



# TEST REPORT

Reference No. .... : WTN22F11236598W001  
FCC ID ..... : 2A9TP-ZIGBEE  
Applicant..... : CES2020 LLC  
Address..... : 150 Bishop Landing, Irvine, CA 92620,USA  
Manufacturer ..... : The same as above  
Address..... : The same as above  
Product Name..... : Zigbee gateway  
Model No..... : Zigbee  
Test specification..... : FCC CFR47 Part 15 Subpart C (Section 15.247): 2020  
Date of Receipt sample .... : 2022-11-25  
Date of Test ..... : 2022-12-05 to 2022-12-07  
Date of Issue..... : 2023-02-13  
Test Report Form No. .... : WEW-15247A-01A  
Test Result..... : Pass

Remarks:

The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of approver.

Prepared By:

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1 Revision History

| Test Report No.    | Date of Issue | Description | Status |
|--------------------|---------------|-------------|--------|
| WTN22F11236598W001 | 2023-02-13    | Original    | Valid  |

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### 3 General Information

#### 3.1 General Description of E.U.T

Product Name ..... : Zigbee gateway

Model No. .... : Zigbee

Model Description ..... : ---

Rated Voltage..... : DC 5V, 0.1A

Battery Capacity ..... : ---

Power Adapter ..... : ---

#### 3.2 Technical Characteristics of EUT

Support Standards ..... : IEEE 802.15.4

Frequency Range ..... : 2405-2475MHz

RF Output Power ..... : 5.84dBm (Conducted )

Modulation ..... : OQPSK

Quantity of Channels ..... : 15

Channel Separation..... : 5MHz

Type of Antenna ..... : PCB Printed Antenna

Antenna Gain ..... : 2.2dBi

#### 3.3 Standards Applicable for Testing

The tests were performed according to following standards:

|                                        |                                                                                                                                                                                          |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| FCC Rules Part 15.247                  | Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz                                   |
| 558074 D01 15.247 Meas Guidance v05r02 | Guidance For Compliance Measurements On Digital Transmission System, Frequency Hopping Spread Spectrum System, And Hybrid System Devices Operating Under Section 15.247 Of The FCC Rules |
| ANSI C63.10-2013                       | American National Standard for Testing Unlicensed Wireless Devices                                                                                                                       |



### 3.4 Test Facility

The test facility has a test site registered with the following organizations:

- **ISED – Registration No.: 21895**

Waltek Testing Group (Foshan) Co., Ltd. has been registered and fully described in a report filed with the Innovation, Science and Economic Development Canada (ISED). The acceptance letter from the ISED is maintained in our files. Registration ISED number: 21895, March 12, 2019

- **FCC – Registration No.: 820106**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 820106, August 16, 2018

- **FCC – Designation No.: CN5034**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation No. CN5034.

- **NVLAP – Lab Code: 600191-0**

Waltek Testing Group (Foshan) Co., Ltd. EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 600191-0.

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

### 3.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test items: ---

Lab information: ---

### 3.6 Abnormalities from Standard Conditions

None.

### 3.7 Disclaimer

The antenna gain information is provided by the customer. The laboratory is not responsible for the accuracy of the antenna gain information.



#### 4 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, with a duty cycle equal to 100%, and to measure its highest possible emissions level, more detailed description as follows:

**Test Mode List**

| Test Mode | Description    | Remark  |
|-----------|----------------|---------|
| TM1       | Low Channel    | 2405MHz |
| TM2       | Middle Channel | 2440MHz |
| TM3       | High Channel   | 2475MHz |

**Test Conditions**

|                       |          |
|-----------------------|----------|
| Temperature:          | 22~25°C  |
| Relative Humidity:    | 50~55%   |
| Atmospheric pressure: | 101.9kPa |

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## 5 Equipment Used during Test

### 5.1 Equipment List

| <input type="checkbox"/> Conducted Emissions 1#         |                            |                 |                   |             |                       |                      |
|---------------------------------------------------------|----------------------------|-----------------|-------------------|-------------|-----------------------|----------------------|
| Item                                                    | Equipment                  | Manufacturer    | Model No.         | Serial No.  | Last Cal Date         | Cal Due Date         |
| 1.                                                      | EMI Test Receiver          | R&S             | ESR3              | 102423      | 2022-01-06            | 2023-01-05           |
| 2.                                                      | LISN                       | R&S             | ENV216            | 101343      | 2022-01-06            | 2023-01-05           |
| 3.                                                      | Cable                      | HUBER+SUHNER    | CBL2-NN-6M        | 223NN624    | 2022-01-06            | 2023-01-05           |
| 4.                                                      | Switch                     | CD              | RSU-A4 18G        | RSUA4008    | 2022-01-06            | 2023-01-05           |
| <input type="checkbox"/> Conducted Emissions 2#         |                            |                 |                   |             |                       |                      |
| Item                                                    | Equipment                  | Manufacturer    | Model No.         | Serial No.  | Last Cal Date         | Cal Due Date         |
| 1.                                                      | EMI Test Receiver          | R&S             | ESCI              | 101178      | 2022-01-06            | 2023-01-05           |
| 2.                                                      | LISN                       | R&S             | ENV216            | 101215      | 2022-01-06            | 2023-01-05           |
| 3.                                                      | Cable                      | HUBER+SUHNER    | CBL2-NN-6M        | 6102701     | 2022-01-06            | 2023-01-05           |
| 4.                                                      | Switch                     | ESE             | RSU/M2            | ---         | 2022-01-07            | 2023-01-06           |
| <input type="checkbox"/> Conducted Emissions 3#         |                            |                 |                   |             |                       |                      |
| Item                                                    | Equipment                  | Manufacturer    | Model No.         | Serial No.  | Last Cal Date         | Cal Due Date         |
| 1.                                                      | EMI Test Receiver          | R&S             | ESR3              | 102842      | 2022-01-06            | 2023-01-05           |
| 2.                                                      | LISN                       | R&S             | ENV216            | 101542      | 2022-01-06            | 2023-01-05           |
| 3.                                                      | Cable                      | YIHENG          | LMR195UF-NMNM-2.5 | ---         | 2022-01-07            | 2023-01-06           |
| 4.                                                      | Manual RF Switch           | YIHENG          | SW-2              | RSU0402     | 2022-01-07            | 2023-01-06           |
| <input checked="" type="checkbox"/> Radiation Emissions |                            |                 |                   |             |                       |                      |
| Item                                                    | Equipment                  | Manufacturer    | Model No.         | Serial No.  | Last Calibration Date | Calibration Due Date |
| 1.                                                      | 3m Semi-anechoic Chamber   | CHANGCHUANG     | 9m×6m×6m          | -           | 2021-01-11            | 2024-01-10           |
| 2.                                                      | EMI Test Receiver          | RS              | ESR7              | 101566      | 2022-01-07            | 2023-01-06           |
| 3.                                                      | EMC Analyzer               | Agilent         | N9020A            | MY48011796  | 2022-05-17            | 2023-05-16           |
| 4.                                                      | Active Loop Antenna        | SCHWARZBECK     | FMZB1519B         | 00004       | 2022-01-10            | 2023-01-09           |
| 5.                                                      | Trilog Broadband Antenna   | SCHWARZBECK     | VULB 9162         | 9162-117    | 2022-01-09            | 2023-01-08           |
| 6.                                                      | Coaxial Cable (below 1GHz) | H+S             | CBL3-NN-12+3 m    | 214NN320    | 2022-01-07            | 2023-01-06           |
| 7.                                                      | Broad-band Horn Antenna    | SCHWARZBECK     | BBHA 9120 D       | 01561       | 2022-01-09            | 2023-01-08           |
| 8.                                                      | Broad-band Horn Antenna    | SCHWARZBECK     | BBHA 9170         | 01119       | 2022-01-09            | 2023-01-08           |
| 9.                                                      | Coaxial Cable (above 1GHz) | Times-Microwave | CBL5-NN           | -           | 2022-01-06            | 2023-01-05           |
| 10.                                                     | Amplifier                  | Lunar E M       | LNA1G18-40        | 20160501002 | 2022-01-06            | 2023-01-05           |



| <input checked="" type="checkbox"/> RF Conducted Testing |                         |              |           |            |                       |                      |
|----------------------------------------------------------|-------------------------|--------------|-----------|------------|-----------------------|----------------------|
| Item                                                     | Equipment               | Manufacturer | Model No. | Serial No. | Last Calibration Date | Calibration Due Date |
| 1.                                                       | Spectrum Analyzer       | Agilent      | N9020A    | MY48011796 | 2022-05-17            | 2023-05-16           |
| 2.                                                       | Analog Signal Generator | Agilent      | N5181A    | MY48180720 | 2022-01-06            | 2023-01-05           |
| 3.                                                       | RF Control Unit         | CHANGCHUANG  | JS0806-2  | -          | 2022-01-06            | 2023-01-05           |

☐: Not Used

☒: Used

## 5.2 Test Software

| Description                               | Manufacturer | Model    | Version   |
|-------------------------------------------|--------------|----------|-----------|
| EMI Test Software (Conducted Emission 1#) | FARATRONIC   | EZ-EMC   | EMEC-3A1  |
| EMI Test Software (Conducted Emission 2#) | FARATRONIC   | EZ-EMC   | CON-03A1  |
| EMI Test Software (Conducted Emission 3#) | FARATRONIC   | EZ-EMC   | COM 3A1.1 |
| EMI Test Software (Radiated Emission)     | FARATRONIC   | EZ-EMC   | RA-03A1-1 |
| RF Conducted Test Software                | TONSCEND     | JS1120-2 | V2.6      |

## 5.3 Special Accessories and Auxiliary Equipment

| Item | Equipment | Manufacturer | Model No. | Serial No. |
|------|-----------|--------------|-----------|------------|
| 1.   | /         | /            | /         | /          |

## 5.4 Measurement Uncertainty

| Parameter                     | Uncertainty             |
|-------------------------------|-------------------------|
| RF Output Power               | ±2.2dB                  |
| Occupied Bandwidth            | ±1.5%                   |
| Conducted Emission            | ±2.6dB                  |
| Transmitter Spurious Emission | ±3.8dB (for 25MHz-1GHz) |
|                               | ±5.0dB (for 1GHz-18GHz) |



## 6 Summary of Test Result

| Test Items                        | FCC Rules                 | Result    |
|-----------------------------------|---------------------------|-----------|
| Antenna Requirement               | §15.203; §15.247(b)(4)(i) | Compliant |
| Restricted Band of Operation      | §15.205                   | Compliant |
| Conducted Emissions               | §15.207(a)                | N/A       |
| Radiated Spurious Emissions       | §15.209(a)                | Compliant |
| Power Spectral Density            | §15.247(e)                | Compliant |
| 6dB Bandwidth                     | §15.247(a)(2)             | Compliant |
| RF Output Power                   | §15.247(b)(3)             | Compliant |
| Band edge (Out of Band Emissions) | §15.247(d)                | Compliant |

Remark:

Pass      Test item meets the requirement

Fail      Test item does not meet the requirement

N/A      Test case does not apply to the test object

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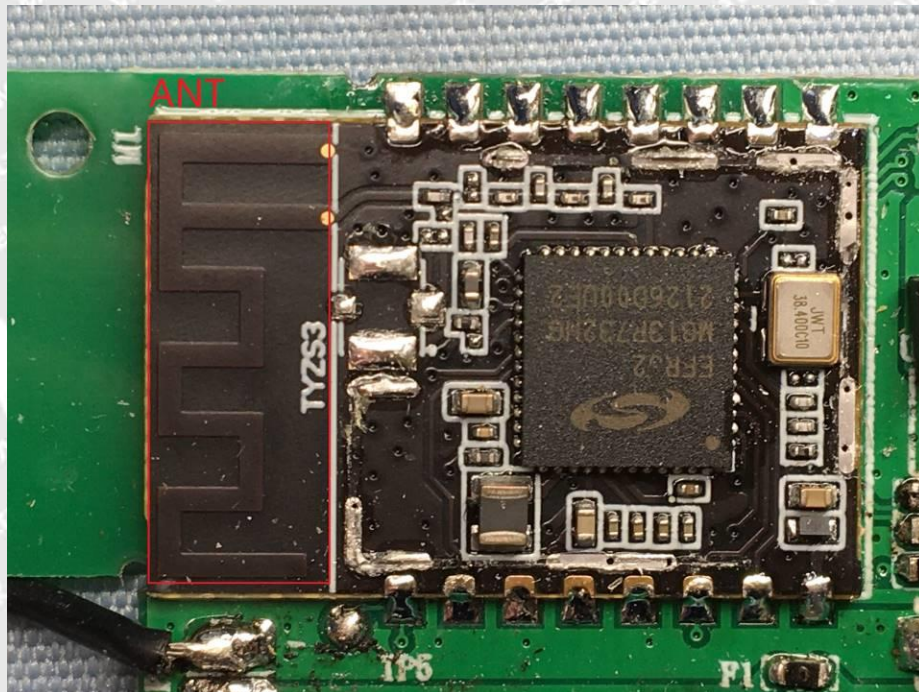
## 6.1 Antenna Requirement

### 6.1.1 Standard Applicable

According to FCC Part 15.203, 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 shall be considered sufficient to comply with the provisions of this section.

### 6.1.2 Evaluation Information

The EUT has a PCB Printed Antenna, the gain is 2.2 dBi, fulfil the requirement of this section.





## 6.2 Field Strength of Spurious Emissions

### 6.2.1 Standard Applicable

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

### 6.2.2 Test Procedure

- 1) The EUT is placed on a turntable, which is 0.8m(Below 1G) 1.5m(above 1G)above ground plane.
- 2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
- 3) EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- 4) Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 5) And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 6) Repeat above procedures until the measurements for all frequencies are complete.
- 7) The radiation measurements are tested under 3-axes(X, Y, Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the Z position. So the data shown was the Z position only.



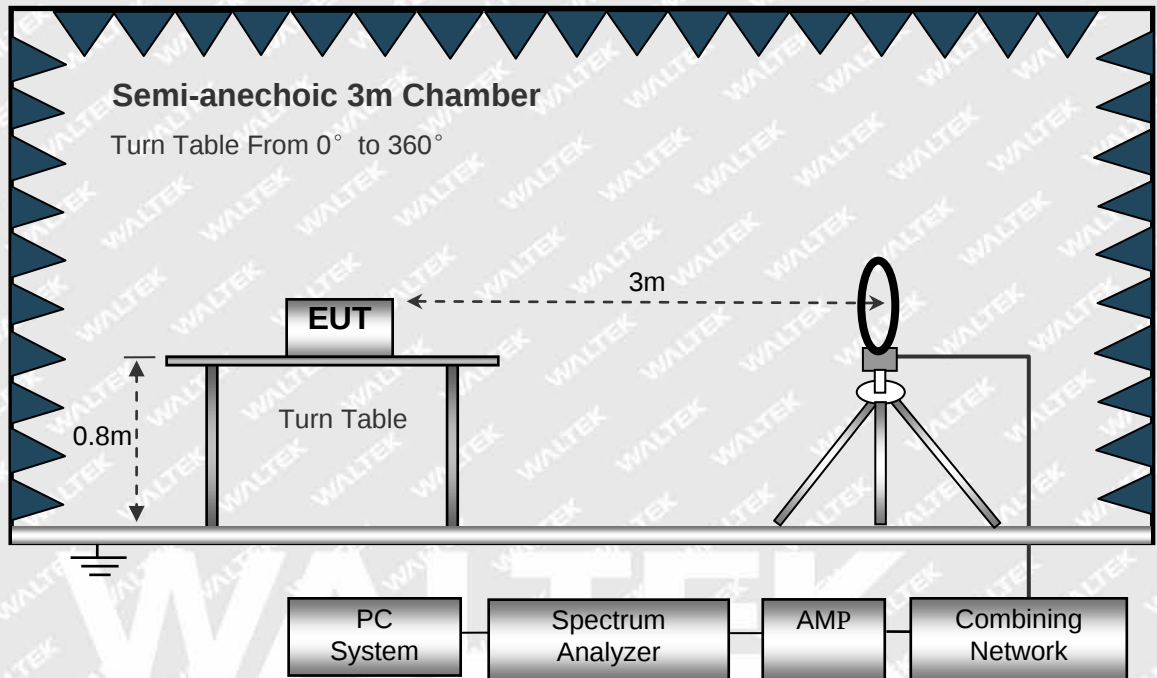
### 6.2.3 Test Setup

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

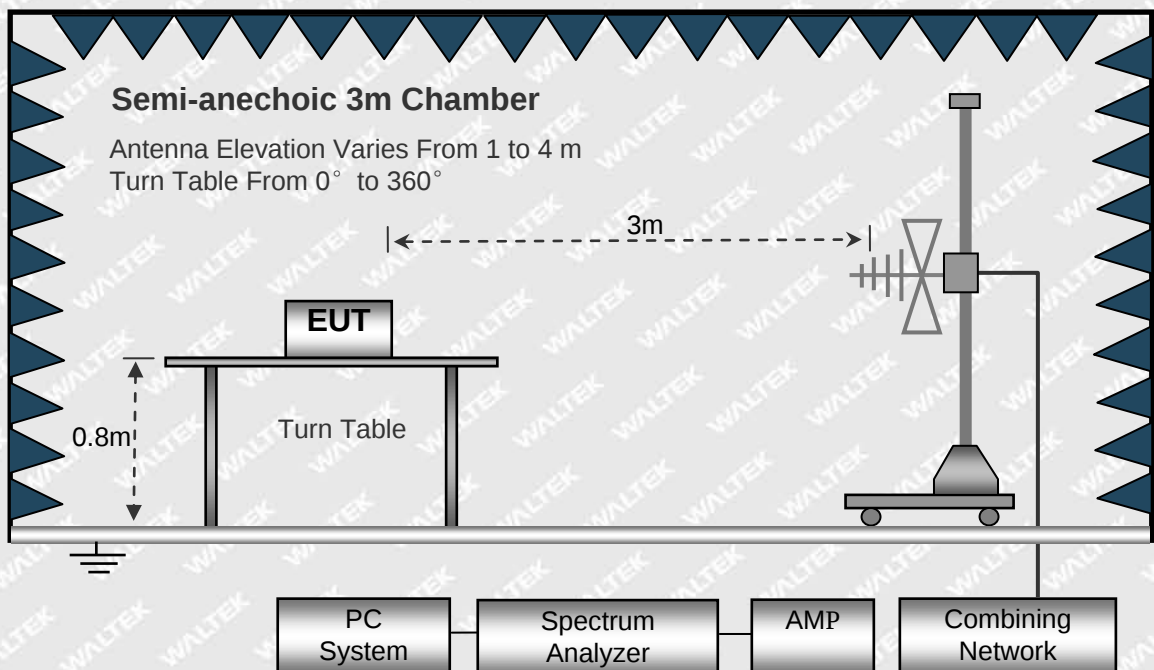
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

The test setup for emission measurement below 30MHz.

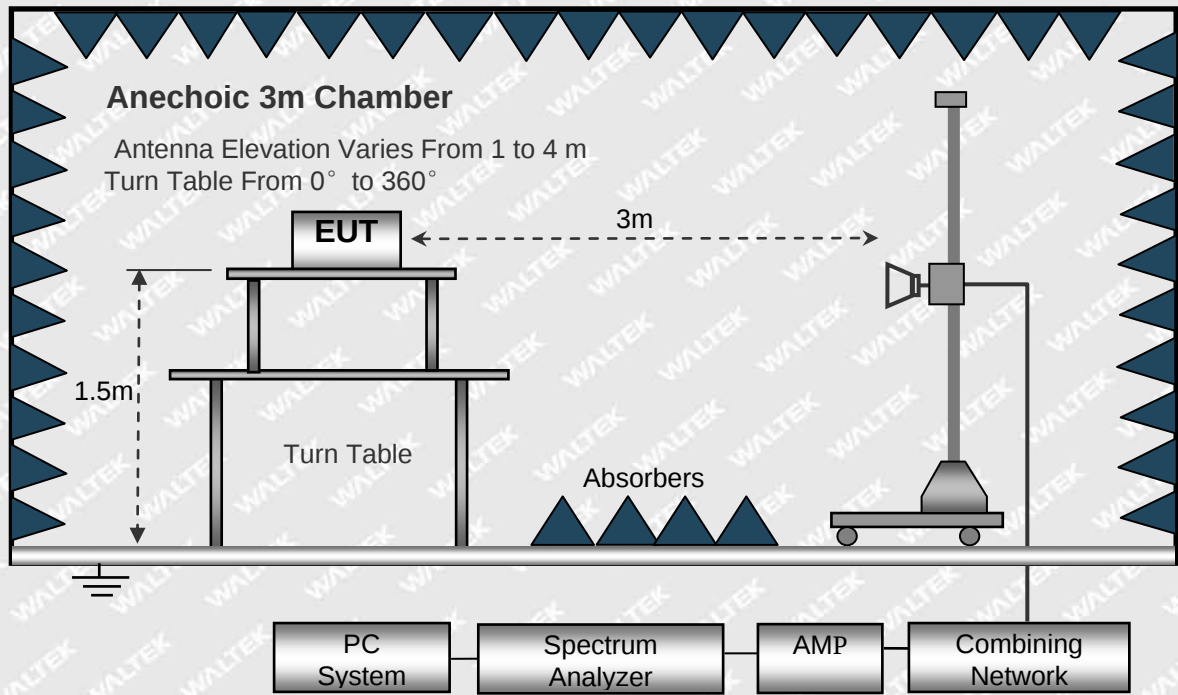


The test setup for emission measurement from 30 MHz to 1 GHz.





The test setup for emission measurement above 1 GHz.



6.2.4 Spectrum Analyzer Setup

9KHz-30MHz

RBW=10kHz

VBW=30kHz

Sweep time=Auto

Trace=Max hold

Detector function=peak

30MHz-1GHz

RBW=120kHz

VBW=300kHz

Sweep time=Auto

Trace=Max hold

Detector function=peak, QP

Above 1GHz

RBW=1MHz

VBW=3MHz(Peak), 10MHz(AV)

Sweep time=Auto

Trace=Max hold

Detector function=peak, AV

6.2.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Corr. Factor}$$

$$\text{Corr. Factor} = \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

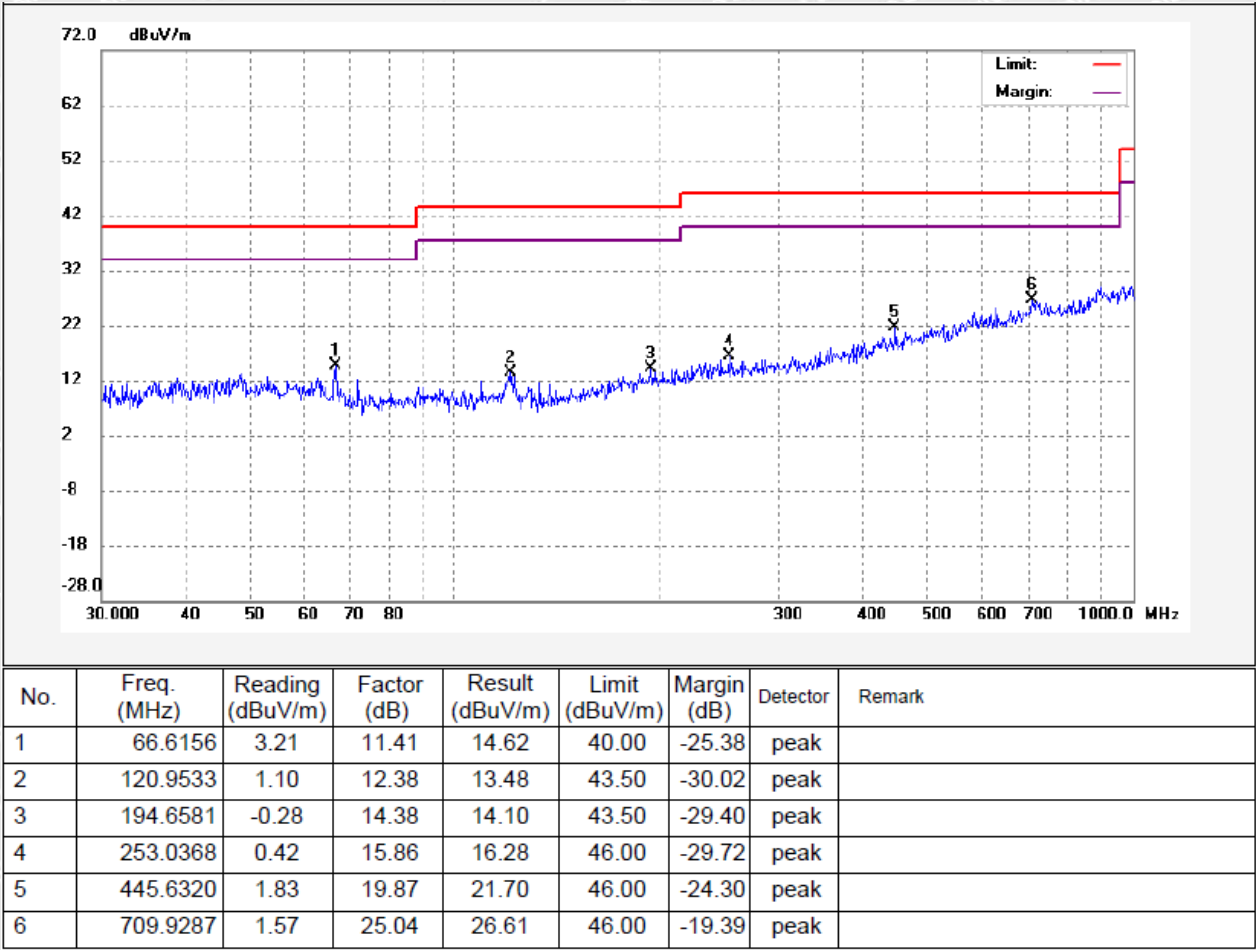


6.2.6 Test Results

Test Frequency: Below 1GHz

Test Channel Low

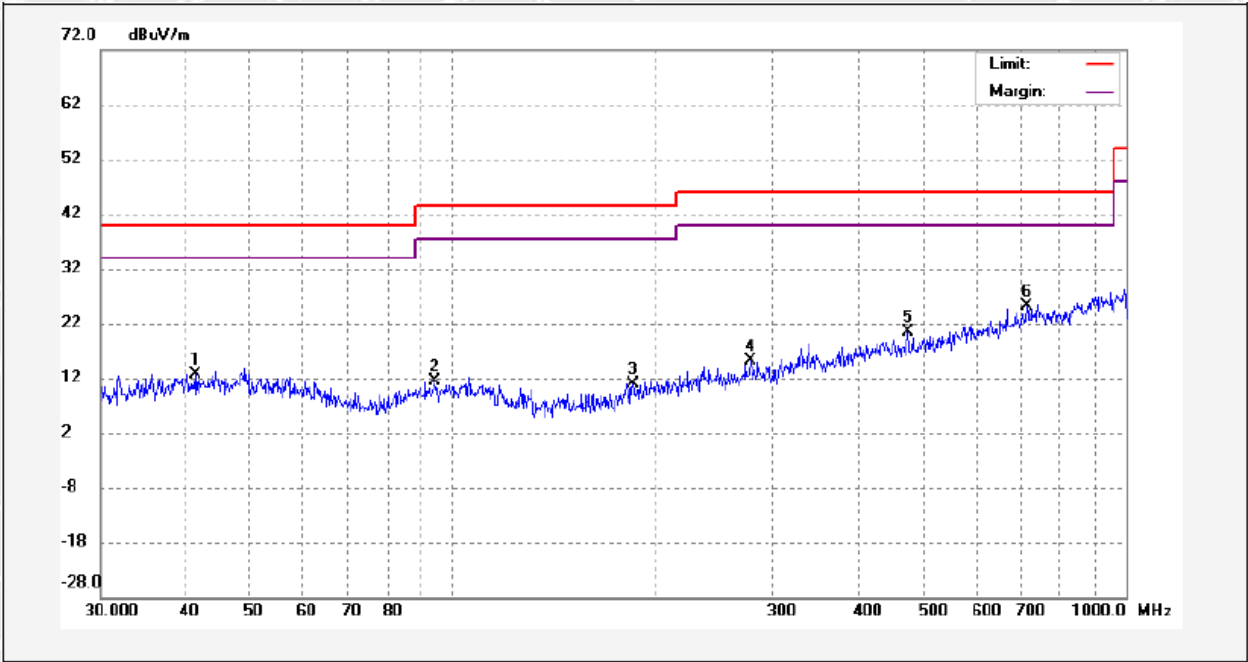
Polarization Vertical





Test Channel Low

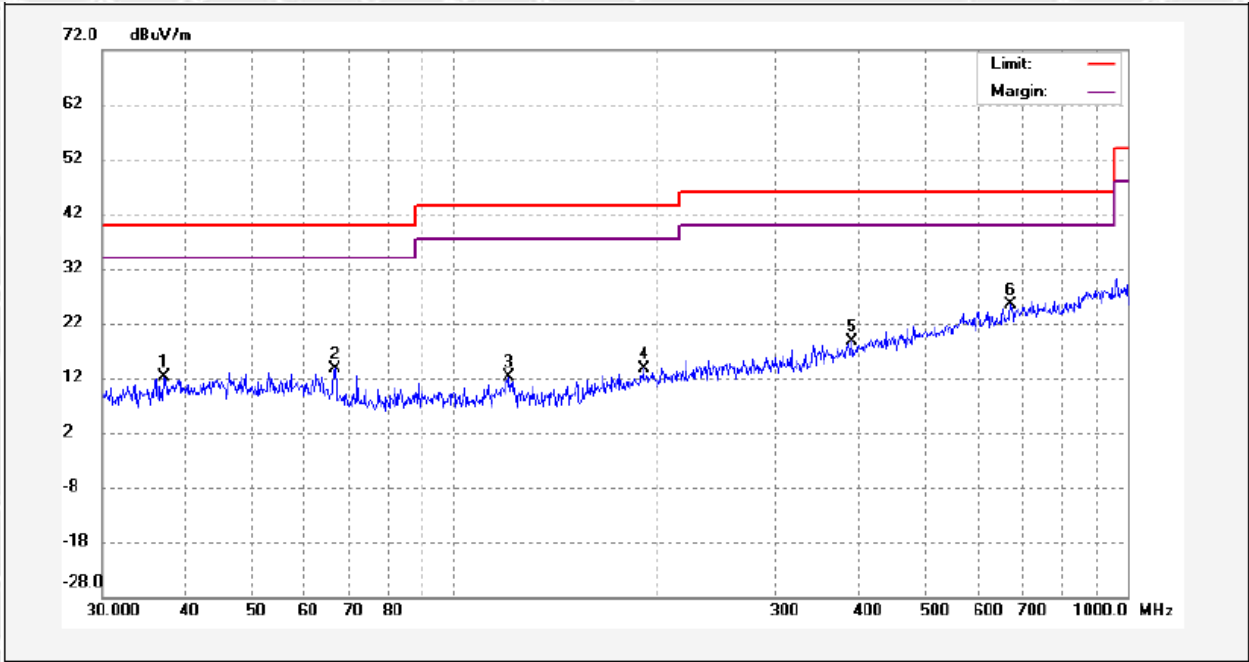
Polarization Horizontal



| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Remark |
|-----|-------------|------------------|-------------|-----------------|----------------|-------------|----------|--------|
| 1   | 41.5670     | -2.40            | 15.06       | 12.66           | 40.00          | -27.34      | peak     |        |
| 2   | 94.2629     | -2.01            | 13.27       | 11.26           | 43.50          | -32.24      | peak     |        |
| 3   | 185.7230    | -0.96            | 11.91       | 10.95           | 43.50          | -32.55      | peak     |        |
| 4   | 277.1907    | -0.09            | 15.21       | 15.12           | 46.00          | -30.88      | peak     |        |
| 5   | 474.1670    | 0.81             | 19.68       | 20.49           | 46.00          | -25.51      | peak     |        |
| 6   | 712.9223    | 1.13             | 24.04       | 25.17           | 46.00          | -20.83      | peak     |        |



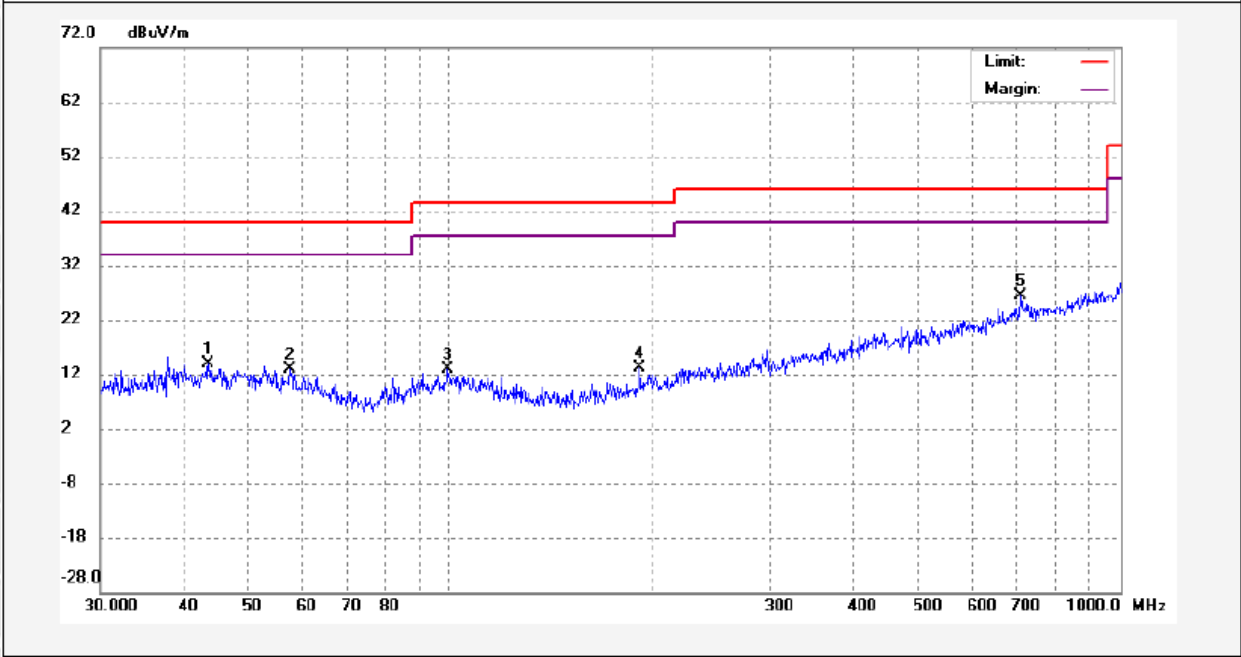
Test Channel Middle Channel Polarization Vertical



| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Remark |
|-----|-------------|------------------|-------------|-----------------|----------------|-------------|----------|--------|
| 1   | 37.2071     | -0.37            | 12.46       | 12.09           | 40.00          | -27.91      | peak     |        |
| 2   | 66.6156     | 2.34             | 11.41       | 13.75           | 40.00          | -26.25      | peak     |        |
| 3   | 120.6991    | -0.35            | 12.41       | 12.06           | 43.50          | -31.44      | peak     |        |
| 4   | 191.1408    | -0.63            | 14.22       | 13.59           | 43.50          | -29.91      | peak     |        |
| 5   | 389.4914    | -0.16            | 18.69       | 18.53           | 46.00          | -27.47      | peak     |        |
| 6   | 672.1370    | 1.22             | 24.07       | 25.29           | 46.00          | -20.71      | peak     |        |



Test Channel      Middle Channel      Polarization      Horizontal

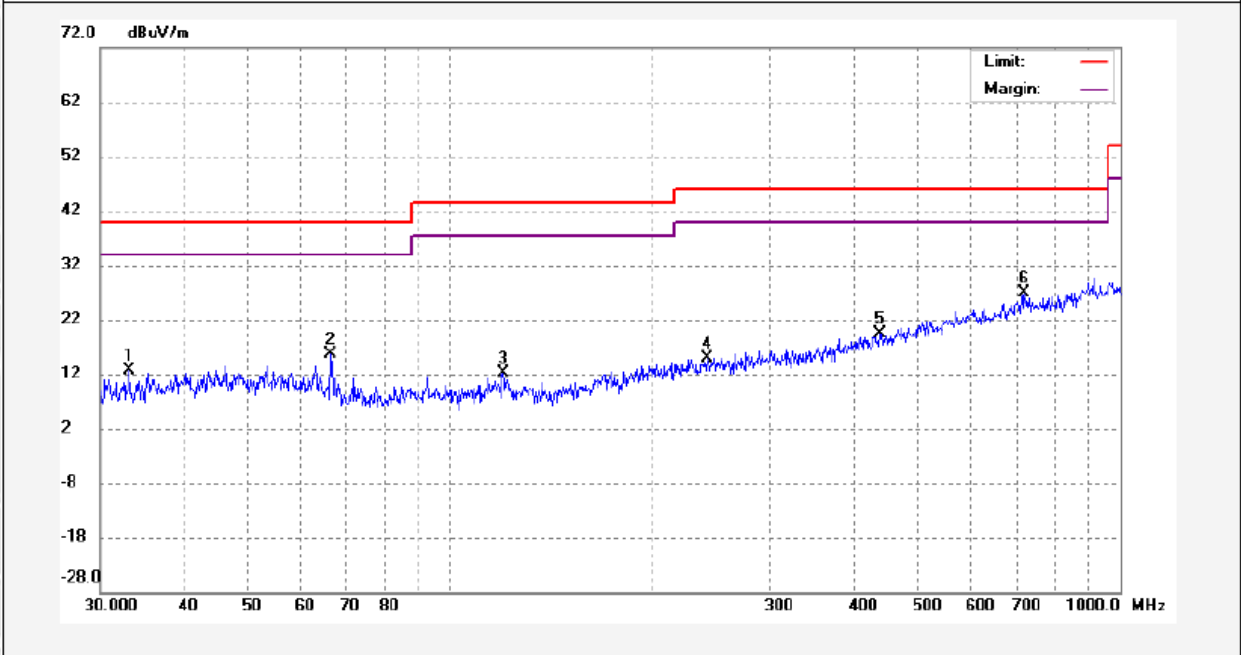


| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Remark |
|-----|-------------|------------------|-------------|-----------------|----------------|-------------|----------|--------|
| 1   | 43.5820     | -1.52            | 15.38       | 13.86           | 40.00          | -26.14      | peak     |        |
| 2   | 57.6545     | -1.08            | 13.91       | 12.83           | 40.00          | -27.17      | peak     |        |
| 3   | 99.2493     | -0.93            | 13.79       | 12.86           | 43.50          | -30.64      | peak     |        |
| 4   | 191.8122    | 0.57             | 12.49       | 13.06           | 43.50          | -30.44      | peak     |        |
| 5   | 710.6759    | 2.38             | 23.96       | 26.34           | 46.00          | -19.66      | peak     |        |



Test Channel    High Channel

Polarization    Vertical



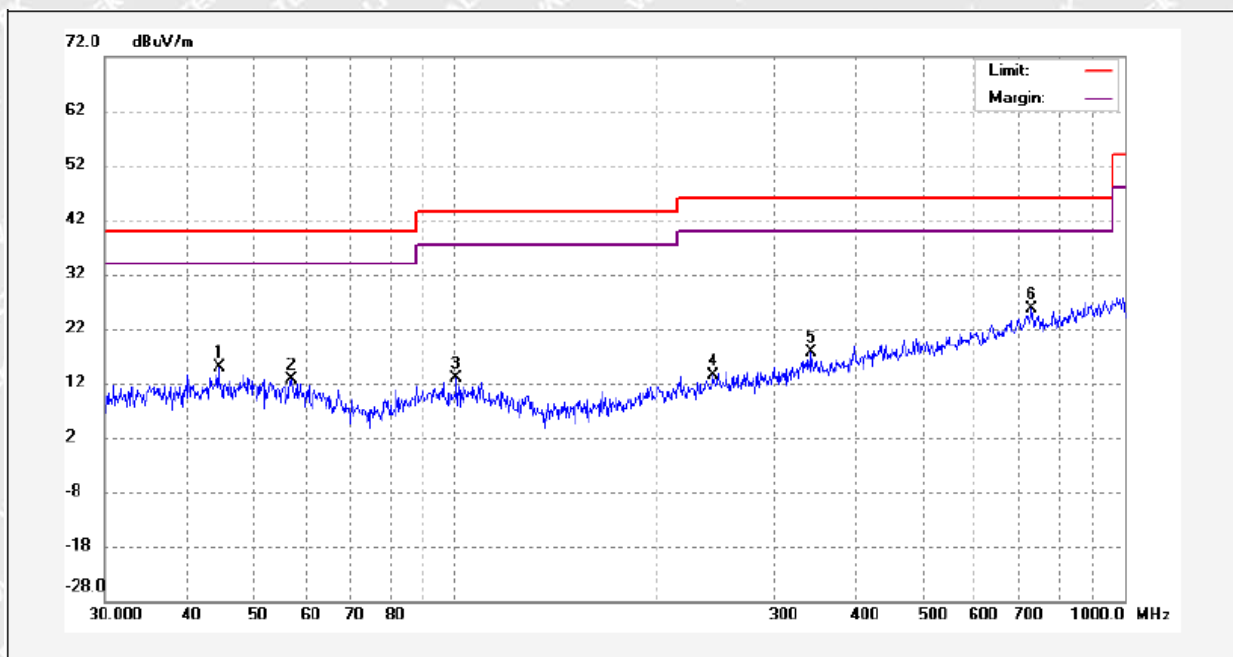
| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Remark |
|-----|-------------|------------------|-------------|-----------------|----------------|-------------|----------|--------|
| 1   | 33.2811     | 0.95             | 11.73       | 12.68           | 40.00          | -27.32      | peak     |        |
| 2   | 66.4523     | 4.12             | 11.44       | 15.56           | 40.00          | -24.44      | peak     |        |
| 3   | 120.2344    | -0.32            | 12.46       | 12.14           | 43.50          | -31.36      | peak     |        |
| 4   | 241.7610    | -0.56            | 15.48       | 14.92           | 46.00          | -31.08      | peak     |        |
| 5   | 437.1200    | -0.34            | 19.75       | 19.41           | 46.00          | -26.59      | peak     |        |
| 6   | 719.9565    | 1.55             | 25.27       | 26.82           | 46.00          | -19.18      | peak     |        |



Test Channel High Channel

Polarization

Horizontal



| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Remark |
|-----|-------------|------------------|-------------|-----------------|----------------|-------------|----------|--------|
| 1   | 44.5555     | -0.52            | 15.45       | 14.93           | 40.00          | -25.07      | peak     |        |
| 2   | 57.0312     | -1.27            | 14.01       | 12.74           | 40.00          | -27.26      | peak     |        |
| 3   | 100.7571    | -1.10            | 13.93       | 12.83           | 43.50          | -30.67      | peak     |        |
| 4   | 243.2918    | -1.00            | 14.38       | 13.38           | 46.00          | -32.62      | peak     |        |
| 5   | 341.6191    | 0.22             | 17.48       | 17.70           | 46.00          | -28.30      | peak     |        |
| 6   | 725.0233    | 1.15             | 24.38       | 25.53           | 46.00          | -20.47      | peak     |        |

**Test Frequency: Above 1GHz**

| Frequency (MHz)               | Reading (dB $\mu$ V/m) | Detector | Polar (H/V) | Corrected Factor (dB) | Result (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) |
|-------------------------------|------------------------|----------|-------------|-----------------------|-----------------------|----------------------|-------------|
| <b>Low Channel-2405MHz</b>    |                        |          |             |                       |                       |                      |             |
| 4810                          | 45.46                  | PK       | H           | -3.59                 | 41.87                 | 74                   | -32.13      |
| 4810                          | 34.87                  | AV       | H           | -3.59                 | 31.28                 | 54                   | -22.72      |
| 7215                          | 42.37                  | PK       | H           | 3.07                  | 45.44                 | 74                   | -28.56      |
| 7215                          | 33.51                  | AV       | H           | 3.07                  | 36.58                 | 54                   | -17.42      |
| 4810                          | 44.84                  | PK       | V           | -3.46                 | 41.38                 | 74                   | -32.62      |
| 4810                          | 34.05                  | AV       | V           | -3.46                 | 30.59                 | 54                   | -23.41      |
| 7215                          | 42.35                  | PK       | V           | 2.97                  | 45.32                 | 74                   | -28.68      |
| 7215                          | 33.95                  | AV       | V           | 2.97                  | 36.92                 | 54                   | -17.08      |
| <b>Middle Channel-2440MHz</b> |                        |          |             |                       |                       |                      |             |
| 4880                          | 45.62                  | PK       | H           | -3.41                 | 42.21                 | 74                   | -31.79      |
| 4880                          | 35.43                  | AV       | H           | -3.41                 | 32.02                 | 54                   | -21.98      |
| 7320                          | 42.55                  | PK       | H           | 3.23                  | 45.78                 | 74                   | -28.22      |
| 7320                          | 33.1                   | AV       | H           | 3.23                  | 36.33                 | 54                   | -17.67      |
| 4880                          | 44.39                  | PK       | V           | -3.26                 | 41.13                 | 74                   | -32.87      |
| 4880                          | 35.52                  | AV       | V           | -3.26                 | 32.26                 | 54                   | -21.74      |
| 7320                          | 42.88                  | PK       | V           | 3.13                  | 46.01                 | 74                   | -27.99      |
| 7320                          | 33.65                  | AV       | V           | 3.13                  | 36.78                 | 54                   | -17.22      |
| <b>High Channel-2475MHz</b>   |                        |          |             |                       |                       |                      |             |
| 4960                          | 45.24                  | PK       | H           | -3.22                 | 42.02                 | 74                   | -31.98      |
| 4960                          | 36.91                  | AV       | H           | -3.22                 | 33.69                 | 54                   | -20.31      |
| 7440                          | 42.3                   | PK       | H           | 3.41                  | 45.71                 | 74                   | -28.29      |
| 7440                          | 33.65                  | AV       | H           | 3.41                  | 37.06                 | 54                   | -16.94      |
| 4960                          | 44.61                  | PK       | V           | -3.03                 | 41.58                 | 74                   | -32.42      |
| 4960                          | 35.47                  | AV       | V           | -3.03                 | 32.44                 | 54                   | -21.56      |
| 7440                          | 42.87                  | PK       | V           | 3.31                  | 46.18                 | 74                   | -27.82      |
| 7440                          | 33.63                  | AV       | V           | 3.31                  | 36.94                 | 54                   | -17.06      |

Note: Testing is carried out with frequency range 9kHz to the tenth harmonics, other than listed in the table above are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.



## 6.3 Power Spectral Density

### 6.3.1 Standard Applicable

According to 15.247(a)(1)(iii), For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### 6.3.2 Test Procedure

According to the KDB 558074, such specifications require that the same method as used to determine the conducted output power shall also be used to determine the power spectral density. The test method of power spectral density as below:

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- d) Set the VBW  $\geq 3 \times \text{RBW}$ .
- e) Detector = power averaging (RMS) or sample detector (when RMS not available).
- f) Ensure that the number of measurement points in the sweep  $\geq 2 \times \text{span/RBW}$ .
- g) Sweep time = auto couple.
- h) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- i) Use the peak marker function to determine the maximum amplitude level.
- j) If measured value exceeds limit, reduce RBW (no less than 3kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

### 6.3.3 Test Result

| Test Mode | Test Channel | Power Spectral Density<br>dBm/3kHz | Limit<br>dBm/3kHz |
|-----------|--------------|------------------------------------|-------------------|
| OQPSK     | Low          | -5.97                              | 8                 |
|           | Middle       | -5.78                              | 8                 |
|           | High         | -7.17                              | 8                 |



## Low Channel



## Middle Channel



## High Channel





## 6.4 6dB Bandwidth

### 6.4.1 Standard Applicable

According to 15.247(a)(2). Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 6.4.2 Test Procedure

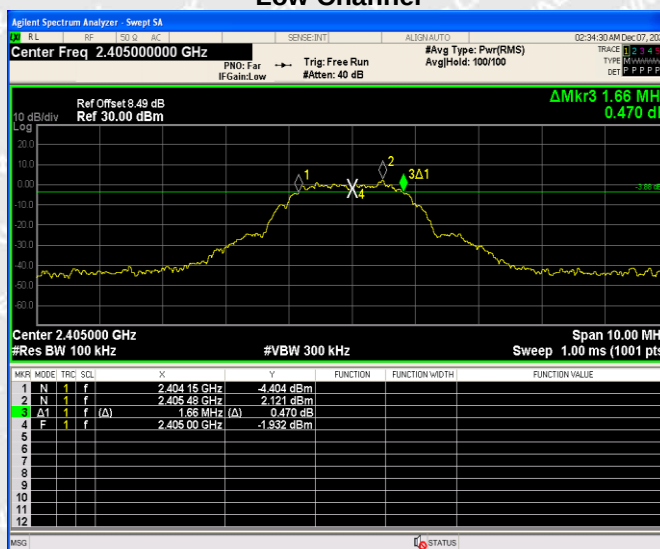
- Set RBW = 100 kHz.
- Set the video bandwidth (VBW)  $\geq 3 \times$  RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude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

### 6.4.3 Test Result

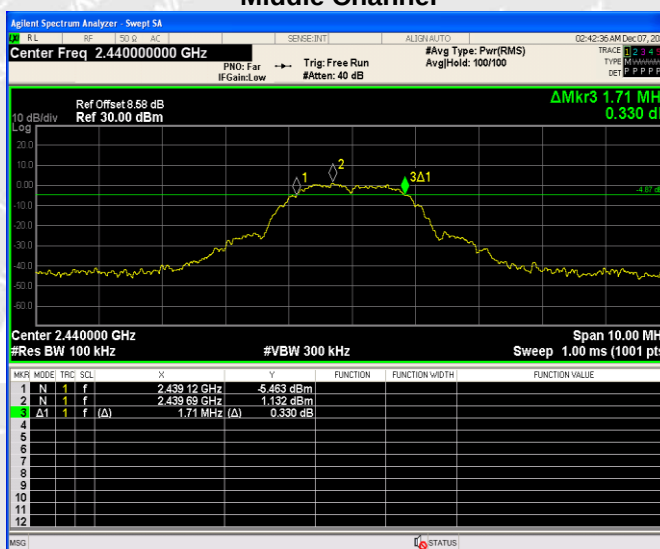
| Test Mode | Test Channel | 6dB Bandwidth<br>MHz | Limit<br>kHz |
|-----------|--------------|----------------------|--------------|
| OQPSK     | Low          | 1.660                | $\geq 500$   |
|           | Middle       | 1.710                | $\geq 500$   |
|           | High         | 1.730                | $\geq 500$   |



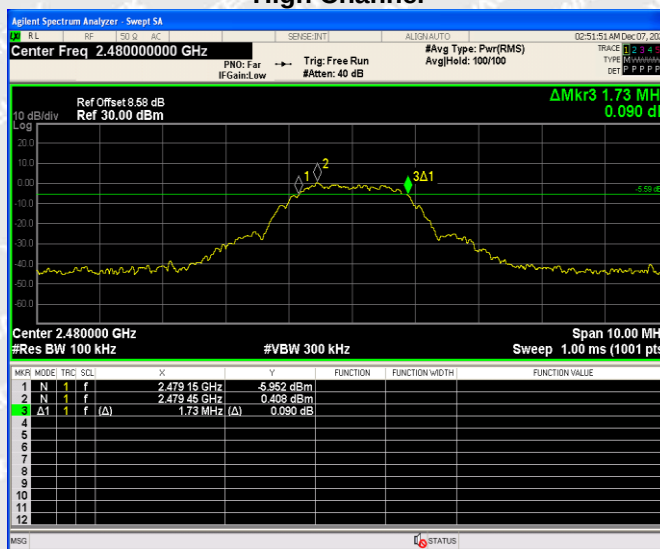
## Low Channel



## Middle Channel



## High Channel





## 6.5 RF Output Power

### 6.5.1 Standard Applicable

According to 15.247(b)(3). For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

### 6.5.2 Test Procedure

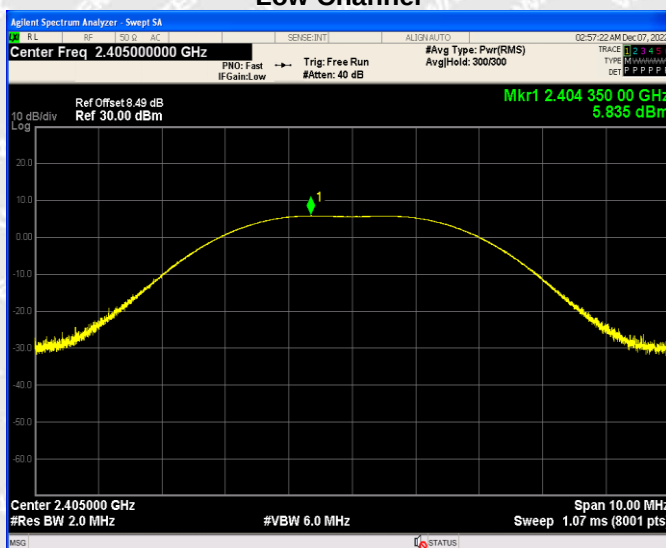
- a) Set the RBW  $\geq$  DTS bandwidth.
- b) Set VBW  $\geq 3 \times$  RBW.
- c) Set span  $\geq 3 \times$  RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

### 6.5.3 Test Result

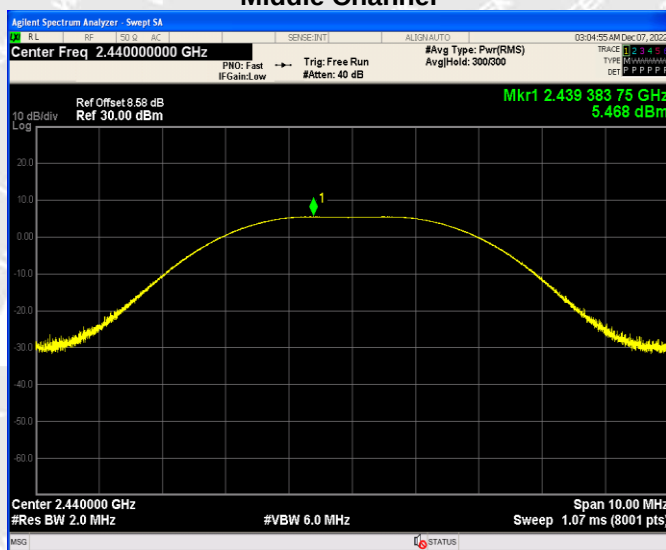
| Modulation | Test Channel | Reading (dBm) | Output Power (mW) | Limit (mW) |
|------------|--------------|---------------|-------------------|------------|
| OQPSK      | Low          | 5.84          | 3.84              | 1000       |
|            | Middle       | 5.47          | 3.52              | 1000       |
|            | High         | 4.42          | 2.77              | 1000       |



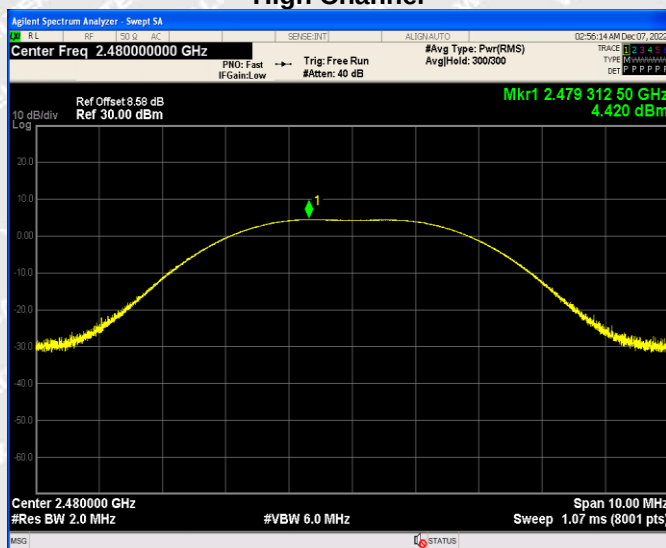
## Low Channel



## Middle Channel



## High Channel





## 6.6 Out of Band Emissions

### 6.6.1 Standard Applicable

According to §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 6.6.2 Test Procedure

According to the KDB 558074, the band-edge radiated test method as follows:

Set span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation (2310MHz to 2420MHz for low bandedge, 2460MHz to 2500MHz for the high bandedge)

RBW = 1MHz, VBW = 1MHz for peak value measured

RBW = 1MHz, VBW = 10Hz for average value measured

Sweep = auto; Detector function = peak/average; Trace = max hold

All the trace to stabilize, set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Those emission must comply with the 15.209 limit for fall in the restricted bands listed in section 15.205. Note that the method of measurement.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in section 8.1.

Report the three highest emissions relative to the limit.

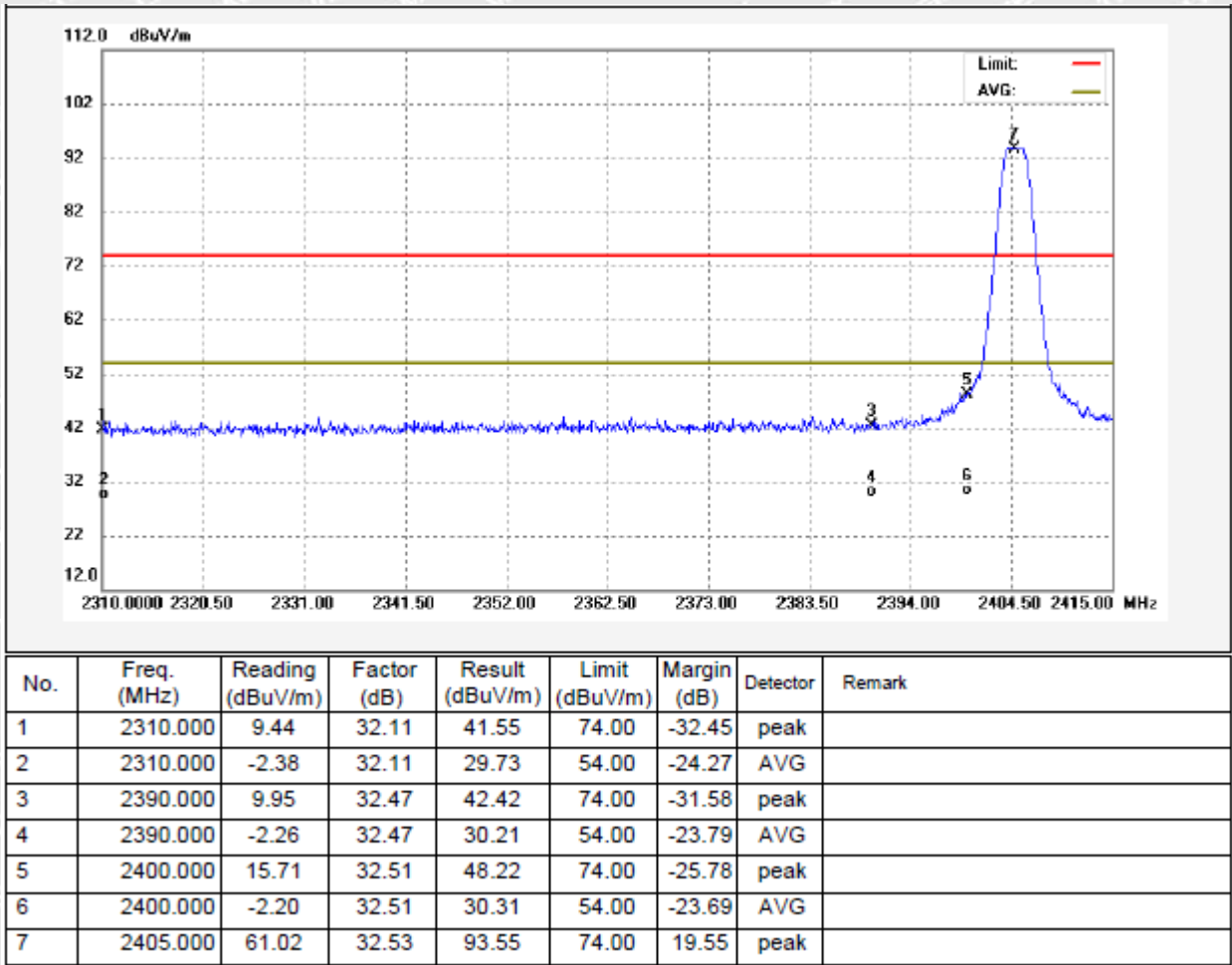


6.6.3 Test Result

Radiated Test

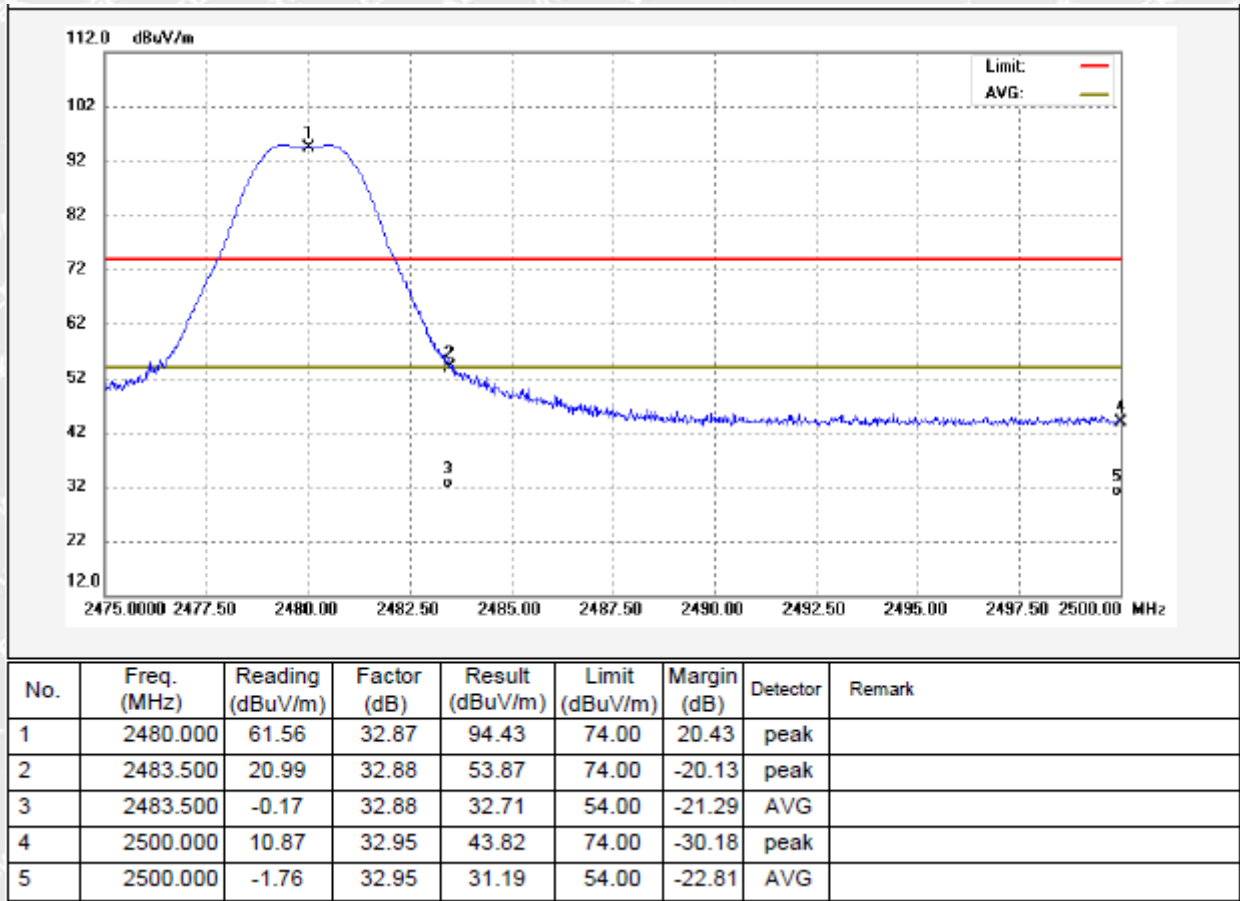
Test Channel Low Channel

Polarization Vertical (worst case)





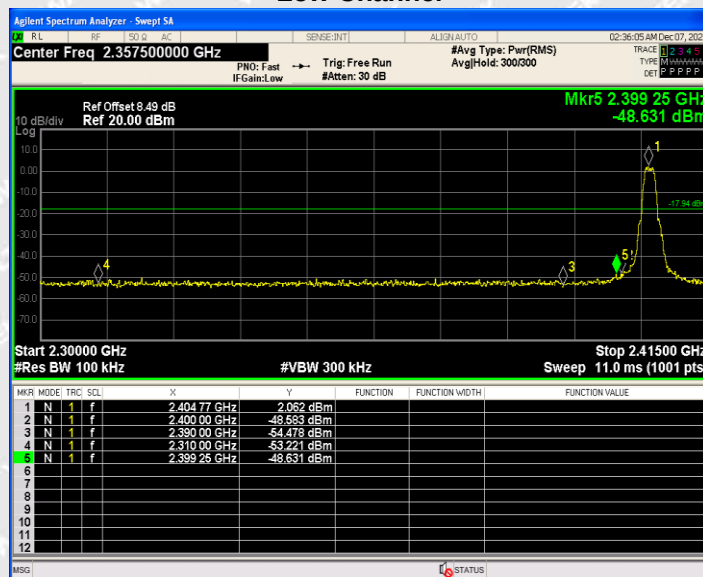
Test Channel    High Channel                      Polarization    Vertical (worst case)



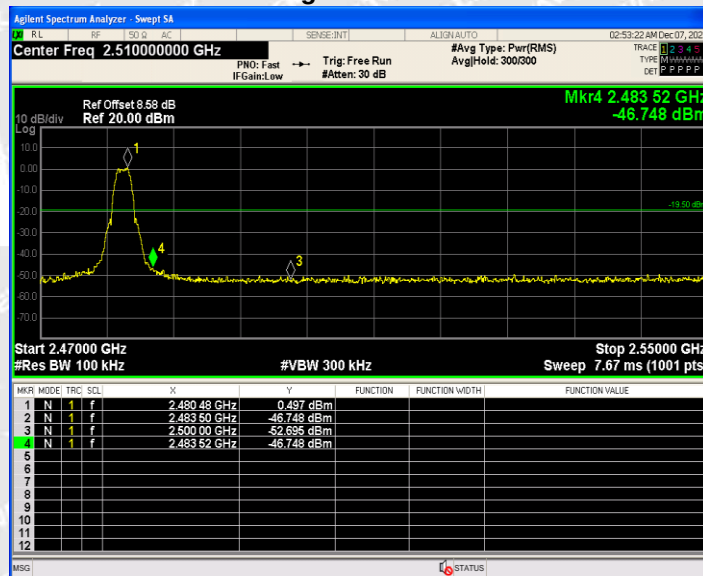


## Conducted Test

## Low Channel



## High Channel





## 7 Photographs Test Setup

### 7.1 Photographs - Radiated Emission Test Setup

30MHz-1GHz



Above 1GHz





## 8 Photographs - Constructional Details

### 8.1 EUT - External Photos

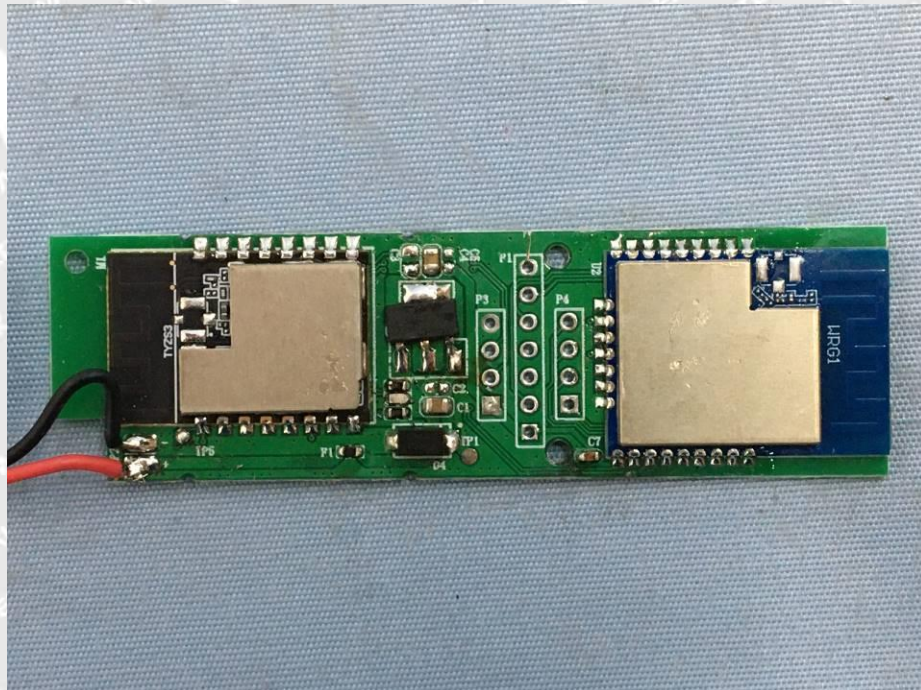
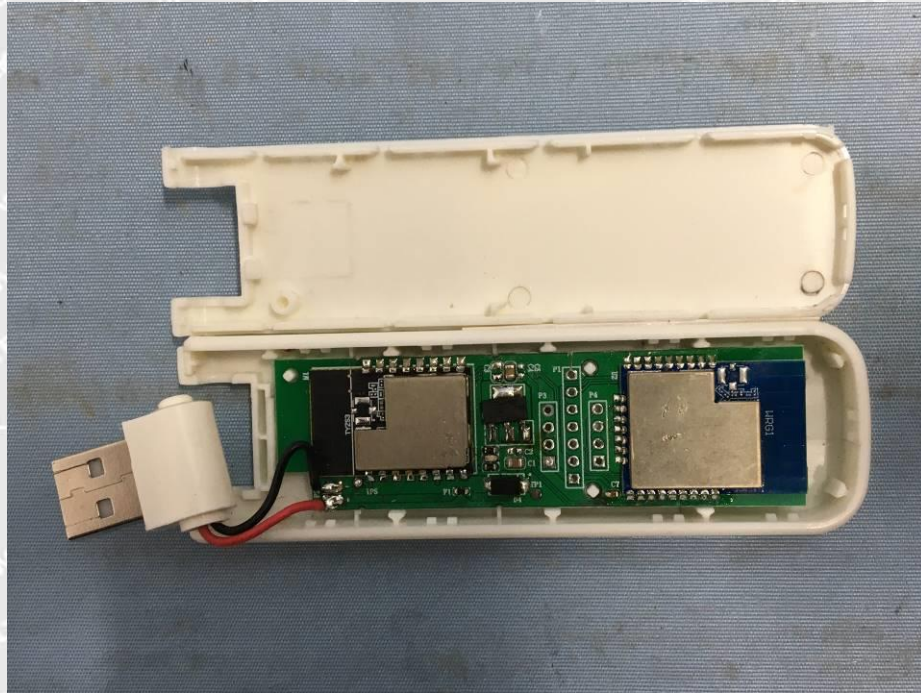


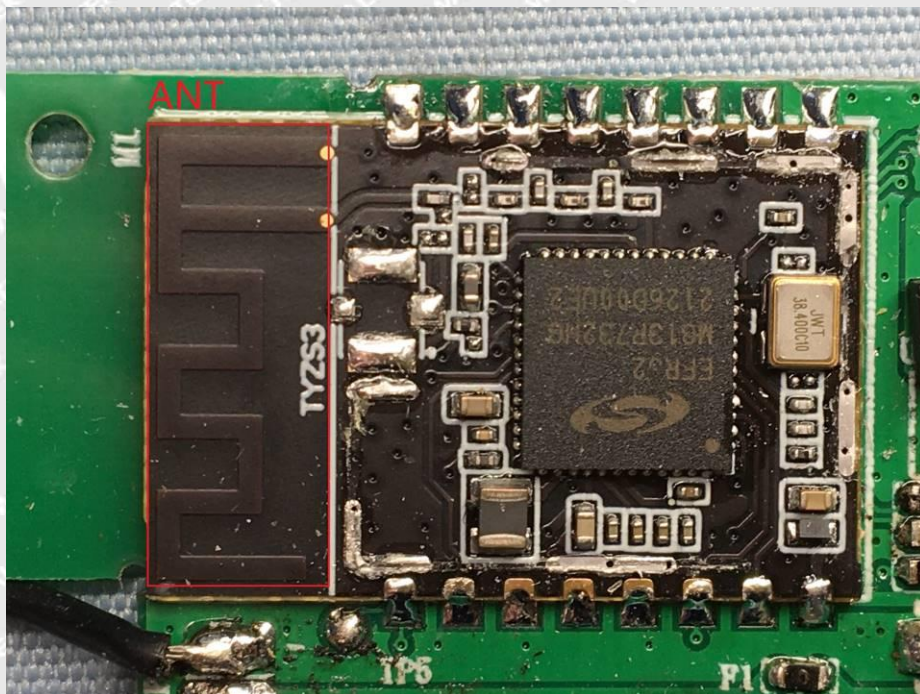
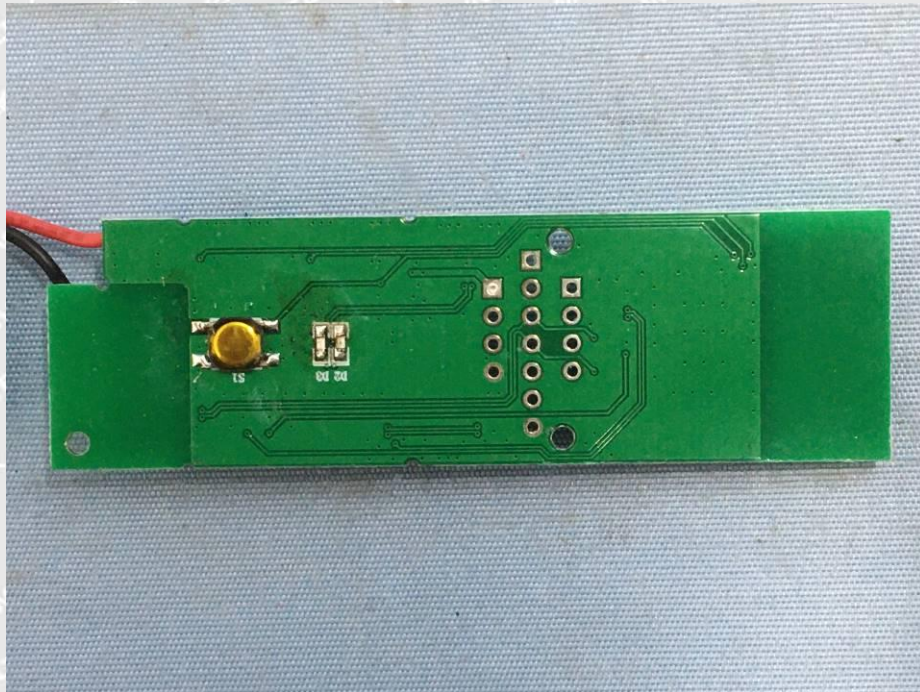






## 8.2 EUT - Internal Photos





=====End of Report=====