Report On

Application for Grant of Equipment Authorization of the
Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

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

Report No. 72141009C **November 2018**

REPORT ON	EMC Evaluation of the Nextivity Inc. Cel-Fi GO RED G32-12/14 Industrial Signal Booster
TEST REPORT NUMBER	72141009C
TEST REPORT DATE	November 2018
PREPARED FOR	Nextivity Inc. 16550 West Bernardo Drive, Bldg 5, Suite 550 San Diego, CA 92127, USA
CONTACT PERSON	CK Li Sr. Principal Engineer, Regulatory CLi@NextivityInc.com (858) 485-9442
PREPARED BY	Xiaoying Zhang **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: Senior EMC Test Engineer/Wireless Team Lead
DATED	November 01, 2018

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

Revision History

72141009C Nextivity Inc. Cel-Fi GO RED Industrial Signal Booster					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
11/01/18	Initial Release				Ferdinand S. Custodio

CONTENTS

SECTION 1

REPORT SUMMARY

Radio Testing of the
Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Nextivity Inc. Cel-Fi GO RED G32-12/14 Industrial Signal Booster to the requirements of FCC Part 15 Subpart C §15.247 and IC 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.
Manufacturer	Nextivity Inc.
EUT	Industrial Signal Booster
Trade Name	Cel-Fi GO RED
Model Number(s)	G32-12/14
FCC ID	YETG32-1214
IC Number	N/A
FCC Classification	Low Power Communications Device Transmitter (DTS)
Serial Number(s)	382829000271
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2017). • 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, April 2018).
Start of Test	September 19, 2018
Finish of Test	September 21, 2018
Name of Engineer(s)	Xiaoying Zhang
Related Document(s)	• KDB 558074 D01 (DTS Meas Guidance v05, August 24, 2018). 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 IC RSS-247 Issue 2 February 2017 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(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 7.1	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 5.2. The EUT is not a stand-alone receiver.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is a Nextivity Inc. Cel-Fi GO RED G32-12/14 Industrial Signal Booster. The EUT is a LTE Distributed Antenna System (DAS) to improve voice and data cellular performance in a Fix Indoor environment. The unit includes Bluetooth LE connectivity. With the use of Nextivity smartphone application, it allows user to register the product, updated software, capture/display details metrics of the system. Only the BT Low Energy function of the EUT was verified in this test report.

1.3.2 EUT General Description

EUT Description	Industrial Signal Booster
Product Marketing Name	Cel-Fi GO RED
Model Number(s)	G32-12/14
Rated Voltage	15V DC via external AC/DC adapter
Mode Verified	BT LE
Capability	LTE (Band 12 and 14) and BT LE
Primary Unit (EUT)	☒ Production
	☐ Pre-Production
	☐ Engineering
Environment	Fix, Indoor
Manufacturer Declared Temperature Range	-20°C to 65°C
Antenna Type	Internal
Manufacturer	Nextivity
Antenna Model	-
Maximum Antenna Gain	-5 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Average Output Power (dBm)	Average Output Power (mW)	Peak Output Power (dBm)	Peak Output Power (mW)
	2402-2480	-1.01	0.793	-0.92	0.809

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT is powered by AC/DC Adaptor. The EUT is connected to a support laptop running Nextivity Integrated Programming Environment V5.1.331 Test Software. Test configuration files can be uploaded to the EUT using this application. The manufacturer provided test files to make the EUT work in Transmit mode covering Low, Middle and High channels. 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, Cell RF ports are terminated by antennas.

1.4.2 EUT Exercise Software

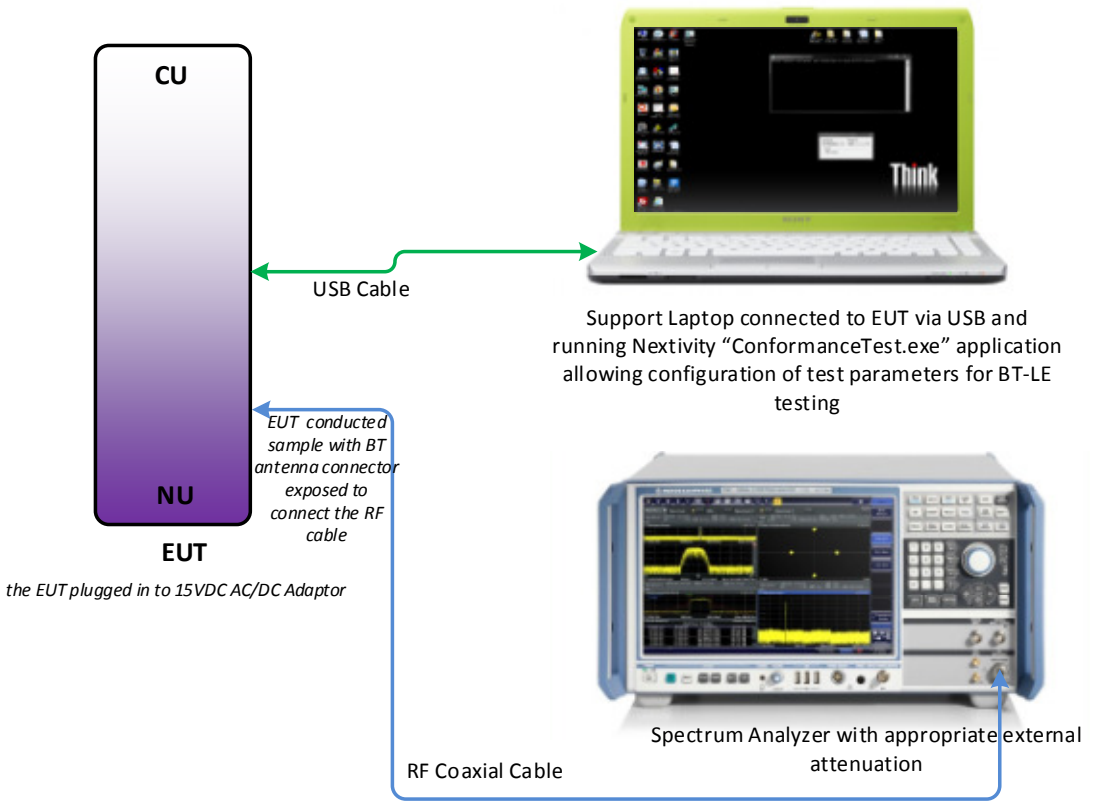
Manufacturer provided a configuration software (ConformanceTest.exe v5.1.331) running from a support laptop where EUT is connected via USB.

1.4.3 Support Equipment and I/O cables

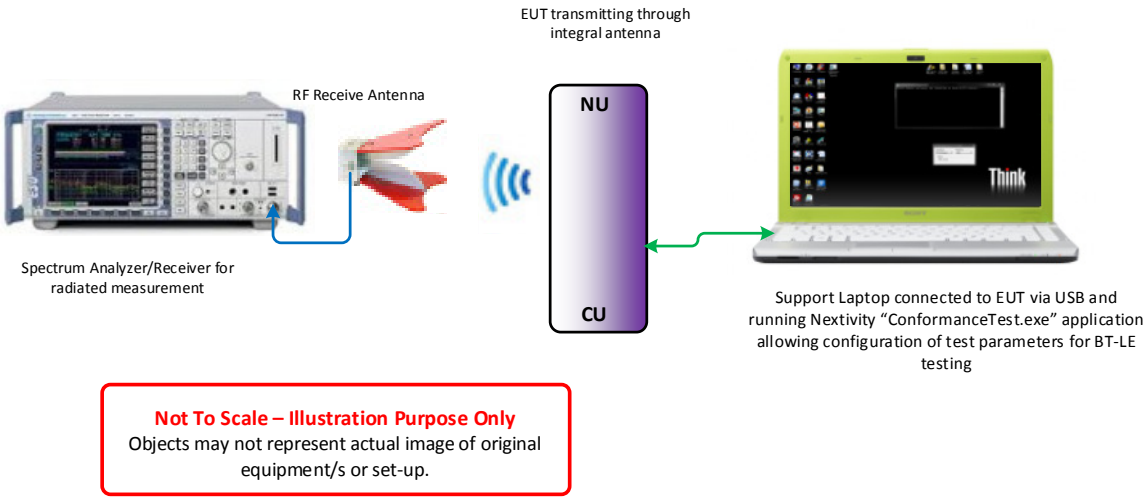
Manufacturer	Equipment/Cable	Description
Sony	Support Laptop	M/N PCG-31311L S/N 27545534 3006488
Sony	Support Laptop AC Adapter	M/N PCGA-AC19V9 S/N 147839091 0023259
HON-KWANG	I.T.E Power Supply	Model: HK-AY-150A160-US S/N: KH30000031 Input: 100-240V, 50/60Hz, 0.8A; Output: 15 VDC 1.6A
API Technologies Corp.	DC Block	M/N: 8037
-	Omni Whip Antenna	Model A21-V33-100 Max. gain 3.0 dBi
-	Omni Whip Antenna	Model A41-V30-100 Max. Gain 2.5 dBi

1.4.4 Simplified Test Configuration Diagram

Antenna Conducted Port Test Configuration



Radiated Test Configuration



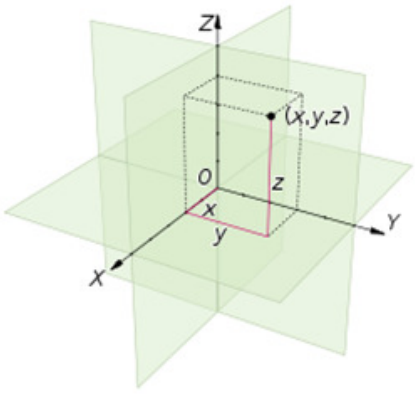
Not To Scale – Illustration Purpose Only
Objects may not represent actual image of original equipment/s or set-up.

1.4.5 Worst Case Configuration

Worst-case configuration used in this test report as per Radiated Spurious Emission:

Mode	Channel	Data Rate
Bluetooth LE	17 (Middle Channel)	1Mbps

EUT is a mobile device. Final installation position is only at Y orientation. For radiated measurements verifications performed using "Y" 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: 382829000271		
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.

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
Nextivity Inc.
Cel-Fi GO RED Industrial Signal Booster

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: 382829000271 / Default Test Configuration

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

September 20, 2018/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	25.4°C
Relative Humidity	54.9%
ATM Pressure	98.6kPa

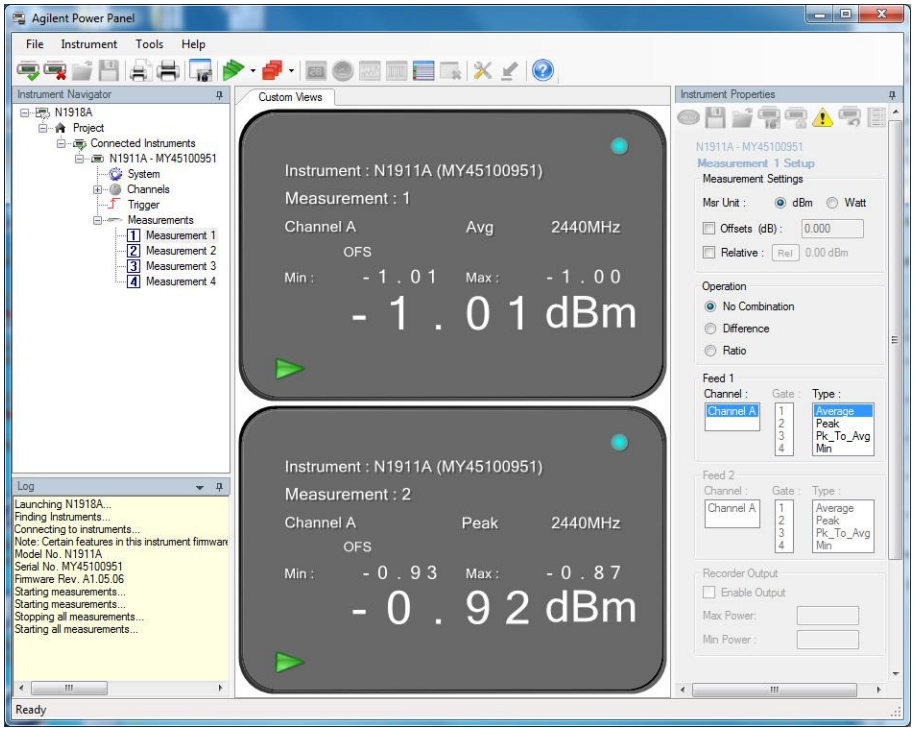
2.1.7 Additional Observations

- 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 v05, August 24, 2018). 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)
	37 (2402 MHz)	GFSK @ 1Mbps	-1.98	-1.86
	17 (2440 MHz)		**-1.01**	**-0.92**
	39 (2480 MHz)		-3.44	-3.29

2.1.9 Sample Test Display



Bluetooth LE Middle Channel 1Mbps

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: 382829000271 / Default Test Configuration

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

September 19, 2018/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	25.2 °C
Relative Humidity	50.3 %
ATM Pressure	98.8 kPa

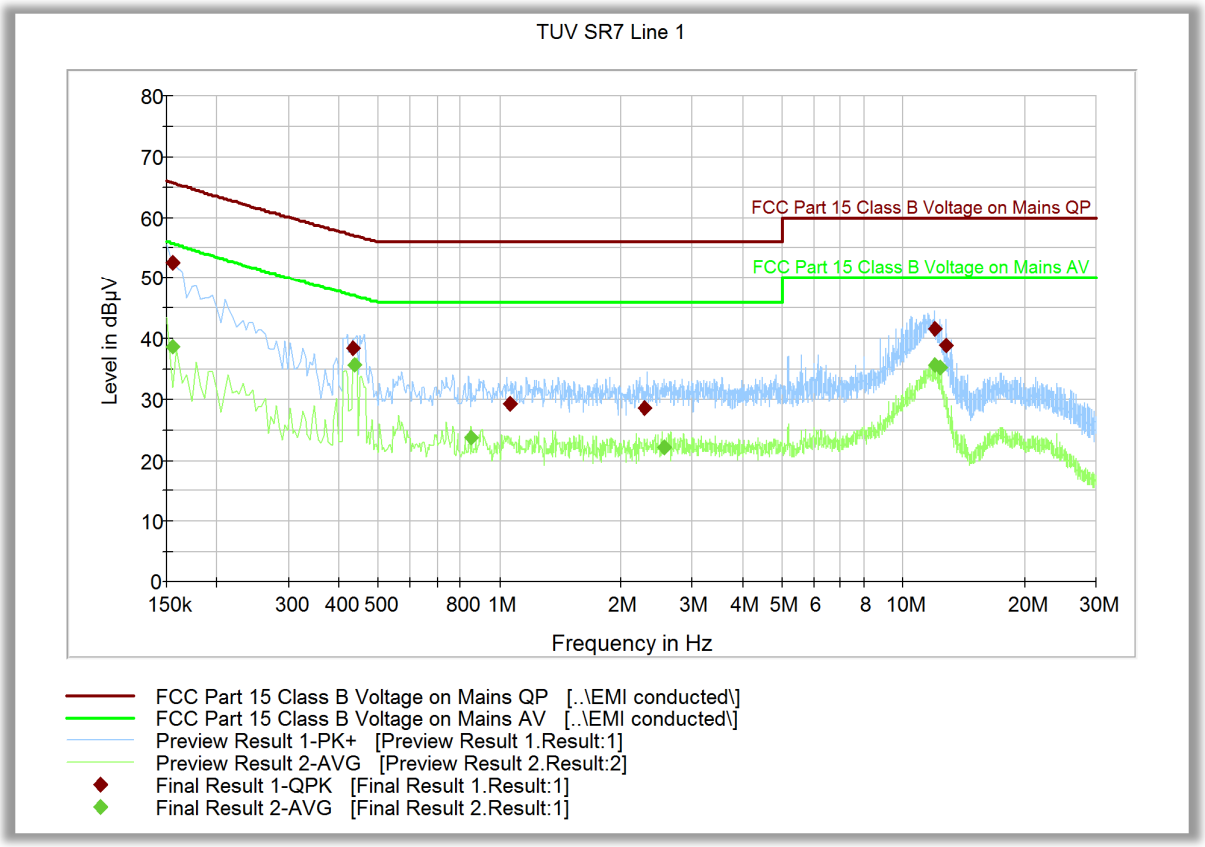
2.2.7 Additional Observations

- The EUT was verified using AC adapter supplied by the manufacturer.
- EUT verified using input voltage of 120VAC 60Hz.
- There are no significant variations in test results between each operating modes. Only the Middle channel operation mode 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



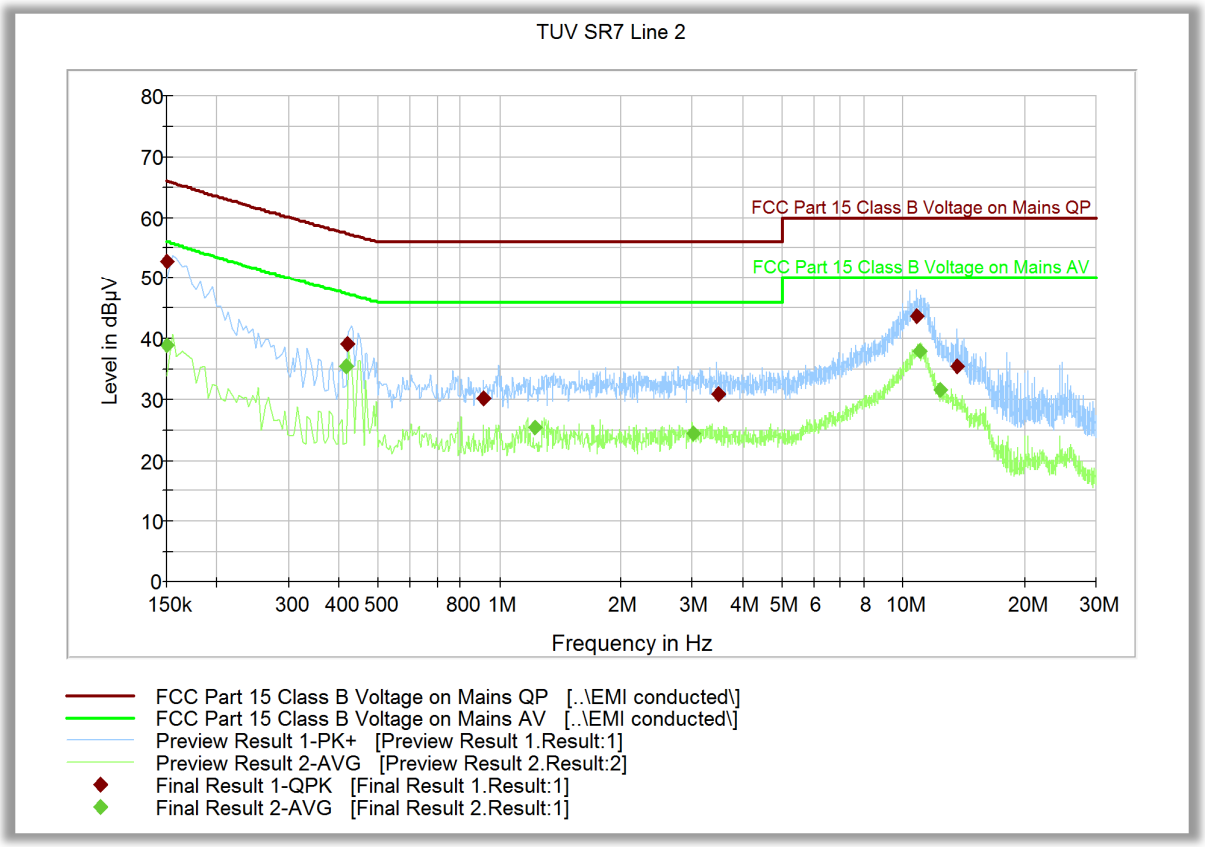
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.154500	52.7	1000.0	9.000	Off	L1	20.3	13.1	65.7
0.433500	38.5	1000.0	9.000	Off	L1	20.3	18.6	57.1
1.063500	29.3	1000.0	9.000	Off	L1	20.1	26.7	56.0
2.292000	28.6	1000.0	9.000	Off	L1	20.5	27.4	56.0
11.998500	41.7	1000.0	9.000	Off	L1	20.7	18.3	60.0
12.799500	39.0	1000.0	9.000	Off	L1	20.7	21.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.154500	38.7	1000.0	9.000	Off	L1	20.3	17.0	55.7
0.438000	35.6	1000.0	9.000	Off	L1	20.3	11.4	47.0
0.847500	23.8	1000.0	9.000	Off	L1	20.2	22.2	46.0
2.548500	22.3	1000.0	9.000	Off	L1	20.3	23.7	46.0
11.998500	35.7	1000.0	9.000	Off	L1	20.7	14.3	50.0
12.399000	35.3	1000.0	9.000	Off	L1	20.7	14.7	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)
0.150000	52.7	1000.0	9.000	Off	N	20.3	13.3	66.0
0.420000	39.0	1000.0	9.000	Off	N	20.3	18.4	57.3
0.915000	30.2	1000.0	9.000	Off	N	20.2	25.8	56.0
3.475500	30.9	1000.0	9.000	Off	N	20.5	25.1	56.0
10.797000	43.7	1000.0	9.000	Off	N	20.6	16.3	60.0
13.591500	35.5	1000.0	9.000	Off	N	20.7	24.5	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.150000	38.9	1000.0	9.000	Off	N	20.3	17.1	56.0
0.415500	35.5	1000.0	9.000	Off	N	20.3	12.0	47.4
1.221000	25.3	1000.0	9.000	Off	N	20.3	20.7	46.0
3.007500	24.5	1000.0	9.000	Off	N	20.5	21.5	46.0
10.986000	37.9	1000.0	9.000	Off	N	20.6	12.1	50.0
12.399000	31.4	1000.0	9.000	Off	N	20.7	18.6	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: 382829000271 / Default Test Configuration

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

September 20, 2018/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	25.4°C
Relative Humidity	54.9%
ATM Pressure	98.6kPa

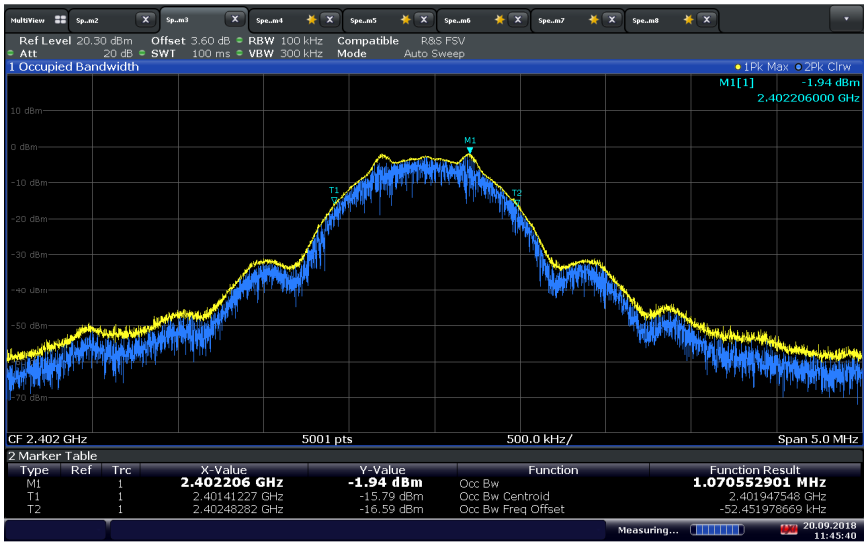
2.3.7 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as a level offset.
- Span is wide enough to capture the channel transmission.
- RBW is 100kHz.
- 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)
Bluetooth LE	37 (2402 MHz)	1.0706
	17 (2440 MHz)	1.0702
	39 (2480 MHz)	1.0646

2.3.9 Test Results Plots



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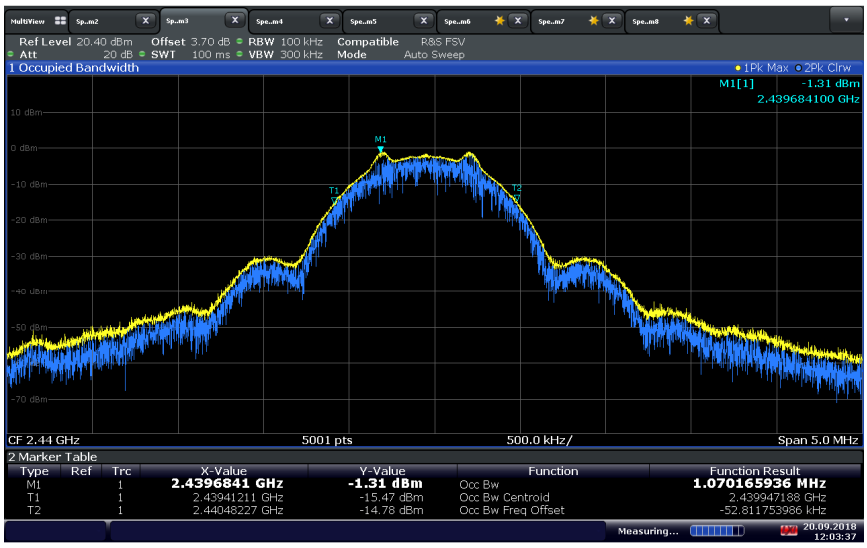
Bluetooth LE Low Channel



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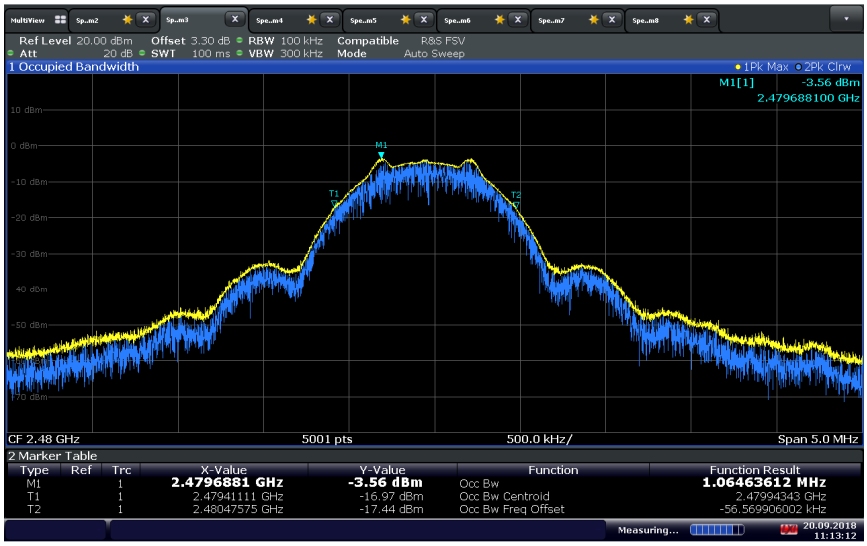
Bluetooth LE Middle Channel



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Bluetooth LE 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: 382829000271 / Default Test Configuration

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

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

September 20, 2018/XYZ

2.4.6 Test Equipment Used

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

2.4.7 Environmental Conditions

Ambient Temperature	25.4°C
Relative Humidity	54.9%
ATM Pressure	98.6kPa

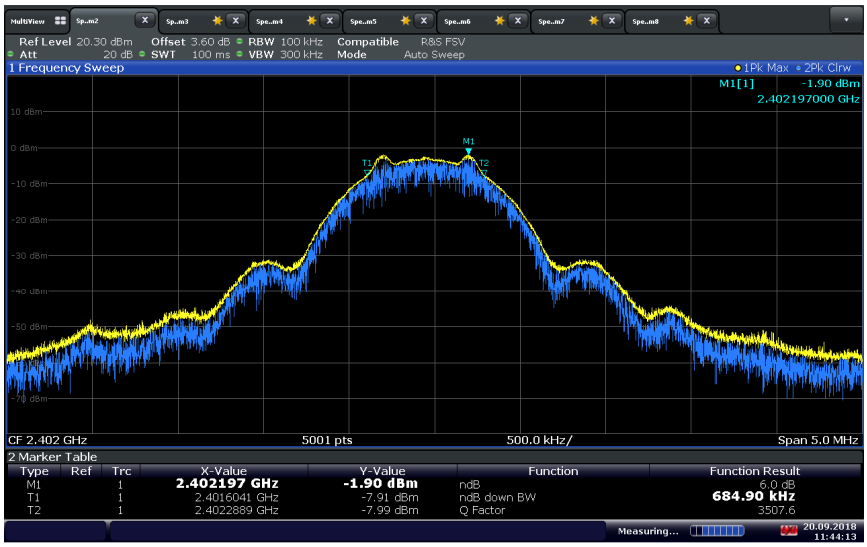
2.4.8 Additional Observations

- This is a conducted test.
- The path loss was measured and entered as a level offset.
- Span is wide enough to capture the channel transmission.
- RBW is set to 100 kHz.
- VBW is ≥3 x RBW.
- Sweep is auto.
- Detector is peak.
- Trace is maxhold.
- The “n” dB down marker function of the spectrum analyzer was used for this test.

2.4.9 Test Results

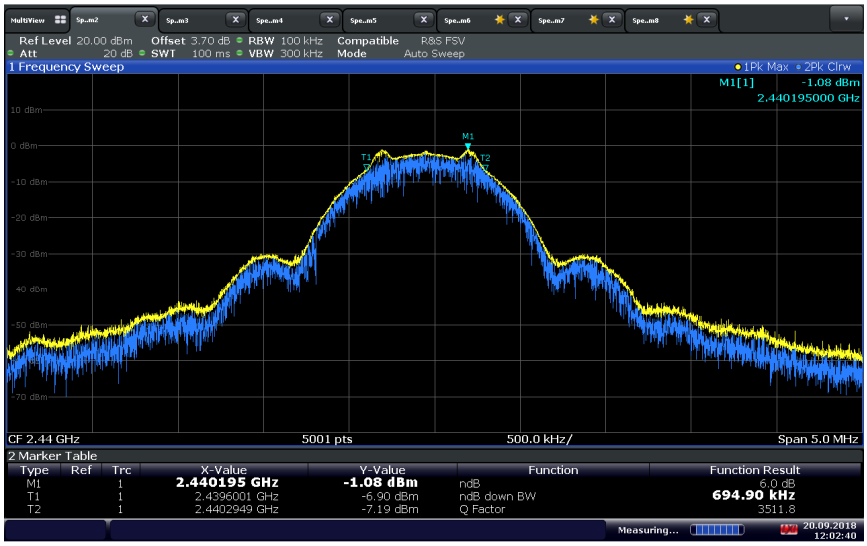
Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	37 (2402 MHz)	0.6849	0.500	Complies
	17 (2440 MHz)	0.6949	0.500	Complies
	39 (2480 MHz)	0.6949	0.500	Complies

2.4.10 Test Results Plots



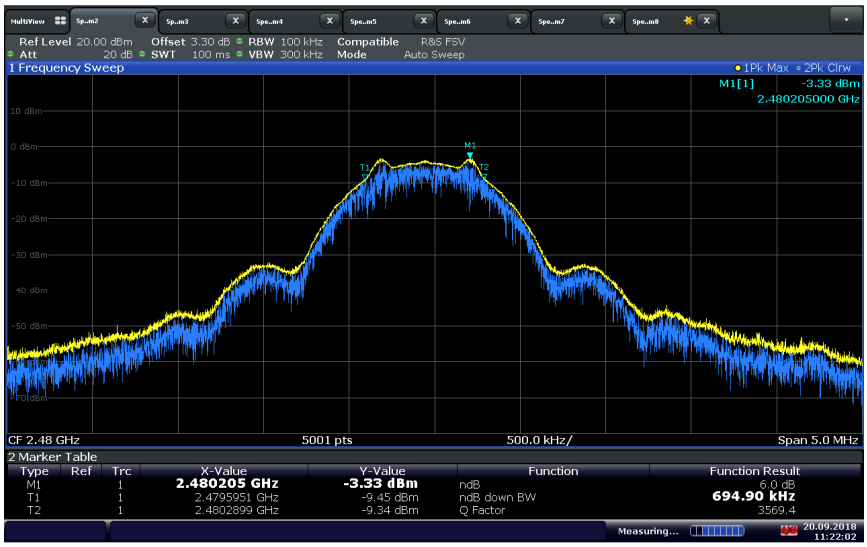
11:44:13 20.09.2018

Bluetooth LE Low Channel



12:02:40 20.09.2018

Bluetooth LE Middle Channel



11:22:03 20.09.2018

Bluetooth LE 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: 382829000271 / Default Test Configuration

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

September 20, 2018/XYZ

2.5.5 Test Equipment Used

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

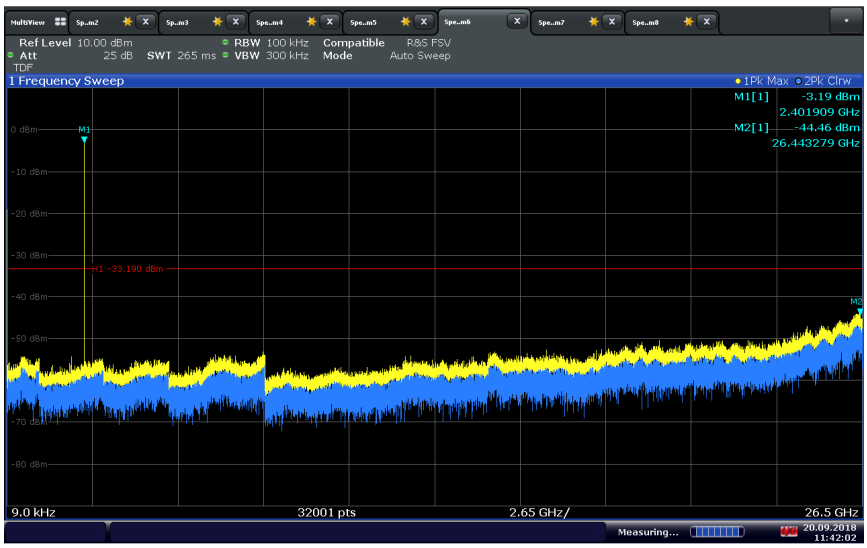
2.5.6 Environmental Conditions

Ambient Temperature	25.4°C
Relative Humidity	54.9%
ATM Pressure	98.6kPa

2.5.7 Additional Observations

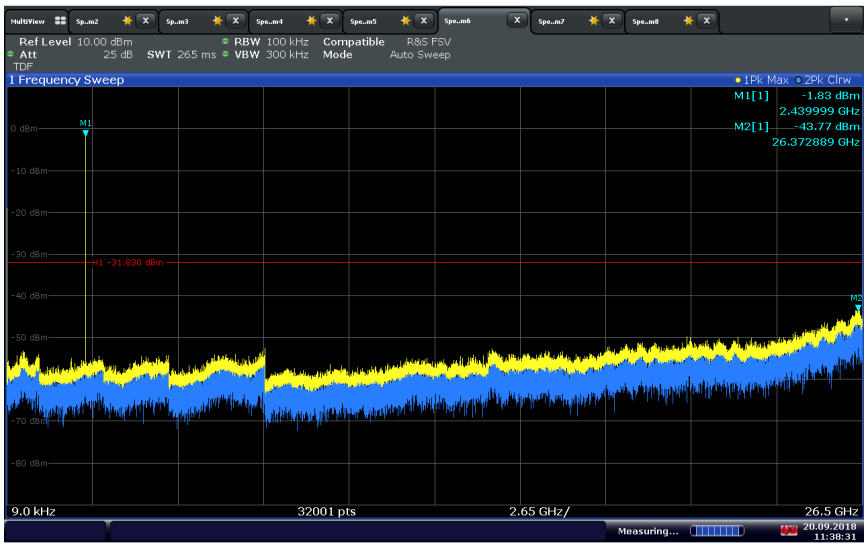
- This is a conducted test.
- TDF (Transducer Factor) was used to compensate for the external attenuator and cable used.
- RBW is 100kHz.VBW is 3 x RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. 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



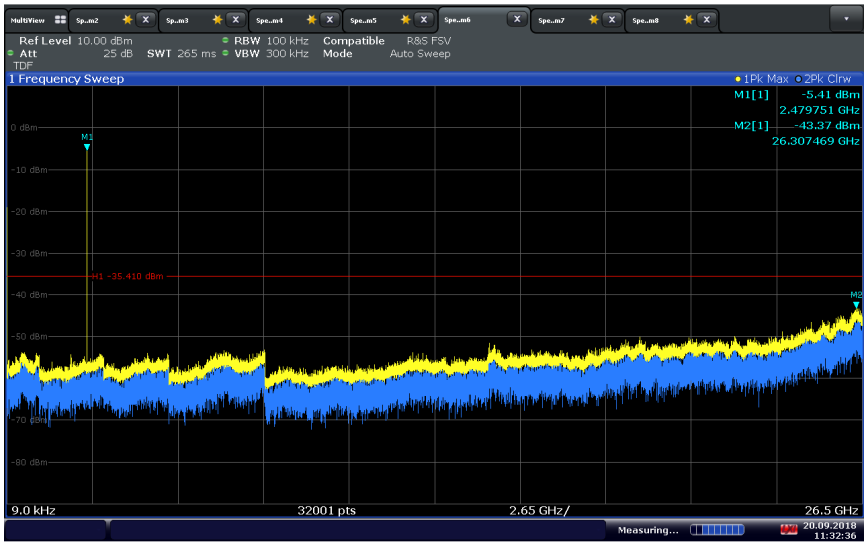
11:42:03 20.09.2018

Bluetooth LE Low Channel



11:38:31 20.09.2018

Bluetooth LE Middle Channel



11:32:37 20.09.2018

Bluetooth LE 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: 382829000271 / Default Test Configuration

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

September 20, 2018/XYZ

2.6.5 Test Equipment Used

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

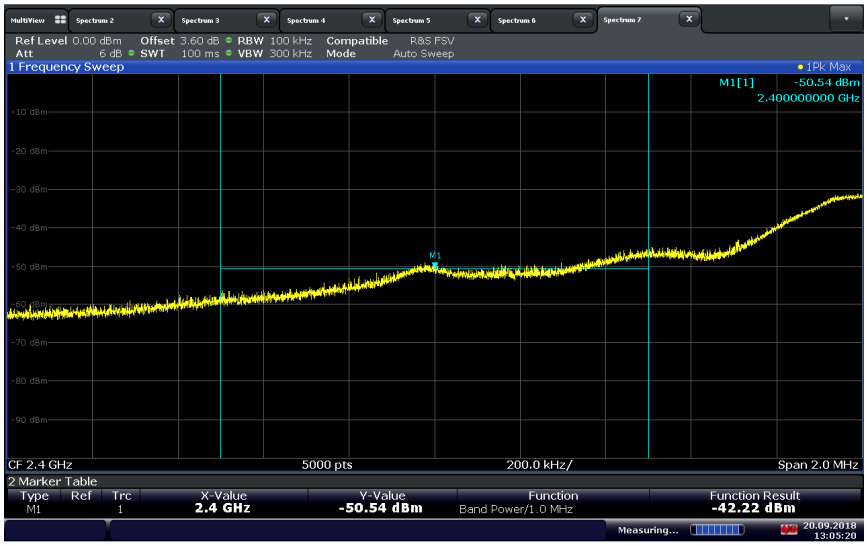
2.6.6 Environmental Conditions

Ambient Temperature	25.4°C
Relative Humidity	54.9%
ATM Pressure	98.6kPa

2.6.7 Additional Observations

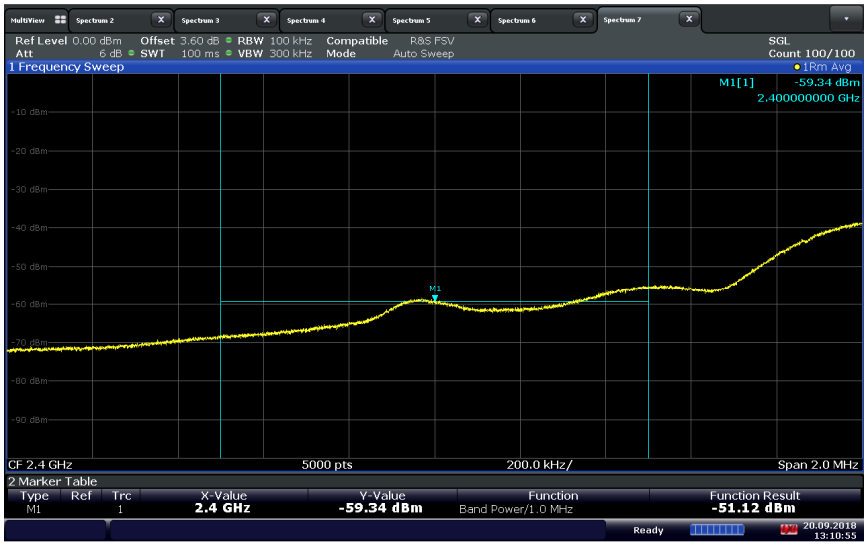
- Setup is identical to “Out-of-Band Emissions – Conducted” test (previous test).
- The path loss was measured and entered as a level offset
- Test methodology is per Clause 8.7.3 of KDB 558074 D01 (DTS Meas Guidance v05, August 24, 2018) which refer to C63.10 Section 11.13.3.2 Peak detection and 11.13.3.2 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 Test Results



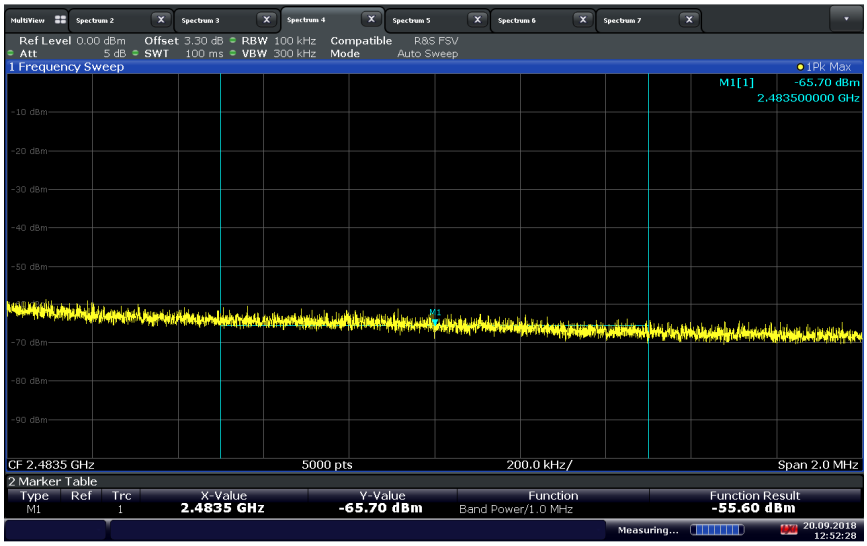
13:05:20 20.09.2018

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



13:10:56 20.09.2018

Bluetooth LE Low Channel (2402 MHz). Limit is -33.19 dBm. Margin is -17.93 dB.
(The highest level of the desired power in the 100 kHz bandwidth within the band is -3.19 dBm)



12:52:29 20.09.2018

Bluetooth LE Upper Band Edge 2483.5MHz (Peak Measurement) @ Ch 2480 MHz
Limit is -35.41 dBm. Margin is -20.19 dB
(The highest level of the desired power in the 100 kHz bandwidth within the band is -5.41 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
= (-55.6 dBm - 5 dBi antenna gain) + 95.23
= 34.63 dBµV/m @ 3 meters (Complies with 54 dBµV/m Average limit. Average testing is not needed)

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: 382829000271 / Default Test Configuration

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

September 20 and 21, 2018/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	25.2 - 25.4 °C
Relative Humidity	54.6 - 54.9 %
ATM Pressure	98.6 - 99.1 kPa

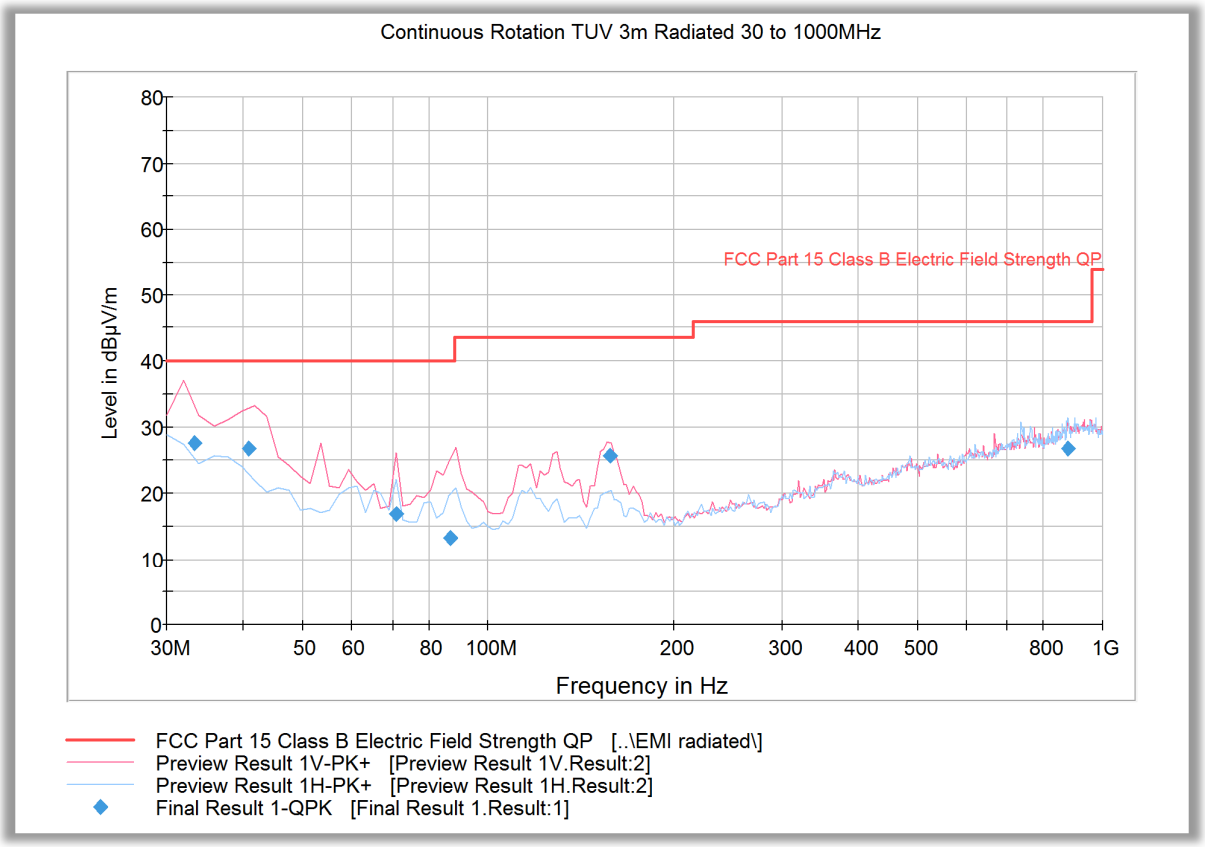
2.7.7 Additional Observations

- 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 (Middle 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**

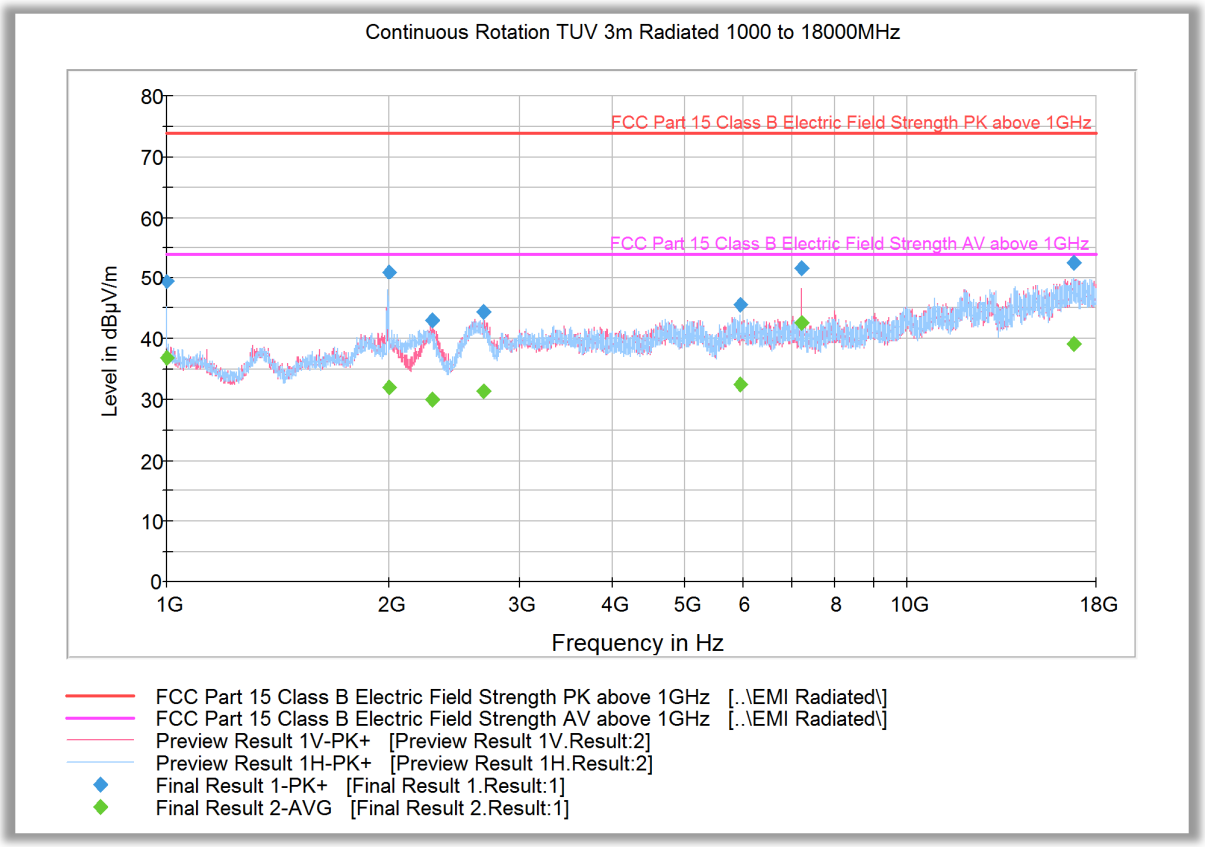
2.7.9 Worst case Test Results for Below 1GHz – Middle Channel



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
33.280000	27.5	1000.0	120.000	100.0	V	210.0	-9.0	12.5	40.0
40.687214	26.7	1000.0	120.000	134.0	V	87.0	-13.0	13.3	40.0
70.941643	16.8	1000.0	120.000	400.0	V	11.0	-17.2	23.2	40.0
86.892745	13.3	1000.0	120.000	150.0	V	335.0	-16.6	26.7	40.0
157.832705	25.7	1000.0	120.000	100.0	V	296.0	-13.1	17.8	43.5
877.598958	26.7	1000.0	120.000	394.0	H	178.0	5.8	19.3	46.0

2.7.10 Test Results for Above 1GHz - Low Channel



Peak Data

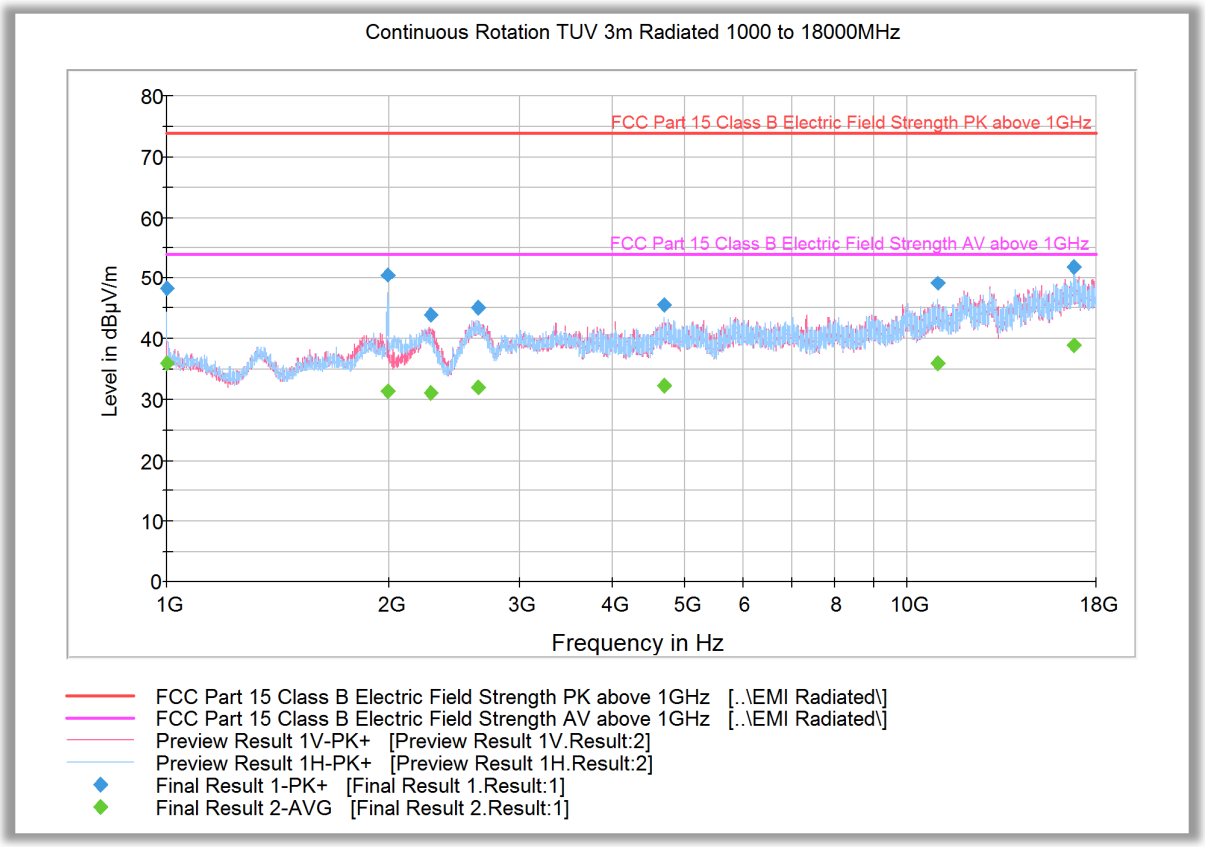
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	49.4	1000.0	1000.000	351.6	H	202.0	-7.0	24.5	73.9
1992.100000	51.0	1000.0	1000.000	228.4	H	274.0	-2.2	22.9	73.9
2281.600000	42.9	1000.0	1000.000	395.0	H	154.0	-1.2	31.0	73.9
2673.766667	44.4	1000.0	1000.000	410.7	H	52.0	-0.3	29.5	73.9
5943.733333	45.5	1000.0	1000.000	147.7	H	201.0	5.5	28.4	73.9
7206.500000	51.7	1000.0	1000.000	301.2	V	168.0	6.5	22.2	73.9
16777.13333	52.5	1000.0	1000.000	352.7	V	143.0	17.8	21.4	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	36.7	1000.0	1000.000	351.6	H	202.0	-7.0	17.2	53.9
1992.100000	32.1	1000.0	1000.000	228.4	H	274.0	-2.2	21.8	53.9
2281.600000	29.8	1000.0	1000.000	395.0	H	154.0	-1.2	24.1	53.9
2673.766667	31.4	1000.0	1000.000	410.7	H	52.0	-0.3	22.5	53.9
5943.733333	32.6	1000.0	1000.000	147.7	H	201.0	5.5	21.3	53.9
7206.500000	42.5	1000.0	1000.000	301.2	V	168.0	6.5	11.4	53.9
16777.13333	39.1	1000.0	1000.000	352.7	V	143.0	17.8	14.8	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.

2.7.11 Test Results for Above 1GHz - Middle Channel



Peak Data

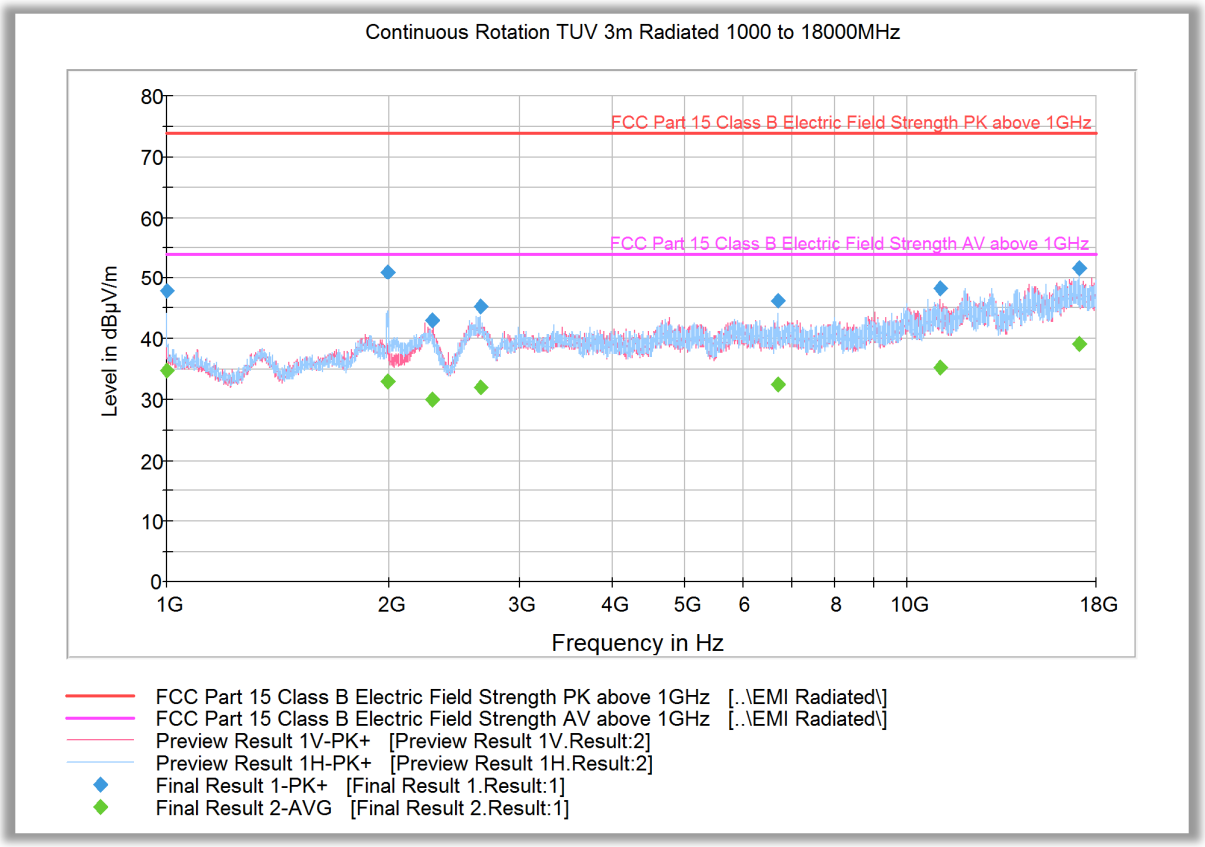
Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	48.3	1000.0	1000.000	219.4	H	251.0	-7.0	25.6	73.9
1991.100000	50.6	1000.0	1000.000	296.2	H	-19.0	-2.2	23.3	73.9
2269.166667	43.9	1000.0	1000.000	195.5	V	11.0	-1.3	30.0	73.9
2634.633333	45.0	1000.0	1000.000	228.4	H	54.0	-0.4	28.9	73.9
4688.233333	45.6	1000.0	1000.000	152.2	H	283.0	3.4	28.3	73.9
10984.66666	49.2	1000.0	1000.000	352.7	H	293.0	11.5	24.7	73.9
16796.93333	51.9	1000.0	1000.000	140.7	H	71.0	17.8	22.0	73.9

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	35.8	1000.0	1000.000	219.4	H	251.0	-7.0	18.1	53.9
1991.100000	31.3	1000.0	1000.000	296.2	H	-19.0	-2.2	22.6	53.9
2269.166667	31.1	1000.0	1000.000	195.5	V	11.0	-1.3	22.8	53.9
2634.633333	32.0	1000.0	1000.000	228.4	H	54.0	-0.4	21.9	53.9
4688.233333	32.1	1000.0	1000.000	152.2	H	283.0	3.4	21.8	53.9
10984.66666	36.0	1000.0	1000.000	352.7	H	293.0	11.5	17.9	53.9
16796.93333	38.9	1000.0	1000.000	140.7	H	71.0	17.8	15.0	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.

2.7.12 Test Results for Above 1GHz - High Channel



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1000.000000	47.8	1000.0	1000.000	182.6	H	239.0	-7.0	26.1	73.9
1991.900000	50.9	1000.0	1000.000	250.5	H	166.0	-2.2	23.0	73.9
2280.100000	42.9	1000.0	1000.000	352.7	H	114.0	-1.2	31.0	73.9
2653.166667	45.3	1000.0	1000.000	352.7	H	254.0	-0.2	28.6	73.9
6678.766667	46.3	1000.0	1000.000	196.5	H	316.0	6.0	27.6	73.9
11089.33333	48.2	1000.0	1000.000	120.7	V	142.0	11.6	25.8	73.9
17068.20000	51.7	1000.0	1000.000	340.1	H	86.0	17.5	22.2	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	34.7	1000.0	1000.000	182.6	H	239.0	-7.0	19.2	53.9
1991.900000	32.8	1000.0	1000.000	250.5	H	166.0	-2.2	21.1	53.9
2280.100000	29.9	1000.0	1000.000	352.7	H	114.0	-1.2	24.0	53.9
2653.166667	32.0	1000.0	1000.000	352.7	H	254.0	-0.2	21.9	53.9
6678.766667	32.4	1000.0	1000.000	196.5	H	316.0	6.0	21.5	53.9
11089.33333	35.2	1000.0	1000.000	120.7	V	142.0	11.6	18.7	53.9
17068.20000	39.1	1000.0	1000.000	340.1	H	86.0	17.5	14.8	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.

2.8 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: 382829000271 / Default Test Configuration

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

September 20, 2018/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	25.2 – 25.4°C
Relative Humidity	54.6 – 54.9%
ATM Pressure	98.6 – 99.1kPa

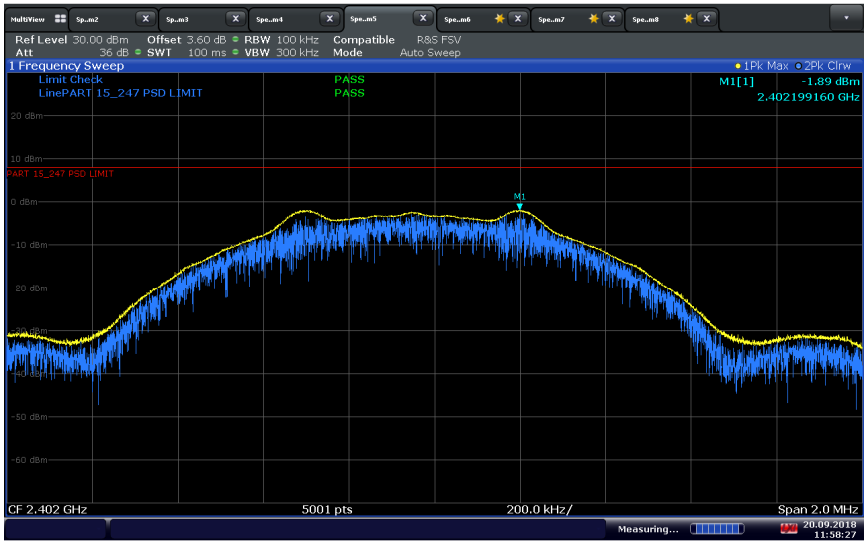
2.8.7 Additional Observations

- This is a conducted test.
- Test procedure is per Section 8.4 of KDB 558074 D01 (DTS Meas Guidance v05, August 24, 2018).
- 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

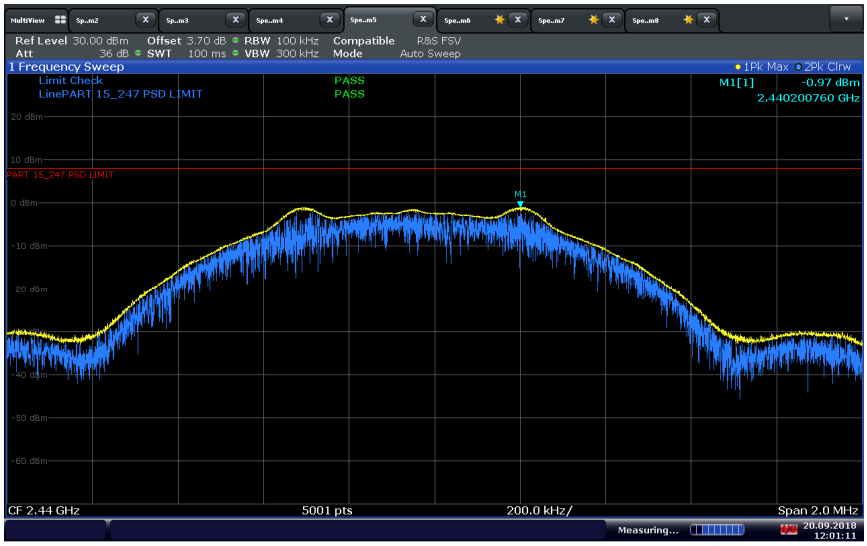
Mode	Channel	Data Rates (Mbps)	Marker Reading using 100 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
Bluetooth LE	37 (2402 MHz)	GFSK @ 1Mbps	-1.89	8	-9.89	Complies
	17 (2440 MHz)	GFSK @ 1Mbps	-0.97	8	-8.97	Complies
	39 (2480 MHz)	GFSK @ 1Mbps	-3.29	8	-11.29	Complies

2.8.9 Test Results Plots



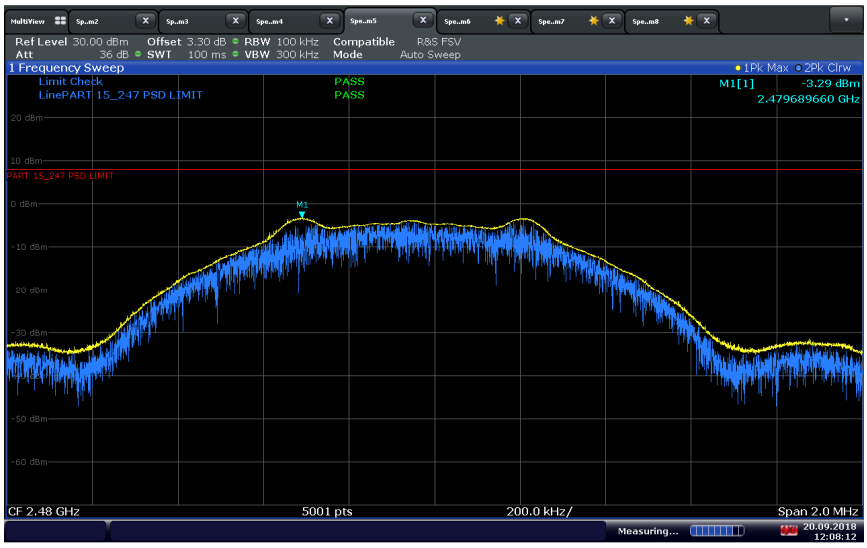
11:58:27 20.09.2018

Bluetooth LE Low Channel



12:01:11 20.09.2018

Bluetooth LE Middle Channel



12:08:12 20.09.2018

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
Conducted Port Setup						
7662	P-Series Power Meter	N1911A	MY45100951	Agilent	06/15/18	06/15/19
7661	50MHz-18GHz Wideband Power Sensor	N1921A	MY45241383	Agilent	06/15/18	06/15/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
8705	3dB Attenuator	HAT-3+	-	Mini Circuit	Verified by 7608 and 7611	
8710	10dB Attenuator	HAT-10+	-	Mini Circuit	Verified by 7608 and 7611	
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	09/19/18	09/19/19
7567	LISN	FCC-LISN-50-25-2	120304	Fischer Custom Comm.	12/14/17	12/14/19
8822	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/06/18	03/06/19
8824	20dB Attenuator	34-20-34	N/A	MCE / Weinschel	03/06/18	03/06/19
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
Radiated Emission						
7611	Signal/Spectrum Analyzer	FSW26	102017	Rhode & Schwarz	05/09/18	05/09/19
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
1002	Bilog Antenna	3142C	00058717	EMCO	11/20/17	11/20/18
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	06/16/18	06/16/20
1193	Pre-amplifier	PAM-0202	185	A.H. Systems, Inc.	04/11/18	04/11/19
8921	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7608 and 7611	
8923	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7608 and 7611	
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	10/15/18	10/15/19
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/13/18	07/13/19
8628	Pre-amplifier	QLI-01182835-JO	8986002	Quinstar	02/06/18	02/06/19
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1049	
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/18/18	07/18/19
11312	Mini Environmental Quality Meter	850027	CF099-56010-340	Sper Scientific	02/26/28	02/26/19
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.1 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.1.1 Radiated Emission Measurements (Below 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.52	1.44	2.07
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (uc):	1.68
				Coverage Factor (k):	2
				Expanded Uncertainty:	3.36

3.1.2 Radiated Emission Measurements (Above 1GHz)

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.00	1.22	1.50
6	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	1.49
				Coverage Factor (k):	2
				Expanded Uncertainty:	2.99

3.1.3 Conducted Antenna Port Measurement

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.34	0.20	0.04
2	Cables	Rectangular	0.30	0.17	0.03
3	EUT Setup	Rectangular	0.50	0.29	0.08
				Combined Uncertainty (u_c):	0.39
				Coverage Factor (k):	1.96
				Expanded Uncertainty:	0.76

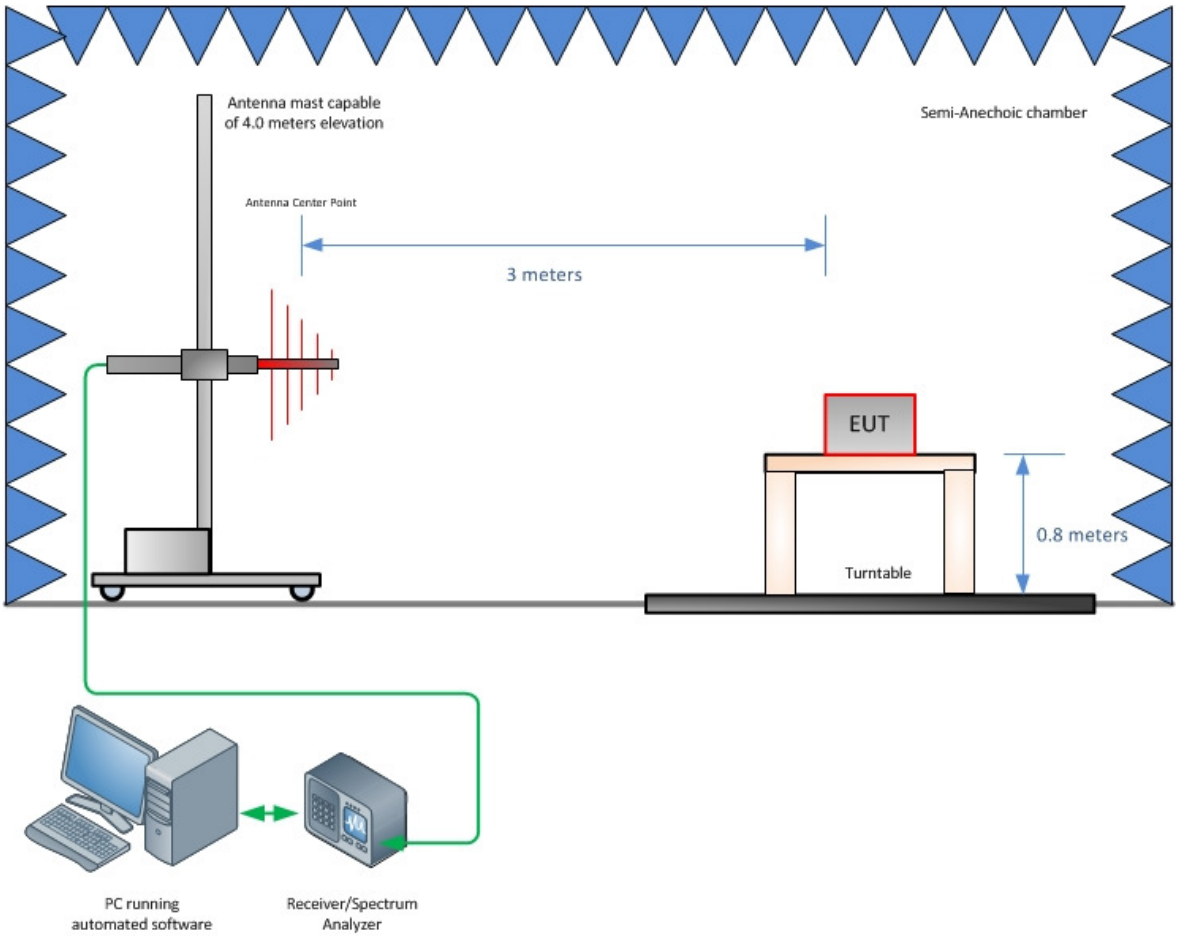
3.1.4 AC Conducted Emissions

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.36	0.21	0.04
2	Cables	Rectangular	0.50	0.29	0.08
3	LISN	Rectangular	0.66	0.38	0.15
4	Attenuator	Rectangular	0.30	0.17	0.03
5	EUT Setup	Rectangular	1.00	0.58	0.33
				Combined Uncertainty (u_c):	0.80
				Coverage Factor (k):	2
				Expanded Uncertainty:	1.59

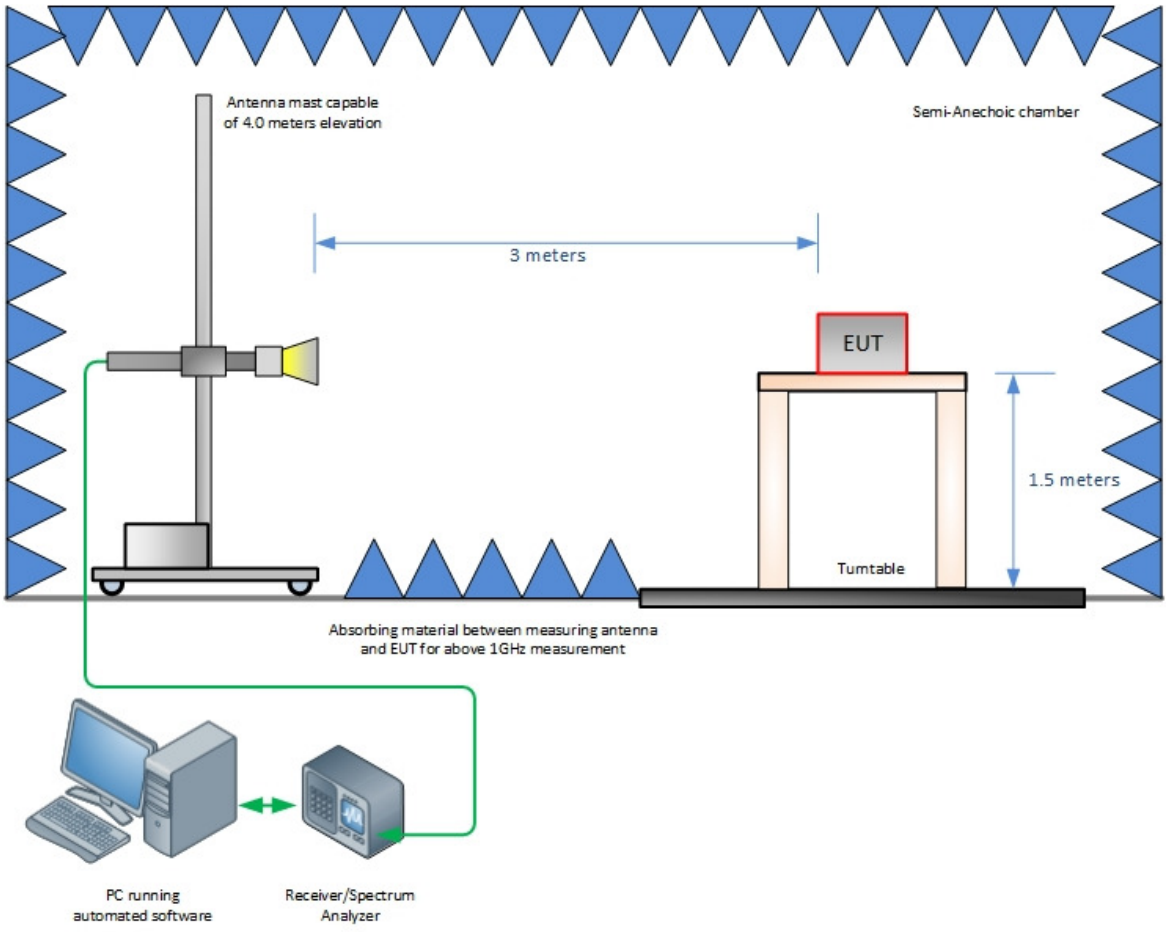
SECTION 4

DIAGRAM OF TEST SETUP

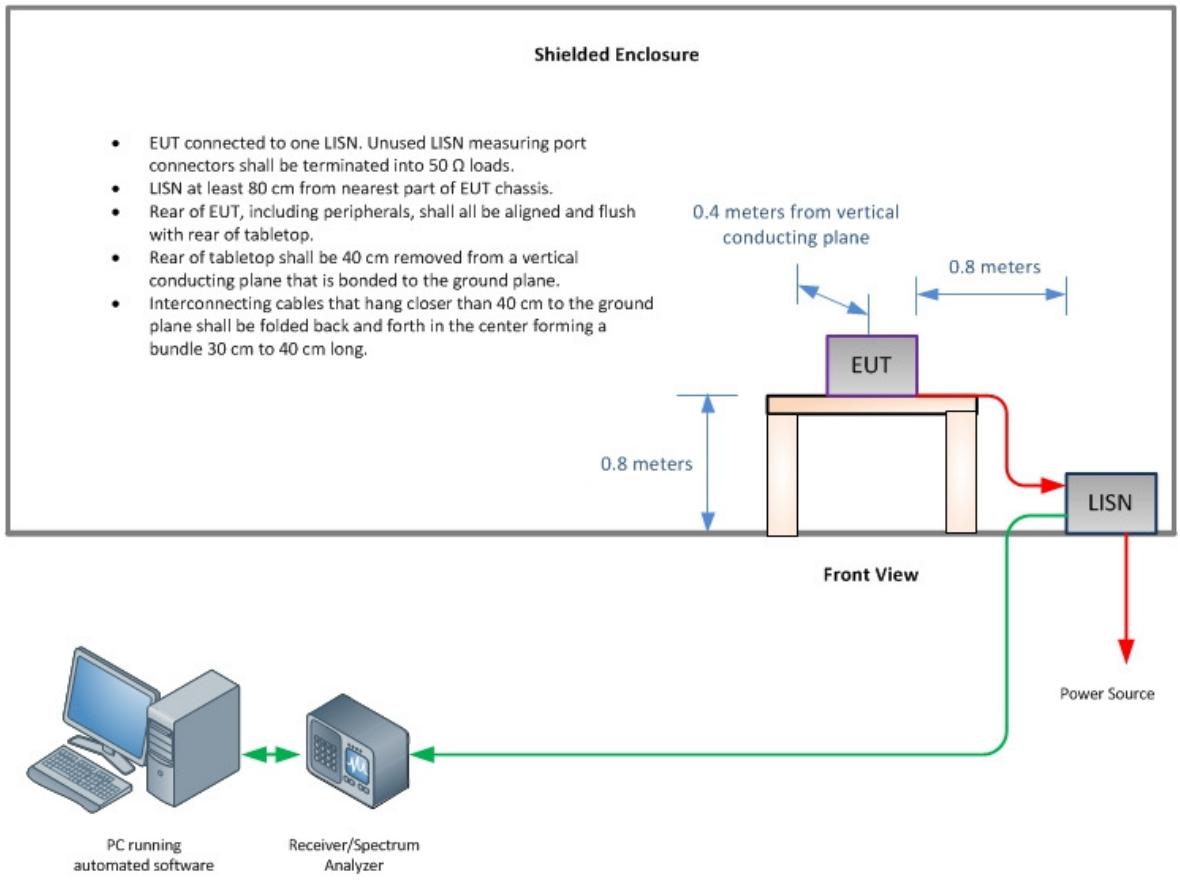
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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