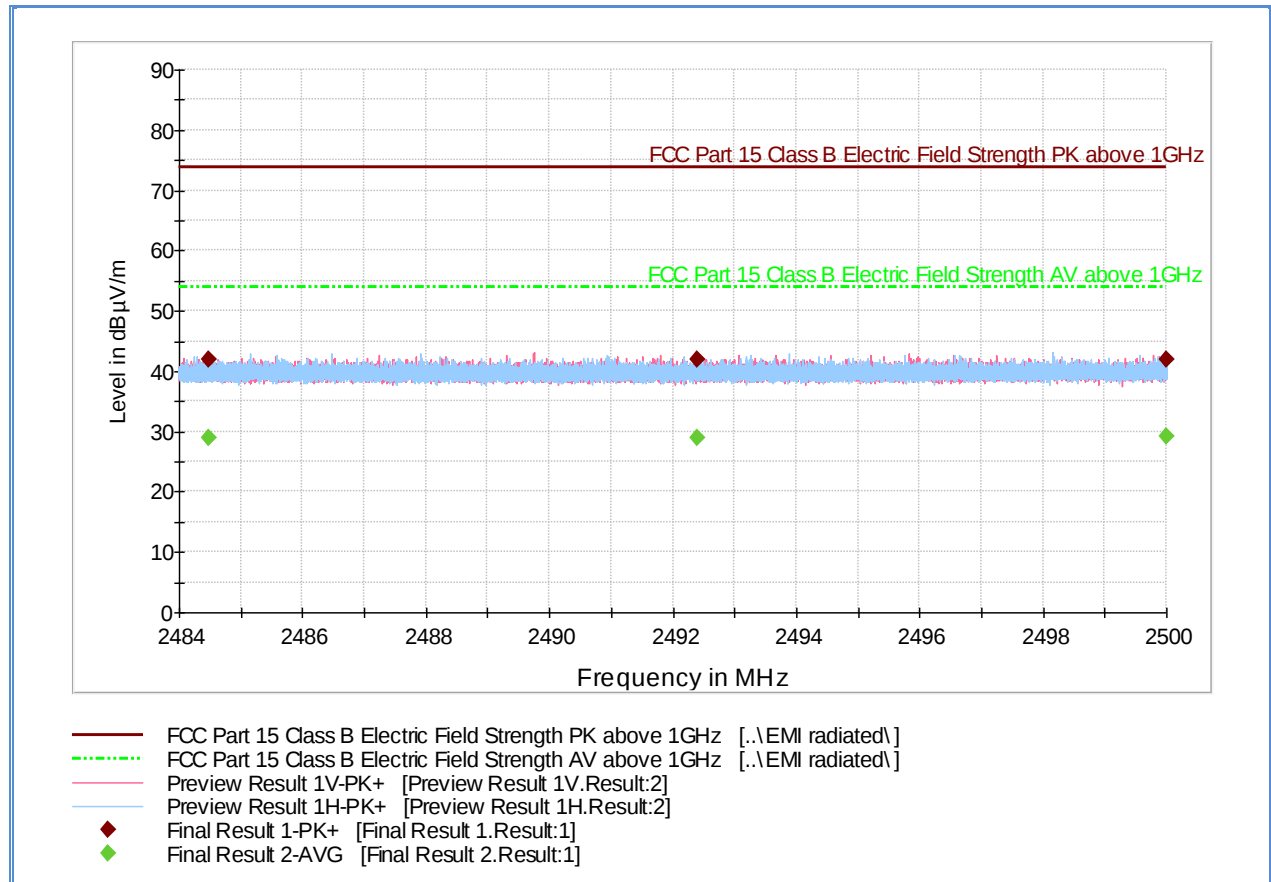
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2311.453333	40.7	1000.0	1000.000	367.1	V	238.0	-1.1	33.2	73.9
2348.762667	41.4	1000.0	1000.000	379.1	V	20.0	-0.8	32.5	73.9
2389.272000	41.6	1000.0	1000.000	155.6	V	157.0	-0.6	32.3	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)
2311.453333	28.0	1000.0	1000.000	367.1	V	238.0	-1.1	25.9	53.9
2348.762667	28.2	1000.0	1000.000	379.1	V	20.0	-0.8	25.7	53.9
2389.272000	28.6	1000.0	1000.000	155.6	V	157.0	-0.6	25.3	53.9

2.6.11 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11b mode High Channel)



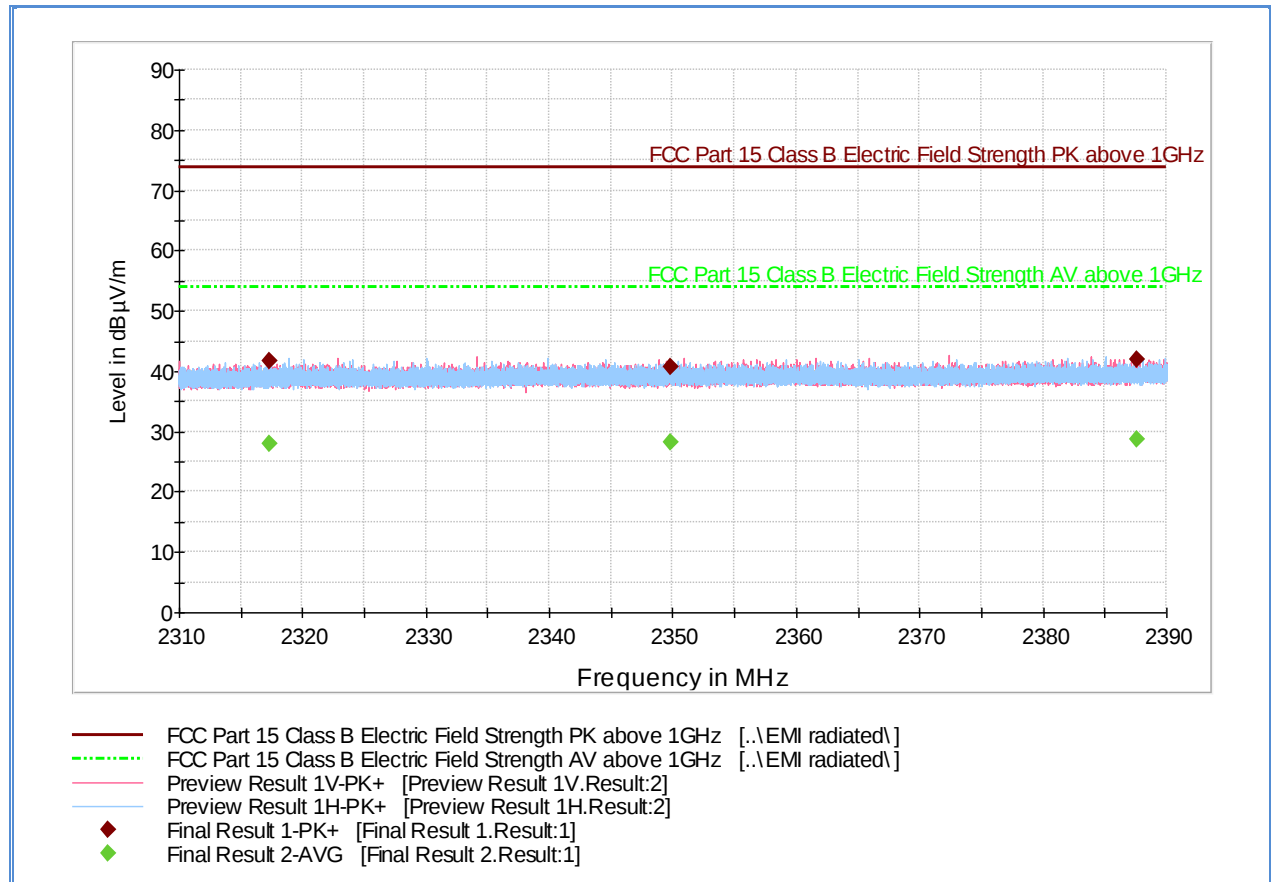
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.480000	41.8	1000.0	1000.000	181.6	V	57.0	-0.1	32.1	73.9
2492.400533	41.9	1000.0	1000.000	259.3	V	168.0	-0.1	32.0	73.9
2500.000000	41.8	1000.0	1000.000	189.5	V	17.0	-0.1	32.1	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)
2484.480000	29.0	1000.0	1000.000	181.6	V	57.0	-0.1	24.9	53.9
2492.400533	29.0	1000.0	1000.000	259.3	V	168.0	-0.1	24.9	53.9
2500.000000	29.1	1000.0	1000.000	189.5	V	17.0	-0.1	24.8	53.9

2.6.12 Test Results Restricted Band 2310MHz to 2390MHz (802.11g mode Low Channel)



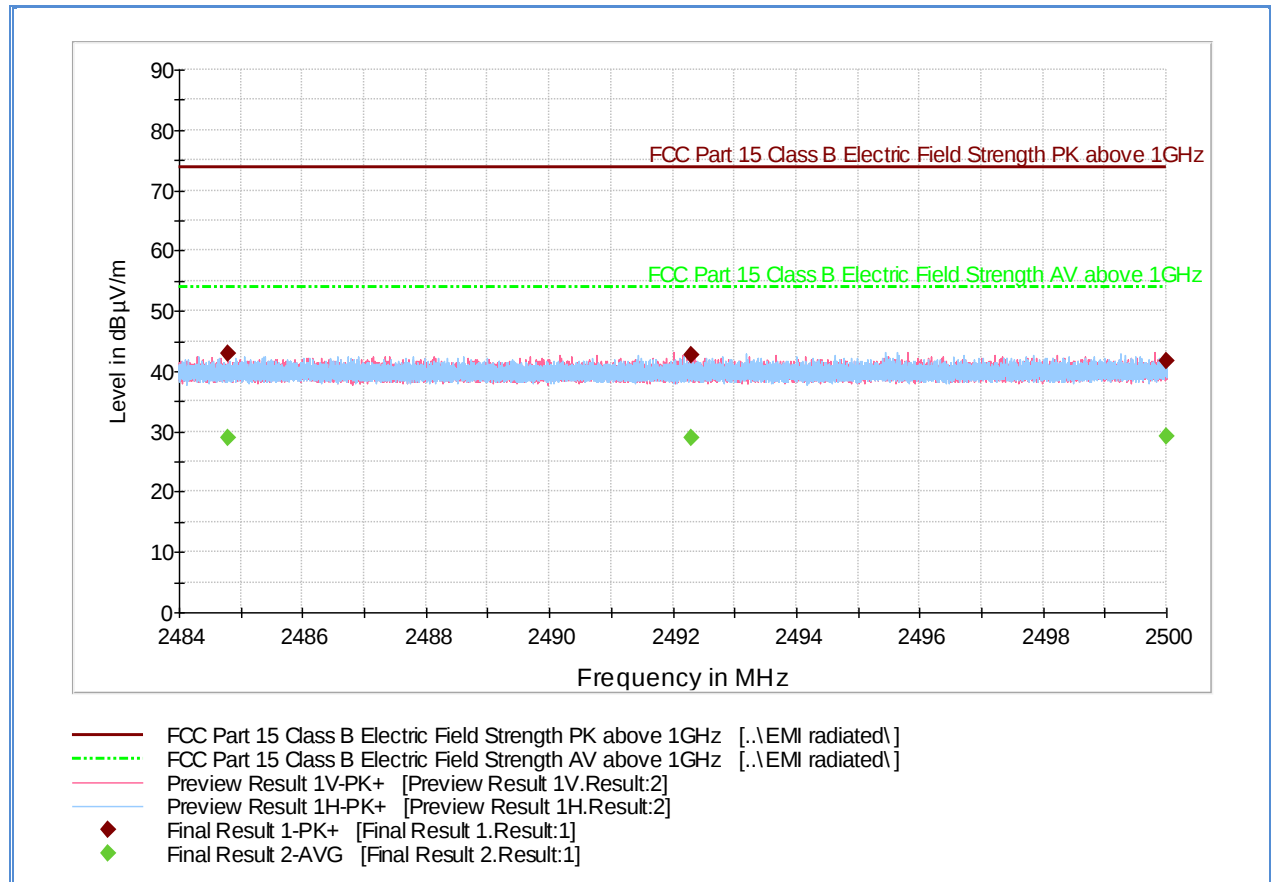
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2317.370667	41.8	1000.0	1000.000	138.7	V	332.0	-1.0	32.1	73.9
2349.877333	40.7	1000.0	1000.000	406.7	V	114.0	-0.8	33.2	73.9
2387.586667	41.8	1000.0	1000.000	228.4	V	303.0	-0.7	32.1	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)
2317.370667	28.1	1000.0	1000.000	138.7	V	332.0	-1.0	25.8	53.9
2349.877333	28.2	1000.0	1000.000	406.7	V	114.0	-0.8	25.7	53.9
2387.586667	28.6	1000.0	1000.000	228.4	V	303.0	-0.7	25.3	53.9

2.6.13 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11g mode High Channel)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.800000	42.9	1000.0	1000.000	300.6	V	63.0	-0.1	31.0	73.9
2492.292267	42.7	1000.0	1000.000	279.3	H	283.0	-0.1	31.2	73.9
2500.000000	41.8	1000.0	1000.000	191.5	V	-3.0	-0.1	32.1	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)
2484.800000	29.0	1000.0	1000.000	300.6	V	63.0	-0.1	24.9	53.9
2492.292267	29.0	1000.0	1000.000	279.3	H	283.0	-0.1	24.9	53.9
2500.000000	29.2	1000.0	1000.000	191.5	V	-3.0	-0.1	24.7	53.9

2.6.14 Test Results Restricted Band 2310MHz to 2390MHz (802.11n HT20 mode Low Channel)



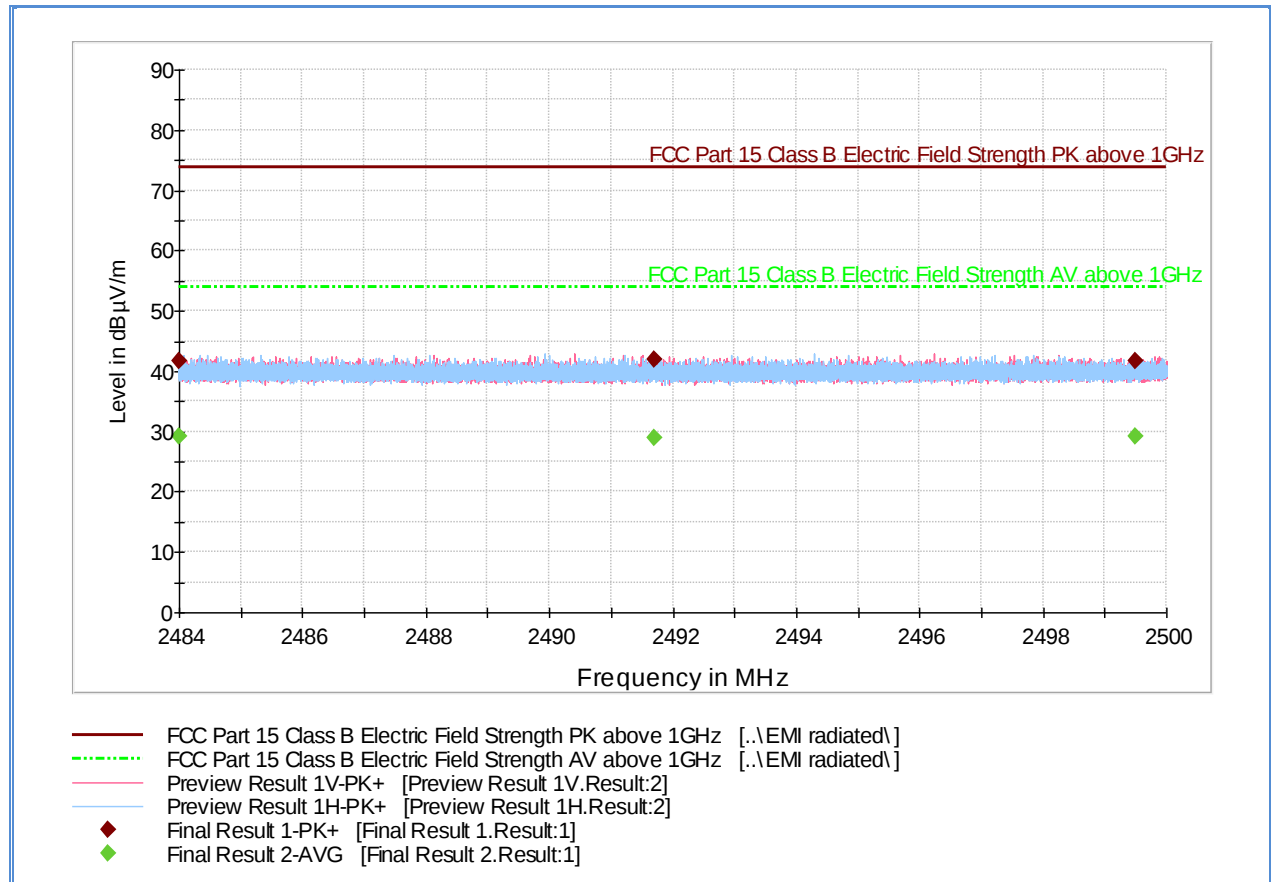
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2313.730667	40.7	1000.0	1000.000	234.4	V	64.0	-1.1	33.2	73.9
2347.693333	41.1	1000.0	1000.000	114.7	V	210.0	-0.8	32.8	73.9
2388.618667	43.0	1000.0	1000.000	102.7	H	270.0	-0.6	30.9	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)
2313.730667	28.0	1000.0	1000.000	234.4	V	64.0	-1.1	25.9	53.9
2347.693333	28.2	1000.0	1000.000	114.7	V	210.0	-0.8	25.7	53.9
2388.618667	29.1	1000.0	1000.000	102.7	H	270.0	-0.6	24.8	53.9

2.6.15 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11n HT20 mode High Channel)



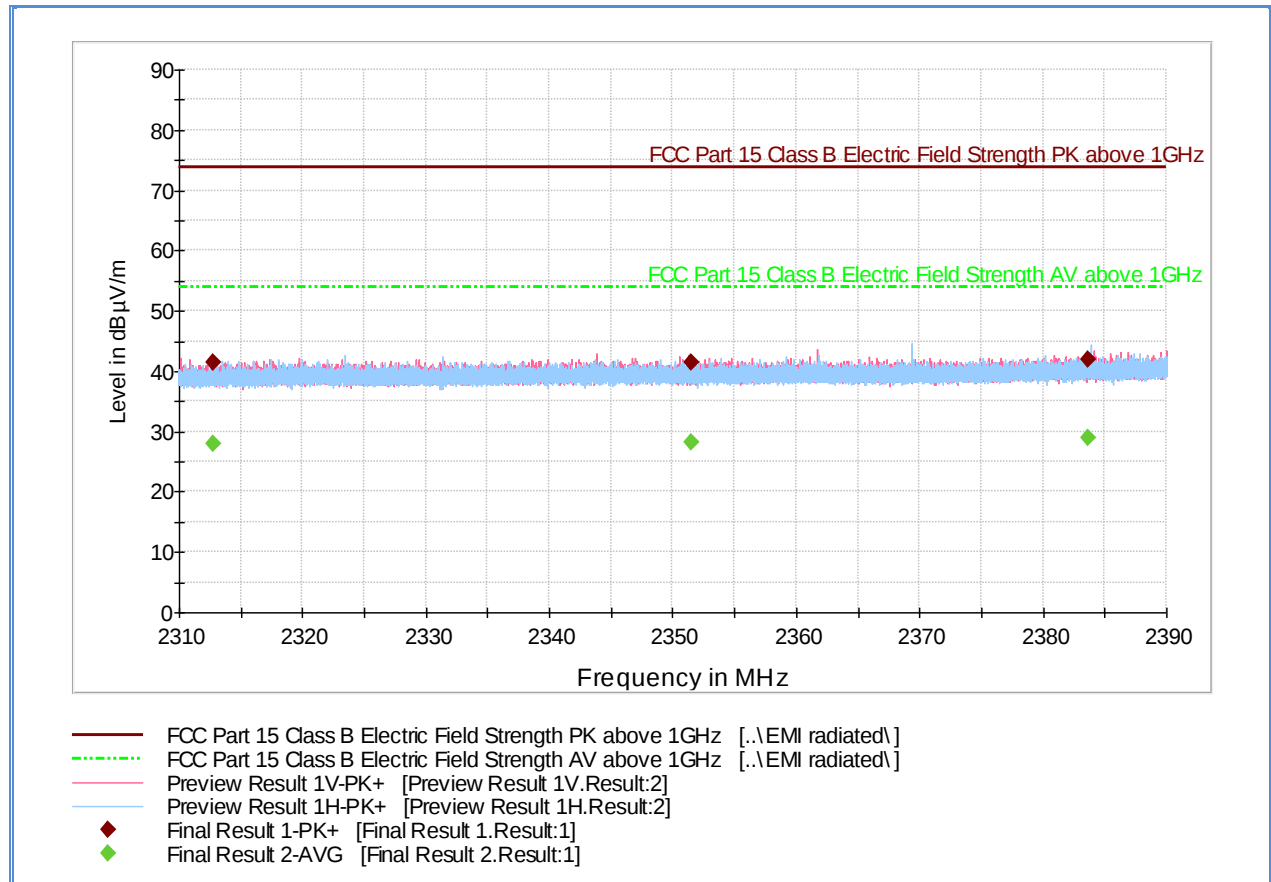
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.000000	41.8	1000.0	1000.000	277.2	H	204.0	-0.1	32.1	73.9
2491.699200	41.8	1000.0	1000.000	302.2	V	11.0	-0.1	32.1	73.9
2499.500000	41.7	1000.0	1000.000	322.2	H	18.0	-0.1	32.2	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)
2484.000000	29.1	1000.0	1000.000	277.2	H	204.0	-0.1	24.8	53.9
2491.699200	29.0	1000.0	1000.000	302.2	V	11.0	-0.1	24.9	53.9
2499.500000	29.1	1000.0	1000.000	322.2	H	18.0	-0.1	24.8	53.9

2.6.16 Test Results Restricted Band 2310MHz to 2390MHz (802.11n HT40 mode Low Channel)



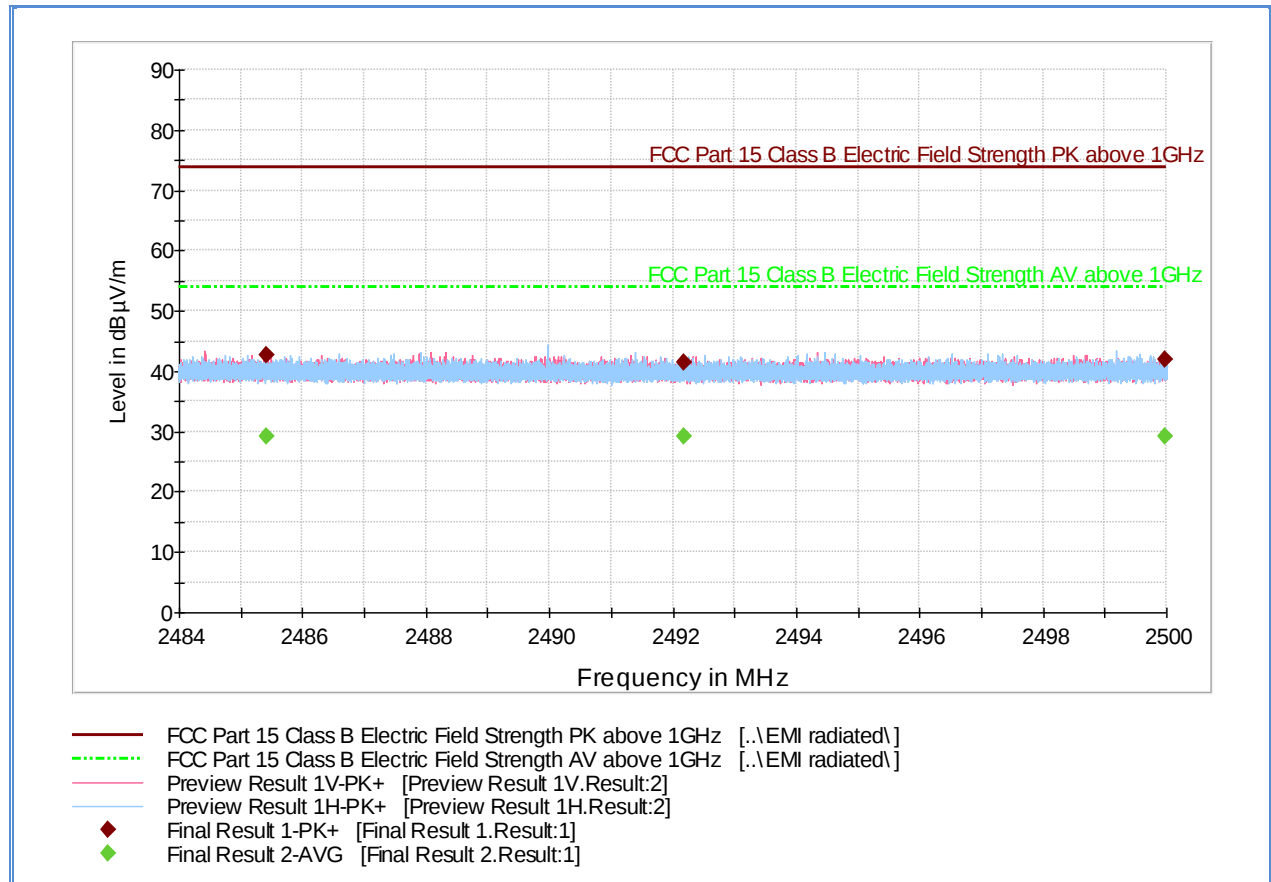
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2312.698667	41.5	1000.0	1000.000	265.3	V	295.0	-1.1	32.4	73.9
2351.546667	41.3	1000.0	1000.000	388.1	V	352.0	-0.8	32.6	73.9
2383.680000	41.8	1000.0	1000.000	138.7	H	102.0	-0.7	32.1	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)
2312.698667	28.1	1000.0	1000.000	265.3	V	295.0	-1.1	25.8	53.9
2351.546667	28.3	1000.0	1000.000	388.1	V	352.0	-0.8	25.6	53.9
2383.680000	28.8	1000.0	1000.000	138.7	H	102.0	-0.7	25.1	53.9

2.6.17 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11n HT40 mode High Channel)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2485.419733	42.8	1000.0	1000.000	366.1	V	300.0	-0.1	31.1	73.9
2492.190400	41.5	1000.0	1000.000	154.6	V	164.0	-0.1	32.4	73.9
2499.977067	41.9	1000.0	1000.000	299.2	H	270.0	-0.1	32.0	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)
2485.419733	29.2	1000.0	1000.000	366.1	V	300.0	-0.1	24.7	53.9
2492.190400	29.1	1000.0	1000.000	154.6	V	164.0	-0.1	24.8	53.9
2499.977067	29.2	1000.0	1000.000	299.2	H	270.0	-0.1	24.7	53.9



2.7 POWER SPECTRAL DENSITY

2.7.1 Specification Reference

Part 15 Subpart C §15.247(e)

2.7.2 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.

2.7.3 Equipment Under Test and Modification State

Serial No: 357932-01-020007-2 / Test Configuration A

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

June 18, 2014 / KAM

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 Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.1 °C
Relative Humidity	44.1.%
ATM Pressure	98.9 kPa

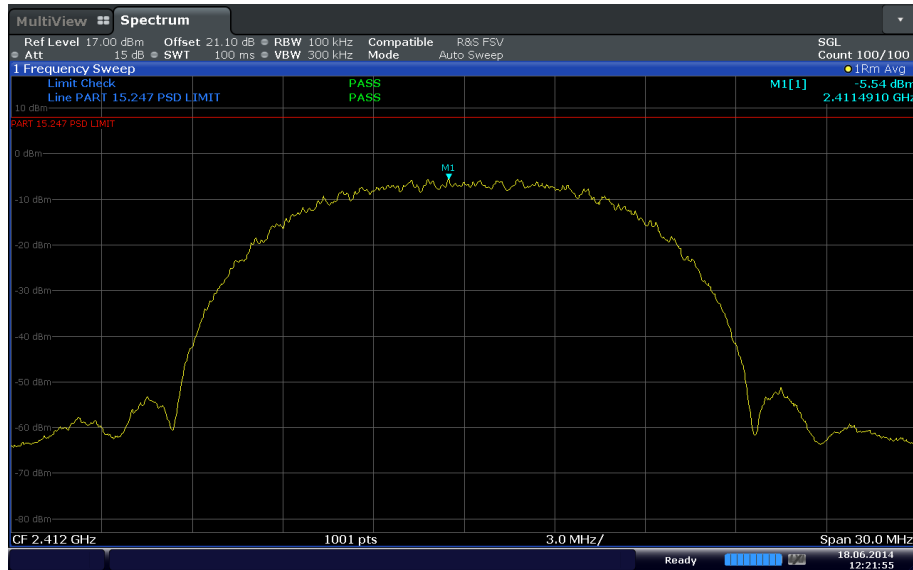
2.7.7 Additional Observations

- This is a conducted test procedure is per Section 10.3 under KDB 558074 D01 DTS Measurement Guidance v03r02 (Compliance Measurement Guidance for 15.247 Digital Transmission Systems, June 05, 2014).
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- Detector is RMS power averaging.
- Trace averaging mode over 100 traces.
- Sweep time is Auto Couple.
- EUT complies with 100 kHz RBW.

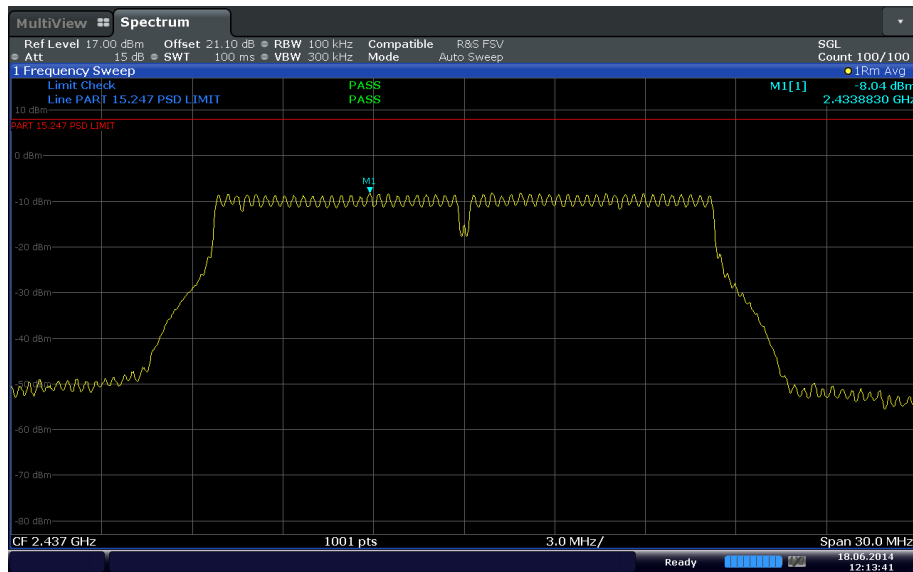
2.7.8 Test Results Summary

Mode	Channel	Marker Reading using 100 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
802.11b	1 (2412 MHz)	-5.54	8	13.54	Complies
	6 (2437 MHz)	-6.39	8	14.39	Complies
	11 (2462 MHz)	-5.83	8	13.83	Complies
802.11g	1 (2412 MHz)	-8.40	8	16.40	Complies
	6 (2437 MHz)	-8.04	8	16.04	Complies
	11 (2462 MHz)	-8.84	8	16.84	Complies
802.11n HT20	1 (2412 MHz)	-8.65	8	16.65	Complies
	6 (2437 MHz)	-8.63	8	16.63	Complies
	11 (2462 MHz)	-9.54	8	17.54	Complies
802.11n HT40	3 (2422 MHz)	-11.86	8	19.86	Complies
	6 (2437 MHz)	-12.28	8	20.28	Complies
	9 (2452 MHz)	-11.78	8	19.78	Complies

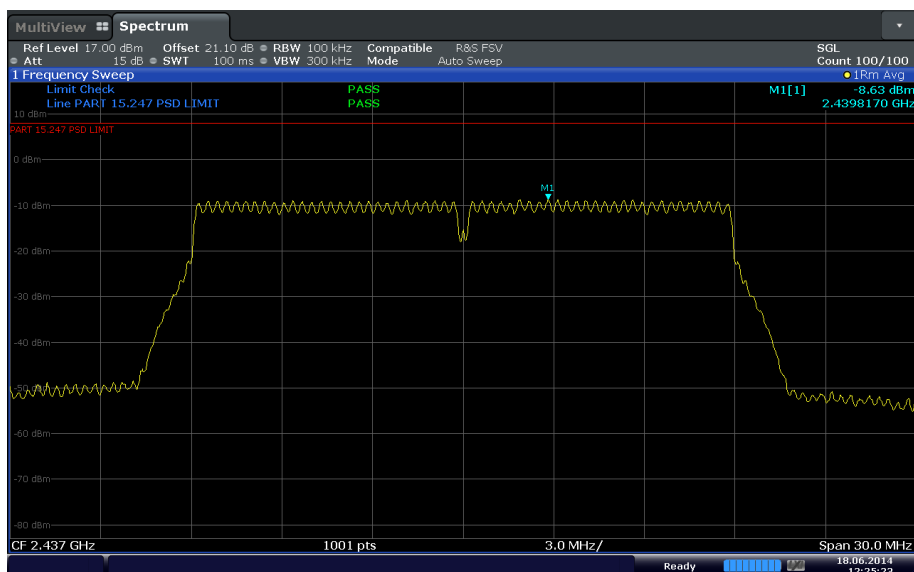
2.7.9 Test Results Plots



802.11b mode Worst Case Channel

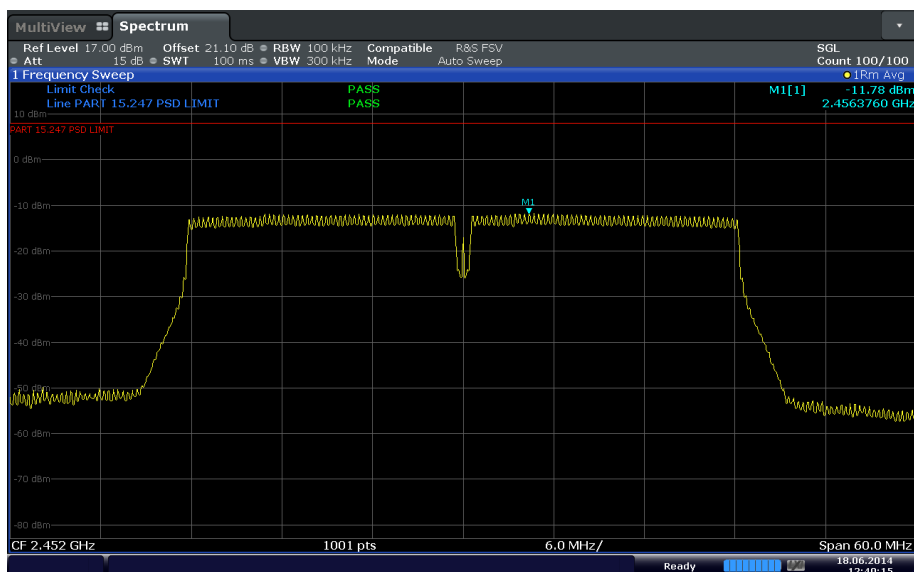


802.11g mode Worst Case Channel



Date: 18 JUN 2014 12:25:23

802.11n mode HT20 Worst Case Channel



Date: 18 JUN 2014 12:40:15

802.11n mode HT40 Worst Case 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						
7569	Series Power Meter	N1911A P-	MY45100625	Agilent	04/22/14	04/22/15
7570	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240588	Agilent	04/09/14	04/09/15
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	12/22/14	12/22/15
Radiated Test Setup						
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/29/14	08/29/15
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/10/14	12/10/15
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	04/08/14	04/08/15
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	04/03/14	04/03/15
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/14	03/17/15
Miscellaneous						
7560	Barometer/Temperature/Humidity Transmitter	iBTHX-W	1240476	Omega	01/30/14	01/30/15
	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 Emission Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	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	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.41
Coverage Factor (k):					2
Expanded Uncertainty:					4.82

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	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.40
Coverage Factor (k):					2
Expanded Uncertainty:					4.81

3.2.3 Conducted Antenna Port Measurement

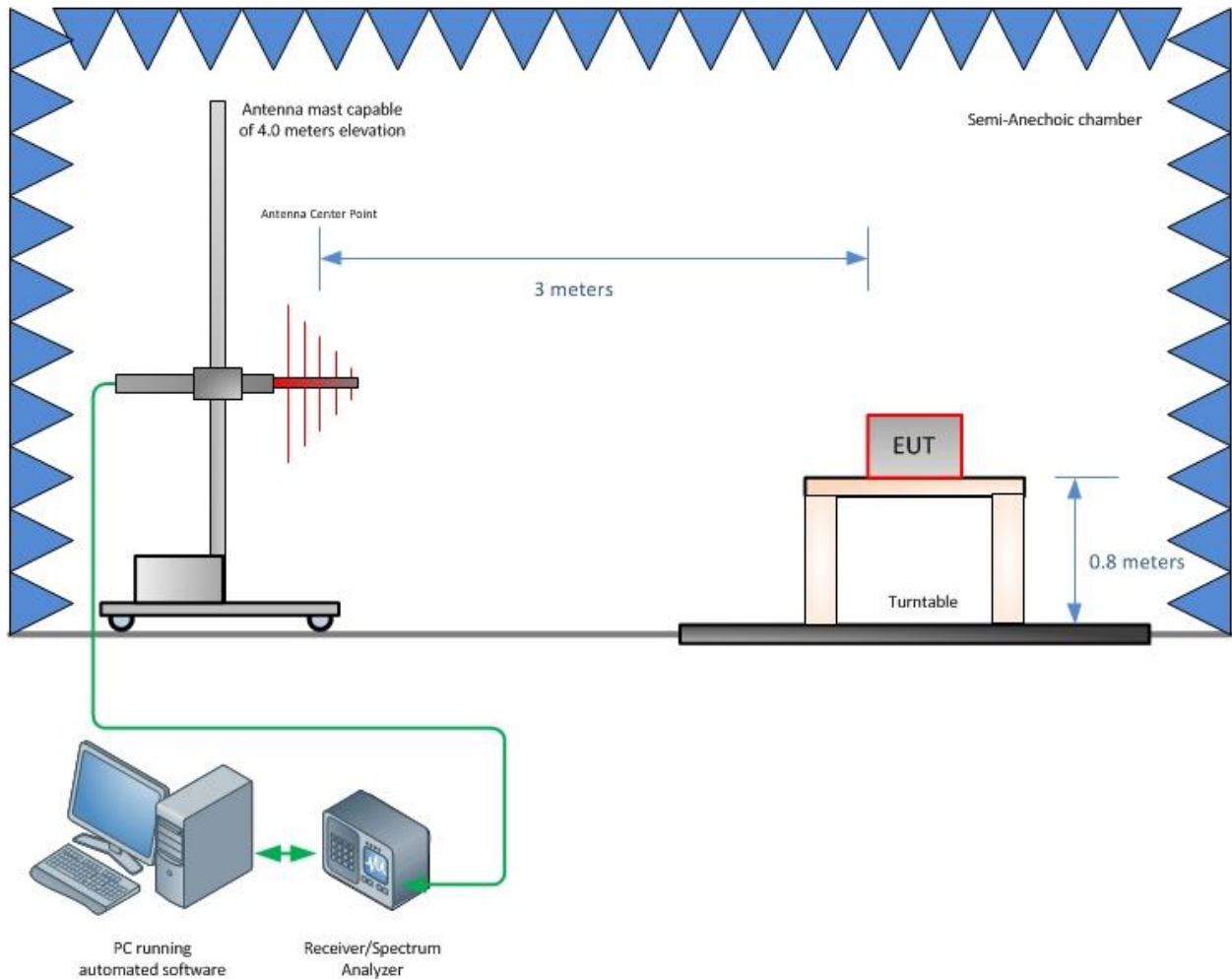
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.34	0.20	0.04
2	Cables	Rectangular	1.00	0.58	0.33
3	EUT Setup	Rectangular	0.50	0.29	0.08
Combined Uncertainty (u_c):					0.67
Coverage Factor (k):					1.96
Expanded Uncertainty:					1.32



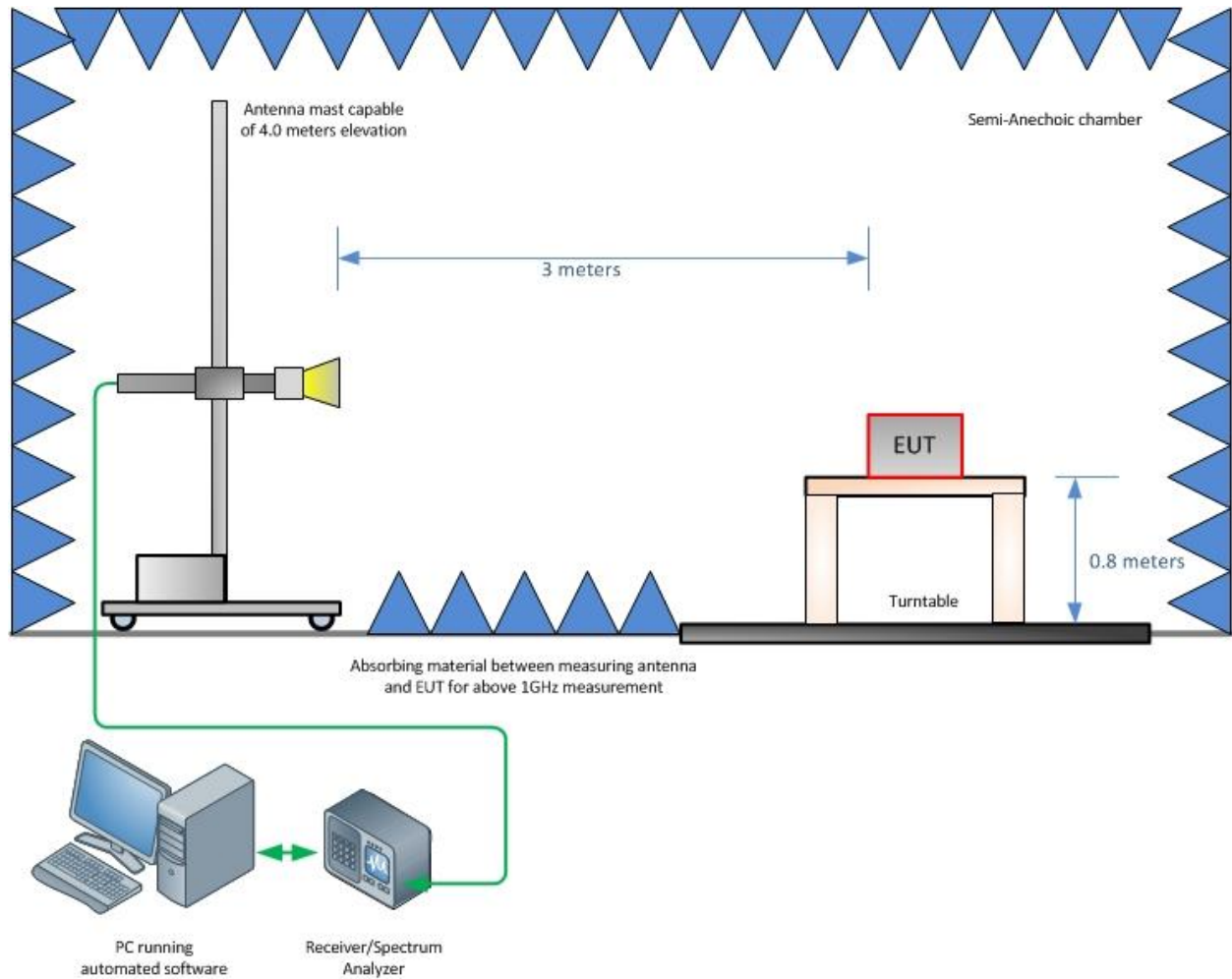
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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