

**Guangzhou MCOHome Technology Co., Ltd**

# RF TEST REPORT

**Report Type:**

FCC Part 15.249 RF report

**Model:**

MH-S220

**REPORT NUMBER:**

190600148SHA-001

**ISSUE DATE:**

December 18, 2019

**DOCUMENT CONTROL NUMBER:**

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## TEST REPORT

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**Manufacturer:** Guangzhou MCOHome Technology Co., Ltd  
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Panyu Avenue North., DongHuan street, Panyu, Guangzhou 511400, China

**Product Name:** Micro Switch

**Type/Model:** MH-S220

**FCC ID:** 2ACTJMHS220

## SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

**47CFR Part 15 (2018):** Radio Frequency Devices (Subpart C)

**ANSI C63.10 (2013):** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

## PREPARED BY:



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## TEST REPORT

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## Revision History

| Report No.       | Version | Description             | Issued Date       |
|------------------|---------|-------------------------|-------------------|
| 190600148SHA-001 | Rev. 01 | Initial issue of report | December 18, 2019 |
|                  |         |                         |                   |
|                  |         |                         |                   |

## Measurement result summary

| TEST ITEM                              | FCC REFERENCE   | RESULT |
|--|-----------------|--------|
| Radiated emission                      | 15.249 & 15.209 | Pass   |
| Power line conducted emission          | 15.207          | Pass   |
| Assigned bandwidth<br>(20dB bandwidth) | 15.215(c)       | Pass   |
| Antenna requirement                    | 15.203          | Pass   |

Notes: 1: NA =Not Applicable

2: The 2.4G Remote Control Device is powered by 2×1.5V  AAA batteries.

3: Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.

4: Additions, Deviations and Exclusions from Standards: None.

## 1 GENERAL INFORMATION

### 1.1 Description of Equipment Under Test (EUT)

|                       |   |
|-----------------------|---|
| Product name:         | Micro Switch  |
| Type/Model:           | MH-S220   |
| Description of EUT:   | The EUT is a Micro switch which contains a Z-Wave module, and there have only one model, we test it and listed the Z-Wave results in this report. |
| Rating:               | 110~250VAC, 50/60Hz, 10A  |
| Category of EUT:      | Class B   |
| EUT type:             | <input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing   |
| Sample received date: | November 15, 2019   |
| Date of test:         | November 15, 2019 ~ December 16, 2019   |

### 1.2 Technical Specification

|                      |                        |
|----------------------|------------------------|
| Frequency Range:     | 902-928MHz             |
| Modulation:          | FSK                    |
| Channel Frequency:   | 1 Channel at 908.42MHz |
| Antenna Information: | 0dBi, wire antenna     |

## TEST REPORT

### 1.3 Description of Test Facility

|            |   |
|------------|---|
| Name:      | Intertek Testing Services Shanghai                                      |
| Address:   | Building 86, No. 1198 Qinzhou Road (North), Shanghai 200233, P.R. China |
| Telephone: | 86 21 61278200  |
| Telefax:   | 86 21 54262353  |

|   |   |
|---|---|
| The test facility is recognized, certified, or accredited by these organizations: | CNAS Accreditation Lab<br>Registration No. CNAS L0139                         |
|   | FCC Accredited Lab<br>Designation Number: CN1175                              |
|   | IC Registration Lab<br>CAB identifier.: CN0051                                |
|   | VCCI Registration Lab<br>Registration No.: R-14243, G-10845, C-14723, T-12252 |
|   | A2LA Accreditation Lab<br>Certificate Number: 3309.02                         |

## 2 TEST SPECIFICATIONS

### 2.1 Standards or specification

47CFR Part 15 (2018)

ANSI C63.10 (2013)

### 2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied. Radiated test mode: EUT transmitted signal with antenna;

The EUT is a handheld device, so three axes (X, Y, Z) were observed while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded.

Within this test report, EUT was tested with modulation and tested under its rating voltage and frequency.

### 2.3 Test peripherals list

The EUT has been tested independently.

### 2.4 Test environment condition:

| Test items                          | Temperature | Humidity |
|-------------------------------------|-------------|----------|
| Radiated emission                   | 22°C        | 53% RH   |
| Assigned bandwidth (20dB bandwidth) | 21°C        | 53% RH   |



## 2.5 Instrument list

| Conducted Emission                  |                             |                   |                 |              |            |
|-------------------------------------|-----------------------------|-------------------|-----------------|--------------|------------|
| Used                                | Equipment                   | Manufacturer      | Type            | Internal no. | Due date   |
| <input checked="" type="checkbox"/> | Test Receiver               | R&S               | ESCS 30         | EC 2107      | 2020-07-15 |
| <input checked="" type="checkbox"/> | A.M.N.                      | R&S               | ESH2-Z5         | EC 3119      | 2020-11-29 |
| <input checked="" type="checkbox"/> | Shielded room               | Zhongyu           | -               | EC 2838      | 2020-01-13 |
| Radiated Emission                   |                             |                   |                 |              |            |
| Used                                | Equipment                   | Manufacturer      | Type            | Internal no. | Due date   |
| <input checked="" type="checkbox"/> | Test Receiver               | R&S               | ESIB 26         | EC 3045      | 2020-09-12 |
| <input checked="" type="checkbox"/> | Bilog Antenna               | TESEQ             | CBL 6112D       | EC 4206      | 2020-12-10 |
| <input checked="" type="checkbox"/> | Horn antenna                | R&S               | HF 906          | EC 3049      | 2020-11-16 |
| <input checked="" type="checkbox"/> | Horn antenna                | ETS               | 3117            | EC 4792-1    | 2020-02-25 |
| <input checked="" type="checkbox"/> | Horn antenna                | TOYO              | HAP18-26W       | EC 4792-3    | 2020-07-09 |
| <input checked="" type="checkbox"/> | Pre-amplifier               | R&S               | Pre-amp 18      | EC5262       | 2020-06-11 |
| <input checked="" type="checkbox"/> | Semi-anechoic chamber       | Albatross project | -               | EC 3048      | 2020-07-31 |
| RF test                             |                             |                   |                 |              |            |
| Used                                | Equipment                   | Manufacturer      | Type            | Internal no. | Due date   |
| <input checked="" type="checkbox"/> | PXA Signal Analyzer         | Keysight          | N9030A          | EC 5338      | 2020-03-04 |
| <input checked="" type="checkbox"/> | PXA Signal Analyzer         | Keysight          | N9030B          | EC 6078      | 2020-06-11 |
| <input checked="" type="checkbox"/> | Power sensor                | Agilent           | U2021XA         | EC 5338-1    | 2020-03-04 |
| <input checked="" type="checkbox"/> | Vector Signal Generator     | Agilent           | N5182B          | EC 5175      | 2020-03-04 |
| <input checked="" type="checkbox"/> | MXG Analog Signal Generator | Agilent           | N5181A          | EC 5338-2    | 2020-03-04 |
| <input checked="" type="checkbox"/> | Test Receiver               | R&S               | ESCI 7          | EC 4501      | 2020-09-12 |
| Additional instrument               |                             |                   |                 |              |            |
| Used                                | Equipment                   | Manufacturer      | Type            | Internal no. | Due date   |
| <input checked="" type="checkbox"/> | Therom-Hygrograph           | ZJ1-2A            | S.M.I.F.        | EC 3783      | 2020-03-10 |
| <input checked="" type="checkbox"/> | Pressure meter              | YM3               | Shanghai Mengde | EC 3320      | 2020-07-01 |

## 2.6 Measurement uncertainty

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

| Test item   | Measurement uncertainty |
|---|-------------------------|
| Maximum peak output power                                   | $\pm 0.74\text{dB}$     |
| Radiated Emissions in restricted frequency bands below 1GHz | $\pm 4.90\text{dB}$     |
| Radiated Emissions in restricted frequency bands above 1GHz | $\pm 5.02\text{dB}$     |
| Emission outside the frequency band                         | $\pm 2.89\text{dB}$     |
| Power line conducted emission                               | $\pm 3.19\text{dB}$     |

### 3 Radiated emission

Test result: Pass

#### 3.1 Limit

| Fundamental Frequency (MHz)                   | Fundamental limit (dBuV/m) | Harmonic limit (dBuV/m) |
|---|----------------------------|-------------------------|
| <input checked="" type="checkbox"/> 902 - 928 | 94                         | 54                      |
| <input type="checkbox"/> 2400 - 2483.5        | 94                         | 54                      |
| <input type="checkbox"/> 5725 - 5875          | 94                         | 54                      |
| <input type="checkbox"/> 24000 - 24250        | 108                        | 68                      |

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits:

| Frequencies (MHz) | Field Strength (microvolts/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                             |

#### 3.2 Measurement Procedure

For Radiated emission below 30MHz:

- The EUT was placed on the top of a rotating table 0.8 meters (0.1 meters for floor standing) above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Both X and Y axes of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### NOTE:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

## TEST REPORT

### For Radiated emission above 30MHz:

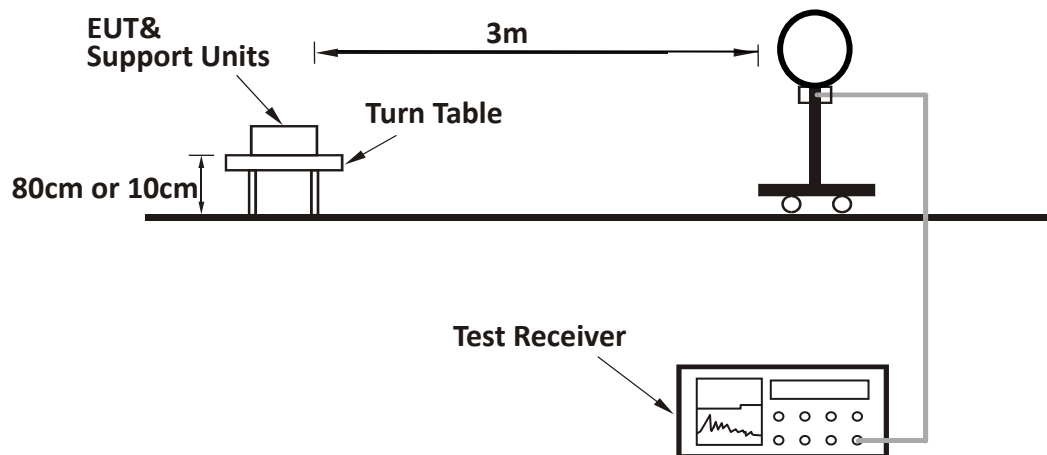
- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) (0.1 meters for floor standing) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

### Note:

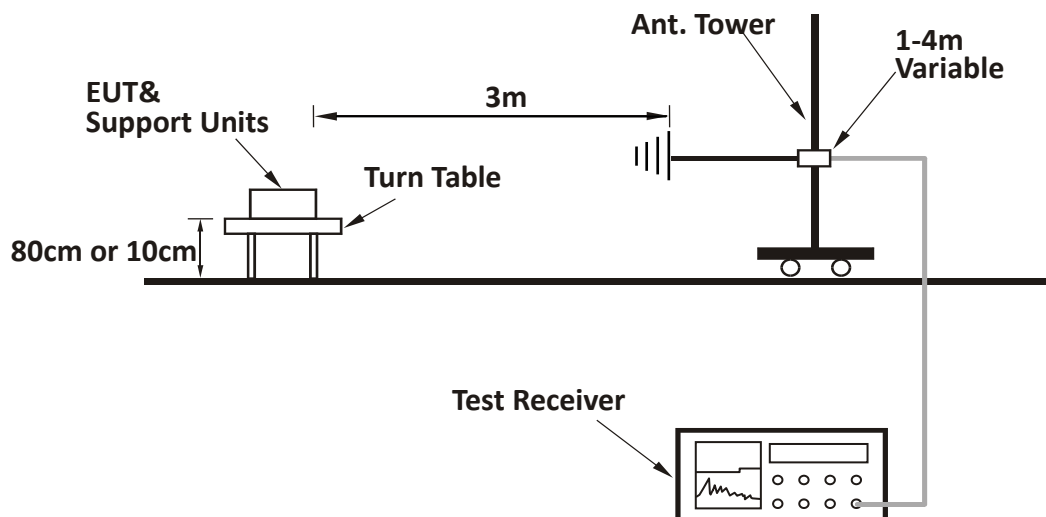
- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) or 3 x RBW (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were investigated and the worst-case emissions are reported

### 3.3 Test Configuration

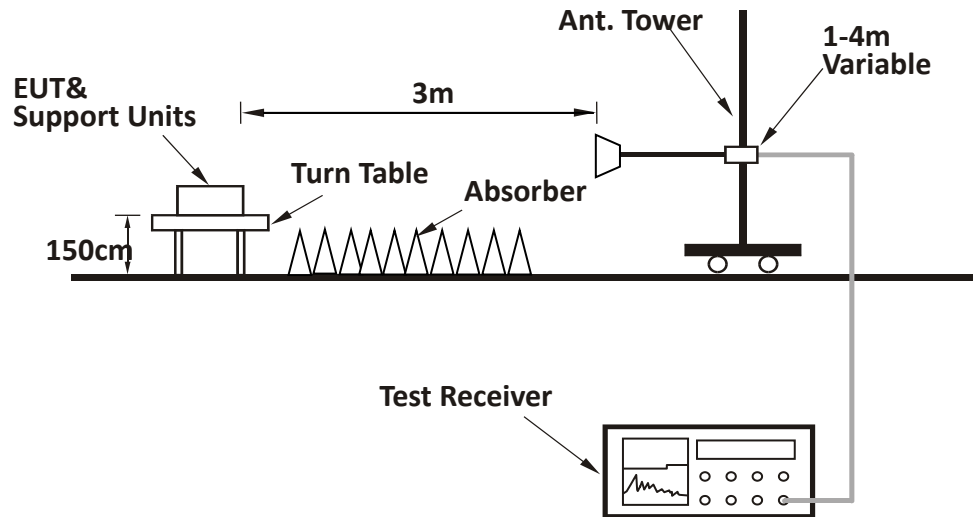
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



**For Radiated emission above 1GHz:**

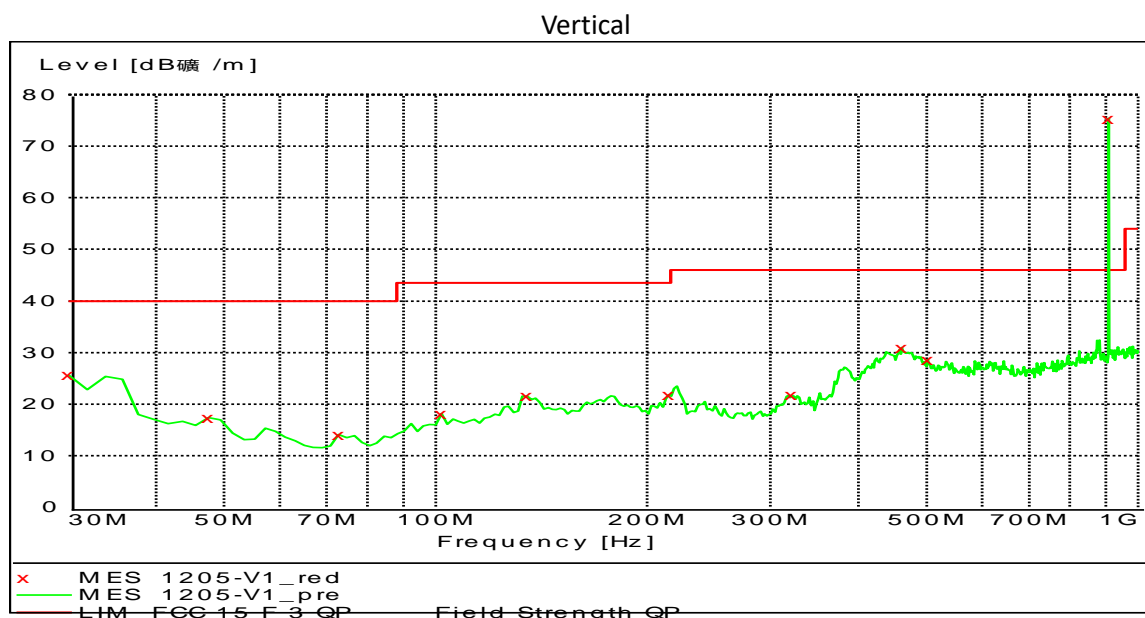
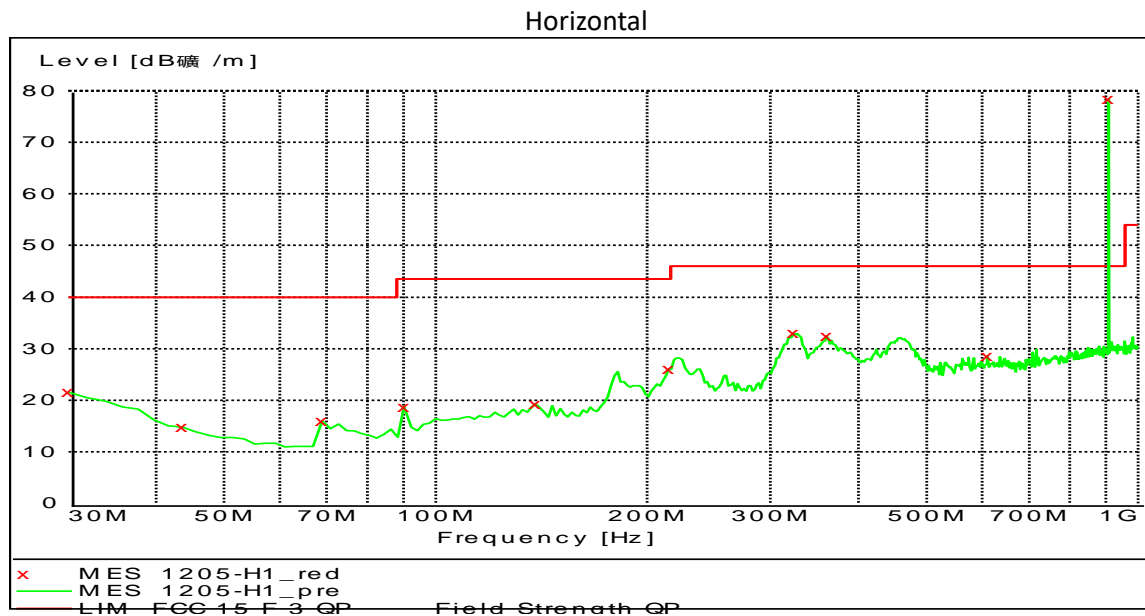


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### 3.4 Test Results of Radiated Emissions

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:



# TEST REPORT

## Test data:

| Polarization | Frequency (MHz) | Corrected Reading (dBuV/m) | Correct Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|--------------|-----------------|----------------------------|-----------------------|----------------|-------------|----------|
| H            | 30.00           | 21.50                      | 18.80                 | 40.00          | 18.50       | PK       |
|              | 43.61           | 14.80                      | 11.70                 | 40.00          | 25.20       | PK       |
|              | 68.88           | 16.00                      | 7.40                  | 40.00          | 24.00       | PK       |
|              | 90.26           | 18.80                      | 10.10                 | 43.50          | 24.70       | PK       |
|              | 138.86          | 19.30                      | 12.60                 | 43.50          | 24.20       | PK       |
|              | 214.67          | 26.10                      | 10.90                 | 43.50          | 17.40       | PK       |
|              | 323.53          | 33.00                      | 15.70                 | 46.00          | 13.00       | PK       |
|              | 360.46          | 32.40                      | 16.70                 | 46.00          | 13.60       | PK       |
|              | 611.22          | 28.50                      | 21.00                 | 46.00          | 17.50       | PK       |
|              | 908.42          | 78.33                      | 23.80                 | 94.00          | 15.67       | PK       |
|              | 902.00          | 35.80                      | 25.40                 | 46.00          | 10.20       | PK       |
|              | 928.00          | 36.50                      | 25.60                 | 46.00          | 9.50        | PK       |
|              | 1816.84         | 47.90                      | -8.70                 | 54.00          | 6.10        | PK       |
|              | 2725.26         | 45.70                      | -6.80                 | 54.00          | 8.30        | PK       |
|              | 3633.68         | 43.60                      | -4.60                 | 54.00          | 10.40       | PK       |
| V            | 30.00           | 25.60                      | 18.80                 | 40.00          | 14.40       | PK       |
|              | 47.49           | 17.40                      | 9.80                  | 40.00          | 22.60       | PK       |
|              | 72.77           | 14.10                      | 7.50                  | 40.00          | 25.90       | PK       |
|              | 101.92          | 18.10                      | 12.20                 | 43.50          | 25.40       | PK       |
|              | 134.97          | 21.50                      | 12.80                 | 43.50          | 22.00       | PK       |
|              | 214.67          | 21.80                      | 10.90                 | 43.50          | 21.70       | PK       |
|              | 321.58          | 21.70                      | 15.60                 | 46.00          | 24.30       | PK       |
|              | 461.54          | 31.00                      | 19.00                 | 46.00          | 15.00       | PK       |
|              | 502.36          | 28.60                      | 19.70                 | 46.00          | 17.40       | PK       |
|              | 908.42          | 75.36                      | 23.60                 | 94.00          | 18.64       | PK       |
|              | 902.00          | 36.70                      | 25.40                 | 46.00          | 9.30        | PK       |
|              | 928.00          | 35.40                      | 25.60                 | 46.00          | 10.60       | PK       |
|              | 1816.84         | 45.80                      | -8.70                 | 54.00          | 8.20        | PK       |
|              | 2725.26         | 42.90                      | -6.80                 | 54.00          | 11.10       | PK       |
|              | 3633.68         | 41.40                      | -4.60                 | 54.00          | 12.60       | PK       |



**TEST REPORT**

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (- Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.  
2. Corrected Reading = Original Receiver Reading + Correct Factor  
3. Margin = Limit - Corrected Reading  
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,  
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,  
Limit = 40.00dBuV/m.  
Then Correct Factor =  $30.20 + 2.00 - 32.00 = 0.20\text{dB/m}$ ;  
Corrected Reading =  $10\text{dBuV} + 0.20\text{dB/m} = 10.20\text{dBuV/m}$ ;  
Margin =  $40.00\text{dBuV/m} - 10.20\text{dBuV/m} = 29.80\text{dB}$ .

## 4 Power line conducted emission

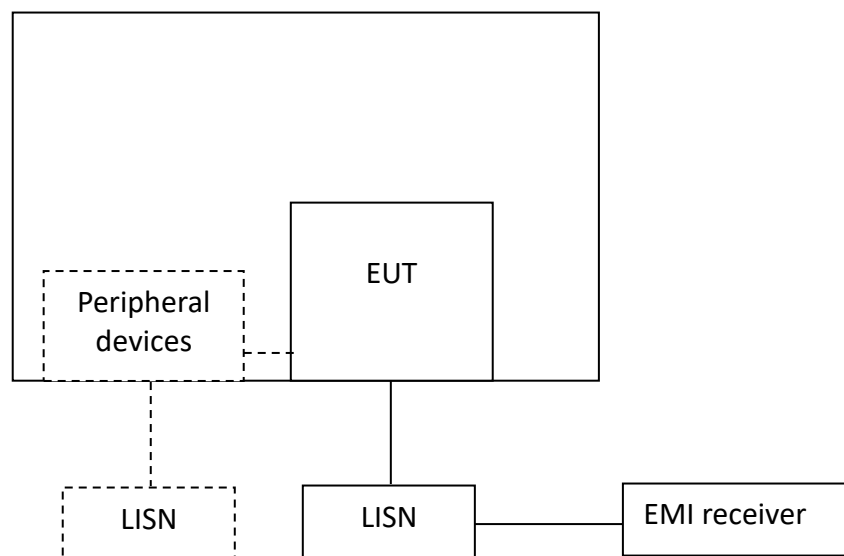
Test result: Pass

### 4.1 Limit

| Frequency of Emission (MHz) | Conducted Limit (dBuV) |            |
|-----------------------------|------------------------|------------|
|                             | QP                     | AV         |
| 0.15-0.5                    | 66 to 56*              | 56 to 46 * |
| 0.5-5                       | 56                     | 46         |
| 5-30                        | 60                     | 50         |

\* Decreases with the logarithm of the frequency.

### 4.2 Test Configuration



**TEST REPORT****4.3 Measurement Procedure**

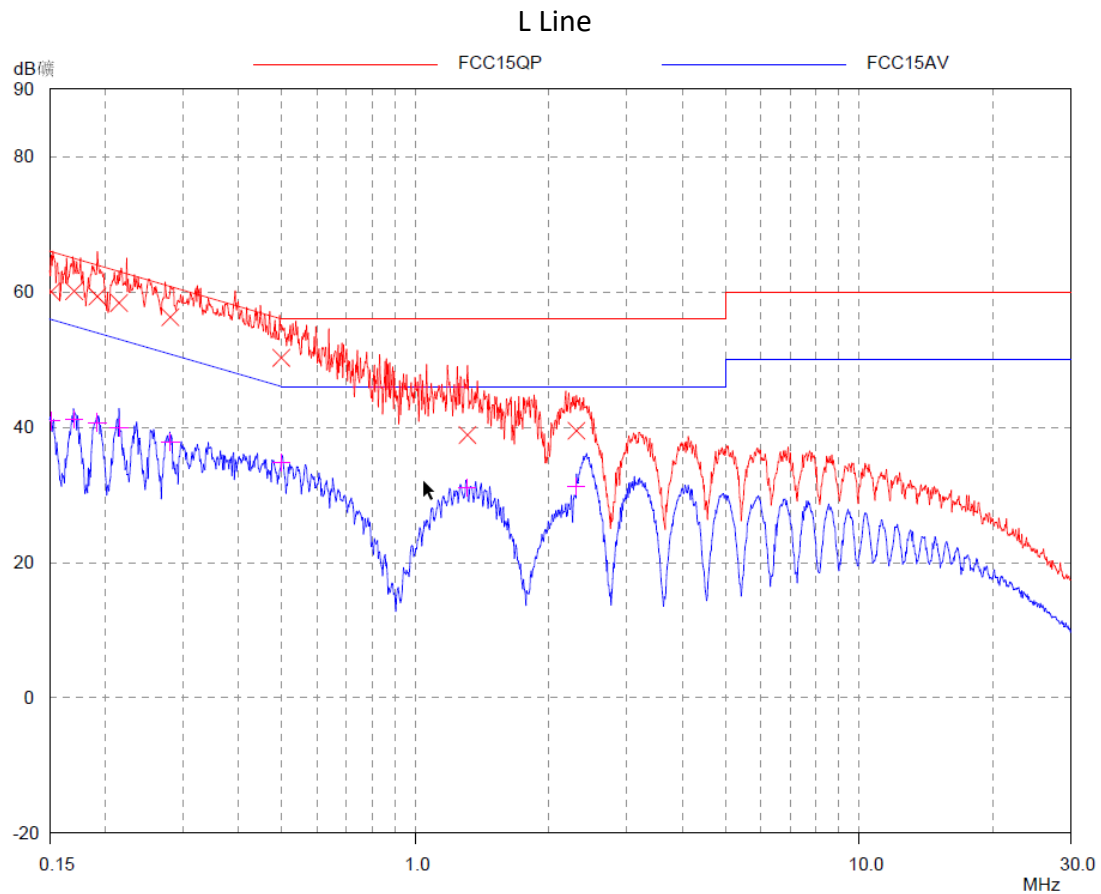
Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50  $\Omega$  LISN port (to which the EUT is connected), where permitted, terminated into a 50  $\Omega$  measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50  $\Omega$  measuring port is terminated by a measuring instrument having 50  $\Omega$  input impedance. All other ports are terminated in 50  $\Omega$  loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

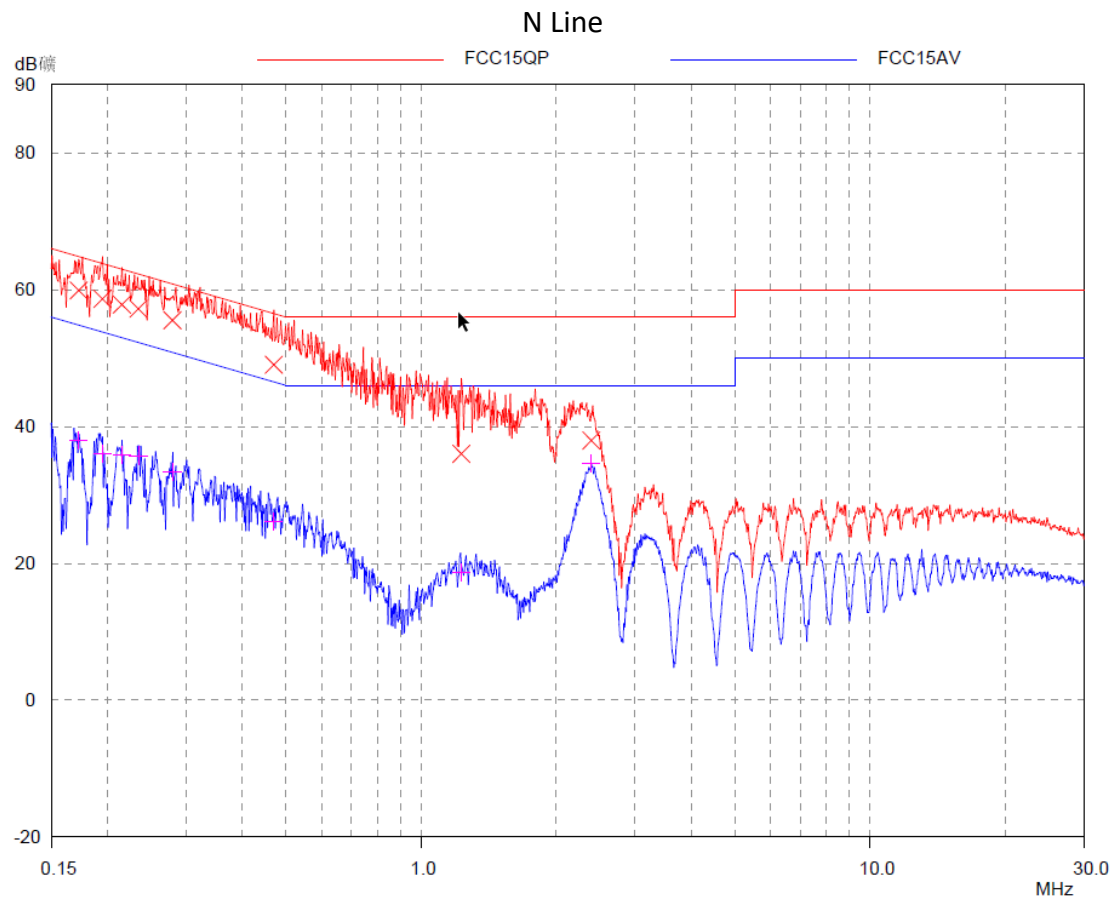
## 4.4 Test Results of Power line conducted emission

Test Curve:



Test Data:

| Frequency<br>(MHz) | Quasi-peak      |                 |                | Average         |                 |                |
|--------------------|-----------------|-----------------|----------------|-----------------|-----------------|----------------|
|                    | level<br>dB(μV) | Limit<br>dB(μV) | Margin<br>(dB) | level<br>dB(μV) | limit<br>dB(μV) | Margin<br>(dB) |
| 0.151              | 60.04           | 65.93           | 5.89           | 40.93           | 55.93           | 15.00          |
| 0.170              | 60.12           | 64.94           | 4.82           | 41.23           | 54.94           | 13.71          |
| 0.192              | 59.32           | 63.94           | 4.62           | 40.72           | 53.94           | 13.22          |
| 0.215              | 58.36           | 63.02           | 4.66           | 39.90           | 53.02           | 13.12          |
| 0.281              | 56.26           | 60.79           | 4.53           | 37.81           | 50.79           | 12.98          |
| 0.499              | 50.25           | 56.02           | 5.77           | 34.75           | 46.02           | 11.27          |
| 1.311              | 38.86           | 56.00           | 17.14          | 31.11           | 46.00           | 14.89          |
| 2.310              | 39.47           | 56.00           | 16.53          | 31.26           | 46.00           | 14.74          |



**Test Data:**

| Frequency<br>(MHz) | Quasi-peak      |                 |                | Average         |                 |                |
|--------------------|-----------------|-----------------|----------------|-----------------|-----------------|----------------|
|                    | level<br>dB(μV) | Limit<br>dB(μV) | Margin<br>(dB) | level<br>dB(μV) | limit<br>dB(μV) | Margin<br>(dB) |
| 0.172              | 59.90           | 64.84           | 4.94           | 38.03           | 54.84           | 16.81          |
| 0.195              | 58.66           | 63.81           | 5.15           | 36.02           | 53.81           | 17.79          |
| 0.216              | 57.82           | 62.98           | 5.16           | 35.91           | 52.98           | 17.07          |
| 0.235              | 57.22           | 62.29           | 5.07           | 35.74           | 52.29           | 16.55          |
| 0.280              | 55.52           | 60.83           | 5.31           | 33.44           | 50.83           | 17.39          |
| 0.470              | 49.04           | 56.52           | 7.48           | 26.16           | 46.52           | 20.36          |
| 1.230              | 36.01           | 56.00           | 19.99          | 18.75           | 46.00           | 27.25          |
| 2.395              | 37.96           | 56.00           | 18.04          | 34.64           | 46.00           | 11.36          |

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

3. Margin = Limit - Corrected Reading

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

**TEST REPORT**

## 5 Assigned bandwidth (20dB bandwidth)

**Test result:** Pass

### 5.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band.

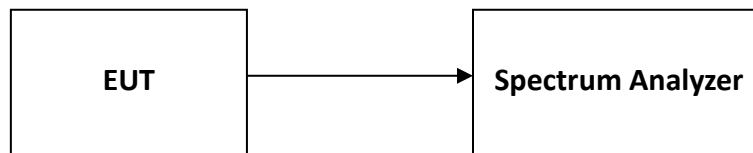
### 5.2 Measurement Procedure

The 20dB Bandwidth is measured using the Spectrum Analyzer.

Set Span = 2 to 3 times the 20dB bandwidth, RBW = approximately 1% of the 20dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.

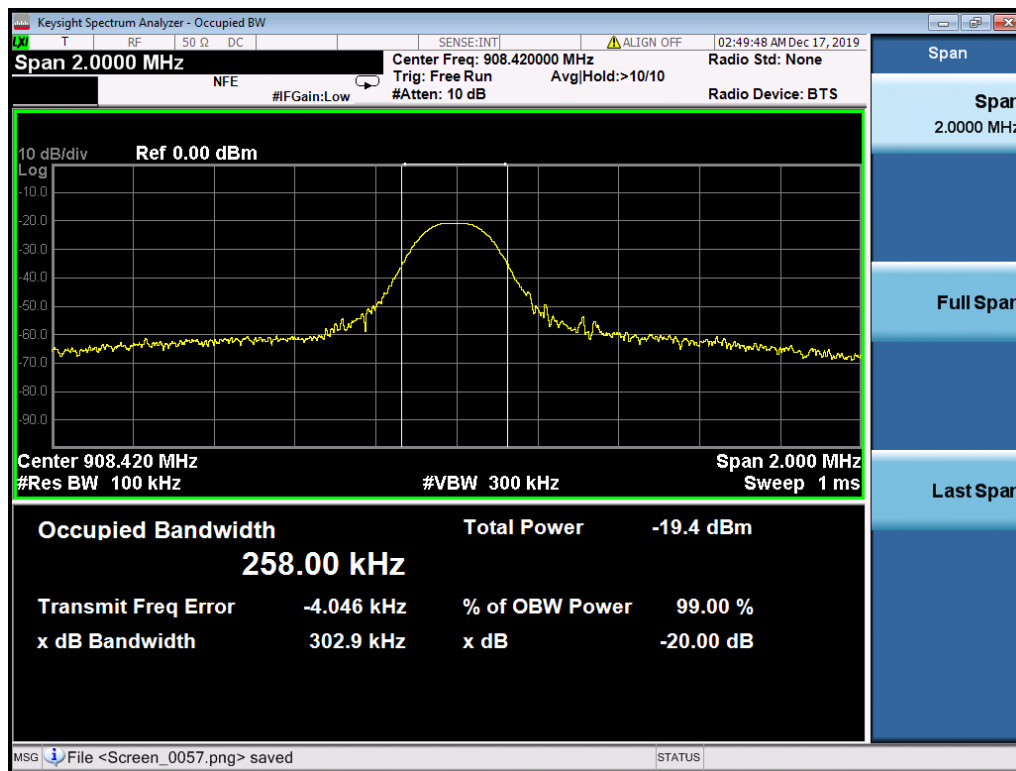
The test was performed at 3 channels (lowest, middle and highest channel).

### 5.3 Test Configuration



## 5.4 The results

| Mode | Channel Frequency | 20dB Bandwidth (kHz) | F <sub>L</sub> (MHz) | F <sub>H</sub> (MHz) |
|------|-------------------|----------------------|----------------------|----------------------|
| 1    | 908.42MHz         | 302.9                | > 902                | < 928                |



## 6 Antenna requirement

### Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

### Result:

EUT uses permanently attached antenna to the intentional radiator, so it can comply with the provisions of this section.

\*\*\*\*\* END \*\*\*\*\*