

# TEST REPORT

Reference No. .... : WTS17S0372796-1E  
FCC ID ..... : 2ACZKAWS2KT  
Applicant ..... : Gradus Group  
Address ..... : 370 West 35th Street, New York, NY 10001, United States  
Manufacturer ..... : Gradus Group  
Address ..... : 370 West 35th Street, New York, NY 10001, United States  
Factory ..... : Relacart Electronics Co.,Ltd.  
Address ..... : No. 10 Fuxing Road, Pingshi Industrial District, Enping City,  
Guangdong, China-529400  
Product Name ..... : Advanced Wireless System Transmitter  
Model No. .... : AWS-2000T  
Brand Name ..... :   
Standards ..... : FCC CFR47 Part 74  
Date of Receipt sample..... : Mar. 07, 2017  
Date of Test..... : Apr. 22 – Jun. 19, 2017  
Date of Issue ..... : Jun. 23, 2017  
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 compiler and approver.

**Prepared By:**

**Waltek Services (Shenzhen) Co., Ltd.**

Address: 1/F., Fukangtai Building, West Baima Road, Songgang Street, Baoan District, Shenzhen,  
Guangdong, China

Tel :+86-755-83551033

Fax:+86-755-83552400

Compiled by:

*Robin Zhou*

Robin Zhou / Test Engineer

Approved by:



Philo Zhong / Manager

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### 3 Revision History

| Test report No.  | Date of Receipt sample | Date of Test              | Date of Issue | Purpose  | Comment | Approved |
|------------------|------------------------|---------------------------|---------------|----------|---------|----------|
| WTS17S0372796-1E | Mar. 07, 2017          | Apr. 22–<br>Jun. 19, 2017 | Jun. 23, 2017 | original | -       | Valid    |

## 4 General Information

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

|                                 |                                        |
|---------------------------------|----------------------------------------|
| <b>Product Name</b>             | : Advanced Wireless System Transmitter |
| <b>Model No.</b>                | : AWS-2000T                            |
| <b>Differences Describe</b>     | : N/A                                  |
| <b>Operation Frequency</b>      | : 522MHz-586MHz, 172channels           |
| <b>The Lowest Oscillator</b>    | : 16MHz                                |
| <b>Antenna installation</b>     | : Permanent wire whip antenna          |
| <b>Antenna Gain</b>             | : 1dBi (Max.)                          |
| <b>Modulation</b>               | : FM                                   |
| <b>Rated System Deviation</b>   | : $\pm 30$ KHz                         |
| <b>Maximum System Deviation</b> | : $\pm 75$ KHz                         |

### 4.2 Details of E.U.T.

|                        |                                                                             |
|------------------------|-----------------------------------------------------------------------------|
| <b>Technical Data:</b> | : DC 3V by 2*1.5V(size "AA" ) batteries,<br>Charging: DC 5V by USB from PC. |
|------------------------|-----------------------------------------------------------------------------|

### 4.3 Channel Plan & List

**Band A Channel List (522MHz-554MHz)**

| Group<br>Channel | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1                | 523.025 | 522.725 | 522.800 | 522.925 | 522.650 | 523.550 | 523.750 | 523.850 | 523.950 | 523.000 |
| 2                | 525.475 | 523.450 | 526.000 | 525.375 | 525.100 | 526.650 | 525.500 | 527.625 | 526.100 | 524.050 |
| 3                | 526.875 | 526.475 | 528.400 | 529.375 | 529.100 | 529.250 | 527.375 | 531.175 | 528.500 | 527.825 |
| 4                | 529.475 | 530.925 | 530.150 | 534.225 | 533.950 | 532.200 | 529.500 | 537.200 | 530.250 | 531.375 |
| 5                | 532.425 | 532.350 | 533.200 | 538.875 | 538.600 | 534.100 | 531.375 | 541.600 | 533.300 | 537.400 |
| 6                | 534.325 | 534.825 | 537.200 | 543.425 | 543.950 | 538.750 | 533.375 | 547.675 | 537.300 | 541.800 |
| 7                | 538.975 | 536.300 | 539.950 | 548.175 | 547.900 | 544.100 | 537.375 |         | 540.050 | 547.875 |
| 8                | 544.325 | 540.625 | 544.975 |         |         | 548.050 | 538.625 |         | 545.075 |         |
| 9                | 548.275 | 545.175 | 547.675 |         |         |         | 542.625 |         | 547.775 |         |
| 10               |         | 553.725 | 549.000 |         |         |         | 548.125 |         | 549.100 |         |
| 11               |         |         | 552.400 |         |         |         | 552.000 |         |         |         |

**Band B Channel List (554MHz-586MHz)**

| Group<br>Channel | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9       | 10      |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1                | 559.750 | 558.800 | 558.000 | 558.350 | 559.575 | 558.825 | 560.250 | 554.550 | 561.425 | 557.800 |
| 2                | 560.850 | 560.250 | 559.750 | 561.425 | 561.900 | 561.225 | 562.050 | 558.225 | 563.150 | 562.350 |
| 3                | 562.700 | 565.300 | 560.850 | 564.425 | 563.475 | 565.350 | 564.000 | 560.700 | 566.300 | 564.375 |
| 4                | 564.850 | 570.700 | 562.700 | 567.275 | 565.725 | 567.375 | 567.500 | 568.575 | 569.525 | 566.625 |
| 5                | 567.500 | 572.775 | 564.850 | 569.675 | 569.625 | 572.550 | 569.050 | 570.675 | 571.250 | 570.000 |
| 6                | 569.050 | 574.325 | 573.450 | 573.875 | 574.725 | 575.625 | 577.600 | 573.300 | 574.550 | 572.925 |
| 7                | 571.450 | 576.450 | 578.325 | 576.425 | 576.150 | 578.925 | 580.050 | 575.175 | 576.575 | 575.775 |
| 8                | 581.000 | 584.375 | 584.100 | 583.250 | 581.475 | 583.575 | 585.300 | 579.450 | 579.875 | 578.475 |
| 9                |         |         |         | 584.225 | 585.900 | 585.975 |         | 582.375 | 582.725 | 580.800 |

#### 4.4 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests; the worst data were recorded and reported.

| Test mode    | Low channel | Middle channel | High channel |
|--------------|-------------|----------------|--------------|
| Transmitting | 522.650MHz  | 553.725MHz     | 585.975MHz   |

| Test Item           | Test Mode               |
|---------------------|-------------------------|
| Radiated Emissions  | Charging + Transmitting |
| Conducted Emissions | Charging + Transmitting |

#### 4.5 Test Facility

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

- **IC – Registration No.: 7760A-1**

Waltek Services (Shenzhen) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration 7760A-1, October 15, 2015

- **FCC Test Site– Registration No.: 328995**

Waltek Services(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. Registration 328995, December 3, 2014.

## 5 Equipment Used during Test

### 5.1 Equipments List

| Conducted Emissions                              |                              |                                  |             |                 |                       |                      |
|--------------------------------------------------|------------------------------|----------------------------------|-------------|-----------------|-----------------------|----------------------|
| Item                                             | Equipment                    | Manufacturer                     | Model No.   | Serial No.      | Last Calibration Date | Calibration Due Date |
| 1.                                               | EMI Test Receiver            | R&S                              | ESCI        | 101155          | Sep.15,2016           | Sep.14,2017          |
| 2.                                               | LISN                         | SCHWARZBECK                      | NSLK 8128   | 8128-289        | Sep.15,2016           | Sep.14,2017          |
| 3.                                               | Limiter                      | York                             | MTS-IMP-136 | 261115-001-0024 | Sep.15,2016           | Sep.14,2017          |
| 4.                                               | Cable                        | LARGE                            | RF300       | -               | Sep.15,2016           | Sep.14,2017          |
| 3m Semi-anechoic Chamber for Radiation Emissions |                              |                                  |             |                 |                       |                      |
| Item                                             | Equipment                    | Manufacturer                     | Model No.   | Serial No.      | Last Calibration Date | Calibration Due Date |
| 1                                                | EMC Analyzer                 | Agilent                          | E7405A      | MY45114943      | Sep.15,2016           | Sep.14,2017          |
| 2                                                | Active Loop Antenna          | Beijing Dazhi                    | ZN30900A    | -               | Sep.15,2016           | Sep.14,2017          |
| 3                                                | Trilog Broadband Antenna     | SCHWARZBECK                      | VULB9163    | 336             | Apr.19,2017           | Apr.18,2018          |
| 4                                                | Coaxial Cable (below 1GHz)   | Top                              | TYPE16(13M) | -               | Sep.15,2016           | Sep.14,2017          |
| 5                                                | Broad-band Horn Antenna      | SCHWARZBECK                      | BBHA 9120 D | 667             | Apr.19,2017           | Apr.18,2018          |
| 6                                                | Broad-band Horn Antenna      | SCHWARZBECK                      | BBHA 9170   | 335             | Apr.19,2017           | Apr.18,2018          |
| 7                                                | Broadband Preamplifier       | COMPLIANCE DIRECTION             | PAP-1G18    | 2004            | Mar.17,2017           | Mar.16,2018          |
| 8                                                | Coaxial Cable (above 1GHz)   | Top                              | 1GHz-25GHz  | EW02014-7       | Apr.10,2017           | Apr.09,2018          |
| 9                                                | Test Receiver                | R&S                              | ESCI        | 101296          | Sep.15,2016           | Sep.14,2017          |
| 10                                               | Trilog Broadband Antenna     | SCHWARZBECK                      | VULB9160    | 9160-3325       | Sep.15,2016           | Sep.14,2017          |
| 11                                               | Amplifier                    | Compliance pirection systems inc | PAP-0203    | 22024           | Sep.15,2016           | Sep.14,2017          |
| 12                                               | Cable                        | HUBER+SUHNER                     | CBL2        | 525178          | Sep.15,2016           | Sep.14,2017          |
| RF Conducted Testing                             |                              |                                  |             |                 |                       |                      |
| Item                                             | Equipment                    | Manufacturer                     | Model No.   | Serial No.      | Last Calibration Date | Calibration Due Date |
| 1.                                               | EMC Analyzer (9k~26.5GHz)    | Agilent                          | E7405A      | MY45114943      | Sep.15,2016           | Sep.14,2017          |
| 2.                                               | Spectrum Analyzer (9k-6GHz)  | R&S                              | FSL6        | 100959          | Sep.15,2016           | Sep.14,2017          |
| 3.                                               | Signal Analyzer (9k~26.5GHz) | Agilent                          | N9010A      | MY50520207      | Sep.15,2016           | Sep.14,2017          |

## 5.2 Measurement Uncertainty

| Parameter                        | Uncertainty                                 |
|----------------------------------|---------------------------------------------|
| Radio Frequency                  | $\pm 1 \times 10^{-6}$                      |
| RF Power                         | $\pm 1.0$ dB                                |
| RF Power Density                 | $\pm 2.2$ dB                                |
| Radiated Spurious Emissions test | $\pm 5.03$ dB (Bilog antenna 30M~1000MHz)   |
|                                  | $\pm 4.74$ dB (Horn antenna 1000M~25000MHz) |

## 5.3 Test Equipment Calibration

All the test equipments used are valid and calibrated by GUANG ZHOU GRG METROLOGY & TEST CO., LTD. address is No.163, Pingyun Rd. West of Huangpu Ave, Tianhe District, Guangzhou, Guangdong, China.

## 6 Test Summary

| Test Items                                                                | Test Requirement      | Test Method         | Result |
|---------------------------------------------------------------------------|-----------------------|---------------------|--------|
| RF Output Power                                                           | 74.861(e)(1)(ii)      | ANSI/TIA-603-D:2010 | C      |
| Modulation Characteristics                                                | 74.861 (e) (3)        | ANSI/TIA-603-D:2010 | C      |
| Occupied Bandwidth                                                        | 2.1049(c)(1)          | ANSI/TIA-603-D:2010 | C      |
| Conducted Emissions                                                       | 15.207(a)             | ANSI C63.10:2013    | C      |
| Radiated Emissions                                                        | 2.1053 & 74.861(e)(6) | ANSI/TIA-603-D:2010 | C      |
| Spurious emissions at antenna terminals                                   | 2.1051                | ANSI/TIA-603-D:2010 | C      |
| Frequencies Stability                                                     | 2.1055(a)(1)          | ANSI/TIA-603-D:2010 | C      |
| SAR Evaluation                                                            | 1.1307(b)(1)          | KDB 447498 D01      | C      |
| Note: C=Compliance; NC=Not Compliance; NT=Not Tested; N/A=Not Applicable. |                       |                     |        |

7 RF Output Power

Test requirement: FCC CFR47 Part 74 Section 74.861(e)(1)(ii)

Test method: Based on ANSI/TIA-603-D: 2010

Limit: According to Part 74.861(e)(1)(ii), the output power shall not exceed 250mW (23.98 dBm).

7.1 Test Procedure

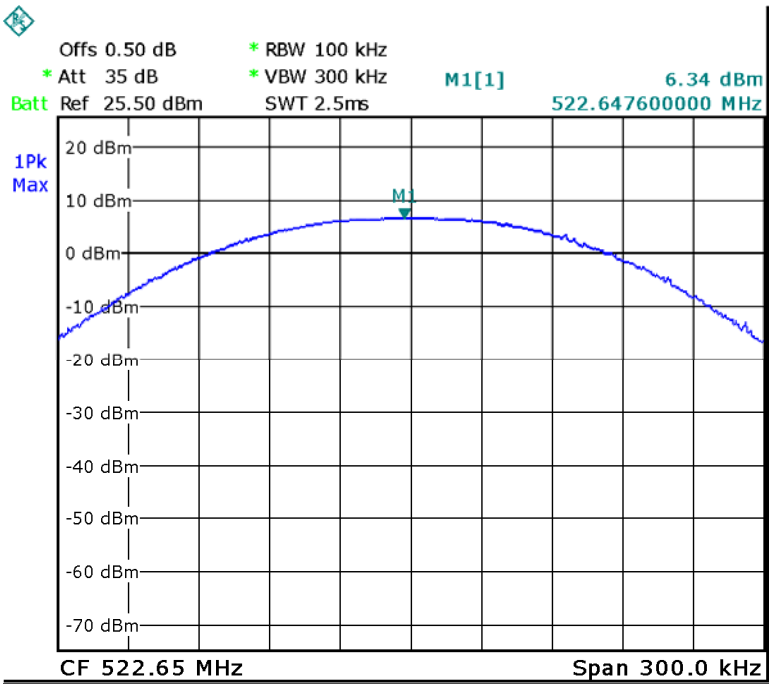
The maximum peak output power was measured with a spectrum analyzer connected to the antenna terminal (conducted measurement) while EUT was operating in normal situation.

7.2 Test result

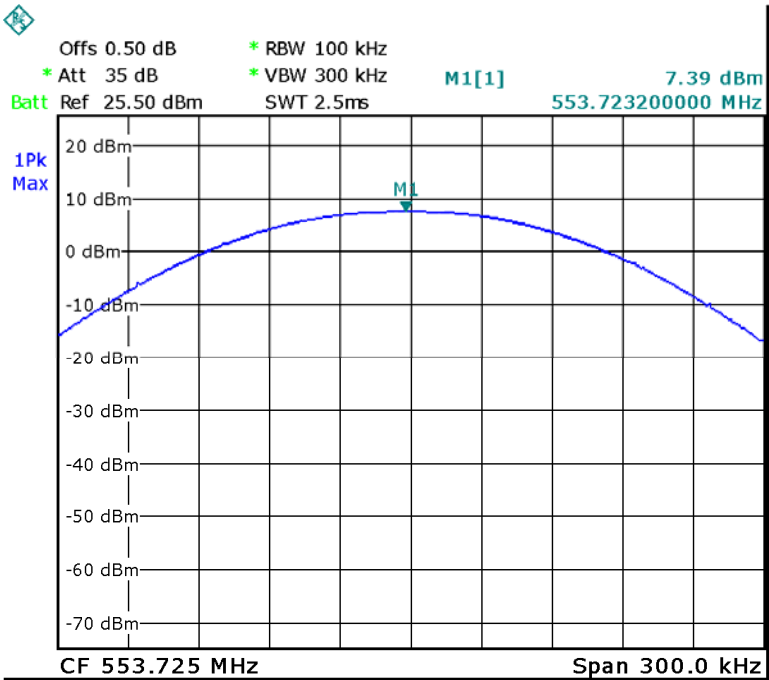
| Power | Test Channel   | RF Output Power (dBm) | Limit (dBm) | Result |
|-------|----------------|-----------------------|-------------|--------|
| Low   | Low Channel    | 6.34                  | 23.98       | PASS   |
|       | Middle Channel | 7.39                  | 23.98       | PASS   |
|       | High Channel   | 7.66                  | 23.98       | PASS   |
| High  | Low Channel    | 14.76                 | 23.98       | PASS   |
|       | Middle Channel | 15.11                 | 23.98       | PASS   |
|       | High Channel   | 15.61                 | 23.98       | PASS   |

Please refer to following plot:

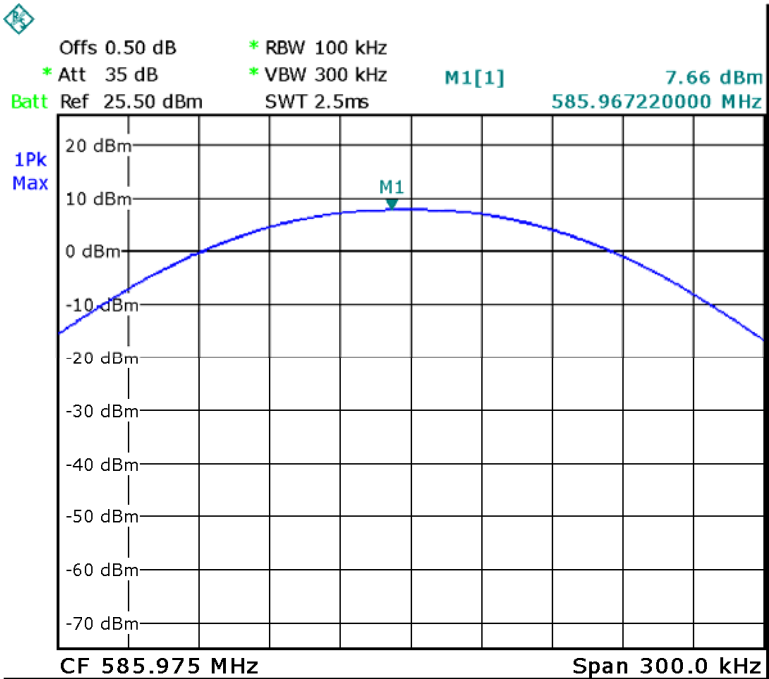
Low Power  
Low Channel



Middle Channel

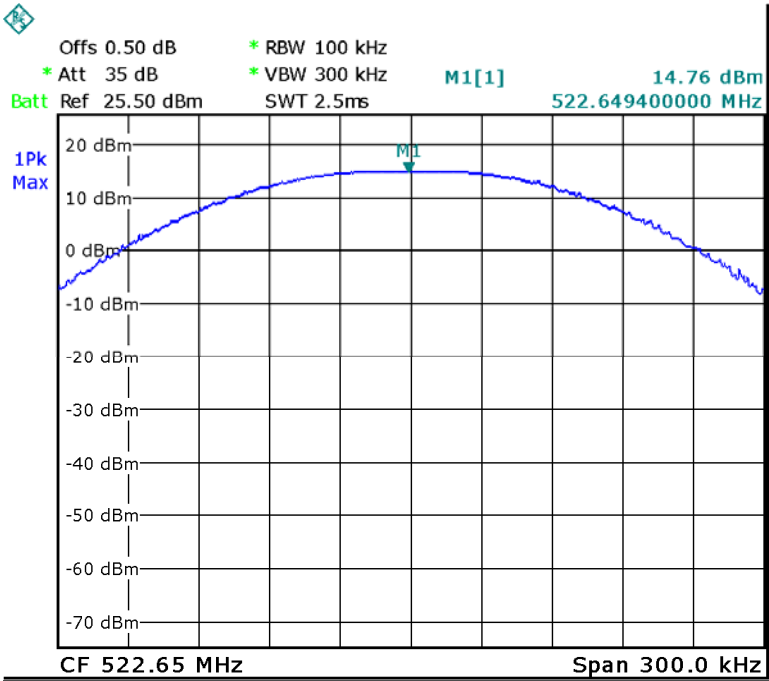


High Channel

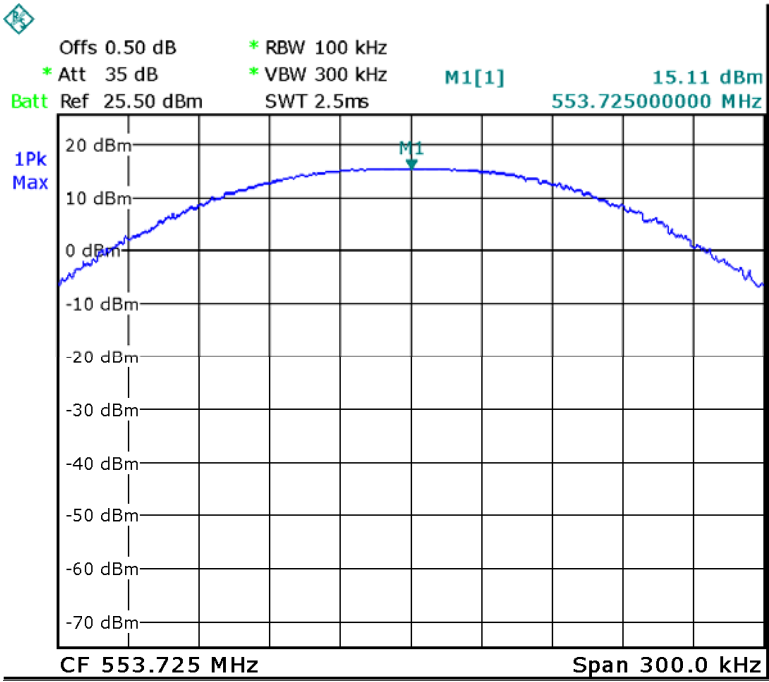


Please refer to following plot:

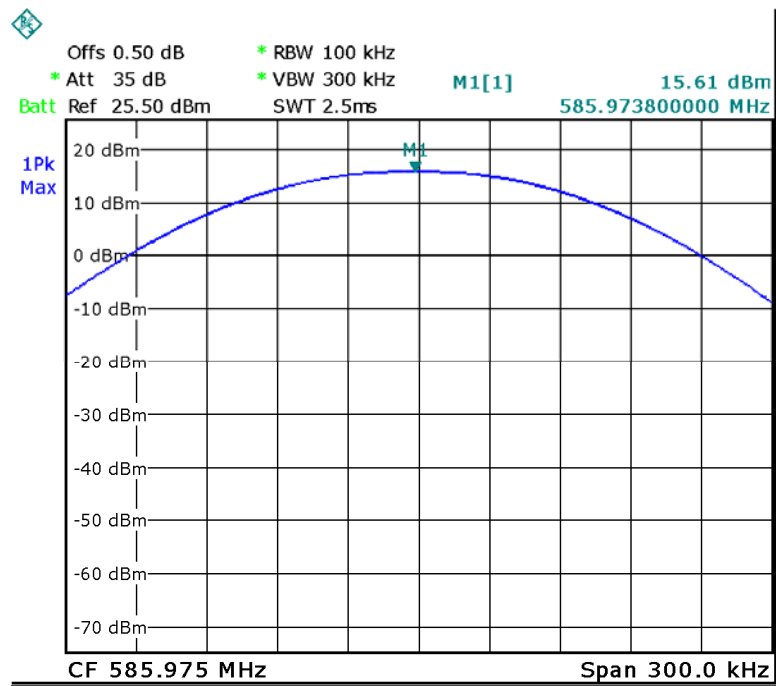
High Power  
Low Channel



Middle Channel



High Channel



## 8 Modulation Characteristics

Test requirement: FCC CFR47 § 74.861 (e) (3)

Test method: Based on ANSI/TIA-603-D: 2010

Requirement: Any form of modulation may be used.

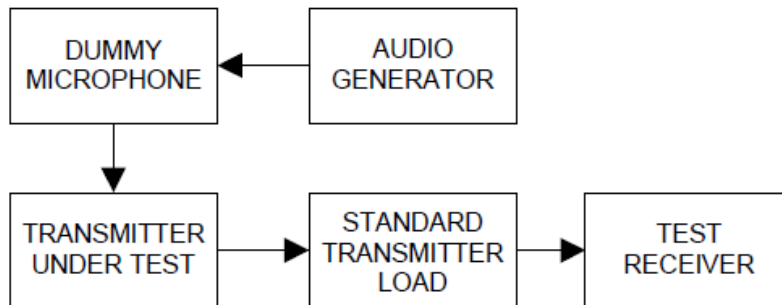
A maximum deviation of  $\pm 75\text{kHz}$  is permitted when frequency modulation is employed.

### 8.1 Test Procedure

#### Modulation Limiting (TIA-603D:2010 Section 2.2.3)

Modulation limiting is the transmitter circuit's ability to limit the transmitter from producing deviations in excess of a rated system deviation.

#### Method of Measurement

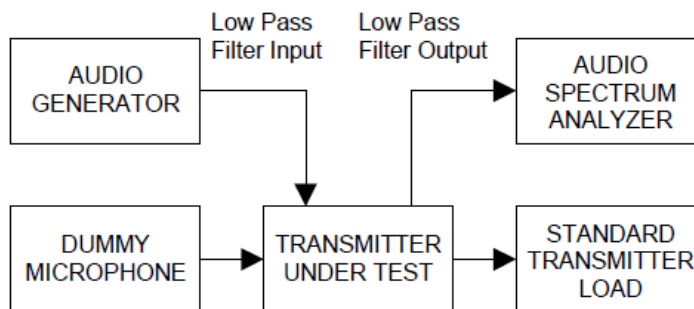


- Connect the equipment as illustrated.
- Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- Set the test receiver to measure peak positive deviation. Set the audio bandwidth for  $\leq 0.25\text{ Hz}$  to  $\geq 15,000\text{ Hz}$ . Turn the de-emphasis function off.
- Apply a 1000 Hz modulating signal to the transmitter from the audio frequency generator, and adjust the level to obtain 60% of full rated system deviation.
- Increase the level from the audio frequency generator by 20 dB in one step (rise time between the 10% and 90% points shall be 0.1 second maximum).
- Measure both the instantaneous and steady-state deviation at and after the time of increasing the audio input level.
- With the level from the audio frequency generator held constant at the level obtained in step e), slowly vary the audio frequency from 300 Hz to 3000 Hz and observe the steady-state deviation. Record the maximum deviation.
- Set the test receiver to measure peak negative deviation and repeat steps d) through g).
- The values recorded in steps g) and h) are the modulation limiting.

### Audio Low Pass Filter Response (TIA-603D:2010 Section 2.2.15)

The audio low pass filter response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

#### Method of Measurement



- Connect the equipment as illustrated.
- Connect the audio frequency generator as close as possible the input of the post limiter low pass filter within the transmitter under test.
- Connect the audio spectrum analyzer to the output of the post limiter low pass filter within the transmitter under test.
- Apply a 1000 Hz tone from the audio frequency generator and adjust the level per manufacturer's specifications.
- Record the dB level of the 1000 Hz spectral line on the audio spectrum analyzer as  $LEV_{REF}$ .
- Set the audio frequency generator to the desired test frequency between 3000 Hz and the upper low pass filter limit.
- Record audio spectrum analyzer levels, at the test frequency in step f).
- Record the dB level on the audio spectrum analyzer as  $LEV_{FREQ}$ .
- Calculate the audio frequency response at the test frequency as:  

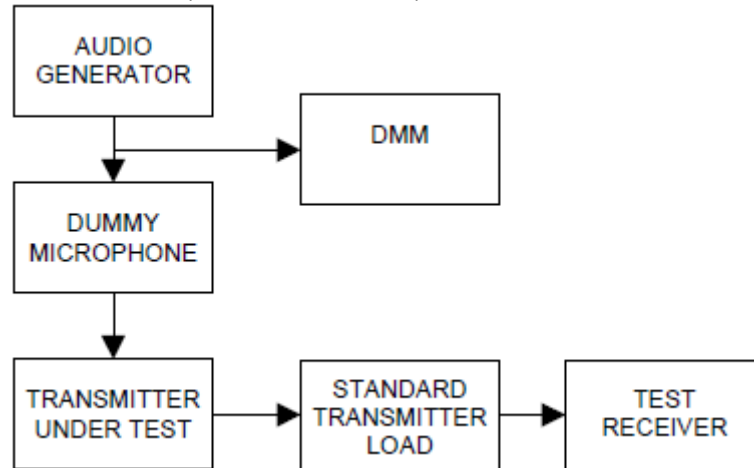
$$low\ pass\ frequency\ response = LEV_{FREQ} - LEV_{REF}$$
- Repeat steps f) through i) for all the desired test frequencies.

**Audio Frequency Response (TIA-603D:2010 Section 2.2.6)**

The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

**Method of Measurement**

Constant deviation test method (300 Hz to 3000 Hz)

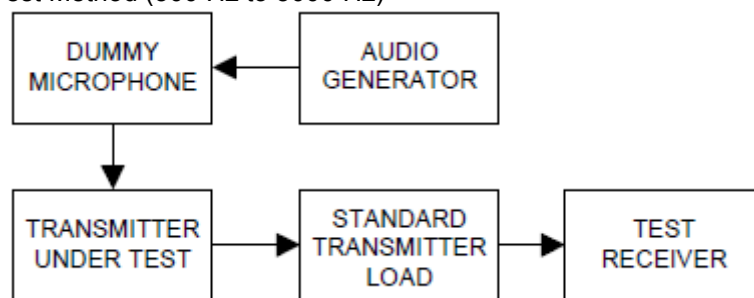


- a) Connect the equipment as illustrated.
- b) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for  $\leq 50$  Hz to  $\geq 15,000$  Hz. Turn the de-emphasis function off.
- c) Set the DMM to measure rms voltage.
- d) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- e) Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
- f) Set the test receiver to measure rms deviation and record the deviation reading.
- g) Record the DMM reading as  $V_{REF}$ .
- h) Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.
- i) Vary the audio frequency generator output level until the deviation reading that was recorded in step f) is obtained.
- j) Record the DMM reading as  $V_{FREQ}$ .
- k) Calculate the audio frequency response at the present frequency as:

$$audio\ frequency\ response = 20 \log_{10} \left( \frac{V_{FREQ}}{V_{REF}} \right)$$

- l) Repeat steps h) through k) for all the desired test frequencies.

## Constant Input Test Method (300 Hz to 3000 Hz)



- a) Connect the equipment as illustrated.
- b) Set the test receiver to measure peak positive deviation. Set the audio bandwidth for  $\leq 50$  Hz to  $\geq 15,000$  Hz. Turn the de-emphasis function off.
- c) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- d) Apply a 1000 Hz tone and adjust the audio frequency generator to produce 20% of the rated system deviation.
- e) Set the test receiver to measure rms deviation and record the deviation reading as DEVREF .
- f) Set the audio frequency generator to the desired test frequency between 300 Hz and 3000 Hz.
- g) Record the test receiver deviation reading as DEVFREQ .
- h) Calculate the audio frequency response at the present frequency as:

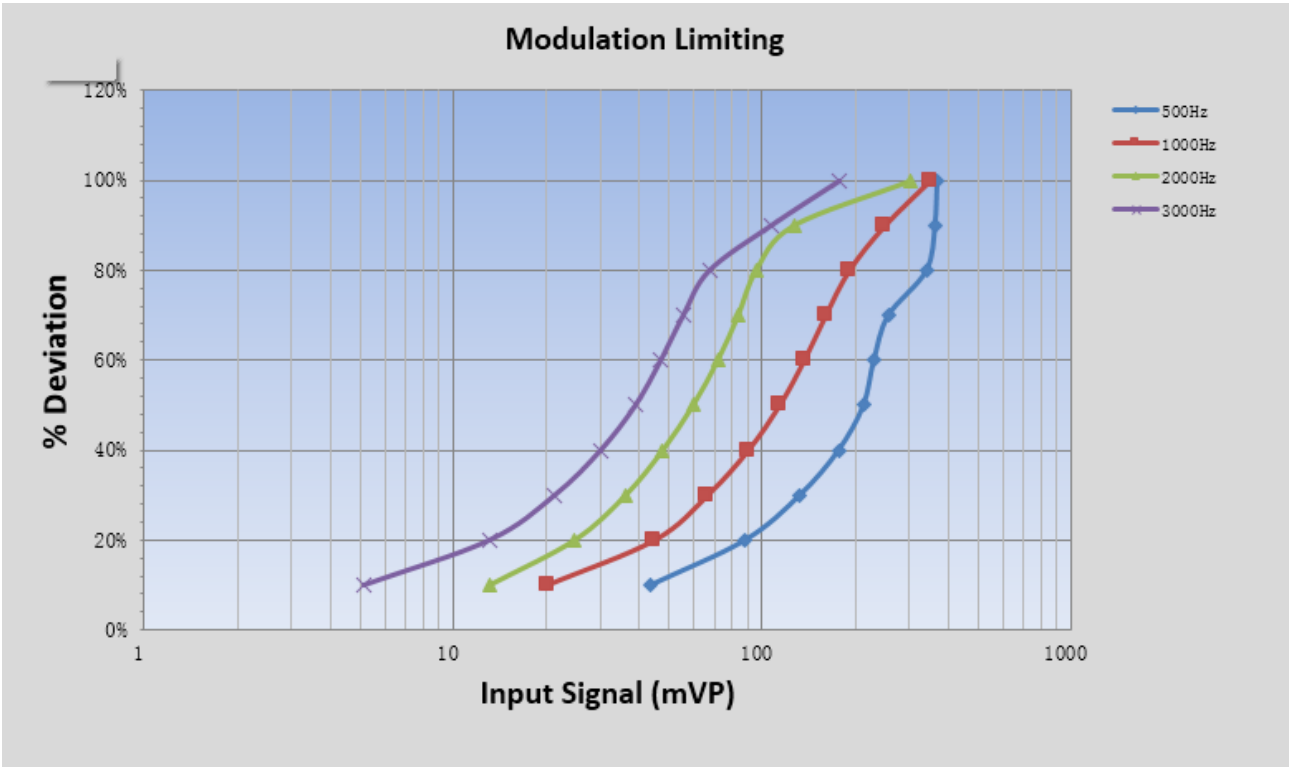
$$\text{audio frequency response} = 20 \log_{10} \left( \frac{DEV_{FREQ}}{DEV_{REF}} \right)$$

- i) Repeat steps f) through h) for all the desired test frequencies.

8.2 Test Result

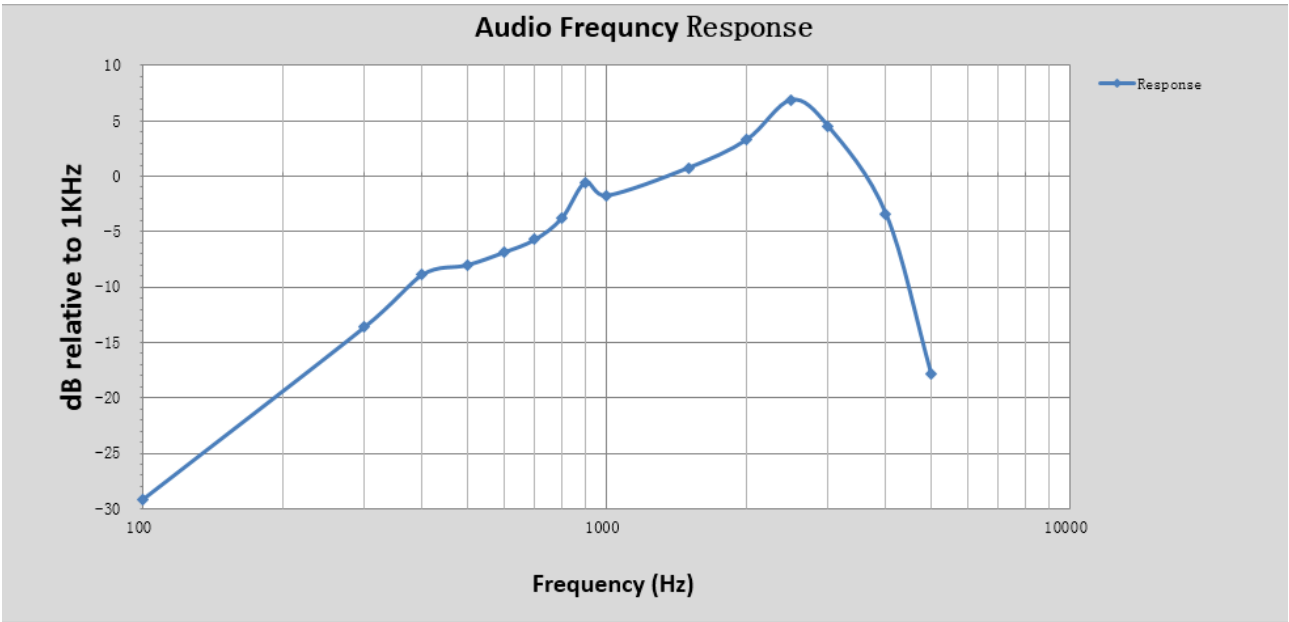
Modulation Limiting Test Result  
Middle Channel

| % Deviation | Input Signal (mVP) |         |         |         |
|-------------|--------------------|---------|---------|---------|
|             | 500 Hz             | 1000 Hz | 2000 Hz | 3000 Hz |
| 10%         | 44                 | 20      | 13      | 5       |
| 20%         | 88                 | 45      | 25      | 13      |
| 30%         | 133                | 66      | 36      | 21      |
| 40%         | 177                | 90      | 48      | 30      |
| 50%         | 213                | 113     | 60      | 39      |
| 60%         | 231                | 136     | 72      | 47      |
| 70%         | 257                | 160     | 84      | 56      |
| 80%         | 341                | 191     | 96      | 67      |
| 90%         | 364                | 249     | 127     | 107     |
| 100%        | 370                | 349     | 303     | 178     |



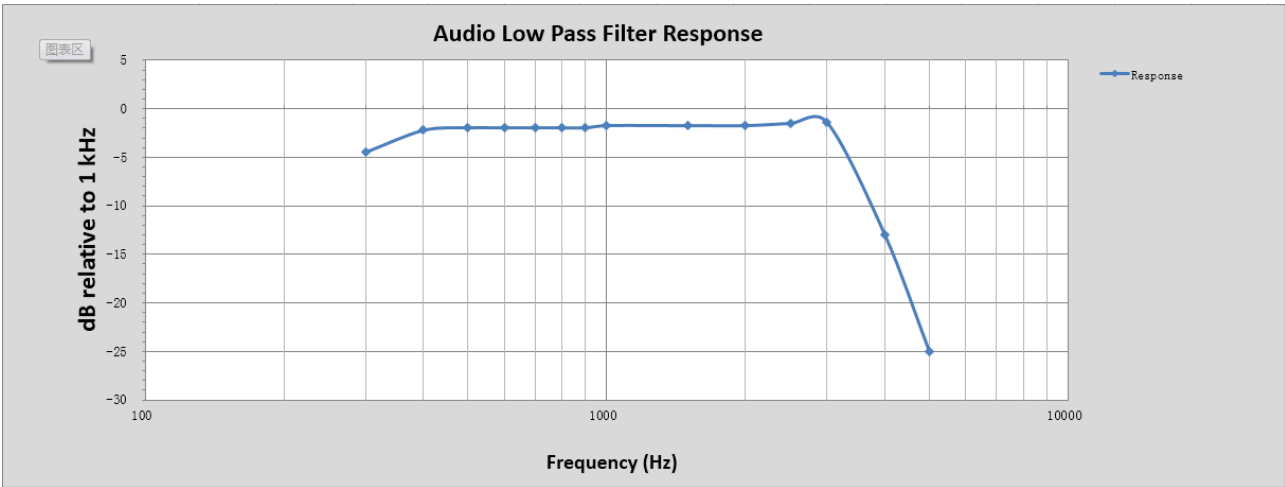
Audio Frequency Response Test Result  
Middle channel

| Frequency(Hz) | Audio Frequency Response(Hz) | Audio Frequency Response(dB) |
|---------------|------------------------------|------------------------------|
| 100           | 29                           | -29.2                        |
| 300           | 188                          | -13.6                        |
| 400           | 319                          | -8.9                         |
| 500           | 389                          | -8.0                         |
| 600           | 459                          | -6.9                         |
| 700           | 529                          | -5.7                         |
| 800           | 598                          | -3.8                         |
| 900           | 659                          | -0.5                         |
| 1000          | 739                          | -1.8                         |
| 1500          | 1118                         | 0.7                          |
| 2000          | 1479                         | 3.3                          |
| 2500          | 1838                         | 6.9                          |
| 3000          | 1978                         | 4.5                          |
| 4000          | 638                          | -3.4                         |
| 5000          | 109                          | -17.8                        |



Audio Low Pass Filter Response Test Result  
Middle channel

| Frequency(Hz) | Audio Frequency Response(Hz) | Audio Frequency Response(dB) |
|---------------|------------------------------|------------------------------|
| 300           | 1045                         | -4.5                         |
| 400           | 1410                         | -2.2                         |
| 500           | 1472                         | -2.0                         |
| 600           | 1472                         | -2.0                         |
| 700           | 1472                         | -2.0                         |
| 800           | 1472                         | -2.0                         |
| 900           | 1472                         | -2.0                         |
| 1000          | 1483                         | -1.7                         |
| 1500          | 1483                         | -1.7                         |
| 2000          | 1483                         | -1.7                         |
| 2500          | 1535                         | -1.5                         |
| 3000          | 1422                         | -1.4                         |
| 4000          | 372                          | -13.0                        |
| 5000          | 51                           | -25.0                        |



## 9 Occupied Bandwidth of Emission

|                   |                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------|
| Test requirement: | FCC CFR47 Part 2 Section 2.1049©(1)                                                        |
| Test method:      | Based on ANSI/TIA-603-D: 2010                                                              |
| Limit:            | According to FCC 74.861 (e)(5), the frequency emission bandwidth shall not exceed 200 kHz. |

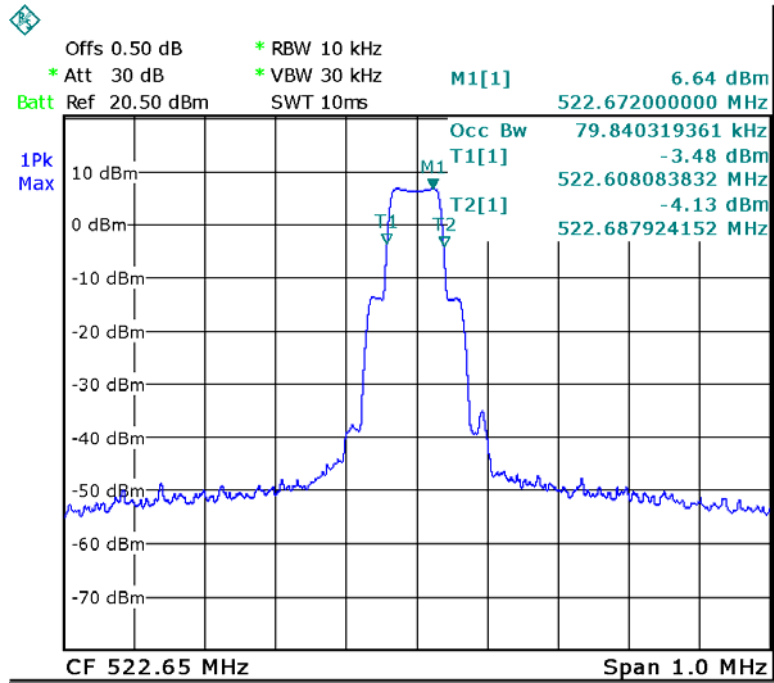
### 9.1 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Turn on the EUT and set it to any one convenient frequency within its operating range.

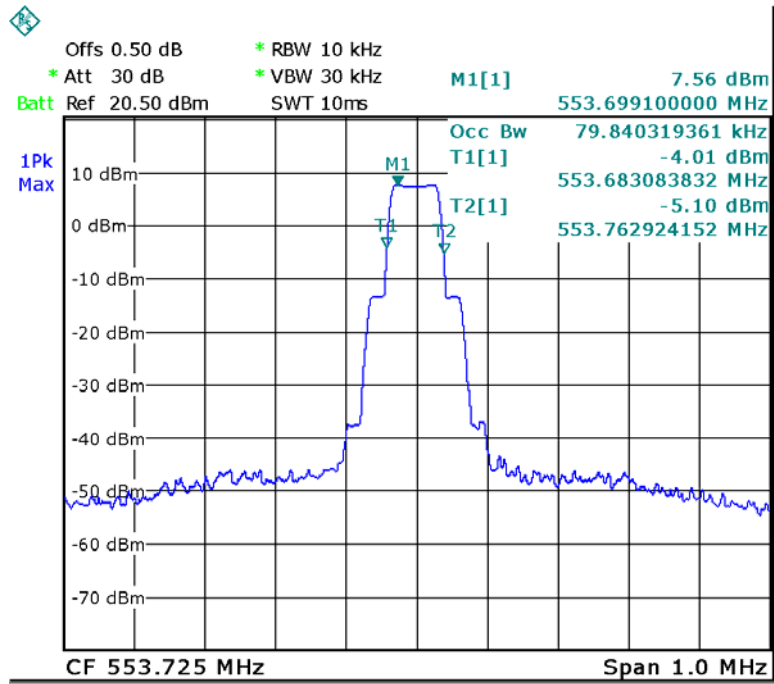
### 9.2 Test Result

| power | Test Channel   | 99% Bandwidth<br>(kHz) | Limit<br>(kHz) | Result |
|-------|----------------|------------------------|----------------|--------|
| Low   | Low Channel    | 79.840                 | 200            | PASS   |
|       | Middle Channel | 79.840                 | 200            | PASS   |
|       | High Channel   | 83.832                 | 200            | PASS   |
| High  | Low Channel    | 77.844                 | 200            | PASS   |
|       | Middle Channel | 75.848                 | 200            | PASS   |
|       | High Channel   | 81.836                 | 200            | PASS   |

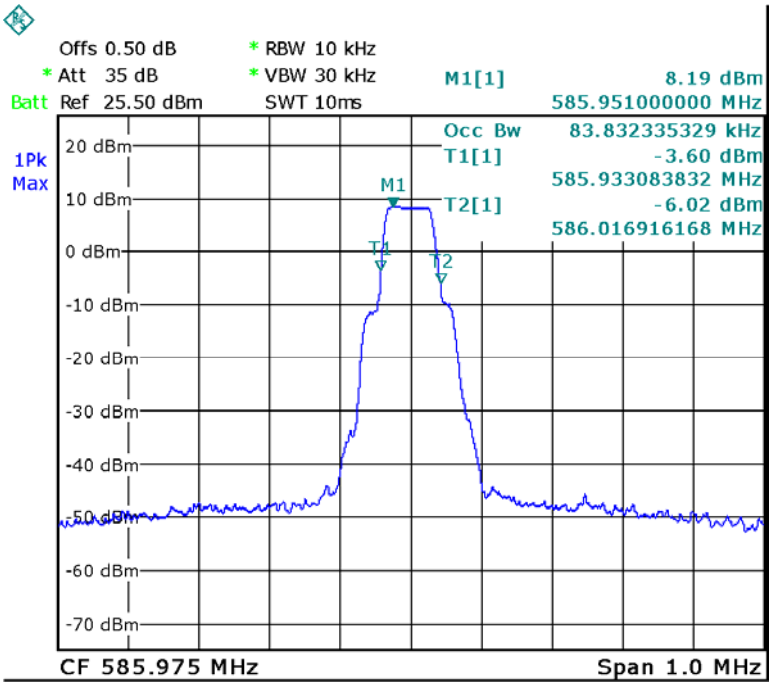
Test Plot:  
Low power  
Low Channel



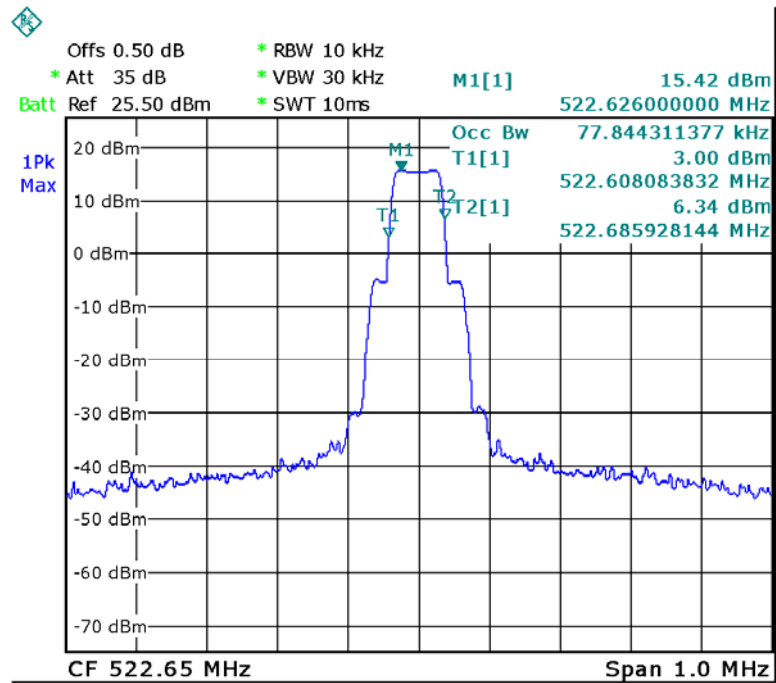
Middle Channel



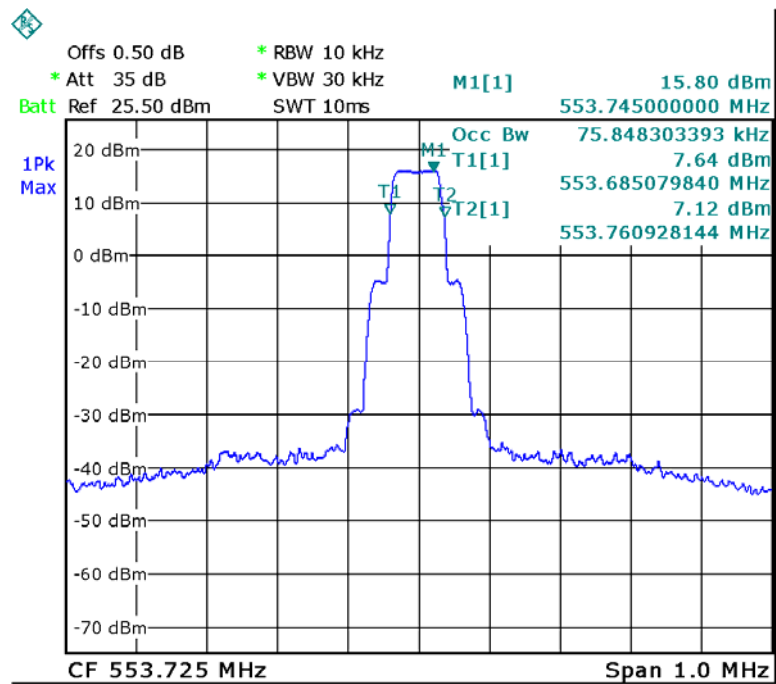
High Channel



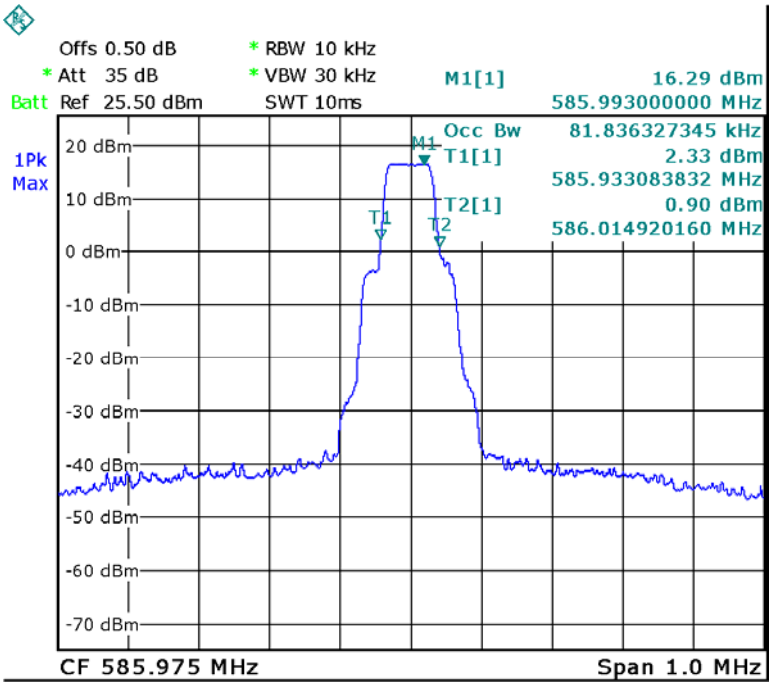
Test Plot:  
High power  
Low Channel



Middle Channel



High Channel



## 10 Spurious Emissions at Antenna Terminals

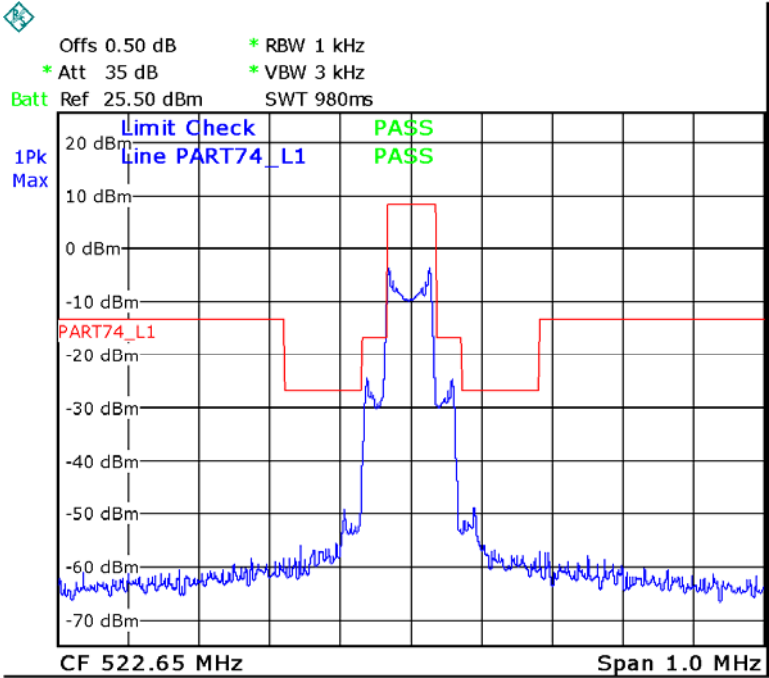
|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test requirement: | FCC CFR47 Part 2 Section 2.1053                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Test method:      | Based on ANSI/TIA-603-D:2010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Limit:            | <p>According to Part 74.861 (e)(6), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:</p> <p>(i) on any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.</p> <p>(ii) on any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.</p> <p>(iii) on any frequency removed from the operating frequency by more than 250 percent up to and the authorized bandwidth shall be attenuated below the un-modulated carrier by at least <math>43 + 10 \log</math> (output power in watts)dB.</p> |

### 10.1 Test Procedure

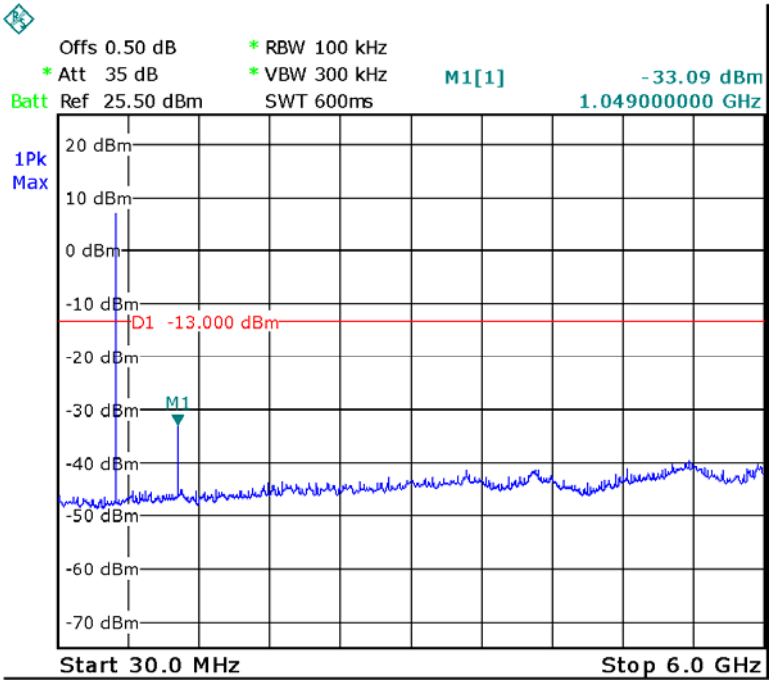
1. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
2. Set the SA on Max-Hold Mode, and then keep the EUT in transmitting mode. Record all the signals from each channel until each one has been recorded.
3. Set the SA on View mode and then plot the result on SA screen.
4. Repeat above procedures until all frequencies measured were complete.

10.2 Test Data

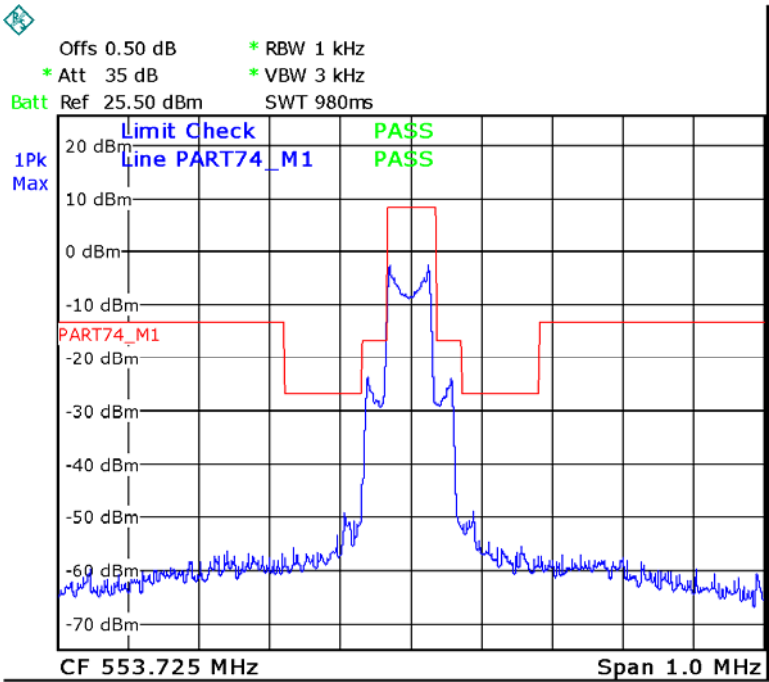
Low Power Emission Mask  
Low Channel



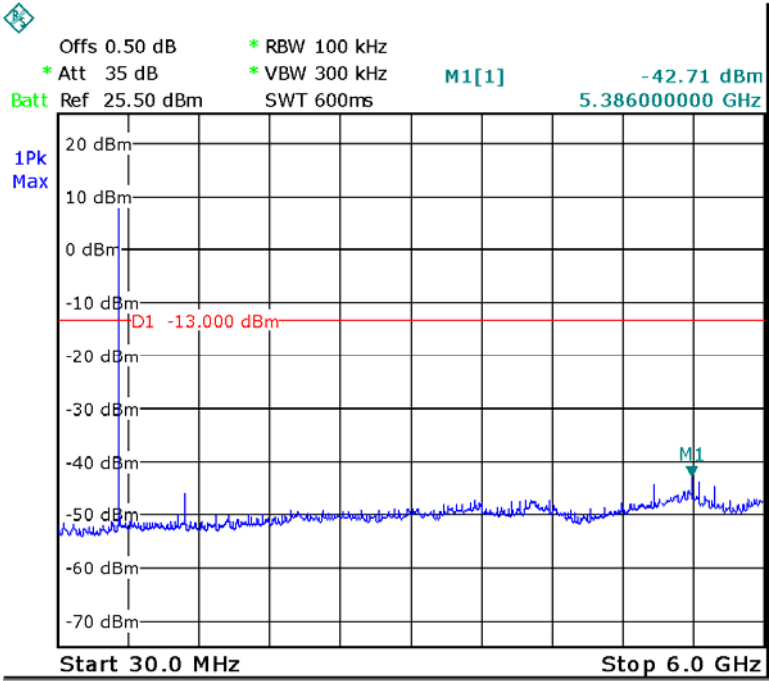
30MHz-6GHz



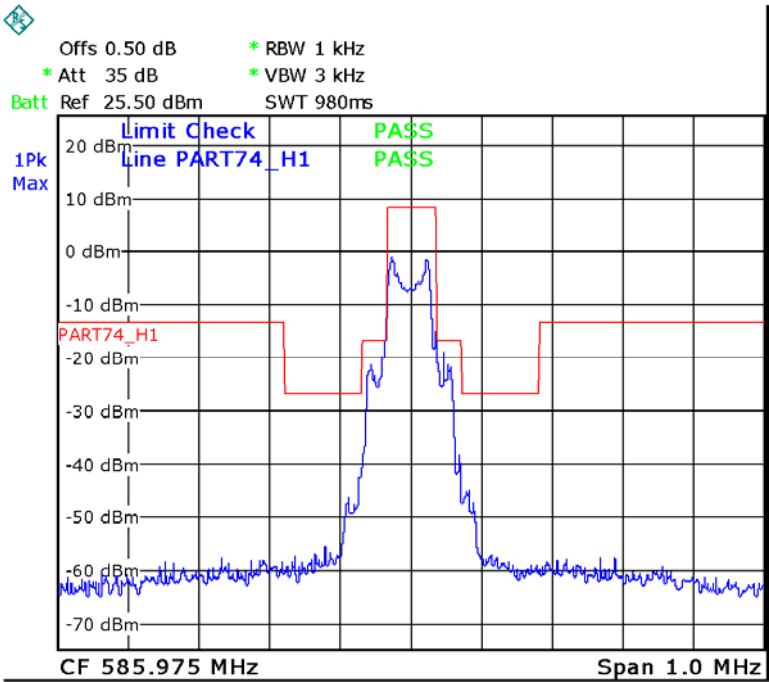
Low Power Emission Mask  
Middle Channel



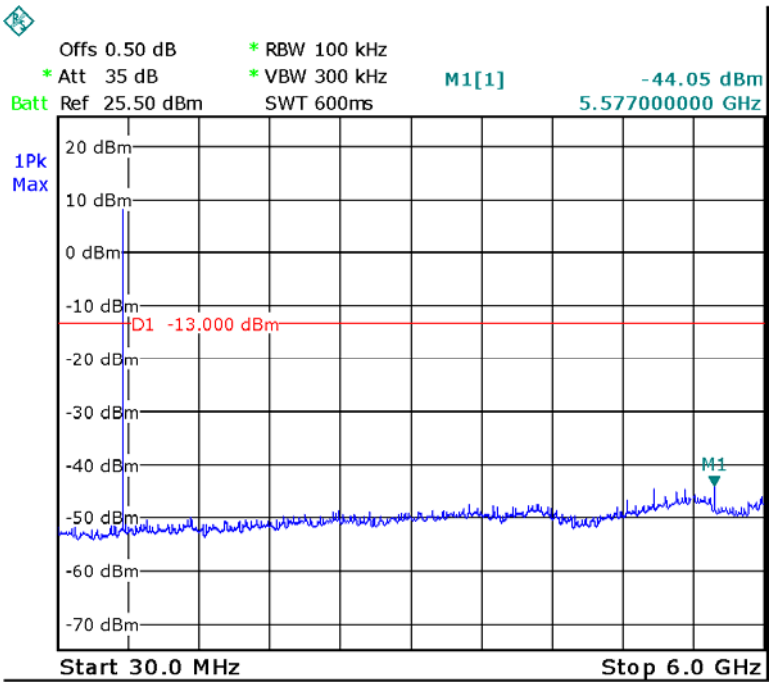
30MHz-6GHz



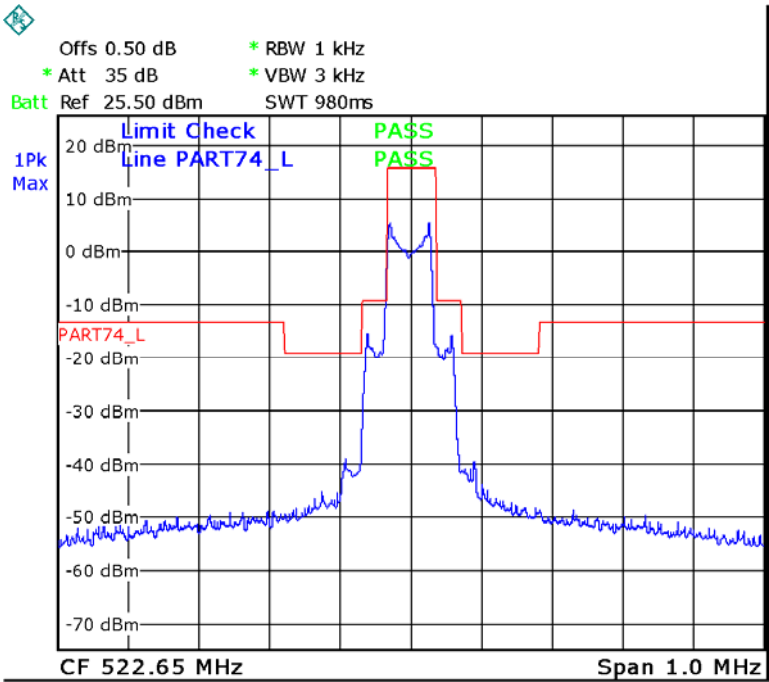
Low Power Emission Mask  
High Channel



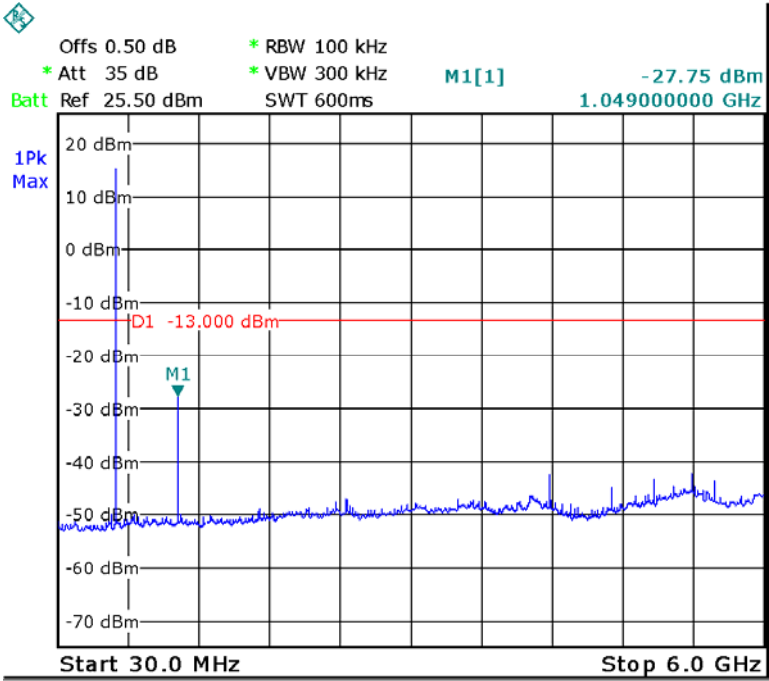
30MHz-6GHz



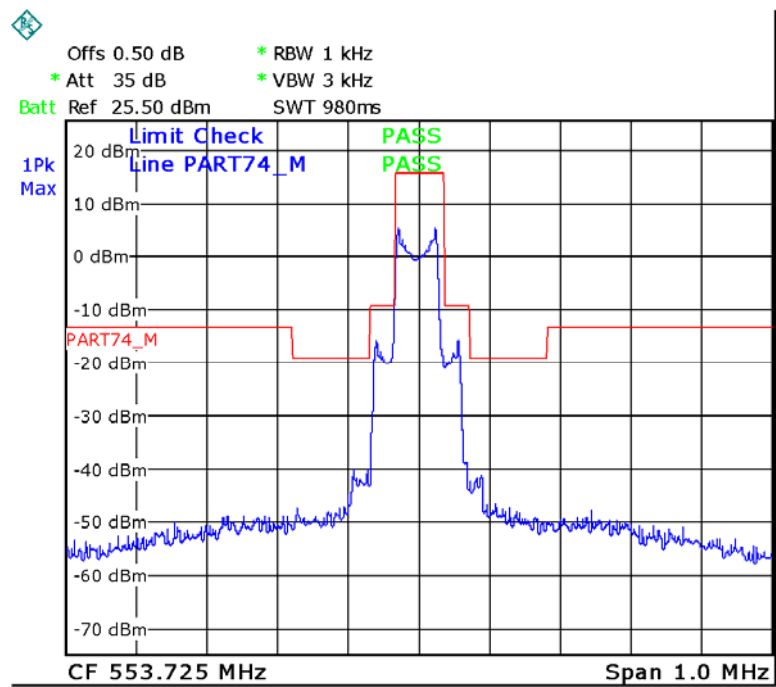
High Power Emission Mask  
Low Channel



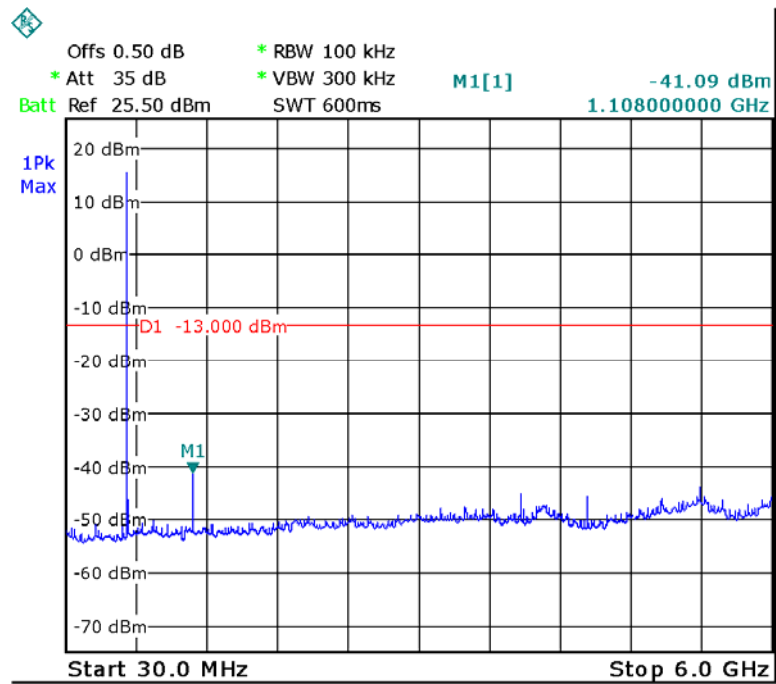
30MHz-6GHz



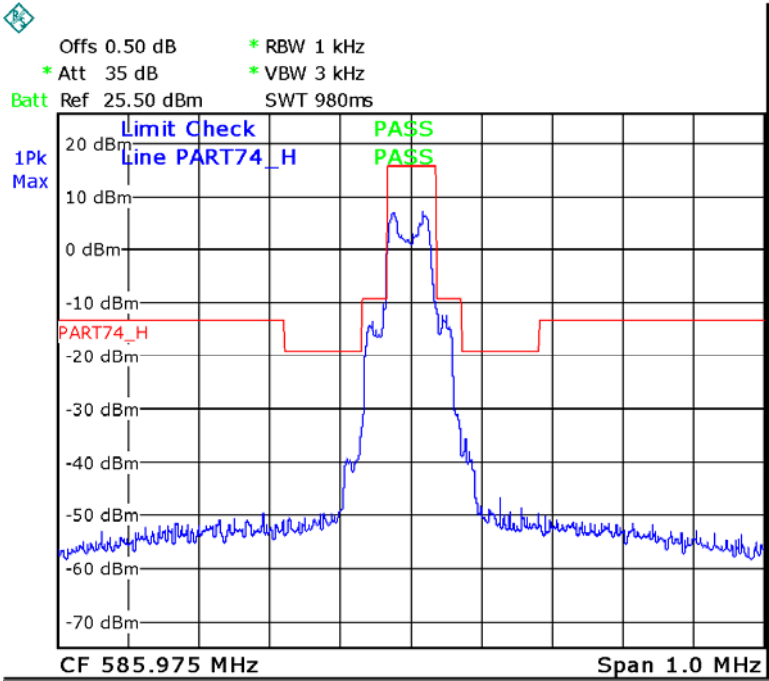
High Power Emission Mask  
Middle Channel



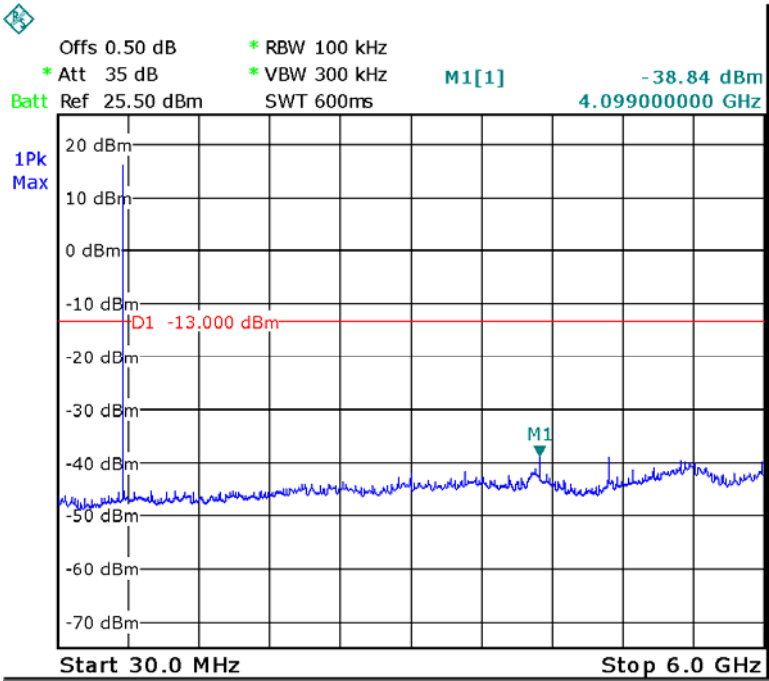
30MHz-6GHz



High Power Emission Mask  
High Channel



30MHz-1GHz



## 11 Conducted Emissions

|                   |                                   |
|-------------------|-----------------------------------|
| Test Requirement: | FCC CFR 47 Part 15 Section 15.207 |
| Test Method:      | ANSI C63.10:2013,ANSI C63.4:2014  |
| Test Result:      | PASS                              |
| Frequency Range:  | 150kHz to 30MHz                   |
| Class/Severity:   | Class B                           |
| Limit:            |                                   |

| Frequency (MHz) | Conducted Limit (dBμV) |           |
|-----------------|------------------------|-----------|
|                 | Qsi-peak               | Average   |
| 0.15 to 0.5     | 66 to 56*              | 56 to 46* |
| 0.5 to 5.0      | 56                     | 46        |
| 5.0 to 30       | 60                     | 50        |

\*Decreases with the logarithm of the frequency.

### 11.1 E.U.T. Operation

Operating Environment :

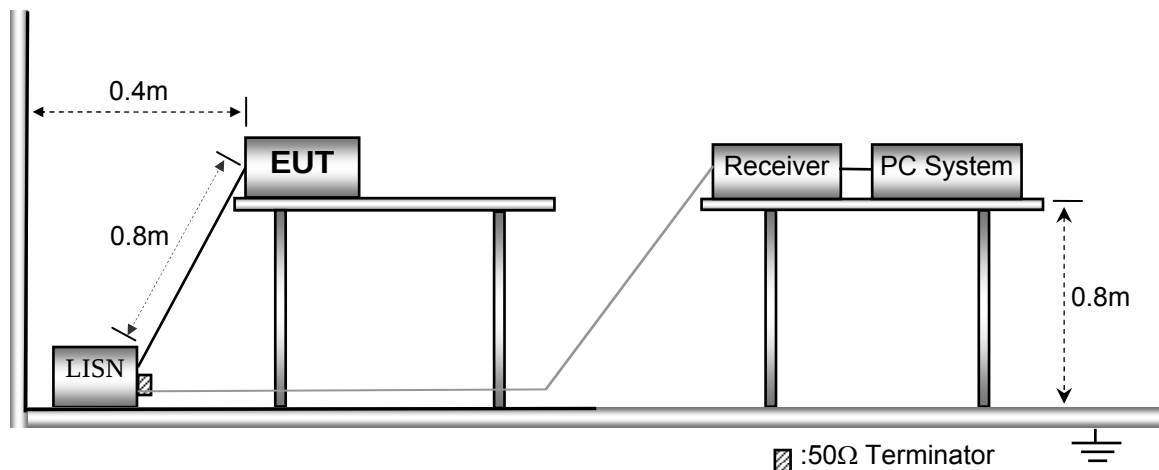
|                       |          |
|-----------------------|----------|
| Temperature:          | 25.5 °C  |
| Humidity:             | 51 % RH  |
| Atmospheric Pressure: | 101.2kPa |

EUT Operation :

Refer to section 4.4

### 11.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10:2013.

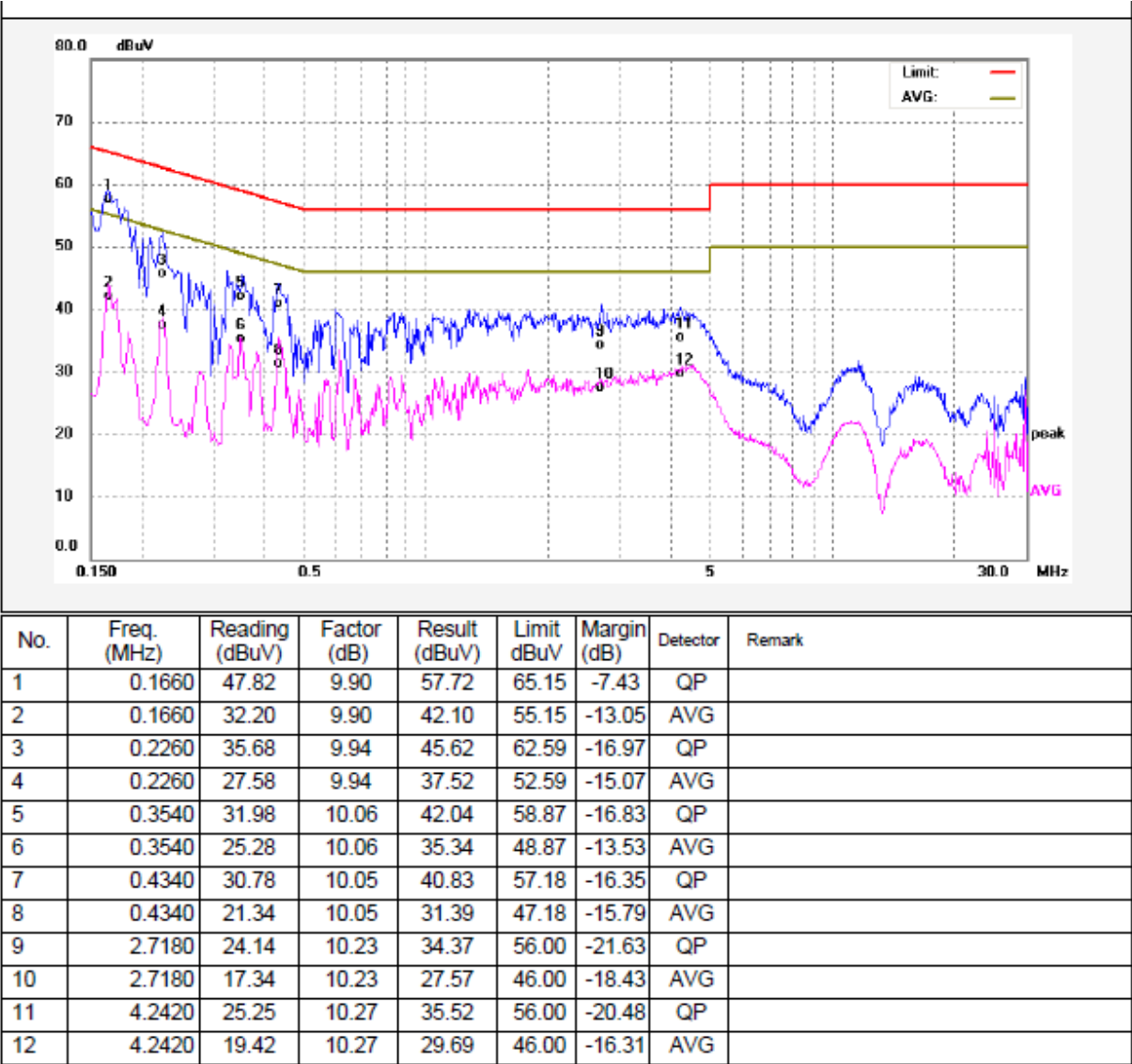


### 11.3 Measurement Description

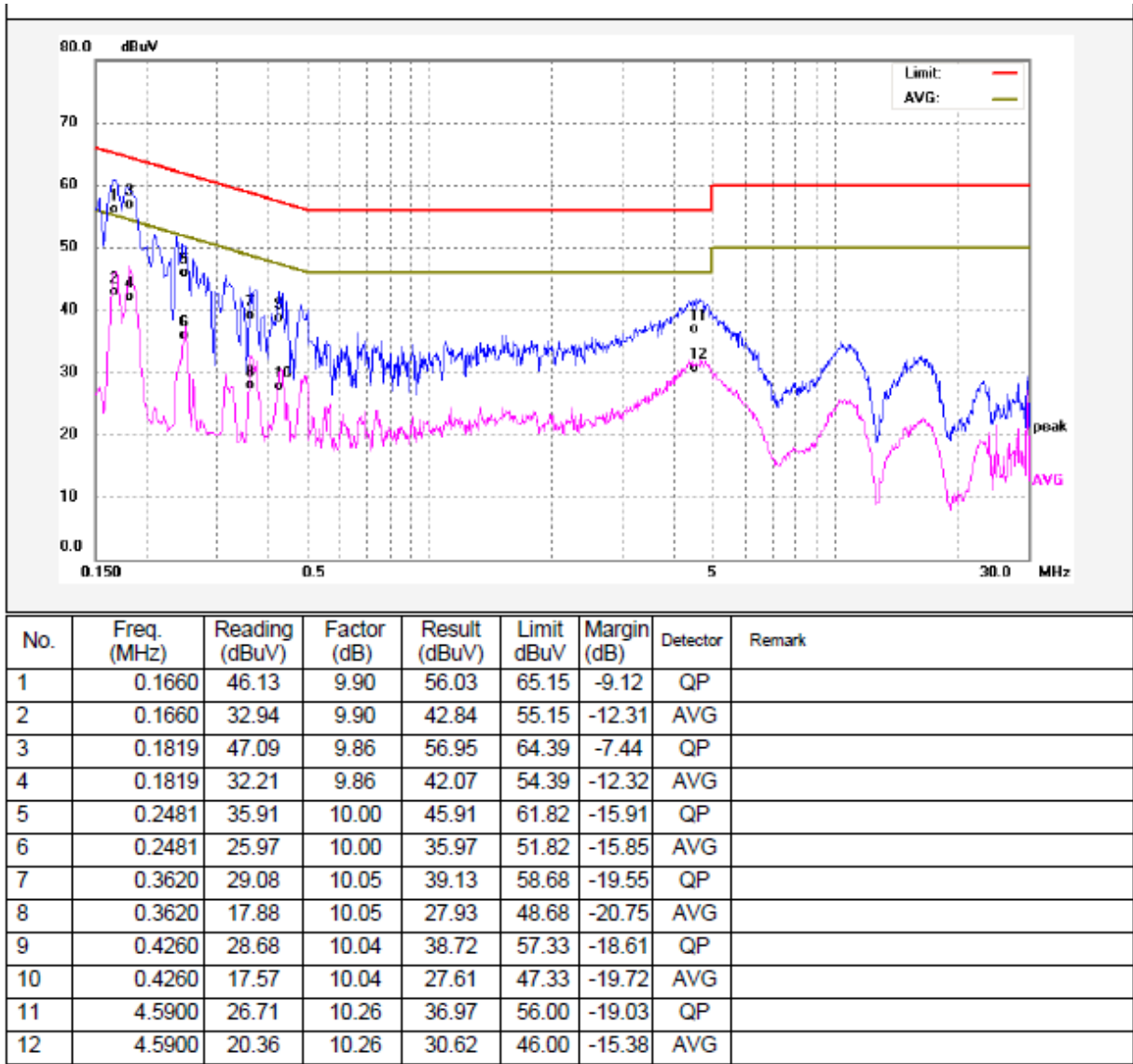
The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

11.4 Conducted Emission Test Result

Live line:



Neutral line:



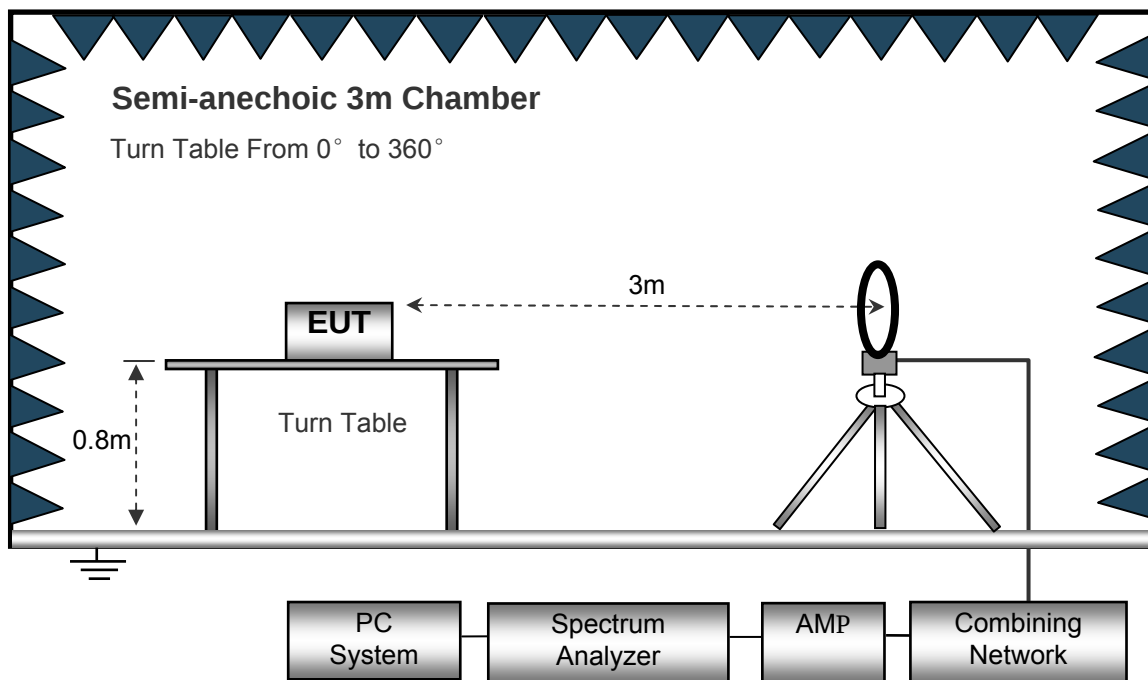
## 12 Radiated Emission Test

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test requirement: | FCC CFR47 Part 2 Section 2.1053                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Test method:      | Based on ANSI/TIA-603-D:2010                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Limit:            | <p>According to Part 74.861 (e)(6), the mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:</p> <p>(i) on any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB.</p> <p>(ii) on any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB.</p> <p>(iii) on any frequency removed from the operating frequency by more than 250 percent up to and the authorized bandwidth shall be attenuated below the un-modulated carrier by at least <math>43 + 10 \log</math> (output power in watts)dB.</p> |

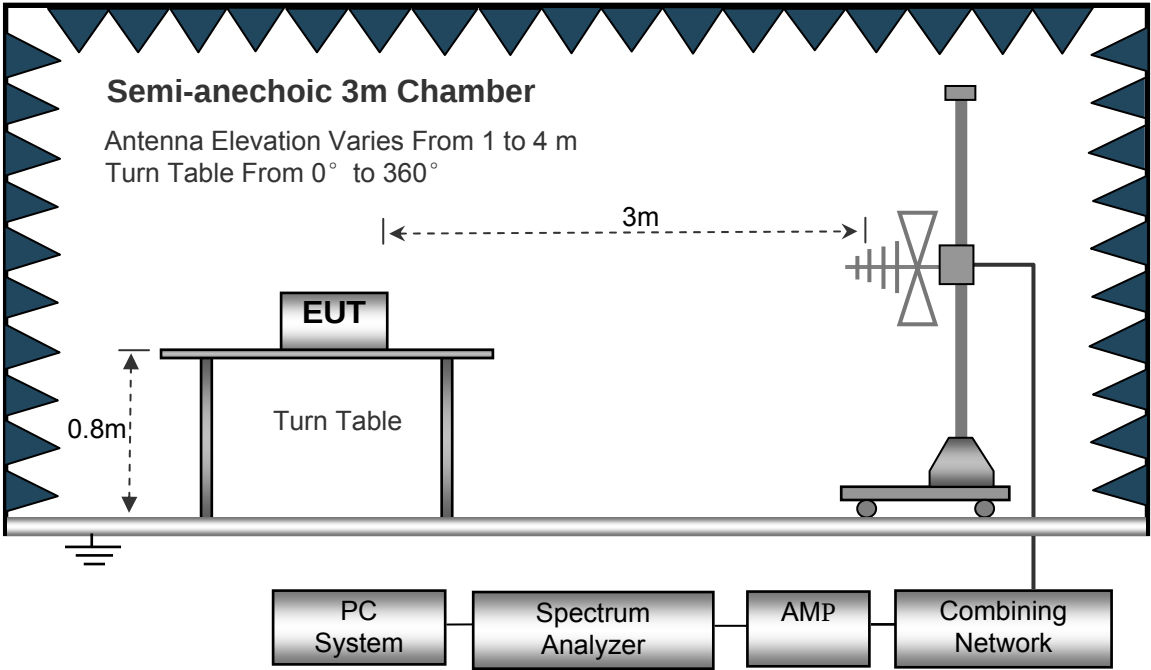
### 12.1 EUT Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10: 2013.

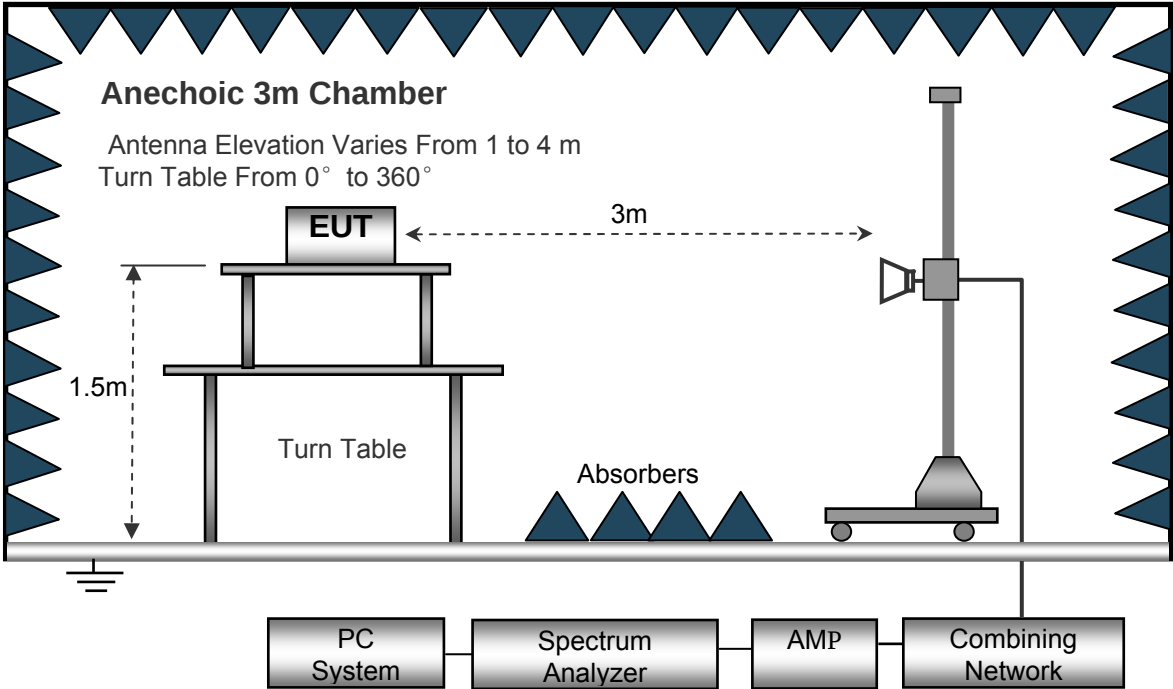
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 KHz to 30 MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission above 1GHz Emissions.



## 12.2 Spectrum Analyzer Setup

According to FCC Part 2 Section 2.1053 Rules, the system was tested 16MHz to 6000MHz.

9kHz ~ 30MHz

Start Frequency .....9kHz  
 Stop Frequency .....30MHz  
 Sweep Speed .....Auto  
 IF Bandwidth.....10KHz  
 Video Bandwidth.....10KHz  
 Resolution Bandwidth .....10KHz

30MHz ~ 1GHz

Start Frequency .....30 MHz  
 Stop Frequency .....1000MHz  
 Sweep Speed.....Auto  
 IF Bandwidth .....120 KHz  
 Video Bandwidth .....300KHz  
 Quasi-Peak Adapter Bandwidth.....120 KHz  
 Quasi-Peak Adapter Mode .....Normal  
 Resolution Bandwidth .....100KHz

Above 1GHz

Start Frequency .....1000 MHz  
 Stop Frequency .....7000MHz  
 Sweep Speed.....Auto  
 IF Bandwidth .....120 KHz  
 Video Bandwidth .....3MHz  
 Quasi-Peak Adapter Bandwidth.....120 KHz  
 Quasi-Peak Adapter Mode .....Normal  
 Resolution Bandwidth .....1MHz

## 12.3 Test Procedure

1. The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane;  
 For above1GHz, the EUT is 1.5m 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 X position. So the data shown was the X position only.

#### 12.4 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:

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

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

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

## 12.5 Test Result

### Low Power

| Frequency                        | Detector | Ant. | Antenna Height | Turntable Angle | Emission Level | Limit | Margin |
|----------------------------------|----------|------|----------------|-----------------|----------------|-------|--------|
| (MHz)                            | r        | Pol  | (m)            | (°)             | (dBm)          | (dBm) | (dB)   |
| <b>Low Channel:522.650MHz</b>    |          |      |                |                 |                |       |        |
| 1045.30                          | Peak     | H    | 1.3            | 10              | -33.12         | -13   | -20.12 |
| 1045.30                          | Peak     | V    | 2.0            | 214             | -36.95         | -13   | -23.95 |
| 1567.95                          | Peak     | H    | 2.0            | 245             | -45.32         | -13   | -32.32 |
| 1567.95                          | Peak     | V    | 1.5            | 162             | -48.91         | -13   | -35.91 |
| 2090.60                          | Peak     | H    | 1.8            | 340             | -44.08         | -13   | -31.08 |
| 2090.60                          | Peak     | V    | 1.5            | 8               | -47.36         | -13   | -34.36 |
| <b>Middle Channel:553.725MHz</b> |          |      |                |                 |                |       |        |
| 1107.45                          | Peak     | H    | 1.1            | 198             | -49.57         | -13   | -36.57 |
| 1107.45                          | Peak     | V    | 1.5            | 80              | -47.33         | -13   | -34.33 |
| 1661.18                          | Peak     | H    | 1.6            | 79              | -46.02         | -13   | -33.02 |
| 1661.18                          | Peak     | V    | 1.2            | 314             | -44.92         | -13   | -31.92 |
| 2214.90                          | Peak     | H    | 1.3            | 139             | -45.66         | -13   | -32.66 |
| 2214.90                          | Peak     | V    | 1.9            | 359             | -43.48         | -13   | -30.48 |
| <b>High Channel:585.975MHz</b>   |          |      |                |                 |                |       |        |
| 1171.95                          | Peak     | H    | 1.3            | 344             | -51.34         | -13   | -38.34 |
| 1171.95                          | Peak     | V    | 1.2            | 58              | -53.22         | -13   | -40.22 |
| 1757.93                          | Peak     | H    | 1.4            | 246             | -47.99         | -13   | -34.99 |
| 1757.93                          | Peak     | V    | 1.2            | 204             | -50.01         | -13   | -37.01 |
| 2343.90                          | Peak     | H    | 1.5            | 169             | -46.64         | -13   | -33.64 |
| 2343.90                          | Peak     | V    | 1.6            | 87              | -44.85         | -13   | -31.85 |

**High Power**

| Frequency                        | Detector | Ant. | Antenna Height | Turntable Angle | Emission Level | Limit | Margin |
|----------------------------------|----------|------|----------------|-----------------|----------------|-------|--------|
| (MHz)                            | r        | Pol  | (m)            | ( ° )           | (dBm)          | (dBm) | (dB)   |
| <b>Low Channel:522.650MHz</b>    |          |      |                |                 |                |       |        |
| 1045.30                          | Peak     | H    | 1.8            | 155             | -28.62         | -13   | -15.62 |
| 1045.30                          | Peak     | V    | 1.6            | 0               | -31.47         | -13   | -18.47 |
| 1567.95                          | Peak     | H    | 1.3            | 68              | -44.03         | -13   | -31.03 |
| 1567.95                          | Peak     | V    | 1.0            | 280             | -47.92         | -13   | -34.92 |
| 2090.60                          | Peak     | H    | 1.6            | 338             | -43.98         | -13   | -30.98 |
| 2090.60                          | Peak     | V    | 1.9            | 190             | -45.25         | -13   | -32.25 |
| <b>Middle Channel:553.725MHz</b> |          |      |                |                 |                |       |        |
| 1107.45                          | Peak     | H    | 1.3            | 212             | -42.17         | -13   | -29.17 |
| 1107.45                          | Peak     | V    | 1.9            | 342             | -45.08         | -13   | -32.08 |
| 1661.18                          | Peak     | H    | 1.8            | 311             | -44.39         | -13   | -31.39 |
| 1661.18                          | Peak     | V    | 1.8            | 170             | -42.05         | -13   | -29.05 |
| 2214.90                          | Peak     | H    | 1.0            | 32              | -44.62         | -13   | -31.62 |
| 2214.90                          | Peak     | V    | 2.0            | 154             | -46.91         | -13   | -33.91 |
| <b>High Channel:585.975MHz</b>   |          |      |                |                 |                |       |        |
| 1171.95                          | Peak     | H    | 1.8            | 273             | -51.43         | -13   | -38.43 |
| 1171.95                          | Peak     | V    | 1.7            | 343             | -48.78         | -13   | -35.78 |
| 1757.93                          | Peak     | H    | 1.1            | 320             | -46.35         | -13   | -33.35 |
| 1757.93                          | Peak     | V    | 2.0            | 144             | -49.07         | -13   | -36.07 |
| 2343.90                          | Peak     | H    | 1.3            | 185             | -44.99         | -13   | -31.99 |
| 2343.90                          | Peak     | V    | 1.4            | 306             | -45.62         | -13   | -32.62 |

The measurements below 1G were more than 20 dB below the limit and not reported.

## 13 Frequency Stability

|                   |                                                                                                  |
|-------------------|--------------------------------------------------------------------------------------------------|
| Test requirement: | FCC CFR47 Part 2 Section 2.1055(a)(a)                                                            |
| Test method:      | Based on ANSI/TIA-603-D: 2010                                                                    |
| Limit:            | According to FCC 74.86(e)(4), the frequency tolerance of the transmitter shall be 0.005 percent. |

### 13.1 Test Configuration

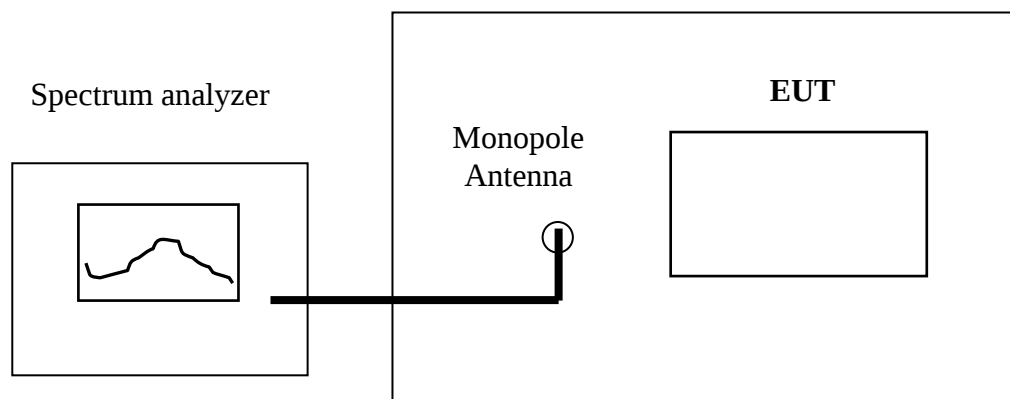


Figure 1

### 13.2 Test Procedure

#### A) Frequency stability versus input voltage

1. Setup the configuration per figure 1 for frequencies measured at an environmental chamber whose temperature is set to 20 °C. Install new batteries in the EUT.
2. Set SA center frequency to the EUT operation frequency. Then set SA RBW to 30 kHz, VBW to 100kHz and frequency span to 500 kHz. Record this frequency to be a reference.
3. Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

#### B) Frequency stability versus environmental temperature

1. Setup the configuration per figure 1 for frequencies measured at an environmental chamber, Install new batteries in the EUT.
2. Turn on EUT and set SA center frequency to the EUT operation frequency, then set SA RBW to 30kHz, VBW to 100kHz and frequency span to 500 kHz. Record this frequency to be a reference.
3. Set the temperature of chamber to 50°C. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the chamber, turn the EUT on and measure the EUT operating frequency.
4. Repeat step 2 with a 10°C decreased per stage until the lowest temperature -30°C is measured, record all measurement frequencies.

### 13.3 Test Result

- a) Frequency stability versus input voltage
- b) The EUT is powered by two 5# Non-rechargeable AA batteries. The nominal voltage is DC 3V, so we select the extreme condition  $\pm 10\%$  according with ANSI/TIA-C60-3D section 1.4.4.3. Low voltage is 2.7V DC and high voltage is 3.3V DC.

#### Low Channel

| Power Supply | Reference Frequency (MHz) | Environment Temperature (°C) | Frequency Measured | Frequency Tolerance (%) |
|--------------|---------------------------|------------------------------|--------------------|-------------------------|
| 2.7V, DC     | 522.65                    | 20                           | 522.652            | 0.00044                 |
| 3.3V, DC     | 522.65                    | 20                           | 522.646            | 0.00078                 |

#### Middle Channel

| Power Supply | Reference Frequency (MHz) | Environment Temperature (°C) | Frequency Measured | Frequency Tolerance (%) |
|--------------|---------------------------|------------------------------|--------------------|-------------------------|
| 2.7V, DC     | 553.725                   | 20                           | 553.723            | 0.00029                 |
| 3.3V, DC     | 553.725                   | 20                           | 553.723            | 0.00029                 |

#### High Channel

| Power Supply | Reference Frequency (MHz) | Environment Temperature (°C) | Frequency Measured | Frequency Tolerance (%) |
|--------------|---------------------------|------------------------------|--------------------|-------------------------|
| 2.7V, DC     | 585.975                   | 20                           | 585.977            | 0.00041                 |
| 3.3V, DC     | 585.975                   | 20                           | 585.976            | 0.00020                 |

## c) Frequency stability versus environmental temperature

| Low Channel:522.650MHz, Limit: 0.005% |              |                                                           |         |
|---------------------------------------|--------------|-----------------------------------------------------------|---------|
| Environment Temperature(°C)           | Power Supply | Frequency Deviation measured with time Elapse(30 minutes) |         |
|                                       |              | MHz                                                       | %       |
| 50                                    | 3V, DC       | 522.656                                                   | 0.00114 |
| 40                                    | 3V, DC       | 522.646                                                   | 0.00073 |
| 30                                    | 3V, DC       | 522.645                                                   | 0.00094 |
| 20                                    | 3V, DC       | 522.648                                                   | 0.00044 |
| 10                                    | 3V, DC       | 522.653                                                   | 0.00058 |
| 0                                     | 3V, DC       | 522.656                                                   | 0.00112 |
| -10                                   | 3V, DC       | 522.646                                                   | 0.00073 |
| -20                                   | 3V, DC       | 522.655                                                   | 0.00105 |
| -30                                   | 3V, DC       | 522.654                                                   | 0.00074 |

| Middle Channel: 553.725MHz, Limit: 0.005% |              |                                                           |         |
|-------------------------------------------|--------------|-----------------------------------------------------------|---------|
| Environment Temperature(°C)               | Power Supply | Frequency Deviation measured with time Elapse(30 minutes) |         |
|                                           |              | MHz                                                       | %       |
| 50                                        | 3V, DC       | 553.720                                                   | 0.00095 |
| 40                                        | 3V, DC       | 553.725                                                   | 0.00008 |
| 30                                        | 3V, DC       | 553.727                                                   | 0.00029 |
| 20                                        | 3V, DC       | 553.728                                                   | 0.00047 |
| 10                                        | 3V, DC       | 553.729                                                   | 0.00063 |
| 0                                         | 3V, DC       | 553.722                                                   | 0.00061 |
| -10                                       | 3V, DC       | 553.720                                                   | 0.00081 |
| -20                                       | 3V, DC       | 553.729                                                   | 0.00081 |
| -30                                       | 3V, DC       | 553.725                                                   | 0.00000 |

| High Channel: 585.975MHz, Limit: 0.005% |              |                                                              |         |
|-----------------------------------------|--------------|--------------------------------------------------------------|---------|
| Environment<br>Temperature(°C)          | Power Supply | Frequency Deviation measured with time<br>Elapse(30 minutes) |         |
|                                         |              | MHz                                                          | %       |
| 50                                      | 3V, DC       | 585.973                                                      | 0.00036 |
| 40                                      | 3V, DC       | 585.975                                                      | 0.00003 |
| 30                                      | 3V, DC       | 585.977                                                      | 0.00032 |
| 20                                      | 3V, DC       | 585.976                                                      | 0.00014 |
| 10                                      | 3V, DC       | 585.971                                                      | 0.00062 |
| 0                                       | 3V, DC       | 585.974                                                      | 0.00010 |
| -10                                     | 3V, DC       | 585.979                                                      | 0.00063 |
| -20                                     | 3V, DC       | 585.980                                                      | 0.00079 |
| -30                                     | 3V, DC       | 585.970                                                      | 0.00082 |

Test Result: The max frequency tolerance rating is 0.00114% < 0.005%. Passed.

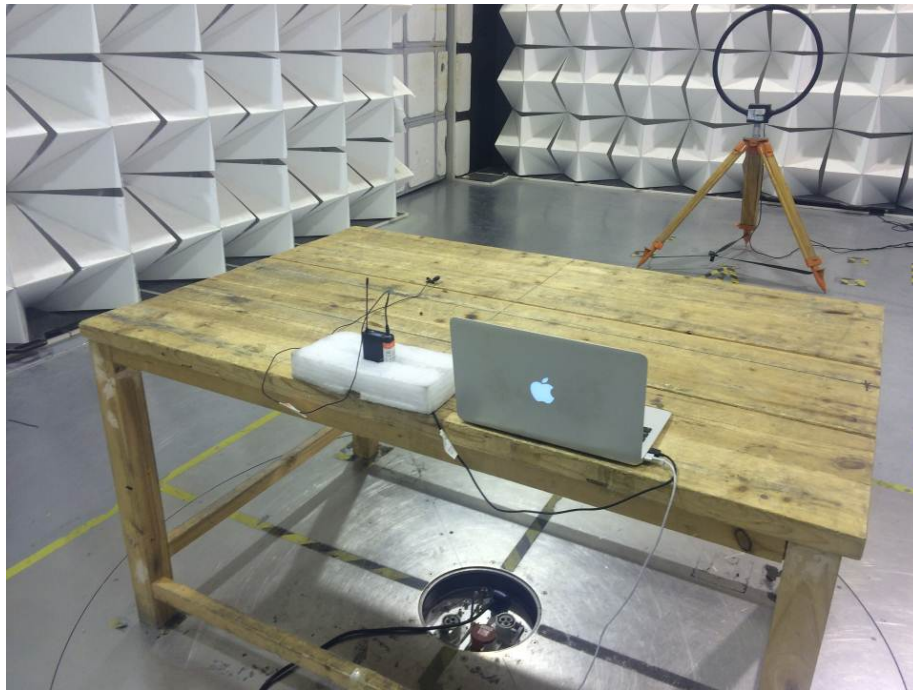
## **14 SAR Evaluation**

Remark: refer to WTS17S0372796-2E SAR Test Report

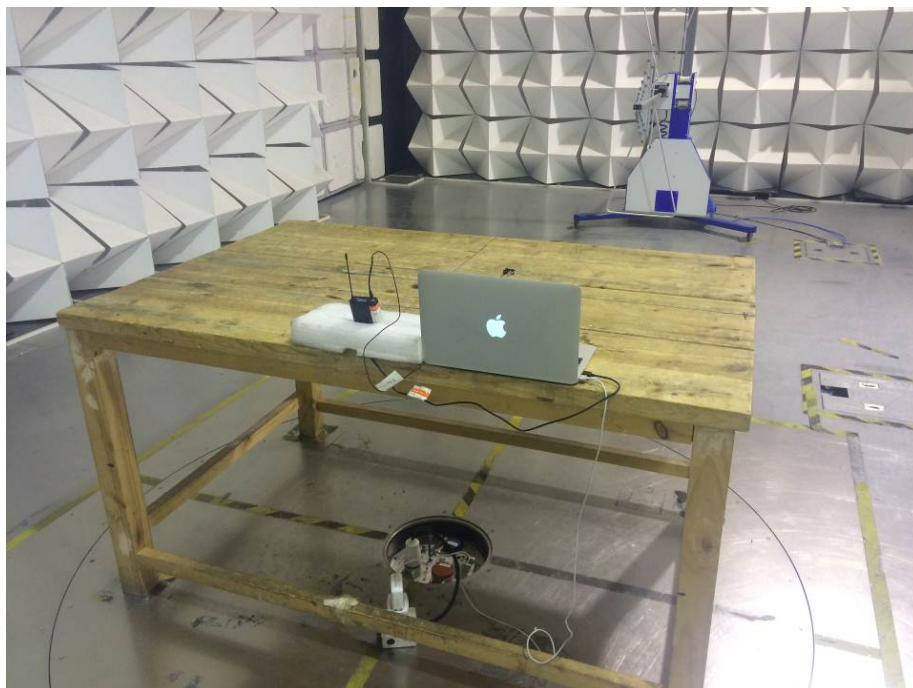
## 15 Photographs –Model AWS-2000T Test Setup

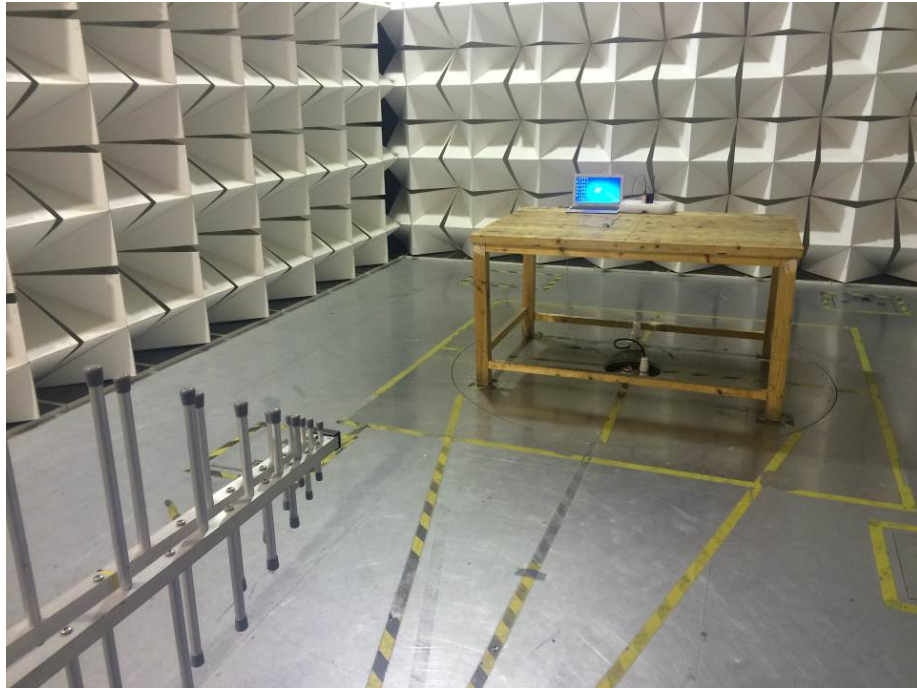
### 15.1 Photograph – Radiation Spurious Emission Test Setup

9KHz~30MHz

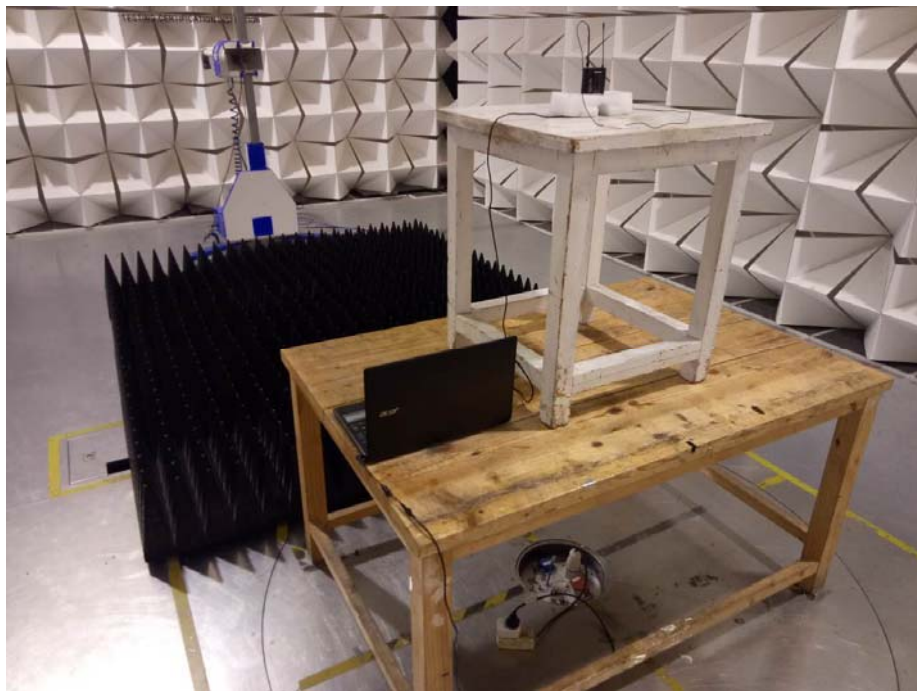


30MHz-1GHz





1GHz-6GHz



## 15.2 Photograph – Conducted Emissions Test Setup



## 16 Photographs – Constructional Details

### 16.1 EUT –Model AWS-2000T External Photos







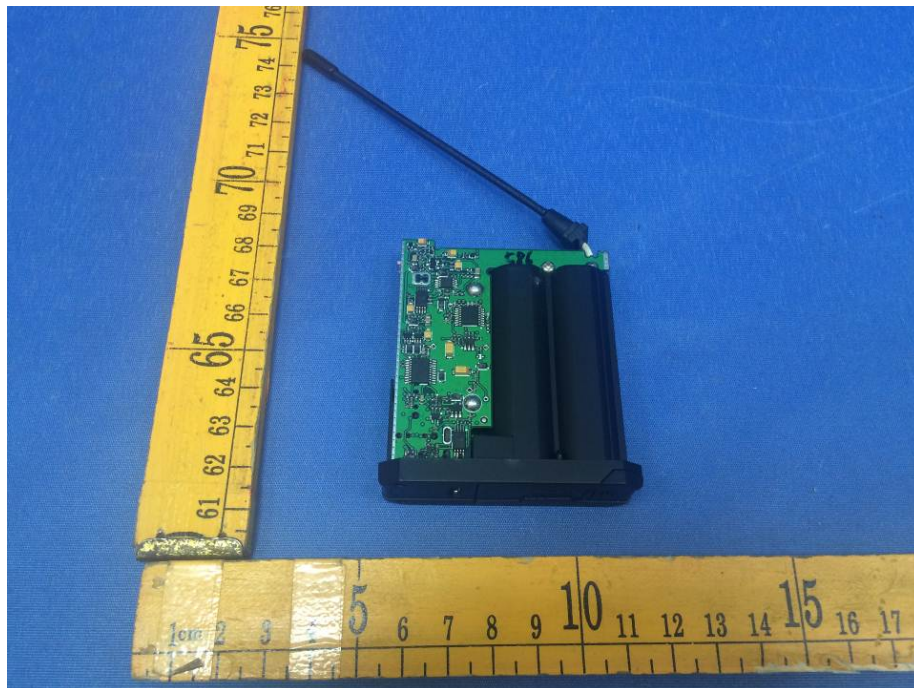


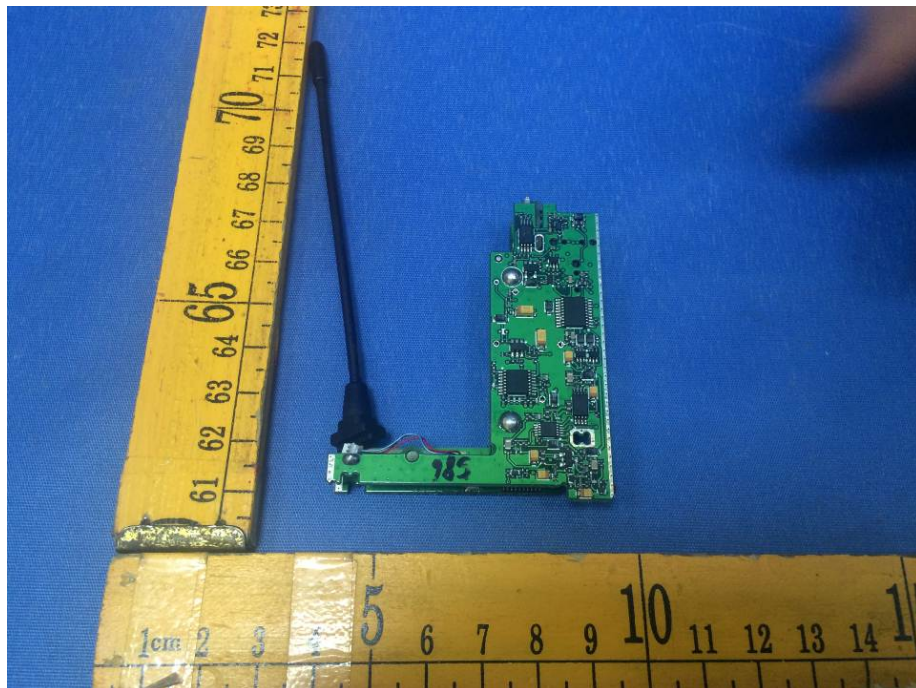
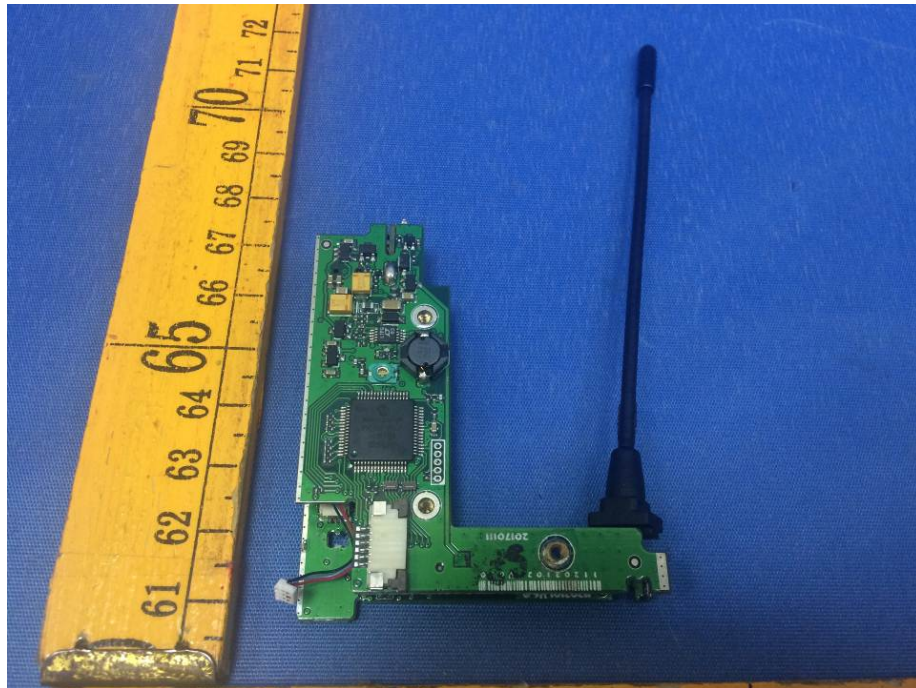


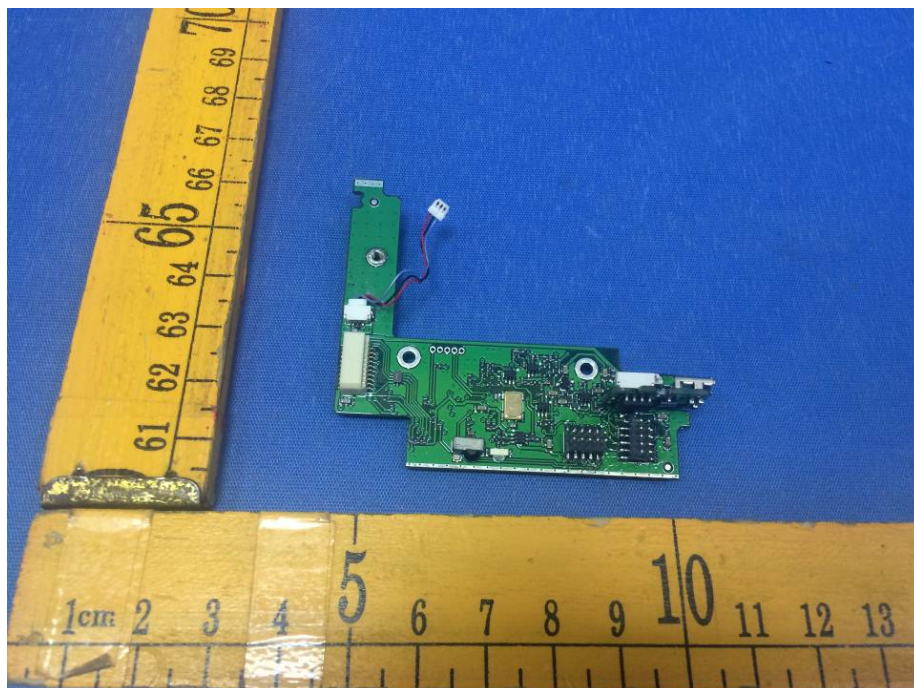
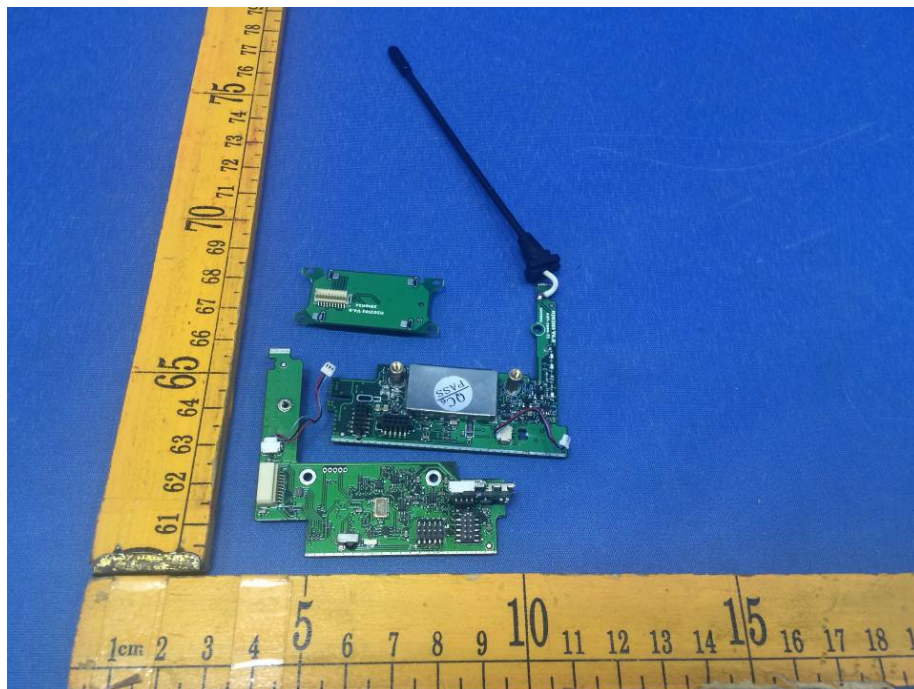


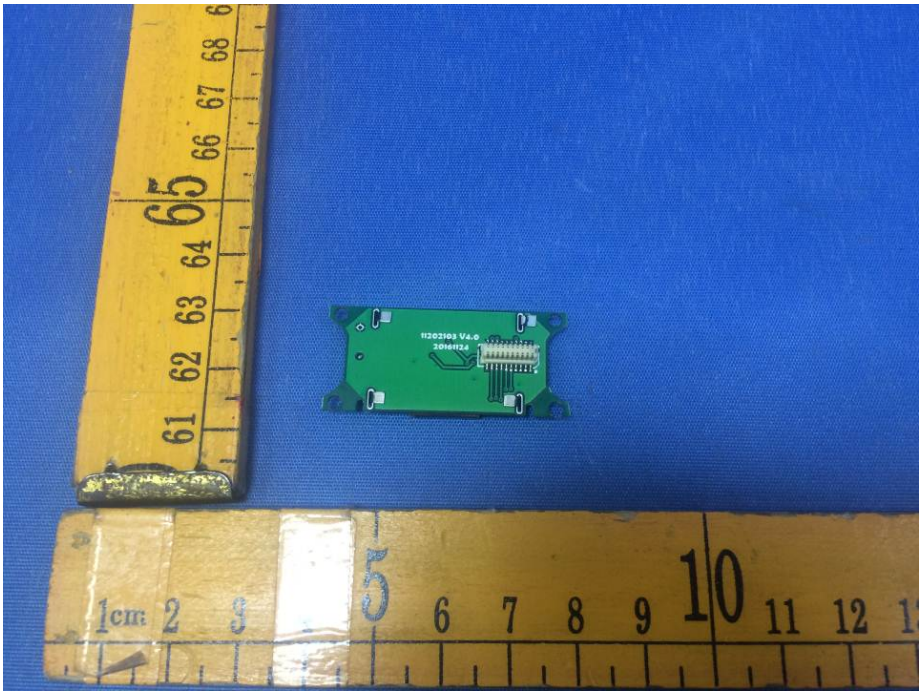
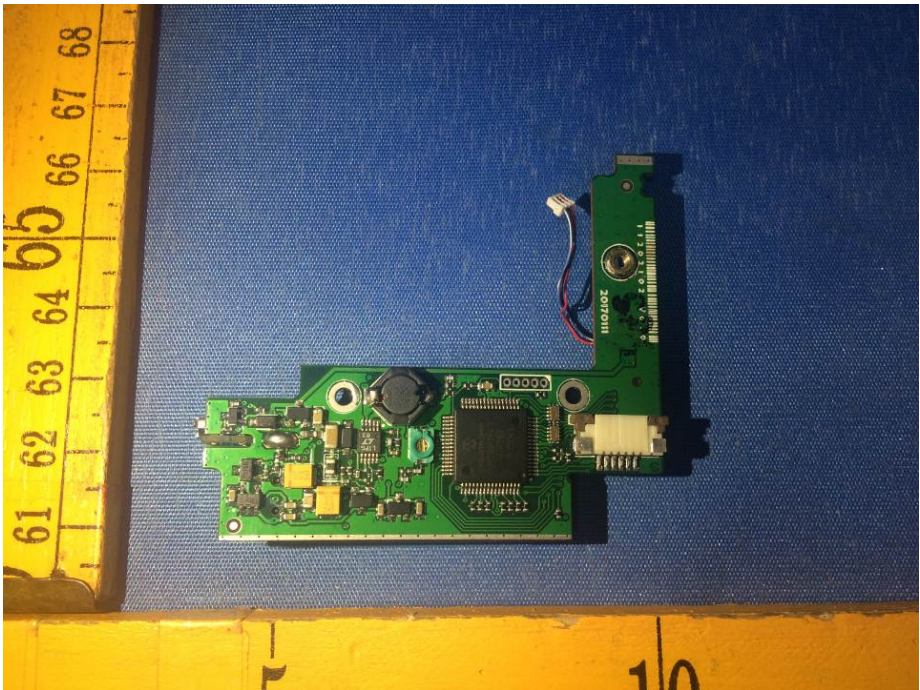
## 16.2 EUT –Model AWS-2000T Internal Photos

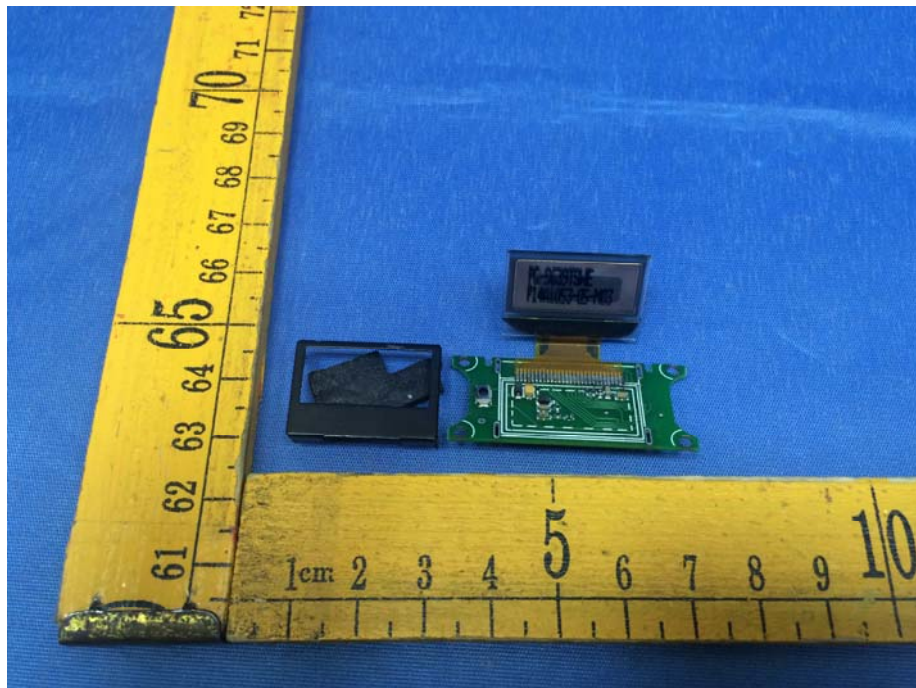
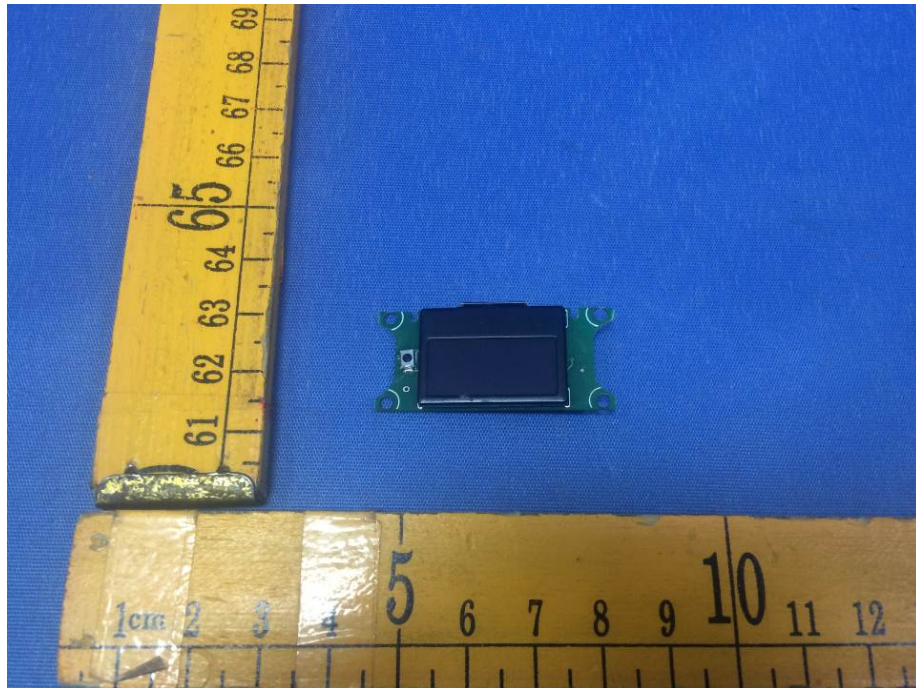


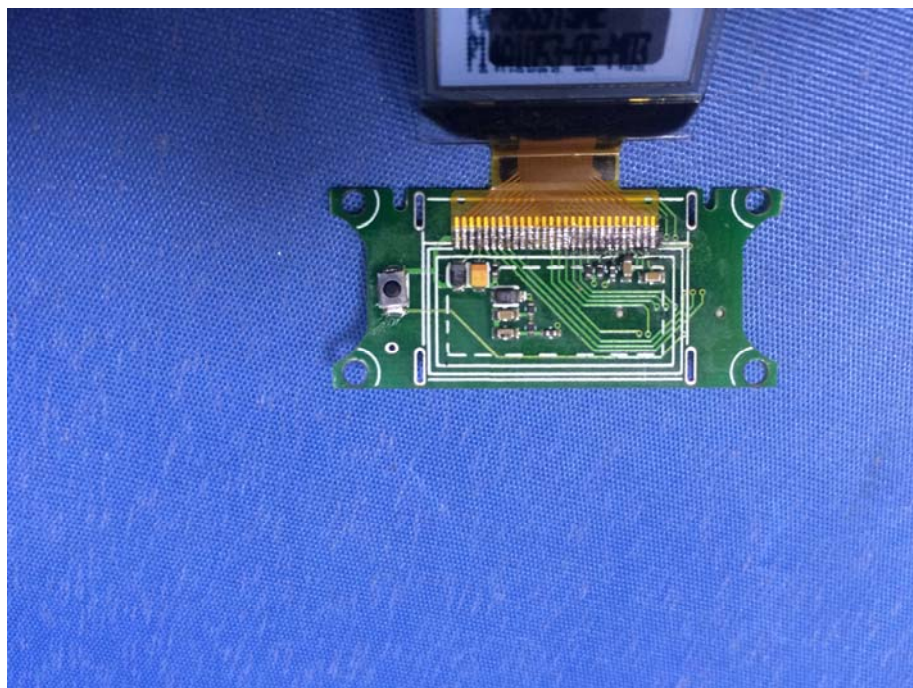
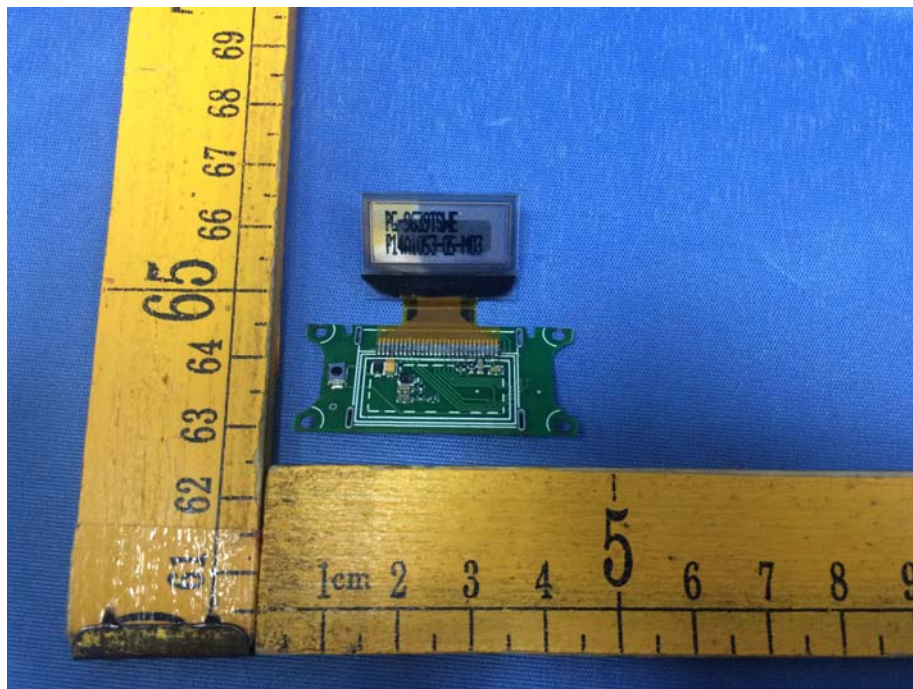


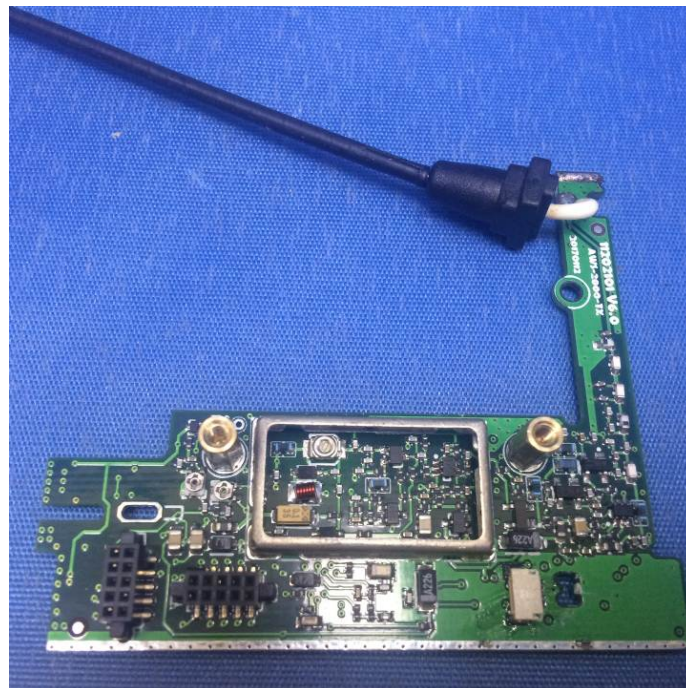
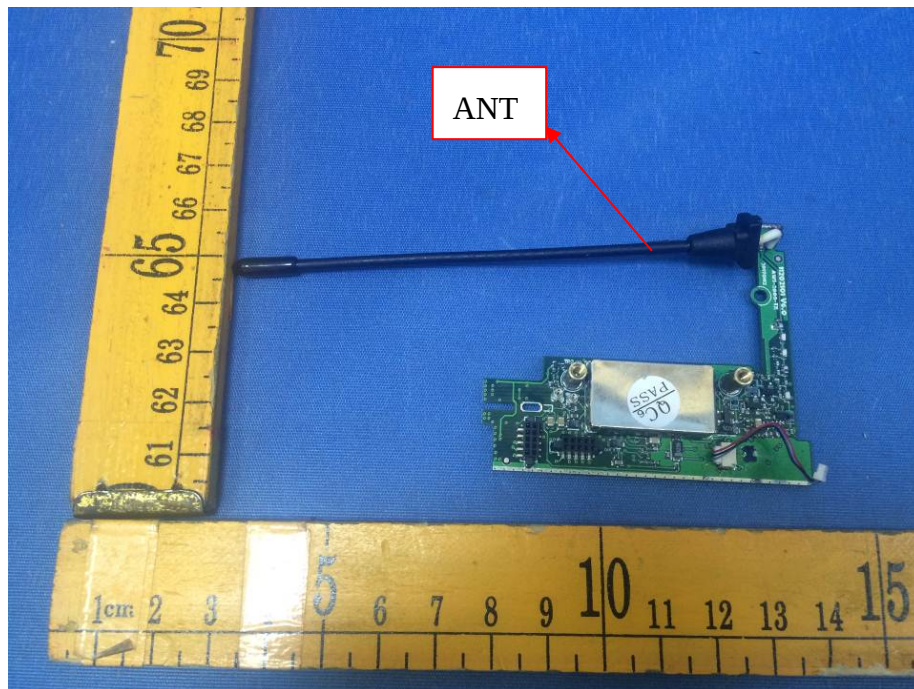














=====End of Report=====