Radio Testing of the
ACR Electronics Inc.
2-Way Iridium Satellite Communicator
Model: Bivy Stick V3

In accordance with FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 3 August 2023

America

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ACR Electronics Inc.
5757 Ravenswood Road
Fort Lauderdale, Florida 33312-6645 USA

COMMERCIAL-IN-CONFIDENCE

Date: May 2024
Document Number: 72185104F Issue 01 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Ivan Retana	May 14, 2024	

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 3 August 2023.

A2LA Cert. No. 2955.13

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REPORT ON	Radio Testing of the ACR Electronics Inc. Model: Bivy Stick 2-Way Iridium Satellite Communicator
TEST REPORT NUMBER	72185104F
TEST REPORT DATE	May 2024
PREPARED FOR	ACR Electronics Inc. 5757 Ravenswood Road Fort Lauderdale, Florida 33312-6645 USA
CONTACT PERSON	Tony Rosen Product & Marketing Manager anthony.rosen@ACRArtex.com +1 (612) 281-2280
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: Senior EMC Test Engineer / Wireless Team Lead
APPROVED BY	Ivan Retana **Name** Authorized Signatory Title: EMC Technical Lead
DATED	May 14, 2024

Revision History

72185104F ACR Electronics Inc. Model: Bivy Stick 2-Way Iridium Satellite Communicator					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
05/14/2024	—	Initial Release			Ivan Retana

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SECTION 1

REPORT SUMMARY

Radio Testing of the
ACR Electronics Inc.
Bivy Stick 2-Way Iridium Satellite Communicator

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Bivy Stick V3 2-Way Iridium Satellite Communicator to the requirements of FCC Part 15 Subpart C §15.247 and IC RSS-247 Issue 3 August 2023.

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	ACR Electronics Inc.
EUT	2-Way Iridium Satellite Communicator
Model Number(s)	V3
Model Name	Bivy Stick
FCC ID	B66-ACRBV3
ISED/IC Number	1322A-ACRBV3
FCC Classification	Low power Communications Device Transmitter (DTS)
Serial Number(s)	N/A
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC Part 15 Subpart C §15.247 (October 1, 2023). • RSS-247–Digital Transmission Systems (DTS), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices (Issue 3, August 2023). • RSS-Gen - General Requirements for Compliance of Radio Apparatus (Issue 5, Amendment 2 February 2021).
Start of Test	February 07, 2024
Finish of Test	February 28, 2024
Name of Engineer(s)	Ferdinand Custodio Omar Castillo
Related Document(s)	• ANSI C63.10-2013. American National Standard of Procedures for Compliance testing of Unlicensed Wireless Devices. • https://abracon.com/datasheets/ACAG0801-2450-T.pdf

- 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 3 August 2023 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 Not applicable. EUT is battery powered.
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 an ACR Electronics Inc. Bivy Stick V3 2-Way Iridium Satellite Communicator. The EUT is used to turn your cell phone into a satellite communication device.

1.3.2 EUT General Description

EUT Description	2-Way Iridium Satellite Communicator
Model Name	Bivy Stick
Model Number	V3
Rated Voltage	3.7 VDC Internal Battery
Mode Verified	Bluetooth 5.0
Capability	Lora (903MHz – 914.2MHz) / (868.10MHz – 868.50MHz), BLE 5.0 (2400MHz to 2483MHz), GPSL1C/A, GLONASS L1OF, BDS B1I, Galileo E1-B/C
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering (same as Production)
Manufacturer Declared Temperature Range	-20°C to 60°C
Antenna Type	Ceramic Chip Antenna
Manufacturer	ABRACON
Antenna Model	ACAG0801-2450-T
Peak Antenna Gain	7.29 dBi (2450 MHz)

1.3.3 Maximum Conducted Output Power

Bluetooth Low Energy (LE)	Frequency Range (MHz)	Gated RMS (dBm)	Duty Cycle (%)
	2402-2480	3.1	100.0

1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
Default	EUT in a test mode configuration. A conducted sample (temporary antenna port with SMA connector) is provided. A series of button presses switches the RF configuration of the EUT. The manufacturer provided a detailed instruction how to switch between modes.

1.4.2 EUT Exercise Software

EUT flashed with a BLE test firmware.

1.4.3 Support Equipment and I/O cables

Manufacturer	Equipment/Cable	Description
-	-	-

1.4.1 Simplified Test Configuration Diagram

Not applicable. EUT verified on a standalone configuration.

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-0412 and A-0413

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
ACR Electronics Inc.
Bivy Stick V3 2-Way Iridium Satellite Communicator

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: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

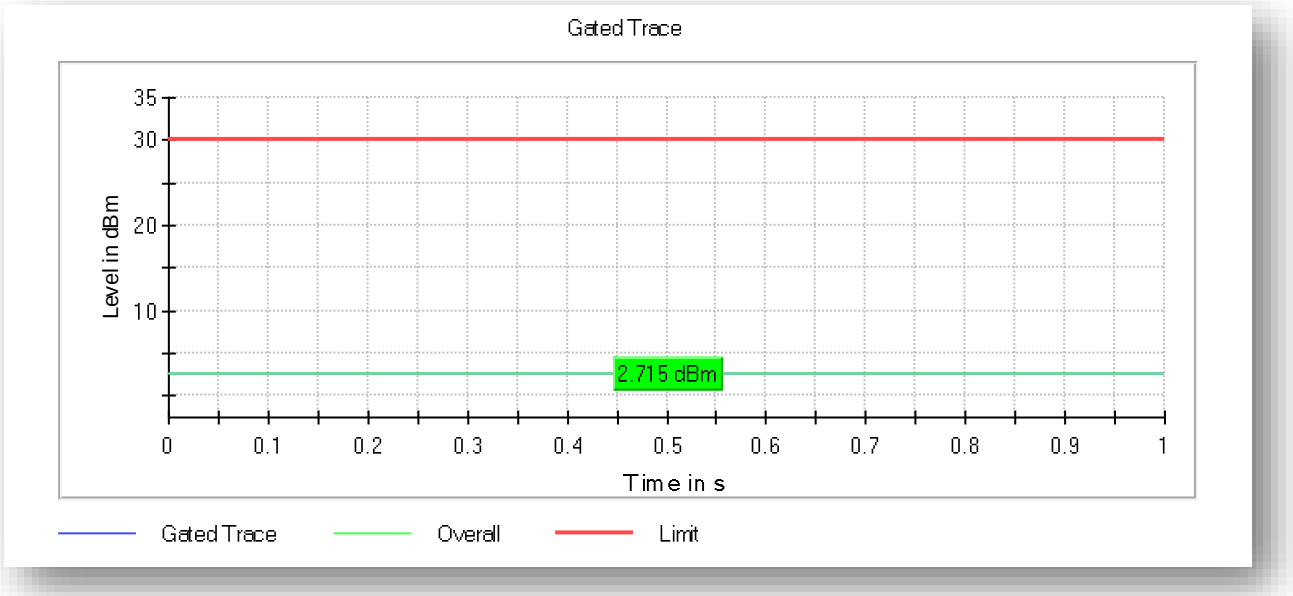
2.1.7 Additional Observations

- 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.

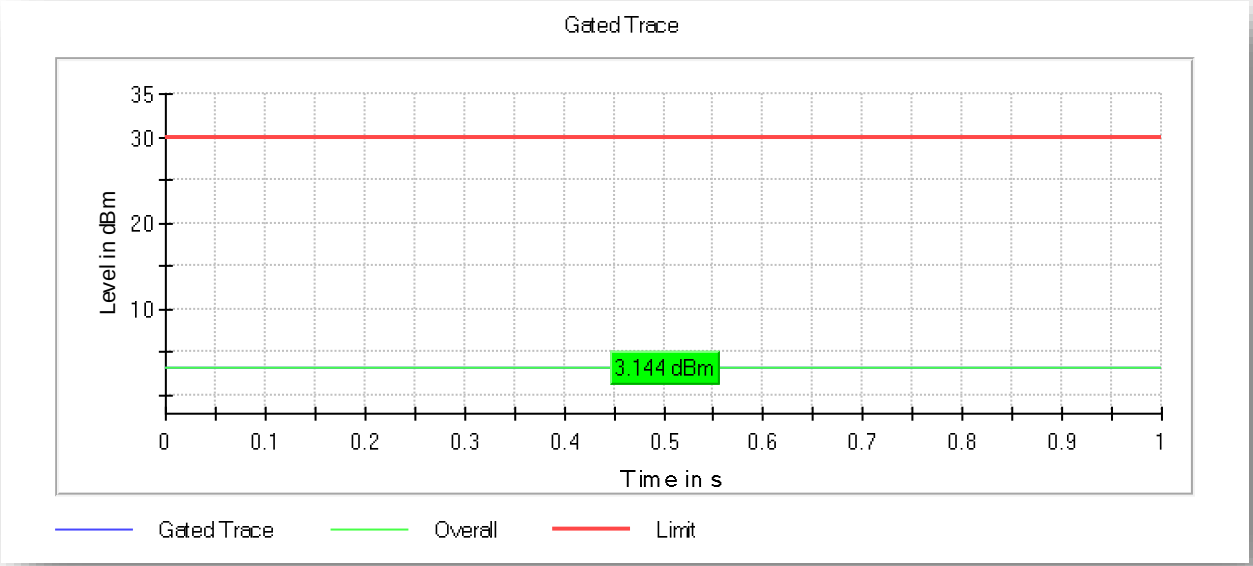
2.1.8 Test Results

DUT Frequency (MHz)	PHY	Gated RMS* (dBm)	Limit Max (dBm)	DutyCycle (%)	Result
2402.000000	1M	2.7	30.0	100.0	PASS
2440.000000	1M	3.1		100.0	PASS
2480.000000	1M	3.0		100.0	PASS

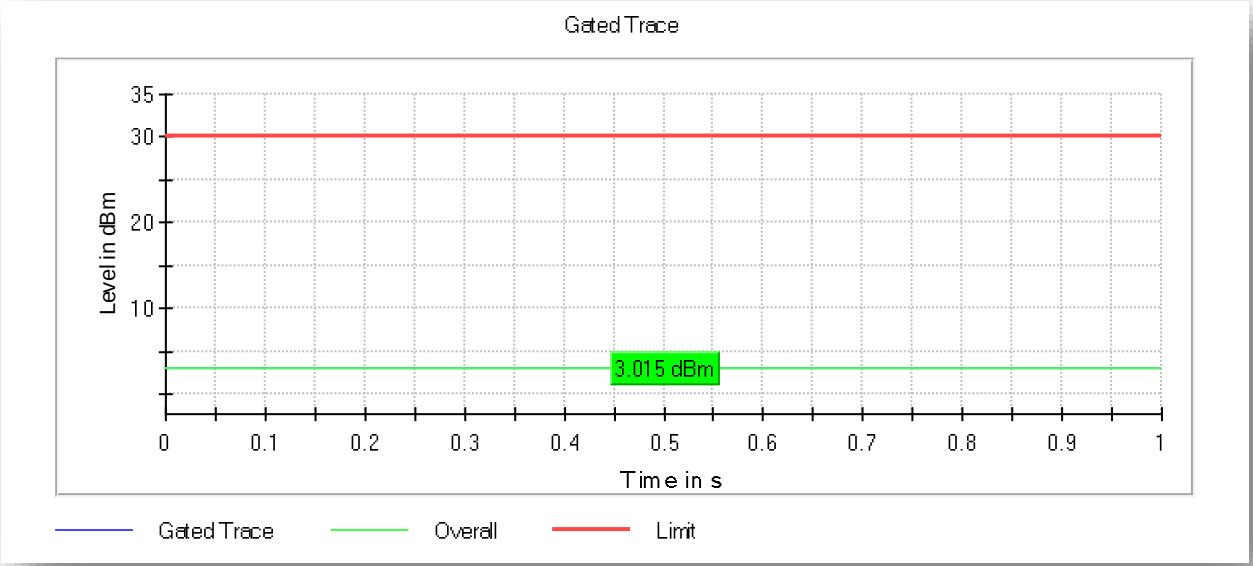
2.1.9 Test Plots



Bluetooth LE. Low Channel



Bluetooth LE. Mid Channel



Bluetooth LE. High Channel

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

Not applicable. EUT is battery powered.

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: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

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.

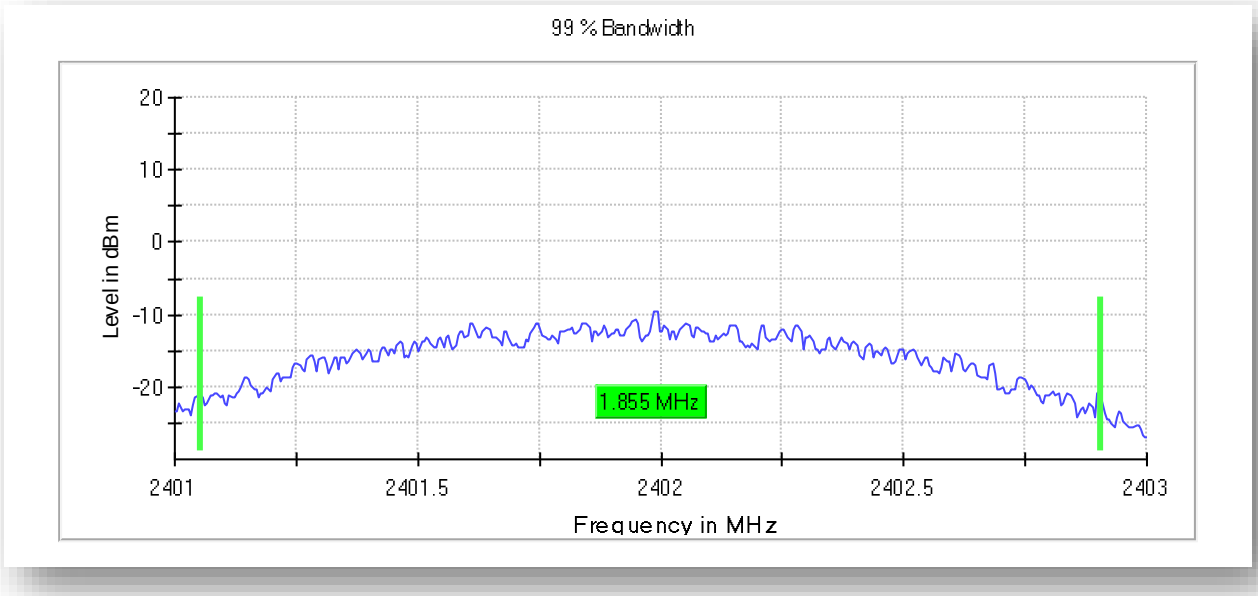
2.3.8 Sample Measurement Settings

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	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.12 dB	0.30 dB

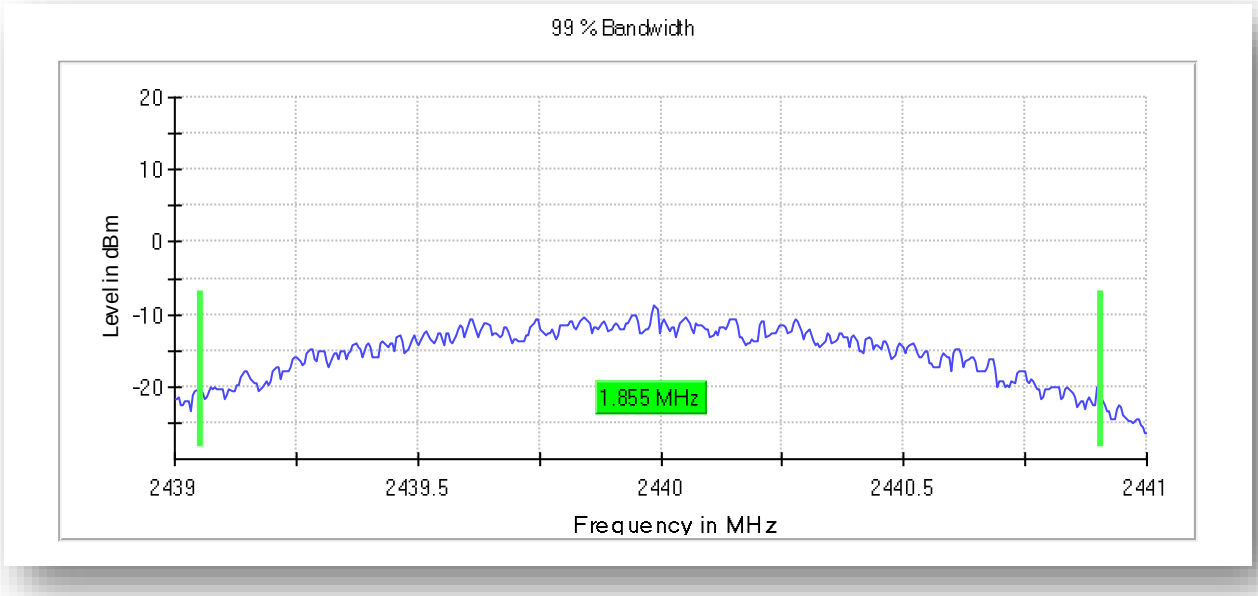
2.3.9 Test Results

DUT Frequency (MHz)	PHY	99% Bandwidth	Band Edge Left (MHz)	Band Edge Right (MHz)	Result
2402.000000	1M	1.855000	***2401.052500***	2402.907500	PASS
2440.000000	1M	1.855000	2439.052500	2440.907500	PASS
2480.000000	1M	1.855000	2479.052500	***2480.907500***	PASS

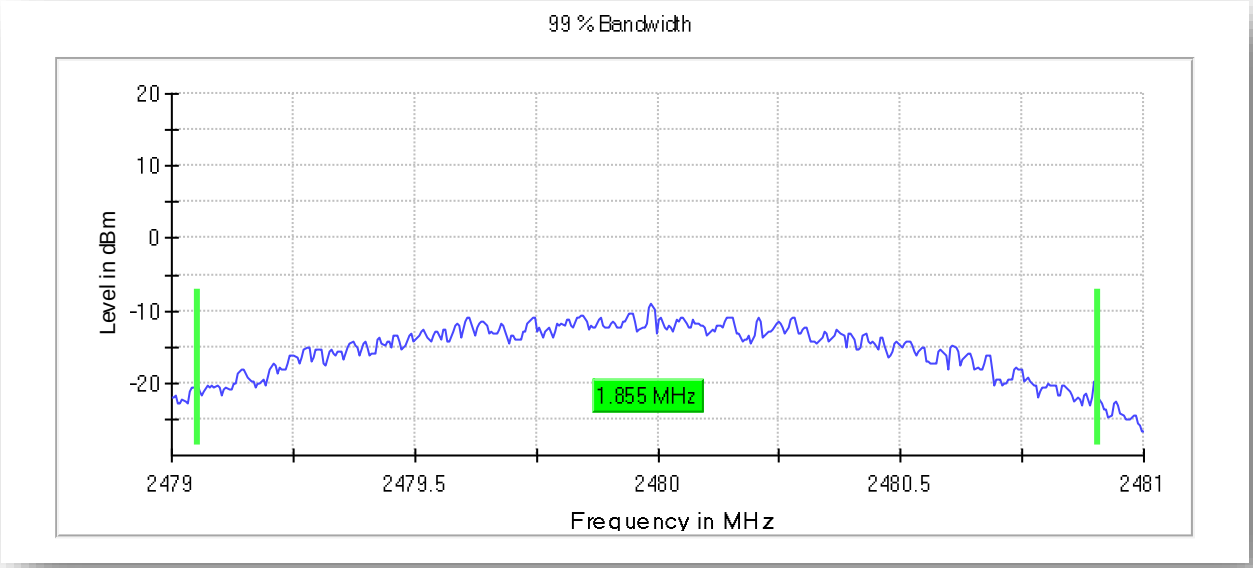
2.3.10 Test Plots



Bluetooth LE Low Channel



Bluetooth LE Middle Channel



Bluetooth LE High Channel

2.4 MINIMUM 6 dB RF BANDWIDTH

2.4.1 Specification Reference

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

2.4.2 Standard Applicable

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

2.4.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

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.

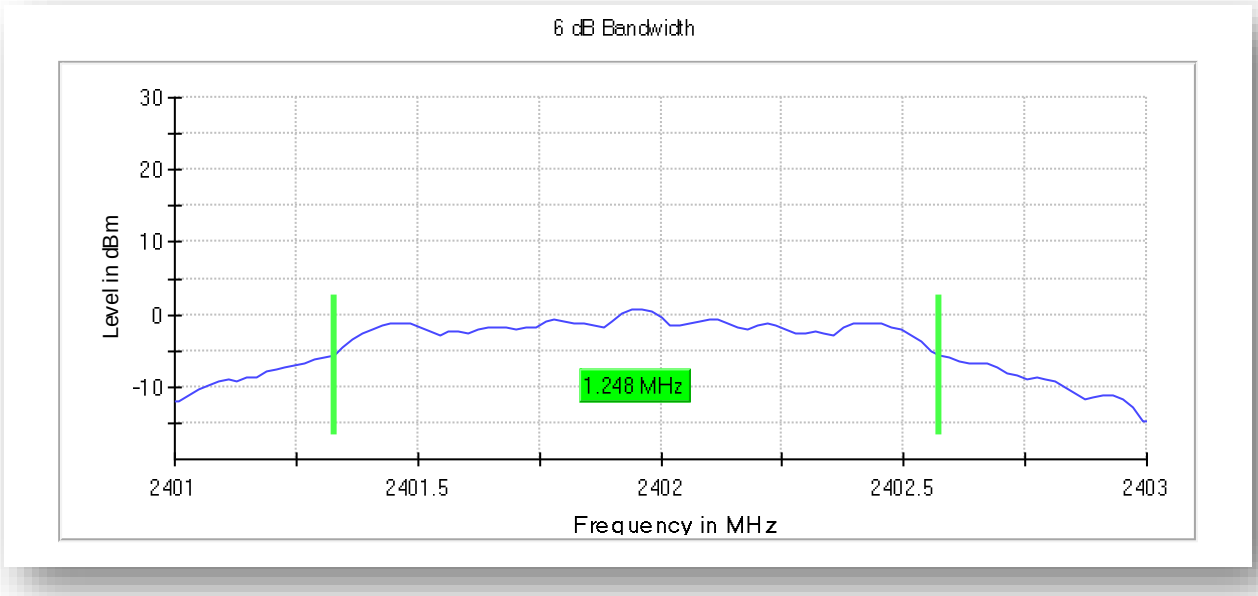
2.4.8 Sample Measurement Settings

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	10 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.02 dB	0.50 dB

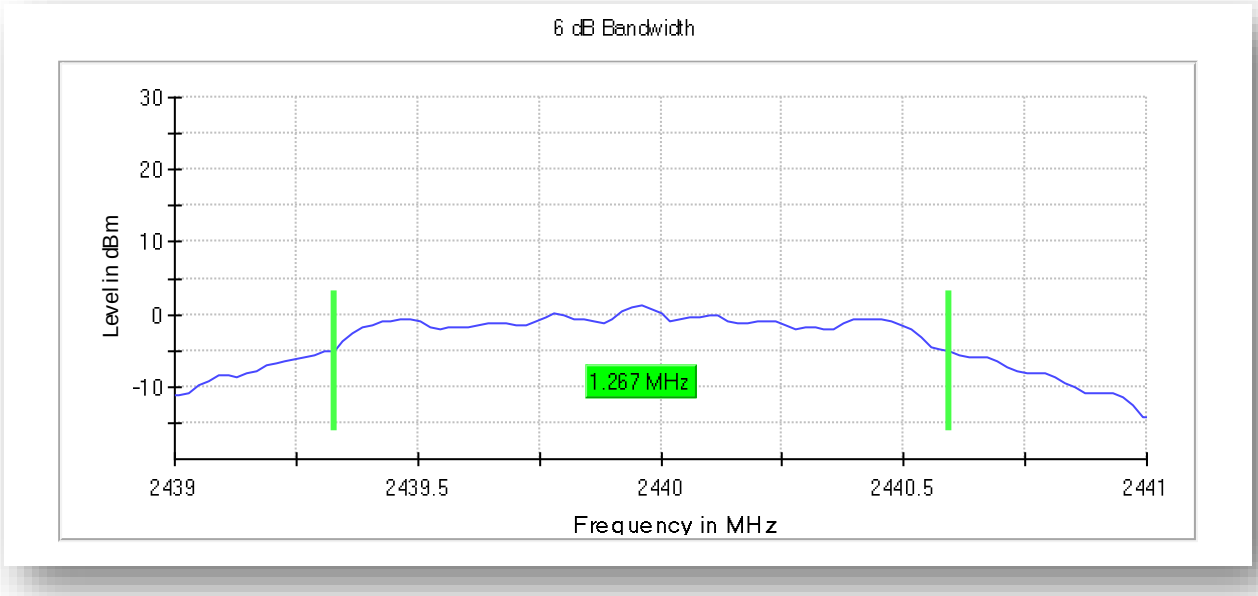
2.4.9 Test Results

DUT Frequency (MHz)	PHY	Limit Min (MHz)	Bandwidth (MHz)	Result
2402.000000	1M	0.500000	1.247524	PASS
2440.000000	1M		1.267326	PASS
2480.000000	1M		1.267326	PASS

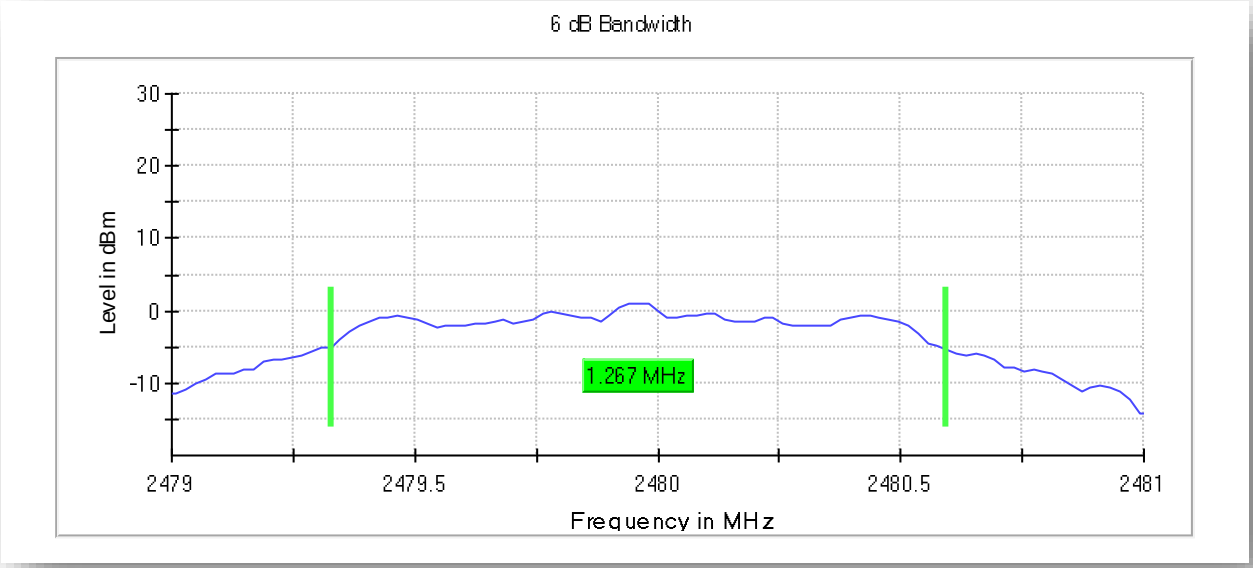
2.4.10 Test Plots



Bluetooth LE Low Channel



Bluetooth LE Middle Channel



Bluetooth LE High Channel

2.5 OUT-OF-BAND EMISSIONS - CONDUCTED

2.5.1 Specification Reference

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

2.5.2 Standard Applicable

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

2.5.3 Equipment Under Test and Modification State

Serial No: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

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).
- 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. Appropriate antenna gain is programmed as Offset for §15.205 verification.

2.5.8 Test Results Low Channel

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
2399.958664	-12.9	-33.3	-24.8	8.5	PASS
7207.035982	-24.5	-27.4	-24.8	2.5	PASS

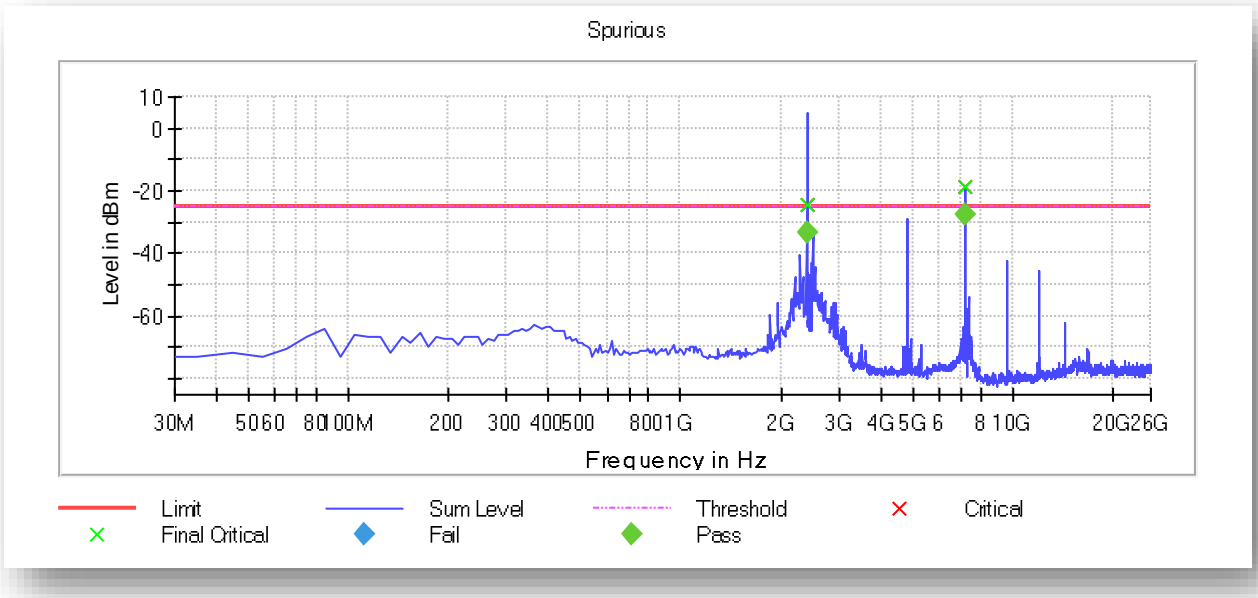
2.5.9 Test Results Mid Channel

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
7321.131722	-19.9	-27.2	-24.2	3.0	PASS

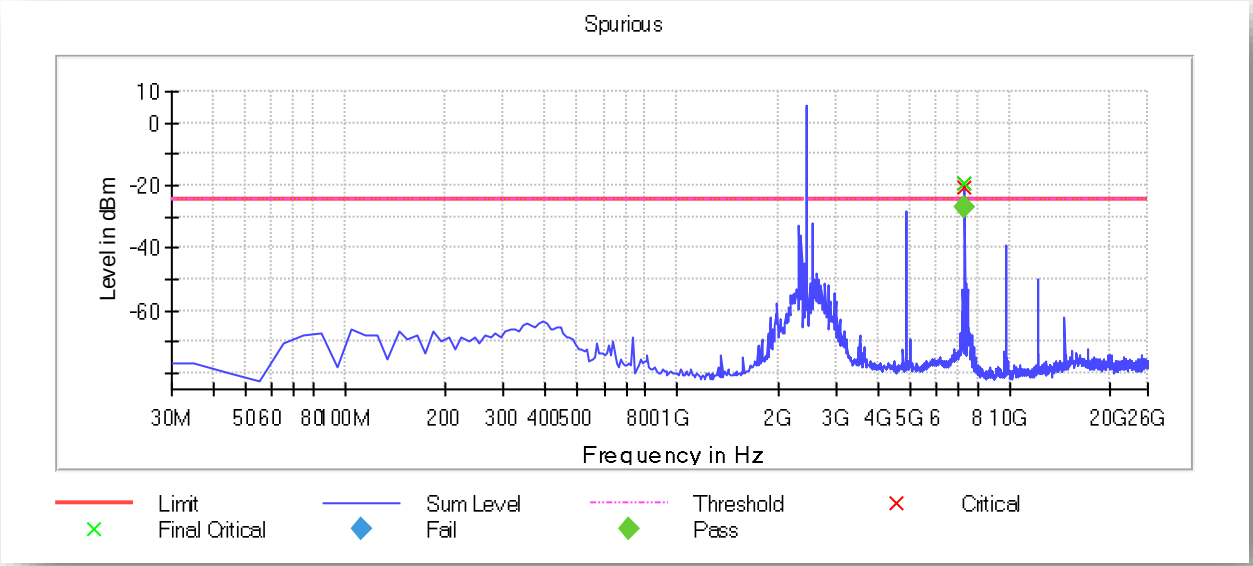
2.5.10 Test Results High Channel

Frequency (MHz)	Level Pre Measurement (dBm)	level (dBm)	Limit (dBm)	Margin (dB)	Result
7438.519232	-19.2	-26.7	-24.0	2.7	PASS

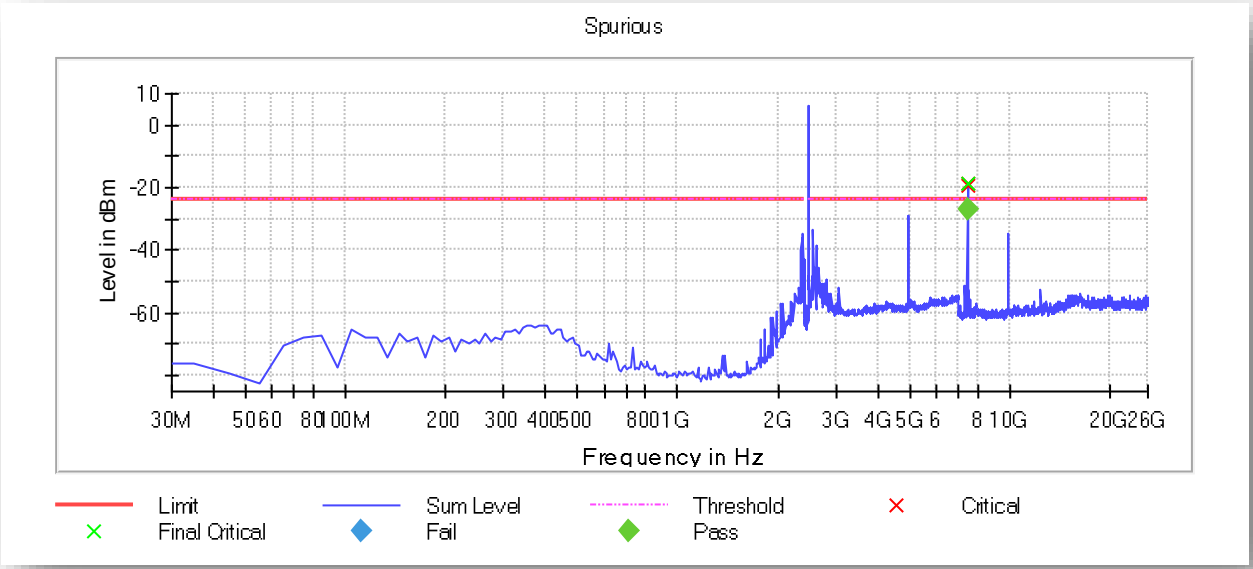
2.5.11 Test Results Plots (§15.247 requirements)



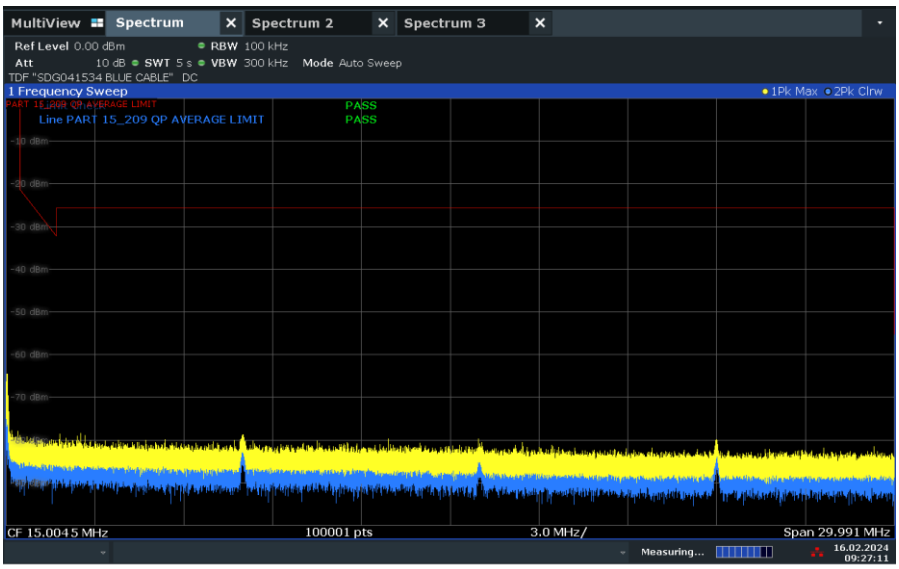
Low Channel



Middle Channel

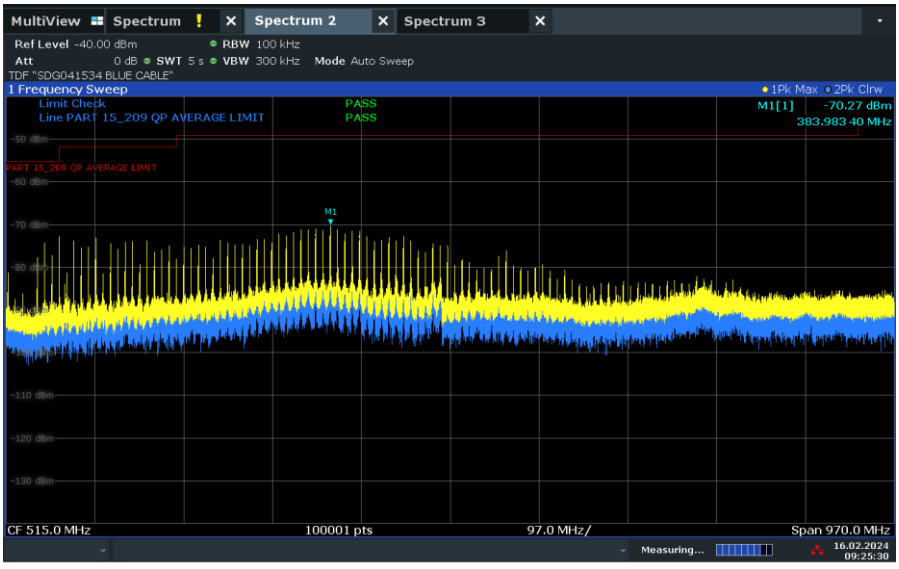


High Channel



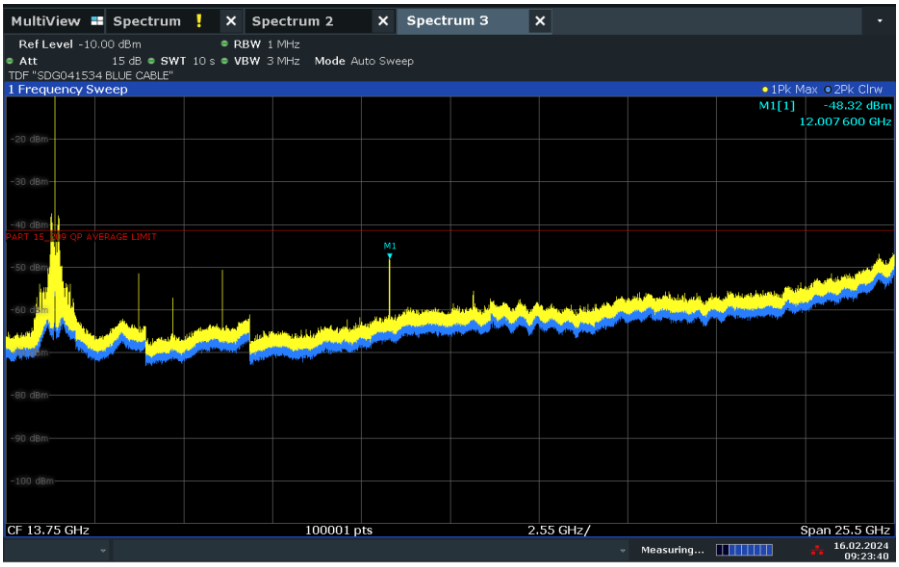
09:27:11 16.02.2024

BLE Low Channel (9kHz to 30MHz)



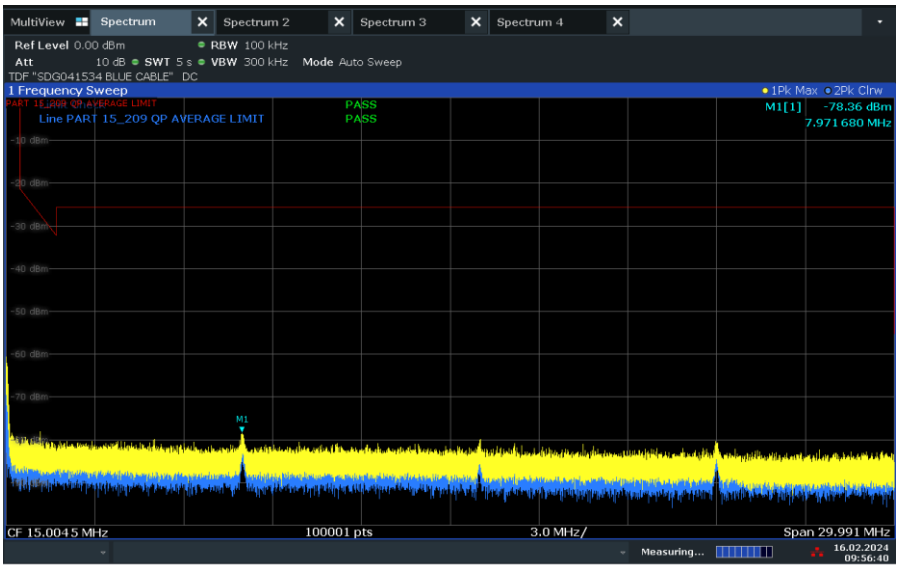
09:25:31 16.02.2024

BLE Low Channel (30MHz to 1GHz)



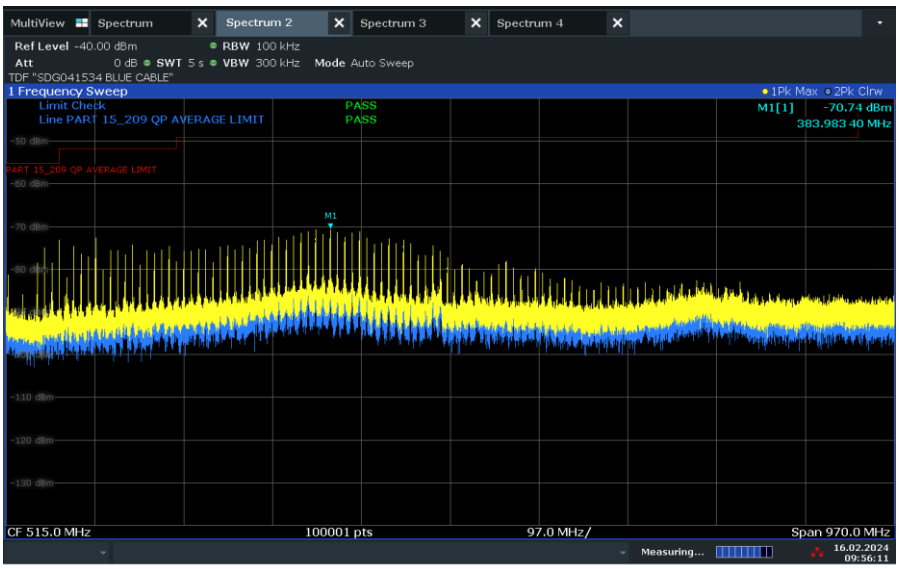
09:23:40 16.02.2024

BLE Low Channel (1GHz to 26.5GHz)



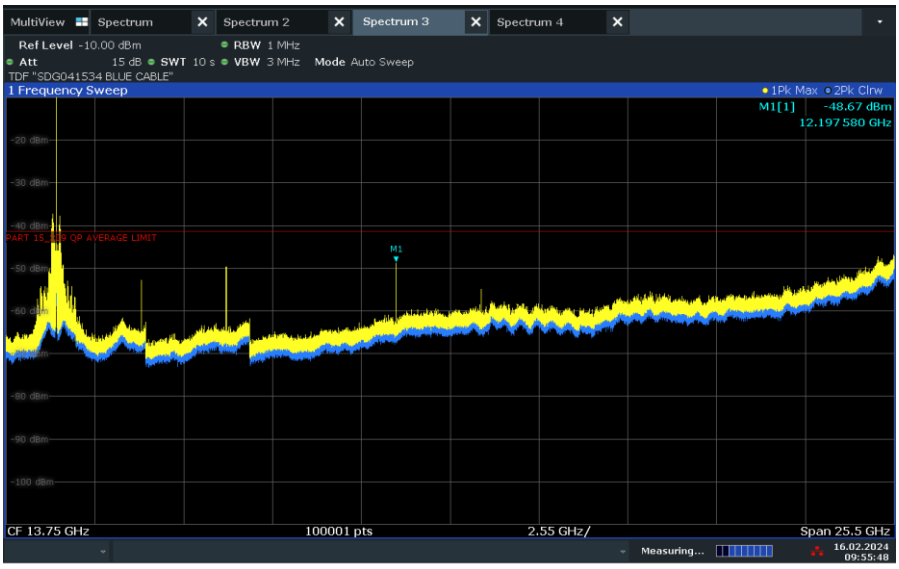
09:56:41 16.02.2024

BLE Mid Channel (9kHz to 30MHz)



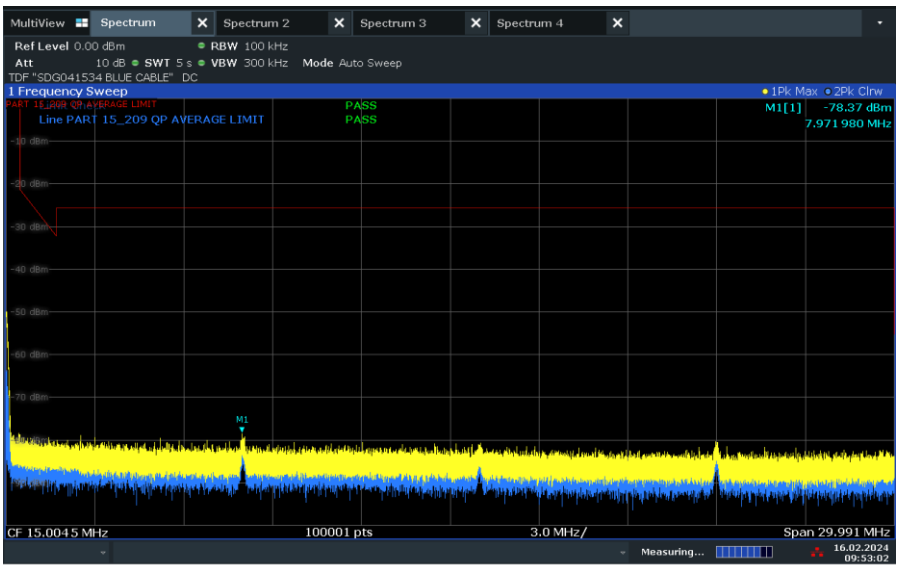
09:56:12 16.02.2024

BLE Mid Channel (30MHz to 1GHz)



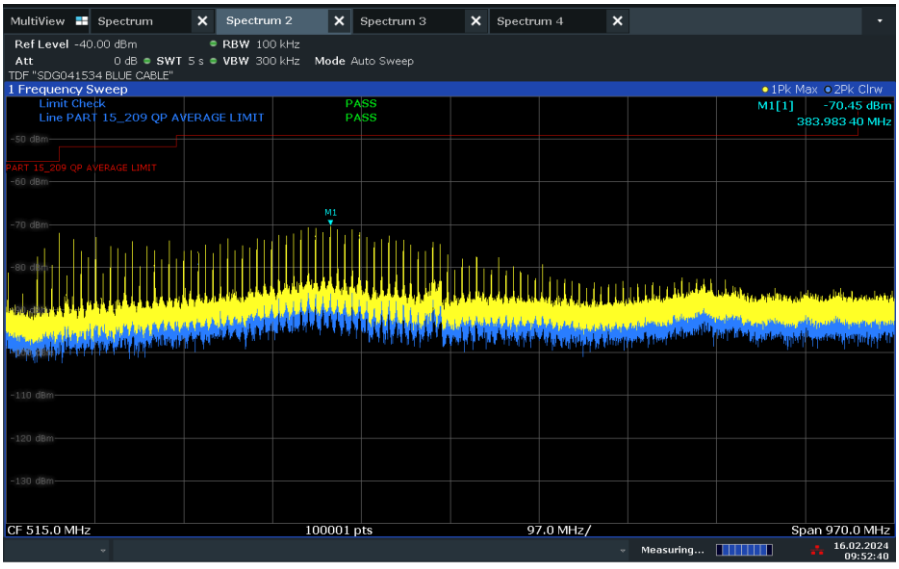
09:55:49 16.02.2024

BLE Mid Channel (1GHz to 26.5GHz)



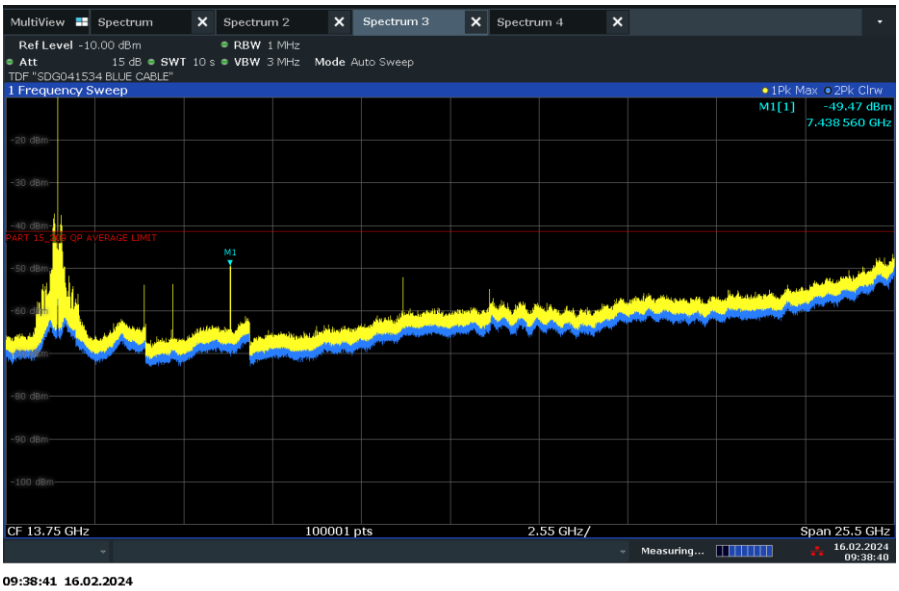
09:53:03 16.02.2024

BLE High Channel (9kHz to 30MHz)



09:52:40 16.02.2024

BLE High Channel (30MHz to 1GHz)



BLE High Channel (1GHz to 26.5GHz)

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: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

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	6 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.19 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	7 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.37 dB	0.50 dB

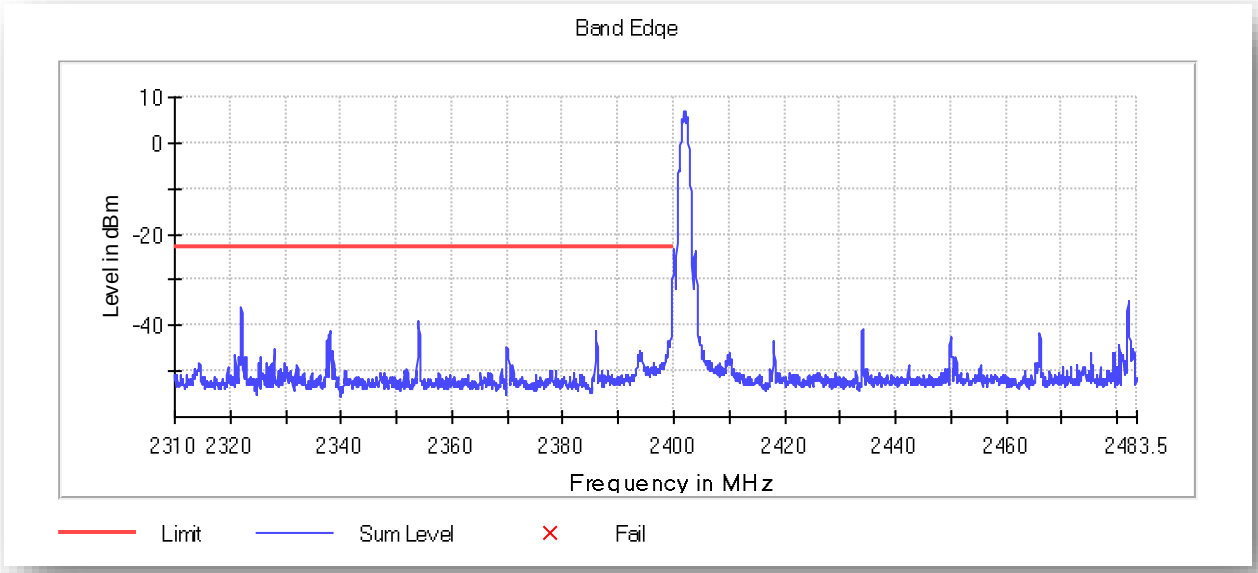
2.6.9 Test Results (Lower Band Edge)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2399.975000	-23.4	0.5	-22.9	PASS
2399.925000	-23.5	0.6	-22.9	PASS
2399.875000	-26.2	3.4	-22.9	PASS
2399.825000	-29.0	6.2	-22.9	PASS
2399.775000	-29.7	6.8	-22.9	PASS
2399.725000	-31.0	8.1	-22.9	PASS
2399.675000	-33.3	10.4	-22.9	PASS
2399.625000	-35.6	12.7	-22.9	PASS
2321.975000	-35.8	12.9	-22.9	PASS
2322.025000	-35.8	12.9	-22.9	PASS
2321.925000	-36.3	13.5	-22.9	PASS
2399.575000	-37.1	14.3	-22.9	PASS
2322.075000	-37.4	14.6	-22.9	PASS
2321.875000	-37.4	14.6	-22.9	PASS
2353.975000	-38.9	16.0	-22.9	PASS

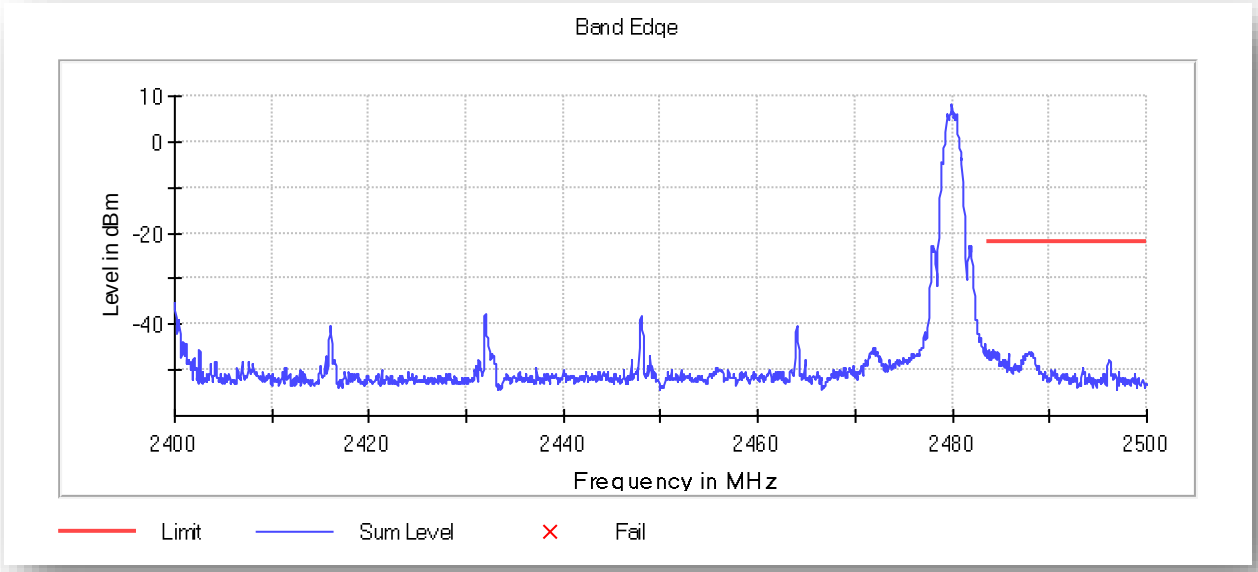
2.6.10 Test Results (Upper Band Edge)

Frequency (MHz)	Level (dBm)	Margin (dB)	Limit (dBm)	Result
2483.725000	-45.4	23.4	-21.9	PASS
2483.775000	-45.5	23.6	-21.9	PASS
2484.225000	-45.6	23.6	-21.9	PASS
2484.175000	-45.6	23.7	-21.9	PASS
2484.675000	-45.8	23.9	-21.9	PASS
2484.375000	-45.8	23.9	-21.9	PASS
2484.325000	-45.9	23.9	-21.9	PASS
2487.925000	-45.9	24.0	-21.9	PASS
2484.125000	-46.0	24.0	-21.9	PASS
2484.075000	-46.0	24.1	-21.9	PASS
2487.975000	-46.1	24.1	-21.9	PASS
2484.625000	-46.1	24.1	-21.9	PASS
2483.675000	-46.1	24.1	-21.9	PASS
2488.175000	-46.2	24.2	-21.9	PASS
2487.875000	-46.2	24.2	-21.9	PASS

2.6.11 Test Plots



Bluetooth LE Low Band Edge 2400MHz 1M PHY



Bluetooth LE Upper Band Edge 2483.5MHz 1M PHY

2.6.12 Upper band edge calculation (2483.5 MHz) within Restricted Band:

- 2483.675000 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
  = (-46.1 dBm +7.29 dBi antenna gain) + 95.2
  = 56.39 dBµV/m @ 3 meters (Peak complies with 74 dBµV/m Peak limit)

- Average result was calculated with nominal Duty Cycle declared by the manufacturer (15.14%)

  E(dBµV/m) = EIRP (dBm) + 95.2
  = (-46.1 dBm +7.29 dBi antenna gain) + 95.2
  = 56.39 dBµV/m + 20log(0.1514)
  = 39.99 dBµV/m @ 3 meters (Average 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: N/A / Default Test Configuration

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

February 6 and 28, 2024, March 13, 2024 / OC

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 (Rancho Bernardo Satellite Facility)

Ambient Temperature	20.8 °C	23.8 °C	22.1 °C
Relative Humidity	53.1 %	26.2 %	49.9 %
ATM Pressure	98.0 kPa	99.1 kPa	99.2 kPa

2.7.7 Additional Observations

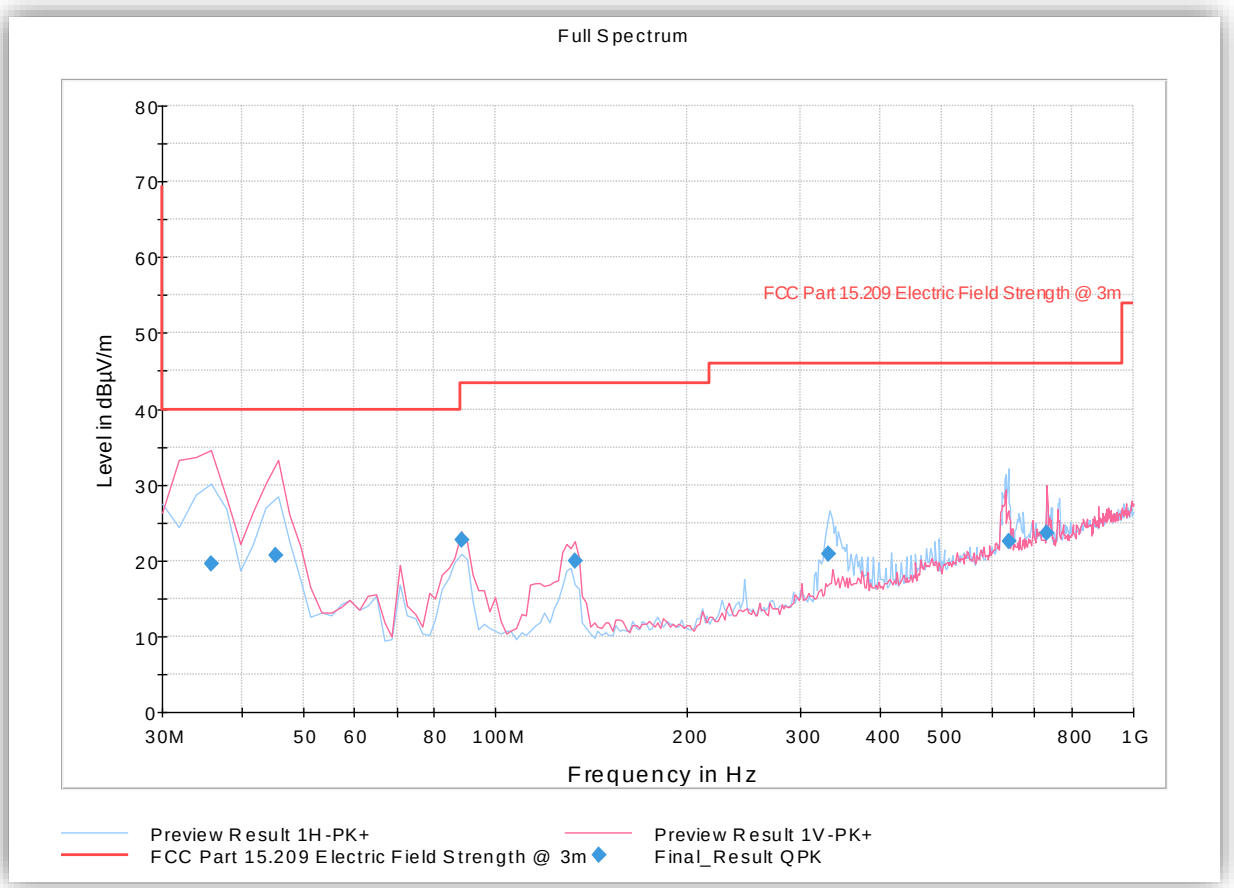
- This is a radiated test. The spectrum was searched from 30MHz to the 10th harmonic.
- There are no emissions found that do not comply to the restricted bands defined in FCC Part 15 Subpart C, 15.205 or Part 15.247(d).
- Only the worst case BLE Channel presented below 1GHz. There are no significant differences in emissions between channels when verifying cabinet spurious emissions.
- Antenna port terminated with 20dB attenuator and 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**

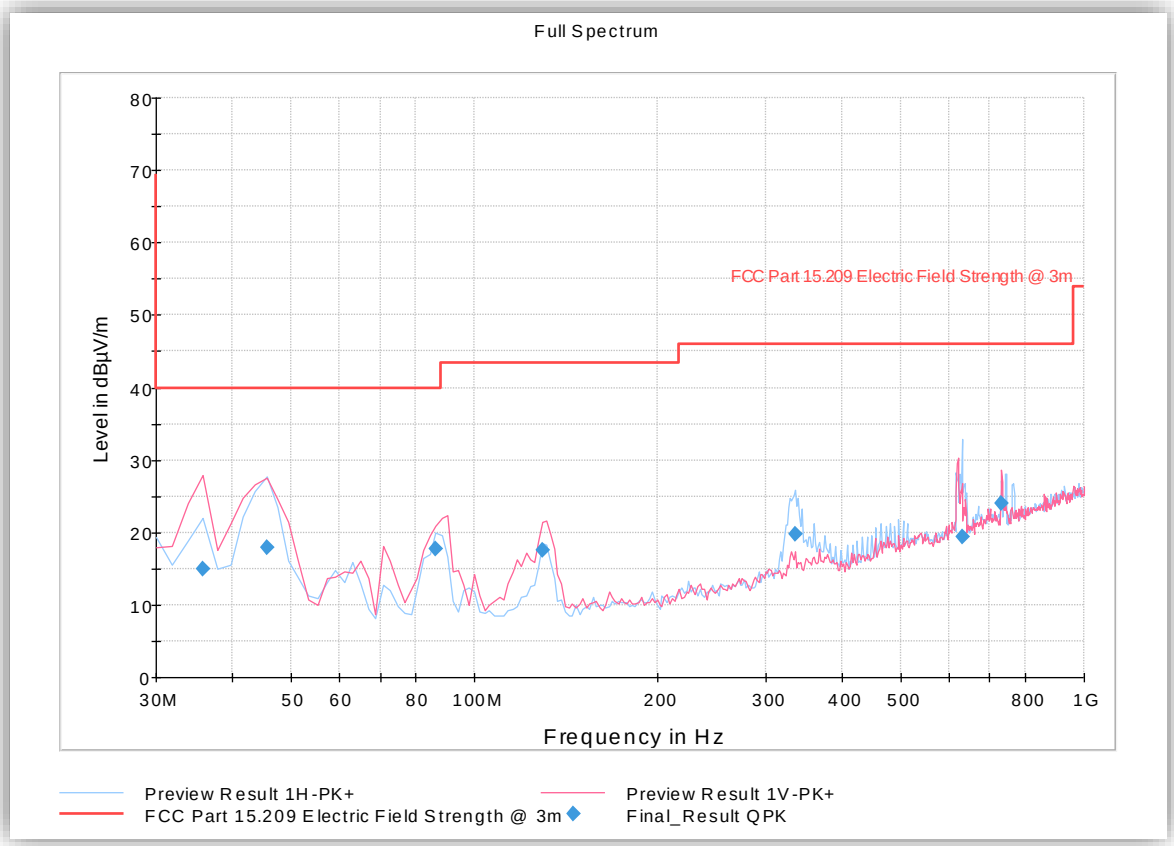
2.7.9 Test Results for 30MHz to 1GHz Low Channel



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)
35.791663	19.57	39.99	20.42	1000.	120.000	104.0	V	283.0	-11.9
45.231102	20.76	39.99	19.23	1000.	120.000	100.0	V	15.0	-15.8
88.476633	22.68	43.49	20.81	1000.	120.000	122.0	V	24.0	-16.7
133.38605	19.92	43.49	23.57	1000.	120.000	104.0	V	-8.0	-16.1
333.16649	20.91	45.99	25.08	1000.	120.000	104.0	H	314.0	-7.9
636.45298	22.46	45.99	23.53	1000.	120.000	296.0	H	217.0	-1.3
731.46348	23.66	45.99	22.33	1000.	120.000	100.0	V	20.0	0.4

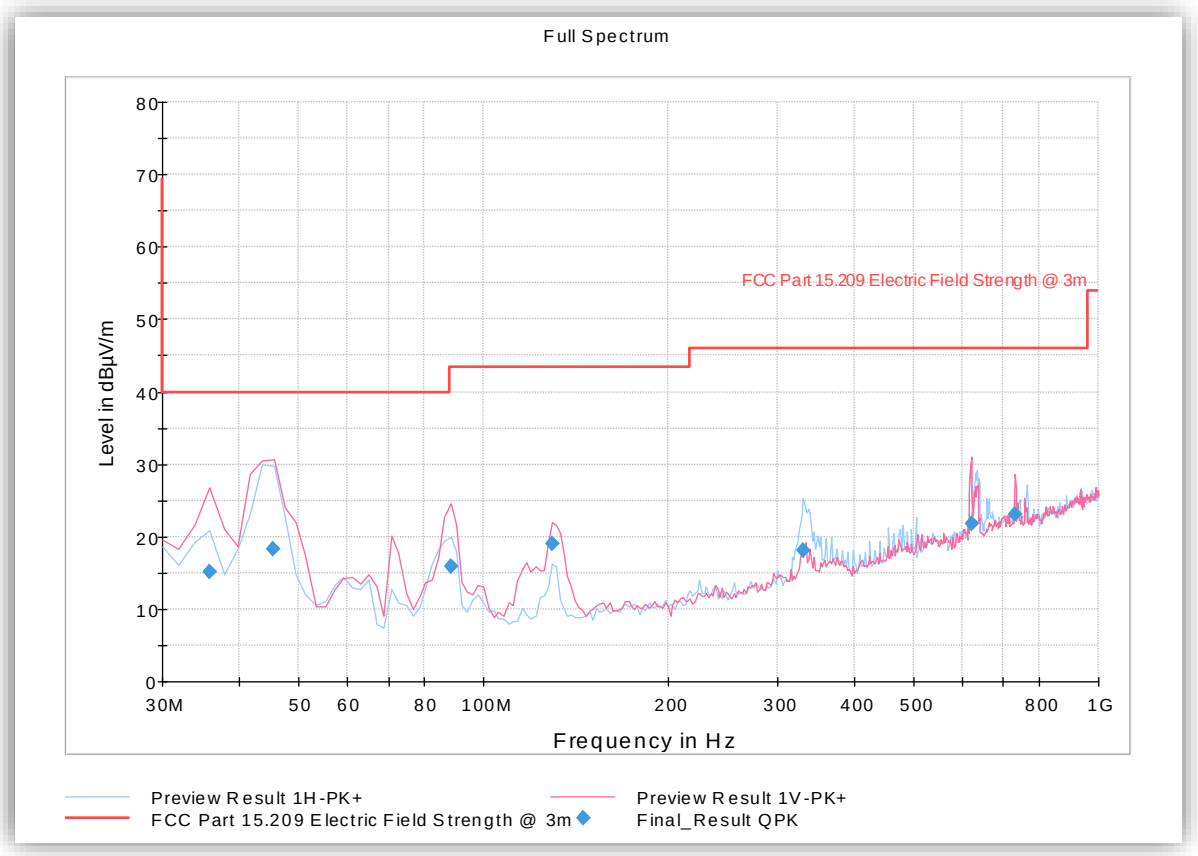
2.7.10 Test Results for 30MHz to 1GHz Middle Channel



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)
35.791663	15.03	39.99	24.96	1000.	120.000	103.0	V	273.0	-11.9
45.711102	17.92	39.99	22.07	1000.	120.000	296.0	H	344.0	-15.9
86.412746	17.78	39.99	22.21	1000.	120.000	125.0	V	25.0	-17.0
129.17827	17.60	43.49	25.89	1000.	120.000	104.0	V	214.0	-16.2
334.95038	19.76	45.99	26.23	1000.	120.000	103.0	H	303.0	-7.8
630.62132	19.42	45.99	26.57	1000.	120.000	303.0	H	99.0	-1.2
731.38348	24.06	45.99	21.93	1000.	120.000	346.0	V	74.0	0.4

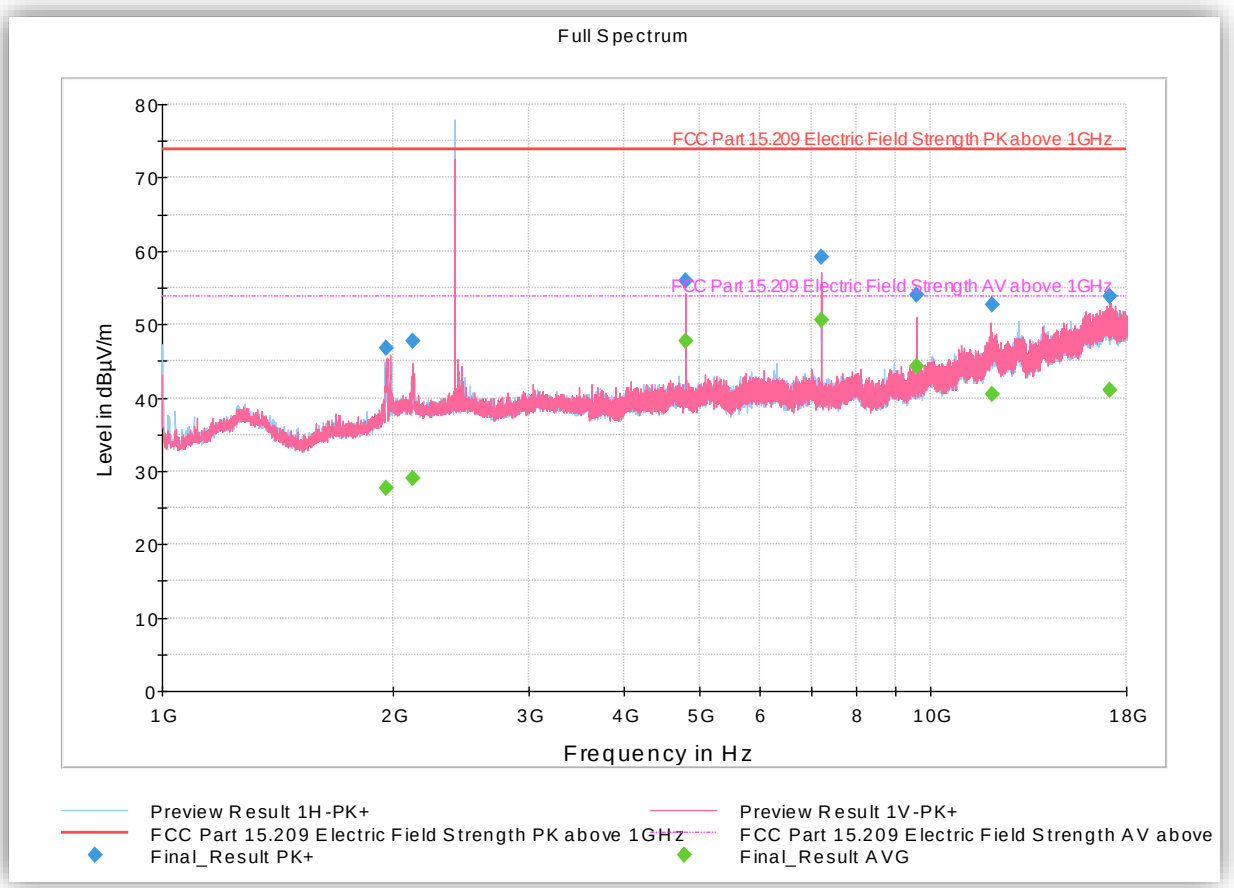
2.7.11 Test Results for 30MHz to 1GHz High Channel



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)
35.831663	15.09	39.99	24.90	1000.	120.000	109.0	V	46.0	-11.9
45.311102	18.37	39.99	21.62	1000.	120.000	138.0	V	16.0	-15.8
88.516633	15.93	43.49	27.56	1000.	120.000	108.0	V	25.0	-16.7
129.45827	19.09	43.49	24.40	1000.	120.000	113.0	V	167.0	-16.2
331.50260	18.03	45.99	27.96	1000.	120.000	106.0	H	104.0	-8.0
620.78188	21.74	45.99	24.25	1000.	120.000	146.0	V	79.0	-1.1
731.42348	23.01	45.99	22.98	1000.	120.000	276.0	V	11.0	0.4

2.7.12 Test Results for 1GHz to 18GHz Low Channel



Peak Data

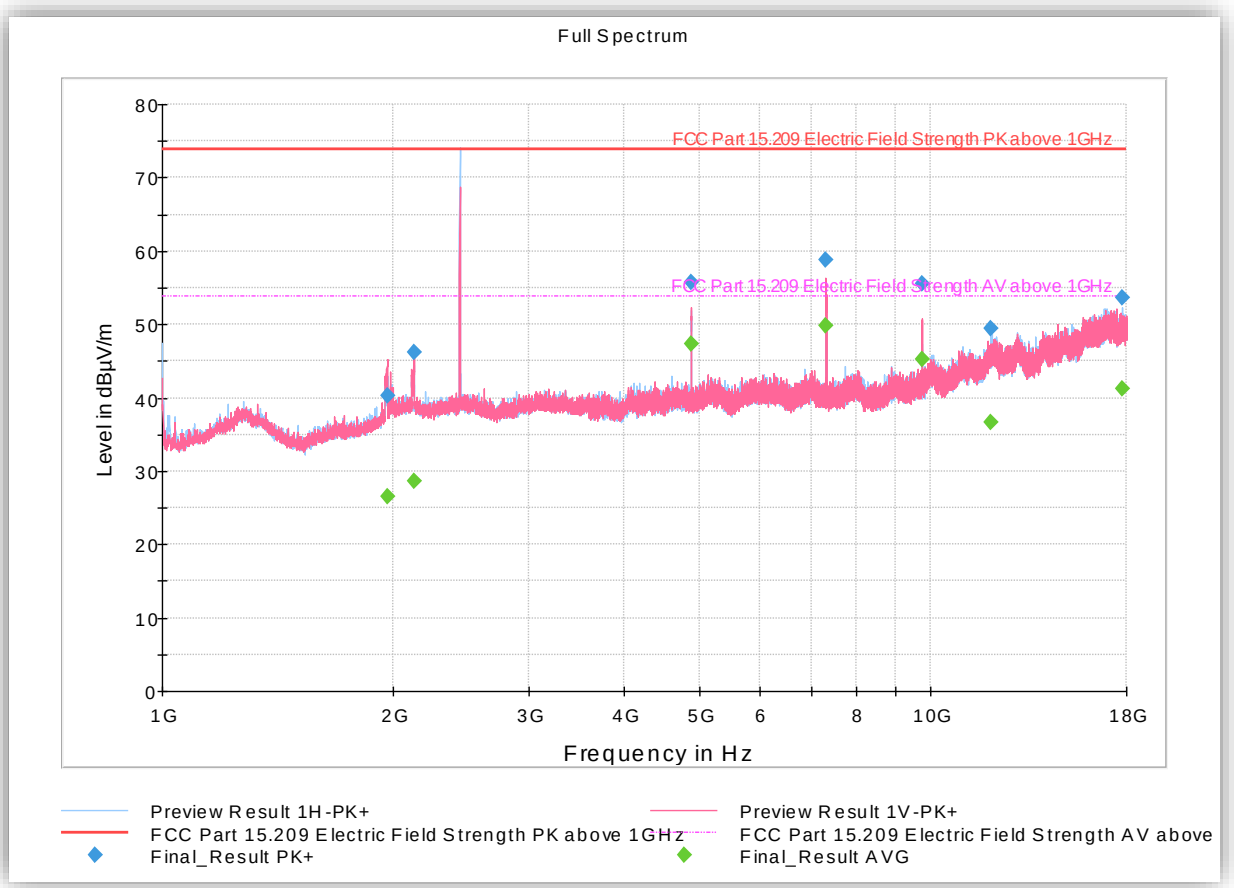
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1960.26666	46.87	73.90	27.03	1000.0	1000.000	179.0	V	259.0	-2.5
2116.90000	47.73	73.90	26.17	1000.0	1000.000	337.0	V	132.0	-1.7
4805.00000	56.02	73.90	17.88	1000.0	1000.000	136.0	V	77.0	4.6
7207.26666	59.22	73.90	14.68	1000.0	1000.000	109.0	V	117.0	8.2
9605.96666	54.00	73.90	19.90	1000.0	1000.000	250.0	V	98.0	11.4
12012.0333	52.70	73.90	21.20	1000.0	1000.000	108.0	V	262.0	16.1
17092.6666	53.82	73.90	20.08	1000.0	1000.000	131.0	V	225.0	22.2

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)
1960.26666	27.70	53.90	26.20	1000.0	1000.000	179.0	V	259.0	-2.5
2116.90000	29.01	53.90	24.89	1000.0	1000.000	337.0	V	132.0	-1.7
4805.00000	47.70	53.90	6.20	1000.0	1000.000	136.0	V	77.0	4.6
7207.26666	50.66	53.90	3.24	1000.0	1000.000	109.0	V	117.0	8.2
9605.96666	44.33	53.90	9.57	1000.0	1000.000	250.0	V	98.0	11.4
12012.0333	40.56	53.90	13.34	1000.0	1000.000	108.0	V	262.0	16.1
17092.6666	41.01	53.90	12.89	1000.0	1000.000	131.0	V	225.0	22.2

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

2.7.13 Test Results for 1GHz to 18GHz Mid Channel



Peak Data

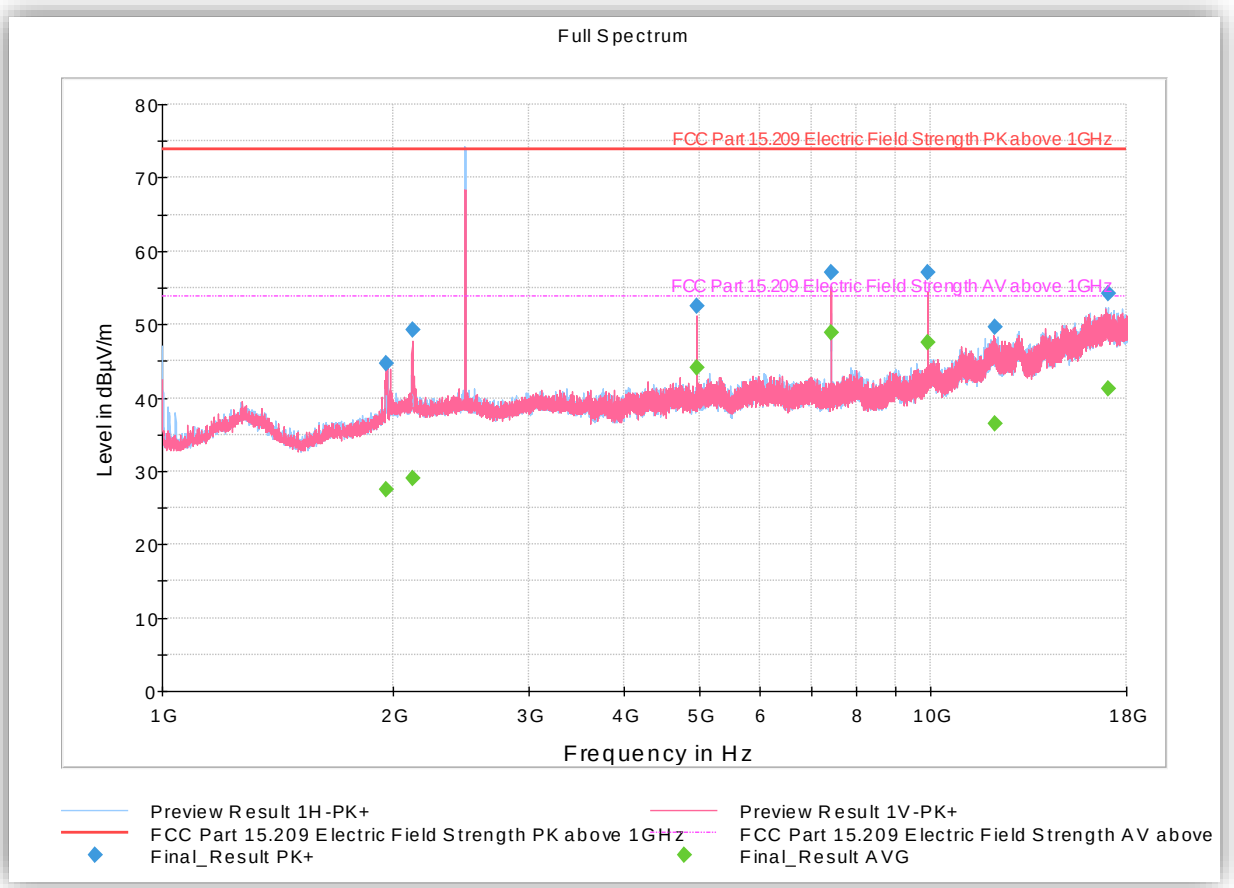
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1961.23333	40.34	73.90	33.56	1000.0	1000.000	385.0	V	43.0	-2.5
2125.06666	46.28	73.90	27.62	1000.0	1000.000	299.0	H	238.0	-1.7
4878.83333	55.73	73.90	18.17	1000.0	1000.000	302.0	V	86.0	4.7
7318.33333	58.73	73.90	15.17	1000.0	1000.000	117.0	V	116.0	8.5
9757.83333	55.64	73.90	18.26	1000.0	1000.000	201.0	V	112.0	11.6
11963.4666	49.53	73.90	24.37	1000.0	1000.000	385.0	H	119.0	16.1
17801.6666	53.74	73.90	20.16	1000.0	1000.000	152.0	H	194.0	22.5

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)
1961.23333	26.57	53.90	27.33	1000.0	1000.000	385.0	V	43.0	-2.5
2125.06666	28.71	53.90	25.19	1000.0	1000.000	299.0	H	238.0	-1.7
4878.83333	47.34	53.90	6.56	1000.0	1000.000	302.0	V	86.0	4.7
7318.33333	49.75	53.90	4.15	1000.0	1000.000	117.0	V	116.0	8.5
9757.83333	45.19	53.90	8.71	1000.0	1000.000	201.0	V	112.0	11.6
11963.4666	36.68	53.90	17.22	1000.0	1000.000	385.0	H	119.0	16.1
17801.6666	41.30	53.90	12.60	1000.0	1000.000	152.0	H	194.0	22.5

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

2.7.14 Test Results for 1GHz to 18GHz High Channel



Peak Data

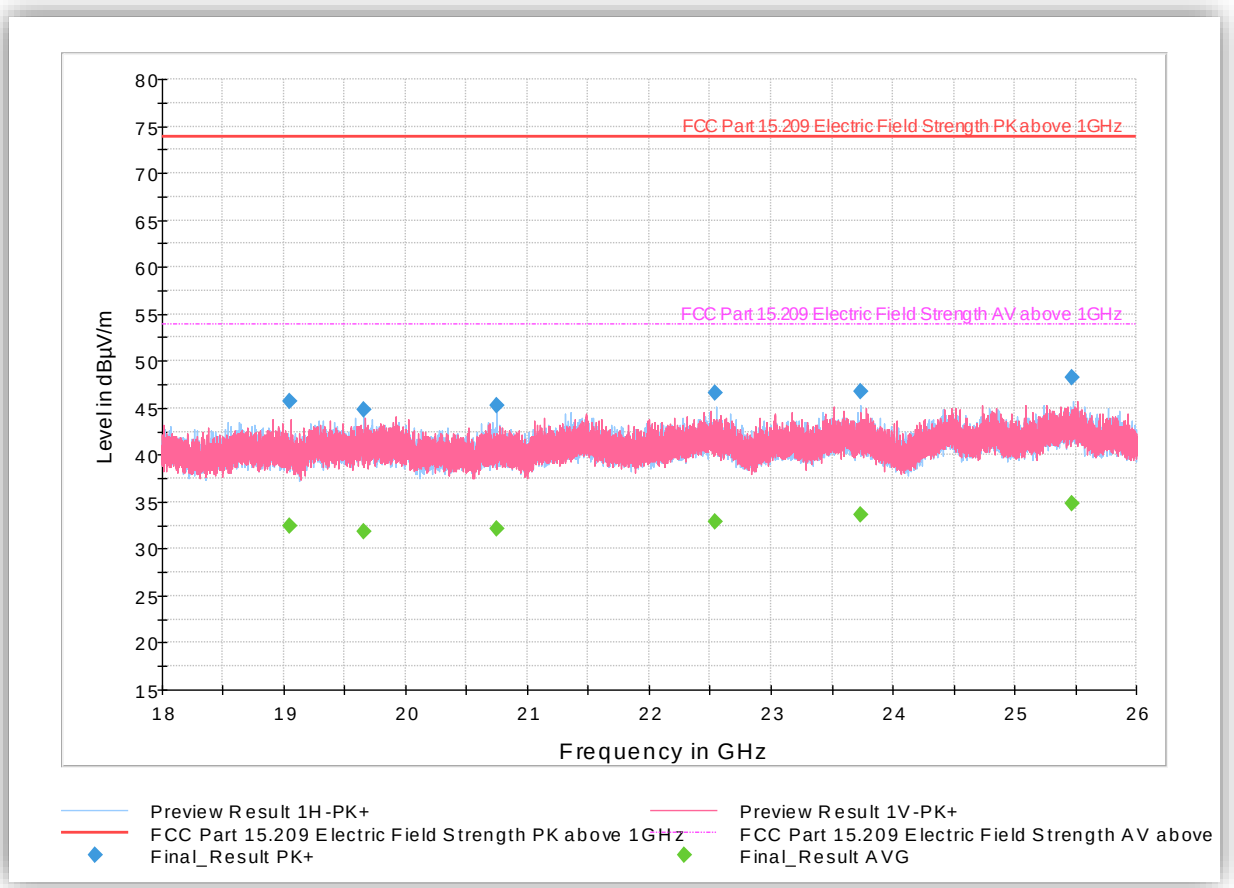
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1958.46666	44.59	73.90	29.31	1000.0	1000.000	102.0	V	199.0	-2.6
2115.20000	49.33	73.90	24.57	1000.0	1000.000	351.0	V	260.0	-1.7
4959.13333	52.45	73.90	21.45	1000.0	1000.000	174.0	V	101.0	4.7
7438.46666	57.06	73.90	16.84	1000.0	1000.000	108.0	V	124.0	8.7
9921.60000	57.17	73.90	16.73	1000.0	1000.000	150.0	V	122.0	12.1
12113.1333	49.58	73.90	24.32	1000.0	1000.000	266.0	H	326.0	16.2
17009.4666	54.26	73.90	19.64	1000.0	1000.000	102.0	H	66.0	22.2

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)
1958.46666	27.49	53.90	26.41	1000.0	1000.000	102.0	V	199.0	-2.6
2115.20000	29.03	53.90	24.87	1000.0	1000.000	351.0	V	260.0	-1.7
4959.13333	44.16	53.90	9.74	1000.0	1000.000	174.0	V	101.0	4.7
7438.46666	48.86	53.90	5.04	1000.0	1000.000	108.0	V	124.0	8.7
9921.60000	47.60	53.90	6.30	1000.0	1000.000	150.0	V	122.0	12.1
12113.1333	36.54	53.90	17.36	1000.0	1000.000	266.0	H	326.0	16.2
17009.4666	41.18	53.90	12.72	1000.0	1000.000	102.0	H	66.0	22.2

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

2.7.15 Test Results for 18GHz to 26GHz Low Channel



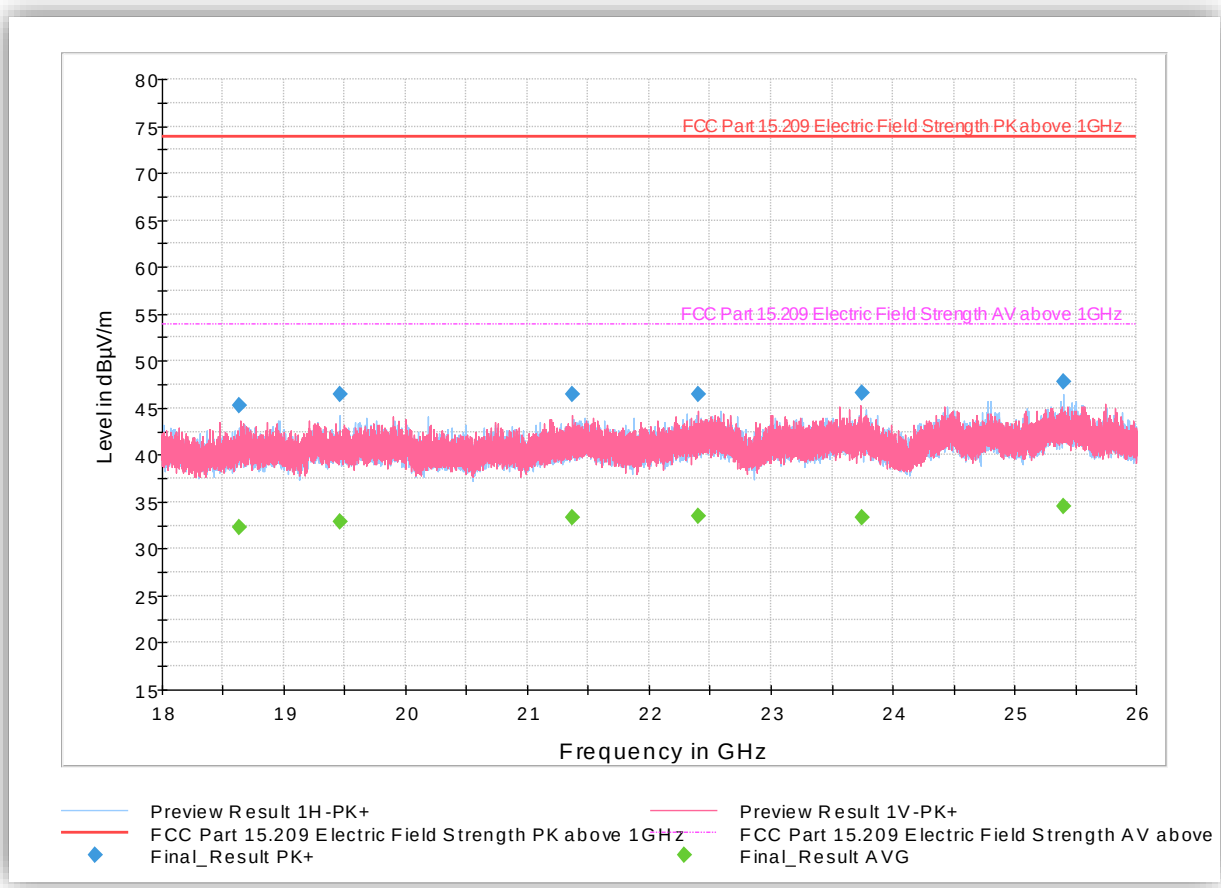
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19051.2666	45.75	73.90	28.15	1000.0	1000.000	159.0	V	280.0	-5.4
19658.3333	44.83	73.90	29.07	1000.0	1000.000	165.0	H	246.0	-5.0
20752.2000	45.20	73.90	28.70	1000.0	1000.000	156.0	H	286.0	-4.9
22545.6666	46.67	73.90	27.23	1000.0	1000.000	139.0	H	-10.0	-2.9
23739.9333	46.80	73.90	27.10	1000.0	1000.000	165.0	H	338.0	-2.2
25475.4000	48.17	73.90	25.73	1000.0	1000.000	138.0	H	-10.0	-1.1

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)
19051.2666	32.43	53.90	21.47	1000.0	1000.000	159.0	V	280.0	-5.4
19658.3333	31.79	53.90	22.11	1000.0	1000.000	165.0	H	246.0	-5.0
20752.2000	32.17	53.90	21.73	1000.0	1000.000	156.0	H	286.0	-4.9
22545.6666	32.93	53.90	20.97	1000.0	1000.000	139.0	H	-10.0	-2.9
23739.9333	33.58	53.90	20.32	1000.0	1000.000	165.0	H	338.0	-2.2
25475.4000	34.85	53.90	19.05	1000.0	1000.000	138.0	H	-10.0	-1.1

2.7.16 Test Results for 18GHz to 26GHz Mid Channel



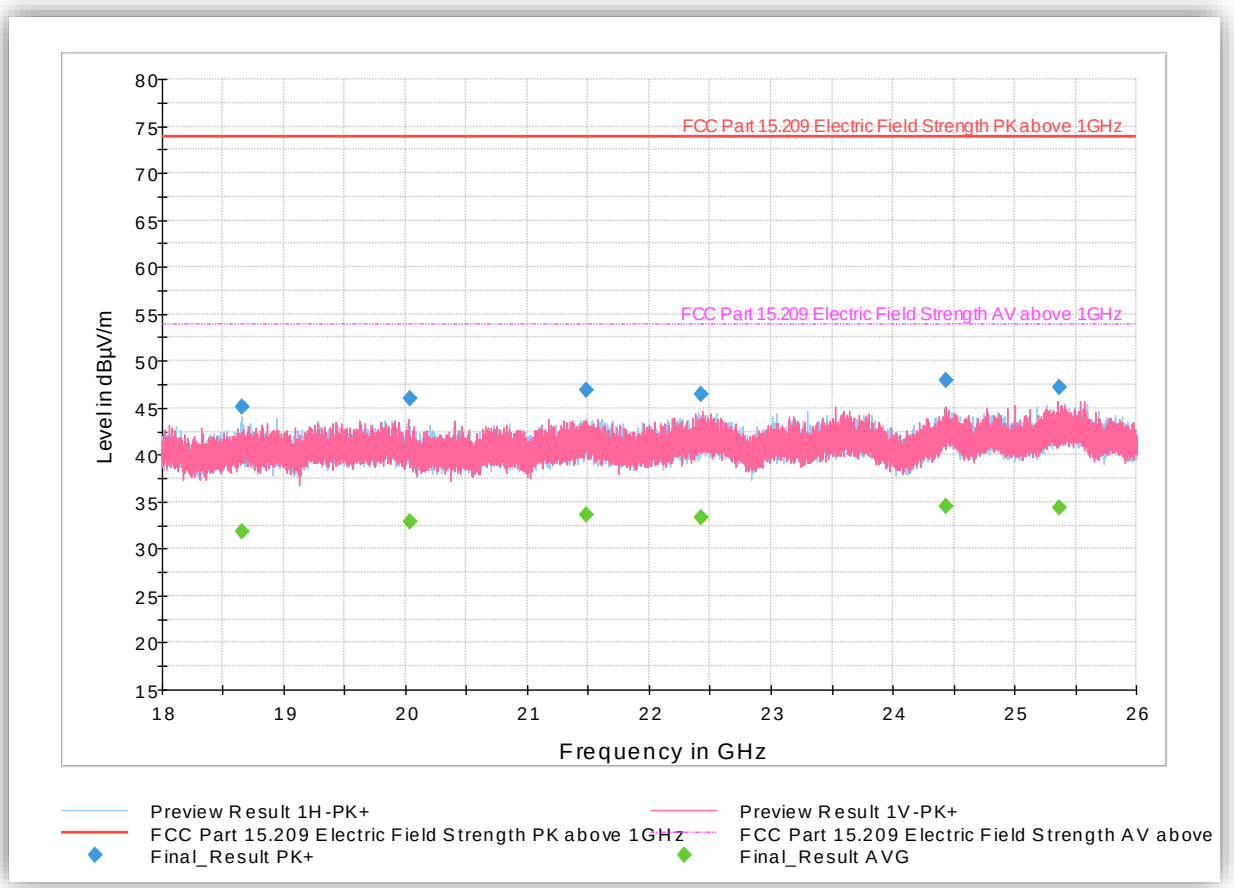
Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
18637.0000	45.32	73.90	28.58	1000.0	1000.000	138.0	V	-10.0	-4.5
19463.4000	46.40	73.90	27.50	1000.0	1000.000	152.0	H	0.0	-4.8
21372.7333	46.51	73.90	27.39	1000.0	1000.000	147.0	V	0.0	-3.9
22404.6000	46.48	73.90	27.42	1000.0	1000.000	165.0	V	-10.0	-3.1
23748.8666	46.63	73.90	27.27	1000.0	1000.000	151.0	V	-10.0	-2.2
25405.5333	47.82	73.90	26.08	1000.0	1000.000	157.0	H	13.0	-1.0

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)
18637.0000	32.31	53.90	21.59	1000.0	1000.000	138.0	V	-10.0	-4.5
19463.4000	32.84	53.90	21.06	1000.0	1000.000	152.0	H	0.0	-4.8
21372.7333	33.33	53.90	20.57	1000.0	1000.000	147.0	V	0.0	-3.9
22404.6000	33.53	53.90	20.37	1000.0	1000.000	165.0	V	-10.0	-3.1
23748.8666	33.38	53.90	20.52	1000.0	1000.000	151.0	V	-10.0	-2.2
25405.5333	34.54	53.90	19.36	1000.0	1000.000	157.0	H	13.0	-1.0

2.7.17 Test Results for 18GHz to 26GHz High Channel



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)
18659.6666	45.15	73.90	28.75	1000.0	1000.000	159.0	H	92.0	-4.5
20034.0666	46.03	73.90	27.87	1000.0	1000.000	161.0	V	0.0	-5.4
21483.5333	46.90	73.90	27.00	1000.0	1000.000	149.0	H	4.0	-3.7
22429.6666	46.52	73.90	27.38	1000.0	1000.000	140.0	V	213.0	-3.1
24432.4666	47.99	73.90	25.91	1000.0	1000.000	162.0	V	320.0	-1.6
25369.5333	47.25	73.90	26.65	1000.0	1000.000	137.0	V	10.0	-1.1

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)
18659.6666	31.88	53.90	22.02	1000.0	1000.000	159.0	H	92.0	-4.5
20034.0666	32.82	53.90	21.08	1000.0	1000.000	161.0	V	0.0	-5.4
21483.5333	33.57	53.90	20.33	1000.0	1000.000	149.0	H	4.0	-3.7
22429.6666	33.39	53.90	20.51	1000.0	1000.000	140.0	V	213.0	-3.1
24432.4666	34.50	53.90	19.40	1000.0	1000.000	162.0	V	320.0	-1.6
25369.5333	34.39	53.90	19.51	1000.0	1000.000	137.0	V	10.0	-1.1

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: N/A / Default Test Configuration

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

February 07, 2024 / 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	18.7 °C
Relative Humidity	55.2 %
ATM Pressure	99.9 kPa

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.

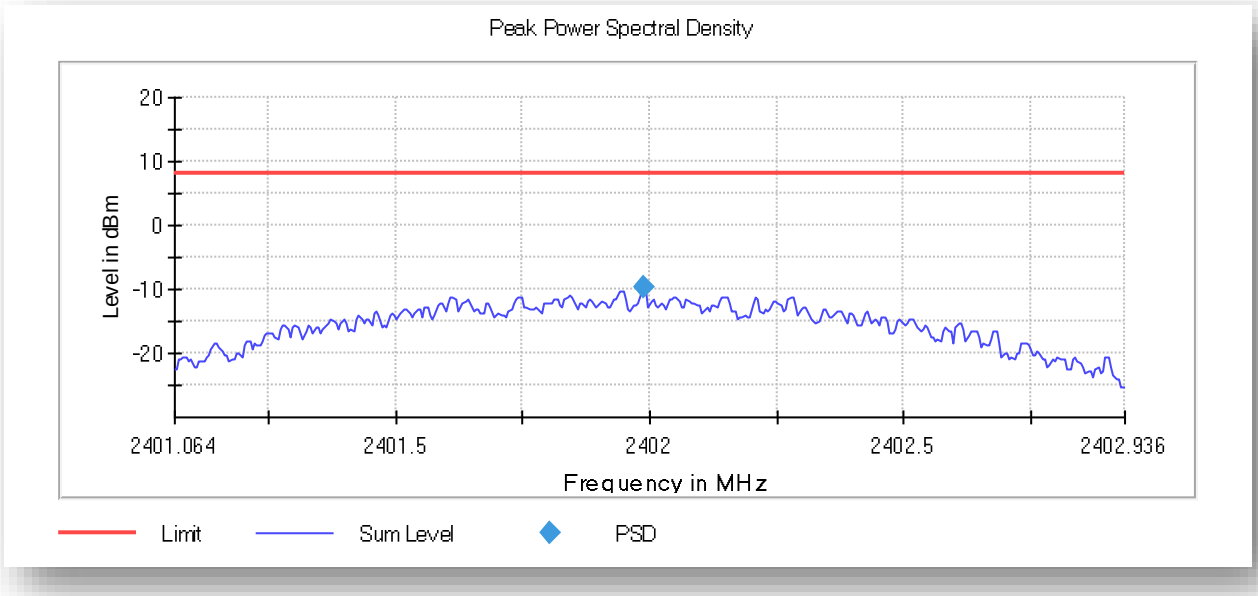
2.8.8 Test Results Summary

DUT Frequency (MHz)	PHY	Frequency (MHz)	PSD (dBm)	Limit Max (dBm)	Result
2402.000000	1M	2401.987491	-9.576	8.0	PASS
2440.000000	1M	2439.987493	-8.857	8.0	PASS
2480.000000	1M	2479.987493	-8.995	8.0	PASS

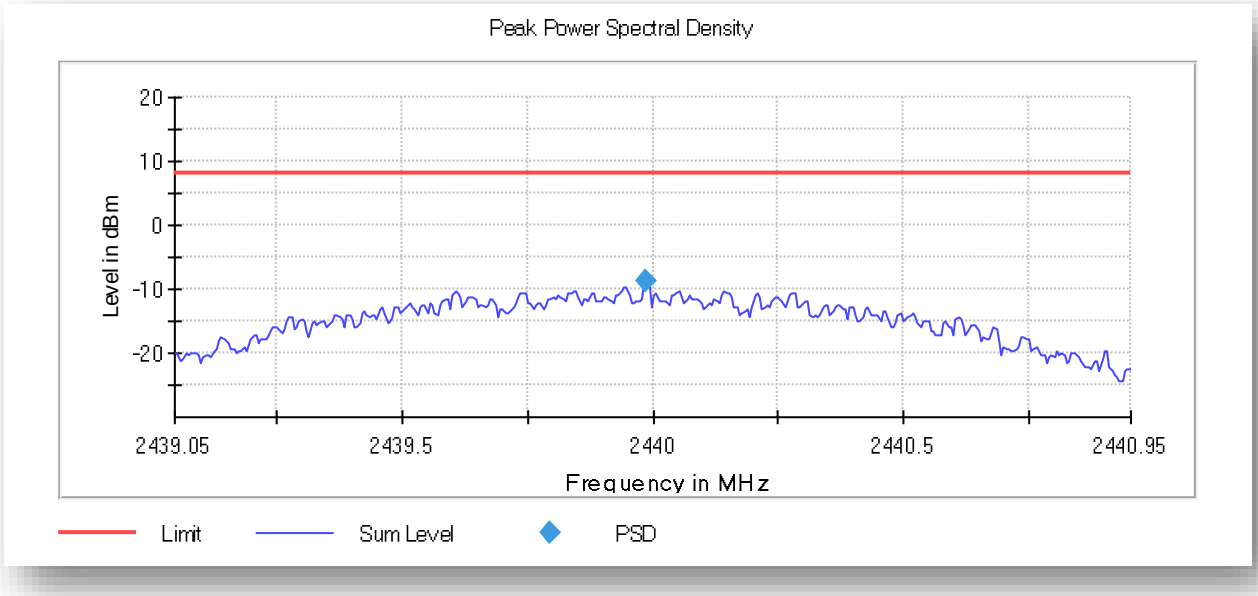
2.8.9 Sample Measurement Settings

Setting	Instrument Value	Target Value
Span	1.871 MHz	1.871 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	374	~ 374
Sweeptime	1.880 ms	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	Sweep	Sweep
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	4 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.27 dB	0.50 dB

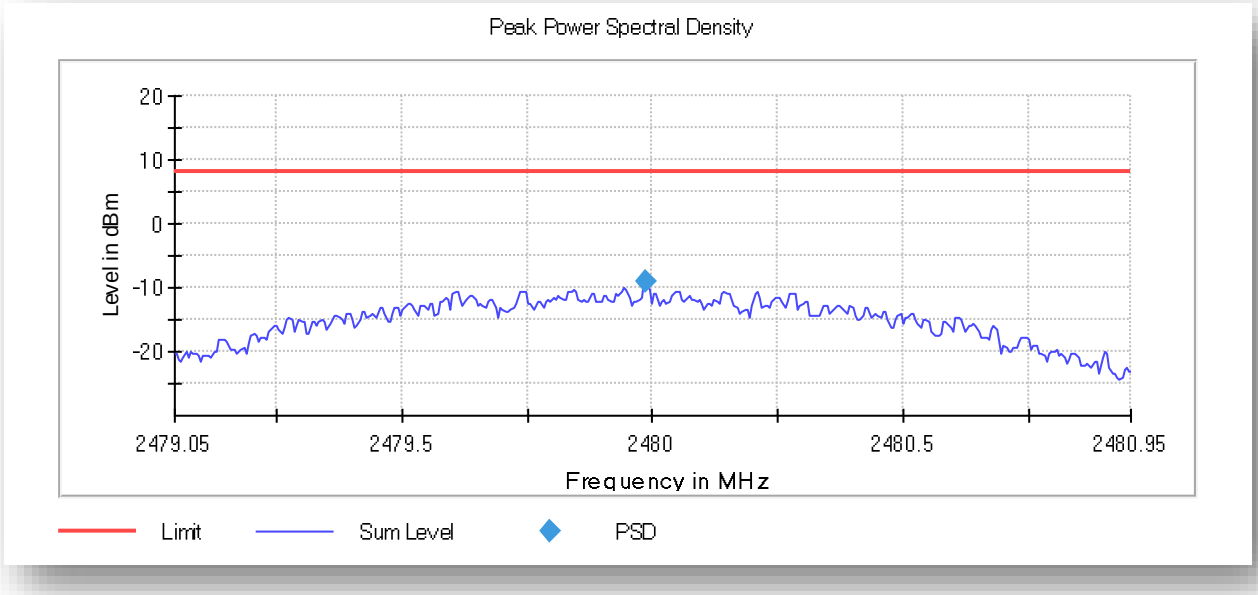
2.8.10 Test Plots



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	1321.3008K30/103166	Rhode & Schwarz	01/24/24	01/24/25
7655	Vector Signal Generator	SMBV100A	260734	Rhode & Schwarz	01/25/24	01/25/25
7654	Signal Generator	SMB 100A	175750	Rhode & Schwarz	01/24/24	01/24/25
7656	OSP with B157	OSP120	101310	Rhode & Schwarz	01/25/24	01/25/25
8825	20dB Attenuator	46-20-34	BK5773	Weinschel Corp.	Verified by 7643 and 7654	
Radiated Emission						
SDRB1033	Bilog Antenna	3142C	00044556	EMCO	10/16/23	10/16/25
SDRB1040	EMI Test Receiver	ESIB40	100292	Rohde & Schwarz	10/02/23	10/02/24
SDGE51235	RF Pre-Amp (9Khz to 1GHz)	310	412802	SONOMA	08/21/23	08/21/24
SDRB1049	EMI Test Receiver	ESU40	100133	Rohde & Schwarz	04/03/23	04/03/24
SDGE07575	Double ridged waveguide horn	3117	00155511	ETS Lindgren	08/08/22	08/08/24
SDGE08628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	02/19/24	02/19/25
SDGE09001	18-26 GHz Antenna	HO42S	101	Custom Microwave Inc.	10/26/23	10/26/25
SDGE40815	18GHz to 40GHz Low Noise Amplifier	SLKKa-30-6	19D18	Spacek Labs	09/06/23	09/06/24
Miscellaneous						
30215	Barometer/Temperature/Humidity	iBTHX-W	15050268	Omega	06/15/23	06/15/24
43003	True RMS Multimeter	85 III	69880143	Fluke	10/02/23	10/02/24
-	Test Software	EMC32	v 11.50.0	Rohde & Schwarz	NCR	

3.2 MEASUREMENT UNCERTAINTY

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

3.2.1 AC Conducted Measurements (for reference only)

	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	0.75	dB	Normal, k=2	2.000	0.38	0.14
4	Receiver sinewave accuracy	1.10	dB	Normal, k=2	2.000	0.55	0.30
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	3.64	dB	Triangular	2.449	1.49	2.21
16	Separation distance at 3 m	0.30	dB	Rectangular	1.732	0.17	0.03
17	Effect of setup table material	0.40	dB	Rectangular	1.732	0.23	0.05
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	2.95	dB	
	Expanded uncertainty			Normal, k=2	**5.89**	**dB**	

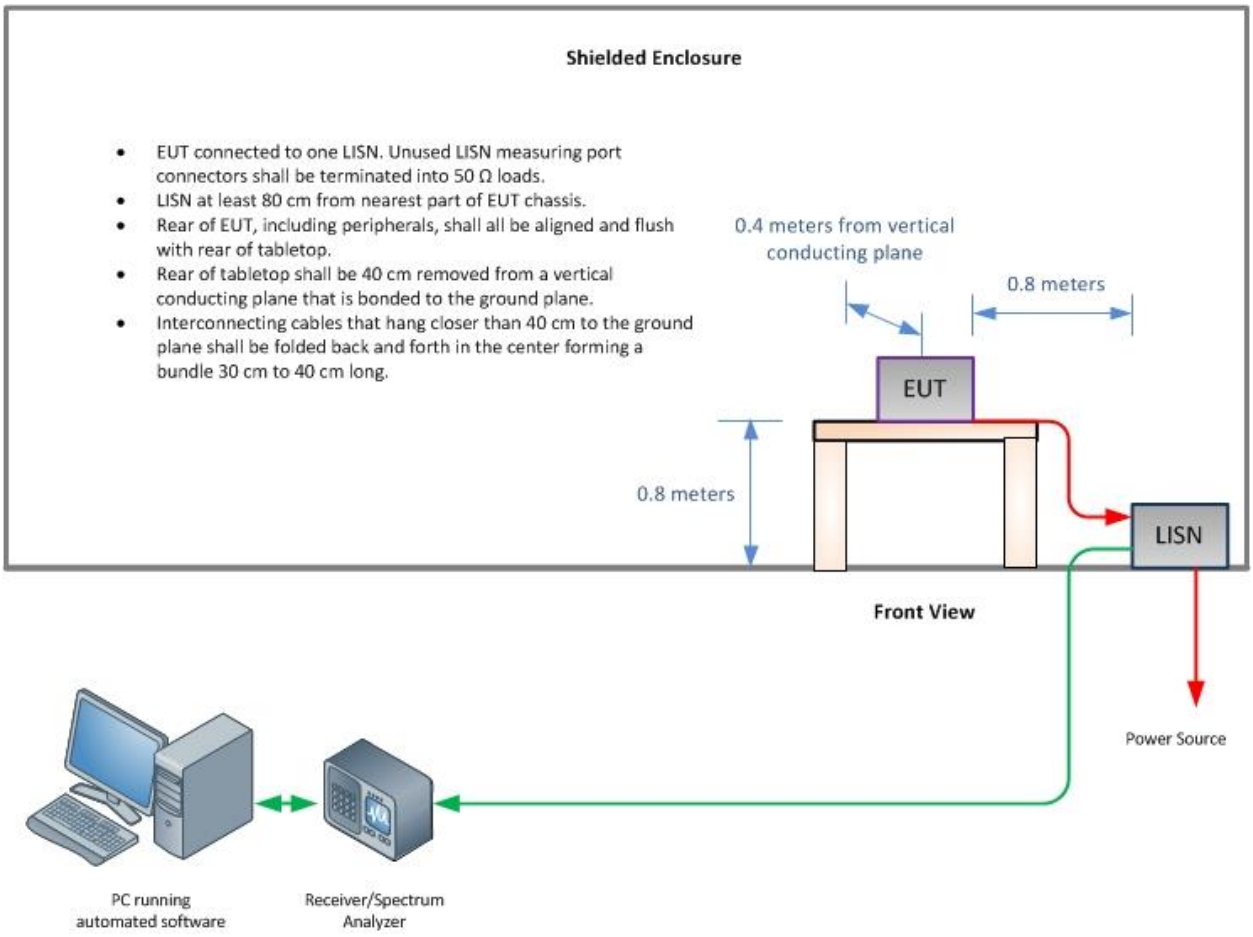
3.2.1 Radiated Emission Measurements (1GHz to 18GHz)

	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**	

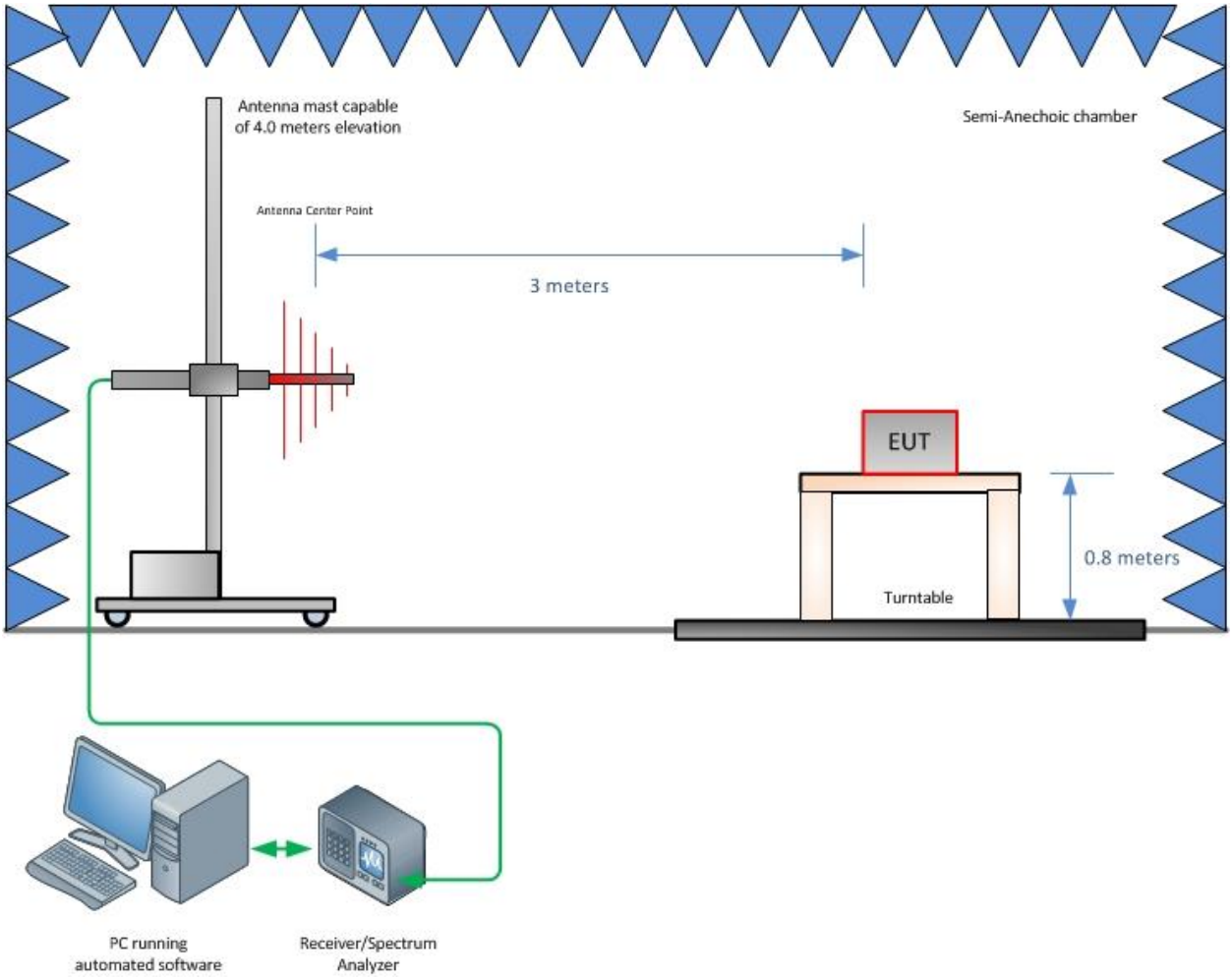
SECTION 4

DIAGRAM OF TEST SETUP

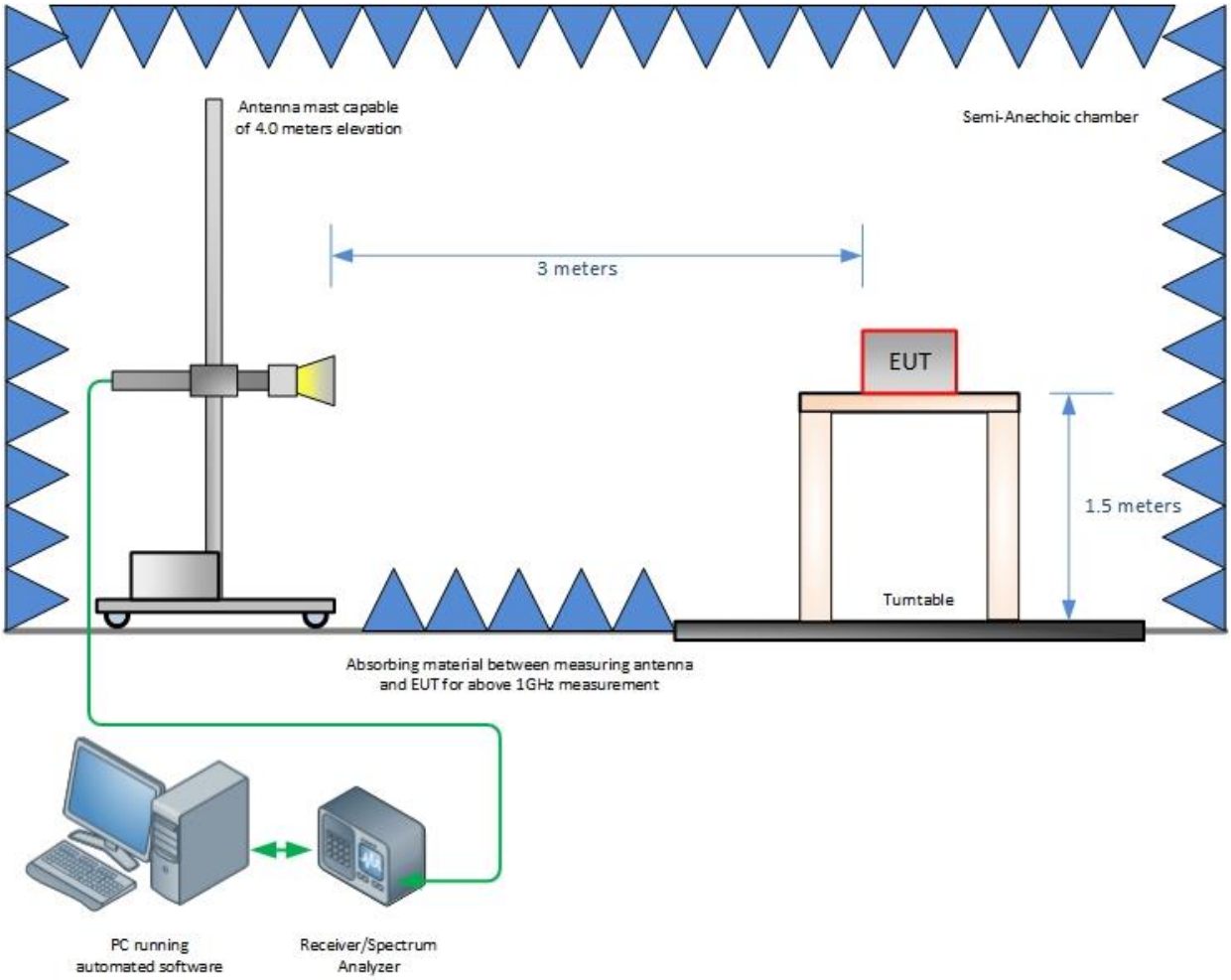
4.1 TEST SETUP DIAGRAM



AC Conducted Emission Test Setup (for reference only)



Radiated Emission Test Setup (Below 1GHz)



Radiated Emission Test Setup (Above 1GHz)

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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