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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<br>Hughes Network Systems<br>9105 Thuraya WLAN Satellite Terminal IP Voyager and Orion IP |
| **TEST REPORT NUMBER** | SD72102234B |
| **PREPARED FOR** | Hughes Network Systems<br>9605 Scranton Road, Suite 500<br>San Diego, CA 92121 |
| **CONTACT PERSON** | Dave Couchman<br>Principal Engineer<br>(858) 452-4648<br>Dave.Couchman@hughes.com |
| **PREPARED BY** | Alex Chang<br>**Name**<br>Title: EMC/Wireless Test Engineer |
| **APPROVED BY** | Juan Manuel Gonzalez<br>**Name**<br>Authorized Signatory<br>Title: Commercial/Wireless EMC Lab Manager |
| **DATED** | March 09, 2015 |



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**Revision History**

| SD72102234B<br>Hughes Network Systems<br>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).<br>• 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. |



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## 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.



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## 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 in 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 Unter 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)<br>Channel 6(Mid Channel 2437 MHz)<br>Channel 11 (High Channel 2462MHz) |
| Channels Verified(n HT40) | Channel 3 (Low Channel 2422 MHz)<br>Channel 6(Mid Channel 2437 MHz)<br>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 |

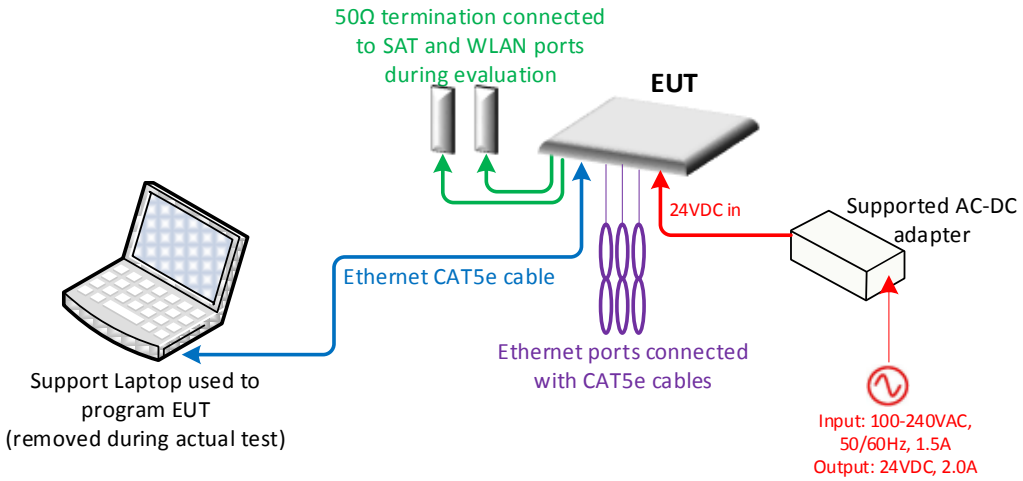
### 1.4.4 Worst Case Configuration

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

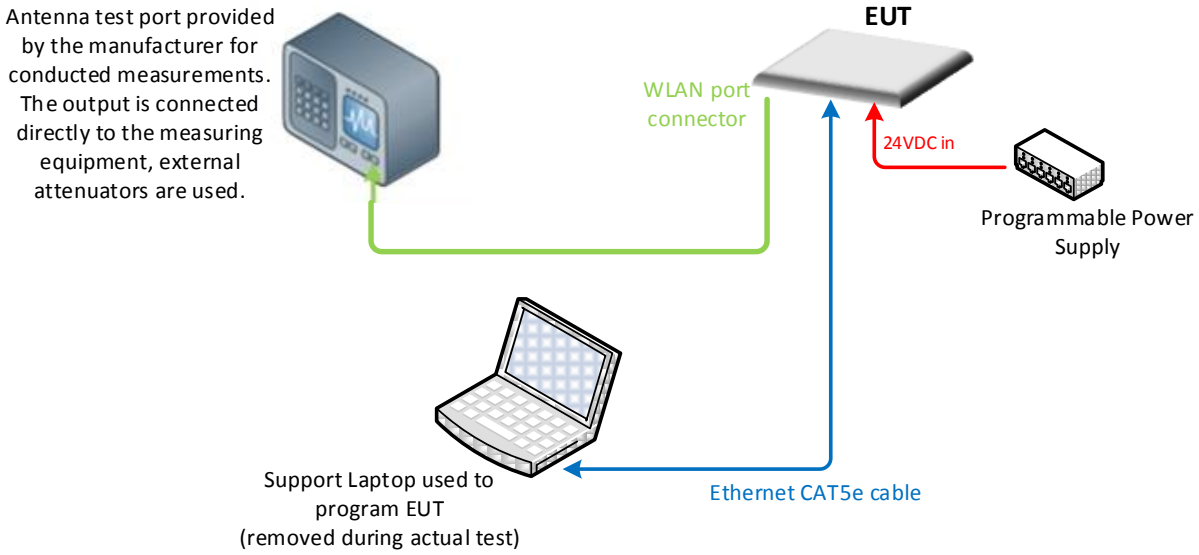
| Mode | Channel | Data Rate |
|---|---|---|
| 802.11b | 1 (Low Channel) | 5.5 Mbps |
| 802.11g | 6 (Mid Channel) | 18 Mbps |
| 802.11n (HT20) | 6 (Mid Channel) | Mcs 0 (72.0 Mbps) |
| 802.11n (HT40) | 6 (Mid Channel) | Mcs 7 (150.0 Mbps) |

### 1.4.5 Simplified Test Configuration Diagram

**Emission Test Setup**




**Conducted Port Measurement Test Setup**




**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 TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.



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**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

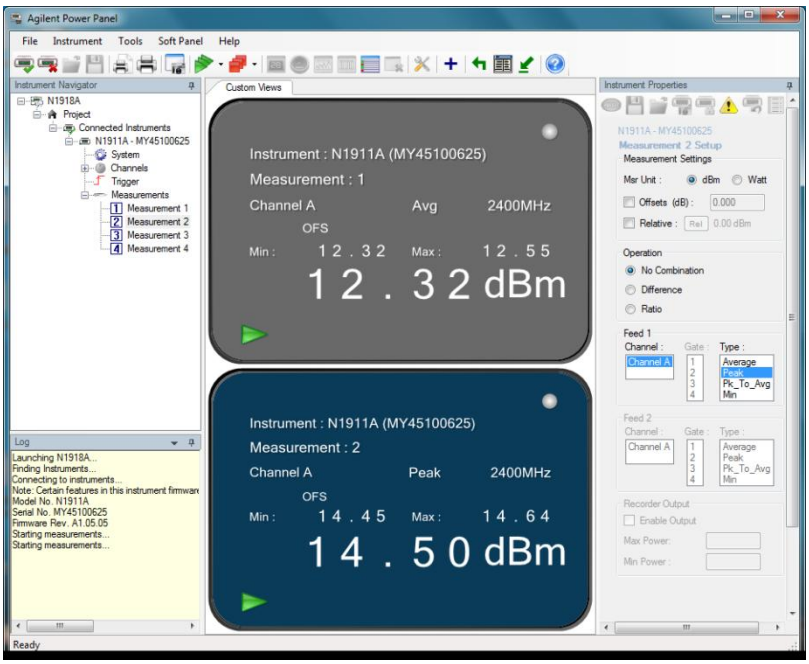
- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- This is a conducted test using Method A: Peak Power Meter 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

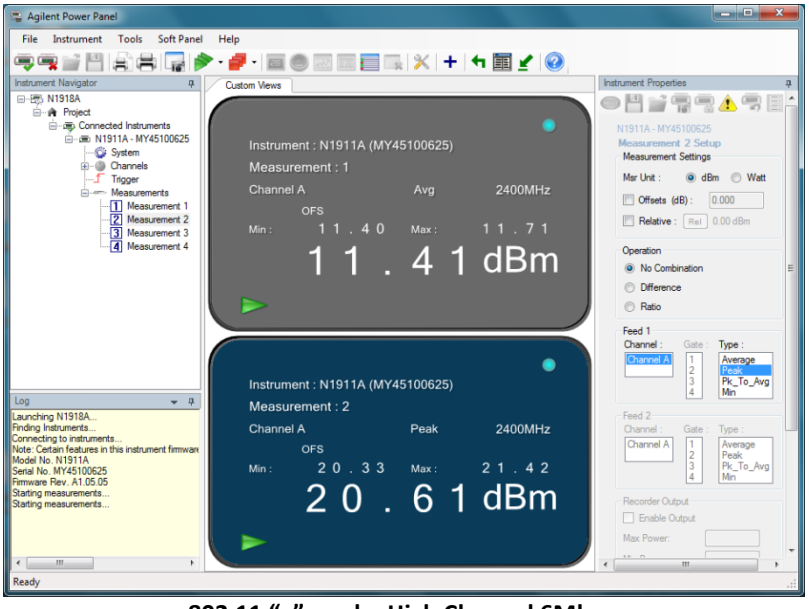
| WLAN Mode | Channel | Data Rates (Mbps) | Measured Average Power (dBm) | Measured Peak Power (dBm) |
|---|---|---|---|---|
| 802.11b | 1 (2412 MHz) | 1 | 12.22 | 15.04 |
| | | 2 | 12.52 | 15.27 |
| | | ***5.5*** | ***12.55*** | ***14.64*** |
| | | 11 | 12.49 | 15.28 |
| | 6 (2437 MHz) | 1 | 12.37 | 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 |

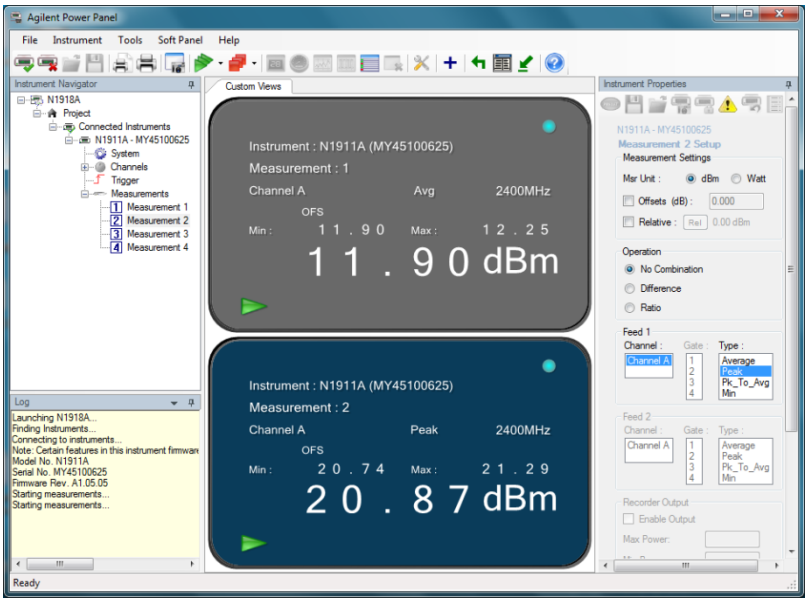
### 2.1.9 Sample Test Display



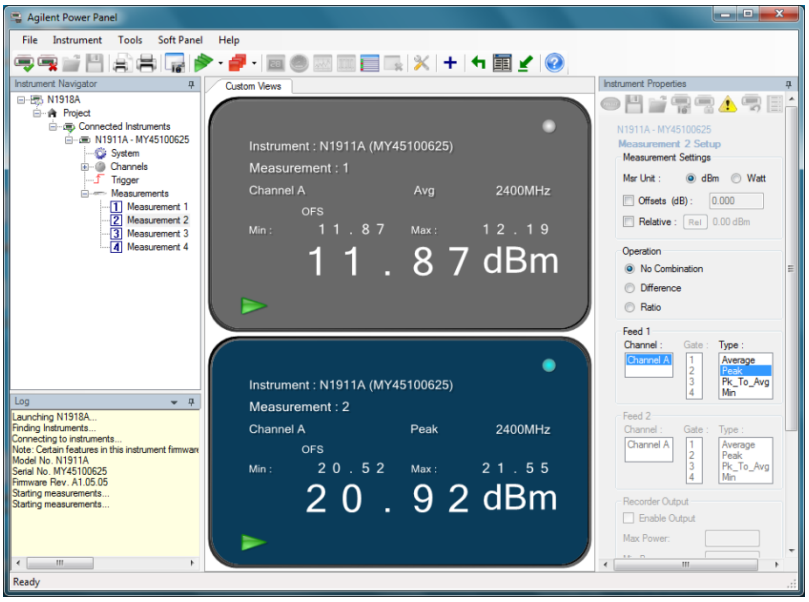

**802.11 “b” mode. Low Channel 5.5Mbps**




**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 |

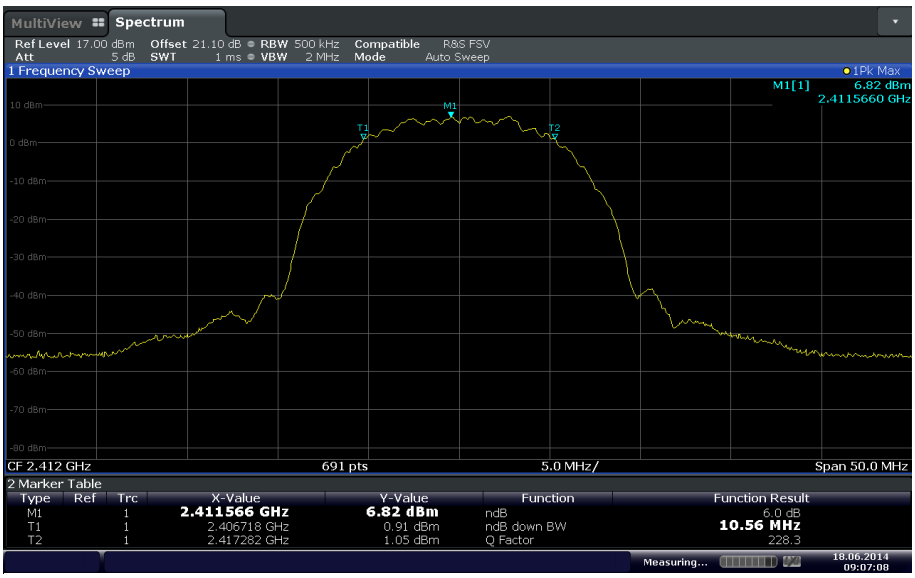
### 2.2.7 Additional Observations

- 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 ≥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

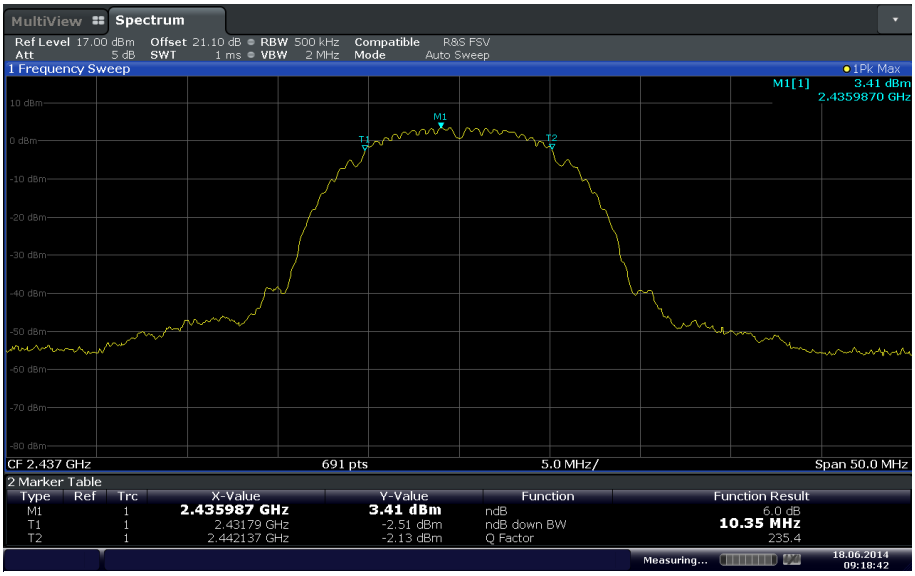
| Mode | Channel | Measured Bandwidth (MHz) | Minimum Bandwidth (MHz) | Compliance |
|---|---|---|---|---|
| 802.11b | 1 (2412 MHz) | 10.56 | 0.500 | Complies |
| | 6 (2437 MHz) | 10.35 | 0.500 | Complies |
| | 11 (2462 MHz) | 10.20 | 0.500 | Complies |
| 802.11g | 1 (2412 MHz) | 16.71 | 0.500 | Complies |
| | 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



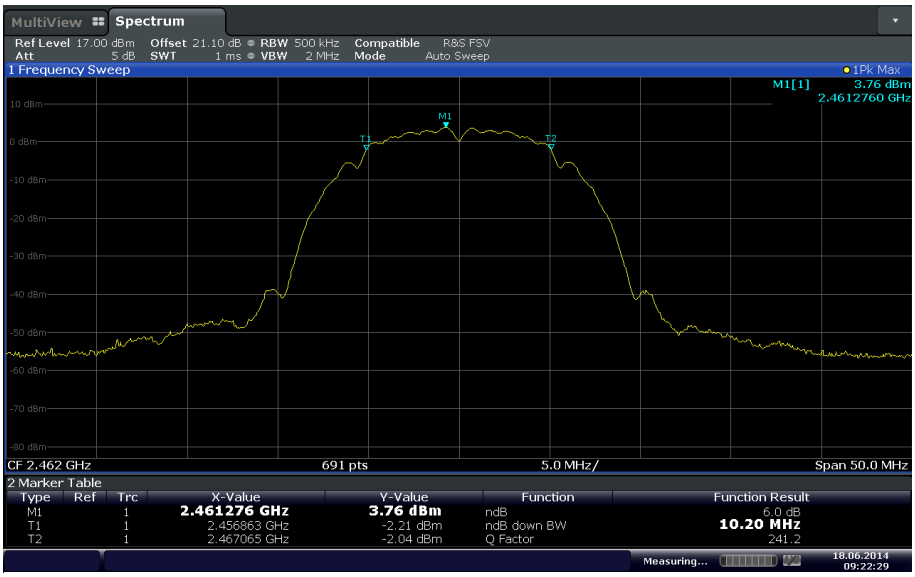

Date: 18.JUN.2014 09:07:08

**802.11b mode_Low Channel**



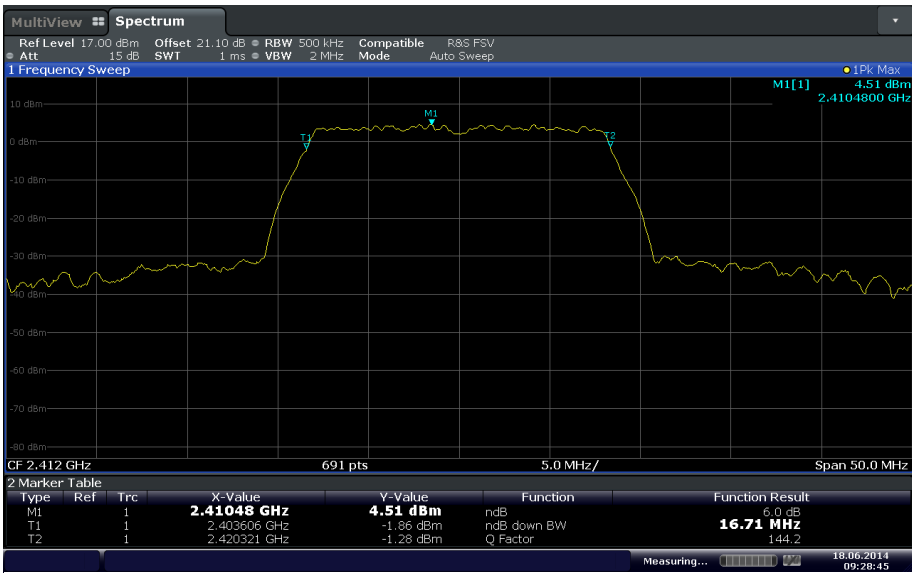

Date: 18.JUN.2014 09:18:42

**802.11b mode_Mid Channel**



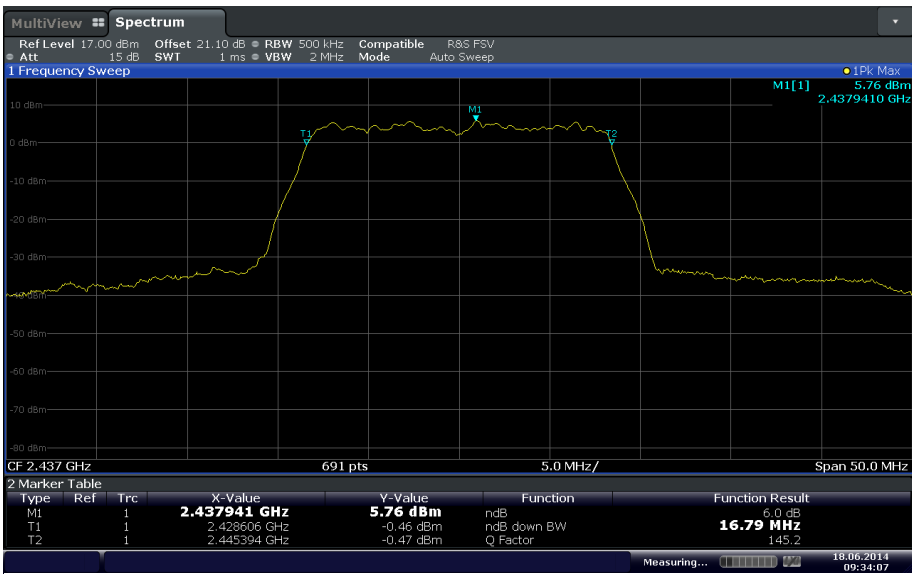

Date: 18.JUN.2014 09:22:29

**802.11b mode_High Channel**



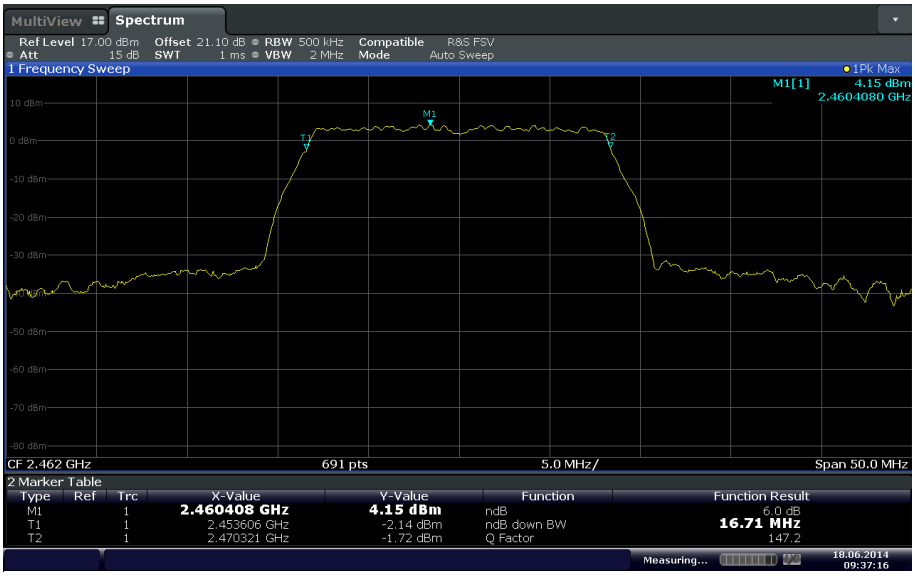

Date: 18.JUN.2014 09:28:45

**802.11g mode_Low Channel**



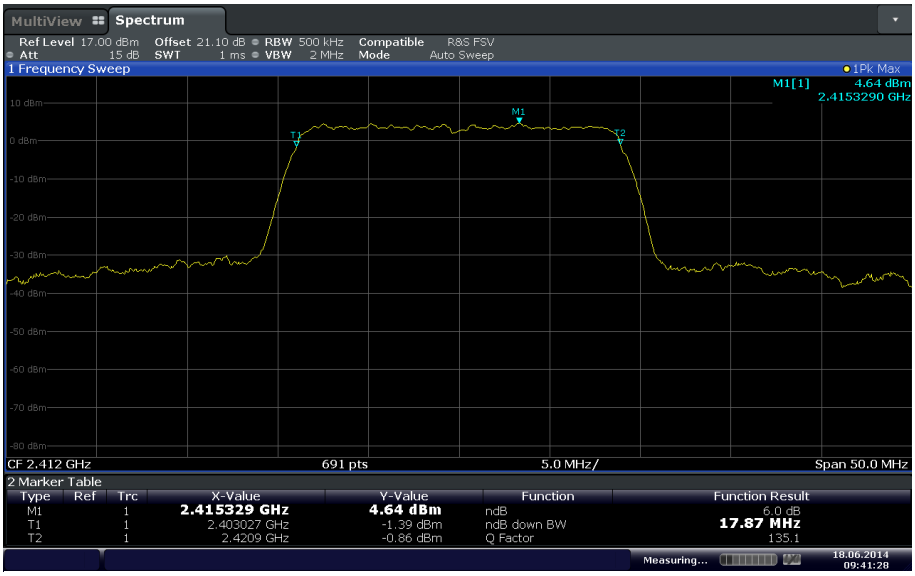

Date: 18.JUN.2014 09:34:07

**802.11g mode_Mid Channel**



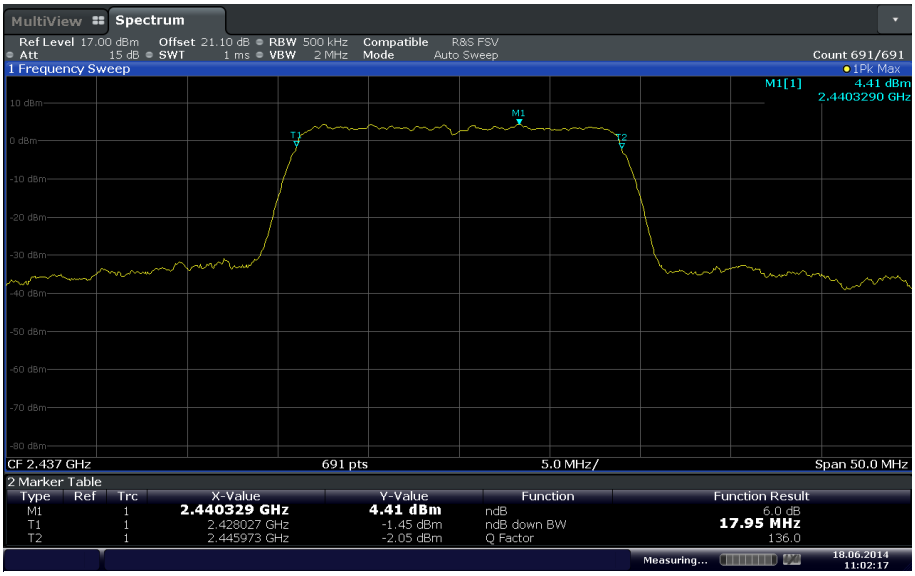

Date: 18.JUN.2014 09:37:16

**802.11g mode_High Channel**



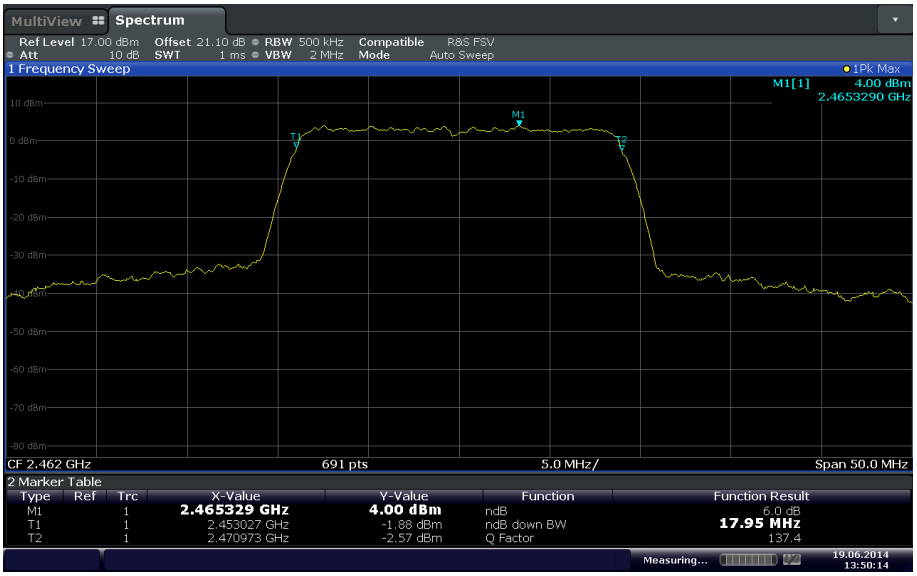

Date: 18.JUN.2014 09:41:28

**802.11n mode HT20_Low Channel**



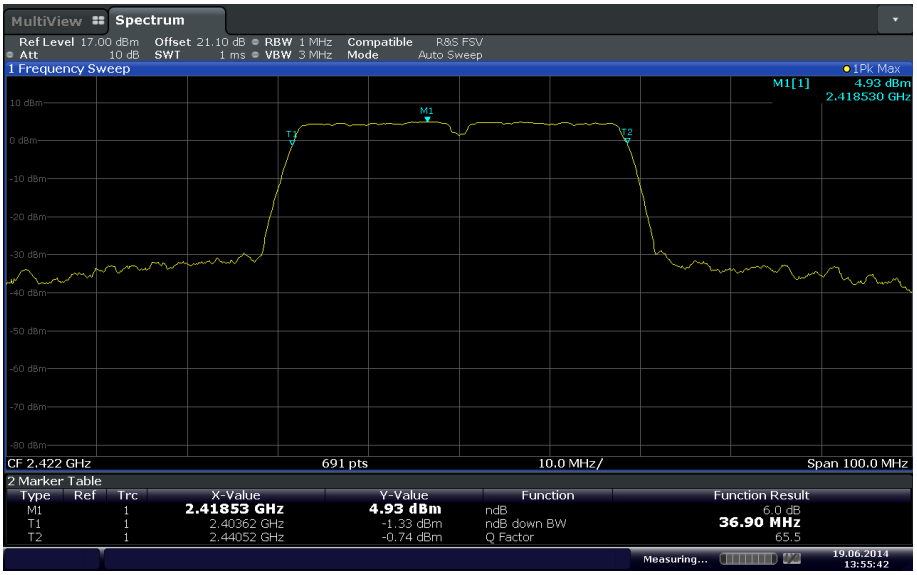

Date: 18.JUN.2014 11:02:17

**802.11n mode HT20_Mid Channel**



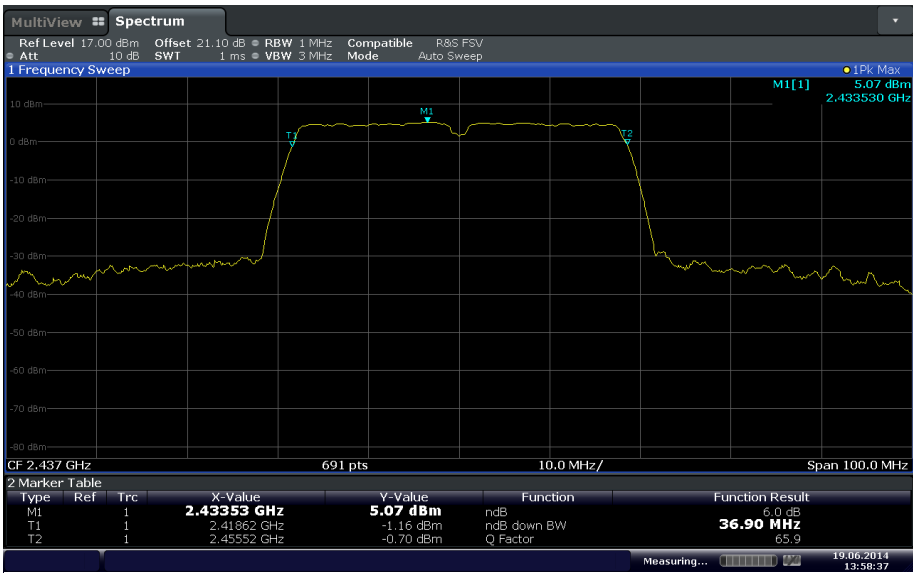

Date: 19.JUN.2014 13:50:14

**802.11n mode HT20_High Channel**



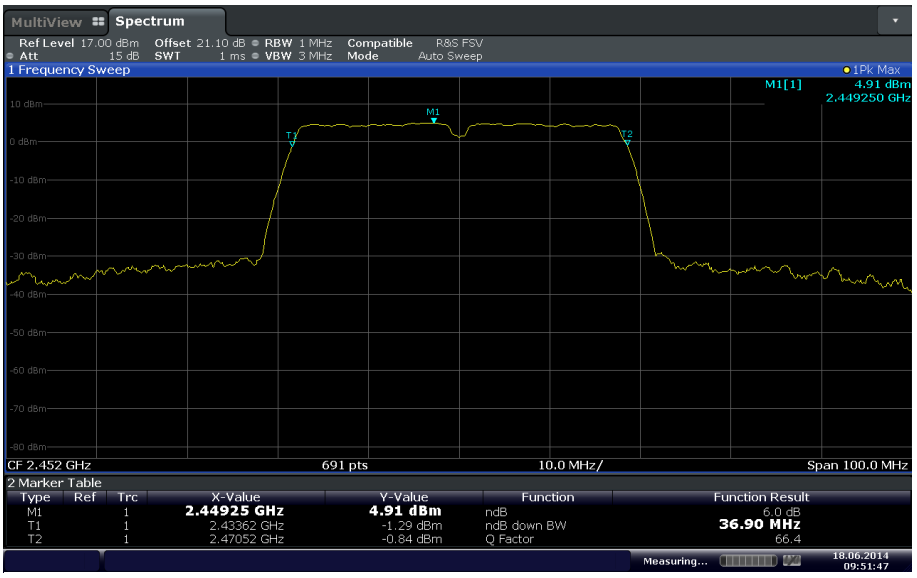

Date: 19.JUN.2014 13:55:43

**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

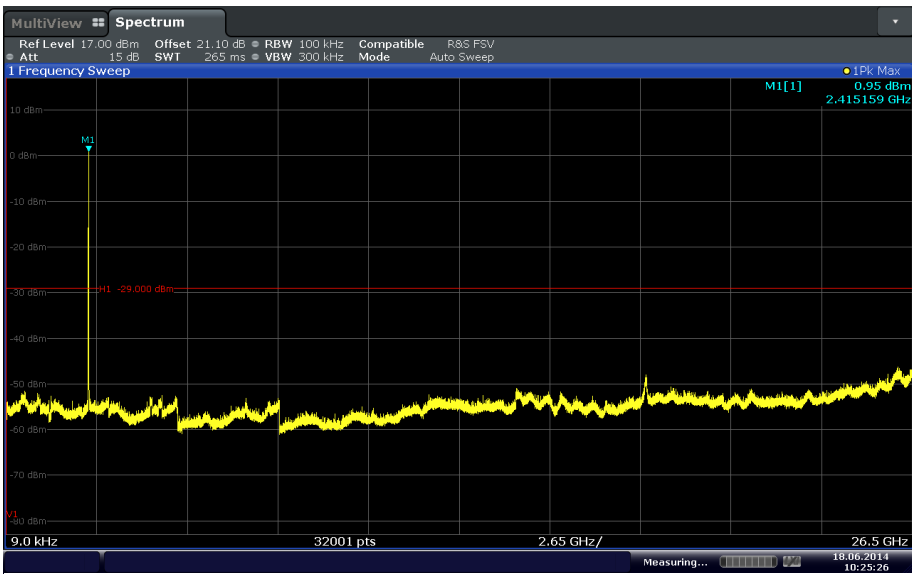
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

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

### 2.3.7 Additional Observations

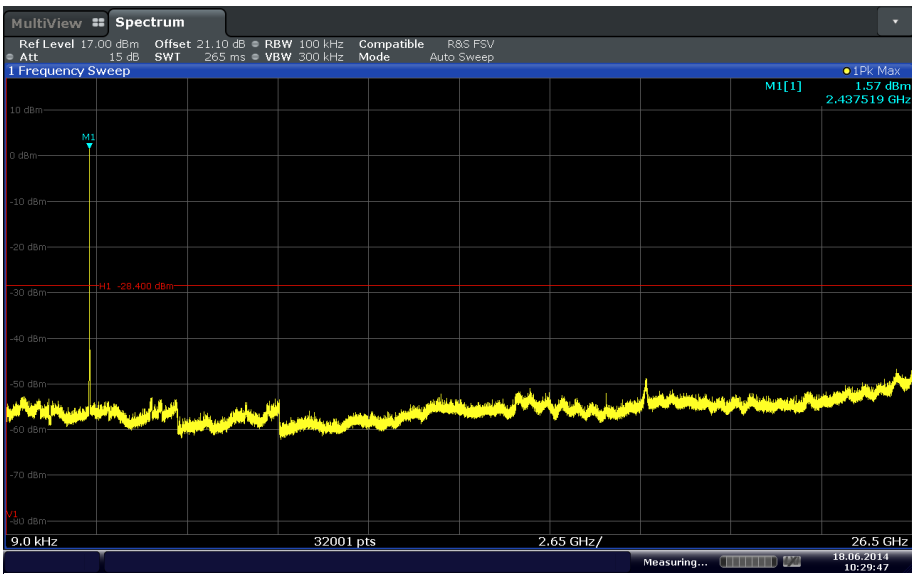
- This is a conducted test.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level 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



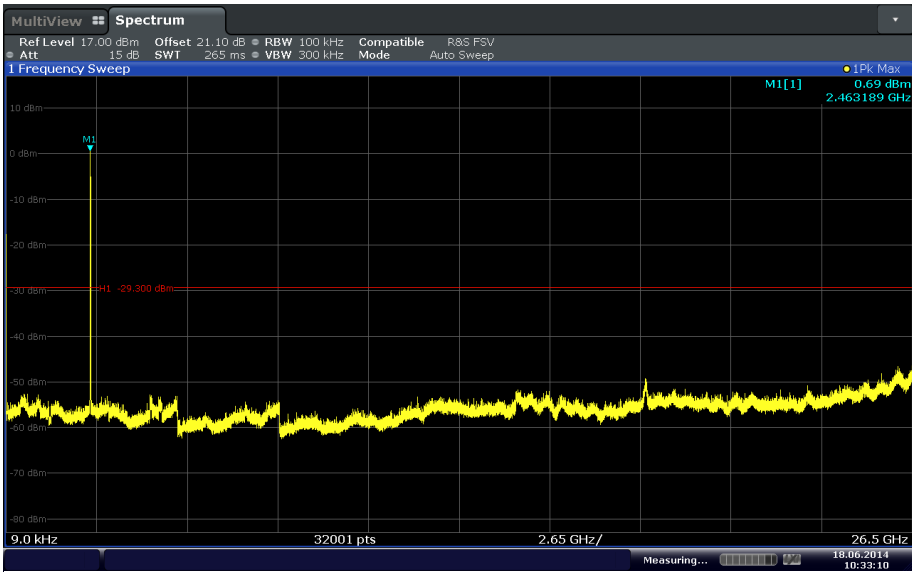

Date:18.JUN.2014 10:25:26

**802.11b mode_Low Channel**

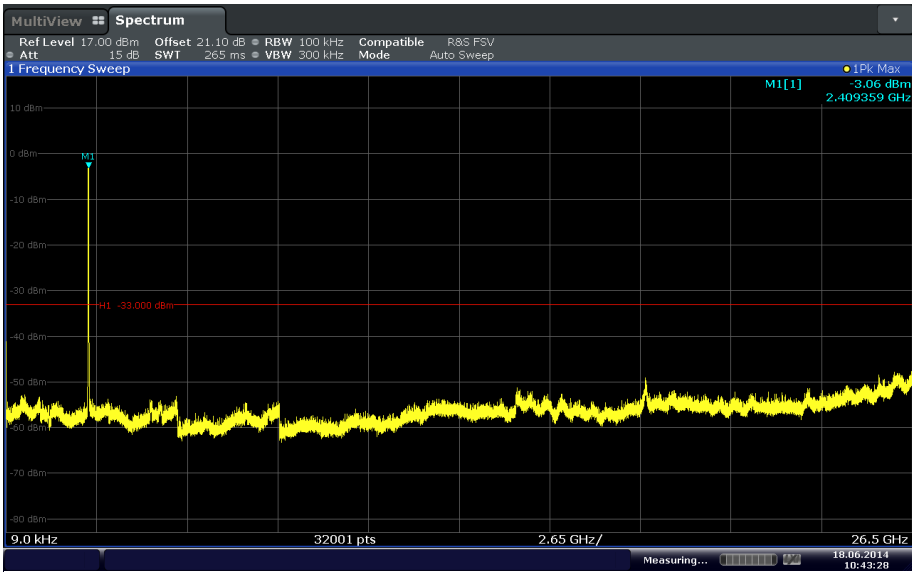



Date:18.JUN.2014 10:29:47

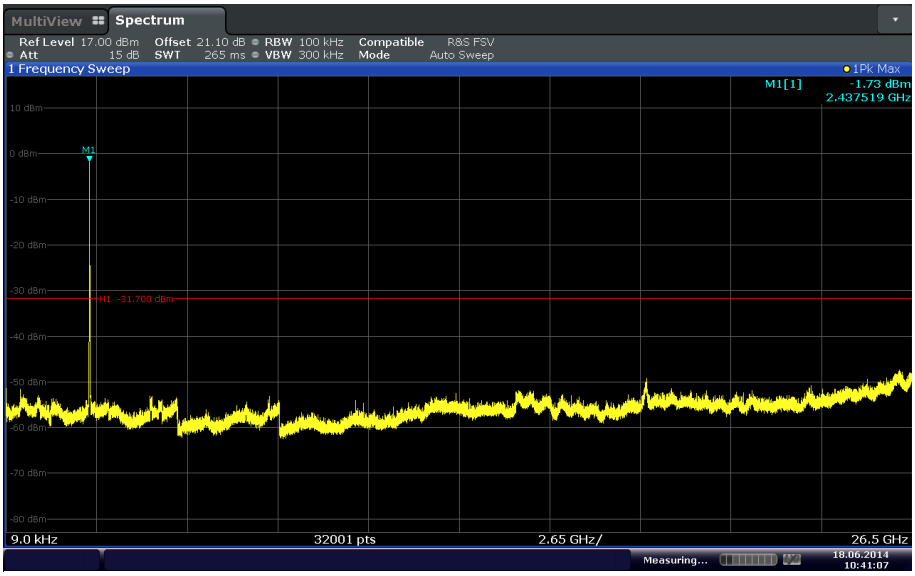
**802.11b mode_Mid Channel**




**802.11b mode_High Channel**

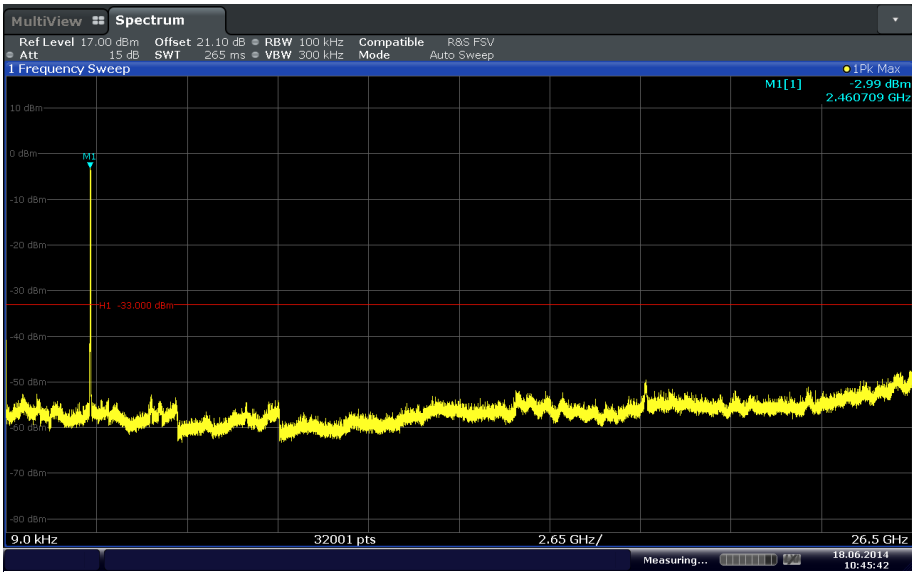



**802.11g mode_Low Channel**



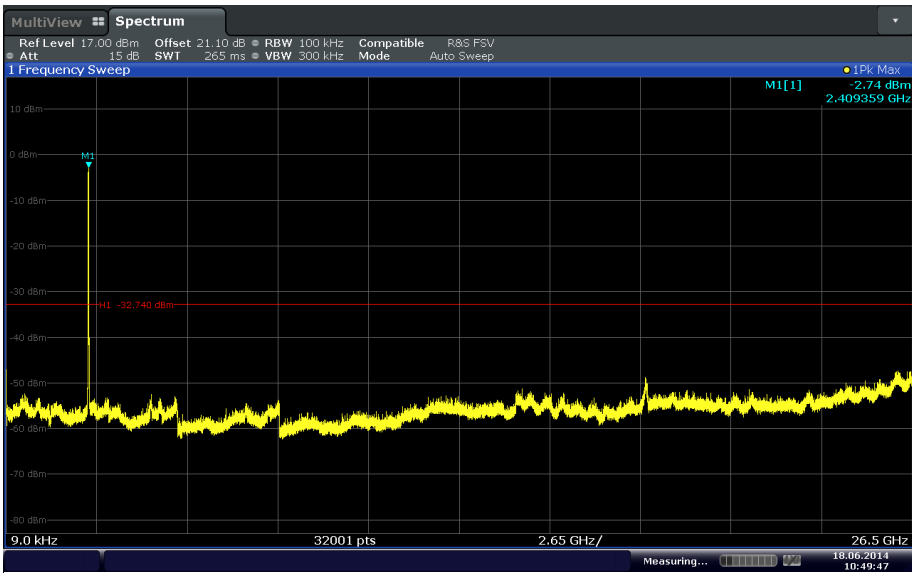

Date: 18.JUN.2014 10:41:08

**802.11g mode_Mid Channel**



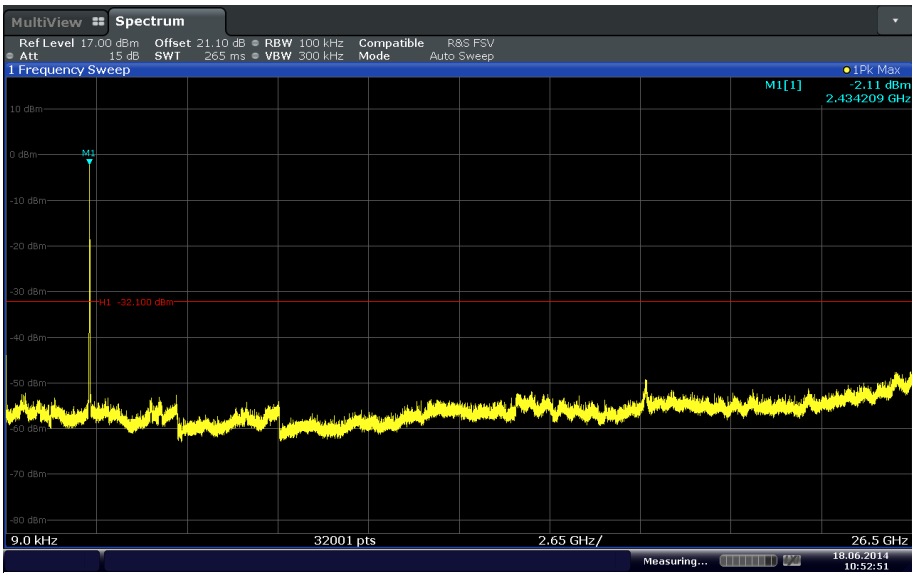

Date: 18.JUN.2014 10:45:42

**802.11g mode_High Channel**



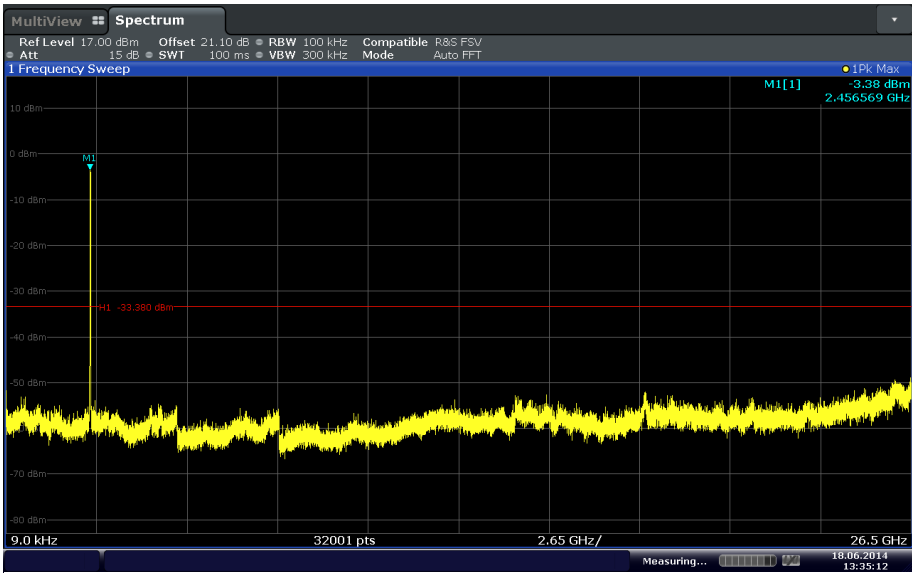

Date:18.JUN.2014 10:49:48

**802.11n mode HT20_Low Channel**



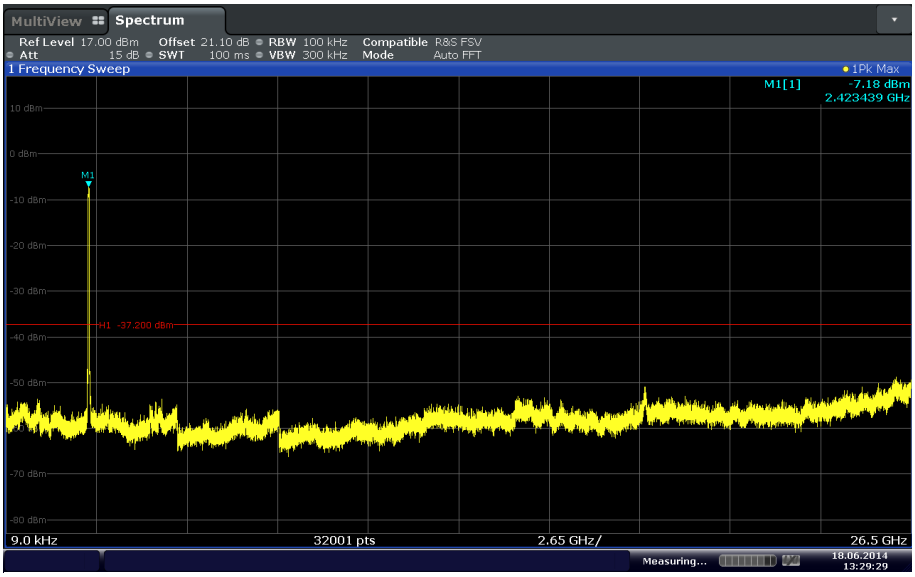

Date:18.JUN.2014 10:52:51

**802.11n mode HT20_Mid Channel**



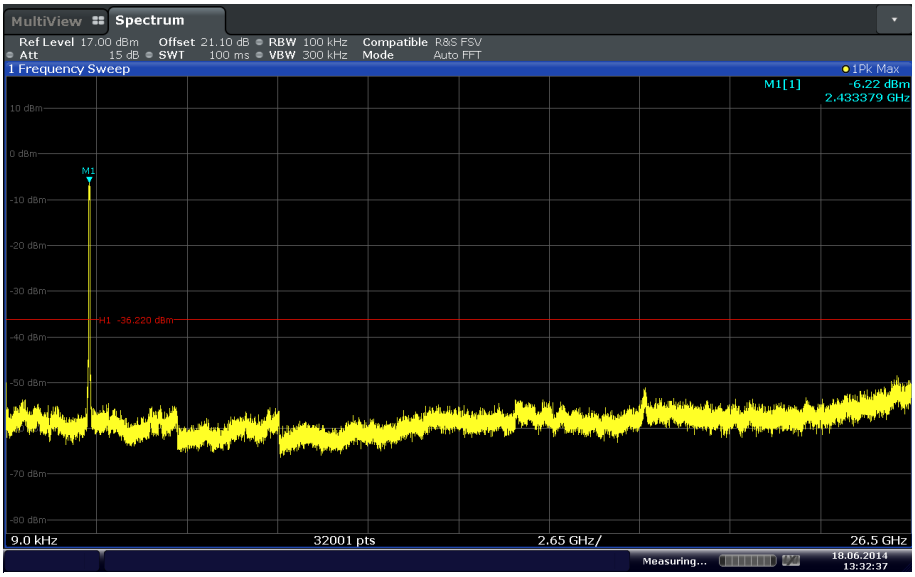

Date: 18.JUN.2014 13:35:13

**802.11n mode HT20_High Channel**



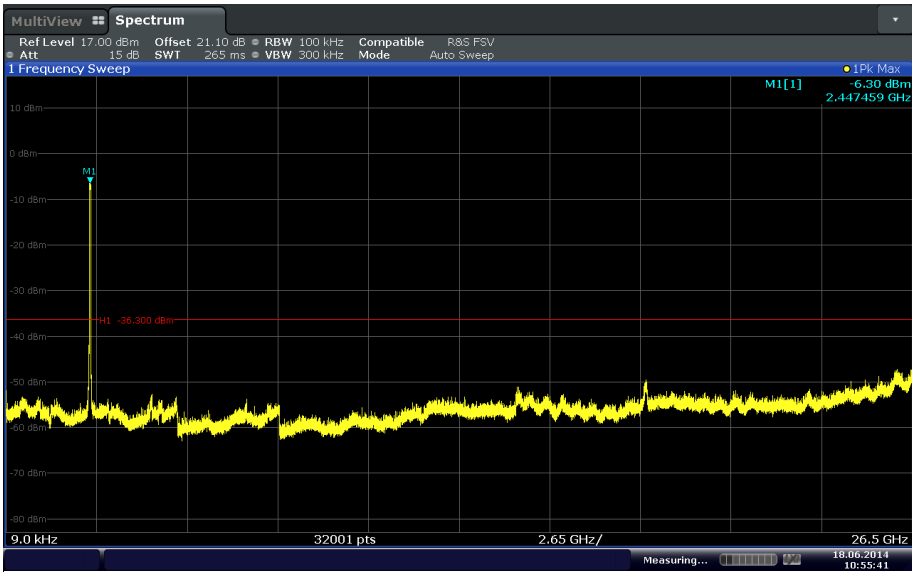

Date: 18.JUN.2014 13:29:28

**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

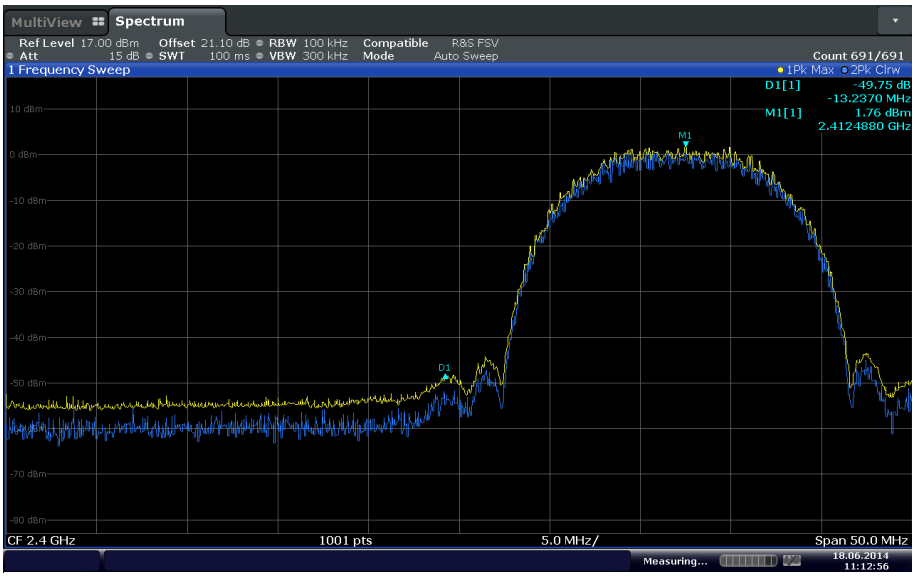
| | |
|---|---|
| Ambient Temperature | 25.1 °C |
| Relative Humidity | 44.1 % |
| ATM Pressure | 98.9 kPa |

### 2.4.7 Additional Observations

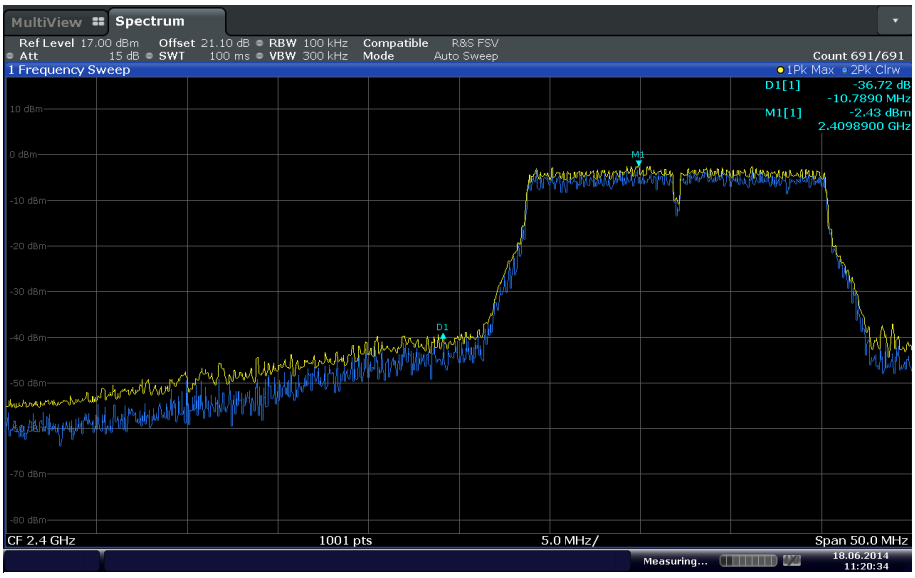
- This is a conducted test.
- An offset of 21.1dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Trace was centred on the band-edge frequency.
- Span was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

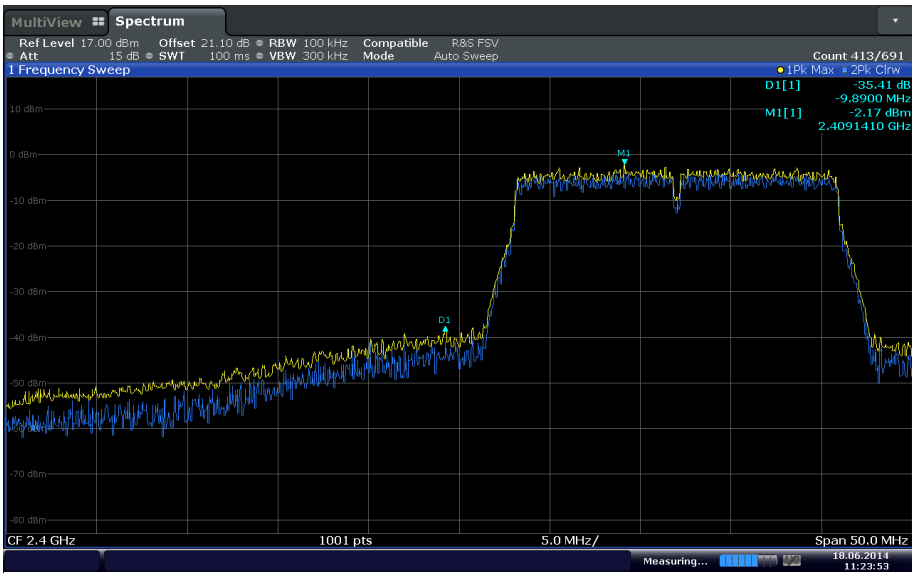
Complies. See attached plots.




**802.11b mode_Low Channel (2412 MHz)**

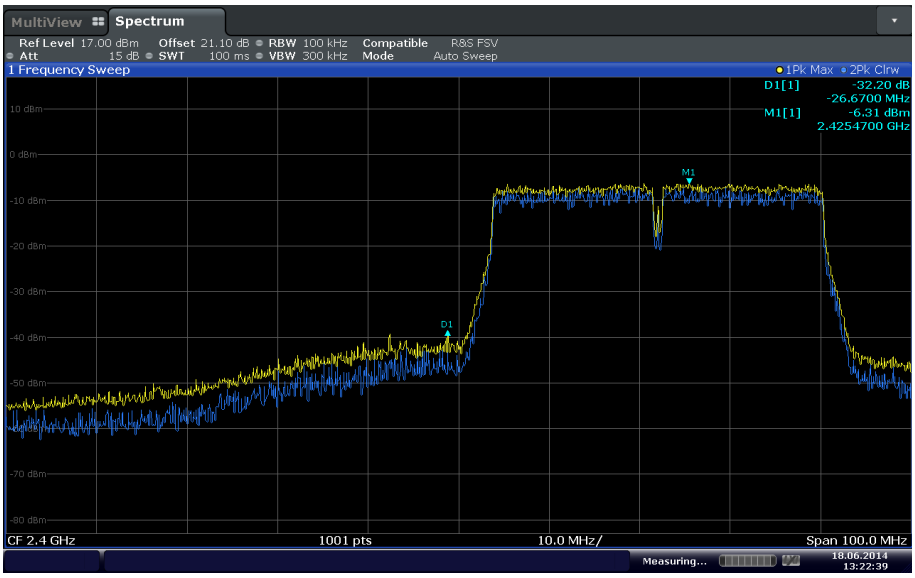



**802.11g mode_Low Channel (2412 MHz)**



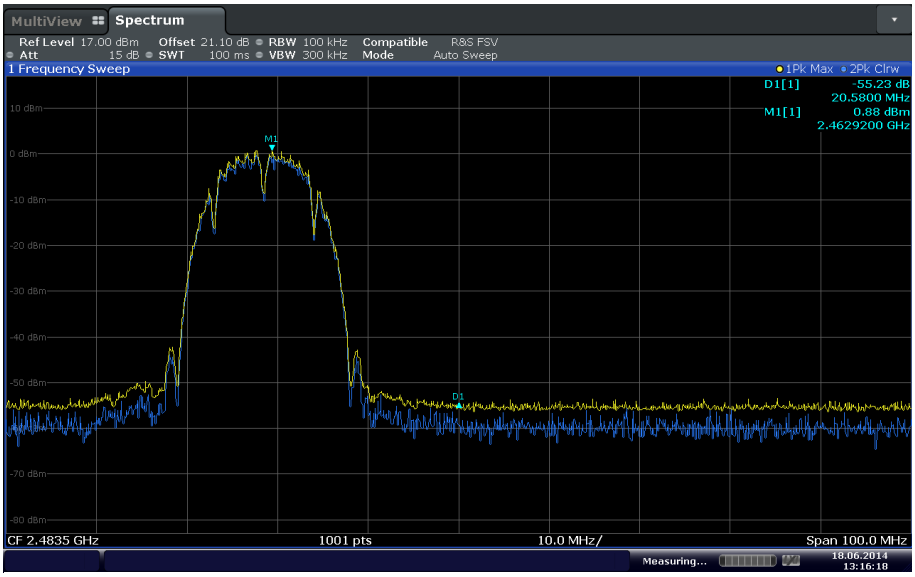

Date: 18.JUN.2014 11:23:53

**802.11n mode HT20_Low Channel (2412 MHz)**



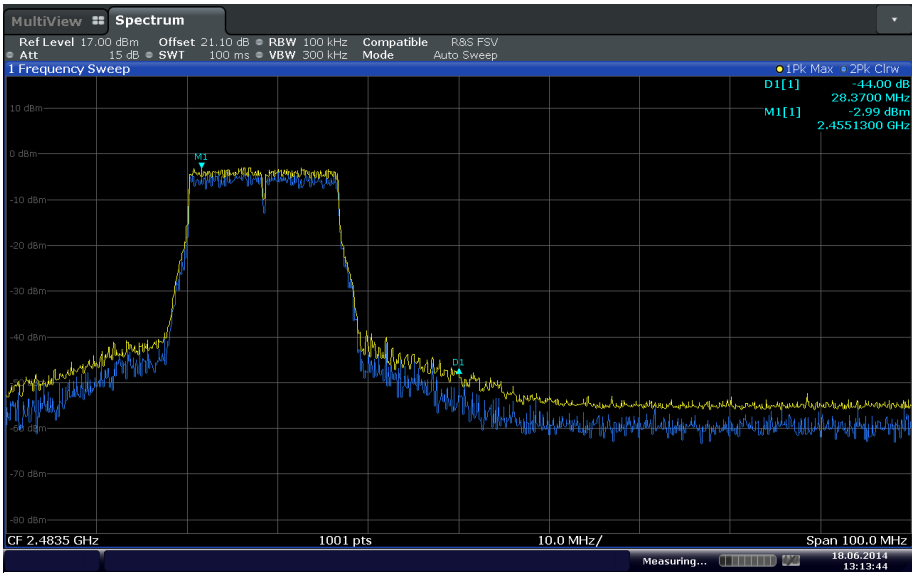

Date: 18.JUN.2014 13:22:39

**802.11n mode HT40_Low Channel (2422 MHz)**



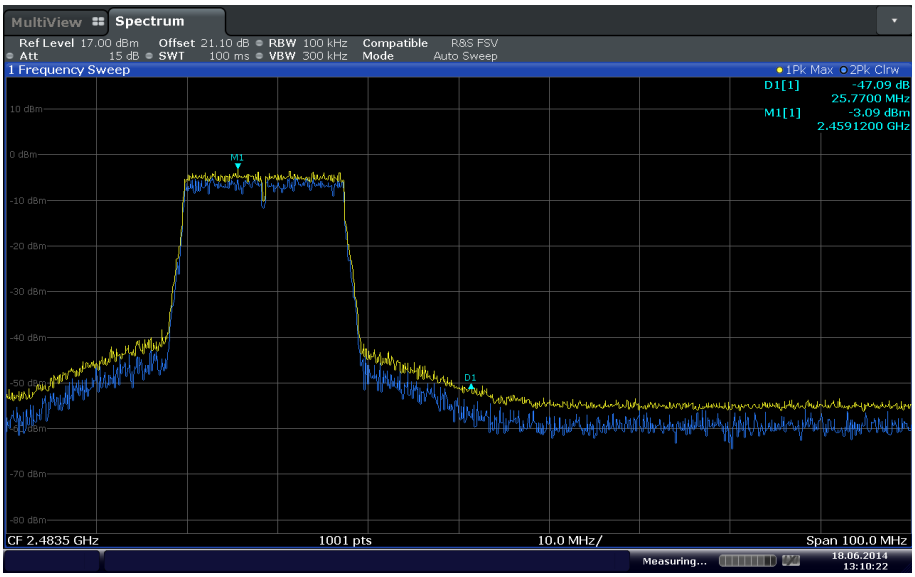

Date:18.JUN.2014 13:16:18

**802.11b mode_High Channel (2462 MHz)**



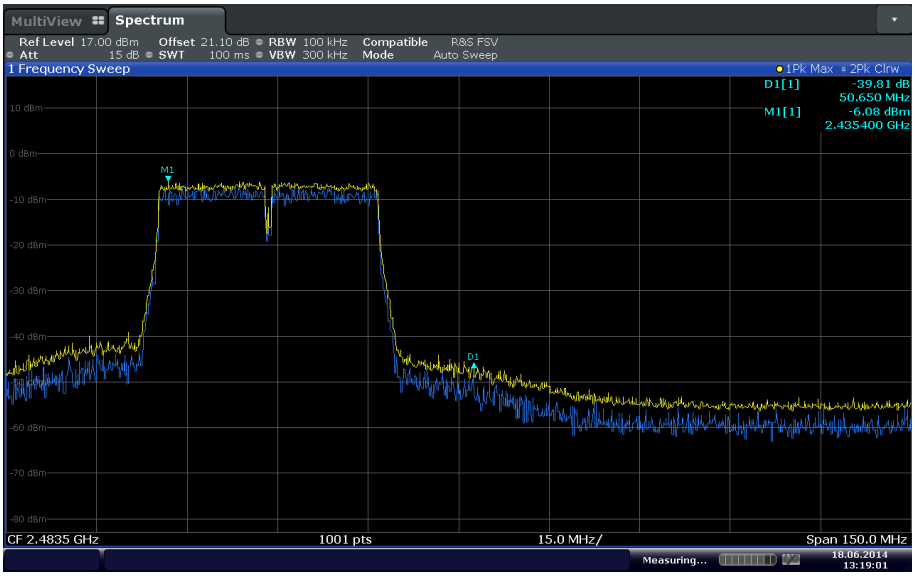

Date:18.JUN.2014 13:13:44

**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 13:19:01

**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 10$^{th}$ 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.

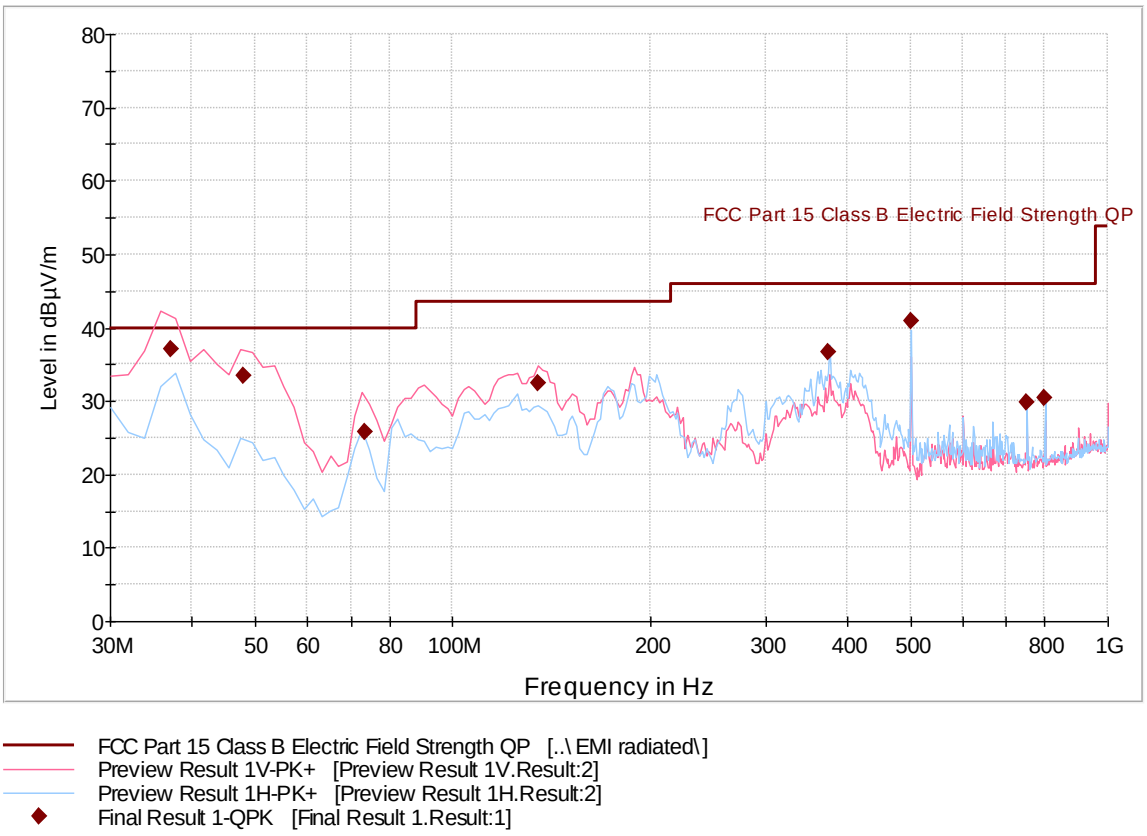
### 2.5.8 Sample Computation (Radiated Emission)

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

### 2.5.9 Test Results

See attached plots.

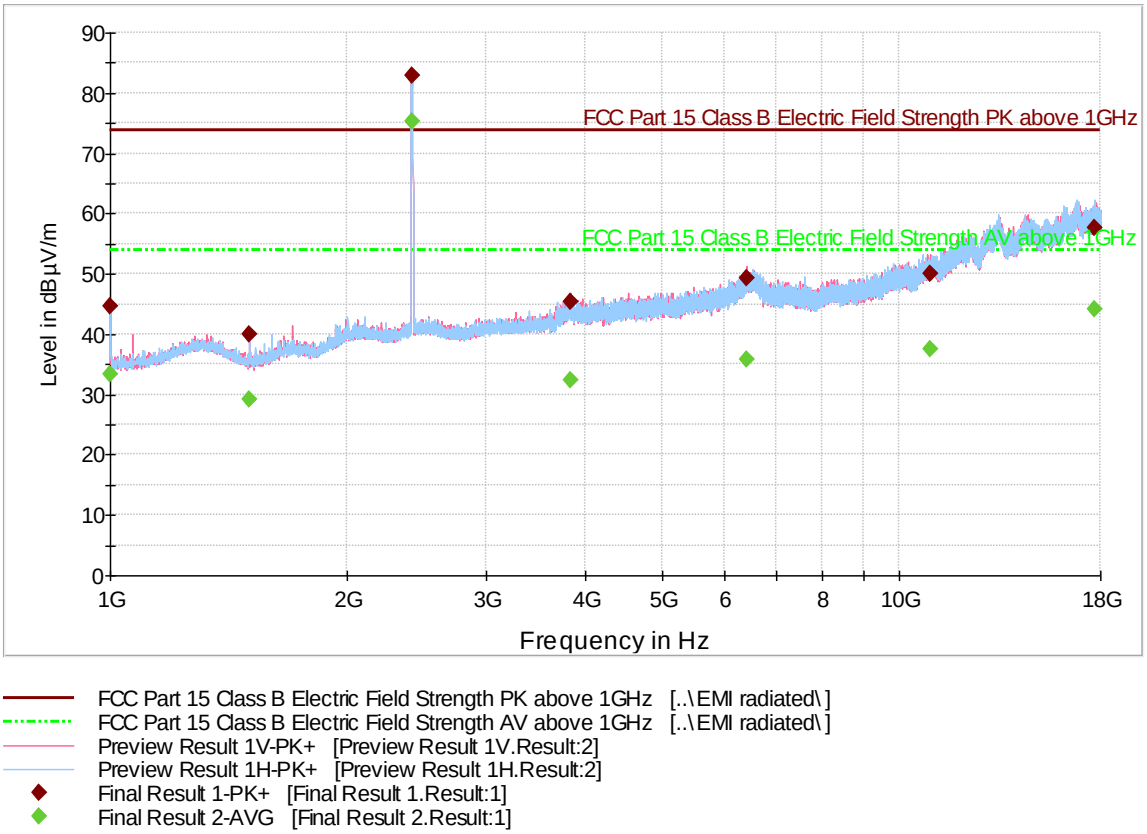
### 2.5.10 Test Results Below 1GHz (WLAN Worst Case Configuration)




**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 |

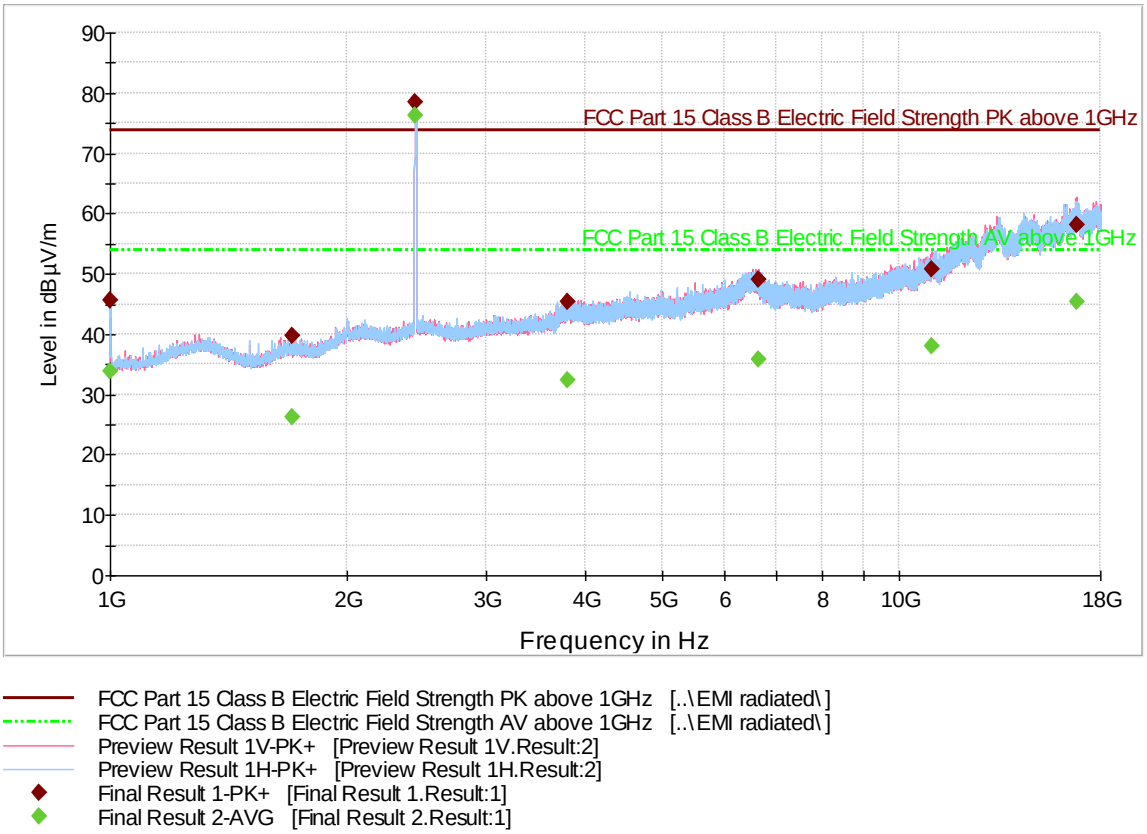
**Average Data**

| 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 |

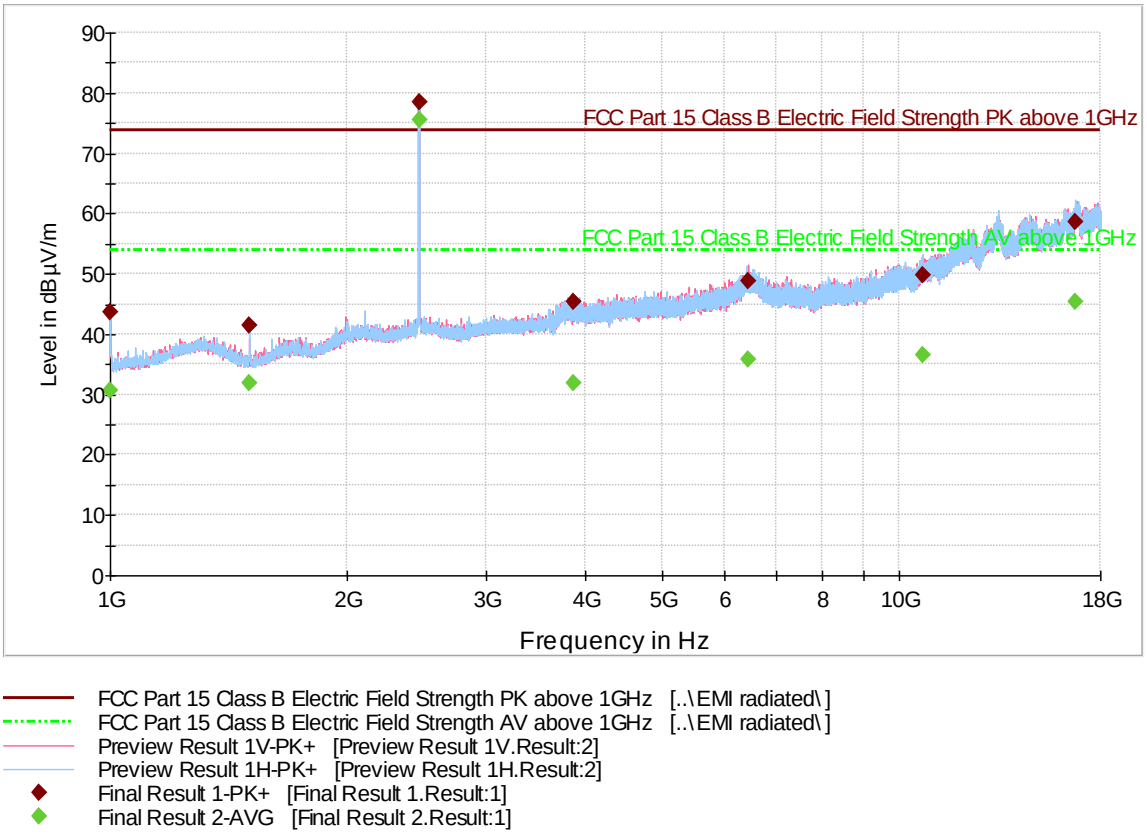
**Average Data**

| 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 |

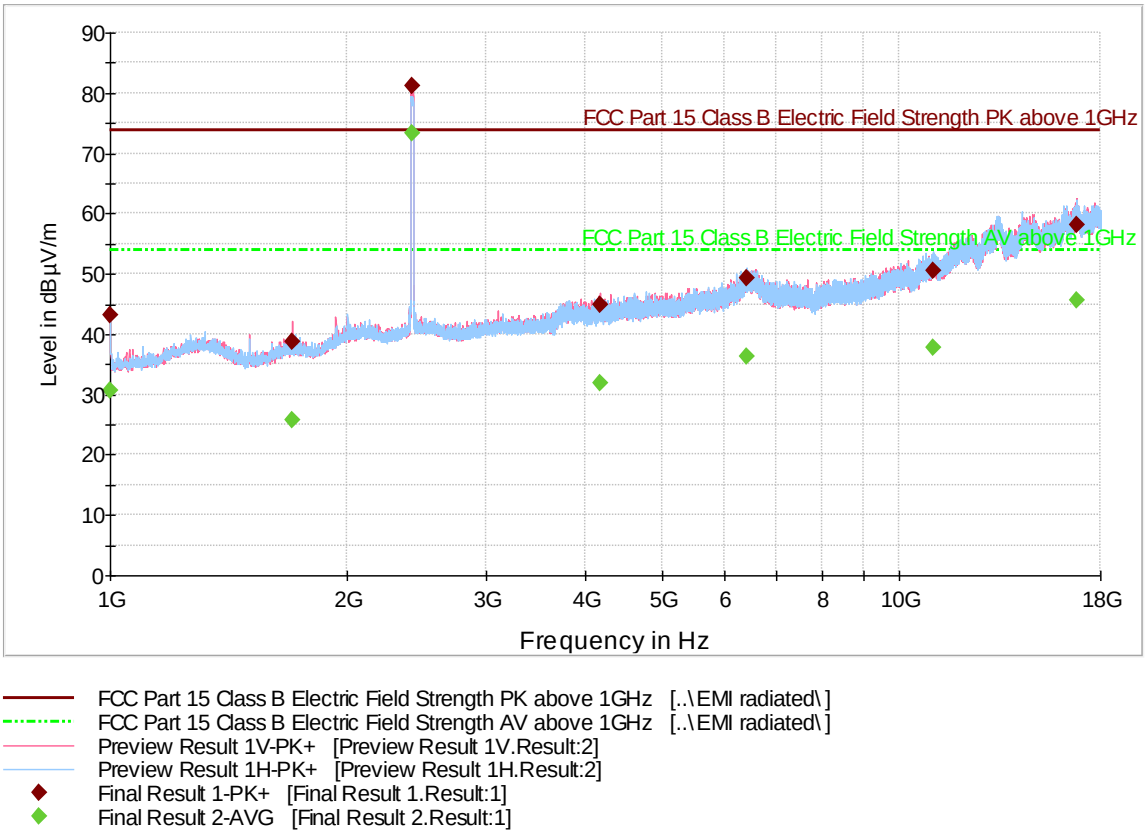
**Average Data**

| 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 |

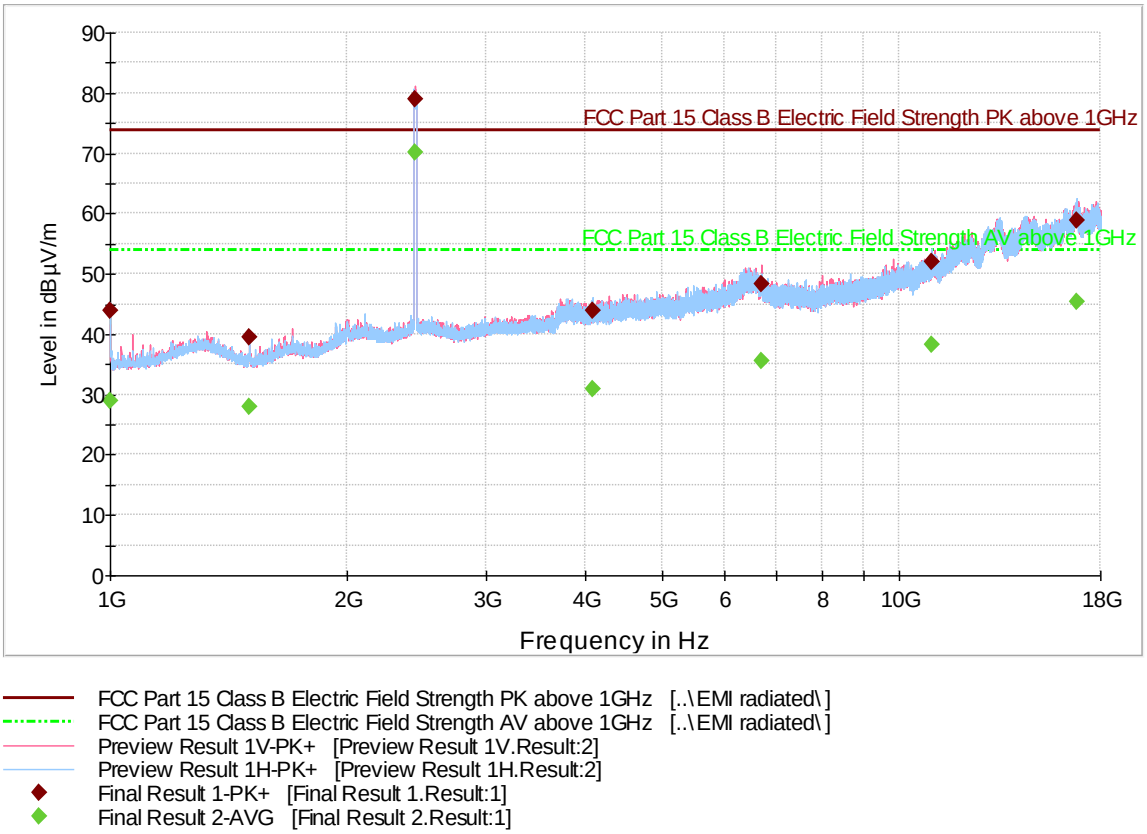
**Average Data**

| 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 |

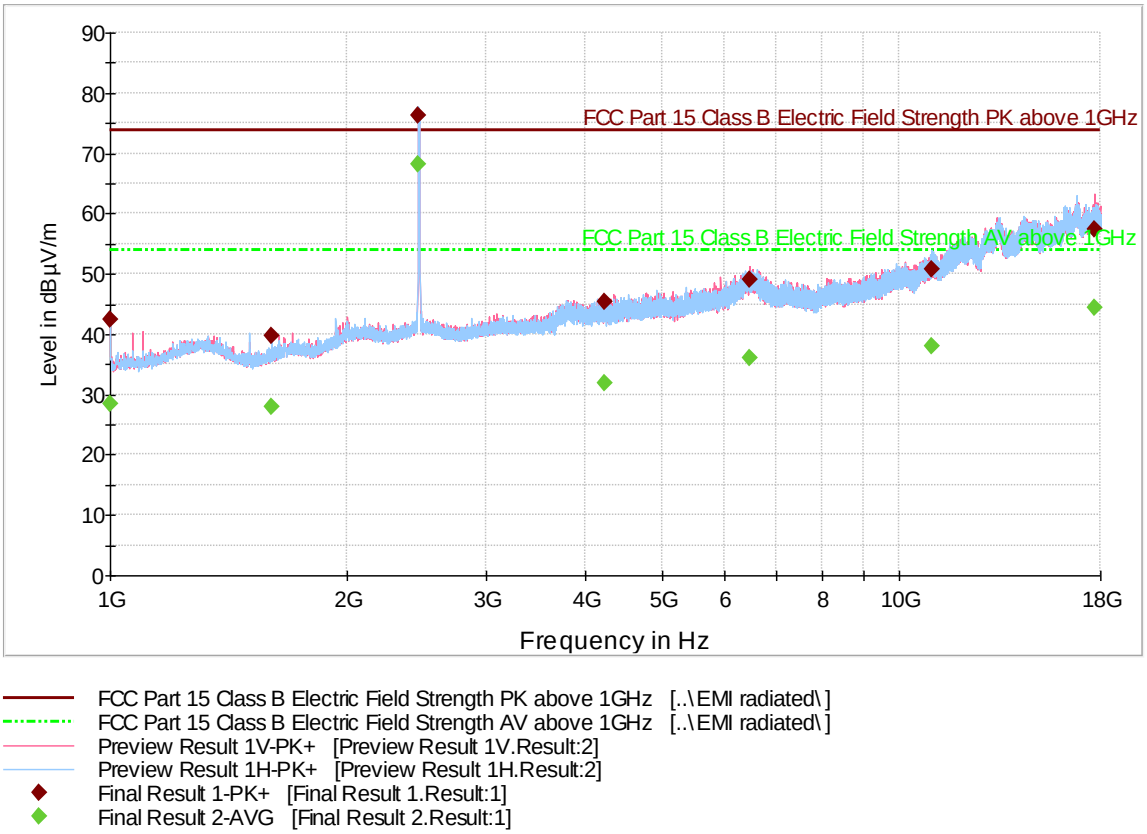
**Average Data**

| 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 |

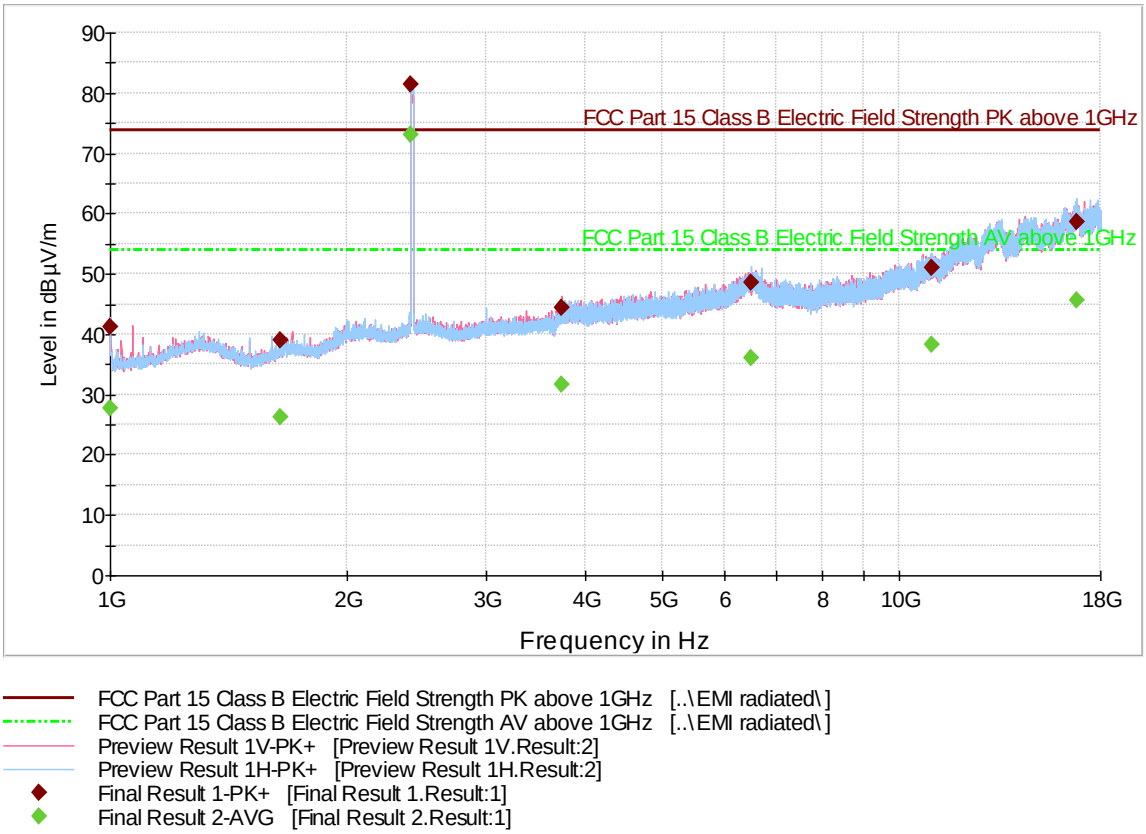
**Average Data**

| 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 |

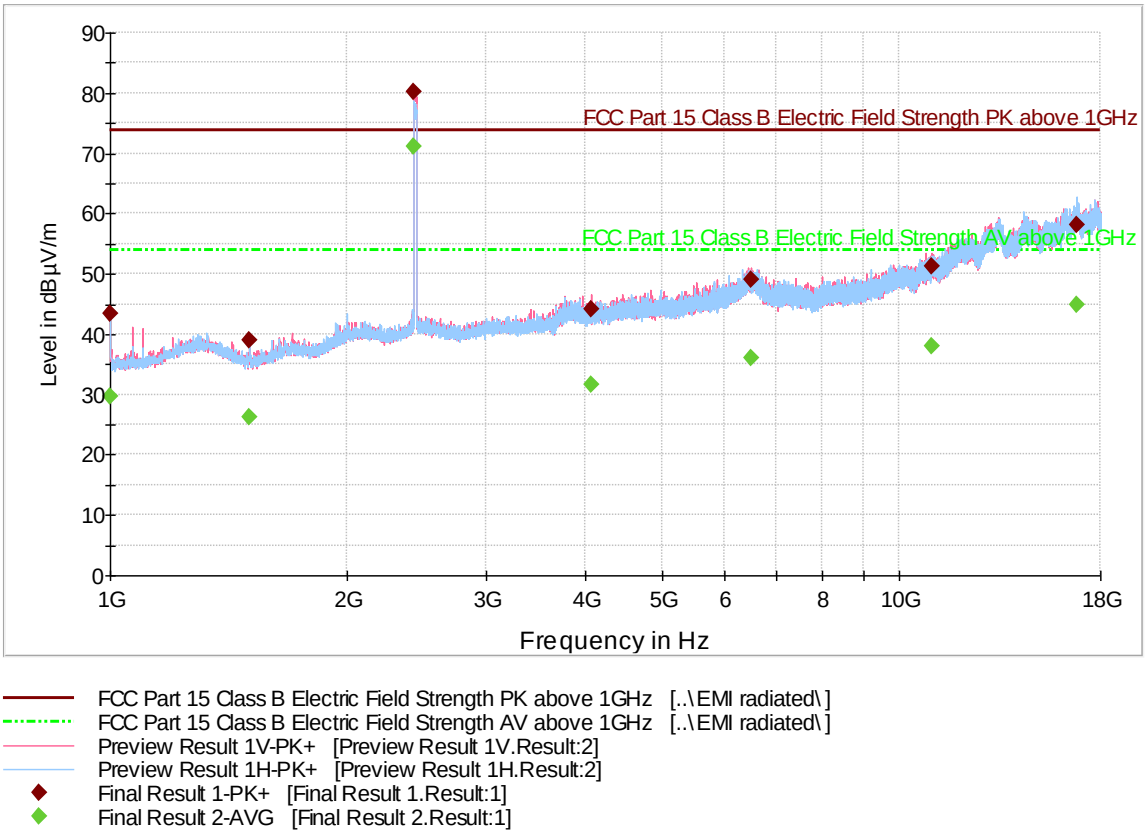
**Average Data**

| 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 |

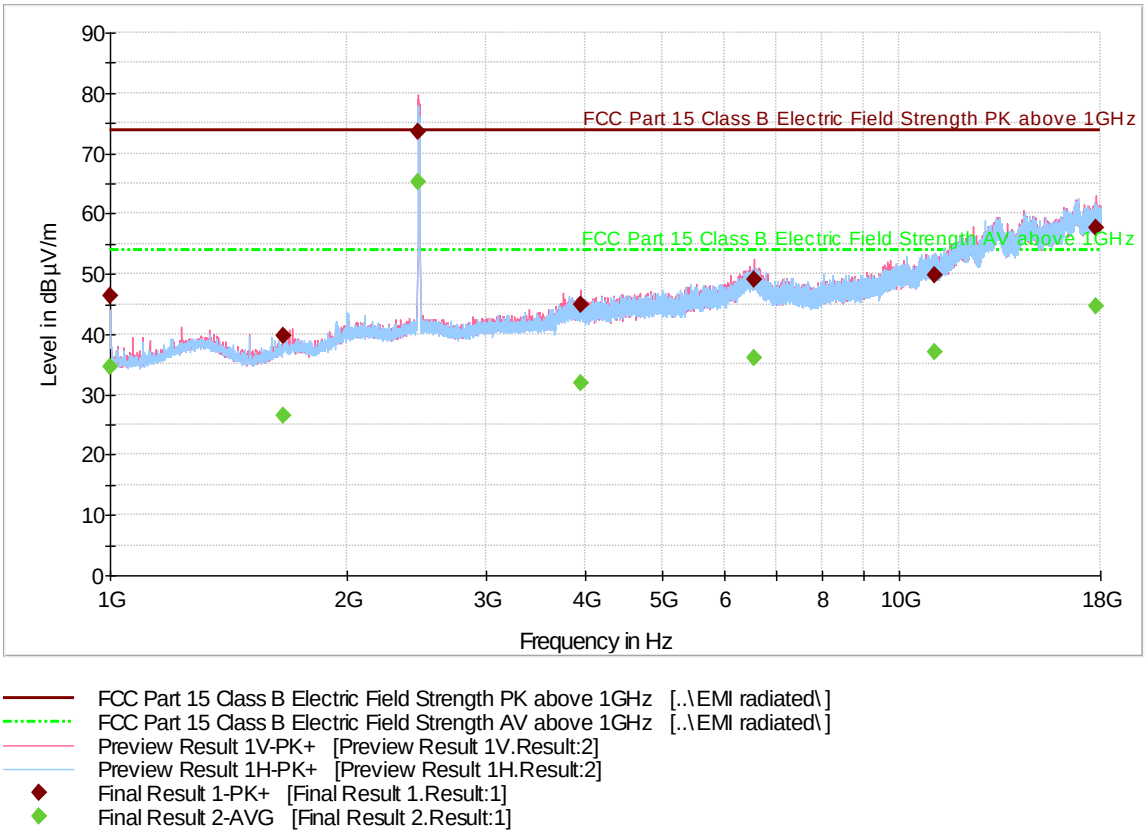
**Average Data**

| 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 |

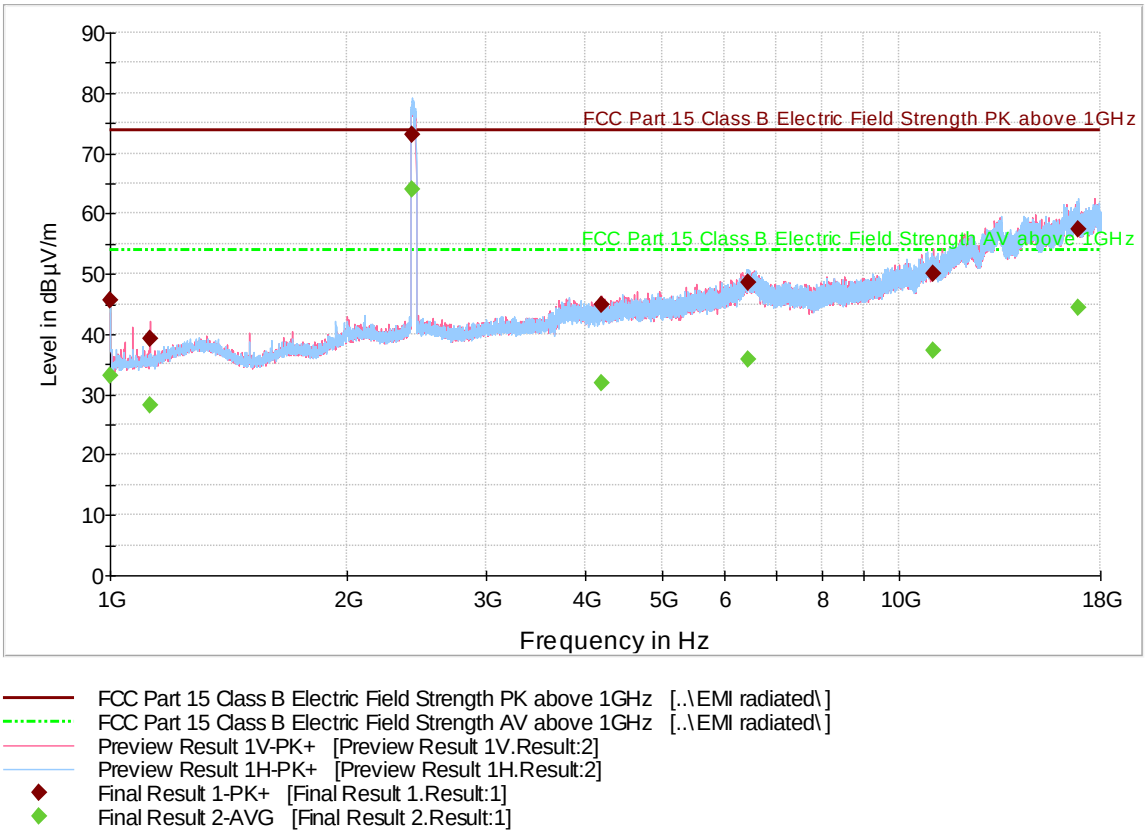
**Average Data**

| 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 |

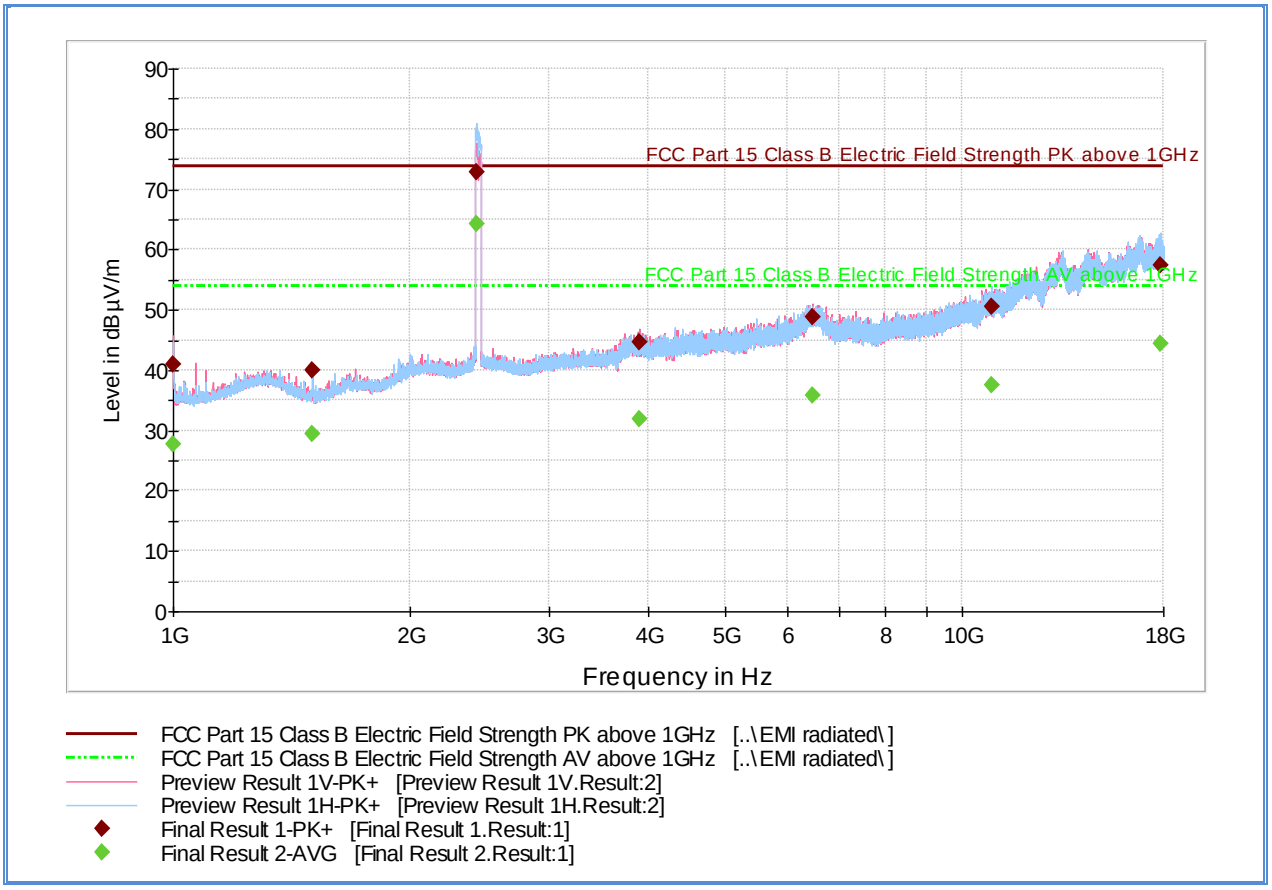
**Average Data**

| 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 |

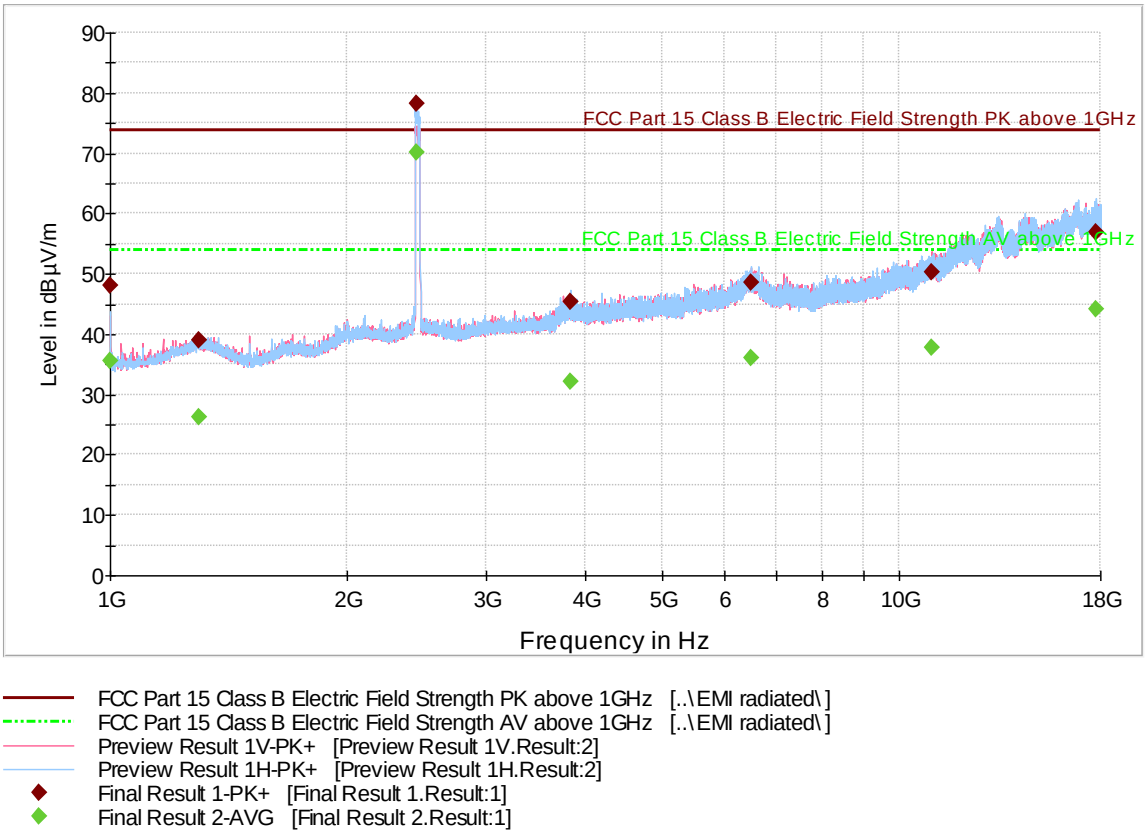
**Average Data**

| 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.

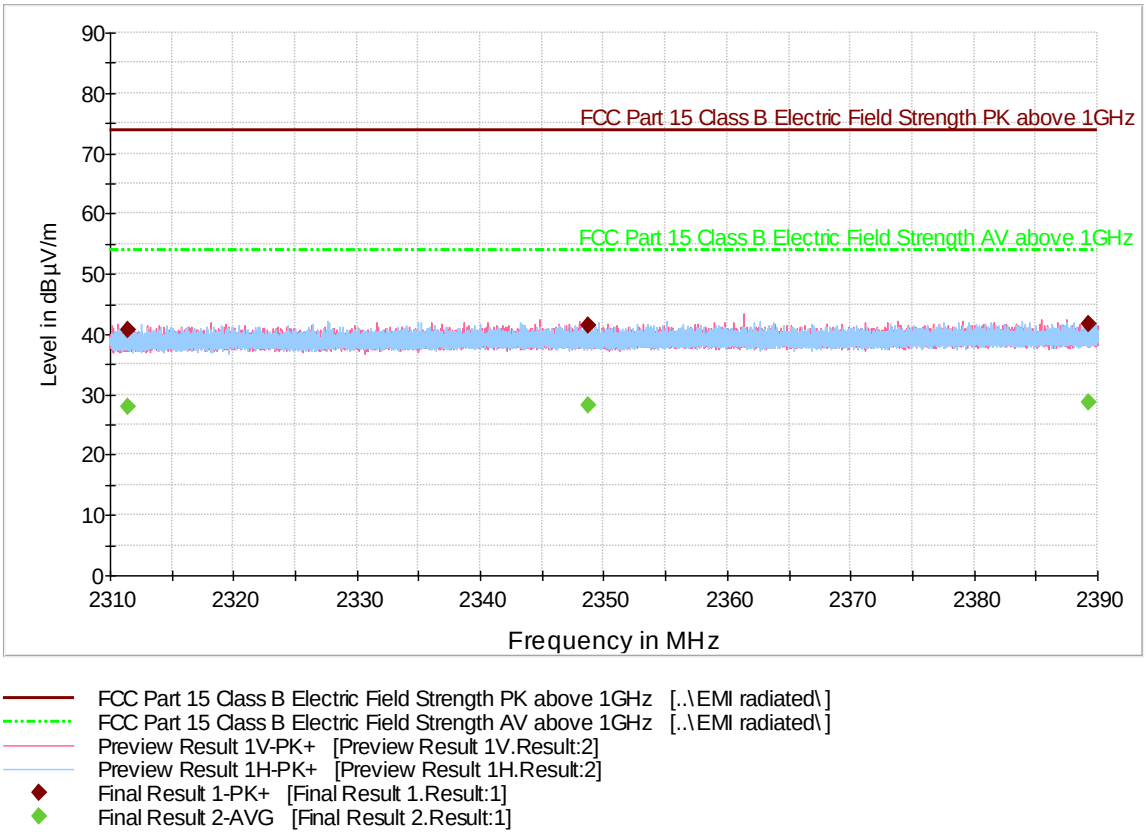
### 2.6.8 Sample Computation (Radiated Emission)

| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dbµV) @ 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)



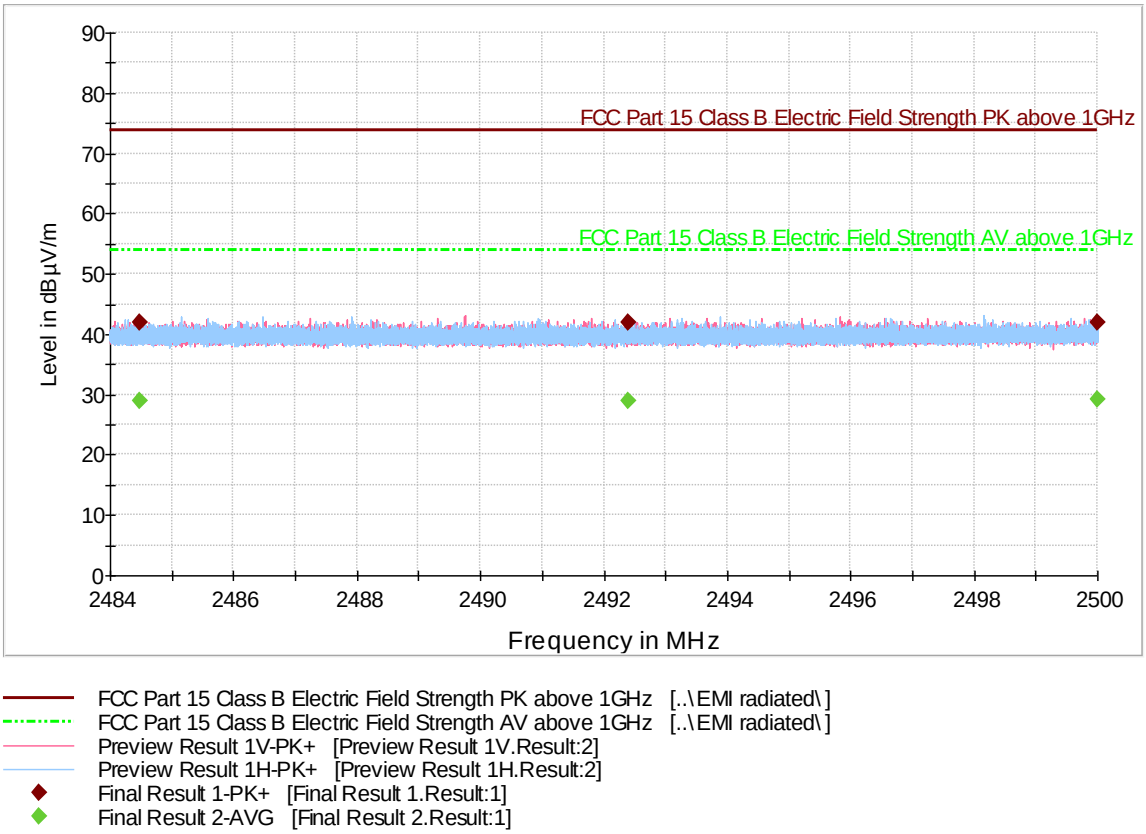

**Peak Data**

| 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)



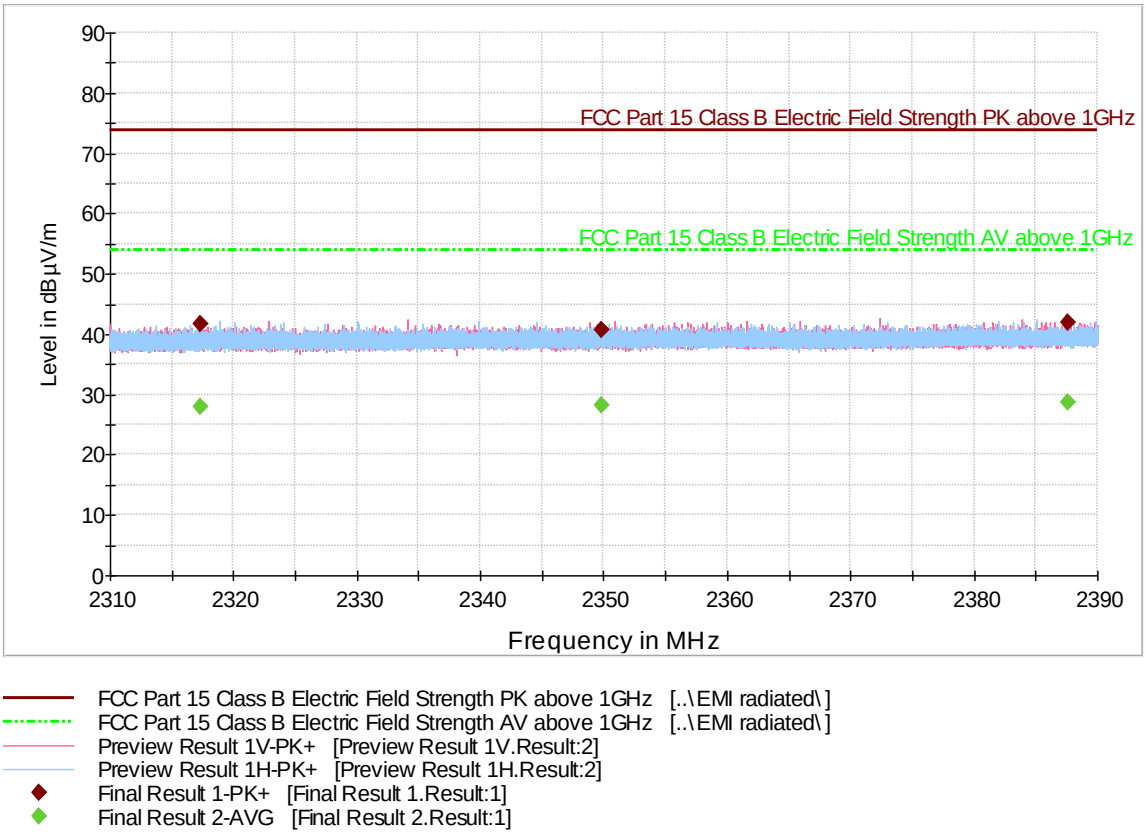

**Peak Data**

| 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)



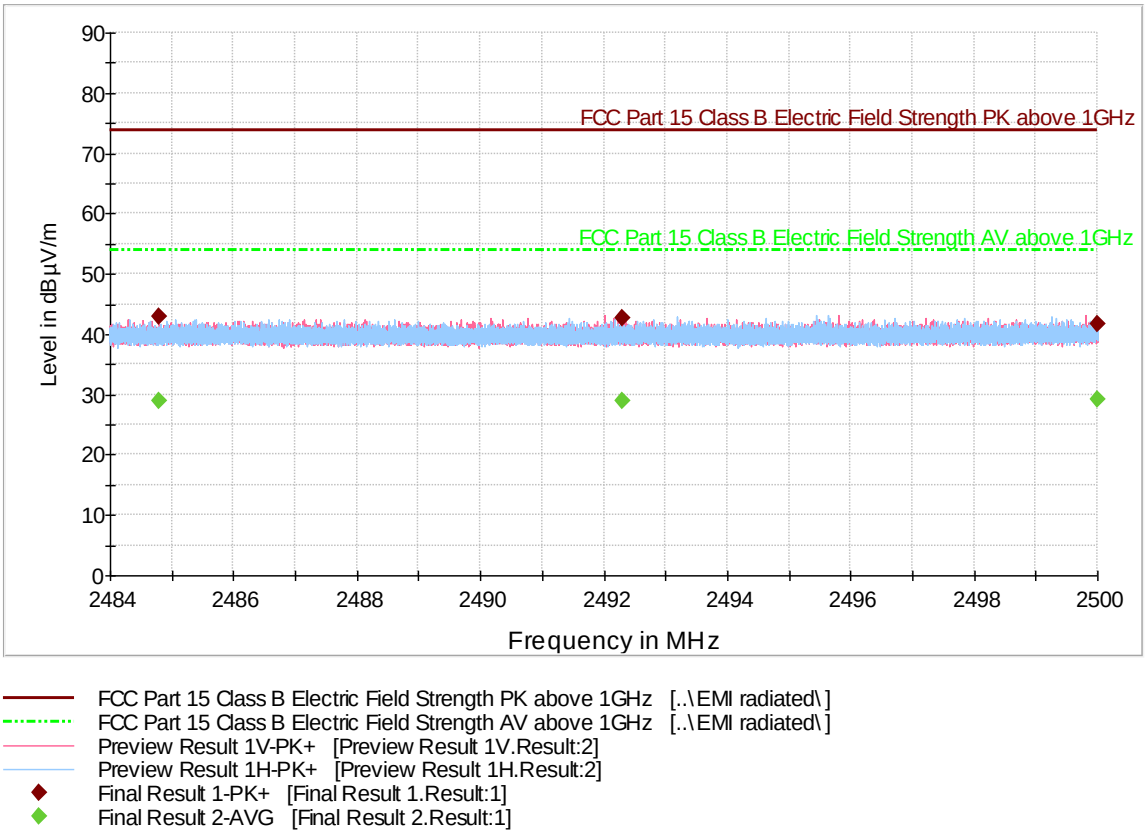

**Peak Data**

| 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)



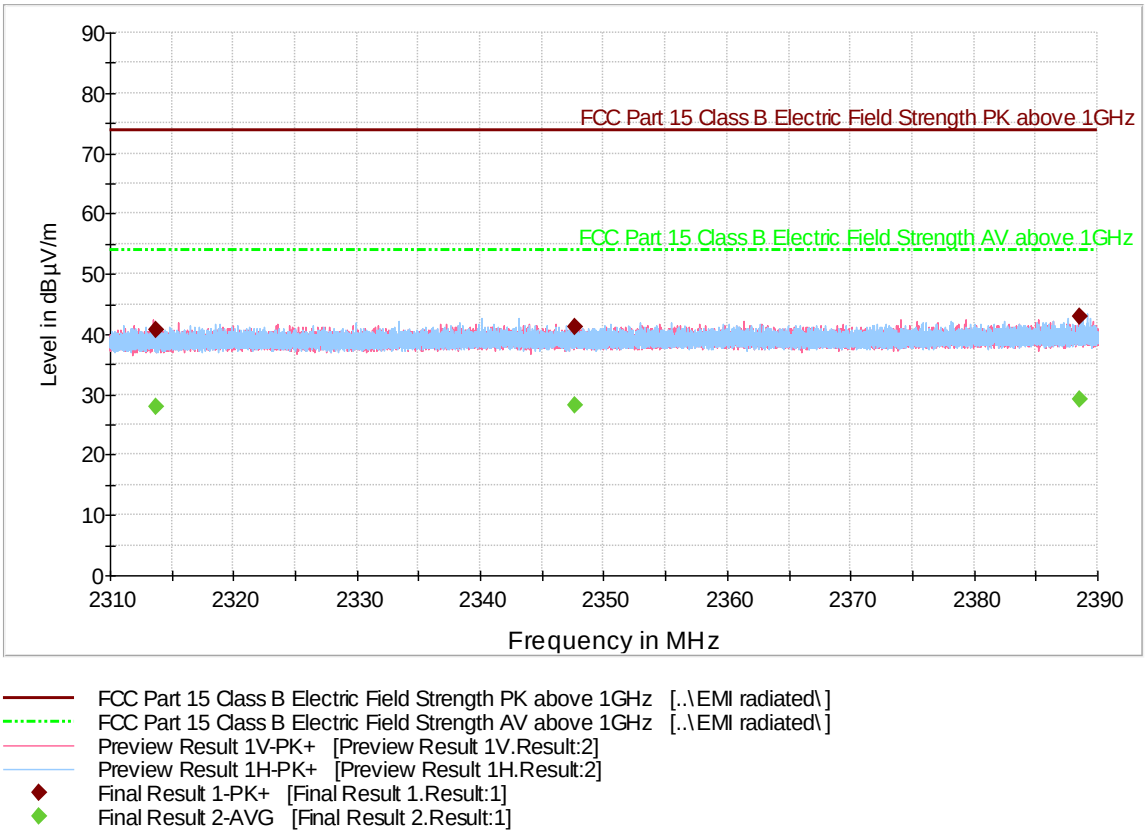

**Peak Data**

| 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)



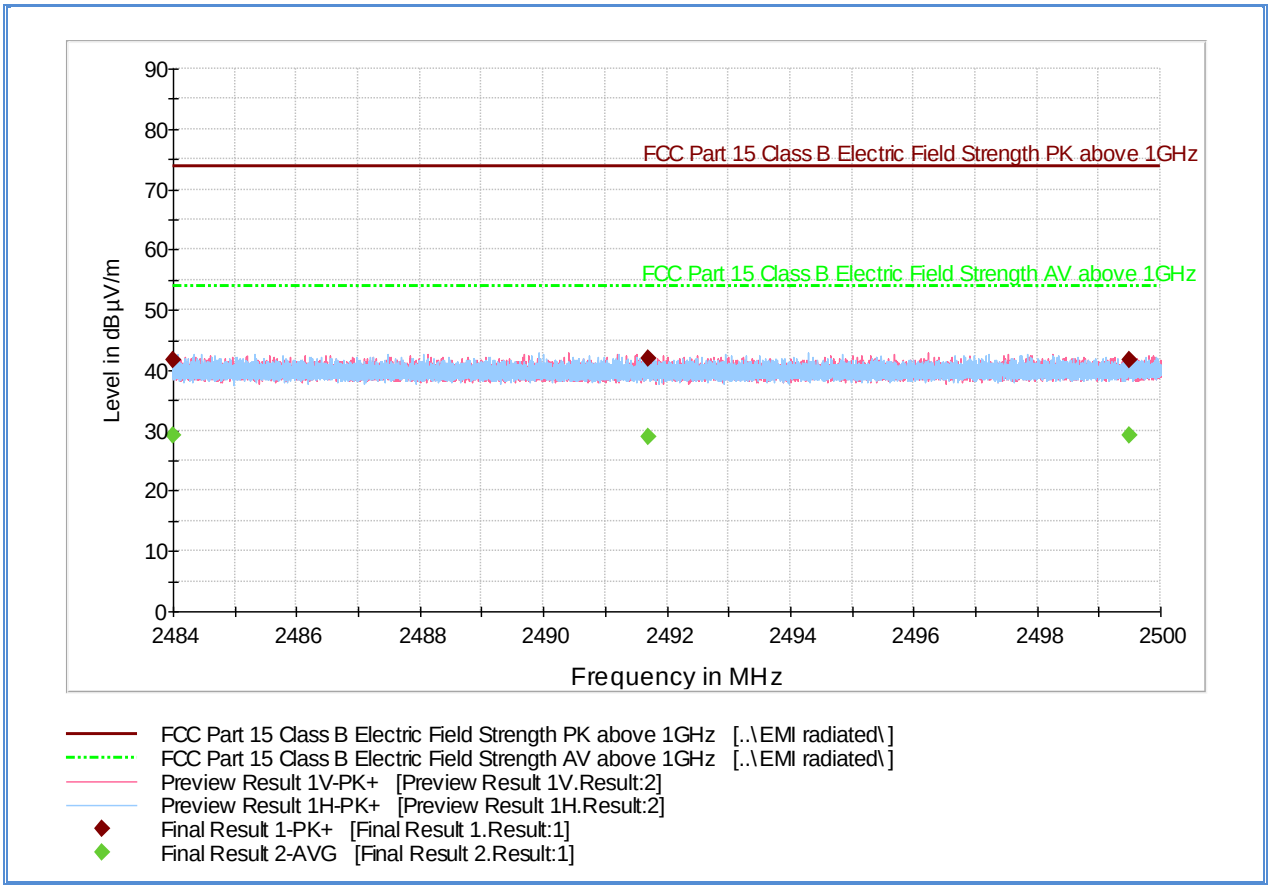

**Peak Data**

| 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)



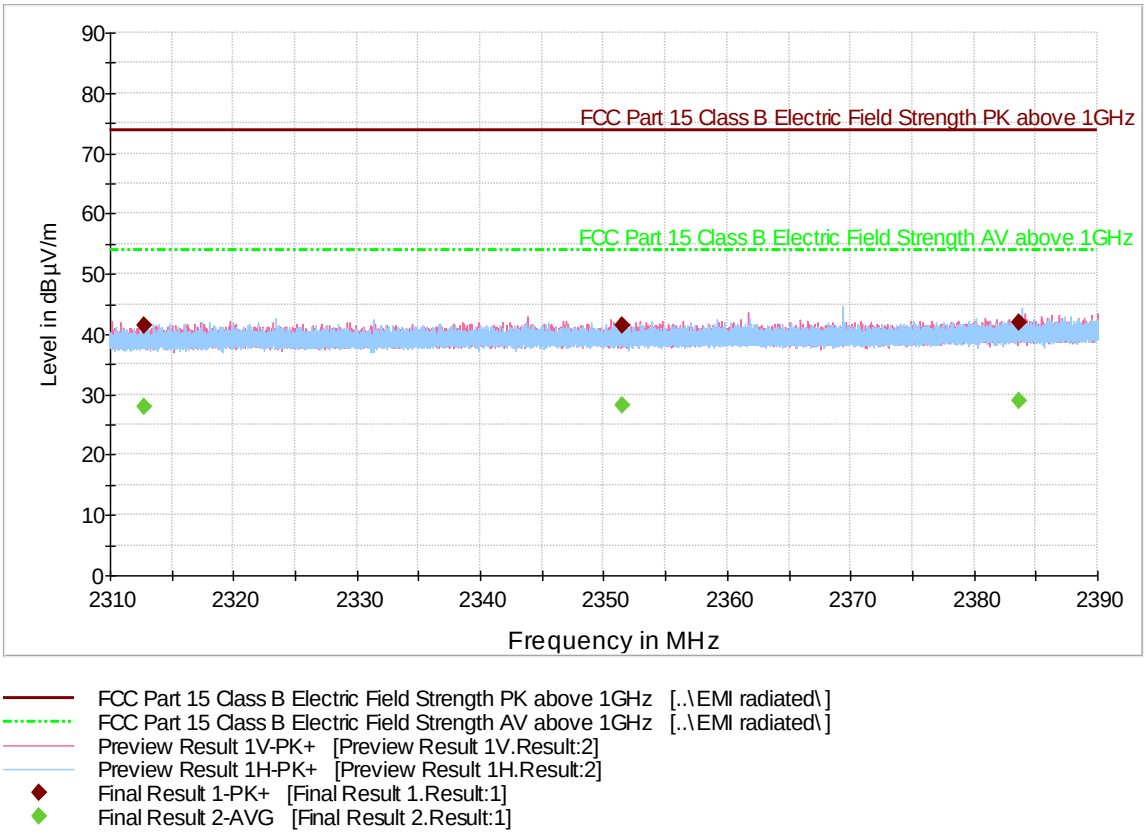

**Peak Data**

| 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)



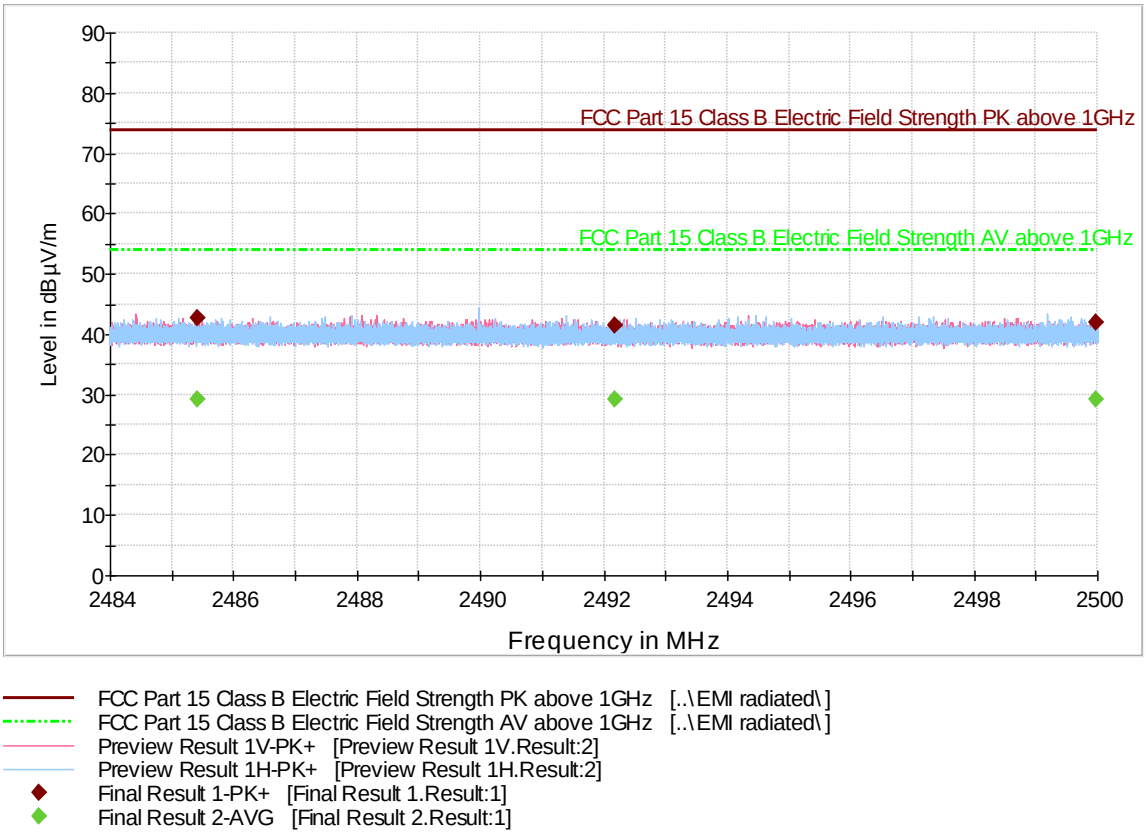

**Peak Data**

| 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 |

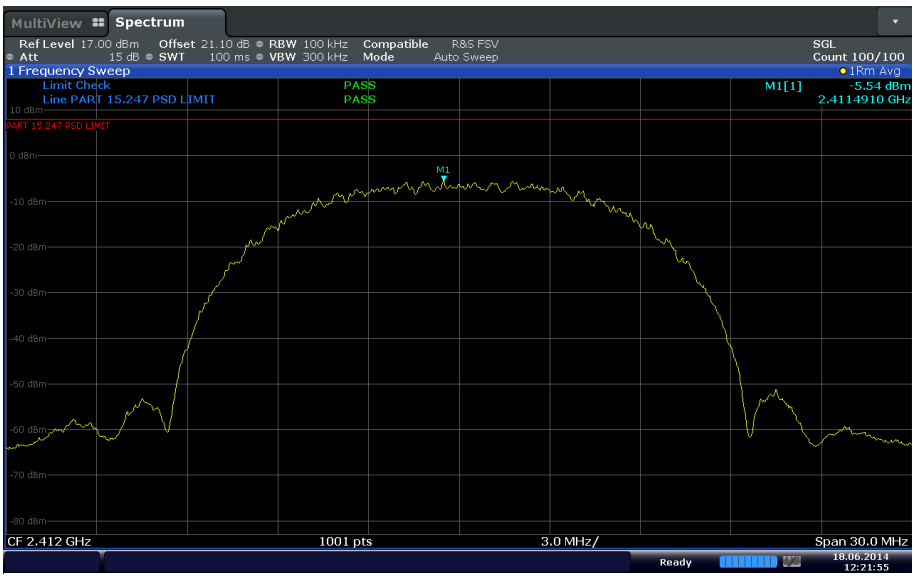
### 2.7.7 Additional Observations

- 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

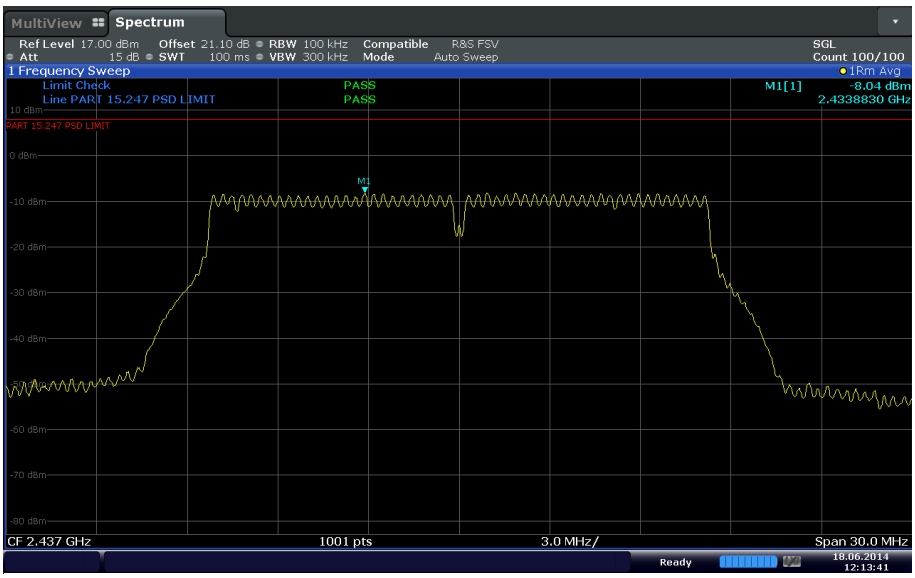
| Mode | Channel | Marker Reading using 100 kHz RBW (dBm) | PSD Limit (dBm) | Margin (dB) | Compliance |
|---|---|---|---|---|---|
| 802.11b | 1 (2412 MHz) | -5.54 | 8 | 13.54 | Complies |
| | 6 (2437 MHz) | -6.39 | 8 | 14.39 | Complies |
| | 11 (2462 MHz) | -5.83 | 8 | 13.83 | Complies |
| 802.11g | 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



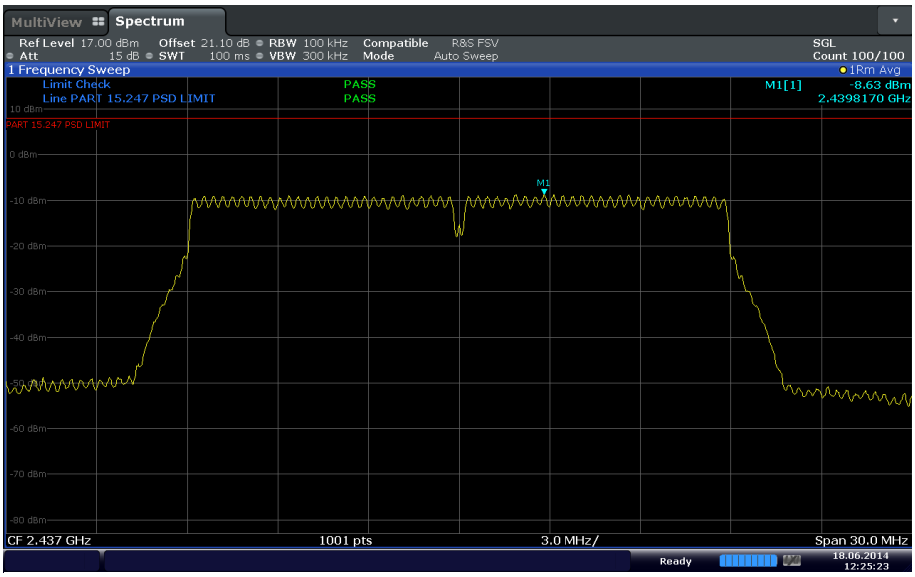

Date:18.JUN.2014 12:21:55

**802.11b mode Worst Case Channel**

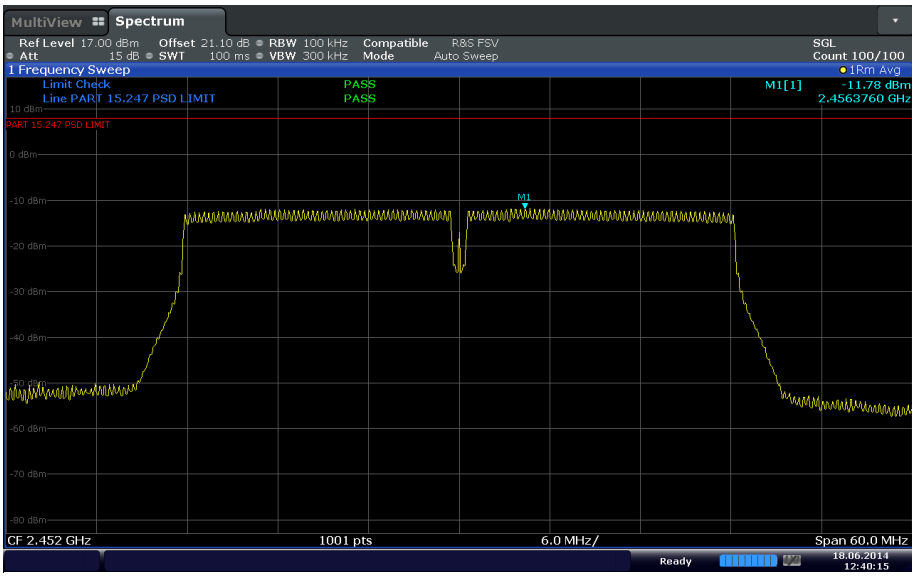



Date:18.JUN.2014 12:13:41

**802.11g mode Worst Case Channel**




**802.11n mode HT20 Worst Case Channel**




**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 |

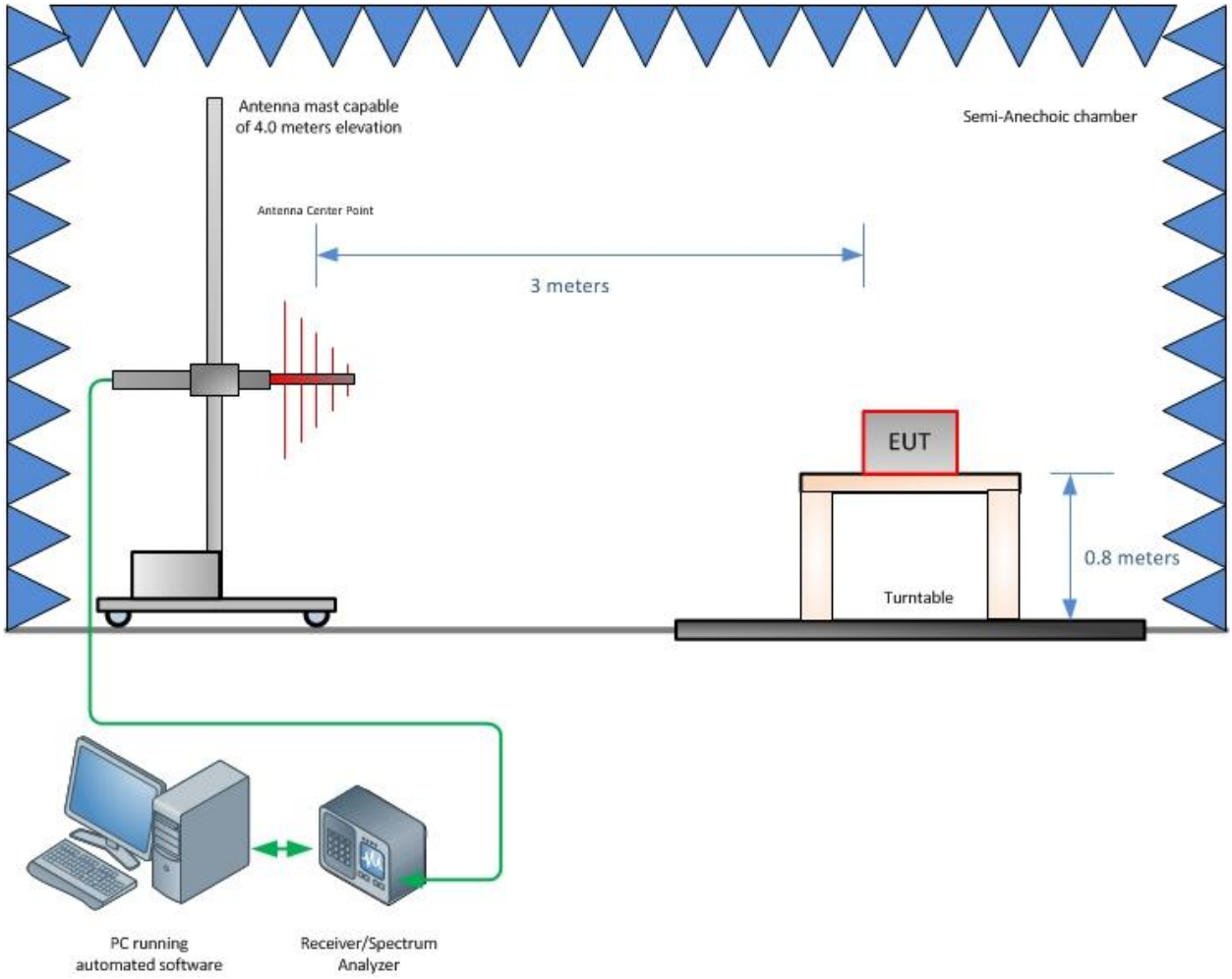
### 3.2.3 Conducted Antenna Port Measurement

| | 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 |

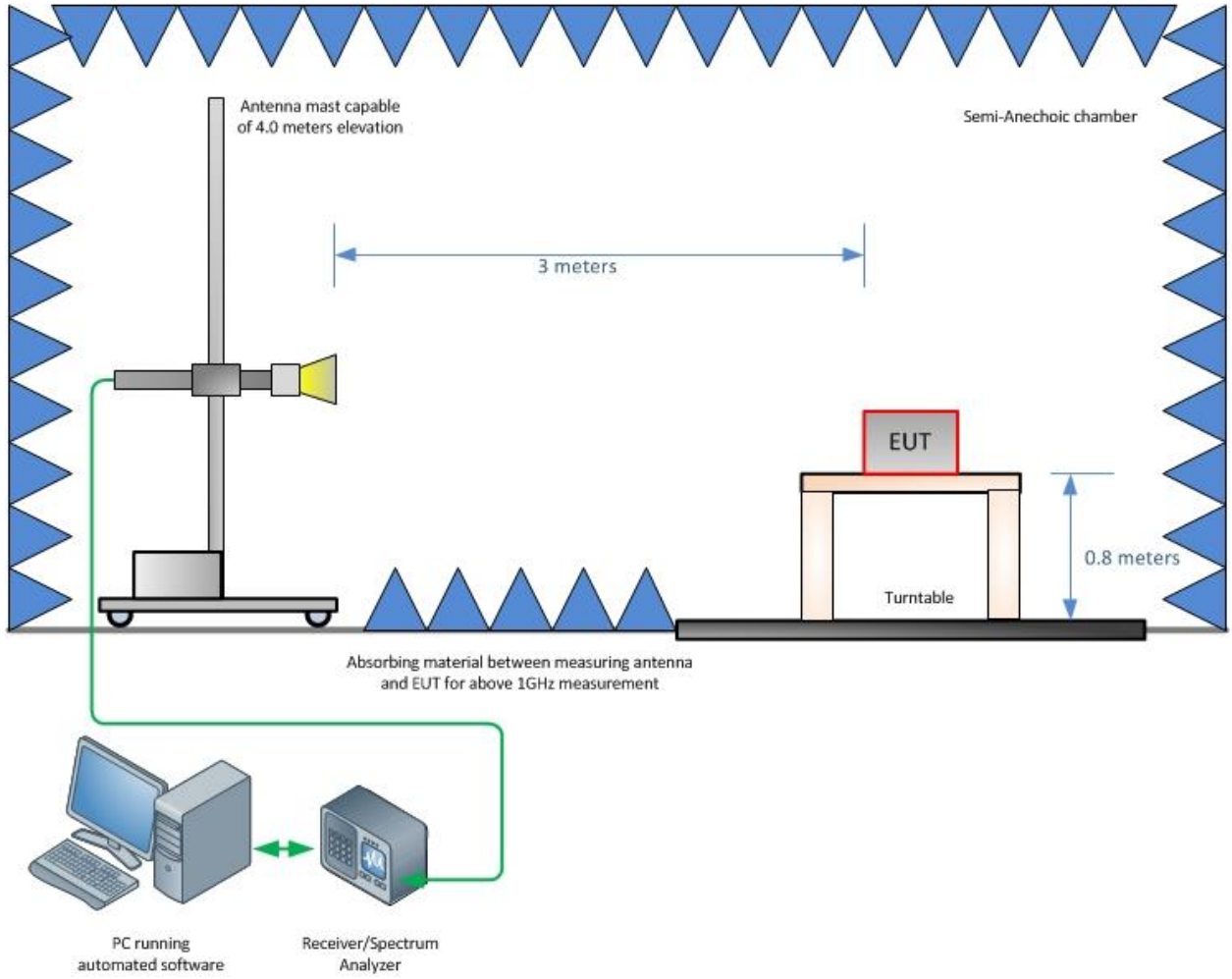
**SECTION 4**

**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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