

# MEASUREMENT REPORT


(FCC : Part 15 Subpart C (15.249) / ANSI C63.4-2014/C63.10-2013)

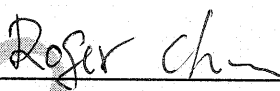


Testing Laboratory  
1288

Product.....: Wireless Keyboard  
Trade Name.....: **ikbc**  
Model No.....: W210, W200  
Applicant.....: MISTEL CO LTD  
Applicant Address.....: 10F-4 No 17 Ln 91 Sec1 Neihu Rd Neihu  
Dist Taipei City114 TW Taiwan

|                      |                   |
|----------------------|-------------------|
| Report Number        | MLT1910P15001     |
| Applicant            | MISTEL CO LTD     |
| Product              | Wireless Keyboard |
| Sample Received Date | 2019/09/23        |
| Sample Tested Date   | 2019/11/27        |

|                    |   |
|--------------------|---|
| Report Prepared By | Jesse Tien  |
| Signature          |  |
| Date Prepared      | 2019/11/28  |

|                      |   |
|----------------------|---|
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| Signature            |  |
| Date Authorized      | 2019/11/28  |

Test By

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laboratory.

This test report not include the evaluation of MU.  
The test results only relate to the submitted test sample.

## Table of Contents

|   |    |
|---|----|
| History of Test Report.....   | 5  |
| 1. General Information.....   | 6  |
| 2. Report of Measurements and Examinations.....                     | 7  |
| 2.1 List of Measurements and Examinations.....                      | 7  |
| 3. Test Configuration of Equipment under Test.....                  | 8  |
| 3.1 Carrier Frequency of Channels.....                              | 8  |
| 3.2 Test Mode and Test Software.....                                | 9  |
| 3.3 TEST Methodology & General Test Procedures.....                 | 10 |
| 3.4 Measurement Uncertainty.....                                    | 11 |
| 3.5 Description of the Support Equipments.....                      | 11 |
| 4. Test and measurement equipment.....                              | 12 |
| 4.1 Calibration.....  | 12 |
| 4.2 Equipment.....  | 12 |
| 5. Antenna Requirements.....  | 14 |
| 5.1 Standard Applicable.....  | 14 |
| 5.2 Antenna Construction and Directional Gain.....                  | 14 |
| 6. Test of Conducted Emission.....                                  | 15 |
| 6.1 Test Limit.....   | 15 |
| 6.2 Test Procedures.....  | 15 |
| 6.3 Typical Test Setup.....   | 16 |
| 6.4 Test Result and Data.....                                       | 17 |
| 7. Test of Radiated Emission.....                                   | 18 |
| 7.1 Test Limit.....   | 18 |
| 7.2 Test Procedures.....  | 19 |
| 7.3 Typical Test Setup.....   | 20 |
| 7.4 Test Result and Data (Fundamental).....                         | 21 |
| 7.5 Test Result and Data (9kHz ~ 30MHz).....                        | 24 |
| 7.6 Test Result and Data (30MHz ~ 1GHz, worst emissions found)..... | 24 |
| 7.7 Test Result and Data (Above 1GHz).....                          | 25 |
| 7.8 Test Result and Data (Band Edge).....                           | 28 |
| 8. 20dB Bandwidth Measurement.....                                  | 30 |
| 8.1 Test Setup.....   | 30 |

|   |    |
|---|----|
| 8.2 Test Limit .....                                | 30 |
| 8.3 Test Procedures .....                           | 30 |
| 8.4 Test Data .....                                 | 30 |
| 9. Restricted Bands of Operation.....               | 33 |
| 9.1 Labeling Requirement .....                      | 33 |
| Appendix I - Photograph of test configuration ..... | 34 |
| Appendix II - Photograph of EUT 2 .....             | 37 |

## History of Test Report

Original Report Issue Date: 2019/11/28

☒ No additional attachment

☐ Additional attachments were issued as in the following record:

| Attachment No. | Issue Date | Description     |
|----------------|------------|-----------------|
| MLT1910P15001  | 2019/11/28 | Original Report |
|                |            |                 |
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## 1. General Information

### 1.1 Introduction

The following measurement report is submitted on behalf of MISTEL CO LTD In support of a Class B Digital Device certification in accordance with Part2 Subpart J and Part 15 Subpart C of the Commission's and Regulations.

### 1.2 Customer Details

|                             |  |
|-----------------------------|--|
| <b>Applicant Name</b>       | MISTEL CO LTD  |
| <b>Applicant Address</b>    | 10F-4 No 17 Ln 91 Sec1 Neihu Rd Neihu Dist Taipei City114<br>TW Taiwan                             |
| <b>Manufacturer Name</b>    | Solid Year Co., Ltd.   |
| <b>Manufacturer Address</b> | 18F, Tower., No. 97, Sec. 1, Xintai 5 <sup>th</sup> , Xizhi Dist, New Taipei<br>City 22175, Taiwan |

### 1.3 Technical data of EUT

|                             |   |
|-----------------------------|---|
| <b>Equipment</b>            | Wireless Keyboard   |
| <b>Model No</b>             | W210, W200  |
| <b>Model Difference</b>     | The difference among series of models W200 is differences<br>are key numbers and dimension. All covered models have<br>electrically identical on the circuitry to each other. |
| <b>FCC ID</b>               | 2AURQ-24W210  |
| <b>Power Type</b>           | DC 1.5V x 2   |
| <b>Type of Modulation</b>   | 2408~2474 MHz   |
| <b>Transfer rate</b>        | GFSK  |
| <b>Type of Antenna</b>      | Printed Antenna   |
| <b>Frequency of Channel</b> | 34  |

During testing the EUT was operated at Tx or Rx mode for each emission measured. This was done in order to ensure that maximum emission levels were attained.

## 2. Report of Measurements and Examinations

### 2.1 List of Measurements and Examinations

| FCC Rule     | Description of Test                       | Result         |
|--------------|---|----------------|
| 15.249(a)    | . Field Strength of Fundamental Emissions | Pass           |
| 15.249(d)    | . Band Edge Emissions                     | Pass           |
| 15.249(a)(d) | . Radiated Emissions                      | Pass           |
| 15.207       | . Conducted Emissions                     | Not applicable |
| 15.215(c)    | . 20dB Bandwidth                          | Pass           |
| 15.203       | . Antenna Requirements                    | Pass           |

### 3. Test Configuration of Equipment under Test

#### 3.1 Carrier Frequency of Channels

| Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|---------|-----------------|
| 01      | 2408            | 13      | 2432            | 25      | 2456            |
| 02      | 2410            | 14      | 2434            | 26      | 2458            |
| 03      | 2412            | 15      | 2436            | 27      | 2460            |
| 04      | 2414            | 16      | 2438            | 28      | 2462            |
| 05      | 2416            | 17      | 2440            | 29      | 2464            |
| 06      | 2418            | 18      | 2442            | 30      | 2466            |
| 07      | 2420            | 19      | 2444            | 31      | 2468            |
| 08      | 2422            | 20      | 2446            | 32      | 2470            |
| 09      | 2424            | 21      | 2448            | 33      | 2472            |
| 10      | 2426            | 22      | 2450            | 34      | 2474            |
| 11      | 2428            | 23      | 2452            | --      | --              |
| 12      | 2430            | 24      | 2454            | --      | --              |



### 3.2 Test Mode and Test Software

- a. During testing, the interface cables and equipment positions were varied according to ANSI C63.10.
- b. The complete test system included PC and EUT for RF test.
- c. An executive “Engineering mode” was executed to keep transmitting and receiving data via Wireless.
- d. New battery was used for all testing and the worst radiated emission.
- e. The following test modes were performed for test:
  - GFSK: CH 01: 2408MHz, CH 17: 2440MHz, CH 34: 2474MHz.

### 3.3 TEST Methodology & General Test Procedures

All testing as described bellowed were performed in accordance ANSI C63.4:2014, C63.10:2013 and FCC CFR 47 Part 15 Subpart C.

#### **Conducted Emissions**

The EUT is placed on a wood table, which is at 0.8 m above ground plane acceding to clause 15.207 and requirements of ANSI C63.4 and C63.10. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz are using CISPR Quasi-Peak / Average detectors. The resolution bandwidth of test receiver/spectrum analyzer is 9 KHz and video bandwidth is 120 KHz.

#### **Radiated Emissions**

The EUT is a placed on a turn table, which is 0.8 m (1.5 m for above 1 GHz) above ground plane. The turntable was rotated through 360 degrees to determine the position of maximum emission level. The EUT is placed at 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

- 1) Putting the EUT on the platform and turning on the EUT (on/off button on the bottom of the EUT).
- 2) Setting test channel described as "Channel setting and operating condition", and testing channel by channel.
- 3) For the spurious emission test based on ANSI C63.4 and C63.10, the resolution bandwidth of test receiver/spectrum analyzer is 120 KHz and video bandwidth is 300 KHz for Quasi-peak detection at frequency 30 MHz~1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz RMS detector for Average Value at frequency above 1GHz.

### 3.4 Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of  $k=2$ .

| Measurement Item                  | MU            |
|-----------------------------------|---------------|
| Conducted emissions               | $\pm 2.24$ dB |
| Radiated emissions (30MHz ~ 1GHz) | $\pm 3.96$ dB |
| Radiated emissions (above 1GHz)   | $\pm 3.74$ dB |

| Measurement Item               | MU               |
|--------------------------------|------------------|
| Radio Frequency                | $\pm 2.18E-08\%$ |
| Total RF power (conducted)     | $\pm 1.32$ dB    |
| RF power density (conducted)   | $\pm 0.44$ dB    |
| Spurious emissions (conducted) | $\pm 2.36$ dB    |
| All emissions (radiated)       | $\pm 4.24$ dB    |

### 3.5 Description of the Support Equipments

#### Setup Diagram

See test photographs attached in appendix 1 for the actual connections between EUT and support equipment.

## **4. Test and measurement equipment**

### **4.1 Calibration**

The measuring equipment utilized to perform the tests documented in the report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### **4.2 Equipment**

The following list contains measurement equipment used for testing. The equipment conforms to the requirement of CISPR 16-1, ANSI C63.2 and. Other required standards.

Calibration of all test and measurement, including any accessories that may effect such calibration, is checked frequently to ensure the accuracy. Adjustments are made and correction factors are applied in accordance with the instructions contained in the respective.



### 3.3 Test Equipment List:

| Item | Instrument        | Mfr/Brand   | Model No.             | Serial No  | Calibrated Date | Next Cal. Date |
|------|-------------------|-------------|-----------------------|------------|-----------------|----------------|
| 1.   | Pre Amplifier     | MLT         | PREAMP6G-01           | 20110209   | 2019/03/19      | 2020/03/19     |
| 2.   | Pre Amplifier     | MLT         | PREAMP6G-02           | 20110301   | 2019/03/19      | 2020/03/19     |
| 3.   | Biconilog Antenna | EMCO        | 3142C                 | 00044568   | 2019/09/23      | 2020/09/23     |
| 4.   | Spectrum Analyzer | Agilent     | E7403A                | US40240137 | 2019/03/25      | 2020/03/25     |
| 5.   | LISN              | EMCO        | 3825/2                | 2658       | 2019/01/15      | 2020/01/15     |
| 6.   | Spectrum Analyzer | Agilent     | E4446A                | US44300422 | 2019/03/13      | 2020/03/13     |
| 7.   | Home Antenna      | SCHWARZBECK | BBHA 9120D            | 304        | 2019/01/07      | 2020/01/07     |
| 8.   | Spectrum Analyzer | Agilent     | E4407B                | US44300422 | 2019/03/13      | 2020/03/13     |
| 9.   | Pre Amplifier     | TA          | 0.10~19.1GHz<br>60dBm | RF01       | 2019/03/14      | 2020/03/14     |
| 10.  | Pre Amplifier     | Herotek     | A402-417              | 30690      | 2018/12/27      | 2019/12/27     |
| 11.  | Spectrum Analyzer | Agilent     | N9010A                | MY50060164 | 2019/08/26      | 2020/08/26     |



## **5. Antenna Requirements**

### **5.1 Standard Applicable**

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 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

### **5.2 Antenna Construction and Directional Gain**

Antenna Type: Printed Antenna

Antenna Gain: 2.15 dBi (Manufacturer Provide)

## 6. Test of Conducted Emission

### 6.1 Test Limit

Conducted Emissions were measured from 150 kHz to 30 MHz with a bandwidth of 9 KHz on the 120 VAC power and return leads of the EUT according to the methods defined in ANSI C63.4-2014. The EUT was placed on a nonmetallic stand in a shielded room 0.8 meters above the ground plane. The interface cables and equipment positioning were varied within limits of reasonable applications to determine the position produced maximum conducted emissions.

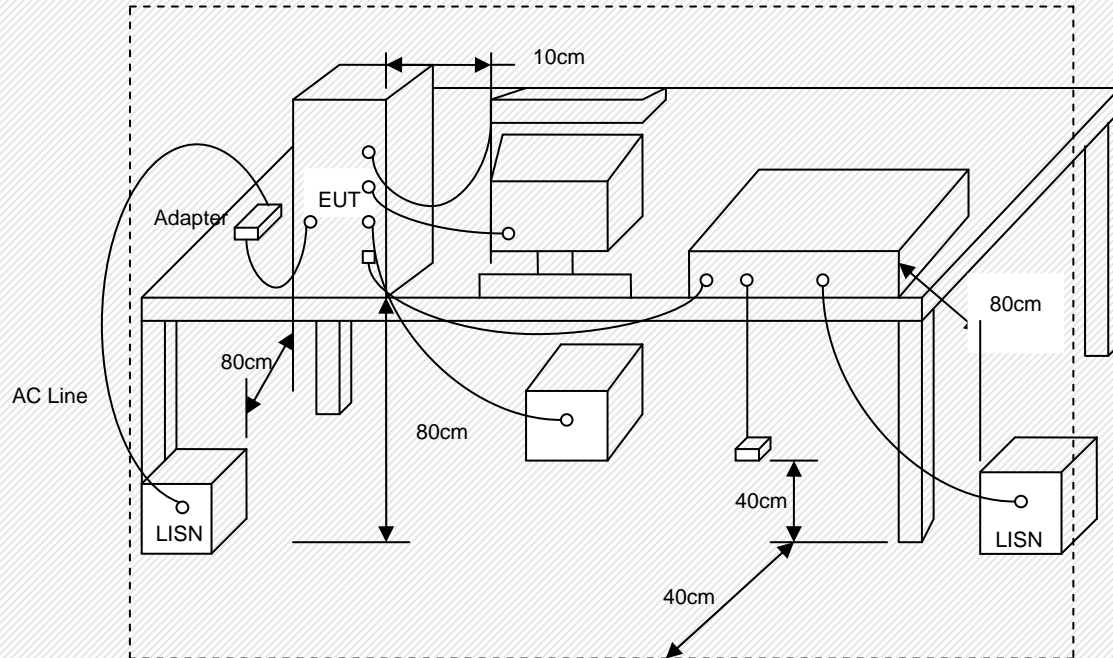
| Frequency (MHz) | Quasi Peak (dB $\mu$ V) | Average (dB $\mu$ V) |
|-----------------|-------------------------|----------------------|
| 0.15 – 0.5      | 66-56*                  | 56-46*               |
| 0.5 – 5.0       | 56                      | 46                   |
| 5.0 – 30.0      | 60                      | 50                   |

\*Decreases with the logarithm of the frequency.

### 6.2 Test Procedures

- The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connecting to the other LISN.
- The LISN provides 50 ohm coupling impedance for the measuring instrument.
- The FCC states that a 50 ohm, 50 micro-Henry LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

### 6.3 Typical Test Setup



#### **6.4 Test Result and Data**

The EUT is battery powered, so no conduction test is required.

## 7. Test of Radiated Emission

### 7.1 Test Limit

Radiated Emissions were measured from 9 KHz to 25 GHz and return leads of the EUT according to the methods defined in ANSI C63.4-2014 and C63.10-2013. In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter measurement is based on the maximum conducted output power, the attenuation required under this paragraph shall be 30dB instead of 20dB. In addition, radiated emissions which fall in section 15.205(a) the restricted bands must also comply with the radiated emission limit specified in section 15.209(a).

| Frequency (MHz) | Field Strength (microvolt/meter) | Measurement Distance (meters) |
|-----------------|----------------------------------|-------------------------------|
| 0.009 ~ 0.490   | 2400/F(kHz)                      | 300                           |
| 0.490 ~ 1.705   | 24000/F(kHz)                     | 30                            |
| 1.705 ~ 30.0    | 30                               | 30                            |
| 30 ~ 88         | 100                              | 3                             |
| 88 ~ 216        | 150                              | 3                             |
| 216 ~ 960       | 200                              | 3                             |
| Above 960       | 500                              | 3                             |

| Fundamental Frequency (MHz)             | Field Strength of Fundamental (millivolts/meter) | Field Strength of Fundamental (dBμV/m at 3-meter) | Detector |
|---|--|---|----------|
| 902 ~ 928<br>2400 ~ 2483<br>5725 ~ 5875 | 50   | 94  | Average  |

Notes:

Peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.



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

| <b>Fundamental Frequency (MHz)</b>      | <b>Field Strength of Fundamental (microvolts/meter)</b> | <b>Field Strength of Fundamental (dBμV/m at 3-meter)</b> | <b>Detector</b> |
|---|---|--|-----------------|
| 902 ~ 928<br>2400 ~ 2483<br>5725 ~ 5875 | 500   | 54   | Average         |

Notes:

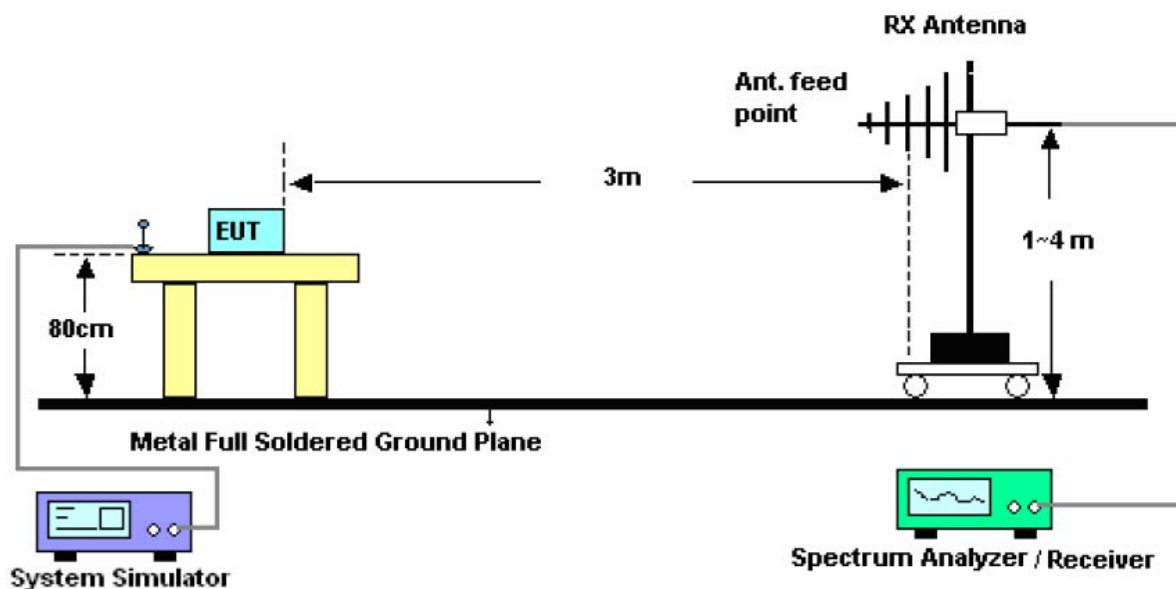
Peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

## 7.2 Test Procedures

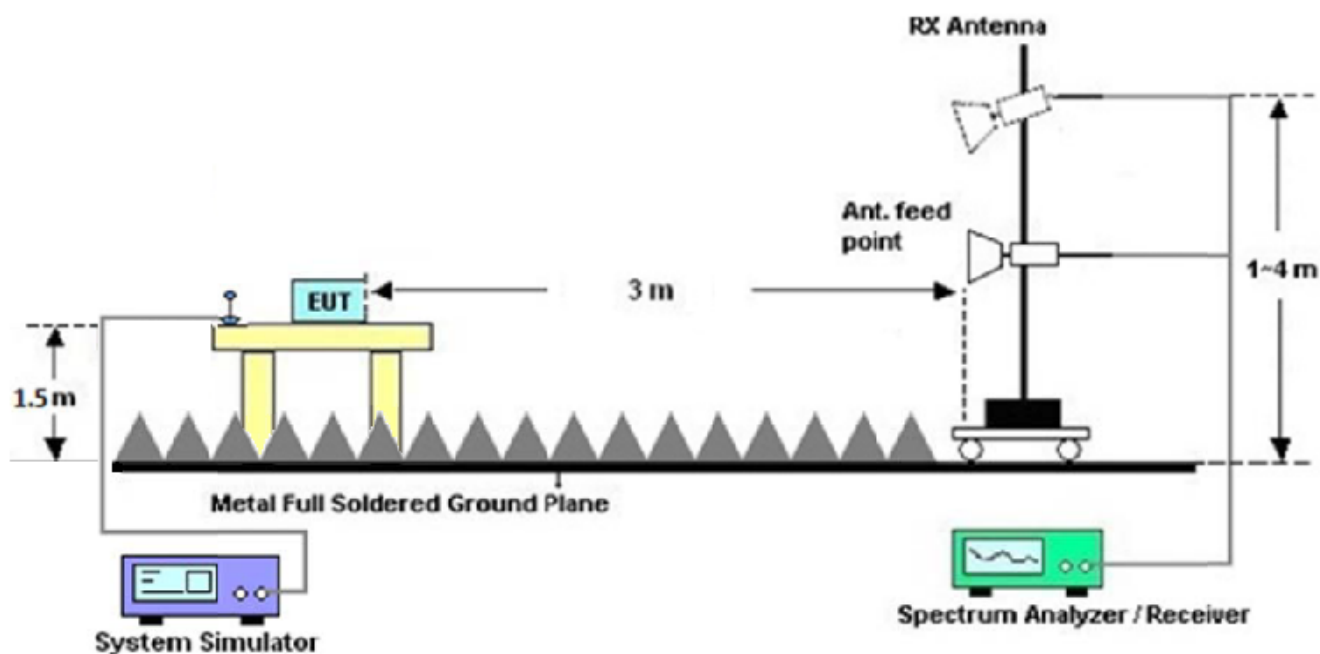
- The EUT was placed on a rotatable table top 0.8 meter above ground (30 MHz to 1 GHz).
- The EUT was placed on a rotatable table top 1.5 meter above ground (above 1 GHz).
- The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- The table was rotated 360 degrees to determine the position of the highest radiation.
- The antenna is a broadband antenna and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 M to 4 M) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- Set the test-receiver system to Peak or CISPR quasi-peak Detect Function and specified bandwidth with Maximum Hold Mode.
- If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

### 7.3 Typical Test Setup

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



#### 7.4 Test Result and Data (Fundamental)

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH1           | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75%   |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2407.54                       | 119.28         | -- | -32.96 | 86.32                 | -- | 114                | 94 | -27.68         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2407.46                         | 117.89         | -- | -32.96 | 84.93                 | -- | 114                | 94 | -29.07         | -- |

**Notes** : Margin<0 is Pass , Margin  $\geq$  0 is Fail

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH17          | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75%   |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2439.52                       | 119.38         | -- | -33.08 | 86.30                 | -- | 114                | 94 | -27.70         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2439.46                         | 118.28         | -- | -33.08 | 85.20                 | -- | 114                | 94 | -28.80         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail



|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH34          | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75%   |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2473.85                       | 118.93         | -- | -32.84 | 86.09                 | -- | 114                | 94 | -27.91         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2473.41                         | 118.24         | -- | -32.85 | 85.39                 | -- | 114                | 94 | -28.61         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail



### 7.5 Test Result and Data (9kHz ~ 30MHz)

The 9kHz - 30MHz spurious emission is under limit 20dB more.

### 7.6 Test Result and Data (30MHz ~ 1GHz, worst emissions found)

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH0           | Temperature | : 28 °C |
| Test Date | : | Oct. 24, 2019 | Humidity    | : 70 %  |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |             |        |                    |                 |             |
|-------------------------------|-------------|--------|--------------------|-----------------|-------------|
| Frequency (MHz)               | Read (dBuV) | Factor | Amplitude (dBuV/m) | Limits (dBuV/m) | Margin (dB) |
| 124.04                        | 51.43       | -31.32 | 20.11              | 43.5            | -23.39      |
| 157.05                        | 39.97       | -29.20 | 10.77              | 43.5            | -32.73      |
| 209.97                        | 52.17       | -27.50 | 24.67              | 43.5            | -18.83      |
| 249.99                        | 56.55       | -25.06 | 31.49              | 46              | -14.51      |
| 470.44                        | 35.55       | -18.15 | 17.40              | 46              | -28.60      |
| 662.58                        | 39.61       | -13.21 | 26.40              | 46              | -19.60      |

| Radiated Emissions (HORIZONTAL) |               |        |                    |                 |             |
|---------------------------------|---------------|--------|--------------------|-----------------|-------------|
| Frequency (MHz)                 | Read (dBuV/m) | Factor | Amplitude (dBuV/m) | Limits (dBuV/m) | Margin (dB) |
| 124.97                          | 51.01         | -31.43 | 19.58              | 43.5            | -23.92      |
| 158.90                          | 47.24         | -29.15 | 18.09              | 43.5            | -25.41      |
| 251.66                          | 51.80         | -24.74 | 27.06              | 46              | -18.94      |
| 317.15                          | 46.42         | -23.19 | 23.23              | 46              | -22.77      |
| 414.96                          | 40.68         | -20.30 | 20.38              | 46              | -25.62      |
| 740.03                          | 37.72         | -10.66 | 27.06              | 46              | -18.94      |

**Notes :** Margin<0 is Pass , Margin $\geq$ 0 is Fail

## 7.7 Test Result and Data (Above 1GHz)

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH1           | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75 %  |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3164.50                       | 69.57          | -- | -31.46 | 38.11                 | -- | 74                 | 54 | -35.89         | -- |
| 4263.00                       | 68.99          | -- | -28.99 | 40.00                 | -- | 74                 | 54 | -34.00         | -- |
| 4816.50                       | 66.54          | -- | -28.13 | 38.41                 | -- | 74                 | 54 | -35.59         | -- |
| 4997.50                       | 73.82          | -- | -27.82 | 46.00                 | -- | 74                 | 54 | -28.00         | -- |
| 5998.50                       | 66.84          | -- | -23.40 | 43.44                 | -- | 74                 | 54 | -30.56         | -- |
| 7224.50                       | 68.39          | -- | -21.33 | 47.06                 | -- | 74                 | 54 | -26.94         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3184.00                         | 68.57          | -- | -31.35 | 37.22                 | -- | 74                 | 54 | -36.78         | -- |
| 4009.50                         | 66.22          | -- | -29.69 | 36.53                 | -- | 74                 | 54 | -37.47         | -- |
| 4816.50                         | 66.79          | -- | -28.13 | 38.66                 | -- | 74                 | 54 | -35.34         | -- |
| 4991.00                         | 68.85          | -- | -27.88 | 40.97                 | -- | 74                 | 54 | -33.03         | -- |
| 5998.50                         | 66.90          | -- | -23.40 | 43.50                 | -- | 74                 | 54 | -30.50         | -- |
| 7224.50                         | 62.21          | -- | -21.33 | 40.88                 | -- | 74                 | 54 | -33.12         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail

|           |   |               |             |        |
|-----------|---|---------------|-------------|--------|
| Power     | : | DC 3V         |             |        |
| Test Mode | : | CH17          | Temperature | : 28°C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75 % |
| Memo      | : |               |             |        |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3171.00                       | 68.99          | -- | -31.42 | 37.57                 | -- | 74                 | 54 | -36.43         | -- |
| 4256.50                       | 69.06          | -- | -29.00 | 40.06                 | -- | 74                 | 54 | -33.94         | -- |
| 4880.50                       | 66.52          | -- | -28.12 | 38.40                 | -- | 74                 | 54 | -35.60         | -- |
| 4997.50                       | 71.49          | -- | -27.82 | 43.67                 | -- | 74                 | 54 | -30.33         | -- |
| 5998.50                       | 66.65          | -- | -23.40 | 43.25                 | -- | 74                 | 54 | -30.75         | -- |
| 7320.50                       | 67.92          | -- | -21.44 | 46.48                 | -- | 74                 | 54 | -27.52         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3067.00                         | 68.89          | -- | -31.31 | 37.58                 | -- | 74                 | 54 | -36.42         | -- |
| 4003.00                         | 66.53          | -- | -29.72 | 36.81                 | -- | 74                 | 54 | -37.19         | -- |
| 4880.50                         | 67.31          | -- | -28.12 | 39.19                 | -- | 74                 | 54 | -34.81         | -- |
| 4991.00                         | 70.09          | -- | -27.88 | 42.21                 | -- | 74                 | 54 | -31.79         | -- |
| 5998.50                         | 65.69          | -- | -23.40 | 42.29                 | -- | 74                 | 54 | -31.71         | -- |
| 7320.50                         | 62.88          | -- | -21.44 | 41.44                 | -- | 74                 | 54 | -32.56         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH34          | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75 %  |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3067.00                       | 69.18          | -- | -31.31 | 37.87                 | -- | 74                 | 54 | -36.13         | -- |
| 4256.50                       | 69.77          | -- | -29.00 | 40.77                 | -- | 74                 | 54 | -33.23         | -- |
| 4948.50                       | 66.18          | -- | -28.08 | 38.10                 | -- | 74                 | 54 | -35.90         | -- |
| 4991.00                       | 72.39          | -- | -27.88 | 44.51                 | -- | 74                 | 54 | -29.49         | -- |
| 5998.50                       | 67.18          | -- | -23.40 | 43.78                 | -- | 74                 | 54 | -30.22         | -- |
| 7422.50                       | 69.51          | -- | -20.84 | 48.67                 | -- | 74                 | 54 | -25.33         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 3190.50                         | 69.01          | -- | -31.31 | 37.70                 | -- | 74                 | 54 | -36.30         | -- |
| 3990.00                         | 66.20          | -- | -29.77 | 36.43                 | -- | 74                 | 54 | -37.57         | -- |
| 4948.50                         | 66.89          | -- | -28.08 | 38.81                 | -- | 74                 | 54 | -35.19         | -- |
| 4997.50                         | 71.09          | -- | -27.82 | 43.27                 | -- | 74                 | 54 | -30.73         | -- |
| 5998.50                         | 66.91          | -- | -23.40 | 43.51                 | -- | 74                 | 54 | -30.49         | -- |
| 7422.50                         | 62.84          | -- | -20.84 | 42.00                 | -- | 74                 | 54 | -32.00         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail



## 7.8 Test Result and Data (Band Edge)

|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH1           | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75%   |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2395.83                       | 84.16          | -- | -32.93 | 51.23                 | -- | 74                 | 54 | -22.77         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2397.22                         | 80.52          | -- | -32.93 | 47.59                 | -- | 74                 | 54 | -26.41         | -- |

**Notes :** Margin<0 is Pass , Margin  $\geq$  0 is Fail



|           |   |               |             |         |
|-----------|---|---------------|-------------|---------|
| Power     | : | DC 3V         |             |         |
| Test Mode | : | CH34          | Temperature | : 28 °C |
| Test Date | : | Oct. 17, 2019 | Humidity    | : 75%   |
| Memo      | : |               |             |         |

| Radiated Emissions (VERTICAL) |                |    |        |                       |    |                    |    |                |    |
|-------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)            | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                               | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2485.61                       | 84.67          | -- | -32.74 | 51.93                 | -- | 74                 | 54 | -22.07         | -- |

| Radiated Emissions (HORIZONTAL) |                |    |        |                       |    |                    |    |                |    |
|---------------------------------|----------------|----|--------|-----------------------|----|--------------------|----|----------------|----|
| Frequency<br>(MHz)              | Read<br>(dBuV) |    | Factor | Amplitude<br>(dBuV/m) |    | Limits<br>(dBuV/m) |    | Margin<br>(dB) |    |
|                                 | PK             | AV |        | PK                    | AV | PK                 | AV | PK             | AV |
| 2484.34                         | 82.86          | -- | -32.75 | 50.11                 | -- | 74                 | 54 | -23.89         | -- |

Notes:

1. Amplitude = Reading Amplitude + Factor
2. Factor = Antenna Factor + Cable Loss – Amplifier Gain
3. The resolution bandwidth of test receiver/spectrum analyzer is 120 KHz and video bandwidth is 300 KHz for Quasi-peak detection at frequency 30 MHz~1GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3 MHz for Peak detection at frequency above 1GHz.
5. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3 MHz RMS detector for Average Value at frequency above 1GHz
6. Where limits are specified for both average and peak detector functions, if the peak measured value complies with the average limit, it is unnecessary to perform an average measurement at frequency above 1GHz.
7. Margin<0 is Pass , Margin $\geq$ 0 is Fail.

## 8. 20dB Bandwidth Measurement

### 8.1 Test Setup

Please refer to section 7.3 (for radiated emissions above 1GHz).

### 8.2 Test Limit

N/A

### 8.3 Test Procedures

- a. Set RBW=100KHz and VBW=300KHz.
- b. The 20 dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB.
- c. The 20 dB Bandwidth was measured and recorded.

### 8.4 Test Data

Test Date: Nov. 18, 2019

Temperature: 25°C

Atmospheric pressure: 1010 hPa

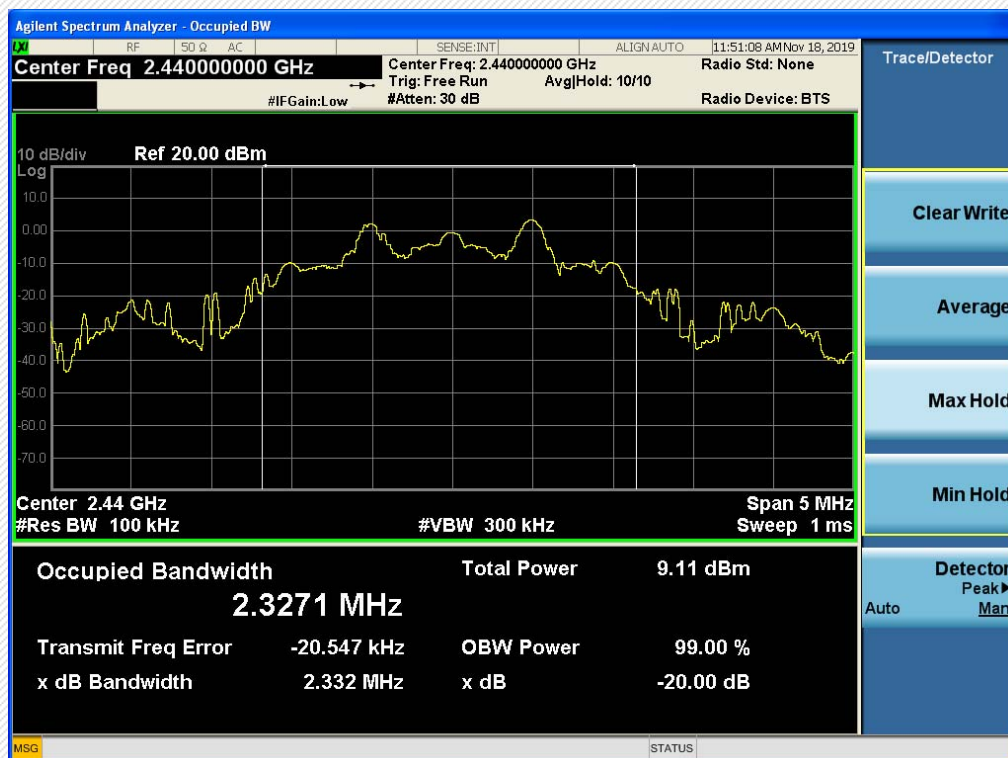
Humidity: 70%

| Modulation Type | Channel | Frequency (MHz) | 20dB Bandwidth (MHz) |
|-----------------|---------|-----------------|----------------------|
| GFSK            | 01      | 2408            | 2.27                 |
|                 | 17      | 2440            | 2.33                 |
|                 | 34      | 2474            | 2.30                 |

Modulation Standard: GFSK  
Channel: 01



Modulation Standard: GFSK  
Channel: 17



Modulation Standard: GFSK  
Channel: 34





## 9. Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

| MHz                 | MHz                   | MHz             | GHz             |
|---------------------|-----------------------|-----------------|-----------------|
| 0.09000 – 0.11000   | 16.42000 – 16.42300   | 399.9 – 410.0   | 4.500 – 5.150   |
| 0.49500 – 0.505**   | 16.69475 – 16.69525   | 608.0 – 614.0   | 5.350 – 5.460   |
| 2.17350 – 2.19050   | 16.80425 – 16.80475   | 960.0 – 1240.0  | 7.250 – 7.750   |
| 4.12500 – 4.12800   | 25.50000 – 25.67000   | 1300.0 – 1427.0 | 8.025 – 8.500   |
| 4.17725 – 4.17775   | 37.50000 – 38.25000   | 1435.0 – 1626.5 | 9.000 – 9.200   |
| 4.20725 – 4.20775   | 73.00000 – 74.60000   | 1645.5 – 1646.5 | 9.300 – 9.500   |
| 6.21500 – 6.21800   | 74.80000 – 75.20000   | 1660.0 – 1710.0 | 10.600 – 12.700 |
| 6.26775 – 6.26825   | 108.00000 – 121.94000 | 1718.8 – 1722.2 | 13.250 – 13.400 |
| 6.31175 – 6.31225   | 123.00000 – 138.00000 | 2200.0 – 2300.0 | 14.470 – 14.500 |
| 8.29100 – 8.29400   | 149.90000 – 150.05000 | 2310.0 – 2390.0 | 15.350 – 16.200 |
| 8.36200 – 8.36600   | 156.52475 – 156.52525 | 2483.5 – 2500.0 | 17.700 – 21.400 |
| 8.37625 – 8.38675   | 156.70000 – 156.90000 | 2655.0 – 2900.0 | 22.010 – 23.120 |
| 8.41425 – 8.41475   | 162.01250 – 167.17000 | 3260.0 – 3267.0 | 23.600 – 24.000 |
| 12.29000 – 12.29300 | 167.72000 – 173.20000 | 3332.0 – 3339.0 | 31.200 – 31.800 |
| 12.51975 – 12.52025 | 240.00000 – 285.00000 | 3345.8 – 3358.0 | 36.430 – 36.500 |
| 12.57675 – 12.57725 | 322.00000 – 335.40000 | 3600.0 – 4400.0 | Above 38.6      |
| 13.36000 – 13.41000 |                       |                 |                 |

\*\* : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

### 9.1 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.