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Report On

Application for Grant of Equipment Authorization of the
St. Jude Medical IESD
SJM Confirm™ DM3500 Implantable Cardiac Monitor

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

Report No. SD72113533-0216A

April 2016

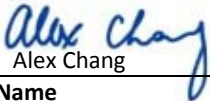


REPORT ON Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 Implantable Cardiac Monitor

TEST REPORT NUMBER SD72113533-0216A

PREPARED FOR St. Jude Medical IESD
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DATED April 26, 2016



Revision History

SD72113533-0216A St. Jude Medical IESD SJM Confirm™ DM3500 Implantable Cardiac Monitor					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
04/26/2016	Initial Release				Juan M. Gonzalez



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SECTION 1

REPORT SUMMARY

Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 Implantable Cardiac Monitor



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the St. Jude Medical IESD SJM Confirm™ DM3500 Implantable Cardiac Monitor 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	St. Jude Medical IESD
Model Name	SJM Confirm™
Model Number(s)	DM3500
FCC ID Number	RIASJMRFCMDM3500
IC Number	8454A-DM3500123
Serial Number(s)	136.01 (Temporary Conducted port sample) 138.01 (Radiated sample)
Number of Samples Tested	2
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October, 2015). • IC RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Device (Issue 1 May 2015) • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 4, November 2014). • 558074 D01 DTS Meas Guidance v03r04 (January 07, 2016) Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • ANSI C63.10-2013. America National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
Start of Test	April 04, 2016
Finish of Test	April 06, 2016
Name of Engineer(s)	Alex Chang
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	
—	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A *	
2.2		RSS-Gen 6.6	99% Emission Bandwidth	Compliant	
2.3	§15.247(a)(2)	RSS-247 5.2(1)	Minimum 6 dB RF Bandwidth	Compliant	
2.4	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
2.5	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.6	§15.247(d)	RSS-Gen 8.9 and 8.10	Spurious Radiated Emissions	Compliant	
2.6		RSS-Gen 7.1	Receiver Spurious Emissions	Compliant	
2.7	§15.247(d)	RSS-Gen 8.9 and 8.10	Radiated Band Edge Measurements	Compliant	
2.8	§15.247(e)	RSS-247 5.2(2)	Power Spectral Density for Digitally Modulated Device	Compliant	

* Not applicable. EUT is battery operated device.



1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a St. Jude Medical IESD Implantable Cardiac Monitor SJM Confirm™, Model DM3500. The EUT is an implantable patient-activated and automatically activated monitoring system that records subcutaneous ECGs. EUT Bluetooth Low Energy (BLE) mode was verified and evaluated in this test report.



1.3.2 EUT General Description

EUT Description	Implantable Cardiac Monitor
Model Name	SJM Confirm™
Model Number(s)	DM3500
Rated Voltage	Internal 3.2VDC
Mode Verified	Bluetooth LE
Capability	Bluetooth LE
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering
Antenna Type	Monopole
Manufacture	St. Jude Medical IESD
Antenna Gain	-12.5 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
	Bluetooth LE	2402 – 2480	-3.14	0.49



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Antenna conducted port test configuration. All measurements were performed on the temporary antenna port and associated with support equipment/programmable boards. The EUT is programmed via USB-to-Serial port using IDLE commands to modify channels number, and Tx power level.
B	Radiated emissions test configuration. The EUT is programmed with support equipment and remotely controlled via Bluetooth connection by a support iPhone app provided by client.

1.4.2 EUT Exercise Software

“Orion_RCT – BT LE Radio Test” software app was provided by client to exercise the EUT to perform radiated emission.

No special software used for conducted port measurement. EUT is programmed via USB-to-Serial connection using IDLE commands to exercise the EUT. IDLE version 2.7.9 was used during evaluation.

1.4.3 Support Equipment and I/O cables

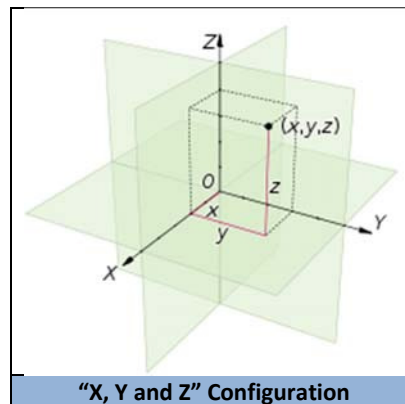
Manufacturer	Equipment/Cable	Description
Dell	Support Laptop	Model: PP18L
Dell	Support Laptop External Power Supply	Model: DA90PS1-00
—	Phantom Cylinder	—
Zurich Med Tech	Phantom Liquid (Fat Liquid Material)	P/N: ZL AAF245 CA

1.4.4 Worst Case Configuration

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

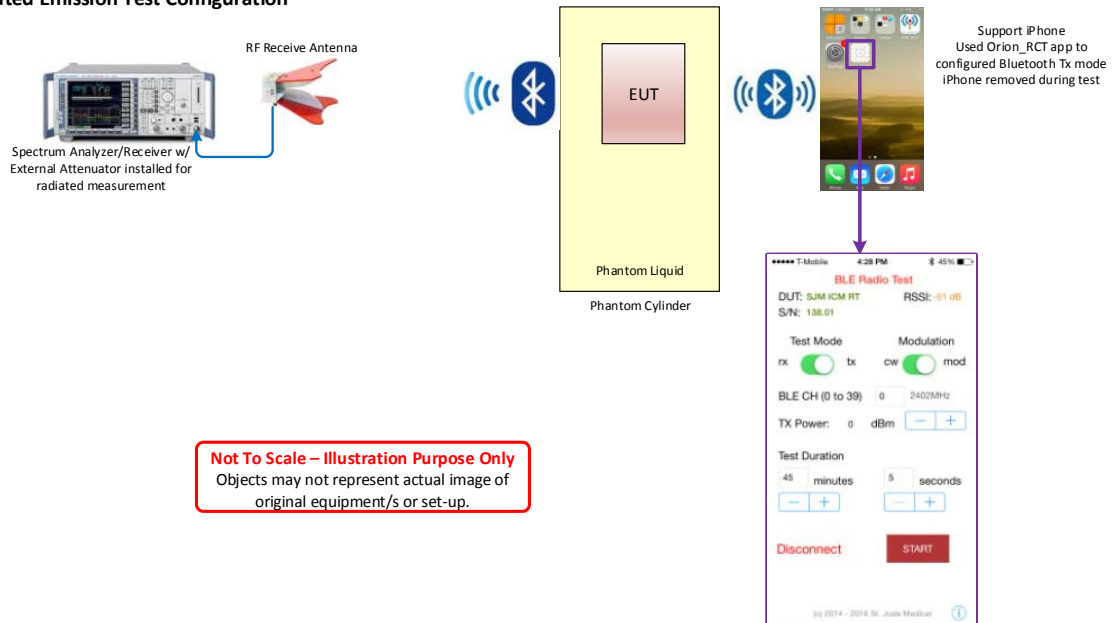
Mode	Channel	Data Rate
Bluetooth LE	0 (Low Channel)	1Mbps

EUT is a portable device. For radiated measurements X, Y and Z orientations were verified. Worst case position is "Z".

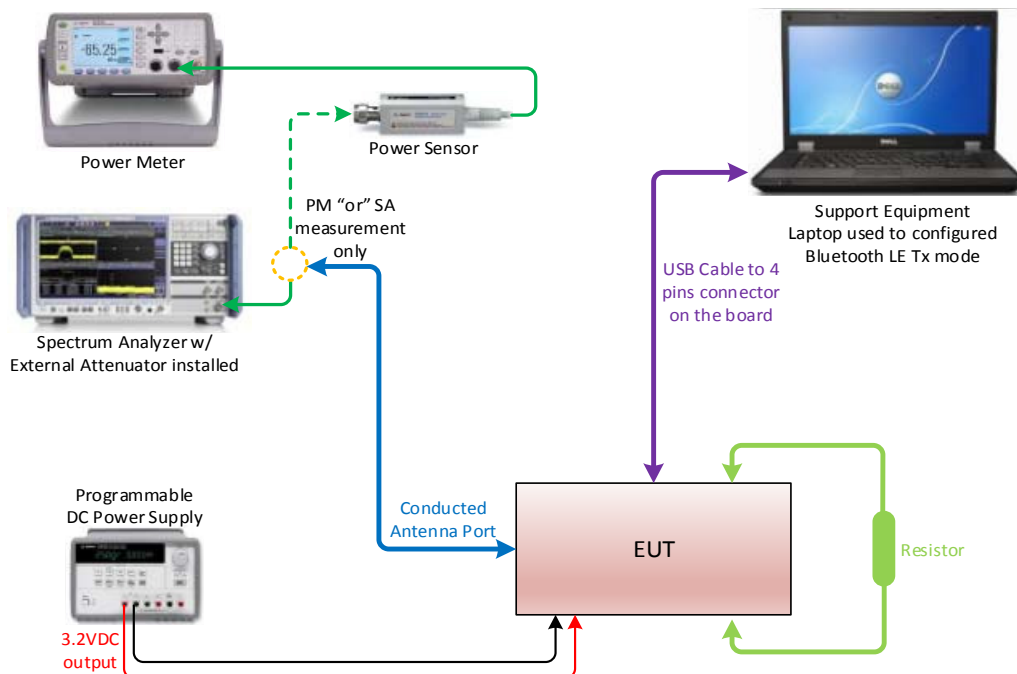


1.4.5 Simplified Test Configuration Diagram

Radiated Emission Test Configuration



Conducted (Antenna Port) 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: 136.01(Temporary Conducted port sample) and 138.01(Radiated sample).		
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, America 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 C63.10-2013. 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: 858 942 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 Innovation, Science and Economic Development Canada Registration No.: 3067A

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



SECTION 2

TEST DETAILS

Radio Testing of the
St. Jude Medical IESD
SJM Confirm™ DM3500 Implantable Cardiac Monitor



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: 136.01 / Test Configuration A

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

April 04, 2016 / AC

2.1.5 Test Equipment Used

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

2.1.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4 °C
Relative Humidity	41.1 %
ATM Pressure	99.5 kPa

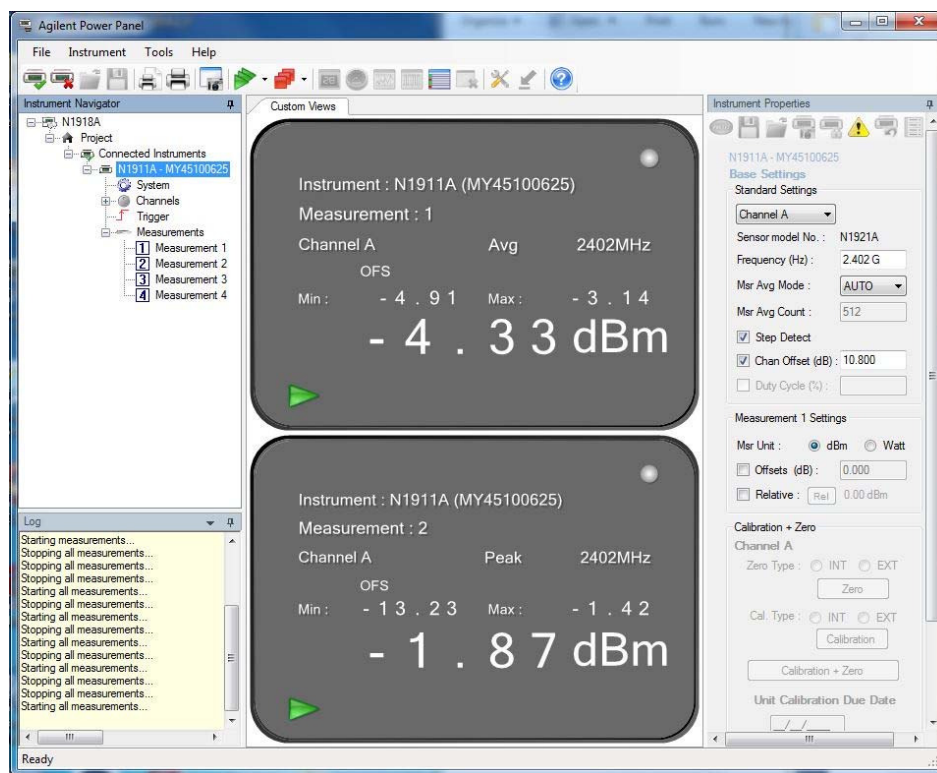
2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- An offset of 10.8dB was added to compensate for the external attenuator and cable used from the antenna port to the power sensor.
- Test methodology is per Clause 9.2.3.1 of KDB 558074 D01 (DTS Meas Guidance v03r04, January 07, 2016). All conditions under this Clause are satisfied.
- Both Peak and Average measurements were recorded.

2.1.8 Test Results

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Average Power (dBm)	Measured Peak Power (dBm)
	0 (2402 MHz)	GFSK @ 1Mbps	-3.14	-1.42
	19 (2440 MHz)		-4.10	-2.15
	39 (2480 MHz)		-4.94	-3.01

2.1.9 Sample Test Display



Bluetooth LE. Low Channel



2.2 99% EMISSION BANDWIDTH

2.2.1 Specification Reference

RSS-Gen Clause 4.6.1

2.2.2 Standard Applicable

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 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 shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold may produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear 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. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

2.2.3 Equipment Under Test and Modification State

Serial No: 136.01 / Test Configuration A

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

April 04, 2016 / AC

2.2.5 Test Equipment Used

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

2.2.6 Environmental Conditions

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4 °C
Relative Humidity	41.1 %
ATM Pressure	99.5 kPa

2.2.7 Additional Observations

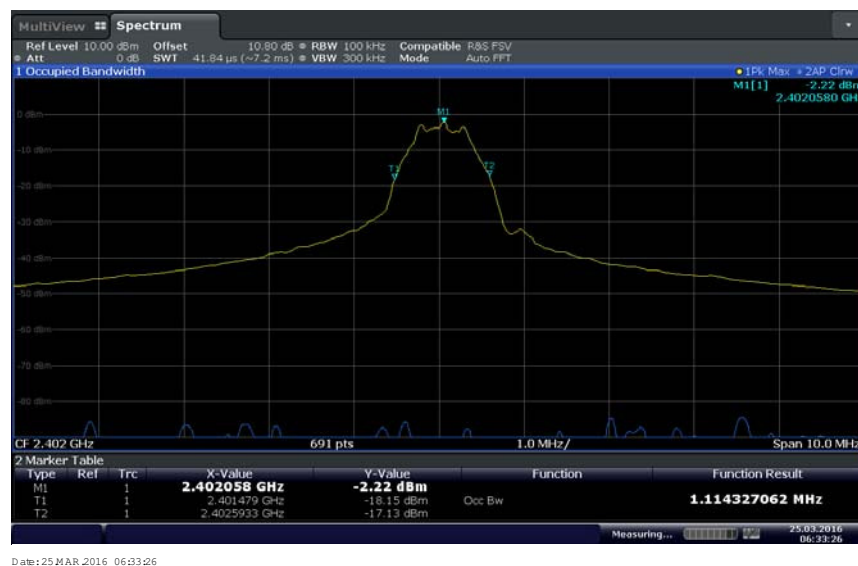
- This is a conducted test.
- An offset of 10.8dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is 1% of the span.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.

- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.2.8 Test Results (For reporting purposes only)

Bluetooth Low Energy (LE)	Channel	Measured 99% Bandwidth (MHz)
	0 (2402 MHz)	1.114
	19 (2440 MHz)	1.114
	39 (2480 MHz)	1.114

2.2.9 Test Results Plots

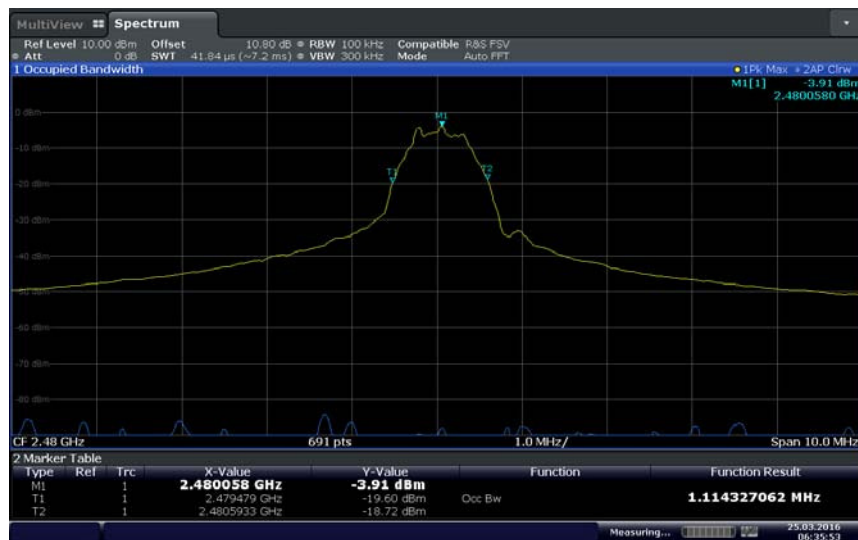


Bluetooth LE Low Channel



Date: 25 MAR 2016 06:34:47

Bluetooth LE Mid Channel



Date: 25 MAR 2016 06:35:53

Bluetooth LE High Channel



2.3 MINIMUM 6 dB RF BANDWIDTH

2.3.1 Specification Reference

Part 15 Subpart C §15.247(a)(2)

2.3.2 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.

2.3.3 Equipment Under Test and Modification State

Serial No: 136.01 / Test Configuration A

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

April 04, 2016 / AC

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	25.4 °C
Relative Humidity	41.1 %
ATM Pressure	99.5 kPa

2.3.7 Additional Observations

- This is a conducted test.
- An offset of 10.8 dB was added to compensate for the external attenuator and cable used.
- Span is wide enough to capture the channel transmission.
- RBW is set to 100 kHz.
- VBW is 3X RBW.
- Sweep is auto.
- Detector is peak.
- The “n” dB down marker function of the spectrum analyzer was used for this test.
- For signal modulation where “n” dB down marker function is not practical, a peak measurement is performed while the trace is in max hold.

2.3.8 Test Results

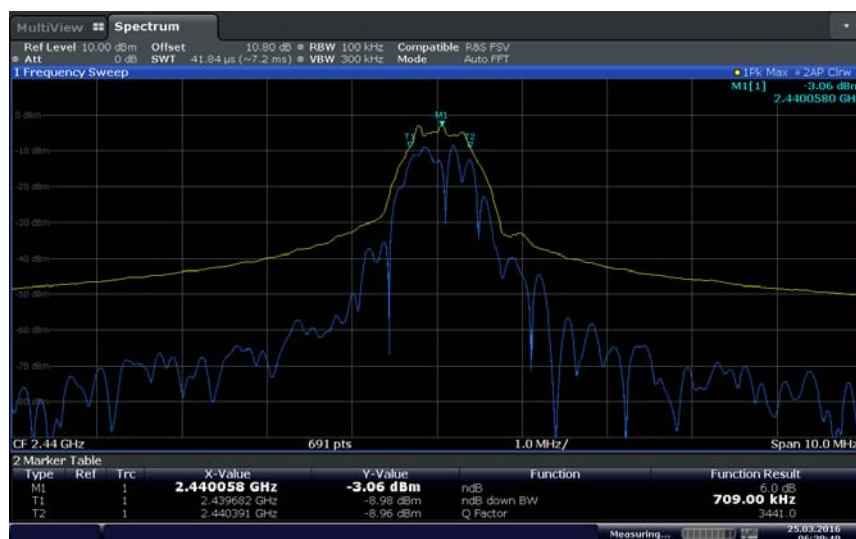
Bluetooth Low Energy (LE)	Channel	Measured Bandwidth (kHz)	Minimum Bandwidth (kHz)	Compliance
	0 (2402 MHz)	695.0	500	Complies
	19 (2440 MHz)	709.0	500	Complies
	39 (2480 MHz)	724.0	500	Complies

2.3.9 Test Results Plots



Date: 25 MAR 2016 06:41:07

Bluetooth LE Low Channel



Date: 25 MAR 2016 06:39:49

Bluetooth LE Mid Channel



Date: 25 MAR 2016 06:38:18

Bluetooth LE High Channel



2.4 OUT-OF-BAND EMISSIONS - CONDUCTED

2.4.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.4.2 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)).

2.4.3 Equipment Under Test and Modification State

Serial No: 136.01 / Test Configuration A

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

April 04, 2016 / AC

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

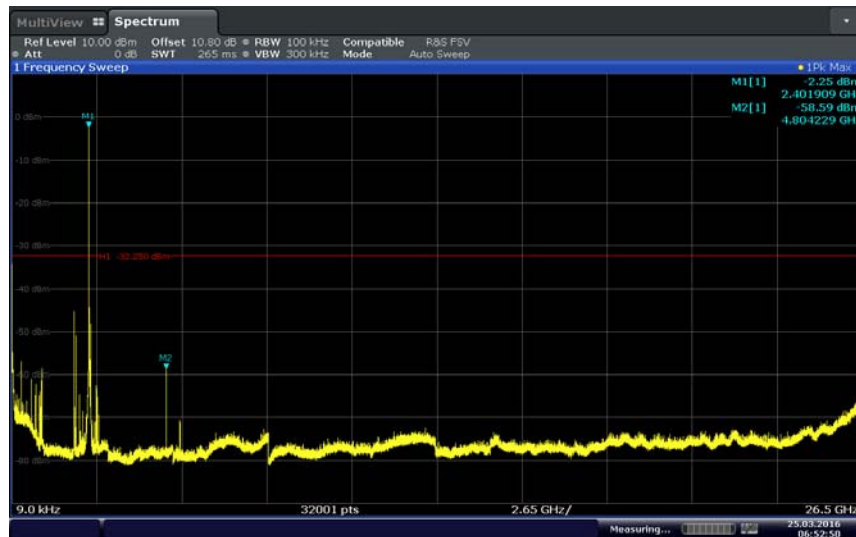
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4 °C
Relative Humidity	41.1 %
ATM Pressure	99.5 kPa

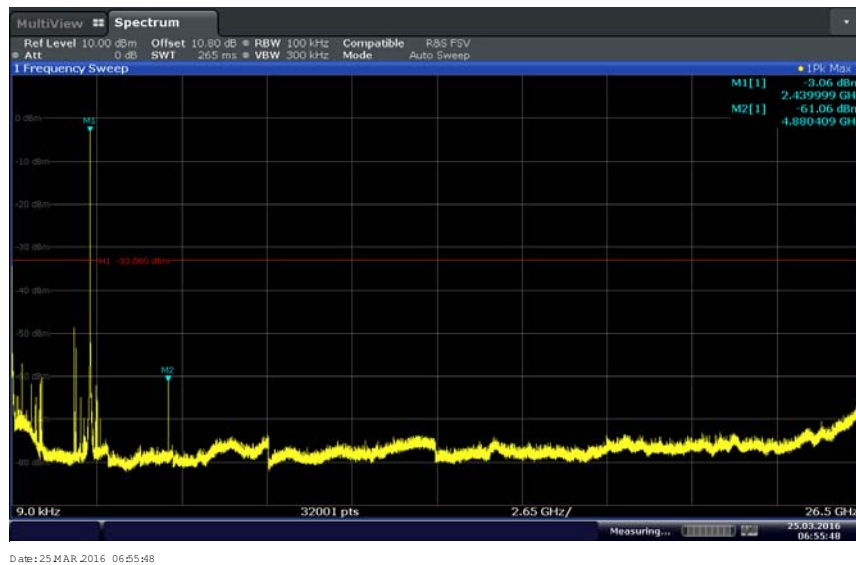
2.4.7 Additional Observations

- This is a conducted test.
- An offset of 10.8dB was added to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 30dB below this level.
- Spectrum was searched from 9 kHz up to 26.5GHz.

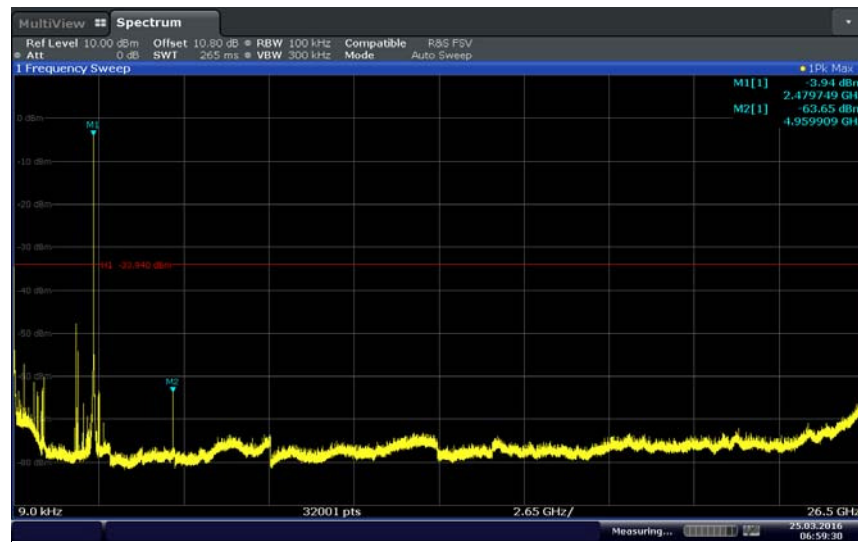
2.4.8 Test Results Plots



Bluetooth LE Low Channel



Bluetooth LE Mid Channel



Bluetooth LE High Channel



2.5 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

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: 136.01 / Test Configuration A

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

April 04, 2016 / AC

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	25.4 °C
Relative Humidity	41.1 %
ATM Pressure	99.5 kPa

2.5.7 Additional Observations

- This is a conducted test.
- Setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
- Both 2.4GHz band-edge 2400MHz and 2483.5MHz emissions was verified in this test.
- Test methodology is per Clause 13.1 of KDB 558074 D01 DTS Meas Guidance v03r04, January 07, 2016)
- Limits are from Section 2.4 of this test report. These are 30dBc from the highest level of the desired power within the band.



2.5.8 Test Results

Complies. See attached plots.



Date: 25 MAR 2016 07:04:38

Bluetooth LE Lower Edge



Date: 25 MAR 2016 07:05:50

Bluetooth LE Higher Edge



2.6 SPURIOUS RADIATED EMISSIONS

2.6.1 Specification Reference

Part 15 Subpart C §15.247(d)

2.6.2 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)).

2.6.3 Equipment Under Test and Modification State

Serial No: 138.01 / Test Configuration B

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

April 05 and 06, 2016 / AC

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	26.6 °C
Relative Humidity	35.7 %
ATM Pressure	99.2 kPa

2.6.7 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 considered worst case configuration (Low Channel) presented for radiated emissions below 1GHz. There are no significant differences in emissions between channels below 1GHz.
- Only noise floor measurements observed above 18GHz.



- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.6.8 for sample computation.

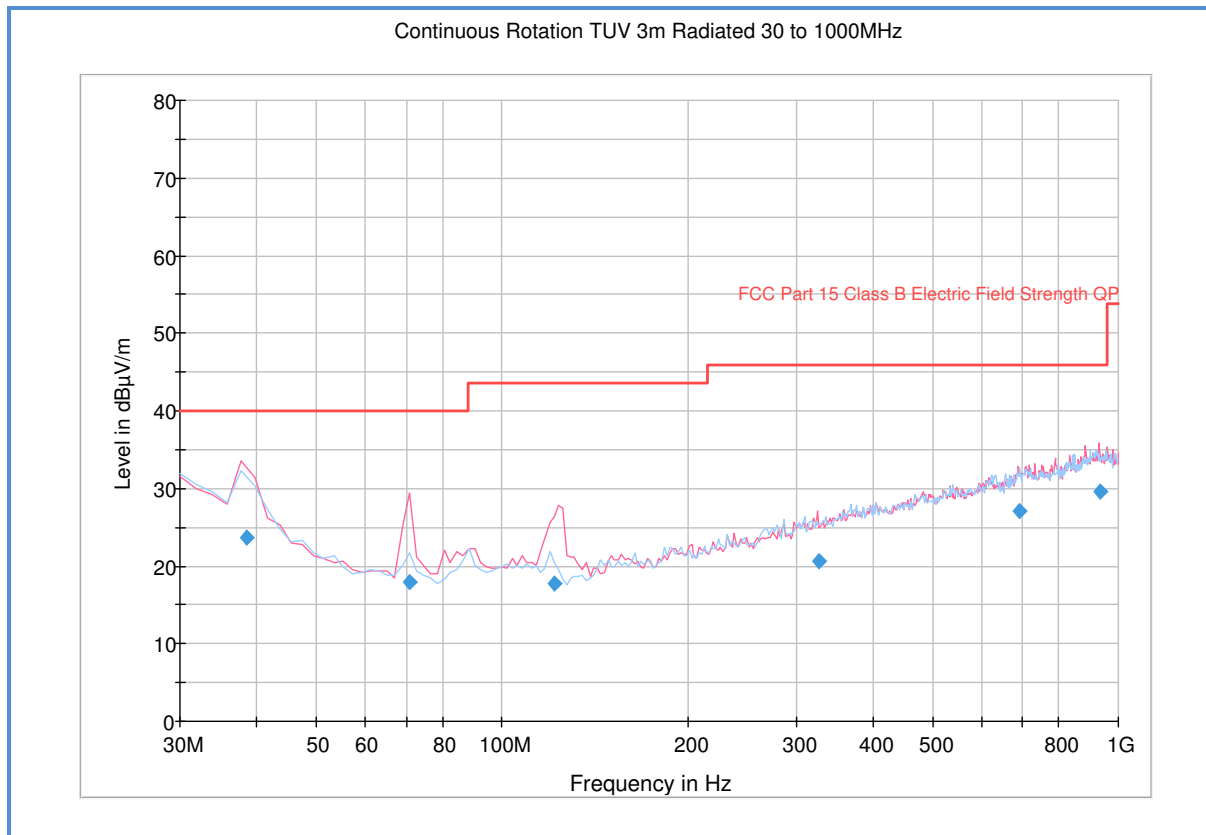
2.6.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dB μ V) @ 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 Quasi Peak Final Measurement (dB μ V/m) @ 30MHz			11.8

2.6.9 Test Results

See attached plots.

2.6.10 Test Results Below 1GHz – (Tx mode in low channel 2402MHz worst case)

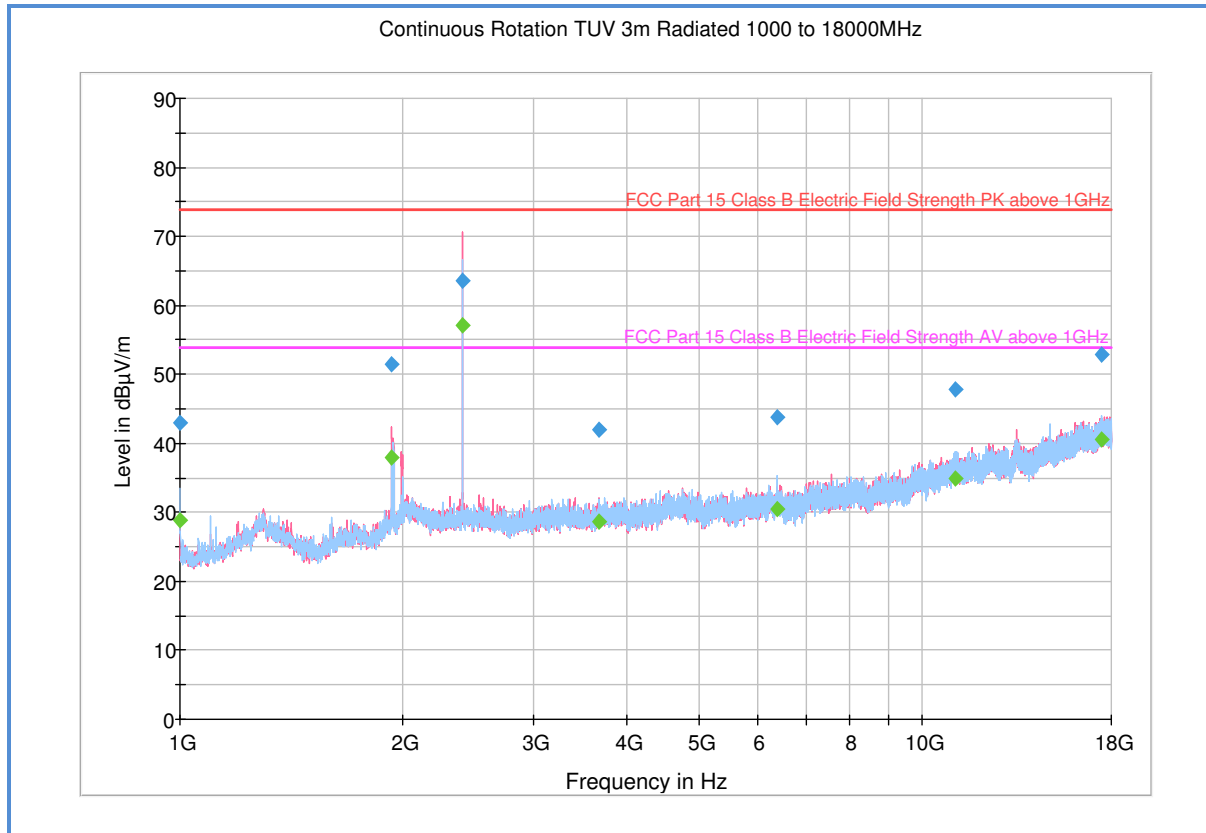


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
38.455551	23.7	1000.0	120.000	120.0	V	121.0	-10.3	16.3	40.0
70.781643	17.9	1000.0	120.000	100.0	V	15.0	-16.8	22.1	40.0
121.826613	17.8	1000.0	120.000	100.0	V	-13.0	-15.4	25.7	43.5
326.270942	20.7	1000.0	120.000	105.0	V	110.0	-6.3	25.3	46.0
692.097956	27.1	1000.0	120.000	214.0	V	281.0	2.7	18.9	46.0
934.563928	29.6	1000.0	120.000	100.0	V	341.0	6.3	16.4	46.0

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

2.6.11 Test Results Above 1GHz (Bluetooth LE Low Channel 2402MHz)



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	43.1	1000.0	1000.000	238.3	H	204.0	-7.8	30.8	73.9
1932.000000	51.5	1000.0	1000.000	301.2	V	95.0	-1.0	22.4	73.9
2401.733333	63.6	1000.0	1000.000	140.6	V	202.0	-1.1	*)	
3678.300000	41.9	1000.0	1000.000	334.1	V	53.0	1.1	32.0	73.9
6387.333333	43.8	1000.0	1000.000	335.1	H	20.0	6.1	30.1	73.9
11078.566667	47.8	1000.0	1000.000	203.3	H	333.0	12.8	26.1	73.9
17455.266667	52.9	1000.0	1000.000	405.4	H	224.0	20.1	21.0	73.9

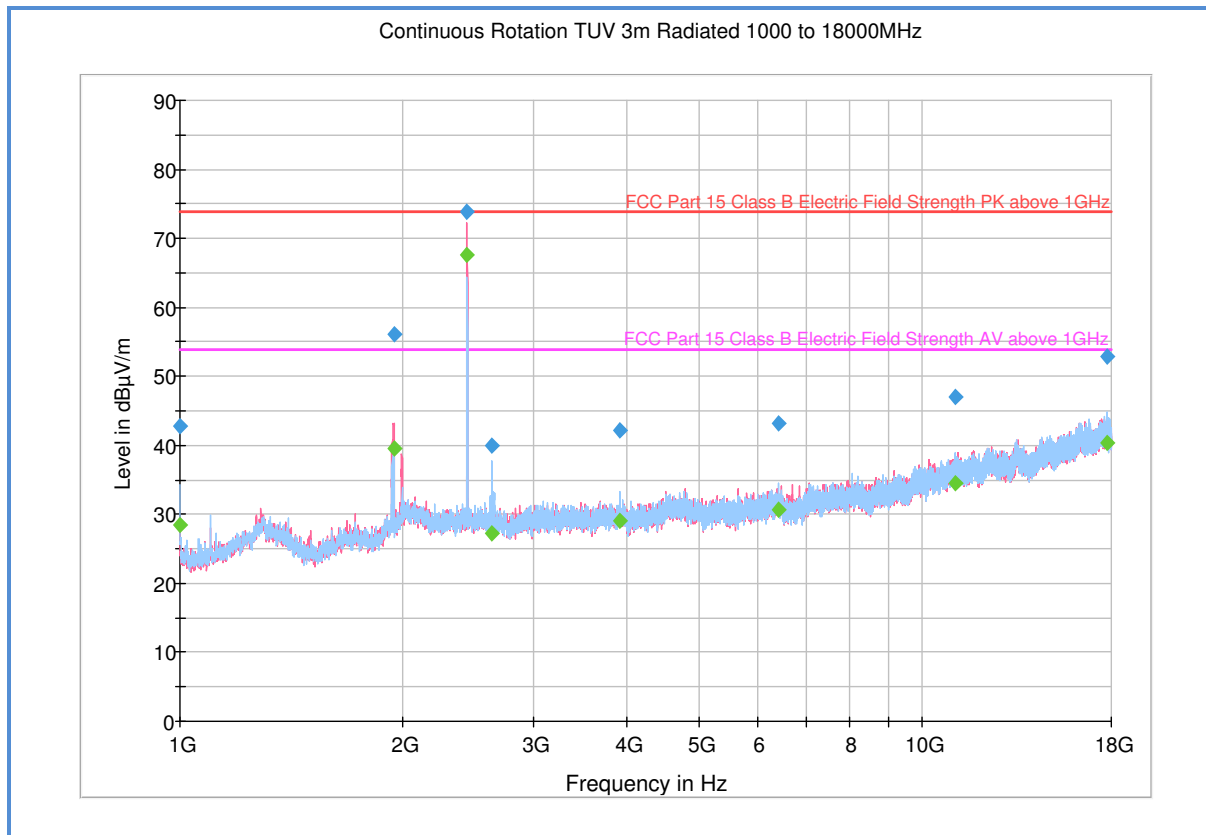
Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.400000	28.8	1000.0	1000.000	238.3	H	204.0	-7.8	25.1	53.9
1932.000000	37.9	1000.0	1000.000	301.2	V	95.0	-1.0	16.0	53.9
2401.733333	57.1	1000.0	1000.000	140.6	V	202.0	-1.1	*)	
3678.300000	28.6	1000.0	1000.000	334.1	V	53.0	1.1	25.3	53.9
6387.333333	30.5	1000.0	1000.000	335.1	H	20.0	6.1	23.4	53.9
11078.566667	34.8	1000.0	1000.000	203.3	H	333.0	12.8	19.1	53.9
17455.266667	40.6	1000.0	1000.000	405.4	H	224.0	20.1	13.3	53.9

*) This is the fundamental frequency and not part of evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 6GHz. Measurements above 6GHz are noise floor figures.

2.6.12 Test Results Above 1GHz (Bluetooth LE Mid Channel 2440MHz)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.500000	42.9	1000.0	1000.000	258.3	H	232.0	-7.8	31.0	73.9
1941.066667	56.0	1000.0	1000.000	405.4	V	-3.0	-1.1	17.9	73.9
2439.733333	73.8	1000.0	1000.000	336.1	V	225.0	-0.9		*)
2636.766667	39.9	1000.0	1000.000	382.0	H	118.0	-1.0	34.0	73.9
3916.266667	42.1	1000.0	1000.000	191.5	H	20.0	2.2	31.8	73.9
6400.133333	43.3	1000.0	1000.000	103.7	H	206.0	6.1	30.6	73.9
11100.466667	47.1	1000.0	1000.000	289.2	H	20.0	12.9	26.8	73.9
17747.866667	52.9	1000.0	1000.000	405.4	H	145.0	20.3	21.0	73.9

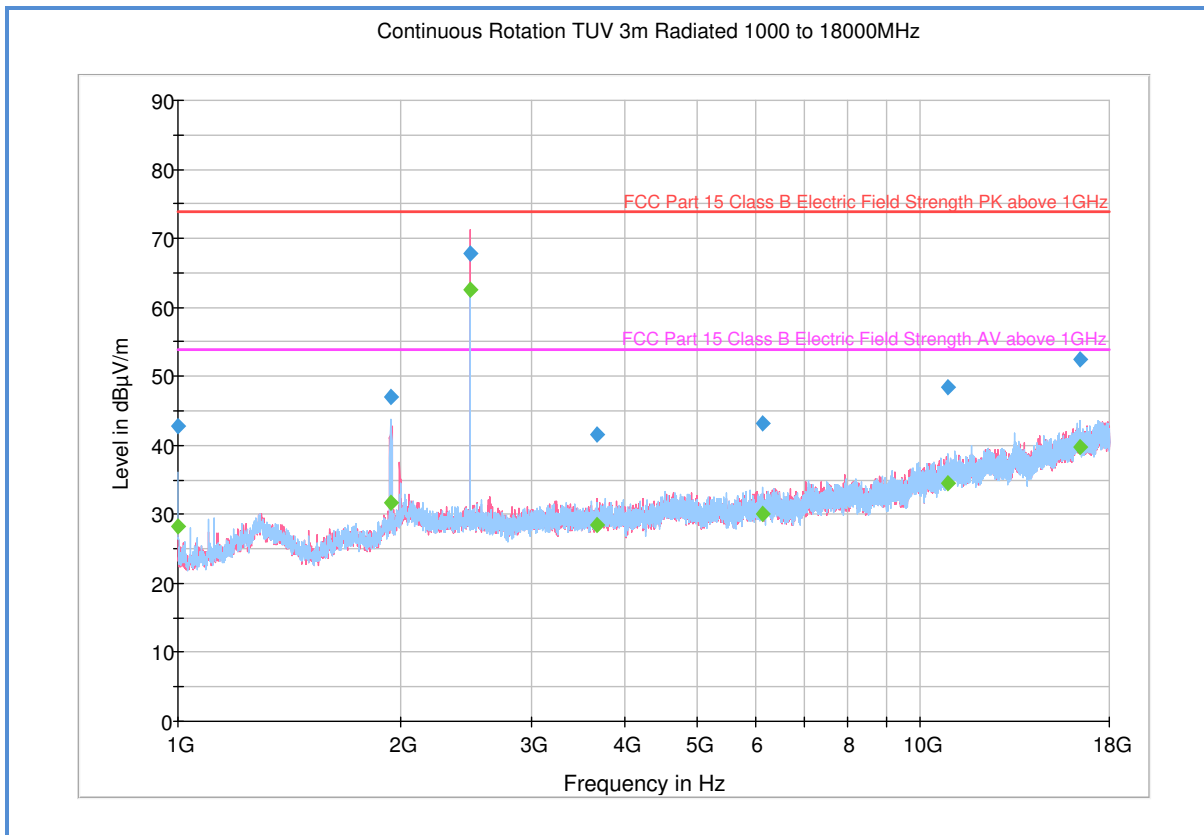
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.500000	28.5	1000.0	1000.000	258.3	H	232.0	-7.8	25.4	53.9
1941.066667	39.5	1000.0	1000.000	405.4	V	-3.0	-1.1	14.4	53.9
2439.733333	67.7	1000.0	1000.000	336.1	V	225.0	-0.9		*)
2636.766667	27.2	1000.0	1000.000	382.0	H	118.0	-1.0	26.7	53.9
3916.266667	29.0	1000.0	1000.000	191.5	H	20.0	2.2	24.9	53.9
6400.133333	30.8	1000.0	1000.000	103.7	H	206.0	6.1	23.1	53.9
11100.466667	34.6	1000.0	1000.000	289.2	H	20.0	12.9	19.3	53.9
17747.866667	40.4	1000.0	1000.000	405.4	H	145.0	20.3	13.5	53.9

*) This is the fundamental frequency and not part of evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 4GHz. Measurements above 4GHz are noise floor figures.

2.6.13 Test Results Above 1GHz (Bluetooth LE High Channel 2480MHz)



Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.500000	42.7	1000.0	1000.000	257.3	H	121.0	-7.8	31.2	73.9
1932.733333	47.0	1000.0	1000.000	368.1	H	16.0	-1.1	26.9	73.9
2480.166667	67.8	1000.0	1000.000	202.3	V	295.0	-0.7	*)	
3668.666667	41.5	1000.0	1000.000	357.1	V	261.0	1.0	32.4	73.9
6146.700000	43.1	1000.0	1000.000	122.7	H	307.0	5.5	30.8	73.9
10905.133333	48.4	1000.0	1000.000	405.4	H	23.0	12.8	25.5	73.9
16410.500000	52.6	1000.0	1000.000	405.4	H	346.0	19.1	21.3	73.9

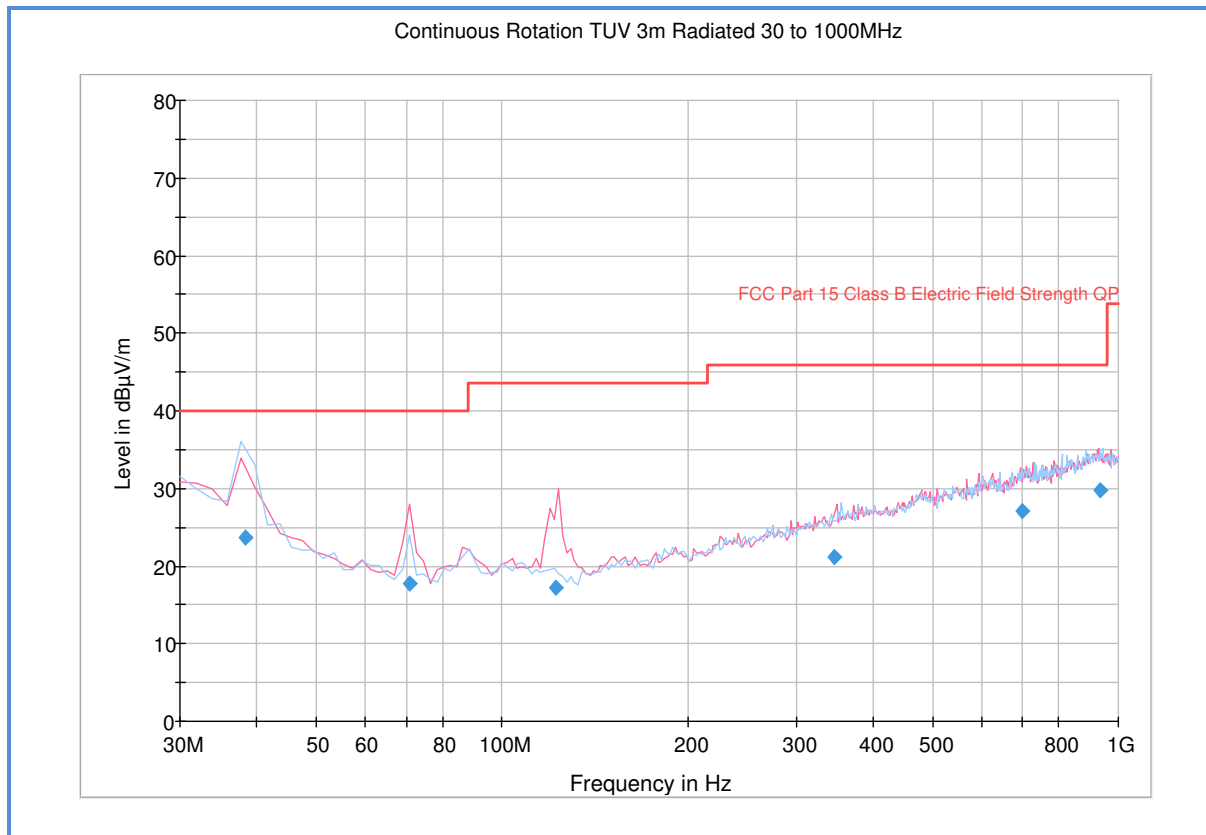
Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.500000	28.3	1000.0	1000.000	257.3	H	121.0	-7.8	25.6	53.9
1932.733333	31.7	1000.0	1000.000	368.1	H	16.0	-1.1	22.2	53.9
2480.166667	62.6	1000.0	1000.000	202.3	V	295.0	-0.7	*)	
3668.666667	28.4	1000.0	1000.000	357.1	V	261.0	1.0	25.5	53.9
6146.700000	30.1	1000.0	1000.000	122.7	H	307.0	5.5	23.8	53.9
10905.133333	34.6	1000.0	1000.000	405.4	H	23.0	12.8	19.3	53.9
16410.500000	39.8	1000.0	1000.000	405.4	H	346.0	19.1	14.1	53.9

*) This is the fundamental frequency and not part of evaluation. Data provided for information purpose only.

Test Notes: No significant emissions observed above 4GHz. Measurements above 4GHz are noise floor figures.

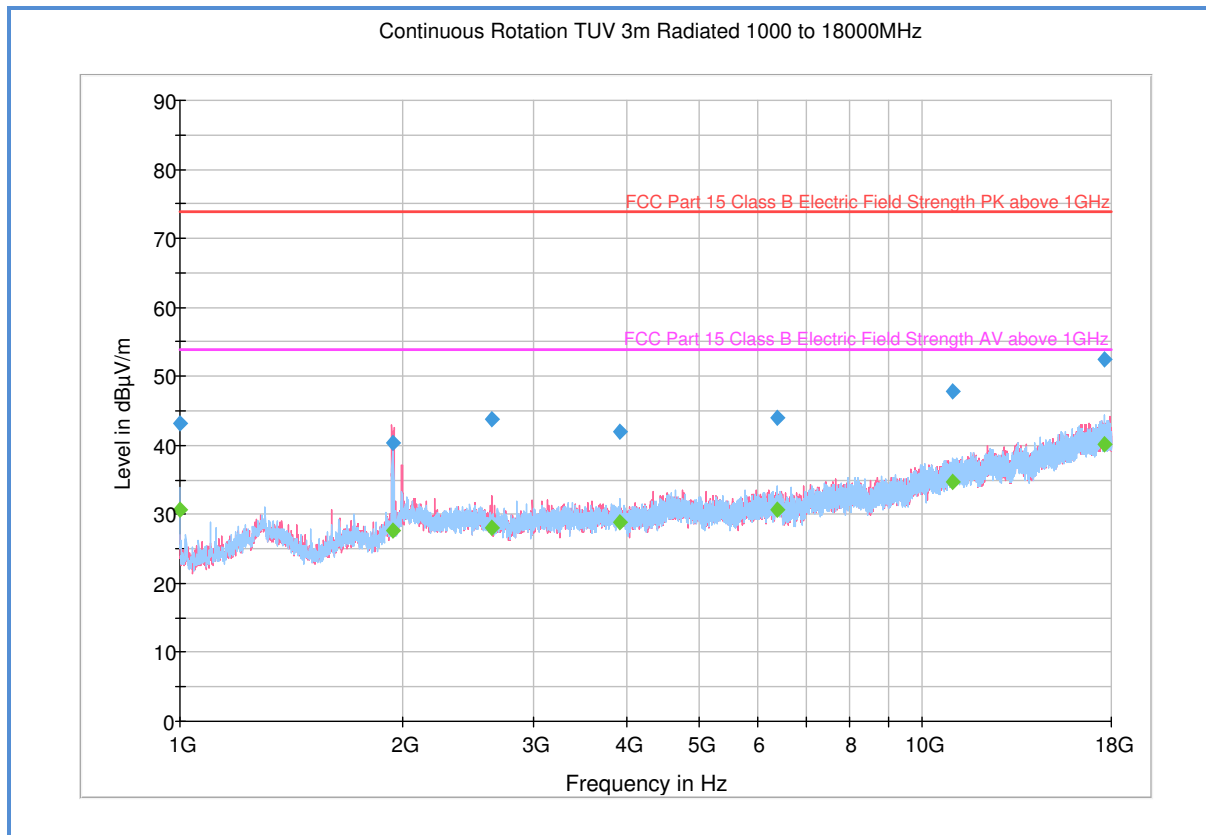
2.6.14 Test Results Below 1GHz (Receive Mode)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
38.255551	23.7	1000.0	120.000	371.0	H	30.0	-10.2	16.3	40.0
70.821643	17.7	1000.0	120.000	200.0	V	342.0	-16.8	22.3	40.0
122.306613	17.2	1000.0	120.000	109.0	V	13.0	-15.4	26.3	43.5
345.837595	21.1	1000.0	120.000	150.0	V	317.0	-5.8	24.9	46.0
697.289619	27.1	1000.0	120.000	133.0	V	197.0	2.8	18.9	46.0
932.243928	29.8	1000.0	120.000	150.0	V	260.0	6.3	16.2	46.0

2.6.15 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)
1000.000000	43.2	1000.0	1000.000	378.0	H	63.0	-7.8	30.7	73.9
1932.766667	40.3	1000.0	1000.000	165.0	V	0.0	-1.1	33.6	73.9
2628.633333	43.9	1000.0	1000.000	206.0	V	164.0	-1.0	30.0	73.9
3914.733333	42.0	1000.0	1000.000	139.0	H	47.0	2.2	31.9	73.9
6378.633333	44.0	1000.0	1000.000	234.0	H	295.0	6.1	29.9	73.9
11011.13333	47.8	1000.0	1000.000	233.0	H	11.0	12.8	26.1	73.9
17611.80000	52.5	1000.0	1000.000	400.0	H	115.0	20.0	21.4	73.9

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.000000	30.7	1000.0	1000.000	378.0	H	63.0	-7.8	23.2	53.9
1932.766667	27.7	1000.0	1000.000	165.0	V	0.0	-1.1	26.2	53.9
2628.633333	28.1	1000.0	1000.000	206.0	V	164.0	-1.0	25.8	53.9
3914.733333	29.0	1000.0	1000.000	139.0	H	47.0	2.2	24.9	53.9
6378.633333	30.8	1000.0	1000.000	234.0	H	295.0	6.1	23.1	53.9
11011.13333	34.7	1000.0	1000.000	233.0	H	11.0	12.8	19.2	53.9
17611.80000	40.2	1000.0	1000.000	400.0	H	115.0	20.0	13.7	53.9

Test Notes: No significant emissions observed above 18GHz.



2.7 RADIATED BAND EDGE MEASUREMENTS AND IMMEDIATE RESTRICTED BANDS

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: 138.01 / Test Configuration B

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

April 05, 2016 / AC

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	26.6 °C
Relative Humidity	35.7 %
ATM Pressure	99.2 kPa

2.7.7 Additional Observations

- This is 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.
- 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.



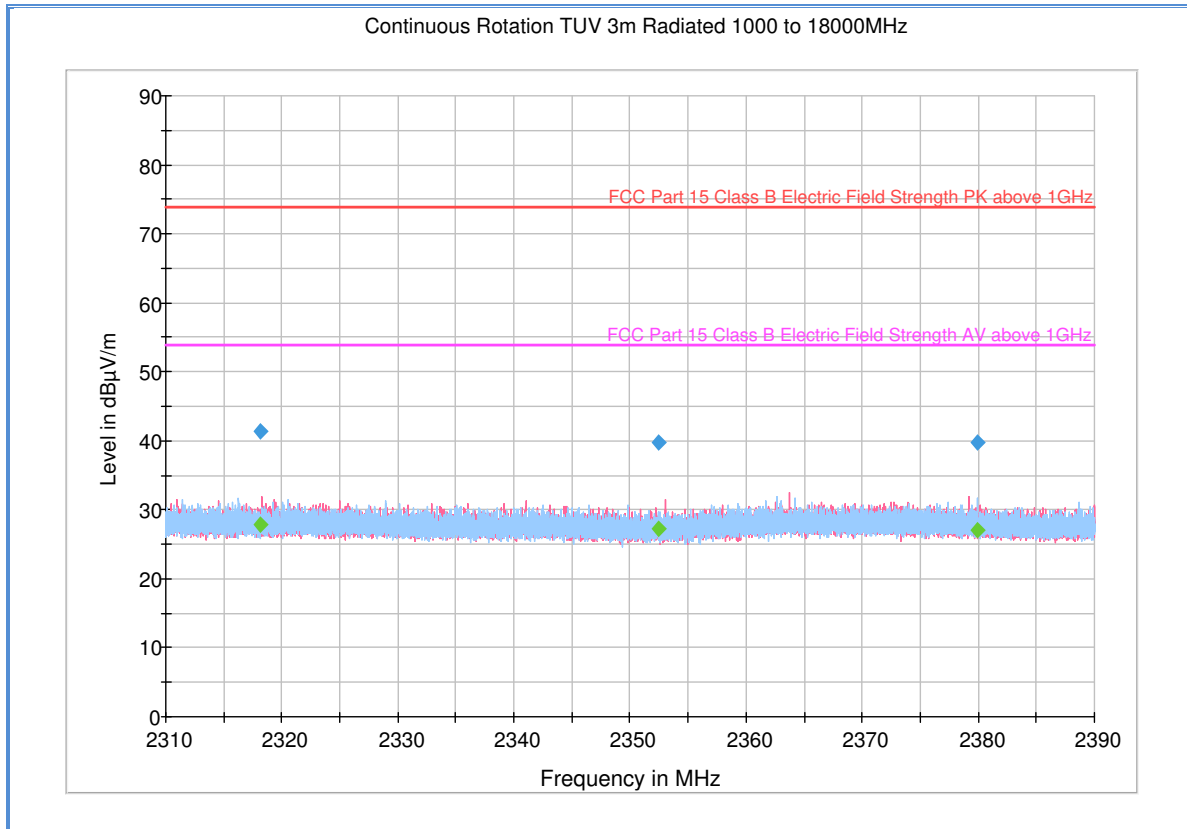
2.7.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dB μ V) @ 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 (dB μ V/m) @ 2400 MHz			53.5

2.7.9 Test Results

See attached plots.

2.7.10 Test Results Restricted Band 2310MHz to 2390MHz (Bluetooth LE Low Channel)



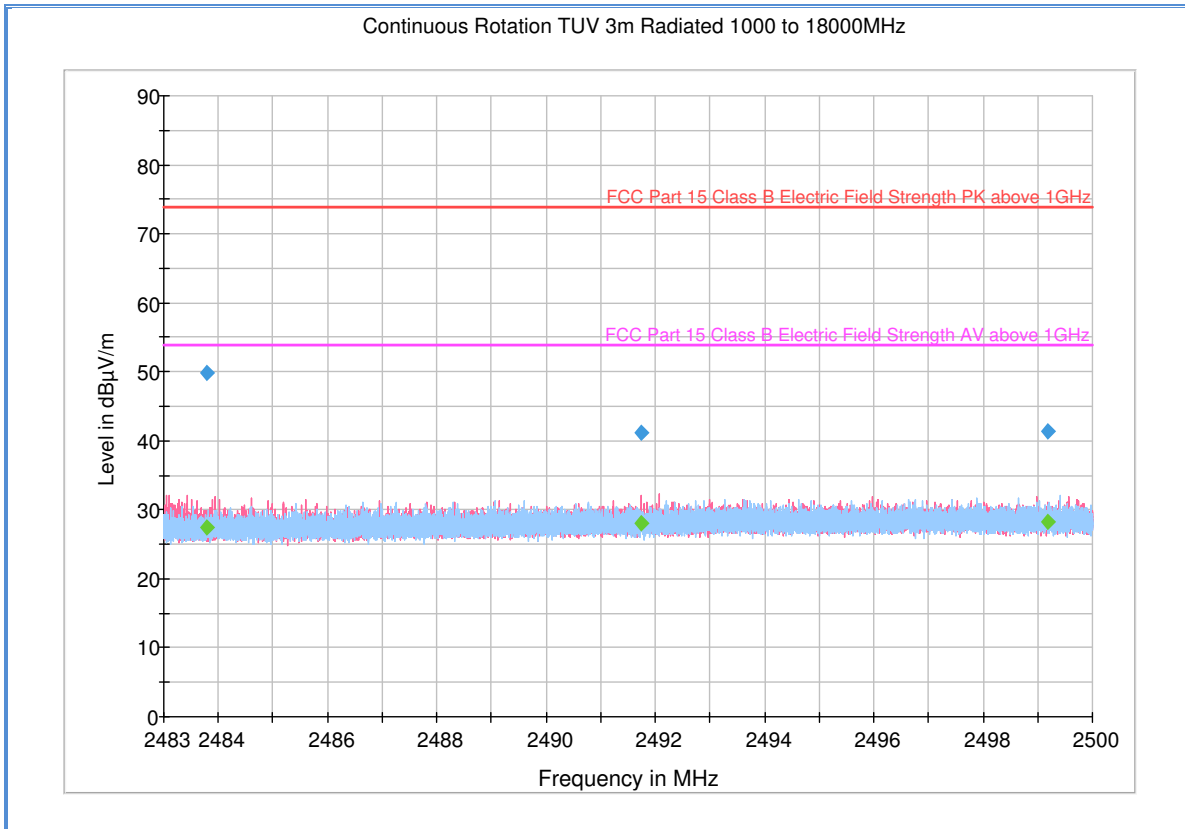
Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2318.104000	41.3	1000.0	1000.000	124.7	V	149.0	-1.1	32.6	73.9
2352.485333	39.8	1000.0	1000.000	334.1	V	342.0	-1.2	34.1	73.9
2379.898667	39.8	1000.0	1000.000	400.0	H	110.0	-1.1	34.1	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)
2318.104000	27.9	1000.0	1000.000	124.7	V	149.0	-1.1	26.0	53.9
2352.485333	27.2	1000.0	1000.000	334.1	V	342.0	-1.2	26.7	53.9
2379.898667	27.0	1000.0	1000.000	400.0	H	110.0	-1.1	34.1	73.9

2.7.11 Test Results Restricted Band 2483.5MHz to 2500MHz (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)
2483.800000	49.8	1000.0	1000.000	103.7	V	272.0	-0.7	24.1	73.9
2491.749900	41.1	1000.0	1000.000	99.7	V	344.0	-0.6	32.8	73.9
2499.173767	41.4	1000.0	1000.000	394.0	V	220.0	-0.6	32.5	73.9

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
2483.800000	27.5	1000.0	1000.000	103.7	V	272.0	-0.7	26.4	53.9
2491.749900	28.1	1000.0	1000.000	99.7	V	344.0	-0.6	25.8	53.9
2499.173767	28.3	1000.0	1000.000	394.0	V	220.0	-0.6	25.6	53.9



2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

Part 15 Subpart C §15.247(e)

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: 136.01 / Test Configuration A

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

April 04, 2016 / AC

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	26.0 °C
Relative Humidity	40.9 %
ATM Pressure	99.5 kPa

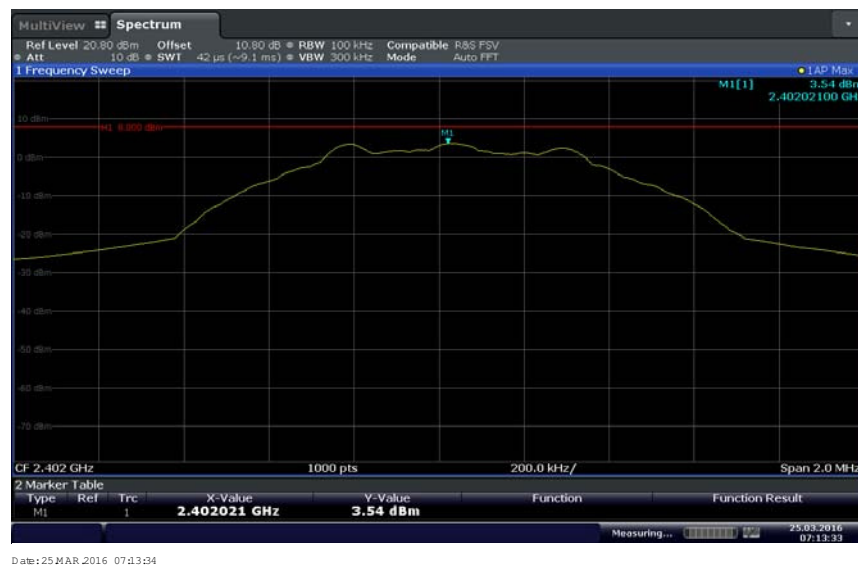
2.8.7 Additional Observations

- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074 (January 07, 2016).
- An offset of 10.8dB was added to compensate for the external attenuator and cable used.
- Detector is RMS power averaging.
- Trace averaging mode over 100 traces.
- Sweep time is Auto Couple.
- EUT complies with 100 kHz RBW.

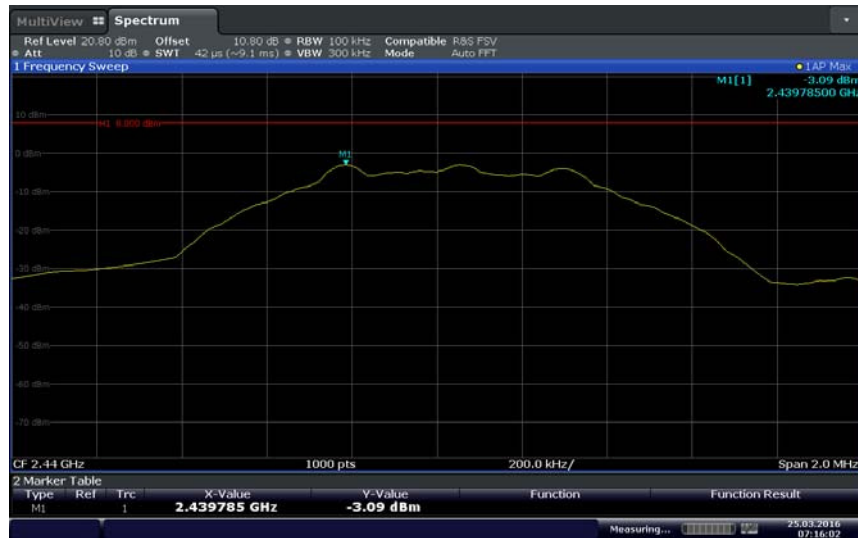
2.8.8 Test Results Summary

Bluetooth Low Energy (LE)	Channel	Marker Reading using 100 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
	0 (2402 MHz)	3.54	8	4.46	Complies
	19 (2440 MHz)	-3.09	8	11.09	Complies
	39 (2480 MHz)	-3.95	8	11.95	Complies

2.8.9 Test Results Plots

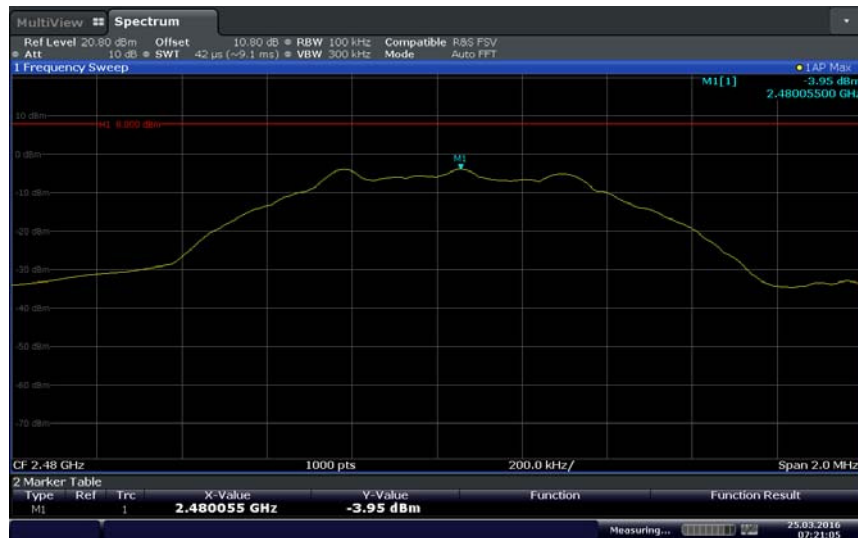


Bluetooth LE Low Channel



Date: 25 MAR 2016 07:16:02

Bluetooth LE Mid Channel



Date: 25 MAR 2016 07:21:05

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 Setup						
7569	Series Power Meter	N1911A P-	MY45100625	Agilent	06/19/15	06/19/16
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	04/10/15	04/10/16
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	02/01/16	02/01/17
7579	Temperature Chamber	115	151617	TestQuity	08/14/15	08/14/16
8808	10dB Attenuator	ATX3396-10	N/A	RF Precision Cables	09/23/15	09/23/16
Radiated Test Setup						
1033	Bilog Antenna	3142C	00044556	EMCO	09/25/14	09/25/16
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.	01/11/16	01/11/17
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/17/16	03/17/17
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/14/15	08/14/16
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	10/19/15	10/19/16
	DC Power Supply	35010M	D102007S	Protek	Verified by 6792	
	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	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.57

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	2.70	1.56	2.43
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					1.78
Coverage Factor (k):					2
Expanded Uncertainty:					3.56

3.2.3 Conducted Antenna Port Measurement

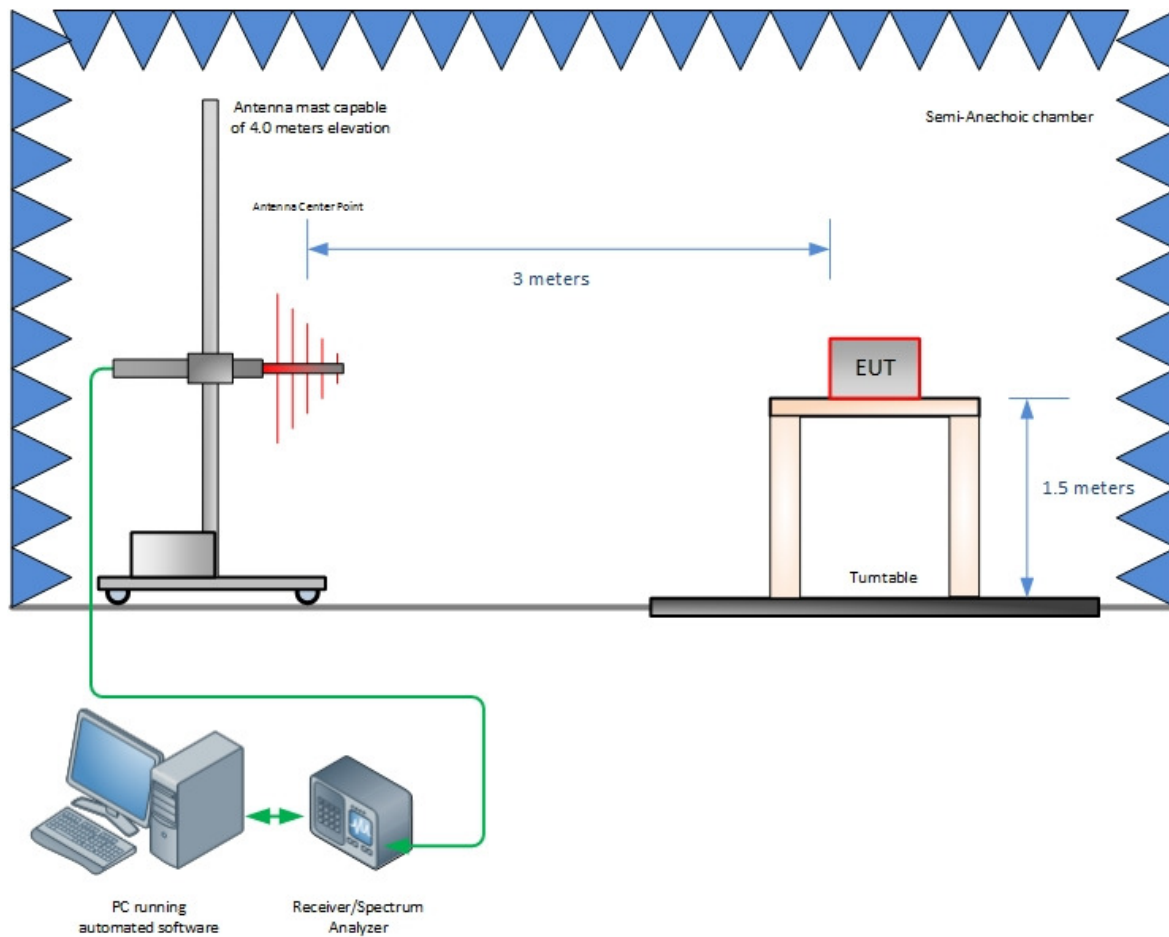
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.34	0.20	0.04
2	Cables	Rectangular	1.00	0.58	0.33
3	EUT Setup	Rectangular	0.50	0.29	0.08
Combined Uncertainty (u_c):					0.67
Coverage Factor (k):					1.96
Expanded Uncertainty:					1.32



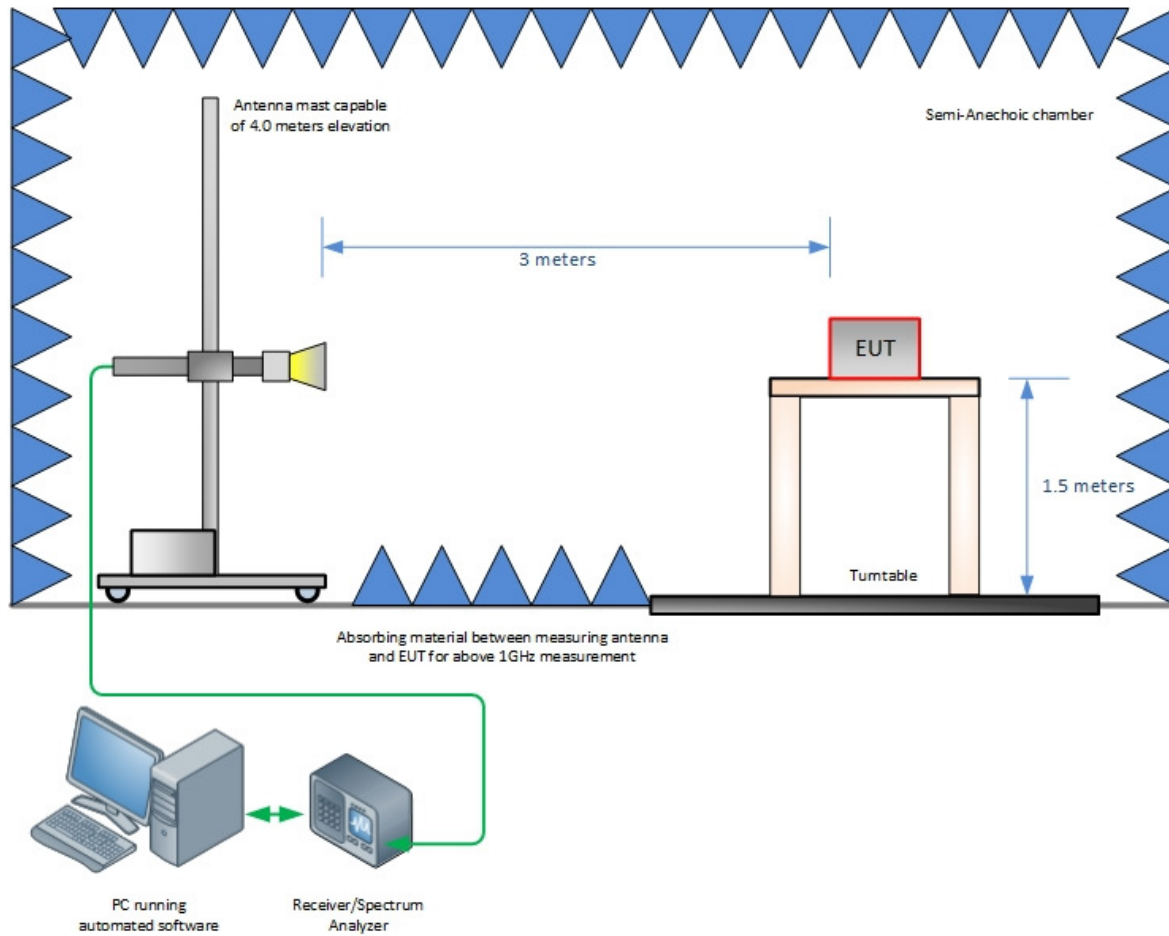
SECTION 4

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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