



427 West 12800 South  
Draper, UT 84020

## Test Report Certification

|                                  |                          |
|----------------------------------|--------------------------|
| <b>FCC ID</b>                    | SWX-UKU                  |
| <b>IC ID</b>                     | 6545A-UKU                |
| <b>Equipment Under Test</b>      | UK-Ultra                 |
| <b>Test Report Serial Number</b> | TR8447_03                |
| <b>Date of Tests</b>             | 9-10, 11, 14 August 2023 |
| <b>Report Issue Date</b>         | 18 December 2023         |

| <b>Test Specification</b>     | <b>Applicant</b>  |
|-------------------------------|---|
| 47 CFR FCC Part 15, Subpart C | Ubiquiti Inc.<br>685 Third Avenue<br>New York, NY 10017<br>U.S.A. |



NVLAP LAB CODE 600241-0

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## 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.

|                     |               |
|---------------------|---------------|
| <b>Applicant</b>    | Ubiquiti Inc. |
| <b>Manufacturer</b> | Ubiquiti Inc. |
| <b>Brand Name</b>   | UBIQUITI      |
| <b>Model Number</b> | UK-Ultra      |
| <b>FCC ID</b>       | SWX-UKU       |
| <b>IC ID</b>        | 6545A-UKU     |

On this 18<sup>th</sup> day of December 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.

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: Kimberly Rodriguez



Reviewed By: Richard L. Winter

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| <b>Revision History</b> |  |                      |
|-------------------------|--|----------------------|
| <b>Revision</b>         | <b>Description</b>   | <b>Date</b>          |
| 01                      | Original Report Release  | 25 August 2023       |
| 02                      | Amend IC ID Number on Title Page and Page 2                            | 28 November 2023     |
| 03                      | Added 3 <sup>rd</sup> Antenna test data to section 5.1, 5.3, 5.4 & 5.6 | 18 December 18, 2023 |

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# 1 Client Information

## 1.1 Applicant

|                     |   |
|---------------------|---|
| <b>Company</b>      | Ubiquiti Inc.<br>685 Third Avenue<br>New York, NY 10017<br>U.S.A. |
| <b>Contact Name</b> | Alex Macon  |
| <b>Title</b>        | Compliance  |

## 1.2 Manufacturer

|                     |   |
|---------------------|---|
| <b>Company</b>      | Ubiquiti Inc.<br>685 Third Avenue<br>New York, NY 10017<br>U.S.A. |
| <b>Contact Name</b> | Alex Macon  |
| <b>Title</b>        | Compliance  |

## 2 Equipment Under Test (EUT)

### 2.1 Identification of EUT

|                        |                  |
|------------------------|------------------|
| <b>Brand Name</b>      | UBIQUITI         |
| <b>Model Number</b>    | UK-Ultra         |
| <b>Serial Number</b>   | 077-M5ELV7       |
| <b>Dimensions (cm)</b> | 13.7 x 8.4 x 3.4 |

### 2.2 Description of EUT

The UK-Ultra is a WiFi mesh that provides simultaneous, dual-band, 2x2 MIMO technology. The UK-Ultra is used to expand the coverage of an UniFi system. The UK-Ultra provides 802.11ac technology for ubiquitous WiFi coverage for both indoor and outdoor use. The UK-Ultra is power from a 48 volt PoE adapter POE-24-12W-G-WH.

This report covers the circuitry of the 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.

| <b>Brand Name<br/>Model Number<br/>Serial Number</b>    | <b>Description</b>    | <b>Name of Interface Ports /<br/>Interface Cables</b> |
|---|-----------------------|---|
| BN: UBIQUITI<br>MN: UK-Ultra (Note 1)<br>SN: 077-M5ELV7 | Wireless Access Point | See Section 2.4                                       |
| BN: UBIQUITI<br>MN: U-POE-af<br>SN: N/A                 | PoE Power Adapter     | Shielded or Un-shielded cat 5e<br>cable / < 3 meters  |
| BN: Dell<br>MN: XPS 13<br>SN: N/A                       | Laptop Computer       | Shielded or Un-shielded cat 5e<br>cable / < 3 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/80cm                   |
| PoE (PoE Injector) | 1                          | Shielded or Un-shielded cat 5e cable/8 meters |
| LAN (PoE Injector) | 1                          | Shielded or Un-shielded cat 5e cable/1 meters |

## 2.5 Operating Environment

|                            |                              |
|----------------------------|------------------------------|
| <b>Power Supply</b>        | 120 Volts AC to 48 Volts PoE |
| <b>AC Mains Frequency</b>  | 60 Hz                        |
| <b>Temperature</b>         | 25.2 – 26.8 °C               |
| <b>Humidity</b>            | 32.6 – 44.4 %                |
| <b>Barometric Pressure</b> | 1015 mBar                    |

## 2.6 Operating Modes

The UK-Ultra was connected to a personal computer laptop and tested using test software in order to enable to constant duty cycle greater than 98% of the WiFi transceiver. All emission modes of 802.11 b/g/n/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

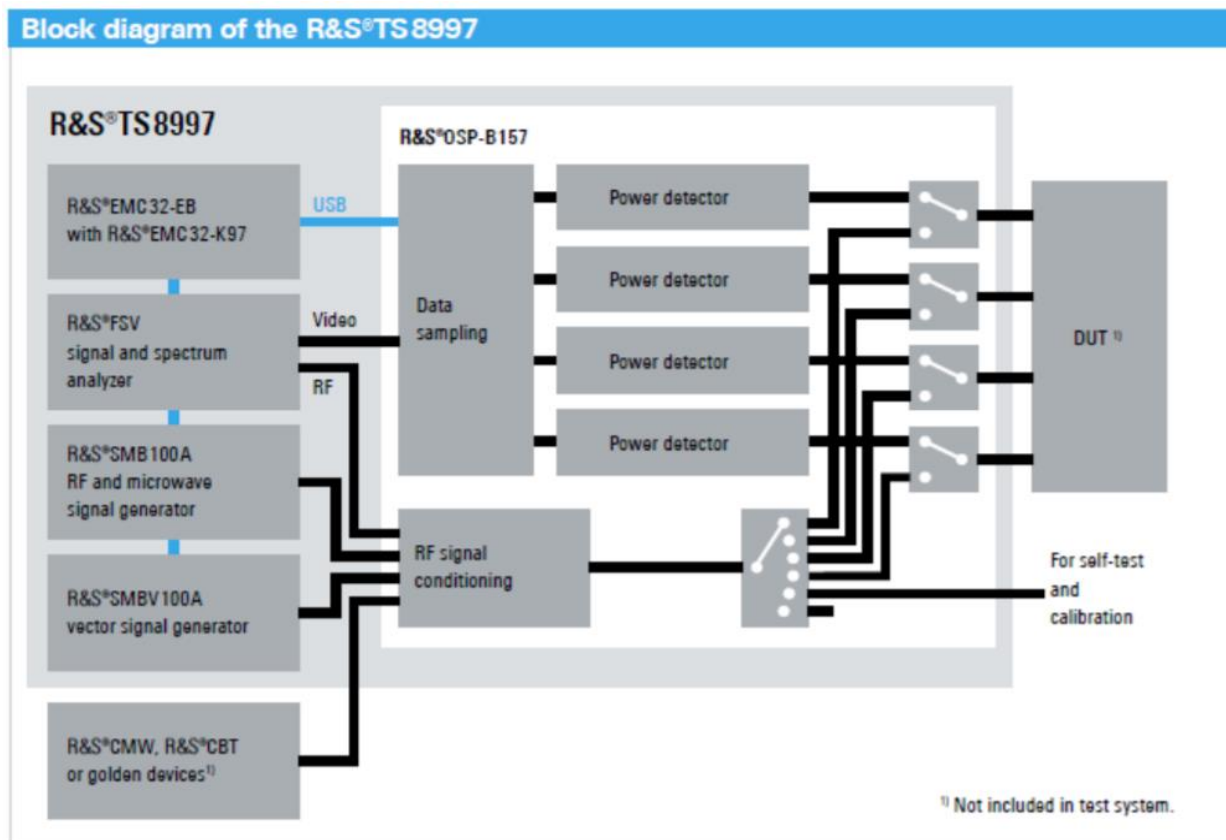


Diagram 1: Test Configuration Block Diagram

## 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

|                        |   |
|------------------------|---|
| <b>Title</b>           | 47 CFR FCC Part 15, Subpart C<br>15.203, 15.207 and 15.247<br>Limits and methods of measurement of radio interference characteristics of radio frequency devices. |
| <b>Purpose of Test</b> | 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                | 2412 to 2462           | Compliant |
| 15.247(b)   | RSS-247 § 5.4 | Peak Output Power                    | 2412 to 2462           | Compliant |
| 15.247(d)   | RSS-247 § 5.4 | Antenna Conducted Spurious Emissions | 0.009 to 40000         | N/A       |
| 15.247(d)   | RSS-247 § 5.4 | Radiated Spurious Emissions          | 0.009 to 40000         | Compliant |
| 15.247(e)   | RSS-247 § 5.2 | Peak Power Spectral Density          | 2412 to 2462           | 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 chamber 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-6754     | 2/22/2023                | 2/27/2024               |
| LISN              | AFJ                 | LS16C/10     | UCL-6749     | 12/6/2021                | 12/6/2023               |
| 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

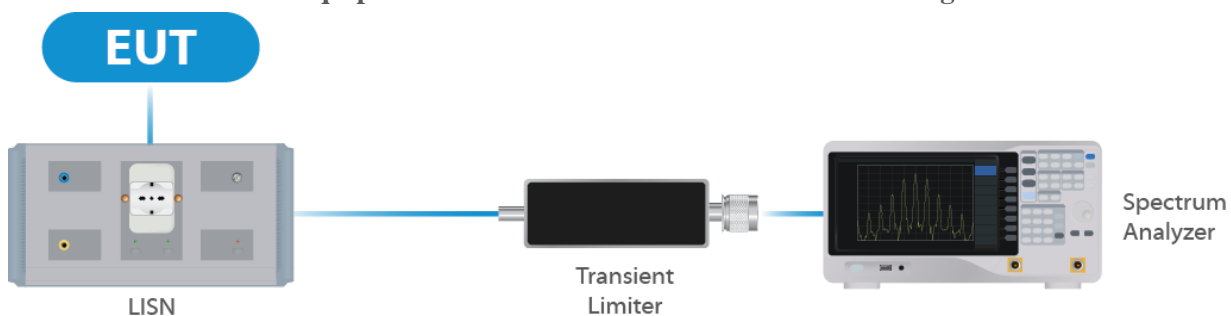


Figure 1: Conducted Emissions Test

### 4.2 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     | 11/7/2022                | 11/7/2023               |
| 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                | 2/22/2024               |
| 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

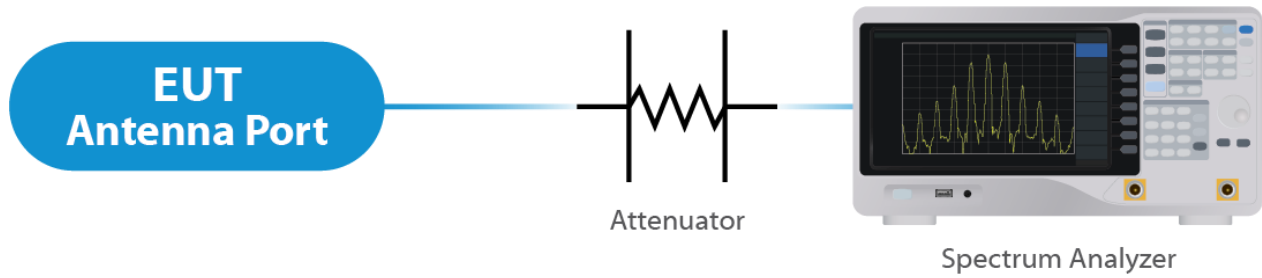


Figure 2: Direct Connect at the Antenna Port Test

### 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     | 1274/2023                | 1274/2024               |
| Pre-Amplifier<br>9 kHz – 1 GHz | Sonoma Instruments | 310N         | UCL-2889     | 10/7/2021                | 10/7/2023               |
| 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     | 12/9/2022                | 12/9/2023               |
| Test Software                  | UCL                | Revision 1   | UCL-3108     | N/A                      | N/A                     |

Table 3: List of equipment used for Radiated Emissions

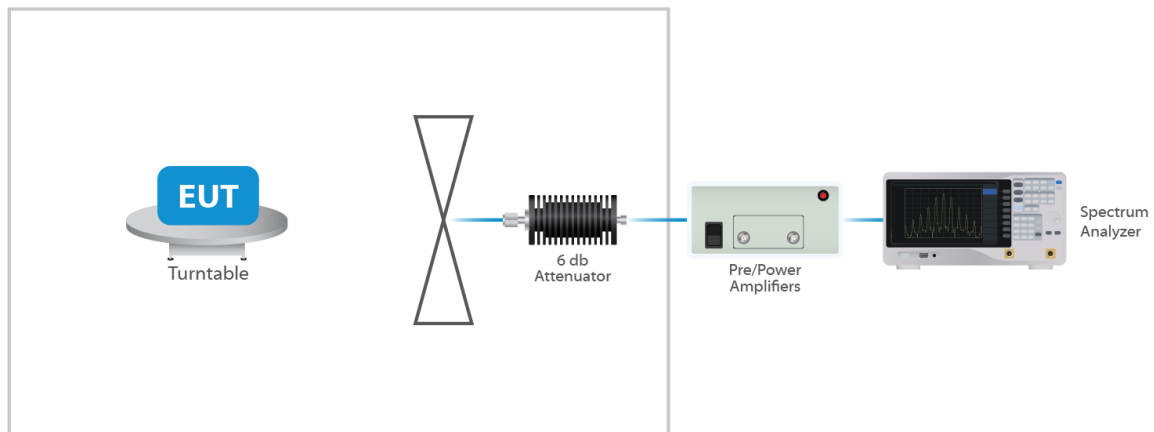


Figure 3: Radiated Emissions Test

## 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 ( $\pm$ 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             |
| <b>Direct Connect Tests</b>           | <b>K Factor</b>         | <b>Value</b>   |
| 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 has 3 antenna options, an integral antenna, external omni antenna and an external panel antenna. As per the manufacturer, the maximum gain of the integral antenna per chain is 4.7 dBi, the omni antenna has a gain of 3.59dBi and the panel antenna has a gain of 10dBi . This is an 802.11 device and utilizes CDD as described in KDB 662911 D01. The antenna is not user replaceable.

For power measurements on IEEE 802.11 devices, Array Gain = 0 dB for  $N_{ANT} \leq 4$ ;

For PSD measurements Array Gain =  $10 \log(N_{ANT}/N_{SS})$  dB = 3.01dB

Integral Antenna Directional Gain = 7.71 (4.7 + 3.01)

Omni Antenna Directional Gain = 6.6 (3.59 + 3.01)

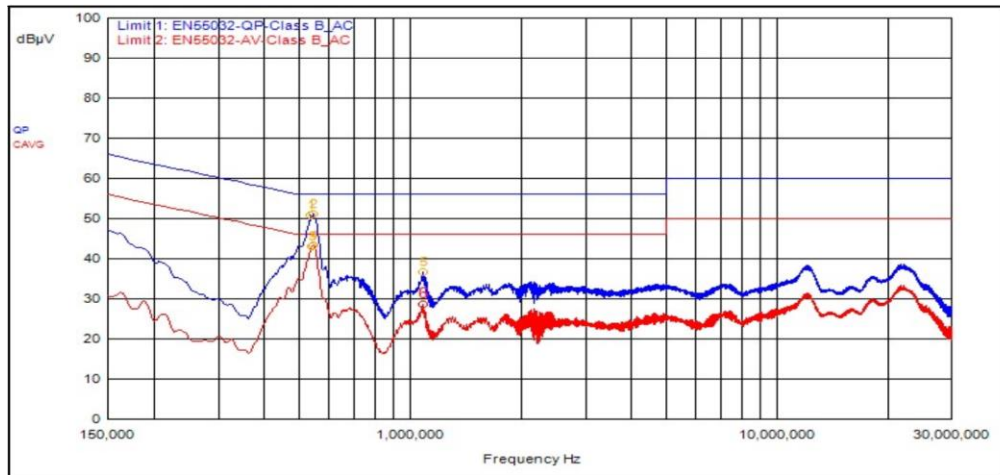
Panel Antenna Directional Gain = 13.01 (10 + 3.01)

#### Results

The EUT complied with the specification.

## 5.2 Conducted Emissions at Mains Ports Data

### Hot Lead



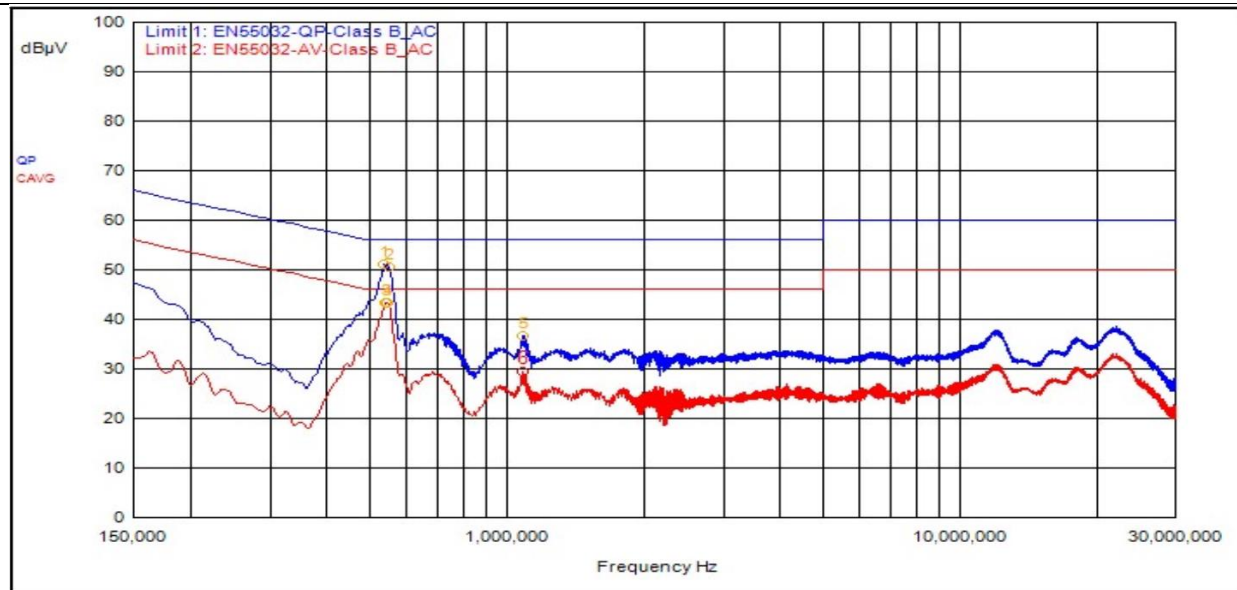
| ID | Frequency  | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit 1 | Limit 1 Dist. | Limit 2 | Limit 2 Dist. | P/F |
|----|------------|-------|-------|--------|----------|------------|------------|---------|---------------|---------|---------------|-----|
| MU | MHz        | dB    | dB    | dB     | Type     | dBµV       | dBµV       | dBµV    | dB            | dBµV    | dB            | P/F |
| 2  | 543,000kHz | 9.49  | 0.00  |        | QPeak    | 41.71      | 51.20      | 56.00   | -4.80         |         |               |     |
| 1  | 537,000kHz | 9.49  | 0.00  |        | QPeak    | 41.29      | 50.78      | 56.00   | -5.22         |         |               |     |
| 5  | 1.086      | 9.58  | 0.00  |        | QPeak    | 26.96      | 36.54      | 56.00   | -19.46        |         |               |     |
| 3  | 540,000kHz | 9.49  | 0.00  |        | C_AVG    | 33.68      | 43.17      |         |               | 46.00   | -2.83         |     |
| 4  | 546,000kHz | 9.49  | 0.00  |        | C_AVG    | 33.80      | 43.29      |         |               | 46.00   | -2.71         |     |
| 6  | 1.086      | 9.58  | 0.00  |        | C_AVG    | 18.98      | 28.56      |         |               | 46.00   | -17.44        |     |

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit: therefore, the EUT was deemed to meet both the average and quasi-peak limits.

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Note 3: The device the transceiver is in is a Class A device and the limits shown are from §15.207 which are the same as the limits for a Class B device under §15.107. These emissions were investigated and were found to be at the same level regardless of whether the transceivers of the device were not powered, powered and idle, or powered and active, therefore, the conducted emissions of the transceivers were deemed compliant with the requirements of the standard.

### Neutral Lead



| 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  | 537,000kHz | 9.62  | 0.00  |        | QPeak    | 41.42      | 51.04      | 56.00   | -4.96         |         |               |     |
| 2  | 549,000kHz | 9.62  | 0.00  |        | QPeak    | 41.06      | 50.68      | 56.00   | -5.32         |         |               |     |
| 5  | 1.086      | 9.56  | 0.00  |        | QPeak    | 27.15      | 36.71      | 56.00   | -19.29        |         |               |     |
| 3  | 540,000kHz | 9.62  | 0.00  |        | C_AVG    | 33.68      | 43.30      |         |               | 46.00   | -2.70         |     |
| 4  | 546,000kHz | 9.62  | 0.00  |        | C_AVG    | 33.65      | 43.27      |         |               | 46.00   | -2.73         |     |
| 6  | 1.086      | 9.56  | 0.00  |        | C_AVG    | 19.86      | 29.42      |         |               | 46.00   | -16.58        |     |

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit: therefore, the EUT was deemed to meet both the average and quasi-peak limits.

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Note 3: The device the transceiver is in is a Class A device and the limits shown are from §15.207 which are the same as the limits for a Class B device under §15.107. These emissions were investigated and were found to be at the same level regardless of whether the transceivers of the device were not powered, powered and idle, or powered and active, therefore, the conducted emissions of the transceivers were deemed compliant with the requirements of the standard.

## Result

The EUT complied with the specification limit.



### 5.3 §15.247(a)(2) Emissions Bandwidth

All chains were measured under the guidance of KDB 558074 Section 8.2. and KDB 66291 D01. Please see associated annex for details on instrument settings.

#### Integral Antenna

| Mode | Frequency (MHz) | 99% Bandwidth (MHz) | 6 dB Bandwidth (MHz) |
|------|-----------------|---------------------|----------------------|
| b 20 | 2412            | 11.50               | 7.15                 |
|      | 2437            | 11.40               | 7.15                 |
|      | 2462            | 11.70               | 7.65                 |
| g 20 | 2412            | 16.20               | 15.50                |
|      | 2437            | 16.20               | 15.50                |
|      | 2462            | 16.20               | 15.75                |
| n 20 | 2412            | 17.40               | 16.10                |
|      | 2437            | 17.50               | 12.75                |
|      | 2462            | 17.30               | 16.05                |
| n 40 | 2422            | 36.00               | 32.85                |
|      | 2437            | 36.00               | 31.40                |
|      | 2452            | 35.75               | 30.35                |

#### Omni Antenna

| Mode | Frequency (MHz) | 99% Bandwidth (MHz) | 6 dB Bandwidth (MHz) |
|------|-----------------|---------------------|----------------------|
| b 20 | 2412            | 11.7                | 7.15                 |
|      | 2437            | 12.7                | 7.15                 |
|      | 2462            | 12.2                | 7.15                 |
| g 20 | 2412            | 16.2                | 16.1                 |
|      | 2437            | 16.1                | 13.9                 |
|      | 2462            | 16.1                | 15.15                |
| n 20 | 2412            | 17.3                | 17.0                 |
|      | 2437            | 17.2                | 16.05                |
|      | 2462            | 17.5                | 16.1                 |
| n 40 | 2422            | 36.0                | 15.25                |
|      | 2437            | 36.0                | 23.65                |
|      | 2452            | 35.75               | 20.45                |

**Panel Antenna**

| <b>Mode</b> | <b>Frequency (MHz)</b> | <b>99% Bandwidth (MHz)</b> | <b>6 dB Bandwidth (MHz)</b> |
|-------------|------------------------|----------------------------|-----------------------------|
| b 20        | 2412                   | 11.8                       | 6.7                         |
|             | 2437                   | 11.7                       | 6.7                         |
|             | 2462                   | 11.6                       | 6.2                         |
| g 20        | 2412                   | 16.3                       | 15.8                        |
|             | 2437                   | 16.3                       | 14.9                        |
|             | 2462                   | 16.3                       | 15.15                       |
| n 20        | 2412                   | 17.2                       | 12.85                       |
|             | 2437                   | 17.3                       | 14.9                        |
|             | 2462                   | 17.3                       | 13.9                        |
| n 40        | 2422                   | 36.0                       | 28.65                       |
|             | 2437                   | 36.0                       | 30.2                        |
|             | 2452                   | 36.0                       | 21.4                        |

**Result**

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

In the configuration tested, the 6dB 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

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.

The maximum average RF conducted output power measured for this device was 21.33 dBm or 135.83 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The Integral antenna has a gain of 4.7 dBi.

### Integral Antenna

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
| b 20            | 2412            | Mcs0      | 17         | 21.32                    | 26.02         |
|                 | 2417            | Mcs0      | 17         | 21.20                    | 25.90         |
|                 | 2422            | Mcs0      | 17         | 20.50                    | 25.20         |
|                 | 2427            | Mcs0      | 17         | 21.24                    | 25.94         |
|                 | 2432            | Mcs0      | 17         | 21.33                    | 26.03         |
|                 | 2437            | Mcs0      | 17         | 21.28                    | 25.98         |
|                 | 2442            | Mcs0      | 16         | 20.13                    | 24.83         |
|                 | 2447            | Mcs0      | 16         | 20.42                    | 25.12         |
|                 | 2452            | Mcs0      | 16         | 20.15                    | 24.85         |
|                 | 2457            | Mcs0      | 16         | 20.44                    | 25.14         |
| g 20            | 2412            | Mcs0      | 14         | 18.11                    | 22.81         |
|                 | 2417            | Mcs0      | 14         | 18.27                    | 22.97         |
|                 | 2422            | Mcs0      | 15         | 19.11                    | 23.81         |
|                 | 2427            | Mcs0      | 14         | 18.14                    | 22.84         |
|                 | 2432            | Mcs0      | 14         | 18.19                    | 22.89         |
|                 | 2437            | Mcs0      | 16         | 20.00                    | 24.70         |
|                 | 2442            | Mcs0      | 16         | 19.77                    | 24.47         |
|                 | 2447            | Mcs0      | 16         | 20.00                    | 24.70         |
|                 | 2452            | Mcs0      | 16         | 19.79                    | 24.49         |
|                 | 2457            | Mcs0      | 16         | 19.90                    | 24.60         |
| n 20            | 2412            | Mcs0      | 17         | 20.93                    | 25.63         |
|                 | 2417            | Mcs0      | 17         | 20.86                    | 25.56         |
|                 | 2422            | Mcs0      | 17         | 20.74                    | 25.44         |
|                 | 2427            | Mcs0      | 17         | 20.71                    | 25.41         |

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
|                 | 2432            | Mcs0      | 17         | 20.49                    | 25.19         |
|                 | 2437            | Mcs0      | 17         | 20.66                    | 25.36         |
|                 | 2442            | Mcs0      | 16         | 19.46                    | 24.16         |
|                 | 2447            | Mcs0      | 16         | 19.96                    | 24.66         |
|                 | 2452            | Mcs0      | 16         | 19.73                    | 24.43         |
|                 | 2457            | Mcs0      | 16         | 19.65                    | 24.35         |
|                 | 2462            | Mcs0      | 16         | 19.59                    | 24.29         |
| n 40            | 2422            | Mcs0      | 16         | 18.90                    | 23.60         |
|                 | 2437            | Mcs0      | 17         | 19.82                    | 24.52         |
|                 | 2452            | Mcs0      | 16         | 18.70                    | 23.40         |

The maximum average RF conducted output power measured for this device was 24.26 dBm or 267 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The omni antenna has a gain of 3.59 dBi.

#### Omni Antenna

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
| b 20            | 2412            | Mcs0      | 14         | 18.11                    | 21.70         |
|                 | 2417            | Mcs0      | 15         | 19.79                    | 23.38         |
|                 | 2422            | Mcs0      | 14         | 18.09                    | 21.68         |
|                 | 2427            | Mcs0      | 15         | 20.00                    | 23.59         |
|                 | 2432            | Mcs0      | 16         | 20.55                    | 24.14         |
|                 | 2437            | Mcs0      | 21         | 24.26                    | 27.85         |
|                 | 2442            | Mcs0      | 20         | 22.71                    | 26.30         |
|                 | 2447            | Mcs0      | 20         | 23.42                    | 27.01         |
|                 | 2452            | Mcs0      | 20         | 22.51                    | 26.10         |
|                 | 2457            | Mcs0      | 20         | 23.52                    | 27.11         |
| g 20            | 2462            | Mcs0      | 20         | 23.40                    | 26.99         |
|                 | 2412            | Mcs0      | 7          | 11.75                    | 15.34         |
|                 | 2417            | Mcs0      | 7          | 11.85                    | 15.44         |
|                 | 2422            | Mcs0      | 8          | 12.92                    | 16.51         |
|                 | 2427            | Mcs0      | 8          | 12.81                    | 16.40         |
|                 | 2432            | Mcs0      | 8          | 12.78                    | 16.37         |
|                 | 2437            | Mcs0      | 9          | 13.68                    | 17.27         |

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
|                 | 2442            | Mcs0      | 13         | 17.12                    | 20.71         |
|                 | 2447            | Mcs0      | 14         | 18.17                    | 21.76         |
|                 | 2452            | Mcs0      | 14         | 17.98                    | 21.57         |
|                 | 2457            | Mcs0      | 14         | 18.06                    | 21.65         |
|                 | 2462            | Mcs0      | 14         | 17.84                    | 21.43         |
| n 20            | 2412            | Mcs0      | 9          | 13.28                    | 16.87         |
|                 | 2417            | Mcs0      | 10         | 14.79                    | 18.38         |
|                 | 2422            | Mcs0      | 10         | 14.42                    | 18.01         |
|                 | 2427            | Mcs0      | 10         | 14.66                    | 18.25         |
|                 | 2432            | Mcs0      | 10         | 14.28                    | 17.87         |
|                 | 2437            | Mcs0      | 11         | 15.42                    | 19.01         |
|                 | 2442            | Mcs0      | 14         | 18.02                    | 21.61         |
|                 | 2447            | Mcs0      | 15         | 19.07                    | 22.66         |
|                 | 2452            | Mcs0      | 16         | 19.66                    | 23.25         |
|                 | 2457            | Mcs0      | 16         | 19.89                    | 23.48         |
| n 40            | 2462            | Mcs0      | 16         | 19.36                    | 22.95         |
|                 | 2422            | Mcs0      | 12         | 15.15                    | 18.74         |
|                 | 2437            | Mcs0      | 14         | 16.88                    | 20.47         |
|                 | 2452            | Mcs0      | 15         | 17.49                    | 21.08         |

The maximum average RF conducted output power measured for this device was 17.8 dBm or 0.6 mW. The limit is 30 dBm or 1 Watt when using antennas with 6 dBi or less gain. The panel antenna has a gain of 10dBi dBi.

#### Panel Antenna

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
| b 20            | 2412            | Mcs0      | 8          | 11.93                    | 21.93         |
|                 | 2417            | Mcs0      | 9          | 13.23                    | 23.23         |
|                 | 2422            | Mcs0      | 9          | 12.84                    | 22.84         |
|                 | 2427            | Mcs0      | 9          | 12.95                    | 22.95         |
|                 | 2432            | Mcs0      | 10         | 14.34                    | 24.34         |
|                 | 2437            | Mcs0      | 12         | 15.71                    | 25.71         |
|                 | 2442            | Mcs0      | 13         | 16.43                    | 26.43         |
|                 | 2447            | Mcs0      | 12         | 15.98                    | 25.98         |

| Modulation (BW) | Frequency (MHz) | Data Rate | TP Setting | Conducted Output Power * | Measured EIRP |
|-----------------|-----------------|-----------|------------|--------------------------|---------------|
|                 | 2452            | Mcs0      | 13         | 16.71                    | 26.71         |
|                 | 2457            | Mcs0      | 13         | 16.91                    | 26.91         |
|                 | 2462            | Mcs0      | 14         | 17.80                    | 27.80         |
| g 20            | 2412            | Mcs0      | 8          | 11.89                    | 21.89         |
|                 | 2417            | Mcs0      | 8          | 12.14                    | 22.14         |
|                 | 2422            | Mcs0      | 6          | 10.29                    | 20.29         |
|                 | 2427            | Mcs0      | 6          | 10.31                    | 20.31         |
|                 | 2432            | Mcs0      | 7          | 11.28                    | 21.28         |
|                 | 2437            | Mcs0      | 8          | 12.19                    | 22.19         |
|                 | 2442            | Mcs0      | 11         | 14.74                    | 24.74         |
|                 | 2447            | Mcs0      | 11         | 14.77                    | 24.77         |
|                 | 2452            | Mcs0      | 12         | 15.37                    | 25.37         |
|                 | 2457            | Mcs0      | 12         | 15.67                    | 25.67         |
| n 20            | 2412            | Mcs0      | 7          | 11.05                    | 21.05         |
|                 | 2417            | Mcs0      | 8          | 12.04                    | 22.04         |
|                 | 2422            | Mcs0      | 8          | 11.94                    | 21.94         |
|                 | 2427            | Mcs0      | 7          | 10.92                    | 20.92         |
|                 | 2432            | Mcs0      | 7          | 10.93                    | 20.93         |
|                 | 2437            | Mcs0      | 9          | 13.02                    | 23.02         |
|                 | 2442            | Mcs0      | 12         | 15.48                    | 25.48         |
|                 | 2447            | Mcs0      | 12         | 15.63                    | 25.63         |
|                 | 2452            | Mcs0      | 13         | 16.15                    | 26.15         |
|                 | 2457            | Mcs0      | 12         | 15.38                    | 25.38         |
| n 40            | 2422            | Mcs0      | 10         | 12.87                    | 22.87         |
|                 | 2437            | Mcs0      | 12         | 14.76                    | 24.76         |
|                 | 2452            | Mcs0      | 13         | 15.26                    | 25.26         |

## 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).

\* Gated EIRP shown in the Annex is the conducted measurement

## **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 plots 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**

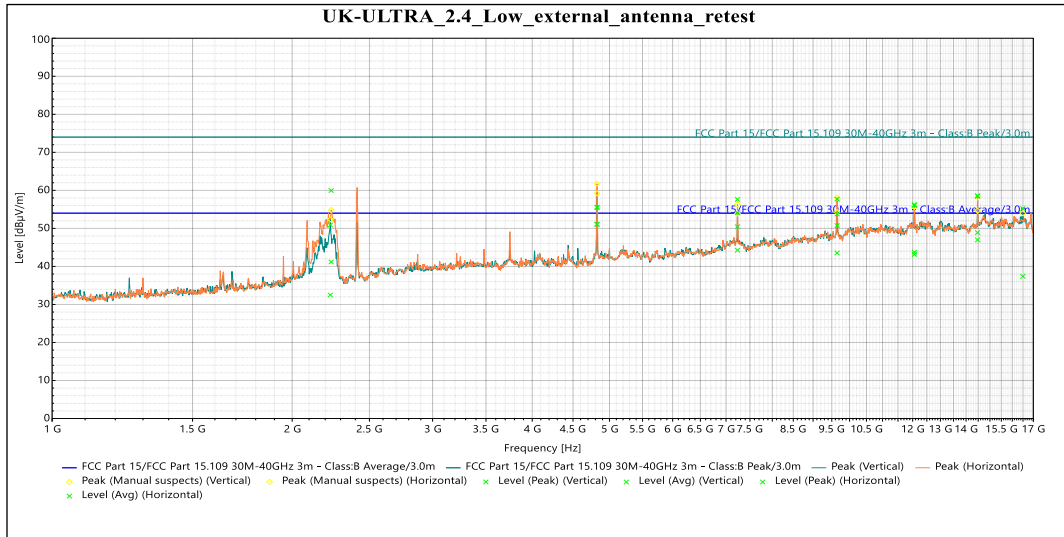
The frequency range from the lowest frequency generated or used in the device to the tenth harmonic of the highest fundamental emissions was investigated to measure any radiated emissions in the restricted bands. The following tables show measurements of any emissions that fell into the restricted bands 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 + 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.

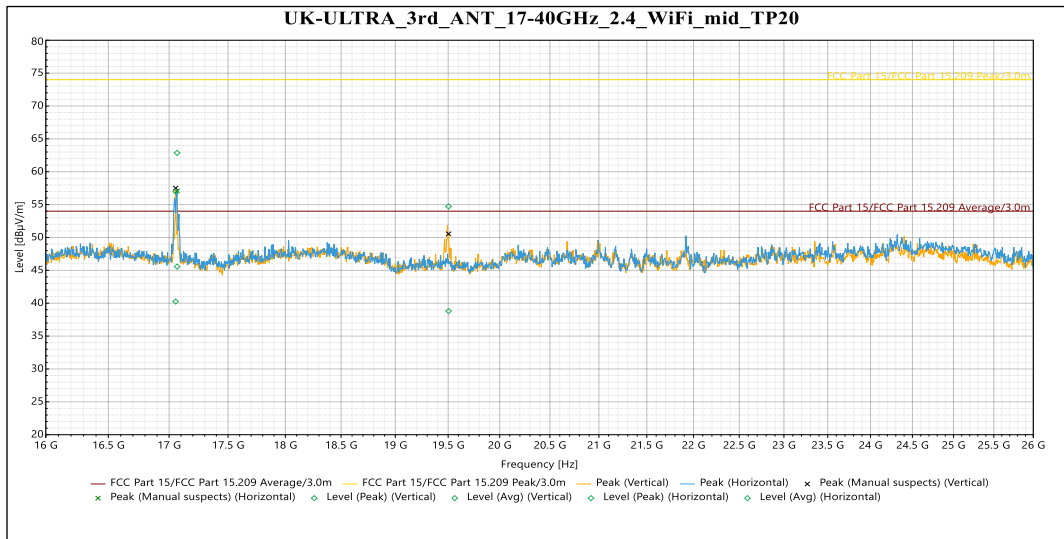
**\*The worst-case measurements from all 3 antenna's noted below.**



| Frequency  | Det. | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol.       | Correction (dB) |
|------------|------|----------------|----------------|-------------|-------------|------------|------------|-----------------|
| 2.233 GHz  | Pk   | 50.898         | 74             | -23.102     | 56          | 2.539      | Vertical   | -3.833          |
| 4.824 GHz  | Pk   | 55.597         | 74             | -18.403     | 131         | 2.177      | Vertical   | 4.375           |
| 7.2354 GHz | Pk   | 54.08          | 74             | -19.92      | 154         | 3.083      | Vertical   | 11.2            |
| 9.6482 GHz | Pk   | 53.769         | 74             | -20.231     | 50          | 2.574      | Vertical   | 12.559          |
| 12.059 GHz | Pk   | 56.003         | 74             | -17.997     | 186         | 2.902      | Vertical   | 15.545          |
| 14.472 GHz | Pk   | 58.461         | 74             | -15.539     | 231         | 2.222      | Vertical   | 15.711          |
| 16.496 GHz | Pk   | 55.189         | 74             | -18.811     | 113         | 1.643      | Vertical   | 18.276          |
| 2.233 GHz  | Av   | 32.466         | 54             | -21.534     | 56          | 2.539      | Vertical   | -3.833          |
| 4.824 GHz  | Av   | 51.041         | 54             | -2.959      | 131         | 2.177      | Vertical   | 4.375           |
| 7.2354 GHz | Av   | 44.26          | 54             | -9.74       | 154         | 3.083      | Vertical   | 11.2            |
| 9.6482 GHz | Av   | 43.538         | 54             | -10.462     | 50          | 2.574      | Vertical   | 12.559          |
| 12.059 GHz | Av   | 43.149         | 54             | -10.851     | 186         | 2.902      | Vertical   | 15.545          |
| 14.472 GHz | Av   | 48.878         | 54             | -5.122      | 231         | 2.222      | Vertical   | 15.711          |
| 16.496 GHz | Av   | 37.376         | 54             | -16.624     | 113         | 1.643      | Vertical   | 18.276          |
| 2.2386 GHz | Pk   | 59.948         | 74             | -14.052     | 358         | 1.638      | Horizontal | -3.866          |
| 4.8238 GHz | Pk   | 55.474         | 74             | -18.526     | 168         | 2.721      | Horizontal | 4.376           |
| 7.2355 GHz | Pk   | 57.619         | 74             | -16.381     | 220         | 1.643      | Horizontal | 11.2            |
| 9.6477 GHz | Pk   | 57.71          | 74             | -16.29      | 184         | 1.643      | Horizontal | 12.56           |
| 12.059 GHz | Pk   | 56.258         | 74             | -17.742     | 206         | 1.996      | Horizontal | 15.545          |
| 14.472 GHz | Pk   | 58.567         | 74             | -15.433     | 261         | 3.079      | Horizontal | 15.711          |
| 2.2386 GHz | Av   | 41.166         | 54             | -12.834     | 358         | 1.638      | Horizontal | -3.866          |
| 4.8238 GHz | Av   | 51.136         | 54             | -2.864      | 168         | 2.721      | Horizontal | 4.376           |
| 7.2355 GHz | Av   | 50.425         | 54             | -3.575      | 220         | 1.643      | Horizontal | 11.2            |
| 9.6477 GHz | Av   | 50.743         | 54             | -3.257      | 184         | 1.643      | Horizontal | 12.56           |
| 12.059 GHz | Av   | 43.722         | 54             | -10.278     | 206         | 1.996      | Horizontal | 15.545          |
| 14.472 GHz | Av   | 46.969         | 54             | -7.031      | 261         | 3.079      | Horizontal | 15.711          |

Table 4: 1-17GHz External Omni Antenna Transmitting at the Lowest Frequency





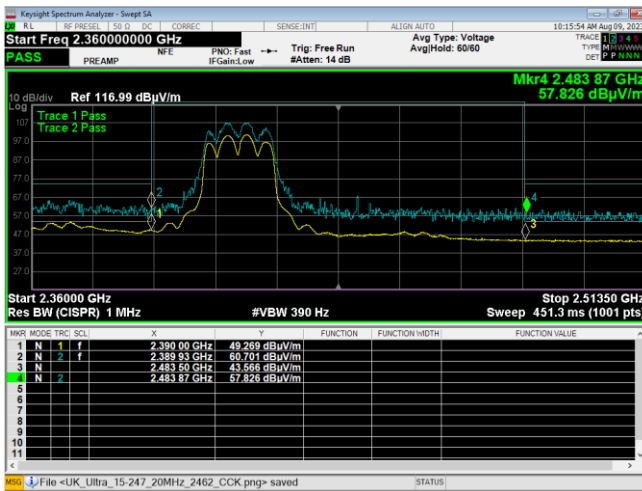
| Frequency  | SR # | Level (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Azimuth (°) | Height (m) | Pol.       | Correction (dB) |
|------------|------|----------------|----------------|-------------|-------------|------------|------------|-----------------|
| 17.055 GHz | Pk   | 56.971         | 74             | -17.029     | 183         | 1.5        | Vertical   | -0.179          |
| 19.504 GHz | Pk   | 54.729         | 74             | -19.271     | 186         | 1.5        | Vertical   | -0.665          |
| 17.055 GHz | Av   | 40.26          | 54             | -13.74      | 183         | 1.5        | Vertical   | -0.179          |
| 19.504 GHz | Av   | 38.813         | 54             | -15.187     | 186         | 1.5        | Vertical   | -0.665          |
| 17.067 GHz | Pk   | 62.857         | 74             | -11.143     | 200         | 1.5        | Horizontal | -0.159          |
| 17.067 GHz | AV   | 45.571         | 54             | -8.429      | 200         | 1.5        | Horizontal | -0.159          |

**Table 5: 17-40GHz Panel Antenna Transmitting at the Middle Frequency**

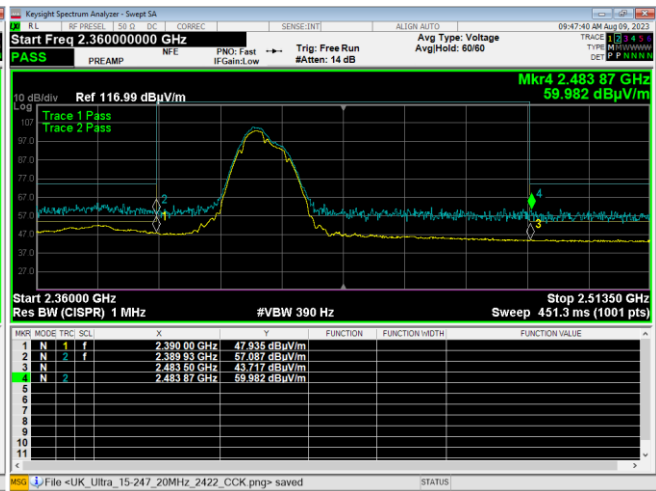
### Band -Edge



### CCK\_2412



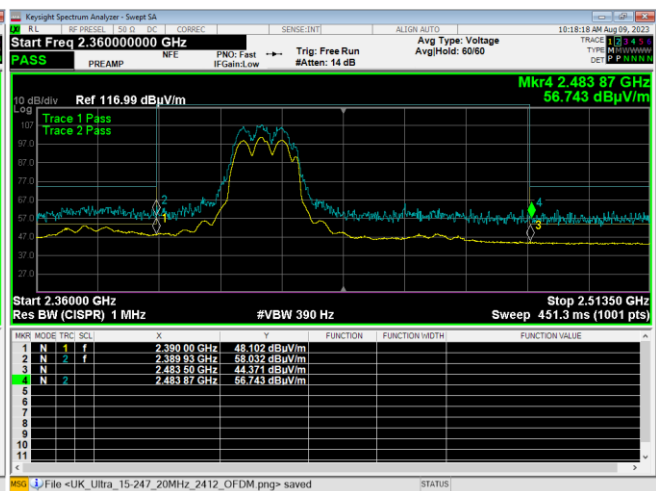
### HT\_2412



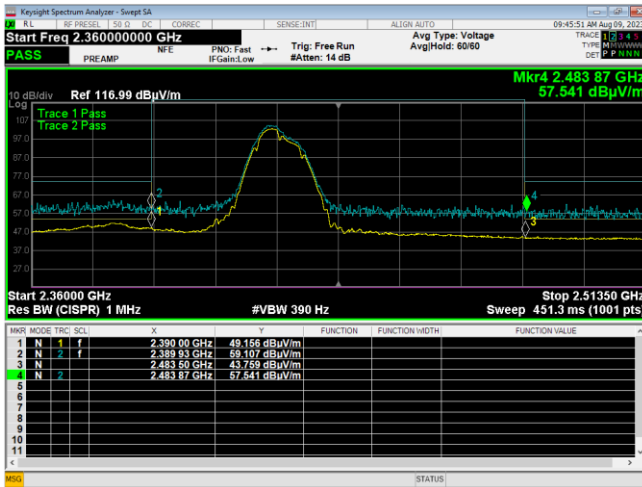
### OFDM\_2412



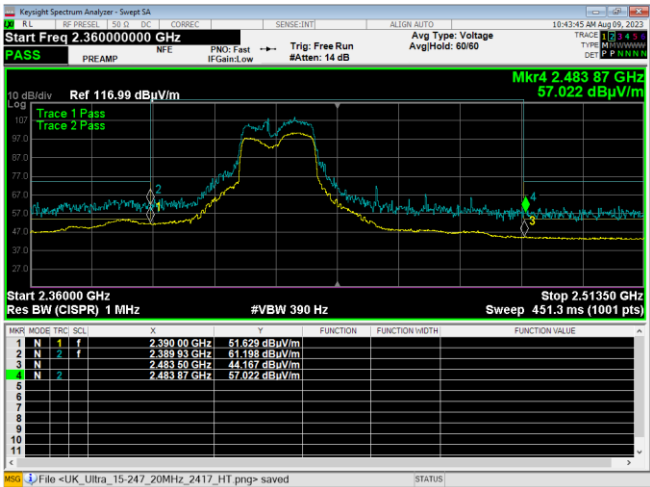
### CCK\_2417



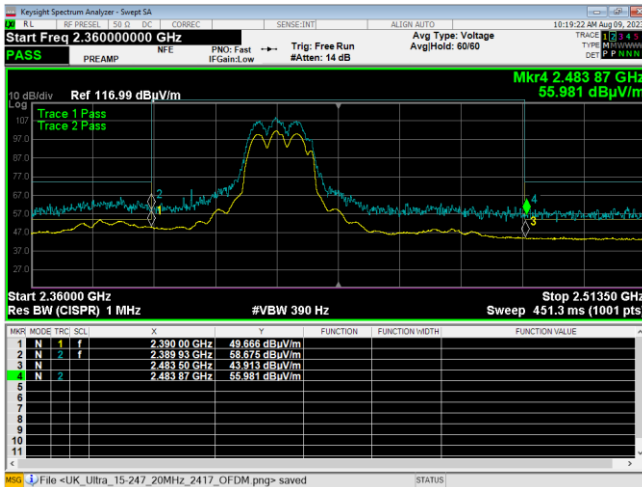
HT\_2412



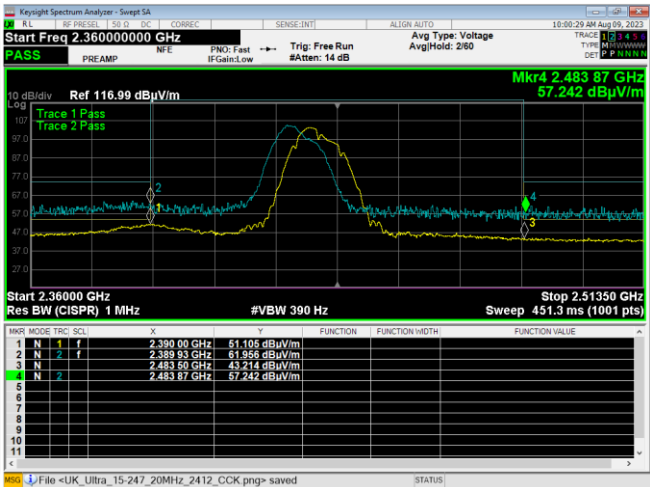
OFDM\_2417



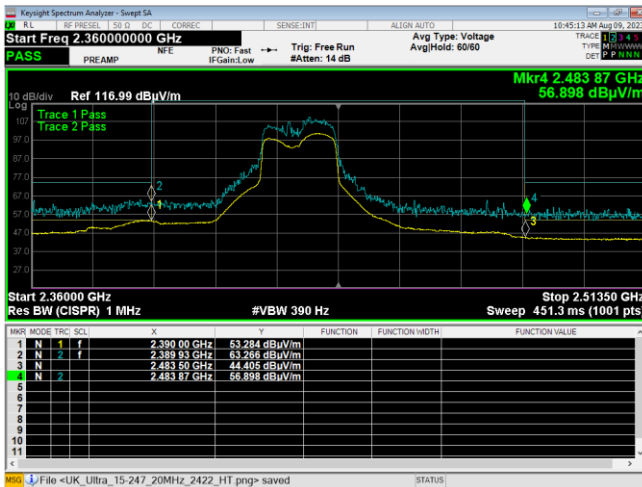
CCK\_2422



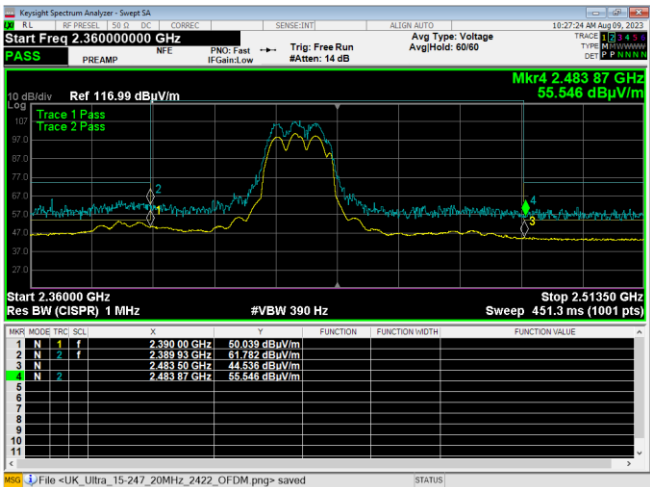
HT\_2422



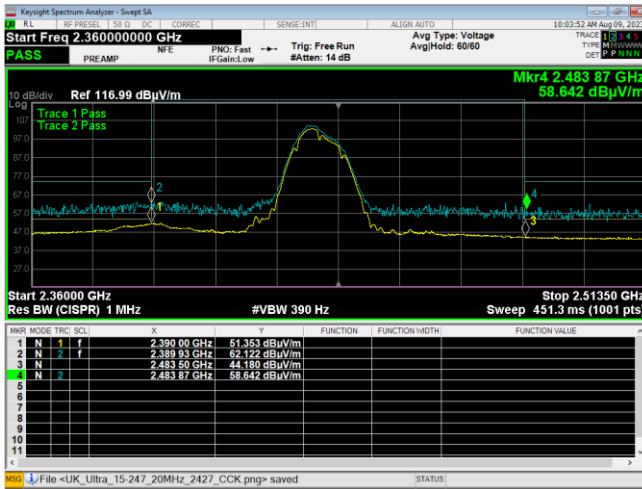
OFDM\_2422



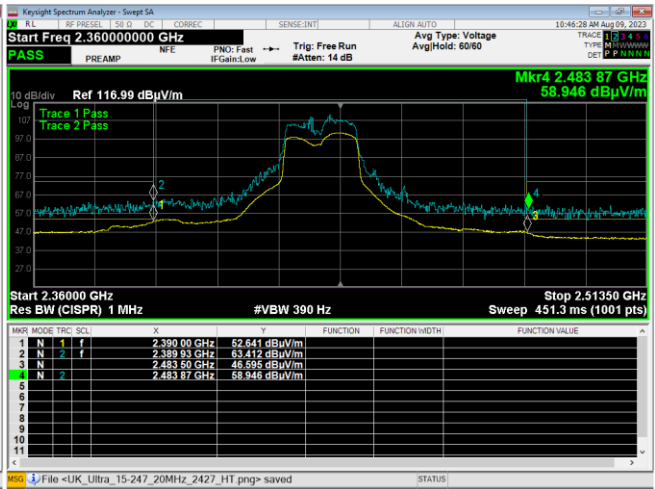
CCK\_2427



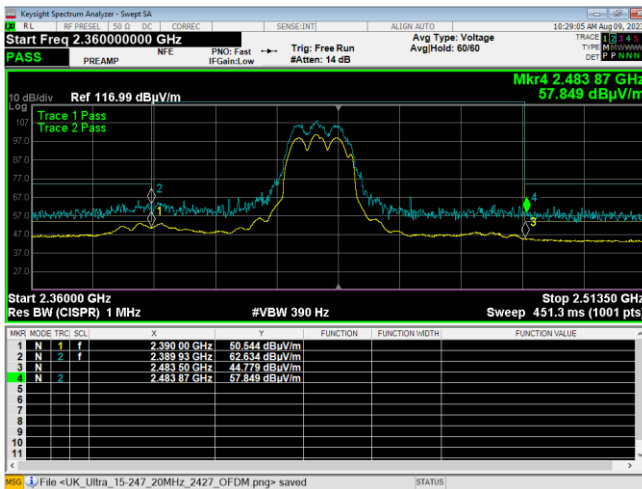
HT\_2427



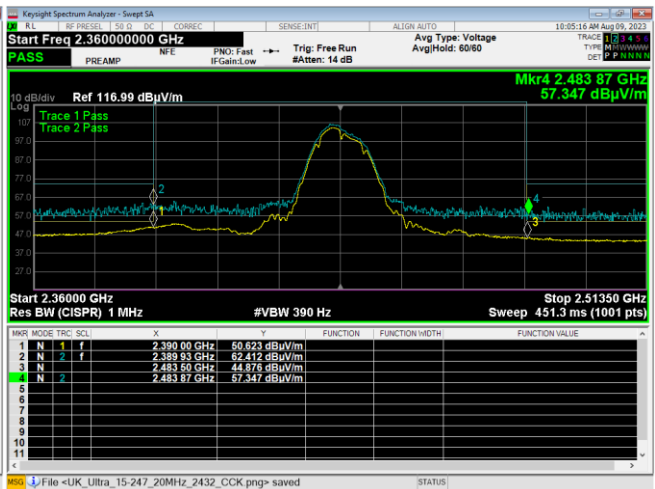
OFDM\_2427



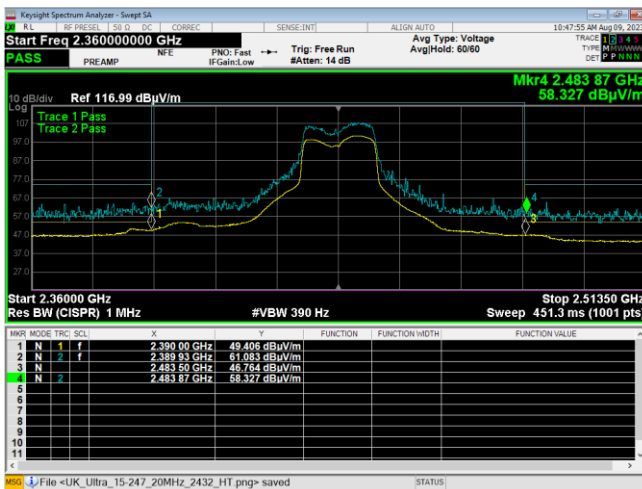
CCK\_2432



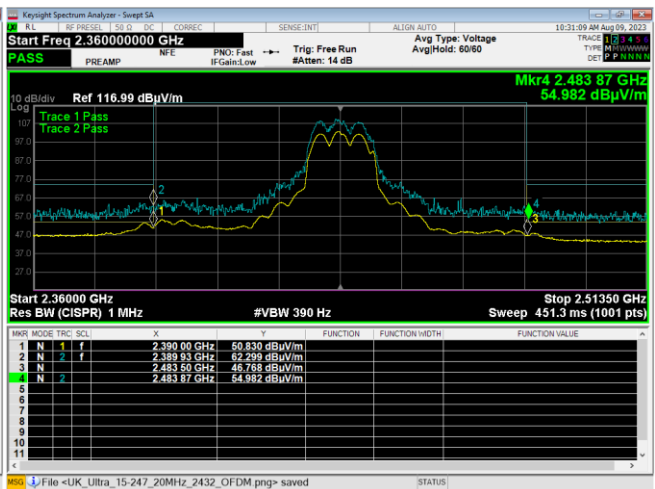
HT\_2432



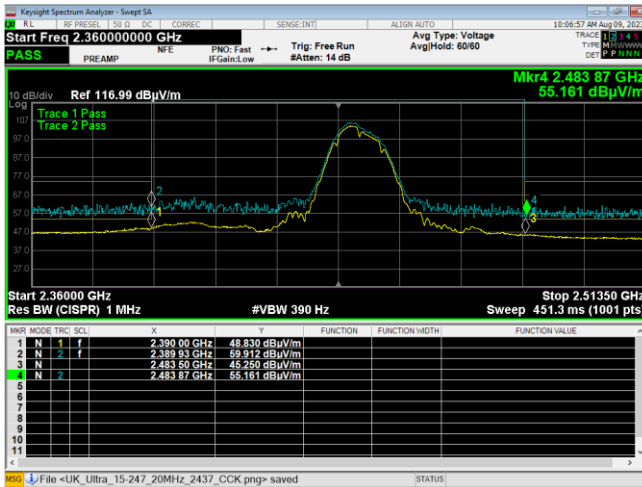
OFDM\_2432



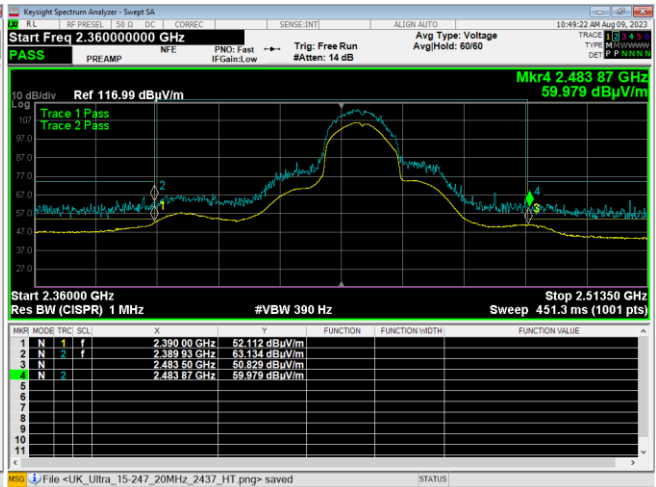
CCK\_2437



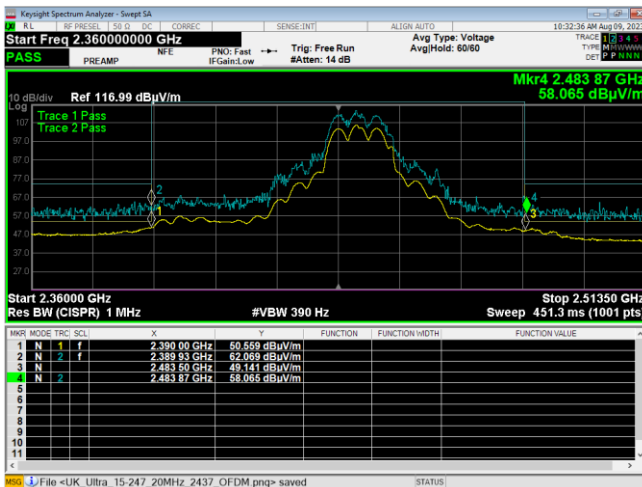
HT\_2437



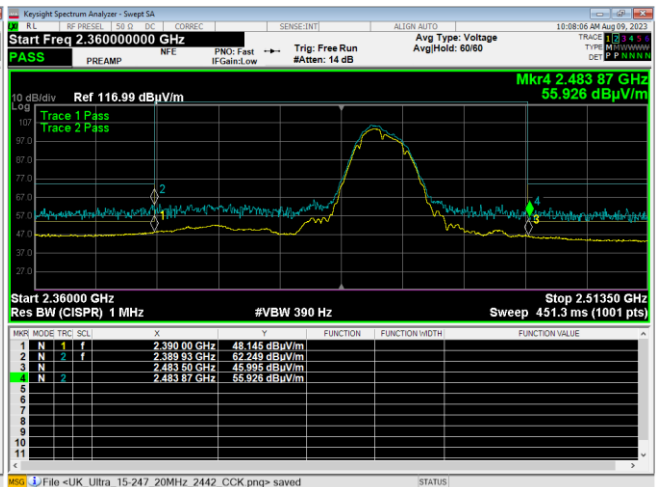
OFDM\_2437



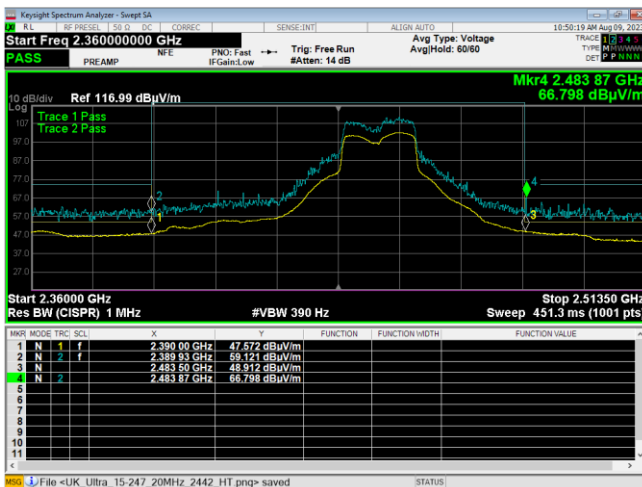
CCK\_2442



HT\_2442



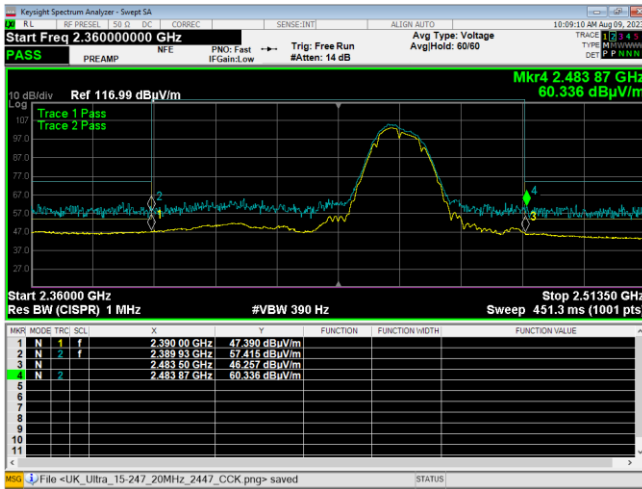
OFDM\_2442



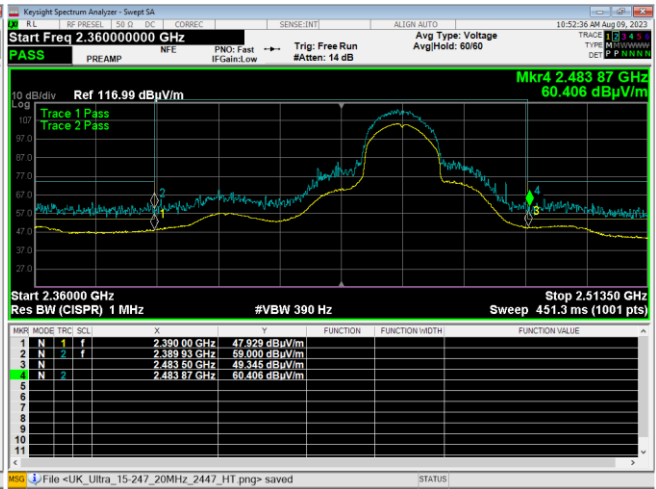
CCK\_2447



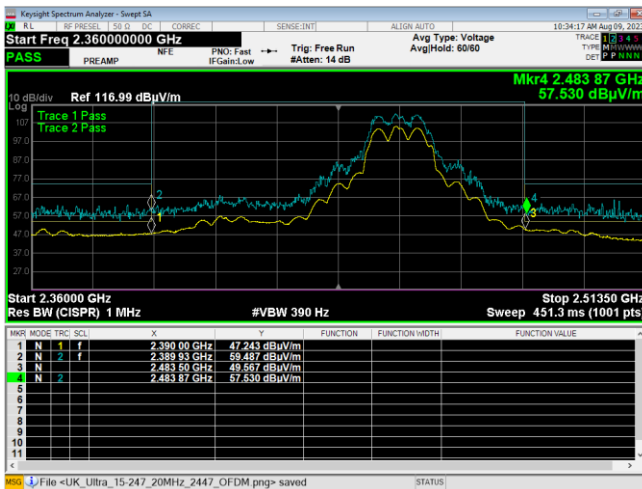
HT\_2447



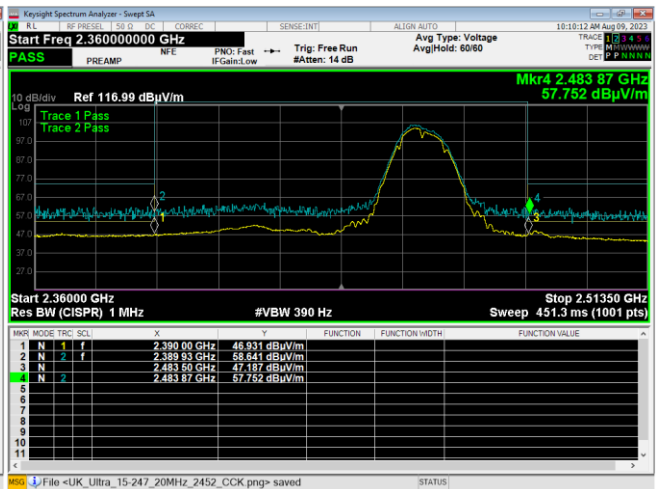
OFDM\_2447



CCK\_2452



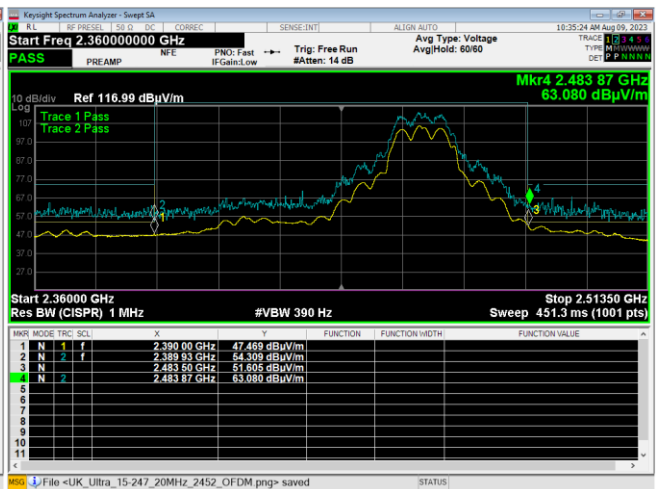
HT\_2452



OFDM\_2452

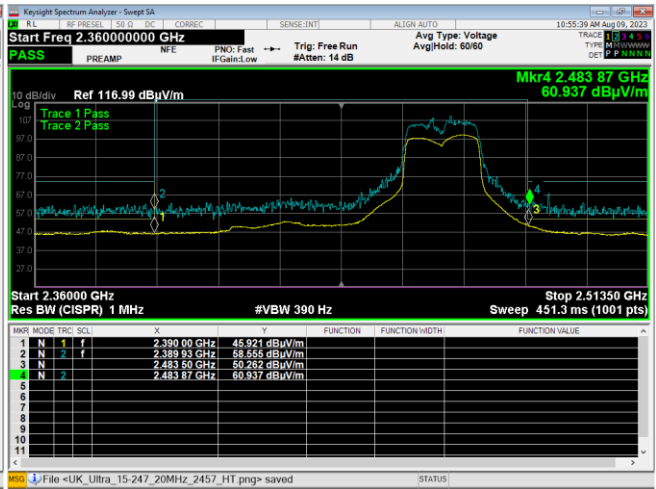
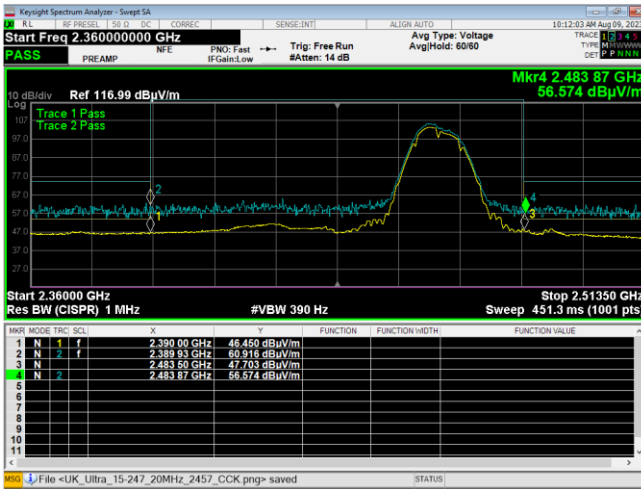


CCK\_2457



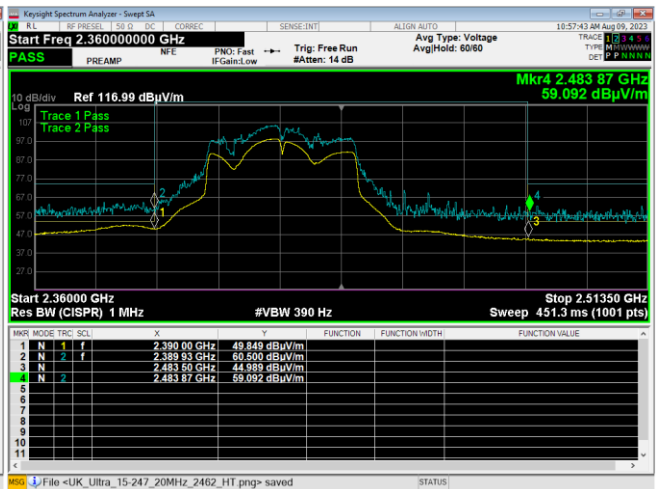
HT\_2457

OFDM\_2457



CCK\_2462

HT\_2462



OFDM\_2462

HT\_2422



HT\_2437

HT\_2542

## 5.6 §15.247(e) Maximum Average Power Spectral Density

All chains were measured and summed under the guidance of KDB 558074 Section 8.4. 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 8 dBm in any 3 kHz band during any time interval of continuous transmission. The antenna gain is 4.7 dBi. Directional Gain = 7.71 PSD limit reduced by 1.71.

### Integral Antenna

| Mode | Frequency (MHz) | Measurement (dBm) | Criteria (dBm) |
|------|-----------------|-------------------|----------------|
| b    | 2412            | -9.48             | 6.29           |
|      | 2437            | -9.23             | 6.29           |
|      | 2462            | -11.96            | 6.29           |
| g    | 2412            | -16.00            | 6.29           |
|      | 2437            | -14.61            | 6.29           |
|      | 2462            | -15.08            | 6.29           |
| n 20 | 2412            | -13.70            | 6.29           |
|      | 2437            | -14.38            | 6.29           |
|      | 2462            | -14.98            | 6.29           |
| n 40 | 2422            | -19.81            | 6.29           |
|      | 2437            | -17.33            | 6.29           |
|      | 2452            | -20.19            | 6.29           |

### Omni Antenna

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. The antenna gain is 3.59 dBi. Directional Gain = 6.6 PSD limit reduced by 0.6.

| Mode | Frequency (MHz) | Measurement (dBm) | Criteria (dBm) |
|------|-----------------|-------------------|----------------|
| b    | 2412            | -13.71            | 7.4            |
|      | 2437            | -6.44             | 7.4            |



|      |      |        |     |
|------|------|--------|-----|
|      | 2462 | -7.41  | 7.4 |
| g    | 2412 | -22.8  | 7.4 |
|      | 2437 | -20.76 | 7.4 |
|      | 2462 | -16.32 | 7.4 |
| n 20 | 2412 | -22.21 | 7.4 |
|      | 2437 | -19.21 | 7.4 |
|      | 2462 | -15.8  | 7.4 |
| n 40 | 2422 | -22.71 | 7.4 |
|      | 2437 | -20.15 | 7.4 |
|      | 2452 | -20.24 | 7.4 |

### Panel Antenna

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. The antenna gain is 4.7 dBi. Directional Gain = 13.01 PSD limit reduced by 7.01.

| Mode | Frequency (MHz) | Measurement (dBm) | Criteria (dBm) |
|------|-----------------|-------------------|----------------|
| b    | 2412            | -9.48             | 0.99           |
|      | 2437            | -9.23             | 0.99           |
|      | 2462            | -11.96            | 0.99           |
| g    | 2412            | -16.0             | 0.99           |
|      | 2437            | -14.61            | 0.99           |
|      | 2462            | -15.08            | 0.99           |
| n 20 | 2412            | -13.7             | 0.99           |
|      | 2437            | -14.68            | 0.99           |
|      | 2462            | -14.98            | 0.99           |
| n 40 | 2422            | -19.81            | 0.99           |
|      | 2437            | -17.33            | 0.99           |
|      | 2452            | -20.19            | 0.99           |

**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 --