TEST REPORT

Test report
On Behalf of
ComNav Technology Ltd.
For
R550 Data Collector
Model No.: R550

FCC ID: 2ACHB-R550

Prepared for :	**ComNav Technology Ltd.** **Building 2, No.618,Chengliu Middle Rd. Jiading district. Shanghai, 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:	**Jun. 05, 2020 -- Jul. 20, 2020**
Date of Report:	**Jul. 20, 2020**
Report Number:	**HK2007011614-10E**

TEST RESULT CERTIFICATION

Applicant's name ..... :	ComNav Technology Ltd.
Address ..... :	Building 2, No.618,Chengliu Middle Rd. Jiading district. Shanghai, China
Manufacture's Name ..... :	ComNav Technology Ltd.
Address ..... :	Building 2, No.618,Chengliu Middle Rd. Jiading district. Shanghai, China

Product description

Trade Mark ..... : SinoGNSS® By ComNav Technology Ltd.

Product name ..... : R550 Data Collector

Model and/or type reference . R550

Standards ..... : FCC Part 15 Subpart C Section 15.225

Date of Test ..... :

Date (s) of performance of tests ..... :	Jun. 05, 2020 -- Jul. 20, 2020
Date of Issue ..... :	Jul. 20, 2020
Test Result ..... :	**Pass**

Testing Engineer : Gary Qian

(Gary Qian)

Technical Manager : Eden Hu

(Eden Hu)

Authorized Signatory : Jason Zhou

(Jason Zhou)

TABLE OF CONTENTS

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 HUAK 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

Product Name:	R550 Data Collector
Model/Type reference:	R550
Serial Model:	N/A
Trade Mark	SinoGNSS® By ComNav Technology Ltd.
FCC ID	2ACHB-R550
Modulation:	ASK
Operation frequency:	**13.56MHz**
Channel number:	1
Channel separation:	/
Antenna type:	FPC Antenna

Note: 1. For more details, refer to the user's manual of the EUT.

3. Genera 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
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.	

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
/	/	/	/	/

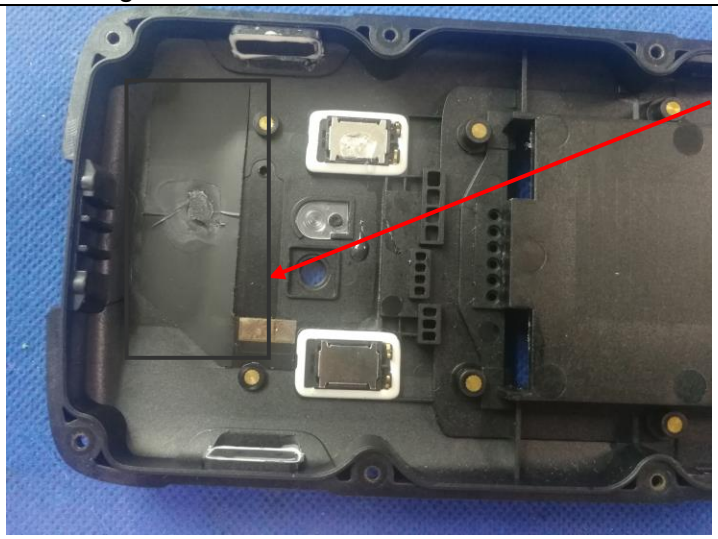
Note:

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:	Antenna
The antenna is internal antenna which red and black wires are wound around the black box and fixed and the best case gain of the antenna is 0dBi.	
	

4.2. Conducted Emission

4.2.1. Conducted Power Line Emission Limit

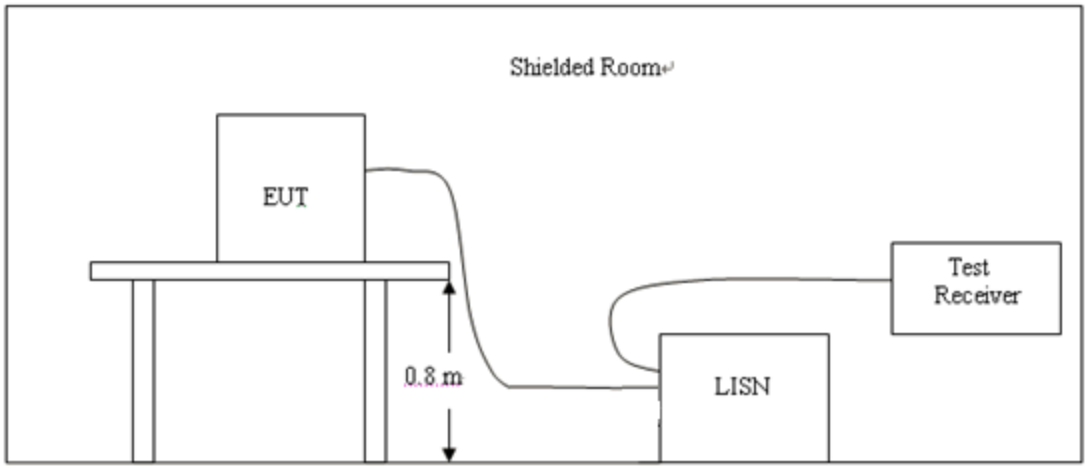
For unintentional device, according to § 15.107(a) Line Conducted Emission Limits is as following

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	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

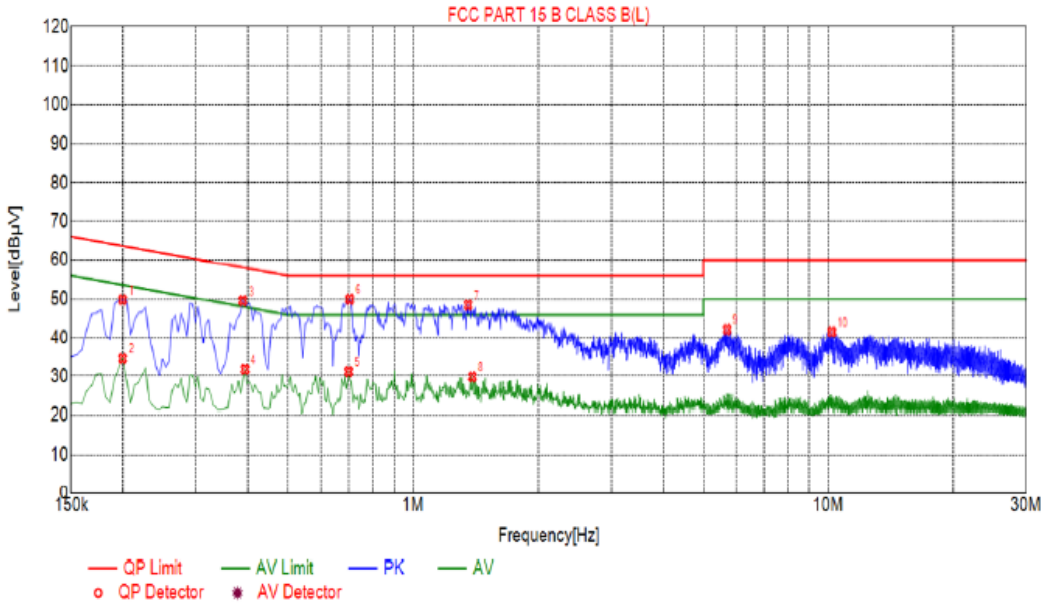
1, The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10.
2, Support equipment, if needed, was placed as per ANSI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

PASS

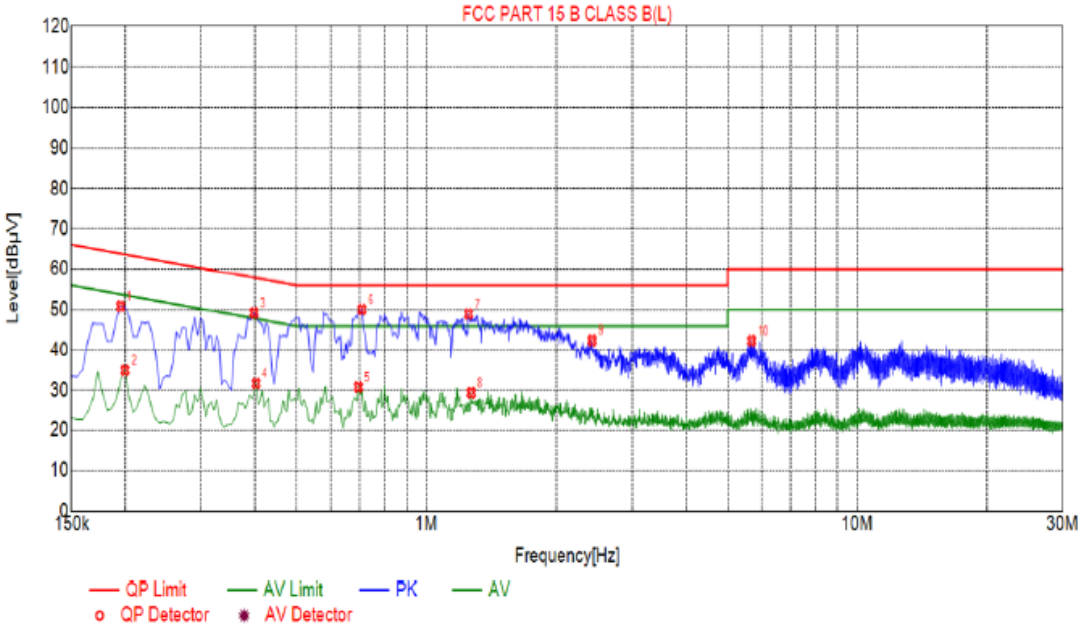
All the test modes completed for test. only the worst result was reported as below:
Remark: Margin = Limit – Level
Correction factor = Cable lose + LISN insertion loss
Level=Test receiver reading + correction factor

Test Specification: Line



Suspected List								
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1995	49.88	10.03	63.63	13.75	39.85	PK	L
2	0.1995	34.59	10.03	53.63	19.04	24.56	AV	L
3	0.3885	49.63	10.04	58.10	8.47	39.59	PK	L
4	0.3930	31.80	10.04	48.00	16.20	21.76	AV	L
5	0.6990	31.18	10.05	46.00	14.82	21.13	AV	L
6	0.7035	49.98	10.05	56.00	6.02	39.93	PK	L
7	1.3560	48.52	10.10	56.00	7.48	38.42	PK	L
8	1.3875	29.80	10.11	46.00	16.20	19.69	AV	L
9	5.7030	42.29	10.24	60.00	17.71	32.05	PK	L
10	10.1985	41.63	10.05	60.00	18.37	31.58	PK	L

Test Specification: Neutral

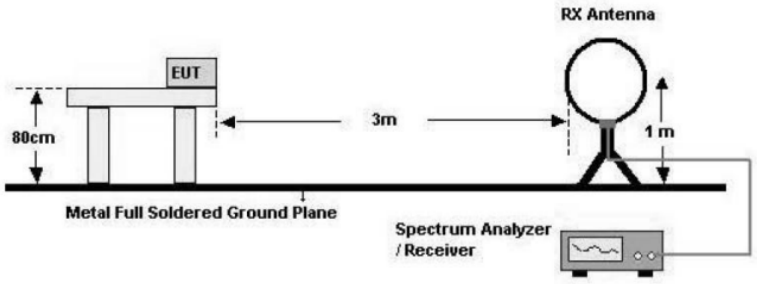
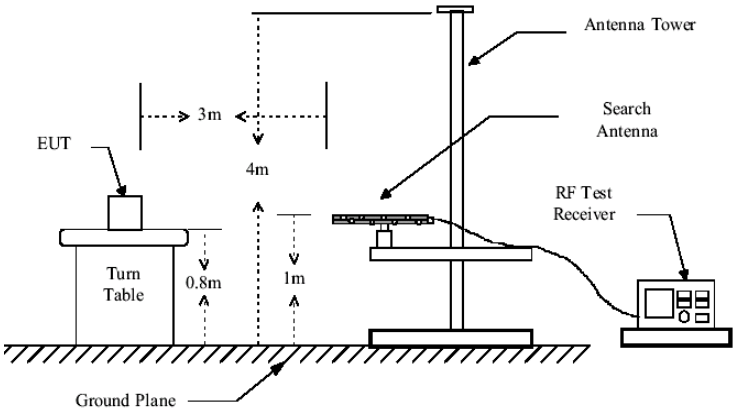
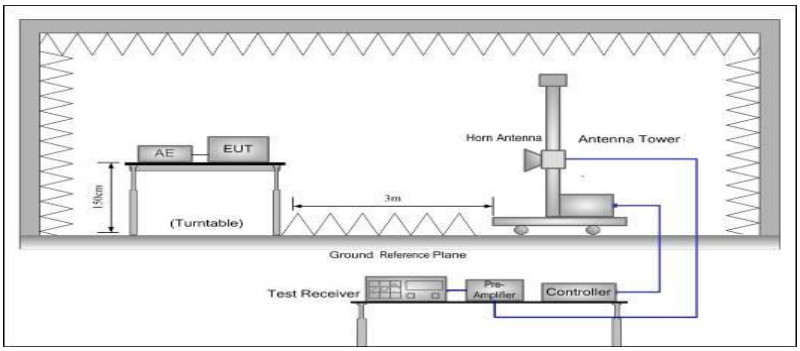


Suspected List								
NO.	Freq. [MHz]	Level [dBµV]	Factor [dB]	Limit [dBµV]	Margin [dB]	Reading [dBµV]	Detector	Type
1	0.1950	50.87	10.03	63.82	12.95	40.84	PK	L
2	0.1995	34.90	10.03	53.63	18.73	24.87	AV	L
3	0.3975	49.24	10.04	57.91	8.67	39.20	PK	L
4	0.4020	31.67	10.04	47.81	16.14	21.63	AV	L
5	0.6945	30.78	10.05	46.00	15.22	20.73	AV	L
6	0.7080	50.07	10.05	56.00	5.93	40.02	PK	L
7	1.2525	48.99	10.09	56.00	7.01	38.90	PK	L
8	1.2705	29.36	10.09	46.00	16.64	19.27	AV	L
9	2.4225	42.54	10.18	56.00	13.46	32.36	PK	L
10	5.6850	42.45	10.24	60.00	17.55	32.21	PK	L

4.3. Radiated Emission Measurement

4.3.1. Test Specification

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.225(a) and 15.209</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013</td></tr>
<tr><td>Frequency Range:</td><td>9 kHz to 1 GHz</td></tr>
<tr><td>Measurement Distance:</td><td>3 m</td></tr>
<tr><td>Antenna Polarization:</td><td>Horizontal & Vertical</td></tr>
<tr><td>Receiver Setup:</td><td>
<table>
<tr><th>Frequency</th><th>Detector</th><th>RBW</th><th>VBW</th><th>Remark</th></tr>
<tr><td>9kHz- 150kHz</td><td>Quasi-peak</td><td>200Hz</td><td>1kHz</td><td>Quasi-peak Value</td></tr>
<tr><td>150kHz-30MHz</td><td>Quasi-peak</td><td>9kHz</td><td>30kHz</td><td>Quasi-peak Value</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>120KHz</td><td>300KHz</td><td>Quasi-peak Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak Value</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average Value</td></tr>
</table>
</td></tr>
<tr><td></td><td>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.</td></tr>
</table>

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 permltted 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
13.19	48.65	15.82	64.47	80.51	-16.04	H	QP
13.19	49.02	15.82	64.84	80.51	-15.67	V	QP
13.84	46.61	15.82	62.43	80.51	-18.08	H	QP
13.84	48.69	15.82	64.51	80.51	-16	V	QP
13.56	87.42	12.33	99.75	124	-24.25	H	Peak
13.56	89.04	12.33	101.37	124	-22.63	V	Peak
13.45	53.4	15.82	69.22	90.47	-21.25	H	QP
13.45	55.23	15.82	71.05	90.47	-19.42	V	QP
13.64	52.35	15.82	68.17	90.47	-22.3	H	QP
13.64	51.09	15.82	66.91	90.47	-23.56	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 (dBµV/m)	Limit@3m (dBµV/m)
--	--	--
--	--	--
--	--	--
--	--	--

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

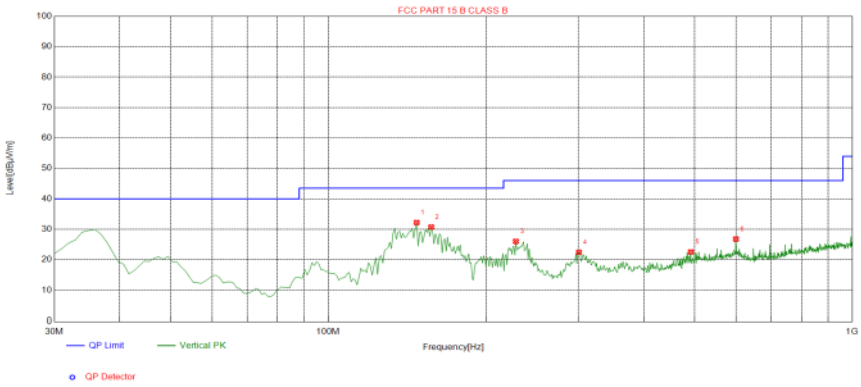
2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

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

Test Graph

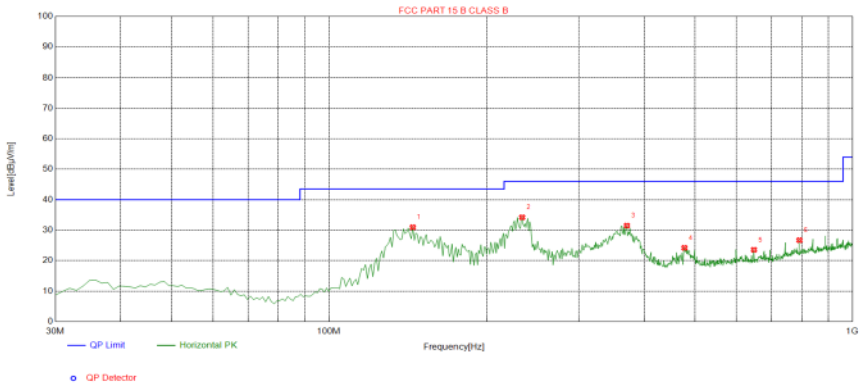


Suspected List

Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	147.4875	-19.00	51.22	32.22	43.50	11.28	100	202	Vertical
2	157.1972	-18.42	49.16	30.74	43.50	12.76	100	202	Vertical
3	228.0781	-14.37	40.40	26.03	46.00	19.97	100	166	Vertical
4	300.9009	-12.72	35.15	22.43	46.00	23.57	100	3	Vertical
5	492.1822	-8.50	31.05	22.55	46.00	23.45	100	137	Vertical
6	599.9600	-6.11	32.90	26.79	46.00	19.21	100	47	Vertical

Vertical

Test Graph

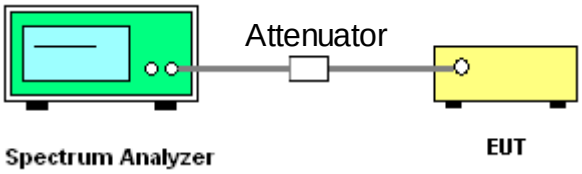


Suspected List

Suspected List									
NO.	Freq. [MHz]	Factor [dB]	Reading [dBµV/m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity
1	144.5746	-19.07	50.02	30.95	43.50	12.55	100	15	Horizontal
2	233.9039	-14.14	48.36	34.22	46.00	11.78	100	254	Horizontal
3	370.8108	-10.99	42.49	31.50	46.00	14.50	100	58	Horizontal
4	477.6176	-8.42	32.62	24.20	46.00	21.80	100	257	Horizontal
5	648.5085	-5.79	29.35	23.56	46.00	22.44	100	270	Horizontal
6	792.2122	-3.24	29.96	26.72	46.00	19.28	100	273	Horizontal

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
	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≥ 1% of the 20 dB bandwidth; VBW≥RBW; Sweep = auto; Detector function = peak; Trace = max hold. 4. Measure and record the results in the test report.
Test setup:	
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).*

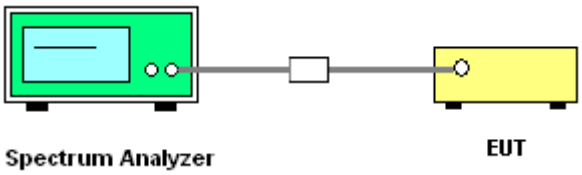
4.4.3. Test data

Test Channel (MHz)	20dB Occupy Bandwidth (kHz)	Limit (kHz)	Conclusion
13.56	2.712	N/A	PASS

Test plots as follows:

4.5. Frequency stability

4.5.1. Test Specification

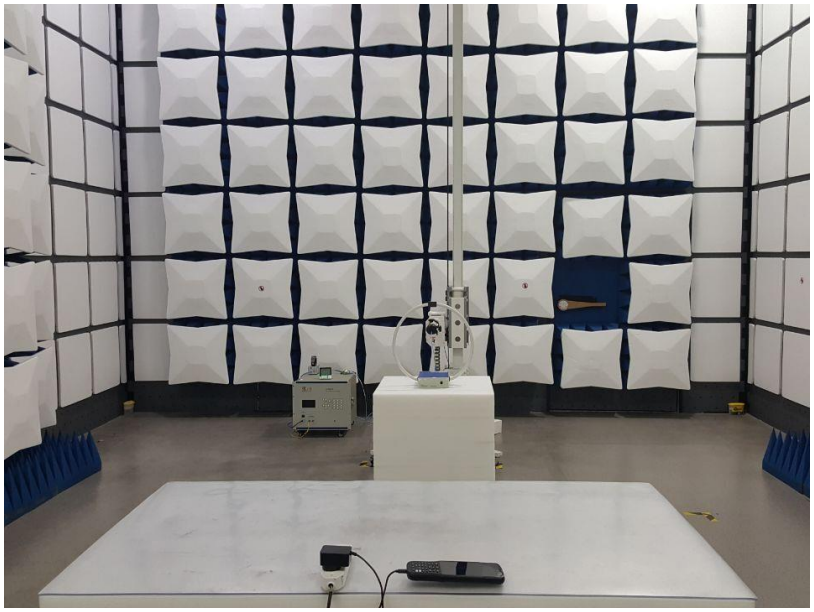
Test Requirement:	FCC Part15 C Section 15.225
Test Method:	ANSI C63.10: 2013
Limit:	+/-0.01%
	1. The equipment under test was connected to an external DC power supply and input rated voltage. 2. RF output was connected to a spectrum analyzer. 3. The EUT was placed inside the temperature chamber. 4. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 25℃ operating frequency as reference frequency. 5. Turn EUT off and set the chamber temperature to －20℃. After the temperature stabilized for approximately 30 minutes recorded the frequency. 6. Repeat step measure with 10℃ increased per stage until the highest temperature of +50℃ reached.
Test setup:	
Test Mode:	Transmitting Mode
Test results:	PASS

4.5.2. Test Data

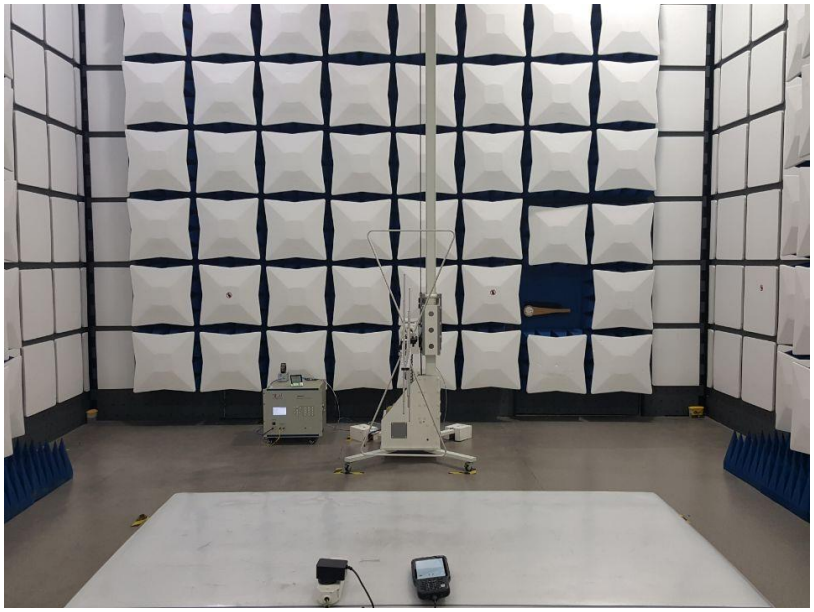
Voltage (Vdc)	Temperature (℃)	Frequency (MHz)	Deviation (%)	Limit (%)
3.8	-20	13.560552	0.00407	+/-0.01%
3.8	-10	13.560587	0.00433	
3.8	0	13.560060	0.00045	
3.8	10	13.560074	0.00055	
3.8	20	13.560739	0.00545	
3.8	30	13.560577	0.00425	
3.8	40	13.560859	0.00633	
3.8	50	13.560245	0.00180	
4.26	-20	13.560983	0.00725	
4.26	-10	13.560194	0.00143	
4.26	0	13.560120	0.00088	
4.26	10	13.560826	0.00609	
4.26	20	13.560661	0.00487	
4.26	30	13.560200	0.00147	
4.26	40	13.560225	0.00166	
4.26	50	13.560165	0.00122	
4.26	-20	13.560694	0.00512	
4.26	-10	13.560914	0.00674	
3.15	0	13.560466	0.00344	
3.15	10	13.560112	0.00083	
3.15	20	13.560405	0.00299	
3.15	30	13.560896	0.00661	
3.15	40	13.560257	0.00189	
3.15	50	13.560623	0.00459	

5. Photos of Test Setup

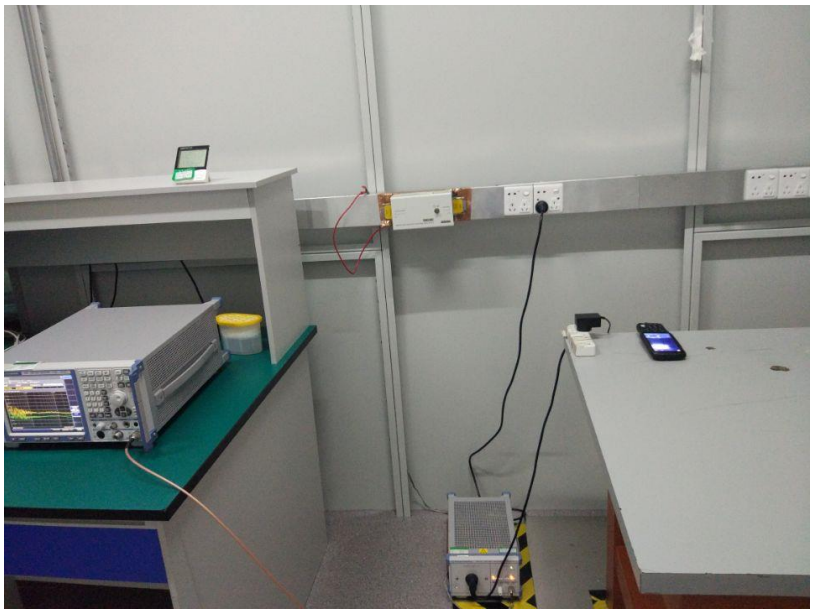
Radiated Emission below 30MHz



Radiated Emission 30-1000MHz



Conduction Emission



6. Photos of EUT

Please refer to the report No.: HK2007011614-8E

END