FCC TEST REPORT

Test report
On Behalf of
Nanjing Co-Lander Network Technology Co.,Ltd
For
High end smart hotel locks
Model No.: LK-201-L, LK-201

FCC ID: 2AR6K-LK201

Prepared for :	**Nanjing Co-Lander Network Technology Co.,Ltd** **No.9,Yuhua East Road, Yuhuatai District, Nanjing City, Jiangsu Province, China**
Prepared By :	**Shenzhen HUAK Testing Technology Co., Ltd.** **1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China**

Date of Test:	**Nov. 13, 2018 ~ Nov. 22, 2018**
Date of Report:	**Nov. 22, 2018**
Report Number:	**HK1811151679-1E**

TEST RESULT CERTIFICATION

Applicant's name.....: Nanjing Co-Lander Network Technology Co.,Ltd

Address .....: No.9,Yuhua East Road, Yuhuatai District, Nanjing City, Jiangsu Province, China

Manufacture's Name.....: Nanjing Co-Lander Network Technology Co.,Ltd

Address .....: No.9,Yuhua East Road, Yuhuatai District, Nanjing City, Jiangsu Province, China

Product description

Trade Mark:

Product name ..... : High end smart hotel locks

Model and/or type reference .: LK-201-L, LK-201

Standards.....: FCC Part15 Subpart C 2017, Section 15.231
ANSI C63.10: 2013

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Date of Test.....:

Date (s) of performance of tests .....: Nov. 13, 2018 ~ Nov. 22, 2018

Date of Issue.....: Nov. 22, 2018

Test Result .....: **Pass**

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

Contents

1 . TEST SUMMARY 4
1.1 TEST FACILITY 4
1.2 TEST FACILITY 4
1.3 MEASUREMENT UNCERTAINTY 4
2. General Information 5
2.1. Description of Device (EUT) 5
2.2. DESCRIPTION OF TEST SETUP 6
2.3. List of channels 6
2.5. Test Equipment List 7
3. Conducted Emission Test 8
3.1 Conducted Power Line Emission Limit 8
3.2 Test Setup 8
3.3 Test Procedure 8
3.4 Test Data 8
4. Radiated Emissions 9
4.1. Standard Applicable 9
4.2. Test Procedure 9
4.3. Corrected Amplitude & Margin Calculation 11
4.4. Environmental Conditions 11
4.5. Test Data 11
5. 20DB Occupy Bandwidth Test 15
5.1. Standard Applicable 15
5.2. Test Procedure 15
5.4. Test Data 15
6. Transmission Time 17
6.1. Standard Applicable 17
6.2. Test Procedure 17
6.3. Environmental Conditions 17
6.4. Test Data 17
7. Duty Cycle 19
7.1. Standard Applicable 19
7.2. Test Procedure 19
7.4. INTRODUCTION TO PDCF reference: 19
7.5. Test Data 20
8. Antenna Connected Construction 23
9. PHOTOGRAPH OF TEST 24

1. TEST SUMMARY

1.1 TEST FACILITY

Standard Section	Test Item	Result
15.203	Antenna Requirement	PASS
15.207	Conducted Emission	N/A
15.205/15.209/15.231(b)	Spurious Emission	PASS
15.231(c)	20dB Occupied Bandwidth	PASS
15.231(a)	Deactivation Testing	PASS
Remark: “N/A” is an abbreviation for Not Applicable.		

1.2 TEST FACILITY

Test Firm : Shenzhen HUAK Testing Technology Co., Ltd.

Address 1F, B2 Building, Junfeng Zhongcheng Zhizao Innovation Park, Fuhai Street, Bao'an District, Shenzhen City, China

1.3 MEASUREMENT UNCERTAINTY

Measurement uncertainty		
Parameter	Conditions	Uncertainty
Occupied Bandwidth	Conducted	±1.5%
Conducted Spurious Emission	Conducted	±2.17dB
Transmission Time	Conducted	±5%
Conducted Emissions	Conducted	±2.88dB
Transmitter Spurious Emissions	Radiated	±5.1dB

2. General Information

2.1. Description of Device (EUT)

Product Name	:	High end smart hotel locks	
Model No.	:	LK-201-L	
Serial No	:	LK-201	
Model Difference	:	All model's the function, software and electric circuit are the same, only with a product color and model named different. Test sample model: LK-201-L.	
Trade Mark	:	乐开云 Lock Winner	
Test Power Supply	:	DC 6V From battery	
Product Description	:	Operation Frequency:	433MHz
		Number of Channel:	1 Channels
		Modulation Type:	GFSK
		Antenna Type:	Internal Antenna
		Antenna Gain(Peak):	1 dbi
Remark: 1)For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.			

2.2. DESCRIPTION OF TEST SETUP

Operation of EUT during Radiation and Above1GHz Radiation testing:

EUT

2.3. List of channels

Channel	Freq. (MHz)	Note (Modulation Type)
01	433	GFSK

2.5. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	L.I.S.N. Artificial Mains Network	R&S	ENV216	HKE-002	Dec. 28, 2017	1 Year
2.	Receiver	R&S	ESCI 7	HKE-010	Dec. 28, 2017	1 Year
3.	RF automatic control unit	Tonscend	JS0806-2	HKE-060	Dec. 28, 2017	1 Year
4.	Spectrum analyzer	R&S	FSP40	HKE-025	Dec. 28, 2017	1 Year
5.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2017	1 Year
6.	Preamplifier	Schwarzbeck	BBV 9743	HKE-006	Dec. 28, 2017	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESCI 7	HKE-010	Dec. 28, 2017	1 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	HKE-012	Dec. 28, 2017	1 Year
9.	Loop Antenna	Schwarzbeck	FMZB 1519 B	HKE-014	Dec. 28, 2017	1 Year
10.	Horn Antenna	Schewarzbeck	9120D	HKE-013	Dec. 28, 2017	1 Year
11.	Pre-amplifier	EMCI	EMC051845 SE	HKE-015	Dec. 28, 2017	1 Year
12.	Pre-amplifier	Agilent	83051A	HKE-016	Dec. 28, 2017	1 Year
13.	EMI Test Software EZ-EMC	Tonscend	JS1120-B Version	HKE-083	Dec. 28, 2017	N/A
14.	Power Sensor	Agilent	E9300A	HKE-086	Dec. 28, 2017	1 Year
15.	Spectrum analyzer	Agilent	N9020A	HKE-048	Dec. 28, 2017	1 Year
16.	Signal generator	Agilent	N5182A	HKE-029	Dec. 28, 2017	1 Year
17.	Signal Generator	Agilent	83630A	HKE-028	Dec. 28, 2017	1 Year
18.	Shielded room	Shiel Hong	4*3*3	HKE-039	Dec. 28, 2017	3 Year

3. Conducted Emission Test

3.1 Conducted Power Line Emission Limit

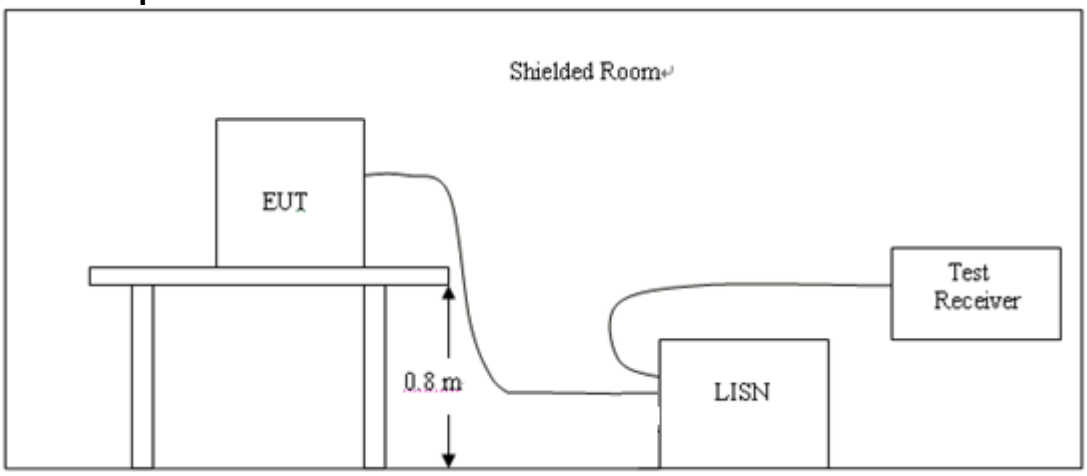
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	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.

3.2 Test Setup



3.3 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.

3.4 Test Data

Not applicable for device which is battery supply.

4. Radiated Emissions

4.1. Standard Applicable

According to §15.231(b), the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** linear interpolations

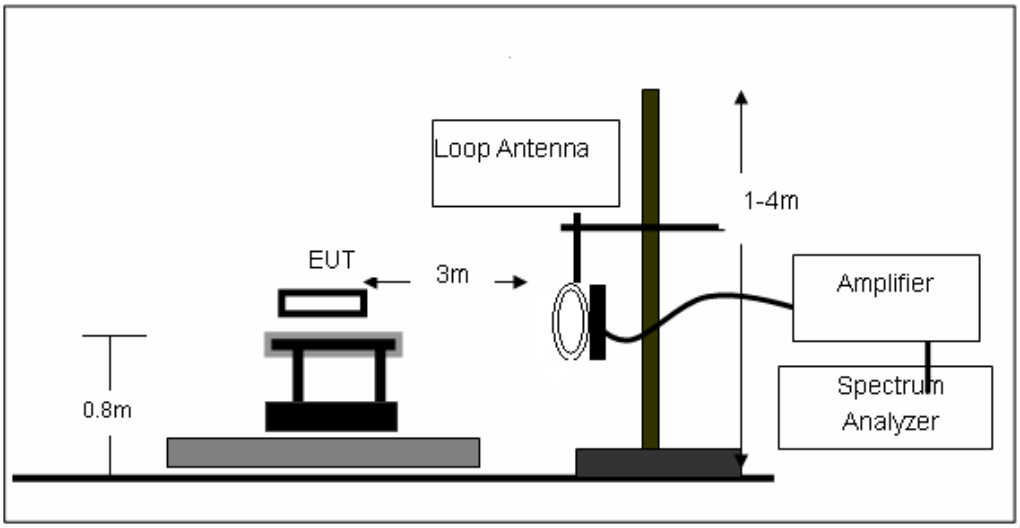
The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

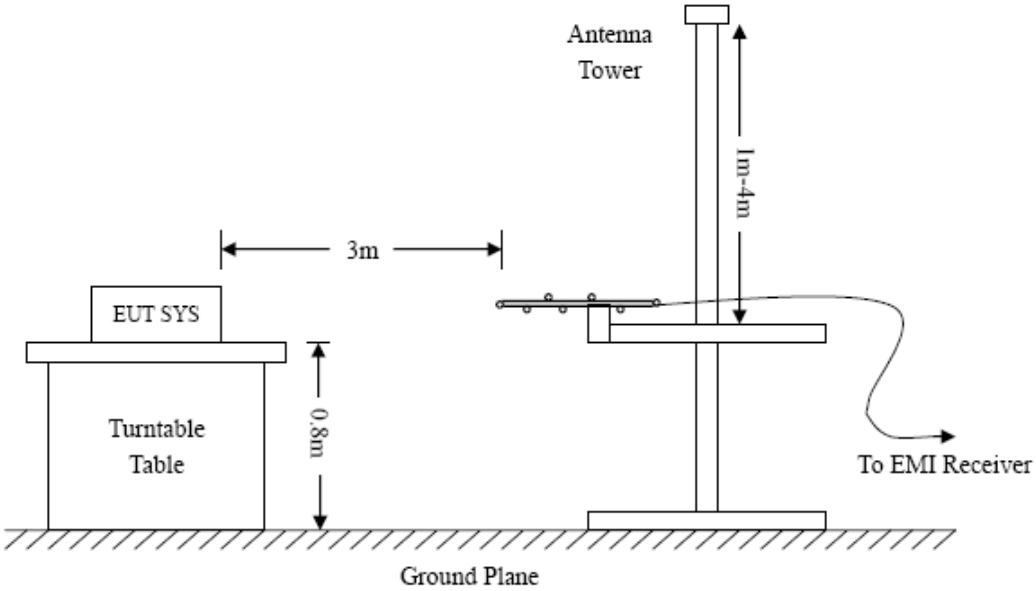
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

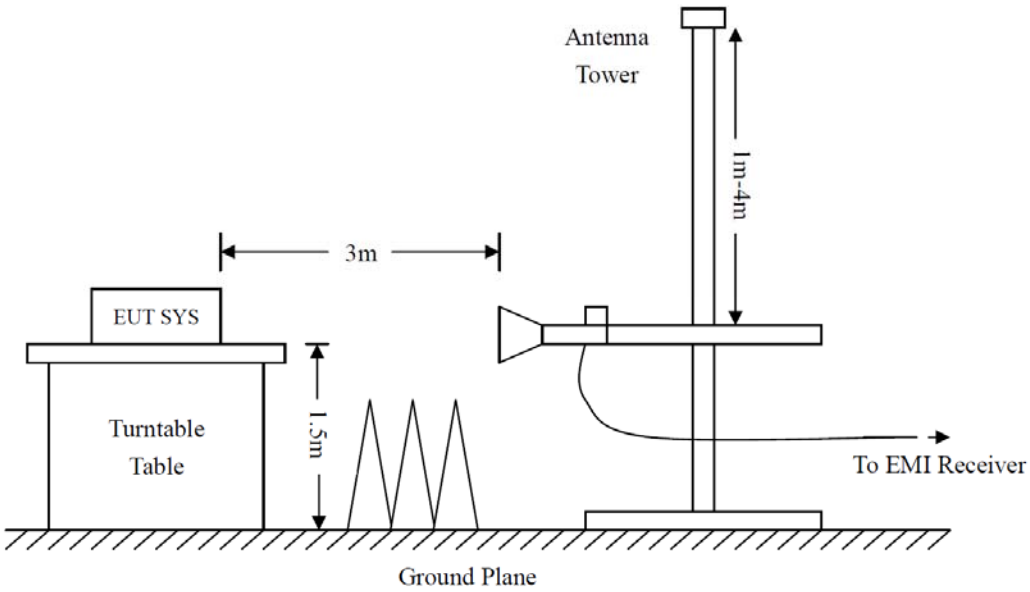
Compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

4.2. Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.231(b) and FCC Part 15.209 Limit.


Loop Antenna
1-4m
EUT
3m
Amplifier
0.8m
Spectrum
Analyzer


Antenna
Tower
1m-4m
3m
EUT SYS
Turntable
Table
0.8m
To EMI Receiver
Ground Plane


Antenna
Tower
1m-4m
3m
EUT SYS
Turntable
Table
1.5m
To EMI Receiver
Ground Plane

4.3. Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading +Ant.Loss +Cab. Loss – Ampl.Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit.For example, a margin of -6dB V means the emission is 6dB V below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part15C Limit

4.4. Environmental Conditions

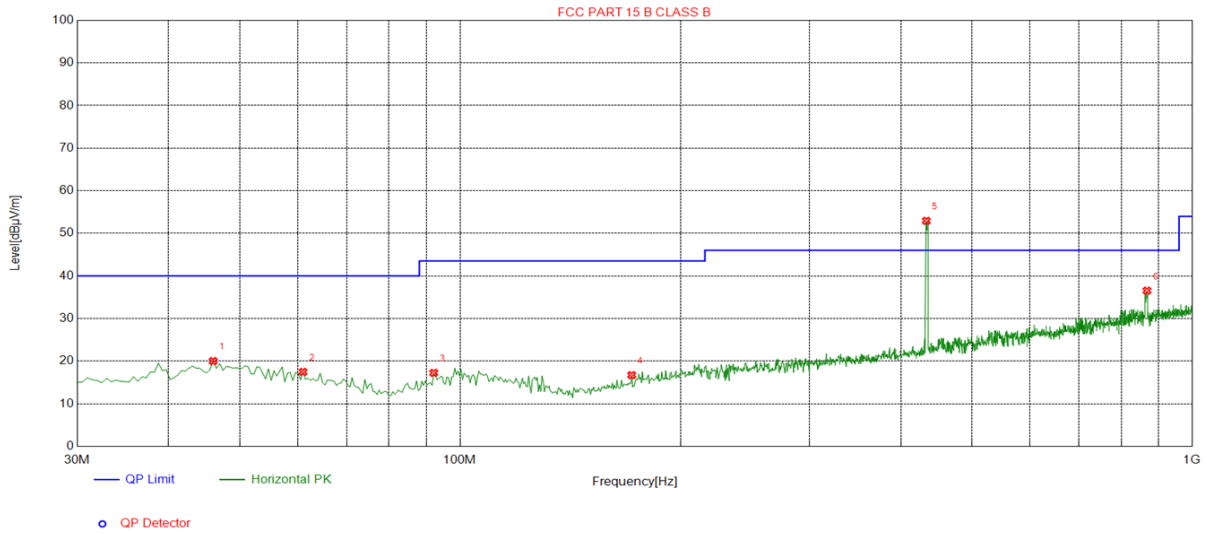
Temperature:	21℃
Relative Humidity:	50%
ATM Pressure:	1011 mbar

4.5. Test Data

According to the data below, the FCC Part 15.205, 15.209 and 15.231 standards, and had the worst margin of:

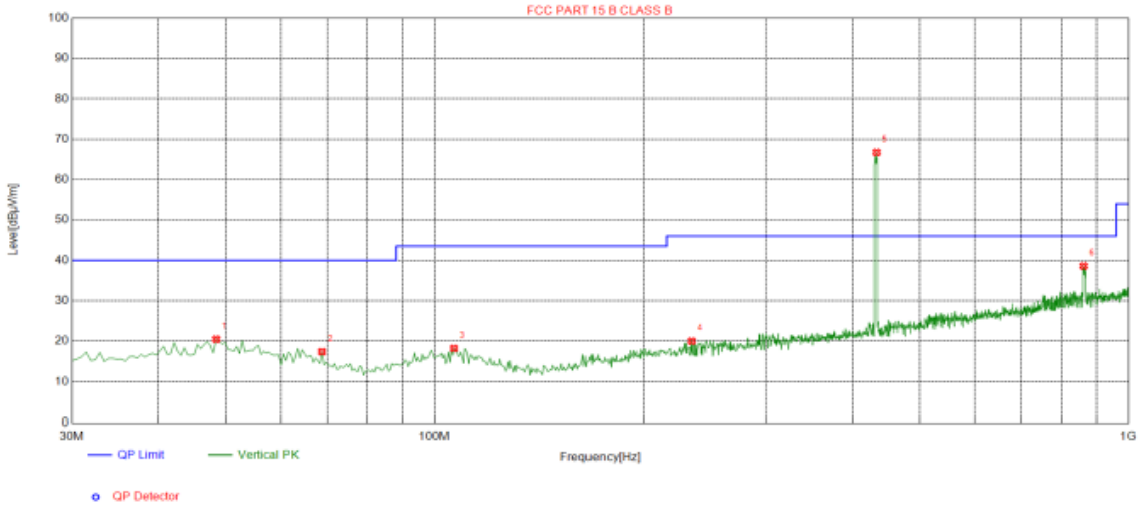
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	46.0050	20.01	-13.65	40.00	19.99	100	158	Horizontal
2	61.0400	17.47	-15.42	40.00	22.53	100	308	Horizontal
3	92.0800	17.24	-16.72	43.50	26.26	100	346	Horizontal
4	171.620	16.71	-17.23	43.50	26.79	100	188	Horizontal
5	433.000	52.93	-9.70	80.80	-6.93	100	165	Horizontal
6	866.080	36.54	-2.30	46.00	9.46	100	240	Horizontal

Vertical



Suspected List								
NO.	Freq. [MHz]	Level [dBμV/m]	Factor [dB]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	48.4300	20.47	-13.65	40.00	19.53	100	164	Vertical
2	68.8000	17.38	-17.37	40.00	22.62	100	62	Vertical
3	106.630	18.20	-15.42	43.50	25.30	100	116	Vertical
4	234.670	20.00	-14.10	46.00	26.00	100	19	Vertical
5	433.000	66.74	-9.70	80.80	-20.74	100	22	Vertical
6	866.775	38.59	-2.42	46.00	7.41	100	323	Vertical

Above 1GHz

No.	Frequency	Reading	Corr.	Duty cycle	Result	Limit	Margin	Deg.	Height	Remark
	MHz	dBuV/m	Factor (dB)	Factor (dB)	dBuV/m	dBuV/m	dB	(°)	(cm)	
1	1302.3	30.72	25.83	N/A	56.55	74	-17.45	166	100	Peak
	1302.3	/	/	-9.86	46.69	54	-7.31	86	100	Ave
2	1736.4	23.65	27.25	N/A	50.9	74	-23.1	245	100	Peak
	1736.4	/	/	-9.86	41.04	54	-12.96	65	100	Ave

Note: Testing is carried out with frequency rang 30MHz to the tenth harmonics, which above 5th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

The fundamental frequency is 433MHz, so the fundamental and spurious emissions radiated limit base on the the operating frequency 433MHz.

Frequency Range (9 kHz-30MHz)

Frequency (MHz)	Level@3m (dBμV/m		Limit@3m (dBμV/m)	
--	--	--	--	--
--	--	--	--	--
--	--	--	--	--

Note: 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement.

5. 20DB Occupy Bandwidth Test

5.1. Standard Applicable

According to FCC Part 15.231(c), The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

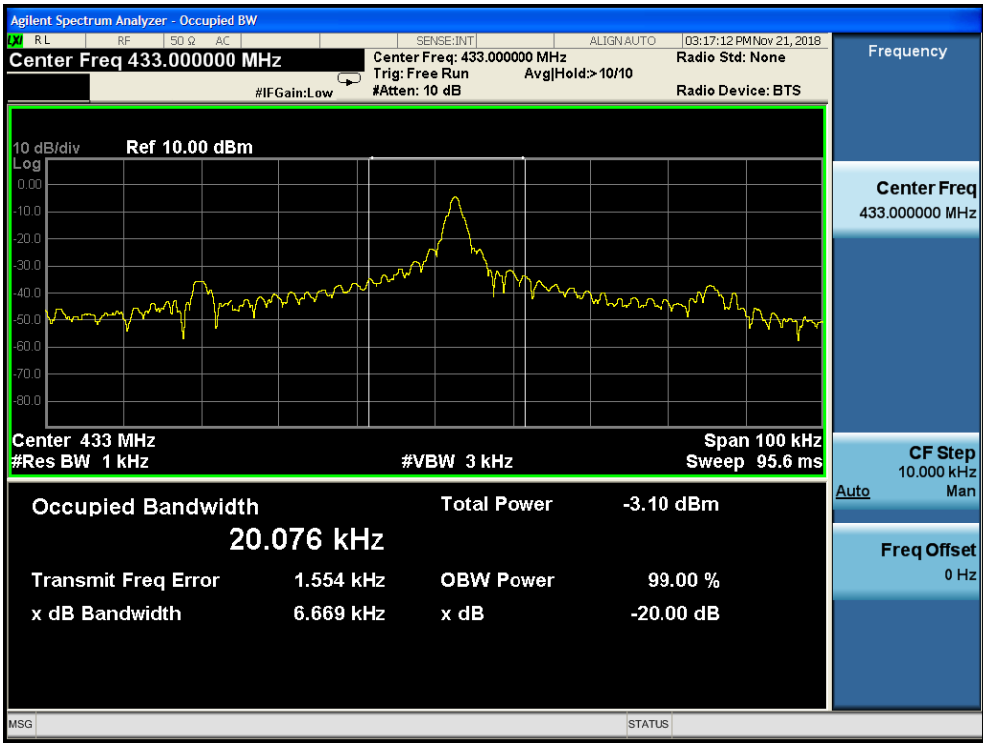
5.2. Test Procedure

With the EUT's antenna attached, the EUT's 20dB Bandwidth power was received by the test antenna, which was connected to the spectrum analyzer with the START, and STOP frequencies set to the EUT'soperation band.

Temperature:	21℃
Relative Humidity:	52%
ATM Pressure:	1011 mbar

5.4. Test Data

Freq. (MHz)	Modulation Type	Bandwidth (kHz)	Limit (kHz)	Results
433	GFSK	6.669	<1082.5	PASS


Agilent Spectrum Analyzer - Occupied BW
Center Freq 433.000000 MHz
Center Freq: 433.000000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 10 dB
#IFGain:Low
Radio Std: None
Radio Device: BTS
03:17:12 PM Nov 21, 2018
Frequency
10 dB/div
Ref 10.00 dBm
Log
Center 433 MHz
#Res BW 1 kHz
#VBW 3 kHz
Span 100 kHz
Sweep 95.6 ms
Occupied Bandwidth
20.076 kHz
Total Power -3.10 dBm
Transmit Freq Error 1.554 kHz
OBW Power 99.00 %
x dB Bandwidth 6.669 kHz
x dB -20.00 dB
Center Freq
433.000000 MHz
CF Step
10.000 kHz
Auto Man
Freq Offset
0 Hz
MSG
STATUS

6. Transmission Time

6.1. Standard Applicable

According to FCC Part 15.231(a), the transmitter shall be complied the following requirements:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

6.2. Test Procedure

With the EUT's antenna attached, the EUT's output signal was received by the test antenna, which was connected to the spectrum analyzer. Set the center frequency to 433MHz, than set the spectrum analyzer to Zero Span for the release time reading. During the testing, the switch was released then the EUT automatically deactivated.

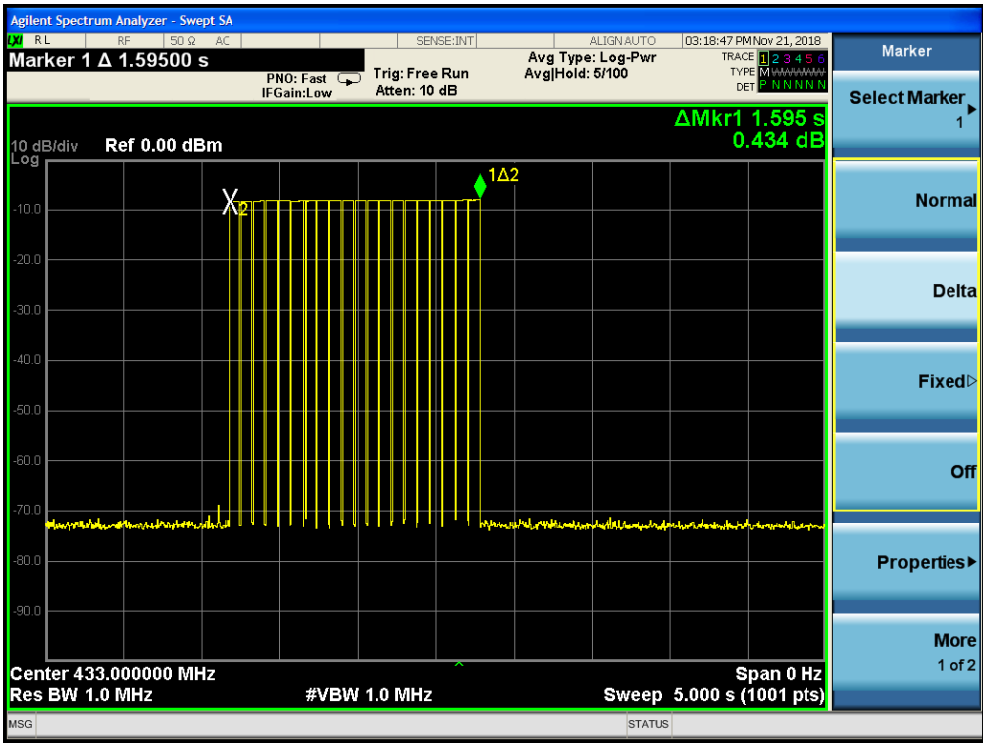
6.3. Environmental Conditions

Temperature:	20℃
Relative Humidity:	52%
ATM Pressure:	1011 mbar

6.4. Test Data

Transmission Type	Test Frequency MHz	Transmission Time seconds	Limit s	Result
Manually	433	1.595	5	PASS

Please refer the following plot.


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 1.59500 s
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
Avg|Hold: 5/100
03:18:47 PM Nov 21, 2018
ΔMkr1 1.595 s
0.434 dB
10 dB/div
Log
Ref 0.00 dBm
1Δ2
Center 433.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 5.000 s (1001 pts)
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2

7. Duty Cycle

7.1. Standard Applicable

According to FCC Part 15.231(b)(2) and 15.35 (c),For pulse operation transmitter, the averaging pulsed emissions are calculated by peak value of measured emission plus duty cycle factor.

7.2. Test Procedure

1) The EUT was placed on a turntable which is 0.8m above ground plane.

2) Set EUT operating in continuous transmitting mode

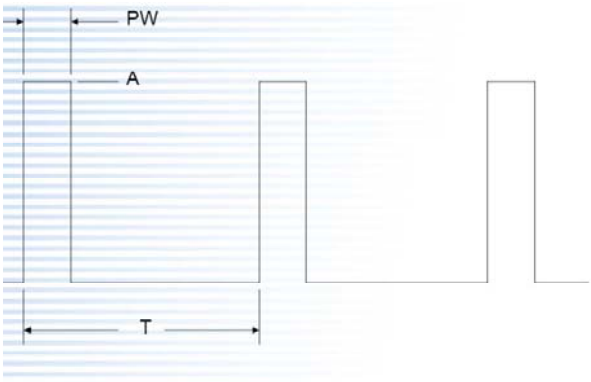
3) Set Test Receiver into spectrum analyzer mode, Tune the spectrum analyzer to the transmitter carrier frequency, and set the spectrum analyzer resolution bandwidth(RBW) to 1000kHz and video bandwidth(VBW) to 1000kHz, Span was set to 0Hz.

4) The Duty Cycle was measured and recorded.

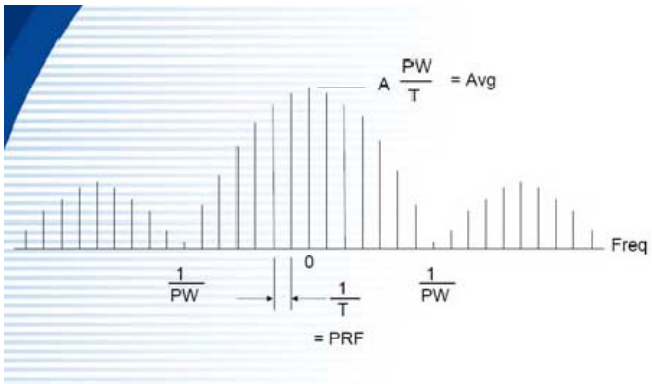
7.4. INTRODUCTION TO PDCF reference:

(§15.35 Measurement detector functions and bandwidths.)

1) Part 15 of the FCC Rules provides for the operation of low power communication devices without an individual license (e.g., intrusion detectors, pulsed water tank level gauges, etc.), subject to certain requirements. Some of these devices use extremely narrow pulses to generate wideband emissions, which are measured to determine compliance with the rules. These measurements are typically performed with a receiver or spectrum analyzer. Depending on a number of factors (e.g., resolution bandwidth, pulsewidth, etc.), the spectrum analyzer may not always display the true peak value of the measured emission. This effect, called “pulse desensitization,” relates to the capabilities of the measuring instrument. For the measurement and reporting of the true peak of pulsed emissions, it may be necessary to apply a “pulse desensitization correction factor” (PDCF) to the measured value, pursuant to 47 CFR 15.35(a).



Periodic Square Pulse



Frequency Spectrum of Periodic Square Pulse

If using spectrum analyzer to measure pulse signal , it have to make sure the RBW use is at least 2/PW.
•When RBW is less than 2/PW, you are able to measure the true peak level of the pulse signal. If this is the case ,
PDCF is required to compensate to determine true peak value.
Pulse desensitization:
PW =29250usec (0.6* 13+ 1.65*13), Period=67500usec, Level=A
RBW>2/PW=0.068K, 1/T=0.15K
NOTE: 2 / PW < RBW, first don't need

2). For the actual test, please refer to the ANSI C63.10,Annex C refer to section 5 for more detail

7.5. Test Data

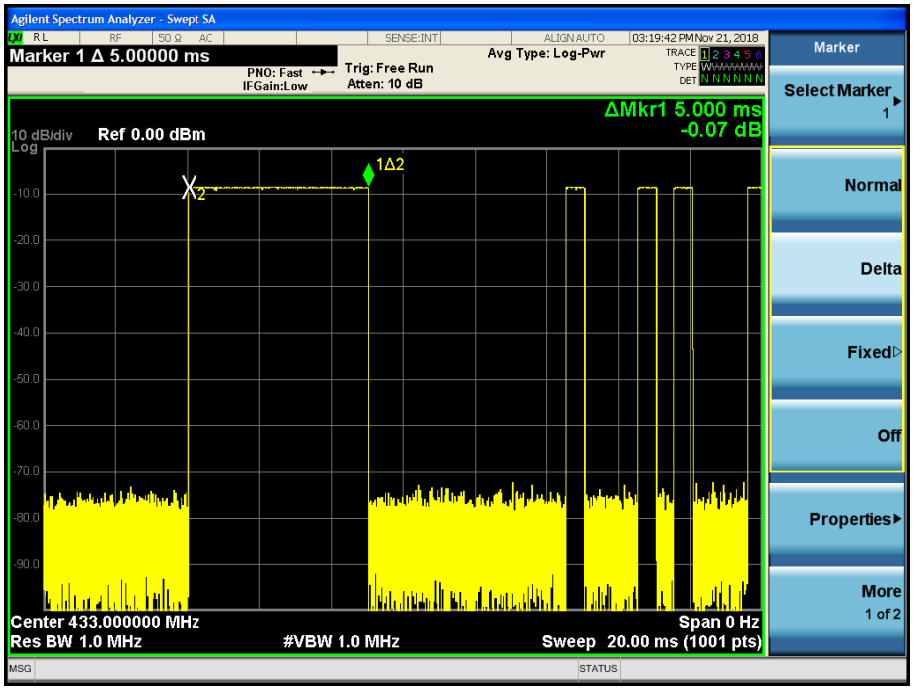
In a 100ms observation period found 4.98ms burst 4 pcs, 0.46ms burst 17 pcs, the Duty Cycle can calculate as below:

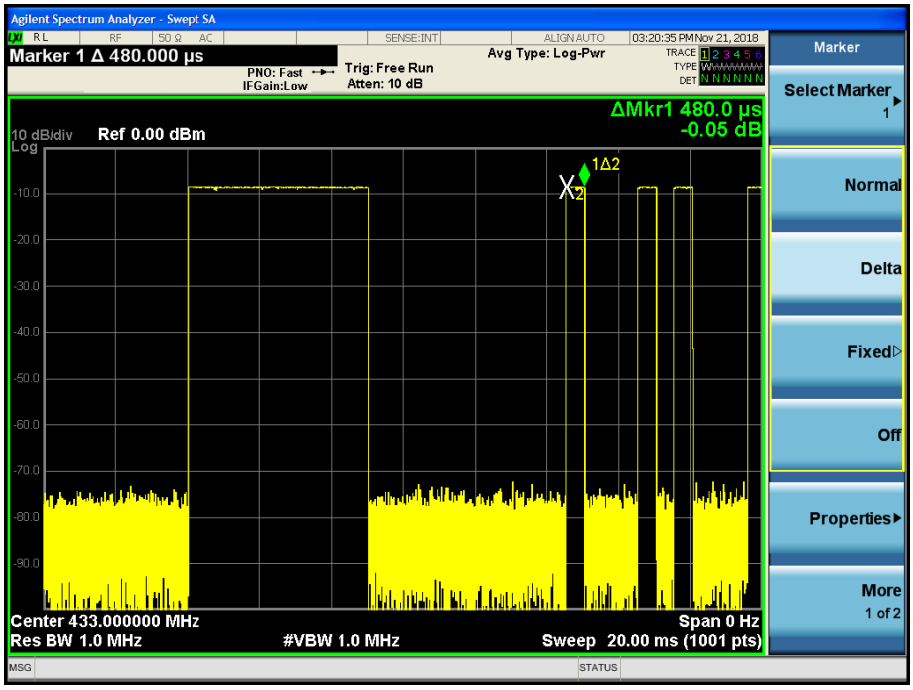
Type of Pulse	Width of Pulse ms	Quantity of Pulse	Transmission Time ms	Total Time(T_{on}) ms
Pulse 1 (Wide)	5.00	4	20.00	28.16
Pulse 2 (Narrow)	0.48	17	8.16	

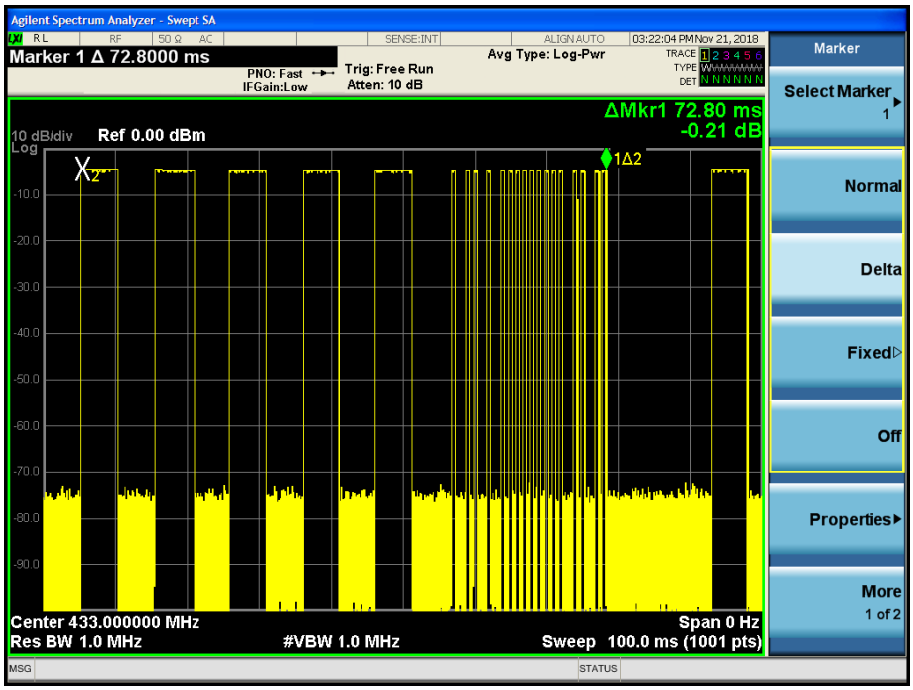
Test Period (T_p) ms	Total Time (T_{on}) ms	Duty Cycle %	Duty Cycle Factor dB
87.6	28.16	32.15	-9.86

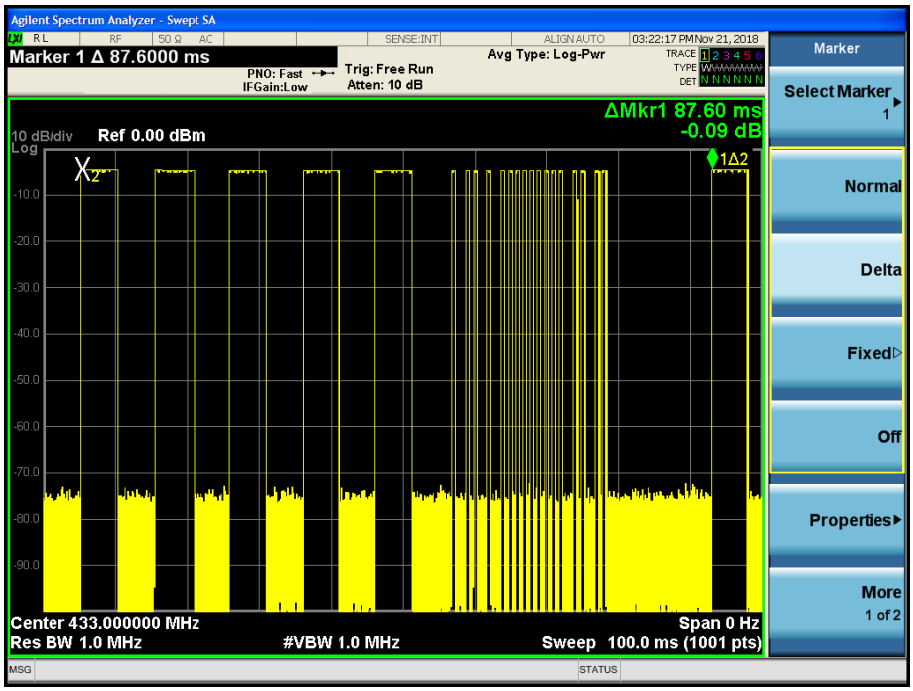
Remark: Duty Cycle Factor=20*log (Duty Cycle)

Please refer to the attached test plots


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 5.00000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
03:19:42 PM Nov 21, 2018
ΔMkr1 5.000 ms
-0.07 dB
10 dB/div Ref 0.00 dBm
Log
1Δ2
Center 433.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 ms (1001 pts)
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 480.000 µs
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
03:20:35 PM Nov 21, 2018
ΔMkr1 480.0 µs
-0.05 dB
10 dB/div Ref 0.00 dBm
Log
1Δ2
Center 433.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 20.00 ms (1001 pts)
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2

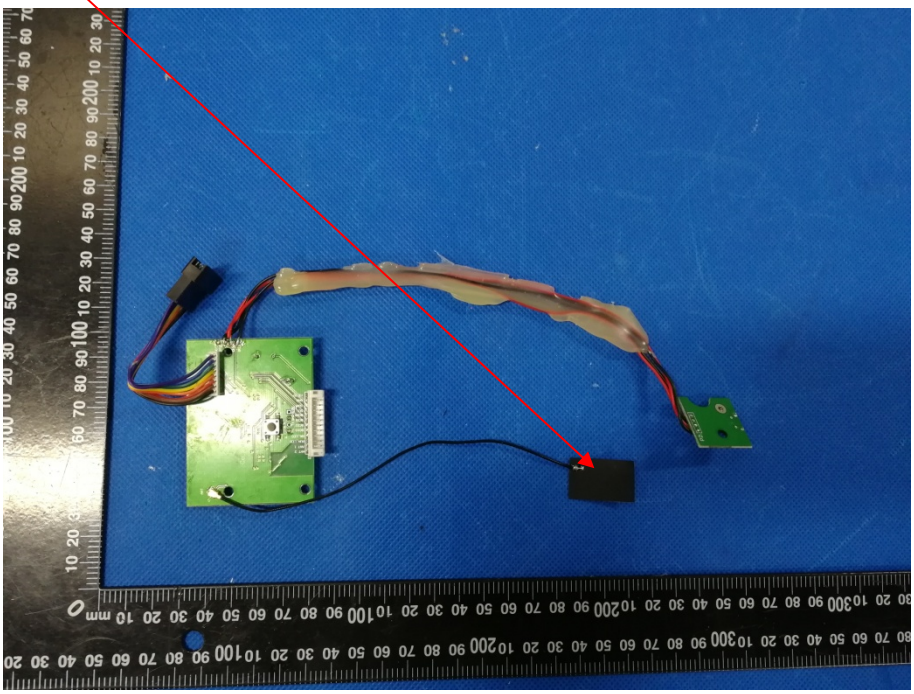
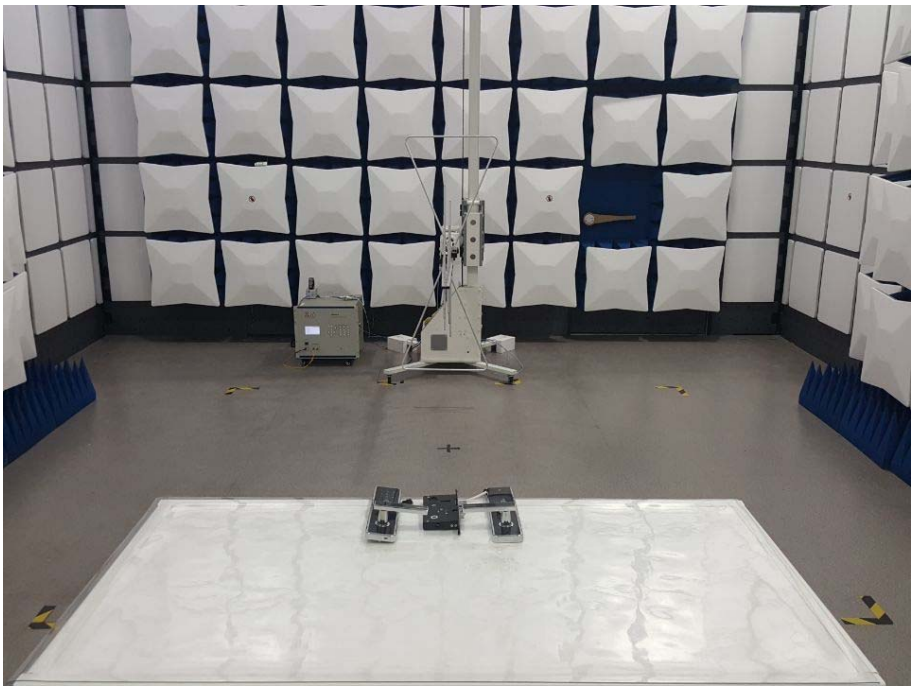

Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 72.8000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
03:22:04 PM Nov 21, 2018
ΔMkr1 72.80 ms
-0.21 dB
10 dB/div Ref 0.00 dBm
Log
1Δ2
Center 433.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 100.0 ms (1001 pts)
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2


Agilent Spectrum Analyzer - Swept SA
Marker 1 Δ 87.6000 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 10 dB
Avg Type: Log-Pwr
03:22:17 PM Nov 21, 2018
ΔMkr1 87.60 ms
-0.09 dB
10 dB/div Ref 0.00 dBm
Log
1Δ2
Center 433.000000 MHz
Res BW 1.0 MHz
#VBW 1.0 MHz
Span 0 Hz
Sweep 100.0 ms (1001 pts)
Marker
Select Marker 1
Normal
Delta
Fixed
Off
Properties
More 1 of 2

8. Antenna Connected Construction

The RF antenna is a Internal Antenna which permanently attached, and the best case gain of the Antenna is 1 dBi. It complies with the standard requirement.

ANTENNA :



9. PHOTOGRAPH OF TEST