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Report On

Application for Grant of Equipment Authorization of the
Harman Becker Automotive Systems, Inc.

VP3/VP4 Silverbox Automotive Infotainment Unit with
Bluetooth/WLAN

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

Report No. SD72102589-0215C

March 2015

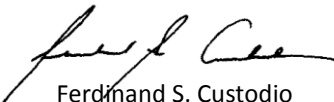



REPORT ON Radio Testing of the
Harman Becker Automotive Systems, Inc.
Automotive Infotainment Unit with Bluetooth/WLAN

TEST REPORT NUMBER SD72102589-0215C

PREPARED FOR Harman Becker Automotive Systems, Inc.
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DATED March 05, 2015



Revision History

| SD72102589-0215C Harman Becker Automotive Systems, Inc. VP3 Silverbox; VP4 Silverbox Automotive Infotainment Unit with Bluetooth/WLAN | | | | | |
|--|-----------------|--------------|--------|----------------|----------------|
| DATE | OLD REVISION | NEW REVISION | REASON | PAGES AFFECTED | APPROVED BY |
| 03/05/2015 | Initial Release | | | | Chip R. Fleury |
| | | | | | |
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CONTENTS

| Section | | Page No |
|----------------|--|----------------|
| 1 | REPORT SUMMARY | 5 |
| 1.1 | Introduction | 6 |
| 1.2 | Brief Summary Of Results | 7 |
| 1.3 | Product Information | 8 |
| 1.4 | EUT Test Configuration | 10 |
| 1.5 | Deviations From The Standard | 13 |
| 1.6 | Modification Record | 13 |
| 1.7 | Test Methodology | 13 |
| 1.8 | Test Facility Location..... | 13 |
| 1.9 | Test Facility Registration..... | 13 |
| 2 | TEST DETAILS | 15 |
| 2.1 | Peak Output Power..... | 16 |
| 2.2 | Conducted Emissions | 20 |
| 2.3 | 99% Emission Bandwidth | 21 |
| 2.4 | Minimum 6 dB Rf Bandwidth..... | 26 |
| 2.5 | Out-Of-Band Emissions - Conducted | 31 |
| 2.6 | Band-Edge Compliance Of Rf Conducted Emissions | 35 |
| 2.7 | Spurious Radiated Emissions | 38 |
| 2.8 | Radiated Band Edge Measurements And Immediate Restricted Bands | 49 |
| 2.9 | Power Spectral Density..... | 55 |
| 3 | TEST EQUIPMENT USED | 60 |
| 3.1 | Test Equipment Used..... | 61 |
| 3.2 | Measurement Uncertainty | 63 |
| 4 | DIAGRAM OF TEST SETUP | 64 |
| 4.1 | Test Setup Diagram..... | 65 |
| 5 | ACCREDITATION, DISCLAIMERS AND COPYRIGHT | 67 |
| 5.1 | Accreditation, Disclaimers and Copyright..... | 68 |



SECTION 1

REPORT SUMMARY

Radio Testing of the
Harman Becker Automotive Systems, Inc.
Automotive Infotainment Unit with Bluetooth/WLAN



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Harman Becker Automotive Systems, Inc. VP3 Silverbox; VP4 Silverbox Automotive Infotainment Unit with Bluetooth/WLAN to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-210 Issue 8 December 2010.

| | |
|-------------------------------|--|
| Objective | To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out. |
| Manufacturer | Harman Becker Automotive Systems, Inc. |
| Model Number(s) | VP3/VP4 Silverbox |
| FCC ID Number | QNGBE2813 |
| IC Number | 6434C-BE2813 |
| Serial Number(s) | <ul style="list-style-type: none">• SN022 (Conducted antenna port testing - Sample #1)• SN023 (Radiated testing - Sample #2) |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | <ul style="list-style-type: none">• FCC Part 15 Subpart C §15.247 (October 1, 2014).• RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010).• RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 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 28, 2015 |
| Finish of Test | March 02, 2015 |
| Name of Engineer(s) | Ferdinand Custodio |
| Related Document(s) | None. Supporting documents for EUT certification are separate exhibits. |



1.2 BRIEF SUMMARY OF RESULTS

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

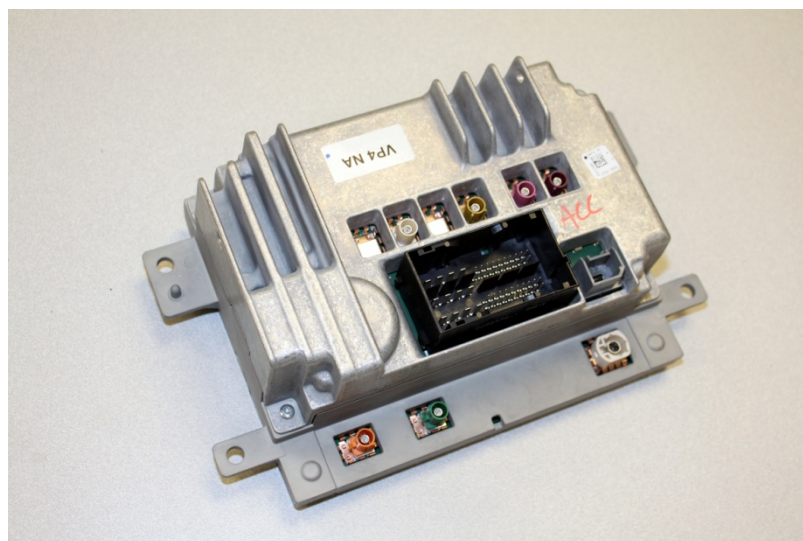
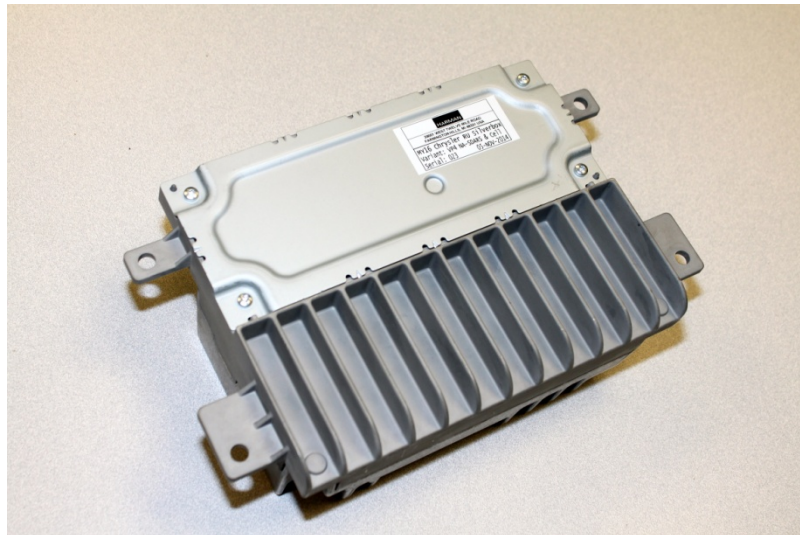
| Section | §15.247 Spec Clause | RSS | Test Description | Result | Comments/ Base Standard |
|---------|---------------------|------------------|---|-----------|----------------------------|
| 2.1 | §15.247(b)(3) | RSS-210 A8.4 (4) | Peak Output Power | Compliant | |
| 2.2 | §15.207 (a) | RSS-Gen 8.8 | Conducted Emissions | N/A | |
| 2.3 | | RSS-Gen 6.6 | 99% Emission Bandwidth | Compliant | |
| 2.4 | §15.247(a)(2) | RSS-210 A8.2(a) | Minimum 6 dB RF Bandwidth | Compliant | |
| 2.5 | §15.247(d) | RSS-210 A8.5 | Out-of-Band Emissions - Conducted | Compliant | |
| 2.6 | §15.247(d) | RSS-210 A8.5 | Band-edge Compliance of RF Conducted Emissions | Compliant | |
| 2.7 | §15.247(d) | RSS-210 A8.5 | Spurious Radiated Emissions | Compliant | |
| 2.7 | | RSS-Gen 7.0 | Receiver Spurious Emissions | Compliant | |
| 2.8 | §15.247(d) | RSS-210 A8.5 | Radiated Band Edge Measurements | Compliant | |
| 2.9 | §15.247(e) | RSS-210 A8.2(b) | Power Spectral Density for Digitally Modulated Device | Compliant | |

N/A *EUT is for automotive installation only and not designed to be connected to the public utility (AC) power line.*

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Harman Becker Automotive Systems, Inc. VP3/VP4 Silverbox VP3 Silverbox; VP4 Silverbox Automotive Infotainment Unit with Bluetooth/WLAN as shown in the photograph below. The EUT is the main unit of an automotive radio system less the display. It houses the AM/FM receiver, GPS receiver, Satellite receiver, BT/WLAN module and CDMA radio. Two models are covered by this test report: VP3 Silverbox and VP4 Silverbox. The two models are identical except for the size of the flash MNAND where the main operating software is stored. VP3 Silverbox uses 8 GB flash MNAND while VP4 Silverbox uses 16 GB flash MNAND. All verifications performed on the VP4 Silverbox. Only the WLAN function of the EUT was verified in this test report.



Equipment Under Test



1.3.2 EUT General Description

| | |
|----------------------|---|
| EUT Description | Automotive Infotainment Unit with Bluetooth/WLAN |
| Model Name | VP3 Silverbox; VP4 Silverbox |
| Model Number(s) | VP3/VP4 Silverbox |
| Rated Voltage | 12VDC (Nominal) |
| Mode Verified | WLAN |
| Capability | 802.11 b and g WLAN (DTS 2.4GHz), Bluetooth 3.0 + HS and CDMA2000 (1xRTT and 1xEVDO using BCO and BC1) |
| Primary Unit (EUT) | <input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering |
| Antenna Type | External PCB Antenna with FAKRA connector (automotive application/professionally installed) |
| Antenna Model | BT-WiFi 68227177AA - FC00AAL34255 |
| Antenna Manufacturer | Laird Technologies |
| Antenna Gain | -0.22 dBi |

1.3.3 Maximum Conducted Output Power

| Mode | Frequency Range (MHz) | Output Power (dBm) | Output Power (mW) |
|---------|-----------------------|--------------------|-------------------|
| 802.11b | 2412-2462 | 14.33 | 27.10 |
| 802.11g | 2412-2462 | 17.94 | 62.23 |



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

| Test Configuration | Description |
|--------------------|---|
| A | Antenna conducted port test configuration. All measurements were performed on the WLAN (Green) antenna connector. A support laptop was used to connect with the EUT via Ethernet with USB adapter on the EUT side. TeraTerm was used to copy/paste WLAN command provided by the manufacturer. Various WLAN test mode parameters were modified using these commands such as Channel, Data Rate and RF Mode. Power parameter was set to "200" which corresponds to the maximum power setting. |
| B | Radiated emissions test configuration. Antenna ports of radio not being verified are either terminated with a 50Ω load or the radio configured in "Receive" mode. |

1.4.2 EUT Exercise Software

Using direct connection via USB, WLAN commands were issued to the EUT using TeraTerm. Manufacturer provided test command files allowing configuration of various RF parameters such as Channel, Data Rate, RF Mode and Power Parameter.

1.4.3 Support Equipment and I/O cables

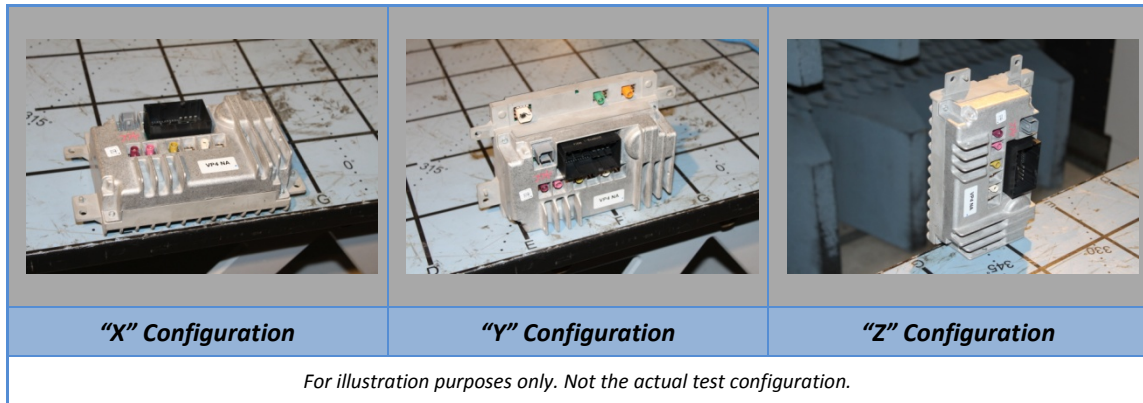
| Manufacturer | Equipment/Cable | Description |
|--------------|------------------------------|---|
| Protek | Laboratory DC Power Supply | M/N 35010M S/N D102007S |
| Chrysler | Main Wiring Harness | 1.1 meters, custom connector with various cables such as power, CAN-C, CAN-HIS, speakers, mics and aux input |
| - | USB cable | 0.8 meter, shielded Type A to Mini5B connector |
| Chrysler | Shark Fin Antenna Assembly | P05091352AC 600517 0794 AM/FM, Sirius XM, GPS and CDMA antenna with 0.8 meter shielded Fakra SMB connector coaxial cable (x3) |
| Chrysler | BT/WLAN Antenna | P68227177AA 200409 1414 Prototype antenna assembly with 0.3 meter shielded Fakra SMB connector coaxial cable (x2) |
| Chrysler | Custom Antenna Cable | 0.15 meter, shielded with Fakra SMB connector |
| MCL | Coaxial SMA Fixed Attenuator | P/N BW-S20W5+ Precision fixed attenuator. 50Ω 5W 20 dB DC to 18GHz. |
| - | SMA 50Ω Termination | P/N R404101000/008269 |

1.4.4 Worst Case Configuration

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

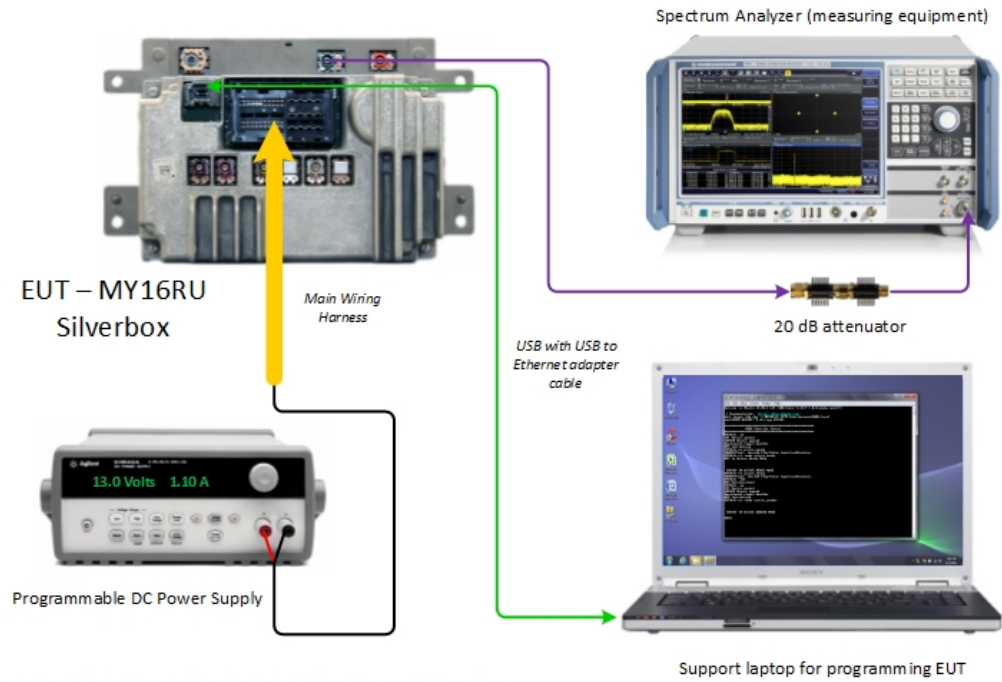
| Mode | Channel | Data Rate |
|---------|-----------------|-----------|
| 802.11b | 1 (Low Channel) | 11Mbps |
| 802.11g | 1 (Low Channel) | 24Mbps |

EUT is a mobile device. Final installation position is unknown at the time of verification. For radiated measurements X, Y and Z orientations were verified. No major variation in emissions observed between the three (3) orientations. Verifications performed using "X" configuration.

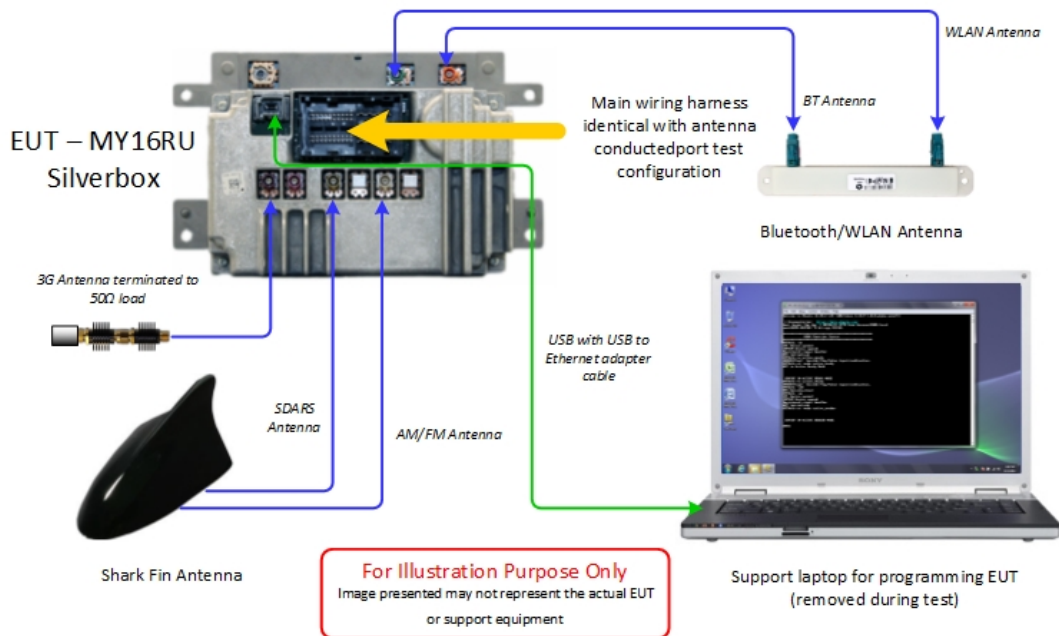


1.4.5 Simplified Test Configuration Diagram

Antenna Conducted Port Test Configuration



Radiated Emissions Test Configuration





1.5 DEVIATIONS FROM THE STANDARD

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

1.6 MODIFICATION RECORD

| Description of Modification | Modification Fitted By | Date Modification Fitted |
|-------------------------------|------------------------|--------------------------|
| Serial Number SN022 and SN023 | | |
| 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. 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. Phone: 858 942 5542 FAX: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US5296

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



1.9.2 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
Harman Becker Automotive Systems, Inc.
Automotive Infotainment Unit with Bluetooth/WLAN



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: SN022 / Test Configuration A

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

February 28 and March 1, 2015/FSC

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

| | |
|---------------------|----------------|
| Ambient Temperature | 20.3-21.1°C |
| Relative Humidity | 50.6-52.2% |
| ATM Pressure | 99.6-100.1 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 21.40dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- Test methodology is per Clause 9.2.3.1 of KDB 558074 D01 (DTS Meas Guidance v03r02, June 05, 2014). All conditions under this Clause were satisfied.
- Both Peak and Average measurements were recorded.
- EUT was transmitting continuously with a constant duty cycle.

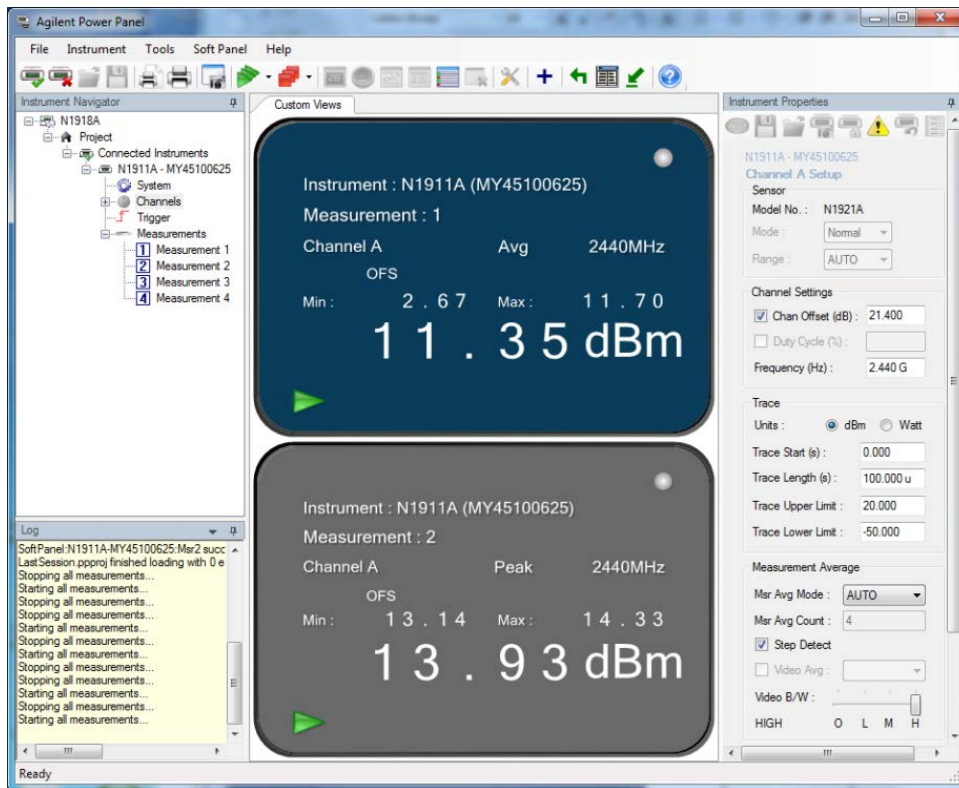


2.1.8 Test Results

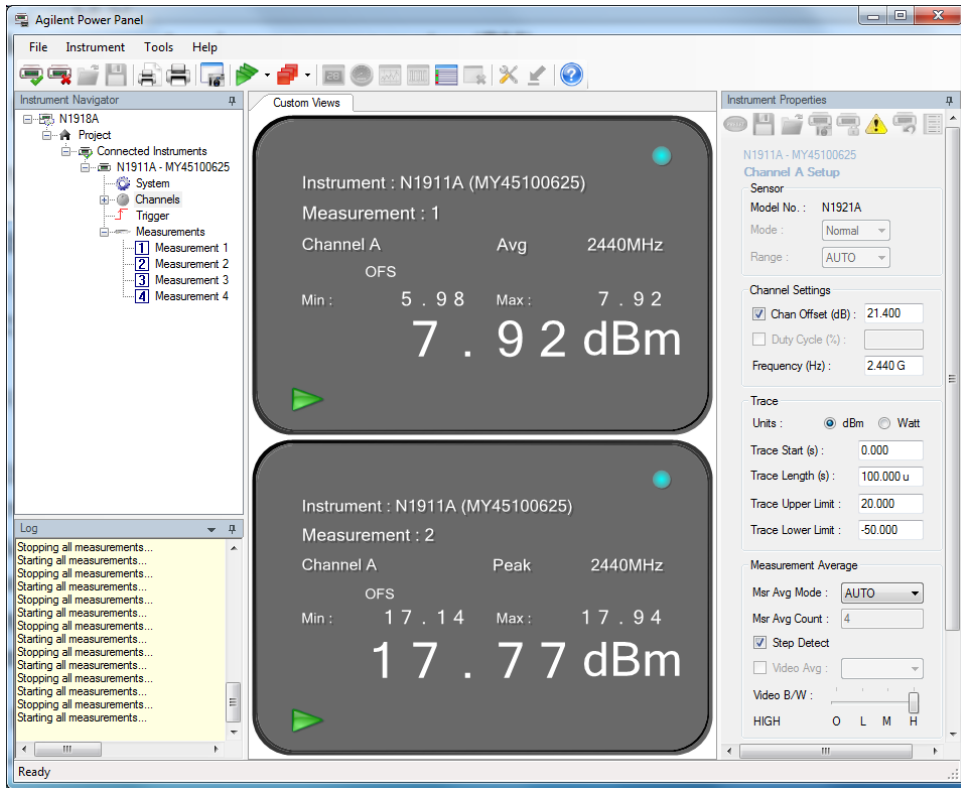
| WLAN Mode | Channel | Data Rates (Mbps) | Measured Average Power (dBm) | Measured Peak Power (dBm) |
|-----------|---------------|-------------------|------------------------------|---------------------------|
| 802.11b | 1 (2412 MHz) | 1 | 11.23 | 13.89 |
| | | 2 | 11.51 | 14.14 |
| | | 5.5 | 11.58 | 13.66 |
| | | 11 | 11.70 | 14.33 |
| | 6 (2437 MHz) | 1 | 11.10 | 13.79 |
| | | 2 | 11.15 | 13.86 |
| | | 5.5 | 11.09 | 13.17 |
| | | 11 | 11.34 | 13.64 |
| | 11 (2462 MHz) | 1 | 11.22 | 14.24 |
| | | 2 | 10.97 | 13.74 |
| | | 5.5 | 11.08 | 13.33 |
| | | 11 | 11.11 | 13.94 |
| 802.11g | 1 (2412 MHz) | 6 | 7.62 | 17.49 |
| | | 9 | 7.74 | 17.38 |
| | | 12 | 7.93 | 17.65 |
| | | 18 | 7.99 | 17.14 |
| | | 24 | 7.92 | 17.94 |
| | | 36 | 7.87 | 17.84 |
| | | 48 | 8.02 | 17.36 |
| | | 54 | 7.96 | 17.70 |
| | 6 (2437 MHz) | 6 | 7.32 | 17.58 |
| | | 9 | 7.36 | 17.11 |
| | | 12 | 7.43 | 17.30 |
| | | 18 | 7.49 | 16.72 |
| | | 24 | 7.24 | 17.53 |
| | | 36 | 7.25 | 17.38 |
| 48 | 7.25 | 16.85 | | |

| WLAN Mode | Channel | Data Rates (Mbps) | Measured Average Power (dBm) | Measured Peak Power (dBm) |
|-----------|---------------|-------------------|------------------------------|---------------------------|
| 802.11g | 6 (2437 MHz) | 54 | 7.19 | 17.09 |
| | 11 (2462 MHz) | 6 | 7.44 | 17.57 |
| | | 9 | 7.49 | 17.27 |
| | | 12 | 7.50 | 17.27 |
| | | 18 | 7.50 | 16.73 |
| | | 24 | 7.46 | 17.54 |
| | | 36 | 7.41 | 17.34 |
| | | 48 | 7.44 | 17.45 |
| | | 54 | 7.41 | 17.11 |

2.1.9 Sample Test Plots



802.11 "b" mode. Low Channel 11Mbps



802.11 "g" mode. Low Channel 24Mbps



2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.2.2 Standard Applicable

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

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

**Decreases with the logarithm of the frequency.*

2.2.3 Equipment Under Test and Modification State

Not performed. EUT is not designed to be connected to the public utility (AC) power line. The EUT only employ battery power for operation (automotive application only). EUT does not include or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines



2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.6

2.3.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

2.3.3 Equipment Under Test and Modification State

Serial No: SN022 / Test Configuration A

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

March 01, 2015/FSC

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility



Ambient Temperature 20.4 °C
 Relative Humidity 52.0 %
 ATM Pressure 100.1 kPa

2.3.7 Additional Observations

- This is a conducted test.
- A correction factor of 21.4dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.3.8 Test Results (For reporting purposes only)

| Mode | Channel | Measured 99% Bandwidth (MHz) |
|---------|---------------|------------------------------|
| 802.11b | 1 (2412 MHz) | 13.632 |
| | 6 (2437 MHz) | 13.589 |
| | 11 (2462 MHz) | 13.632 |
| 802.11g | 1 (2412 MHz) | 16.714 |
| | 6 (2437 MHz) | 16.801 |
| | 11 (2462 MHz) | 16.801 |

2.3.9 Test Results Plots



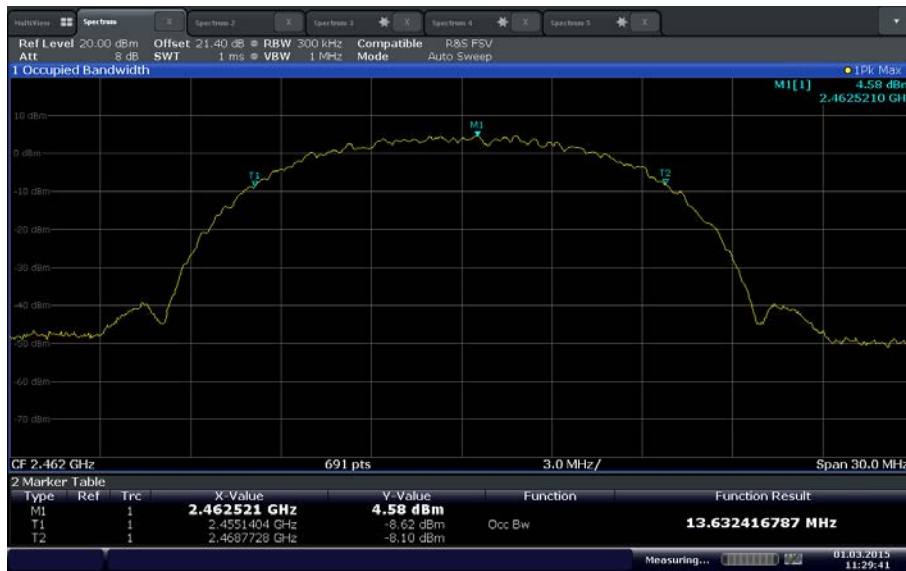
Date: 1 MAR 2015 10:01:55

802.11b Low Channel



Date: 1.MAR.2015 11:24:47

802.11b Mid Channel



Date: 1.MAR.2015 11:29:41

802.11b High Channel



Date: 1.MAR.2015 11:48:21

802.11g Low Channel



Date: 1.MAR.2015 12:04:19

802.11g Mid Channel



Date: 1 MAR 2015 12:08:54

802.11g High Channel



2.4 MINIMUM 6 dB RF BANDWIDTH

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.4.2 Standard Applicable

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

2.4.3 Equipment Under Test and Modification State

Serial No: SN022 / Test Configuration A

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

March 01, 2015/FSC

2.4.5 Test Equipment Used

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

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

| | |
|---------------------|-----------|
| Ambient Temperature | 20.4 °C |
| Relative Humidity | 52.0 % |
| ATM Pressure | 100.1 kPa |

2.4.7 Additional Observations

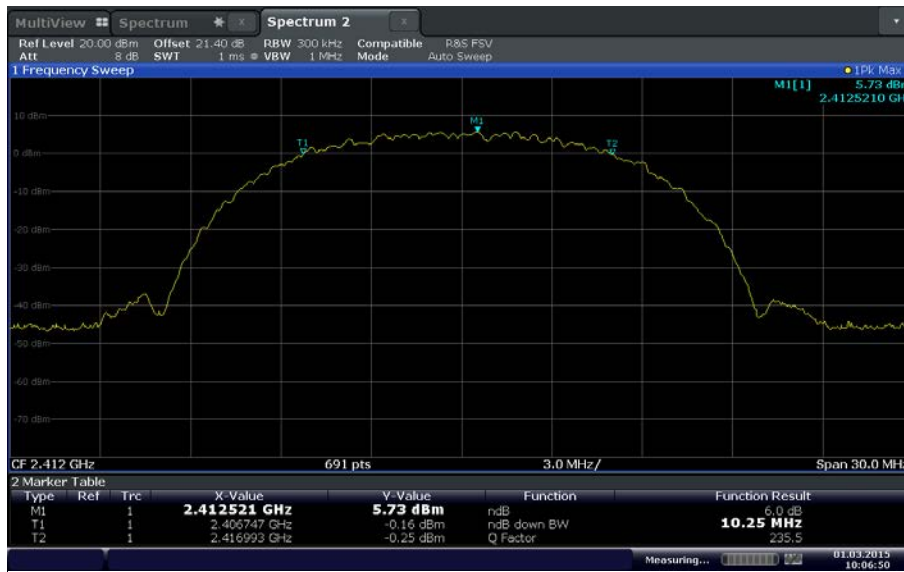
- This is a conducted test.
- A correction factor of 21.4dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is set to 100 kHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.
- For signal modulation where “n” dB down marker function is not practical (if applicable, i.e. 802.11g or 802.11n due to the center frequency notch), a peak measurement is performed while the trace is in max hold.
- A horizontal line is drawn 6dB below the peak measurement.
- 6dB bandwidth is where the lower and upper edge of the signal intersects the drawn line using delta marker type measurement.



2.4.8 Test Results

| Mode | Channel | Measured Bandwidth (MHz) | Minimum Bandwidth (MHz) | Compliance |
|---------|---------------|--------------------------|-------------------------|------------|
| 802.11b | 1 (2412 MHz) | 10.25 | 0.500 | Complies |
| | 6 (2437 MHz) | 10.29 | 0.500 | Complies |
| | 11 (2462 MHz) | 10.29 | 0.500 | Complies |
| 802.11g | 1 (2412 MHz) | 16.63 | 0.500 | Complies |
| | 6 (2437 MHz) | 16.63 | 0.500 | Complies |
| | 11 (2462 MHz) | 16.63 | 0.500 | Complies |

2.4.9 Test Results Plots



Date: 1 MAR 2015 10:06:50

802.11b Low Channel



Date: 1.MAR.2015 11:23:22

802.11b Mid Channel



Date: 1.MAR.2015 11:30:44

802.11b High Channel



Date: 1 MAR 2015 11:49:38

802.11g Low Channel



Date: 1 MAR 2015 12:03:12

802.11g Mid Channel



Date: 1 MAR 2015 12:10:20

802.11g High Channel



2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

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: SN022 / Test Configuration A

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

March 01, 2015/FSC

2.5.5 Test Equipment Used

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

2.5.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

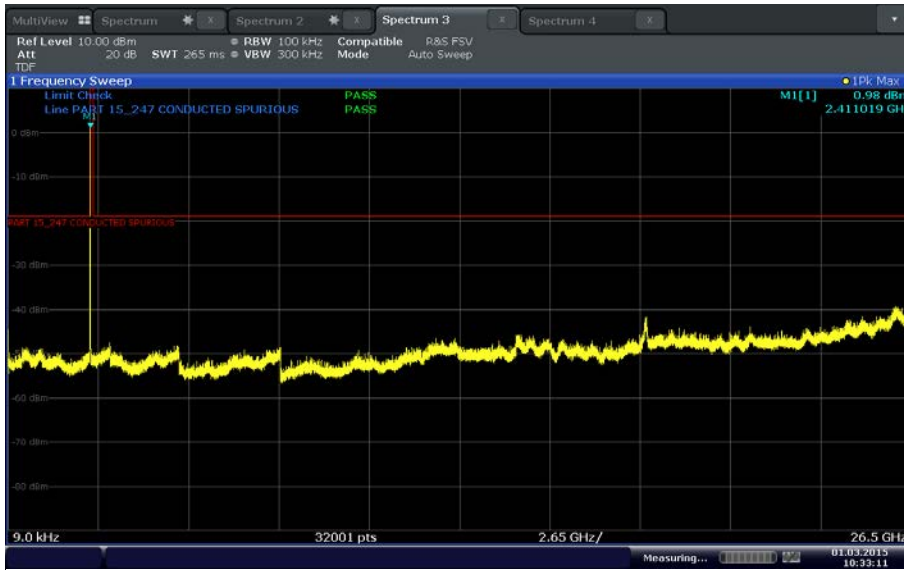
| | |
|---------------------|-----------|
| Ambient Temperature | 20.4 °C |
| Relative Humidity | 52.0 % |
| ATM Pressure | 100.1 kPa |

2.5.7 Additional Observations

- This is a conducted test.
- A transducer factor (TDF) was added to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 20dB below this level.
- Spectrum was searched from 9 kHz up to 26.5GHz.
- Sweep points set to maximum.

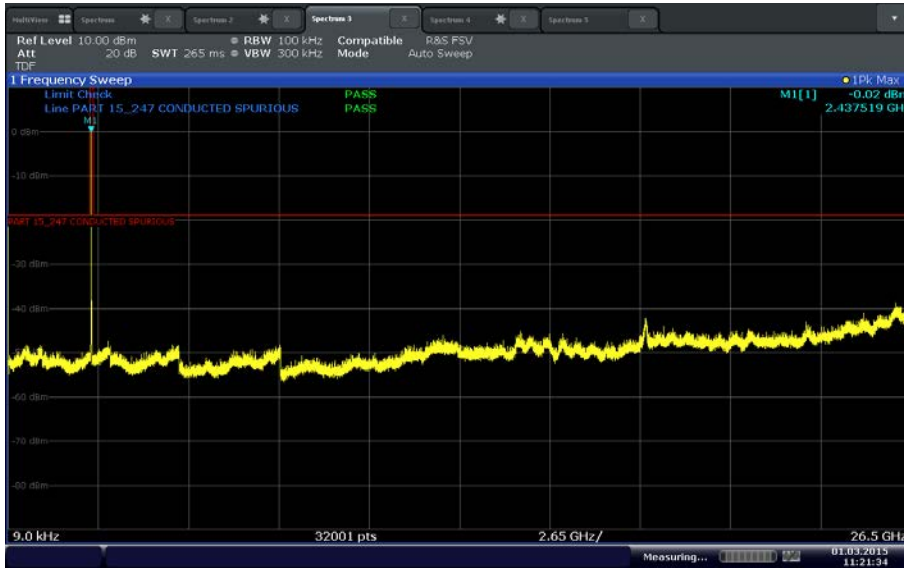


2.5.8 Test Results Plots



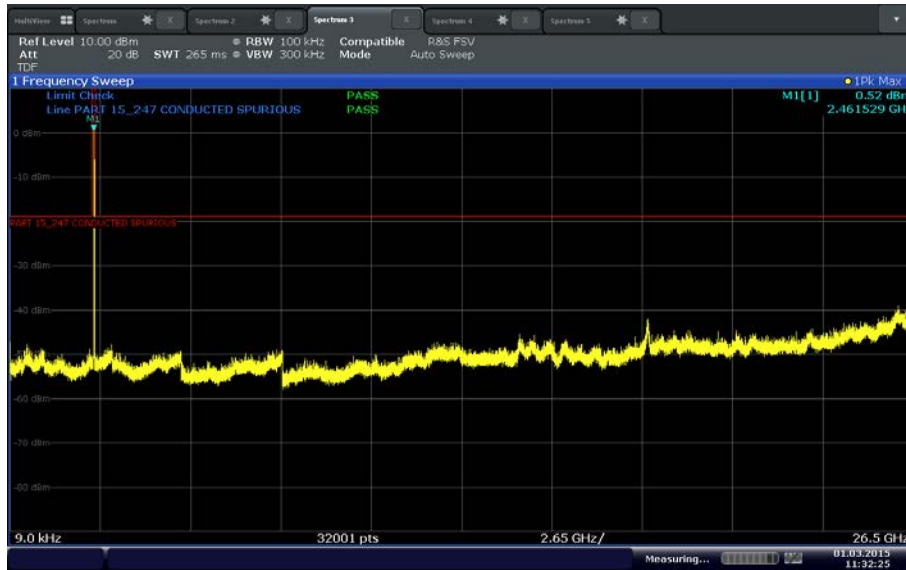
Date: 1 MAR 2015 10:33:11

802.11b Low Channel



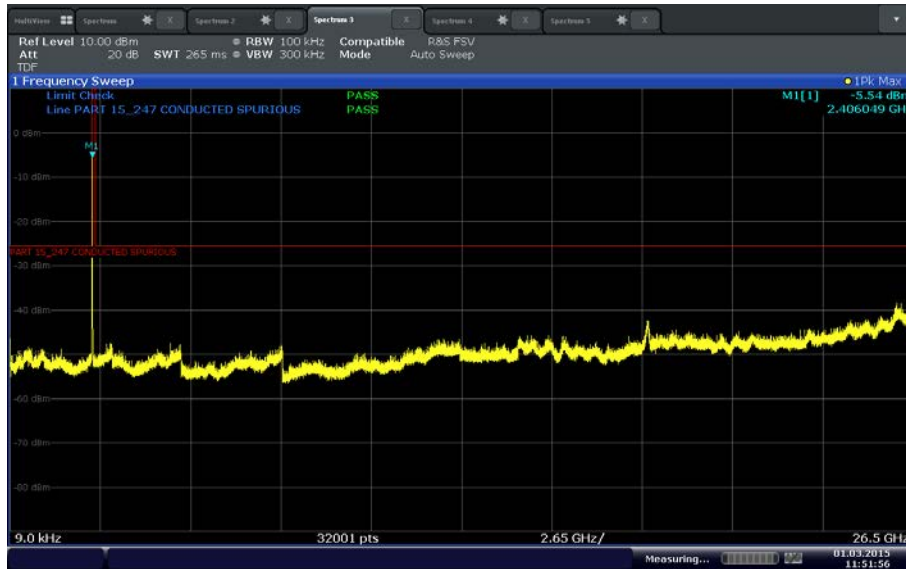
Date: 1 MAR 2015 11:21:34

802.11b Mid Channel



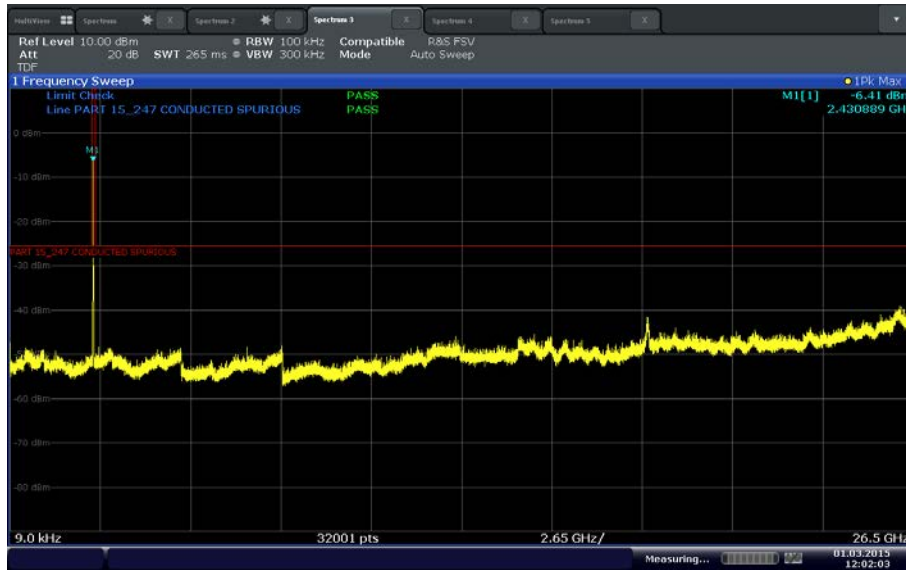
Date: 1 MAR 2015 11:32:25

802.11b High Channel



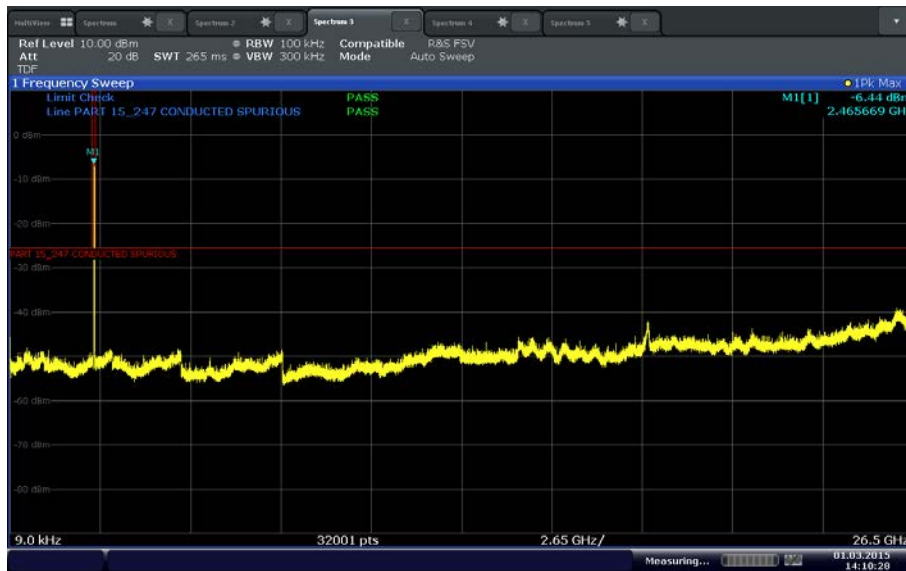
Date: 1 MAR 2015 11:51:56

802.11g Low Channel



Date: 1.MAR.2015 12:02:04

802.11g Mid Channel



Date: 1.MAR.2015 14:10:28

802.11g High Channel



2.6 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.6.2 Standard Applicable

See previous test.

2.6.3 Equipment Under Test and Modification State

Serial No: SN022 / Test Configuration A

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

March 01, 2015/FSC

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

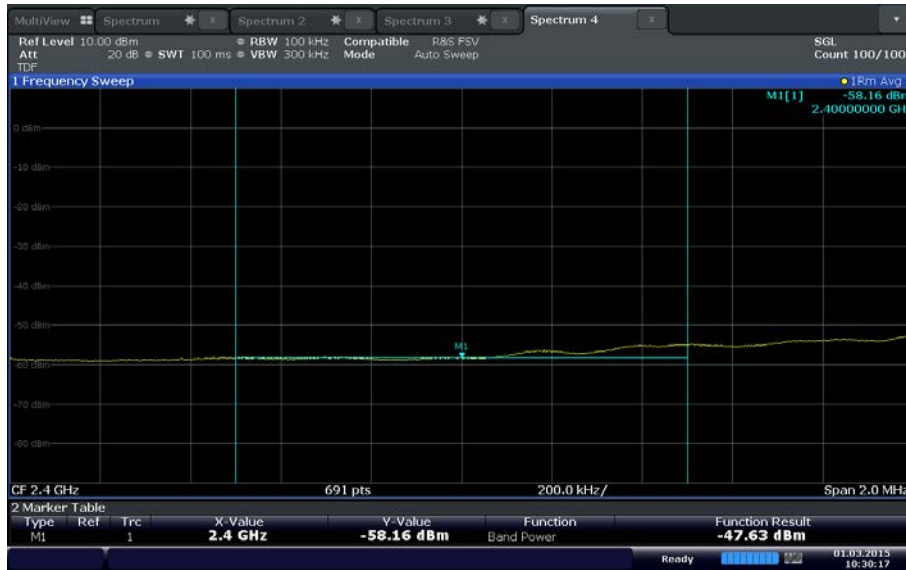
| | |
|---------------------|-----------|
| Ambient Temperature | 20.4 °C |
| Relative Humidity | 52.0 % |
| ATM Pressure | 100.1 kPa |

2.6.7 Additional Observations

- Setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
- 2.4GHZ band-edges (2400MHz and 2483.5MHz) were verified in this test.
- Test methodology is per Clause 13.3.1 of KDB 558074 (D01 DTS Meas Guidance v03r02, June 05, 2015); trace averaging with continuous EUT transmission at full power.
- Limits are from Section 2.9 of this test report. These are maximum PSD level used to establish the reference level (Clause 11.2 of KDB 558074).

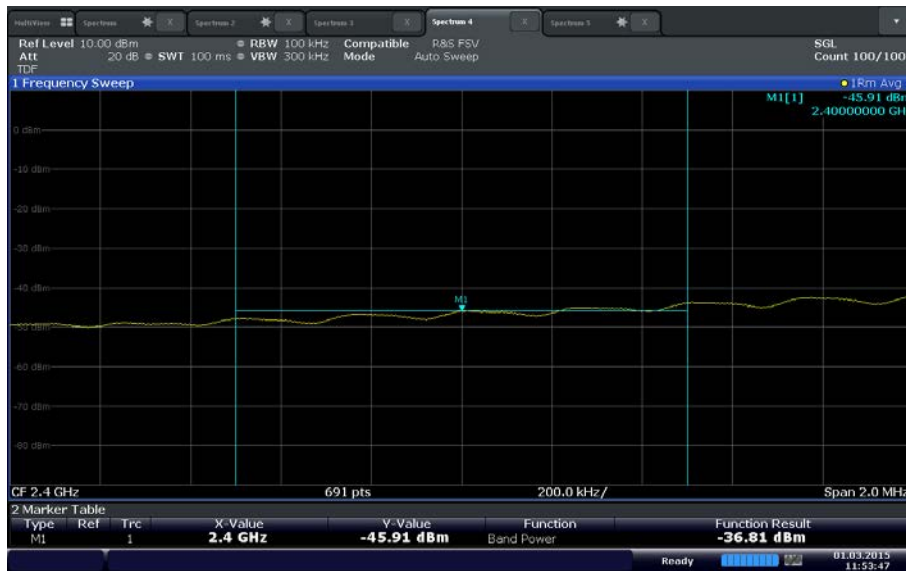
2.6.8 Test Results

Complies. See attached plots.



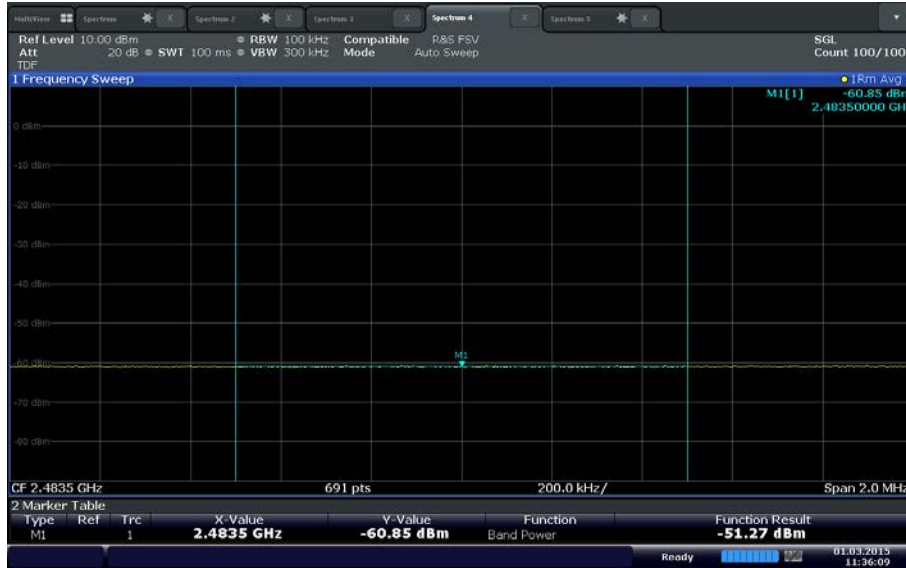
Date: 1.MAR.2015 10:30:18

802.11b Low Channel (2412 MHz). Limit is -17.96 dBm (from PSD of 2.04 dBm). Margin is -29.67 dB.



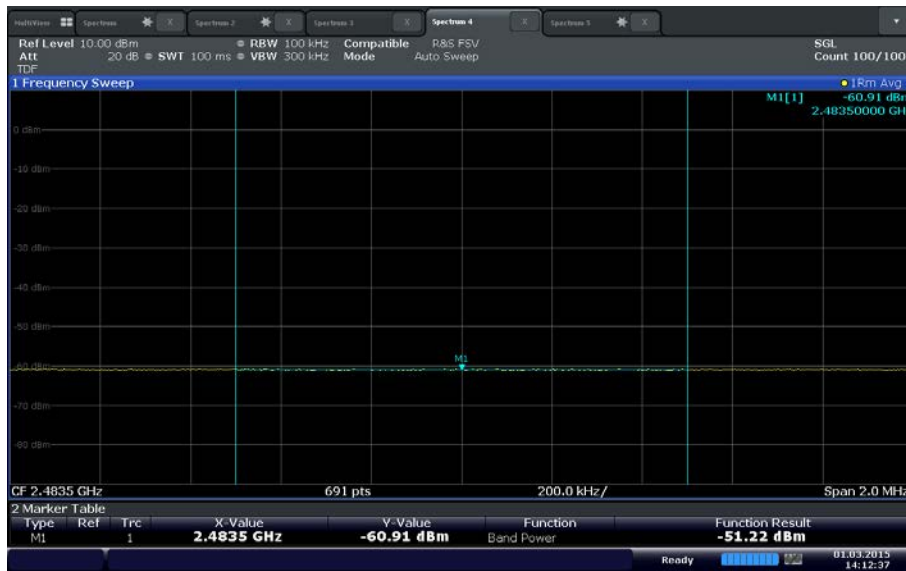
Date: 1.MAR.2015 11:53:46

802.11g Low Channel (2412 MHz). Limit is -25.51 dBm (from PSD of -5.51dBm). Margin is -11.30 dB.



Date: 1.MAR.2015 11:36:09

802.11b High Channel (2462 MHz). Limit is -18.6 dBm (from PSD of 1.40 dBm). Margin is -32.67 dB.



Date: 1.MAR.2015 14:12:37

802.11g High Channel (2462 MHz). Limit is -26.09 dBm (from PSD of -6.09dBm). Margin is -25.13 dB.



2.7 SPURIOUS RADIATED EMISSIONS

2.7.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.7.2 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)).

2.7.3 Equipment Under Test and Modification State

Serial No: SN023 / Test Configuration B

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

March 01 and 02, 2015/FSC

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 | 20.4 – 20.6 °C |
| Relative Humidity | 49.6 - 52.0 % |
| ATM Pressure | 100 - 100.1 kPa |

2.7.7 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.

2.7.8 Sample Computation (Radiated Emission)

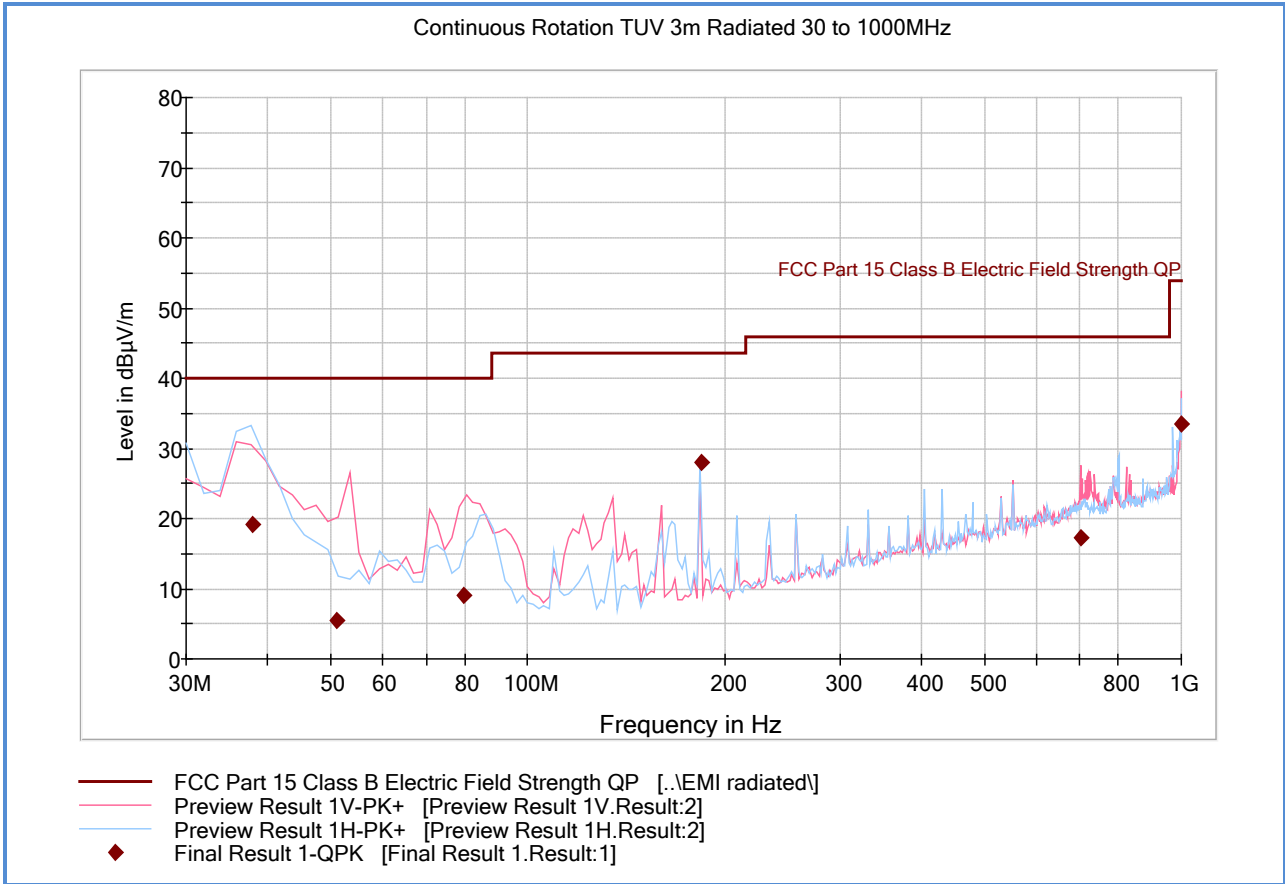
| | | |
|---|----------------------------|-------------|
| Measuring equipment raw measurement (db μ V) @ 30 MHz | | 24.4 |
| Correction Factor (dB) | Asset# 1066 (cable) | 0.3 |
| | Asset# 1172 (cable) | 0.3 |
| | Asset# 1016 (preamplifier) | -30.7 |
| | Asset# 1175(cable) | 0.3 |
| | Asset# 1002 (antenna)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

2.7.9 Test Results

See attached plots.



2.7.10 Test Results Below 1GHz (Receive Mode)

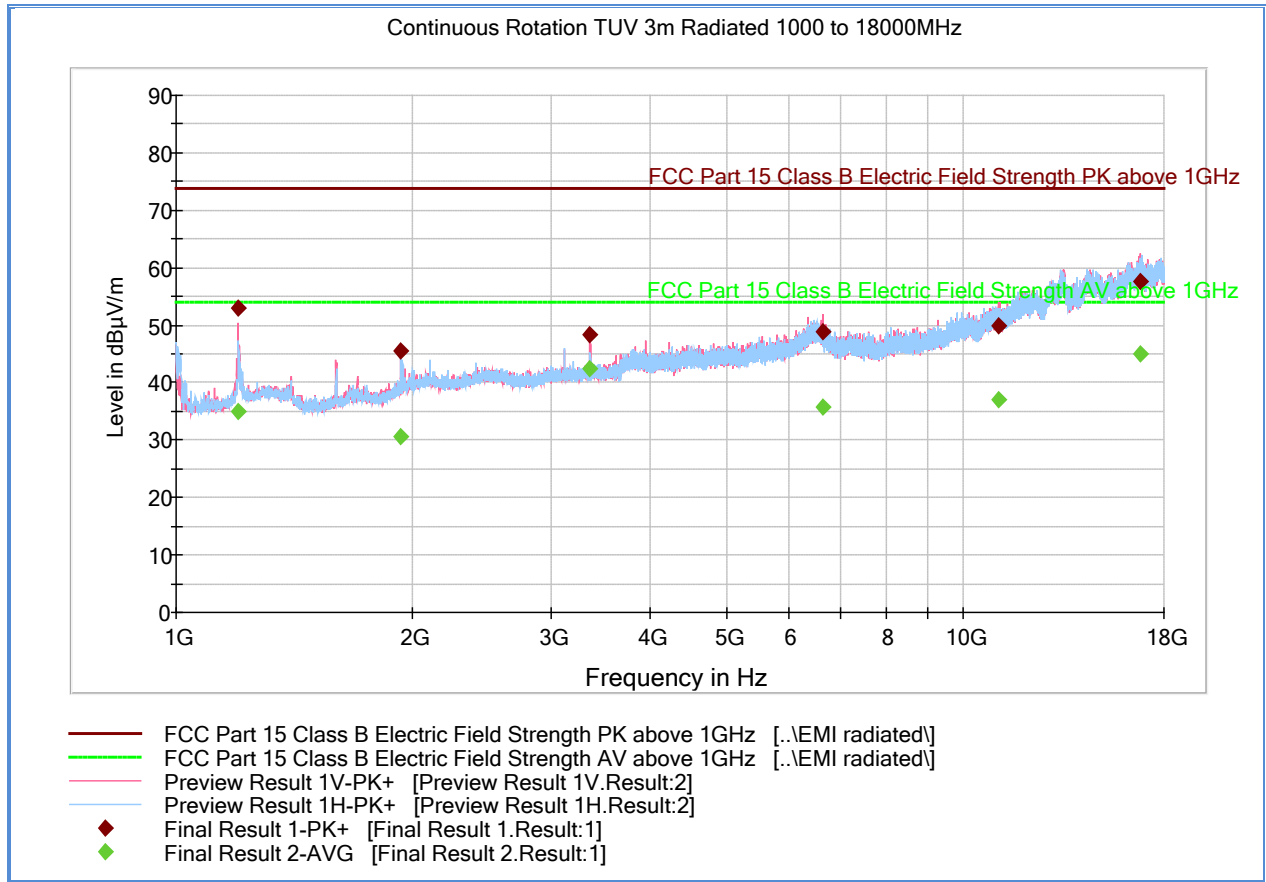


Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 37.815551 | 19.1 | 1000.0 | 120.000 | 400.0 | H | 15.0 | -15.1 | 20.9 | 40.0 |
| 51.006653 | 5.5 | 1000.0 | 120.000 | 150.0 | V | 106.0 | -19.7 | 34.5 | 40.0 |
| 79.981082 | 9.1 | 1000.0 | 120.000 | 100.0 | V | 232.0 | -21.6 | 30.9 | 40.0 |
| 184.287134 | 28.0 | 1000.0 | 120.000 | 177.0 | H | 157.0 | -16.8 | 15.5 | 43.5 |
| 700.321283 | 17.2 | 1000.0 | 120.000 | 122.0 | V | 338.0 | -1.4 | 28.8 | 46.0 |
| 999.560000 | 33.5 | 1000.0 | 120.000 | 212.0 | V | 220.0 | 1.7 | 20.4 | 53.9 |



2.7.11 Test Results Above 1GHz (Receive Mode)



Peak Data

| Frequency (MHz) | MaxPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1200.600000 | 52.9 | 1000.0 | 1000.000 | 206.5 | V | 85.0 | -6.2 | 21.0 | 73.9 |
| 1932.566667 | 45.6 | 1000.0 | 1000.000 | 277.3 | H | 88.0 | -2.0 | 28.3 | 73.9 |
| 3359.600000 | 48.3 | 1000.0 | 1000.000 | 200.5 | V | 188.0 | 1.5 | 25.6 | 73.9 |
| 6631.933333 | 48.8 | 1000.0 | 1000.000 | 155.7 | V | 74.0 | 10.9 | 25.1 | 73.9 |
| 11092.13333 | 50.0 | 1000.0 | 1000.000 | 139.7 | V | 167.0 | 14.5 | 23.9 | 73.9 |
| 16814.90000 | 57.7 | 1000.0 | 1000.000 | 375.1 | V | -20.0 | 23.5 | 16.2 | 73.9 |

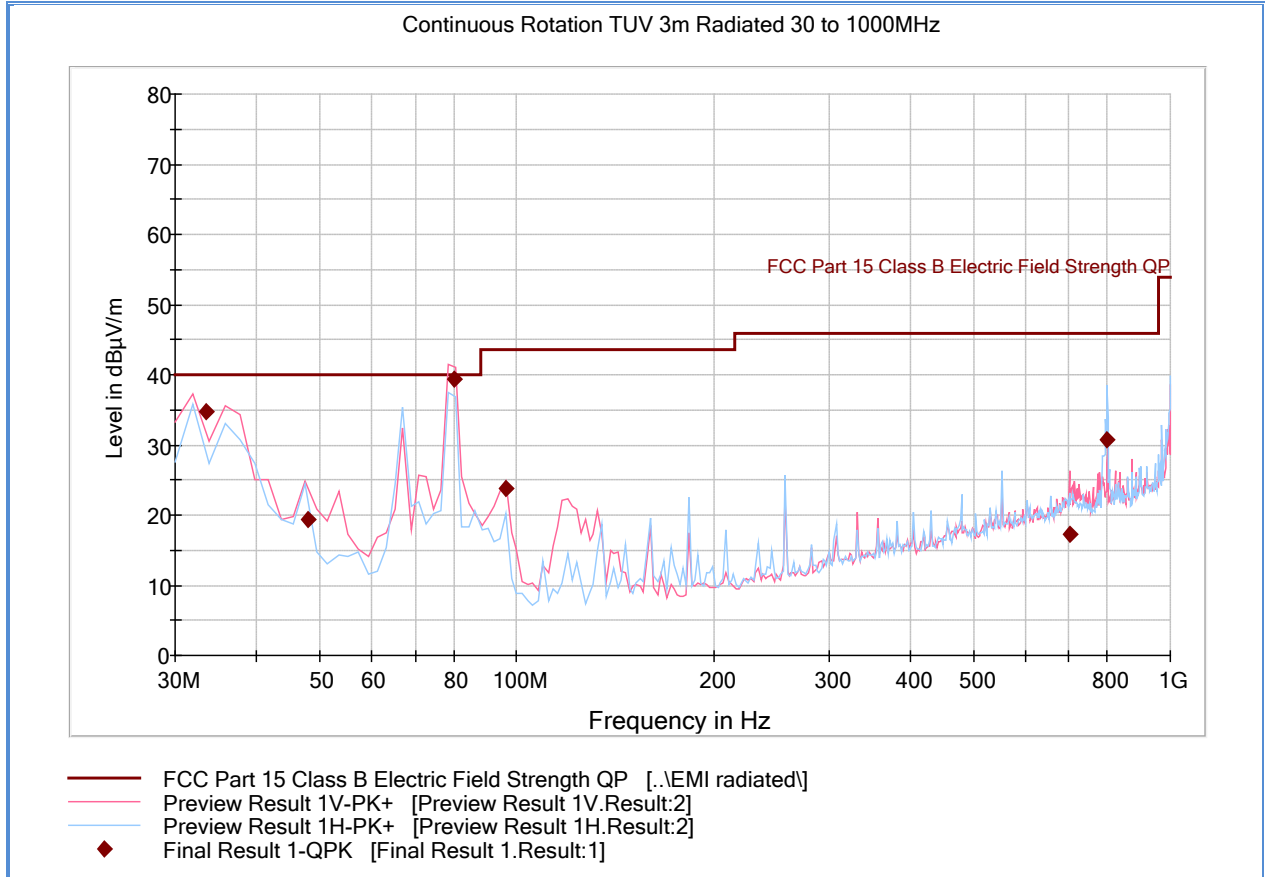
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1200.600000 | 35.1 | 1000.0 | 1000.000 | 206.5 | V | 85.0 | -6.2 | 18.8 | 53.9 |
| 1932.566667 | 30.7 | 1000.0 | 1000.000 | 277.3 | H | 88.0 | -2.0 | 23.2 | 53.9 |
| 3359.600000 | 42.4 | 1000.0 | 1000.000 | 200.5 | V | 188.0 | 1.5 | 11.5 | 53.9 |
| 6631.933333 | 35.7 | 1000.0 | 1000.000 | 155.7 | V | 74.0 | 10.9 | 18.2 | 53.9 |
| 11092.13333 | 36.9 | 1000.0 | 1000.000 | 139.7 | V | 167.0 | 14.5 | 17.0 | 53.9 |
| 16814.90000 | 44.9 | 1000.0 | 1000.000 | 375.1 | V | -20.0 | 23.5 | 9.0 | 53.9 |

Test Notes: No significant emissions observed above 8GHz.



2.7.12 Test Results Below 1GHz (WLAN worst Case Configuration)



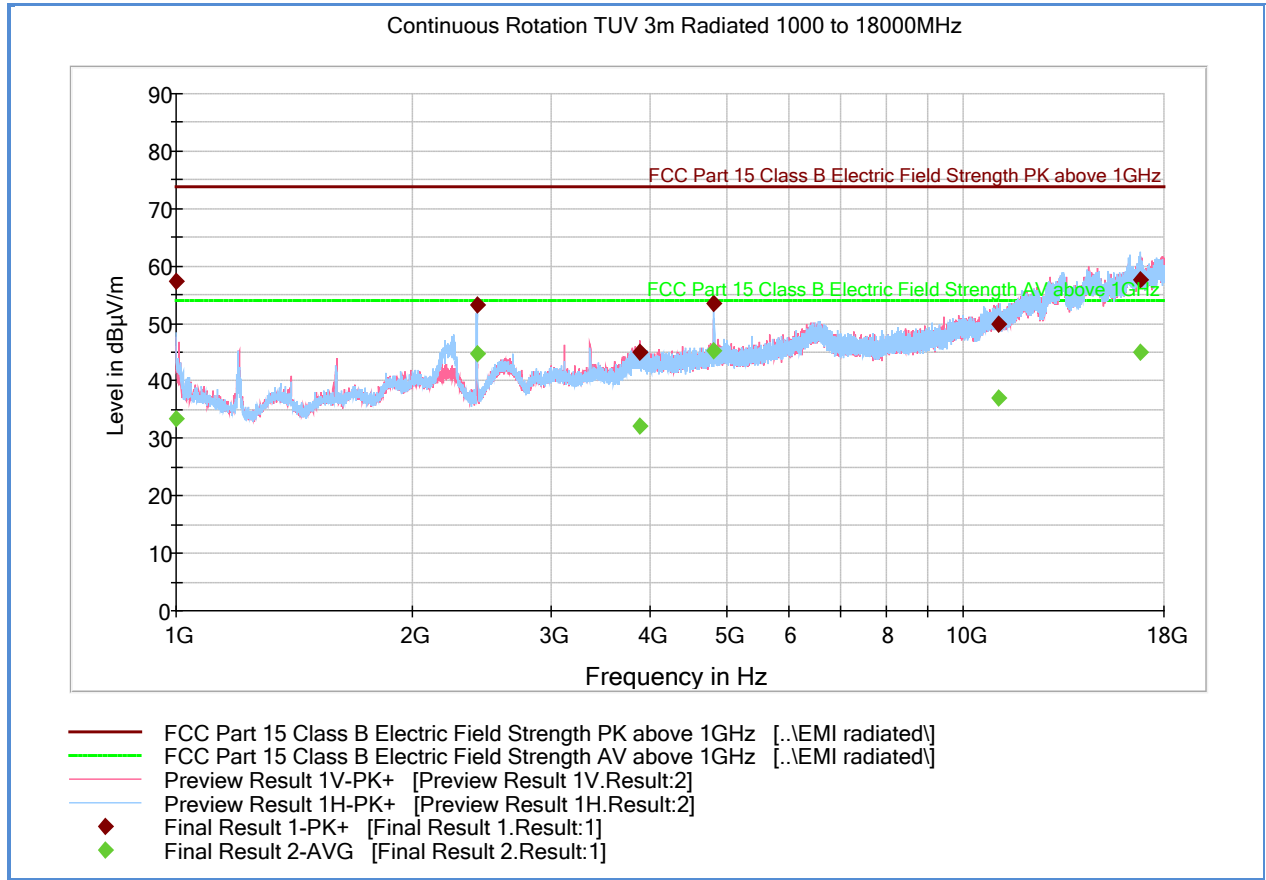
Quasi Peak Data

| Frequency (MHz) | QuasiPeak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|--------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 33.400000 | 34.7 | 1000.0 | 120.000 | 129.0 | V | 321.0 | -12.8 | 5.3 | 40.0 |
| 48.014990 | 19.4 | 1000.0 | 120.000 | 100.0 | V | 244.0 | -19.0 | 20.6 | 40.0 |
| 79.997194 | 39.4 | 1000.0 | 120.000 | 106.0 | V | 202.0 | -21.6 | 0.6 | 40.0 |
| 96.012184 | 23.8 | 1000.0 | 120.000 | 100.0 | V | 299.0 | -19.7 | 19.7 | 43.5 |
| 703.081283 | 17.3 | 1000.0 | 120.000 | 150.0 | V | 302.0 | -1.3 | 28.7 | 46.0 |
| 799.939559 | 30.7 | 1000.0 | 120.000 | 109.0 | H | 8.0 | -1.5 | 15.3 | 46.0 |

Test Notes: Only worst case channel presented for spurious emissions below 1GHz.



2.7.13 Test Results Above 1GHz (802.11b 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000 | 57.2 | 1000.0 | 1000.000 | 229.4 | H | 0.0 | -7.4 | 16.7 | 73.9 |
| 2409.100000 | 53.2 | 1000.0 | 1000.000 | 102.7 | H | -20.0 | -0.5 | 20.7 | 73.9 |
| 3880.933333 | 45.1 | 1000.0 | 1000.000 | 117.7 | V | 218.0 | 4.9 | 28.8 | 73.9 |
| 4829.366667 | 53.6 | 1000.0 | 1000.000 | 291.2 | H | 78.0 | 5.7 | 20.3 | 73.9 |
| 11077.000000 | 49.8 | 1000.0 | 1000.000 | 165.6 | V | 20.0 | 14.6 | 24.1 | 73.9 |
| 16781.866667 | 57.5 | 1000.0 | 1000.000 | 280.2 | H | 3.0 | 23.6 | 16.4 | 73.9 |

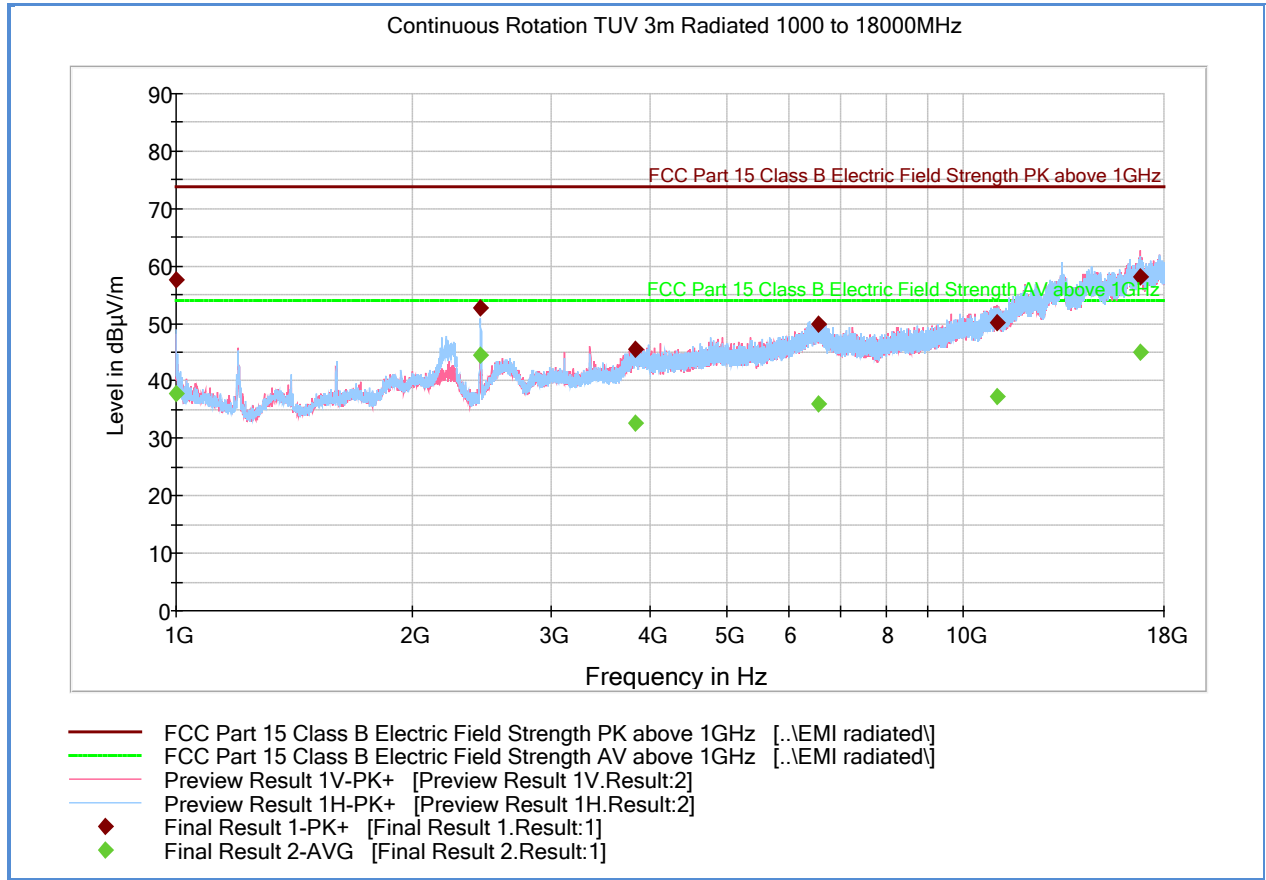
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000 | 33.5 | 1000.0 | 1000.000 | 229.4 | H | 0.0 | -7.4 | 20.4 | 53.9 |
| 2409.100000 | 44.7 | 1000.0 | 1000.000 | 102.7 | H | -20.0 | -0.5 | 9.2 | 53.9 |
| 3880.933333 | 32.2 | 1000.0 | 1000.000 | 117.7 | V | 218.0 | 4.9 | 21.7 | 53.9 |
| 4829.366667 | 45.3 | 1000.0 | 1000.000 | 291.2 | H | 78.0 | 5.7 | 8.6 | 53.9 |
| 11077.000000 | 37.1 | 1000.0 | 1000.000 | 165.6 | V | 20.0 | 14.6 | 16.8 | 53.9 |
| 16781.866667 | 45.0 | 1000.0 | 1000.000 | 280.2 | H | 3.0 | 23.6 | 8.9 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.7.14 Test Results Above 1GHz (802.11b Mid 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.000000 | 57.7 | 1000.0 | 1000.000 | 277.2 | H | -20.0 | -7.4 | 16.2 | 73.9 |
| 2435.566667 | 52.6 | 1000.0 | 1000.000 | 102.7 | H | -3.0 | -0.4 | 21.3 | 73.9 |
| 3829.000000 | 45.6 | 1000.0 | 1000.000 | 203.3 | V | 164.0 | 4.9 | 28.3 | 73.9 |
| 6560.500000 | 49.8 | 1000.0 | 1000.000 | 355.1 | H | 22.0 | 11.3 | 24.1 | 73.9 |
| 11054.933333 | 50.2 | 1000.0 | 1000.000 | 401.1 | V | 212.0 | 14.7 | 23.7 | 73.9 |
| 16795.266667 | 58.2 | 1000.0 | 1000.000 | 238.4 | V | 176.0 | 23.7 | 15.7 | 73.9 |

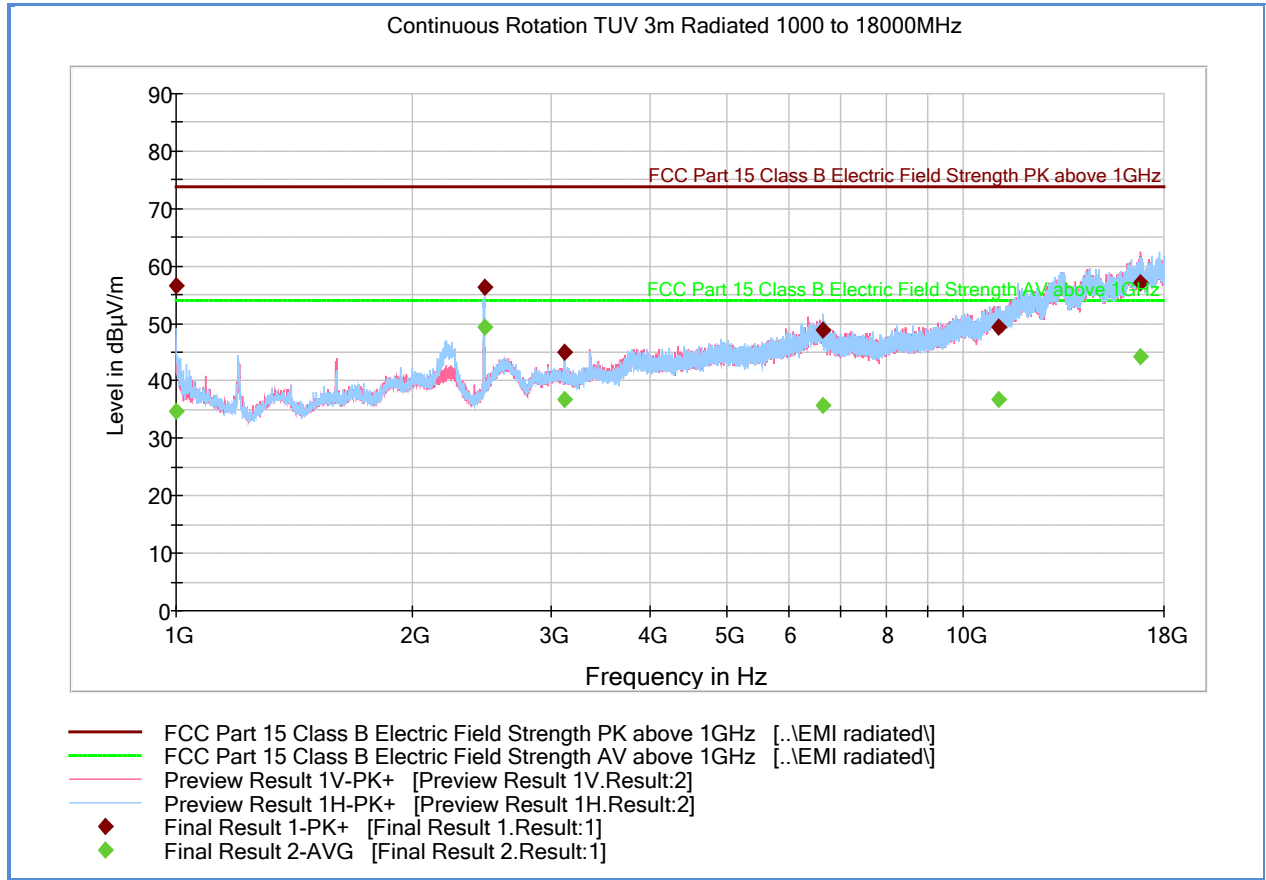
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.000000 | 37.7 | 1000.0 | 1000.000 | 277.2 | H | -20.0 | -7.4 | 16.2 | 53.9 |
| 2435.566667 | 44.4 | 1000.0 | 1000.000 | 102.7 | H | -3.0 | -0.4 | 9.5 | 53.9 |
| 3829.000000 | 32.6 | 1000.0 | 1000.000 | 203.3 | V | 164.0 | 4.9 | 21.3 | 53.9 |
| 6560.500000 | 36.0 | 1000.0 | 1000.000 | 355.1 | H | 22.0 | 11.3 | 17.9 | 53.9 |
| 11054.933333 | 37.4 | 1000.0 | 1000.000 | 401.1 | V | 212.0 | 14.7 | 16.5 | 53.9 |
| 16795.266667 | 45.0 | 1000.0 | 1000.000 | 238.4 | V | 176.0 | 23.7 | 8.9 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.7.15 Test Results Above 1GHz (802.11b 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.800000 | 56.5 | 1000.0 | 1000.000 | 280.2 | H | 16.0 | -7.4 | 17.4 | 73.9 |
| 2461.800000 | 56.4 | 1000.0 | 1000.000 | 99.7 | H | 299.0 | -0.2 | 17.5 | 73.9 |
| 3118.400000 | 45.0 | 1000.0 | 1000.000 | 115.7 | V | 202.0 | 1.0 | 28.9 | 73.9 |
| 6623.566667 | 48.9 | 1000.0 | 1000.000 | 103.7 | H | 41.0 | 11.0 | 25.0 | 73.9 |
| 11114.433333 | 49.4 | 1000.0 | 1000.000 | 100.7 | V | 109.0 | 14.4 | 24.5 | 73.9 |
| 16834.000000 | 57.2 | 1000.0 | 1000.000 | 164.6 | V | 264.0 | 23.3 | 16.7 | 73.9 |

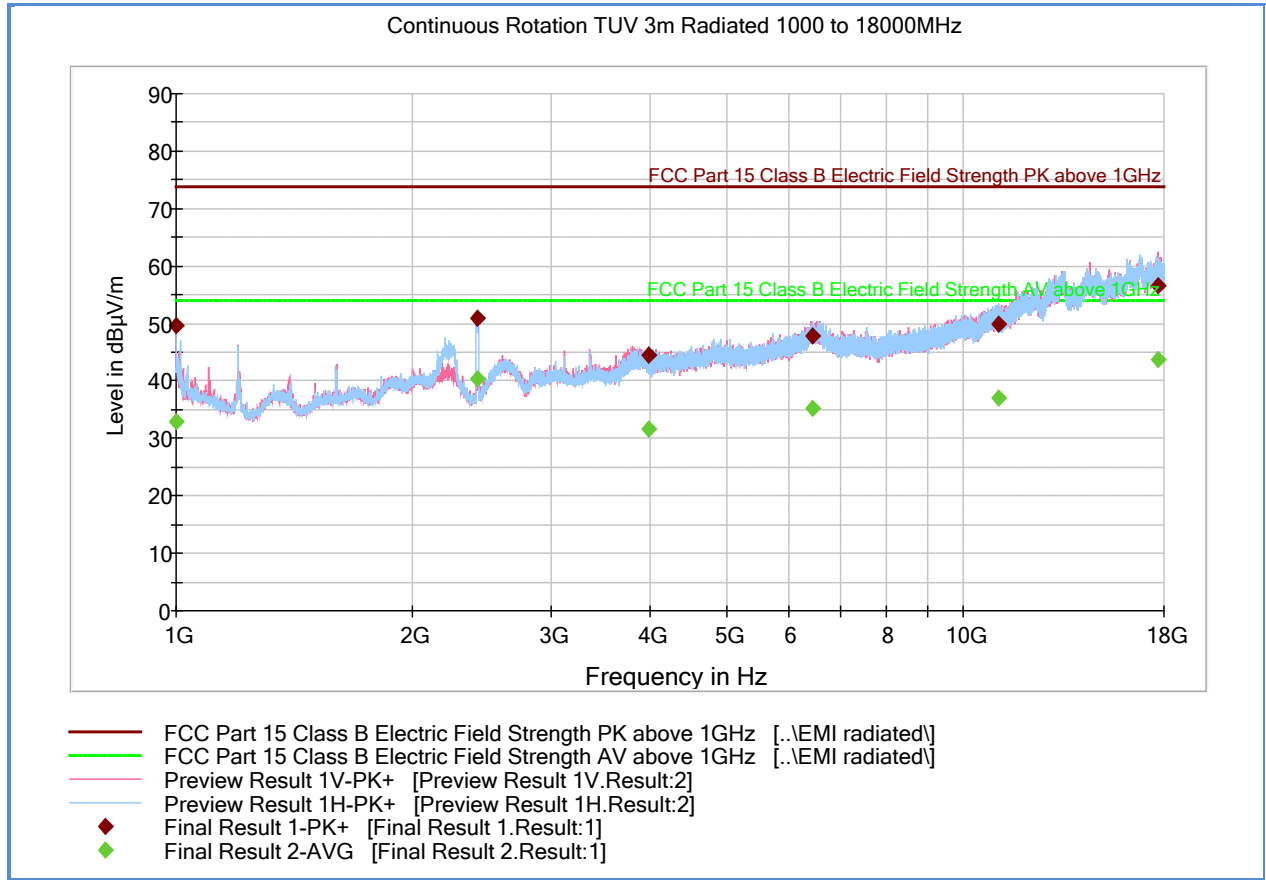
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.800000 | 34.8 | 1000.0 | 1000.000 | 280.2 | H | 16.0 | -7.4 | 19.1 | 53.9 |
| 2461.800000 | 49.4 | 1000.0 | 1000.000 | 99.7 | H | 299.0 | -0.2 | 4.5 | 53.9 |
| 3118.400000 | 36.7 | 1000.0 | 1000.000 | 115.7 | V | 202.0 | 1.0 | 17.2 | 53.9 |
| 6623.566667 | 35.7 | 1000.0 | 1000.000 | 103.7 | H | 41.0 | 11.0 | 18.2 | 53.9 |
| 11114.433333 | 36.8 | 1000.0 | 1000.000 | 100.7 | V | 109.0 | 14.4 | 17.1 | 53.9 |
| 16834.000000 | 44.3 | 1000.0 | 1000.000 | 164.6 | V | 264.0 | 23.3 | 9.6 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.7.16 Test Results Above 1GHz (802.11g 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.500000 | 49.5 | 1000.0 | 1000.000 | 279.3 | H | 148.0 | -7.4 | 24.4 | 73.9 |
| 2417.433333 | 50.8 | 1000.0 | 1000.000 | 103.7 | H | 344.0 | -0.5 | 23.1 | 73.9 |
| 3976.500000 | 44.5 | 1000.0 | 1000.000 | 322.2 | V | 146.0 | 4.8 | 29.4 | 73.9 |
| 6435.600000 | 47.9 | 1000.0 | 1000.000 | 337.1 | H | 79.0 | 11.1 | 26.0 | 73.9 |
| 11082.333333 | 49.9 | 1000.0 | 1000.000 | 239.4 | H | 162.0 | 14.6 | 24.0 | 73.9 |
| 17728.033333 | 56.6 | 1000.0 | 1000.000 | 345.1 | V | 5.0 | 23.1 | 17.3 | 73.9 |

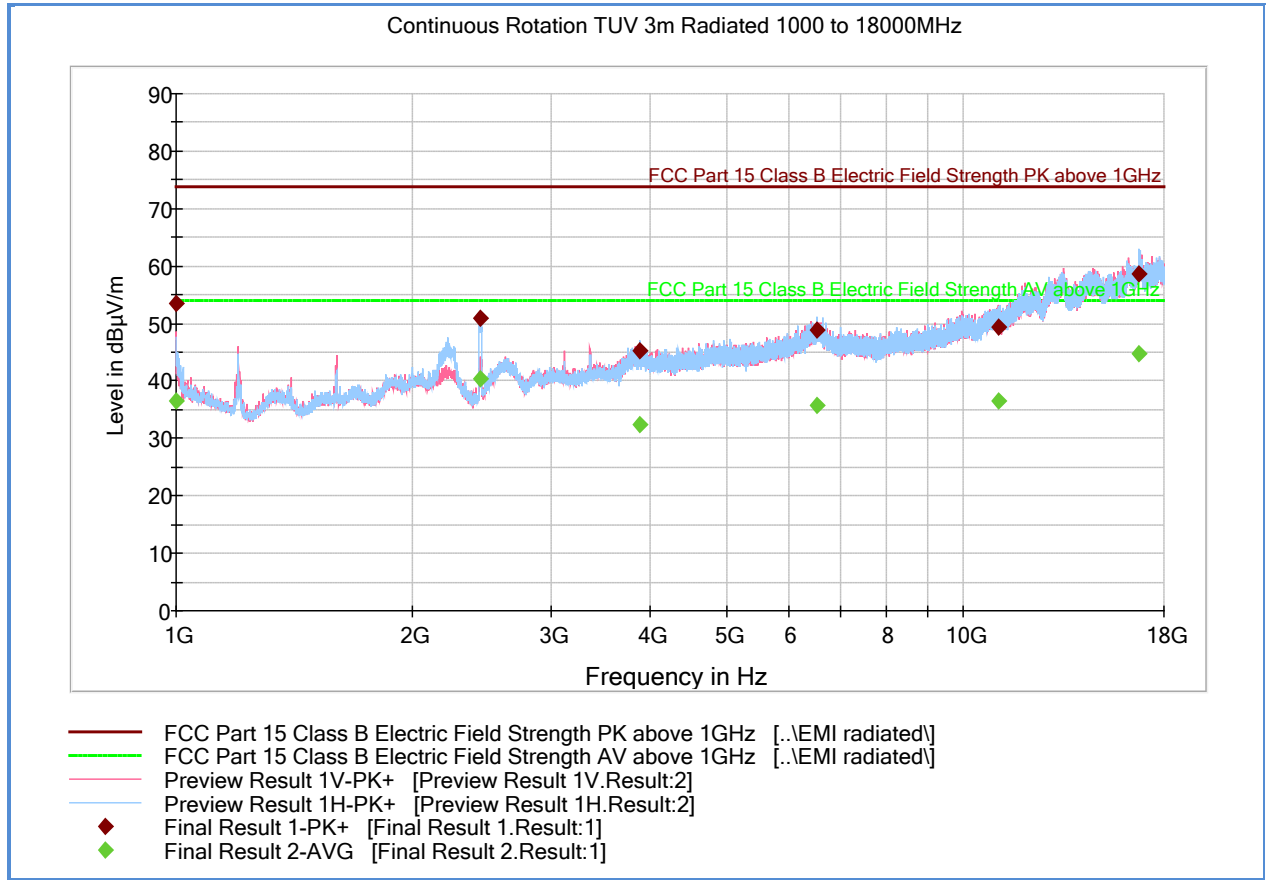
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.500000 | 32.9 | 1000.0 | 1000.000 | 279.3 | H | 148.0 | -7.4 | 21.0 | 53.9 |
| 2417.433333 | 40.4 | 1000.0 | 1000.000 | 103.7 | H | 344.0 | -0.5 | 13.5 | 53.9 |
| 3976.500000 | 31.7 | 1000.0 | 1000.000 | 322.2 | V | 146.0 | 4.8 | 22.2 | 53.9 |
| 6435.600000 | 35.2 | 1000.0 | 1000.000 | 337.1 | H | 79.0 | 11.1 | 18.7 | 53.9 |
| 11082.333333 | 37.1 | 1000.0 | 1000.000 | 239.4 | H | 162.0 | 14.6 | 16.8 | 53.9 |
| 17728.033333 | 43.8 | 1000.0 | 1000.000 | 345.1 | V | 5.0 | 23.1 | 10.1 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.7.17 Test Results Above 1GHz (802.11g Mid 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000 | 53.6 | 1000.0 | 1000.000 | 192.5 | V | 32.0 | -7.4 | 20.3 | 73.9 |
| 3880.900000 | 45.2 | 1000.0 | 1000.000 | 407.8 | H | 101.0 | 4.9 | 28.7 | 73.9 |
| 6519.166667 | 48.9 | 1000.0 | 1000.000 | 407.8 | H | 74.0 | 11.2 | 25.0 | 73.9 |
| 11105.733333 | 49.3 | 1000.0 | 1000.000 | 345.2 | V | 291.0 | 14.5 | 24.6 | 73.9 |
| 16757.700000 | 58.6 | 1000.0 | 1000.000 | 250.4 | H | 183.0 | 23.4 | 15.3 | 73.9 |
| 2437.433333 | 50.8 | 1000.0 | 1000.000 | 103.7 | H | 344.0 | -0.5 | 23.1 | 73.9 |

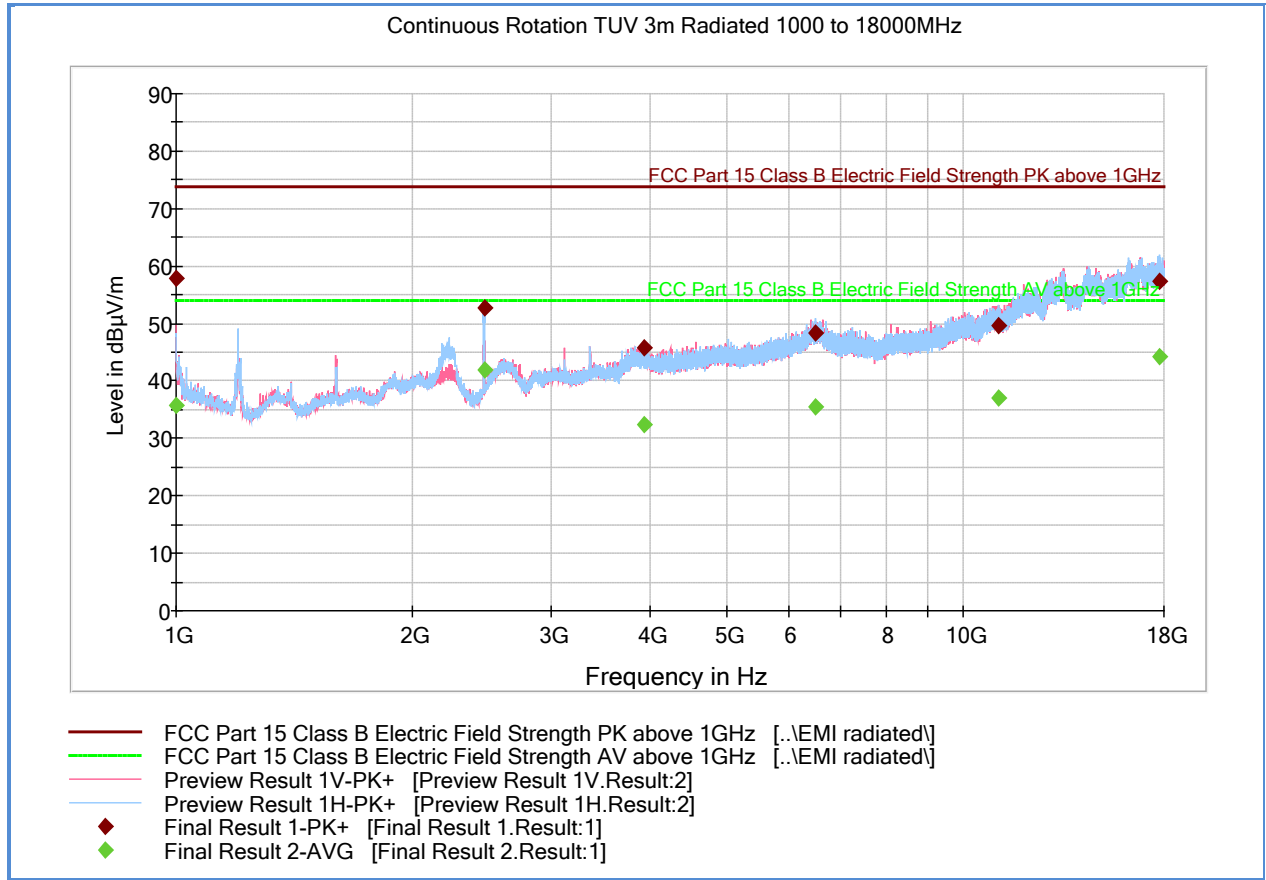
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.400000 | 36.6 | 1000.0 | 1000.000 | 192.5 | V | 32.0 | -7.4 | 17.3 | 53.9 |
| 3880.900000 | 32.4 | 1000.0 | 1000.000 | 407.8 | H | 101.0 | 4.9 | 21.5 | 53.9 |
| 6519.166667 | 35.8 | 1000.0 | 1000.000 | 407.8 | H | 74.0 | 11.2 | 18.1 | 53.9 |
| 11105.733333 | 36.5 | 1000.0 | 1000.000 | 345.2 | V | 291.0 | 14.5 | 17.4 | 53.9 |
| 16757.700000 | 44.8 | 1000.0 | 1000.000 | 250.4 | H | 183.0 | 23.4 | 9.1 | 53.9 |
| 2437.433333 | 40.4 | 1000.0 | 1000.000 | 103.7 | H | 344.0 | -0.5 | 13.5 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.7.18 Test Results Above 1GHz (802.11g 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.900000 | 57.9 | 1000.0 | 1000.000 | 165.6 | V | -3.0 | -7.4 | 16.0 | 73.9 |
| 2465.600000 | 52.7 | 1000.0 | 1000.000 | 103.7 | H | 305.0 | -0.2 | 21.2 | 73.9 |
| 3928.566667 | 45.8 | 1000.0 | 1000.000 | 406.7 | V | 326.0 | 4.9 | 28.1 | 73.9 |
| 6490.000000 | 48.2 | 1000.0 | 1000.000 | 250.3 | H | 313.0 | 11.1 | 25.7 | 73.9 |
| 11072.366667 | 49.6 | 1000.0 | 1000.000 | 124.7 | H | 75.0 | 14.6 | 24.3 | 73.9 |
| 17798.700000 | 57.4 | 1000.0 | 1000.000 | 407.8 | H | 148.0 | 23.3 | 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 1000.900000 | 35.9 | 1000.0 | 1000.000 | 165.6 | V | -3.0 | -7.4 | 18.0 | 53.9 |
| 2465.600000 | 41.8 | 1000.0 | 1000.000 | 103.7 | H | 305.0 | -0.2 | 12.1 | 53.9 |
| 3928.566667 | 32.4 | 1000.0 | 1000.000 | 406.7 | V | 326.0 | 4.9 | 21.5 | 53.9 |
| 6490.000000 | 35.5 | 1000.0 | 1000.000 | 250.3 | H | 313.0 | 11.1 | 18.4 | 53.9 |
| 11072.366667 | 36.9 | 1000.0 | 1000.000 | 124.7 | H | 75.0 | 14.6 | 17.0 | 53.9 |
| 17798.700000 | 44.3 | 1000.0 | 1000.000 | 407.8 | H | 148.0 | 23.3 | 9.6 | 53.9 |

Test Notes: Measurement was performed with a 2.4GHz notch filter. Measurement within the filter range is ignored. No significant emissions observed above 10GHz. Measurements above 10GHz are noise floor figures.



2.8 RADIATED BAND EDGE MEASUREMENTS AND IMMEDIATE RESTRICTED BANDS

2.8.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.8.2 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)).

2.8.3 Equipment Under Test and Modification State

Serial No: SN023 / Test Configuration B

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

March 01 and 02, 2015/FSC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

| | |
|---------------------|---------|
| Ambient Temperature | 20.6 °C |
| Relative Humidity | 49.4 % |
| ATM Pressure | 100 kPa |

2.8.7 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.
- Only worst-case WiFi mode presented (See Section 1.4.4 of this test report for details).



- 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.

2.8.8 Sample Computation (Radiated Emission)

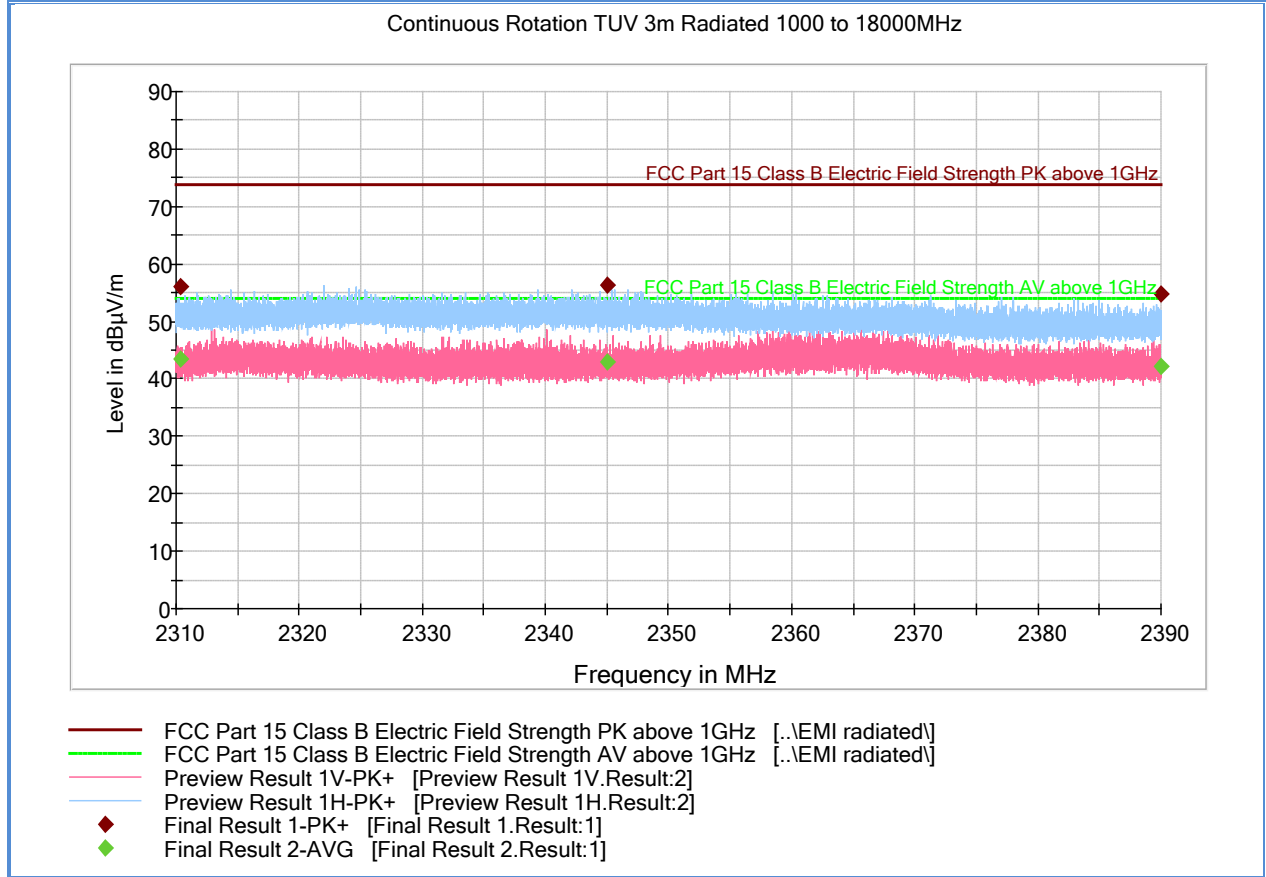
| | | |
|---|---------------------------|-------------|
| Measuring equipment raw measurement (db μ V) @ 2400 MHz | | 53.9 |
| Correction Factor (dB) | Asset# 1153 (cable) | 3.4 |
| | Asset# 8628(preamplifier) | -36.5 |
| | Asset#7575 (antenna) | 32.7 |
| Reported Max Peak Final Measurement (dbμV/m)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

2.8.9 Test Results

See attached plots.



2.8.10 Test Results Restricted Band 2310MHz to 2490MHz (802.11 b 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2310.400000 | 56.0 | 1000.0 | 1000.000 | 100.7 | H | 322.0 | -1.1 | 17.9 | 73.9 |
| 2344.976000 | 56.2 | 1000.0 | 1000.000 | 104.8 | H | 306.0 | -0.9 | 17.7 | 73.9 |
| 2390.000000 | 54.7 | 1000.0 | 1000.000 | 99.7 | H | 323.0 | -0.6 | 19.2 | 73.9 |

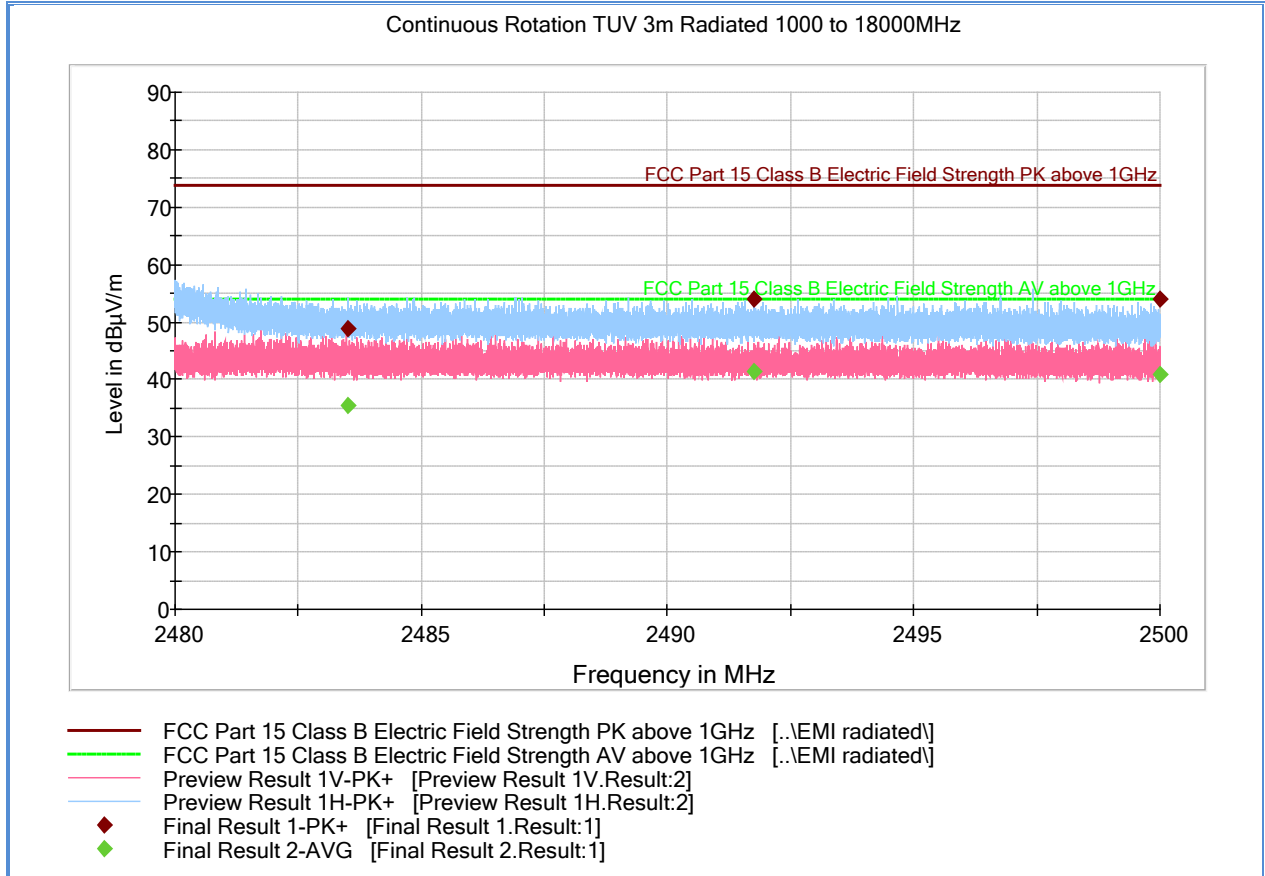
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2310.400000 | 43.5 | 1000.0 | 1000.000 | 100.7 | H | 322.0 | -1.1 | 10.4 | 53.9 |
| 2344.976000 | 43.0 | 1000.0 | 1000.000 | 104.8 | H | 306.0 | -0.9 | 10.9 | 53.9 |
| 2390.000000 | 42.2 | 1000.0 | 1000.000 | 99.7 | H | 323.0 | -0.6 | 11.7 | 53.9 |

Test Notes: 2.4GHz notch filter removed for this test.



2.8.11 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11 b 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2483.522000 | 48.8 | 1000.0 | 1000.000 | 162.6 | H | 113.0 | -0.1 | 25.1 | 73.9 |
| 2491.749333 | 54.0 | 1000.0 | 1000.000 | 102.7 | H | 319.0 | -0.1 | 19.9 | 73.9 |
| 2500.000000 | 54.1 | 1000.0 | 1000.000 | 132.7 | H | 320.0 | -0.1 | 19.8 | 73.9 |

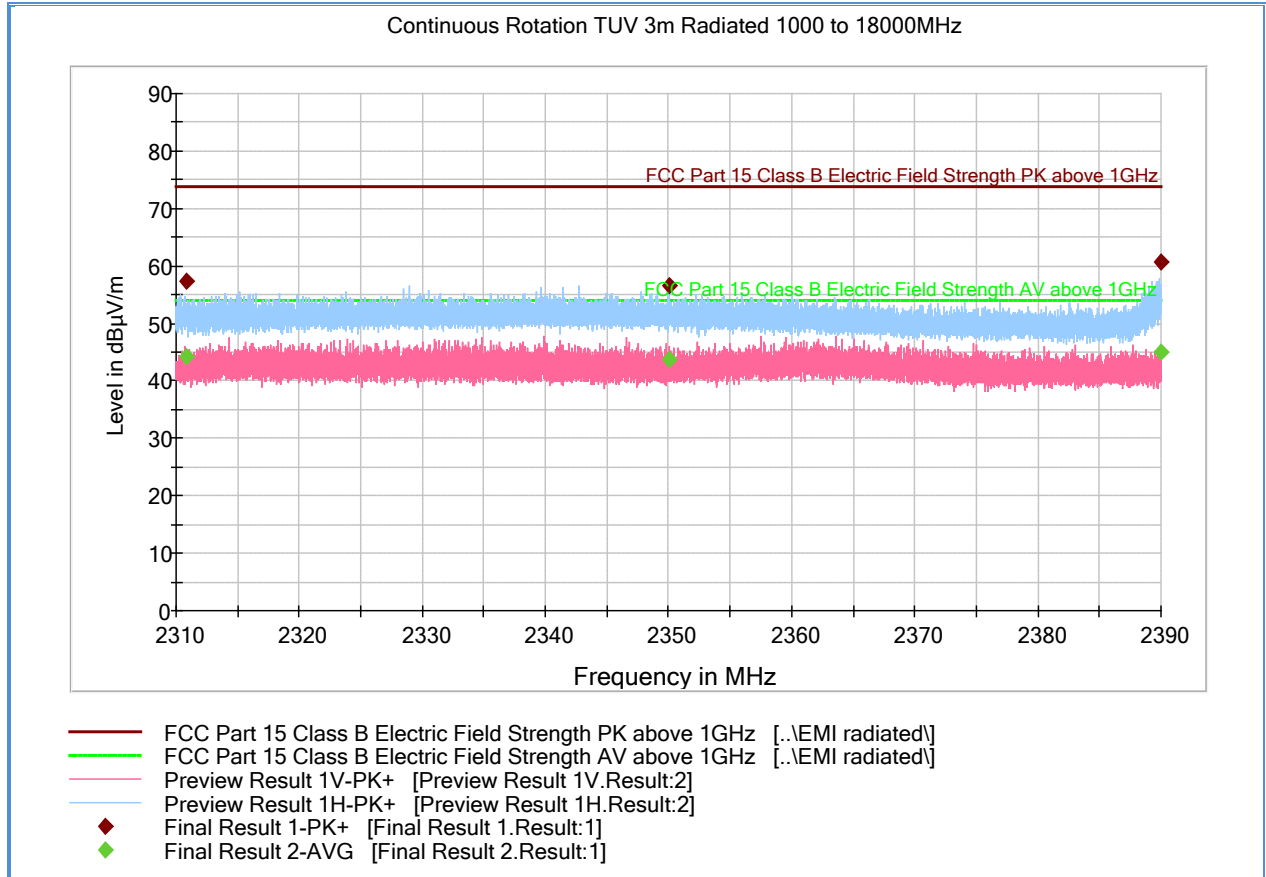
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2483.522000 | 35.4 | 1000.0 | 1000.000 | 162.6 | H | 113.0 | -0.1 | 18.5 | 53.9 |
| 2491.749333 | 41.5 | 1000.0 | 1000.000 | 102.7 | H | 319.0 | -0.1 | 12.4 | 53.9 |
| 2500.000000 | 41.0 | 1000.0 | 1000.000 | 132.7 | H | 320.0 | -0.1 | 12.9 | 53.9 |

Test Notes: 2.4GHz notch filter removed for this test.



2.8.12 Test Results Restricted Band 2310MHz to 2490MHz (802.11 g 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2310.880000 | 57.4 | 1000.0 | 1000.000 | 103.7 | H | 318.0 | -1.1 | 16.5 | 73.9 |
| 2350.056000 | 56.6 | 1000.0 | 1000.000 | 101.7 | H | 303.0 | -0.8 | 17.3 | 73.9 |
| 2390.000000 | 60.6 | 1000.0 | 1000.000 | 102.7 | H | 303.0 | -0.6 | 13.3 | 73.9 |

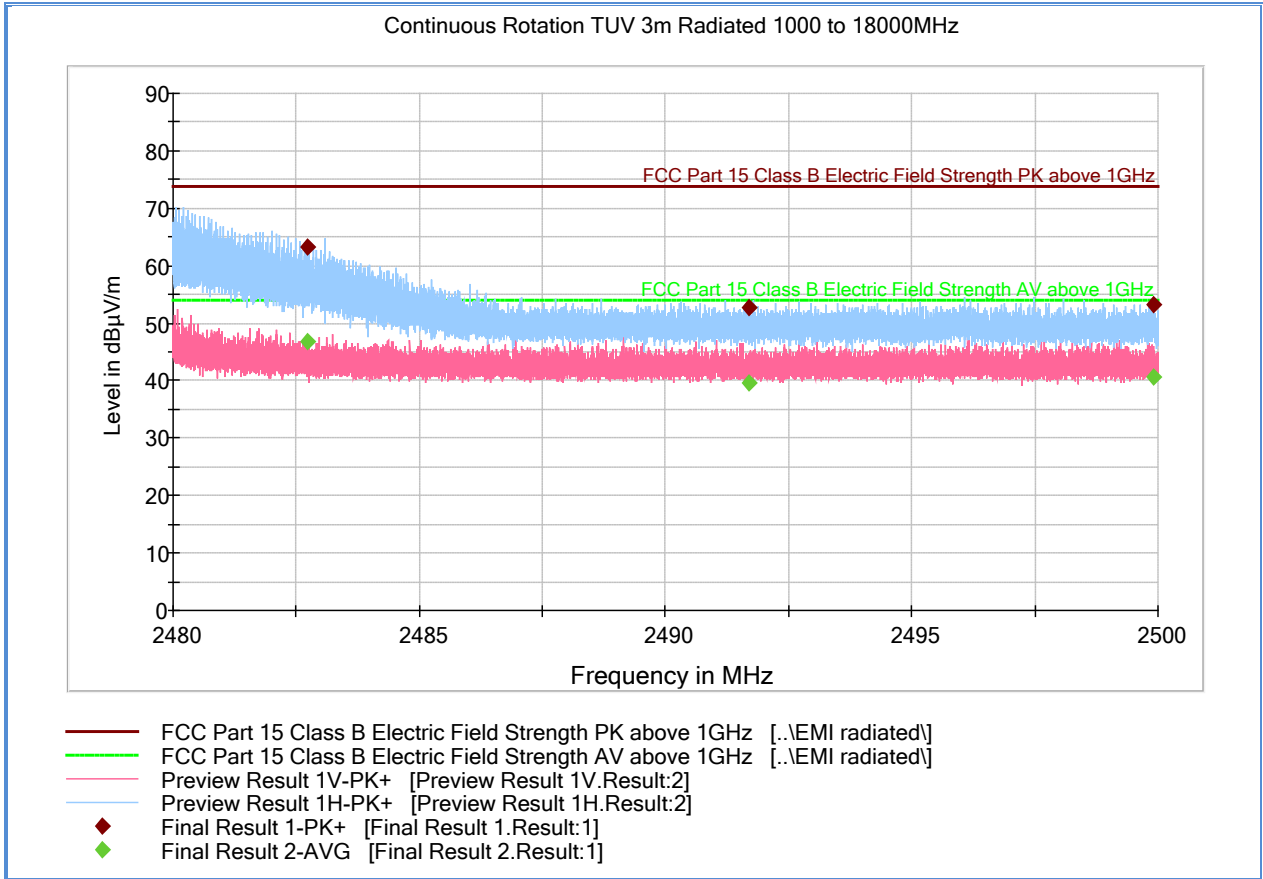
Average Data

| Frequency (MHz) | Average (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2310.880000 | 44.3 | 1000.0 | 1000.000 | 103.7 | H | 318.0 | -1.1 | 9.6 | 53.9 |
| 2350.056000 | 43.7 | 1000.0 | 1000.000 | 101.7 | H | 303.0 | -0.8 | 10.2 | 53.9 |
| 2390.000000 | 45.0 | 1000.0 | 1000.000 | 102.7 | H | 303.0 | -0.6 | 8.9 | 53.9 |

Test Notes: 2.4GHz notch filter removed for this test.



2.8.13 Test Results Restricted Band 2483.5MHz to 2500MHz (802.11 g 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2482.732000 | 63.2 | 1000.0 | 1000.000 | 101.7 | H | 156.0 | -0.1 | 10.7 | 73.9 |
| 2491.701333 | 52.8 | 1000.0 | 1000.000 | 139.7 | H | 318.0 | -0.1 | 21.1 | 73.9 |
| 2499.921333 | 53.2 | 1000.0 | 1000.000 | 131.7 | H | 306.0 | -0.1 | 20.7 | 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) |
|-----------------|------------------|-----------------|-----------------|-------------|--------------|---------------|------------|-------------|----------------|
| 2482.732000 | 46.8 | 1000.0 | 1000.000 | 101.7 | H | 156.0 | -0.1 | 7.1 | 53.9 |
| 2491.701333 | 39.5 | 1000.0 | 1000.000 | 139.7 | H | 318.0 | -0.1 | 14.4 | 53.9 |
| 2499.921333 | 40.6 | 1000.0 | 1000.000 | 131.7 | H | 306.0 | -0.1 | 13.3 | 53.9 |

Test Notes: 2.4GHz notch filter removed for this test.



2.9 POWER SPECTRAL DENSITY

2.9.1 Specification Reference

Part 15 Subpart C §15.247(e)

2.9.2 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.

2.9.3 Equipment Under Test and Modification State

Serial No: SN022 / Test Configuration A

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

March 01, 2015/FSC

2.9.5 Test Equipment Used

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

2.9.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

| | |
|---------------------|-----------|
| Ambient Temperature | 20.4 °C |
| Relative Humidity | 52.0 % |
| ATM Pressure | 100.1 kPa |

2.9.7 Additional Observations

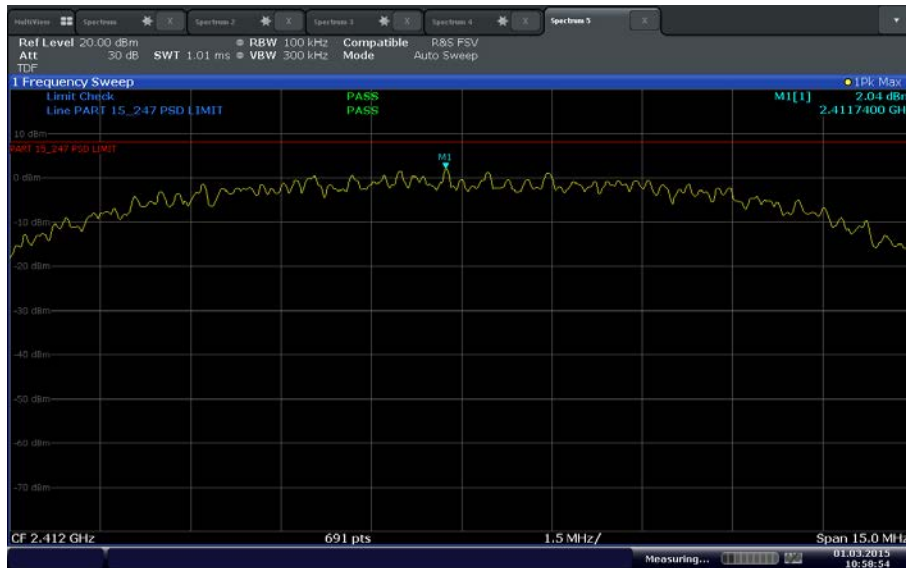
- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074 (June 05, 2014).
- A transducer factor (TDF) was added to compensate for the external attenuator and cable used.
- Span was 1.5X of 6dB bandwidth (DTS bandwidth)
- Detector is Peak.
- Trace mode is Max Hold.
- Sweep time is Auto Couple.
- RBW initially set to 100 kHz and VBW set to 3X RBW. RBW can be reduced but not less than 3 kHz until EUT complies.
- EUT complies with 100 kHz RBW.



2.9.8 Test Results Summary

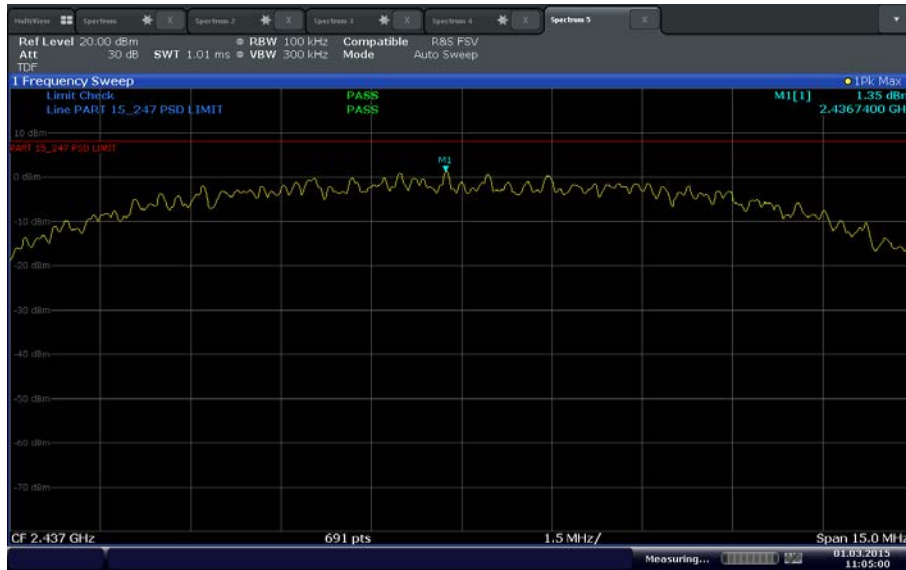
| Mode | Channel | Marker Reading using 100 kHz RBW (dBm) | PSD Limit (dBm) | Margin (dB) | Compliance |
|---------|---------------|--|-----------------|-------------|------------|
| 802.11b | 1 (2412 MHz) | 2.04 | 8 | 5.96 | Complies |
| | 6 (2437 MHz) | 1.35 | 8 | 6.65 | Complies |
| | 11 (2462 MHz) | 1.40 | 8 | 6.60 | Complies |
| 802.11g | 1 (2412 MHz) | -5.51 | 8 | 13.51 | Complies |
| | 6 (2437 MHz) | -6.67 | 8 | 14.67 | Complies |
| | 11 (2462 MHz) | -6.09 | 8 | 14.09 | Complies |

2.9.9 Test Results Plots



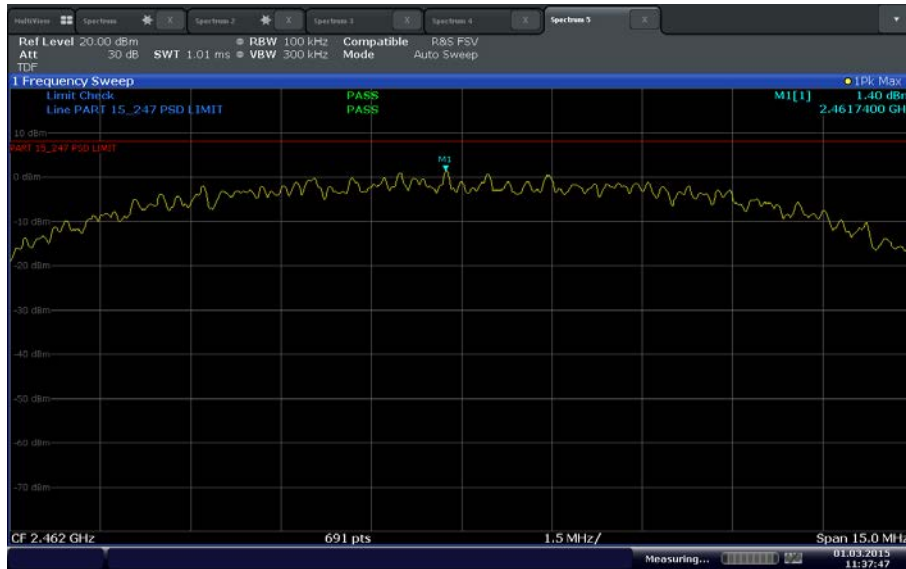
Date: 1.MAR.2015 10:58:54

802.11b Low Channel



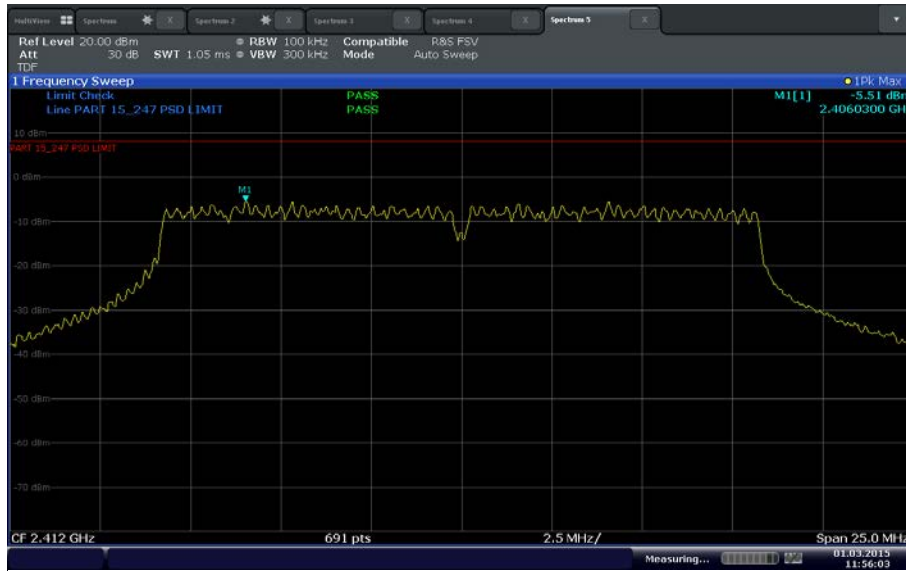
Date: 1 MAR 2015 11:05:01

802.11b Mid Channel



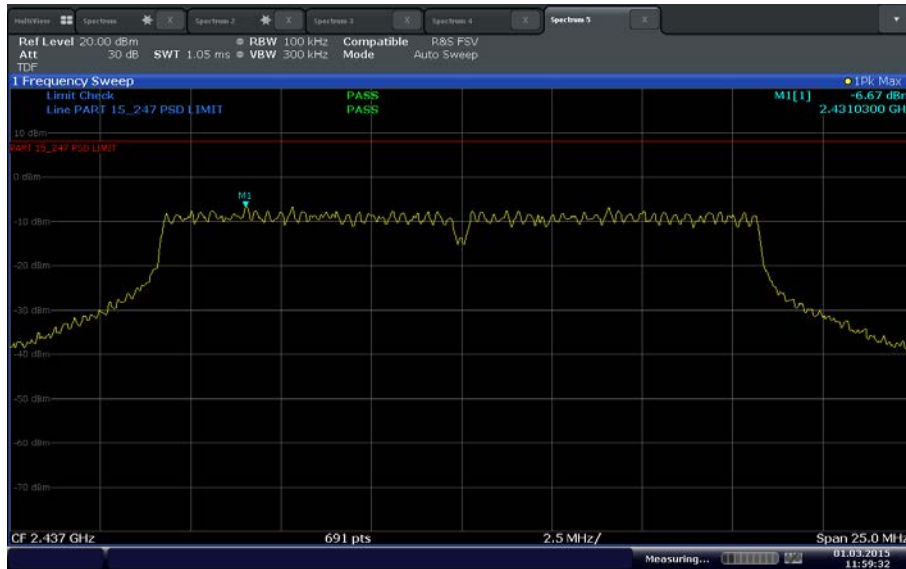
Date: 1 MAR 2015 11:37:47

802.11b High Channel



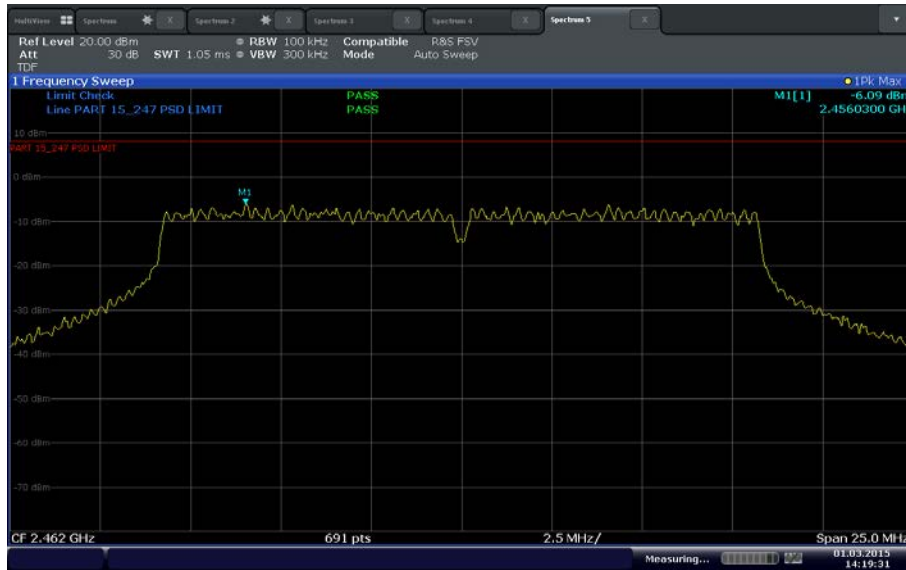
Date: 1.MAR.2015 11:56:03

802.11g Low Channel



Date: 1.MAR.2015 11:59:33

802.11g Mid Channel



Date: 1 MAR 2015 14:19:32

802.11g High Channel



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

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

| ID Number (SDGE/SDRB) | Test Equipment | Type | Serial Number | Manufacturer | Cal Date | Cal Due Date |
|------------------------------|---|--------------------|---------------|----------------------------|---------------------------|--------------|
| Antenna Conducted Port Setup | | | | | | |
| 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 |
| 7608 | Vector Signal Generator | SMBV100A | 259021 | Rhode & Schwarz | 06/06/14 | 06/06/15 |
| 8825 | 20dB Attenuator | 46-20-34 | BK5773 | Weinschel Corp. | Verified by 7582 and 7608 | |
| 8832 | 20dB Attenuator | 34-20-34 | BP4150 | MCE/Weinschel | Verified by 7582 and 7608 | |
| Radiated Emissions | | | | | | |
| 1002 | Bilog Antenna | 3142C | 00058717 | ETS-Lindgren | 01/30/14 | 01/30/16 |
| 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 |
| 1040 | EMI Test Receiver | ESIB40 | 100292 | Rhode & Schwarz | 08/29/14 | 08/29/15 |
| 1049 | EMI Test Receiver | ESU | 100133 | Rhode & Schwarz | 03/17/14 | 03/17/15 |
| 1016 | Pre-amplifier | PAM-0202 | 187 | PAM | 12/10/14 | 12/10/15 |
| 1153 | High-frequency cable | SucoFlex 100 SX | N/A | Suhner | 04/03/14 | 04/03/15 |
| 8543 | High-frequency cable | Micropore 19057793 | N/A | United Microwave Products | 09/04/14 | 09/04/15 |
| 1150 | Horn antenna | 3160-09 | 012054-004 | ETS | 04/26/13 | 04/26/15 |
| 1151 | Pre-amplifier | TS-PR26 | 100026 | Rhode & Schwarz | 05/02/13 | 05/02/15 |
| 6815 | 2.4GHz Band Notch Filter | BRM50702 | 008 | Micro-Tronics | Verified by 1049 | |
| Miscellaneous | | | | | | |
| 6792 | Multimeter | 3478A | 2911A70964 | Hewlett Packard | 08/12/14 | 08/12/15 |
| 7560 | Barometer/Temperature /Humidity Transmitter | iBTHX-W | 1240476 | Omega | 01/30/14 | 02/30/15 |
| | DC Power Supply | 35010M | D102007S | Protek | Verified by 6792 | |
| | Test Software | EMC32 | V8.53 | Rhode & Schwarz | N/A | |

FCC ID QNGBE2813
IC: 6434C-BE2813
Report No. SD72102589-0215C





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 | 3.55 | 2.05 | 4.20 |
| 6 | EUT Setup | Rectangular | 1.00 | 0.58 | 0.33 |
| Combined Uncertainty (u_c): | | | | | 2.23 |
| Coverage Factor (k): | | | | | 2 |
| Expanded Uncertainty: | | | | | 4.45 |

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 | 3.55 | 2.05 | 4.20 |
| 6 | EUT Setup | Rectangular | 1.00 | 0.58 | 0.33 |
| Combined Uncertainty (u_c): | | | | | 2.22 |
| Coverage Factor (k): | | | | | 2 |
| Expanded Uncertainty: | | | | | 4.44 |

3.2.3 Conducted Antenna Port Measurement

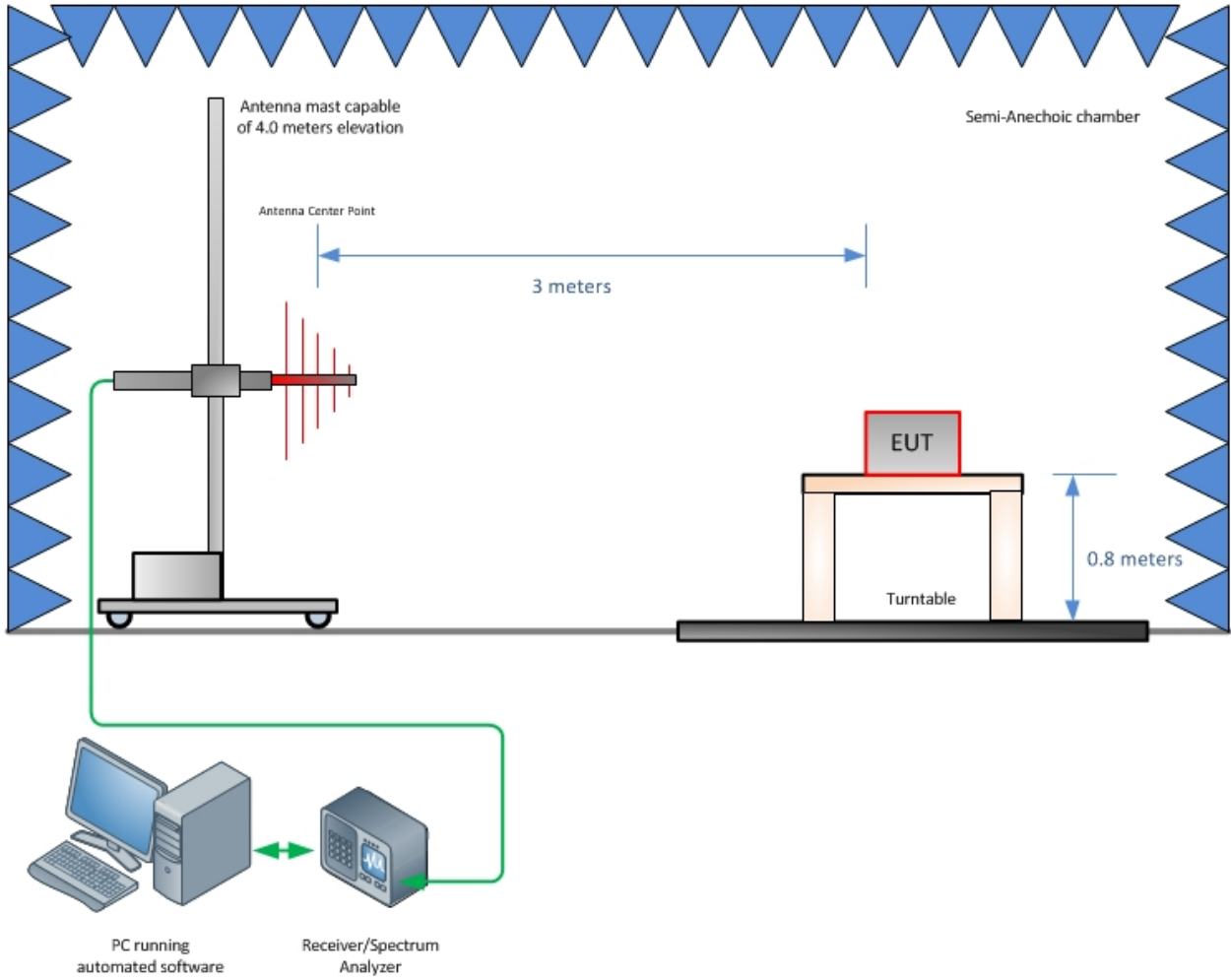
| Contribution | | Probability Distribution Type | Probability Distribution x_i | Standard Uncertainty $u(x_i)$ | $[u(x_i)]^2$ |
|---------------------------------|----------------------------|-------------------------------|--------------------------------|-------------------------------|--------------|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



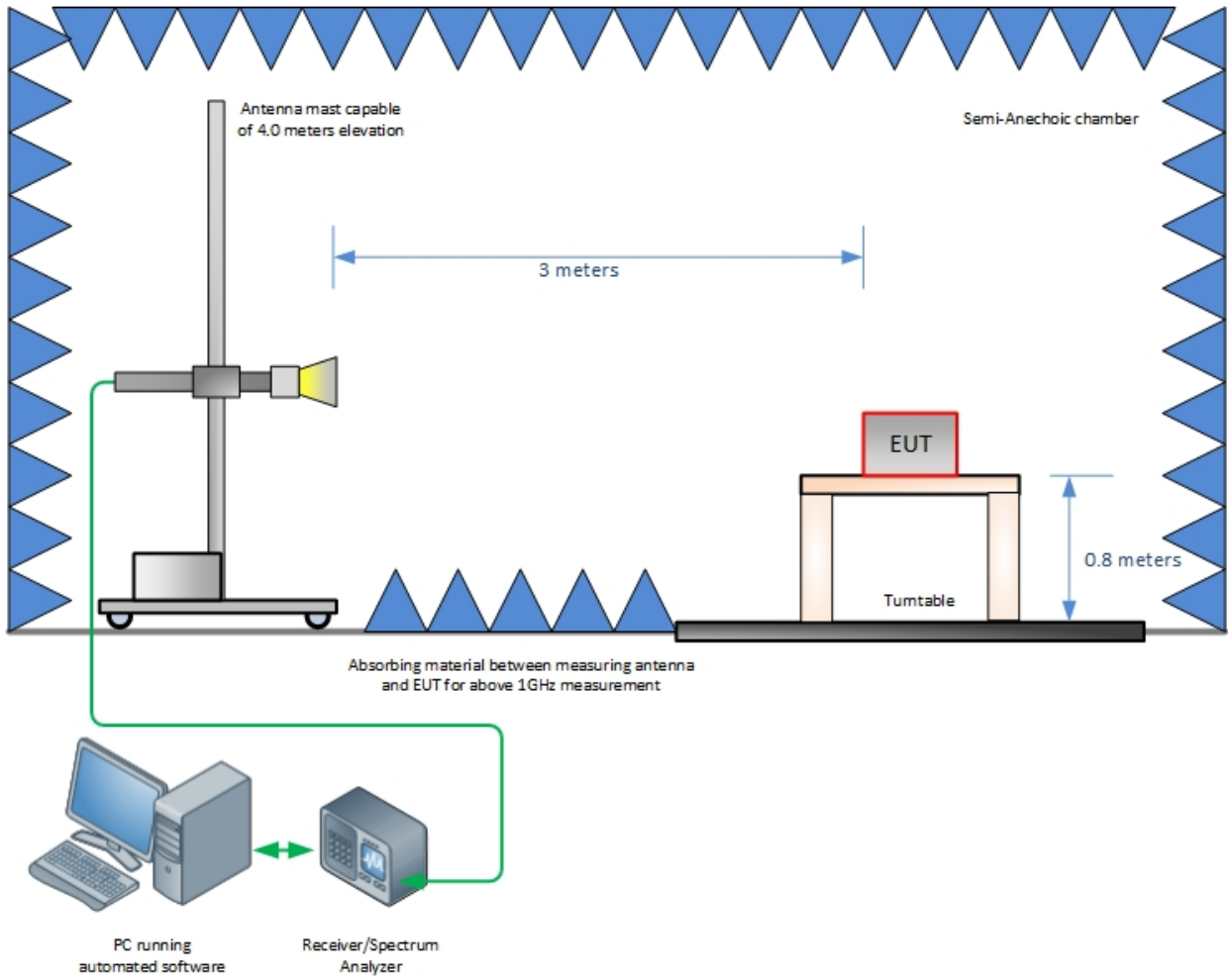
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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