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Report On

Application for Grant of Equipment Authorization of the
St. Jude Medical IESD
IPG (Implantable Pulse Generator)
Models: SCS (Spinal Cord Stimulation), DBS (Deep Brain Stimulation) and DRG (Dorsal Root Ganglion)

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

Report No. SD72113237-0116A March 2016

REPORT ON	Radio Testing of the St. Jude Medical IESD IPG (Implantable Pulse Generator)
TEST REPORT NUMBER	SD72113237-0116A
PREPARED FOR	St. Jude Medical IESD 15900 Valley View Court Sylmar, CA 91342 USA
CONTACT PERSON	Jorge Amely-Velez Sr. Principal Engineer (818) 493-2818 jamely-velez@sjm.com
PREPARED BY	Alex Chang **Name** Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
DATED	March 24, 2016

Revision History

SD72113237-0116A St. Jude Medical IESD IPG (Implantable Pulse Generator) SCS (Spinal Cord Stimulation), DBS (Deep Brain Stimulation) and DRG (Dorsal Root Ganglion)					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
03/24/2016	Initial Release				Ferdinand Custodio

CONTENTS

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
St. Jude Medical IESD
IPG (Implantable Pulse Generator)

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the St. Jude Medical IESD IPG (Implantable Pulse Generator) models: SCS (Spinal Cord Stimulation), DBS (Deep Brain Stimulation) and DRG (Dorsal Root Ganglion) 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 Number(s)	3664
FCC ID Number	RIASJMRFC
IC Number	8454A-M3660123
Serial Number(s)	N/A
Number of Samples Tested	1
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	February 26, 2016
Finish of Test	March 10, 2016
Name of Engineer(s)	Alex Chang Nikolay Shtin
Related Document(s)	• None. Supporting documents for EUT certification are separate exhibits. • All conducted port measurement leveraged from original evaluated test report; which under TÜV SÜD test report ref. No. SD1406553A Rev.02.

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	N/P	See notes
—	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A *	
2.2		RSS-Gen 6.6	99% Emission Bandwidth	N/P	See notes
2.3	§15.247(a)(2)	RSS-247 5.2(1)	Minimum 6 dB RF Bandwidth	N/P	See notes
2.4	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	N/P	See notes
2.5	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	N/P	See notes
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	N/P	See notes

* Not applicable. EUT is battery operated device.
N/P The conducted port measurement were leveraged from the original module which was previously evaluated under TÜV SÜD test report ref. No. SD1406553A Rev.02. No further evaluation considered necessary.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) was a St. Jude Medical IESD IPG (Implantable Pulse Generator) models for SCS (Spinal Cord Stimulation), DBS (Deep Brain Stimulation) and DRG (Dorsal Root Ganglion). The EUT uses Bluetooth Low Energy (BLE) technology for communications. The Bluetooth LE function was verified in this test report. A new model 3664 was added to the existing family model and this new model is identical to models 3660, 3661, 6660, 6661 and 3665. The only difference is the antenna specification and only limited evaluation considered necessary in this test report. See below for model differences.

1.3.2 Model Differences

	Model Number	Description
Original models	3660	Orion IPG, 5.3Ah, SCS, SJM header
	3661	Orion IPG, 5.3Ah, SCS, 1.27mm header
	3662	Orion IPG, 7.5Ah, SCS, SJM header
	3663	Orion IPG, 7.5Ah, SCS, 1.27mm header
	6660	Orion IPG, 5.3Ah, DBS, Tonic, SJM header
	6661	Orion IPG, 5.3Ah, DBS, Tonic, 1.27mm header
	6662	Orion IPG, 7.5Ah, DBS, Tonic, SJM header
	6663	Orion IPG, 7.5Ah, DBS, Tonic, 1.27mm header
	3665	Orion IPG, 5.3Ah, SCS, Tonic, SJM header
	3667	Orion IPG, 7.5Ah, SCS, Tonic, SJM header
New model	***3664***	***Proclaim™ IPG, 5.3Ah, DRG, DRG header***

Models 6660 and 3665 are RF identical to model 3660
Models 6662 and 3667 are RF identical to model 3662
Model 6661 is RF identical to model 3661
Model 6663 is RF identical to model 3663
Conducted sample of Model 3664 is identical to models 3660, 3661, 6660, 6661 and 3665
Radiated sample of Model 3664 is RF unique.

1.3.3 EUT General Description

EUT Description	IPG (Implantable Pulse Generator)
Model Name	SCS (Spinal Cord Stimulation), DBS (Deep Brain Stimulation) and DRG (Dorsal Root Ganglion)
Model Number(s)	3664
Rated Voltage	Internal 2.5VDC
Mode Verified	Bluetooth LE
Capability	Bluetooth LE
Primary Unit (EUT)	☒ Production
	☐ Pre-Production
	☐ Engineering
Antenna Type	Patch
Antenna Gain	-11.4 dBi

1.3.4 Maximum Conducted Output Power

Mode	Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
Bluetooth LE	2402 – 2480	-1.13	0.77

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 Tera Term commands to modify channels number, data rates and Tx power level. (All the conducted port measurement were leveraged from original module which was previously evaluated, no additional test data had taken for the new model considered necessary).
B	Radiated emissions test configuration. The EUT is programmed with support equipment and remotely controlled via Bluetooth connection by a support iPod 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 Tera Term commands to exercise the EUT.

1.4.3 Support Equipment and I/O cables

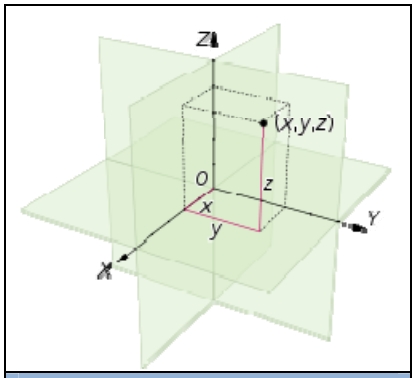
Manufacturer	Equipment/Cable	Description
Apple	iPod Touch	Model: A1509
—	Phantom Cylinder	—
Zurich Med Tech	Phantom Liquid (Fat Liquid Material)	P/N: ZL AAF245 CA

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	00 (Low Channel)	1Mbps

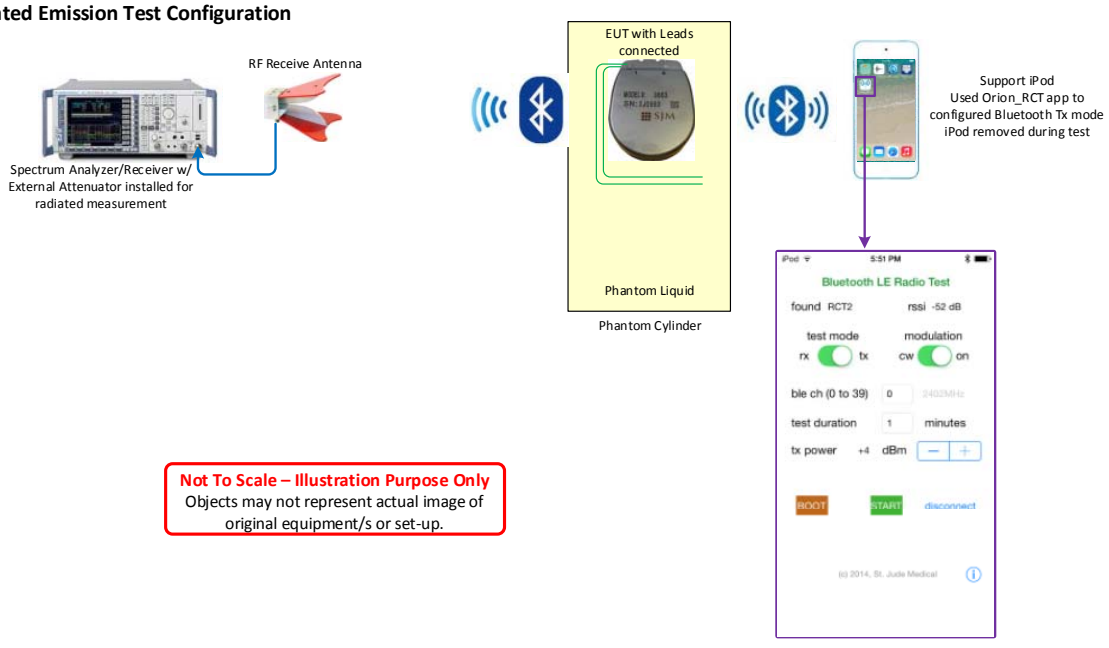
EUT is a mobile device. For radiated measurements X, Y and Z orientations were verified. Worst case position is "X" (EUT flat on the test fixture).



"X, Y and Z" Configuration

1.4.5 Simplified Test Configuration Diagram

Radiated Emission Test Configuration



Not To Scale – Illustration Purpose Only
Objects may not represent actual image of original equipment/s or set-up.

1.5 DEVIATIONS FROM THE STANDARD

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

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A		
N/A	—	—

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

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.10-2013, 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 C63.10-2013. 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 (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 Innovation, Science and Economic Development 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
St. Jude Medical IESD
IPG (Implantable Pulse Generator)

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: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

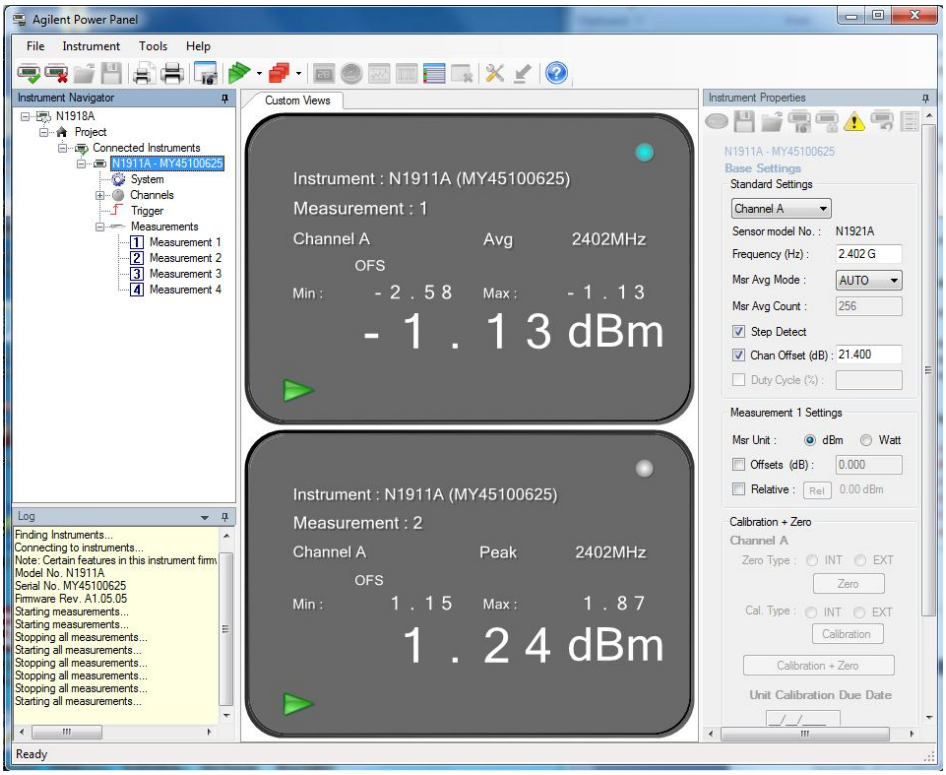
2.1.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- An offset of 21.4dB 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)
	00 (2402 MHz)	GFSK @ 1Mbps	**-1.13**	**1.87**
	19 (2440 MHz)		-3.86	0.89
	39 (2480 MHz)		-5.98	0.33

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: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

2.2.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- This is a conducted test.
- An offset of 21.4dB 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.

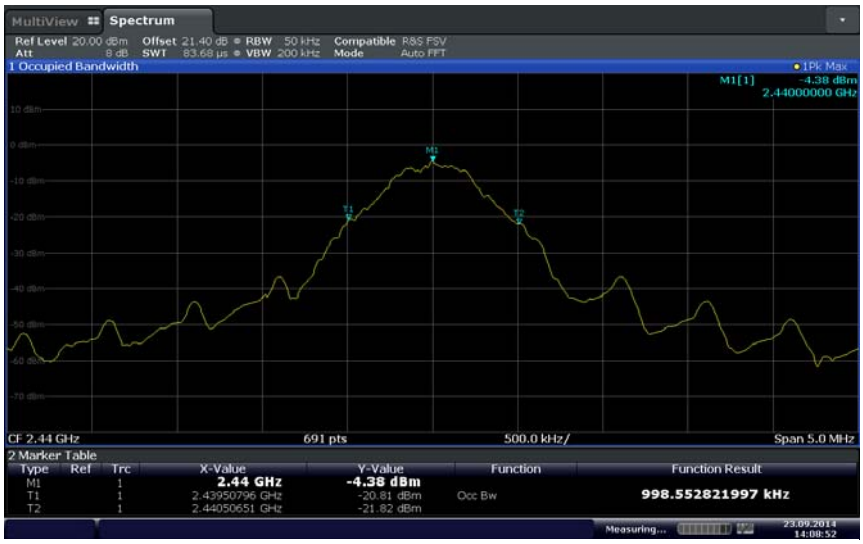
- Sweep is auto.
- Detector is peak.
- The % Power Bandwidth setting in the spectrum analyzer was set to 99% (default).
- The Channel Bandwidth measurement function of the spectrum analyzer was used for this test.

2.2.8 Test Results (For reporting purposes only)

Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	00 (2402 MHz)	1.093
	19 (2440 MHz)	0.999
	39 (2480 MHz)	0.962

2.2.9 Test Results Plots

Bluetooth LE Low Channel



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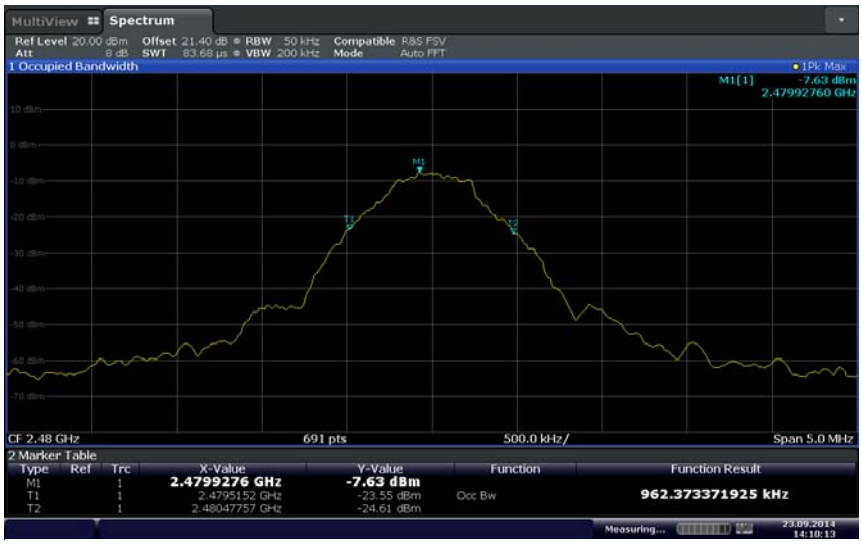
Bluetooth LE Mid Channel



Date: 23.SEP.2014 14:10:14

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: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

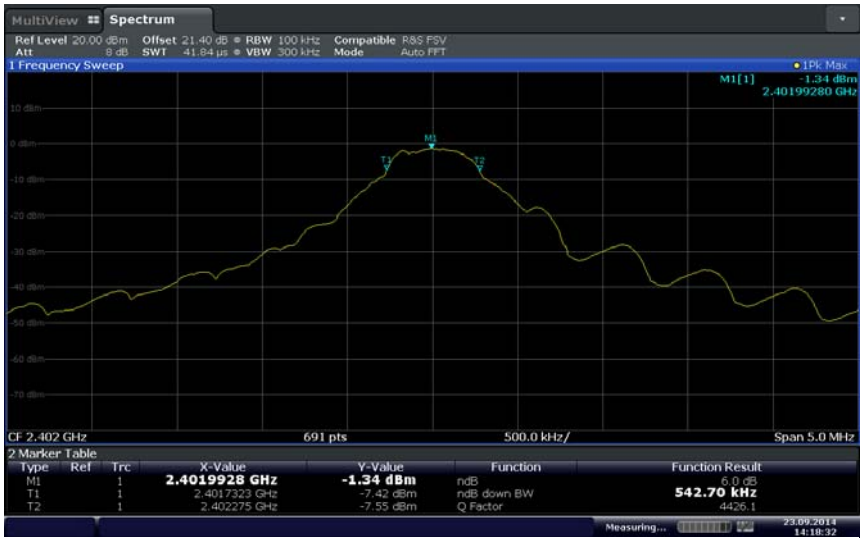
2.3.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- This is a conducted test.
- An offset of 21.4 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

Mode	Channel	Measured Bandwidth (kHz)	Minimum Bandwidth (kHz)	Compliance
Bluetooth LE	00 (2402 MHz)	542.7	500	Complies
	19 (2440 MHz)	542.7	500	Complies
	39 (2480 MHz)	542.7	500	Complies

2.3.9 Test Results Plots



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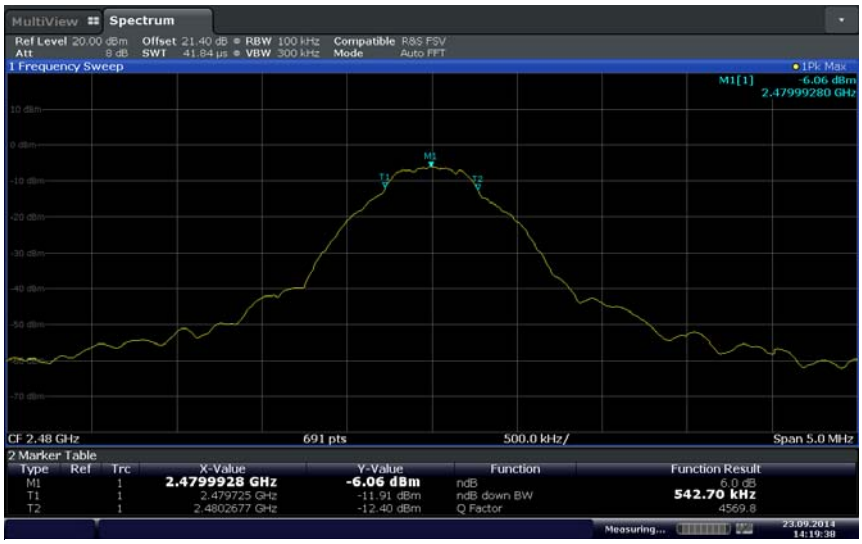
Bluetooth LE Low Channel

Date: 23.SEP.2014 14:17:05

Bluetooth LE Mid Channel



Date: 23.SEP.2014 14:19:38

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: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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

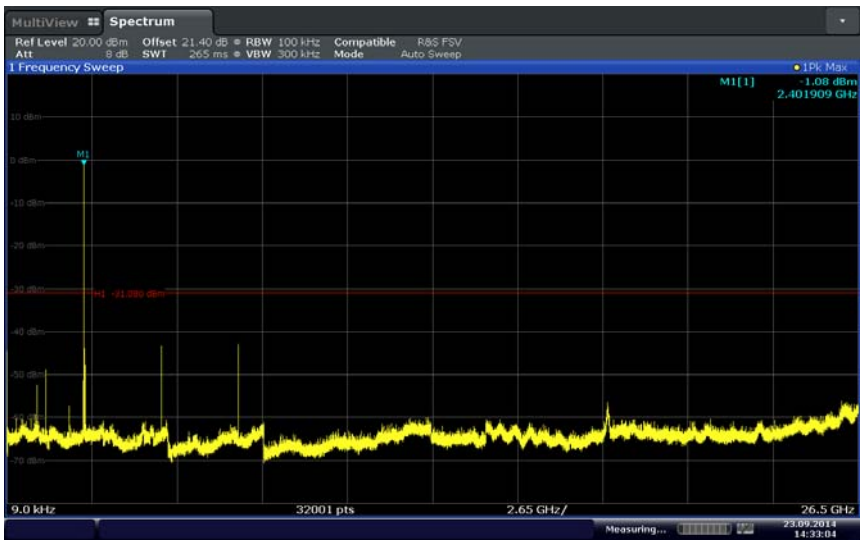
Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

2.4.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- This is a conducted test.
- An offset of 21.4dB 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



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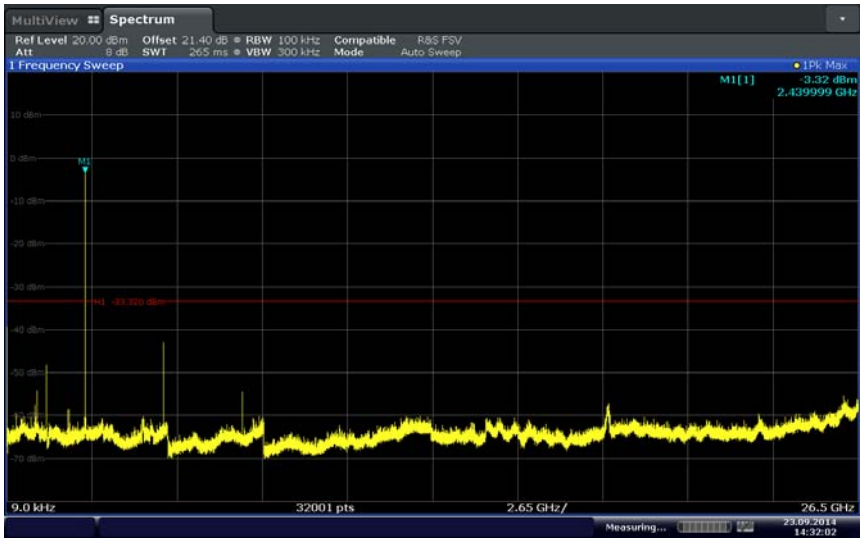
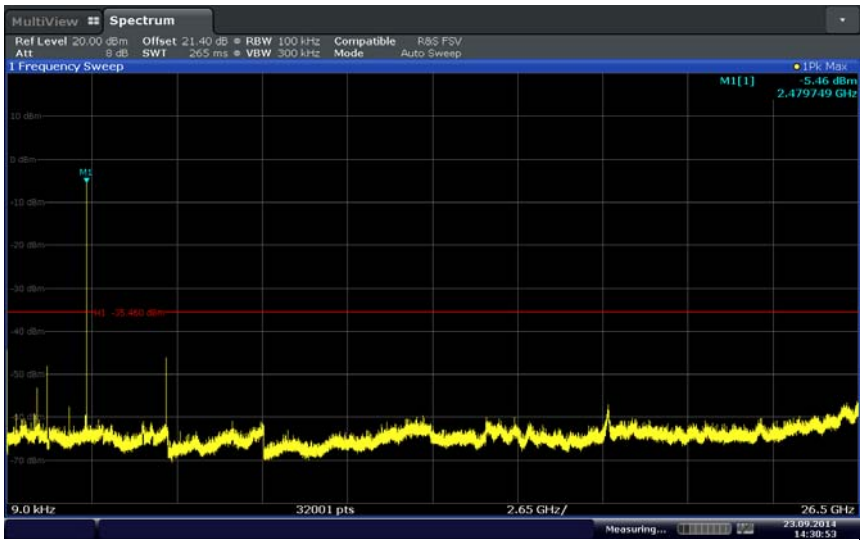
Bluetooth LE Low Channel



Date: 23.SEP.2014 14:32:02

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

See previous test.

2.5.3 Equipment Under Test and Modification State

Serial No: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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

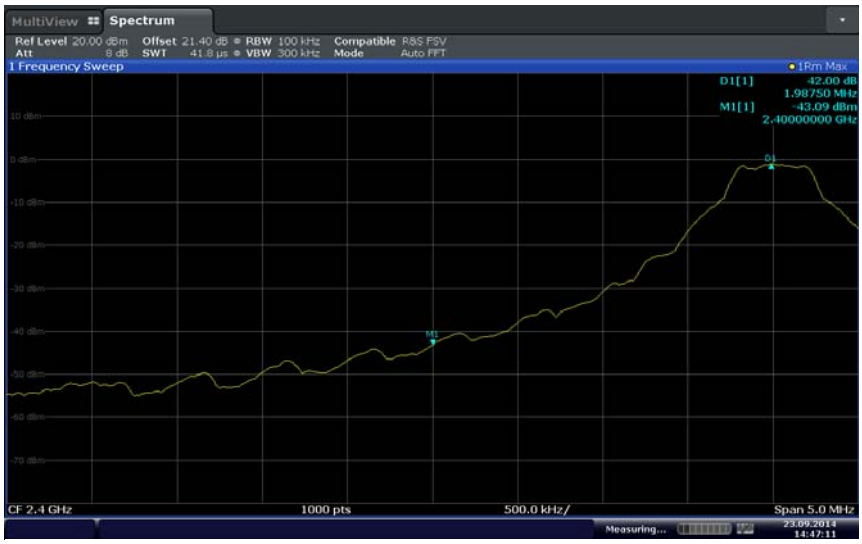
Ambient Temperature	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

2.5.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02
- 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 13.3.1 of KDB 558074 D01 DTS Meas Guidance v03r04, January 07, 2016); trace averaging with continuous EUT transmission at full power.
- 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.



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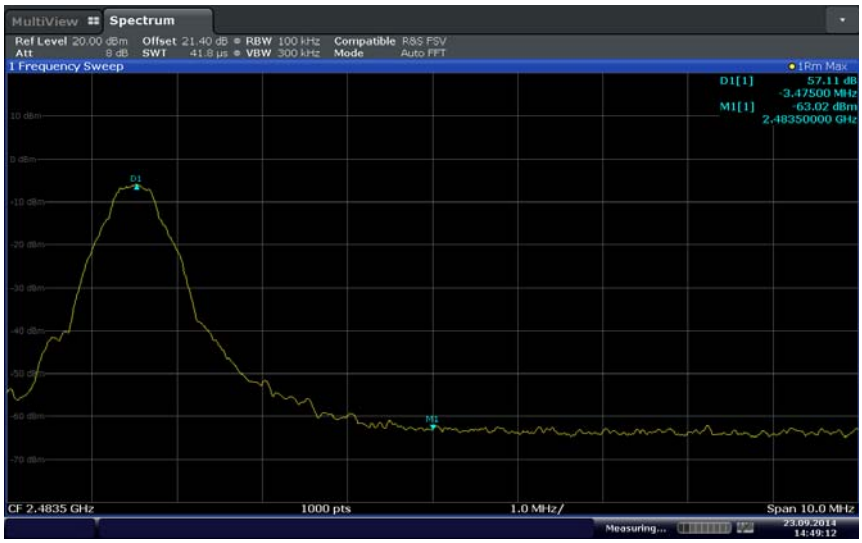
Bluetooth LE Lower Edge



Date: 23.SEP.2014 14:49:11

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: N/A / Test Configuration B

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

February 26, 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	25.5°C
Relative Humidity	23.9%
ATM Pressure	99.5 kPa

2.6.7 Additional Observations

- This is a radiated test and only presented for the new model 3664. For all other models test data please refer to previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- 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 (Mid 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.

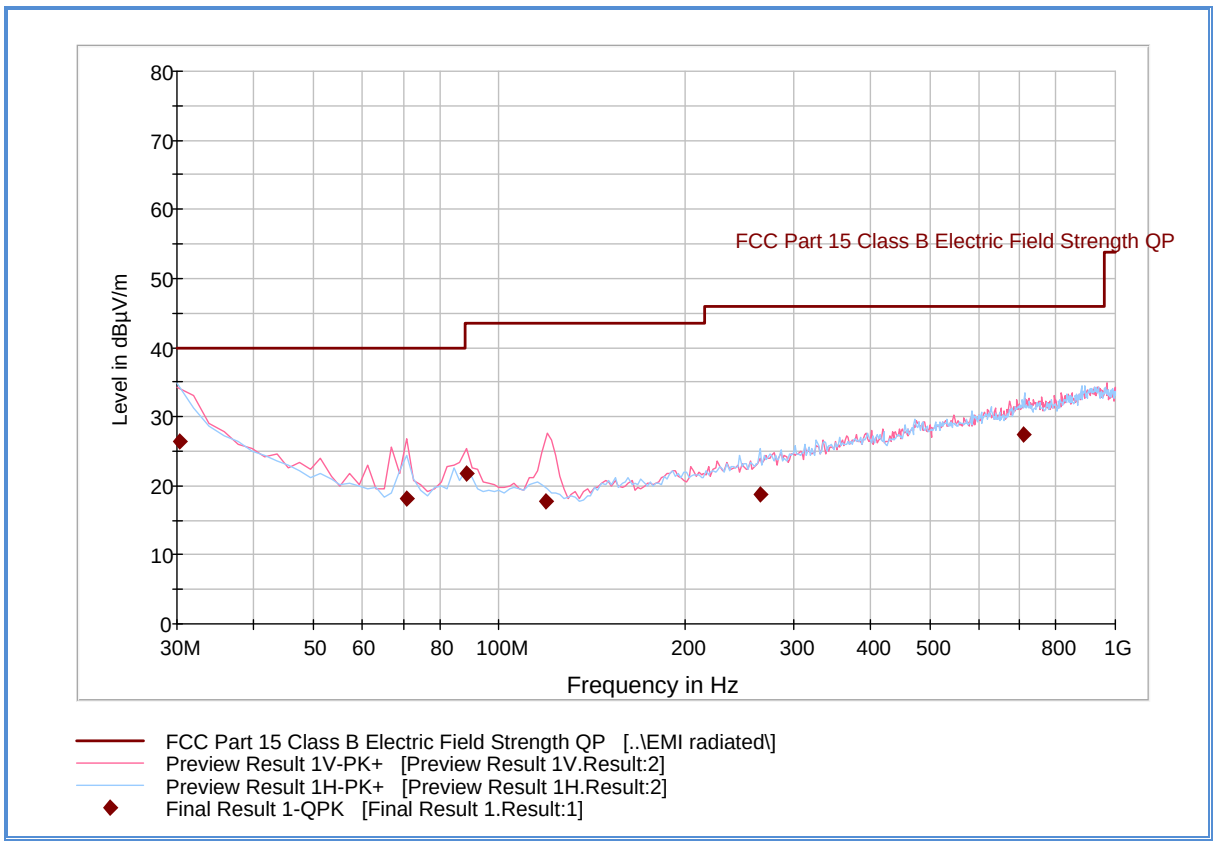
2.6.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (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 Quasi Peak Final Measurement (dBµV/m) @ 30MHz			**11.8**

2.6.9 Test Results

See attached plots.

2.6.10 Test Results Below 1GHz – model 3664 (Tx mode in mid channel 2440MHz worst case)

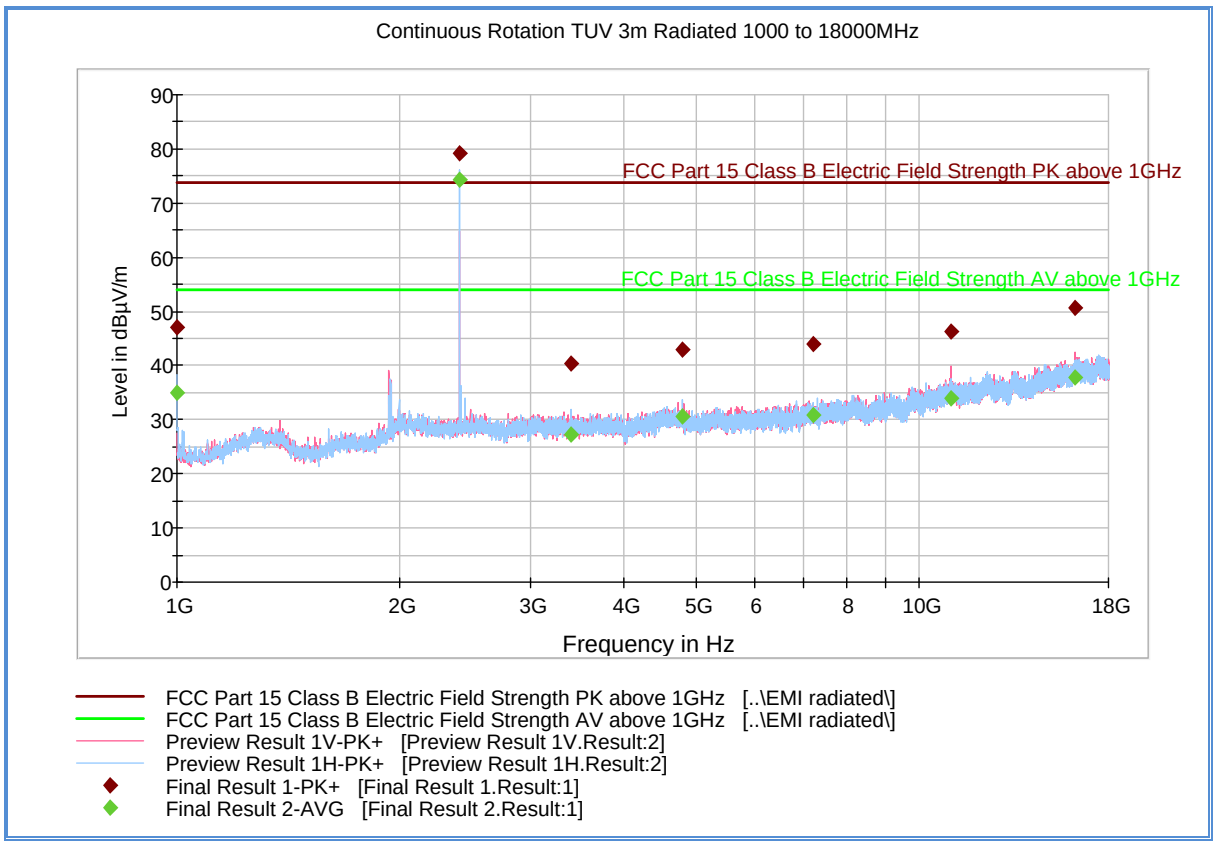


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
30.360000	26.4	1000.0	120.000	100.0	V	18.0	-5.7	13.6	40.0
70.661643	18.1	1000.0	120.000	400.0	V	342.0	-16.8	21.9	40.0
88.756633	21.7	1000.0	120.000	100.0	V	226.0	-15.4	21.8	43.5
119.258838	17.8	1000.0	120.000	100.0	V	18.0	-15.0	25.7	43.5
265.570421	18.8	1000.0	120.000	134.0	H	224.0	-8.3	27.2	46.0
709.744609	27.5	1000.0	120.000	109.0	H	44.0	3.5	18.5	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 of Model 3664)



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	47.1	1000.0	1000.000	151.0	H	105.0	-7.9	26.8	73.9
2402.133333	79.3	1000.0	1000.000	149.0	H	205.0	-1.3	*)	
3395.100000	40.3	1000.0	1000.000	404.0	H	243.0	0.4	33.6	73.9
4803.866667	43.0	1000.0	1000.000	138.0	H	108.0	2.9	30.9	73.9
7206.500000	43.9	1000.0	1000.000	230.0	H	202.0	6.4	30.1	73.9
11057.000000	46.4	1000.0	1000.000	126.0	V	47.0	11.6	27.5	73.9
16235.033333	50.7	1000.0	1000.000	151.0	V	94.0	17.1	23.2	73.9

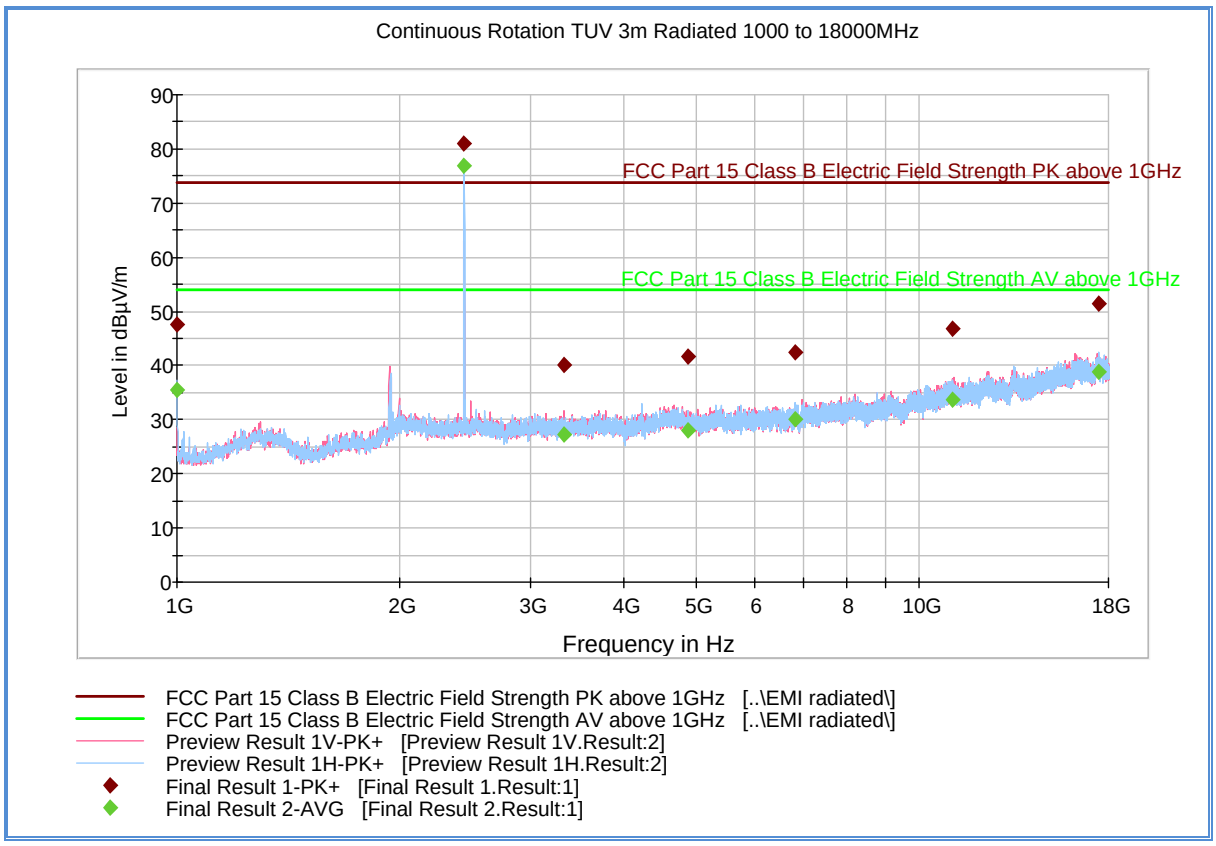
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	35.0	1000.0	1000.000	151.0	H	105.0	-7.9	18.9	53.9
2402.133333	74.4	1000.0	1000.000	149.0	H	205.0	-1.3	*)	
3395.100000	27.3	1000.0	1000.000	404.0	H	243.0	0.4	26.6	53.9
4803.866667	30.5	1000.0	1000.000	138.0	H	108.0	2.9	23.4	53.9
7206.500000	31.0	1000.0	1000.000	230.0	H	202.0	6.4	22.9	53.9
11057.000000	33.9	1000.0	1000.000	126.0	V	47.0	11.6	20.0	53.9
16235.033333	37.7	1000.0	1000.000	151.0	V	94.0	17.1	16.2	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 8GHz. Measurements above 8GHz are noise floor figures.

2.6.12 Test Results Above 1GHz (Bluetooth LE Mid Channel of Model 3664)



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	47.6	1000.0	1000.000	152.0	H	185.0	-7.9	26.3	73.9
2439.933333	81.0	1000.0	1000.000	136.0	H	217.0	-1.0	*)	
3322.966667	40.0	1000.0	1000.000	285.0	V	278.0	0.4	33.9	73.9
4881.133333	41.7	1000.0	1000.000	177.0	V	181.0	2.8	32.2	73.9
6819.866667	42.5	1000.0	1000.000	373.0	H	276.0	5.8	31.4	73.9
11100.800000	46.8	1000.0	1000.000	406.9	V	75.0	11.5	27.1	73.9
17470.566667	51.4	1000.0	1000.000	191.0	H	291.0	18.0	22.5	73.9

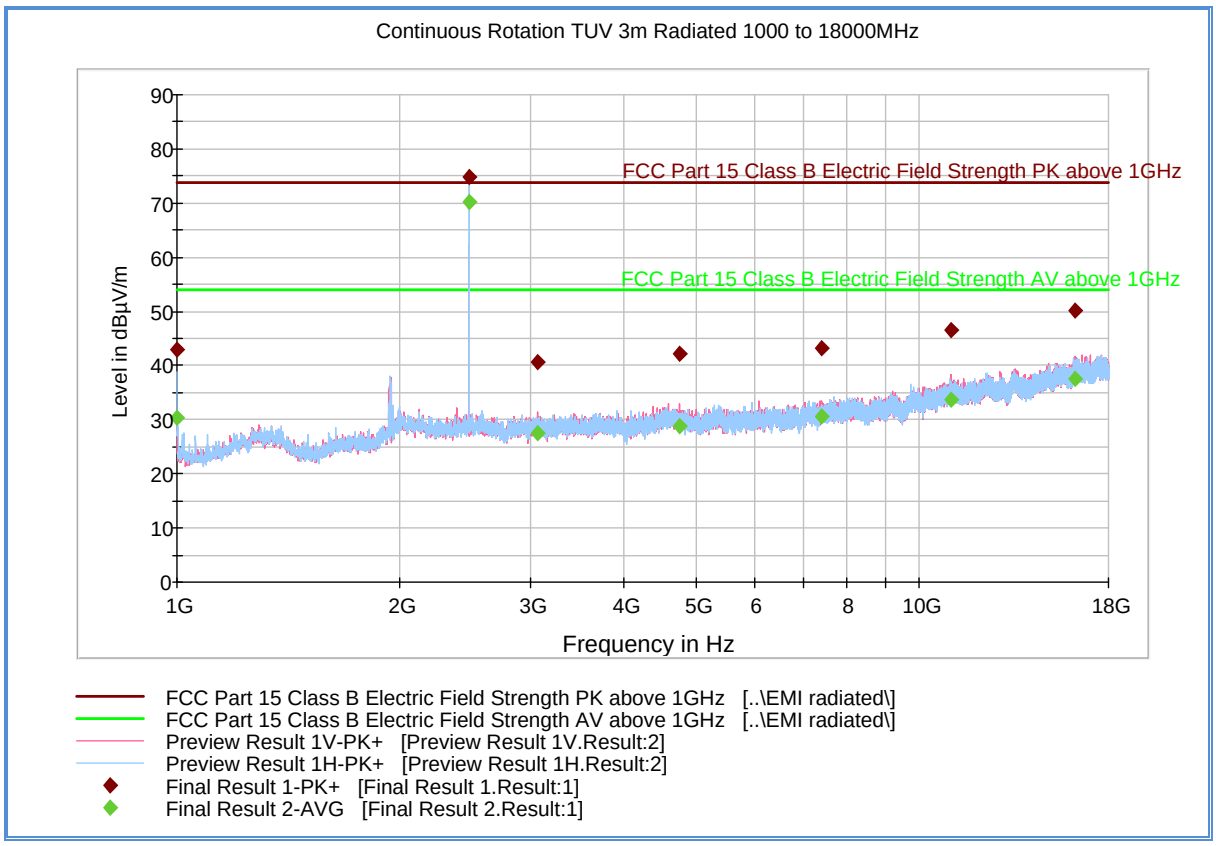
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	35.6	1000.0	1000.000	152.0	H	185.0	-7.9	18.3	53.9
2439.933333	76.9	1000.0	1000.000	136.0	H	217.0	-1.0	*)	
3322.966667	27.3	1000.0	1000.000	285.0	V	278.0	0.4	26.6	53.9
4881.133333	28.1	1000.0	1000.000	177.0	V	181.0	2.8	25.8	53.9
6819.866667	30.1	1000.0	1000.000	373.0	H	276.0	5.8	23.8	53.9
11100.800000	33.7	1000.0	1000.000	406.9	V	75.0	11.5	20.2	53.9
17470.566667	38.7	1000.0	1000.000	191.0	H	291.0	18.0	15.2	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 8GHz. Measurements above 8GHz are noise floor figures.

2.6.13 Test Results Above 1GHz (Bluetooth LE High Channel of Model 3664)



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	42.9	1000.0	1000.000	192.0	H	1.0	-7.9	31.0	73.9
2479.766667	74.9	1000.0	1000.000	137.0	H	216.0	-0.9	*)	
3056.666667	40.5	1000.0	1000.000	200.0	V	151.0	0.1	33.4	73.9
4763.466667	42.1	1000.0	1000.000	165.0	V	264.0	2.9	31.8	73.9
7389.366667	43.2	1000.0	1000.000	124.0	V	314.0	6.7	30.7	73.9
11046.100000	46.6	1000.0	1000.000	300.0	V	106.0	11.7	27.3	73.9
16202.733333	50.2	1000.0	1000.000	350.0	V	168.0	17.1	23.7	73.9

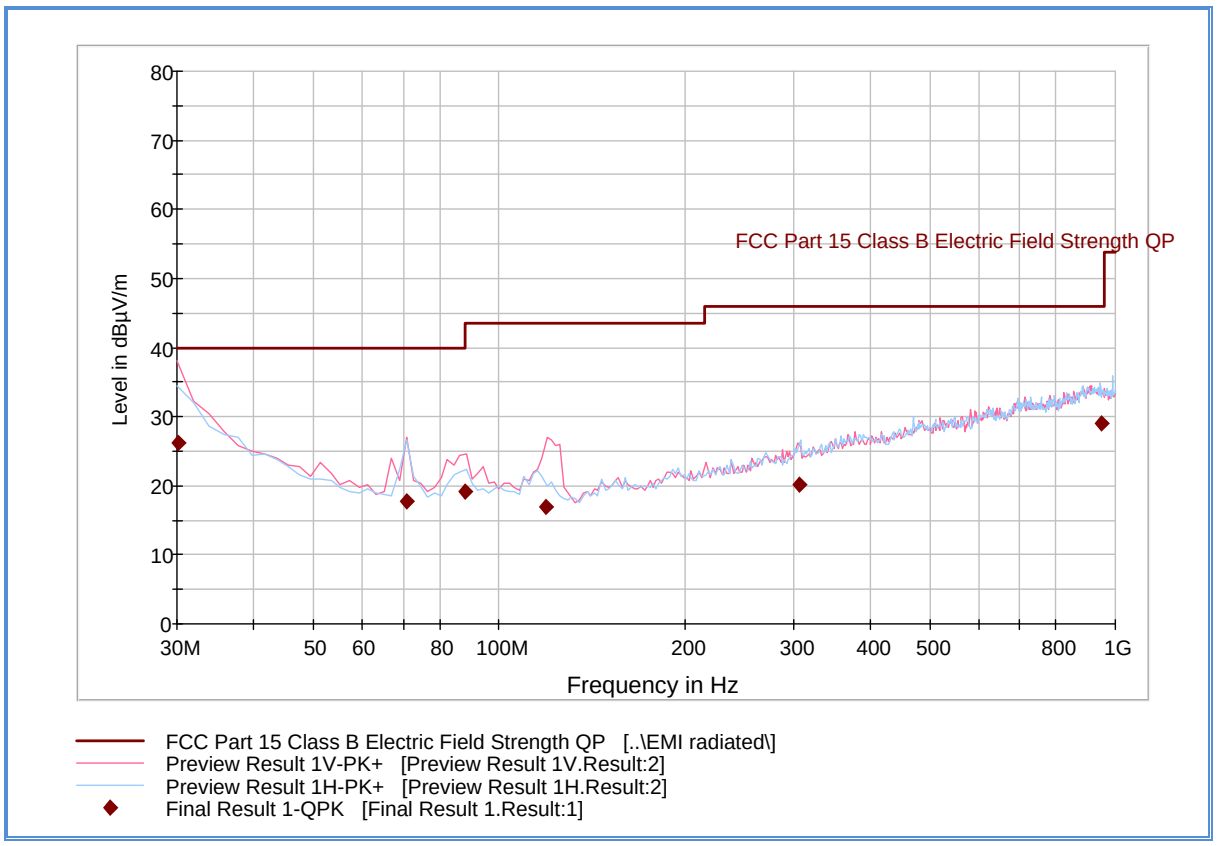
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	30.3	1000.0	1000.000	192.0	H	1.0	-7.9	23.6	53.9
2479.766667	70.2	1000.0	1000.000	137.0	H	216.0	-0.9	*)	
3056.666667	27.5	1000.0	1000.000	200.0	V	151.0	0.1	26.4	53.9
4763.466667	28.7	1000.0	1000.000	165.0	V	264.0	2.9	25.2	53.9
7389.366667	30.5	1000.0	1000.000	124.0	V	314.0	6.7	23.4	53.9
11046.100000	33.8	1000.0	1000.000	300.0	V	106.0	11.7	20.1	53.9
16202.733333	37.6	1000.0	1000.000	350.0	V	168.0	17.1	16.3	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 8GHz. Measurements above 8GHz are noise floor figures.

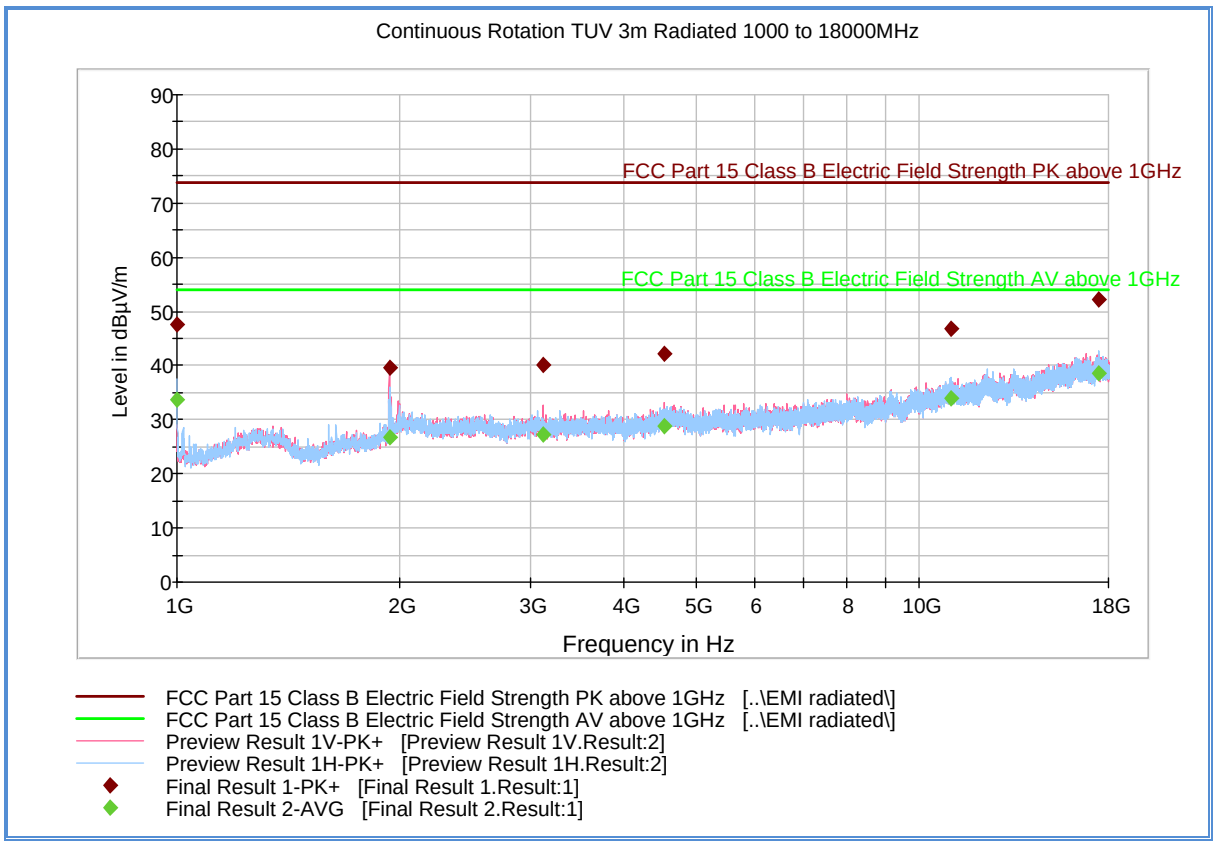
2.6.14 Test Results Below 1GHz (Receive Mode for model 3664)



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)
30.080000	26.1	1000.0	120.000	100.0	V	19.0	-5.6	13.9	40.0
70.661643	17.8	1000.0	120.000	400.0	V	11.0	-16.8	22.2	40.0
87.852745	19.1	1000.0	120.000	100.0	V	222.0	-15.6	20.9	40.0
119.298838	17.0	1000.0	120.000	100.0	V	19.0	-15.0	26.5	43.5
307.055952	20.1	1000.0	120.000	338.0	H	169.0	-6.7	25.9	46.0
946.851142	29.0	1000.0	120.000	370.0	H	32.0	6.3	17.0	46.0

2.6.15 Test Results Above 1GHz (Receive Mode for model 3664)



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	47.6	1000.0	1000.000	151.0	H	186.0	-7.9	26.3	73.9
1932.933333	39.6	1000.0	1000.000	286.0	V	54.0	-1.6	34.3	73.9
3116.633333	40.1	1000.0	1000.000	124.0	V	98.0	0.2	33.8	73.9
4540.733333	42.2	1000.0	1000.000	205.0	V	337.0	2.6	31.7	73.9
11070.23333	46.9	1000.0	1000.000	100.0	H	180.0	11.6	27.1	73.9
17466.76666	52.2	1000.0	1000.000	100.0	H	231.0	18.1	21.7	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)
1000.400000	33.7	1000.0	1000.000	151.0	H	186.0	-7.9	20.2	53.9
1932.933333	26.8	1000.0	1000.000	286.0	V	54.0	-1.6	27.1	53.9
3116.633333	27.2	1000.0	1000.000	124.0	V	98.0	0.2	26.7	53.9
4540.733333	28.9	1000.0	1000.000	205.0	V	337.0	2.6	25.0	53.9
11070.23333	33.9	1000.0	1000.000	100.0	H	180.0	11.6	20.0	53.9
17466.76666	38.7	1000.0	1000.000	100.0	H	231.0	18.1	15.2	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: N/A / Test Configuration B

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

February 26, 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	24.1°C
Relative Humidity	55.6%
ATM Pressure	99.0 kPa

2.7.7 Additional Observations

- This is a radiated test and only presented for the new model 3664. For all other models test data please refer to previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- 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.

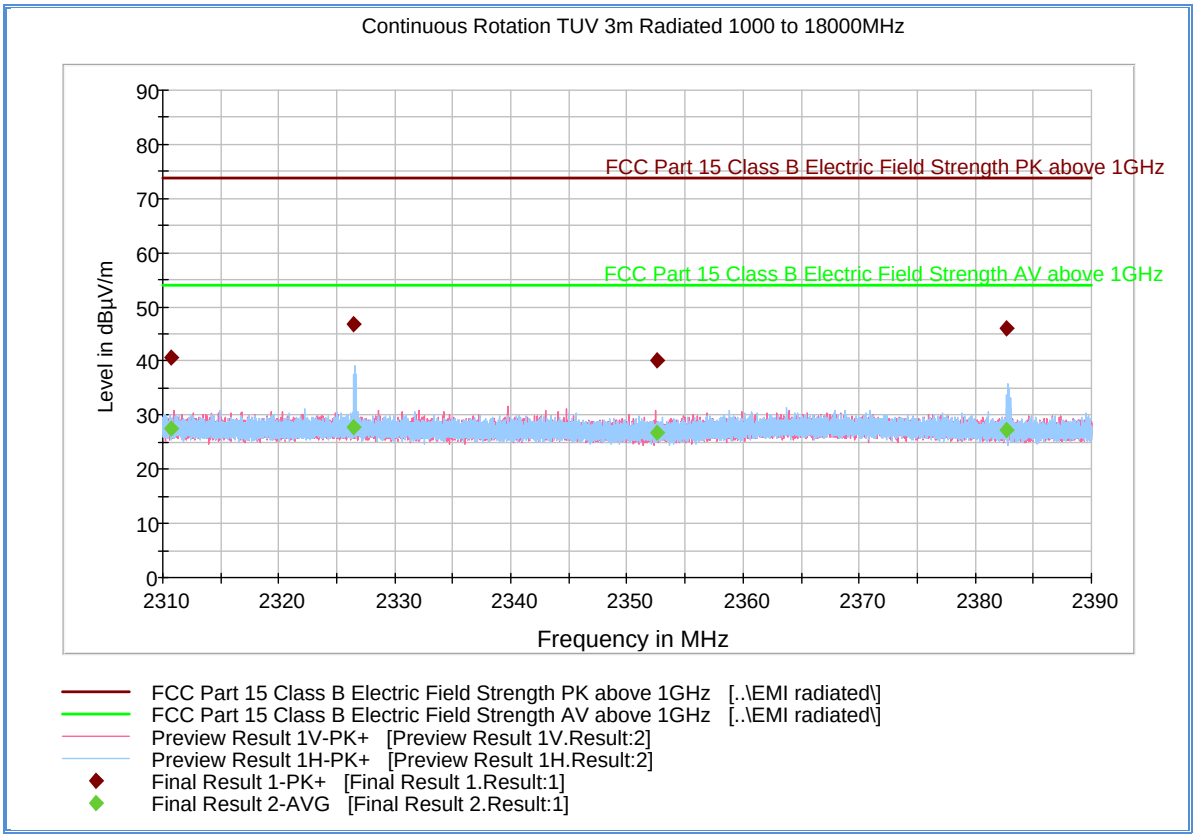
2.7.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (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**

2.7.9 Test Results

See attached plots.

2.7.10 Test Results Restricted Band 2310MHz to 2390MHz (Bluetooth LE Low Channel for model 3664)



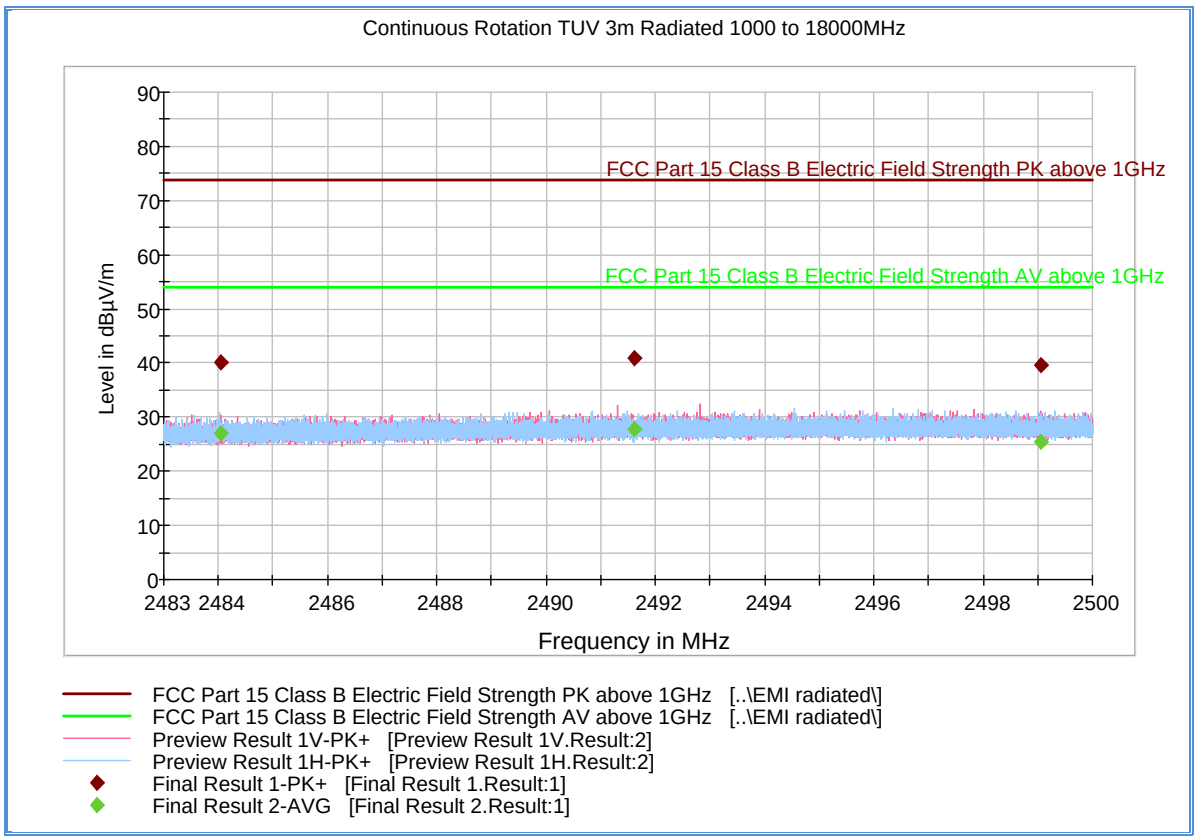
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2310.762667	40.5	1000.0	1000.000	137.0	V	216.0	-1.3	33.4	73.9
2326.386667	46.8	1000.0	1000.000	137.0	H	207.0	-1.3	27.1	73.9
2352.621333	40.1	1000.0	1000.000	151.0	V	343.0	-1.4	33.8	73.9
2382.637333	46.1	1000.0	1000.000	137.0	H	215.0	-1.4	27.8	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)
2310.762667	27.5	1000.0	1000.000	137.0	V	216.0	-1.3	26.4	53.9
2326.386667	27.7	1000.0	1000.000	137.0	H	207.0	-1.3	26.2	53.9
2352.621333	26.9	1000.0	1000.000	151.0	V	343.0	-1.4	27.0	53.9
2382.637333	27.4	1000.0	1000.000	137.0	H	215.0	-1.4	26.5	53.9

2.7.11 Test Results Restricted Band 2483.5MHz to 2500MHz (Bluetooth LE High Channel for model 3664)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2491.604500	40.9	1000.0	1000.000	124.0	H	82.0	-0.8	33.0	73.9
2484.037000	40.1	1000.0	1000.000	115.0	H	36.0	-0.9	33.8	73.9
2499.044600	39.6	1000.0	1000.000	120.0	H	50.0	-0.8	34.3	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)
2491.604500	27.7	1000.0	1000.000	124.0	H	82.0	-0.8	26.2	53.9
2484.037000	27.0	1000.0	1000.000	115.0	H	36.0	-0.9	26.9	53.9
2499.044600	25.4	1000.0	1000.000	120.0	H	50.0	-0.8	28.5	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: Refer to original test report / Test Configuration A

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

September 23, 2014 / 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	25.0°C
Relative Humidity	51.4%
ATM Pressure	99.0 kPa

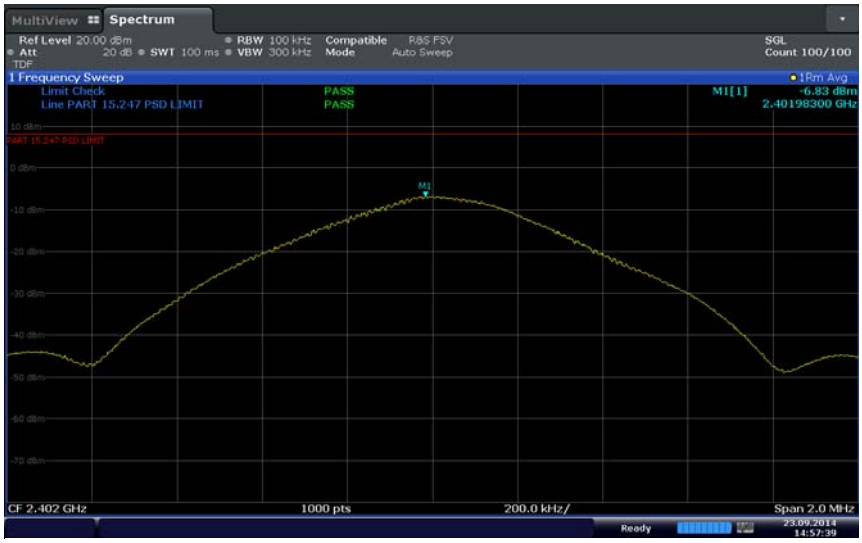
2.8.7 Additional Observations

- This section of test data was leveraged from previous test report under TÜV SÜD test report ref. No. SD1406553A Rev.02.
- This is a conducted test.
- Test procedure is per Section 10.3 of KDB 558074 (January 07, 2016).
- An offset of 21.4dB 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

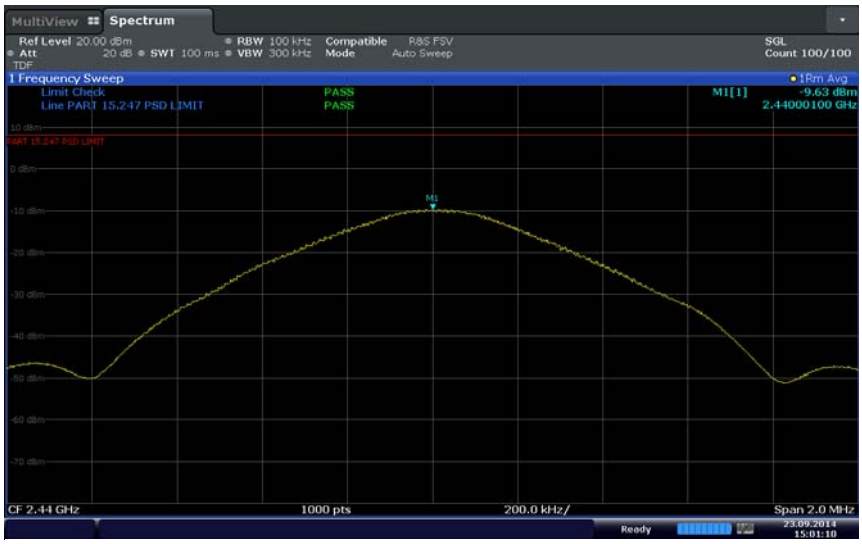
Mode	Channel	Marker Reading using 100 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
Bluetooth LE	00 (2402 MHz)	-6.83	8	14.83	Complies
	19 (2440 MHz)	-9.63	8	17.63	Complies
	39 (2480 MHz)	-11.80	8	19.80	Complies

2.8.9 Test Results Plots



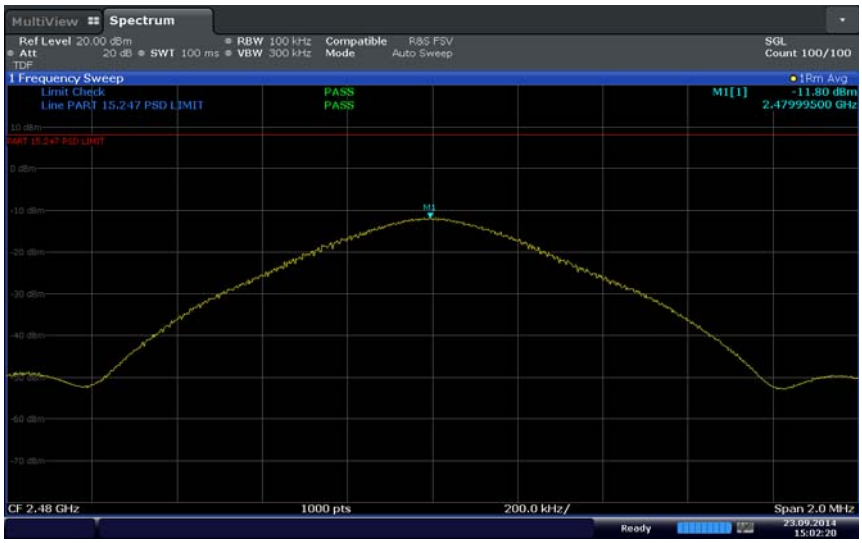
Date: 23.SEP.2014 14:57:39

Bluetooth LE Low Channel



Date: 23.SEP.2014 15:01:11

Bluetooth LE Mid Channel



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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	04/22/14	04/22/15
7570	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240588	Agilent	04/09/14	04/09/15
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	11/19/13	11/19/14
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	01/20/14	01/20/15
-	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7582	
Radiated Test Setup						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	11/06/15	11/06/17
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	04/27/15	04/27/16
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	03/20/15	03/20/16
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	09/29/15	09/29/16
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	03/11/15	03/11/16
1016	Pre-amplifier	PAM-0202	187	PAM	12/15/15	12/15/16
Miscellaneous						
6792	Multimeter	3478A	2911A70964	Hewlett Packard	08/12/14	08/12/14
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	01/30/14	01/30/15
1123	DC Power Supply	E3631A	N/A	Hewlett Packard	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

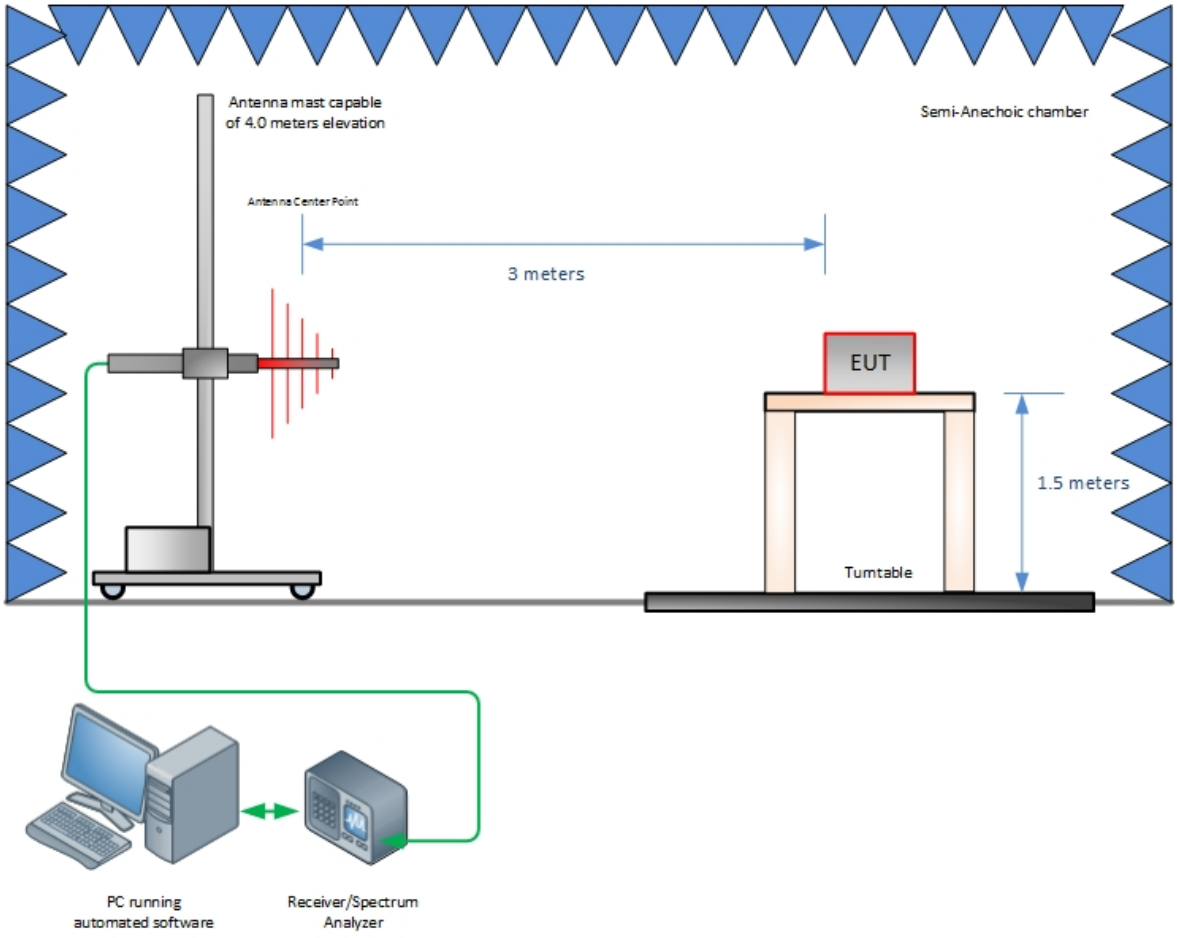
3.2.2 Radiated Emission Measurements (Above 1GHz)

	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

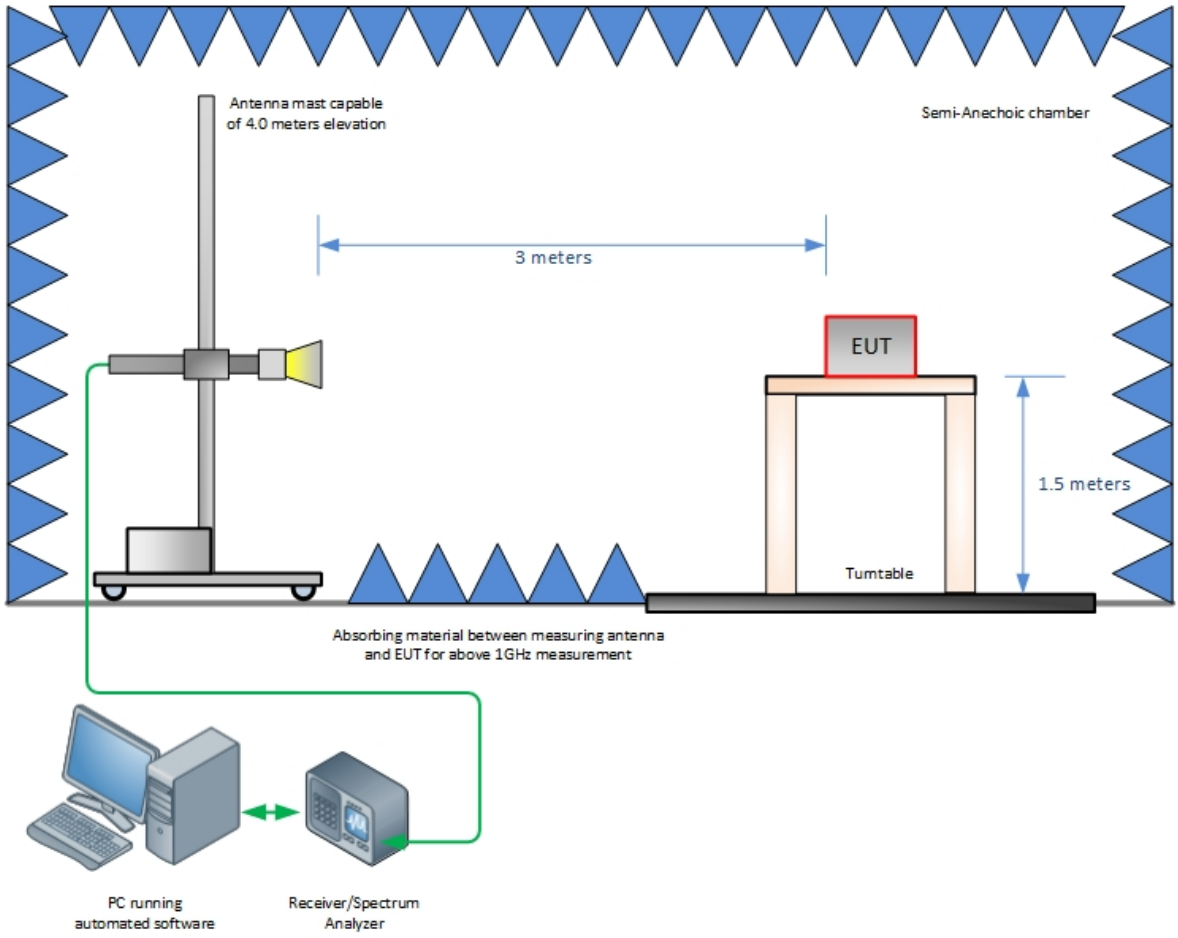
SECTION 4

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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