UNIFIED COMPLIANCE LABORATORY

427 West 12800 South
Draper, UT 84020

Test Report

Certification

FCC ID	SWX-UKPRO
ISED ID	6545A-UKPRO
Equipment Under Test	U7-Outdoor
Test Report Serial Number	TR8835_03
Date of Test(s)	22, 27 – 30 November; 8 December 2023 2 January; 14 February; 17 – 18 April 2024
Report Issue Date	19 April 2024

Test Specification	Applicant
47 CFR FCC Part 15, Subpart E	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

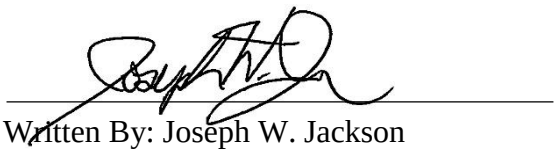
This report has been prepared by Unified Compliance Laboratory (UCL) to document compliance of the device described below with the requirement of Federal Communication Commissions (FCC) Part 15, Subpart E. This report may be reproduced in full. Partial reproduction of this report may only be made with 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	U7-Outdoor
FCC ID	SWX-UKPRO
ISED ID	6545A-UKPRO

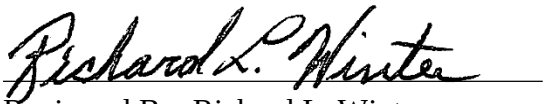
On this 19th day of April 2024, I individually and for Unified Compliance Laboratory certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge and are made in good faith.

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	19 April 2024
02	Added IC Number on Title Page and Page 2. Added Clarification Information in Section 5.4.3	22 April 2024
03	New Model Number	10 May 2024

Table of Contents

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	U7-Outdoor
Serial Number	68D79A05C391
Dimensions (cm)	17.0 x 20.8 x 5.5

2.2 Description of EUT

The U7-Outdoor is a PoE powered WiFi 7 access point with a 2.5 GbE PoE port. The U7-Outdoor provides a 3.6 Gbps aggregate throughput rate. The U7-Outdoor transmits in the 2.4 (2x2) GHz and 5 (2x2) GHz frequency bands and uses an internal integrated or external dipole antenna. The U7-Outdoor is powered by an 802.3at PoE power adapter. The U7-Outdoor is an outdoor device.

Band	WiFi Mode	Modulation Bandwidth	Modulation Type	Frequency (MHz)
UNII-1	a	20 MHz	OFDM	5180, 5200, 5210, 5240
	ax	20 MHz	HE	5180, 5200, 5210, 5240
	ax	40 MHz	HE	5190, 5230
	ax	80 MHz	HE	5210

This report covers the circuitry of the device subject to FCC Part 15, Subpart E. 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: U7-Outdoor (Note 1) SN: 68D79A05C391	WiFi Access Point	See Section 2.4
BN: UBIQUITI MN: U-POE-at SN: N/A	PoE Power Adapter	Unshielded Cat 5e cable/1 meters
BN: Dell MN: XPS 13 SN: N/A	Laptop Personal Computer	Unshielded Cat 5e cable/1 meters

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/80 cm
POE (POE Injector)	1	Unshielded Cat 5e cable/8 meters
LAN (POE Injector)	1	Unshielded Cat 5e cable/1 meters

2.5 Operating Environment

Power Supply	120 Volts AC Mains to 48 Volts PoE
AC Mains Frequency	60 Hz
Temperature	22.7 – 23.8 °C
Humidity	25.1 – 34.1 %
Barometric Pressure	1015 mBar

2.6 Operating Modes

The U7-Outdoor was tested using test software in order to enable a constant transmission. The measurements within this report are corrected to reference a 100% duty cycle. All emission modes of 802.11 a/ax were investigated. All measurements are reported with the worst-case mode (802.11ax) unless otherwise stated.

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

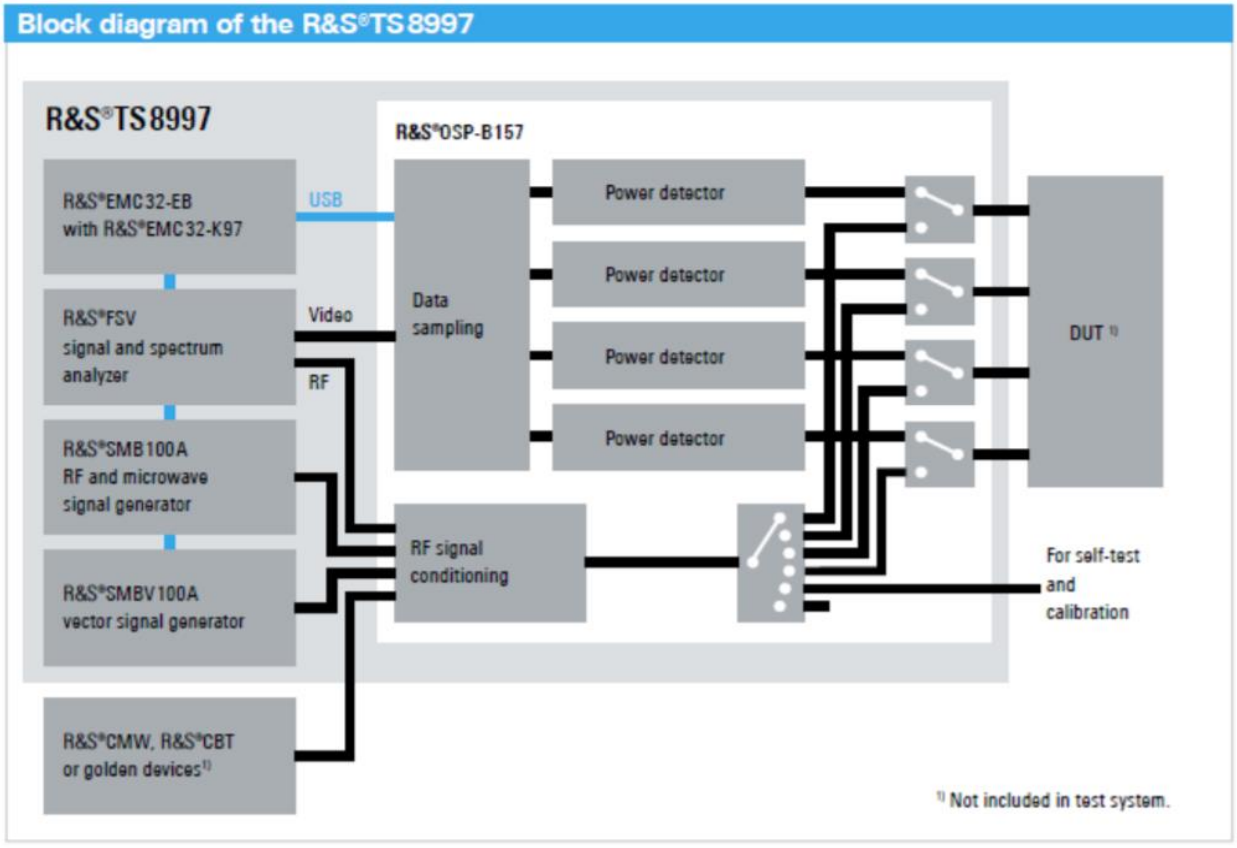


Diagram 1: Test Configuration Block Diagram

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 E, Section 15.407 Limits and methods of measurement of radio interference characteristics of Unlicensed National Information Infrastructure 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 15.407

See test standard for details.

3.3 FCC Part 15, Subpart E

3.3.1 Summary of Tests

FCC Section	ISED Section	Environmental Phenomena	Frequency Range (MHZ)	Result
15.407(a)	N/A	Antenna requirements	Structural Requirement	Compliant
15.407(b)	RSS-Gen	Conducted Disturbance at Mains Port	0.15 to 30	Compliant
15.407(c)	RSS-247 §6.2.2, §6.2.3	Bandwidth Requirement	5180 to 5210	Compliant
15.407(e)	RSS-247 §6.2.2, §6.2.3	Peak Output Power	5180 to 5210	Compliant
15.407(f)	RSS-247 §6.2.2, §6.2.3	Antenna Conducted Spurious Emissions	0.009 to 40000	N/A
15.407(g)	RSS-247 §6.2.2, §6.2.3	Radiated Spurious Emissions	0.009 to 40000	Compliant
15.407(h)	RSS-247 §6.2.2, §6.2.3	Peak Power Spectral Density	5180 to 5210	Compliant
The testing was performed according to the procedures in ANSI C63.10-2013, KDB 789033 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 2024. This site has also been registered with Innovations, Science and Economic Development (ISED) department as 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	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

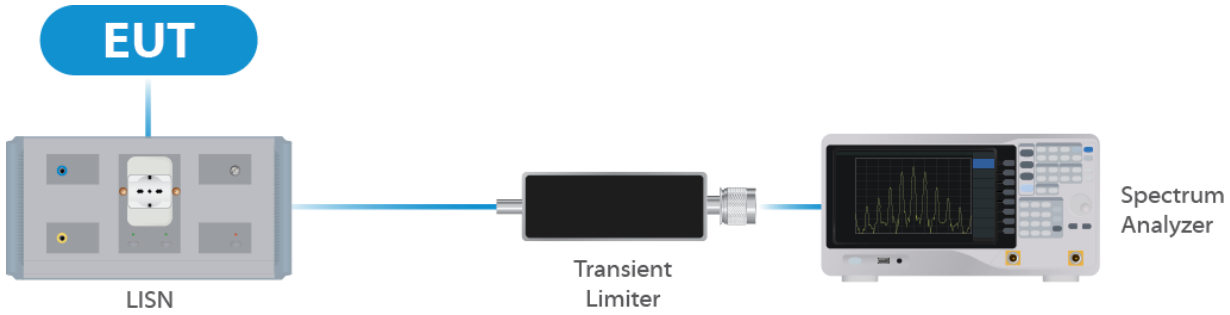


Figure 1: Conducted Emissions Test

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	11/27/2024
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	2/22/2023	3/20/2024
Switch Extension	R&S	OSP-150W	UCL-2870	2/22/2023	2/22/2024

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

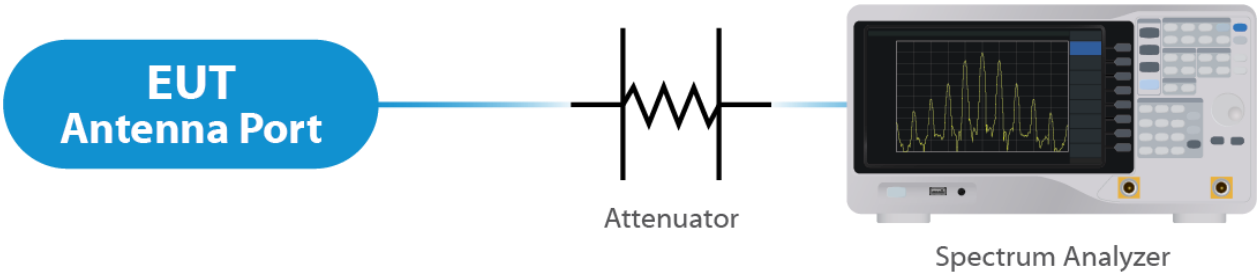


Figure 2: Direct Connect at the Antenna Port Test

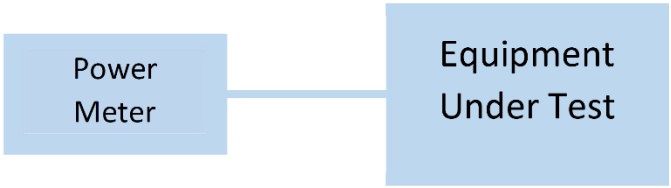


Figure 3: Output Power Measurement

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	9/22/2022	9/22/2024
Log Periodic	Scwarzbeck	STLP 9129	UCL-3068	1/27/2023	1/27/2025
15 - 40 GHz Horn Antenna	Scwarzbeck	BBHA 9170	UCL-2487	6/09/2022	6/09/2024
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

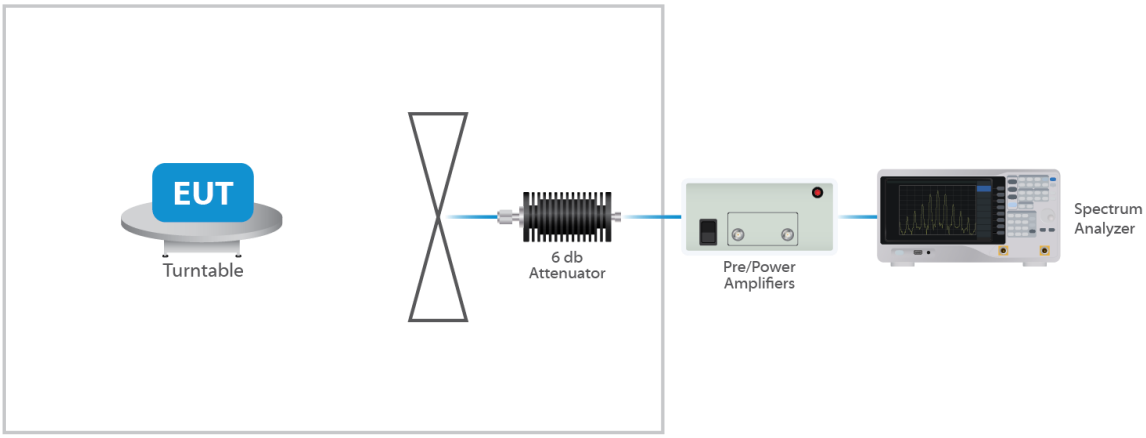


Figure 4: Radiated Emissions Test

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 EUT uses an internal antenna and an optional external antenna. Per the manufacturer, the Maximum gain of the internal antenna per chain is 12.5 dBi and the Maximum gain of the external antenna per chain is 4.57 dBi. This is an 802.11 device and utilizes CDD as described in KDB 662911 D01. The internal antenna is not user replaceable, the external antenna is user replaceable. For CDD transmissions, directional gain is calculated as follows.

Array Gain = 10 log(NANT/NSS) dB
NANT = number of transmit antennas and
NSS = number of spatial streams. NSS = 1 considered worst case.

For power measurements on IEEE 802.11 devices, Array Gain = 0 dB for NANT ≤ 4;
For PSD measurements when Nss=1: Array Gain = 10 log(NANT/NSS) dB + Antenna Gain (dBi).

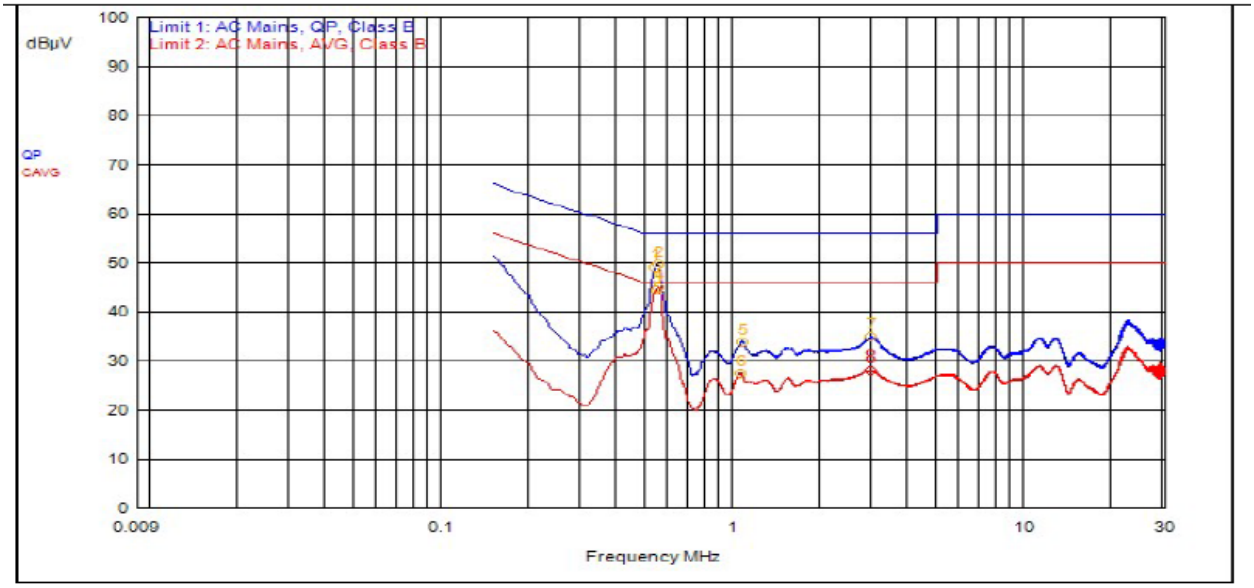
Or 3.01 dB + 12.5 dBi = 15.51 dBi for the internal antenna and 3.01 dB + 4.57 dBi = 7.58 dBi for the external antenna.

Results

The EUT complied with the specification

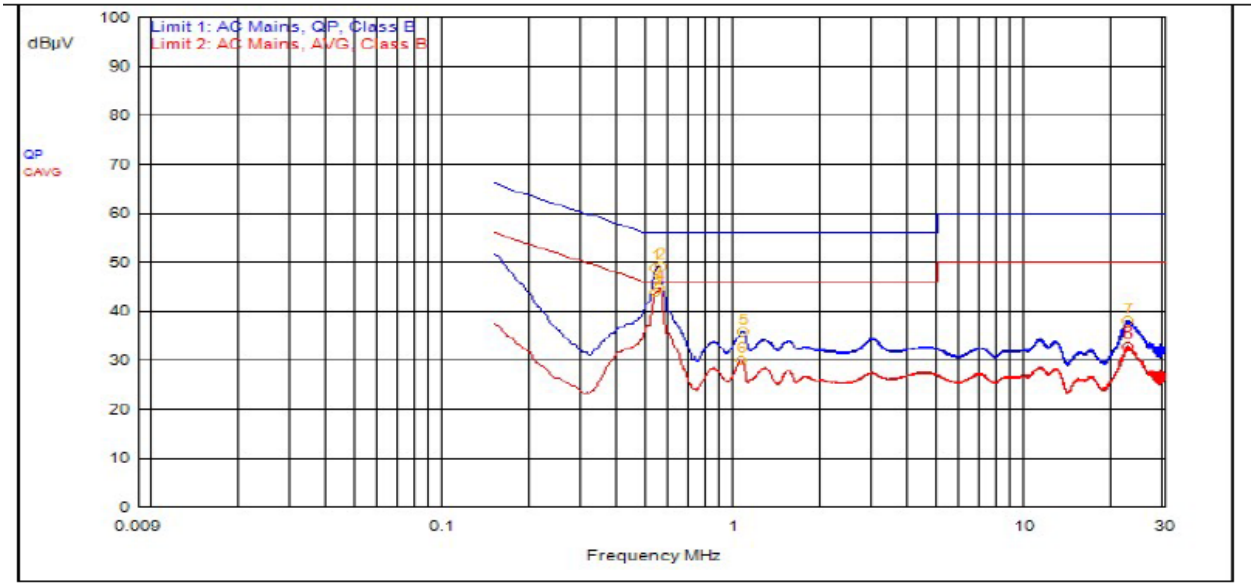
5.2 Conducted Emissions at Mains Ports Data

5.2.1 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	549,000kHz	12.41	0.00		QPeak	37.23	49.64	56.00	-6.36			
1	537,000kHz	12.41	0.00		QPeak	36.86	49.27	56.00	-6.73			
7	2.952	12.30	0.10		QPeak	22.60	35.00	56.00	-21.00			
5	1.059	12.38	0.10		QPeak	21.45	33.93	56.00	-22.07			
3	540,000kHz	12.41	0.00		C_AVG	32.16	44.57			46.00	-1.43	
4	549,000kHz	12.41	0.00		C_AVG	32.72	45.13			46.00	-0.87	
6	1.047	12.38	0.10		C_AVG	14.97	27.45			46.00	-18.55	
8	2.949	12.30	0.10		C_AVG	15.75	28.15			46.00	-17.85	

5.2.2 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
2	555,000kHz	12.41	0.00		QPeak	36.62	49.03	56.00	-6.97			
1	537,000kHz	12.42	0.00		QPeak	36.51	48.93	56.00	-7.07			
5	1.065	12.39	0.10		QPeak	23.39	35.88	56.00	-20.12			
7	22.383	12.39	0.20		QPeak	25.60	38.19	60.00	-21.81			
3	537,000kHz	12.42	0.00		C_AVG	31.47	43.89			46.00	-2.11	
4	552,000kHz	12.41	0.00		C_AVG	32.38	44.79			46.00	-1.21	
6	1.050	12.39	0.10		C_AVG	17.54	30.03			46.00	-15.97	
8	22.386	12.39	0.20		C_AVG	20.28	32.87			50.00	-17.13	

Result

The EUT complied with the specification limit.

5.3 §15.403(i) 26 dB Emissions Bandwidth

All chains were measured under the guidance of KDB 789033 Section II.C. and KDB 66291 D01. Please see associated annex for details on instrument settings.

5.3.1 Internal Antenna

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
OFDM 20	5180	16.9	22.2
OFDM 20	5210	16.9	22.5
OFDM 20	5240	16.9	21.7
he 20	5180	27.8	23.6
he 20	5210	27.8	22.8
he 20	5240	31.0	22.6
he 40	5190	39.0	42.0
he 40	5230	38.5	43.2
he 80	5210	79.0	88.0

5.3.2 External Antenna

Nominal BW (MHz)	Frequency (MHz)	99% Bandwidth (MHz)	Emissions 26 dB Bandwidth (MHz)
OFDM 20	5180	16.8	22.4
OFDM 20	5210	18.2	34.4
OFDM 20	5240	22.3	39.0
he 20	5180	30.8	22.3
he 20	5210	26.8	22.4
he 20	5240	31.5	38.6
he 40	5190	38.5	44.1
he 40	5230	38.5	44.0
he 80	5210	79.0	91.5

Result

All chains were tested and the highest bandwidth per chain is reported above.
The 26 dB bandwidths are reported for information purposes. Please see Annex for all bandwidth measurements.

5.4 §15.407(a)(2) Maximum Average Output Power

All chains were measured and summed under the guidance of KDB 789033 Section II. E.2. and KDB 66291 D01. Please see associated annex for details on instrument settings.

The maximum average RF conducted output power measured for this device was 23.43 dBm or 220.29 mW for the internal antenna and 27.25 dBm or 530.88 mW for the external antenna.

The limit is 30 dBm, or 1 Watt when using an antenna with 23 dBi (Fixed point to point) or 6 dBi (indoor/outdoor access point) or less gain. The antenna has a gain of 12.5 dBi for the internal antenna and a gain of 4.57 dBi for the external antenna.

5.4.1 Internal Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Nss2-Mcs0	19	19.34	31.84	4.96
OFDM 20	5210	Nss2-Mcs0	22	23.29	35.79	8.23
OFDM 20	5240	Nss2-Mcs0	21	22.67	35.17	7.46
HE 20	5180	Nss2-Mcs0	18	19.23	31.73	3.74
HE 20	5210	Nss2-Mcs0	22	23.43	35.93	7.76
HE 20	5240	Nss2-Mcs0	22	22.74	35.24	6.97
HE 40	5190	Nss2-Mcs0	17	18.41	30.91	-0.16
HE 40	5230	Nss2-Mcs0	20	21.60	34.10	2.96
HE 80	5210	Nss2-Mcs0	18	19.19	31.69	-2.38

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Nss1-Mcs0	19	19.90	32.40	5.18
OFDM 20	5210	Nss1-Mcs0	19	20.34	32.84	5.81
OFDM 20	5240	Nss1-Mcs0	18	19.58	32.08	5.02
HE 20	5180	Nss1-Mcs0	18	19.21	31.71	4.28
HE 20	5210	Nss1-Mcs0	19	20.47	32.97	5.37
HE 20	5240	Nss1-Mcs0	18	19.68	32.18	4.65
HE 40	5190	Nss1-Mcs0	17	18.44	30.94	0.65
HE 40	5230	Nss1-Mcs0	18	19.77	32.27	1.90
HE 80	5210	Nss1-Mcs0	18	19.27	31.77	-1.62

5.4.2 External Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Nss2-Mcs0	22	22.77	27.34	8.42
OFDM 20	5210	Nss2-Mcs0	26	26.28	30.85	11.92
OFDM 20	5240	Nss2-Mcs0	27	27.25	31.82	12.76
HE 20	5180	Nss2-Mcs0	20	20.74	25.31	5.85
HE 20	5210	Nss2-Mcs0	23	23.83	28.40	8.79
HE 20	5240	Nss2-Mcs0	26	26.52	31.09	11.47
HE 40	5190	Nss2-Mcs0	18	18.88	23.45	1.01
HE 40	5230	Nss2-Mcs0	21	22.12	26.69	4.18
HE 80	5210	Nss2-Mcs0	18	18.77	23.34	-2.18

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP	Measured PSD
OFDM 20	5180	Nss1-Mcs0	22	22.77	27.34	8.42
OFDM 20	5210	Nss1-Mcs0	26	26.28	30.85	11.92
OFDM 20	5240	Nss1-Mcs0	27	27.25	31.82	12.76
HE 20	5180	Nss1-Mcs0	20	20.74	25.31	5.85
HE 20	5210	Nss1-Mcs0	23	23.83	28.40	8.79
HE 20	5240	Nss1-Mcs0	26	26.52	31.09	11.47
HE 40	5190	Nss1-Mcs0	18	18.88	23.45	1.01
HE 40	5230	Nss1-Mcs0	21	22.12	26.69	4.18
HE 80	5210	Nss1-Mcs0	18	18.77	23.34	-2.18

5.4.3 30 Degree Elevation Gain

The information in this section regarding elevation gain applies to the US (FCC) market only.

Internal Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP
OFDM 20	5180	Nss2-Mcs0	12	12.34	19.84
OFDM 20	5210	Nss2-Mcs0	15	16.29	23.79

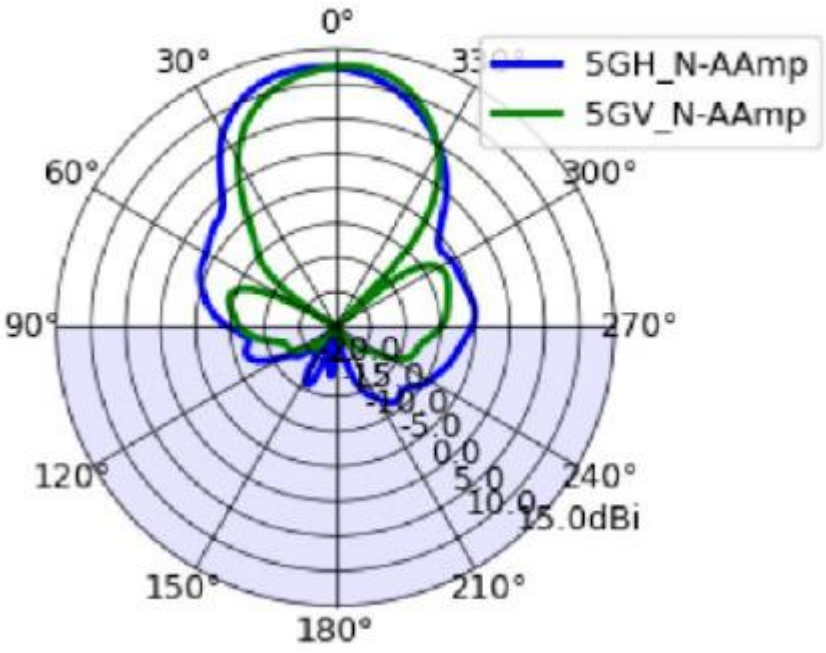
OFDM 20	5240	Nss2-Mcs0	14	15.67	23.17
HE 20	5180	Nss2-Mcs0	12	13.23	20.73
HE 20	5210	Nss2-Mcs0	15	16.43	23.93
HE 20	5240	Nss2-Mcs0	15	15.74	23.24
HE 40	5190	Nss2-Mcs0	12	13.41	20.91
HE 40	5230	Nss2-Mcs0	13	14.60	22.10
HE 80	5210	Nss2-Mcs0	12	13.19	20.69

External Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Conducted Output Power	Measured EIRP
OFDM 20	5180	Nss2-Mcs0	15	15.77	20.34
OFDM 20	5210	Nss2-Mcs0	16	16.28	20.85
OFDM 20	5240	Nss2-Mcs0	16	16.25	20.82
HE 20	5180	Nss2-Mcs0	15	15.74	20.31
HE 20	5210	Nss2-Mcs0	15	15.83	20.40
HE 20	5240	Nss2-Mcs0	15	15.52	20.09
HE 40	5190	Nss2-Mcs0	15	15.88	20.45
HE 40	5230	Nss2-Mcs0	15	16.12	20.69
HE 80	5210	Nss2-Mcs0	15	15.77	20.34

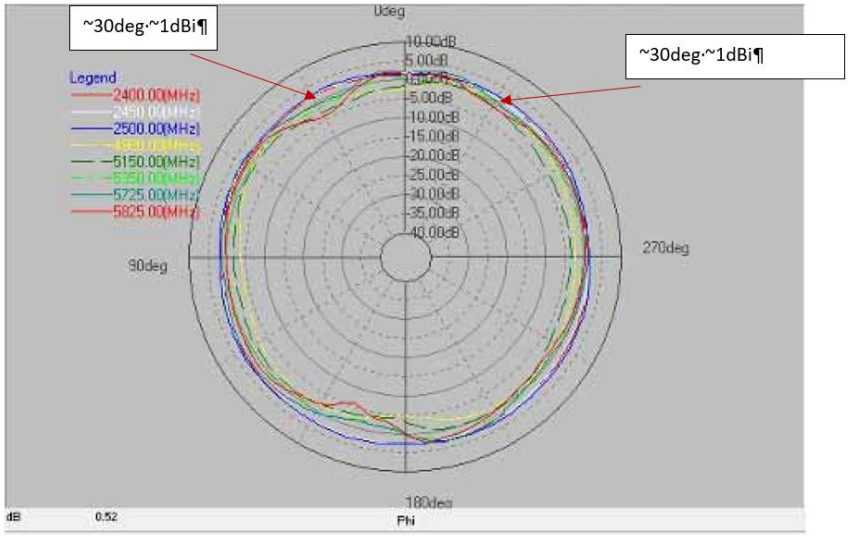
Result

In the configuration tested, the maximum summed average RF output power was less than 1 watt; therefore, the EUT compiled with the requirements of the specification (see spectrum analyzer plots in attached Annex).



The antenna gain is circular and at 30 degrees it is approximately 7.5 dBi.

Figure 1: Internal Antenna Elevation Plot Greater Then 30-Degrees from Horizon



X-Y Plane (E-total)

The antenna gain is circular and at 30 degrees it is approximately 1 dBi.

Figure 2: Omni Antenna Elevation Plot Greater Then 30-Degrees from Horizon

5.5 §15.407(b) Spurious Emissions

5.5.1 Conducted Spurious Emissions

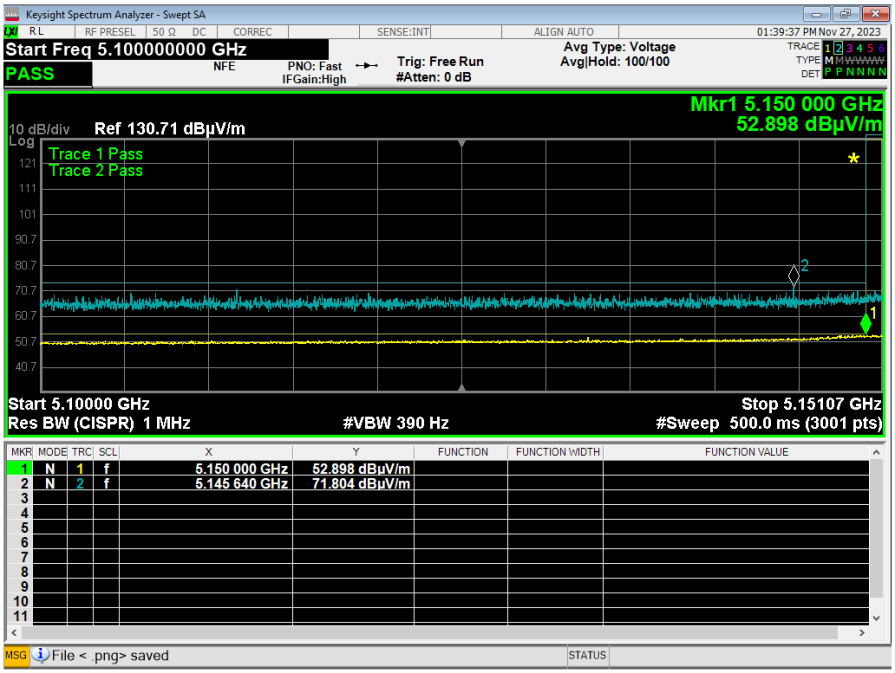
The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental frequency was investigated to measure any antenna-conducted emissions. The graphs show the measurement data from spurious emissions noted across the frequency range when transmitting at the lowest frequency, middle frequency and upper frequency. Shown below are plots with the EUT turned to the upper and lower channels with the antenna gain of 4.57 dBi for the external antenna and 12.5 dBi for the internal antenna accounted for. These demonstrate compliance with the provisions of this section at the band edges.

The emissions must be remain below -27 dBm EIRP.

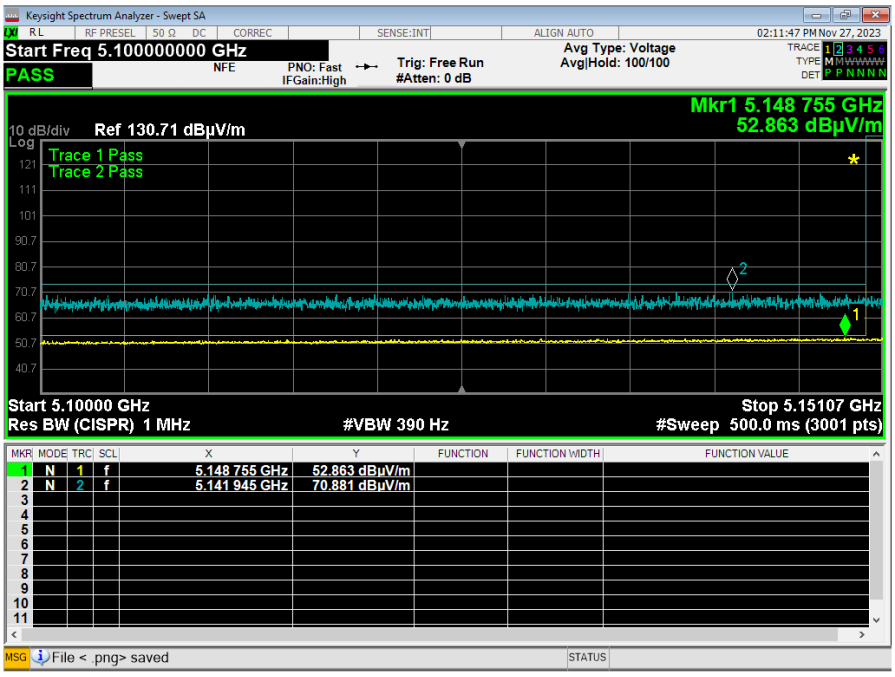
Result

Conducted spurious emissions were below -27 dBm; therefore, the EUT complies with the specification.

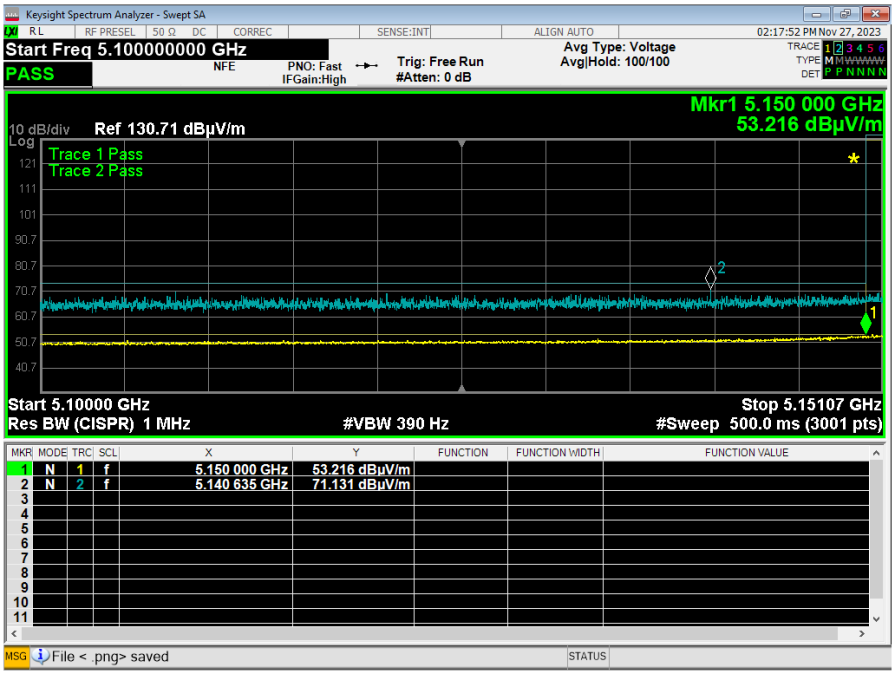
Internal Antenna



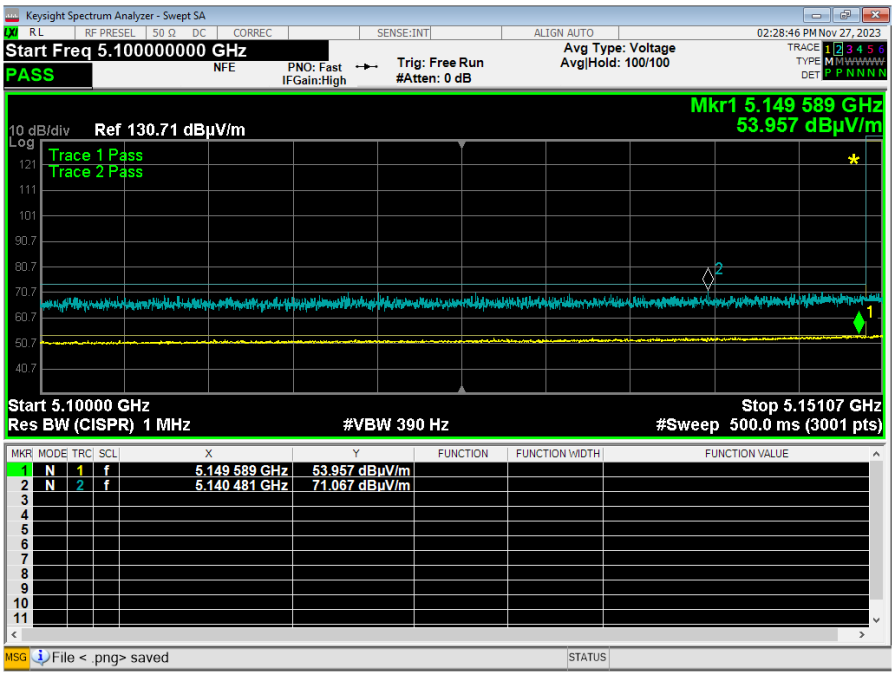
Graph 3: Band Edge Low a Mode 20 MHz



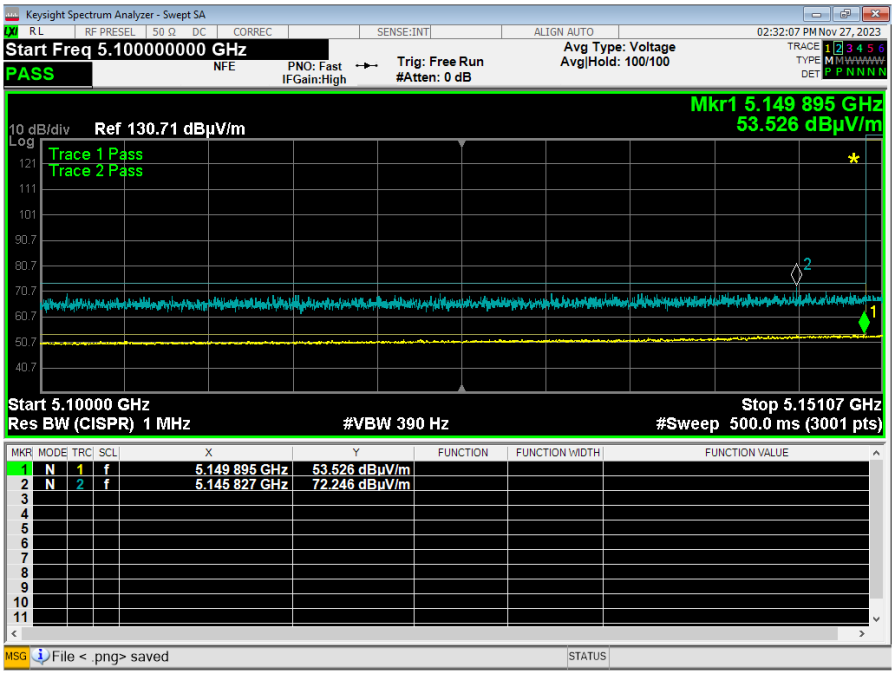
Graph 4: Band Edge High a Mode 20 MHz



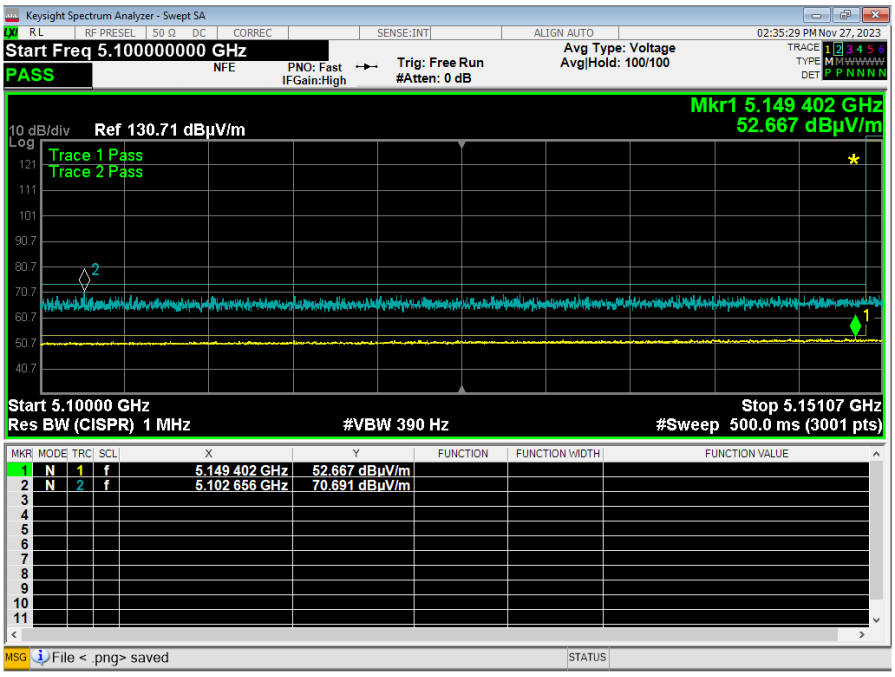
Graph 5: Band Edge Low ax Mode 20 MHz



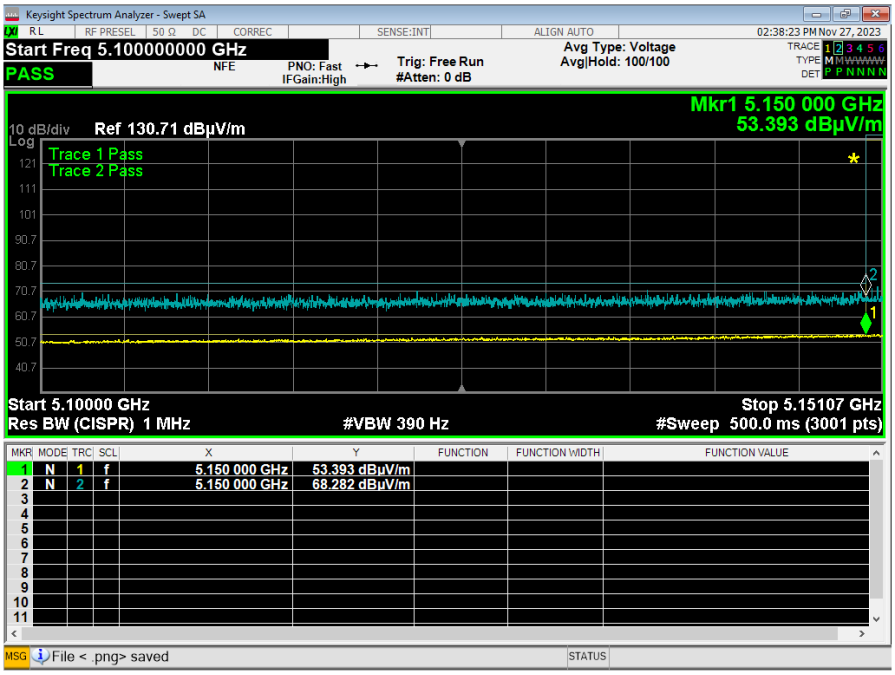
Graph 6: Band Edge High ax Mode 20 MHz



Graph 7: Band Edge Low ax Mode 40 MHz

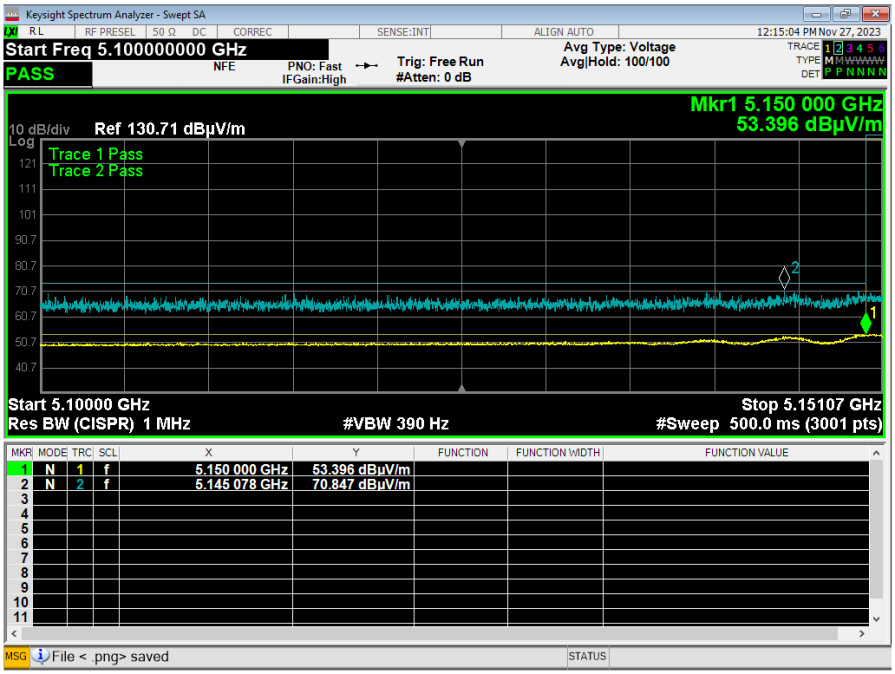


Graph 8: Band Edge High ax Mode 40 MHz

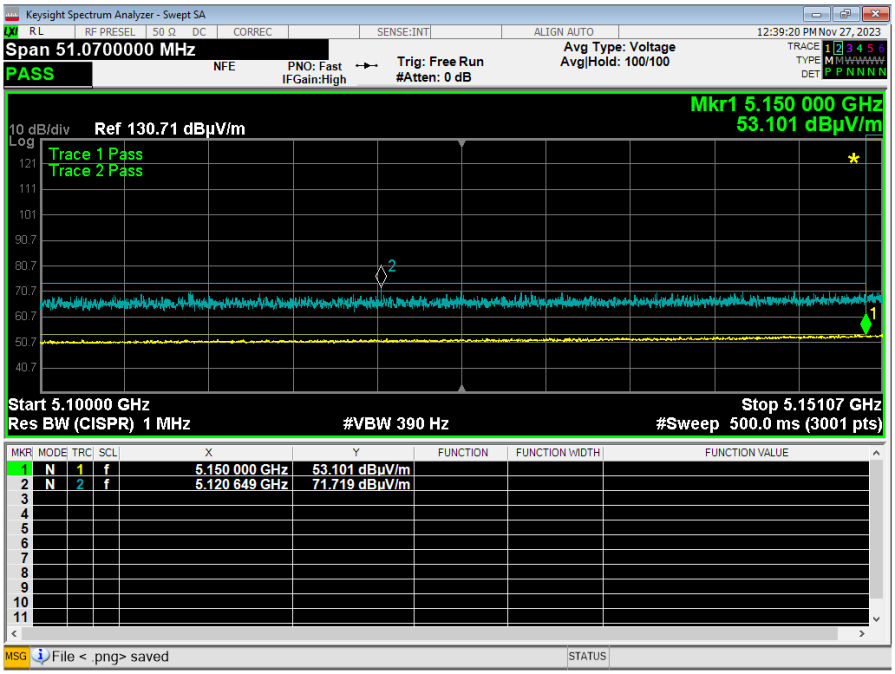


Graph 9: Band Edge ax Mode 80 MHz

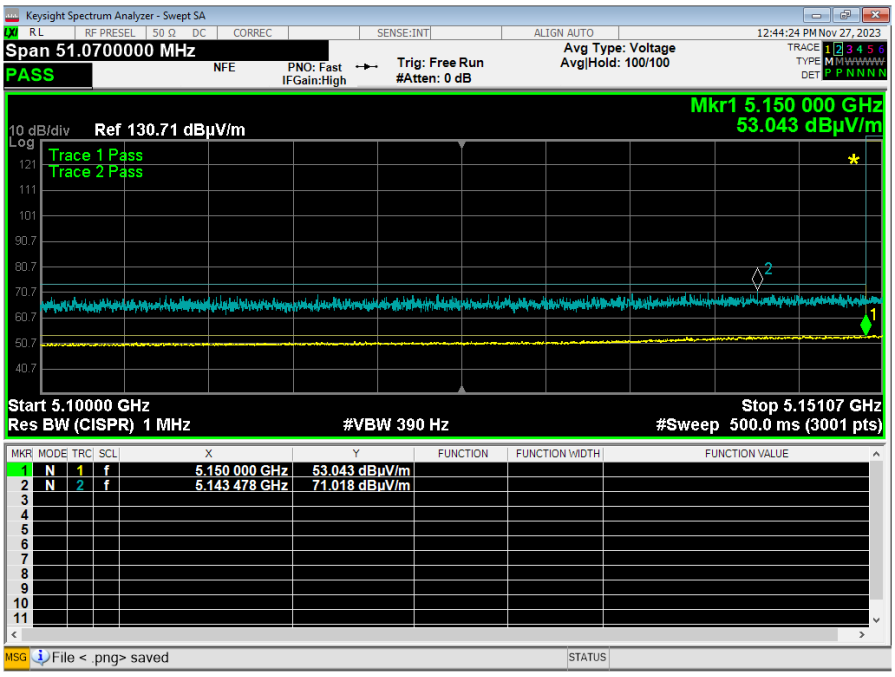
External Antenna



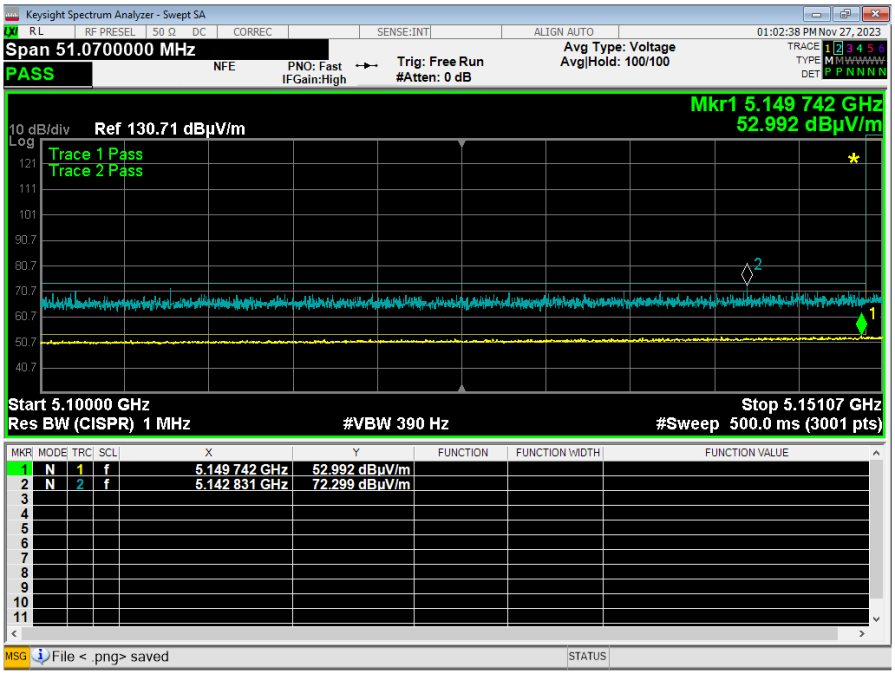
Graph 10: Band Edge Low a Mode 20 MHz



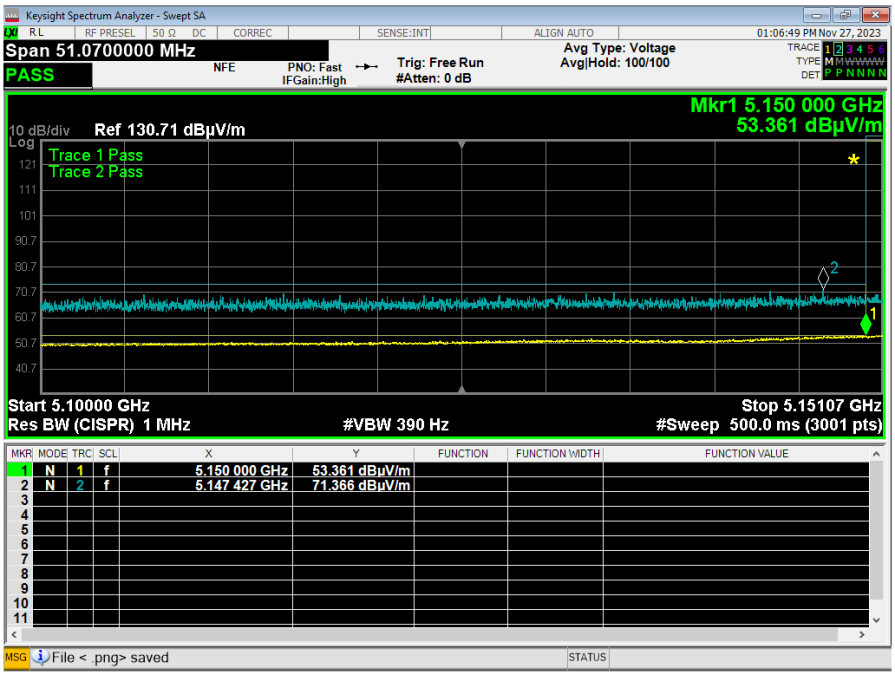
Graph 11: Band Edge High a Mode 20 MHz



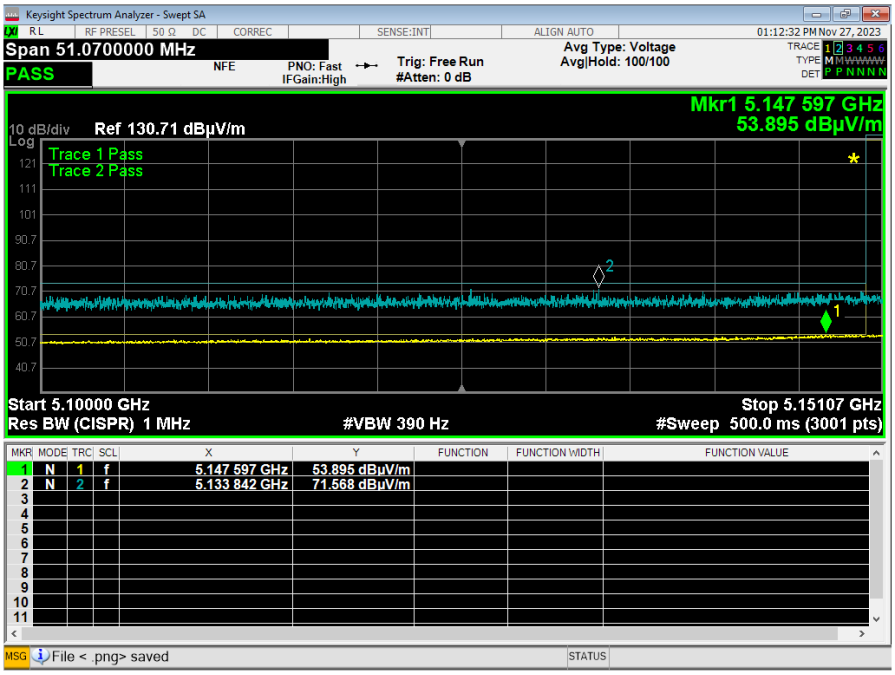
Graph 12: Band Edge Low ax Mode 20 MHz



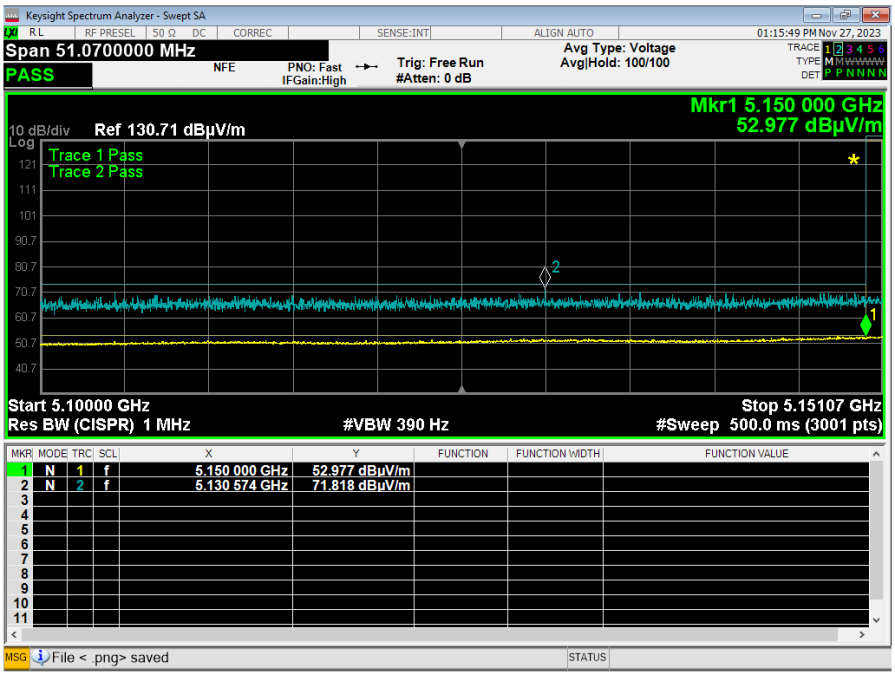
Graph 13: Band Edge High ax Mode 20 MHz



Graph 14: Band Edge Low ax Mode 40 MHz



Graph 15: Band Edge High ax Mode 40 MHz



Graph 16: Band Edge ax Mode 80 MHz

5.5.2 Radiated Spurious Emissions in the Restricted Bands of § 15.205

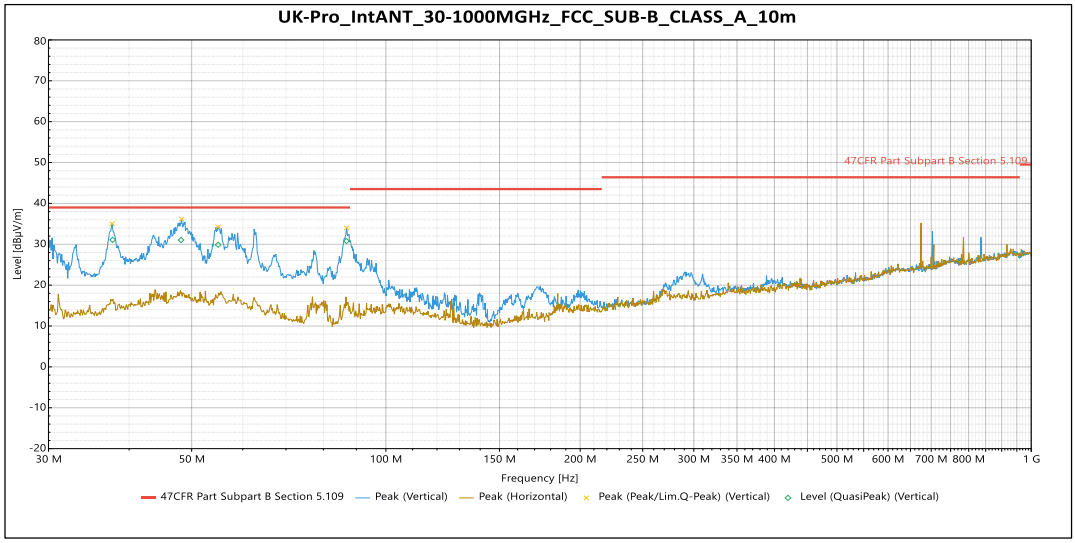
The EUT uses various power settings based on the channel in use. In order to reduce test time, the radiated spurious emissions at the lowest, middle, and highest channel were measured at the maximum power of TP30, as this setting was found to be worst case for spurious emissions. Power was subsequently reduced during in-band and band edge testing. The band edge at the restricted band ending at 5150 MHz was measured using radiated measurement. All emissions modes were tested, and the worst-case measurement are shown below. For frequencies above 1 GHz, a measurement of 3 meters was used. For frequencies below 1 GHz, a measurement distance of 10 meters was used.

Correction Factor = Antenna Factor + Cable Loss - Pre-Amplifier Gain, 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. All emissions me the limits specified in § 15.407(b). Representative band edge plots are included in this report. See Annex for Conducted Band edge plots.

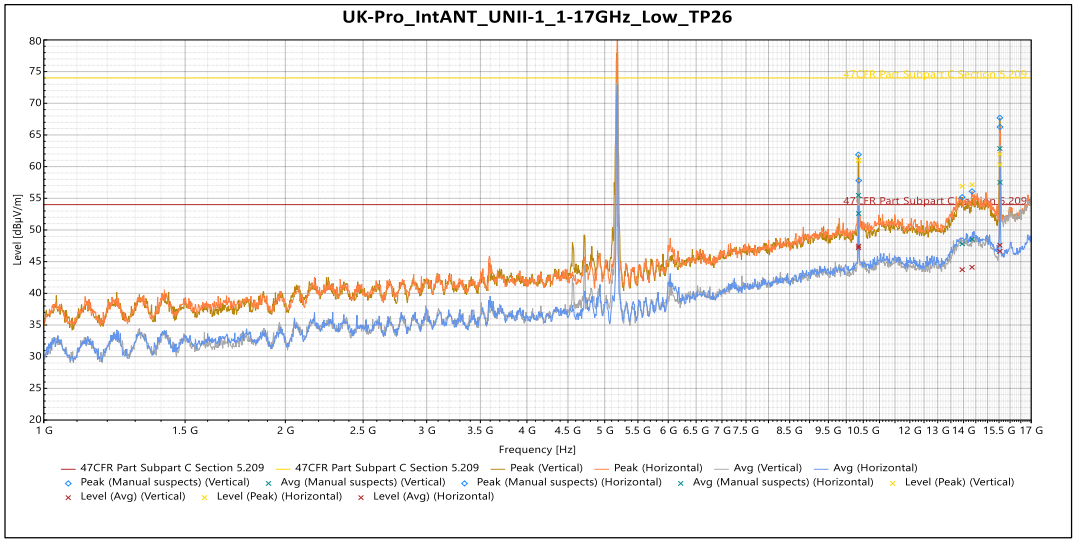
Internal Antenna



QuasiPeak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
37.726 MHz	31.084	39	-7.916	98	1.019	Vertical	-14.6
48.139 MHz	31.043	39	-7.957	76	2.405	Vertical	-12.303
54.963 MHz	29.877	39	-9.123	306	3.932	Vertical	-12.674
86.879 MHz	30.788	39	-8.212	178	1.35	Vertical	-17.381
Note: No Significant emissions were observed in the horizontal orientation of the antenna							

Table 4: Radiated Emissions 30 – 1000 MHz



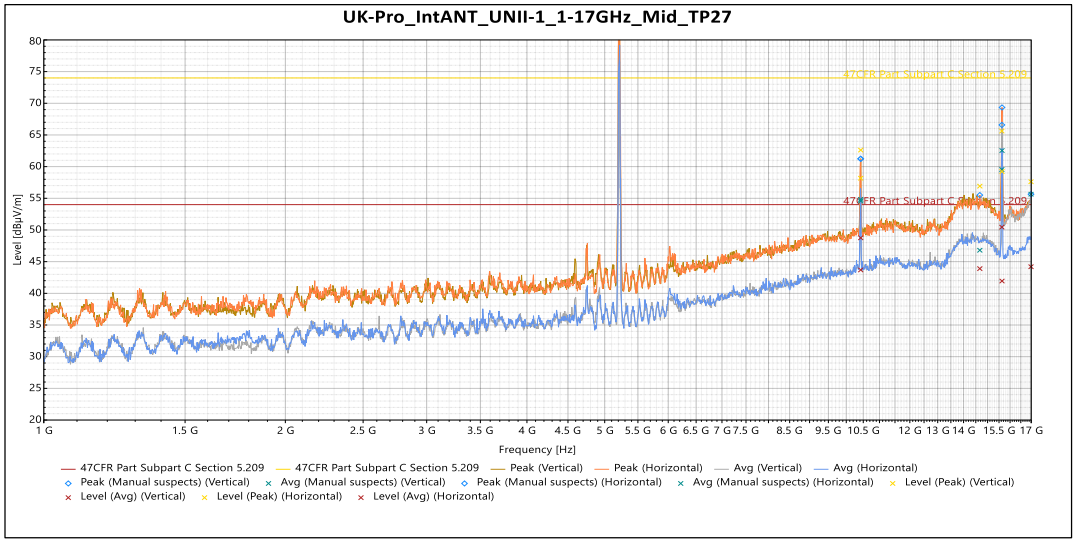
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.355 GHz	60.984	74	-13.016	22	2.65	Vertical	6.525
13.946 GHz	56.895	74	-17.105	8	1.643	Vertical	11.084
15.539 GHz	61.954	74	-12.046	31	2.645	Vertical	9.51
10.362 GHz	60.998	74	-13.002	52	1.638	Horizontal	6.587
14.346 GHz	57.137	74	-16.863	279	1.643	Horizontal	11.833
15.544 GHz	60.279	74	-13.721	328	3.153	Horizontal	9.501

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.355 GHz	47.193	54	-6.807	22	2.65	Vertical	6.525
13.946 GHz	43.736	54	-10.264	8	1.643	Vertical	11.084
15.539 GHz	47.587	54	-6.413	31	2.645	Vertical	9.51
10.362 GHz	47.45	54	-6.55	52	1.638	Horizontal	6.587
14.346 GHz	44.109	54	-9.891	279	1.643	Horizontal	11.833
15.544 GHz	46.625	54	-7.375	328	3.153	Horizontal	9.501

Table 5: Radiated Emissions 1 – 17 GHz Transmitting on the Lowest Frequency



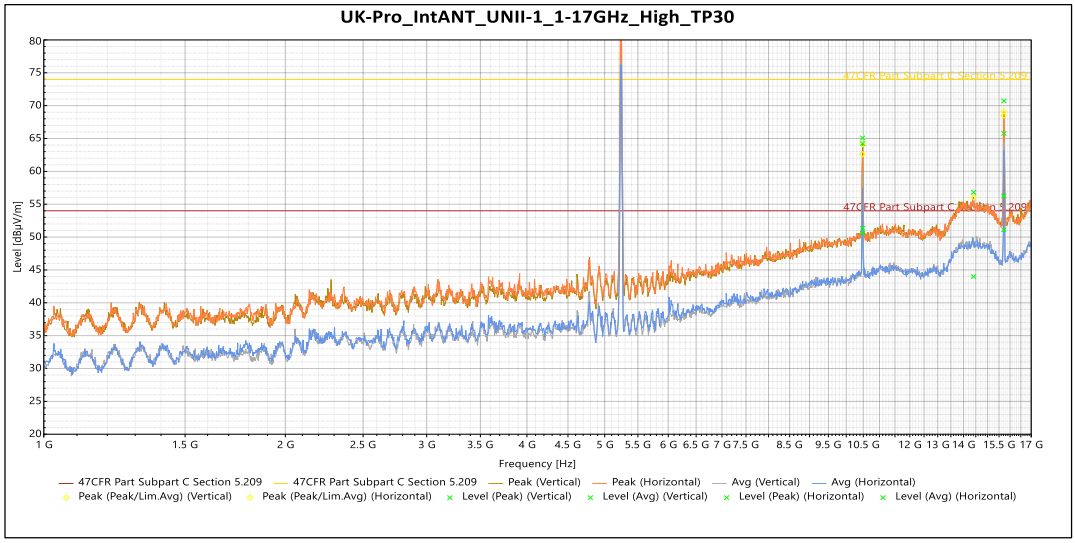
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.423 GHz	62.607	74	-11.393	38	2.816	Vertical	6.956
15.627 GHz	65.61	74	-8.39	76	1.5	Vertical	9.307
16.991 GHz	57.624	74	-16.376	227	4	Vertical	13.514
10.422 GHz	58.171	74	-15.829	186	3.798	Horizontal	6.954
14.67 GHz	56.921	74	-17.079	19	2.816	Horizontal	11.677
15.634 GHz	59.226	74	-14.774	325	3.149	Horizontal	9.272

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.423 GHz	48.756	54	-5.244	38	2.816	Vertical	6.956
15.627 GHz	50.454	54	-3.546	76	1.5	Vertical	9.307
16.991 GHz	44.201	54	-9.799	227	4	Vertical	13.514
10.422 GHz	43.689	54	-10.311	186	3.798	Horizontal	6.954
14.67 GHz	43.9	54	-10.1	19	2.816	Horizontal	11.677
15.634 GHz	41.942	54	-12.058	325	3.149	Horizontal	9.272

Table 6: Radiated Emissions 1 – 17 GHz Transmitting on the Middle Frequency



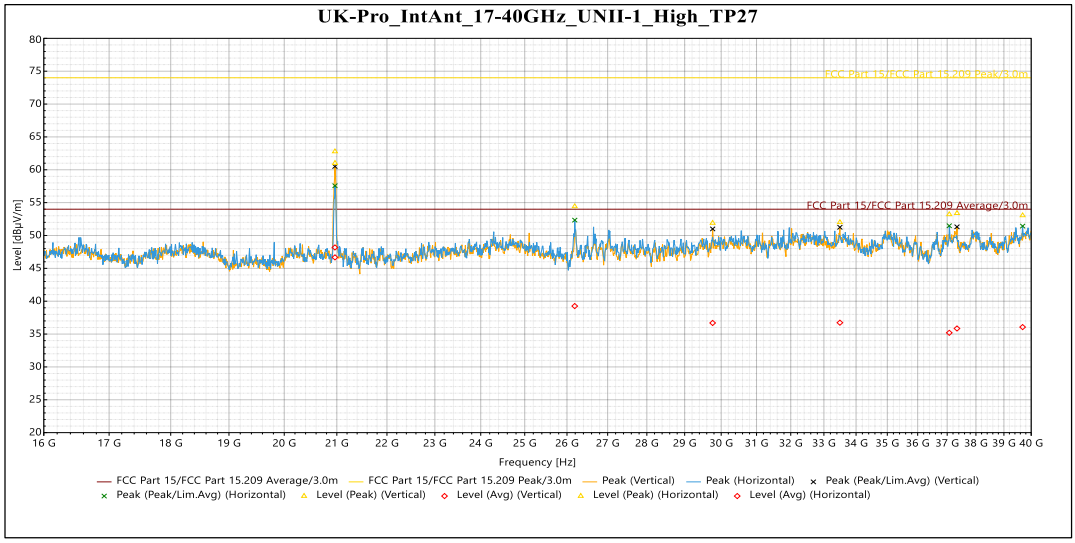
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.481 GHz	65.091	74	-8.909	6	1.643	Vertical	6.85
14.409 GHz	56.814	74	-17.186	73	3.652	Vertical	11.973
15.717 GHz	70.723	74	-3.277	55	3.802	Vertical	9.257
10.479 GHz	64.229	74	-9.771	2	1.638	Horizontal	6.857
15.717 GHz	65.773	74	-8.227	45	3.149	Horizontal	9.257

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.481 GHz	51.341	54	-2.659	6	1.643	Vertical	6.85
14.409 GHz	43.981	54	-10.019	73	3.652	Vertical	11.973
15.717 GHz	56.25	54	2.25	55	3.802	Vertical	9.257
10.479 GHz	50.56	54	-3.44	2	1.638	Horizontal	6.857
15.717 GHz	51.107	54	-2.893	45	3.149	Horizontal	9.257

Table 7: Radiated Emissions 1 – 17 GHz Transmitting on the Highest Frequency



Peak

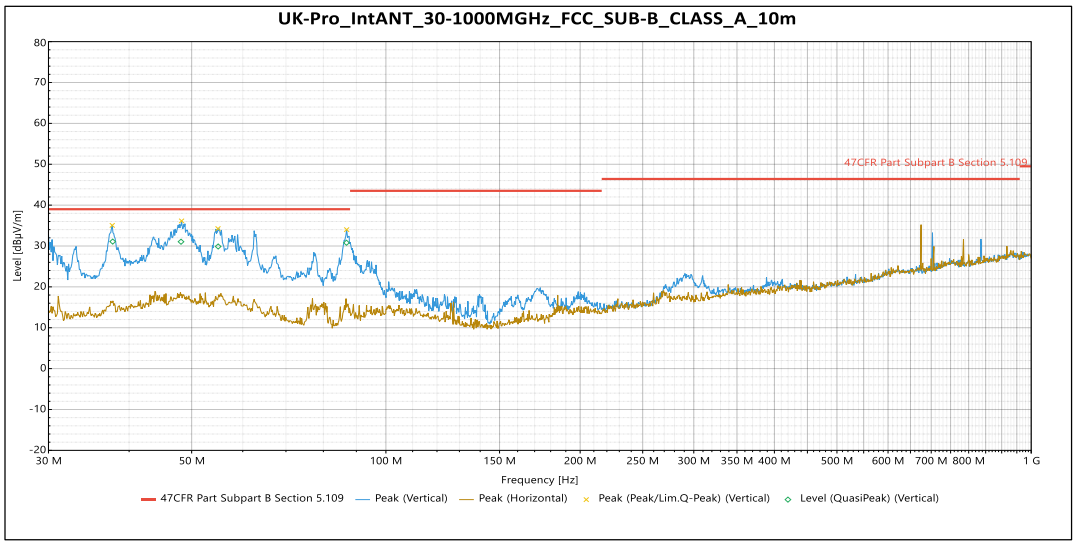
Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.963 GHz	62.783	74	-11.217	60	Vertical	0.391
29.763 GHz	51.9	74	-22.1	262	Vertical	1.179
33.494 GHz	52	74	-22	19	Vertical	2.348
37.338 GHz	53.386	74	-20.614	80	Vertical	3.976
20.964 GHz	61.012	74	-12.988	55	Horizontal	0.407
26.188 GHz	54.422	74	-19.578	348	Horizontal	0.395
37.072 GHz	53.206	74	-20.794	32	Horizontal	4.087
39.683 GHz	53.053	74	-20.947	57	Horizontal	2.772

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.963 GHz	48.184	54	-5.816	60	Vertical	0.391
29.763 GHz	36.695	54	-17.305	262	Vertical	1.179
33.494 GHz	36.731	54	-17.269	19	Vertical	2.348
37.338 GHz	35.847	54	-18.153	80	Vertical	3.976
20.964 GHz	46.673	54	-7.327	55	Horizontal	0.407
26.188 GHz	39.263	54	-14.737	348	Horizontal	0.395
37.072 GHz	35.192	54	-18.808	32	Horizontal	4.087
39.683 GHz	36.065	54	-17.935	57	Horizontal	2.772

Table 8: Radiated Emissions 17 – 40 GHz on the Highest Frequency (worse case)

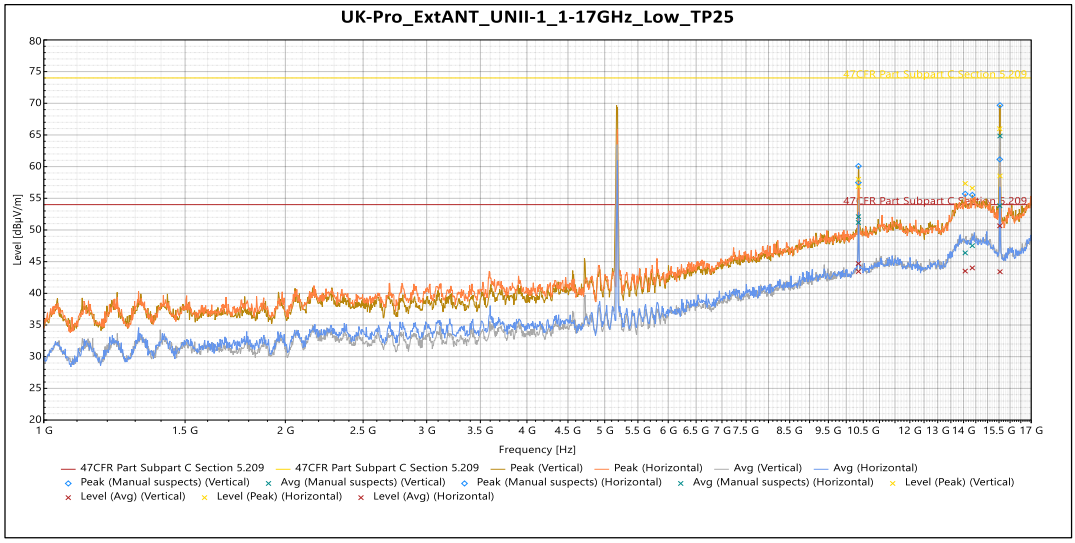
External Antenna



QuasiPeak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin	Azimuth (°)	Height	Pol.	Correction (dB)
37.726 MHz	31.084	39	-7.916	98	1.019	Vertical	-14.6
48.139 MHz	31.043	39	-7.957	76	2.405	Vertical	-12.303
54.963 MHz	29.877	39	-9.123	306	3.932	Vertical	-12.674
86.879 MHz	30.788	39	-8.212	178	1.35	Vertical	-17.381
Note: No Significant emissions were observed in the horizontal orientation of the antenna							

Table 9: Radiated Emissions 30 – 1000 MHz



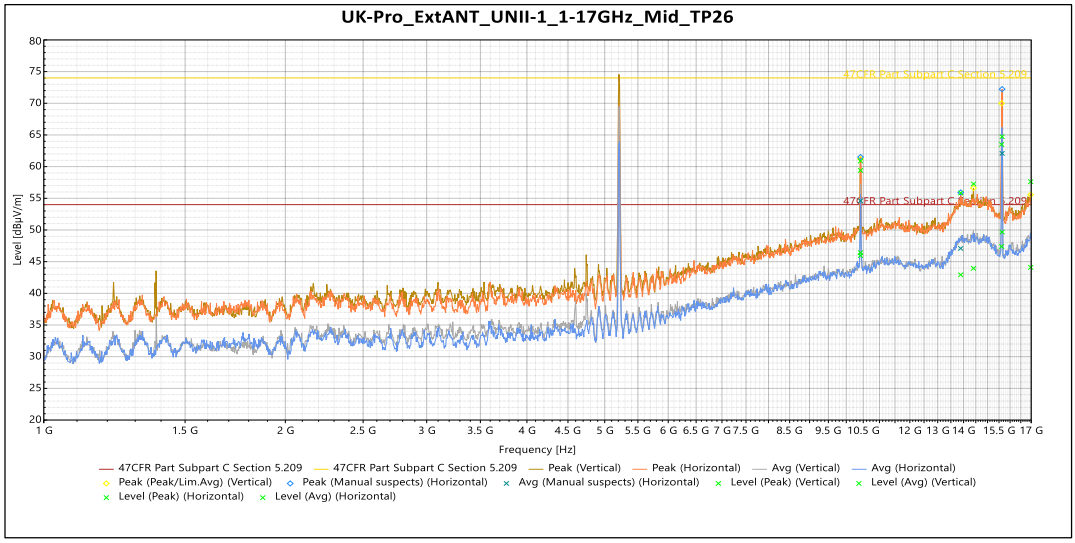
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.357 GHz	56.838	74	-17.162	20	3.149	Vertical	6.542
14.357 GHz	56.6	74	-17.4	330	2.325	Vertical	11.919
15.545 GHz	58.528	74	-15.472	80	2.645	Vertical	9.499
10.355 GHz	57.998	74	-16.002	13	3.154	Horizontal	6.525
14.068 GHz	57.339	74	-16.661	260	3.311	Horizontal	11.107
15.534 GHz	65.977	74	-8.023	110	3.311	Horizontal	9.52

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.357 GHz	43.45	54	-10.55	20	3.149	Vertical	6.542
14.357 GHz	44.012	54	-9.988	330	2.325	Vertical	11.919
15.545 GHz	43.409	54	-10.591	80	2.645	Vertical	9.499
10.355 GHz	44.697	54	-9.303	13	3.154	Horizontal	6.525
14.068 GHz	43.514	54	-10.486	260	3.311	Horizontal	11.107
15.534 GHz	50.65	54	-3.35	110	3.311	Horizontal	9.52

Table 10: Radiated Emissions 1 – 17 GHz Transmitting on the Lowest Frequency



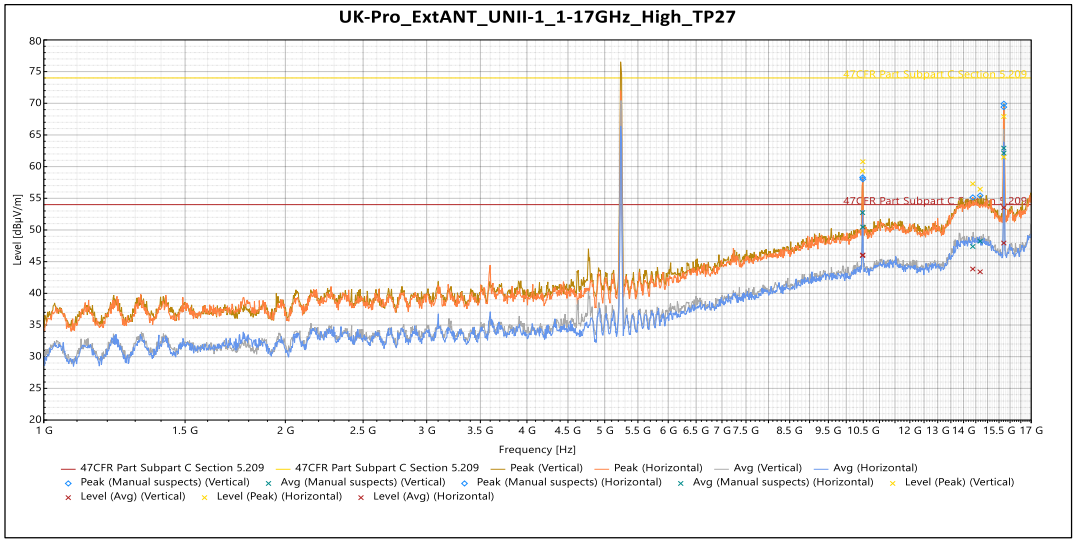
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.416 GHz	60.895	74	-13.105	36	3.802	Vertical	6.938
14.405 GHz	57.27	74	-16.73	106	3.802	Vertical	12.006
15.617 GHz	63.5	74	-10.5	39	3.311	Vertical	9.356
17 GHz	57.617	74	-16.383	257	3.311	Vertical	13.493
10.417 GHz	59.388	74	-14.612	74	2.816	Horizontal	6.941
13.887 GHz	55.834	74	-18.166	312	3.311	Horizontal	10.84
15.639 GHz	64.725	74	-9.275	42	3.153	Horizontal	9.248

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.416 GHz	46.417	54	-7.583	36	3.802	Vertical	6.938
14.405 GHz	43.94	54	-10.06	106	3.802	Vertical	12.006
15.617 GHz	47.391	54	-6.609	39	3.311	Vertical	9.356
17 GHz	44.103	54	-9.897	257	3.311	Vertical	13.493
10.417 GHz	45.967	54	-8.033	74	2.816	Horizontal	6.941
13.887 GHz	42.929	54	-11.071	312	3.311	Horizontal	10.84
15.639 GHz	49.673	54	-4.327	42	3.153	Horizontal	9.248

Table 11: Radiated Emissions 1 – 17 GHz Transmitting on the Middle Frequency



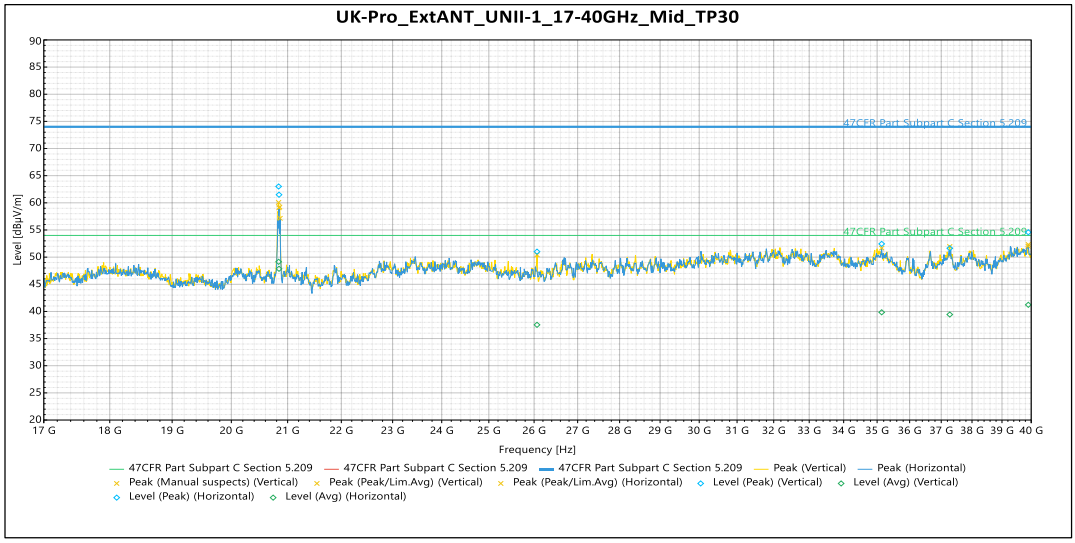
Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.487 GHz	60.784	74	-13.216	44	1.643	Vertical	6.844
14.684 GHz	56.438	74	-17.562	218	1.638	Vertical	11.627
15.717 GHz	67.911	74	-6.089	50	2.65	Vertical	9.257
10.478 GHz	59.286	74	-14.714	81	1.643	Horizontal	6.861
14.377 GHz	57.288	74	-16.712	118	4	Horizontal	11.978
15.715 GHz	61.502	74	-12.498	165	3.802	Horizontal	9.256

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	Correction (dB)
10.487 GHz	46.052	54	-7.948	44	1.643	Vertical	6.844
14.684 GHz	43.398	54	-10.602	218	1.638	Vertical	11.627
15.717 GHz	53.534	54	-0.466	50	2.65	Vertical	9.257
10.478 GHz	45.975	54	-8.025	81	1.643	Horizontal	6.861
14.377 GHz	43.838	54	-10.162	118	4	Horizontal	11.978
15.715 GHz	47.943	54	-6.057	165	3.802	Horizontal	9.256

Table 12: Radiated Emissions 1 – 17 GHz Transmitting on the Highest Frequency



Peak

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.837 GHz	63.014	74	-10.986	83	Vertical	-0.92
26.066 GHz	51.011	74	-22.989	1	Vertical	-2.012
37.275 GHz	51.635	74	-22.365	171	Vertical	3.503
20.844 GHz	61.488	74	-12.512	319	Horizontal	-0.944
35.139 GHz	52.439	74	-21.561	7	Horizontal	2.826
39.9 GHz	54.575	74	-19.425	25	Horizontal	2.523

Avg

Frequency	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Pol.	Correction (dB)
20.837 GHz	49.139	54	-4.861	83	Vertical	-0.92
26.066 GHz	37.533	54	-16.467	1	Vertical	-2.012
37.275 GHz	39.43	54	-14.57	171	Vertical	3.503
20.844 GHz	47.853	54	-6.147	319	Horizontal	-0.944
35.139 GHz	39.84	54	-14.16	7	Horizontal	2.826
39.9 GHz	41.221	54	-12.779	25	Horizontal	2.523

Table 13: Radiated Emissions 17 – 40 GHz on the Middle Frequency (worse case)

5.6 §15.407(a) Maximum Power Spectral Density

All chains were measured and summed under the guidance of KDB 789033 Section II. F. and KDB 66291 D01. Please see associated annex for details on instrument settings.

The maximum average power spectral density conducted from the intentional radiator of the antenna shall not be greater than 17 dBm in any 1 MHz band during any time interval of continuous transmission.

As per KDB 662911, When the EUT is using spatial-multiplexing in HE modes, there is no additional array gain to accommodate. When the EUT uses Nss=1 data rates; the internal antenna gain is 12.5 dBi + Array gain of 3.01 dB which is a total of 15.51 dBi; the external antenna gain is 4.57 dBi + Array gain of 3.01 dB which is a total of 7.58 dBi.

Results of this testing are summarized.

5.6.1 Internal Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Nss2-Mcs0	19	4.96
OFDM 20	5210	Nss2-Mcs0	22	8.23
OFDM 20	5240	Nss2-Mcs0	21	7.46
HE 20	5180	Nss2-Mcs0	18	3.74
HE 20	5210	Nss2-Mcs0	22	7.76
HE 20	5240	Nss2-Mcs0	22	6.97
HE 40	5190	Nss2-Mcs0	17	-0.16
HE 40	5230	Nss2-Mcs0	20	2.96
HE 80	5210	Nss2-Mcs0	18	-2.38

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Nss1-Mcs0	19	5.18
OFDM 20	5210	Nss1-Mcs0	19	5.81
OFDM 20	5240	Nss1-Mcs0	18	5.02
HE 20	5180	Nss1-Mcs0	18	4.28
HE 20	5210	Nss1-Mcs0	19	5.37
HE 20	5240	Nss1-Mcs0	18	4.65

HE 40	5190	Nss1-Mcs0	17	0.65
HE 40	5230	Nss1-Mcs0	18	1.90
HE 80	5210	Nss1-Mcs0	18	-1.62

5.6.2 External Antenna

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Nss2-Mcs0	22	8.42
OFDM 20	5210	Nss2-Mcs0	26	11.92
OFDM 20	5240	Nss2-Mcs0	27	12.79
HE 20	5180	Nss2-Mcs0	20	5.85
HE 20	5210	Nss2-Mcs0	23	8.79
HE 20	5240	Nss2-Mcs0	26	11.47
HE 40	5190	Nss2-Mcs0	18	1.01
HE 40	5230	Nss2-Mcs0	21	4.18
HE 80	5210	Nss2-Mcs0	18	-2.18

Modulation (BW)	Frequency (MHz)	Data Rate	TP Setting	Measured PSD
OFDM 20	5180	Nss1-Mcs0	22	8.42
OFDM 20	5210	Nss1-Mcs0	26	11.92
OFDM 20	5240	Nss1-Mcs0	27	12.79
HE 20	5180	Nss1-Mcs0	20	5.85
HE 20	5210	Nss1-Mcs0	23	8.79
HE 20	5240	Nss1-Mcs0	26	11.47
HE 40	5190	Nss1-Mcs0	18	1.01
HE 40	5230	Nss1-Mcs0	21	4.18
HE 80	5210	Nss1-Mcs0	18	-2.18

Result

The maximum summed average power spectral density was less than the limit of 10.5 dBm (Nss1 7.49) for the internal antenna and 17dBm for the external antenna; therefore, the EUT complies with the specification.

-- End of Test Report --