**MEASUREMENT REPORT**
FCC PART 15.247 Bluetooth**Applicant Name:**

Sirius XM Radio Inc.
1500 Eckington Place, NE
Washington, DC 20002
United States
Attn: Beejay Jolayemi

Date of Testing:

11/04 - 11/21/2019

Test Site/Location:

PCTEST Lab. Columbia, MD, USA

Test Report Serial No.:

1M1911040180-04.RS2

FCC ID:

RS2LBEE5HY1MW

APPLICANT:

Sirius XM Radio Inc.

Application Type:

Class II Permissive Change

Model:

LBEE5HY1MW

EUT Type:

BT/WiFi Module

Max. RF Output Power:

4.337 mW (6.37 dBm) Peak Conducted

Frequency Range:

2402 – 2480MHz

Type of Modulation:

GFSK, $\pi/4$ -DQPSK, 8DPSK

FCC Classification:

FCC Part 15 Spread Spectrum Transmitter (DSS)

FCC Rule Part(s):

Part 15 Subpart C (15.247)

Test Procedure(s):

ANSI C63.10-2013

Class II Permissive Change:

Please see FCC change document

Original Grant Date:

12/23/2019

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.


Randy Ortanez
President

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 1 of 32

TABLE OF CONTENTS

1.0	INTRODUCTION	3
1.1	Scope	3
1.2	PCTEST Test Location	3
1.3	Test Facility / Accreditations	3
2.0	PRODUCT INFORMATION	4
2.1	Equipment Description	4
2.2	Device Capabilities	4
2.3	Test Configuration	4
2.4	EMI Suppression Device(s)/Modifications	4
3.0	DESCRIPTION OF TESTS	5
3.1	Evaluation Procedure	5
3.2	AC Line Conducted Emissions	5
3.3	Radiated Emissions	6
3.4	Environmental Conditions	6
4.0	ANTENNA REQUIREMENTS	7
5.0	MEASUREMENT UNCERTAINTY	8
6.0	TEST EQUIPMENT CALIBRATION DATA	9
7.0	TEST RESULTS	10
7.1	Summary	10
7.2	Output Power Measurement	11
7.3	Radiated Spurious Emission Measurements – Above 1GHz	18
7.4	Radiated Spurious Emissions Measurements – Below 1GHz	25
7.5	Line Conducted Measurement Data	29
8.0	CONCLUSION	32

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 2 of 32

1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

1.2 PCTEST Test Location

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility located at 7185 Oakland Mills Road, Columbia, MD 21046. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

1.3 Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21046, U.S.A.

- PCTEST is an ISO 17025-2005 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISSED Standards (RSS).
- PCTEST facility is a registered (2451B) test laboratory with the site description on file with ISSED.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 3 of 32

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Sirius XM BT/WiFi Module FCC ID: RS2LBEE5HY1MW**. The test data contained in this report pertains only to the emissions due to the EUT's Bluetooth transmitter.

The EUT is integrated into a host device certified under FCC ID: RS2SXBW1.

Test Device Serial No.: 89337

2.2 Device Capabilities

This device contains the following capabilities:

2.4GHz WiFi, 5GHz UNII, Bluetooth, Bluetooth LE

Ch.	Frequency (MHz)
00	2402
:	:
39	2441
:	:
78	2480

Table 2-1. Frequency/ Channel Operations

Note: This device is capable of operating in hopping and non-hopping mode. The EUT can hop between 79 different channels in the 2400 – 2483.5MHz band.

2.3 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013. ANSI C63.10-2013 was also used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setup and 3.3 for radiated emissions test setups.

2.4 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 4 of 32

3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that the cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.5. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 5 of 32

3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

FCC ID: RS2LBEE5HY1MW	 ENGINEERING LABORATORY, INC.		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	 SAFARI IS HERE	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module	Page 6 of 32		

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antennas of the EUT are **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 7 of 32

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty ($\pm$ dB)
Conducted Bench Top Measurements	1.13
Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 8 of 32

6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Keysight	N9030A	PXA Signal Analyzer (26.5GHz)	9/13/2019	Annual	9/13/2020	MY54490576
Emco	3115	Horn Antenna (1-18GHz)	3/28/2018	Biennial	3/28/2020	9704-5182
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	6/5/2019	Annual	6/5/2020	100342
Rohde & Schwarz	SFUNIT-Rx	Shielded Filter Unit	7/11/2019	Annual	7/11/2020	102134
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	4/19/2018	Biennial	4/19/2020	A051107
Agilent	N9038A	MXE EMI Receiver	7/17/2019	Annual	7/17/2020	MY51210133
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	6/18/2018	Biennial	6/18/2020	114451

Table 6-1. Annual Test Equipment Calibration Schedule

Notes:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 9 of 32

7.0 TEST RESULTS

7.1 Summary

Company Name: Sirius XM Radio Inc.
 FCC ID: RS2LBEE5HY1MW
 Method/System: Frequency Hopping Spread Spectrum (FHSS)
 Number of Channels: 79

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(b)(1)	Peak Transmitter Output Power	< 1 Watt if ≥ 75 non-overlapping channels used	CONDUCTED	PASS	Section 7.2
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	RADIATED	PASS	Section 7.3 Section 7.4
15.207	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 7.5

Table 7-1. Summary of Test Results

Notes:

- 1) All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables, directional couplers, and attenuators used as part of the system to maintain a link between the call box and the EUT at all frequencies of interest.
- 3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.
- 4) For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "BT Auto," Version 3.5.
- 5) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST "Chamber Automation," Version 1.3.1.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 10 of 32

7.2 Output Power Measurement

§15.247 (b.1)

Test Overview and Limits

Measurement is made while the EUT is operating in non-hopping transmission mode. The powers shown below were measured using a spectrum analyzer.

The maximum permissible output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 7.8.5

ANSI C63.10-2013 – Section 11.9.2.3.2 method AVGPM-G

Test Settings

Peak Power Measurement

1. Span = approximately 5x 20dB bandwidth, centered on hopping channel
2. RBW > 20dB bandwidth of emission being measured
3. VBW $\geq$ RBW
4. Sweep = auto
5. Detector = peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-1. Test Instrument & Measurement Setup

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	SiriusXM SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 11 of 32

Notes

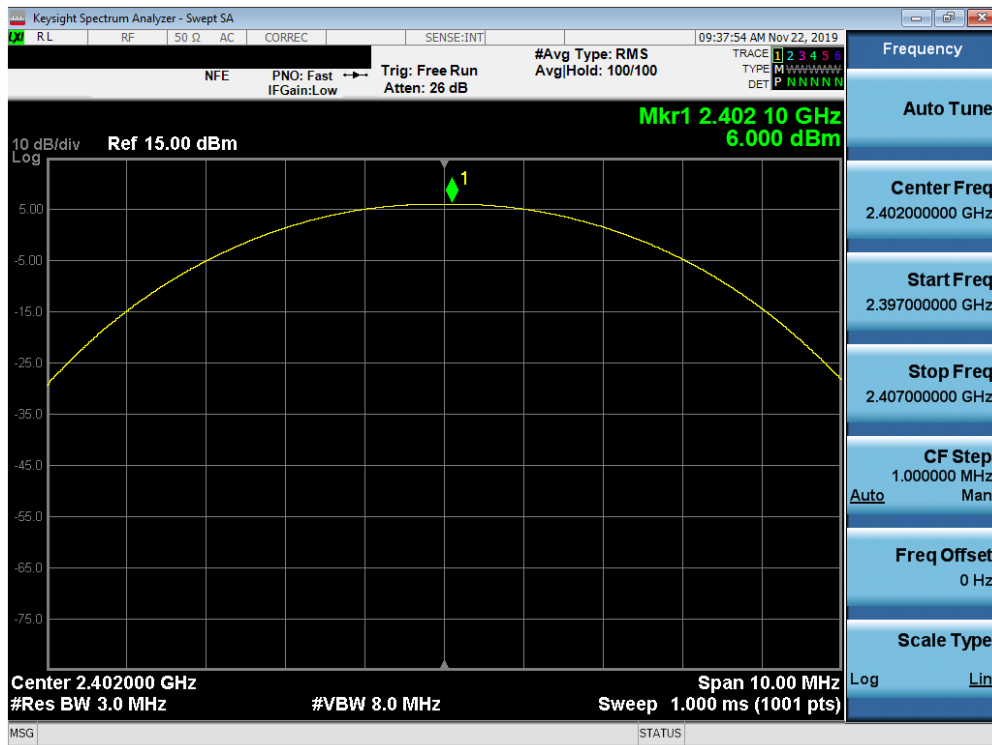
1. The conducted powers were measured for the purpose of ensuring that the powers are less than or equal to the powers of the original certified module (FCC ID: VPYLBEE5HY1MW).
2. This unit was tested with all possible data rates and the highest peak power is reported with the unit transmitting at 1Mbps. Final results were obtained using calibrated attenuators and cables. The following formula was used:

$$\text{Output Power (dBm)} = \text{Raw Analyzer Level (dBm)} + \text{Cable Loss (dB)}$$

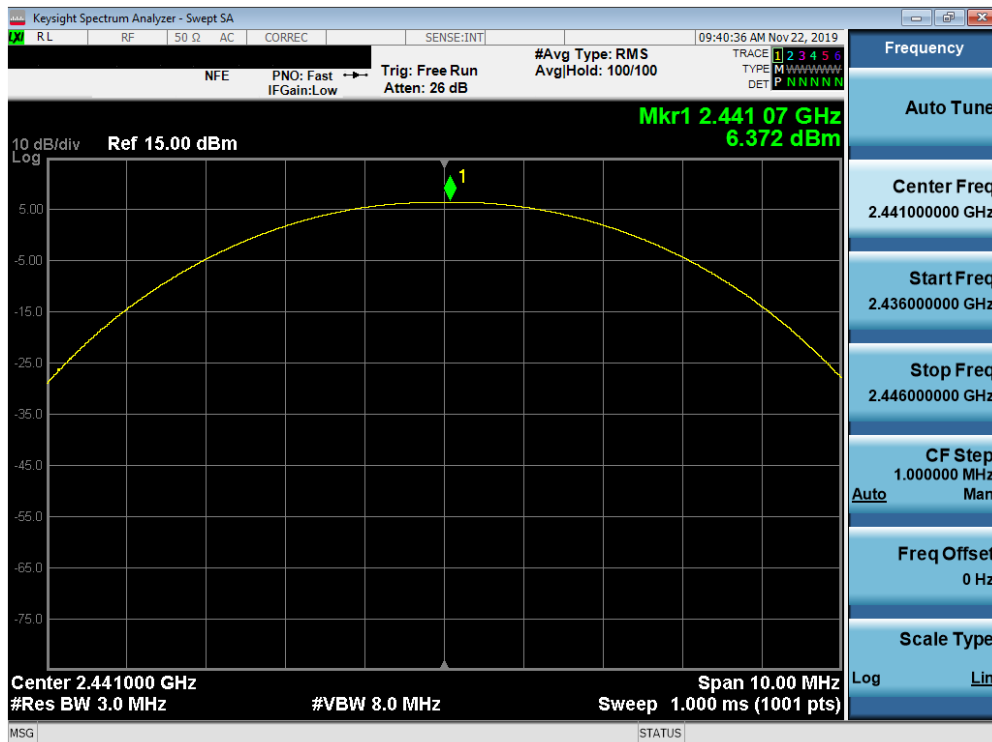
Frequency [MHz]	Data Rate [Mbps]	Mod.	Channel No.	Peak Conducted Power	
				[dBm]	[mW]
2402	1.0	GFSK	0	6.00	3.981
2441	1.0	GFSK	39	6.37	4.337
2480	1.0	GFSK	78	5.86	3.858
2402	2.0	$\pi/4$ -DQPSK	0	3.75	2.370
2441	2.0	$\pi/4$ -DQPSK	39	4.53	2.836
2480	2.0	$\pi/4$ -DQPSK	78	3.75	2.369
2402	3.0	8DPSK	0	4.10	2.573
2441	3.0	8DPSK	39	4.89	3.080
2480	3.0	8DPSK	78	4.08	2.561

Table 7-2. Conducted Output Power Measurements

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 12 of 32

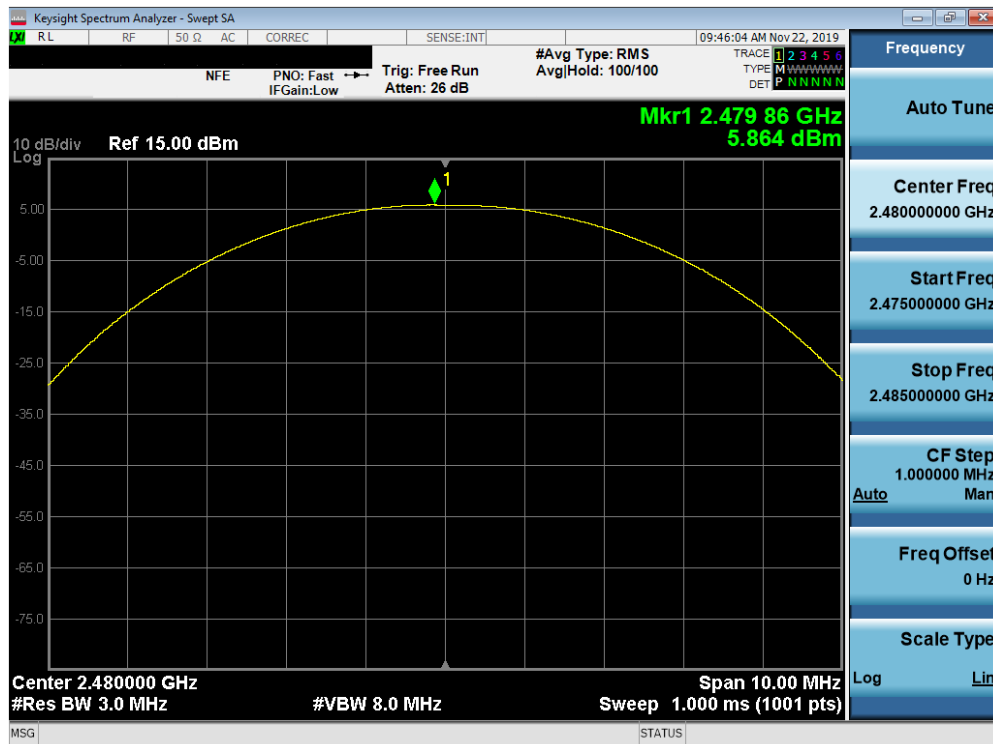


Plot 7-1. Peak Conducted Power (1Mbps – Ch. 0)

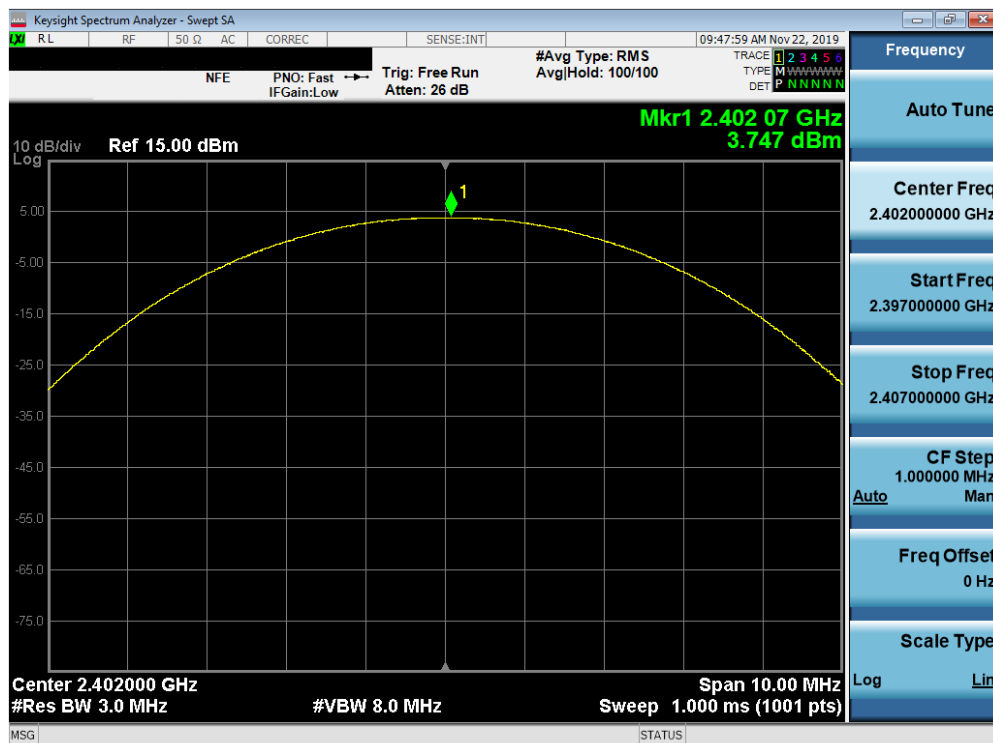


Plot 7-2. Peak Conducted Power (1Mbps – Ch. 39)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 13 of 32

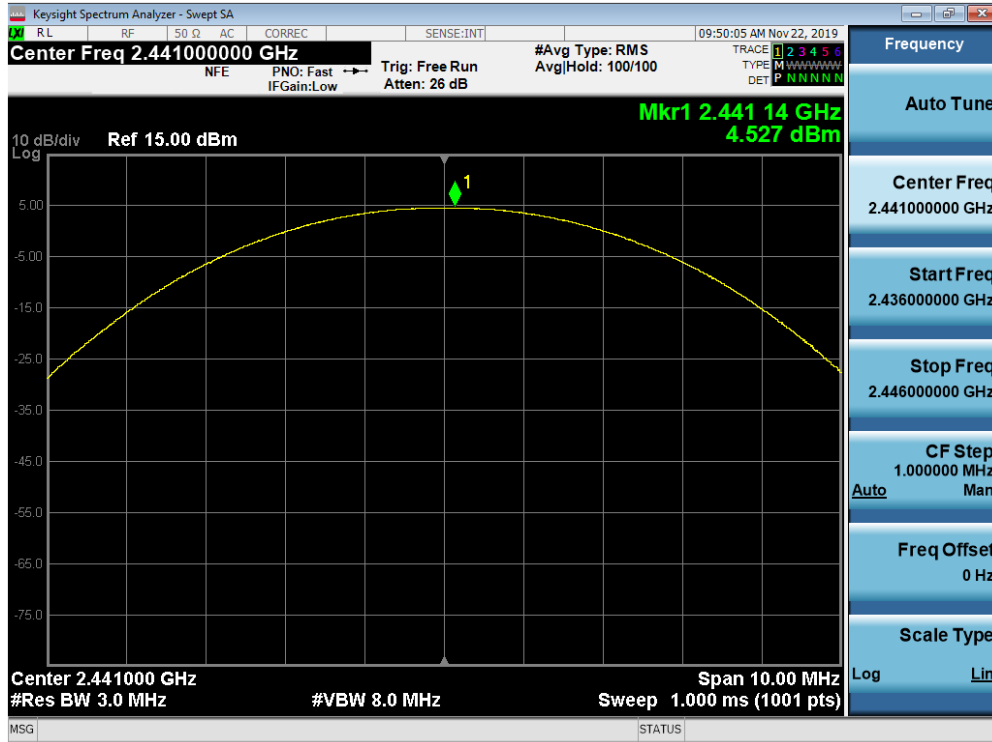


Plot 7-3. Peak Conducted Power (1Mbps – Ch. 78)

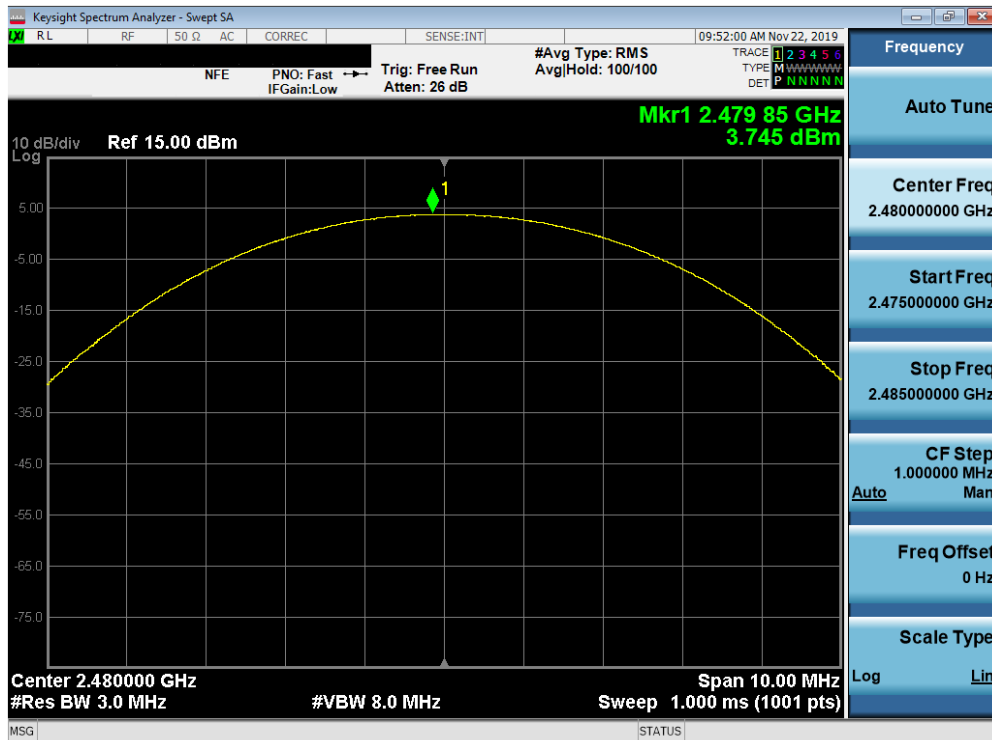


Plot 7-4. Peak Conducted Power (2Mbps – Ch. 0)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 14 of 32

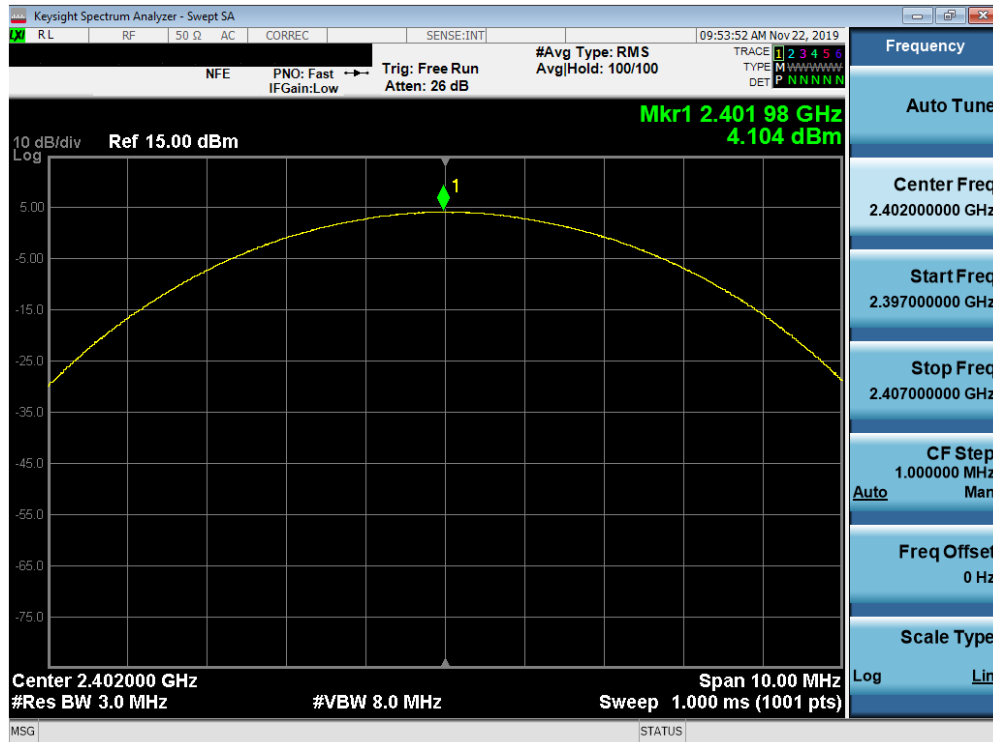


Plot 7-5. Peak Conducted Power (2Mbps – Ch. 39)

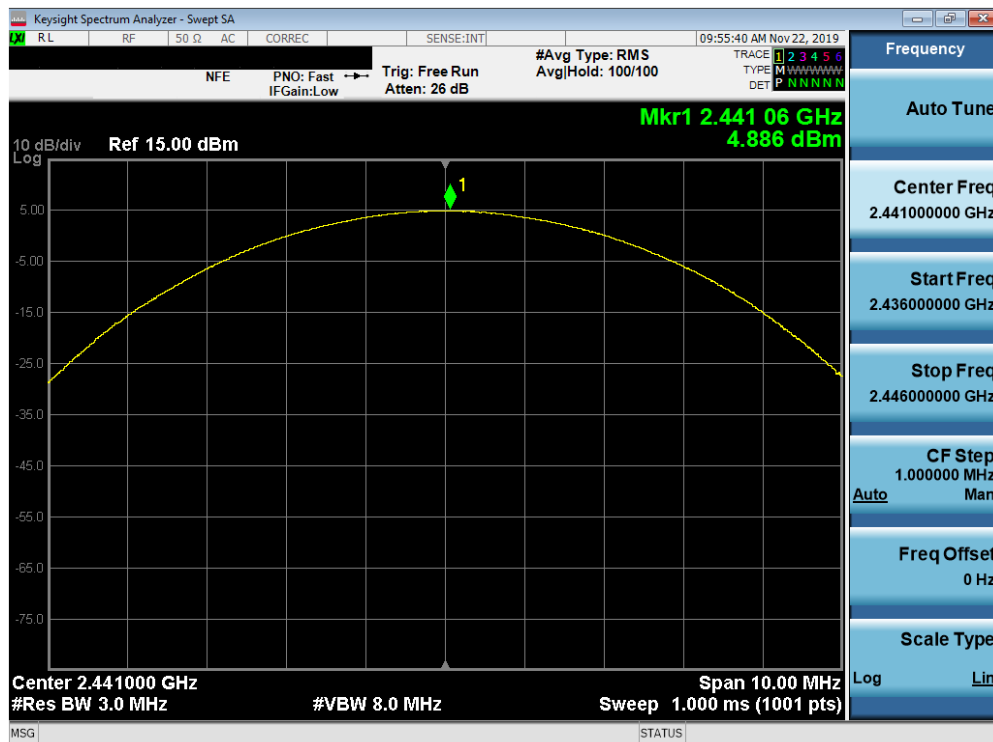


Plot 7-6. Peak Conducted Power (2Mbps – Ch. 78)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 15 of 32

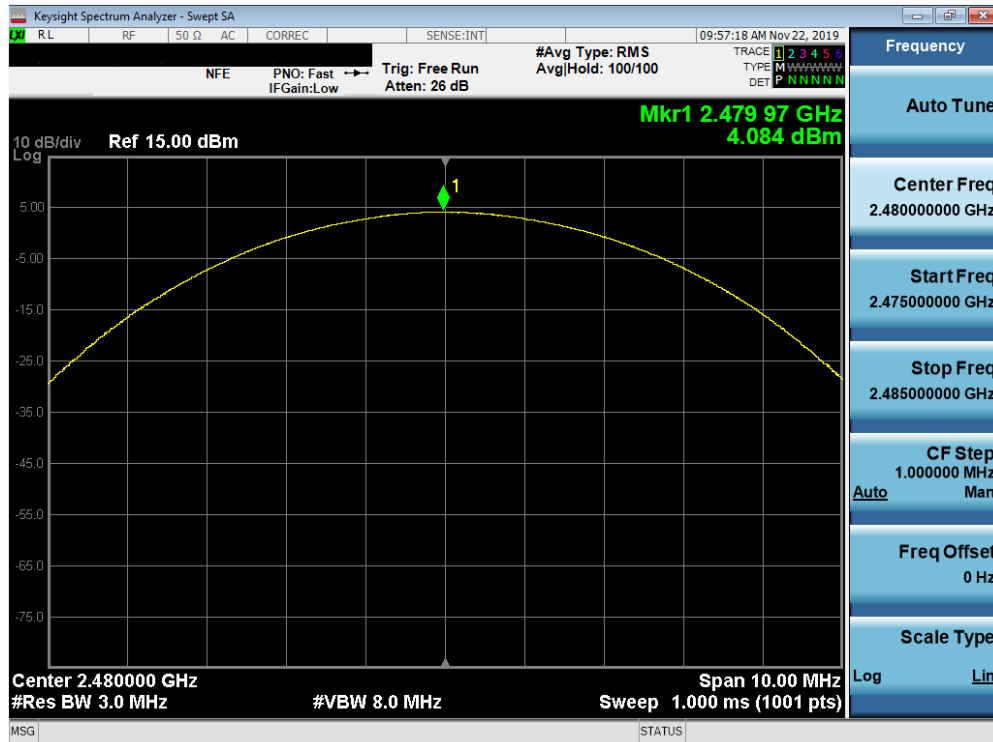


Plot 7-7. Peak Conducted Power (3Mbps – Ch. 0)



Plot 7-8. Peak Conducted Power (3Mbps – Ch. 39)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 16 of 32



Plot 7-9. Peak Conducted Power (3Mbps – Ch. 78)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 17 of 32

7.3 Radiated Spurious Emission Measurements – Above 1GHz

§15.205 §15.209 §15.247 (d);

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-3 per Section 15.209.

Frequency	Field Strength [$\mu\text{V/m}$]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-3. Radiated Limits

Test Procedure Used

ANSI C63.10-2013 – Section 6.6.4.3

Test Settings

Average Field Strength Measurements per Section 4.1.4.2.3 of ANSI C63.10-2013

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 1kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to stabilize

Peak Field Strength Measurements per Section 4.1.4.2.2 of ANSI C63.10-2013

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in Table 7-4 below
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 18 of 32

Frequency	RBW
9 – 150kHz	200 – 300Hz
0.15 – 30MHz	9 – 10kHz
30 – 1000MHz	100 – 120kHz
> 1000MHz	1MHz

Table 7-4. RBW as a Function of Frequency

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

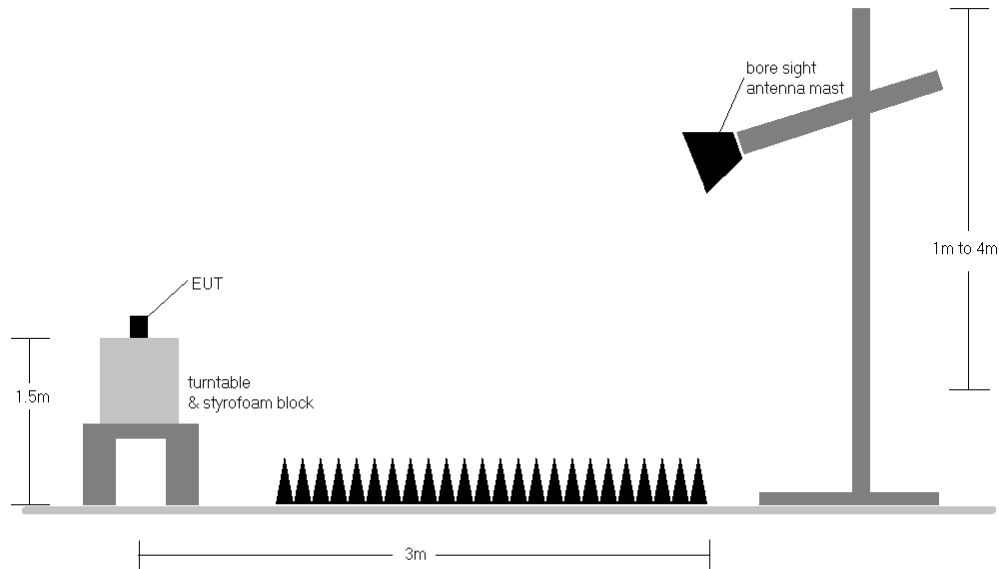


Figure 7-2. Radiated Test Setup >1GHz

Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-3.
2. No significant radiated emissions were found in the 2310 - 2390MHz restricted band.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested while powered by a 12V DC power source (battery).
5. The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported.
6. The duty cycle correction factor was not applied to noise floor measurements.
7. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Siriusxm SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 19 of 32

Sample Calculation

- Field Strength Level $[\text{dB}\mu\text{V/m}] = \text{Analyzer Level} [\text{dBm}] + 107 + \text{AFCL} [\text{dB/m}] + \text{Duty Cycle Correction} [\text{dB}]$
- $\text{AFCL} [\text{dB/m}] = \text{Antenna Factor} [\text{dB/m}] + \text{Cable Loss} [\text{dB}]$
- $\text{Margin} [\text{dB}] = \text{Field Strength Level} [\text{dB}\mu\text{V/m}] - \text{Limit} [\text{dB}\mu\text{V/m}]$

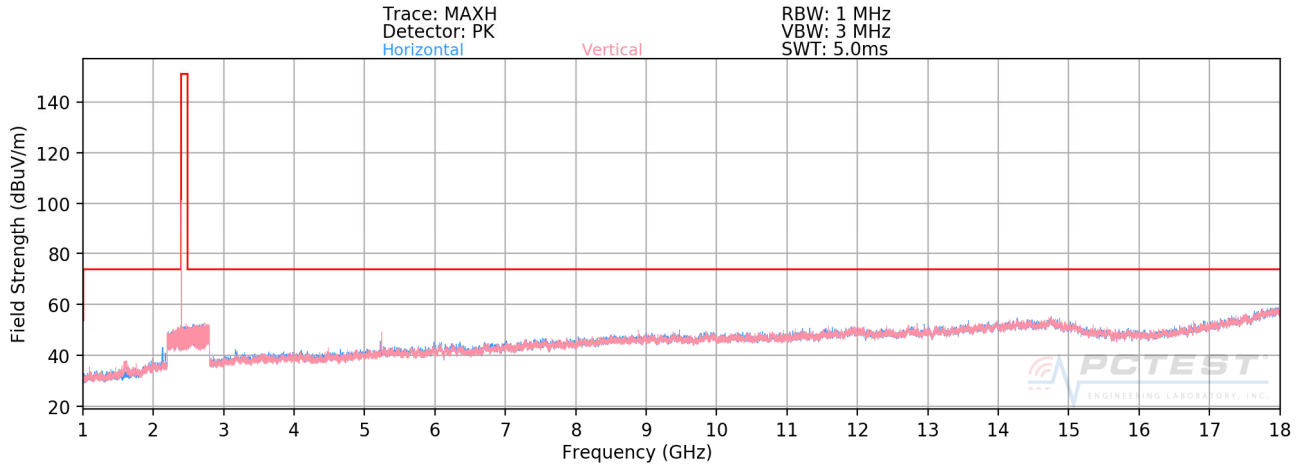
Duty Cycle Correction Factor Calculation

- Channel hop rate = 800 hops/second (AFH Mode)
- Adjusted channel hop rate for DH5 mode = 133.33 hops/second
- Time per channel hop = $1 / 133.33 \text{ hops/second} = 7.50 \text{ ms}$
- Time to cycle through all channels = $7.50 \times 20 \text{ channels} = 150 \text{ ms}$
- Number of times transmitter hits on one channel = $100 \text{ ms} / 150 \text{ ms} = 1 \text{ time(s)}$
- Worst case dwell time = 7.5 ms
- Duty cycle correction factor = $20\log_{10}(7.5\text{ms}/100\text{ms}) = -22.5 \text{ dB}$

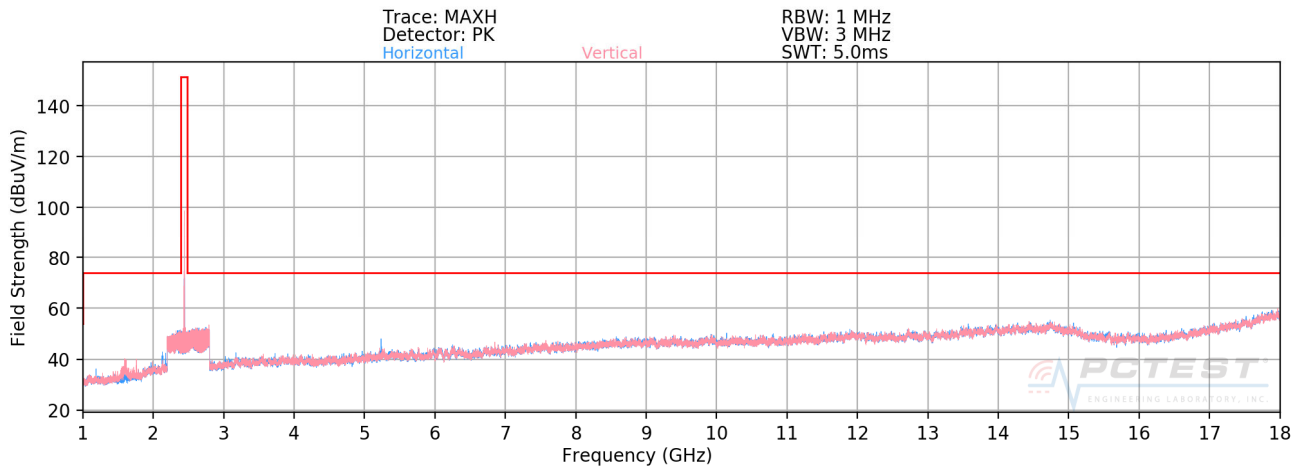
FCC ID: RS2LBEE5HY1MW	 MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module	Page 20 of 32	

Radiated Spurious Emission Measurements

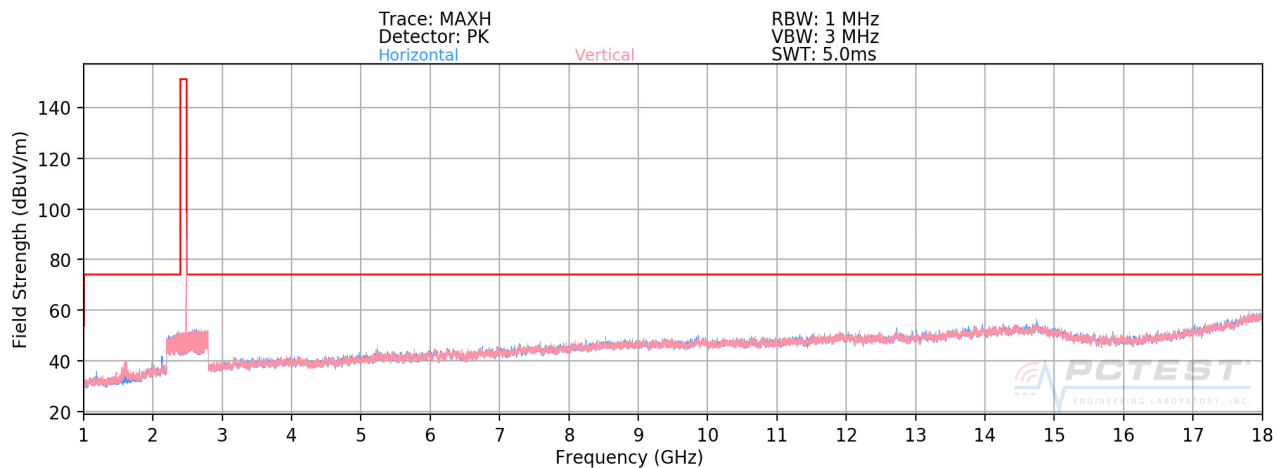
§15.205 §15.209 §15.247 (d)



Plot 7-10. Radiated Spurious Plot above 1GHz (BT- Ch. 0)



Plot 7-11. Radiated Spurious Plot above 1GHz (BT- Ch. 39)

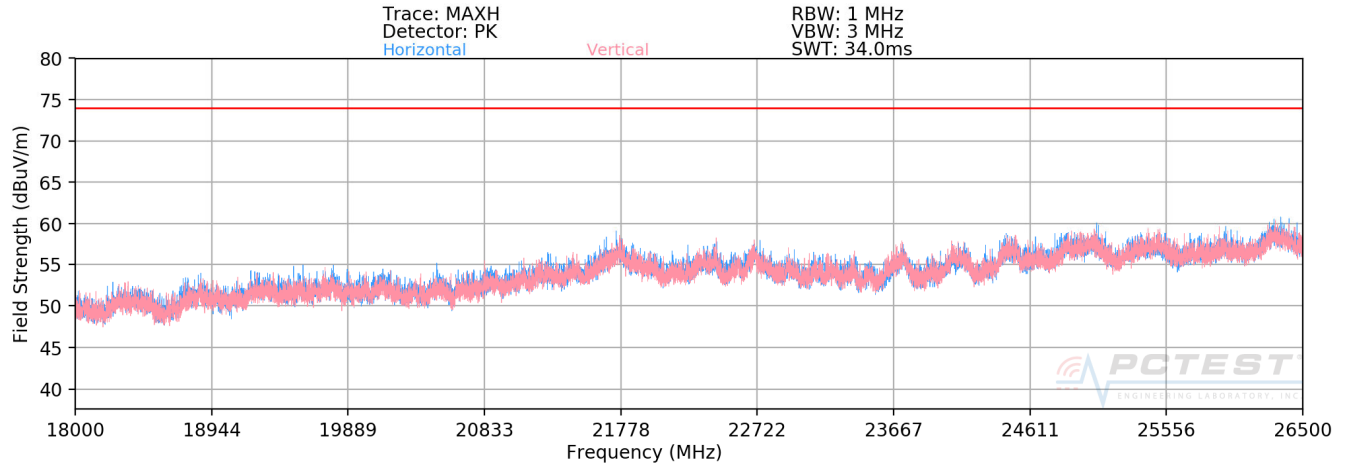


Plot 7-12. Radiated Spurious Plot above 1GHz (BT- Ch. 78)

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	Siriusxm SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 21 of 32

Radiated Spurious Emissions Measurements (Above 18GHz)

\$15.209



Plot 7-13. Radiated Spurious Plot above 18GHz

FCC ID: RS2LBEE5HY1MW	 MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 22 of 32

Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247 (d)

Worst Case Mode: Bluetooth
Worst Case Data Rate: 1 Mbps
Measurement Distance: 3 Meters
Operating Frequency: 2402MHz
Channel: 0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBμV/m]	Limit [dBμV/m]	Margin [dB]
4804.00	Avg	V	186	194	-79.14	2.97	-22.50	8.33	53.98	-45.65
4804.00	Peak	V	186	194	-66.90	2.97	0.00	43.07	73.98	-30.91
12010.00	Avg	V	-	-	-81.75	14.09	0.00	39.34	53.98	-14.64
12010.00	Peak	V	-	-	-69.76	14.09	0.00	51.33	73.98	-22.65

Table 7-5. Radiated Measurements

Worst Case Mode: Bluetooth
Worst Case Data Rate: 1 Mbps
Measurement Distance: 3 Meters
Operating Frequency: 2442MHz
Channel: 40

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBμV/m]	Limit [dBμV/m]	Margin [dB]
4884.00	Avg	V	121	170	-77.93	3.90	-22.50	10.47	53.98	-43.51
4884.00	Peak	V	121	170	-65.62	3.90	0.00	45.28	73.98	-28.70
7326.00	Avg	V	131	173	-80.53	7.93	-22.50	11.90	53.98	-42.08
7326.00	Peak	V	131	173	-68.32	7.93	0.00	46.61	73.98	-27.37
12210.00	Avg	V	-	-	-82.04	13.91	0.00	38.87	53.98	-15.11
12210.00	Peak	V	-	-	-69.76	13.91	0.00	51.15	73.98	-22.83

Table 7-6. Radiated Measurements

FCC ID: RS2LBEE5HY1MW	 MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 23 of 32

Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247 (d)

Worst Case Mode:	Bluetooth
Worst Case Data Rate:	1 Mbps
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Duty Cycle Correction [dB]	Field Strength [dBμV/m]	Limit [dBμV/m]	Margin [dB]
4960.00	Avg	V	125	171	-77.07	3.61	-22.50	11.04	53.98	-42.94
4960.00	Peak	V	125	171	-66.33	3.61	0.00	44.28	73.98	-29.70
7440.00	Avg	V	122	182	-80.26	8.30	-22.50	12.54	53.98	-41.44
7440.00	Peak	V	122	182	-68.11	8.30	0.00	47.19	73.98	-26.79
12400.00	Avg	V	-	-	-81.90	14.09	0.00	39.19	53.98	-14.79
12400.00	Peak	V	-	-	-69.54	14.09	0.00	51.55	73.98	-22.43

Table 7-7. Radiated Measurements

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 24 of 32

7.4 Radiated Spurious Emissions Measurements – Below 1GHz

§15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-8 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-8. Radiated Limits

Test Procedures Used

ANSI C63.10-2013

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 25 of 32

Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

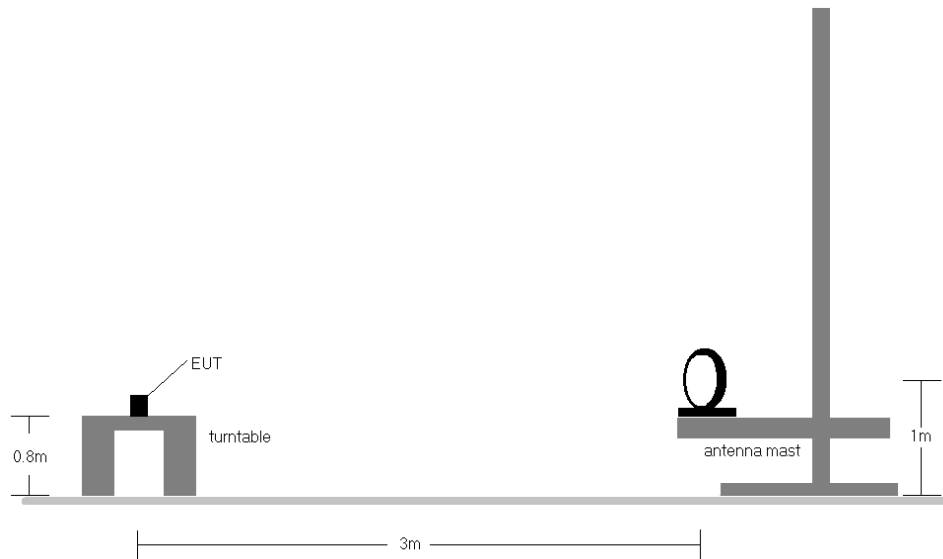


Figure 7-3. Radiated Test Setup < 30Mhz

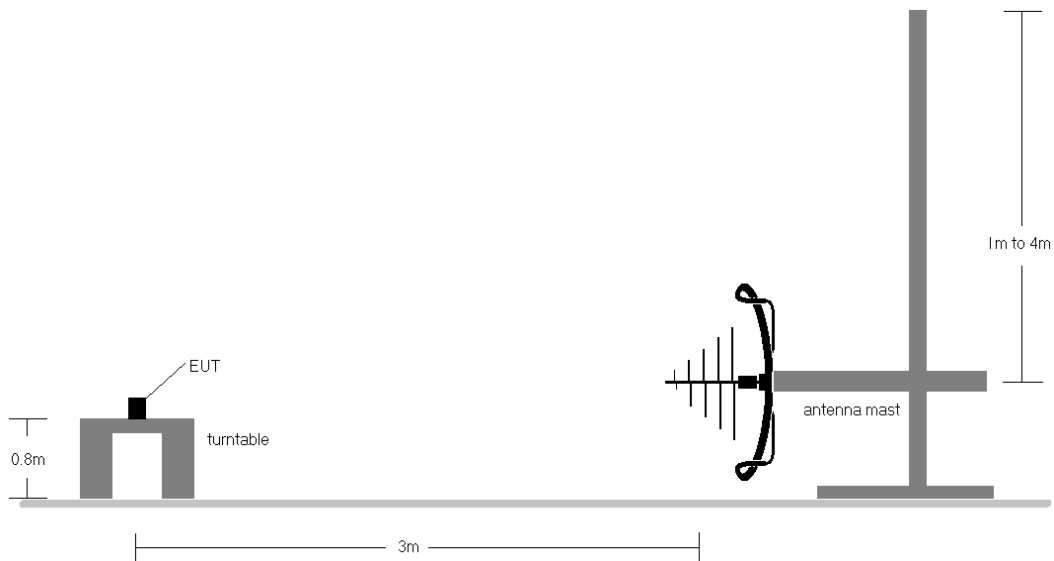


Figure 7-4. Radiated Test Setup < 1GHz

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	SiriusXM SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 26 of 32

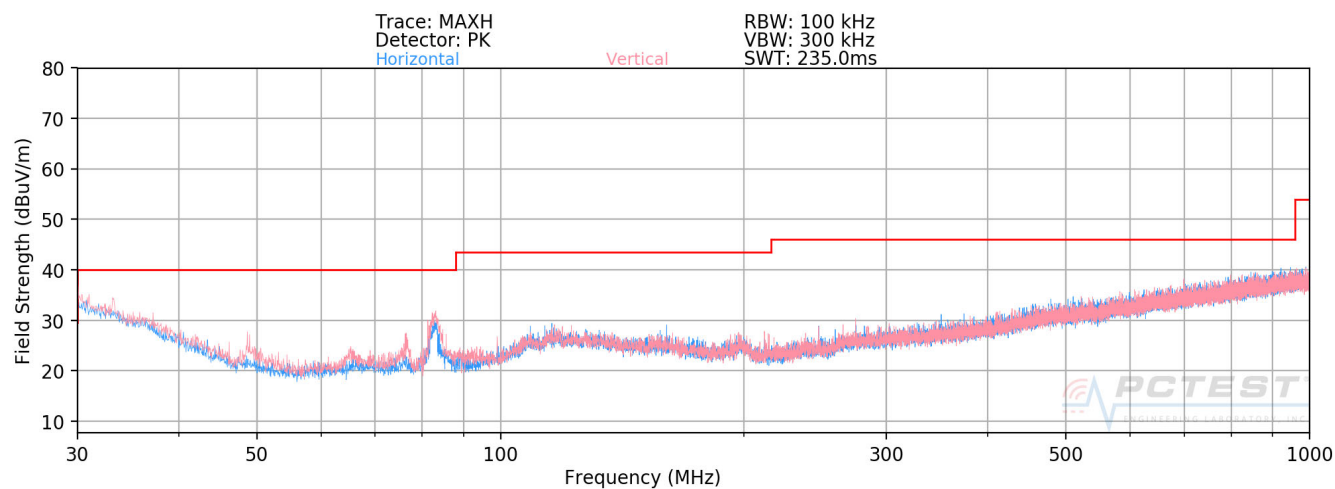
Test Notes

1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-8.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested while powered by a 12V DC power source (battery).
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

FCC ID: RS2LBEE5HY1MW	 MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module	Page 27 of 32	

Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 7-14. Radiated Spurious Plot below 1GHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
47.20	Quasi-Peak	V	-94.62	15.30	27.68	40.00	-12.32
77.61	Quasi-Peak	V	-94.21	14.75	27.54	40.00	-12.46
84.32	Quasi-Peak	V	-88.72	14.17	32.45	40.00	-7.55
123.11	Quasi-Peak	H	-95.76	20.39	31.63	43.52	-11.89
124.72	Quasi-Peak	H	-95.65	20.42	31.78	43.52	-11.74

Table 7-9. Radiated Spurious Measurements

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	SiriusXM SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 28 of 32

7.5 Line Conducted Measurement Data

§15.207

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207.

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

Table 7-9. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)		Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 29 of 32

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

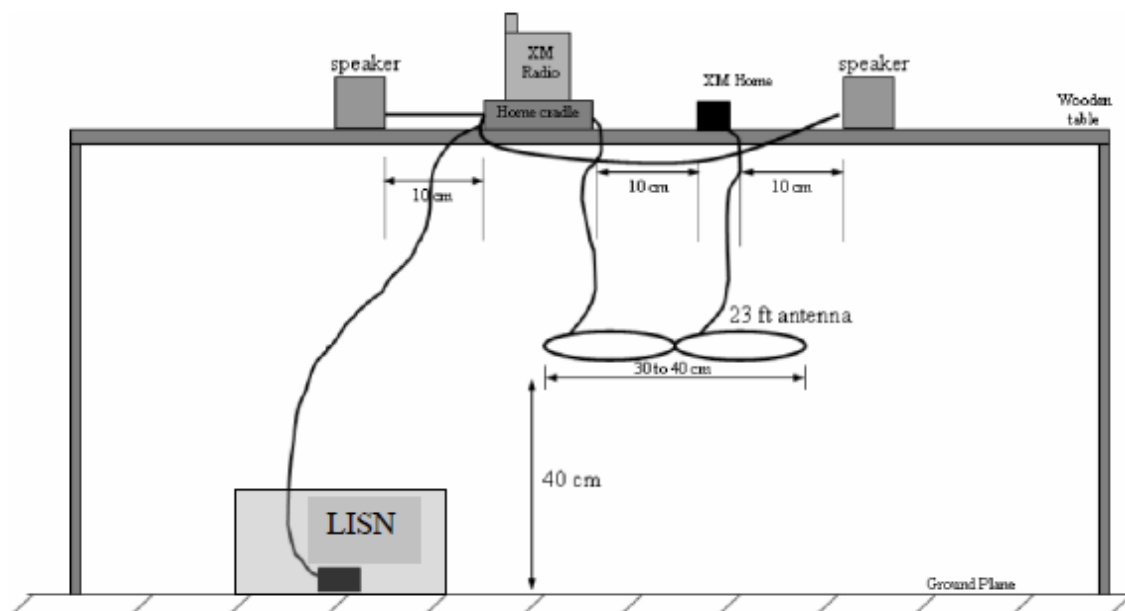
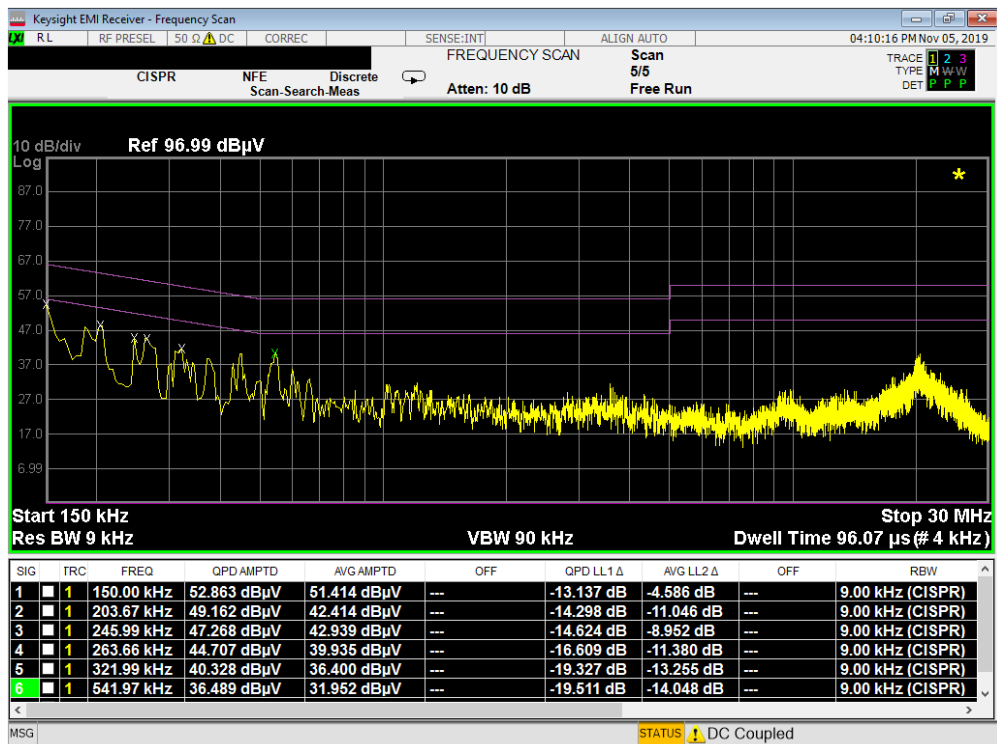


Figure 7-5. Test Instrument & Measurement Setup

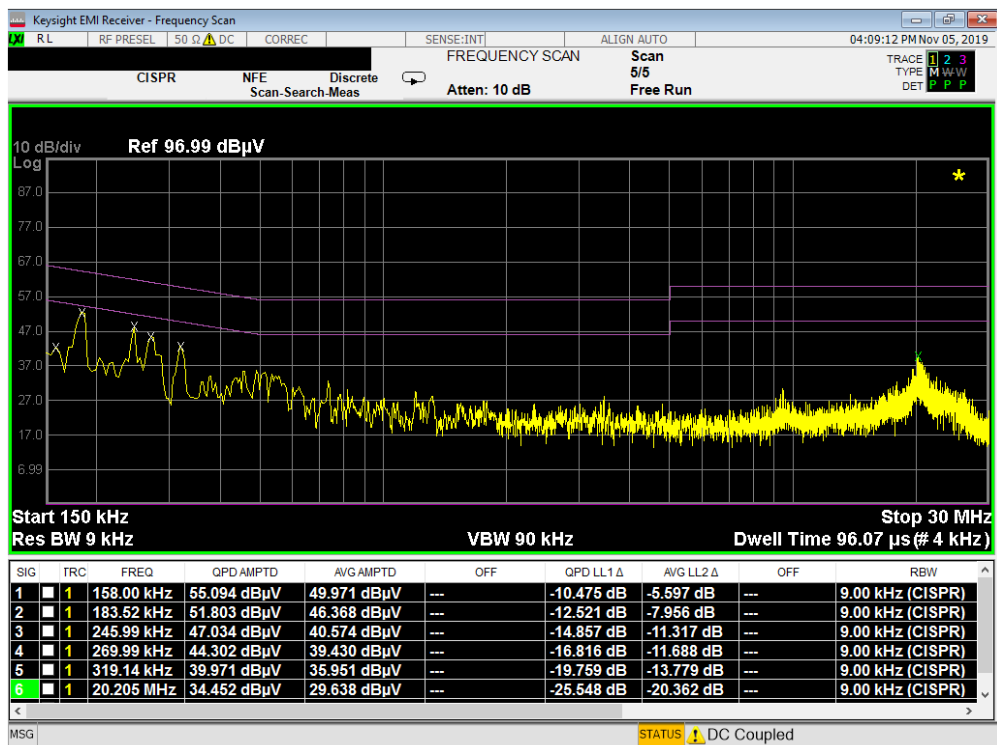
Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207.
3. $\text{Corr. (dB)} = \text{Cable loss (dB)} + \text{LISN insertion factor (dB)}$
4. $\text{QP/AV Level (dB}\mu\text{V)} = \text{QP/AV Analyzer/Receiver Level (dB}\mu\text{V)} + \text{Corr. (dB)}$
5. $\text{Margin (dB)} = \text{QP/AV Limit (dB}\mu\text{V)} - \text{QP/AV Level (dB}\mu\text{V)}$
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

FCC ID: RS2LBEE5HY1MW	PCTEST ENGINEERING LABORATORY, INC.	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)	SiriusXM SATELLITE RADIO	Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 30 of 32



Plot 7-15. Line-Conducted Test Plot (L1)



Plot 7-16. Line-Conducted Test Plot (N)

FCC ID: RS2LBEE5HY1MW	MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module		Page 31 of 32

8.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Sirius XM BT/WiFi Module FCC ID: RS2LBEE5HY1MW** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

FCC ID: RS2LBEE5HY1MW		MEASUREMENT REPORT (CLASS II PERMISSIVE CHANGE)			Approved by: Quality Manager
Test Report S/N: 1M1911040180-04.RS2	Test Dates: 11/04 - 11/21/2019	EUT Type: BT/WiFi Module			Page 32 of 32