Radio Testing of the

Diamond Kinetics
Bluetooth Low Energy Module
Model: DKT003

In accordance with

FCC Part 15 Subpart C §15.247
RSS-247 Issue 2 February 2017

America

Add value.
Inspire trust.

Diamond Kinetics
700 River Ave, Suite 100,
Pittsburgh, PA 15212

COMMERCIAL-IN-CONFIDENCE

Date: July 2020
Document Number: 72161007A Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Ferdinand S. Custodio	July 20, 2020	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD document control rules.

EXECUTIVE SUMMARY
The EUT in general was confirmed to be in compliance with FCC Part 15 Subpart C §15.247 and RSS-247 Issue 2 February 2017.

A2LA Cert. No. 2955.13

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REPORT ON	Radio Testing of the Diamond Kinetics Bluetooth Low Energy Module Model: DKT003
TEST REPORT NUMBER	72161007A
TEST REPORT DATE	July 2020
PREPARED FOR	Diamond Kinetics 700 River Ave, Suite 100, Pittsburgh, PA 15212
CONTACT PERSON	Jeremy Rittenhouse Platform Engineer jrittenhouse@diamondkinetics.com (412) 223-5341
PREPARED BY	Xiaoying Zhang **Name** Authorized Signatory Title: EMC/Wireless Test Engineer

Revision History

72161007A Diamond Kinetics Bluetooth Low Energy Module DKT003					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
07/20/2020	—	Initial Release			Ferdinand S. Custodio

CONTENTS

SECTION 1

1 REPORT SUMMARY

Radio Testing of the
Diamond Kinetics
Bluetooth Low Energy Module DKT003

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Diamond Kinetics Bluetooth Low Energy Module DKT003 to the requirements of FCC Part 15 Subpart C §15.247 and RSS-247 Issue 2 February 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. The EUT can be embedded in three hosts: • SwingTracker • PitchTracker Baseball • PitchTracker Softball Radiated Spurious Emissions were tested on the three hosts samples.
Manufacturer	Diamond Kinetics
EUT	Bluetooth Low Energy Module
Trade Name	DKT003
Model Name	DKT003
FCC ID	2ABWR-DKT003
IC Number	12312A-DKT003
FCC Classification	Low power Communications Device Transmitter (DTS)
Serial Number(s)	N/A (Engineering Samples)
Number of Samples Tested	1 (Conducted Sample) 3 (Hosts)
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2019). • RSS-247–Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices (Issue 2, February 2017). • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 5, Amendment 1 March 2019).
Start of Test	June 24, 2020
Finish of Test	July 09, 2020
Name of Engineer(s)	Xiaoying Zhang

Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices. • KDB 558074 D01 15.247 v05r02 Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under Section 15.247 of the FCC rules. • 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 and RSS-247 Issue 2 February 2017 with cross-reference to the corresponding IC RSS standard are shown below.

Section	§15.247 Spec Clause	RSS	Test Description	Result	Comments /Base Standard
2.1	§15.247(b)(3)	RSS-247 5.4(d)	Peak Output Power	Compliant	
2.2	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	Compliant	
2.3	-	RSS-Gen 6.7	99% Emission Bandwidth	Compliant	
2.4	§15.247(a)(2)	RSS-247 5.2(a)	Minimum 6 dB RF Bandwidth	Compliant	
2.5	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
2.6	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.7	§15.247(d)	RSS-247 5.5	Radiated Spurious Emissions	Compliant	
	-	RSS-Gen 7.3 and 7.4	Receiver Spurious Emissions	N/A*	
2.8	§15.247(e)	RSS-247 5.2(b)	Power Spectral Density for Digitally Modulated Device	Compliant	

N/A* Not required as per RSS-Gen 5.3 The EUT does not fall into any category defined as Receiver under RSS-Gen.

1.3 Product Information

1.3.1 Technical Description

The Equipment Under Test (EUT) is a Diamond Kinetics DKT003 Bluetooth Low Energy (BLE) 5.0 module based on Dialog Semiconductor DA14695. The EUT is designed to embed inside a baseball, softball, or be attached to a baseball bat. It communicates IMU sensor data with a mobile phone or other BLE device. The system is powered off a single 3.7V lithium polymer cell which can be charged by inductive wireless charging.

1.3.2 EUT General Description

EUT Description	Bluetooth Low Energy Module
Trade Name	DKT003
Model Name	DKT003
Rated Voltage	3.7 VDC (Battery powered)
Mode Verified	BT LE 5.0
Capability	BT LE 5.0
Primary Unit (EUT)	☐ Production
	☐ Pre-Production
	☒ Engineering
Antenna Type	Chip Antenna
Manufacturer	Johanson
Antenna Model	2450AT18A100E
Maximum Antenna Gain	Max. 0.5 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Average Output Power (dBm)	Average Output Power (mW)	Declared Max. Duty Cycle (%)
	2402-2480	-3.01	0.50	42.4

1.4 EUT Test configuration

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT was charged by wireless charger. The EUT was preloaded with companion Bluetooth app firmware and set to work in Transmit mode covering Low, Middle and High channels, 1M and 2M PHY using LightBlue app on cell phone. For Conducted tests, the antenna port was connected to the Spectrum Analyser or Power Meter when used with a conducted RF Cable. For Radiated tests, EUT was tested in three different hosts.

1.4.2 EUT Exercise Software

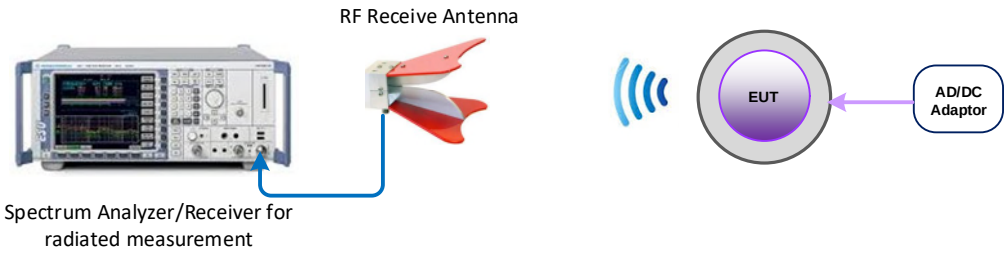
Bluetooth app firmware preloaded on the EUTs.

1.4.3 Support Equipment and I/O cables

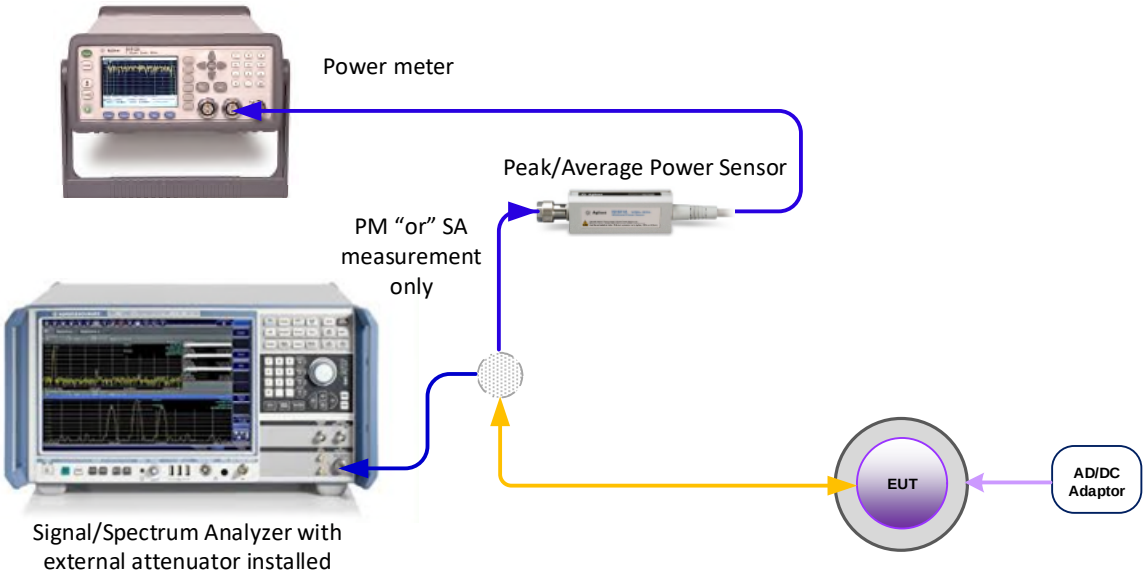
Manufacturer	Equipment/Cable	Description
Diamond Kinetics	USB Wireless Charger	Model: T200, IP: 5VDC, 1.5A, OP: 5VDC, 1000mA, FCC ID: 2ABW7-T200
Apple	AC/DC Adaptor	Model: A1385, IP: 100-240VAC, 50/60Hz, 0.15A, OP: 5VDC, 1A

1.4.4 Simplified Test Configuration Diagram

Radiated Test Configuration



Conducted (Antenna Port) Test Configuration



For illustration purpose only and not to scale

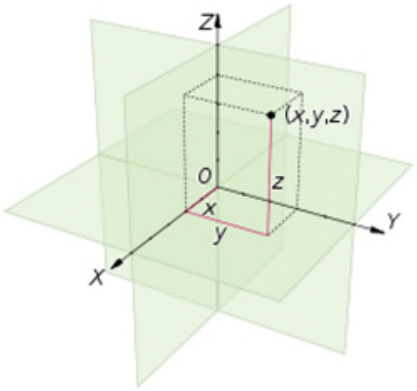
Image presented may not represent the actual EUT or support equipment (Support laptop is common to both configurations, connection to the access point through Ethernet cable)

1.4.5 Worst Case Configuration

Worst-case configuration used in this test report as per Conducted Output Power measurements:

Mode	Channel	PHY
Bluetooth LE	17 (Middle Channel)	1M
Bluetooth LE	37 (Low Channel)	2M

For radiated measurements X, Y, and Z orientations were verified. The verification was determined "X" as worst case configuration.



1.5 Deviations from the Standard

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

1.6 Modification Record

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number: N/A (Engineering Samples)		
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 C63.10-2013. 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)

16936 Via Del Campo, 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 (IC) 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 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 for radio equipment testing with Registration No. 22806-1.

1.9.3 BSMI – Laboratory Code: SL2-IN-E-028R (US0102)

TUV Product Service Inc. (San Diego) is a recognized EMC testing laboratory by the BSMI under the MRA (Mutual Recognition Arrangement) with the United States. Accreditation includes CNS 13438 up to 6GHz.

1.9.4 NCC (National Communications Commission - US0102)

TUV SUD America Inc. (San Diego) is listed as a Foreign Recognized Telecommunication Equipment Testing Laboratory and is accredited to ISO/IEC 17025 (A2LA Certificate No.2955.13) which under APEC TEL MRA Phase 1 was designated as a Conformity Assessment Body competent to perform testing of equipment subject to the Technical Regulations covered under its scope of accreditation including RTTE01, PLMN01 and PLMN08 for TTE type of testing and LP002 for Low-Power RF Device type of testing.

1.9.5 VCCI – Registration No. A-0280 and A-0281

TUV SUD America Inc. (San Diego) is a VCCI registered measurement facility which includes radiated field strength measurement, radiated field strength measurement above 1GHz, mains port interference measurement and telecommunication port interference measurement.

1.9.6 RRA – Identification No. US0102

TUV SUD America Inc. (San Diego) is National Radio Research Agency (RRA) recognized laboratory under Phase I of the APEC Tel MRA.

1.9.7 OFCA – U.S. Identification No. US0102

TUV SUD America Inc. (San Diego) is recognized by Office of the Communications Authority (OFCA) under Appendix B, Phase I of the APEC Tel MRA.

SECTION 2

2 TEST DETAILS

EMC Evaluation of the
Diamond Kinetics
Bluetooth Low Energy Module DKT003

2.1 Peak Output Power

2.1.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(b)(3)
RSS-247, Clause 5.4 (d)

2.1.2 Standard Applicable

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands, the maximum peak conducted output shall not exceed 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

2.1.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

July 06, 2020/XYZ

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

Ambient Temperature	23.4°C
Relative Humidity	48.2%
ATM Pressure	98.6kPa

2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [average] output power) using direct connection to a power meter.
- The path loss was measured and entered as a level offset.
- Test methodology is per Clause 8.3.2.3 of KDB 558074 D01 (DTS Meas Guidance v05r02, April 2, 2019) which refers to subclause 11.9.2.3 of ANSI C63.10. All conditions under this Clause are satisfied.
- Both Peak and Average measurements were recorded.

2.1.8 Test Results

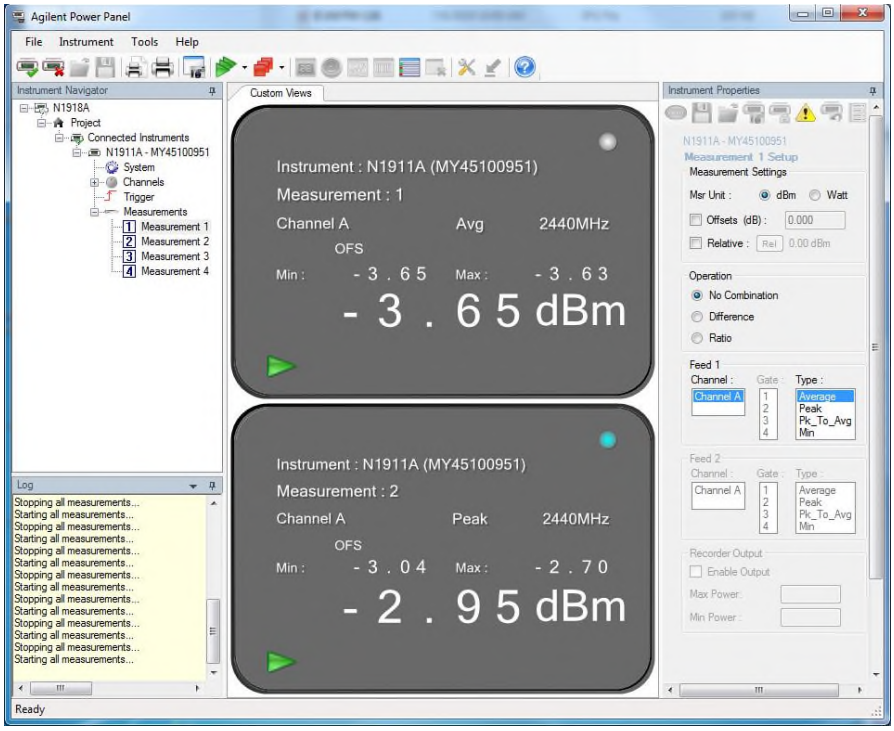
The Maximum Power Setting for 1M PHY is 4.5 dBm.

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Average Power (dBm)	Measured Peak Power (dBm)
	37 (2402 MHz)	GFSK @ LE 1M	-3.99	-3.02
	17 (2440 MHz)	**GFSK @ LE 1M**	**-3.63**	**-2.70**
	39 (2480 MHz)	GFSK @ LE 1M	-3.79	-2.95

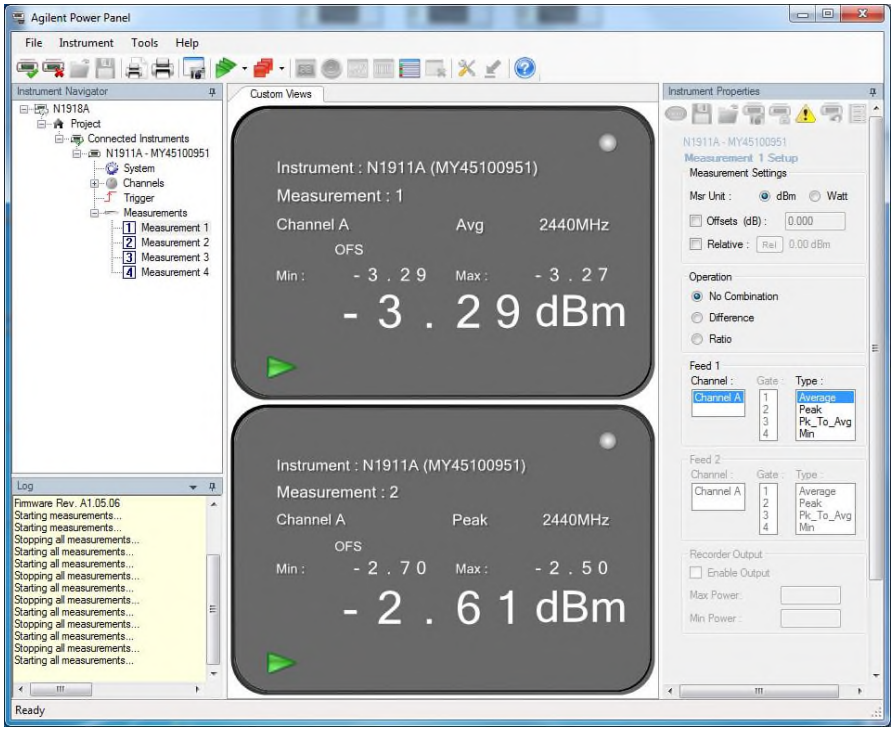
The Maximum Power Setting for 2M PHY is 5 dBm.

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Average Power (dBm)	Measured Peak Power (dBm)
	37 (2402 MHz)	**GFSK @ LE 2M**	**-3.01**	**-2.26**
	17 (2440 MHz)	GFSK @ LE 2M	-3.27	-2.50
	39 (2480 MHz)	GFSK @ LE 2M	-3.10	-2.35

2.1.9 Sample Test Display



Bluetooth LE 1M Middle Channel



Bluetooth LE 2M Middle Channel

2.2 Conducted Emissions

2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.207(a)
RSS-GEN, Clause 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

Serial No: N/A / Default Test Configuration

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

June 26, 2020/XYZ

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	23.5 °C
Relative Humidity	53.2 %
ATM Pressure	98.6 kPa

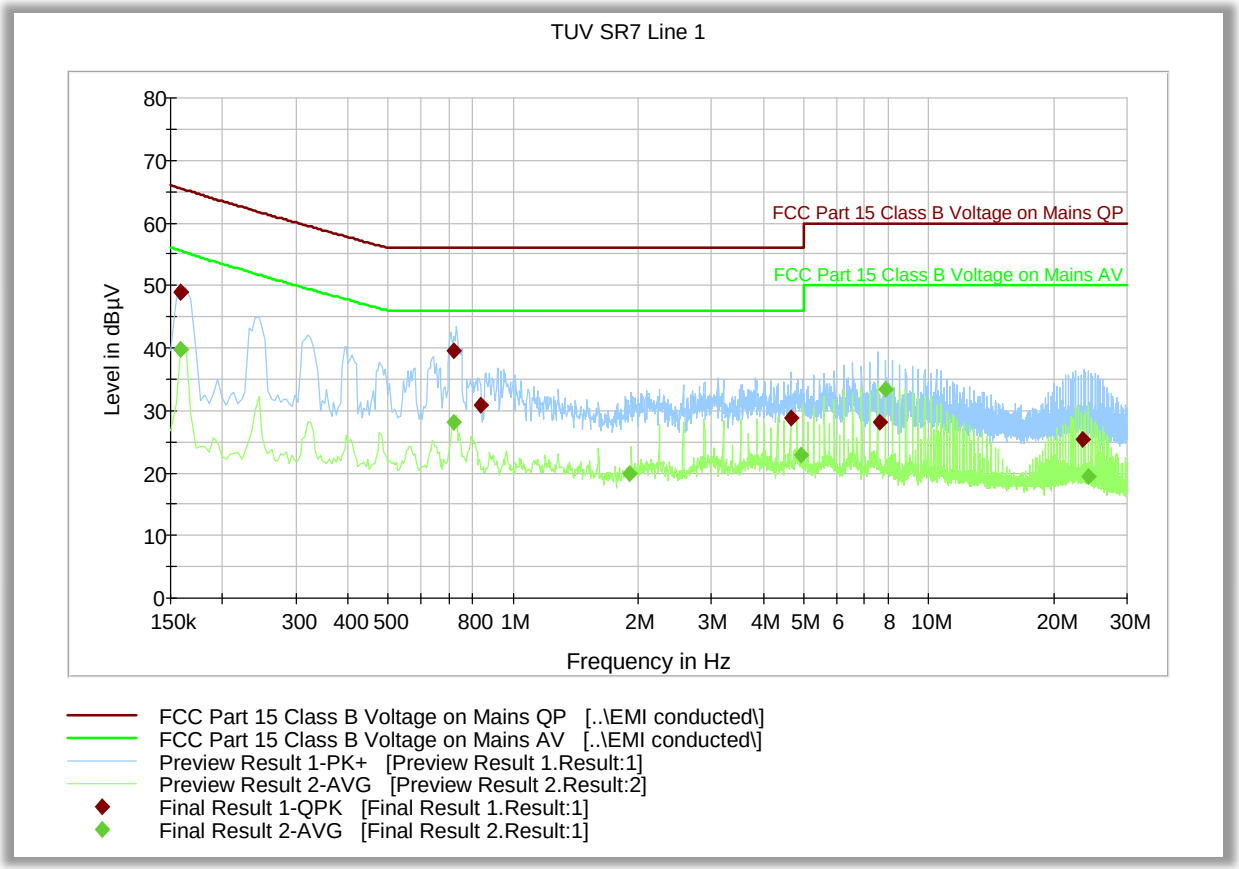
2.2.7 Additional Observations

- The EUT was verified using AC wireless adapter supplied by the manufacturer.
- EUT verified using input voltage of 120VAC 60Hz.
- There are no significant variations in test results between each operating mode. Only the Middle channel operation mode of representative host PitchTracker Softball is presented.
- 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 2.2.8 for sample computation.

2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbµV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7567 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.2.9 Test Results - Conducted Emissions Line 1 – Hot



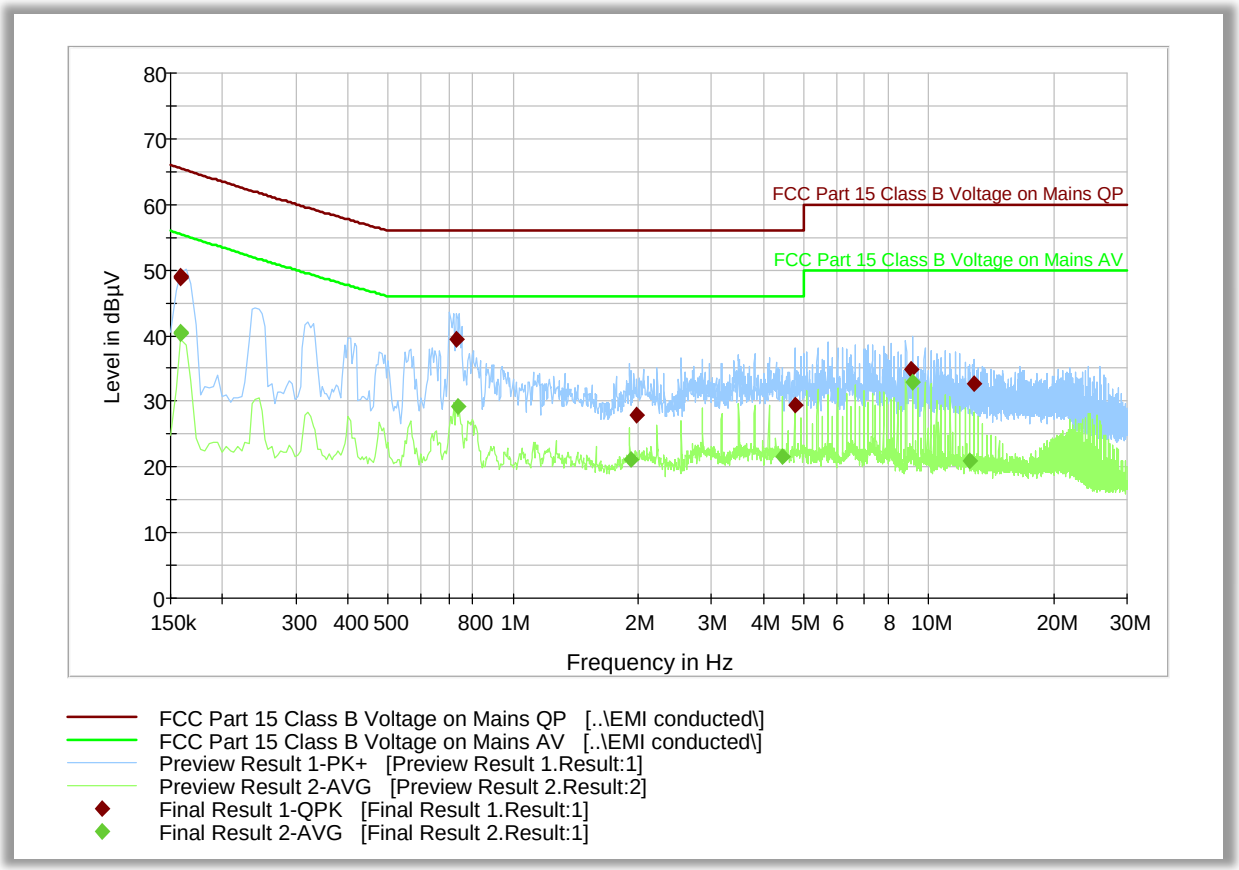
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.159000	48.9	1000.0	9.000	Off	L1	19.7	16.6	65.5
0.717000	39.6	1000.0	9.000	Off	L1	19.4	16.4	56.0
0.838500	30.8	1000.0	9.000	Off	L1	19.5	25.2	56.0
4.681500	28.7	1000.0	9.000	Off	L1	19.9	27.3	56.0
7.624500	28.1	1000.0	9.000	Off	L1	19.9	31.9	60.0
23.505000	25.4	1000.0	9.000	Off	L1	20.1	34.6	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.159000	39.9	1000.0	9.000	Off	L1	19.7	15.6	55.5
0.721500	28.1	1000.0	9.000	Off	L1	19.4	17.9	46.0
1.905000	20.0	1000.0	9.000	Off	L1	19.5	26.0	46.0
4.924500	22.8	1000.0	9.000	Off	L1	20.0	23.2	46.0
7.858500	33.4	1000.0	9.000	Off	L1	19.9	16.6	50.0
24.216000	19.4	1000.0	9.000	Off	L1	20.1	30.6	50.0

2.2.10 Test Result - Conducted Emissions Line 2 – Neutral



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.159000	48.9	1000.0	9.000	Off	N	19.7	16.6	65.5
0.730500	39.4	1000.0	9.000	Off	N	19.5	16.6	56.0
1.986000	27.9	1000.0	9.000	Off	N	19.6	28.1	56.0
4.762500	29.5	1000.0	9.000	Off	N	19.9	26.5	56.0
9.051000	34.8	1000.0	9.000	Off	N	20.0	25.2	60.0
12.862500	32.6	1000.0	9.000	Off	N	20.0	27.4	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.159000	40.5	1000.0	9.000	Off	N	19.7	15.0	55.5
0.735000	29.2	1000.0	9.000	Off	N	19.5	16.8	46.0
1.923000	21.2	1000.0	9.000	Off	N	19.6	24.8	46.0
4.447500	21.6	1000.0	9.000	Off	N	19.8	24.4	46.0
9.141000	33.0	1000.0	9.000	Off	N	20.0	17.0	50.0
12.511500	20.8	1000.0	9.000	Off	N	20.0	29.2	50.0

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.7

2.3.2 Standard Applicable

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and one below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall e reported for all equipment in additon to the specified bandwidth required in the applicable RSSs.

The following conditions shall be observed for measuring the occpied bandwidth:

- 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, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sample detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occpied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied / x dB and video bandwidth (VBW) shall be samller than three times the RBW value. Video averaging is not permitted.

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 occupied bandwidth (or the 99% emission bandwidth).

2.3.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

June 24, 2020/XYZ

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

Ambient Temperature	22.7°C
Relative Humidity	53.7%
ATM Pressure	98.5kPa

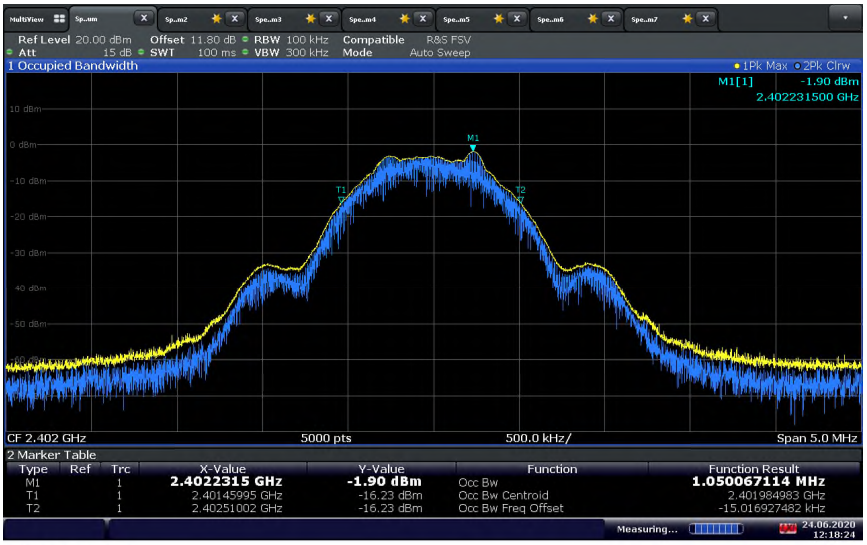
2.3.7 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as a level offset.
- Test methodology is per Clause 6.9.3 of ANSI C63.10. All conditions under this Clause are satisfied.
- Span is between 1.5 to 5 times of the OBW.
- RBW is set to 100 kHz.
- VBW is 3 x RBW.
- Sweep is auto.
- Detector is peak.
- Trace mode is max hold.
- 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)	
		LE 1M	LE 2M
Bluetooth LE	37 (2402 MHz)	1.05	2.08
	17 (2440 MHz)	1.05	2.09
	39 (2480 MHz)	1.04	2.08

2.3.9 Test Results Plots



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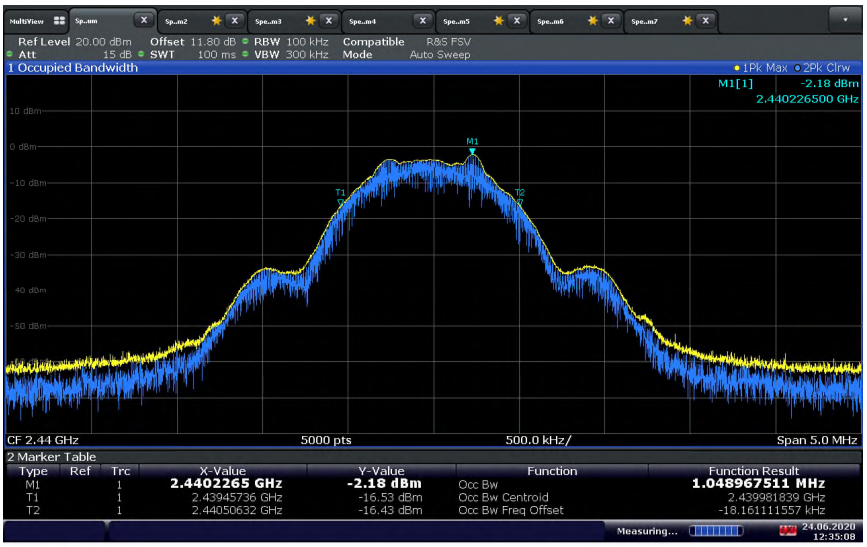
Bluetooth LE 1M Low Channel



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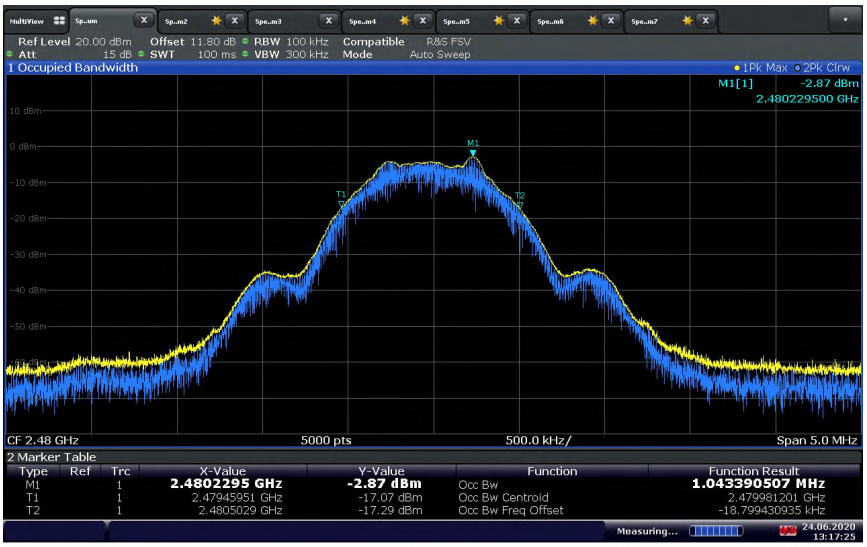
Bluetooth LE 1M Middle Channel



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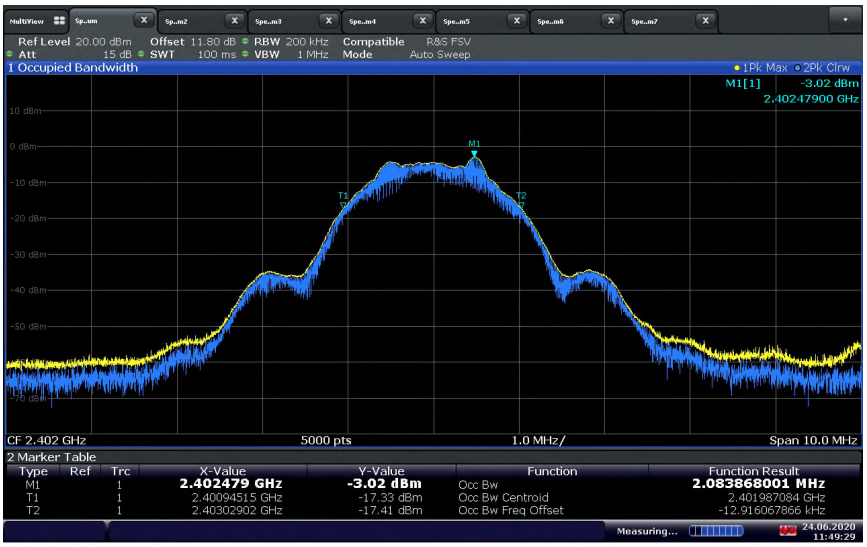
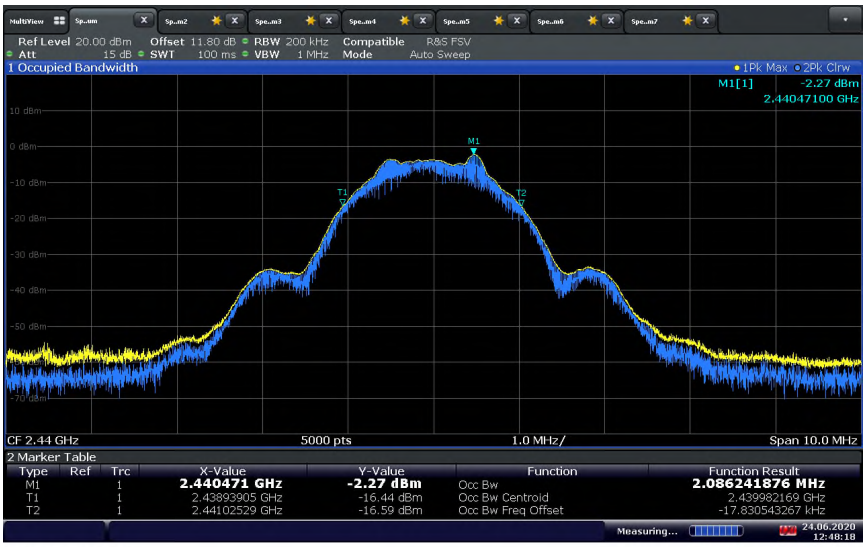
Bluetooth LE 1M High Channel



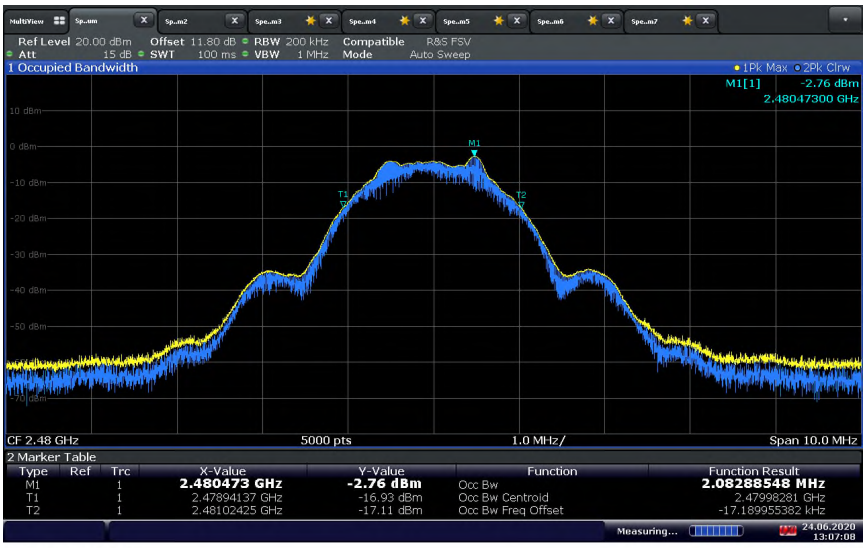
11:49:30 24.06.2020

Bluetooth LE 2M Low Channel



12:48:18 24.06.2020

Bluetooth LE 2M Middle Channel



13:07:08 24.06.2020

Bluetooth LE 2M High Channel

2.4 Minimum 6 dB RF bandwidth

2.4.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(a)(2)
RSS-247, Clause 5.2 (a)

2.4.2 Standard Applicable

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

June 24, 2020/XYZ

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

Ambient Temperature	22.7°C
Relative Humidity	53.7%
ATM Pressure	98.5kPa

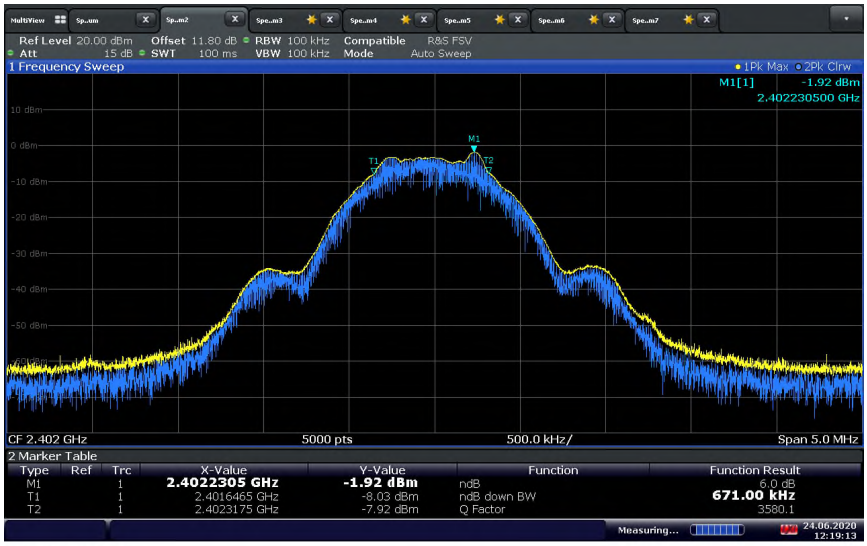
2.4.7 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as a level offset.
- Test methodology is per Clause 6.9.2 of ANSI C63.10. All conditions under this Clause are satisfied.
- Span is between 1.5 to 5 times of the OBW.
- RBW is 100kHz.
- VBW is 3 x RBW.
- Sweep is auto.
- Detector is peak.
- Trace mode is max hold.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.4.8 Test Results

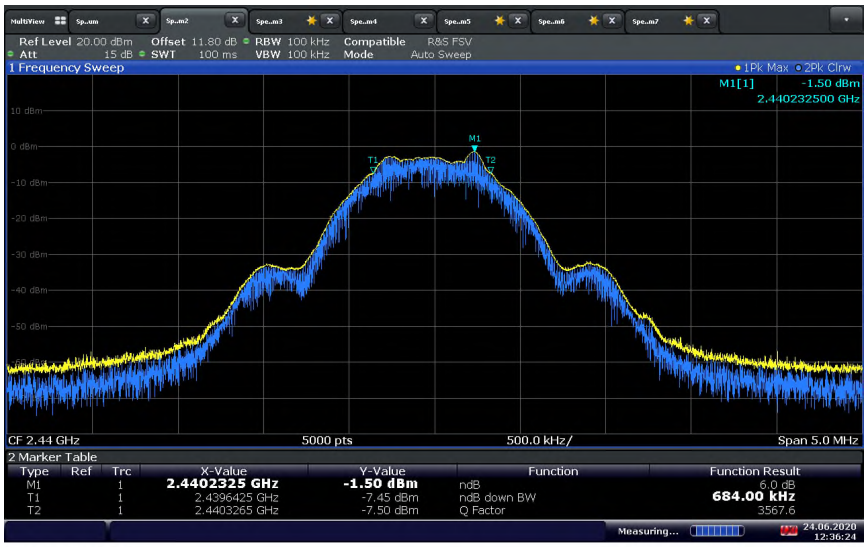
Mode	Channel	PHY	Measured Bandwidth (MHz)	Min. Bandwidth (MHz)	Compliance
Bluetooth LE	37 (2402 MHz)	LE 1M	0.671	0.500	Complies
		LE 2M	1.34	0.500	Complies
	17 (2440 MHz)	LE 1M	0.684	0.500	Complies
		LE 2M	1.34	0.500	Complies
	39 (2480 MHz)	LE 1M	0.666	0.500	Complies
		LE 2M	1.35	0.500	Complies

2.4.9 Test Results Plots



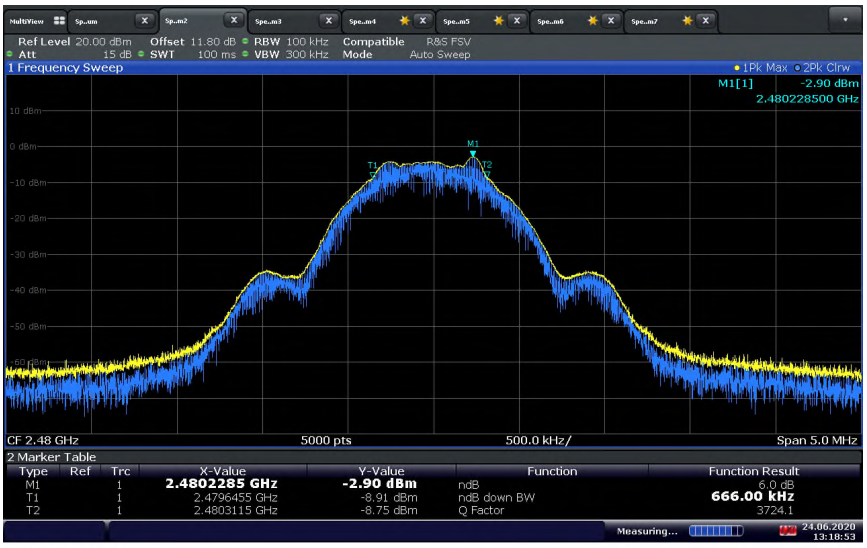
12:19:14 24.06.2020

Bluetooth LE 1M Low Channel



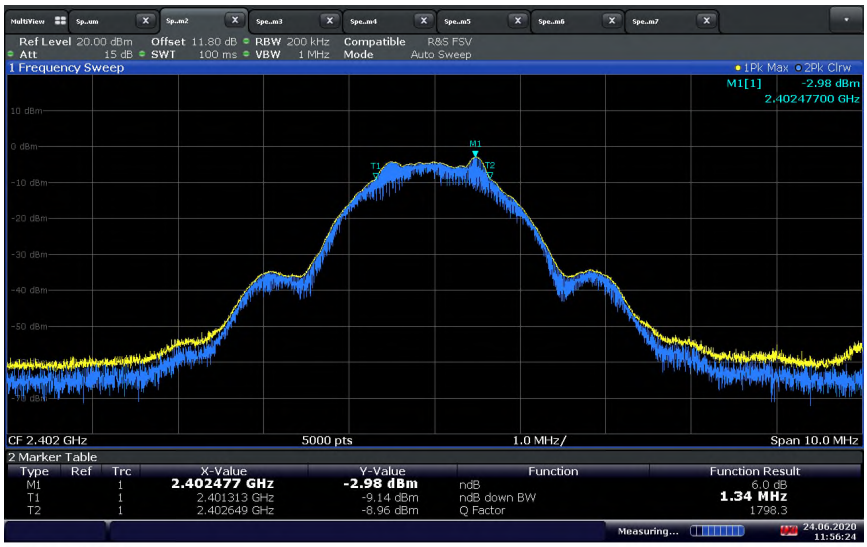
12:36:25 24.06.2020

Bluetooth LE 1M Middle Channel



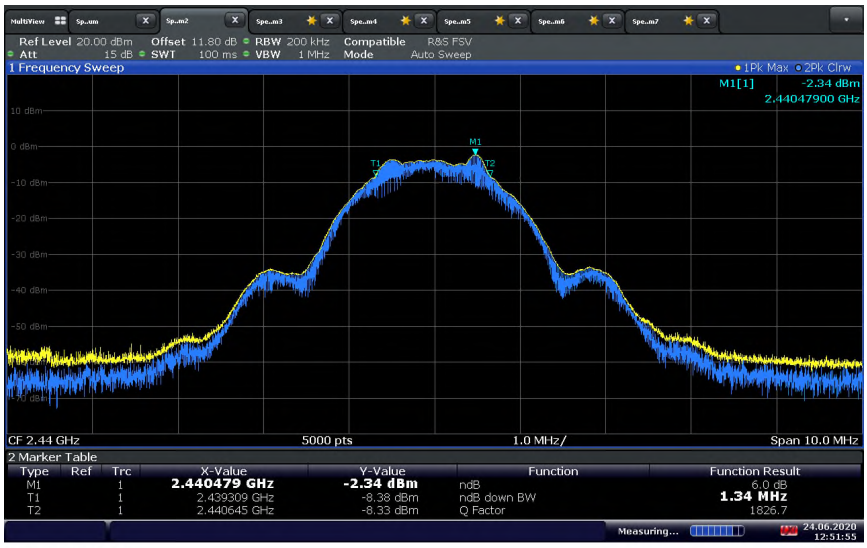
13:18:53 24.06.2020

Bluetooth LE 1M High Channel



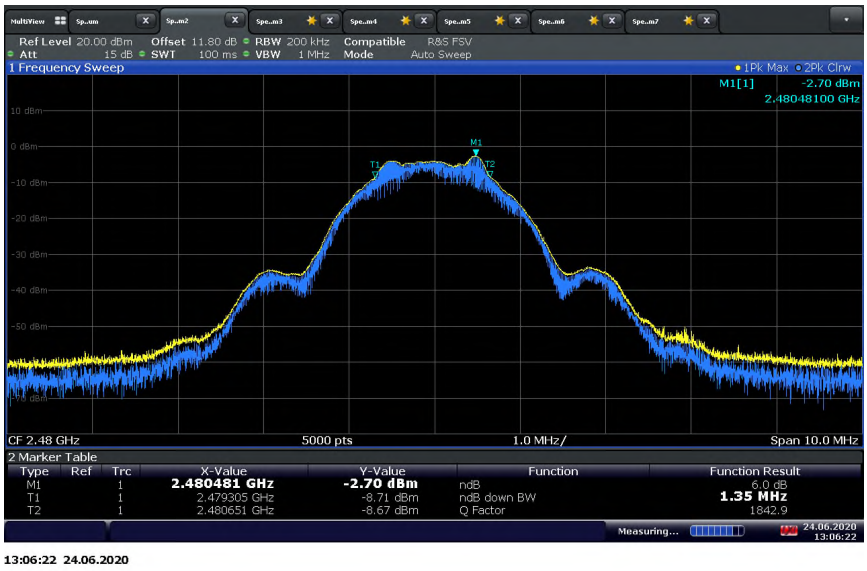
11:56:25 24.06.2020

Bluetooth LE 2M Low Channel



12:51:55 24.06.2020

Bluetooth LE 2M Middle Channel



13:06:22 24.06.2020

Bluetooth LE 2M High Channel

2.5 Out-of-band Emissions - Conducted

2.5.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
RSS-247, Clause 5.5

2.5.2 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

2.5.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

June 24, 2020/XYZ

2.5.5 Test Equipment Used

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

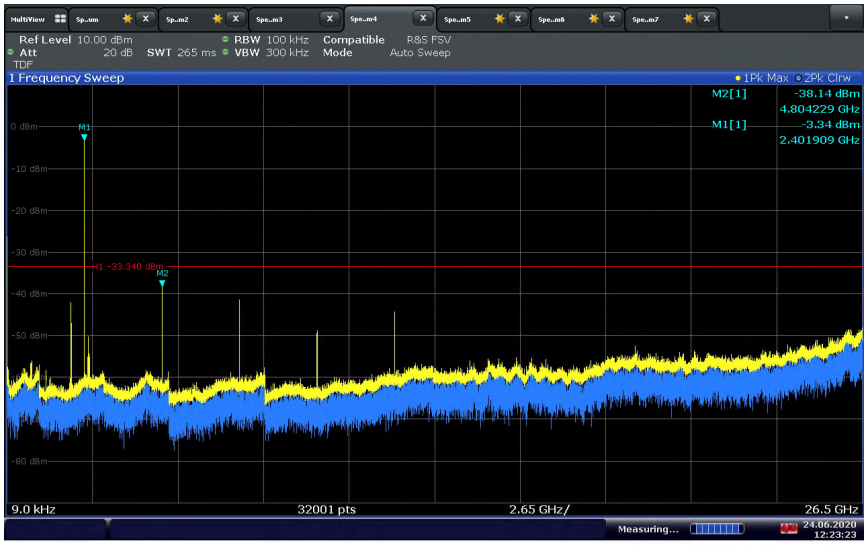
2.5.6 Environmental Conditions

Ambient Temperature	22.7°C
Relative Humidity	53.7%
ATM Pressure	98.5kPa

2.5.7 Additional Observations

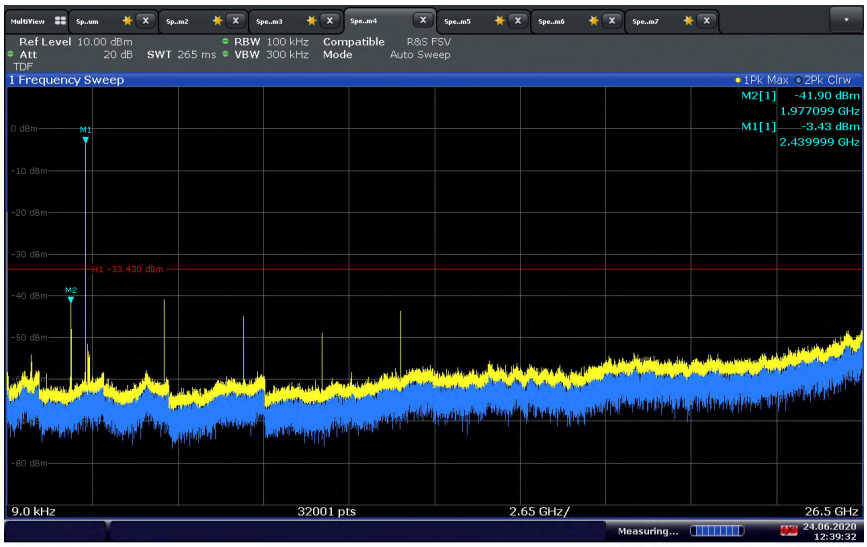
- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3 x RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band.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

2.5.8 Test Results Plots



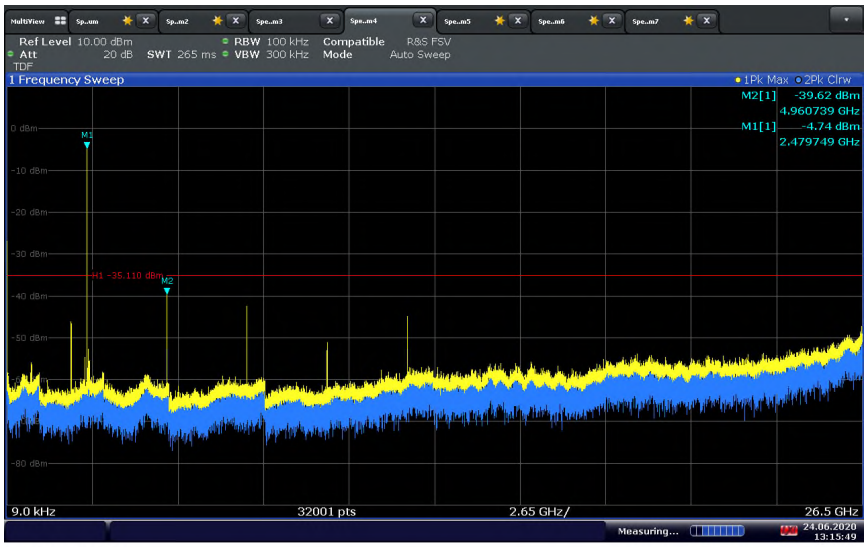
12:23:23 24.06.2020

Bluetooth LE 1M Low Channel



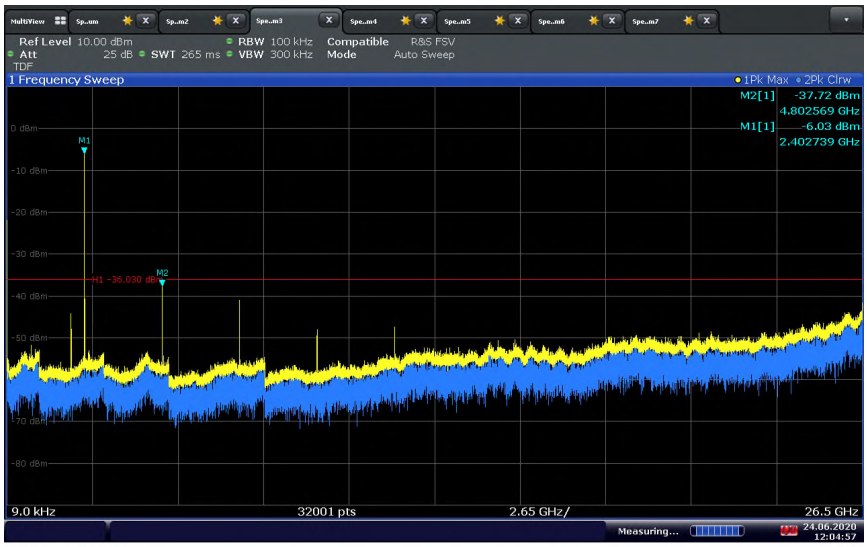
12:39:33 24.06.2020

Bluetooth LE 1M Middle Channel



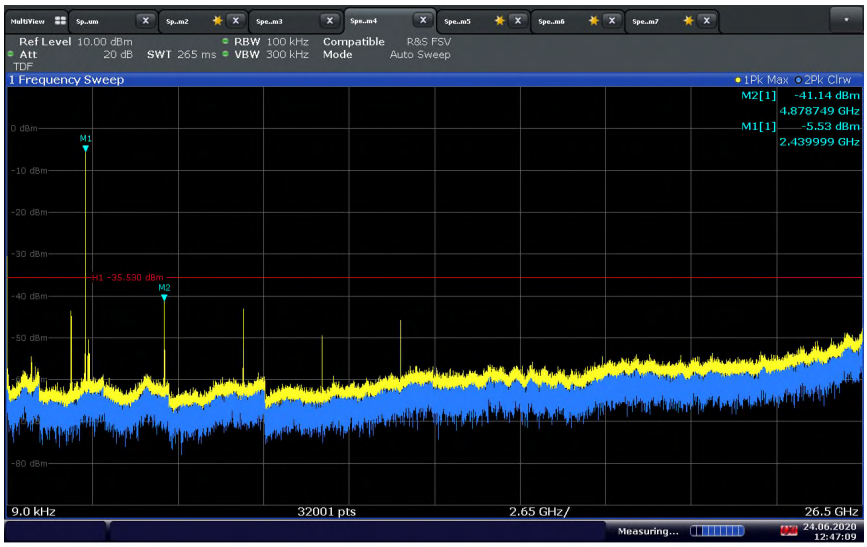
13:15:49 24.06.2020

Bluetooth LE 1M High Channel



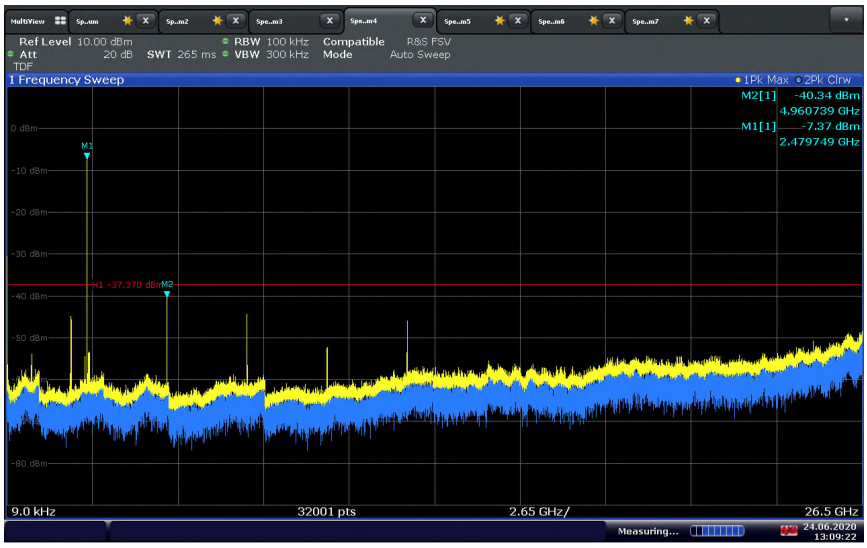
12:04:57 24.06.2020

Bluetooth LE 2M Low Channel



12:47:10 24.06.2020

Bluetooth LE 2M Middle Channel



13:09:22 24.06.2020

Bluetooth LE 2M High Channel

2.6 Band-edge Compliance of RF Conducted Emissions

2.6.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
FCC 47 CFR Part 15, Clause 15.205
RSS-247, Clause 5.5

2.6.2 Standard Applicable

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 / Default Test Configuration

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

June 24 and June 09, 2020/XYZ

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

Ambient Temperature	22.7 - 23.2°C
Relative Humidity	53.7 - 59.0%
ATM Pressure	98.5 - 98.7kPa

2.6.7 Additional Observations

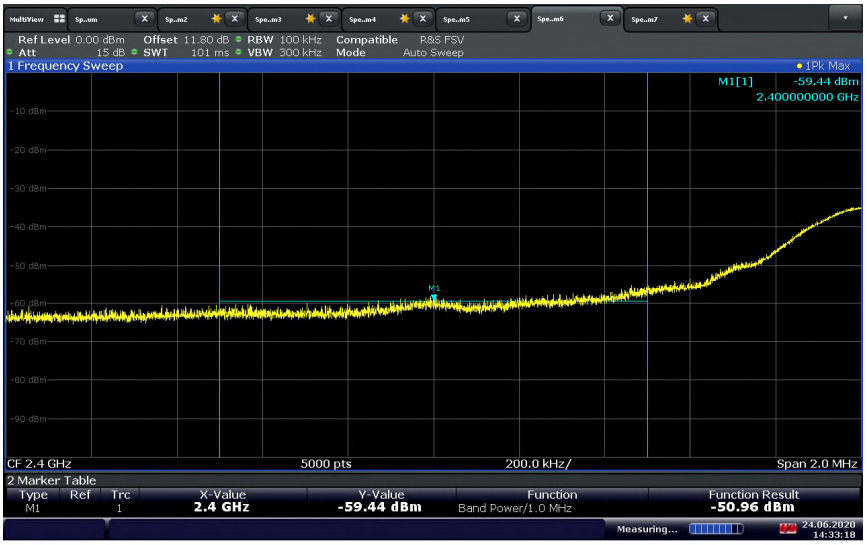
- This is both conducted and radiated test.
- For radiated testing, the spectrum was searched from 2310MHz to 2390MHz for lower immediate restricted band and 2483.5MHz to 2500MHz for the upper immediate restricted band.

  The testing was performed on one host as representative model with 2M PHY setting as the worst case configuration.

  There are no emissions found that do not comply with the restricted bands defined in FCC Part 15 Subpart C, 15.205.

- For conducted Testing, setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
  The path loss was measured and entered as a level offset.
  Test methodology is per Clause 8.7.3 of KDB 558074 D01 (DTS Meas Guidance v05r02, April 2, 2019) which refer to C63.10 Section 11.13.3.2 Peak detection and 11.13.3.2 trace averaging with continuous EUT transmission at full power.
  The highest level of the desired power in the 100 kHz bandwidth within the band were tested , Limits are 30dBc from the highest level of the desired power within the band.

2.6.8 Conducted Test Results



14:33:18 24.06.2020

BT LE 1M Low Band Edge 2400MHz (Peak Measurement) @ Ch 2402 MHz (For reference only. not in the restricted band)

14:34:39 24.06.2020

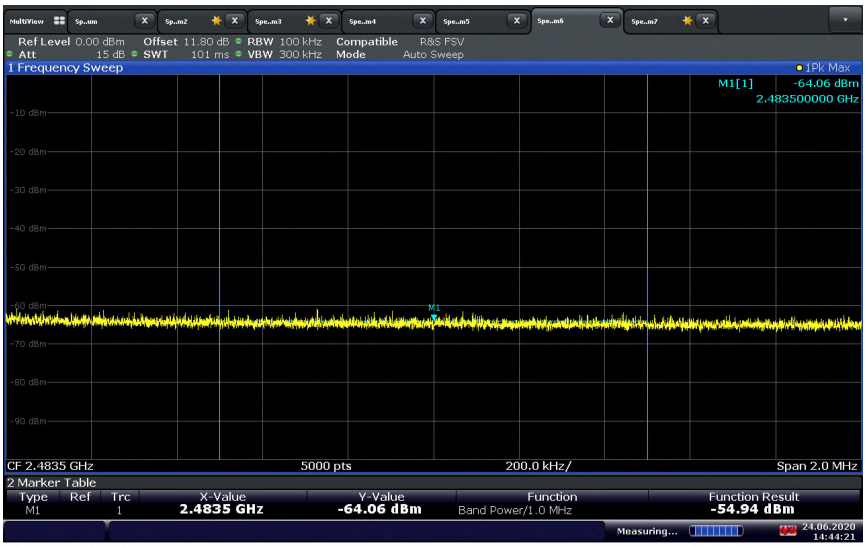
BT LE 1M Low Band Edge (Average Measurement). Limit is -33.03 dBm. Margin is -27.65 dB. (The highest level of the desired power within the band is -3.03 dBm)

14:42:38 24.06.2020

BT LE 2M Low Band Edge 2400MHz (Peak Measurement) @ Ch 2402 MHz (For reference only. not in the restricted band)

14:38:29 24.06.2020

BT LE 2M Low Band Edge (Average Measurement). Limit is -32.18 dBm. Margin is -5.44 dB. (The highest level of the desired power within the band is -2.18 dBm)



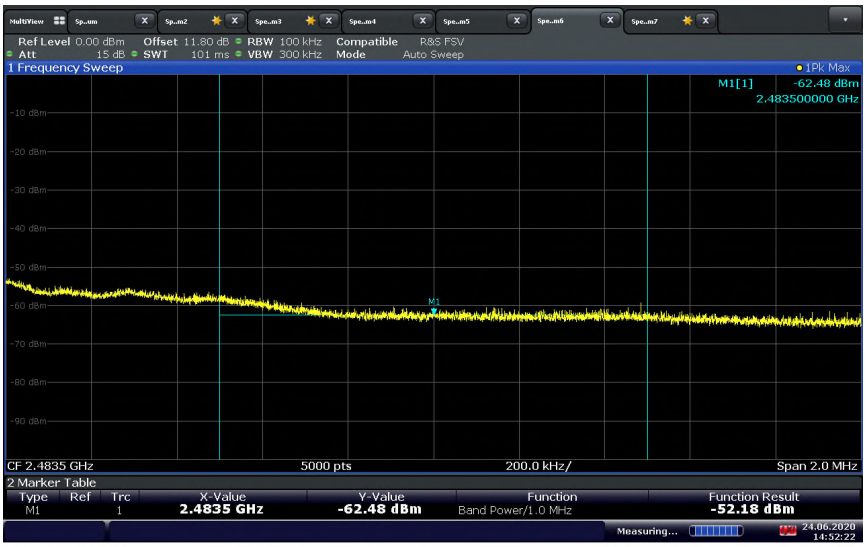
14:44:22 24.06.2020

BT LE 1M Upper Band Edge 2483.5MHz (Peak Measurement) @ Ch 2480 MHz
Limit is -32.17 dBm. Margin is -22.77 dB (The highest level of the desired power within the band is -2.17 dBm)

Upper band edge calculation (2483.5 MHz):

- 2483.5 MHz (in the restricted bands)
- Use the following formula as per Section 12.7.2 (d)(2) in C63.10: 2013:

E (dBµV/m) = EIRP (dBm) + 95.23
= (-54.94 dBm + 0.5 dBi antenna gain) + 95.23
= 40.79 dBµV/m @ 3 meters (Complies with 54 dBµV/m Average limit. Average testing is not needed)



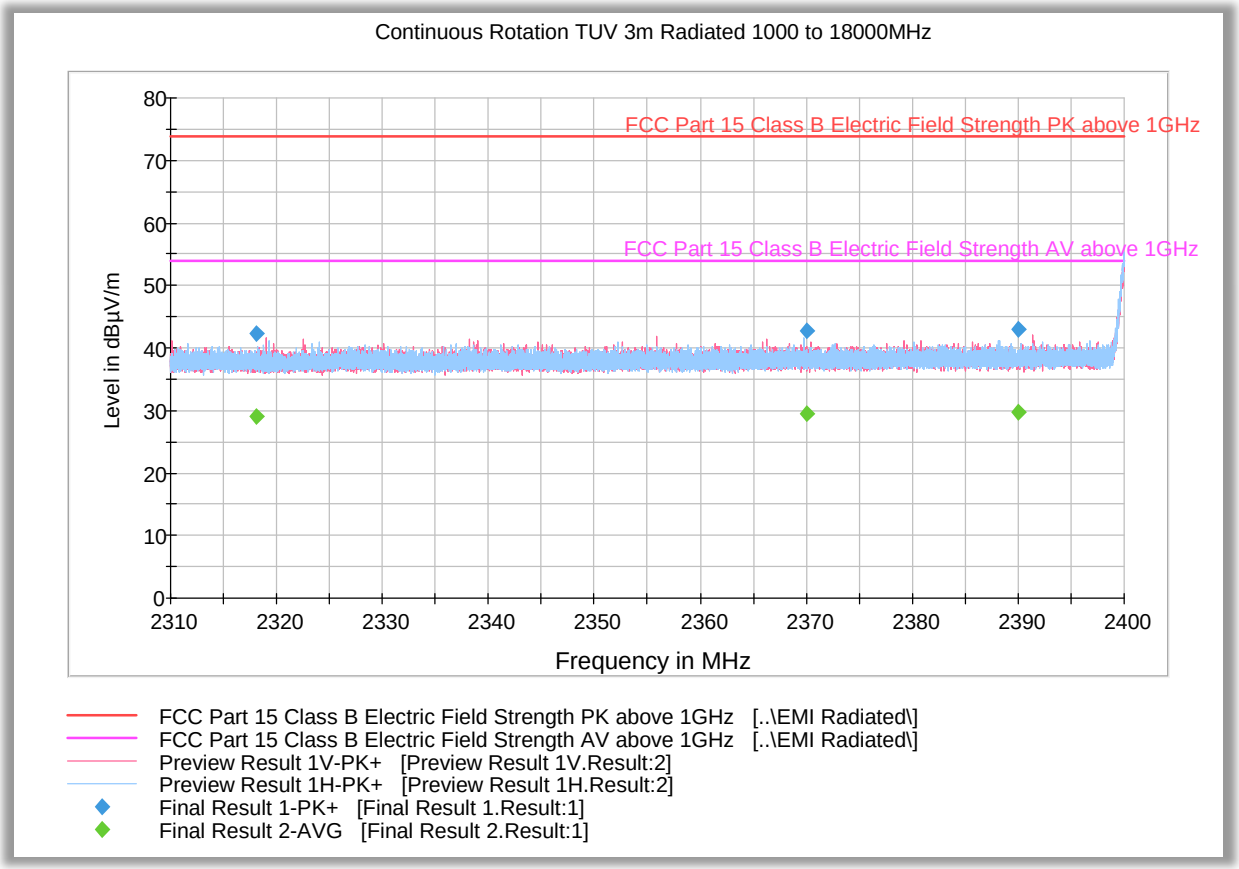
BT LE 2M Upper Band Edge 2483.5MHz (Peak Measurement) @ Ch 2480 MHz
Limit is -32.41 dBm. Margin is -19.77 dB (The highest level of the desired within the band is -2.41 dBm)

Upper band edge calculation (2483.5 MHz):

- 2483.5 MHz (in the restricted bands)
- Use the following formula as per Section 12.7.2 (d)(2) in C63.10: 2013:

E (dBµV/m) = EIRP (dBm) + 95.23
= (-52.18 dBm + 0.5 dBi antenna gain) + 95.23
= 43.55 dBµV/m @ 3 meters (Complies with 54 dBµV/m Average limit. Average testing is not needed)

2.6.9 Test Results Restricted Band 2310MHz to 2390MHz (Low Channel 2M PHY)



Peak Data

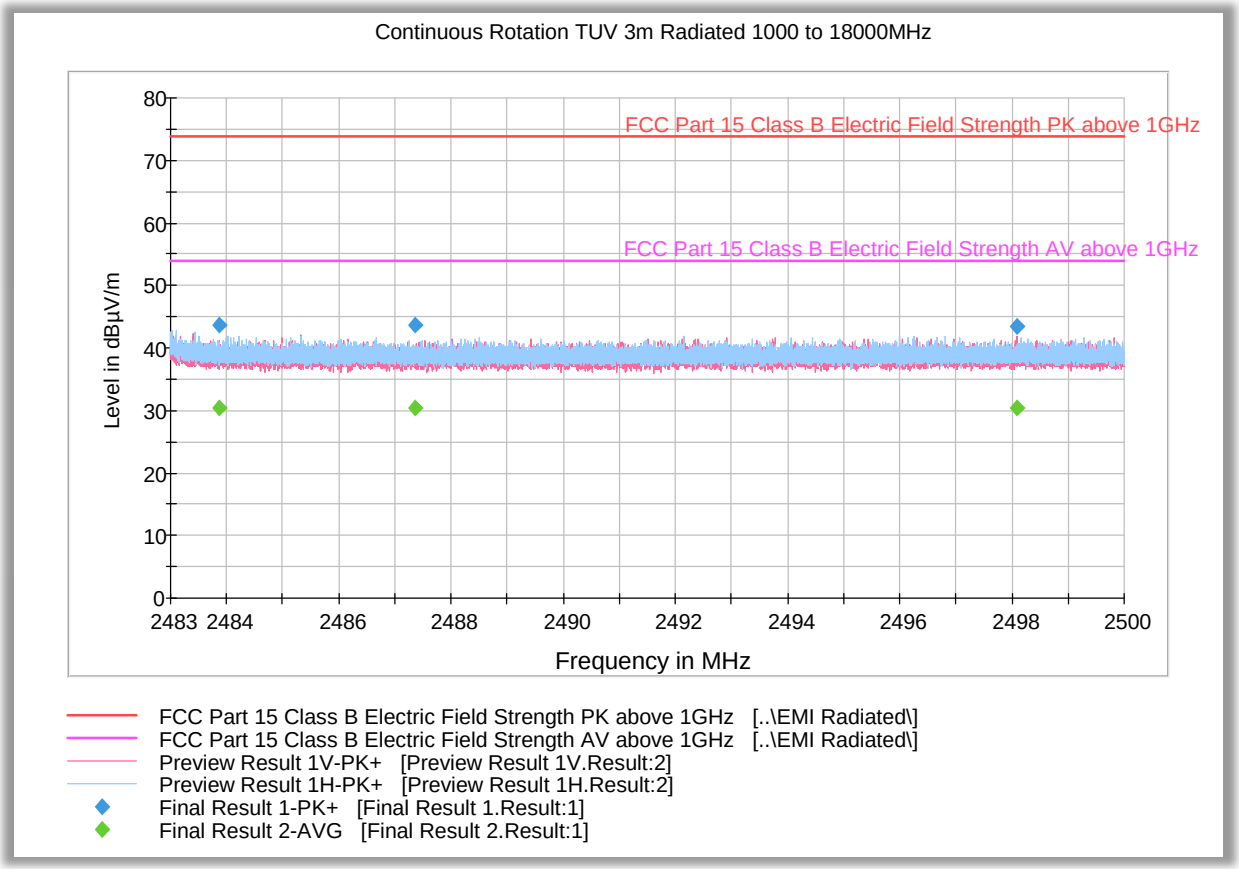
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2318.10200	42.2	1000.	1000.000	383.1	V	161.0	-1.1	31.7	73.9
2370.01700	42.8	1000.	1000.000	251.4	H	167.0	-0.8	31.1	73.9
2390.00000	42.9	1000.	1000.000	330.2	H	-4.0	-0.6	3.7	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)
2318.10200	29.1	1000.	1000.000	383.1	V	161.0	-1.1	24.8	53.9
2370.01700	29.6	1000.	1000.000	251.4	H	167.0	-0.8	24.3	53.9
2390.00000	29.7	1000.	1000.000	330.2	H	-4.0	-0.6	-9.8	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.6.10 Test Results Restricted Band 2483MHz to 2500MHz (High Channel 2M PHY)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
2483.86463	43.7	1000.	1000.000	300.2	H	204.0	0.0	30.2	73.9
2487.36463	43.7	1000.	1000.000	290.3	V	289.0	0.0	30.2	73.9
2498.08353	43.3	1000.	1000.000	178.6	V	245.0	0.0	30.6	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)
2483.86463	30.4	1000.	1000.000	300.2	H	204.0	0.0	23.5	53.9
2487.36463	30.4	1000.	1000.000	290.3	V	289.0	0.0	23.5	53.9
2498.08353	30.4	1000.	1000.000	178.6	V	245.0	0.0	23.5	53.9

Test Notes: 2.4GHz notch filter removed for this test.

2.7 Radiated Spurious Emissions

2.7.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
RSS-247, Clause 5.5

2.7.2 Standard Applicable

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 / Default Test Configuration

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

June 25, 29 and July 06, 2020/XYZ

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	22.9 - 23.4 °C
Relative Humidity	48.2 – 59.3 %
ATM Pressure	98.5 – 98.7 kPa

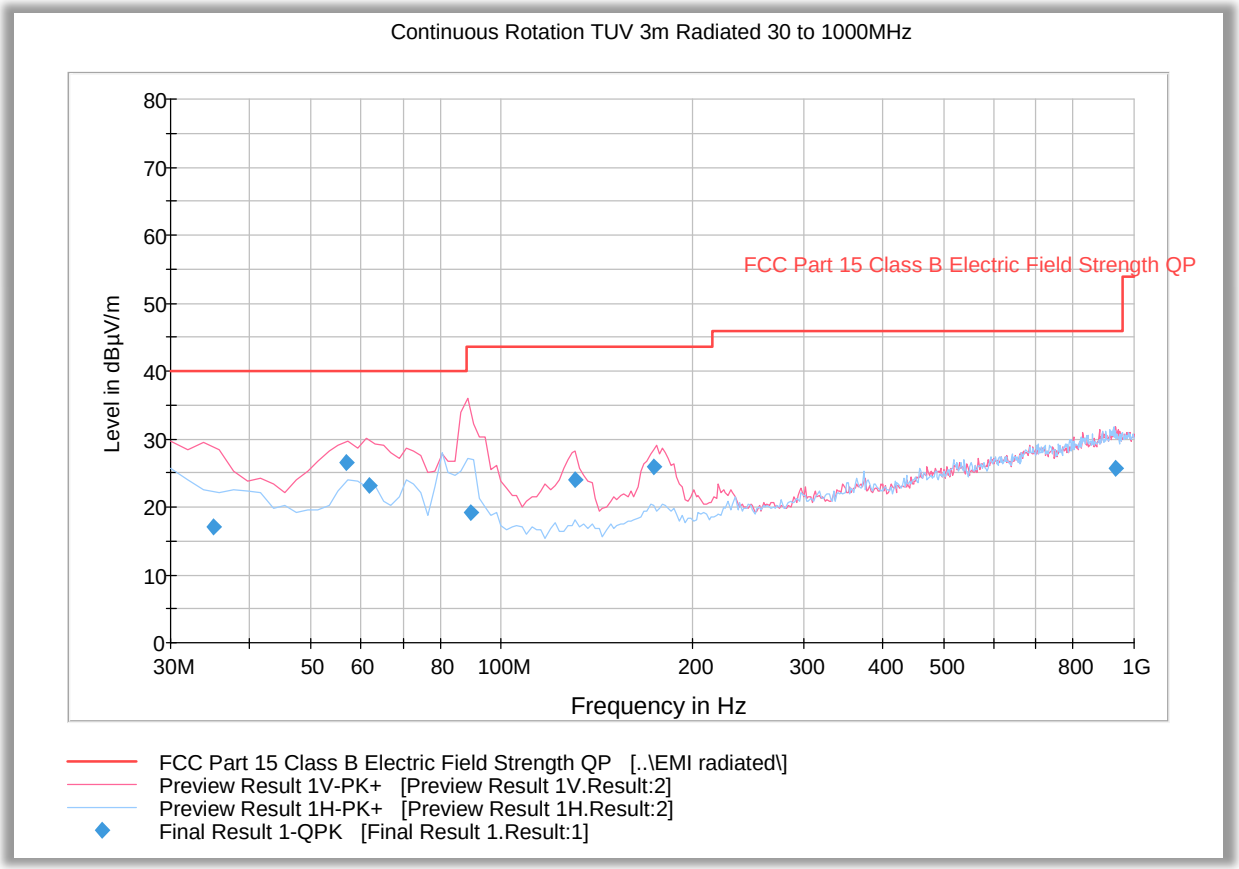
2.7.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case BLE 1M PHY (Middle Channel), and 2M PHY (Low Channel) presented for below 1GHz. There are no significant differences in emissions between all channels.
- Only noise floor measurements observed above 18GHz.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.7.8 for sample computation.

2.7.8 Sample Computation (Radiated Emission)

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

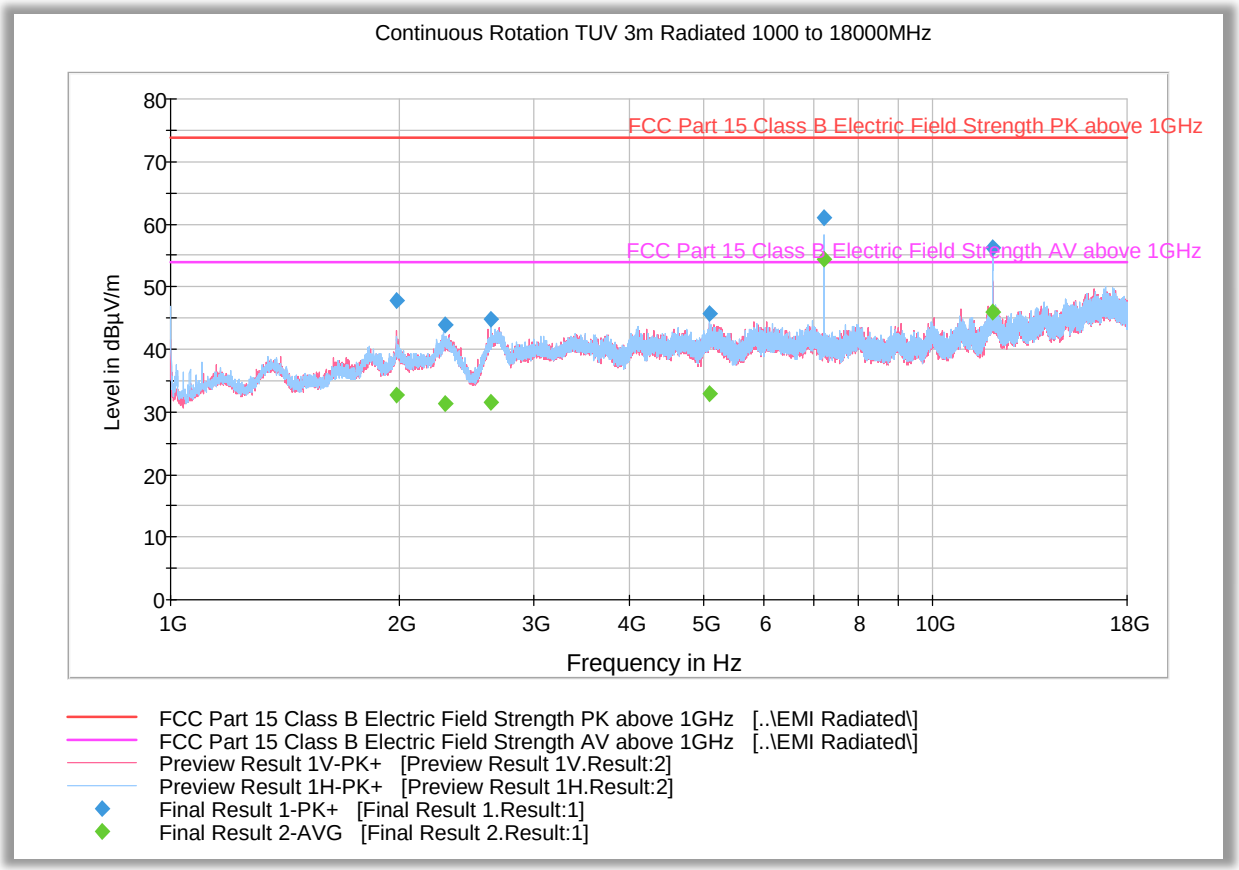
2.7.9 Worst case Test Results for Below 1GHz – Middle Channel for BT LE 1M PHY (SwingTacker host)



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)
35.047776	17.1	1000.0	120.000	100.0	V	160.0	-11.1	22.9	40.0
56.814429	26.6	1000.0	120.000	150.0	V	168.0	-15.1	13.4	40.0
61.982204	23.2	1000.0	120.000	100.0	V	310.0	-16.9	16.8	40.0
89.516633	19.3	1000.0	120.000	100.0	V	15.0	-14.9	24.2	43.5
130.738277	23.9	1000.0	120.000	100.0	V	219.0	-14.6	19.6	43.5
174.511583	25.9	1000.0	120.000	100.0	V	147.0	-11.8	17.6	43.5
936.971703	25.7	1000.0	120.000	150.0	V	344.0	5.9	20.3	46.0

2.7.10 Test Results for Above 1GHz – Low Channel for BT LE 1M PHY (SwingTacker host)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1976.16666	47.7	1000.	1000.000	116.7	V	292.0	-1.7	26.2	73.9
2288.63333	43.9	1000.	1000.000	152.2	V	211.0	-1.1	30.0	73.9
2635.20000	44.7	1000.	1000.000	252.4	H	177.0	0.6	29.2	73.9
5102.06666	45.7	1000.	1000.000	116.7	H	271.0	4.9	28.2	73.9
7205.20000	60.9	1000.	1000.000	275.3	H	111.0	7.6	13.0	73.9
12008.4333	56.1	1000.	1000.000	252.4	H	67.0	13.0	17.8	73.9

Average Data

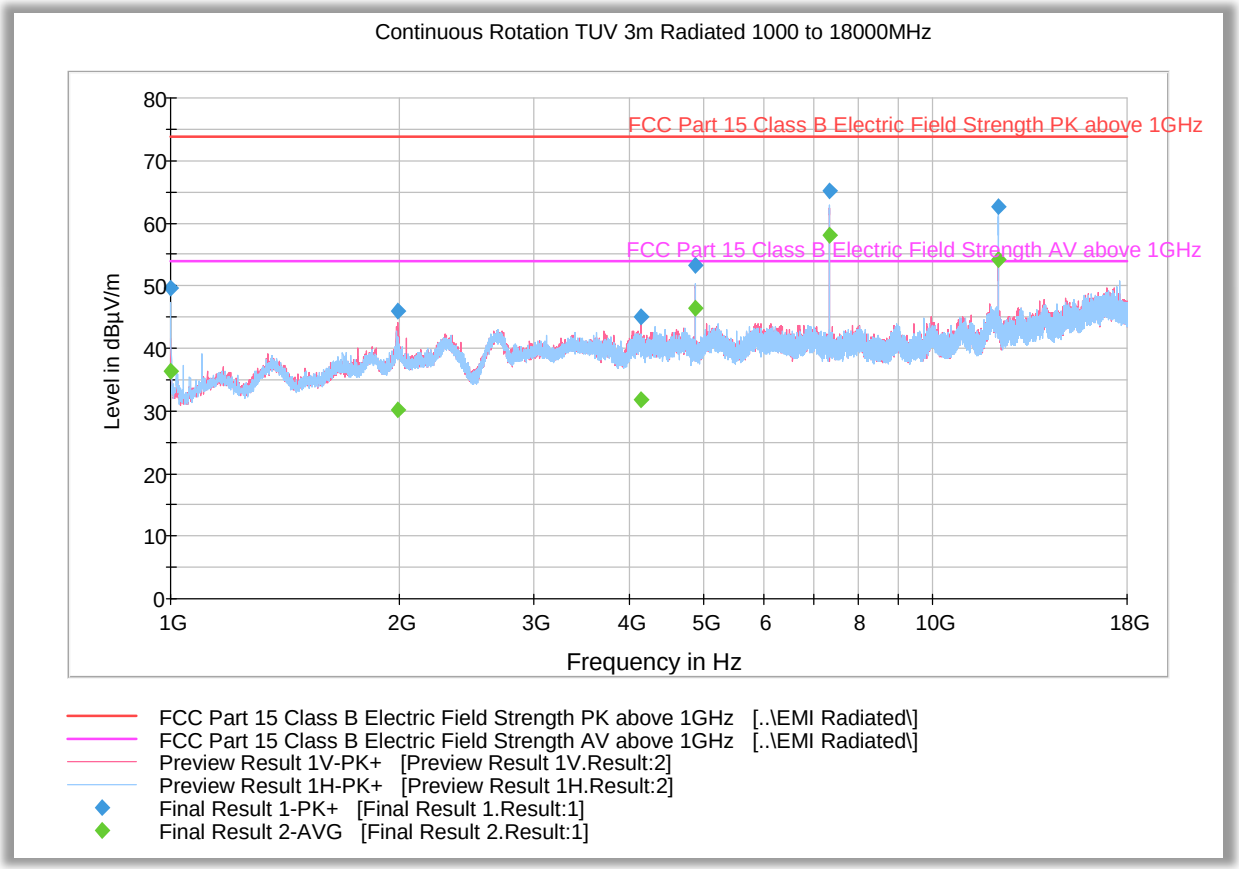
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1976.16666	32.6	1000.	1000.000	116.7	V	292.0	-1.7	21.3	53.9
2288.63333	31.2	1000.	1000.000	152.2	V	211.0	-1.1	22.7	53.9
2635.20000	31.6	1000.	1000.000	252.4	H	177.0	0.6	22.3	53.9
5102.06666	32.9	1000.	1000.000	116.7	H	271.0	4.9	21.0	53.9
7205.20000	54.5	1000.	1000.000	275.3	H	111.0	7.6	-0.6*	53.9
12008.4333	46.1	1000.	1000.000	252.4	H	67.0	13.0	7.8	53.9

Test Notes:

* The max. duty cycle of the EUT is 42.4%, and the duty cycle correction factor is -7.45 dB. The spurious emission passes the limit after application of duty cycle correction.

Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.11 Test Results for Above 1GHz - Middle Channel for BT LE 1M PHY (SwingTacker host)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	49.5	1000.	1000.000	102.8	H	11.0	-7.4	24.4	73.9
1987.33333	45.9	1000.	1000.000	244.4	V	107.0	-1.6	28.0	73.9
4136.63333	45.1	1000.	1000.000	295.3	V	251.0	4.2	28.8	73.9
4880.40000	53.3	1000.	1000.000	302.2	H	182.0	4.6	20.6	73.9
7319.10000	65.2	1000.	1000.000	166.6	H	104.0	7.7	8.7	73.9
12201.1000	62.5	1000.	1000.000	179.6	H	100.0	12.9	11.4	73.9

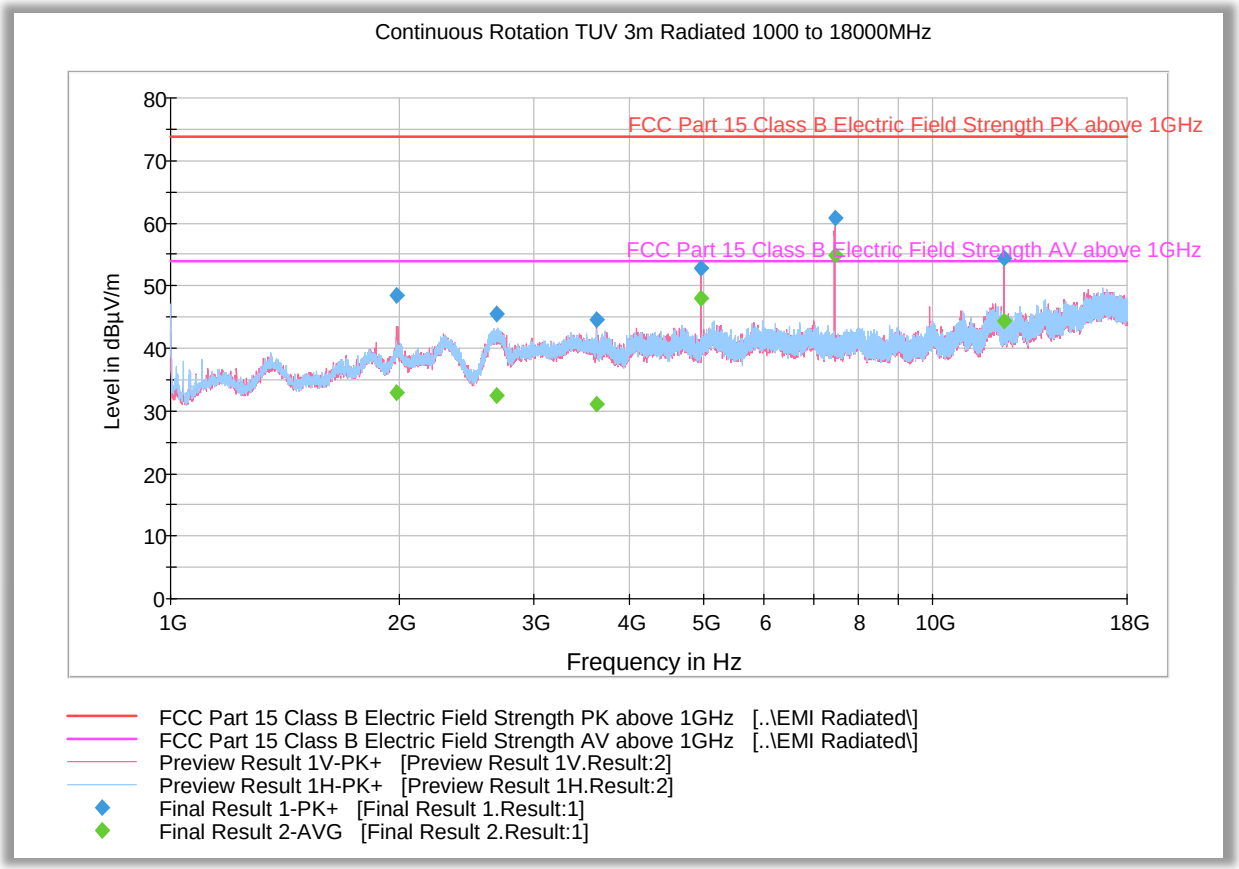
Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	36.4	1000.	1000.000	102.8	H	11.0	-7.4	17.5	53.9
1987.33333	30.1	1000.	1000.000	244.4	V	107.0	-1.6	23.8	53.9
4136.63333	31.7	1000.	1000.000	295.3	V	251.0	4.2	22.2	53.9
4880.40000	46.5	1000.	1000.000	302.2	H	182.0	4.6	7.4	53.9
7319.10000	58.0	1000.	1000.000	166.6	H	104.0	7.7	-4.1*	53.9
12201.1000	54.2	1000.	1000.000	179.6	H	100.0	12.9	-0.3	53.9

Test Notes:
* The max. duty cycle of the EUT is 42.4%, and the duty cycle correction factor is -7.45 dB. The spurious emission passes the limit after duty cycle correction applies.

Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.12 Test Results for Above 1GHz - High Channel for BT LE 1M PHY (SwingTacker host)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1976.16666	48.3	1000.	1000.000	178.6	V	273.0	-1.7	25.6	73.9
2678.60000	45.4	1000.	1000.000	251.5	V	83.0	0.5	28.5	73.9
3628.96666	44.7	1000.	1000.000	337.2	V	50.0	2.9	29.2	73.9
4959.83333	52.8	1000.	1000.000	202.5	V	249.0	4.6	21.1	73.9
7440.53333	60.8	1000.	1000.000	186.6	V	327.0	7.8	13.1	73.9
12401.1333	54.5	1000.	1000.000	315.2	V	293.0	12.5	19.4	73.9

Average Data

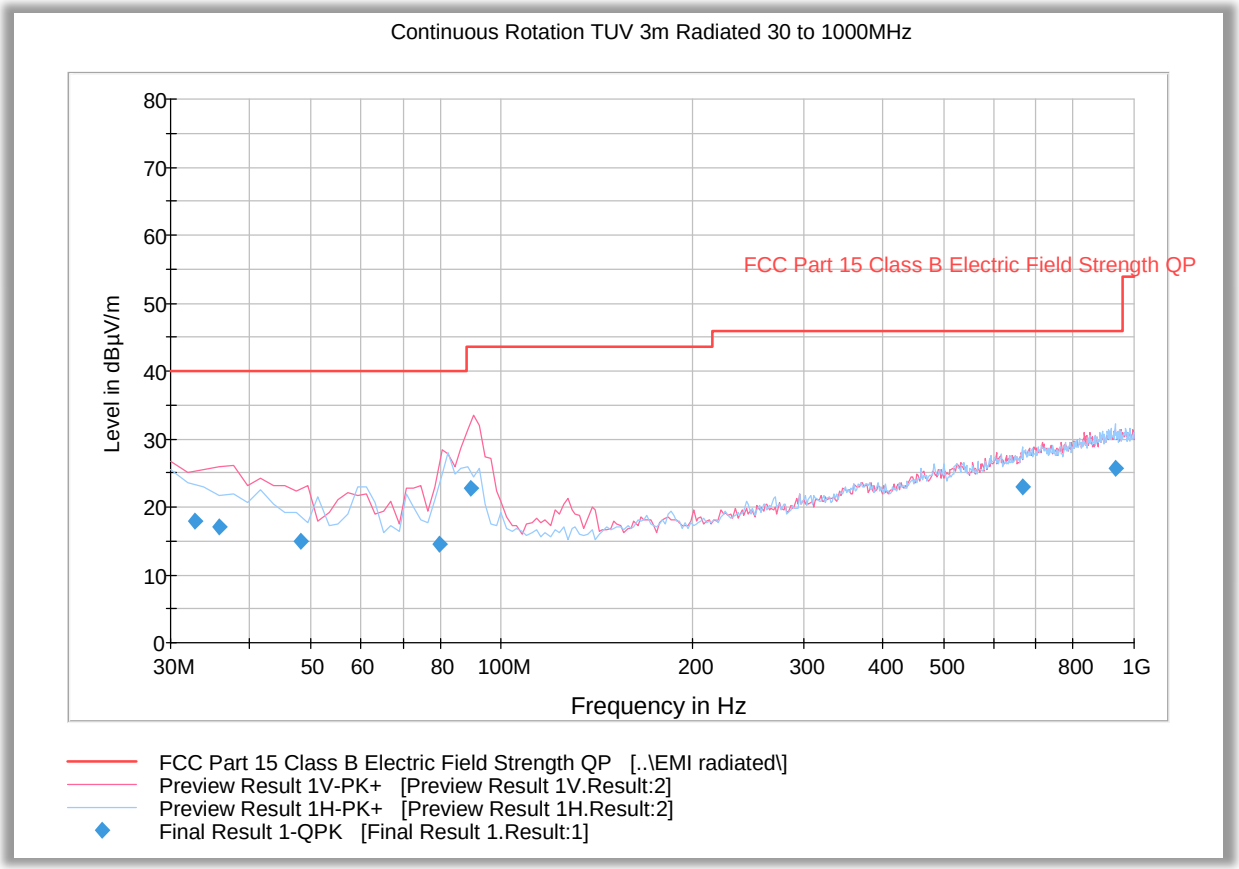
Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1976.16666	32.9	1000.	1000.000	178.6	V	273.0	-1.7	21.0	53.9
2678.60000	32.5	1000.	1000.000	251.5	V	83.0	0.5	21.4	53.9
3628.96666	31.1	1000.	1000.000	337.2	V	50.0	2.9	22.8	53.9
4959.83333	47.9	1000.	1000.000	202.5	V	249.0	4.6	6.0	53.9
7440.53333	54.8	1000.	1000.000	186.6	V	327.0	7.8	-0.9*	53.9
12401.1333	44.3	1000.	1000.000	315.2	V	293.0	12.5	9.6	53.9

Test Notes:

* The max. duty cycle of the EUT is 42.4%, and the duty cycle correction factor is -7.45 dB. The spurious emission passes the limit after duty cycle correction applies.

Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

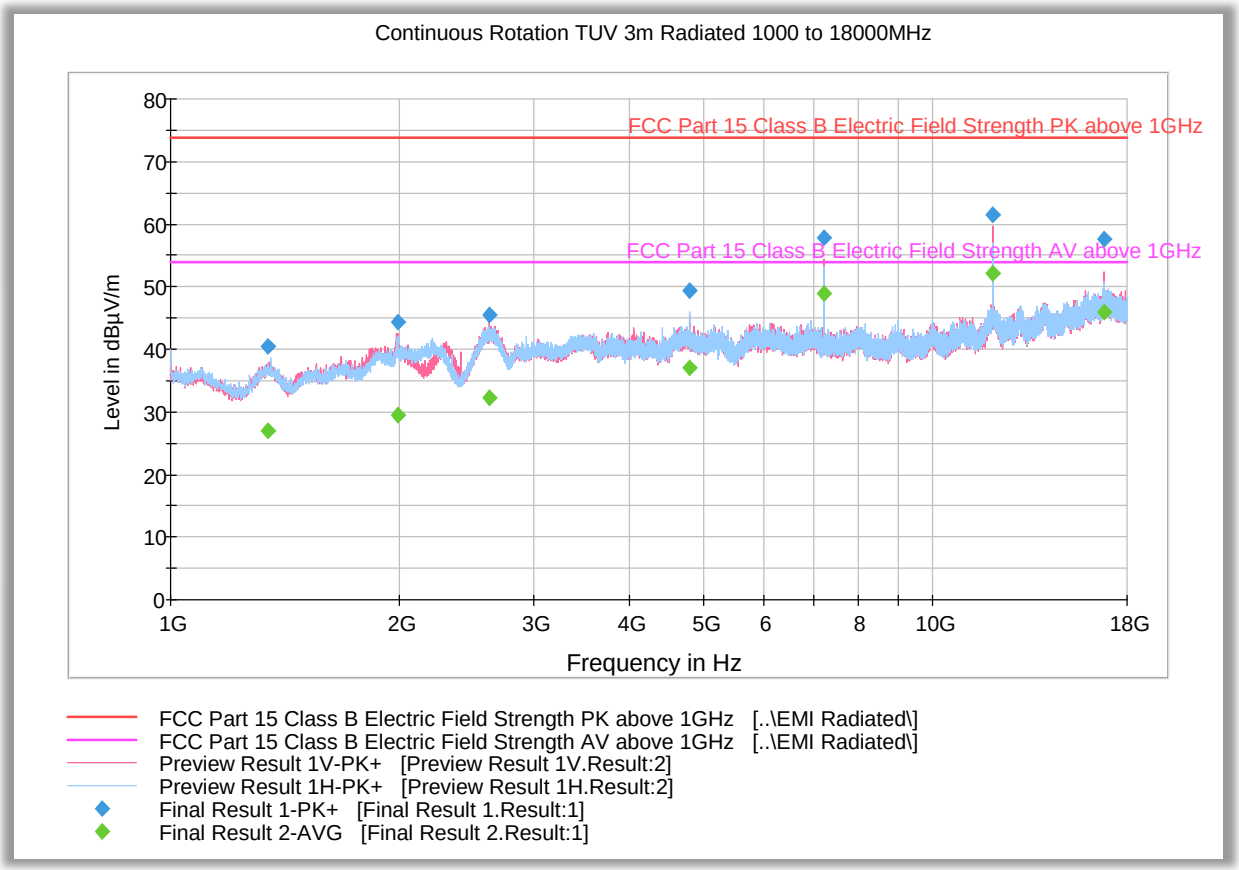
2.7.13 Worst case Test Results for Below 1GHz – Low Channel for BT LE 2M PHY (PitchTracker Baseball host)



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)
32.840000	17.9	1000.0	120.000	100.0	V	46.0	-9.5	22.1	40.0
35.855551	17.1	1000.0	120.000	105.0	V	245.0	-11.6	22.9	40.0
48.078878	15.0	1000.0	120.000	100.0	V	263.0	-14.1	25.0	40.0
79.981082	14.5	1000.0	120.000	400.0	V	342.0	-16.8	25.5	40.0
89.660521	22.8	1000.0	120.000	100.0	V	-10.0	-14.9	20.7	43.5
667.211303	22.9	1000.0	120.000	143.0	H	155.0	1.9	23.1	46.0
935.187816	25.7	1000.0	120.000	364.0	H	249.0	5.9	20.3	46.0

2.7.14 Test Results for Above 1GHz – Low Channel for BT LE 2M PHY (PitchTracker Baseball host)



Peak Data

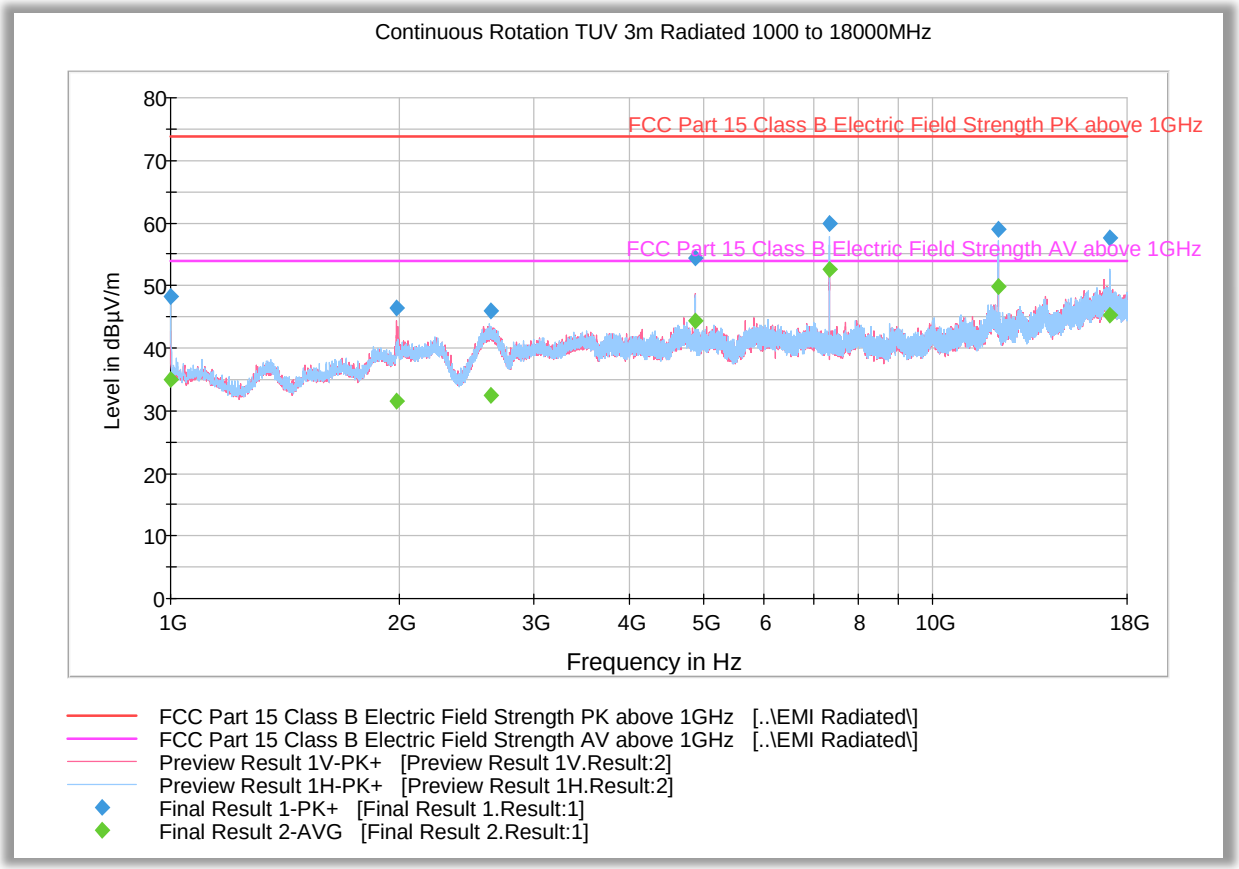
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1340.40000	40.5	1000.	1000.000	152.2	V	19.0	-5.6	33.4	73.9
1984.10000	44.2	1000.	1000.000	151.2	H	-13.0	-1.6	29.7	73.9
2615.53333	45.5	1000.	1000.000	218.4	H	0.0	0.5	28.4	73.9
4805.00000	49.3	1000.	1000.000	300.2	H	136.0	4.9	24.6	73.9
7204.23333	57.8	1000.	1000.000	185.6	V	149.0	7.6	16.1	73.9
12007.3000	61.5	1000.	1000.000	243.4	V	129.0	13.0	12.4	73.9
16817.2000	57.7	1000.	1000.000	147.7	V	215.0	17.8	16.2	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)
1340.40000	27.0	1000.	1000.000	152.2	V	19.0	-5.6	26.9	53.9
1984.10000	29.4	1000.	1000.000	151.2	H	-13.0	-1.6	24.5	53.9
2615.53333	32.3	1000.	1000.000	218.4	H	0.0	0.5	21.6	53.9
4805.00000	37.1	1000.	1000.000	300.2	H	136.0	4.9	16.8	53.9
7204.23333	48.8	1000.	1000.000	185.6	V	149.0	7.6	5.1	53.9
12007.3000	52.2	1000.	1000.000	243.4	V	129.0	13.0	1.7	53.9
16817.2000	46.0	1000.	1000.000	147.7	V	215.0	17.8	7.9	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.15 Test Results for Above 1GHz - Middle Channel for BT LE 2M PHY (PitchTracker Baseball host)



Peak Data

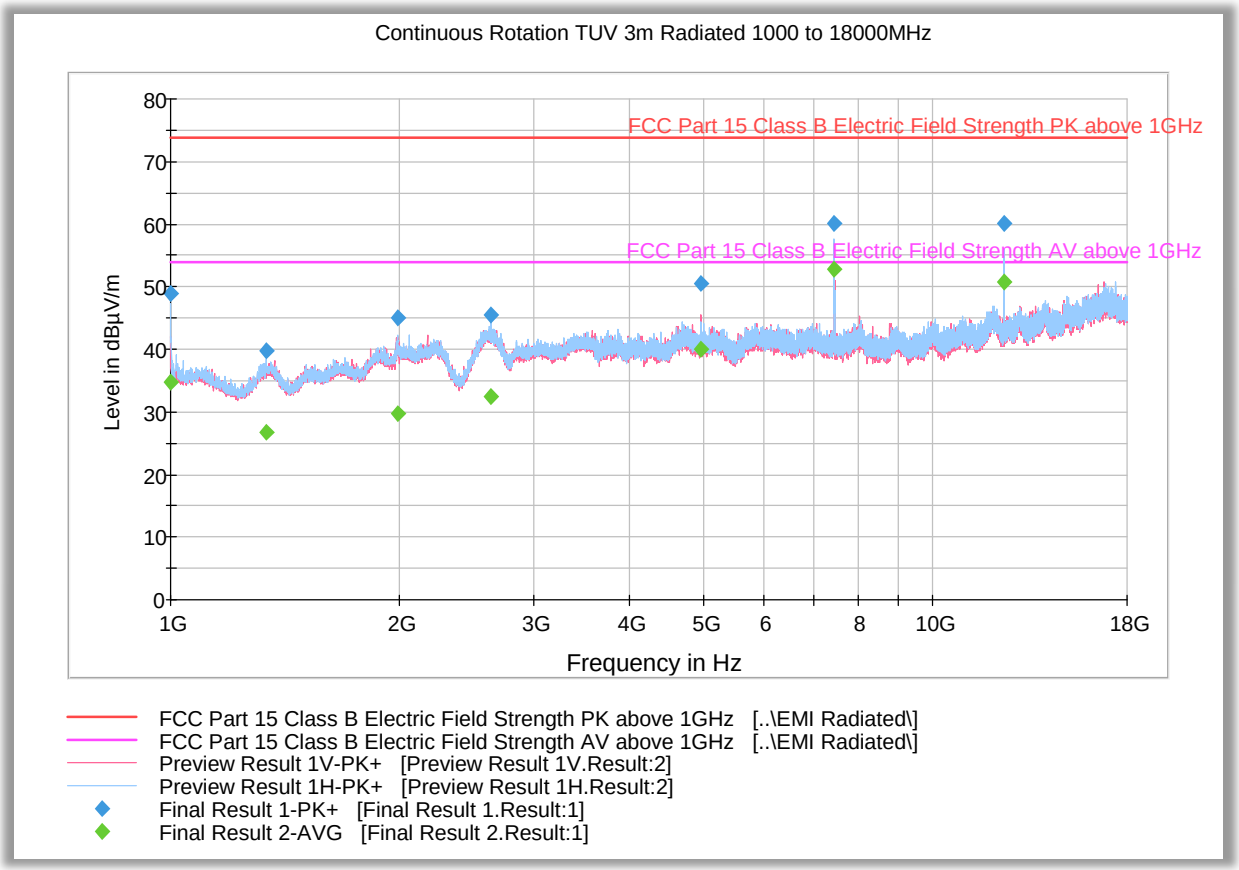
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	48.2	1000.	1000.000	279.3	H	267.0	-7.4	25.7	73.9
1976.00000	46.5	1000.	1000.000	116.7	V	216.0	-1.7	27.4	73.9
2626.73333	45.9	1000.	1000.000	388.0	H	354.0	0.5	28.0	73.9
4881.13333	54.4	1000.	1000.000	203.5	V	56.0	4.6	19.5	73.9
7318.53333	59.8	1000.	1000.000	113.7	H	185.0	7.7	14.1	73.9
12202.2333	59.1	1000.	1000.000	220.4	H	37.0	12.9	14.8	73.9
17076.3000	57.6	1000.	1000.000	342.1	H	204.0	18.0	16.3	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)
1000.00000	34.9	1000.	1000.000	279.3	H	267.0	-7.4	19.0	53.9
1976.00000	31.6	1000.	1000.000	116.7	V	216.0	-1.7	22.3	53.9
2626.73333	32.4	1000.	1000.000	388.0	H	354.0	0.5	21.5	53.9
4881.13333	44.2	1000.	1000.000	203.5	V	56.0	4.6	9.7	53.9
7318.53333	52.6	1000.	1000.000	113.7	H	185.0	7.7	1.3	53.9
12202.2333	49.8	1000.	1000.000	220.4	H	37.0	12.9	4.1	53.9
17076.3000	45.3	1000.	1000.000	342.1	H	204.0	18.0	8.6	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.16 Test Results for Above 1GHz - High Channel for BT LE 2M PHY (Pitch Tracker Baseball host)



Peak Data

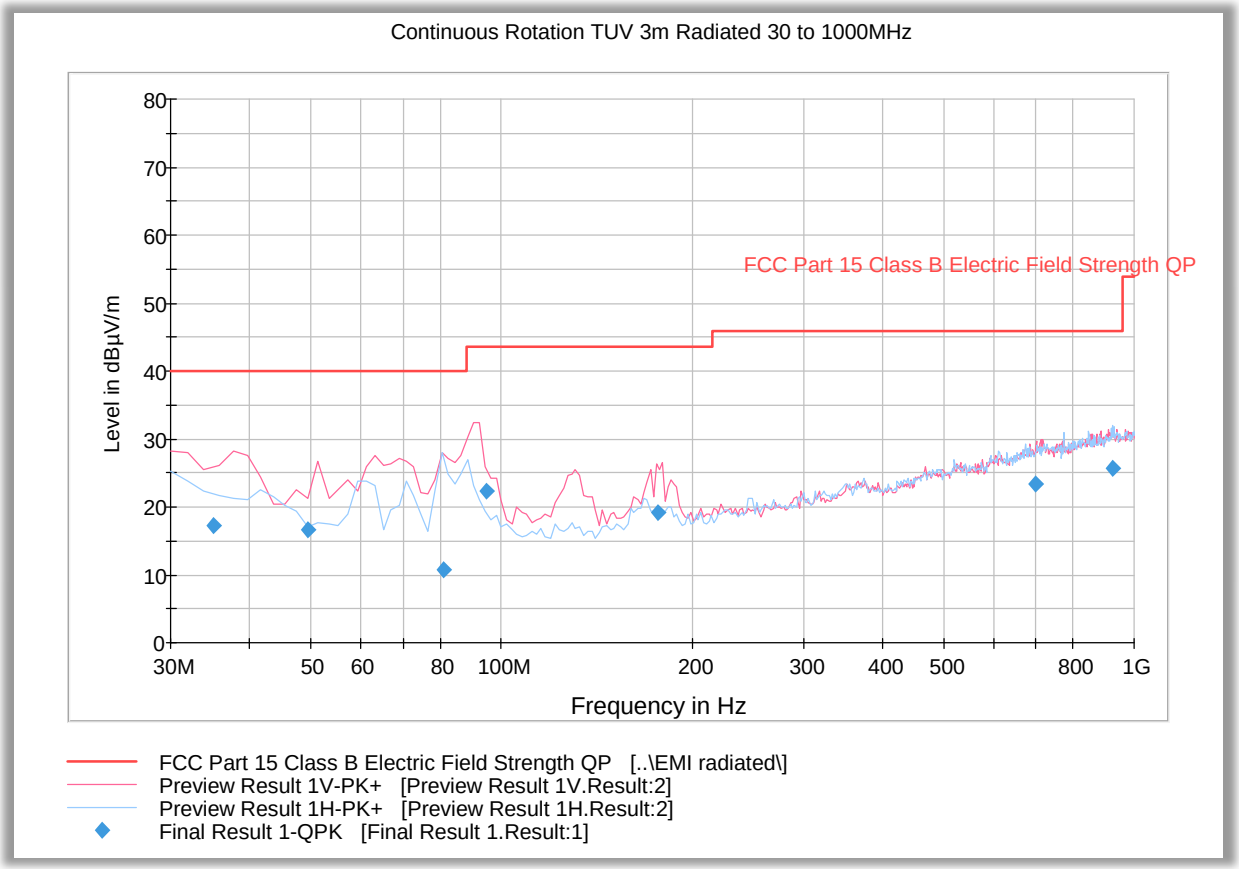
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.40000	48.9	1000.	1000.000	289.3	H	-1.0	-7.4	25.0	73.9
1333.76666	39.8	1000.	1000.000	347.1	V	234.0	-5.6	34.1	73.9
1983.93333	45.0	1000.	1000.000	304.2	H	-13.0	-1.6	28.9	73.9
2631.96666	45.4	1000.	1000.000	147.7	H	19.0	0.5	28.5	73.9
4961.03333	50.5	1000.	1000.000	178.6	V	57.0	4.6	23.4	73.9
7438.26666	60.1	1000.	1000.000	170.6	H	185.0	7.8	13.8	73.9
12402.2666	60.0	1000.	1000.000	309.2	H	177.0	12.5	13.9	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)
1000.40000	34.8	1000.	1000.000	289.3	H	-1.0	-7.4	19.1	53.9
1333.76666	26.8	1000.	1000.000	347.1	V	234.0	-5.6	27.1	53.9
1983.93333	29.7	1000.	1000.000	304.2	H	-13.0	-1.6	24.2	53.9
2631.96666	32.4	1000.	1000.000	147.7	H	19.0	0.5	21.5	53.9
4961.03333	39.9	1000.	1000.000	178.6	V	57.0	4.6	14.0	53.9
7438.26666	52.9	1000.	1000.000	170.6	H	185.0	7.8	1.0	53.9
12402.2666	50.8	1000.	1000.000	309.2	H	177.0	12.5	3.1	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

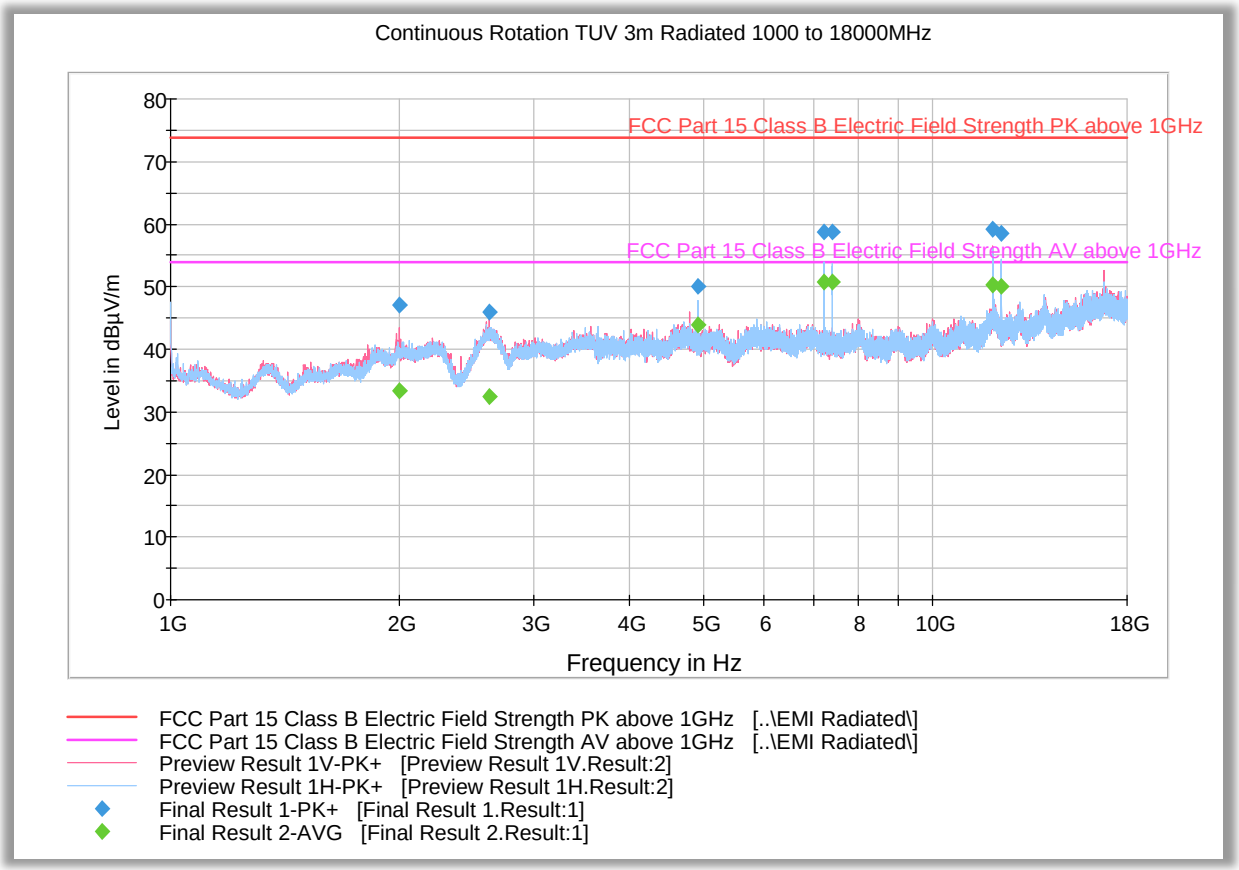
2.7.17 Worst case Test Results for Below 1GHz – Low Channel for BT LE 2M PHY (PitchTracker Softball host)



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)
35.015551	17.3	1000.0	120.000	100.0	V	15.0	-11.1	22.7	40.0
49.462766	16.7	1000.0	120.000	109.0	V	253.0	-14.3	23.3	40.0
81.061082	10.7	1000.0	120.000	350.0	H	-15.0	-16.8	29.3	40.0
94.644409	22.3	1000.0	120.000	115.0	V	-2.0	-13.2	21.2	43.5
176.455471	19.1	1000.0	120.000	100.0	V	309.0	-11.9	24.4	43.5
699.361283	23.4	1000.0	120.000	105.0	V	197.0	2.5	22.6	46.0
926.268377	25.7	1000.0	120.000	365.0	H	260.0	6.0	20.3	46.0

2.7.18 Test Results for Above 1GHz – Low Channel for BT LE 2M PHY (PitchTracker Softball host)



Peak Data

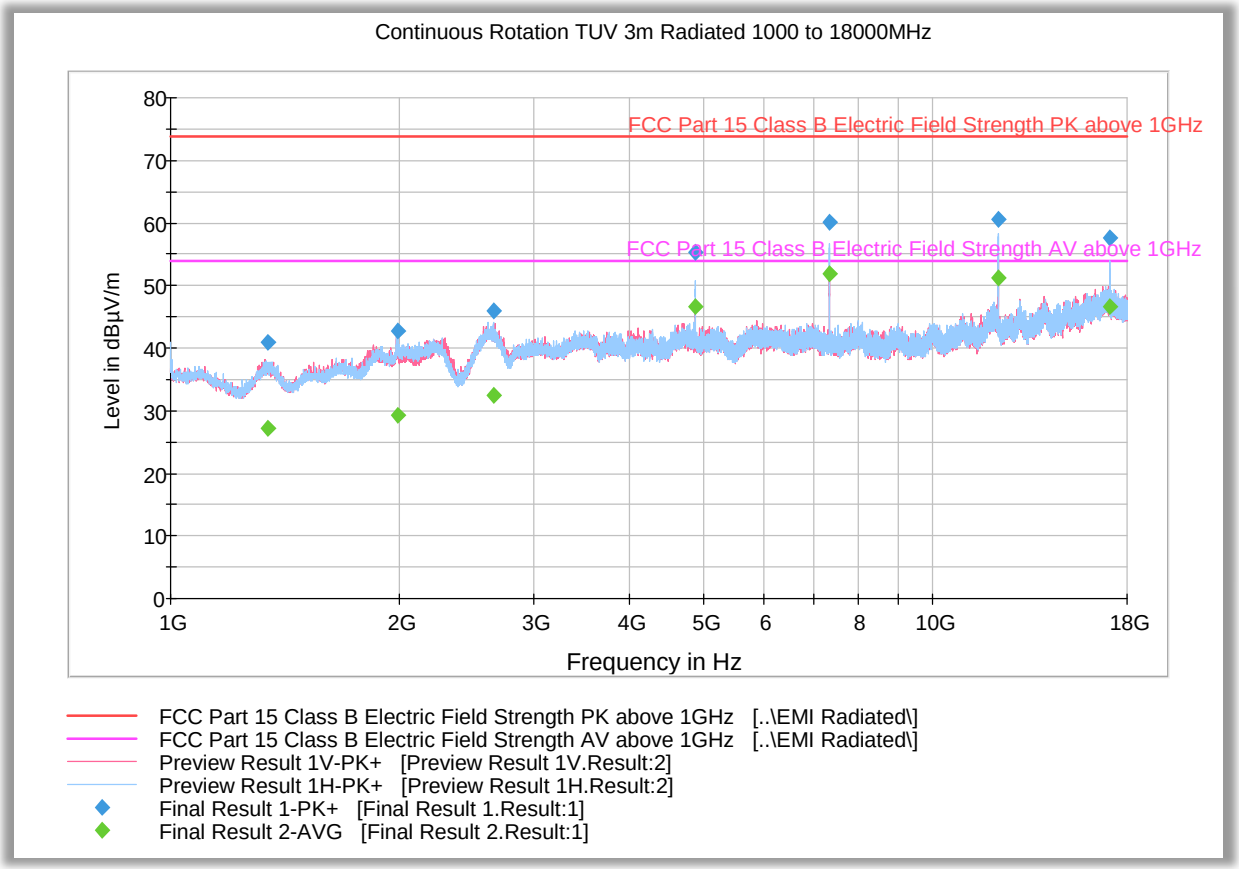
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1993.60000	47.2	1000.	1000.000	187.6	V	-1.0	-1.6	26.8	73.9
2624.83333	45.8	1000.	1000.000	216.5	V	333.0	0.5	28.1	73.9
4930.76666	50.0	1000.	1000.000	153.7	H	260.0	4.6	27.9	73.9
7205.43333	58.8	1000.	1000.000	251.4	H	184.0	7.6	15.1	73.9
7396.33333	58.7	1000.	1000.000	152.2	H	159.0	7.9	15.2	73.9
12012.8000	59.3	1000.	1000.000	103.7	V	89.0	13.0	14.6	73.9
12327.6666	58.5	1000.	1000.000	178.6	H	140.0	12.6	15.4	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)
1993.60000	33.4	1000.	1000.000	187.6	V	-1.0	-1.6	20.5	53.9
2624.83333	32.5	1000.	1000.000	216.5	V	333.0	0.5	21.4	53.9
4930.76666	43.9	1000.	1000.000	153.7	H	260.0	4.6	10.0	53.9
7205.43333	50.8	1000.	1000.000	251.4	H	184.0	7.6	3.1	53.9
7396.33333	50.6	1000.	1000.000	152.2	H	159.0	7.9	3.3	53.9
12012.8000	50.4	1000.	1000.000	103.7	V	89.0	13.0	3.5	53.9
12327.6666	50.1	1000.	1000.000	178.6	H	140.0	12.6	3.8	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.19 Test Results for Above 1GHz - Middle Channel for BT LE 2M PHY (PitchTracker Softball host)



Peak Data

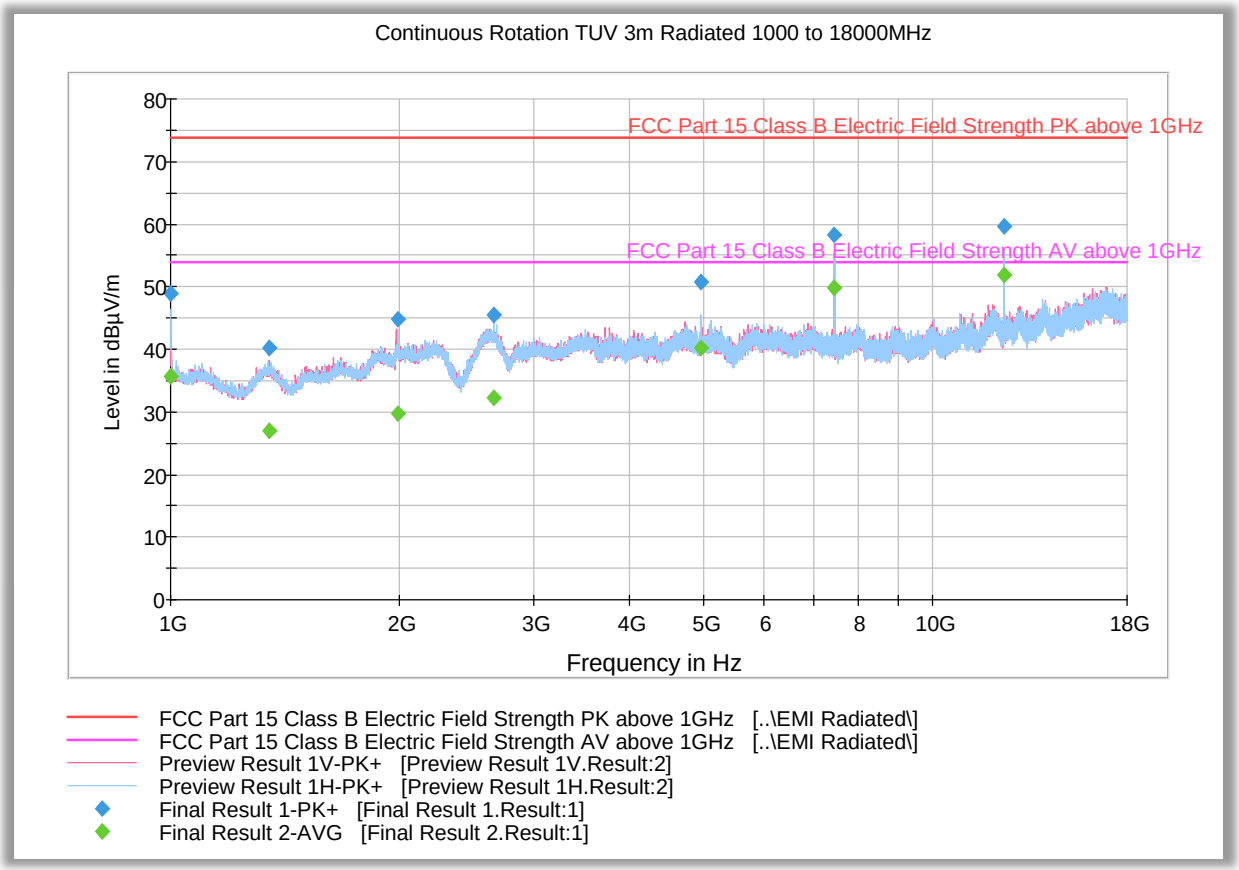
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1340.93333	41.0	1000.	1000.000	152.2	H	136.0	-5.6	32.9	73.9
1986.93333	42.8	1000.	1000.000	406.7	V	10.0	-1.6	31.1	73.9
2649.36666	45.8	1000.	1000.000	152.6	H	177.0	0.6	28.1	73.9
4880.73333	55.3	1000.	1000.000	143.7	H	196.0	4.6	18.6	73.9
7321.36666	60.0	1000.	1000.000	366.1	H	140.0	7.7	13.9	73.9
12197.1333	60.6	1000.	1000.000	352.1	H	80.0	12.9	13.3	73.9
17076.5333	57.7	1000.	1000.000	252.5	H	101.0	18.0	16.2	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)
1340.93333	27.2	1000.	1000.000	152.2	H	136.0	-5.6	26.7	53.9
1986.93333	29.2	1000.	1000.000	406.7	V	10.0	-1.6	24.7	53.9
2649.36666	32.5	1000.	1000.000	152.6	H	177.0	0.6	21.4	53.9
4880.73333	46.6	1000.	1000.000	143.7	H	196.0	4.6	7.3	53.9
7321.36666	51.8	1000.	1000.000	366.1	H	140.0	7.7	2.1	53.9
12197.1333	51.2	1000.	1000.000	352.1	H	80.0	12.9	2.7	53.9
17076.5333	46.7	1000.	1000.000	252.5	H	101.0	18.0	7.2	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.7.20 Test Results for Above 1GHz - High Channel for BT LE 2M PHY (PitchTracker Softball host)



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.00000	49.0	1000.	1000.000	279.3	H	120.0	-7.4	24.9	73.9
1344.56666	40.1	1000.	1000.000	366.1	V	230.0	-5.6	33.8	73.9
1985.40000	44.8	1000.	1000.000	279.3	H	12.0	-1.6	29.1	73.9
2654.46666	45.5	1000.	1000.000	120.7	H	3.0	0.6	28.4	73.9
4958.93333	50.8	1000.	1000.000	123.7	H	226.0	4.6	23.1	73.9
7438.26666	58.3	1000.	1000.000	153.2	H	159.0	7.8	15.6	73.9
12397.5666	59.7	1000.	1000.000	366.1	H	114.0	12.5	14.2	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)
1000.00000	35.7	1000.	1000.000	279.3	H	120.0	-7.4	18.2	53.9
1344.56666	27.0	1000.	1000.000	366.1	V	230.0	-5.6	26.9	53.9
1985.40000	29.6	1000.	1000.000	279.3	H	12.0	-1.6	24.3	53.9
2654.46666	32.2	1000.	1000.000	120.7	H	3.0	0.6	21.7	53.9
4958.93333	40.3	1000.	1000.000	123.7	H	226.0	4.6	13.6	53.9
7438.26666	49.9	1000.	1000.000	153.2	H	159.0	7.8	4.0	53.9
12397.5666	51.8	1000.	1000.000	366.1	H	114.0	12.5	2.1	53.9

Test Notes: Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures.

2.8 Power Spectral Density

2.8.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(e)
RSS-247, Clause 5.2(b)

2.8.2 Standard Applicable

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: N/A / Default Test Configuration

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

July 06, 2020/XYZ

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

Ambient Temperature	23.4°C
Relative Humidity	48.2%
ATM Pressure	98.6kPa

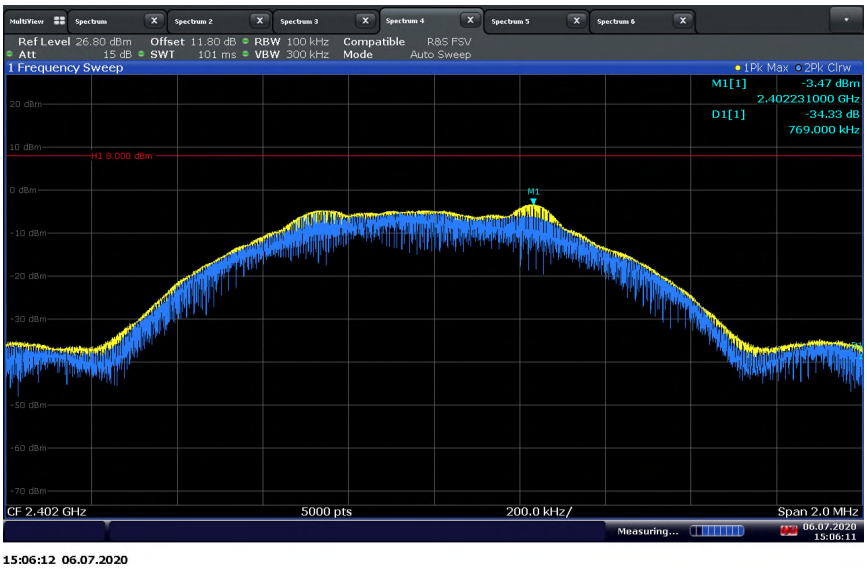
2.8.7 Additional Observations

- This is a conducted test.
- Test procedure is 11.10 of ANSI C63.10 2013 per Section 8.4 of KDB558075 D01 v05r02.
- The path loss for was measured and entered as a level offset
- Set span to at least 1.5 times the OBW
- Set RBW to 3 kHz ≤ RBW ≤ 100 kHz
- VBW ≥ 3 x RBW
- Detector is peak.
- Trace is max hold.
- Sweep time is auto.
- EUT complies with 100 kHz RBW.

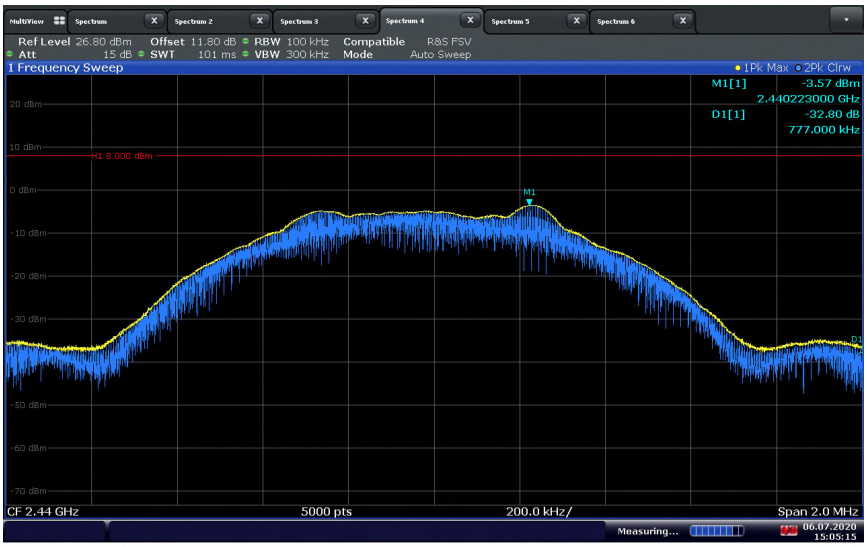
2.8.8 Test Results Summary

Mode	Channel	Modulation	PSD using 100 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
Bluetooth LE	37 (2402 MHz)	GFSK @ LE 1M	-3.47	8	11.47	Complies
		GFSK @ LE 2M	-4.63	8	12.63	Complies
	17 (2440 MHz)	GFSK @ LE 1M	-3.57	8	11.57	Complies
		GFSK @ LE 2M	-4.50	8	12.50	Complies
	39 (2480 MHz)	GFSK @ LE 1M	-3.83	8	11.83	Complies
		GFSK @ LE 2M	-4.85	8	12.85	Complies

2.8.9 Test Results Plots



Bluetooth LE 1M Low Channel



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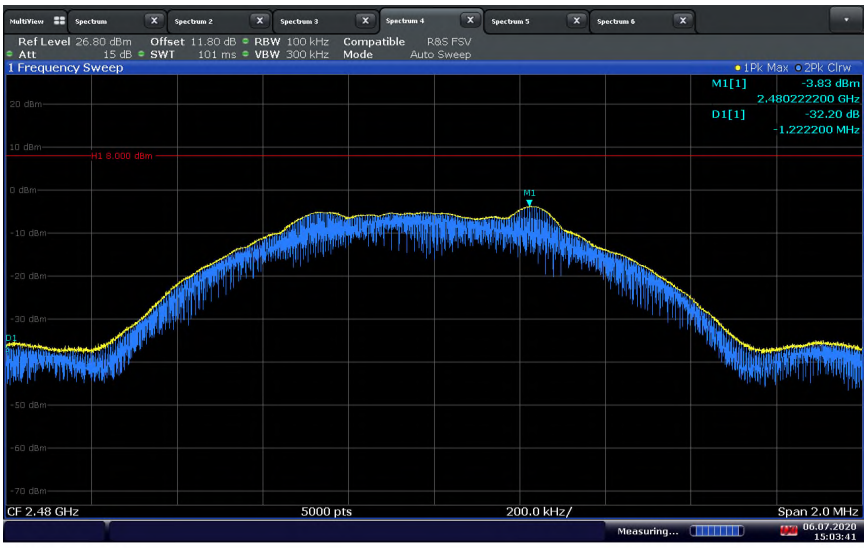
Bluetooth LE 1M Middle Channel



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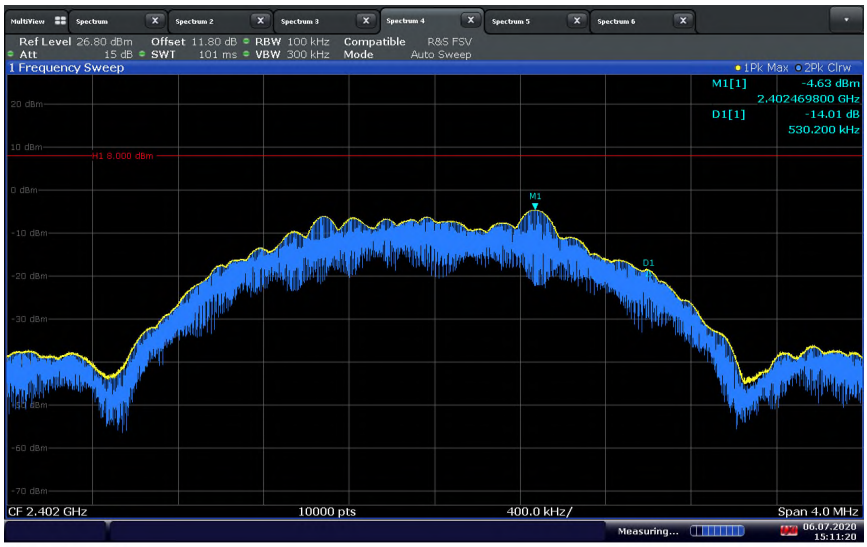
Bluetooth LE 1M High Channel



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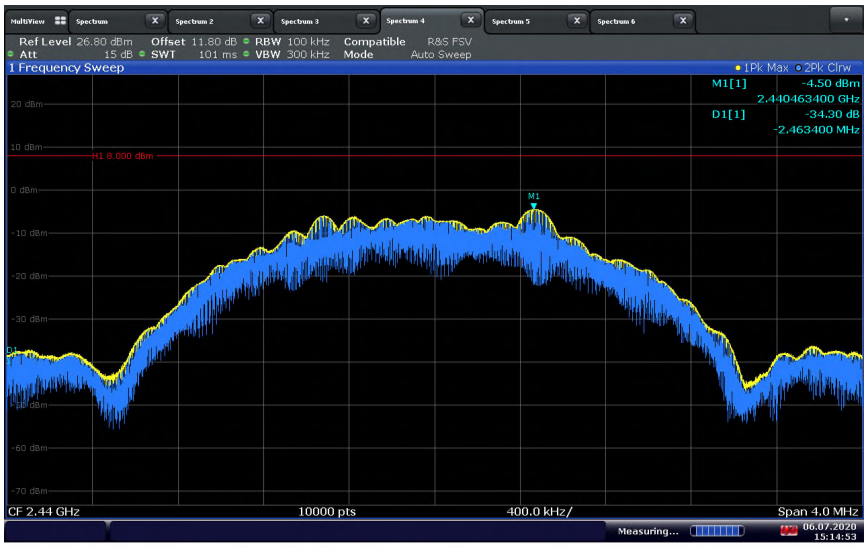
Bluetooth LE 2M Low Channel



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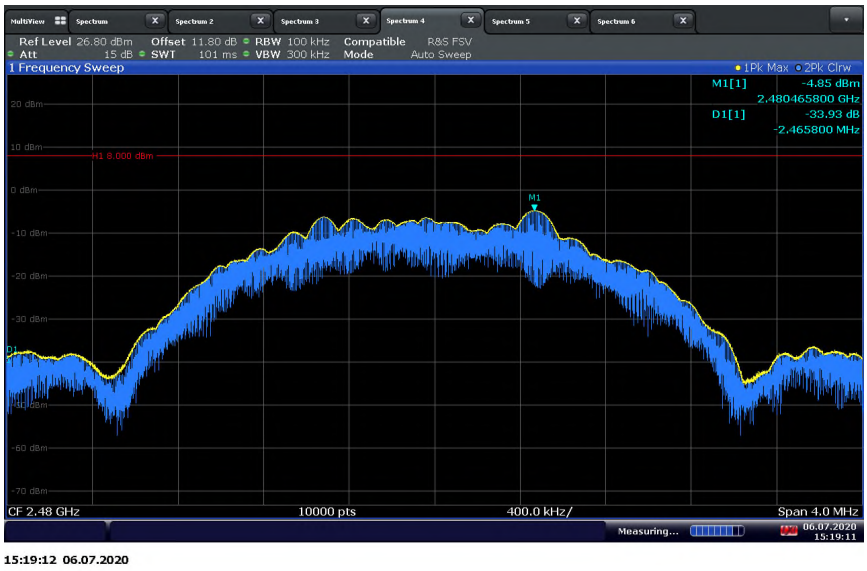
Bluetooth LE 2M Middle Channel



Bluetooth LE 2M High Channel

SECTION 3

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
Conducted Port Setup						
7662	P-Series Power Meter	N1911A	MY45100951	Agilent	06/28/19	06/28/20
7661	50MHz-18GHz Wideband Power Sensor	N1921A	MY45241383	Agilent	07/24/19	07/24/20
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	10/10/19	10/10/21
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	01/22/20	01/22/21
8710	10dB Attenuator	HAT-10+	-	Mini Circuit	Verified by 7608 and 7582	
Conducted Emissions						
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/18/19	10/18/20
7567	LISN	FCC-LISN-50-25-2-10	120304	Fisher Custom Comm	01/27/20	01/27/21
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/26/20	02/26/21
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	02/26/20	02/26/21
Radiated Emission						
1033	Bilog Antenna	3142C	00044556	EMCO	11/06/18	11/06/20
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	08/20/18	08/20/20
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/26/20	02/26/21
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/11/19	10/11/20
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/18/19	10/18/20
1016	Pre-amplifier	PAM-0202	187	A.H. Systems, Inc.	02/26/20	02/26/21
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 7608 and 7582	
Miscellaneous						
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	05/22/20	05/22/21
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 Measurement Uncertainty

Calculation of Measurement Uncertainty per CISPR 16-4-2:2011 with Corr. 1

3.2.1 Antenna Conducted Port Measurements

	Input Quantity (Contribution) Xi	Value		Prob. Dist.	Divisor	ui(x)	ui(x)2
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Cable attenuation	1.00	dB	Normal, k=2	2.000	0.50	0.25
3	Receiver sinewave accuracy	0.08	dB	Normal, k=2	2.000	0.04	0.00
4	Receiver pulse amplitude	0.00	dB	Rectangular	1.732	0.00	0.00
5	Receiver pulse repetition rate	0.00	dB	Rectangular	1.732	0.00	0.00
6	Noise floor proximity	0.00	dB	Rectangular	1.732	0.00	0.00
7	Frequency interpolation	0.10	dB	Rectangular	1.732	0.06	0.00
8	Mismatch	0.07	dB	U-shaped	1.414	0.05	0.00
	Combined standard uncertainty			Normal		0.52	dB
	Expanded uncertainty			Normal, k=2		**1.03**	**dB**

3.2.2 Radiated Measurements (Below 1GHz)

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20	dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75	dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45	dB	Normal, k=2	2.000	0.23	0.05
5	Receiver pulse amplitude	1.50	dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50	dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50	dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95	dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30	dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10	dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12	dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00	dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90	dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00	dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.76	dB	Triangular	2.449	1.54	2.36
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.77	dB	Rectangular	1.732	0.44	0.20
18	Table height at 3 m	0.10	dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00	dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00	dB				0.00
	Combined standard uncertainty			Normal		2.95	dB
	Expanded uncertainty			Normal, k=2		**5.90**	**dB**

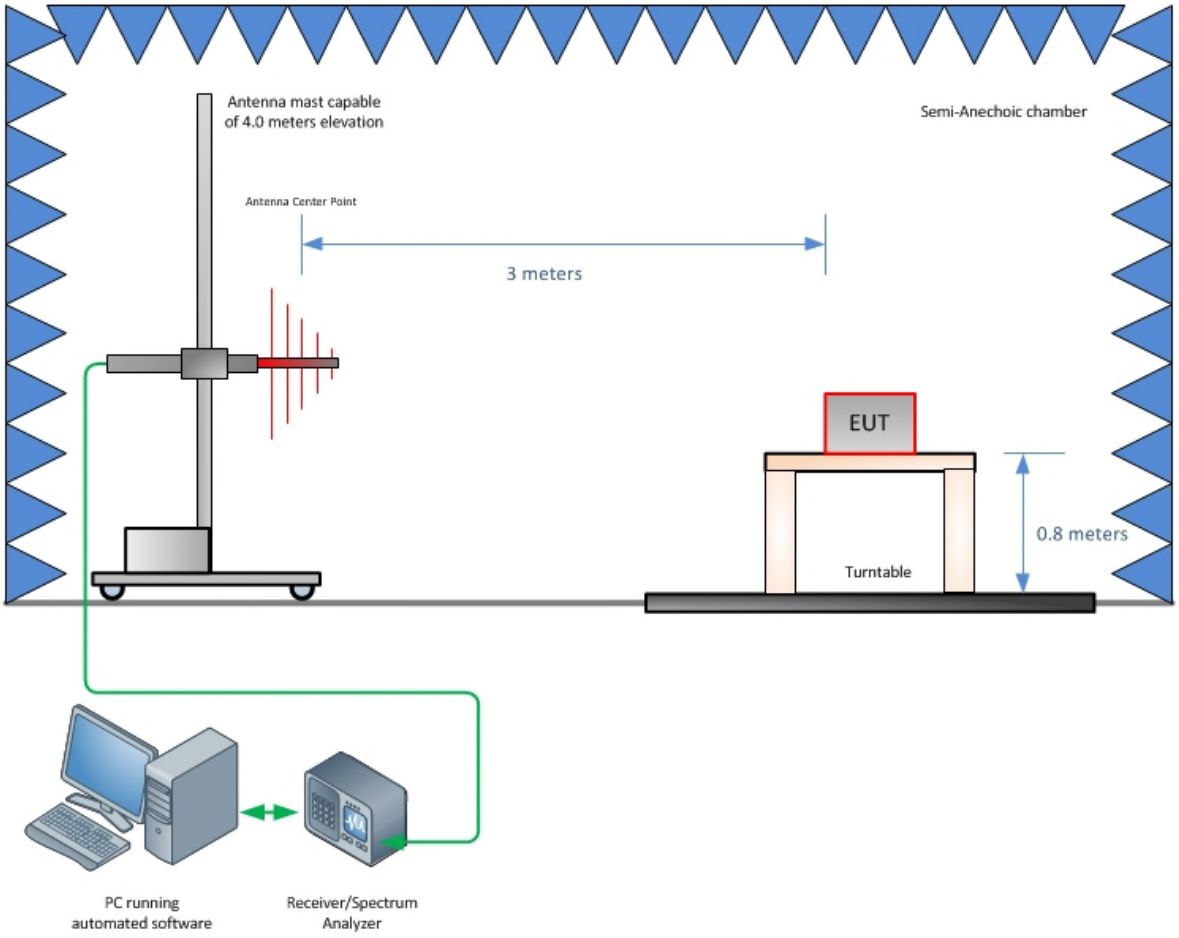
3.2.3 Radiated Emission Measurements (Above 1GHz)

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20	dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75	dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45	dB	Normal, k=2	2.000	0.23	0.05
5	Receiver pulse amplitude	1.50	dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50	dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50	dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95	dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30	dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10	dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12	dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00	dB	Rectangular	1.732	0.58	0.33
13	Cross-polarisation	0.90	dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00	dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.25	dB	Triangular	2.449	1.33	1.76
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.77	dB	Rectangular	1.732	0.44	0.20
18	Table height at 3 m	0.10	dB	Normal, k=2	2.000	0.05	0.00
19	Near-field effects	0.00	dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00	dB				0.00
	Combined standard uncertainty			Normal	2.85	dB	
	Expanded uncertainty			Normal, k=2	**5.70**	**dB**	

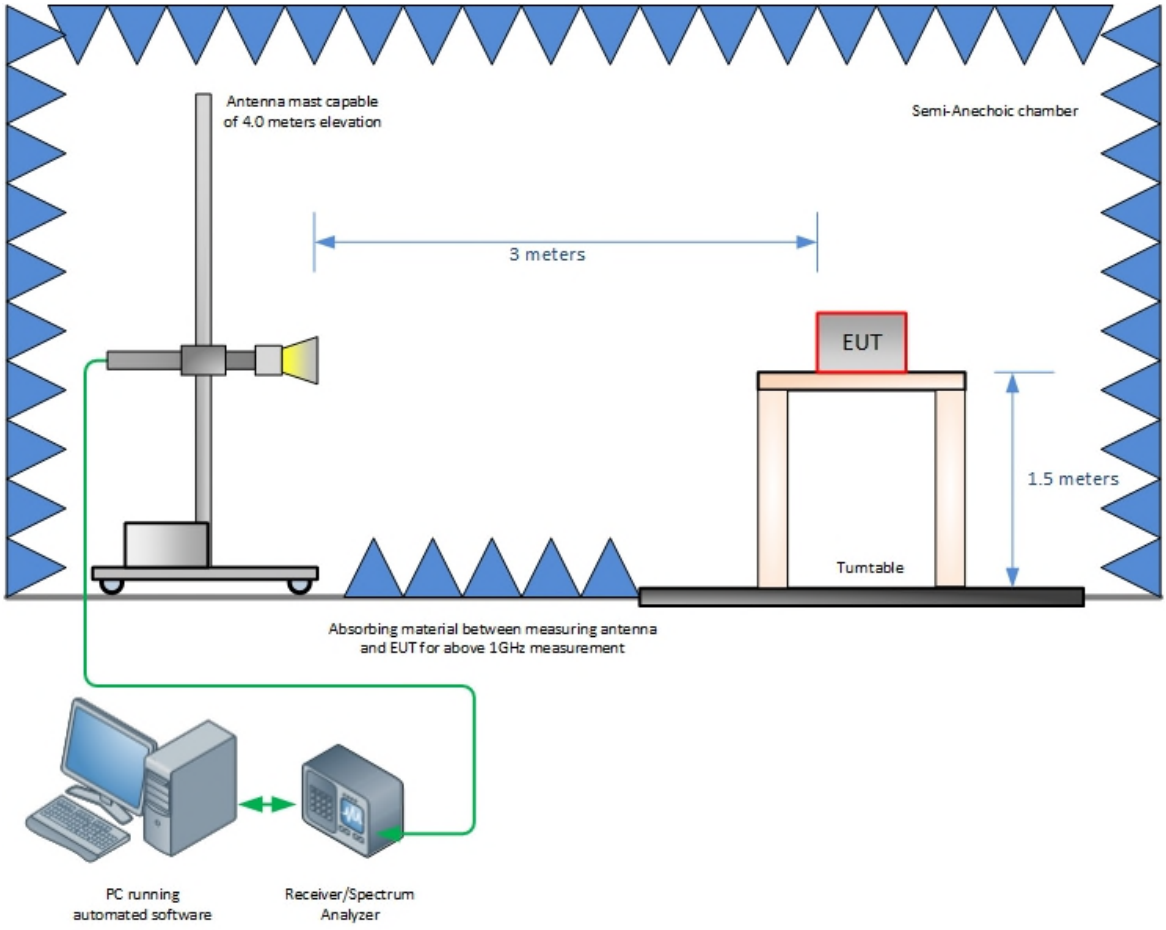
SECTION 4

4 Diagram of Test Setup

4.1 Test Setup Diagram



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

5 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 Accreditation, Disclaimers and Copyright

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