



## FCC Test Report

Report No: FCS202008060

Issued for

|  |   |
|--|---|
| Applicant:   | Aiwa Electronics International Co., Ltd   |
| Address:   | 4F., No. 24, Ln. 141, Sec. 3, Beishen Rd.,<br>Shenkeng Dist., New Taipei City 222, Taiwan<br>(R.O.C.) |
| Product Name:  | SB-X100   |
| Brand Name:  | aiwa  |
| Model Name:  | SB-X100   |
| Series Model:  | N/A   |
| FCC ID:  | 2AW6X-SB-X100   |
| Issued By: Flux Compliance Service Laboratory<br>Add: Room 105 Floor Bao hao Technology Building 1 NO.15 Gong yeWest Road Hi-Tech<br>Industrial, Song shan lake Dongguan<br>Tel: 769-27280901 Fax:769-27280901 <a href="http://www.FCS-lab.com">http://www.FCS-lab.com</a> |   |

**FCS REPORT**

| Table of Contents   | Page      |
|---|-----------|
| <b>1. Summary of Test Results .....</b>                                   | <b>7</b>  |
| <b>1.1 Test Laboratory .....</b>  | <b>8</b>  |
| <b>1.2 Measurement Uncertainty .....</b>                                  | <b>8</b>  |
| <b>1.3 Test Environment Conditions .....</b>                              | <b>8</b>  |
| <b>2. General Information.....</b>  | <b>9</b>  |
| <b>2.1 General Description of The EUT .....</b>                           | <b>9</b>  |
| <b>2.2 Channel List .....</b>   | <b>10</b> |
| <b>2.3 Assistant Equipment Used For Test.....</b>                         | <b>10</b> |
| <b>2.4 Description of The Test Modes .....</b>                            | <b>10</b> |
| <b>2.5 Block Diagram Showing The Configuration of System Tested .....</b> | <b>11</b> |
| <b>2.6 Equipments List .....</b>  | <b>11</b> |
| <b>3. 6dB Bandwidth .....</b>   | <b>13</b> |
| <b>3.1 Block Diagram of Test Setup .....</b>                              | <b>13</b> |
| <b>3.2 Limit .....</b>  | <b>13</b> |
| <b>3.3 Test Procedure .....</b>   | <b>13</b> |
| <b>3.4 Test Result.....</b>   | <b>14</b> |
| <b>3.5 Original Test data .....</b>                                       | <b>14</b> |
| <b>4. Conducted Peak Output Power .....</b>                               | <b>16</b> |
| <b>4.1 Block Diagram of Test Setup .....</b>                              | <b>16</b> |
| <b>4.2 Limit .....</b>  | <b>16</b> |
| <b>4.3 Test Procedure .....</b>   | <b>16</b> |
| <b>4.5 Test Result.....</b>   | <b>16</b> |
| <b>5. Power Spectral Density .....</b>                                    | <b>17</b> |
| <b>5.1 Block Diagram of Test Setup .....</b>                              | <b>17</b> |
| <b>5.2 Limit .....</b>  | <b>17</b> |
| <b>5.3 Test Procedure .....</b>   | <b>17</b> |

| Table of Contents   | Page      |
|---|-----------|
| <b>5.4 Test Result .....</b>                                | <b>18</b> |
| <b>5.5 Original Test data .....</b>                         | <b>19</b> |
| <b>6. BandEdge and Spurious Emissions (Conducted) .....</b> | <b>21</b> |
| <b>6.1 Block Diagram of Test Setup .....</b>                | <b>21</b> |
| <b>6.2 Limit .....</b>                                      | <b>21</b> |
| <b>6.3 Test Procedure .....</b>                             | <b>21</b> |
| <b>6.4 Test Result .....</b>                                | <b>22</b> |
| <b>6.5 Original Test data .....</b>                         | <b>23</b> |
| <b>7. Radiated Spurious Emission .....</b>                  | <b>26</b> |
| <b>7.1 Block Diagram of Test Setup .....</b>                | <b>26</b> |
| <b>7.2 FCC 15.209 Limit .....</b>                           | <b>27</b> |
| <b>7.3 Test Procedure .....</b>                             | <b>28</b> |
| <b>7.4 Test Result .....</b>                                | <b>29</b> |
| <b>8. Band Edge Compliance(radiated method).....</b>        | <b>35</b> |
| <b>8.1 Block Diagram of Test Setup .....</b>                | <b>35</b> |
| <b>8.2 Limit .....</b>                                      | <b>35</b> |
| <b>8.3 Test Procedure .....</b>                             | <b>35</b> |
| <b>8.4 Test Result .....</b>                                | <b>35</b> |
| <b>8.5 Original Test data .....</b>                         | <b>35</b> |
| <b>9. Power Line Conducted Emission .....</b>               | <b>40</b> |
| <b>9.1 Block Diagram of Test Setup .....</b>                | <b>40</b> |
| <b>9.2 Limit .....</b>                                      | <b>40</b> |
| <b>9.3 Test Procedure .....</b>                             | <b>40</b> |
| <b>9.4 Test Result .....</b>                                | <b>41</b> |
| <b>9.5 Original Test data .....</b>                         | <b>41</b> |
| <b>10. Antenna Requirements .....</b>                       | <b>43</b> |
| <b>10.1 Limit .....</b>                                     | <b>43</b> |

**Table of Contents****Page**

|                          |           |
|--------------------------|-----------|
| <b>10.2 Result .....</b> | <b>43</b> |
|--------------------------|-----------|

### Revision History

| Rev. | Issue Date     | Effect Page | Contents      |
|------|----------------|-------------|---------------|
| 01   | 05 August 2020 | All         | Initial Issue |
|      |                |             |               |

## TEST RESULT CERTIFICATION

Applicant's Name .....: Aiwa Electronics International Co., Ltd

Address .....: 4F., No. 24, Ln. 141, Sec. 3, Beishen Rd., Shenkeng Dist., New Taipei City 222, Taiwan (R.O.C.)

Manufacture's Name .....: Aiwa Electronics International Co., Ltd

Address .....: 4F., No. 24, Ln. 141, Sec. 3, Beishen Rd., Shenkeng Dist., New Taipei City 222, Taiwan (R.O.C.)

### Product Description

Product Name .....: SB-X100

Brand Name .....: aiwa

Model Name .....: SB-X100

Series Model .....: N/A

Test Standards .....: FCC Rules and Regulations Part 15 Subpart C

Test Procedure .....: ANSI C63.10:2013

This device described above has been tested FCS, the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

This report shall not be reproduced except in full, without the written approval of FCS, this document may be altered or revised by FCS, personal only, and shall be noted in the revision of the document..

### Date of Test.....:

Date (s) of performance of tests.: 23 July 2020 ~ 05 August 2020

Date of Issue .....: 05 August 2020

Test Result .....: Pass

Prepared By : 

(Chris Chen/Engineer)

Approved By : 

(Brown Lu)

## 1. Summary of Test Results

| Standard Section   | Test Item                                       | Judgment | Remark |
|--|---|----------|--------|
| FCC Part 15.247(a)(2)                                    | 6dB Bandwidth                                   | PASS     |        |
| FCC Part 15.247(b)(3)                                    | Conducted Output Power                          | PASS     |        |
| FCC Part 15.247(e)                                       | Power Spectral Density                          | PASS     | --     |
| FCC Part 15.247(d)<br>RSS-247 5.5                        | Band-edge and Spurious Emissions<br>(Conducted) | PASS     |        |
| FCC Part 15.247(d)<br>FCC Part 15.209<br>FCC Part 15.205 | Radiated Spurious Emissions                     | PASS     |        |
| FCC Part 15.247(d)<br>FCC Part 15.209<br>FCC Part 15.205 | Radiated Band Edge Compliance                   | PASS     |        |
| FCC Part 15.207  | Conducted Emission                              | PASS     | --     |
| FCC Part 15.203  | Antenna Requirement                             | PASS     | --     |

NOTE:

(1)" N/A" denotes test is not applicable in this Test Report

## 1.1 Test Laboratory

|                          |   |
|--------------------------|---|
| Company Name:            | Flux Compliance Service Laboratory  |
| Address:                 | Room 105 Floor Bao hao Technology Building 1 NO.15 Gong yeWest Road Hi-Tech Industrial, Song shan lake Dongguan |
| Telephone:               | +86-769-27280901  |
| Fax:                     | +86-769-27280901  |
| A2LA Accreditation No. : |   |

## 1.2 Measurement Uncertainty

The reported uncertainty of measurement  $y \pm U$ , where expended uncertainty  $U$  is based on a standard uncertainty multiplied by a coverage factor of  $k=2$ , providing a level of confidence of approximately 95 %.

| No. | Items   | Uncertainty    |
|-----|---|----------------|
| 1   | RF output power, conducted                    | $\pm 0.71$ dB  |
| 2   | Unwanted Emissions, conducted                 | $\pm 2.988$ dB |
| 3   | Conducted Emission (9KHz-150KHz)              | $\pm 4.13$ dB  |
| 4   | Conducted Emission (150KHz-30MHz)             | $\pm 4.74$ dB  |
| 5   | All emissions, radiated(<1G) 30MHz-1000MHz    | $\pm 5.2$ dB   |
| 6   | All emissions, radiated(>1G) 1000MHz -3000MHz | $\pm 4.66$ dB  |
| 7   | All emissions, radiated(<1G) 3000MHz -6000MHz | $\pm 5.31$ dB  |

## 1.3 Test Environment Conditions

During the measurement the environmental conditions were within the listed ranges:

|                   |           |
|-------------------|-----------|
| Temperature rang: | 20-26°C   |
| Humidity range:   | 40-65%    |
| Pressure range:   | 86-106Kpa |

## 2. General Information

### 2.1 General Description of The EUT

|   |   |
|---|---|
| Product Name  | SB-X100                                 |
| Trade Name  | aiwa                                    |
| Model Name  | SB-X100                                 |
| Series Model  | N/A                                     |
| Model Difference  | N/A                                     |
| Operation Frequency   | 2402 – 2480 MHz                         |
| Modulation  | GFSK                                    |
| Antenna Type  | FPCB antenna, maximum PK gain: 2.96 dBi |
| Adapter   | N/A                                     |
| Battery   | DC 7.4V 2000mAh Li Battery              |
| Hardware version number   | N/A                                     |
| Software version number   | N/A                                     |
| Connecting I/O Port(s)  | Please refer to the User's Manual       |
| Note: For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual. |   |

## 2.2 Channel List

| Channel List |                 |         |                 |         |                 |
|--------------|-----------------|---------|-----------------|---------|-----------------|
| Channel      | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| 00           | 2402            | 14      | 2430            | 29      | 2458            |
| 01           | 2404            | 15      | 2432            | 30      | 2460            |
| 02           | 2406            | 16      | 2434            | 31      | 2462            |
| 03           | 2408            | 17      | 2436            | 32      | 2464            |
| 04           | 2410            | 18      | 2438            | 33      | 2466            |
| 05           | 2412            | 19      | 2440            | 34      | 2468            |
| 06           | 2414            | 20      | 2442            | 35      | 2470            |
| 07           | 2416            | 21      | 2444            | 36      | 2472            |
| 08           | 2418            | 22      | 2446            | 37      | 2474            |
| 09           | 2420            | 23      | 2448            | 38      | 2476            |
| 10           | 2422            | 24      | 2450            | 39      | 2478            |
| 11           | 2424            | 25      | 2452            | /       | /               |
| 12           | 2426            | 26      | 2454            | /       | /               |
| 13           | 2428            | 27      | 2456            | /       | /               |

## 2.3 Assistant Equipment Used For Test

| Assistant equipment | Manufacturer | Model number |
|---------------------|--------------|--------------|
| /                   | /            | /            |
| /                   | /            | /            |

## 2.4 Description of The Test Modes

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

| Worst Mode | Description | Data Rate/Modulation |
|------------|-------------|----------------------|
| Mode 1     | TX CH00     | GFSK                 |
| Mode 2     | TX CH19     | GFSK                 |
| Mode 3     | TX CH39     | GFSK                 |

## 2.5 Block Diagram Showing The Configuration of System Tested

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of FHSS



## 2.6 Equipments List

### Radiation Test equipment

| Kind of Equipment                | Manufacturer | Type No.     | Company No. | Last calibration | Calibrated until |
|----------------------------------|--------------|--------------|-------------|------------------|------------------|
| EMI Test Receiver                | R&S          | ESRP 3       | FCS-E001    | 2020.05.31       | 2021.05.30       |
| Signal Analyzer                  | R&S          | FSV40-N      | FCS-E012    | 2020.06.05       | 2021.06.04       |
| Active loop Antenna              | ZHINAN       | ZN30900C     | FCS-E013    | 2020.03.11       | 2021.03.10       |
| Bilog Antenna                    | SCHWARZBECK  | VULB 9168    | FCS-E002    | 2020.03.26       | 2021.03.25       |
| Horn Antenna                     | SCHWARZBECK  | BBHA 9120D   | FCS-E003    | 2020.05.31       | 2021.05.30       |
| SHF-EHF Horn Antenna (18G-40GHz) | A-INFO       | LB-180400-KF | FCS-E018    | 2020.05.31       | 2021.05.30       |
| Pre-Amplifier(0.1M-3G Hz)        | EMCI         | EM330N       | FCS-E004    | 2020.05.31       | 2021.05.30       |
| Pre-Amplifier (1G-18GHz)         | N/A          | TSAMP-0518SE | FCS-E014    | 2020.03.03       | 2021.03.02       |
| Temperature & Humidity           | HTC-1        | victor       | FCS-E005    | 2020.05.31       | 2021.05.30       |

## Conduction Test equipment

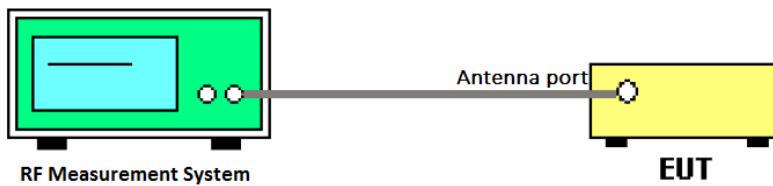
| Kind of Equipment      | Manufacturer | Type No. | Company No. | Last calibration | Calibrated until |
|------------------------|--------------|----------|-------------|------------------|------------------|
| EMI Test Receiver      | R&S          | ESPI     | FCS-E020    | 2020.05.31       | 2021.05.30       |
| LISN                   | R&S          | ENV216   | FCS-E007    | 2020.05.15       | 2021.05.14       |
| LISN                   | ETS          | 3810/2NM | FCS-E009    | 2020.03.15       | 2021.03.14       |
| Temperature & Humidity | HTC-1        | victor   | FCS-E008    | 2020.05.31       | 2021.05.30       |

## RF Connected Test

| Kind of Equipment   | Manufacturer | Type No. | Company No. | Last calibration | Calibrated until |
|---------------------|--------------|----------|-------------|------------------|------------------|
| MXA SIGNAL Analyzer | Keysight     | N9020A   | FCS-E015    | 2020.03.02       | 2021.03.01       |
| Power sensor        | Keysight     | U2021XA  | MY54080020  | 2020.03.02       | 2021.03.01       |
| Attenuator          | MCL          | BW-N6W5+ | SF495801    | 2020.03.02       | 2021.03.01       |
| RF cable            | FUJIKURA     | 10D2W    | 02          | 2020.03.02       | 2021.03.01       |

### 3. 6dB Bandwidth and 99% Occupied Bandwidth

#### 3.1 Block Diagram of Test Setup



#### 3.2 Limit

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 kHz

#### 3.3 Test Procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable
- (2) Set the spectrum analyzer as follows:

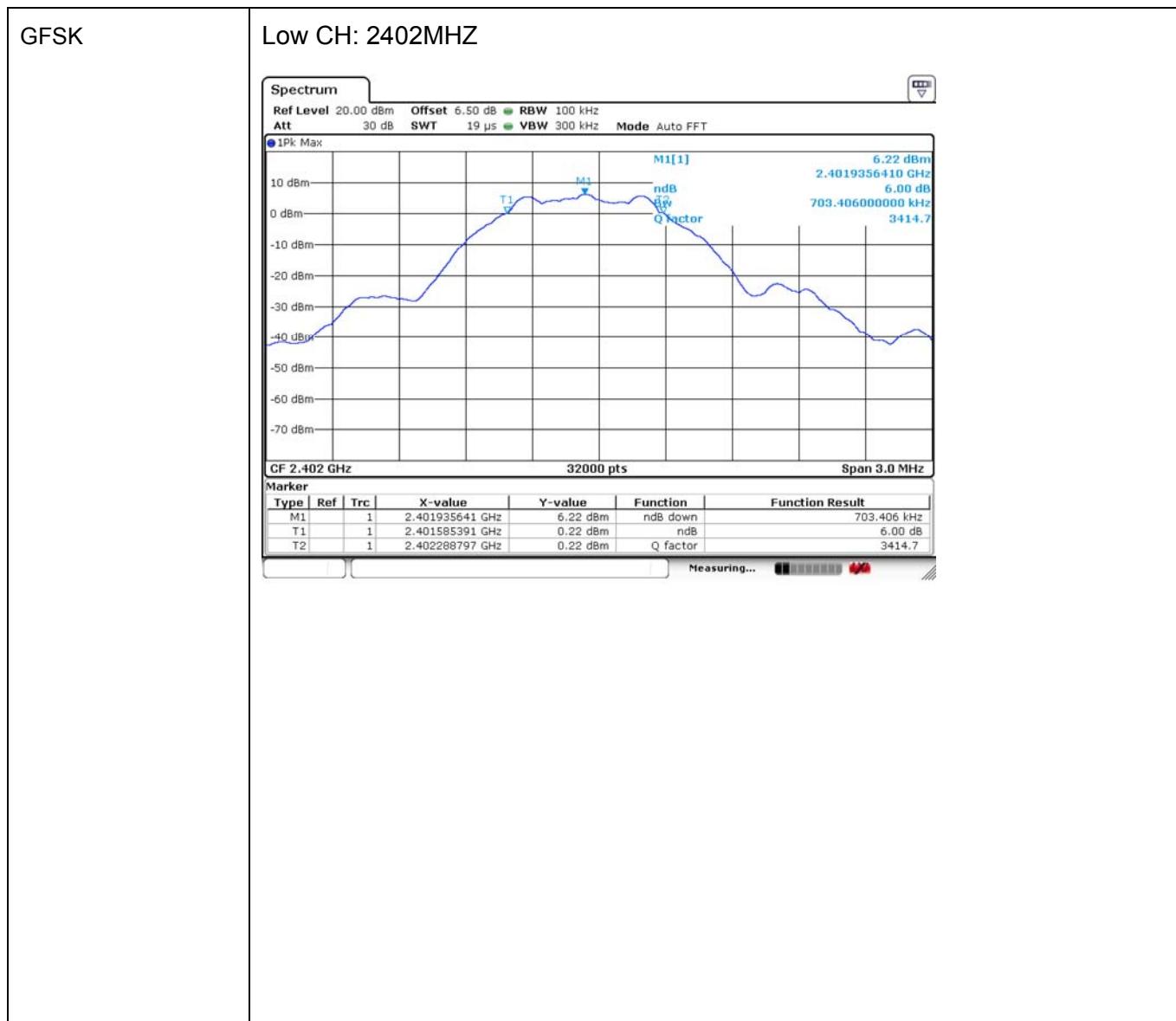
|               |               |
|---------------|---------------|
| RBW           | 100KHz/30KHz  |
| VBW           | 300KHz/100KHz |
| Detector Mode | Peak          |
| Sweep time    | Auto          |
| Trace mode    | Max hold      |

- (3) Allow the trace to stabilize, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

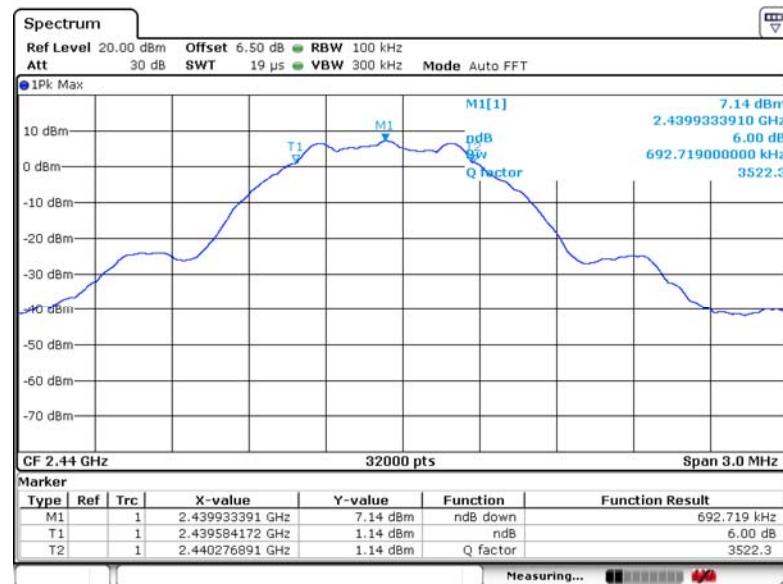
### 3.4 Test Result

| Mode | Frequency(MHz) | 6dB bandwidth Result(MHz) | Limit (MHz) | Conclusion |
|------|----------------|---------------------------|-------------|------------|
| GFSK | 2402           | 0.703                     | 0.5         | Pass       |
|      | 2440           | 0.693                     | 0.5         | Pass       |
|      | 2480           | 0.701                     | 0.5         | Pass       |

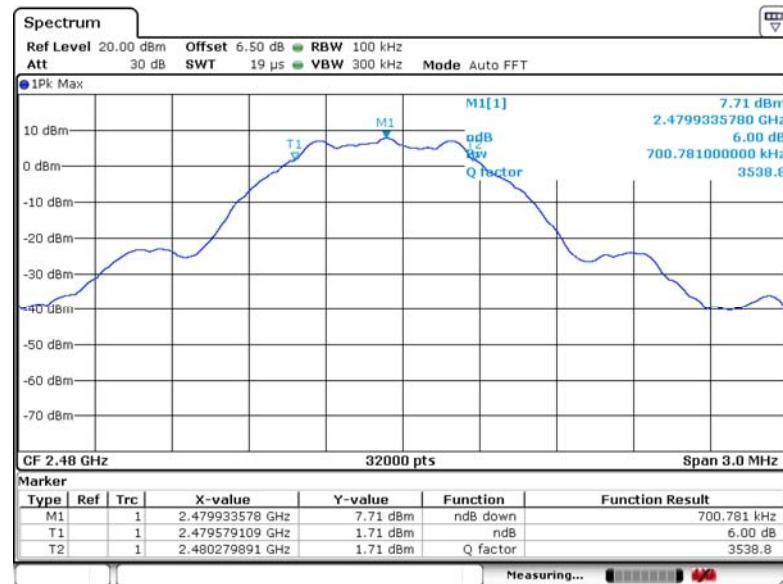
### 3.5 Original Test data



### Middle CH: 2440MHZ

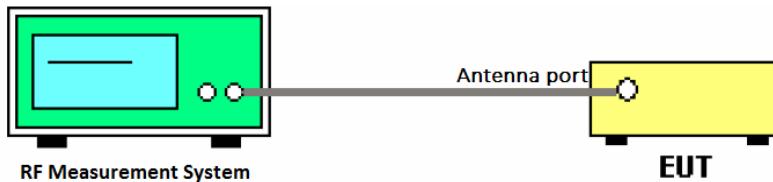


### High CH: 2480MHZ



## 4. Conducted Peak Output Power

### 4.1 Block Diagram of Test Setup



### 4.2 Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi

### 4.3 Test Procedure

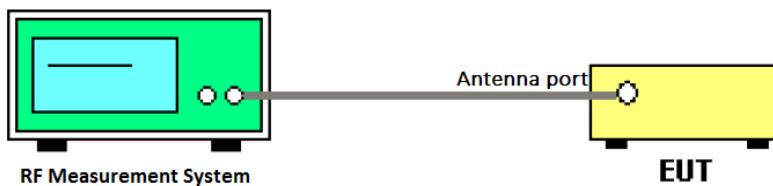
(1) Connect each EUT's antenna output to power sensor by RF cable and attenuator

### 4.5 Test Result

| Mode | Frequency(MHz) | Result(dBm) | Limit(dBm) | Conclusion |
|------|----------------|-------------|------------|------------|
| GFSK | 2402           | 6.50        | 30         | Pass       |
|      | 2440           | 7.36        | 30         | Pass       |
|      | 2480           | 7.92        | 30         | Pass       |

## 5. Power Spectral Density

### 5.1 Block Diagram of Test Setup



### 5.2 Limit

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

### 5.3 Test Procedure

(1) Connect EUT's antenna output to spectrum analyzer by RF cable

(2) Set the spectrum analyzer as follows:

|                  |  |
|------------------|--|
| Center frequency | DTS Channel center frequency                     |
| RBW              | $3\text{KHz} \leq \text{RBW} \leq 100\text{KHz}$ |
| VBW              | $\geq 3\text{RBW}$                               |
| Span             | 1.5 times the DTS bandwidth                      |
| Detector Mode    | PK   |
| Sweep time       | Auto   |
| Trace mode       | Max hold   |

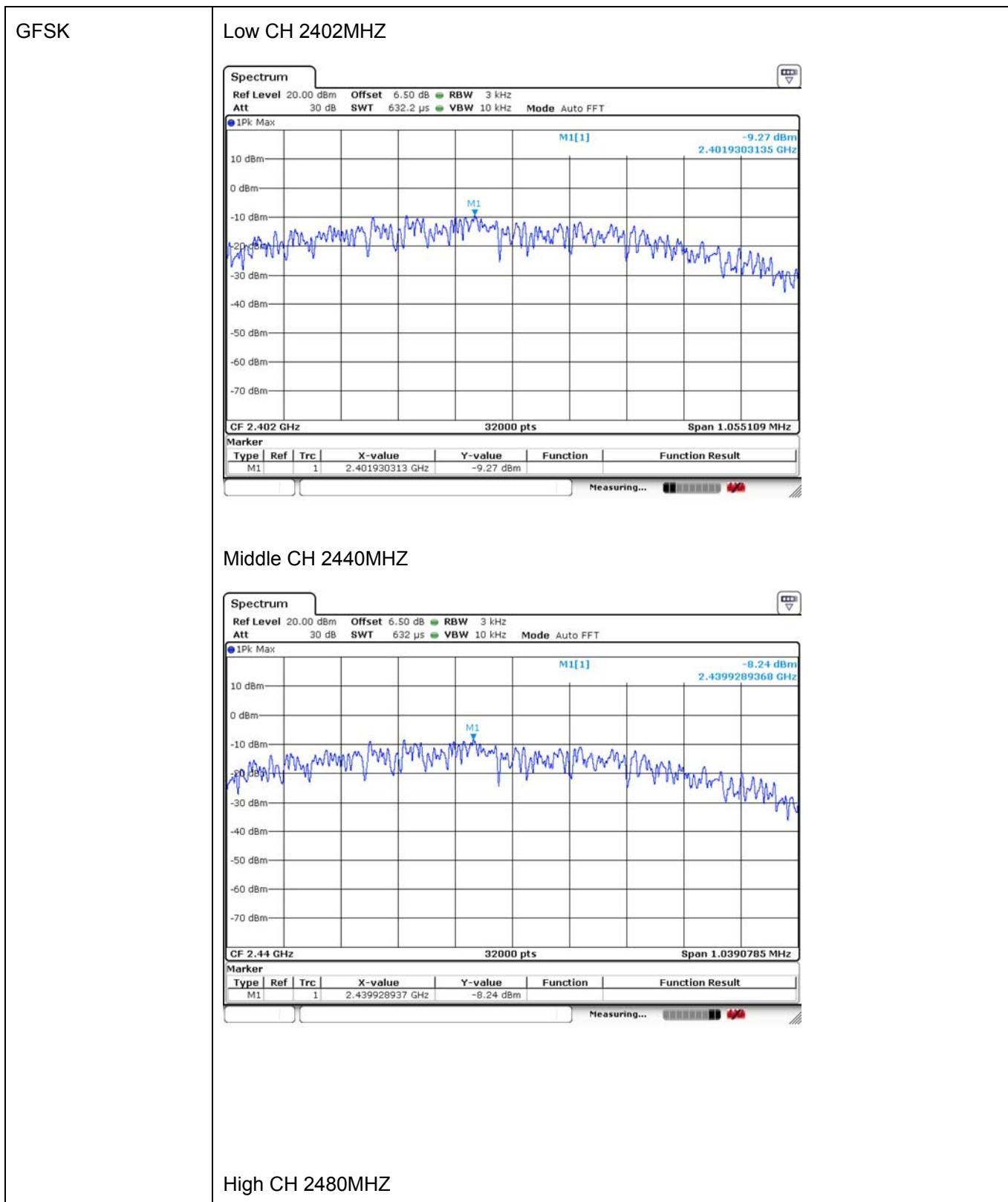
(3) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.

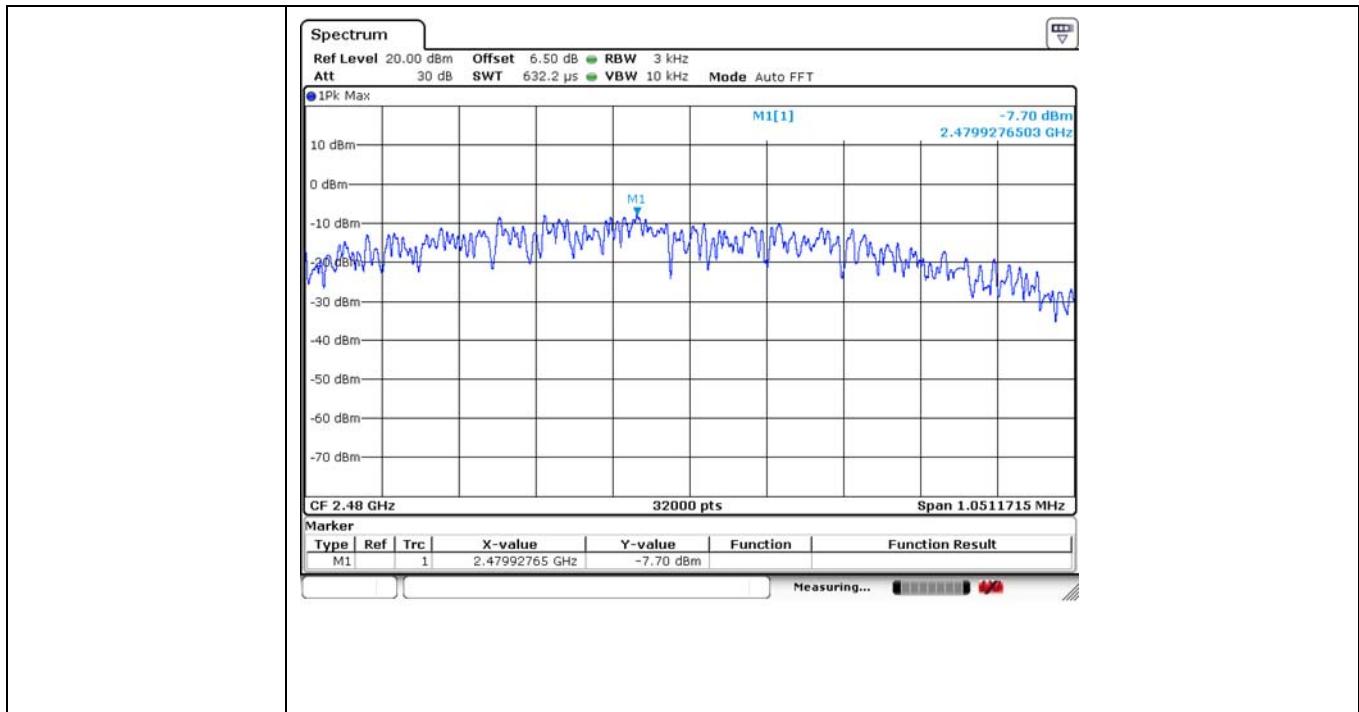
(4) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

## 5.4 Test Result

| Mode | Frequency(MHz) | Result<br>(dBm) | Limit<br>(dBm) | Conclusion |
|------|----------------|-----------------|----------------|------------|
| GFSK | 2402           | -9.27           | 8.00           | Pass       |
|      | 2440           | -8.24           | 8.00           | Pass       |
|      | 2480           | -7.70           | 8.00           | Pass       |

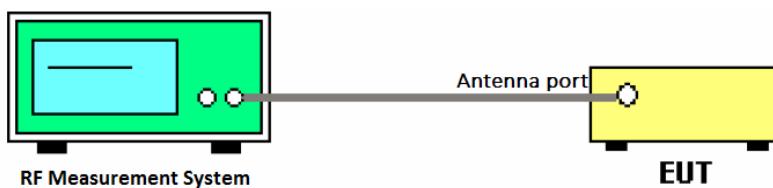
## 5.5 Original Test data





## 6. BandEdge and Spurious Emissions (Conducted)

### 6.1 Block Diagram of Test Setup



### 6.2 Limit

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power

### 6.3 Test Procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable
- (2) Establish a reference level by using the following procedure:

| Center frequency | DTS Channel center frequency |
|------------------|------------------------------|
| RBW              | 100KHz                       |
| VBW              | 300KHz                       |
| Span             | 1.5 times the DTS bandwidth  |
| Detector Mode    | Peak                         |
| Sweep time       | Auto                         |
| Trace mode       | Max hold                     |

- (3) Allow the trace to stabilize, use the peak marker function to determine the maximum peak power level to establish the reference level.
- (4) Set the spectrum analyzer as follows:

|      |  |
|------|--|
| RBW  | 100KHz                                   |
| VBW  | 300KHz                                   |
| Span | Encompass frequency range to be measured |

|                              |                 |
|------------------------------|-----------------|
| Number of measurement points | $\geq$ span/RBW |
| Detector Mode                | Peak            |
| Sweep time                   | Auto            |
| Trace mode                   | Max hold        |

(5) Allow the trace to stabilize, use the peak marker function to determine the maximum amplitude of all unwanted emissions outside of the authorized frequency band

#### 6.4 Test Result

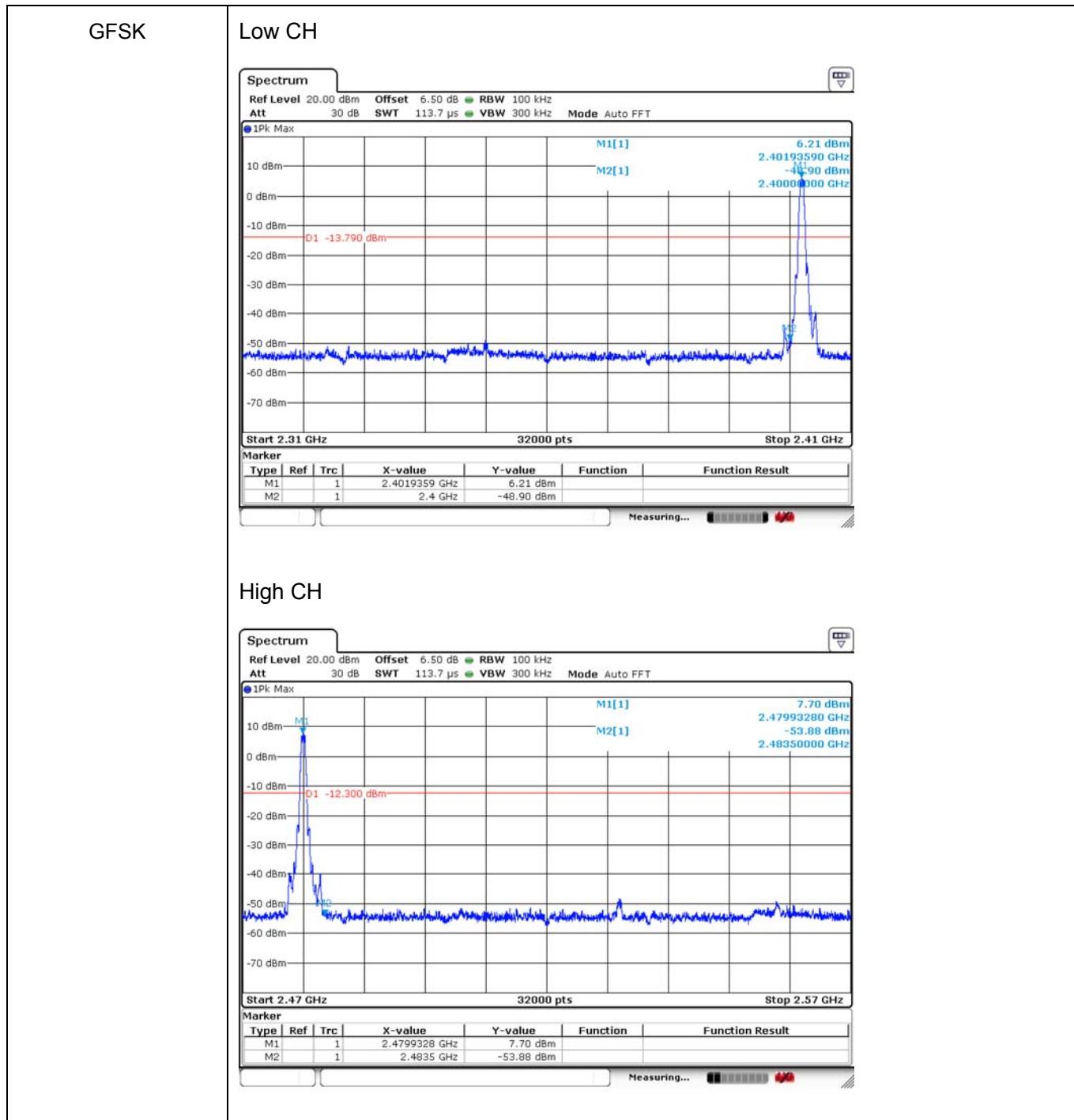
##### Band Edge

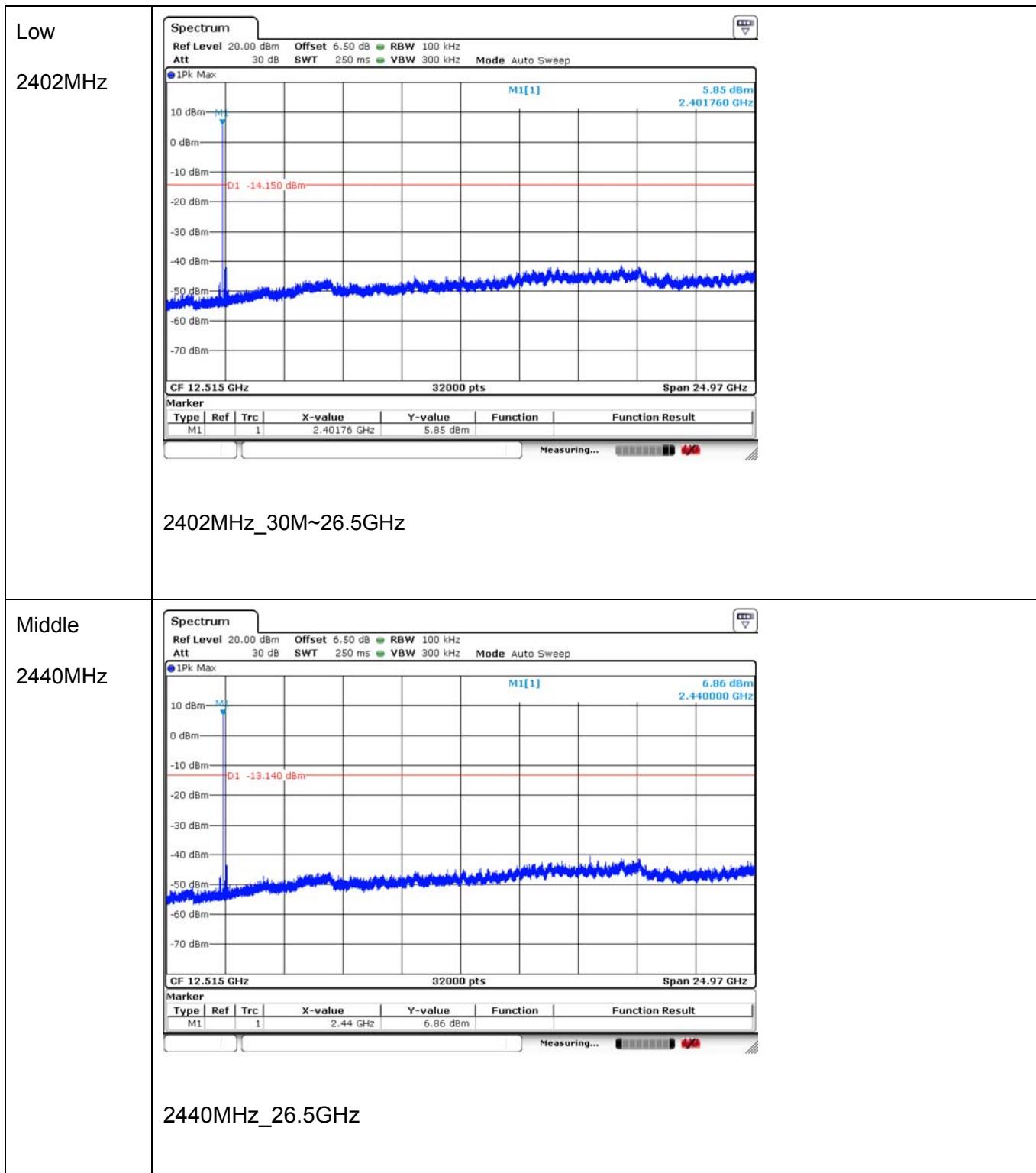
| Mode | Frequency(MHz) | Conclusion |
|------|----------------|------------|
| GFSK | 2402           | Pass       |
|      | 2480           | Pass       |

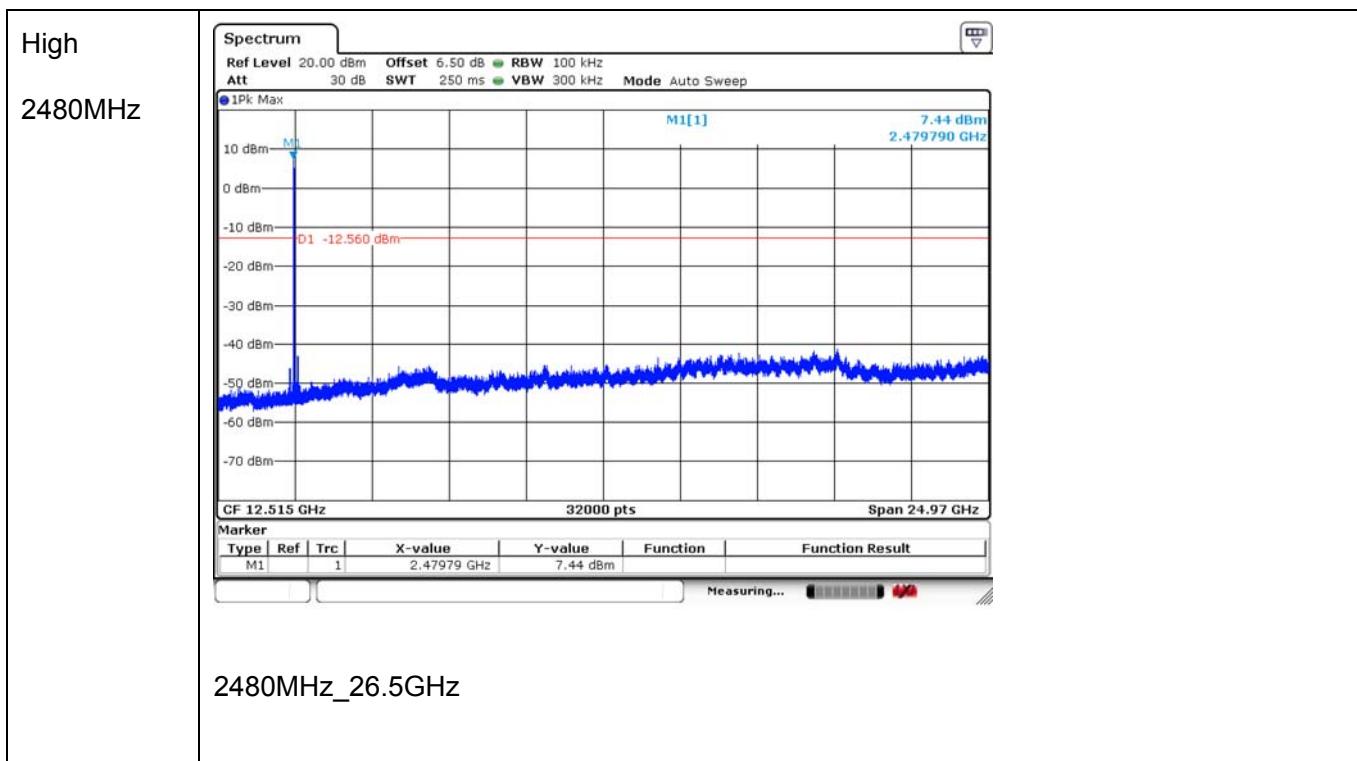
##### SPURIOUS EMISSIONS

| Mode | Frequency(MHz) | Conclusion |
|------|----------------|------------|
| GFSK | 2402           | Pass       |
|      | 2440           | Pass       |
|      | 2480           | Pass       |

## 6.5 Original Test data



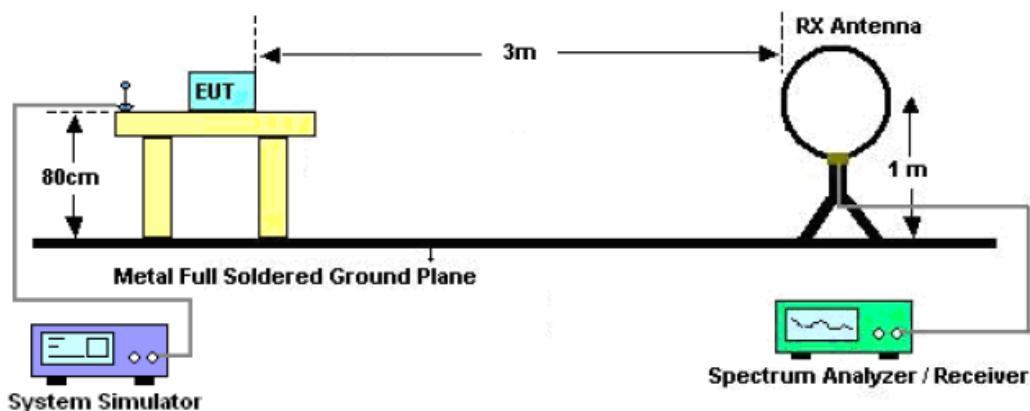




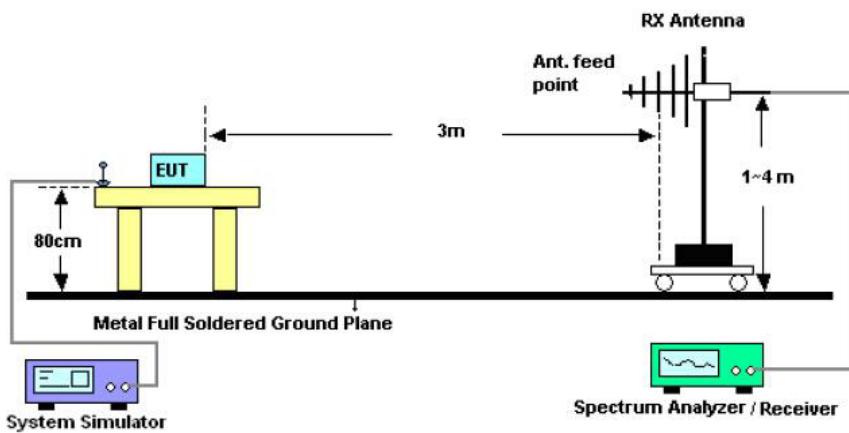
## 7. Radiated Spurious Emission

### 7.1 Block Diagram of Test Setup

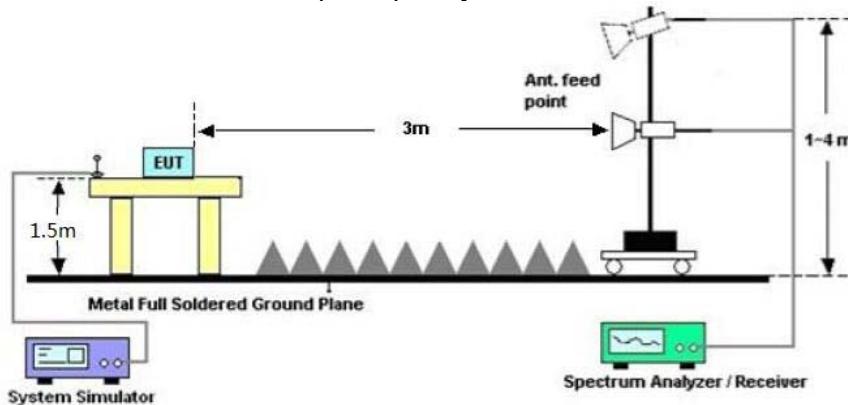
Radiated Emission Test-Setup Frequency Below 30MHz



Radiated Emission Test-Setup Frequency 30MHz-1000MHz



Radiated Emission Test-Setup Frequency Above 1000MHz



## 7.2 FCC 15.209 Limit

| Frequency(MHz) | Distance Meters | Field Strengths Limit   |                                   |
|----------------|-----------------|---|-----------------------------------|
|                |                 | $\mu\text{V}/\text{m}$  | $\text{dB}(\mu\text{V})/\text{m}$ |
| 0.009~0.490    | 300             | 2400/F(KHz)   | 67.6-20log(F)                     |
| 0.490~1.705    | 30              | 24000/F(KHz)  | 87.6-20log(F)                     |
| 1.705~30.0     | 30              | 30  | 29.54                             |
| 30~88          | 3               | 100   | 40.0                              |
| 88~216         | 3               | 150   | 43.5                              |
| 216~960        | 3               | 200   | 46.0                              |
| 960~1000       | 3               | 500   | 54.0                              |
| Above 1000     | 3               | 74.0dB $\mu\text{V}/\text{m}$ —Peak<br>54.0 dB $\mu\text{V}/\text{m}$ --Average |                                   |

### Remark:

(1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000MHz, radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer than that specified, and the limit at closer measurement distance can be extrapolated by below formula:

All restriction band should comply with 15.209, other emission should be at least 20dB below the fundamental.

$$\text{Limit}_{3\text{m}} (\text{dB}\mu\text{V}/\text{m}) = \text{Limit}_{30\text{m}}(\text{dB}\mu\text{V}/\text{m}) + 40\text{Log}(30\text{m}/3\text{m})$$

### (3) Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions or comply with 15.209 limits

### 7.3 Test Procedure

(1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber for below 1G and 150 cm above the ground plane inside a semi-anechoic chamber for above 1G.

(2) Test antenna was located 3m from the EUT on an adjustable mast, and the antenna used as below table.

| Test frequency range | Test antenna used                         | Test antenna distance |
|----------------------|---|-----------------------|
| 9kHz-30MHz           | Active Loop antenna                       | 3m                    |
| 30MHz-1GHz           | Trilog Broadband Antenna                  | 3m                    |
| 1GHz-18GHz           | Double Ridged Horn<br>Antenna(1GHz-18GHz) | 3m                    |
| 18GHz-40GHz          | Horn Antenna(18GHz-40GHz)                 | 3m                    |

According to ANSI C63.10:2013 clause 6.4.4.2 and 6.5.3, for measurements below 30 MHz, the loop antenna was positioned with its plane vertical from the EUT and rotated about its vertical axis for maximum response at each azimuth position around the EUT. And the loop antenna also be positioned with its plane horizontal at the specified distance from the EUT. The center of the loop is 1 m above the ground. For measurement above 30MHz, the trilog Broadband Antenna or Horn Antenna was located 3m from EUT. Measurements were made with the antenna positioned in both the horizontal and vertical planes of Polarization, and the measurement antenna was varied from 1 m to 4 m. in height above the reference ground plane to obtain the maximum signal strength.

(3) Below pre-scan procedure was first performed in order to find prominent frequency spectrum radiated emissions from 9 kHz to 25 GHz:

- Scanning the peak frequency spectrum with the antenna specified in step (3), and the EUT was rotated 360 degree, the antenna height was varied from 1m to 4m (Except loop antenna, it's fixed 1m above ground.)
- Change work frequency or channel of device if practicable.
- Change modulation type of device if practicable.
- Change power supply range from 85% to 115% of the rated supply voltage
- Rotated EUT through three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions.

Spectrum frequency from 9 kHz to 25 GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 18 GHz to 25 GHz, so below final test was performed with frequency range from 9 kHz to 18 GHz.

(4) For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipment and all of the interface cables were changed according to ANSI C63.10:2013 on Radiated Emission test.

(5) The emissions from 9 kHz to 1GHz were measured based on CISPR QP detector except for the frequency bands 9-90 kHz, 110-490 kHz, for emissions from 9 kHz-90 kHz, 110 kHz-490 kHz and above 1 GHz were measured based on average detector, for emissions above 1 GHz, peak emissions also be measured and need comply with Peak limit.

(6) The emissions from 9 kHz to 1 GHz, QP or average values were measured with EMI receiver with below RBW

|                |         |
|----------------|---------|
| Frequency band | RBW     |
| 9 kHz-150 kHz  | 200 Hz  |
| 150 kHz-30 MHz | 9 kHz   |
| 30 MHz-1 GHz   | 120 kHz |

(7) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1 MHz, VBW is set at 3 MHz for Peak measure; RBW 1 MHz VBW 10 Hz for Average measure (according ANSI C63.10:2013 clause 4.1.4.2.2 procedure for average measure).

(8) X axis, Y axis, Z axis are tested, and worse setup X axis is reported

#### 7.4 Test Result

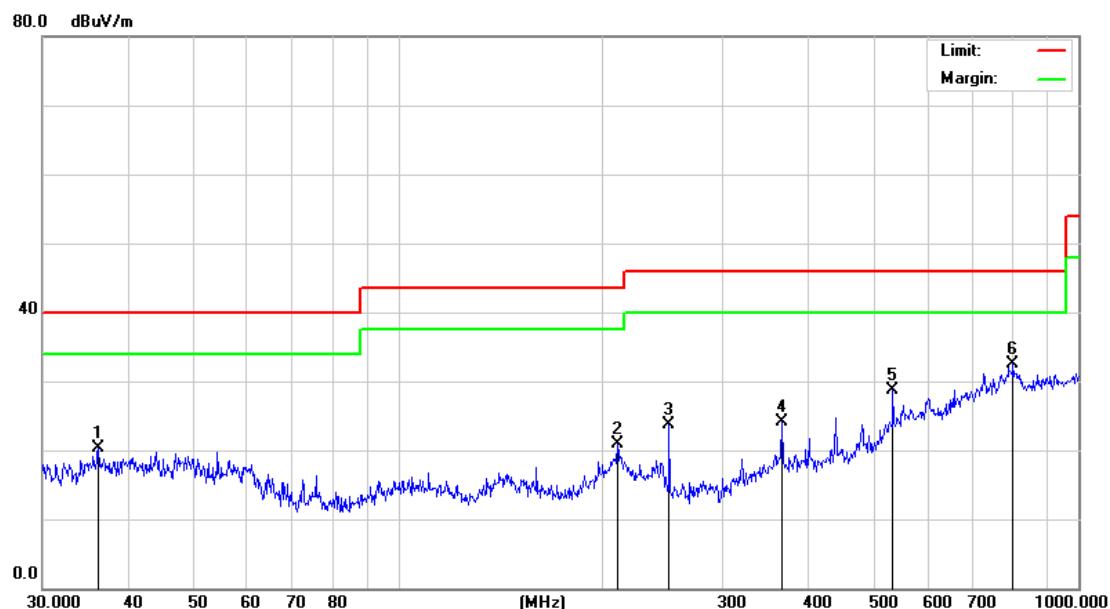
Pass

All the emissions except fundamental emission from 9 kHz to 25 GHz were comply with 15.209 limits.

Note1: According exploratory test no any obvious emission was detected from 9 kHz to 30 MHz and 18 GHz to 25 GHz.

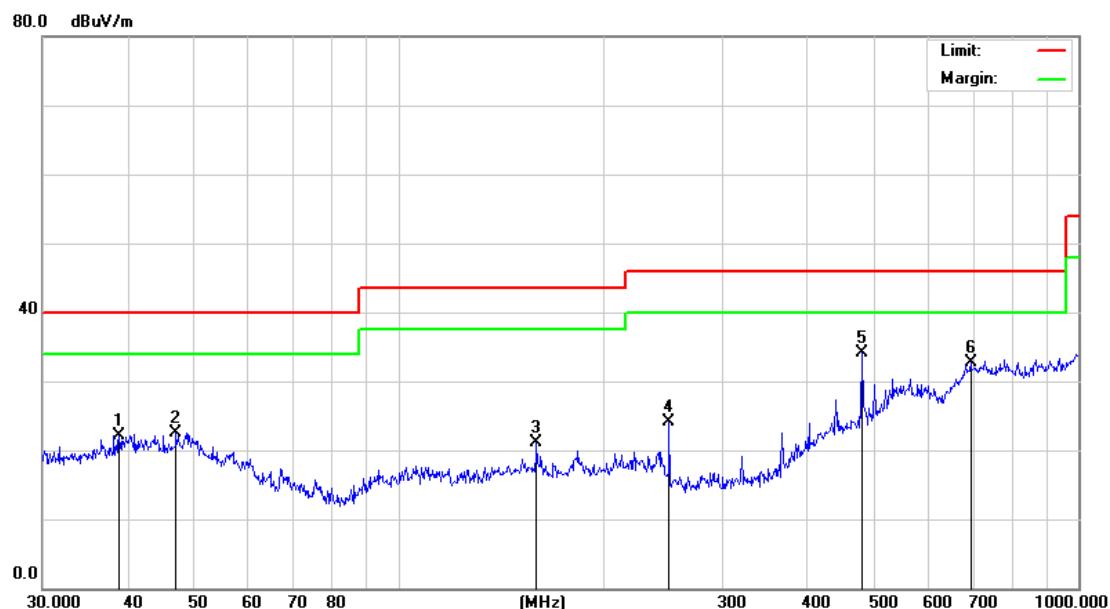
Note2: For emissions above 1 GHz. If peak results comply with AV limit, AV Result is deemed to comply with AV limit.

## Vertical



| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   |          |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|
|     |     |          | Level   | Factor  | ment     |        |        |          |
|     |     | MHz      | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector |
| 1   |     | 36.2541  | 24.87   | -4.64   | 20.23    | 40.00  | -19.77 | peak     |
| 2   |     | 210.0482 | 24.72   | -3.75   | 20.97    | 43.50  | -22.53 | peak     |
| 3   |     | 250.3012 | 32.65   | -8.93   | 23.72    | 46.00  | -22.28 | peak     |
| 4   |     | 366.8231 | 28.36   | -4.25   | 24.11    | 46.00  | -21.89 | peak     |
| 5   |     | 533.8321 | 27.98   | 0.73    | 28.71    | 46.00  | -17.29 | peak     |
| 6   | *   | 801.7863 | 24.92   | 7.67    | 32.59    | 46.00  | -13.41 | peak     |

## Horizontal



| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   |          |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|
|     |     |          | Level   |         |          |        |        |          |
|     |     | MHz      | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector |
| 1   |     | 38.8878  | 24.57   | -2.38   | 22.19    | 40.00  | -17.81 | peak     |
| 2   |     | 47.1599  | 25.24   | -2.74   | 22.50    | 40.00  | -17.50 | peak     |
| 3   |     | 159.7844 | 27.70   | -6.54   | 21.16    | 43.50  | -22.34 | peak     |
| 4   |     | 250.3012 | 33.02   | -8.93   | 24.09    | 46.00  | -21.91 | peak     |
| 5   | *   | 480.5276 | 33.53   | 0.56    | 34.09    | 46.00  | -11.91 | peak     |
| 6   |     | 694.4174 | 25.64   | 7.03    | 32.67    | 46.00  | -13.33 | peak     |

## TEST RESULT AND DATA (BETWEEN 1~25 GHZ)

|             |                     |             |              |
|-------------|---------------------|-------------|--------------|
| Power       | : 7.4V from battery | Pol/Phase   | : HORIZONTAL |
| Test Mode 1 | : TX , CH0          | Temperature | : 30 °C      |
| Memo        |                     | Humidity    | : 59 %       |

| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4804.000  | 53.69         | 5.06   | 58.75          | 74.00          | -15.25 | peak          |
| 4804.000  | 42.35         | 5.06   | 47.41          | 54.00          | -6.59  | AVG           |
| 7206.000  | 46.88         | 7.03   | 53.91          | 74.00          | -20.09 | peak          |
| 7206.000  | 35.94         | 7.03   | 42.97          | 54.00          | -11.03 | AVG           |

|             |                     |             |            |
|-------------|---------------------|-------------|------------|
| Power       | : 7.4V from battery | Pol/Phase   | : VERTICAL |
| Test Mode 1 | : TX , CH0          | Temperature | : 30 °C    |
| Memo        |                     | Humidity    | : 59 %     |

| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4804.000  | 50.13         | 5.06   | 55.19          | 74.00          | -18.81 | peak          |
| 4804.000  | 40.32         | 5.06   | 45.38          | 54.00          | -8.62  | AVG           |
| 7206.000  | 44.57         | 7.03   | 51.6           | 74.00          | -22.40 | peak          |
| 7206.000  | 33.65         | 7.03   | 40.68          | 54.00          | -13.32 | AVG           |

## Note:

The disturbance above 18GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

|             |                     |             |              |
|-------------|---------------------|-------------|--------------|
| Power       | : 7.4V from battery | Pol/Phase   | : HORIZONTAL |
| Test Mode 1 | : TX , CH19         | Temperature | : 30 °C      |
| Memo        |                     | Humidity    | : 59 %       |

| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4880.000  | 53.36         | 5.14   | 58.50          | 74.00          | -15.50 | peak          |
| 4880.000  | 43.21         | 5.14   | 48.35          | 54.00          | -5.65  | AVG           |
| 7320.000  | 45.89         | 7.52   | 53.41          | 74.00          | -20.59 | peak          |
| 7320.000  | 34.25         | 7.52   | 41.77          | 54.00          | -12.23 | AVG           |

|             |                     |             |            |
|-------------|---------------------|-------------|------------|
| Power       | : 7.4V from battery | Pol/Phase   | : VERTICAL |
| Test Mode 1 | : TX , CH19         | Temperature | : 30 °C    |
| Memo        |                     | Humidity    | : 59 %     |

| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4880.000  | 50.01         | 5.14   | 55.15          | 74.00          | -18.85 | peak          |
| 4880.000  | 39.87         | 5.14   | 45.01          | 54.00          | -8.99  | AVG           |
| 7320.000  | 43.25         | 7.52   | 50.77          | 74.00          | -23.23 | peak          |
| 7320.000  | 33.36         | 7.52   | 40.88          | 54.00          | -13.12 | AVG           |

Note:

The disturbance above 18GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

|             |                     |             |              |
|-------------|---------------------|-------------|--------------|
| Power       | : 7.4V from battery | Pol/Phase   | : HORIZONTAL |
| Test Mode 1 | : TX , CH39         | Temperature | : 30 °C      |
| Memo        |                     | Humidity    | : 59 %       |

| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4960.000  | 53.41         | 5.22   | 58.63          | 74.00          | -15.37 | peak          |
| 4960.000  | 43.36         | 5.22   | 48.58          | 54.00          | -5.42  | AVG           |
| 7440.000  | 45.24         | 8.06   | 53.3           | 74.00          | -20.7  | peak          |
| 7440.000  | 33.98         | 8.06   | 42.04          | 54.00          | -11.96 | AVG           |

|             |                     |             |            |
|-------------|---------------------|-------------|------------|
| Power       | : 7.4V from battery | Pol/Phase   | : VERTICAL |
| Test Mode 1 | : TX , CH39         | Temperature | : 30 °C    |
| Memo        |                     | Humidity    | : 59 %     |

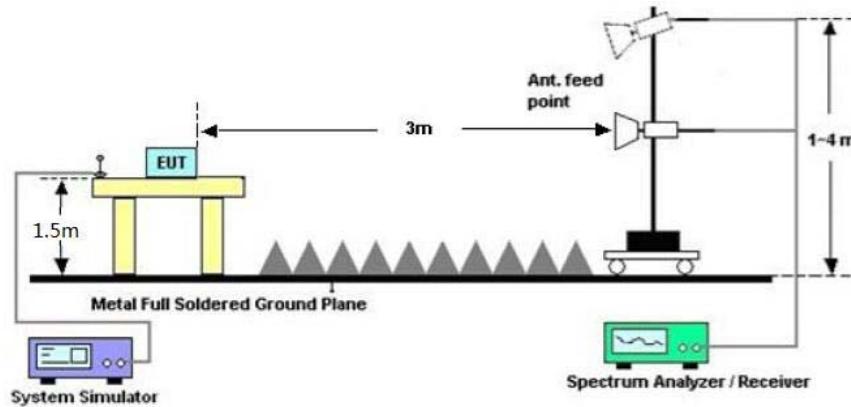
| Frequency | Meter Reading | Factor | Emission Level | Limits         | Margin | Detector Type |
|-----------|---------------|--------|----------------|----------------|--------|---------------|
| (MHz)     | (dB $\mu$ V)  | (dB)   | (dB $\mu$ V/m) | (dB $\mu$ V/m) | (dB)   |               |
| 4960.000  | 51.32         | 5.22   | 56.54          | 74.00          | -17.46 | peak          |
| 4960.000  | 40.69         | 5.22   | 45.91          | 54.00          | -8.09  | AVG           |
| 7440.000  | 43.28         | 8.06   | 51.34          | 74.00          | -22.66 | peak          |
| 7440.000  | 33.16         | 8.06   | 41.22          | 54.00          | -12.78 | AVG           |

Note:

The disturbance above 18GHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed.

## 8. Band Edge Compliance(radiated method)

### 8.1 Block Diagram of Test Setup



### 8.2 Limit

All restriction band should comply with 15.209, other emission should be at least 20dB below the fundamental.

### 8.3 Test Procedure

Same with clause 7.3 except change investigated frequency range from 2310 MHz to 2410 MHz and 2475 MHz to 2500 MHz.

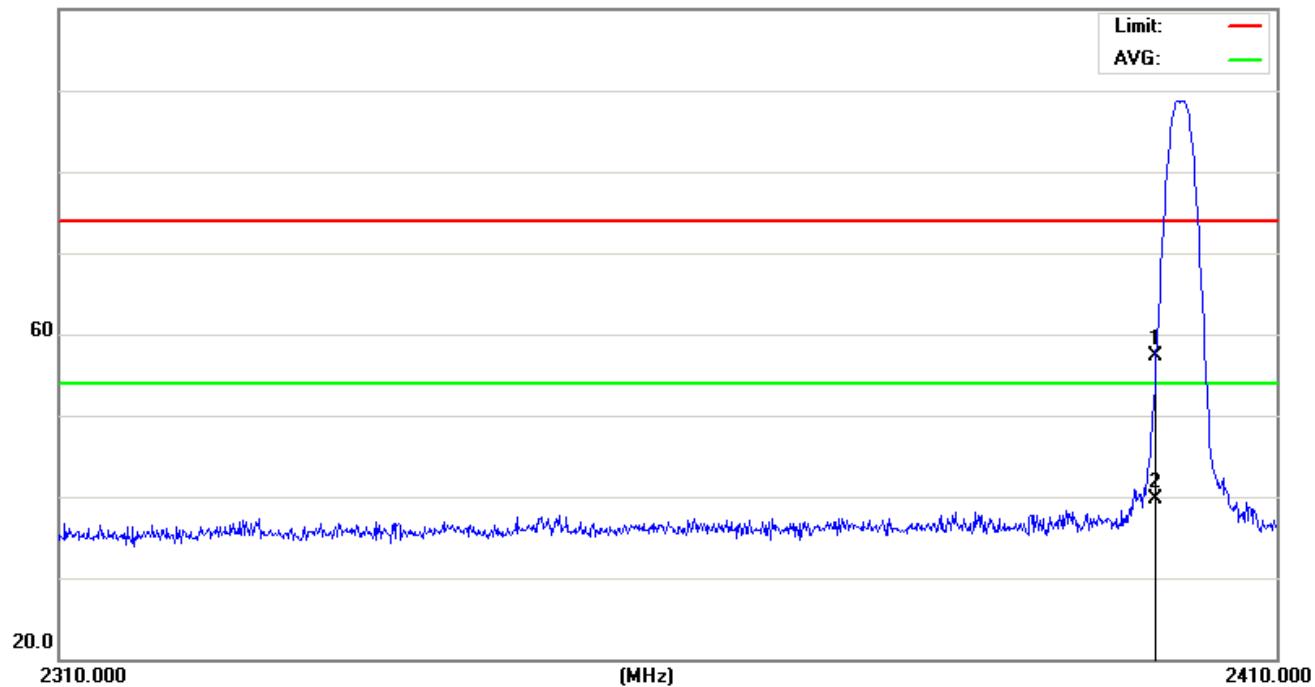
### 8.4 Test Result

PASS. (See below detailed test result)

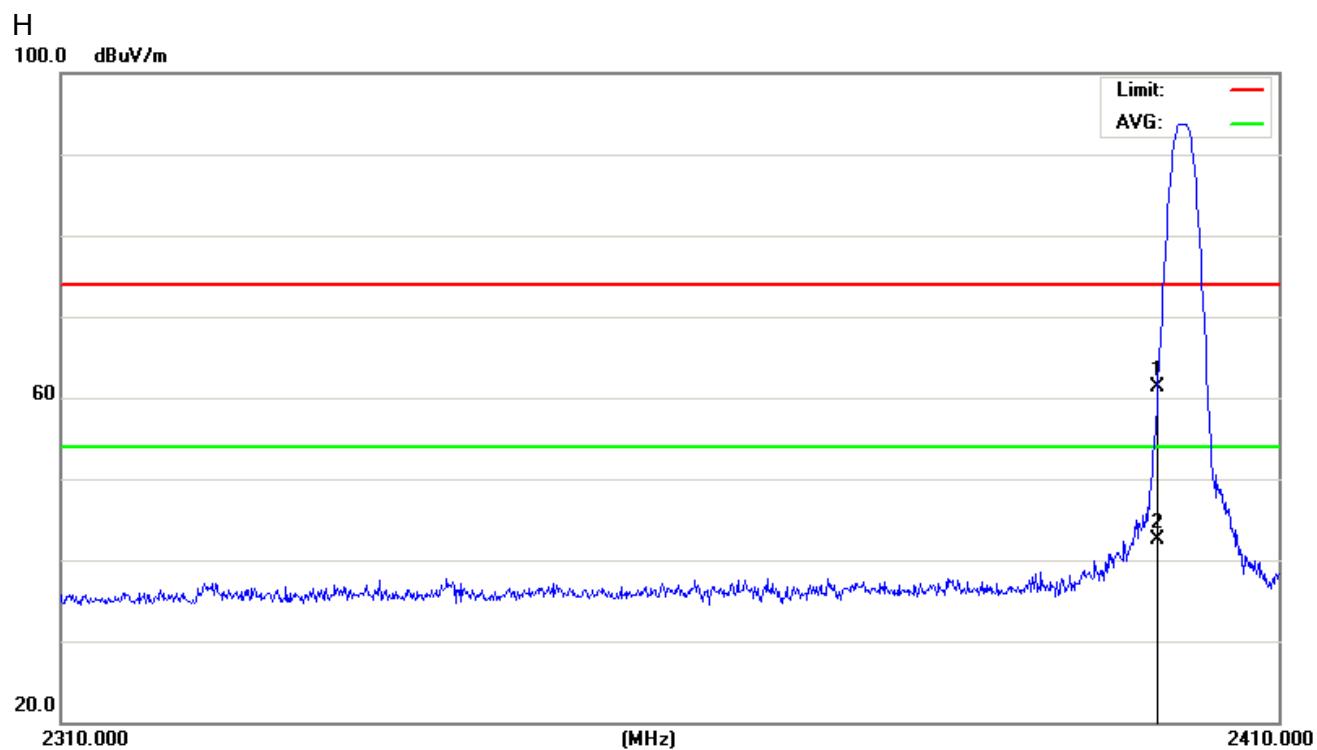
### 8.5 Original Test data

V

100.0 dBuV/m

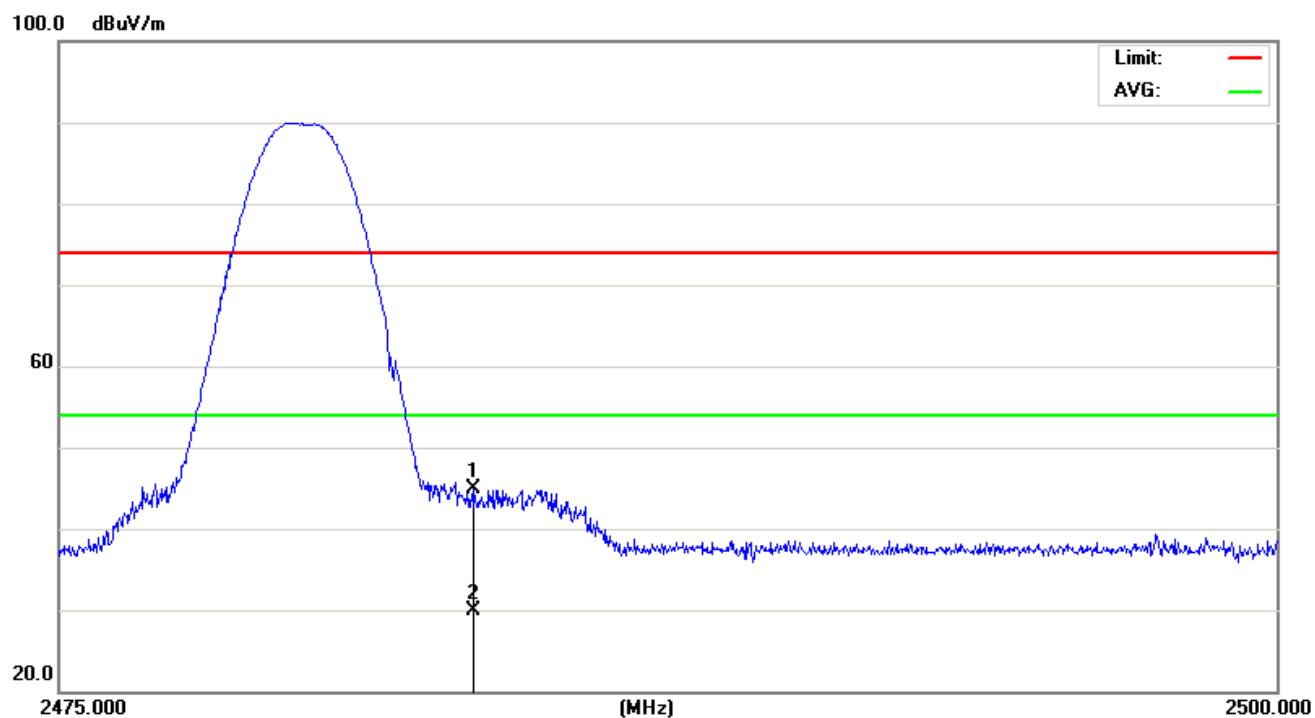


| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   |          |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|
|     |     |          | Level   | Factor  | ment     |        |        |          |
|     |     | MHz      | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector |
| 1   |     | 2400.000 | 63.02   | -5.70   | 57.32    | 74.00  | -16.68 | peak     |
| 2   | *   | 2400.000 | 45.39   | -5.70   | 39.69    | 54.00  | -14.31 | AVG      |



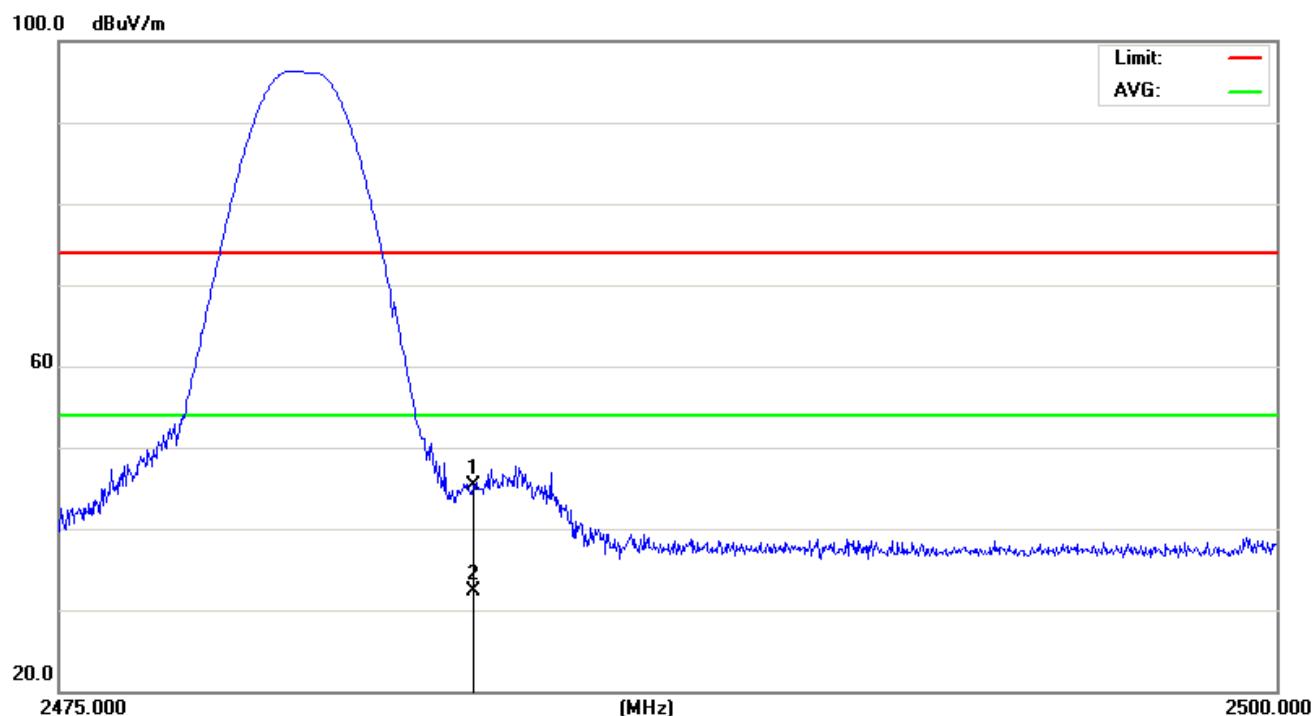
| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit  | Over   |          |
|-----|-----|----------|---------|---------|----------|--------|--------|----------|
|     |     |          | Level   | Factor  | ment     |        |        |          |
|     |     | MHz      | dBuV    | dB      | dBuV/m   | dBuV/m | dB     | Detector |
| 1   |     | 2400.000 | 66.96   | -5.70   | 61.26    | 74.00  | -12.74 | peak     |
| 2   | *   | 2400.000 | 48.13   | -5.70   | 42.43    | 54.00  | -11.57 | AVG      |

V



| No. | Mk. | Freq.    | Reading | Correct | Measure- | Limit | Over        |
|-----|-----|----------|---------|---------|----------|-------|-------------|
|     |     |          | Level   | Factor  | ment     |       |             |
|     |     | MHz      | dBuV    | dB      | dBuV/m   | dB    | Detector    |
| 1   |     | 2483.500 | 49.98   | -4.98   | 45.00    | 74.00 | -29.00 peak |
| 2   | *   | 2483.500 | 34.86   | -4.98   | 29.88    | 54.00 | -24.12 AVG  |

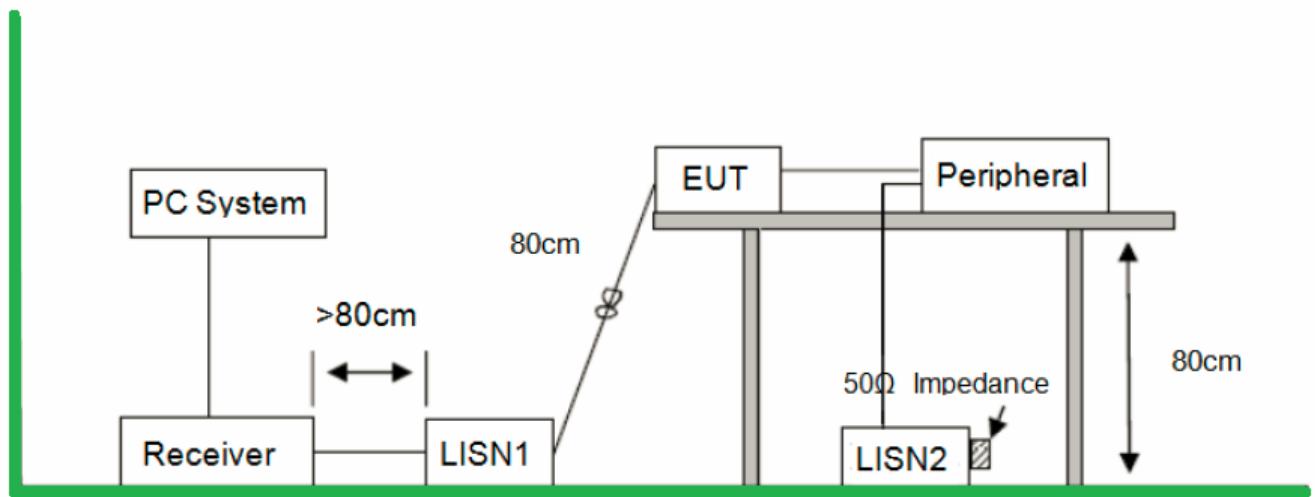
H



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measure-<br>ment | Limit  | Over           |
|-----|-----|----------|---------------|----------------|------------------|--------|----------------|
|     |     | MHz      | dBuV          | dB             | dBuV/m           | dBuV/m | dB<br>Detector |
| 1   |     | 2483.500 | 50.18         | -4.98          | 45.20            | 74.00  | -28.80 peak    |
| 2   | *   | 2483.500 | 37.23         | -4.98          | 32.25            | 54.00  | -21.75 AVG     |

## 9. Power Line Conducted Emission

### 9.1 Block Diagram of Test Setup



### 9.2 Limit

| Frequency     | Quasi-Peak Level<br>dB(μV) | Average Level<br>dB(μV) |
|---------------|----------------------------|-------------------------|
| 150KHz-500KHz | 66 ~ 56*                   | 56 ~ 46*                |
| 500KHz-5MHz   | 56                         | 46                      |
| 5MHz-30MHz    | 60                         | 50                      |

Note 1: \* Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies

### 9.3 Test Procedure

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 10.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.4 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission

level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions.

Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit.

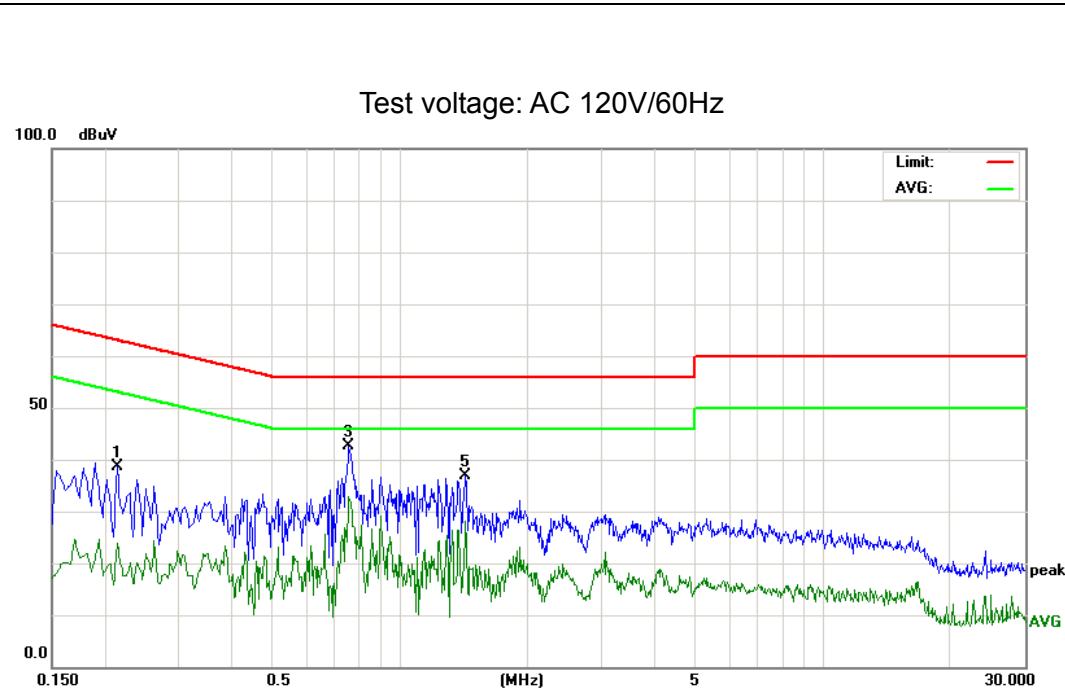
The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 9 kHz.

## 9.4 Test Results

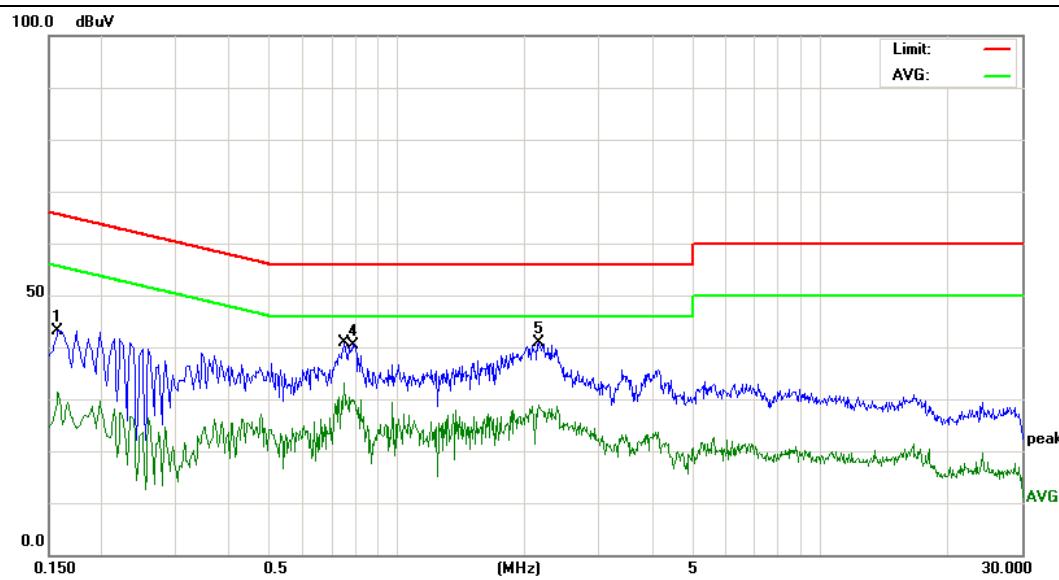
PASS. (See below detailed test result)

## 9.5 Original Test data



| No. Mk. | Freq.  | Reading Level | Correct Factor | Measure-<br>ment | Limit | Over   |          |
|---------|--------|---------------|----------------|------------------|-------|--------|----------|
|         | MHz    | dBuV          | dB             | dBuV             | dBuV  | dB     | Detector |
| 1       | 0.2140 | 27.58         | 11.03          | 38.61            | 63.04 | -24.43 | peak     |
| 2       | 0.2140 | 12.91         | 11.03          | 23.94            | 53.04 | -29.10 | AVG      |
| 3       | 0.7580 | 32.65         | 9.93           | 42.58            | 56.00 | -13.42 | peak     |
| 4 *     | 0.7580 | 22.89         | 9.93           | 32.82            | 46.00 | -13.18 | AVG      |
| 5       | 1.4260 | 26.89         | 9.93           | 36.82            | 56.00 | -19.18 | peak     |
| 6       | 1.4260 | 18.28         | 9.93           | 28.21            | 46.00 | -17.79 | AVG      |

N



| No. | Mk. | Freq.  | Reading | Correct | Measure- | Limit | Over   | Detector |
|-----|-----|--------|---------|---------|----------|-------|--------|----------|
|     |     |        | Level   | Factor  | ment     |       |        |          |
|     |     | MHz    | dBuV    | dB      | dBuV     | dBuV  | dB     |          |
| 1   |     | 0.1580 | 31.49   | 11.75   | 43.24    | 65.56 | -22.32 | peak     |
| 2   |     | 0.1580 | 19.53   | 11.75   | 31.28    | 55.56 | -24.28 | AVG      |
| 3   | *   | 0.7500 | 23.20   | 9.93    | 33.13    | 46.00 | -12.87 | AVG      |
| 4   |     | 0.7860 | 30.54   | 9.93    | 40.47    | 56.00 | -15.53 | peak     |
| 5   |     | 2.1619 | 31.00   | 9.96    | 40.96    | 56.00 | -15.04 | peak     |
| 6   |     | 2.1619 | 18.97   | 9.96    | 28.93    | 46.00 | -17.07 | AVG      |

## 10. Antenna Requirements

### 10.1 Limit

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### 10.2 Result

The antennas used for this product are integrated antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 2.96 dBi.

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