

# TEST REPORT

**Reference No.**..... : WTX22X05085238W  
**FCC ID** ..... : 2ATY4-UM89P51  
**Applicant** ..... : Ultimate IOT (Shanghai) Technology Ltd.  
**Address** ..... : Building C, No. 888, Huanhu 2nd Road (West), Lin-Gang Special Area,  
China (Shanghai) Pilot FTZ, China  
**Manufacturer** ..... : Ultimate IOT (Henan) Technology Ltd.  
**Address** ..... : Opto-electromechanical Industrial Park, No. 55, Yulan Street, Hi-tech  
Develoment Zone, Zhengzhou, Henan 450001 China  
**Product Name** ..... : Zigbee  
**Model No.**..... : UM89P51  
**Standards** ..... : FCC Part 15.247  
**Date of Receipt sample** .... : 2022-05-05  
**Date of Test**..... : 2022-05-05 to 2022-05-31  
**Date of Issue** ..... : 2022-05-31  
**Test Report Form No.** ..... : WTX\_Part 15\_247W  
**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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## Report version

| Version No. | Date of issue | Description |
|-------------|---------------|-------------|
| Rev.00      | 2022-05-31    | Original    |
| /           | /             | /           |

## 1. GENERAL INFORMATION

---

### 1.1 Product Description for Equipment Under Test (EUT)

| General Description of EUT                                                             |         |
|----------------------------------------------------------------------------------------|---------|
| Product Name:                                                                          | Zigbee  |
| Trade Name:                                                                            | /       |
| Model No.:                                                                             | UM89P51 |
| Adding Model(s):                                                                       | /       |
| Rated Voltage:                                                                         | DC3.3V  |
| Note: The test data is gathered from a production sample provided by the manufacturer. |         |

| Technical Characteristics of EUT                                                           |                      |
|--------------------------------------------------------------------------------------------|----------------------|
| Support Standards:                                                                         | IEEE802.15.4         |
| Frequency Range:                                                                           | 2405-2480MHz         |
| RF Output Power:                                                                           | 12.01dBm (Conducted) |
| Type of Modulation:                                                                        | OQPSK                |
| Quantity of Channels:                                                                      | 16                   |
| Channel Separation:                                                                        | 5MHz                 |
| Type of Antenna:                                                                           | External antenna     |
| Antenna Gain:                                                                              | 0dBi                 |
| Note: The Antenna Gain is provided by the customer and can affect the validity of results. |                      |

## 1.2 Test Standards

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 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

**558074 D01 DTS Meas Guidance v05r02:** Guidance for performing Compliance Measurement on Digital Transmission Systems operating under section 15.247.

**ANSI C63.10-2013:** American National Standard for Testing Unlicensed Wireless Devices.

**Maintenance of compliance** is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

## 1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, KDB 558074 D01 DTS Meas Guidance v05r02.

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted accordingly in reference to the Operating Instructions.

## 1.4 Test Facility

### **Address of the test laboratory**

Laboratory: Waltek Testing Group (Shenzhen) Co., Ltd.

Address: 1/F., Room 101, Building 1, Hongwei Industrial Park, Liuxian 2nd Road, Block 70 Bao'an District, Shenzhen, Guangdong, China

### **FCC – Registration No.: 125990**

Waltek Testing Group (Shenzhen) 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. The Designation Number is CN5010, and Test Firm Registration Number is 125990.

### **Industry Canada (IC) Registration No.: 11464A**

The 3m Semi-anechoic chamber of Waltek Testing Group (Shenzhen) Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 11464A.

## 1.5 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         | 2405MHz |
| TM2            | Middle      | 2445MHz |
| TM3            | High        | 2480MHz |
|                |             |         |

| Test Conditions    |           |
|--------------------|-----------|
| Temperature:       | 22~25 °C  |
| Relative Humidity: | 45~55 %.  |
| ATM Pressure:      | 1019 mbar |

| EUT Cable List and Details |            |                     |                        |
|----------------------------|------------|---------------------|------------------------|
| Cable Description          | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| /                          | /          | /                   | /                      |

| Special Cable List and Details |            |                     |                        |
|--------------------------------|------------|---------------------|------------------------|
| Cable Description              | Length (m) | Shielded/Unshielded | With / Without Ferrite |
| USB Cable                      | 1.0        | Shielded            | Without Ferrite        |

| Auxiliary Equipment List and Details |              |          |               |
|--------------------------------------|--------------|----------|---------------|
| Description                          | Manufacturer | Model    | Serial Number |
| Notebook                             | Lenovo       | L13 Yoga | /             |

**1.6 Measurement Uncertainty**

| <b>Measurement uncertainty</b> |            |                                |
|--------------------------------|------------|--------------------------------|
| Parameter                      | Conditions | Uncertainty                    |
| RF Output Power                | Conducted  | $\pm 0.42\text{dB}$            |
| Occupied Bandwidth             | Conducted  | $\pm 1.5\%$                    |
| Power Spectral Density         | Conducted  | $\pm 1.8\text{dB}$             |
| Conducted Spurious Emission    | Conducted  | $\pm 2.17\text{dB}$            |
| Conducted Emissions            | Conducted  | 9-150kHz $\pm 3.74\text{dB}$   |
|                                |            | 0.15-30MHz $\pm 3.34\text{dB}$ |
| Transmitter Spurious Emissions | Radiated   | 30-200MHz $\pm 4.52\text{dB}$  |
|                                |            | 0.2-1GHz $\pm 5.56\text{dB}$   |
|                                |            | 1-6GHz $\pm 3.84\text{dB}$     |
|                                |            | 6-26GHz $\pm 3.92\text{dB}$    |

**1.7 Test Equipment List and Details**

| No.                                                       | Description             | Manufacturer    | Model                 | Serial No.  | Cal Date   | Due. Date  |
|-----------------------------------------------------------|-------------------------|-----------------|-----------------------|-------------|------------|------------|
| SEMT-1075                                                 | Communication Tester    | Rohde & Schwarz | CMW500                | 148650      | 2022-03-22 | 2023-03-21 |
| SEMT-1063                                                 | GSM Tester              | Rohde & Schwarz | CMU200                | 114403      | 2022-03-22 | 2023-03-21 |
| SEMT-1072                                                 | Spectrum Analyzer       | Agilent         | E4407B                | MY41440400  | 2022-03-25 | 2023-03-24 |
| SEMT-1079                                                 | Spectrum Analyzer       | Agilent         | N9020A                | US47140102  | 2022-03-22 | 2023-03-21 |
| SEMT-1080                                                 | Signal Generator        | Agilent         | 83752A                | 3610A01453  | 2022-03-22 | 2023-03-21 |
| SEMT-1081                                                 | Vector Signal Generator | Agilent         | N5182A                | MY47070202  | 2022-03-22 | 2023-03-21 |
| SEMT-1028                                                 | Power Divider           | Weinschel       | 1506A                 | PM204       | 2022-03-22 | 2023-03-21 |
| SEMT-C001                                                 | Cable                   | Zheng DI        | LL142-07-07-10M(A)    | /           | /          | /          |
| SEMT-C002                                                 | Cable                   | Zheng DI        | ZT40-2.92J-2.92J-6M   | /           | /          | /          |
| SEMT-C003                                                 | Cable                   | Zheng DI        | ZT40-2.92J-2.92J-2.5M | /           | /          | /          |
| SEMT-C004                                                 | Cable                   | Zheng DI        | 2M0RFC                | /           | /          | /          |
| SEMT-C005                                                 | Cable                   | Zheng DI        | 1M0RFC                | /           | /          | /          |
| SEMT-C006                                                 | Cable                   | Zheng DI        | 1M0RFC                | /           | /          | /          |
| <input checked="" type="checkbox"/> Chamber A: Below 1GHz |                         |                 |                       |             |            |            |
| SEMT-1031                                                 | Spectrum Analyzer       | Rohde & Schwarz | FSP30                 | 836079/035  | 2022-03-22 | 2023-03-21 |
| SEMT-1007                                                 | EMI Test Receiver       | Rohde & Schwarz | ESVB                  | 825471/005  | 2022-03-22 | 2023-03-21 |
| SEMT-1008                                                 | Amplifier               | Agilent         | 8447F                 | 3113A06717  | 2022-01-07 | 2023-01-06 |
| SEMT-1069                                                 | Loop Antenna            | Schwarz beck    | FMZB 1516             | 9773        | 2021-03-20 | 2023-03-19 |
| SEMT-1068                                                 | Broadband Antenna       | Schwarz beck    | VULB9163              | 9163-333    | 2021-03-20 | 2023-03-19 |
| <input checked="" type="checkbox"/> Chamber A: Above 1GHz |                         |                 |                       |             |            |            |
| SEMT-1031                                                 | Spectrum Analyzer       | Rohde & Schwarz | FSP30                 | 836079/035  | 2022-03-22 | 2023-03-21 |
| SEMT-1007                                                 | EMI Test Receiver       | Rohde & Schwarz | ESVB                  | 825471/005  | 2022-03-22 | 2023-03-21 |
| SEMT-1043                                                 | Amplifier               | C&D             | PAP-1G18              | 2002        | 2022-03-22 | 2023-03-21 |
| SEMT-1042                                                 | Horn Antenna            | ETS             | 3117                  | 00086197    | 2021-03-19 | 2023-03-18 |
| SEMT-1121                                                 | Horn Antenna            | Schwarzbeck     | BBHA 9170             | BBHA9170582 | 2021-04-27 | 2023-04-26 |
| SEMT-1216                                                 | Pre-amplifier           | Schwarzbeck     | BBV 9721              | 9721-031    | 2022-03-25 | 2023-03-24 |



|                                                       |                          |                 |             |            |            |            |
|-------------------------------------------------------|--------------------------|-----------------|-------------|------------|------------|------------|
| SEMT-1163                                             | Spectrum Analyzer        | Rohde & Schwarz | FSP40       | 100612     | 2022-03-22 | 2023-03-21 |
| <input type="checkbox"/> Chamber B:Below 1GHz         |                          |                 |             |            |            |            |
| SEMT-1068                                             | Trilog Broadband Antenna | Schwarz beck    | VULB9163(B) | 9163-635   | 2021-04-09 | 2023-04-08 |
| SEMT-1067                                             | Amplifier                | Agilent         | 8447D       | 2944A10179 | 2022-03-22 | 2023-03-21 |
| SEMT-1066                                             | EMI Test Receiver        | Rohde & Schwarz | ESPI        | 101391     | 2022-03-22 | 2023-03-21 |
| <input type="checkbox"/> Chamber C:Below 1GHz         |                          |                 |             |            |            |            |
| SEMT-1319                                             | EMI Test Receiver        | Rohde & Schwarz | ESIB 26     | 100401     | 2022-01-07 | 2023-01-06 |
| SEMT-1343                                             | Trilog Broadband Antenna | Schwarz beck    | VULB 9168   | 1194       | 2021-05-28 | 2023-05-27 |
| SEMT-1333                                             | Amplifier                | HP              | 8447F       | 2944A03869 | 2022-03-22 | 2023-03-21 |
| <input checked="" type="checkbox"/> Conducted Room 1# |                          |                 |             |            |            |            |
| SEMT-1001                                             | EMI Test Receiver        | Rohde & Schwarz | ESPI        | 101611     | 2022-03-21 | 2023-03-20 |
| SEMT-1002                                             | Pulse Limiter            | Rohde & Schwarz | ESH3-Z2     | 100911     | 2022-03-25 | 2023-03-24 |
| SEMT-1003                                             | AC LISN                  | Schwarz beck    | NSLK8126    | 8126-224   | 2022-03-22 | 2023-03-21 |
| <input type="checkbox"/> Conducted Room 2#            |                          |                 |             |            |            |            |
| SEMT-1334                                             | EMI Test Receiver        | Rohde & Schwarz | ESPI        | 101259     | 2022-03-22 | 2023-03-21 |
| SEMT-1336                                             | LISN                     | Rohde & Schwarz | ENV 216     | 100097     | 2022-03-22 | 2023-03-21 |

| Software List                           |              |        |         |
|-----------------------------------------|--------------|--------|---------|
| Description                             | Manufacturer | Model  | Version |
| EMI Test Software (Radiated Emission)*  | Farad        | EZ-EMC | RA-03A1 |
| EMI Test Software (Conducted Emission)* | Farad        | EZ-EMC | RA-03A1 |

\*Remark: indicates software version used in the compliance certification testing.

## 2. SUMMARY OF TEST RESULTS

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

N/A: Not applicable.

### **3. Antenna Requirement**

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#### **3.1 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.

#### **3.2 Evaluation Information**

This product has an External Antenna, fulfill the requirement of this section.

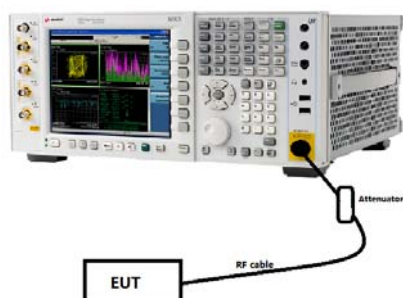
## 4. Power Spectral Density

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### 4.1 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 8dBm in any 3kHz band during any time interval of continuous transmission.

### 4.2 Test Setup Block Diagram



### 4.3 Test Procedure

According to the KDB 558074 D01 v05r02 Subclause 8.4 and ANSI C63.10-2013 Subclause 11.10.2, the test method of power spectral density as below:

Method PKPSD (peak PSD)

- 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  $\geq 3 \times \text{RBW}$ .
- Detector = peak.
- Sweep time = auto couple.
- 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 requirement, then reduce RBW (but no less than 3 kHz) and repeat.

### 5.4 Summary of Test Results/Plots

Please refer to Appendix A

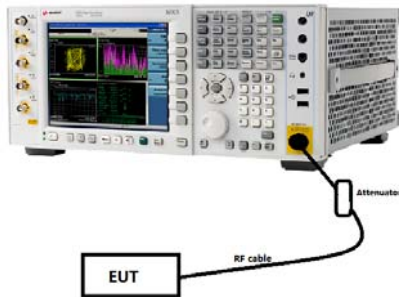
## 5. 6dB Bandwidth

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### 5.1 Standard Applicable

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

### 5.2 Test Setup Block Diagram



### 5.3 Test Procedure

- Set RBW = 100kHz.
- 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 6dB relative to the maximum level measured in the fundamental emission.

### 5.4 Summary of Test Results/Plots

Please refer to Appendix B

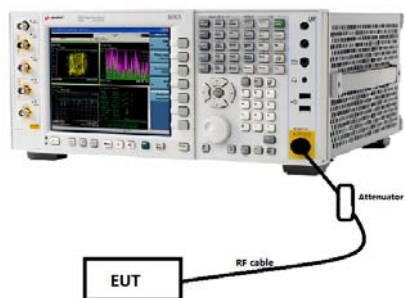
## 6. RF Output Power

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### 6.1 Standard Applicable

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

### 6.2 Test Setup Block Diagram



### 6.3 Test Procedure

- Set the RBW  $\geq$  DTS bandwidth.
- Set VBW  $\geq$  3RBW.
- Set span  $\geq$  3RBW.
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use peak marker function to determine the peak amplitude level.

### 6.4 Summary of Test Results/Plots

Please refer to Appendix C

## 7. Field Strength of Spurious Emissions

### 7.1 Standard Applicable

According to §15.247(d), in any 100kHz 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 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, 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 30dB instead of 20dB. 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.

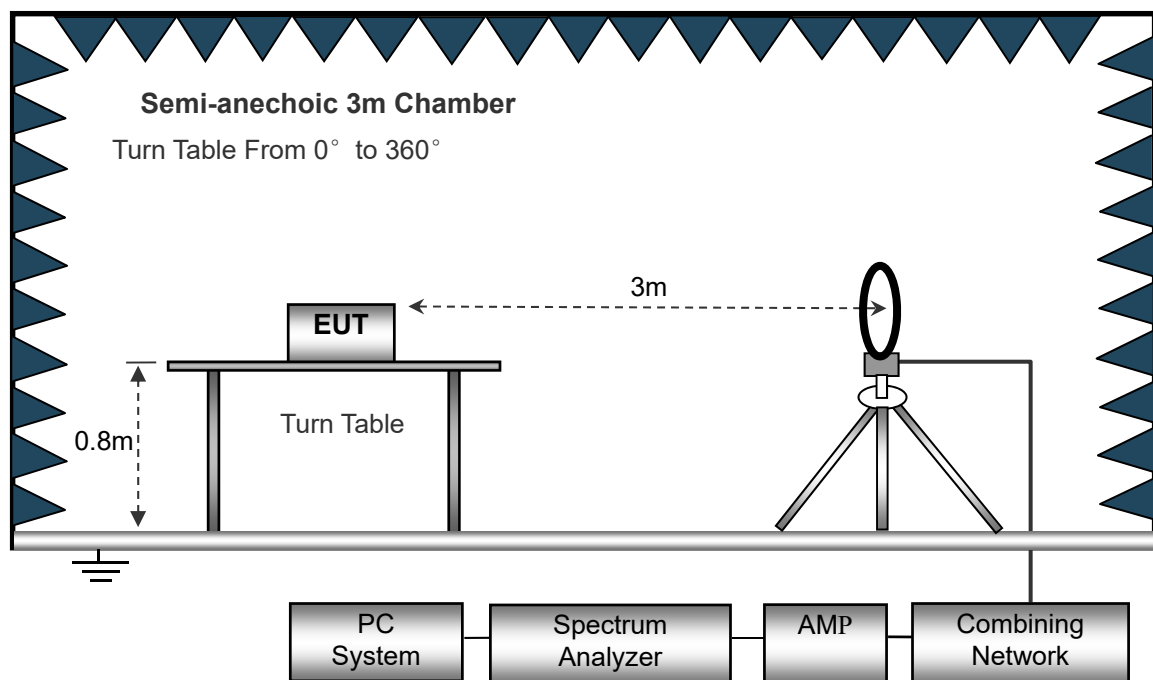
### 7.2 Test Procedure

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.

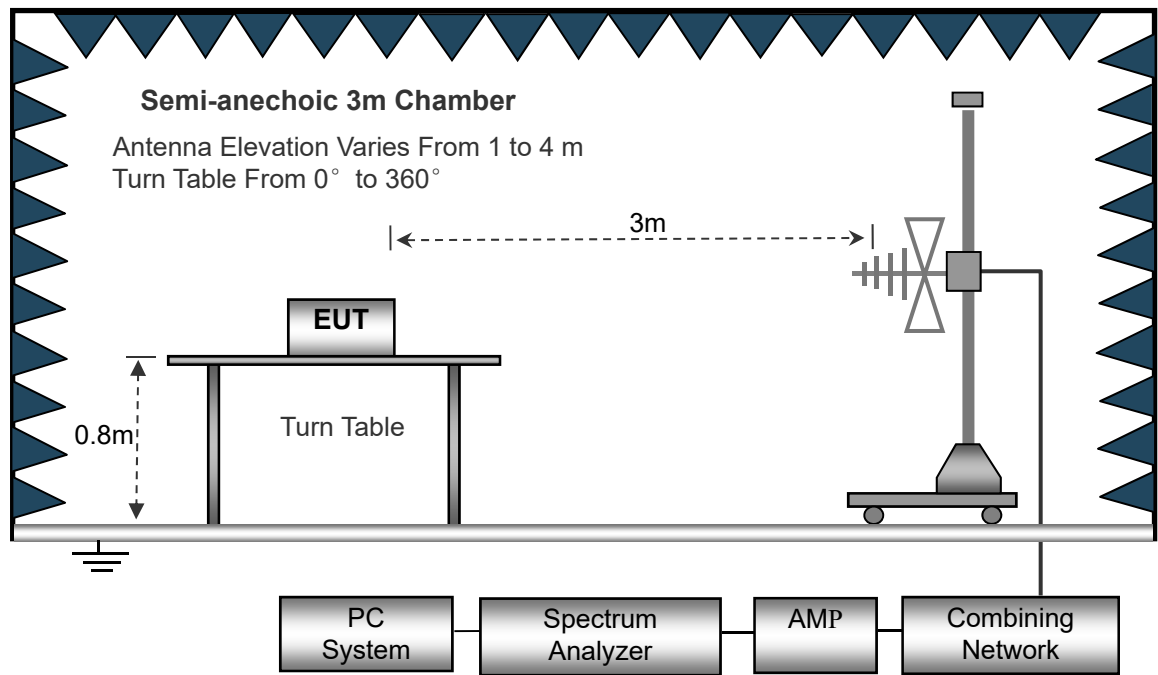
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10cm.

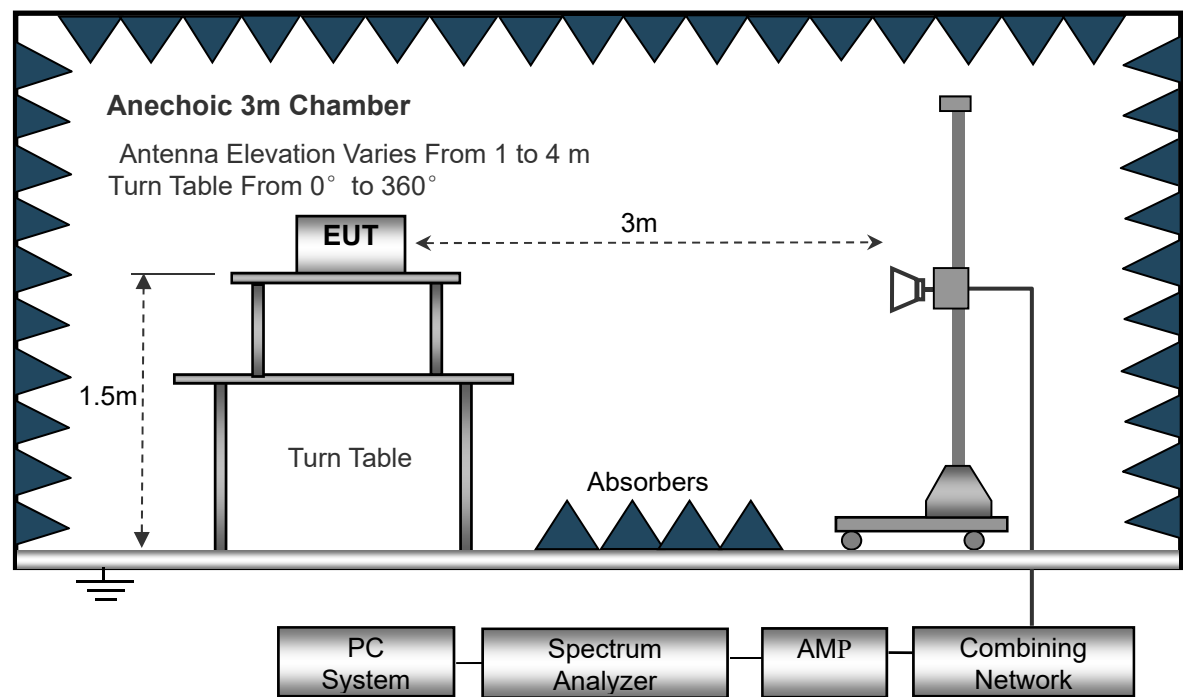
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1GHz.



Frequency :9kHz-30MHz  
RBW=10KHz,  
VBW =30KHz  
Sweep time= Auto  
Trace = max hold  
Detector function = peak

Frequency :30MHz-1GHz  
RBW=120KHz,  
VBW=300KHz  
Sweep time= Auto  
Trace = max hold  
Detector function = peak, QP

Frequency :Above 1GHz  
RBW=1MHz,  
VBW=3MHz(Peak), 10Hz(AV)  
Sweep time= Auto  
Trace = max hold  
Detector function = peak, AV



### 7.3 Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

### 7.4 Summary of Test Results/Plots

*Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.*

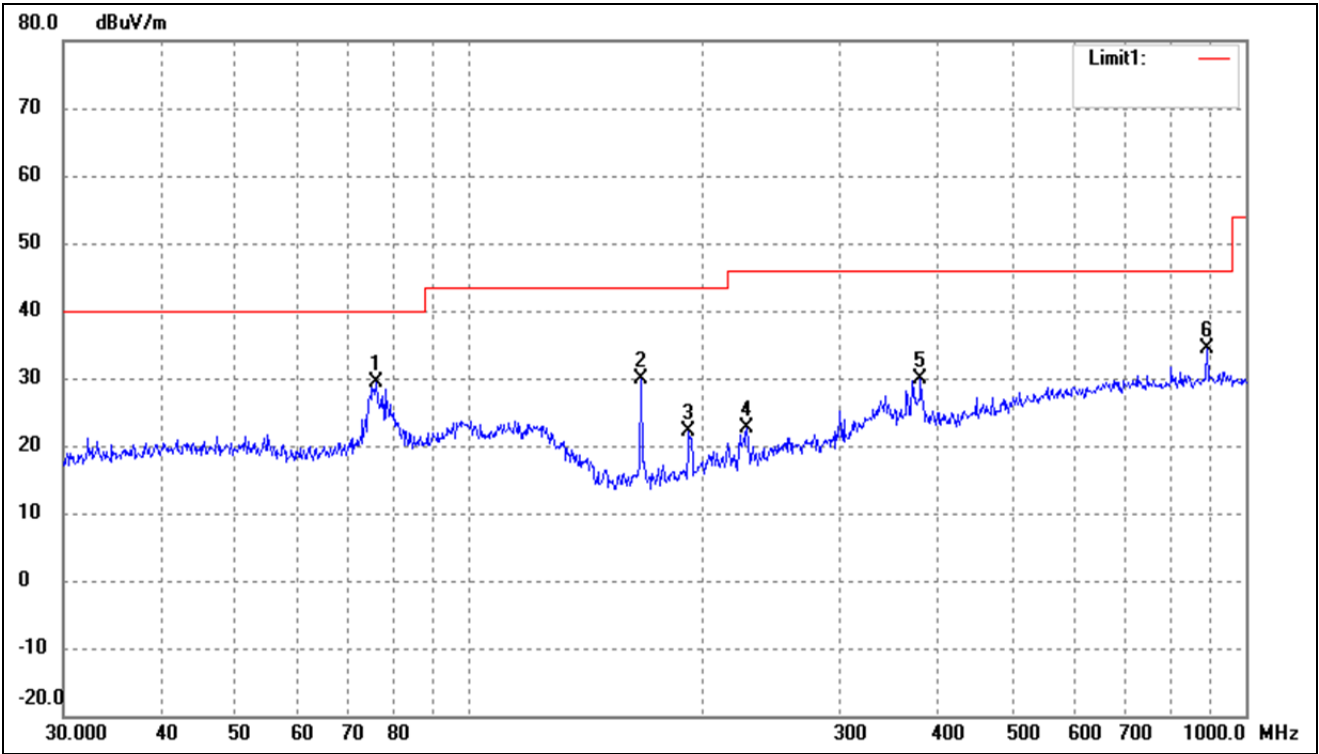
➤ Spurious Emissions Below 1GHz

|              |     |           |            |
|--------------|-----|-----------|------------|
| Test Channel | Low | Polarity: | Horizontal |
|--------------|-----|-----------|------------|



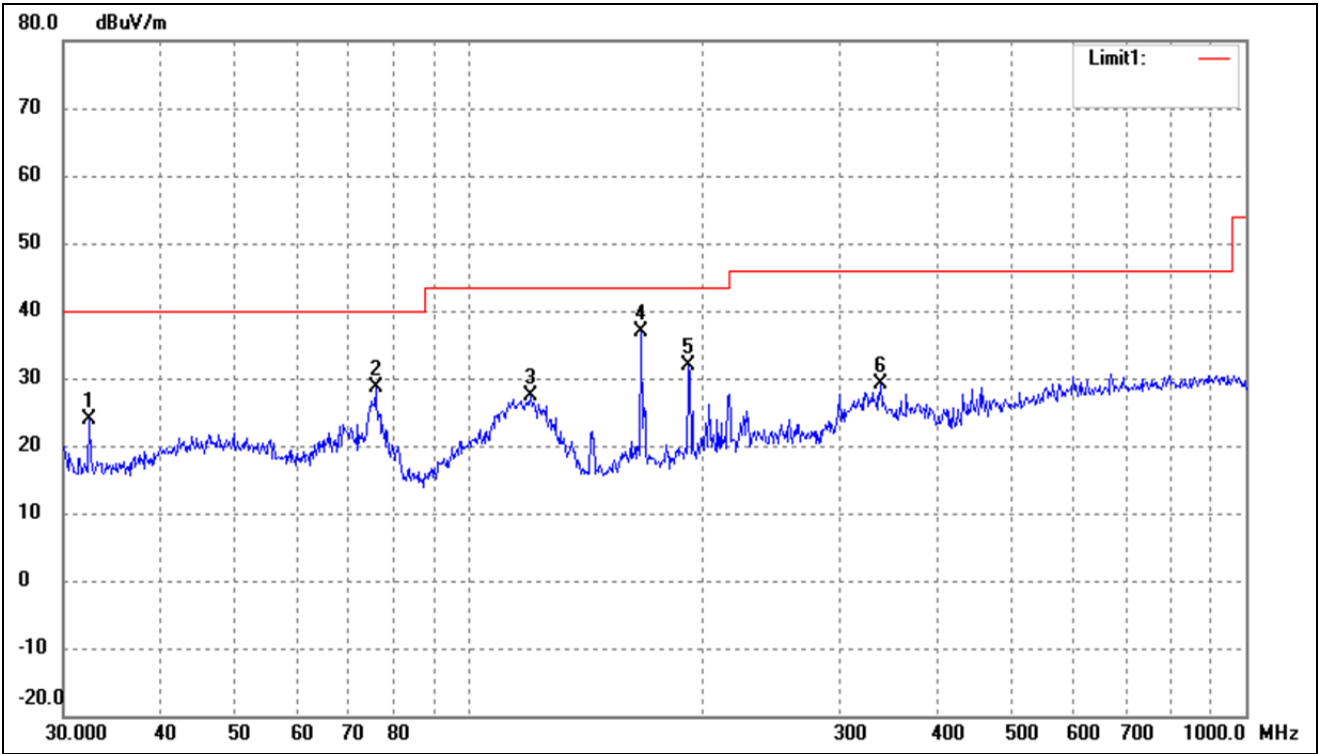
| No. | Frequency<br>(MHz) | Reading<br>(dBuV/m) | Correct<br>dB/m | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Degree<br>( ) | Height<br>(cm) | Remark |
|-----|--------------------|---------------------|-----------------|--------------------|-------------------|----------------|---------------|----------------|--------|
| 1   | 32.4059            | 36.16               | -8.85           | 27.31              | 40.00             | -12.69         | -             | -              | peak   |
| 2   | 75.7114            | 41.07               | -10.49          | 30.58              | 40.00             | -9.42          | -             | -              | peak   |
| 3   | 166.0680           | 49.85               | -11.90          | 37.95              | 43.50             | -5.55          | -             | -              | peak   |
| 4   | 191.7450           | 43.94               | -9.98           | 33.96              | 43.50             | -9.54          | -             | -              | peak   |
| 5   | 216.0240           | 37.95               | -9.26           | 28.69              | 46.00             | -17.31         | -             | -              | peak   |
| 6   | 338.4001           | 35.85               | -5.76           | 30.09              | 46.00             | -15.91         | -             | -              | peak   |

|              |     |           |          |
|--------------|-----|-----------|----------|
| Test Channel | Low | Polarity: | Vertical |
|--------------|-----|-----------|----------|



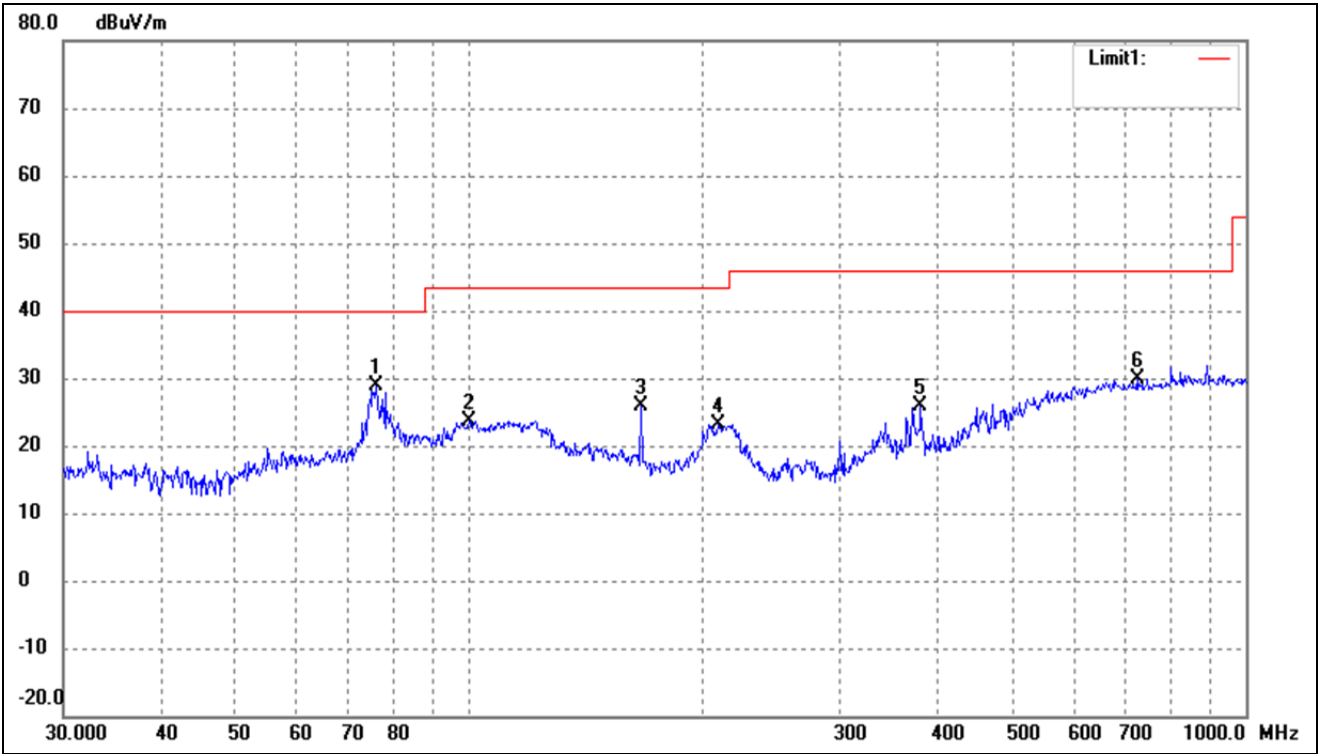
| No. | Frequency | Reading  | Correct | Result   | Limit    | Margin | Degree | Height | Remark |
|-----|-----------|----------|---------|----------|----------|--------|--------|--------|--------|
|     | (MHz)     | (dBuV/m) | dB/m    | (dBuV/m) | (dBuV/m) | (dB)   | ( )    | (cm)   |        |
| 1   | 75.7114   | 39.77    | -10.49  | 29.28    | 40.00    | -10.72 | -      | -      | peak   |
| 2   | 166.0680  | 41.70    | -11.90  | 29.80    | 43.50    | -13.70 | -      | -      | peak   |
| 3   | 191.7450  | 32.09    | -9.98   | 22.11    | 43.50    | -21.39 | -      | -      | peak   |
| 4   | 227.6906  | 31.48    | -8.94   | 22.54    | 46.00    | -23.46 | -      | -      | peak   |
| 5   | 381.2487  | 34.46    | -4.46   | 30.00    | 46.00    | -16.00 | -      | -      | peak   |
| 6   | 890.7278  | 31.72    | 2.68    | 34.40    | 46.00    | -11.60 | -      | -      | peak   |

|              |        |           |            |
|--------------|--------|-----------|------------|
| Test Channel | Middle | Polarity: | Horizontal |
|--------------|--------|-----------|------------|



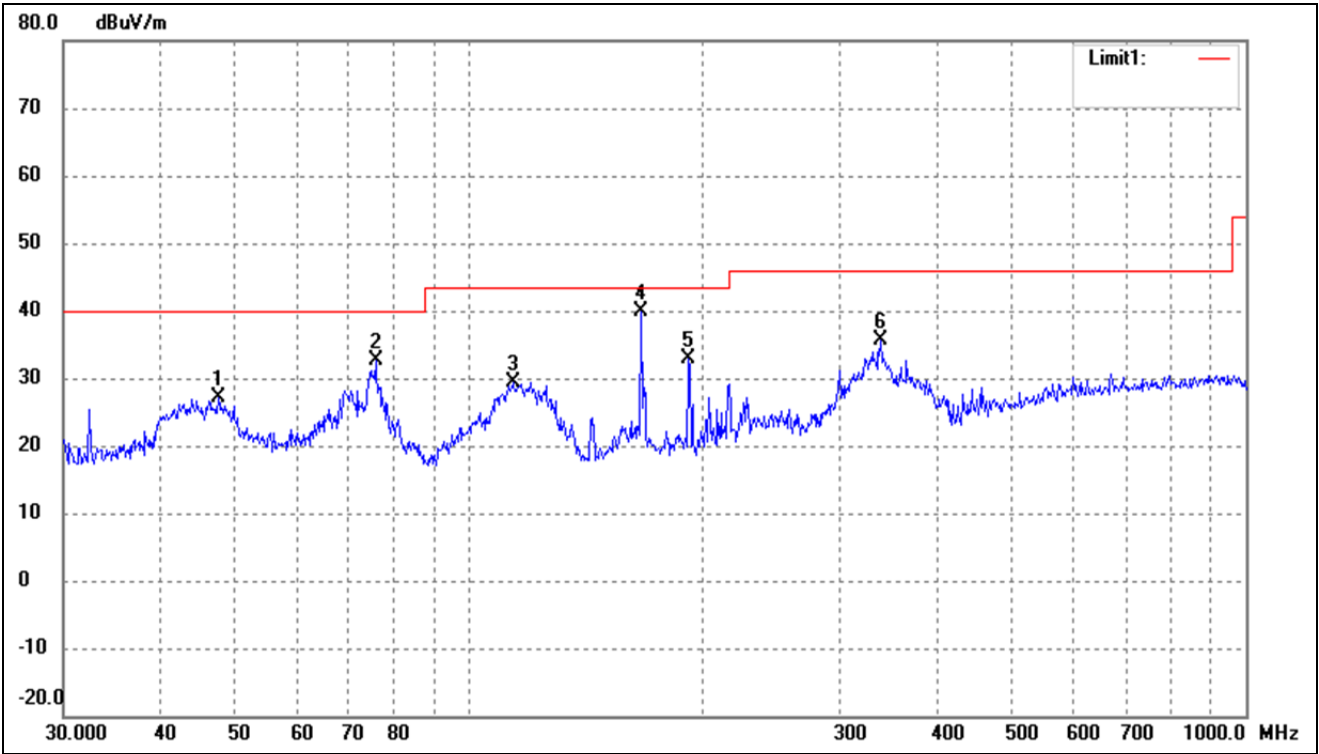
| No. | Frequency | Reading  | Correct | Result   | Limit    | Margin | Degree | Height | Remark |
|-----|-----------|----------|---------|----------|----------|--------|--------|--------|--------|
|     | (MHz)     | (dBuV/m) | dB/m    | (dBuV/m) | (dBuV/m) | (dB)   | ( )    | (cm)   |        |
| 1   | 32.4059   | 32.66    | -8.85   | 23.81    | 40.00    | -16.19 | -      | -      | peak   |
| 2   | 75.7113   | 39.07    | -10.49  | 28.58    | 40.00    | -11.42 | -      | -      | peak   |
| 3   | 119.8555  | 36.91    | -9.59   | 27.32    | 43.50    | -16.18 | -      | -      | peak   |
| 4   | 166.0680  | 48.85    | -11.90  | 36.95    | 43.50    | -6.55  | -      | -      | peak   |
| 5   | 191.7450  | 41.94    | -9.98   | 31.96    | 43.50    | -11.54 | -      | -      | peak   |
| 6   | 338.4001  | 34.85    | -5.76   | 29.09    | 46.00    | -16.91 | -      | -      | peak   |

|              |        |           |          |
|--------------|--------|-----------|----------|
| Test Channel | Middle | Polarity: | Vertical |
|--------------|--------|-----------|----------|



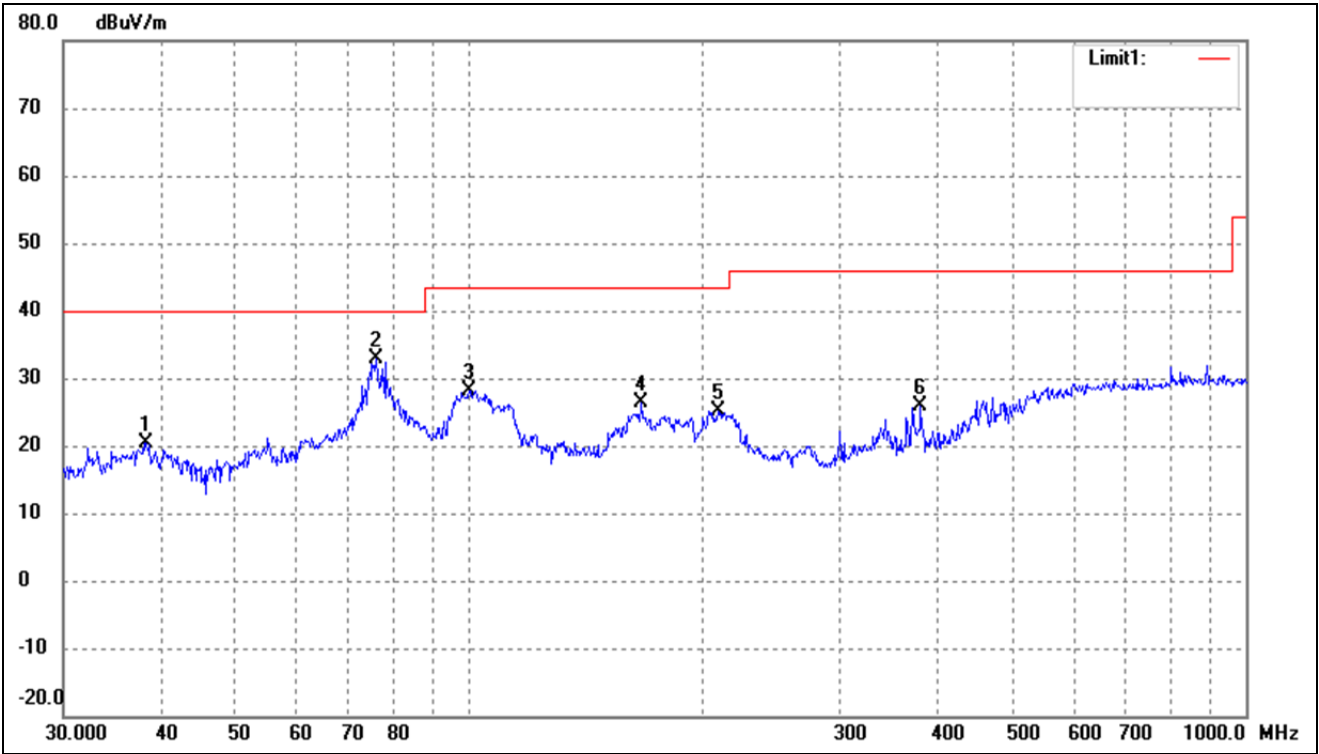
| No. | Frequency<br>(MHz) | Reading<br>(dBuV/m) | Correct<br>dB/m | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Degree<br>( ) | Height<br>(cm) | Remark |
|-----|--------------------|---------------------|-----------------|--------------------|-------------------|----------------|---------------|----------------|--------|
| 1   | 75.7113            | 39.27               | -10.49          | 28.78              | 40.00             | -11.22         | -             | -              | peak   |
| 2   | 99.8777            | 32.43               | -8.75           | 23.68              | 43.50             | -19.82         | -             | -              | peak   |
| 3   | 166.0680           | 37.70               | -11.90          | 25.80              | 43.50             | -17.70         | -             | -              | peak   |
| 4   | 209.3129           | 32.69               | -9.44           | 23.25              | 43.50             | -20.25         | -             | -              | peak   |
| 5   | 381.2486           | 30.46               | -4.46           | 26.00              | 46.00             | -20.00         | -             | -              | peak   |
| 6   | 724.2611           | 28.36               | 1.59            | 29.95              | 46.00             | -16.05         | -             | -              | peak   |

|              |      |           |            |
|--------------|------|-----------|------------|
| Test Channel | High | Polarity: | Horizontal |
|--------------|------|-----------|------------|



| No. | Frequency<br>(MHz) | Reading<br>(dBuV/m) | Correct<br>dB/m | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Degree<br>( ) | Height<br>(cm) | Remark |
|-----|--------------------|---------------------|-----------------|--------------------|-------------------|----------------|---------------|----------------|--------|
| 1   | 47.4917            | 34.00               | -6.97           | 27.03              | 40.00             | -12.97         | -             | -              | peak   |
| 2   | 75.7112            | 43.07               | -10.49          | 32.58              | 40.00             | -7.42          | -             | -              | peak   |
| 3   | 113.7142           | 38.47               | -9.14           | 29.33              | 43.50             | -14.17         | -             | -              | peak   |
| 4   | 166.0680           | 51.85               | -11.90          | 39.95              | 43.50             | -3.55          | -             | -              | peak   |
| 5   | 191.7450           | 42.94               | -9.98           | 32.96              | 43.50             | -10.54         | -             | -              | peak   |
| 6   | 338.4001           | 41.35               | -5.76           | 35.59              | 46.00             | -10.41         | -             | -              | peak   |

|              |      |           |          |
|--------------|------|-----------|----------|
| Test Channel | High | Polarity: | Vertical |
|--------------|------|-----------|----------|



| No. | Frequency | Reading  | Correct | Result   | Limit    | Margin | Degree | Height | Remark |
|-----|-----------|----------|---------|----------|----------|--------|--------|--------|--------|
|     | (MHz)     | (dBuV/m) | dB/m    | (dBuV/m) | (dBuV/m) | (dB)   | ( )    | (cm)   |        |
| 1   | 38.3462   | 27.81    | -7.40   | 20.41    | 40.00    | -19.59 | -      | -      | peak   |
| 2   | 75.7113   | 43.27    | -10.49  | 32.78    | 40.00    | -7.22  | -      | -      | peak   |
| 3   | 99.8777   | 36.93    | -8.75   | 28.18    | 43.50    | -15.32 | -      | -      | peak   |
| 4   | 166.6513  | 38.28    | -11.87  | 26.41    | 43.50    | -17.09 | -      | -      | peak   |
| 5   | 209.3129  | 34.69    | -9.44   | 25.25    | 43.50    | -18.25 | -      | -      | peak   |
| 6   | 381.2486  | 30.46    | -4.46   | 26.00    | 46.00    | -20.00 | -      | -      | peak   |

Remark: ‘-’Means’ the test Degree and Height are not recorded by the test software and only show the worst case in the test report.

## ➤ Spurious Emissions Above 1GHz

| Frequency              | Reading  | Correct | Result   | Limit    | Margin | Polar | Detector |
|------------------------|----------|---------|----------|----------|--------|-------|----------|
| (MHz)                  | (dBuV/m) | dB      | (dBuV/m) | (dBuV/m) | (dB)   | H/V   |          |
| Low Channel-2405MHz    |          |         |          |          |        |       |          |
| 4810                   | 50.75    | -6.11   | 44.64    | 74.00    | -29.36 | H     | PK       |
| 7215                   | 49.93    | -1.63   | 48.30    | 74.00    | -25.70 | H     | PK       |
| 4810                   | 51.07    | -6.11   | 44.96    | 74.00    | -29.04 | V     | PK       |
| 7215                   | 49.50    | -1.63   | 47.87    | 74.00    | -26.13 | V     | PK       |
| Middle Channel-2445MHz |          |         |          |          |        |       |          |
| 4890                   | 55.82    | -5.90   | 49.92    | 74.00    | -24.08 | H     | PK       |
| 7335                   | 49.22    | -1.58   | 47.64    | 74.00    | -26.36 | H     | PK       |
| 4890                   | 55.77    | -5.90   | 49.87    | 74.00    | -24.13 | V     | PK       |
| 7335                   | 48.82    | -1.58   | 47.24    | 74.00    | -26.76 | V     | PK       |
| High Channel-2480MHz   |          |         |          |          |        |       |          |
| 4960                   | 50.68    | -5.71   | 44.97    | 74.00    | -29.03 | H     | PK       |
| 7440                   | 50.58    | -1.52   | 49.06    | 74.00    | -24.94 | H     | PK       |
| 4960                   | 50.89    | -5.71   | 45.18    | 74.00    | -28.82 | V     | PK       |
| 7440                   | 49.31    | -1.52   | 47.79    | 74.00    | -26.21 | V     | PK       |

*Note: Testing is carried out with frequency rang 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.*



## 8. Out of Band Emissions

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### 8.1 Standard Applicable

According to §15.247 (d), in any 100kHz 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 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, 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 30dB instead of 20dB. 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).

### 8.2 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 KDB publication number: 913591 may be used for the radiated bandedge measurements.

According to the KDB 558074, the conducted spurious emissions test method as follows:

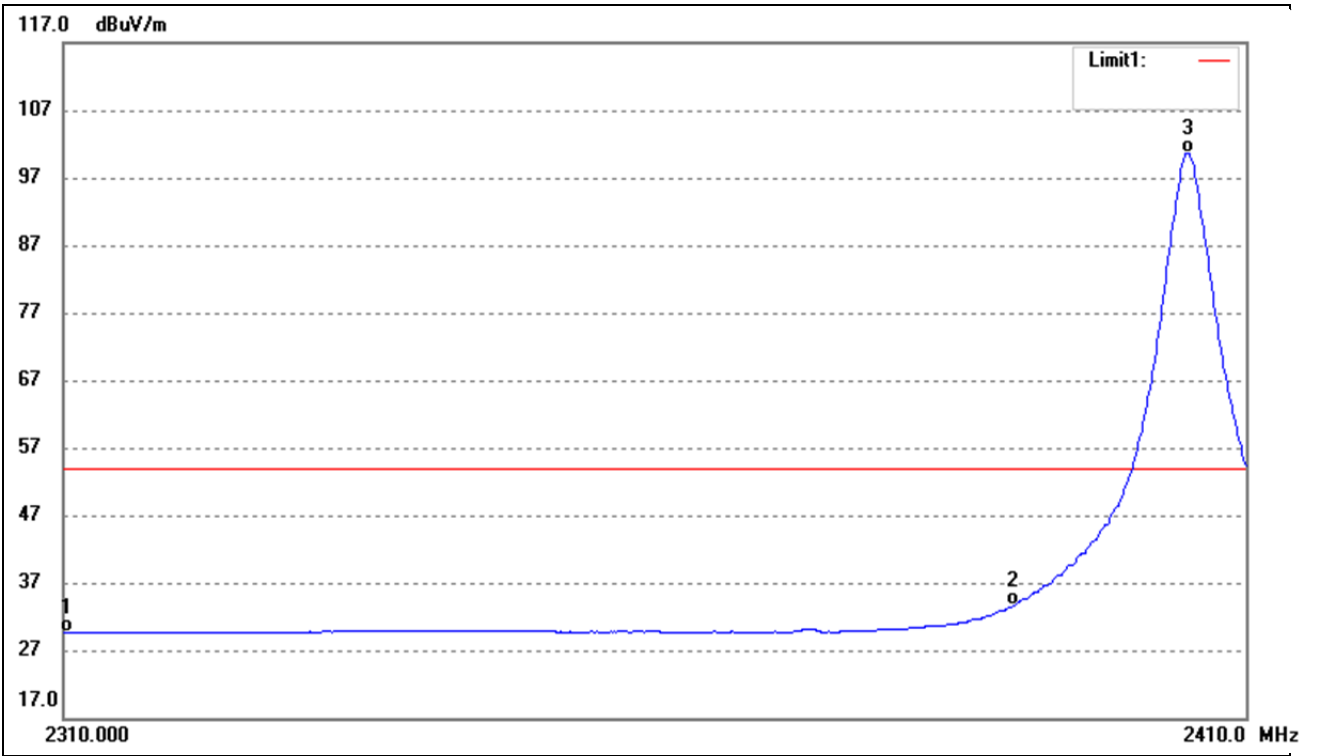
1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100kHz.
4. Set VBW  $\geq$  300kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100kHz bandwidth.

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.

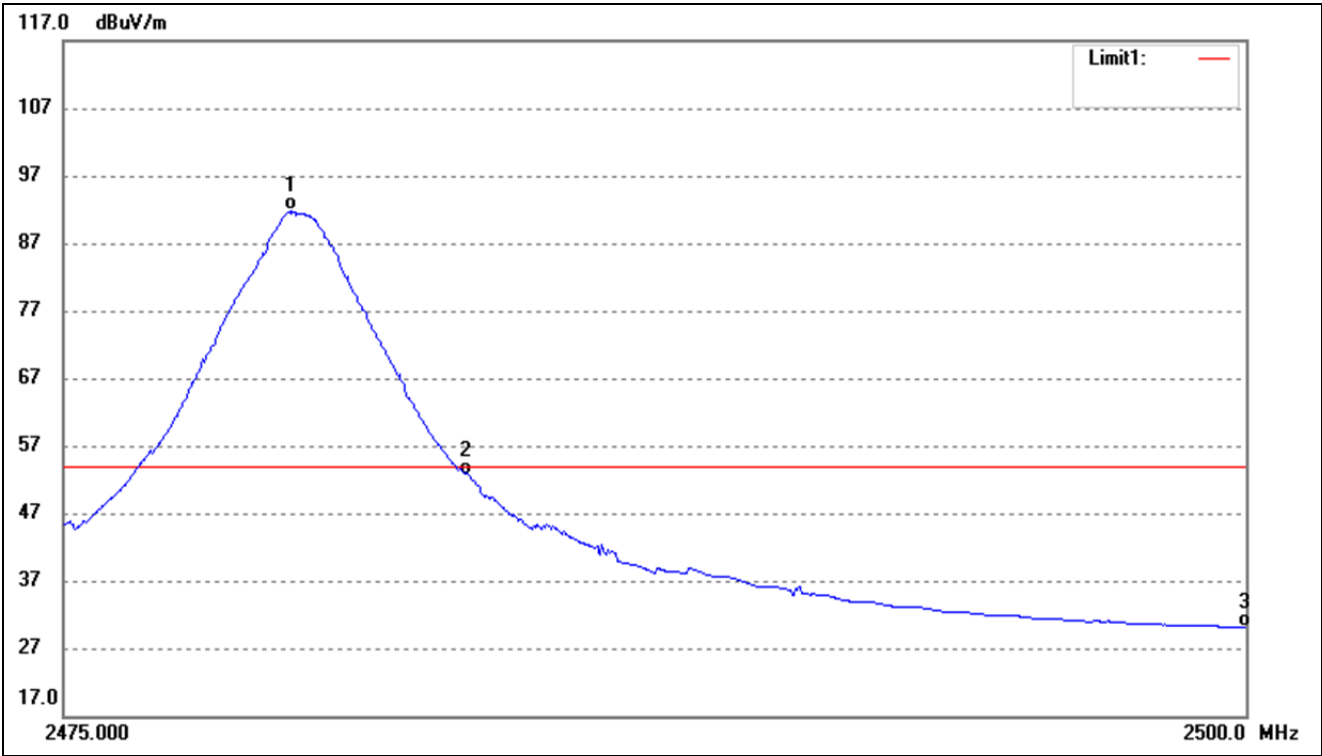
8.3 Summary of Test Results/Plots

|              |     |           |                         |
|--------------|-----|-----------|-------------------------|
| Test Channel | Low | Polarity: | Horizontal (worst case) |
|--------------|-----|-----------|-------------------------|



| No. | Frequency<br>(MHz) | Reading<br>(dBuV/m) | Correct<br>dB/m | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark           |
|-----|--------------------|---------------------|-----------------|--------------------|-------------------|----------------|------------------|
| 1   | 2310.000           | 40.43               | -10.82          | 29.61              | 54.00             | -24.39         | Average Detector |
|     | 2310.000           | 51.82               | -10.82          | 41.00              | 74.00             | -33.00         | Peak Detector    |
| 2   | 2390.000           | 44.25               | -10.70          | 33.55              | 54.00             | -20.45         | Average Detector |
|     | 2390.000           | 59.38               | -10.70          | 48.68              | 74.00             | -25.32         | Peak Detector    |
| 3   | 2405.001           | 111.39              | -10.68          | 100.71             | /                 | /              | Average Detector |
|     | 2404.491           | 113.66              | -10.68          | 102.98             | /                 | /              | Peak Detector    |

|              |      |           |                         |
|--------------|------|-----------|-------------------------|
| Test Channel | High | Polarity: | Horizontal (worst case) |
|--------------|------|-----------|-------------------------|



| No. | Frequency<br>(MHz) | Reading<br>(dBuV/m) | Correct<br>Factor(dB) | Result<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) | Remark           |
|-----|--------------------|---------------------|-----------------------|--------------------|-------------------|----------------|------------------|
| 1   | 2479.780           | 102.40              | -10.58                | 91.82              | /                 | /              | Average Detector |
|     | 2480.479           | 107.57              | -10.58                | 96.99              | /                 | /              | Peak Detector    |
| 2   | 2483.500           | 63.33               | -10.58                | 52.75              | 54.00             | -1.25          | Average Detector |
|     | 2483.500           | 77.90               | -10.58                | 67.32              | 74.00             | -6.68          | Peak Detector    |
| 3   | 2500.000           | 40.69               | -10.55                | 30.14              | 54.00             | -23.86         | Average Detector |
|     | 2500.000           | 52.69               | -10.55                | 42.14              | 74.00             | -31.86         | Peak Detector    |

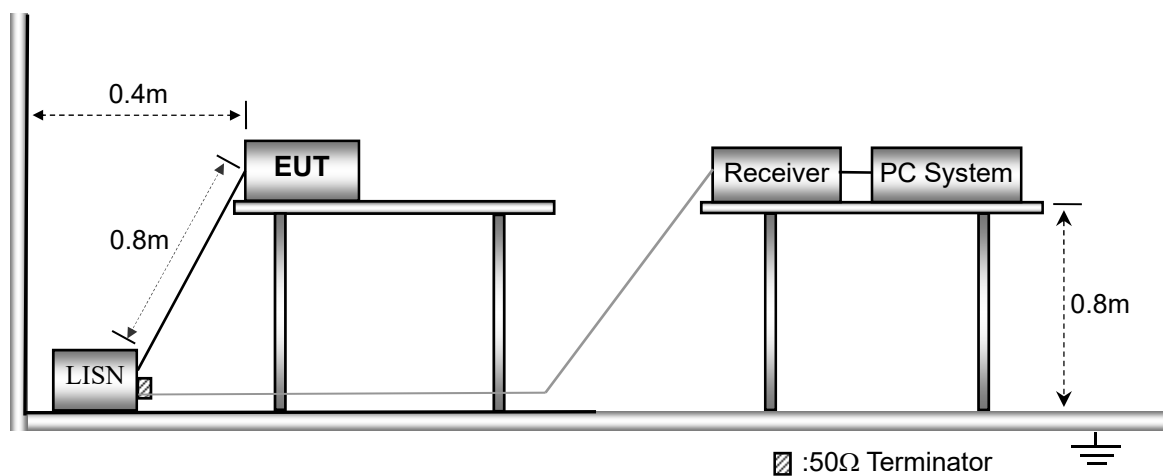
## 9. Conducted Emissions

### 9.1 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40cm long in the middle. The spacing between the peripherals was 10cm.

### 9.2 Basic Test Setup Block Diagram



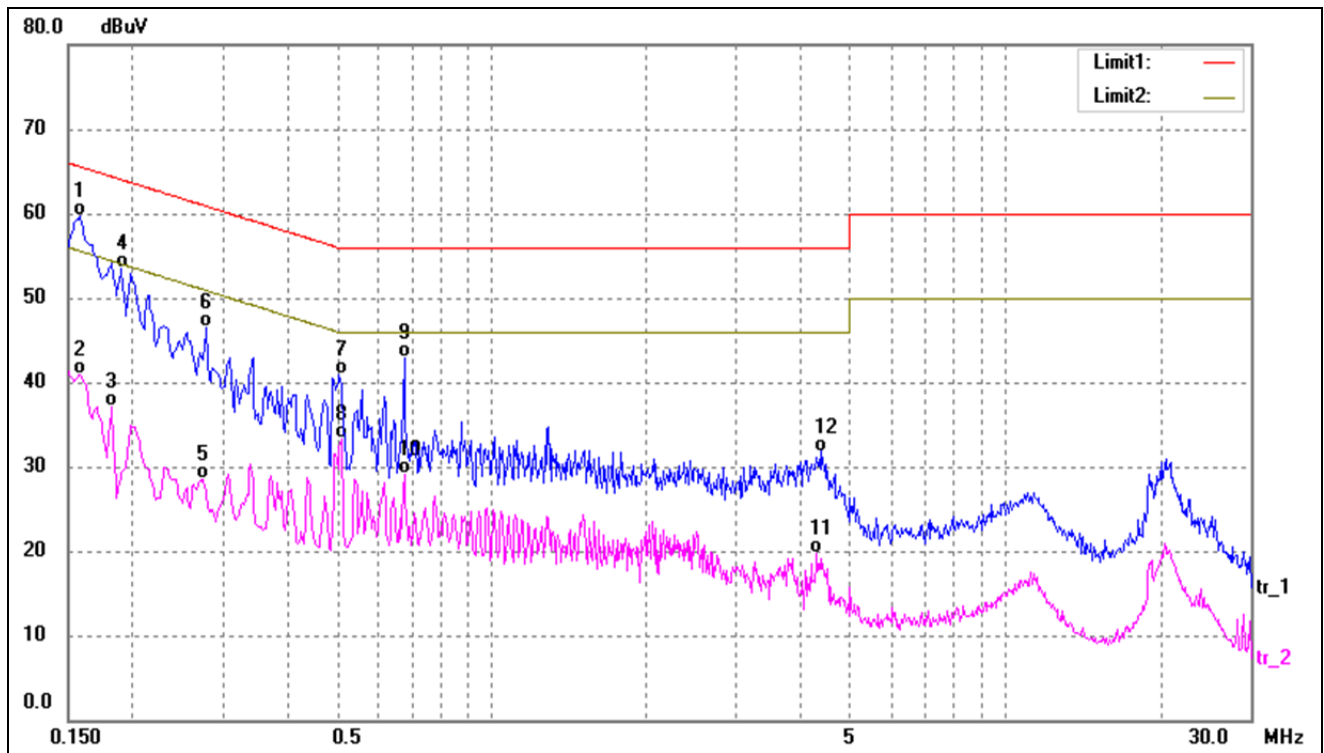
### 9.3 Test Receiver Setup

During the conducted emission test, the test receiver was set with the following configurations:

|                                    |        |
|------------------------------------|--------|
| Start Frequency .....              | 150kHz |
| Stop Frequency .....               | 30MHz  |
| Sweep Speed .....                  | Auto   |
| IF Bandwidth.....                  | 10kHz  |
| Quasi-Peak Adapter Bandwidth ..... | 9kHz   |
| Quasi-Peak Adapter Mode .....      | Normal |

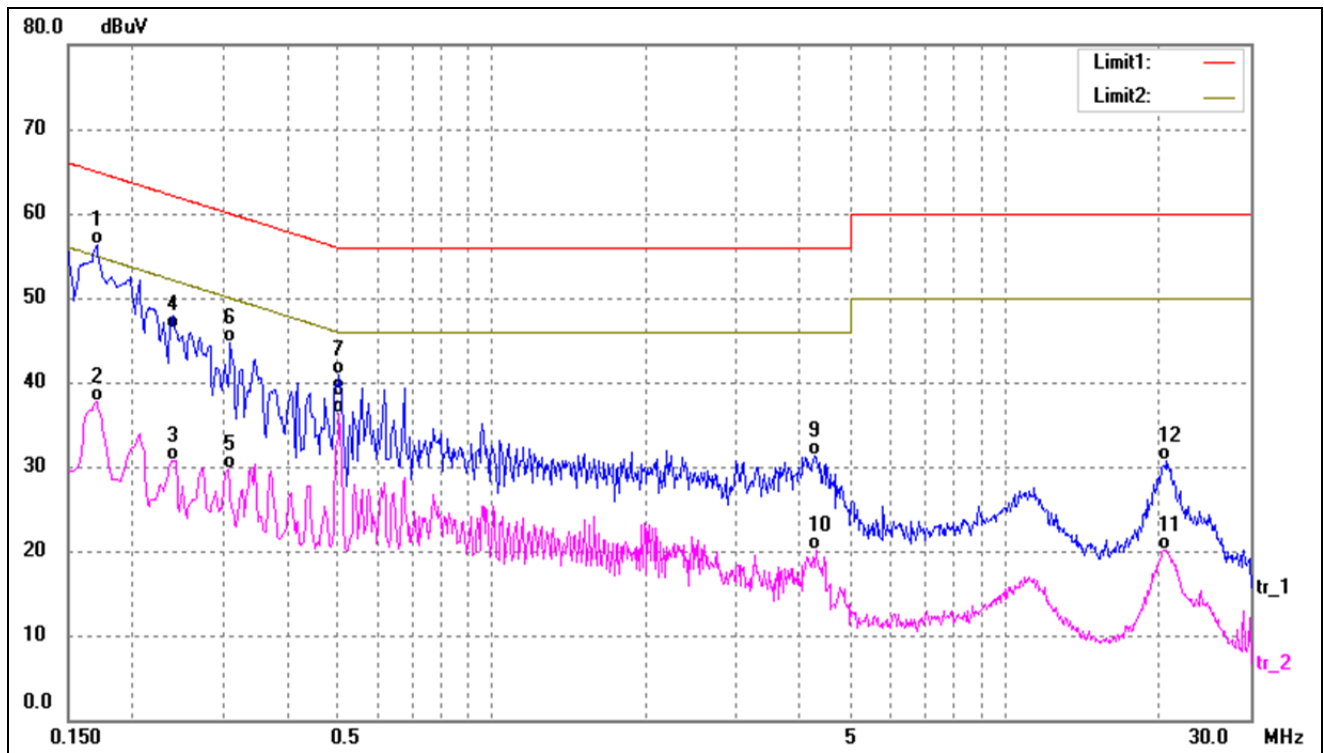
### 9.4 Summary of Test Results/Plots

|           |               |             |           |         |
|-----------|---------------|-------------|-----------|---------|
| Test Mode | Communication | AC120V 60Hz | Polarity: | Neutral |
|-----------|---------------|-------------|-----------|---------|



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Detector |
|-----|--------------------|-------------------|-----------------|------------------|-----------------|----------------|----------|
| 1*  | 0.1580             | 49.27             | 10.37           | 59.64            | 65.57           | -5.93          | QP       |
| 2   | 0.1580             | 30.61             | 10.37           | 40.98            | 55.57           | -14.59         | AVG      |
| 3   | 0.1820             | 26.81             | 10.37           | 37.18            | 54.39           | -17.21         | AVG      |
| 4   | 0.1900             | 43.06             | 10.37           | 53.43            | 64.04           | -10.61         | QP       |
| 5   | 0.2740             | 18.19             | 10.35           | 28.54            | 51.00           | -22.46         | AVG      |
| 6   | 0.2780             | 36.13             | 10.34           | 46.47            | 60.88           | -14.41         | QP       |
| 7   | 0.5060             | 30.65             | 10.26           | 40.91            | 56.00           | -15.09         | QP       |
| 8   | 0.5100             | 23.11             | 10.27           | 33.38            | 46.00           | -12.62         | AVG      |
| 9   | 0.6780             | 32.47             | 10.37           | 42.84            | 56.00           | -13.16         | QP       |
| 10  | 0.6780             | 18.75             | 10.37           | 29.12            | 46.00           | -16.88         | AVG      |
| 11  | 4.3140             | 9.74              | 10.03           | 19.77            | 46.00           | -26.23         | AVG      |
| 12  | 4.3660             | 21.77             | 10.03           | 31.80            | 56.00           | -24.20         | QP       |

|           |               |             |           |      |
|-----------|---------------|-------------|-----------|------|
| Test Mode | Communication | AC120V 60Hz | Polarity: | Line |
|-----------|---------------|-------------|-----------|------|



| No. | Frequency<br>(MHz) | Reading<br>(dBuV) | Correct<br>(dB) | Result<br>(dBuV) | Limit<br>(dBuV) | Margin<br>(dB) | Detector |
|-----|--------------------|-------------------|-----------------|------------------|-----------------|----------------|----------|
| 1*  | 0.1700             | 45.84             | 10.37           | 56.21            | 64.96           | -8.75          | QP       |
| 2   | 0.1700             | 27.40             | 10.37           | 37.77            | 54.96           | -17.19         | AVG      |
| 3   | 0.2380             | 20.41             | 10.36           | 30.77            | 52.17           | -21.40         | AVG      |
| 4   | 0.2416             | 36.01             | 10.36           | 46.37            | 62.04           | -15.67         | QP       |
| 5   | 0.3060             | 19.33             | 10.33           | 29.66            | 50.08           | -20.42         | AVG      |
| 6   | 0.3100             | 34.31             | 10.33           | 44.64            | 59.97           | -15.33         | QP       |
| 7   | 0.5060             | 30.61             | 10.26           | 40.87            | 56.00           | -15.13         | QP       |
| 8   | 0.5060             | 25.96             | 10.26           | 36.22            | 46.00           | -9.78          | AVG      |
| 9   | 4.2660             | 21.26             | 10.03           | 31.29            | 56.00           | -24.71         | QP       |
| 10  | 4.2740             | 9.98              | 10.03           | 20.01            | 46.00           | -25.99         | AVG      |
| 11  | 20.4740            | 9.89              | 10.25           | 20.14            | 50.00           | -29.86         | AVG      |
| 12  | 20.6300            | 20.53             | 10.24           | 30.77            | 60.00           | -29.23         | QP       |

APPENDIX SUMMARY

|                   |                 |               |           |
|-------------------|-----------------|---------------|-----------|
| Project No.       | WTX22X05085238W | Test Engineer | Gala      |
| Start date        | 2022/5/12       | Finish date   | 2022/5/18 |
| Temperature       | 23℃             | Humidity      | 45%       |
| RF specifications | Zigbee          |               |           |

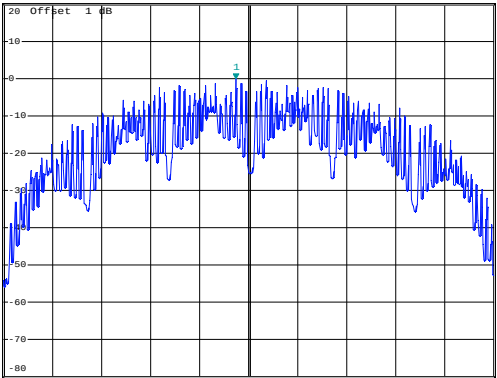
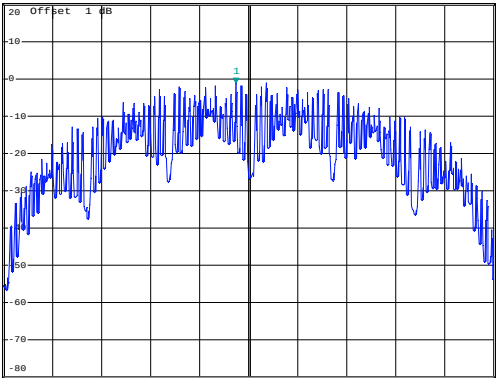
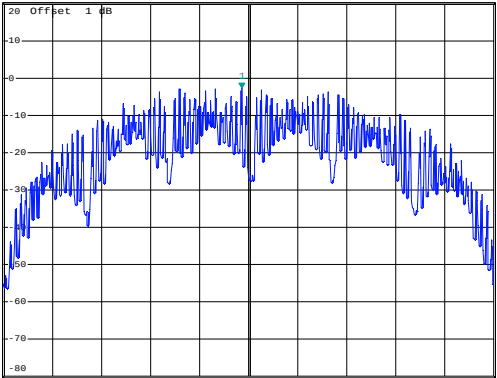
| APPENDIX | Description of Test Item        | Result    |
|----------|---------------------------------|-----------|
| A        | Power Spectral Density          | Compliant |
| B        | DTS Bandwidth 99% Bandwidth     | Compliant |
| C        | RF Output Power                 | Compliant |
| D        | Conducted Out of Band Emissions | Compliant |

APPENDIX A

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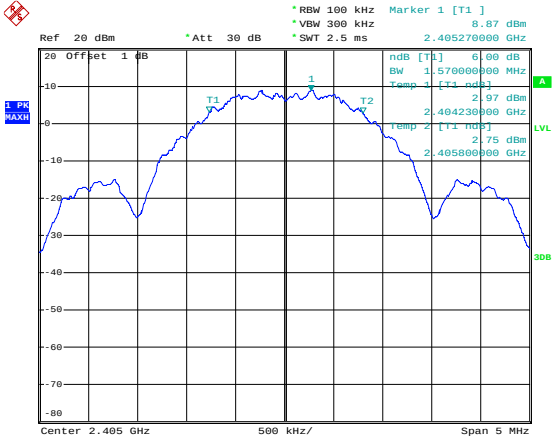
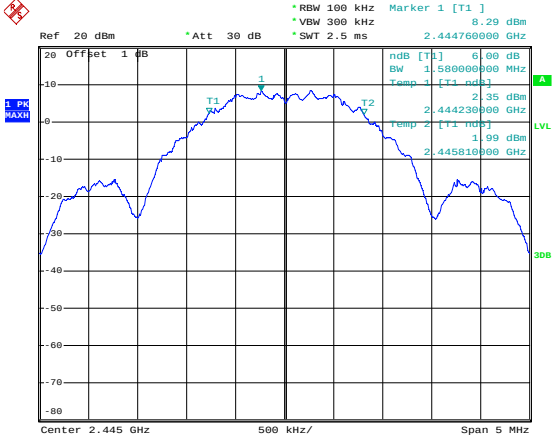
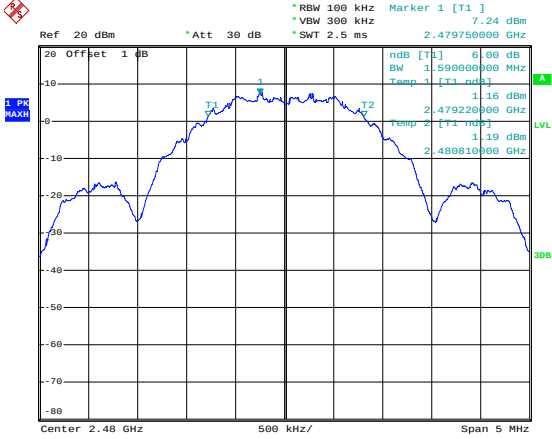
| Power Spectral Density |              |                                    |                   |
|------------------------|--------------|------------------------------------|-------------------|
| Test Mode              | Test Channel | Power Spectral Density<br>dBm/3kHz | Limit<br>dBm/3kHz |
| Zigbee                 | Low          | -0.15                              | 8                 |
|                        | Middle       | -1.07                              | 8                 |
|                        | High         | -2.76                              | 8                 |



|               |                                                                                                                                                                                                                                                                                                                                                                             |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Low</p>    | <div data-bbox="646 273 1201 712"><p>Ref 20 dBm *Att 30 dB RBW 3 kHz Marker 1 [T1] -0.15 dBm<br/>VBW 10 kHz 2.484922800 GHz<br/>SWT 340 ms</p><p>1 PK MAXH</p><p>20 Offset 1 dB</p><p>Center 2.485 GHz 300 kHz/ Span 3 MHz</p><p>A LVL 30B</p></div> <p>Date: 18.MAY.2022 10:37:06</p>    |
| <p>Middle</p> | <div data-bbox="646 813 1201 1252"><p>Ref 20 dBm *Att 30 dB RBW 3 kHz Marker 1 [T1] -1.07 dBm<br/>VBW 10 kHz 2.444922800 GHz<br/>SWT 340 ms</p><p>1 PK MAXH</p><p>20 Offset 1 dB</p><p>Center 2.445 GHz 300 kHz/ Span 3 MHz</p><p>A LVL 30B</p></div> <p>Date: 18.MAY.2022 10:37:40</p>  |
| <p>High</p>   | <div data-bbox="646 1355 1201 1794"><p>Ref 20 dBm *Att 30 dB RBW 3 kHz Marker 1 [T1] -2.76 dBm<br/>VBW 10 kHz 2.479950000 GHz<br/>SWT 340 ms</p><p>1 PK MAXH</p><p>20 Offset 1 dB</p><p>Center 2.48 GHz 300 kHz/ Span 3 MHz</p><p>A LVL 30B</p></div> <p>Date: 18.MAY.2022 10:38:07</p> |

APPENDIX B

| DTS Bandwidth |              |                       |              |
|---------------|--------------|-----------------------|--------------|
| Test Mode     | Test Channel | 6 dB Bandwidth<br>kHz | Limit<br>kHz |
| Zigbee        | Low          | 1570                  | ≥500         |
|               | Middle       | 1580                  | ≥500         |
|               | High         | 1590                  | ≥500         |

|               |                                                                                                                                                                 |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Low</p>    | <div data-bbox="647 275 1201 712"><p>Date: 18.MAY.2022 10:41:58</p></div>     |
| <p>Middle</p> | <div data-bbox="647 817 1201 1254"><p>Date: 18.MAY.2022 10:42:30</p></div>   |
| <p>High</p>   | <div data-bbox="647 1359 1201 1796"><p>Date: 18.MAY.2022 10:42:51</p></div> |

APPENDIX C

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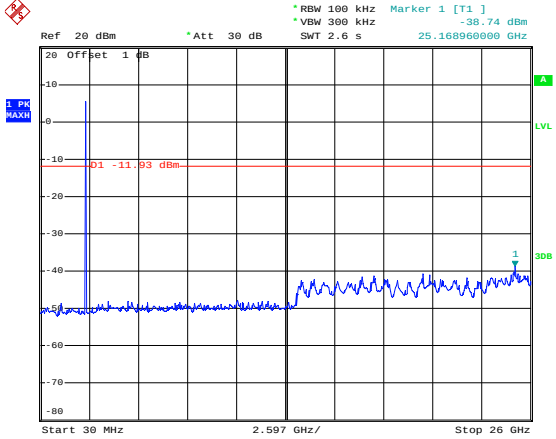
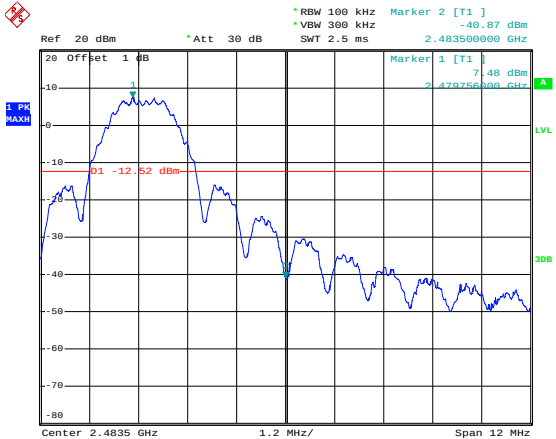
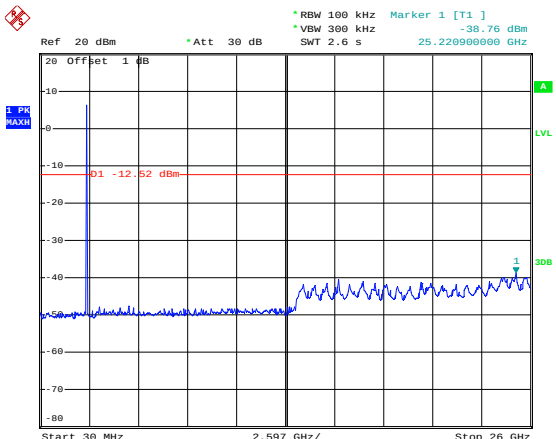
| RF Output Power |              |                |              |
|-----------------|--------------|----------------|--------------|
| Test Mode       | Test Channel | Reading<br>dBm | Limit<br>dBm |
| Zigbee          | Low          | 12.01          | 30.00        |
|                 | Middle       | 11.47          | 30.00        |
|                 | High         | 10.68          | 30.00        |

|            |                                                                            |
|------------|----------------------------------------------------------------------------|
| <p>Low</p> | <div data-bbox="647 232 1201 672"></div> <p>Date: 18.MAY.2022 10:34:38</p> |
|------------|----------------------------------------------------------------------------|

APPENDIX D

Conducted Out of Band Emissions

|               |                                                                              |
|---------------|------------------------------------------------------------------------------|
| <p>Low</p>    | <div data-bbox="646 405 1201 844"></div> <p>Date: 18.MAY.2022 12:02:57</p>   |
|               | <div data-bbox="646 945 1201 1384"></div> <p>Date: 18.MAY.2022 12:03:20</p>  |
| <p>Middle</p> | <div data-bbox="646 1487 1201 1926"></div> <p>Date: 18.MAY.2022 12:05:05</p> |

|      |                                                                                                                                  |
|------|----------------------------------------------------------------------------------------------------------------------------------|
|      | <div><p>Date: 18.MAY.2022 12:05:18</p></div>   |
| High | <div><p>Date: 18.MAY.2022 12:06:31</p></div>  |
|      | <div><p>Date: 18.MAY.2022 12:06:58</p></div> |

## **APPENDIX PHOTOGRAPHS**

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**Please refer to “ANNEX”**

**\*\*\*\*\* END OF REPORT \*\*\*\*\***