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MEASUREMENT REPORT FCC PART 15.247 / ISED RSS-247 Bluetooth (Low Energy)

Applicant Name:
Samsung Electronics Co., Ltd.
129, Samsung-ro,
Yeongtong-gu, Suwon-si
Gyeonggi-do, 16677, Korea

Date of Testing:
04/01 - 6/10/2022
Test Report Issue Date:
6/10/2022
Test Site/Location:
Element Lab. Columbia, MD, USA
Test Report Serial No.:
1M2204010046-10.A3L

FCC ID:	A3LSMF936U
IC:	649E-SMF936W
APPLICANT:	Samsung Electronics Co., Ltd.

Application Type: Certification
Model: SM-F936U
HVIN: SM-F936W
Additional Model: SM-F936U1
EUT Type: Portable Handset
Max. RF Output Power: 85.507 mW (19.32 dBm) Peak Conducted
Frequency Range: 2402 – 2480MHz
FCC Classification: Digital Transmission System (DTS)
FCC Rule Part(s): Part 15 Subpart C (15.247)
ISED Specification: RSS-247 Issue 2Part 15 Subpart C (15.247) of the FCC Rules and RSS-247 of the Innovation, Science and Economic Development Canada Rules.
Test Procedure(s): ANSI C63.10-2013, KDB 558074 D01 v05r02, KDB 648474 D03 v01r04

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013 and KDB 558074 D01 v05r02. Test results reported herein relate only to the item(s) tested.

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

RJ Ortanez
Executive Vice President



FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 1 of 75

V9.0 02/01/2019

TABLE OF CONTENTS

1.0	INTRODUCTION	3
1.1	Scope	3
1.2	Element Test Location.....	3
1.3	Test Facility / Accreditations.....	3
2.0	PRODUCT INFORMATION.....	4
2.1	Equipment Description	4
2.2	Device Capabilities.....	4
2.3	Antenna Description	4
2.4	Test Configuration	5
2.5	Software and Firmware	5
2.6	EMI Suppression Device(s)/Modifications	5
3.0	DESCRIPTION OF TESTS	6
3.1	Evaluation Procedure	6
3.2	AC Line Conducted Emissions	6
3.3	Radiated Emissions.....	7
3.4	Environmental Conditions.....	7
4.0	ANTENNA REQUIREMENTS	8
5.0	MEASUREMENT UNCERTAINTY	9
6.0	TEST EQUIPMENT CALIBRATION DATA	10
7.0	TEST RESULTS.....	11
7.1	Summary.....	11
7.2	6dB Bandwidth Measurement – Bluetooth (LE).....	12
7.3	Output Power Measurement – Bluetooth (LE).....	24
7.4	Power Spectral Density – Bluetooth (LE)	36
7.5	Conducted Emissions at the Band Edge	48
7.6	Conducted Spurious Emissions.....	55
7.7	Radiated Spurious Emission Measurements.....	63
7.8	Radiated Restricted Band Edge Measurements.....	70
7.9	Line-Conducted Test Data.....	71
8.0	CONCLUSION.....	75

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 2 of 75

1.0 INTRODUCTION

1.1 Scope

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

1.2 Element Test Location

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

1.3 Test Facility / Accreditations

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

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 3 of 75

V9.0 02/01/2019

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMF936U**. The data found in this test report was taken with the EUT operating in Bluetooth low energy mode. While in low energy mode, the Bluetooth transmitter hops pseudo-randomly between 40 channels, three of which are “advertising channels”. When the transmitter is hopping only between the three advertising channels, the EUT does not fall under the category of a “hopper” as defined in 15.247(a)(iii) which states that a “frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.” As operation on only the advertising channels does not qualify the EUT as a hopper, the EUT is certified as a DTS device in this mode. The data found in this report is representative of the device when it transmits on its advertising channels. Typical Bluetooth operation is covered under the DSS report found with this application.

Test Device Serial No.: 0109M, 0070M, 3059R, 0303M, 0374M, 0417M

2.2 Device Capabilities

This device contains the following capabilities:

850/1900 GSM/GPRS/EDGE, 850/1700/1900 WCDMA/HSPA, Multi-band LTE, Multi-band 5G NR (FR1 and FR2), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5,6GHz), Bluetooth (1x, EDR, LE), NFC, UWB, Wireless Power Transfer

Ch.	Frequency (MHz)
0	2402
:	:
19	2440
:	:
39	2480

Table 2-1. Frequency / Channel Operations

2.3 Antenna Description

Following antenna was used for the testing.

Antenna	Frequency [GHz]	Antenna Gain (dBi)
1	2.4	-2.05
2	2.4	-5.15

Table 2-2. Antenna Peak Gain

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 4 of 75



2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10-2013 and KDB 558074 D01 v05r02. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

This device supports wireless charging capability and, thus, is subject to the test requirements of KDB 648474 D03 v01r04. Additional radiated spurious emission measurements were performed with the EUT lying flat on an authorized wireless charging pad (WCP) EP-N5100 while operating under normal conditions in a simulated call or data transmission configuration. The worst case radiated emissions data is shown in this report.

This device supports three configurations: one is with screen open, the screen is half open (90 degrees), and one is with screen closed. All configurations are tested, and the worst case radiated emissions data is shown in this report.

2.5 Software and Firmware

The test was conducted with software/firmware version F936USQU0AVEC installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 5 of 75

V9.0 02/01/2019

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB 558074 D01 v05r02 were used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 AC Line Conducted Emissions

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

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

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

Line conducted emissions test results are shown in Section 7.9. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 6 of 75

3.3 Radiated Emissions

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

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

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

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 414788 D01 v01r01.

3.4 Environmental Conditions

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 7 of 75

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

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

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

Conclusion:

The EUT complies with the requirement of §15.203.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 8 of 75

5.0 MEASUREMENT UNCERTAINTY

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

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 9 of 75

6.0 TEST EQUIPMENT CALIBRATION DATA

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

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	ETS-001	EMC Cable and Switch System	12/9/2021	Annual	12/9/2022	ETS-001
-	ETS-002	EMC Cable and Switch System	12/9/2021	Annual	12/9/2022	ETS-002
-	AP2-001	EMC Cable and Switch System	1/4/2022	Annual	1/4/2023	AP2-001
-	AP2-002	EMC Cable and Switch System	1/4/2022	Annual	1/4/2023	AP2-002
-	BT1	Bluetooth Cable Set	12/19/2021	Annual	12/19/2022	BT1
Agilent	N4010A	Wireless Connectivity Test Set	N/A			GB46170464
Agilent	N4010A	Wireless Connectivity Test Set	N/A			GB44450273
Agilent	N9038A	MKE EMI Receiver	1/21/2022	Annual	1/21/2023	MY51210133
Agilent	N9020A	MXA Signal Analyzer	3/4/2022	Annual	3/4/2023	US46470561
Emco	3115	Horn Antenna (1-18GHz)	6/18/2020	Biennial	6/18/2022	9704-5182
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	7/9/2020	Biennial	7/9/2022	114451
Pasternack	NMLC-2	Line Conducted Emissions Cable (NM)	12/19/2021	Annual	12/19/2022	NMLC-2
Rohde & Schwarz	CMU200	Base Station Simulator	N/A			836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	N/A			833855/0010
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	8/10/2021	Annual	8/10/2022	100342
Solar Electronics	8012-50-R-24-BNC	Line Impedance Stabilization Network	9/21/2021	Biennial	9/21/2022	310233
Sunol	DRH-118	Horn Antenna (1-18GHz)	2/14/2022	Biennial	2/14/2024	A050307
Sunol	J85	Bi-Log Antenna (30M - 5GHz)	7/27/2020	Biennial	7/27/2022	A051107

Table 6-1. Annual Test Equipment Calibration Schedule

Note:

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 10 of 75

7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.
 FCC ID: A3LSMF936U
 FCC Classification: Digital Transmission System (DTS)
 Number of Channels: 40

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	RADIATED	PASS	Sections 7.7, 7.8
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	Section 7.9

Table 7-1. Summary of Test Results

Notes:

- All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
- The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.
- For conducted spurious emissions, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST “Bluetooth LE Automation,” Version 3.6.
- For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is PCTEST “Chamber Automation,” Version 1.3.1.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 11 of 75

7.2 6dB Bandwidth Measurement – Bluetooth (LE)

§15.247(a.2); RSS-247 [5.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2
KDB 558074 D01 v05r02 – Section 8.2

Test Settings

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW \geq 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Setup

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



Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 12 of 75

V9.0 02/01/2019

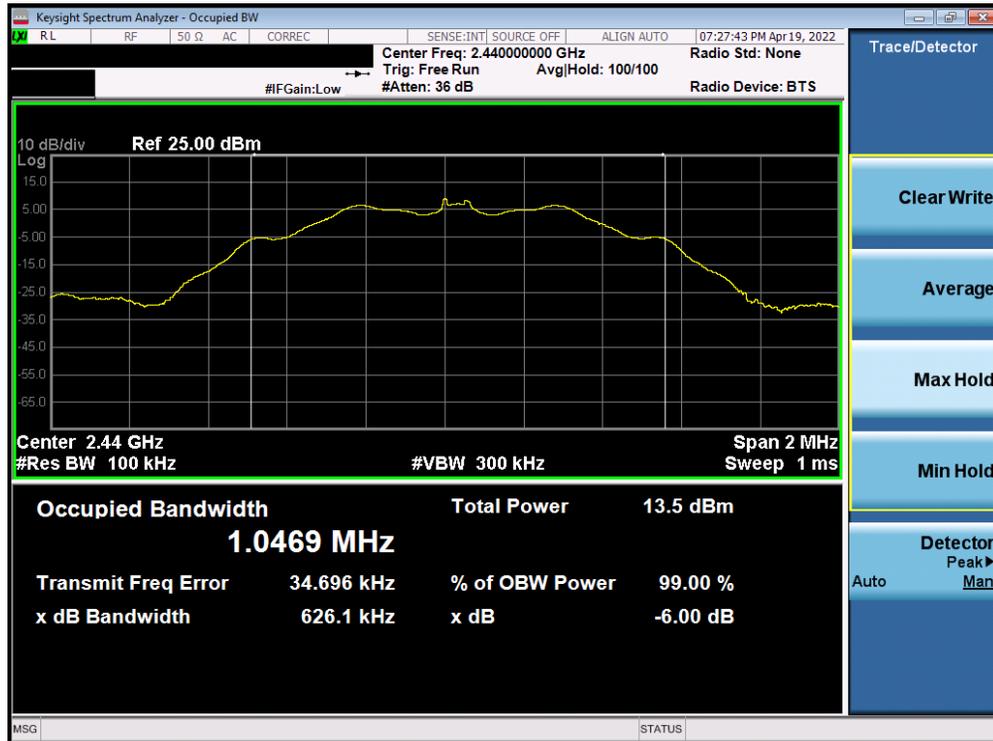
Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	125 kbps	0	LE	628.3	500	Pass
2440	125 kbps	19	LE	626.1	500	Pass
2480	125 kbps	39	LE	622.5	500	Pass
2402	500 kbps	0	LE	675.3	500	Pass
2440	500 kbps	19	LE	664.0	500	Pass
2480	500 kbps	39	LE	645.1	500	Pass
2402	1 Mbps	0	LE	677.8	500	Pass
2440	1 Mbps	19	LE	698.0	500	Pass
2480	1 Mbps	39	LE	658.0	500	Pass
2402	2 Mbps	0	LE	1111	500	Pass
2440	2 Mbps	19	LE	1142	500	Pass
2480	2 Mbps	39	LE	1121	500	Pass

Table 7-2. Conducted Bandwidth Measurements – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 13 of 75

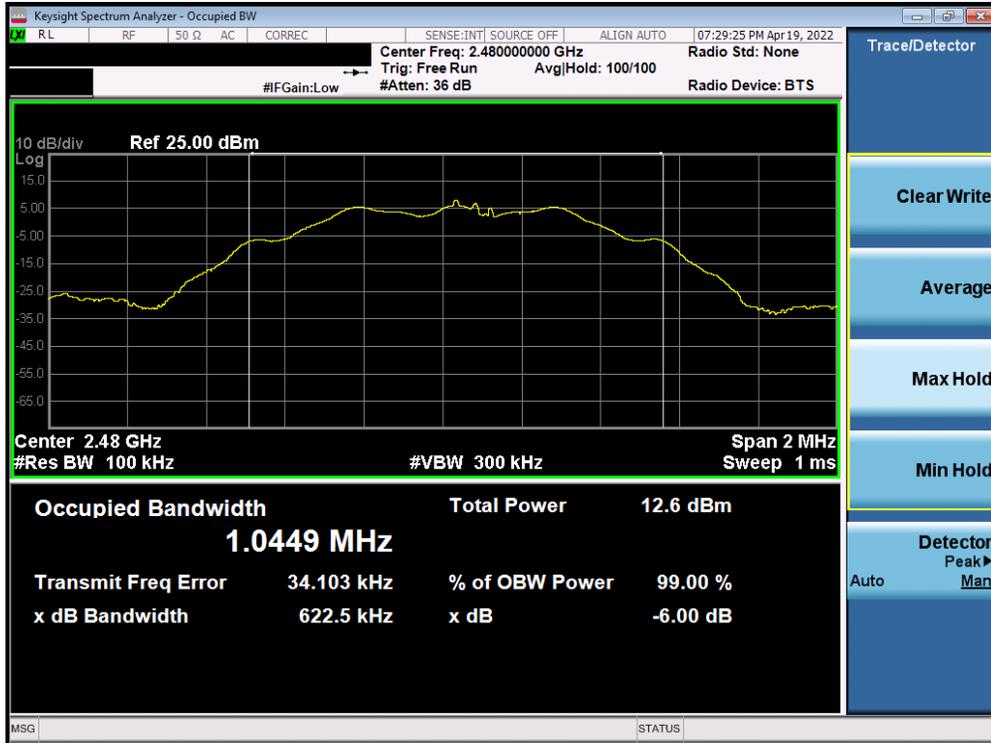


Plot 7-1. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 0) – Antenna 1

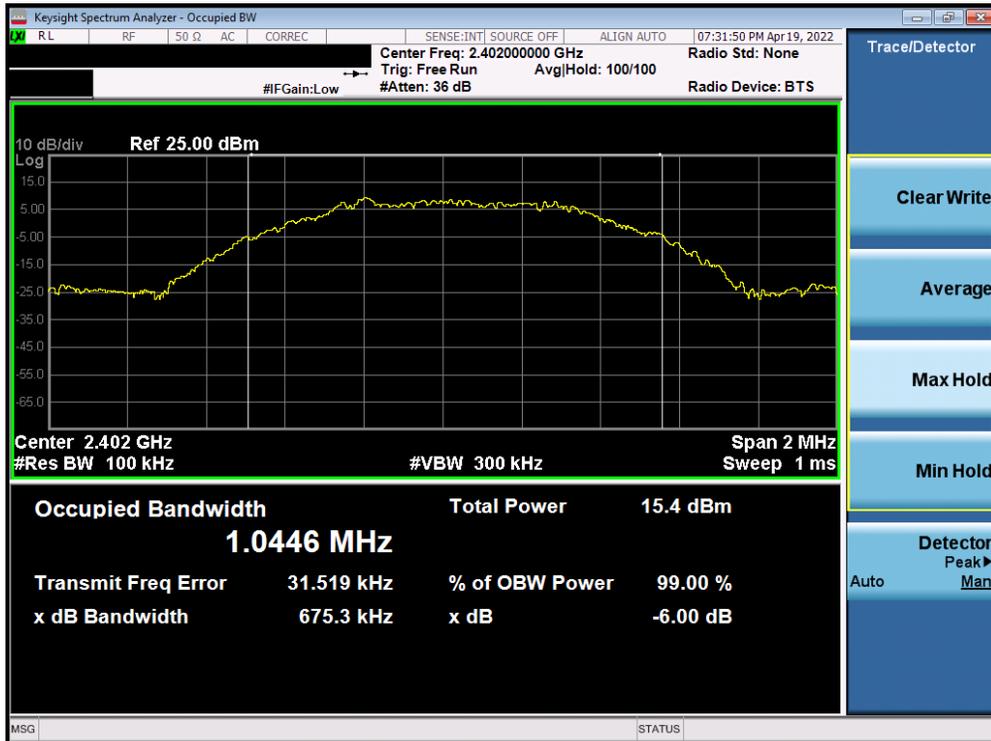


Plot 7-2. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 14 of 75



Plot 7-3. 6dB Bandwidth Plot (Bluetooth (LE), 125kbps – Ch. 39) – Antenna 1

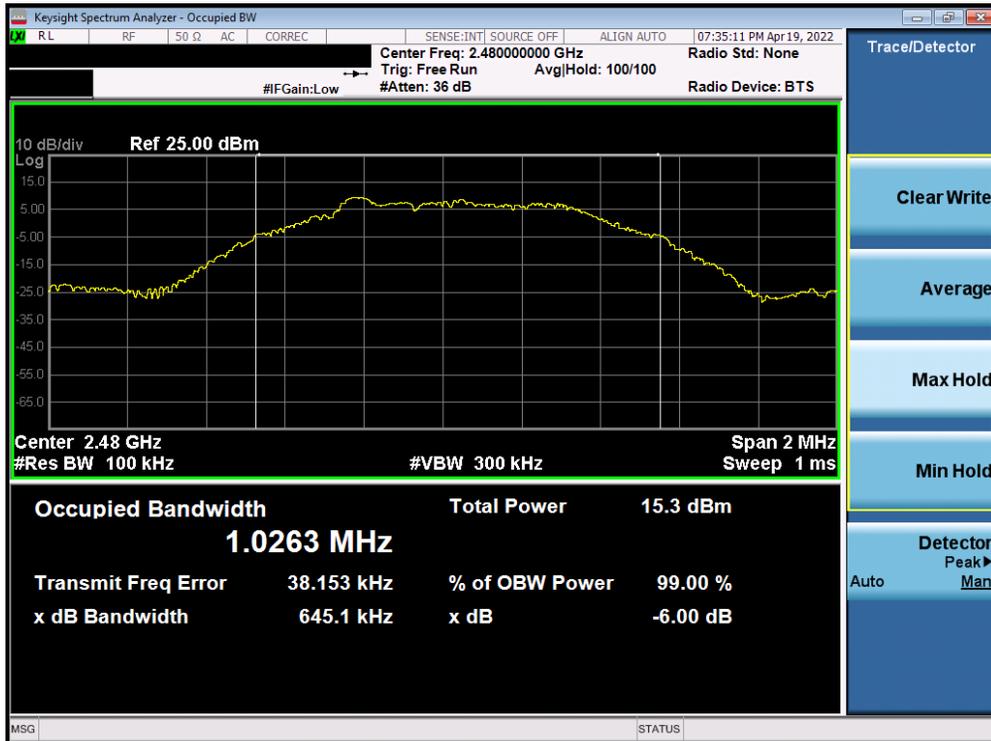


Plot 7-4. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 15 of 75

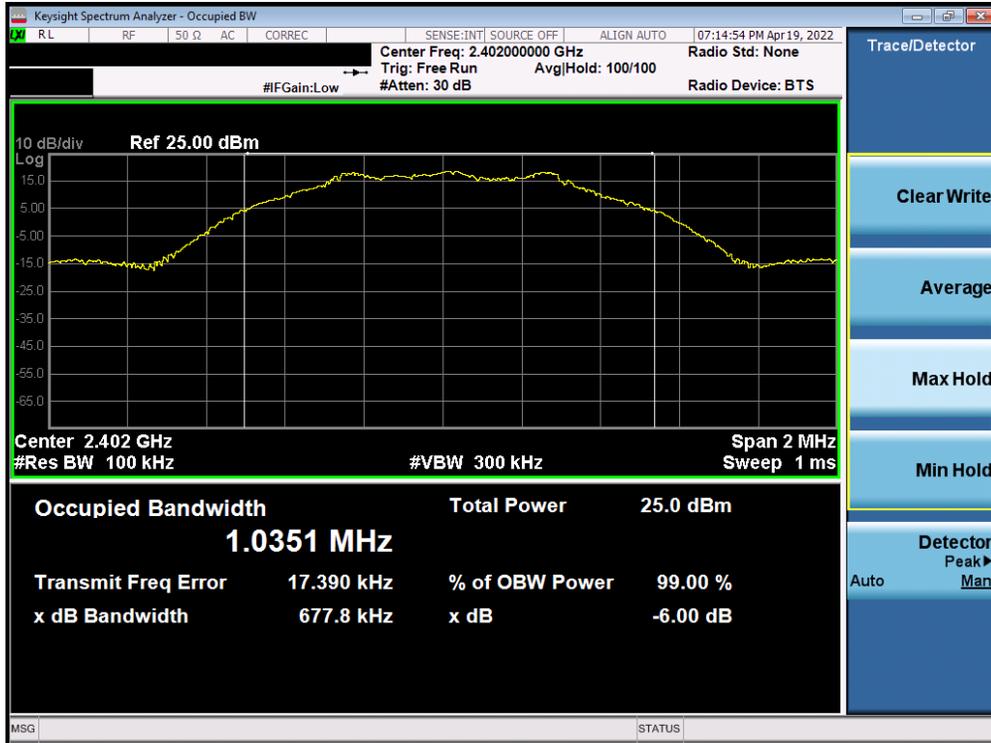


Plot 7-5. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 19) – Antenna 1

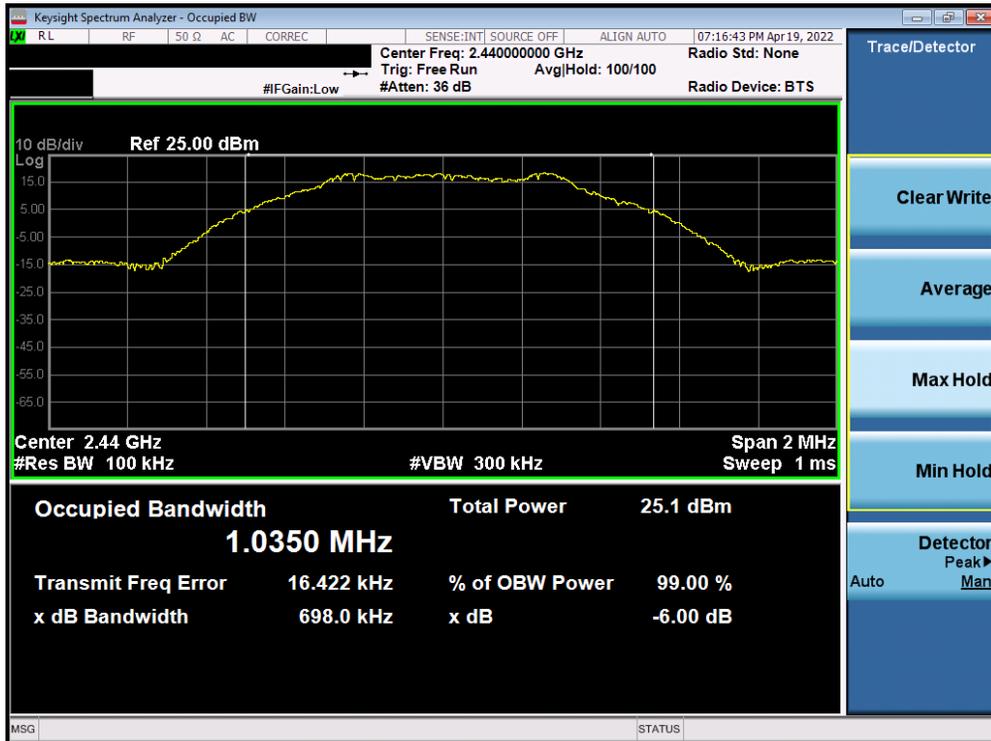


Plot 7-6. 6dB Bandwidth Plot (Bluetooth (LE), 500kbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 16 of 75

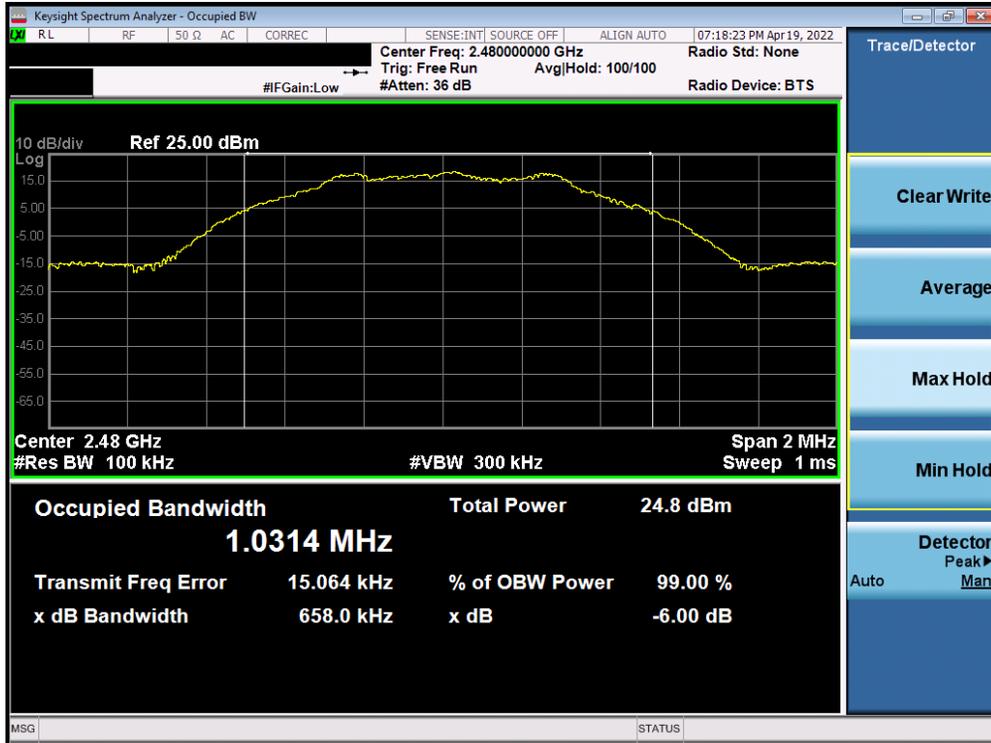


Plot 7-7. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

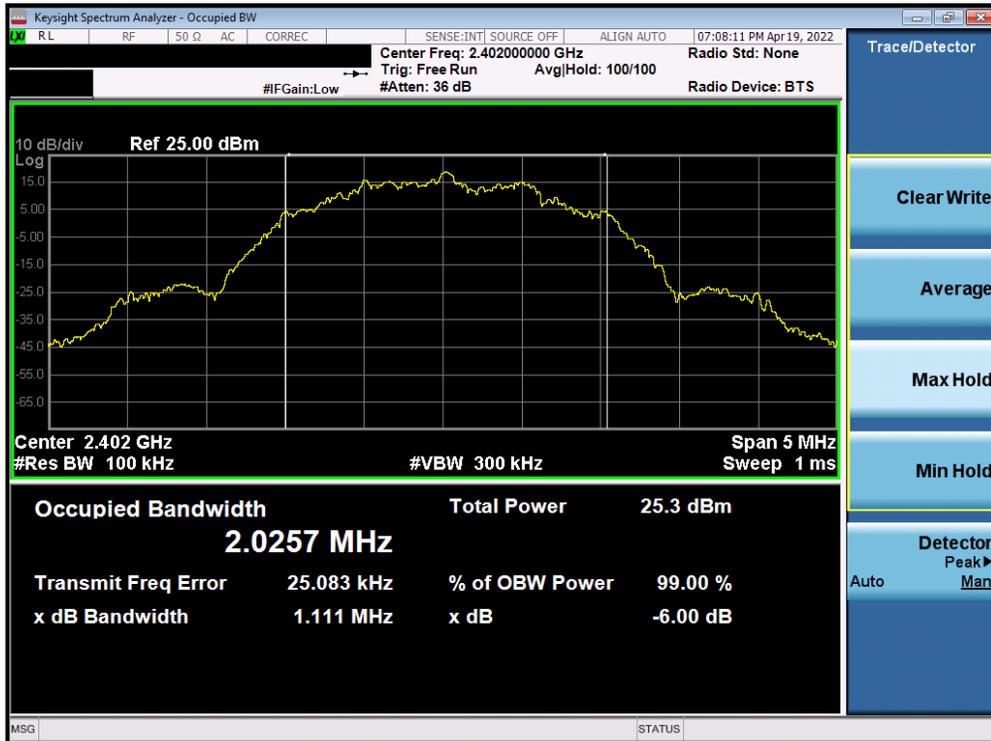


Plot 7-8. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 17 of 75

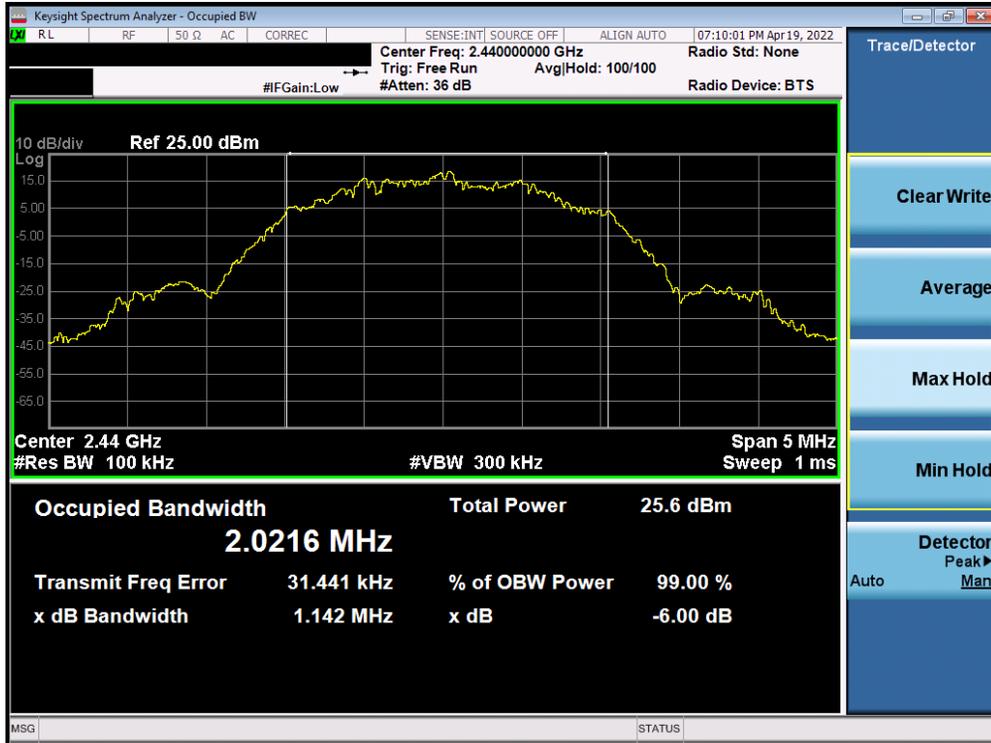


Plot 7-9. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 1

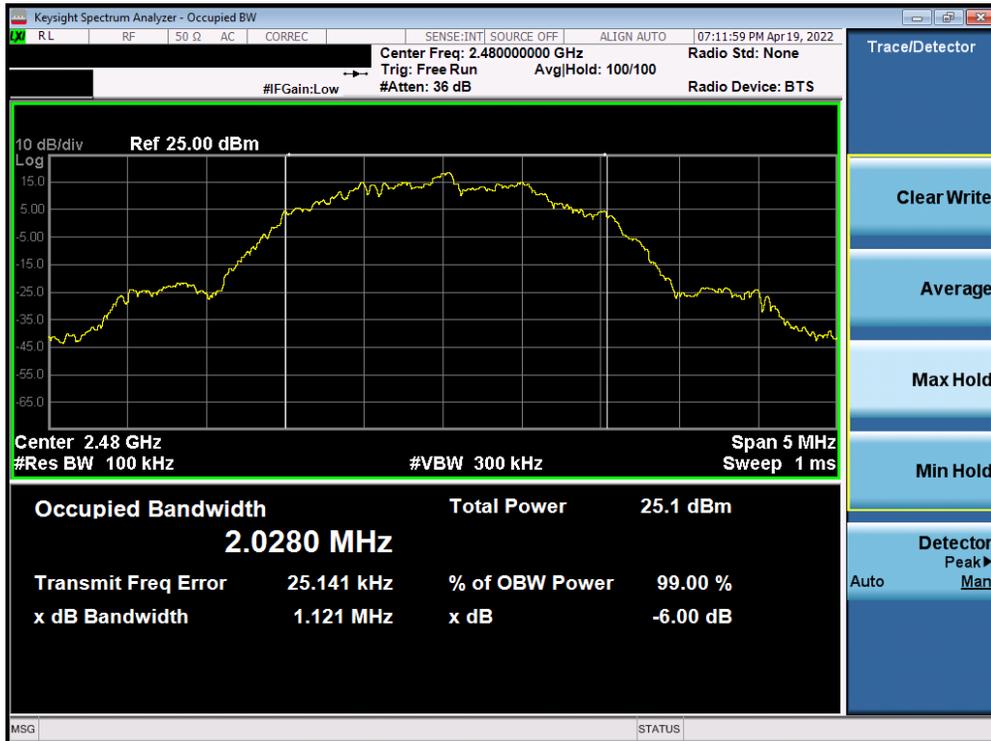


Plot 7-10. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 18 of 75



Plot 7-11. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Antenna 1



Plot 7-12. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 19 of 75	

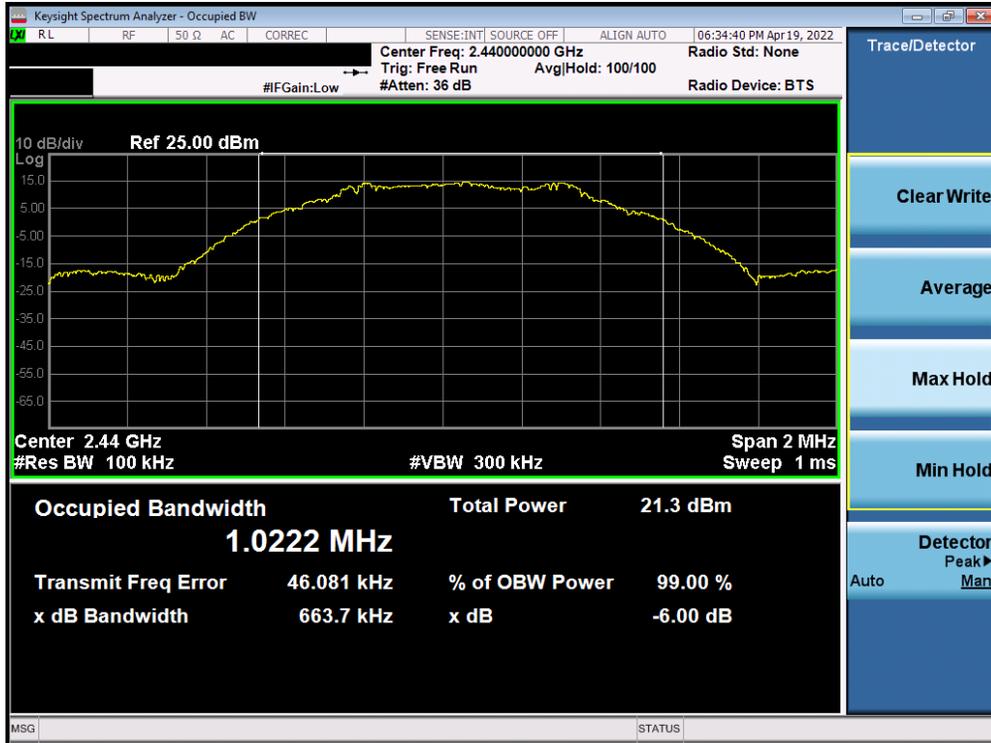
Frequency [MHz]	Data Rate	Channel No.	Bluetooth Mode	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
2402	1 Mbps	0	LE	679.4	500	Pass
2440	1 Mbps	19	LE	663.7	500	Pass
2480	1 Mbps	39	LE	675.9	500	Pass
2402	2 Mbps	0	LE	1111	500	Pass
2440	2 Mbps	19	LE	1140	500	Pass
2480	2 Mbps	39	LE	1125	500	Pass

Table 7-3. Conducted Bandwidth Measurements – Antenna 2

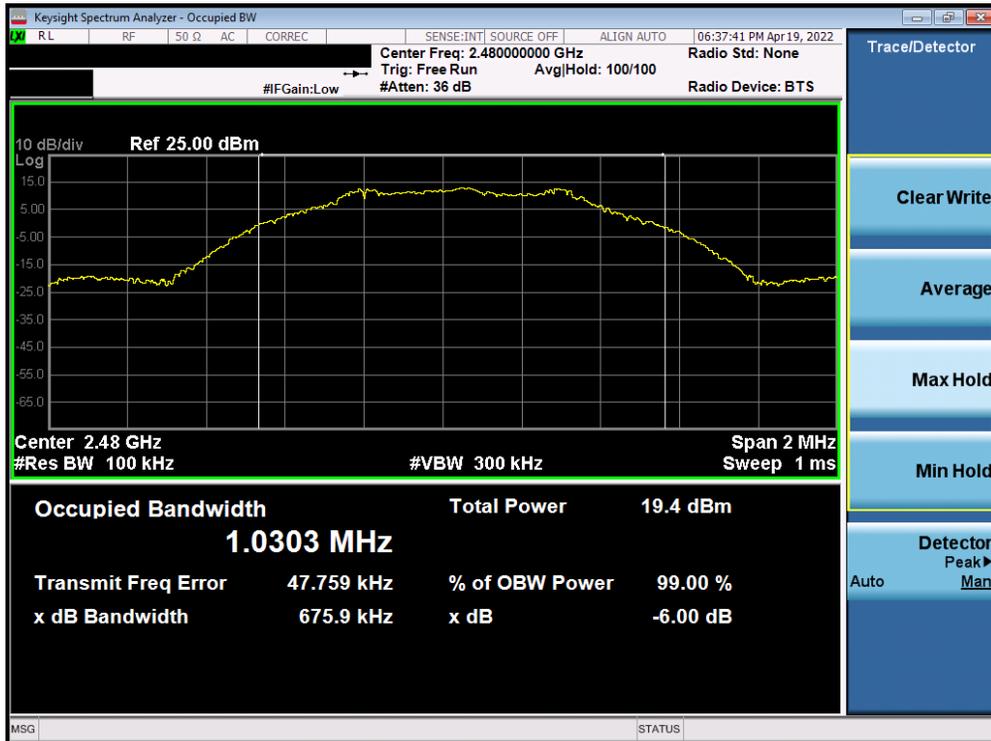


Plot 7-13. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 20 of 75

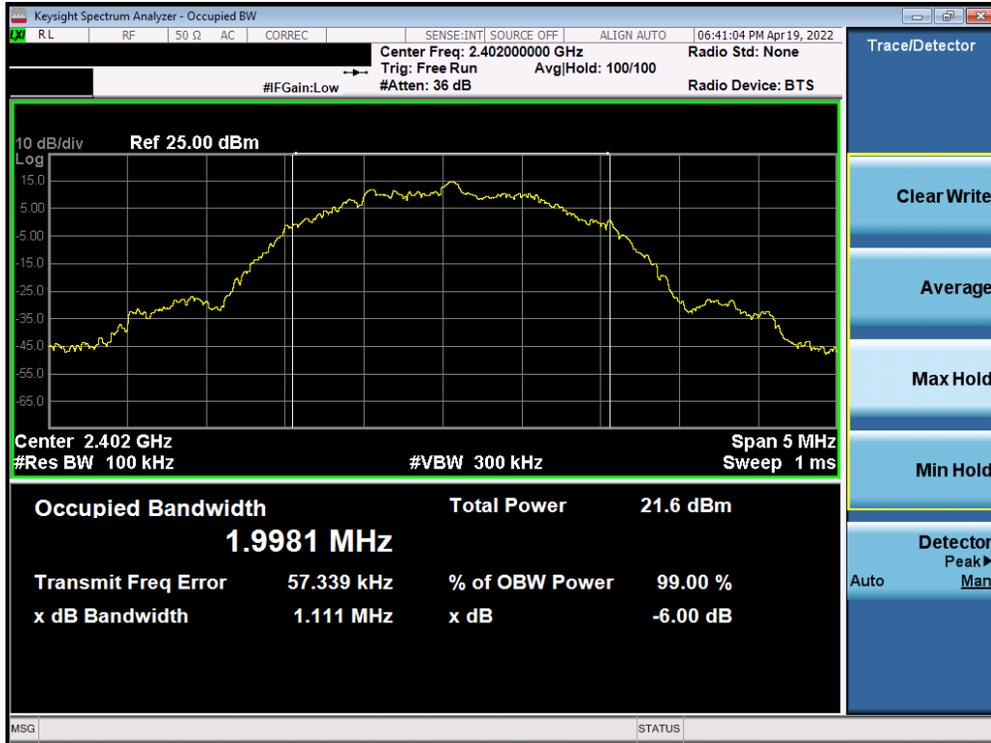


Plot 7-14. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 2

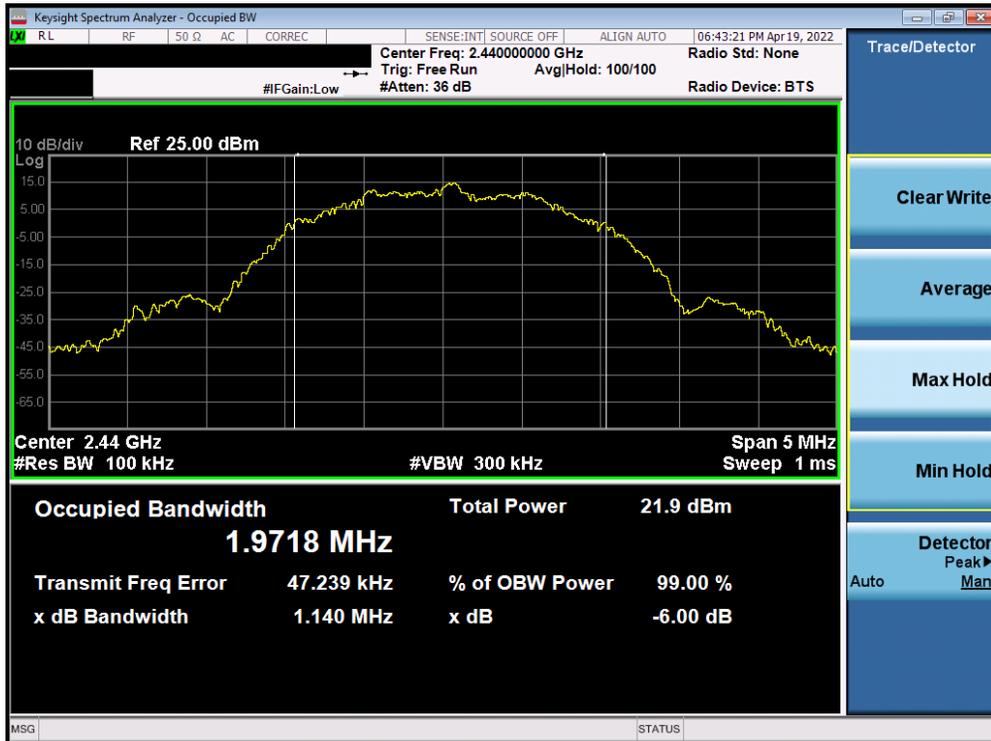


Plot 7-15. 6dB Bandwidth Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 21 of 75

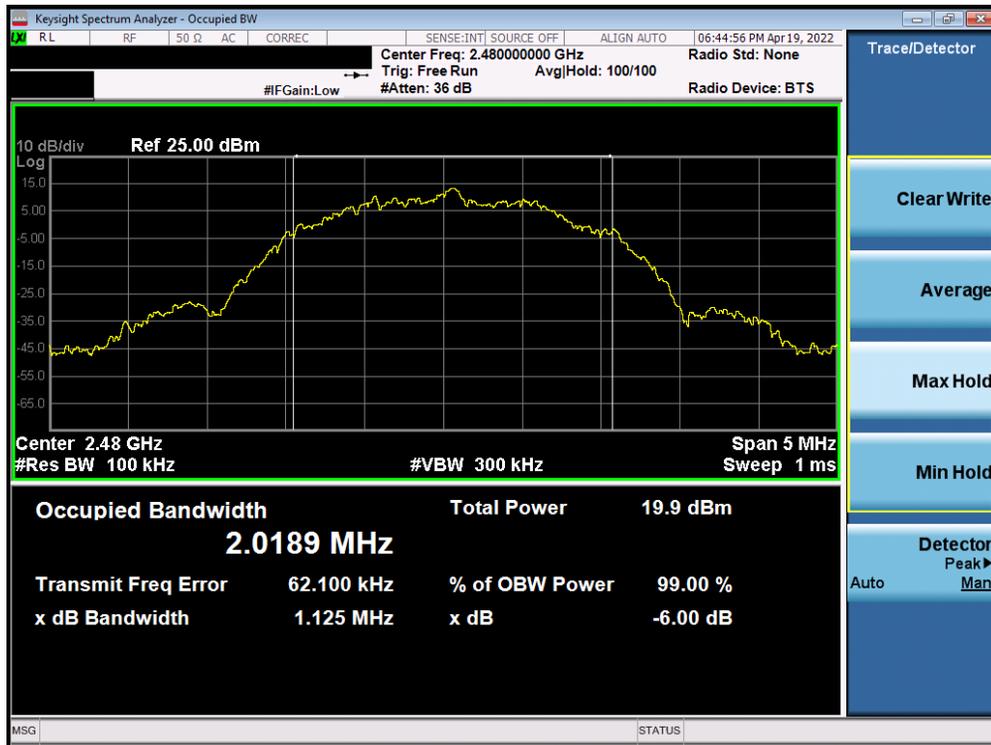


Plot 7-16. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 2



Plot 7-17. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 22 of 75



Plot 7-18. 6dB Bandwidth Plot (Bluetooth (LE), 2Mbps - Ch. 39) - Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 23 of 75

7.3 Output Power Measurement – Bluetooth (LE)

§15.247(b.3); RSS-247 [5.4(4)]

Test Overview and Limits

The transmitter antenna terminal of the EUT is connected to the input of a spectrum analyzer. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.1
KDB 558074 D01 v05r02 – Section 8.3.1.1

Test Settings

1. RBW = 3MHz
2. VBW = 50MHz
3. Span $\geq 3 \times$ RBW
4. Sweep = auto couple
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

Test Setup

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



Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None

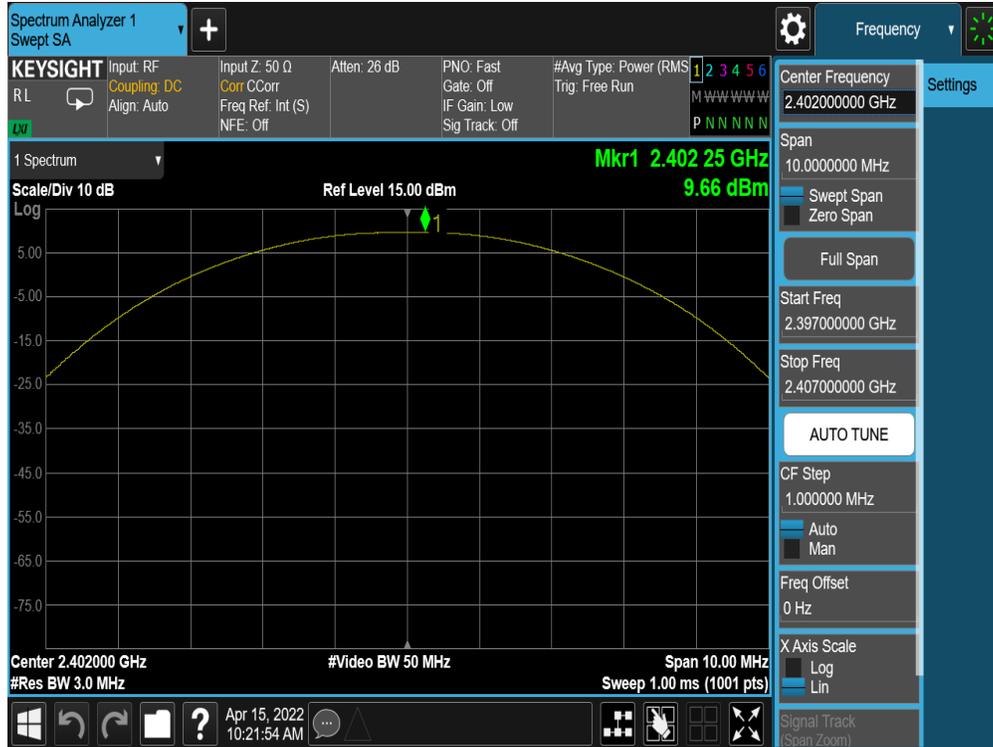
FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 24 of 75

V9.0 02/01/2019

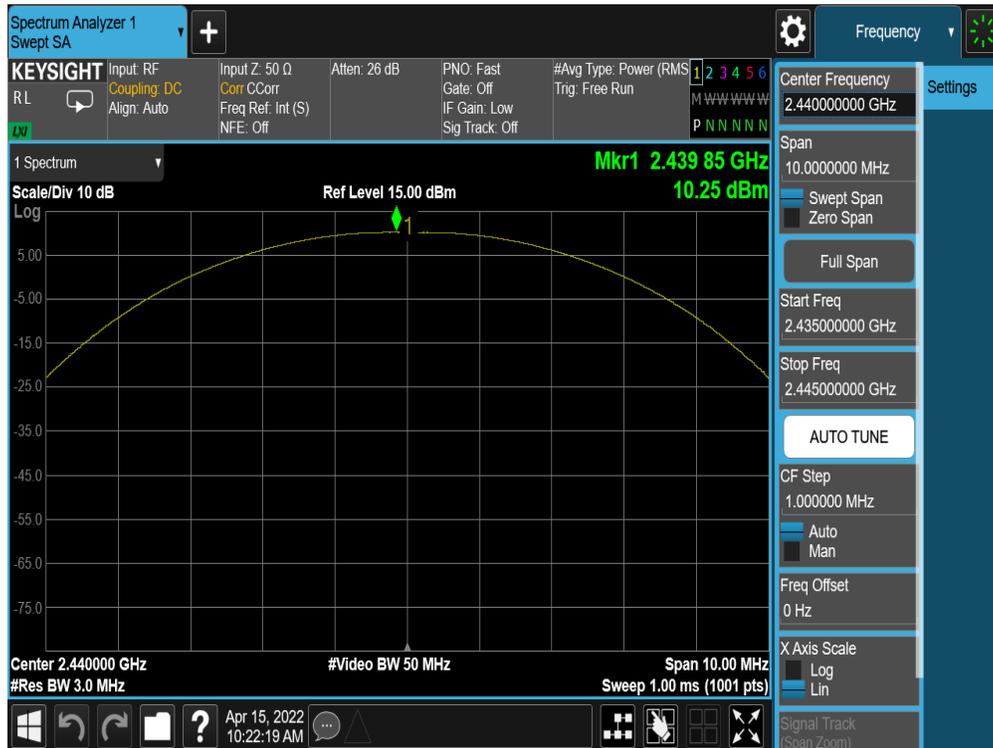
Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power		Ant. Gain [dBi]	EIRP [dBm]	Limit [dBm]	Margin [dB]
				[dBm]	[mW]				
2402	125 kbps	0	LE	9.66	9.247	-2.05	7.61	36.02	-28.41
2440	125 kbps	19	LE	10.25	10.593	-2.05	8.20	36.02	-27.82
2480	125 kbps	39	LE	9.16	8.241	-2.05	7.11	36.02	-28.91
2402	500 kbps	0	LE	9.74	9.419	-2.05	7.69	36.02	-28.33
2440	500 kbps	19	LE	10.31	10.740	-2.05	8.26	36.02	-27.76
2480	500 kbps	39	LE	9.24	8.395	-2.05	7.19	36.02	-28.83
2402	1 Mbps	0	LE	18.65	73.282	-2.05	16.60	36.02	-19.42
2440	1 Mbps	19	LE	18.96	78.705	-2.05	16.91	36.02	-19.11
2480	1 Mbps	39	LE	18.59	72.277	-2.05	16.54	36.02	-19.48
2402	2 Mbps	0	LE	18.90	77.625	-2.05	16.85	36.02	-19.17
2440	2 Mbps	19	LE	19.32	85.507	-2.05	17.27	36.02	-18.75
2480	2 Mbps	39	LE	19.06	80.538	-2.05	17.01	36.02	-19.01

Table 7-4. Conducted Output Power Measurements (Bluetooth (LE)) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 25 of 75

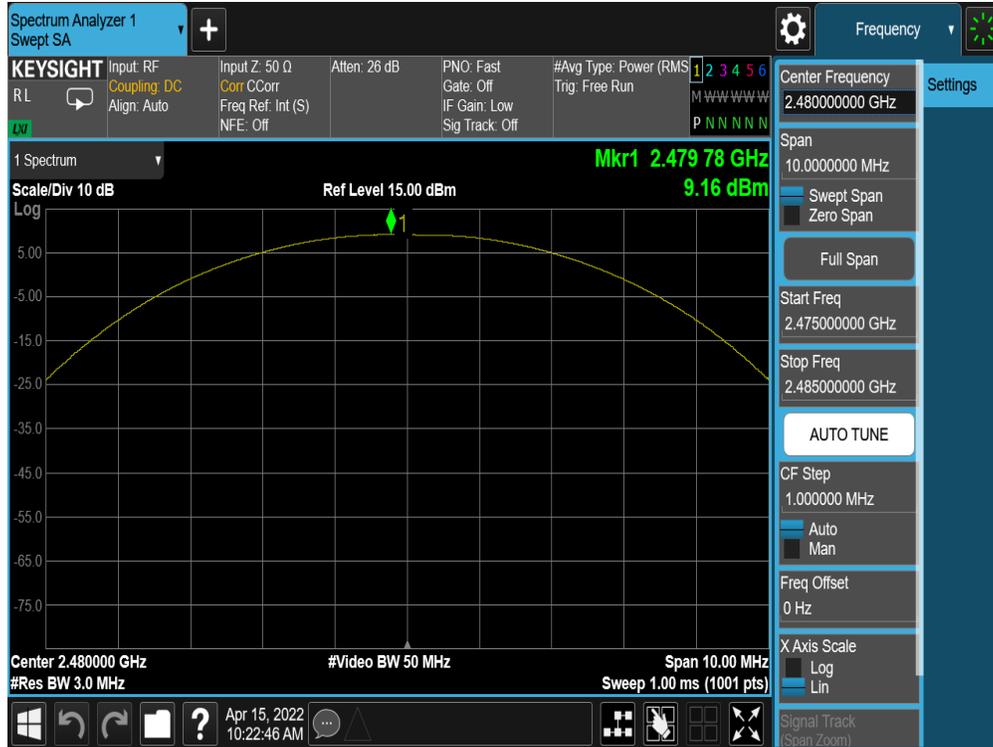


Plot 7-19. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 0) – Antenna 1

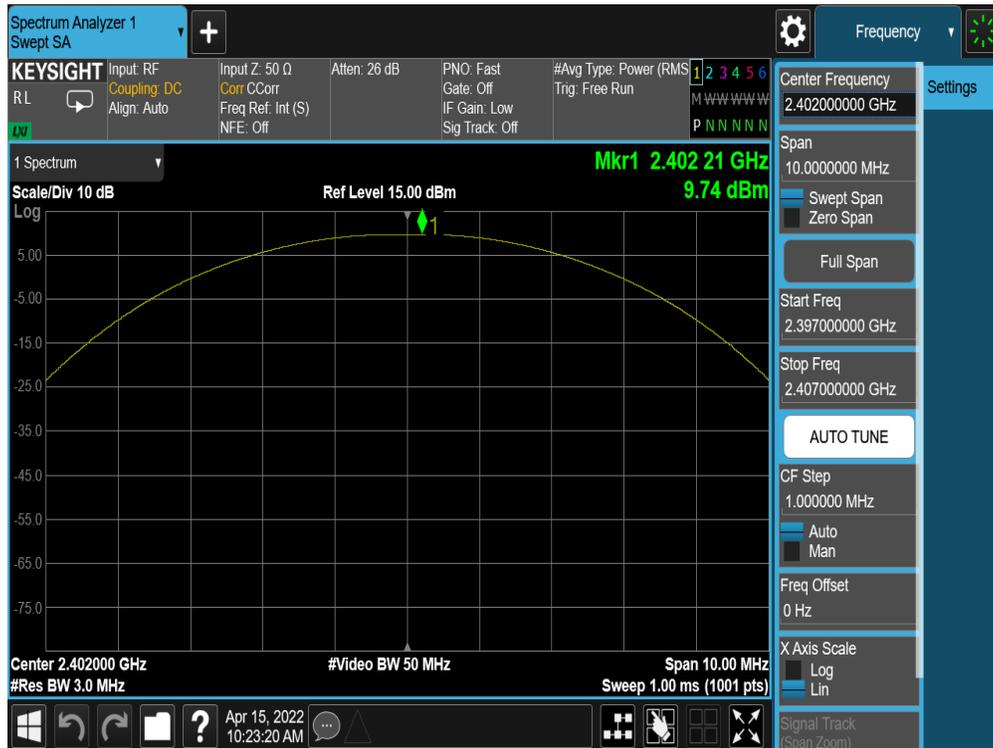


Plot 7-20. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 26 of 75

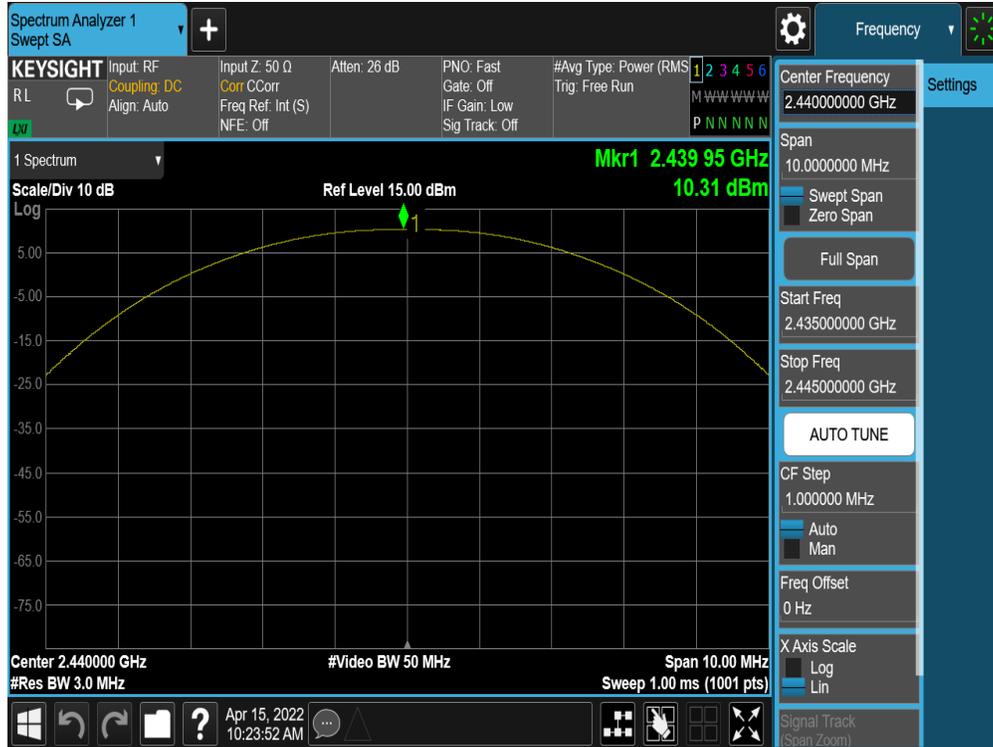


Plot 7-21. Peak Power Plot (Bluetooth (LE), 125kbps – Ch. 39) – Antenna 1

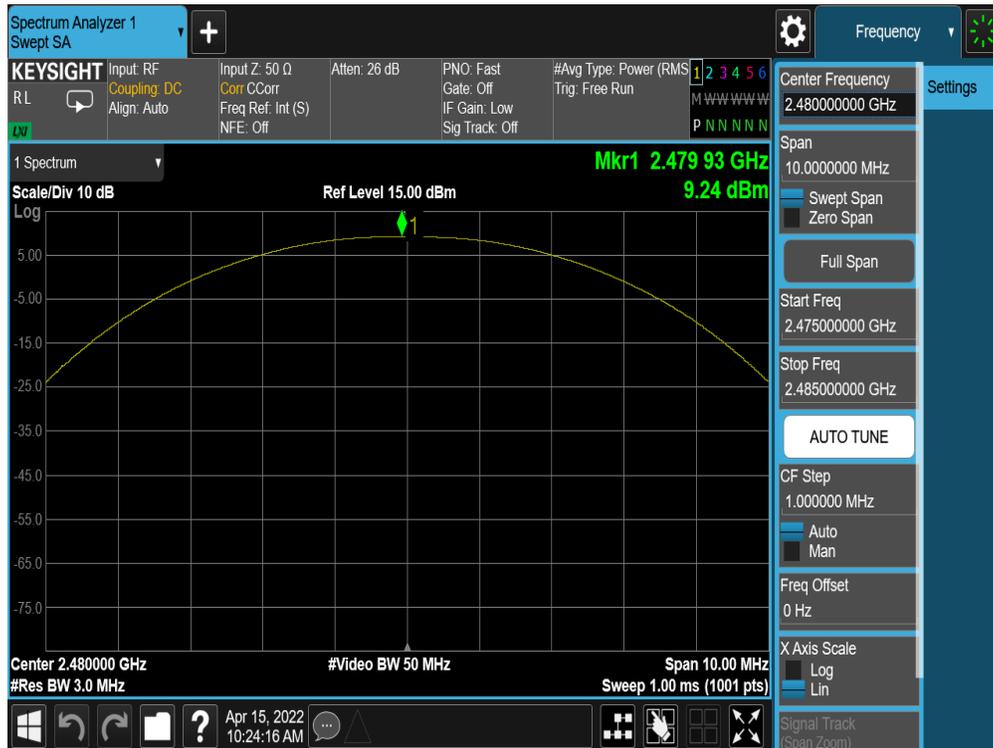


Plot 7-22. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 27 of 75

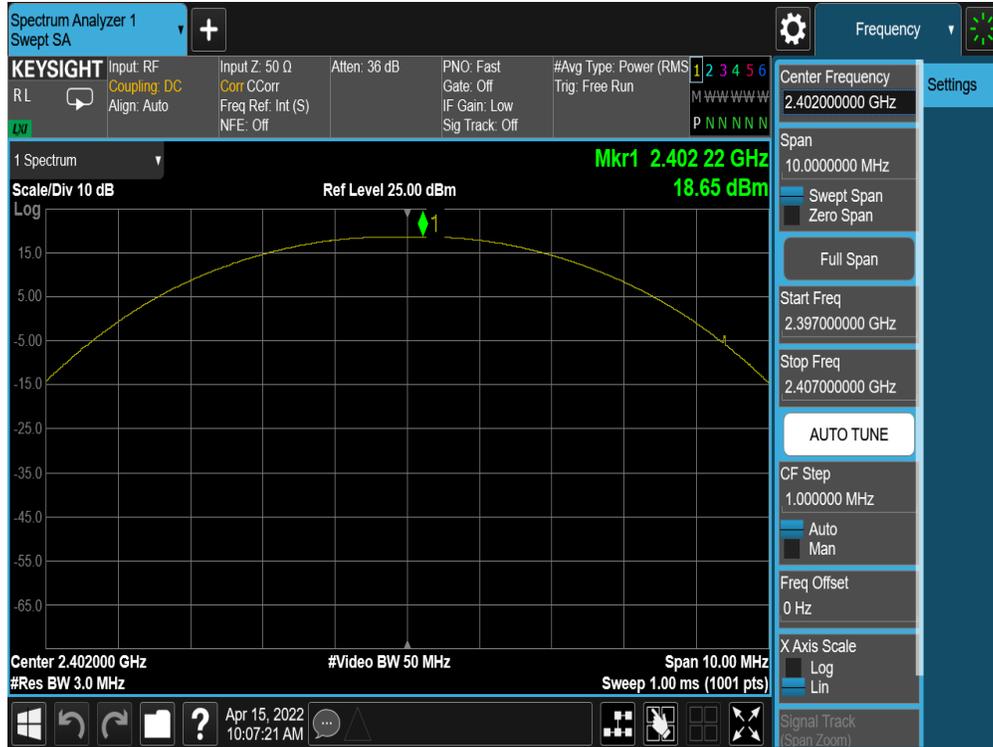


Plot 7-23. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 19) – Antenna 1



Plot 7-24. Peak Power Plot (Bluetooth (LE), 500kbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 28 of 75

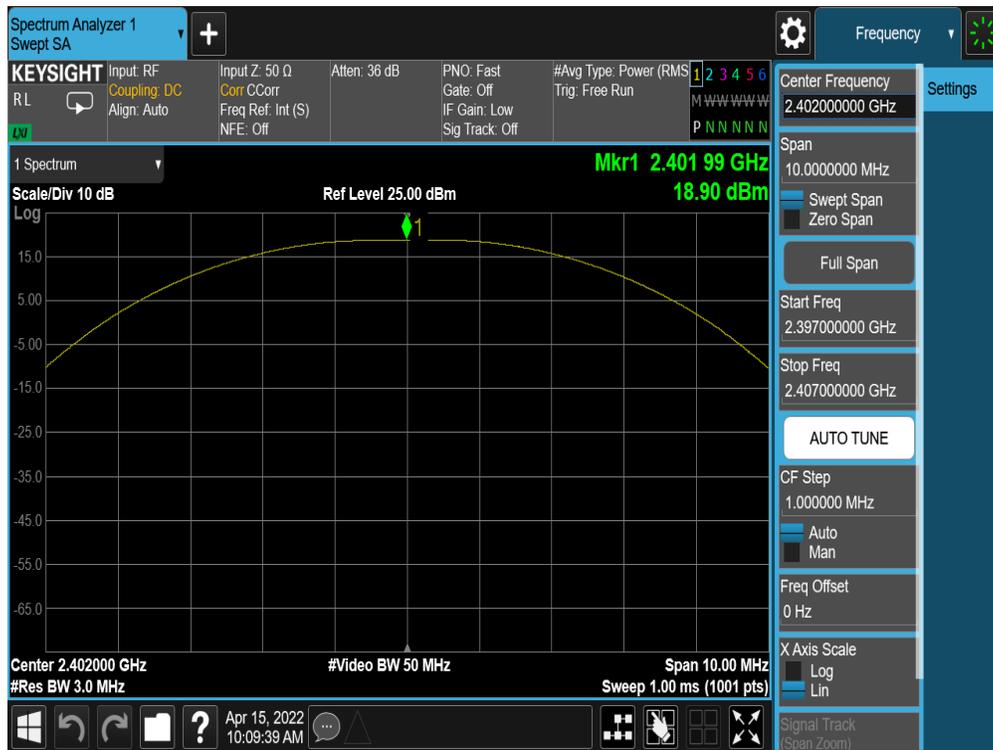
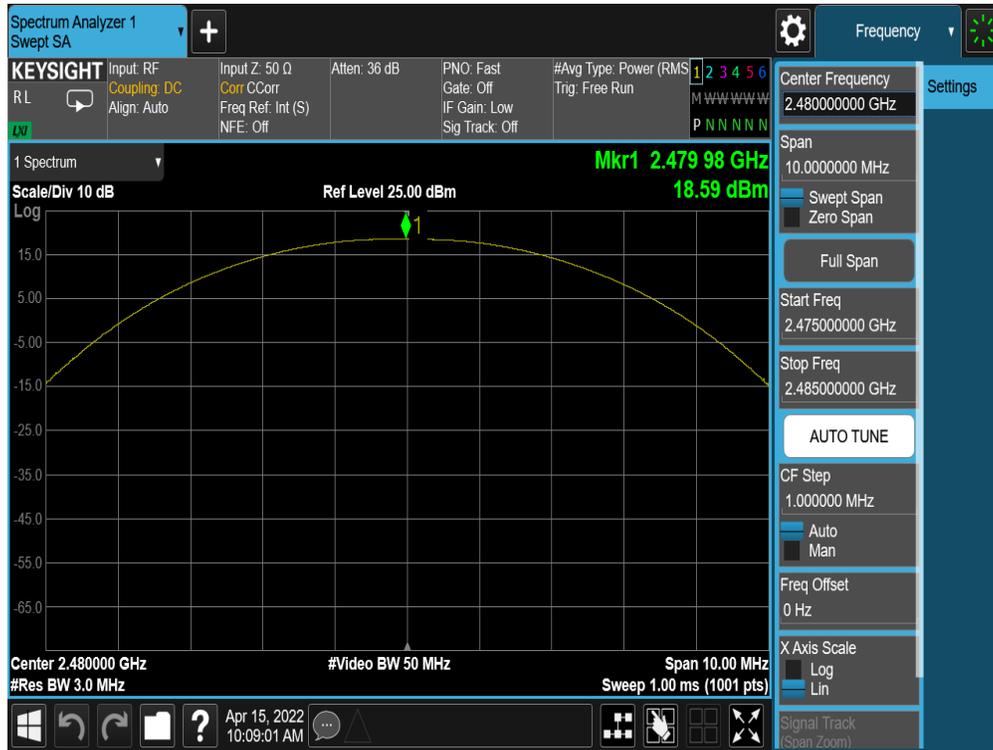


Plot 7-25. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

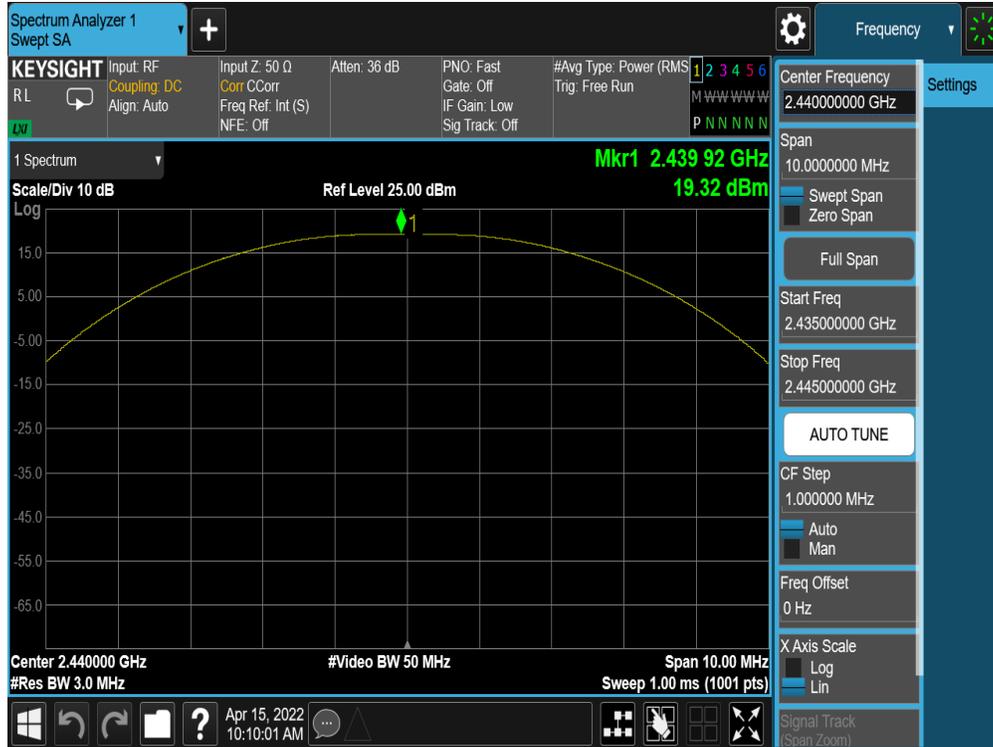


Plot 7-26. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 29 of 75



FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 30 of 75



FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 31 of 75

Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Peak Conducted Power		Ant. Gain [dBi]	EIRP [dBm]	Limit [dBm]	Margin [dB]
				[dBm]	[mW]				
2402	1 Mbps	0	LE	15.16	32.832	-5.15	10.01	36.02	-26.01
2440	1 Mbps	19	LE	15.42	34.818	-5.15	10.27	36.02	-25.75
2480	1 Mbps	39	LE	13.58	22.803	-5.15	8.43	36.02	-27.59
2402	2 Mbps	0	LE	15.52	35.678	-5.15	10.37	36.02	-25.65
2440	2 Mbps	19	LE	15.80	38.019	-5.15	10.65	36.02	-25.37
2480	2 Mbps	39	LE	14.08	25.568	-5.15	8.93	36.02	-27.09

Table 7-5. Conducted Output Power Measurements (Bluetooth (LE)) – Antenna 2



Plot 7-31. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

MEASUREMENT REPORT (CERTIFICATION)			Approved by: Technical Manager
FCC ID: A3LSMF936U	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 32 of 75

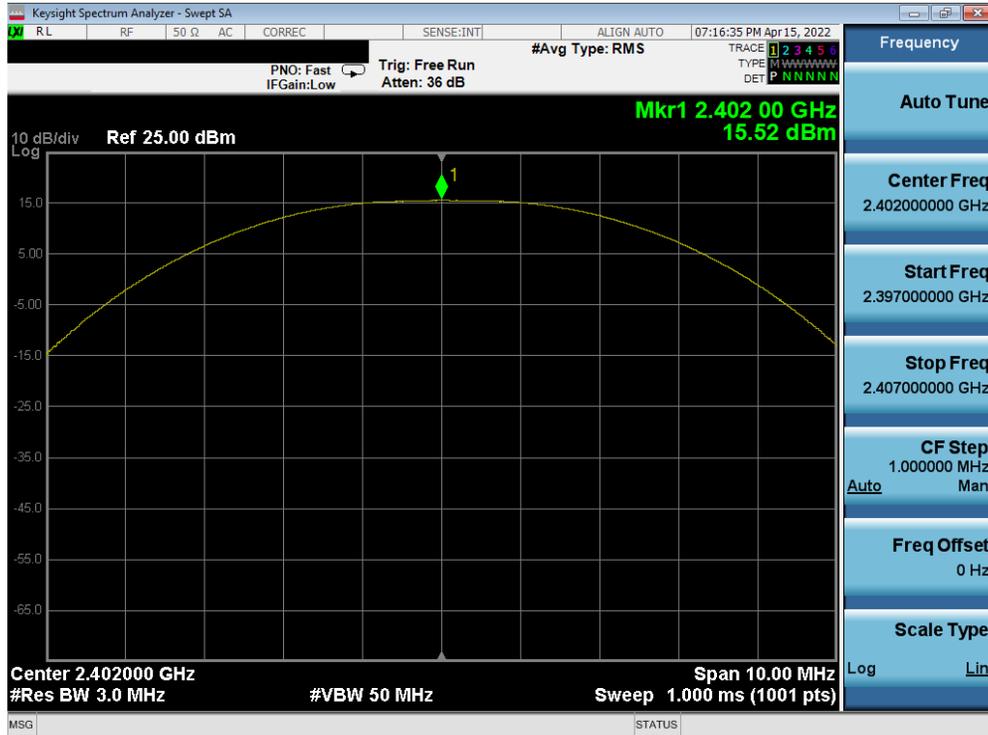


Plot 7-32. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 2

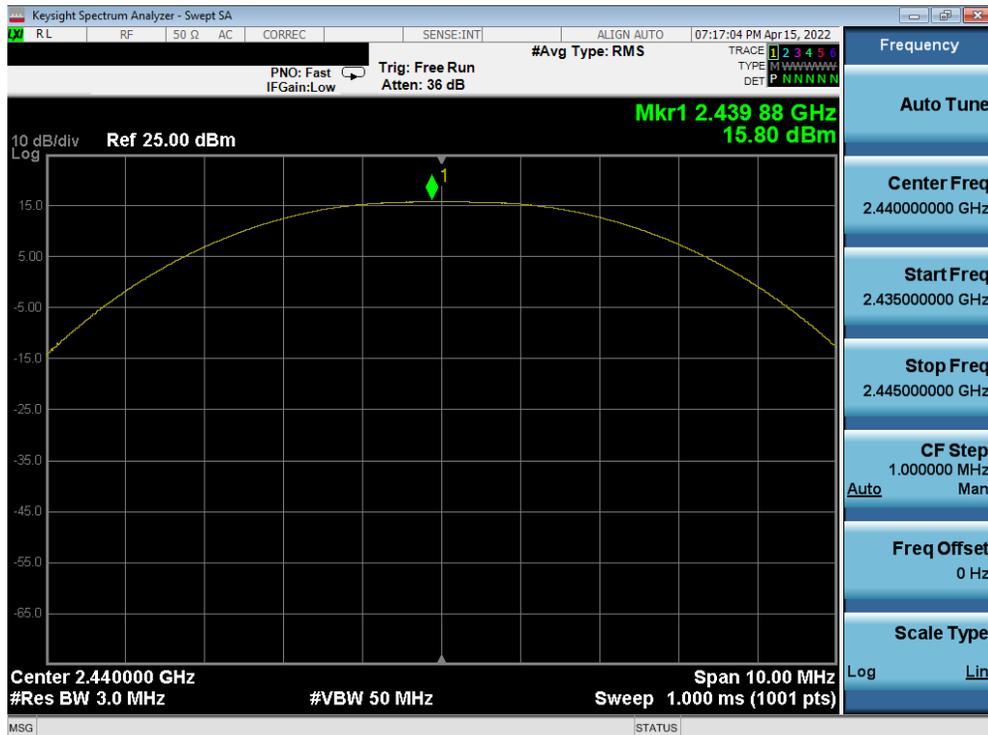


Plot 7-33. Peak Power Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 33 of 75



Plot 7-34. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 2



Plot 7-35. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 34 of 75



Plot 7-36. Peak Power Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 35 of 75

7.4 Power Spectral Density – Bluetooth (LE)

§15.247(e); RSS-247 [5.2]

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Section 11.10.2 Method PKPSD

KDB 558074 D01 v05r02 – Section 8.4 DTS Maximum Power Spectral Density level in the fundamental emission

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

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



Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

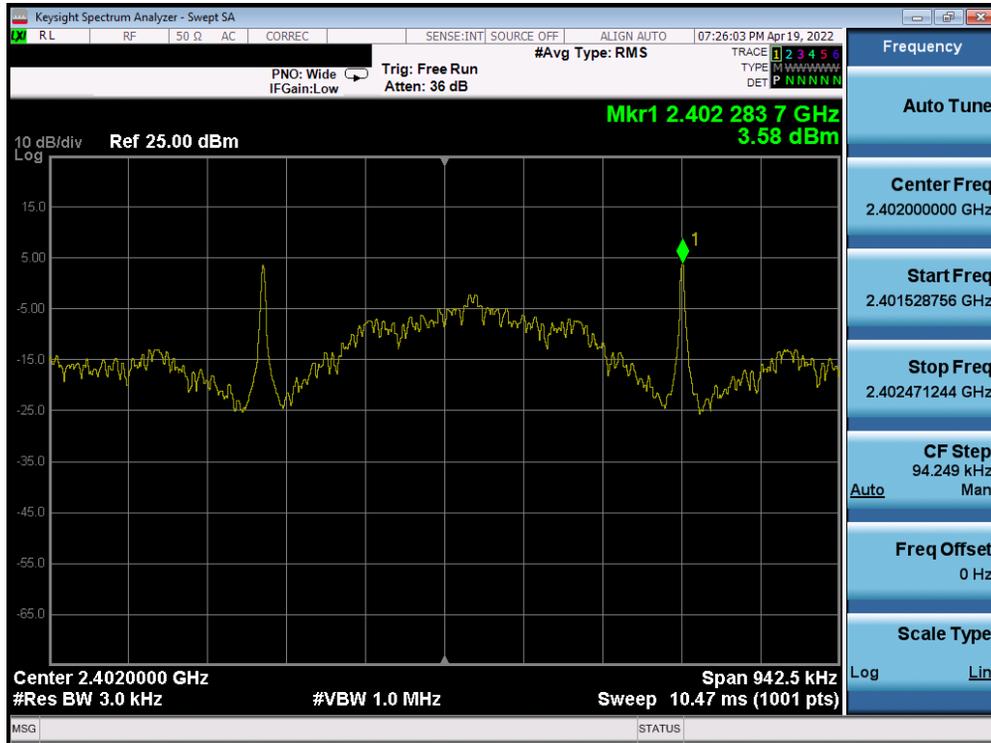
FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 36 of 75

V9.0 02/01/2019

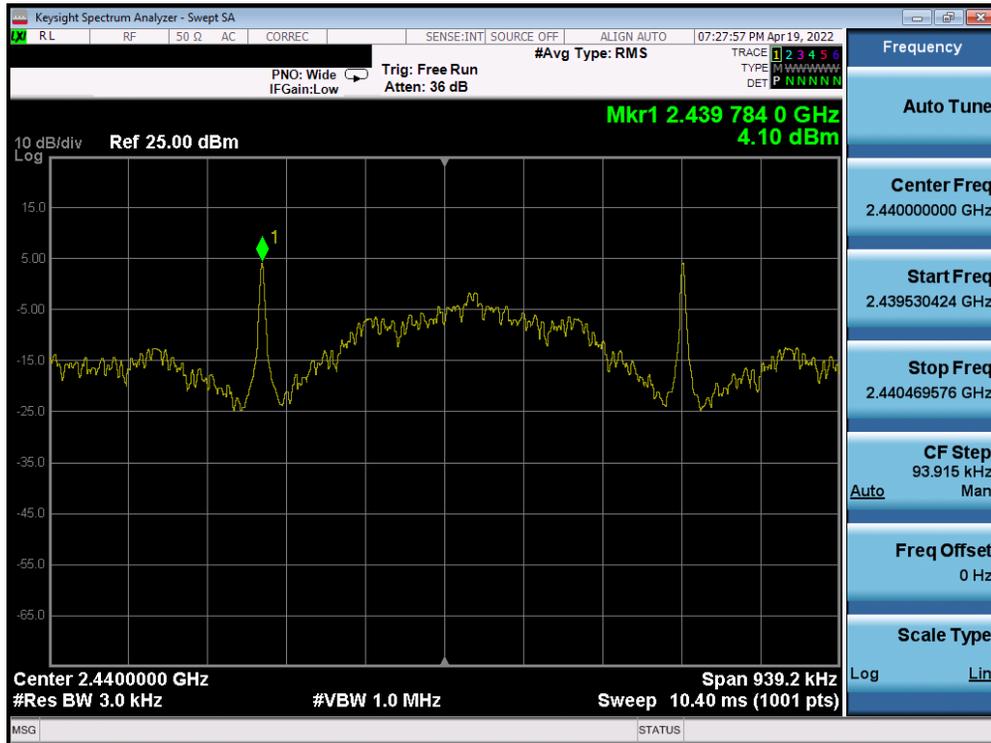
Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	125 kbps	0	LE	3.58	8.0	-4.42
2440	125 kbps	19	LE	4.10	8.0	-3.90
2480	125 kbps	39	LE	3.12	8.0	-4.88
2402	500 kbps	0	LE	3.45	8.0	-4.55
2440	500 kbps	19	LE	4.00	8.0	-4.00
2480	500 kbps	39	LE	3.01	8.0	-4.99
2402	1 Mbps	0	LE	3.95	8.0	-4.05
2440	1 Mbps	19	LE	4.32	8.0	-3.68
2480	1 Mbps	39	LE	3.80	8.0	-4.20
2402	2 Mbps	0	LE	1.19	8.0	-6.81
2440	2 Mbps	19	LE	1.58	8.0	-6.42
2480	2 Mbps	39	LE	1.29	8.0	-6.71

Table 7-6. Conducted Power Density Measurements

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 37 of 75

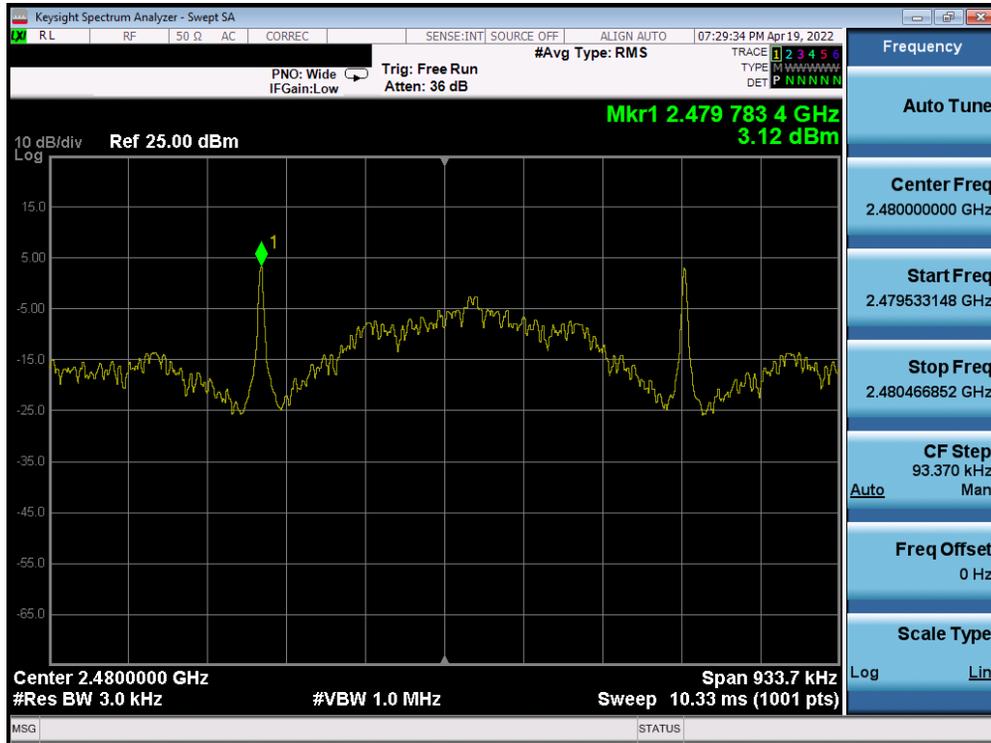


Plot 7-37. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 0) – Antenna 1

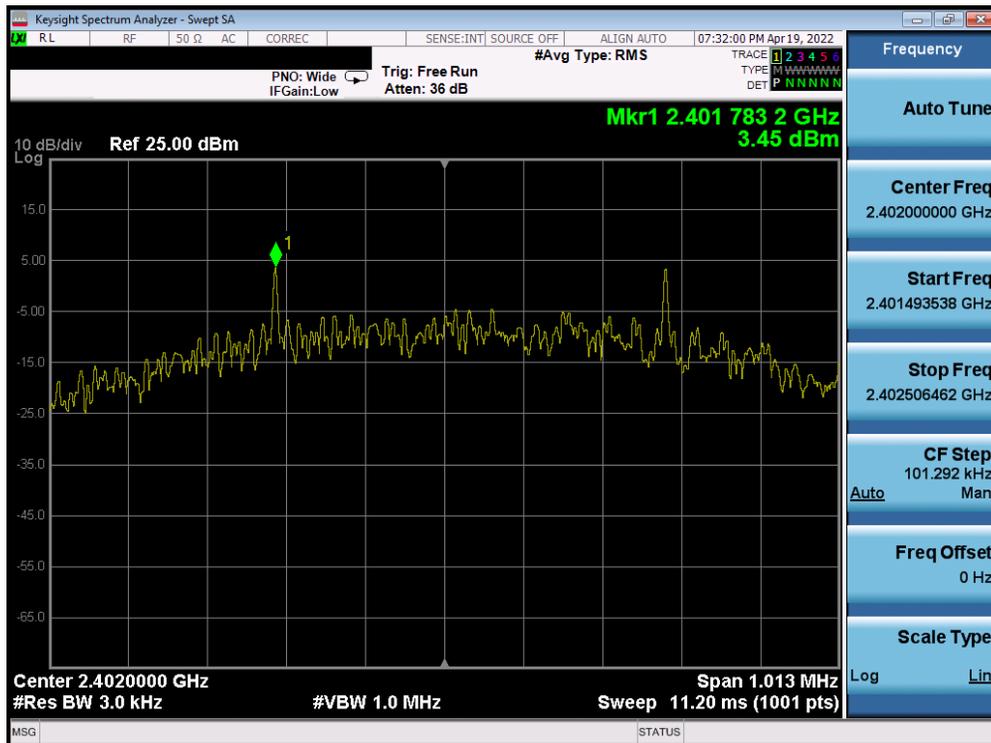


Plot 7-38. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 38 of 75

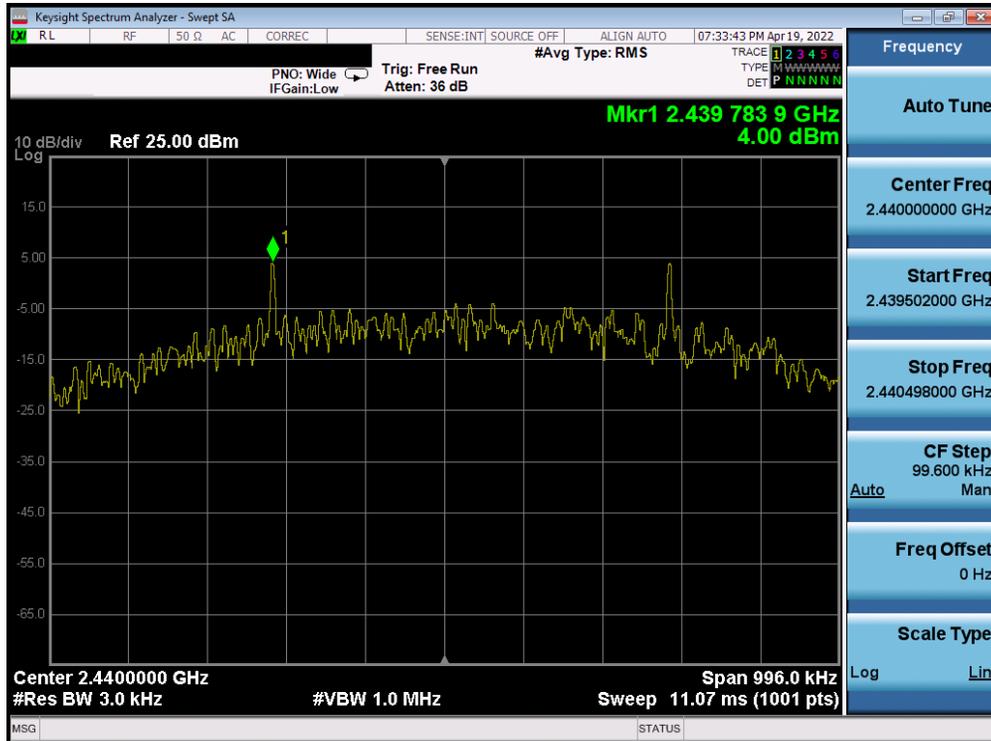


Plot 7-39. Power Spectral Density Plot (Bluetooth (LE), 125kbps – Ch. 39) – Antenna 1

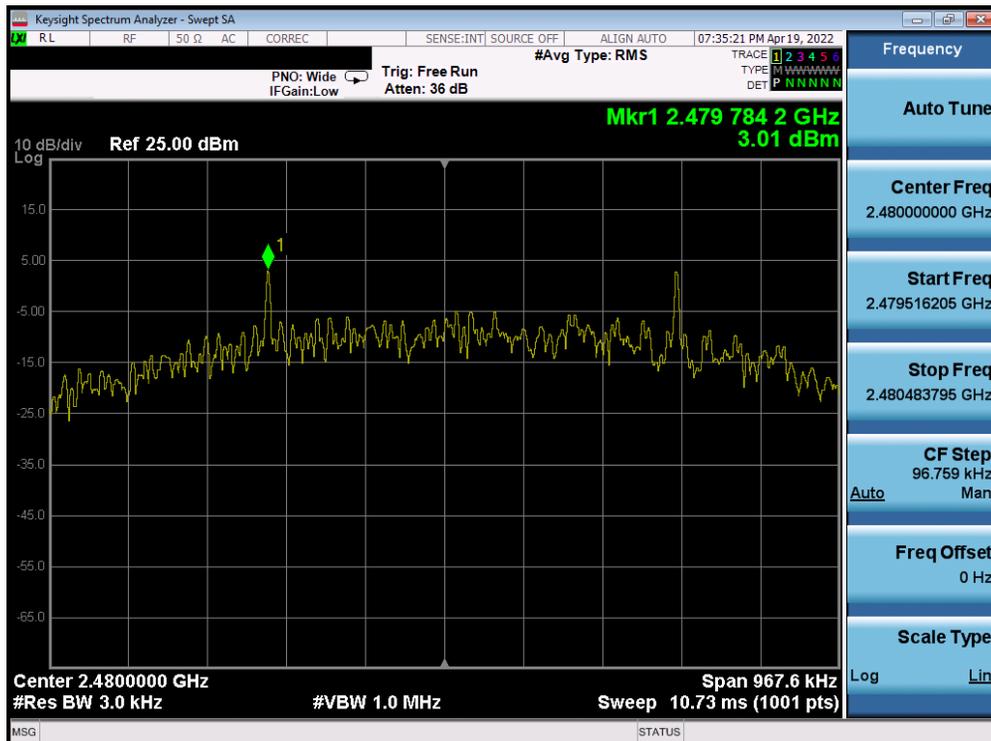


Plot 7-40. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 39 of 75

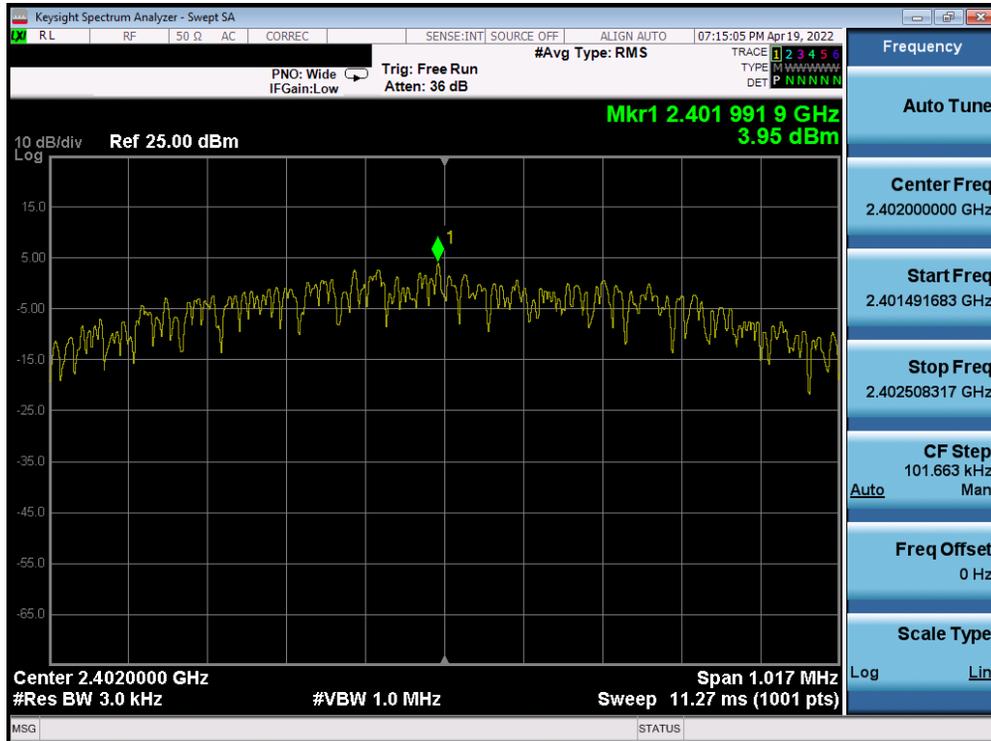


Plot 7-41. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 19) – Antenna 1

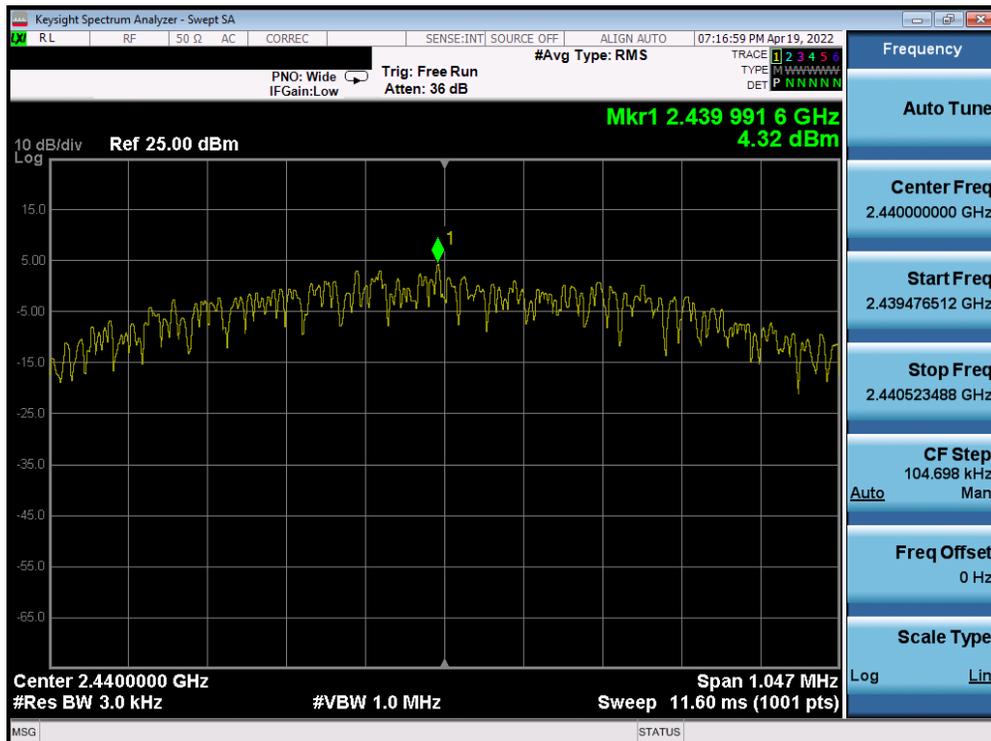


Plot 7-42. Power Spectral Density Plot (Bluetooth (LE), 500kbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 40 of 75

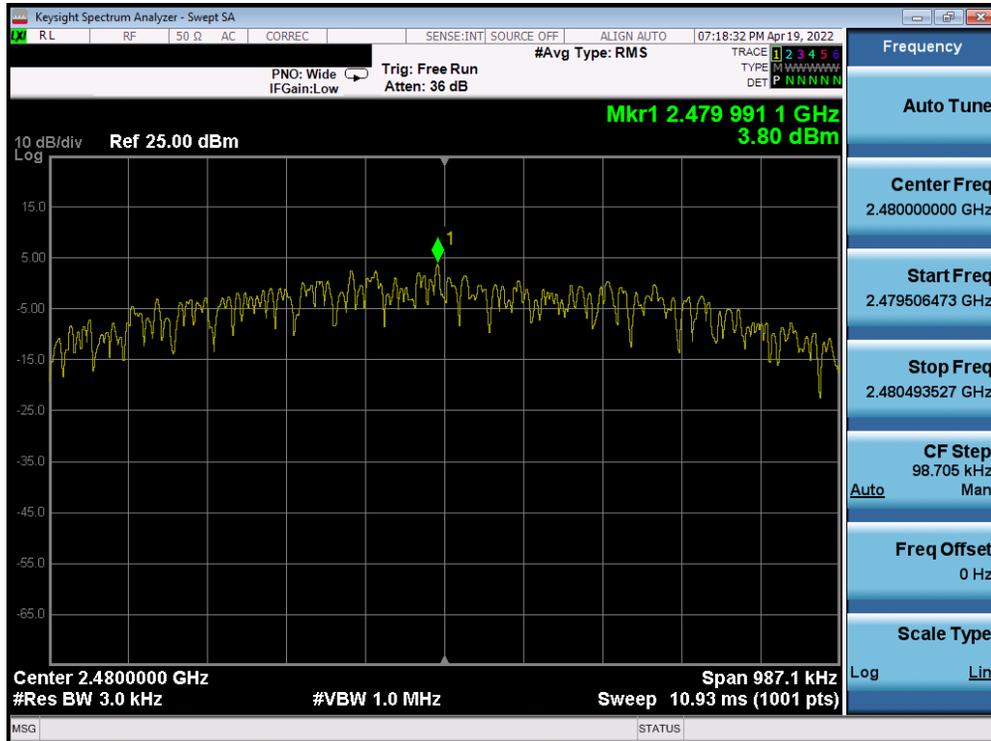


Plot 7-43. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

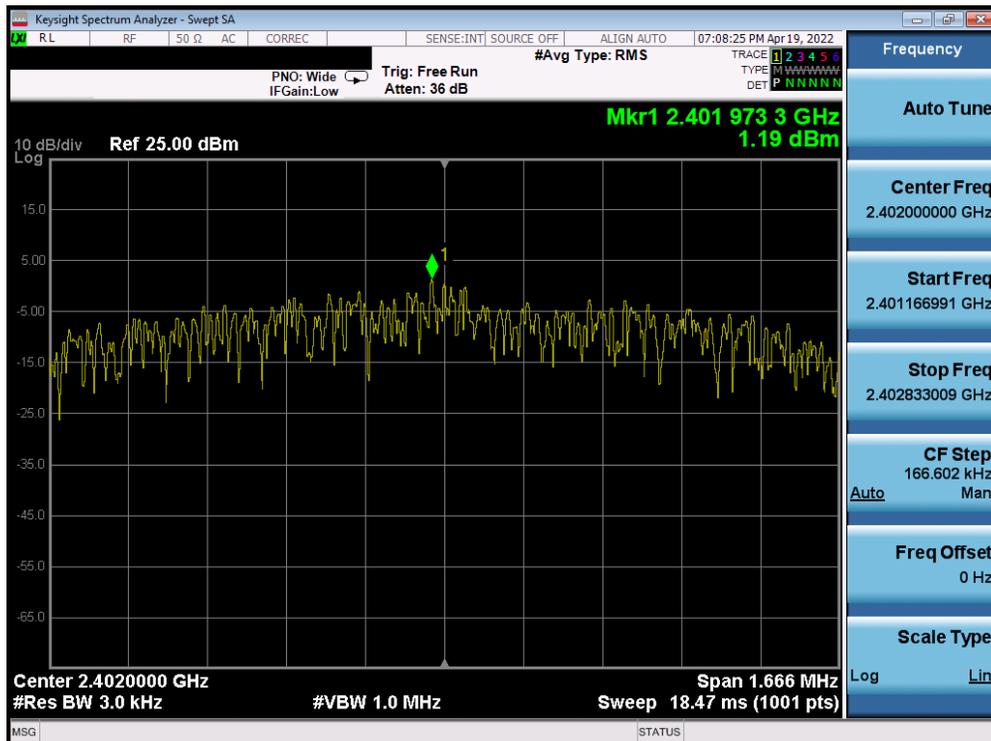


Plot 7-44. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 41 of 75

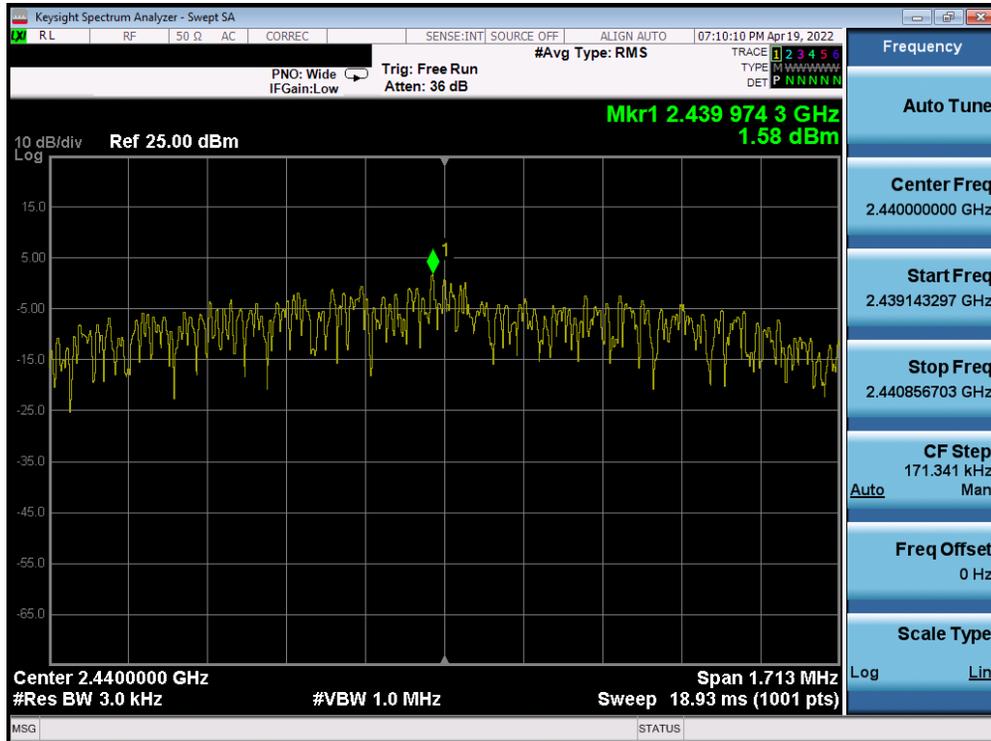


Plot 7-45. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 1

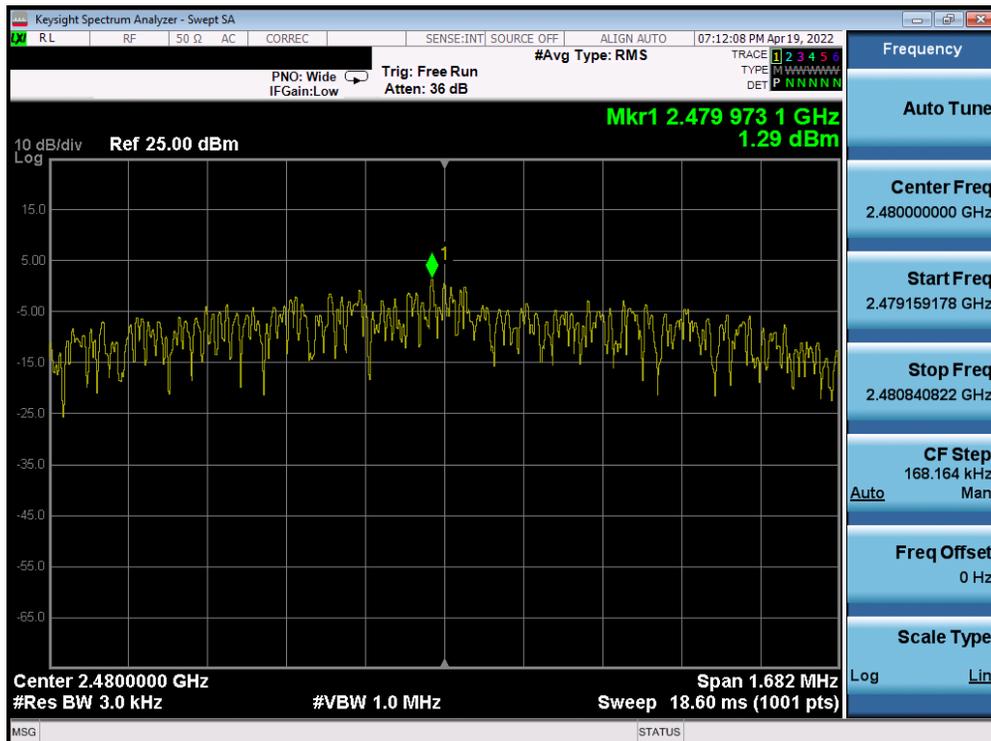


Plot 7-46. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 42 of 75



Plot 7-47. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Antenna 1

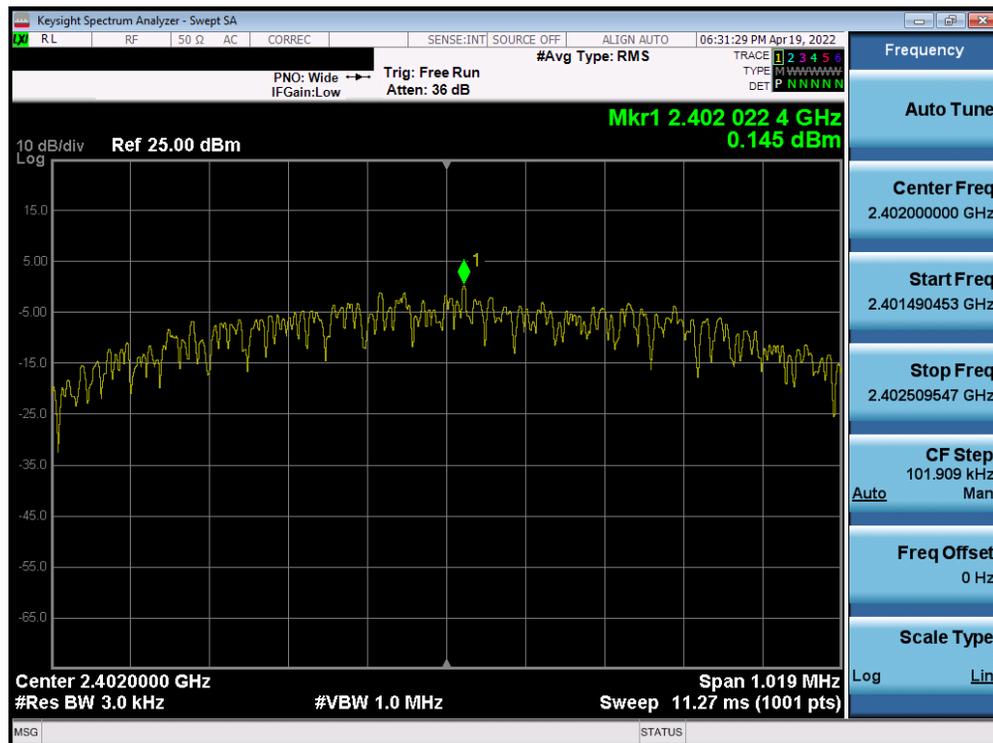


Plot 7-48. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 43 of 75

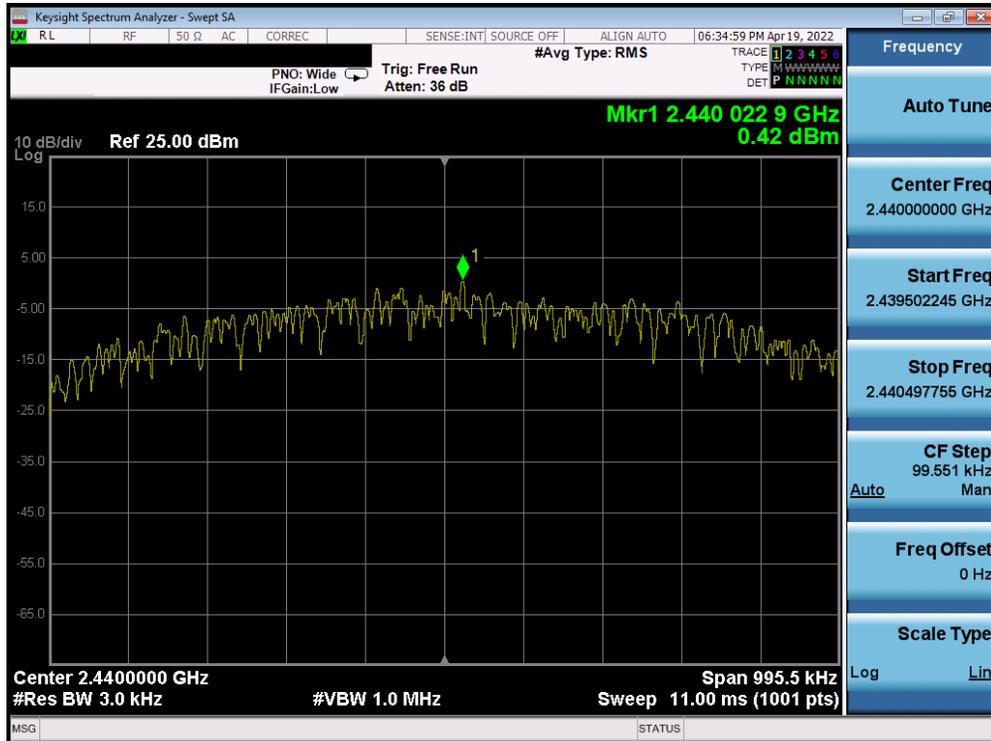
Frequency [MHz]	Data Rate [Mbps]	Channel No.	Bluetooth Mode	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	1 Mbps	0	LE	0.15	8.0	-7.86
2440	1 Mbps	19	LE	0.42	8.0	-7.59
2480	1 Mbps	39	LE	-1.53	8.0	-9.53
2402	2 Mbps	0	LE	-2.65	8.0	-10.65
2440	2 Mbps	19	LE	-2.38	8.0	-10.38
2480	2 Mbps	39	LE	-4.08	8.0	-12.08

Table 7-7. Conducted Power Density Measurements – Antenna 2

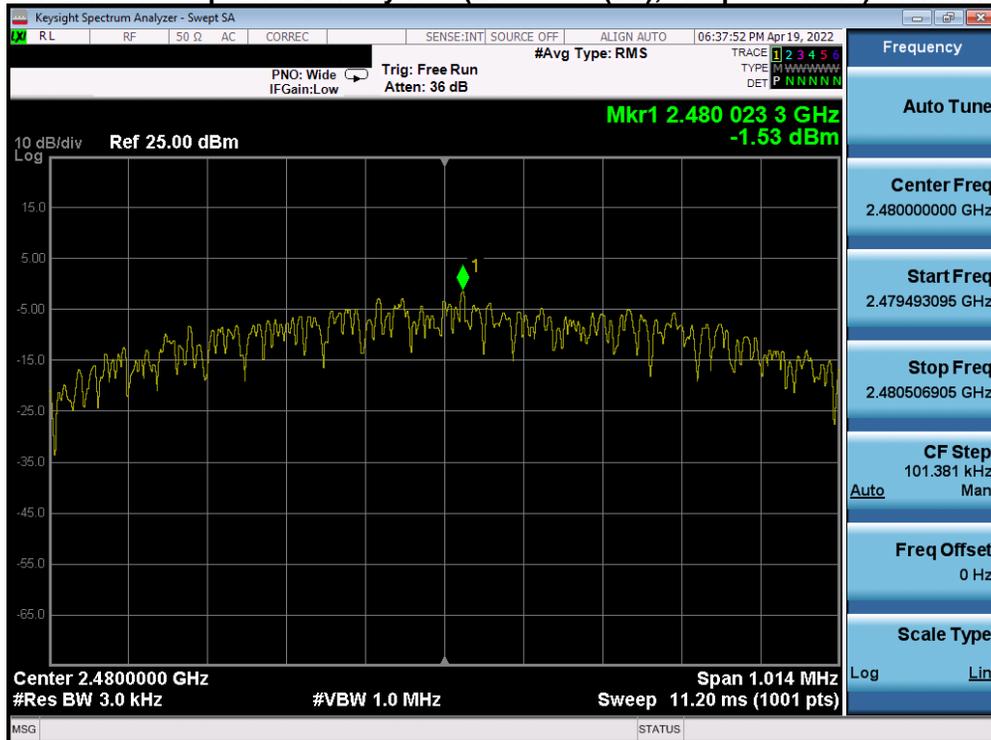


Plot 7-49. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

FCC ID: A3LSMF936U		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 44 of 75	

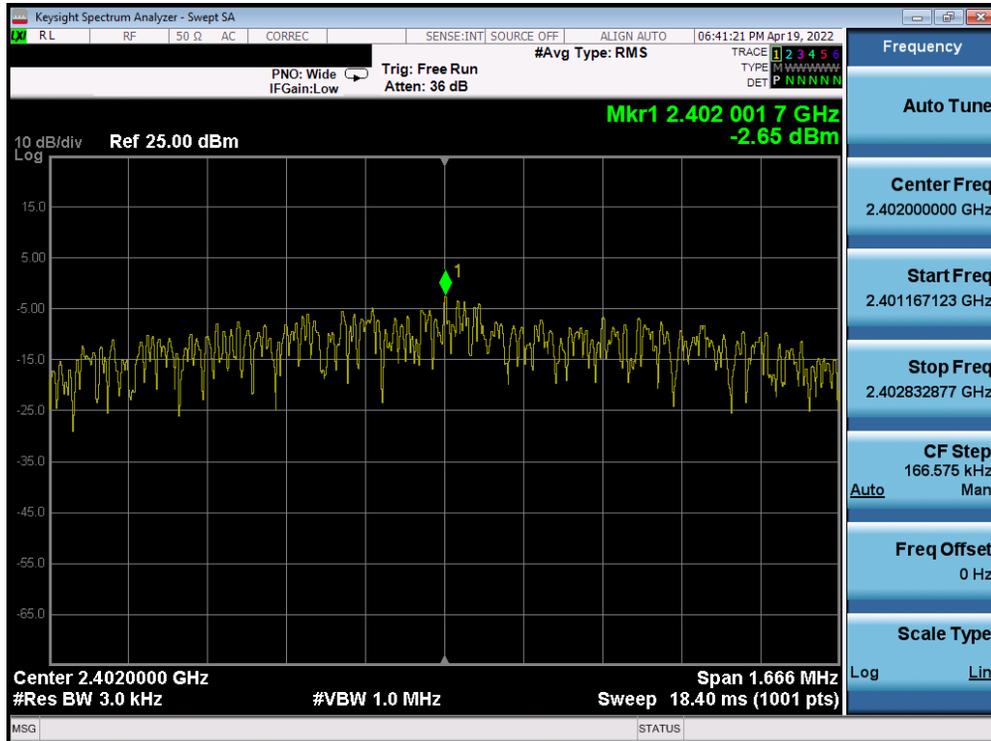


Plot 7-50. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 2

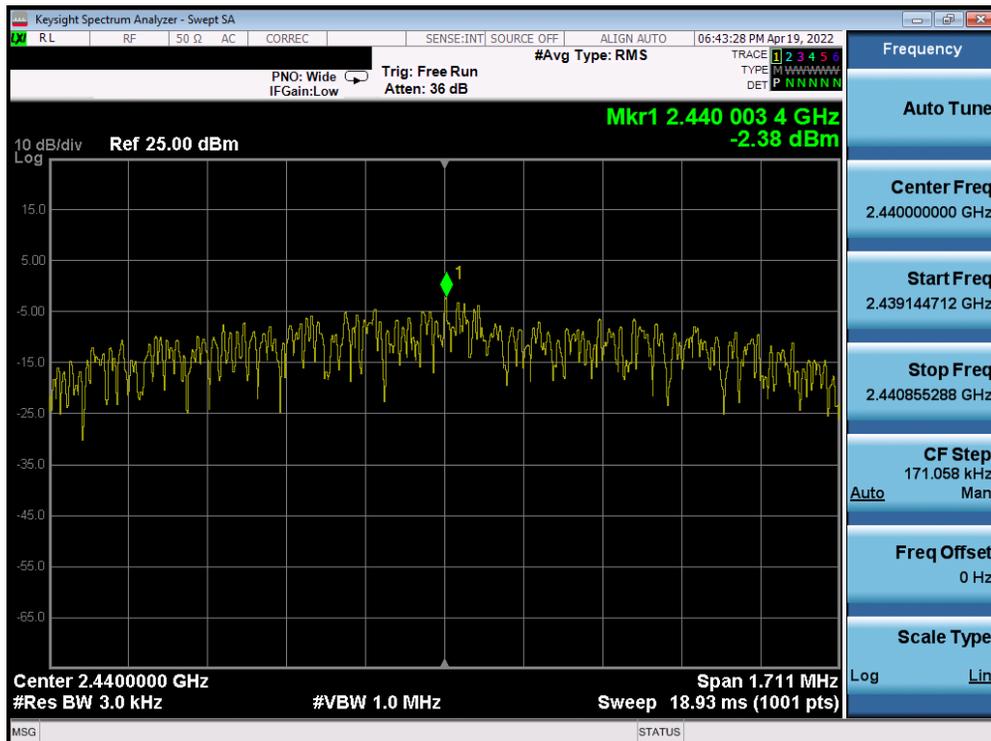


Plot 7-51. Power Spectral Density Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 45 of 75

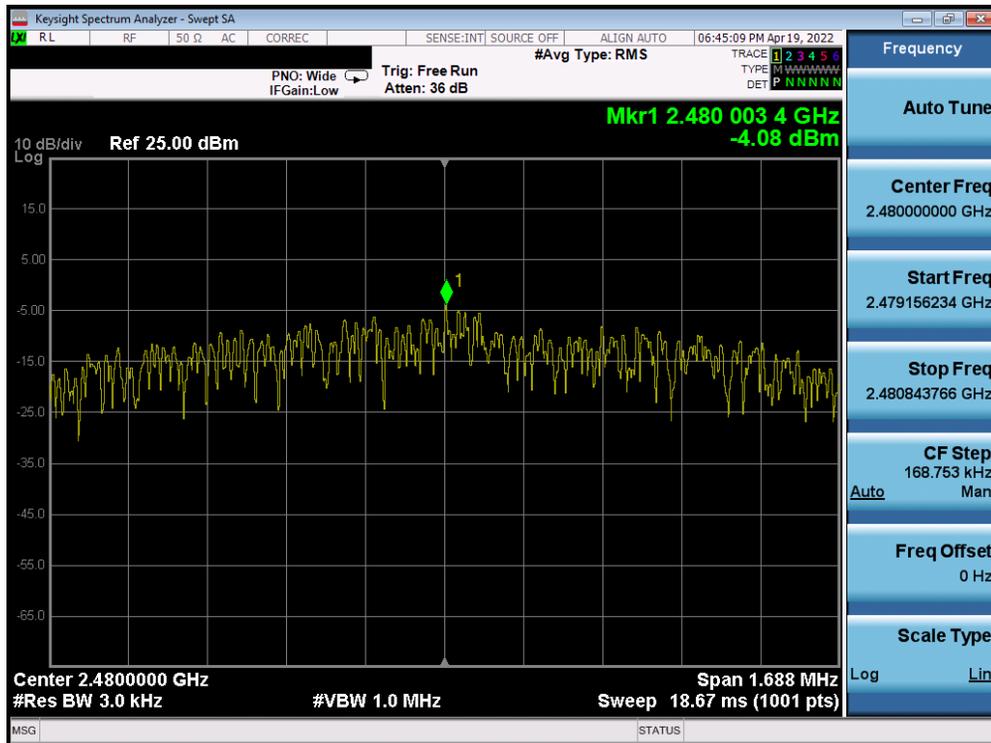


Plot 7-52. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 2



Plot 7-53. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 19) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 46 of 75



Plot 7-54. Power Spectral Density Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 47 of 75

7.5 Conducted Emissions at the Band Edge

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

For the following out of band conducted spurious emissions plots at the band edge, the EUT was set to transmit at maximum power with the largest packet size available. These settings produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3
KDB 558074 D01 v05r02 – Section 8.7.2

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

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



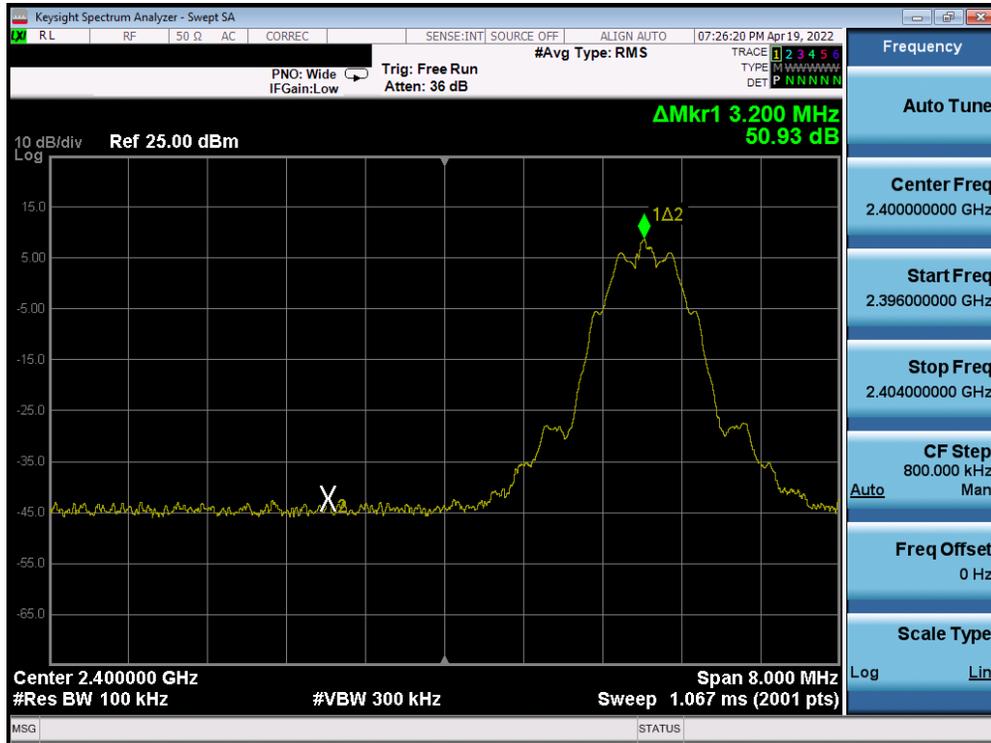
Figure 7-4. Test Instrument & Measurement Setup

Test Notes

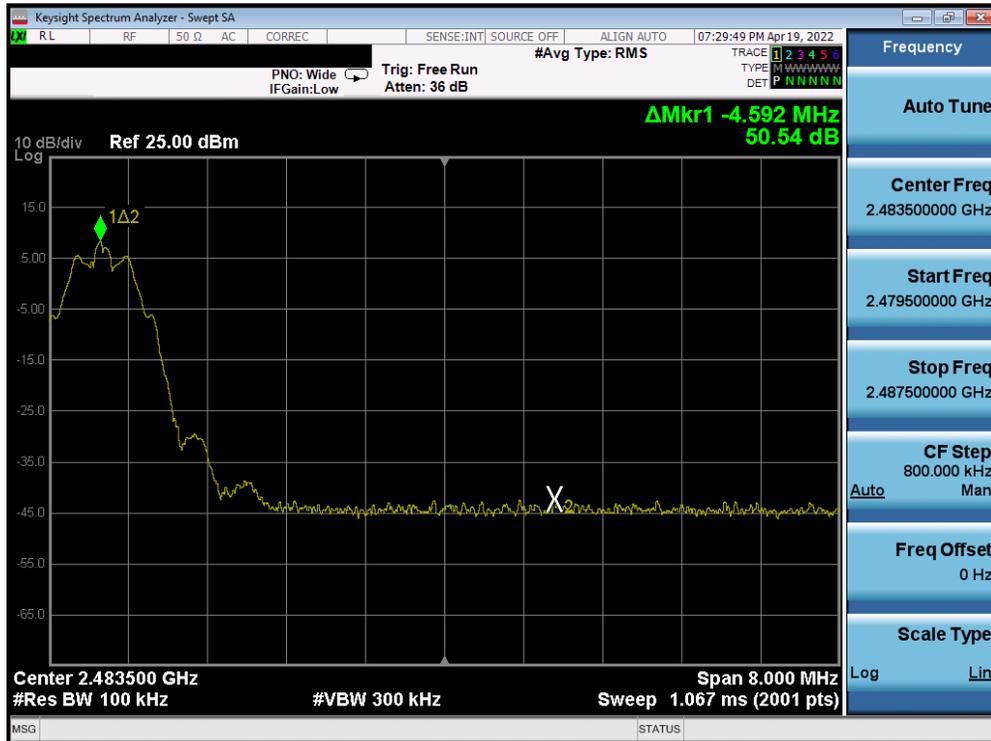
None

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 48 of 75

V9.0 02/01/2019

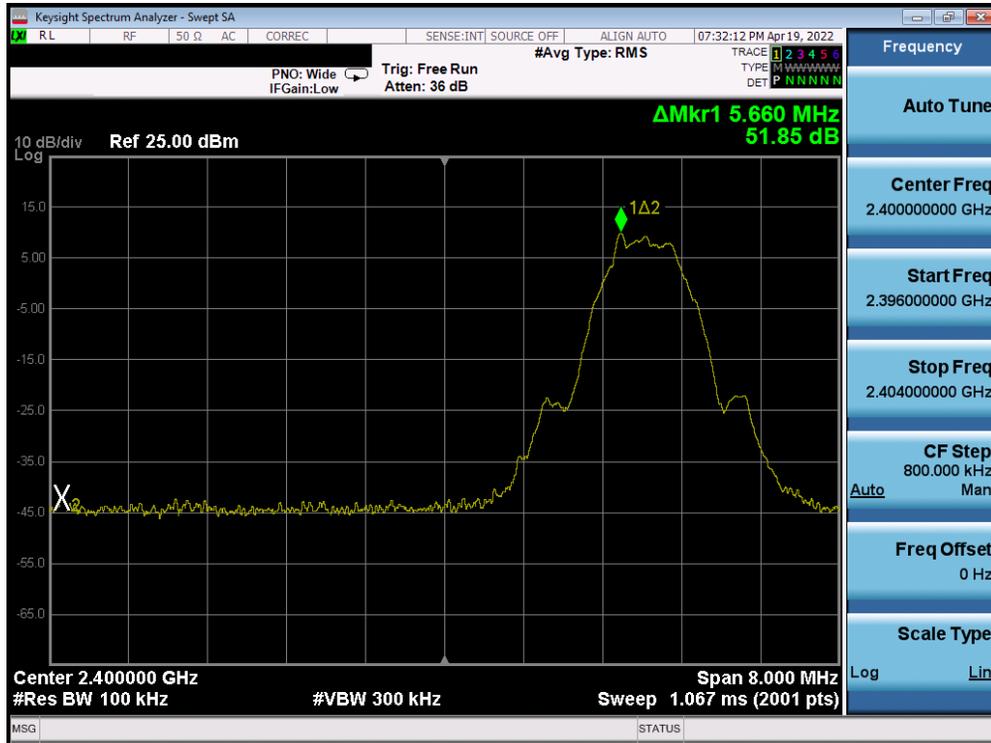


Plot 7-55. Band Edge Plot (Bluetooth (LE), 125kbps – Ch. 0) – Antenna 1

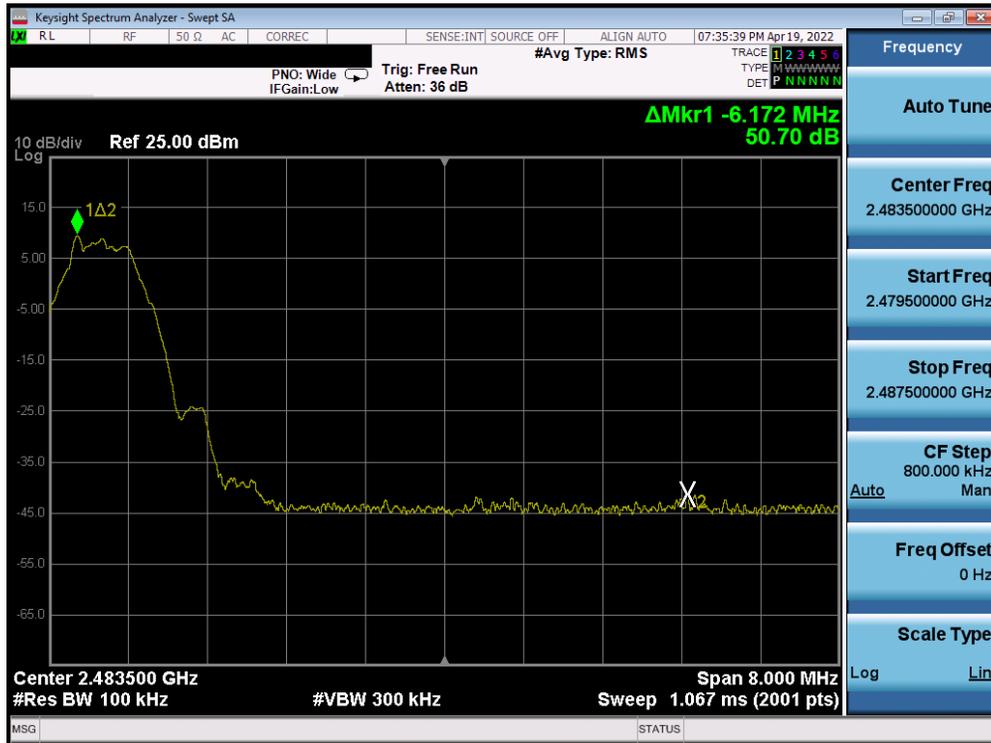


Plot 7-56. Band Edge Plot (Bluetooth (LE), 125kbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 49 of 75

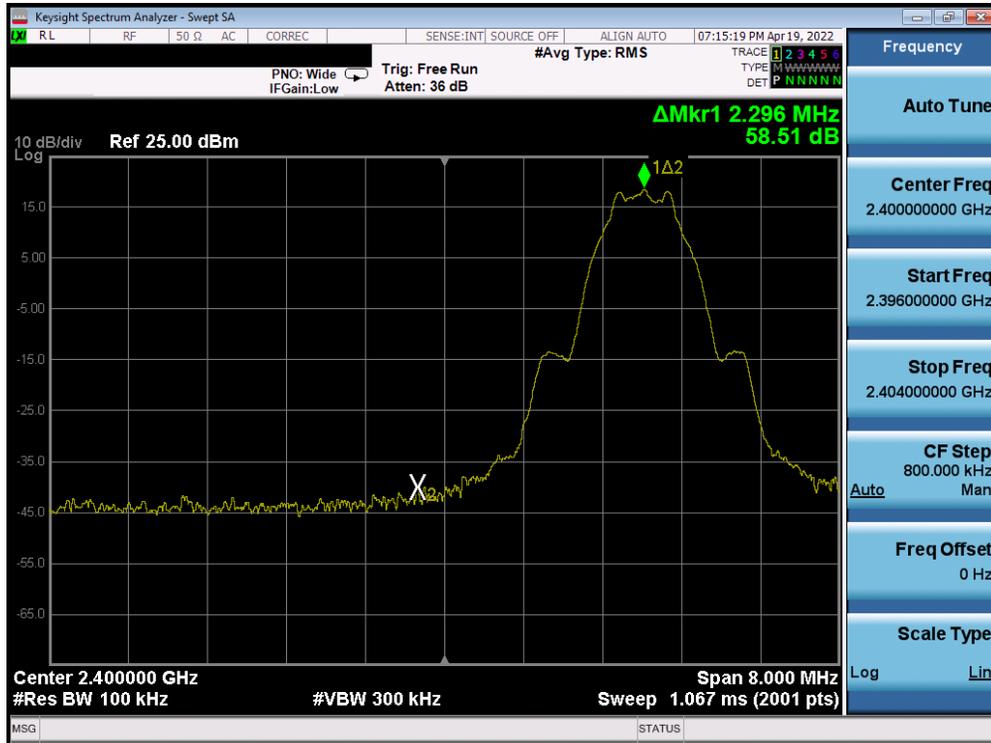


Plot 7-57. Band Edge Plot (Bluetooth (LE), 500kbps – Ch. 0) – Antenna 1

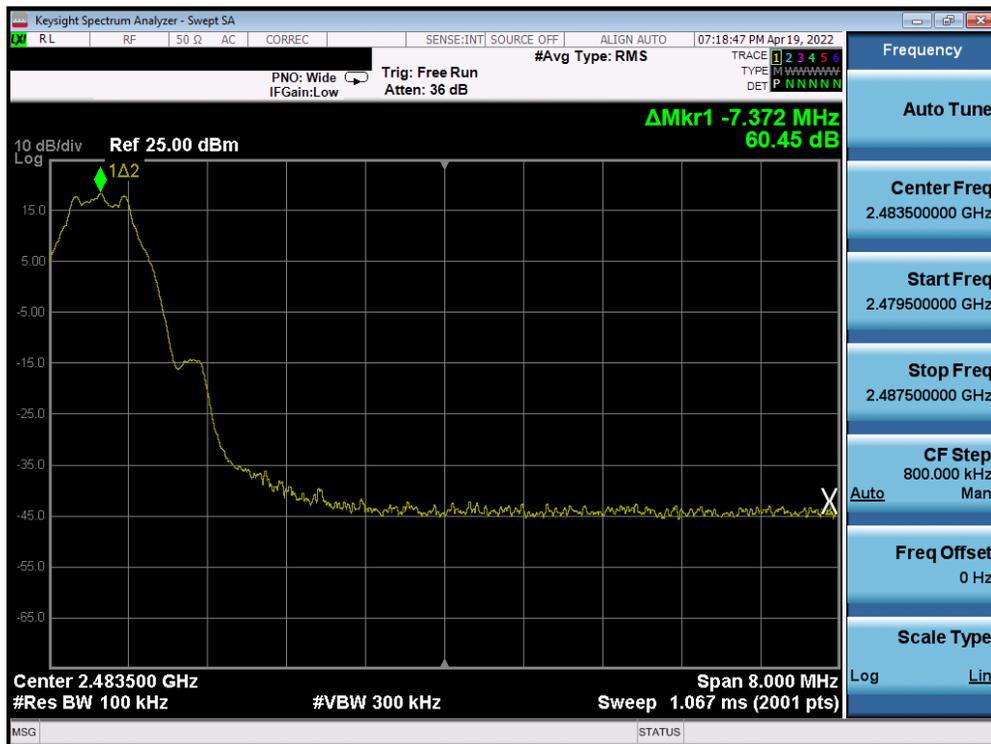


Plot 7-58. Band Edge Plot (Bluetooth (LE), 500kbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 50 of 75

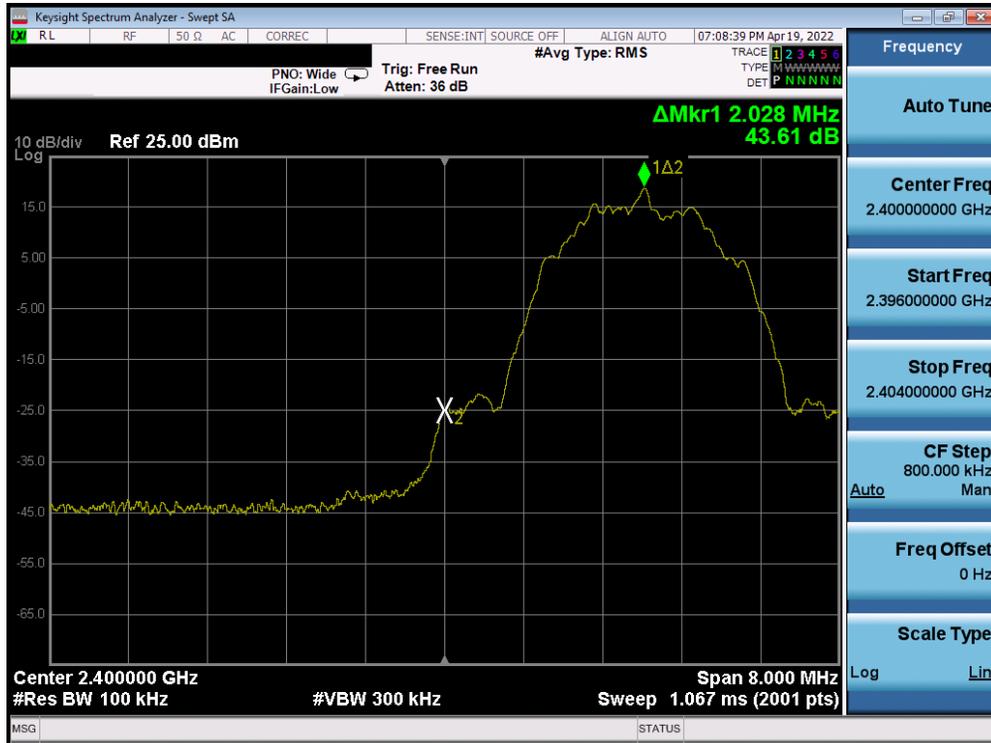


Plot 7-59. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

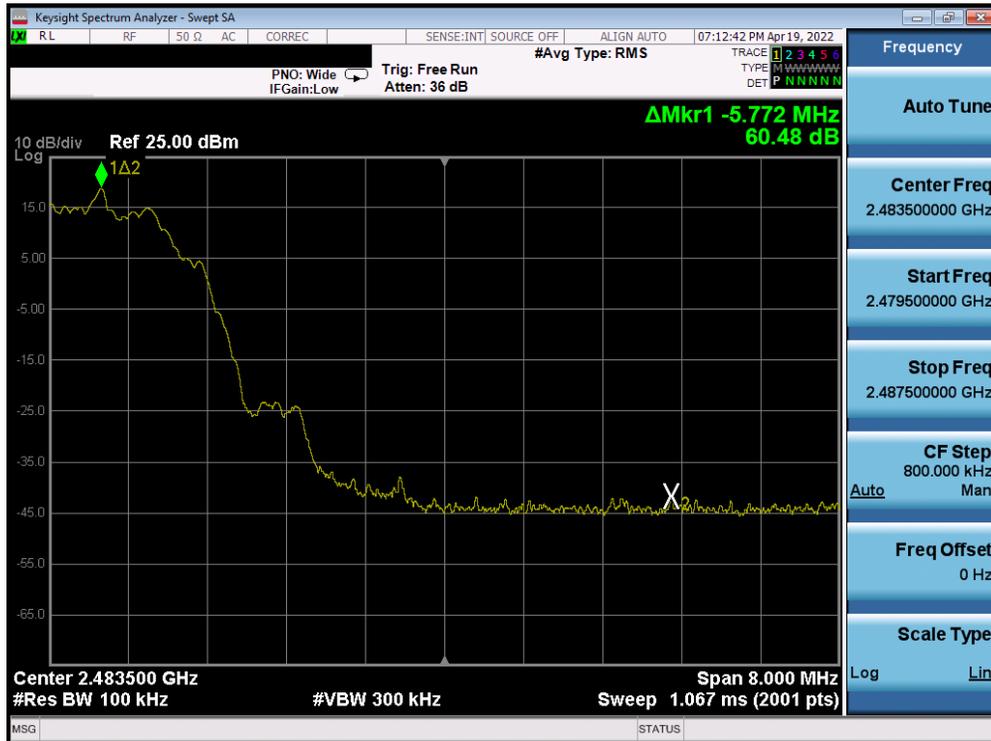


Plot 7-60. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 51 of 75

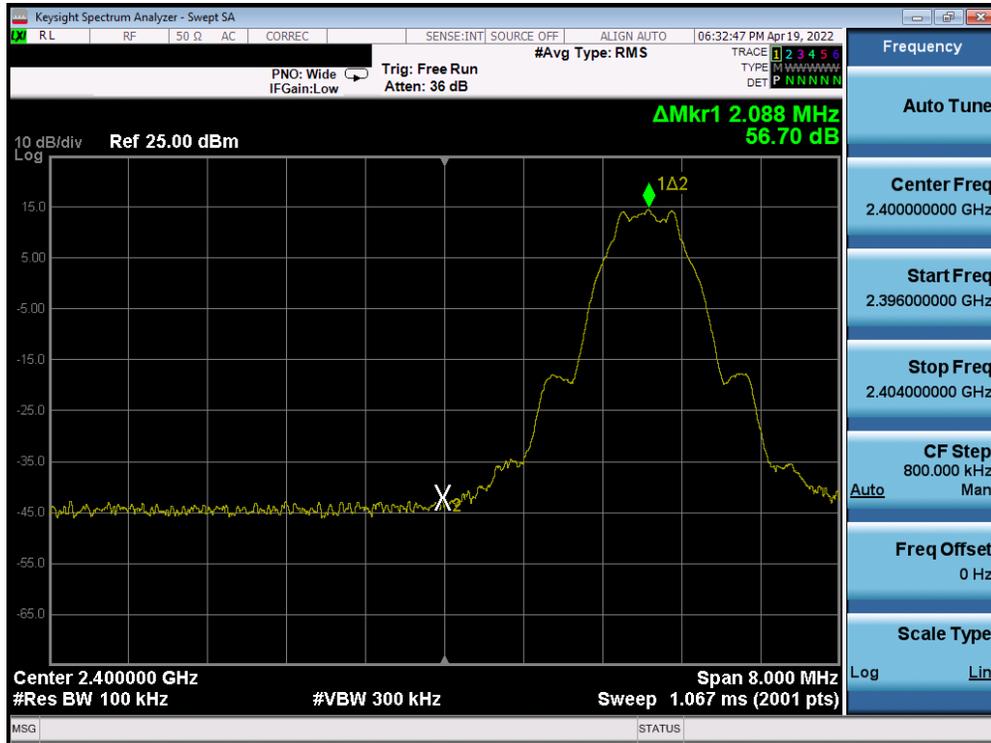


Plot 7-61. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 1

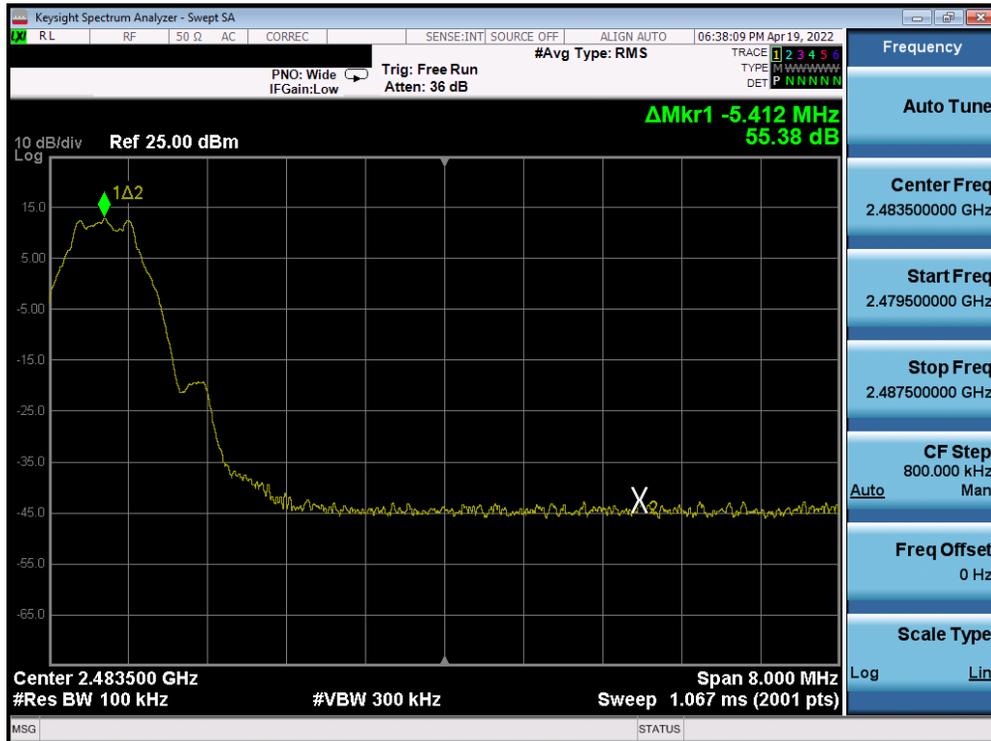


Plot 7-62. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 52 of 75

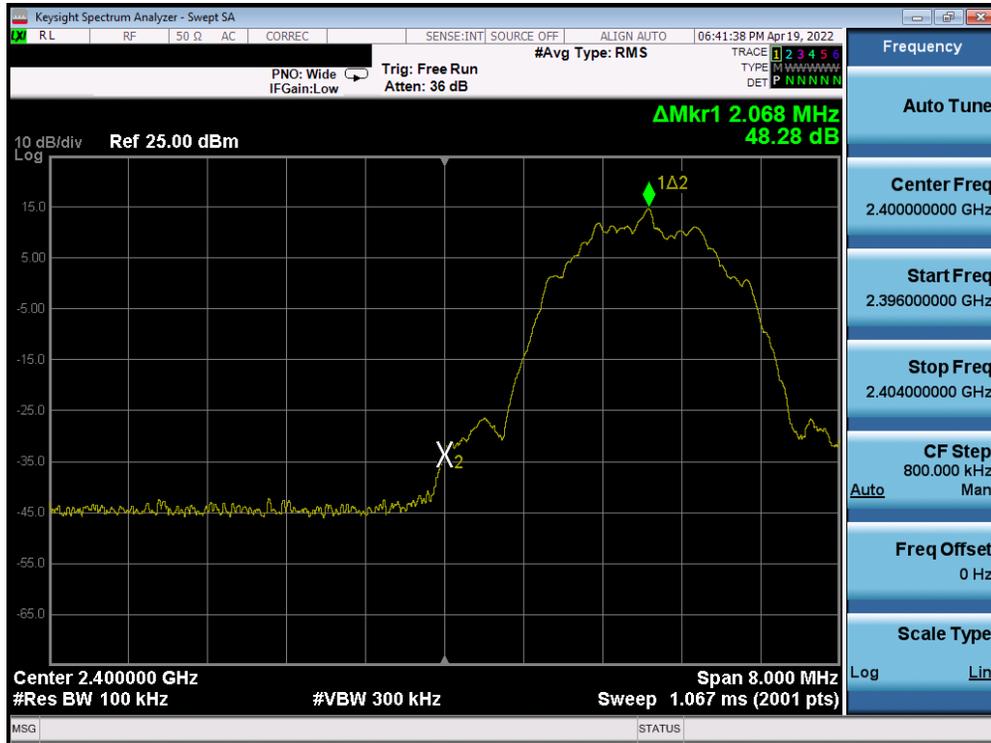


Plot 7-63. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

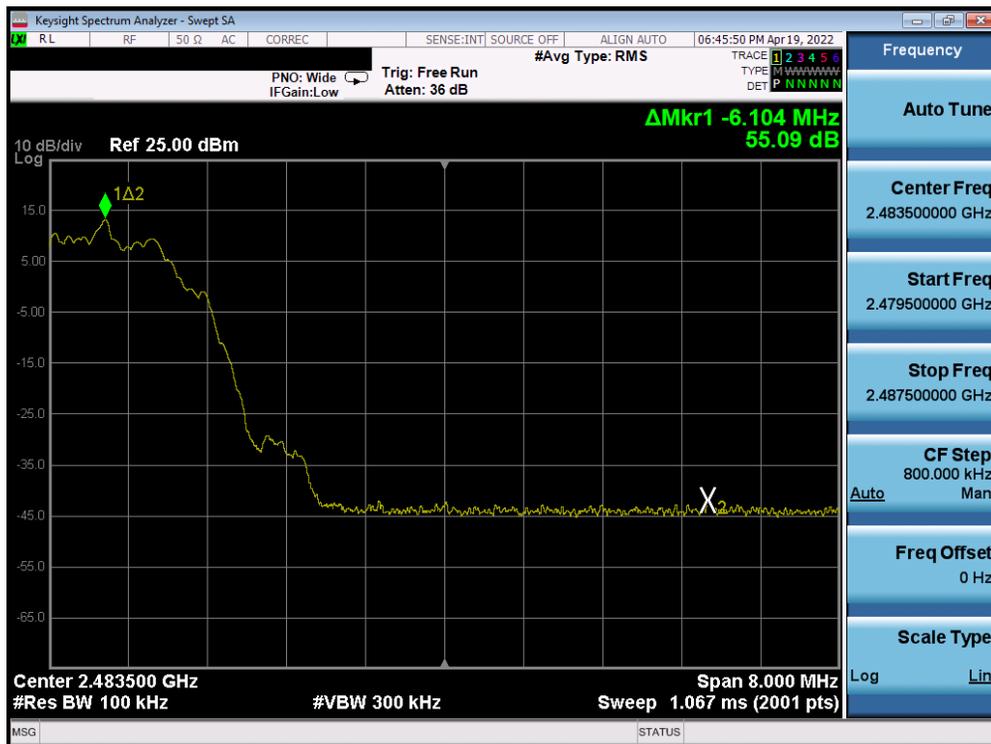


Plot 7-64. Band Edge Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 53 of 75



Plot 7-65. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 0) – Antenna 2



Plot 7-66. Band Edge Plot (Bluetooth (LE), 2Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 54 of 75

7.6 Conducted Spurious Emissions

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the procedure in Section 8.5 of KDB 558074 D01 v05r02 and Section 11.11.3 of ANSI C63.10-2013.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3
KDB 558074 D01 v05r02 – Section 8.5

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

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



Figure 7-5. Test Instrument & Measurement Setup

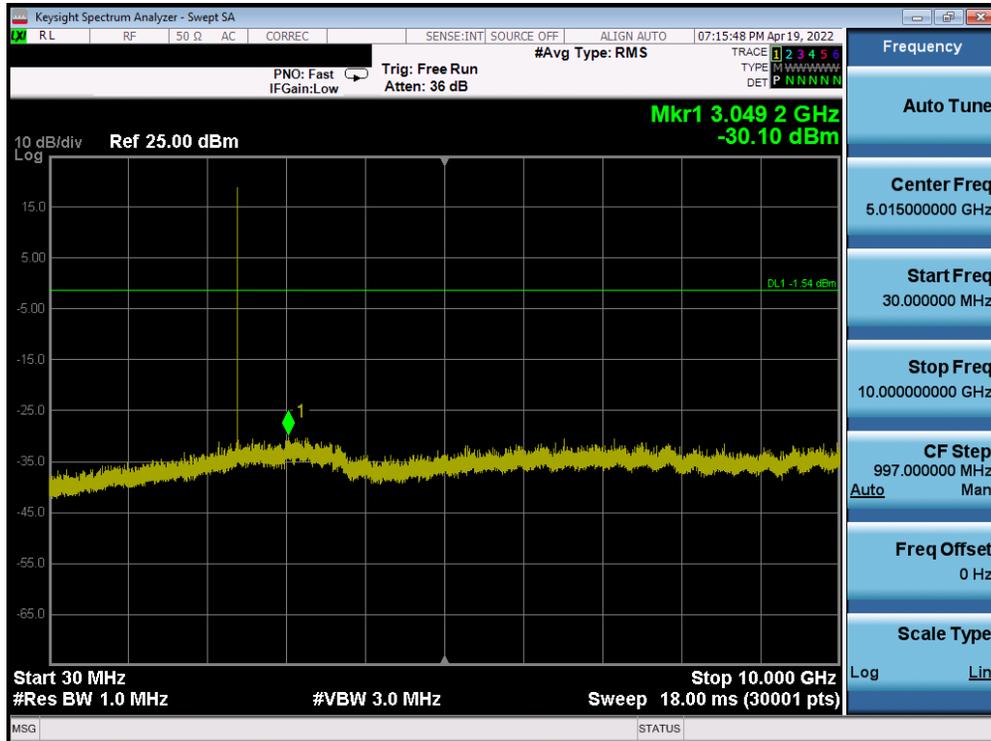
FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 55 of 75

V9.0 02/01/2019

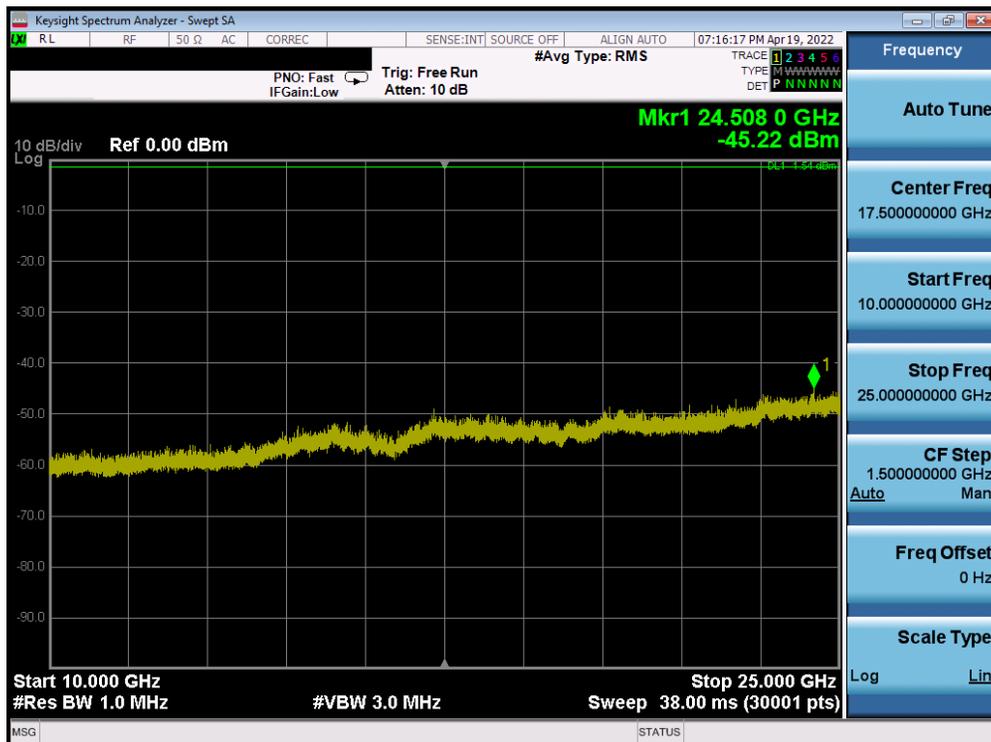
Test Notes

1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.
2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1MHz RBW, the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.
3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 56 of 75

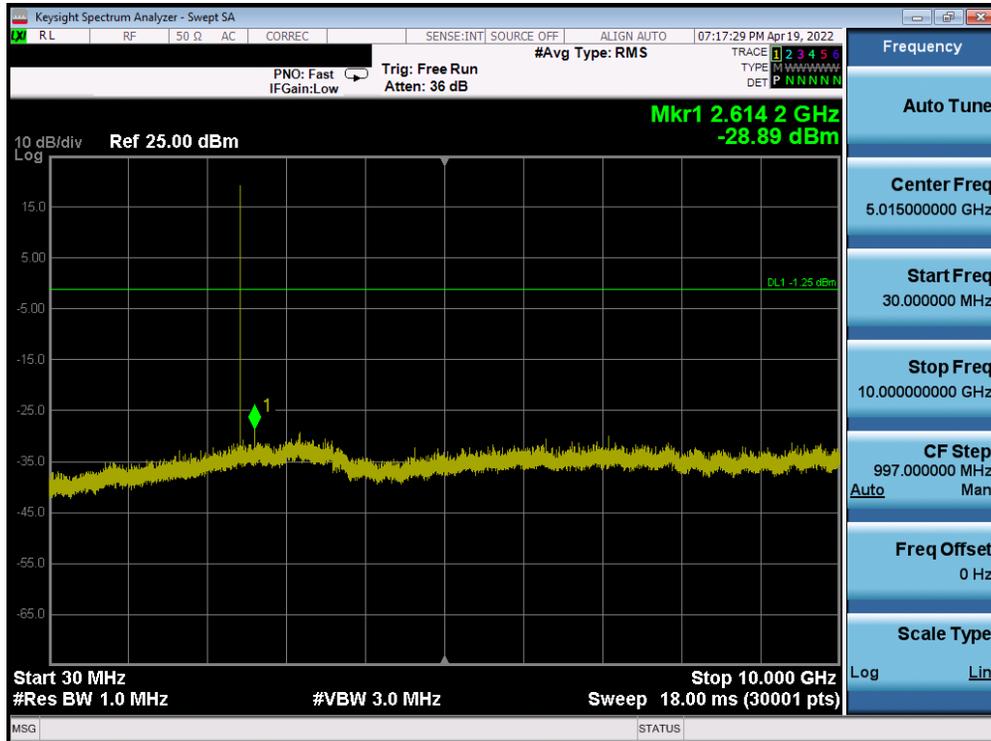


Plot 7-67. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

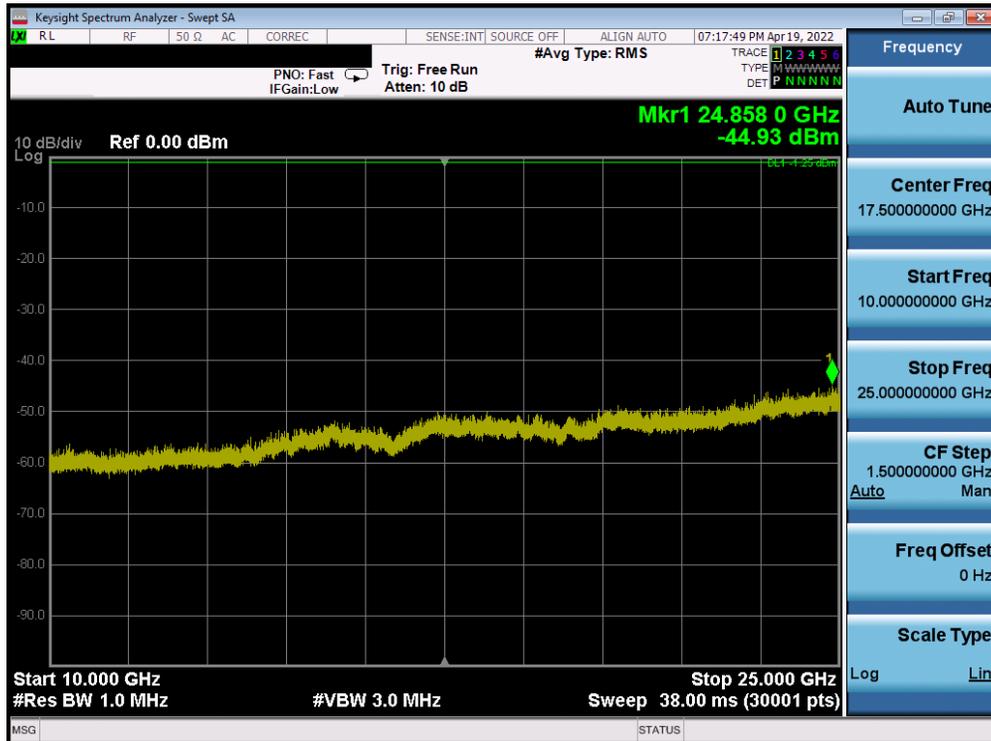


Plot 7-68. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 57 of 75

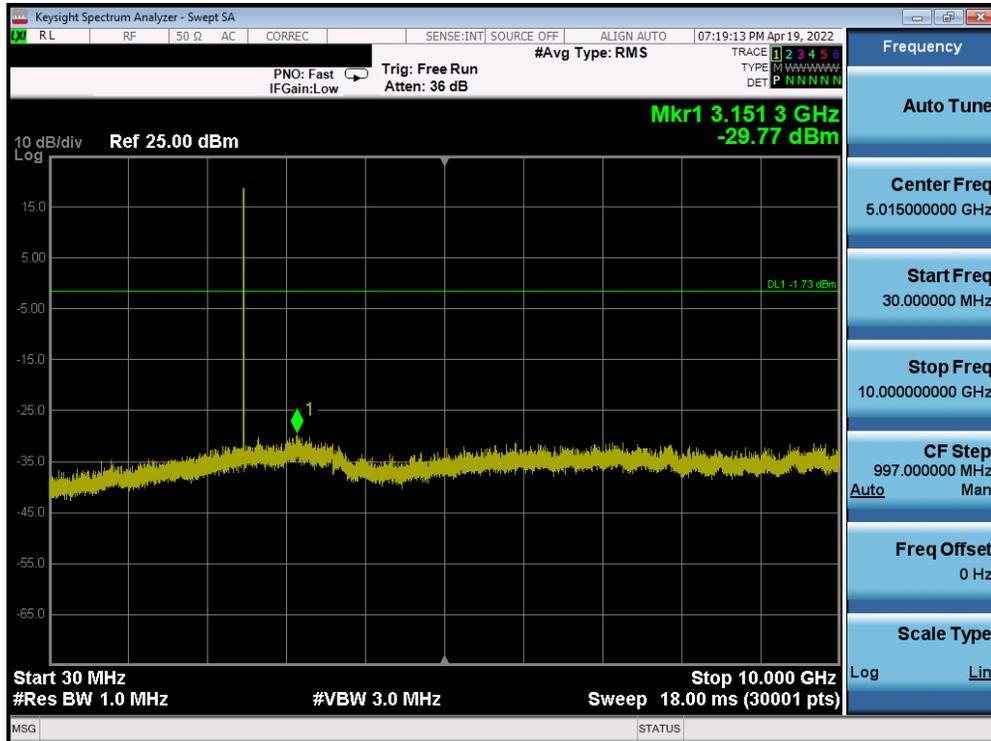


Plot 7-69. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 1

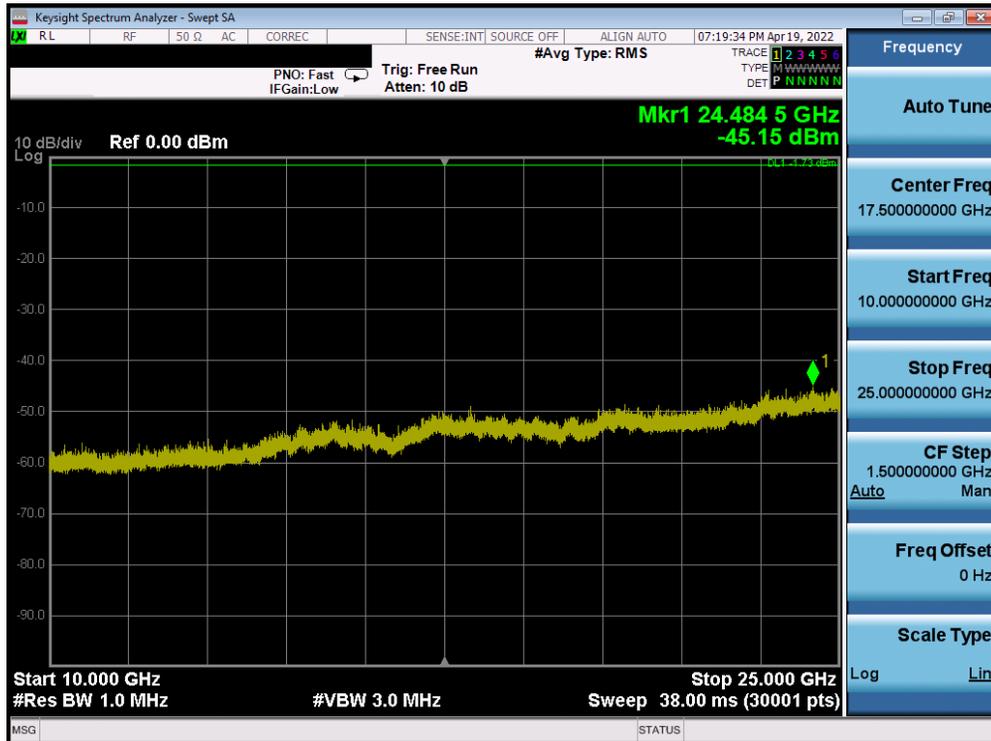


Plot 7-70. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 58 of 75

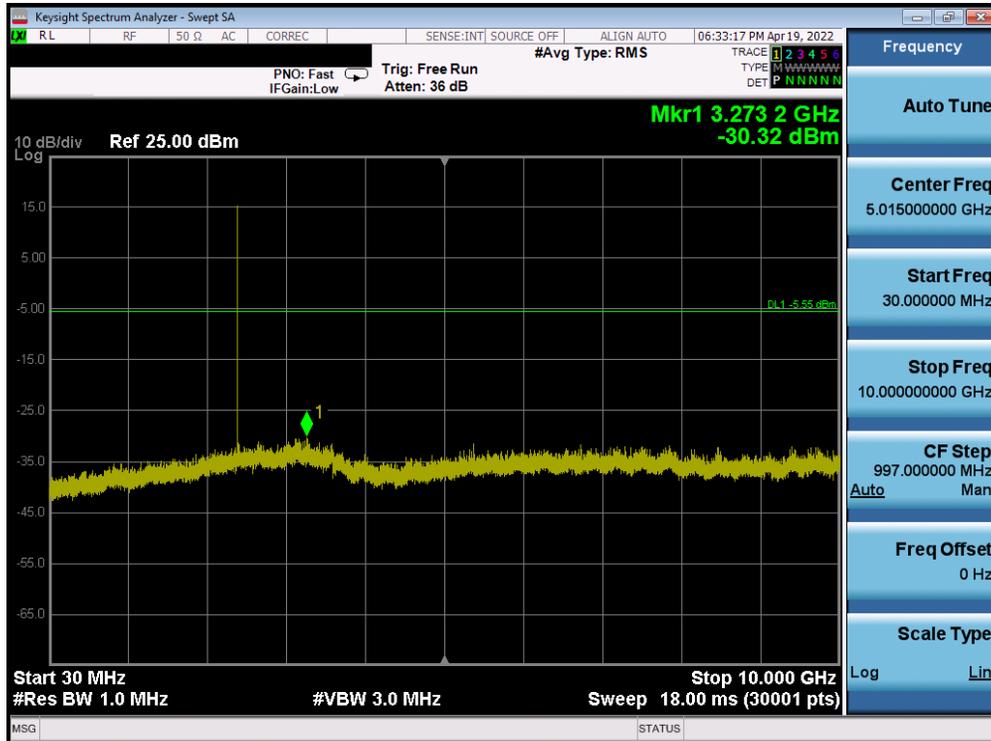


Plot 7-71. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 1

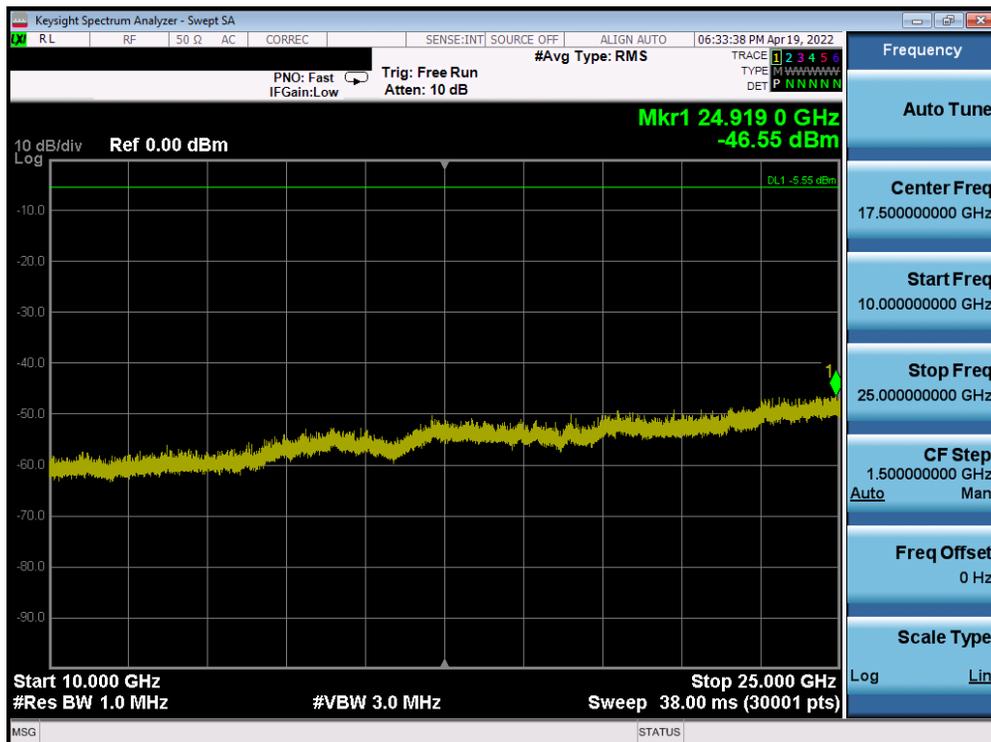


Plot 7-72. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 59 of 75

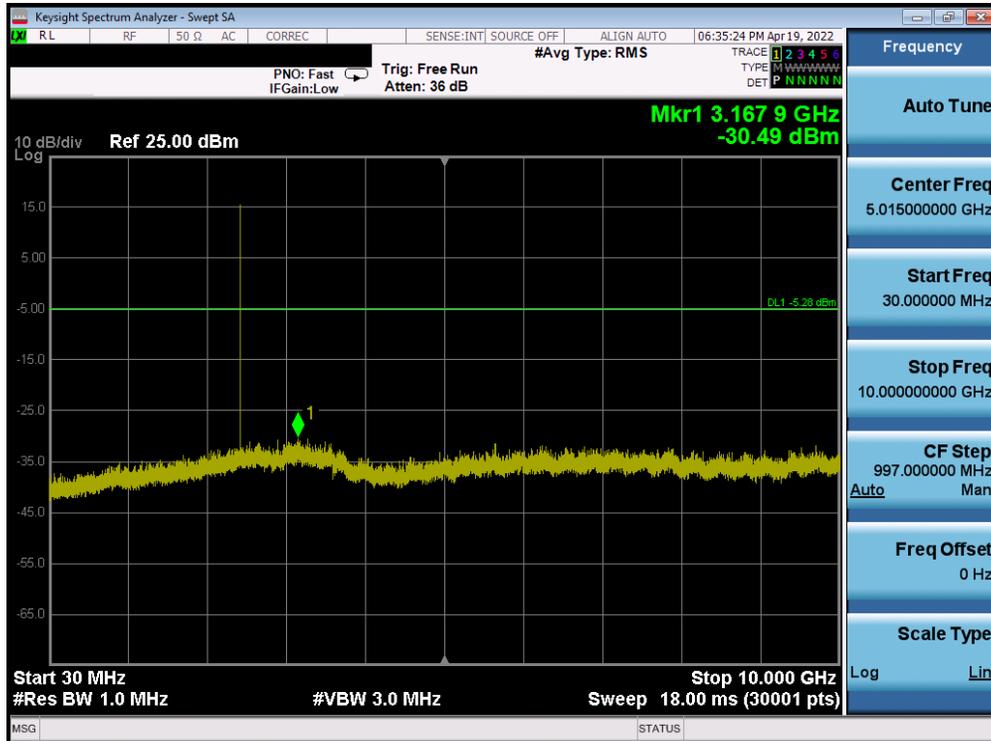


Plot 7-73. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

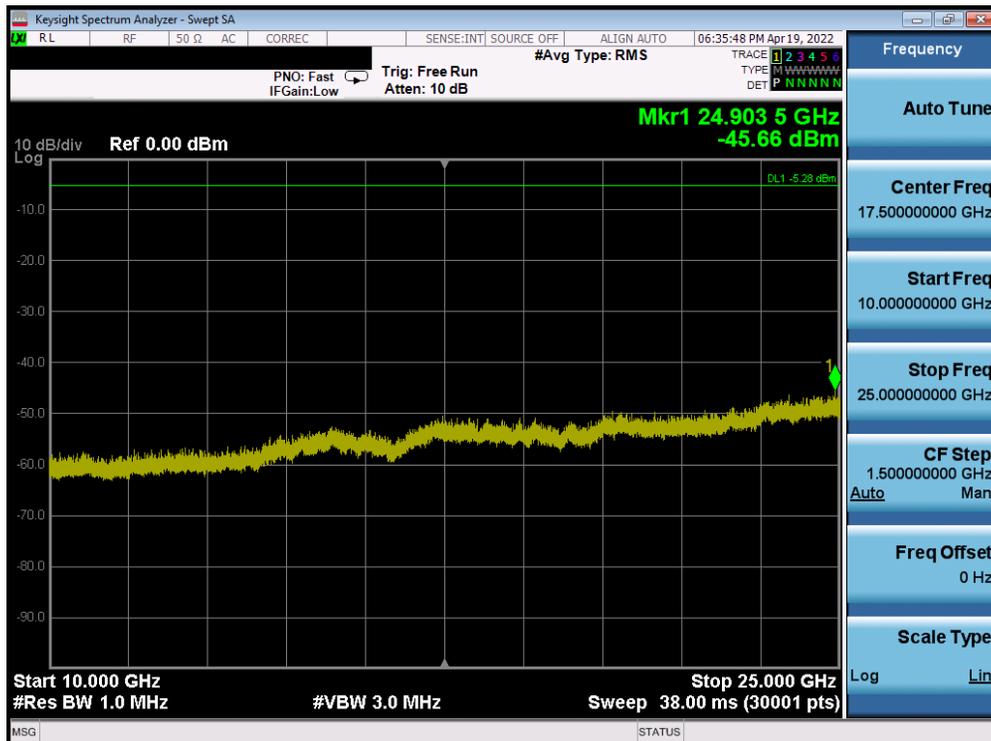


Plot 7-74. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 0) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 60 of 75

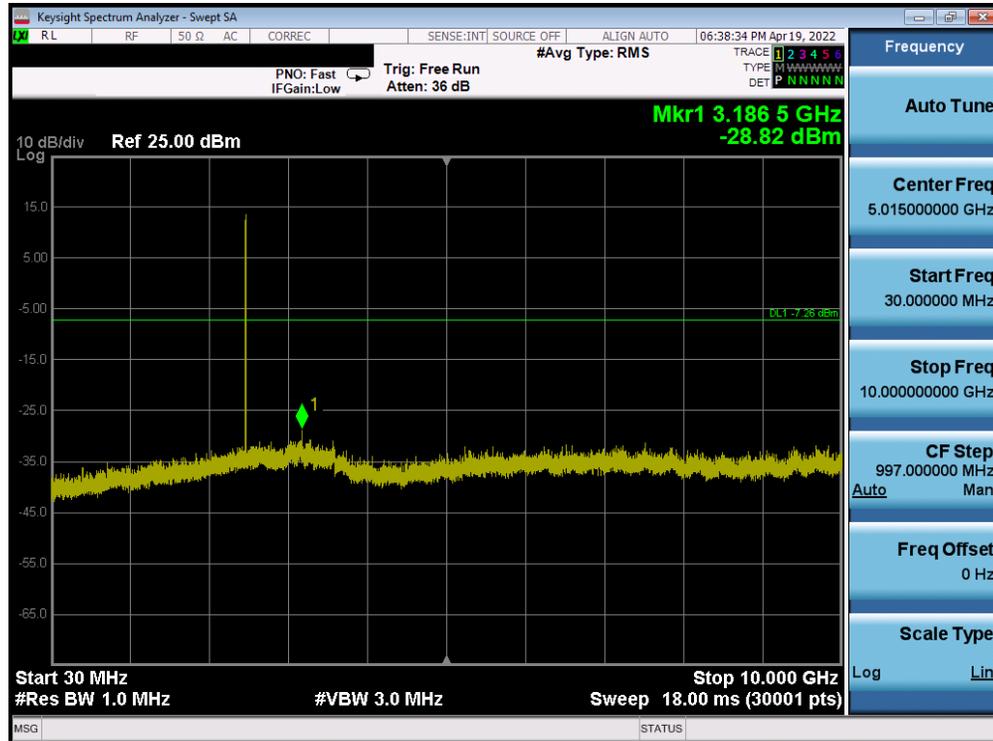


Plot 7-75. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 2

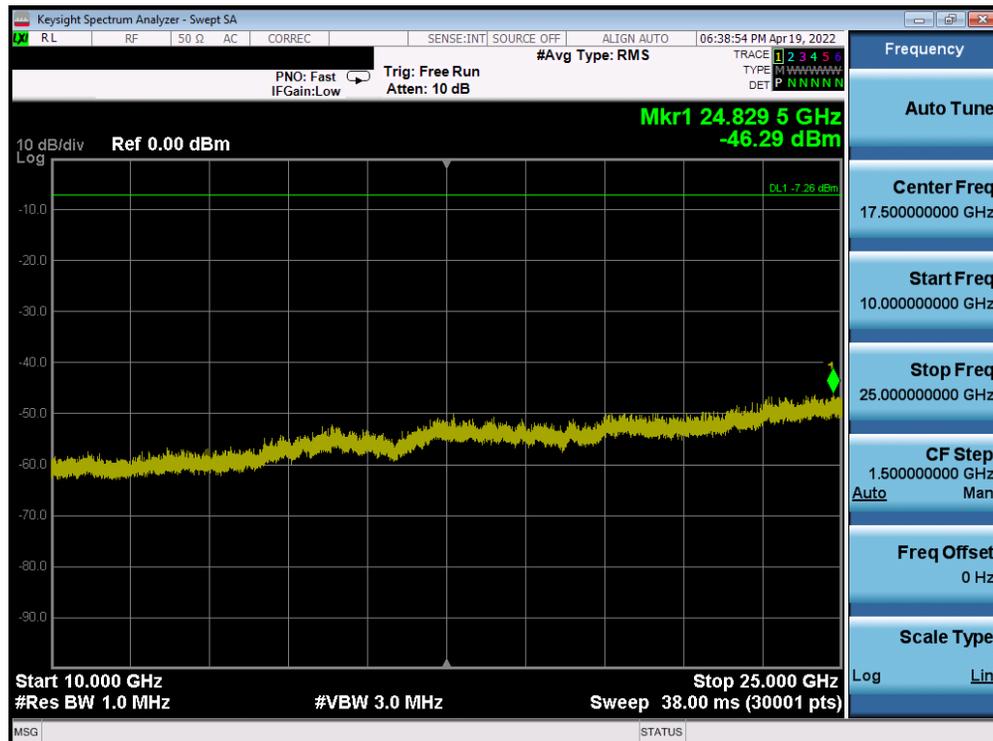


Plot 7-76. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 19) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 61 of 75



Plot 7-77. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2



Plot 7-78. Conducted Spurious Plot (Bluetooth (LE), 1Mbps – Ch. 39) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 62 of 75



7.7 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Test Overview and Limit

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

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-8 per Section 15.209 and RSS-Gen (8.9).

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

Table 7-8. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.6.4.3

KDB 558074 D01 v05r02 – Section 8.6, 8.7

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3kHz > 1/T
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times (1/duty cycle) traces

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 63 of 75

V9.0 02/01/2019

Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in Table 7-9 below
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

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

Table 7-9. RBW as a Function of Frequency

Test Setup

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

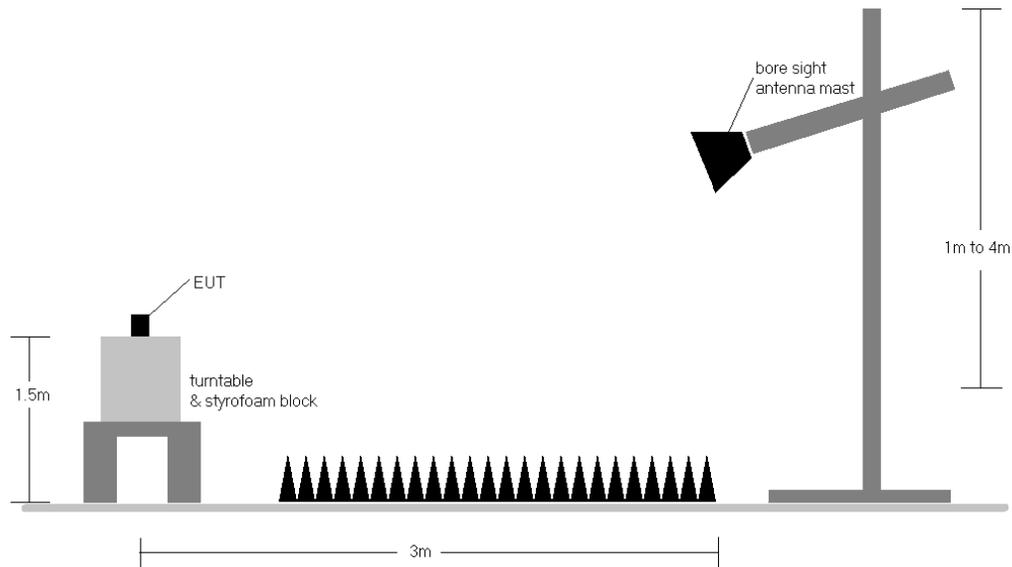


Figure 7-6. Radiated Test Setup >1GHz

FCC ID: A3LSMF936U		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 64 of 75	

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of KDB 558074 D01 v05r02 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-8.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Average measurements were recorded using a VBW of 3kHz, per Section 4.1.4.2.3 of ANSI C63.10-2013, since 1/T is equal to just under 3kHz. This method was used because the EUT could not be configured to operate with a duty cycle > 98%. Both average and peak measurements were made using a peak detector
7. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
8. No significant radiated band edge emissions were found in the 2310 – 2390MHz restricted band.
9. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB_{\mu V/m}]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB_{\mu V/m}]}$ – Limit $_{[dB_{\mu V/m}]}$

Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.8 was calculated using the formula:
Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 65 of 75



Radiated Spurious Emission Measurements – Antenna 1
 §15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz
 Channel: 0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	V	-	-	-79.01	4.41	32.40	53.98	-21.58
4804.00	Peak	V	-	-	-65.98	4.41	45.43	73.98	-28.55
12010.00	Avg	V	-	-	-78.64	14.26	42.62	53.98	-11.36
12010.00	Peak	V	-	-	-67.99	14.26	53.27	73.98	-20.71

Table 7-10. Radiated Measurements @ 3 meters – Antenna 1

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2440MHz
 Channel: 19

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4880.00	Avg	V	-	-	-77.84	4.34	33.50	53.98	-20.48
4880.00	Peak	V	-	-	-65.24	4.34	46.10	73.98	-27.88
7320.00	Avg	V	-	-	-80.11	7.81	34.70	53.98	-19.28
7320.00	Peak	V	-	-	-69.01	7.81	45.80	73.98	-28.18
12200.00	Avg	V	-	-	-78.88	13.87	41.99	53.98	-11.98
12200.00	Peak	V	-	-	-68.74	13.87	52.13	73.98	-21.84

Table 7-11. Radiated Measurements @ 3 meters – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 66 of 75

V9.0 02/01/2019



Radiated Spurious Emission Measurements – Antenna 1
§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz
 Channel: 39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	V	-	-	-78.21	4.22	33.01	53.98	-20.97
4960.00	Peak	V	-	-	-66.31	4.22	44.91	73.98	-29.07
7440.00	Avg	V	-	-	-79.41	7.47	35.06	53.98	-18.92
7440.00	Peak	V	-	-	-68.44	7.47	46.03	73.98	-27.95
12400.00	Avg	V	-	-	-78.77	13.97	42.20	53.98	-11.78
12400.00	Peak	V	-	-	-69.90	13.97	51.07	73.98	-22.91

Table 7-12. Radiated Measurements @ 3 meters – Antenna 1

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 67 of 75

V9.0 02/01/2019



Radiated Spurious Emission Measurements – Antenna 2
§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz
 Channel: 0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	V	-	-	-78.21	4.41	33.20	53.98	-20.78
4804.00	Peak	V	-	-	-66.36	4.41	45.05	73.98	-28.93
12010.00	Avg	V	-	-	-79.44	14.26	41.82	53.98	-12.16
12010.00	Peak	V	-	-	-68.58	14.26	52.68	73.98	-21.30

Table 7-13. Radiated Measurements @ 3 meters – Antenna 2

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2440MHz
 Channel: 19

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4880.00	Avg	V	-	-	-78.17	4.34	33.17	53.98	-20.81
4880.00	Peak	V	-	-	-66.27	4.34	45.07	73.98	-28.91
7320.00	Avg	V	-	-	-79.23	7.81	35.58	53.98	-18.40
7320.00	Peak	V	-	-	-68.58	7.81	46.23	73.98	-27.75
12200.00	Avg	V	-	-	-78.89	13.87	41.98	53.98	-11.99
12200.00	Peak	V	-	-	-69.68	13.87	51.19	73.98	-22.78

Table 7-14. Radiated Measurements @ 3 meters – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 68 of 75

V9.0 02/01/2019



Radiated Spurious Emission Measurements – Antenna 2
 §15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Bluetooth Mode: LE
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz
 Channel: 39

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	V	-	-	-78.21	4.22	33.01	53.98	-20.97
4960.00	Peak	V	-	-	-66.31	4.22	44.91	73.98	-29.07
7440.00	Avg	V	-	-	-79.41	7.47	35.06	53.98	-18.92
7440.00	Peak	V	-	-	-68.44	7.47	46.03	73.98	-27.95
12400.00	Avg	V	-	-	-78.77	13.97	42.20	53.98	-11.78
12400.00	Peak	V	-	-	-69.90	13.97	51.07	73.98	-22.91

Table 7-15. Radiated Measurements @ 3 meters – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 69 of 75

V9.0 02/01/2019



7.8 Radiated Restricted Band Edge Measurements

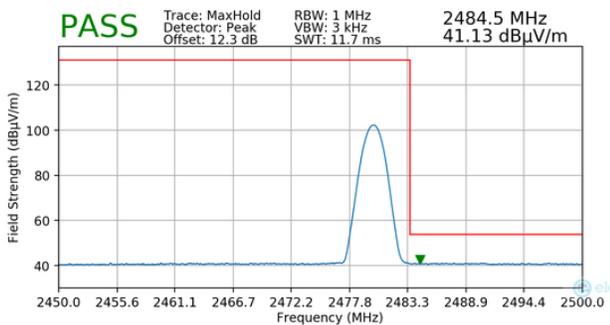
§15.205 §15.209; RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

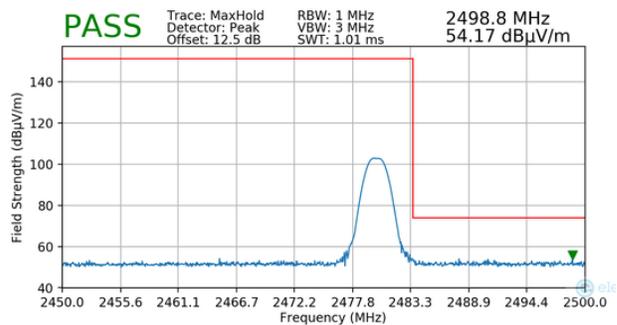
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + \text{Attenuator}) - \text{Preamplifier Gain}$$

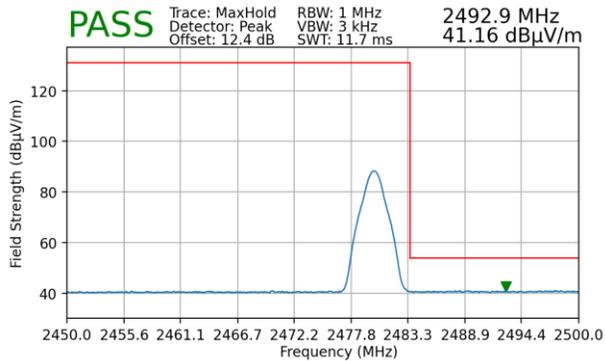
Bluetooth Mode:	LE
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	39



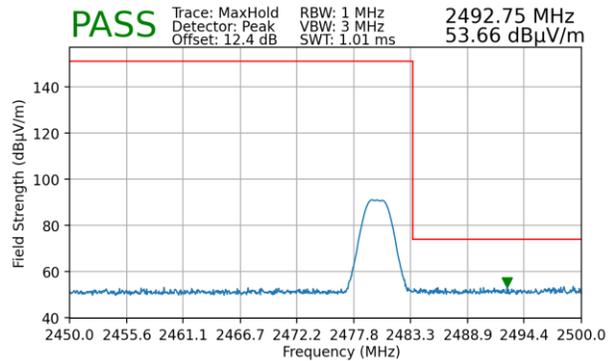
Plot 7-79. Radiated Restricted Upper Band Edge Measurement (Average) – Antenna 1



Plot 7-80. Radiated Restricted Upper Band Edge Measurement (Peak) – Antenna 1



Plot 7-81. Radiated Restricted Upper Band Edge Measurement (Average) – Antenna 2



Plot 7-82. Radiated Restricted Upper Band Edge Measurement (Peak) – Antenna 2

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 70 of 75

V9.0 02/01/2019

7.9 Line-Conducted Test Data

§15.207; RSS-Gen [8.8]

Test Overview and Limit

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

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

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

Table 7-16. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

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

Average Field Strength Measurements

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

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 71 of 75

V9.0 02/01/2019

Test Setup

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

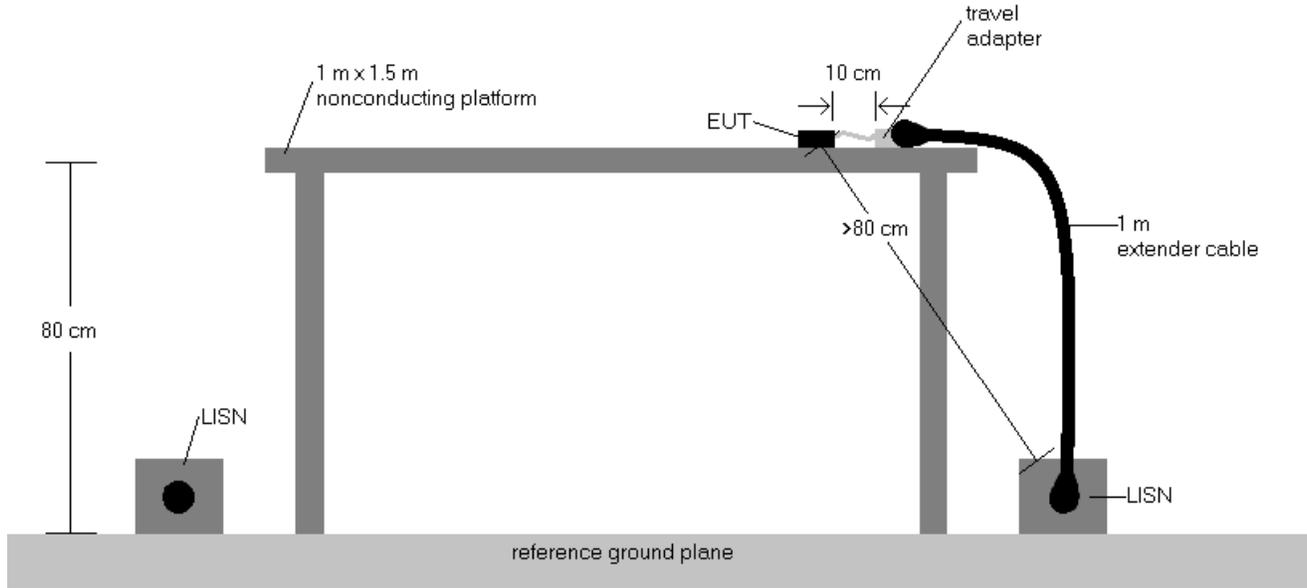
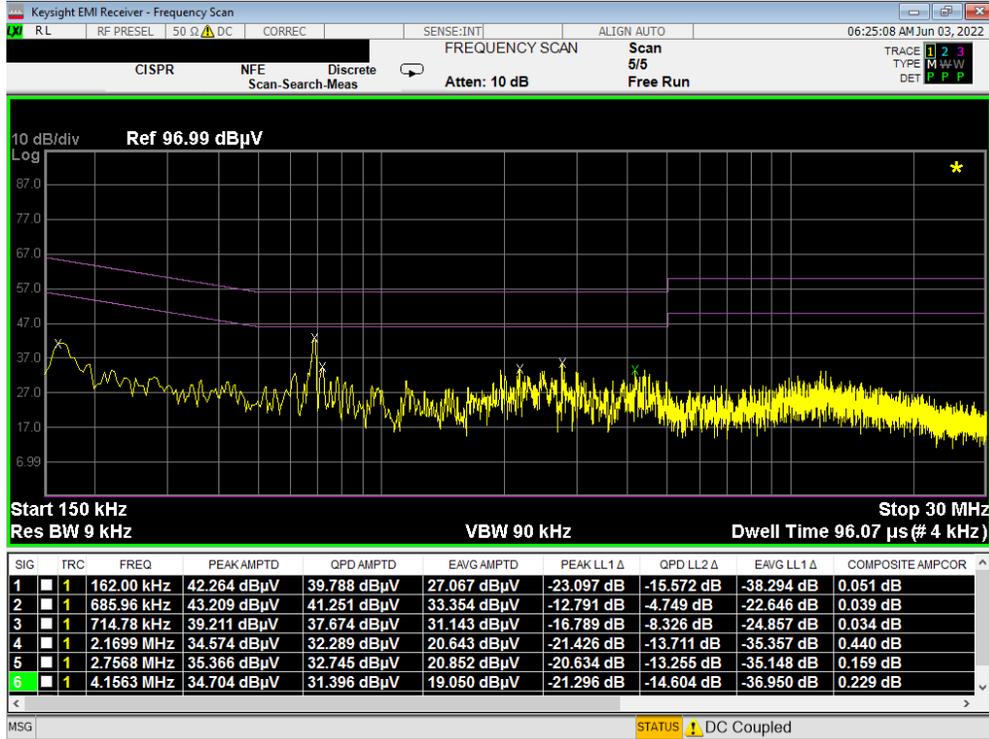


Figure 7-7. Test Instrument & Measurement Setup

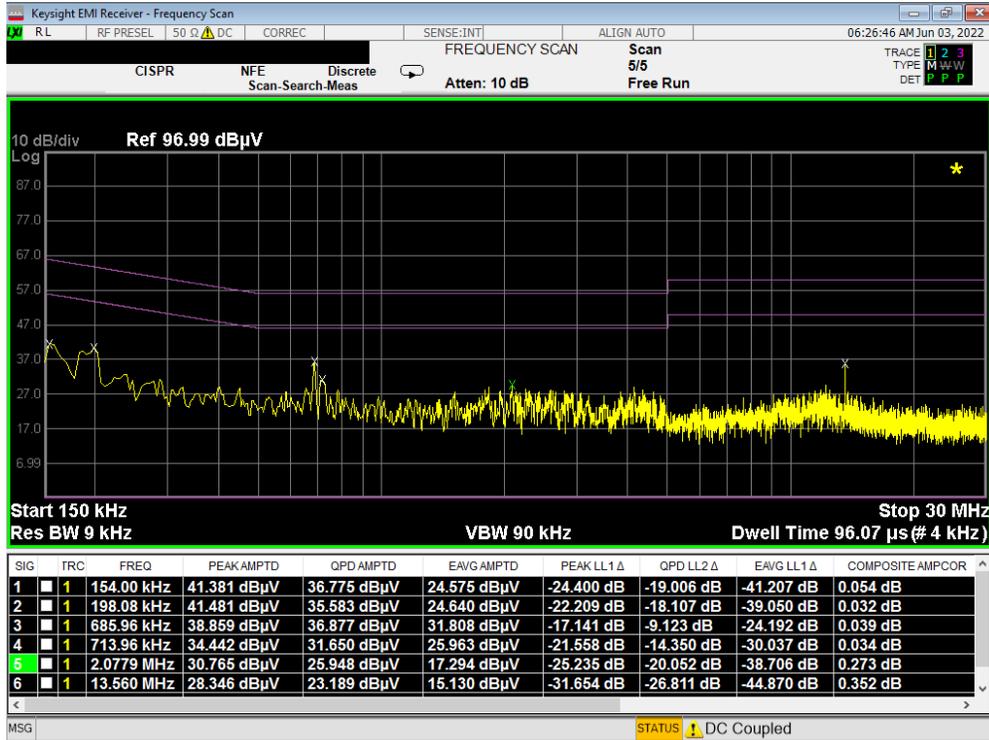
Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen (8.8).
3. $\text{Corr. (dB)} = \text{Cable loss (dB)} + \text{LISN insertion factor (dB)}$
4. $\text{QP/AV Level (dB}\mu\text{V)} = \text{QP/AV Analyzer/Receiver Level (dB}\mu\text{V)} + \text{Corr. (dB)}$
5. $\text{Margin (dB)} = \text{QP/AV Limit (dB}\mu\text{V)} - \text{QP/AV Level (dB}\mu\text{V)}$
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 72 of 75

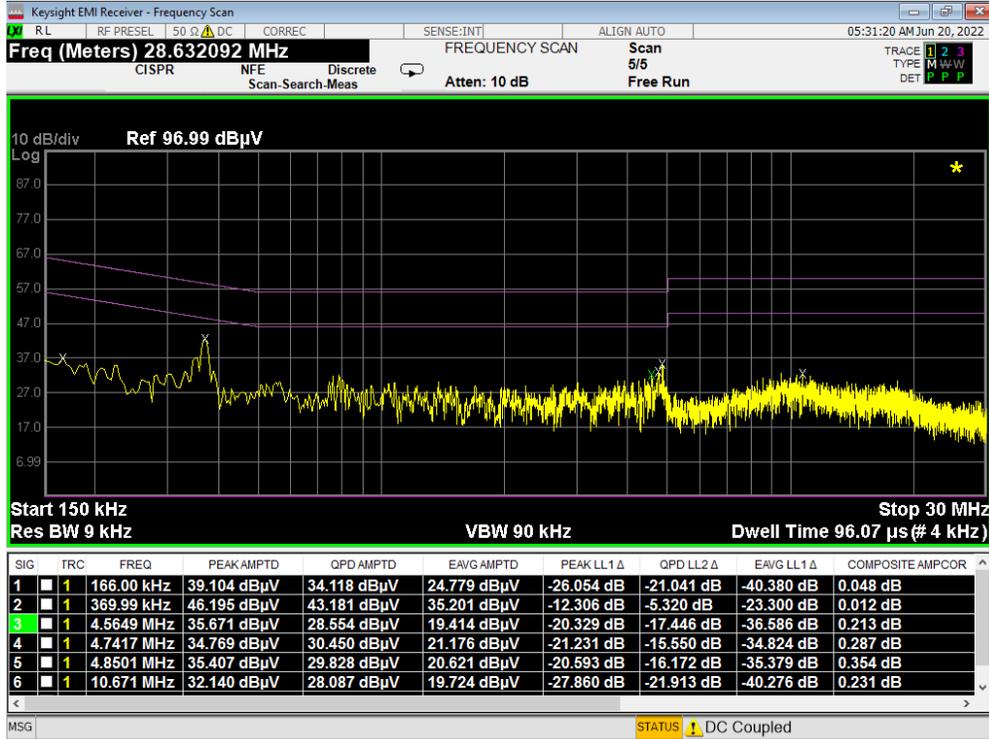


Plot 7-83. Line Conducted Plot with Bluetooth LE (L1) - Open

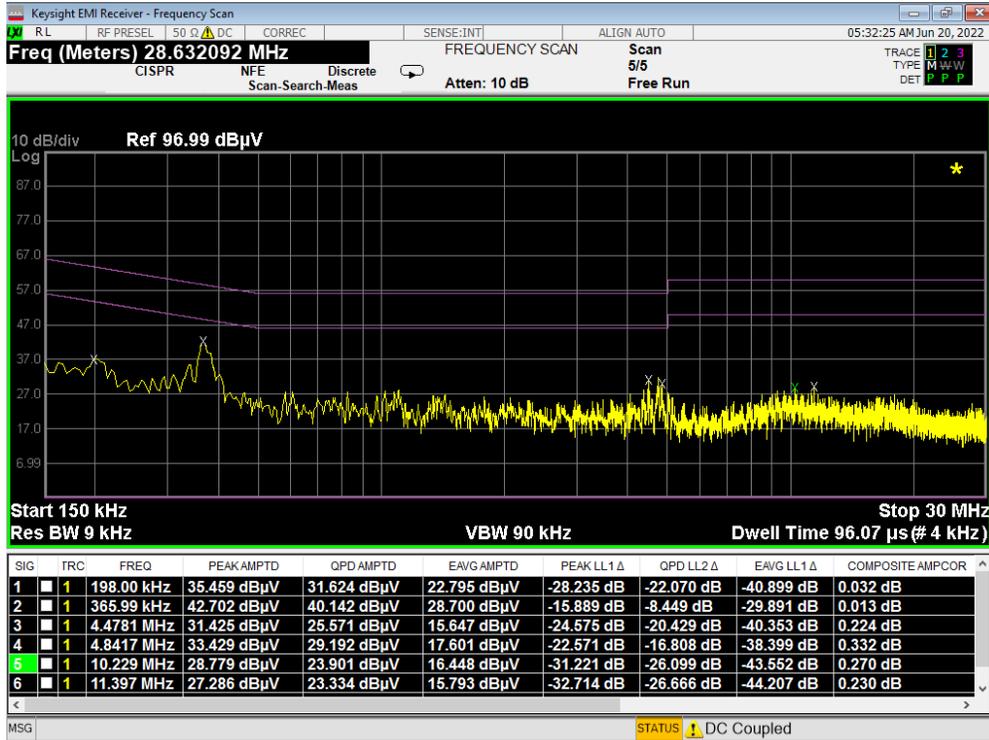


Plot 7-84. Line Conducted Plot with Bluetooth LE (N) - Open

MEASUREMENT REPORT (CERTIFICATION)			Approved by: Technical Manager
FCC ID: A3LSMF936U	Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	Page 73 of 75
	EUT Type: Portable Handset		



Plot 7-85. Line Conducted Plot with Bluetooth LE (L1) - Closed



Plot 7-86. Line Conducted Plot with Bluetooth LE (N) - Closed

FCC ID: A3LSMF936U		MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 74 of 75	

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMF936U** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules and with RSS-247 of the Innovation, Science and Economic Development Canada Rules.

FCC ID: A3LSMF936U	MEASUREMENT REPORT (CERTIFICATION)		Approved by: Technical Manager
Test Report S/N: 1M2204010046-10.A3L	Test Dates: 04/01 - 6/10/2022	EUT Type: Portable Handset	Page 75 of 75