

# TEST REPORT



**CTK Co., Ltd.**  
(Ho-dong), 113, Yejik-ro, Cheoin-gu,  
Yongin-si, Gyeonggi-do, Korea  
Tel: +82-31-339-9970  
Fax: +82-31-624-9501

Report No.:  
CTK-2017-01591  
Page (1) / (38) Pages

## 1. Client

- Name : MANGOSLAB CO., LTD.
- Address : 20, Pangyo-ro 289beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea, 13488
- Date of Receipt : 2017-06-07

## 2. Manufacturer

- Name : MANGOSLAB CO., LTD.
- Address : 20, Pangyo-ro 289beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea, 13488

**3. Use of Report :** For FCC Certification & Canadian Certification

**4. Test Sample / Model:** Sticky Note Printer / MIP-001

**5. Date of Test :** 2017-08-04 to 2017-08-16

**6. Test Standard(method) used :** FCC 47 CFR part 15 subpart C 15.247

**7. Testing Environment:** Temp.: (23 ± 1) °C, Humidity: (51 ± 3) % R.H.

**8. Test Results :** Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

|             |                            |                              |
|-------------|----------------------------|------------------------------|
| Affirmation | Tested by                  | Technical Manager            |
|             | Bongseok, Kim: (Signature) | Young-taek, Lee: (Signature) |

2017-08-24

Republic of KOREA **CTK Co., Ltd.**



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Page (2) / (38) Pages

## REPORT REVISION HISTORY

| Date       | Revision                | Page No |
|------------|-------------------------|---------|
| 2017-08-24 | Issued (CTK-2017-01591) | all     |
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## 1. General Product Description

### 1.1 Client Information

|                       |                                                                                                             |
|-----------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Company</b>        | MANGOSLAB CO., LTD.                                                                                         |
| <b>Contact Point</b>  | 20, Pangyo-ro 289beon-gil, Bundang-gu, Seongnam-si, Gyeonggido, Korea, 13488                                |
| <b>Contact Person</b> | Name : Park Yongshik<br>E-mail : petepark@mangoslab.com<br>Tel : +82-31-5171-5741<br>Fax : +82-31-5171-5743 |

### 1.2 Product Information

|                                         |                                                        |
|-----------------------------------------|--------------------------------------------------------|
| <b>FCC ID</b>                           | 2AM37-MIP-001                                          |
| <b>IC</b>                               | 23079-MIP001                                           |
| <b>Product Description</b>              | Sticky Note Printer                                    |
| <b>Model name</b>                       | MIP-001                                                |
| <b>Operating Frequency</b>              | 2 402 MHz - 2 480 MHz                                  |
| <b>RF Output Power</b>                  | 3.67 dBm (2.328 mW)                                    |
| <b>Antenna Specification</b>            | Antenna type : Internal Antenna<br>Peak Gain : 0.4 dBi |
| <b>Number of channels</b>               | 40                                                     |
| <b>Channel Spacing</b>                  | 2 MHz                                                  |
| <b>Type of Modulation</b>               | GFSK                                                   |
| <b>Power Source</b>                     | DC 24 V                                                |
| <b>Firmware Version Id Number(FVIN)</b> | V1.05                                                  |
| <b>Test SW Version</b>                  | BlueSuite: 2.6.2                                       |
| <b>RF Power setting in Test SW</b>      | Initial value                                          |

### 1.3 Peripheral Devices

| Device     | Manufacturer            | Model No.         | Serial No.      |
|------------|-------------------------|-------------------|-----------------|
| Notebook   | Hewlett Packard Co.,Ltd | HP ProBook 650 G1 | 5CG5114K13      |
| AC Adapter | Hewlett Packard Co.,Ltd | PPP012D-S         | WCN XF0AAR7S2XX |

|                                                                                                                                                                                 |                                                                                                                                               |                                                        |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|
| <br><b>CTK Co., Ltd.</b><br><small>The Prime Leader of Global Regulatory Certification</small> | <b>CTK Co., Ltd.</b><br>(Ho-dong), 113, Yejik-ro, Cheoin-gu,<br>Yongin-si, Gyeonggi-do, Korea<br>Tel: +82-31-339-9970<br>Fax: +82-31-624-9501 | Report No.:<br>CTK-2017-01591<br>Page (5) / (38) Pages |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|--|

## 2. Facility and Accreditations

### 2.1 Test Facility

The measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yong-in-si, Gyeonggi-do, Korea.

### 2.2 Laboratory Accreditations and Listings

| Country | Agency      | Scope of Accreditation                                                                           | Registration Number                | Logo                                                                                  |
|---------|-------------|--------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------------------------------------------------------------|
| USA     | <b>FCC</b>  | FCC Part 15 & 18<br>EMI (Electromagnetic Interference / Emission)                                | 805871                             |    |
| CANADA  | <b>IC</b>   | IC<br>EMI (3/10m test site)                                                                      | 8737A-2                            |    |
| JAPAN   | <b>VCCI</b> | VCCI V-3<br>EMI (Electromagnetic Interference / Emission)                                        | C-986<br>T-1843<br>R-3627<br>G-387 |   |
| KOREA   | <b>MSIP</b> | EMI (Electromagnetic Interference / Emission)<br>EMS (Electromagnetic Susceptibility / Immunity) | KR0025                             |  |

### 2.3 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

### 3. Test Specifications

#### 3.1 Standards

| Section in FCC                                                                                                                    | Section in RSS | Requirement(s)                      | Status (Note 1) | Test Condition |
|-----------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------------|-----------------|----------------|
| 15.247(a)                                                                                                                         | RSS-247 5.2(a) | 6 dB Bandwidth                      | C               | Conducted      |
| 15.247(e)                                                                                                                         | RSS-247 5.2(b) | Transmitter power spectral density  | C               |                |
| 15.247(b)                                                                                                                         | RSS-247 5.4(d) | Maximum peak conducted output power | C               |                |
| 15.247(d)                                                                                                                         | RSS-247 5.5    | Unwanted emission                   | C               |                |
| 15.209                                                                                                                            | RSS-Gen 6.13   | Transmitter emission                | C               | Radiated       |
| 15.207(a)                                                                                                                         | RSS-Gen 8.8    | AC Conducted Emission               | C               | Line Conducted |
| <b>Note 1:</b> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable                                                         |                |                                     |                 |                |
| <b>Note 2:</b> The data in this test report are traceable to the national or international standards.                             |                |                                     |                 |                |
| <b>Note 3:</b> The sample was tested according to the following specification: FCC Part 15.247, ANSI C63.10-2013, RSS-247 Issue 2 |                |                                     |                 |                |
| <b>Note 4:</b> The tests were performed according to the method of measurements prescribed in KDB No.558074.                      |                |                                     |                 |                |

#### 3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.  
During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.  
The results are only attached worst cases.

##### Test Frequency

| Lowest channel | Middle channel | Highest channel |
|----------------|----------------|-----------------|
| 2 402 MHz      | 2 440 MHz      | 2 480 MHz       |

##### Test mode

| Modulation | Duty Cycle |
|------------|------------|
| GFSK       | 61.0%      |

##### AC/DC Adapter

|           |                       |
|-----------|-----------------------|
| Adapter 1 | Model : YHY-24002000  |
| Adapter 2 | Model : GM65-240200-D |

### 3.3 Maximum Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.  
Coverage factor  $k = 2$ , Confidence levels of 95 %

| Description                          | Uncertainty |
|--------------------------------------|-------------|
| Conducted RF Output Power            | 1.5 dB      |
| Occupied Bandwidth                   | 0.1 MHz     |
| Unwanted Emission(conducted)         | 3.0 dB      |
| Radiated Emissions ( $f \leq 1$ GHz) | 4.0 dB      |
| Radiated Emissions ( $f > 1$ GHz)    | 5.0 dB      |

## 4. Technical Characteristic Test

### 4.1 6dB Bandwidth

#### Test Procedures(ANSI C63.10-2013 6.9.2)

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.

#### Test Procedures(ANSI C63.10-2013 6.9.3)

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

Use the 99% power bandwidth function of the instrument and report the measured bandwidth.

#### Test Settings :

Center frequency = the highest, middle and the lowest channels

- a) RBW = 100 kHz
- b) VBW  $\geq 3 \times$  RBW
- c) Detector = peak
- d) Trace mode = Max hold
- e) Sweep = auto couple
- f) Allow trace to fully stabilize
- g) 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.

#### **Limit :**

---

6 dB Bandwidth > 500kHz

---

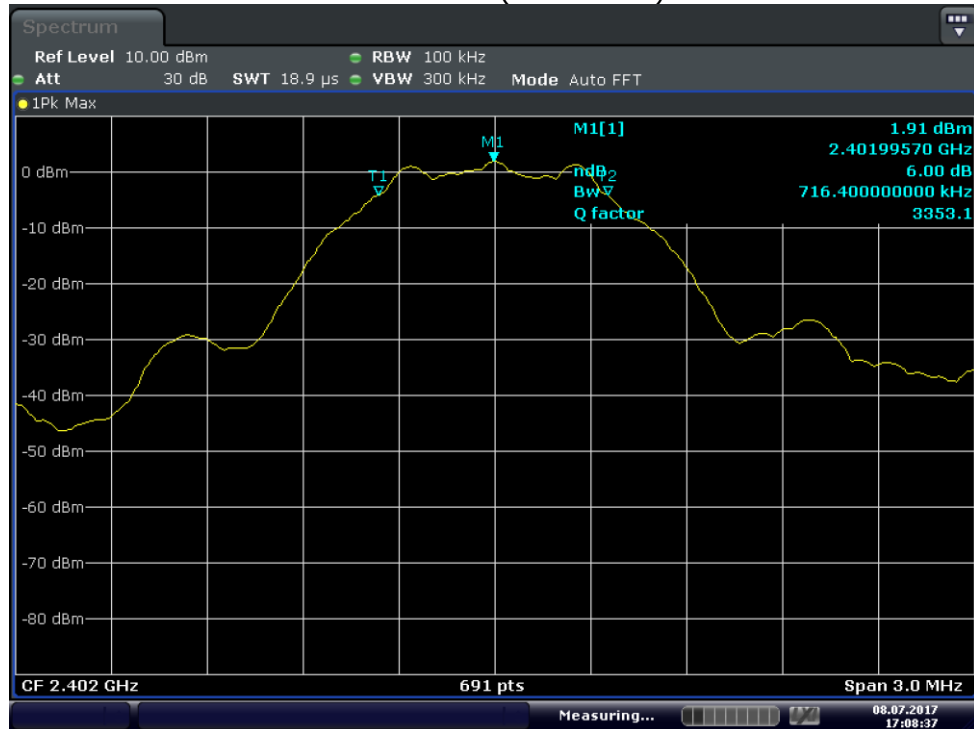
**Test Data :**

| Channel | Frequency<br>[MHz] | 6 dB Bandwidth<br>[MHz] | 99% Bandwidth<br>[MHz] | Result   |
|---------|--------------------|-------------------------|------------------------|----------|
| Low     | 2 402              | 0.716 4                 | 1.063 7                | Complies |
| Middle  | 2 440              | 0.716 4                 | 1.059 3                | Complies |
| High    | 2 480              | 0.725 0                 | 1.063 7                | Complies |

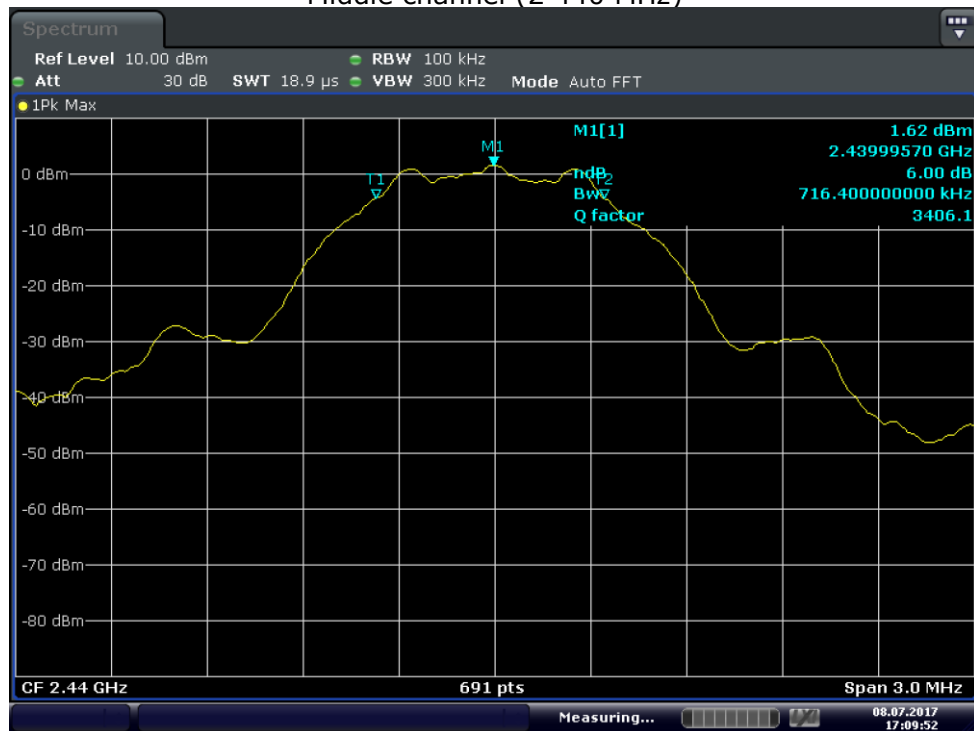
See next pages for actual measured spectrum plots.

## 6dB Bandwidth

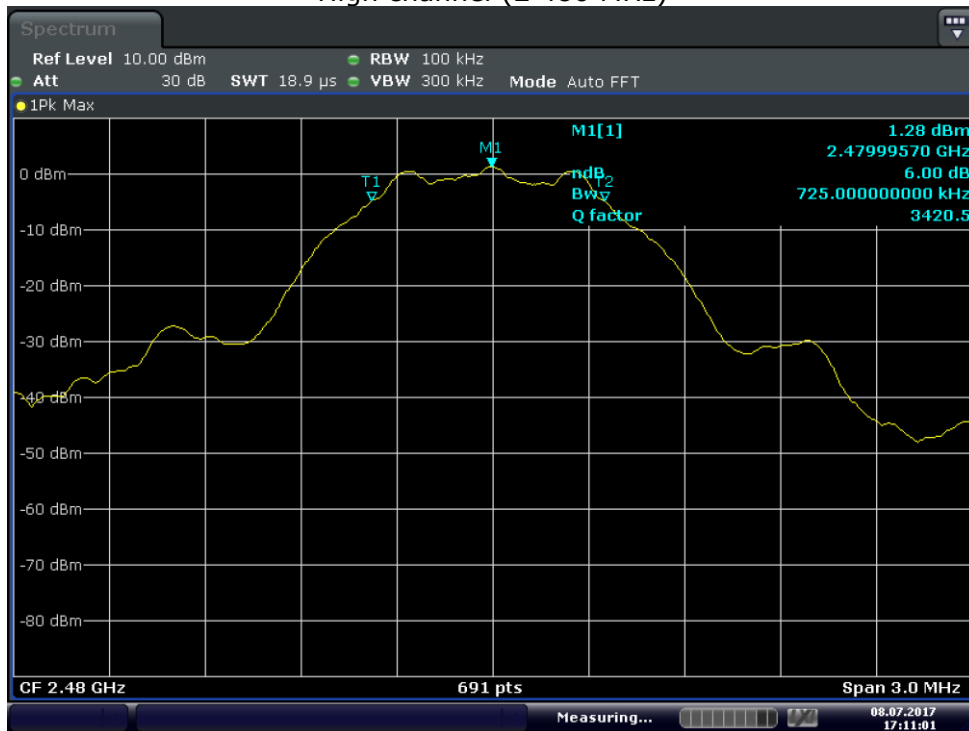
Low channel (2 402 MHz)



Middle channel (2 440 MHz)

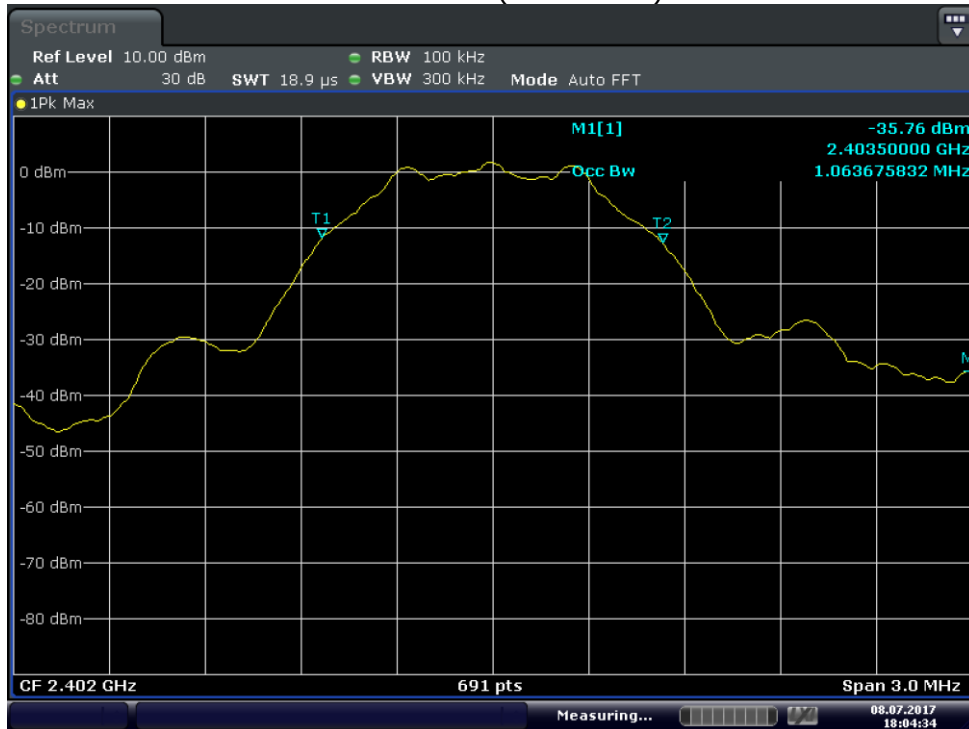


High channel (2 480 MHz)

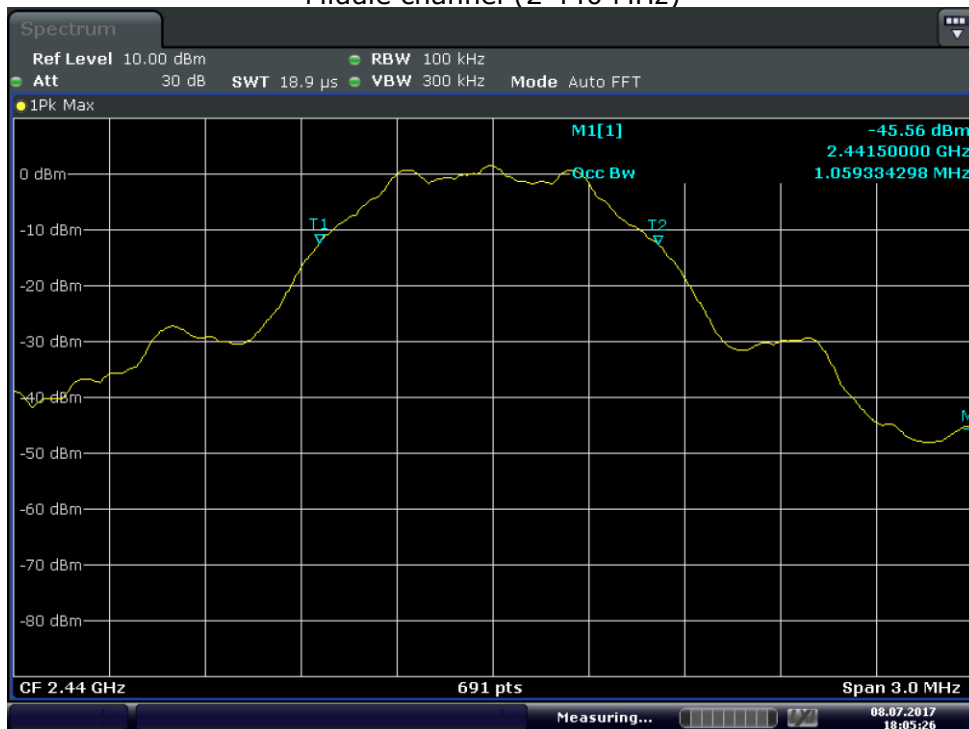


## 99% Bandwidth

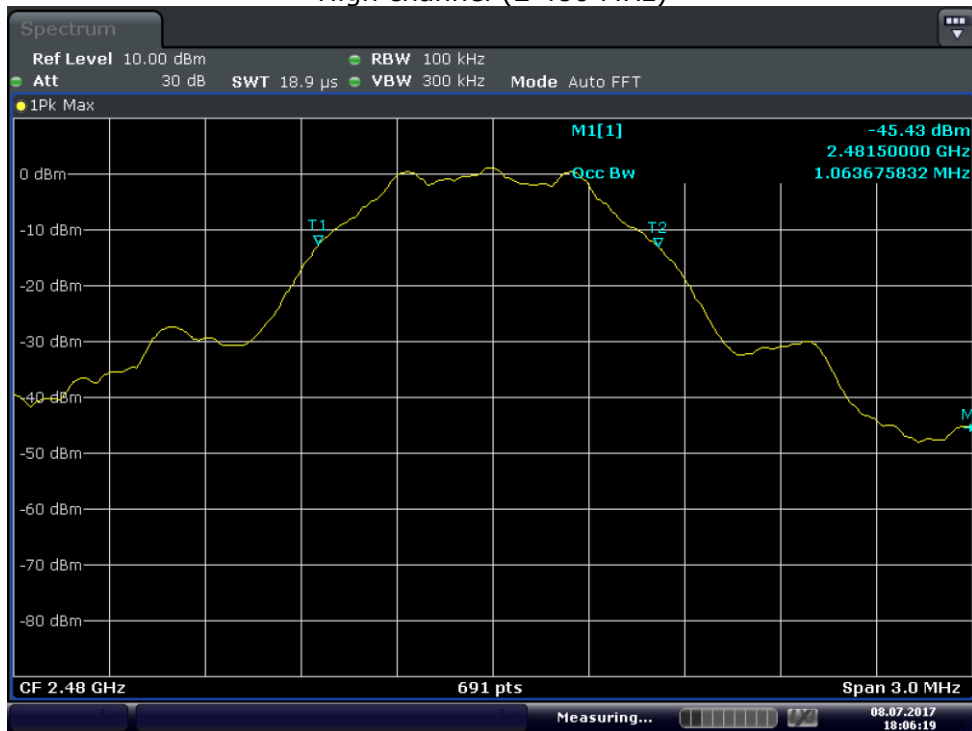
Low channel (2 402 MHz)



Middle channel (2 440 MHz)



High channel (2 480 MHz)



## 4.2 Maximum peak Conducted Output Power

### Test Procedures(ANSI C63.10-2013 11.9.1)

The following procedure can be used when the maximum available RBW of the instrument is less than the DTS bandwidth:

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

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

#### Limit :

---

Maximum Output Power < 1 W (30 dBm)

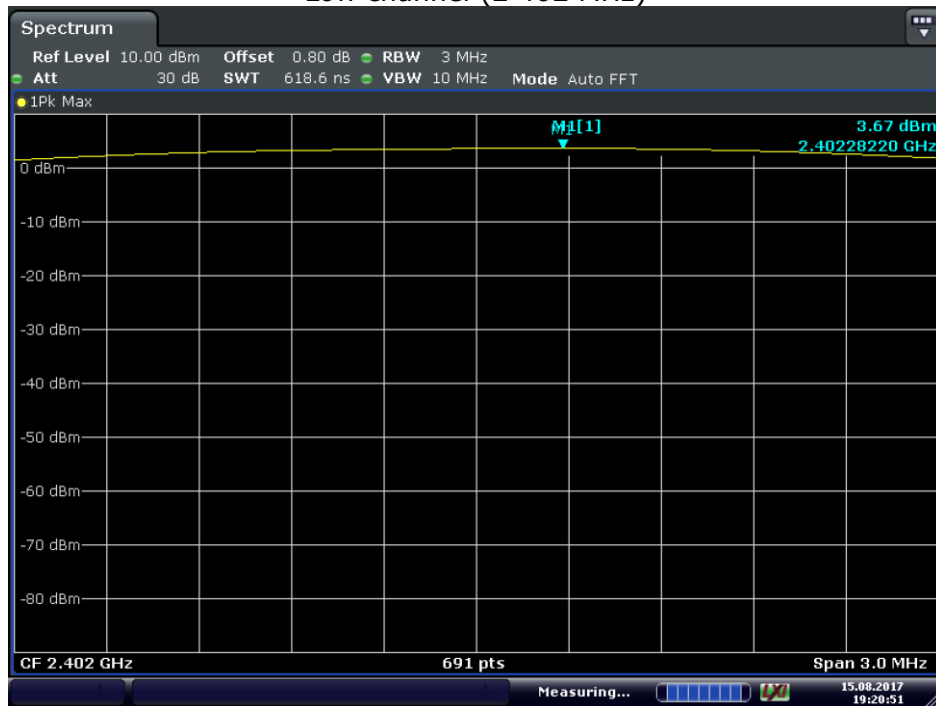
---

#### Test Data :

| Channel | Frequency [MHz] | Measurement data [dBm] | Limit [dBm] | Result   |
|---------|-----------------|------------------------|-------------|----------|
| Low     | 2 402           | 3.67                   | 30          | Complies |
| Middle  | 2 440           | 2.81                   | 30          | Complies |
| High    | 2 480           | 2.76                   | 30          | Complies |

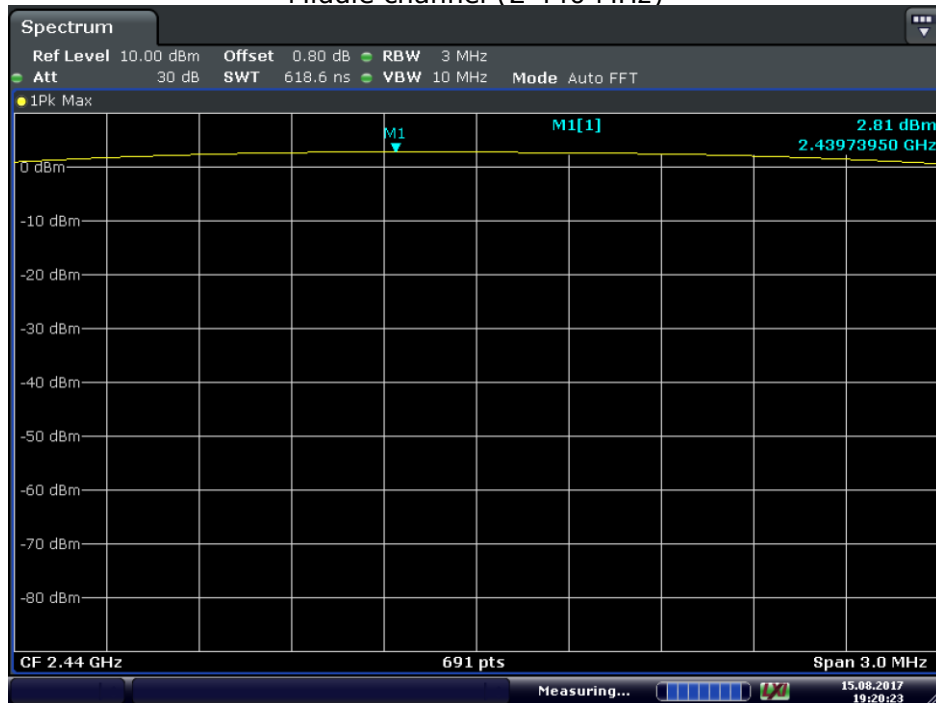
See next pages for actual measured spectrum plots.

### Low channel (2 402 MHz)



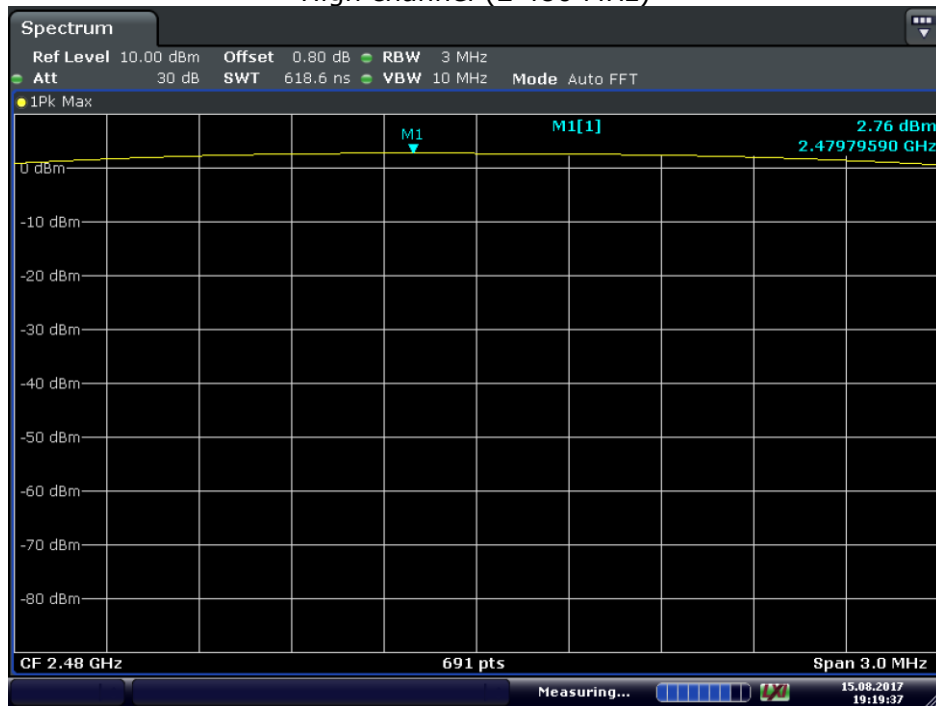
Date: 15.AUG.2017 19:20:52

### Middle channel (2 440 MHz)



Date: 15.AUG.2017 19:20:24

High channel (2 480 MHz)



Date: 15.AUG.2017 19:19:38

## 4.3 Power Spectral Density

### Test Procedures(ANSI C63.10-2013 11.10.2)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance.

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

- a) RBW :  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
- b) VBW  $\geq 3 \times \text{RBW}$
- c) span  $\geq 1.5 \times \text{DTS bandwidth}$
- d) Sweep time = auto couple
- e) Detector = peak
- f) Trace mode= max hold
- g) Allow trace to fully stabilize
- h) Use the peak marker function to determine the maximum amplitude level within the RBW.

#### **Limit :**

---

Power Spectral Density < 8 dBm @ 3 kHz BW

---

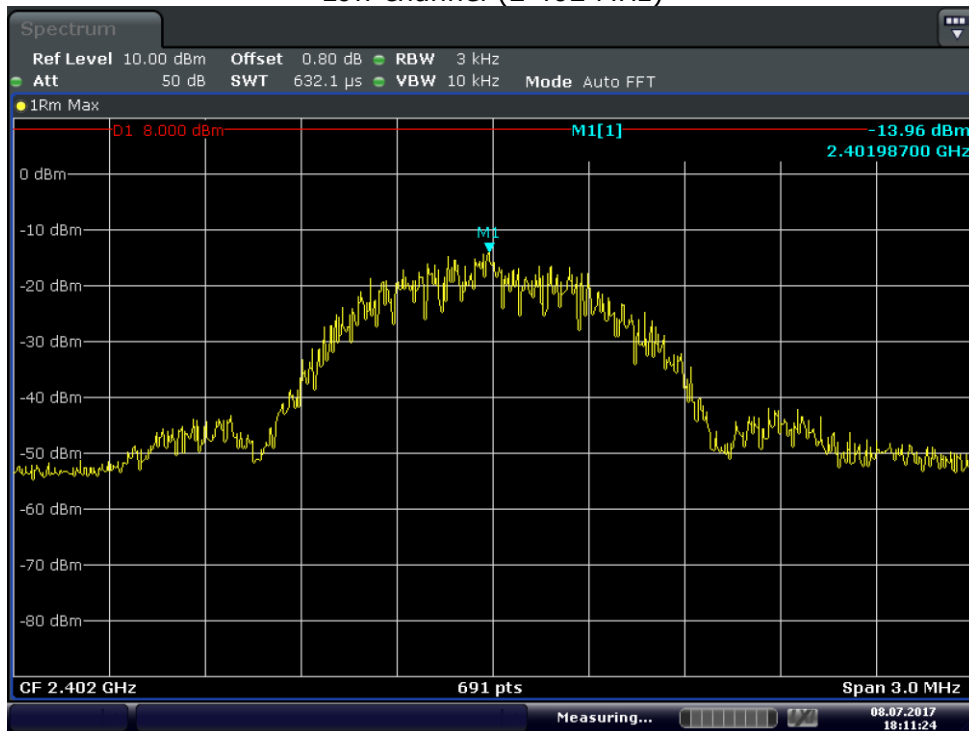
#### **Test Data :**

##### **Test mode : 802.11b**

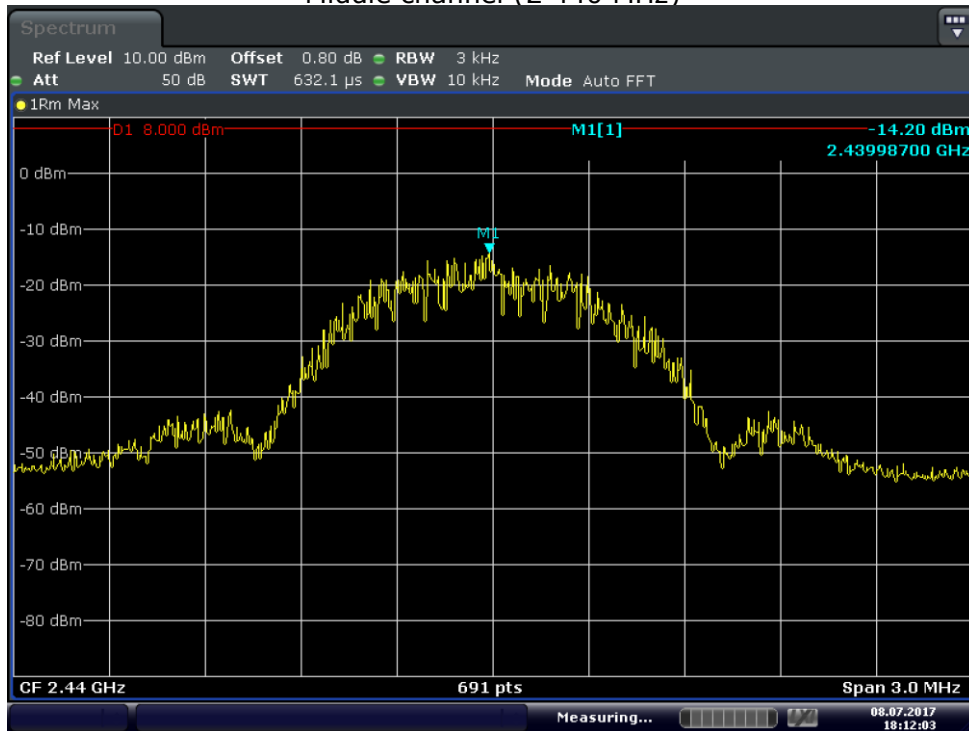
| Channel | Frequency [MHz] | Measurement data [dBm] | Limit [dBm] | Result   |
|---------|-----------------|------------------------|-------------|----------|
| Low     | 2 402           | -13.96                 | 8           | Complies |
| Middle  | 2 440           | -14.20                 | 8           | Complies |
| High    | 2 480           | -14.51                 | 8           | Complies |

See next pages for actual measured spectrum plots.

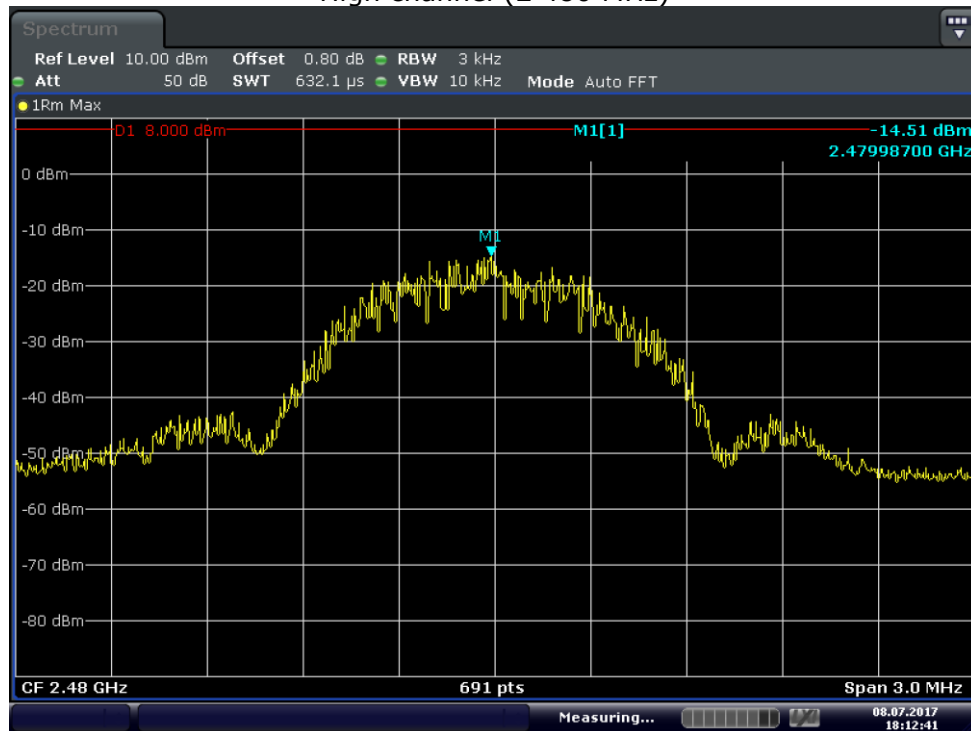
Low channel (2 402 MHz)



Middle channel (2 440 MHz)



### High channel (2 480 MHz)



## 4.4 Band Edge & Conducted Spurious emission

### Test Procedures(ANSI C63.10-2013 11.11.3)

The Unwanted emission from the EUT were measured according to the dictates PKPSD measurement procedure in section 11.11 of ANSI C63.10-2013.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

#### Test Settings:

Center frequency = the highest, middle and the lowest channels

- |                                                                           |                             |
|---------------------------------------------------------------------------|-----------------------------|
| a) RBW = 100 kHz                                                          | b) VBW $\geq 3 \times$ RBW  |
| c) Detector = peak                                                        | d) Sweep time = auto couple |
| e) Trace mode= max hold                                                   |                             |
| f) Allow trace to fully stabilize                                         |                             |
| g) Use the peak marker function to determine the maximum amplitude level. |                             |

#### **Limit :**

---

Emission level < 20 dBc

---

#### **Test results: Complies**

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest in-band spectral density. Therefore the applying equipment meets the requirement.

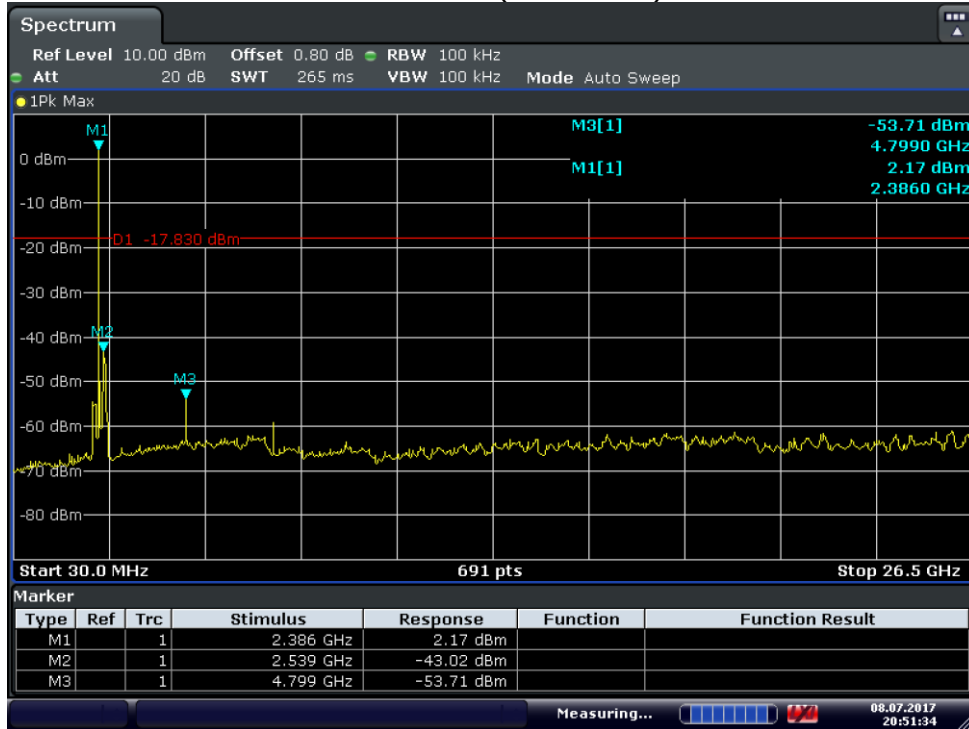
See next pages for actual measured spectrum plots.

## Band-edge

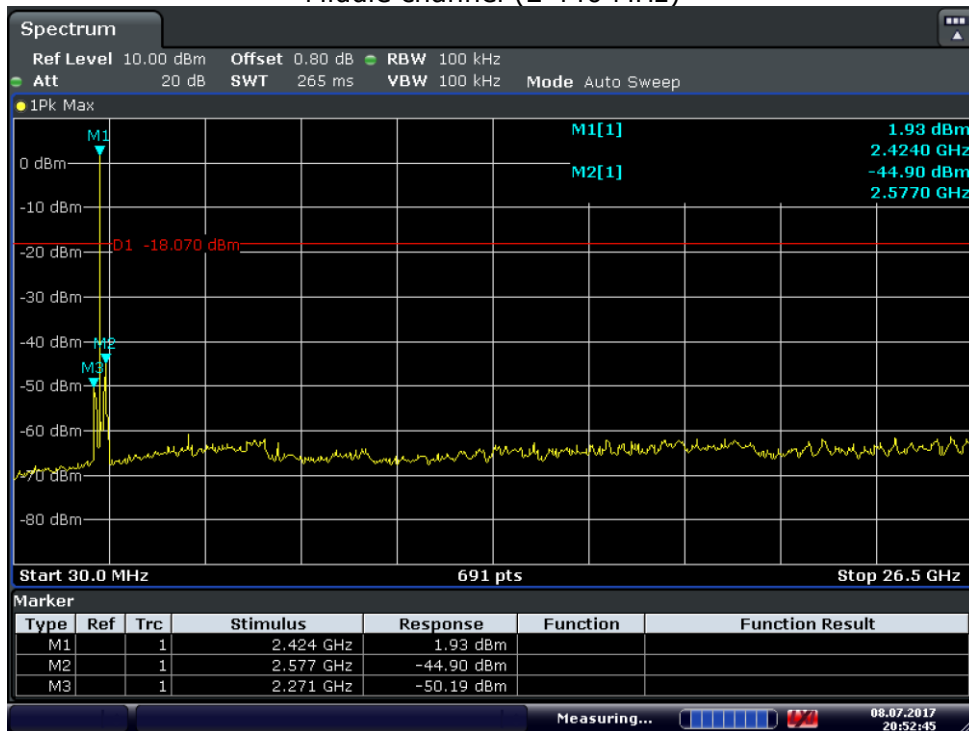


## Conducted Spurious emission

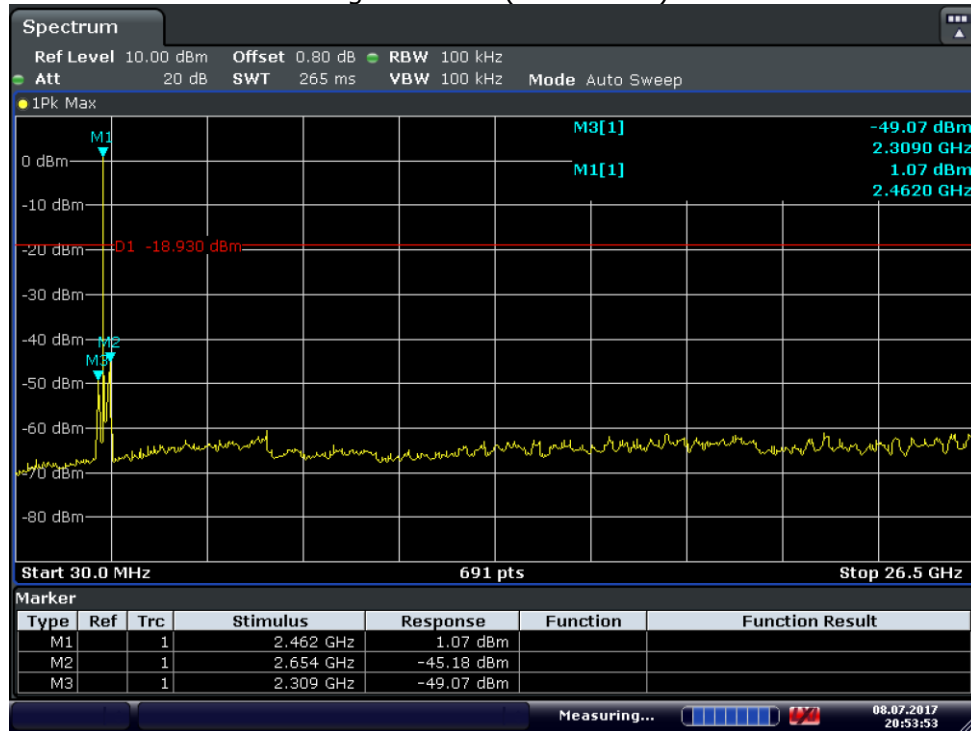
Low channel (2 402 MHz)



Middle channel (2 440 MHz)



### High channel (2 480 MHz)



## 4.5 Radiated Emission

### Test Location

- ☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)  
☒ 3 m SAC (test distance : 3 m)

### Test Procedures

- 1) In the frequency range of 9 kHz to 30 MHz, magnetic field is measured with Loop Antenna. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
- 2) In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) and Horn Test Antenna(above 1 GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.

### Instrument Settings

Frequency Range = 9 kHz ~ 25 GHz (2.4 GHz 10<sup>th</sup> harmonic)

- a) RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz, 9 kHz for  $f < 30$  MHz
- b) VBW  $\geq$  RBW
- c) Sweep time = auto couple

## Limit :

Unwanted emissions that do not fall within the restricted frequency bands of Table 1 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

FCC Part 15 § 15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

**Table 1. Restricted Frequency Bands**

| MHz                      | MHz               | MHz                 | MHz           | MHz         | GHz                     |
|--------------------------|-------------------|---------------------|---------------|-------------|-------------------------|
| 0.09-0.11                | 8.37626-8.38675   | 73-74.6             | 399.9-410     | 2690-2900   | 10.6-12.7               |
| <sup>1</sup> 0.495-0.505 | 8.41425-8.41475   | 74.8-75.2           | 608-614       | 3260-3267   | 13.25-13.4              |
| 2.1735-2.1905            | 12.29-12.293      | 108-121.94          | 960-1240      | 3332-3339   | 14.47-14.5              |
| 4.125-4.128              | 12.51975-12.52025 | 123-138             | 1300-1427     | 3345.8-3358 | 15.35-16.2              |
| 4.17725-4.17775          | 12.57675-12.57725 | 149.9-150.05        | 1435-1626.5   | 3600-4400   | 17.7-21.4               |
| 4.20725-4.20775          | 13.36-13.41       | 156.52475-156.52525 | 1645.5-1646.5 | 4500-5150   | 22.01-23.12             |
| 6.215-6.218              | 16.42-16.423      | 156.7-156.9         | 1660-1710     | 5350-5460   | 23.6-24                 |
| 6.26775-6.26825          | 16.69475-16.69525 | 162.0125-167.17     | 1718.8-1722.2 | 7250-7750   | 31.2-31.8               |
| 6.31175-6.31225          | 16.80425-16.80475 | 167.72-173.2        | 2200-2300     | 8025-8500   | 36.43-36.5              |
| 8.291-8.294              | 25.5-25.67        | 240-285             | 2310-2390     | 9000-9200   | <sup>2</sup> Above 38.6 |
| 8.362-8.366              | 37.5-38.25        | 322-335.4           | 2483.5-2500   | 9300-9500   |                         |

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup> Above 38.6

§ 15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 2. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

**Table 2. General Field Strength Limits for Licence-Exempt Transmitters**

| Frequency(MHz) | Field Strength<br>uV/m@3m | Field Strength<br>dBuV/m@3m | Measurement<br>Distance (meters) |
|----------------|---------------------------|-----------------------------|----------------------------------|
| 0.009-0.490    | 2400/F(kHz)               | -                           | 300                              |
| 0.490-1.705    | 24000/F(kHz)              | -                           | 30                               |
| 1.705-30       | 30                        | -                           | 30                               |
| 30-88          | 100**                     | 40                          | 3                                |
| 88-216         | 150**                     | 43.5                        | 3                                |
| 216-960        | 200**                     | 46                          | 3                                |
| Above 960      | 500                       | 54                          | 3                                |

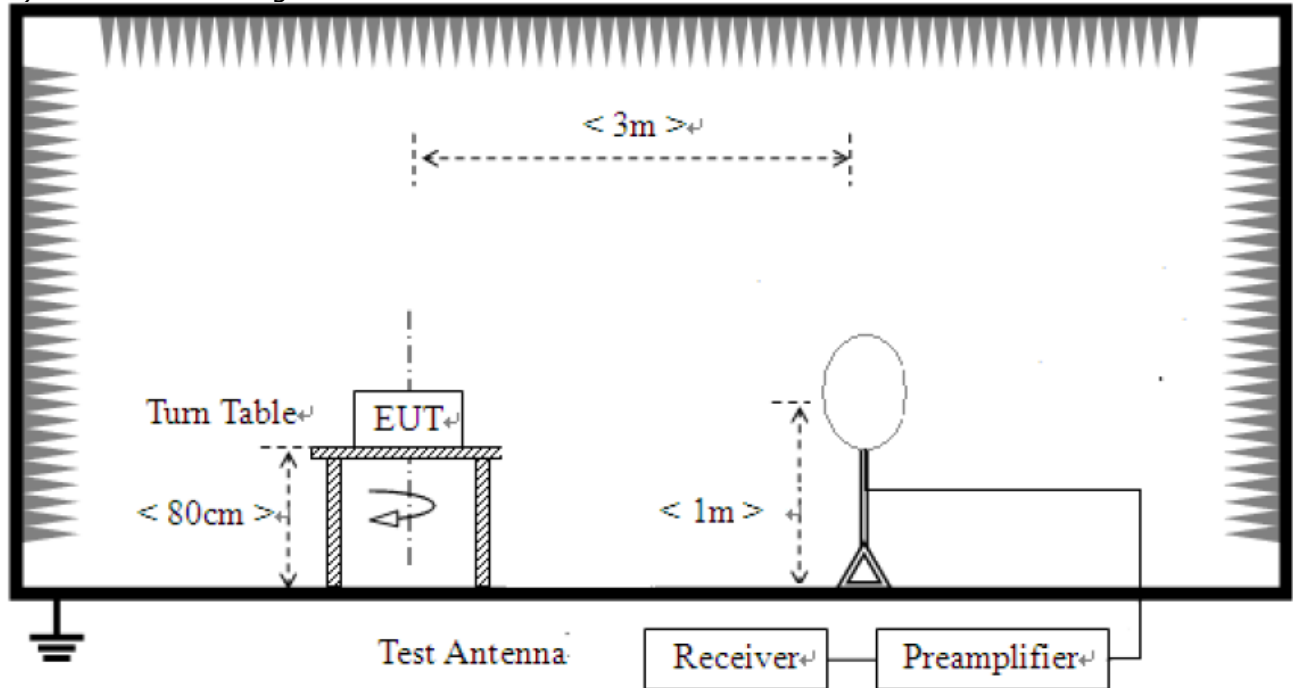
\*\* Except as provided in 15.209(g).fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note :

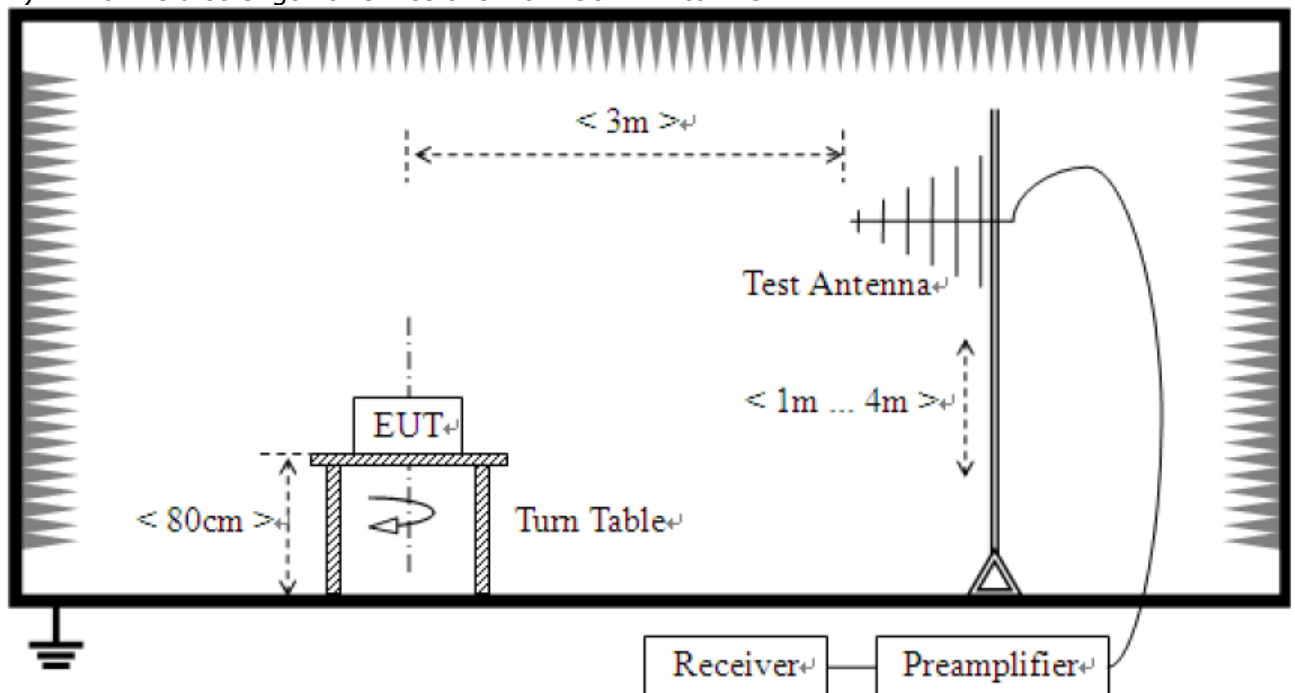
- 1) For above 1 GHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit.
- 2) For above 1 GHz, limit field strength of harmonics : 54 dBuV/m@3m (AV) and 74 dBuV/m@3m (PK)
- 3) For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement.(Duty Cycle is > 98%,)
- 4) Duty Cycle is < 98%, VBW setting will need to > 1/T.

## Test Setup:

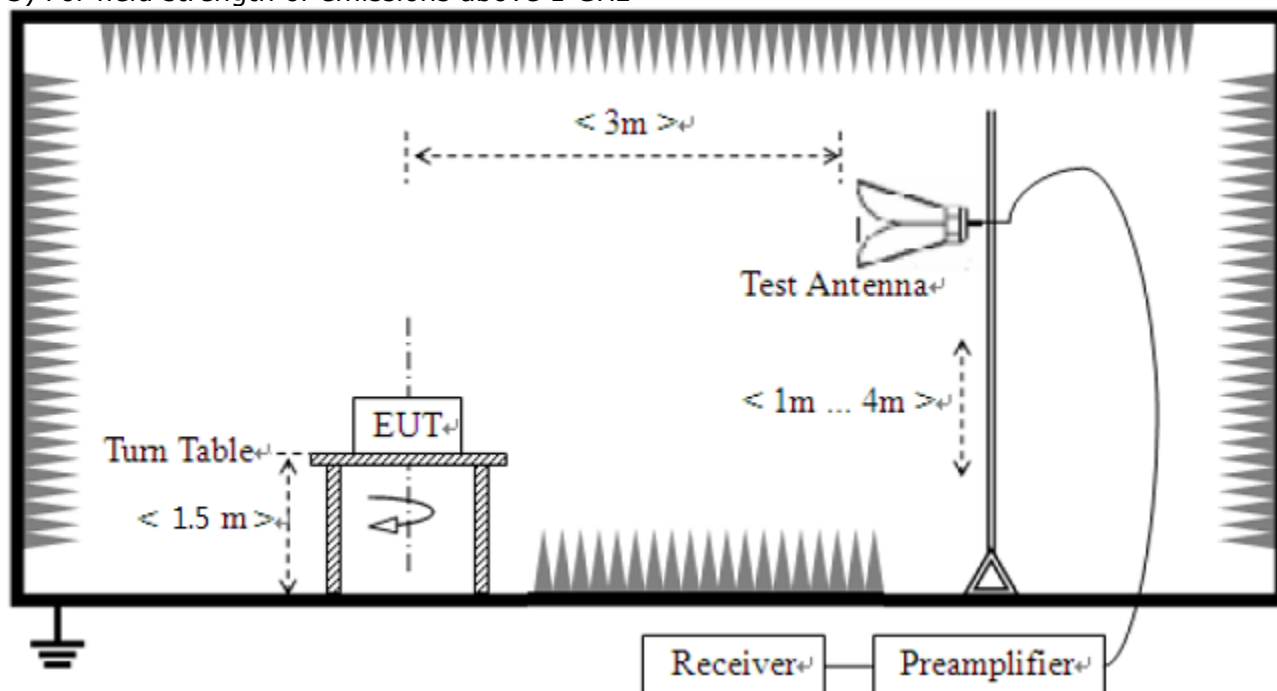
- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



### 3) For field strength of emissions above 1 GHz



## Test results

### 1) 9 kHz to 30 MHz

The requirements are:

☒ Complies

| Frequency (MHz) | Measured Data (dBuV/m) | Margin (dB) | Remark   |
|-----------------|------------------------|-------------|----------|
| -               | -                      | -           | See note |

#### Note :

The amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)

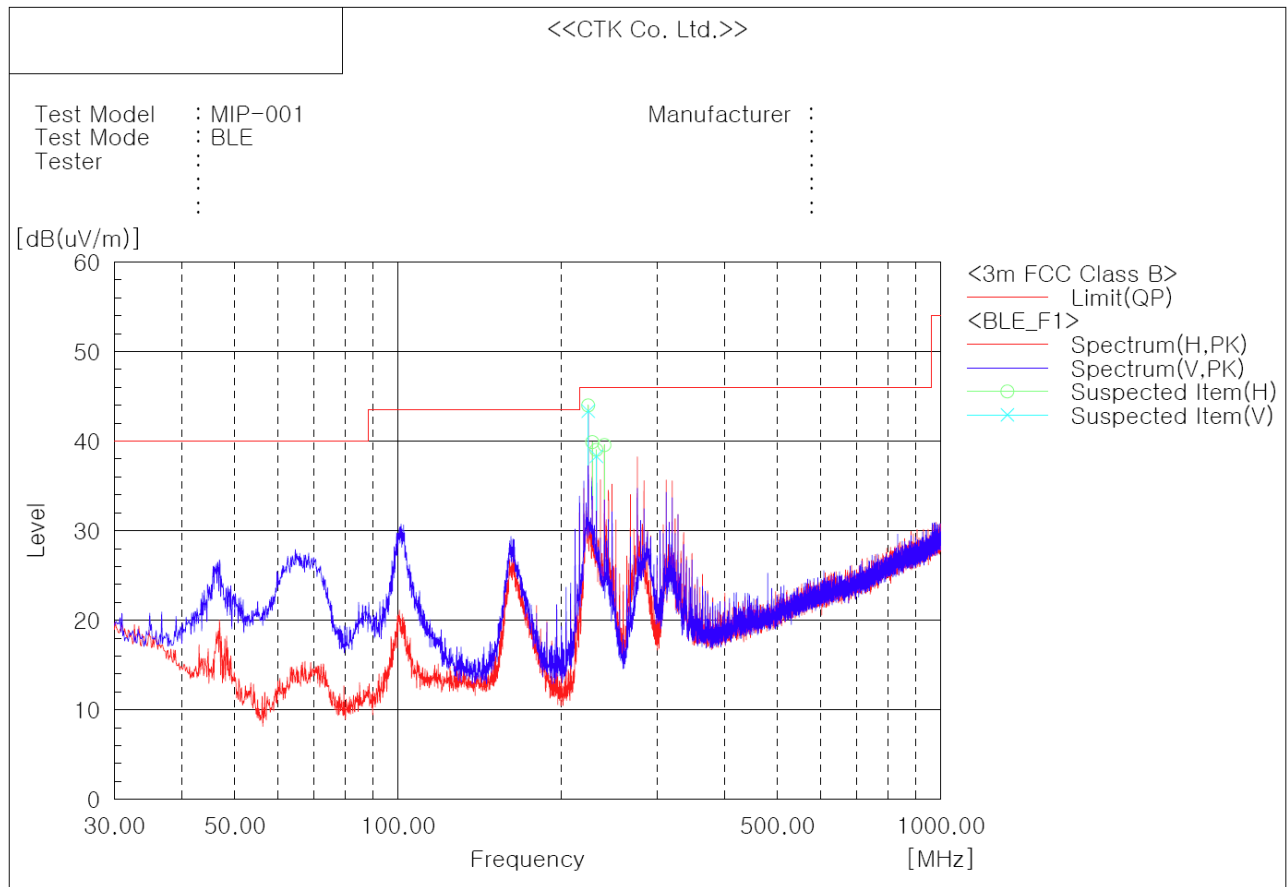
## 2) 30 MHz to 1 GHz

**Test mode : Adapter 1, Lowest Channel(Worst case)**

The requirements are:

☒ Complies

### Test Data



#### Spectrum Selection

| No. | Frequency [MHz] | (P) | Reading [dB(uV)] | c.f [dB(1/m)] | Result PK [dB(uV/m)] | Limit QP [dB(uV/m)] | Margin QP [dB] | Height [cm] | Angle [deg] |
|-----|-----------------|-----|------------------|---------------|----------------------|---------------------|----------------|-------------|-------------|
| 1   | 224.000         | H   | 56.0             | -12.0         | 44.0                 | 46.0                | 2.0            | 101.0       | 169.0       |
| 2   | 224.000         | V   | 55.4             | -12.0         | 43.4                 | 46.0                | 2.6            | 101.0       | 191.0       |
| 3   | 228.001         | H   | 51.4             | -11.5         | 39.9                 | 46.0                | 6.1            | 101.0       | 357.0       |
| 4   | 232.003         | H   | 50.0             | -11.0         | 39.0                 | 46.0                | 7.0            | 101.0       | 357.0       |
| 5   | 232.003         | V   | 49.3             | -11.0         | 38.3                 | 46.0                | 7.7            | 101.0       | 217.0       |
| 6   | 240.005         | H   | 49.9             | -10.3         | 39.6                 | 46.0                | 6.4            | 101.0       | 169.0       |

#### Remark :

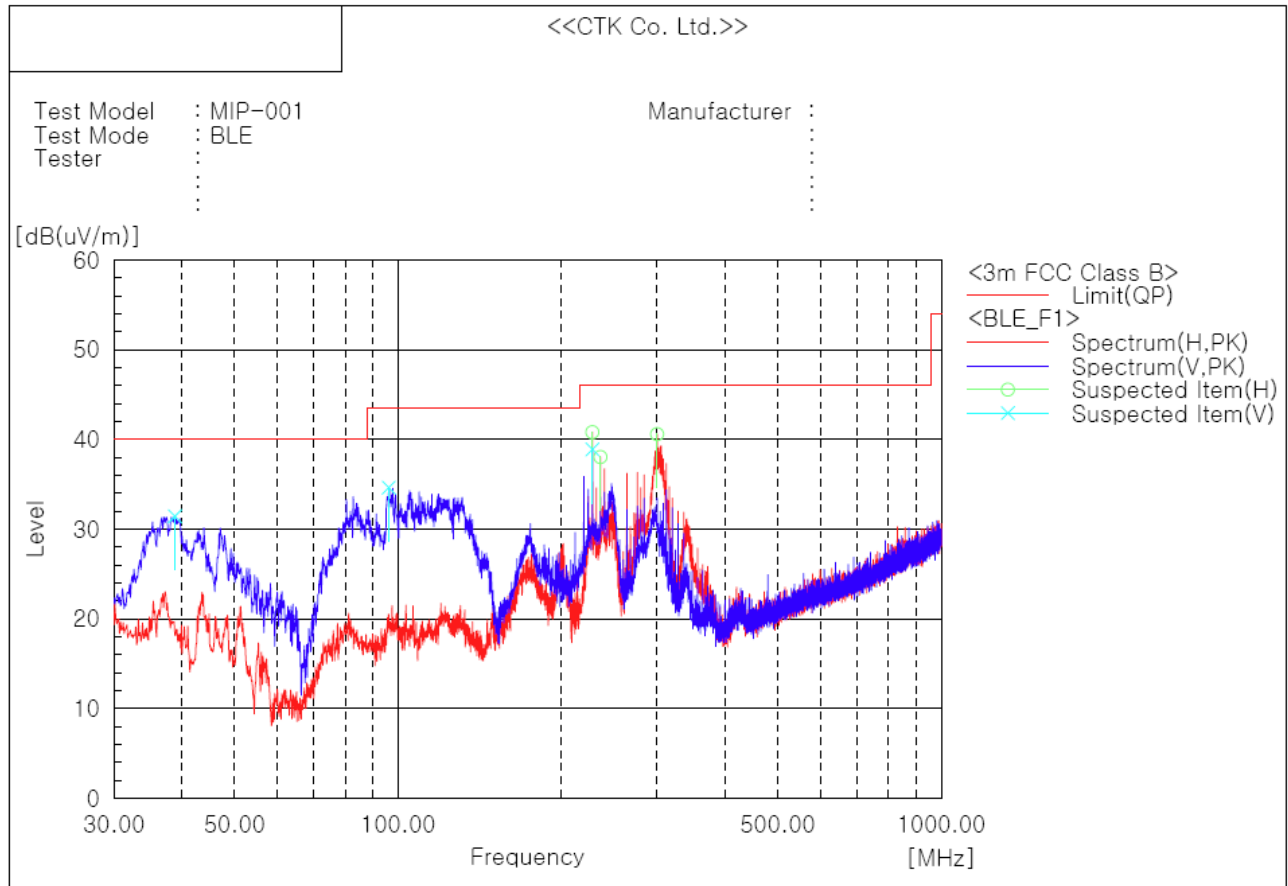
1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the Peak(PK) value.

**Test mode : Adapter 2, Lowest Channel(Worst case)**

The requirements are:

☒ Complies

**Test Data**



Spectrum Selection

| No. | Frequency<br>[MHz] | (P) | Reading<br>[dB(uV)] | c.f<br>[dB(1/m)] | Result<br>PK<br>[dB(uV/m)] | Limit<br>QP<br>[dB(uV/m)] | Margin<br>QP<br>[dB] | Height<br>[cm] | Angle<br>[deg] |
|-----|--------------------|-----|---------------------|------------------|----------------------------|---------------------------|----------------------|----------------|----------------|
| 1   | 38.851             | V   | 41.5                | -10.1            | 31.4                       | 40.0                      | 8.6                  | 100.0          | 322.0          |
| 2   | 96.203             | V   | 48.9                | -14.3            | 34.6                       | 43.5                      | 8.9                  | 100.0          | 217.0          |
| 3   | 228.001            | H   | 52.3                | -11.5            | 40.8                       | 46.0                      | 5.2                  | 200.0          | 138.0          |
| 4   | 228.001            | V   | 50.4                | -11.5            | 38.9                       | 46.0                      | 7.1                  | 100.0          | 191.0          |
| 5   | 236.004            | H   | 48.6                | -10.6            | 38.0                       | 46.0                      | 8.0                  | 100.0          | 357.0          |
| 6   | 300.024            | H   | 49.5                | -8.9             | 40.6                       | 46.0                      | 5.4                  | 100.0          | 222.0          |

**Remark :**

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
2. Result = Reading + c.f(Correction factor)
3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
4. This data is the peak(PK) value.

### 3) above 1 GHz

The requirements are:

☒ Complies

#### Test Data

##### Test mode : Adapter 1(Worst case), Lowest frequency(2 402 MHz)

| Frequency [MHz] | Ant. Pol. (V/H) | Reading* [dBuV/m] | c.f [dB/m] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|-----------------|-----------------|-------------------|------------|-----------------|----------------|-------------|--------|
| 2 390           | V               | 49.37             | -4.07      | <b>45.30</b>    | 54             | 8.70        | Peak   |
| 4 804           | V               | 47.24             | 2.75       | <b>49.99</b>    | 54             | 4.01        | Peak   |
| 7 206           | V               | 46.25             | 5.69       | <b>51.94</b>    | 54             | 2.06        | Peak   |

##### Test mode : Adapter 1(Worst case), Middle frequency(2 440 MHz)

| Frequency [MHz] | Ant. Pol. (V/H) | Reading* [dBuV/m] | c.f [dB/m] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|-----------------|-----------------|-------------------|------------|-----------------|----------------|-------------|--------|
| 4 880           | V               | 46.51             | 2.75       | <b>49.26</b>    | 54             | 4.74        | Peak   |
| 7 320           | V               | 46.20             | 5.35       | <b>51.54</b>    | 54             | 2.46        | Peak   |

##### Test mode : Adapter 1(Worst case), Highest frequency(2 480 MHz)

| Frequency [MHz] | Ant. Pol. (V/H) | Reading* [dBuV/m] | c.f [dB/m] | Result [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Remark |
|-----------------|-----------------|-------------------|------------|-----------------|----------------|-------------|--------|
| 2 492           | V               | 44.66             | -3.91      | <b>40.75</b>    | 54             | 13.25       | Peak   |
| 4 960           | V               | 45.70             | 1.91       | <b>47.61</b>    | 54             | 6.39        | Peak   |
| 7 440           | V               | 45.23             | 5.85       | <b>51.08</b>    | 54             | 2.92        | Peak   |

#### Remarks

1. The Unwanted emission was measured in the following position: EUT stand-up position(Z axis), lie-down position(X,Y axis). The worst emission was found in lie-down position(X axis) and the worst case was recorded.
  2. Result = Reading + c.f(correction factor) + Duty cycle c.f
  3. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
- \* Reading data is the peak value.

## 4.6 AC Power Line Conducted Emissions

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits.

### Instrument Settings

IF Band Width: 9 kHz

### Test Procedures

The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m.

Amplitude measurements were performed with a quasi-peak detector and an average detector.

### Limit

| Frequency<br>(MHz) | Conducted Limit (dBuV) |           |
|--------------------|------------------------|-----------|
|                    | Quasi-peak             | Average** |
| 0.15 ~ 0.5         | 66 to 56*              | 56 to 46* |
| 0.5 ~ 5            | 56                     | 46        |
| 5 ~ 30             | 60                     | 50        |

\* The level decreases linearly with the logarithm of the frequency.

\*\* A linear average detector is required.

## Test Results

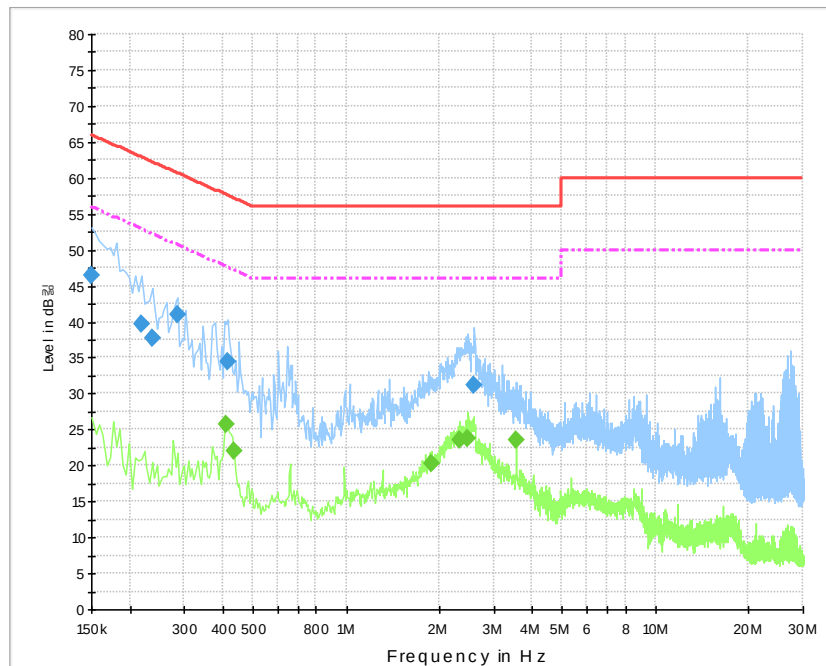
The requirements are:

☒ Complies

## Test Data

### Test mode : Adapter 1, Lowest Channel(Worst case) [L1]

Class B\_L1



### Final Result 1

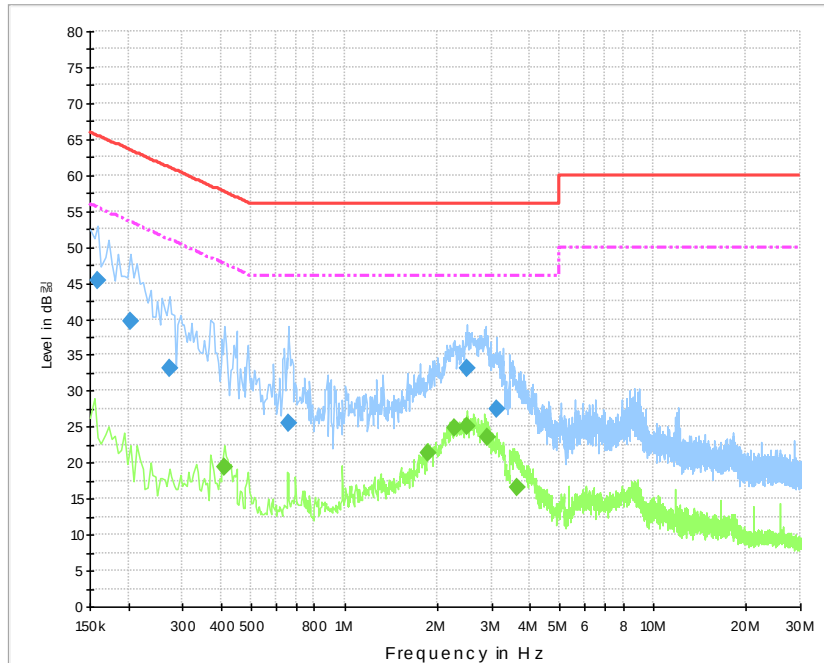
| Frequency (MHz) | QuasiPeak (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.150000        | 46.5             | 1000.0          | 9.000           | On     | L1   | 9.7        | 19.5        | 66.0         |
| 0.217500        | 39.7             | 1000.0          | 9.000           | On     | L1   | 9.8        | 23.2        | 62.9         |
| 0.235500        | 37.8             | 1000.0          | 9.000           | On     | L1   | 9.7        | 24.5        | 62.3         |
| 0.285000        | 41.0             | 1000.0          | 9.000           | On     | L1   | 9.7        | 19.7        | 60.7         |
| 0.415500        | 34.5             | 1000.0          | 9.000           | On     | L1   | 9.9        | 23.0        | 57.5         |
| 2.598000        | 31.1             | 1000.0          | 9.000           | On     | L1   | 9.8        | 24.9        | 56.0         |

### Final Result 2

| Frequency (MHz) | CAverage (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.411000        | 25.7            | 1000.0          | 9.000           | On     | L1   | 9.9        | 21.9        | 47.6         |
| 0.433500        | 22.0            | 1000.0          | 9.000           | On     | L1   | 9.9        | 25.2        | 47.2         |
| 1.887000        | 20.2            | 1000.0          | 9.000           | On     | L1   | 9.7        | 25.8        | 46.0         |
| 2.328000        | 23.6            | 1000.0          | 9.000           | On     | L1   | 9.8        | 22.4        | 46.0         |
| 2.481000        | 23.7            | 1000.0          | 9.000           | On     | L1   | 9.8        | 22.3        | 46.0         |
| 3.547500        | 23.5            | 1000.0          | 9.000           | On     | L1   | 9.8        | 22.5        | 46.0         |

## [NEUTRAL]

Class B\_N



### Final Result 1

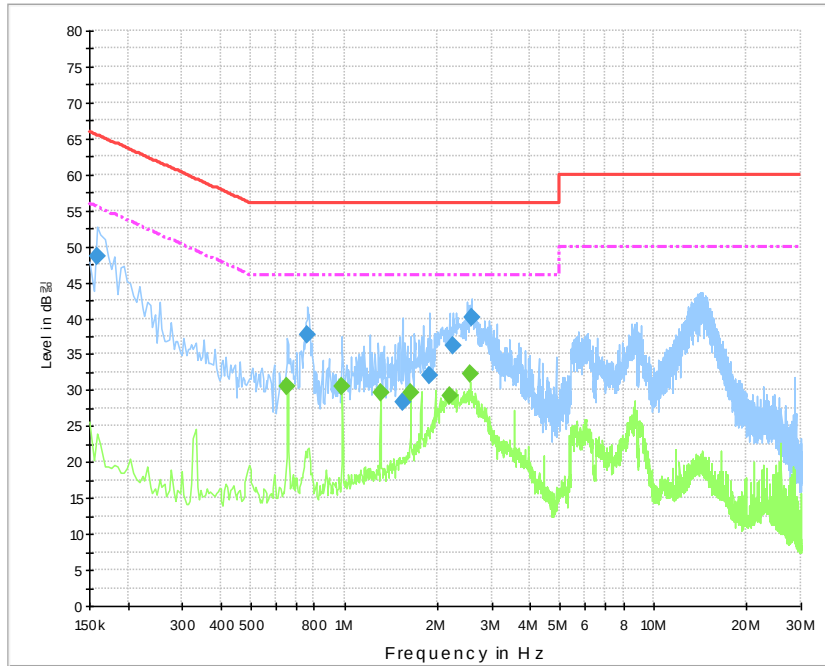
| Frequency (MHz) | QuasiPeak (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.159000        | 45.4             | 1000.0          | 9.000           | On     | N    | 9.8        | 20.1        | 65.5         |
| 0.204000        | 39.6             | 1000.0          | 9.000           | On     | N    | 9.9        | 23.8        | 63.4         |
| 0.271500        | 33.2             | 1000.0          | 9.000           | On     | N    | 9.7        | 27.9        | 61.1         |
| 0.658500        | 25.4             | 1000.0          | 9.000           | On     | N    | 9.9        | 30.6        | 56.0         |
| 2.503500        | 33.1             | 1000.0          | 9.000           | On     | N    | 9.8        | 22.9        | 56.0         |
| 3.106500        | 27.5             | 1000.0          | 9.000           | On     | N    | 9.8        | 28.5        | 56.0         |

### Final Result 2

| Frequency (MHz) | CAverage (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.411000        | 19.5            | 1000.0          | 9.000           | On     | N    | 9.9        | 28.1        | 47.6         |
| 1.873500        | 21.4            | 1000.0          | 9.000           | On     | N    | 9.7        | 24.6        | 46.0         |
| 2.283000        | 24.9            | 1000.0          | 9.000           | On     | N    | 9.8        | 21.1        | 46.0         |
| 2.503500        | 25.2            | 1000.0          | 9.000           | On     | N    | 9.8        | 20.8        | 46.0         |
| 2.917500        | 23.6            | 1000.0          | 9.000           | On     | N    | 9.8        | 22.4        | 46.0         |
| 3.628500        | 16.5            | 1000.0          | 9.000           | On     | N    | 9.8        | 29.5        | 46.0         |

**Test mode : Adapter 2, Lowest Channel(Worst case)  
[L1]**

Class B\_L 1



**Final Result 1**

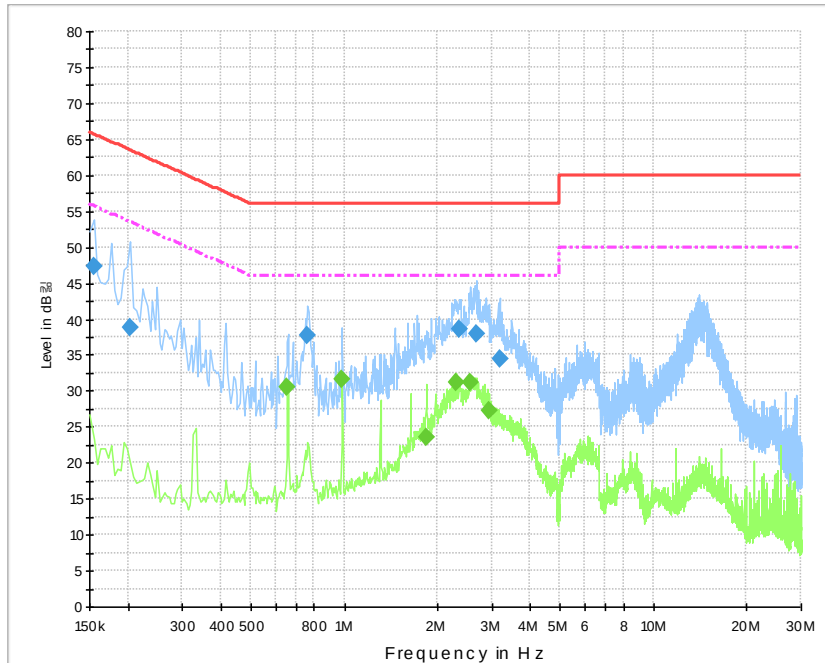
| Frequency (MHz) | QuasiPeak (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.159000        | 48.7             | 1000.0          | 9.000           | On     | L1   | 9.8        | 16.8        | 65.5         |
| 0.762000        | 37.7             | 1000.0          | 9.000           | On     | L1   | 9.8        | 18.3        | 56.0         |
| 1.540500        | 28.3             | 1000.0          | 9.000           | On     | L1   | 9.7        | 27.7        | 56.0         |
| 1.882500        | 32.0             | 1000.0          | 9.000           | On     | L1   | 9.7        | 24.0        | 56.0         |
| 2.247000        | 36.1             | 1000.0          | 9.000           | On     | L1   | 9.8        | 19.9        | 56.0         |
| 2.589000        | 40.0             | 1000.0          | 9.000           | On     | L1   | 9.8        | 16.0        | 56.0         |

**Final Result 2**

| Frequency (MHz) | CAverage (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.654000        | 30.4            | 1000.0          | 9.000           | On     | L1   | 9.9        | 15.6        | 46.0         |
| 0.987000        | 30.6            | 1000.0          | 9.000           | On     | L1   | 9.7        | 15.4        | 46.0         |
| 1.311000        | 29.7            | 1000.0          | 9.000           | On     | L1   | 9.7        | 16.3        | 46.0         |
| 1.639500        | 29.7            | 1000.0          | 9.000           | On     | L1   | 9.7        | 16.3        | 46.0         |
| 2.202000        | 29.2            | 1000.0          | 9.000           | On     | L1   | 9.8        | 16.8        | 46.0         |
| 2.557500        | 32.3            | 1000.0          | 9.000           | On     | L1   | 9.8        | 13.7        | 46.0         |

## [NEUTRAL]

Class B\_N



### Final Result 1

| Frequency (MHz) | QuasiPeak (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|------------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.154500        | 47.3             | 1000.0          | 9.000           | On     | N    | 9.8        | 18.5        | 65.8         |
| 0.204000        | 38.7             | 1000.0          | 9.000           | On     | N    | 9.9        | 24.8        | 63.4         |
| 0.762000        | 37.8             | 1000.0          | 9.000           | On     | N    | 9.8        | 18.2        | 56.0         |
| 2.350500        | 38.5             | 1000.0          | 9.000           | On     | N    | 9.8        | 17.5        | 56.0         |
| 2.674500        | 38.0             | 1000.0          | 9.000           | On     | N    | 9.8        | 18.0        | 56.0         |
| 3.174000        | 34.5             | 1000.0          | 9.000           | On     | N    | 9.8        | 21.5        | 56.0         |

### Final Result 2

| Frequency (MHz) | CAverage (dBuV) | Meas. Time (ms) | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBuV) |
|-----------------|-----------------|-----------------|-----------------|--------|------|------------|-------------|--------------|
| 0.654000        | 30.6            | 1000.0          | 9.000           | On     | N    | 9.9        | 15.4        | 46.0         |
| 0.982500        | 31.7            | 1000.0          | 9.000           | On     | N    | 9.8        | 14.3        | 46.0         |
| 1.846500        | 23.7            | 1000.0          | 9.000           | On     | N    | 9.7        | 22.4        | 46.0         |
| 2.296500        | 31.1            | 1000.0          | 9.000           | On     | N    | 9.8        | 14.9        | 46.0         |
| 2.548500        | 31.2            | 1000.0          | 9.000           | On     | N    | 9.8        | 14.8        | 46.0         |
| 2.931000        | 27.3            | 1000.0          | 9.000           | On     | N    | 9.8        | 18.7        | 46.0         |

## APPENDIX A – Test Equipment Used For Tests

|    | Name of Equipment   | Manufacturer    | Model No. | Serial No.    | Date of Calibration | Due Date   |
|----|---------------------|-----------------|-----------|---------------|---------------------|------------|
| 1  | Signal Analyzer     | Agilent         | N9020A    | MY48011598    | 2016-11-01          | 2017-11-01 |
| 2  | Signal Generator    | Rohde & Schwarz | SMB100A   | 175528        | 2016-11-01          | 2017-11-01 |
| 3  | EMI Test Receiver   | Rohde & Schwarz | ESCI7     | 100814        | 2016-11-01          | 2017-11-01 |
| 4  | Bilog Antenna       | Schaffner       | CBL6111C  | 2551          | 2016-05-13          | 2018-05-13 |
| 5  | Active Loop Antenna | SCHWARZBECK     | FMZB 1513 | 1513-126      | 2016-05-25          | 2018-05-25 |
| 6  | 6dB Attenuator      | R&S             | DNF       | 272.4110.50-2 | 2016-11-01          | 2017-11-01 |
| 7  | 6dB Attenuator      | R&S             | DNF       | 272.4110.50-1 | 2017-02-03          | 2018-02-03 |
| 8  | AMPLIFIER           | SONOMA          | 310       | 291721        | 2017-02-02          | 2018-02-02 |
| 9  | EMI Test Receiver   | Rohde & Schwarz | ESU40     | 100336        | 2017-05-12          | 2018-05-12 |
| 10 | Preamplifier        | Agilent         | 8449B     | 3008A02011    | 2016-12-01          | 2017-12-01 |
| 11 | Horn Antenna        | ETS-Lindgren    | 3115      | 00078894      | 2015-09-02          | 2017-09-02 |
| 12 | Horn Antenna        | ETS-Lindgren    | 3116      | 00062504      | 2015-09-04          | 2017-09-04 |
| 13 | Horn Antenna        | ETS-Lindgren    | 3117      | 00154525      | 2015-09-02          | 2017-09-02 |
| 14 | Active Loop Antenna | SCHWARZBECK     | FMZB 1513 | 1513-125      | 2017-05-16          | 2018-05-16 |
| 15 | Band Reject Filter  | Micro Tronics   | BRM50702  | G233          | 2017-02-03          | 2018-02-03 |
| 16 | Signal Analyzer     | R&S             | FSV30     | 100925        | 2017-02-02          | 2018-02-02 |
| 17 | LISN                | Rohde & Schwarz | ENV216    | 101760        | 2017-02-03          | 2018-02-03 |

## APPENDIX B – EUT Photographs

