Radio Testing of the
Savant Systems, Inc.
Wireless Controller
Model: SAVANT POWER DIRECTORLITE

In accordance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 2 February 2017

America

Add value.
Inspire trust.

Savant Systems, Inc.
45 Perseverance Way
Hyannis MA USA 02601

COMMERCIAL-IN-CONFIDENCE

Date: September 2022
Document Number: 72182290A Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Omar Castillo	September 28, 2022	

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

EXECUTIVE SUMMARY
A sample of this product was tested and found to be in compliance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 2 February 2017.

A2LA Cert. No. 2955.13

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REPORT ON	Radio Testing of the Savant Systems, Inc. Model: SAVANT POWER DIRECTORLITE (Wireless Controller)
TEST REPORT NUMBER	72182290A
TEST REPORT DATE	September 2022
PREPARED FOR	Savant Systems, Inc. 45 Perseverance Way Hyannis MA USA 02601
CONTACT PERSON	Lori Pass Hardware Engineer lori.pass@savant.com (508) 683-2430
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: Senior EMC Test Engineer / Wireless Team Lead
APPROVED BY	Omar Castillo **Name** Authorized Signatory Title: Senior EMC/Wireless Test Engineer
DATED	September 28, 2022

Revision History

72182290A Savant Systems, Inc. Model: SAVANT POWER DIRECTORLITE					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
09/28/2022	—	Initial Release			Omar Castillo

CONTENTS

SECTION 1

REPORT SUMMARY

Radio Testing of the
Savant Systems, Inc.
SAVANT POWER DIRECTORLITE Wireless Controller

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the SAVANT POWER DIRECTORLITE Wireless 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	Savant Systems, Inc.
EUT	HST-DIRECTORLITE SAVANT POWER DIRECTORLITE
Model Number	HST-DIRECTORLITE
Model Name	SAVANT POWER DIRECTORLITE
FCC ID	ASU-DIRECTORLITE
IC Number	10052A-DIRECTORLITE
FCC Classification	Low power Communications Device Transmitter (DTS)
Serial Number(s)	347650038
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2021). • RSS-247–Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices (Issue 2, February 2017). • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 5, Amendment 2 February 2021).
Start of Test	September 09, 2022
Finish of Test	September 14, 2022
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices. • KDB 558074 D01 15.247 v05r02 Guidance for compliance measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under Section 15.247 of the FCC rules. • Supporting documents for EUT certification are separate exhibits.

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 2 February 2017 with cross-reference to the corresponding IC RSS standard are shown below.

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

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

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment Under Test (EUT) is a SAVANT POWER DIRECTORLITE Wireless Controller for smart energy management. The EUT consists of Linux application processor with BLE microcontrollers and 1x WiFi/BLE module. The EUT acts as a bridge between BLE communications to IP network (either Ethernet or WiFi). The device is powered via either Power-over-Ethernet (PoE) or 5V AC-DC adapter.

1.3.2 EUT General Description

EUT Description	Wireless Controller for Smart Energy Management
Model Name	SAVANT POWER DIRECTORLITE
Model Number	HST-DIRECTORLITE
Rated Voltage	120VAC AC to 5V DC (3A)
Mode Verified	Bluetooth LE 5.1
Capability	BLE 5.1, 2.4/5.0 GHz IEEE 802.11 a/b/g/n/ac
Primary Unit (EUT)	☐ Production
	☒ Pre-Production
	☐ Engineering
Manufacturer Declared Temperature Range	0°C to 40°C
Antenna Type	Wi-Fi Dual-band Stubby Antenna
Manufacturer	World Products Inc.
Antenna Model	WPANT30094-R1A
Maximum Antenna Gain	2.0 dBi

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Gated RMS (dBm)	Duty Cycle (%)
	2402-2480	4.4	63.1% / 33.3%

See section 2.1.8 of this test report. Duty cycle figures are for both 1M and 2M PHY.

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

<table>
<tr><th>Test Configuration</th><th>Description</th></tr>
<tr><td>Default</td><td>Antenna Conducted Port Configuration. Direct measurement from the antenna port. The EUT is connected to a support laptop connected by a programming dongle, a 10 pin Tag Connect and a USB-C cable. nRF Connect and PuTTY were used on the support laptop for BLE 5.1 RF test configurations. The following settings were used for both 1M and 2M PHY configurations:

<table>
<tr><td>Transmit Power</td><td>8dBm</td></tr>
<tr><td>Packet Type</td><td>PRBS9</td></tr>
<tr><td>Packet Length</td><td>37 Bytes</td></tr>
</table>

For Cabinet Spurious Emissions, identical configurations are used with the antenna port terminated.</td></tr>
</table>

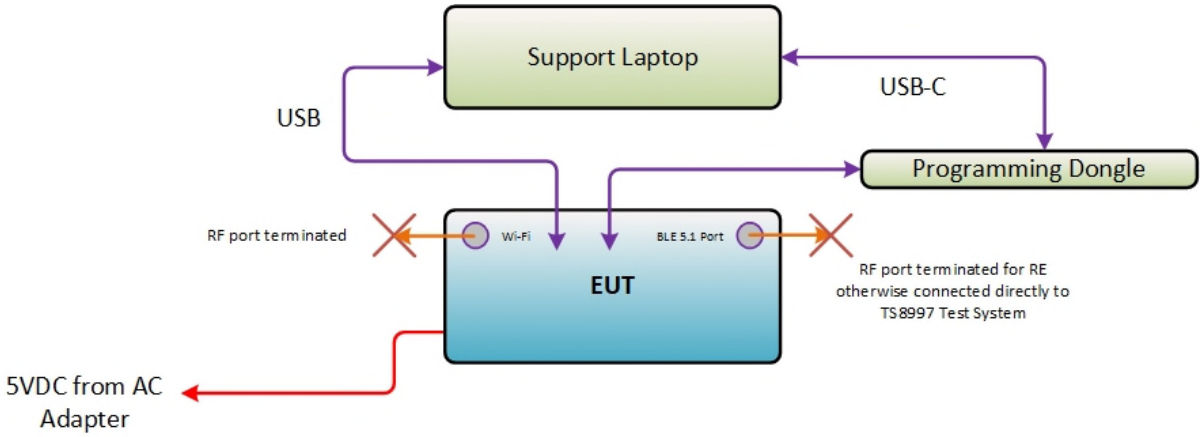
1.4.2 EUT Exercise Software

nRF Connect for Desktop v3.11.0

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
Lenovo	Support laptop	Model:Thinkpad T440S, S/N: PC-03BBGR
Racepoint	Laptop to EUT	Programming Dongle
-	TC2050-CTX	10 pin Tag Connect cable
Mean Well	EUT AC Adapter	Model: GST18U05 P1J

1.4.1 Simplified Test Configuration Diagram



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: No modifications		
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

TÜV SÜD 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 (ISED) Registration No.: 3067A-1 & 22806-1

The 10m Semi-anechoic chamber of TÜV SÜD 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 TÜV SÜD 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)

TÜV 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)

TÜV SÜD 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 LP0002 for Low-Power RF Device type of testing.

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

TÜV SÜD 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

TÜV SÜD 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

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

SECTION 2

TEST DETAILS

Radio Testing of the
Savant Systems, Inc.
SAVANT POWER DIRECTORLITE Wireless 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: 347650038 / Default Test Configuration

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

September 10, 2022 / FSC

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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

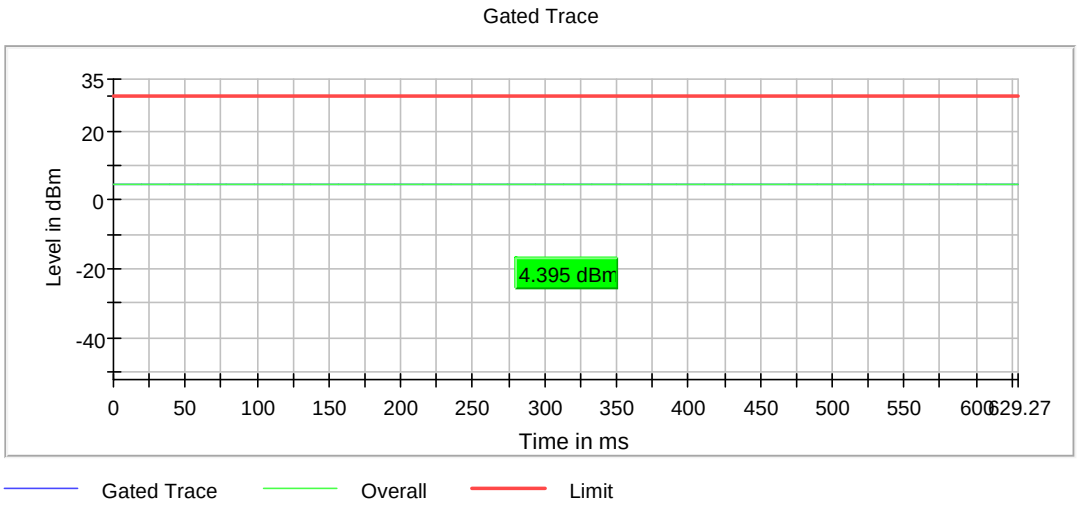
2.1.7 Additional Observations

- This is a conducted test using direct connection to the TS8997 Test System.
- The path loss was all accounted for with the test system calibration.
- Test methodology is per FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.9.2.3.2.

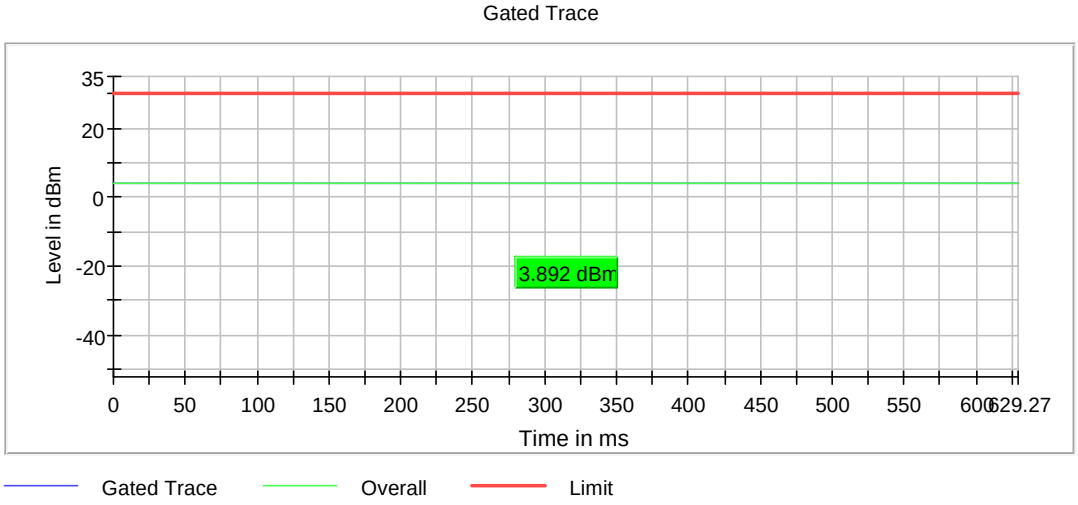
2.1.8 Test Results

DUT Frequency (MHz)	PHY	Gated RMS* (dBm)	Limit Max (dBm)	DutyCycle (%)	Result
2402.000000	1M	4.4	30.0	63.133	PASS
2440.000000	1M	3.9		63.133	PASS
2480.000000	1M	3.5		63.135	PASS
2402.000000	2M	4.4		33.373	PASS
2440.000000	2M	3.9		33.374	PASS
2480.000000	2M	3.4		33.374	PASS

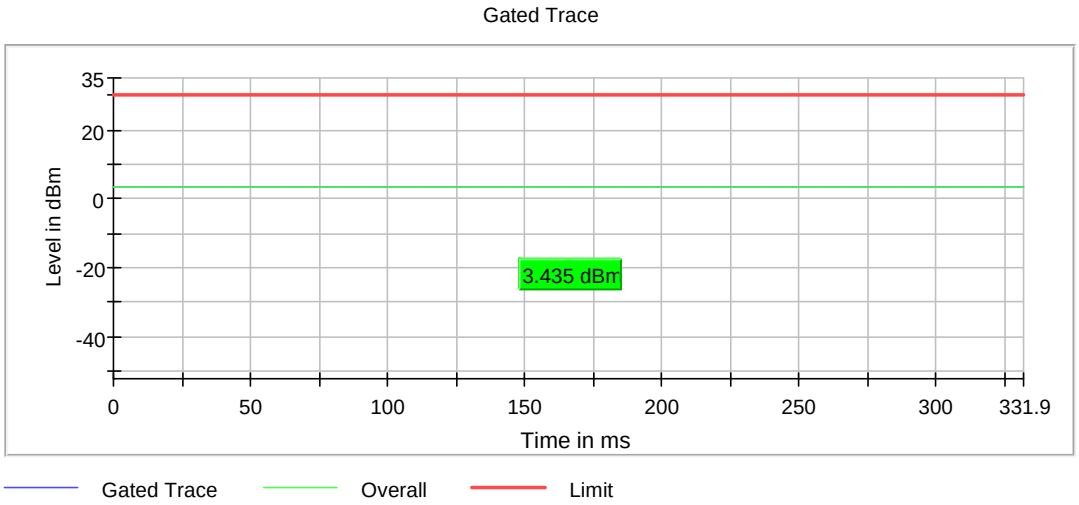
2.1.9 Sample Test Plots



Bluetooth LE. Low Channel 1M PHY



Bluetooth LE. Mid Channel 1M PHY



Bluetooth LE. High Channel 2M PHY

2.1.10 Power Meter Settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs

2.2 CONDUCTED EMISSIONS

2.2.1 Specification Reference

FCC 47 CFR Part 15, Clause 15.207(a)
RSS-GEN, Clause 8.8

2.2.2 Standard Applicable

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

**Decreases with the logarithm of the frequency.*

2.2.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 14, 2022 / FSC

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 (Mira Mesa Facility)

Ambient Temperature	27.0 °C
Relative Humidity	48.6 %
ATM Pressure	100.0 kPa

2.2.7 Additional Observations

Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.2.8 for sample computation.

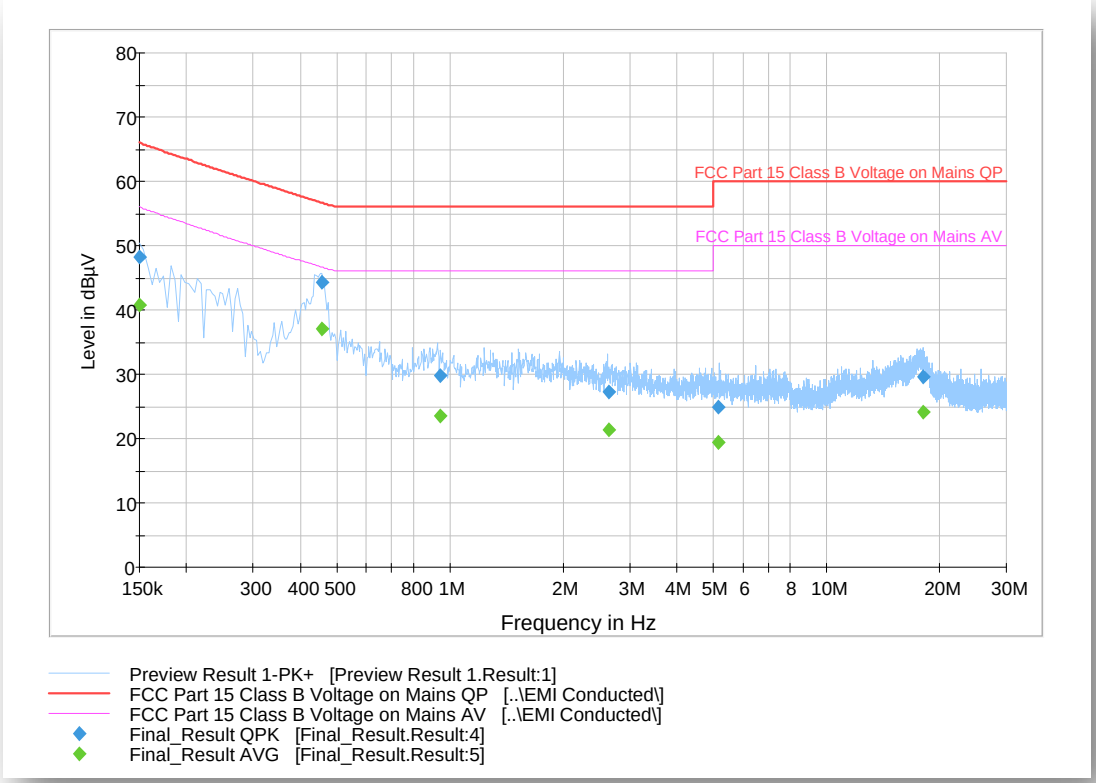
2.2.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbµV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbµV) @ 150kHz			**26.2**

2.2.9 Test Results

Compliant. See attached plots and tables.

2.2.10 TX Mode (120V-60Hz) Line 1



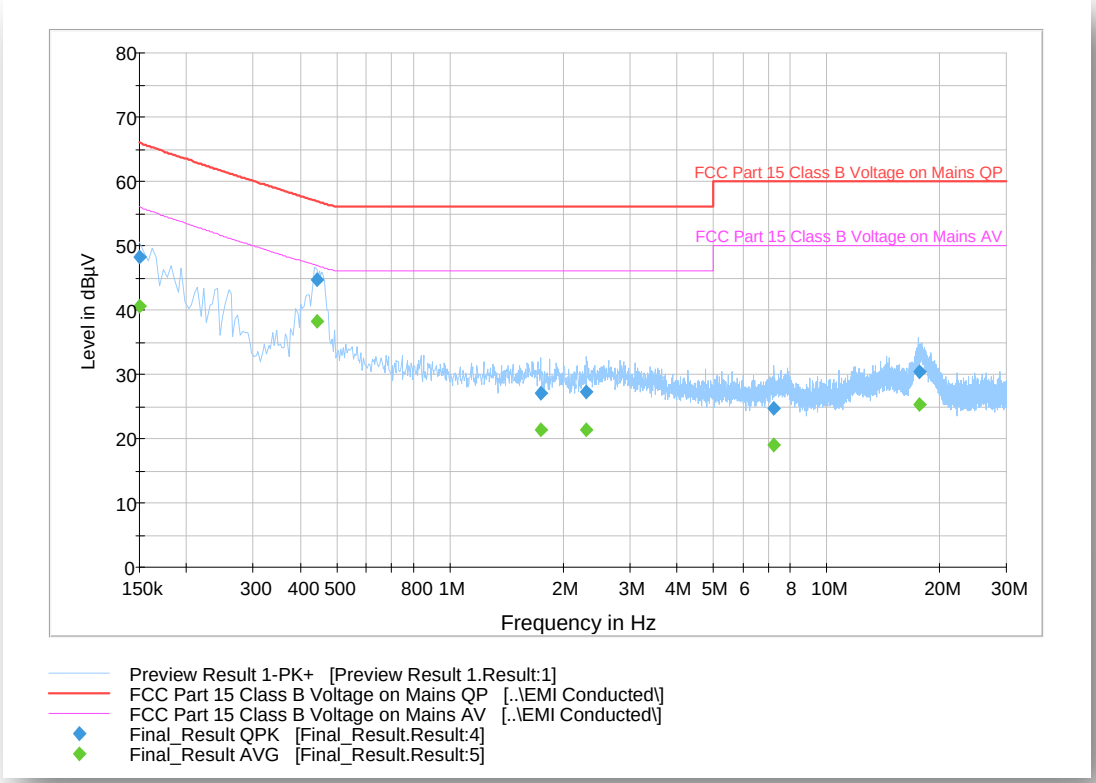
Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	48.14	66.00	17.86	1000.0	9.000	L1	ON	20.5
0.458000	44.22	56.68	12.46	1000.0	9.000	L1	ON	20.3
0.939280	29.85	56.00	26.15	1000.0	9.000	L1	ON	20.3
2.636365	27.34	56.00	28.66	1000.0	9.000	L1	ON	20.5
5.171558	24.97	60.00	35.03	1000.0	9.000	L1	ON	20.5
18.058345	29.59	60.00	30.41	1000.0	9.000	L1	ON	20.9

Average Data

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	40.75	56.00	15.25	1000.0	9.000	L1	ON	20.5
0.458000	37.06	46.66	9.60	1000.0	9.000	L1	ON	20.3
0.939280	23.55	46.00	22.45	1000.0	9.000	L1	ON	20.3
2.636365	21.46	46.00	24.54	1000.0	9.000	L1	ON	20.5
5.171558	19.32	50.00	30.68	1000.0	9.000	L1	ON	20.5
18.058345	24.15	50.00	25.85	1000.0	9.000	L1	ON	20.9

2.2.11 TX Mode (120V-60Hz) Line 2



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	48.17	66.00	17.83	1000.0	9.000	N	ON	20.6
0.442500	44.69	56.94	12.25	1000.0	9.000	N	ON	20.4
1.746225	27.13	56.00	28.87	1000.0	9.000	N	ON	20.5
2.307903	27.21	56.00	28.79	1000.0	9.000	N	ON	20.5
7.250573	24.63	60.00	35.37	1000.0	9.000	N	ON	20.5
17.593880	30.39	60.00	29.61	1000.0	9.000	N	ON	20.8

Average Data

Frequency (MHz)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	40.62	56.00	15.38	1000.0	9.000	N	ON	20.6
0.442500	38.27	46.93	8.65	1000.0	9.000	N	ON	20.4
1.746225	21.36	46.00	24.64	1000.0	9.000	N	ON	20.5
2.307903	21.33	46.00	24.67	1000.0	9.000	N	ON	20.5
7.250573	18.95	50.00	31.05	1000.0	9.000	N	ON	20.5
17.593880	25.27	50.00	24.73	1000.0	9.000	N	ON	20.8

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

Serial No: 347650038 / Default Test Configuration

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

September 10, 2022 / FSC

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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

2.3.7 Additional Observations

- This is a conducted test using direct connection to the TS8997 Test System.

- The path loss was all accounted for with the test system calibration.
- Test methodology is per Test according to FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1.

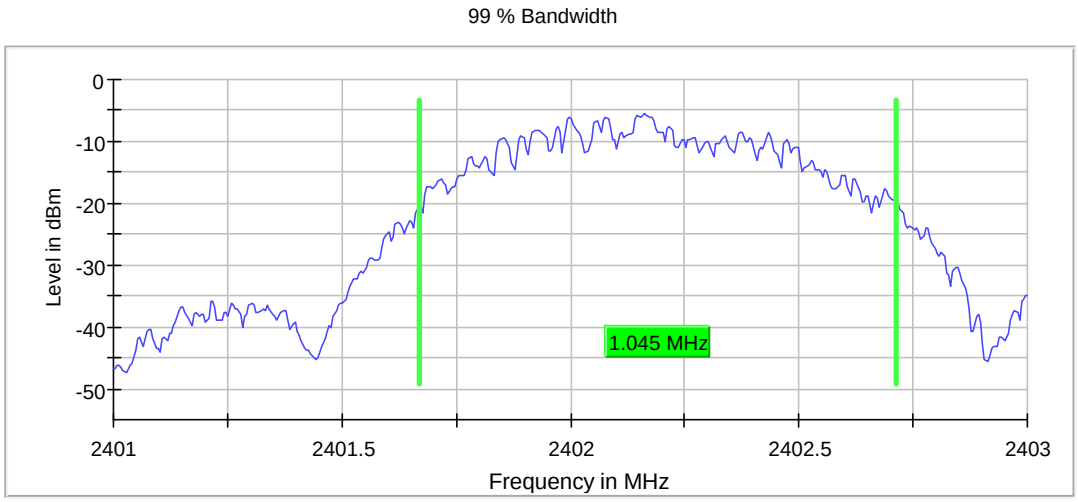
2.3.8 Sample Measurement Settings

Setting	Instrument Value	Target Value
Span	2.000 MHz	2.000 MHz
RBW	10.000 kHz	>= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	400	~ 400
Sweeptime	189.648 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	9 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.06 dB	0.30 dB

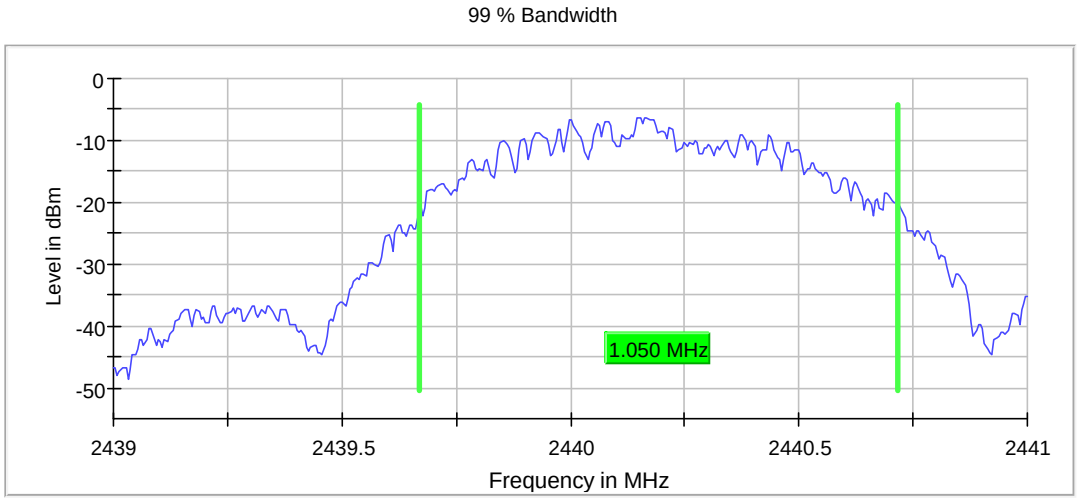
2.3.9 Test Results

DUT Frequency (MHz)	PHY	99% Bandwidth	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2402.000000	1M	1.045000	2401.667500	2402.712500	PASS
2440.000000	1M	1.050000	2439.667500	2440.717500	PASS
2480.000000	1M	1.050000	2479.672500	2480.722500	PASS
2402.000000	2M	2.040000	***2401.185000***	2403.225000	PASS
2440.000000	2M	2.040000	2439.185000	2441.225000	PASS
2480.000000	2M	2.040000	2479.185000	***2481.225000***	PASS

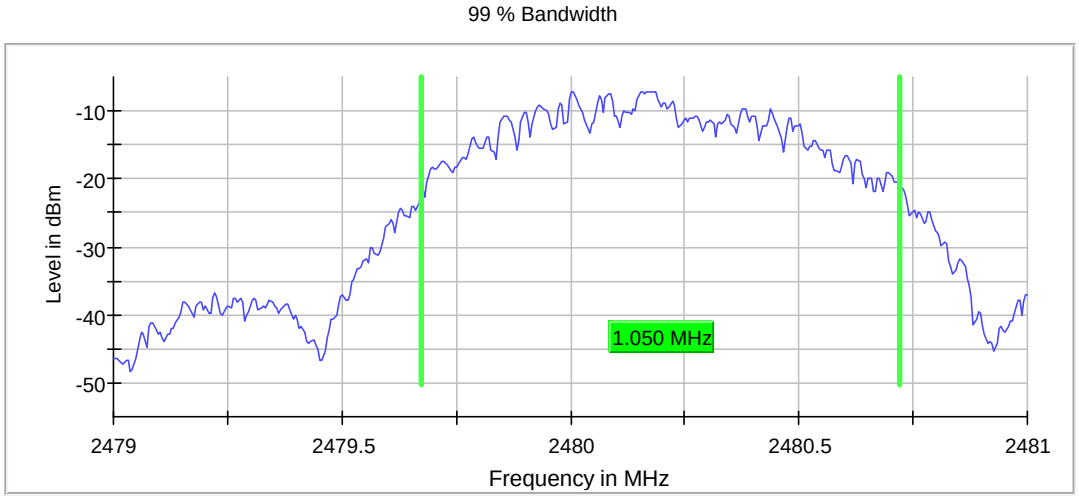
2.3.10 Test Plots



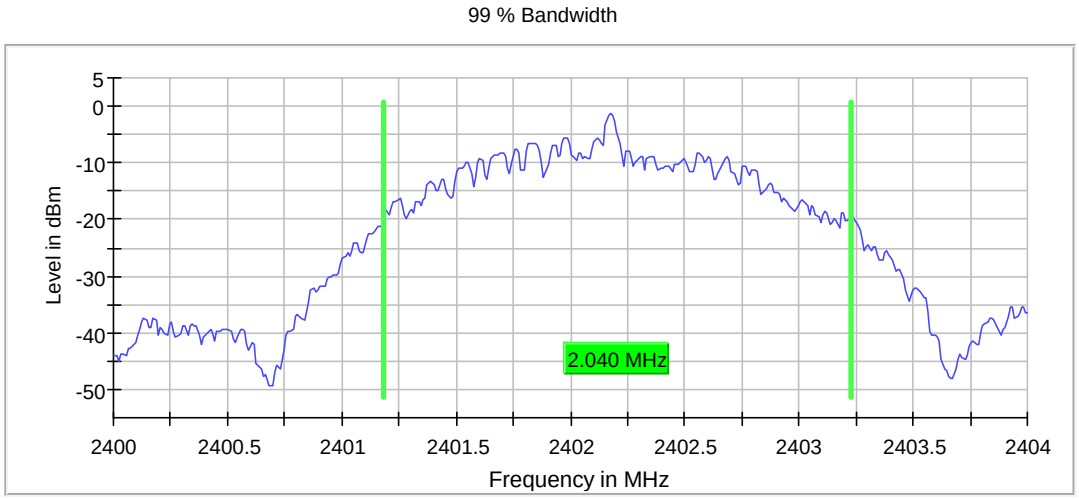
Bluetooth LE Low Channel 1M PHY



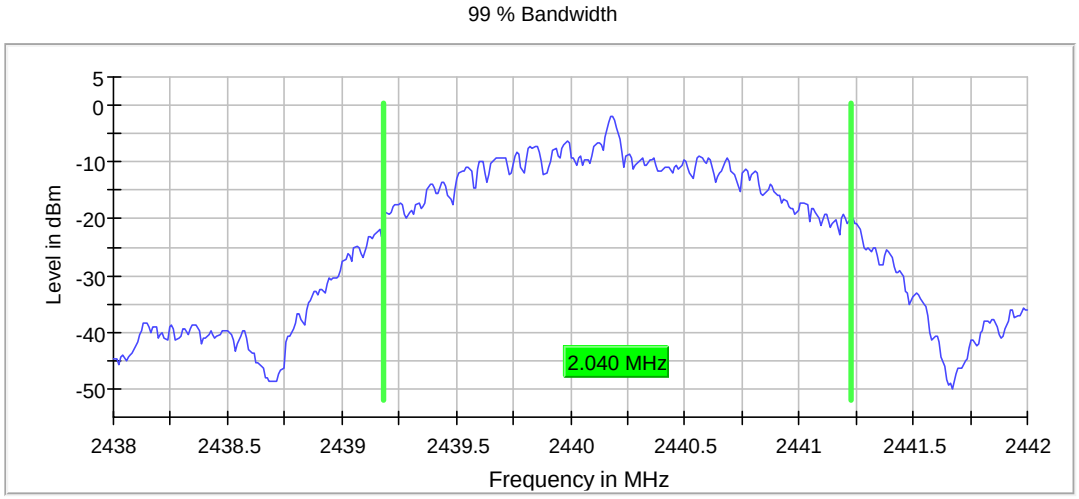
Bluetooth LE Middle Channel 1M PHY



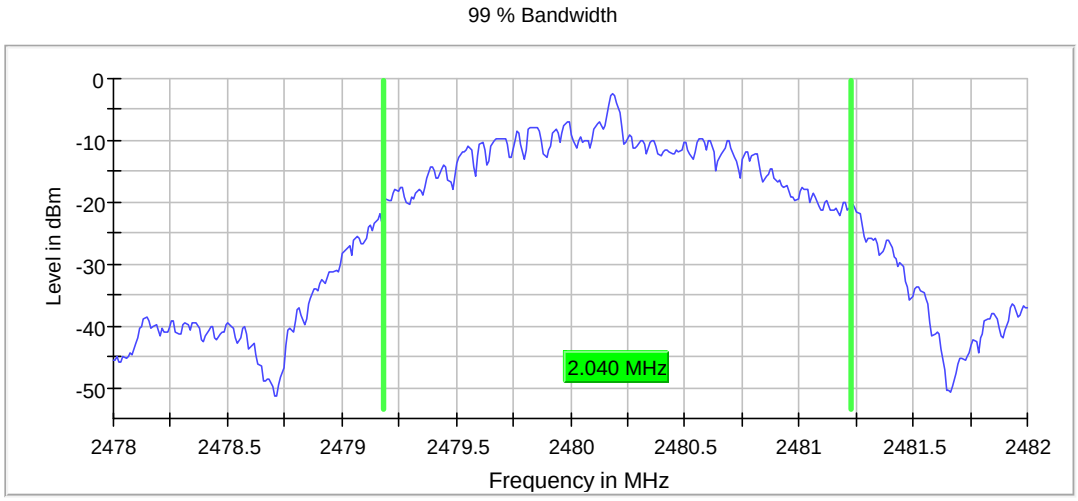
Bluetooth LE High Channel 1M PHY



Bluetooth LE Low Channel 2M PHY



Bluetooth LE Middle Channel 2M PHY



Bluetooth LE High Channel 2M PHY

2.4 MINIMUM 6 dB RF BANDWIDTH

2.4.1 Specification Reference

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

2.4.2 Standard Applicable

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

2.4.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 10, 2022 / FSC

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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

2.4.7 Additional Observations

- This is a conducted test using direct connection to the TS8997 Test System.
- The path loss was all accounted for with the test system calibration.
- Test methodology is per FCC title 47 part 15 §15.247(a), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.8.1.

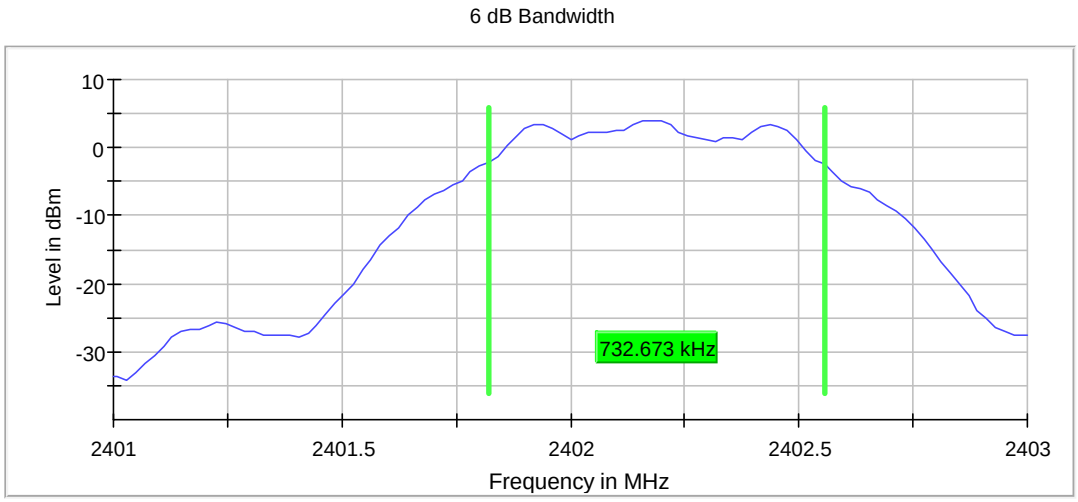
2.4.8 Sample Measurement Settings

Setting	Instrument Value	Target Value
Span	2.000 MHz	2.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	101	~ 40
Sweeptime	18.938 µs	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	11 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.18 dB	0.50 dB

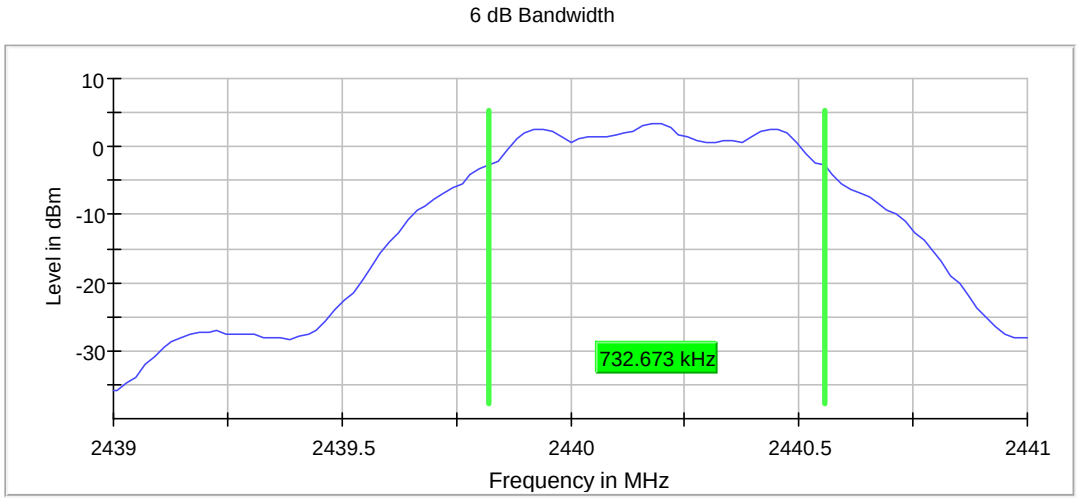
2.4.9 Test Results

DUT Frequency (MHz)	PHY	Limit Min (MHz)	Bandwidth (MHz)	Result
2402.000000	1M	0.500000	0.732673	PASS
2440.000000	1M		0.732673	PASS
2480.000000	1M		0.732673	PASS
2402.000000	2M		1.188119	PASS
2440.000000	2M		1.188119	PASS
2480.000000	2M		1.188119	PASS

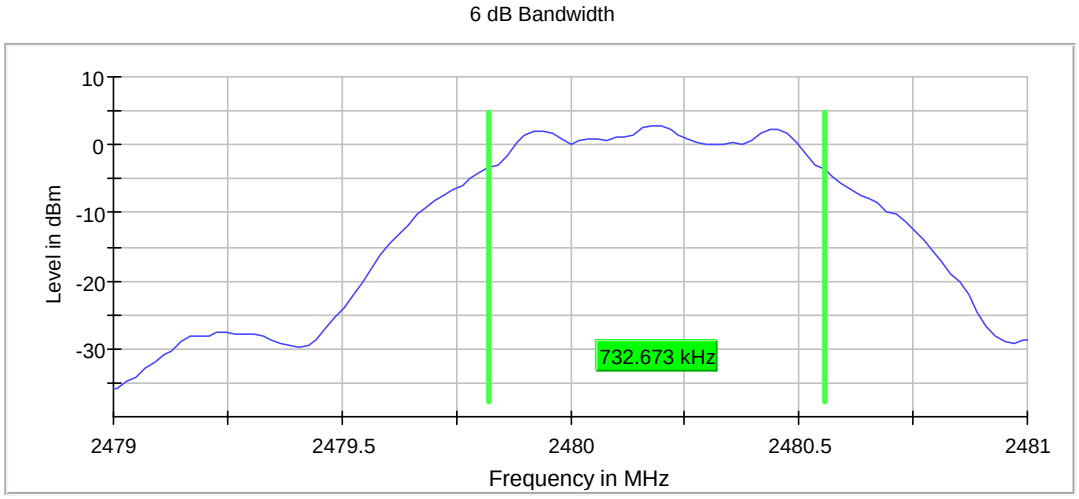
2.4.10 Test Plots



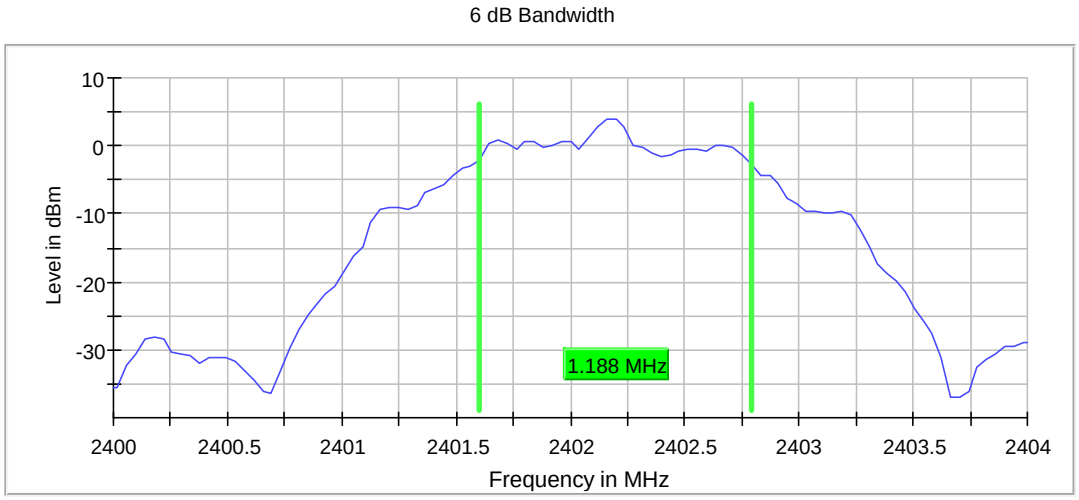
Bluetooth LE Low Channel 1M PHY



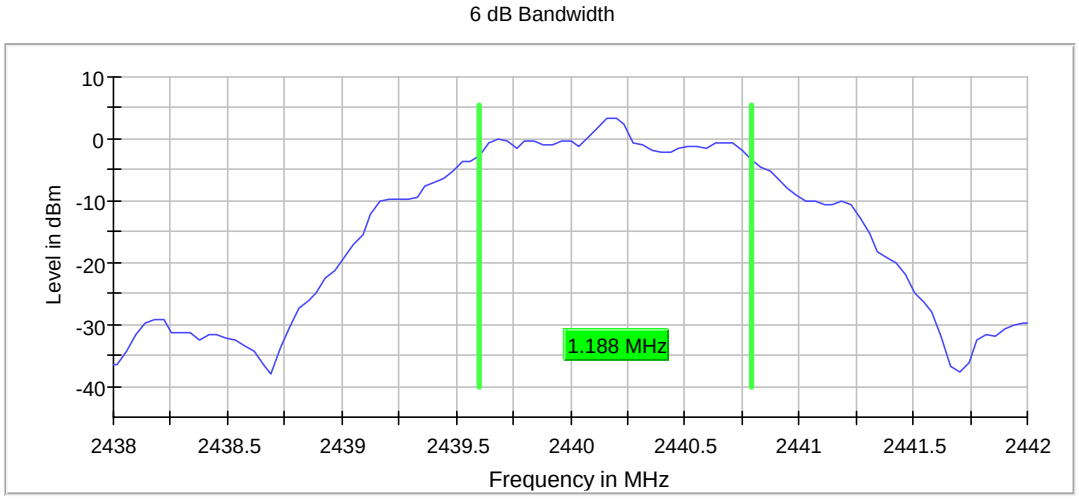
Bluetooth LE Middle Channel 1M PHY



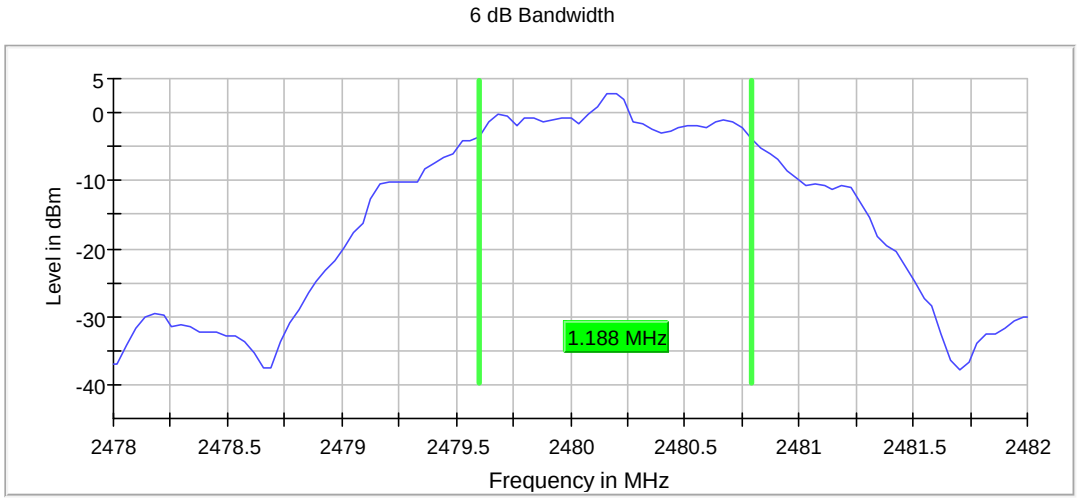
Bluetooth LE High Channel 1M PHY



Bluetooth LE Low Channel 2M PHY



Bluetooth LE Middle Channel 2M PHY



Bluetooth LE High Channel 2M PHY

2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

2.5.1 Specification Reference

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

2.5.2 Standard Applicable

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

2.5.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 10, 2022 / FSC

2.5.5 Test Equipment Used

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

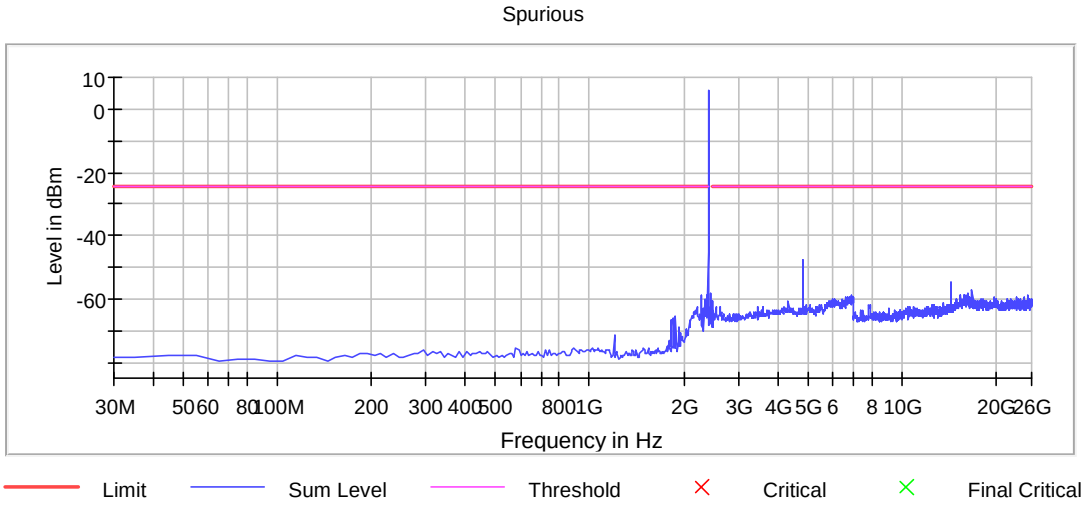
2.5.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

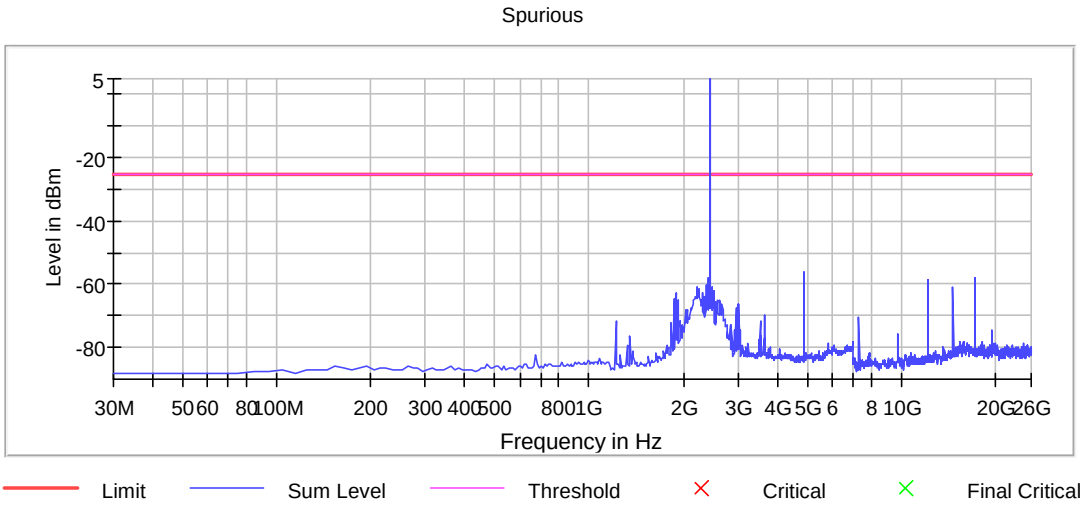
2.5.7 Additional Observations

- This is a conducted test using a spectrum analyser.
- The path loss was all accounted for using a transducer factor (TDF) including the maximum antenna gain of 2 dBi.
- Test methodology is per FCC title 47 part 15 §15.247(d), KDB 558074 D01 DTS Meas Guidance v05 and ANSI C63.10-2013 11.11.2 & 11.11.3.
- Both §15.205 and §15.247(d) requirements verified.
- Limits of §15.209 is converted to EIRP using formula from Clause 12.7.2(d) of ANSI C63.10-2013. Limit is based on 100kHz RBW, for above 1GHz, requirement is 1MHz RBW.
- For §15.247(d) requirement, no emissions observed within the measurement threshold during prescan, further verification is not required.

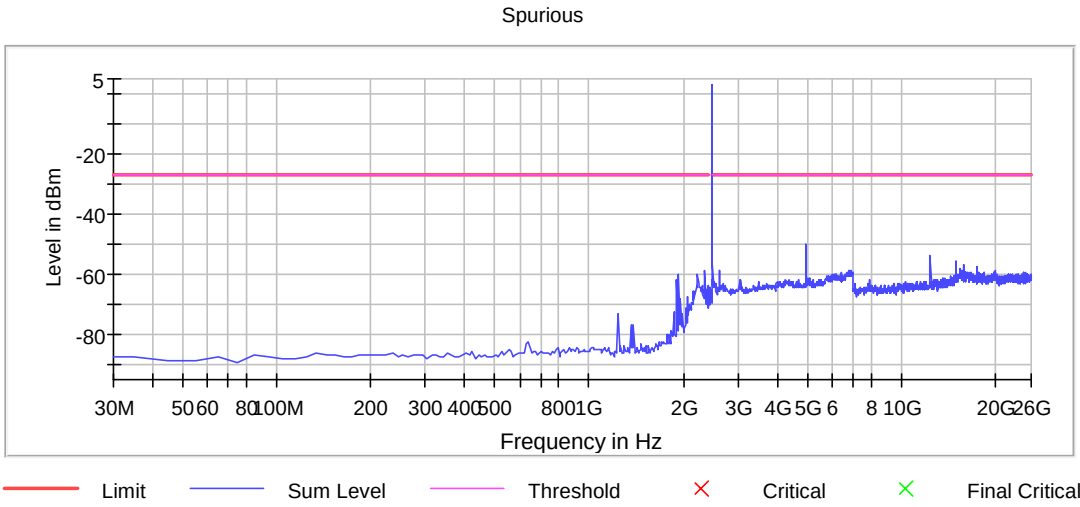
2.5.8 Test Results Plots (§15.247 requirements)



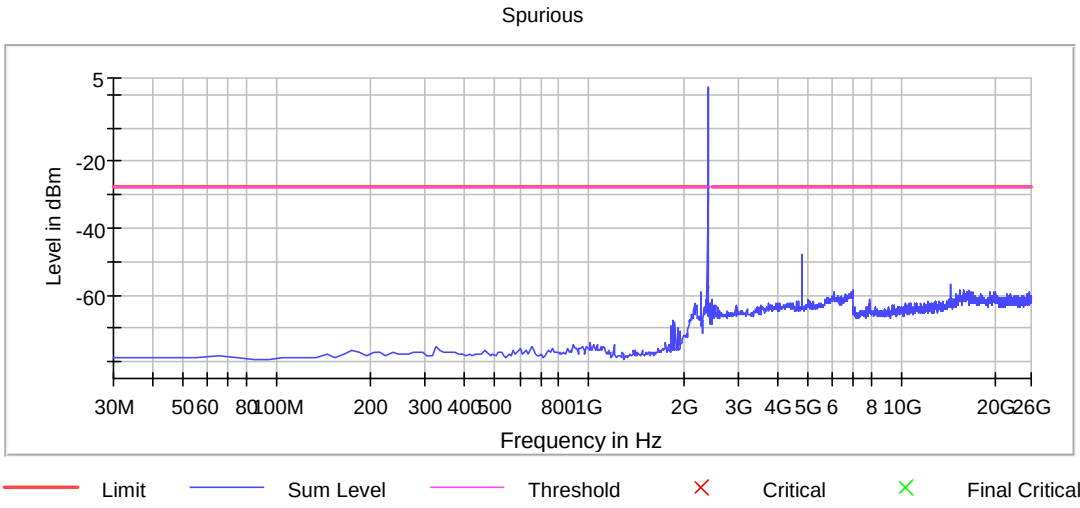
Low Channel 1M PHY



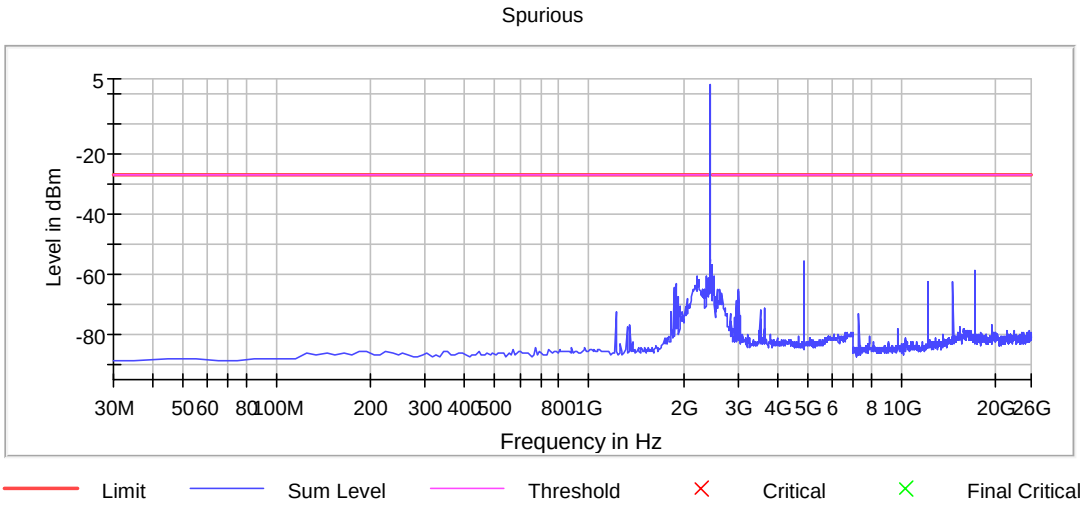
Middle Channel 1M PHY



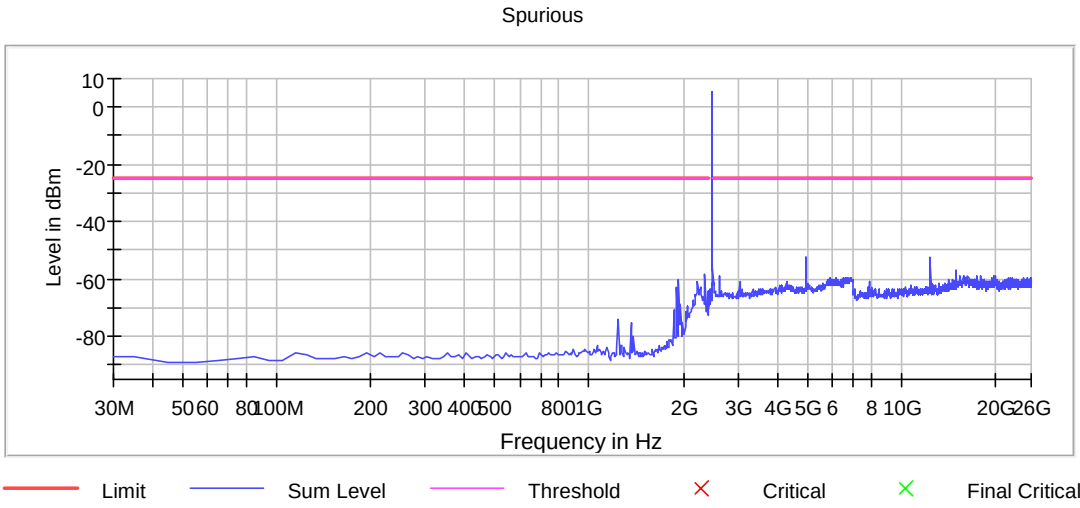
High Channel 1M PHY



Low Channel 2M PHY



Mid Channel 2M PHY



High Channel 2M PHY

2.5.9 Test Results Plots (§15.205 requirements)

Plots presented covering 30MHz up to 26GHz is using Peak Detector with the 2dBi antenna gain as an offset. Limit used is for Average measurement. To obtain corresponding Average value from Peak measurement, Duty Cycle Correction factor will be applied.

Sample Calculation (Low Channel 1M PHY)

Duty Cycle for 1M PHY = 63.1%
DCCF = 20 log (0.631)
= 3.4 dB

Limit at second harmonic = -41.23 dBm (from 54dBµV/m @ 3 meters)
1M PHY second harmonic emissions = -46.54 dBm (Low Channel)

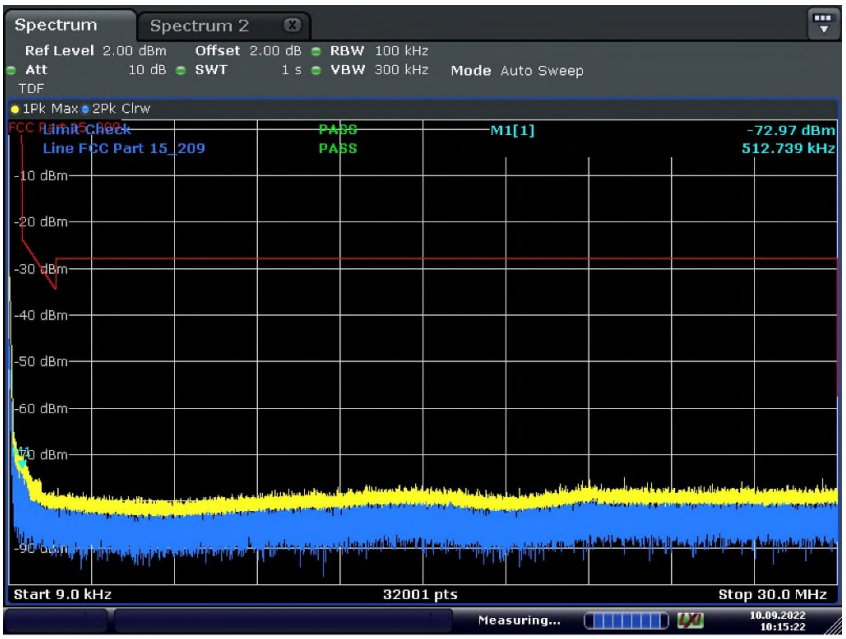
Average Calculation = -46.54 dBm -3.4 dB
= -49.94 dBm (complies with -41.23dBm Average limit)

Sample Calculation (Low Channel 2M PHY)

Duty Cycle for 1M PHY = 33.3%
DCCF = 20 log (0.333)
= 9.55 dB

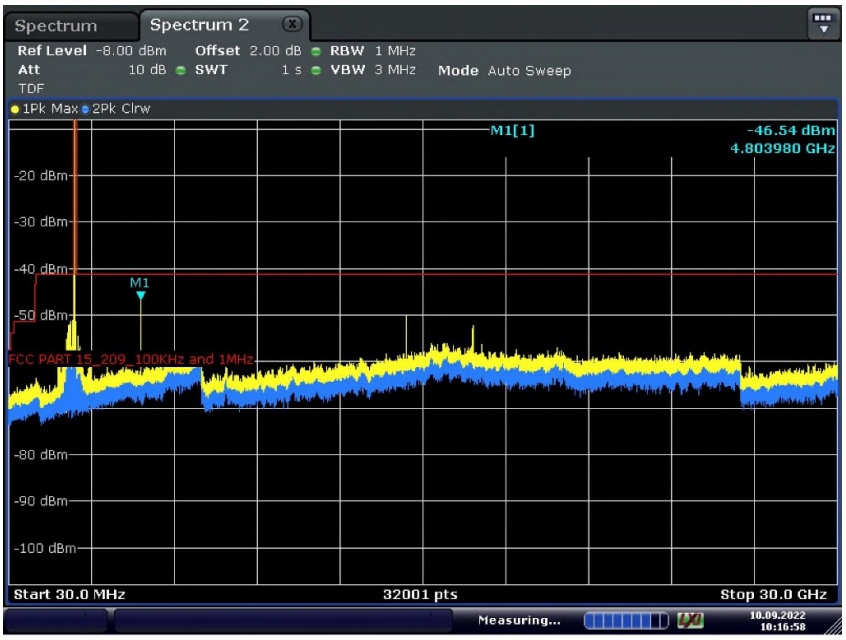
Limit at second harmonic = -41.23 dBm (from 54dBµV/m @ 3 meters)
Worst case second harmonic emissions = -46.86 dBm (Low Channel)

Average Calculation = -46.86 dBm -9.55 dB
= -56.41 dBm (complies with -41.23dBm Average limit)



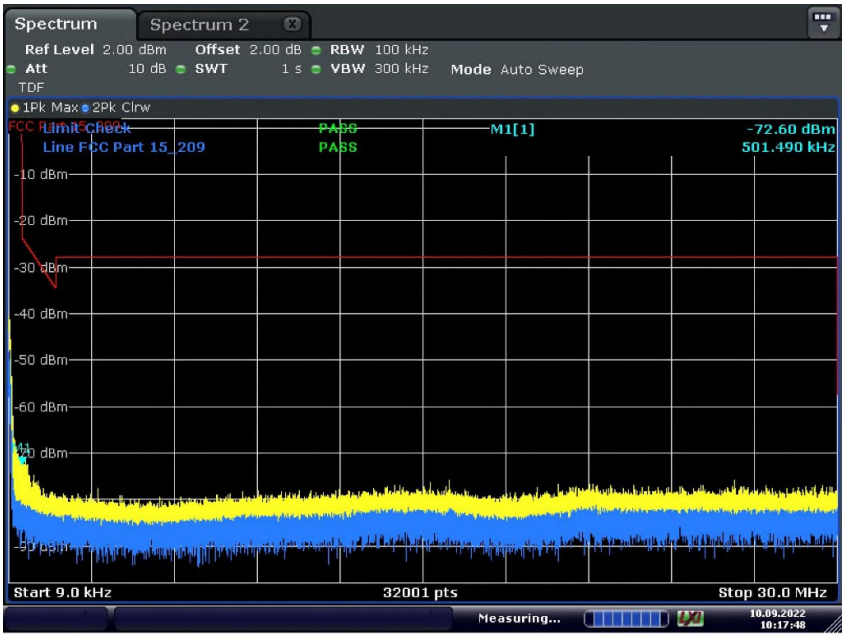
Date: 10.SEP.2022 10:15:23

BLE Low Channel 1M PHY (9kHz to 30MHz)



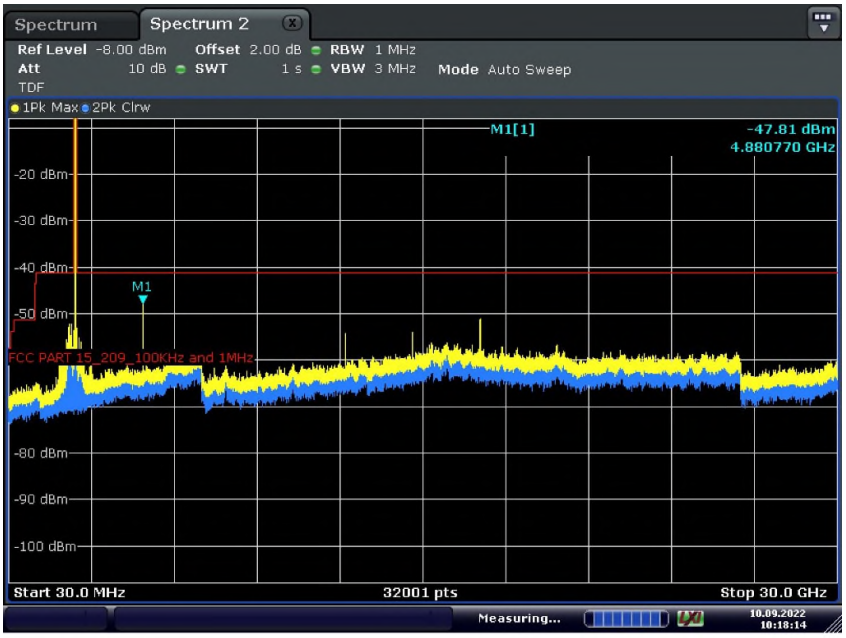
Date: 10.SEP.2022 10:16:58

BLE Low Channel 1M PHY (30MHz to 26GHz)



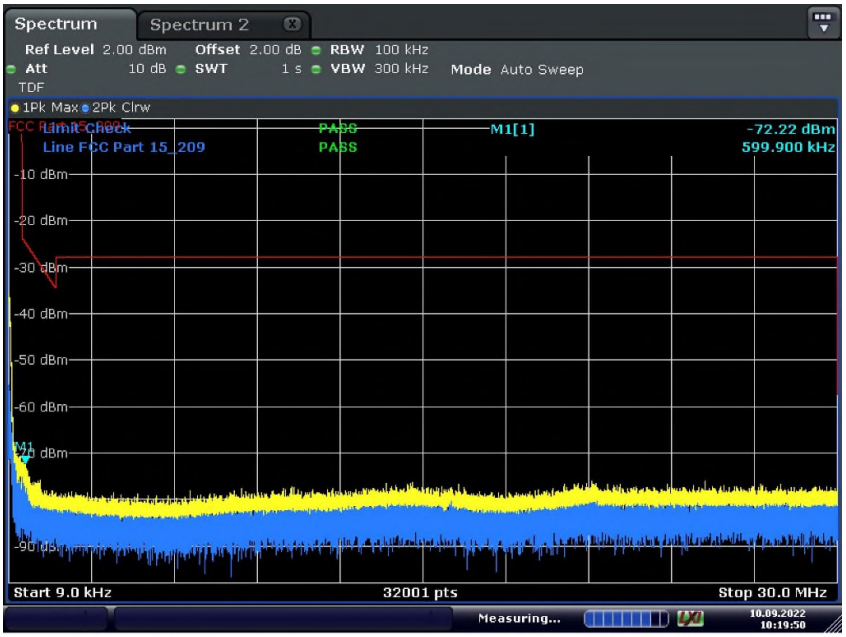
Date: 10.SEP.2022 10:17:48

BLE Mid Channel 1M PHY (9kHz to 30MHz)



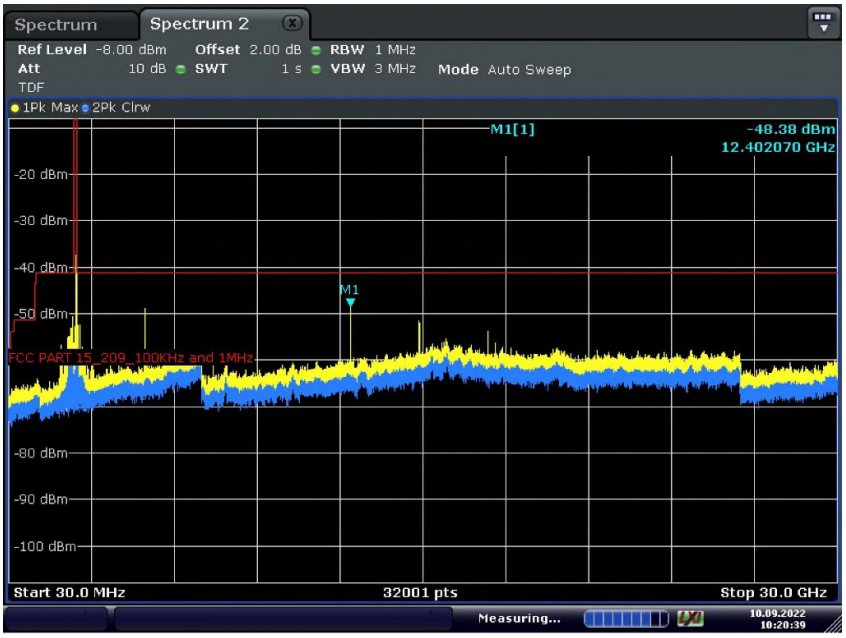
Date: 10.SEP.2022 10:18:14

BLE Mid Channel 1M PHY (30MHz to 26GHz)



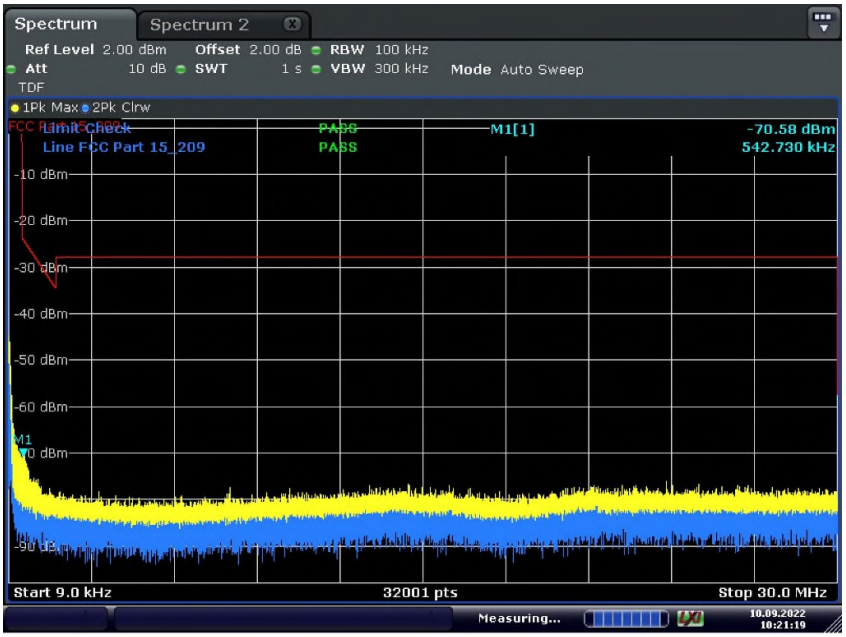
Date: 10.SEP.2022 10:19:50

BLE High Channel 1M PHY (9kHz to 30MHz)



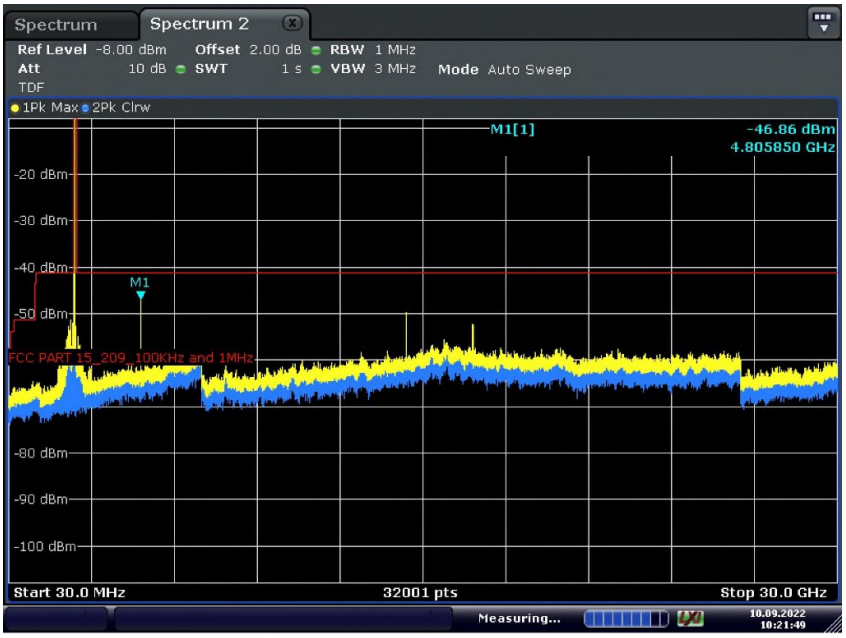
Date: 10.SEP.2022 10:20:39

BLE High Channel 1M PHY (30MHz to 26GHz)



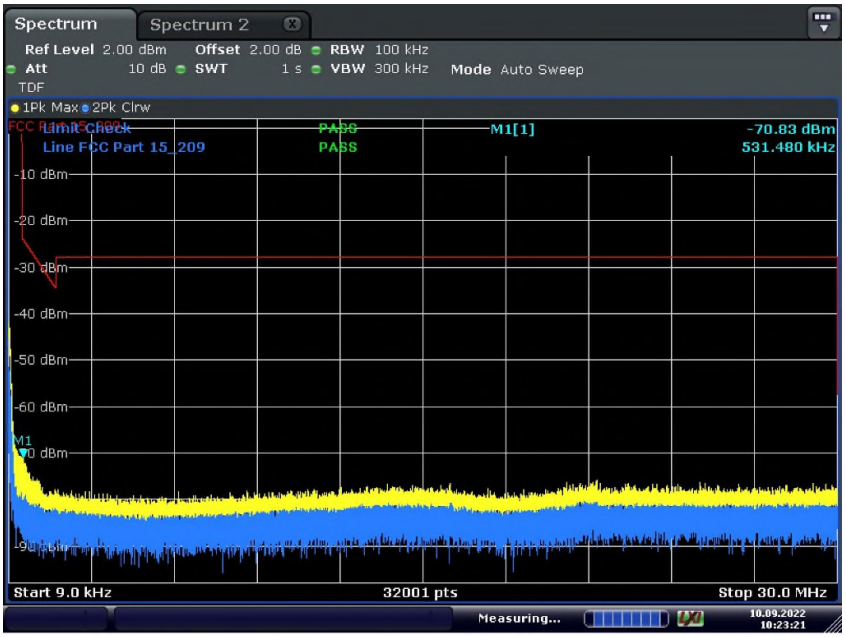
Date: 10.SEP.2022 10:21:19

BLE Low Channel 2M PHY (9kHz to 30MHz)



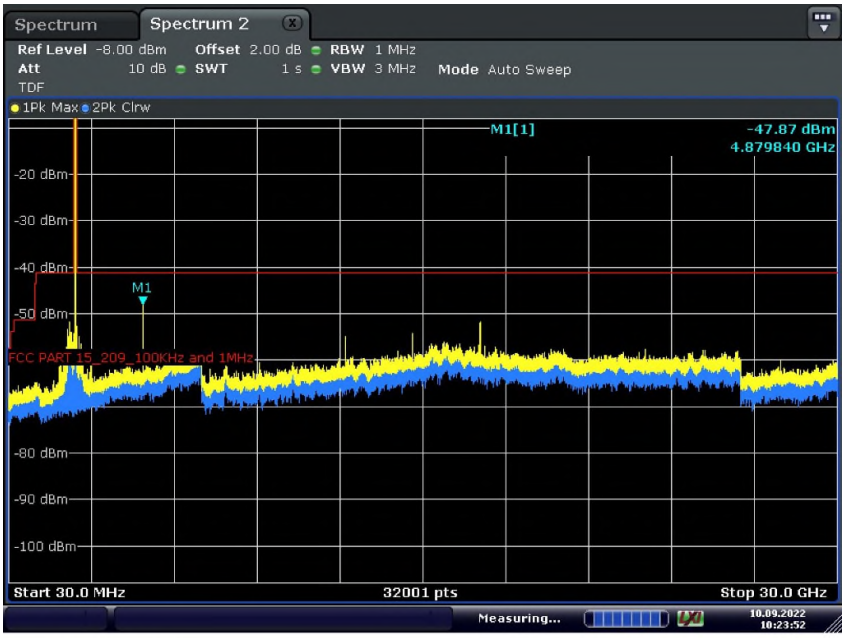
Date: 10.SEP.2022 10:21:49

BLE Low Channel 2M PHY (30MHz to 26GHz)



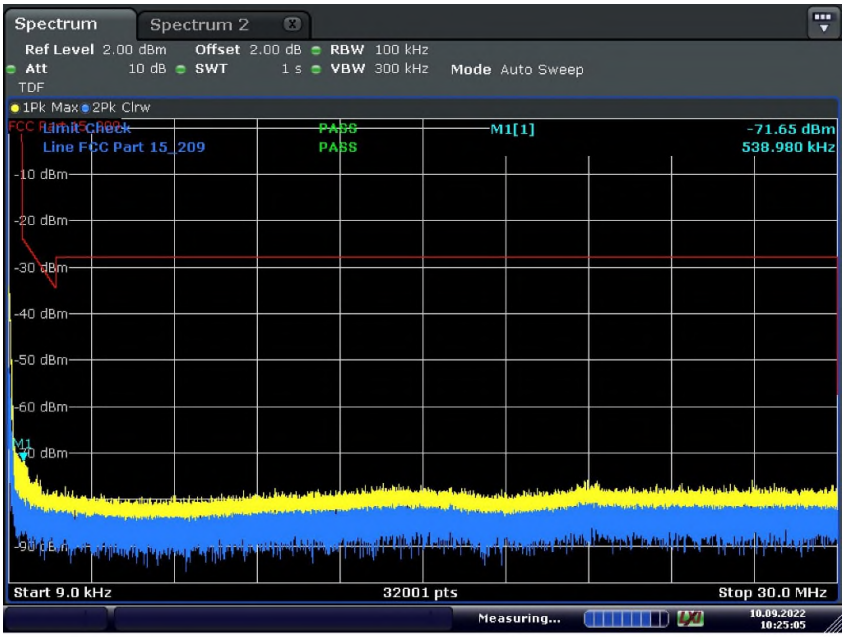
Date: 10.SEP.2022 10:23:21

BLE Mid Channel 2M PHY (9kHz to 30MHz)



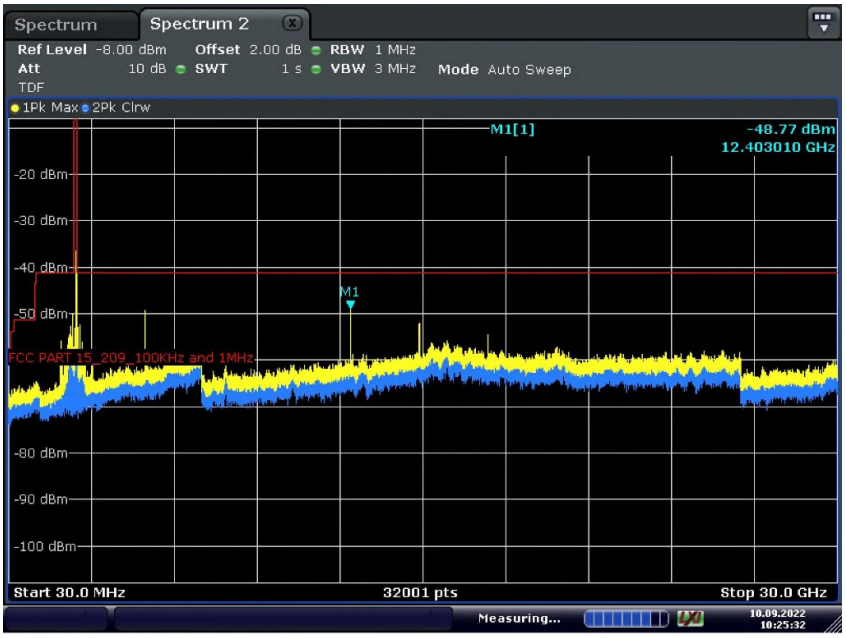
Date: 10.SEP.2022 10:23:52

BLE Mid Channel 2M PHY (30MHz to 26GHz)



Date: 10.SEP.2022 10:25:05

BLE High Channel 2M PHY (9kHz to 30MHz)



Date: 10.SEP.2022 10:25:32

BLE High Channel 2M PHY (30MHz to 26GHz)

2.6 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

2.6.1 Specification Reference

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

2.6.2 Standard Applicable

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

2.6.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 10, 2022 / 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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

2.6.7 Additional Observations

- This is a conducted test using direct connection to the Spectrum Analyzer being controlled by the TS8997 Test System.
- The path loss was all accounted for with the test system calibration.
- Test methodology is per FCC title 47 part 15 §15.247(d), KDB 558074 D01 DTS Meas Guidance v05 8.7 and ANSI C63.10-2013.

2.6.8 Sample Measurement Settings

Measurement 1		
Setting	**Instrument Value**	**Target Value**
Span	90.000 MHz	90.000 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1800	~ 1800
Sweeptime	113.672 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.00 dB	0.50 dB

Measurement 2		
Setting	**Instrument Value**	**Target Value**
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	94.727 µs	AUTO
Reference Level	0.000 dBm	0.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	FFT	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	10 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.03 dB	0.50 dB

2.6.9 Test Results (Lower Band Edge 1M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-47.1	23.1	-24.0	PASS
2399.925000	-48.5	24.5	-24.0	PASS
2399.325000	-49.6	25.6	-24.0	PASS
2399.275000	-49.8	25.8	-24.0	PASS
2399.625000	-49.8	25.9	-24.0	PASS
2399.825000	-49.9	25.9	-24.0	PASS
2399.875000	-49.9	26.0	-24.0	PASS
2399.375000	-50.0	26.1	-24.0	PASS
2399.675000	-50.0	26.1	-24.0	PASS
2399.575000	-50.2	26.3	-24.0	PASS
2399.775000	-50.3	26.4	-24.0	PASS
2399.725000	-50.9	27.0	-24.0	PASS
2399.225000	-51.1	27.1	-24.0	PASS
2399.525000	-52.1	28.1	-24.0	PASS
2399.175000	-52.1	28.2	-24.0	PASS

2.6.10 Test Results (Upper Band Edge 1M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.525000	-53.1	27.8	-25.3	PASS
2484.225000	-53.7	28.4	-25.3	PASS
2484.275000	-53.7	28.4	-25.3	PASS
2483.625000	-53.8	28.6	-25.3	PASS
2485.625000	-54.0	28.7	-25.3	PASS
2485.675000	-54.0	28.8	-25.3	PASS
2483.925000	-54.0	28.8	-25.3	PASS
2484.075000	-54.1	28.8	-25.3	PASS
2484.025000	-54.1	28.9	-25.3	PASS
2483.775000	-54.3	29.0	-25.3	PASS
2483.675000	-54.3	29.0	-25.3	PASS
2483.875000	-54.4	29.1	-25.3	PASS
2484.325000	-54.5	29.2	-25.3	PASS
2483.825000	-54.5	29.2	-25.3	PASS
2484.125000	-54.7	29.4	-25.3	PASS

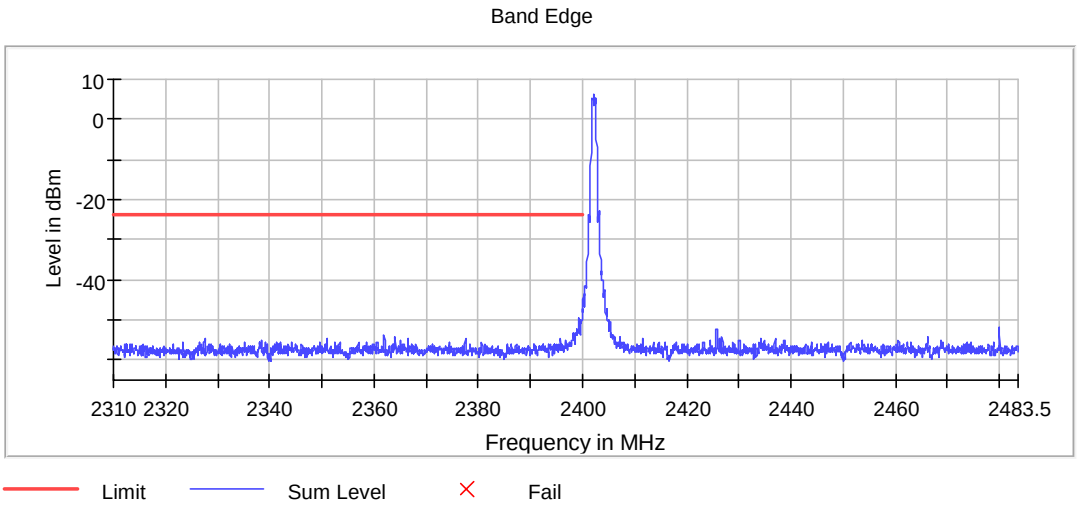
2.6.11 Test Results (Lower Band Edge 2M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-34.0	10.1	-23.9	PASS
2399.925000	-35.2	11.3	-23.9	PASS
2399.875000	-38.6	14.7	-23.9	PASS
2399.825000	-40.7	16.7	-23.9	PASS
2399.775000	-42.4	18.4	-23.9	PASS
2399.725000	-43.8	19.9	-23.9	PASS
2399.675000	-46.3	22.3	-23.9	PASS
2399.375000	-46.7	22.8	-23.9	PASS
2399.225000	-46.8	22.8	-23.9	PASS
2399.425000	-46.8	22.8	-23.9	PASS
2399.275000	-47.0	23.1	-23.9	PASS
2399.525000	-47.2	23.3	-23.9	PASS
2399.475000	-47.3	23.4	-23.9	PASS
2399.575000	-48.0	24.1	-23.9	PASS
2399.175000	-48.0	24.1	-23.9	PASS

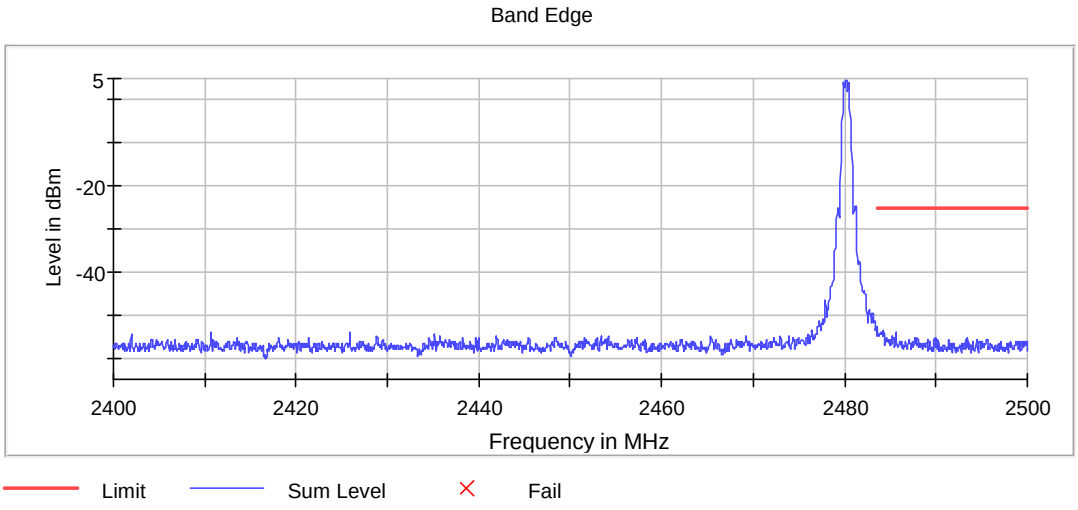
2.6.12 Test Results (Upper Band Edge 2M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2484.575000	-50.5	25.3	-25.2	PASS
2484.525000	-50.5	25.3	-25.2	PASS
2483.675000	-50.7	25.4	-25.2	PASS
2483.725000	-50.9	25.7	-25.2	PASS
2483.625000	-51.4	26.2	-25.2	PASS
2483.825000	-51.6	26.4	-25.2	PASS
2483.875000	-51.7	26.5	-25.2	PASS
2483.525000	-51.9	26.6	-25.2	PASS
2485.575000	-52.0	26.7	-25.2	PASS
2484.625000	-52.1	26.9	-25.2	PASS
2484.475000	-52.2	27.0	-25.2	PASS
2484.025000	-52.2	27.0	-25.2	PASS
2485.525000	-52.3	27.1	-25.2	PASS
2484.775000	-52.8	27.5	-25.2	PASS
2485.625000	-52.8	27.6	-25.2	PASS

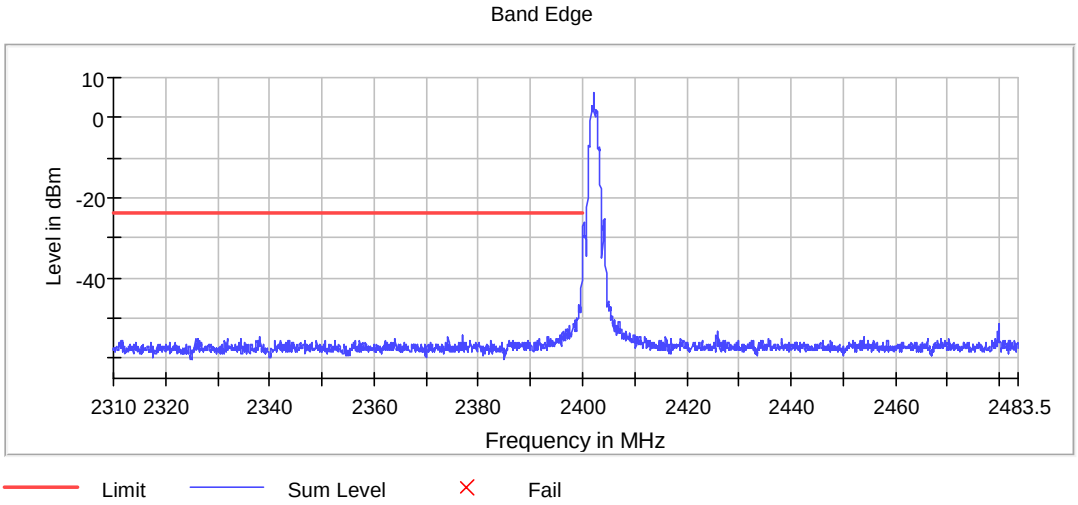
2.6.13 Test Plots



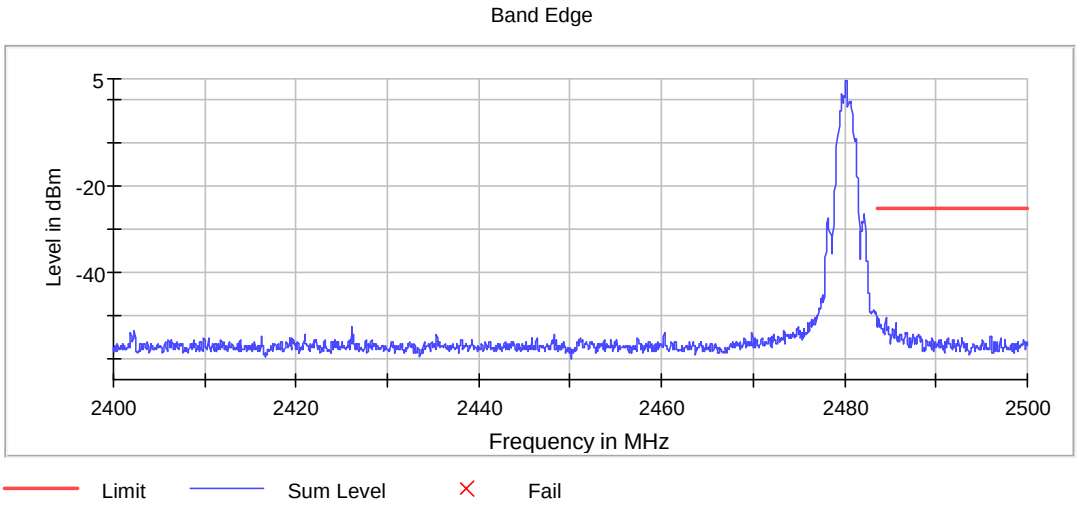
Bluetooth LE Low Band Edge 2400MHz 1M PHY



Bluetooth LE Upper Band Edge 2483.5MHz 1M PHY



Bluetooth LE Low Band Edge 2400MHz 2M PHY



Bluetooth LE Upper Band Edge 2483.5MHz 2M PHY

2.6.14 Upper band edge calculation (2483.5 MHz) within Restricted Band for 1M PHY:

- 2483.525000 MHz (in the restricted bands)
- Procedure is per Clause 12.7.2 of ANSI C63.10-2013.
- Use the following formula as per Clause 12.7.2(d) of ANSI C63.10-2013.

E(dBµV/m) = EIRP (dBm) + 95.2
= -53.1 dBm + 2 dBi antenna gain + 95.2
= 44.1 dBµV/m @ 3 meters (Peak complies with 54 dBµV/m Average limit)

2.6.15 Upper band edge calculation (2483.5 MHz) within Restricted Band for 2M PHY:

- 2483.525000 MHz (in the restricted bands)
- Procedure is per Clause 12.7.2 of ANSI C63.10-2013.
- Use the following formula as per Clause 12.7.2(d) of ANSI C63.10-2013.

E(dBµV/m) = EIRP (dBm) + 95.2
= -51.9 dBm + 2 dBi antenna gain + 95.2
= 45.3 dBµV/m @ 3 meters (Peak complies with 54 dBµV/m Average limit)

2.7 RADIATED SPURIOUS EMISSIONS

2.7.1 Specification Reference

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

2.7.2 Standard Applicable

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

2.7.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 14, 2022 / FSC

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 (Mira Mesa Facility)

Ambient Temperature	27.0°C
Relative Humidity	48.6%
ATM Pressure	100.0kPa

2.7.7 Additional Observations

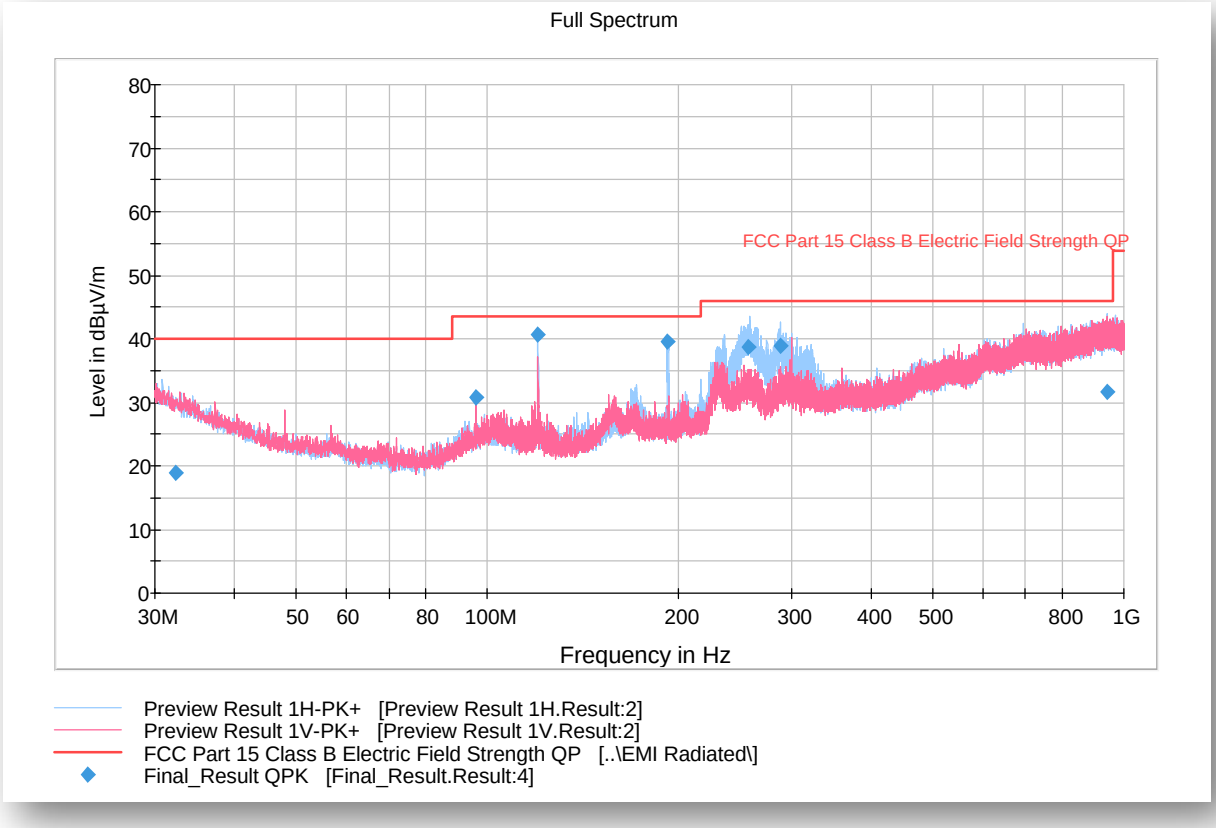
- This is a radiated test. The spectrum was searched from 9kHz to the 10th harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case BLE (Low Channel) presented. There are no significant differences in emissions between channels when verifying cabinet spurious emissions.
- Antenna port terminated with 50 Ω load. Emissions coming out of the cabinet being verified

- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.7.8 for sample computation.

2.7.8 Sample Computation (Radiated Emission)

Measuring equipment raw measurement (dbµV) @ 30 MHz			-0.8
Correction Factor (dB)	Asset# 1066 (cable)	18.1	12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

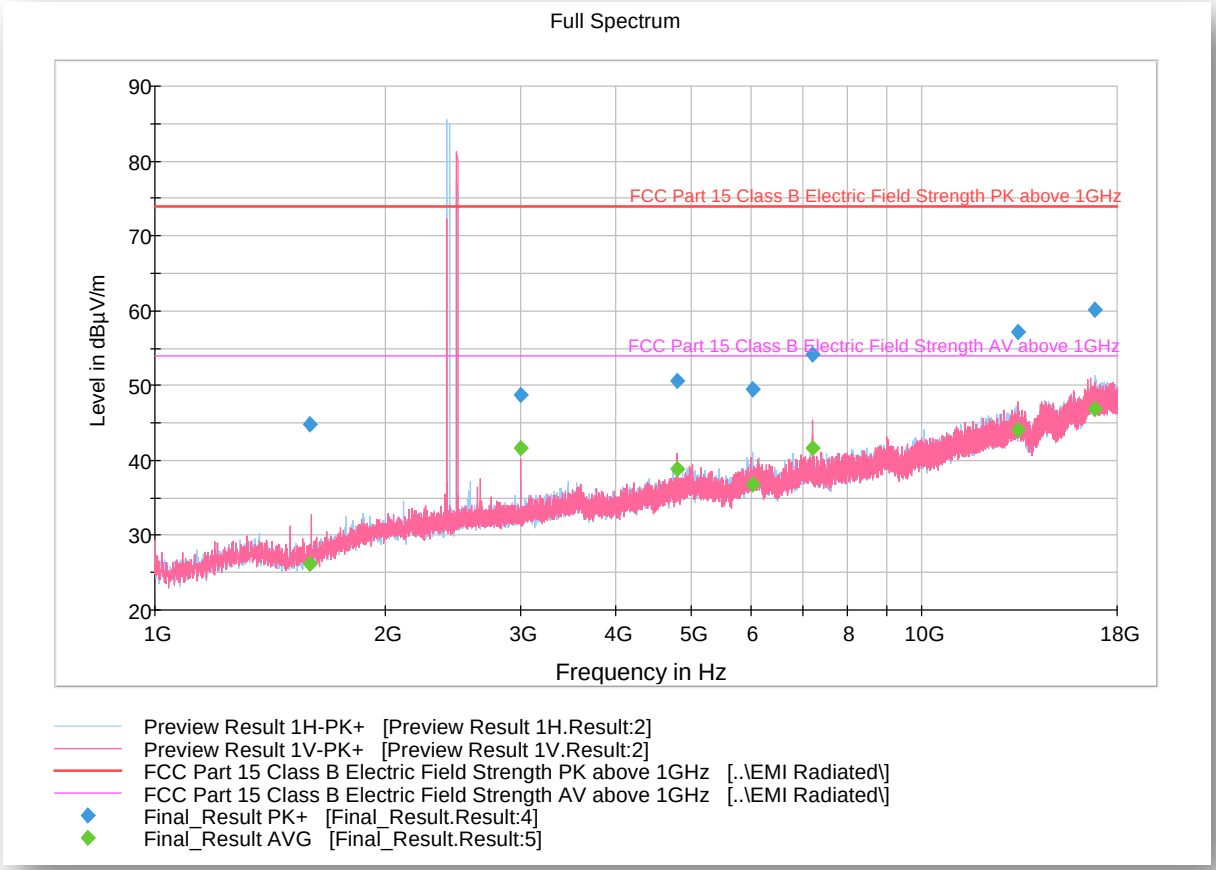
2.7.9 Test Results for 30MHz to 1GHz



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.360000	18.86	40.00	21.14	1000.	120.000	220.0	H	199.0	21
95.992333	30.80	43.50	12.70	1000.	120.000	205.0	H	234.0	15
119.98366	40.62	43.50	2.88	1000.	120.000	225.0	H	274.0	14
192.02233	39.60	43.50	3.90	1000.	120.000	119.0	H	329.0	17
257.15600	38.68	46.00	7.32	1000.	120.000	125.0	H	-14.0	19
287.85100	38.98	46.00	7.02	1000.	120.000	125.0	H	50.0	20
940.62733	31.62	46.00	14.38	1000.	120.000	282.0	H	273.0	31

2.7.10 Test Results for 1GHz to 18GHz



Peak Data

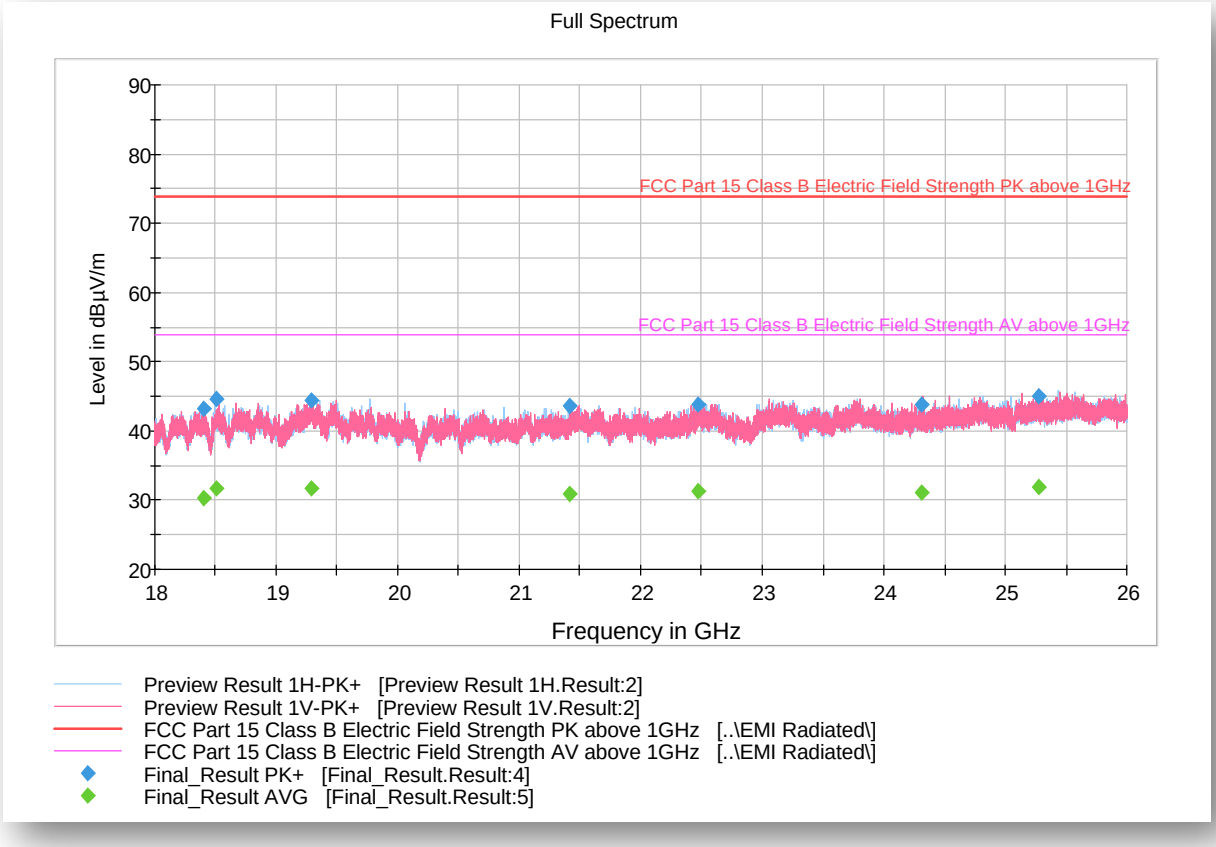
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1594.13333	44.76	73.90	29.14	1000.0	1000.000	167.0	V	232.0	-4
2999.96666	48.74	73.90	25.16	1000.0	1000.000	234.0	V	194.0	2
4804.00000	50.65	73.90	23.25	1000.0	1000.000	255.0	V	308.0	5
6025.50000	49.41	73.90	24.49	1000.0	1000.000	205.0	H	5.0	5
7206.10000	54.11	73.90	19.79	1000.0	1000.000	302.0	V	41.0	6
13344.0666	57.13	73.90	16.77	1000.0	1000.000	306.0	V	34.0	13
16826.1333	60.05	73.90	13.85	1000.0	1000.000	125.0	H	304.0	17

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1594.13333	26.17	53.90	27.73	1000.0	1000.000	167.0	V	232.0	-4
2999.96666	41.65	53.90	12.25	1000.0	1000.000	234.0	V	194.0	2
4804.00000	38.77	53.90	15.13	1000.0	1000.000	255.0	V	308.0	5
6025.50000	36.82	53.90	17.08	1000.0	1000.000	205.0	H	5.0	5
7206.10000	41.61	53.90	12.29	1000.0	1000.000	302.0	V	41.0	6
13344.0666	44.16	53.90	9.74	1000.0	1000.000	306.0	V	34.0	13
16826.1333	46.84	53.90	7.06	1000.0	1000.000	125.0	H	304.0	17

Test Notes: Fundamental will be ignored for this test (antenna port terminated).

2.7.11 Test Results for 18GHz to 26GHz



Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18402.7745	43.19	73.90	30.71	1000.0	1000.000	163.0	H	304.0	-4
18505.4325	44.62	73.90	29.28	1000.0	1000.000	137.0	H	216.0	-3
19289.0805	44.37	73.90	29.53	1000.0	1000.000	213.0	V	89.0	-2
21412.1680	43.61	73.90	30.29	1000.0	1000.000	190.0	H	38.0	-3
22476.7005	43.71	73.90	30.19	1000.0	1000.000	187.0	H	340.0	-1
24312.0975	43.81	73.90	30.09	1000.0	1000.000	163.0	V	204.0	-1
25274.0965	44.92	73.90	28.98	1000.0	1000.000	202.0	V	327.0	0

Average Data

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18402.7745	30.19	53.90	23.71	1000.0	1000.000	163.0	H	304.0	-4
18505.4325	31.72	53.90	22.18	1000.0	1000.000	137.0	H	216.0	-3
19289.0805	31.61	53.90	22.29	1000.0	1000.000	213.0	V	89.0	-2
21412.1680	30.85	53.90	23.05	1000.0	1000.000	190.0	H	38.0	-3
22476.7005	31.29	53.90	22.61	1000.0	1000.000	187.0	H	340.0	-1
24312.0975	31.04	53.90	22.86	1000.0	1000.000	163.0	V	204.0	-1
25274.0965	31.88	53.90	22.02	1000.0	1000.000	202.0	V	327.0	0

2.8 POWER SPECTRAL DENSITY

2.8.1 Specification Reference

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

2.8.2 Standard Applicable

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

2.8.3 Equipment Under Test and Modification State

Serial No: 347650038 / Default Test Configuration

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

September 10, 2022 / FSC

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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	25.6°C
Relative Humidity	61.7%
ATM Pressure	98.5kPa

2.8.7 Additional Observations

- This is a conducted test using direct connection to the TS8997 Test System.
- The path loss was all accounted for with the test system calibration.
- Test methodology is per FCC title 47 part 15 §15.247(a),(e), KDB 558074 D01 DTS Meas Guidance v05 F and ANSI C63.10-2013.

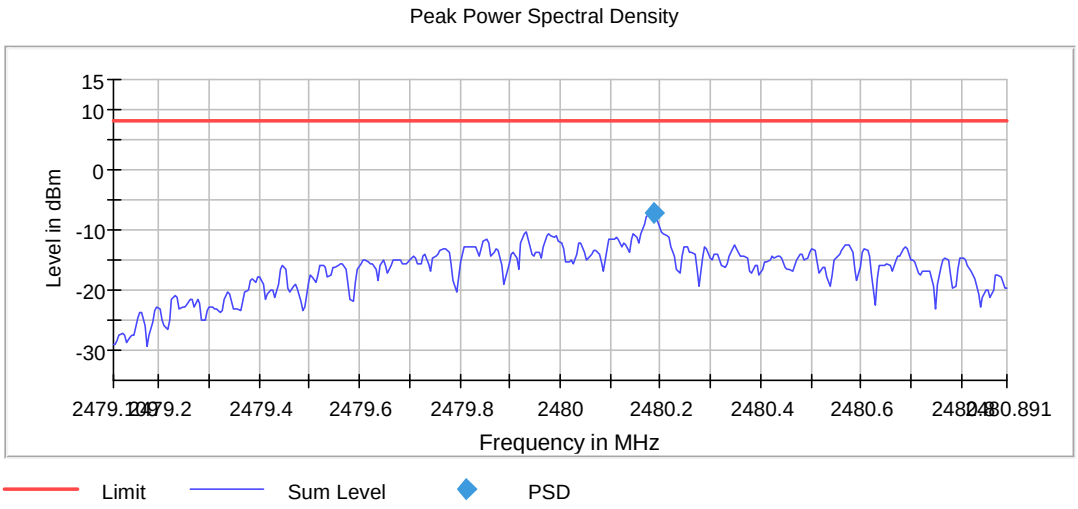
2.8.8 Test Results Summary

DUT Frequency (MHz)	PHY	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	1M	2402.157358	-5.325	8.0	PASS
2440.000000	1M	2440.162354	-6.129	8.0	PASS
2480.000000	1M	2480.182336	-6.907	8.0	PASS
2402.000000	2M	2402.177717	-6.135	8.0	PASS
2440.000000	2M	2440.182723	-6.598	8.0	PASS
2480.000000	2M	2480.187729	-7.183	8.0	PASS

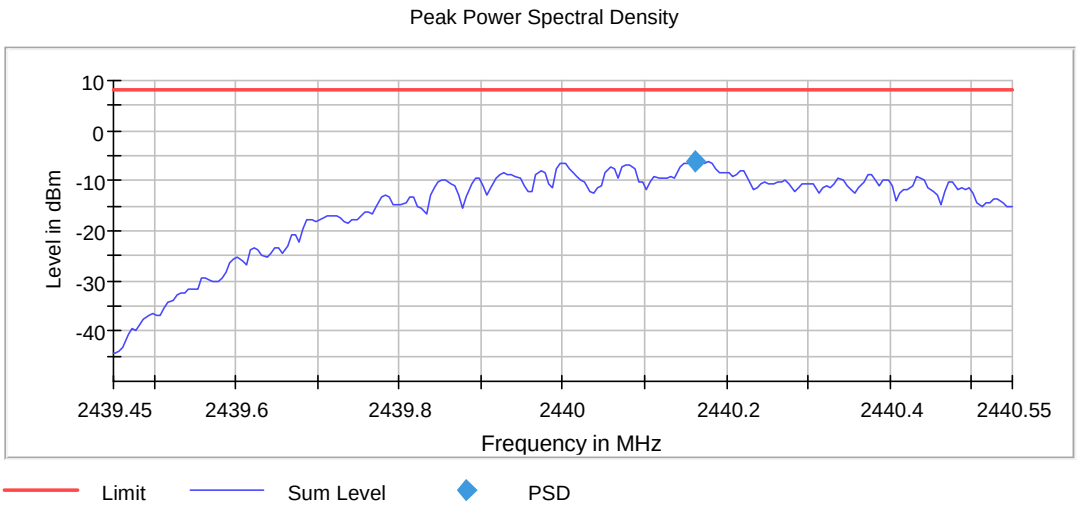
2.8.9 Sample Measurement Settings

Setting	Instrument Value	Target Value
Span	1.099 MHz	1.099 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	220	~ 220
Sweeptime	1.100 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Attenuation	10.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	8 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.21 dB	0.50 dB

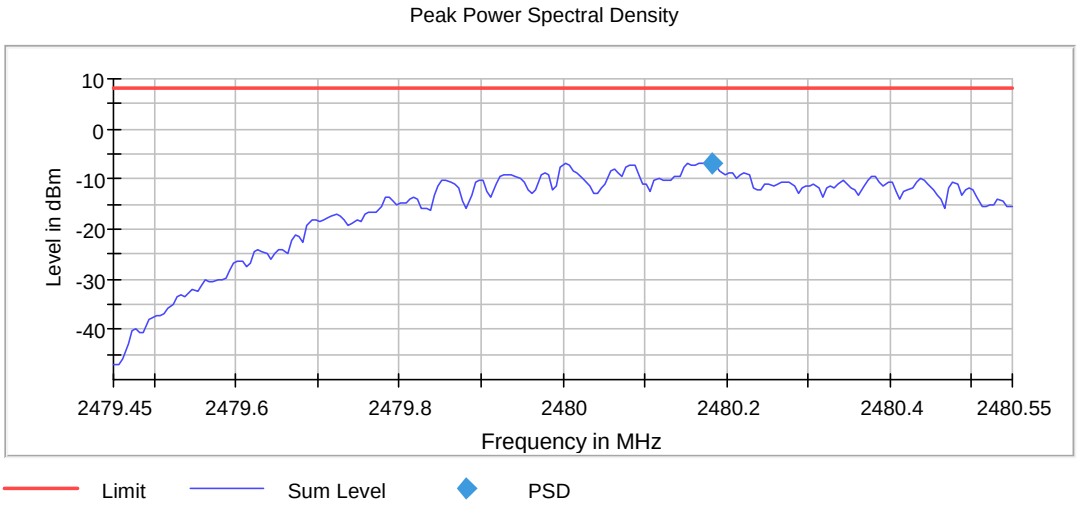
2.8.10 Worst CaseTest Plots



Bluetooth LE Low Channel



Bluetooth LE Mid Channel



Bluetooth LE High Channel

SECTION 3

TEST EQUIPMENT USED

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Conducted Port Setup						
7643	Signal/Spectrum Analyzer	FSV30	1321.3008K30/103166	Rhode & Schwarz	09/02/21	12/02/22
7655	Vector Signal Generator	SMBV100A	260734	Rhode & Schwarz	09/02/21	12/02/22
7654	Signal Generator	SMB 100A	175750	Rhode & Schwarz	09/02/21	12/02/22
7656	OSP with B157	OSP120	101310	Rhode & Schwarz	09/02/21	12/02/22
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 7643 and 7654	
AC Conducted Emissions						
1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	10/01/21	10/01/22
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	03/28/22	03/28/23
6837	LISN	FCC-LISN-50-25-2	05024	Fischer Custom Comm.	10/22/21	10/22/22
8870	Bi-Directional Attenuator	34-20-34	BP8030	MCE / Weinschel	02/28/22	02/28/23
Radiated Emission						
1002	Bilog Antenna	3142C	00058717	ETS-Lindgren	10/21/21	10/21/23
7631	Double-ridged waveguide horn	3117	00205418	ETS-Lindgren	09/16/20	09/16/22
7611	Signal & Spectrum Analyzer	FSW26	102017	Rohde & Schwarz	02/09/22	02/09/23
1049	EMI Test Receiver	ESU	100133	Rohde & Schwarz	10/01/21	10/01/22
46797	Preamplifier	PS-122	181925	Com Power	10/11/21	10/11/22
9001	Horn antenna (18-26.5GHz)	HO42S	101	Custom Microwave	09/23/21	09/23/23
9002	Horn antenna (26-40 GHz)	HO28S	102	Custom Microwaves	09/23/21	09/23/23
40815	18GHz to 40GHz Low Noise Amplifier	SLKKa-30-6	19D18	Spacek Labs	10/11/21	10/11/22
Miscellaneous						
7619	Barometer/ Temperature/Humidity	iBTHX-W	15250268	Omega	05/27/22	05/27/23
43003	True RMS Multimeter	85 III	69880143	Fluke	11/19/21	11/19/22
	Test Software	EMC32	V10.50.40	Rhode & Schwarz	N/A	

3.2 Measurement Uncertainty

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

3.2.1 AC Conducted Measurements

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	LISN-receiver attenuation	0.10	dB	Normal, k=2	2.000	0.05	0.00
3	LISN voltage division factor	0.30	dB	Normal, k=2	2.000	0.15	0.02
4	Receiver sinewave accuracy	0.36	dB	Normal, k=2	2.000	0.18	0.03
5	Receiver pulse amplitude	1.50	dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50	dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.00	dB	Rectangular	1.732	0.00	0.00
8	AMN VDF frequency interpolation	0.10	dB	Rectangular	1.732	0.06	0.00
9	Mismatch	0.07	dB	U-shaped	1.414	0.05	0.00
10	LISN impedance	2.65	dB	Triangular	2.449	1.08	1.17
11	Effect of mains disturbance	0.00	dB			0.00	0.00
12	Effect of the environment						
	Combined standard uncertainty			Normal	1.66	dB	
	Expanded uncertainty			**Normal, k=2**	**3.31**	**dB**	

3.2.2 Radiated Measurements (30MHz to 1GHz)

	Input Quantity (Contribution) X_i	Value		Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10	dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20	dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.58	dB	Normal, k=2	2.000	0.29	0.08
4	Receiver sinewave accuracy	0.15	dB	Normal, k=2	2.000	0.08	0.01
5	Receiver pulse amplitude	1.50	dB	Rectangular	1.732	0.87	0.75
6	Receiver pulse repetition rate	1.50	dB	Rectangular	1.732	0.87	0.75
7	Noise floor proximity	0.50	dB	Rectangular	1.732	0.29	0.08
8	Mismatch: antenna-receiver	0.95	dB	U-shaped	1.414	0.67	0.45
9	AF frequency interpolation	0.30	dB	Rectangular	1.732	0.17	0.03
10	AF height deviations	0.10	dB	Rectangular	1.732	0.06	0.00
11	Directivity difference at 3 m	3.12	dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 3 m	1.00	dB	Rectangular	1.732	0.58	0.33
13	Cross-polarization	0.90	dB	Rectangular	1.732	0.52	0.27
14	Balance	0.00	dB	Rectangular	1.732	0.00	0.00
15	Site imperfections	3.99	dB	Triangular	2.449	1.63	2.65
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.57	dB	Rectangular	1.732	0.33	0.11
18	Table height at 3 m	0.10	dB	Normal, k=2	2.000	0.05	0.00

19	Near-field effects	0.00	dB	Triangular	2.449	0.00	0.00
20	Effect of ambient noise on OATS	0.00	dB				0.00
	Combined standard uncertainty			Normal	2.97	dB	
	Expanded uncertainty			Normal, k=2	**5.94**	**dB**	

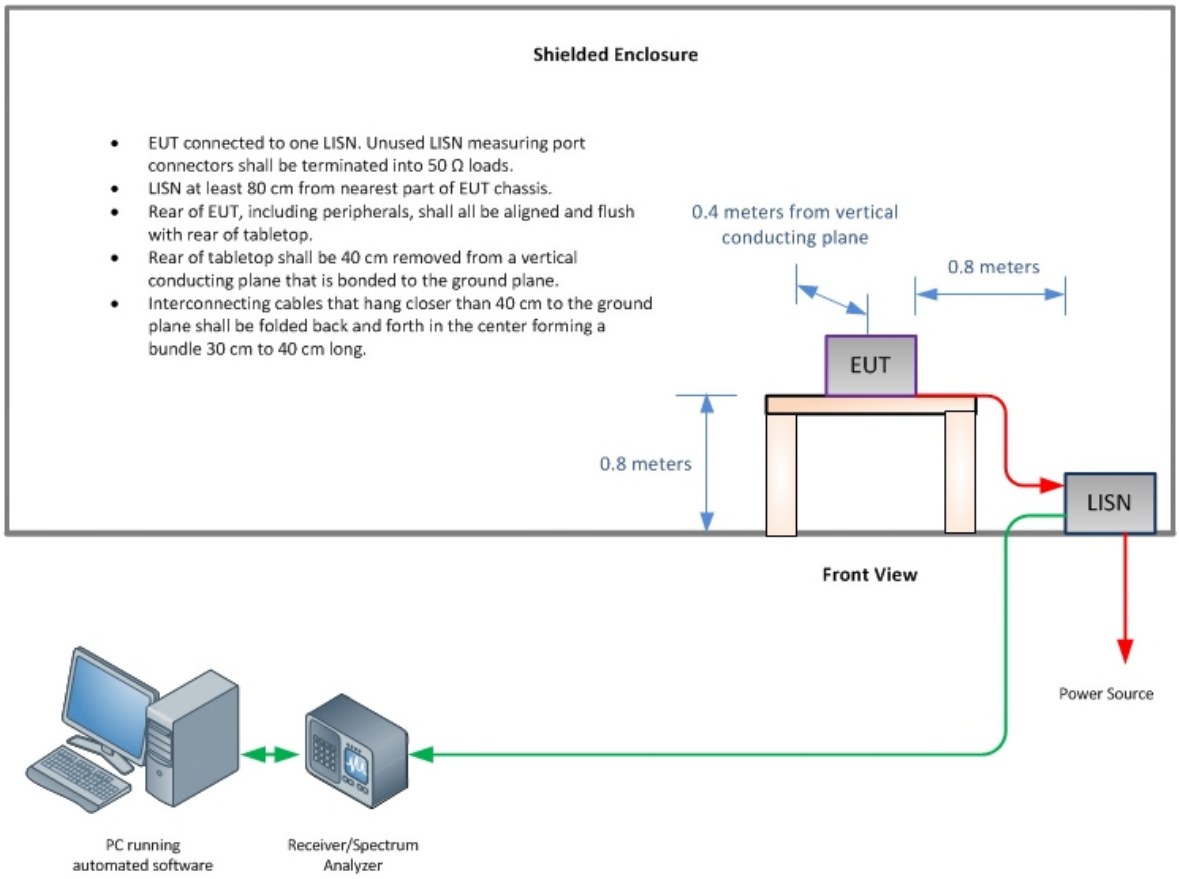
3.2.1 Radiated Emission Measurements (1GHz to 18GHz)

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

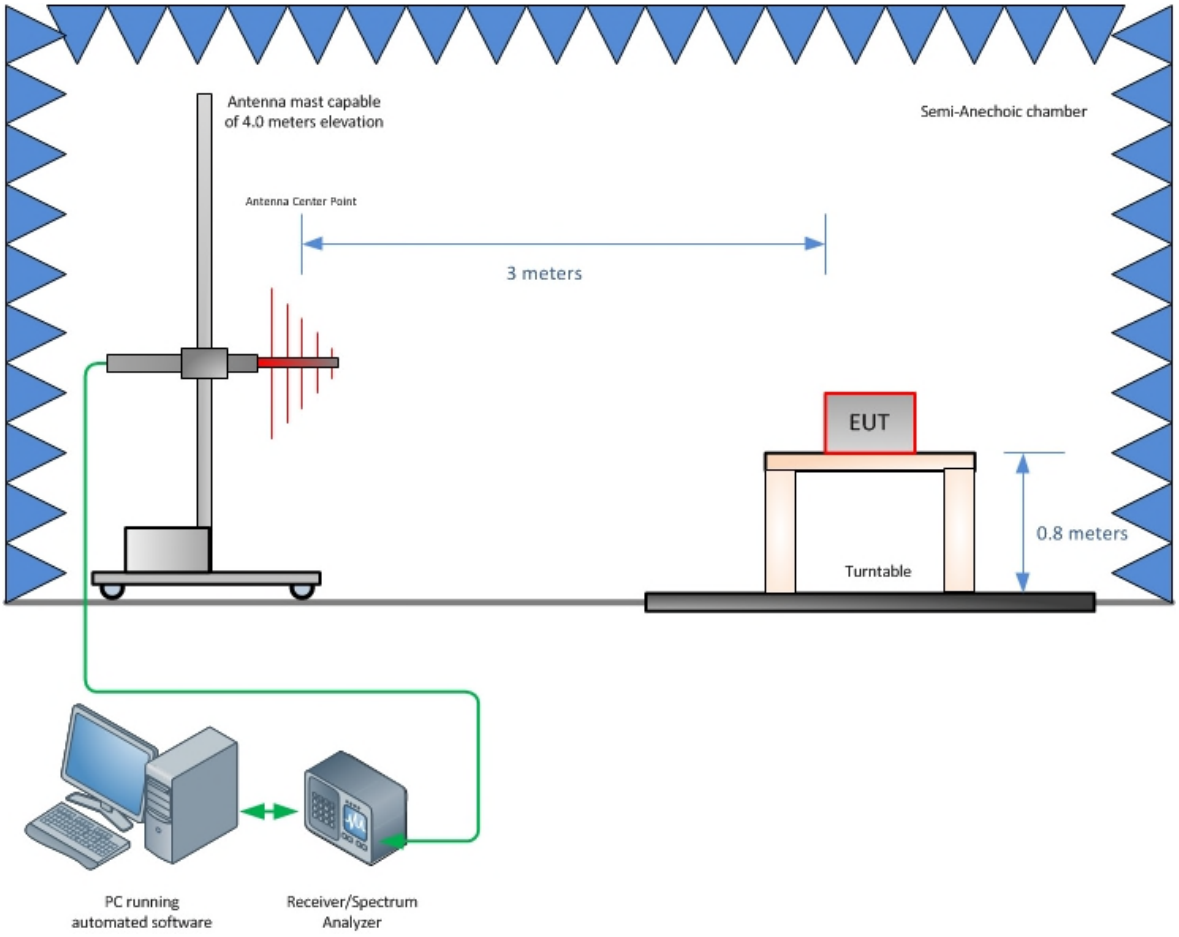
SECTION 4

DIAGRAM OF TEST SETUP

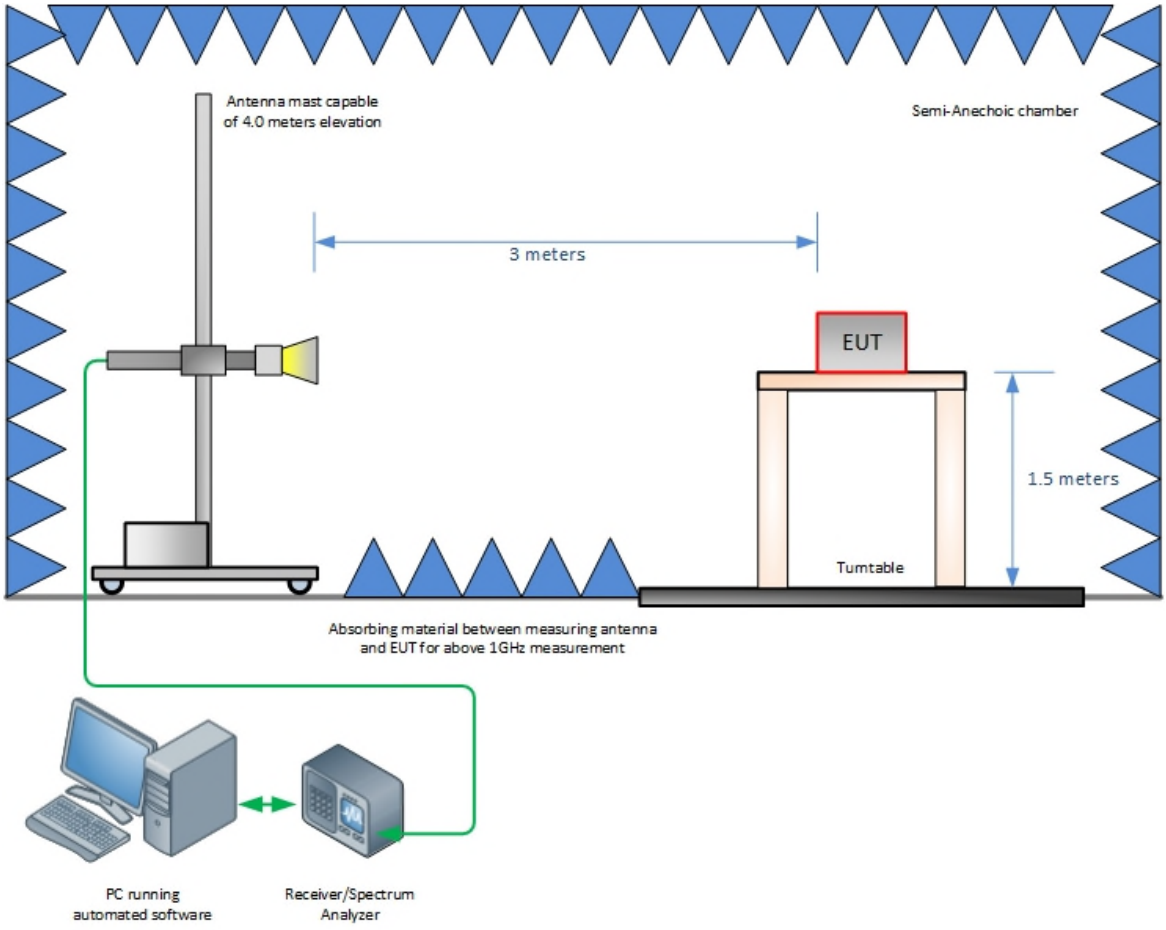
4.1 Test Setup Diagram



AC Conducted Emission Test Setup



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

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5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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