America

Choose certainty.
Add value.

Report On

Application for Grant of Equipment Authorization of the
Blast Motion
B0317A Wireless Motion Sensor

FCC Part 15 Subpart C §15.247 (DTS)
RSS-247 Issue 2 March 2017

Report No. SD72130891-0817A **October, 2017**

REPORT ON	Radio Testing of the Blast Motion B0317A Wireless Motion Sensor
TEST REPORT NUMBER	SD72130891-0817A
PREPARED FOR	Blast Motion 5803 Newton Drive Suite D Carlsbad, CA 92008
CONTACT PERSON	Brad Peone Sr. Test Engineer (847) 778-0604 bpeone@blastmotion.com
PREPARED BY	Omar Castillo **Name** Authorized Signatory Title: EMC Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
DATED	October 25, 2017

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

Revision History

SD72130891-0817A Blast Motion Blast Motion Precision Sensor Wireless Motion Sensor B0317A					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
10/25/2017	Initial Release				Ferdie Custodio

CONTENTS

Section		Page No
1	**REPORT SUMMARY**	**4**
1.1	Introduction	5
1.2	Brief Summary Of Results	6
1.3	Product Information	7
1.4	EUT Test Configuration	8
1.5	Deviations From The Standard	10
1.6	Modification Record	10
1.7	Test Methodology	10
1.8	Test Facility Location	10
1.9	Test Facility Registration	11
2	**TEST DETAILS**	**12**
2.1	Peak Output Power	13
2.2	Conducted Emissions	18
2.3	99% Emission Bandwidth	19
2.4	Minimum 6 dB RF Bandwidth	22
2.5	Out-Of-Band Emissions - Radiated	25
2.6	Band-Edge Compliance And Immediate Restricted Band	31
2.7	Spurious Radiated Emissions	33
2.8	Power Spectral Density	34
3	**TEST EQUIPMENT USED**	**38**
3.1	Test Equipment Used	39
3.2	Measurement Uncertainty	40
4	**DIAGRAM OF TEST SETUP**	**41**
4.1	Test Setup Diagram	42
5	**ACCREDITATION, DISCLAIMERS AND COPYRIGHT**	**44**
5.1	Accreditation, Disclaimers and Copyright	45

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
Blast Motion
Wireless Motion Sensor

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Blast Motion Blast Motion Precision Sensor B0317A to the requirements of FCC Part 15 Subpart C §15.247 and RSS-247 Issue 2 March 2017.

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	Blast Motion
Model Number(s)	B0317A
FCC ID Number	SN2-B0113
IC Number	11003A-B0113
Serial Number(s)	451736000043 451736000044 451736000045
Number of Samples Tested	3
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2016). • RSS-247 Issue 2 March 2017 - Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices. • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014). • 558074 D01 DTS Meas Guidance v04, (April 05, 2017) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • ANSI C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Start of Test	September 27, 2017
Finish of Test	September 28, 2017
Name of Engineer(s)	Ferdinand Custodio Omar Castillo
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 - Radiated	Compliant	
2.6	§15.247(d)	RSS-247 5.5	Band-edge Compliance and Immediate Restricted Band	Compliant	
2.7	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	N/A[1]	Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v03r04
2.8	§15.247(e)	RSS-247 5.2(2)	Power Spectral Density for Digitally Modulated Device	Compliant	

N/A Not performed. EUT is a battery powered device
N/A[1] Not performed. Test results from "Out-of-Band Emissions – Radiated" covers this requirement

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Blast Amber 3 sensor is a Bluetooth Low Energy motion capture sensor to collect and transmit motion data to a smart phone or other mobile devices. A 9 axis inertial measurement unit (IMU) that records acceleration, angular rate and geo-magnetic field (e-compass) and communicates with a smart phone over a wireless Bluetooth low energy connection.

.

1.3.2 EUT General Description

EUT Description	Wireless Motion Sensor
Model Name	Blast Motion Precision Sensor
Model Number(s)	B0317A
Rated Voltage	3V Coin Cell Battery (CR2032)
Mode Verified	Bluetooth Low Energy (BT LE)
Capability	Bluetooth Low Energy (BT LE) only
Primary Unit (EUT)	☐ Production
	☒ Pre-Production
	☐ Engineering
Antenna Type	RF Chip antenna
Antenna Manufacturer	Pulse Electronics
Antenna Model Number (Mfg P/N)	W3092
Antenna Dimensions	2.0 mm x 1.2 mm
Antenna Gain	0.89 dBi (Typ.)

1.3.3 Maximum Peak Conducted Output Power

Mode	Frequency Range (MHz)	Output Power EIRP (dBm)	Output Power EIRP (mW)
Bluetooth LE	2402-2480	-10.55	0.0881

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Radiated only configuration. EUT transmitting through the integral antenna. Multiple samples were provided so EUT's battery was fully charged when testing each BT channel

1.4.2 EUT Exercise Software

A test firmware was loaded to the EUT which enable cycling of Low, Mid and High channels @ 100% duty cycle (modulated) as well as Normal Operation and Receive modes. Blast Motion's framework was used to change between BT channels (viewer version 4.2.13.111)

1.4.3 Support Equipment and I/O cables

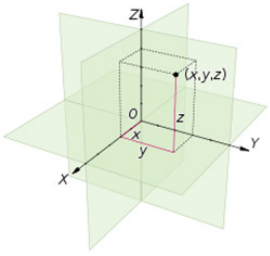
Manufacturer	Equipment/Cable	Description
LG	AC/DC Adapter (USB 5VDC)	Model: MCS-04WR2 SN:RB471056094-
Blast Motion	Wireless Charger	Model V20
-	USB to micro USB cable	24AWG
Apple	Cell Phone	IPhone 5S

1.4.4 Worst Case Configuration

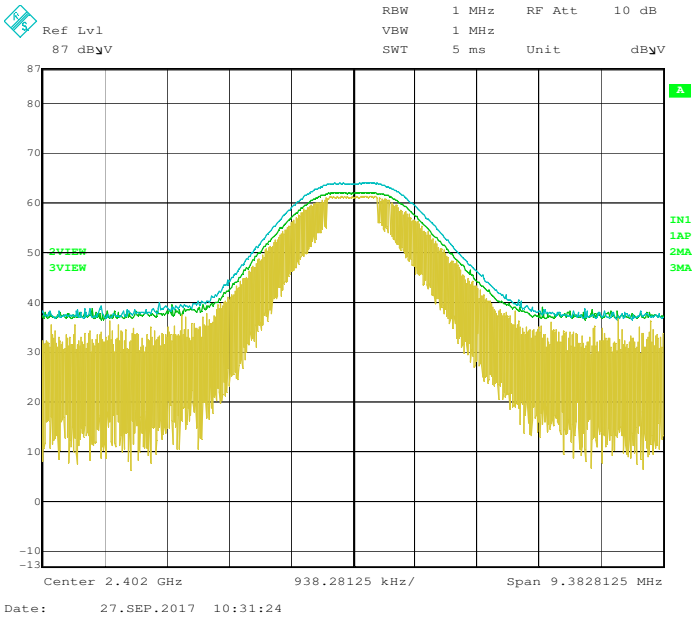
Worst-case configuration used in this test report as per fundamental field strength measurements:

Mode	Channel	Data Rate
Bluetooth LE	38 (Middle Channel)	1Mbps

EUT is a RF module. For radiated measurements, the EUT was verified installed on a development board using the worst-case axis ("X") verified via prescan.



Please see verification plot on the following page.



1.4.5 Simplified Test Configuration Diagram

Not required. EUT was verified on a stand-alone test configuration.

1.5 DEVIATIONS FROM THE STANDARD

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

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number 451736000043		
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 C63.10-2013. American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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)

16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 678 1400 Fax: 858 546 0364.

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Designation 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 Designation is US1146.

1.9.2 Innovation, Science and Economic Development Canada (ISED) Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Rancho Bernardo) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 3067A-1.

The 3m Semi-anechoic chamber of TUV SUD America Inc. (San Diego Mira Mesa) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada (ISED) for radio equipment testing with Registration No. 22806-1.

SECTION 2

TEST DETAILS

Radio Testing of the
Blast Motion
Wireless Motion Sensor

2.1 PEAK OUTPUT POWER

2.1.1 Specification Reference

Part 15 Subpart C §15.247(b)(3) and RSS-247 5.4(4)

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: 451736000043 / Default Test Configuration

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

September 27, 2017/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	28.2 °C
Relative Humidity	40.1 %
ATM Pressure	99.8 kPa

2.1.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- Test Methodology is per Clause 3.0 of KDB558074 D01 DTS Meas Guidance v03r04.
- Calculate the EIRP from the radiated field strength in the far field using Equation (22) of ANSI C63.10-2013:

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

Where

EIRP is the equivalent isotropically radiated power, in dBm
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
d_{Meas} is the measurement distance, in m

- Calculate the conducted power from the EIRP using Equation (23) of ANSI C63.10-2013:

$$P_{Cond} = EIRP - G_{EUT}$$

Where

P_{Cond} is the measured power at feedpoint of the EUT antenna, in dBm
EIRP is the equivalent isotropically radiated power, in dBm
G_{EUT} is the gain of the EUT radiating element (antenna), in dBi

- 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.

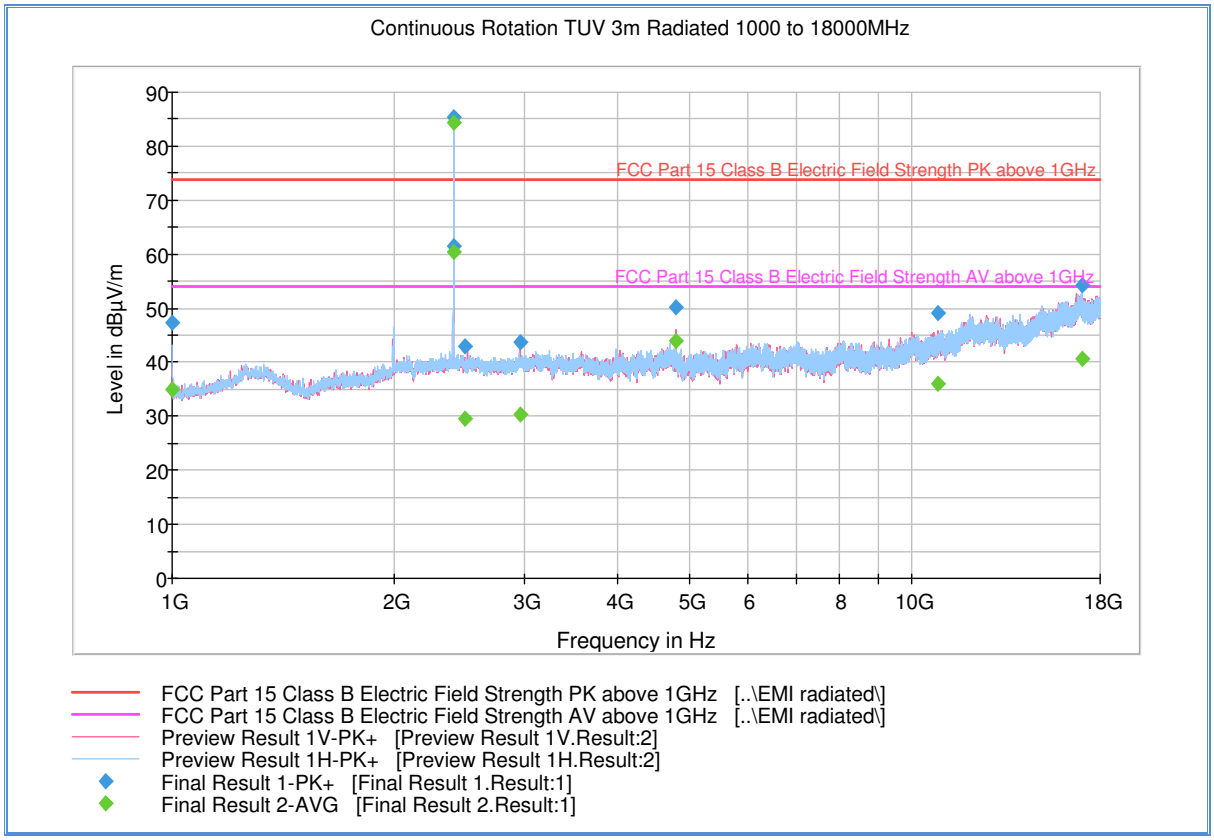
2.1.8 Sample Computation (Radiated Emission)

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**

2.1.9 Test Results

See attached plots.

2.1.11 Low Channel Fundamental Field Strength Measurement



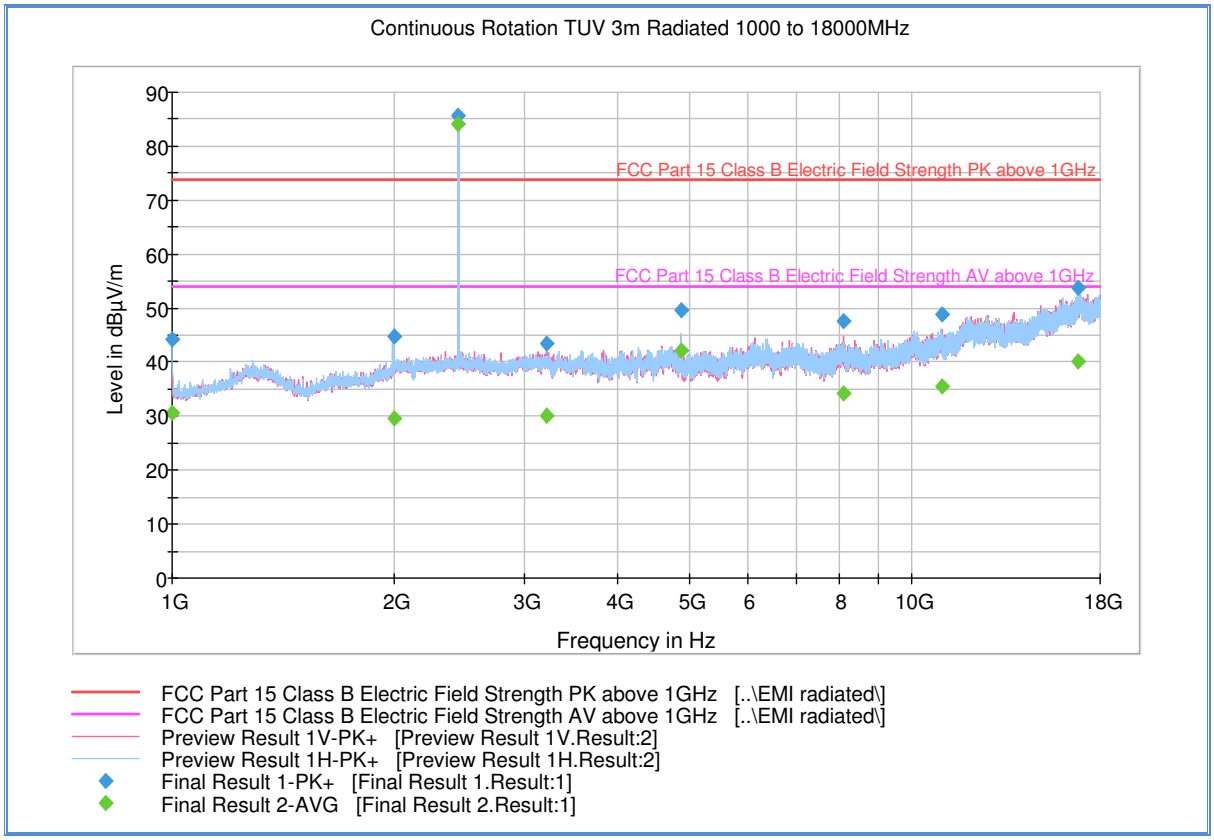
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2402.166667	85.4	1000.0	1000.000	240.2	H	75.0	-1.0

Therefore EIRP = 85.4 + 20log(3) -104.7
= -9.75dBm

P_{Cond} = EIRP - G_{EUT}
= -9.75 dBm – 1dBi
= -10.75 dBm. Complies with 30dBm limit.

2.1.12 Mid Channel Fundamental Field Strength Measurement



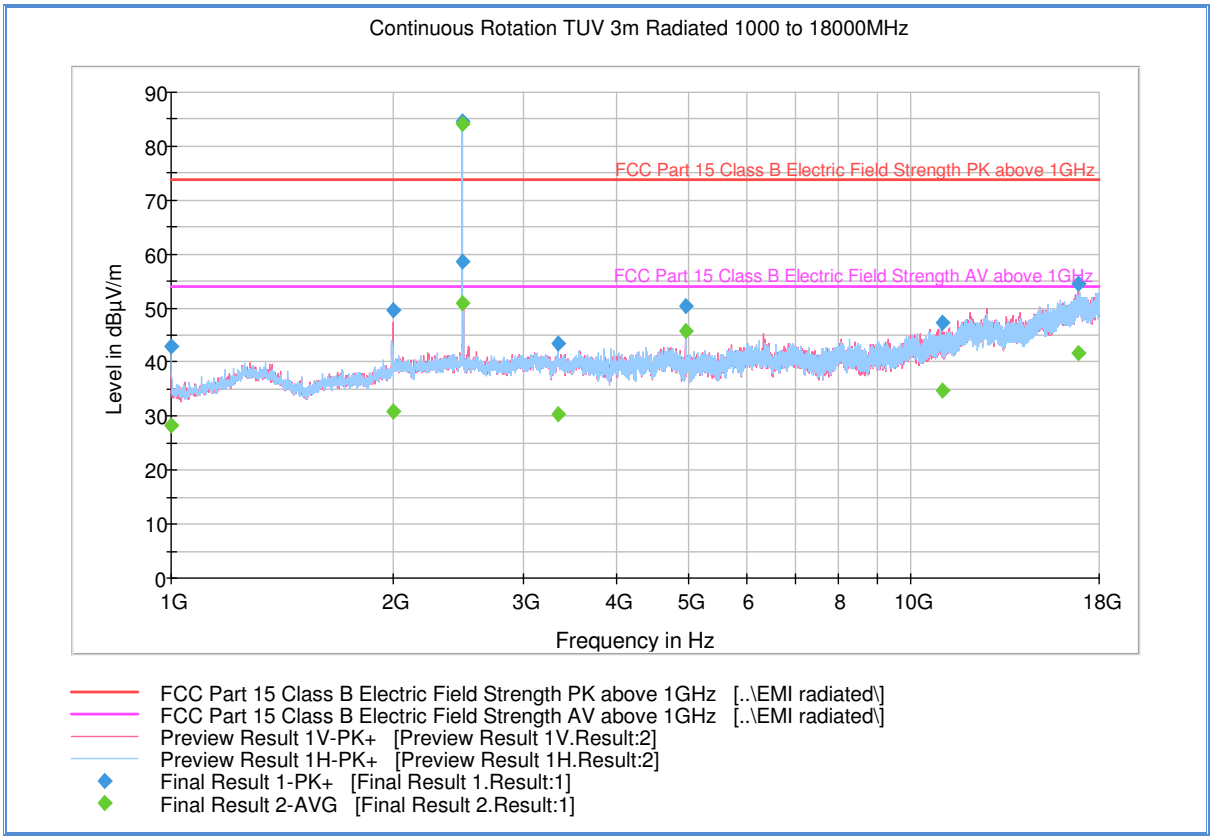
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2439.700000	85.6	1000.0	1000.000	136.4	V	295.0	-0.5

Therefore EIRP = 85.6 + 20log(3) -104.7
= -9.5 dBm

P_{Cond} = EIRP - G_{EUT}
= -9.55 dBm – 1 dBi
= -10.55 dBm. Complies with 30dBm limit.

2.1.13 High Channel Fundamental Field Strength Measurement



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)
2479.966667	84.6	1000.0	1000.000	100.4	V	194.0	-0.2

Therefore EIRP = 84.6 + 20log(3) -104.7
= -10.55 dBm

P_{Cond} = EIRP - G_{EUT}
= -10.55 dBm – 1 dBi
= -11.55 dBm. Complies with 30dBm limit.

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

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

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 battery powered device.

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: 451736000043 / Default Test Configuration

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

September 28, 2017/OC

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.0 °C
Relative Humidity	43.3 %
ATM Pressure	98.9 kPa

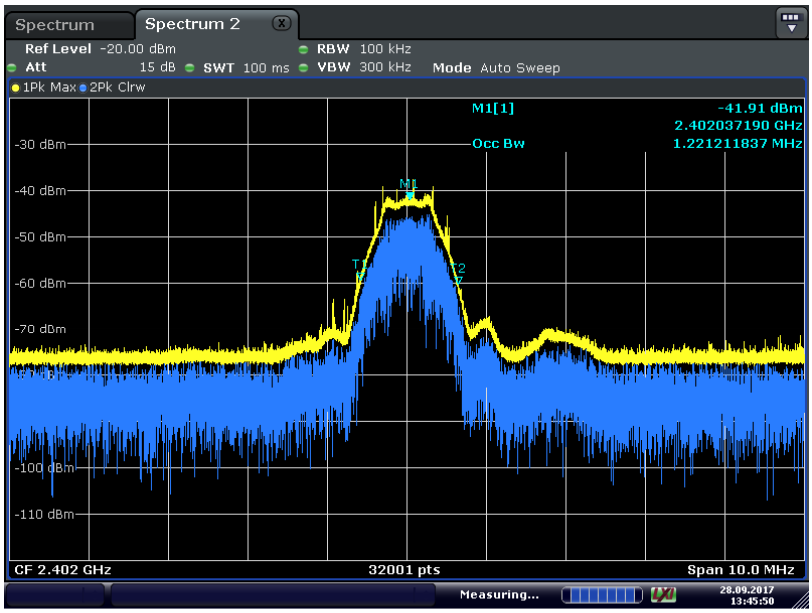
2.3.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.3.8 Test Results (For reporting purposes only)

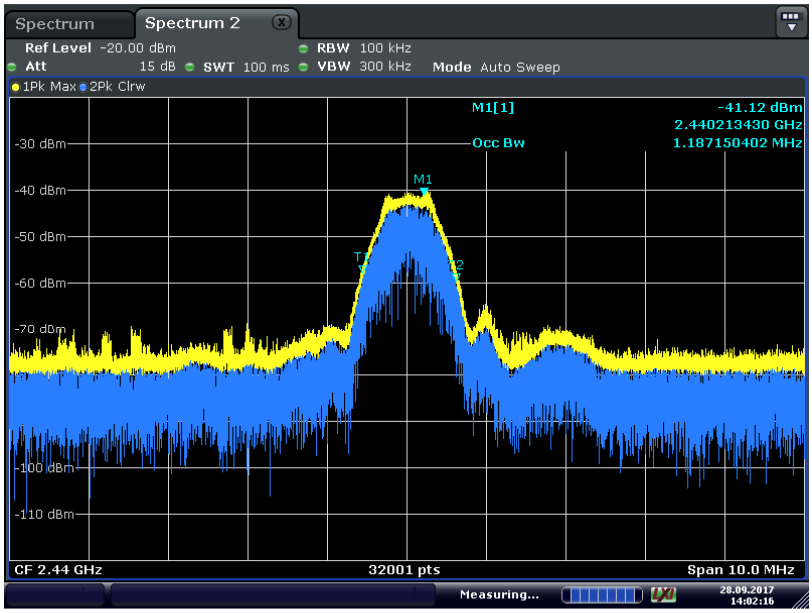
Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	37 (2402 MHz)	1.221
	17 (2440 MHz)	1.187
	39 (2480 MHz)	1.194

2.3.9 Test Results Plots



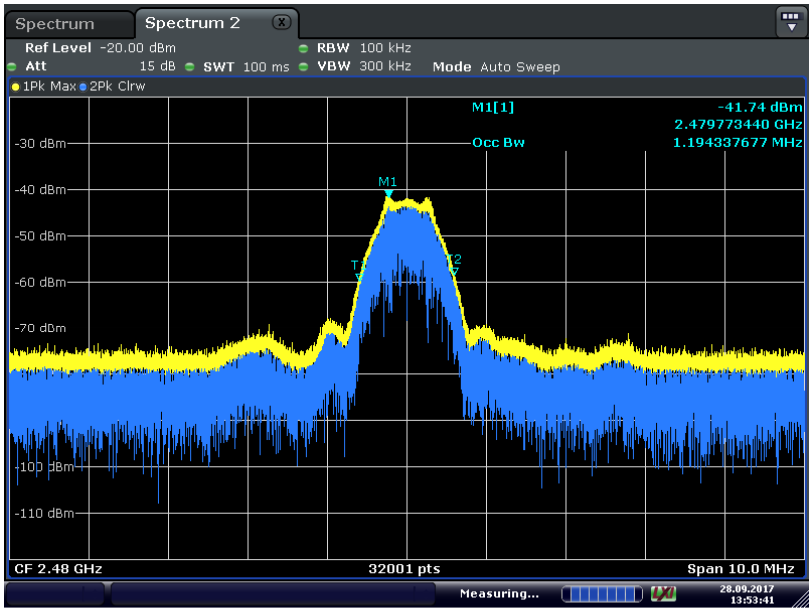
Date: 28.SEP.2017 13:45:50

Bluetooth LE Low Channel



Date: 28.SEP.2017 14:02:16

Bluetooth LE Mid Channel



Date: 28.SEP.2017 13:53:42

Bluetooth LE High Channel

2.4 MINIMUM 6 dB RF BANDWIDTH

2.4.1 Specification Reference

Part 15 Subpart C §15.247(a)(2) and RSS-247 5.2(1)

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: 451736000043 / Default Test Configuration

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

Seprember 28, 2017/OC

2.4.5 Test Equipment Used

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

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.0 °C
Relative Humidity	43.3 %
ATM Pressure	98.9 kPa

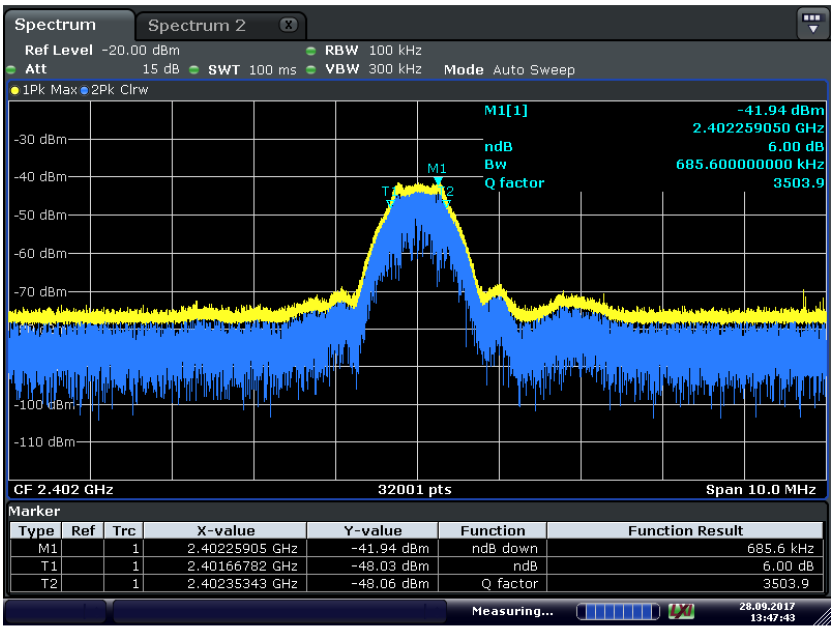
2.4.7 Additional Observations

- This is a radiated test.
- Span is wide enough to capture the channel transmission.
- RBW was set to 100 kHz while VBW is ≥3X RBW.
- Sweep is auto while Detector used is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.4.8 Test Results

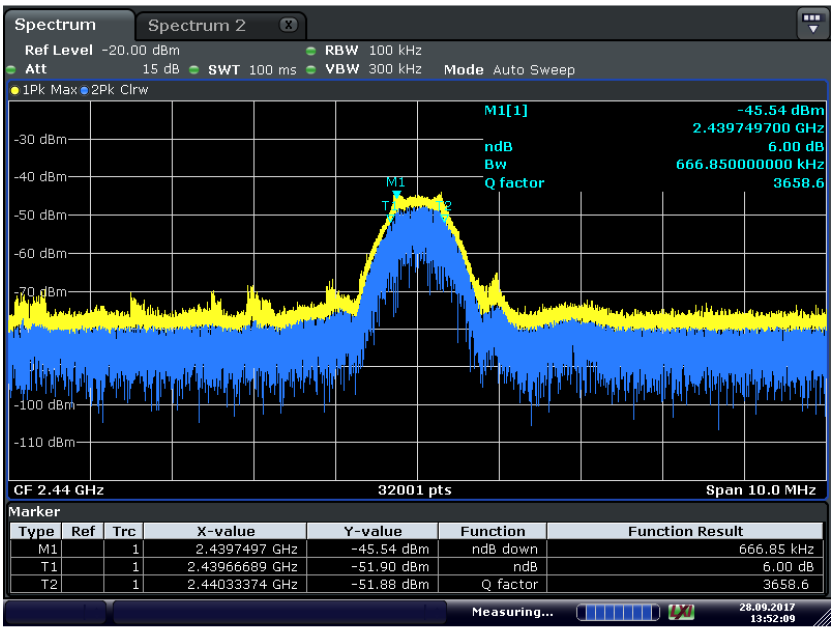
Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	37 (2402 MHz)	0.685	0.500	Complies
	38 (2426 MHz)	0.666	0.500	Complies
	39 (2480 MHz)	0.644	0.500	Complies

2.4.9 Test Results Plots



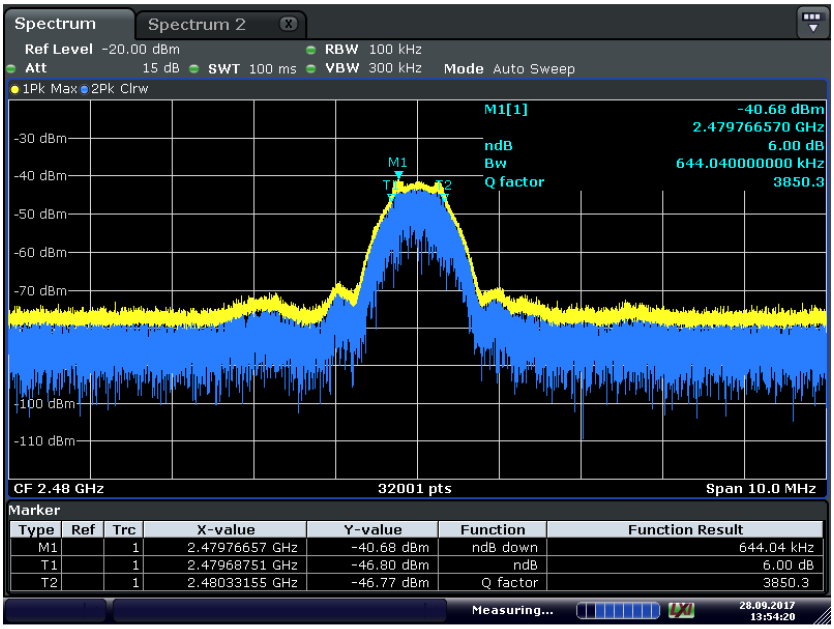
Date: 28.SEP.2017 13:47:43

Bluetooth LE Low Channel



Date: 28.SEP.2017 13:52:09

Bluetooth LE Mid Channel



Date: 28.SEP.2017 13:54:20

Bluetooth LE High Channel

2.5 OUT-OF-BAND EMISSIONS - RADIATED

2.5.1 Specification Reference

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

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: 451736000043 / Default Test Configuration

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

September 27, 2017/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	28.2 °C
Relative Humidity	40.1 %
ATM Pressure	99.8 kPa

2.5.7 Additional Observations

- This is a radiated test.
- Data presented is per§15.209(a) and §15.205(c). Test results are considered worst case compared to the 20dBc limit.
- It was verified however that all emissions measured complies with the 20dBc limit.
- 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 2.5.8 for sample computation.

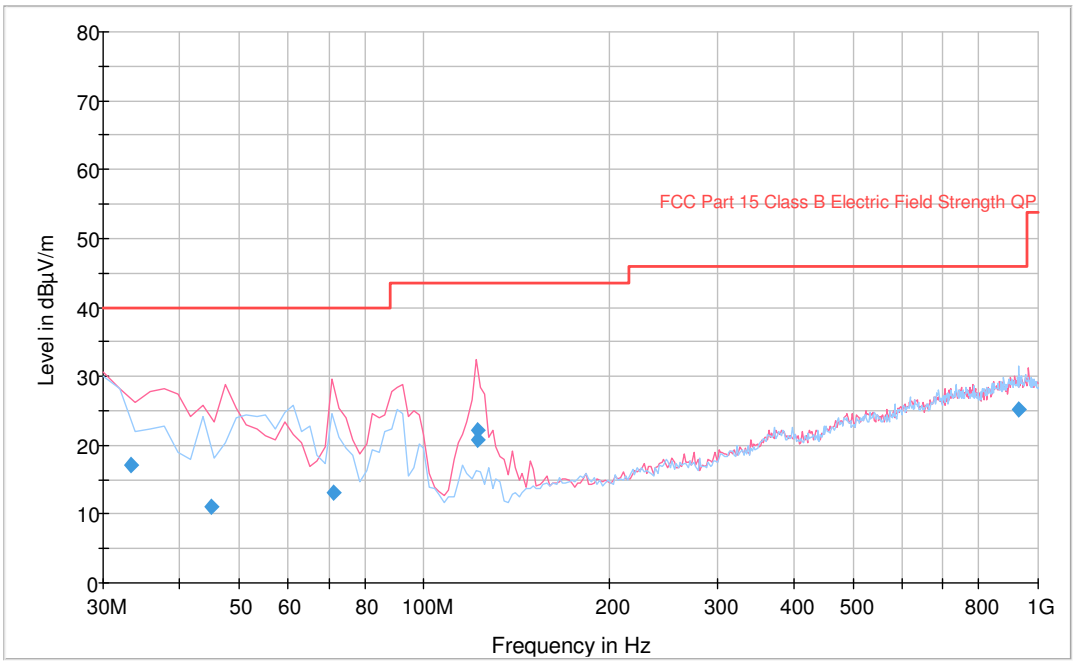
2.5.8 Sample Computation (Radiated Emission)

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

2.5.9 Test Results

See attached plots.

2.5.10 Test Results Below 1GHz (Worst Case Channel – Mid Channel)

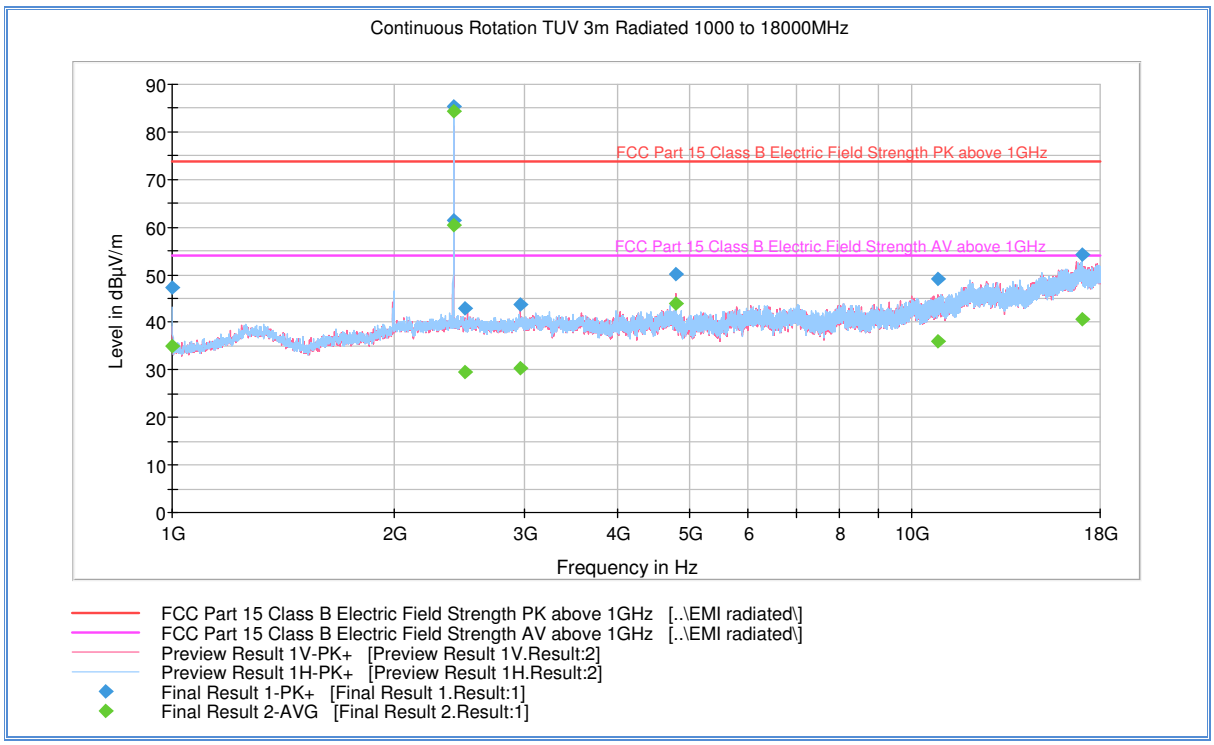


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
33.240000	17.1	1000.0	120.000	100.0	V	-12.0	-8.4	22.9	40.0
45.054990	11.2	1000.0	120.000	114.0	V	229.0	-13.6	28.8	40.0
71.301643	13.2	1000.0	120.000	132.0	V	165.0	-17.0	26.8	40.0
122.066613	22.1	1000.0	120.000	100.0	V	18.0	-15.9	21.4	43.5
122.242725	20.9	1000.0	120.000	200.0	V	349.0	-15.9	22.6	43.5
930.180040	25.1	1000.0	120.000	400.0	H	331.0	6.1	20.9	46.0

Test Notes: Since the measured fundamental frequency level is 85.6dBµV/m (from Section 2.1 of this test report). Therefore the limit as per Part 15 Subpart C §15.247(d) will be 65.6 dBµV/m. Test results from §15.209(a) and §15.205(c) presented (worst case). EUT complies.

2.5.11 Test Results Above 1GHz (Low Channel)



Peak Data

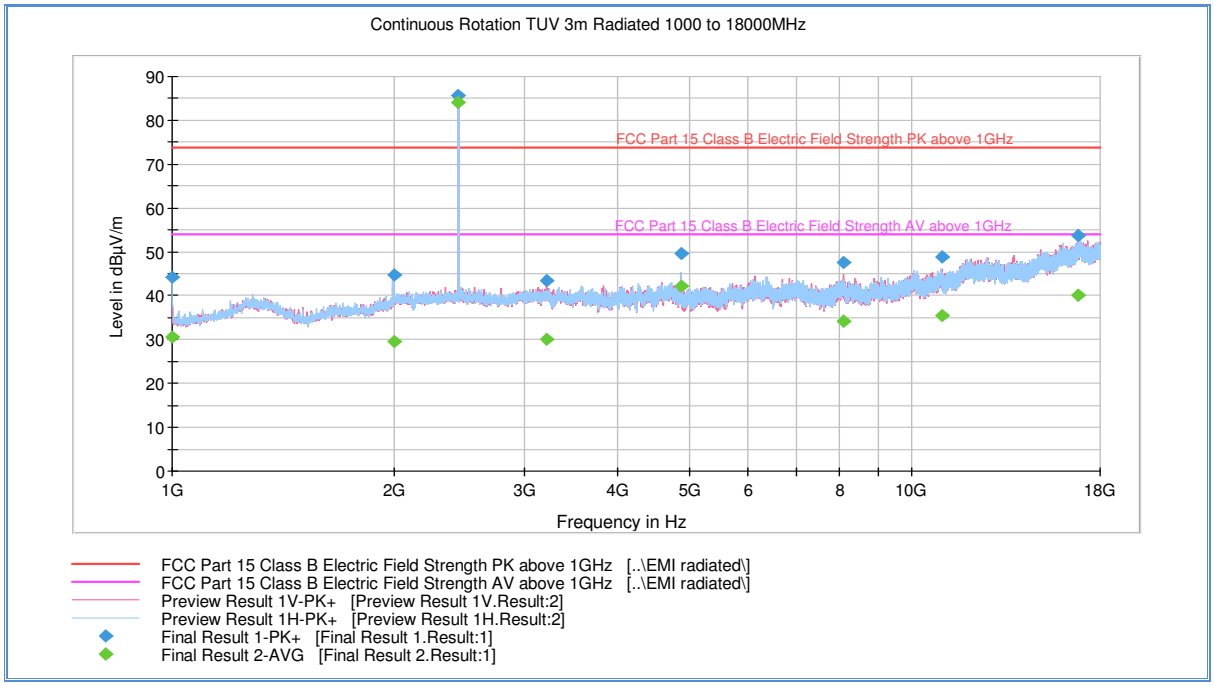
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	47.4	1000.0	1000.000	141.4	H	249.0	-7.2	26.5	73.9
2400.000000	61.4	1000.0	1000.000	240.2	H	43.0	-1.0	12.5	73.9
2402.166667	85.4	1000.0	1000.000	240.2	H	75.0	-1.0	Fundamental	
2483.500000	42.9	1000.0	1000.000	333.1	V	178.0	-0.2	31.0	73.9
2958.233333	43.6	1000.0	1000.000	385.0	V	243.0	0.4	30.3	73.9
4805.933333	50.0	1000.0	1000.000	350.1	V	12.0	4.2	23.9	73.9
10861.500000	49.0	1000.0	1000.000	406.7	V	90.0	14.2	24.9	73.9
16992.433333	54.2	1000.0	1000.000	179.3	H	20.0	22.8	19.7	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	35.0	1000.0	1000.000	141.4	H	249.0	-7.2	18.9	53.9
2400.666667	60.3	1000.0	1000.000	240.2	H	43.0	-1.0	-6.4	53.9
2402.166667	84.2	1000.0	1000.000	240.2	H	75.0	-1.0	Fundamental	
2483.500000	29.5	1000.0	1000.000	333.1	V	178.0	-0.2	24.4	53.9
2958.233333	30.3	1000.0	1000.000	385.0	V	243.0	0.4	23.6	53.9
4805.933333	43.9	1000.0	1000.000	350.1	V	12.0	4.2	10.0	53.9
10861.500000	35.9	1000.0	1000.000	406.7	V	90.0	14.2	18.0	53.9
16992.433333	40.5	1000.0	1000.000	179.3	H	20.0	22.8	13.4	53.9

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

2.5.12 Test Results Above 1GHz (Mid Channel)



Peak Data

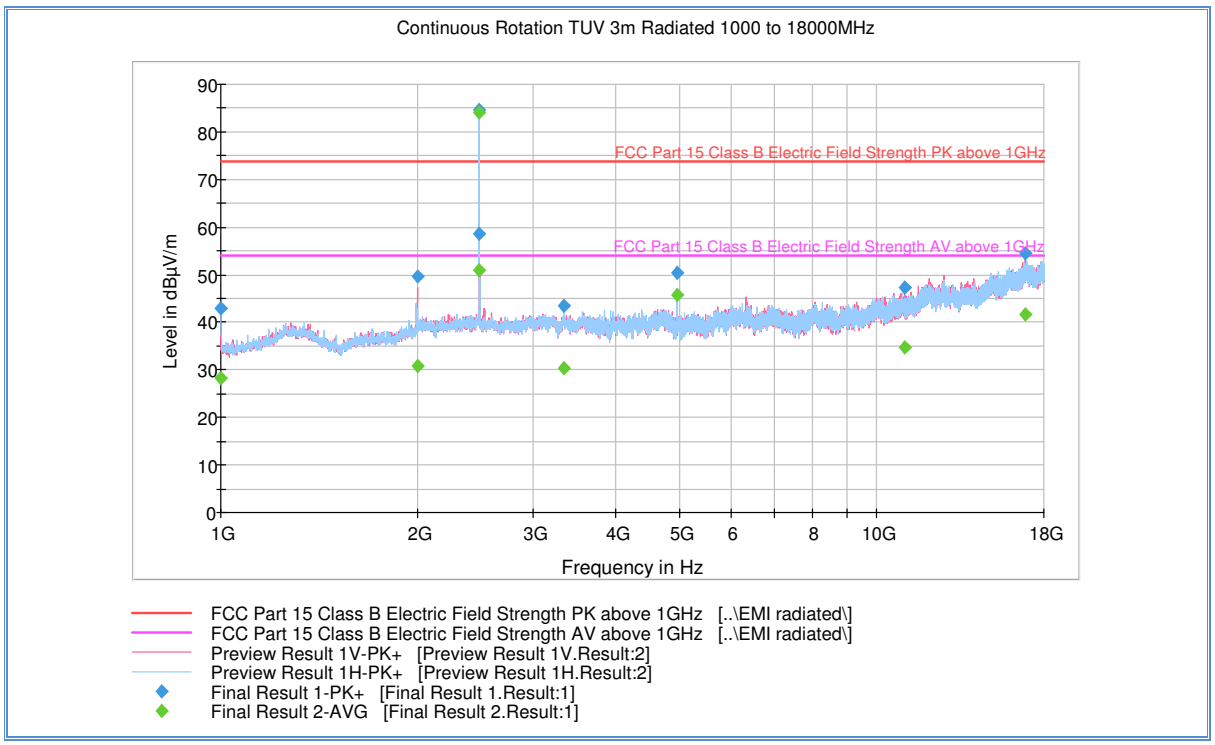
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	44.3	1000.0	1000.000	185.3	H	200.0	-7.2	29.6	73.9
1993.366667	44.6	1000.0	1000.000	283.1	H	16.0	-2.0	29.3	73.9
2439.700000	85.6	1000.0	1000.000	136.4	V	295.0	-0.5	Fundamental	
3205.100000	43.4	1000.0	1000.000	261.2	V	193.0	1.1	30.5	73.9
4879.966667	49.5	1000.0	1000.000	215.3	V	322.0	4.1	24.4	73.9
8096.000000	47.7	1000.0	1000.000	406.7	V	157.0	8.7	26.2	73.9
11007.333333	48.8	1000.0	1000.000	406.7	V	178.0	13.7	25.1	73.9
16826.800000	53.9	1000.0	1000.000	293.1	H	316.0	23.0	20.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.400000	30.6	1000.0	1000.000	185.3	H	200.0	-7.2	23.3	53.9
1993.366667	29.6	1000.0	1000.000	283.1	H	16.0	-2.0	24.3	53.9
2439.700000	84.2	1000.0	1000.000	136.4	V	295.0	-0.5	Fundamental	
3205.100000	30.0	1000.0	1000.000	261.2	V	193.0	1.1	23.9	53.9
4879.966667	42.3	1000.0	1000.000	215.3	V	322.0	4.1	11.6	53.9
8096.000000	34.2	1000.0	1000.000	406.7	V	157.0	8.7	19.7	53.9
11007.333333	35.4	1000.0	1000.000	406.7	V	178.0	13.7	18.5	53.9
16826.800000	40.2	1000.0	1000.000	293.1	H	316.0	23.0	13.7	53.9

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

2.5.13 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)
1000.800000	42.8	1000.0	1000.000	269.2	H	64.0	-7.2	31.1	73.9
1993.166667	49.7	1000.0	1000.000	207.3	V	256.0	-2.0	24.2	73.9
2479.966667	84.6	1000.0	1000.000	100.4	V	194.0	-0.2	Fundamental	
2482.533333	58.5	1000.0	1000.000	100.4	V	248.0	-0.2	15.4	73.9
3342.966667	43.6	1000.0	1000.000	380.0	H	183.0	1.1	30.3	73.9
4957.966667	50.4	1000.0	1000.000	180.3	V	83.0	3.4	23.5	73.9
11037.033333	47.4	1000.0	1000.000	385.0	V	14.0	13.8	26.5	73.9
16901.366667	54.6	1000.0	1000.000	397.0	V	44.0	23.1	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)
1000.800000	28.2	1000.0	1000.000	269.2	H	64.0	-7.2	25.7	53.9
1993.166667	30.9	1000.0	1000.000	207.3	V	256.0	-2.0	23.0	53.9
2479.966667	84.0	1000.0	1000.000	100.4	V	194.0	-0.2	Fundamental	
2482.533333	50.8	1000.0	1000.000	100.4	V	248.0	-0.2	3.1	53.9
3342.966667	30.4	1000.0	1000.000	380.0	H	183.0	1.1	23.5	53.9
4957.966667	45.7	1000.0	1000.000	180.3	V	83.0	3.4	8.2	53.9
11037.033333	34.8	1000.0	1000.000	385.0	V	14.0	13.8	19.1	53.9
16901.366667	41.6	1000.0	1000.000	397.0	V	44.0	23.1	12.3	53.9

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

2.6 BAND-EDGE COMPLIANCE AND IMMEDIATE RESTRICTED BAND

2.6.1 Specification Reference

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

2.6.2 Standard Applicable

See previous test.

2.6.3 Equipment Under Test and Modification State

Serial No: 451736000043 / Default Test Configuration

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

September 27, 2017/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

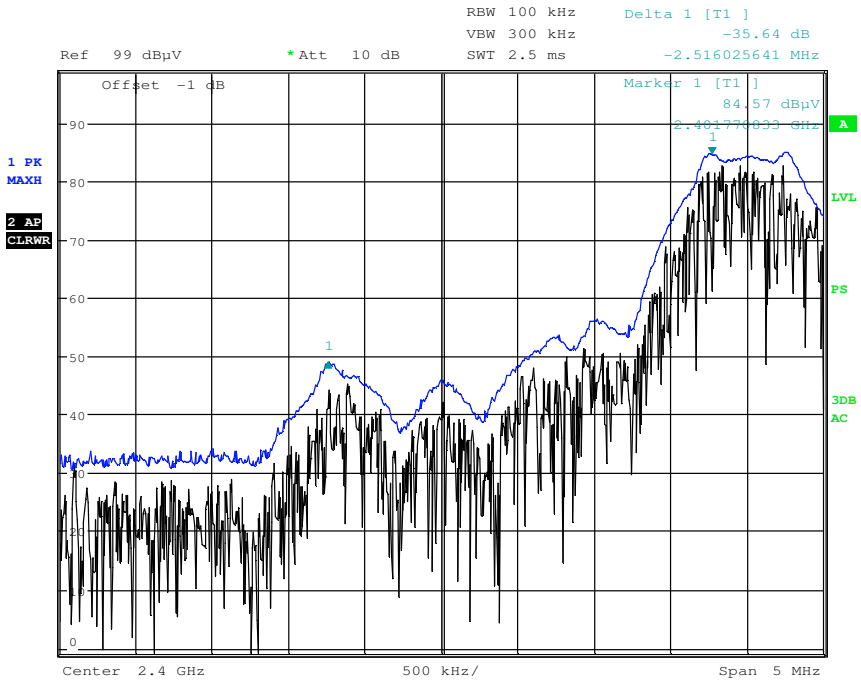
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.2 °C
Relative Humidity	40.9 %
ATM Pressure	99.5 kPa

2.6.7 Additional Observations

Test results from Section 2.5.11 and 2.5.13 applies (Immediate Restricted Band and Upper Band Edge) for upper band edge, see test plot on the following page for lower band edge (not in restricted band).

2.6.8 Lower Band Edge Test Result



Date: 27.SEP.2017 14:23:49

2.7 SPURIOUS RADIATED EMISSIONS

2.7.1 Specification Reference

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

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

Not performed. The EUT is deemed to comply with this requirement (Clause 12.2.7 of KDB558074 D01 DTS Meas Guidance v03r04) by virtue of Section 2.5 test results.

2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

Part 15 Subpart C §15.247(e) and RSS-247 5.2(2)

2.8.2 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.

2.8.3 Equipment Under Test and Modification State

Serial No: 451736000043 / Default Test Configuration

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

September 28, 2017/OC

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	25.0 °C
Relative Humidity	43.3 %
ATM Pressure	98.9 kPa

2.8.7 Additional Observations

- This is a radiated test. Test performed at the same time fundamental field strength were measured (Section 2.1 of this test report).
- Test Methodology is per Clause 3.0 and 10.2 of KDB558074 D01 DTS Meas Guidance v03r04.
- The 8dBm PSD limit was first converted to field strength utilizing the same formula used in Section 2.1 of this test report.

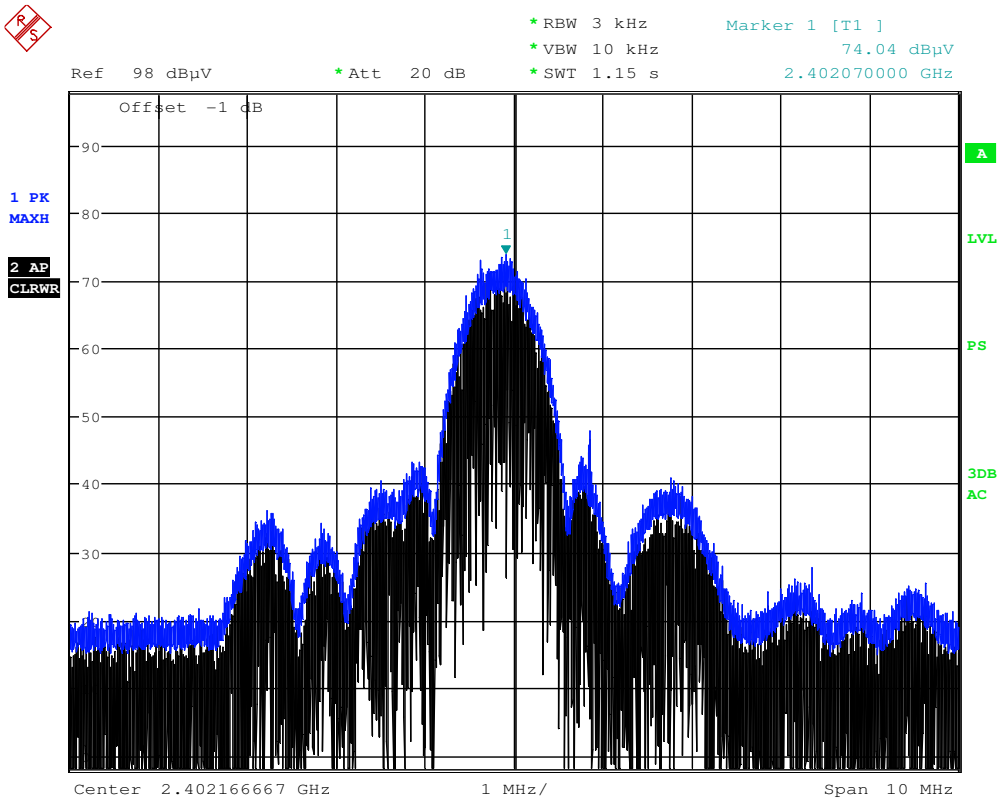
  E_{Limit} = EIRP - 20log(d_{Meas}) + 104.7
  = 8 dBm – 20log(3 meters) + 104.7
  = 103.16 dBµV/m @ 3 meters.

- Since the 8dBm PSD limit is not an EIRP limit, the antenna gain of the EUT will be deducted from the measurement plots and will be verified against the 103.16 dBµV/m calculated limit.

2.8.8 Test Results Summary

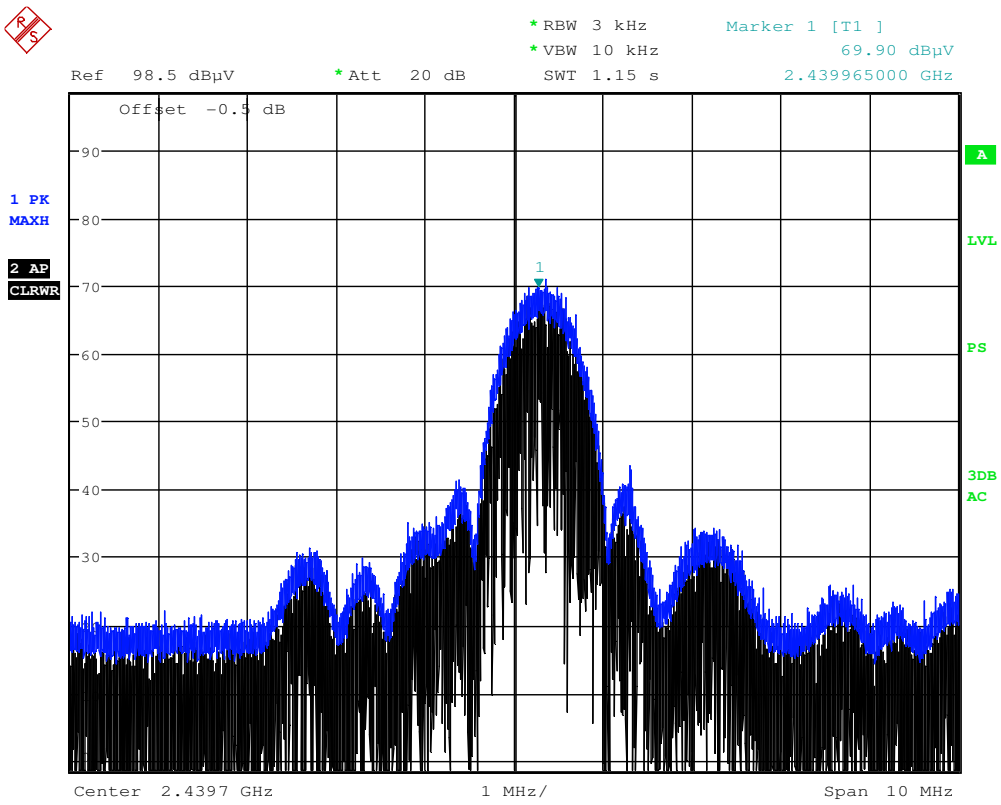
Channel	Marker Reading using 3 kHz RBW (dBµV/m)	Calculated PSD: Marker Reading – Antenna Gain (dBµV/m)	Calculated PSD Limit (dBµV/m)	Margin (dB)	Compliance
37 (2402 MHz)	74.04	73.4	103.16	29.76	Complies
17 (2440 MHz)	69.9	68.9		34.26	Complies
39 (2480 MHz)	66.05	65.05		38.11	Complies

2.8.9 Test Results Plots

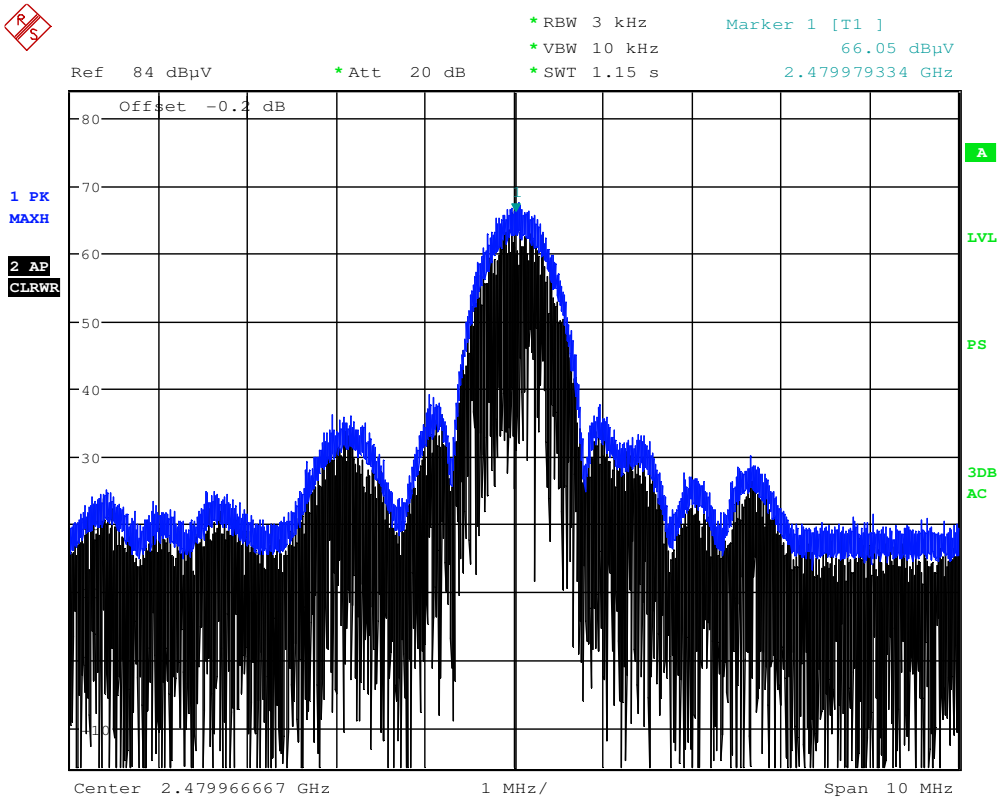


Date: 28.SEP.2017 15:47:57

Bluetooth LE Low Channel



Bluetooth LE Mid Channel



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
Radiated Test Setup						
7643	Signal Analyzer	FSV30	103166	Rhode & Schwarz	03/28/17	03/28/18
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/07/16	10/07/17
1016	Pre-amplifier	PAM-0202	187	PAM	02/09/17	02/09/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/01/17	06/01/18
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/13/17	07/13/18
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/09/17	02/09/18
Miscellaneous						
7554	Barometer/Temperature/Humidity Transmitter	iBTHX-W	0400706	Omega	01/17/17	01/17/18
	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 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	Triangular	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.68
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.36

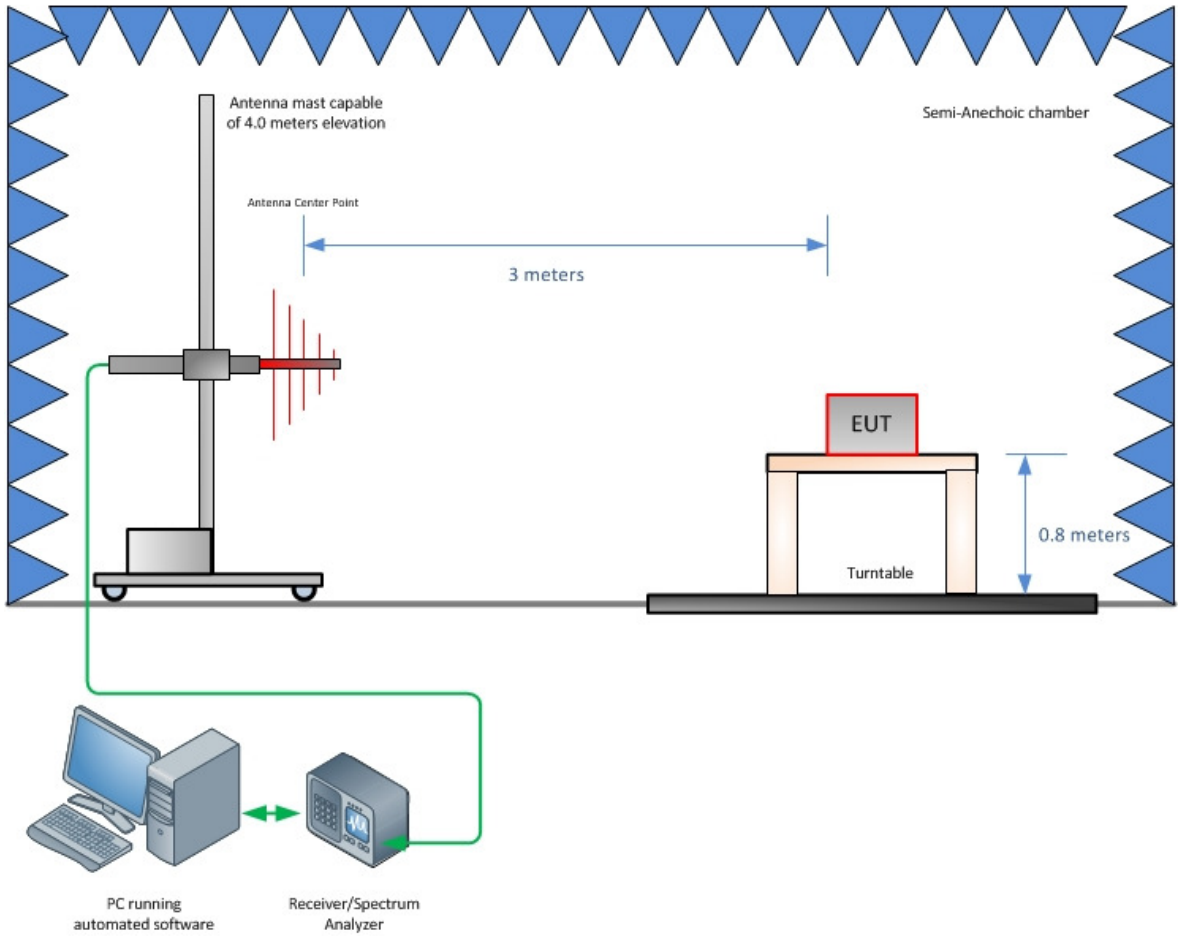
3.2.2 Radiated Emission Measurements (Above 1GHz)

	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	Triangular	3.00	1.22	1.5
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

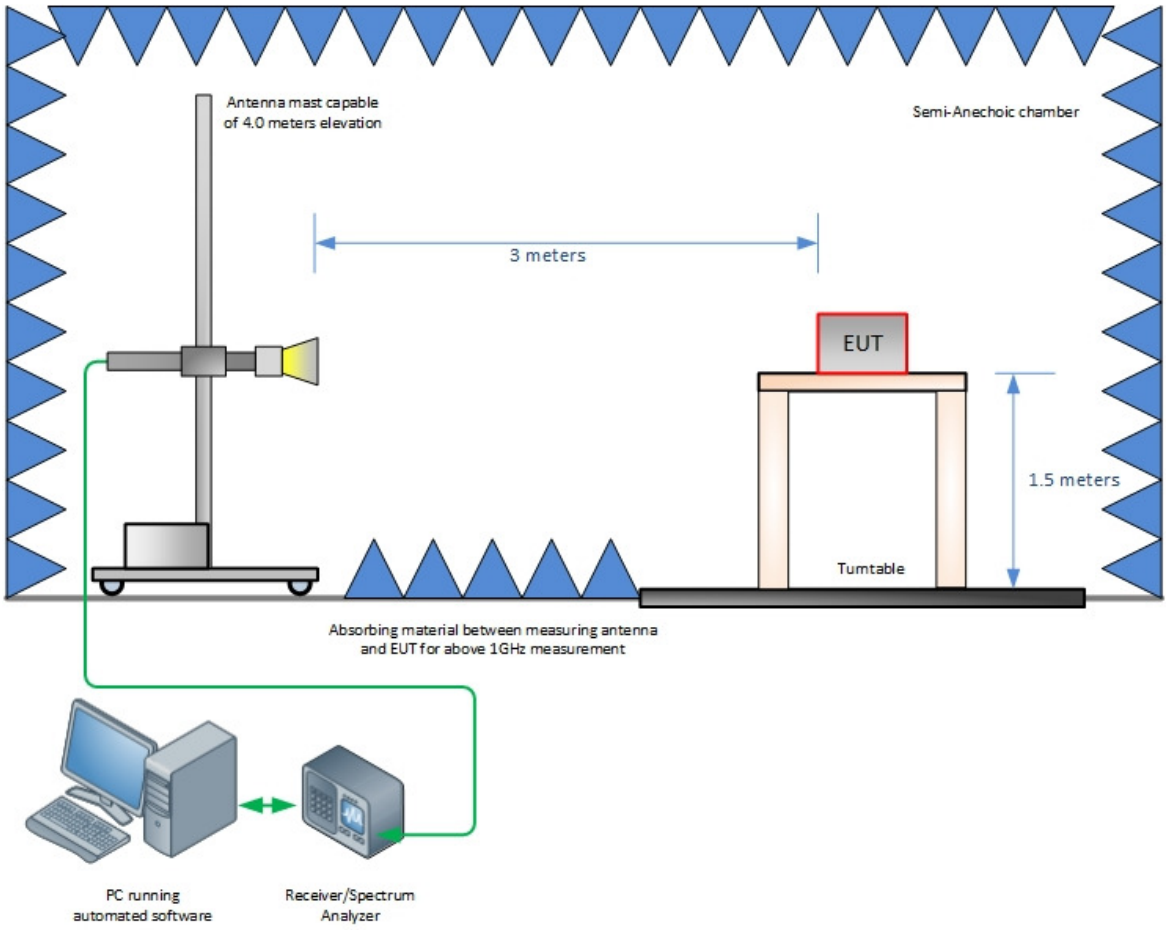
SECTION 4

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

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