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MEASUREMENT REPORT
FCC Part 15.407 802.11a/ax/be WiFi 6GHz

Applicant Name:
Microsoft
Corporation 1
Microsoft Way
Redmond, WA 98052-8300
United States

Date of Testing:
4/1/2025 - 6/16/2025
Test Report Issue Date:
6/23/2025
Test Site/Location:
Element Lab., Columbia, MD, USA **Test Report Serial No.:** 1M2504010035-11.C3K

FCC ID:	**C3K00002102A**
APPLICANT:	**Microsoft Corporation**

Application Type:	Class II Permissive Change, Module Host Integration Limited
EUT Type:	Modular Approval - Host Integration (Portable Computing Device)
Frequency Range:	5935 – 7115MHz OFDM,
Modulation Type:	OFDMA
FCC Classification:	15E 6GHz Low Power Dual Client (6CD) Part 15
FCC Rule Part(s):	Subpart E (15.407)
Test Procedure(s):	ANSI C63.10:2020, KDB 987594 D02 v03
Permissive Change(s):	Please see change document

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 C63.10:2020. 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

ACCREDITED
CERT #2041.01

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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

Measurements were conducted at the Element laboratory(ies) indicated in Section 1.3 below. All measurement facilities are compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

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).

- Element Washington DC LLC facility is a registered (2451B) test laboratory with the site description on file with ISED.

- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreements (MRAs).

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Microsoft Portable Computing Device containing module FCC ID: C3K00002102A**. The test data contained in this report pertains only to the emissions due to the EUT's UNII transmitter.

The equipment under test (EUT), Model 2119, integrates two previously certified modules. The first module is a WLAN/Bluetooth module authorized under FCC ID: C3K00002102A, and the second is a cellular module authorized under FCC ID: C3K2119. No hardware or software modifications have been made to either module as part of this host integration. The evaluation in this report demonstrates compliance of the host device with the applicable FCC rules, considering the co-location and simultaneous transmission of the integrated modules.

Test Device Serial No.: 0F3496C25123T8, 0F3493C25123T8

2.2 Device Capabilities

This device contains the following capabilities:

Bluetooth (1x, EDR, LE), 802.11b/g/n/ac/ax/be WLAN, 802.11a/n/ac/ax/be UNII (5GHz and GHz), Multi-band LTE, Multi-Band NR (FR1)

Band 5		Band 6		Band 7		Band 8	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
2	5935	97	6435	117	6535	189	6895
:	:	:	:	:	:	:	:
45	6175	105	6475	149	6695	209	6995
:	:	:	:	:	:	:	:
93	6415	113	6515	185	6875	233	7115

Table 2-1. 802.11a/ax/be (20MHz) Frequency / Channel Operations

Band 5		Band 6		Band 7		Band 8	
Ch.	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**	**Ch.**	**Frequency (MHz)**
3	5965	99	6445	123	6565	187	6885
:	:	:	:	:	:	:	:
43	6165	107	6485	155	6725	211	7005
:	:	:	:	:	:	:	:
91	6405	115	6525	179	6845	227	7085

Table 2-2. 802.11ax/be (40MHz BW) Frequency / Channel Operations

Band 5		Band 6		Band 7		Band 8	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
7	5985	103	6465	119	6545	199	6945
:	:			:	:	:	:
39	6145			151	6705	215	7025
:	:			:	:		
87	6385			183	6865		

Table 2-3. 802.11ax/be (80MHz BW) Frequency / Channel Operations

Band 5		Band 6		Band 7		Band 8	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
15	6025	111	6505	143	6665	207	6985
47	6185			175	6825		
79	6345						

Table 2-4. 802.11ax/be (160MHz BW) Frequency / Channel Operations

Band 5		Band 6		Band 7		Band 8	
Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)	Ch.	Frequency (MHz)
31	6105	95	6425	127	6585	191	6905
63	6265			159	6745		

Table 2-5. 802.11be (320MHz BW) Frequency / Channel Operations

Notes:

1. 6GHz NII operation is possible in 20MHz, 40MHz, 80MHz, 160MHz, and 320MHz channel bandwidths. 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 B)2)b) of ANSI C63.10:2020. 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 [%]
6GHz	a	98.63
	ax (HE20)	99.24
	be (EHT20)	99.63
	ax (HE40)	98.74
	be (EHT40)	98.69
	ax (HE80)	98.75
	be (EHT80)	98.88
	ax (HE160)	98.87
	be (EHT160)	98.89
	be (EHT320)	97.95

Table 2-6. Measured Duty Cycles

2. The device employs MIMO technology. Below are the possible configurations.

WiFi Configurations		SISO		CDD		SDM	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
6GHz	11a	✓	✓	✓	✓	×	×
	11ax	✓	✓	✓	✓	✓	✓
	11be	✓	✓	✓	✓	✓	✓

Table 2-7. Antenna / Technology Configurations

✓= Support; ×= NOT Support
SISO = Single Input Single Output
SDM = Spatial Diversity Multiplexing – MIMO function
CDD = Cyclic Delay Diversity – 2Tx Function

3. The device supports the following data rates (shown in Mbps):

802.11a	MCS Index		Spatial Stream	OFDM (802.11ax/be)															
20MHz				20MHz			40MHz			80MHz			160MHz			320MHz			
	HT	EHT		0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	0.8µs GI	1.6µs GI	3.2µs GI	
6	0	0	1	8.6	8.1	7.3	17.2	16.3	14.6	36	34	30.6	72.1	68.1	61.3	144.1	136.1	122.5	
9	1	1	1	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5	288.2	272.2	245	
12	2	2	1	25.8	24.4	21.9	51.6	48.8	43.9	108.1	102.1	91.9	216.2	204.2	183.8	432.4	408.3	367.5	
18	3	3	1	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245	576.5	544.4	490	
24	4	4	1	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5	864.7	816.7	735	
36	5	5	1	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490	1152.9	1088.9	980	
48	7	6	1	77.4	73.1	65.8	154.9	146.3	131.6	324.3	306.3	275.6	648.5	612.5	551.3	1297.1	1225	1102.5	
54		7	1	86	81.3	73.1	172.1	162.5	146.3	360.3	340.3	306.3	720.6	680.6	612.5	1441.2	1361.1	1225	
		8	1	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735	1729.4	1633.3	1470	
		9	1	114.7	108.3	97.5	229.4	216.7	195	480.4	453.7	408.3	960.8	907.4	816.7	1921.6	1814.8	1633.3	
		10	1	129	121.9	109.7	258.1	243.8	219.4	540.4	510.4	459.4	1080.9	1020.8	918.8	2161.8	2041.7	1837.5	
		11	1	143.4	135.4	121.9	286.8	270.8	243.8	600.5	567.1	510.4	1201	1134.3	1020.8	2402	2268.5	2041.7	
		12	1	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225	1102.5	2594.1	2450	2205	
		13	1	172.1	162.5	146.3	344.1	325	292.5	720.6	680.6	612.5	1441.2	1361.1	1225	2882.4	2722.2	2450	
6	8	0	2	17.2	16.3	14.6	34.4	32.5	29.3	72.1	68.1	61.3	144.1	136.1	122.5	288.2	272.2	245	
9	9	1	2	34.4	32.5	29.3	68.8	65	58.5	144.1	136.1	122.5	288.2	272.2	245	576.5	544.4	490	
12	10	2	2	51.6	48.8	43.9	103.2	97.5	87.8	216.2	204.2	183.8	432.4	408.3	367.5	864.7	816.7	735	
18	11	3	2	68.8	65	58.5	137.6	130	117	288.2	272.2	245	576.5	544.4	490	1152.9	1088.9	980	
24	12	4	2	103.2	97.5	87.8	206.5	195	175.5	432.4	408.3	367.5	864.7	816.7	735	1729.4	1633.3	1470	
36	13	5	2	137.6	130	117	275.3	260	234	576.5	544.4	490	1152.9	1088.9	980	2305.9	2177.8	1960	
48	14	6	2	154.9	146.3	131.6	309.7	292.5	263.3	648.5	612.5	551.3	1297.1	1225	1102.5	2594.1	2450	2205	
54	15	7	2	172.1	162.5	146.3	344.1	325	292.5	720.6	680.6	612.5	1441.2	1361.1	1225	2882.4	2722.2	2450	
		8	2	206.5	195	175.5	412.9	390	351	864.7	816.7	735	1729.4	1633.3	1470	3458.8	3266.7	2940	
		9	2	229.4	216.7	195	458.8	433.3	390	960.8	907.4	816.7	1921.6	1814.8	1633.3	3843.1	3629.6	3266.7	
		10	2	258.1	243.8	219.4	516.2	487.5	438.8	1080.9	1020.8	918.8	2161.8	2041.7	1837.5	4323.5	4083.3	3675	
		11	2	286.8	270.8	243.8	573.5	541.7	487.5	1201	1134.3	1020.8	2402	2268.5	2041.7	4803.9	4537	4083.3	
		12	2	309.7	292.5	263.3	619.4	585	526.5	1297.1	1225	1102.5	2594.1	2450	2205	5188.2	4900	4410	
		13	2	344.1	325	292.5	688.2	650	585	1441.2	1361.1	1225	2882.4	2722.2	2450	5764.7	5444.4	4900	

Table 2-8. Supported Data Rates

2.3 Antenna Description

The following antenna gains are used in this device per the "Unlicensed Band Antenna Gain" document provided by the client. This document is also included in the filing as a public exhibit.

	Measured Directional Gain [dBi]
5925 – 6425 MHz	8.22
6425 – 6525 MHz	6.98
6525 – 6875 MHz	6.82
6875 – 7125 MHz	7.73

Table 2-9. Antenna Peak Gain

The directional antenna gains were measured per the guidance of KDB 662911 D03. The measurement report is uploaded as part of this filing.

2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10:2020 and KDB 987594 D02 v01r01. ANSI C63.10:2020 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.

This device supports operation under control of either a low-power indoor access point or standard power access point. The worst-case emissions data is shown in this report.

This device operates in the 5.925-7.125 GHz band when under control of a low power indoor access point. Additionally, the device may operate in the 5.925-6.425 GHz and 6.525-6.875 GHz bands when under control of a standard power access point.

2.5 Software and Firmware

The test was conducted with firmware version 3.1.0.1407 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.

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 C63.10:2020) and the guidance provided in KDB 987594 D02 v01r01 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 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 7.2.2. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

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 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 precautions were 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 were 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).

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 connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10:2020. 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 (±dB)
Contention Based Protocol Conducted Measurements	0.86
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

Table 5-1. Measurement Uncertainty Budget

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
-	WL25-1	Conducted Cable Set (25GHz)	2/25/2025	Annual	2/25/2026	WL25-1
-	WL25-2	Conducted Cable Set (25GHz)	2/25/2025	Annual	2/25/2026	WL25-2
-	WL40-1	Conducted Cable Set (40GHz)	2/25/2025	Annual	2/25/2026	WL40-1
-	MD 1M 18-40	EMCCable and Switch System	2/25/2025	Annual	2/25/2026	MD 1M 18-40
-	AP2-001	EMCCable and Switch System	2/25/2025	Annual	2/25/2026	AP2-001
-	ETS-001	EMCCable and Switch System	2/25/2025	Annual	2/25/2026	ETS-001
Agilent	N9038A	MXE EMI Receiver	9/16/2024	Annual	9/16/2025	MY51210133
Agilent	N9020A	MXA Signal Analyzer	5/7/2025	Annual	5/7/2026	US46470561
Agilent	N9030A	PXA Signal Analyzer (44GHz)	10/16/2024	Annual	10/16/2025	MY49430494
Anritsu	MA24408A	Microwave Peak Power Sensor	10/2/2024	Annual	10/2/2025	11675
EMCO	3115	Horn Antenna (1-18GHz)	9/6/2024	Biennial	9/6/2025	9704-5182
EMCO	3116	Horn Antenna (18-40GHz)	7/5/2023	Biennial	7/5/2025	9203-2178
ETS-Lindgren	3116C	Horn Antenna (18-40GHz)	4/22/2025	Biennial	4/22/2027	218893
Keysight Technologies	N9020A	MXA Signal Analyzer	2/7/2025	Annual	2/7/2026	MY53421544
Keysight Technologies	N9030A	PXA Signal Analyzer	8/26/2024	Annual	8/26/2025	MY54490576
Keysight Technologies	N9030B	PXA Signal Analyzer	9/19/2024	Annual	9/19/2025	MY57141001
Pasternack	NMLC-2	Line Condcuted Emissions Cable	3/25/2025	Annual	3/25/2026	NMLC-2
Rohde & Schwarz	TC-TA18	Vivaldi Antenna	4/15/2024	Biennial	4/15/2026	101058
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	10/16/2024	Annual	10/16/2025	100342
Rohde & Schwarz	ESU40	EMI Test Receiver (40GHz)	11/25/2024	Annual	11/25/2025	100348
Rohde & Schwarz	ESW44	EMI Test Receiver (44GHz)	3/25/2025	Annual	3/25/2026	101716
Rohde & Schwarz	CMX500	5G Radio Communication Tester	N/A			101202
Sunol	JB6	Bi-Log Antenna (20M-6GHz)	3/24/2025	Biennial	3/25/2027	A082816
Sunol	JB5	Bi-Log Antenna (20M-5GHz)	9/11/2024	Biennial	9/11/2026	A051107

Table 6-1. Test Equipment Calibration Table – MD

Component	Serial Number
MegaPhase Cable TM26-S1S1-36	18160103 003
Pasternack 6dB Attenuator PE7005-6	N/A

Table 6-2. WL25-1 Conducted Cable Set Components

Component	Serial Number
MiniCircuirs Cable CBL-2FT-SMSM+	77743
MCL 6dB Attenuator BW-S6W2+	1314

Table 6-3. WL25-2 Conducted Cable Set Components

Component	Serial Number
MegaPhase Cable TM40K1K1-36	18160102 001
MCL 10dB Attenuator BW-K10 2W44+	1902

Table 6-4. WL40-1 Conducted Cable Set Components

Component	Serial Number
Pasternak Cable RG214/U	111815
Sucoflex Cable 106A	246420-001
Rohde & Schwarz SF Unit	102134

Table 6-5. ETS-001 EMC Cable and Switch System Components

Component	Serial Number
MiniCircuits Cable CBL-0.5M-SMNM+	47261
Micro-Coax Utiflex Cable UFB311A-Q-3346-50U50U MFR 64639	231978-001
Micro-Coax Utiflex Cable UFB311A-1-0629-50U50U MFR 64639	231986-002
MegaPhase Cable NC29-N1N1-324	19046401 001
MegaPhase Flex Cable 10511-1	15044701-006
Micro-Coas Utiflex Cable UFB311A-Q-3446-50U50U MFR 64639	231978-002
Micro-Coas Utiflex Cable UFB311A-1-0629-50U50U MFR 64639	231986-001
Micro-Coas Utiflex Cable UFB142A-0-0659-50U50U MFR 64639	232069-001
Rohde & Schwarz SF Unit	102138

Table 6-6. AP2-001 EMC Cable and Switch System Components

Component	Serial Number
MegaPhase Cable TM40-K1K1-30	20233002-004
UTIPLEX Cable	64639 232063-001
Rohde & Schwarz Pre-amp RS-PR1840 18G-40G	9037.7670.02

Table 6-7. MD 1M 18-40 EMC Cable and Switch System Components

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.

7.0 TEST RESULTS

7.1 Summary

Company Name: Microsoft Corporation
FCC ID: C3K00002102A
FCC Classification: 15E 6GHz Low Power Dual Client (6CD)

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
2.1046, 15.407(a)(11)	RSS-248(4.5)	Maximum Conducted Output Power	N/A	CONDUCTED	PASS	See Original Filing for Module
15.407(a)(8), 15.407(a)(7)	RSS-248(4.5)	Maximum Radiated Output Power	< 24dBm over the frequency band of operation <30dBm over the frequency band of operation when connecting to a standard power access point		PASS	See Original Filing for Module
2.1049, 15.407(a)(10)	RSS-248(4.4)	Occupied Bandwidth/ 26dB Bandwidth	99% of the occupied bandwidth of any channel must be contained within each of its respective U-NII sub bands. The maximum transmitter channel bandwidth for U-NII devices in the 5.925-7.125 GHz band is 320 megahertz.		PASS	See Original Filing for Module
15.407(a)(8), 15.407(a)(7)	RSS-248(4.5)	Maximum Power Spectral Density	< -1dBm/MHz e.i.r.p. <17dBm/MHz when operating with a standard power access point		PASS	See Original Filing for Module
15.407(b)(7)	RSS-248(4.6)	In-Band Emissions	EUT must meet the limits detailed in 15.407(b)(7)		PASS	See Original Filing for Module
15.407(d)(6)	RSS-248(4.7)	Contention Based Protocol	EUT must detect AWGN signal with 90% (or better) certainty		PASS	See CBP Report
15.407(b)(6)	RSS-248(4.6)	Undesirable Emissions	< -27dBm/MHz e.i.r.p. outside of the 5.925 – 7.125GHz band	RADIATED / CONDUCTED	PASS	Section 7.2
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		PASS	Section 7.2
15.407(b)(9)	RSS-Gen (8.8)	AC Conducted Emissions (150kHz – 30MHz)	< FCC 15.207 limits	LINE CONDUCTED	PASS	Section 7.3

Table 7-1. Summary of Test Results

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. The test results shown in the following sections represent the worst-case emissions.
2) For 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 1.6.4.
3) The test data shown in this report follows the test plan prepared by the Grantee after consultation with FCC.

7.2 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 its maximum power control level, as defined in ANSI C63.10:2020, and at the appropriate frequencies. All channels, modes (e.g. 802.11a, 802.11ax (20/40/80/160/320MHz), and modulations/data rates were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst-case emissions are reported in this section.

For transmitters operating in the 5.925-7.125 GHz band: All emissions outside of the 5.925-7.125 GHz band shall not exceed an EIRP of -27dBm/MHz (68.2dBuV/m at a 3m distance). Emissions found in a restricted band are subject to the limits of 15.209 as shown in the table below.

Frequency	Field Strength [μV/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 7-2. Radiated Limits

Test Procedures Used

ANSI C63.10:2020– Sections 12.7.7.2, 12.7.6, 12.7.5

Test Settings – Above 1GHz

Average Field Strength Measurements (Method AD – Average Detection)

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 ≥ 2 x span\\RBW)
6. Sweep time = auto
7. Trace (RMS) averaging was performed over at least 100 traces.

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.

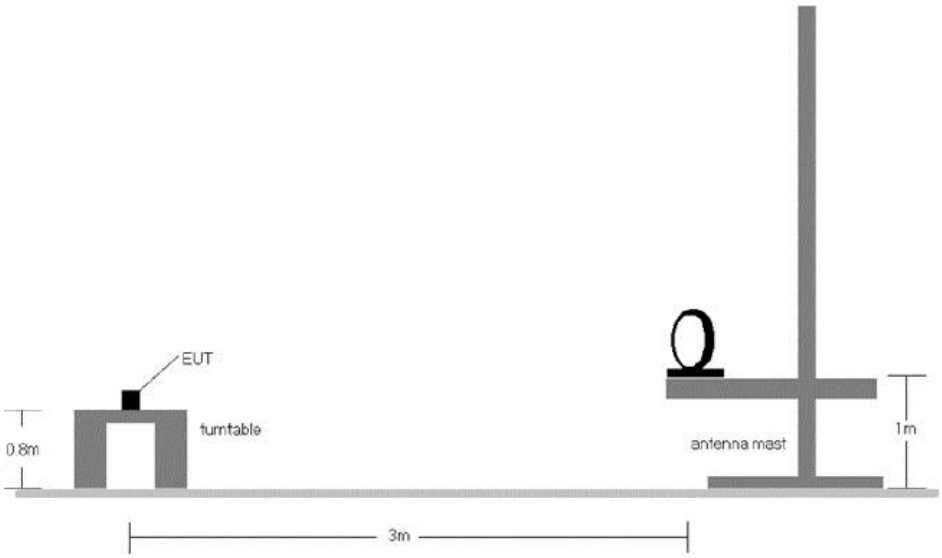


Figure 7-1. Radiated Test Setup < 30MHz

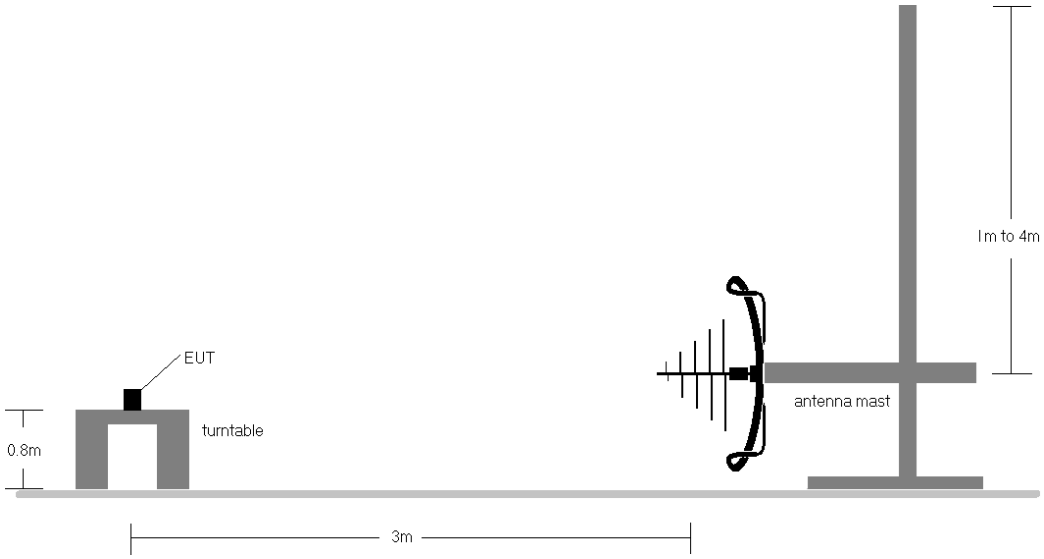


Figure 7-2. Radiated Test Setup < 1GHz

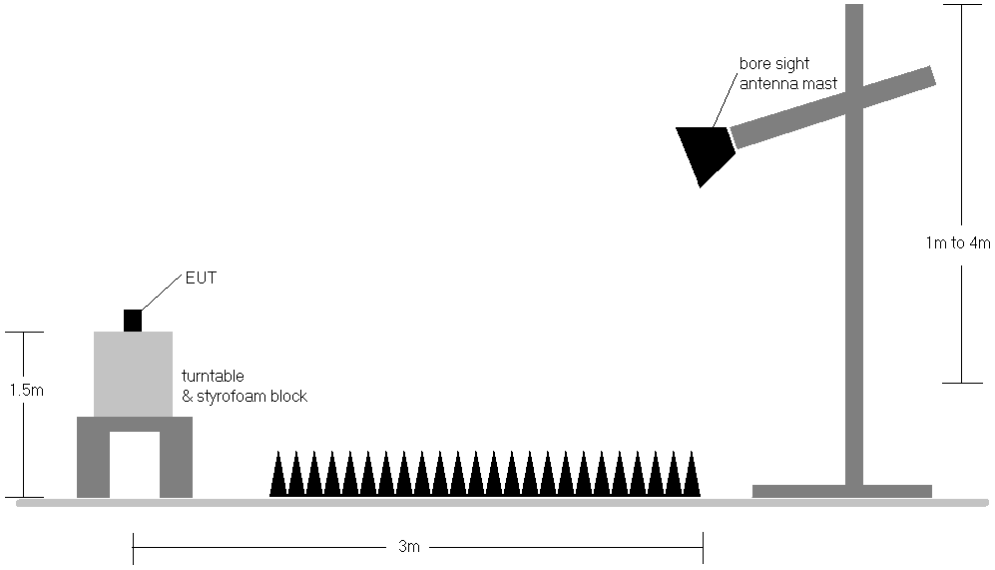


Figure 7-3. Radiated Test Setup > 1GHz

Figure 7-4. Conducted Test Setup for Band Edge > 1GHz

Test Notes

1. All spurious emissions lying in restricted bands specified in §15.205 are below the limits specified in §15.209. All spurious emissions that do not lie in a restricted band are subject to an average limit of -27dBm/MHz. At 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dBμV/m.
2. All spurious emissions that do not lie in a restricted band are subject to a peak limit not to exceed 20dB of the average limit [68.2dBμV/m]. If a peak measurement passes the average limit, it was determined no further investigation is necessary.
3. The antenna is manipulated through typical positions, polarity, and length during the tests. The EUT is manipulated through three orthogonal planes.
4. 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.
5. 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.
6. The 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. The "-" shown in the following RSE tables are used to denote a noise floor measurement.
7. In the case where a peak-detector measurement passed the given RMS limit it was determined sufficient to demonstrate compliance.
8. 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.
9. Restricted Band Edge testing was performed using conducted setup per ANSI C63.10:2020 Sec. 12.7.4.2.
10. Radiated Band Edge test cases were determined based on the original filing for the module, and by the manufacturer provided document Host Test Plan for Limited Module.

Sample Calculations

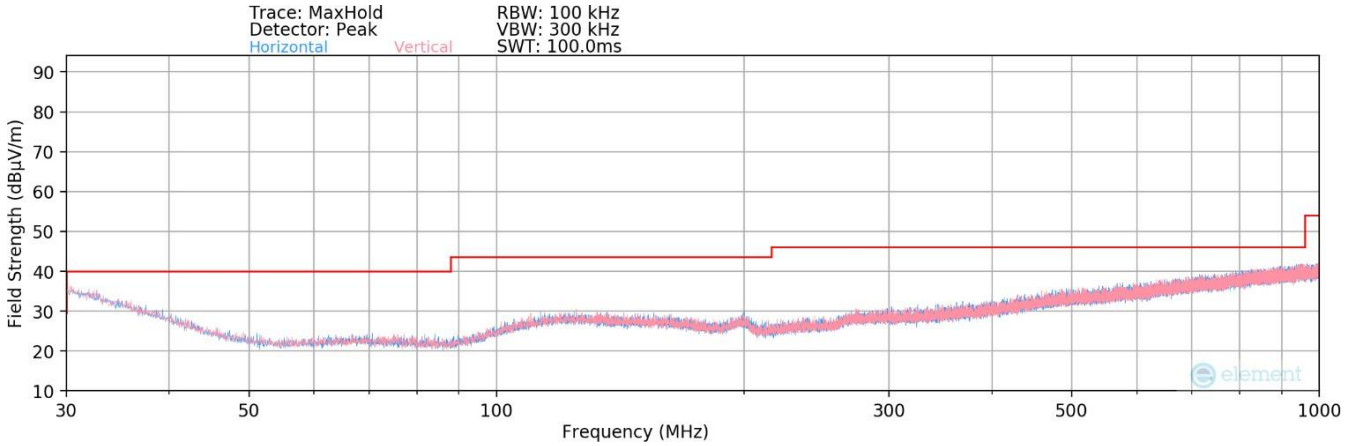
Determining Spurious Emissions Levels

- Field Strength Level [dBµV/m] = Analyzer Level [dBm] + 107 + AFCL [dB/m]
- AFCL [dB/m] = Antenna Factor [dB/m] + Cable Loss [dB]
- Margin [dB] = Field Strength Level [dBµV/m] – Limit [dBµV/m]

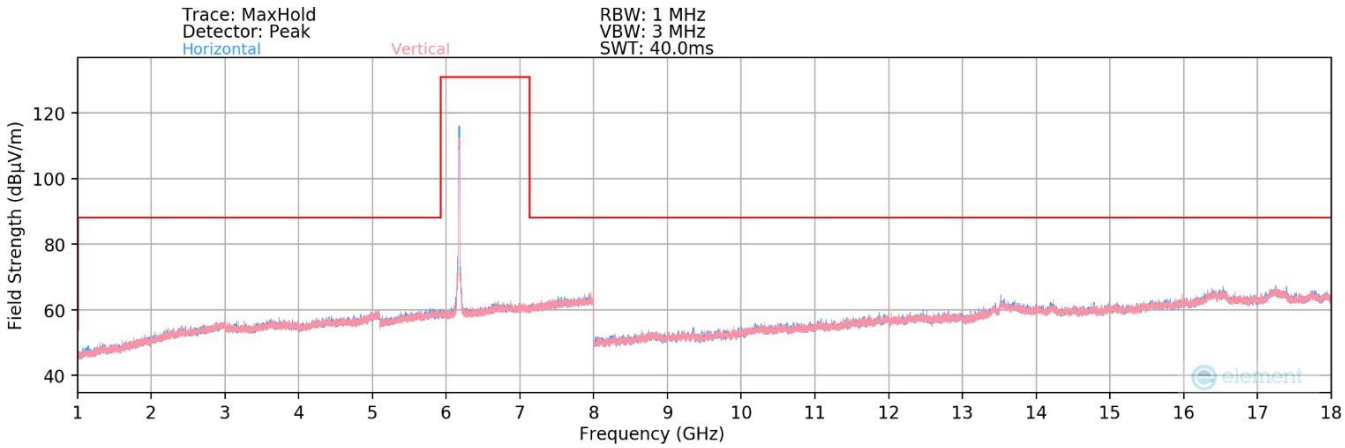
Conducted Band Edge Field Strength Conversion

- Field Strength Level [dBµV/m] = EIRP [dBm] + 95.2

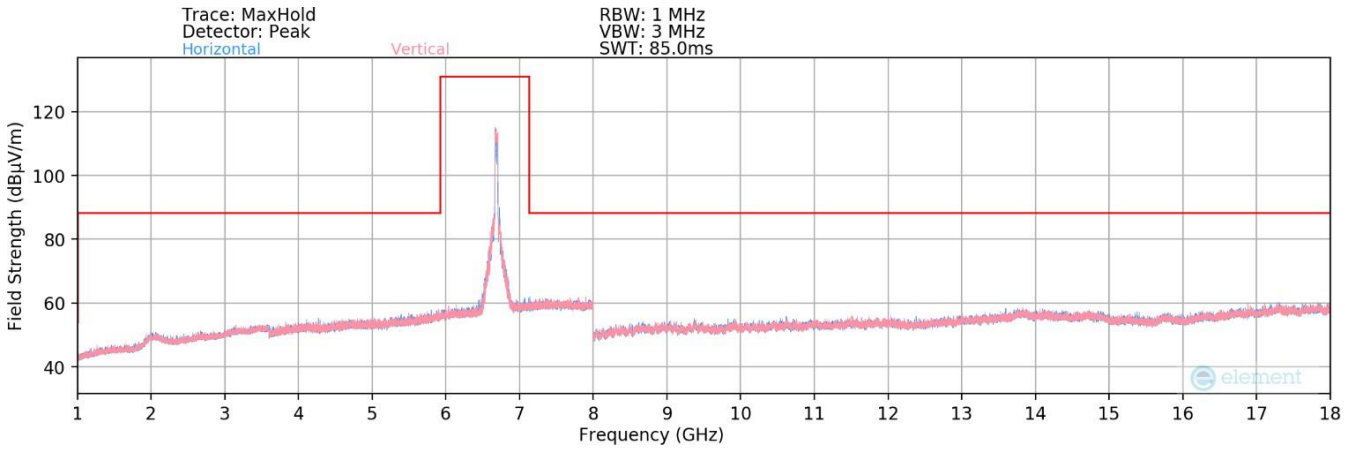
7.2.1 MIMO Radiated Spurious Emission Measurements



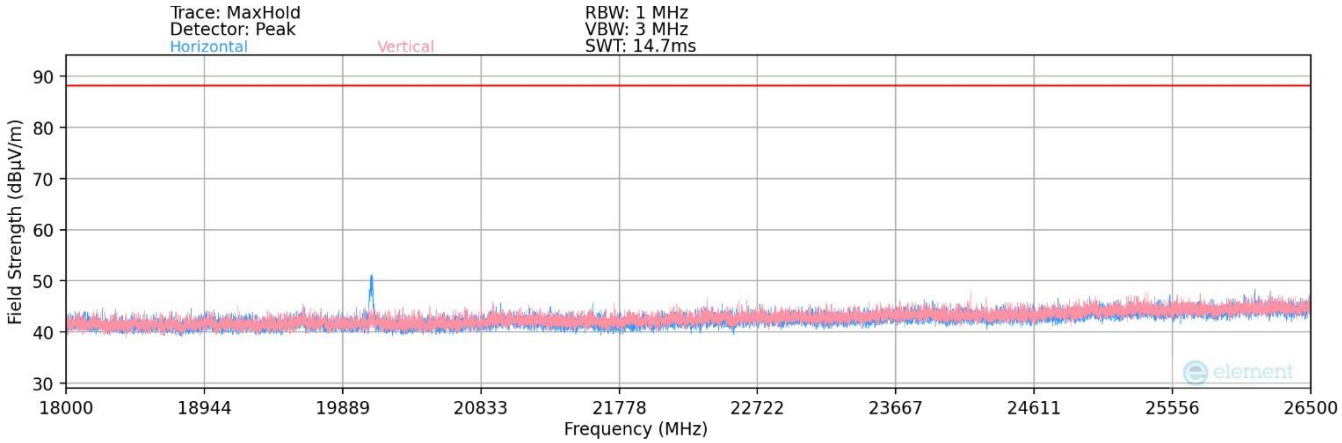
Plot 7-1. Radiated Spurious Plot below 1GHz MIMO (802.11be – Ch.49)



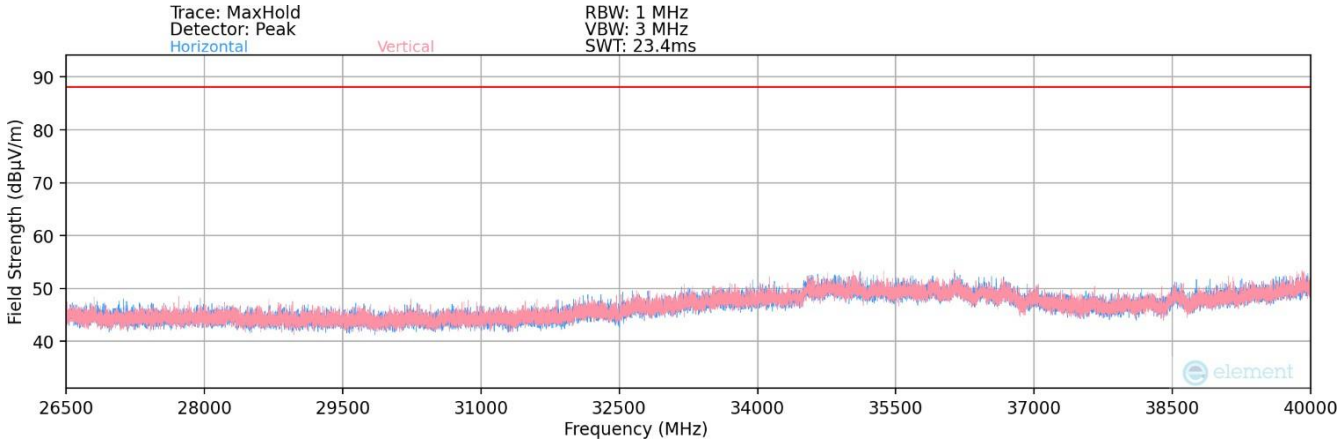
Plot 7-2. Radiated Spurious Plot 1GHz – 18GHz MIMO (802.11be – UNII Band 5 Ch. 49 52T)



Plot 7-3. Radiated Spurious Plot 1GHz – 18GHz MIMO (802.11be – UNII Band 7 Ch. 149 52T)



Plot 7-4. Radiated Spurious Plot 18GHz - 26.5GHz (802.11be (20MHz 52T) Ch.149)



Plot 7-5. Radiated Spurious Plot 26.5GHz - 40GHz (802.11be(20MHz 52T) Ch.149)

MIMO Radiated Spurious Emission Measurements – UNII Band 5

Worst Case Mode: 802.11be
Worst Case Transfer Rate: MCS0
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 6175MHz
Channel: 45

Mode	Antenna	UNII Band	Channel	Test Channel Freq. [MHz]	RU Index	Restricted	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
802.11be RU 52T	MIMO	5	45	6175	39	*	12350.00	Average	H	117	160	-83.56	20.21	0.00	43.65	53.98	-10.33
						*	12350.00	Peak	H	117	160	-69.43	20.21	0.00	57.78	73.98	-16.20
						*	18525.00	Average	H	-	-	-65.05	1.00	-9.54	33.40	53.98	-20.58
						*	18525.00	Peak	H	-	-	-55.00	1.00	-9.54	43.46	73.98	-30.52
							24700.00	Peak	H	-	-	-57.02	4.23	-9.54	44.67	68.20	-23.53
							30875.00	Peak	H	-	-	-57.73	5.66	-9.54	45.39	68.20	-22.81

Table 7-3. Radiated Measurements MIMO

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]
200.00	Quasi-Peak	V	-	-	-71.59	-13.60	21.81	43.52	-21.71

Table 7-4. Radiated Measurements MIMO below 1GHz

Worst Case Mode: 802.11ax
Worst Case Transfer Rate: MCS0
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 6105MHz
Channel: 31

Mode	Antenna	UNII Band	Channel	Test Channel Freq. [MHz]	Restricted	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
802.11be	MIMO	5	31	6105	*	12210.00	Average	H	-	-	-88.01	0.00	41.45	53.98	-12.53
					*	12210.00	Peak	H	-	-	-75.22	0.00	54.24	73.98	-19.74
					*	18315.00	Average	H	-	-	-66.45	-9.54	32.19	53.98	-21.79
					*	18315.00	Peak	H	-	-	-56.54	-9.54	42.10	73.98	-31.88
						24420.00	Peak	H	-	-	-55.17	-9.54	46.04	68.20	-22.16
						30525.00	Peak	H	-	-	-54.98	-9.54	48.45	68.20	-19.75

Table 7-5. Radiated Measurements MIMO

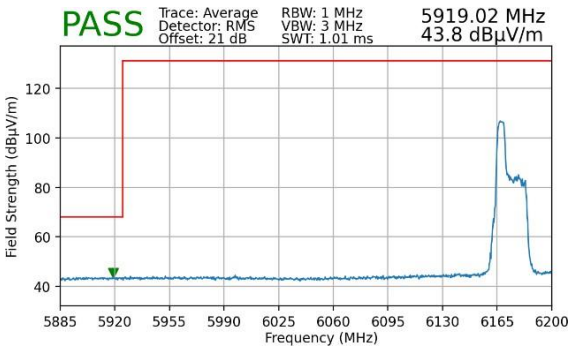
Worst Case Mode:	802.11be
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	6695MHz
Channel:	149

Mode	Antenna	UNII Band	Channel	Test Channel Freq. [MHz]	Restricted	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
802.11a	MIMO	7	149	6695	*	13390.00	Average	H	-	-	-87.22	25.25	0.00	45.03	53.98	-8.95
					*	13390.00	Peak	H	-	-	-76.73	25.25	0.00	55.52	73.98	-18.46
					*	20085.00	Average	H	150	30	-55.23	2.07	-9.54	44.30	53.98	-9.68
					*	20085.00	Peak	H	150	30	-42.32	2.07	-9.54	57.21	73.98	-16.77
						26780.00	Peak	H	-	-	-51.06	5.18	-9.54	51.58	68.20	-16.62
						33475.00	Peak	H	-	-	-52.38	8.48	-9.54	53.56	68.20	-14.64

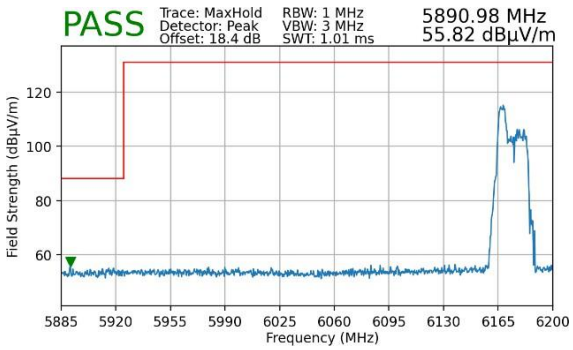
Table 7-6. Radiated Measurements MIMO

7.2.2 MIMO Band Edge Measurements (20MHz BW)

Worst Case Mode:	802.11be
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	6175MHz
Channel:	45
RU:	37

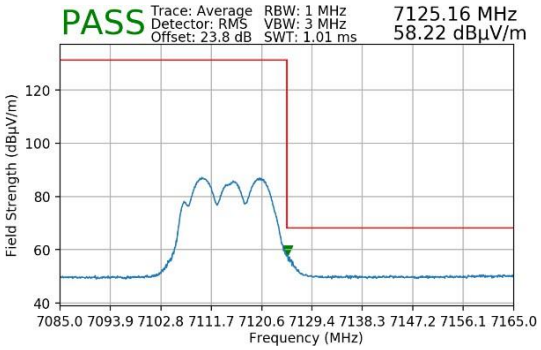


Plot 7-6. Lower Band Edge Plot MIMO (Average – UNII Band 5)

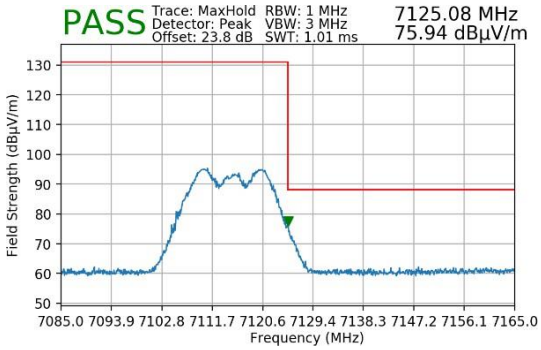


Plot 7-7. Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	7115MHz
Channel:	233



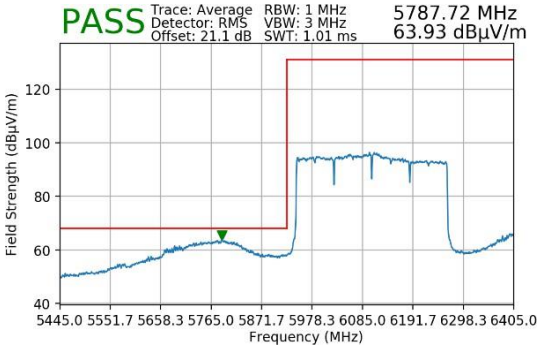
Plot 7-8. Upper Band Edge Plot MIMO (Average – UNII Band 8)



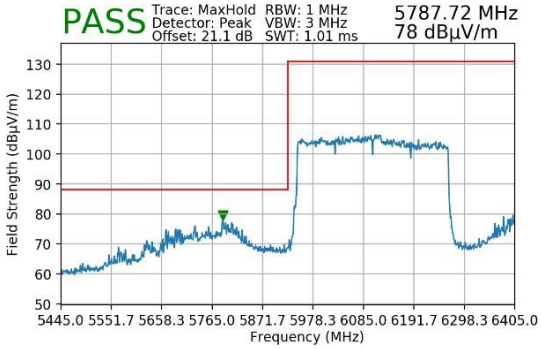
Plot 7-9. Upper Band Edge Plot MIMO (Peak – UNII Band 8)

7.2.3 MIMO Band Edge Measurements (320MHz BW)

Worst Case Mode:	802.11be
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	6105MHz
Channel:	31

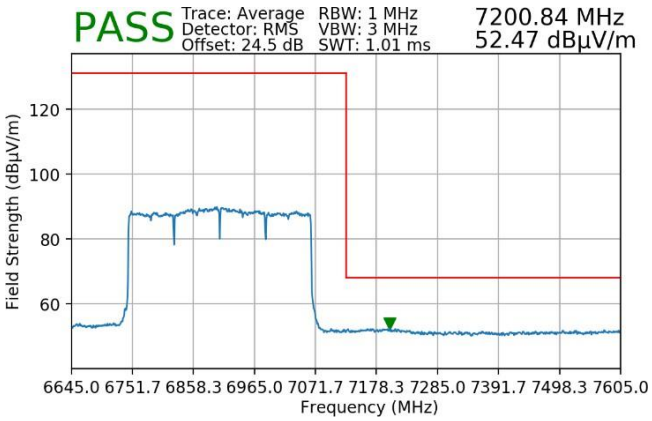


Plot 7-10. Lower Band Edge Plot MIMO (Average – UNII Band 5)

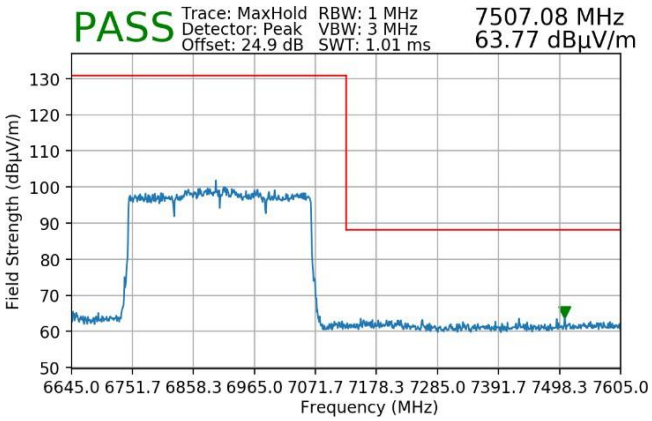


Plot 7-11. Lower Band Edge Plot MIMO (Peak – UNII Band 5)

Worst Case Mode:	802.11be
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	6905MHz
Channel:	191



Plot 7-12. Upper Band Edge Plot MIMO (Average – UNII Band 8)



Plot 7-13. Upper Band Edge Plot MIMO (Peak – UNII Band 8)

7.3 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 Section 15.207.

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

Table 7-7. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10:2020, 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.

Test Setup

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

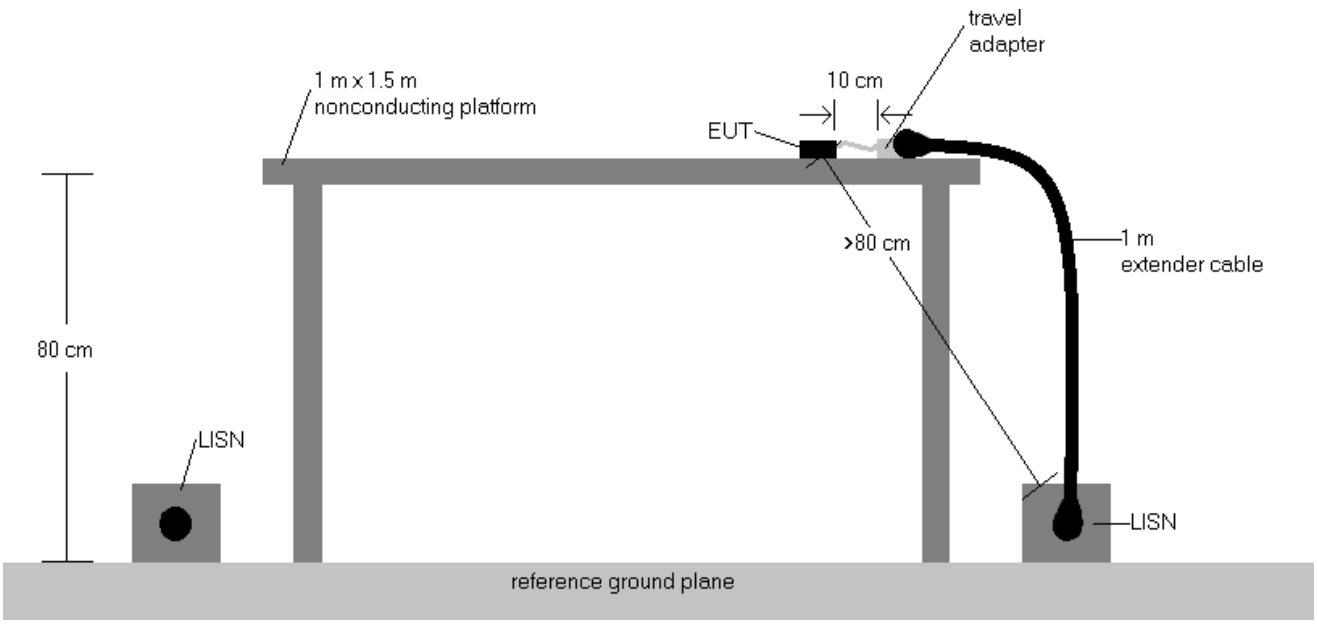
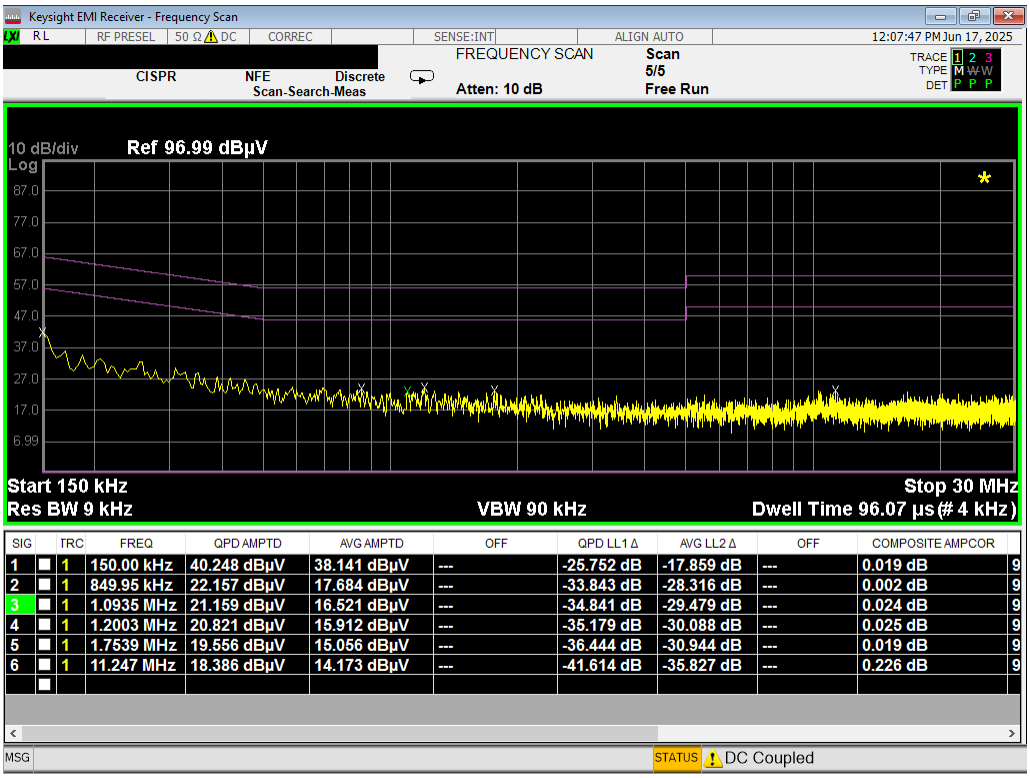


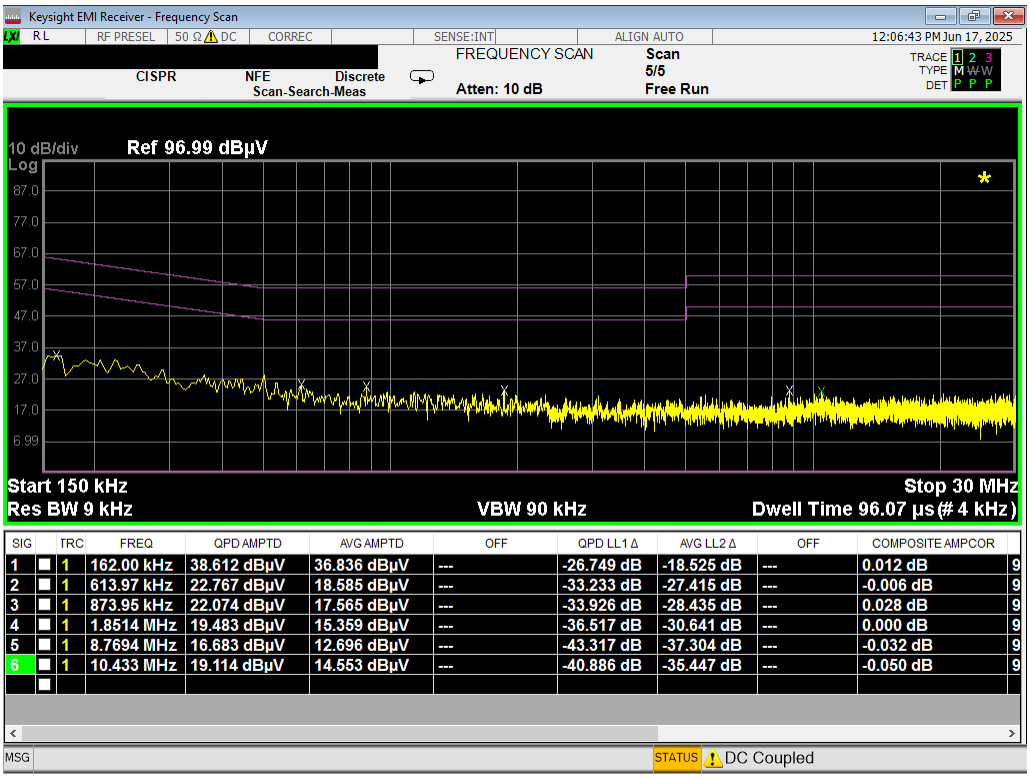
Figure 7-5. Test Instrument & Measurement Setup

Test Notes

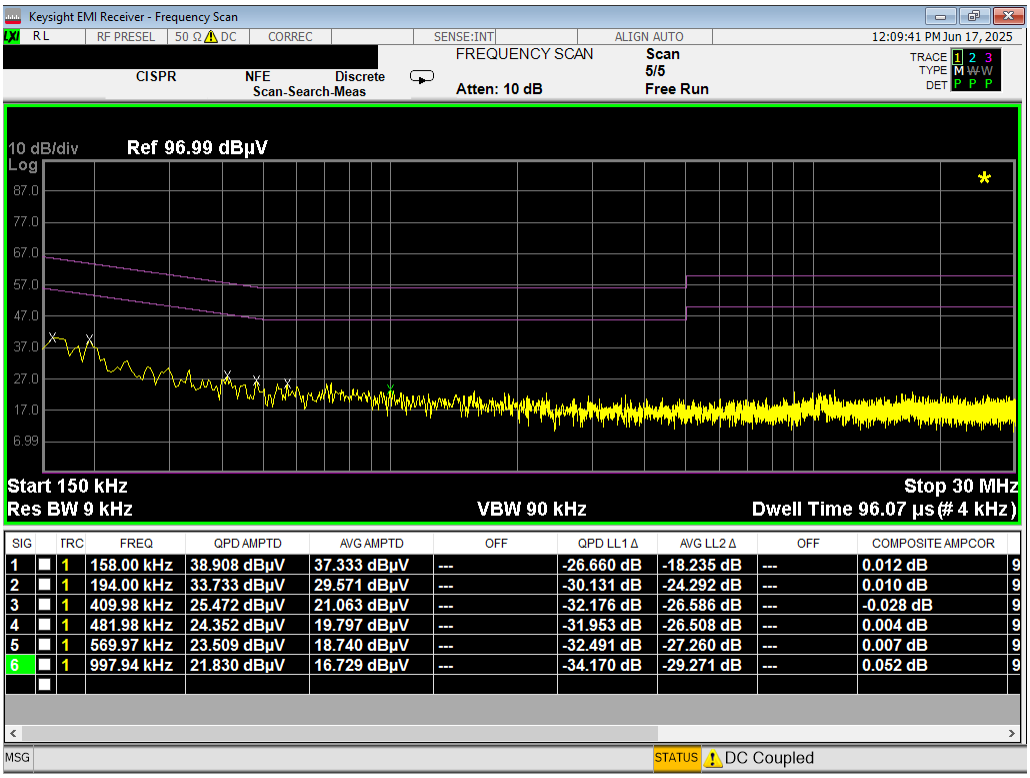
1. All modes of operation were investigated, and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz is specified in 15.207.
3. Corr. (dB) = Cable loss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



Plot 7-14. Line Conducted Plot with 802.11a UNII Band 5 – Ch.45 (L1)

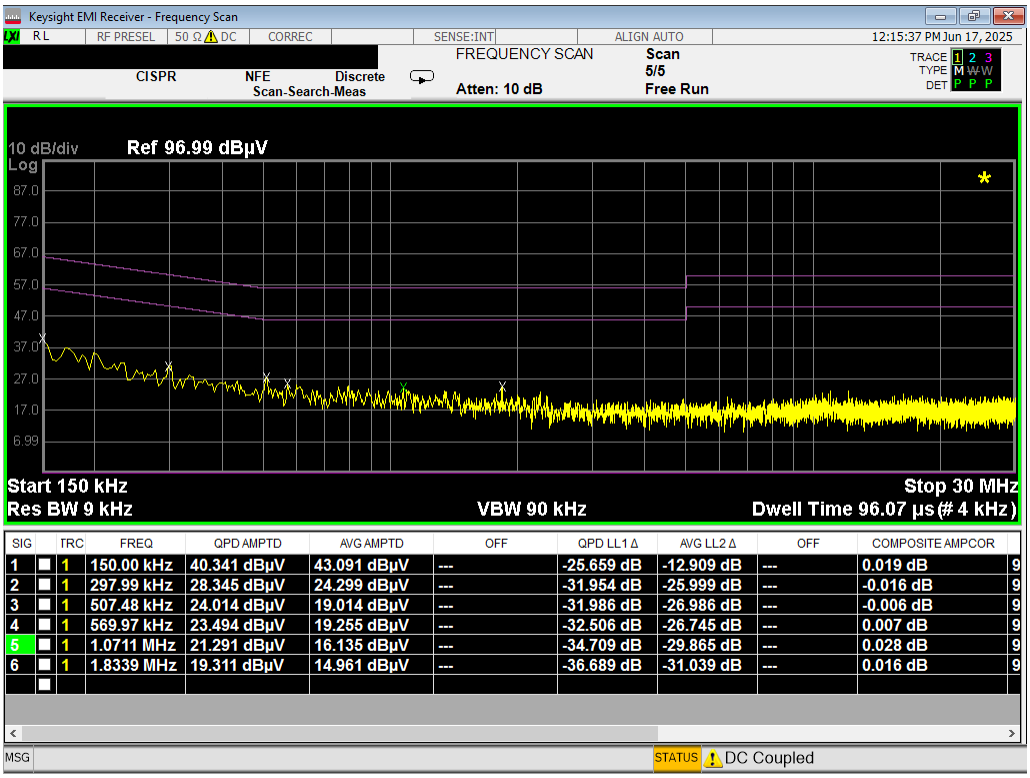


Plot 7-15. Line Conducted Plot with 802.11a UNII Band 5 – Ch.45 (N)



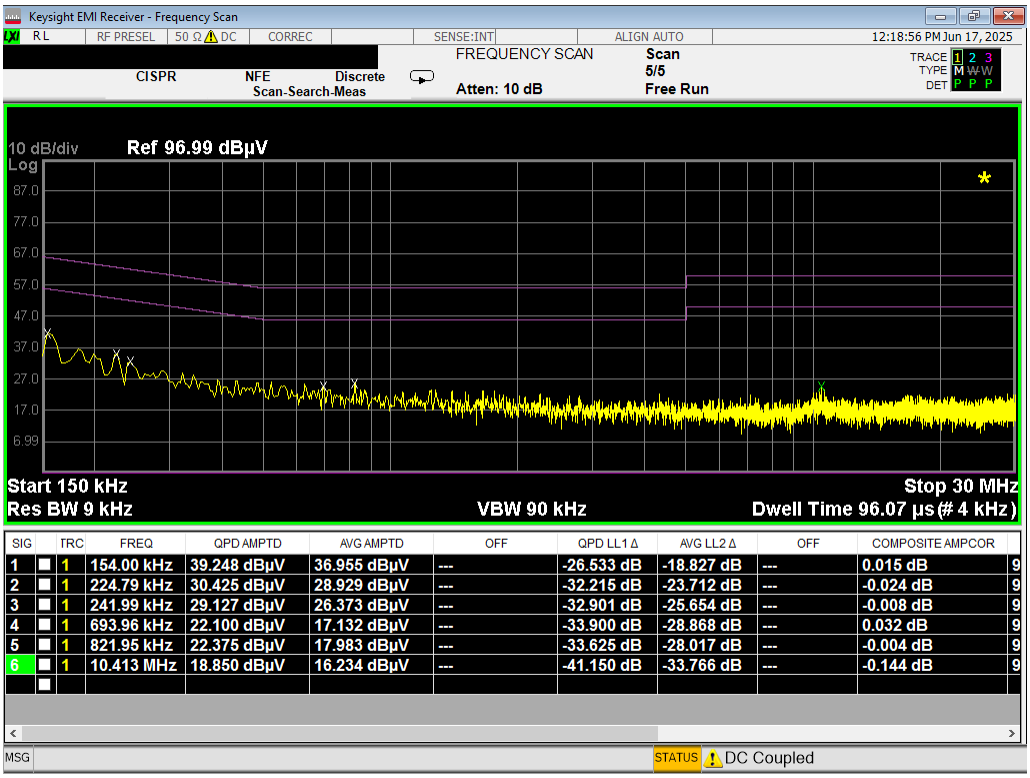
SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR	
1	1	158.00 kHz	38.908 dBµV	37.333 dBµV	---	-26.660 dB	-18.235 dB	---	0.012 dB	9
2	1	194.00 kHz	33.733 dBµV	29.571 dBµV	---	-30.131 dB	-24.292 dB	---	0.010 dB	9
3	1	409.98 kHz	25.472 dBµV	21.063 dBµV	---	-32.176 dB	-26.586 dB	---	-0.028 dB	9
4	1	481.98 kHz	24.352 dBµV	19.797 dBµV	---	-31.953 dB	-26.508 dB	---	0.004 dB	9
5	1	569.97 kHz	23.509 dBµV	18.740 dBµV	---	-32.491 dB	-27.260 dB	---	0.007 dB	9
6	1	997.94 kHz	21.830 dBµV	16.729 dBµV	---	-34.170 dB	-29.271 dB	---	0.052 dB	9

Plot 7-16. Line Conducted Plot with 802.11a UNII Band 6 – Ch.105 (L1)

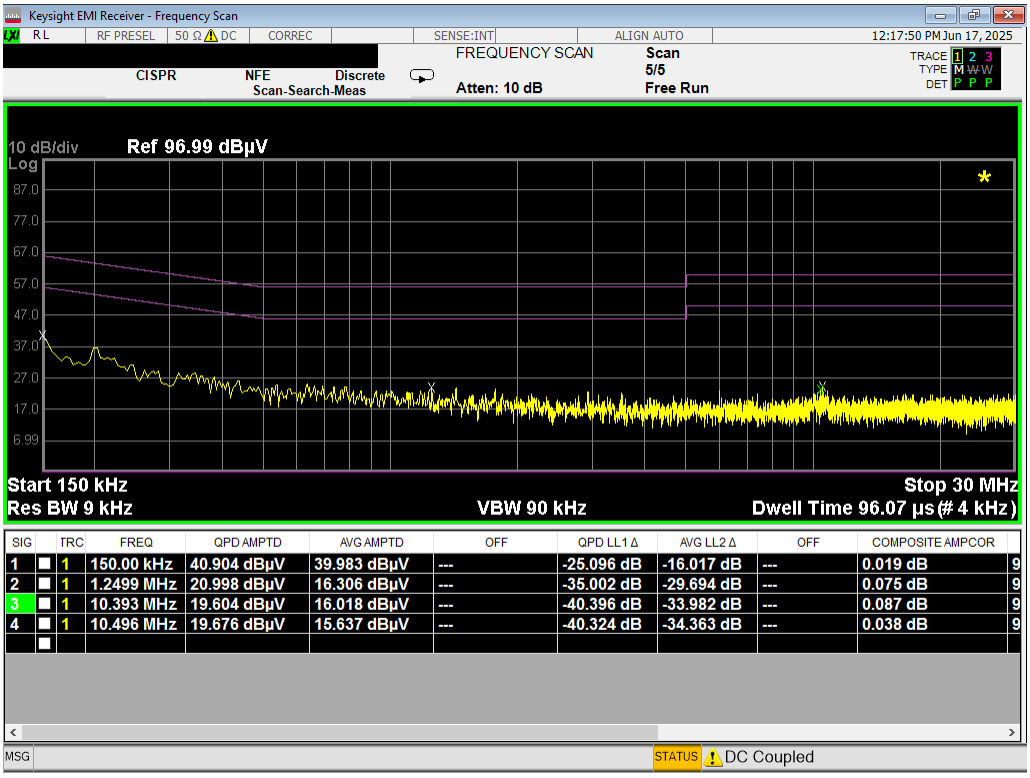


SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR	
1	1	150.00 kHz	40.341 dBµV	43.091 dBµV	---	-25.659 dB	-12.909 dB	---	0.019 dB	9
2	1	297.99 kHz	28.345 dBµV	24.299 dBµV	---	-31.954 dB	-25.999 dB	---	-0.016 dB	9
3	1	507.48 kHz	24.014 dBµV	19.014 dBµV	---	-31.986 dB	-26.986 dB	---	-0.006 dB	9
4	1	569.97 kHz	23.494 dBµV	19.255 dBµV	---	-32.506 dB	-26.745 dB	---	0.007 dB	9
5	1	1.0711 MHz	21.291 dBµV	16.135 dBµV	---	-34.709 dB	-29.865 dB	---	0.028 dB	9
6	1	1.8339 MHz	19.311 dBµV	14.961 dBµV	---	-36.689 dB	-31.039 dB	---	0.016 dB	9

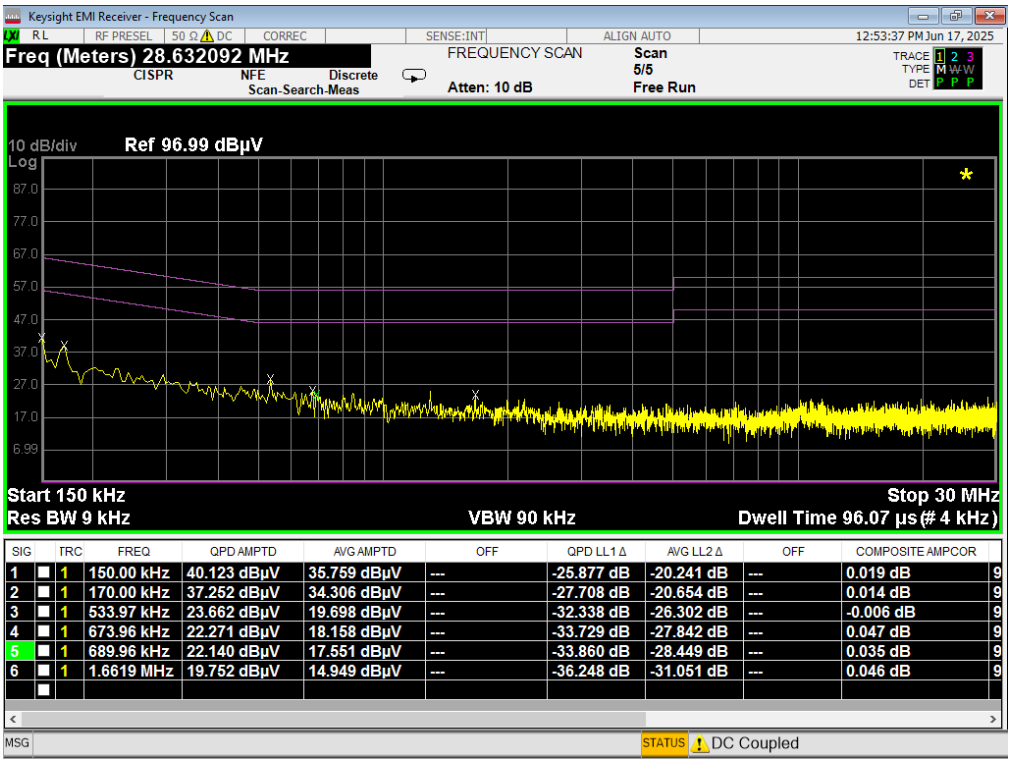
Plot 7-17. Line Conducted Plot with 802.11a UNII Band 6 – Ch.105 (N)



Plot 7-18. Line Conducted Plot with 802.11a UNII Band 7 – Ch.149 (L1)

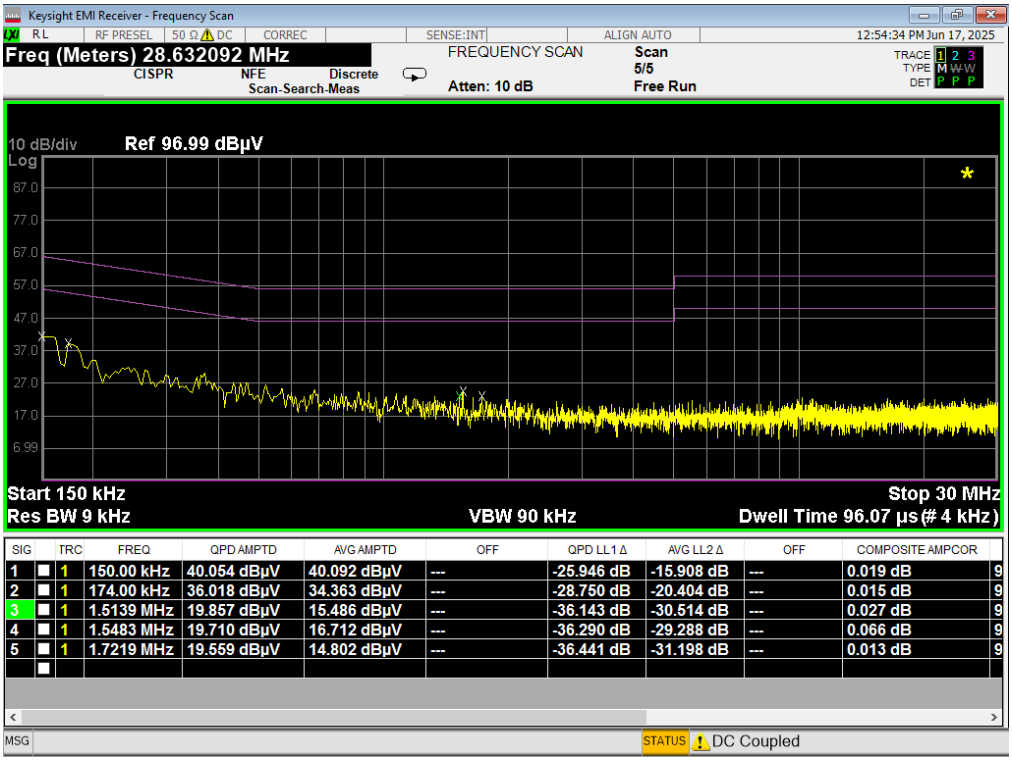


Plot 7-19. Line Conducted Plot with 802.11a UNII Band 7 – Ch.149 (N)



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR	
1	1	150.00 kHz	40.123 dBµV	35.759 dBµV	---	-25.877 dB	-20.241 dB	---	0.019 dB	9
2	1	170.00 kHz	37.252 dBµV	34.306 dBµV	---	-27.708 dB	-20.654 dB	---	0.014 dB	9
3	1	533.97 kHz	23.662 dBµV	19.698 dBµV	---	-32.338 dB	-26.302 dB	---	-0.006 dB	9
4	1	673.96 kHz	22.271 dBµV	18.158 dBµV	---	-33.729 dB	-27.842 dB	---	0.047 dB	9
5	1	689.96 kHz	22.140 dBµV	17.551 dBµV	---	-33.860 dB	-28.449 dB	---	0.035 dB	9
6	1	1.6619 MHz	19.752 dBµV	14.949 dBµV	---	-36.248 dB	-31.051 dB	---	0.046 dB	9

Plot 7-20. Line Conducted Plot with 802.11a UNII Band 8 – Ch.209 (L1)



SIG	TRC	FREQ	QPD AMPTD	AVG AMPTD	OFF	QPD LL1 Δ	AVG LL2 Δ	OFF	COMPOSITE AMPCOR	
1	1	150.00 kHz	40.054 dBµV	40.092 dBµV	---	-25.946 dB	-15.908 dB	---	0.019 dB	9
2	1	174.00 kHz	36.018 dBµV	34.363 dBµV	---	-28.750 dB	-20.404 dB	---	0.015 dB	9
3	1	1.5139 MHz	19.857 dBµV	15.486 dBµV	---	-36.143 dB	-30.514 dB	---	0.027 dB	9
4	1	1.5483 MHz	19.710 dBµV	16.712 dBµV	---	-36.290 dB	-29.288 dB	---	0.066 dB	9
5	1	1.7219 MHz	19.559 dBµV	14.802 dBµV	---	-36.441 dB	-31.198 dB	---	0.013 dB	9

Plot 7-21. Line Conducted Plot with 802.11a UNII Band 8 – Ch.209 (N)

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Microsoft Module FCC: C3K00002102A** is in compliance with the relevant FCC rules for module integration into a host product.