America

Choose certainty.
Add value.

Report On

Application for Grant of Equipment Authorization of the
Macnica Americas Inc.
Odyssey Max 10 FPGA and BLE Sensor Kit

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

Report No. SD72103365-0315 March 2015

REPORT ON	Radio Testing of the Macnica Americas Inc. FPGA and BLE Sensor Kit
TEST REPORT NUMBER	SD72103365-0315
PREPARED FOR	Macnica Americas Inc. 380 Stevens Avenue, STE-206, Solana Beach, California 92075
CONTACT PERSON	Jeremy Nightingale Technical Director (214) 226-3346 jeremy.nightingale@macnica.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
APPROVED BY	Chip R. Fleury **Name** Authorized Signatory
DATED	March 27, 2015

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

Revision History

SD72103365-0315 Macnica Americas Inc. Odyssey Max 10 FPGA and BLE Sensor Kit					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/27/2015	Initial Release				Chip R. Fleury

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

CONTENTS

Section **Page No**

1 REPORT SUMMARY 5

1.1 Introduction 6
1.2 Brief Summary Of Results 7
1.3 Product Information 8
1.4 EUT Test Configuration 10
1.5 Deviations From The Standard 12
1.6 Modification Record 12
1.7 Test Methodology 12
1.8 Test Facility Location 12
1.9 Test Facility Registration 12

2 TEST DETAILS 14

2.1 Peak Output Power 15
2.2 Conducted Emissions 17
2.3 99% Emission Bandwidth 18
2.4 Minimum 6 dB RF Bandwidth 19
2.5 Out-Of-Band Emissions - Conducted 20
2.6 Band-Edge Compliance Of RF Conducted Emissions 21
2.7 Spurious Radiated Emissions 22
2.8 Radiated Band Edge Measurements And Immediate Restricted Bands 30
2.9 Power Spectral Density 34

3 TEST EQUIPMENT USED 35

3.1 Test Equipment Used 36
3.2 Measurement Uncertainty 37

4 DIAGRAM OF TEST SETUP 38

4.1 Test Setup Diagram 39

5 ACCREDITATION, DISCLAIMERS AND COPYRIGHT 41

5.1 Accreditation, Disclaimers and Copyright 42

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

SECTION 1

REPORT SUMMARY

Radio Testing of the
Macnica Americas Inc.
FPGA and BLE Sensor Kit

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

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Macnica Americas Inc. Odyssey Max 10 FPGA and BLE Sensor Kit to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-210 Issue 8 December 2010.

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Macnica Americas Inc.
Model Number(s)	ODYSSEY-MAX10-KIT
FCC ID Number	2AEDQODSY001
IC Number	20022-ODSY001
Serial Number(s)	17
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2014). • RSS-210 - Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment (Issue 8, December 2010). • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014).
Start of Test	March 26, 2015
Finish of Test	March 26, 2015
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	• Supporting documents for EUT certification are separate exhibits. • Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA (Issued November 05, 2013). • KDB 12172 D01 Determining ERP and EIRP v01. Guidelines for Determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of a RF Transmitting System

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

1.2 BRIEF SUMMARY OF RESULTS

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

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments/ Base Standard
2.1	§15.247(b)(3)	RSS-210 A8.4 (4)	Peak Output Power	Compliant	
2.2	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A[1]	
2.3		RSS-Gen 6.6	99% Emission Bandwidth	N/A[2]	
2.4	§15.247(a)(2)	RSS-210 A8.2(a)	Minimum 6 dB RF Bandwidth	N/A[2]	
2.5	§15.247(d)	RSS-210 A8.5	Out-of-Band Emissions - Conducted	N/A[2]	
2.6	§15.247(d)	RSS-210 A8.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	§15.247(d)	RSS-210 A8.5	Spurious Radiated Emissions	Compliant	
2.7		RSS-Gen 7.1	Receiver Spurious Emissions	Compliant	
2.8	§15.247(d)	RSS-210 A8.5	Radiated Band Edge Measurements	Compliant	
2.9	§15.247(e)	RSS-210 A8.2(b)	Power Spectral Density for Digitally Modulated Device	N/A[2]	

N/A[1] Not performed. EUT is a USB powered device. For reference verification, test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

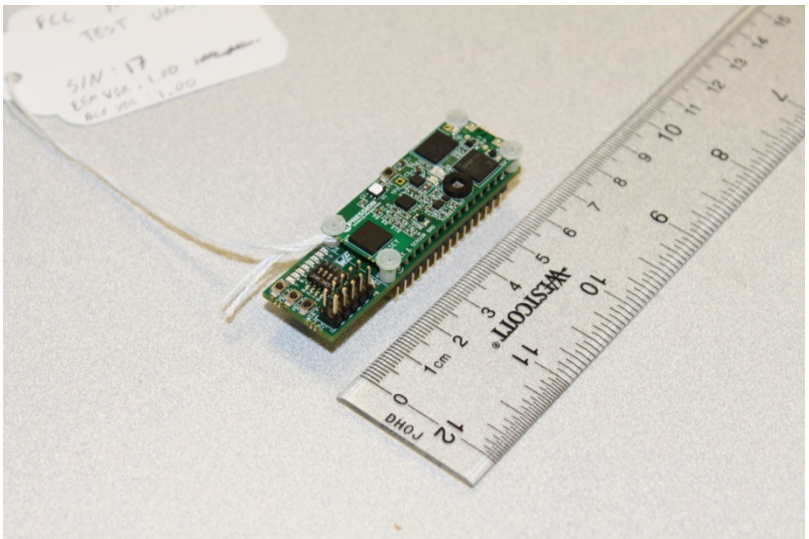
N/A[2] Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

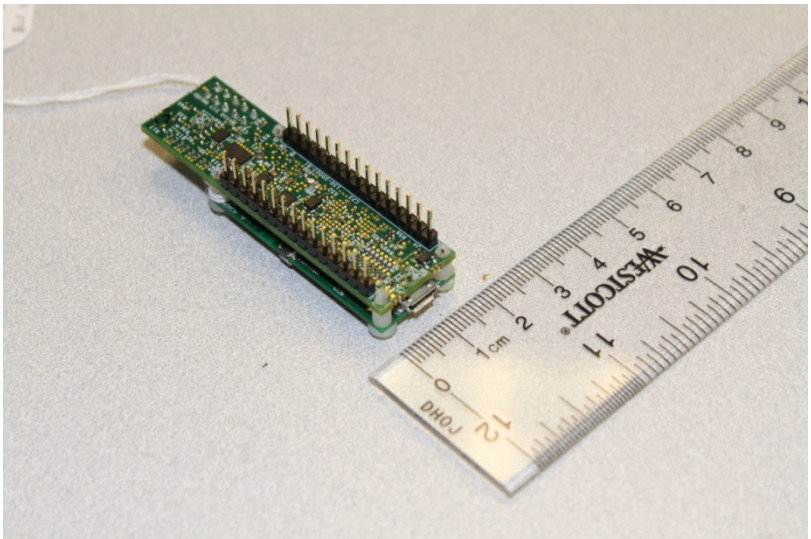
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a Macnica Americas Inc. Odyssey Max 10 FPGA and BLE Sensor Kit as shown in the photographs below. The EUT is an evaluation board designed to help software, hardware, and product designers evaluate many of the silicon devices used on kit, including a BLE module, allowing them to understand the feasibility of these devices for use in their own end products. It also allows for proof-of-concept designs based around the devices on the board.





Equipment Under Test

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

1.3.2 EUT General Description

EUT Description	FPGA and BLE Sensor Kit
Model Name	Odyssey Max 10
Model Number(s)	ODYSSEY-MAX10-KIT
Rated Voltage	5VDC via USB
Mode Verified	Bluetooth LE
Capability	Bluetooth LE
Primary Unit (EUT)	☐ Production
	☒ Pre-Production
	☐ Engineering
Antenna Type (Integral)	Broadcom PCB Antenna
Antenna Gain	-1.5 dBi

1.3.3 Maximum Peak Output Power (EIRP)

Modulation	Frequency Range (MHz)	Field Strength (Peak - dBµV/m @ 3 meters)	Peak Output Power EIRP (dBm)	Peak Output Power EIRP (mW)
GFSK	2402-2480	91.4	-3.83	0.414

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

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Radiated emissions test configuration. The EUT is transmitting through the integral antenna. The EUT is placed on a test mode (Low, Mid and High Channels @ CW max. power). The EUT is connected to a support laptop via USB. Commands are executed using Windows command prompt.

1.4.2 EUT Exercise Software

The Manufacturing Bluetooth Test tool (MBT tool) included as part of the Broadcom WICED Smart SDK, version 2.1.1, was used to place the EUT in a test mode. Command line instructions were executed on the support laptop that invoked the MBT tool which in turn instructed the EUT to enter test mode.

In order for the EUT to accept instructions from the MBT tool, the following modifications were made to EUT. These modifications are not expected to have any impact on the RF aspects of the EUT, and the board was designed to allow the modification for testing purposes:

- The 10K pull-down resistor R55 on the Max10 board was removed
- A 10K pull-up resistor was added to the unpopulated site of R56”.

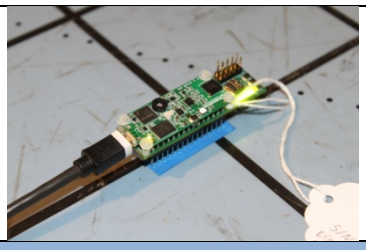
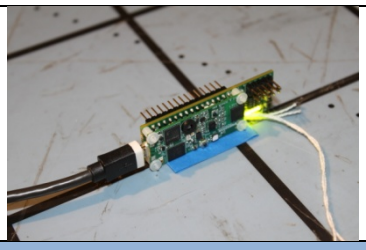
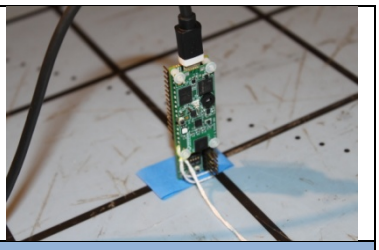
1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
-	USB cable	3 meters, shielded, Type A to Micro-B connector
Asus	Support Laptop	Model: K200MA-DS01T S/N:E4N0CX606279162
Asus	Support AC Adapter	M/N AD890326 S/N N/A

1.4.4 Worst Case Configuration

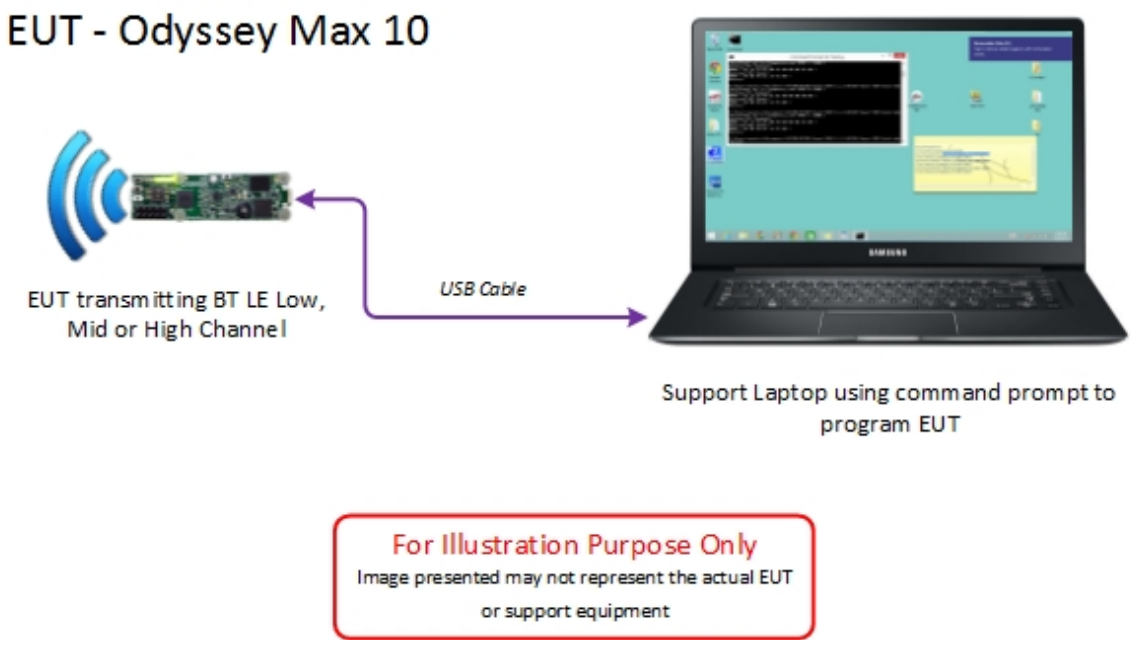
Worst-case configuration used in this test report as per maximum peak EIRP output power measurement is High Channel (2480 MHz).

EUT is a mobile device. For radiated measurements X, Y and Z orientations were verified. Worst case position are “X” and “Z”. Verification performed using “X” configuration.

		
“X” Configuration	***“Y” Configuration***	***“Z” Configuration***

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

1.4.5 Simplified Test Configuration Diagram



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

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 17		
N/A		

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
For conducted and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

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

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

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

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

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

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

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

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
Macnica Americas Inc.
FPGA and BLE Sensor Kit

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

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: 17/ Default Test Configuration

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

March 26, 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	24.2 °C
Relative Humidity	48.2 %
ATM Pressure	98.6 kPa

2.1.7 Additional Observations

- This is a radiated test. Test plots and results are from Section 2.7 of this test report (Spurious Radiated Emissions).
- Field strength measurement were converted to EIRP using the formula:

$$\mathbf{eirp = pt \times gt = (E \times d)^2/30}$$

This is from Section 1.3.1 of KDB 12172 D01 Determining ERP and EIRP v01

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

Where:

pt = transmitter output power in watts
gt = numeric gain of the transmitting antenna
E = electric field strength in V/m
d = measurement distance in meters (m)

- Sample calculation (91.4 dBµV/m):

Convert field strength in dBµV/m to V/m using the following formula:

$$V/m = 10^{\left(\frac{\left(db\mu\frac{V}{m}\right)-120}{20}\right)}$$

$$V/m = 10^{\left(\frac{(91.4)-120}{20}\right)}$$

$$V/m = 0.03715$$

Calculate EIRP using the following formula:

$$EIRP = \frac{(\mathrm{E\ x\ d})^2}{30}$$

$$EIRP = \frac{(0.03715\ \mathrm{x}\ 3)^2}{30}$$

$$EIRP = 0.000414\ \mathrm{Watt}$$

2.1.8 Test Results

Bluetooth Low Energy (LE)	Channel	Measured Peak Power EIRP (dBµV/m)	Calculated Peak EIRP (dBm)	Calculated Peak EIRP (mW)
	37 (2402 MHz)	83.5	-11.73	0.067
	17 (2440 MHz)	86.2	-9.03	0.125
	39 (2480 MHz)	91.4	-3.83	0.414

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

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

Not performed. EUT is a USB powered device. For reference verification, test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

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

Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

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

Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

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

Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

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

Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

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: 17/ Default Test Configuration

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

March 26, 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	24.2 °C
Relative Humidity	48.2 %
ATM Pressure	98.6 kPa

2.7.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the considered worst case Bluetooth channel presented for radiated emissions below 1GHz. There are no significant differences in emissions between all three test channels below 1GHz.

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

- 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)

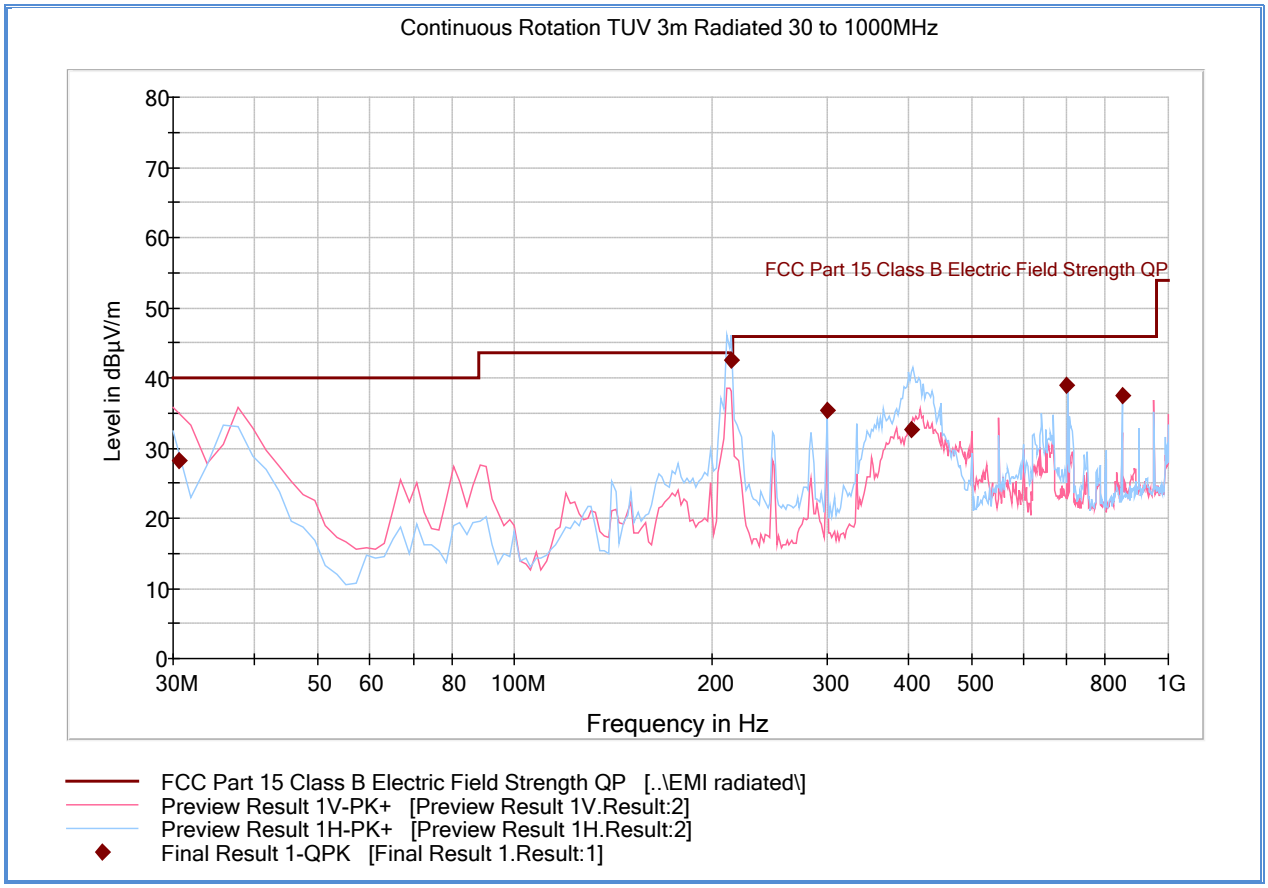
Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

2.7.9 Test Results

See attached plots.

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

2.7.10 Test Results Below 1GHz (Receive Mode)



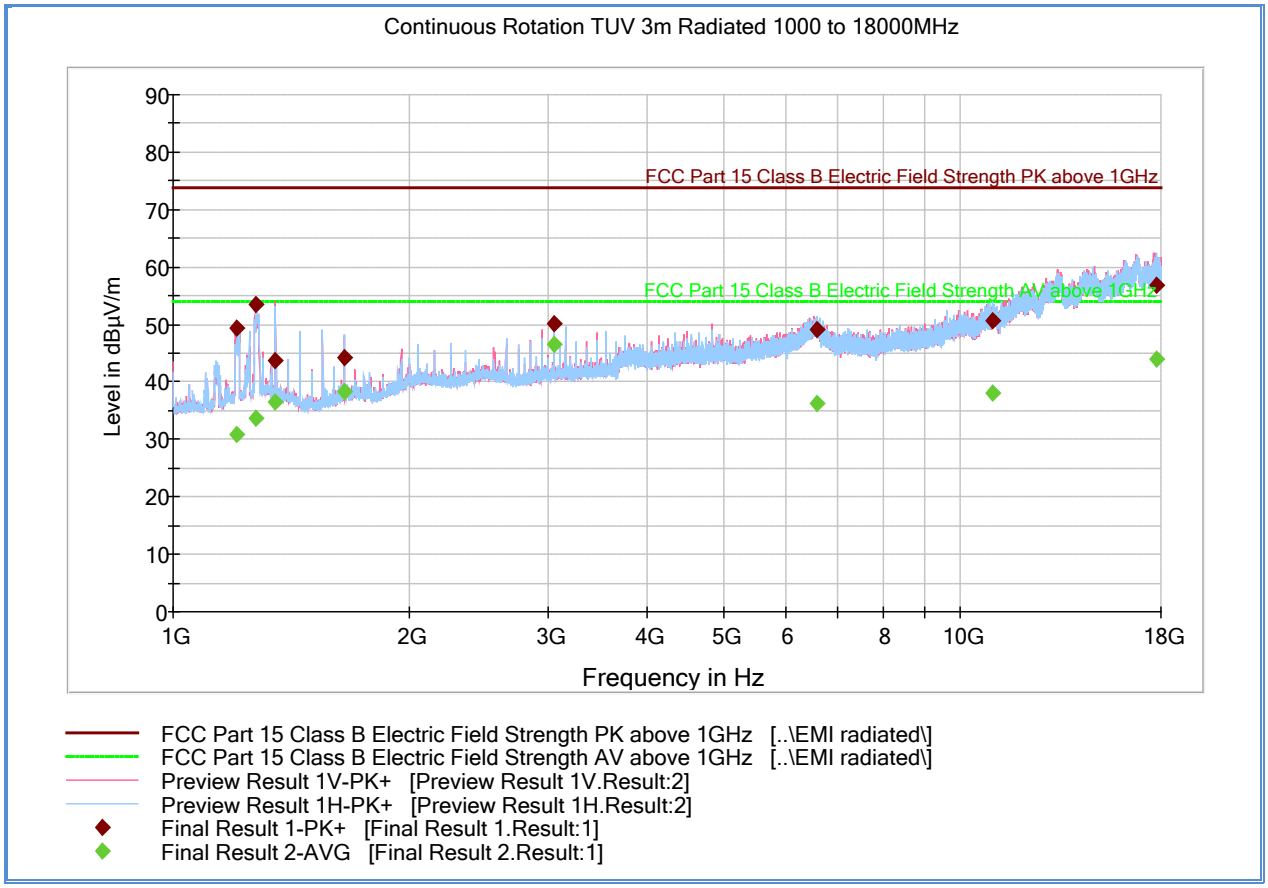
Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.680000	28.2	1000.0	120.000	100.0	V	-10.0	-11.8	11.8	40.0
214.189339	42.5	1000.0	120.000	100.0	H	82.0	-16.0	1.0	43.5
300.000401	35.3	1000.0	120.000	100.0	H	117.0	-12.5	10.7	46.0
405.114228	32.6	1000.0	120.000	196.0	H	38.0	-9.2	13.4	46.0
700.001283	39.0	1000.0	120.000	109.0	H	164.0	-1.6	7.0	46.0
850.000641	37.4	1000.0	120.000	100.0	H	281.0	-0.5	8.6	46.0

Test Notes: Only worst case channel presented for spurious emissions below 1GHz. Emission @ 214.2MHz verified coming from support equipment (laptop).

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

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)
1206.633333	49.5	1000.0	1000.000	120.7	H	123.0	-6.2	24.4	73.9
1272.366667	53.4	1000.0	1000.000	103.7	H	120.0	-5.7	20.5	73.9
1349.833333	43.6	1000.0	1000.000	173.6	V	294.0	-5.6	30.3	73.9
1650.166667	44.2	1000.0	1000.000	202.3	H	277.0	-4.9	29.7	73.9
3050.033333	50.2	1000.0	1000.000	103.7	H	207.0	1.0	23.7	73.9
6564.300000	49.1	1000.0	1000.000	234.4	H	130.0	11.3	24.8	73.9
11008.83333	50.7	1000.0	1000.000	102.8	H	3.0	14.9	23.2	73.9
17765.03333	56.9	1000.0	1000.000	403.3	H	20.0	23.2	17.0	73.9

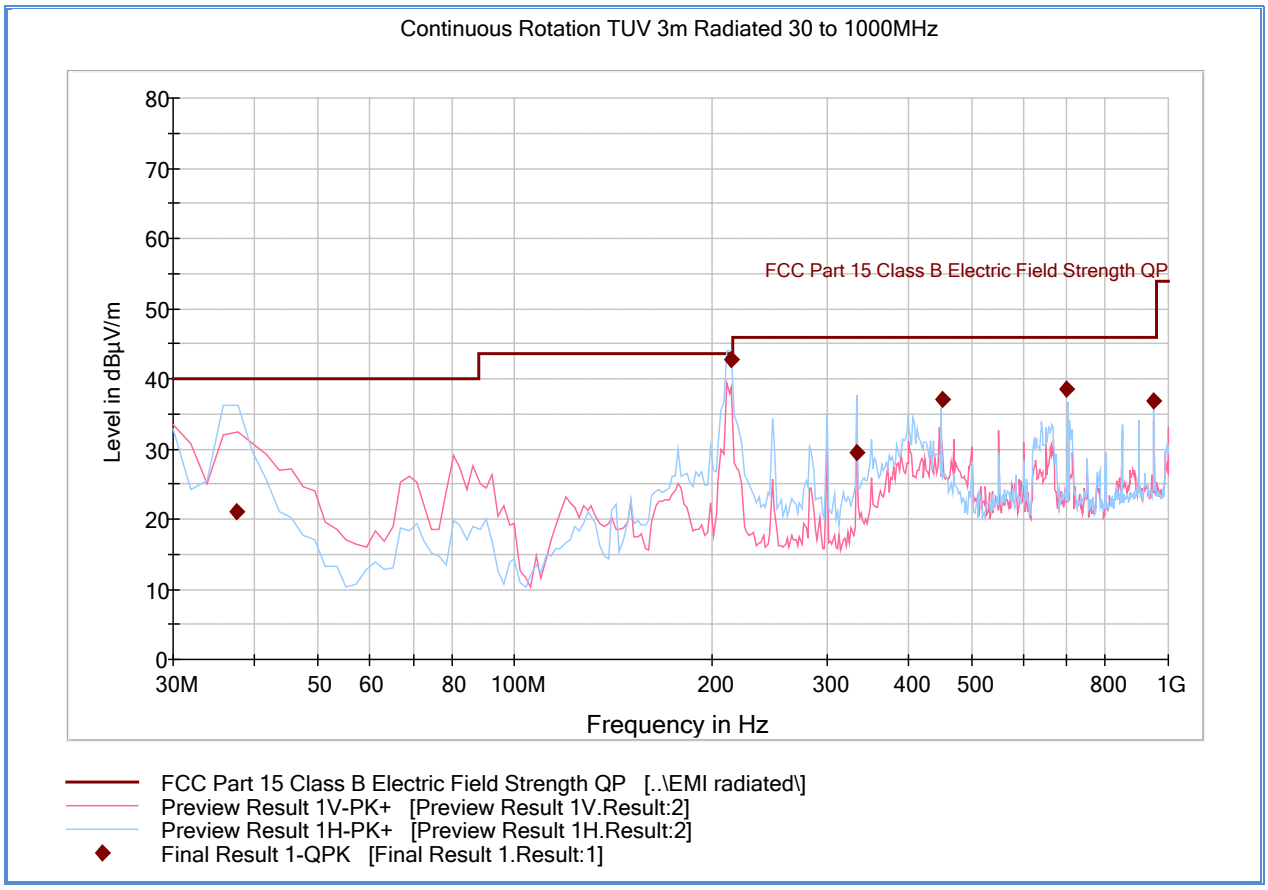
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1206.633333	30.8	1000.0	1000.000	120.7	H	123.0	-6.2	23.1	53.9
1272.366667	33.6	1000.0	1000.000	103.7	H	120.0	-5.7	20.3	53.9
1349.833333	36.4	1000.0	1000.000	173.6	V	294.0	-5.6	17.5	53.9
1650.166667	38.4	1000.0	1000.000	202.3	H	277.0	-4.9	15.5	53.9
3050.033333	46.6	1000.0	1000.000	103.7	H	207.0	1.0	7.3	53.9
6564.300000	36.3	1000.0	1000.000	234.4	H	130.0	11.3	17.6	53.9
11008.83333	38.0	1000.0	1000.000	102.8	H	3.0	14.9	15.9	53.9
17765.03333	44.0	1000.0	1000.000	403.3	H	20.0	23.2	9.9	53.9

Test Notes: No significant emissions observed above 6GHz.

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

2.7.12 Test Results Below 1GHz (Bluetooth LE)



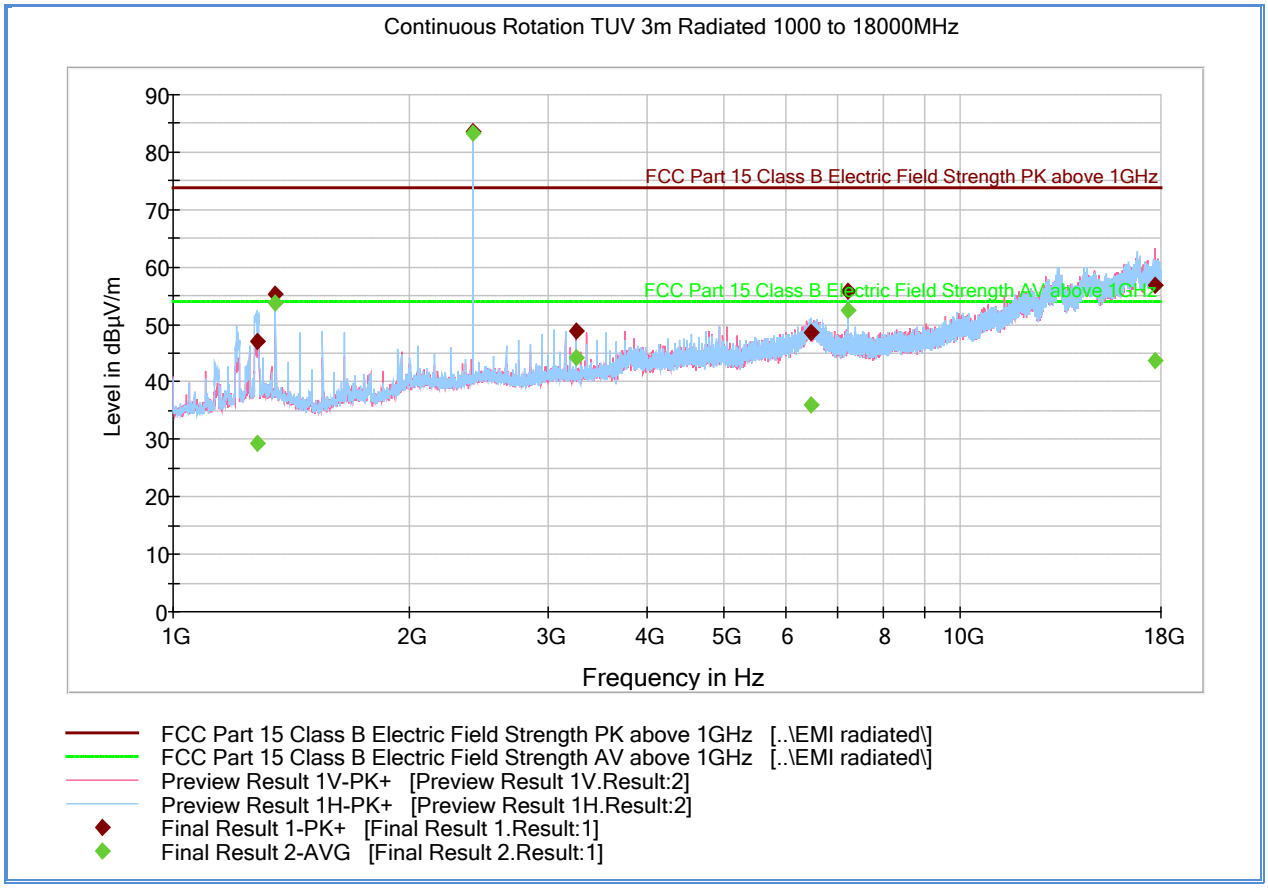
Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
37.455551	21.1	1000.0	120.000	350.0	H	342.0	-15.4	18.9	40.0
214.229339	42.8	1000.0	120.000	116.0	H	87.0	-15.9	0.7	43.5
333.286493	29.4	1000.0	120.000	100.0	H	287.0	-11.6	16.6	46.0
449.999760	37.0	1000.0	120.000	100.0	H	147.0	-8.2	9.0	46.0
700.001283	38.6	1000.0	120.000	115.0	H	171.0	-1.6	7.4	46.0
950.002806	36.9	1000.0	120.000	143.0	H	280.0	1.6	9.1	46.0

Test Notes: Only worst case channel presented for spurious emissions below 1GHz. Emission @ 214.2MHz verified coming from support equipment (laptop).

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

2.7.13 Test Results Above 1GHz (Bluetooth LE 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)
1278.233333	47.1	1000.0	1000.000	123.7	H	117.0	-5.7	26.8	73.9
1349.833333	55.3	1000.0	1000.000	117.7	H	272.0	-5.6	18.6	73.9
2402.133333	83.5	1000.0	1000.000	104.7	V	288.0	-0.6	Fundamental	
3249.866667	48.7	1000.0	1000.000	103.7	V	77.0	1.3	25.2	73.9
6468.333333	48.7	1000.0	1000.000	201.3	H	-20.0	11.1	25.2	73.9
7205.933333	55.9	1000.0	1000.000	250.4	H	172.0	9.8	18.0	73.9
17711.233333	56.9	1000.0	1000.000	403.3	V	7.0	23.1	17.0	73.9

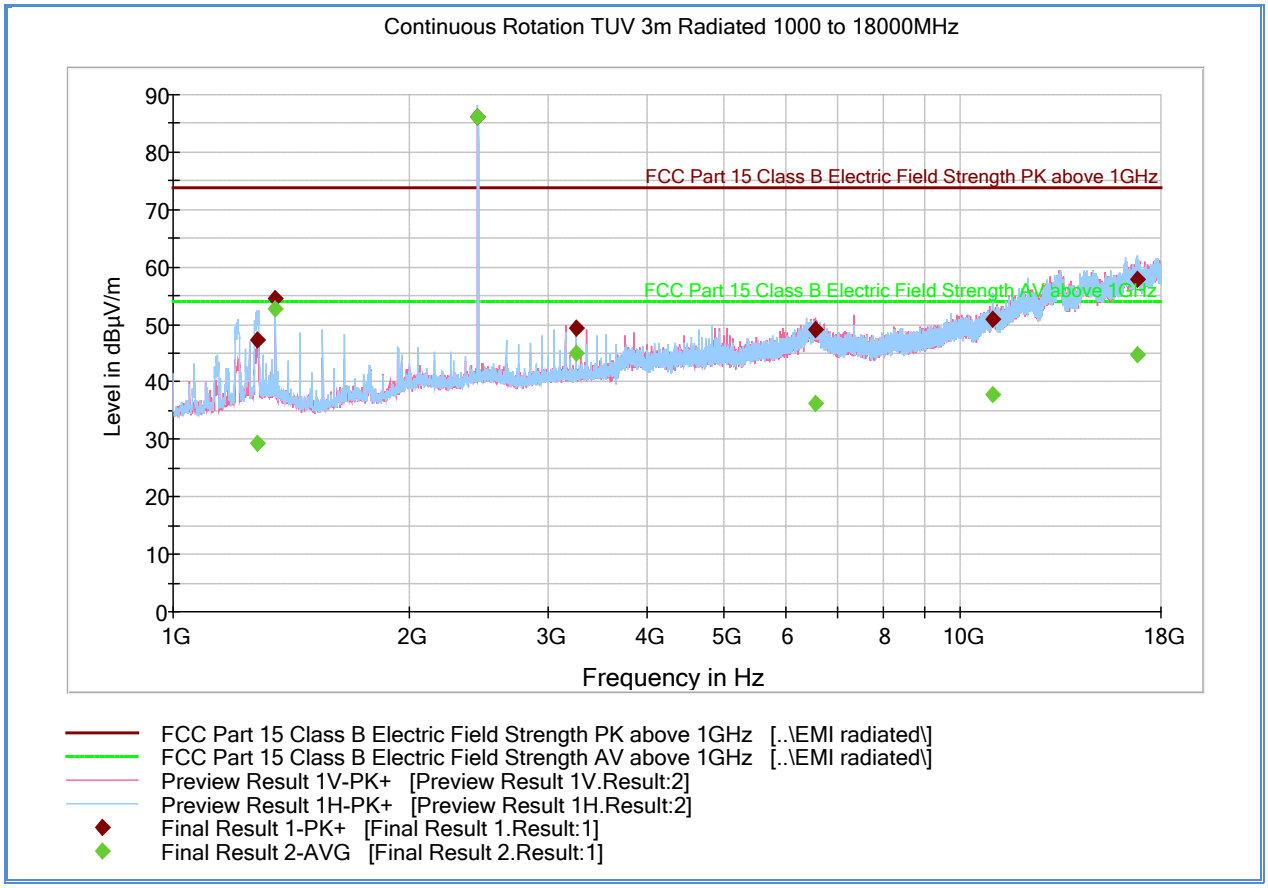
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1278.233333	29.3	1000.0	1000.000	123.7	H	117.0	-5.7	24.6	53.9
1349.833333	53.7	1000.0	1000.000	117.7	H	272.0	-5.6	0.2	53.9
2402.133333	83.3	1000.0	1000.000	104.7	V	288.0	-0.6	Fundamental	
3249.866667	44.3	1000.0	1000.000	103.7	V	77.0	1.3	9.6	53.9
6468.333333	36.0	1000.0	1000.000	201.3	H	-20.0	11.1	17.9	53.9
7205.933333	52.5	1000.0	1000.000	250.4	H	172.0	9.8	1.4	53.9
17711.233333	43.6	1000.0	1000.000	403.3	V	7.0	23.1	10.3	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

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

2.7.14 Test Results Above 1GHz (Bluetooth LE 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)
1278.766667	47.4	1000.0	1000.000	123.7	H	116.0	-5.7	26.6	73.9
1349.833333	54.6	1000.0	1000.000	123.7	H	272.0	-5.6	19.3	73.9
2440.100000	86.2	1000.0	1000.000	115.7	H	145.0	-0.3	Fundamental	
3249.866667	49.2	1000.0	1000.000	102.7	V	77.0	1.3	24.7	73.9
6539.933333	49.1	1000.0	1000.000	403.3	V	145.0	11.2	24.8	73.9
10997.333333	50.9	1000.0	1000.000	156.6	H	20.0	14.9	23.0	73.9
16801.466667	57.8	1000.0	1000.000	172.6	H	310.0	23.7	16.1	73.9

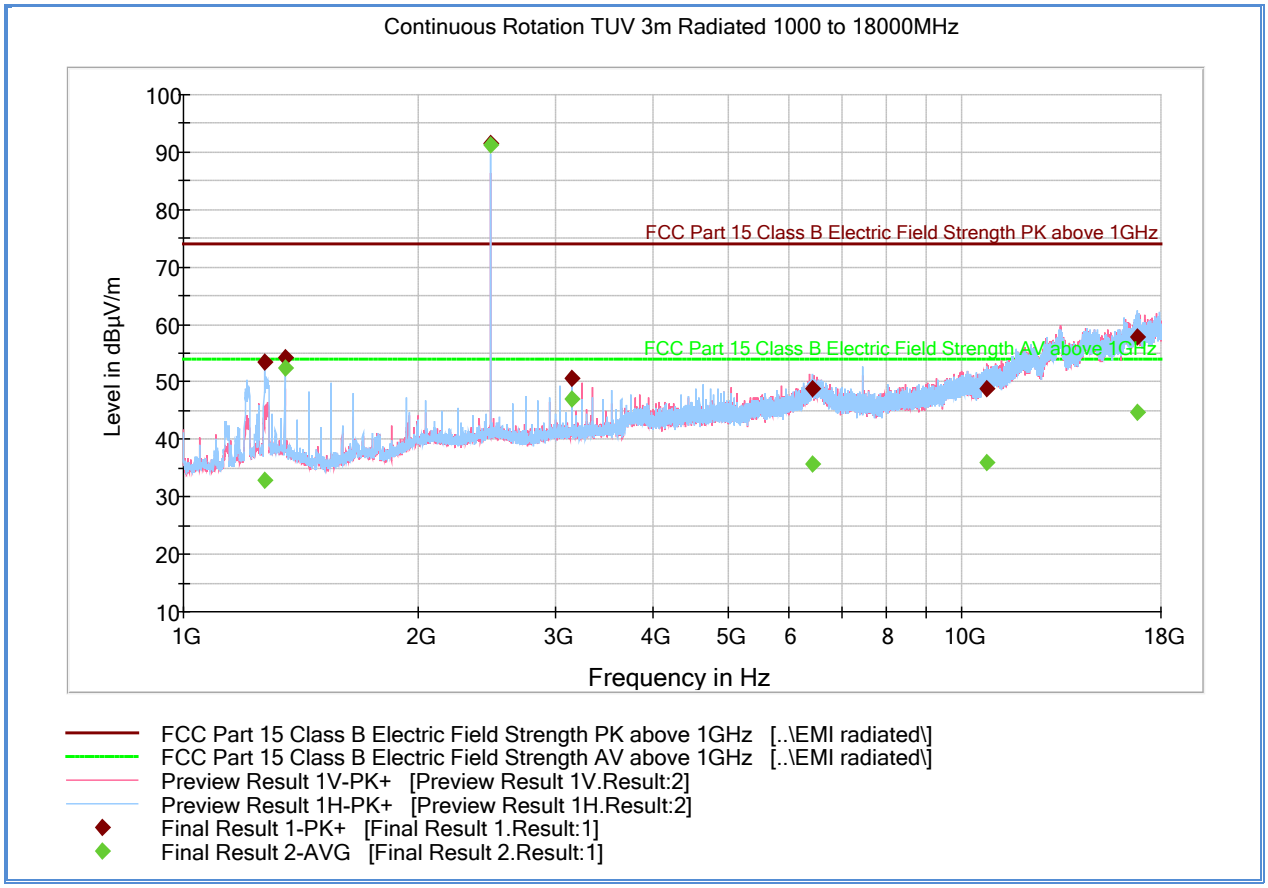
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1278.766667	29.3	1000.0	1000.000	123.7	H	116.0	-5.7	24.6	53.9
1349.833333	52.7	1000.0	1000.000	123.7	H	272.0	-5.6	1.2	53.9
2440.100000	86.1	1000.0	1000.000	115.7	H	145.0	-0.3	Fundamental	
3249.866667	45.1	1000.0	1000.000	102.7	V	77.0	1.3	8.8	53.9
6539.933333	36.2	1000.0	1000.000	403.3	V	145.0	11.2	17.7	53.9
10997.333333	37.9	1000.0	1000.000	156.6	H	20.0	14.9	16.0	53.9
16801.466667	44.8	1000.0	1000.000	172.6	H	310.0	23.7	9.1	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

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

2.7.15 Test Results Above 1GHz (Bluetooth LE 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)
1271.233333	53.3	1000.0	1000.000	102.7	H	122.0	-5.7	20.6	73.9
1349.833333	54.3	1000.0	1000.000	124.7	H	272.0	-5.6	19.6	73.9
2479.966667	91.4	1000.0	1000.000	103.7	H	145.0	-0.1	Fundamental	
3150.133333	50.8	1000.0	1000.000	103.7	V	76.0	1.0	23.1	73.9
6428.233333	48.9	1000.0	1000.000	403.3	H	192.0	11.2	25.0	73.9
10744.066667	48.8	1000.0	1000.000	324.1	V	234.0	14.0	25.1	73.9
16796.366667	57.9	1000.0	1000.000	151.6	H	238.0	23.7	16.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1271.233333	32.9	1000.0	1000.000	102.7	H	122.0	-5.7	21.0	53.9
1349.833333	52.4	1000.0	1000.000	124.7	H	272.0	-5.6	1.5	53.9
2479.966667	91.4	1000.0	1000.000	103.7	H	145.0	-0.1	Fundamental	
3150.133333	46.9	1000.0	1000.000	103.7	V	76.0	1.0	7.0	53.9
6428.233333	35.8	1000.0	1000.000	403.3	H	192.0	11.2	18.1	53.9
10744.066667	36.1	1000.0	1000.000	324.1	V	234.0	14.0	17.8	53.9
16796.366667	44.8	1000.0	1000.000	151.6	H	238.0	23.7	9.1	53.9

Test Notes: No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

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

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: 17/ Default Test Configuration

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

March 26, 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	24.2 °C
Relative Humidity	48.2 %
ATM Pressure	98.6 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.

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

- 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)

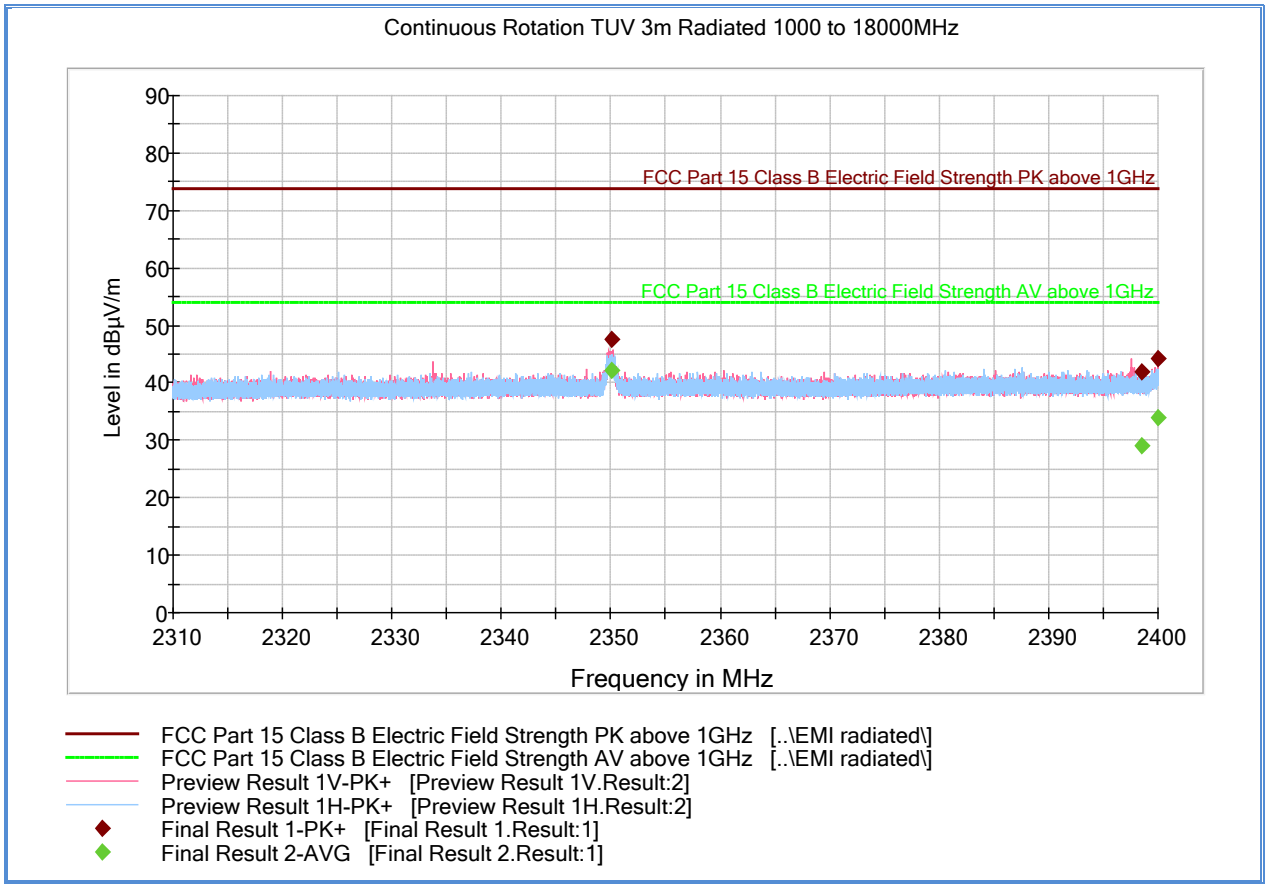
Measuring equipment raw measurement (dbµV) @ 2400 MHz			53.9
Correction Factor (dB)	Asset# 1153 (cable)	3.4	-0.4
	Asset# 8628(preamplifier)	-36.5	
	Asset#7575 (antenna)	32.7	
Reported Max Peak Final Measurement (dbµV/m) @ 2400 MHz			**53.5**

2.8.9 Test Results

See attached plots.

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

2.8.10 Test Results Restricted Band 2310MHz to 2490MHz (Bluetooth LE 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)
2350.060000	47.5	1000.0	1000.000	107.7	V	286.0	-0.8	26.4	73.9
2398.510000	41.9	1000.0	1000.000	191.5	V	164.0	-0.6	32.0	73.9
2400.000000	44.1	1000.0	1000.000	113.7	V	286.0	-0.6	29.8	73.9

Average Data

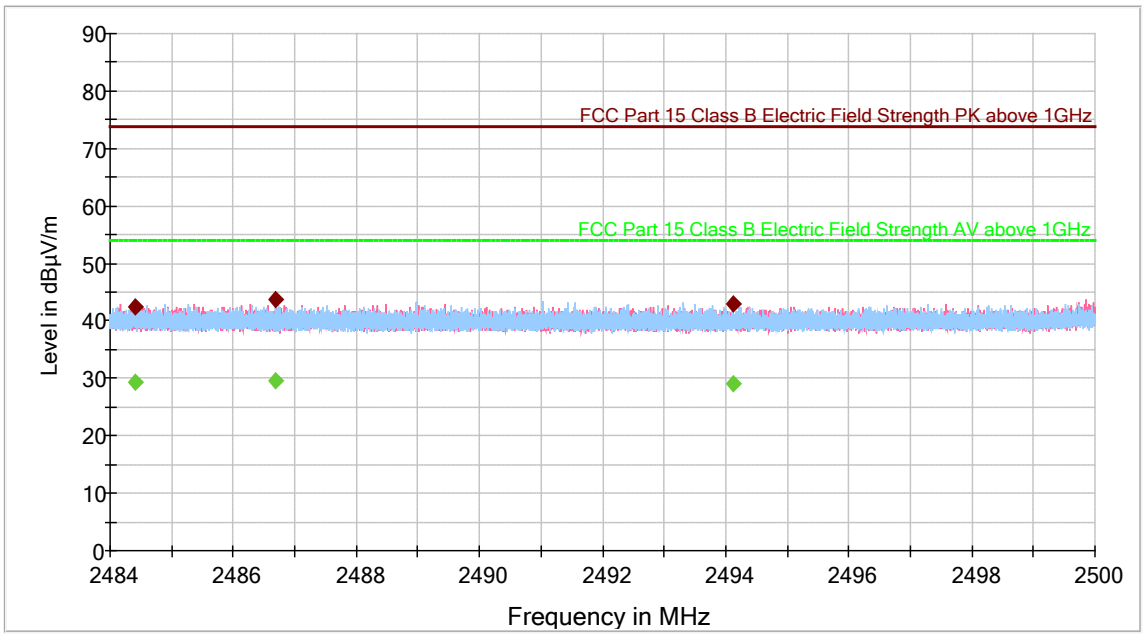
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2350.060000	42.2	1000.0	1000.000	107.7	V	286.0	-0.8	11.7	53.9
2398.510000	29.0	1000.0	1000.000	191.5	V	164.0	-0.6	24.9	53.9
2400.000000	34.0	1000.0	1000.000	113.7	V	286.0	-0.6	19.9	53.9

Test Notes:

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

2.8.11 Test Results Restricted Band 2483.5MHz to 2500MHz (Bluetooth LE High Channel)

Continuous Rotation TUV 3m Radiated 1000 to 18000MHz



FCC Part 15 Class B Electric Field Strength PK above 1GHz [..\EMI radiated\]
FCC Part 15 Class B Electric Field Strength AV above 1GHz [..\EMI radiated\]
Preview Result 1V-PK+ [Preview Result 1V.Result:2]
Preview Result 1H-PK+ [Preview Result 1H.Result:2]
Final Result 1-PK+ [Final Result 1.Result:1]
Final Result 2-AVG [Final Result 2.Result:1]

Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.400000	42.5	1000.0	1000.000	366.1	V	221.0	-0.1	31.4	73.9
2486.683200	43.7	1000.0	1000.000	103.7	H	270.0	-0.1	30.2	73.9
2494.118933	42.8	1000.0	1000.000	290.2	H	159.0	-0.1	31.1	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2484.400000	29.2	1000.0	1000.000	366.1	V	221.0	-0.1	24.7	53.9
2486.683200	29.6	1000.0	1000.000	103.7	H	270.0	-0.1	24.3	53.9
2494.118933	29.1	1000.0	1000.000	290.2	H	159.0	-0.1	24.8	53.9

Test Notes:

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

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

Not performed. Test results from Report Number: 13U15716-1 Revision C Certification Test Report for Broadcom Bluetooth Module, Model Number: BCM20732S. Issued by UL Verification Services Inc. 47173 Benicia Street, Fremont, CA 94538, USA applies.

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

SECTION 3

TEST EQUIPMENT USED

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

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
Radiated Test Setup						
1184	Spectrum Analyzer	FSEM	849718/025	Rhode & Schwarz	06/27/14	06/27/15
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	01/30/14	01/30/16
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	04/08/14	04/08/15
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	04/03/14	04/03/15
1150	Horn antenna	3160-09	012054-004	ETS	04/26/13	04/26/15
1151	Pre-amplifier	TS-PR26	100026	Rhode & Schwarz	05/02/13	05/02/15
8760	Pre-amplifier	ZKL-2	1001	Mini-Circuits	09/04/14	09/04/15
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	04/03/14	04/03/15
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	09/04/14	09/04/15
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
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 7608 and 1049	
1016	Pre-amplifier	PAM-0202	187	PAM	05/05/14	05/05/15
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	06/06/14	06/06/15
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/12/14	08/12/15
7554	Barometer/Temperature /Humidity Transmitter	iBTHX-W	0400706	Omega	01/30/14	01/30/16
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

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

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

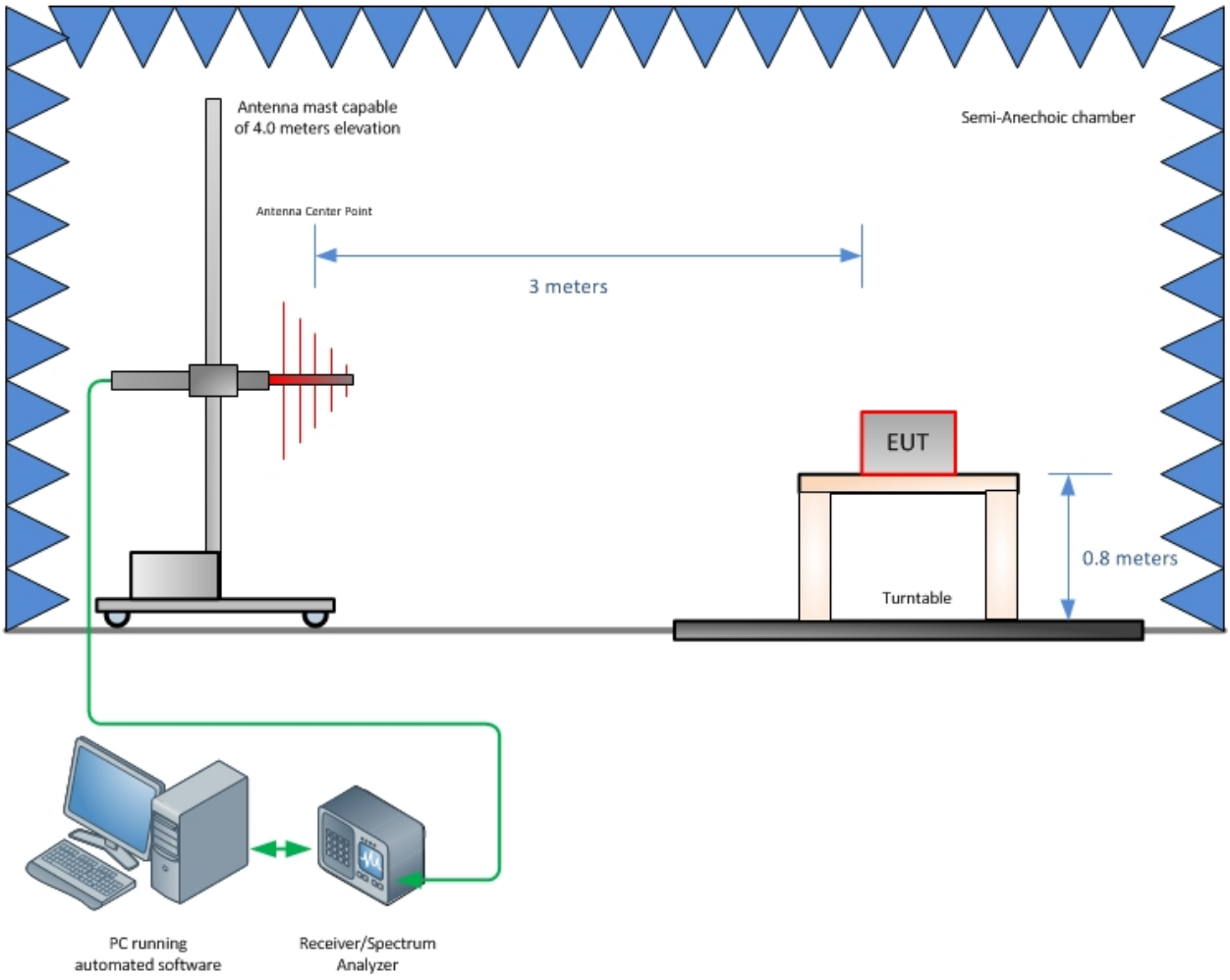
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

SECTION 4

DIAGRAM OF TEST SETUP

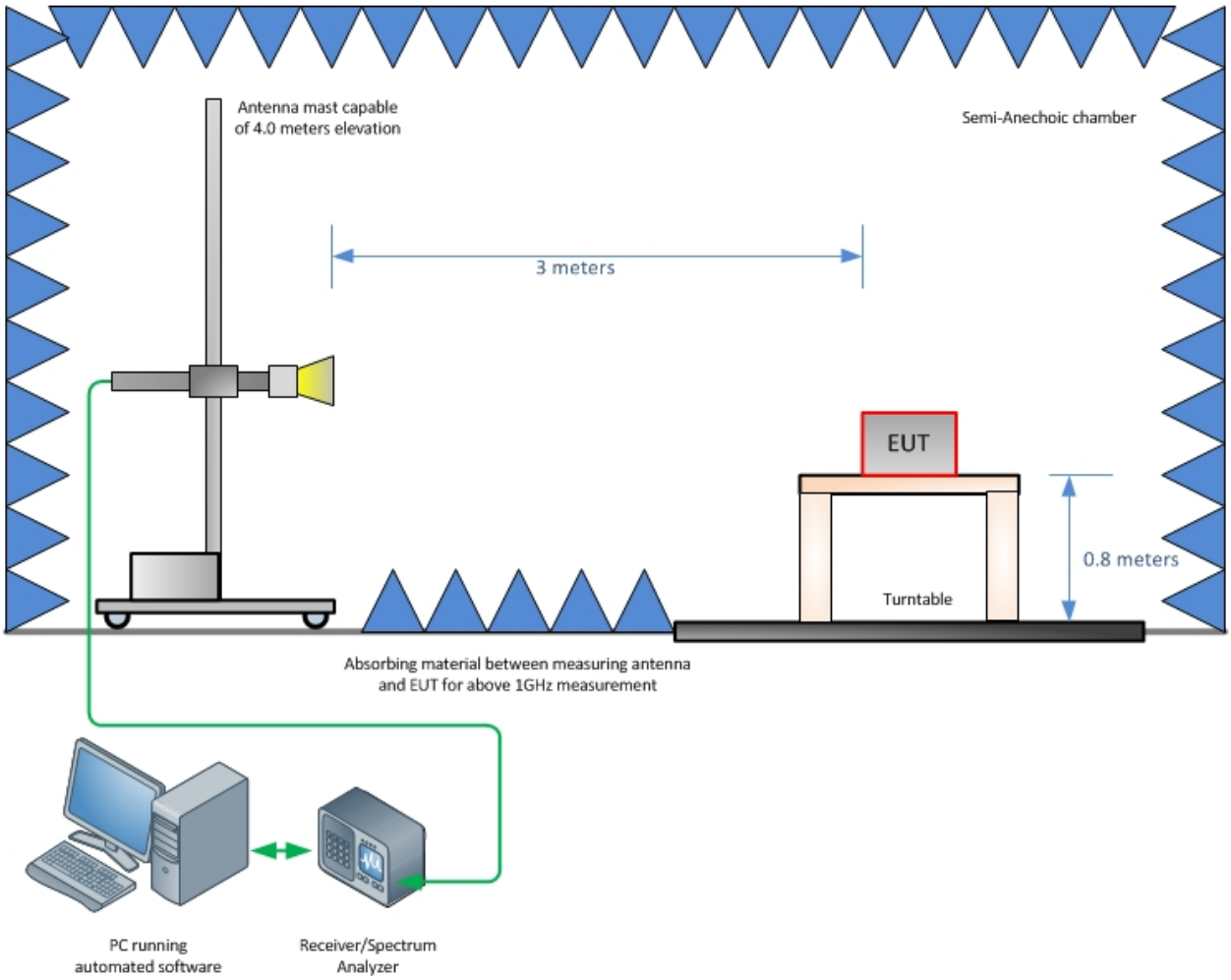
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)

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



Radiated Emission Test Setup (Above 1GHz)

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

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government
and professional organization certifications for
AAMI, ACIL, AEA, ANSI, IEEE, A2LA, NIST and VCCI.

A2LA Cert. No. 2955.13

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