

## RADIO TEST REPORT

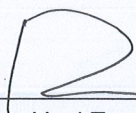
The device described below is tested by Dongguan Nore Testing Center Co., Ltd. to determine the maximum emission levels emanating from the device, the severe levels which the device can endure and E.U.T.'s performance criterion. The test results, data evaluation, test procedures, and equipment of configurations shown in this report were made in accordance with the procedures in ANSI C63.10(2013).

Applicant/Manufacturer : DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD.  
Address : 262 shidan Rd., 3rd industrial Area, Juzhou, Shijie Town, Dongguan city, China  
Factory : DONGGUAN TOGRAN ELECTRONICS TECHNOLOGY CO.,LTD.  
Address : 262 shidan Rd., 3rd industrial Area, Juzhou, Shijie Town, Dongguan city, China  
E.U.T. : Dongle  
Brand Name : Togran  
Model No. : TM156, MJ-156, MJ-156B(For model difference, refer to section 1.)  
FCC ID : 2AGLG-TM156DONGLE  
Measurement Standard : FCC PART 15.249: 2017  
Date of Receiver : March 15, 2019  
Date of Test : March 15, 2019 to April 11, 2019  
Date of Report : April 11, 2019

This Test Report is Issued Under the Authority of :

Prepared by

Approved & Authorized Signer

  
Rose Hu / Engineer

  
Lori Fan / Authorized Signatory

This test report is for the customer shown above and their specific product only. This report applies to above tested sample only and shall not be reproduced in part without written approval of Dongguan Nore Testing Center Co., Ltd.

## Table of Contents

|                                                        |           |
|--------------------------------------------------------|-----------|
| <b>1. GENERAL INFORMATION .....</b>                    | <b>4</b>  |
| 1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST ..... | 4         |
| 1.2 RELATED SUBMITTAL(S) / GRANT (S).....              | 6         |
| 1.3 TEST METHODOLOGY .....                             | 6         |
| 1.4 EQUIPMENT MODIFICATIONS.....                       | 6         |
| 1.5 SUPPORT DEVICE .....                               | 6         |
| 1.6 TEST FACILITY AND LOCATION .....                   | 7         |
| 1.7 SUMMARY OF TEST RESULTS .....                      | 8         |
| <b>2. SYSTEM TEST CONFIGURATION.....</b>               | <b>9</b>  |
| 2.1 EUT CONFIGURATION .....                            | 9         |
| 2.2 SPECIAL ACCESSORIES .....                          | 9         |
| 2.3 DESCRIPTION OF TEST MODES .....                    | 9         |
| 2.4 EUT EXERCISE .....                                 | 9         |
| <b>3. CONDUCTED EMISSIONS TEST .....</b>               | <b>10</b> |
| 3.1 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) ..... | 10        |
| 3.2 TEST CONDITION.....                                | 10        |
| 3.3 MEASUREMENT RESULTS .....                          | 10        |
| <b>4. RADIATED EMISSION TEST.....</b>                  | <b>13</b> |
| 4.1 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) ..... | 13        |
| 4.2 MEASUREMENT PROCEDURE .....                        | 14        |
| 4.3 LIMIT .....                                        | 15        |
| 4.4 MEASUREMENT RESULTS .....                          | 16        |
| <b>5. 20DB BANDWIDTH.....</b>                          | <b>20</b> |
| 5.1 MEASUREMENT PROCEDURE .....                        | 20        |
| 5.2 TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION) ..... | 20        |
| 5.3 MEASUREMENT RESULTS .....                          | 20        |
| <b>6. BAND EDGE .....</b>                              | <b>23</b> |
| 6.1 MEASUREMENT PROCEDURE .....                        | 23        |
| 6.2 LIMIT .....                                        | 23        |
| 6.3 MEASUREMENT RESULTS .....                          | 23        |
| <b>7. ANTENNA REQUIREMENT .....</b>                    | <b>26</b> |
| 7.1 MEASUREMENT PROCEDURE .....                        | 26        |
| 7.2 MEASUREMENT RESULTS .....                          | 26        |
| <b>8. TEST EQUIPMENT LIST.....</b>                     | <b>27</b> |

## Revision History of This Test Report

| Report Number  | Description   | Issued Date |
|----------------|---------------|-------------|
| NTC1903155FV00 | Initial Issue | 2019-04-11  |
|                |               |             |
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## 1. GENERAL INFORMATION

### 1.1 Product Description for Equipment under Test

|                              |                                                                                                                                                                   |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name                 | : Dongle                                                                                                                                                          |
| Main model number            | : TM156                                                                                                                                                           |
| Additional Model number      | : MJ-156, MJ-156B                                                                                                                                                 |
| Brand Name                   | : Togran                                                                                                                                                          |
| Model Difference Description | : These models have the same circuitry, electrical mechanical, PCB Layout and physical construction .<br>The differences in model number due to marketing purpose |
| Power Supply                 | : DC 5V From PC                                                                                                                                                   |
| Test Voltage                 | : AC 120V/50Hz (PC Input)                                                                                                                                         |
| Operating Temperature Range  | : 0°C to 40°C (Declaration by manufacturer)                                                                                                                       |
| Remake                       | : N/A                                                                                                                                                             |
| Hardware version             | : V00                                                                                                                                                             |
| Software version             | : V00                                                                                                                                                             |
| Note                         | : N/A                                                                                                                                                             |

#### Technical Specification:

##### 2.4G Function:

|                   |                                      |
|-------------------|--------------------------------------|
| Frequency Range   | : 2403~2480MHz                       |
| Modulation Type   | : GFSK                               |
| Number of Channel | : 16                                 |
| Antenna Type      | : PCB                                |
| Antenna Gain      | : 0dBi (Declaration by manufacturer) |

### Channel List:

| Channel | Frequency<br>MHz | Channel | Frequency<br>MHz | Channel | Frequency<br>MHz |
|---------|------------------|---------|------------------|---------|------------------|
| 1       | 2403             | 7       | 2445             | 13      | 2419             |
| 2       | 2426             | 8       | 2466             | 14      | 2439             |
| 3       | 2441             | 9       | 2414             | 15      | 2453             |
| 4       | 2463             | 10      | 2436             | 16      | 2480             |
| 5       | 2407             | 11      | 2459             |         |                  |
| 6       | 2422             | 12      | 2473             |         |                  |

**Note:** The Lowest, middle, and the Highest frequency of channel were selected to perform the test. The frequency selected see below:

The Lowest frequency: 2403MHz  
The middle frequency: 2441MHz  
The Highest frequency: 2480MHz

## 1.2 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: **2AGLG-TM156DONGLE** filing to comply with Section 15.249 of the FCC Part 15 (2017), Subpart C Rule.

## 1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Radiated emission measurement was performed in semi-anechoic chamber and conducted emission measurement was performed in shield room. For radiated emission measurement, preliminary scans were performed in the semi-anechoic chamber only to determine the worst case modes. All radiated tests were performed at an antenna to EUT distance of 3 meters.

## 1.4 Equipment Modifications

Not available for this EUT intended for grant.

## 1.5 Support Device

|             |                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------|
| Notebook PC | : Manufacturer: Lenovo<br>Model: TP00067A<br>P/N: SL10G10768<br>S/N: PF-0DS3YC 15/12<br>CE, FCC: DOC |
| Adapter     | : Manufacturer: Lenovo<br>Model: ADLX65NLC3A<br>I/P: AC 100-240V 50-60Hz, 1.8A<br>O/P: DC 20V 3.25A  |

## 1.6 Test Facility and Location

### Site Description

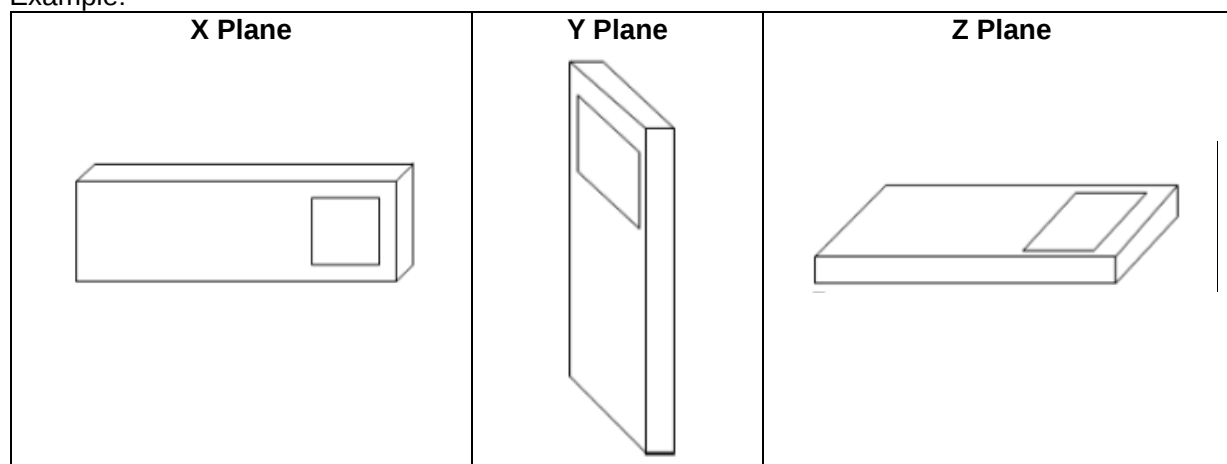
- EMC Lab : Listed by CNAS, August 13, 2018  
The certificate is valid until August 13, 2024  
The Laboratory has been assessed and proved to be in compliance with CNAS/CL01  
The Certificate Registration Number is L5795.
- Listed by A2LA, November 01, 2017  
The certificate is valid until December 31, 2019  
The Laboratory has been assessed and proved to be in compliance with ISO17025  
The Certificate Registration Number is 4429.01
- Listed by FCC, November 06, 2017  
The Designation Number is CN1214  
Test Firm Registration Number: 907417
- Listed by Industry Canada, June 08, 2017  
The Certificate Registration Number. Is 46405-9743
- Name of Firm : Dongguan Nore Testing Center Co., Ltd.  
(Dongguan NTC Co., Ltd.)
- Site Location : Building D, Gaosheng Science and Technology  
Park, Hongtu Road, Nancheng District, Dongguan  
City, Guangdong Province, China.

## 1.7 Summary of Test Results

| FCC Rules          | Description Of Test         | Uncertainty               | Result    |
|--------------------|-----------------------------|---------------------------|-----------|
| §15.207(a)         | AC Power Conducted Emission | ±1.06dB                   | Compliant |
| §15.249(a)/ 15.209 | Radiated Emissions          | ±3.70dB                   | Compliant |
| §15.249(d)/ 15.205 | Band Edge                   | ±1.70dB                   | Compliant |
| §15.215(c)         | 20dB Bandwidth              | ±1.42 x10 <sup>-4</sup> % | Compliant |
| §15.203            | Antenna Requirement         | N/A                       | Compliant |

Note: The EUT operating multiple positions, so the EUT shall be performed three orthogonal planes. The worst plane is Z.

Example:



## **2. System Test Configuration**

### **2.1 EUT Configuration**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

### **2.2 Special Accessories**

Not available for this EUT intended for grant.

### **2.3 Description of test modes**

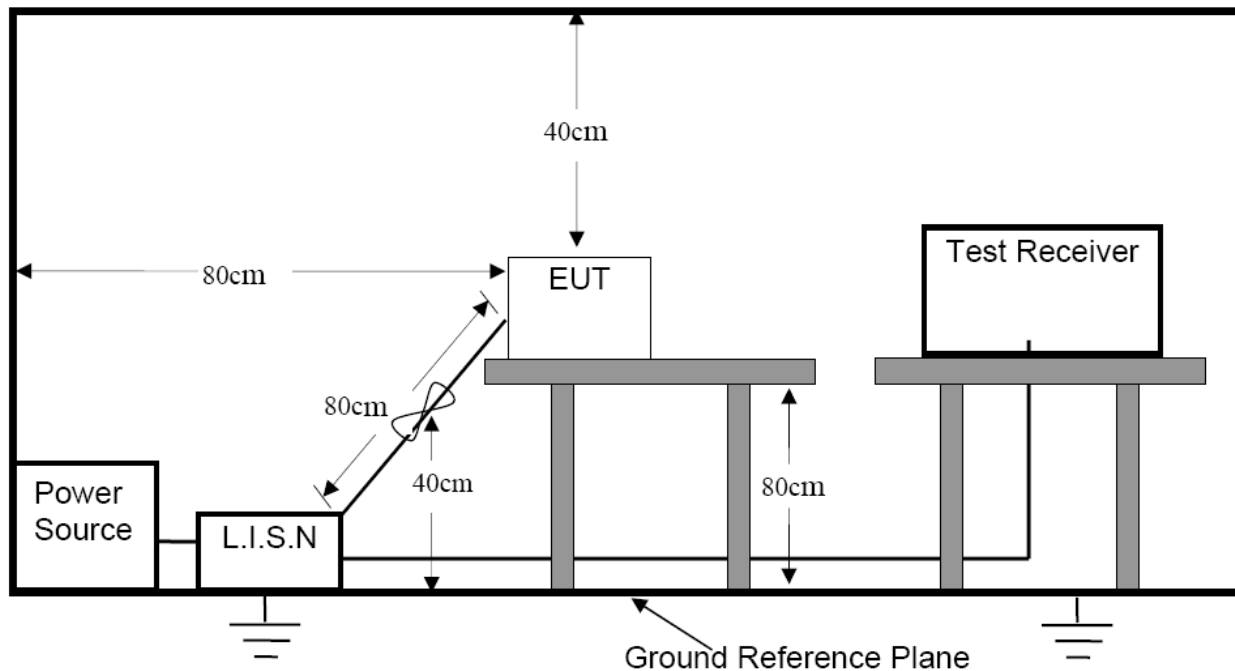
The EUT has been tested under operating condition. The Lowest, middle and highest frequencies were chosen for testing.

### **2.4 EUT Exercise**

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements.

### 3. Conducted Emissions Test

#### 3.1 Test SET-UP (Block Diagram of Configuration)



#### 3.2 Test Condition

Test Requirement: FCC Part 15.207

Frequency Range: 150KHz ~ 30MHz

Detector: RBW 9KHz, VBW 30KHz

Operation Mode: TX

#### 3.3 Measurement Results

Please refer to following the test plots of the worst case: Middle channel.



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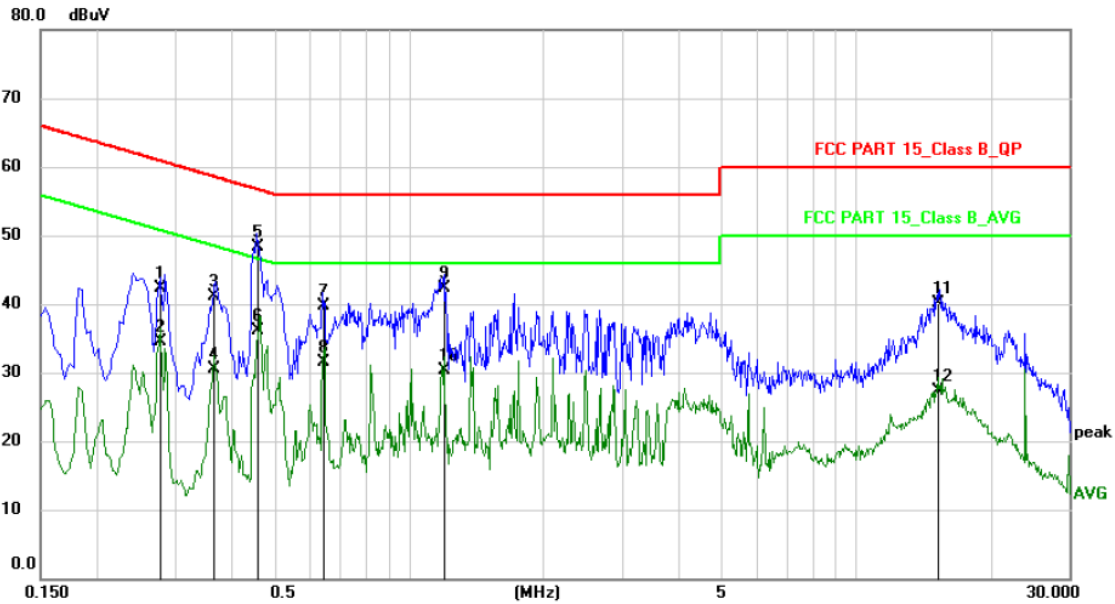
### Conducted Emission Measurement

File :TM156G

Data :#5

Date: 2019/3/19

Time: 20:29:07



Site

Phase: **L1**

Temperature: 26

Limit: FCC PART 15\_Class B\_QP

Power: AC 120V 60Hz

Humidity: 50 %

EUT: Dongle

M/N: TM156

Mode: TX

Note:

| No. Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|---------|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1       | 0.2779       | 31.79                    | 10.61                   | 42.40                    | 60.88         | -18.48     | QP       |         |
| 2       | 0.2779       | 23.89                    | 10.61                   | 34.50                    | 50.88         | -16.38     | AVG      |         |
| 3       | 0.3660       | 30.59                    | 10.61                   | 41.20                    | 58.59         | -17.39     | QP       |         |
| 4       | 0.3660       | 19.89                    | 10.61                   | 30.50                    | 48.59         | -18.09     | AVG      |         |
| 5 *     | 0.4580       | 37.68                    | 10.62                   | 48.30                    | 56.73         | -8.43      | QP       |         |
| 6       | 0.4580       | 25.58                    | 10.62                   | 36.20                    | 46.73         | -10.53     | AVG      |         |
| 7       | 0.6419       | 29.07                    | 10.63                   | 39.70                    | 56.00         | -16.30     | QP       |         |
| 8       | 0.6419       | 20.97                    | 10.63                   | 31.60                    | 46.00         | -14.40     | AVG      |         |
| 9       | 1.2020       | 31.75                    | 10.65                   | 42.40                    | 56.00         | -13.60     | QP       |         |
| 10      | 1.2020       | 19.75                    | 10.65                   | 30.40                    | 46.00         | -15.60     | AVG      |         |
| 11      | 15.2500      | 29.43                    | 10.67                   | 40.10                    | 60.00         | -19.90     | QP       |         |
| 12      | 15.2500      | 16.63                    | 10.67                   | 27.30                    | 50.00         | -22.70     | AVG      |         |



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### Conducted Emission Measurement

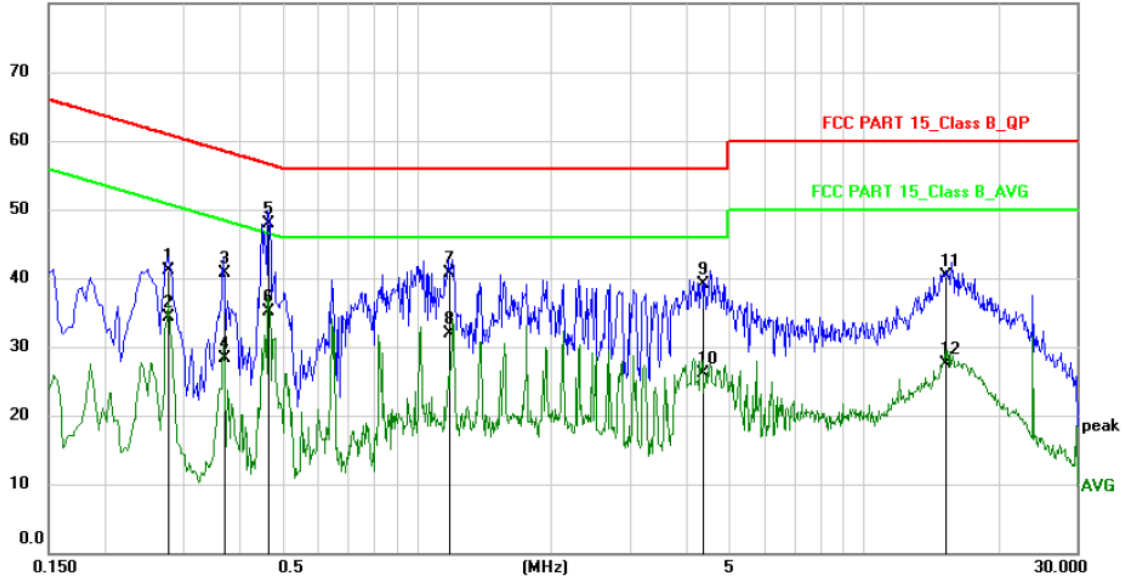
File :TM156G

Data :#6

Date: 2019/3/19

Time: 20:36:36

80.0 dBuV



Site

Phase: **N**

Temperature: 26

Limit: FCC PART 15\_Class B\_QP

Power: AC 120V 60Hz

Humidity: 50 %

EUT: Dongle

M/N: TM156

Mode: TX

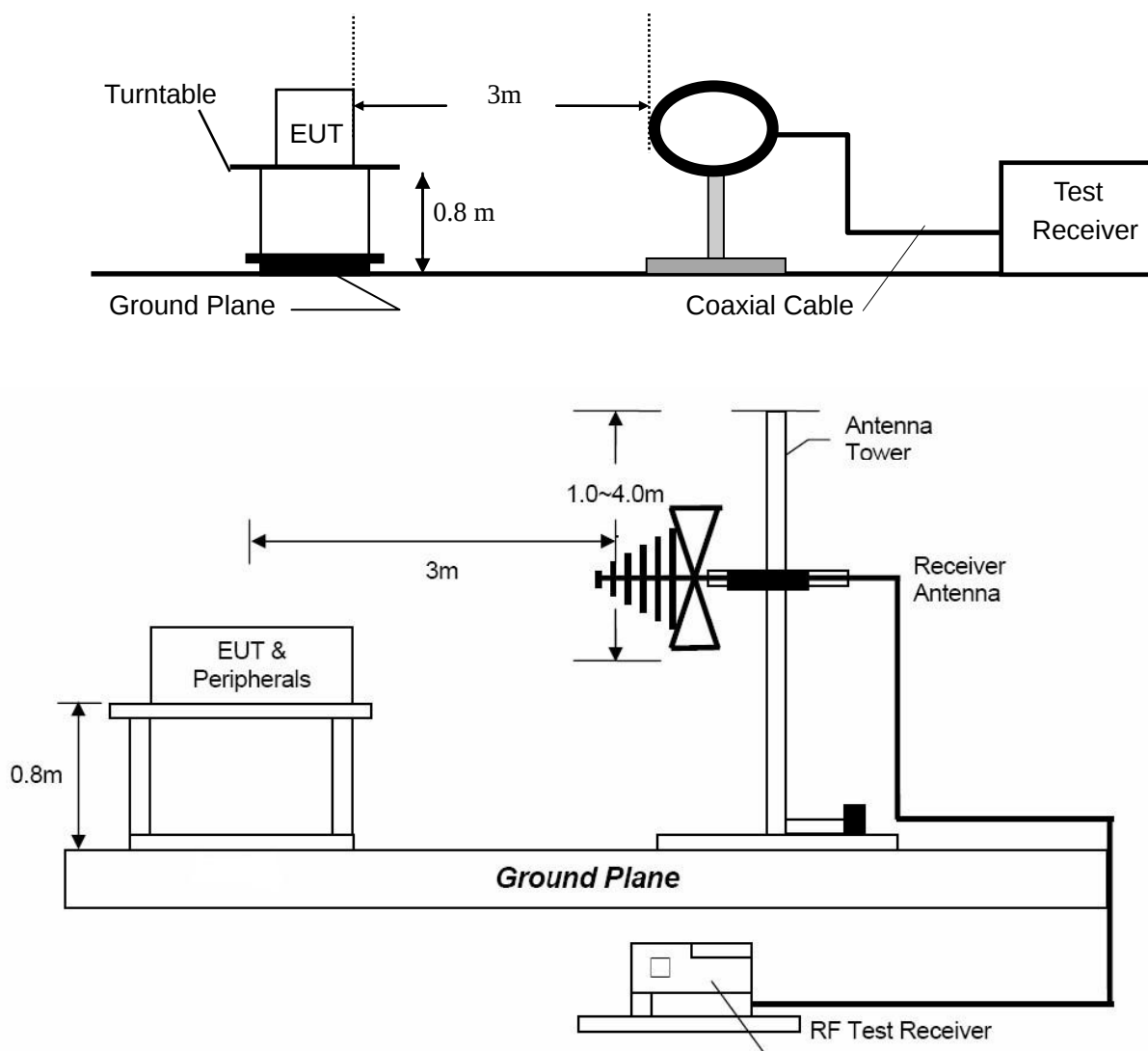
Note:

| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV | Limit<br>dBuV | Over<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|--------------------------|---------------|------------|----------|---------|
| 1   |     | 0.2779       | 30.59                    | 10.61                   | 41.20                    | 60.88         | -19.68     | QP       |         |
| 2   |     | 0.2779       | 23.79                    | 10.61                   | 34.40                    | 50.88         | -16.48     | AVG      |         |
| 3   |     | 0.3700       | 30.19                    | 10.61                   | 40.80                    | 58.50         | -17.70     | QP       |         |
| 4   |     | 0.3700       | 17.79                    | 10.61                   | 28.40                    | 48.50         | -20.10     | AVG      |         |
| 5   | *   | 0.4660       | 37.28                    | 10.62                   | 47.90                    | 56.58         | -8.68      | QP       |         |
| 6   |     | 0.4660       | 24.58                    | 10.62                   | 35.20                    | 46.58         | -11.38     | AVG      |         |
| 7   |     | 1.1820       | 30.05                    | 10.65                   | 40.70                    | 56.00         | -15.30     | QP       |         |
| 8   |     | 1.1820       | 21.25                    | 10.65                   | 31.90                    | 46.00         | -14.10     | AVG      |         |
| 9   |     | 4.3778       | 28.44                    | 10.66                   | 39.10                    | 56.00         | -16.90     | QP       |         |
| 10  |     | 4.3778       | 15.54                    | 10.66                   | 26.20                    | 46.00         | -19.80     | AVG      |         |
| 11  |     | 15.2500      | 29.63                    | 10.67                   | 40.30                    | 60.00         | -19.70     | QP       |         |
| 12  |     | 15.2500      | 16.83                    | 10.67                   | 27.50                    | 50.00         | -22.50     | AVG      |         |

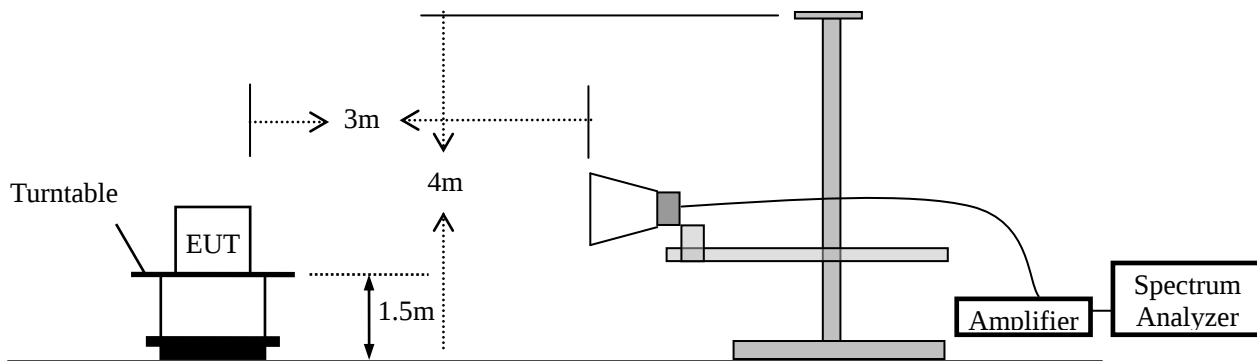
## 4. Radiated Emission Test

### 4.1 Test SET-UP (Block Diagram of Configuration)

#### 4.1.1 Radiated Emission Test Set-Up, Frequency Below 30MHz



#### 4.1.2 Radiated Emission Test Set-Up, Frequency above 1GHz



#### 4.2 Measurement Procedure

- Blow 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi- anechoic chamber room.
- For the radiated emission test above 1GHz:  
The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full anechoic chamber room. The table was rotated 360 degrees to determine the position of the highest radiation. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
- A Quasi-peak measurement was then made for that frequency point for below 1GHz test. PK and AV for above 1GHz emission test.

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

| Frequency Band (MHz) | Level   | Resolution Bandwidth | Video Bandwidth |
|----------------------|---------|----------------------|-----------------|
| 30 to 1000           | QP      | 120 kHz              | 300 kHz         |
| Above 1000           | Peak    | 1 MHz                | 3 MHz           |
|                      | Average | 1 MHz                | 10 Hz           |

#### 4.3 Limit

| Frequency range MHz | Distance Meters | Field Strengths Limit (15.209)          |                                                  |
|---------------------|-----------------|-----------------------------------------|--------------------------------------------------|
|                     |                 | $\mu\text{V/m}$                         |                                                  |
| 0.009 ~ 0.490       | 300             | $2400/F(\text{kHz})$                    |                                                  |
| 0.490 ~ 1.705       | 30              | $24000/F(\text{kHz})$                   |                                                  |
| 1.705 ~ 30          | 30              | 30                                      |                                                  |
| 30 ~ 88             | 3               | 100                                     |                                                  |
| 88 ~ 216            | 3               | 150                                     |                                                  |
| 216 ~ 960           | 3               | 200                                     |                                                  |
| Above 960           | 3               | 500                                     |                                                  |
| Frequency range MHz | Distance Meters | Field Strengths Limit (15.249)          |                                                  |
|                     |                 | mV/m<br>(Field strength of fundamental) | $\mu\text{V/m}$<br>(Field strength of Harmonics) |
| 902 ~ 928           | 3               | 50                                      | 500                                              |
| 2400 ~ 2483.5       | 3               | 50                                      | 500                                              |
| 5725 ~ 5875         | 3               | 50                                      | 500                                              |
| 24000 ~ 2425000     | 3               | 250                                     | 2500                                             |

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

#### 4.4 Measurement Results

Please refer to following the test plots of the worst case: Middle channel.



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### Radiated Emission Measurement

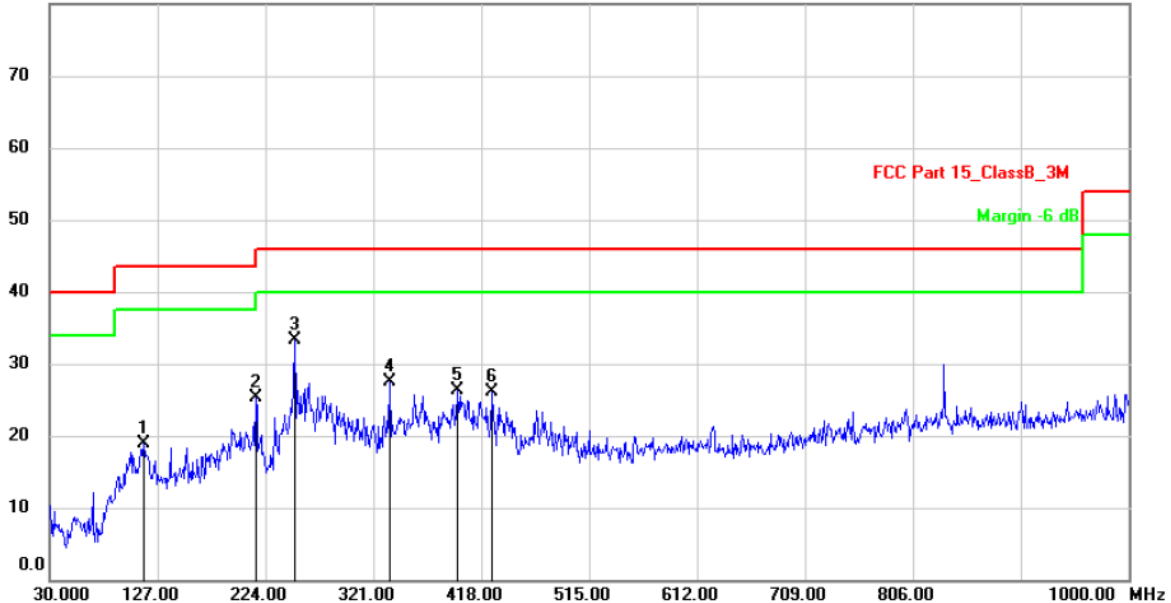
File :TM156G

Data :#59

Date: 2019/4/10

Time: 11:28:40

80.0 dBuV/m



Site: 3m Chamber

Polarization: **Horizontal**

Temperature: 26

Limit: FCC Part 15\_ClassB\_3M

Power: AC120V/60Hz

Humidity: 47 %

EUT: Dongle

Distance: 3m

M/N: TM156

Mode: TX

Note:

| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measurement | Limit  | Over   | Antenna Height | Table Degree |         |
|-----|-----|----------|---------------|----------------|-------------|--------|--------|----------------|--------------|---------|
|     |     | MHz      | dBuV          | dB/m           | dBuV/m      | dBuV/m | dB     | cm             | degree       | Comment |
| 1   |     | 114.3900 | 31.86         | -12.87         | 18.99       | 43.50  | -24.51 | QP             |              |         |
| 2   |     | 215.2700 | 38.51         | -13.11         | 25.40       | 43.50  | -18.10 | QP             |              |         |
| 3   | *   | 250.1900 | 45.01         | -11.69         | 33.32       | 46.00  | -12.68 | QP             |              |         |
| 4   |     | 335.5500 | 36.98         | -9.43          | 27.55       | 46.00  | -18.45 | QP             |              |         |
| 5   |     | 396.6600 | 35.36         | -9.13          | 26.23       | 46.00  | -19.77 | QP             |              |         |
| 6   |     | 427.7000 | 34.67         | -8.48          | 26.19       | 46.00  | -19.81 | QP             |              |         |

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



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### Radiated Emission Measurement

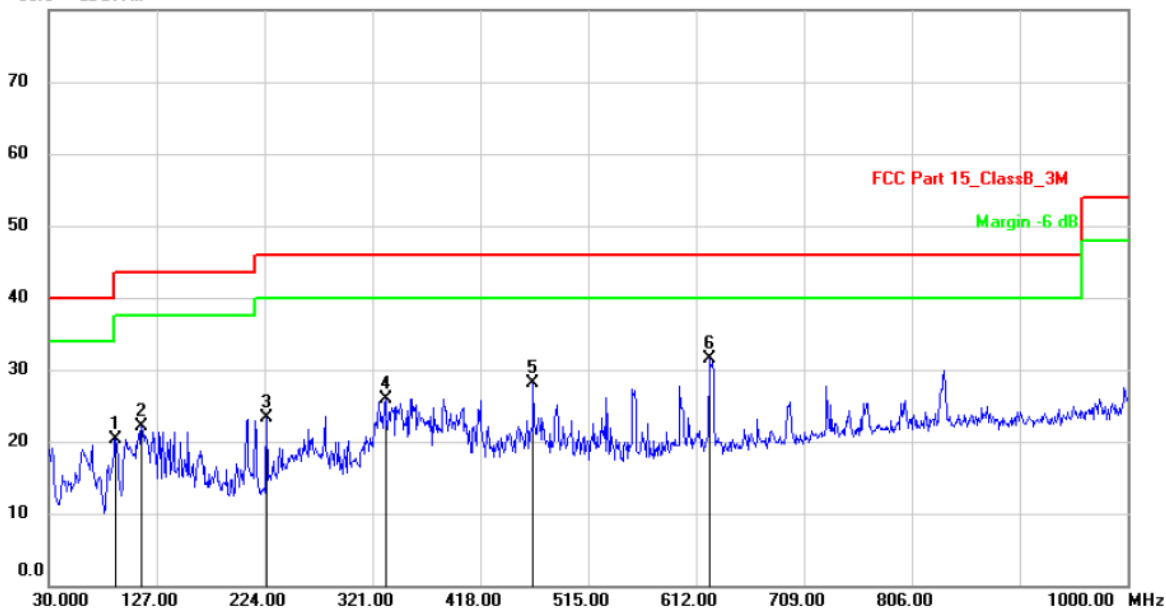
File : TM156G

Data : #58

Date: 2019/4/10

Time: 11:20:53

80.0 dBuV/m



Site: 3m Chamber

Polarization: **Vertical**

Temperature: 26

Limit: FCC Part 15\_ClassB\_3M

Power: AC120V/60Hz

Humidity: 47 %

EUT: Dongle

Distance: 3m

M/N: TM156

Mode: TX

Note:

| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-ment | Limit  | Over   | Antenna Height | Table Degree |         |
|-----|-----|----------|---------------|----------------|--------------|--------|--------|----------------|--------------|---------|
|     |     | MHz      | dBuV          | dB/m           | dBuV/m       | dBuV/m | dB     | cm             | degree       | Comment |
| 1   |     | 90.1400  | 37.30         | -16.90         | 20.40        | 43.50  | -23.10 | QP             |              |         |
| 2   |     | 113.4200 | 38.21         | -16.03         | 22.18        | 43.50  | -21.32 | QP             |              |         |
| 3   |     | 225.9400 | 39.07         | -15.67         | 23.40        | 46.00  | -22.60 | QP             |              |         |
| 4   |     | 332.6400 | 37.52         | -11.52         | 26.00        | 46.00  | -20.00 | QP             |              |         |
| 5   |     | 465.5300 | 37.65         | -9.58          | 28.07        | 46.00  | -17.93 | QP             |              |         |
| 6   | *   | 623.6400 | 38.33         | -6.89          | 31.44        | 46.00  | -14.56 | QP             |              |         |

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

|                    |         |               |                |
|--------------------|---------|---------------|----------------|
| Frequency Range:   | 1-25GHz | Test Date :   | April 09, 2019 |
| Test Result:       | PASS    | Temperature : | 21 °C          |
| Measured Distance: | 3m      | Humidity :    | 55 %           |
| Test By:           | Sance   |               |                |

| Freq.<br>(MHz)                 | Ant.Pol.<br>(H/V) | Reading<br>Level(dBuV) |       | Factor<br>(dB/m) | Emission Level<br>(dBuV) |       | Limit 3m<br>(dBuV/m) |       | Margin<br>(dB) |        |
|--------------------------------|-------------------|------------------------|-------|------------------|--------------------------|-------|----------------------|-------|----------------|--------|
|                                |                   | PK                     | AV    |                  | PK                       | AV    | PK                   | AV    | PK             | AV     |
| Operation Mode: TX Mode (Low)  |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2403                           | V                 | 87.99                  | 39.99 | 0.13             | 88.12                    | 40.12 | 114.00               | 94.00 | -25.88         | -53.88 |
| 4806                           | V                 | 52.37                  | 32.03 | 6.30             | 58.67                    | 38.33 | 74.00                | 54.00 | -15.33         | -15.67 |
| 7209                           | V                 | 44.94                  | 30.66 | 10.44            | 55.38                    | 41.10 | 74.00                | 54.00 | -18.62         | -12.90 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2403                           | H                 | 94.11                  | 41.46 | 0.13             | 94.24                    | 41.59 | 114.00               | 94.00 | -19.76         | -52.41 |
| 4806                           | H                 | 55.56                  | 32.26 | 6.30             | 61.86                    | 38.56 | 74.00                | 54.00 | -12.14         | -15.44 |
| 7209                           | H                 | 44.7                   | 30.71 | 10.44            | 55.14                    | 41.15 | 74.00                | 54.00 | -18.86         | -12.85 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |
| Operation Mode: TX Mode (Mid)  |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2441                           | V                 | 89.15                  | 37.88 | 0.24             | 89.39                    | 38.12 | 114.00               | 94.00 | -24.61         | -55.88 |
| 4882                           | V                 | 53.39                  | 31.65 | 6.60             | 59.99                    | 38.25 | 74.00                | 54.00 | -14.01         | -15.75 |
| 7323                           | V                 | 45.95                  | 31.26 | 10.55            | 56.50                    | 41.81 | 74.00                | 54.00 | -17.50         | -12.19 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2441                           | H                 | 95.26                  | 41.11 | 0.24             | 95.50                    | 41.35 | 114.00               | 94.00 | -18.50         | -52.65 |
| 4882                           | H                 | 54.58                  | 31.94 | 6.60             | 61.18                    | 38.54 | 74.00                | 54.00 | -12.82         | -15.46 |
| 7323                           | H                 | 45.4                   | 31.23 | 10.55            | 55.95                    | 41.78 | 74.00                | 54.00 | -18.05         | -12.22 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |
| Operation Mode: TX Mode (High) |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2480                           | V                 | 86.23                  | 39.48 | 0.34             | 86.57                    | 39.82 | 114.00               | 94.00 | -27.43         | -54.18 |
| 4960                           | V                 | 51.36                  | 31.31 | 6.89             | 58.25                    | 38.20 | 74.00                | 54.00 | -15.75         | -15.80 |
| 7440                           | V                 | 45.61                  | 31.29 | 10.60            | 56.21                    | 41.89 | 74.00                | 54.00 | -17.79         | -12.11 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |
| 2480                           | H                 | 92.58                  | 41.18 | 0.34             | 92.92                    | 41.52 | 114.00               | 94.00 | -21.08         | -52.48 |
| 4960                           | H                 | 53.13                  | 31.61 | 6.89             | 60.02                    | 38.50 | 74.00                | 54.00 | -13.98         | -15.50 |
| 7440                           | H                 | 46.45                  | 31.24 | 10.60            | 57.05                    | 41.84 | 74.00                | 54.00 | -16.95         | -12.16 |
| ---                            |                   |                        |       |                  |                          |       |                      |       |                |        |

- Note:**
- (1) All Readings are Peak Value and AV.
  - (2) Emission Level= Reading Level + Factor
  - (3) Factor= Antenna Gain + Cable Loss – Amplifier Gain
  - (4) Data of measurement within this frequency range shown “ ---” in the table above means the reading of emissions are attenuated more than 10dB below the permissible limits.
  - (5) Measurement uncertainty :  $\pm 3.7$ dB.
  - (6) Horn antenna used for the emission over 1000MHz.

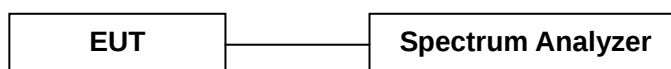
## 5. 20dB Bandwidth

### 5.1 Measurement Procedure

The 20dB bandwidth of the emission was contained within the frequency band designated which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over excepted variations in temperature and supply voltage were considered, FCC Rule 15.215(c):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RBW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. Use the spectrum 20dB down delta function to measure the bandwidth.

### 5.2 Test SET-UP (Block Diagram of Configuration)



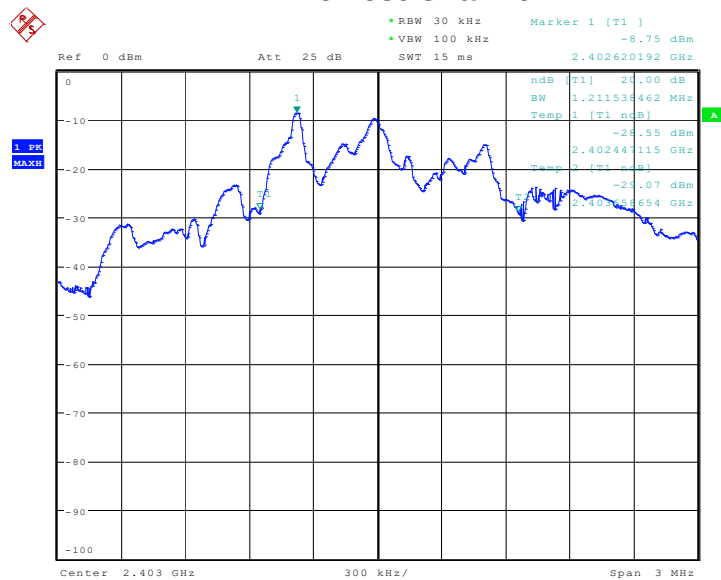
### 5.3 Measurement Results

Refer to attached data chart.

|                    |       |               |                |
|--------------------|-------|---------------|----------------|
| RBW:               | 30KHz | VBW:          | 100KHz         |
| Spectrum Detector: | PK    | Temperature : | 22 °C          |
| Test By:           | Sance | Humidity :    | 54 %           |
| Test Result:       | PASS  | Test Date :   | March 22, 2019 |

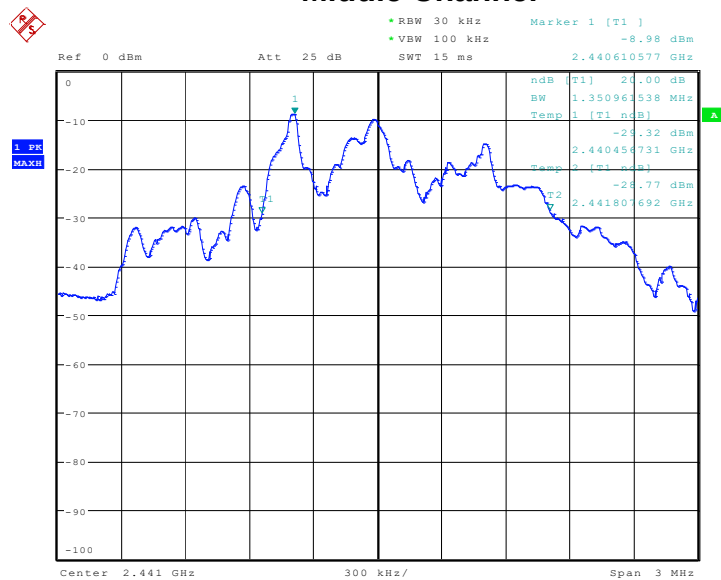
| Channel frequency (MHz) | 20dB Down BW(kHz) |
|-------------------------|-------------------|
| 2403                    | 1212              |
| 2441                    | 1351              |
| 2480                    | 1423              |

## Lowest Channel



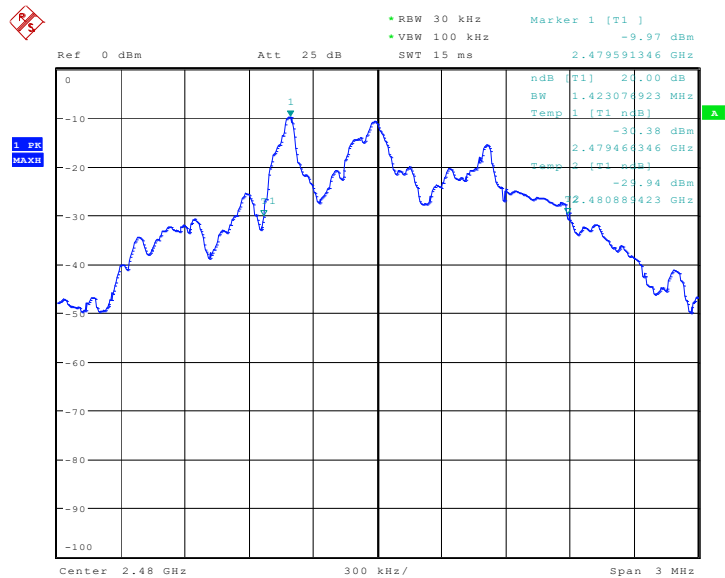
Date: 22.MAR.2019 14:10:24

## Middle Channel



Date: 22.MAR.2019 14:15:10

Highest Channel



Date: 22.MAR.2019 14:19:52

## 6. Band Edge

### 6.1 Measurement Procedure

Same as Radiated Emission Test.

### 6.2 Limit

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

### 6.3 Measurement Results

|                    |         |             |                |
|--------------------|---------|-------------|----------------|
| Operation Mode:    | TX Mode | Test Date : | April 09, 2019 |
| Temperature :      | 21 °C   | Humidity :  | 55 %           |
| Test Result:       | PASS    | Test By:    | Sance          |
| Measured Distance: | 3m      |             |                |

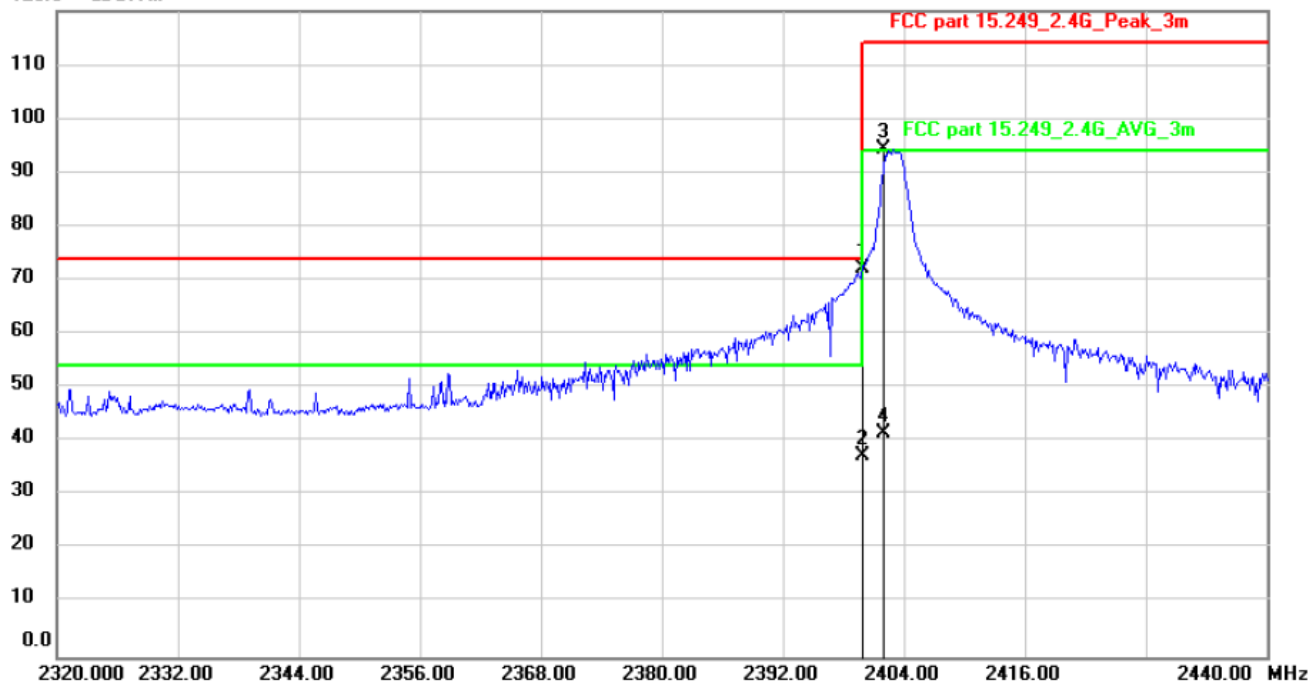
| Freq.<br>(MHz) | Ant.Pol.<br>(H/V) | Reading<br>Level(dBuV) |       | Factor<br>(dB/m) | Emission Level<br>(dBuV) |       | Limit 3m<br>(dBuV/m) |       | Margin<br>(dB) |        |
|----------------|-------------------|------------------------|-------|------------------|--------------------------|-------|----------------------|-------|----------------|--------|
|                |                   | PK                     | AV    |                  | PK                       | AV    | PK                   | AV    | PK             | AV     |
| 2390.000       | H                 | 66.8                   | 36.77 | 0.09             | 66.89                    | 36.86 | 74.00                | 54.00 | -7.11          | -17.14 |
| 2390.000       | V                 | 72.16                  | 37.28 | 0.09             | 72.25                    | 37.37 | 74.00                | 54.00 | -1.75          | -16.63 |
| 2483.500       | H                 | 68.87                  | 36.72 | 0.35             | 69.22                    | 37.07 | 74.00                | 54.00 | -4.78          | -16.93 |
| 2483.500       | V                 | 62.97                  | 33.18 | 0.35             | 63.32                    | 33.53 | 74.00                | 54.00 | -10.68         | -20.47 |

**Note:** (1) Emission Level= Reading Level + Factor  
 (2) Factor= Antenna Gain + Cable Loss – Amplifier Gain  
 (3) Horn antenna used for the emission over 1000MHz.

## Low channel

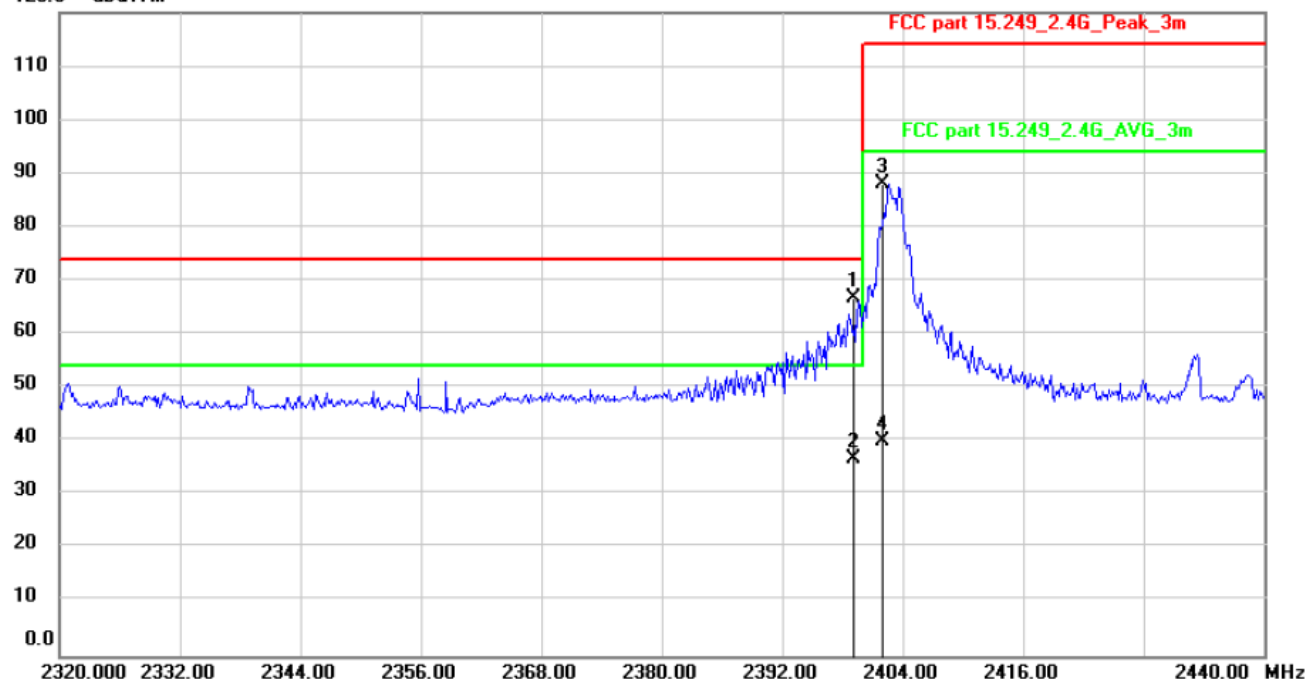
Horizontal

120.0 dBuV/m



Vertical

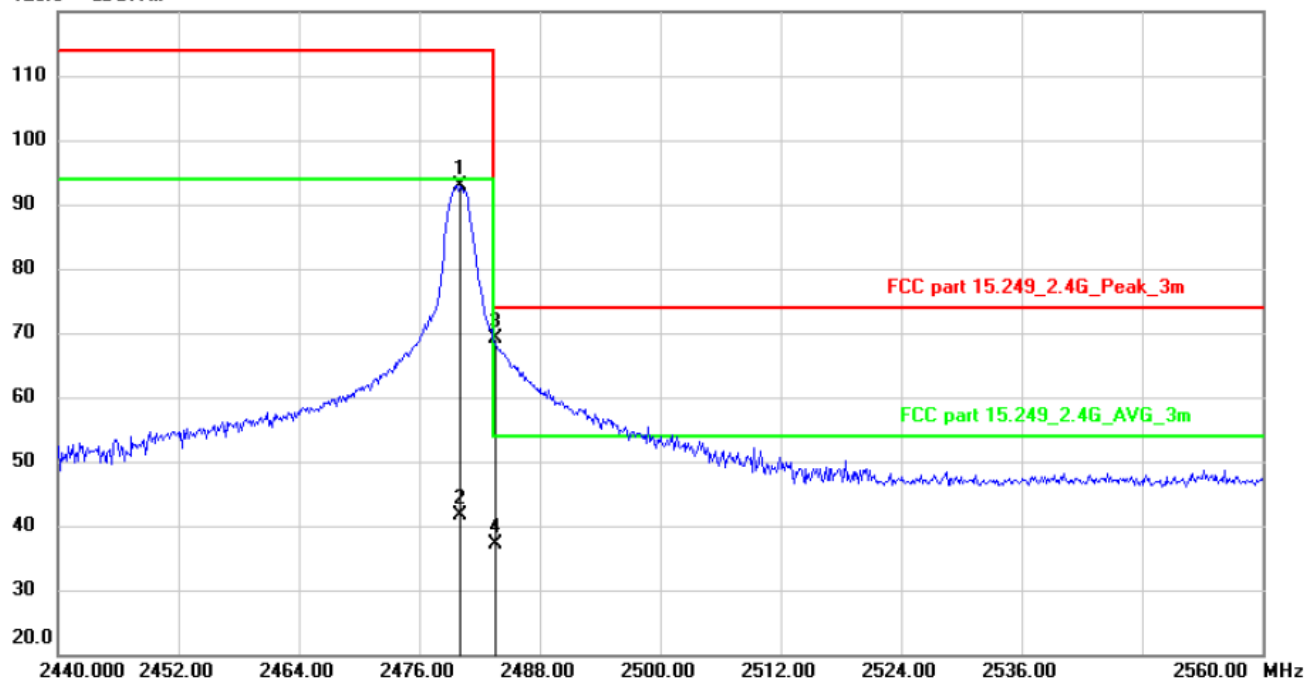
120.0 dBuV/m



## High channel

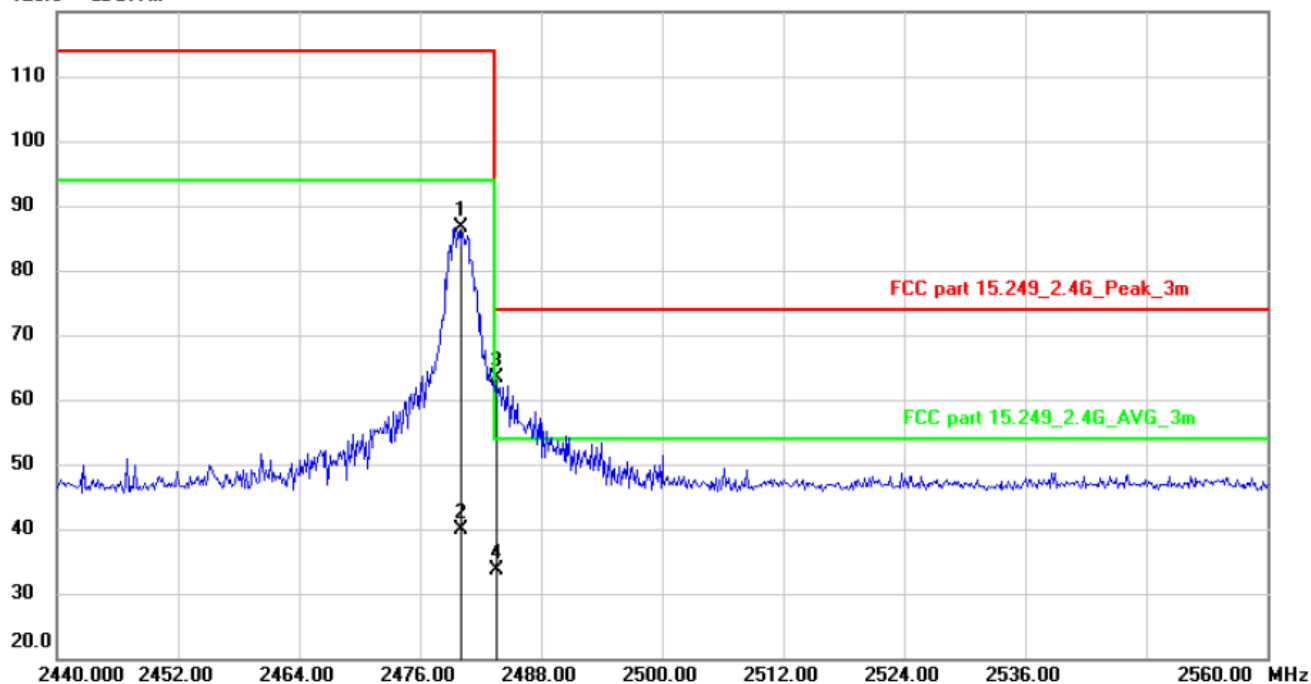
Horizontal

120.0 dBuV/m



Vertical

120.0 dBuV/m



## 7. Antenna requirement

### 7.1 Measurement Procedure

According to of FCC part 15C section 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, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

### 7.2 Measurement Results

The antenna is PCB antenna and no consideration of replacement, and the best case gain of the antenna is 0dBi. So, the antenna is consider meet the requirement.

## 8. Test Equipment List

| No. | Equipment                      | Manufacturer                      | Model No.  | Serial No.     | Characteristics | Last Cal.     | Cal. Interval |
|-----|--------------------------------|-----------------------------------|------------|----------------|-----------------|---------------|---------------|
| 1.  | Test Receiver                  | Rohde & Schwarz                   | ESCI7      | 100837         | 9KHz~7GHz       | Mar. 13, 2019 | Mar. 12, 2020 |
| 2.  | Antenna                        | Schwarzbeck                       | VULB9162   | 9162-010       | 30MHz~7GHz      | Mar. 22, 2019 | Mar. 21, 2020 |
| 3.  | Spectrum Analyzer              | Rohde & Schwarz                   | FSU26      | 200409/026     | 20Hz~26.5GHz    | Mar. 13, 2019 | Mar. 12, 2020 |
| 4.  | Spectrum Analyzer              | Keysight                          | N9020A     | MY54200831     | 20Hz~26.5GHz    | Apr. 24, 2018 | Apr. 23, 2019 |
| 5.  | Spectrum Analyzer              | Rohde & Schwarz                   | FSV40      | 101003         | 10Hz~40GHz      | Apr. 24, 2018 | Apr. 23, 2019 |
| 6.  | Horn Antenna                   | Schwarzbeck                       | BBHA9170   | 9170-372       | 15GHz~40GHz     | Mar. 22, 2019 | Mar. 21, 2020 |
| 7.  | Pre-Amplifier                  | EMCI                              | EMC 184045 | 980102         | 18GHz~40GHz     | Apr. 24, 2018 | Apr. 23, 2019 |
| 8.  | Power Sensor                   | DARE                              | RPR3006W   | 15I00041SN O64 | 100MHz~6GHz     | Mar. 13, 2019 | Mar. 12, 2020 |
| 9.  | Communication Tester           | Rohde & Schwarz                   | CMW500     | 149004         | 70MHz~6GHz      | Mar. 13, 2019 | Mar. 12, 2020 |
| 10. | Horn Antenna                   | COM-Power                         | AH-118     | 071078         | 500MHz~18GHz    | Mar. 22, 2019 | Mar. 21, 2020 |
| 11. | Pre-Amplifier                  | HP                                | HP 8449B   | 3008A00964     | 1GHz~26.5GHz    | Mar. 13, 2019 | Mar. 12, 2020 |
| 12. | Pre-Amplifier                  | HP                                | HP 8447D   | 1145A00203     | 100KHz~1.3GHz   | Mar. 13, 2019 | Mar. 12, 2020 |
| 13. | Loop Antenna                   | Schwarzbeck                       | FMZB 1513  | 1513-272       | 9KHz~30MHz      | Apr. 24, 2018 | Apr. 23, 2019 |
| 14. | Temperature & Humidity Chamber | REMAFEE                           | SYHR225L   | N/A            | -40~150℃        | Apr. 24, 2018 | Apr. 23, 2019 |
| 15. | DC Source                      | MY                                | MY8811     | N/A            | 0~30V           | Mar. 22, 2019 | Mar. 21, 2020 |
| 16. | Temporary antenna connector    | TESCOM                            | SS402      | N/A            | 9KHz~25GHz      | N/A           | N/A           |
| 17. | Test Receiver                  | Rohde & Schwarz                   | ESCI       | 101152         | 9KHz~3GHz       | Mar. 13, 2019 | Mar. 12, 2020 |
| 18. | L.I.S.N                        | Rohde & Schwarz                   | ENV 216    | 101317         | N/A             | Mar. 13, 2019 | Mar. 12, 2020 |
| 19. | L.I.S.N                        | Schwarzbeck                       | NNLK8129   | 8129212        | N/A             | Mar. 06, 2019 | Mar. 05, 2020 |
| 20. | RF Switching Unit              | Compliance Direction Systems Inc. | RSU-M2     | 38311          | N/A             | Mar. 13, 2019 | Mar. 12, 2020 |
| 21. | Test Software                  | EZ                                | EZ_EMCC    | N/A            | N/A             | N/A           | N/A           |

Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

---End---