



FCC TEST REPORT

**Test report
On Behalf of
AES GmbH
For
AES Multi frequency RFID Reader USB Device
Model No.: SA2-USB-V2, SA2-V2**

FCC ID: 2ATGK-SA2

Prepared for : AES GmbH
Markt 14, 99310 Arnstadt, Germany

Prepared By : Shenzhen HUAKE Testing Technology Co., Ltd.
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Date of Test: April 09, 2019 ~ April 24, 2019

Date of Report: April 24, 2019

Report Number: HK1904170845-2E



TEST RESULT CERTIFICATION

Applicant's name: AES GmbH
 Address: Markt 14, 99310 Arnstadt, Germany
Manufacture's Name.....: AES GmbH
 Address: Markt 14, 99310 Arnstadt, Germany

Product description

Trade Mark: Smart Access

Product name.....: AES Multi frequency RFID Reader USB Device
 Model and/or type reference : SA2-USB-V2, SA2-V2
Standards: FCC Rules and Regulations Part 15 Subpart C Section 15.225
 ANSI C63.10: 2013

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Date of Test:
 Date (s) of performance of tests: April 09, 2019 ~ April 24, 2019
 Date of Issue.....: April 24, 2019
 Test Result.....: **Pass**

Testing Engineer : Gary Qian
 (Gary Qian)

Technical Manager : Eden Hu
 (Eden Hu)

Authorized Signatory : Jason Zhou
 (Jason Zhou)



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1. Test Result Summary

Requirement	CFR 47 Section	Result
Conduction Emission, 0.15MHz to 30MHz	§15.207	PASS
Radiation Emission	§15.225, §15.205, §15.209, §15.35	PASS
Occupied Bandwidth	§ 15.215	PASS
Antenna requirement	§ 15.203	PASS
Frequency stability	§ 15.225	PASS

Note:

1. PASS: Test item meets the requirement.
2. Fail: Test item does not meet the requirement.
3. N/A: Test case does not apply to the test object.
4. The test result judgment is decided by the limit of test standard.

1.1. TEST FACILITY

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

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

FCC designation number : CN1229

test firm registration number : 616276

1.2. 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. EUT Description

Equipment	AES Multi frequency RFID Reader USB Device
Model Name	SA2-USB-V2
Serial No	SA2-V2
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: SA2-USB-V2.
FCC ID	2ATGK-SA2
Antenna Type	Internal Antenna
Antenna Gain	0 dBi
Operation frequency	13.56MHz
Modulation Type	ASK
Power Source	DC Voltage
Power Rating	SA2-USB DC5V from USB SA2-CAN DC12V from Battery



3. General Information

3.1. Test Environment and Mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test Mode:	
Operation mode:	Keep the EUT in continuous transmitting with modulation
<p>The sample was placed (0.8m below 1GHz, 1.5m above 1GHz) above the ground plane of 3m chamber. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating the turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.</p>	

Per-test mode.			
We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which was shown in this test report and defined as follows:			
Axis	X	Y	Z
Field Strength(dBuV/m)	62.47	65.62	62.59
Final Test Mode:			
According to ANSI C63.10 standards, the test results are both the “worst case” and “worst setup”: Y axis (see the test setup photo)			

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Equipment	Model No.	Serial No.	FCC ID	Trade Name
/	/	/	/	/

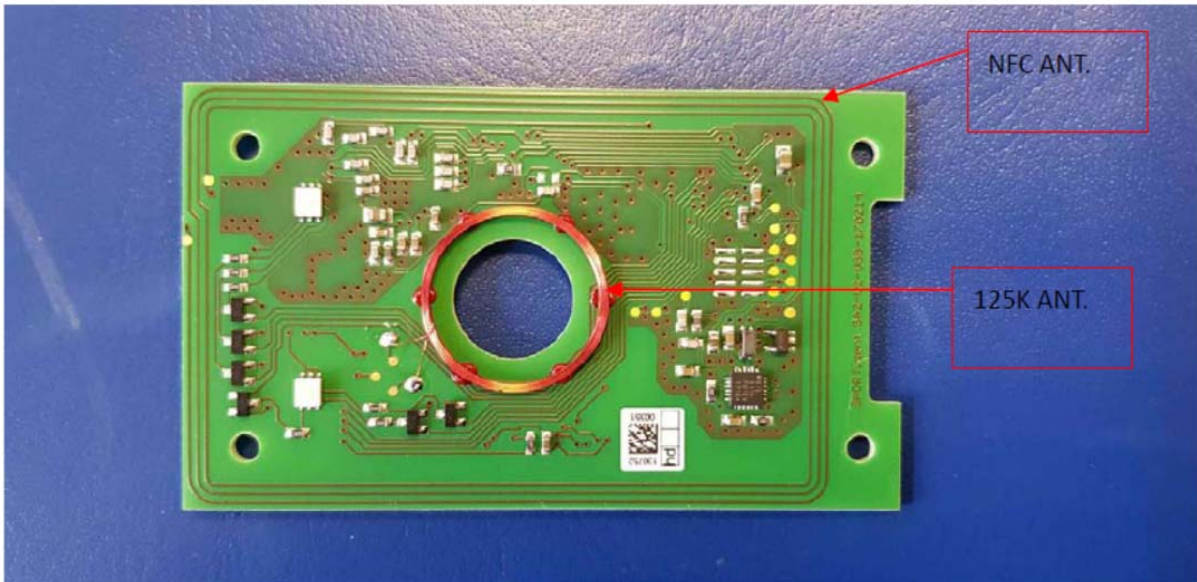
Note:

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.

4. Test Results and Measurement Data

4.1. Antenna Requirement

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, 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.	
E.U.T Antenna:	Internal Antenna
The antenna used in this product is a Internal Antenna, The directional gains of antenna used for transmitting is 0dBi.	





4.2. Conducted Emission

4.2.1. Conducted Power Line Emission Limit

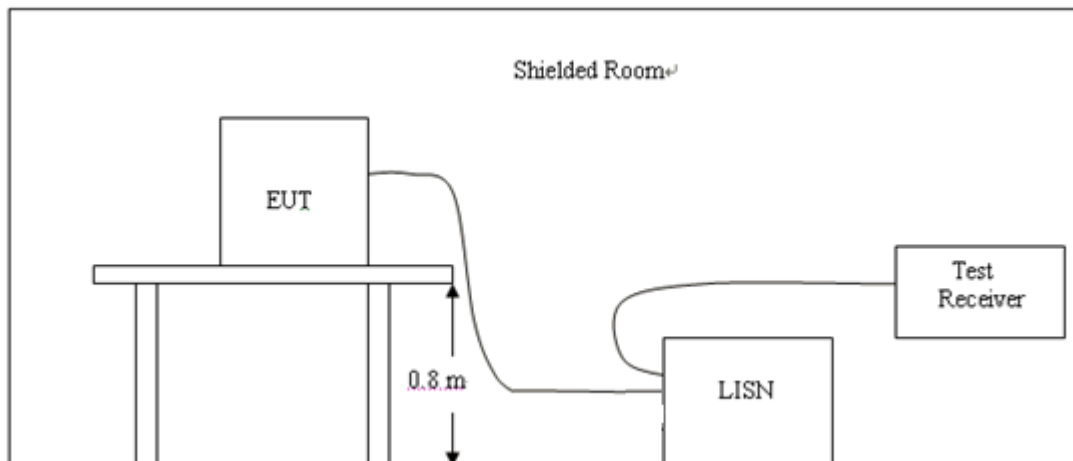
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

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.

4.2.2. Test Setup

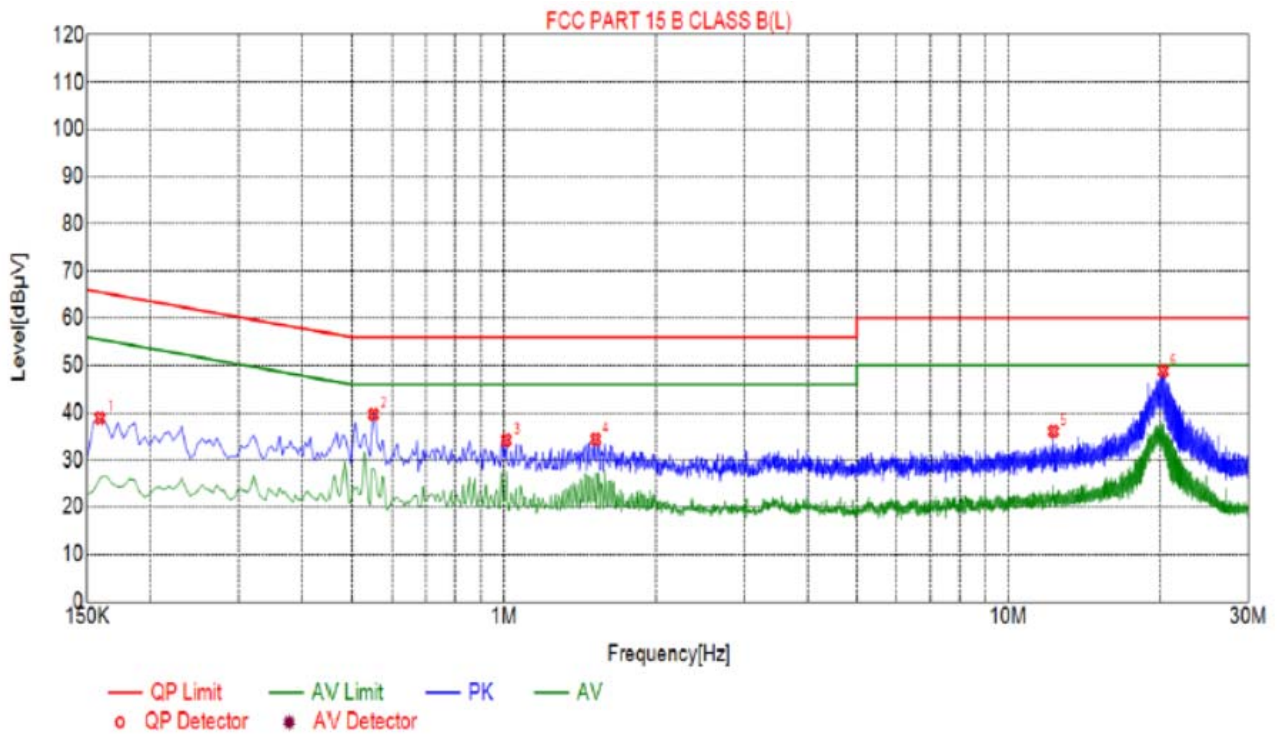


4.2.3. Test Procedure

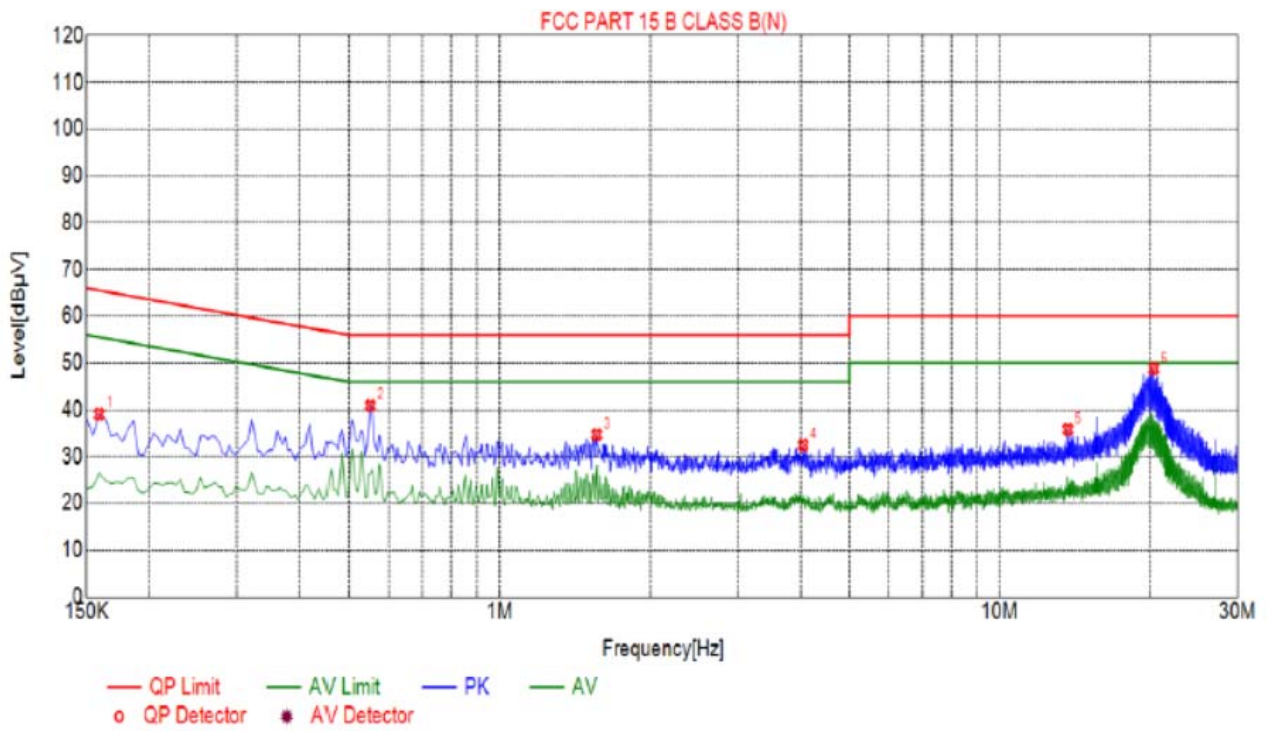
- 1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
- 2, Support equipment, if needed, was placed as per 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.



4.2.4. Test Result



Suspected List						
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector
1	0.1590	38.87	10.01	65.52	26.65	PK
2	0.5505	39.71	10.06	56.00	16.29	PK
3	1.0095	34.24	10.06	56.00	21.76	PK
4	1.5180	34.41	10.11	56.00	21.59	PK
5	12.2865	36.08	9.98	60.00	23.92	PK
6	20.3100	48.83	10.12	60.00	11.17	PK



Suspected List						
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Detector
1	0.1590	39.07	10.01	65.52	26.45	PK
2	0.5505	40.90	10.06	56.00	15.10	PK
3	1.5630	34.73	10.11	56.00	21.27	PK
4	4.0425	32.49	10.25	56.00	23.51	PK
5	13.7040	35.83	9.96	60.00	24.17	PK
6	20.3595	48.83	10.12	60.00	11.17	PK



4.3. Radiated Emission Measurement

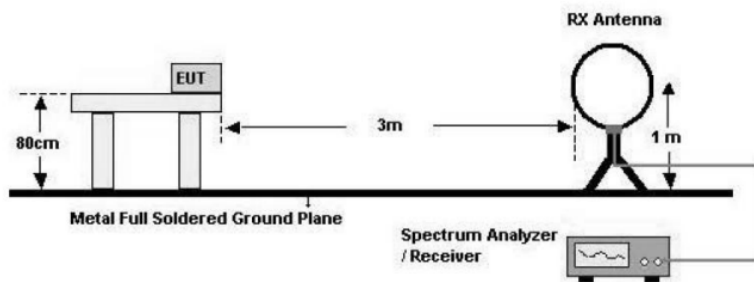
4.3.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.225(a) and 15.209				
Test Method:	ANSI C63.10:2013				
Frequency Range:	9 kHz to 1 GHz				
Measurement Distance:	3 m				
Antenna Polarization:	Horizontal & Vertical				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	9kHz- 150kHz	Quasi-peak	200Hz	1kHz	Quasi-peak Value
	150kHz- 30MHz	Quasi-peak	9kHz	30kHz	Quasi-peak Value
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
Peak		1MHz	10Hz	Average Value	
<ol style="list-style-type: none"> 1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter camber in below 1GHz, 1.5m above the ground in above 1GHz. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. 					

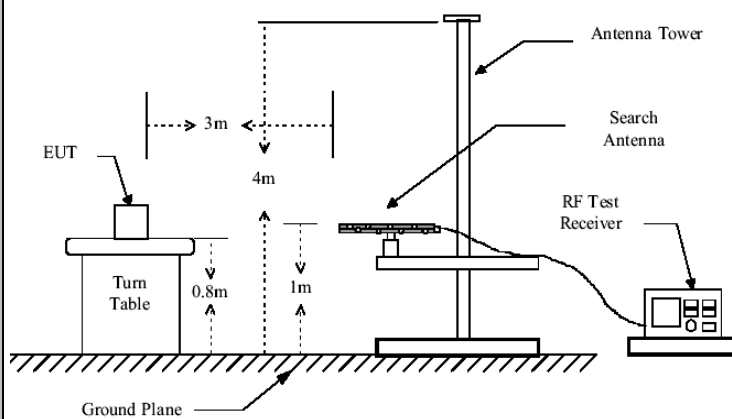
Test setup:

For radiated emissions

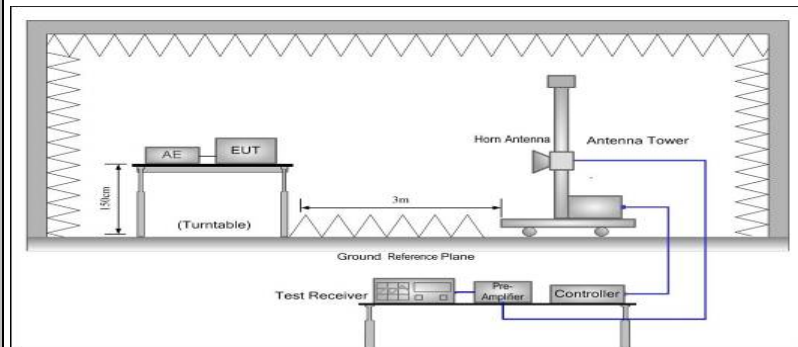
Below 30 MHz



30MHz to 1GHz



Above 1GHz



Test Mode:

Transmitting Mode

Test results:

PASS

4.3.2. Limit

(a) The field strength of any emission within this band shall not exceed 10,000 microvolts/meter at 3 meters. 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.



4.3.3. Frequencies in restricted band are complied to limit on Paragraph 15.209

Frequency Range (MHz)	Distance (m)	Field strength (dB μ V/m)	Field strength (microvolts/meter)
0.009-0.490	300	20log 2400/F (kHz)	2400/F (kHz)
0.490-1.705	30	20log 24000/F (kHz)	24000/F (kHz)
1.705-30	30	20log 30	30
30-88	3	40.0	100**
88-216	3	43.5	150**
216-960	3	46.0	200**
Above 960	3	54.0	500

NOTE:

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., S 15.231 and 15.241.

4.3.4. Test Instruments

Radiated Emission Test Site (966)				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
ESPI Test Receiver	ROHDE&SCHWARZ	ESVD	100008	Dec. 27, 2019
Spectrum Analyzer	ROHDE&SCHWARZ	FSEM	848597/001	Dec. 27, 2019
Pre-amplifier	EM Electronics Corporation CO.,LTD	EM30265	07032613	Dec. 27, 2019
Pre-amplifier	HP	8447D	2727A05017	Dec. 27, 2019
Loop antenna	ZHINAN	ZN30900A	12024	Dec. 27, 2019
Broadband Antenna	Schwarzbeck	VULB9163	340	Dec. 27, 2019
Horn Antenna	Schwarzbeck	BBHA 9120D	631	Dec. 27, 2019
Coax cable	HUAK	N/A	N/A	Dec. 27, 2019
Coax cable	HUAK	N/A	N/A	Dec. 27, 2019
Coax cable	HUAK	N/A	N/A	Dec. 27, 2019
Coax cable	HUAK	N/A	N/A	Dec. 27, 2019
EMI Test Software	Shurple Technology	EZ-EMC	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).



4.3.5. Test Data

Field Strength of Fundamental

Frequency (MHz)	Reading (dBuV/m)	Correction Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Polar (H/V)	Detector
13.21	45.58	15.82	61.40	80.51	-19.11	H	QP
13.21	46.06	15.82	61.88	80.51	-18.63	V	QP
13.85	48.68	15.82	64.50	80.51	-16.01	H	QP
13.85	47.47	15.82	63.29	80.51	-17.22	V	QP
13.56	84.16	12.33	96.49	124	-27.51	H	Peak
13.56	83.75	12.33	96.08	124	-27.92	V	Peak
13.45	52.94	15.82	68.76	90.47	-21.71	H	QP
13.45	50.04	15.82	65.86	90.47	-24.61	V	QP
13.62	49.33	15.82	65.15	90.47	-25.32	H	QP
13.62	46.90	15.82	62.72	90.47	-27.75	V	QP

Remark: Margin = Result - Limit

Result = Reading + Correction Factor

Correction Factor = Antenna Factor + Cable Factor

Harmonics and Spurious Emissions

Frequency Range (9 kHz-30MHz)

Frequency (MHz)	Level@3m (dB μ V/m)	Limit@3m (dB μ V/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



About 30MHz-1GHz

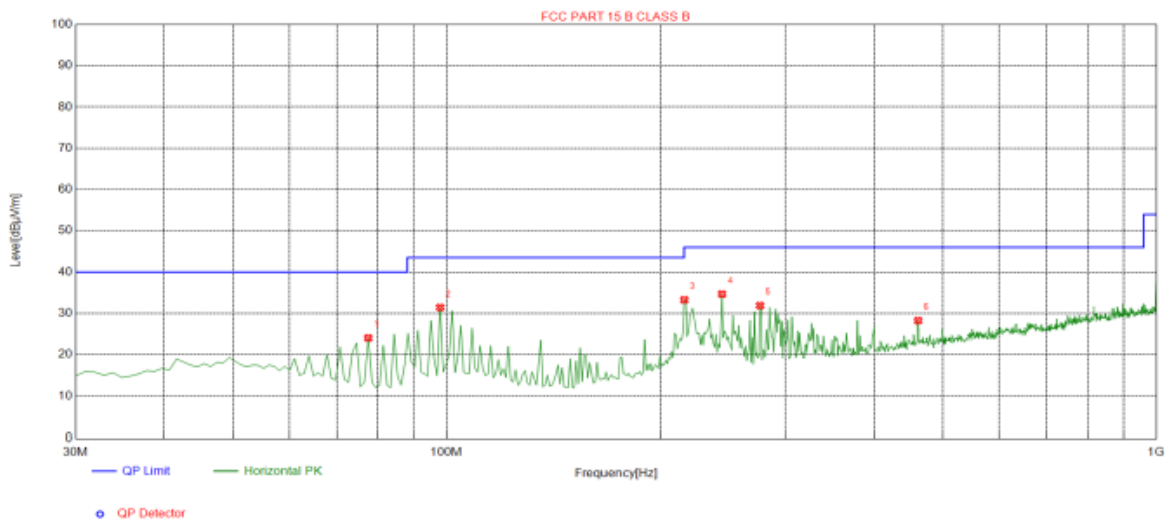
Note: this EUT was tested in 3 orthogonal positions and the worst case position data was reported.

Remark:

Margin = Limit – Level

Level=Test receiver reading + correction factor

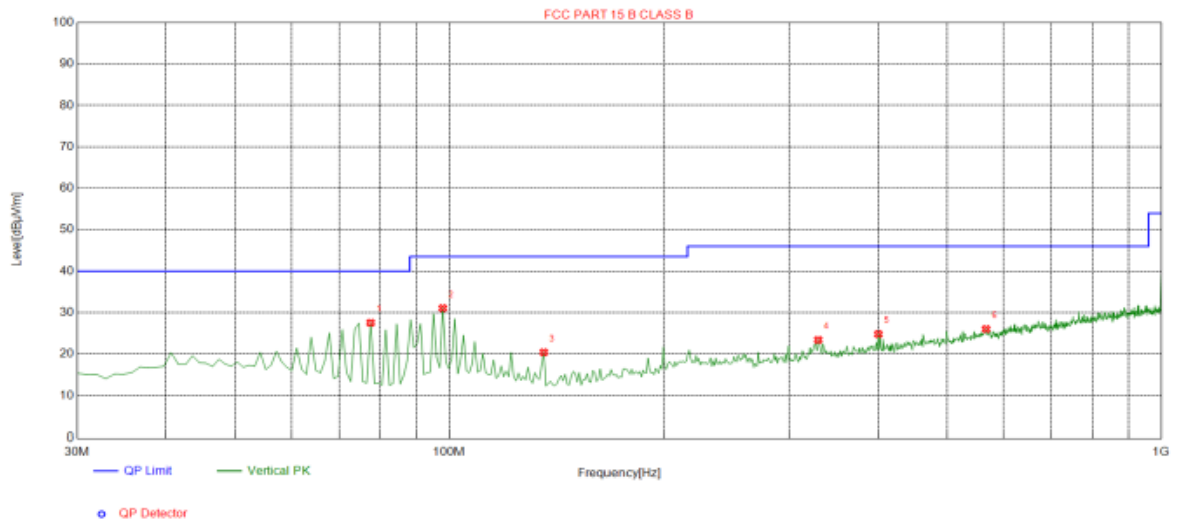
Horizontal



Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	77.5300	24.05	-19.03	40.00	15.95	100	350	Horizontal
2	97.9000	31.43	-15.75	43.50	12.07	100	350	Horizontal
3	216.240	33.27	-14.65	46.00	12.73	100	268	Horizontal
4	244.370	34.68	-13.65	46.00	11.32	100	272	Horizontal
5	276.380	31.89	-13.40	46.00	14.11	100	285	Horizontal
6	461.650	28.24	-8.61	46.00	17.76	100	144	Horizontal



Vertical

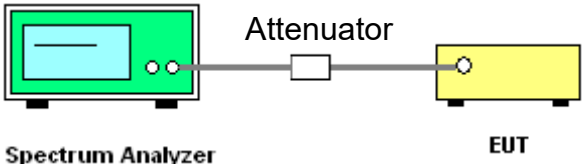


Suspected List								
NO.	Freq. [MHz]	Level [dBµV/m]	Factor [dB]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	77.5300	27.54	-19.03	40.00	12.46	100	92	Vertical
2	97.9000	31.08	-15.75	43.50	12.42	100	124	Vertical
3	135.730	20.42	-18.92	43.50	23.08	100	10	Vertical
4	329.730	23.40	-11.60	46.00	22.60	100	50	Vertical
5	400.540	24.82	-10.40	46.00	21.18	100	107	Vertical
6	567.380	26.03	-6.47	46.00	19.97	100	241	Vertical



4.4. Occupied Bandwidth

4.4.1. Test Specification

Test Requirement:	FCC Part15 C Section 15.215(c)
Test Method:	ANSI C63.10: 2013
Limit:	N/A
	<ol style="list-style-type: none"> 1. According to the follow Test-setup, keep the relative position between the artificial antenna and the EUT. 2. Set to the maximum power setting and enable the EUT transmit continuously. 3. Use the following spectrum analyzer settings for 20dB Bandwidth measurement. Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel; $RBW \geq 1\%$ of the 20 dB bandwidth; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test setup:	 <p>The diagram shows a green Spectrum Analyzer connected via a cable to a white Attenuator, which is then connected to a yellow EUT (Equipment Under Test).</p>
Test Mode:	Transmitting Mode
Test results:	PASS

4.4.2. Test Instruments

RF Test Room				
Equipment	Manufacturer	Model	Serial Number	Calibration Due
Spectrum Analyzer	Agilent	N9020A	MY49100060	Dec. 27, 2019

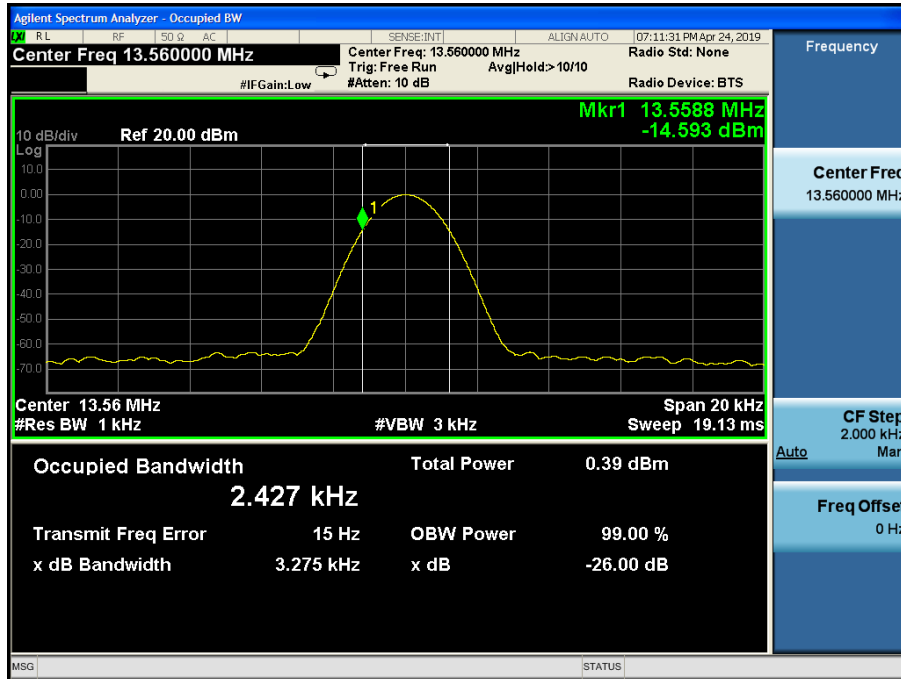
Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).



4.4.3. Test data

Test Channel (MHz)	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Conclusion
13.56	3.275	N/A	PASS

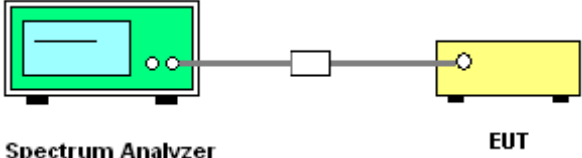
Test plots as follows:





4.5. Frequency stability

4.5.1. Test Specification

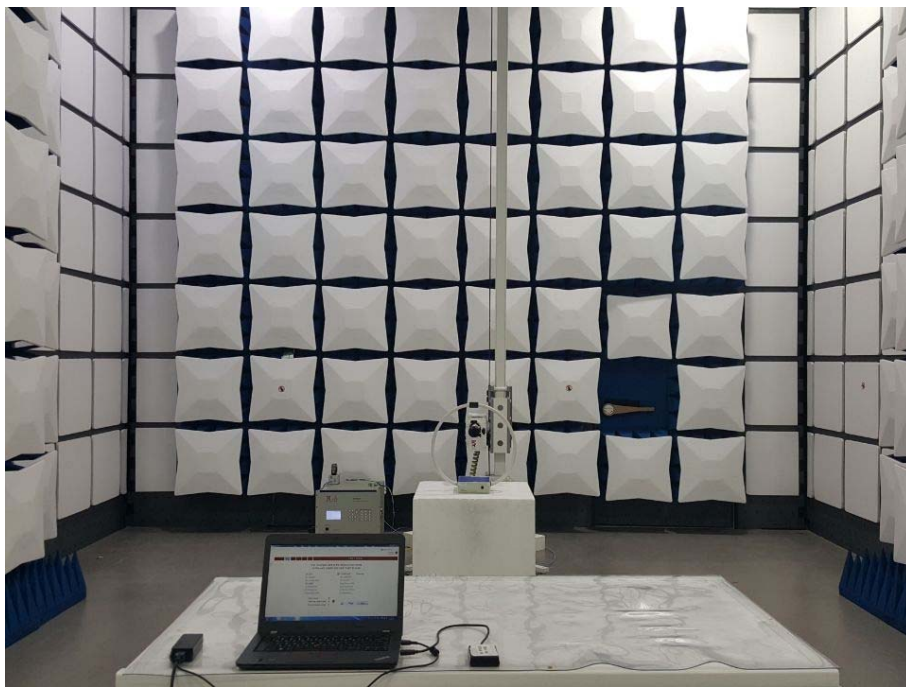
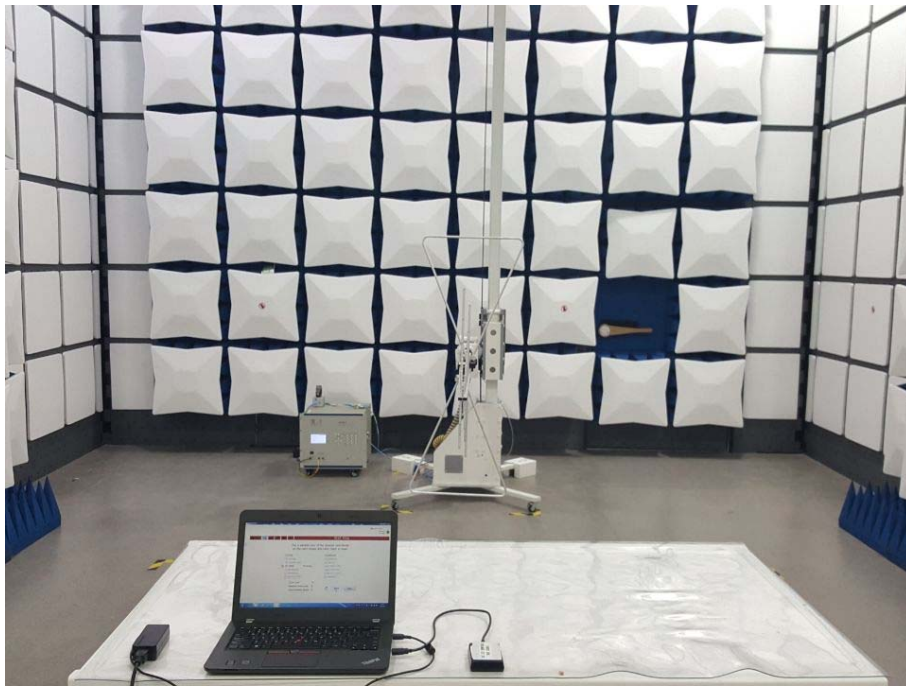
Test Requirement:	FCC Part15 C Section 15.225
Test Method:	ANSI C63.10: 2013
Limit:	+/-0.01%
	<ol style="list-style-type: none">1. The equipment under test was connected to an external DC power supply and input rated voltage.2. RF output was connected to a spectrum analyzer.3. The EUT was placed inside the temperature chamber.4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25°C operating frequency as reference frequency.5. Turn EUT off and set the chamber temperature to - 20°C. After the temperature stabilized for approximately 30 minutes recorded the frequency.6. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.
Test setup:	 <p>The diagram illustrates the test setup. On the left is a Spectrum Analyzer, represented by a green box with a screen and two knobs. A cable connects it to a small white rectangular component, likely a coupler or adapter. This component is further connected to the EUT (Equipment Under Test), represented by a yellow box. Labels 'Spectrum Analyzer' and 'EUT' are placed below their respective components.</p>
Test Mode:	Transmitting Mode
Test results:	PASS

**4.5.2. Test Data**

Voltage (Vdc)	Temperature (°C)	Frequency (MHz)	Deviation (%)	Limit (%)
3.7	-20	13.560174	0.00128%	+/-0.01%
3.7	-10	13.560173	0.00128%	
3.7	0	13.559998	-0.00001%	
3.7	10	13.560379	0.00279%	
3.7	20	13.560074	0.00055%	
3.7	30	13.560256	0.00189%	
3.7	40	13.560043	0.00032%	
3.7	50	13.560217	0.00160%	
4.255	-20	13.560154	0.00114%	
4.255	-10	13.560221	0.00163%	
4.255	0	13.560087	0.00064%	
4.255	10	13.560375	0.00277%	
4.255	20	13.559977	-0.00017%	
4.255	30	13.560349	0.00257%	
4.255	40	13.559979	-0.00015%	
4.255	50	13.560194	0.00143%	
3.145	-20	13.560154	0.00114%	
3.145	-10	13.560221	0.00163%	
3.145	0	13.560346	0.00255%	
3.145	10	13.559961	-0.00029%	
3.145	20	13.559966	-0.00025%	
3.145	30	13.560614	0.00453%	
3.145	40	13.559876	-0.00091%	
3.145	50	13.560340	0.00251%	

Appendix A: Photographs of Test Setup

Radiated Emission





Conducted Emission





Appendix B: PHOTOS OF THE EUT

Reference to the reporter : ANNEX A of external photos and ANNEX B of internal photos

*******END OF REPORT*******