

**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:**

TTRF15.249\_V1 © 2018 Intertek



**TEST REPORT**

**Applicant:** Guangzhou MCOHome Technology Co., Ltd  
Room 1504-1505, Building NO.23 Tianan Headquarter Center, No.555  
Panyu Avenue North., DongHuan street, Panyu, Guangzhou 511400, China

**Manufacturer:** Guangzhou MCOHome Technology Co., Ltd  
Room 1504-1505, Building NO.23 Tianan Headquarter Center, No.555  
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:**

---

Project Engineer  
Wade Zhang

**REVIEWED BY:**

---

Reviewer  
Daniel Zhao

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

**TEST REPORT****Content**

<b>REVISION HISTORY.....</b>	<b>4</b>
<b>MEASUREMENT RESULT SUMMARY .....</b>	<b>5</b>
<b>1    GENERAL INFORMATION .....</b>	<b>6</b>
1.1    DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) .....	6
1.2    TECHNICAL SPECIFICATION .....	6
1.3    DESCRIPTION OF TEST FACILITY .....	7
<b>2    TEST SPECIFICATIONS.....</b>	<b>8</b>
2.1    STANDARDS OR SPECIFICATION .....	8
2.2    MODE OF OPERATION DURING THE TEST.....	8
2.3    TEST PERIPHERALS LIST .....	8
2.4    TEST ENVIRONMENT CONDITION:.....	8
2.5    INSTRUMENT LIST .....	9
2.6    MEASUREMENT UNCERTAINTY .....	10
<b>3    RADIATED EMISSION .....</b>	<b>11</b>
3.1    LIMIT .....	11
3.2    MEASUREMENT PROCEDURE .....	11
3.3    TEST CONFIGURATION .....	13
3.4    TEST RESULTS OF RADIATED EMISSIONS .....	15
<b>4    POWER LINE CONDUCTED EMISSION.....</b>	<b>18</b>
4.1    LIMIT .....	18
4.2    TEST CONFIGURATION .....	18
4.3    MEASUREMENT PROCEDURE .....	19
4.4    TEST RESULTS OF POWER LINE CONDUCTED EMISSION.....	20
<b>5    ASSIGNED BANDWIDTH (20DB BANDWIDTH) .....</b>	<b>22</b>
5.1    LIMIT .....	22
5.2    MEASUREMENT PROCEDURE .....	22
5.3    TEST CONFIGURATION .....	22
5.4    THE RESULTS.....	23
<b>6    ANTENNA REQUIREMENT.....</b>	<b>24</b>

**TEST REPORT****Revision History**

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

**TEST REPORT****Measurement result summary**

TEST ITEM	FCC REFERANCE	RESULT
Radiated emission	15.249 & 15.209	Pass
Power line conducted emission	15.207	Pass
Assigned bandwidth (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.

**TEST REPORT****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 Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab CAB identifier.: CN0051
	VCCI Registration Lab Registration No.: R-14243, G-10845, C-14723, T-12252
	A2LA Accreditation Lab Certificate Number: 3309.02

**TEST REPORT****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

**TEST REPORT**
**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

**TEST REPORT****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	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

**TEST REPORT****3 Radiated emission****Test result:** **Pass****3.1 Limit**

<b>Fundamental Frequency (MHz)</b>	<b>Fundamental limit (dBuV/m)</b>	<b>Harmonic limit (dBuV/m)</b>
<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:

<b>Frequencies (MHz)</b>	<b>Field Strength (microvolts/meter)</b>	<b>Measurement Distance (meters)</b>
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:**

- a) 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.
- 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) Both X and Y axes of the antenna are set to make the measurement.
- d) 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.
- e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

**NOTE:**

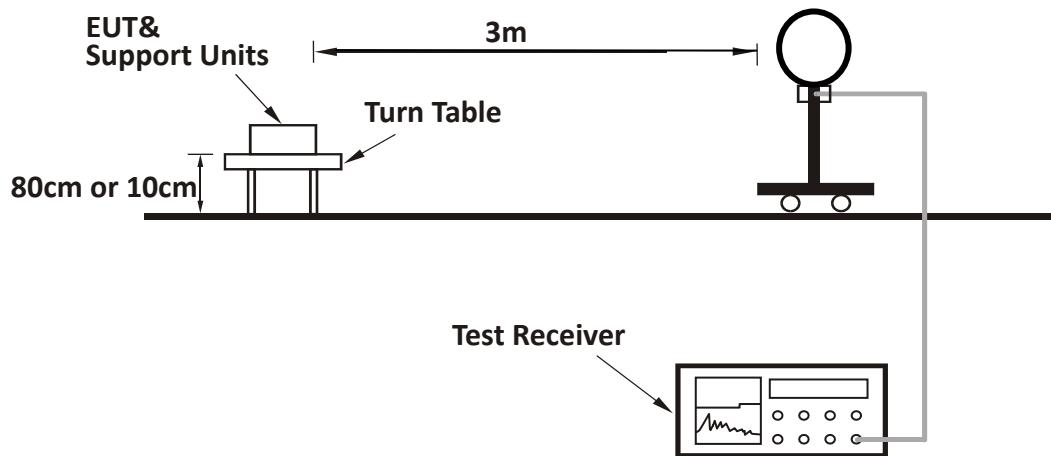
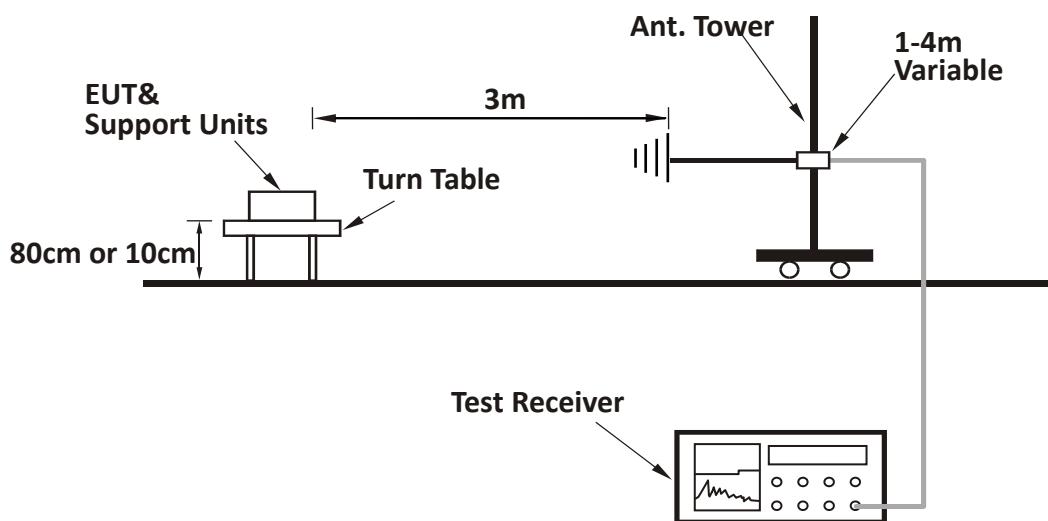
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

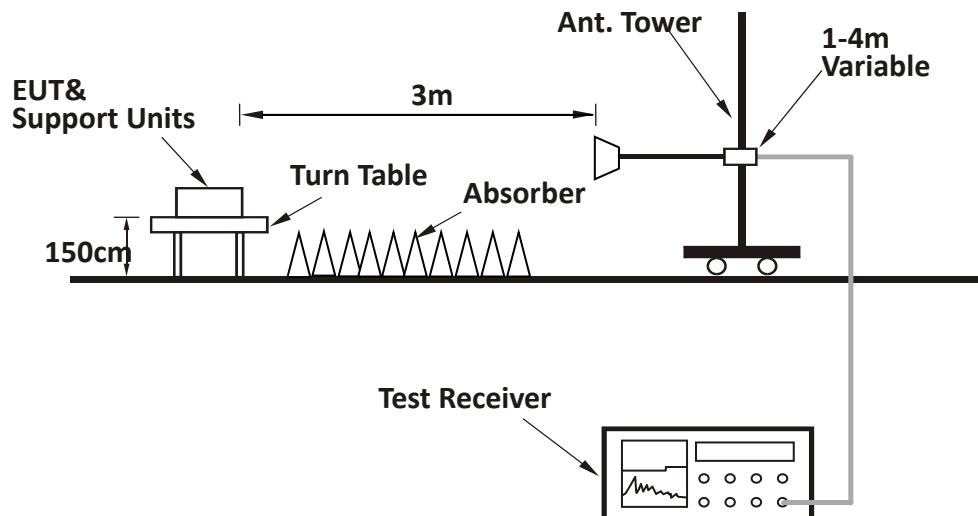
**TEST REPORT****For Radiated emission above 30MHz:**

- 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  $3 \times RBW$  (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

**TEST REPORT****3.3 Test Configuration****For Radiated emission below 30MHz:****For Radiated emission 30MHz to 1GHz:**

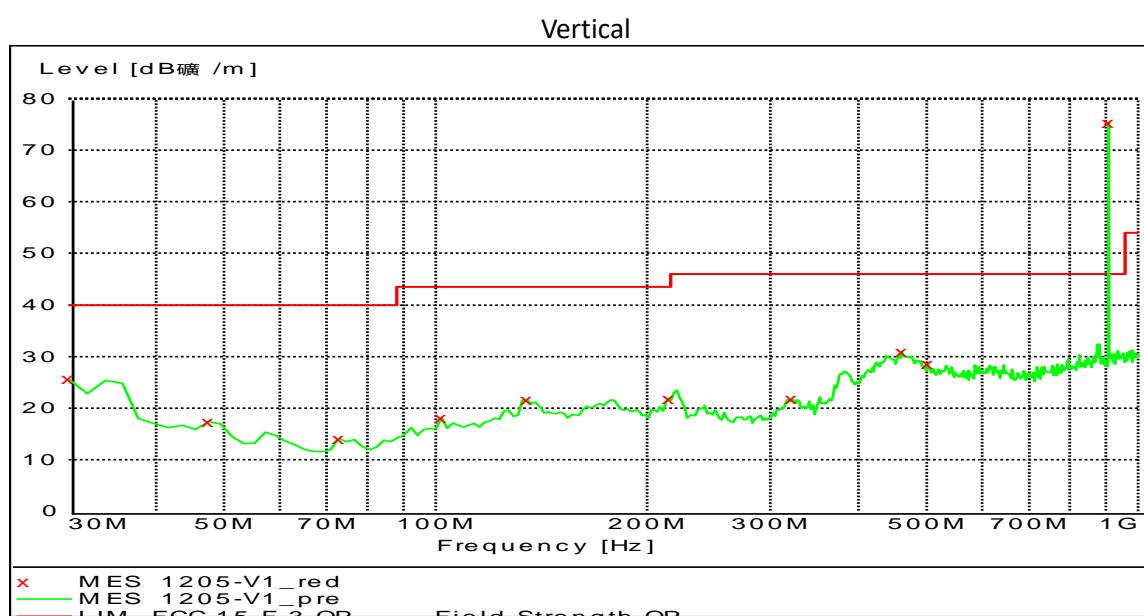
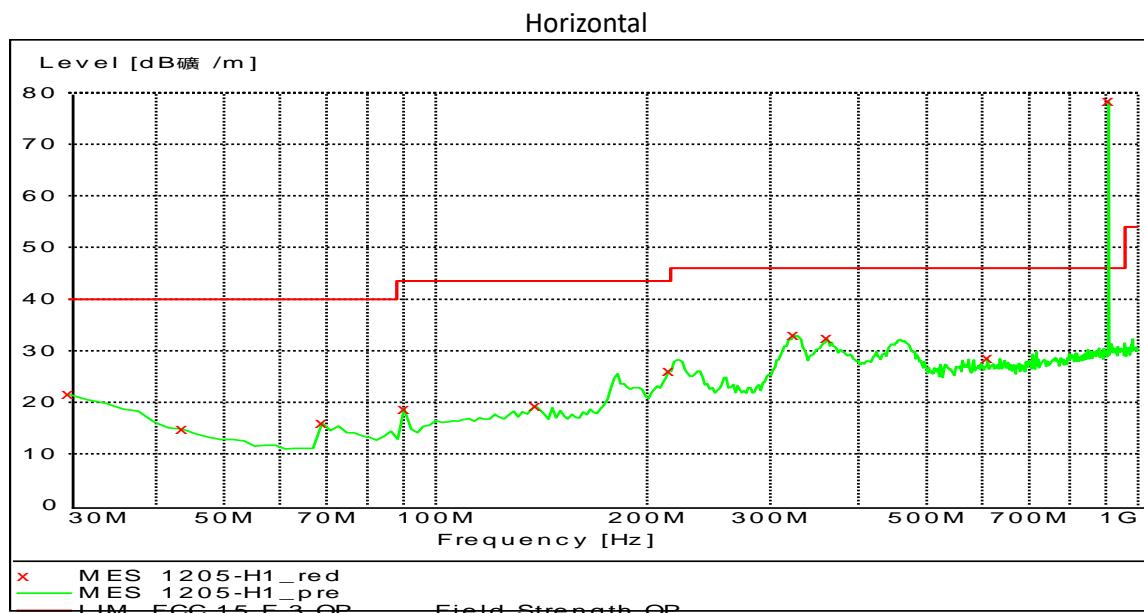
**TEST REPORT****For Radiated emission above 1GHz:**

## TEST REPORT

### 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**

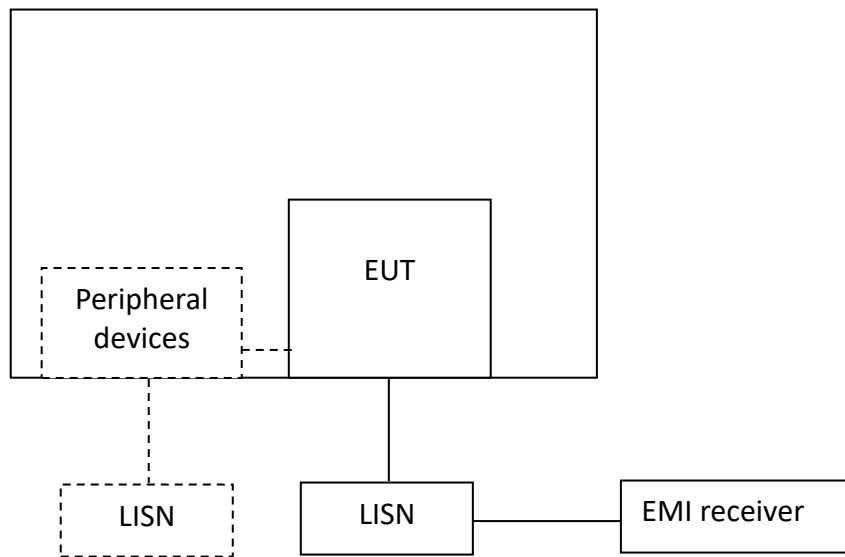
Remark: 1. Correct Factor = Antenna Factor + Cable Loss (- Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.  
2. Corrected Reading = Original Receiver Reading + Correct Factor  
3. Margin = Limit - Corrected Reading  
4. If the PK Corrected 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 =  $30.20 + 2.00 - 32.00 = 0.20$ dB/m;  
Corrected Reading =  $10\text{dBuV} + 0.20\text{dB/m} = 10.20\text{dBuV/m}$ ;  
Margin =  $40.00\text{dBuV/m} - 10.20\text{dBuV/m} = 29.80\text{dB}$ .

**TEST REPORT****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.

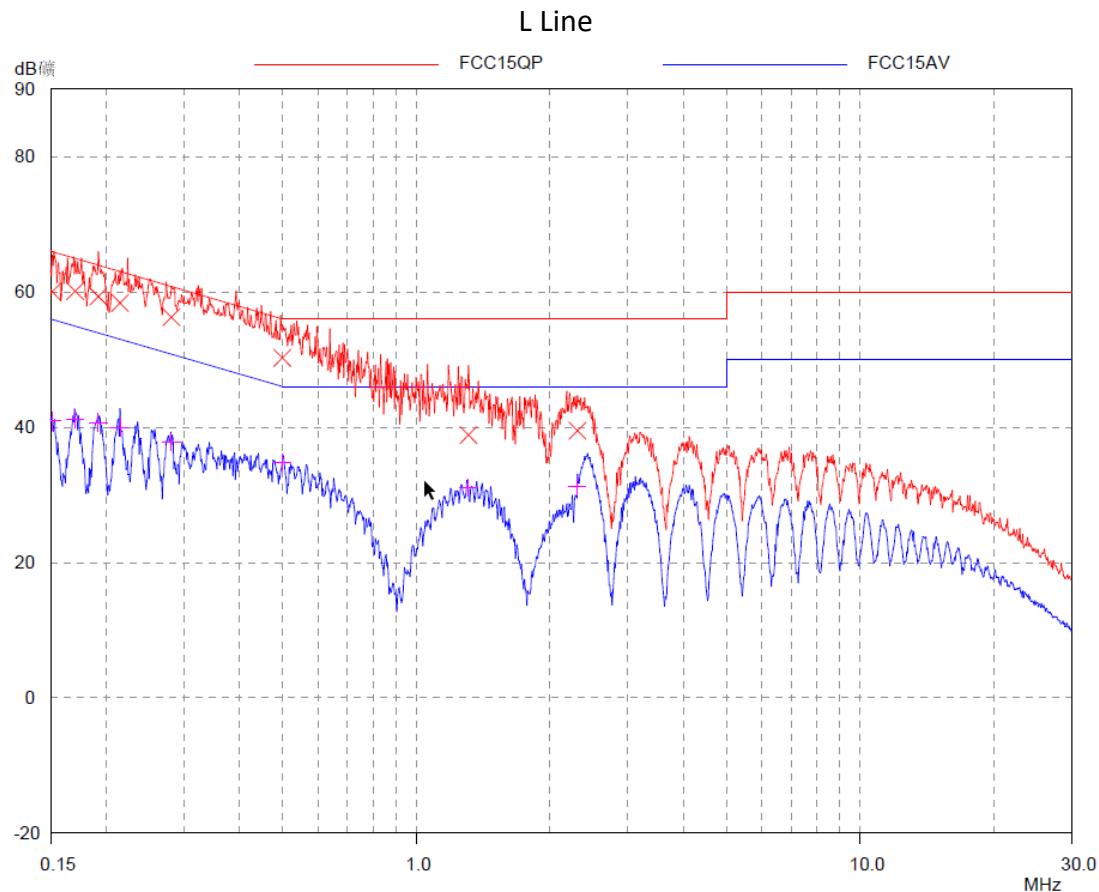
**4.2 Test Configuration**

**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 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω 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 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

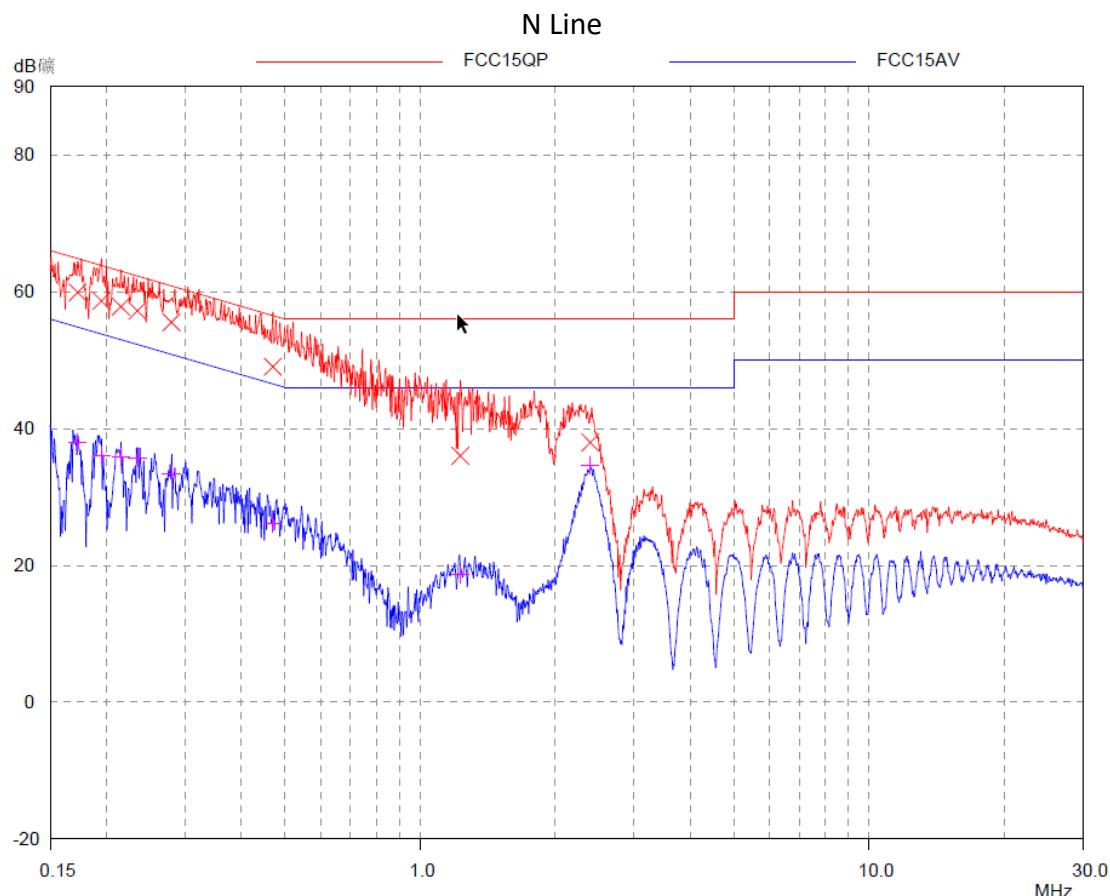
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on 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.

**TEST REPORT**
**4.4 Test Results of Power line conducted emission**
**Test Curve:**

**Test Data:**

Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (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 REPORT


**Test Data:**

Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (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**

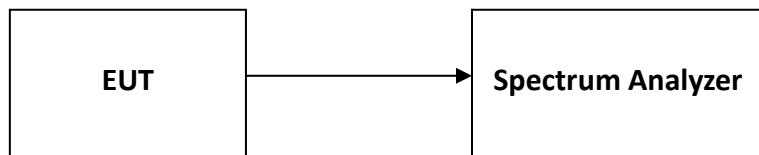
Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band.

**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.

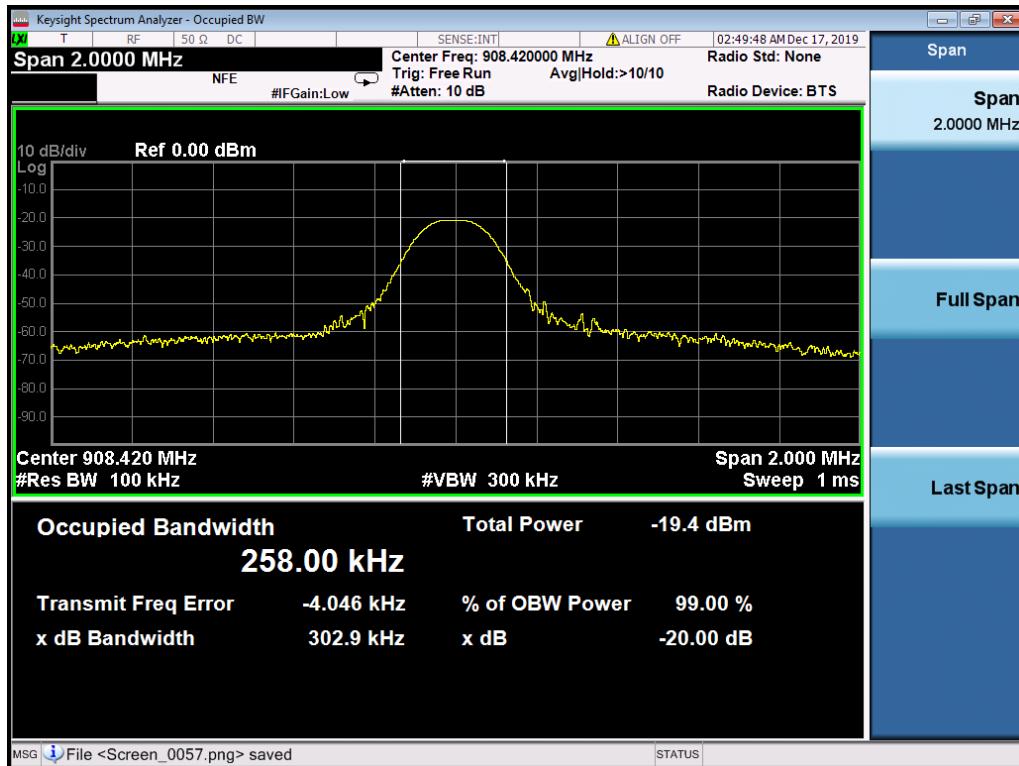
The test was performed at 3 channels (lowest, middle and highest channel).

**5.3 Test Configuration**

## TEST REPORT

## 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



**TEST REPORT**

## 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 \*\*\*\*\*