FCC ID: MHAPHYSDT
IC: 5681A-PHYSDT

Report On

Application for Grant of Equipment Authorization of the
Data Sciences International
PhysioDetect, F1

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

Report No.NC72145027.1 Rev A February 2019

REPORT ON	EMC Evaluation of the Data Sciences International PhysioDetect, F1
TEST REPORT NUMBER	NC72145027.1 Rev A
TEST REPORT DATE	February 2019
PREPARED FOR	Data Sciences International 16550 West Bernardo Drive, Bldg 5, Suite 550 San Diego, CA 92127, USA
CONTACT PERSON	Matt Kunz Sr. Principal Engineer, Regulatory mkunz@datasci.com (651) 414-5410
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APPROVED BY	Joel Schneider **Name** Authorized Signatory Title: Senior EMC Engineer
DATED	12 February 2019

Revision History

DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
07 Feb 2019	Initial Release				
12 Feb 2019		Rev A	Correcting Model name to PhysioDetect, F1	1, 2, 5, 6, 8, 17	NA

CONTENTS

SECTION 1

REPORT SUMMARY

Radio Testing of the
Data Sciences International
PhysioDetect, F1

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Data Sciences International PhysioDetect, F1 radio 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	Data Sciences International
EUT	p/n 275-0027-001
Model Name	PhysioDetect, F1
FCC Classification	Low power Communications device Transmitter (DTS)
Serial Number(s)	1047157
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (December 20, 2018). • 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, November 2018).
Start of Test	January 11, 2019
Finish of Test	January 24, 2019
Name of Engineer(s)	Greg Jakubowski
Related Document(s)	• KDB 558074 D01 (DTS Meas Guidance v05, August 24, 2018). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247. • 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	
-	-	RSS-Gen 6.7	99% Emission Bandwidth	Compliant	
-	§15.247(a)(2)	RSS-247 5.2(a)	Minimum 6 dB RF Bandwidth	Compliant	
-	§15.247(d)	RSS-247 5.5	Out-of-Band Emissions - Conducted	Compliant	
-	§15.247(d)	RSS-247 5.5	Band-edge Compliance of RF Conducted Emissions	Compliant	
-	§15.247(d)	RSS-247 5.5	Radiated Spurious Emissions	Compliant	
-	-	RSS-Gen 7.1	Receiver Spurious Emissions	N/A	
2.3	§15.247(d)	RSS-247 5.5	Radiated Band Edge Measurements and Restricted Bands	Compliant	
-	§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.

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is a Data Sciences International PhysioDetect, F1 with Bluetooth Low Energy. The EUT uses two bi-directional radios. One is a Bluetooth Low Energy (BLE) 2.4GHz radio to communicate with a tablet or phone and the other communicates with DSI's PhysioTel Digital implants. The differing implant models will communicate at 916MHz for US/Japan, 868MHz for Europe, and 795MHz for China covering most of DSI's global markets. PhysioDetect is essentially a battery operated, hand held device repeater between a tablet running DSI's custom app and it's digital implants. The Gateway Module is housed in a small hand-held plastic enclosure powered by a lithium ion battery. A USB-C port is used for charging purposes only, no USB communications. A single power on/off button controls the power with two LEDs indicating power and charging status. It will be attached to a tablet via a rugged tablet enclosure. PhysioDetect's main purpose is in a laboratory controlled benign environment. Only the BT Low Energy function of the EUT was verified in this test report.

1.3.2 EUT General Description

EUT Description	Gateway Module with Bluetooth Low Energy
Model Name	PhysioDetect, F1
Rated Voltage	1.7-3.6 VDC
Mode Verified	BT LE
Capability	BT LE
Primary Unit (EUT)	☐ Production
	☐ Pre-Production
	☒ Engineering
Manufacturer Declared Temperature Range	0°C to 40°C
Antenna Type	PCB Monopole
Manufacturer	Data Sciences International
Antenna Model	-
Maximum Antenna Gain	2 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Peak Output Power (dBm)	Peak Output Power (mW)
	2402-2480	1.95	1.567

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	The EUT is powered by an internal Lithium battery or a mini USB. The EUT is temporarily connected to a support laptop running UART Emulator Test Software. Test configuration files can then be uploaded to the EUT. The manufacturer provided test files to configure the EUT for transmit mode covering Low, Mid and High channels. For Conducted tests, the internal PCB antenna was bypassed by connecting a microwave coaxial connector & cable which adapts to an SMA connector. This port was connected to the Spectrum Analyser via an RF Cable. For Radiated tests, the external adapter cable is disconnected which re-engages the nominal internal PCB antenna.

1.4.2 EUT Exercise Software

The manufacturer provided configuration software (UART Emultor) running from a support laptop where the EUT is connected via a temporary ribbon cable.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Dell	Equip. Model: D630, DSI#10814	Support laptop
DSI	Equip.	Expander board
DSI	Cable	15 pin flat I/O ribbon
Florida RF Labs	6’ coax cable. #FL200.	TUV ID: NBLE03506 SMA
Murata	Miniaturized Microwave Coaxial Connector Cable	0.8D single shield FEP cable

1.4.5 Worst Case Configuration

Worst-case configuration used in this test report is determined by comparing the radiated field strength level at 2.4835GHz where the high channel's upper band meets a restricted band per FCC §15.205. Levels compared over 3 othogonal axes (i.e. on its back, upright, or side).

Mode	Channel	Data Rate
Bluetooth LE	80 (High Channel, 2.480 GHz)	2Mbps

Comparison at 2.4835 GHz

Power (Battery / USB)	**Axes** (Flat, Upright, Side)	**Polarity** (V/H)	**Antenna Height** (cm)	**Azimuth** (Degrees)	**Level** (dBuV)
Battery	Flat	h	171	357	62.32
Battery	Upright	v	136	43	62.89
Battery	Side	h	360	329	**64.18**
USB	Flat	h	171	328	61.6
USB	Upright	v	154	197	62.2
USB	Side	h	148	298	61.2

Final test position for radiated measurements were with the device oriented on its side. See test photos

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
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

141 14th St NW New Brighton, MN 55112 Phone: 651-631-2487 (45.071,-93.189)

1.9 TEST FACILITY REGISTRATION

1.9.1 A2LA Certificate Number 2955.11

TUV SUD America Inc. (New Brighton), 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 US1148.

1.9.2 Innovation, Science and Economic Development Canada (IC) Registration No.: 4512A

The 3m Semi-anechoic chamber of TUV SUD America Inc. (MN) has been registered by Certification and Engineering Bureau of Innovation, Science and Economic Development Canada for radio equipment testing with Registration No. 4512A.

SECTION 2

TEST DETAILS

Radio Testing of the
Data Sciences International
PhysioDetect, F1

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: 1047157 / Default Test Configuration

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

January 21-24, 2019 / GSJ

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	22-23°C
Relative Humidity	31-38%
ATM Pressure	98.5-99.8kPa

2.1.7 Additional Observations

- This is a conducted test (Maximum conducted [peak] output power) using direct connection to a spectrum analyzer.
- The path loss was measured and entered as a level offset.
- Test methodology is per Clause 8.3.1.1 of KDB 558074 D01 (DTS Meas Guidance v05, August 24, 2018). All conditions under this Clause are satisfied.
- Peak measurements were recorded.

2.1.8 Test Results

Bluetooth Low Energy (LE)	Channel	Modulation	Measured Peak Power (dBm)
	2 (2402 MHz)	GFSK @ 2Mbps	**1.95**
	40 (2440 MHz)		1.21
	80 (2480 MHz)		1.52

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 Additional Observations

- The EUT was verified using AC adapter supplied by the manufacturer.
- EUT verified using input voltage of 110VAC 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 BAT-EMC 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 2.2.4 for sample computation.

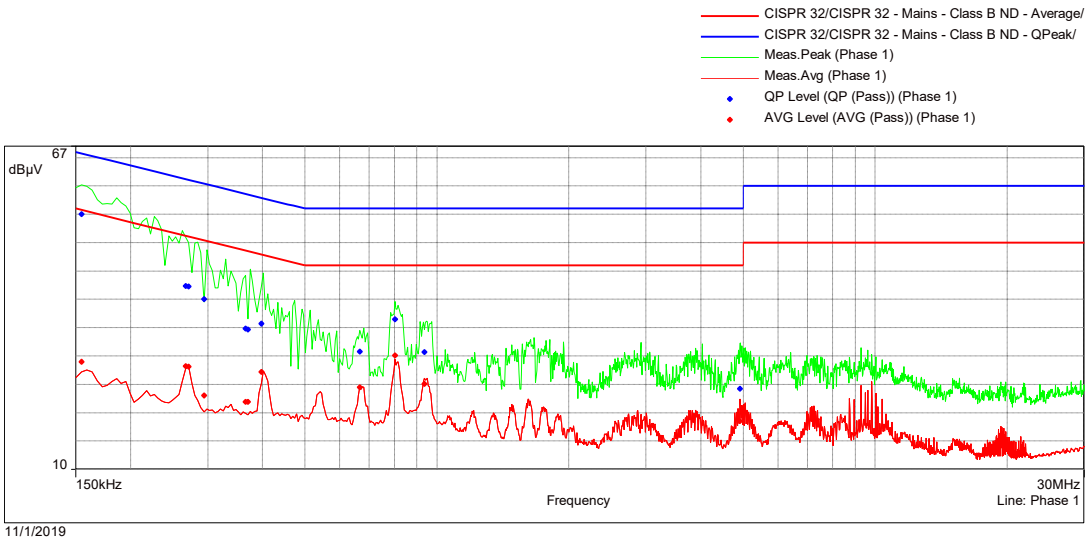
2.2.4 Sample Computation (Conducted Emission – Quasi Peak)

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**

2.2.5 Test Results - Conducted Emissions

L1 [110VAC, 60Hz] F1 w/ Apple supply.

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150kHz- 30MHz	L1	9kHz	4.5kHz	5000 ms/MHz



Limit:	Line Tested:	Test Results:
CISPR 32 - Mains - Class B	L1	Pass

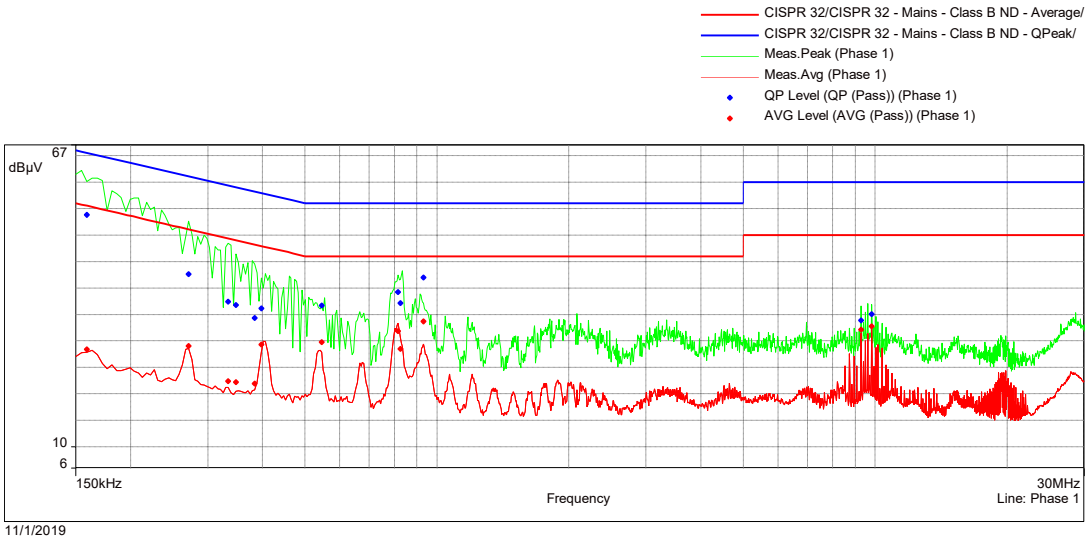
Test Notes: 110VAC 60Hz

L1 [110VAC, 60Hz] F1 w/ Apple supply.
Data Table

Frequency	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
153.026kHz	29.01	55.75	-26.74	55.02	65.75	-10.74	Pass
269.038kHz	28.17	51.21	-23.04	42.35	61.21	-18.87	Pass
269.897kHz	28.14	51.07	-22.93	42.22	61.07	-18.86	Pass
293.468kHz	23.05	50.41	-27.36	40.04	60.41	-20.37	Pass
367.635kHz	21.93	48.59	-26.66	34.82	58.59	-23.77	Pass
370.321kHz	21.88	48.49	-26.61	34.67	58.49	-23.82	Pass
399.532kHz	27.22	47.91	-20.68	35.73	57.91	-22.18	Pass
668.878kHz	24.46	46.00	-21.54	30.73	56.00	-25.27	Pass
803.526kHz	30.06	46.00	-15.94	36.43	56.00	-19.57	Pass
936.827kHz	25.05	46.00	-20.95	30.64	56.00	-25.36	Pass
4.920673MHz	18.55	46.00	-27.45	24.25	56.00	-31.75	Pass

N [110VAC, 60Hz] F1 w/ Apple supply.

Frequency Range	Line Tested	RBW	Step Size	Sweep Time
150kHz- 30MHz	N	9kHz	4.5kHz	5000 ms/MHz



Limit:	Line Tested:	Test Results:
CISPR 32 - Mains - Class B	N	Pass

Test Notes: 110VAC 60Hz

N [110VAC, 60Hz] F1 w/ Apple supply.
Data Table

Frequency	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)	QPeak (dBuV)	QPeak Limit (dBuV)	QPeak Margin (dB)	Result
158.923kHz	28.40	55.52	-27.11	53.78	65.52	-11.74	Pass
269.256kHz	29.00	51.07	-22.07	42.61	61.07	-18.46	Pass
335.686kHz	22.36	49.34	-26.98	37.39	59.34	-21.95	Pass
346.269kHz	22.24	49.01	-26.77	36.76	59.01	-22.25	Pass
383.41kHz	21.95	48.19	-26.25	34.28	58.19	-23.91	Pass
399.692kHz	29.31	47.91	-18.59	36.11	57.91	-21.79	Pass
544.032kHz	29.73	46.00	-16.27	36.68	56.00	-19.32	Pass
814.75kHz	31.84	46.00	-14.16	39.21	56.00	-16.79	Pass
825.506kHz	28.48	46.00	-17.52	37.16	56.00	-18.84	Pass
933.994kHz	33.71	46.00	-12.29	41.93	56.00	-14.07	Pass
9.284968MHz	32.12	50.00	-17.88	33.91	60.00	-26.09	Pass
9.823718MHz	32.81	50.00	-17.19	35.08	60.00	-24.92	Pass

2.3 99% EMISSION BANDWIDTH

2.3.1 Specification Reference

RSS-Gen Clause 6.7

2.3.2 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.

2.3.3 Equipment Under Test and Modification State

p/n 275-0027-001

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

21 January 2019/Greg Jakubowski

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	23°C
Relative Humidity	35%
ATM Pressure	99kPa

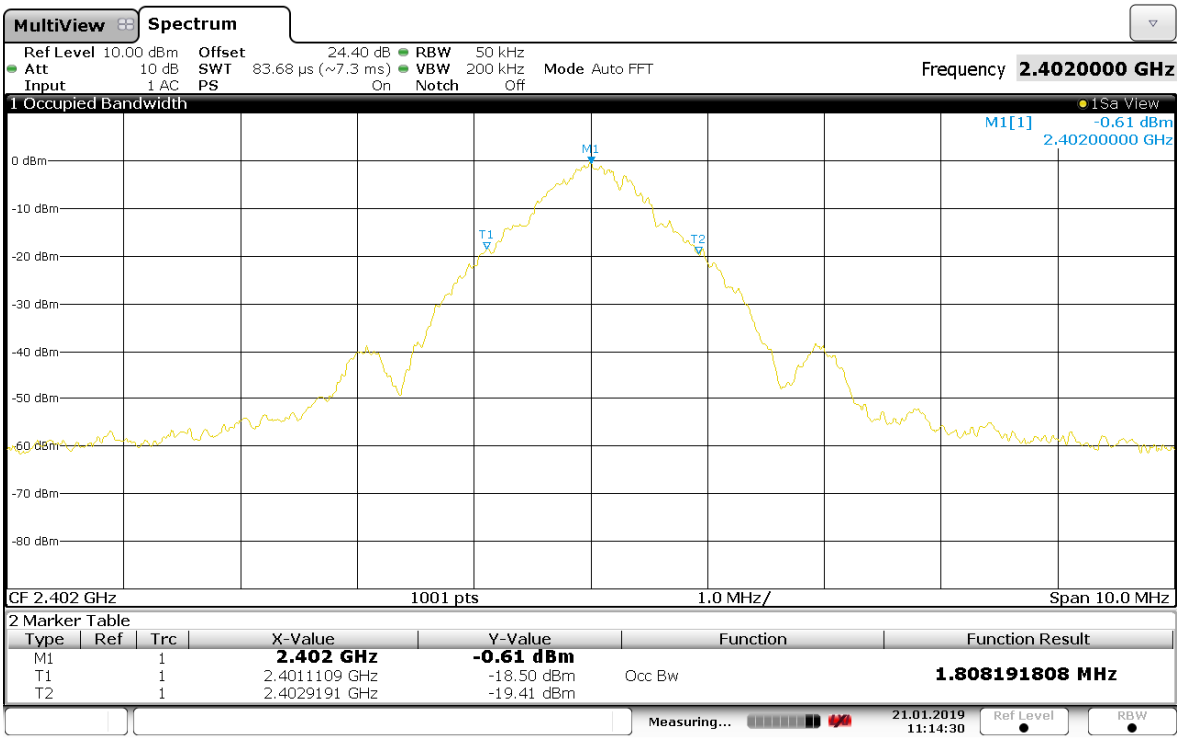
2.3.7 Additional Observations

- 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 50kHz.
- 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.

2.3.8 Test Results (For reporting purposes only)

Mode	Channel	Measured 99% Bandwidth (MHz)
Bluetooth LE	2 (2402 MHz)	1.80
	40 (2440 MHz)	1.84
	80 (2480 MHz)	1.84

2.3.9 Test Results Plots



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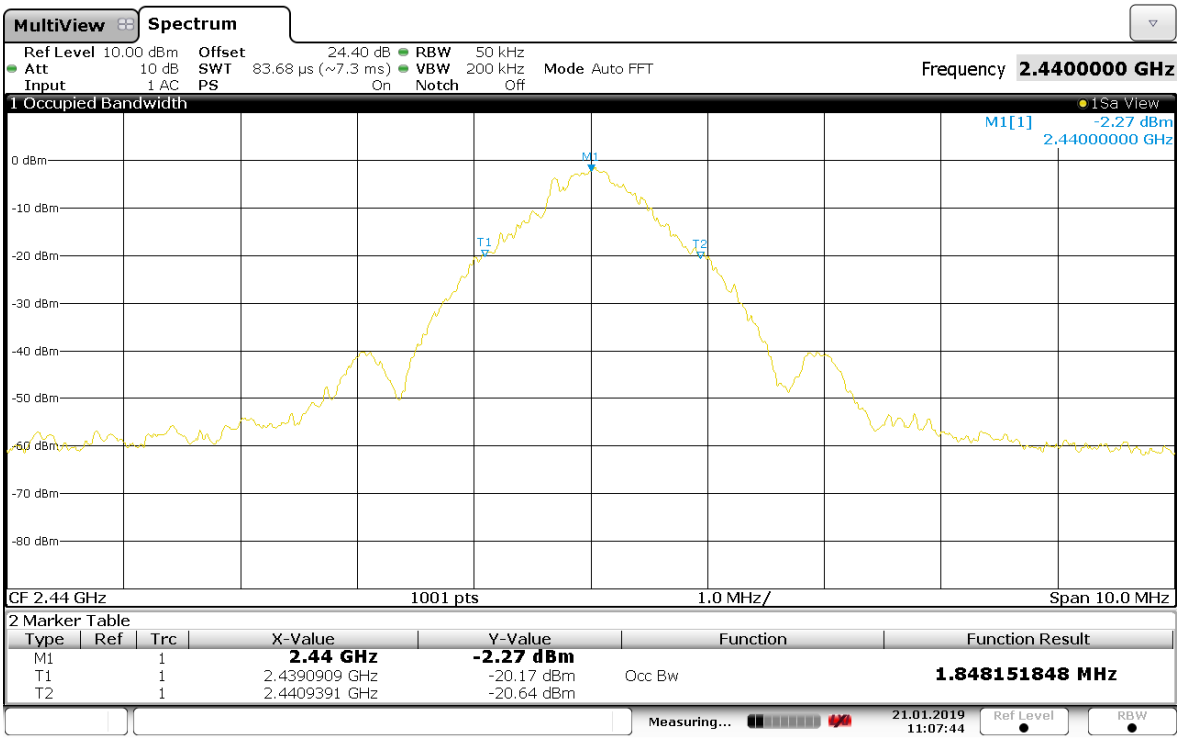
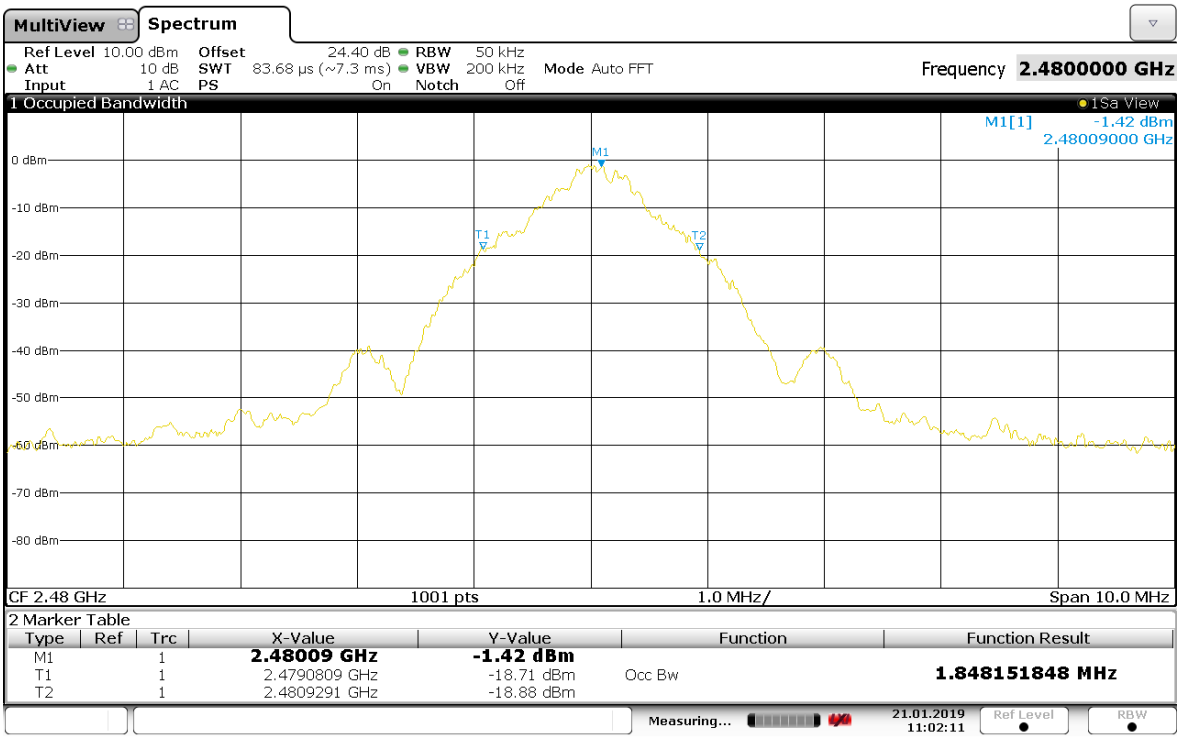
Bluetooth LE Low Channel



Bluetooth LE Mid 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

p/n 275-0027-001

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

21 January 2019/Greg Jakubowski

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	23°C
Relative Humidity	35%
ATM Pressure	99kPa

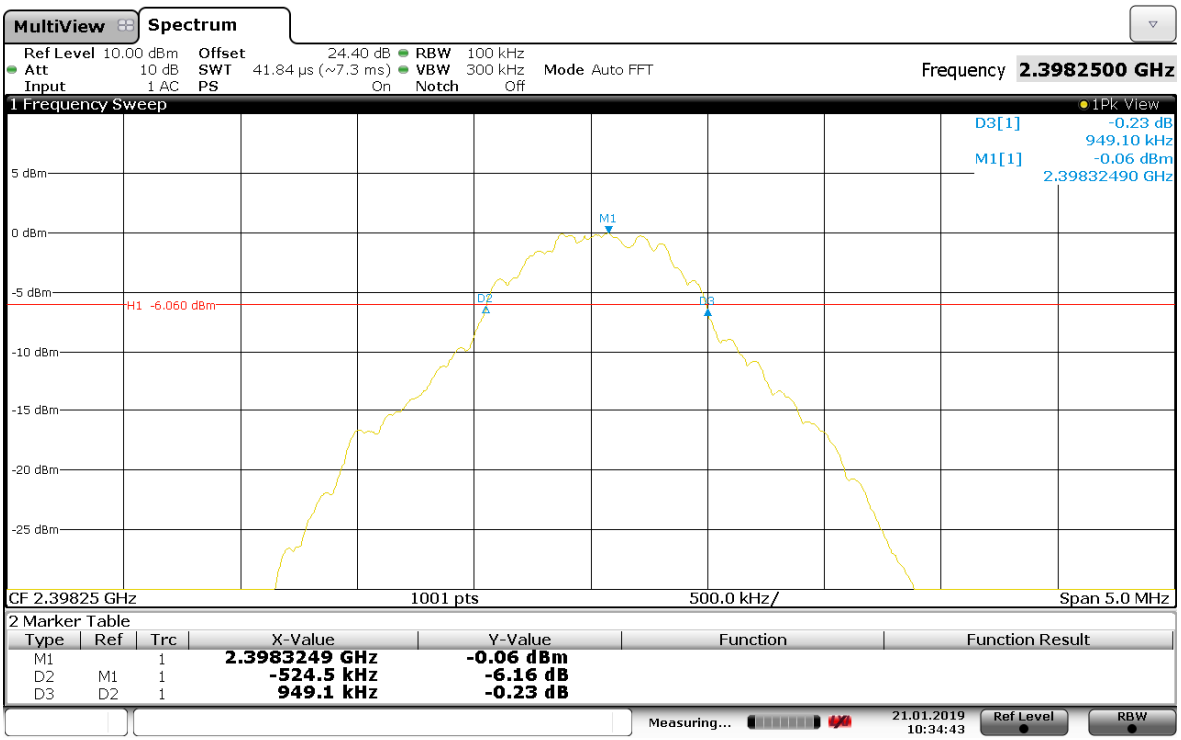
2.4.7 Additional Observations

- 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 ≥3X 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.

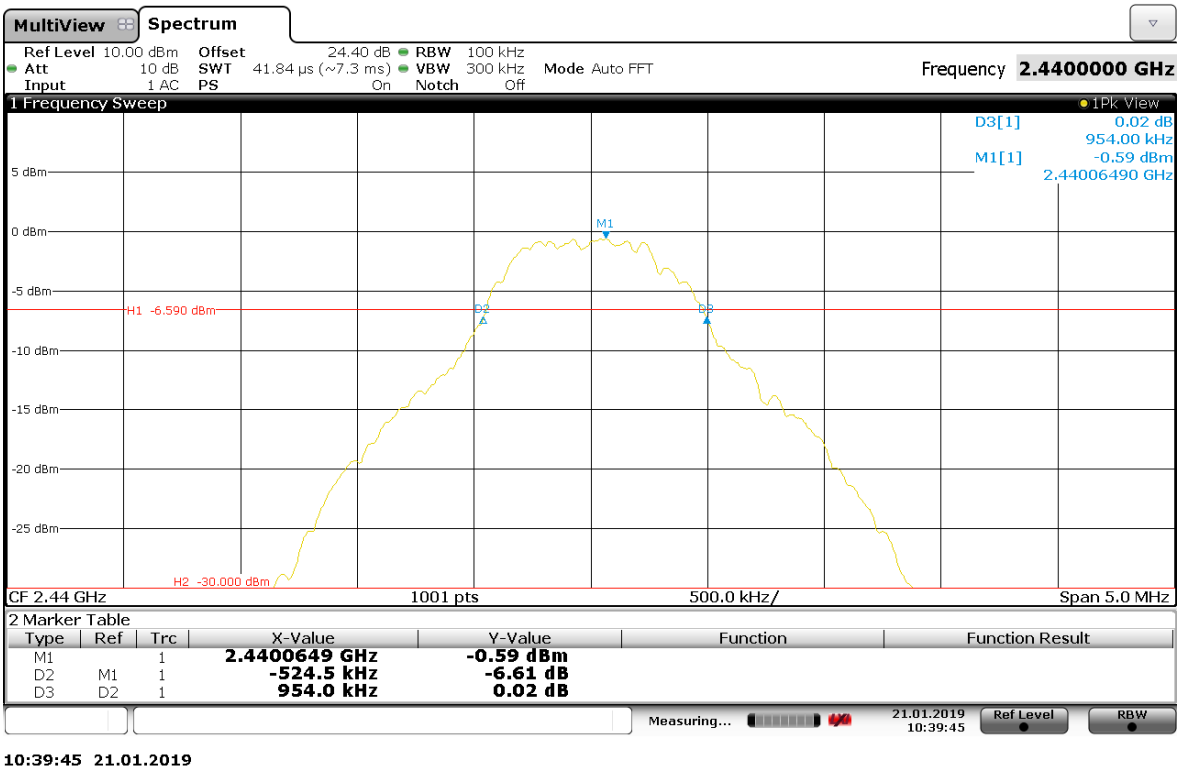
2.4.8 Test Results

Mode	Channel	Measured Bandwidth (MHz)	Minimum Bandwidth (MHz)	Compliance
Bluetooth LE	2 (2402 MHz)	0.949	0.500	Complies
	40 (2440 MHz)	0.954	0.500	Complies
	80 (2480 MHz)	0.914	0.500	Complies

2.4.9 Test Results Plots



Bluetooth LE Low Channel



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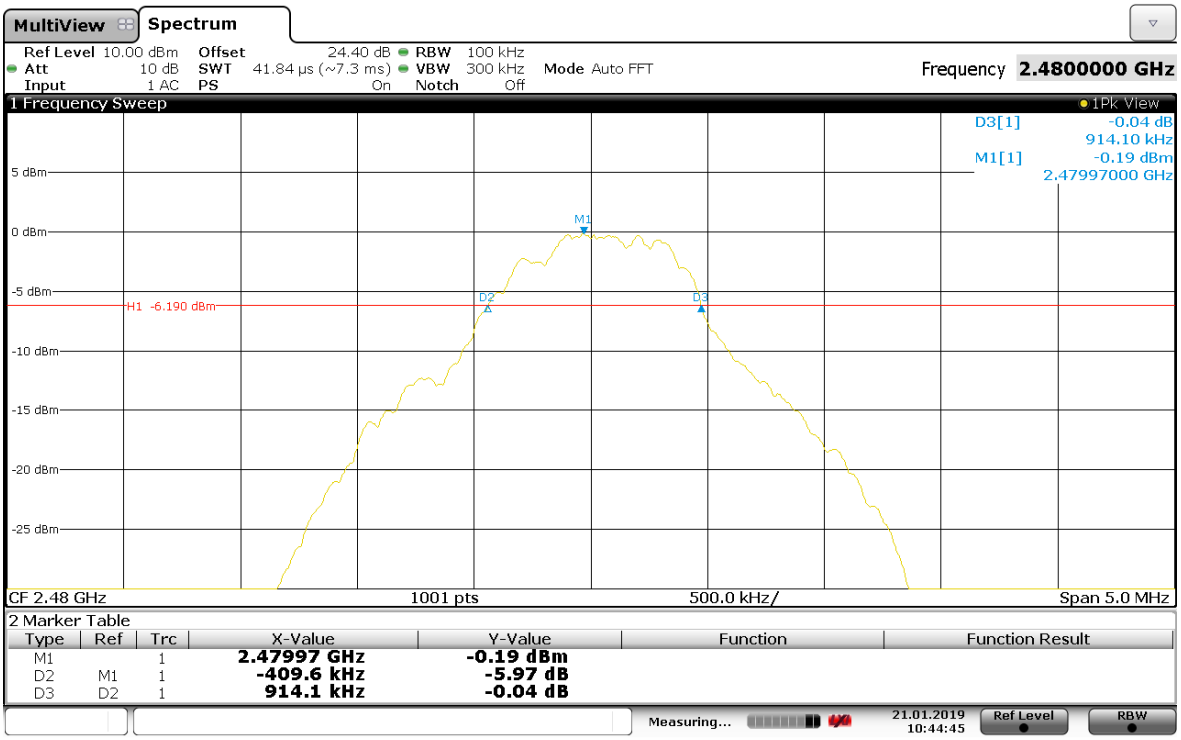
Bluetooth LE Mid Channel



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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

p/n 275-0027-001

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

21 January 2019/Greg Jakubowski

2.5.5 Test Equipment Used

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

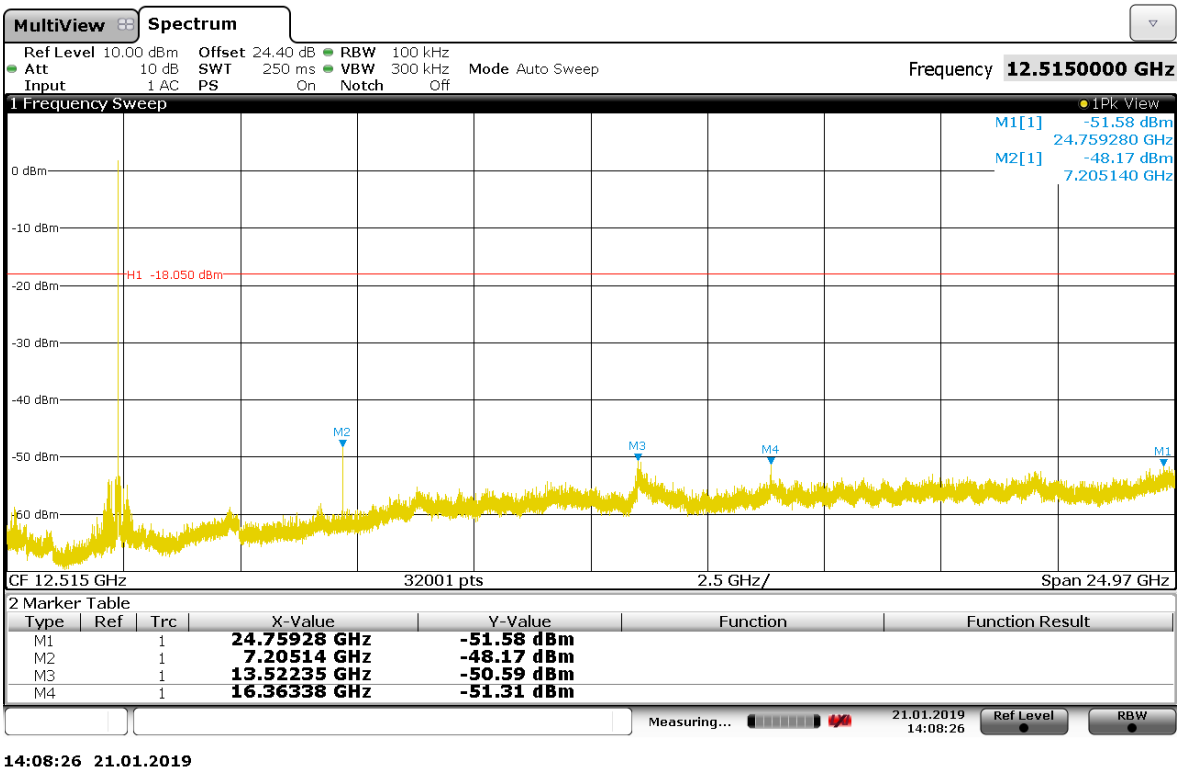
2.5.6 Environmental Conditions

Ambient Temperature	23°C
Relative Humidity	35%
ATM Pressure	99kPa

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 3X RBW.
- Sweep is auto. Detector is peak. Trace is max hold.
- Initial scan was performed to determine the highest level of the desired power within the band. Limit (display line) was drawn 20dB below this level.
- Spectrum was searched from 30 MHz up to 25GHz.

2.5.8 Test Results Plots



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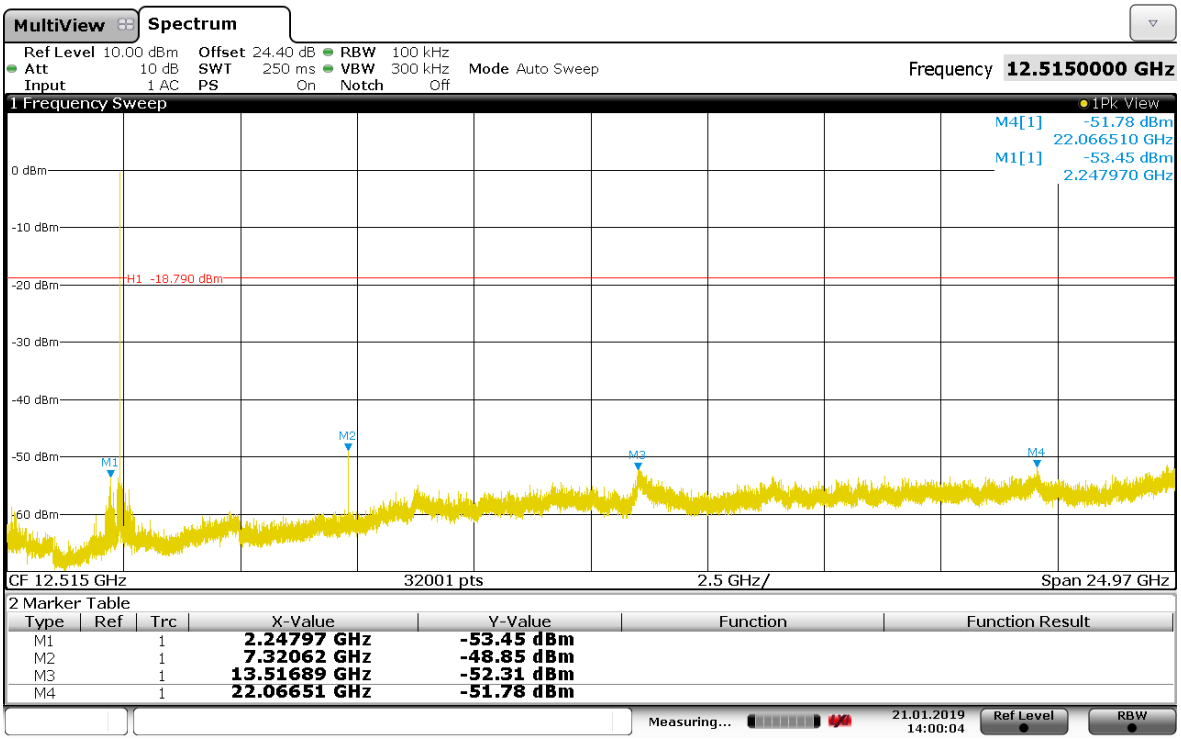
Bluetooth LE Low Channel



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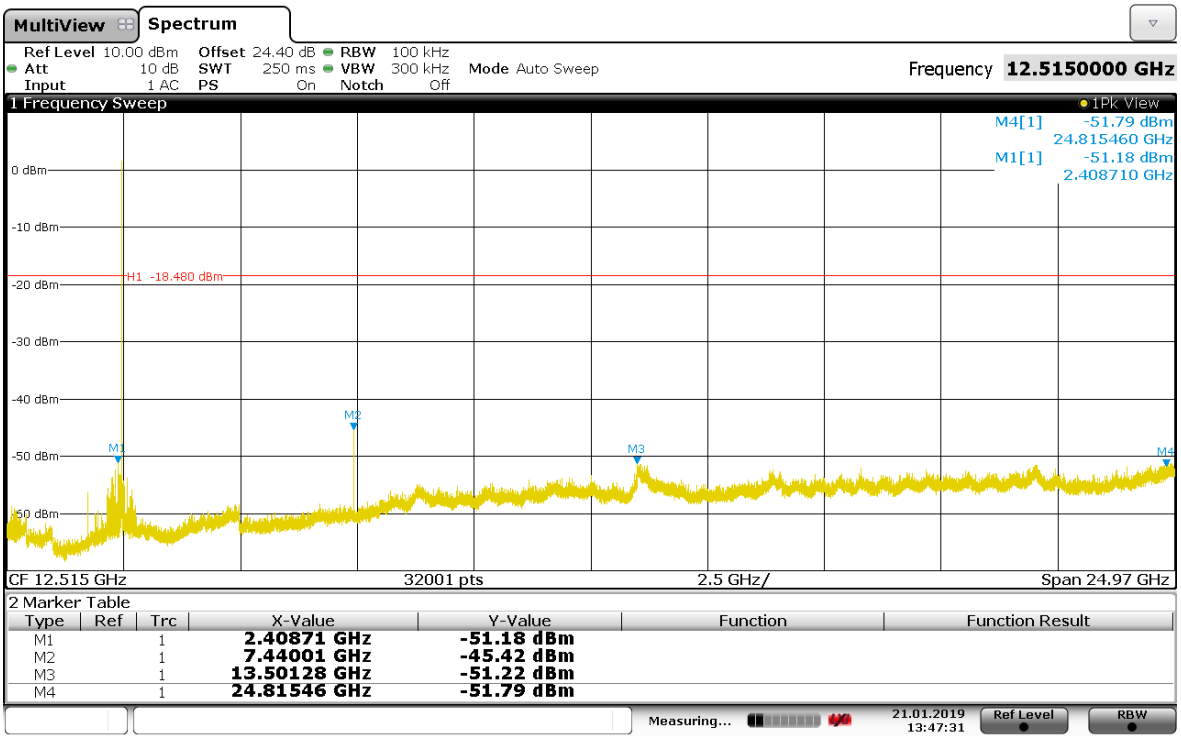
Bluetooth LE Mid Channel



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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

p/n 275-0027-001

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

21 January 2019/Greg Jakubowski

2.6.5 Test Equipment Used

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

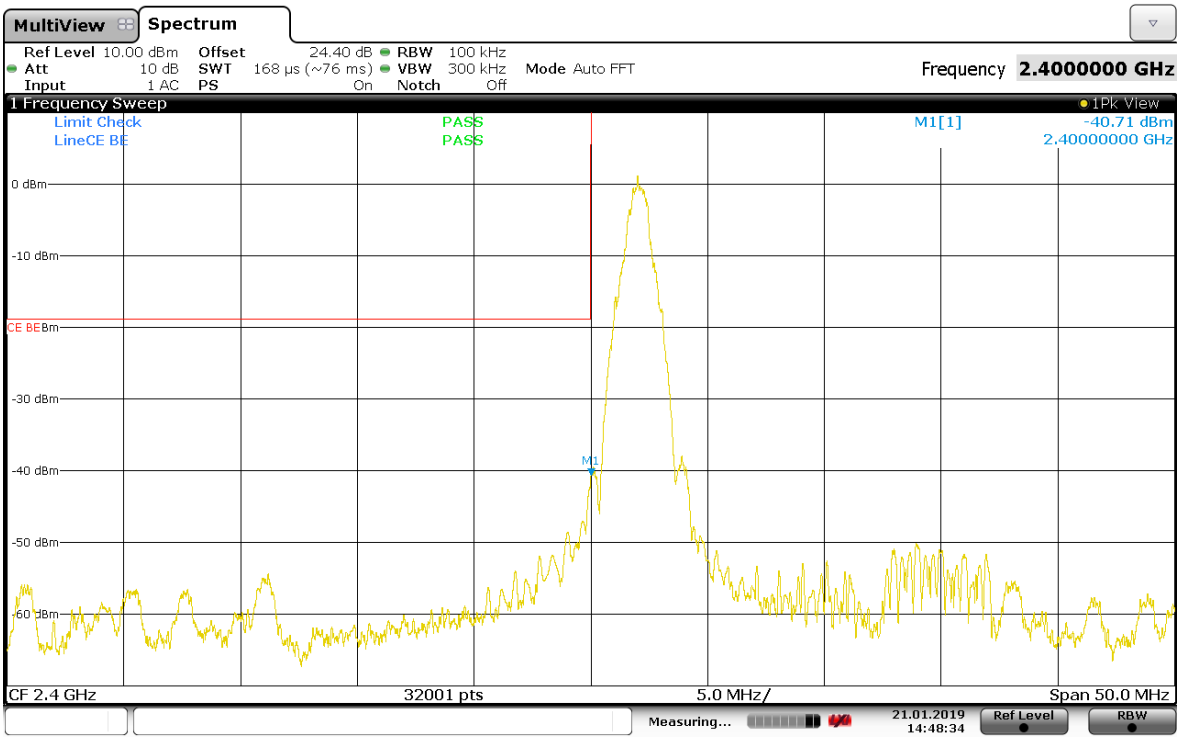
2.6.6 Environmental Conditions

Ambient Temperature	23°C
Relative Humidity	34%
ATM Pressure	99kPa

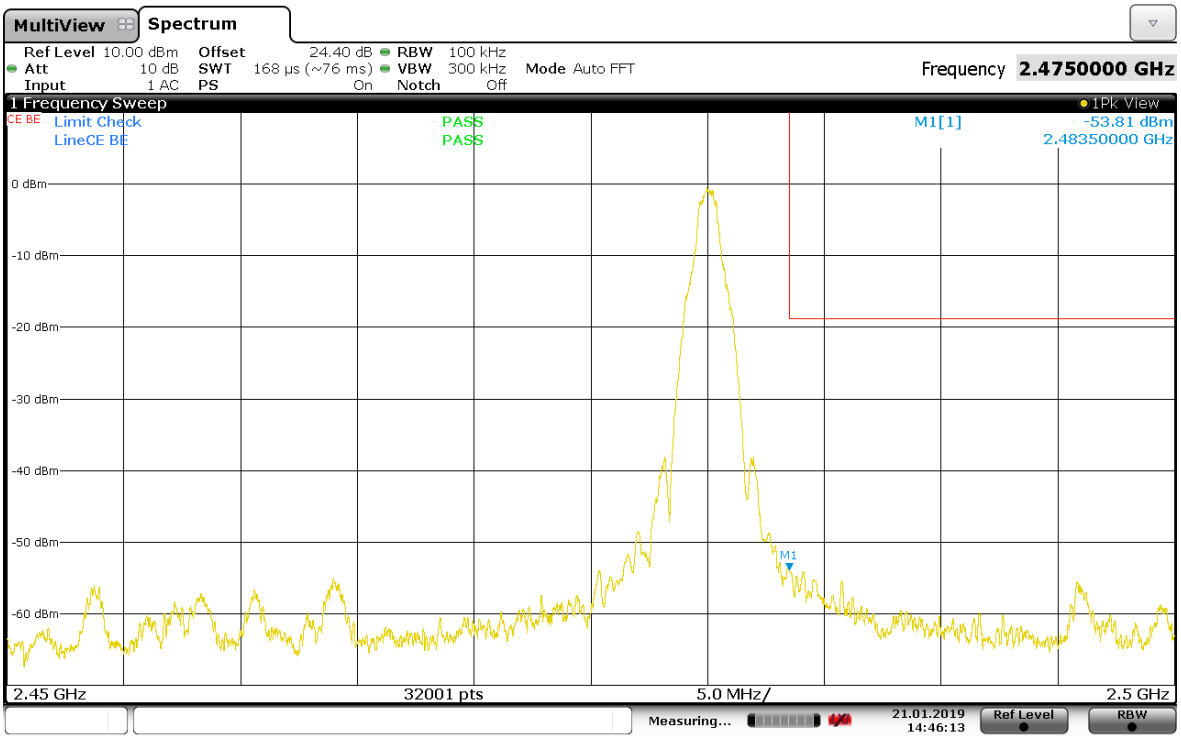
2.6.7 Additional Observations

- 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 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 -20dBc from the highest level of the desired power within the band.

2.6.8 Test Results



Bluetooth LE Low Channel (2402 MHz). Limit is -20 dBc.



14:46:13 21.01.2019

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

Upper band edge calculation (2483.5 MHz) for radiated spurious in restricted band:

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

E(dBµV/m) = EIRP (dBm) + 95.26
= (-53.8 dBm + 2 dBi antenna gain) + 95.26
= 43.46 dBµV/m @ 3 meters (Complies with 74 dBµV/m limit)

Upper band edge conducted spurious - Bluetooth LE High Channel (2480 MHz). Limit is -20 dBc.

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

p/n 275-0027-001

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

22 January 2019/Greg Jakubowski

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	23 °C
Relative Humidity	35 %
ATM Pressure	99 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).
- There are no significant differences in emissions between all channels.

- Only noise floor measurements observed above 18GHz.
- Measurement was done using BAT-EMC 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.

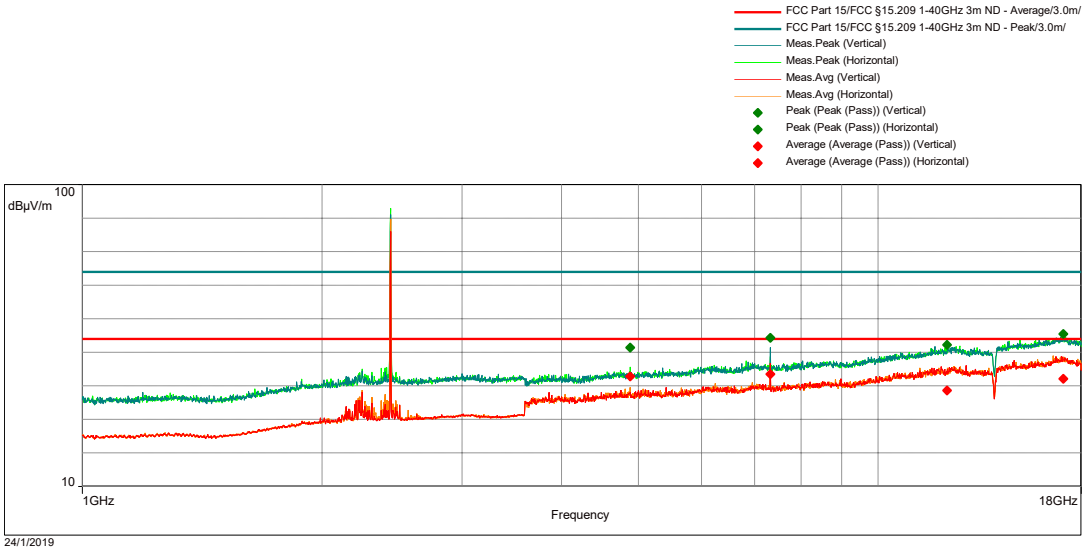
2.7.8 Sample Computation (Radiated Emission)

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 TEST DATA

Test RE 1-18GHz mid ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
1GHz- 18GHz	Vertical	3m	1MHz	18001Pts	Auto
1GHz- 18GHz	Horizontal	3m	1MHz	18001Pts	Auto



Limit:
FCC §15.209 1-40GHz 3m

Test Results:
Pass

Test Notes:

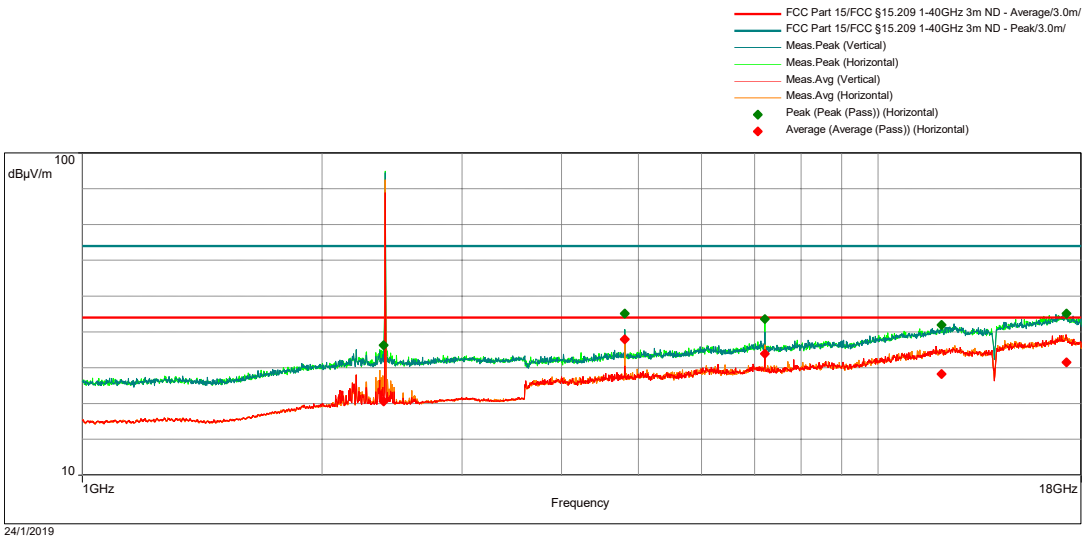
Test RE 1-18GHz mid ch

Data Table

Frequency	Peak Level (dBuV)	Peak Limit (dBuV)	Peak Margin (dB)	Average Level (dBuV)	Average Limit (dBuV)	Average Margin (dB)	Azimuth (°)	Height (m)	Polarity	Peak Result	Average Result
4.8800246GHz	51.41	74.00	-22.59	42.77	54.00	-11.23	349.00	2.32	Horizontal	Pass	Pass
7.3190486GHz	54.28	74.00	-19.72	43.45	54.00	-10.55	333.00	1.71	Horizontal	Pass	Pass
12.20027GHz	52.23	74.00	-21.77	38.59	54.00	-15.41	260.00	2.80	Vertical	Pass	Pass
17.08844GHz	55.49	74.00	-18.51	42.04	54.00	-11.96	360.00	1.60	Horizontal	Pass	Pass

Test RE 1-18GHz low ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
1GHz- 18GHz	Vertical	3m	1MHz	18001Pts	Auto
1GHz- 18GHz	Horizontal	3m	1MHz	18001Pts	Auto



Limit:
FCC §15.209 1-40GHz 3m

Test Results:
Pass

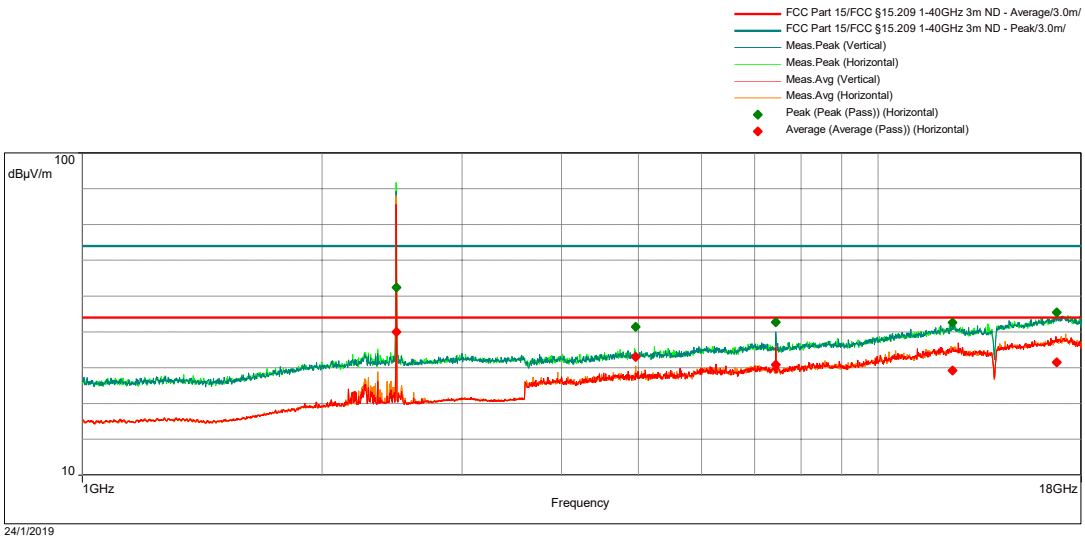
Test Notes:

Test RE 1-18GHz low ch
Data Table

Frequency	Peak Level (dBuV)	Peak Limit (dBuV)	Peak Margin (dB)	Average Level (dBuV)	Average Limit (dBuV)	Average Margin (dB)	Azimuth (°)	Height (m)	Polarity	Peak Result	Average Result
2.3904514GHz	46.31	74.00	-27.69	30.55	54.00	-23.45	337.00	3.87	Horizontal	Pass	Pass
4.8039113GHz	55.16	74.00	-18.84	47.94	54.00	-6.06	341.00	3.05	Horizontal	Pass	Pass
7.2056928GHz	53.62	74.00	-20.38	43.84	54.00	-10.16	10.00	3.71	Horizontal	Pass	Pass
12.010275GHz	51.91	74.00	-22.09	38.24	54.00	-15.76	219.00	2.58	Horizontal	Pass	Pass
17.239584GHz	55.13	74.00	-18.87	41.52	54.00	-12.48	37.00	3.83	Horizontal	Pass	Pass

Test RE 1-18GHz high ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
1GHz- 18GHz	Vertical	3m	1MHz	18001Pts	Auto
1GHz- 18GHz	Horizontal	3m	1MHz	18001Pts	Auto



Limit:
FCC §15.209 1-40GHz 3m

Test Results:
Pass

Test Notes:

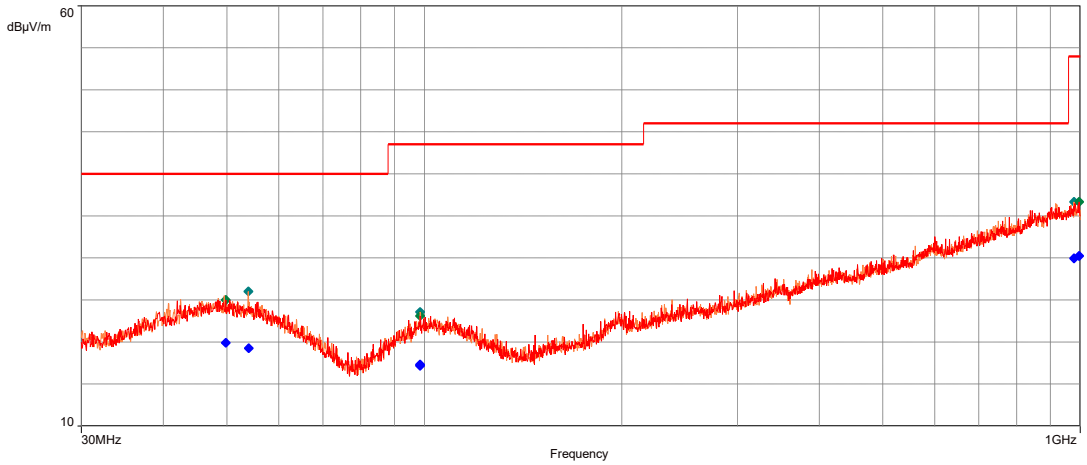
Test RE 1-18GHz high ch

Data Table

Frequency	Peak Level (dBuV)	Peak Limit (dBuV)	Peak Margin (dB)	Average Level (dBuV)	Average Limit (dBuV)	Average Margin (dB)	Azimuth (°)	Height (m)	Polarity	Peak Result	Average Result
2.4822794GHz	62.37	74.00	-11.63	50.03	54.00	-3.97	344.00	3.62	Horizontal	Pass	Pass
4.9602191GHz	51.46	74.00	-22.54	43.05	54.00	-10.95	327.00	3.62	Horizontal	Pass	Pass
7.4400353GHz	52.72	74.00	-21.28	40.87	54.00	-13.13	327.00	1.90	Horizontal	Pass	Pass
12.39929GHz	52.58	74.00	-21.42	39.17	54.00	-14.83	17.00	1.00	Horizontal	Pass	Pass
16.76096GHz	55.40	74.00	-18.60	41.54	54.00	-12.46	350.00	2.80	Horizontal	Pass	Pass

Test RE 30M-1GHz mid ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
30MHz- 1GHz	Vertical	3m	120kHz	18001Pts	Auto
30MHz- 1GHz	Horizontal	3m	120kHz	18001Pts	Auto



Limit:
FCC §15.209

Test Results:
Pass

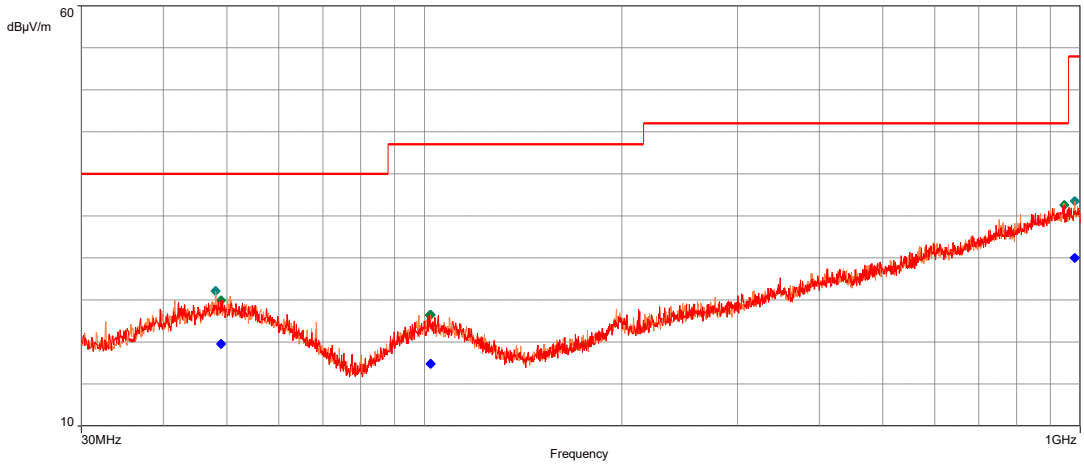
Test Notes:

Test RE 30M-1GHz mid ch
Data Table

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity	Result
49.759064MHz	19.92	40.00	-20.08	34.00	2.83	Vertical	Pass
53.976716MHz	19.27	40.00	-20.73	139.00	3.09	Horizontal	Pass
98.53034MHz	17.19	43.50	-26.31	13.00	3.79	Horizontal	Pass
98.543615MHz	17.30	43.50	-26.20	343.00	1.03	Vertical	Pass
977.98919MHz	29.97	53.97	-24.00	321.00	1.87	Horizontal	Pass
995.48663MHz	30.25	53.97	-23.72	245.00	2.48	Vertical	Pass

Test RE 30M-1GHz low ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
30MHz- 1GHz	Vertical	3m	120kHz	18001Pts	Auto
30MHz- 1GHz	Horizontal	3m	120kHz	18001Pts	Auto



Limit:
FCC §15.209

Test Results:
Pass

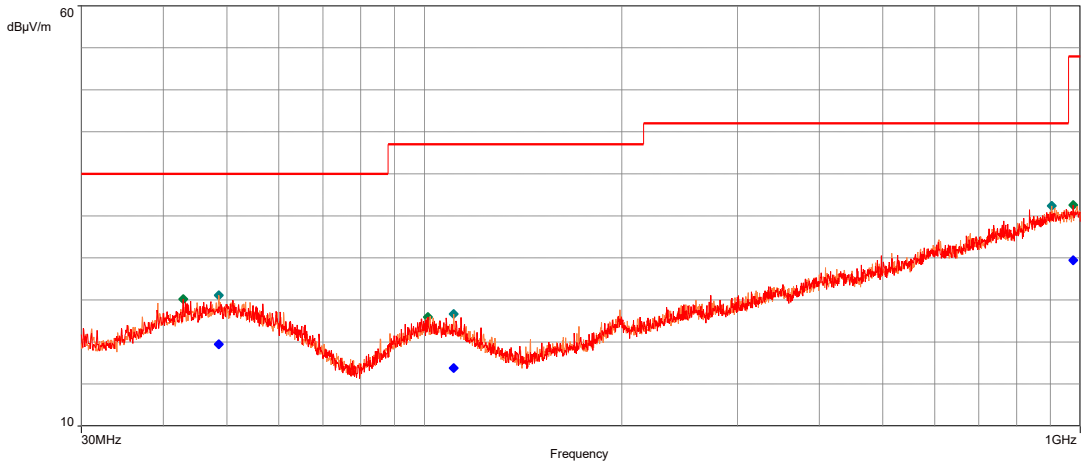
Test Notes:

Test RE 30M-1GHz low ch
Data Table

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity	Result
49.027356MHz	19.76	40.00	-20.24	50.00	1.96	Vertical	Pass
102.22011MHz	17.39	43.50	-26.11	7.00	2.95	Horizontal	Pass
981.64769MHz	30.01	53.97	-23.96	352.00	1.54	Horizontal	Pass

Test RE 30M-1GHz high ch

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
30MHz- 1GHz	Vertical	3m	120kHz	18001Pts	Auto
30MHz- 1GHz	Horizontal	3m	120kHz	18001Pts	Auto



Limit:
FCC §15.209

Test Results:
Pass

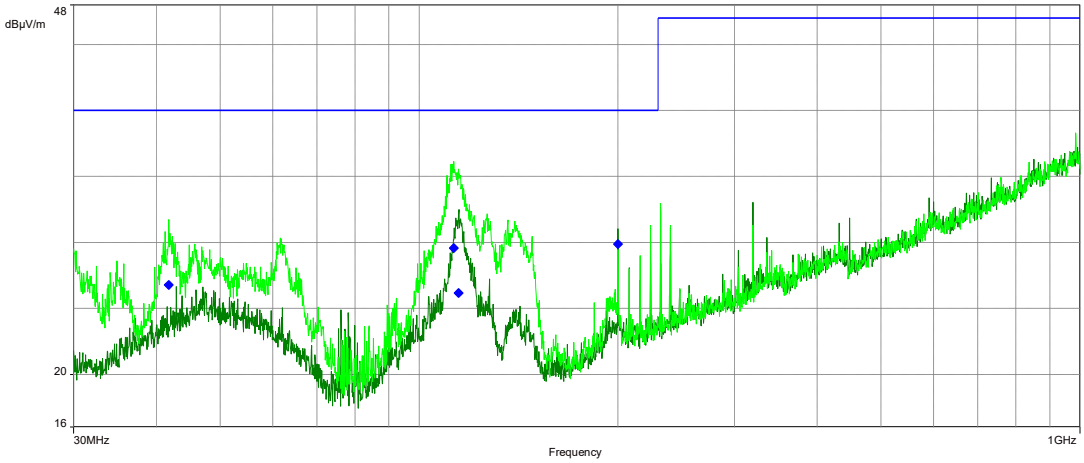
Test Notes:

Test RE 30M-1GHz high ch
Data Table

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity	Result
48.584343MHz	19.73	40.00	-20.27	8.00	3.64	Horizontal	Pass
110.83946MHz	16.91	43.50	-26.59	29.00	2.90	Horizontal	Pass
975.85959MHz	29.73	53.97	-24.24	212.00	1.32	Vertical	Pass

Test RE 30M-1GHz F1 and F3 w Apple chargers at 110VAC 60Hz and 100VAC 50Hz

Frequency Range	Polarity	Antenna Distance	RBW	Step Size	Sweep Time
30MHz- 1GHz	Vertical	3m	120kHz	18001Pts	1 ms/MHz
30MHz- 1GHz	Horizontal	3m	120kHz	18001Pts	1 ms/MHz



Limit:
CISPR 11 - Group 1 - On a Test Site

Test Results:
Pass

Test Notes: F1 and F3 with Apple chargers

Test RE 30M-1GHz F1 and F3 w Apple chargers at 110VAC 60Hz and 100VAC 50Hz

Data Table

OS

Frequency	QP Level (dBuV)	QP Limit (dBuV)	Margin (dB)	Azimuth (°)	Height (m)	Polarity	Result
41.779389MHz	26.76	40.00	-13.24	285.00	1.03	Vertical	Pass
112.90354MHz	29.56	40.00	-10.44	96.00	1.03	Vertical	Pass
114.77915MHz	26.15	40.00	-13.85	177.00	2.71	Horizontal	Pass
200.00281MHz	29.86	40.00	-10.14	256.00	1.68	Horizontal	Pass

Test No significant emissions observed above 18GHz. Measurements above 18GHz are noise floor figures. **Notes:**

2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

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

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

p/n 275-0027-001

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

21 January 2019/Greg Jakubowski

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°C
Relative Humidity	34%
ATM Pressure	99kPa

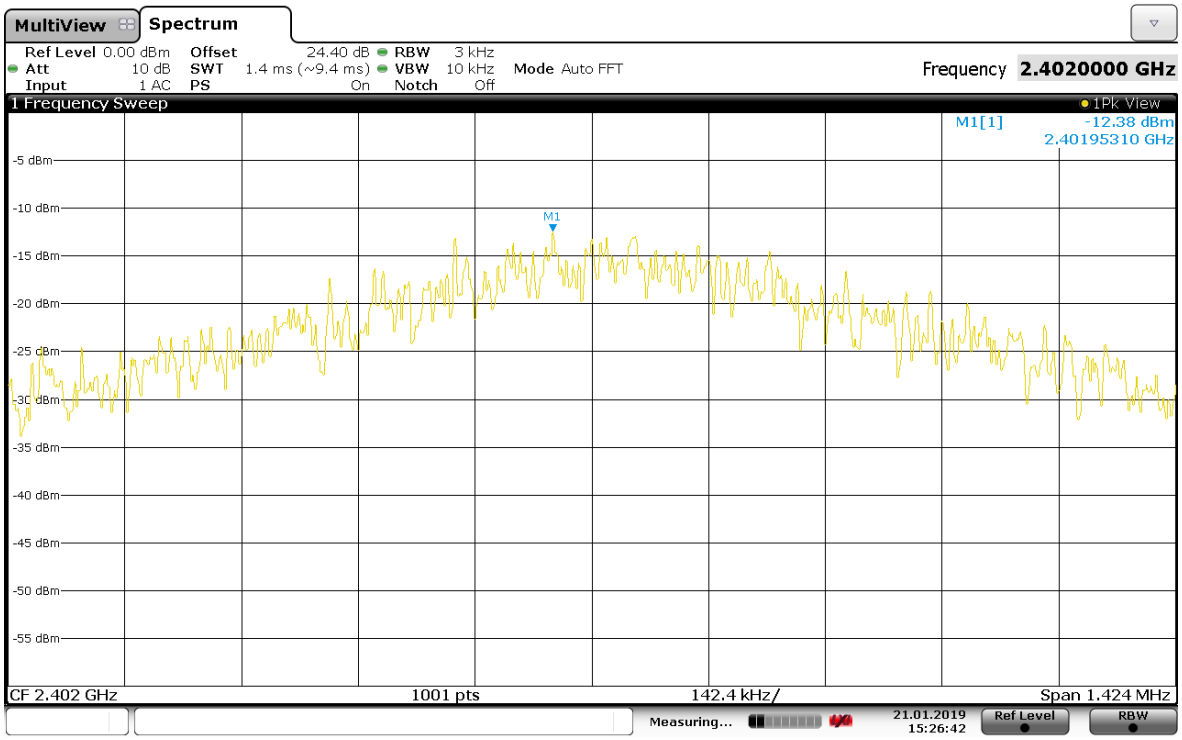
2.8.7 Additional Observations

- This is a conducted test.
- Test procedure is per Section 11.10.2 of ANSI C63.10
- The path loss for was measured and entered as a level offset
- Detector is peak.
- Sweep time is Auto.

2.8.8 Test Results Summary

Mode	Channel	Data Rates (Mbps)	Marker Reading using 3 kHz RBW (dBm)	PSD Limit (dBm/3kHz)	Compliance
Bluetooth LE	2 (2402 MHz)	GFSK @ 2Mbps	-12.3	8	Complies
	40 (2440 MHz)	GFSK @ 2Mbps	-12.4	8	Complies
	80 (2480 MHz)	GFSK @ 2Mbps	-12.4	8	Complies

2.8.9 Test Results Plots



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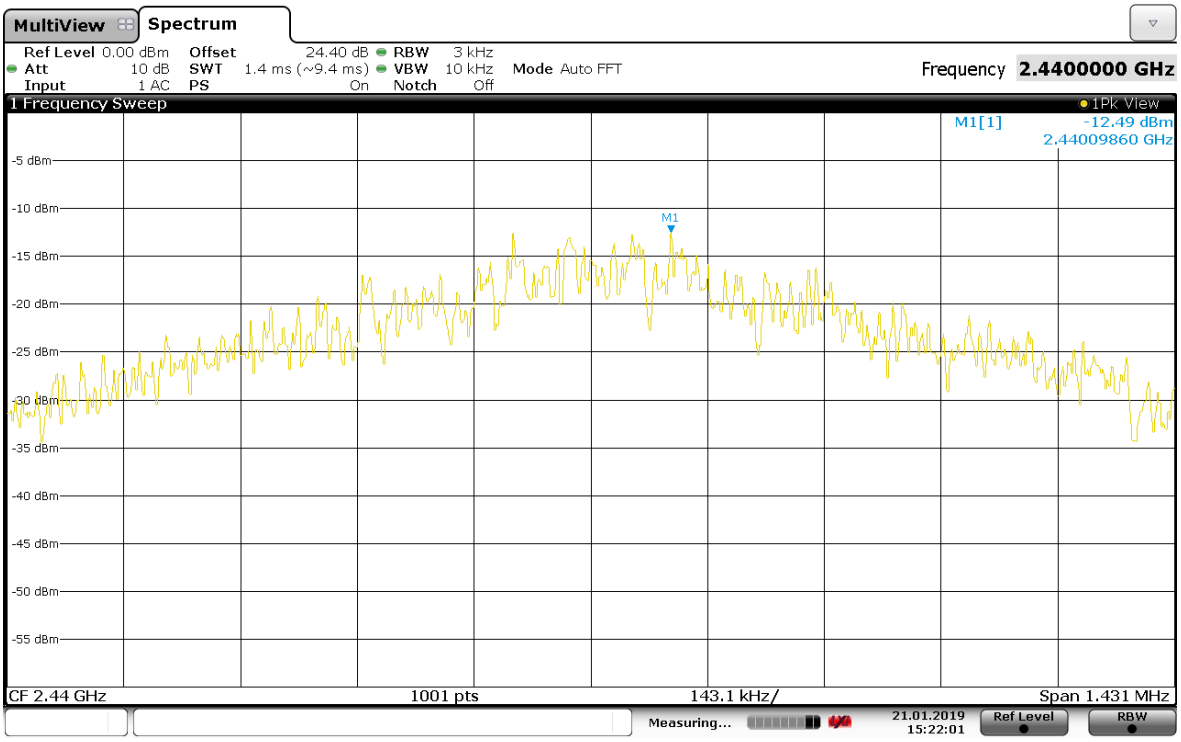
Bluetooth LE Low Channel



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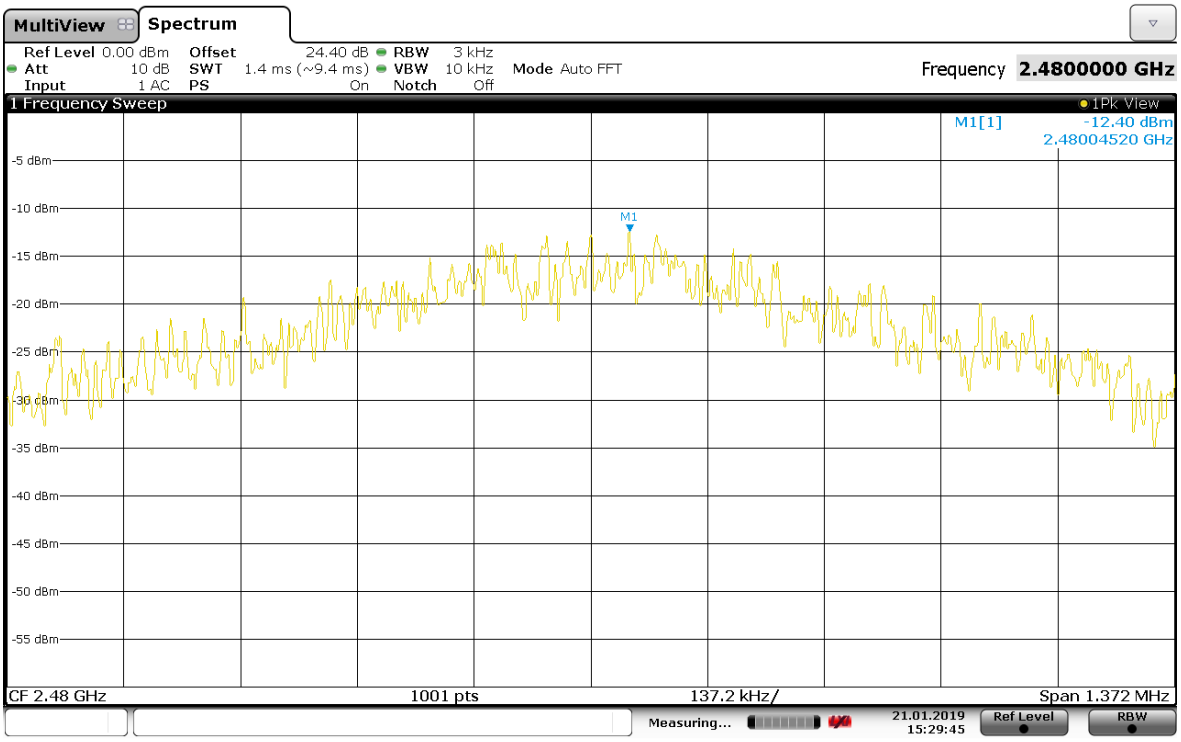
Bluetooth LE Middle Channel



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Bluetooth LE High Channel

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

Radiated emissions 30-25000 MHz

Equipment Description	Equipment Manufacturer	Equipment Model #	Equipment SN#	Asset #	Frequency Range	Calibrated On	Calibration Due
Antenna - Biconical-Log	ETS Lindgren	3142C	00079889	NBLE11578	30MHz - 1GHz	8/9/2018	8/9/2019
Antenna - Trilog	Schwarzbeck	VULB 9162	9162-196	NBLE11579	30 MHz - 8 GHz	11/20/2018	11/20/2020
Antenna - DRG	ETS-Lindgren	3117	218816	NBLE11630	1-18 GHz	8/25/2018	8/25/2019
Attenuator - Hestish - 6dB Attenuators	Hestish	X001MTFKY5	11608	NBLE11608	9 kHz - 3 GHz	10/29/2018	10/29/2019
Cable - SMA - Purple - 6ft	Florida RF Labs	FL200	6ft-3	NBLE03508	0.01-26.5 GHz	12/5/2018	12/5/2019
Cable - N - Blue - 3m	Teledyne Strom Microwave	90-195-3MTR	182984-001	NBLE11612	10MHz - 18GHz	11/1/2018	11/1/2019
Cable - N - Blue - 3m	Teledyne Strom Microwave	90-195-3MTR	182984-003	NBLE11614	10MHz - 18GHz	11/1/2018	11/1/2019
Cable - N - Blue - 8m	Teledyne Strom Microwave	90-195-8MTR	182982-004	NBLE11618	10MHz - 18GHz	11/1/2018	11/1/2019
Cable - SMA - Blue - 3ft				WRLE11252	10 MHz - 26.5 GHz	11/13/2018	11/13/2019
Preamplifier - 8447D	Hewlett-Packard	8447D	2944A08773	NBLE11141	100 kHz - 1.3 GHz	1/4/2019	1/4/2020
Preamplifier - PAM-118A	Com-Power	PAM-118A	18040002	WRLE11519	0.5-18GHz	1/4/2019	1/4/2020
Receiver - R&S ESW	Rohde & Schwarz	ESW44	101537	NBLE11555	2 Hz - 44 GHz	6/5/2018	6/5/2019
Receiver - R&S ESU	Rohde & Schwarz	ESU 26	100379	WRLE10998	20 Hz - 26.5 GHz	12/13/2018	12/13/2019
Amplifier, 2-8 GHz	Hewlett-Packard	11975A	2738A01200	WRLE02127	2-8 GHz	04/09/2018	04/09/2019
Harmonic Mixer, 26.5-40 GHz	Hewlett-Packard	11970A	2332A01861	WRLE02661	26.5-40 GHz	01/04/2019	02/04/2019
Harmonic Mixer, 18-26.5 GHz	Hewlett-Packard	11970K	2332A01170	WRLE02662	18-26.5 GHz	01/04/2019	02/04/2019
Antenna, Ridge Guide 18-40 GHz	EMCO/EMC Test	3116	2005	WRLE06717	18-40 GHz	09/13/2018	09/13/2019
Spectrum Analyzer	Hewlett-Packard	8566B	2618A02947	WRLE11456	n/a	01/10/2019	01/10/2020
Spectrum Analyzer, Display	Hewlett-Packard	85662A	2403A09226	WRLE11457	n/a	01/10/2019	01/10/2020

Conducted RF port

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE03506	Florida RF Labs	Cable, SMA 6ft	FL200	6ft-1	B	10/29/2018	10/29/2019
WRLE11397	Meca	Attenuator, 20dB	603-20-1F18	11397	B	06/07/2018	06/07/2019
NBLE11555	Rohde & Schwarz	Receiver, 2 Hz-44 GHz	ESW44	101537	G	04/19/2018	04/19/2019

AC line conducted emissions

Device #	Manufacturer	Description	Model	Serial #	Cal Code	Cal Date	Cal Due
NBLE10466	Weinschel	Attenuator, 20dB	34-20-34	BR2651	B	11/02/2018	11/02/2019
WRLE10946	Fischer Custom Comm.	LISN	FCC-LISN-50-25-2-10	120310	G	09/26/2018	09/26/2019
NBLE11592	Rohde & Schwarz	EMI Test Receiver	ESR7	101771	G	08/20/2018	08/20/2019

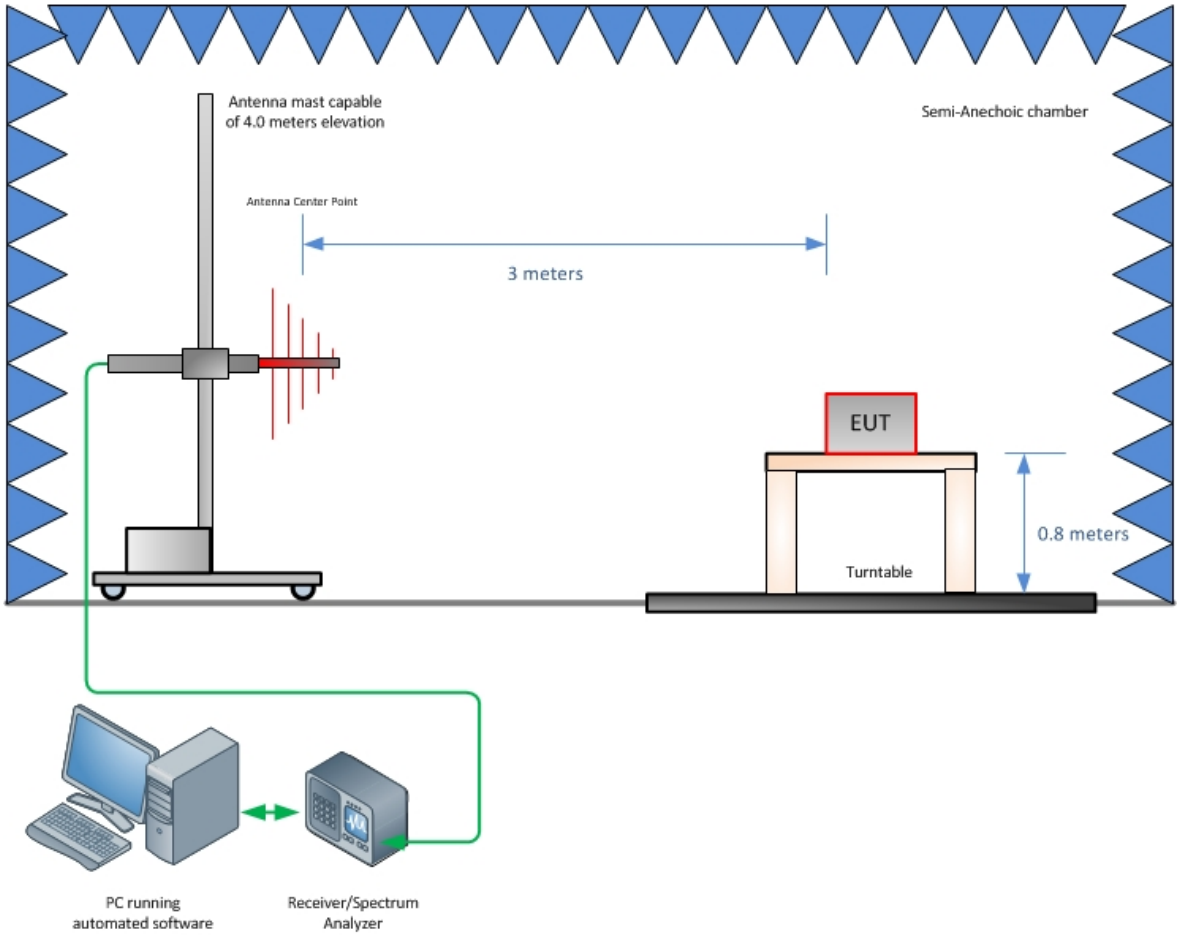
3.1.1 Conducted Antenna Port Measurement

	Contribution	Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.08	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

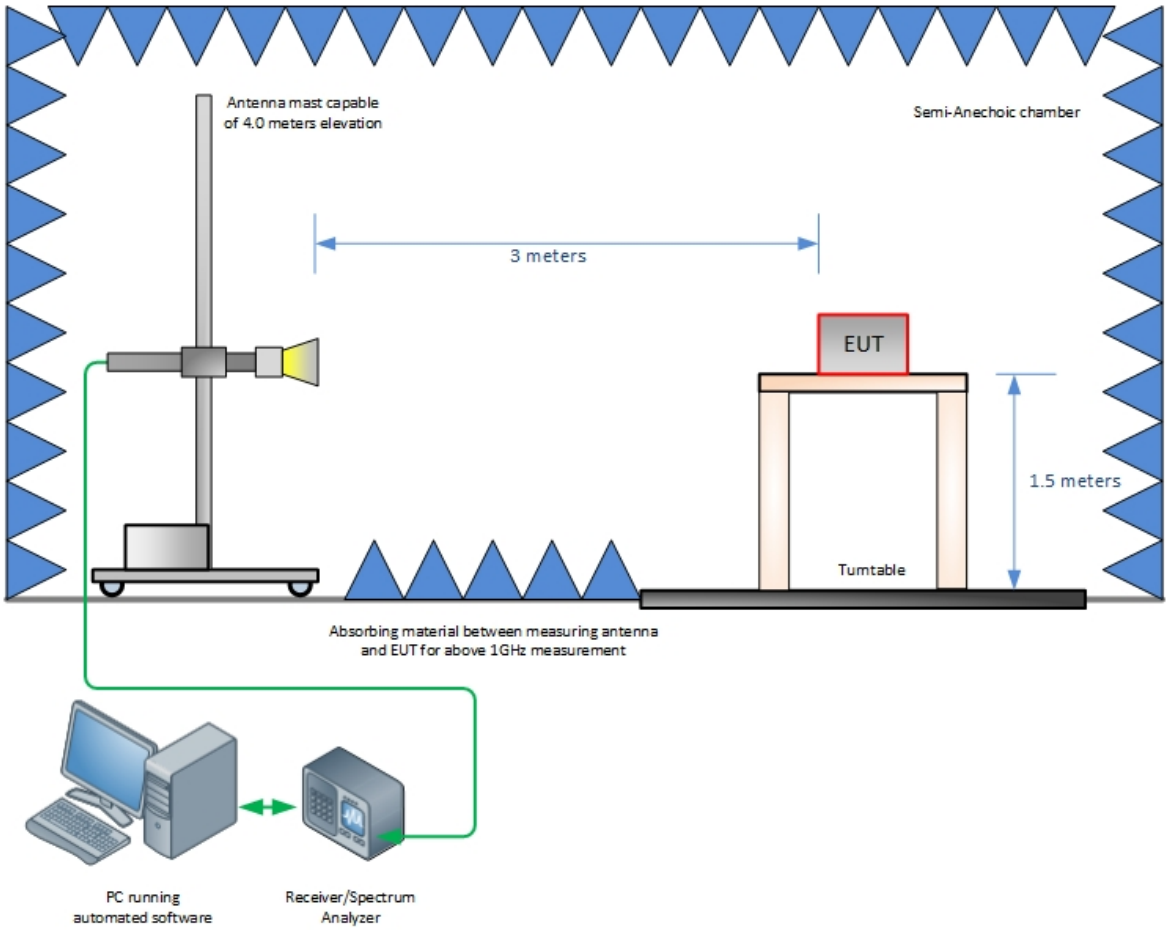
SECTION 4

DIAGRAM OF TEST SETUP

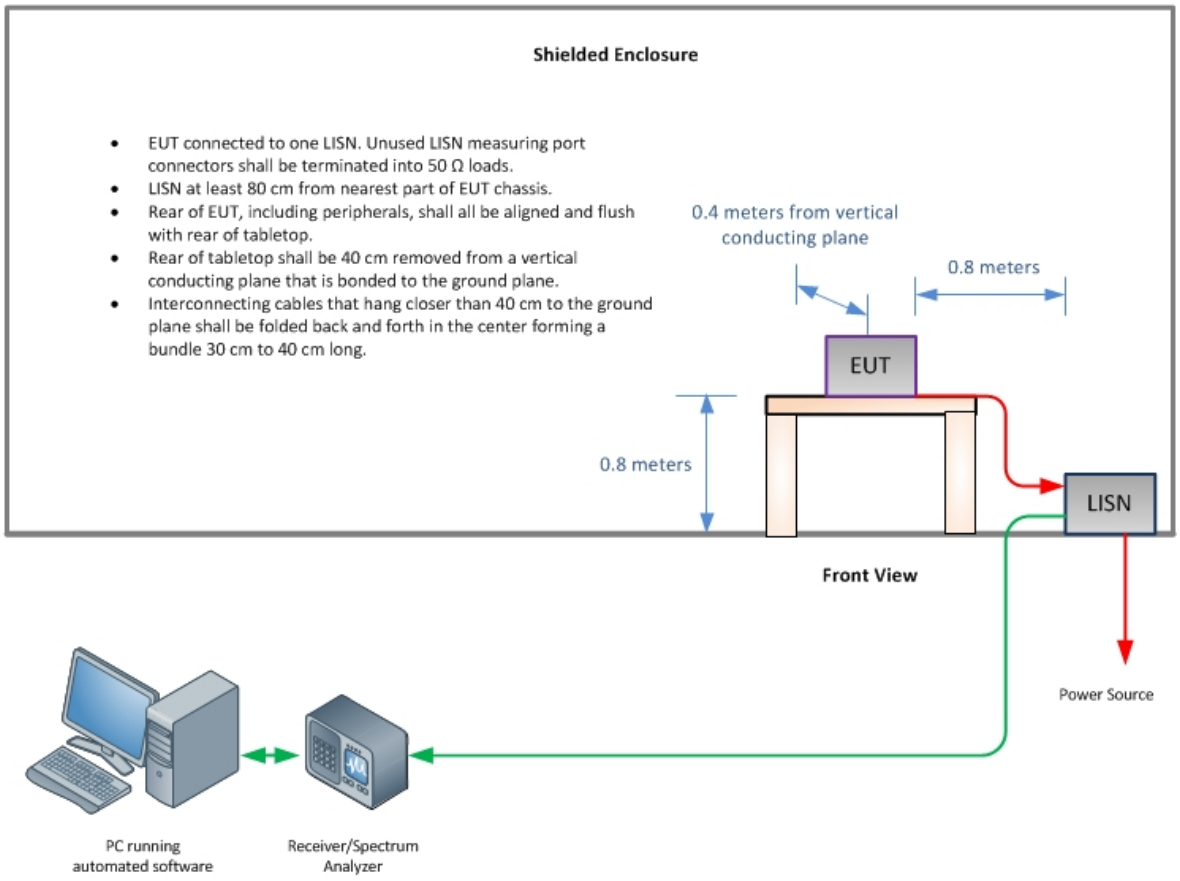
4.1 TEST SETUP DIAGRAM



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



Conducted Emission Test Setup

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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