



427 West 12800 South
Draper, UT 84020

Test Report Certification

FCC ID	SWX-WAVEPC
IC ID	6545A-WAVEPC
Equipment Under Test	Wave-Pico
Test Report Serial Number	TR8648_03
Date of Test(s)	November 1 – 16, 2023
Report Issue Date	17 November 2023

Test Specification	Applicant
47 CFR FCC Part 15, Subpart C RSS-GEN	Ubiquiti Inc. 685 Third Avenue, 27 th Floor New York, NY 10019 U.S.A.



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.

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

On this 17th day of November 2023, 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.

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Unified Compliance Laboratory



Written By: Clay Allred



Reviewed By: Richard L. Winter

Revision History		
Revision	Description	Date
01	Original Report Release	17 November 2023
02	Amend Power Supply Model in Sections 2.2 and 2.3	19 December 2023
03	Amend Antenna Gain in Section 5.1	4 January 2024

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1 Client Information

1.1 Applicant

Company	Ubiquiti Inc. 685 Third Avenue, 27 th Floor New York, NY 10017 U.S.A.
Contact Name	Alex Macon
Title	Compliance

1.2 Manufacturer

Company	Ubiquiti Inc. 685 Third Avenue, 27 th Floor 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-Pico
Serial Number	A1A
Dimensions (cm)	15.2 x 15.2 x 5.6

2.2 Description of EUT

The Wave-Pico is a 60 GHz point-to-multipoint customer premise equipment that features wave technology with a high throughput rate. The Wave-Pico is also equipped with a 5 GHz WiFi 6 backup radio to sustain connectivity during a 60 GHz link disruption caused by inclement weather conditions. A Bluetooth LE transceiver is included for device management. The Wave-Pico is an outdoor device and has an Ethernet port which is used for data transfer and to provide power using a Model GP-H480-050G 48-volt PoE power adapter.

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-Pico (Note 1) SN: A1A	Wireless Access Point	See Section 2.4
BN: UBIQUITI MN: GP-H480-050G SN: N/A	PoE Power Adapter	Shielded or Un-shielded cat 5e cable
BN: Dell MN: XPS 13 SN: N/A	Laptop Computer	Shielded or Un-shielded cat 5e cable

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 Mains	1	3 conductor power cord/80cm
PoE (PoE Injector)	1	Shielded or Un-Shielded Cat 5e Cable/> 3 meters
LAN (PoE Injector)	1	Shielded or Un-Shielded Cat 5e Cable/> 3 Meters

2.5 Operating Environment

Power Supply	120 Volts ac to 48 Volts PoE
AC Mains Frequency	60 Hz
Temperature	21 - 24 °C
Humidity	17.57 – 33.6 %
Barometric Pressure	1019 mBar

2.6 Operating Modes

The Wave-Pico 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 WiFi 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

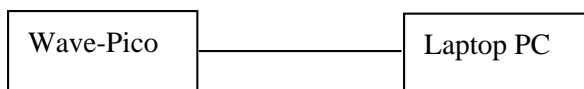


Diagram 1: Test Configuration Block Diagram

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 15.255 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 15.255

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
15.255 (e)	RSS-210 § J.4	Bandwidth Requirement	57000 - 71000	Compliant
15.255 (c)	RSS-210 § J.4	Peak Output Power	57000 - 71000	Compliant
15.255 (d)	RSS-210 § J.3	Antenna Conducted Spurious Emissions	0.009 to 40000	N/A
15.255 (d)	RSS-210 § J.3	Radiated Spurious Emissions	0.009 to 200000	Compliant
15.255 (c)	RSS-210 § J.4	Peak Power Spectral Density	57000 - 71000	Compliant
15.255 (f)	RSS-210 § J.6	Frequency Stability	57000 - 71000	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 558074 and 47 CFR Part 15.				

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 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 2024. 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 2024.

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-2500	7/13/2023	7/13/2024
LISN	AFJ	LS16C/10	UCL-2512	5/26/2023	5/26/2024
ISN	Teseq	ISN T800	UCL-2974	6/27/2022	6/27/2024
LISN	Com-Power	LIN-120C	UCL-2612	1/24/2023	1/24/2024
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

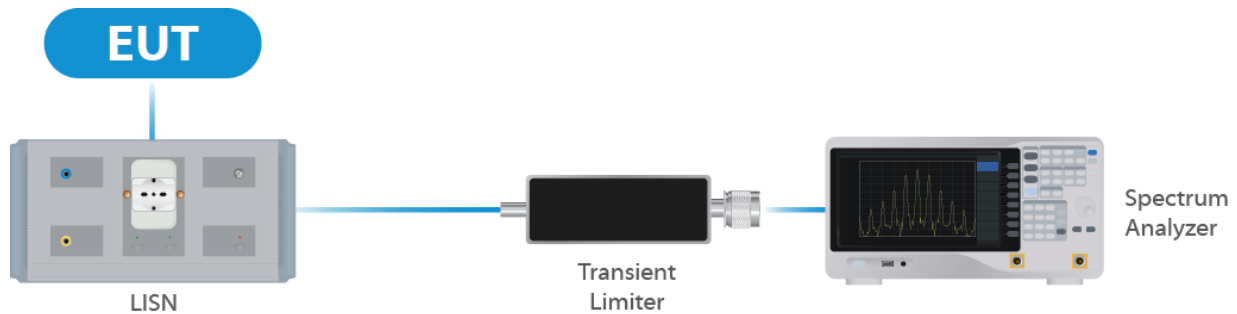


Figure 1: Conducted Emissions Test

4.2 Radiated Emissions

Type of Equipment	Manufacturer	Model Number	Asset Number	Date of Last Calibration	Due Date of Calibration
EMI Receiver	Keysight	N9038A	UCL-2778	1/27/2023	1/27/2024
Pre-Amplifier 9 kHz – 1 GHz	Sonoma Instruments	310N	UCL-2889	10/7/2021	12/7/2023
Double Ridge Horn Antenna	Com-Power	AH-118	UCL-5582	1/27/2023	1/27/2025
Log Periodic	Scwarzbeck	STLP 9129	UCL-3068	1/27/2023	1/27/2025
15 - 40 GHz Horn Antenna	ETS-Lindgren	3116C	UCL-7209	6/1/2022	6/6/2024
Pre-Amplifier 9 kHz – 1 GHz	Sonoma Instruments	310N	UCL-4793	12/01/2022	12/01/2023
Pre-Amplifier 1 – 18 GHz	Com-Power	PAM 118A	UCL-3833	12/9/2022	12/9/2023
Pre-Amplifier 1 – 18 GHz	The EMC Shop	PA18G	UCL-5896	7/6/2023	7/6/2024

Pre-Amplifier 15 – 40 GHz	L3 Harris	LNA-40-18004000-40-15P	UCL-4465	11/3/2021	11/3/2023
Test Software	UCL	Revision 1	UCL-3108	N/A	N/A
Conical Horn Antenna	VDI	WR15CH	UCL-5774	N/A	N/A
Conical Horn Antenna	VDI	WR12CH	UCL-4869	N/A	N/A
Conical Horn Antenna	VDI	WR19CH	UCL-4873	N/A	N/A
Conical Horn Antenna	VDI	WR5.1CH	UCL-4880	N/A	N/A
Conical Horn Antenna	VDI	WR8.0CH	UCL-4886	N/A	N/A
Spectrum Analyzer Extension Module	VDI	SAX 705	UCL-4887	N/A	N/A
Spectrum Analyzer Extension Module	VDI	SAX 706	UCL-4883	N/A	N/A
USB Switch	Keysight	U1816C	UCL-4957	N/A	N/A
Spectrum Analyzer	Keysight	N9041B	UCL-4964	1/15/2023	1/15/2024

Table 2: List of equipment used for Radiated Emissions

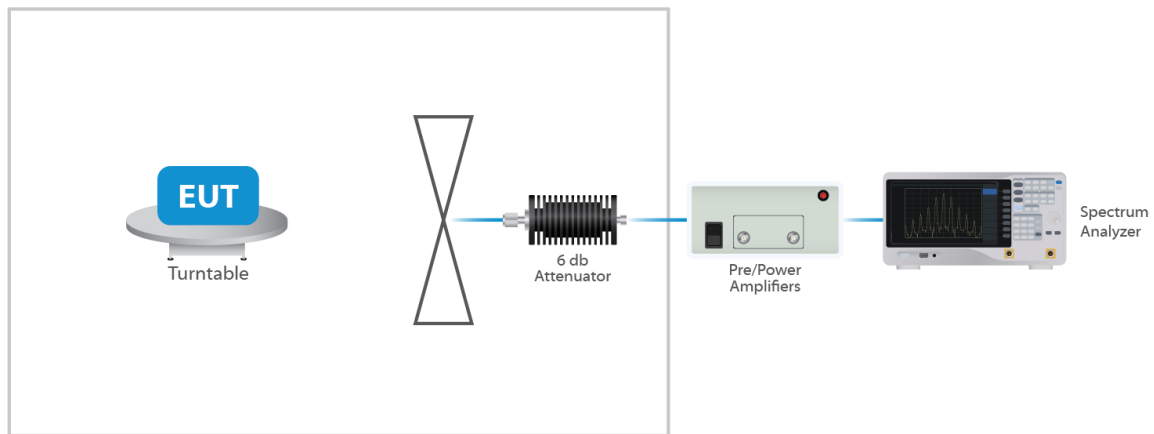


Figure 2: Radiated Emissions Test

4.3 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.

4.4 Measurement Uncertainty

Test	Uncertainty (\pm 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

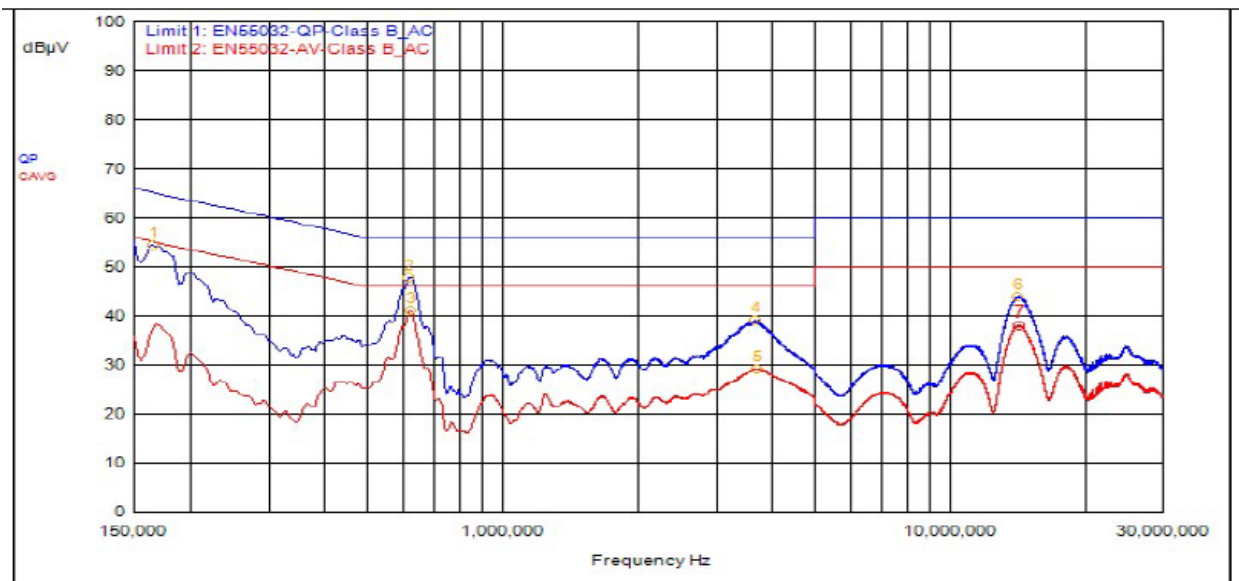
5.1 §15.203 Antenna Requirements

The EUT uses an internal patch antenna (Model #: 140-04449). As per the manufacturer the maximum gain of the antenna per chain is 27.7 dBi. This is an 802.11 device and utilizes CDD as described in KDB 662911 D01. The antenna is not user replaceable.

Results

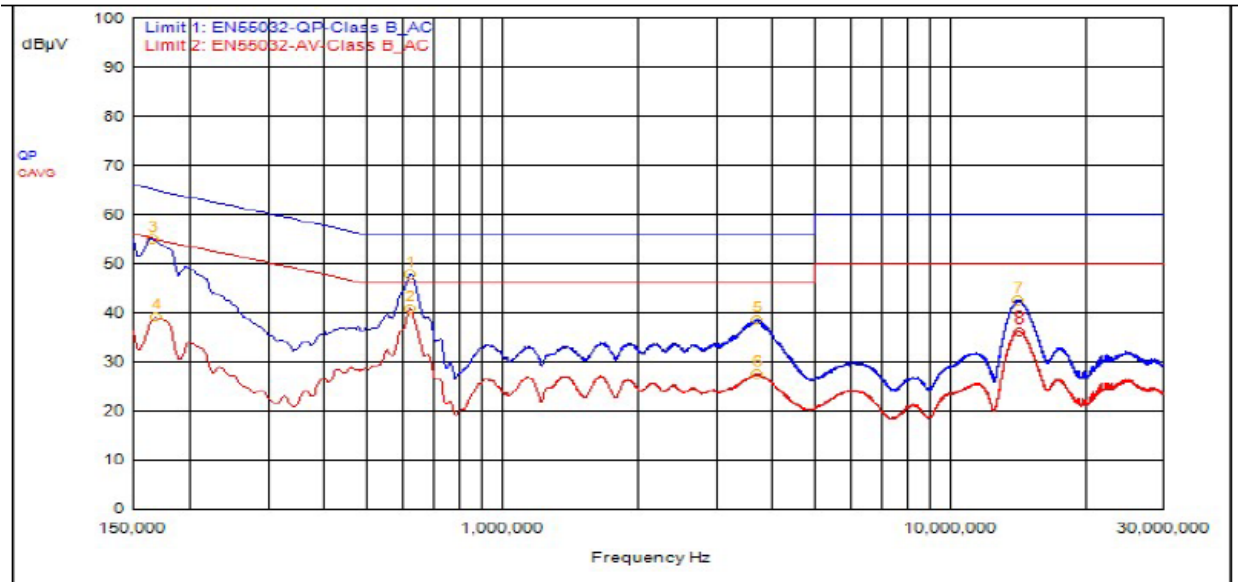
The EUT complied with the specification

5.1.1 Line



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
2	618,000kHz	9.50	0.00		QPeak	38.34	47.84	56.00	-8.16			
1	165,000kHz	9.49	0.00		QPeak	44.96	54.45	65.21	-10.75			
6	14.184	9.68	0.00		QPeak	34.09	43.77	60.00	-16.23			
4	3.678	9.58	0.00		QPeak	29.57	39.15	56.00	-16.85			
3	621,000kHz	9.50	0.00		C_AVG	31.60	41.10			46.00	-4.90	
5	3.711	9.58	0.00		C_AVG	19.58	29.16			46.00	-16.84	
7	14.226	9.68	0.00		C_AVG	28.27	37.95			50.00	-12.05	

5.1.2 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	624,000kHz	9.58	0.00		QPeak	38.13	47.71	56.00	-8.29			
3	165,000kHz	9.62	0.00		QPeak	45.42	55.04	65.21	-10.17			
7	14.208	9.73	0.00		QPeak	32.88	42.61	60.00	-17.39			
5	3.693	9.60	0.00		QPeak	28.90	38.50	56.00	-17.50			
2	624,000kHz	9.58	0.00		C_AVG	31.16	40.74			46.00	-5.26	
4	168,000kHz	9.62	0.00		C_AVG	29.41	39.03			55.06	-16.03	
6	3.699	9.60	0.00		C_AVG	17.93	27.53			46.00	-18.47	
8	14.226	9.73	0.00		C_AVG	26.46	36.19			50.00	-13.81	

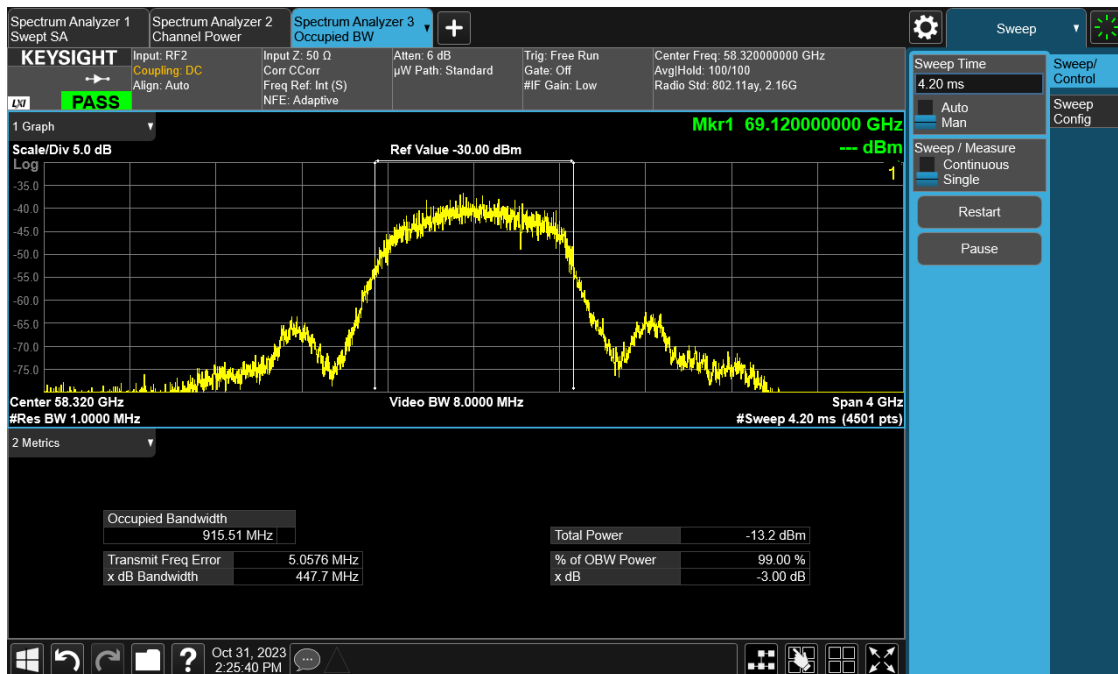
5.2 Emissions Bandwidth

Channel Width (GHz)	Frequency (MHz)	Emissions 99% Bandwidth (MHz)
1.06	58320	915.5
	63720	933.4
	70200	909.0
2.12	58320	1849.4
	63720	1815.9
	69120	1769.7

Result

All chains were tested and the highest bandwidth per chain is reported above.

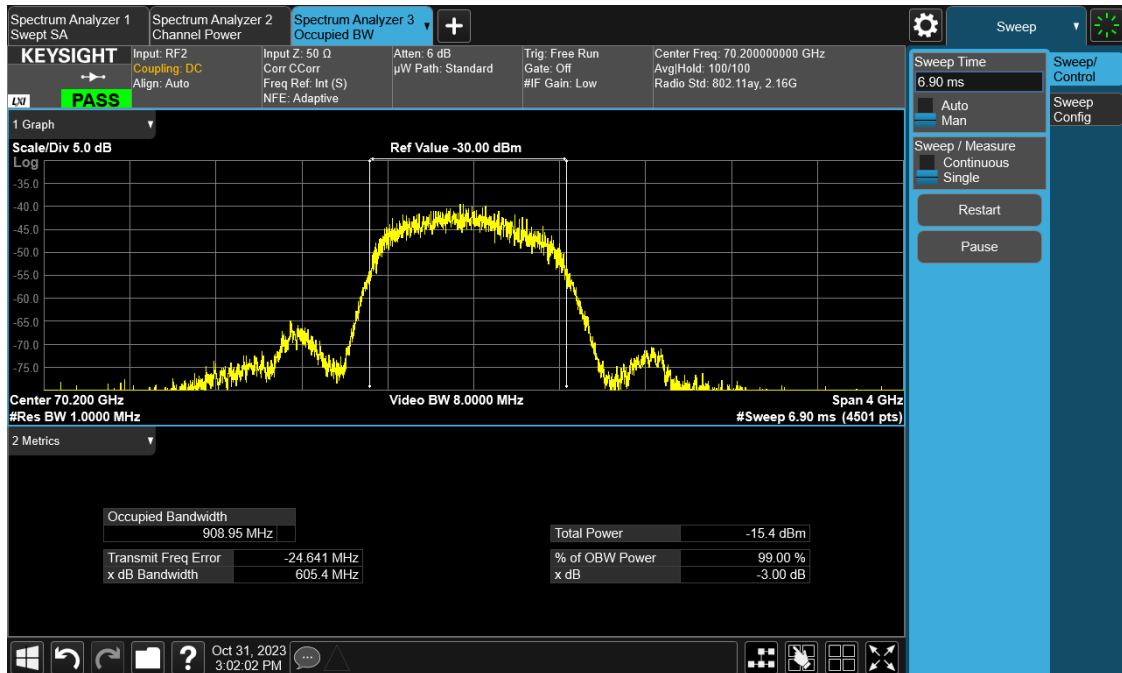
In the configuration tested, the 99% bandwidth was greater than 500 kHz; therefore, the EUT complied with the requirements of the specification (see spectrum analyzer plot below).



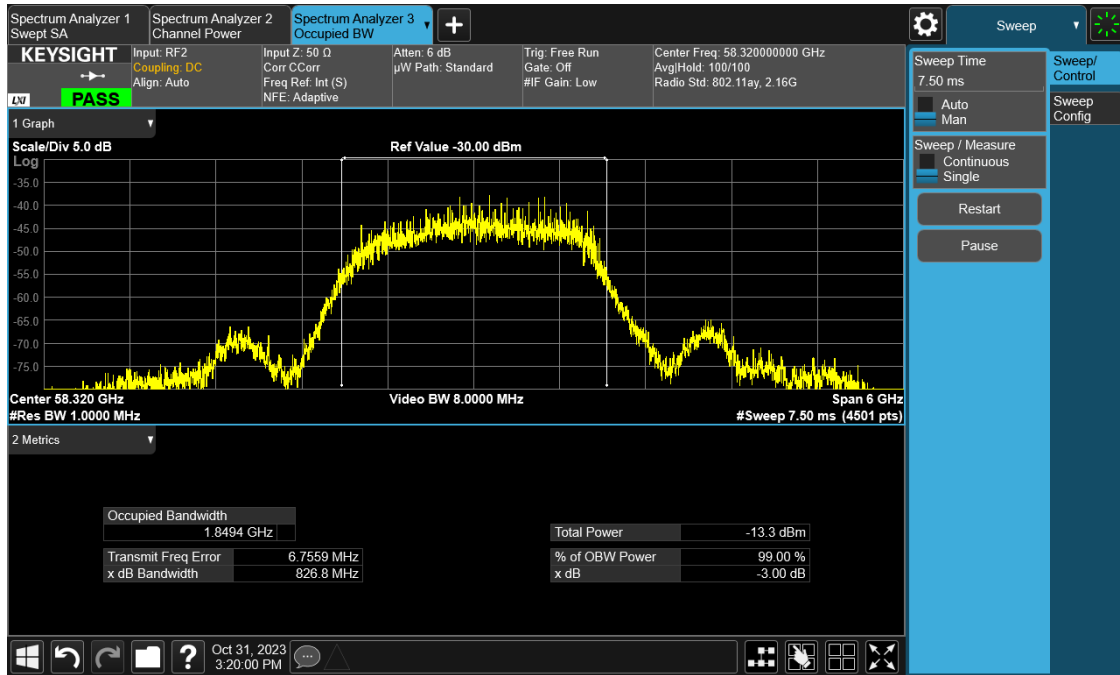
Graph 1: 58,320MHz, 1,060MHz Emissions Bandwidth



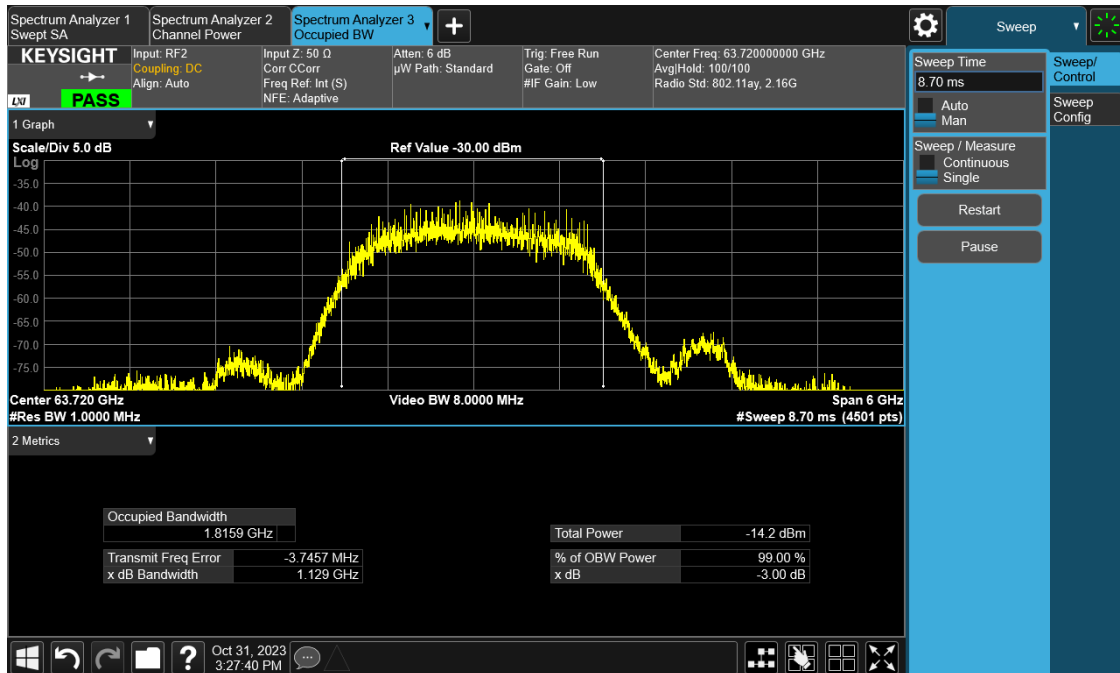
Graph 2: 63,720, 1,060MHz Emissions Bandwidth



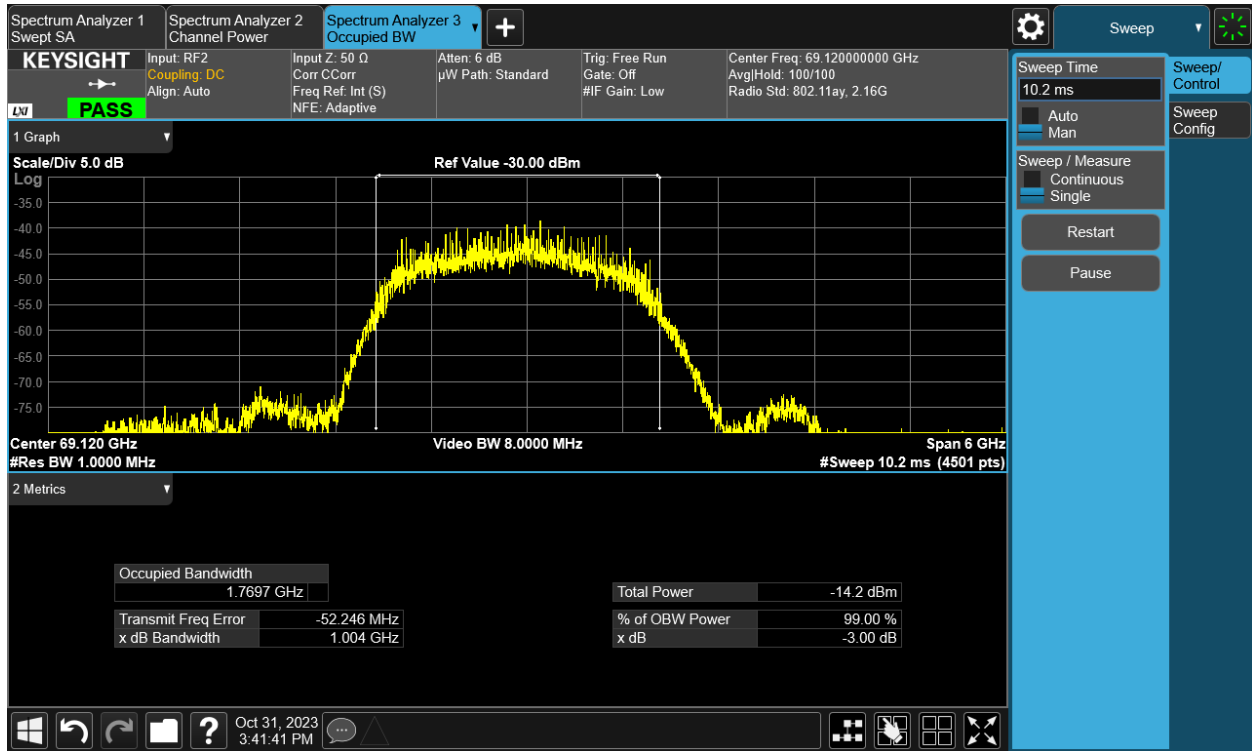
Graph 3: 70,200MHz, 1,060 Emissions Bandwidth



Graph 4: 58,320MHz, 2,160MHz Emissions Bandwidth



Graph 5: 63,720MHz 2,160MHz Emissions Bandwidth



Graph 6: 69,120MHz, 2,160MHz Emissions Bandwidth

5.3 §15.255(c)(1)(i) Maximum Peak and Average Output Power

All chains were measured and summed under the guidance of KDB 558074 Section 8.3.2.3. and KDB 66291 D01. Please see associated annex for details on instrument settings.

5.3.1 Peak

The maximum Peak RF EIRP measured for this device was 42.9 dBm. The limit is 43 dBm.

Nominal BW	Frequency (MHz)	Air Path Loss (dB)	Total Correction	Peak SA Reading	Conducted Peak	Peak Conducted Limit	EIRP Peak	Peak EIRP Limit
1.08	58320	77.3	56.1	-13.2	15.2	27	42.9	43
	63720	78.1	56.5	-14.5	14.5	27	42.2	43
	70200	78.9	57.0	-15.2	14.1	27	41.8	43
2.12	58320	77.3	56.1	-13.3	15.1	27	42.8	43
	63720	78.1	56.5	-14.2	14.6	27	42.3	43
	69120	78.2	56.6	-14.2	15.1	27	42.8	43

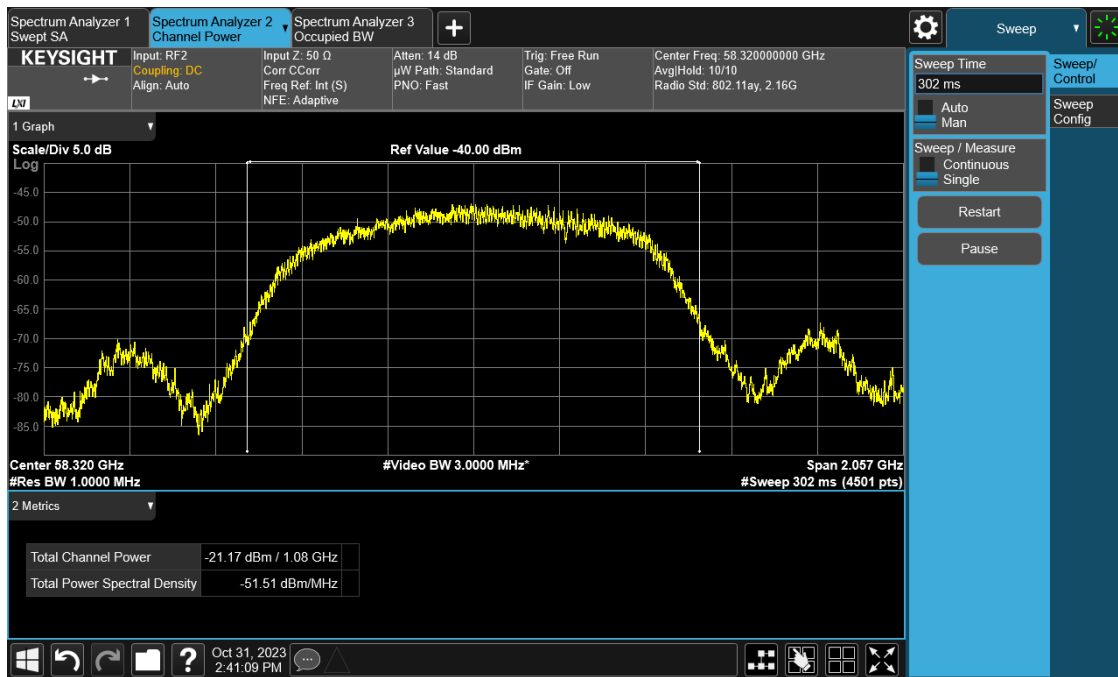
5.3.2 Average

The maximum average RF EIRP measured for this device was 34.9 dBm. The limit is 40 dBm.

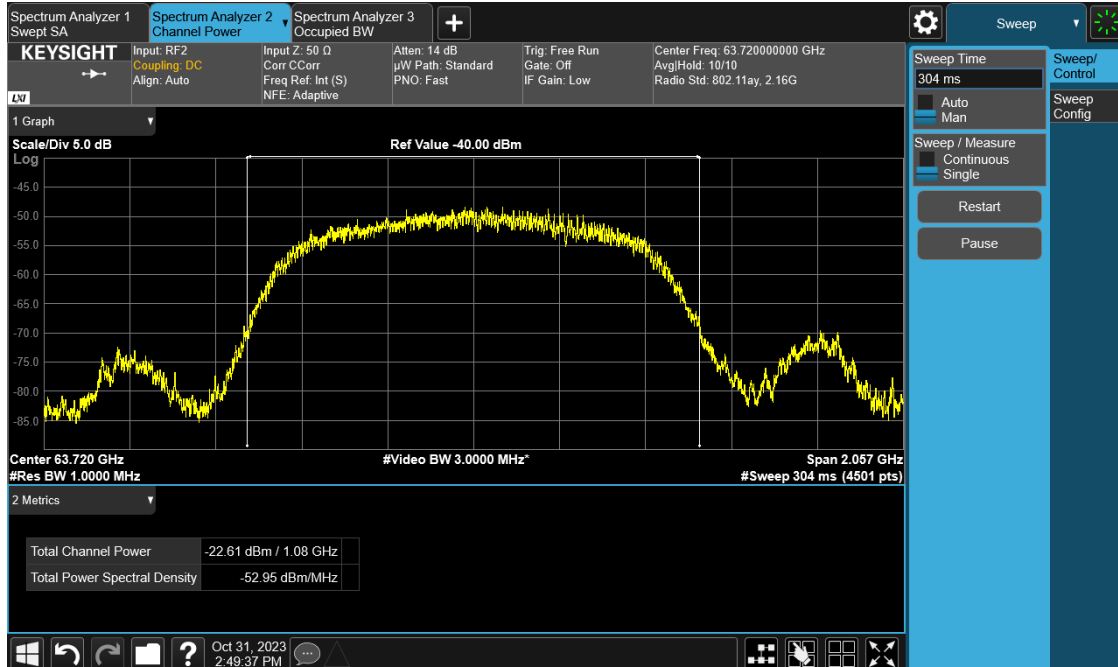
Nominal BW	Frequency (MHz)	Air Path Loss (dB)	Total Correction	AvG SA Reading	EIRP Avg	Avg EIRP Limit	Avg Delta
1.08	58320	77.3	56.1	-21.2	34.9	40	-5.1
	63720	78.1	56.5	-22.6	33.9	40	-6.1
	70200	78.9	57.0	-23.5	33.5	40	-6.5
2.12	58320	77.3	56.1	-21.8	34.3	40	-5.7
	63720	78.1	56.5	-23.2	33.3	40	-6.7
	69120	78.2	56.6	-23.1	33.9	40	-6.1

Result

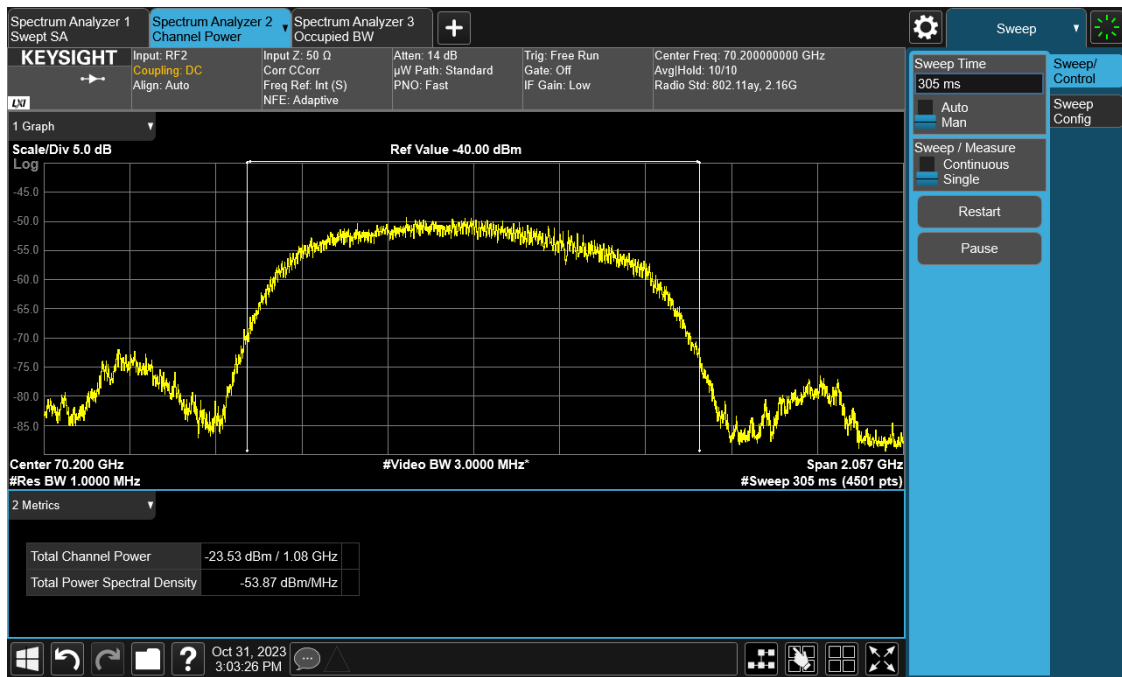
In the configuration tested, the maximum average RF EIRP was less than 40 dBm; therefore, the EUT complied with the requirements of the specification. (see spectrum analyzer plot below).



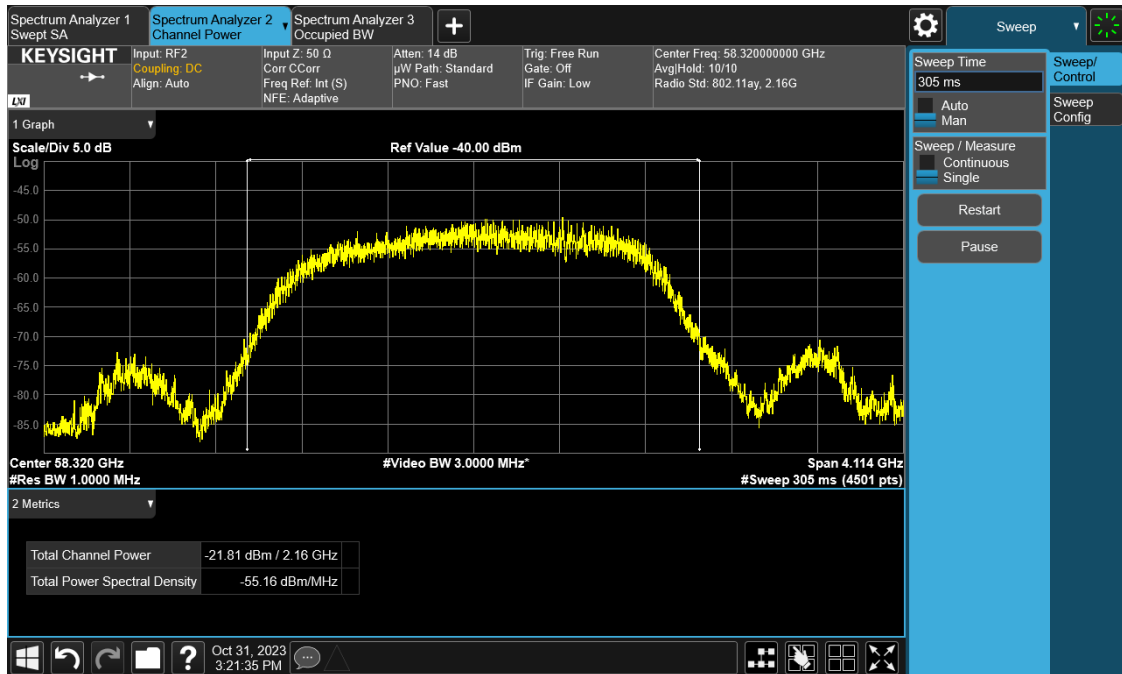
Graph 7: 58,320MHz, 1.060MHz Average RF Emissions



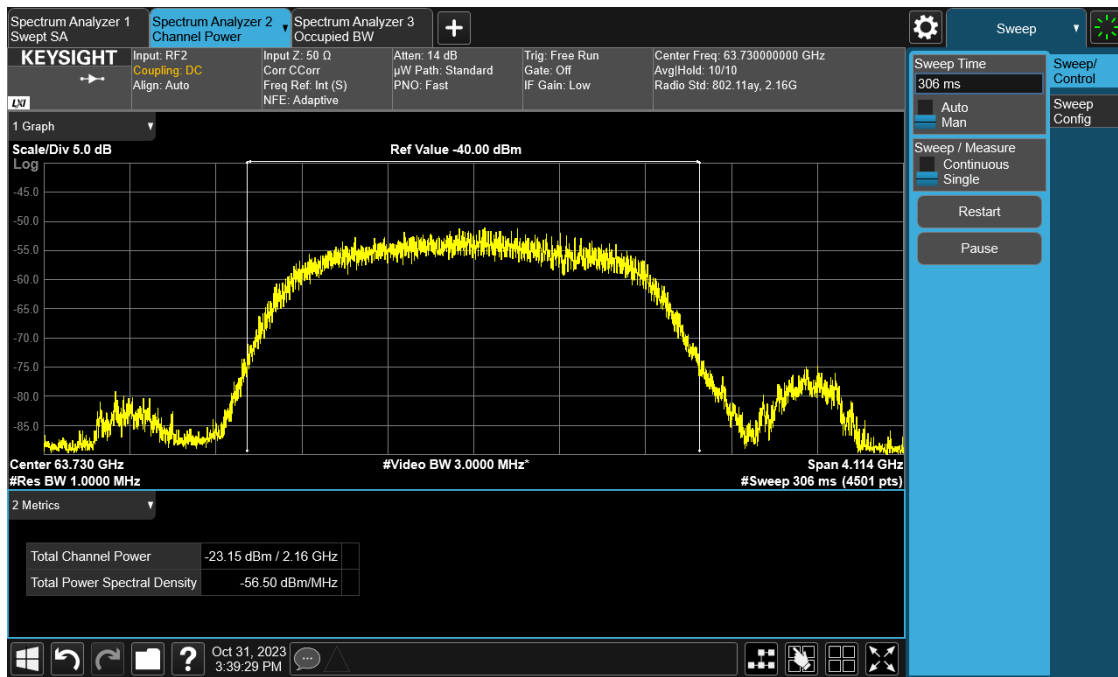
Graph 8: 63,720, 1,060MHz Average RF Emissions



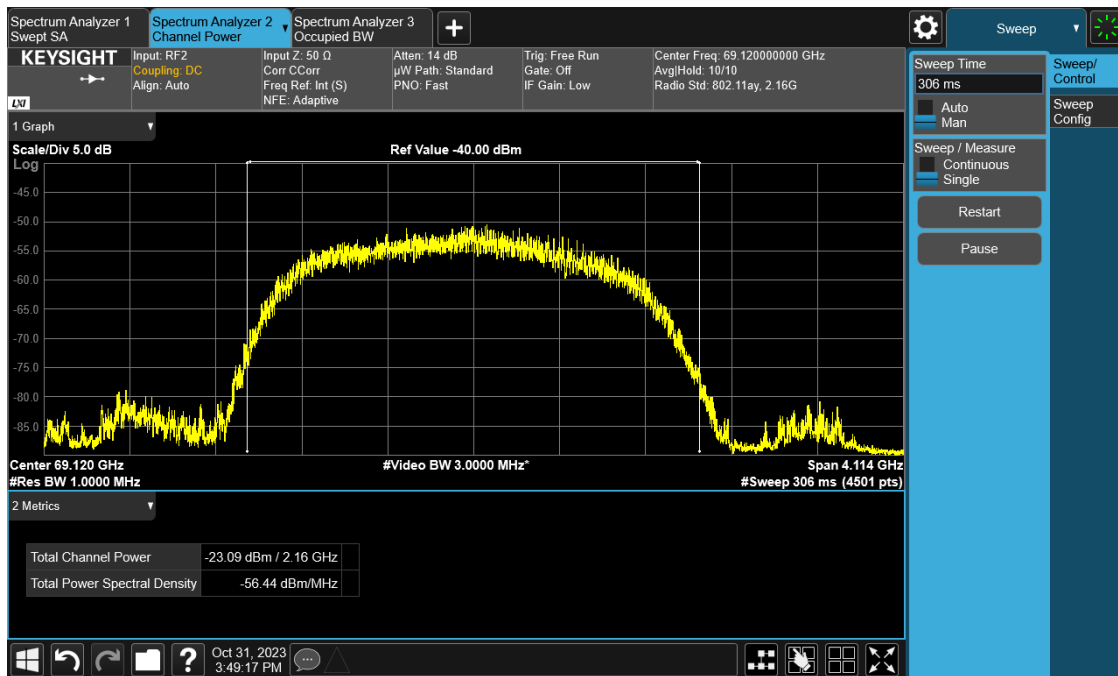
Graph 9: 70,200MHz, 1,060 Average RF Emissions



Graph 10: 58,320MHz, 2,160MHz Average RF Emissions



Graph 11: 63,720MHz 2,160MHz Average RF Emissions



Graph 12: 69,120MHz, 2,160MHz Average RF Emissions

5.4 §15.255(d) Spurious Emissions

5.4.1 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 between 18.0 and 40 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 bands must meet the limits specified in §15.209. Tabular data for each of the spurious emissions is shown below for each of the units. The BLE radio and 60 GHz radio are active during all plots. The limit above 40 GHz is 90pW/cm². The measurement distance above 40 GHz was 3 meters.

Result

All emissions in the restricted bands of §15.205 met the limits specified in §15.209. All emissions met the limits set out in 15.255(d) therefore, the EUT complies with the specification.

Frequency	Level (dB μ V/m)	Limit (dB μ V/m)	Margin	Azimuth (°)	Height	Det.	Pol.	Correction (dB)
30.386 MHz	18.991	49	-30.009	183	3.66	QP	Vertical	-7.957
192 MHz	31.232	53.5	-22.268	185	2.059	QP	Vertical	-16.393
384.03 MHz	43.962	56	-12.038	109	2.401	QP	Vertical	-12.176
480 MHz	48.842	56	-7.158	265	1.863	QP	Vertical	-9.391
575.95 MHz	40.156	56	-15.844	216	1.681	QP	Vertical	-8.42
30.229 MHz	21.821	49	-27.179	19	4	QP	Horizontal	-7.836
191.99 MHz	37.968	53.5	-15.532	303	1.701	QP	Horizontal	-16.394
287.95 MHz	39.99	56	-16.01	125	1.138	QP	Horizontal	-14.117
384.04 MHz	47.542	56	-8.458	328	2.22	QP	Horizontal	-12.176
480.02 MHz	55.57	56	-0.43	1	1.858	QP	Horizontal	-9.39
575.96 MHz	51.906	56	-4.094	143	1.496	QP	Horizontal	-8.421

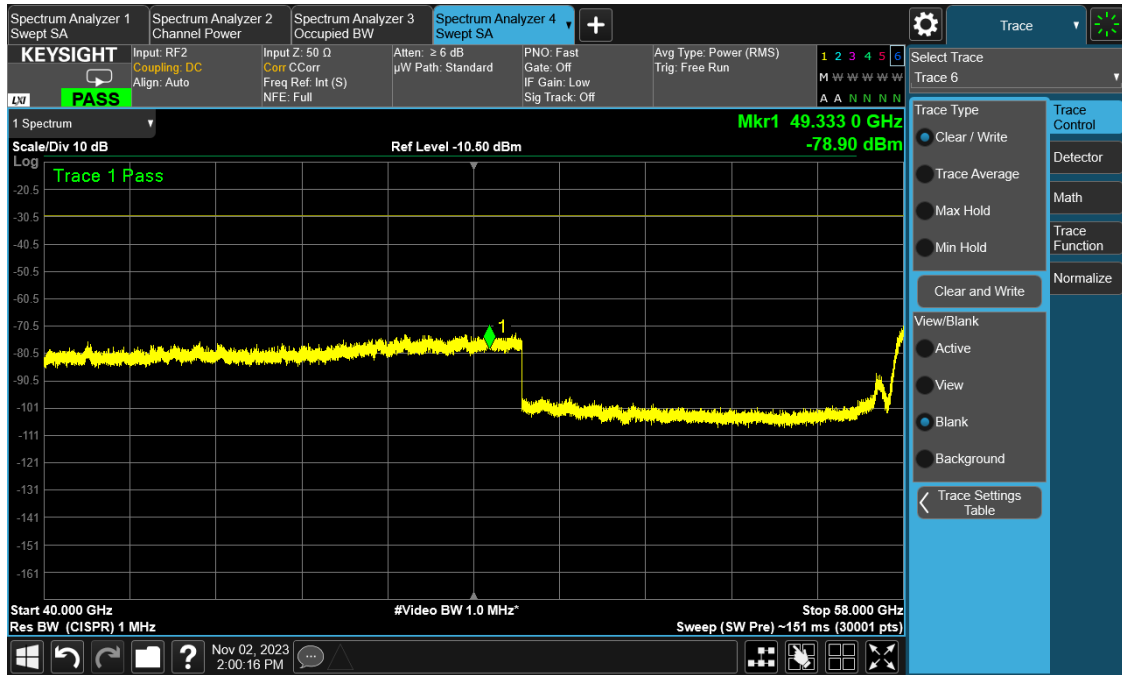
Radiated Spurious Emissions 30-1000MHz (Worst Case)

Frequency	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Det.	Correction (dB)
6.2359 GHz	56.484	74	-17.516	49	2.65	Vertical	Pk	-3.438
10.397 GHz	55.536	74	-18.464	251	3.153	Vertical	Pk	6.888
14.007 GHz	55.445	74	-18.555	221	3.802	Vertical	Pk	11.082
16.955 GHz	55.076	74	-18.924	267	3.798	Vertical	Pk	13.484
6.2359 GHz	40.349	54	-13.651	49	2.65	Vertical	AV	-3.438
10.397 GHz	41.469	54	-12.531	251	3.153	Vertical	AV	6.888
14.007 GHz	42.093	54	-11.907	221	3.802	Vertical	AV	11.082
16.955 GHz	42.382	54	-11.618	267	3.798	Vertical	AV	13.484
6.2402 GHz	60.093	74	-13.907	74	1.5	Horizontal	Pk	-3.428
14.332 GHz	55.377	74	-18.623	235	1.643	Horizontal	Pk	11.71
16.998 GHz	56.163	74	-17.837	343	1.638	Horizontal	Pk	13.497
6.2402 GHz	45.032	54	-8.968	74	1.5	Horizontal	AV	-3.428
14.332 GHz	42.225	54	-11.775	235	1.643	Horizontal	AV	11.71
16.998 GHz	42.846	54	-11.154	343	1.638	Horizontal	AV	13.497

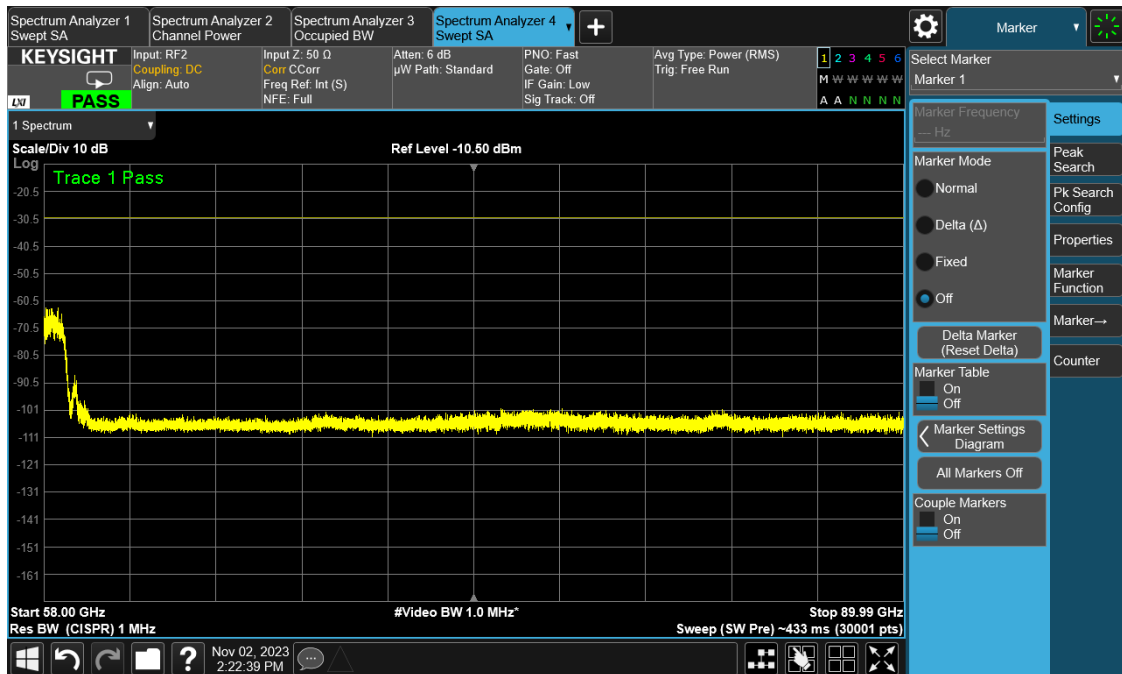
Radaited Spurious Emissions 1-17GHz (Worst Case)

Frequency	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Det.	Correction (dB)
31.64 GHz	52.372	74	-21.628	321	1.5	Vertical	Pk	1.787
32.489 GHz	53.2	74	-20.8	196	1.5	Vertical	Pk	2.277
31.64 GHz	38.061	54	-15.939	321	1.5	Vertical	Av	1.787
32.489 GHz	38.983	54	-15.017	196	1.5	Vertical	Av	2.277
29.754 GHz	52.828	74	-21.172	359	1.5	Horizontal	Pk	1.104
35.01 GHz	53.964	74	-20.036	253	1.5	Horizontal	Pk	3.737
38.061 GHz	53.375	74	-20.625	337	1.5	Horizontal	Pk	3.252
39.852 GHz	54.19	74	-19.81	242	1.5	Horizontal	Pk	3.234
29.754 GHz	38.438	54	-15.562	359	1.5	Horizontal	Av	1.104
35.01 GHz	38.073	54	-15.927	253	1.5	Horizontal	Av	3.737
38.061 GHz	37.342	54	-16.658	337	1.5	Horizontal	Av	3.252
39.852 GHz	38.424	54	-15.576	242	1.5	Horizontal	Av	3.234

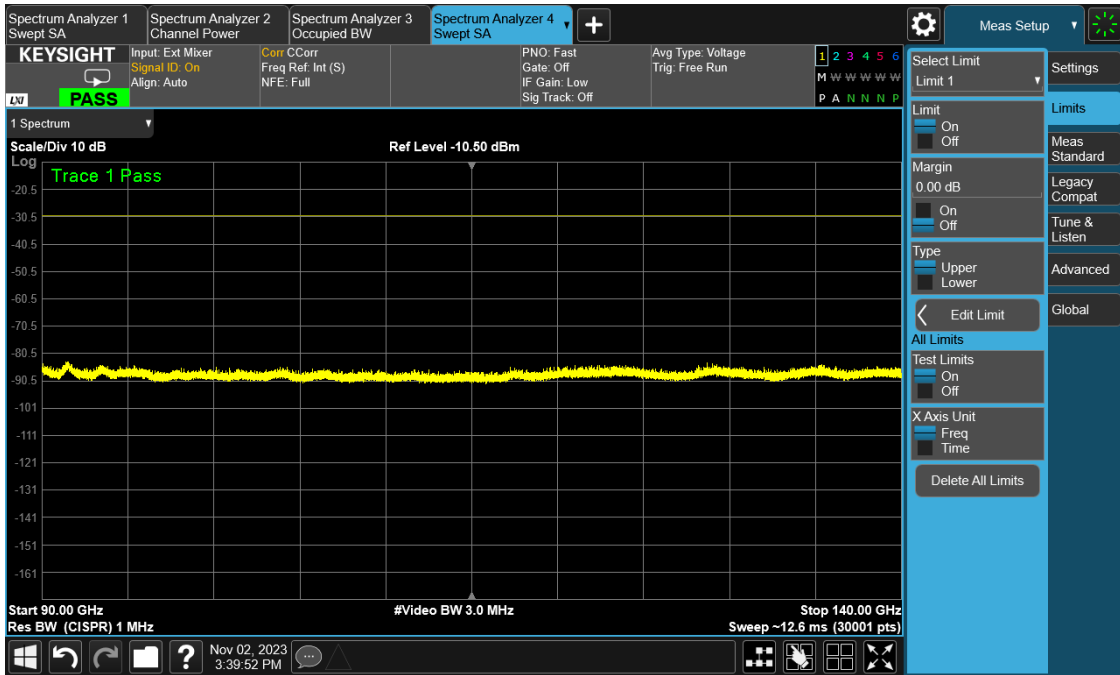
Radaited Spurious Emissions 17-40GHz (Worst Case)



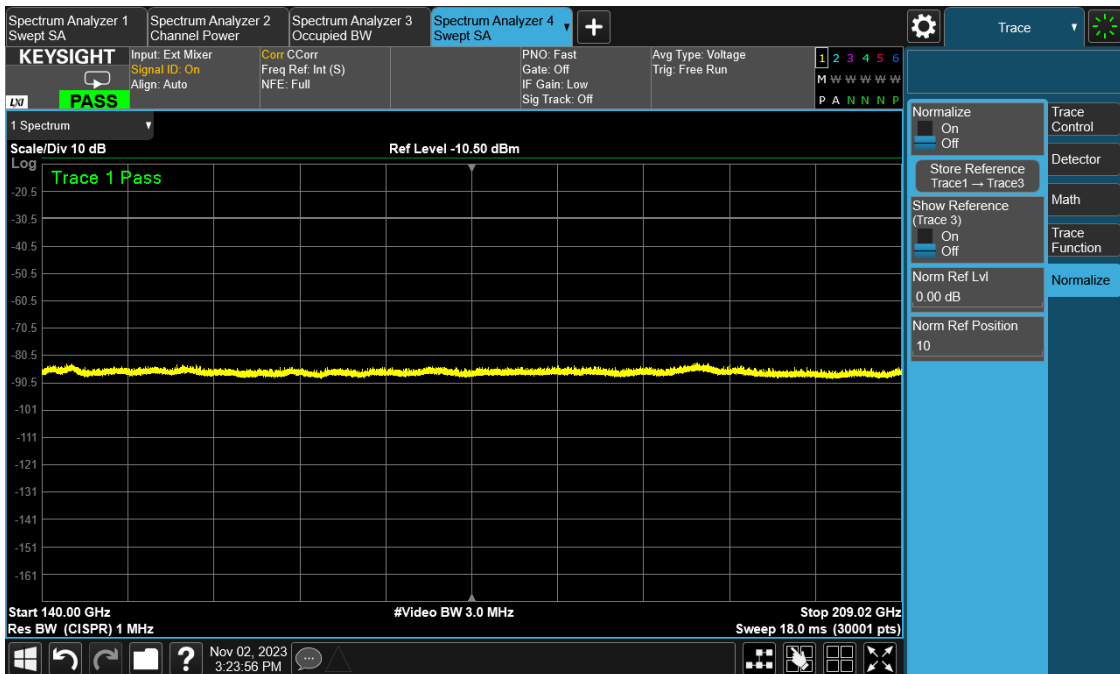
Radated Spurious Emissions 40-58GHz (Worst Case) (No emisisions of significance)



Radated Spurious Emissions 60-90GHz (Worst Case) (No emisisions of significance)



Radaited Spurious Emissions 90-140GHz (Worst Case) (No emisisions of signifigance)



Radaited Spurious Emissions 140-200GHz (Worst Case) (No emisisions of signifigance)

5.5 §15.255(f) Frequency Stability

5.5.1 Frequency stability

Fundamental emissions must be contained within the frequency bands specified during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to $+50$ degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

The device was placed in a temperature chamber with an receive antenna placed on the outside of the chamber in order to measure the low and High fundamental frequency. Measurements were taken at the intervals and temperatures noted below, and the resultant frequency error is recorded below.

Temp	Low Channe; Frequency Error (MHz)				High Channel Frequency Error (MHz)				Result
	Start-up	2 min	5 min	10 min	Start-up	2 min	5 min	10 min	
25	13.1				-19.8				N/A
-20	16.9	19.0	15.5	17.5	-18.7	-16.5	-13.0	-4.6	Pass
-10	19.7	17.8	17.0	16.2	14.5	11.0	9.3	9.0	Pass
0	-30.3	-28.4	-29.0	-27.8	-3.7	-7.4	-6.0	-6.4	Pass
10	15.3	14.6	10.1	6.5	-15.5	-16.9	-15.9	-13.8	Pass
20	10.0	8.9	9.1	10.6	-12.4	-18.5	-17.3	-17.7	Pass
30	10.3	10.6	11.3	10.0	-19.0	-19.4	-21.0	-20.5	Pass
40	10.1	9.1	8.8	9.4	-14.8	-16.8	-15.0	-16.9	Pass
50	8.0	6.6	6.9	7.0	-14.2	-12.3	-13.3	-15.1	Pass

Result

All emissions were contained within the specified frequency band of 51-71GHz. All emissions met the limits set out in 15.255(f) therefore, the EUT complies with the specification.

-- End of Test Report --