UNIFIED COMPLIANCE LABORATORY

427 West 12800 South
Draper, UT 84020

Test Report

Certification

FCC ID	SWX-WAVEML
IC ID	6545A-WAVEML
Equipment Under Test	Wave-MLO5
Test Report Serial Number	TR9532_01
Date of Test(s)	13, 29 August and 4 September 2024
Report Issue Date	21 November 2024

Test Specification	Applicant
47 CFR FCC Part 15, Subpart C	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.

NVLAP TESTING ilac-MRA

NVLAP LAB CODE 600241-0

Certification of Engineering Report

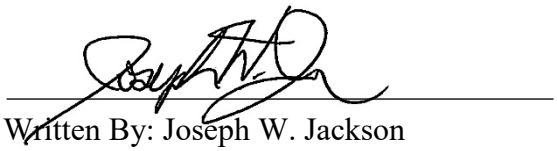
This report has been prepared by Unified Compliance Laboratory (UCL) to document compliance of the device described below with the requirement of Federal Communication Commissions (FCC) Part 15, Subpart C. This report may be reproduced in full. Partial reproduction of this report may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested with the specifications provided by the manufacturer.

Applicant	Ubiquiti Inc.
Manufacturer	Ubiquiti Inc.
Brand Name	UBIQUITI
Model Number	Wave-MLO5
FCC ID	SWX-WAVEML
IC ID	6545A-WAVEML

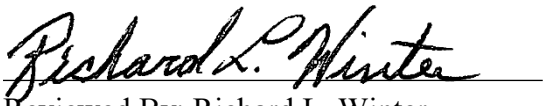
On this 21st day of November 2024, I individually and for Unified Compliance Laboratory certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge and are made in good faith.

Although NVLAP has accredited the Unified Compliance Laboratory testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the U.S. federal government.

Unified Compliance Laboratory



Written By: Joseph W. Jackson



Reviewed By: Richard L. Winter

Revision History		
Revision	**Description**	**Date**
01	Original Report Release	21 November 2024

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1 Client Information

1.1 Applicant

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Alex Macon
Title	Compliance

1.2 Manufacturer

Company	Ubiquiti Inc. 685 Third Avenue New York, NY 10017 U.S.A.
Contact Name	Alex Macon
Title	Compliance

2 Equipment Under Test (EUT)

2.1 Identification of EUT

Brand Name	UBIQUITI
Model Number	Wave-MLO5
Serial Number	2F2513
Dimensions (cm)	24.9 x 8.2 x 4.8

2.2 Description of EUT

The Wave-MLO5 is a 5 GHz point-to-point customer premise equipment which features wave technology with a high throughput rate. The 5 GHz radio supports U-NII-1, U-NII-2 and U-NII-3 bands. The Wave-MLO5 has Bluetooth LE transceiver for system management. The Wave-MLO5 is an outdoor device and has an Ethernet port which is used for data transfer and is powered using a Model POE-54-30W-10G-WH 54-volt PoE power adapter.

This report covers the circuitry of the Bluetooth device subject to FCC Part 15, Subpart C. The circuitry of the device subject to FCC Part 15 Subpart B was found to be compliant and is covered under a separate Unified Compliance Laboratory test report.

2.3 EUT and Support Equipment

The EUT and support equipment used during the test are listed below.

Brand Name **Model Number** **Serial Number**	**Description**	**Name of Interface Ports / Interface Cables**
BN: UBIQUITI MN: Wave-MLO5 SN: 2F2513	Wireless Access Point	See Section 2.4
BN: UBIQUITI MN: POE-54-30W-10G-WH SN: N/A	PoE Injector Power Supply	Shielded or Un-shielded Cat 5e cable (Note 2)
BN: Dell MN: XPS 13 SN: N/A	Laptop Computer	Shielded or Un-shielded Cat 5e cable (Note 2)

Notes: (1) EUT
(2) Interface port connected to EUT (See Section 2.4)

The support equipment listed above was not modified in order to achieve compliance with this standard.

2.4 Interface Ports on EUT

Name of Ports	No. of Ports Fitted to EUT	Cable Description/Length

AC (PoE Injector)	1	3 conductor power cord/80cm
LAN (PoE Injector)	1	Shielded or Un-shielded cat 5e cable/1 meter
Data	1	Shielded or Un-shielded cat 5e cable/1 meter

2.5 Operating Environment

Power Supply	120 Volts AC Mains to 54 Volts PoE
AC Mains Frequency	60 Hz
Temperature	21.1 – 22.7 °C
Humidity	23.7 – 30.8 %
Barometric Pressure	1012 mBar

2.6 Operating Modes

The Wave-MLO5 was connected to a personal computer laptop and tested using test software in order to enable to constant duty cycle greater or equal to 98% of the Bluetooth transceiver.

2.7 EUT Exercise Software

EUT firmware version 1.0 was used to operate the transmitter using a constant transmit mode.

2.8 Block Diagram of Test Configuration

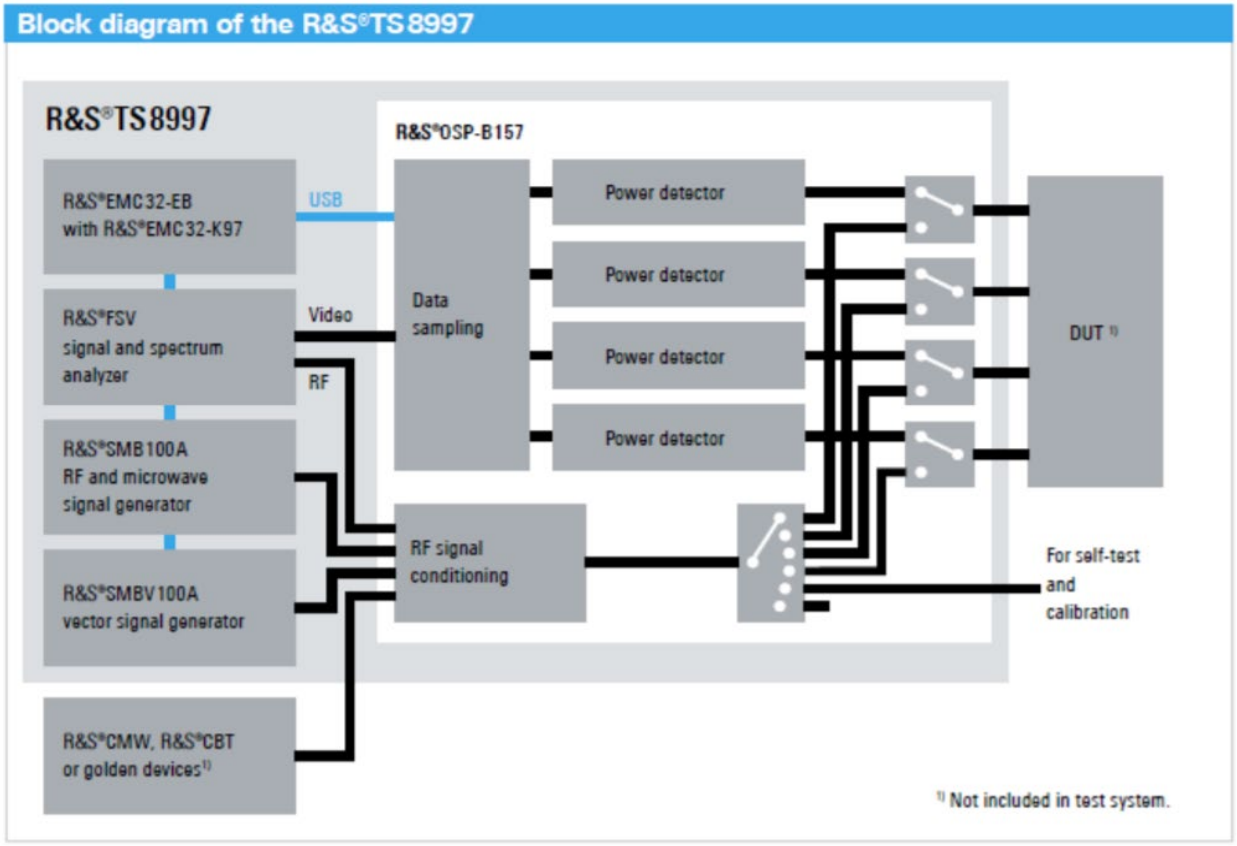


Diagram 1: Test Configuration Block Diagram

2.9 Modification Incorporated/Special Accessories on EUT

There were no modifications made to the EUT during testing to comply with the specification.

2.10 Deviation, Opinions Additional Information or Interpretations from Test Standard

There were no deviations, opinions, additional information or interpretations from the test specification.

3 Test Specification, Method and Procedures

3.1 Test Specification

Title	47 CFR FCC Part 15, Subpart C 15.203, 15.207 and 15.247 Limits and methods of measurement of radio interference characteristics of radio frequency devices.
Purpose of Test	The tests were performed to demonstrate initial compliance

3.2 Methods & Procedures

3.2.1 47 CFR FCC Part 15 Section 15.203

See test standard for details.

3.2.2 47 CFR FCC Part 15 Section 15.207

See test standard for details.

3.2.3 47 CFR FCC Part 15 Section 15.247

See test standard for details.

3.3 FCC Part 15, Subpart C

3.3.1 Summary of Tests

FCC Section	ISED Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.203	N/A	Antenna requirements	Structural Requirement	Compliant
15.207	RSS-Gen	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.247(a)	RSS-247 § 5.2	Bandwidth Requirement	2400 to 2483.5	Compliant
15.247(b)	RSS-247 § 5.4	Peak Output Power	2400 to 2483.5	Compliant
15.247(d)	RSS-247 § 5.4	Antenna Conducted Spurious Emissions	0.009 to 26000	N/A
15.247(d)	RSS-247 § 5.4	Radiated Spurious Emissions	0.009 to 26000	Compliant
15.247(e)	RSS-247 § 5.2	Peak Power Spectral Density	2400 to 2483.5	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074 and 47 CFR Part 15. Where applicable, KDB 662911 was followed to sum required measurements.				

3.4 Results

In the configuration tested, the EUT complied with the requirements of the specification.

3.5 Test Location

Testing was performed at the Unified Compliance Laboratory 3-Meter and 10-Meter chambers located at 427 West 12800 South, Draper, UT 84020. Unified Compliance Laboratory is accredited by National Voluntary Laboratory Accreditation Program (NVLAP); NVLAP Code 600241-0 which is effective until 30 June 2025. This site has also been registered with Innovations, Science and Economic Development (ISED) department and was accepted under Appendix B, Phase 1 procedures of the APEC Tel MRA for Canadian recognition. ISED No.: 25346, effective until 30 June 2025.

Unified Compliance Laboratory has been assigned Designation Number US5037 by the FCC and Conformity Assessment Number US0223 by ISED.

4 Test Equipment

4.1 Conducted Emissions at Mains Ports

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	AFJ	FFT3010	UCL-6754	1/23/2024	2/26/2025
LISN	AFJ	LS16C/10	UCL-2512	7/08/2024	7/08/2025
ISN	Teseq	ISN T800	UCL-2974	7/09/2024	7/09/2025
LISN	AFJ	LS16C\10	UCL-6749	1/29/2024	1/29/2025
AC Power Source	Laplace Instruments	AC1000A	UCL-2857	N/A	N/A
Test Software	UCL	Revision 1	UCL-3107	N/A	N/A

Table 1: List of equipment used for Conducted Emissions Testing at Mains Port

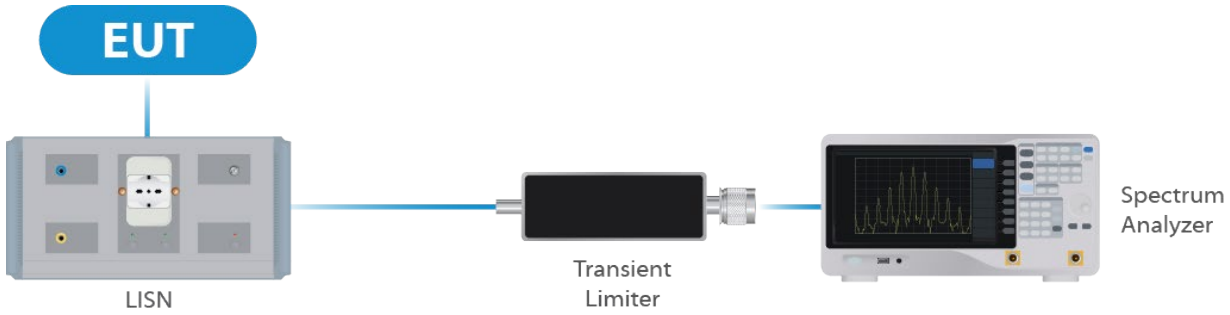


Figure 1: Conducted Emissions Test

4.2 Direct Connect at the Antenna Port Tests

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
Spectrum Analyzer	R&S	FSV40	UCL-2861	11/27/2023	12/22/2024
Signal Generator	R&S	SMB100A	UCL-2864	N/A	N/A
Vector Signal Generator	R&S	SMBV100A	UCL-2873	N/A	N/A
Switch Extension	R&S	OSP-B157WX	UCL-2867	4/12/2024	4/19/2025
Switch Extension	R&S	OSP-150W	UCL-2870	4/12/2024	4/19/2025

Table 2: List of equipment used for Direct Connect at the Antenna Port

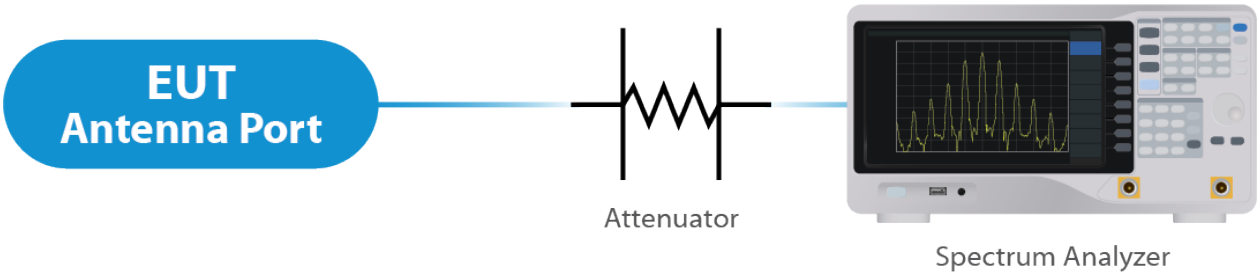


Figure 2: Direct Connect at the Antenna Port Test

4.3 Radiated Emissions

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	Keysight	N9038A	UCL-2778	1/25/2024	1/29/2025
Pre-Amplifier 9 kHz – 1 GHz	Sonoma Instruments	310N	UCL-2889	1/19/2024	1/19/2026
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3062	2/22/2023	2/22/2025
Broadband Antenna	Scwarzbeck	VULB 9163	UCL-3071	1/11/2023	1/11/2025
Double Ridge Horn Antenna	Scwarzbeck	BBHA 9120D	UCL-3065	3/10/2023	3/10/2025
Log Periodic	Scwarzbeck	STLP 9129	UCL-3068	1/27/2023	1/27/2025
15 - 40 GHz Horn Antenna	Scwarzbeck	BBHA 9170	UCL-2487	3/10/2023	3/10/2025
1 – 18 GHz Amplifier	Com-Power	PAM 118A	UCL-3833	1/19/2024	1/19/2026
Test Software	UCL	Revision 1	UCL-3108	N/A	N/A

Table 3: List of equipment used for Radiated Emissions

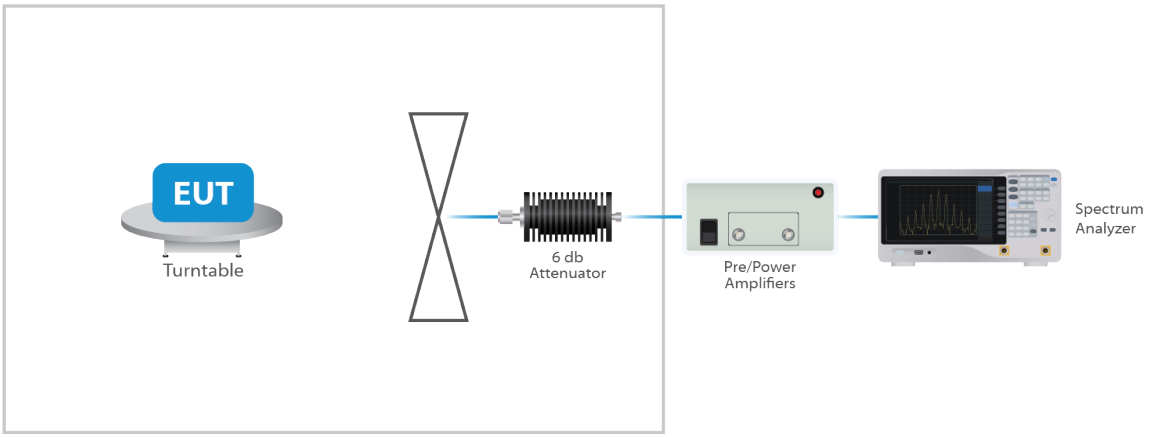


Figure 3: Radiated Emissions Test

4.4 Equipment Calibration

All applicable equipment is calibrated using either an independent calibration laboratory or Unified Compliance Laboratory personnel at intervals defined in ANSI C63.4:2014 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to traceability is on file and is available for examination upon request.

4.5 Measurement Uncertainty

Test	Uncertainty (± dB)	Confidence (%)
Conducted Emissions	1.44	95
Radiated Emissions (9 kHz to 30 MHz)	2.50	95
Radiated Emissions (30 MHz to 1 GHz)	4.38	95
Radiated Emissions (1 GHz to 18 GHz)	4.37	95
Radiated Emissions (18 GHz to 40 GHz)	3.93	95
Direct Connect Tests	**K Factor**	**Value**
Emissions Bandwidth	2	2.0%
Output Power	2	1.0 dB
Peak Power Spectral Density	2	1.3 dB
Band Edge	2	0.8 dB
Transmitter Spurious Emissions	2	1.8 dB

5 Test Results

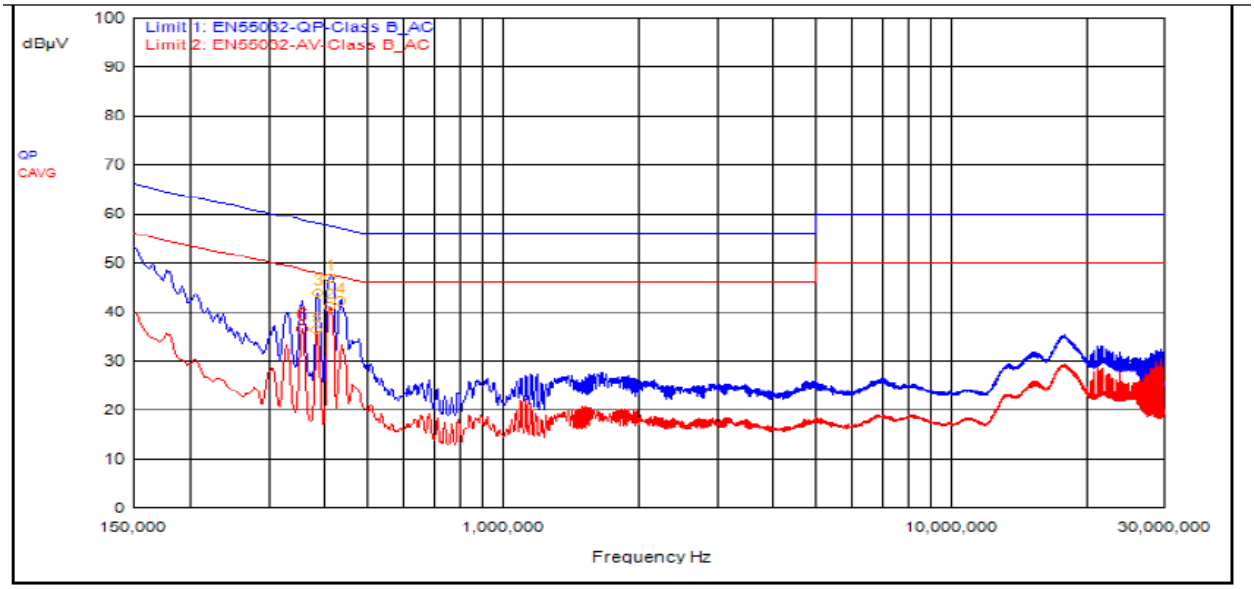
5.1 §15.203 Antenna Requirements

The Bluetooth portion of the DUT uses an internal integrated. As per the manufacturer, the Maximum gain of the antenna is -1 dBi. The antenna is not user replaceable.

Results

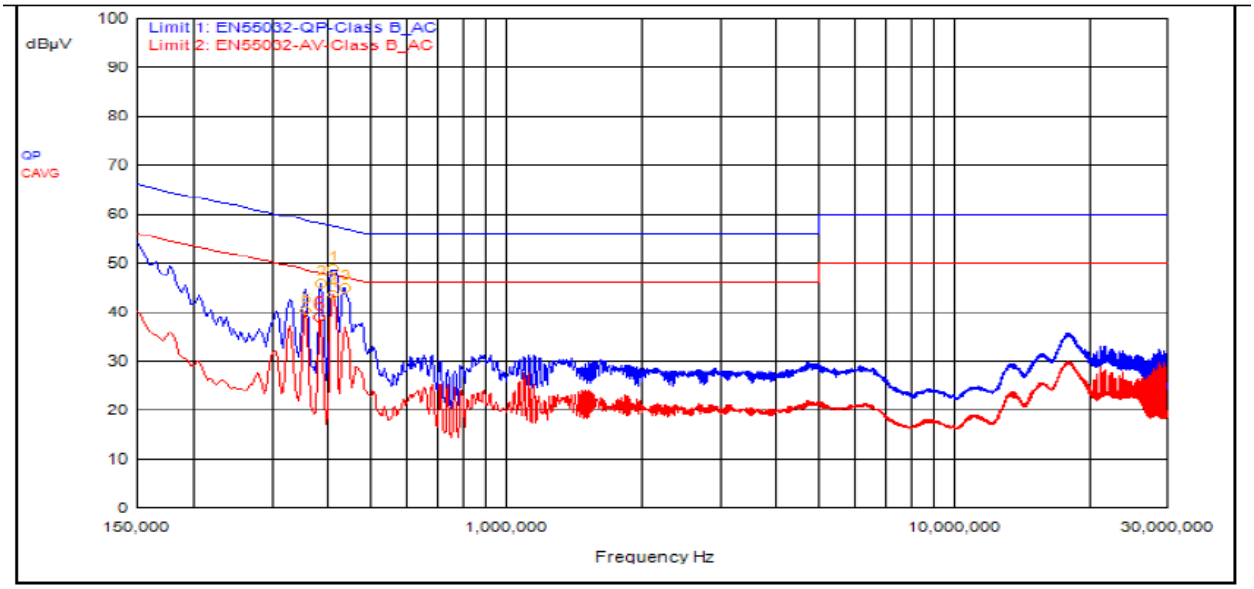
The EUT complied with the specification

5.2 Conducted Emissions at Mains Ports Data



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.	P/F
MU	MHz	dB	dB	dB	Type	dBµV	dBµV	dBµV	dB	dBµV	dB	P/F
1	411,000kHz	9.63			QPeak	37.40	47.03	57.63	-10.60			
3	387,000kHz	9.63			QPeak	34.35	43.98	58.13	-14.15			
4	432,000kHz	9.64			QPeak	32.63	42.27	57.21	-14.95			
2	411,000kHz	9.63			C_AVG	31.42	41.05			47.63	-6.58	
5	384,000kHz	9.63			C_AVG	26.89	36.52			48.19	-11.67	
6	357,000kHz	9.63			C_AVG	27.08	36.71			48.80	-12.09	

Graph 1: Conducted Emissions Plot - Neutral



ID	Frequency	Probe	Cable	Atten.	Detector	Meter Read	Meas Level	Limit 1	Limit 1 Dist.	Limit 2	Limit 2 Dist.	P/F
MU	MHz	dB	dB	dB	Type	dBµV	dBµV	dBµV	dB	dBµV	dB	P/F
1	411,000kHz	9.49			QPeak	39.26	48.75	57.63	-8.88			
3	435,000kHz	9.49			QPeak	35.61	45.10	57.16	-12.06			
2	387,000kHz	9.48			QPeak	36.48	45.96	58.13	-12.16			
4	411,000kHz	9.49			C_AVG	33.99	43.48			47.63	-4.15	
5	357,000kHz	9.48			C_AVG	30.67	40.15			48.80	-8.65	
6	384,000kHz	9.48			C_AVG	29.47	38.95			48.19	-9.24	

Graph 2: Conducted Emissions Plot – Line 1

Result

The EUT complied with the specification limit.

5.3 §15.247(a)(2) Emissions Bandwidth

Frequency (MHz)	Emissions 6 dB Bandwidth (MHz)	Emissions 99% Bandwidth (MHz)
2402	0.65	1.0
2442	0.67	1.0
2480	0.67	1.0

Result

In the configuration tested, the 6 dB bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plot within the Annex).

5.4 §15.247(b)(3) Maximum Average Output Power

The maximum average RF conducted output power measured for this device was 6.58 dBm or 4.55 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The antenna has a gain of -1 dBi.

Frequency (MHz)	Measured Output Power (dBm)	Output Power (mW)
2402	5.88	3.87
2442	6.52	4.49
2480	6.58	4.55

Result

In the configuration tested, the maximum average RF output power was less than 1 watt; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plot within the Annex).

5.5 §15.247(d) Spurious Emissions

5.5.1 Conducted Spurious Emissions

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The table show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown within the Annex are plot(s) with the EUT tuned to the upper and lower channels. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be attenuated 30 dB below the highest power spectral density level measured within the authorized band as measured with a 100 kHz RBW.

Result

Conducted spurious emissions were attenuated 30 dB or more below the fundamental; therefore, the EUT complies with the specification.

5.5.2 Radiated Spurious Emissions in the Restricted Bands of §15.205

The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emissions was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emissions that fell into the restricted bands of §15.205. The tables show the worst-case emissions measured from the EUT. For frequencies above 18.0 GHz, a measurement distance of 1 meter was used. The noise floor was a minimum of 6 dB below the limits. The emissions in the restricted bans must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. Plots of the band edges are also shown.

Correction Factor = Antenna Factor (dBi) + Cable Loss (dB) - Pre-Amplifier Gain (dB), and is added to the Receiver reading.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209; therefore, the EUT complies with the specification.

QuasiPeak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
31.30 MHz	39.85	40.0	-0.15	119	1	Vertical	-4.36
42.05 MHz	28.35	40.0	-11.65	295	1.97	Vertical	-11.55
282.57 MHz	31.96	47.0	-15.04	44	1.8	Horizontal	-9.99

Table 4: Radiated Emissions 30 – 1000 MHz

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
12.38 GHz	54.97	74.0	-19.03	83	1.834	Vertical	11.05
13.78 GHz	56.86	74.0	-17.14	211	1.643	Vertical	13.08
14.83 GHz	57.10	74.0	-16.60	359	1.638	Vertical	13.81
10.94 GHz	54.91	74.0	-19.09	303	1.5	Horizontal	11.51
13.93 GHz	58.35	74.0	-15.65	251	1.638	Horizontal	13.33
14.61 GHz	57.86	74.0	-16.14	350	1.643	Horizontal	14.14

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
12.38 GHz	41.71	54.0	-12.29	83	1.834	Vertical	11.05
13.78 GHz	43.71	54.0	-10.29	211	1.643	Vertical	13.08
14.83 GHz	44.29	54.0	-9.71	359	1.638	Vertical	13.81
10.94 GHz	42.03	54.0	-11.97	303	1.5	Horizontal	11.51
13.93 GHz	44.34	54.0	-9.66	251	1.638	Horizontal	13.33
14.61 GHz	44.73	54.0	-9.27	350	1.643	Horizontal	14.14

Table 5: Radiated Emissions 1 – 17 GHz Lowest Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
11.49 GHz	53.38	74.0	-20.62	57	3.798	Vertical	10.71
14.37 GHz	57.86	74.0	-16.14	181	1.838	Vertical	13.70
10.36 GHz	54.15	74.0	-19.85	110	3.802	Horizontal	9.19
10.95 GHz	54.84	74.0	-19.16	266	1.5	Horizontal	11.43
14.67 GHz	58.12	74.0	-15.88	248	1.643	Horizontal	14.28

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
11.49 GHz	40.39	54.0	-13.61	57	3.798	Vertical	10.71
14.37 GHz	44.50	54.0	-9.50	181	1.838	Vertical	13.70
10.36 GHz	43.21	54.0	-10.79	110	3.802	Horizontal	9.19
10.95 GHz	41.71	54.0	-12.29	266	1.5	Horizontal	11.43
14.67 GHz	44.99	54.0	-9.01	248	1.643	Horizontal	14.28

Table 6: Radiated Emissions 1 – 17 GHz Middle Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
14.46 GHz	57.07	74.0	-19.93	175	2.146	Vertical	13.53
10.36 GHz	55.73	74.0	-18.27	219	1.638	Horizontal	9.19
14.65 GHz	58.07	74.0	-15.93	280	2.142	Horizontal	14.24

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
14.46 GHz	44.21	54.0	-9.79	175	2.146	Vertical	13.53
10.36 GHz	46.72	54.0	-7.28	219	1.638	Horizontal	9.19
14.65 GHz	44.92	54.0	-9.08	280	2.142	Horizontal	14.24

Table 7: Radiated Emissions 1 – 17 GHz Highest Frequency

Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
16.59 GHz	51.22	74.0	-22.78	359	Vertical	1.36
22.93 GHz	50.56	74.0	-23.44	4	Vertical	0.88
23.34 GHz	51.51	74.0	-22.49	84	Vertical	1.63
18.36 GHz	50.74	74.0	-23.26	55	Horizontal	-0.01
22.98 GHz	55.98	74.0	-18.02	49	Horizontal	1.11
25.61 GHz	53.94	74.0	-20.06	346	Horizontal	3.73
25.84 GHz	52.30	74.0	-21.70	359	Horizontal	2.46

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
16.59 GHz	38.03	54.0	-15.97	359	Vertical	1.36
22.93 GHz	37.50	54.0	-16.50	4	Vertical	0.88
23.34 GHz	38.17	54.0	-15.83	84	Vertical	1.63
18.36 GHz	37.33	54.0	-16.67	55	Horizontal	-0.01
22.98 GHz	49.43	54.0	-4.57	49	Horizontal	1.11
25.61 GHz	40.56	54.0	-13.44	346	Horizontal	3.73
25.84 GHz	39.15	54.0	-14.85	359	Horizontal	2.46

Table 8: Radiated Emissions 17 – 40 GHz Lowest Frequency (worse case)

5.6 §15.247(e) Maximum Average Power Spectral Density

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. Results of this testing are summarized.

Frequency (MHz)	Measurement (dBm)	Criteria (dBm)
2402	2.40	8.0
2442	2.44	8.0
2480	2.48	8.0

Result

The maximum average power spectral density was less than the limit of 8 dBm; therefore, the EUT complies with the specification.

-- End of Test Report –