

Radio Testing of the
Masimo
Wrist Worn Device
Model: W1

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

Masimo
52 Discovery
Irvine, CA 92618



America

Add value.
Inspire trust.

COMMERCIAL-IN-CONFIDENCE

Date: June 2022

Document Number: 72180289A Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Omar Castillo	June 20, 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.



DISCLAIMER AND COPYRIGHT

This report has been prepared by TÜV SÜD America with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD America. No part of this document may be reproduced without the prior written approval of TÜV SÜD America.

ACCREDITATION

Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

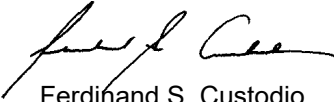
A2LA Cert. No. 2955.13

TÜV SÜD America, Inc.
10040 Mesa Rim Road
San Diego, CA 92121-2912

TÜV SÜD America, Inc.
Rancho Bernardo Facility
16936 Via Del Campo
San Diego, CA 92127

Phone: 858 678 1400
www.TÜV-sud-america.com



REPORT ON	Radio Testing of the Masimo Model: W1 (Wrist Worn Device)
TEST REPORT NUMBER	72180289A
TEST REPORT DATE	June 2022
PREPARED FOR	Masimo 52 Discovery Irvine, CA 92618
CONTACT PERSON	Alex Chang Senior Manager, EMC alex.chang@masimo.com (949) 405-3950
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	June 20, 2022



Revision History

72180289A Masimo Model: W1					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
06/20/2022	—	Initial Release			Omar Castillo

CONTENTS

Section	Page No
1	REPORT SUMMARY 5
1.2	Brief Summary Of Results 7
1.3	Product Information 8
1.4	EUT Test Configuration 8
1.5	Deviations From The Standard 9
1.6	Modification Record 10
1.7	Test Methodology 10
1.8	Test Facility Location 10
1.9	Test Facility Registration 10
2	TEST DETAILS 12
2.1	Peak Output Power 13
2.2	Conducted Emissions 16
2.3	99% Emission Bandwidth 17
2.4	Minimum 6 dB RF Bandwidth 22
2.5	Out-Of-Band Emissions - Conducted 27
2.6	Band-Edge Compliance Of RF Conducted Emissions 34
2.7	Radiated Spurious Emissions 44
2.8	Power Spectral Density 51
3	TEST EQUIPMENT USED 56
3.1	Test Equipment Used 57
3.2	Measurement Uncertainty 58
4	DIAGRAM OF TEST SETUP 61
4.1	Test Setup Diagram 62
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT 65
5.1	Accreditation, Disclaimers and Copyright 66



SECTION 1

REPORT SUMMARY

Radio Testing of the
Masimo
W1 Wrist Worn Device



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Masimo W1 Wrist Worn Device 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	Masimo
EUT	Wrist Worn Device
Trade Name	W1
Model Name	W1
FCC ID	VKF-MASIW1
IC Number	7362A-MASIW1
FCC Classification	Low power Communications Device Transmitter (DTS)
Serial Number(s)	FD00000083
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none">• 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	May 25, 2022
Finish of Test	June 06, 2022
Name of Engineer(s)	Ferdinand Custodio
Related Document(s)	<ul style="list-style-type: none">• 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	N/A	
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 EUT does not have provisions to connect directly to public AC mains. AC Conducted Emissions not required.
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 Masimo W1 Wrist Worn Device. The EUT operates standalone, and the internal battery can be charged using a wireless charger.

1.3.2 EUT General Description

EUT Description	Wrist Worn Device
Trade Name	W1
Model Name	W1
Rated Voltage	5 VDC battery powered
Mode Verified	Bluetooth LE 5.0
Capability	IEEE 802.15.1 Bluetooth Low Energy (BLE 5.0)
Primary Unit (EUT)	<input type="checkbox"/> Production <input checked="" type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
Manufacturer Declared Temperature Range	0°C to 35°C
Antenna Type	Chip Antenna
Manufacturer	Johanson
Antenna Model	2450AD18A7250, Masimo P/N: 101413
Maximum Antenna Gain	3.0 dBi
Antenna Data Sheet	https://www.johansontechnology.com/datasheets/2450AD18A7250/2450AD18A7250.pdf

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Gated RMS (dBm)	Duty Cycle (%)
	2402-2480	-3.6	100.0

See section 2.1.8 of this test report.

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description				
Default	<p>Antenna Conducted Port Configuration. A temporary antenna connector was provided for the evaluation. The EUT is connected to a support laptop connected via a FTDI USB cable. The support laptop is running PuTTY which enables configuration of the BLE 5.0 RF module. TX and RX test modes are available. The following settings were used for both 1M and 2M PHY configurations:</p> <table border="1"> <tr> <td>Data Rate</td><td>1Mbit or 2Mbit</td></tr> <tr> <td>Output Power</td><td>Pos8dBm</td></tr> </table> <p>For Cabinet Spurious Emissions, identical configurations are used with the antenna port terminated.</p>	Data Rate	1Mbit or 2Mbit	Output Power	Pos8dBm
Data Rate	1Mbit or 2Mbit				
Output Power	Pos8dBm				

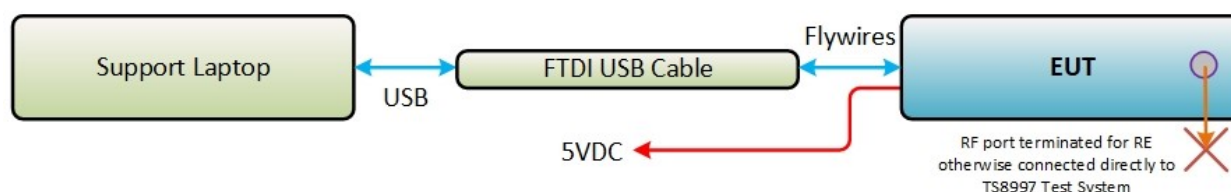
1.4.2 EUT Exercise Software

Firmware used during verification is V0001.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
HP	Support laptop	Model: Elitebook, S/N:78900672
HP	Support laptop AC Adapter	P/N: 854055-004
-	Laptop to EUT	USB FTDI Cable

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
Masimo
W1 Wrist Worn Device



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: FD00000083 / Default Test Configuration

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

May 25, 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	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

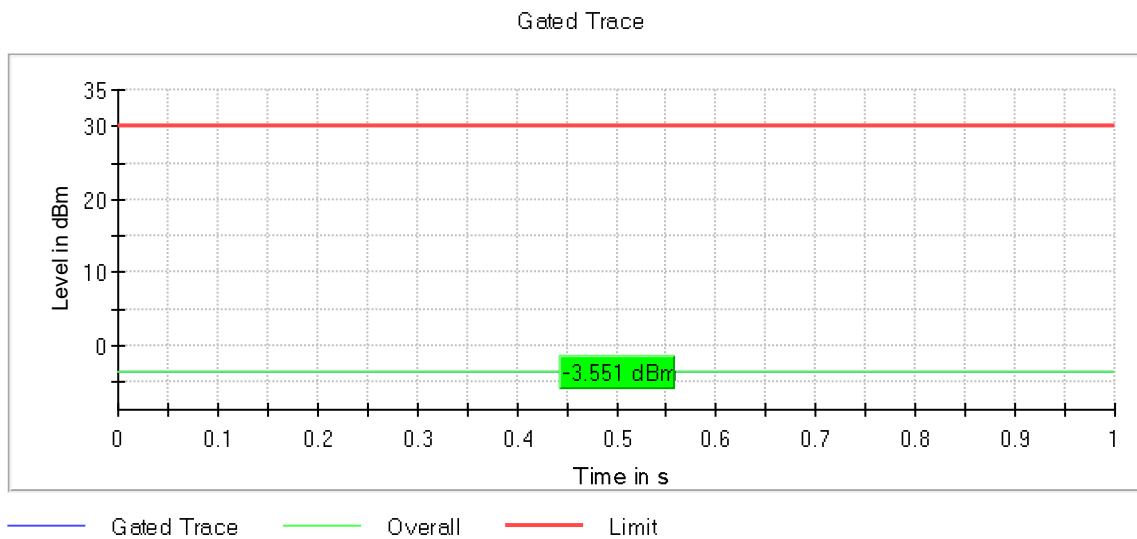
2.1.7 Additional Observations

- 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

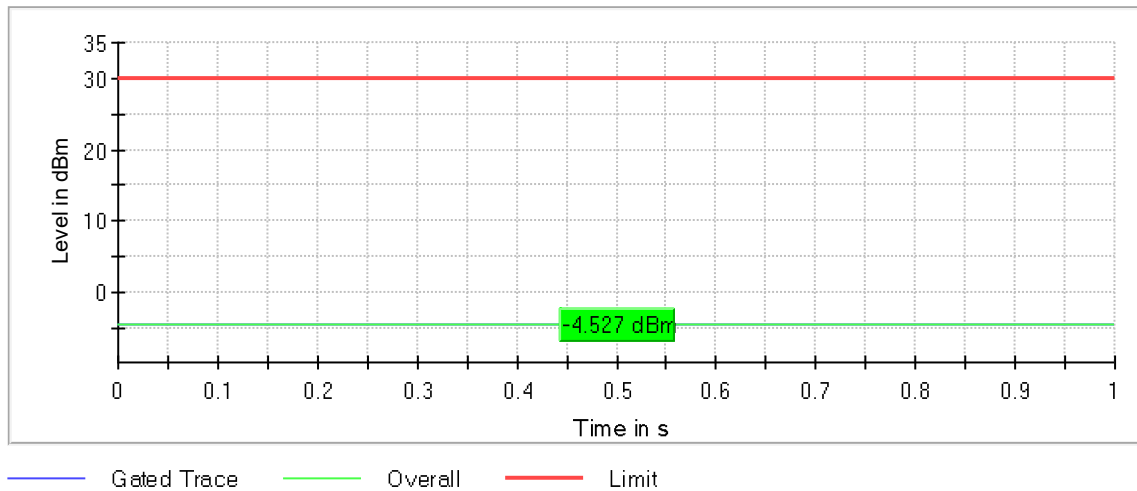
DUT Frequency (MHz)	PHY	Gated RMS (dBm)	Limit Max (dBm)	DutyCycle (%)	Result
2402.000000	1M	-3.6	30.0	100.0	PASS
2440.000000	1M	-4.5		100.0	PASS
2480.000000	1M	-4.3		100.0	PASS
2402.000000	2M	-4.9		100.0	PASS
2440.000000	2M	-5.1		100.0	PASS
2480.000000	2M	-5.0		100.0	PASS

2.1.9 Sample Test Plots



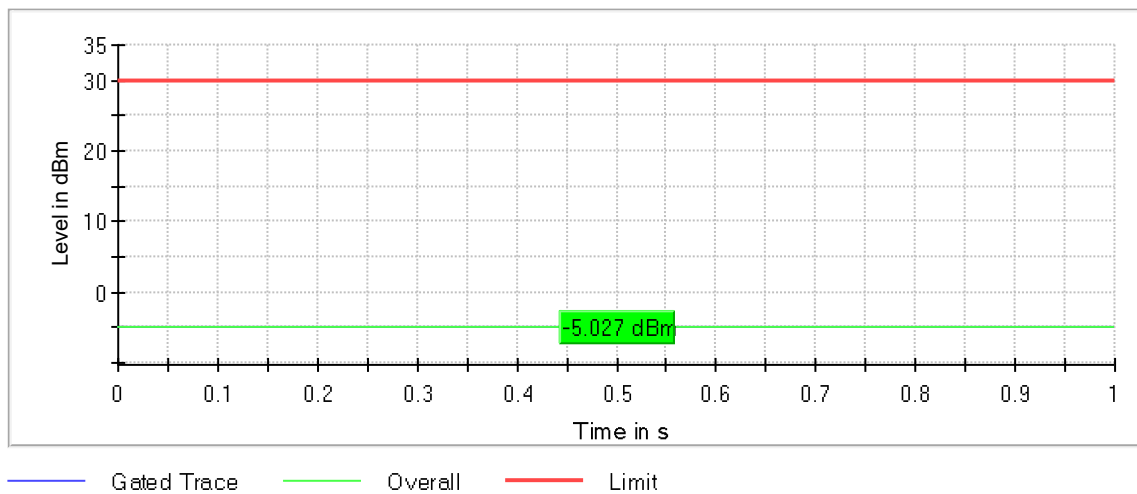
Bluetooth LE. Low Channel 1M PHY

Gated Trace



Bluetooth LE. Mid Channel 1M PHY

Gated Trace



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 μ s	1.000 μ s

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 μ H/50 ohms line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	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:

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

N/A. EUT does not have provisions to connect directly to public AC mains. AC Conducted Emissions verification doesn't apply. The EUT is a battery powered watch charged wirelessly (no direct connection to public AC mains). AC Conducted Emissions shall be performed on the Wireless charger.



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: FD00000083 / Default Test Configuration

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

May 25, 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	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

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.

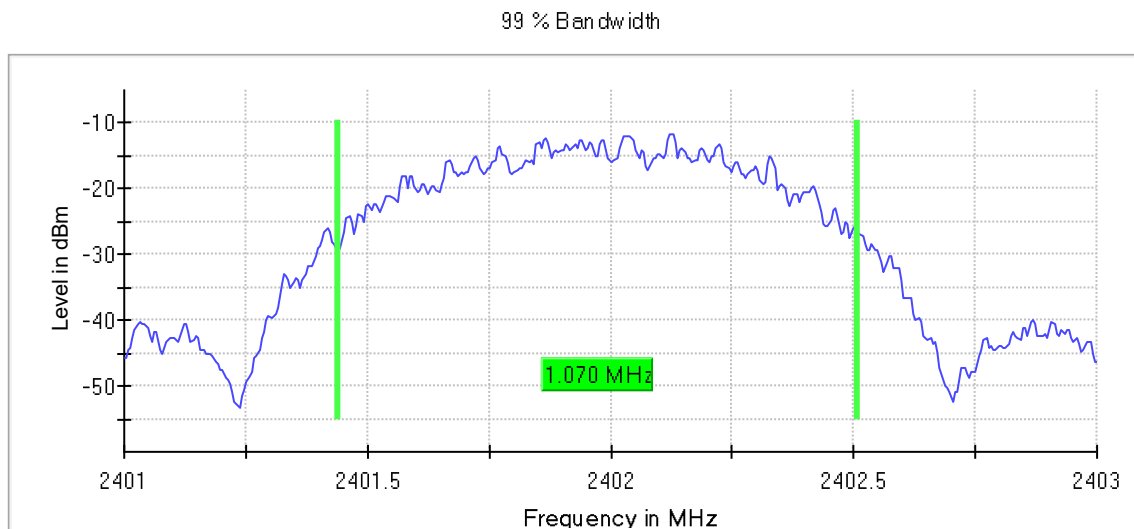
2.3.8 Sample Measurement Settings

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 μ s	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
Preamplifier	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

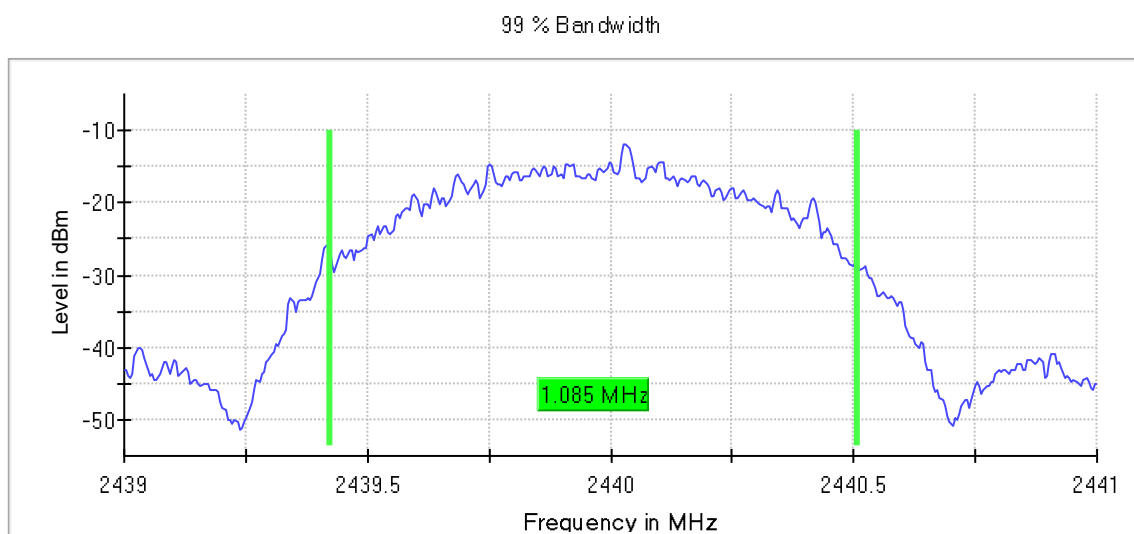
2.3.9 Test Results

DUT Frequency (MHz)	PHY	99% Bandwidth	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2402.000000	1M	1.070000	2401.437500	2402.507500	PASS
2440.000000	1M	1.085000	2439.422500	2440.507500	PASS
2480.000000	1M	1.085000	2479.422500	2480.507500	PASS
2402.000000	2M	2.080000	2400.925000	2403.005000	PASS
2440.000000	2M	2.100000	2438.925000	2441.025000	PASS
2480.000000	2M	2.080000	2478.915000	2480.995000	PASS

2.3.10 Test Plots

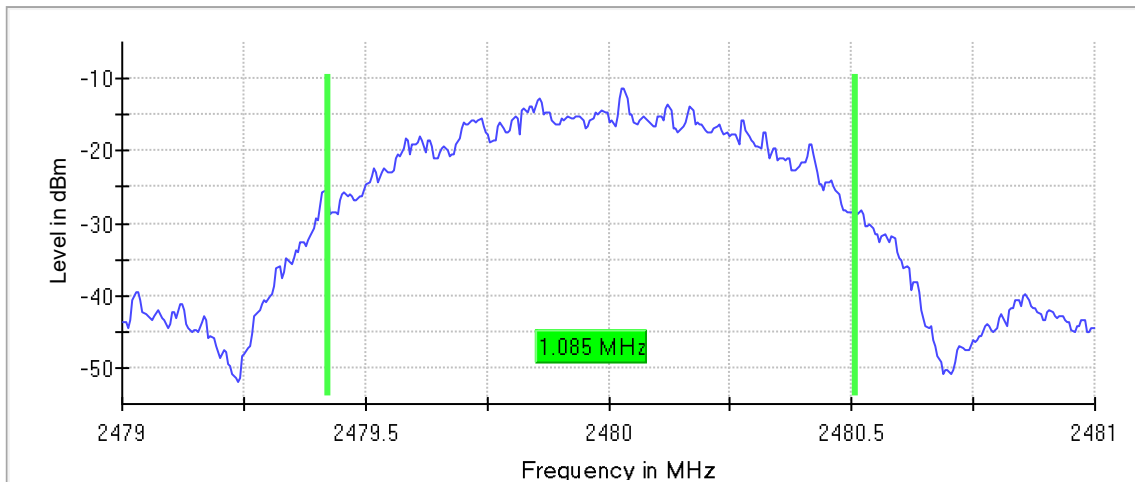


Bluetooth LE Low Channel 1M PHY



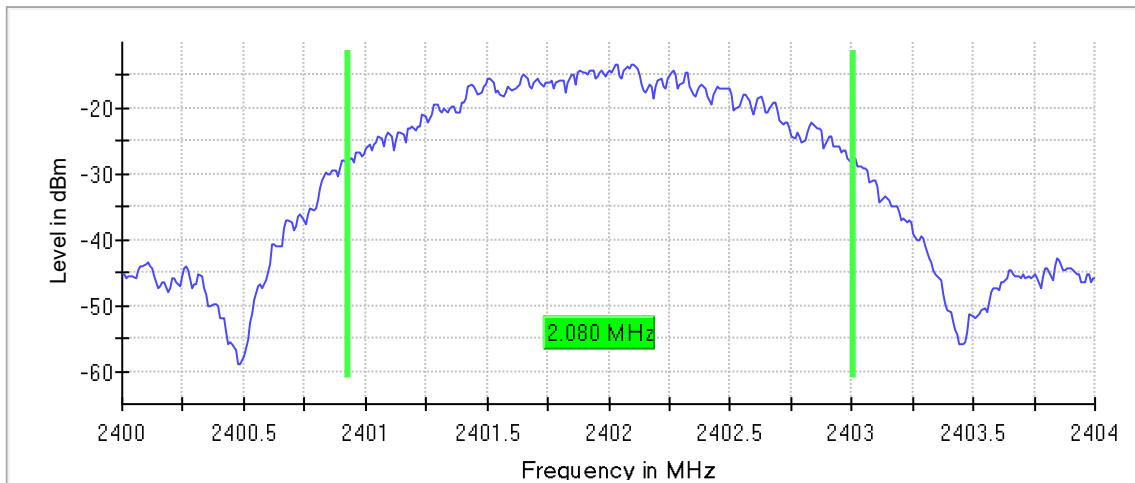
Bluetooth LE Middle Channel 1M PHY

99 % Bandwidth



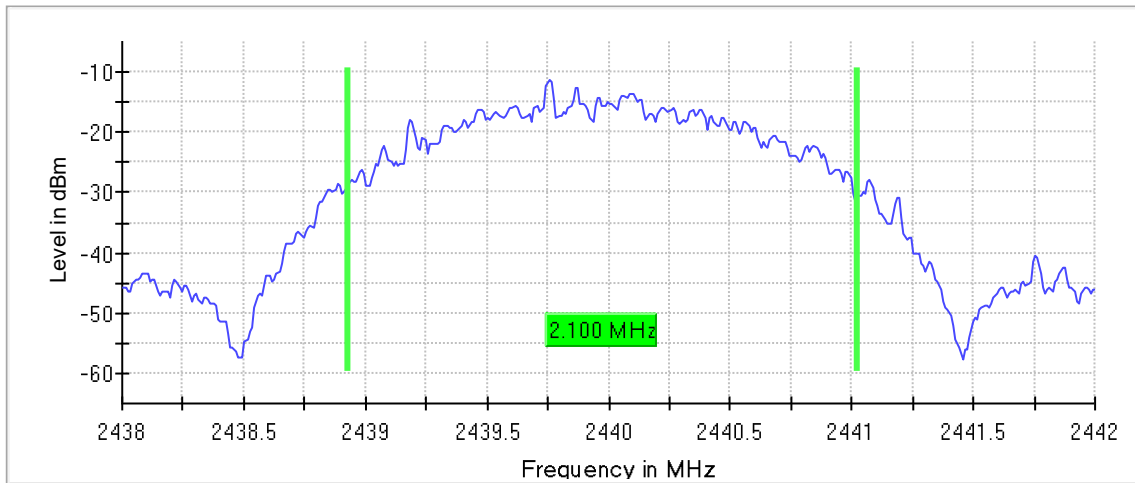
Bluetooth LE High Channel 1M PHY

99 % Bandwidth



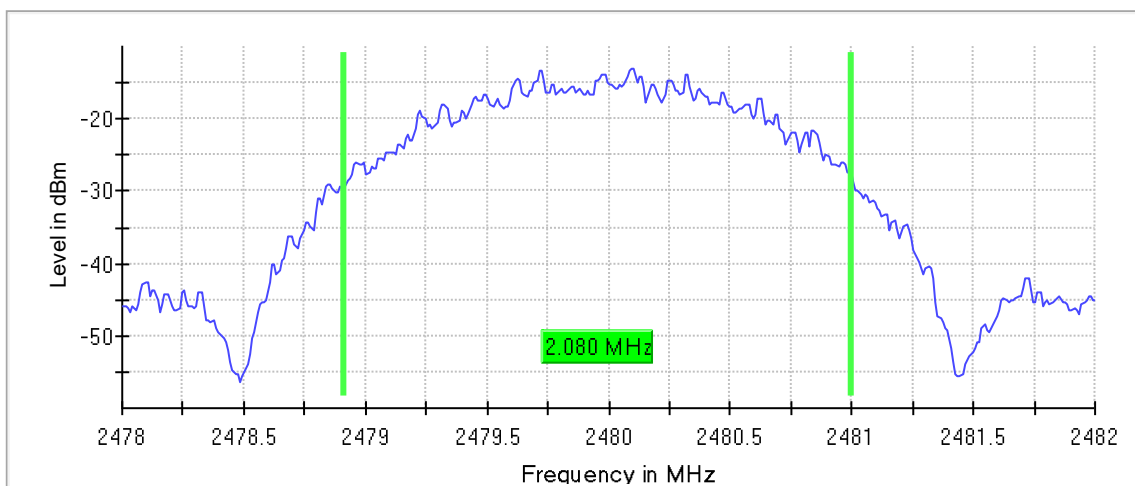
Bluetooth LE Low Channel 2M PHY

99 % Bandwidth



Bluetooth LE Middle Channel 2M PHY

99 % Bandwidth



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: FD00000083 / Default Test Configuration

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

May 25, 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	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

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.

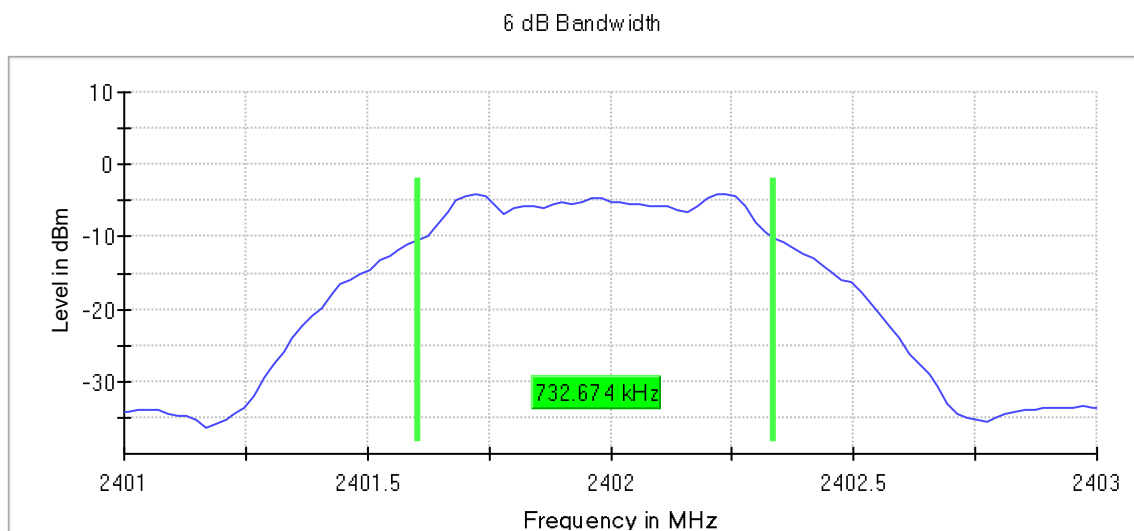
2.4.8 Sample Measurement Settings

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 μ s	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
Preamplifier	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

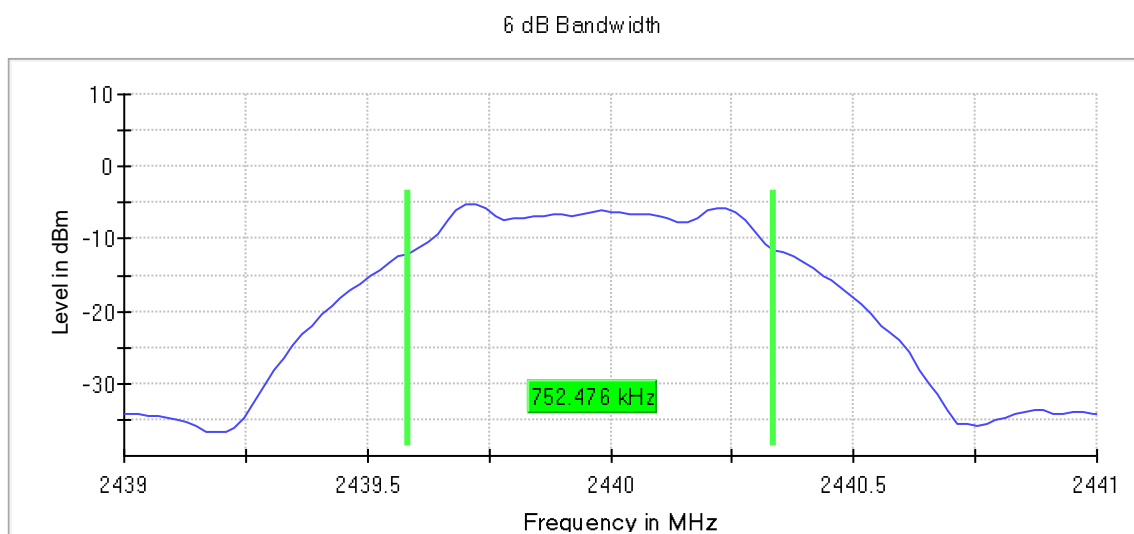
2.4.9 Test Results

DUT Frequency (MHz)	PHY	Limit Min (MHz)	Bandwidth (MHz)	Result
2402.000000	1M	0.500000	0.732674	PASS
2440.000000	1M		0.752476	PASS
2480.000000	1M		0.752476	PASS
2402.000000	2M		1.306930	PASS
2440.000000	2M		1.346534	PASS
2480.000000	2M		1.346534	PASS

2.4.10 Test Plots

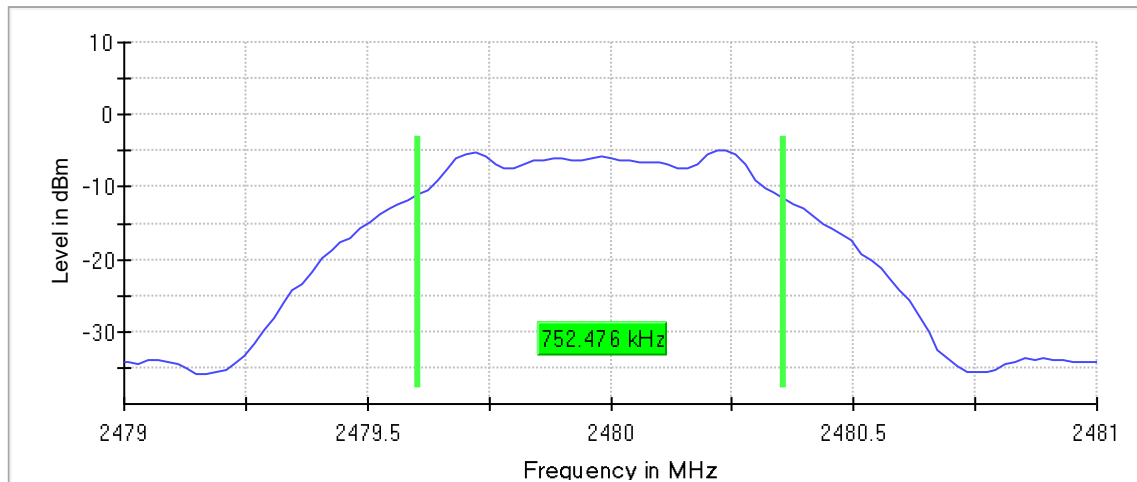


Bluetooth LE Low Channel 1M PHY



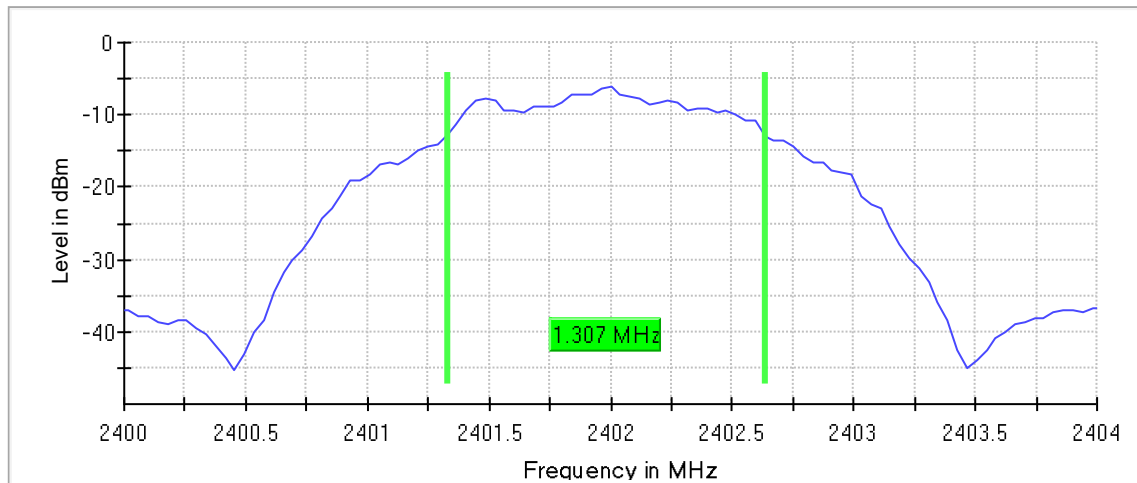
Bluetooth LE Middle Channel 1M PHY

6 dB Bandwidth



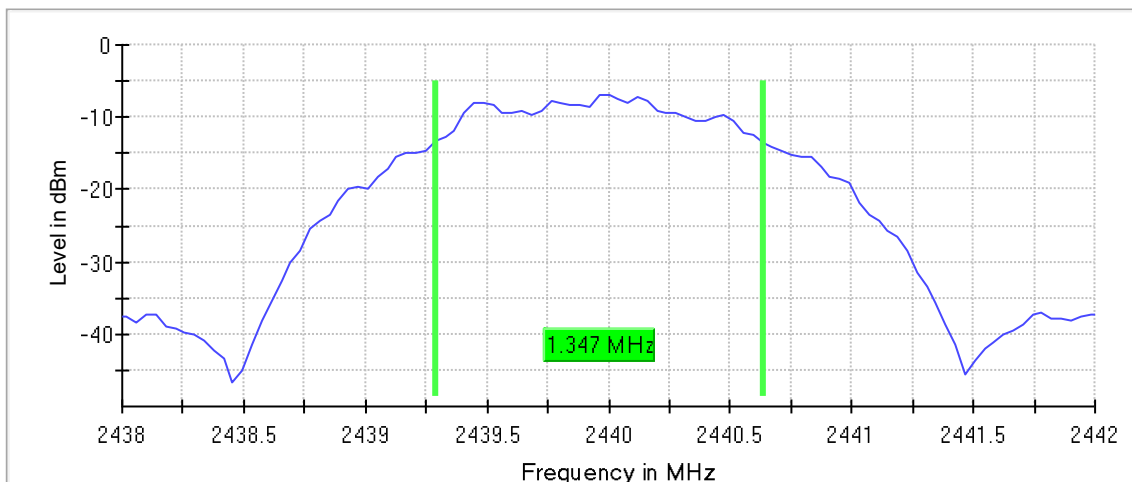
Bluetooth LE High Channel 1M PHY

6 dB Bandwidth



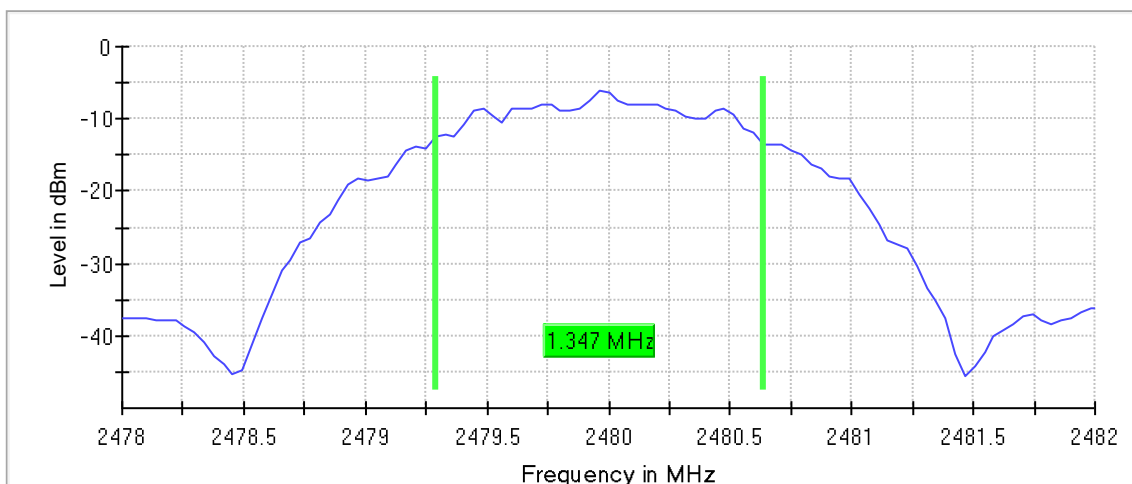
Bluetooth LE Low Channel 2M PHY

6 dB Bandwidth



Bluetooth LE Middle Channel 2M PHY

6 dB Bandwidth



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: FD00000083 / Default Test Configuration

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

May 25, 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.

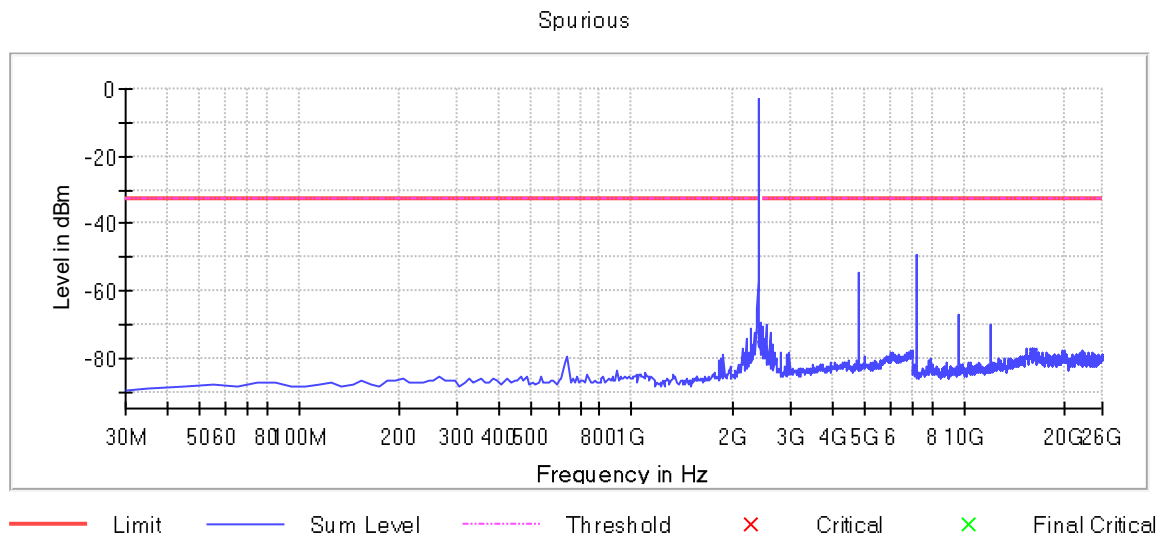
2.5.6 Environmental Conditions (Rancho Bernardo Satellite Facility)

Ambient Temperature	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

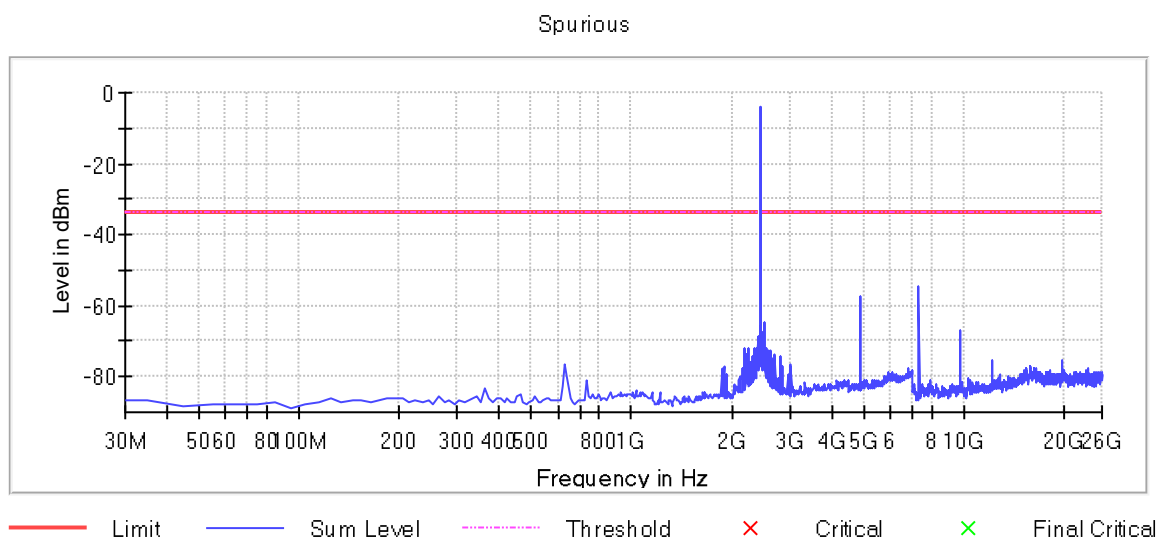
2.5.7 Additional Observations

- 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 3 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, therefore, plots presented with 1MHz RBW above 1GHz are worse case.
- 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)

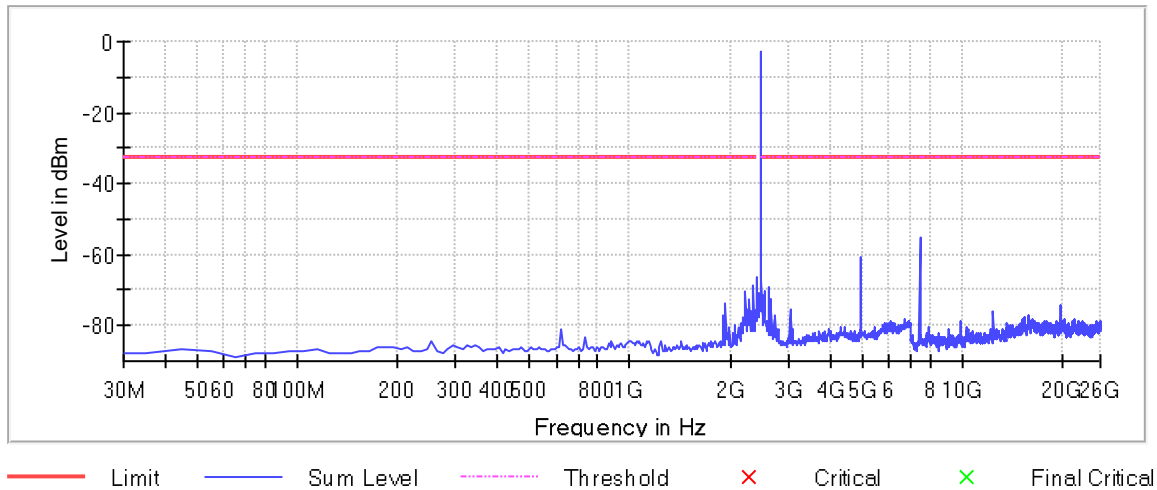


Low Channel 1M PHY



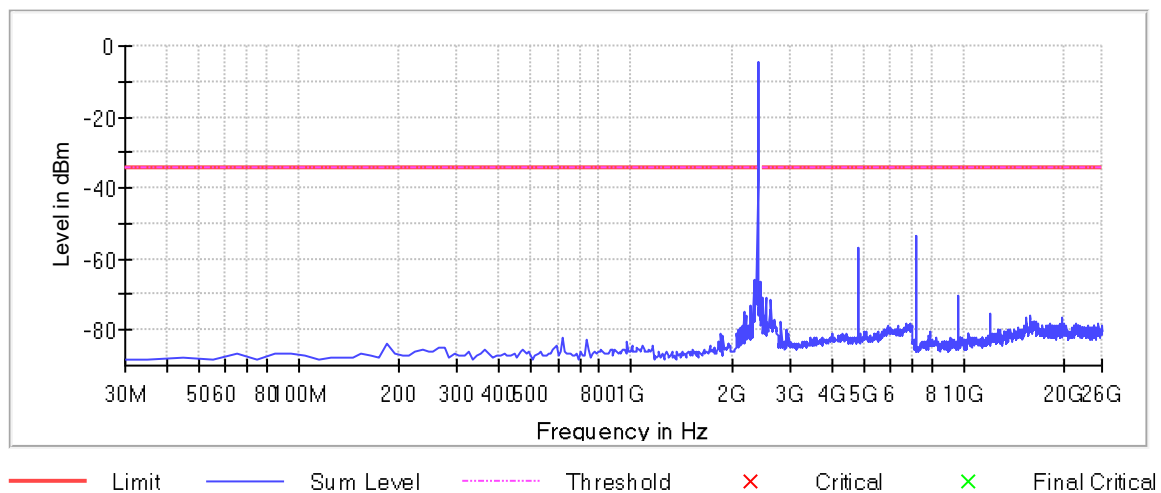
Middle Channel 1M PHY

Spurious



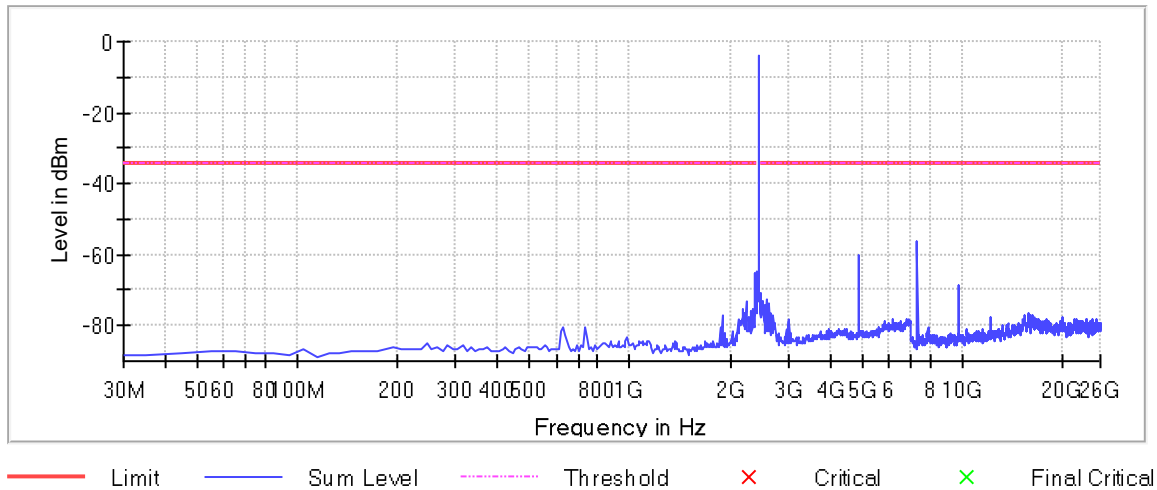
High Channel 1M PHY

Spurious



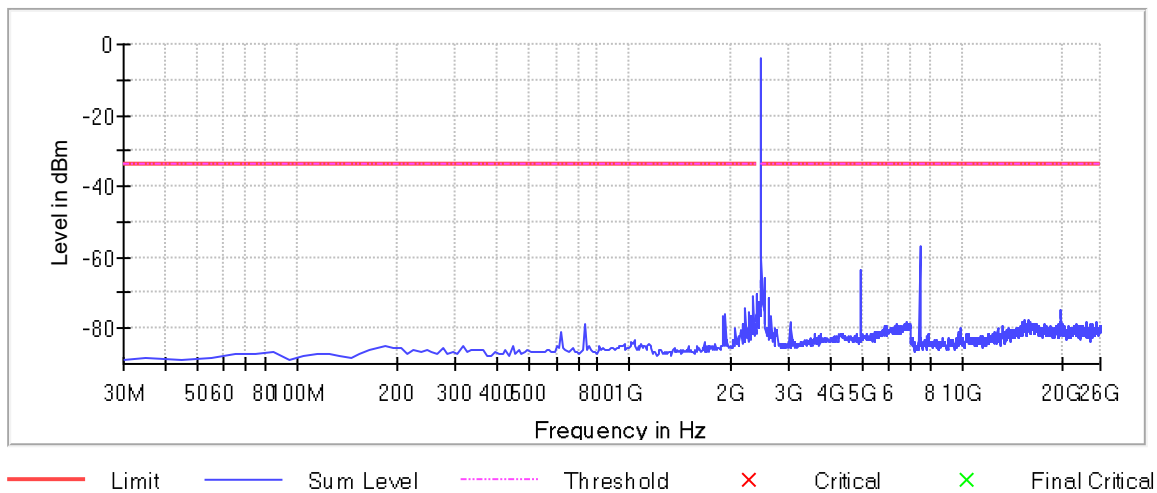
Low Channel 2M PHY

Spurious



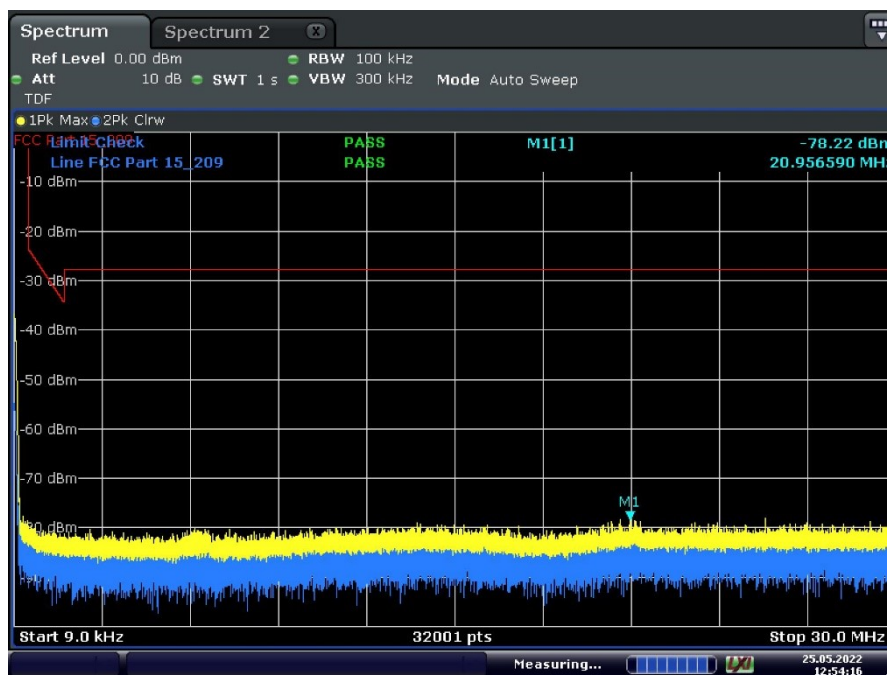
Mid Channel 2M PHY

Spurious



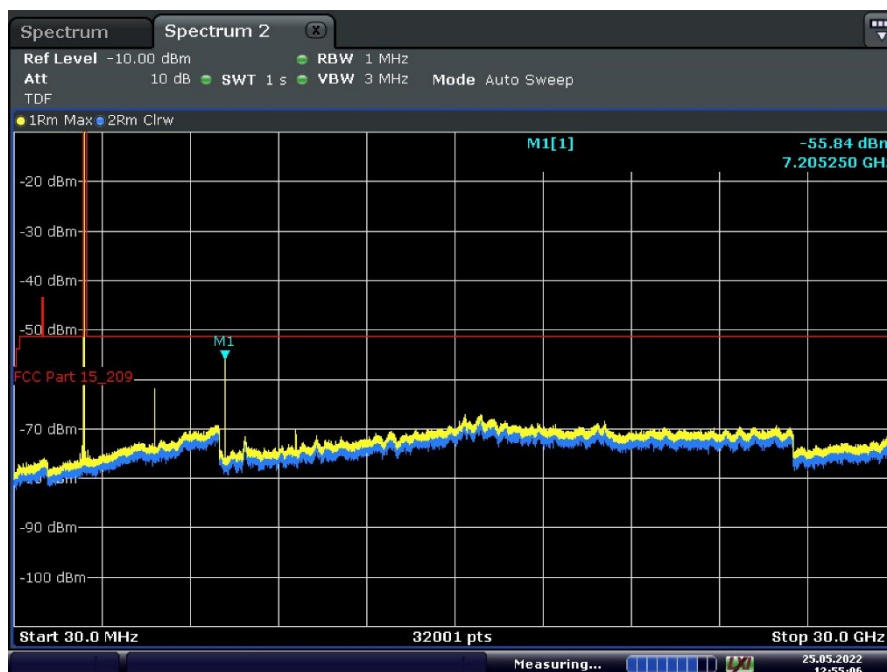
High Channel 2M PHY

2.5.9 Test Results Plots (§15.205 requirements)



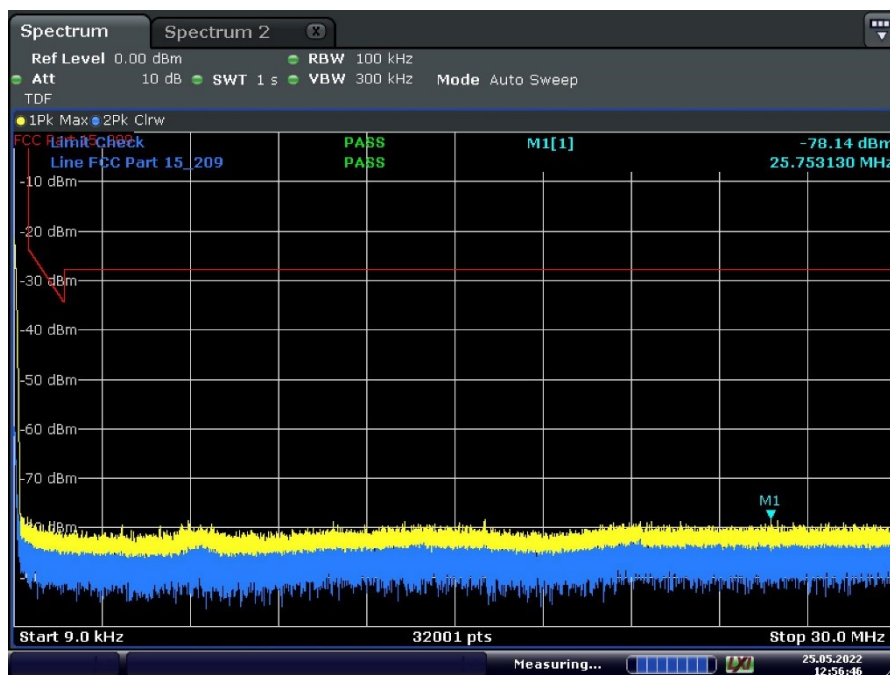
Date: 25.MAY.2022 12:54:16

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



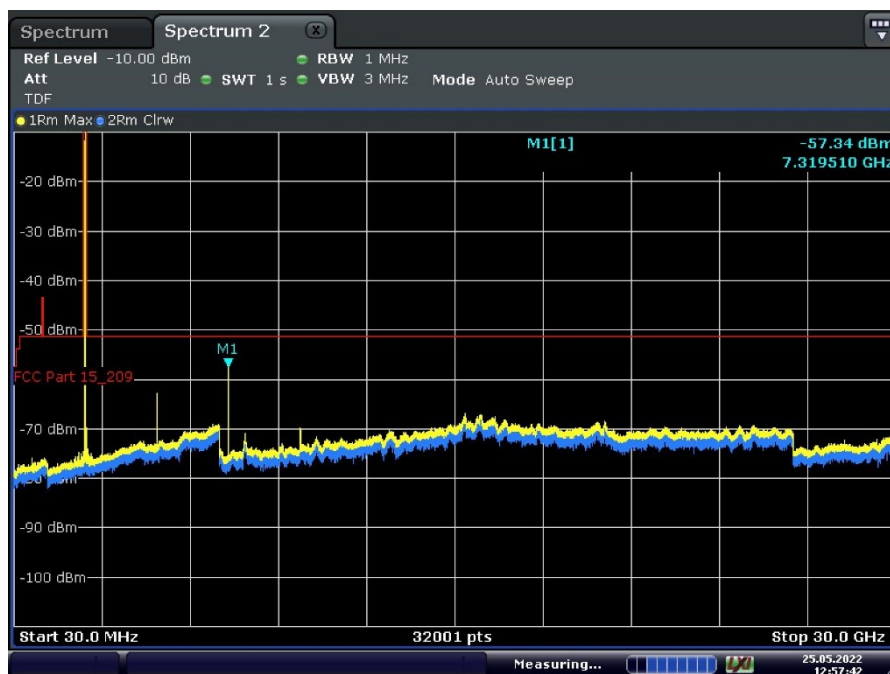
Date: 25.MAY.2022 12:55:07

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



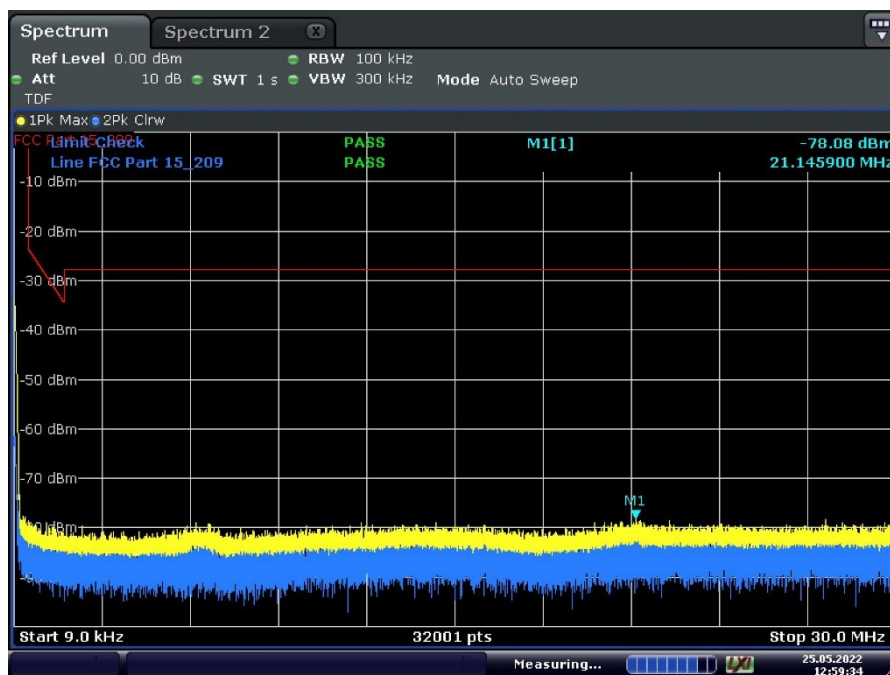
Date: 25.MAY.2022 12:56:46

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



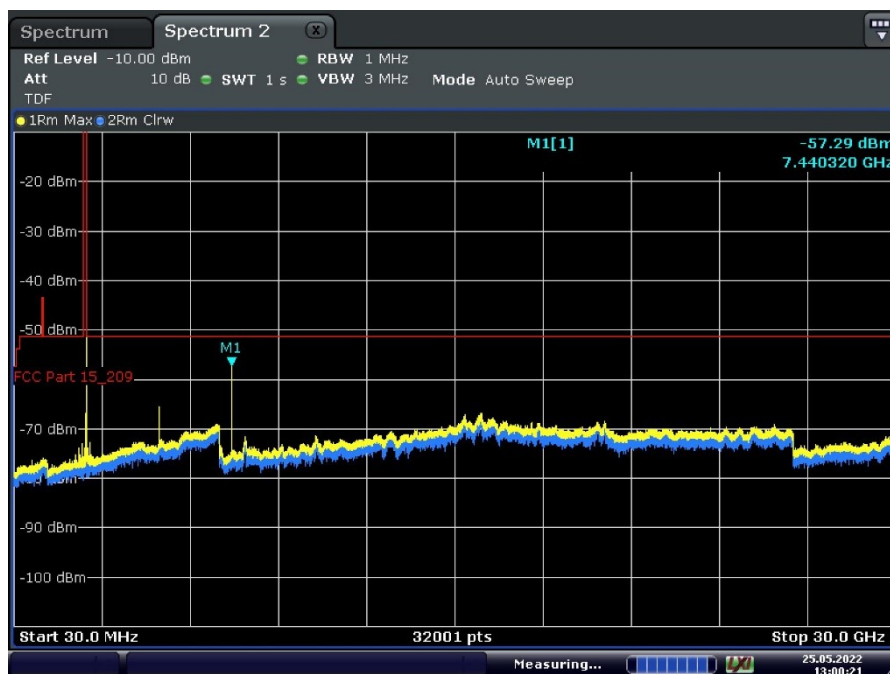
Date: 25.MAY.2022 12:57:42

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



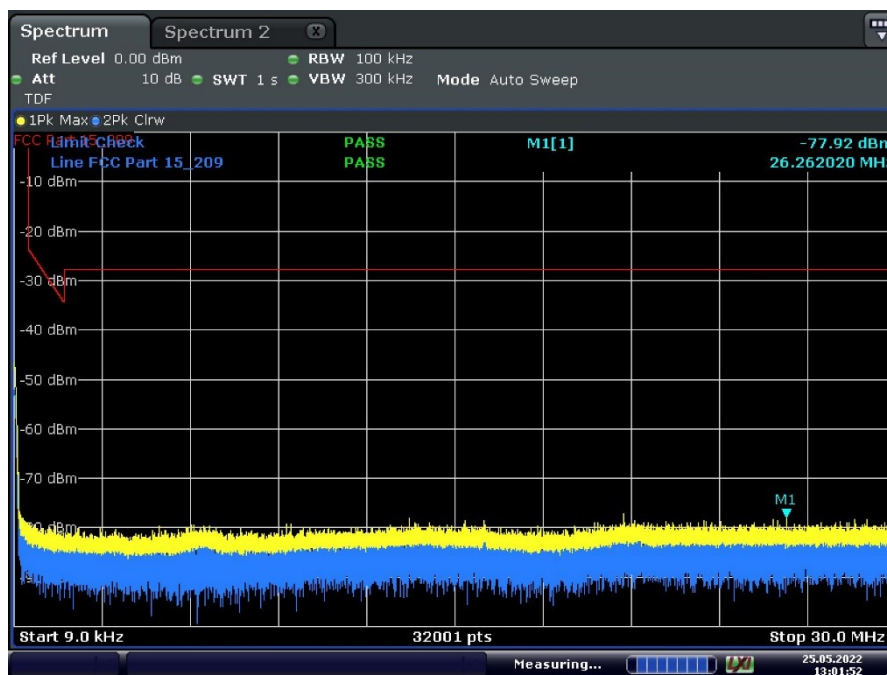
Date: 25.MAY.2022 12:59:35

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



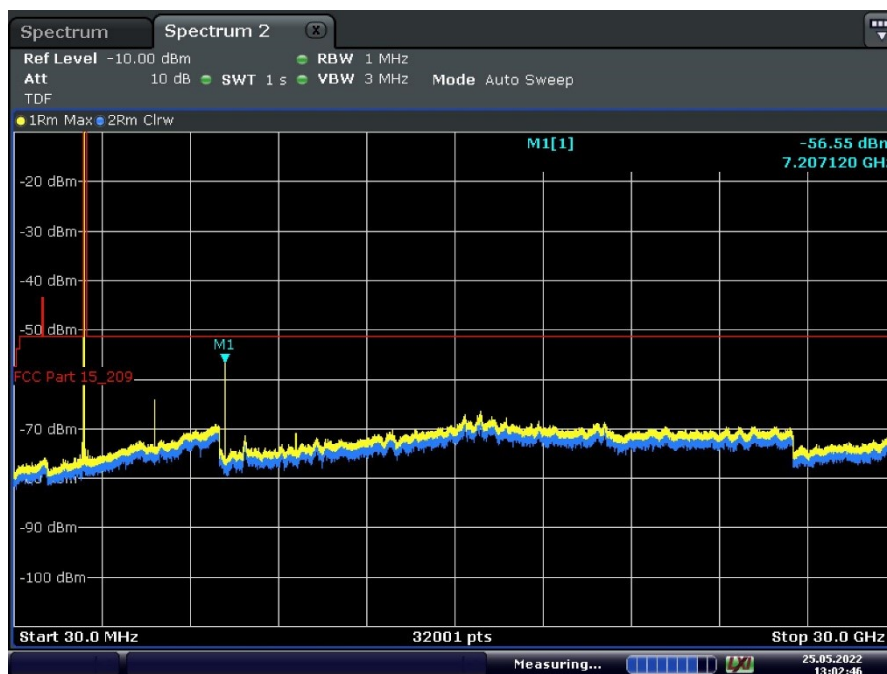
Date: 25.MAY.2022 13:00:21

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



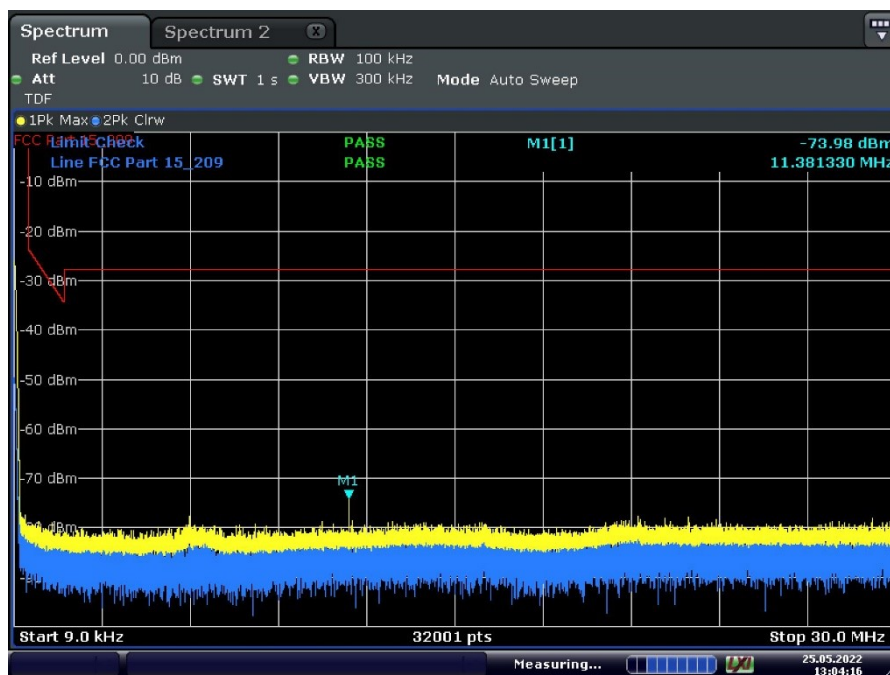
Date: 25.MAY.2022 13:01:52

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



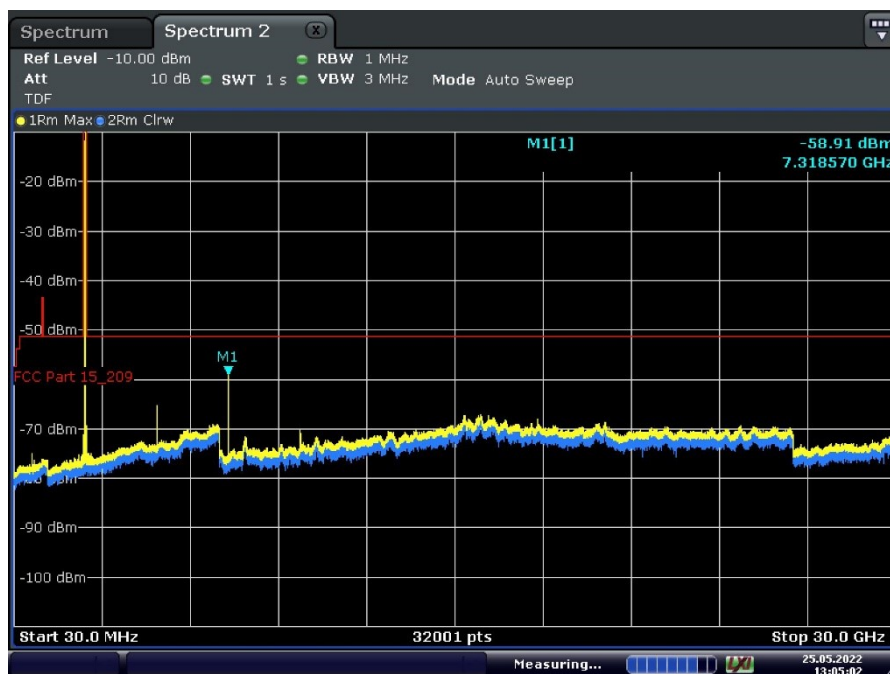
Date: 25.MAY.2022 13:02:46

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



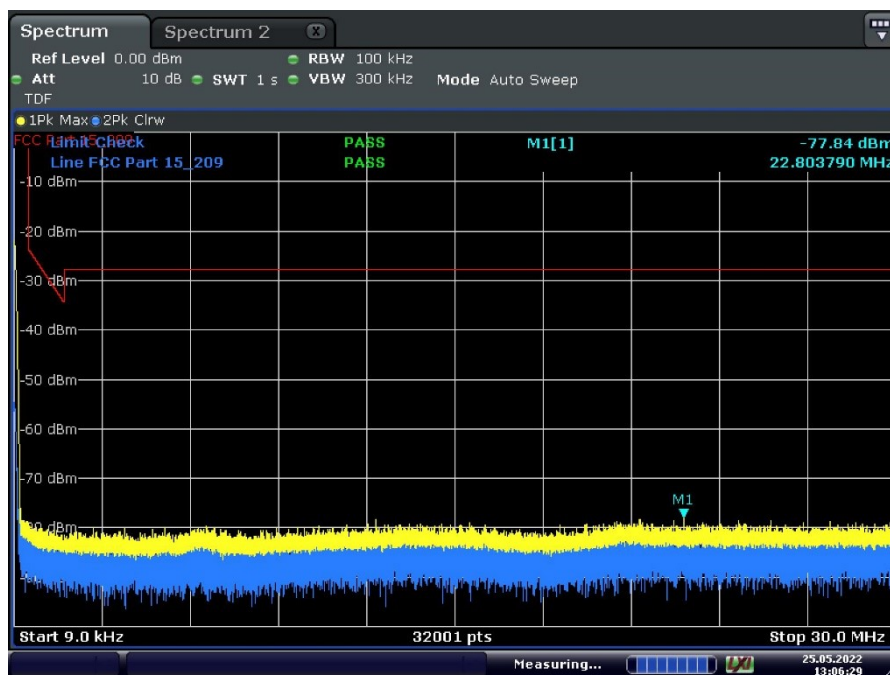
Date: 25.MAY.2022 13:04:16

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



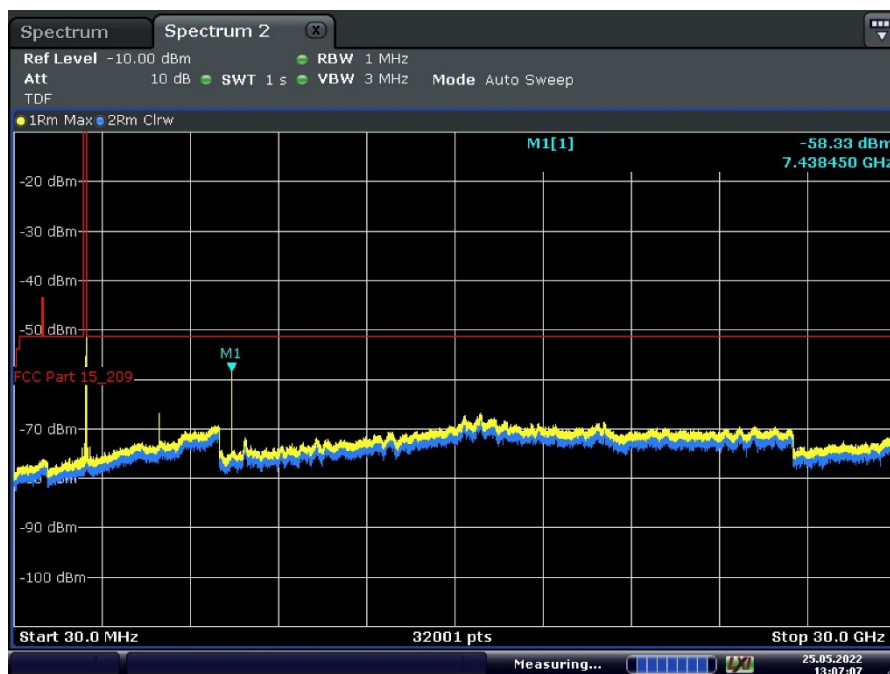
Date: 25.MAY.2022 13:05:03

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



Date: 25.MAY.2022 13:06:29

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



Date: 25.MAY.2022 13:07:07

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: FD00000083 / Default Test Configuration

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

May 25, 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	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

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 μ s	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 μ s	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	-51.6	20.9	-30.7	PASS
2399.925000	-52.2	21.5	-30.7	PASS
2399.875000	-54.6	23.9	-30.7	PASS
2399.825000	-56.8	26.2	-30.7	PASS
2399.725000	-58.0	27.3	-30.7	PASS
2399.775000	-58.0	27.4	-30.7	PASS
2399.625000	-58.4	27.7	-30.7	PASS
2399.675000	-58.7	28.0	-30.7	PASS
2399.575000	-58.7	28.0	-30.7	PASS
2399.275000	-59.0	28.4	-30.7	PASS
2399.325000	-59.3	28.6	-30.7	PASS
2399.225000	-59.4	28.7	-30.7	PASS
2399.475000	-59.5	28.9	-30.7	PASS
2399.425000	-60.1	29.4	-30.7	PASS
2399.375000	-60.1	29.4	-30.7	PASS

2.6.10 Test Results (Upper Band Edge 1M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.725000	-61.5	29.3	-32.1	PASS
2483.575000	-61.9	29.7	-32.1	PASS
2483.775000	-62.0	29.9	-32.1	PASS
2483.675000	-62.2	30.0	-32.1	PASS
2484.075000	-62.3	30.1	-32.1	PASS
2484.025000	-62.3	30.2	-32.1	PASS
2483.625000	-62.5	30.4	-32.1	PASS
2483.525000	-62.6	30.4	-32.1	PASS
2484.125000	-62.7	30.6	-32.1	PASS
2485.825000	-62.8	30.6	-32.1	PASS
2485.875000	-63.0	30.8	-32.1	PASS
2485.025000	-63.2	31.0	-32.1	PASS
2483.925000	-63.2	31.1	-32.1	PASS
2484.975000	-63.2	31.1	-32.1	PASS
2483.975000	-63.2	31.1	-32.1	PASS



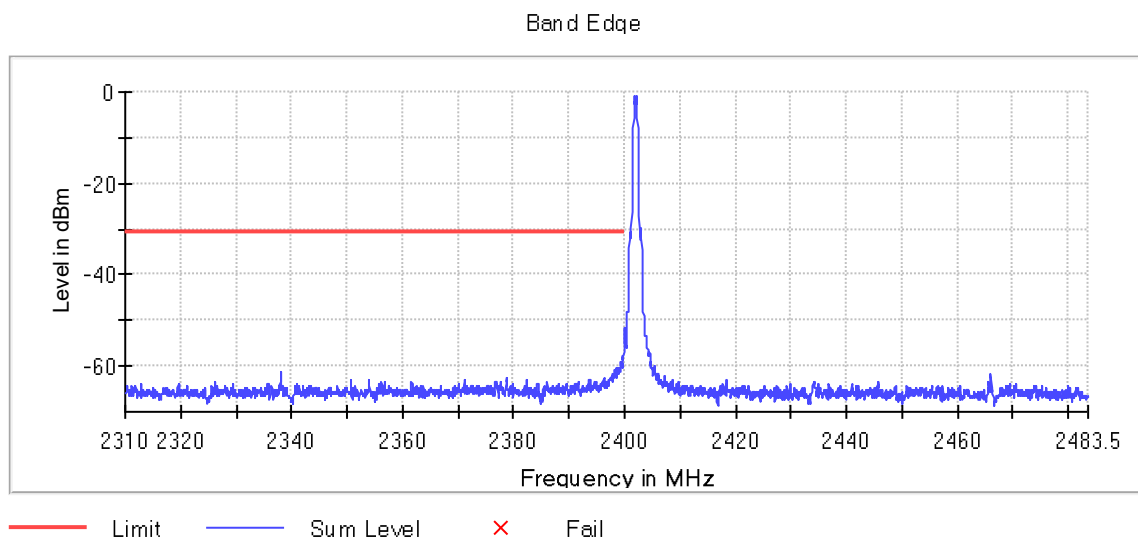
2.6.11 Test Results (Lower Band Edge 2M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-34.1	1.0	-33.1	PASS
2399.925000	-36.4	3.3	-33.1	PASS
2399.875000	-37.8	4.7	-33.1	PASS
2399.825000	-38.9	5.8	-33.1	PASS
2399.775000	-41.6	8.5	-33.1	PASS
2399.725000	-42.8	9.7	-33.1	PASS
2399.675000	-45.1	12.0	-33.1	PASS
2399.625000	-47.1	14.0	-33.1	PASS
2399.575000	-49.7	16.6	-33.1	PASS
2399.525000	-50.7	17.6	-33.1	PASS
2399.475000	-53.3	20.2	-33.1	PASS
2399.425000	-54.2	21.1	-33.1	PASS
2399.225000	-54.6	21.5	-33.1	PASS
2399.275000	-54.8	21.7	-33.1	PASS
2399.175000	-55.2	22.1	-33.1	PASS

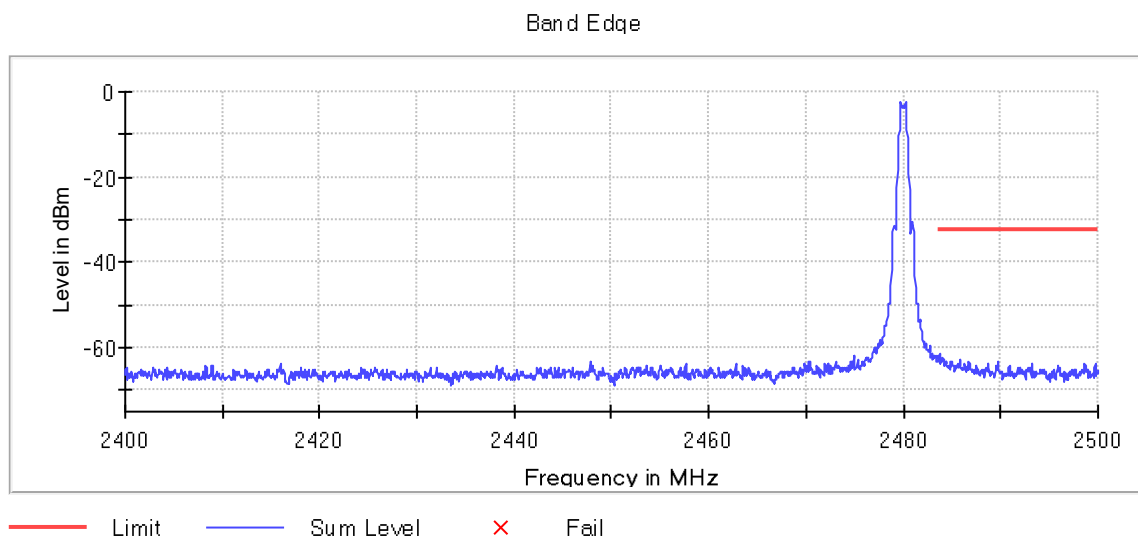
2.6.12 Test Results (Upper Band Edge 2M PHY)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.875000	-57.8	24.5	-33.3	PASS
2483.825000	-57.8	24.5	-33.3	PASS
2484.075000	-58.7	25.4	-33.3	PASS
2483.525000	-58.8	25.4	-33.3	PASS
2484.125000	-59.1	25.8	-33.3	PASS
2483.575000	-59.1	25.8	-33.3	PASS
2484.225000	-59.3	25.9	-33.3	PASS
2483.625000	-59.3	25.9	-33.3	PASS
2484.025000	-59.3	26.0	-33.3	PASS
2483.975000	-59.4	26.1	-33.3	PASS
2483.775000	-59.4	26.1	-33.3	PASS
2483.925000	-59.8	26.4	-33.3	PASS
2483.725000	-60.0	26.6	-33.3	PASS
2483.675000	-60.0	26.6	-33.3	PASS
2484.175000	-60.1	26.8	-33.3	PASS

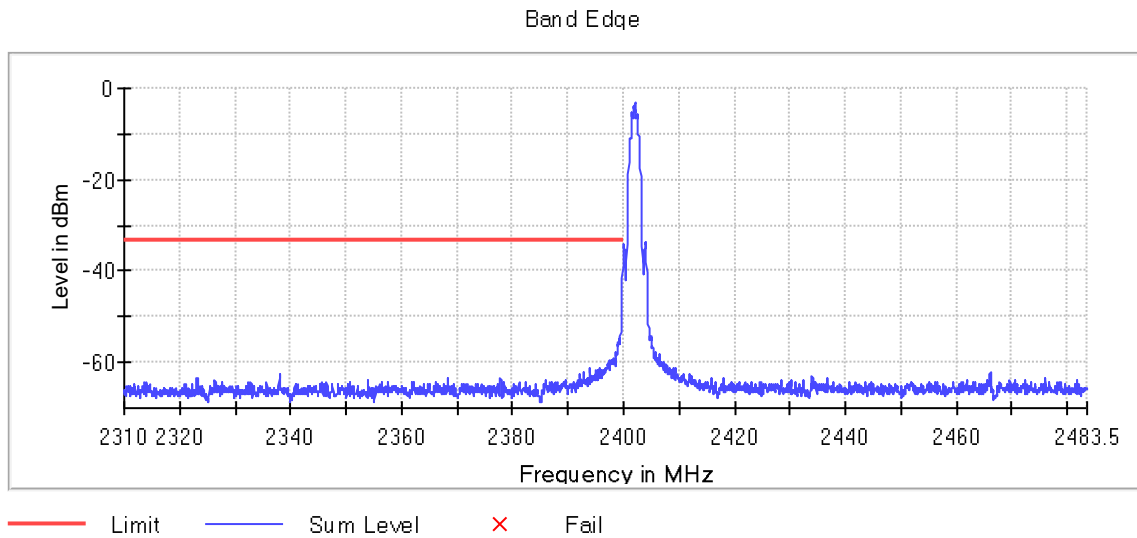
2.6.13 Test Plots



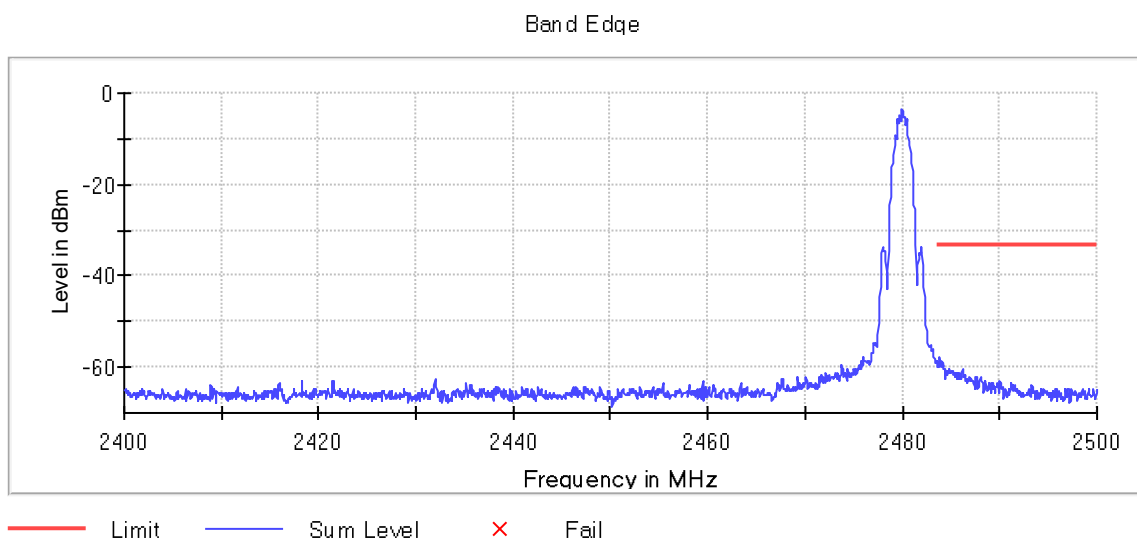
Bluetooth LE Low Band Edge 2400MHz 1M PHY



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.

$$\begin{aligned} E(\text{dB}\mu\text{V/m}) &= \text{EIRP (dBm)} + 95.2 \\ &= (-62.6 \text{ dBm} + 3 \text{ dBi antenna gain}) + 95.2 \\ &= 35.6 \text{ dB}\mu\text{V/m @ 3 meters (Peak complies with 54 dB}\mu\text{V/m Average limit)} \end{aligned}$$

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.

$$\begin{aligned} E(\text{dB}\mu\text{V/m}) &= \text{EIRP (dBm)} + 95.2 \\ &= (-58.8 \text{ dBm} + 3 \text{ dBi antenna gain}) + 95.2 \\ &= 39.4 \text{ dB}\mu\text{V/m @ 3 meters (Peak complies with 54 dB}\mu\text{V/m Average limit)} \end{aligned}$$



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: FD00000083 / Default Test Configuration

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

June 06, 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	23.1°C
Relative Humidity	28.3 %
ATM Pressure	100.1kPa

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



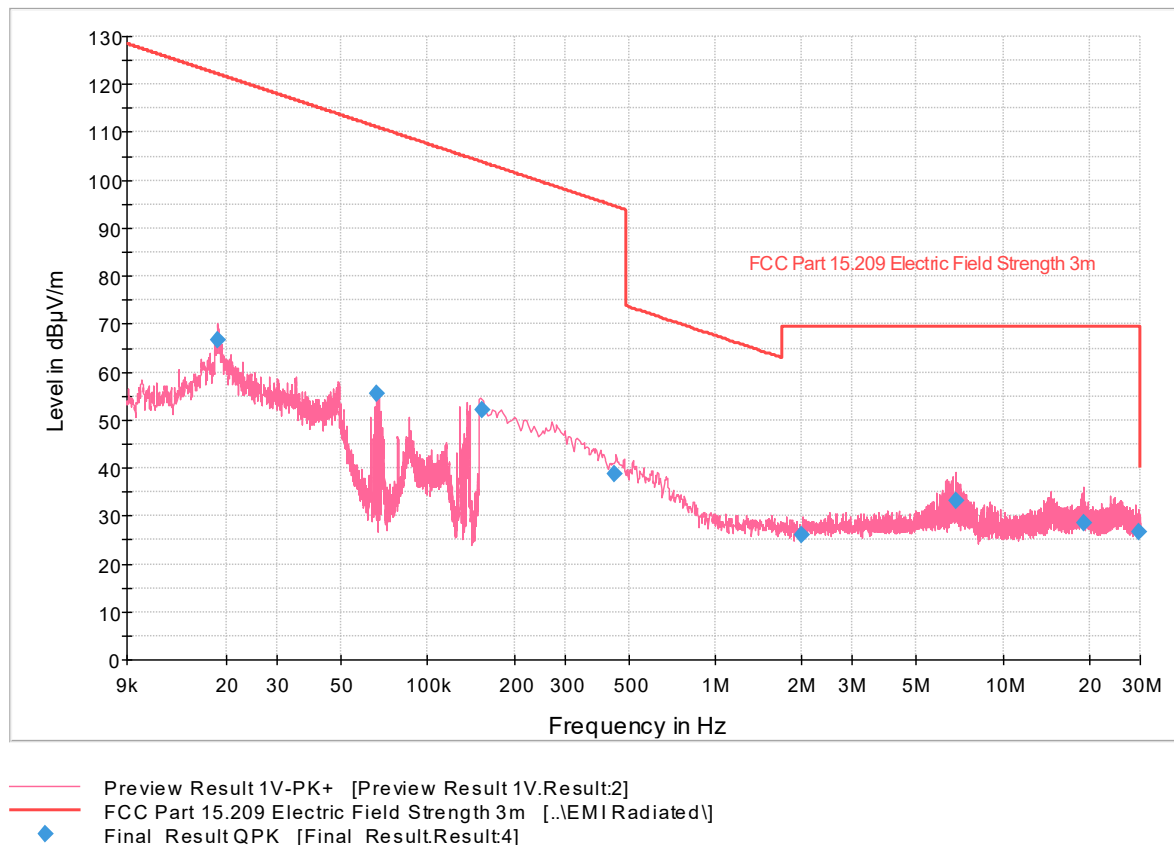
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.7.8 for sample computation.

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 9kHz to 30MHz

Full Spectrum

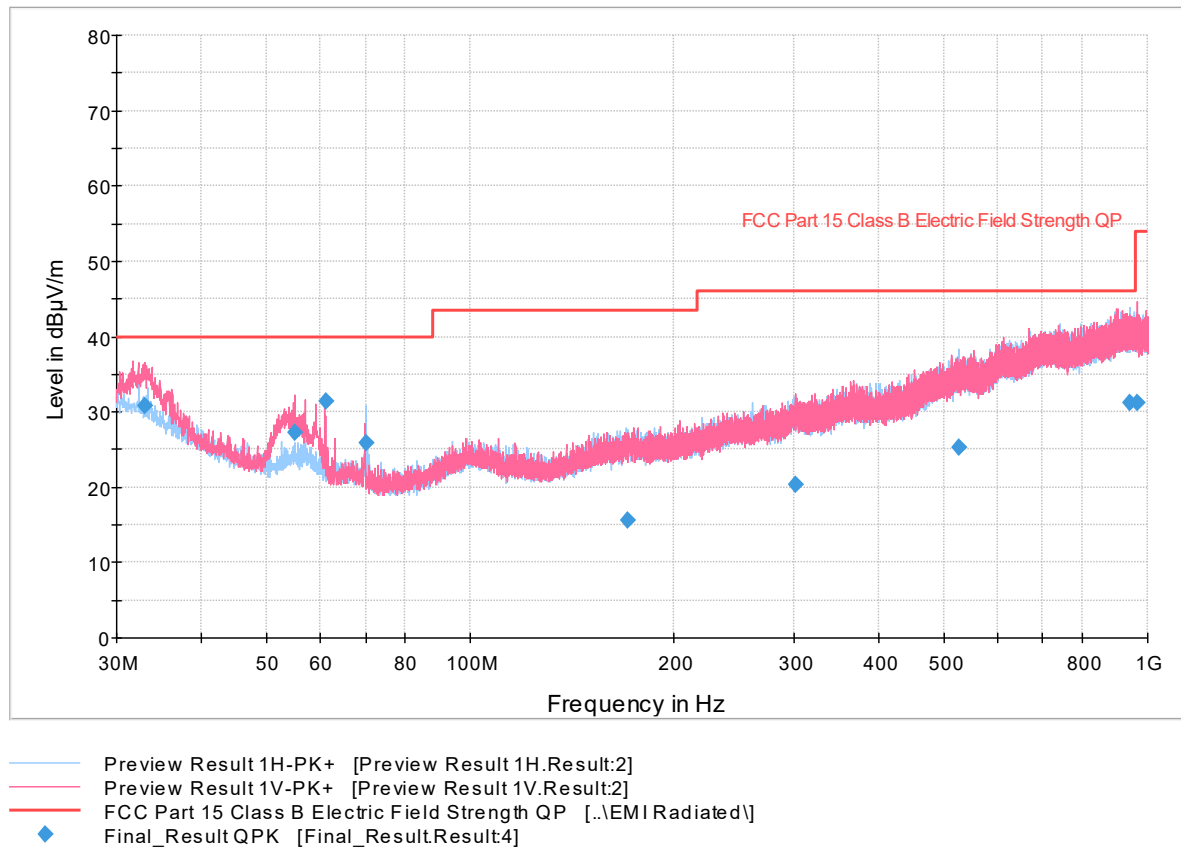


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Height (cm)	Azimuth (deg)	Corr. (dB/m)
0.018695	66.61	122.1	55.55	1000.	0.200	400.0	H	205.0	22
0.066571	55.54	111.1	55.60	1000.	0.200	400.0	H	109.0	20
0.154500	52.11	103.8	51.72	1000.	9.000	400.0	H	100.0	20
0.445655	38.88	94.62	55.74	1000.	9.000	400.0	H	14.0	19
1.985662	25.97	69.50	43.53	1000.	9.000	400.0	H	353.0	20
6.882884	33.27	69.50	36.23	1000.	9.000	400.0	H	346.0	20
18.982999	28.52	69.50	40.98	1000.	9.000	400.0	H	6.0	23
29.786415	26.64	69.50	42.86	1000.	9.000	400.0	H	190.0	25

2.7.10 Test Results for 30MHz to 1GHz

Full Spectrum

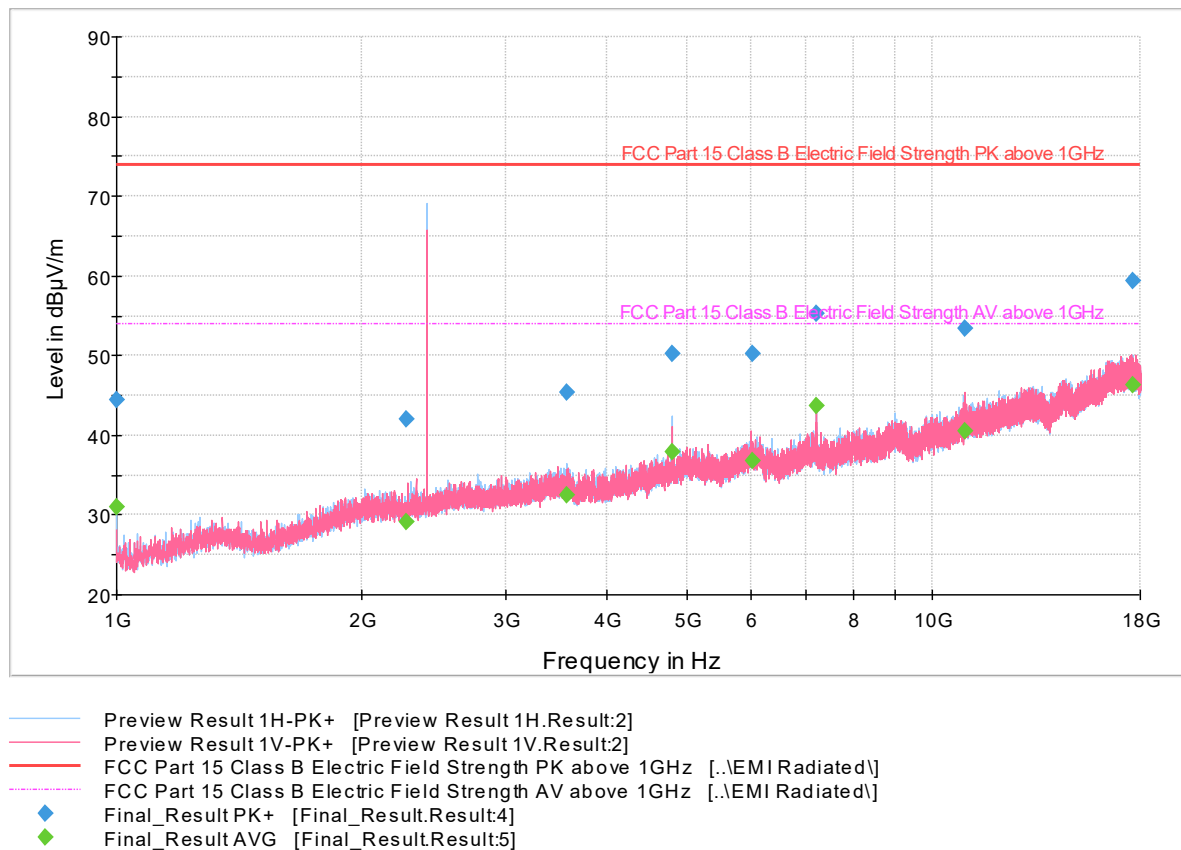


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
33.106000	30.77	40.00	9.23	1000.	120.000	107.0	V	39.0	21
55.026000	27.27	40.00	12.73	1000.	120.000	182.0	V	228.0	14
61.015333	31.47	40.00	8.53	1000.	120.000	116.0	V	297.0	13
69.981000	25.93	40.00	14.07	1000.	120.000	125.0	H	223.0	12
170.91566	15.56	43.50	27.94	1000.	120.000	371.0	H	158.0	17
301.69533	20.43	46.00	25.57	1000.	120.000	390.0	V	145.0	22
526.11900	25.29	46.00	20.71	1000.	120.000	283.0	H	318.0	26
940.28300	31.27	46.00	14.73	1000.	120.000	205.0	H	210.0	31
964.55233	31.26	53.90	22.64	1000.	120.000	125.0	V	284.0	31

2.7.11 Test Results for 1GHz to 18GHz

Full Spectrum



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)
1000.00000	44.52	73.90	29.38	1000.0	1000.000	255.0	H	4.0	-6
2267.56666	42.02	73.90	31.88	1000.0	1000.000	335.0	V	197.0	0
3571.50000	45.35	73.90	28.55	1000.0	1000.000	166.0	H	18.0	4
4802.80000	50.31	73.90	23.59	1000.0	1000.000	335.0	H	306.0	5
6011.00000	50.23	73.90	23.67	1000.0	1000.000	212.0	V	228.0	5
7207.46666	55.20	73.90	18.70	1000.0	1000.000	152.0	H	254.0	6
10974.2000	53.48	73.90	20.42	1000.0	1000.000	355.0	V	110.0	13
17639.1333	59.42	73.90	14.48	1000.0	1000.000	365.0	H	82.0	19



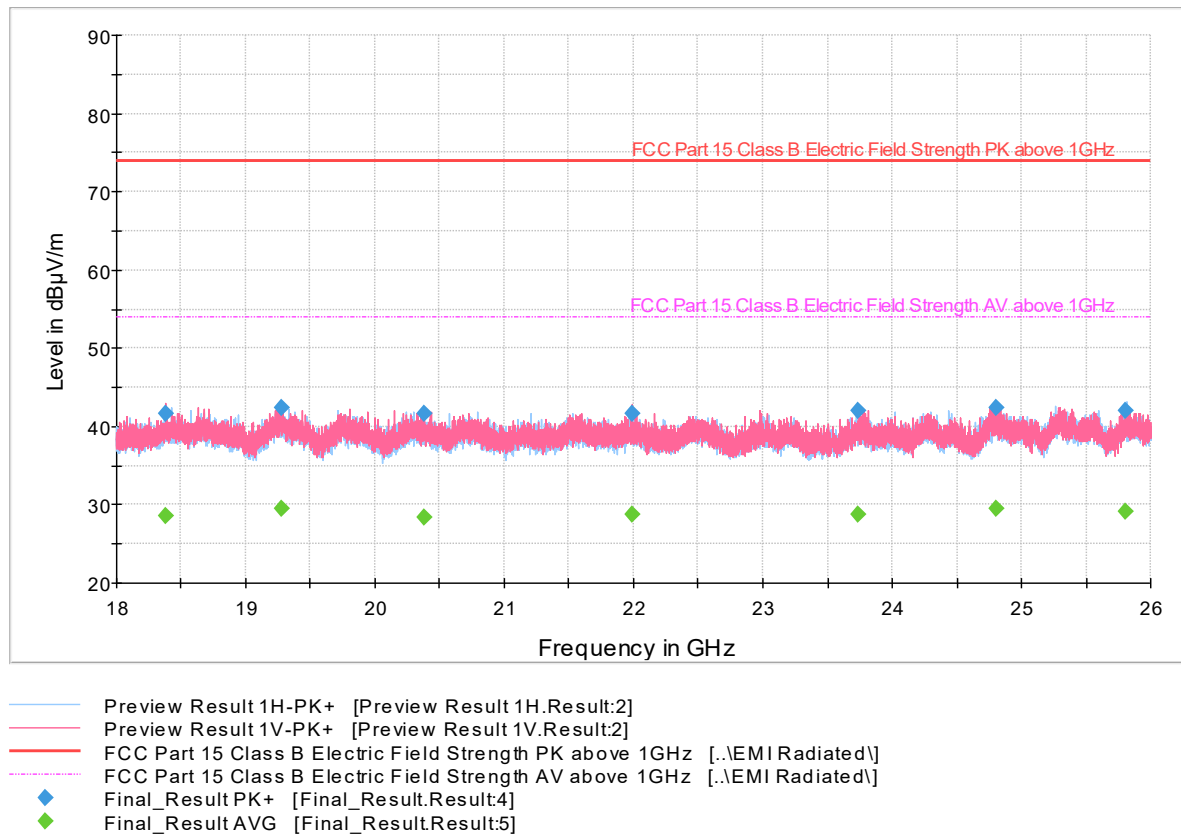
Average Data

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1000.00000	31.02	53.90	22.88	1000.0	1000.000	255.0	H	4.0	-6
2267.56666	29.09	53.90	24.81	1000.0	1000.000	335.0	V	197.0	0
3571.50000	32.60	53.90	21.30	1000.0	1000.000	166.0	H	18.0	4
4802.80000	37.95	53.90	15.95	1000.0	1000.000	335.0	H	306.0	5
6011.00000	36.71	53.90	17.19	1000.0	1000.000	212.0	V	228.0	5
7207.46666	43.73	53.90	10.17	1000.0	1000.000	152.0	H	254.0	6
10974.2000	40.50	53.90	13.40	1000.0	1000.000	355.0	V	110.0	13
17639.1333	46.36	53.90	7.54	1000.0	1000.000	365.0	H	82.0	19

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

2.7.12 Test Results for 18GHz to 26GHz

Full Spectrum



Peak Data

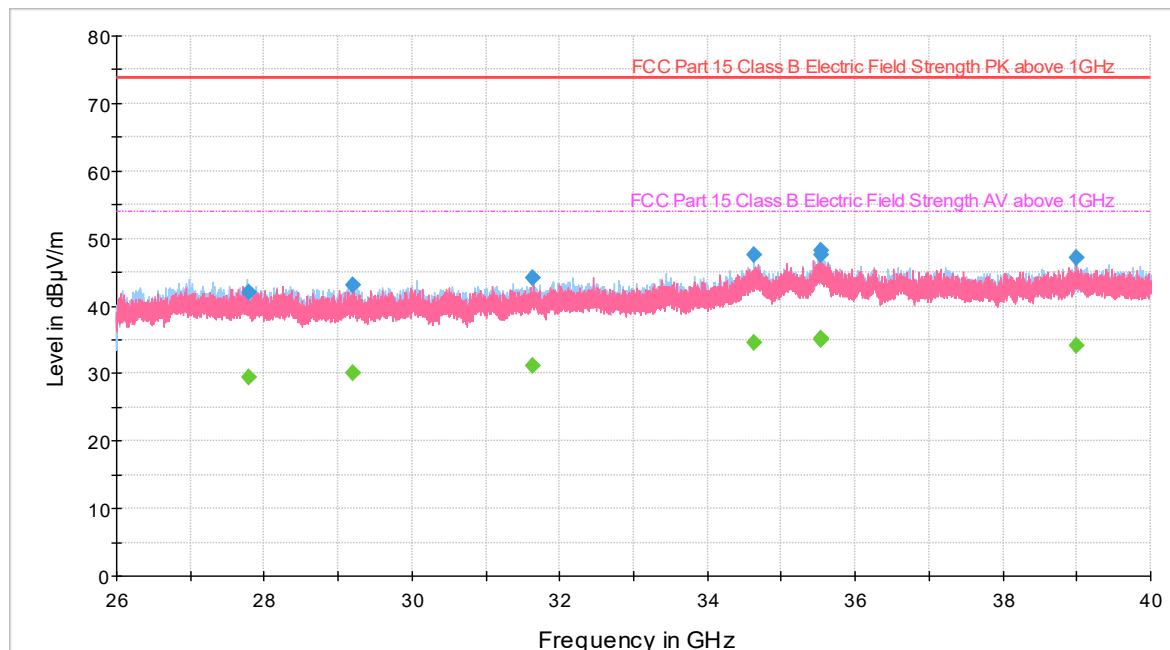
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18375.0855	41.58	73.90	32.32	1000.0	1000.000	163.0	V	61.0	-3
19277.2820	42.36	73.90	31.54	1000.0	1000.000	163.0	V	249.0	-2
20381.8375	41.64	73.90	32.26	1000.0	1000.000	204.0	V	102.0	-3
21992.2475	41.59	73.90	32.31	1000.0	1000.000	163.0	V	259.0	-1
23737.8015	42.02	73.90	31.88	1000.0	1000.000	206.0	H	350.0	1
24807.5030	42.32	73.90	31.58	1000.0	1000.000	207.0	V	61.0	2
25806.5710	42.03	73.90	31.87	1000.0	1000.000	188.0	H	286.0	2

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)
18375.0855	28.65	53.90	25.25	1000.0	1000.000	163.0	V	61.0	-3
19277.2820	29.56	53.90	24.34	1000.0	1000.000	163.0	V	249.0	-2
20381.8375	28.46	53.90	25.44	1000.0	1000.000	204.0	V	102.0	-3
21992.2475	28.70	53.90	25.20	1000.0	1000.000	163.0	V	259.0	-1
23737.8015	28.82	53.90	25.08	1000.0	1000.000	206.0	H	350.0	1
24807.5030	29.53	53.90	24.37	1000.0	1000.000	207.0	V	61.0	2
25806.5710	29.16	53.90	24.74	1000.0	1000.000	188.0	H	286.0	2

2.7.13 Test Results for 26GHz to 40GHz

Full Spectrum



- Preview Result 1H-PK+ [Preview Result 1H.Result:2]
- Preview Result 1V-PK+ [Preview Result 1V.Result:2]
- FCC Part 15 Class B Electric Field Strength PK above 1GHz [..\EMI Radiated\]
- FCC Part 15 Class B Electric Field Strength AV above 1GHz [..\EMI Radiated\]
- ◆ Final_Result PK+ [Final_Result.Result:4]
- ◆ Final_Result AVG [Final_Result.Result:5]

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)
27789.3076	42.08	73.90	31.82	1000.0	1000.000	225.0	H	64.0	2
29205.8719	43.05	73.90	30.85	1000.0	1000.000	138.0	H	168.0	3
31629.3769	44.08	73.90	29.82	1000.0	1000.000	151.0	H	88.0	5
34633.2623	47.47	73.90	26.43	1000.0	1000.000	125.0	H	228.0	7
35529.8388	47.58	73.90	26.32	1000.0	1000.000	175.0	H	350.0	7
35535.6042	48.13	73.90	25.77	1000.0	1000.000	128.0	H	350.0	7
39000.4719	47.07	73.90	26.83	1000.0	1000.000	194.0	H	298.0	8

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)
27789.3076	29.43	53.90	24.47	1000.0	1000.000	225.0	H	64.0	2
29205.8719	30.16	53.90	23.74	1000.0	1000.000	138.0	H	168.0	3
31629.3769	31.22	53.90	22.68	1000.0	1000.000	151.0	H	88.0	5
34633.2623	34.46	53.90	19.44	1000.0	1000.000	125.0	H	228.0	7
35529.8388	35.00	53.90	18.90	1000.0	1000.000	175.0	H	350.0	7
35535.6042	35.28	53.90	18.62	1000.0	1000.000	128.0	H	350.0	7
39000.4719	34.20	53.90	19.70	1000.0	1000.000	194.0	H	298.0	8

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: FD00000083 / Default Test Configuration

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

May 25, 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	22.3°C
Relative Humidity	41.0%
ATM Pressure	99.3kPa

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

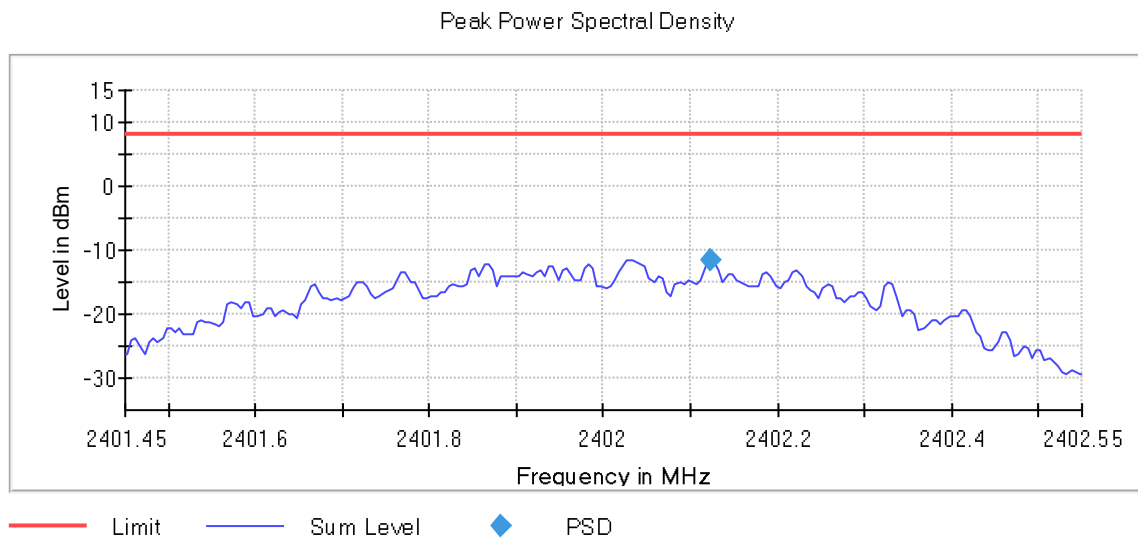
DUT Frequency (MHz)	PHY	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	1M	2402.122390	-11.621	8.0	PASS
2440.000000	1M	2440.027469	-11.712	8.0	PASS
2480.000000	1M	2480.032463	-11.343	8.0	PASS

2402.000000	2M	2401.927485	-15.768	8.0	PASS
2440.000000	2M	2439.752524	-14.867	8.0	PASS
2480.000000	2M	2480.102490	-16.041	8.0	PASS

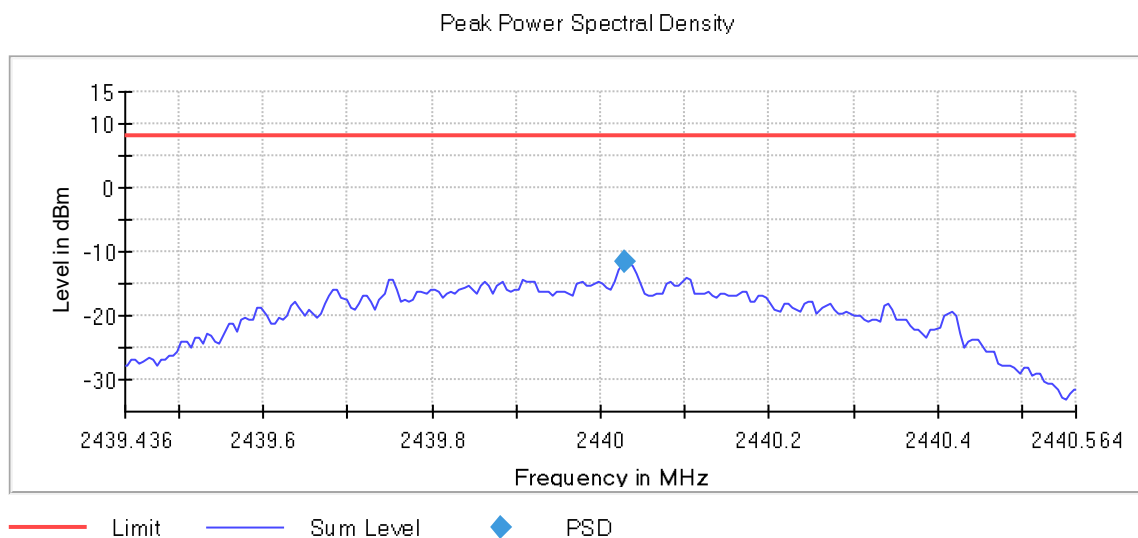
2.8.9 Sample Measurement Settings

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

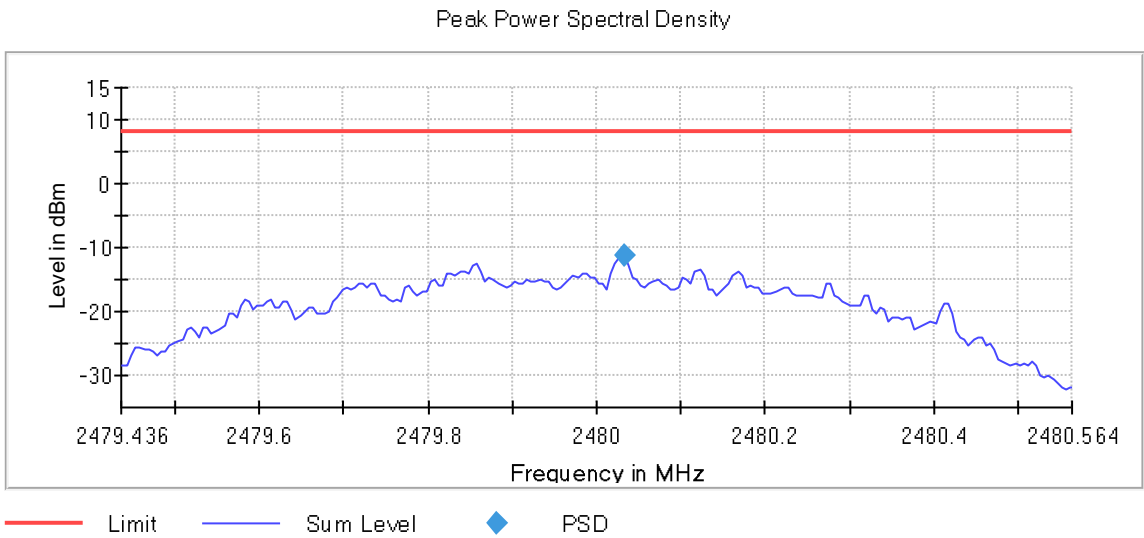
2.8.10 Worst Case Test Plots



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	1321.3008K3 0/103166	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	
Radiated Emission						
6628	Loop Antenna	HFH 2 –Z2	880 458/25	Rohde & Schwarz	5/22/20	06/22/22
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						
11312	Mini Environmental Quality Meter	850026	850027	Sper Scientific	07/19/21	07/19/22
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
6672	D.C. Power Supply	E3611A	KR73012637	Hewlett Packard	Verified by 43003	
	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 Radiated Measurements (9kHz to 30MHz)

	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	0.44 dB	Normal, k=2	2.000	0.22	0.05
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 10 m	3.12 dB	Rectangular	1.732	1.80	3.24
12	Phase center location at 10 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	0.00 dB	Triangular	2.449	0.00	0.00
16	Separation distance at 10 m	0.30 dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.00 dB	Rectangular	1.732	0.00	0.00
18	Table height at 10 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	2.45	dB	
Expanded uncertainty			Normal, k=2	4.91	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)

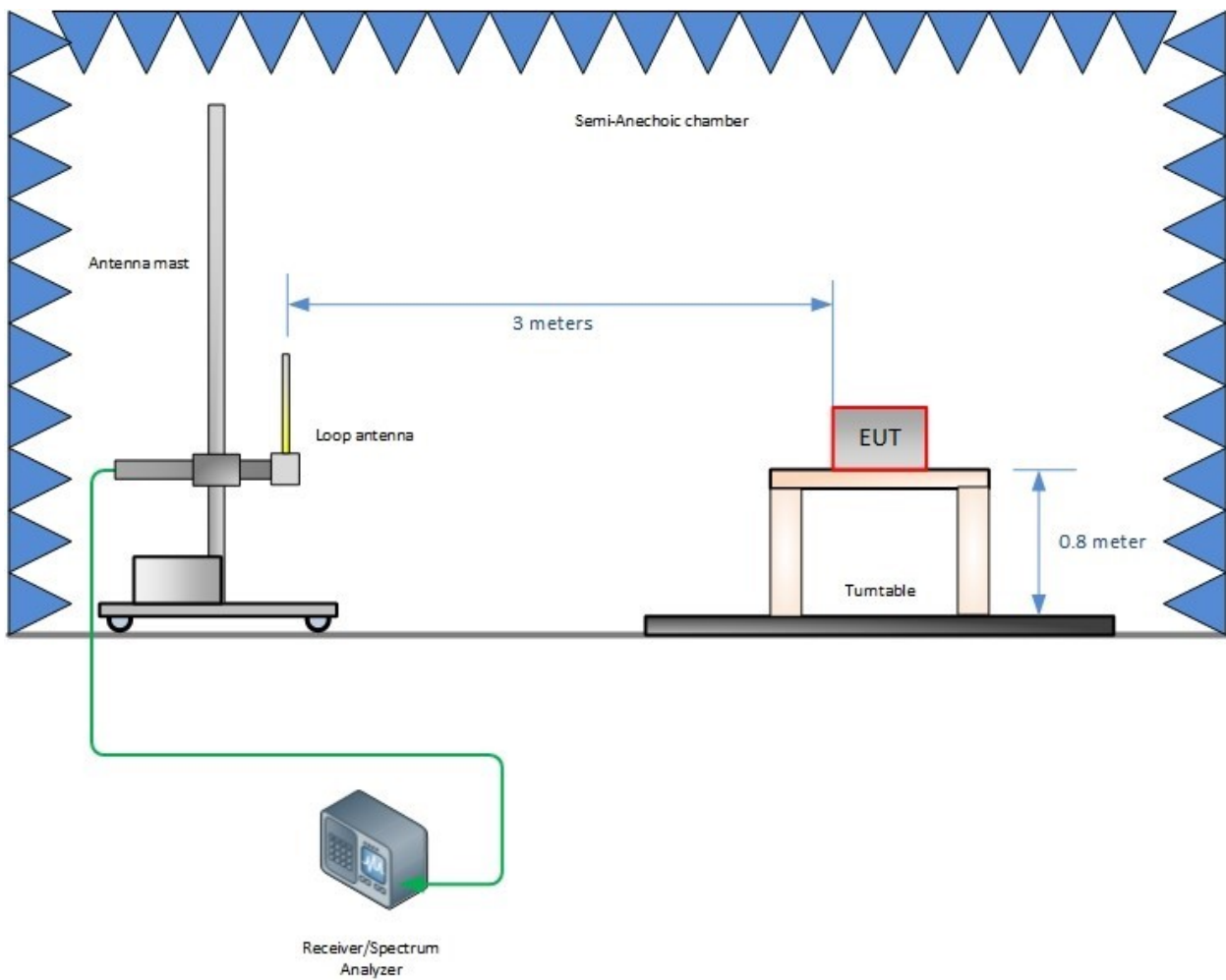
	Input Quantity (Contribution) X_i	Value	Prob. Dist.	Divisor	$u_i(x)$	$u_i(x)^2$
1	Receiver reading	0.10 dB	Normal, k=1	1.000	0.10	0.01
2	Attenuation: antenna-receiver	0.20 dB	Normal, k=2	2.000	0.10	0.01
3	Antenna factor AF	0.75 dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	0.45 dB	Normal, 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	



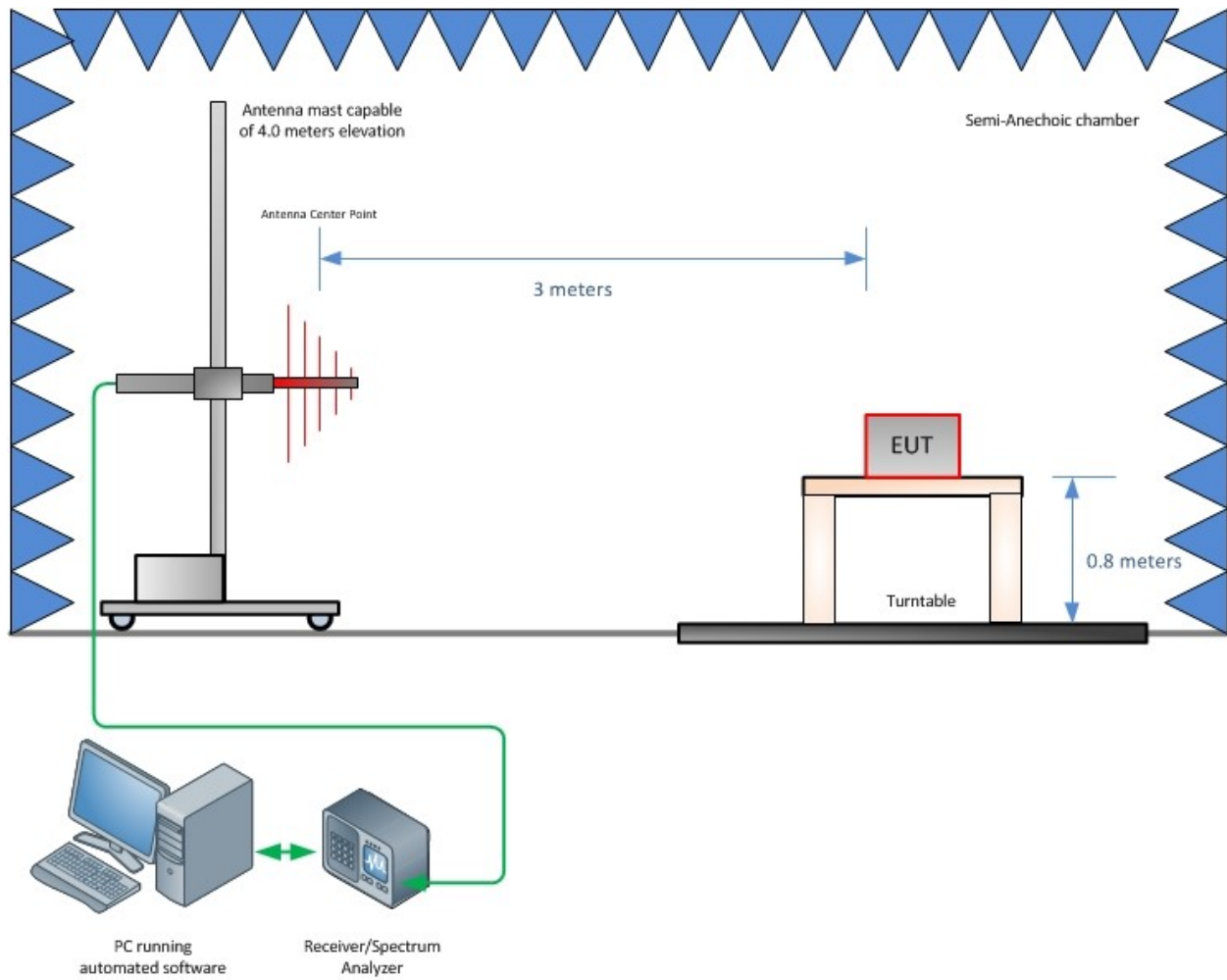
SECTION 4

DIAGRAM OF TEST SETUP

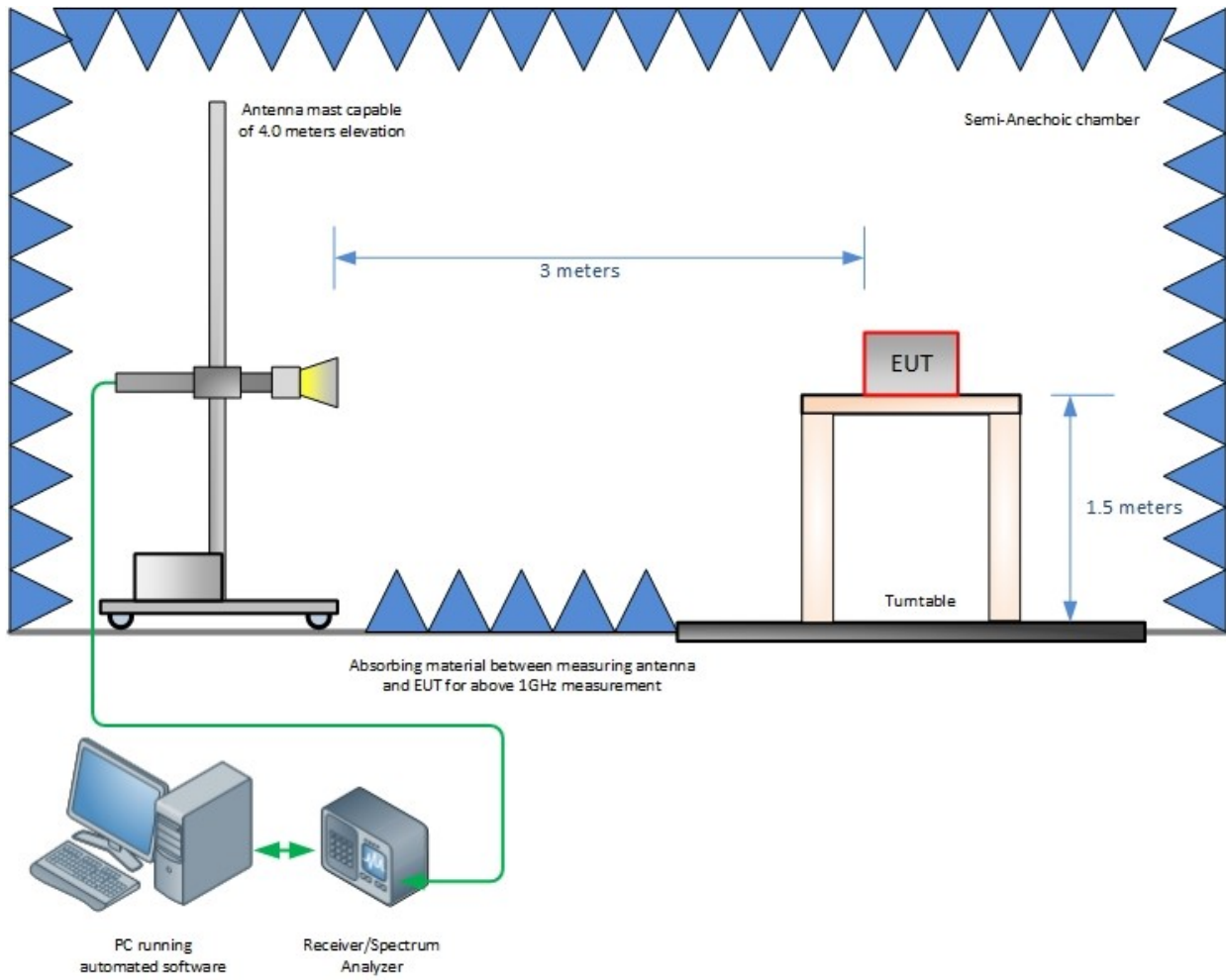
4.1 Test Setup Diagram



Radiated Emission Test Setup (Below 30MHz)



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)



SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

TÜV SÜD America Inc.'s reports apply only to the specific sample tested under stated test conditions. It is the manufacturer's responsibility to assure the continued compliance of production units of this model. TÜV SÜD America, Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV SÜD America, Inc.'s issued reports.

This report is the confidential property of the client. As a mutual protection to our clients, the public and TÜV SÜD America, Inc., extracts from the test report shall not be reproduced, except in full without TÜV SÜD America, Inc.'s written approval.

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal government.

TÜV SÜD America, Inc. and its professional staff hold government and professional organization certifications for AAMI, ACIL, AEA, ANSI, IEEE, A2LA, NIST and VCCI.



A2LA Cert. No. 2955.13

