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MEASUREMENT REPORT FCC PART 15.247 802.11b/g/n/ax (OFDM)

Applicant Name:

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

Date of Testing:

11/07-12/28/2023

Test Report Issue Date:

12/29/2023

Test Site/Location:

Element lab., Columbia, MD, USA

Test Report Serial No.:

1M2311010111-11.A3L

FCC ID:**A3LSMA356U****APPLICANT:****Samsung Electronics Co., Ltd.****Application Type:**

Certification

Model:

SM-A356U

Additional Model(s):

SM-A356U1, SM-S356V

EUT Type:

Portable Handset

Frequency Range:

2412 – 2472MHz

Modulation Type:

CCK, DSSS, OFDM

FCC Classification:

Digital Transmission System (DTS)

FCC Rule Part(s):

Part 15 Subpart C (15.247)

Test Procedure(s):

ANSI C63.10-2013, 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. 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: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Channel Bandwidth [MHz]	IEEE Mode	Tx Frequency [MHz]	MIMO			
			Avg. Conducted		Peak Conducted	
			Max. Power [mW]	Max. Power [dBm]	Max. Power [mW]	Max. Power [dBm]
20	802.11b	2412 - 2472	124.74	20.96	432.26	26.36
	802.11g	2412 - 2472	112.72	20.52	695.87	28.43
	802.11n	2412 - 2472	113.76	20.56	839.70	29.24
	802.11ax	2412 - 2472	107.89	20.33	718.78	28.57

EUT Overview

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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.

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2.0 TEST INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Samsung Portable Handset FCC ID: A3LSMA356U**. The test data contained in this report pertains only to the emissions due to the EUT's WLAN (DTS) transmitter.

Test Device Serial No.: 0897M, 1078M

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), 802.11b/g/n/ax WLAN, 802.11a/n/ac/ax UNII (5GHz), Bluetooth (1x, EDR, LE), NFC

Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
1	2412	8	2447
2	2417	9	2452
3	2422	10	2457
4	2427	11	2462
5	2432	12	2467
6	2437	13	2472
7	2442		

Table 2-1. Frequency \ Channel Operations

Notes:

1. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of ANSI C63.10-2013 and KDB 558074 D01 v05r02. The RBW and VBW were both greater than 50\T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

802.11 Mode/Band		MIMO (1+2)			
		Duty Cycle [%]	Pulse Width	Period	Radiated DCCF [dB]
2.4GHz	b	98.95	8.603	8.694	N/A
	g	96.74	2.791	2.885	0.14
	n (HT20)	96.48	2.579	2.673	0.16
	ax (HE20)	95.66	2.095	2.190	0.19

Table 2-2. Measured Duty Cycles

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2.3 Test Configuration

ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. See Sections 7.8 for AC line conducted emissions test setups, 7.7 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

2.4 Antenna Description

The following antenna gains were used for the testing.

Frequency [GHz]	Antenna-1 Gain [dBi]	Antenna-2 Gain [dBi]	Directional Gain [dBi]
2.4	-3.15	-3.16	-0.14

Table 2-3. Antenna Peak Gain

2.5 Software and Firmware

The test was conducted with software/firmware version A356USQU0AWJ2 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.

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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) was used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 AC Line Conducted Emissions

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

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that 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 0. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

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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).

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4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules\Regulations:

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

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

Conclusion:

The EUT unit complies with the requirement of §15.203.

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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

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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
-	AP2-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	AP2-001
-	ETS-001	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-001
-	ETS-002	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	ETS-002
-	MD 1M 18-40	EMC Cable and Switch System	1/11/2023	Annual	1/11/2024	MD 1M 18-40
-	WL40-1	Conducted Cable Set (40GHz)	1/12/2023	Annual	1/12/2024	WL40-1
-	WL25-1	Conducted Cable Set (25GHz)	1/12/2023	Annual	1/12/2024	WL25-1
Anritsu	MA24406A	Microwave Peak Power Sensor	9/7/2023	Annual	9/7/2024	11240
Emco	3115	Horn Antenna (1-18GHz)	8/8/2022	Biennial	8/8/2024	9704-5182
Emco	3116	Horn Antenna (18 - 40GHz)	7/5/2022	Biennial	7/5/2024	9203-2178
Pastermack	MNLC-2	Line Conducted Emission Cable (NM)	1/11/2023	Annual	1/11/2024	MNLC-2
ETS-Lindgren	3816/2NM	Line Impedance Stabilization Network	8/11/2022	Biennial	8/11/2024	114451
ETS Lindgren	3116C	1-18 GHz DRG Horn Antenna	2/27/2023	Biennial	2/27/2024	00218893
ETS Lindgren	3115	Double Ridged Guide Horn	4/12/2022	Biennial	4/12/2024	82333
Com-Power	AL-130	9kHz - 30MHz Loop Antenna	4/13/2022	Biennial	4/13/2025	121034
Keysight Technologies	N9020A	MXA Signal Analyzer	3/15/2023	Annual	3/15/2024	MY54500644
Keysight Technologies	N9030A	PXA Signal Analyzer (44GHz)	3/15/2023	Annual	3/15/2024	MY52350166
Keysight Technologies	N9030A	PXA Signal Analyzer	1/31/2023	Annual	1/31/2024	MY55410501
Keysight Technologies	N9030B	PXA Signal Analyzer, Multi-touch	9/7/2023	Annual	9/7/2024	MY57141001
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	9/25/2023	Annual	9/25/2024	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	9/11/2023	Annual	9/11/2024	100348
Rohde & Schwarz	ESW44	EMI Test Receiver 2Hz to 44 GHz	3/1/2023	Annual	3/1/2024	101716
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	1/13/2023	Annual	1/13/2024	103200
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	2/21/2023	Biennial	2/21/2025	A051107
Sunol	JB6	LB6 Antenna	3/2/2023	Biennial	3/2/2025	A082816

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.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Samsung Electronics Co., Ltd.

FCC ID: A3LSMA356U

FCC Classification: Digital Transmission System (DTS)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2(a)]	6dB Bandwidth	The minimum 6 dB bandwidth shall be at least 500 kHz.	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(b)]	Transmitter Output Power	shall not exceed 1 W		PASS	Section 7.3
N/A	RSS-247 [5.4(b)]	e.i.r.p.	shall not exceed 4 W		PASS	Section 7.3
15.247(e)	RSS-247 [5.2(b)]	Transmitter Power Spectral Density	shall not be greater than 8 dBm in any 3 kHz 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	Section 7.7
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen [8.8])	LINE CONDUCTED	PASS	Section 7.8

Table 7-1. Summary of Test Results

Notes:

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

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7.2 6dB Bandwidth Measurement

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 its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated and the worst case configuration results are reported in this section.

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure Used

ANSI C63.10-2013 – Section 11.8.2 Option 2

Test Settings

1. The signal analyzer's automatic bandwidth measurement capability 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 $\geq 3 \times$ 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.

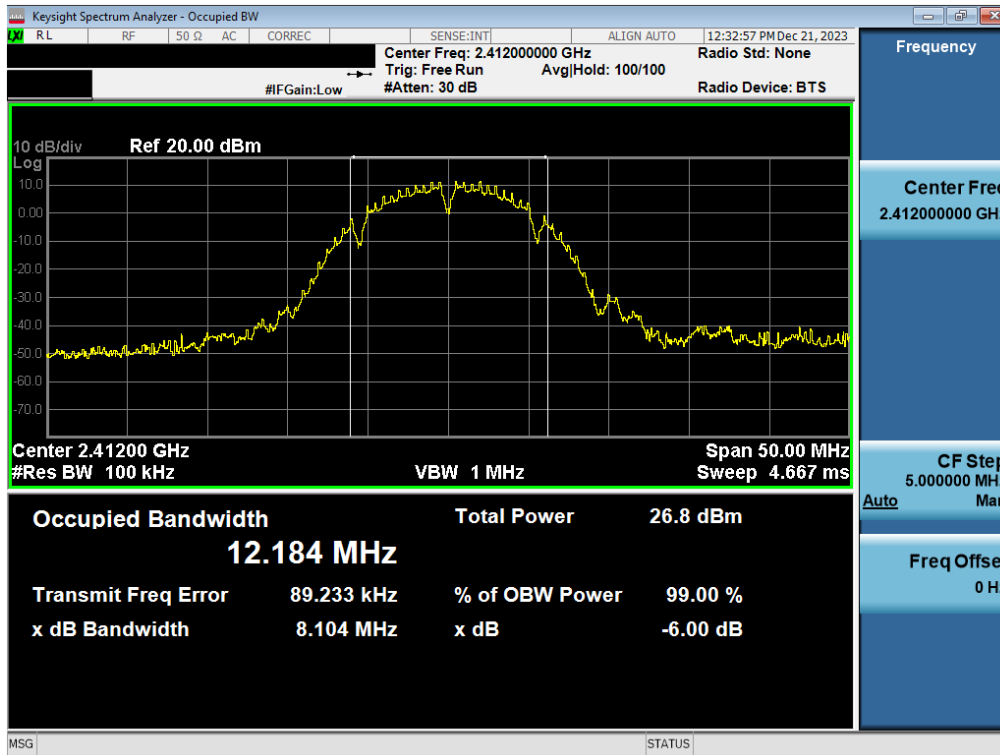
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6dB Bandwidth Measurements

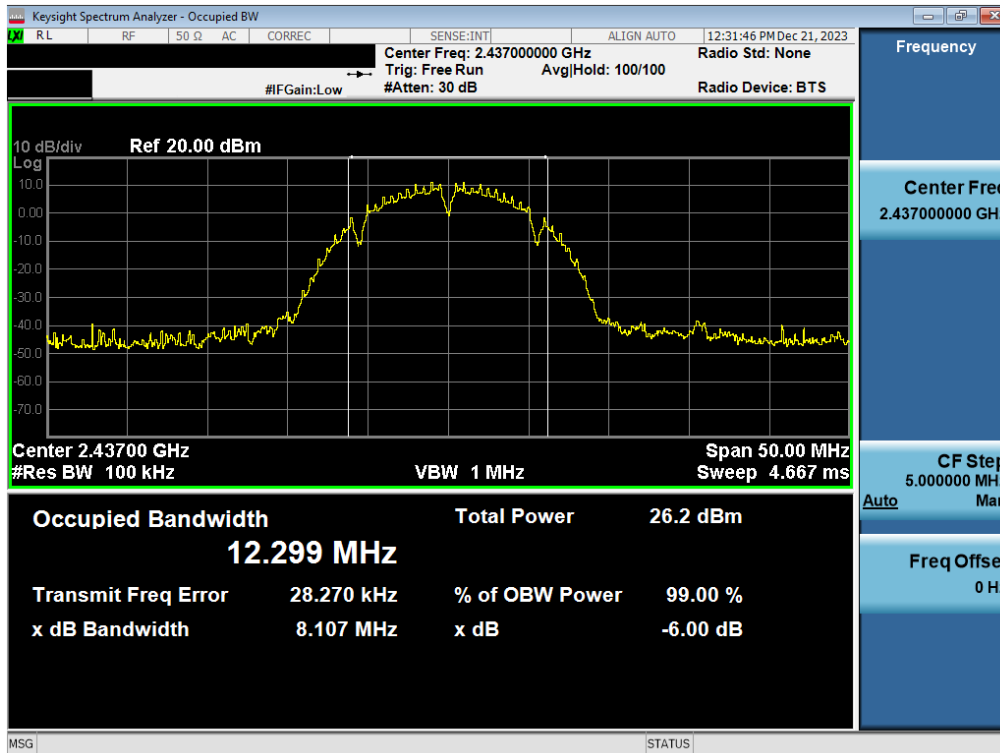
Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	Antenna-1 6dB Bandwidth [MHz]	Antenna-2 6dB Bandwidth [MHz]	Minimum Bandwidth [MHz]
2412	1	b	1	8.10	8.10	0.500
2437	6	b	1	8.11	8.09	0.500
2462	11	b	1	8.03	8.08	0.500
2412	1	g	6	16.10	15.73	0.500
2437	6	g	6	16.49	16.39	0.500
2462	11	g	6	16.43	16.41	0.500
2412	1	n	6.5/7.2 (MCS0)	17.69	17.02	0.500
2437	6	n	6.5/7.2 (MCS0)	17.83	17.66	0.500
2462	11	n	6.5/7.2 (MCS0)	17.64	17.66	0.500
2412	1	ax	6.5/7.2 (MCS0)	19.07	18.16	0.500
2437	6	ax	6.5/7.2 (MCS0)	19.09	19.02	0.500
2462	11	ax	6.5/7.2 (MCS0)	19.17	19.27	0.500

Table 7-2. Conducted 6dB Bandwidth Measurements MIMO

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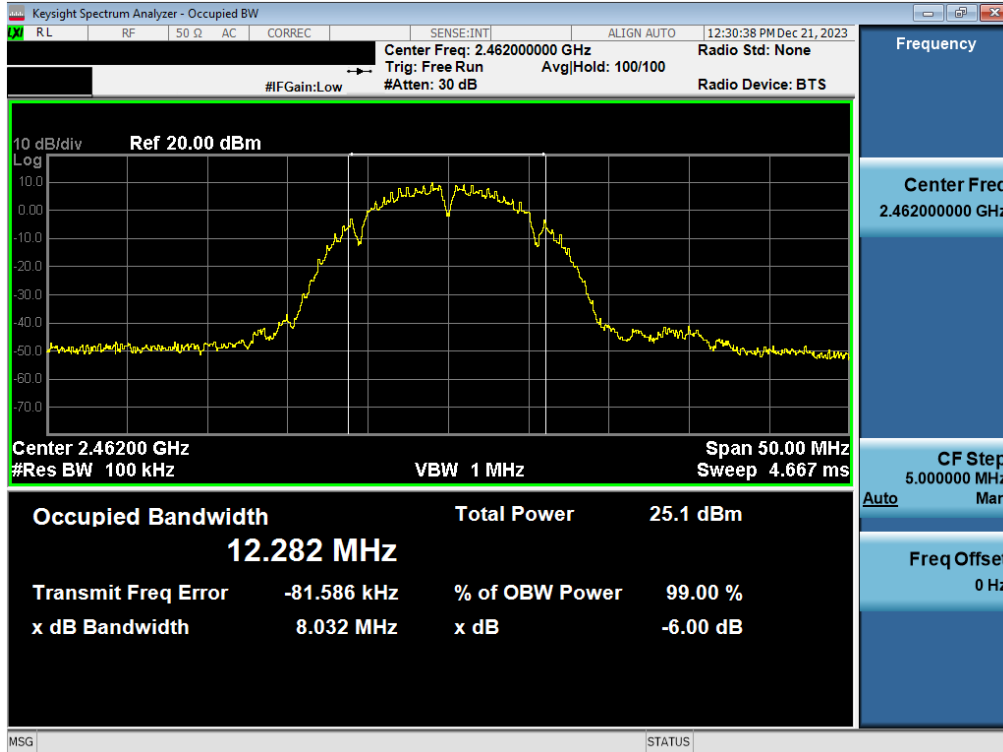


Plot 7-1. 6dB Bandwidth Plot (802.11b – Ch. 1) – MIMO ANT1

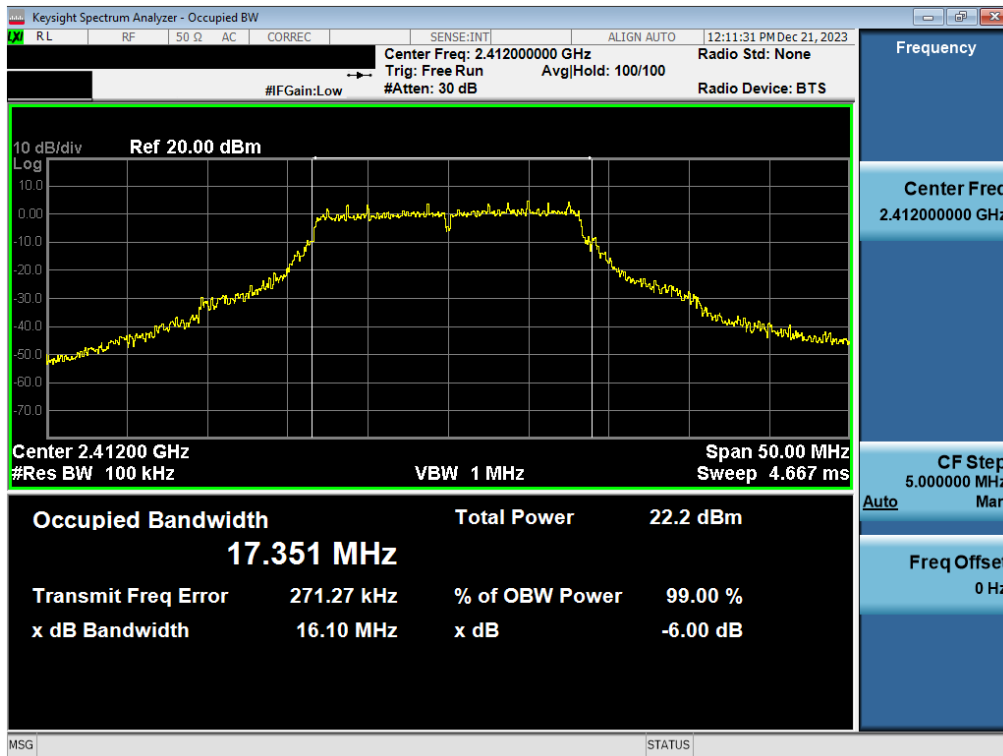


Plot 7-2. 6dB Bandwidth Plot (802.11b – Ch. 6) – MIMO ANT1

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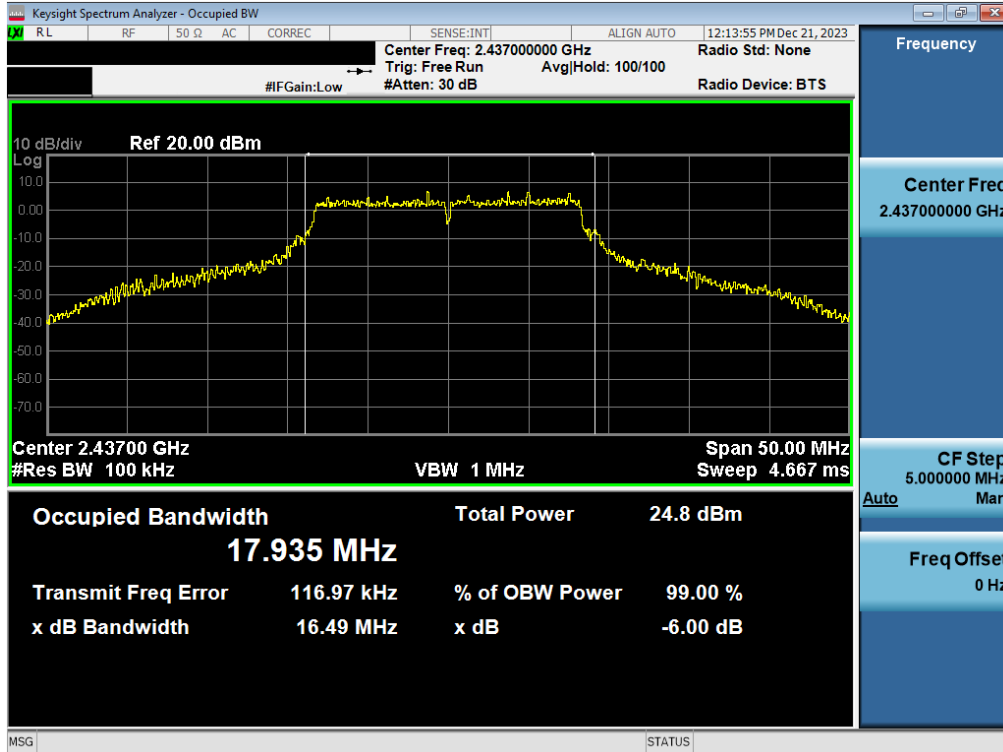


Plot 7-3. 6dB Bandwidth Plot (802.11b – Ch. 11) – MIMO ANT1

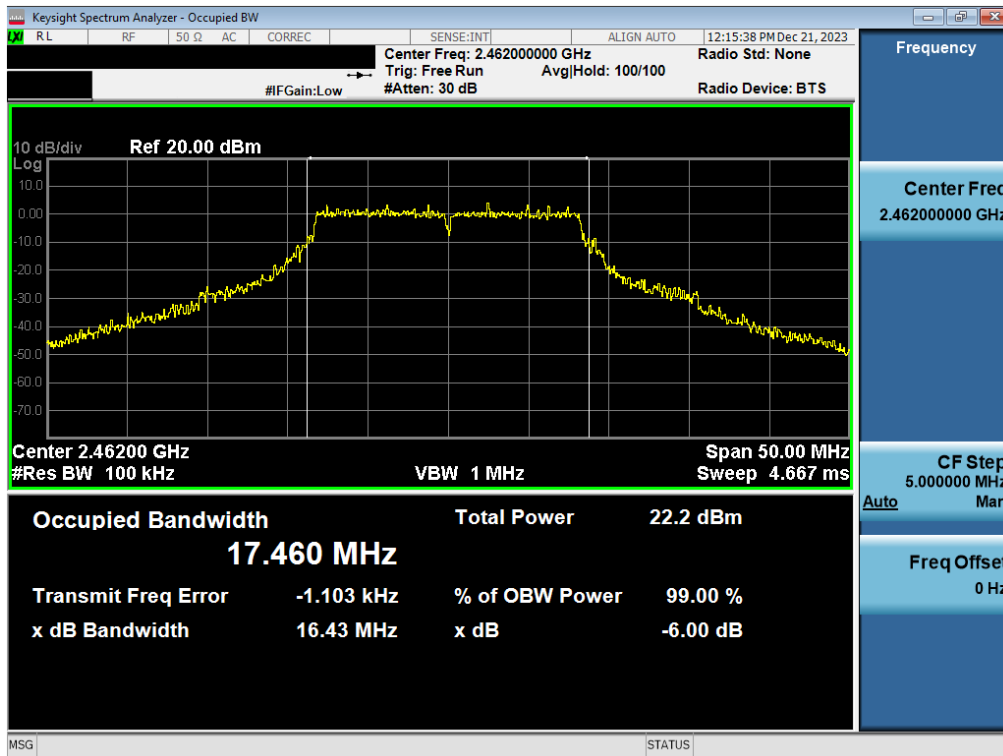


Plot 7-4. 6dB Bandwidth Plot (802.11g – Ch. 1) – MIMO ANT1

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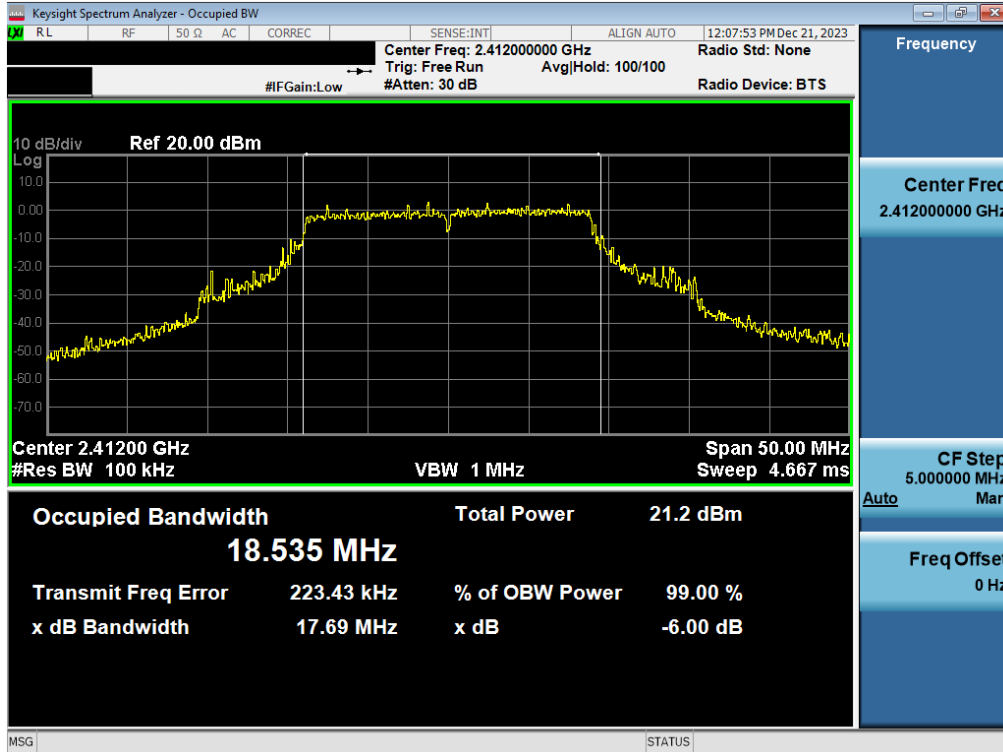


Plot 7-5. 6dB Bandwidth Plot (802.11g – Ch. 6) – MIMO ANT1

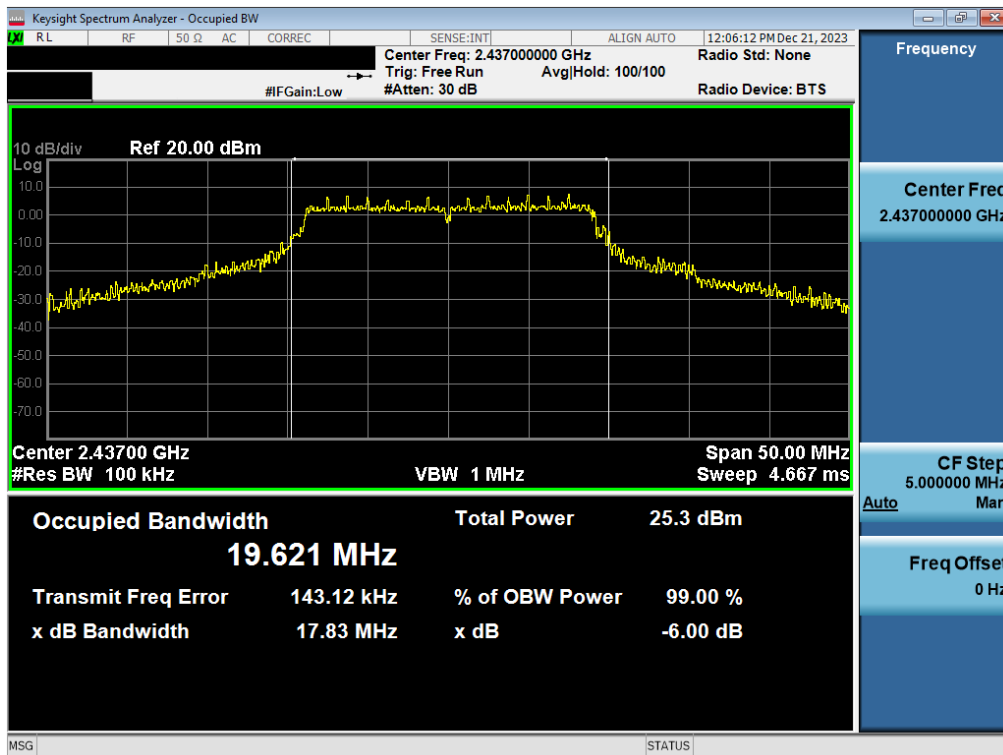


Plot 7-6. 6dB Bandwidth Plot (802.11g – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 17 of 82

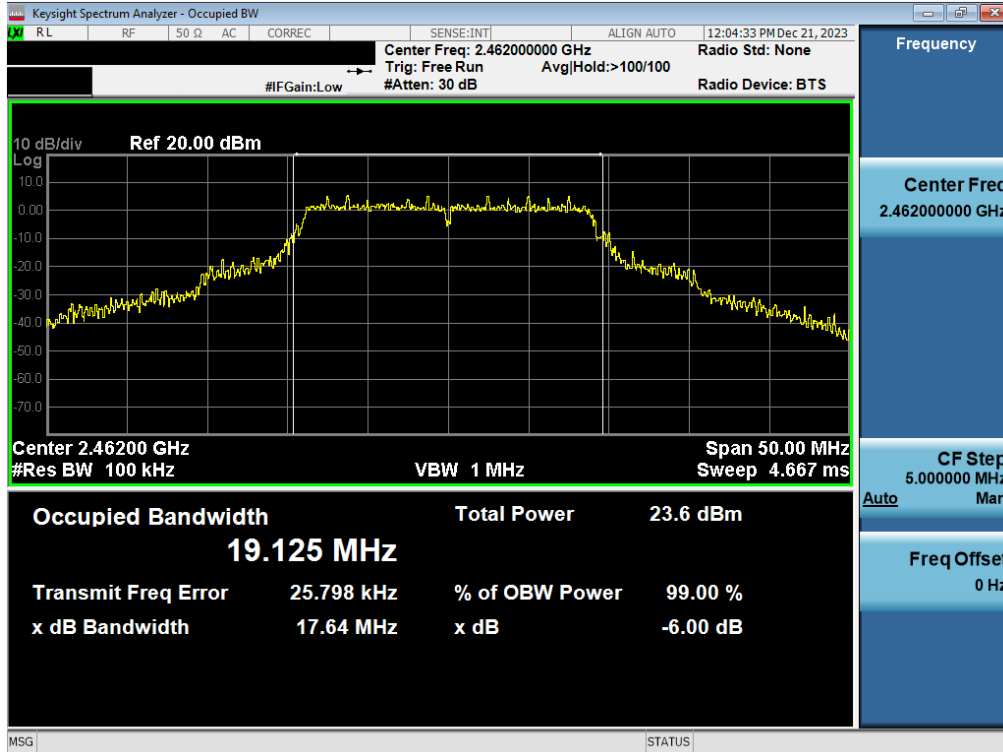


Plot 7-7. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1) – MIMO ANT1

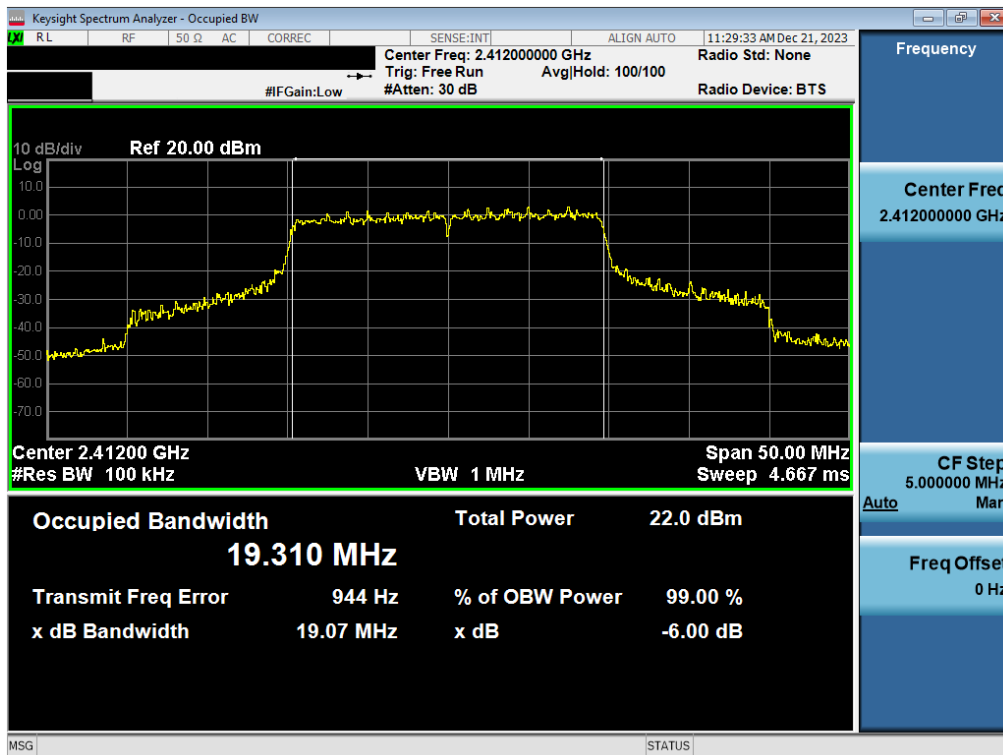


Plot 7-8. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 18 of 82

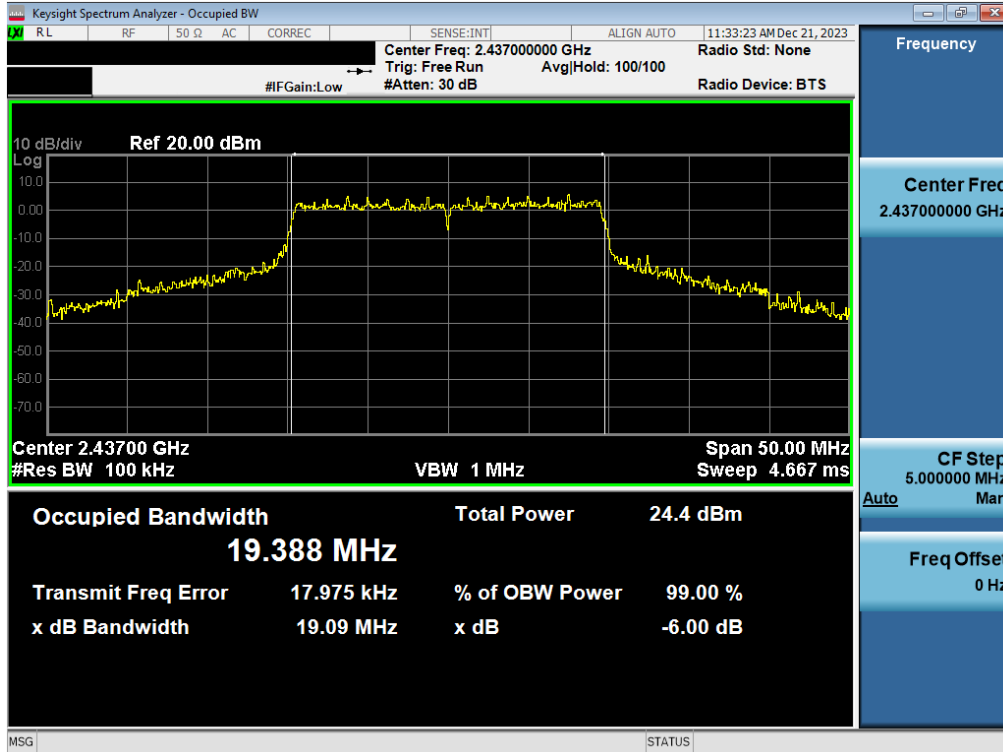


Plot 7-9. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT1

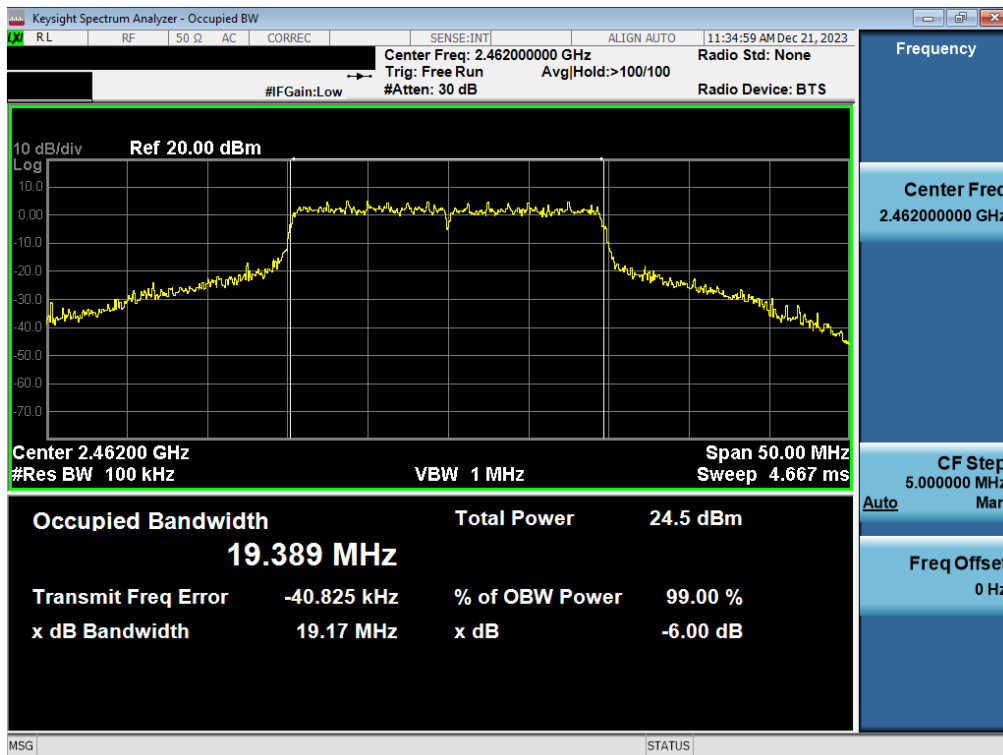


Plot 7-10. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 19 of 82

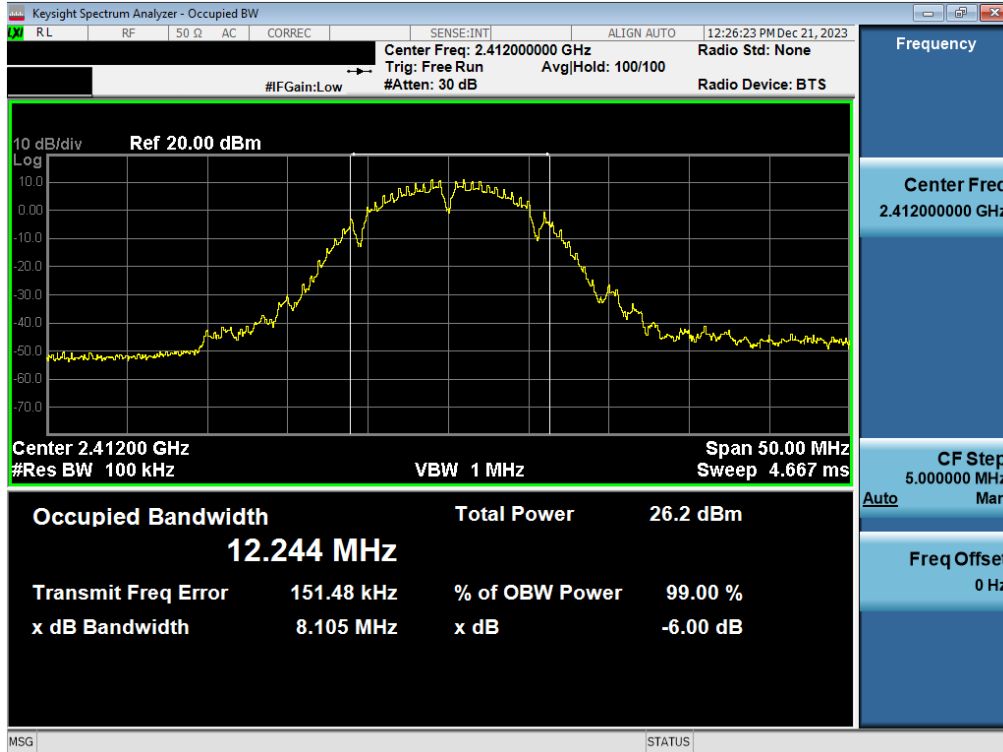


Plot 7-11. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 6) – MIMO ANT1

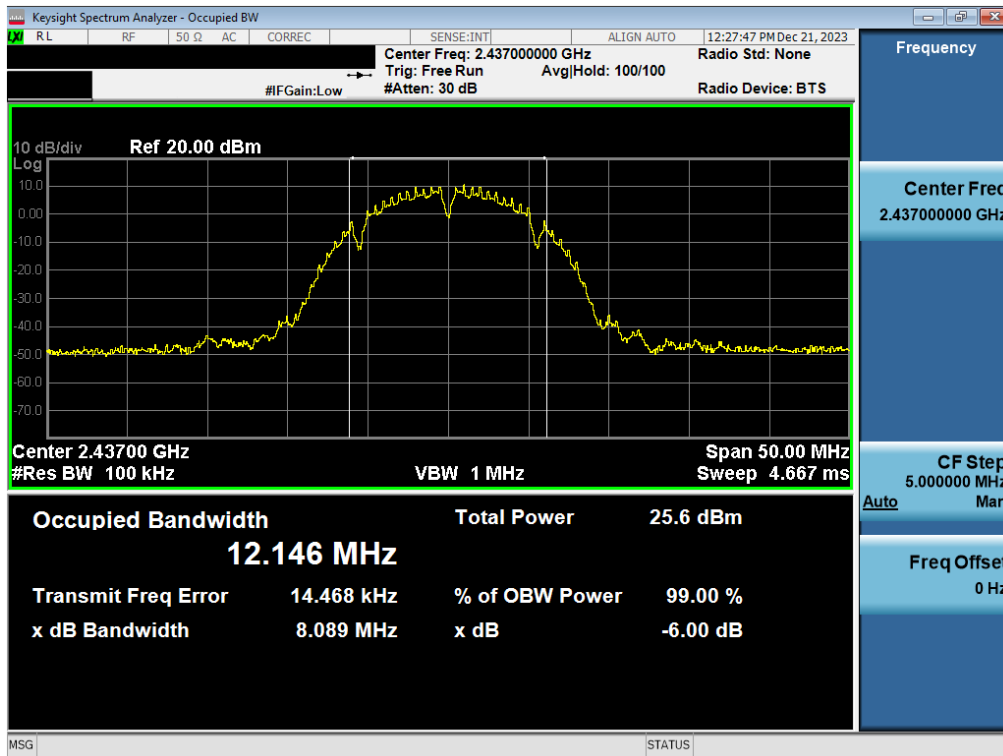


Plot 7-12. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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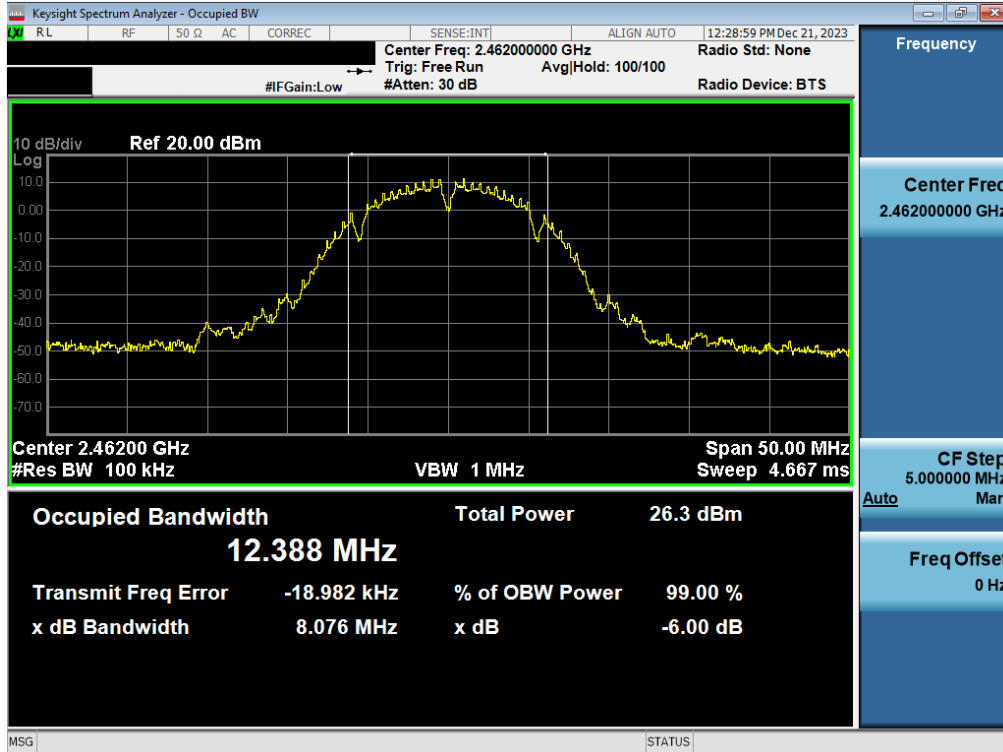


Plot 7-13. 6dB Bandwidth Plot (802.11b – Ch. 1) – MIMO ANT2

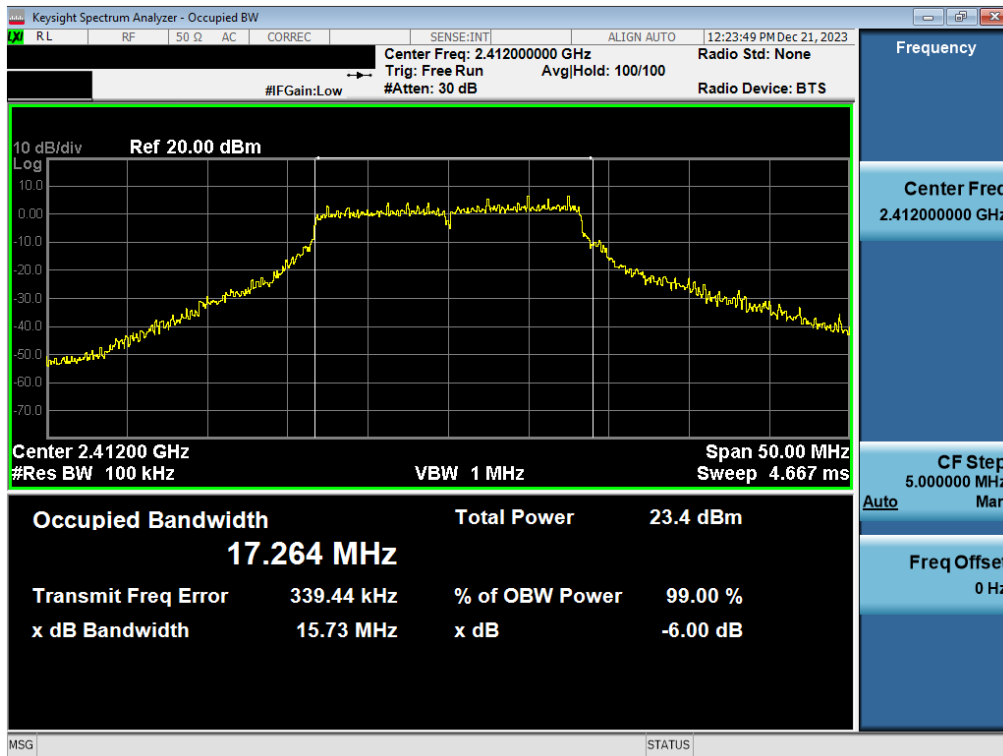


Plot 7-14. 6dB Bandwidth Plot (802.11b – Ch. 6) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 21 of 82

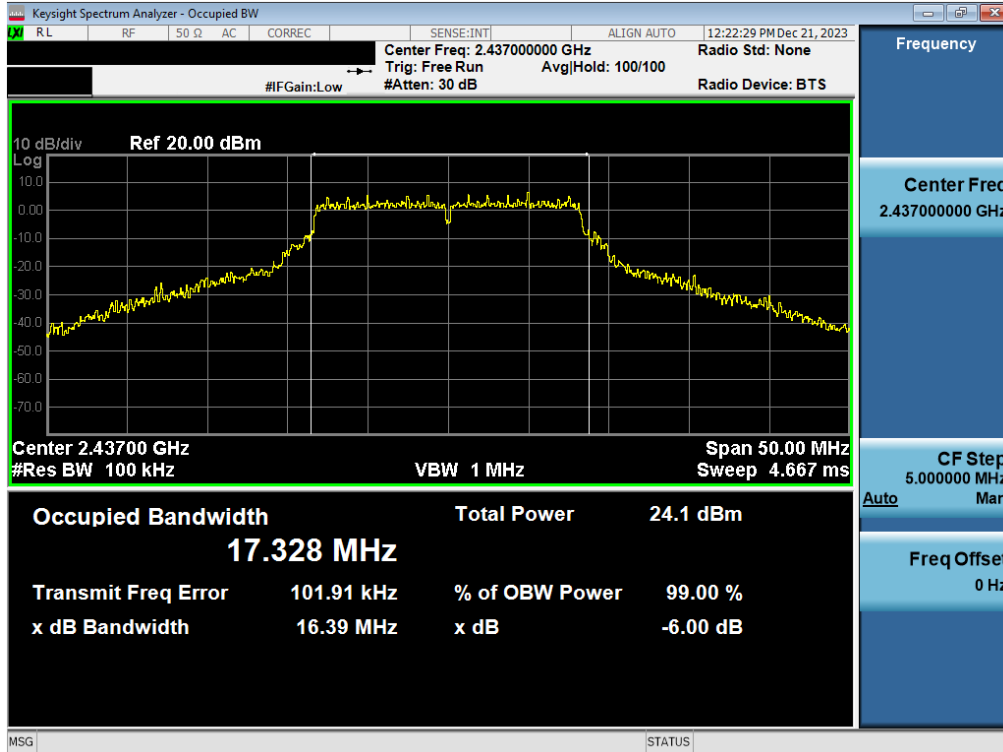


Plot 7-15. 6dB Bandwidth Plot (802.11b – Ch. 11) – MIMO ANT2

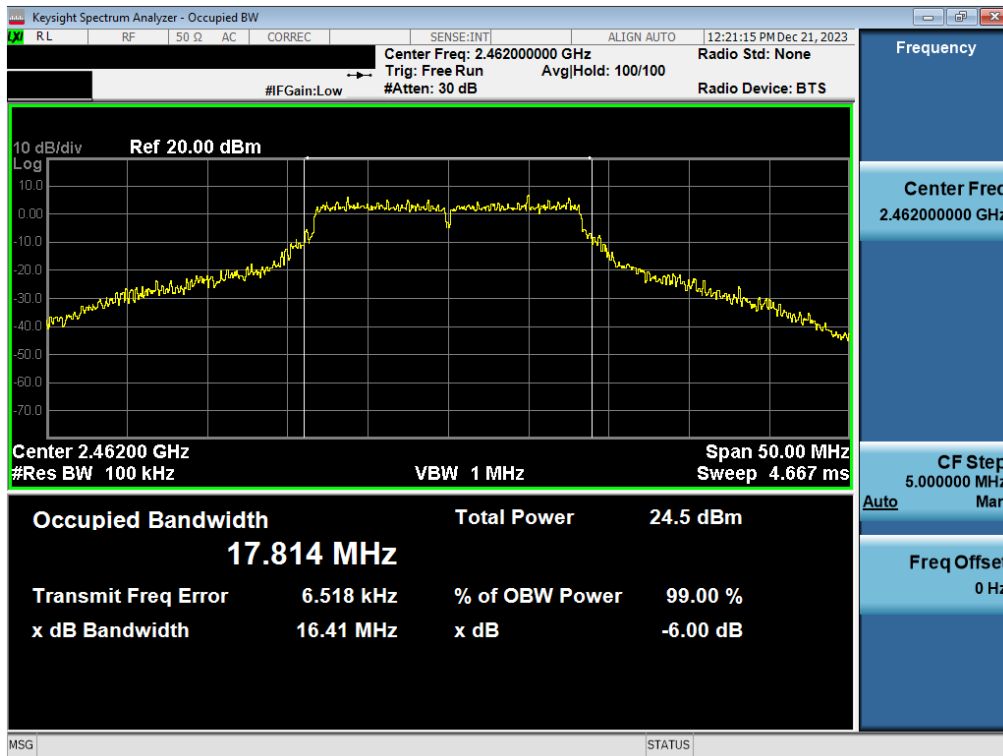


Plot 7-16. 6dB Bandwidth Plot (802.11g – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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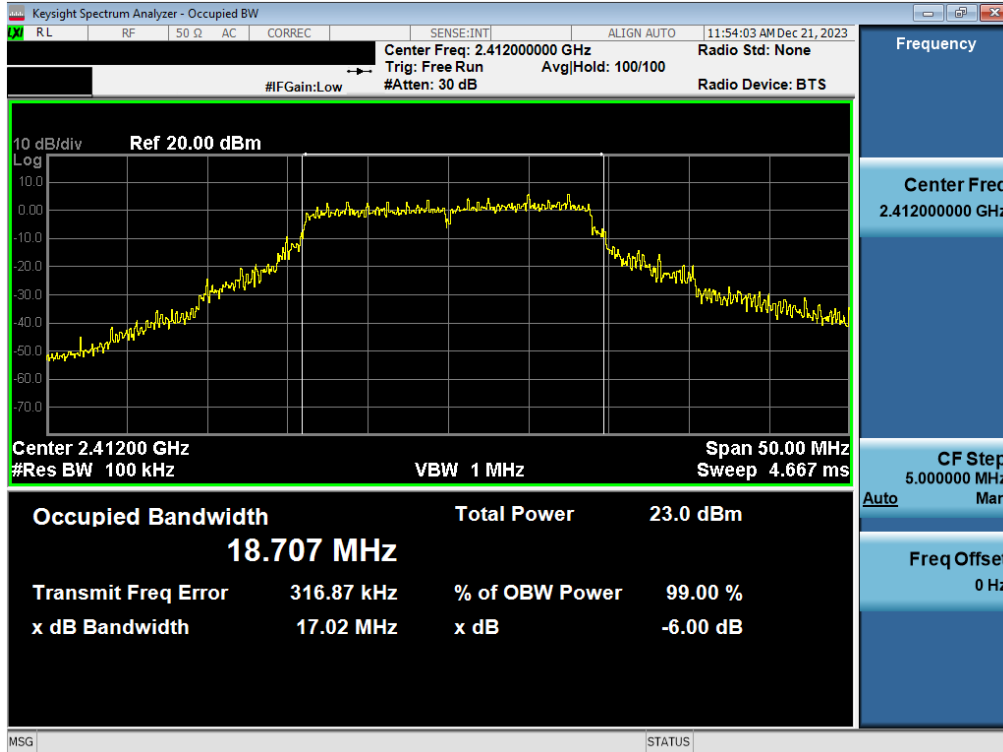


Plot 7-17. 6dB Bandwidth Plot (802.11g – Ch. 6) – MIMO ANT2

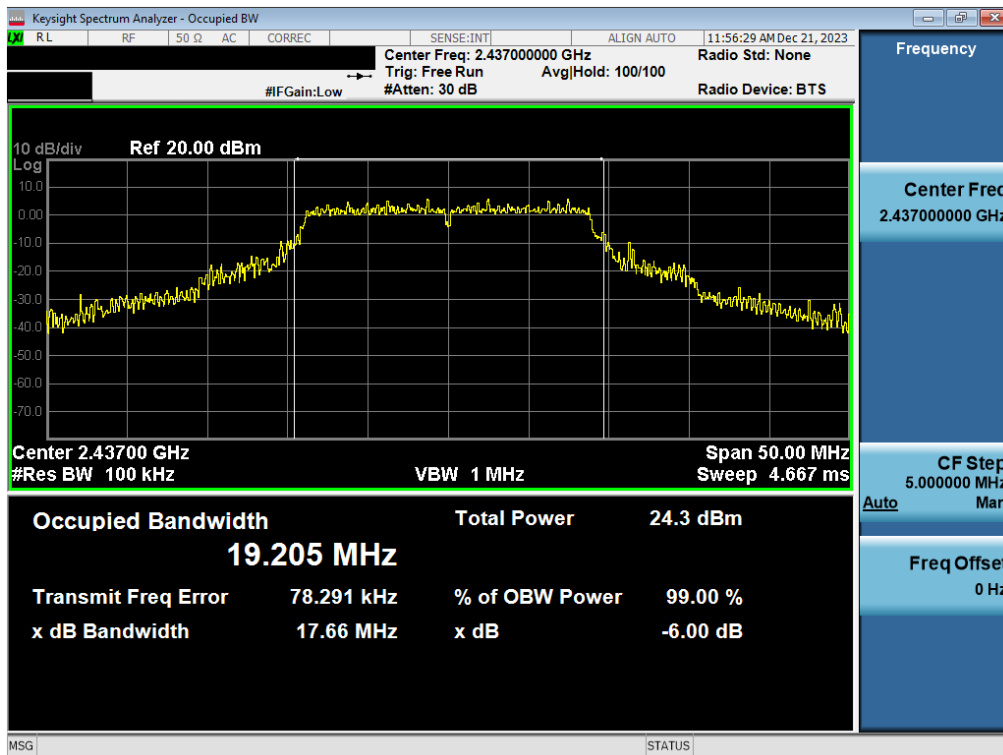


Plot 7-18. 6dB Bandwidth Plot (802.11g – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 23 of 82

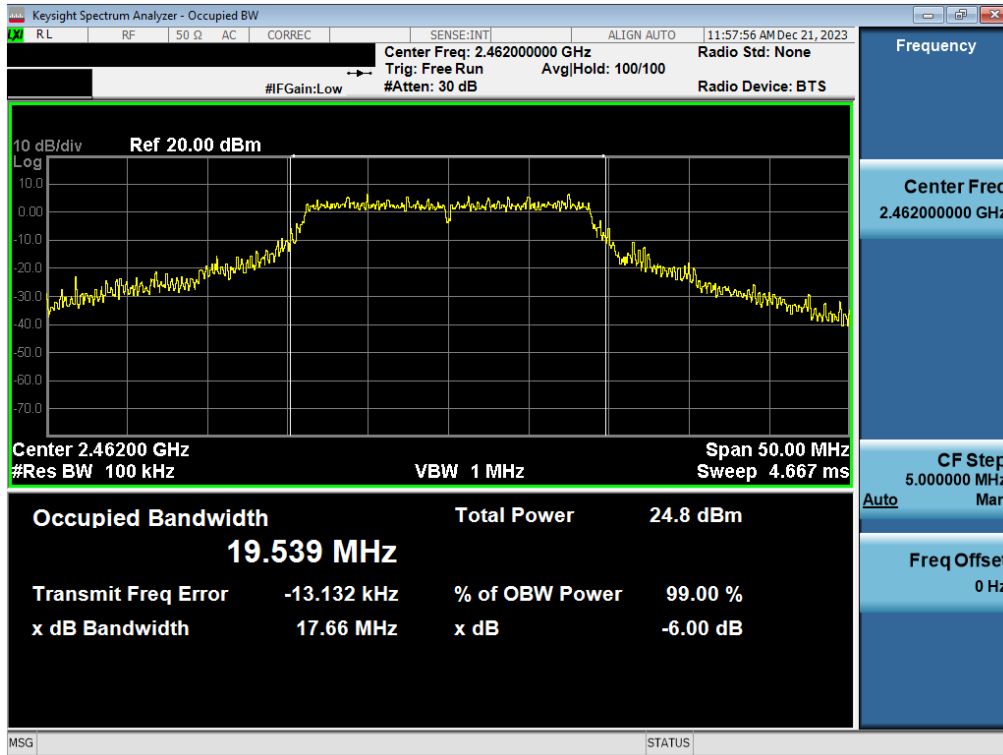


Plot 7-19. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 1) – MIMO ANT2

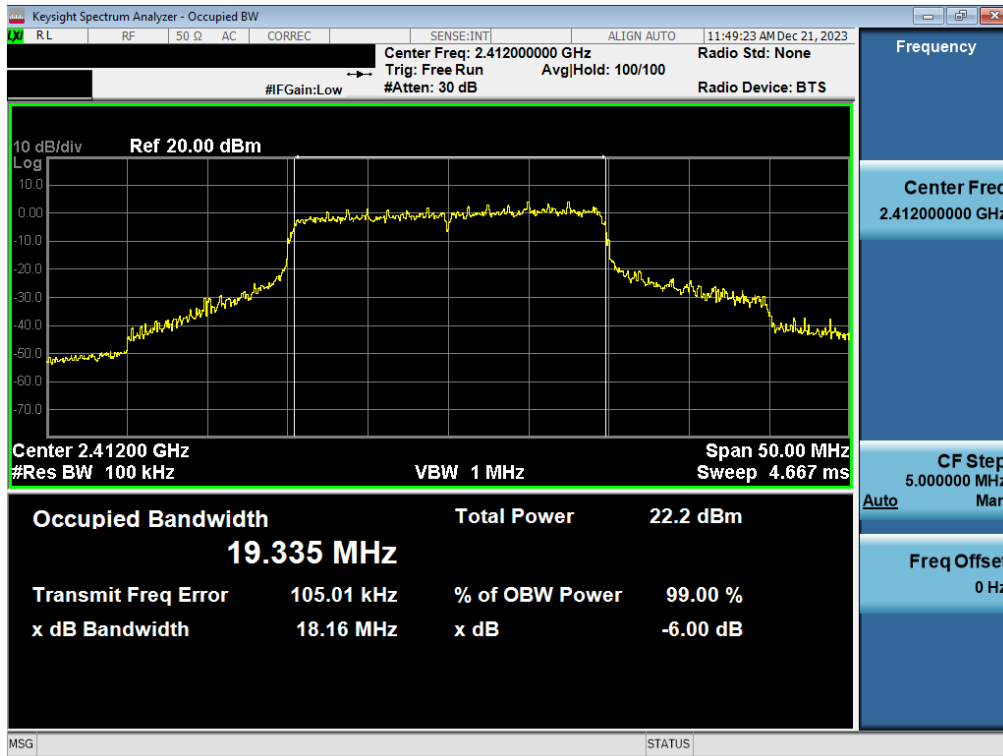


Plot 7-20. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 6) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 24 of 82

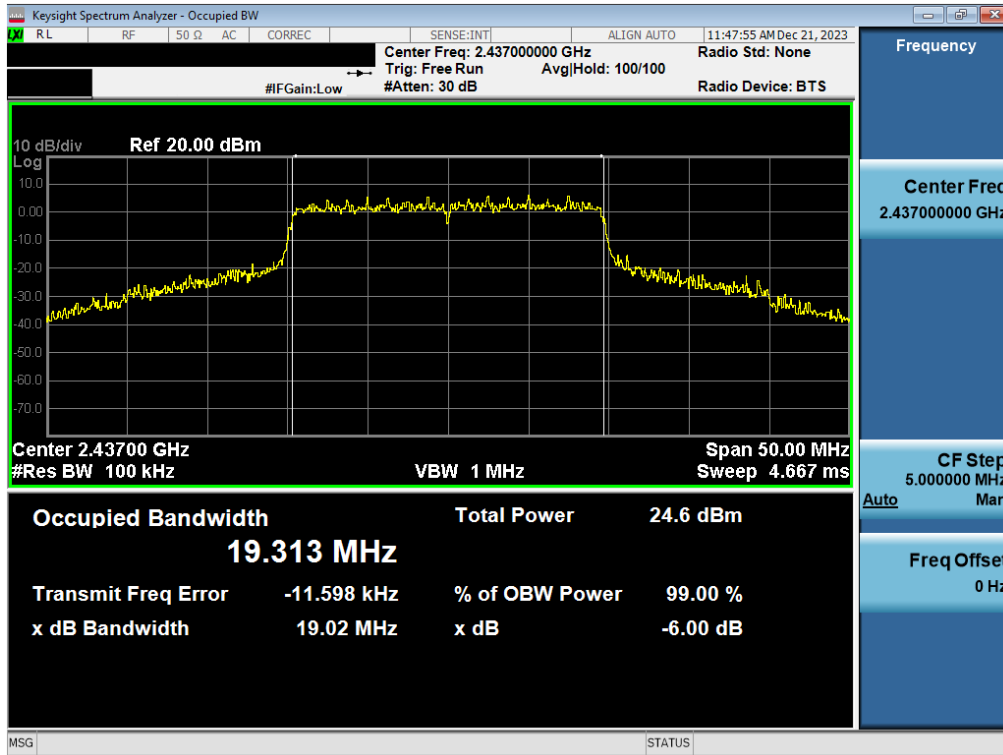


Plot 7-21. 6dB Bandwidth Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT2

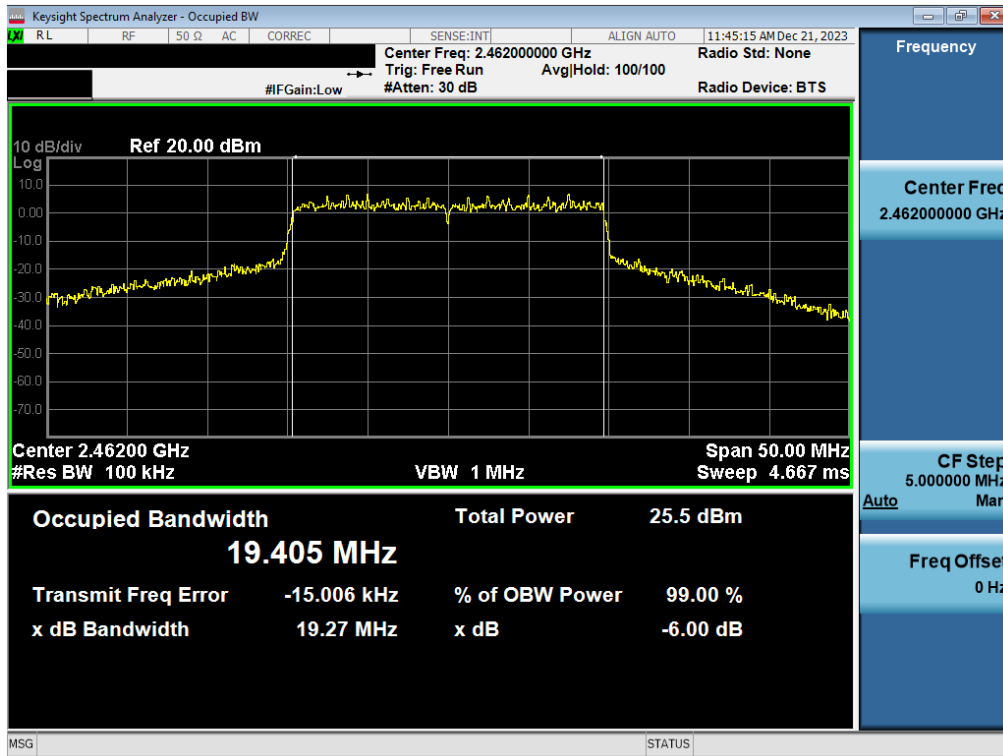


Plot 7-22. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 25 of 82



Plot 7-23. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 6) – MIMO ANT2



Plot 7-24. 6dB Bandwidth Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 26 of 82

7.3 Output Power Measurement

Test Overview and Limits

A transmitter antenna terminal of EUT is connected to the input of an RF power sensor. Measurement is made using a broadband power meter capable of making peak and average measurements while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt per 15.247 and RSS-247.

Test Procedure Used

ANSI C63.10-2013 – Section 11.9.1.3 PKPM1 Peak Power Method

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

ANSI C63.10-2013 – Section 14.2 Measure-and-Sum Technique

Test Settings

Method PKPM1 (Peak Power Measurement)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

Method AVGPM-G (Average Power Measurement)

Average power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

Test Setup

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



Figure 7-2. Test Instrument & Measurement Setup for Power Meter Measurements

Test Notes

None.

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IEEE 802.11b
IEEE 802.11g
IEEE 802.11n
IEEE 802.11ax SU

2.4GHz WIFI (20MHz 802.11b MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Freq [MHz]	Channel	Detector	Conducted Power [dBm]								
			ANT1	ANT2	MIMO						
2412	1	Average	17.95	17.94	20.96	30.00	-9.04	-0.14	20.82	36.02	-15.20
2437	6		17.91	17.58	20.76	30.00	-9.24	-0.14	20.62	36.02	-15.40
2462	11		17.56	17.81	20.70	30.00	-9.30	-0.14	20.56	36.02	-15.46
2467	12		17.62	17.45	20.55	30.00	-9.45	-0.14	20.41	36.02	-15.61
2472	13		17.63	17.22	20.44	30.00	-9.56	-0.14	20.30	36.02	-15.72
2412	1		Peak	22.79	23.11	25.96	30.00	-4.04	-0.14	25.82	36.02
2417	2	23.12		22.56	25.86	30.00	-4.14	-0.14	25.71	36.02	-10.31
2437	6	23.01		23.66	26.36	30.00	-3.64	-0.14	26.21	36.02	-9.81
2462	11	23.06		23.16	26.12	30.00	-3.88	-0.14	25.98	36.02	-10.04
2467	12	23.32		22.96	26.15	30.00	-3.85	-0.14	26.01	36.02	-10.01
2472	13	22.89		22.58	25.75	30.00	-4.25	-0.14	25.60	36.02	-10.42
2.4GHz WIFI (20MHz 802.11g MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Freq [MHz]	Channel	Detector	Conducted Power [dBm]								
			ANT1	ANT2	MIMO						
2412	1	Average	16.29	16.29	19.30	30.00	-10.70	-0.14	19.16	36.02	-16.86
2417	2		17.47	17.26	20.38	30.00	-9.62	-0.14	20.24	36.02	-15.78
2437	6		17.52	17.31	20.43	30.00	-9.57	-0.14	20.29	36.02	-15.73
2462	11		17.29	17.71	20.52	30.00	-9.48	-0.14	20.38	36.02	-15.64
2467	12		11.04	11.69	14.39	30.00	-15.61	-0.14	14.25	36.02	-21.77
2472	13		0.48	0.50	3.50	30.00	-26.50	-0.14	3.36	36.02	-32.66
2412	1	Peak	25.12	24.28	27.73	30.00	-2.27	-0.14	27.59	36.02	-8.43
2437	6		25.21	24.33	27.80	30.00	-2.20	-0.14	27.66	36.02	-8.36
2462	11		25.70	25.11	28.43	30.00	-1.57	-0.14	28.28	36.02	-7.74
2467	12		19.14	19.89	22.54	30.00	-7.46	-0.14	22.40	36.02	-13.62
2472	13		9.80	9.77	12.80	30.00	-17.20	-0.14	12.65	36.02	-23.37
2.4GHz WIFI (20MHz 802.11n MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Freq [MHz]	Channel	Detector	Conducted Power [dBm]								
			ANT1	ANT2	MIMO						
2412	1	Average	14.17	14.32	17.26	30.00	-12.74	-0.14	17.12	36.02	-18.90
2417	2		17.32	17.18	20.26	30.00	-9.74	-0.14	20.12	36.02	-15.90
2437	6		17.29	17.11	20.21	30.00	-9.79	-0.14	20.07	36.02	-15.95
2462	11		17.22	17.86	20.56	30.00	-9.44	-0.14	20.42	36.02	-15.60
2467	12		11.16	11.23	14.20	30.00	-15.80	-0.14	14.06	36.02	-21.96
2472	13		-1.77	-1.38	1.44	30.00	-28.56	-0.14	1.30	36.02	-34.72
2412	1	Peak	24.12	24.16	27.15	30.00	-2.85	-0.14	27.01	36.02	-9.01
2417	2		26.14	26.25	29.21	30.00	-0.79	-0.14	29.06	36.02	-6.96
2437	6		26.32	26.14	29.24	30.00	-0.76	-0.14	29.10	36.02	-6.92
2462	11		25.89	26.08	29.00	30.00	-1.00	-0.14	28.85	36.02	-7.17
2467	12		22.19	23.11	25.68	30.00	-4.32	-0.14	25.54	36.02	-10.48
2472	13		10.48	11.25	13.89	30.00	-16.11	-0.14	13.75	36.02	-22.27
2.4GHz WIFI (20MHz 802.11ax MIMO)						Conducted Power Limit [dBm]	Conducted Power Margin [dB]	Directional Ant. Gain [dBi]	Max e.i.r.p [dBm]	e.i.r.p Limit [dBm]	e.i.r.p Margin [dB]
Freq [MHz]	Channel	Detector	Conducted Power [dBm]								
			ANT1	ANT2	MIMO						
2412	1	Average	13.19	13.35	16.28	30.00	-13.72	-0.14	16.14	36.02	-19.88
2417	2		17.42	17.21	20.33	30.00	-9.67	-0.14	20.19	36.02	-15.83
2437	6		17.34	17.15	20.26	30.00	-9.74	-0.14	20.12	36.02	-15.90
2462	11		17.01	17.16	20.10	30.00	-9.90	-0.14	19.96	36.02	-16.06
2467	12		8.21	8.58	11.41	30.00	-18.59	-0.14	11.27	36.02	-24.75
2472	13		0.32	0.08	3.21	30.00	-26.79	-0.14	3.07	36.02	-32.95
2412	1	Peak	23.01	24.34	26.73	30.00	-3.27	-0.14	26.59	36.02	-9.43
2417	2		25.41	25.63	28.53	30.00	-1.47	-0.14	28.39	36.02	-7.63
2437	6		25.48	25.63	28.57	30.00	-1.43	-0.14	28.42	36.02	-7.60
2462	11		24.63	24.94	27.80	30.00	-2.20	-0.14	27.65	36.02	-8.37
2467	12		18.30	19.62	22.02	30.00	-7.98	-0.14	21.88	36.02	-14.14
2472	13		10.44	11.77	14.17	30.00	-15.83	-0.14	14.02	36.02	-22.00

Table 7-3. Conducted Output Power Measurements MIMO

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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7.4 Power Spectral Density

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 its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates are investigated and the worst-case configuration results are reported in this section.

The maximum permissible power spectral density shall not be greater than 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10-2013 – Section 11.10.2 Method PKPSD

ANSI C63.10-2013 – Section 14.3.1 Measure-and-Sum Technique

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 = 10kHz
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

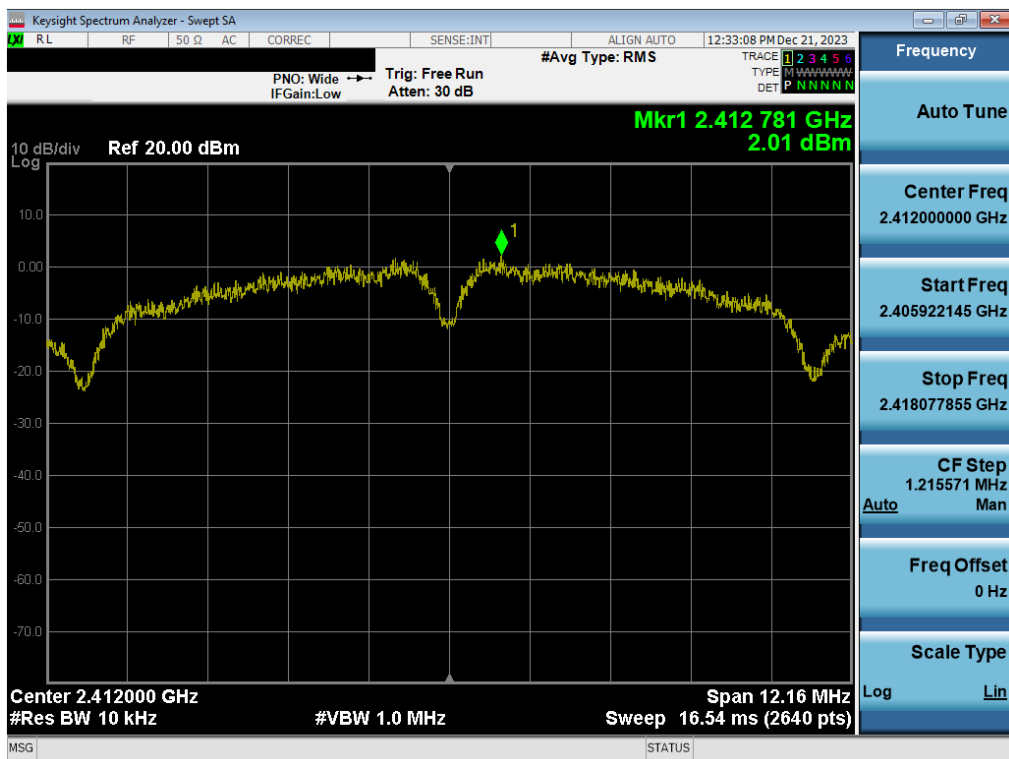
None.

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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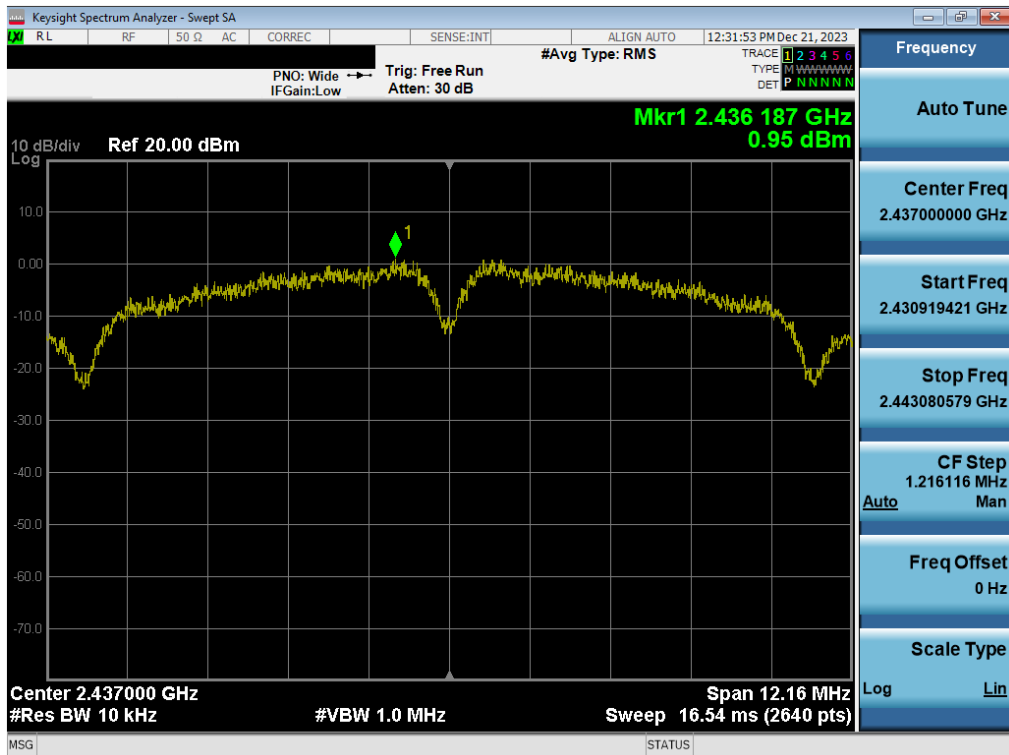
Frequency [MHz]	Channel No.	802.11 Mode	Data Rate [Mbps]	ANT 1 Power Spectral Density [dBm]	ANT 2 Power Spectral Density [dBm]	Summed MIMO Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]	Pass / Fail
2412	1	b	1	2.01	1.38	4.72	8.00	-3.28	Pass
2437	6	b	1	0.95	0.32	3.66	8.00	-4.34	Pass
2462	11	b	1	0.26	1.02	3.66	8.00	-4.34	Pass
2412	1	g	6	-5.03	-4.33	-1.65	8.00	-9.65	Pass
2437	6	g	6	-2.32	-3.57	0.11	8.00	-7.89	Pass
2462	11	g	6	-5.02	-2.05	-0.28	8.00	-8.28	Pass
2412	1	n	6.5/7.2 (MCS0)	-3.82	-2.66	-0.19	8.00	-8.19	Pass
2437	6	n	6.5/7.2 (MCS0)	-1.18	-2.14	1.38	8.00	-6.62	Pass
2462	11	n	6.5/7.2 (MCS0)	-2.54	-1.64	0.94	8.00	-7.06	Pass
2462	1	ax	6.5/7.2 (MCS0)	-7.23	-6.61	-3.90	9.00	-12.90	Pass
2462	6	ax	6.5/7.2 (MCS0)	-4.73	-4.62	-1.66	10.00	-11.66	Pass
2462	11	ax	6.5/7.2 (MCS0)	-5.09	-3.26	-1.07	11.00	-12.07	Pass

Table 7-4. MIMO Conducted Power Spectral Density Results

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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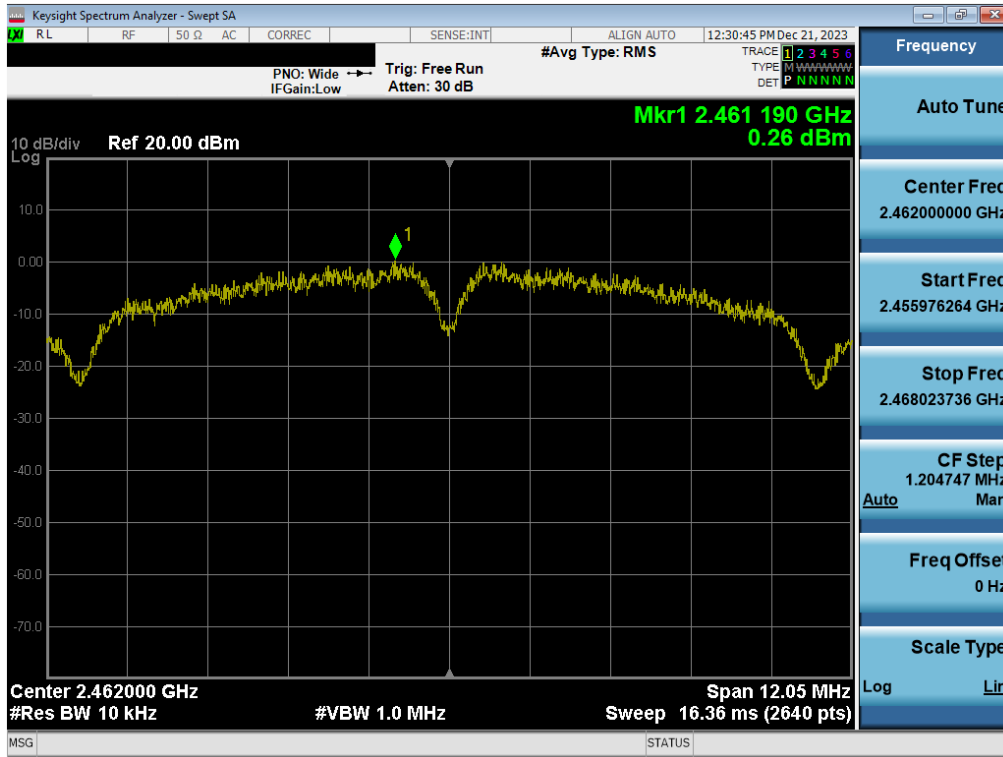


Plot 7-25. Power Spectral Density Plot (802.11b – Ch. 1) – MIMO ANT1

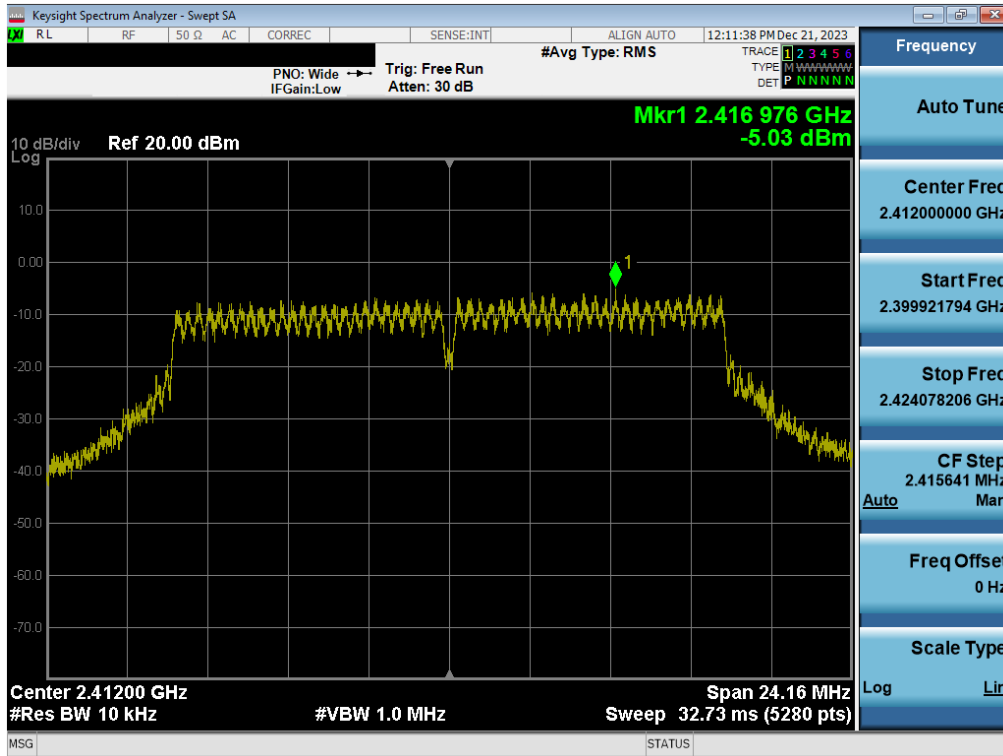


Plot 7-26. Power Spectral Density Plot (802.11b – Ch. 6) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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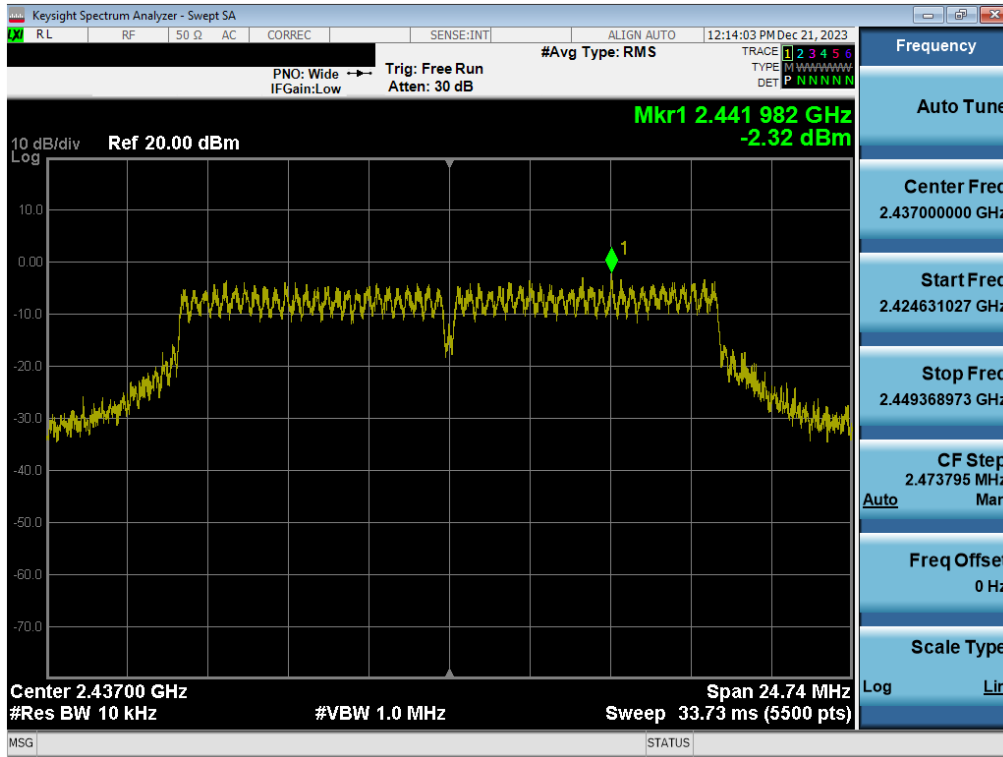


Plot 7-27. Power Spectral Density Plot (802.11b – Ch. 11) – MIMO ANT1

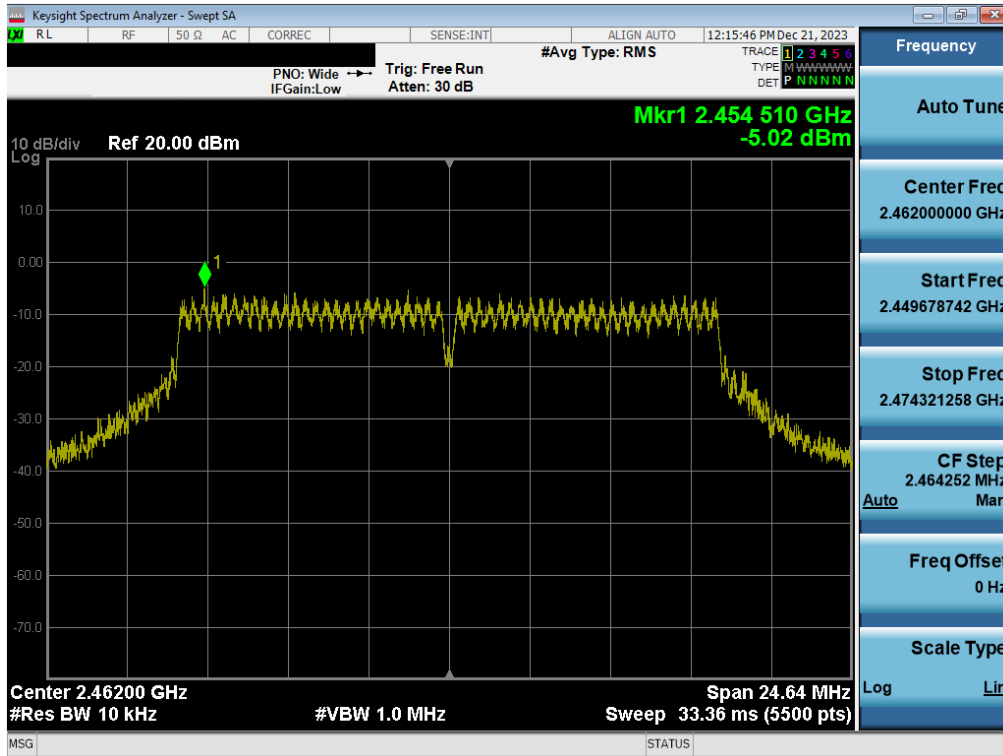


Plot 7-28. Power Spectral Density Plot (802.11g – Ch. 1) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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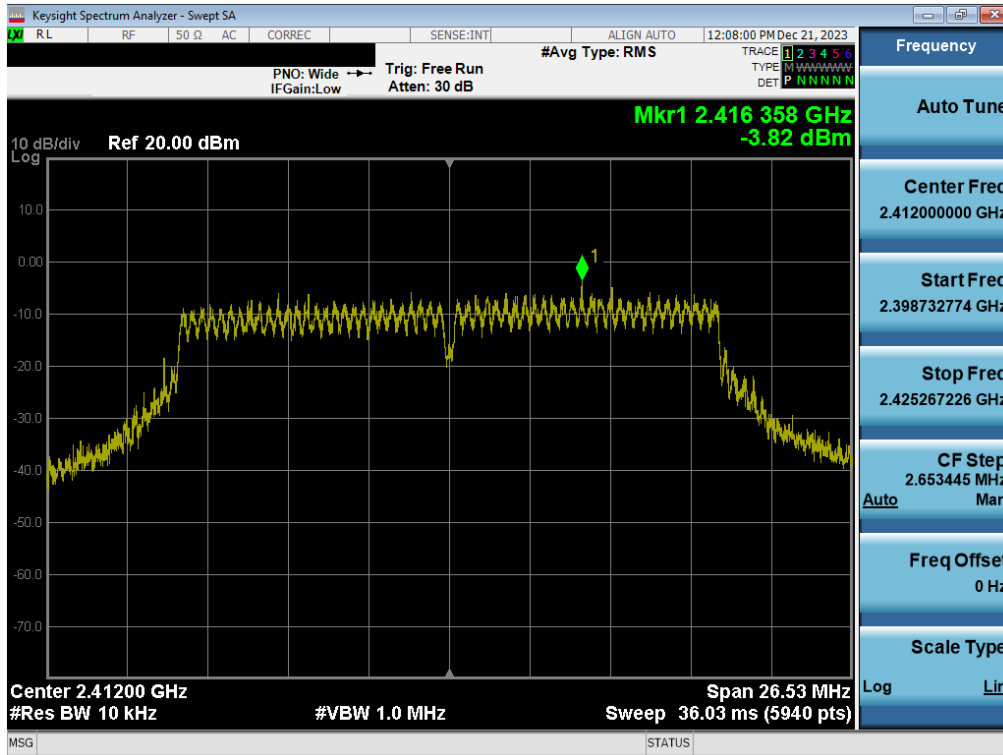


Plot 7-29. Power Spectral Density Plot (802.11g – Ch. 6) – MIMO ANT1

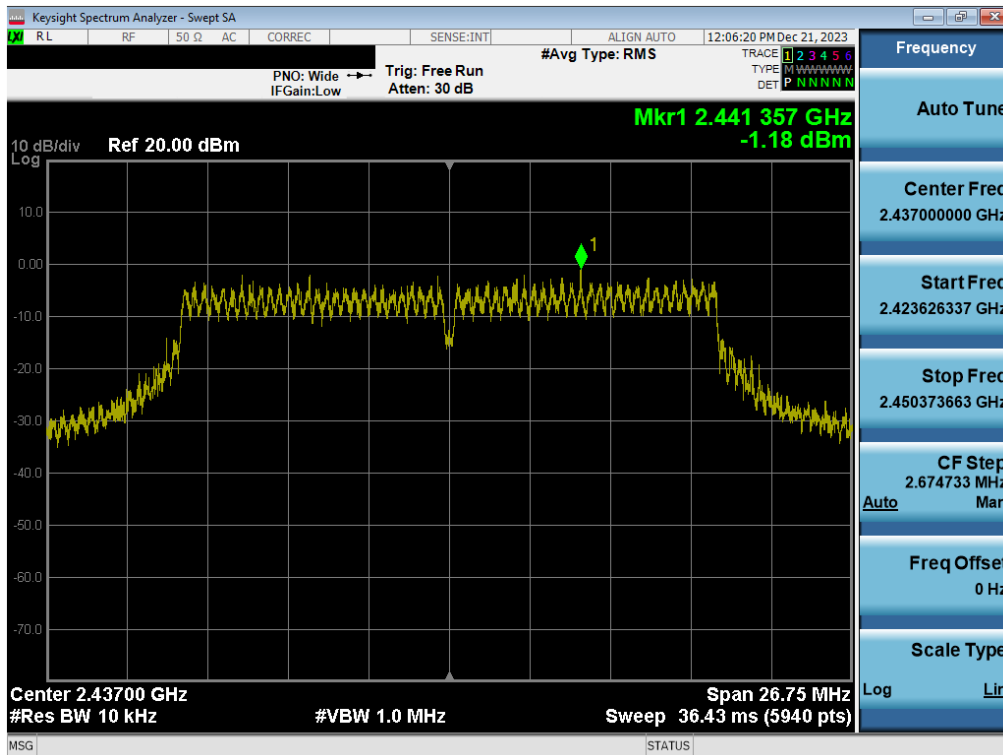


Plot 7-30. Power Spectral Density Plot (802.11g – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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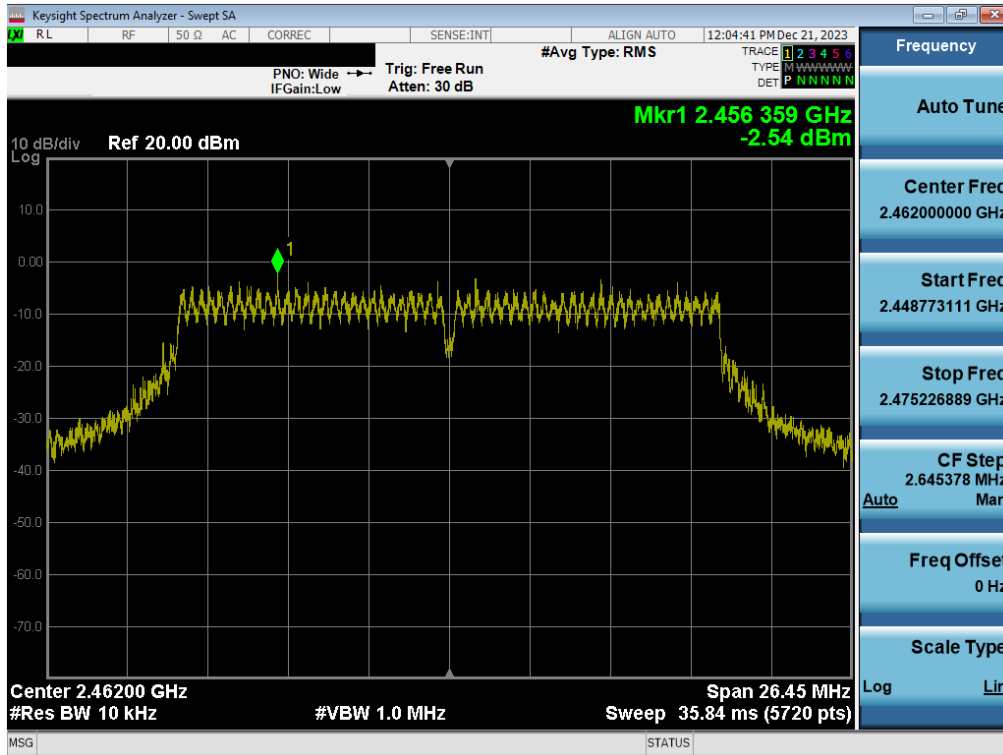


Plot 7-31. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 1) – MIMO ANT1

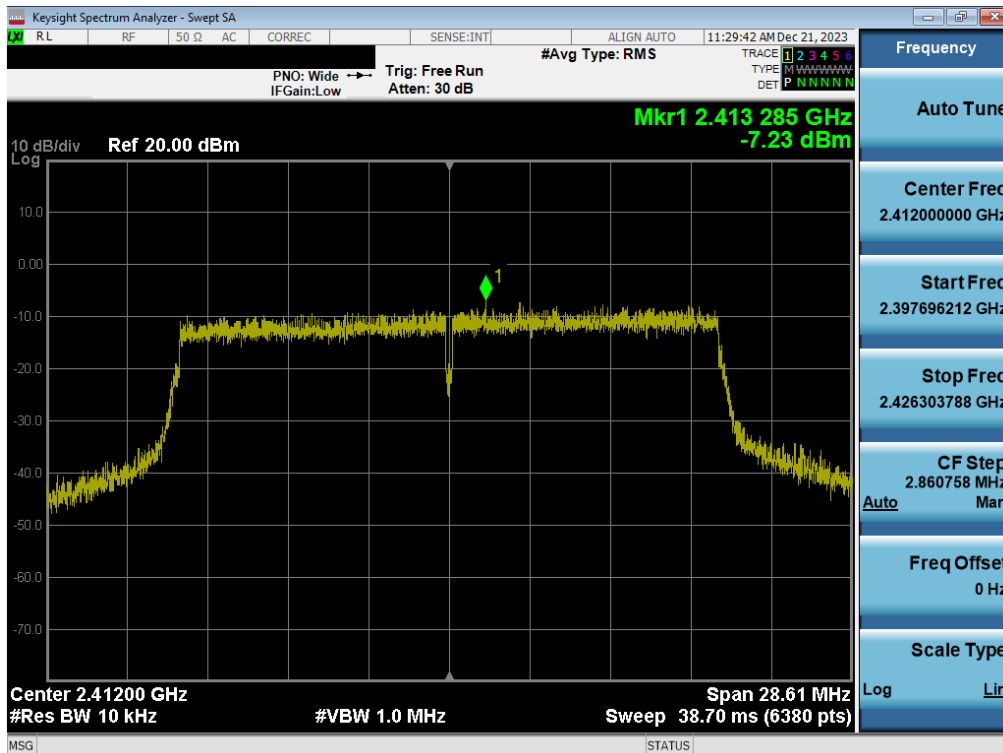


Plot 7-32. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 6) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 34 of 82

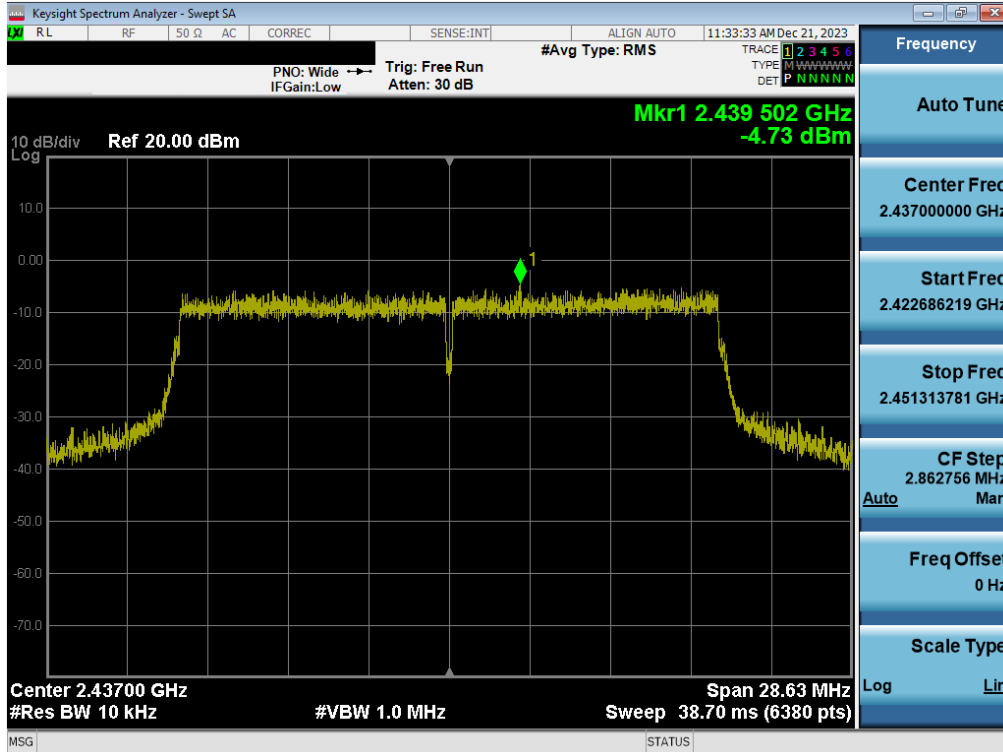


Plot 7-33. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT1

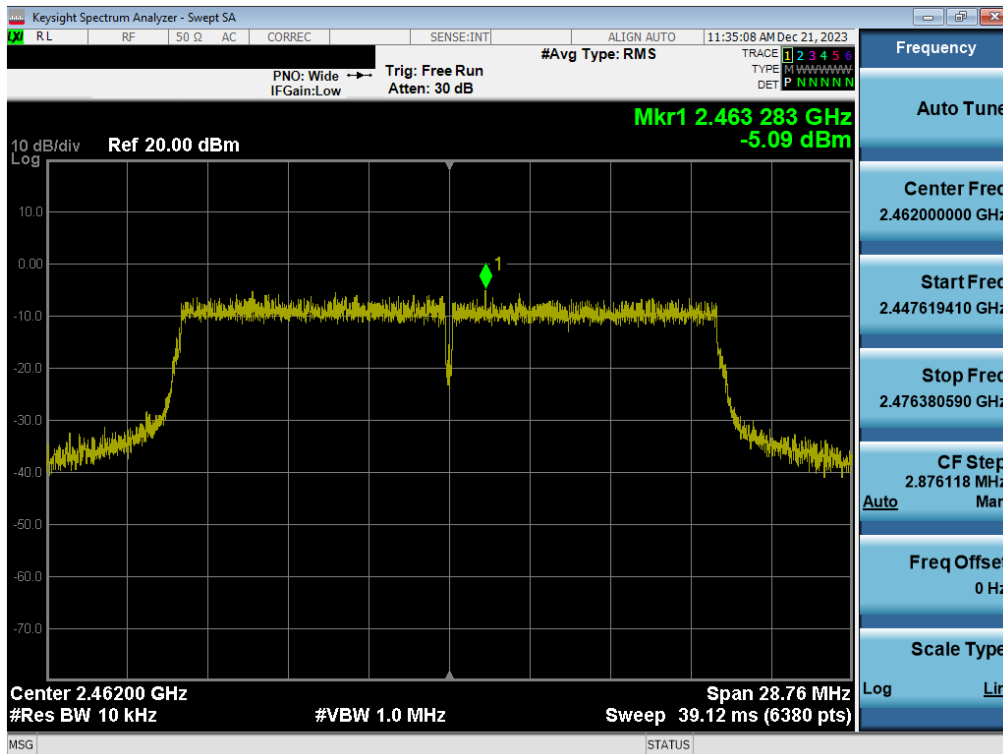


Plot 7-34. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 35 of 82

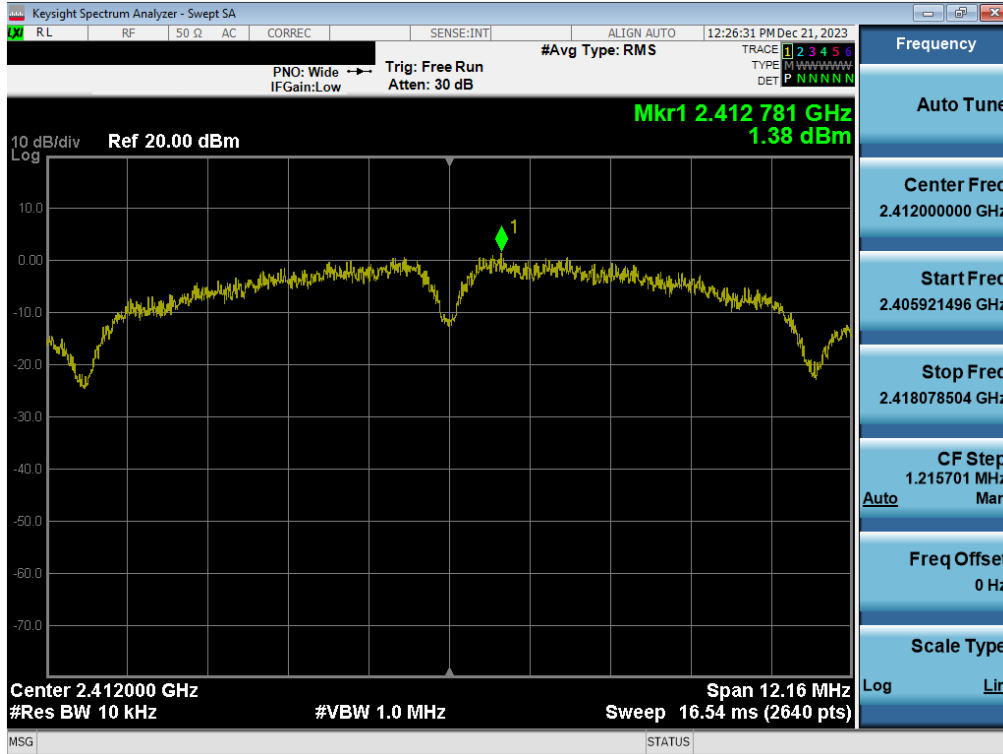


Plot 7-35. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 6) – MIMO ANT1

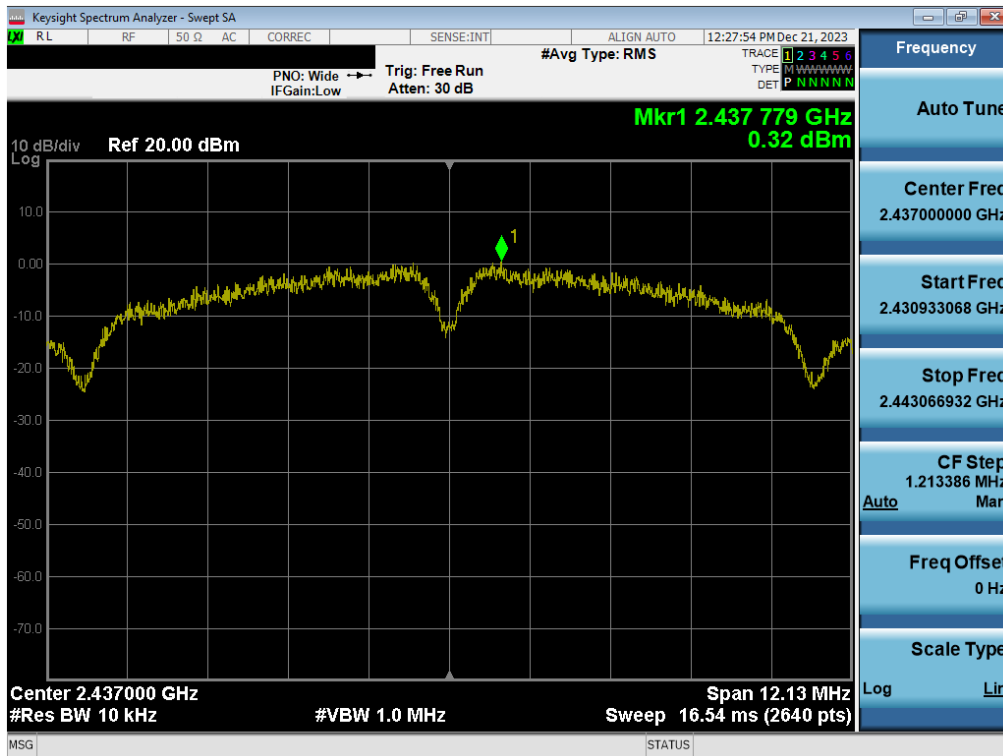


Plot 7-36. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 36 of 82

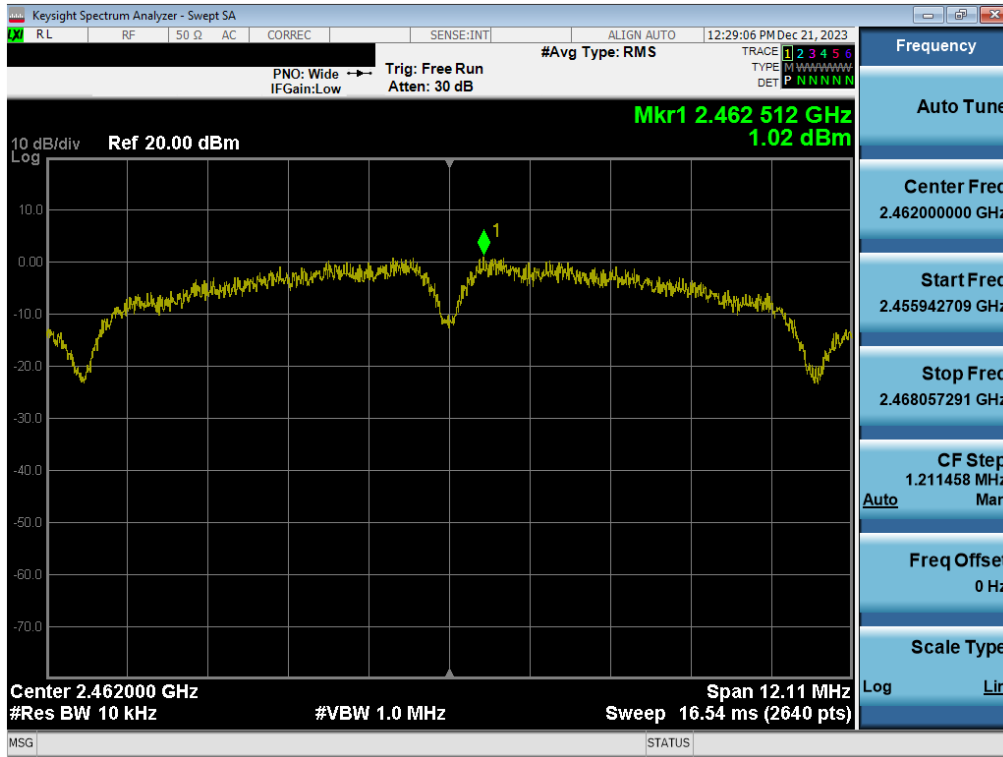


Plot 7-37. Power Spectral Density Plot (802.11b – Ch. 1) – MIMO ANT2

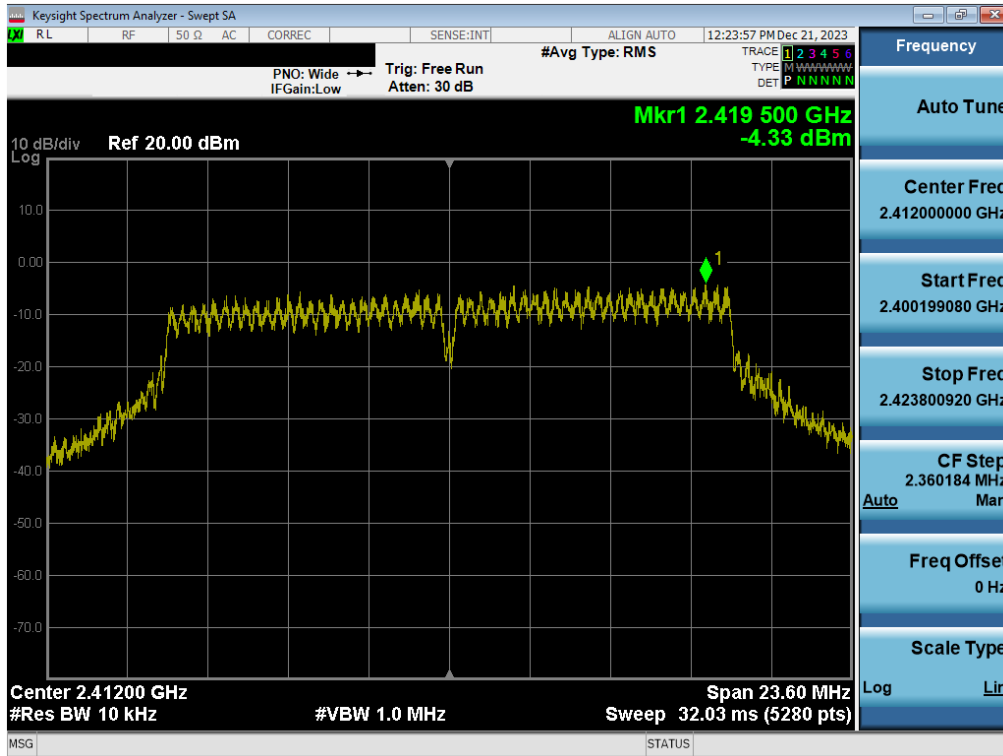


Plot 7-38. Power Spectral Density Plot (802.11b – Ch. 6) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 37 of 82

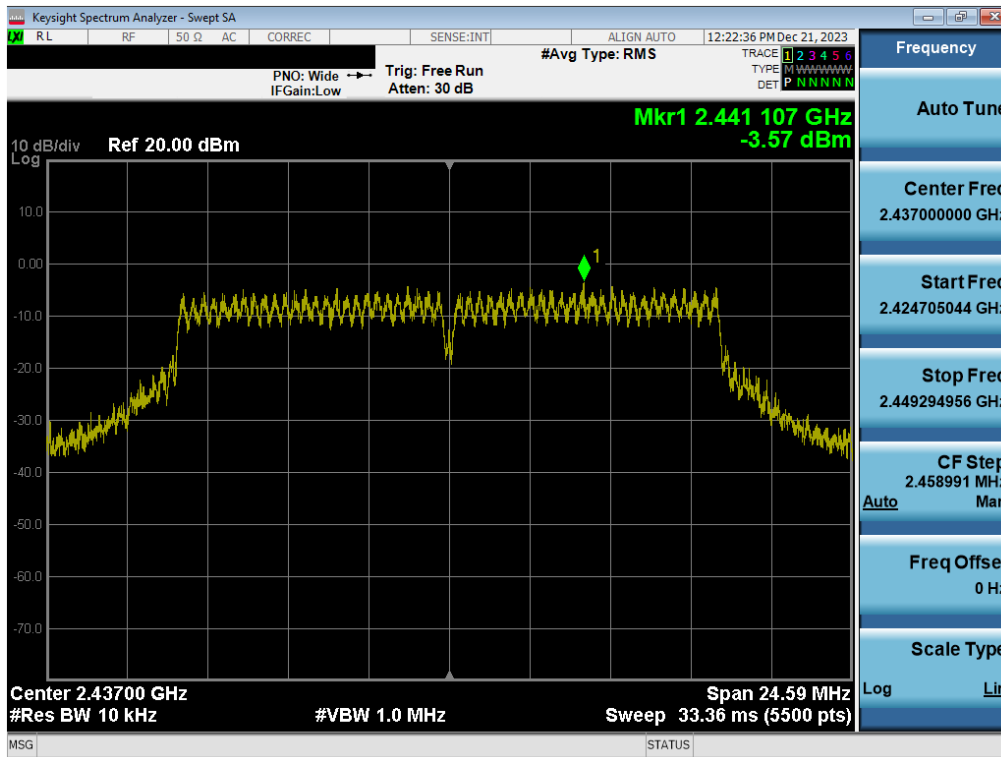


Plot 7-39. Power Spectral Density Plot (802.11b – Ch. 11) – MIMO ANT2

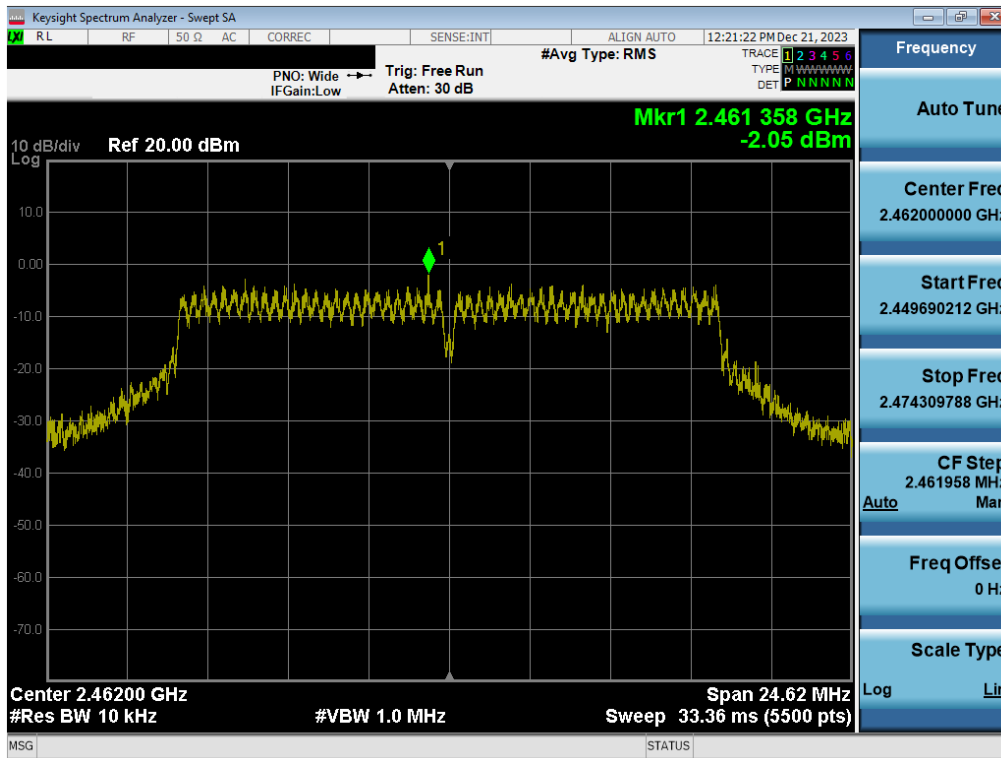


Plot 7-40. Power Spectral Density Plot (802.11g – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 38 of 82

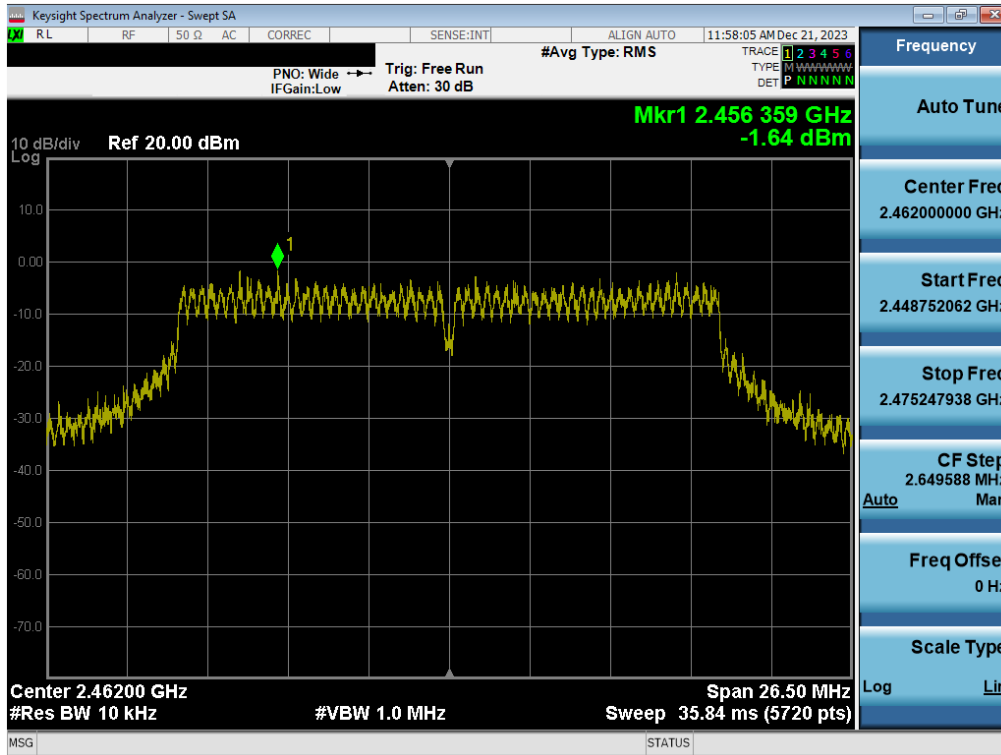


Plot 7-41. Power Spectral Density Plot (802.11g – Ch. 6) – MIMO ANT2

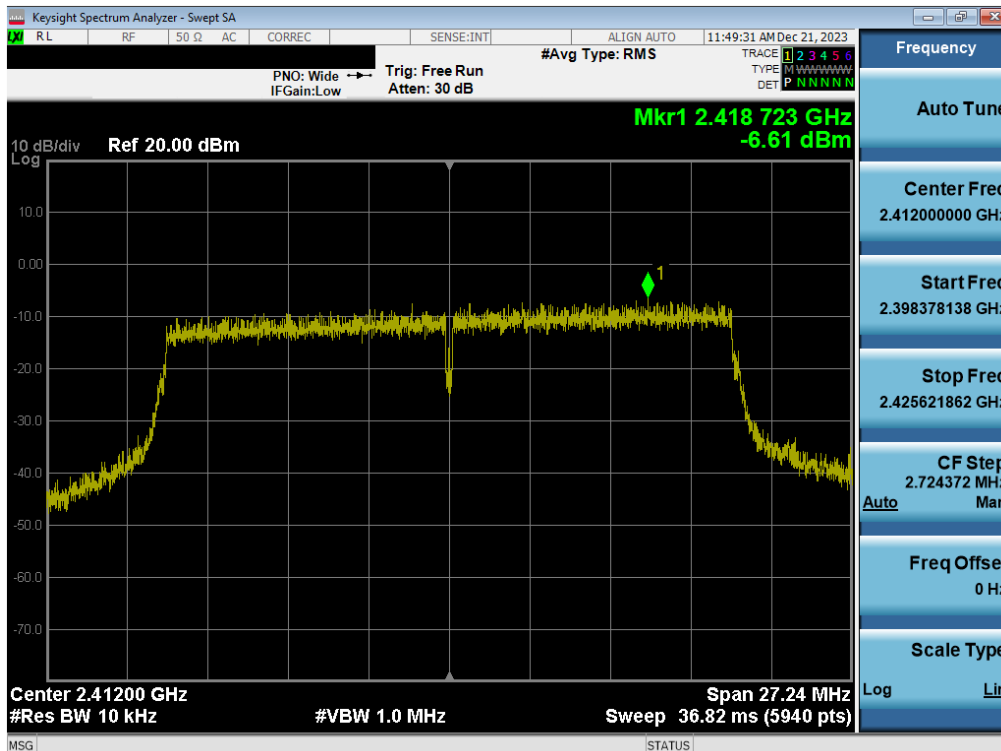


Plot 7-42. Power Spectral Density Plot (802.11g – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 39 of 82

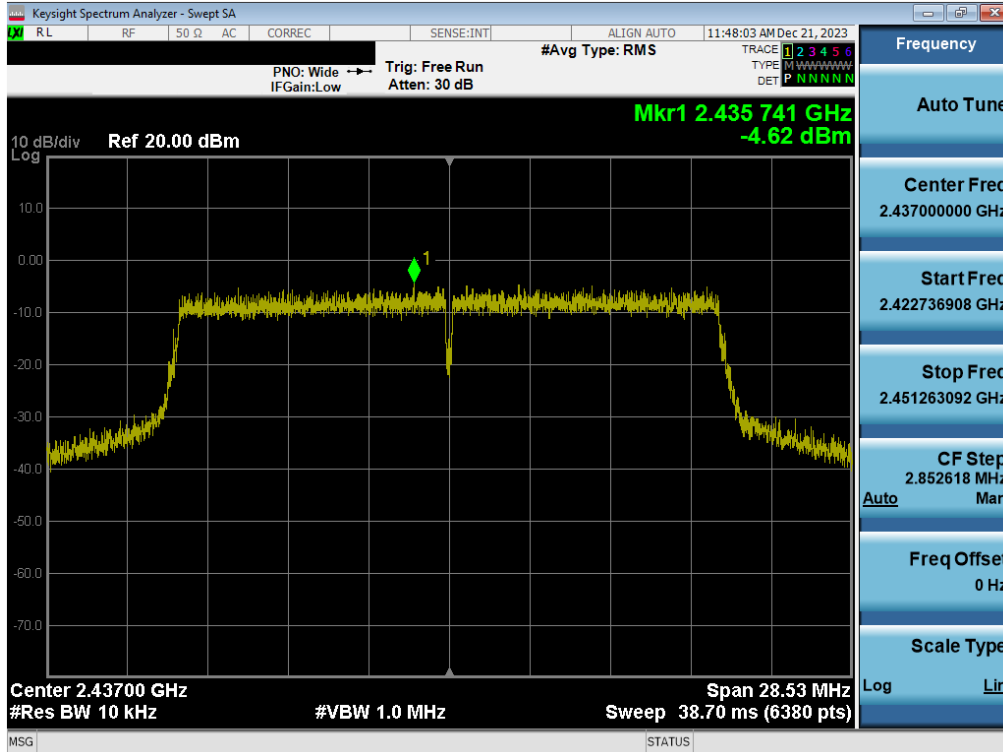


Plot 7-45. Power Spectral Density Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT2

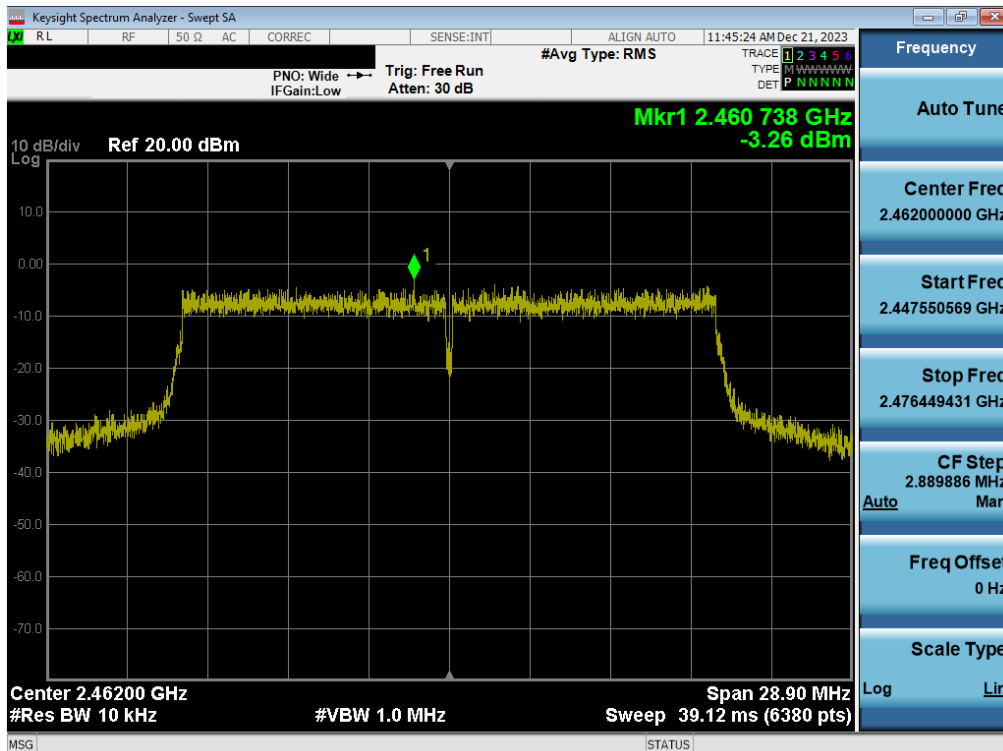


Plot 7-46. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-47. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 6) – MIMO ANT2



Plot 7-48. Power Spectral Density Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 42 of 82

7.5 Conducted Band Edge Emissions

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. For the following out of band conducted spurious emissions plots at the band edge, the EUT was set at a data rate of 1Mbps for “b” mode, 6 Mbps for “g” mode, 6.5\7.2Mbps for “n” mode, and 8.6Mbps for “ax” mode as 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 per the PSD procedure (Section 7.4).

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3

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 = 1MHz
5. Detector = Peak
6. Number of sweep points $\geq 2 \times \text{Span} \backslash \backslash \text{RBW}$
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.

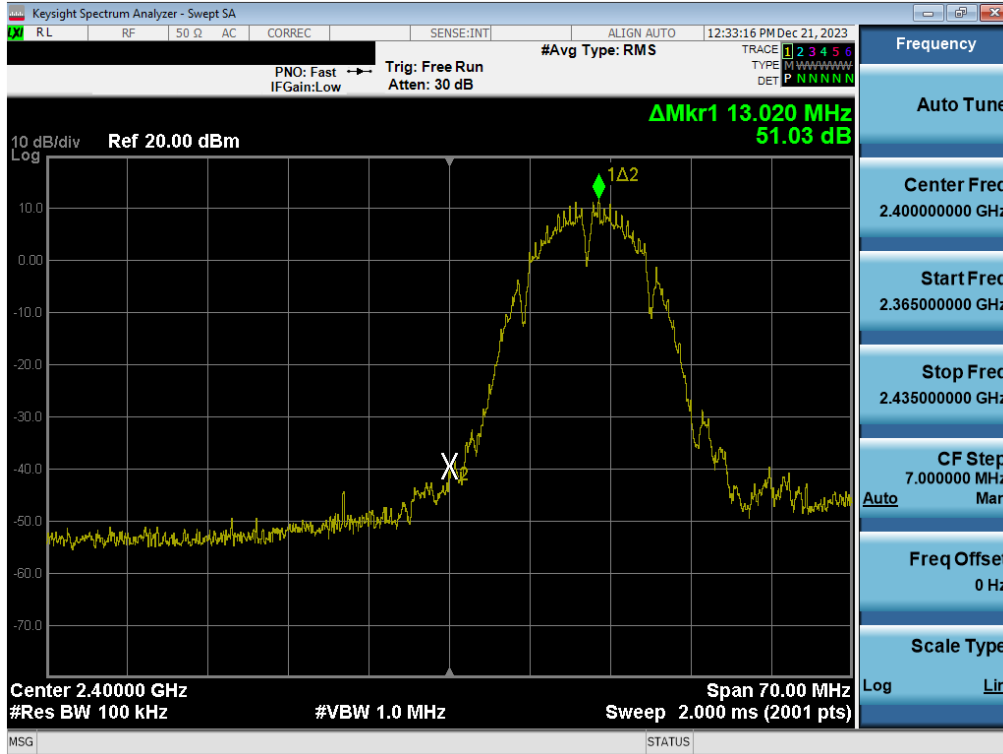


Figure 7-4. Test Instrument & Measurement Setup

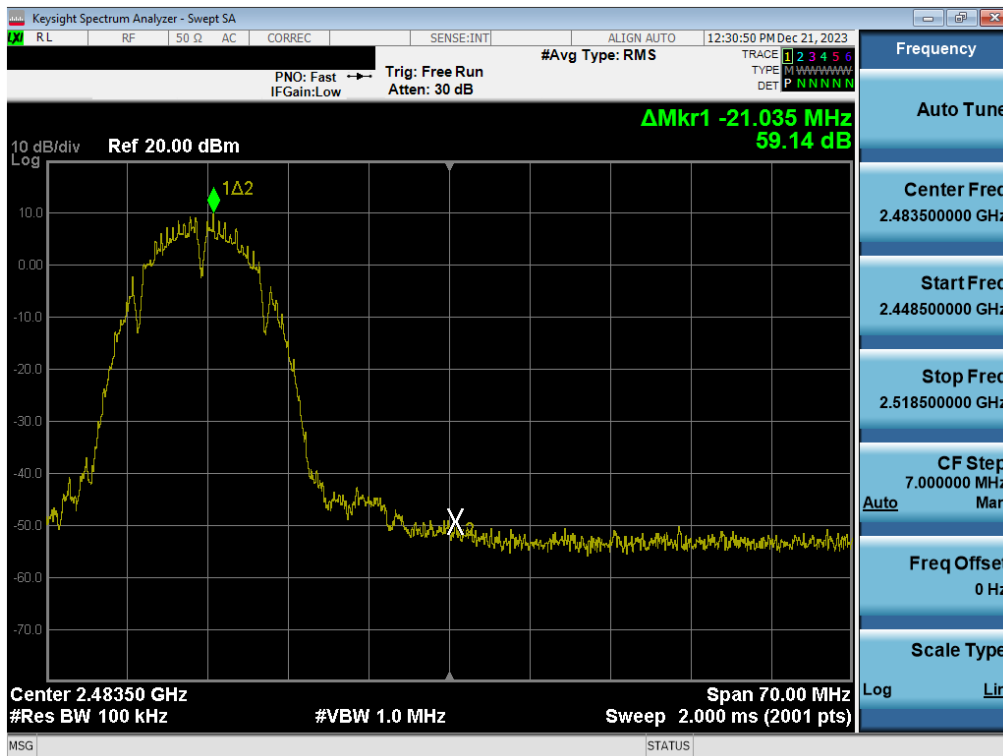
Test Notes

None.

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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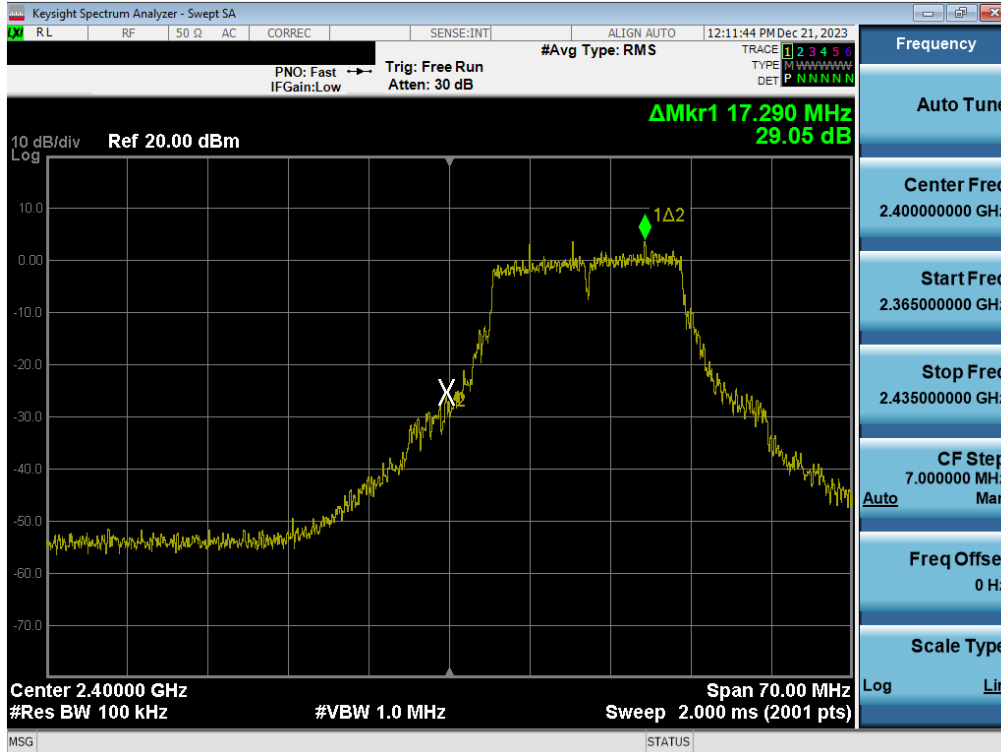


Plot 7-49. Band Edge Plot (802.11b – Ch. 1) – MIMO ANT1

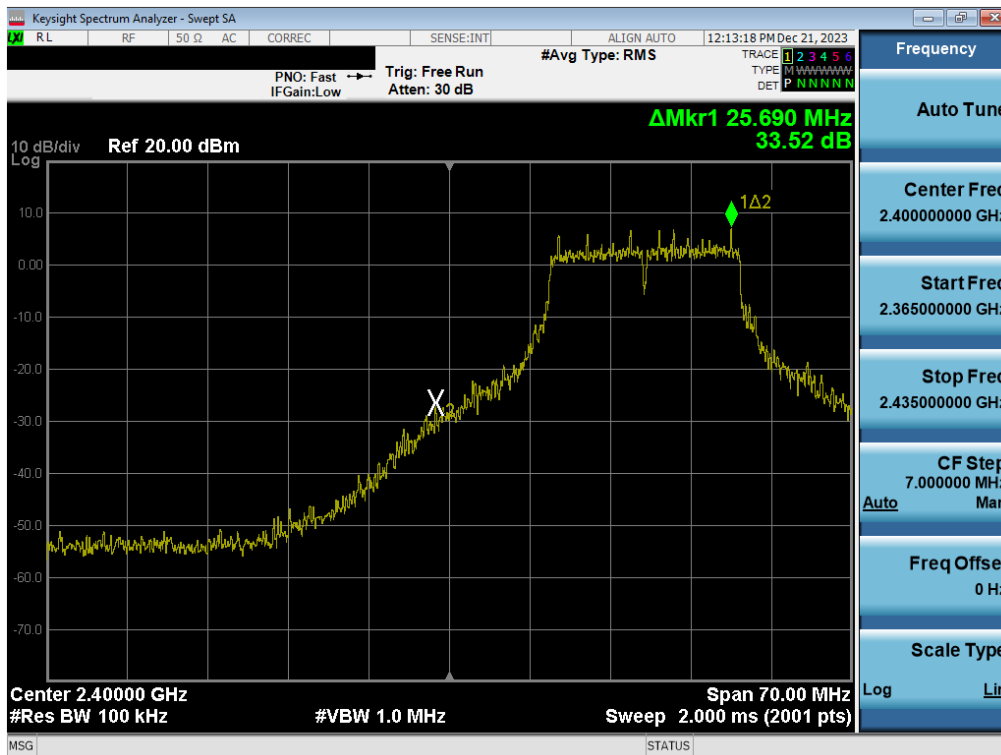


Plot 7-50. Band Edge Plot (802.11b – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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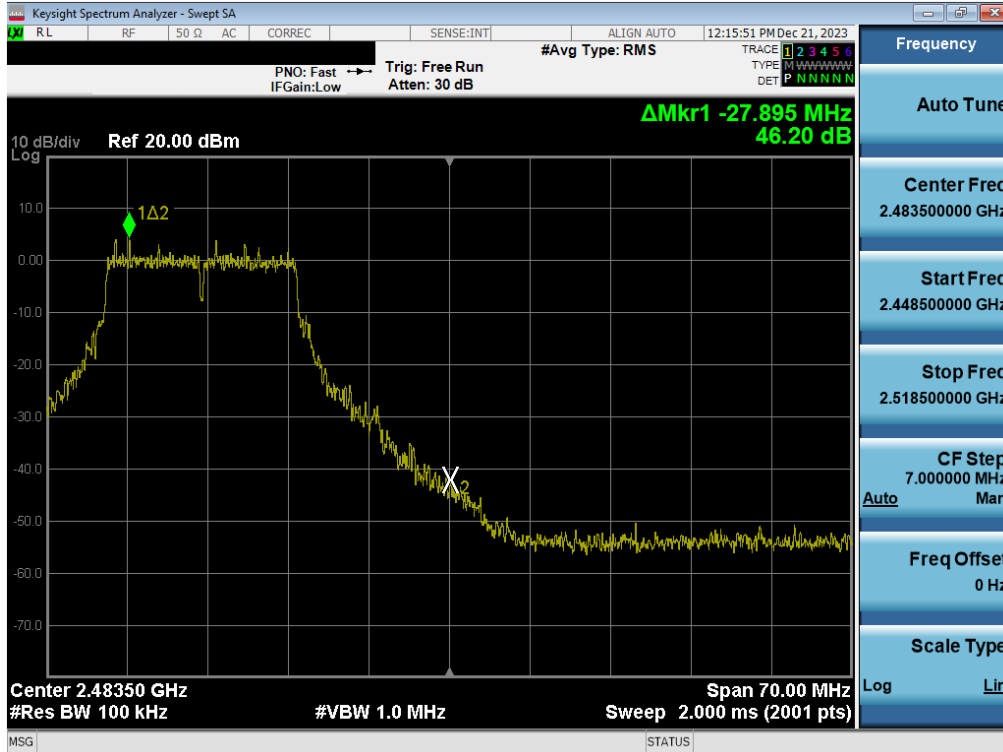


Plot 7-51. Band Edge Plot (802.11g- Ch. 1) – MIMO ANT1

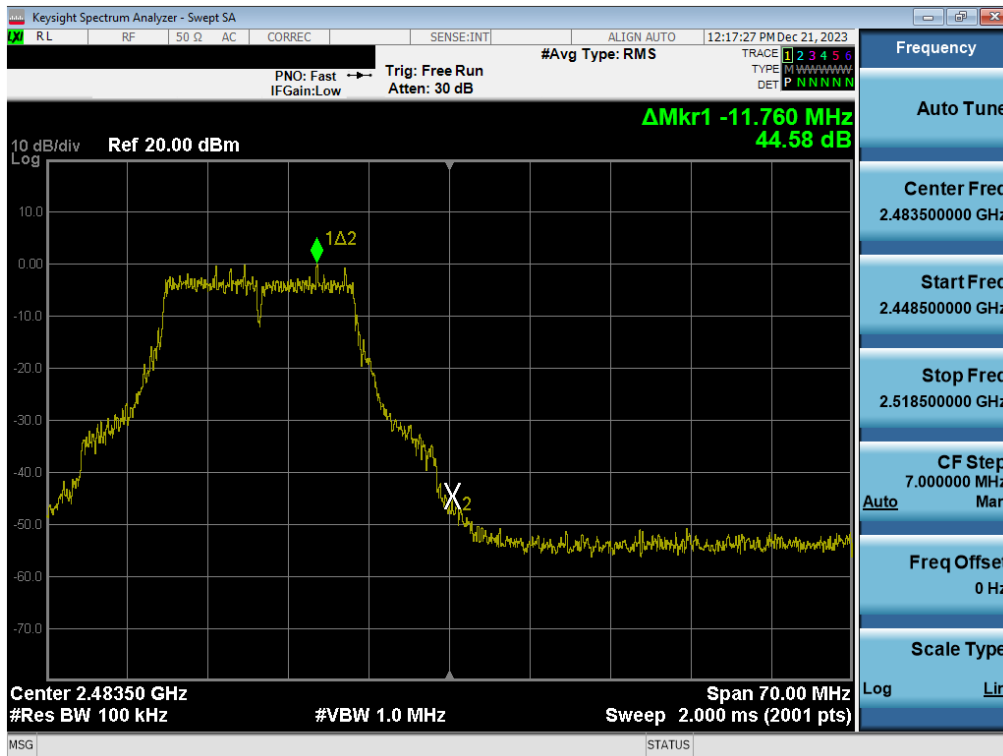


Plot 7-52. Band Edge Plot (802.11g- Ch. 2) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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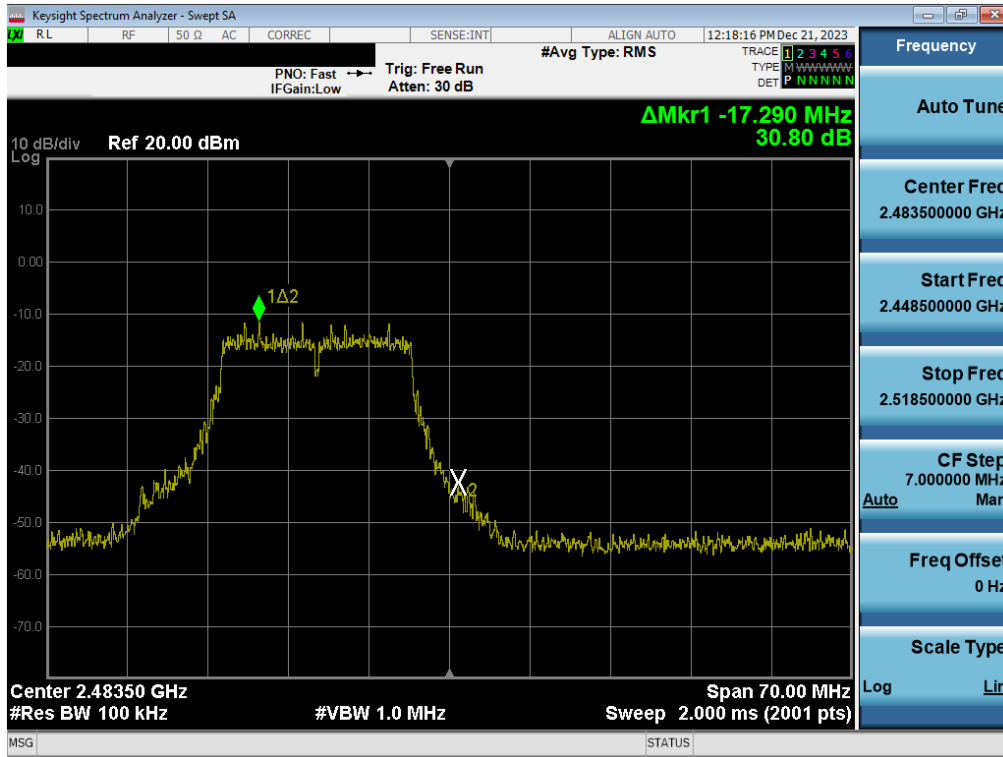


Plot 7-53. Band Edge Plot (802.11g - Ch. 11) - MIMO ANT1

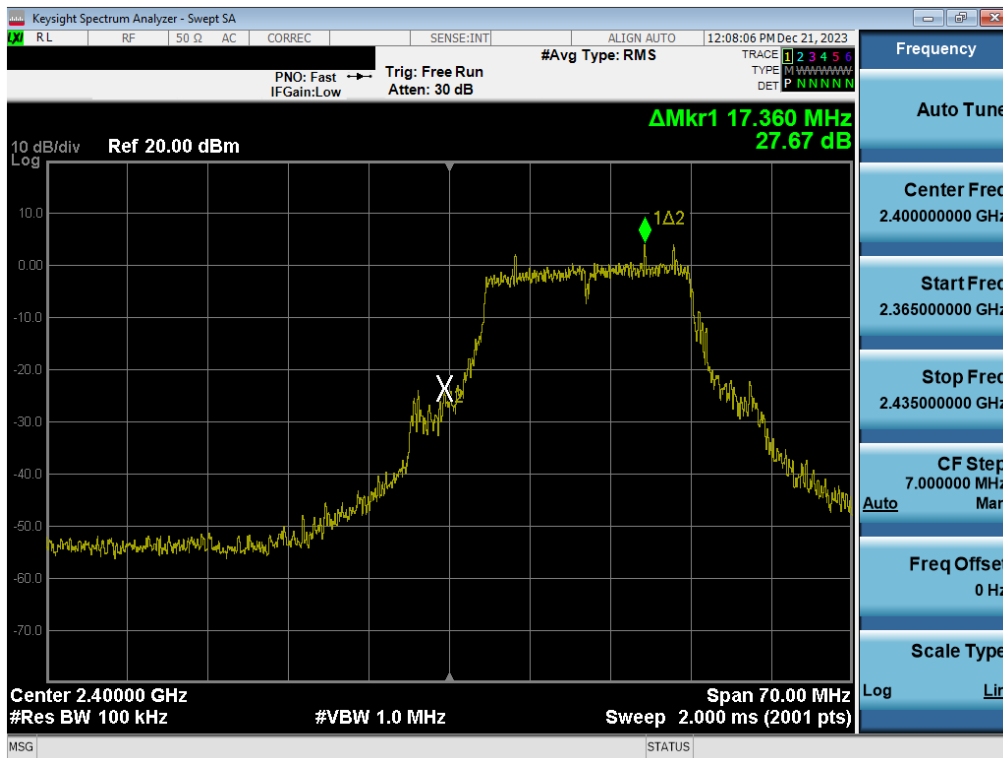


Plot 7-54. Band Edge Plot (802.11g - Ch. 12) - MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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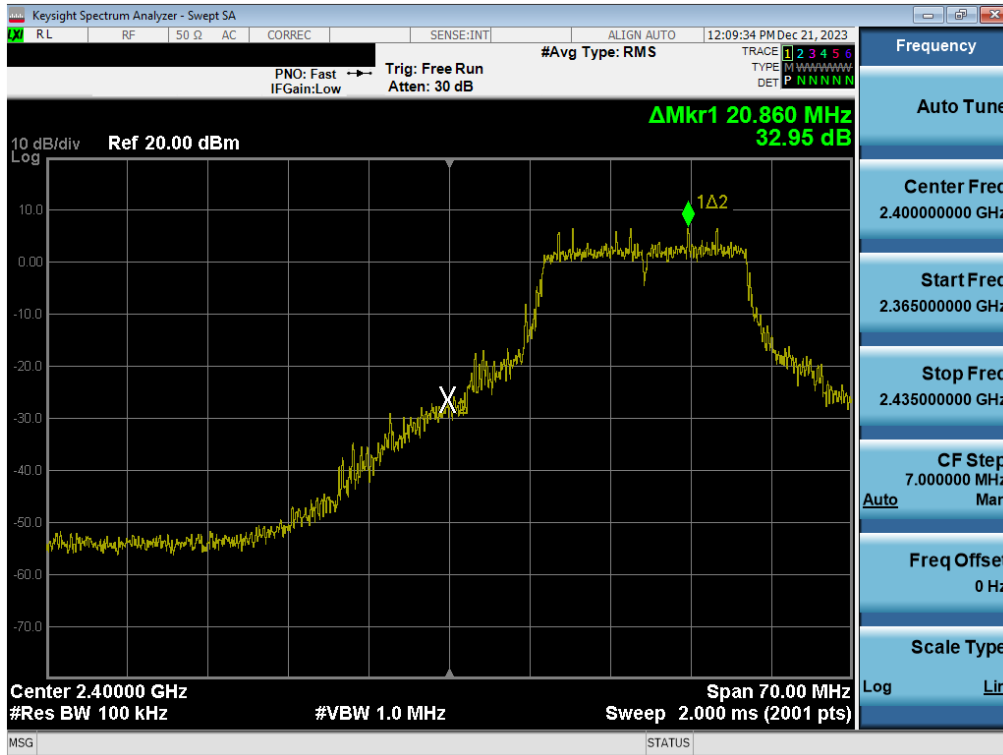


Plot 7-55. Band Edge Plot (802.11g – Ch. 13) – MIMO ANT1

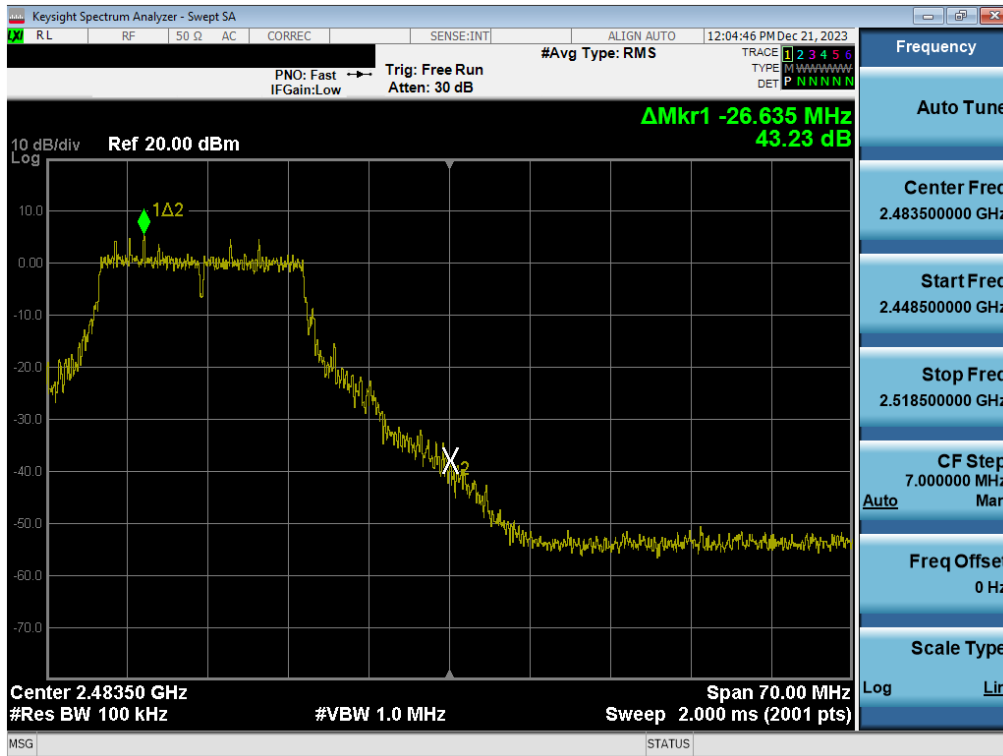


Plot 7-56. Band Edge Plot (802.11n (2.4GHz) – Ch. 1) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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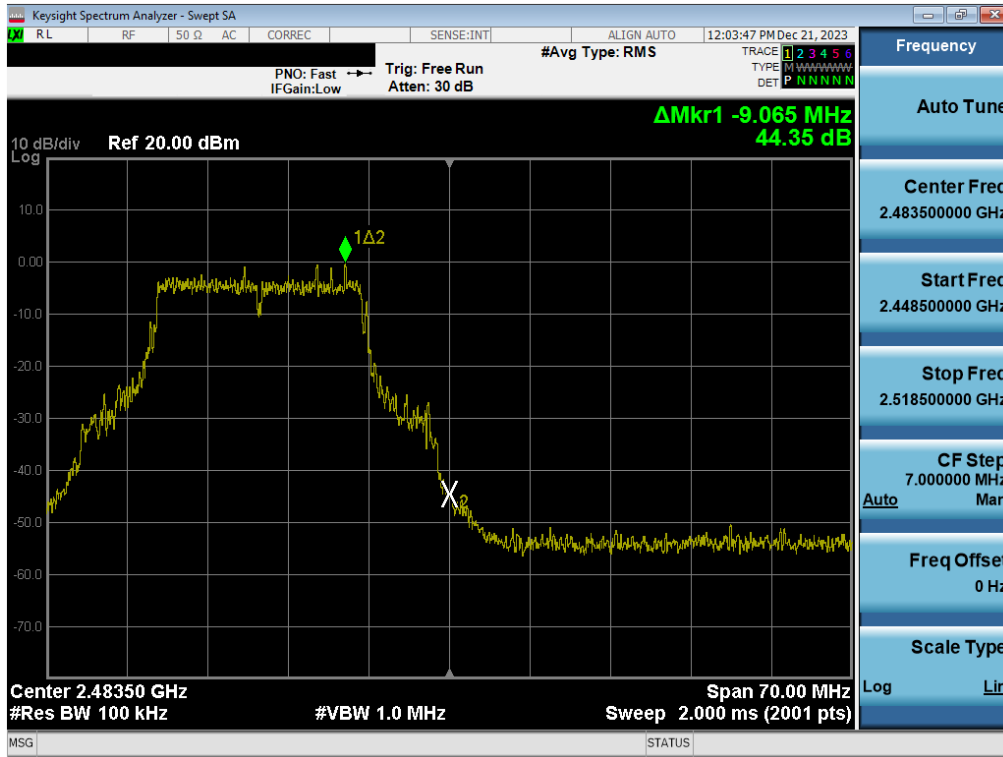


Plot 7-57. Band Edge Plot (802.11n (2.4GHz) – Ch. 2) – MIMO ANT1

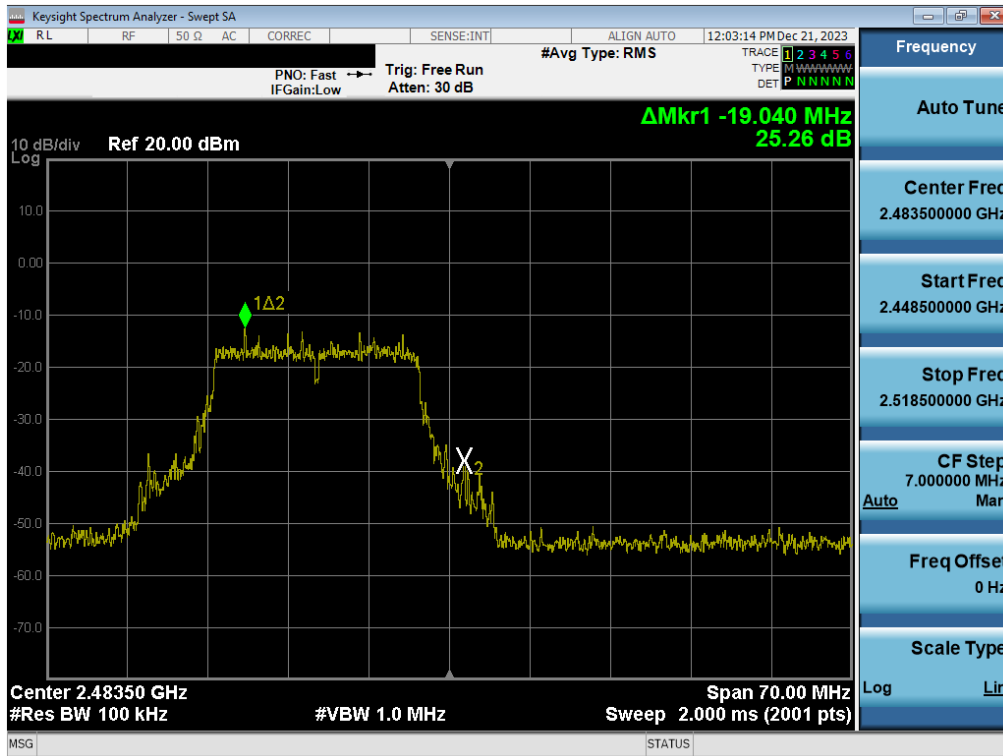


Plot 7-58. Band Edge Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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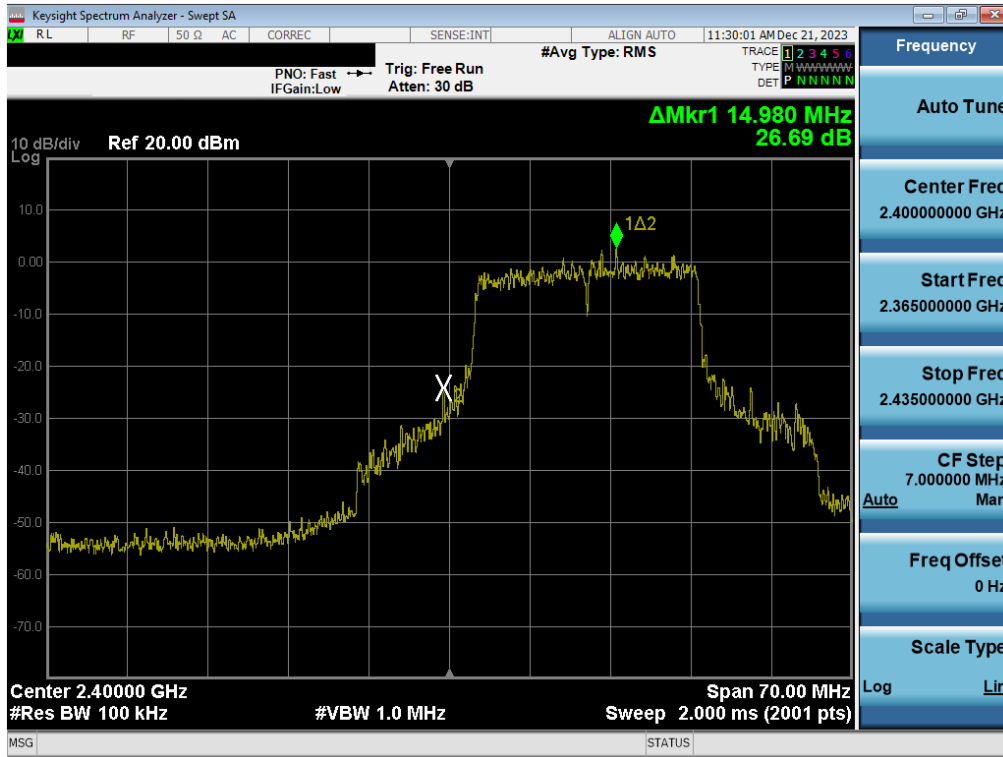


Plot 7-59. Band Edge Plot (802.11n (2.4GHz) – Ch. 12) – MIMO ANT1

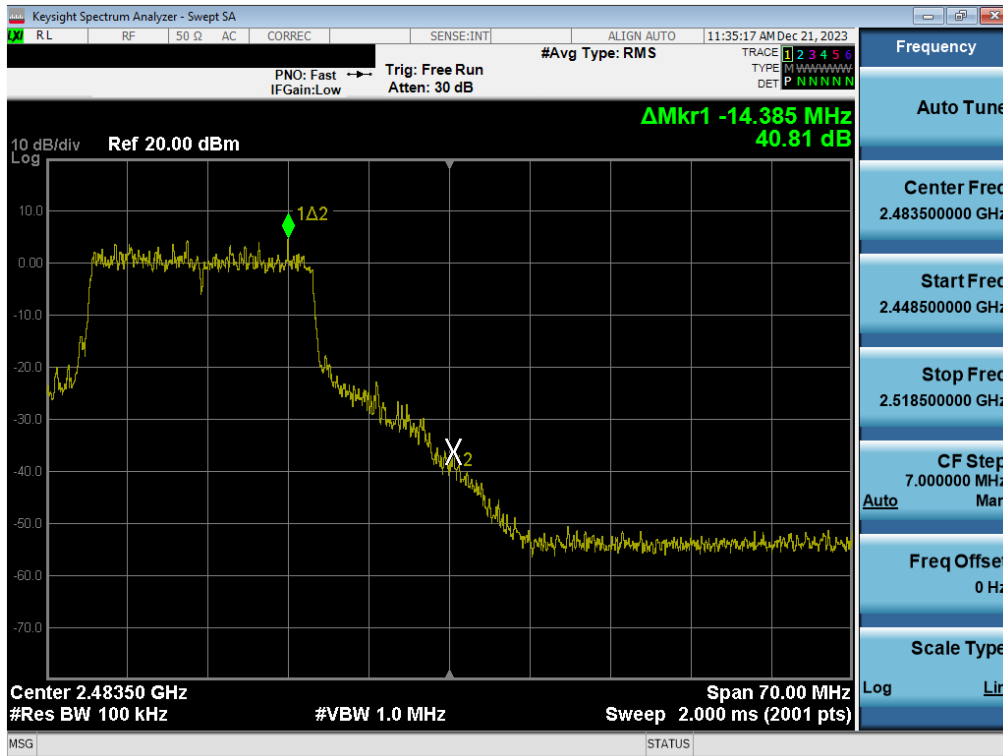


Plot 7-60. Band Edge Plot (802.11n (2.4GHz) – Ch. 13) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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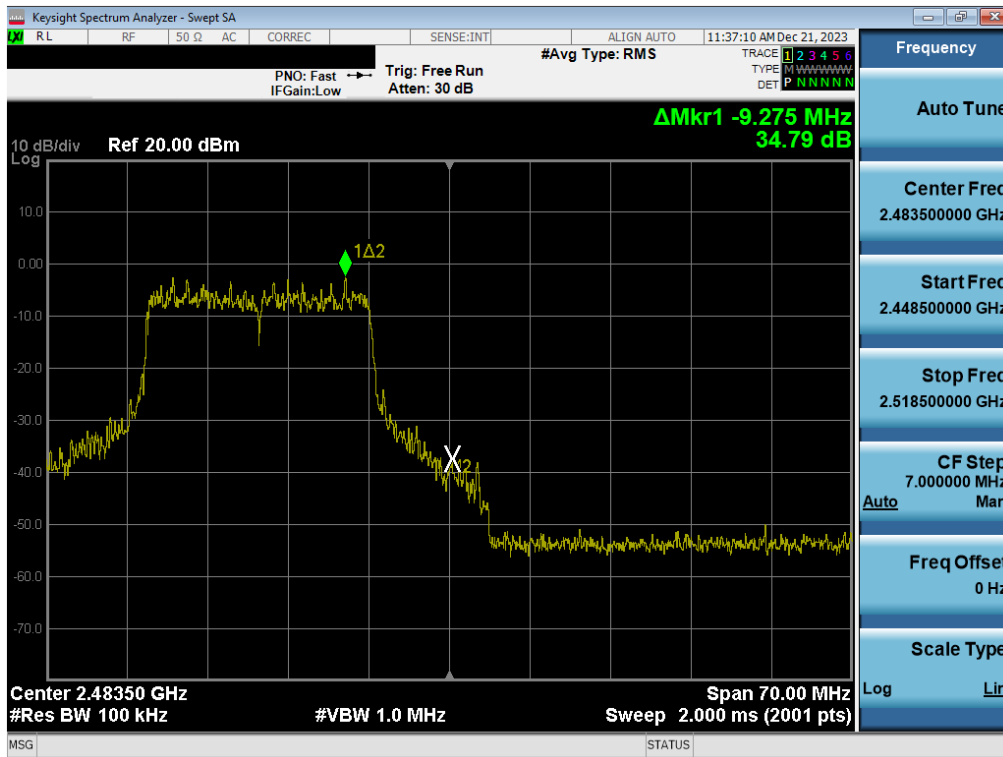


Plot 7-61. Band Edge Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT1

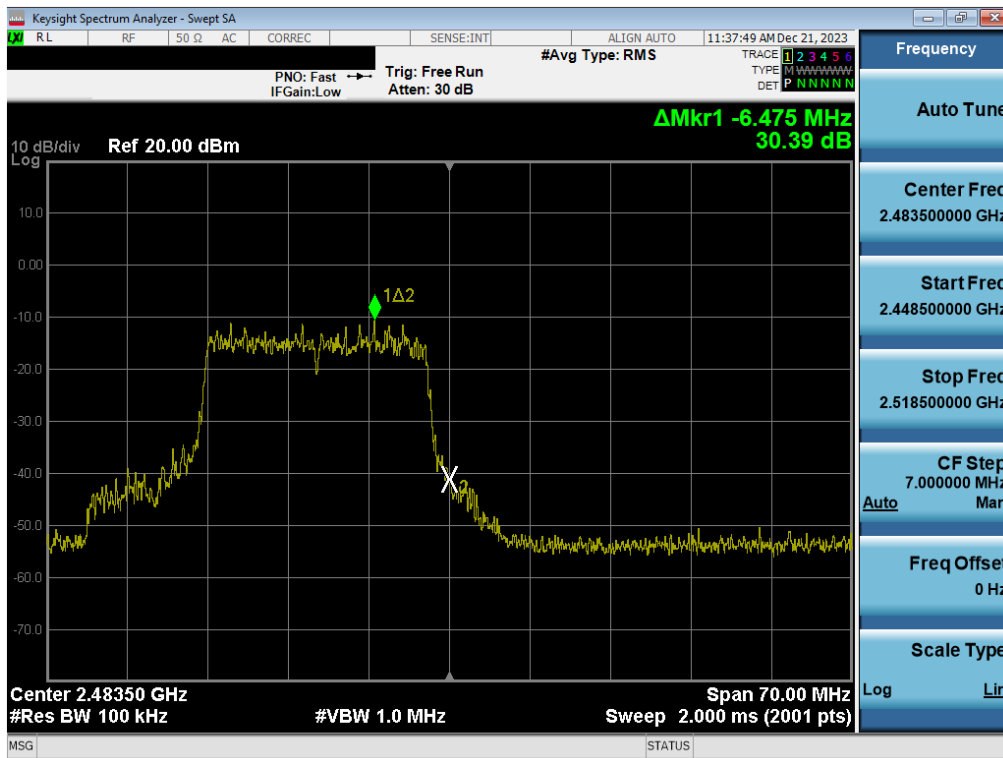


Plot 7-62. Band Edge Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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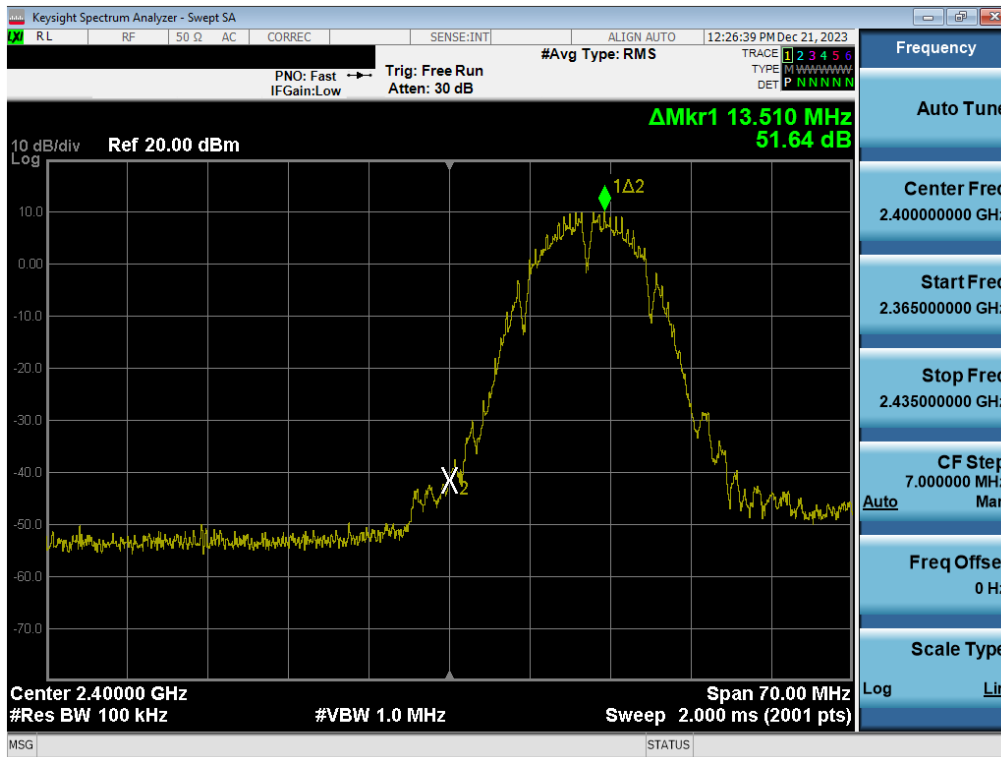


Plot 7-63. Band Edge Plot (802.11ax (2.4GHz) – Ch. 12) – MIMO ANT1

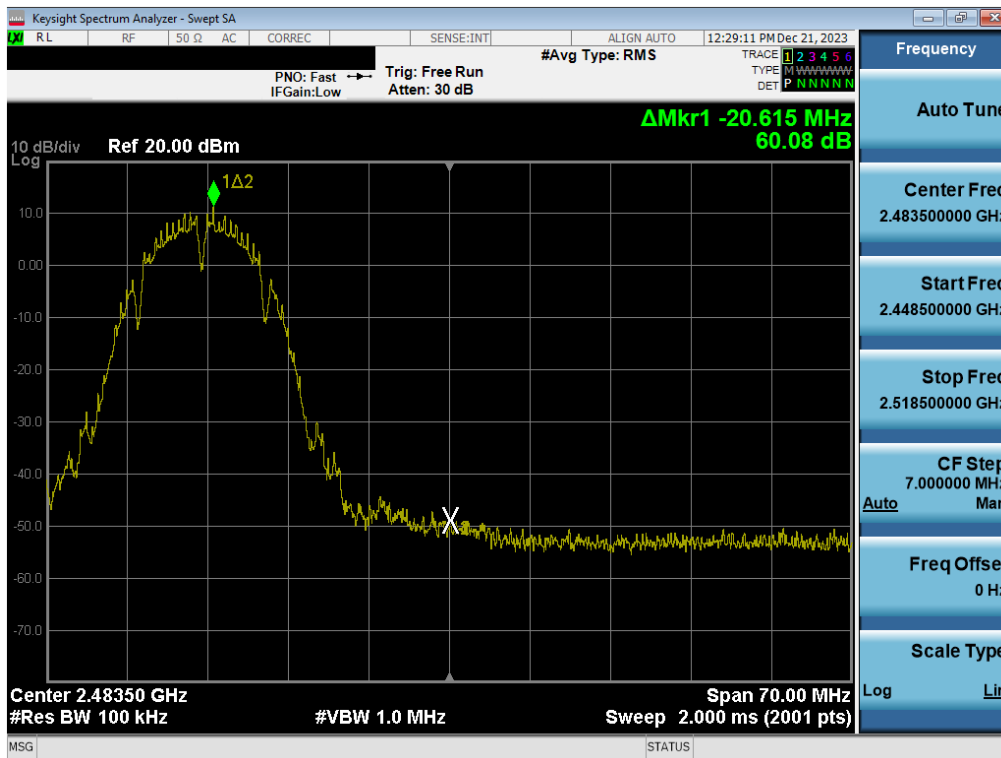


Plot 7-64. Band Edge Plot (802.11ax (2.4GHz) – Ch. 13) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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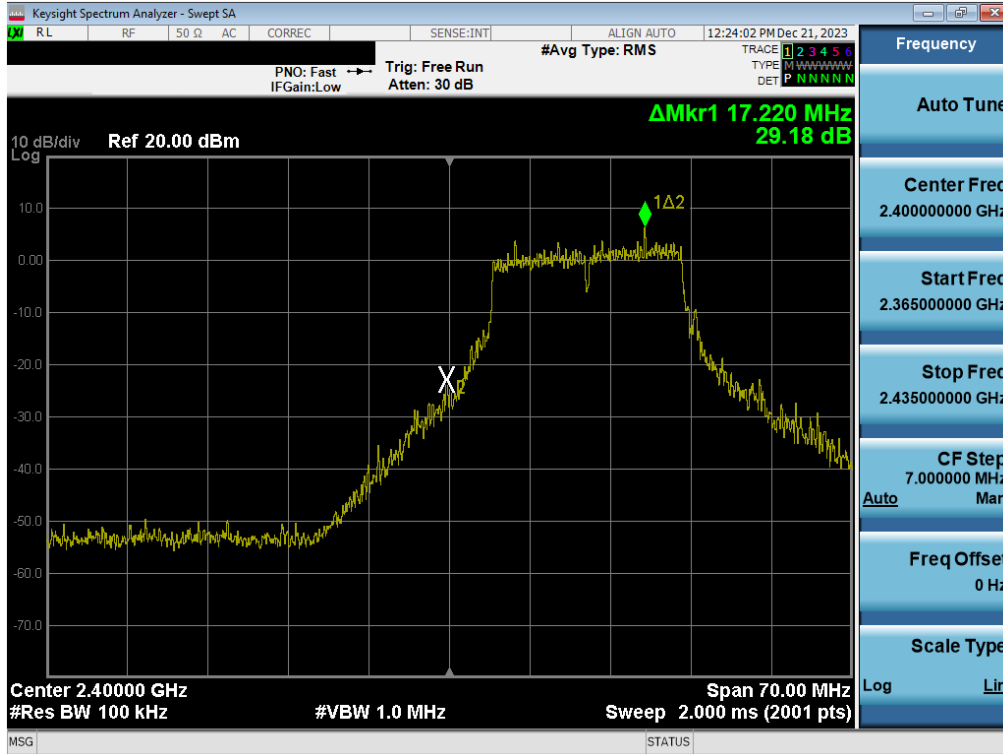


Plot 7-65. Band Edge Plot (802.11b – Ch. 1) – MIMO ANT2

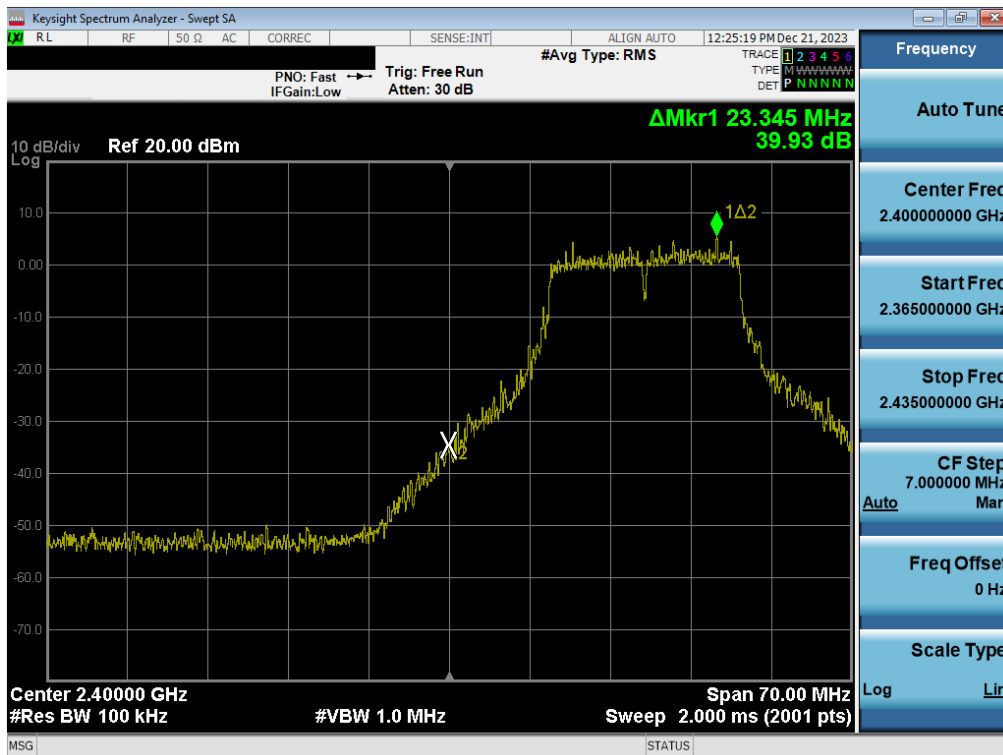


Plot 7-66. Band Edge Plot (802.11b – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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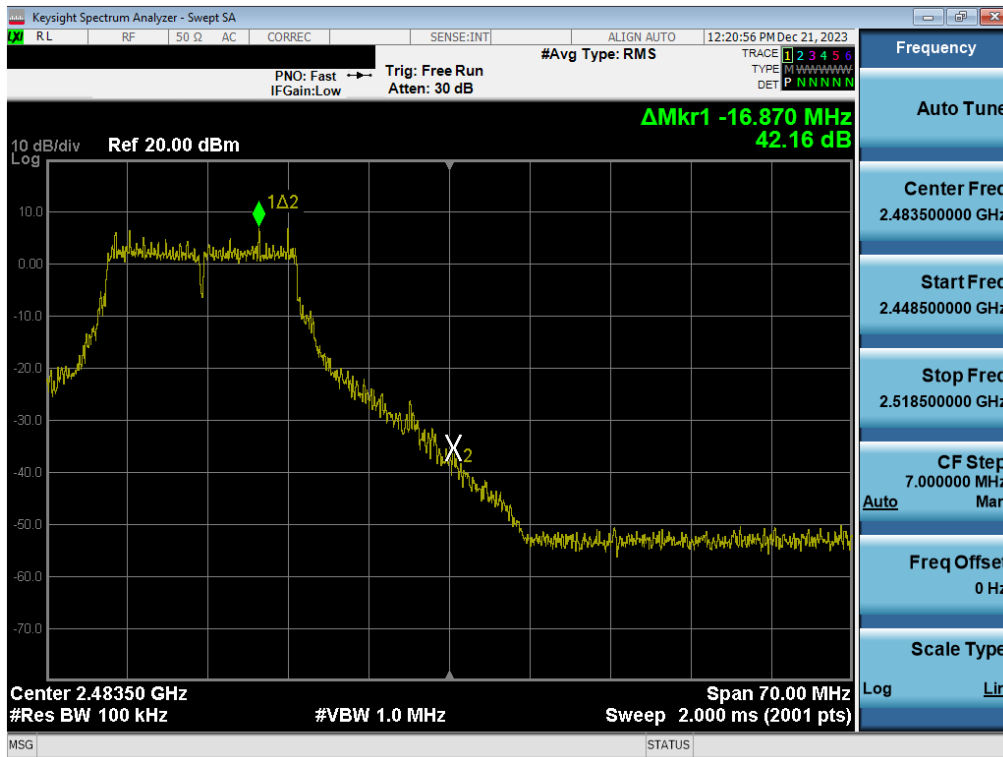


Plot 7-67. Band Edge Plot (802.11g- Ch. 1) – MIMO ANT2

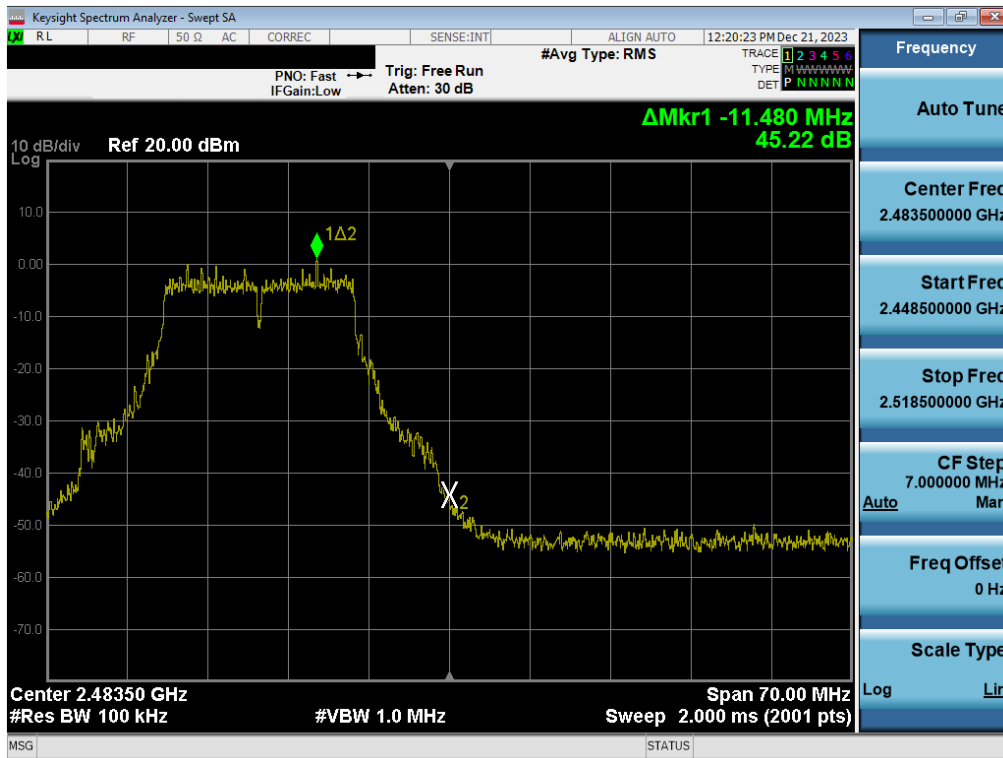


Plot 7-68. Band Edge Plot (802.11g- Ch. 2) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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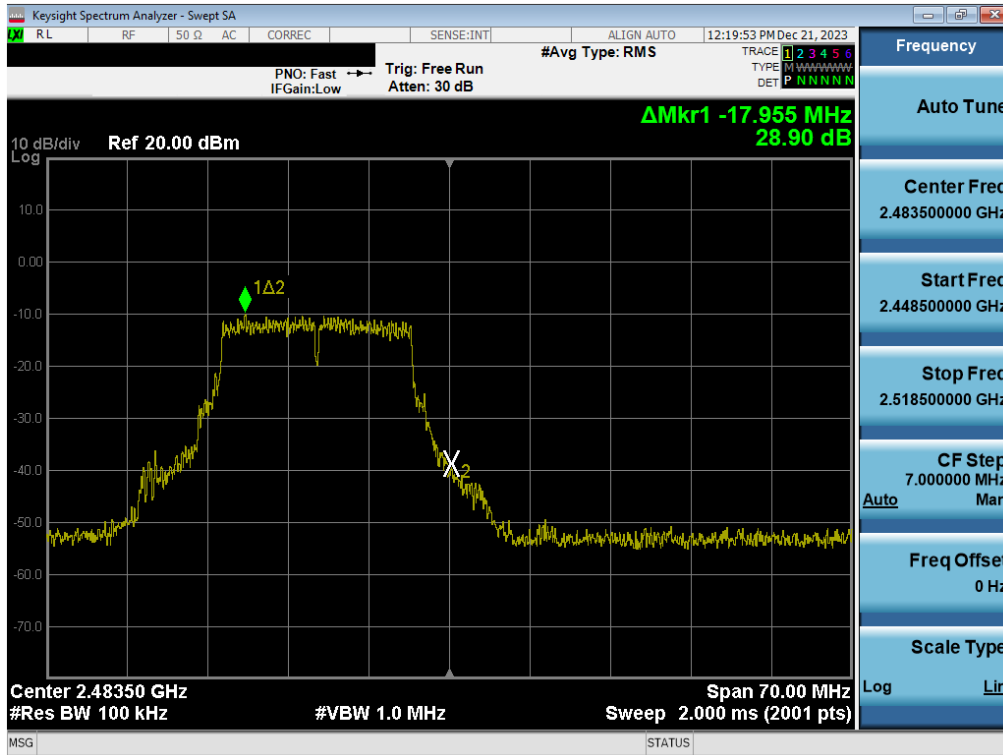


Plot 7-69. Band Edge Plot (802.11g – Ch. 11) – MIMO ANT2

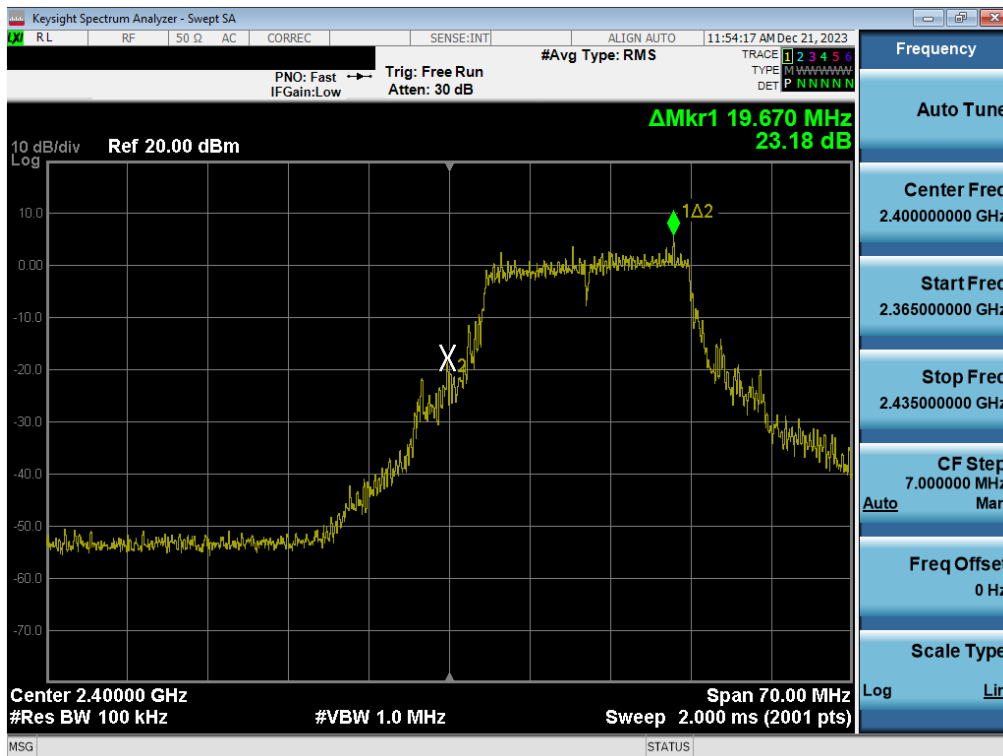


Plot 7-70. Band Edge Plot (802.11g – Ch. 12) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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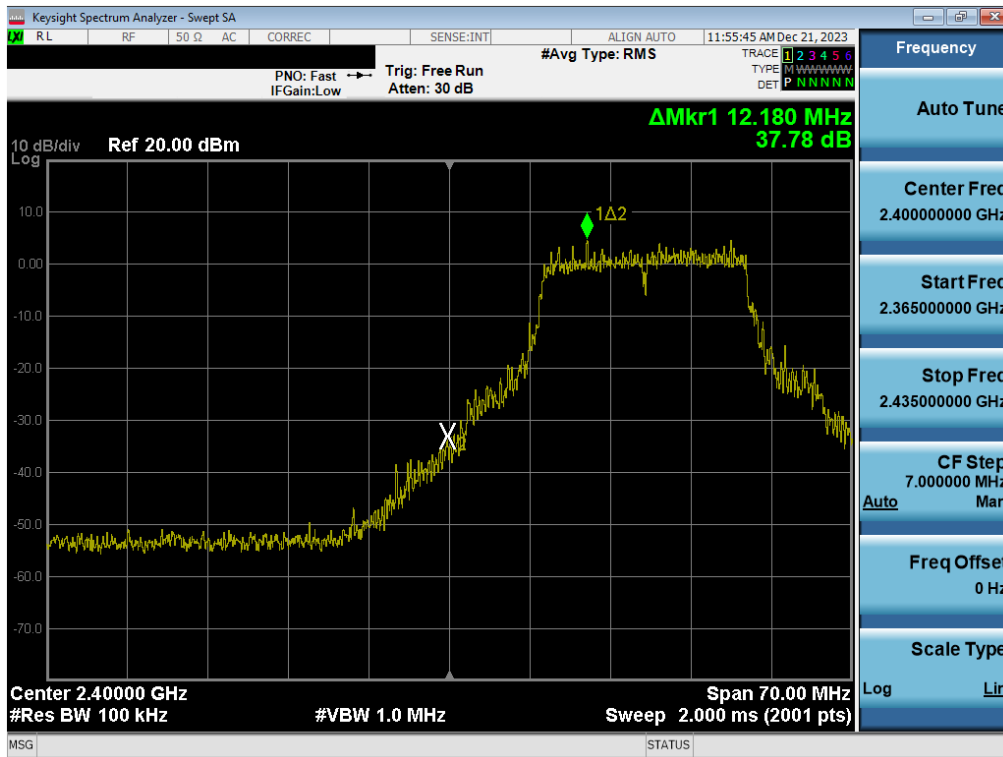


Plot 7-71. Band Edge Plot (802.11g – Ch. 13) – MIMO ANT2

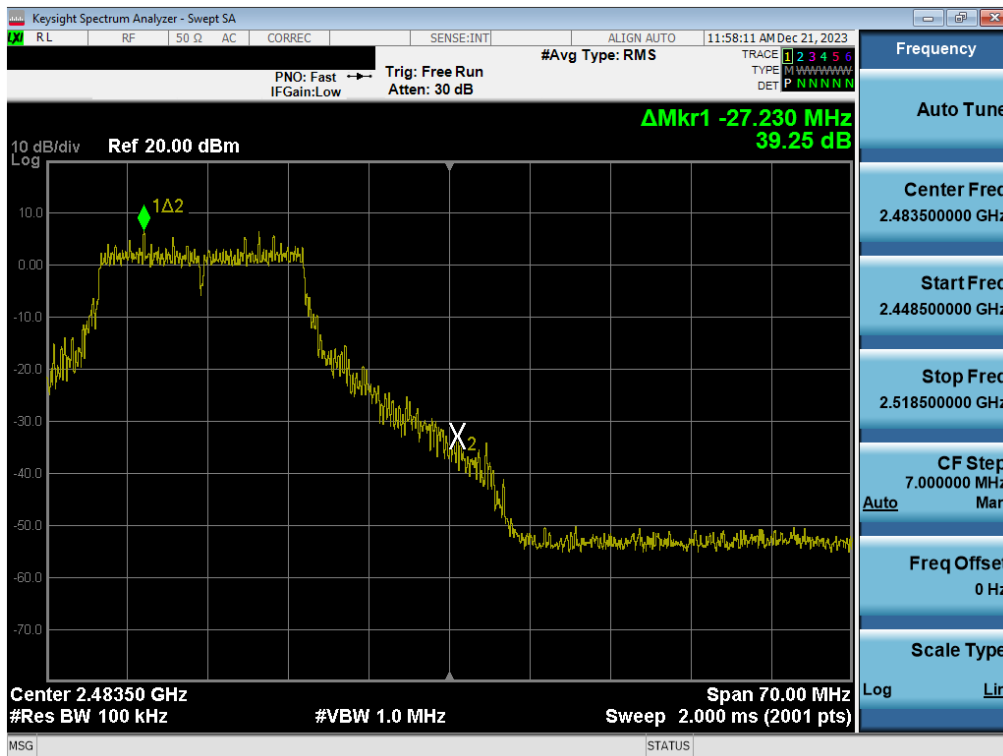


Plot 7-72. Band Edge Plot (802.11n (2.4GHz) – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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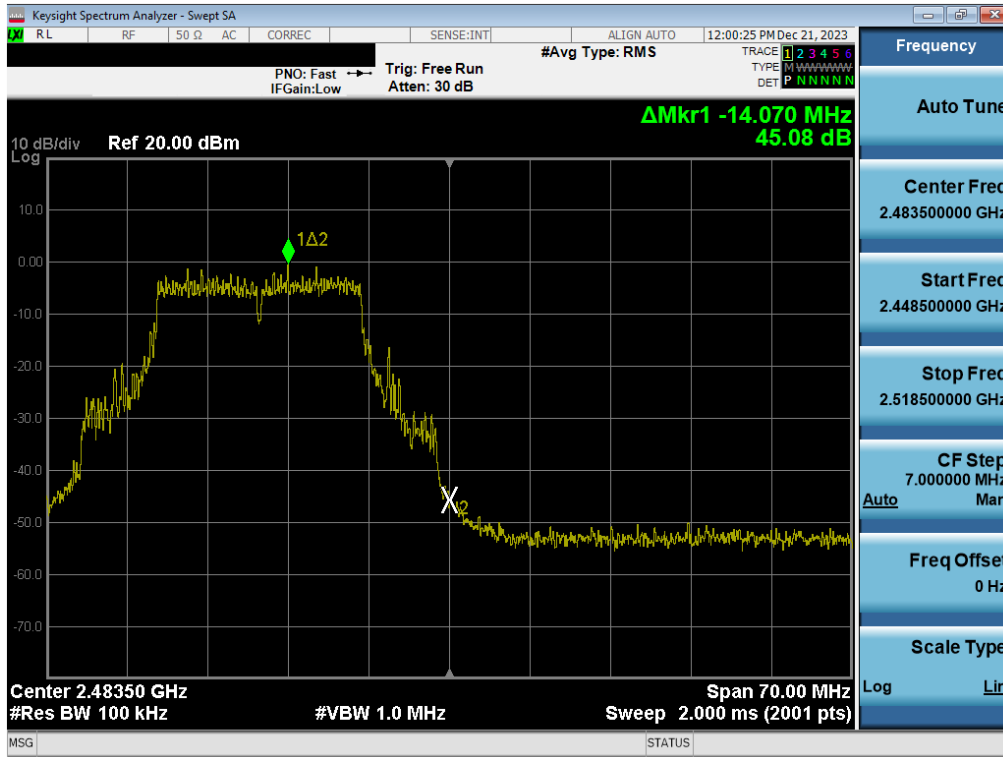


Plot 7-73. Band Edge Plot (802.11n (2.4GHz) – Ch. 2) – MIMO ANT2

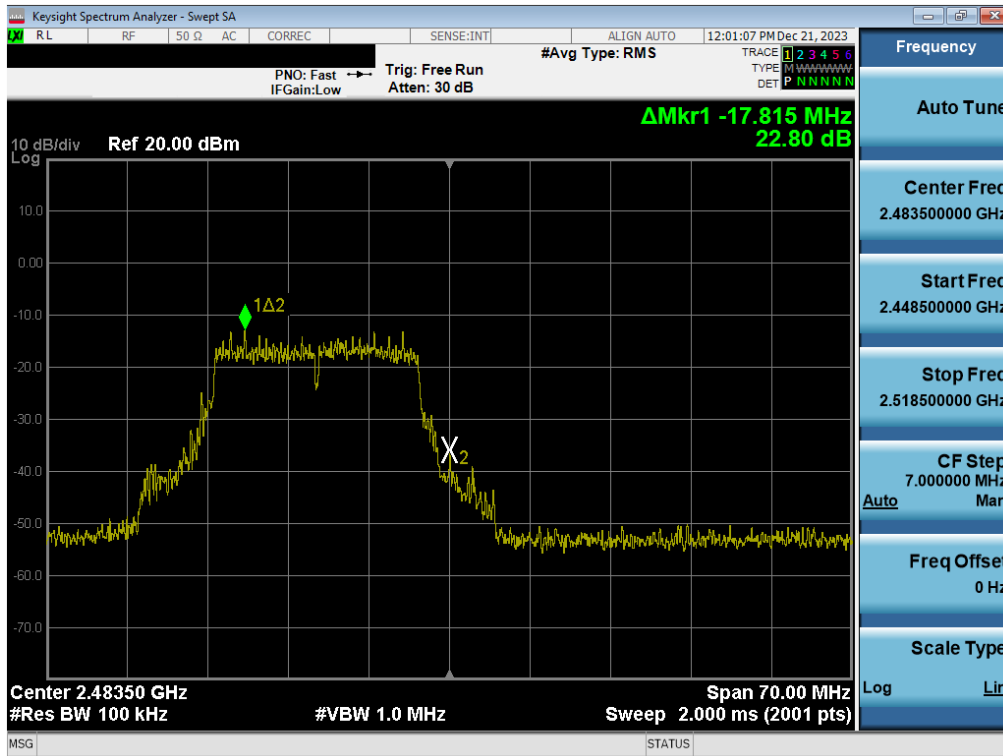


Plot 7-74. Band Edge Plot (802.11n (2.4GHz) – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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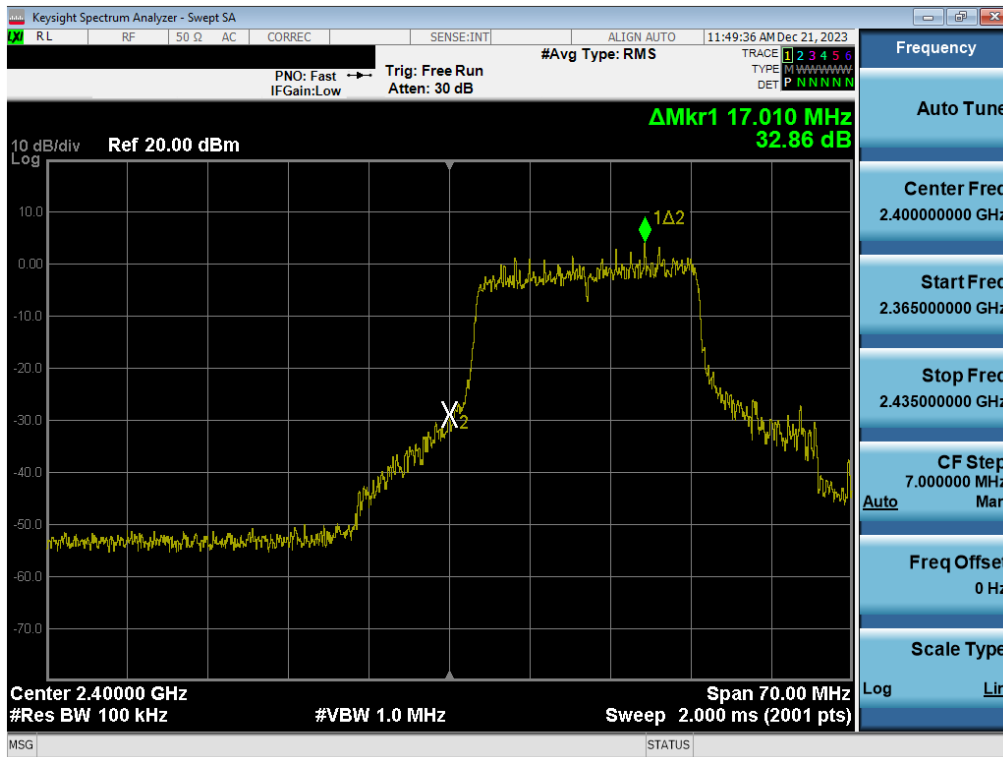


Plot 7-75. Band Edge Plot (802.11n (2.4GHz) – Ch. 12) – MIMO ANT2

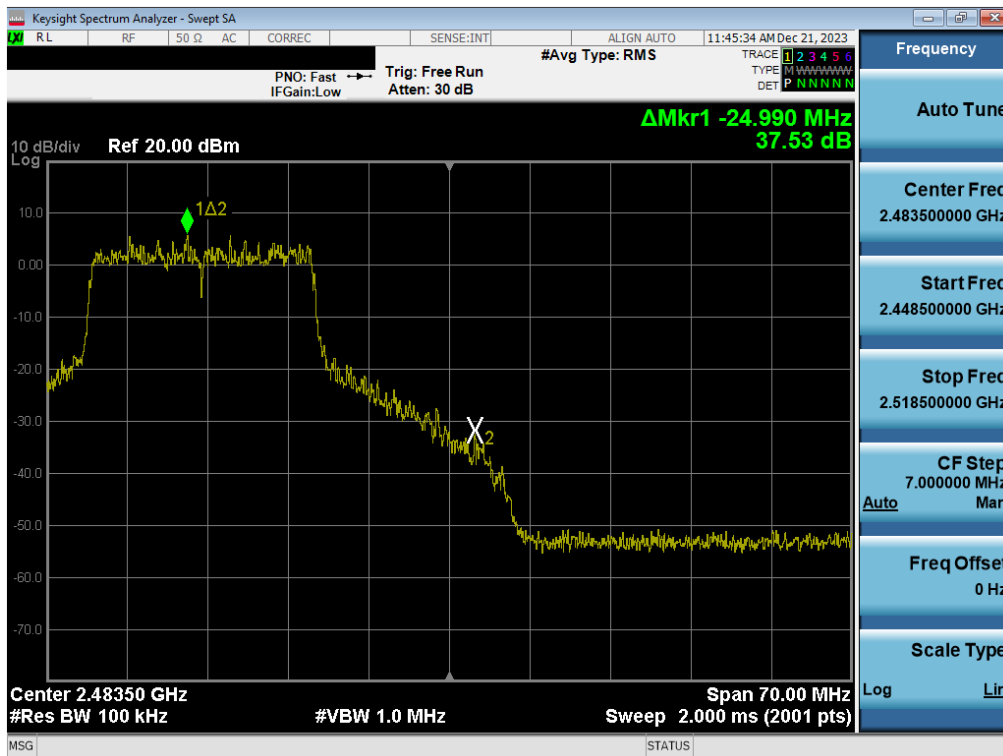


Plot 7-76. Band Edge Plot (802.11n (2.4GHz) – Ch. 13) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-77. Band Edge Plot (802.11ax (2.4GHz) – Ch. 1) – MIMO ANT2

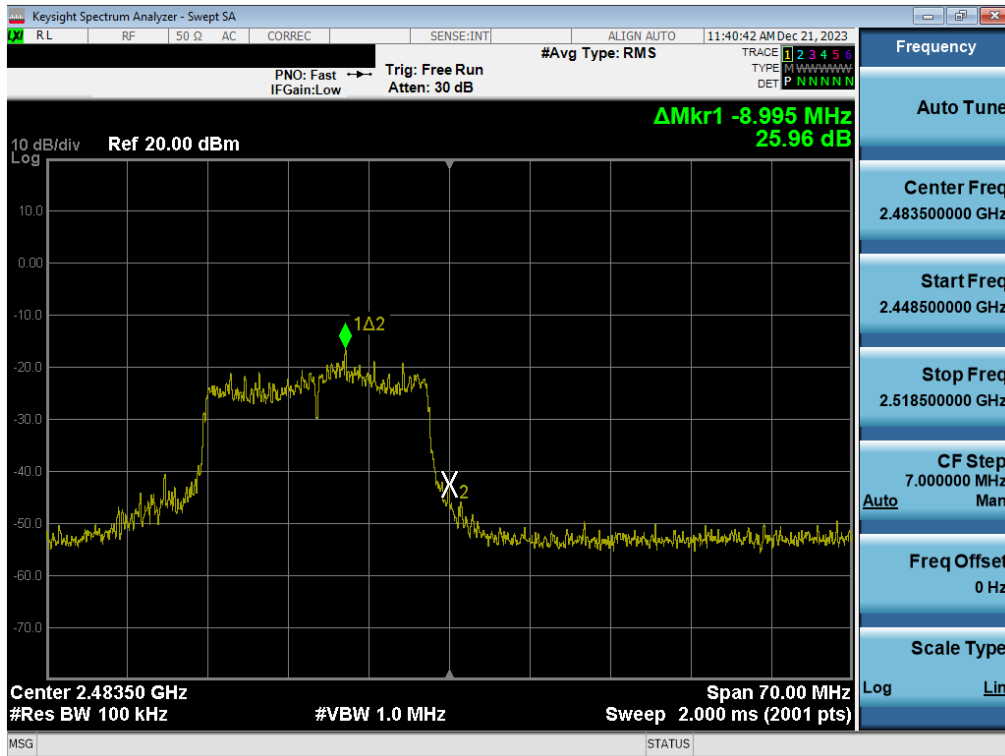


Plot 7-78. Band Edge Plot (802.11ax (2.4GHz) – Ch. 11) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-79. Band Edge Plot (802.11ax (2.4GHz) – Ch. 12) – MIMO ANT2



Plot 7-80. Band Edge Plot (802.11ax (2.4GHz) – Ch. 13) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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7.6 Conducted Spurious Emissions

Test Overview and Limit

All out of band emissions are measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates were investigated to determine the worst-case configuration. For the following out of band conducted spurious emissions plots, the EUT was investigated in all available data rates for “b”, “g”, “n”, “ax” modes. The worst-case spurious emissions for the 2.4GHz band were found while transmitting in “b” mode at 1 Mbps and are shown in the plots below.

The limit for out-of-band spurious emissions at the band edge is 30dB 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 11.11.3 of ANSI C63.10-2013.

Test Procedure Used

ANSI C63.10-2013 – Section 11.11.3

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

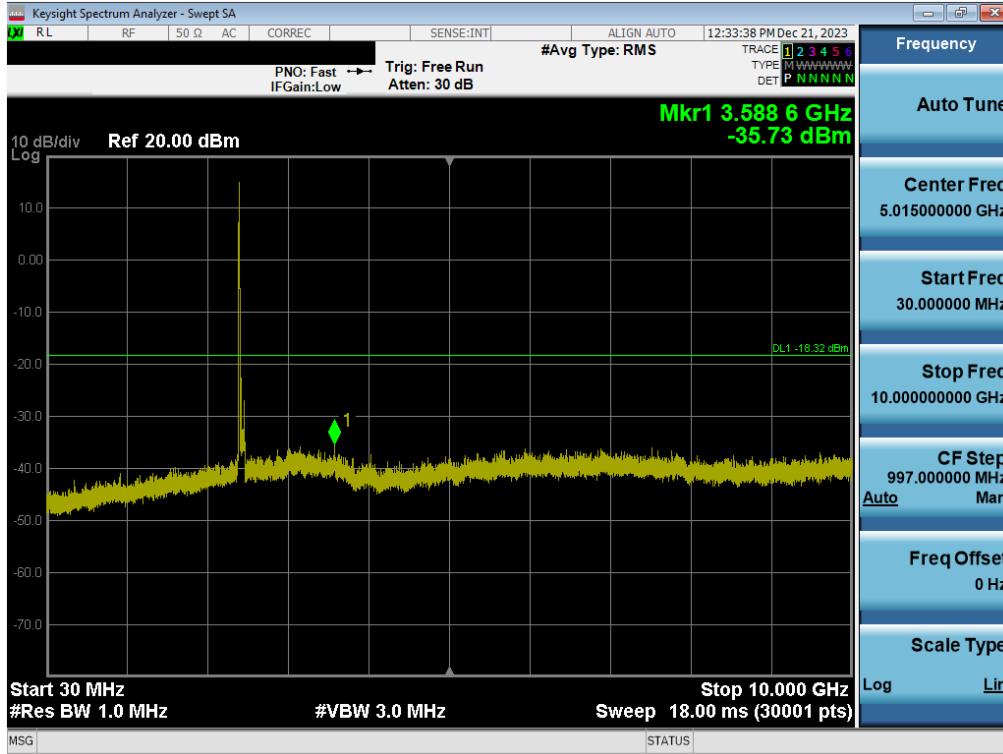
FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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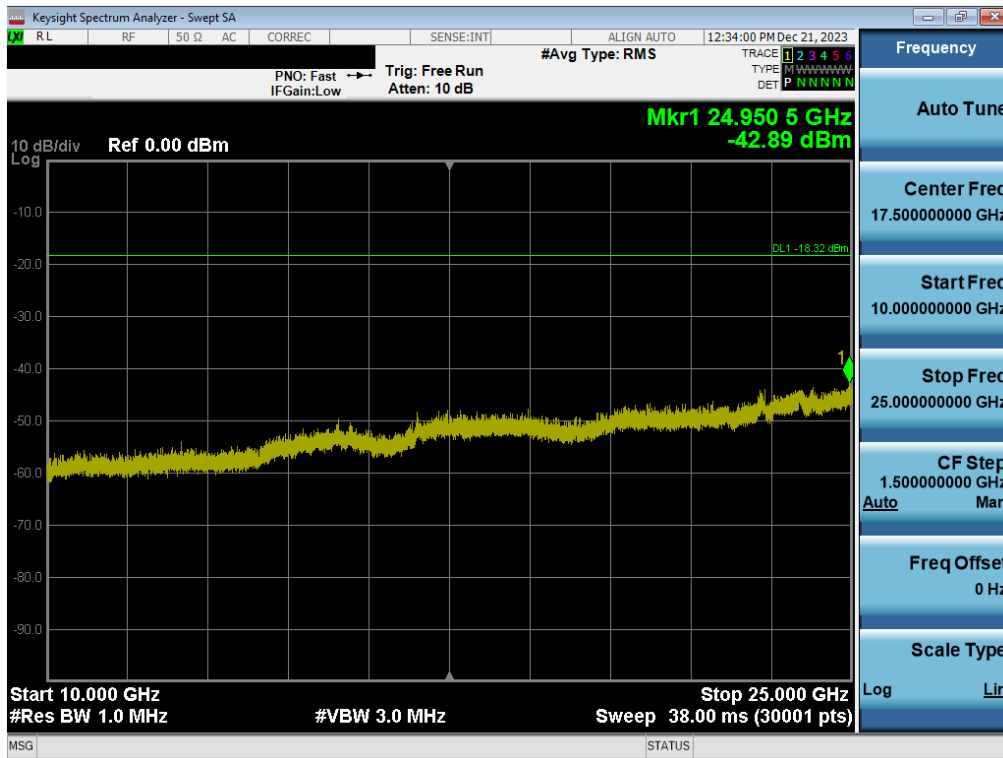
Test Notes

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 30dB 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 30dB 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.

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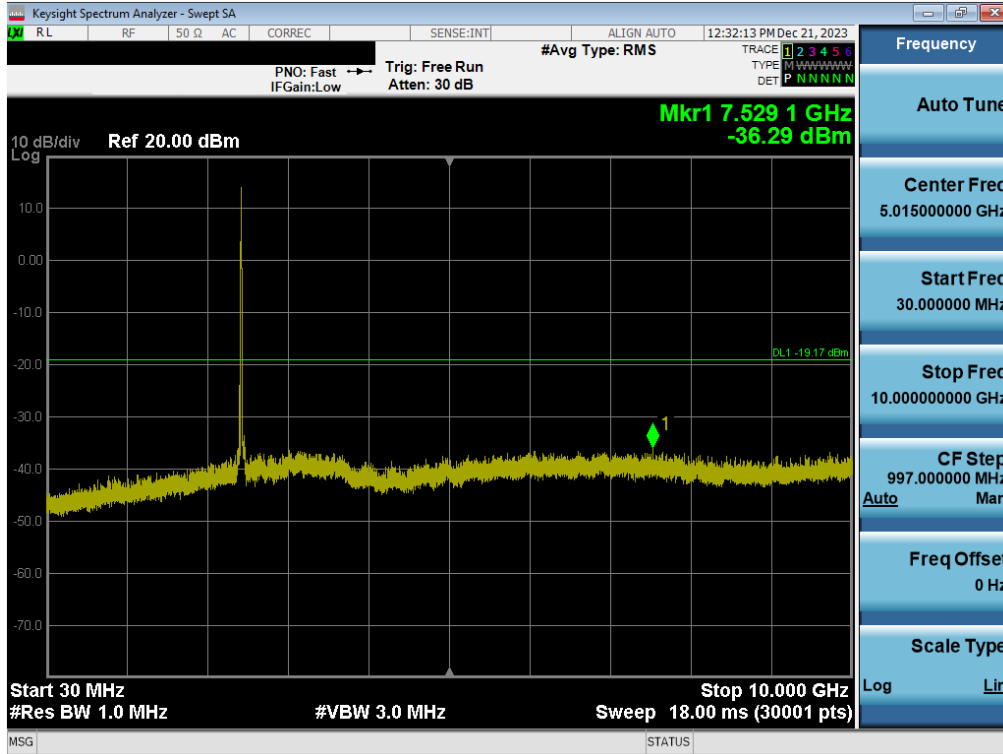


Plot 7-81. Conducted Spurious Plot (802.11b – Ch. 1) – MIMO ANT1

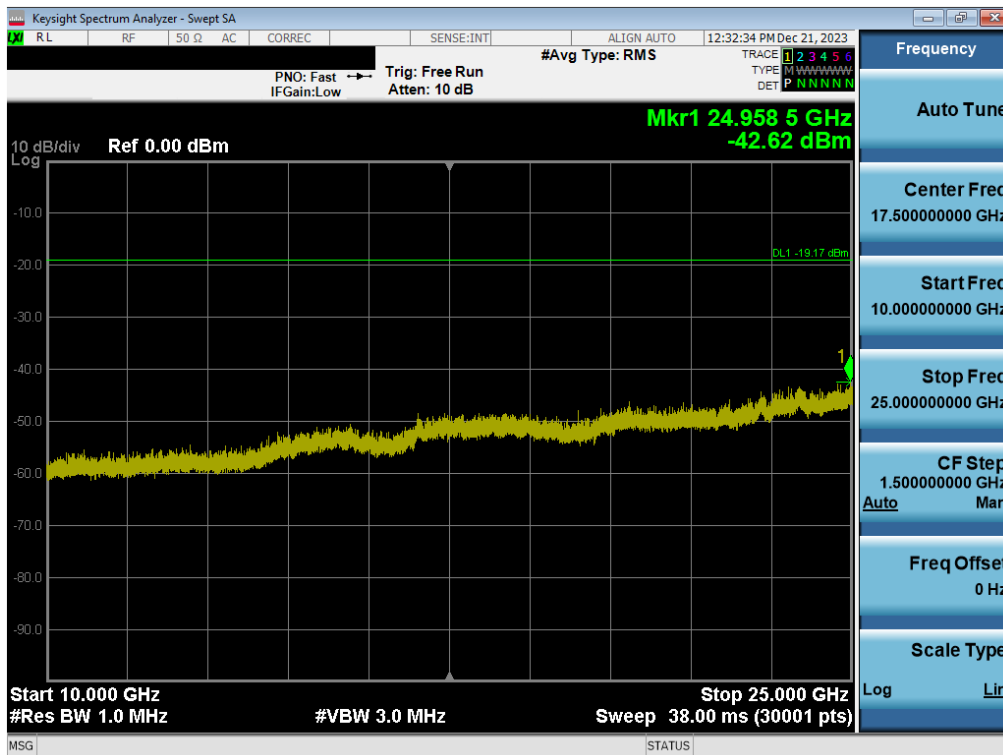


Plot 7-82. Conducted Spurious Plot (802.11b – Ch. 1) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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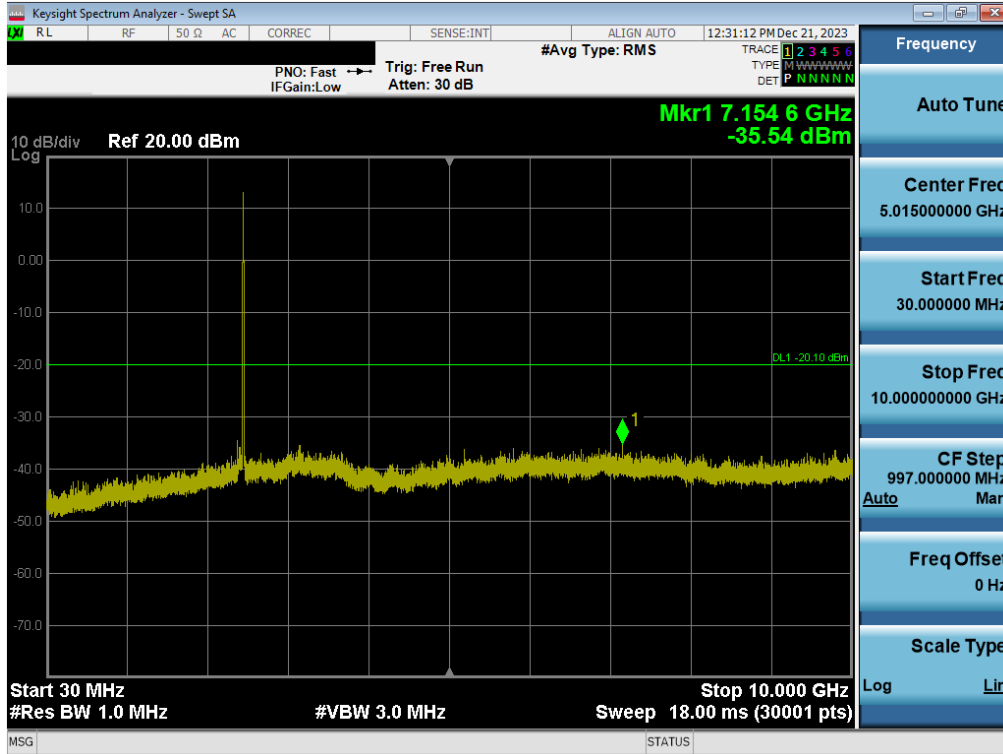


Plot 7-83. Conducted Spurious Plot (802.11b – Ch. 6) – MIMO ANT1

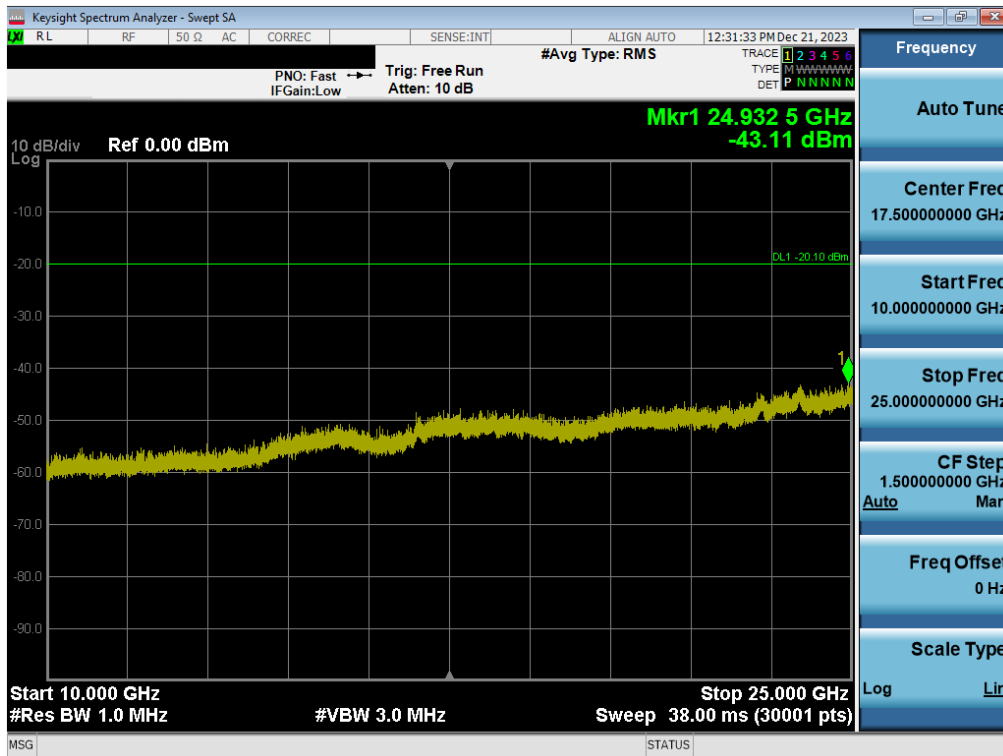


Plot 7-84. Conducted Spurious Plot (802.11b – Ch. 6) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
Test Report S/N: 1M2311010111-11.A3L	Test Dates: 11/07-12/28/2023	EUT Type: Portable Handset	Page 63 of 82

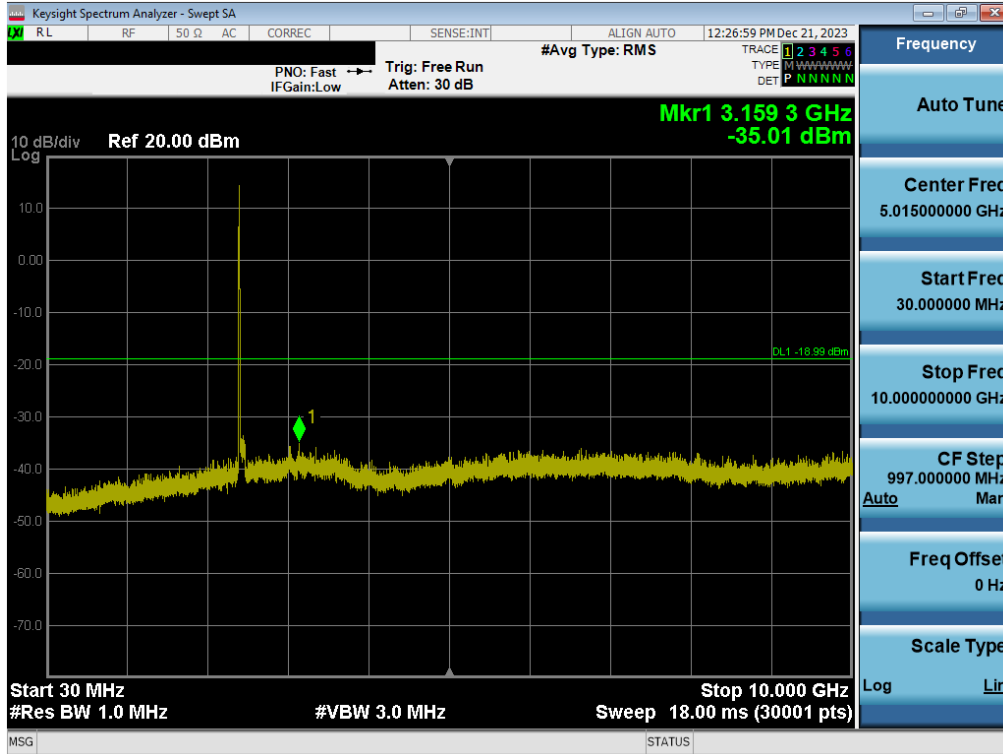


Plot 7-85. Conducted Spurious Plot (802.11b – Ch. 11) – MIMO ANT1

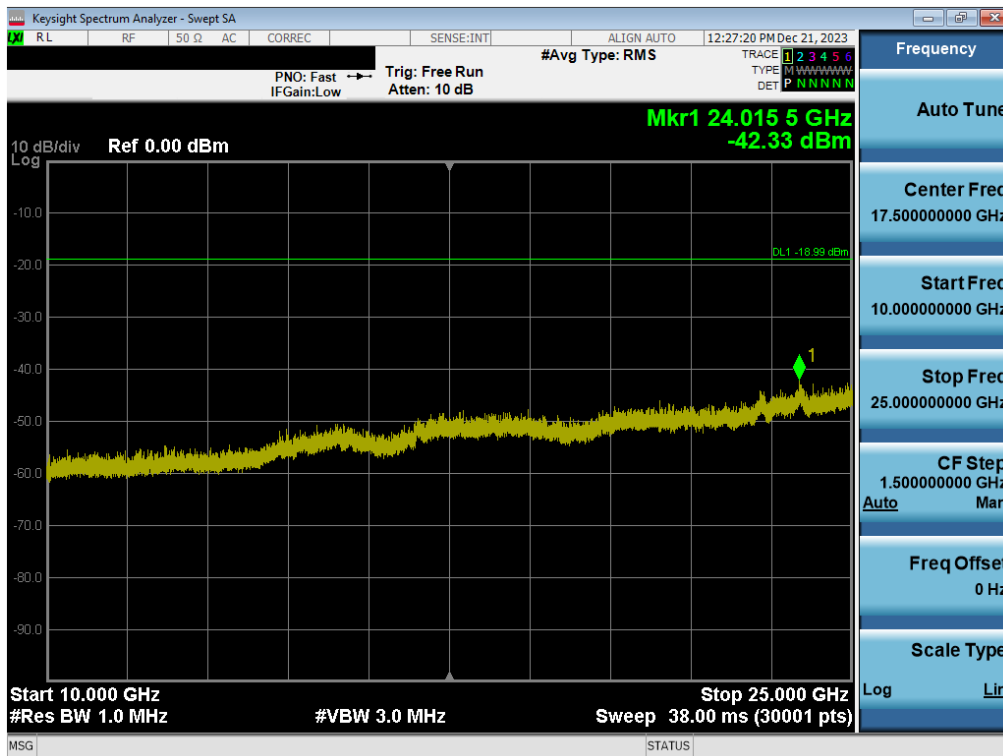


Plot 7-86. Conducted Spurious Plot (802.11b – Ch. 11) – MIMO ANT1

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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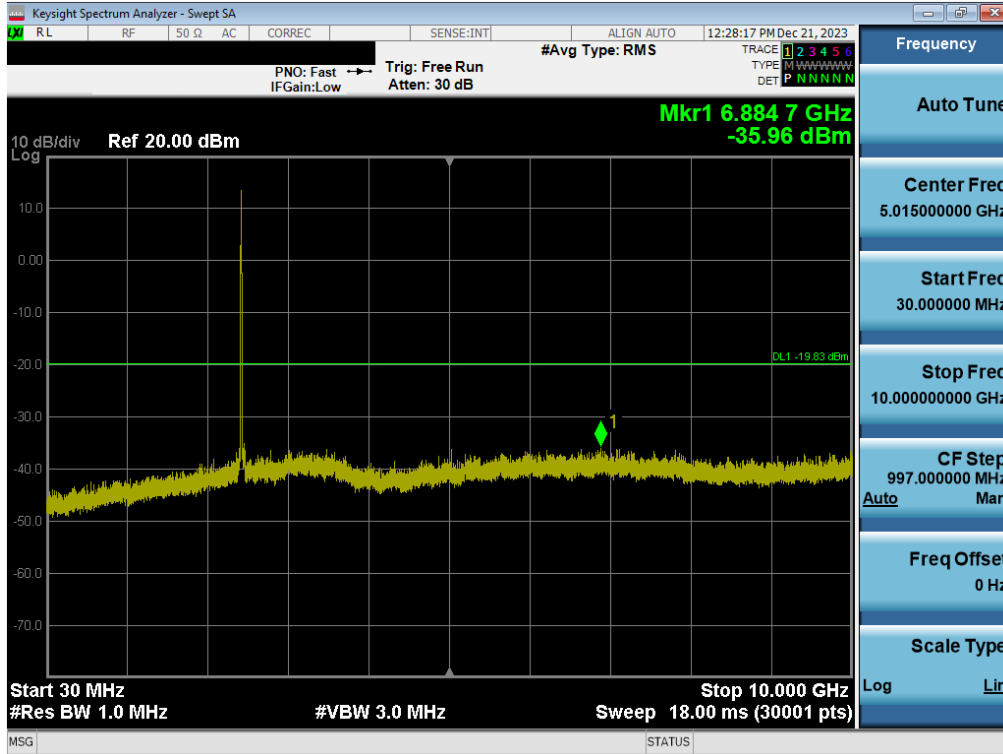


Plot 7-87. Conducted Spurious Plot (802.11b – Ch. 1) – MIMO ANT2

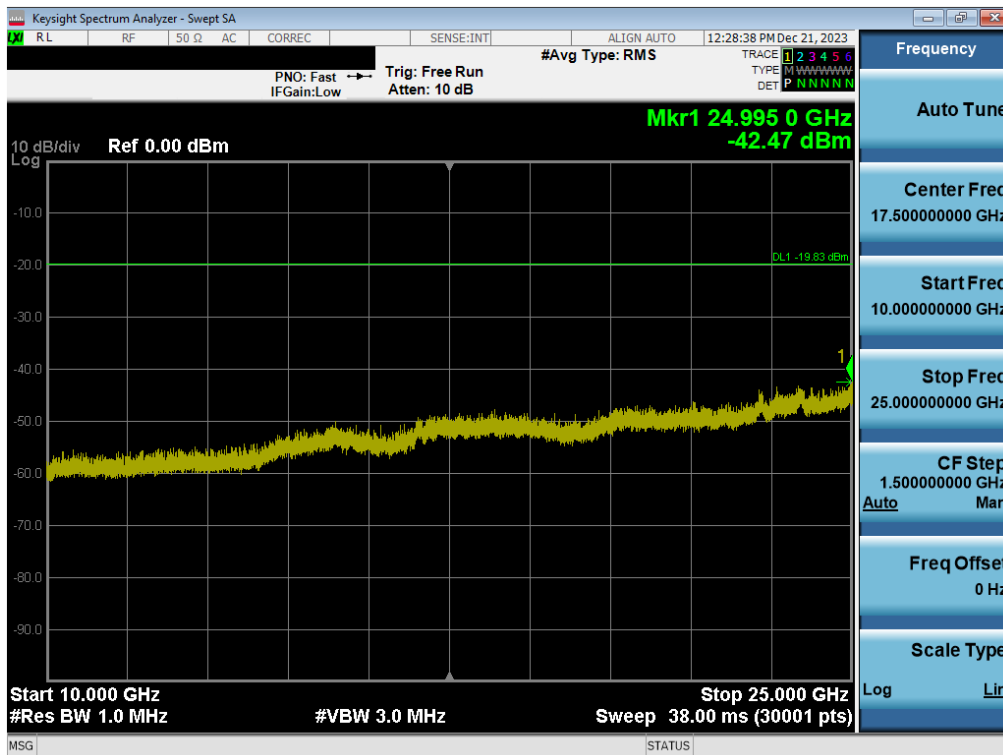


Plot 7-88. Conducted Spurious Plot (802.11b – Ch. 1) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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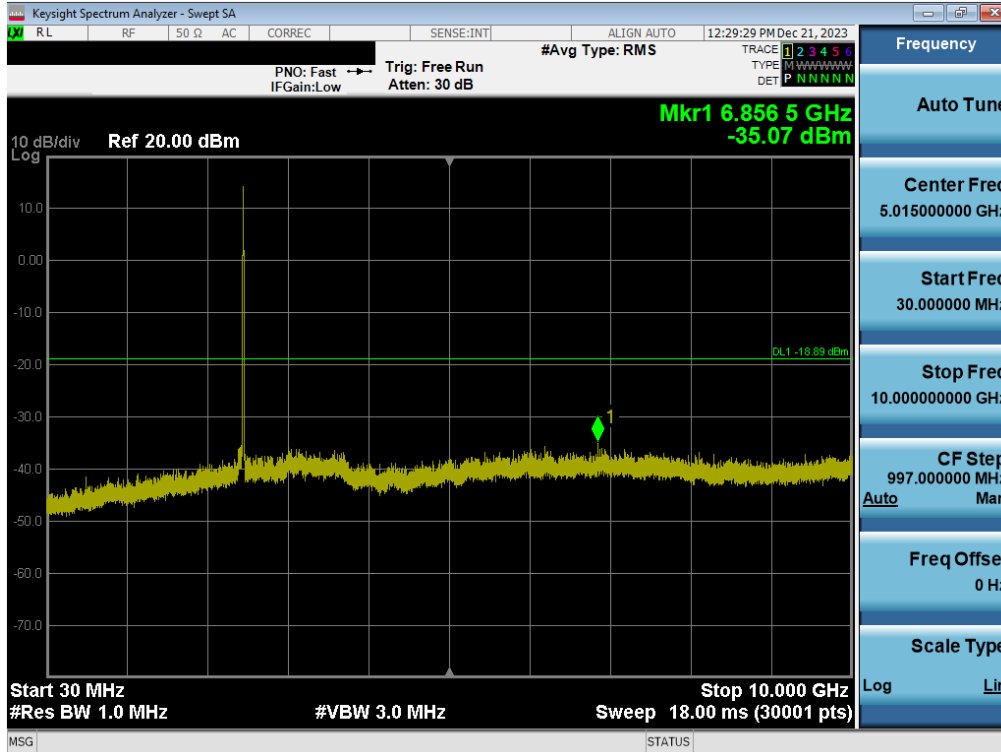


Plot 7-89. Conducted Spurious Plot (802.11b – Ch. 6) – MIMO ANT2

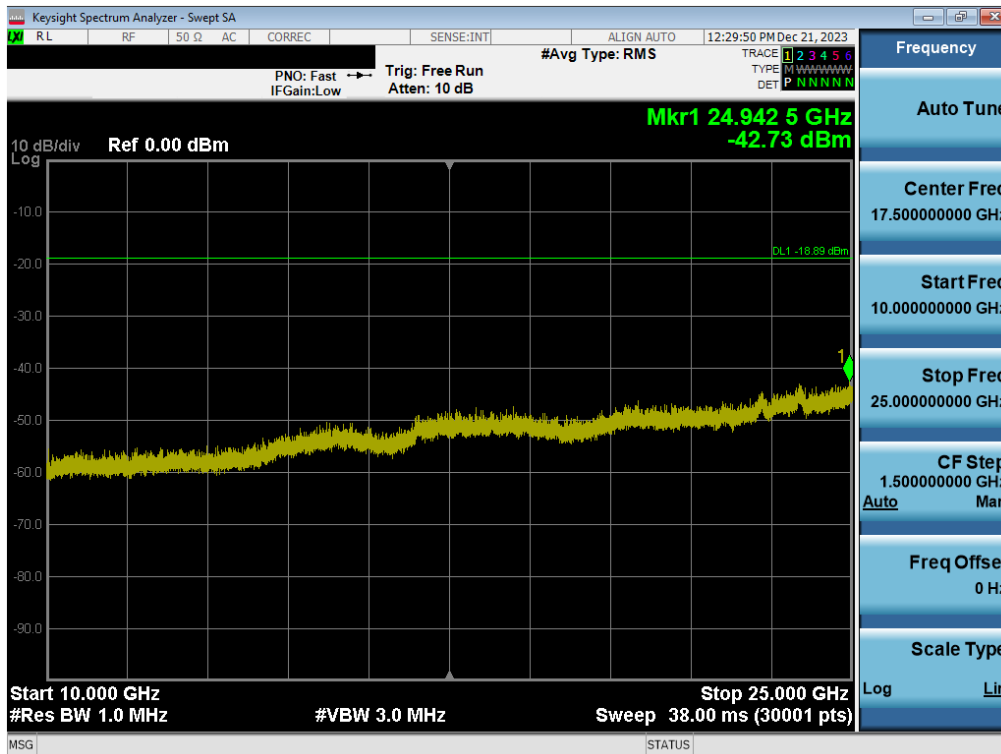


Plot 7-90. Conducted Spurious Plot (802.11b – Ch. 6) – MIMO ANT2

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-91. Conducted Spurious Plot (802.11b – Ch. 11) – MIMO ANT2



Plot 7-92. Conducted Spurious Plot (802.11b – Ch. 11) – MIMO ANT2

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7.7 Radiated Emission Measurements

Test Overview and Limit

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

All out of band emissions appearing in a restricted band as specified in FCC §15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown FCC §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 7-5. Radiated Limits

Test Procedures Used

ANSI C63.10-2013 – Section 6.6.4.3

Test Settings – Above 1GHz

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 = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be $\geq 2 \times \text{span} \backslash \backslash \text{RBW}$)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces

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Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Test Settings – Below 1GHz

Quasi-Peak Field Strength Measurements

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

Test Setup

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

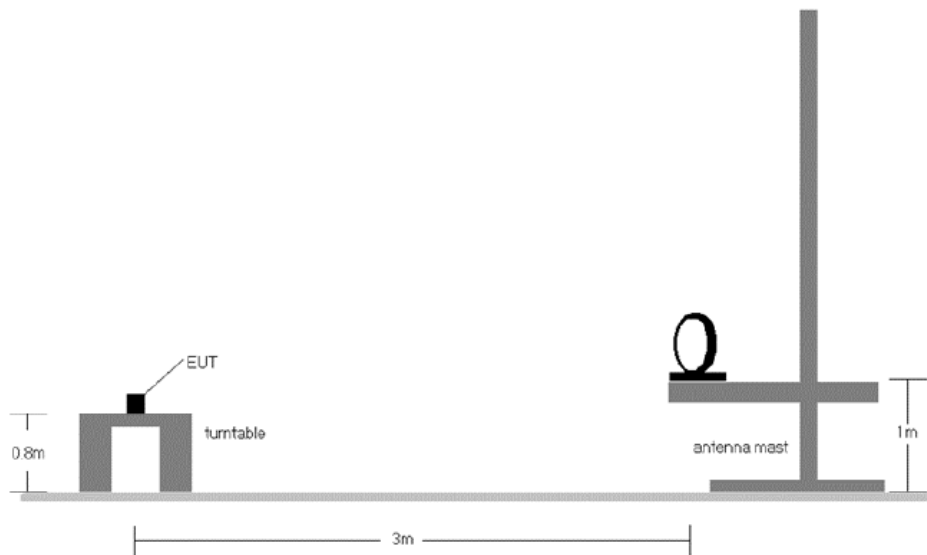


Figure 7-6. Radiated Test Setup < 30MHz

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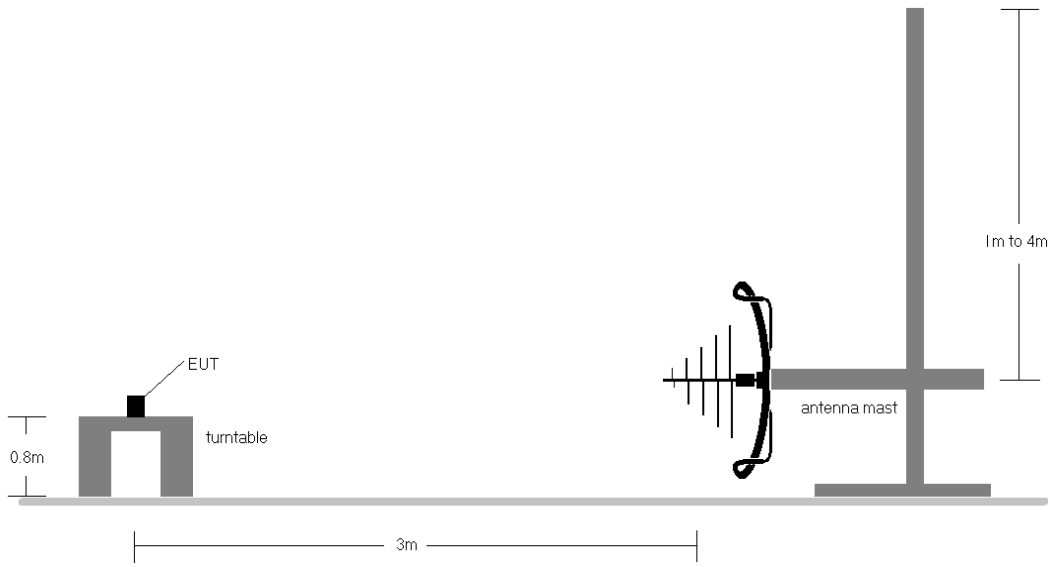


Figure 7-7. Radiated Test Setup < 1GHz

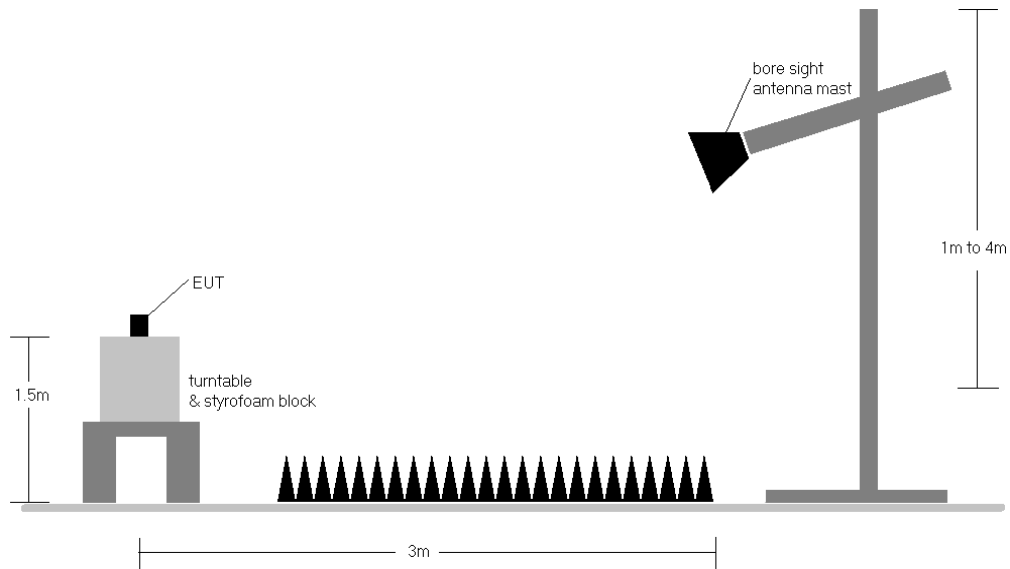


Figure 7-8. Radiated Test Setup > 1GHz

Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of ANSI C63.10-2013 Section 11.3 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 limits shown in §15.209.

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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. 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.
7. wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section.
8. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
9. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst-case results during the transmitter spurious emissions testing.
10. No spurious emissions were detected within 20dB of the limit below 30MHz.
11. The results recorded using the broadband antenna are known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
12. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

Sample Calculations

Determining Spurious Emissions Levels

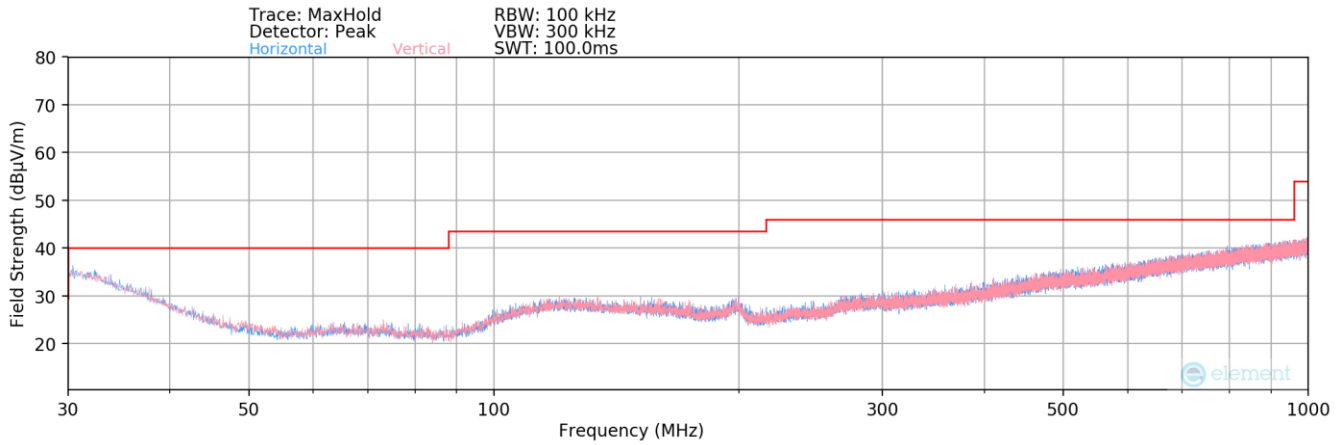
- Field Strength Level $_{[dB_{\mu V/m}]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB_{\mu V/m}]}$ – Limit $_{[dB_{\mu V/m}]}$

Radiated Band Edge Measurement Offset

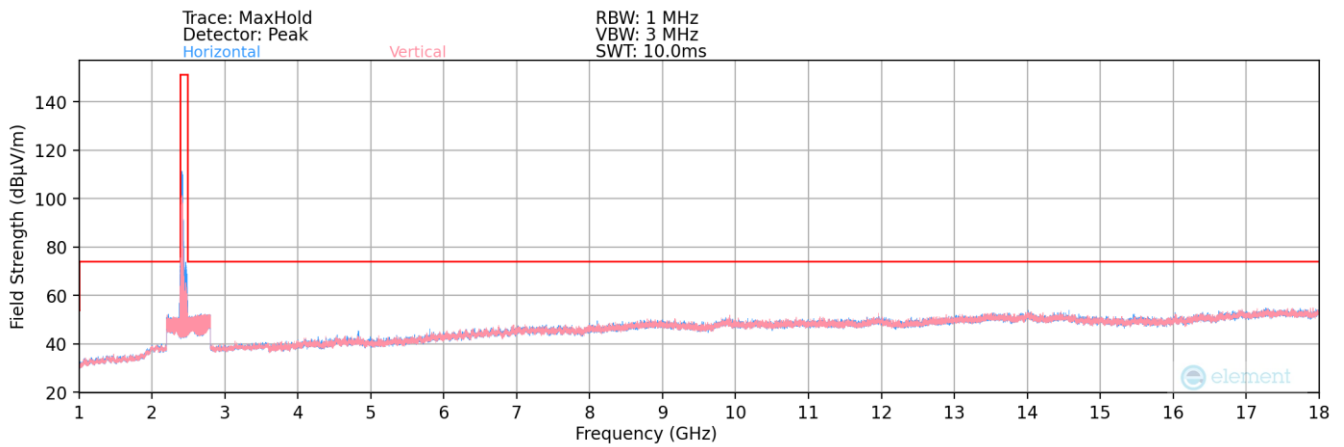
- The amplitude offset shown in the radiated restricted band edge plots in Section 7.7 was calculated using the formula:
Offset (dB) = (Antenna Factor + Cable Loss + Attenuator) – Preamplifier Gain

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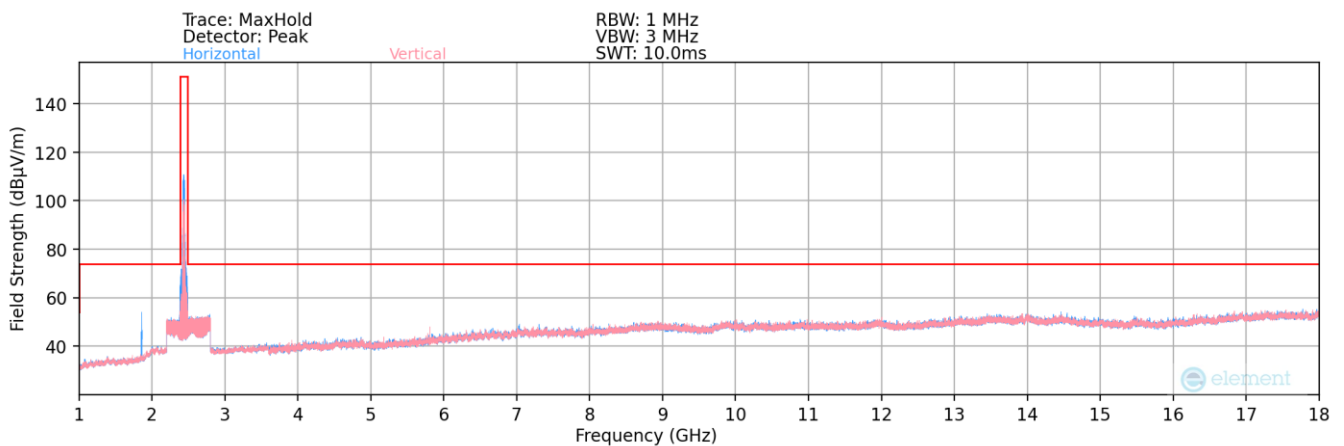
7.7.1 MIMO Radiated Spurious Emission Measurements



Plot 7-93. MIMO Radiated Spurious Plot below 1GHz ANT1

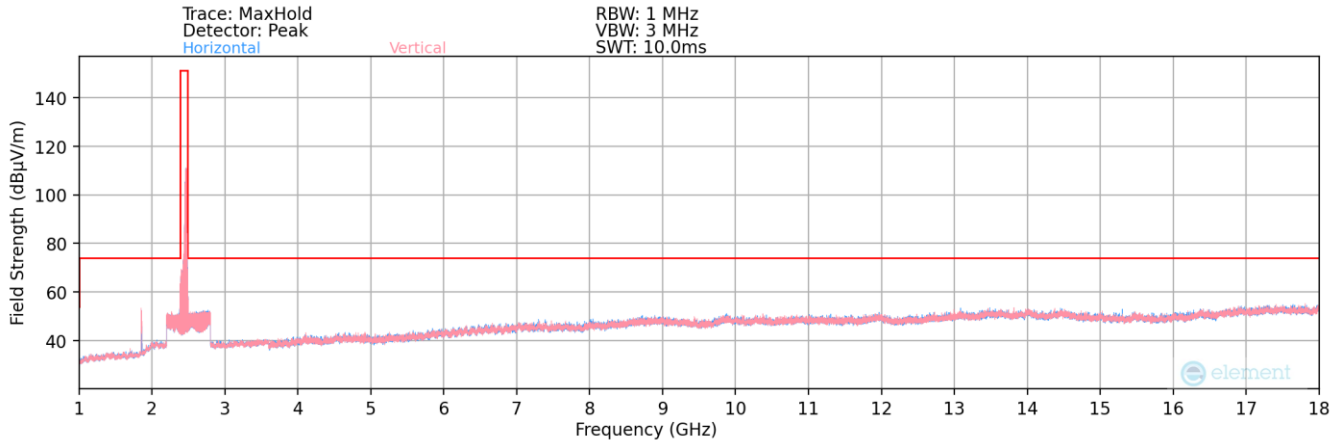


Plot 7-94. MIMO Radiated Spurious Plot above 1GHz (802.11b – Ch. 1)

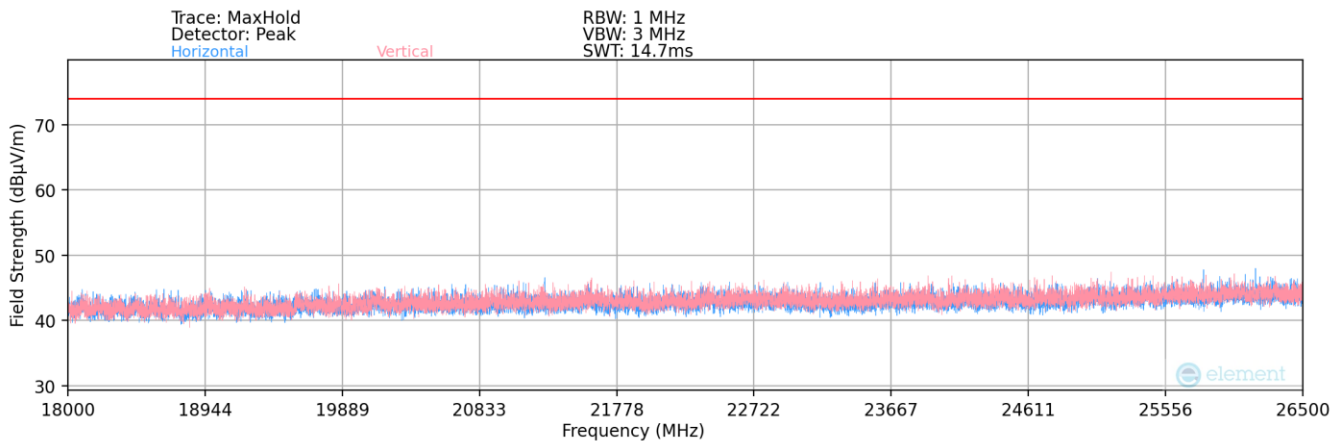


Plot 7-95. MIMO Radiated Spurious Plot above 1GHz (802.11b – Ch. 6)

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Plot 7-96. MIMO Radiated Spurious Plot above 1GHz (802.11b – Ch. 11)



Plot 7-97. MIMO Radiated Spurious Plot above 18GHz

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Worst Case Mode: 802.11b
 Worst Case Transfer Rate: 1 Mbps
 Distance of Measurements: 3 Meters
 Operating Frequency: 2412MHz
 Channel: 1

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]
4824.00	Avg	H	121	166	-72.99	2.81	36.82	53.98	-17.16
4824.00	Peak	H	121	166	-61.00	2.81	48.81	73.98	-25.17
12060.00	Avg	H	-	-	-80.39	12.85	39.46	53.98	-14.52
12060.00	Peak	H	-	-	-69.09	12.85	50.76	73.98	-23.22

Table 7-6. Radiated Measurements MIMO

Worst Case Mode: 802.11b
 Worst Case Transfer Rate: 1 Mbps
 Distance of Measurements: 3 Meters
 Operating Frequency: 2437MHz
 Channel: 6

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]
4874.00	Avg	H	120	169	-75.48	3.15	34.67	53.98	-19.30
4874.00	Peak	H	120	169	-62.93	3.15	47.22	73.98	-26.75
7311.00	Avg	H	-	-	-78.16	9.58	38.42	53.98	-15.56
7311.00	Peak	H	-	-	-66.50	9.58	50.08	73.98	-23.90
12185.00	Avg	H	-	-	-80.10	13.06	39.96	53.98	-14.02
12185.00	Peak	H	-	-	-68.26	13.06	51.80	73.98	-22.18

Table 7-7. Radiated Measurements MIMO

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Worst Case Mode: 802.11b
 Worst Case Transfer Rate: 1 Mbps
 Distance of Measurements: 3 Meters
 Operating Frequency: 2462MHz
 Channel: 11

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]
4924.00	Avg	H	120	154	-74.39	3.02	35.63	53.98	-18.35
4924.00	Peak	H	120	154	-63.05	3.02	46.97	73.98	-27.01
7386.00	Avg	H	-	-	-78.35	9.34	37.99	53.98	-15.99
7386.00	Peak	H	-	-	-66.48	9.34	49.86	73.98	-24.12
12310.00	Avg	H	-	-	-80.29	13.24	39.95	53.98	-14.03
12310.00	Peak	H	-	-	-68.81	13.24	51.43	73.98	-22.55

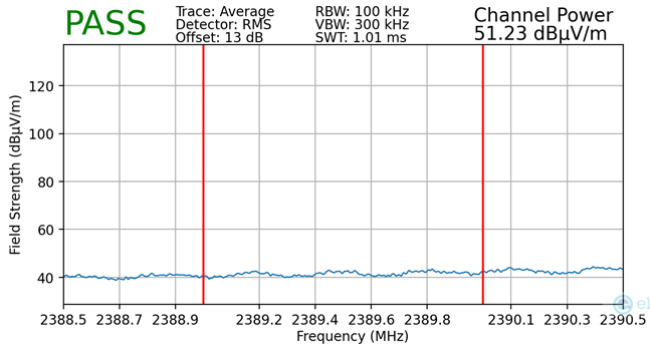
Table 7-8. Radiated Measurements MIMO

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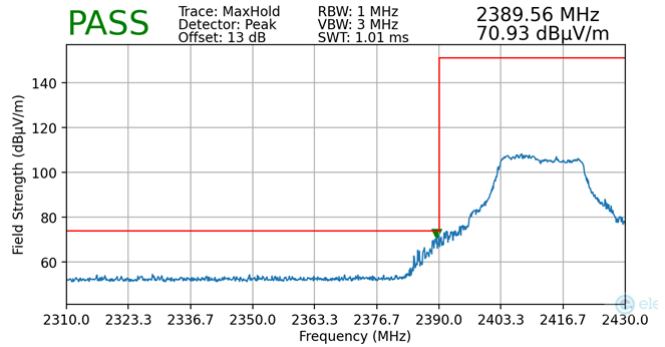
7.7.2 MIMO Radiated Restricted Band Edge Measurements

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

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	2412MHz
Channel:	1

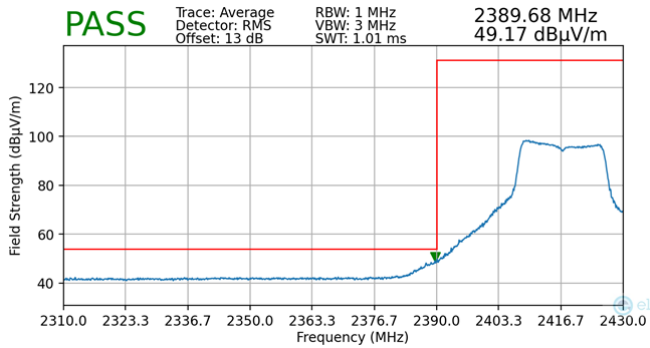


Plot 7-98. Radiated Restricted Lower Band Edge Measurement (Average)

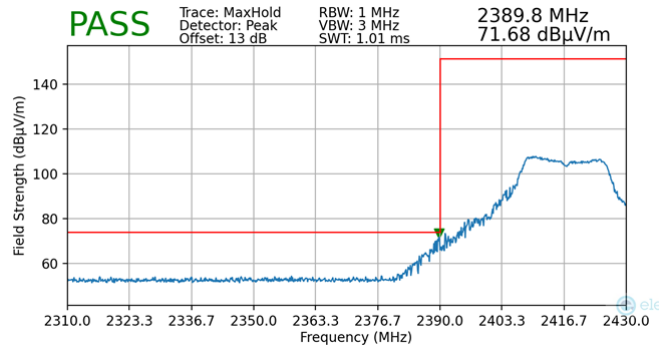


Plot 7-99. Radiated Restricted Lower Band Edge Measurement (Peak)

Worst Case Mode:	802.11n
Worst Case Transfer Rate:	MCS8
Distance of Measurements:	3 Meters
Operating Frequency:	2417MHz
Channel:	2



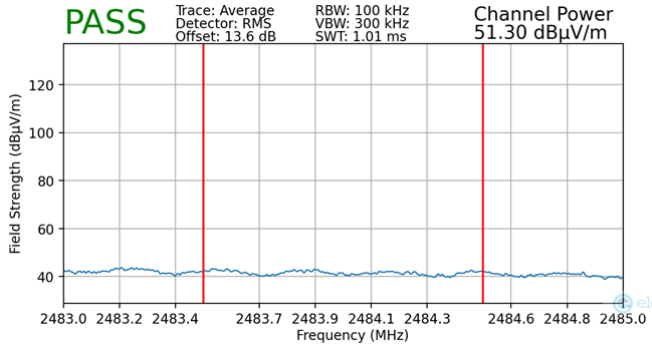
Plot 7-100. Radiated Restricted Lower Band Edge Measurement (Average)



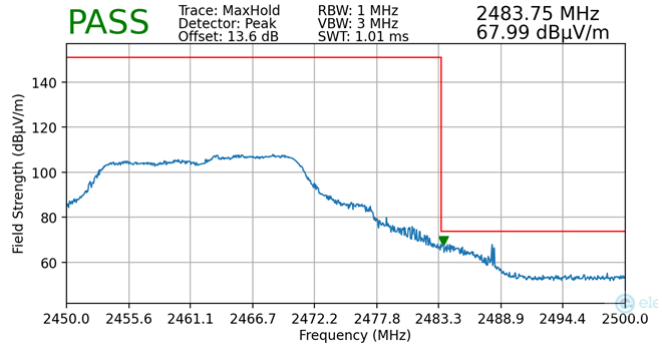
Plot 7-101. Radiated Restricted Lower Band Edge Measurement (Peak)

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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Worst Case Mode: 802.11n
 Worst Case Transfer Rate: MCS8
 Distance of Measurements: 3 Meters
 Operating Frequency: 2462MHz
 Channel: 11

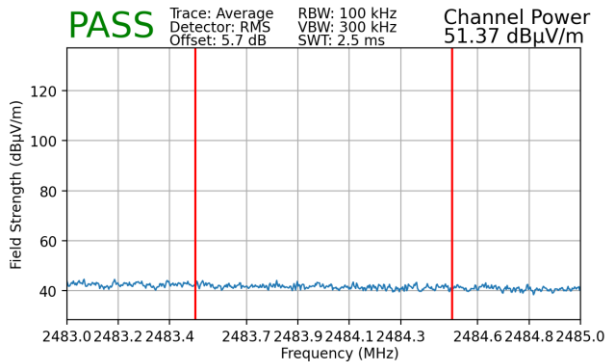


Plot 7-102. Radiated Restricted Upper Band Edge Measurement (Average)

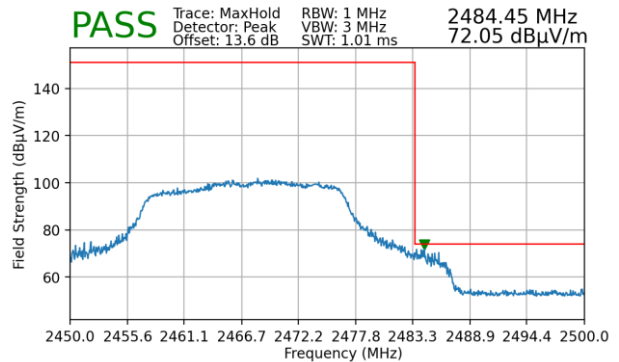


Plot 7-103. Radiated Restricted Upper Band Edge Measurement (Peak)

Worst Case Mode: 802.11n
 Worst Case Transfer Rate: MCS8
 Distance of Measurements: 3 Meters
 Operating Frequency: 2467MHz
 Channel: 12



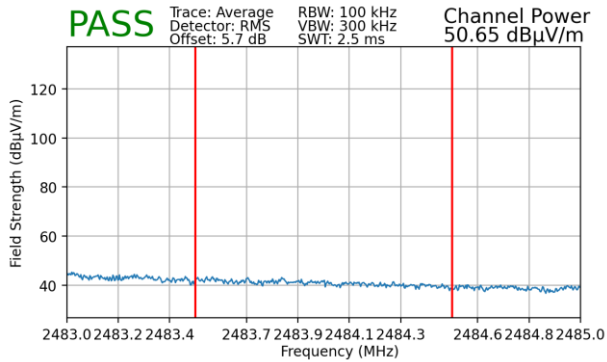
Plot 7-104. Radiated Restricted Upper Band Edge Measurement (Average)



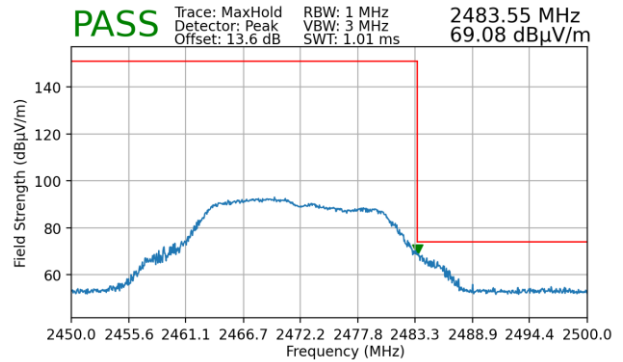
Plot 7-105. Radiated Restricted Upper Band Edge Measurement (Peak)

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Worst Case Mode: 802.11n
 Worst Case Transfer Rate: MCS8
 Distance of Measurements: 3 Meters
 Operating Frequency: 2472MHz
 Channel: 13



Plot 7-106. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-107. Radiated Restricted Upper Band Edge Measurement (Peak)

FCC ID: A3LSMA356U	MEASUREMENT REPORT		Approved by: Technical Manager
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7.8 Line-Conducted Test Data

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 §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 7-9. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

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

Average Field Strength Measurements

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

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Test Setup

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

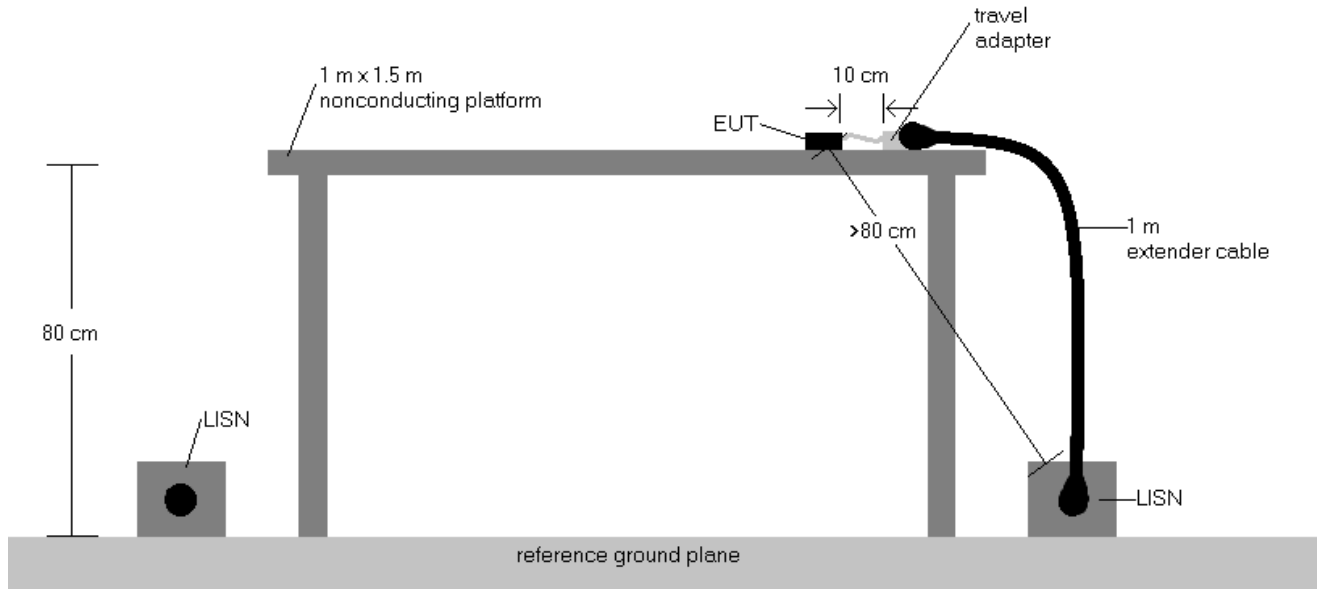
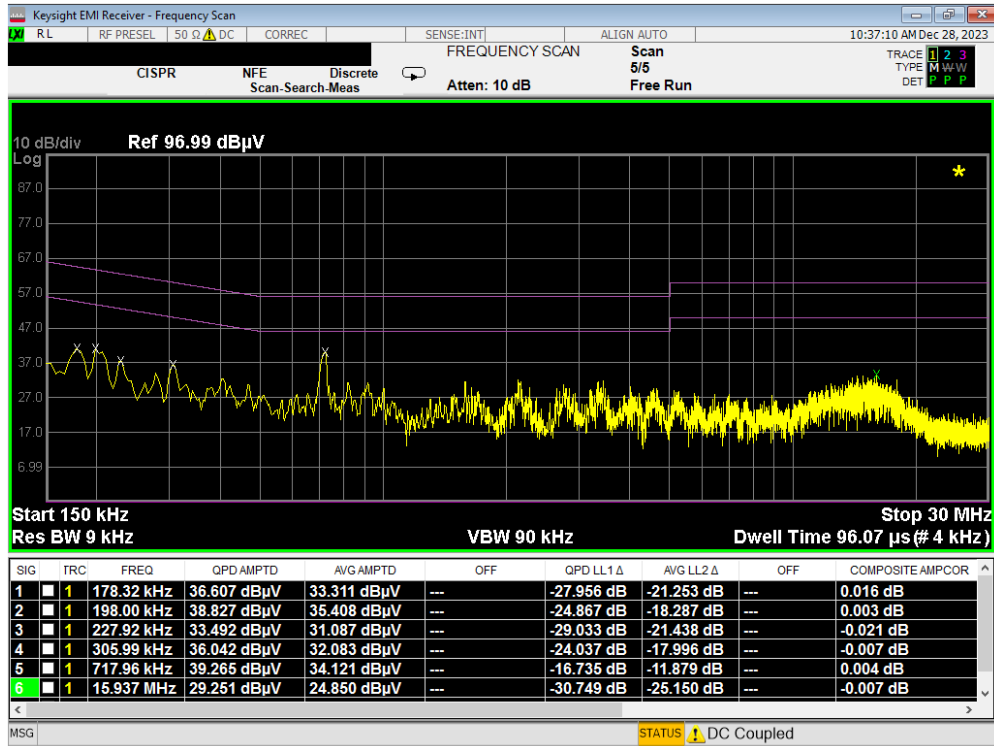


Figure 7-9. Test Instrument & Measurement Setup

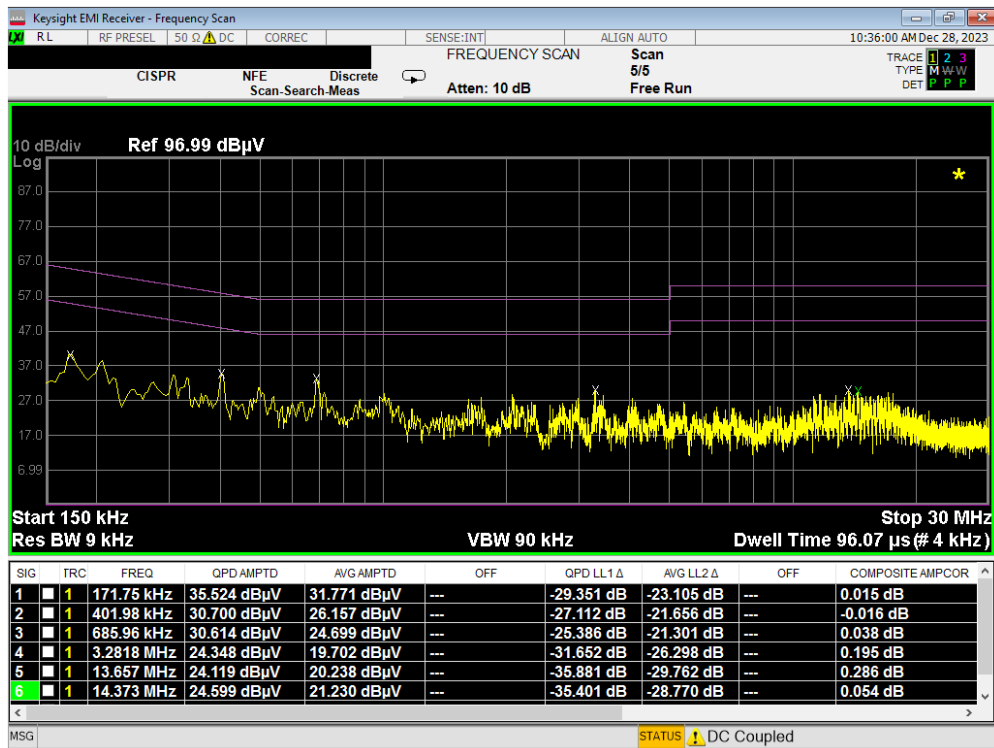
Test Notes

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. $\text{QP}\backslash\text{AV Level (dB}\mu\text{V)} = \text{QP}\backslash\text{AV Analyzer}\backslash\text{Receiver Level (dB}\mu\text{V)} + \text{Corr. (dB)}$
5. $\text{Margin (dB)} = \text{QP}\backslash\text{AV Limit (dB}\mu\text{V)} - \text{QP}\backslash\text{AV Level (dB}\mu\text{V)}$
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

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Plot 7-108. Line Conducted Plot with 802.11b (L1)



Plot 7-109. Line Conducted Plot with 802.11b (N)

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CONCLUSION

The data collected relate only the item(s) tested and show that the **Samsung Portable Handset FCC ID: A3LSMA356U** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules.

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