

## FCC RADIO TEST REPORT

Applicant..... : Unfolded Circle ApS  
Address..... : Nordre Fasanvej 124A 1TV 2000 Frederiksberg Denmark  
Manufacturer..... : Unfolded Circle ApS  
Address..... : Nordre Fasanvej 124A 1TV 2000 Frederiksberg Denmark  
Factory..... : Unfolded Circle ApS  
Address..... : Nordre Fasanvej 124A 1TV 2000 Frederiksberg Denmark  
Product Name..... : Remote Two  
Brand Name..... : Unfolded Circle  
Model No. .... : UCR2  
FCC ID..... : 2BAA9-UCR2  
Measurement Standard..... : 47 CFR FCC Part 15, Subpart C (Section 15.247)  
Receipt Date of Samples.... : March 28, 2023  
Date of Tested..... : March 28, 2023 to June 30, 2023  
Date of Report..... : July 06, 2023

This report shows that above equipment is technically compliant with the requirements of the standards above. All test results in this report apply only to the tested sample(s). Without prior written approval of Dongguan Nore Testing Center Co., Ltd, this report shall not be reproduced except in full.



Prepared by

Rose Hu / Project Engineer



Approved by

Iori Fan / Authorized Signatory

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## Revision History

[illegible]

## 1. Summary of Test Result

| FCC Rules                    | Description of Test                              | Result | Remarks |
|------------------------------|--------------------------------------------------|--------|---------|
| §15.207 (a)                  | AC Power Conducted Emission                      | PASS   | ---     |
| §15.247(b)(3)                | Maximum Conducted Output Power                   | PASS   | ---     |
| §15.247(a)(2)                | 6dB Bandwidth                                    | PASS   | ---     |
| §15.247(e)                   | Power Spectral Density                           | PASS   | ---     |
| §15.247(d)                   | Band Edge and Conducted Spurious Emissions       | PASS   | ---     |
| §15.247(d), §15.209, §15.205 | Radiated Spurious Emissions and Restricted Bands | PASS   | ---     |
| §15.203                      | Antenna Requirement                              | PASS   | ---     |

## 2. General Description of EUT

| Product Information     |                                                                                                                                |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Product Name:           | Remote Two                                                                                                                     |
| Main Model Name:        | UCR2                                                                                                                           |
| Additional Model Name:  | N/A                                                                                                                            |
| Model Difference:       | N/A                                                                                                                            |
| S/N:                    | 2303-1627                                                                                                                      |
| Brand Name:             | Unfolded Circle                                                                                                                |
| Hardware Version:       | V1.0                                                                                                                           |
| Software Version:       | V1.0                                                                                                                           |
| Rating:                 | DC 3.7V li-ion battery or DC 5V come from charging dock                                                                        |
| Typical arrangement:    | Table-top                                                                                                                      |
| I/O Port:               | Refer to user manual                                                                                                           |
| Accessories Information |                                                                                                                                |
| Adapter:                | N/A                                                                                                                            |
| Cable:                  | N/A                                                                                                                            |
| Other:                  | N/A                                                                                                                            |
| Additional Information  |                                                                                                                                |
| Note:                   | N/A                                                                                                                            |
| Remark:                 | All the information above are provided by the manufacturer. More detailed feature of the EUT please refers to the user manual. |

| Technical Specification                                           |                                                |
|-------------------------------------------------------------------|------------------------------------------------|
| Frequency Range:                                                  | 2412-2462MHz for IEEE 802.11b/g/n(HT20)        |
| Modulation Technology:                                            | DSSS, OFDM                                     |
| Modulation Type:                                                  | CCK, DQPSK, DBPSK, 64-QAM, 16-QAM, QPSK, BPSK, |
| Number of Channel:                                                | 11                                             |
| Channel Space:                                                    | 5MHz                                           |
| Antenna Type:                                                     | SMD antenna                                    |
| Number of Antenna                                                 | 1                                              |
| Antenna Gain:                                                     | 1.5 dBi (Declared by the manufacturer)         |
| Note: This report only applies to 2.4GHz WLAN feature of the EUT. |                                                |

Channel list

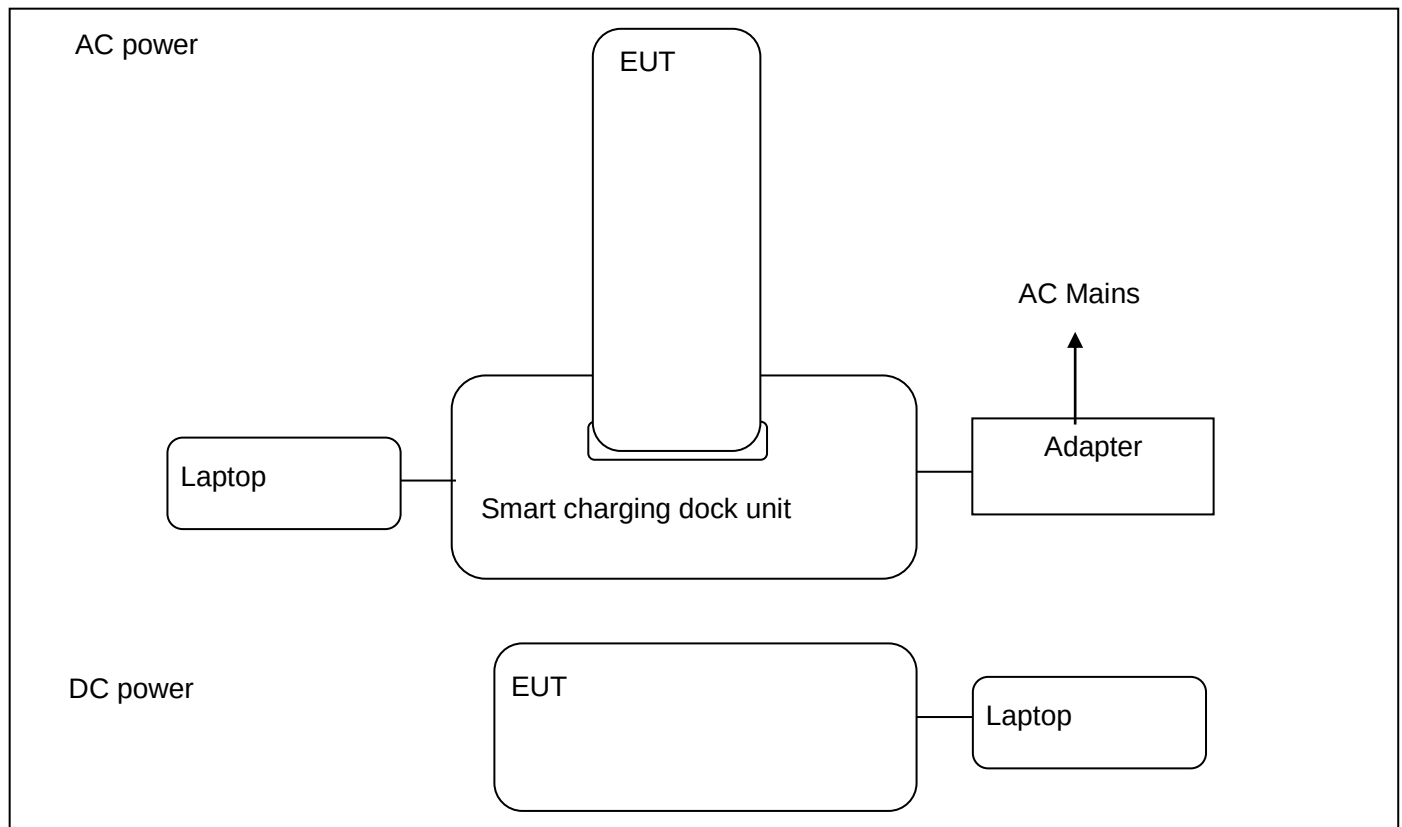
| IEEE 802.11b/ g/ n(HT20) |                    |
|--------------------------|--------------------|
| Channel                  | Frequency<br>(MHz) |
| 1                        | 2412               |
| 2                        | 2417               |
| 3                        | 2422               |
| 4                        | 2427               |
| 5                        | 2432               |
| 6                        | 2437               |
| 7                        | 2442               |
| 8                        | 2447               |
| 9                        | 2452               |
| 10                       | 2457               |
| 11                       | 2462               |

### 3. Test Channels and Modes Detail

| Mode |        | Channel | Frequency (MHz) | Remark                   |
|------|--------|---------|-----------------|--------------------------|
| 1    | TX     | 1       | 2412            | IEEE 802.11b/ g/ n(HT20) |
|      |        | 6       | 2437            | IEEE 802.11b/ g/ n(HT20) |
|      |        | 11      | 2462            | IEEE 802.11b/ g/ n(HT20) |
| 2    | Normal | ---     |                 |                          |

Note: TX mode means that the EUT was programmed to be in continuously transmitting mode.

### 4. Configuration of EUT



### 5. Modification of EUT

No modifications are made to the EUT during all test items.



## 6. Description of Support Device

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| No. | Equipment        | Brand              | M/N             | S/N      | Cable Specification                                                         | Remarks                        |
|-----|------------------|--------------------|-----------------|----------|-----------------------------------------------------------------------------|--------------------------------|
| 1.  | PC               | Lenovo             | R720-15<br>1KBN | PF0Z35FH | I/P: AC 100-240V<br>50-60Hz, 1.5A<br>O/P: DC 20V 6.75A                      | Provide by the Lab             |
| 2.  | Adapter          | Delta              | ADL135N<br>DC3A | ---      | AC Line: 1.10m<br>unshielded<br>DC Line: 1.15m<br>unshielded with a<br>core | Provide by the Lab             |
| 3.  | Test fixture     | ---                | ---             | ---      | ----                                                                        | Provide by the<br>manufacturer |
| 4.  | Charging<br>dock | Unfolded<br>circle | UCD2            | ---      | ---                                                                         | Provide by the<br>manufacturer |

| Software  | Power Setting      |         |
|-----------|--------------------|---------|
|           | Mode               | Setting |
| SecureCRT | IEEE 802.11b       | 13      |
|           | IEEE 802.11g       | 12      |
|           | IEEE 802.11n(HT20) | 12      |

## 7. Test Facility and Location

|                                   |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-----------------------------------|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Site                         | : | Dongguan Nore Testing Center Co., Ltd. (Dongguan NTC Co., Ltd.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Accreditations and Authorizations | : | <p>The Laboratory has been assessed and proved to be in compliance with CNAS/CL01<br/>Listed by CNAS, August 13, 2018<br/>The Certificate Registration Number is L5795.</p> <p>The Laboratory has been assessed and proved to be in compliance with ISO17025<br/>Listed by A2LA, November 01, 2017<br/>The Certificate Registration Number is 4429.01<br/>The Certificate is valid until December 31, 2023</p> <p>Listed by FCC, November 06, 2017<br/>Test Firm Registration Number is 907417</p> <p>Listed by Industry Canada, June 08, 2017<br/>The Certificate Registration Number is 46405-9743A<br/>The CAB identifier number: CN0015</p> |
| Test Site Location                | : | Building D, Gaosheng Science and Technology Park, Hongtu Road, Nancheng District, Dongguan City, Guangdong Province, China                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

## 8. Applicable Standards and References

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

### Test Standards:

47 CFR Part 15, Subpart C, 15.247

ANSI C63.10-2013

### References Test Guidance:

DTS KDB 558074 D01 15.247 Meas Guidance v05r02

## 9. Deviations and Abnormalities from Standard Conditions

No additions, deviations and exclusions from the standard.

## 10. Test Conditions

| No. | Test Item                                        | Test Mode | Test Voltage             | Tested by | Remarks    |
|-----|--------------------------------------------------|-----------|--------------------------|-----------|------------|
| 1.  | AC Power Conducted Emission                      | 2         | AC 120V/60Hz             | Sean      | See note 1 |
| 2.  | Max. Conducted Output Power                      | 1         | DC 3.7V                  | Sean      | See note 1 |
| 3.  | 6dB Bandwidth                                    | 1         | DC 3.7V                  | Sean      | See note 1 |
| 4.  | Power Spectral Density                           | 1         | DC 3.7V                  | Sean      | See note 1 |
| 5.  | Band Edge and Conducted Spurious Emissions       | 1         | DC 3.7V                  | Sean      | See note 1 |
| 6.  | Radiated Spurious Emissions and Restricted Bands | 1, 2      | AC 120V/60Hz,<br>DC 3.7V | Sean      | See note 1 |
| 7.  | Antenna Requirement                              | ---       | ---                      | ---       | ---        |

**Note:**

1. The testing climatic conditions for temperature, humidity, and atmospheric pressure are within: 15~35 °C, 30~70%, 86~106kPa
2. For test voltage AC 120V/60Hz was the input voltage of the charging docking and Laptop.
3. As the EUT can be operated multiple positions, all X,Y,Z axis were considered during the test and only the worst case X was recorded.

## 11. Measurement Uncertainty

| No. | Test Item                    | Frequency      | Uncertainty             | Remarks |
|-----|------------------------------|----------------|-------------------------|---------|
| 1.  | Conducted Emission           | 150KHz ~ 30MHz | ±3.04 dB                | ---     |
| 2.  | Radiated Emission Test       | 9kHz ~ 30MHz   | ±5.04 dB                | ---     |
|     |                              | 30MHz ~ 1GHz   | ±5.04 dB                | ---     |
|     |                              | 1GHz ~ 18GHz   | ±5.23 dB                | ---     |
|     |                              | 18GHz ~ 40GHz  | ±5.23 dB                | ---     |
| 3.  | Conducted Spurious Emissions | 10Hz ~ 40GHz   | ±0.78 dB                | ---     |
| 4.  | RF Output Power              | 10Hz ~ 40GHz   | ±0.86 dB                |         |
| 5.  | Power Spectral Density       | 10Hz ~ 40GHz   | ±1.06 dB                |         |
| 6.  | Occupied Channel Bandwidth   | ---            | ±1.42 x10 <sup>-7</sup> | ---     |

**Note:**

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The measurement uncertainty levels above are estimated and calculated according to CISPR 16-4-2.
3. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

## 12. Sample Calculations

| Conducted Emission                                                                                                                                                                                                                                                                                                                                                                                   |                      |                     |                    |              |           |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|---------------------|--------------------|--------------|-----------|----------|
| Freq. (MHz)                                                                                                                                                                                                                                                                                                                                                                                          | Reading Level (dBuV) | Correct Factor (dB) | Measurement (dBuV) | Limit (dBuV) | Over (dB) | Detector |
| 0.1539                                                                                                                                                                                                                                                                                                                                                                                               | 31.31                | 10.59               | 41.90              | 65.79        | -23.89    | QP       |
| <p>Where,</p> <p>Freq. = Emission frequency in MHz</p> <p>Reading Level = Spectrum Analyzer/Receiver reading</p> <p>Corrector Factor = Insertion loss of LISN + Cable Loss + RF Switching Unit attenuation</p> <p>Measurement = Reading + Corrector Factor</p> <p>Limit = Limit stated in standard</p> <p>Margin = Measurement - Limit</p> <p>Detector = Reading for Quasi-Peak / Average / Peak</p> |                      |                     |                    |              |           |          |

| Radiated Spurious Emissions and Restricted Bands                                                                                                                                                                                                                                                                                                                                                       |                      |                       |                      |                |           |          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------------|----------------------|----------------|-----------|----------|
| Freq. (MHz)                                                                                                                                                                                                                                                                                                                                                                                            | Reading Level (dBuV) | Correct Factor (dB/m) | Measurement (dBuV/m) | Limit (dBuV/m) | Over (dB) | Detector |
| 44.5500                                                                                                                                                                                                                                                                                                                                                                                                | 26.11                | -7.61                 | 18.50                | 40.00          | -21.50    | QP       |
| <p>Where,</p> <p>Freq. = Emission frequency in MHz</p> <p>Reading Level = Spectrum Analyzer/Receiver reading</p> <p>Corrector Factor = Antenna Factor + Cable Loss - Pre-amplifier</p> <p>Measurement = Reading + Corrector Factor</p> <p>Limit = Limit stated in standard</p> <p>Over = Margin, which calculated by Measurement - Limit</p> <p>Detector = Reading for Quasi-Peak / Average / Peak</p> |                      |                       |                      |                |           |          |

Note: For all conducted test items, the spectrum analyzer offset or transducer is derived from RF cable loss and attenuator factor. The offset or transducer is equal to the RF cable loss plus attenuator factor.

## 13. Test Items and Results

### 13.1 Conducted Emissions Measurement

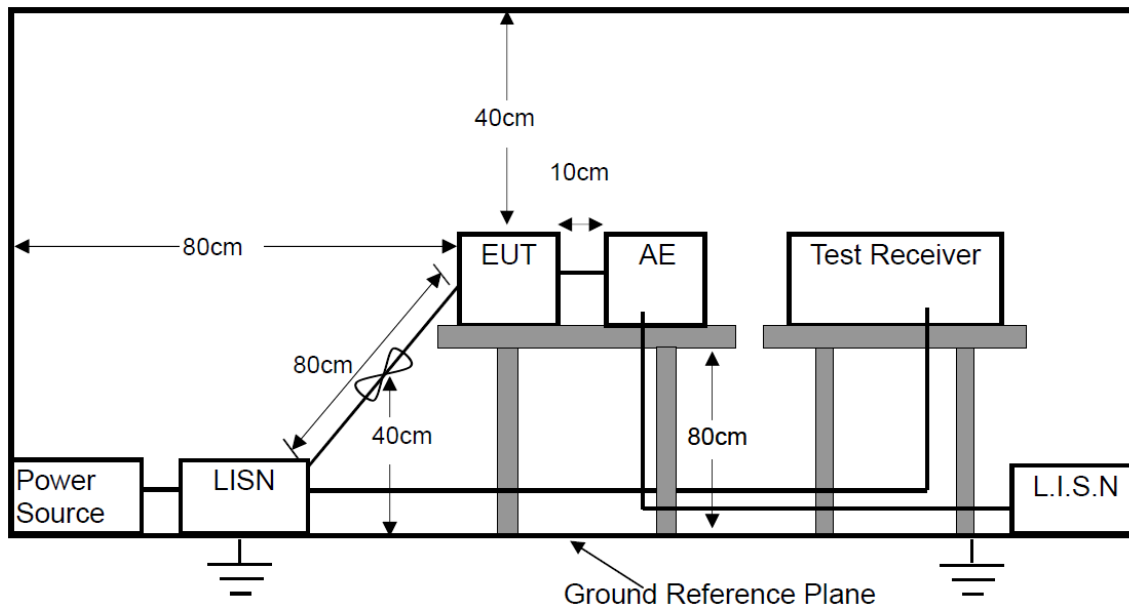
#### LIMITS

According to the requirements of FCC PART 15.207, the limits are as follows:

| Frequency (MHz) | Quasi-peak | Average  |
|-----------------|------------|----------|
| 0.15 to 0.5     | 66 to 56   | 56 to 46 |
| 0.5 to 5        | 56         | 46       |
| 5 to 30         | 60         | 50       |

Note: 1. If the limits for the average detector are met when using the quasi-peak detector, then the limits for the measurements with the average detector are considered to be met.  
2. The lower limit shall apply at the transition frequencies.  
3. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5MHz.

#### BLOCK DIAGRAM OF TEST SETUP



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## TEST PROCEDURES

- a. The EUT was placed on a wooden table 0.8m height from the metal ground plan and 0.4m from the conducting wall of the shielding room and it was kept at 0.8m from any other grounded conducting surface.
- b. All I/O cables and support devices were positioned as per ANSI C63.10.
- c. Connect mains power port of the EUT to a line impedance stabilization network (LISN).
- d. Connect all support devices to the other LISN and AAN, if needed.
- e. Scan the frequency range from 150KHz to 30MHz at both sides of AC line for maximum conducted interference checking and record the test data.

## TEST RESULTS

PASS

Please refer to the following pages.

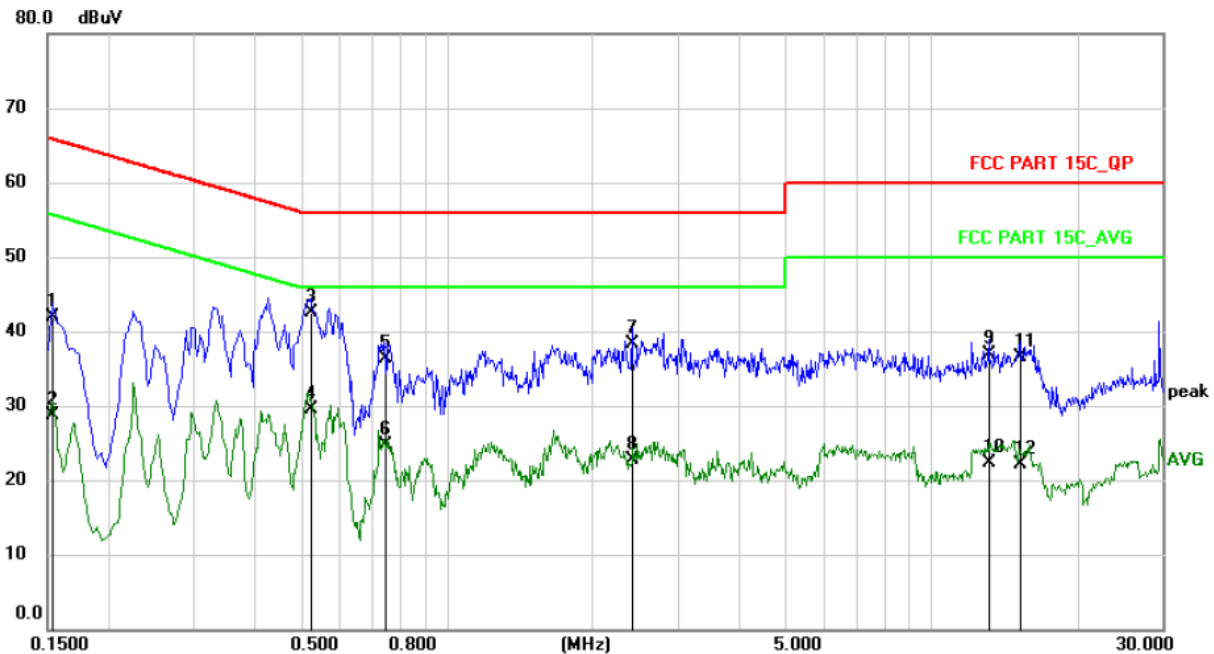


|              |                               |
|--------------|-------------------------------|
| M/N: UCR2    | Testing Voltage: AC 120V 60Hz |
| Phase: L1    | Detector: QP & AVG            |
| Test Mode: 2 |                               |

## Conducted Emission Measurement

Date: 2023/5/22

Time: 16:42:17



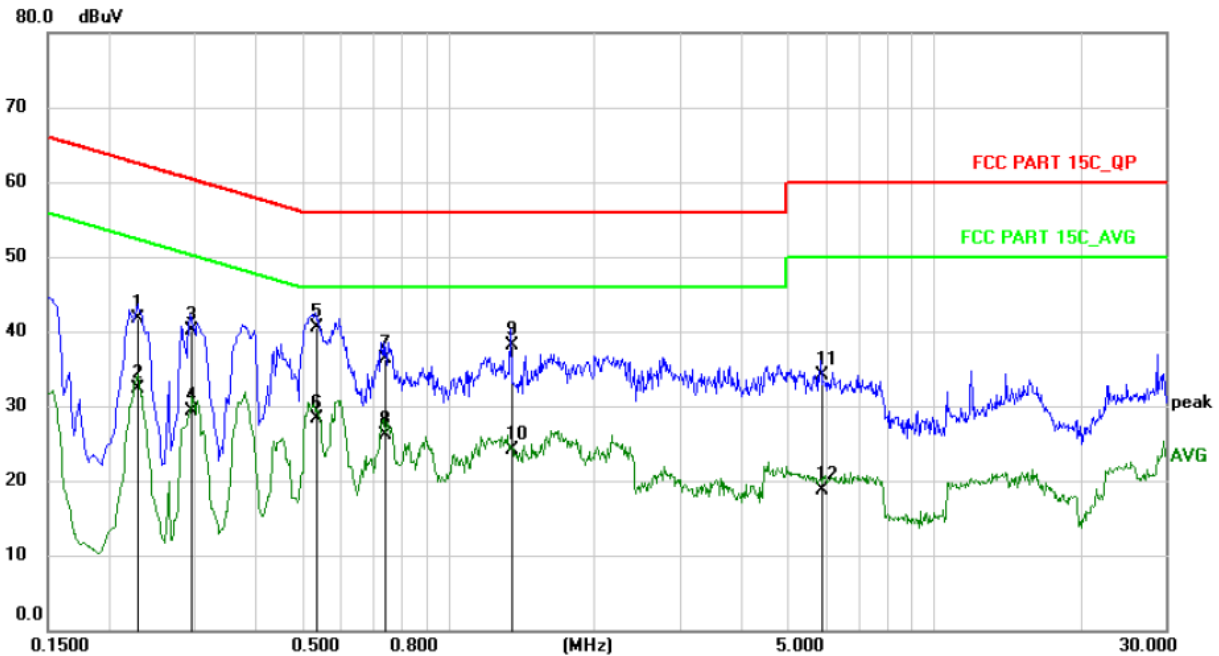
| No. Mk. | Freq.   | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|---------|---------|---------------|----------------|-------------|-------|--------|----------|---------|
|         | MHz     | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1       | 0.1539  | 31.31         | 10.59          | 41.90       | 65.79 | -23.89 | QP       |         |
| 2       | 0.1539  | 18.11         | 10.59          | 28.70       | 55.79 | -27.09 | AVG      |         |
| 3 *     | 0.5260  | 31.90         | 10.60          | 42.50       | 56.00 | -13.50 | QP       |         |
| 4       | 0.5260  | 19.00         | 10.60          | 29.60       | 46.00 | -16.40 | AVG      |         |
| 5       | 0.7460  | 25.79         | 10.61          | 36.40       | 56.00 | -19.60 | QP       |         |
| 6       | 0.7460  | 14.09         | 10.61          | 24.70       | 46.00 | -21.30 | AVG      |         |
| 7       | 2.4180  | 27.78         | 10.62          | 38.40       | 56.00 | -17.60 | QP       |         |
| 8       | 2.4180  | 12.18         | 10.62          | 22.80       | 46.00 | -23.20 | AVG      |         |
| 9       | 13.1819 | 26.14         | 10.76          | 36.90       | 60.00 | -23.10 | QP       |         |
| 10      | 13.1819 | 11.64         | 10.76          | 22.40       | 50.00 | -27.60 | AVG      |         |
| 11      | 15.2300 | 25.81         | 10.79          | 36.60       | 60.00 | -23.40 | QP       |         |
| 12      | 15.2300 | 11.41         | 10.79          | 22.20       | 50.00 | -27.80 | AVG      |         |

|              |                               |
|--------------|-------------------------------|
| M/N: UCR2    | Testing Voltage: AC 120V 60Hz |
| Phase: N     | Detector: QP & AVG            |
| Test Mode: 2 |                               |

## Conducted Emission Measurement

Date: 2023/5/22

Time: 16:50:09



| No. Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit | Over   | Detector | Comment |
|---------|--------|---------------|----------------|-------------|-------|--------|----------|---------|
|         | MHz    | dBuV          | dB             | dBuV        | dBuV  | dB     |          |         |
| 1       | 0.2300 | 31.13         | 10.57          | 41.70       | 62.45 | -20.75 | QP       |         |
| 2       | 0.2300 | 21.73         | 10.57          | 32.30       | 52.45 | -20.15 | AVG      |         |
| 3       | 0.2940 | 29.62         | 10.58          | 40.20       | 60.41 | -20.21 | QP       |         |
| 4       | 0.2940 | 18.72         | 10.58          | 29.30       | 50.41 | -21.11 | AVG      |         |
| 5 *     | 0.5340 | 29.93         | 10.57          | 40.50       | 56.00 | -15.50 | QP       |         |
| 6       | 0.5340 | 17.83         | 10.57          | 28.40       | 46.00 | -17.60 | AVG      |         |
| 7       | 0.7420 | 25.83         | 10.57          | 36.40       | 56.00 | -19.60 | QP       |         |
| 8       | 0.7420 | 15.63         | 10.57          | 26.20       | 46.00 | -19.80 | AVG      |         |
| 9       | 1.3460 | 27.63         | 10.57          | 38.20       | 56.00 | -17.80 | QP       |         |
| 10      | 1.3460 | 13.53         | 10.57          | 24.10       | 46.00 | -21.90 | AVG      |         |
| 11      | 5.8659 | 23.49         | 10.61          | 34.10       | 60.00 | -25.90 | QP       |         |
| 12      | 5.8659 | 8.09          | 10.61          | 18.70       | 50.00 | -31.30 | AVG      |         |

## 13.2 Maximum Conducted Output Power Measurement

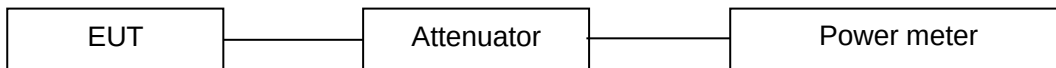
### LIMITS

For system using digital modulation in the 2400-2483.5 MHz bands, the limit for peak output power is 1 Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi. The e.i.r.p. shall not exceed 4 W.

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

### BLOCK DIAGRAM OF TEST SETUP



### TEST PROCEDURES

ANSI C63.10 - 2013, Section 11.9.1.3

ANSI C63.10 - 2013, Section 11.9.2.3.2

### TEST RESULTS

PASS

Please refer to the following table.

| Channel                   | Frequency (MHz) | Data Rate (Mbps) | Peak Output Power (dBm) | Limit (dBm) | Result |
|---------------------------|-----------------|------------------|-------------------------|-------------|--------|
| <b>IEEE 802.11b</b>       |                 |                  |                         |             |        |
| 1                         | 2412            | 1                | 15.436                  | ≤30         | PASS   |
| 6                         | 2437            | 1                | 12.363                  | ≤30         | PASS   |
| 11                        | 2462            | 1                | 12.614                  | ≤30         | PASS   |
| <b>IEEE 802.11g</b>       |                 |                  |                         |             |        |
| 1                         | 2412            | 6                | 14.252                  | ≤30         | PASS   |
| 6                         | 2437            | 6                | 11.776                  | ≤30         | PASS   |
| 11                        | 2462            | 6                | 12.125                  | ≤30         | PASS   |
| <b>IEEE 802.11n(HT20)</b> |                 |                  |                         |             |        |
| 1                         | 2412            | MCS0             | 13.578                  | ≤30         | PASS   |
| 6                         | 2437            | MCS0             | 11.386                  | ≤30         | PASS   |
| 11                        | 2462            | MCS0             | 11.844                  | ≤30         | PASS   |

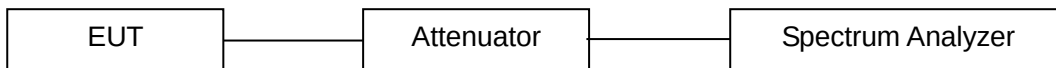
| Channel                   | Fre.<br>(MHz) | Data<br>Rate<br>(Mbps) | Peak Output<br>Power<br>(dBm) | Ant<br>Gain<br>(dBi) | Total E.I.R.P<br>Measurement<br>(dBm) | E.I.R.P<br>(dBm) | Result |
|---------------------------|---------------|------------------------|-------------------------------|----------------------|---------------------------------------|------------------|--------|
| <b>IEEE 802.11b</b>       |               |                        |                               |                      |                                       |                  |        |
| 1                         | 2412          | 1                      | 15.436                        | 1.5                  | 15.44                                 | ≤36              | PASS   |
| 6                         | 2437          | 1                      | 12.363                        | 1.5                  | 12.36                                 | ≤36              | PASS   |
| 11                        | 2462          | 1                      | 12.614                        | 1.5                  | 12.61                                 | ≤36              | PASS   |
| <b>IEEE 802.11g</b>       |               |                        |                               |                      |                                       |                  |        |
| 1                         | 2412          | 6                      | 14.252                        | 1.5                  | 14.25                                 | ≤36              | PASS   |
| 6                         | 2437          | 6                      | 11.776                        | 1.5                  | 11.78                                 | ≤36              | PASS   |
| 11                        | 2462          | 6                      | 12.125                        | 1.5                  | 12.13                                 | ≤36              | PASS   |
| <b>IEEE 802.11n(HT20)</b> |               |                        |                               |                      |                                       |                  |        |
| 1                         | 2412          | MCS0                   | 13.578                        | 1.5                  | 13.58                                 | ≤35.58           | PASS   |
| 6                         | 2437          | MCS0                   | 11.386                        | 1.5                  | 11.39                                 | ≤35.58           | PASS   |
| 11                        | 2462          | MCS0                   | 11.844                        | 1.5                  | 11.84                                 | ≤35.58           | PASS   |

### 13.3 6dB Bandwidth Measurement

#### LIMITS

The minimum 6dB bandwidth shall be at least 500 kHz

#### BLOCK DIAGRAM OF TEST SETUP



#### TEST PROCEDURES

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below according to DTS KDB 558074 D01 15.247 Meas Guidance v05r02:

- Set the RBW = 100KHz.
- Set the VBW  $\geq 3 \times$  RBW
- Set the Detector = peak.
- Set the Sweep time = auto couple.
- Set the Trace mode = max hold.
- Allow trace to fully stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

#### TEST RESULTS

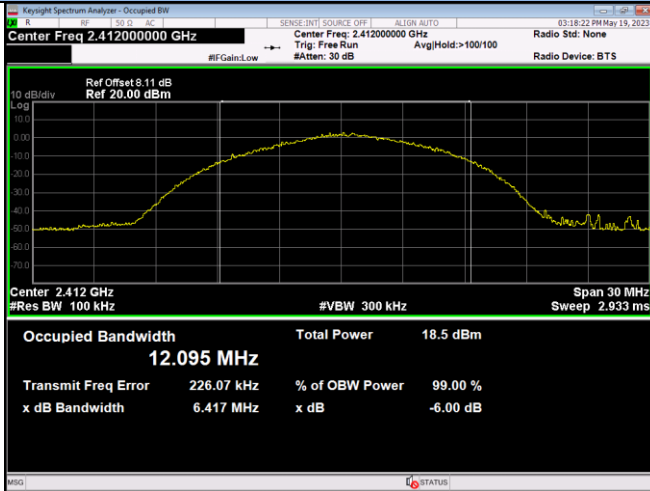
PASS

Please refer to the following tables.

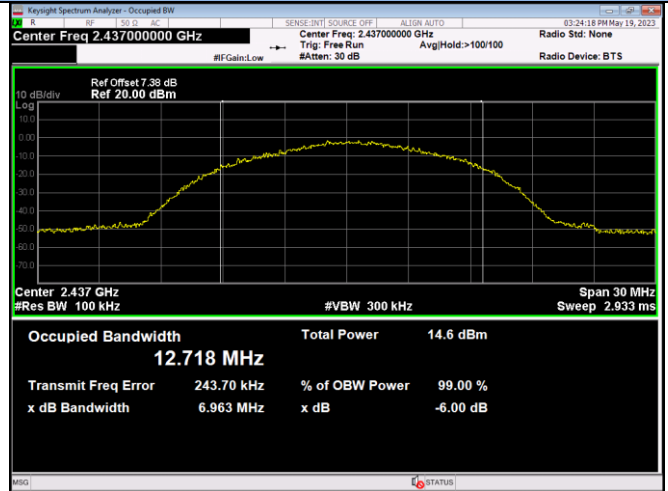
| Channel                   | Frequency (MHz) | Data Rate (Mbps) | 6dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Limit (MHz) | Result |
|---------------------------|-----------------|------------------|---------------------|---------------------|-------------|--------|
| <b>IEEE 802.11b</b>       |                 |                  |                     |                     |             |        |
| 1                         | 2412            | 1                | 6.417               | ---                 | >0.5        | PASS   |
| 6                         | 2437            | 1                | 6.963               | ---                 | >0.5        | PASS   |
| 11                        | 2462            | 1                | 6.620               | ---                 | >0.5        | PASS   |
| <b>IEEE 802.11g</b>       |                 |                  |                     |                     |             |        |
| 1                         | 2412            | 6                | 13.89               | ---                 | >0.5        | PASS   |
| 6                         | 2437            | 6                | 16.12               | ---                 | >0.5        | PASS   |
| 11                        | 2462            | 6                | 16.40               | ---                 | >0.5        | PASS   |
| <b>IEEE 802.11n(HT20)</b> |                 |                  |                     |                     |             |        |
| 1                         | 2412            | MCS0             | 13.89               | ---                 | >0.5        | PASS   |
| 6                         | 2437            | MCS0             | 16.39               | ---                 | >0.5        | PASS   |
| 11                        | 2462            | MCS0             | 17.57               | ---                 | >0.5        | PASS   |

## Test Plots of 6dB Bandwidth

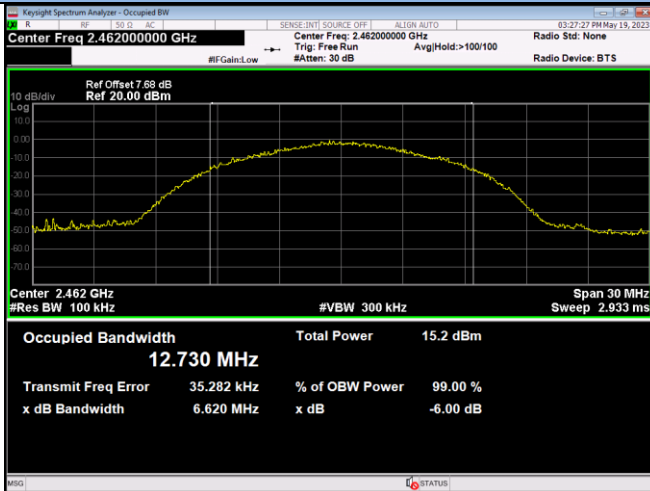
### IEEE 802.11b - 2412MHz



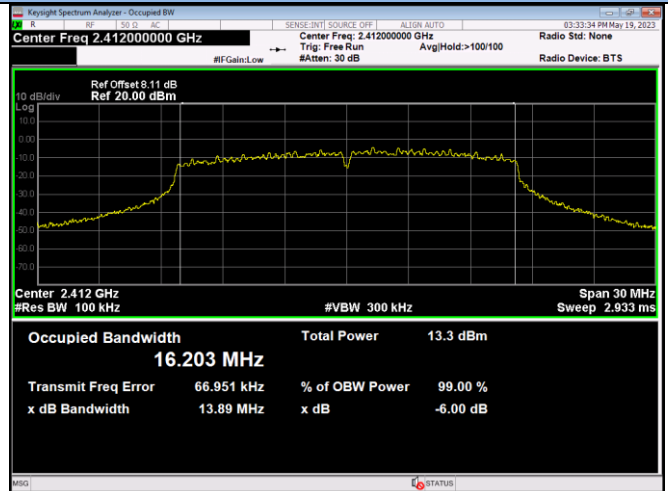
### IEEE 802.11b - 2437MHz



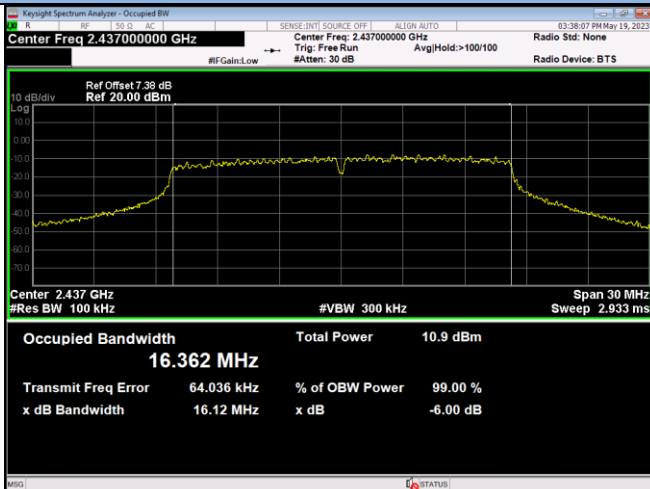
### IEEE 802.11b - 2462MHz



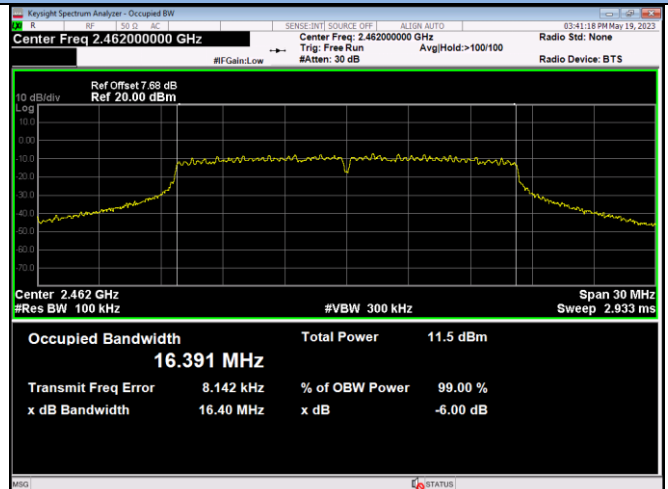
### IEEE 802.11g - 2412MHz



### IEEE 802.11g - 2437MHz



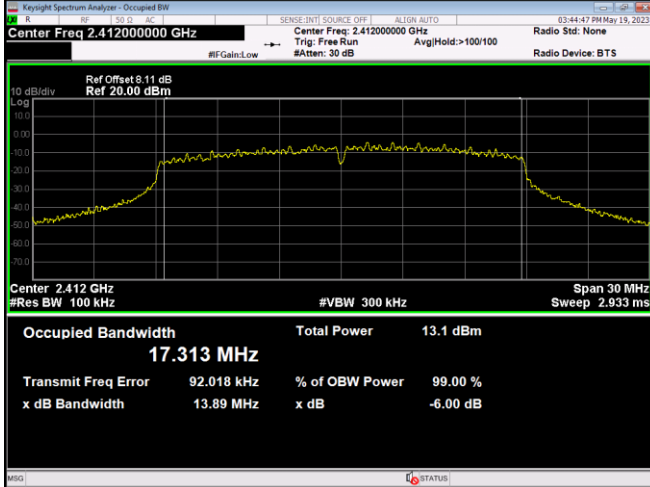
### IEEE 802.11g - 2462MHz



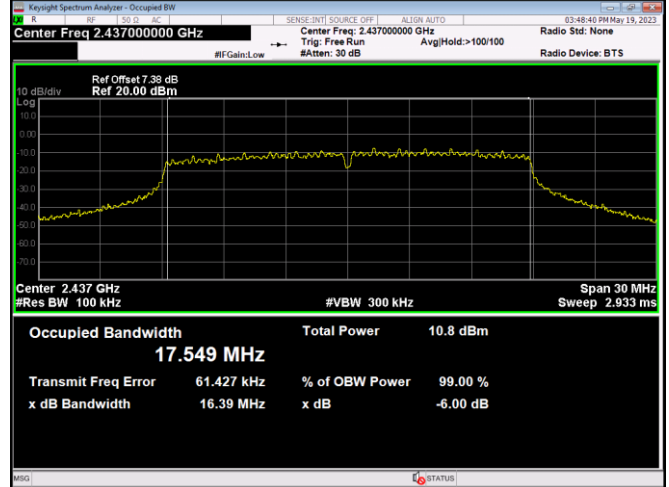


### Test Plots of 6dB Bandwidth

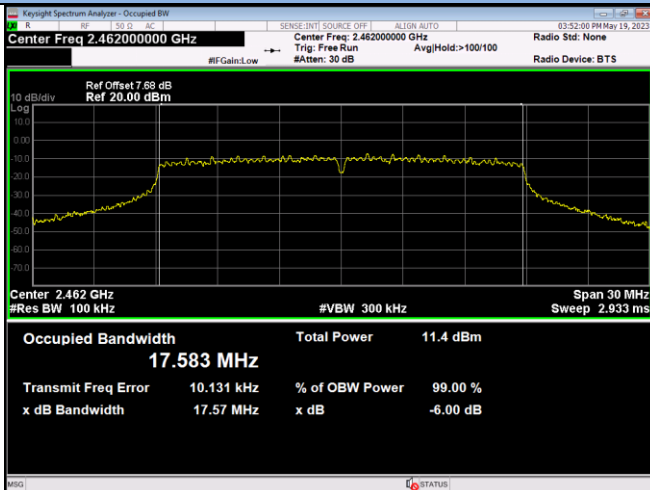
#### IEEE 802.11n(HT20) - 2412MHz



#### IEEE 802.11n(HT20) - 2437MHz



#### IEEE 802.11n(HT20) - 2462MHz

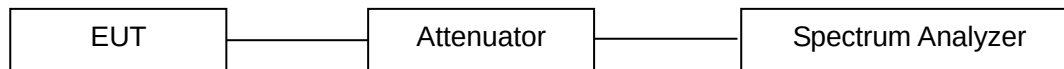


## 13.4 Power Spectral Density Measurement

### LIMITS

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

### BLOCK DIAGRAM OF TEST SETUP



### TEST PROCEDURES

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below according to FCC DTS KDB 558074 D01 15.247 Meas Guidance v05r02:

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100\text{KHz}$
- Set the VBW  $\geq 3 \times \text{RBW}$ .
- Set the Detector = peak.
- Set the Sweep time = auto couple.
- Set the Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

### TEST RESULTS

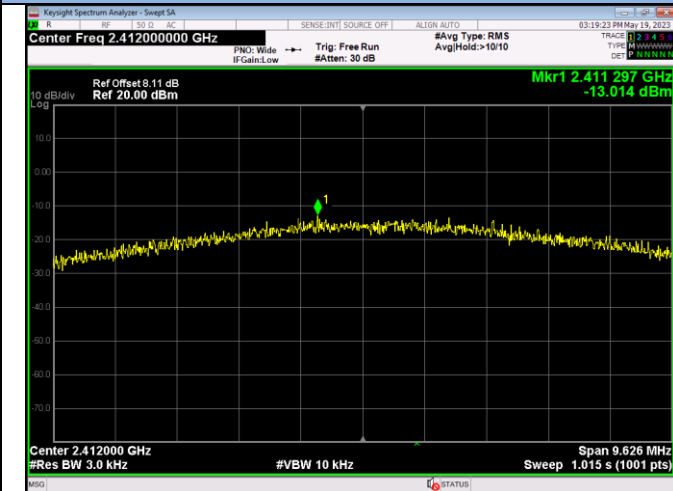
PASS

Please refer to the following table.

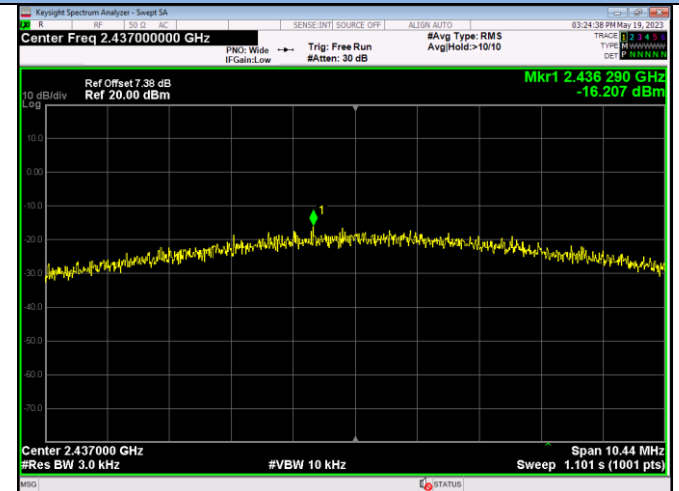
| Channel                   | Frequency (MHz) | Data Rate (Mbps) | PSD dBm / 3kHz | Limit dBm / 3kHz | Result |
|---------------------------|-----------------|------------------|----------------|------------------|--------|
| <b>IEEE 802.11b</b>       |                 |                  |                |                  |        |
| 1                         | 2412            | 1                | -13.014        | 8                | PASS   |
| 6                         | 2437            | 1                | -16.207        | 8                | PASS   |
| 11                        | 2462            | 1                | -16.141        | 8                | PASS   |
| <b>IEEE 802.11g</b>       |                 |                  |                |                  |        |
| 1                         | 2412            | 6                | -18.016        | 8                | PASS   |
| 6                         | 2437            | 6                | -21.789        | 8                | PASS   |
| 11                        | 2462            | 6                | -20.783        | 8                | PASS   |
| <b>IEEE 802.11n(HT20)</b> |                 |                  |                |                  |        |
| 1                         | 2412            | MCS0             | -19.326        | 8                | PASS   |
| 6                         | 2437            | MCS0             | -21.616        | 8                | PASS   |
| 11                        | 2462            | MCS0             | -20.236        | 8                | PASS   |

## Test Plots of Power Spectral Density

### IEEE 802.11b - 2412MHz



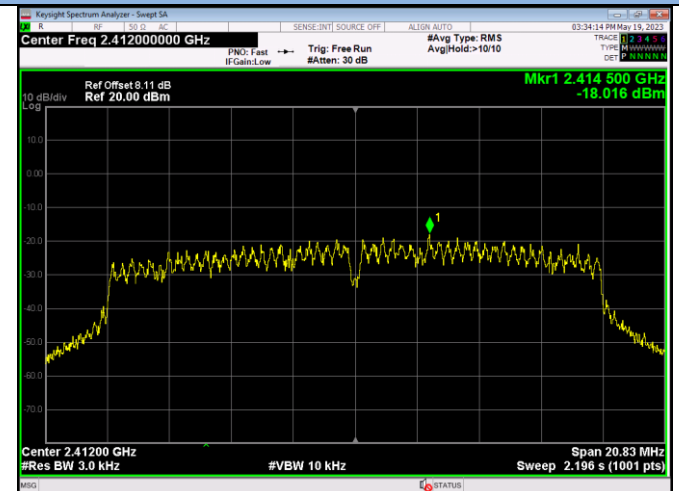
### IEEE 802.11b - 2437MHz



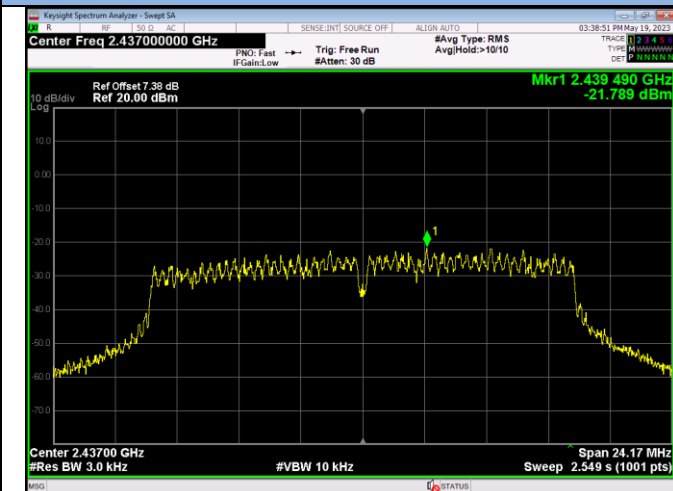
### IEEE 802.11b - 2462MHz



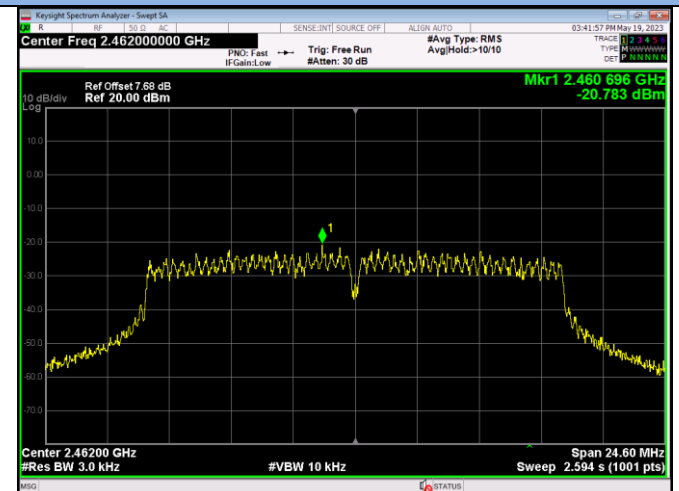
### IEEE 802.11g - 2412MHz



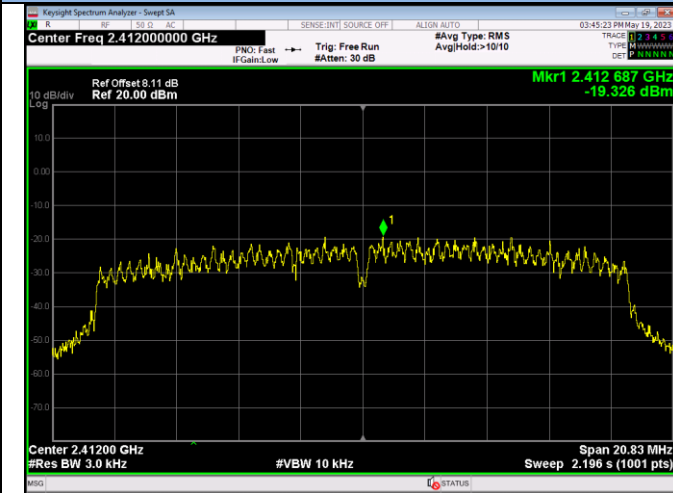
### IEEE 802.11g - 2437MHz



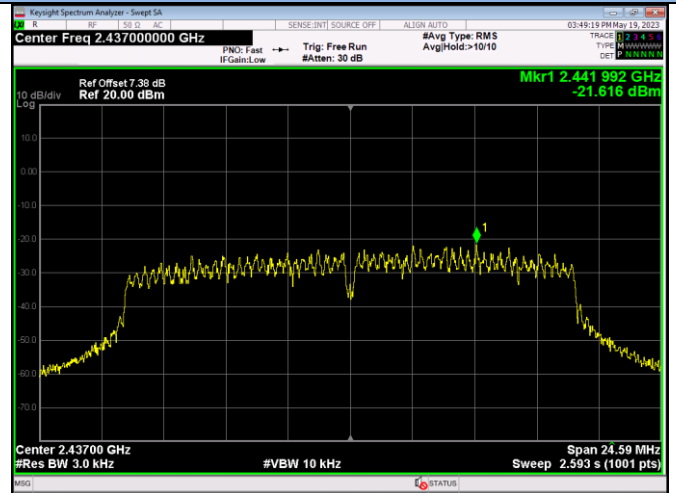
### IEEE 802.11g - 2462MHz



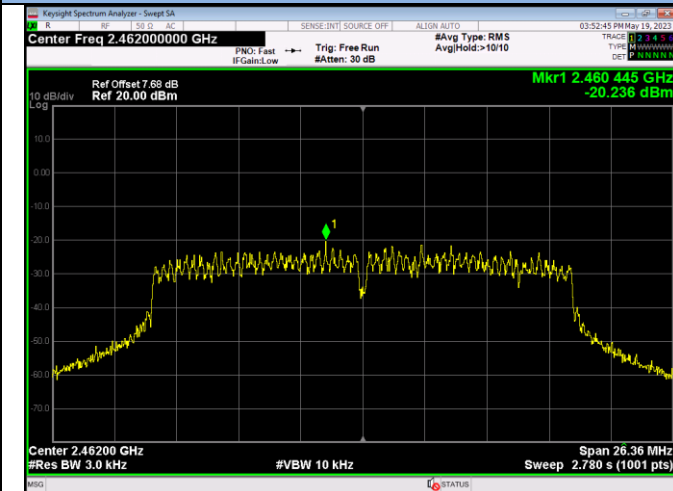
### IEEE 802.11n(HT20) - 2412MHz



### IEEE 802.11n(HT20) - 2437MHz



### IEEE 802.11n(HT20) - 2462MHz



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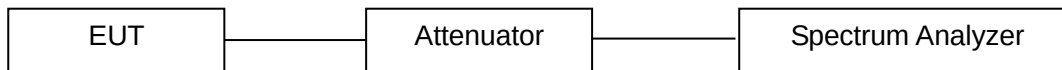
---

## 13.5 Band Edge and Conducted Spurious Emissions Measurement

### LIMITS

In any 100KHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100KHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

### BLOCK DIAGRAM OF TEST SETUP



### TEST PROCEDURES

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer was set as below according to ANSI C63.10-2013, Section 11.11

#### Measurement Procedure REF

- a. Set the RBW = 100 kHz.
- b. Set the VBW  $\geq$  300 kHz.
- c. Set the Detector = peak.
- d. Set the Sweep time = auto couple.
- e. Trace mode = max hold.
- f. Allow trace to fully stabilize.
- g. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

---

### Measurement Procedure OOB

- a. Set RBW = 100 kHz.
- b. Set VBW  $\geq$  300 kHz.
- c. Set the Detector = peak.
- d. Set the Sweep = auto couple.
- e. Set the Trace Mode = max hold.
- f. Allow trace to fully stabilize.
- g. Use the peak marker function to determine the maximum amplitude level.

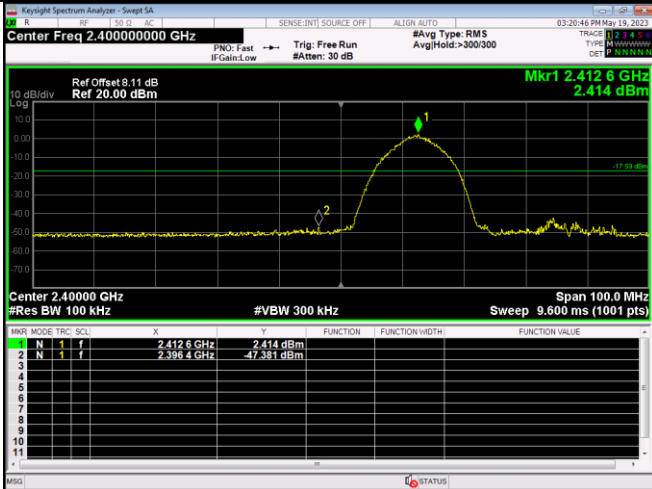
### TEST RESULTS

PASS

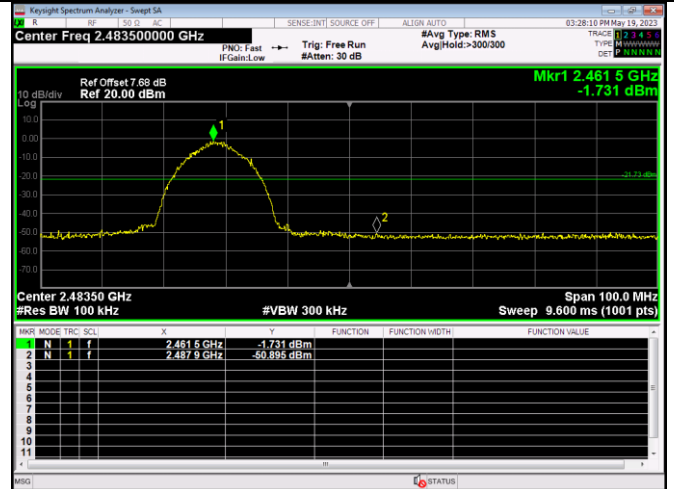
Please refer to the following test plots.

## Band Edge

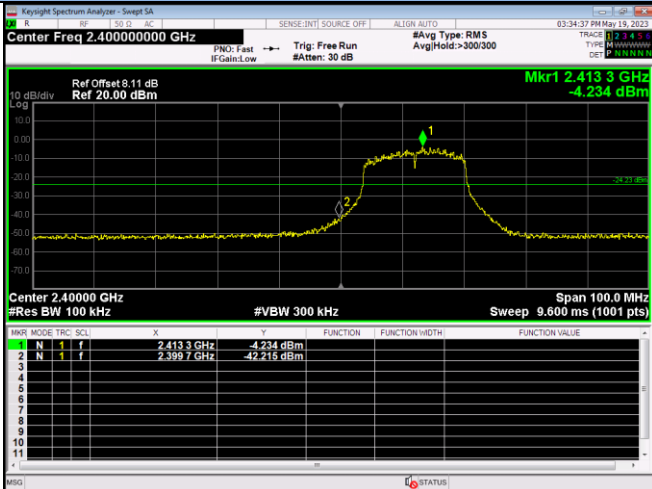
### IEEE 802.11b / Low Channel



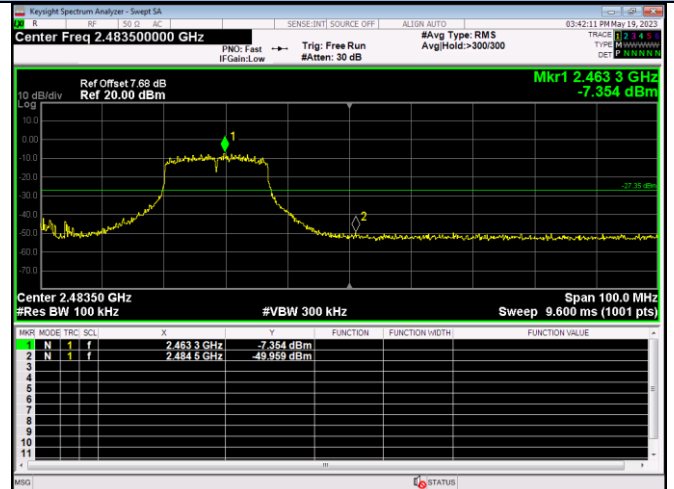
### IEEE 802.11b / High Channel



### IEEE 802.11g / Low Channel



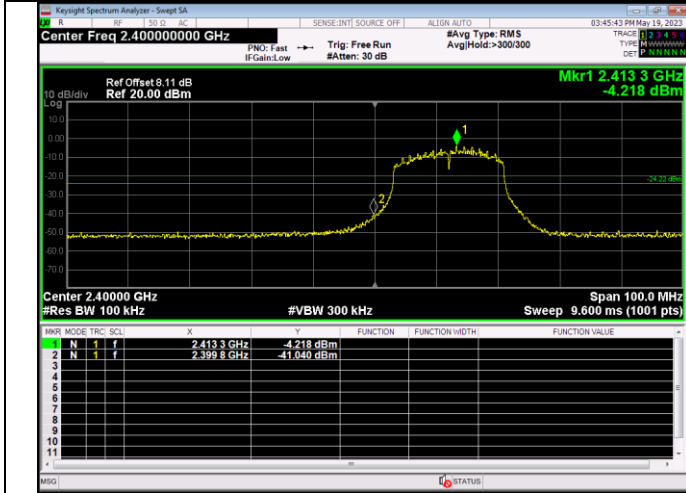
### IEEE 802.11g / High Channel



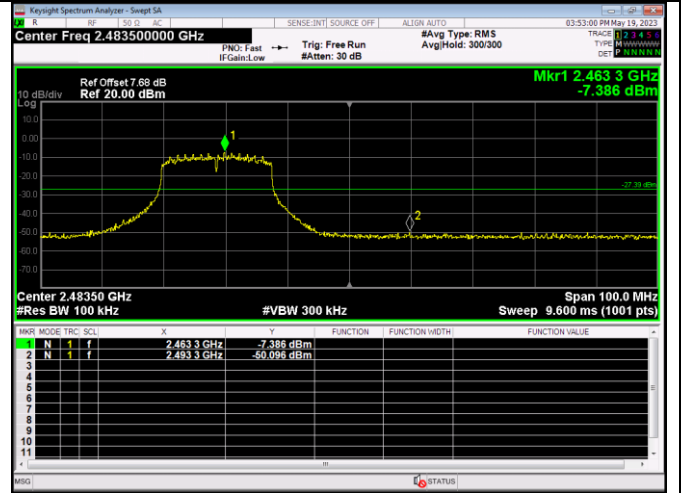


## Band Edge

### IEEE 802.11n(HT20) / Low Channel

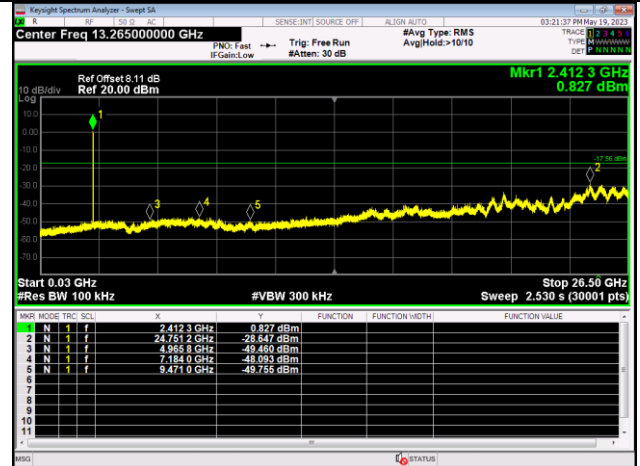
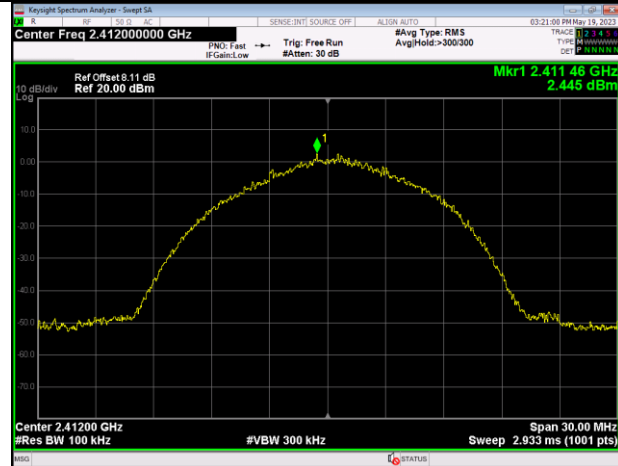


### IEEE 802.11n(HT20) / High Channel

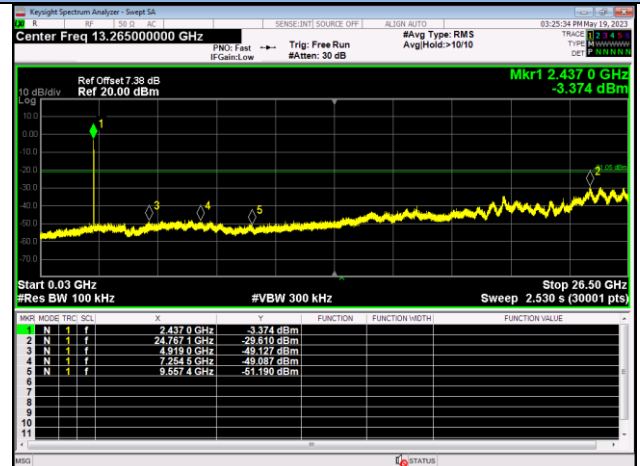
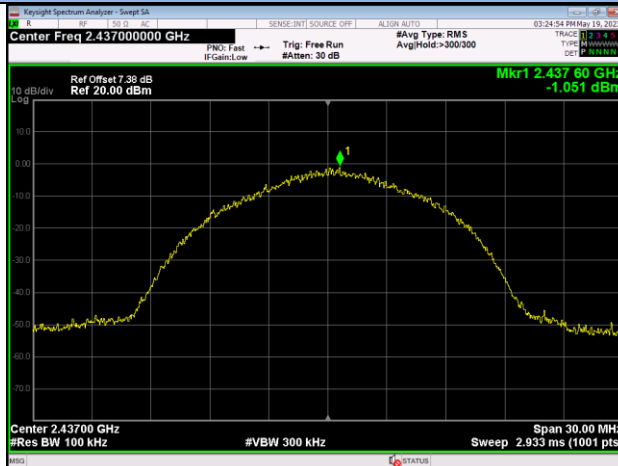


## Conducted Spurious Emissions – IEEE 802.11b (The Worst Case)

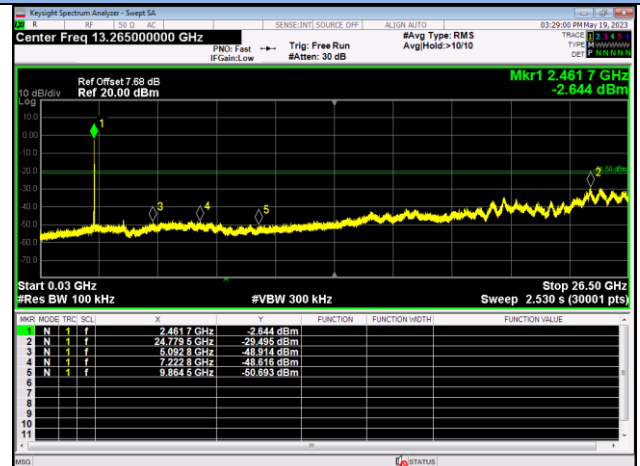
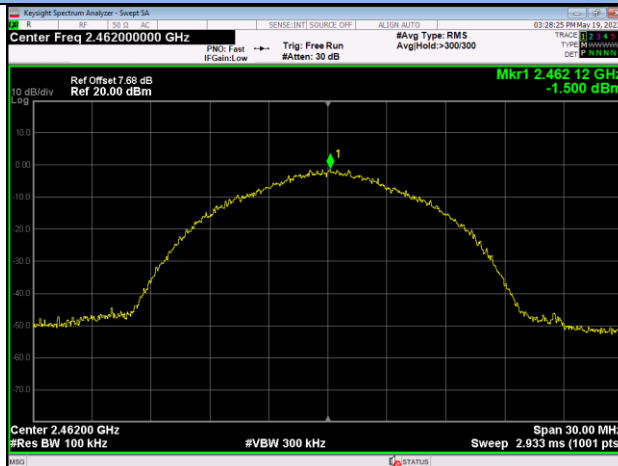
### Lowest Channel



### Middle Channel



### Highest Channel



## 13.6 Radiated Spurious Emissions and Restricted Bands Measurement

### LIMIT of Radiated Band Edges and non-restricted bands

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB.

### LIMIT of Restricted bands

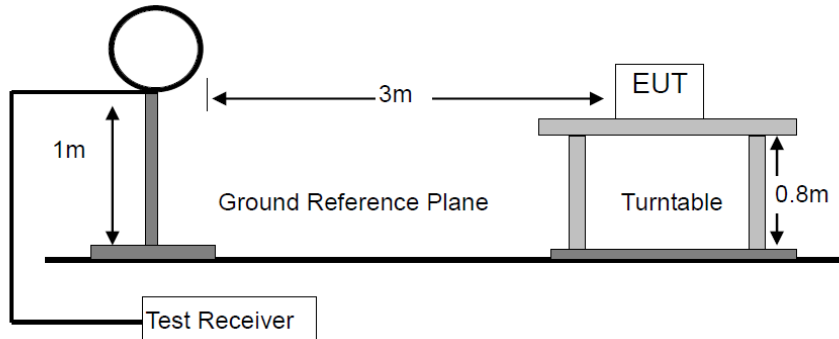
In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below:

| Frequency range<br>MHz | Distance Meters | Field Strengths Limit (15.209) |
|------------------------|-----------------|--------------------------------|
|                        |                 | $\mu\text{V/m}$                |
| 0.009 ~ 0.490          | 300             | $2400/F(\text{kHz})$           |
| 0.490 ~ 1.705          | 30              | $24000/F(\text{kHz})$          |
| 1.705 ~ 30             | 30              | 30                             |
| 30 ~ 88                | 3               | 100                            |
| 88 ~ 216               | 3               | 150                            |
| 216 ~ 960              | 3               | 200                            |
| Above 960              | 3               | 500                            |

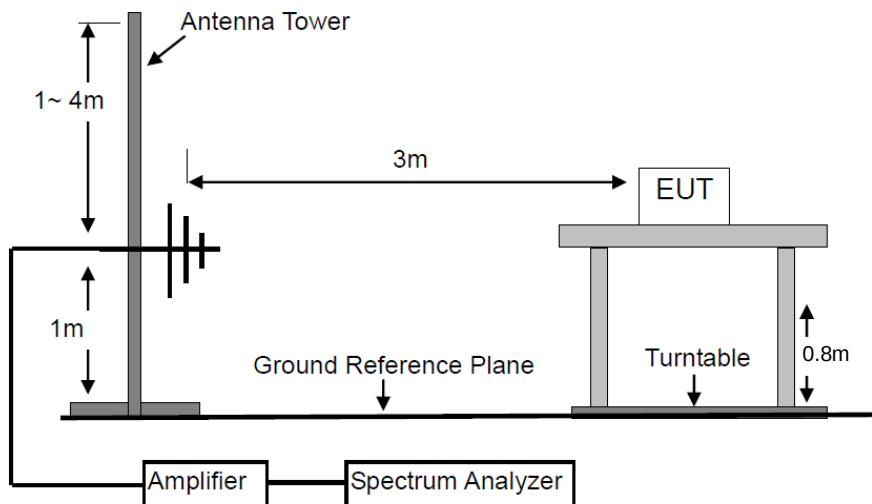
- Remark:
- (1) Emission level (dB) $\mu\text{V}$  = 20 log Emission level  $\mu\text{V/m}$
  - (2) The smaller limit shall apply at the cross point between two frequency bands.
  - (3) As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.
  - (4) The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.
  - (5) §15.247(d) specifies that emissions which fall in the restricted bands, as defined in §15.205 comply with radiated emission limits specified in §15.209.

## BLOCK DIAGRAM OF TEST SETUP

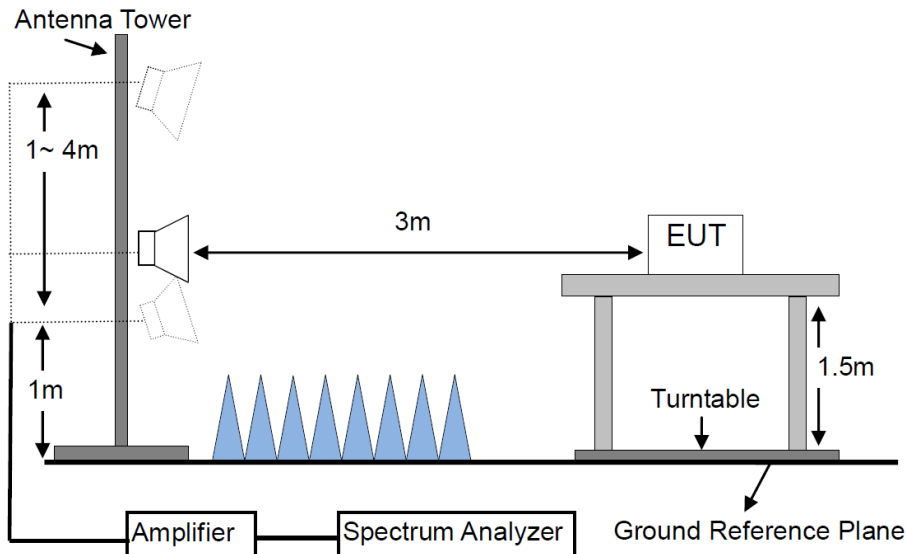
For Radiated Emission below 30MHz



For Radiated Emission 30-1000MHz



For Radiated Emission Above 1000MHz.



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## TEST PROCEDURES

- a. Below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.

- b. For the radiated emission test above 1GHz:

The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

- c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
- f. A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

g. Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and packet type.

The worst case was found when the EUT was positioned on Z axis for radiated emission.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

| Frequency Band (MHz) | Detector | Resolution Bandwidth | Video Bandwidth |
|----------------------|----------|----------------------|-----------------|
| 0.009~0.15           | QP & AVG | 200 Hz               | 1 kHz           |
| 0.15~30              | QP & AVG | 10 kHz               | 30 kHz          |
| 30 to 1000           | QP       | 120 kHz              | 300 kHz         |
| Above 1000           | Peak     | 1 MHz                | 3 MHz           |
|                      | Average  | 1 MHz                | 10 Hz           |

## TEST RESULTS

PASS

Please refer to the following pages of the worst case.

M/N: UCR2

Testing Voltage: DC 3.7V

Polarization: Horizontal

Detector: QP

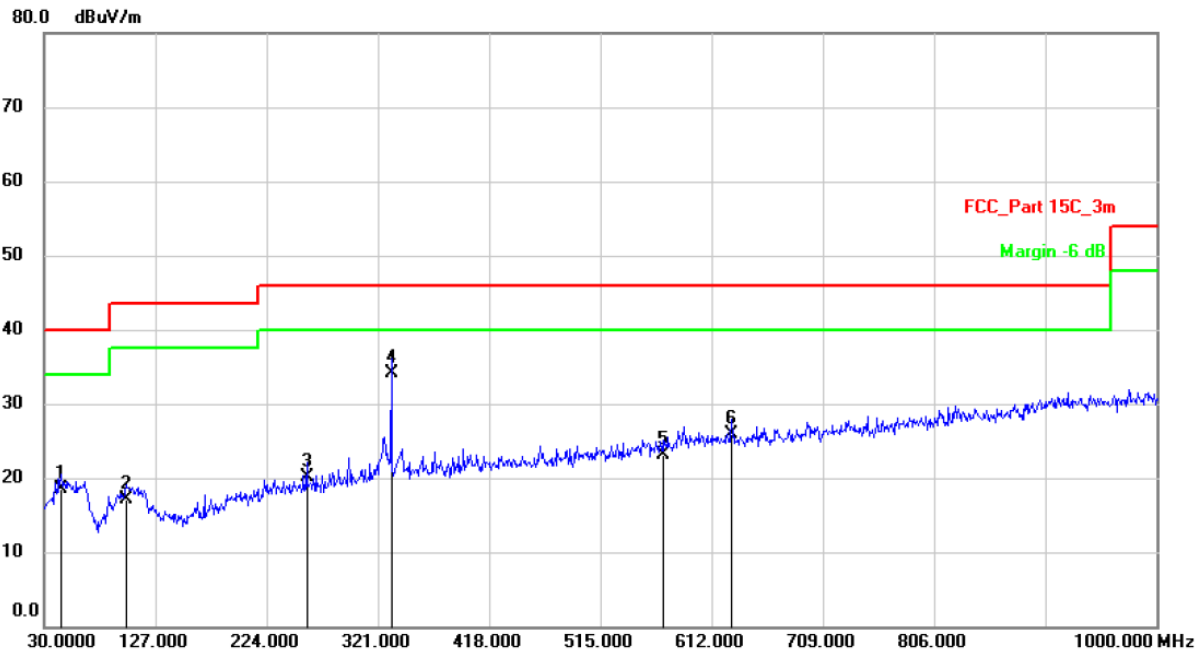
Test Mode: 1 (IEEE 802.11b Low channel)

Distance: 3m

## Radiated Emission Measurement

Date: 2023/5/17

Time: 21:19:40



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-ment | Limit  | Over   |          |         |
|-----|-----|----------|---------------|----------------|--------------|--------|--------|----------|---------|
|     |     | MHz      | dBuV          | dB/m           | dBuV/m       | dBuV/m | dB     | Detector | Comment |
| 1   |     | 44.5500  | 26.11         | -7.61          | 18.50        | 40.00  | -21.50 | QP       |         |
| 2   |     | 101.7800 | 24.61         | -7.51          | 17.10        | 43.50  | -26.40 | QP       |         |
| 3   |     | 258.9200 | 26.29         | -6.19          | 20.10        | 46.00  | -25.90 | QP       |         |
| 4   | *   | 332.6400 | 38.67         | -4.57          | 34.10        | 46.00  | -11.90 | QP       |         |
| 5   |     | 569.3200 | 23.30         | -0.20          | 23.10        | 46.00  | -22.90 | QP       |         |
| 6   |     | 629.4600 | 24.88         | 1.02           | 25.90        | 46.00  | -20.10 | QP       |         |

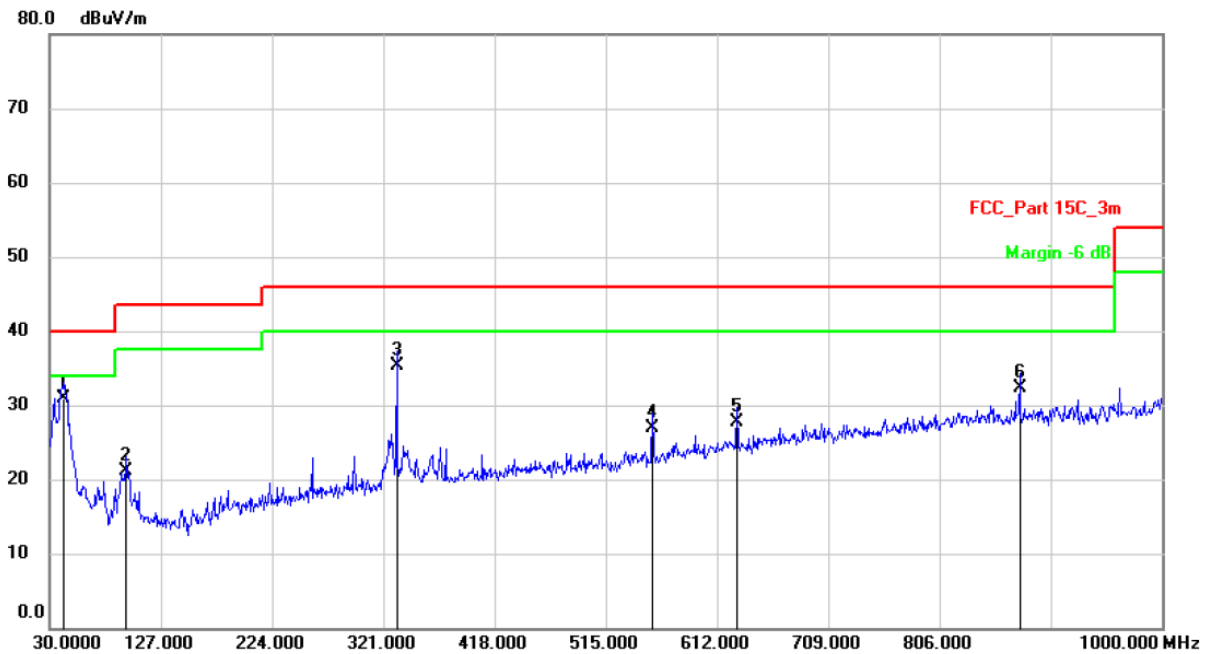
Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.

|                                         |                          |
|-----------------------------------------|--------------------------|
| M/N: UCR2                               | Testing Voltage: DC 3.7V |
| Polarization: Vertical                  | Detector: QP             |
| Test Mode: 1 (IEEE 802.11b Low channel) | Distance: 3m             |

## Radiated Emission Measurement

Date: 2023/5/17

Time: 21:25:53



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measurement | Limit  | Over   |          |         |
|-----|-----|----------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz      | dBuV          | dB/m           | dBuV/m      | dBuV/m | dB     | Detector | Comment |
| 1   | *   | 42.6100  | 38.72         | -7.72          | 31.00       | 40.00  | -9.00  | QP       |         |
| 2   |     | 96.9300  | 29.99         | -8.89          | 21.10       | 43.50  | -22.40 | QP       |         |
| 3   |     | 332.6400 | 40.87         | -5.57          | 35.30       | 46.00  | -10.70 | QP       |         |
| 4   |     | 555.7400 | 28.53         | -1.63          | 26.90       | 46.00  | -19.10 | QP       |         |
| 5   |     | 629.4600 | 27.40         | 0.30           | 27.70       | 46.00  | -18.30 | QP       |         |
| 6   |     | 875.8400 | 27.38         | 4.92           | 32.30       | 46.00  | -13.70 | QP       |         |

Note: Below 30MHz, the emissions are lower than 20dB below the allowable limit.



| Modulation:<br>TX (IEEE 802.11b the worst case) |                       |                        |       | Test Result: PASS |                            |       | Test frequency range: 1-25GHz |       |                |        |
|-------------------------------------------------|-----------------------|------------------------|-------|-------------------|----------------------------|-------|-------------------------------|-------|----------------|--------|
| Freq.<br>(MHz)                                  | Ant.<br>Pol.<br>(H/V) | Reading<br>Level(dBuV) |       | Factor<br>(dB/m)  | Emission Level<br>(dBuV/m) |       | Limit 3m<br>(dBuV/m)          |       | Margin<br>(dB) |        |
|                                                 |                       | PK                     | AV    |                   | PK                         | AV    | PK                            | AV    | PK             | AV     |
| Operation Mode: TX Mode (Low)                   |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4824                                            | H                     | 53.84                  | 36.61 | 6.38              | 60.22                      | 42.99 | 74.00                         | 54.00 | -13.78         | -11.01 |
| 7236                                            | H                     | 42.97                  | 32.07 | 10.48             | 53.45                      | 42.55 | 74.00                         | 54.00 | -20.55         | -11.45 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4824                                            | V                     | 50.79                  | 37.72 | 6.38              | 57.17                      | 44.10 | 74.00                         | 54.00 | -16.83         | -9.90  |
| 7236                                            | V                     | 45.47                  | 31.35 | 10.48             | 55.95                      | 41.83 | 74.00                         | 54.00 | -18.05         | -12.17 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| Operation Mode: TX Mode (Mid)                   |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4874                                            | H                     | 61.34                  | 43.17 | 6.56              | 67.90                      | 49.73 | 74.00                         | 54.00 | -6.10          | -4.27  |
| 7311                                            | H                     | 46.42                  | 33.32 | 10.53             | 56.95                      | 43.85 | 74.00                         | 54.00 | -17.05         | -10.15 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4874                                            | V                     | 53.06                  | 40.42 | 6.56              | 59.62                      | 46.98 | 74.00                         | 54.00 | -14.38         | -7.02  |
| 7311                                            | V                     | 44.55                  | 32.32 | 10.53             | 55.08                      | 42.85 | 74.00                         | 54.00 | -18.92         | -11.15 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| Operation Mode: TX Mode (High)                  |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4924                                            | H                     | 51.77                  | 39.92 | 6.76              | 58.53                      | 46.68 | 74.00                         | 54.00 | -15.47         | -7.32  |
| 7386                                            | H                     | 43.76                  | 31.81 | 10.57             | 54.33                      | 42.38 | 74.00                         | 54.00 | -19.67         | -11.62 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| 4924                                            | V                     | 52.15                  | 36.80 | 6.76              | 58.91                      | 43.56 | 74.00                         | 54.00 | -15.09         | -10.44 |
| 7386                                            | V                     | 44.20                  | 31.55 | 10.57             | 54.77                      | 42.12 | 74.00                         | 54.00 | -19.23         | -11.88 |
| ---                                             |                       |                        |       |                   |                            |       |                               |       |                |        |
| Spurious Emission in restricted band:           |                       |                        |       |                   |                            |       |                               |       |                |        |
| 2390.000                                        | H                     | 54.33                  | 34.76 | 0.09              | 54.42                      | 34.85 | 74.00                         | 54.00 | -19.58         | -19.15 |
| 2390.000                                        | V                     | 54.67                  | 36.04 | 0.09              | 54.76                      | 36.13 | 74.00                         | 54.00 | -19.24         | -17.87 |
| 2483.500                                        | H                     | 49.25                  | 39.21 | 0.34              | 49.59                      | 39.55 | 74.00                         | 54.00 | -24.41         | -14.45 |
| 2483.500                                        | V                     | 46.29                  | 37.31 | 0.34              | 46.63                      | 37.65 | 74.00                         | 54.00 | -27.37         | -16.35 |

Remark: 1. Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits.  
2. Others emissions are attenuated 20dB below the limits, so it does not record in report.

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## 13.7 Antenna Requirement

### STANDARD APPLICABLE

According to of FCC part 15C section 15.203 and 15.247:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Systems operating in the 2400-2483.5MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum peak output power of the intentional radiator is reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

### ANTENNA CONNECTED CONSTRUCTION

The antenna is SMD antenna that no antenna other than furnished by the responsible party shall be used with the device, and the best case gain of the antenna is 1.5dBi, Therefore, the antenna is considered to meet the requirement.

## 14. Test Equipment List

| Item | Equipment                      | Manufacturer                      | Model No. | Serial No.        | Last Cal.     | Cal. Interval |
|------|--------------------------------|-----------------------------------|-----------|-------------------|---------------|---------------|
| 1.   | Test Receiver                  | Rohde & Schwarz                   | ESCI7     | 100837            | Mar. 13, 2023 | 1 Year        |
| 2.   | Antenna                        | Schwarzbeck                       | VULB9162  | 9162-010          | Mar. 23, 2022 | 2 Year        |
| 3.   | Spectrum Analyzer              | Rohde & Schwarz                   | FSU26     | 200409/026        | Mar. 13, 2023 | 1 Year        |
| 4.   | Spectrum Analyzer              | Keysight                          | N9020A    | MY54200831        | Mar. 13, 2023 | 1 Year        |
| 5.   | Spectrum Analyzer              | Keysight                          | N9010B    | 1215146           | Sep. 06, 2023 | 1 Year        |
| 6.   | Horn Antenna                   | Schwarzbeck                       | BBHA9170  | 9170-172          | Mar. 23, 2022 | 2 Year        |
| 7.   | Power Sensor                   | DARE                              | RPR3006W  | 15I00041SNO<br>64 | Mar. 13, 2023 | 1 Year        |
| 8.   | Communication Tester           | Rohde & Schwarz                   | CMW500    | 149004            | Mar. 13, 2023 | 1 Year        |
| 9.   | Horn Antenna                   | COM-Power                         | AH-118    | 071078            | Mar. 23, 2022 | 2 Year        |
| 10.  | Pre-Amplifier                  | HP                                | HP 8449B  | 3008A00964        | Mar. 13, 2023 | 1 Year        |
| 11.  | Pre-Amplifier                  | HP                                | HP 8447D  | 1145A00203        | Mar. 13, 2023 | 1 Year        |
| 12.  | Loop Antenna                   | Schwarzbeck                       | FMZB 1513 | 1513-272          | Mar. 23, 2022 | 2 Year        |
| 13.  | Test Receiver                  | Rohde & Schwarz                   | ESCI      | 101152            | Mar. 13, 2023 | 1 Year        |
| 14.  | L.I.S.N                        | Rohde & Schwarz                   | ENV 216   | 101317            | Mar. 13, 2023 | 1 Year        |
| 15.  | L.I.S.N                        | Rohde & Schwarz                   | ESH2-Z5   | 893606/014        | Mar. 13, 2023 | 1 Year        |
| 16.  | RF Switching Unit              | Compliance Direction Systems Inc. | RSU-M2    | 38311             | Mar. 13, 2023 | 1 Year        |
| 17.  | Temperature & Humidity Chamber | REMAFEE                           | SYHR225L  | N/A               | Mar. 13, 2023 | 1 Year        |
| 18.  | DC Source                      | Maynuo                            | MY8811    | N/A               | Mar. 13, 2023 | 1 Year        |
| 19.  | Temporary antenna connector    | TESCOM                            | SS402     | N/A               | N/A           | N/A           |
| 20.  | Chamber                        | SAEMC                             | 9*7*7m    | N/A               | Apr. 21, 2023 | 2 Year        |
| 21.  | Test Software                  | EZ                                | EZ_EMC    | N/A               | N/A           | N/A           |

Note: For photographs of EUT and measurement, please refer to appendix in separate documents.

---End---