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Report On

Application for Grant of Equipment Authorization of the
Oculus VR, LLC
3P-A Constellation Sensor

FCC Part 15 Subpart C §15.247 (FHSS)
IC RSS-247 Issue 1 May 2015
IC RSS-Gen Issue 4, November 2014

Report No. SD72112194-1215B December 2015

REPORT ON	Radio Testing of the Oculus VR, LLC Constellation Sensor
TEST REPORT NUMBER	SD72112194-1215B
PREPARED FOR	Oculus VR, LLC 1 Hacker Way Menlo Park, CA 94025
CONTACT PERSON	Pelagio Payumo Consumer Product Health & Safety Manager (408) 564-9962 pelagio.payumo@oculus.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Chip R. Fleury Name Authorized Signatory Title: West Coast EMC Manager
DATED	December 16, 2015

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

Revision History

SD72112194-1215B Oculus VR, LLC 3P-A Constellation Sensor					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
12/16/2015	Initial Release				Chip R. Fleury

CONTENTS

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Oculus VR, LLC
Constellation Sensor

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Oculus VR, LLC 3P-A Constellation Sensor to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 1 May 2015.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Oculus VR, LLC
Model Number(s)	3P-A
FCC ID Number	2AGOZ3P-A
IC Number	20849-3PA
Serial Number(s)	N/A (Engineering Sample)
Number of Samples Tested	1 (Radiated sample only)
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2014). • IC RSS-247 Issue 1 May 2015 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices. • IC RSS-Gen Issue 4, November 2014 - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014). • Public Notice (DA 00-705 Released March 30, 2000) Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.
Start of Test	October 08, 2015
Finish of Test	October 12, 2015
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	• setup and connection.txt • SD72112194-1215A Facebook Oculus HM-A FCC IC Part 15.247 RSS247 Test Report.docx • 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 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	§15.207 (a)	RSS-Gen 8.8	Conducted Emissions	Compliant*	
2.2	§15.247(a)(1)	RSS-247 5.1 (2)	Carrier Frequency Separation	Compliant*	
2.3	§15.247(a)(1) (iii)	RSS-247 5.1 (4)	Number of Hopping Frequencies	Compliant*	
2.4	§15.247(a)(1) (iii)	RSS-247 5.1 (4)	Time of Occupancy (Dwell Time)	Compliant*	
2.5	§15.215(c)	RSS-247 5.1 (1)	20 dB Bandwidth	Compliant*	
2.6		RSS-Gen 6.6	99% Emission Bandwidth	Compliant*	
2.7	§15.247(b)(1)	RSS-247 5.4 (2)	Peak Output Power	Compliant*	
2.8	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant*	
2.9	§15.247(d)	RSS-247 5.5	Spurious RF Conducted Emissions	Compliant	
2.10	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	Compliant	
2.11	§15.247(d)	RSS-Gen 8.9 and 8.10	Radiated Immediate Restricted Bands	Compliant	

Compliant* *- Test results from SD72112194-1215A Facebook Oculus HM-A FCC IC Part 15.247 RSS247 Test Report.docx applies. All antenna conducted port verifications were performed on the Headset Master (HMD) that has the same RF chip; identical modulation scheme and identical radio transmit power as the EUT*

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was an Oculus VR, LLC 3P-A Constellation Sensor as shown in the photograph below. The EUT is part of a Virtual Reality Headset System comprising of the EUT, the Oculus Remote (Simple Input Device) and the Oculus Virtual Reality Headset.

Equipment Under Test

1.3.2 EUT General Description

EUT Description	Constellation Sensor
Model Name	3P-A
Model Number(s)	3P-A
Rated Voltage	5VDC via USB
Mode Verified	Proprietary 2.4GHz FHSS in the ISM Band
Capability	Proprietary 2.4GHz FHSS in the ISM Band
Modulation	GFSK
Primary Unit (EUT)	☐ Production
	☐ Pre-Production
	☒ Engineering
Antenna Type	Multilayer Ceramic Antenna
Antenna Manufacturer	PSA Walsin Technology Corporation
Antenna Model Number	RFANT3216120A5T Series
Antenna Dimensions	3.2mm x 1.6mm x 1.2mm
Antenna Gain	2.12dBi

1.3.3 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	AverageOutput Power (dBm))	Peak Output Power (dBm)	Peak Output Power (mW)
FHSS	2404-2478	0.22	2.57	1.81

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna Conducted Port Single Carrier Test Mode. Actual verifications were performed on the Headset Master (HMD) that has the same RF chip; identical modulation scheme and identical radio transmit power as the EUT (Headset Master has a temporary antenna connector for conducted RF testing). The term "EUT" referred in this test report therefore applies to both the Headset Master (Conducted) and the Tracker (Radiated). Manufacturer provided a Command Prompt window wherein a command could be issued forcing the EUT to single carrier test mode.
B	Radiated Test Mode. Batch files were provided by the manufacturer to program the EUT firmware in Normal mode (hopping), Low Channel Tx mode, Mid Channel Tx mode and High Channel Tx mode.

1.4.2 EUT Exercise Software

Command Prompt window on the host PC (support laptop) to program as per Test Configuration (Section 1.4.1).

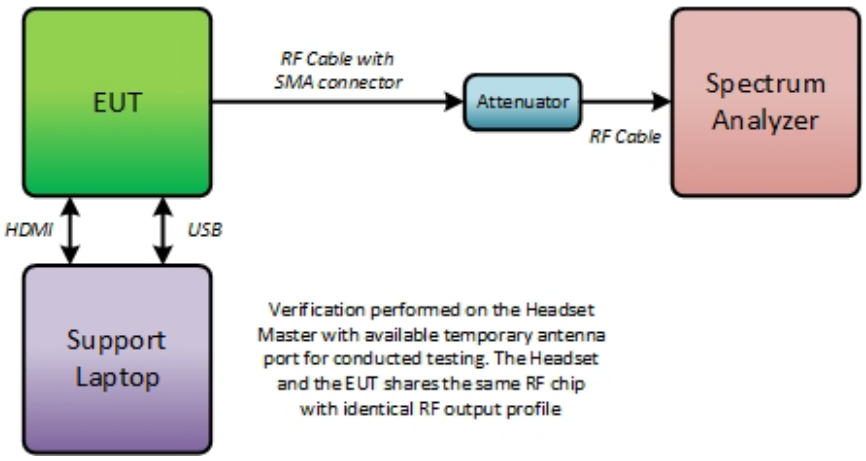
1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Apple Inc.	Support laptop	Model MacBookPro 11.3 S/N: C02LX29CFR1M
LiteOn Technology Corporation	AC Adapter for Support Laptop	Model PA-1850-7 NSW25679

1.4.4 Worst Case Configuration

The EUT has only one modulation scheme. Worst case Channel based from power measurements is Low channel.

1.4.5 Simplified Test Configuration Diagram (Antenna conducted port otherwise stand-alone for Radiated)



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

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

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

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

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.

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

SECTION 2

TEST DETAILS

Radio Testing of the
Oculus VR, LLC
Constellation Sensor

2.1 CONDUCTED EMISSIONS

2.1.1 Specification Reference

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

2.1.2 Standard Applicable

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

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

**Decreases with the logarithm of the frequency.*

2.1.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 09, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	25.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.5 kPa

2.1.7 Additional Observations

- The EUT was verified using the host laptop[1] supplied by the manufacturer.
- Test performed for reference only and to show general compliance with the rules.
- Only worst case channel configuration verified. EUT was transmitting at 2404 MHz (non-hopping) during verification.

[1] *See Section 1.4.3 of this test report for list of support equipment*

- 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 2.1.8 for sample computation.

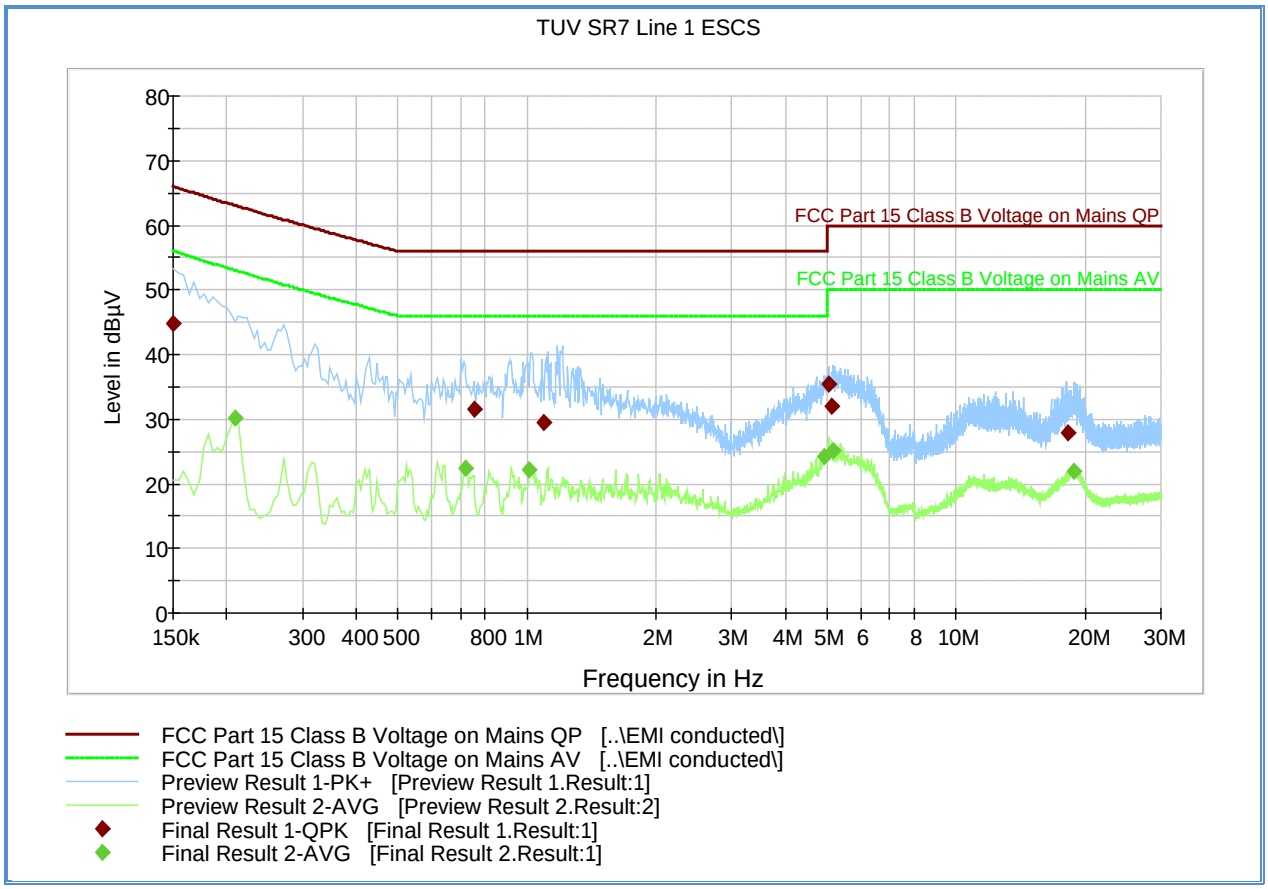
2.1.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbµV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.1.9 Test Results

Compliant. See attached plots and tables.

2.1.10 FCC Conducted Emissions Line 1 - Hot



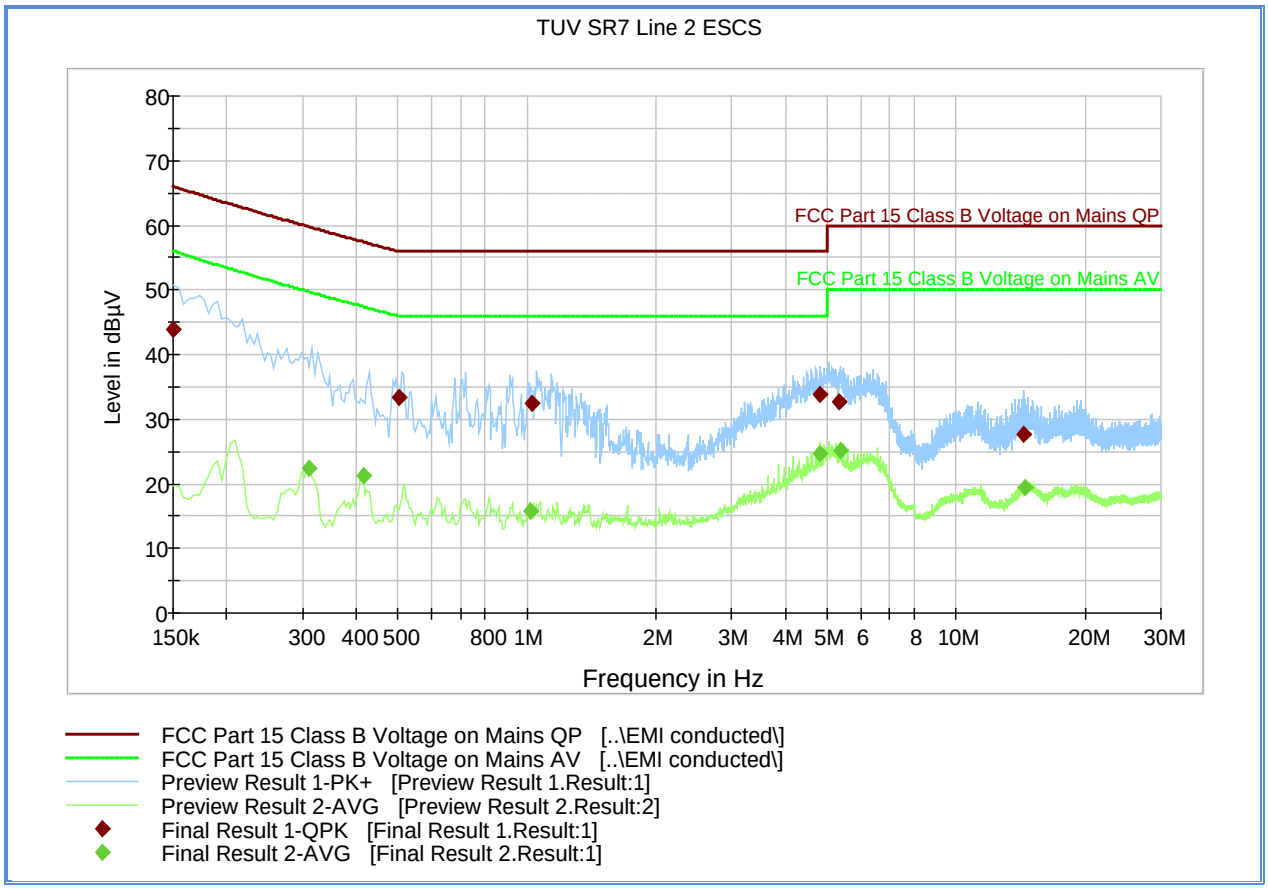
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	44.9	1000.0	9.000	Off	L1	20.1	21.1	66.0
0.757500	31.6	1000.0	9.000	Off	L1	20.1	24.4	56.0
1.095000	29.4	1000.0	9.000	Off	L1	20.3	26.6	56.0
5.046000	35.4	1000.0	9.000	Off	L1	20.6	24.6	60.0
5.149500	31.9	1000.0	9.000	Off	L1	20.6	28.1	60.0
18.168000	27.8	1000.0	9.000	Off	L1	21.0	32.2	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.208500	30.2	1000.0	9.000	Off	L1	20.1	22.9	53.1
0.721500	22.3	1000.0	9.000	Off	L1	20.2	23.7	46.0
1.014000	22.2	1000.0	9.000	Off	L1	20.2	23.8	46.0
4.933500	24.2	1000.0	9.000	Off	L1	20.6	21.8	46.0
5.158500	25.2	1000.0	9.000	Off	L1	20.6	24.8	50.0
18.834000	22.0	1000.0	9.000	Off	L1	21.0	28.0	50.0

2.1.11 FCC Conducted Emissions Line 2 – Neutral



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	43.8	1000.0	9.000	Off	N	20.1	22.2	66.0
0.505500	33.4	1000.0	9.000	Off	N	20.1	22.6	56.0
1.027500	32.4	1000.0	9.000	Off	N	20.2	23.6	56.0
4.825500	33.8	1000.0	9.000	Off	N	20.5	22.2	56.0
5.356500	32.7	1000.0	9.000	Off	N	20.6	27.3	60.0
14.379000	27.6	1000.0	9.000	Off	N	20.8	32.4	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.312000	22.4	1000.0	9.000	Off	N	20.1	27.3	49.7
0.415500	21.3	1000.0	9.000	Off	N	20.2	26.1	47.4
1.018500	15.8	1000.0	9.000	Off	N	20.2	30.2	46.0
4.830000	24.7	1000.0	9.000	Off	N	20.5	21.3	46.0
5.370000	25.0	1000.0	9.000	Off	N	20.6	25.0	50.0
14.478000	19.3	1000.0	9.000	Off	N	20.8	30.7	50.0

2.2 CARRIER FREQUENCY SEPARATION

2.2.1 Specification Reference

Part 15 Subpart C §15.247(a)(1) and RSS-247 5.1 (2)

2.2.2 Standard Applicable

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

2.2.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 2015/FSC

2.2.5 Test Equipment Used

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

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility.

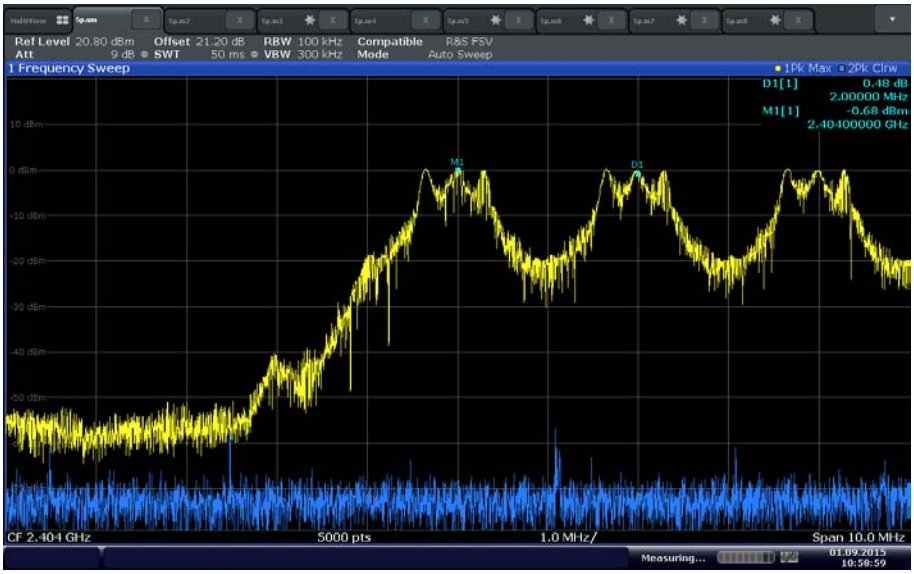
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.2.7 Additional Observations

- Hopping function enabled.
- Span is wide enough to capture the peaks of two adjacent channels.
- RBW is 1% of the span.
- VBW is 3x RBW
- Sweep is auto

- Detector is peak.
- Trace is max hold.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Marker-delta function is used between the peaks of the adjacent channels.
- Limit used is >490 kHz (2/3 of worst case 20dB BW).

2.2.8 **Test Results**



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Observed carrier frequency separation between Channel 4 and Channel 6 = 2 MHz (**Complies**. Greater than 490 kHz, this is 2/3 of 0.7352 MHz 20 dB BW)

2.3 NUMBER OF HOPPING FREQUENCIES

2.3.1 Specification Reference

Part 15 Subpart C §15.247(a)(1)(iii) and RSS-247 5.1 (4)

2.3.2 Standard Applicable

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.3.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

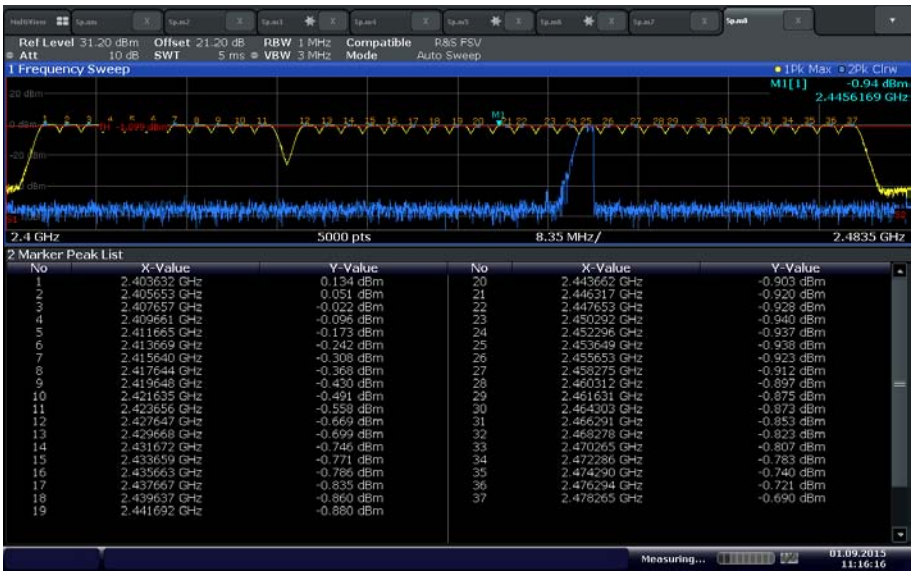
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.3.7 Additional Observations

- Hopping function enabled.
- Span was set to the entire Frequency Band.
- RBW is >1% of the span.
- VBW is 3x RBW
- Sweep is auto
- Trace was set to Max Hold.
- Marker Peak List function of the spectrum analyzer was used for this test.

2.3.8 Test Results

Observed Number of Hopping Frequencies is = **37 (Complies)**



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2.4 GHz Frequency Band showing 37 channels where the EUT hops

2.4 TIME OF OCCUPANCY (DWELL TIME)

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(1)(iii) and RSS-247 5.1 (4)

2.4.2 Standard Applicable

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

2.4.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.4.7 Additional Observations

- Hopping function enabled.
- Span = zero span, centered on a hopping channel.
- RBW is 1MHz.
- VBW is 3x RBW
- Detector is peak.
- A single pulse is first measured. This measurement is then used to compute the average time of occupancy in the required period (no. of channels x 0.4 second).
- Marker Peak List function of the spectrum analyzer was used to determine the number of pulses within 3.16 seconds.
- Threshold set to -10 dBm in order to capture actual transmission within the channel being investigated (adjacent channel transmissions are rejected).

2.4.8 Test Results

Modulation	Measured time of occupancy	Requirement
GFSK	4.28 ms	<400 ms

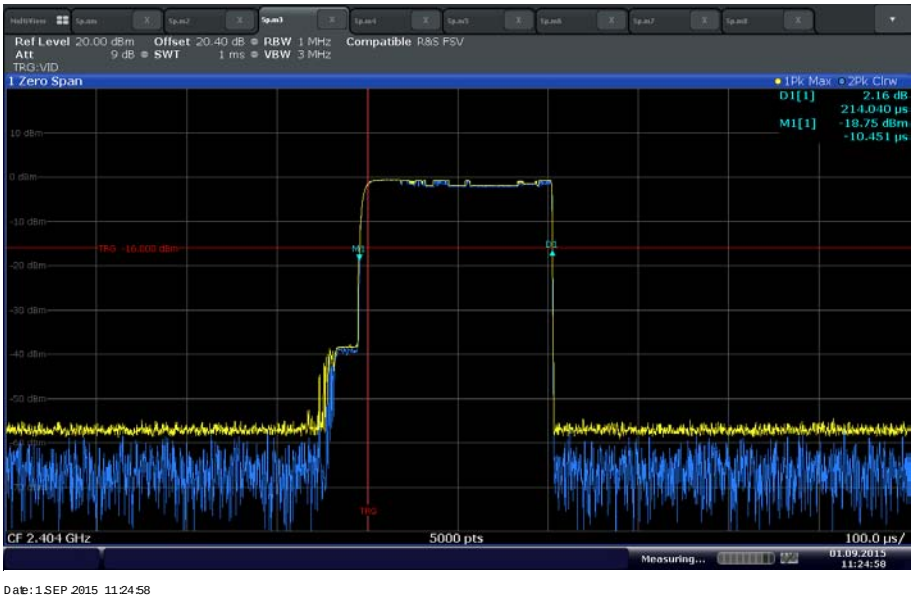
2.4.9 Sample Computation

Width of single pulse = 0.000214 second
Observed occurrence = 20 pulses/1.48 seconds
Required period = 37 channels x 0.4 second
= 14.8 seconds

Average time of occupancy = Pulse width x #pulses in 1.48 seconds x 10
= 0.000214 second x 20 x 10
= 0.0428 second

Compliance = **Complies**. 0.0428 second < 0.4 second

2.4.10 Test Results Plots



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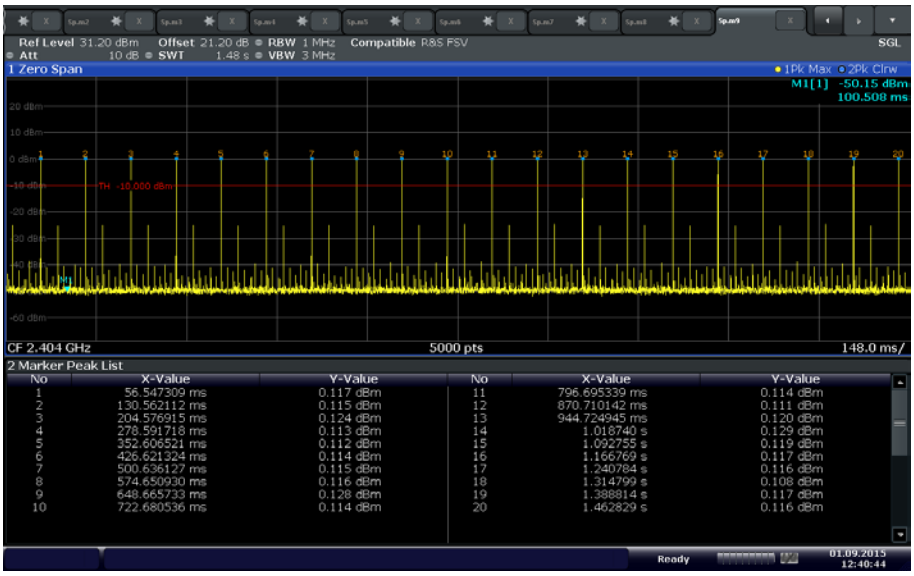
GFSK width of single pulse (0.214 ms)



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20 pulses/1.48 seconds

2.5 20 dB BANDWIDTH

2.5.1 Specification Reference

Part 15 Subpart C §15.215(c) and RSS-247 5.1 (1)

2.5.2 Standard Applicable

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

2.5.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.5.7 Additional Observations

- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Span is approximately 2 to 3 times the expected 20dB bandwidth.
- RBW is ≥ 1% of the expected 20dB bandwidth while VBW is ≥ RBW.
- Sweep is auto.
- Detector is peak.
- Max hold function activated.
- "n dB down" marker function (20dB) of the spectrum analyzer was used for this test.

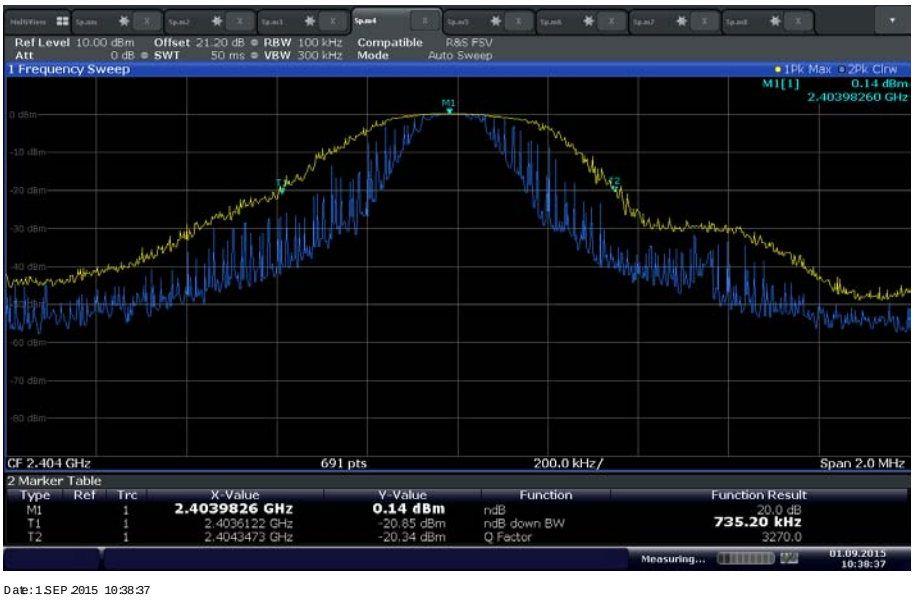
2.5.8 Test Results

Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	4	2404	0.7352
	40	2440	0.7120
	78	2478	0.7265

Using worst case 20 dB BW:

2404 MHz – (0.7352/2) = 2403.6324 MHz (within the frequency band - **Compliant**)
2478 MHz + (0.7352/2) = 2478.3675 MHz (within the frequency band - **Compliant**)

2.5.9 Test Results Plots



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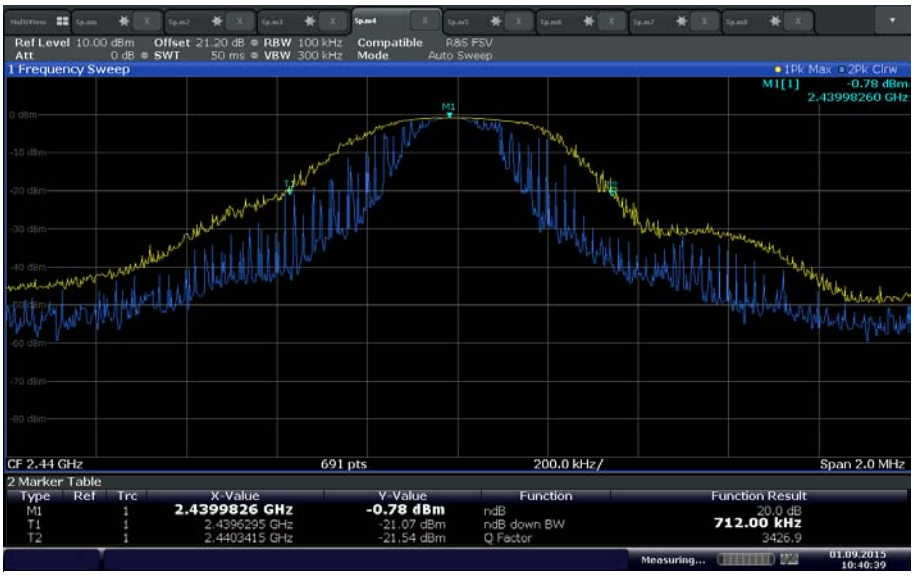
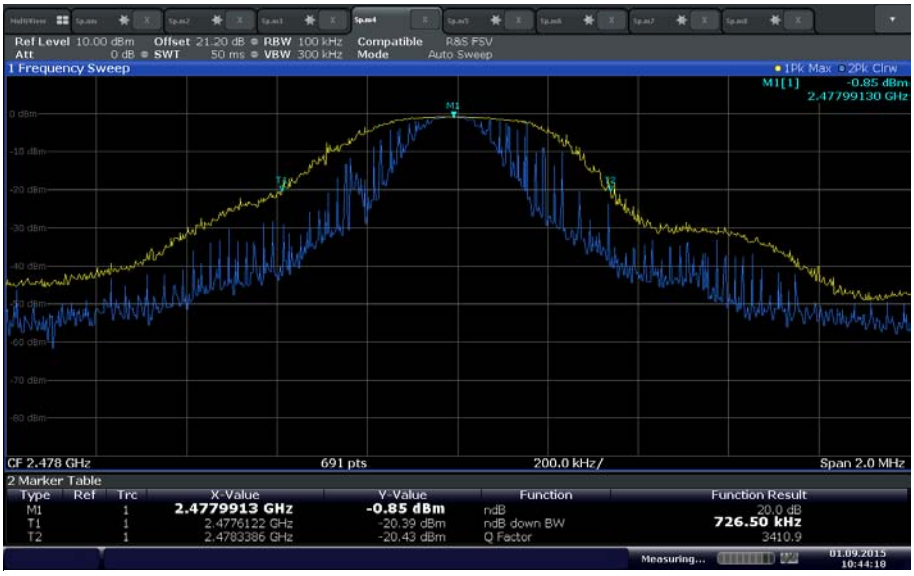
Low Channel (2404 MHz)



Date: 1.SEP.2015 10:40:39

Mid Channel (2440 MHz)



Date: 1.SEP.2015 10:44:19

High Channel (2478 MHz)

2.6 99% EMISSION BANDWIDTH

2.6.1 Specification Reference

RSS-Gen Clause 6.6

2.6.2 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.

2.6.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

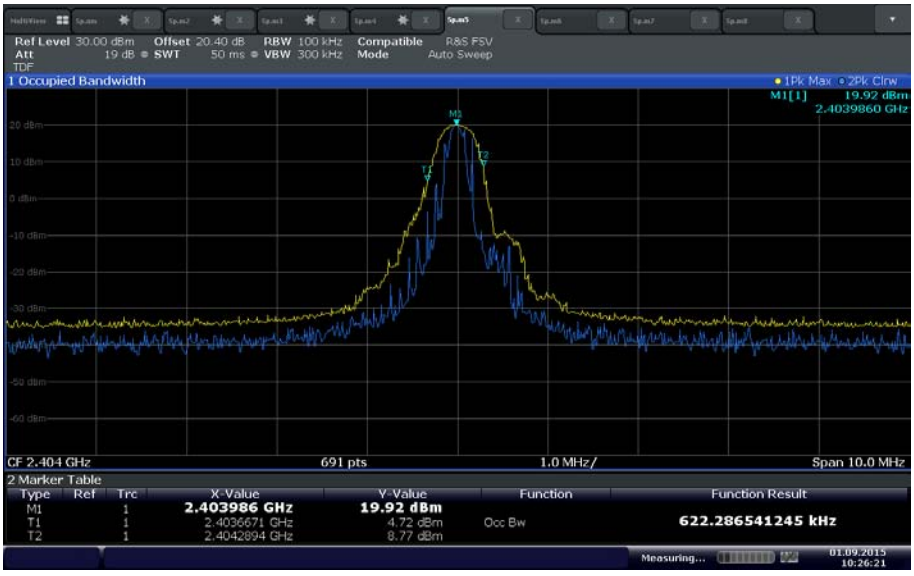
2.6.7 Additional Observations

- This is a conducted test.
- A TDF factor was used to compensate for the external attenuator and cable used within the frequency band.
- 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 OBW power measurement function of the spectrum analyzer was used for this test.

2.6.8 Test Results (For reporting purposes only)

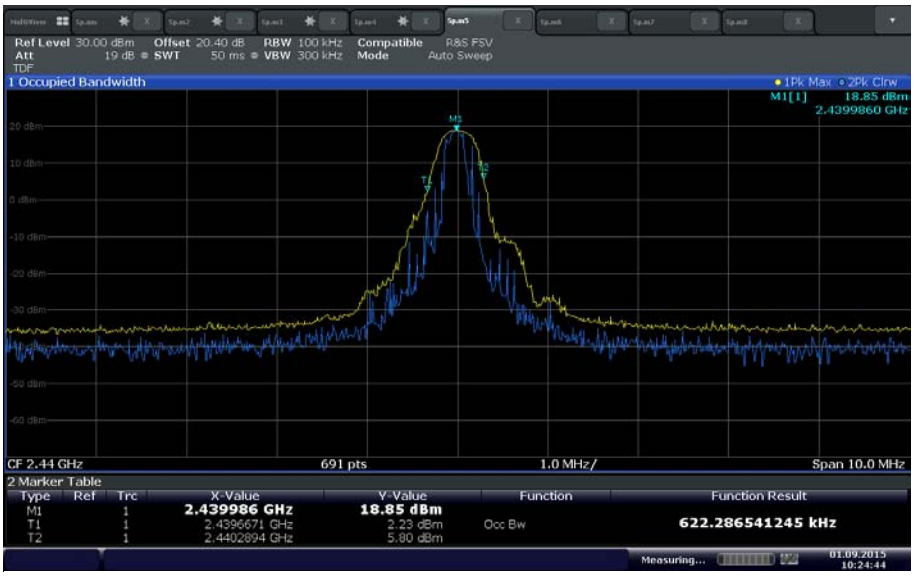
Modulation	Channel	Frequency (MHz)	Measured 20dB Bandwidth (MHz)
GFSK	4	2404	0.622
	40	2440	0.622
	78	2478	0.637

2.6.9 Test Results Plots



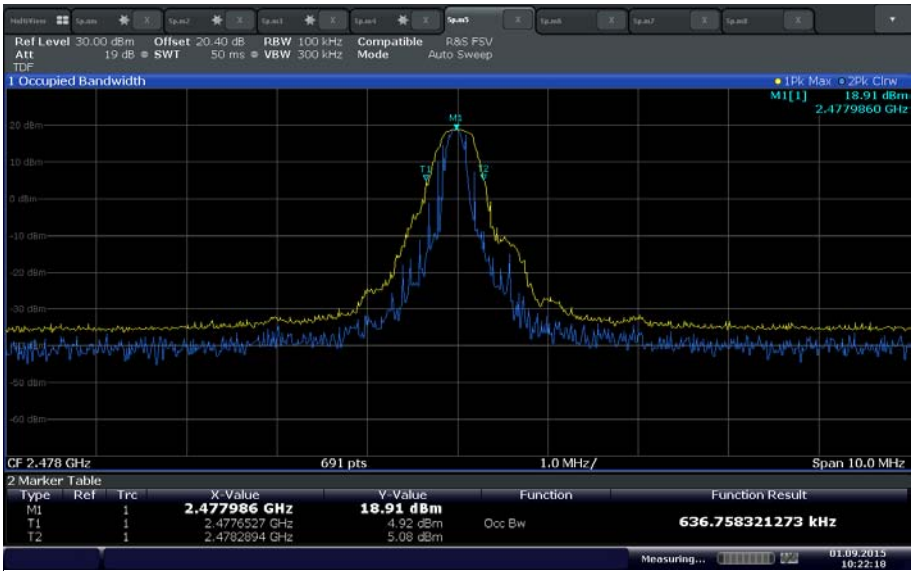
Date: 1.SEP.2015 10:26:22

Low Channel (2404 MHz)



Date: 1.SEP.2015 10:24:44

Mid Channel (2440 MHz)



Date: 1.SEP.2015 10:22:18

High Channel (2478 MHz)

2.7 PEAK OUTPUT POWER

2.7.1 Specification Reference

Part 15 Subpart C §15.247(b)(1) and RSS-247 5.4 (2)

2.7.2 Standard Applicable

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

2.7.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.7.7 Additional Observations

- This is a conducted test using a Peak Power Meter.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- EUT was verified while in single carrier test mode.

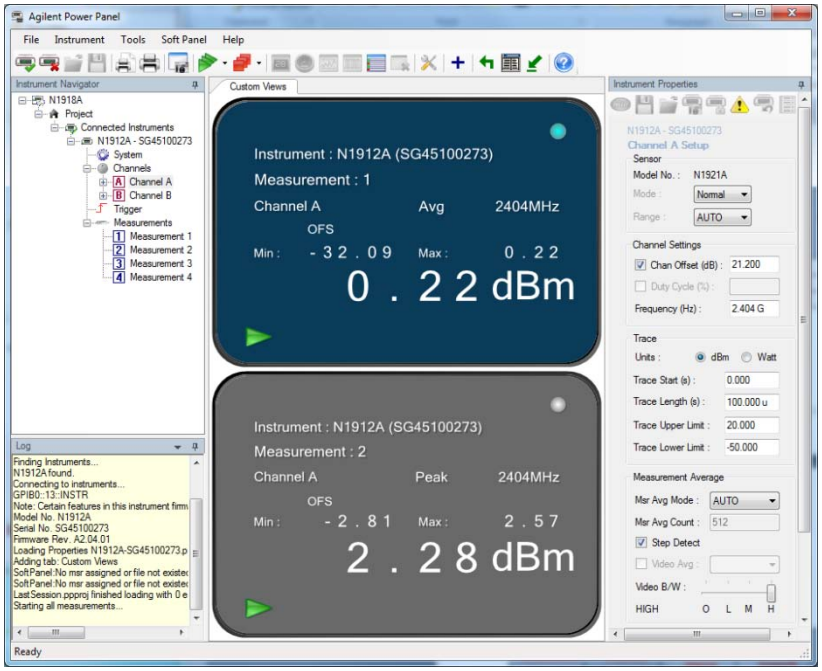
2.7.8 Test Results (Conducted)

Modulation	Channel	Frequency (MHz)	Measured Average Output Power (dBm)	Measured Peak Output Power (dBm)	Measured Peak Output Power (mW)	Limit (mW)
GFSK	4	2404	0.22	2.57	1.81	125.0
	40	2440	-0.81	2.27	1.69	125.0
	78	2478	-0.64	2.20	1.66	125.0

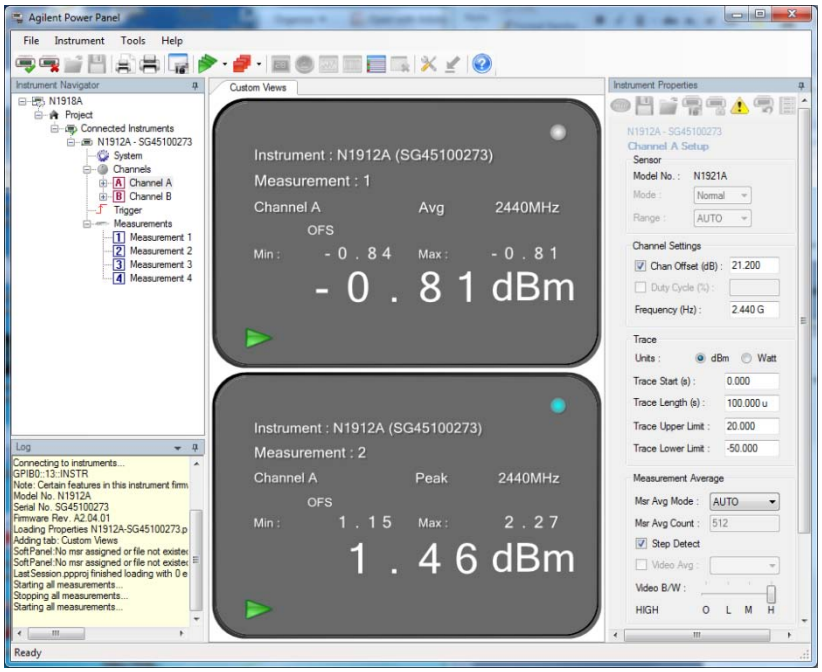
2.7.9 Test Results (*De Facto* EIRP Limit)

Modulation	Channel	Frequency (MHz)	Measured Peak Output Power (dBm))	Antenna Gain (dBi)	Calculated Peak Output Power EIRP (dBm))	Limit (dBm))
GFSK	4	2404	2.57	2.12	4.69	27

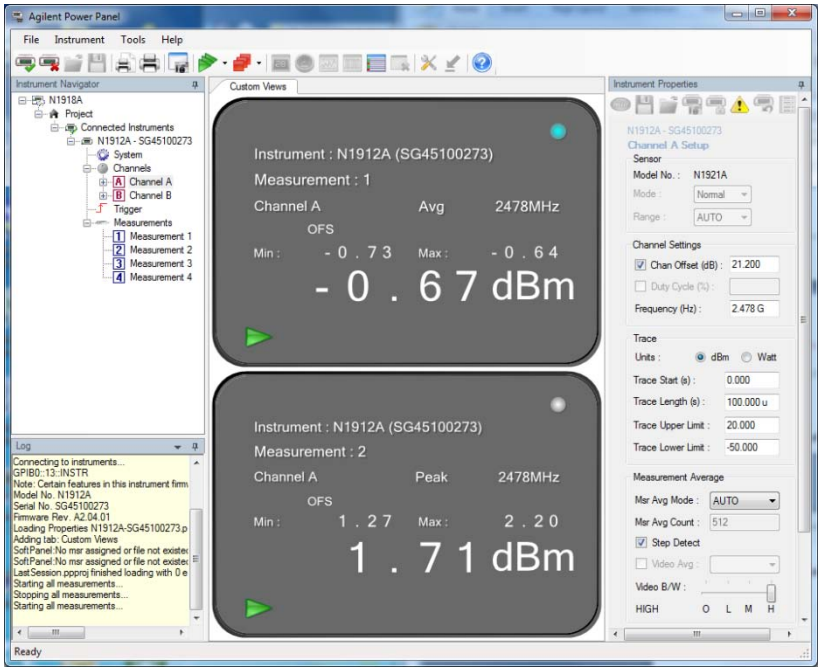
2.7.10 Test Display



Low channel (Channel 4 2404 MHz)



Mid channel (Channel 40 2440 MHz)



High channel (Channel 78 2478 MHz)

2.8 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.8.1 Specification Reference

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

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: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

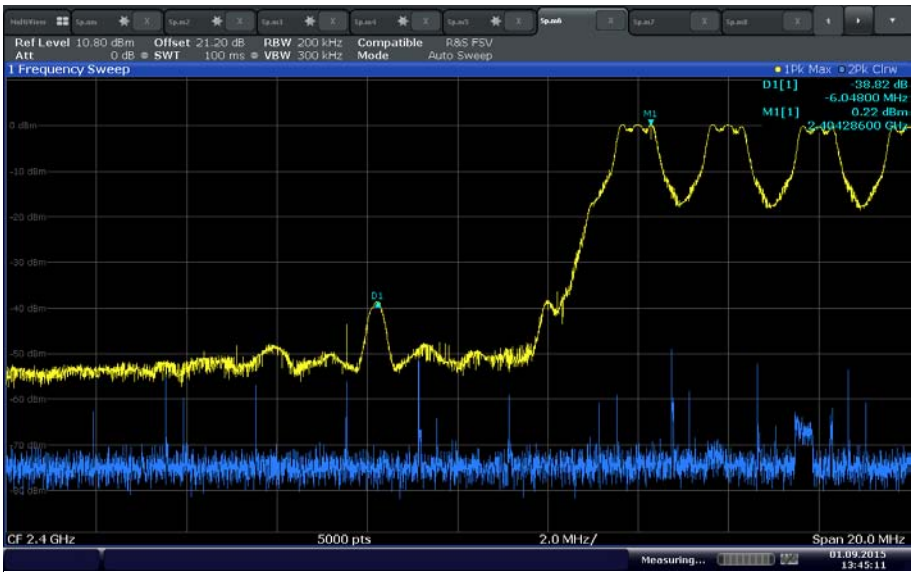
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.8.7 Additional Observations

- This is a conducted test.
- An offset of 21.2dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the peak level of the emission operating on the channel closest to the band edge.
- RBW is ≥ 1% of the span, VBW is ≥ RBW.
- Sweep is auto, detector is peak, trace is max hold.
- Trace allowed to stabilize. Marker-delta function used to verify compliance.

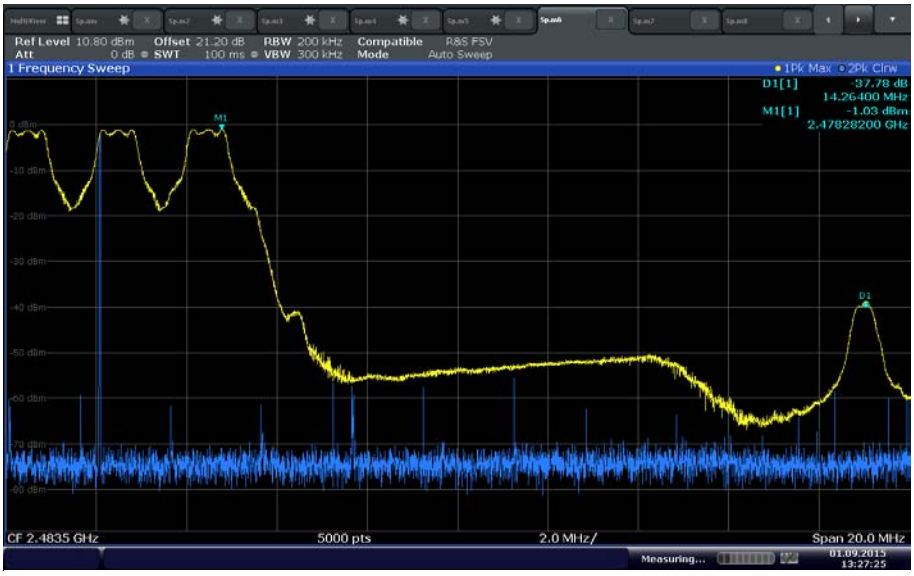
- Limit is 20dBc.
- Both Hopping and Non-Hopping mode verified.

2.8.8 **Test Results**



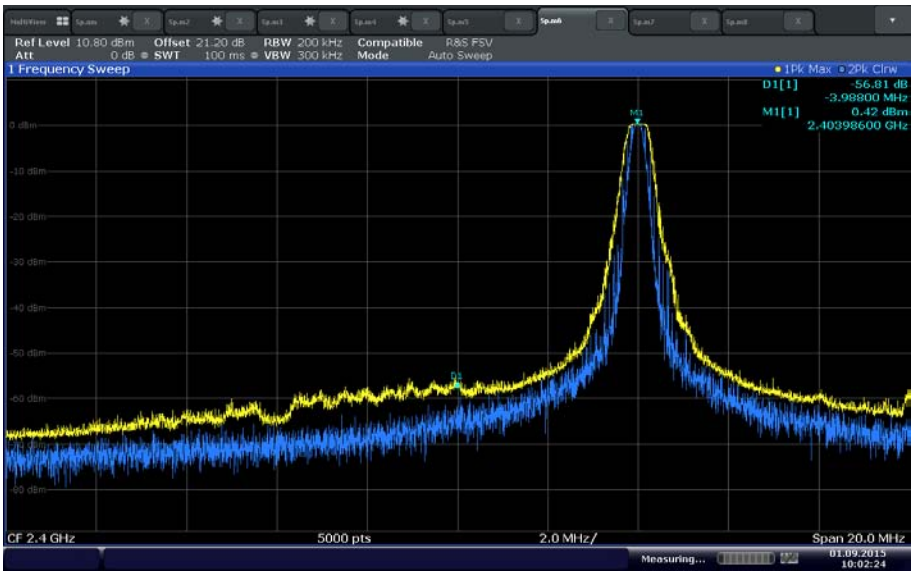
Date: 1.SEP.2015 13:45:11

Hopping lower band edge



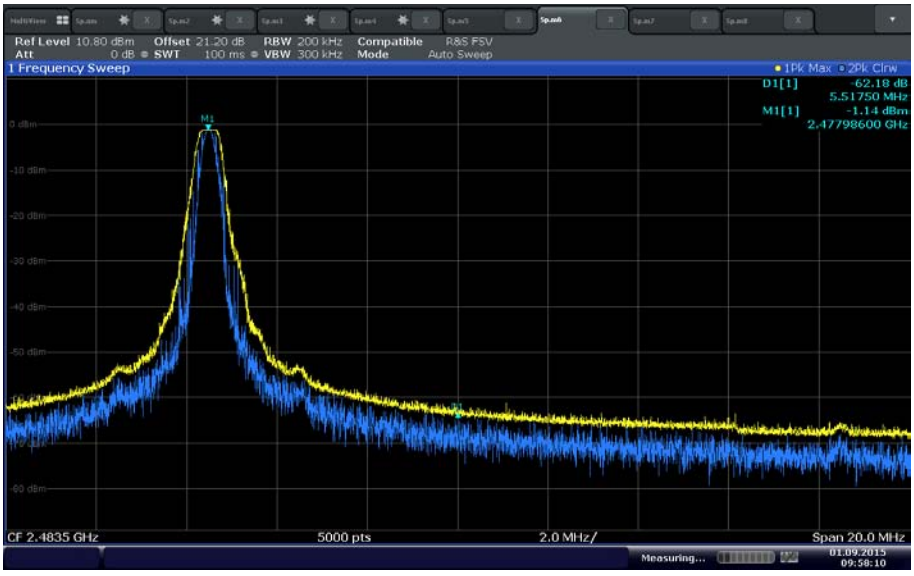
Date: 1.SEP.2015 13:27:25

Hopping upper band edge



Date: 1.SEP.2015 10:02:24

Non-hopping lower band edge



Date: 1.SEP.2015 09:58:10

Non-hopping upper band edge

2.9 SPURIOUS RF CONDUCTED EMISSIONS

2.9.1 Specification Reference

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

2.9.2 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)).

2.9.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration A

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

October 08, 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 performed at TÜV SÜD America Inc. Rancho Bernardo facility.

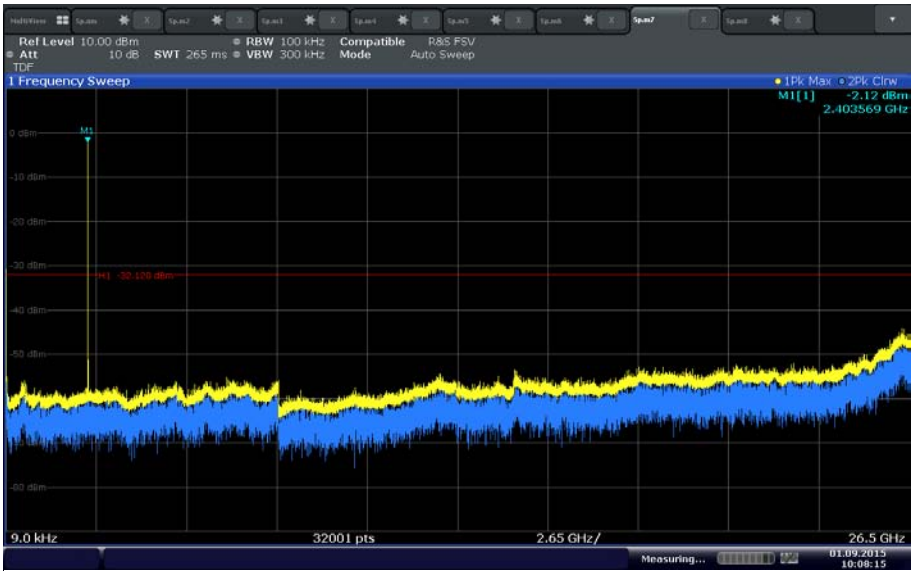
Ambient Temperature	24.8 °C
Relative Humidity	57.1 %
ATM Pressure	99.1 kPa

2.9.7 Additional Observations

- This is a conducted test.
- A TDF factor was used to compensate for the external attenuator and cable used within the frequency band.
- Span is from 9 kHz up to 26.5GHz (to cover 10th harmonic of the High Channel).
- Sweep point setting of the spectrum analyzer is set to maximum (32001).
- RBW is 100 kHz, VBW is ≥ RBW.
- Sweep is auto, detector is peak.

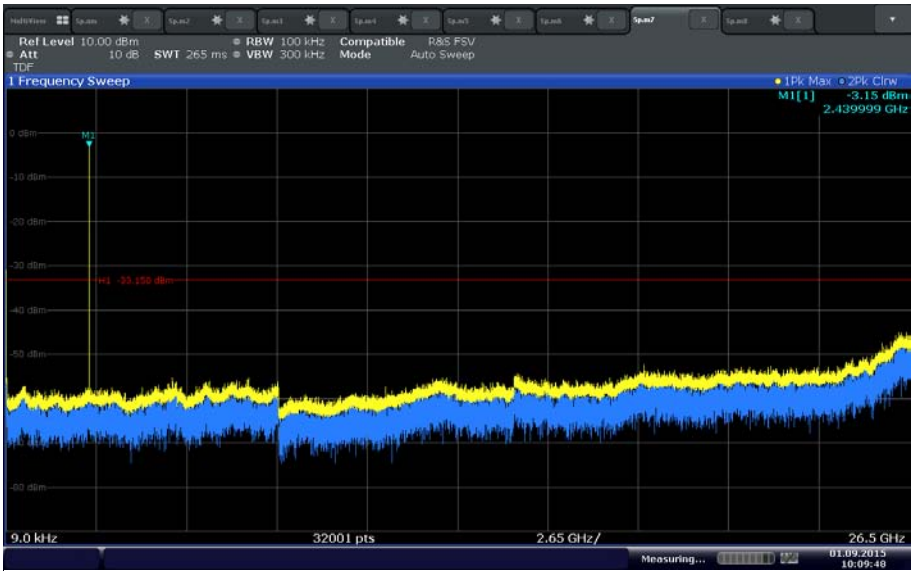
- Trace is max hold.
- Trace allowed to stabilize. Maximum spurious emission compared to limit.
- Limit is 20dBc (30dBc presented, worst case).

2.9.8 **Test Results Plots**



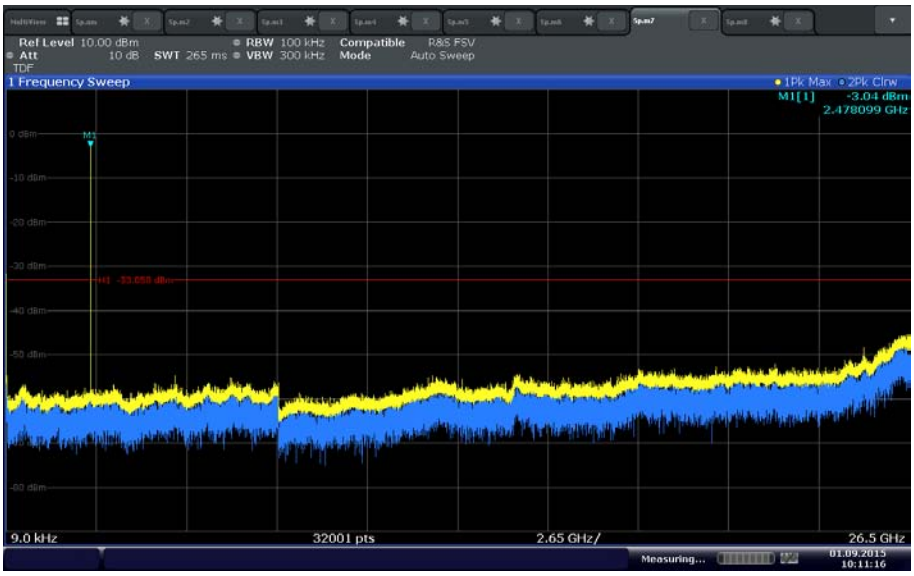
Date: 1.SEP.2015 10:08:16

Low Channel (2404 MHz)



Date: 1.SEP.2015 10:09:48

Mid Channel (2440 MHz)



Date: 1.SEP.2015 10:11:16

High Channel (2478 MHz)

2.10 SPURIOUS RADIATED EMISSIONS

2.10.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 / 8.10

2.10.2 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)).

2.10.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration B

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

October 12, 2015/FSC

2.10.5 Test Equipment Used

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

2.10.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.6 °C
Relative Humidity	48.2 %
ATM Pressure	98.7 kPa

2.10.7 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).
- For Hopping mode verification, both the HMD and the Tracker were verified at the same time. Both units will default to hopping configuration when in normal mode.

- 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 2.10.8 for sample computation.

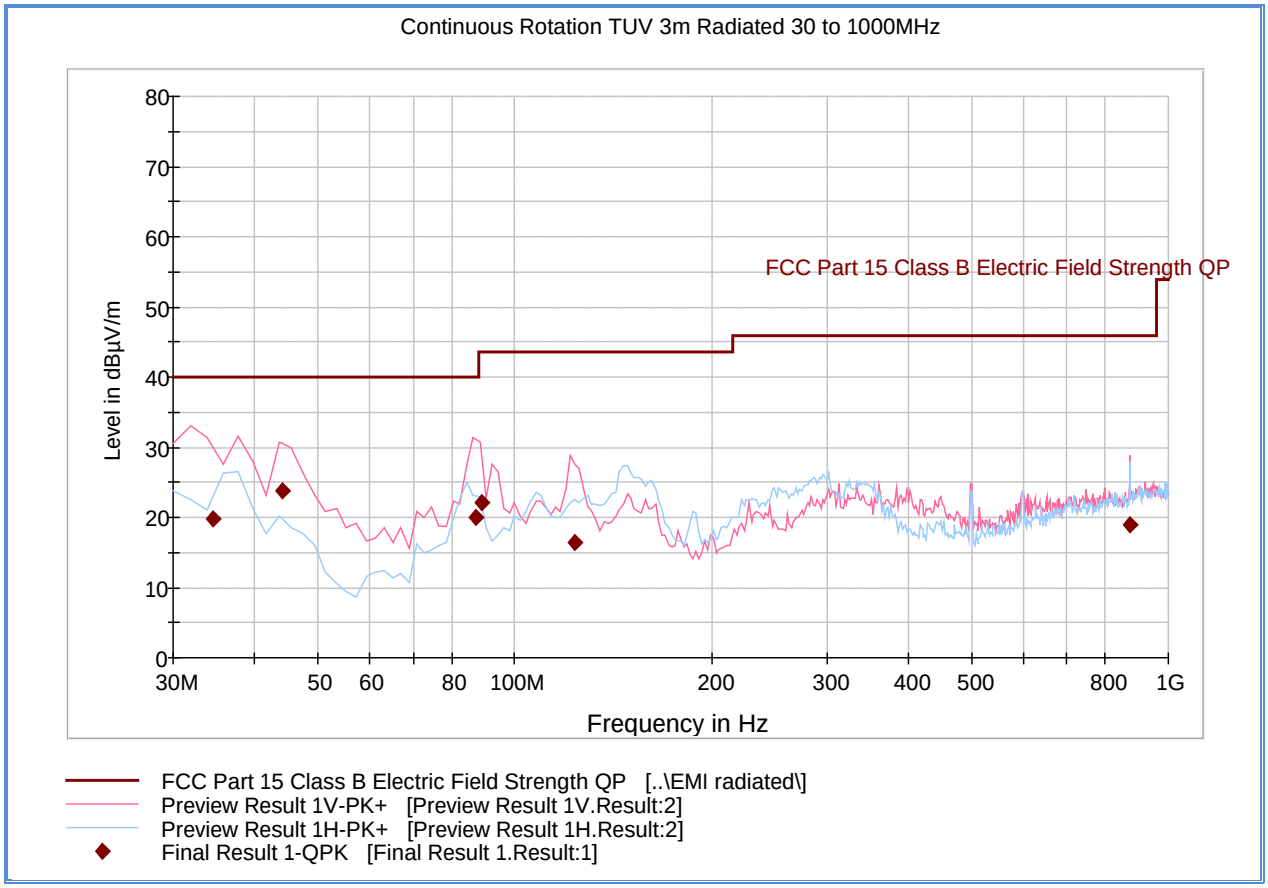
2.10.8 Sample Computation (Radiated Emission)

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**

2.10.9 Test Results

See attached plots.

2.10.10 Test Results Below 1GHz (Worst Case Channel – Non-hopping)

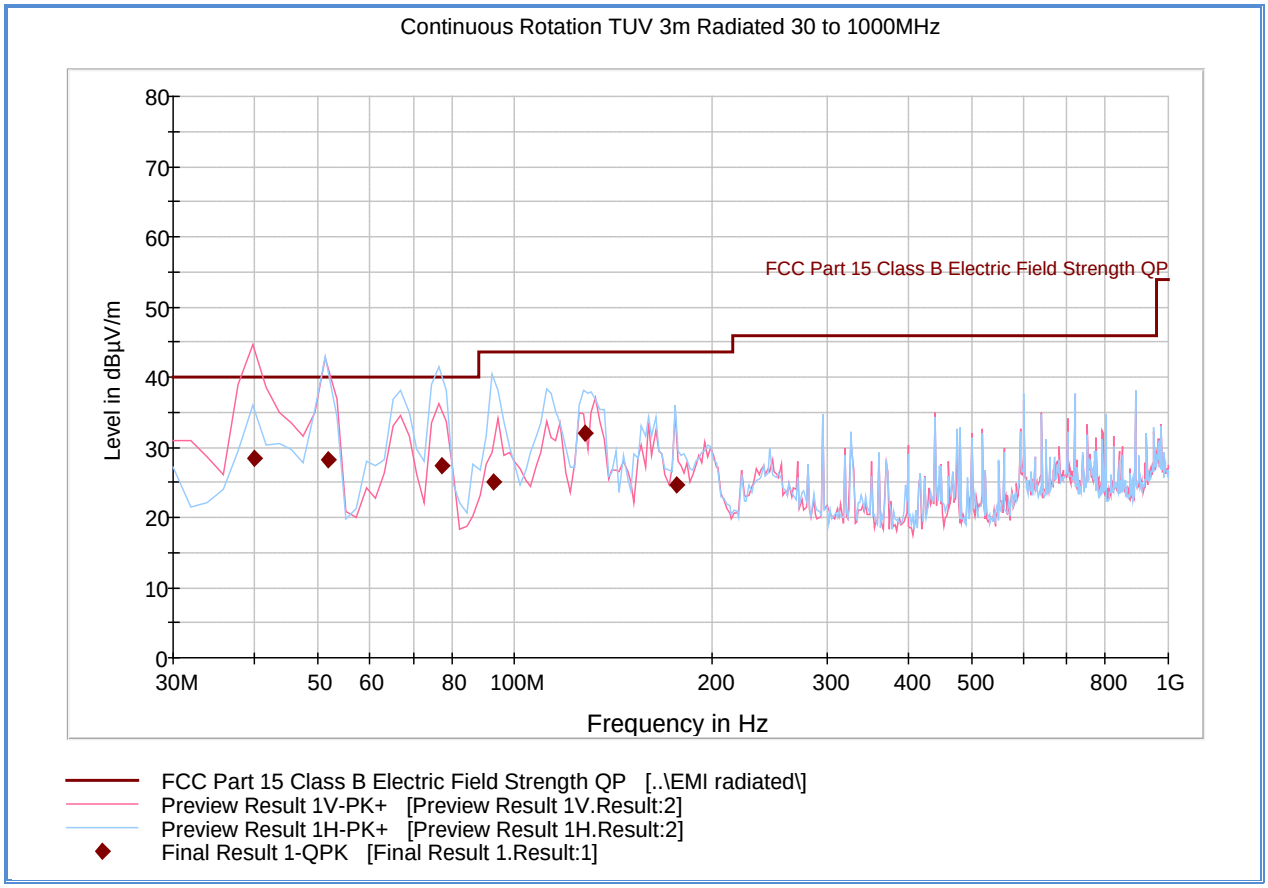


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
34.440000	19.8	1000.0	120.000	150.0	V	291.0	-13.9	20.2	40.0
44.087214	23.7	1000.0	120.000	100.0	V	48.0	-18.3	16.3	40.0
87.148858	19.9	1000.0	120.000	104.0	V	10.0	-21.3	20.1	40.0
89.092745	22.0	1000.0	120.000	103.0	V	-15.0	-21.0	21.5	43.5
123.226613	16.4	1000.0	120.000	200.0	V	62.0	-20.6	27.1	43.5
872.567295	18.9	1000.0	120.000	103.0	V	133.0	-0.3	27.1	46.0

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

2.10.11 **Test Results Below 1GHz (Hopping)**

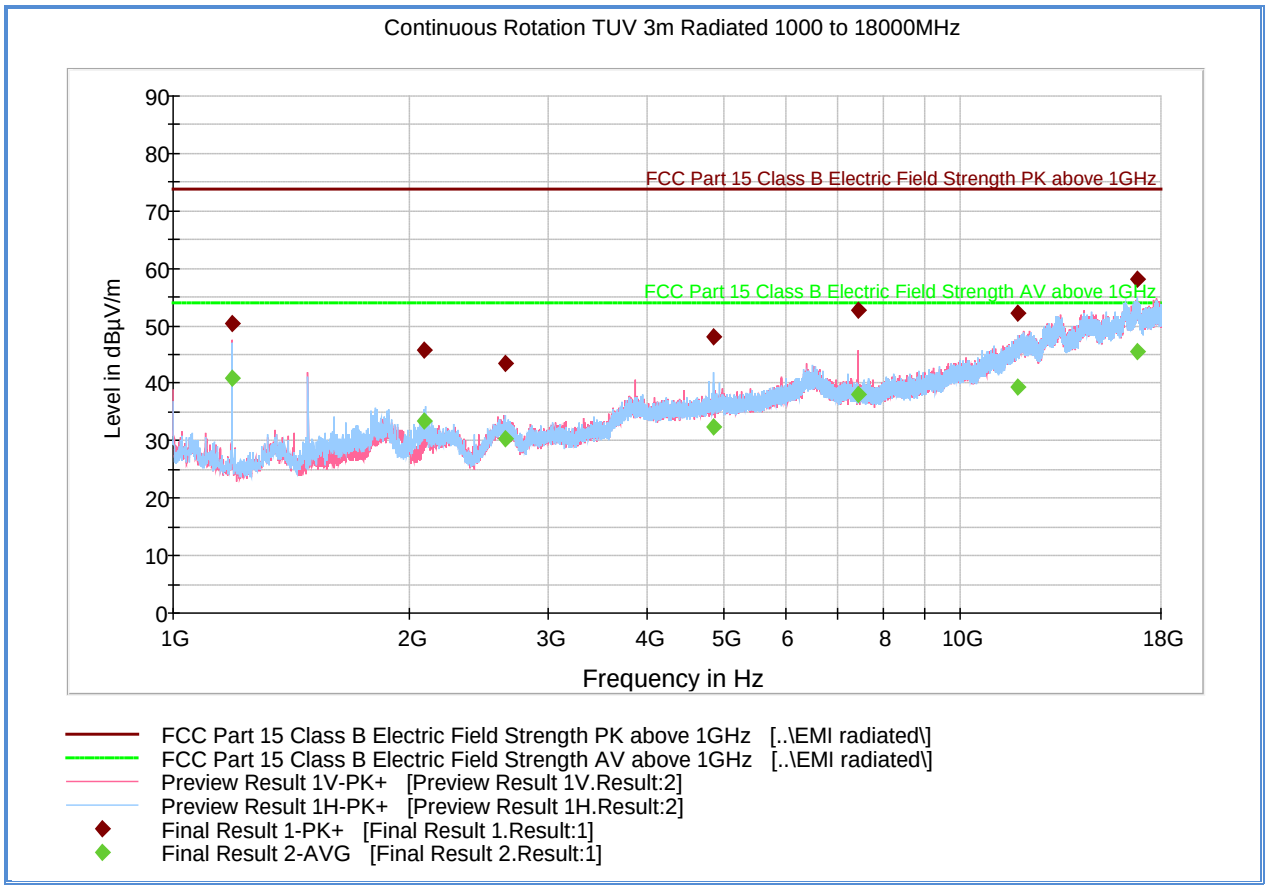


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
39.959439	28.4	1000.0	120.000	167.0	V	267.0	-16.6	11.6	40.0
51.742766	28.2	1000.0	120.000	250.0	H	327.0	-20.3	11.8	40.0
77.413307	27.4	1000.0	120.000	244.0	H	133.0	-22.2	12.6	40.0
93.004409	25.1	1000.0	120.000	198.0	H	-15.0	-20.3	18.4	43.5
127.994389	31.9	1000.0	120.000	250.0	H	272.0	-21.1	11.6	43.5
176.831583	24.6	1000.0	120.000	150.0	H	15.0	-18.0	18.9	43.5

Test Notes:

2.10.12 Test Results Above 1GHz (Hopping)



Peak Data

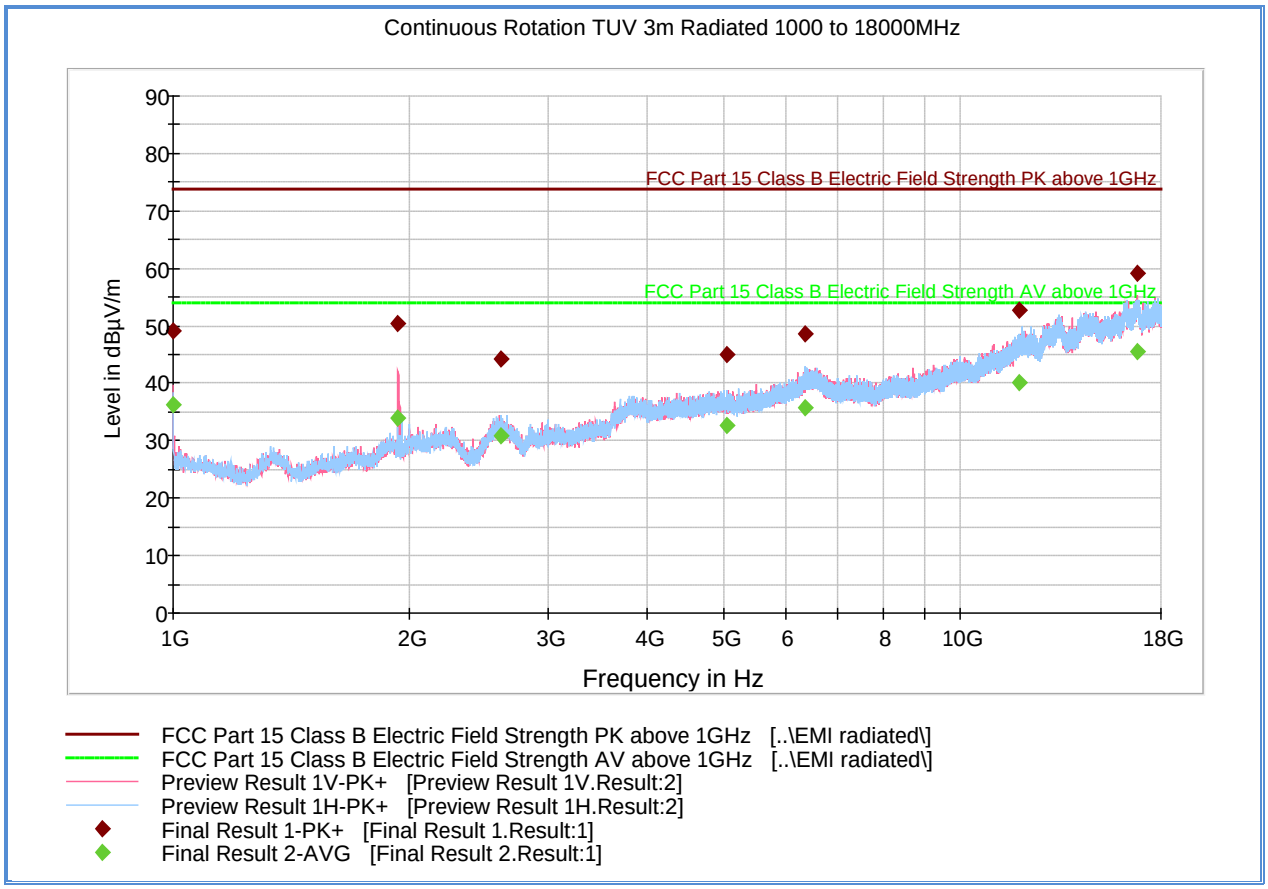
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1187.766667	50.3	1000.0	1000.000	205.5	V	154.0	-6.3	23.6	73.9
2088.533333	45.9	1000.0	1000.000	153.7	H	201.0	-1.5	28.0	73.9
2640.900000	43.4	1000.0	1000.000	264.3	H	170.0	-0.2	30.5	73.9
4856.033333	48.2	1000.0	1000.000	171.6	H	16.0	6.0	25.7	73.9
7423.933333	52.7	1000.0	1000.000	151.6	V	202.0	9.6	21.2	73.9
11823.300000	52.1	1000.0	1000.000	185.5	H	201.0	17.0	21.8	73.9
16800.733333	58.0	1000.0	1000.000	164.6	H	174.0	24.8	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)
1187.766667	40.8	1000.0	1000.000	205.5	V	154.0	-6.3	13.1	53.9
2088.533333	33.3	1000.0	1000.000	153.7	H	201.0	-1.5	20.6	53.9
2640.900000	30.4	1000.0	1000.000	264.3	H	170.0	-0.2	23.5	53.9
4856.033333	32.4	1000.0	1000.000	171.6	H	16.0	6.0	21.5	53.9
7423.933333	38.1	1000.0	1000.000	151.6	V	202.0	9.6	15.8	53.9
11823.300000	39.2	1000.0	1000.000	185.5	H	201.0	17.0	14.7	53.9
16800.733333	45.5	1000.0	1000.000	164.6	H	174.0	24.8	8.4	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.10.13 Test Results Above 1GHz Low Channel



Peak Data

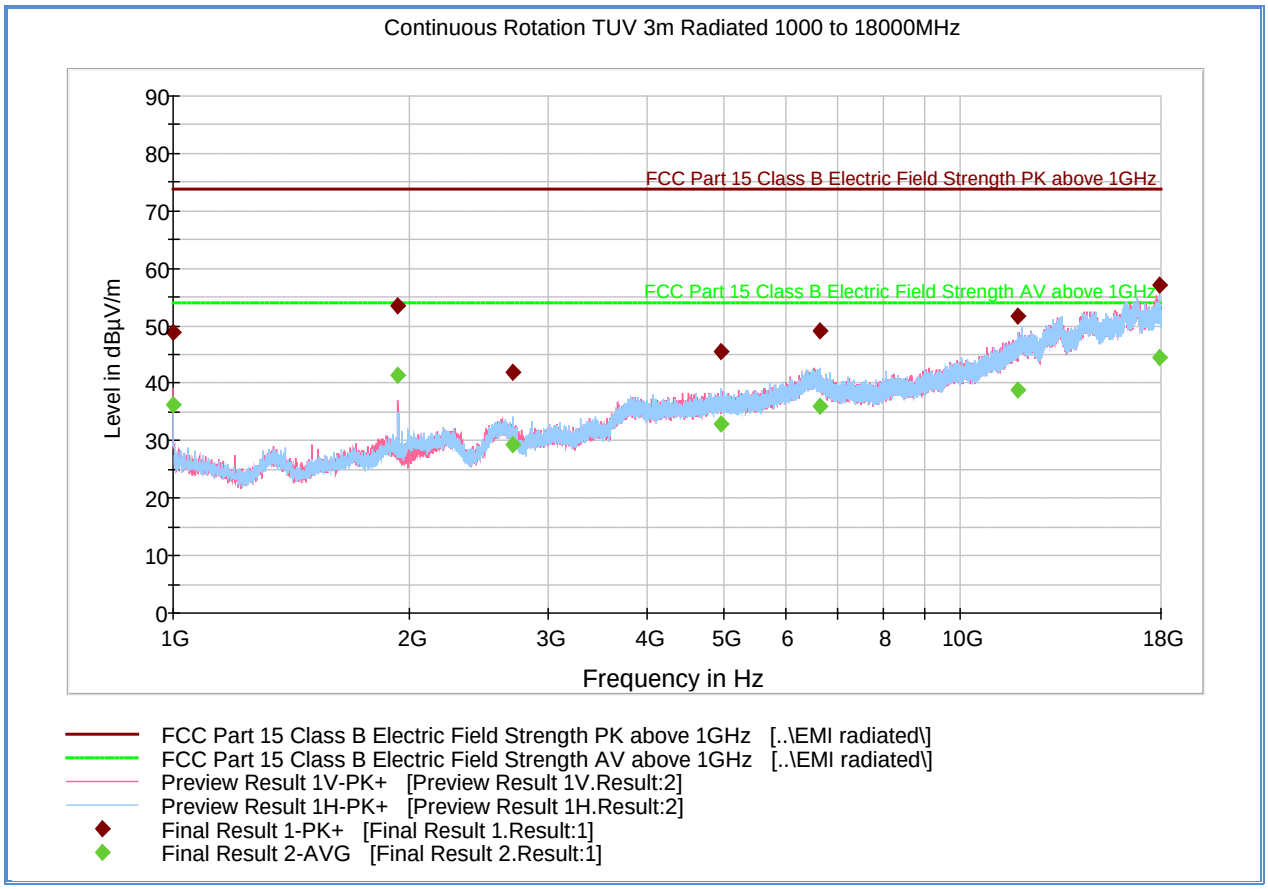
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	49.1	1000.0	1000.000	188.5	V	190.0	-7.2	24.8	73.9
1932.566667	50.5	1000.0	1000.000	169.6	V	149.0	-2.3	23.4	73.9
2606.633333	44.1	1000.0	1000.000	254.3	H	228.0	0.1	29.8	73.9
5057.466667	45.1	1000.0	1000.000	179.6	H	172.0	6.5	28.8	73.9
6341.633333	48.6	1000.0	1000.000	130.7	H	123.0	11.0	25.3	73.9
11897.133333	52.8	1000.0	1000.000	251.5	H	190.0	17.7	21.1	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	36.1	1000.0	1000.000	188.5	V	190.0	-7.2	17.8	53.9
1932.566667	34.1	1000.0	1000.000	169.6	V	149.0	-2.3	19.8	53.9
2606.633333	31.0	1000.0	1000.000	254.3	H	228.0	0.1	22.9	53.9
5057.466667	32.5	1000.0	1000.000	179.6	H	172.0	6.5	21.4	53.9
6341.633333	35.8	1000.0	1000.000	130.7	H	123.0	11.0	18.1	53.9
11897.133333	40.1	1000.0	1000.000	251.5	H	190.0	17.7	13.8	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.10.14 Test Results Above 1GHz Mid Channel



Peak Data

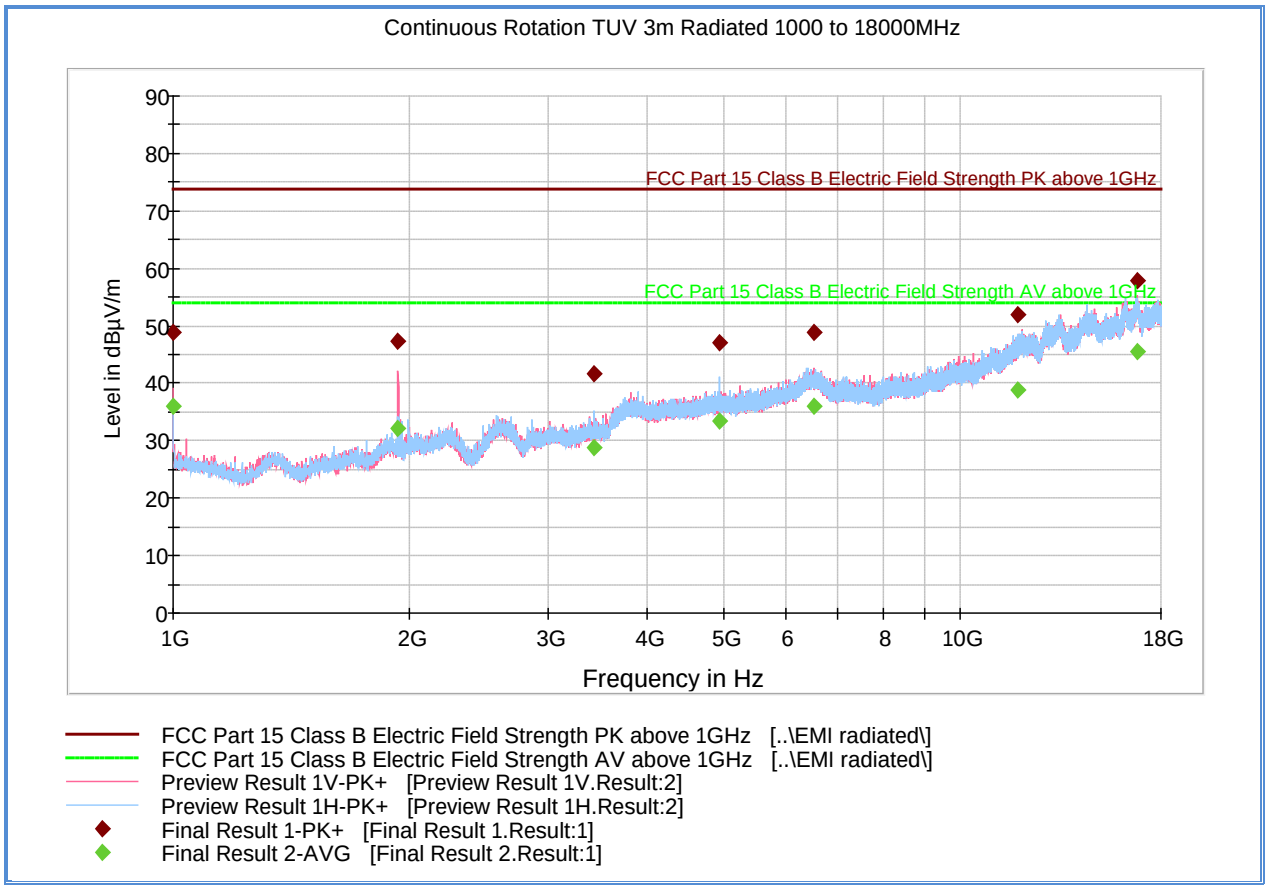
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.8	1000.0	1000.000	180.6	V	153.0	-7.2	25.1	73.9
1932.366667	53.5	1000.0	1000.000	233.4	V	245.0	-2.3	20.4	73.9
2705.633333	41.9	1000.0	1000.000	232.4	H	5.0	0.2	32.0	73.9
4962.366667	45.5	1000.0	1000.000	130.7	H	70.0	6.5	28.4	73.9
6633.600000	49.1	1000.0	1000.000	141.7	H	29.0	11.3	24.8	73.9
11816.166667	51.8	1000.0	1000.000	202.3	H	162.0	17.0	22.1	73.9
17928.400000	57.2	1000.0	1000.000	195.5	H	23.0	24.0	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)
1000.000000	36.2	1000.0	1000.000	180.6	V	153.0	-7.2	17.7	53.9
1932.366667	41.4	1000.0	1000.000	233.4	V	245.0	-2.3	12.5	53.9
2705.633333	29.3	1000.0	1000.000	232.4	H	5.0	0.2	24.6	53.9
4962.366667	32.9	1000.0	1000.000	130.7	H	70.0	6.5	21.0	53.9
6633.600000	36.1	1000.0	1000.000	141.7	H	29.0	11.3	17.8	53.9
11816.166667	38.8	1000.0	1000.000	202.3	H	162.0	17.0	15.1	53.9
17928.400000	44.5	1000.0	1000.000	195.5	H	23.0	24.0	9.4	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.10.15 Test Results Above 1GHz 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)
1000.000000	49.0	1000.0	1000.000	177.6	V	20.0	-7.2	24.9	73.9
1932.166667	47.3	1000.0	1000.000	224.4	V	10.0	-2.3	26.6	73.9
3433.100000	41.6	1000.0	1000.000	140.7	H	123.0	1.8	32.3	73.9
4956.300000	47.0	1000.0	1000.000	163.6	H	181.0	6.5	26.9	73.9
6518.200000	48.8	1000.0	1000.000	115.7	V	27.0	11.5	25.1	73.9
11820.300000	52.0	1000.0	1000.000	284.2	H	-20.0	17.0	21.9	73.9
16794.833333	58.0	1000.0	1000.000	244.4	V	63.0	24.7	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	35.9	1000.0	1000.000	177.6	V	20.0	-7.2	18.0	53.9
1932.166667	32.2	1000.0	1000.000	224.4	V	10.0	-2.3	21.7	53.9
3433.100000	28.8	1000.0	1000.000	140.7	H	123.0	1.8	25.1	53.9
4956.300000	33.4	1000.0	1000.000	163.6	H	181.0	6.5	20.5	53.9
6518.200000	35.9	1000.0	1000.000	115.7	V	27.0	11.5	18.0	53.9
11820.300000	38.7	1000.0	1000.000	284.2	H	-20.0	17.0	15.2	53.9
16794.833333	45.5	1000.0	1000.000	244.4	V	63.0	24.7	8.4	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 8GHz. Measurements above 8GHz are noise floor figures.

2.11 RADIATED IMMEDIATE RESTRICTED BANDS

2.11.1 Specification Reference

Part 15 Subpart C §15.247(d) and RSS-Gen 8.9 / 8.10

2.11.2 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)).

2.11.3 Equipment Under Test and Modification State

Serial No: N/A /Test Configuration B

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

October 12, 2015/FSC

2.11.5 Test Equipment Used

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

2.11.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.6 °C
Relative Humidity	48.2 %
ATM Pressure	98.7 kPa

2.11.7 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.
- Both Non-hopping and Hopping modes presented.

- 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 2.11.8 for sample computation.

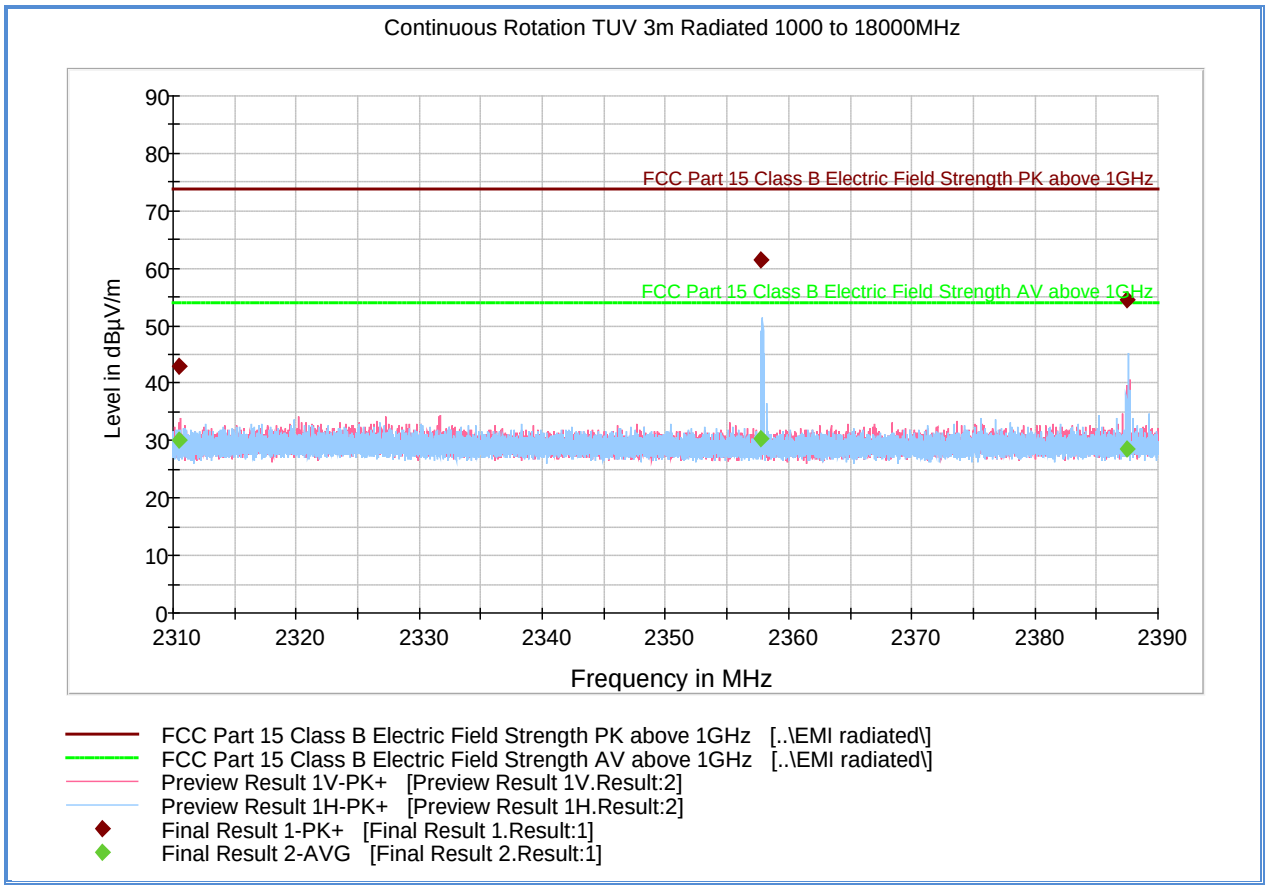
2.11.8 Sample Computation (Radiated Emission)

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**

2.11.9 Test Results

See attached plots.

2.11.10 **Test Results Restricted Band 2310MHz to 2390MHz (Hopping)**



Peak Data

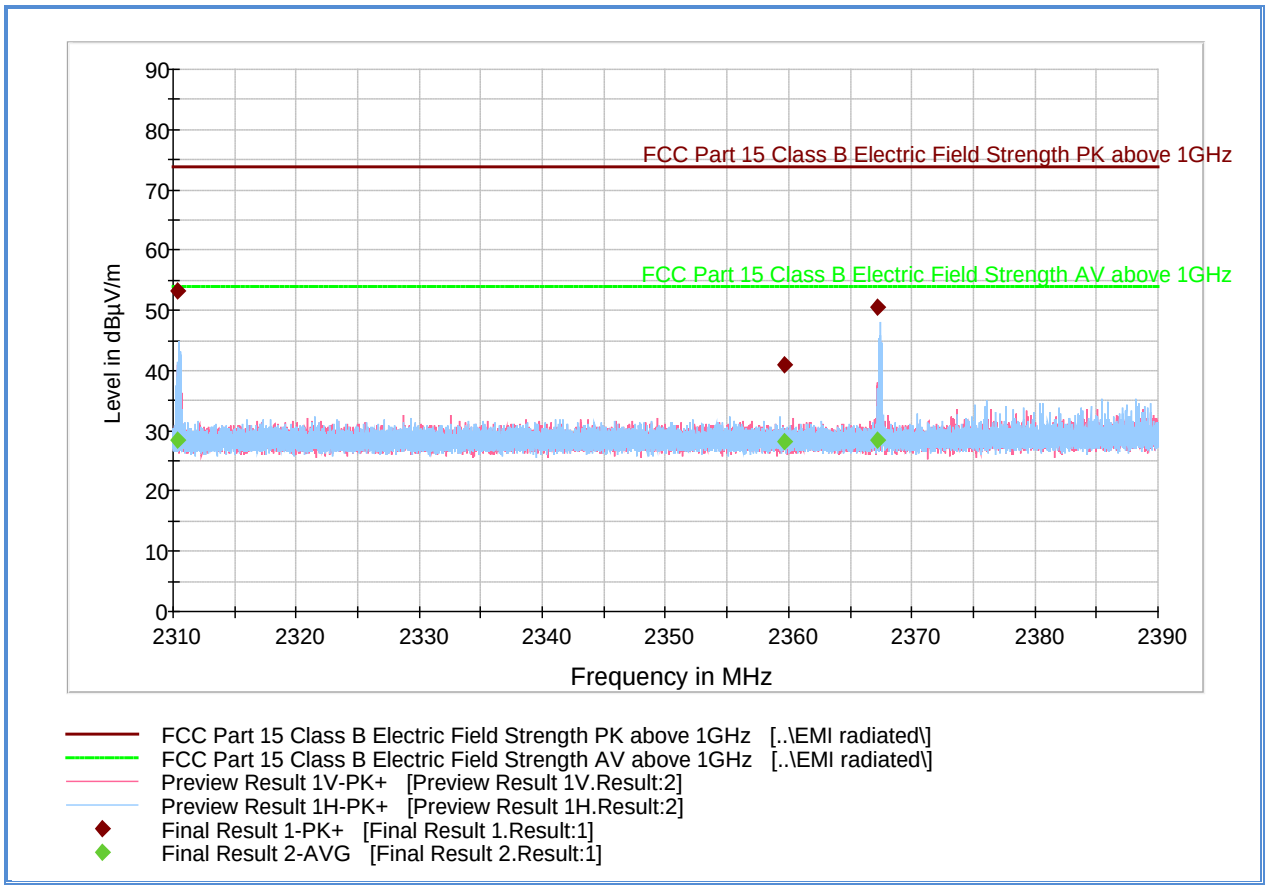
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.448000	42.9	1000.0	1000.000	198.5	V	169.0	-0.7	31.0	73.9
2357.714667	61.5	1000.0	1000.000	198.5	H	45.0	-0.7	12.4	73.9
2387.442667	54.6	1000.0	1000.000	198.5	H	112.0	-0.6	19.3	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)
2310.448000	30.2	1000.0	1000.000	198.5	V	169.0	-0.7	23.7	53.9
2357.714667	30.4	1000.0	1000.000	198.5	H	45.0	-0.7	23.5	53.9
2387.442667	28.6	1000.0	1000.000	198.5	H	112.0	-0.6	25.3	53.9

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

2.11.11 Test Results Restricted Band 2310MHz to 2390MHz (Low Channel)



Peak Data

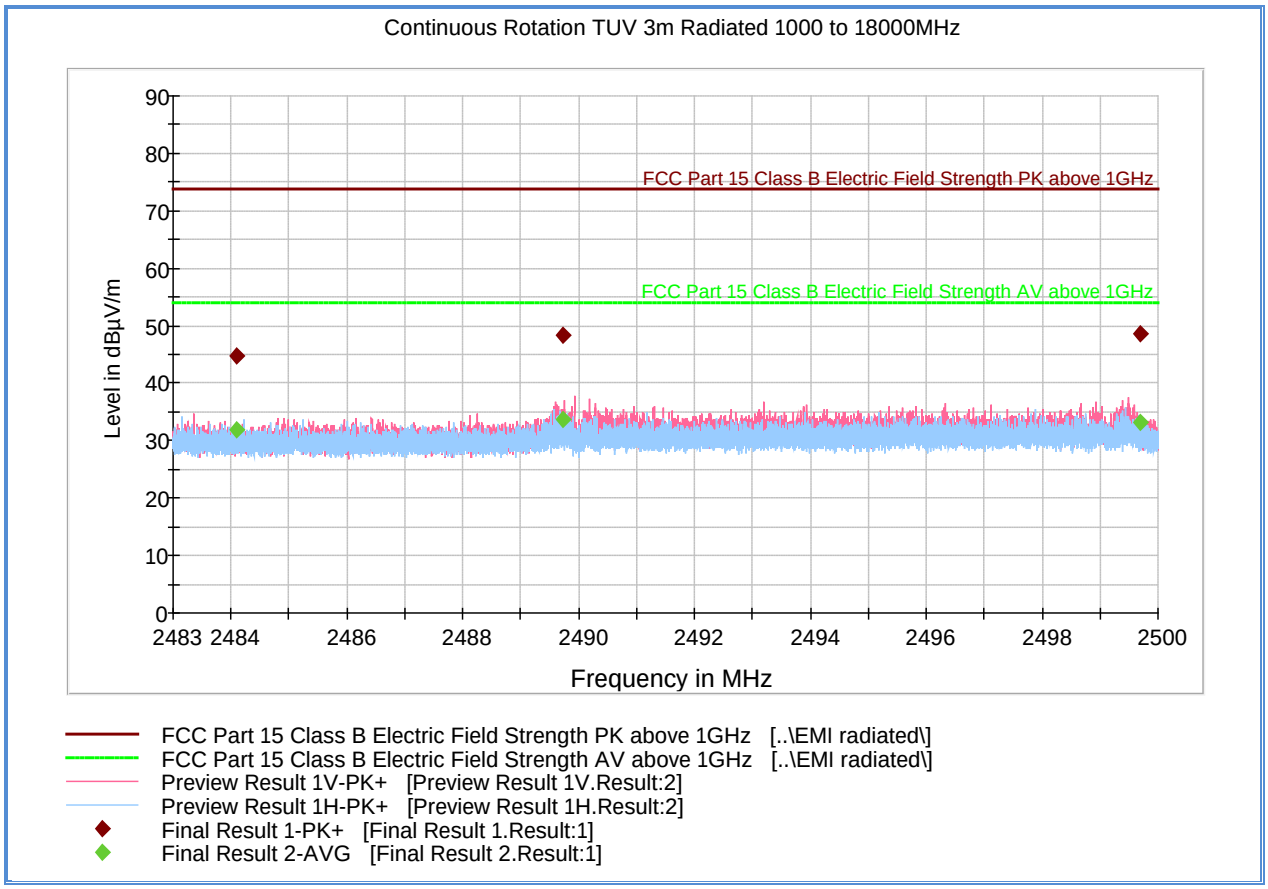
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.400000	53.2	1000.0	1000.000	207.5	H	52.0	-0.7	20.7	73.9
2359.682667	40.9	1000.0	1000.000	202.3	H	38.0	-0.7	33.0	73.9
2367.261333	50.5	1000.0	1000.000	117.7	H	308.0	-0.7	23.4	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)
2310.400000	28.4	1000.0	1000.000	207.5	H	52.0	-0.7	25.5	53.9
2359.682667	28.1	1000.0	1000.000	202.3	H	38.0	-0.7	25.8	53.9
2367.261333	28.4	1000.0	1000.000	117.7	H	308.0	-0.7	25.5	53.9

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

2.11.12 Test Results Restricted Band 2483.5MHz to 2500MHz (Hopping)



Peak Data

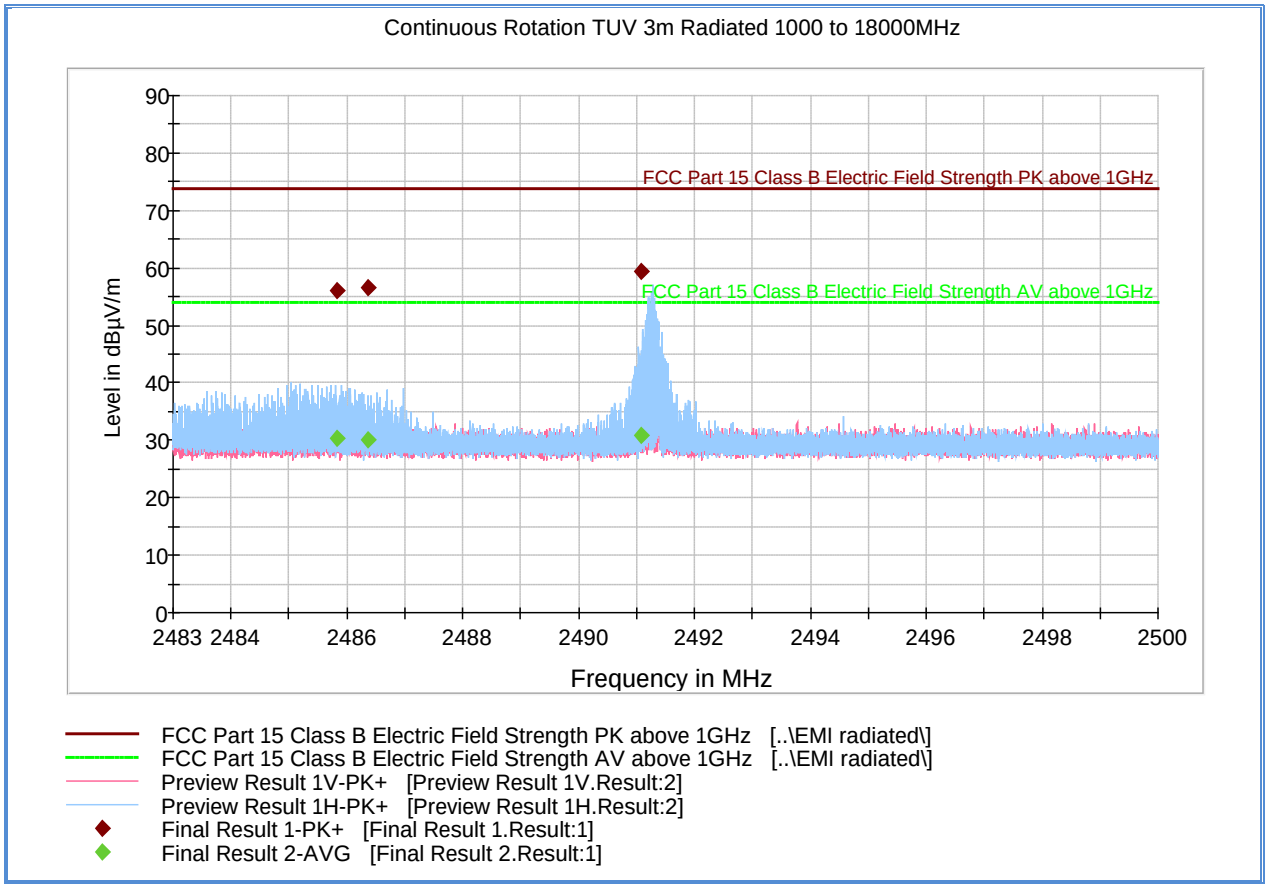
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.100000	44.7	1000.0	1000.000	103.7	V	242.0	-0.1	29.2	73.9
2489.720700	48.4	1000.0	1000.000	200.5	V	233.0	0.0	25.5	73.9
2499.683767	48.6	1000.0	1000.000	200.5	V	233.0	0.0	25.3	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)
2484.100000	31.9	1000.0	1000.000	103.7	V	242.0	-0.1	22.0	53.9
2489.720700	33.6	1000.0	1000.000	200.5	V	233.0	0.0	20.3	53.9
2499.683767	33.2	1000.0	1000.000	200.5	V	233.0	0.0	20.7	53.9

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

2.11.13 Test Results Restricted Band 2483.5MHz to 2500MHz (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)
2485.830933	56.1	1000.0	1000.000	131.7	H	35.0	0.0	17.8	73.9
2486.372900	56.5	1000.0	1000.000	207.5	H	301.0	0.0	17.4	73.9
2491.073900	59.3	1000.0	1000.000	131.7	H	35.0	0.0	14.6	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)
2485.830933	30.3	1000.0	1000.000	131.7	H	35.0	0.0	23.6	53.9
2486.372900	30.2	1000.0	1000.000	207.5	H	301.0	0.0	23.7	53.9
2491.073900	30.8	1000.0	1000.000	131.7	H	35.0	0.0	23.1	53.9

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

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						
7604	P-Series Power Meter	N1912A	SG45100273	Agilent	05/27/15	05/27/16
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	04/10/15	04/10/16
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	03/25/15	03/25/16
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	04/29/15	04/29/16
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7611	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/16/15	12/16/16
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	02/28/14	02/28/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/20/15	03/20/16
1150	Horn antenna	3160-09	012054-004	ETS	07/16/15	07/16/17
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/08/15	05/08/16
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	04/03/15	04/03/16
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 1003 and 7611	
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1003 and 7611	
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	04/10/15	04/10/16
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	07/14/15	07/14/16
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/20/15	02/20/16
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	04/09/15	04/09/16
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated 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	0.57	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

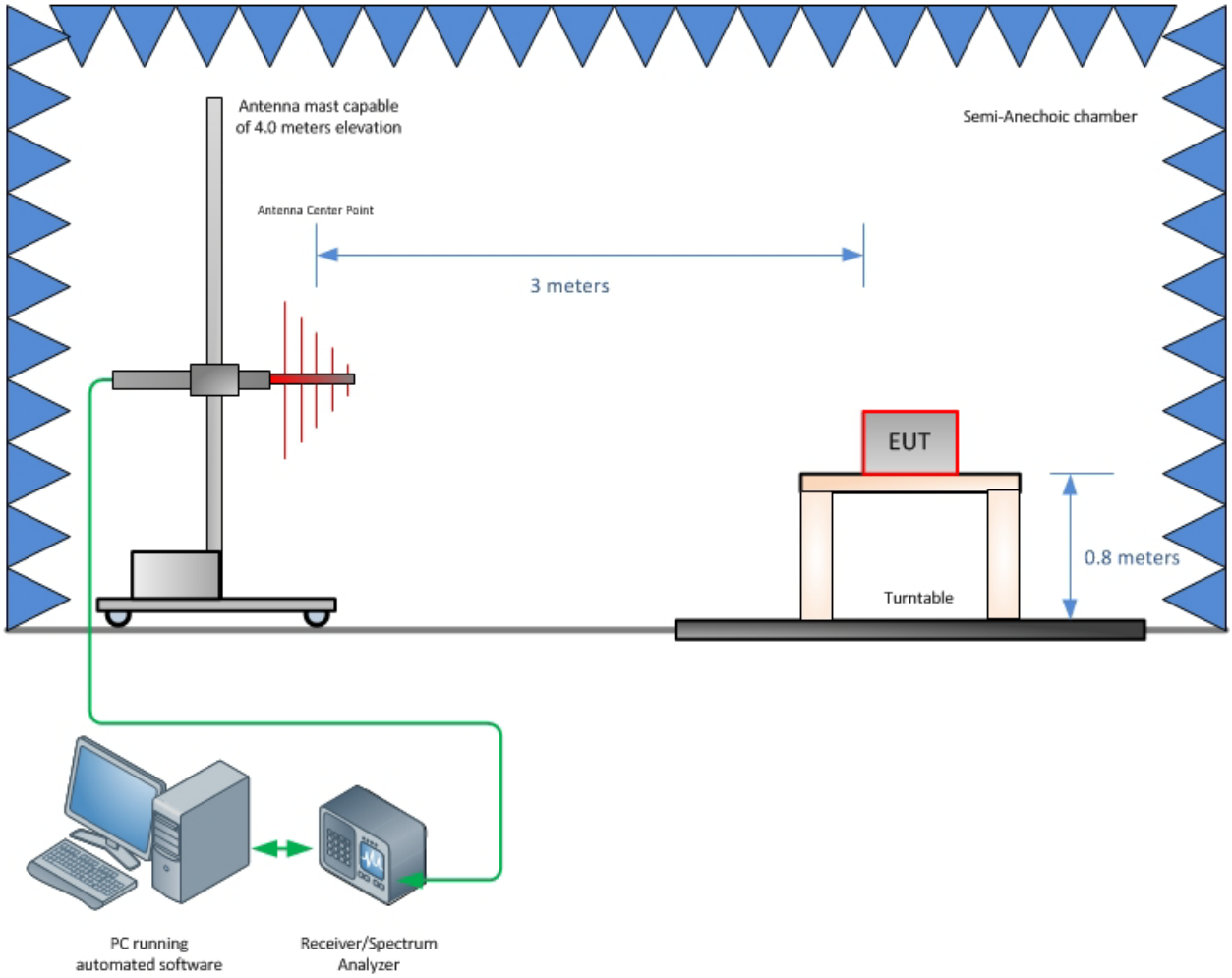
3.2.1 AC Conducted Measurements

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.80
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.59

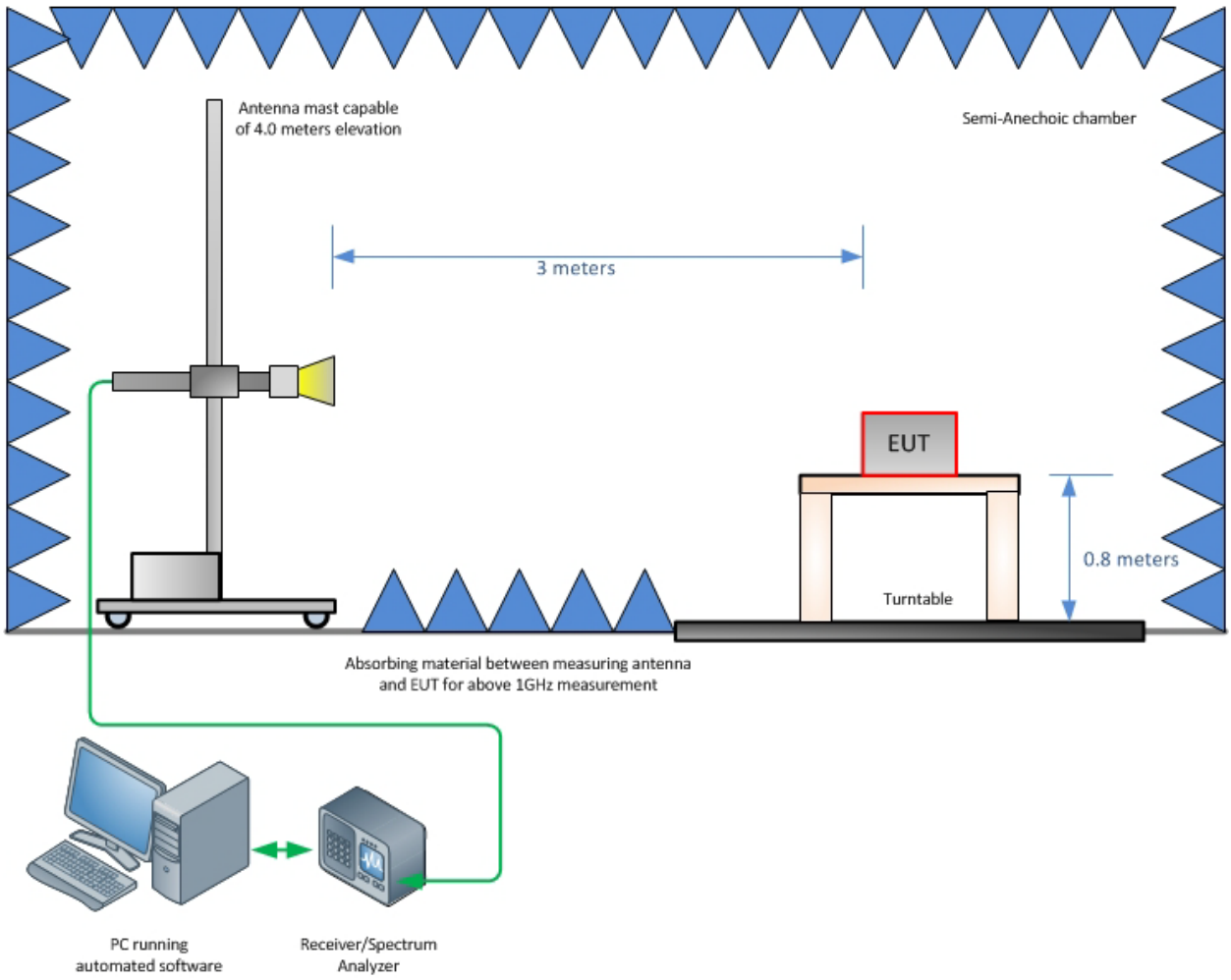
SECTION 4

DIAGRAM OF TEST SETUP

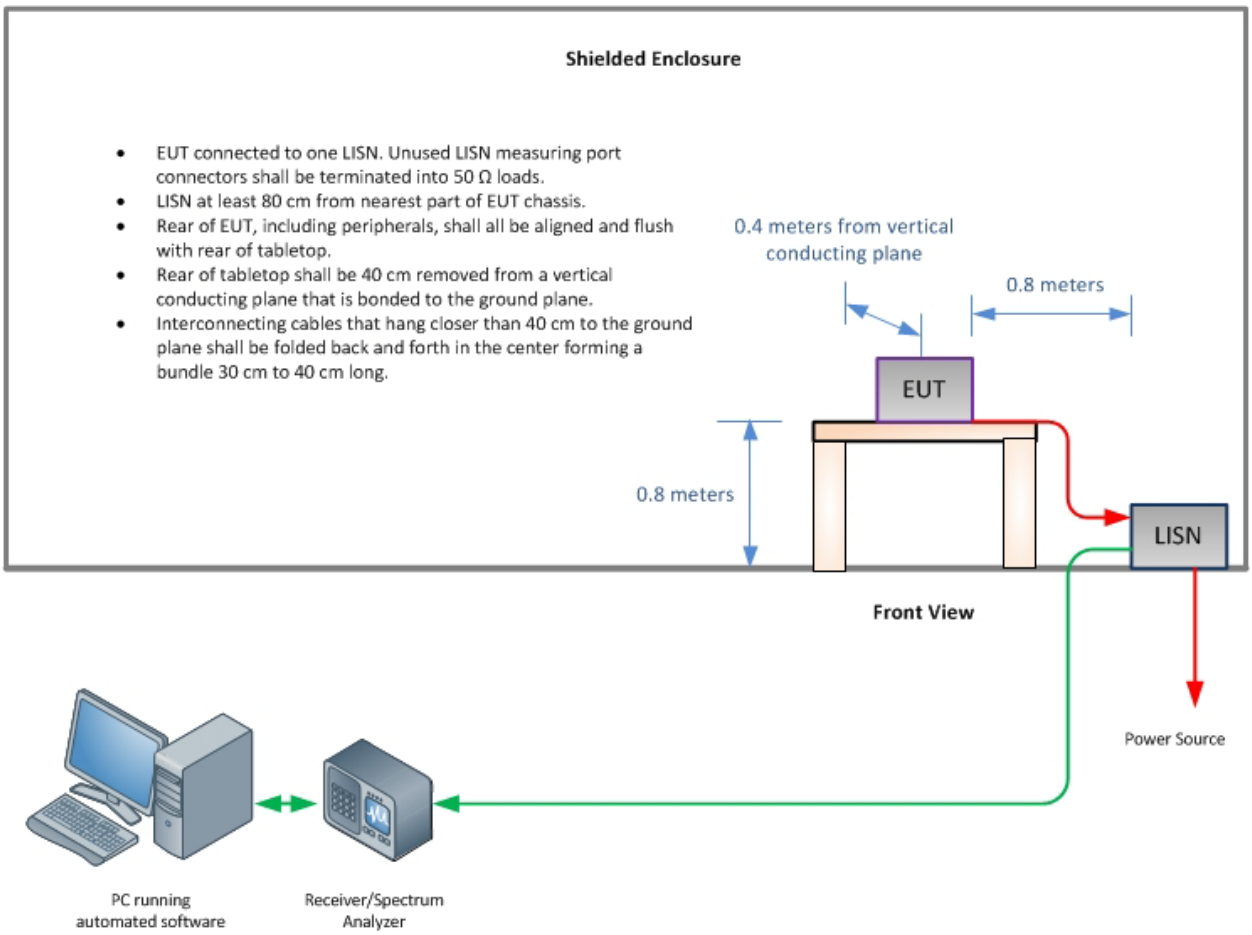
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup

SECTION 5

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