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Report On

Application for Grant of Equipment Authorization of the
Deere and Company
PH85234863 Controller

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

Report No.WW72137311-0318B

April 2018

REPORT ON EMC Evaluation of the
Deere and Company
MowerPlus Smart Connector Controller

TEST REPORT NUMBER WW72137311-0318B

TEST REPORT DATE April 2018

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Deere and Company
MowerPlus Smart Connector Controller

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Deere and Company MowerPlus Smart Connector Controller 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	Deere and Company
EUT	Controller
Model Name	MowerPlus Smart Connector
Model Number(s)	PH85234863
FCC ID	2AAFX-PH85234863
IC Number	11137A-PH85234863
FCC Classification	Low Power Communications Device Transmitter (DTS)
Serial Number(s)	PHCN001400018 (Conducted) PHCN001400004 (Radiated)
Number of Samples Tested	2
Test Specification/Issue/Date	<ul style="list-style-type: none">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 4, November 2014).
Start of Test	April 03, 2018
Finish of Test	April 06, 2018
Name of Engineer(s)	Xiaoying Zhang Ferdinand S. Custodio
Related Document(s)	<ul style="list-style-type: none">KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247.Prescan Test Instructions for TUV.docxSupporting 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	
-	§15.207(a)	RSS-Gen 8.8	Conducted Emissions	N/A	
2.2	-	RSS-Gen 6.6	99% Emission Bandwidth	Compliant	
2.3	§15.247(a)(2)	RSS-247 5.2(a)	Minimum 6 dB RF Bandwidth	Compliant	
2.4	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
2.5	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
2.6	§15.247(d)	RSS-247 5.5	Radiated Spurious Emissions	Compliant	
-	-	RSS-Gen 7.1	Receiver Spurious Emissions	N/A*	
2.7	§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 has no receiver stand-alone mode.

N/A EUT is not equipped to operate from the public utility AC power supply either directly or indirectly.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is a Deere and Company MowerPlus Smart Connector. The EUT will read vehicle information from the CAN bus and convey that information to the user's mobile device via Bluetooth.

1.3.2 EUT General Description

EUT Description	Controller
Model Name	PH85234863
Rated Voltage	12 VDC
Mode Verified	BT LE
Capability	BT LE
Primary Unit (EUT)	<input checked="" type="checkbox"/> Production <input type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
Manufacturer Declared Temperature Range	-40°C to 85°C
Antenna Manufacturer	John Deere
Antenna Type	Inverted F PCB antenna.
Antenna Model	N/A
Maximum Antenna Gain	0.3 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Avg Output Power (dBm)	Avg Output Power (mW)	Peak Output Power (dBm)	Peak Output Power (mW)
	2402-2480	11.43	13.9	12.37	17.26

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	Manufacturer provided detailed instructions how to exercise the EUT during verification. Procedure was documented in the document "Prescan Test Instructions for TUV.docx" provided by the client. RF configuration of the EUT were configured through a UART connection through a laptop running TeraTerm.

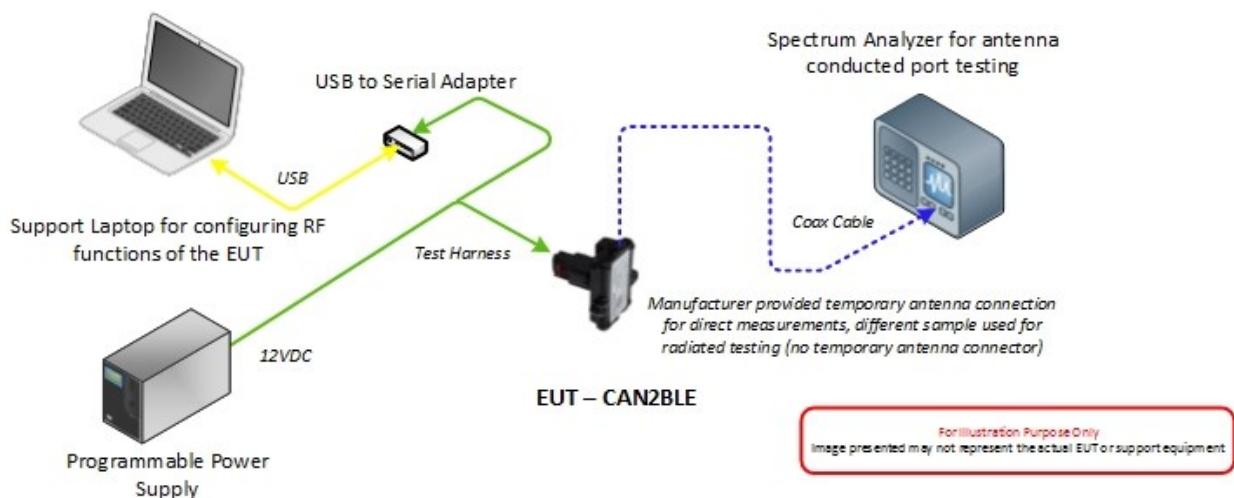
1.4.2 EUT Exercise Software

Terminal emulator TeraTerm release 4.98.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
HP	Support Laptop	ZBook 15 G2 S/N CND621590W
EverStart	12VDC Battery	Maxx Marine Battery, Group Size 29DC
Protek	Laboratory Programmable Power Supply	M/N 35010M S/N D102007S
-	Custom test harness	1.5 meters, unshielded custom cable
Belkin	USB to Serial Adapter	P/N F5U257 Serial Adapter

1.4.4 Simplified Test Configuration Diagram

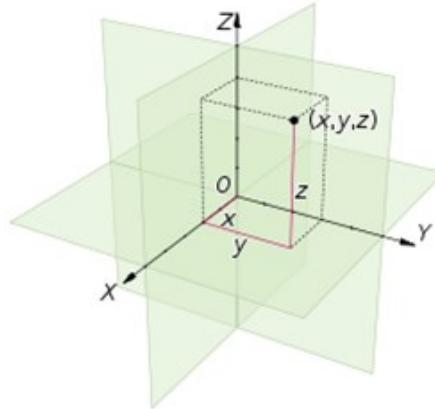


1.4.5 Worst Case Configuration

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

Mode	Channel	Data Rate
Bluetooth LE	37 (Low Channel)	1Mbps

EUT is a mobile device. Final installation position is only at Y orientation. For radiated measurements verifications performed using "Y" configuration. "Y" configuration is when the label of the EUT is facing the receive antenna vertically.



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: PHCN001400018 (conducted) and PHCN001400004 (radiated)		
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.

FCC ID: 2AAFX-PH85234863
IC: 11137A-PH85234863
Report No. WW72137311-0318B



SECTION 2

TEST DETAILS

Radio Testing of the
Deere and Company
PH85234863 Controller

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: PHCN001400018 / Default Test Configuration

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

April 5, 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	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.1kPa

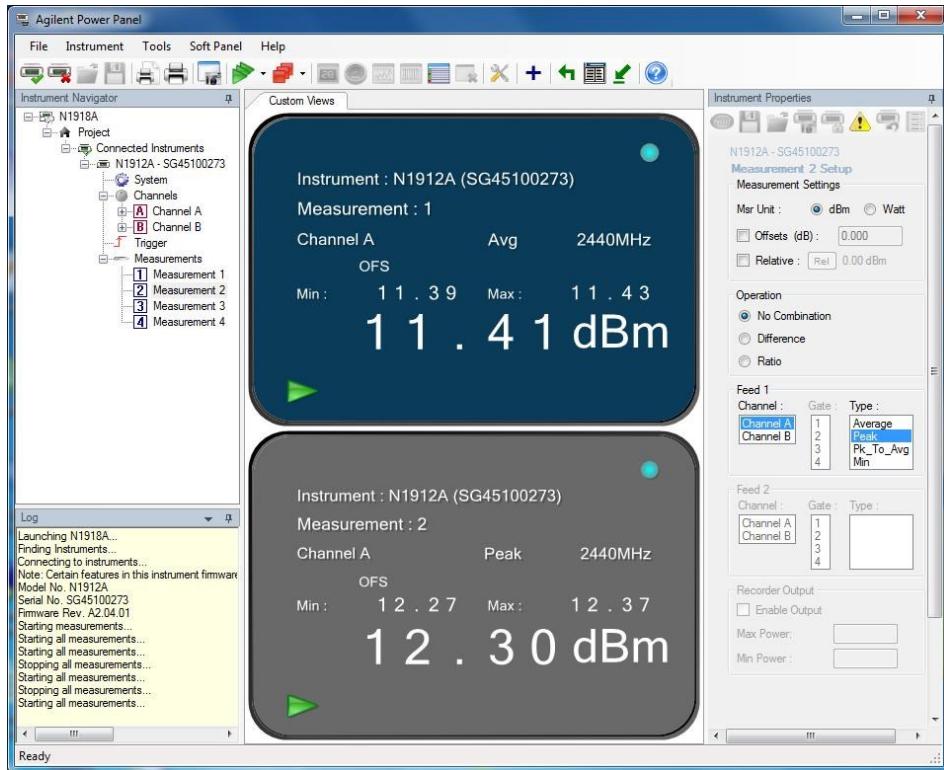
2.1.7 Additional Observations

- 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 9.2.3.1 of KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017). 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	11.12	12.07
	17 (2440 MHz)	11.43	12.37	
	39 (2480 MHz)	11.14	12.06	

2.1.9 Sample Test Display



Bluetooth LE. Mid Channel 1Mbps

2.1.10 Duty Cycle Calculation (for Band Edge calculations)



$$\text{Duty Cycle} = \text{On Time} / (\text{On Time} + \text{off Time}) = 2.10621 / 2.49825 = 0.843$$



$$\text{Duty Cycle} = \text{On Time} / (\text{On Time} + \text{off Time}) = 2.10621 * 7 / 17.45775 = 0.845$$

2.2 99% EMISSION BANDWIDTH

2.2.1 Specification Reference

RSS-Gen Clause 6.6

2.2.2 Standard Applicable

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3x RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

2.2.3 Equipment Under Test and Modification State

Serial No: PHCN001400018 / Default Test Configuration

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

April 05, 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

Ambient Temperature	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.2kPa

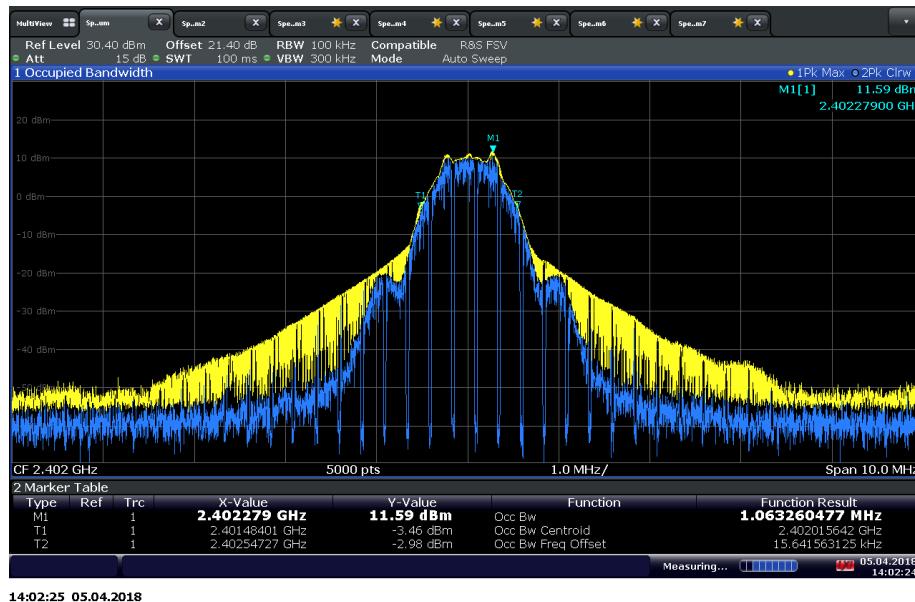
2.2.7 Additional Observations

- 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 3X 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.

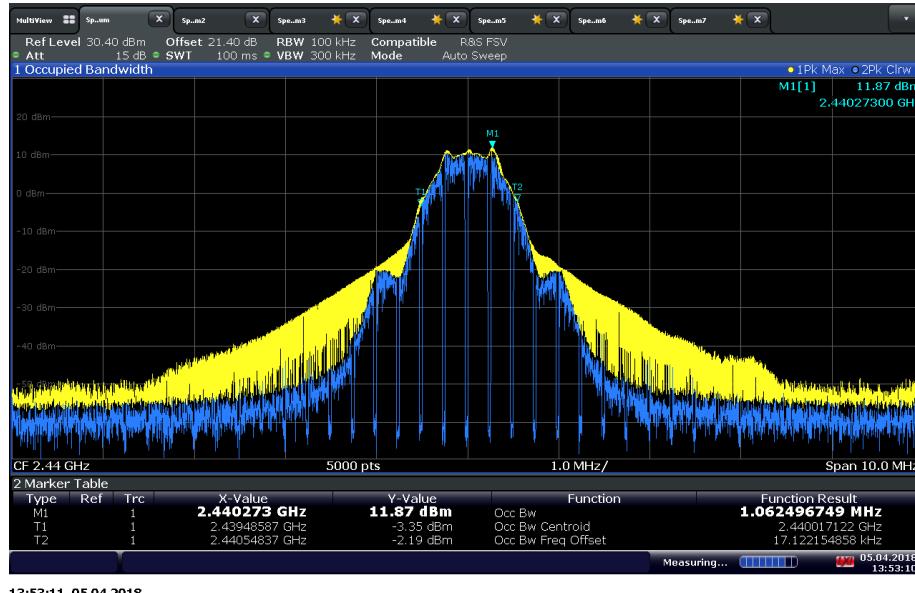
2.2.8 Test Results (For reporting purposes only)

Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	37 (2402 MHz)	1.06
	17 (2440 MHz)	1.06
	39 (2480 MHz)	1.06

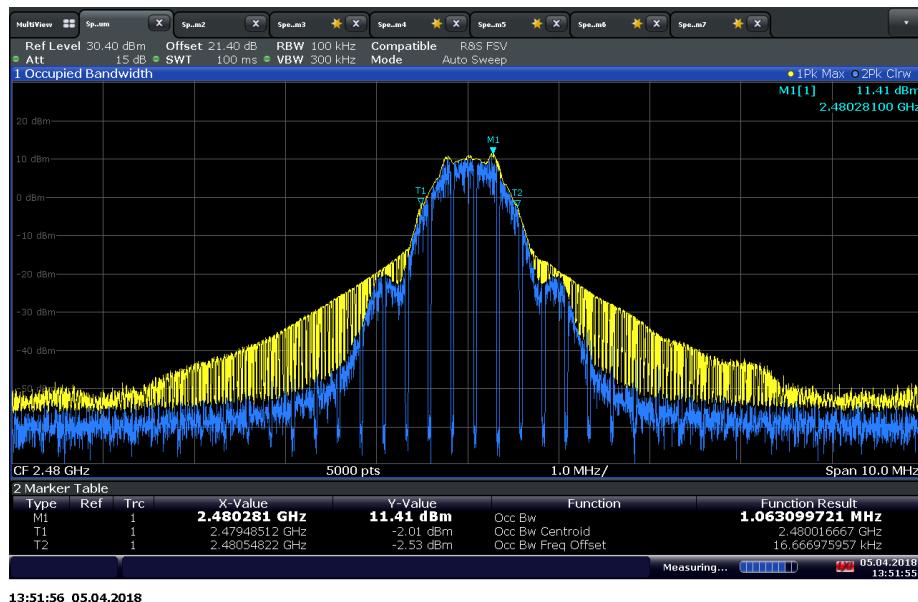
2.2.9 Test Results Plots



Bluetooth LE Low Channel



Bluetooth LE Mid Channel



Bluetooth LE High Channel

2.3 MINIMUM 6 dB RF BANDWIDTH

2.3.1 Specification Reference

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

2.3.2 Standard Applicable

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

2.3.3 Equipment Under Test and Modification State

Serial No: PHCN001400018 / Default Test Configuration

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

April 05, 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	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.2kPa

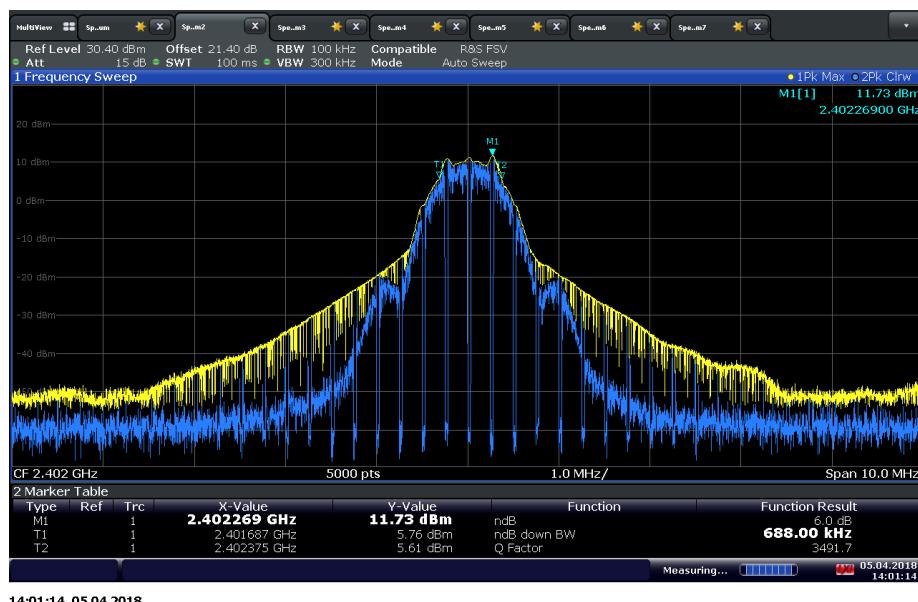
2.3.7 Additional Observations

- 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 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.

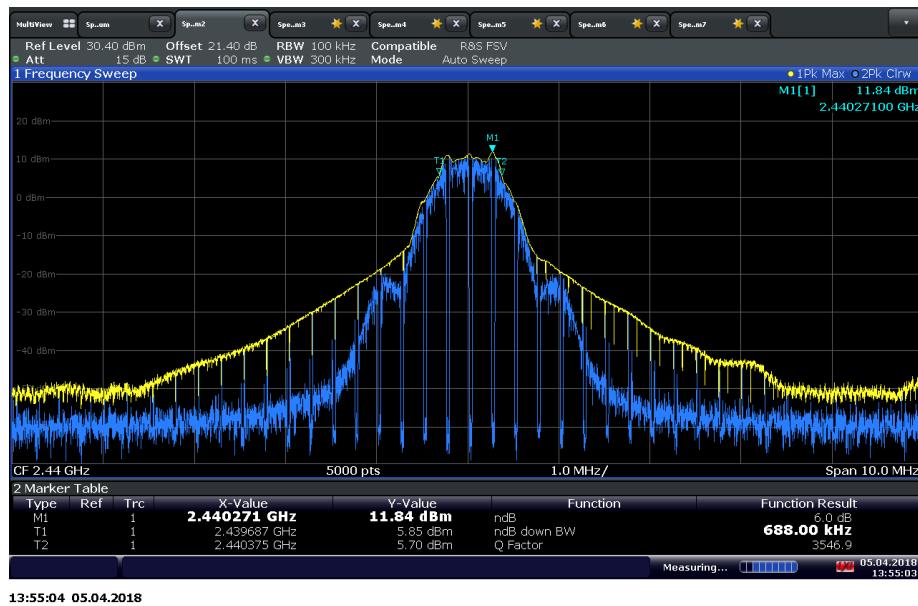
2.3.8 Test Results

Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	37 (2402 MHz)	0.688	0.500	Complies
	17 (2440 MHz)	0.688	0.500	Complies
	39 (2480 MHz)	0.680	0.500	Complies

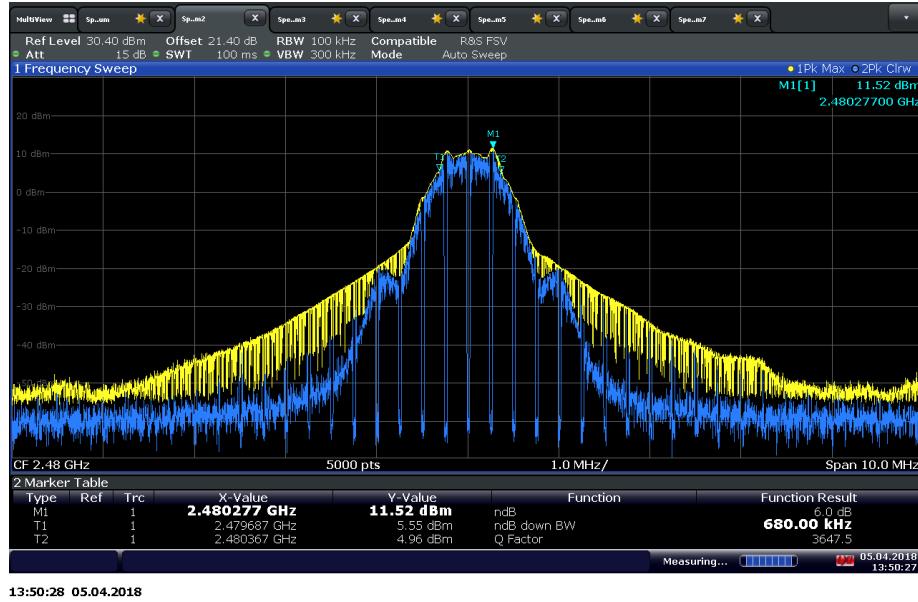
2.3.9 Test Results Plots



Bluetooth LE Low Channel



Bluetooth LE Mid Channel



Bluetooth LE High Channel

2.4 OUT-OF-BAND EMISSIONS - CONDUCTED

2.4.1 Specification Reference

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

2.4.2 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)).

2.4.3 Equipment Under Test and Modification State

Serial No: PHCN001400018 / Default Test Configuration

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

April 05, 2018/XYZ

2.4.5 Test Equipment Used

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

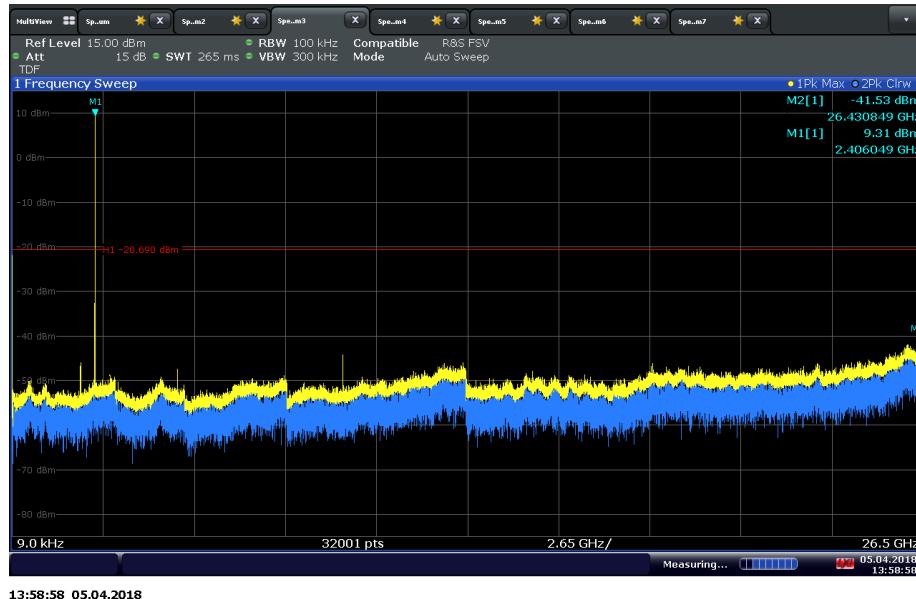
2.4.6 Environmental Conditions

Ambient Temperature	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.1kPa

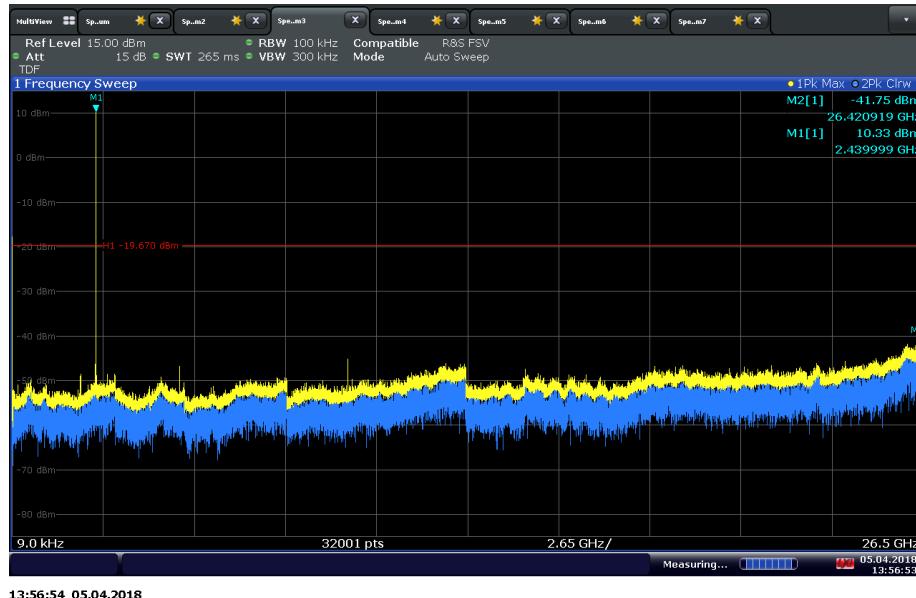
2.4.7 Additional Observations

- 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.

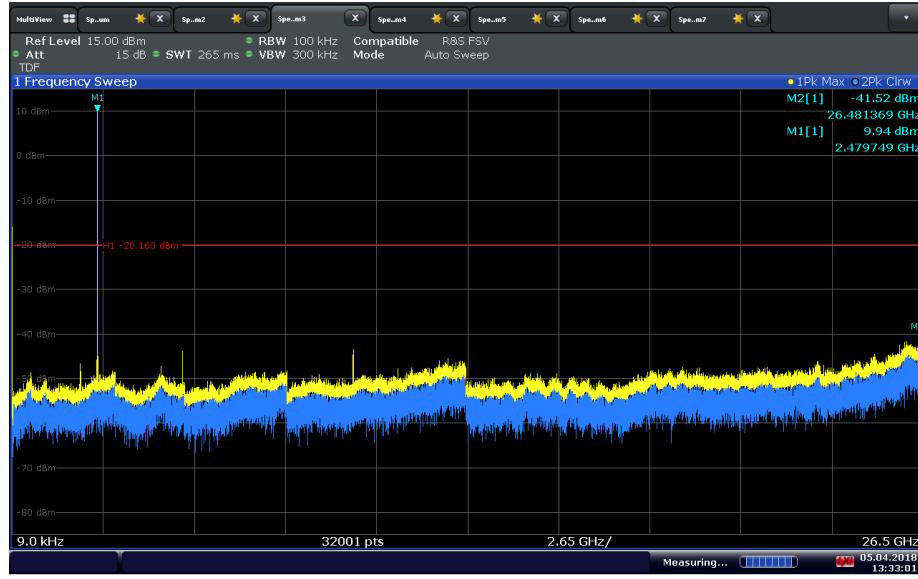
2.4.8 Test Results Plots



Bluetooth LE Low Channel



Bluetooth LE Mid Channel



Bluetooth LE High Channel

2.5 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.5.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
FCC 47 CFR Part 15, Clause 15.205
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: PHCN001400018 / Default Test Configuration

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

April 5, 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	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.1kPa

2.5.7 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 13.3.1 of KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017); 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.

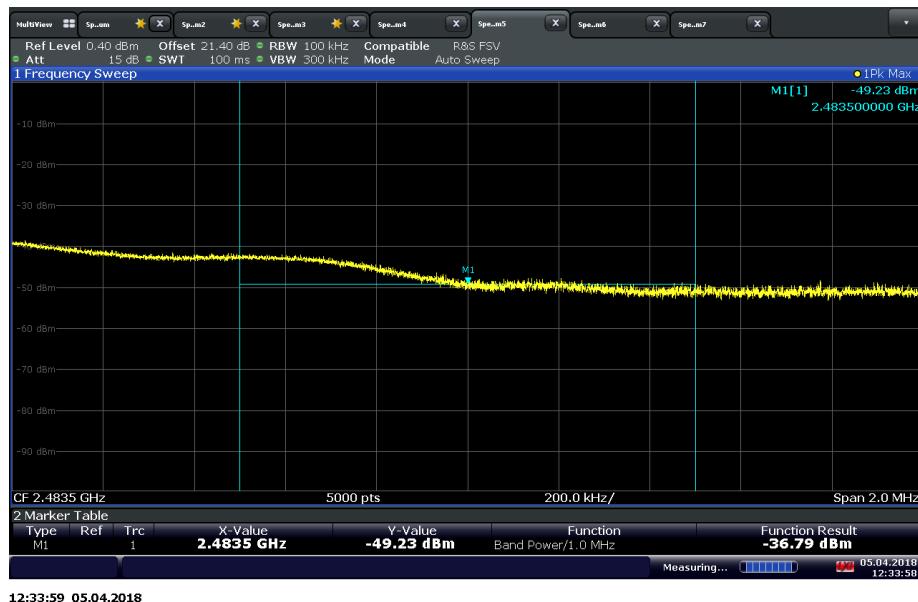
2.5.8 Test Results



Bluetooth LE Low Band Edge 2400MHz (Peak Measurement). Complies with worse case 30 dBc requirement (9.31dBm) from Section 2.4.8 of this test report



Bluetooth LE Low Band Edge 2400 MHz (Average Measurement). Complies with worse case 30 dBc requirement (9.31dBm) from Section 2.4.8 of this test report



Bluetooth LE Upper Band Edge 2483.5MHz (Peak Measurement) @ Ch 2480 MHz

Upper band edge calculation (2483.5 MHz):

- 2483.5 MHz (in the restricted bands)
- Use the following formula as per Section 12.2.2 (e) in KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017):

$$\begin{aligned}
 E(\text{dB}\mu\text{V}/\text{m}) &= \text{EIRP (dBm)} + 95.26 \\
 &= (-36.79 \text{ dBm} + 0.3 \text{ dBi antenna gain}) + 95.26 \\
 &= 58.777 \text{ dB}\mu\text{V}/\text{m} @ 3 \text{ meters} \text{ (Complies with 74 dB}\mu\text{V}/\text{m limit)}
 \end{aligned}$$



Bluetooth LE High Channel (2480 MHz)

Upper band edge calculation (2483.5 MHz):

- 2483.5 MHz (in the restricted bands)
- Use the following formula as per Section 12.2.2 (e) in KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017):

$$\begin{aligned}
 E(\text{dB}\mu\text{V/m}) &= \text{EIRP (dBm)} + \text{Duty Cycle Correction Factor} + 95.26 \\
 &= (-54.19 \text{ dBm} + 0.3 \text{ dBi antenna gain}) + 10\lg(1/0.85) + 95.26 \\
 &= 42.08 \text{ dB}\mu\text{V/m} @ 3 \text{ meters} \text{ (Complies with 54 dB}\mu\text{V/m limit)}
 \end{aligned}$$

2.6 RADIATED SPURIOUS EMISSIONS

2.6.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.247(d)
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: PHCN001400004 / Default Test Configuration

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

April 04, 2018/FSC

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions

Ambient Temperature	21.7°C
Relative Humidity	54.9%
ATM Pressure	99.5kPa

2.6.7 Additional Observations

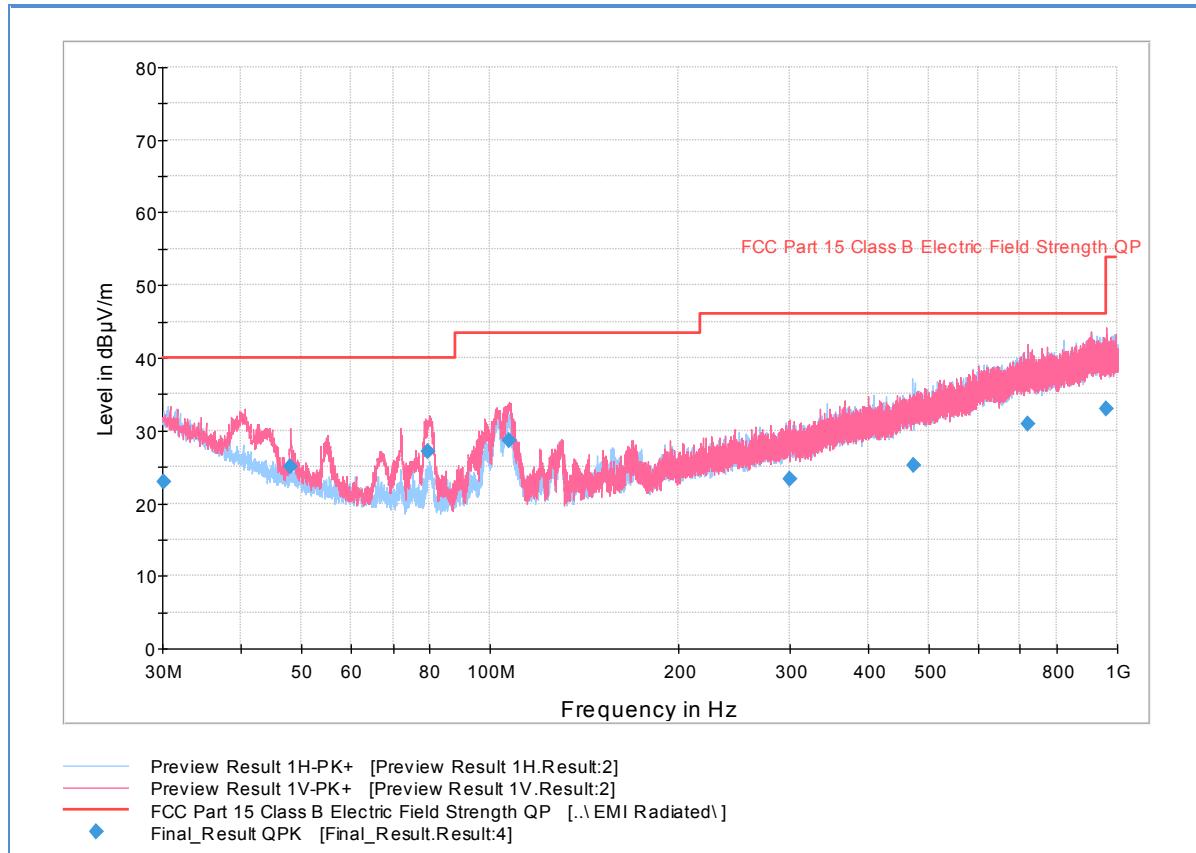
- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case BLE (Low Channel) presented for below 1GHz. There are no significant 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 2.6.8 for sample computation.

2.6.8 Sample Computation (Radiated Emission)

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

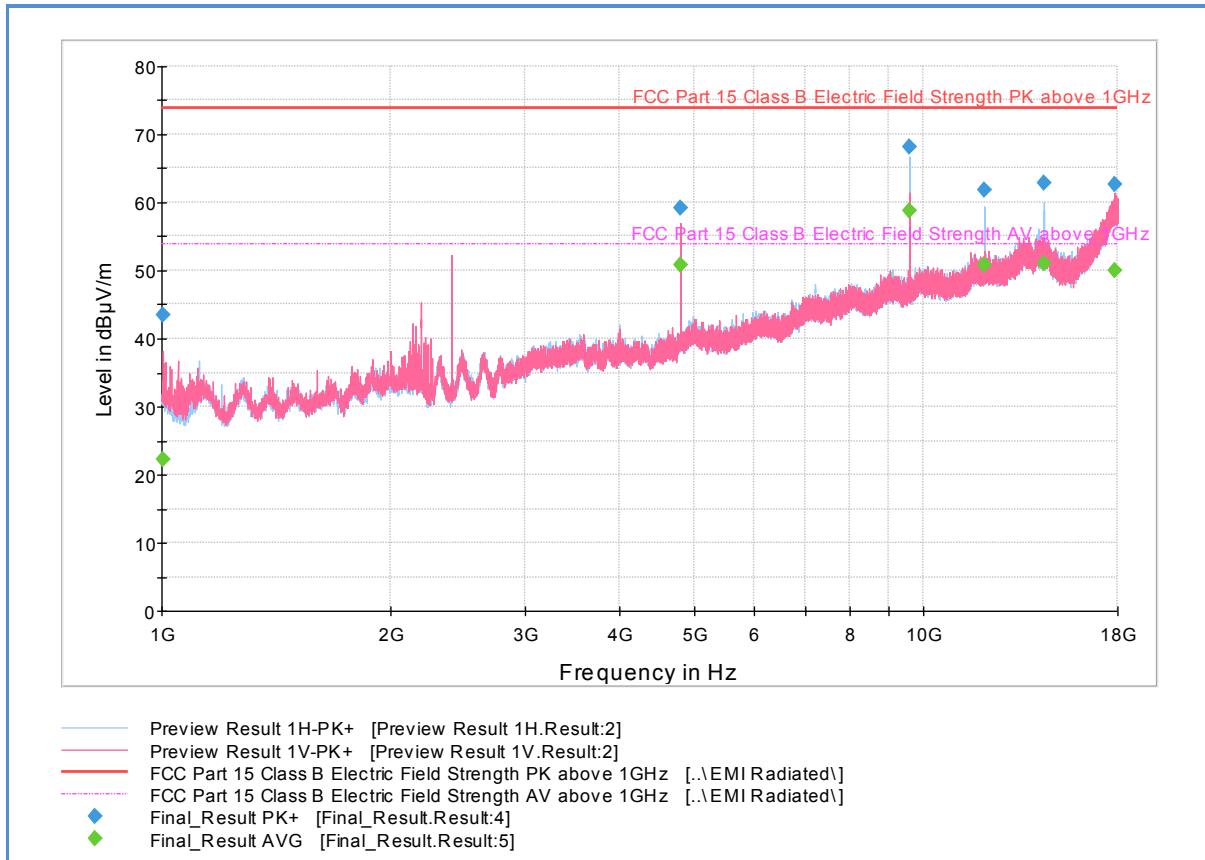
2.6.9 Worst case Test Results for Below 1GHz – Low Channel



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
30.160000	22.89	1000.0	120.000	274.8	H	128.0	25.2	17.11	40.00
47.969667	25.04	1000.0	120.000	99.9	V	13.0	17.0	14.96	40.00
79.627333	27.09	1000.0	120.000	125.3	V	184.0	14.0	12.91	40.00
107.307333	28.72	1000.0	120.000	103.6	V	298.0	16.1	14.78	43.50
300.223333	23.37	1000.0	120.000	108.7	V	173.0	22.8	22.63	46.00
472.442000	25.27	1000.0	120.000	218.9	H	225.0	27.3	20.73	46.00

2.6.10 Test Results for Above 1GHz - Low Channel



Peak Data

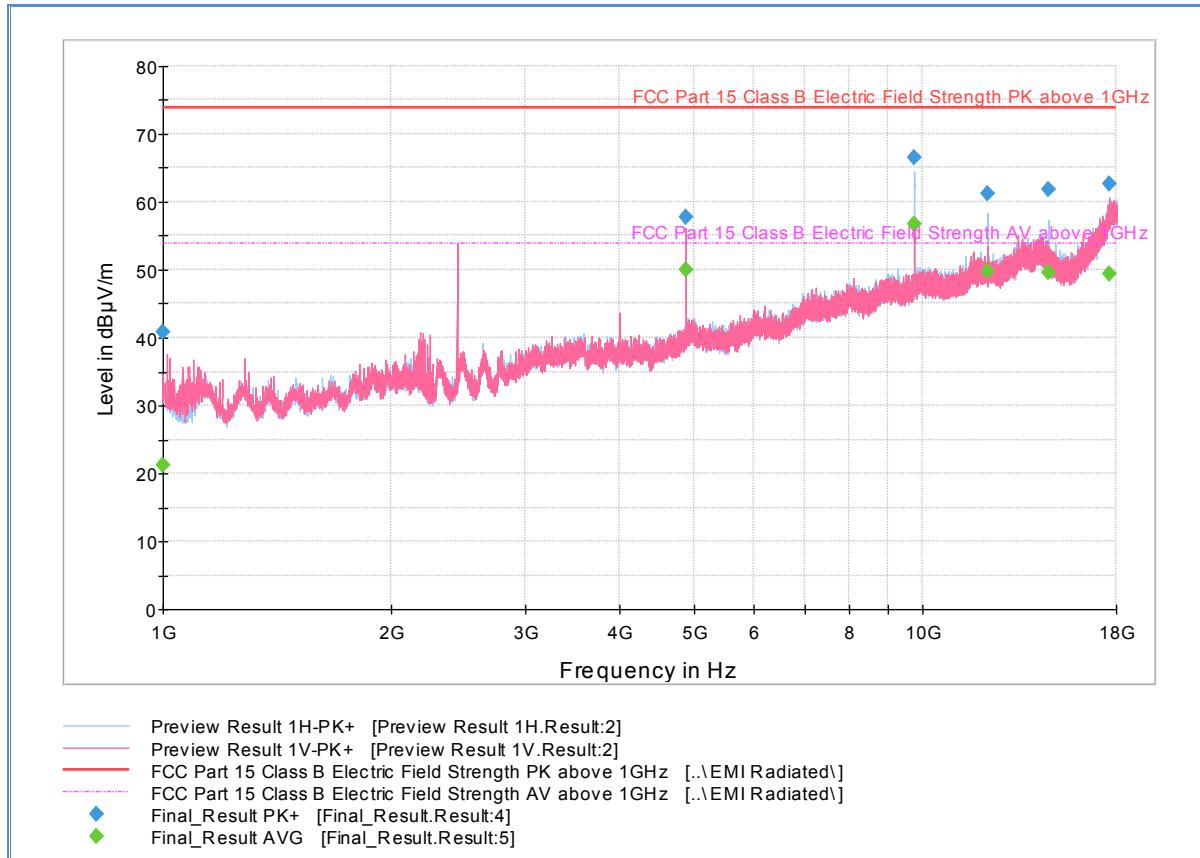
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1005.200000	43.52	1000.0	1000.000	225.3	V	298.0	-4.5	30.38	73.90
4804.633333	59.28	1000.0	1000.000	396.0	V	278.0	10.4	14.62	73.90
9609.166667	68.25	1000.0	1000.000	278.7	H	302.0	20.8	5.65	73.90
12008.86666	61.76	1000.0	1000.000	197.3	H	51.0	23.4	12.14	73.90
14410.56666	62.76	1000.0	1000.000	188.7	H	17.0	26.3	11.14	73.90
17830.13333	62.56	1000.0	1000.000	311.4	V	2.0	32.1	11.34	73.90

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1005.200000	22.34	1000.0	1000.000	225.3	V	298.0	-4.5	31.56	53.90
4804.633333	50.83	1000.0	1000.000	396.0	V	278.0	10.4	3.07	53.90
9609.166667	58.76	1000.0	1000.000	278.7	H	302.0	20.8	-4.86	53.90
12008.86666	50.92	1000.0	1000.000	197.3	H	51.0	23.4	2.98	53.90
14410.56666	51.11	1000.0	1000.000	188.7	H	17.0	26.3	2.79	53.90
17830.13333	50.02	1000.0	1000.000	311.4	V	2.0	32.1	3.88	53.90

Test Notes: 9609.17 MHz is not in the restricted band and will be subjected to 30dBc limit based from 11.73 dBm EIRP Average measurement. Since 11.73 dBm EIRP = 106.96 dBμV/m @ 3 meters, therefore $106.96 - 58.76 = 48.2$ dB (Complies). Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.6.11 Test Results for Above 1GHz - Middle Channel



Peak Data

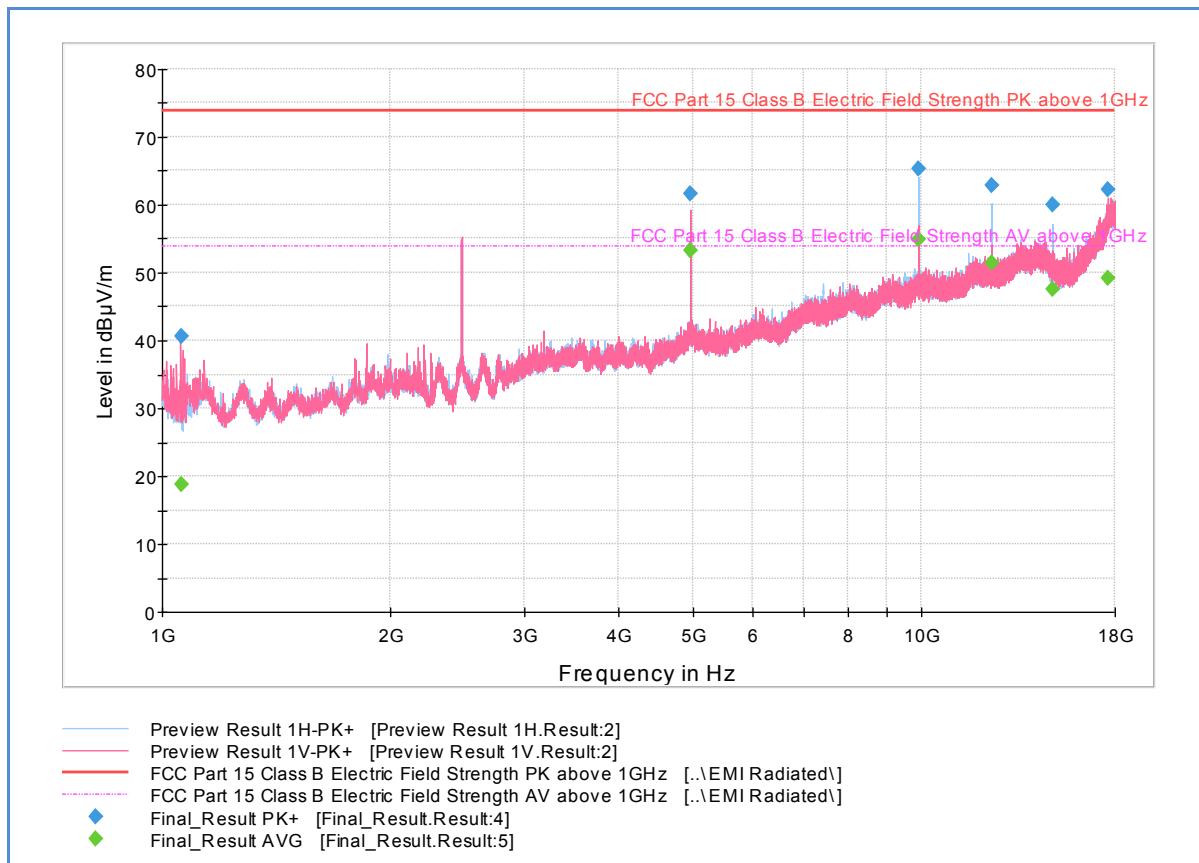
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.800000	40.89	1000.0	1000.000	174.7	V	335.0	-4.6	33.01	73.90
4879.600000	57.74	1000.0	1000.000	288.3	V	268.0	10.8	16.16	73.90
9759.033333	66.54	1000.0	1000.000	211.8	H	301.0	21.2	7.36	73.90
12201.500000	61.14	1000.0	1000.000	274.6	H	294.0	23.3	12.76	73.90
14641.700000	61.83	1000.0	1000.000	207.7	H	-2.0	25.7	12.07	73.90
17654.100000	62.64	1000.0	1000.000	410.2	V	10.0	31.0	11.26	73.90

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1000.800000	21.15	1000.0	1000.000	174.7	V	335.0	-4.6	32.75	53.90
4879.600000	49.91	1000.0	1000.000	288.3	V	268.0	10.8	3.99	53.90
9759.033333	56.80	1000.0	1000.000	211.8	H	301.0	21.2	-2.90	53.90
12201.500000	49.87	1000.0	1000.000	274.6	H	294.0	23.3	4.03	53.90
14641.700000	49.66	1000.0	1000.000	207.7	H	-2.0	25.7	4.24	53.90
17654.100000	49.47	1000.0	1000.000	410.2	V	10.0	31.0	4.43	53.90

Test Notes: 9759.03 MHz is not in the restricted band and will be subjected to 30dBc limit based from 11.73 dBm EIRP Average measurement. Since 11.73 dBm EIRP = 106.96 dBμV/m @ 3 meters, therefore 106.96 – 56.80 = 50.16 dB (Complies). Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.6.12 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)
1062.000000	40.65	1000.0	1000.000	307.9	V	200.0	-4.0	33.25	73.90
4960.633333	61.59	1000.0	1000.000	300.6	V	261.0	11.0	12.31	73.90
9921.233333	65.21	1000.0	1000.000	314.6	H	300.0	21.8	8.69	73.90
12398.733333	62.79	1000.0	1000.000	209.2	H	273.0	23.4	11.11	73.90
14878.60000	60.04	1000.0	1000.000	225.1	H	104.0	24.9	13.86	73.90
17621.83333	62.16	1000.0	1000.000	125.3	V	124.0	30.7	11.74	73.90

Average Data

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1062.000000	18.82	1000.0	1000.000	307.9	V	200.0	-4.0	35.08	53.90
4960.633333	53.32	1000.0	1000.000	300.6	V	261.0	11.0	0.58	53.90
9921.233333	54.98	1000.0	1000.000	314.6	H	300.0	21.8	-1.08	53.90
12398.733333	51.51	1000.0	1000.000	209.2	H	273.0	23.4	2.39	53.90
14878.60000	47.56	1000.0	1000.000	225.1	H	104.0	24.9	6.34	53.90
17621.83333	49.23	1000.0	1000.000	125.3	V	124.0	30.7	4.67	53.90

Test Notes: 9921.23 MHz is not in the restricted band and will be subjected to 30dBc limit based from 11.73 dBm EIRP Average measurement. Since 11.73 dBm EIRP = 106.96 dBµV/m @ 3 meters, therefore $106.96 - 54.98 = 51.98$ dB (Complies). Measurement was performed with a 2.4GHz notch filter. No significant emissions observed above 18GHz. Measurements above 18GHz were noise floor figures.

2.7 POWER SPECTRAL DENSITY

2.7.1 Specification Reference

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

2.7.2 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.

2.7.3 Equipment Under Test and Modification State

Serial No: PHCN001400018 / Default Test Configuration

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

April 05, 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

Ambient Temperature	20.5°C
Relative Humidity	59.3%
ATM Pressure	99.2kPa

2.7.7 Additional Observations

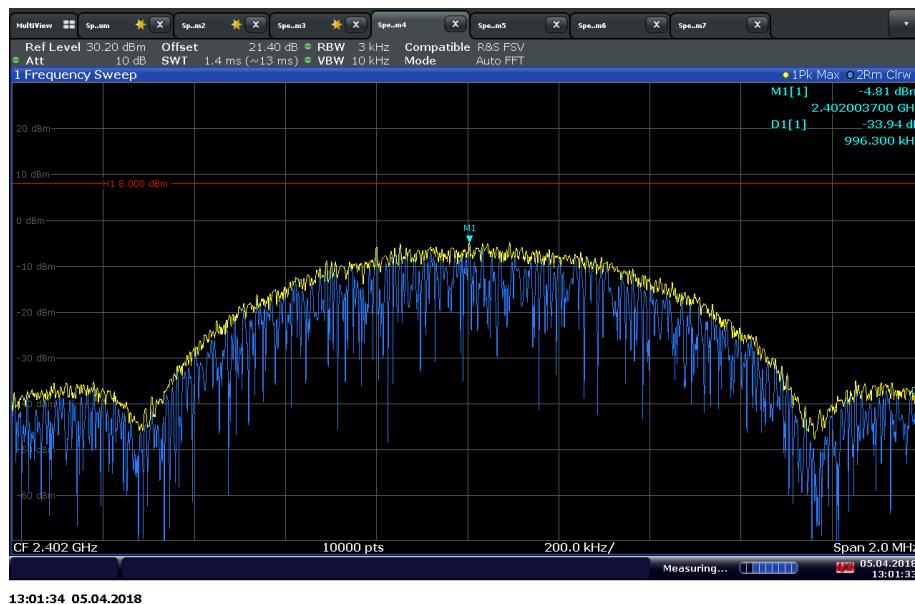
- This is a conducted test.
- Test procedure is per Section 10.2 of KDB 558074 D01 (DTS Meas Guidance v04, April 05, 2017).
- The path loss for was measured and entered as a level offset
- Detector is Peak.
- Trace is max hold.
- Sweep time is Auto.
- EUT complies with 3 kHz RBW.



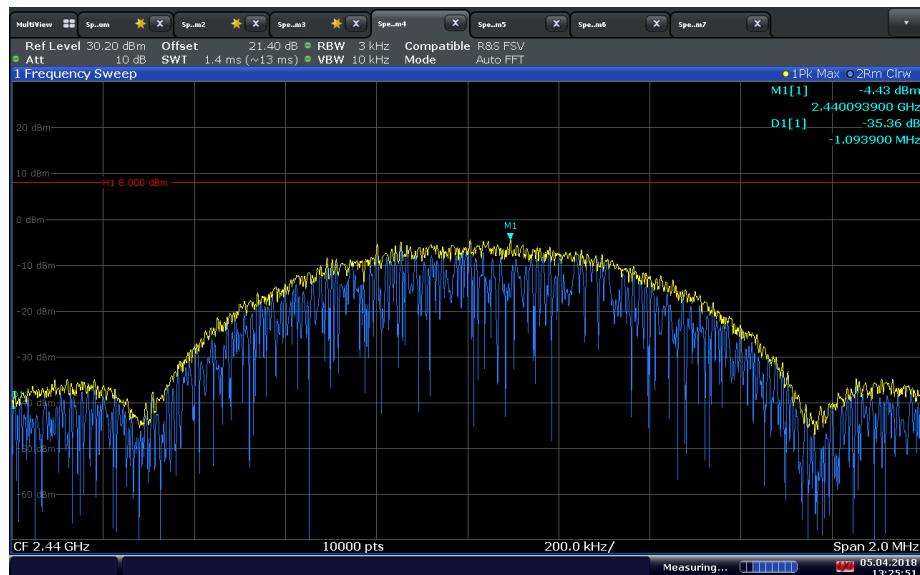
2.7.8 Test Results Summary

Mode	Channel	Data Rates (Mbps)	Marker Reading using 3 kHz RBW (dBm)	PSD Limit (dBm)	Margin (dB)	Compliance
Bluetooth LE	37 (2402 MHz)	GFSK @ 1Mbps	-4.81	8	3.19	Complies
	17 (2440 MHz)	GFSK @ 1Mbps	-4.43	8	3.57	Complies
	39 (2480 MHz)	GFSK @ 1Mbps	-4.76	8	3.24	Complies

2.7.9 Test Results Plots

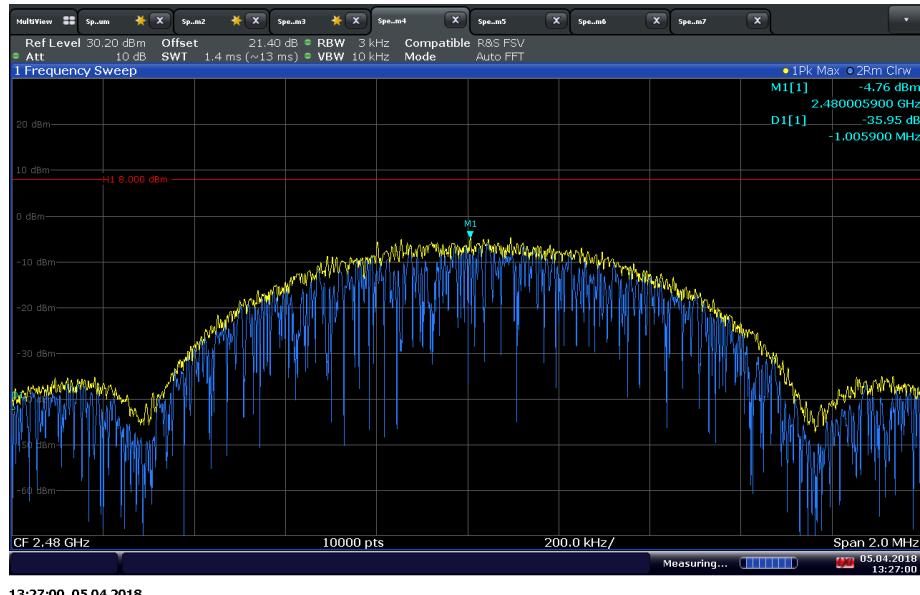


Bluetooth LE Low Channel



13:25:51 05.04.2018

Bluetooth LE Middle Channel



13:27:00 05.04.2018

Bluetooth LE High Channel

FCC ID: 2AAFX-PH85234863
IC: 11137A-PH85234863
Report No. WW72137311-0318B



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						
7604	P-Series Power Meter	N1912A	SG45100273	Agilent	08/14/17	08/14/18
7605	50MHz-18GHz Wideband Power Sensor	N1921A	MY51100054	Agilent	05/19/17	05/19/18
7582	Signal/Spectrum Analyzer	FSW26	101614	Rhode & Schwarz	12/14/17	12/14/18
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/30/17	05/30/18
7608	Vector Signal Generator	SMBV100A	259021	Rhode & Schwarz	09/19/17	09/19/19
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 1003 and 7582	
8832	20dB Attenuator	34-20-34	BP4150	MCE/Weinschel	Verified by 1003 and 7582	
Radiated Emission						
1033	Bilog Antenna	3142C	00044556	EMCO	10/11/16	10/11/18
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/17	06/15/18
7620	EMI Test Receiver	ESU40	100399	Rhode & Schwarz	10/17/17	10/17/18
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	05/30/17	05/30/18
7631	Double-ridged waveguide horn antenna	3117	00205418	ETS-Lindgren	08/03/17	08/03/18
8891	Pre-Amplifier	PE15A3262	1012	TUV SUD America	06/15/17	06/15/18
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 7620 and 1003	
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	Verified by 7620 and 1003	
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	Verified by 7620 and 1003	
1054	Horn antenna (18-40 GHz)	3116	9407-2233	EMCO	10/25/17	10/25/18
	Pre-amplifier (18-40 GHz)	SLKKa-30-6	15G27	Spacek Labs	Verified by 7620 and 1003	
Miscellaneous						
6708	Multimeter	34401A	US36086974	Hewlett Packard	07/05/17	07/05/18
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 Radiated Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.75	0.44	0.19
4	Antenna	Rectangular	3.52	1.44	2.07
5	Site	Rectangular	1.00	0.58	0.33
6	EUT Setup	Rectangular	0.45	0.26	0.07
		Combined Uncertainty (u_c):			1.66
		Coverage Factor (k):			2
		Expanded Uncertainty:			3.31

3.2.2 Radiated Emission Measurements (Above 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	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

3.2.3 Conducted Antenna Port Measurements

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.08	0.05	0.00
2	Cables	Rectangular	0.30	0.17	0.03
3	EUT Setup	Rectangular	0.50	0.29	0.08
		Combined Uncertainty (u_c):			0.34
		Coverage Factor (k):			1.96
		Expanded Uncertainty:			0.67

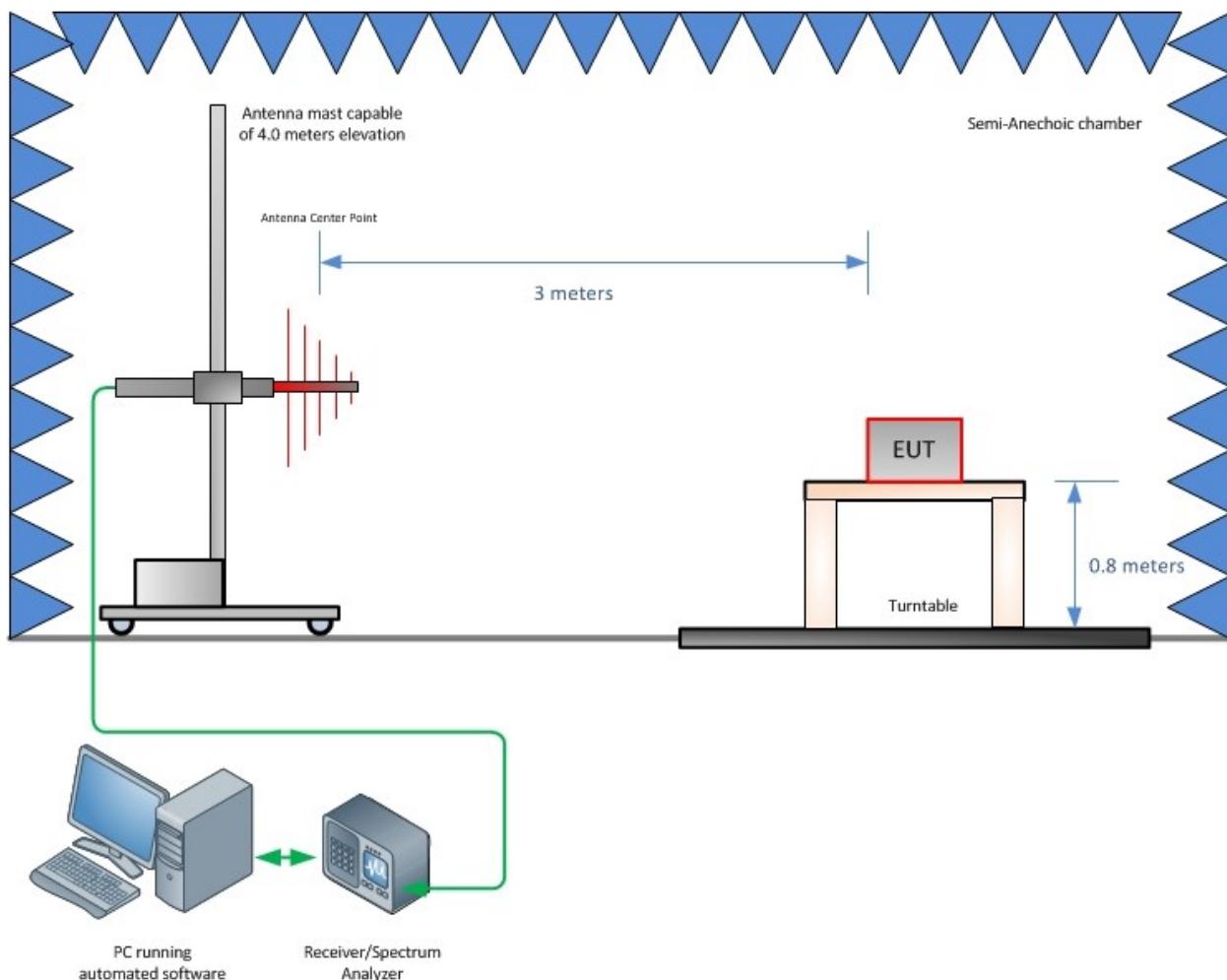
FCC ID: 2AAFX-PH85234863
IC: 11137A-PH85234863
Report No. WW72137311-0318B



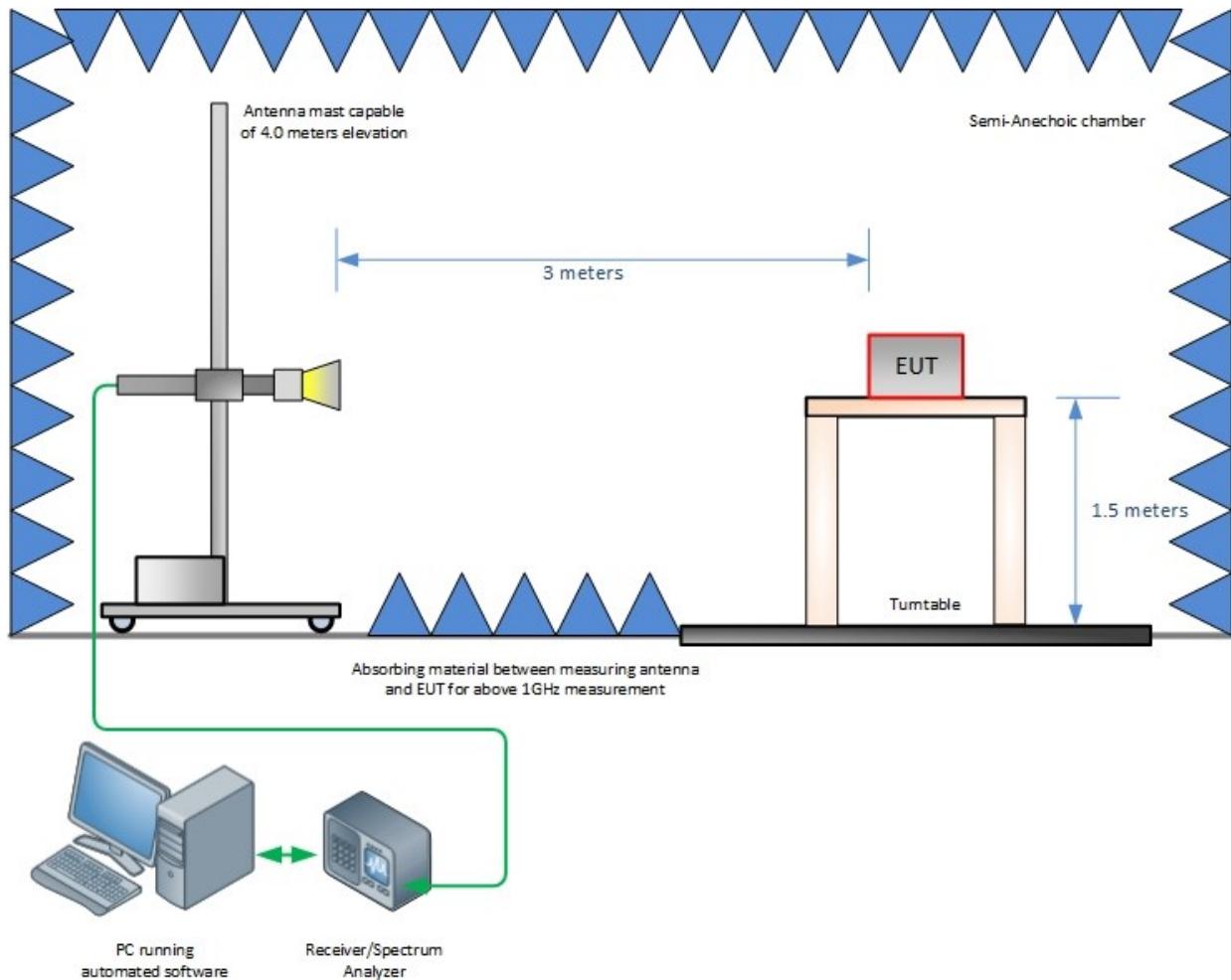
SECTION 4

DIAGRAM OF TEST SETUP

4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



FCC ID: 2AAFX-PH85234863
IC: 11137A-PH85234863
Report No. WW72137311-0318B



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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