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Report On

Application for Grant of Equipment Authorization of the
CalAmp Wireless Networks Corp.
FOB10-BL Bluetooth Keyfob

FCC Part 15 Subpart C §15.247 (FHSS)
IC RSS-247 Issue 1 May 2015

Report No. SD72109242-0815C Rev.1

August 2015





REPORT ON Radio Testing of the
CalAmp Wireless Networks Corp.
Bluetooth Keyfob

TEST REPORT NUMBER SD72109242-0815C Rev.1

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Title: West Coast EMC Manager

DATED August 31, 2015



Revision History

SD72109242-0815C Rev.1 CalAmp Wireless Networks Corp. FOB10-BL Bluetooth Keyfob					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
08/31/2015	Initial Release				Chip R. Fleury
10/15/2015	Initial Release	Rev.1	Client requested model number change from FOB10-BL100 and FOB10-BL300 to FOB10-BL only (single model)		Ferdinand S. Custodio



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SECTION 1

REPORT SUMMARY

Radio Testing of the
CalAmp Wireless Networks Corp.
Bluetooth Keyfob



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the CalAmp Wireless Networks Corp. FOB10-BL Bluetooth Keyfob 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	CalAmp Wireless Networks Corp.
Model Number(s)	FOB10-BL
FCC ID Number	APV-FOB10
IC Number	5843C-FOB10
Serial Number(s)	N/A
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).• 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.• 558074 D01 DTS Meas Guidance v03r03, (June 09, 2015) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.
Start of Test	August 24, 2015
Finish of Test	August 28, 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-247 5.4(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-247 5.2(1)	Minimum 6 dB RF Bandwidth	Compliant	
2.5	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
2.6	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	Compliant	
2.7		RSS-Gen 7.1	Receiver Spurious Emissions	Compliant	
2.8	§15.247(d)	RSS-Gen 8.9 and 8.10	Radiated Band Edge Measurements	Compliant	
2.9	§15.247(e)	RSS-247 5.2(2)	Power Spectral Density for Digitally Modulated Device	Compliant	

N/A *Not performed. EUT is battery powered.*

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a CalAmp Wireless Networks Corp. FOB10-BL Bluetooth Keyfob as shown in the photograph below. The EUT uses a single CR2032 3 volts coin cell battery. The EUT provides unique serial number and pushbutton status via Bluetooth 4.0 Low Energy technology to a host LMU device for purposes of a wide range of applications including Driver ID, privacy mode management, job status, panic button and others. The Bluetooth LE function of the EUT was verified in this test report.



Equipment Under Test



1.3.2 **EUT General Description**

EUT Description	Bluetooth Keyfob
Model Name	FOB10-BL
Model Number(s)	FOB10-BL
Rated Voltage (Battery Type)	Single coin cell battery (CR2032 3V)
Mode Verified	BT LE
Capability	Bluetooth LE (Single Mode)
Primary Unit (EUT)	<input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
Antenna Type	Johanson Technology 2.45 GHz Antenna (P/N 2450AT42A100)
Antenna Gain	0 dBi (Peak Gain)

1.3.3 **Maximum Conducted Output Power (Peak)**

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
Bluetooth LE	2402-2480	0.43	1.104

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna conducted port test configuration. A modified sample with temporary antenna port connector was used for this test. The EUT will activate the advertising channels every time a button is pressed. Test mode not available at the time of testing.
B	Radiated emissions test configuration. A button is pressed to activate the advertising channels (Low, Mid and High). The process was repeated until all required measurement points are recorded. Test mode not available at the time of testing.

1.4.2 EUT Exercise Software

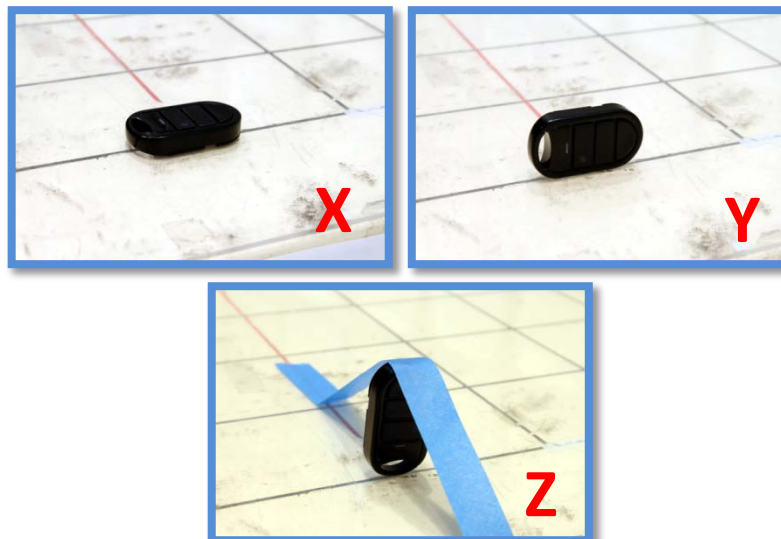
None. No special software was used to exercise the EUT during verification

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
-	-	-

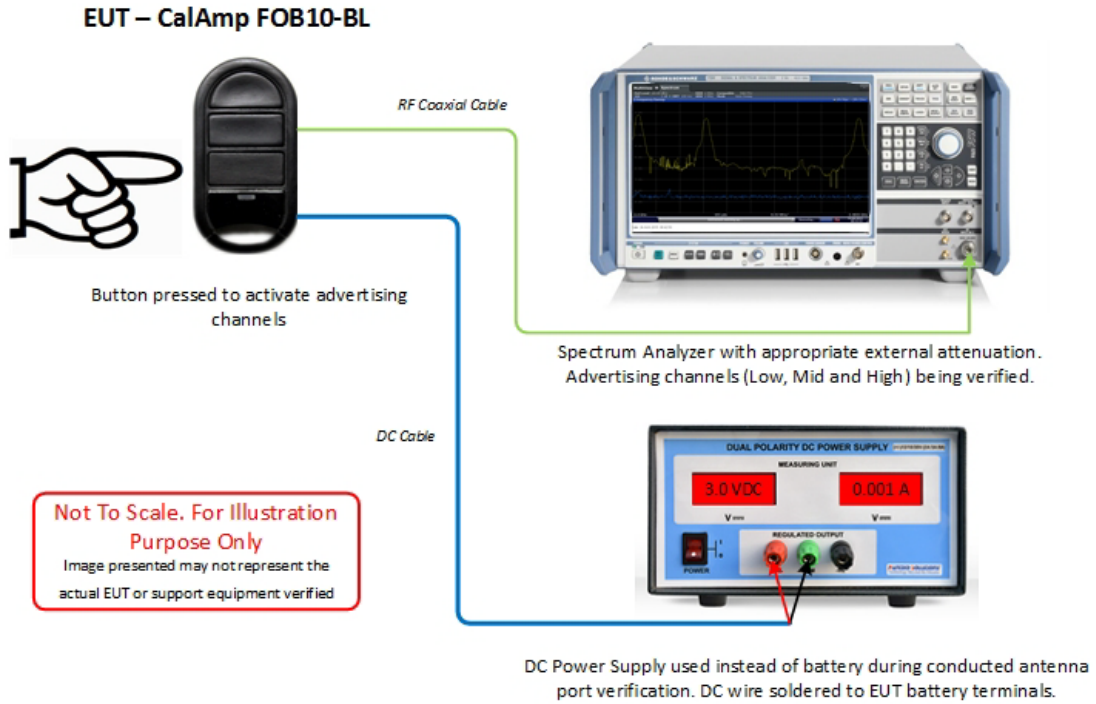
1.4.4 Worst Case Configuration

Not applicable. The EUT will transmit on all three (3) advertising channels when a button is pressed. For radiated measurements, all three axes were verified with all channels transmitting instead of individual channels (test mode) which was not available at the time of verification:

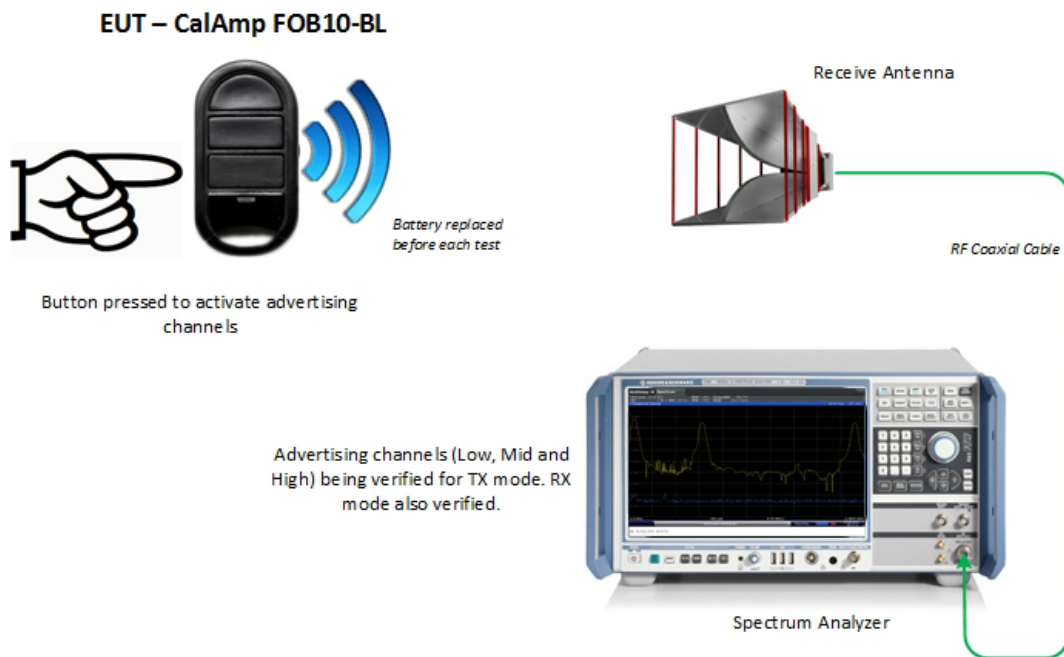


1.4.5 Simplified Test Configuration Diagram

Conducted Antenna Port Test Configuration



Radiated Test Setup 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 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 C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

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

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

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

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.



1.9.2 **Industry Canada (IC) Registration No.: 3067A**

The 10m Semi-anechoic chamber of TÜV SÜD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.



SECTION 2

TEST DETAILS

Radio Testing of the
CalAmp Wireless Networks Corp.
Bluetooth Keyfob



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: N/A / Test Configuration A

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

August 28, 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	23.8°C
Relative Humidity	47.6 %
ATM Pressure	98.4 kPa

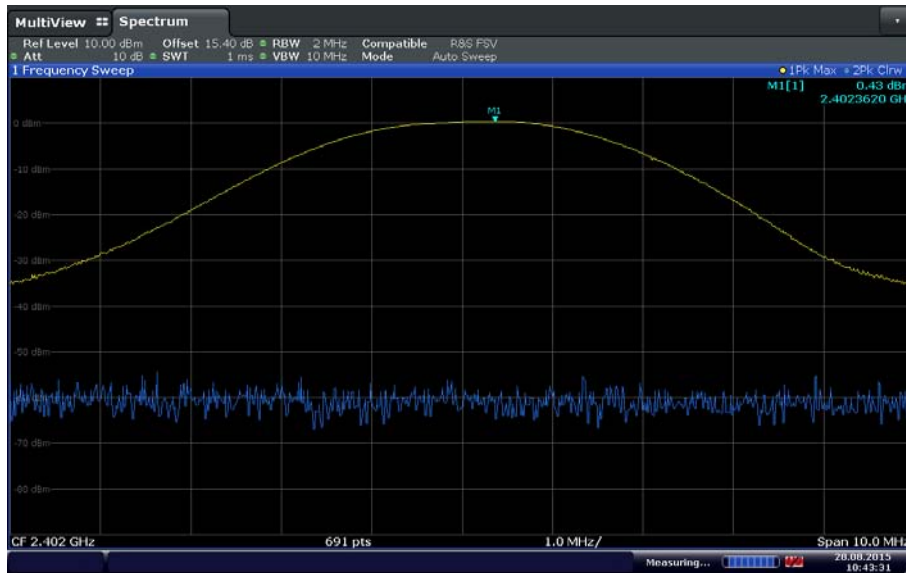
2.1.7 **Additional Observations**

- This is a conducted test (Maximum Peak Conducted Output Power) using direct connection to a spectrum analyzer.
- An offset of 15.4dB was added to compensate for the external attenuator and cable used from the antenna port to the spectrum analyzer.
- Test methodology is per Clause 9.1.1 of KDB 558074 D01 (DTS Meas Guidance v03r03, June 09, 2015). All conditions under this Clause were satisfied.

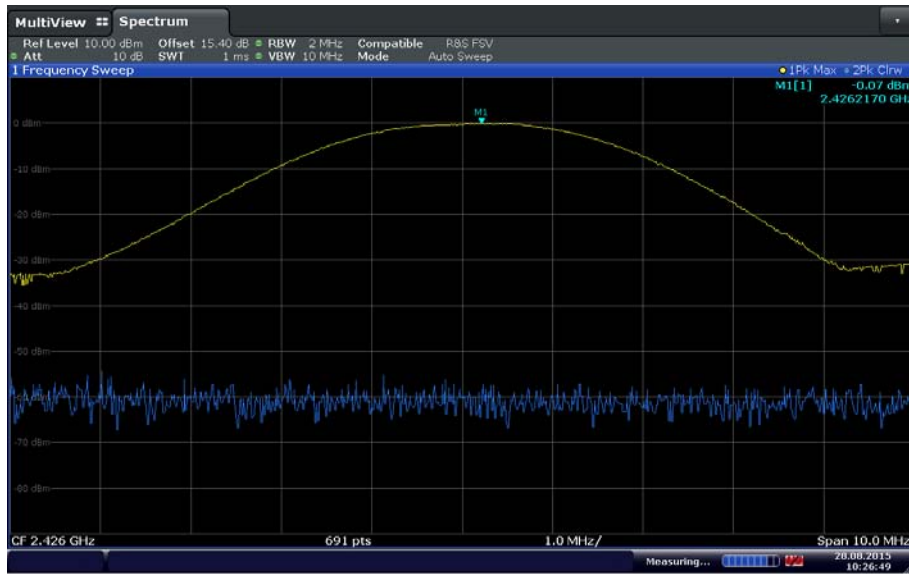
2.1.8 Test Results

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Peak Power (dBm)	Measured Peak Power (mW)
	37 (2402 MHz)	GFSK @ 1Mbps	0.43	1.104
	38 (2426 MHz)		-0.07	0.984
	39 (2480 MHz)		-1.29	0.743

2.1.9 Test Plots

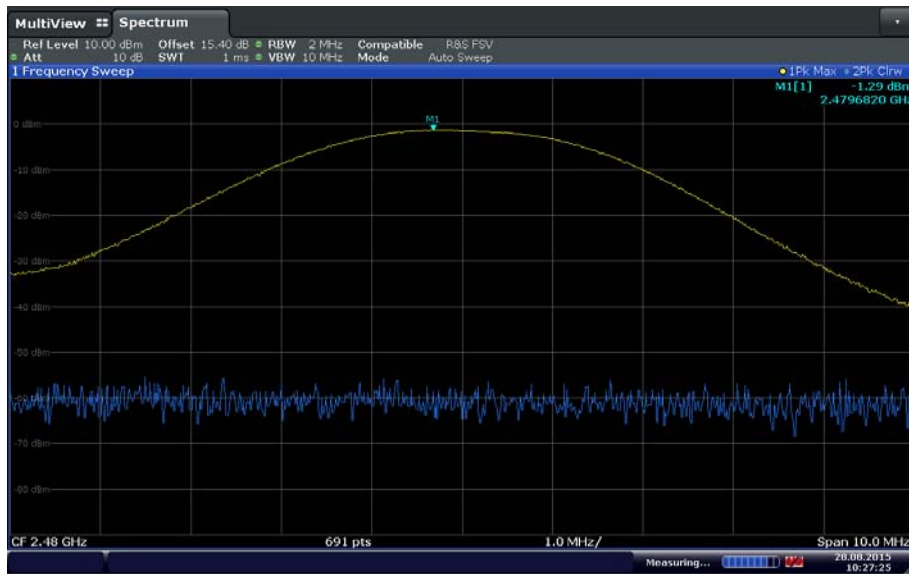


Bluetooth LE. Low Channel



Date: 28 AUG 2015 10:26:50

Bluetooth LE. Mid Channel



Date: 28 AUG 2015 10:27:25

Bluetooth LE. High Channel



2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

Part 15 Subpart C §15.207(a)

2.2.2 Standard Applicable

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

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

Serial No: N/A /Test Configuration B

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

Not performed. EUT is battery powered.



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: N/A / Test Configuration A

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

August 25, 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 49.6 %
 ATM Pressure 98.3 kPa

2.3.7 **Additional Observations**

- This is a conducted test. EUT on normal advertising mode (test mode not available).
- A correction factor of 15.4 dB was used to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% to 5% 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)**

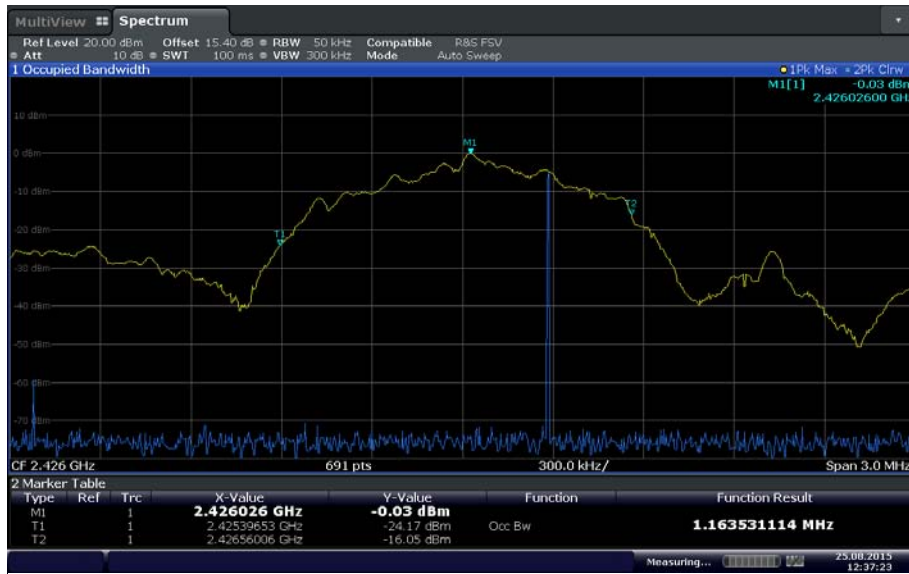
Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	37 (2402 MHz)	1.472
	38 (2426 MHz)	1.164
	39 (2480 MHz)	1.107

2.3.9 **Test Plots**



Date: 25 AUG 2015 12:23:38

Bluetooth LE. Low Channel



Date: 25 AUG 2015 12:37:23

Bluetooth LE. Mid Channel



Date: 25 AUG 2015 12:49:15

Bluetooth LE. 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: N/A / Test Configuration A

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

August 25, 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	49.6 %
ATM Pressure	98.3 kPa

2.4.7 **Additional Observations**

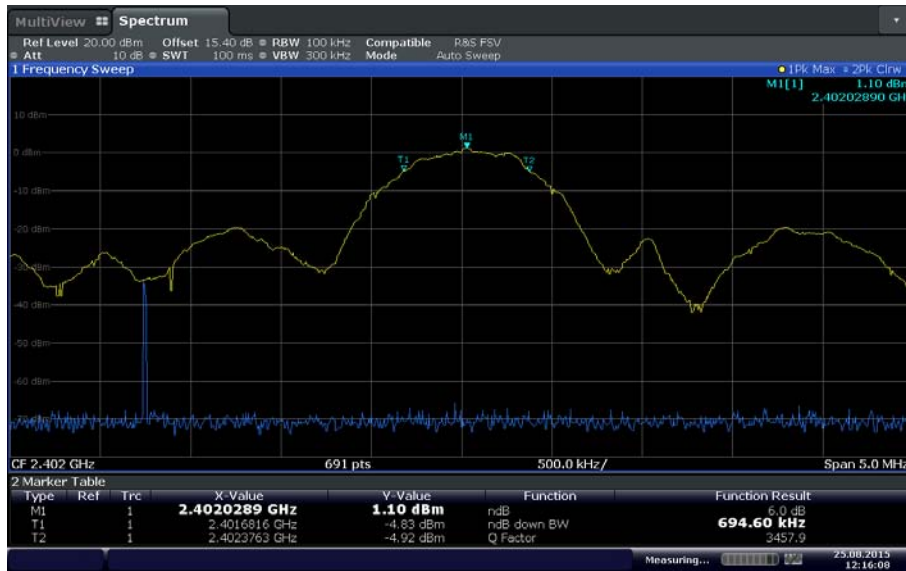
- This is a conducted test.
- A correction factor of 15.4 dB was used to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is set to 100 kHz.
- VBW is $\geq 3X$ RBW.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.



2.4.8 Test Results

Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	37 (2402 MHz)	0.695	0.500	Complies
	38 (2426 MHz)	0.673	0.500	Complies
	39 (2480 MHz)	0.615	0.500	Complies

2.4.9 Test Results Plots



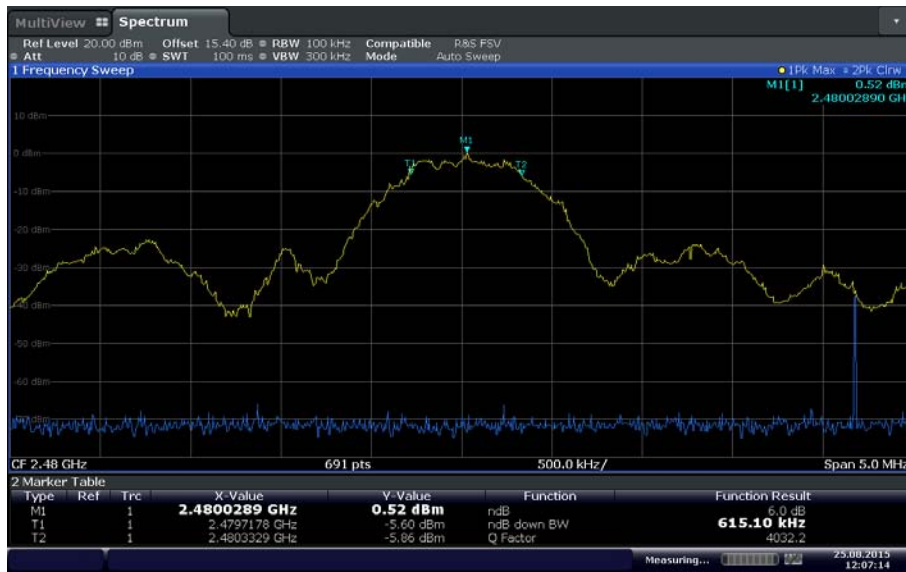
Date: 25 AUG 2015 12:16:08

Bluetooth LE Low Channel



Date: 25 AUG 2015 12:11:03

Bluetooth LE Mid Channel



Date: 25 AUG 2015 12:07:14

Bluetooth LE 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: N/A / Test Configuration A

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

August 25, 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

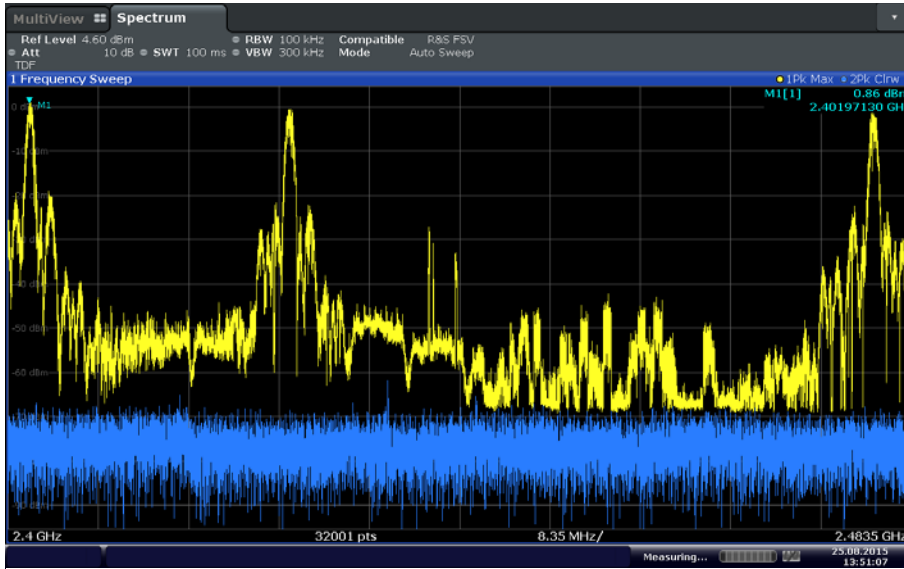
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.8°C
Relative Humidity	49.6 %
ATM Pressure	98.3 kPa

2.5.7 Additional Observations

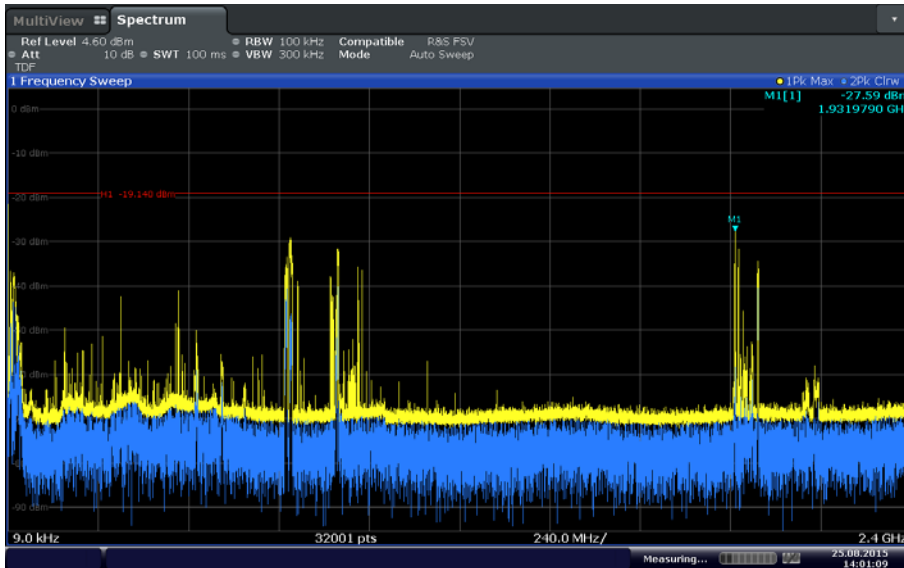
- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold. Sweep points set to maximum.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 20dB below this level.
- Spectrum was searched from 9 kHz up to 26.5GHz.
- Since advertising mode uses all three (3) channels at the same time, sweep was broken down to sections rather than individual channel scan.

2.5.8 Test Results Plots



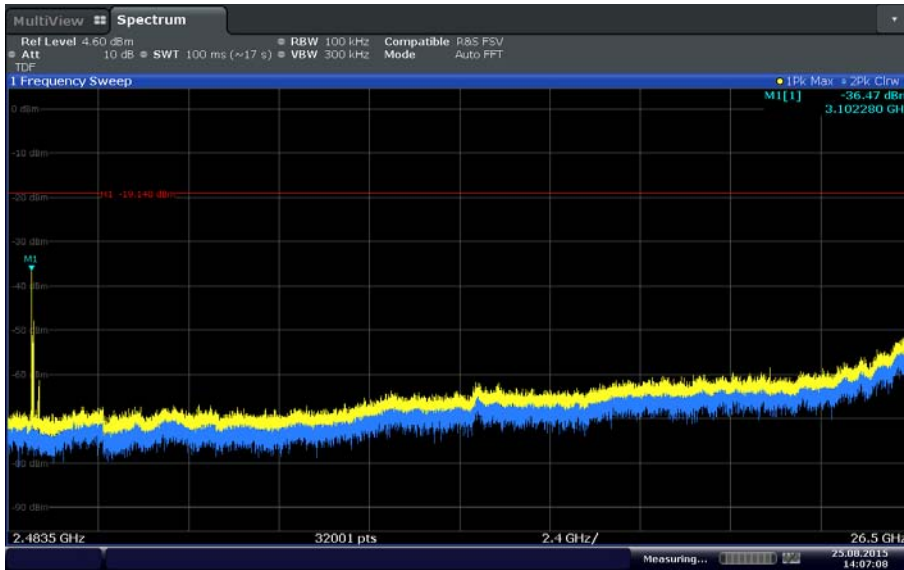
Date: 25 AUG 2015 13:51:07

Bluetooth LE 2.4GHz to 2.4835GHz Sweep (Limit line established)



Date: 25 AUG 2015 14:01:08

Bluetooth LE 9kHz to 2.4GHz Sweep



Date: 25 AUG 2015 14:07:08

Bluetooth LE 2.4835GHz to 26.5GHz Sweep



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: N/A / Test Configuration A

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

August 25, 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

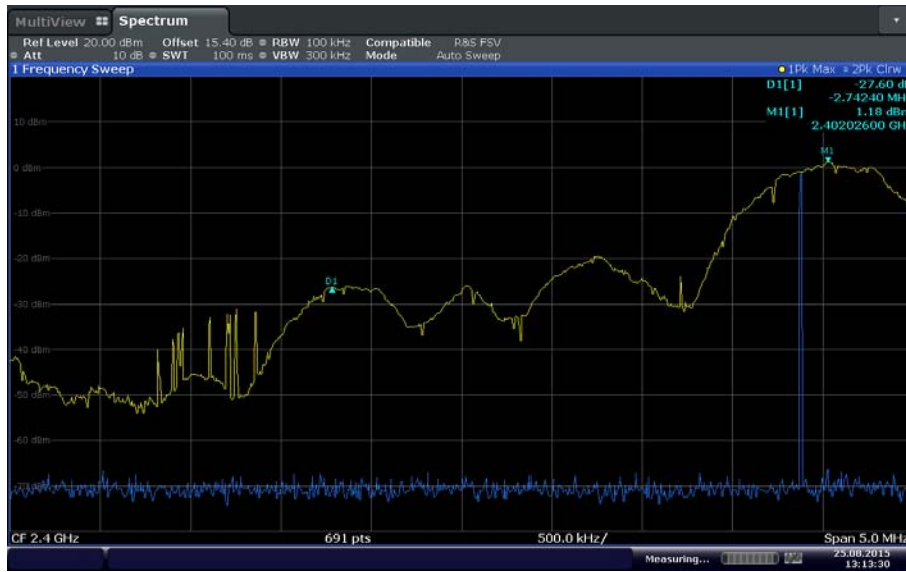
Ambient Temperature	24.8°C
Relative Humidity	49.6 %
ATM Pressure	98.3 kPa

2.6.7 Additional Observations

- This is a conducted test.
- A correction factor of 15.4 dB was used 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.
- Trace was centred on the band-edge frequency.
- Span was set to encompass the band-edge frequency and the peak of the emission.
- Using Marker function, peak of the emission was determined and the delta to the band-edge frequency measured.
- Band-edges were verified ≤ 20 dBc.

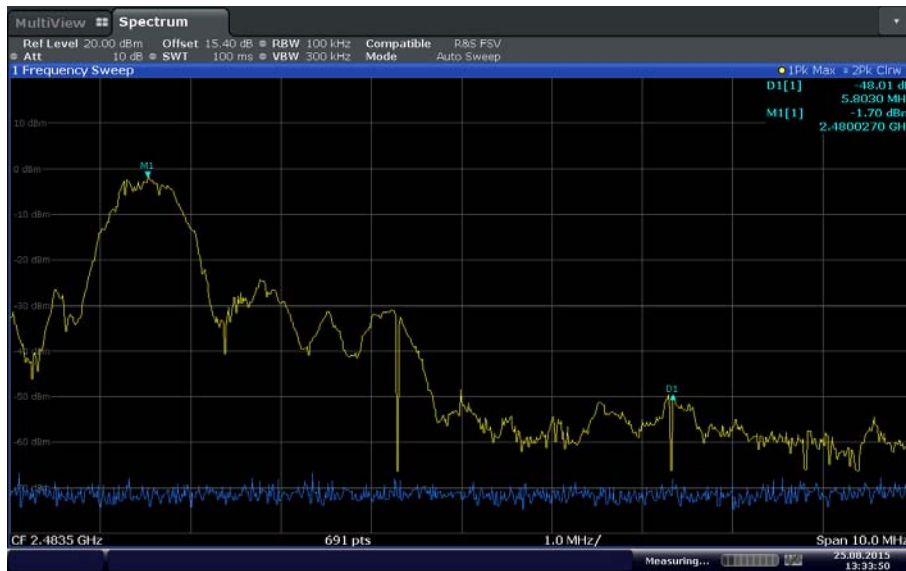
2.6.8 Test Results

Complies. See attached plots.



Date: 25 AUG 2015 13:13:30

Bluetooth LE Low Channel (2402 MHz)



Date: 25 AUG 2015 13:33:50

Bluetooth LE High Channel (2480 MHz)



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: N/A / Test Configuration B

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

August 24, 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	23.7°C
Relative Humidity	47.3 %
ATM Pressure	98.5 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 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)**

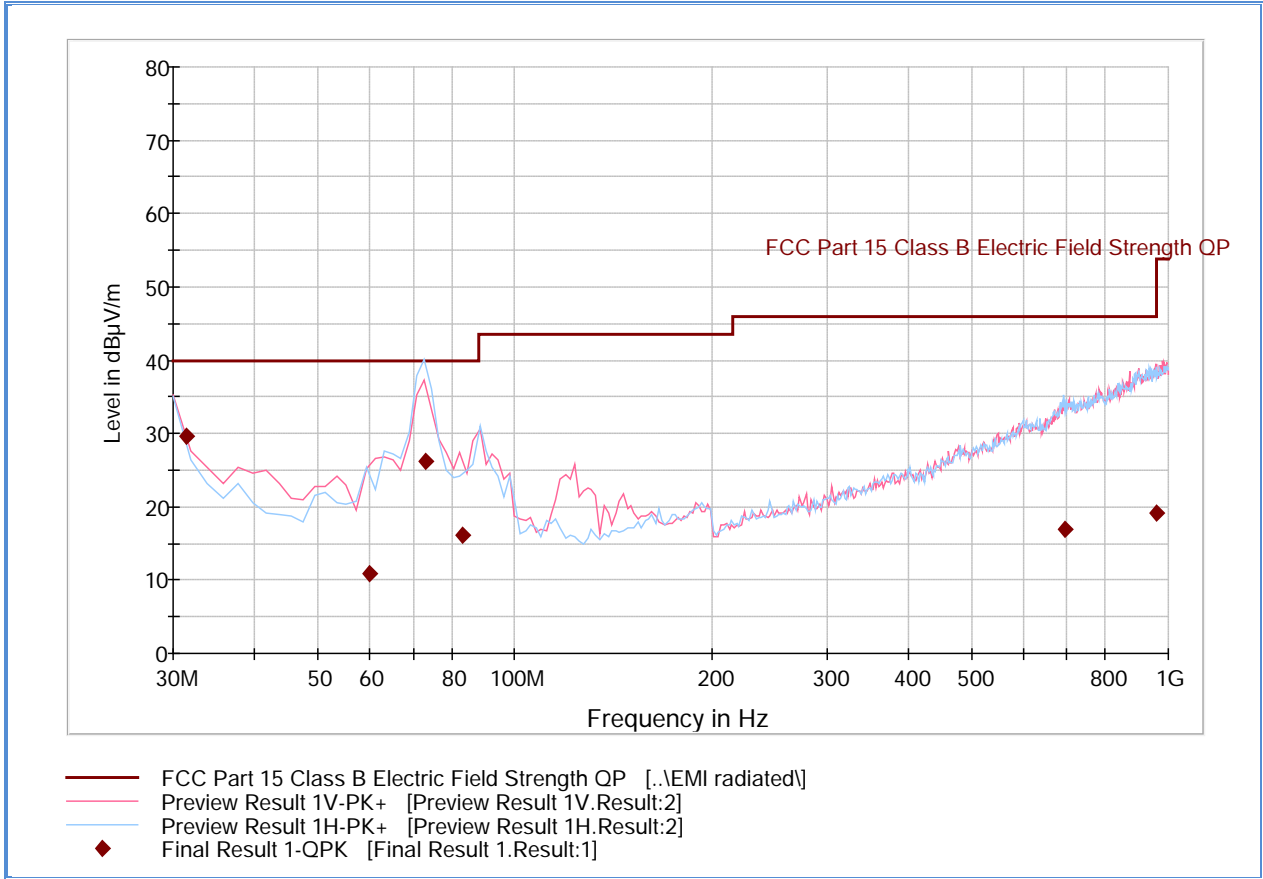
Measuring equipment raw measurement (db μ V) @ 30 MHz		24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3
	Asset# 1172 (cable)	0.3
	Asset# 1016 (preamplifier)	-30.7
	Asset# 1175(cable)	0.3
	Asset# 1002 (antenna)	17.2
Reported QuasiPeak Final Measurement (dbμV/m) @ 30MHz		11.8

2.7.9 **Test Results**

See attached plots.



2.7.10 Test Results Below 1GHz (Receive Mode)

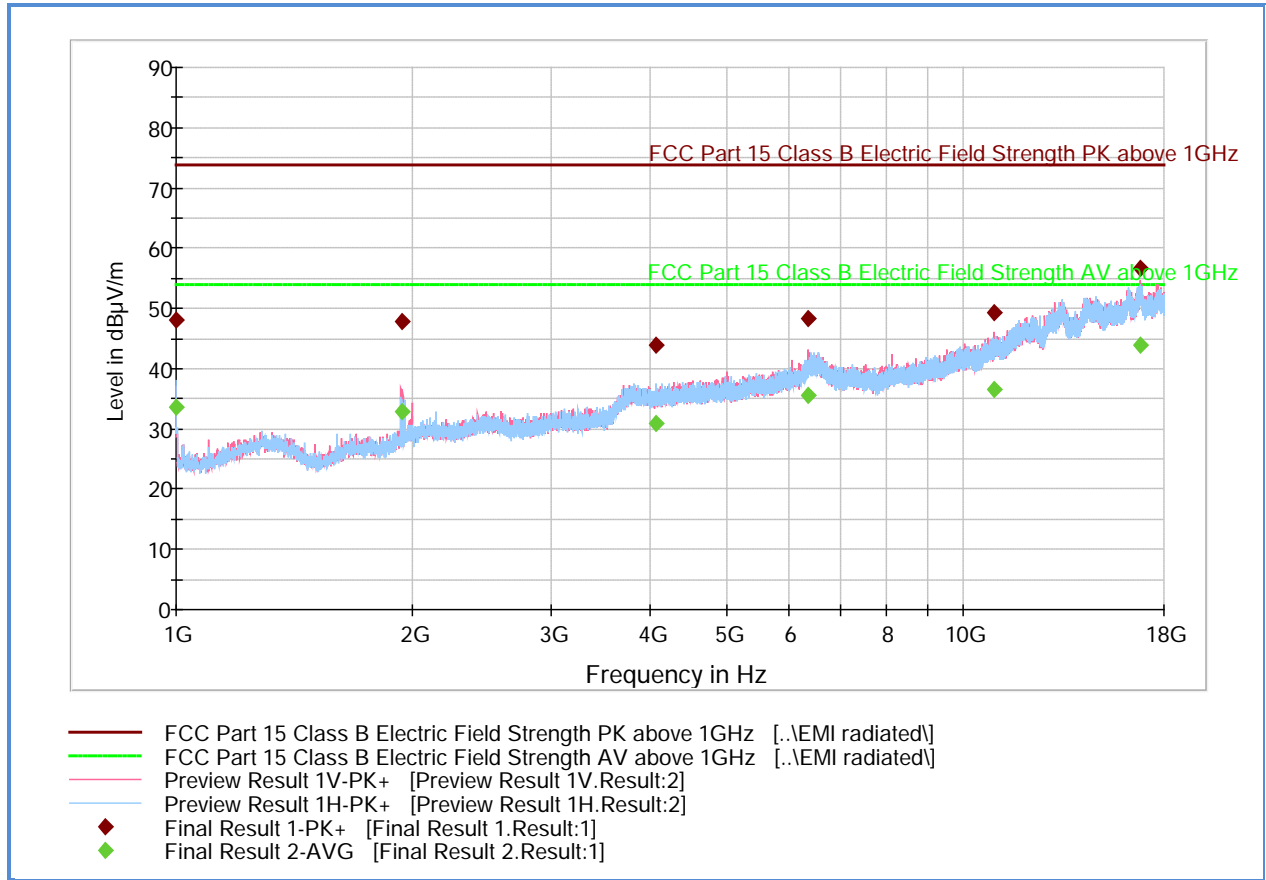


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.400000	29.6	1000.0	120.000	105.0	V	145.0	-12.2	10.4	40.0
59.918317	11.0	1000.0	120.000	300.0	H	264.0	-21.8	29.0	40.0
73.205531	26.1	1000.0	120.000	400.0	H	-2.0	-22.4	13.9	40.0
83.092745	16.0	1000.0	120.000	100.0	V	18.0	-21.7	24.0	40.0
693.505731	16.9	1000.0	120.000	339.0	H	190.0	-2.0	29.1	46.0
959.458357	19.2	1000.0	120.000	250.0	V	113.0	1.4	26.8	46.0



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)
1000.400000	48.1	1000.0	1000.000	287.3	H	-4.0	-7.2	25.8	73.9
1932.766667	47.7	1000.0	1000.000	401.1	V	122.0	-2.3	26.2	73.9
4066.033333	43.8	1000.0	1000.000	156.7	H	9.0	5.0	30.1	73.9
6358.933333	48.3	1000.0	1000.000	168.6	V	310.0	10.9	25.6	73.9
10958.83333	49.3	1000.0	1000.000	247.4	V	192.0	14.8	24.6	73.9
16794.93333	56.6	1000.0	1000.000	322.2	V	216.0	23.8	17.3	73.9

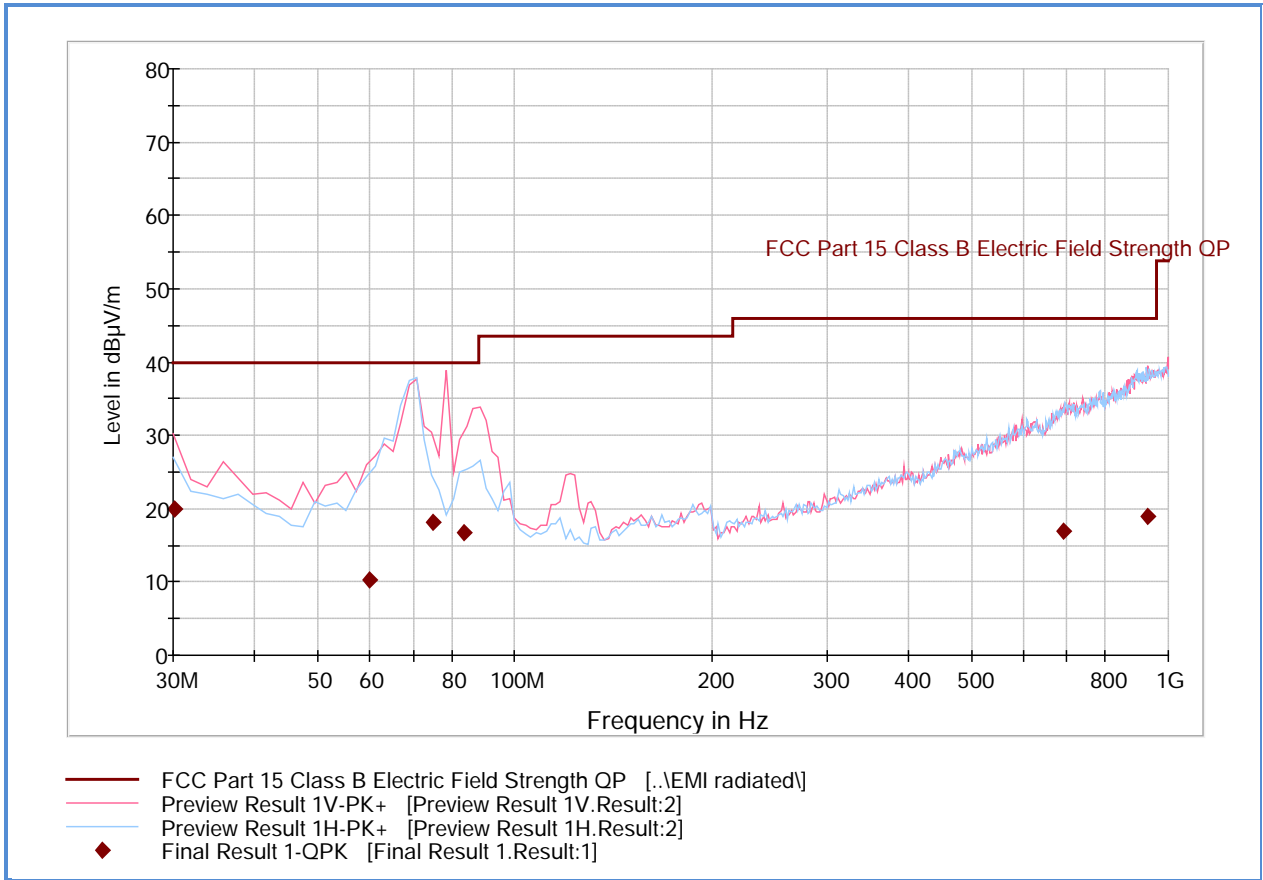
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	33.6	1000.0	1000.000	287.3	H	-4.0	-7.2	20.3	53.9
1932.766667	32.9	1000.0	1000.000	401.1	V	122.0	-2.3	21.0	53.9
4066.033333	30.9	1000.0	1000.000	156.7	H	9.0	5.0	23.0	53.9
6358.933333	35.6	1000.0	1000.000	168.6	V	310.0	10.9	18.3	53.9
10958.83333	36.6	1000.0	1000.000	247.4	V	192.0	14.8	17.3	53.9
16794.93333	44.0	1000.0	1000.000	322.2	V	216.0	23.8	9.9	53.9

Test Notes: No significant emissions observed above 3GHz.



2.7.12 Test Results Below 1GHz (Bluetooth LE)

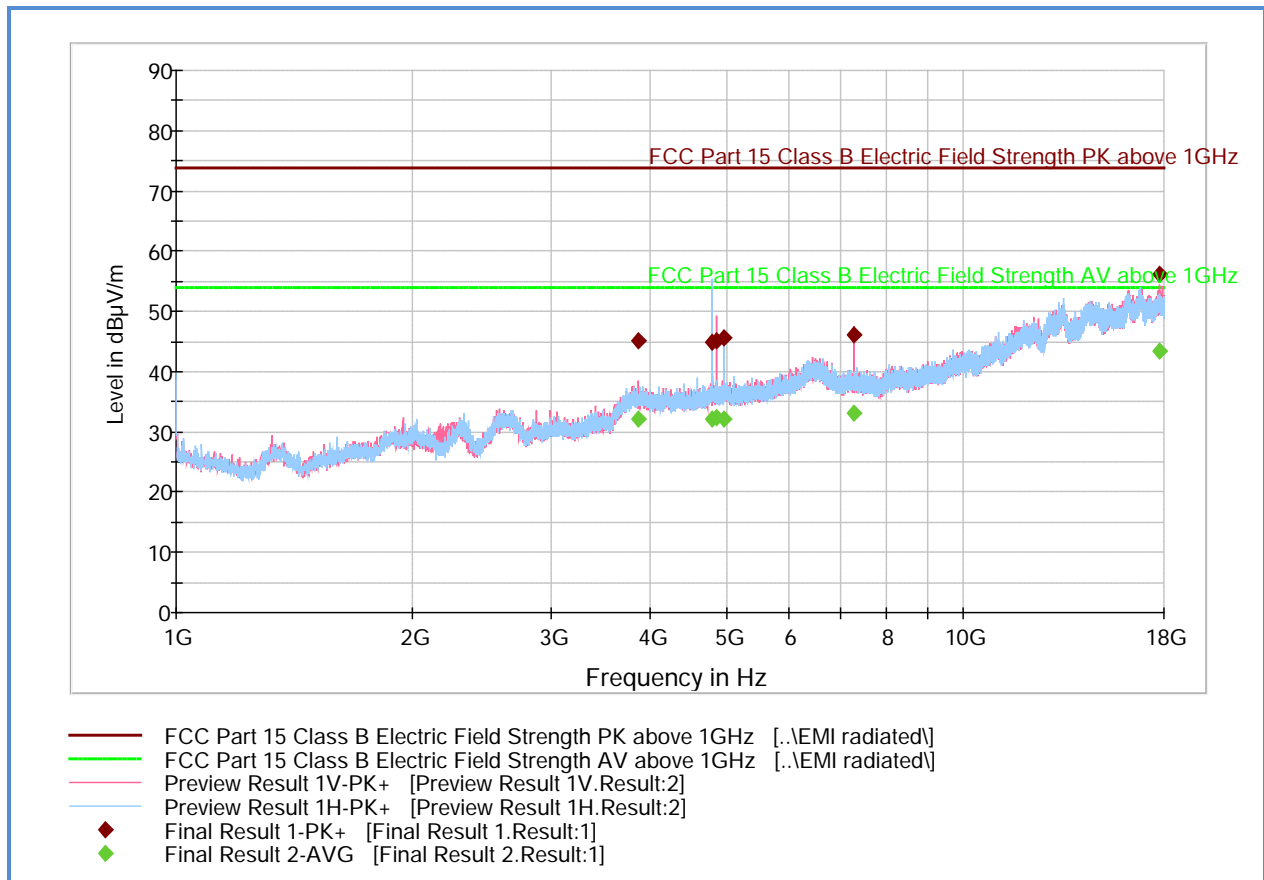


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.160000	19.9	1000.0	120.000	156.0	V	343.0	-11.7	20.1	40.0
59.918317	10.3	1000.0	120.000	100.0	V	40.0	-21.8	29.7	40.0
75.117194	18.2	1000.0	120.000	200.0	V	17.0	-22.3	21.8	40.0
83.532745	16.7	1000.0	120.000	100.0	V	11.0	-21.7	23.3	40.0
692.849619	17.0	1000.0	120.000	100.0	H	32.0	-2.0	29.0	46.0
930.123928	19.0	1000.0	120.000	170.0	V	67.0	1.4	27.0	46.0



2.7.13 Test Results Above 1GHz (Bluetooth LE Advertising 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)
3862.033333	45.2	1000.0	1000.000	319.2	V	20.0	4.9	28.7	73.9
4804.800000	44.8	1000.0	1000.000	401.7	H	139.0	5.6	29.1	73.9
4853.700000	45.2	1000.0	1000.000	200.5	V	292.0	5.9	28.7	73.9
4959.500000	45.7	1000.0	1000.000	407.4	H	116.0	6.4	28.2	73.9
7278.900000	46.0	1000.0	1000.000	402.7	V	202.0	9.6	27.9	73.9
17732.000000	56.1	1000.0	1000.000	275.3	V	69.0	22.9	17.8	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)
3862.033333	32.1	1000.0	1000.000	319.2	V	20.0	4.9	21.8	53.9
4804.800000	32.2	1000.0	1000.000	401.7	H	139.0	5.6	21.7	53.9
4853.700000	32.3	1000.0	1000.000	200.5	V	292.0	5.9	21.6	53.9
4959.500000	32.2	1000.0	1000.000	407.4	H	116.0	6.4	21.7	53.9
7278.900000	33.1	1000.0	1000.000	402.7	V	202.0	9.6	20.8	53.9
17732.000000	43.4	1000.0	1000.000	275.3	V	69.0	22.9	10.5	53.9

Test Notes: Only the worst configuration presented (Y axis) since the EUT is transmitting on all three (3) advertising channels. No significant emissions observed above 18GHz. Measurements above 18GHz were 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: N/A / Test Configuration B

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

August 24, 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	23.7°C
Relative Humidity	47.3 %
ATM Pressure	98.5 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 the worst configuration presented (Y axis) since the EUT is transmitting on all three (3) advertising channels.
- 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)**

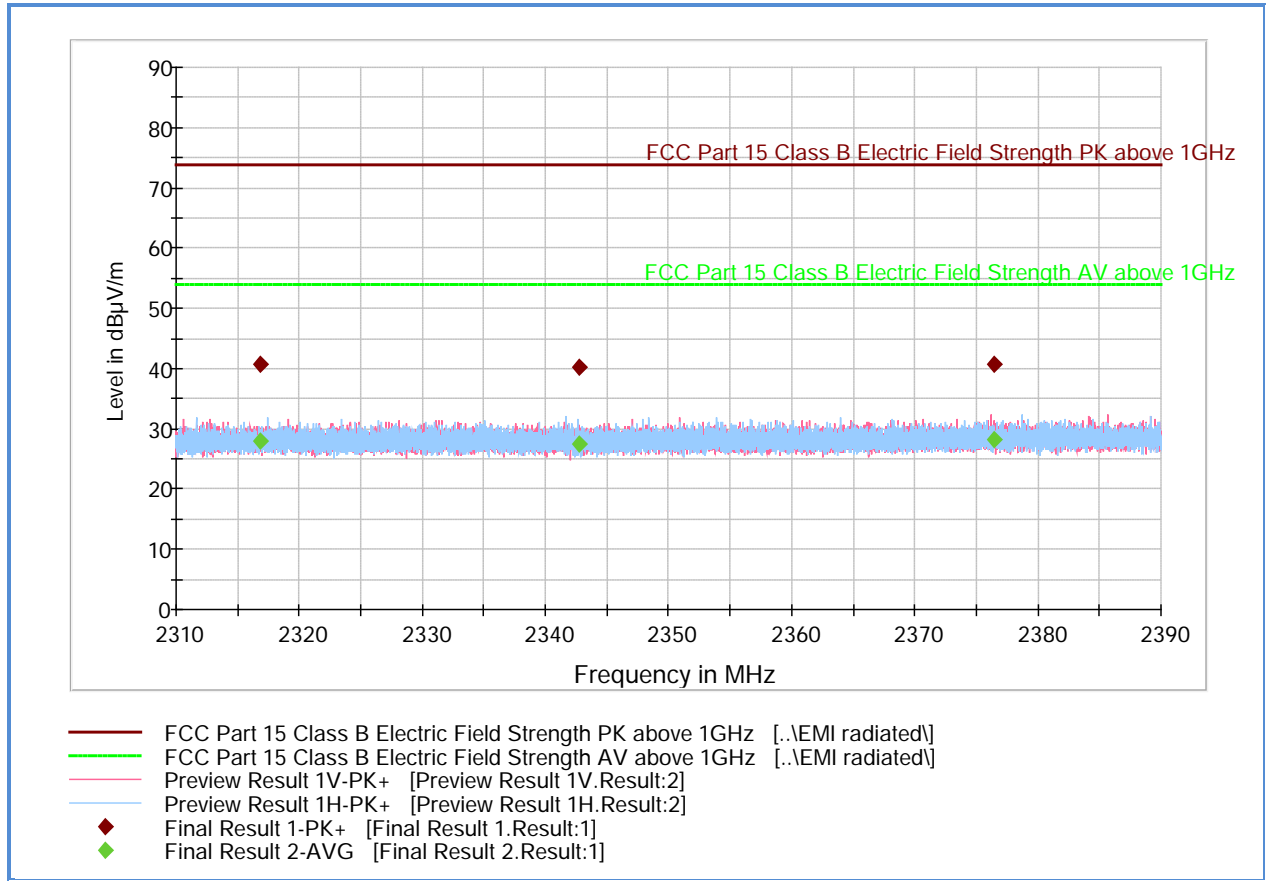
Measuring equipment raw measurement (db μ V) @ 2400 MHz		53.9
Correction Factor (dB)	Asset# 1153 (cable)	3.4
	Asset# 8628 (preamplifier)	-36.5
	Asset#7575 (antenna)	32.7
Reported Max Peak Final Measurement (dbμV/m) @ 2400 MHz		53.5

2.8.9 **Test Results**

See attached plots.



2.8.10 Test Results Restricted Band 2310MHz to 2390MHz (Bluetooth LE Advertising 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)
2316.810667	40.7	1000.0	1000.000	101.7	H	-3.0	-0.8	33.2	73.9
2342.720000	40.3	1000.0	1000.000	198.5	H	193.0	-0.7	33.6	73.9
2376.416000	40.7	1000.0	1000.000	152.6	V	98.0	-0.7	33.2	73.9

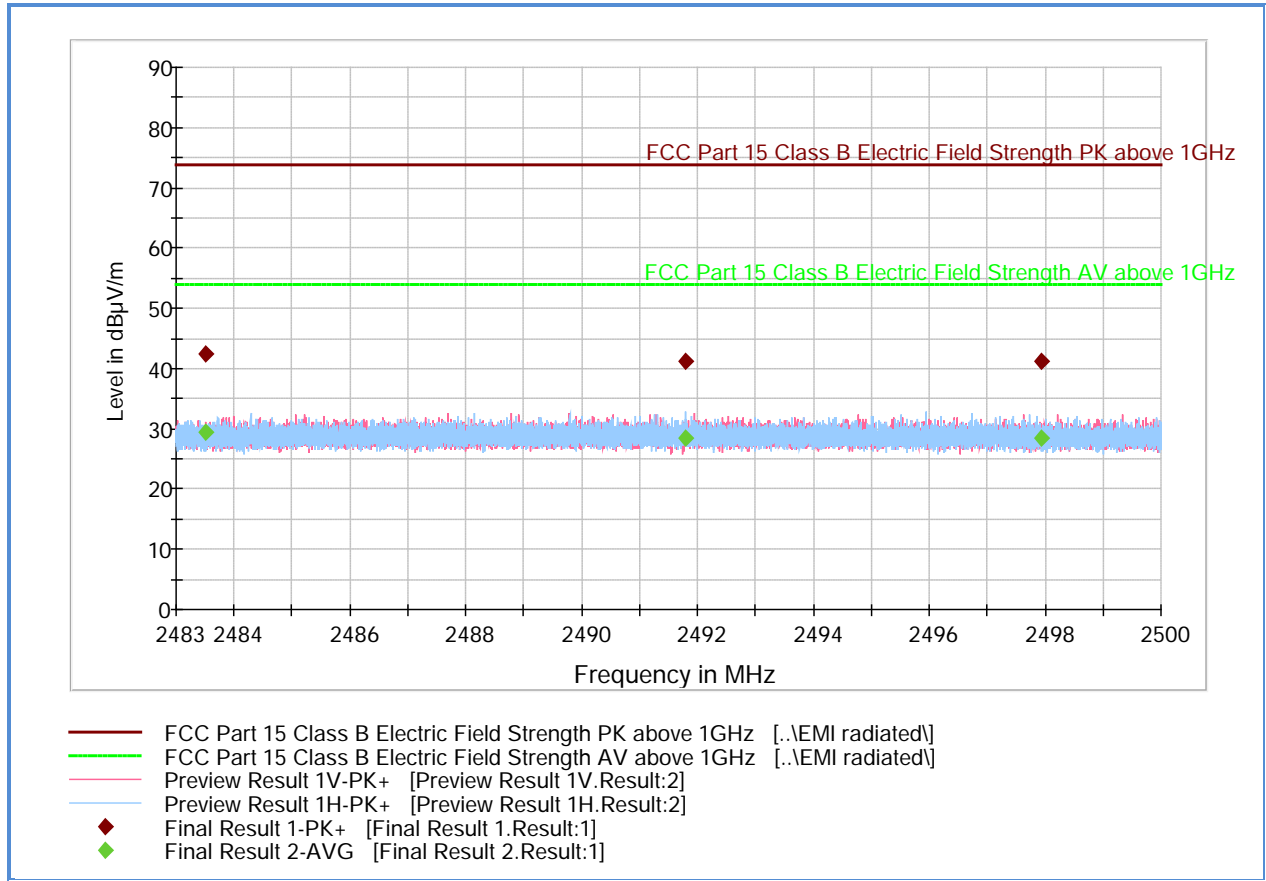
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2316.810667	27.8	1000.0	1000.000	101.7	H	-3.0	-0.8	26.1	53.9
2342.720000	27.5	1000.0	1000.000	198.5	H	193.0	-0.7	26.4	53.9
2376.416000	28.1	1000.0	1000.000	152.6	V	98.0	-0.7	25.8	53.9

Test Notes:



2.8.11 Test Results Restricted Band 2483.5MHz to 2500MHz (Bluetooth LE Advertising 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)
2483.500000	42.4	1000.0	1000.000	101.6	H	5.0	-0.1	31.5	73.9
2491.782767	41.1	1000.0	1000.000	103.7	H	232.0	-0.1	32.8	73.9
2497.943533	41.2	1000.0	1000.000	300.6	H	16.0	-0.1	32.7	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)
2483.500000	29.5	1000.0	1000.000	101.5	H	5.0	-0.1	24.4	53.9
2491.782767	28.5	1000.0	1000.000	103.7	H	232.0	-0.1	25.4	53.9
2497.943533	28.4	1000.0	1000.000	300.6	H	16.0	-0.1	25.5	53.9

Test Notes:



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: N/A / Test Configuration A

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

August 28, 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	23.8°C
Relative Humidity	47.6 %
ATM Pressure	98.4 kPa

2.9.7 **Additional Observations**

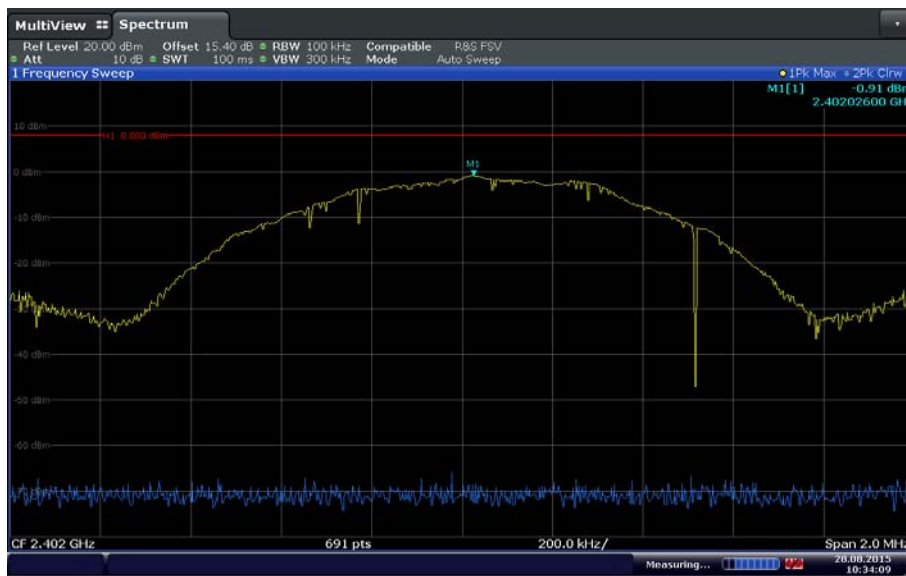
- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074 v03r03, (June 09, 2015).
- A correction factor of 15.4 dB was used to compensate for the external attenuator and cable used.
- Detector is Peak.
- Trace Mode is Max hold.
- Sweep time is Auto Couple.
- EUT complies with 100 kHz RBW.



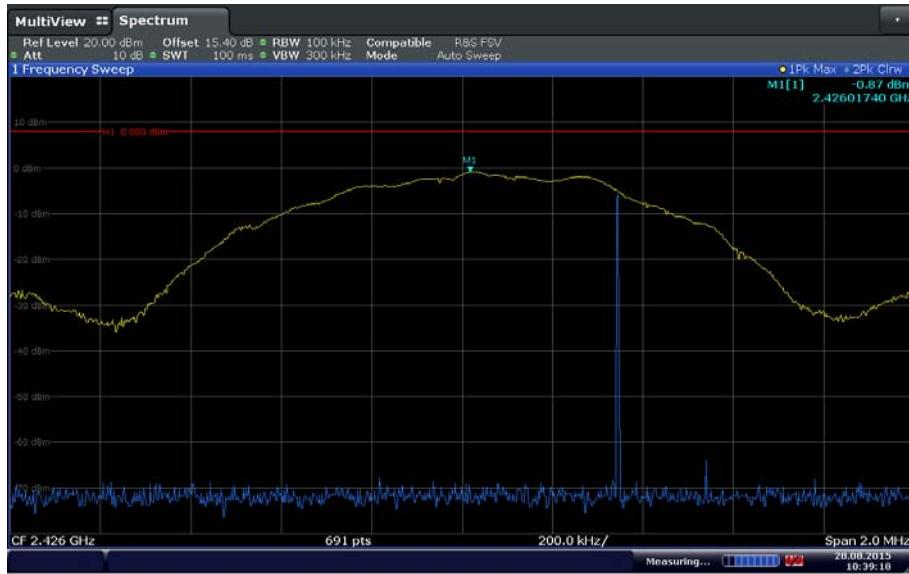
2.9.8 Test Results Summary (PKPSD Method)

Mode	Channel	Marker Reading using 100 kHz RBW (dBm)	PSD Limit (dBm)	Compliance
Bluetooth LE	37 (2402 MHz)	-0.91	8	Complies
	38 (2426 MHz)	-0.87	8	Complies
	39 (2480 MHz)	-1.42	8	Complies

2.9.9 Test Results Plots

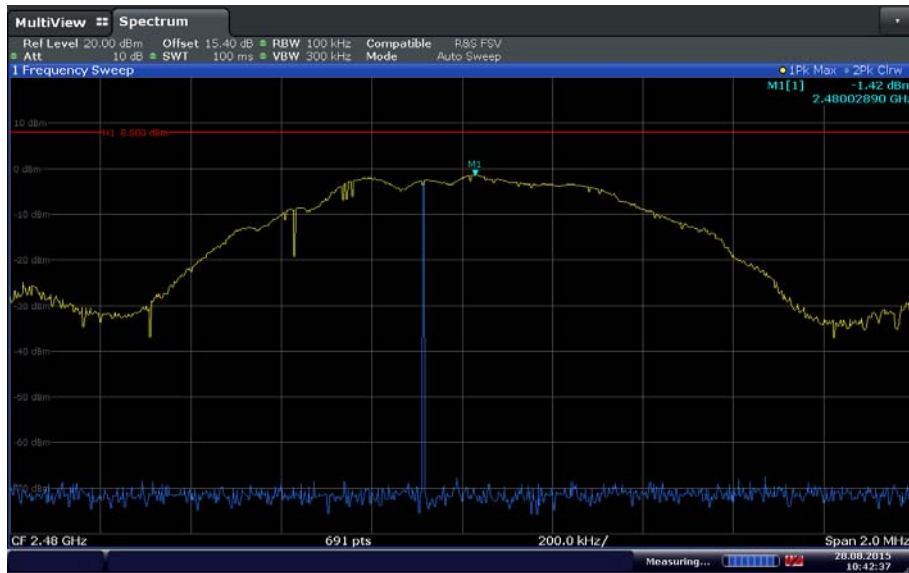


Bluetooth LE Low Channel



Date: 28.AUG.2015 10:39:18

Bluetooth LE Mid Channel



Date: 28.AUG.2015 10:42:37

Bluetooth LE 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 Test Setup						
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	12/22/14	12/22/15
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	03/25/15	03/25/16
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	07/29/15	07/29/16
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	04/29/15	04/29/16
-	12db Attenuator	BW-N12W5	N/A	MCL	Verified by 1003 and 7611	
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7611	
8773	10dB Attenuator	606-10-1F4/DR	N/A	Meca	Verified by 1003 and 7611	
8769	3dB Attenuator	606-03-1F4/DR	N/A	Meca	Verified by 1003 and 7611	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	04/27/15	04/27/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/20/15	03/20/16
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	09/04/14	09/04/15
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	08/29/14	08/29/15
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/10/14	12/10/15
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

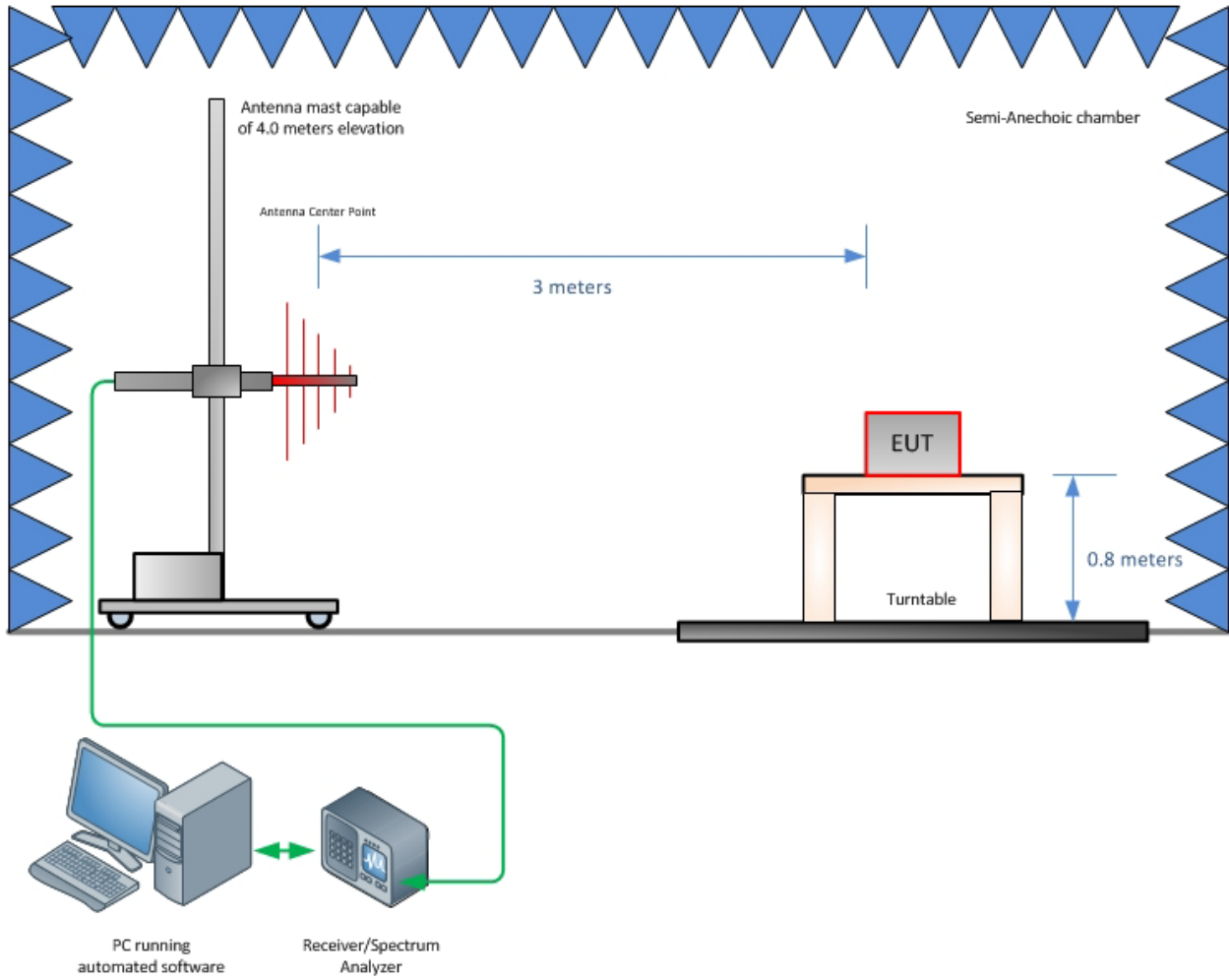
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.72
Coverage Factor (k):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



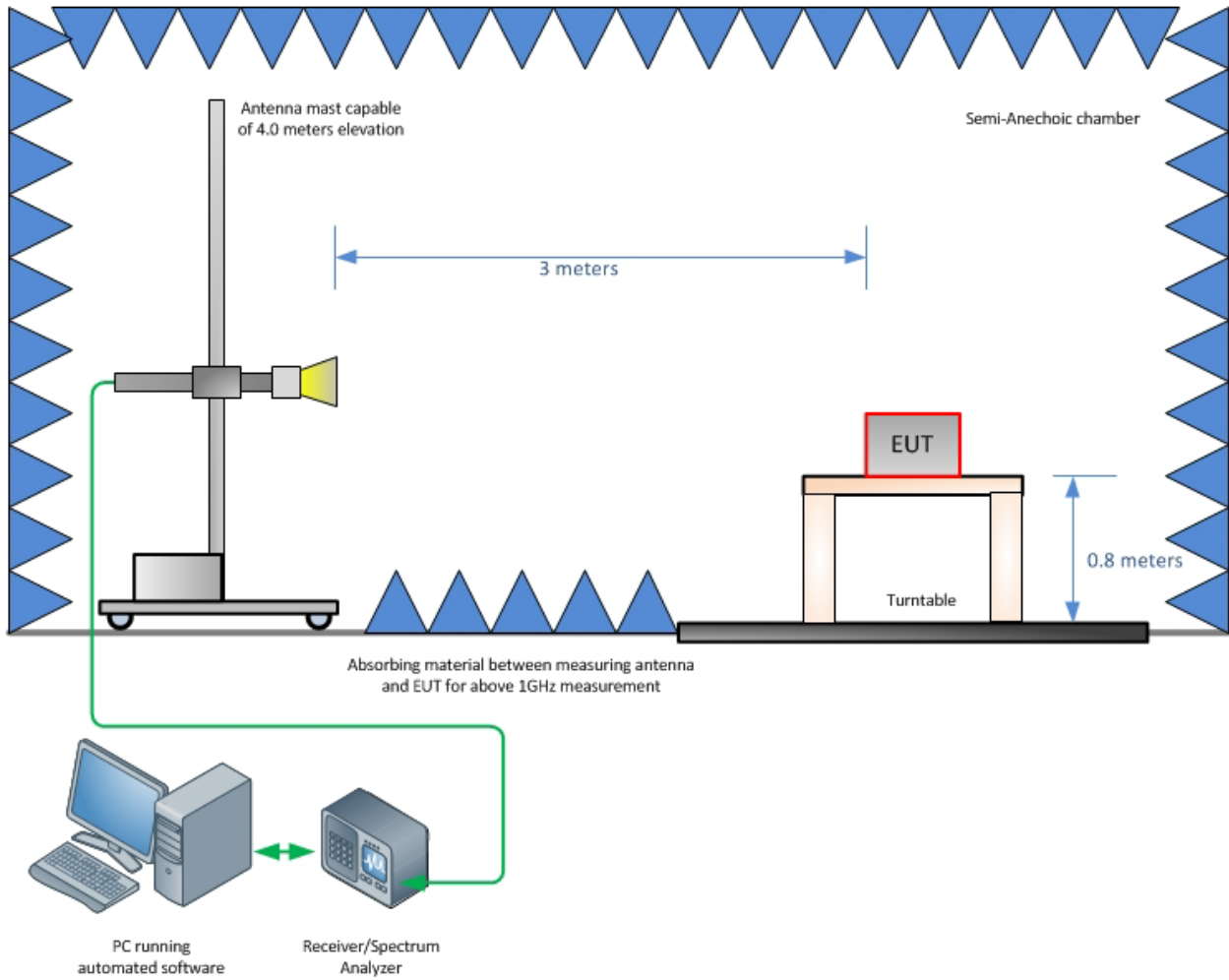
SECTION 4

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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