

# FCC RADIO TEST REPORT

**FCC ID: 2ARTQ-OPS200N**

**Product:** Wireless thermostat

**Trade Name:** N/A

**Model Name:** OPS200N+OTS200N

**Serial Model:** OPS200+OTS200, OPS300+OTS300

**Report No.:** UNIA2018110215FR-01

## Prepared for

Okaylight Technology Co.,LTD

1st Floor, Building 3, LiKe Science and Technology Park, Changsheng North Road, Dalang Town, Dongguan, Guangdong Province, China

## Prepared by

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### TEST RESULT CERTIFICATION

*Kahn Yang*

**Applicant's name** .....: Okaylight Technology Co.,LTD  
**Address** .....: 1st Floor, Building 3, LiKe Science and Technology Park,  
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**Address** .....: 1st Floor, Building 3, LiKe Science and Technology Park,  
 Changsheng North Road, Dalang Town, Dongguan,  
 Guangdong Province, China

#### Product description

**Product name** .....: Wireless thermostat  
**Trade Mark** .....: N/A  
**Model and/or type reference** ..: OPS200N+OTS200N, OPS200+OTS200, OPS300+OTS300

**Standards**.....: FCC Rules and Regulations Part 15 Subpart C Section 15.247  
 ANSI C63.10: 2013

This device described above has been tested by Shenzhen United Testing Technology Co., Ltd., and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

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**Date of Receive**.....: Oct. 24, 2018  
**Date (s) of performance of tests** .....: Oct. 24, 2018 -- Nov. 08, 2018  
**Date of Issue** .....: Nov. 08, 2018  
**Test Result**.....: Pass

Prepared by:

\_\_\_\_\_

Kahn yang/Editor

*Sherwin Qian*

Reviewer:

\_\_\_\_\_

Sherwin Qian/Supervisor

Approved & Authorized Signer:

\_\_\_\_\_



Liuze/Manager

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# 1 TEST SUMMARY

## 1.1 TEST PROCEDURES AND RESULTS

FCC Part 15.247, Subpart C			
Standard section	Test Item	Judgment	Remark
15.207	Conducted emission	PASS	--
15.247(a)(2)	6dB Bandwidth	PASS	--
15.247(b)(3)	Output Power	PASS	--
15.109/15.205/ 15.209	Radiated Spurious Emission	PASS	--
15.247(d)	Conducted Spurious & Band Edge Emission	PASS	--
15.247(e)	Power Spectral Density	N/A	--
15.247(d)	Band Edge Emission	N/A	--
15.203	Antenna requirement	PASS	--

Note: 1."N/A"denotes test is not applicable in this Test report  
 2.all tests are according to ANSI C63.10-2013

## 1.2 TEST FACILITY

Test Firm : Shenzhen United Testing Technology Co., Ltd.  
 Address : 2F, Annex Bldg, Jiahuangyuan Tech Park, #365 Baotian 1 Rd, Tiegang Community, Xixiang Str, Bao'an District, Shenzhen, China

The testing quality ability of our laboratory meet with "Quality Law of People's Republic of China" Clause 19.The testing quality system of our laboratory meets with ISO/IEC-17025 requirements, which is approved by CNAS. This approval result is accepted by MRA of APLAC.

Our test facility is recognized, certified, or accredited by the following organizations:

CNAS-LAB Code: L6494

The EMC Laboratory has been assessed and in compliance with CNAS-CL01 accreditation criteria for testing Laboratories (identical to ISO/IEC 17025:2017 General Requirements) for the Competence of testing Laboratories.

Designation Number: CN1227

Test Firm Registration Number: 674885

The EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications commission. The acceptance letter from the FCC is maintained in our files.

## 1.3 MEASUREMENT UNCERTAINTY

### Measurement Uncertainty

Conducted Emission Expanded Uncertainty = 2.23dB, k=2  
 Radiated emission expanded uncertainty(9kHz-30MHz) = 3.08dB, k=2  
 Radiated emission expanded uncertainty(30MHz-1000MHz) = 4.42dB, k=2  
 Radiated emission expanded uncertainty(Above 1GHz) = 4.06dB, k=2

## 2 GENERAL INFORMATION

### 2.1 ENVIRONMENTAL CONDITIONS

Temperature	Normal Temperature:	25°C
Voltage	Normal Voltage	Transmitter: DC 3.0V from battery Receiver: AC 120V/60Hz
Other	Relative Humidity	55 %
	Air Pressure	101 kPa

### 2.2 GENERAL DESCRIPTION OF EUT

Equipment	Wireless thermostat
Trade Mark	N/A
Model Name	OPS200N+OTS200N
Serial No.	OPS200+OTS200, OPS300+OTS300
Model Difference	All models have the same functionality, software and electronics, only the color, front frame shape and model name may differ. Test sample model: OPS200N+OTS200N
FCC ID	2ARTQ-OPS200N
Antenna Type	PCB Antenna
Antenna Gain	0dbi
Frequency Range	2435MHz
Number of Channels	1
Modulation Type	GFSK
Battery	N/A
Power Source	Transmitter: DC 3.0V from battery Receiver: AC 120V/60Hz
Adapter Model	N/A

### 2.3 Carrier Frequency of Channels

Channel	Frequency (MHz)
00	2435

## 2.4 Operation of EUT during testing

**Operating Mode:** Transmitting mode  
**Channel:** 2435MHz

## 2.5 DESCRIPTION OF TEST SETUP

Operation of EUT during Conducted testing: N/A

Operation of EUT during Radiation and Above1GHz Radiation testing:



## 2.6 MEASUREMENT INSTRUMENTS LIST

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until
<b>CONDUCTED EMISSIONS TEST</b>					
1	AMN	Schwarzbeck	NNLK8121	8121370	2019.9.9
2	AMN	ETS	3810/2	00020199	2019.9.9
3	EMI TEST RECEIVER	Rohde&Schwarz	ESCI	101210	2019.9.9
4	AAN	TESEQ	T8-Cat6	38888	2019.9.9
<b>RADIATED EMISSION TEST</b>					
1	Horn Antenna	Sunol	DRH-118	A101415	2019.9.29
2	BicoNILog Antenna	Sunol	JB1 Antenna	A090215	2019.9.29
3	PREAMP	HP	8449B	3008A00160	2019.9.9
4	PREAMP	HP	8447D	2944A07999	2019.9.9
5	EMI TEST RECEIVER	Rohde&Schwarz	ESR3	101891	2019.9.9
6	VECTOR Signal Generator	Rohde&Schwarz	SMU200A	101521	2019.9.28
7	Signal Generator	Agilent	E4421B	MY4335105	2019.9.28
8	MXA Signal Analyzer	Agilent	N9020A	MY50510140	2019.9.28
9	MXA Signal Analyzer	Agilent	N9020A	MY51110104	2019.9.9
10	ANT Tower&Turn table Controller	Champro	EM 1000	60764	2019.9.28
11	Anechoic Chamber	Taihe Maorui	9m*6m*6m	966A0001	2019.9.9

12	Shielding Room	Taihe Maorui	6.4m*4m*3m	643A0001	2019.9.9
13	RF Power sensor	DARE	RPR3006W	15I00041SNO88	2019.3.14
14	RF Power sensor	DARE	RPR3006W	15I00041SNO89	2019.3.14
15	RF power divider	Anritsu	K241B	992289	2019.9.28
16	Wideband radio communication tester	Rohde&Schwarz	CMW500	154987	2019.9.28
17	Biconical antenna	Schwarzbeck	VHA 9103	91032360	2019.9.8
18	Biconical antenna	Schwarzbeck	VHA 9103	91032361	2019.9.8
19	Broadband Hybrid Antennas	Schwarzbeck	VULB9163	VULB9163#958	2019.9.8
20	Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1680	2019.1.12
21	Active Receive Loop Antenna	Schwarzbeck	FMZB 1919B	00023	2019.11.02
22	Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170651	2019.03.14
23	Microwave Broadband Preamplifier	Schwarzbeck	BBV 9721	100472	2019.10.24
24	Active Loop Antenna	Com-Power	AL-130R	10160009	2019.05.10
25	Power Meter	KEYSIGHT	N1911A	MY50520168	2019.05.10

### 3 TEST CONDITIONS AND RESULTS

#### 3.1 CONDUCTED EMISSIONS TEST

##### Limit

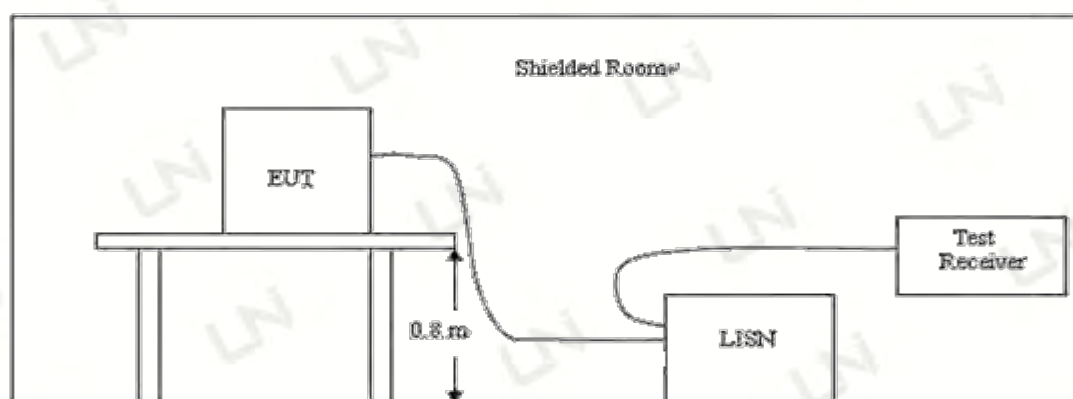
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency (MHz)	Maximum RF Line Voltage(dB $\mu$ V)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15~0.50	79	66	66~56*	56~46*
0.50~5.00	73	60	56	46
5.00~30.0	73	60	60	50

Decreasing linearly with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limit is same as above table.

##### Test Setup



##### Test Procedure

- 1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
- 2, Support equipment, if needed, was placed as per ANSI C63.10.
- 3, All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10.
- 4, If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5, All support equipments received AC power from a second LISN, if any.
- 6, The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7, Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

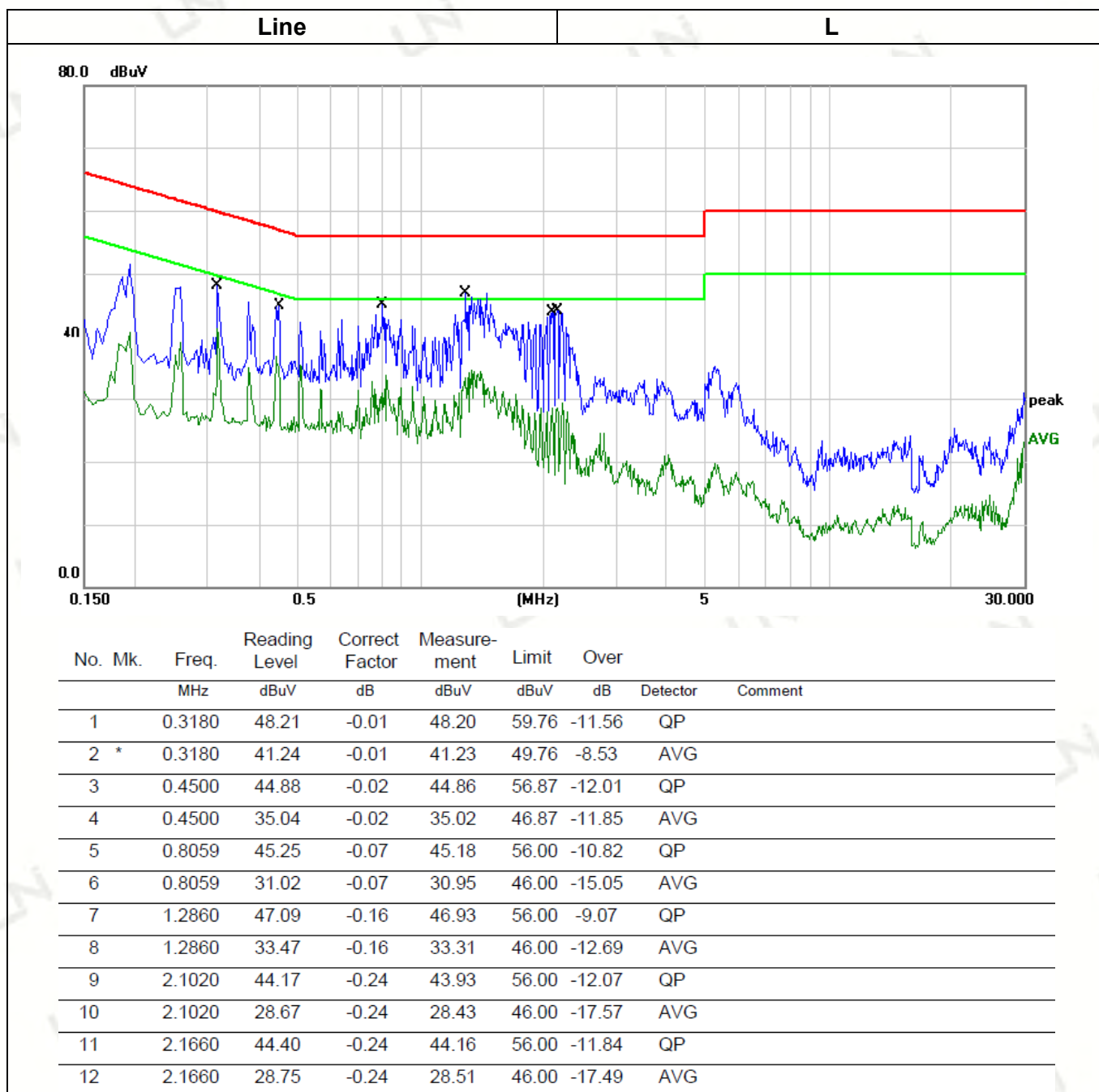
##### Test Result

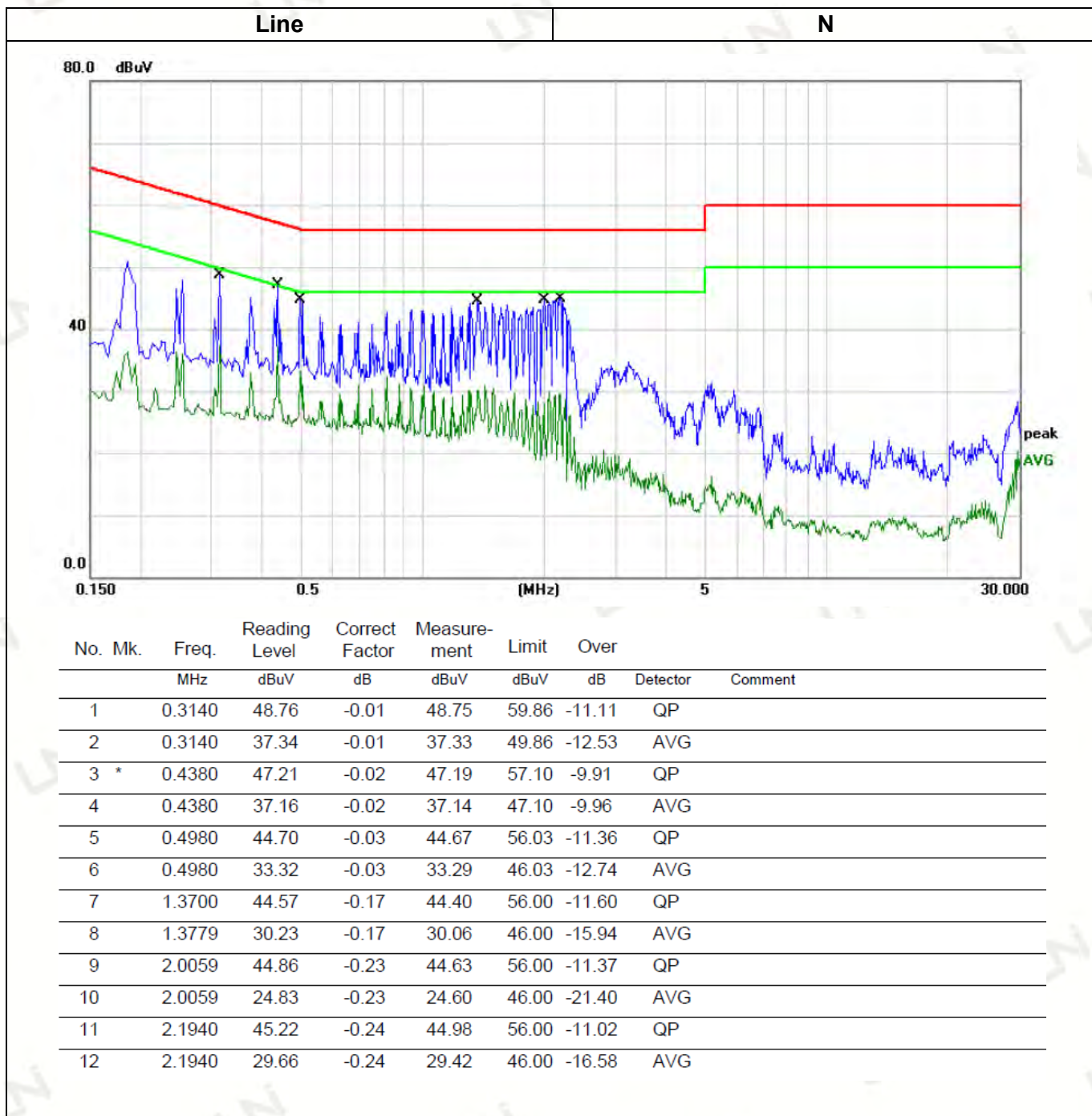
---PASS---



Please refer to test data as follows:

Temperature:	25°C	Relative Humidity:	48%
Test Date:	Oct. 30, 2018	Pressure:	1030hPa
Test Voltage:	Transmitter: DC 3.0V from battery Receiver: AC 120V/60Hz	Polarization:	





### 3.2 RADIATED EMISSION TEST

#### Limit

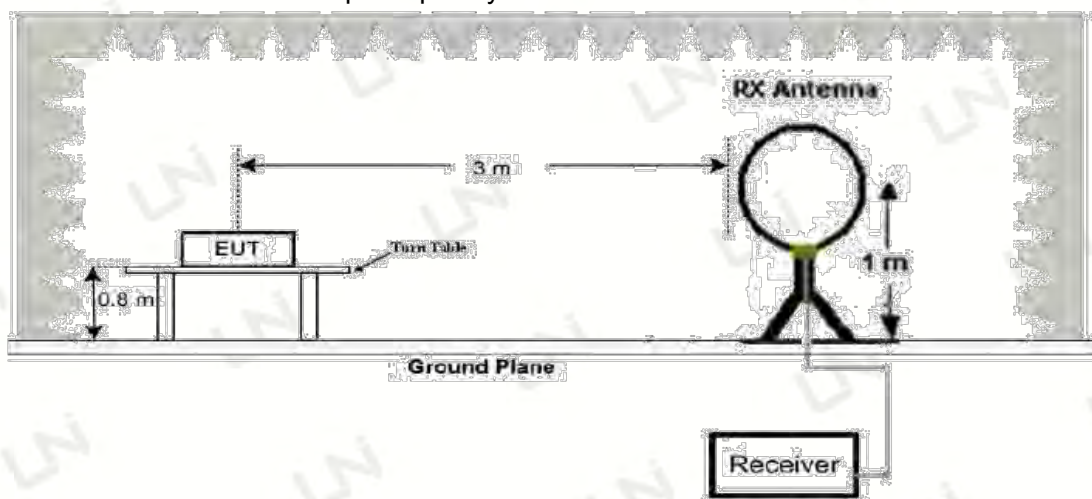
For unintentional device, according to § 15.209(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Distance (Meters)	Radiated (dB $\mu$ V/m)	Radiated ( $\mu$ V/m)
30-88	3	40	100
88-216	3	43.5	150
216-960	3	46	200
Above 960	3	54	500

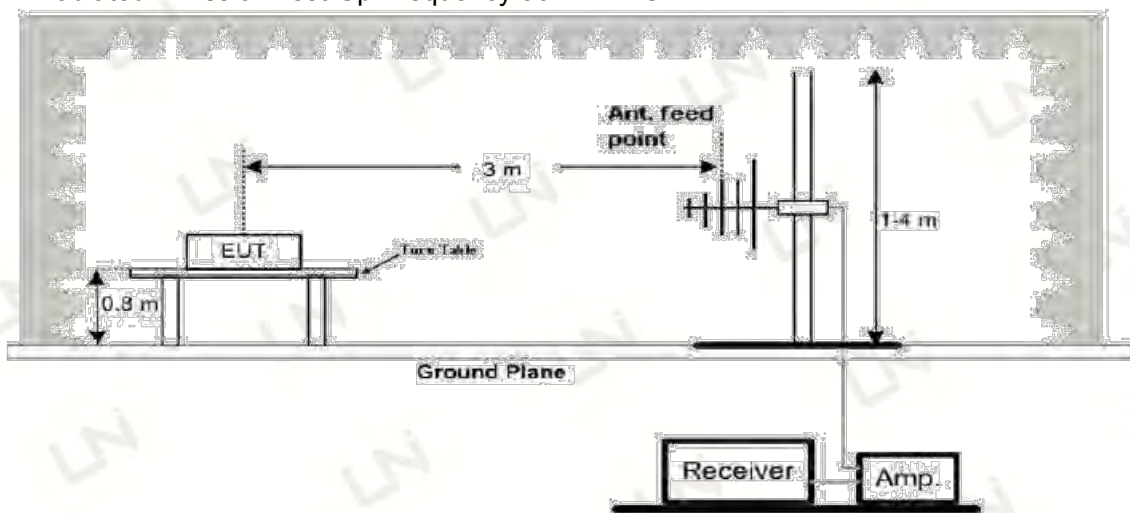
For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

#### Test Setup

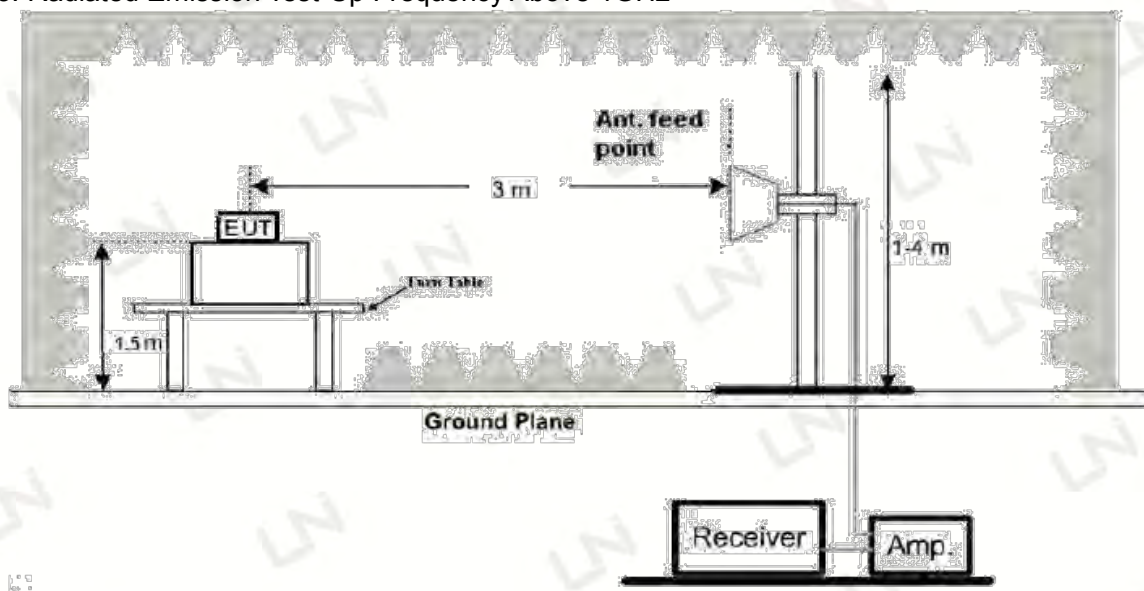
##### 1. Radiated Emission Test-Up Frequency Below 30MHz



##### 2. Radiated Emission Test-Up Frequency 30MHz~1GHz



### 3. Radiated Emission Test-Up Frequency Above 1GHz



#### Test Procedure

1. Below 1GHz measurement the EUT is placed on turntable which is 0.8m above ground plane. And above 1GHz measurement EUT was placed on low permittivity and low tangent turn table which is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. The test frequency range from 9KHz to 25GHz per FCC PART 15.33(a).

#### Note:

For battery operated equipment, the equipment tests shall be performed using a new battery.

#### Test Result

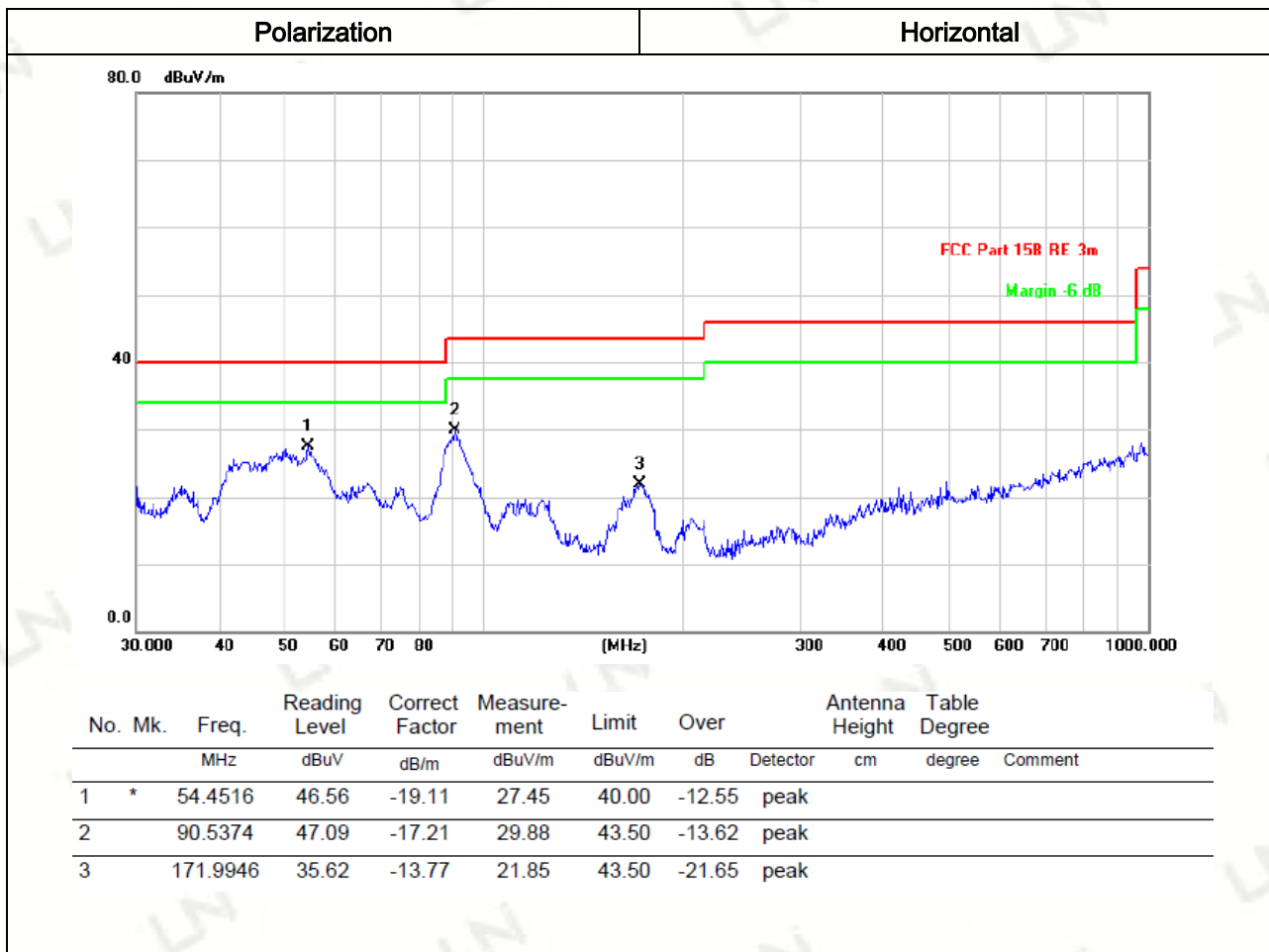
**---PASS---**

#### Remark:

1. All modes of GFSK were test at Low, Middle, and High channel, only the worst result of GFSK High Channel was reported for below 1GHz test.
2. By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "Z axis" position was the worst, and test data recorded in this report.
3. Radiated emission test from 9KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9KHz to 30MHz and not recorded in this report.

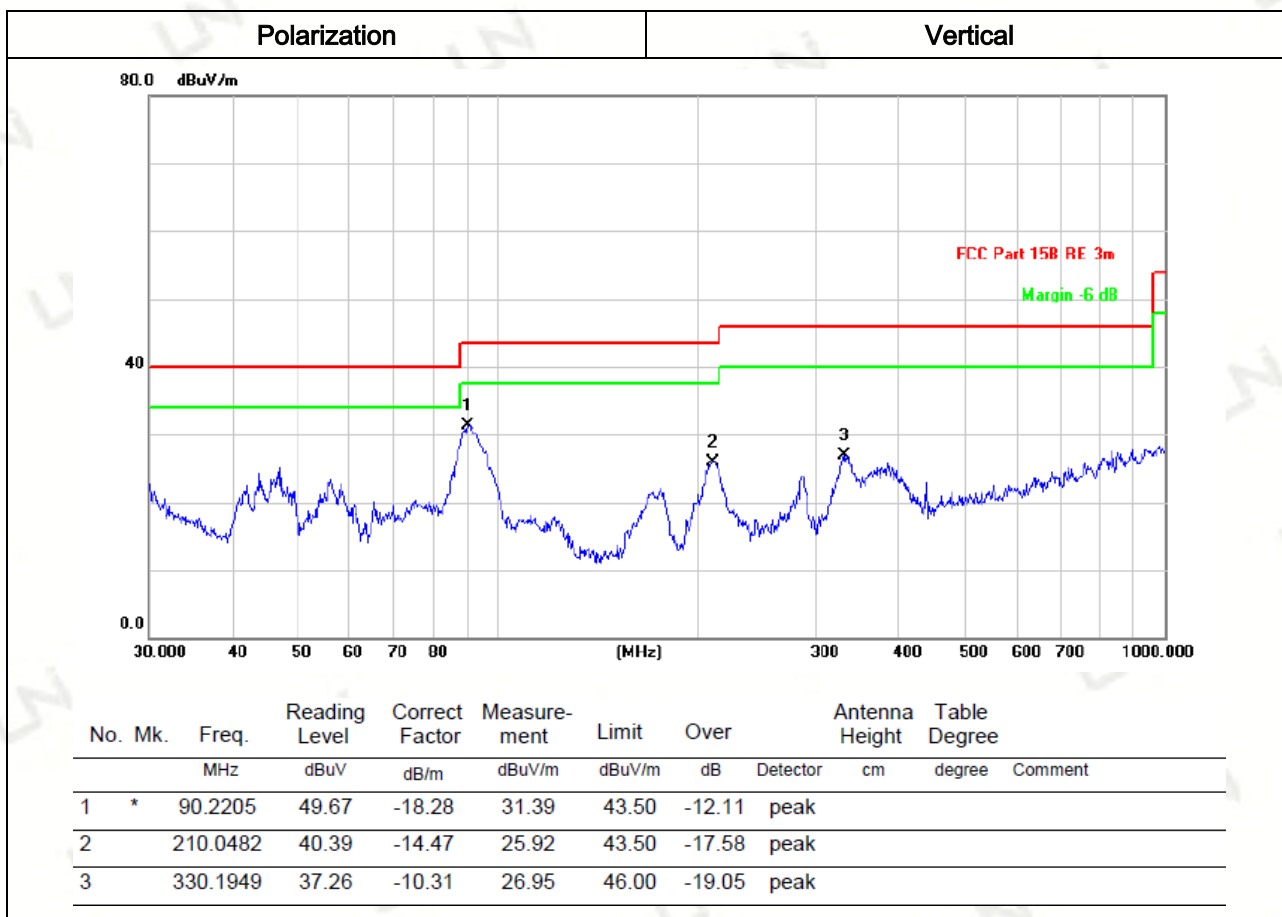
Below 1GHz Test Results:

Temperature:	24°C	Relative Humidity:	45%
Test Date:	Oct. 30, 2018	Pressure:	1030hPa
Test Voltage:	Transmitter: DC 3.0V from battery Receiver: AC 120V/60Hz	Phase:	Horizontal
Test Mode:	Normal working mode		



Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit  
 Factor = Ant. Factor + Cable Loss – Pre-amplifier

Temperature:	24°C	Relative Humidity:	45%
Test Date:	Oct. 30, 2018	Pressure:	1030hPa
Test Voltage:	Transmitter: DC 3.0V from battery Receiver: AC 120V/60Hz	Polarization:	Vertical
Test Mode:	Normal working mode		



Remark: Absolute Level = Reading Level + Factor, Margin = Absolute Level – Limit  
 Factor = Ant. Factor + Cable Loss – Pre-amplifier

Remark:

- (1) Measuring frequencies from 9 KHz to the 1 GHz, Radiated emission test from 9KHz to 30MHz was verified, and no any emission was found except system noise floor.
- (2) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (3) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz.

Above 1 GHz Test Results :

Horizontal:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4870.00	51.07	-3.58	47.49	74	26.51	PK
4870.00	37.56	-3.58	33.98	54	20.02	AV
5745.00	55.21	-2.24	52.97	74	21.03	PK
5745.00	40.95	-2.24	38.71	54	15.29	AV
7305.00	54.44	-0.87	53.57	74	20.43	PK
7305.00	38.06	-0.87	37.19	54	16.81	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
4870.00	52.08	-3.58	48.50	74	25.50	PK
4870.00	39.22	-3.58	35.64	54	18.36	AV
5745.00	55.47	-2.24	53.23	74	20.77	PK
5745.00	40.03	-2.24	37.79	54	16.21	AV
7305.00	54.67	-0.87	53.80	74	20.20	PK
7305.00	39.06	-0.87	38.19	54	15.81	AV

Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier. Margin = Absolute Level – Limit

Remark:

- (1) Measuring frequencies from 1 GHz to the 25 GHz.
- (2) “F” denotes fundamental frequency; “H” denotes spurious frequency. “E” denotes band edge frequency.
- (3) \* denotes emission frequency which appearing within the Restricted Bands specified in provision of 15.205, then the general radiated emission limits in 15.209 apply.
- (4) Data of measurement within this frequency range shown “---” in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
- (5) The IF bandwidth of EMI Test Receiver between 30MHz to 1GHz was 120KHz, 1 MHz for measuring above 1 GHz, below 30MHz was 10KHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for peak measurement with peak detector at frequency above 1GHz. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 10Hz for Average measurement with peak detection at frequency above 1GHz.
- (6) When the test results of Peak Detected below the limits of Average Detected, the Average Detected is not need completed. For example: Top Channel at Fundamental 73.16dBuV/m(PK Value) <93.98(AV Limit), at harmonic 53.20 dBuV/m(PK Value) <54 dBuV/m(AV Limit), the Average Detected not need to completed.
- (7) All modes of operation were investigated and the worst-case emissions are reported.

### **Limits**

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

### **Test Procedure**

The band edge compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW to 100KHz and VBM to 300KHz to measure the peak field strength and set RBW to 1MHz and VBW to 10Hz to measure the average radiated field strength. The conducted RF band edge was measured by using a spectrum analyzer. Set span wide enough to capture the highest in-band emission and the emission at the band edge. Set RBW to 100 KHz and VBW to 300 KHz, to measure the conducted peak band edge.

### **Test Result**

Not applicable to this device



### 3.4 Maximum Peak Output Power

#### Limit

The Maximum Peak Output Power Measurement is 30dBm.

#### Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

#### Test Configuration



#### Test Result

---PASS---

Type	Channel	Output power (dBm)	Antenna Gain (dbi)	EIRP (dBm)	Limit (dBm)	Result
GFSK	00	-7.36	0.00	-7.36	30.00	Pass

### 3.5 Power Spectral Density

#### Limit

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

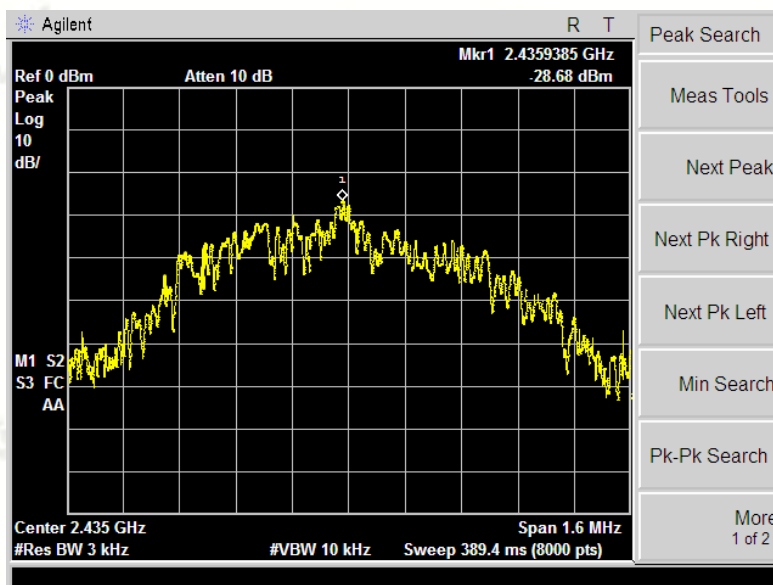
#### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW  $\geq$  3 kHz.
3. Set the VBW  $\geq$  3 $\times$  RBW.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8dBm.

#### Test Results

---PASS---

Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
GFSK	00	-28.68	8	Pass



### 3.6 OCCUPIED BANDWIDTH MEASUREMENT

#### Limit

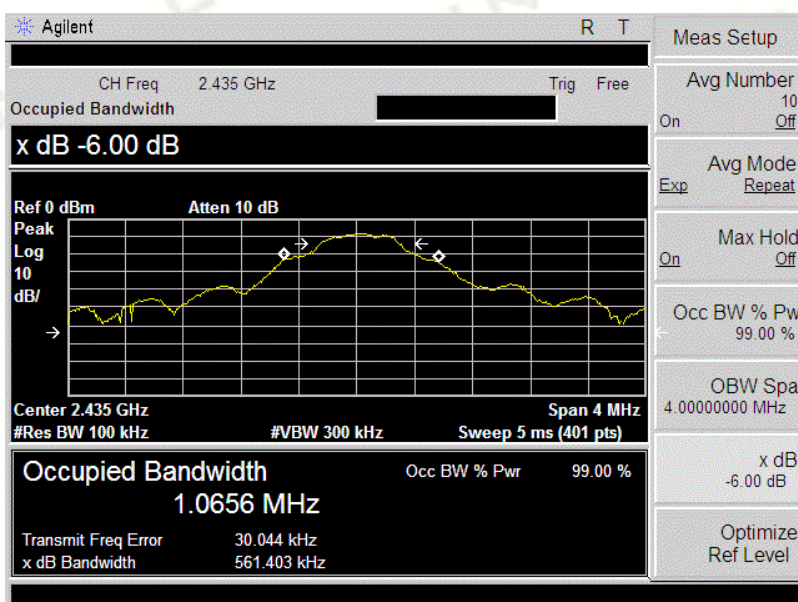
For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

#### Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

GFSK Modulation:

Frequency	6dB Bandwidth (MHz)	99% OBW (MHz)	Limit (KHz)	Result
2435	0.561403	1.0656	≥500	PASS



### 3.7 Out-of-band Emissions

#### Limit

In any 100 kHz 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 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF con-ducted or a radiated measurement, pro-vided the transmitter demon-strates compliance with the peak conducted power limits. If the transmitter com-plies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

#### Test Procedure

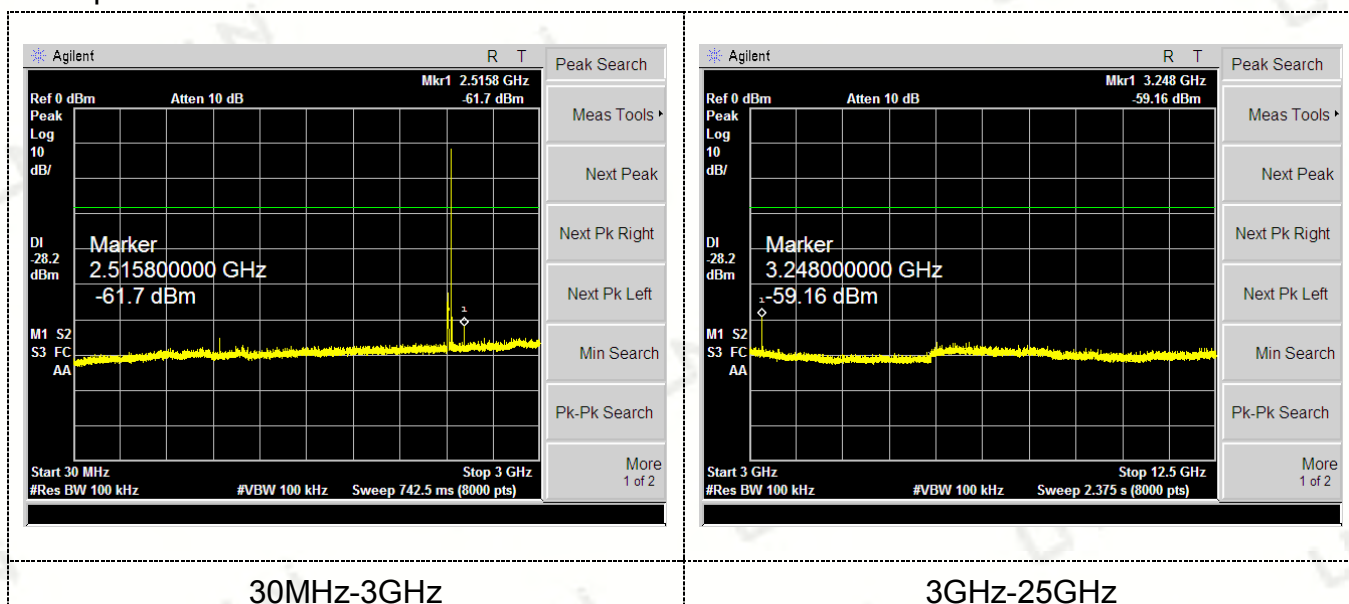
Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold.

Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

#### Test Results

Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

Test plot as follows:



#### 4 ANTENNA REQUIREMENT

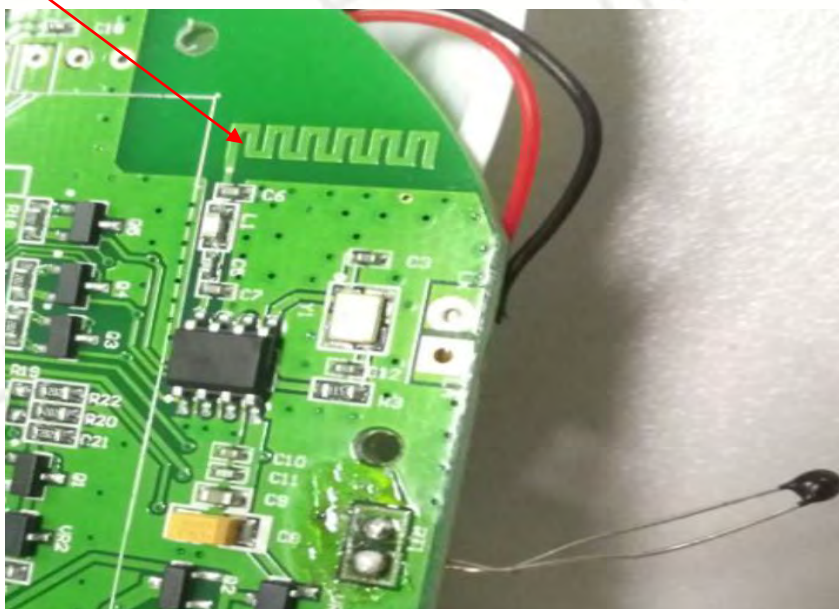
Standard Applicable:

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.

Antenna Connected Construction

The antenna used in this product is a Integral Antenna, The directional gains of antenna used for transmitting is 1.5dBi.

transmitter ANTENNA



Receiver ANTENNA



### 5 PHOTOGRAPH OF TEST

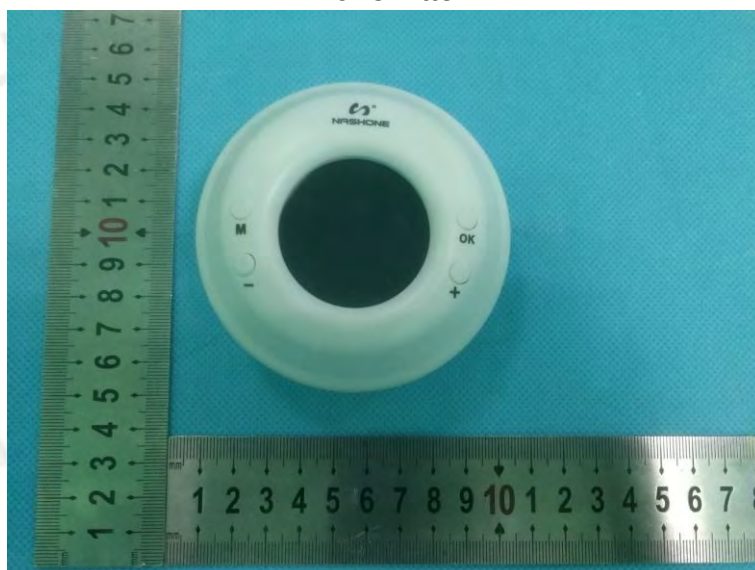


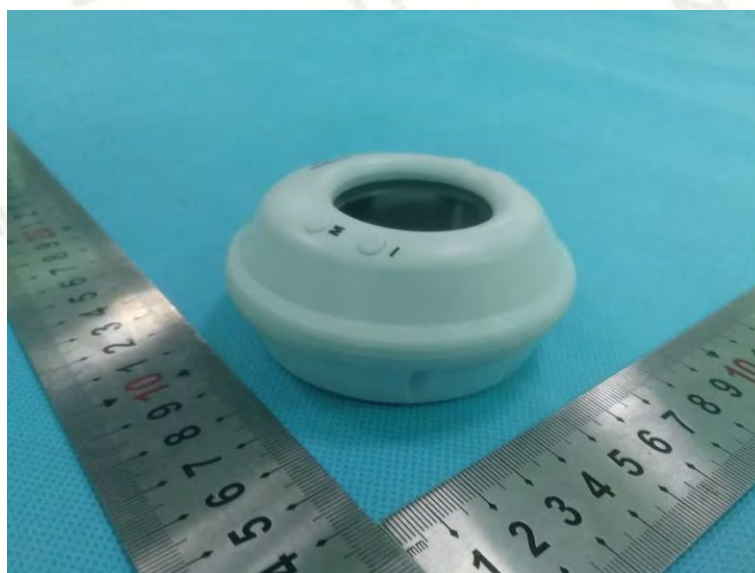
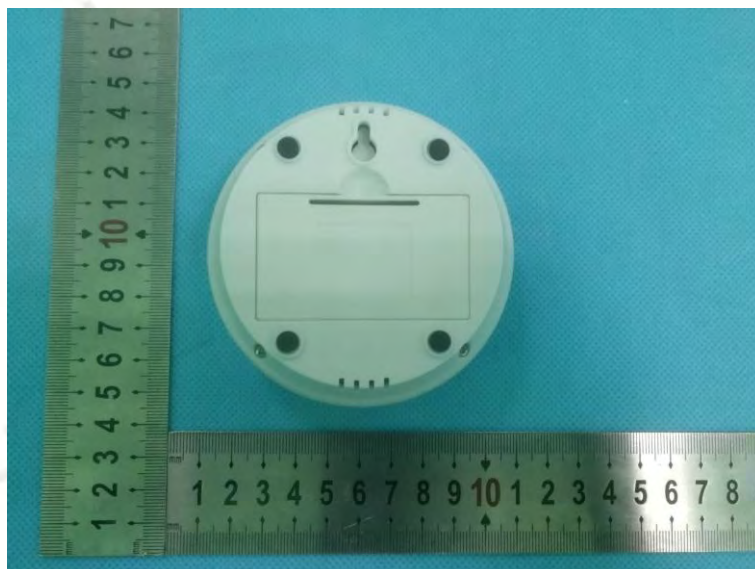
# 6 PHOTOGRAPH OF EUT

## External photos



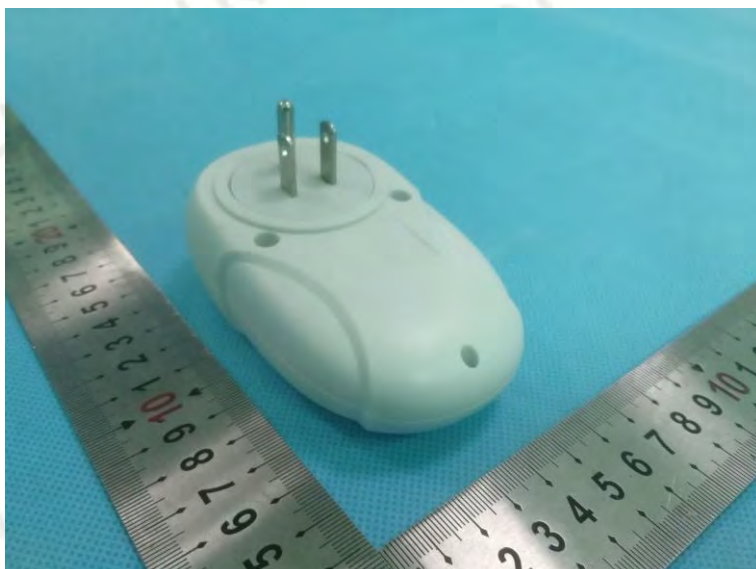
## Transmitter





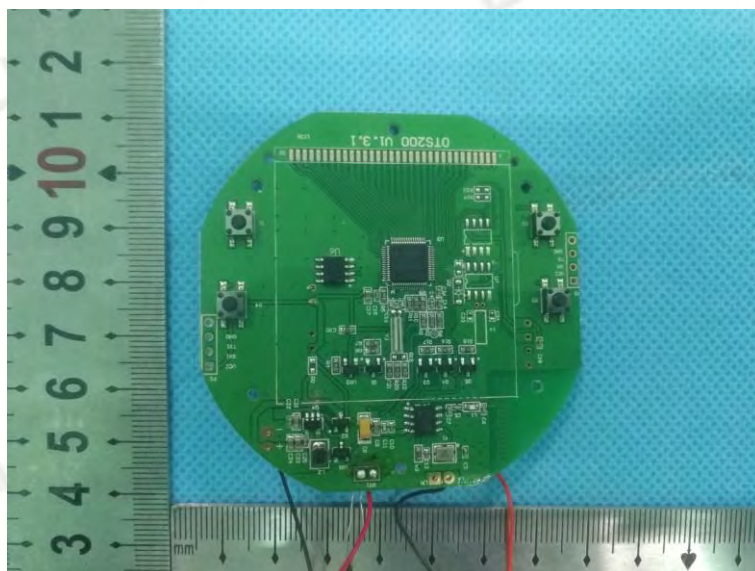
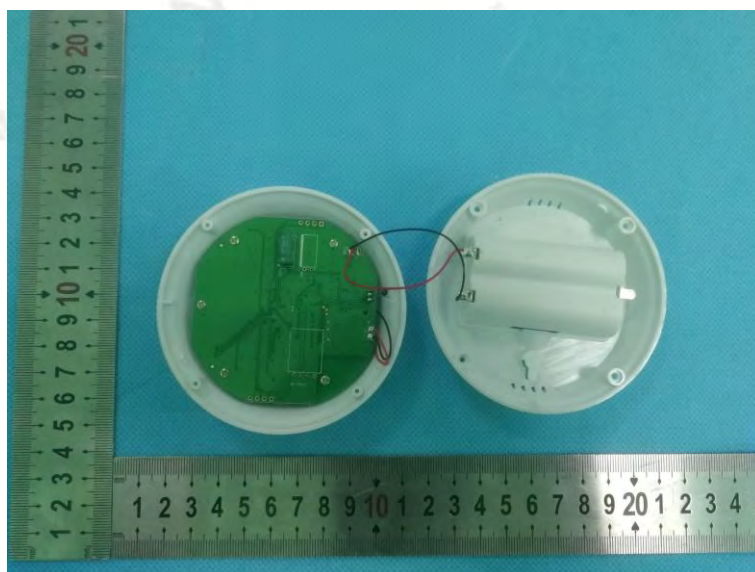
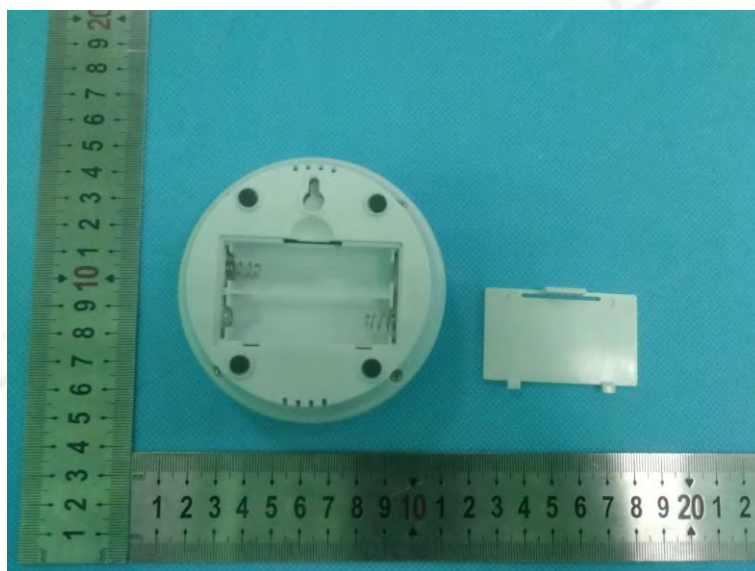


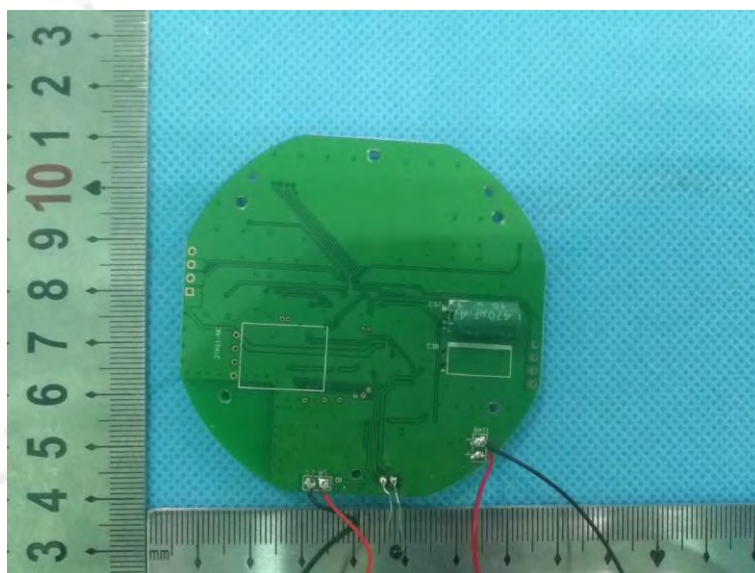
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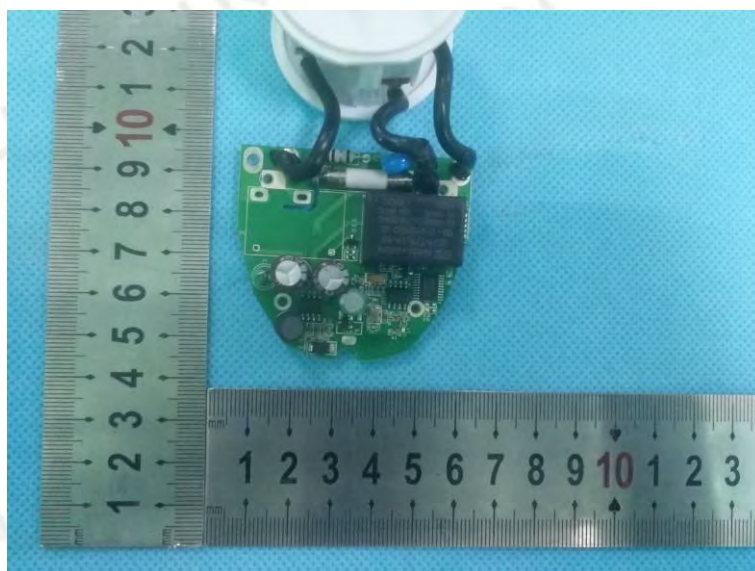


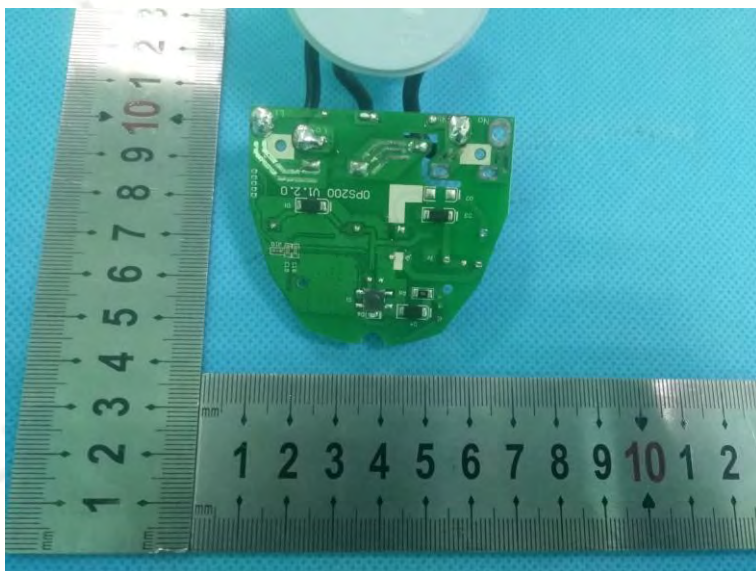
**Internal Photos**  
transmitter





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\*\*\*\*\*End of Report\*\*\*\*\*