

FCC 47 CFR PART 15 SUBPART C

CERTIFICATION TEST REPORT

OF

ShineRFStick

MODEL No.: ShineRFStick

Trademark: N/A

FCC ID: 2AAJ9-SHINERFSTICK

REPORT NO: ES160809022E

ISSUE DATE: December 22, 2016

Prepared for

SHENZHEN GROWATT NEW ENERGY TECHNOLOGY CO., LTD.

1st East & 3rd Floor, Jiayu Industrial Zone, Xibianling, Shangwu Village,
Shiyan, Baoan District, Shenzhen, China

Prepared by

EMTEK (SHENZHEN) CO., LTD

Bldg 69, Majialong Industry Zone, Nanshan District,
Shenzhen, Guangdong, China

TEL: 86-755-26954280

FAX: 86-755-26954282

TEST RESULT CERTIFICATION

Applicant:	SHENZHEN GROWATT NEW ENERGY TECHNOLOGY CO., LTD. 1st East & 3rd Floor, Jiayu Industrial Zone, Xibianling, Shangwu Village, Shiyan, Baoan District, Shenzhen, China
Manufacturer:	SHENZHEN GROWATT NEW ENERGY TECHNOLOGY CO., LTD. 1st East & 3rd Floor, Jiayu Industrial Zone, Xibianling, Shangwu Village, Shiyan, Baoan District, Shenzhen, China
Product Description:	ShineRFStick
Model Number:	ShineRFStick
Serial Number:	N/A
File Number:	ES160809022E
Date of Test:	July 20, 2016 to December 20, 2016

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 2, Subpart J FCC 47 CFR Part 15, Subpart C	PASS

We hereby certify that:

The above equipment was tested by SHENZHEN EMTEK CO., LTD. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 2 and Part 15.231 REQUIREMENTS.

The test results of this report relate only to the tested sample identified in this report.

Date of Test : July 20, 2016 to December 20, 2016

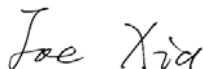
Prepared by : 
Sevin Li/EditorReviewer : 
Joe Xia/SupervisorApprove & Authorized Signer : 
Lisa Wang/Manager

Table of Contents

1	EUT TECHNICAL DESCRIPTION	4
2	SUMMARY OF TEST RESULT	5
3	TEST METHODOLOGY	6
3.1	GENERAL DESCRIPTION OF APPLIED STANDARDS	6
3.2	MEASUREMENT EQUIPMENT USED	6
3.3	DESCRIPTION OF TEST MODES	7
4	FACILITIES AND ACCREDITATIONS	8
4.1	FACILITIES	8
4.2	LABORATORY ACCREDITATIONS AND LISTINGS	8
5	TEST SYSTEM UNCERTAINTY	9
6	SETUP OF EQUIPMENT UNDER TEST	10
6.1	RADIO FREQUENCY TEST SETUP 1	10
6.2	RADIO FREQUENCY TEST SETUP 2	10
6.3	CONDUCTED EMISSION TEST SETUP	12
6.4	BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM	13
6.5	SUPPORT EQUIPMENT	13
7	TEST REQUIREMENTS	14
7.1	20DB BANDWIDTH	14
7.2	FREQUENCY STABILITY	17
7.3	RADIATED SPURIOUS EMISSION	19
7.4	TRANSMISSION TIME REQUIREMENT	35
7.5	CONDUCTED EMISSIONS TEST	37
7.6	ANTENNA APPLICATION	40

1 EUT TECHNICAL DESCRIPTION

Characteristics	Description
Modulation:	GFSK
Operating Frequency Range(s):	433.23MHz – 434.59MHz
Number of Channels:	18 channel
Antenna Type :	Spring antenna
Antenna Gain:	2.15 dBi
Power supply:	☒ DC 5-15V
	☐ Adapter supply:

Note: for more details, please refer to the User's manual of the EUT.

2 SUMMARY OF TEST RESULT

FCC Part Clause	Test Parameter	Verdict	Remark
15.231(c)	20dB Bandwidth	PASS	
15.231(d)	Frequency stability	N/A	
15.231(e)	Radiated Spurious Emissions	PASS	
15.231(a)	Transmission Time Requirement	PASS	
15.203	Antenna Requirement	PASS	
15.207(a)	Conducted Emission	PASS	
NOTE1: N/A (Not Applicable)			

RELATED SUBMITTAL(S) / GRANT(S):

This submittal(s) (test report) is intended for FCC ID: 2AAJ9-SHINERFSTICK filing to comply with Section 15.231 of the FCC Part 15, Subpart C Rules

3 TEST METHODOLOGY

3.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

FCC 47 CFR Part 2, Subpart J

FCC 47 CFR Part 15, Subpart C

3.2 MEASUREMENT EQUIPMENT USED

1.1.1. Radiated Emission Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.
EMI Test Receiver	Rohde & Schwarz	ESU	1302.6005.26	May 29, 2016
Pre-Amplifier	HP	8447D	2944A07999	May 28, 2016
Bilog Antenna	Schwarzbeck	VULB9163	142	May 28, 2016
Loop Antenna	ARA	PLA-1030/B	1029	May 28, 2016
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170399	May 28, 2016
Horn Antenna	Schwarzbeck	BBHA 9120	D143	May 28, 2016
Cable	Schwarzbeck	AK9513	ACRX1	May 29, 2016
433MHz Band Reject Filter(Cavity)	Wi	WRCFV8-417-429-437-449-70SS	SN 1	May 28, 2016
Cable	Rosenberger	N/A	FP2RX2	May 29, 2016
Cable	Schwarzbeck	AK9513	CRPX1	May 29, 2016
Cable	Schwarzbeck	AK9513	CRRX2	May 29, 2016

1.1.2. Radio Frequency Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.
EMI Test Receiver	Rohde & Schwarz	FSV30	103040	May 28, 2016

1.1.3. Radio Frequency Test Equipment

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.
Spectrum Analyzer	Agilent	E4407B	88156318	May 28, 2016
Signal Analyzer	Agilent	N9010A	My53470879	May 28, 2016
Power meter	Anritsu	ML2495A	0824006	May 28, 2016
Power sensor	Anritsu	MA2411B	0738172	May 28, 2016

Remark: Each piece of equipment is scheduled for calibration once a year.

3.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics

The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting mode is programmed.

The new batteries were used in the test

Frequency and Channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	433.23	7	433.71	13	434.19
2	433.31	8	433.79	14	434.27
3	433.39	9	433.87	15	434.35
4	433.47	10	433.95	16	434.43
5	433.55	11	433.03	17	434.51
6	433.63	12	434.11	18	434.59

Test Frequency and Channel list:

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	433.23	10	433.95	18	434.59

4 FACILITIES AND ACCREDITATIONS

4.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Bldg 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.10 and CISPR Publication 22.

4.2 LABORATORY ACCREDITATIONS AND LISTINGS

Site Description

EMC Lab.

: Accredited by CNAS, 2016.10.24

The certificate is valid until 2022.10.28

The Laboratory has been assessed and proved to be in compliance with CNAS-CL01: 2006(identical to ISO/IEC17025: 2005)

The Certificate Registration Number is L229

Accredited by TUV Rheinland Shenzhen, 2016.05.19

The Laboratory has been assessed according to the requirements ISO/IEC 17025.

Accredited by FCC, July 12, 2016

The Certificate Registration Number is 406365.

Accredited by Industry Canada, November 24, 2015

The Certificate Registration Number is 4480A-2

5 TEST SYSTEM UNCERTAINTY

The following measurement uncertainty levels have been estimated for tests performed on the apparatus:

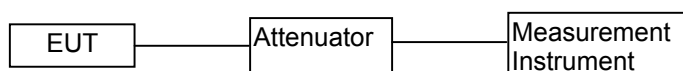
Parameter	Uncertainty
Radio Frequency	$\pm 1 \times 10^{-5}$
Conducted Emissions Test	$\pm 2.0\text{dB}$
Radiated Emission Test	$\pm 2.0\text{dB}$
20dB Bandwidth Test	$\pm 1.0\text{dB}$
All emission, radiated	$\pm 3\text{dB}$
Temperature	$\pm 0.5^{\circ}\text{C}$
Humidity	$\pm 3\%$

Measurement Uncertainty for a level of Confidence of 95%

6 SETUP OF EQUIPMENT UNDER TEST

6.1 RADIO FREQUENCY TEST SETUP 1

The component's antenna ports(s) of the EUT are connected to the measurement instrument per an appropriate attenuator. The EUT is controlled by PC/software to emit the specified signals for the purpose of measurements.



6.2 RADIO FREQUENCY TEST SETUP 2

The test site semi-anechoic chamber has met the requirement of NSA tolerance 4 dB according to the standards: ANSI C63.10. The test distance is 3m. The setup is according to the requirements in Section 13.1.4.1 of ANSI C63.10-2013 and CAN/CSA-CEI/IEC CISPR 22.

The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Below 30MHz:

The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna (loop antenna). The Antenna should be positioned with its plane vertical at the specified distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. The center of the loop shall be 1 m above the ground. For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT.

Above 30MHz:

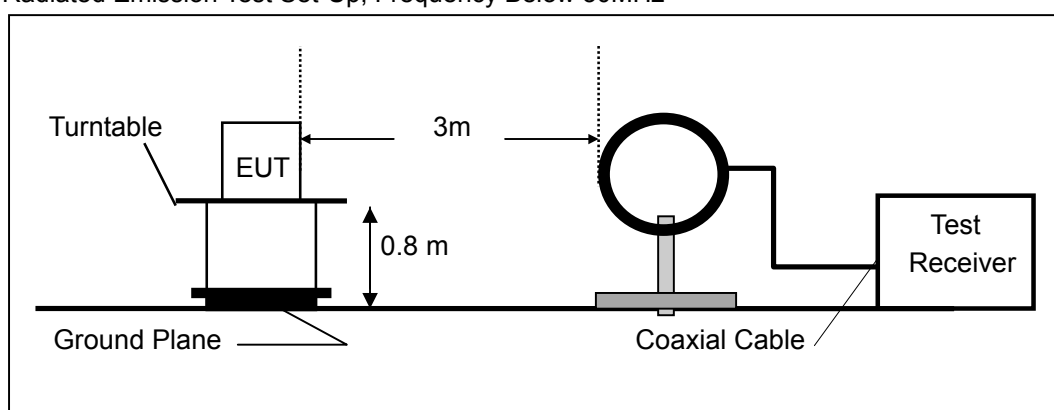
The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

Above 1GHz:

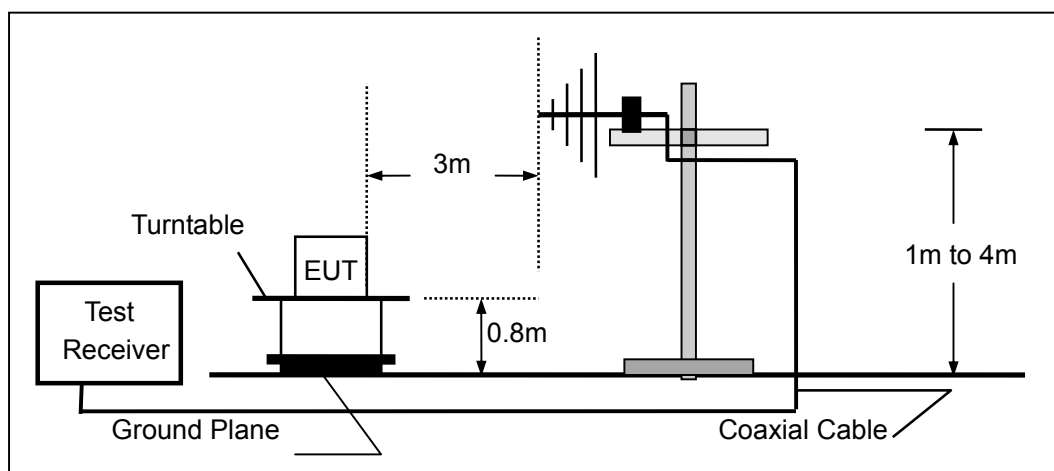
(Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.)

The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).

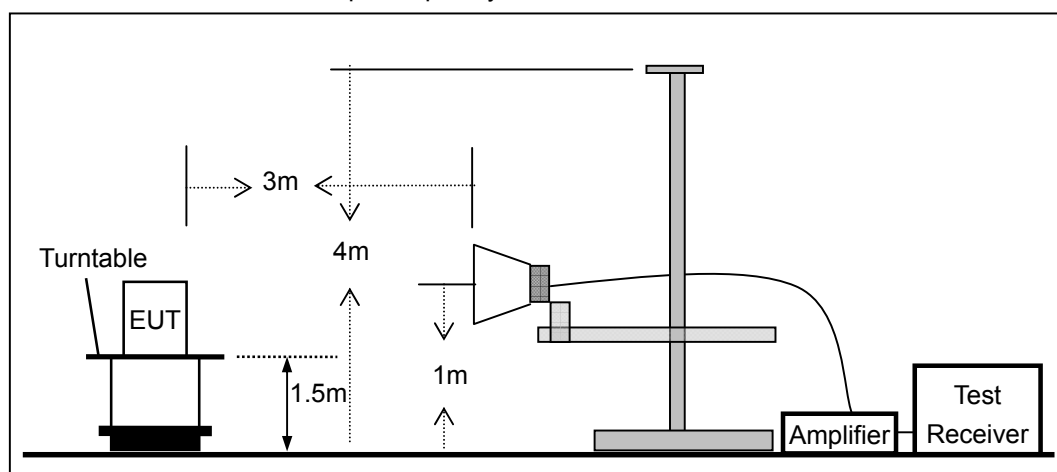
(a) Radiated Emission Test Set-Up, Frequency Below 30MHz



(b) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(c) Radiated Emission Test Set-Up, Frequency above 1000MHz

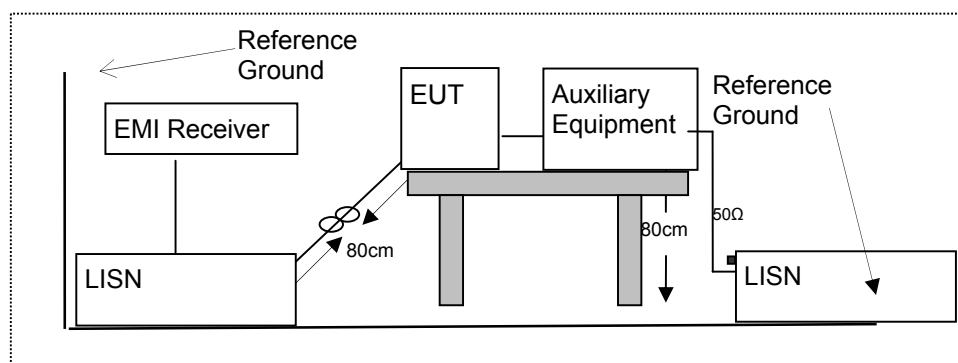


6.3 CONDUCTED EMISSION TEST SETUP

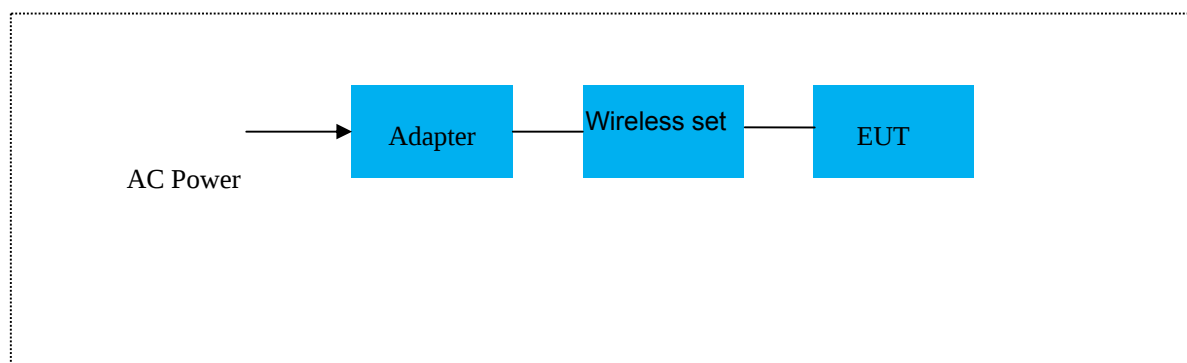
The mains cable of the EUT (ShineRFStick) must be connected to LISN. The LISN shall be placed 0.8 m from the boundary of EUT and bonded to a ground reference plane for LISN mounted on top of the ground reference plane. This distance is between the closest points of the LISN and the EUT. All other units of the EUT and associated equipment shall be at least 0.8m from the LISN.

Ground connections, where required for safety purposes, shall be connected to the reference ground point of the LISN and, where not otherwise provided or specified by the manufacturer, shall be of same length as the mains cable and run parallel to the mains connection at a separation distance of not more than 0.8 m.

According to the requirements in ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-Peak and average detector mode.



6.4 BLOCK DIAGRAM CONFIGURATION OF TEST SYSTEM



6.5 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1.	Wireless set	GROWATT	/	A13081145	Power transfer
2.	Adapter	HUONIU	HNBL050100WX	/	Input: AC 100-240V, 50/60Hz,0.2A Max Output: DC 5V, 1A

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

7 TEST REQUIREMENTS

7.1 20DB BANDWIDTH

7.1.1 Applicable Standard

According to FCC Part 2.1049 and part 15.231(c)

7.1.2 Conformance Limit

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. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

7.1.3 Test Configuration

Test according to clause 6.1 radio frequency test setup 1

7.1.4 Test Procedure

The EUT was operating in transmit mode and controlled its channel. Printed out the test result from the spectrum by hard copy function.

The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

Set to the maximum power setting and enable the EUT transmit continuously

Set RBW =10 kHz.

Set the video bandwidth (VBW) ≥ 3 RBW.

Set Span= approximately 2 to 3 times the occupied bandwidth

Set Detector = Peak.

Set Trace mode = max hold.

Set Sweep = auto couple.

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the markerdelta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation.

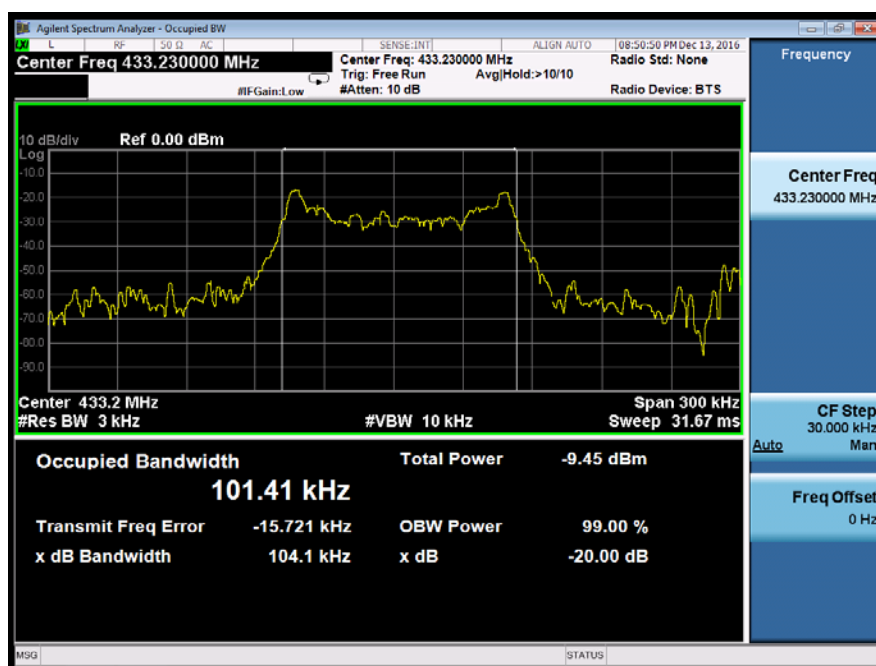
Measure and record the results in the test report.

Test Results

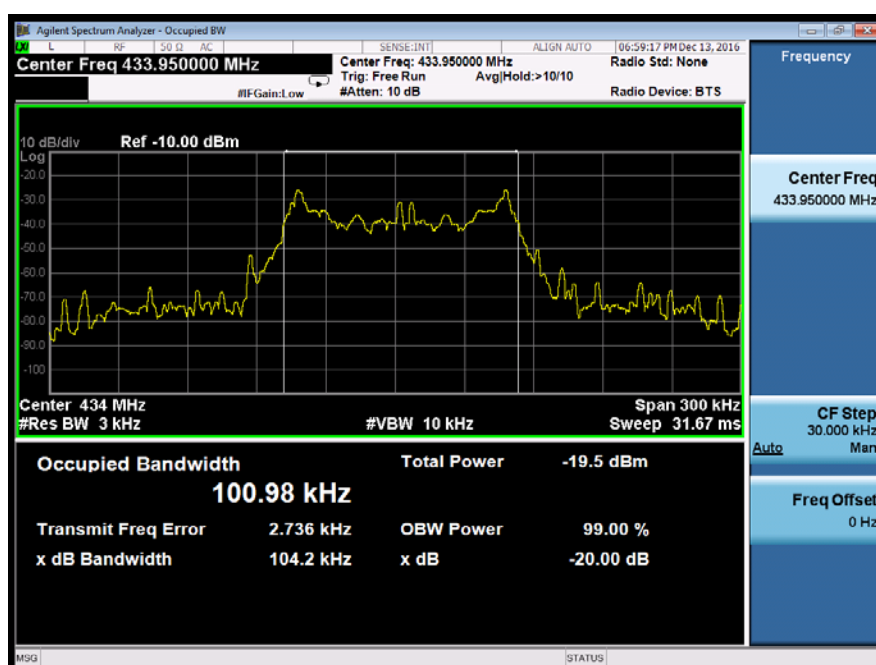
Temperature:	24°C	Test Date:	December 13, 2016
Humidity:	53 %	Test By:	King Kong

Modulation Mode	Channel Number	Channel Frequency (MHz)	Measurement Bandwidth (kHz)	Limit (kHz)	Verdict
GFSK	1	433.23	104.1	1083	PASS
	10	433.95	104.2	1085	PASS
	18	434.59	104.1	1086	PASS
Note: Limit=0.25% of the center frequency=f* 0.25%					

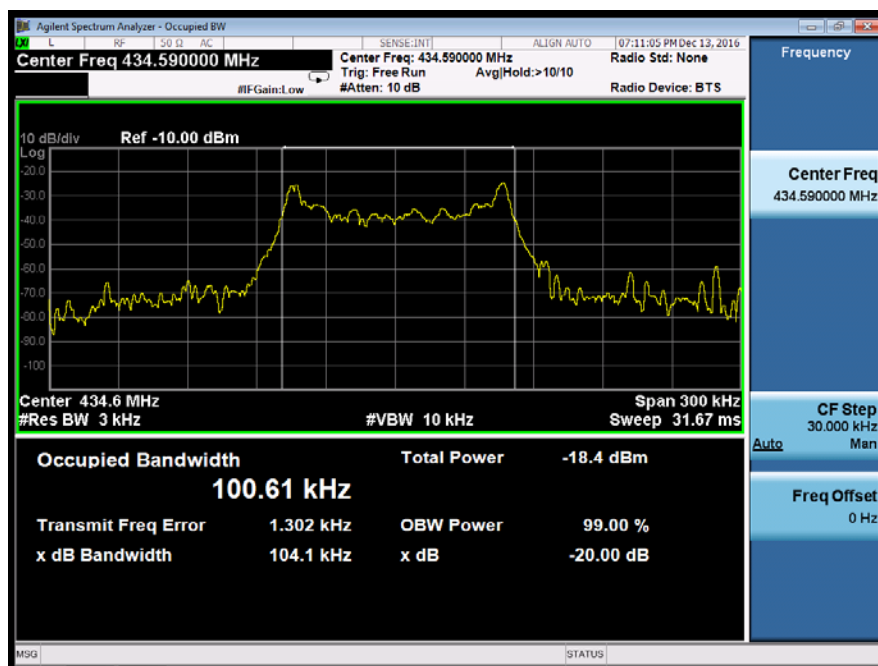
Test Model	Occupied Bandwidth	
	Channel 1	GFSK Modulation



Test Model	Occupied Bandwidth	
	Channel 10	GFSK Modulation



Test Model	Occupied Bandwidth Channel 18	GFSK Modulation
------------	----------------------------------	-----------------



7.2 FREQUENCY STABILITY

7.2.1 Applicable Standard

According to FCC Part 2.1055 and part 15.231(d)

7.2.2 Conformance Limit

According to part 15.231(d), For devices operating within the frequency band 40.66-40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be $\pm 0.01\%$. This frequency tolerance shall be maintained for a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery

7.2.3 Test Configuration

Test according to clause 6.1 radio frequency test setup

7.2.4 Test Procedures

Connect the EUT to frequency analyzer via the antenna connector.

EUT was placed at temperature chamber and connected to an external power supply.

Temperature and voltage condition shall be tested to confirm frequency stability.

(a) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(b) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point, which shall be specified by the manufacturer.

7.2.5 Test Results

Operation Mode	Channel Number	Test Condition		Channel Frequency (MHz)	Freq.Dev. (Hz)	Deviation (ppm)	Limit (ppm)
		Voltage (V)	Temp (°C)				
ASK	CH0	Vnom	-20	-	-	-	10
			-10	-	-	-	10
			0	-	-	-	10
			10	-	-	-	10
			20	-	-	-	10
			30	-	-	-	10
			40	-	-	-	10
			50	-	-	-	10
		85% Vnom	20	-	-	-	10
		115% Vnom	20	-	-	-	10
VERDICT				N/A			
Note: Not applicable, the device operating without the frequency band 40.66-40.70MHz.							

7.3 RADIATED SPURIOUS EMISSION

7.3.1 Applicable Standard

According to FCC Part 15.231(e) and 15.209

7.3.2 Conformance Limit

In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Frequencies (MHz)	Field strength of fundamental @3m
	(uV/m)
40.66-40.70	1000
70-130	500
130-174	500 to 1500*
174-260	1500
260-470	1500 to 5000*
Above 470	5000

* Linear interpolation

Frequencies (MHz)	Field strength of Spurious emissions @3m
	(uV/m)
40.66-40.70	100
70-130	50
130-174	50 to 150*
174-260	150
260-470	150 to 500*
Above 470	500

* Linear interpolation

The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions

The FCC specified emission limits were calculated according to the EUT operating frequency and obtained by following linear interpolation equations:

(a) For fundamental frequency:

$$f_{EUT} : \text{EUT Operating Frequency Emission Limit (uV/m)}$$

$$= [f_{EUT}(\text{MHz}) - 260(\text{MHz})] \times \frac{5000(\text{uV/m}) - 1500(\text{uV/m})}{470(\text{MHz}) - 260(\text{MHz})} + 1500(\text{uV/m})$$

(b) For spurious frequencies:

$$f_{EUT} : \text{EUT Operating Frequency Emission Limit (V/m)}$$

$$= [f_{EUT}(\text{MHz}) - 260(\text{MHz})] \times \frac{500(\text{uV/m}) - 150(\text{uV/m})}{470(\text{MHz}) - 260(\text{MHz})} + 150(\text{uV/m})$$

Other emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or comply with the radiated emissions limits specified in section 15.209(a) limit in the table below has to be followed.

Note:

- (1) The tighter limit applies at the band edges.
- (2) Emission level (dBuV/m)=20log Emission level (uV/m).

FCC Part15 (15.231) , Subpart C		
Fundamental Frequency	Field Strength Of Fundamental	Field Strength of Spurious Emissions
433.23MHz	AV:72.84 dBuV/m at 3m distance	AV:52.84 dBuV/m at 3m distance
	PK:92.84 dBuV/m at 3m distance	PK:72.84 dBuV/m at 3m distance
433.95MHz	AV:72.87 dBuV/m at 3m distance	AV:52.87 dBuV/m at 3m distance
	PK:92.87 dBuV/m at 3m distance	PK:72.87 dBuV/m at 3m distance
434.59MHz	AV:72.89 dBuV/m at 3m distance	AV:52.89 dBuV/m at 3m distance
	PK:92.89 dBuV/m at 3m distance	PK:72.89 dBuV/m at 3m distance

According to FCC Part15.205, Restricted bands

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
10.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

According to FCC Part15.205, the level of any transmitter spurious emission in Restricted bands shall not exceed the level of the emission specified in the following table

Restricted Frequency(MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)	Measurement Distance
0.009~0.490	2400/F(KHz)	300	See the remark
0.490~1.705	24000/F(KHz)	30	
1.705~30.0	30	30	
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Remark :1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

3. Distance extrapolation factor =40log(Specific distance/ test distance)(dB);

Limit line=Specific limits(dBuV) + distance extrapolation factor.

for the frequency ranges below 30 MHz, a narrower RBW is used for these ranges but the measured value should add a RBW correction factor (RBWCF) where RBWCF [dB] =10*Ig(100 [kHz]/narrower RBW [kHz]). , the narrower RBW is 1 kHz and RBWCF is 20 dB for the frequency 9 kHz to 150 kHz, and the narrower RBW is 10 kHz and RBWCF is 10 dB for the frequency 150 kHz to 30 MHz.

7.3.3 Test Configuration

Test according to clause 6.2 radio frequency test setup 2

7.3.4 Test Procedure

This test is required for any spurious emission that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

The EUT was placed on a turn table which is 0.8m above ground plane.

Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Span = wide enough to fully capture the emission being measured

RBW = 100 kHz for $f < 1$ GHz (30MHz to 1GHz), 200Hz for $f < 150$ KHz (9KHz to 150KHz), 9KHz for $f < 30$ MHz (150KHz to 30MHz), 1MHz for $f < 5$ GHz

VBW $\geq$ RBW Sweep = auto

Detector function = peak

Trace = max hold

Follow the guidelines in ANSI C63.10-2013 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. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data.

Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

- Calculation of Average factor

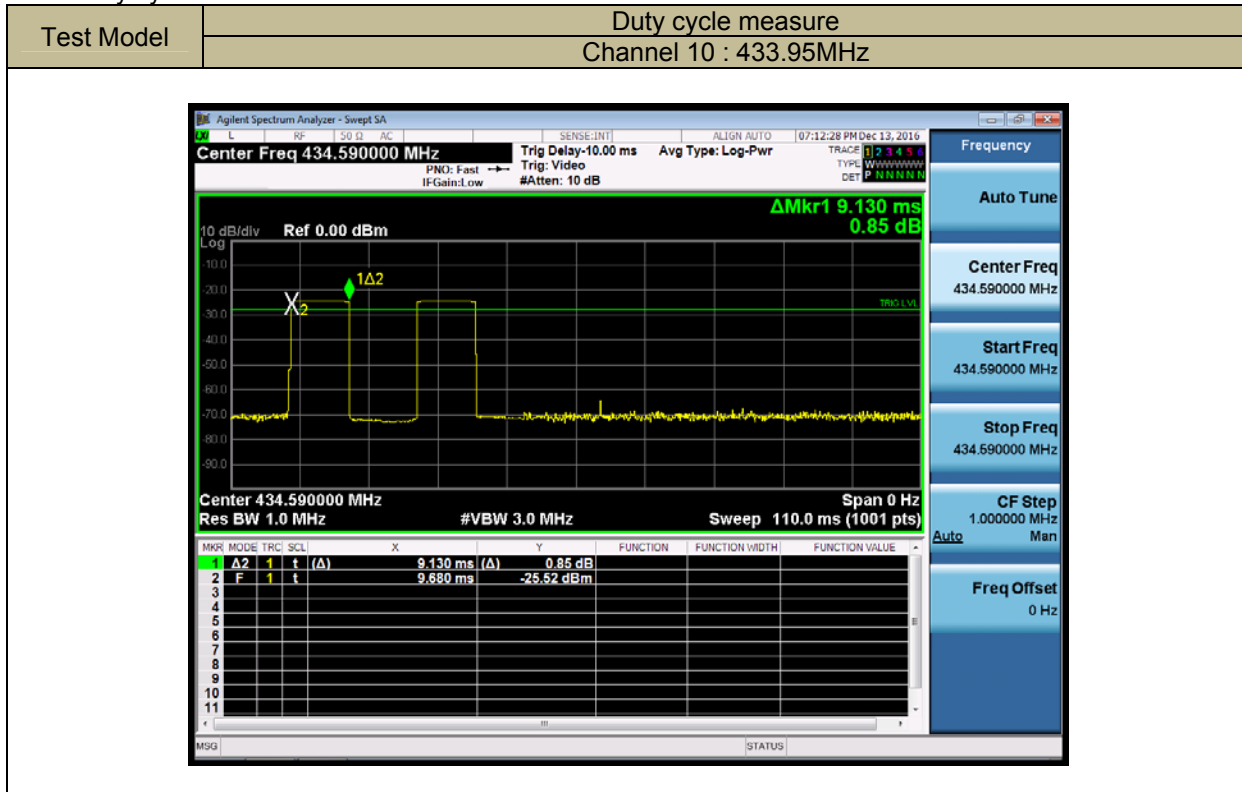
The output field strengths of specification in accordance with the FCC rules specify measurements with an average detector. During the test, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The duty cycle is measured in 100ms or the repetition cycle period, whichever is a shorter time frame, the duty cycle is measured by placing the spectrum analyzer to set zero span at 100kHz resolution bandwidth.

Averaging factor in dB = $20\log(\text{duty cycle})$

7.3.5 Test Results

■ Duty cycle measure



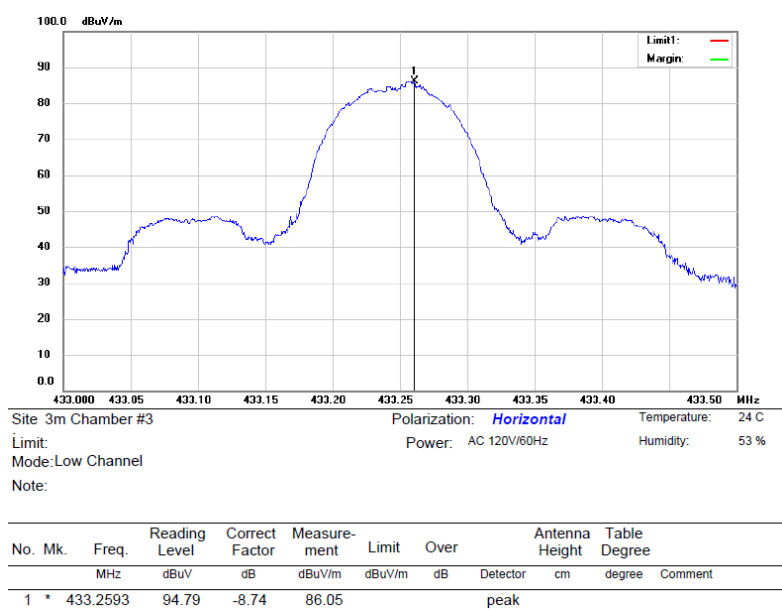
■ Field Strength of the fundamental signal

Temperature:	24℃	Test Date:	December 10, 2016
Humidity:	53 %	Test By:	KK
Test mode:	TX Mode		

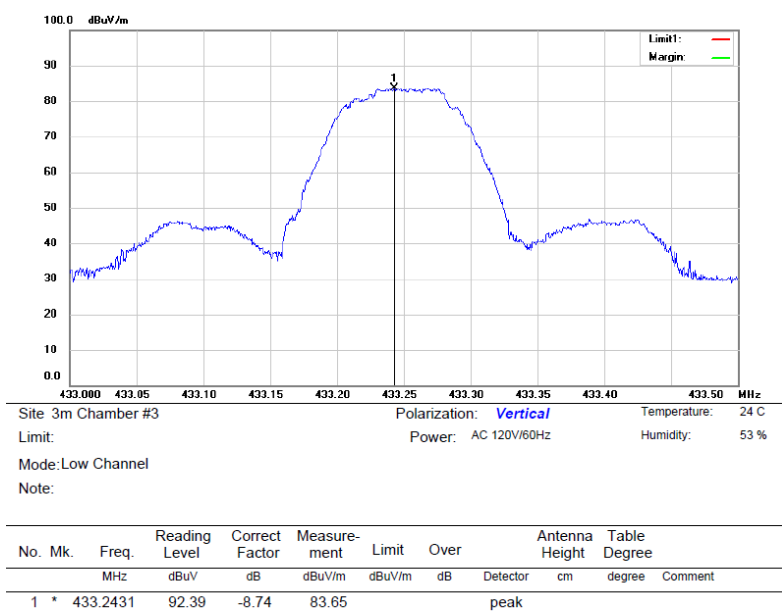
Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
433.23	V	83.65	68.88	92.84	72.84	-9.19	-3.96
433.23	H	86.05	71.28	92.84	72.84	-6.79	-1.56
433.95	V	77.45	62.68	92.87	72.87	-15.42	-10.19
433.95	H	82.51	67.74	92.87	72.87	-10.36	-5.13
434.59	V	76.32	61.55	92.89	72.89	-16.57	-11.34
434.59	H	84.11	69.34	92.89	72.89	-8.78	-3.55

Note: (1) Correct Factor= Antenna Factor +Cable Loss- Amplifier Gain
 (2) Emission Level= Reading Level+Probe Factor +Cable Loss
 (3) True Value = Emission Level + Duty Cycle Correction Factor
 (4) DF= Duty Cycle Correction Factor
 (5) Duty Cycle Correction Factor (dB) = $20 \cdot \log(\text{Duty cycle}) = 20 \cdot \log[(9.13 \cdot 2)/100] = -14.77\text{dB}$
 (6) average results= peak results + DF

For 433.23MHz
Fundamental signal-H

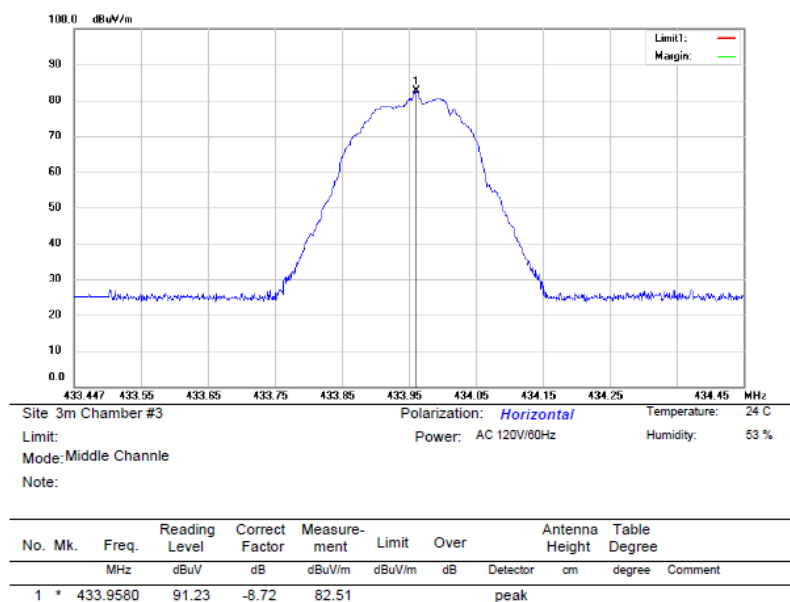


Fundamental signal-V

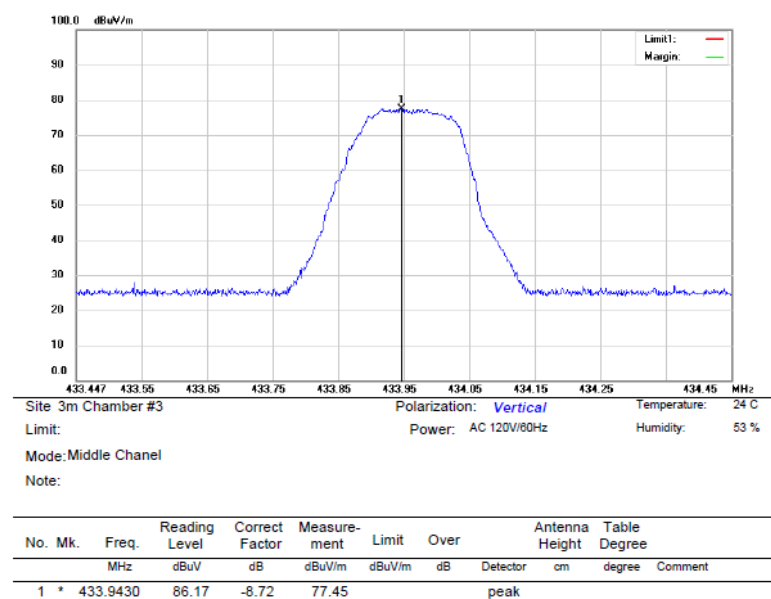


For 433.95MHz

Fundamental signal-H

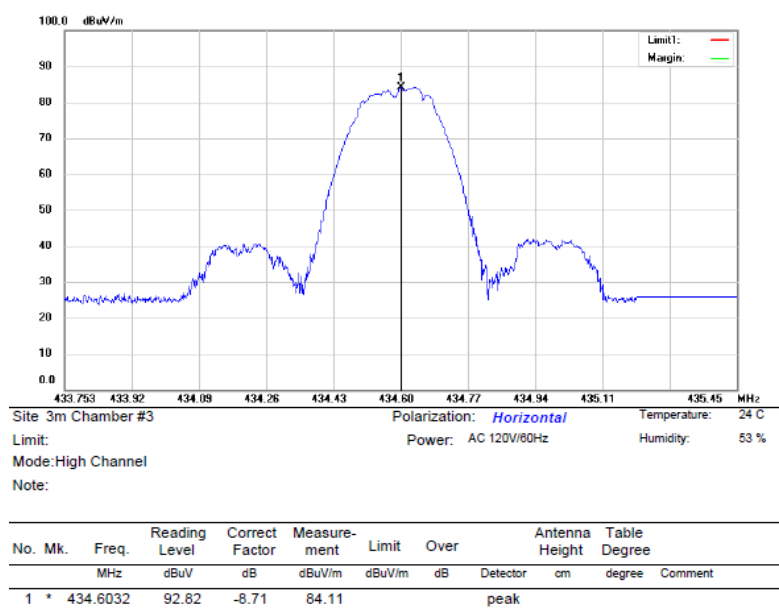


Fundamental signal-V

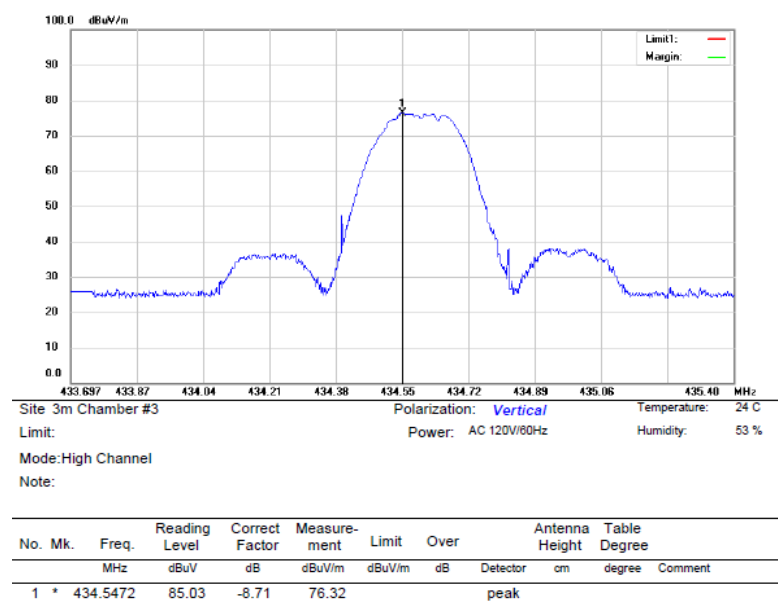


For 434.59MHz

Fundamental signal-H



Fundamental signal-V



■ Spurious Emission below 30MHz (9KHz to30MHz)

Temperature:	24℃	Test Date:	December 10, 2016
Humidity:	53 %	Test By:	KK
Test mode:	TX Mode		

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Over(dB)	
		PK	AV	PK	AV	PK	AV
--	--	--	--	--	--	--	--

Note: the amplitude of spurious emission that is attenuated by more than 20dB below the permissible limit has no need to be reported.

Distance extrapolation factor =40log(Specific distance/ test distance)(dB);

Limit line=Specific limits(dBuV) + distance extrapolation factor

■ Radiated spurious emission above 1GHz

Test By:	King Kong	Test Date :	December 10, 2016
Frequency Range:	1000~4000MHz	Temperature :	24℃
Test Result:	PASS	Humidity :	53 %
Measured Distance:	3m		

For 433.23MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Limit 3m(dBuV/m)	Margin (dB)
		PK	PK	AV	
1299.69	V	39.68	72.84	52.84	-13.16
1732.92	V	41.87	72.84	52.84	-10.97
1360.89*	V	46.12	72.84	52.84	-6.72
1299.69	H	40.98	72.84	52.84	-11.86
1732.92	H	41.44	72.84	52.84	-11.40
1362.25*	H	47.36	72.84	52.84	-5.48

For 433.95MHz

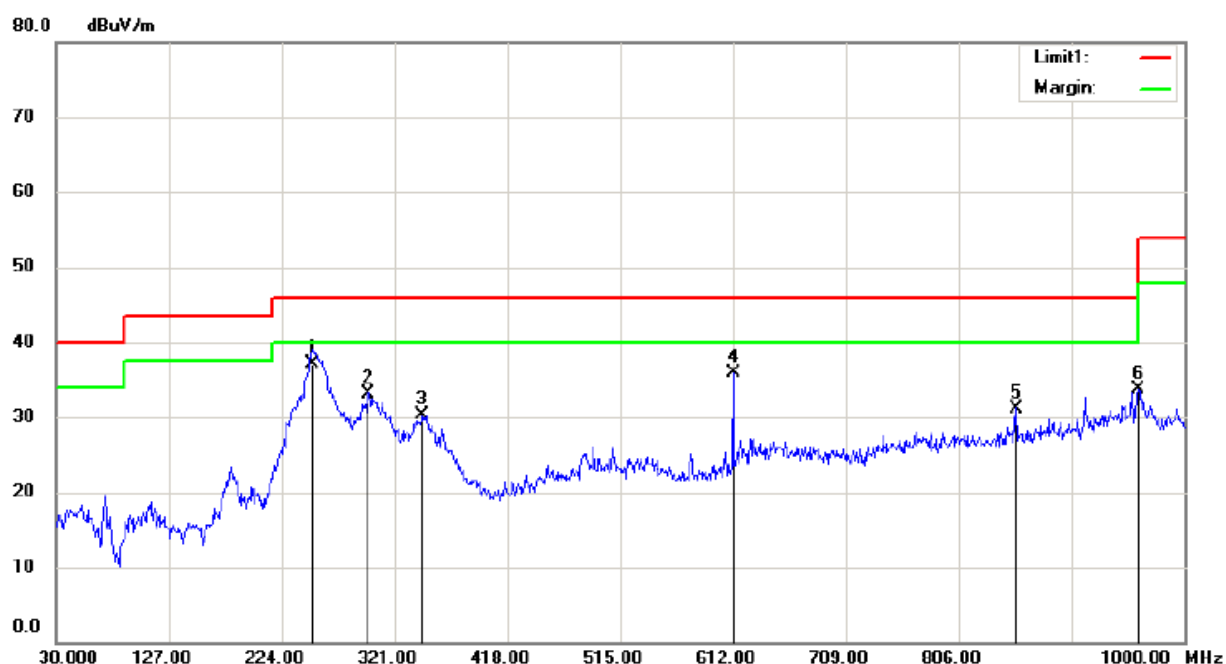
Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m)	Limit 3m(dBuV/m)	Limit 3m(dBuV/m)	Margin (dB)
		PK	PK	AV	
1301.85*	V	40.26	72.87	52.87	-12.61
1735.80	V	42.02	72.87	52.87	-10.85
1360.24*	V	45.88	72.87	52.87	-6.99
1301.85 *	H	39.38	72.87	52.87	-13.49
1735.80	H	42.38	72.87	52.87	-10.49
1360.74*	H	45.84	72.87	52.87	-7.03

For 434.59MHz

Freq. (MHz)	Ant.Pol. H/V	Emission Level(dBuV/m) PK	Limit 3m(dBuV/m) PK	Limit 3m(dBuV/m) AV	Margin (dB)
1303.77 *	V	40.58	72.89	52.89	-12.31
1738.36	V	42.21	72.89	52.89	-10.68
1361.02*	V	46.02	72.89	52.89	-6.87
1303.77 *	H	42.08	72.89	52.89	-10.81
1738.36	H	41.95	72.89	52.89	-10.94
1360.87*	H	44.87	72.89	52.89	-8.02

Note: (1) All Readings are Peak Value.
 (2) Correct Factor= Antenna Factor +Cable Loss- Amplifier Gain
 (3) Emission Level= Reading Level+Probe Factor +Cable Loss
 (4) True Value = Emission Level + Duty Cycle Correction Factor
 (5) DF= Duty Cycle Correction Factor
 (6) Duty Cycle Correction Factor (dB) = $20\log[(0.9275+0.2319*18+0.4348*5)/91.7]=-22.01\text{dB}$
 (7) Margin = TrueValue – limit(if margin is minus means under limit)
 (8) The “*” means restricted bands
 (8) All the x/y/z orientation has been investigated, and only worst case is presented in this report.

■ Radiated spurious emission below 1GHz



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

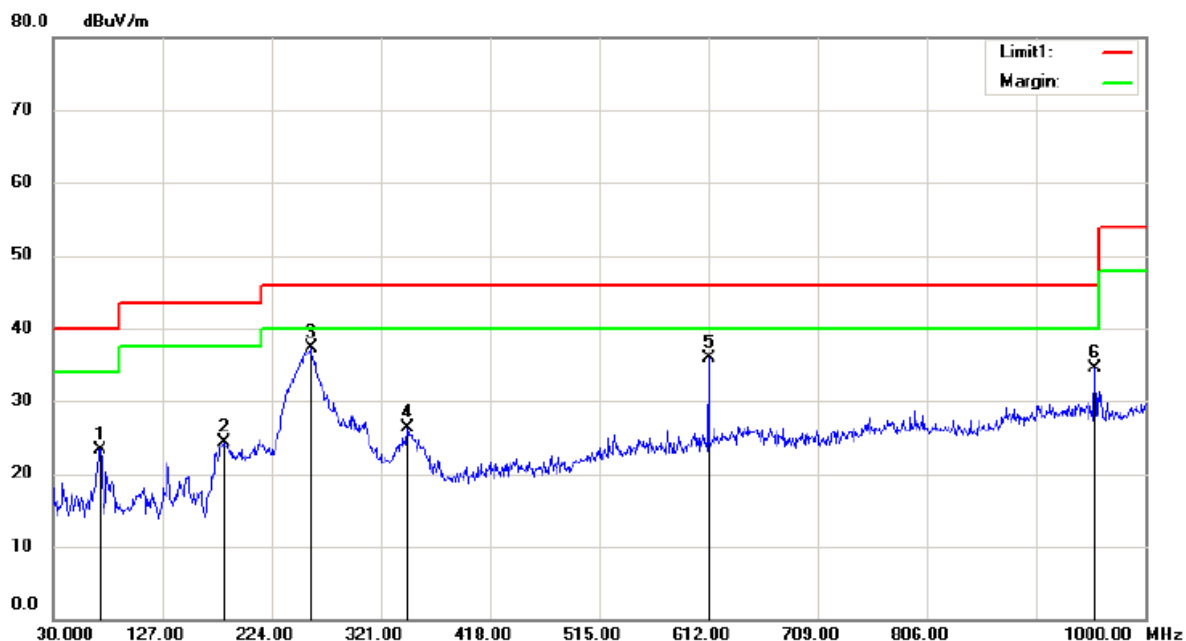
Mode: low channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1	*	250.1900	48.70	-11.60	37.10	46.00	-8.90	QP		
2		298.6900	43.23	-10.03	33.20	46.00	-12.80	QP		
3		345.2500	39.52	-9.22	30.30	46.00	-15.70	QP		
4		612.0000	40.53	-4.63	35.90	46.00	-10.10	QP		
5		855.4700	33.72	-2.52	31.20	46.00	-14.80	QP		
6		960.2300	34.31	-0.61	33.70	54.00	-20.30	QP		

*:Maximum data x:Over limit !:over margin

Operator: KK



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

Mode:low channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		71.7100	40.70	-17.34	23.36	40.00	-16.64			peak
2		181.3200	38.79	-14.44	24.35	43.50	-19.15			peak
3	*	258.9200	47.99	-10.76	37.23	46.00	-8.77			peak
4		345.2500	35.55	-9.22	26.33	46.00	-19.67			peak
5		612.0000	40.48	-4.63	35.85	46.00	-10.15			peak
6		955.3800	35.26	-0.68	34.58	46.00	-11.42			peak

*:Maximum data x:Over limit !:over margin

Operator: KK



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

Mode: Middle Channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Antenna Height cm	Table Degree degree	Comment
1		180.3500	41.87	-14.57	27.30	43.50	-16.20	QP			
2	*	254.0700	48.76	-11.26	37.50	46.00	-8.50	QP			
3		298.6900	43.23	-10.03	33.20	46.00	-12.80	QP			
4		345.2500	39.42	-9.22	30.20	46.00	-15.80	QP			
5		612.0000	40.43	-4.63	35.80	46.00	-10.20	QP			
6		888.4500	32.85	-1.15	31.70	46.00	-14.30	QP			

*:Maximum data x:Over limit !:over margin

Operator: KK



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

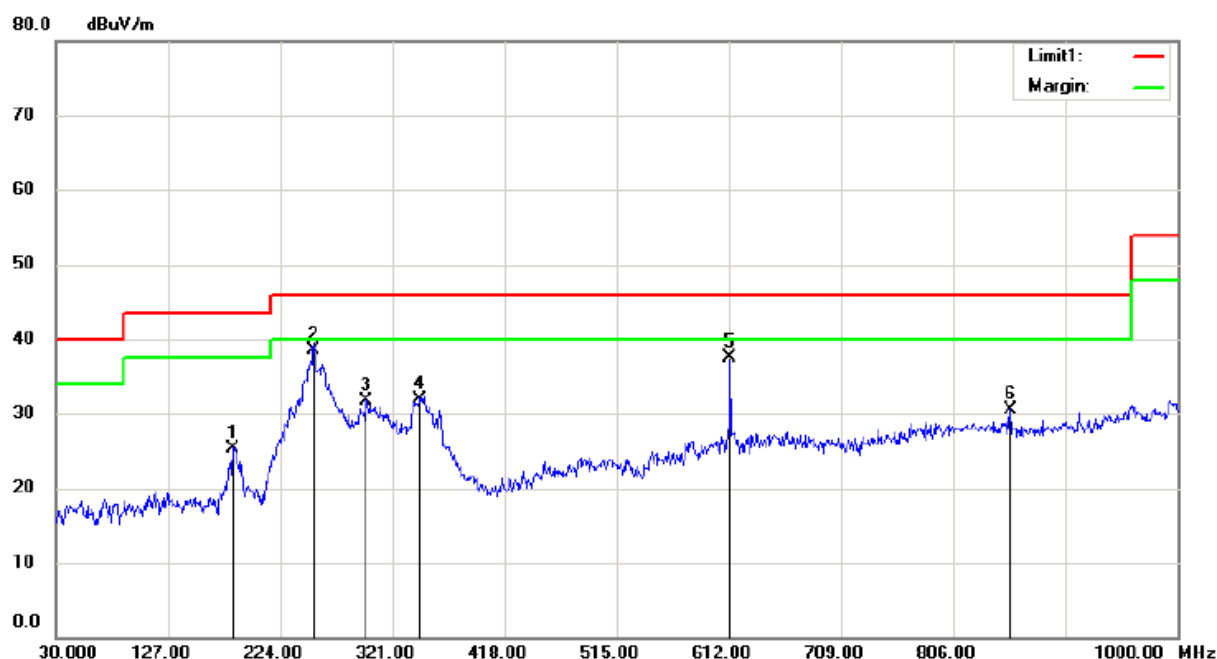
Mode:Middle Channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree degree	Comment
1		83.3500	39.38	-16.18	23.20	40.00	-16.80	QP		
2		149.3100	39.89	-16.59	23.30	43.50	-20.20	QP		
3	*	260.8600	48.78	-10.78	38.00	46.00	-8.00	QP		
4		296.7500	37.19	-9.89	27.30	46.00	-18.70	QP		
5		612.0000	39.63	-4.63	35.00	46.00	-11.00	QP		
6		955.3800	31.68	-0.68	31.00	46.00	-15.00	QP		

*:Maximum data x:Over limit !:over margin

Operator: KK



Site 3m Chamber #1

Polarization: **Horizontal**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

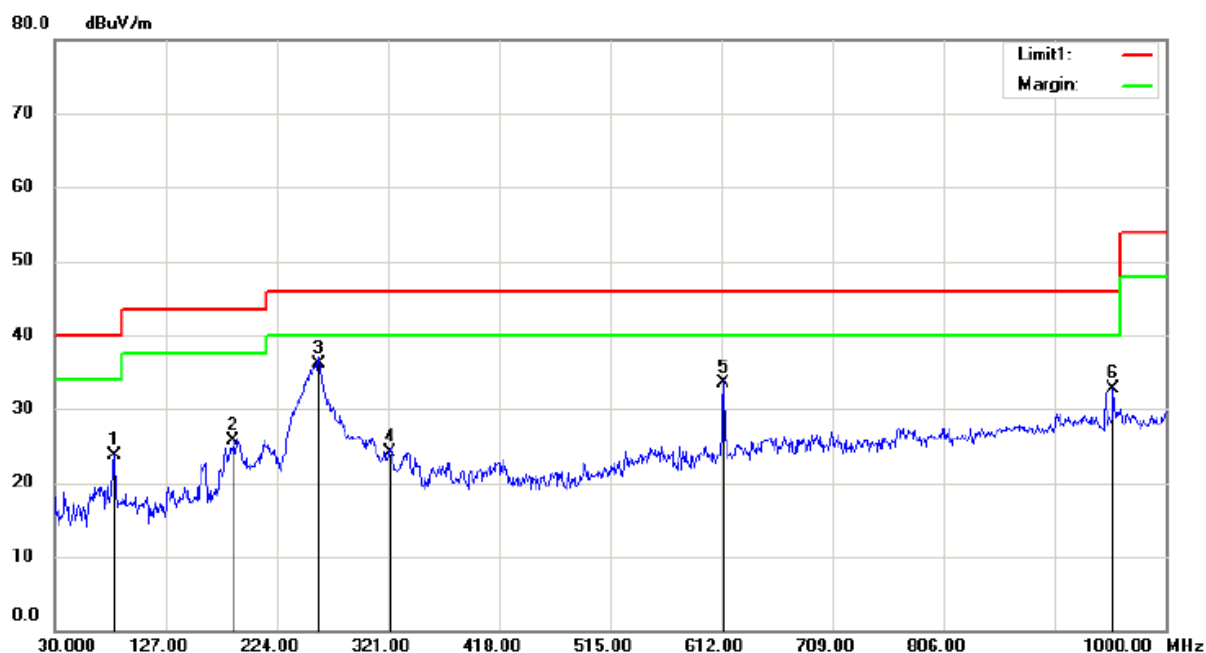
Mode:High channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	Comment
1		183.2600	39.59	-14.19	25.40	43.50	-18.10	QP		
2	*	253.1000	49.84	-11.34	38.50	46.00	-7.50	QP		
3		298.6900	41.73	-10.03	31.70	46.00	-14.30	QP		
4		345.2500	41.22	-9.22	32.00	46.00	-14.00	QP		
5		612.9700	42.14	-4.54	37.60	46.00	-8.40	QP		
6		855.4700	33.02	-2.52	30.50	46.00	-15.50	QP		

*:Maximum data x:Over limit !:over margin

Operator: KK



Site 3m Chamber #1

Polarization: **Vertical**

Temperature: 22 C

Limit: (RE)FCC PART 15 CLASS B

Power: AC 120V/60Hz

Humidity: 50 %

Mode: High channel

Note:

No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Antenna Height cm	Table Degree	
							Detector		degree	Comment
1		82.3800	40.34	-16.64	23.70	40.00	-16.30	QP		
2		186.1700	39.73	-13.93	25.80	43.50	-17.70	QP		
3	*	260.8600	46.98	-10.78	36.20	46.00	-9.80	QP		
4		322.9400	34.14	-9.94	24.20	46.00	-21.80	QP		
5		613.9400	38.06	-4.46	33.60	46.00	-12.40	QP		
6		954.4100	33.39	-0.69	32.70	46.00	-13.30	QP		

*:Maximum data x:Over limit !:over margin

Operator: KK

7.4 TRANSMISSION TIME REQUIREMENT

7.4.1 Applicable Standard

According to FCC Part 15.231(a)

7.4.2 Conformance Limit

(a) The provisions of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(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.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

7.4.3 Test Configuration

Test according to clause 6.2 radio frequency test setup 2

7.4.4 Test Procedure

The following table is the setting of spectrum analyzer.

Spectrum analyzer	Setting
Attenuation	Auto
Span Frequency	0Hz
RB	100KHz
VB	100KHz
Detector	Peak
Trace	Max hold
Sweep Time	6S

- The transmitter output (antenna port) was connected to the spectrum analyzer.
- Set RBW of spectrum analyzer to 100KHz and VBW to 100KHz, Set Detector to Peak, Trace to Max Hold.
- Set the span to 0Hz and the sweep time to 6s and record the value.

7.4.5 Test Results

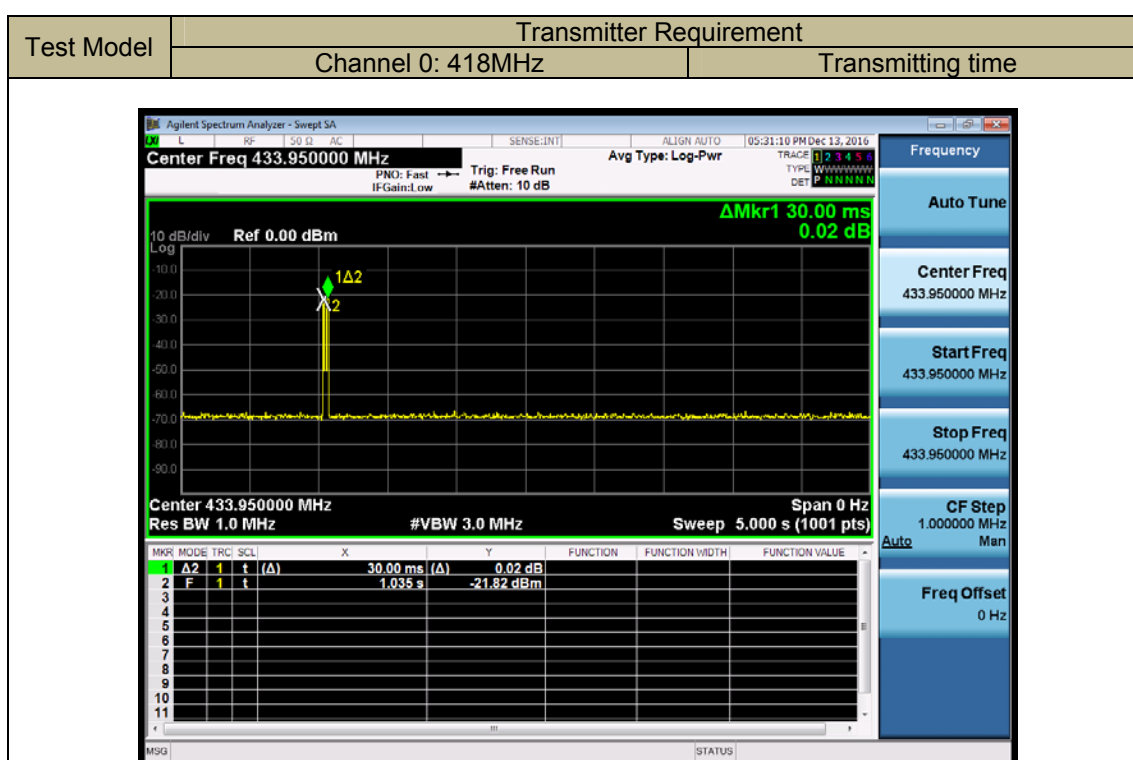
All test mode were tested, only worst case represented in this report as follows:

Temperature:	24°C	Test Date:	December 13, 2016
Humidity:	53 %	Test By:	KK
Test mode:	TX Mode		

Frequency.(MHz)	Transmitting time	Limit	Verdict
433.95	0.03S	5 seconds	PASS

Note1: The signal bandwidth was measured ($2/PW=2/0.00913=0.22\text{kHz}$) and less then 100kHz RBW so PDCF factor is not required

Note2: The PW data see the page 21.



7.5 CONDUCTED EMISSIONS TEST

7.5.1 Applicable Standard

According to FCC Part 15.207(a)

7.5.2 Conformance Limit

Frequency(MHz)	Conducted Emission Limit	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

7.5.3 Test Configuration

Test according to clause 7.3 conducted emission test setup

7.5.4 Test Procedure

The EUT was placed on a table which is 0.8m above ground plane.

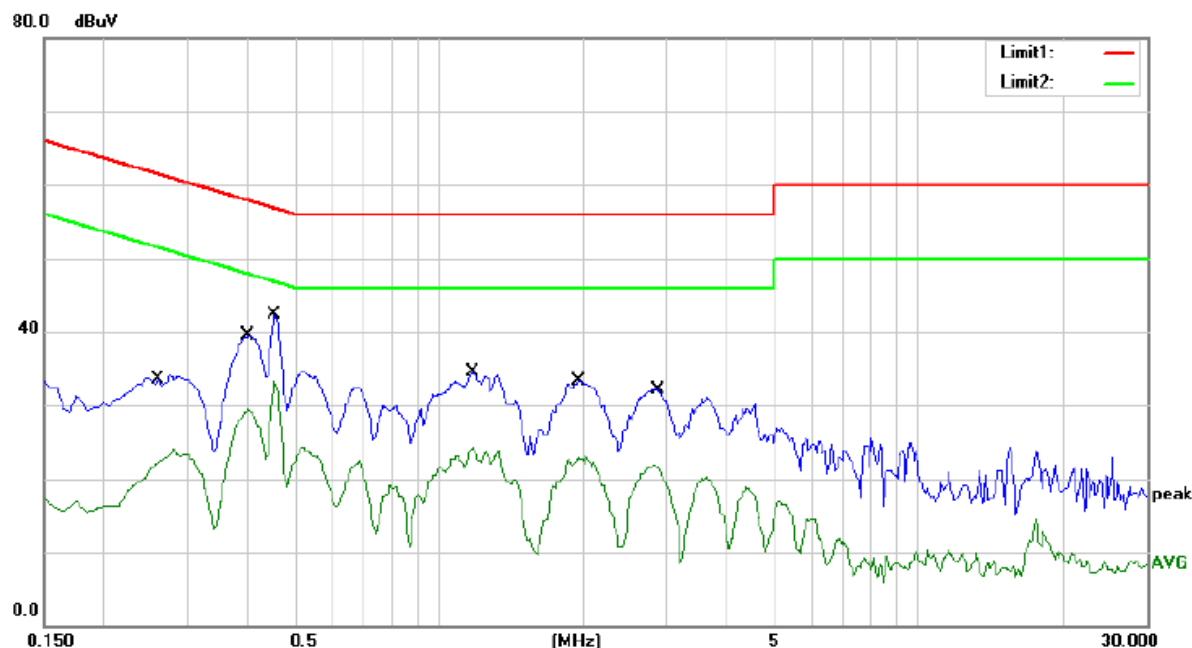
Maximum procedure was performed on the highest emissions to ensure EUT compliance.

Repeat above procedures until all frequency measured were complete.

7.5.5 Test Results

Pass

The 120V & 240V voltage have been tested, and the worst result recorded was report as below:



Site Conduction #1

Phase: **N**

Temperature: 22

Limit: (CE)FCC PART 15 class B_QP

Power: AC 120V/60Hz

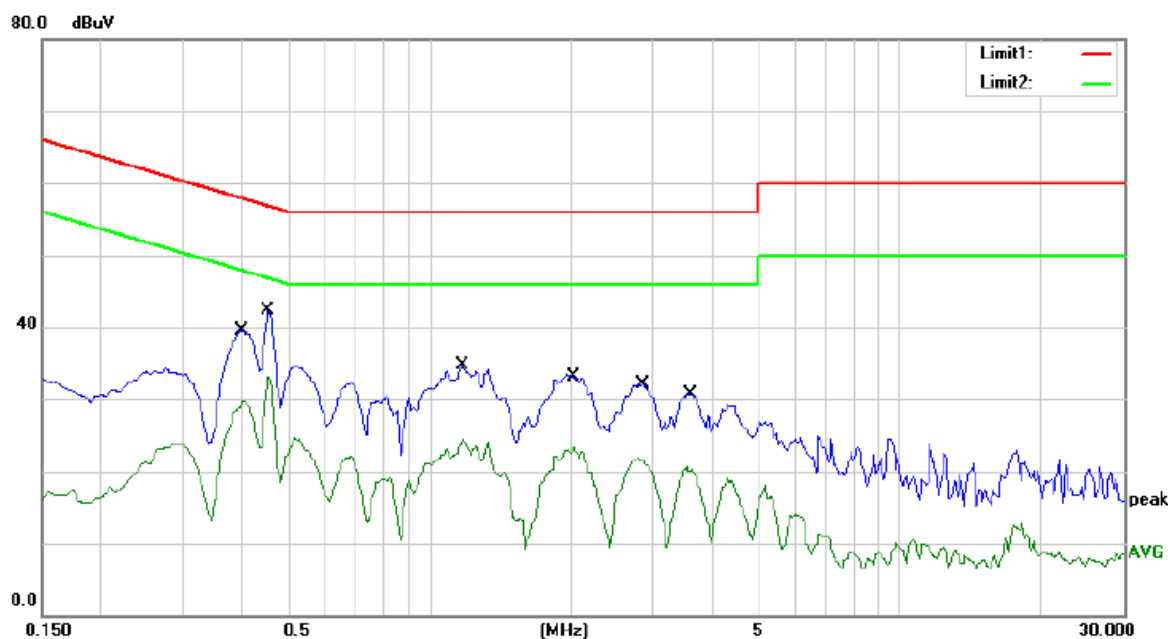
Humidity: 55 %

Mode: TX Low channel

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2600	33.49	0.00	33.49	61.43	-27.94	QP	
2		0.2600	22.54	0.00	22.54	51.43	-28.89	AVG	
3		0.4000	39.54	0.00	39.54	57.85	-18.31	QP	
4		0.4000	29.43	0.00	29.43	47.85	-18.42	AVG	
5		0.4550	42.32	0.00	42.32	56.78	-14.46	QP	
6	*	0.4550	33.23	0.00	33.23	46.78	-13.55	AVG	
7		1.1800	34.57	0.00	34.57	56.00	-21.43	QP	
8		1.1800	24.27	0.00	24.27	46.00	-21.73	AVG	
9		1.9550	22.86	0.00	22.86	46.00	-23.14	AVG	
10		1.9650	33.33	0.00	33.33	56.00	-22.67	QP	
11		2.8390	32.14	0.00	32.14	56.00	-23.86	QP	
12		2.8390	21.92	0.00	21.92	46.00	-24.08	AVG	

:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator: KK



Site Conduction #1

Phase: **N**

Temperature: 22

Limit: (CE)EN55022 class B_QP

Power: AC 230V/50Hz

Humidity: 55 %

Mode: TX Low channel

Note:

No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2600	33.49	0.00	33.49	61.43	-27.94	QP	
2		0.2600	22.54	0.00	22.54	51.43	-28.89	AVG	
3		0.4000	39.54	0.00	39.54	57.85	-18.31	QP	
4		0.4000	29.43	0.00	29.43	47.85	-18.42	AVG	
5		0.4550	42.32	0.00	42.32	56.78	-14.46	QP	
6	*	0.4550	33.23	0.00	33.23	46.78	-13.55	AVG	
7		1.1800	34.57	0.00	34.57	56.00	-21.43	QP	
8		1.1800	24.27	0.00	24.27	46.00	-21.73	AVG	
9		1.9550	22.86	0.00	22.86	46.00	-23.14	AVG	
10		1.9650	33.33	0.00	33.33	56.00	-22.67	QP	
11		2.8390	32.14	0.00	32.14	56.00	-23.86	QP	
12		2.8390	21.92	0.00	21.92	46.00	-24.08	AVG	

*:Maximum data x:Over limit !:over margin Comment: Factor build in receiver. Operator: KK

7.6 Antenna Application

7.6.1 Antenna Requirement

Standard	Requirement
FCC CRF Part 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. 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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

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.

7.6.2 Result

PASS.

The EUT has 1 antenna: Spring Antenna, the gain is 2.15 dBi;

- Note:
- ☐ Antenna use a permanently attached antenna which is not replaceable.
 - ☒ Not using a standard antenna jack or electrical connector for antenna replacement
 - ☐ The antenna has to be professionally installed (please provide method of installation)

which in accordance to section 15.203, please refer to the internal photos.

END OF REPORT