

FCC Test Report

Client Name : Lunu Solutions GmbH

Client Address : Am Bahnhof Westend 9-11, 14059 Berlin,
Germany

Product Name : mPOS Terminal

Report Date : Sept. 27, 2022

Shenzhen Anbotek Compliance Laboratory Limited



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TEST REPORT

Applicant : Lunu Solutions GmbH
Manufacturer : UAB DANNIE LT
Product Name : mPOS Terminal
Model No. : 1.0
Trade Mark : LUNU
Rating(s) : Input: 5V $\overline{=}$ (with DC 3.7V, 3000mAh battery inside)

Test Standard(s) : FCC Part15 Subpart C, Section 15.225

Test Method(s) : ANSI C63.10: 2020

The device described above is tested by Shenzhen Anbotek Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotek Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 15 Subpart C requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotek Compliance Laboratory Limited.

Date of Receipt

Jul. 25, 2022

Date of Test

Jul. 25 ~ Aug. 30, 2022

Prepared By

Ella Liang

(Ella Liang)

Approved & Authorized Signer

Kingkong Jin

(Kingkong Jin)



Revision History

Report Version	Description	Issued Date
R00	Original Issue.	Sept. 27, 2022



1. General Information

1.1. Client Information

Applicant	:	Lunu Solutions GmbH
Address	:	Am Bahnhof Westend 9-11, 14059 Berlin, Germany
Manufacturer	:	UAB DANNIE LT
Address	:	Sausupio g. 11A, LT-02301 Vilnius
Factory	:	UAB DANNIE LT
Address	:	Sausupio g. 11A, LT-02301 Vilnius

1.2. Description of Device (EUT)

Product Name	:	mPOS Terminal
Model No.	:	1.0
Trade Mark	:	LUNU
Test Power Supply	:	DC 3.7V battery inside
Test Sample No.	:	1-2-1(Normal Sample), 1-2-2(Engineering Sample)
Adapter	:	Model: EE5020-P25 Input: 100-240V~ 50/60Hz 0.5A Output: 5V= 2000mA

RF Specification

Operation Frequency	:	13.56MHz
Number of Channel	:	1 Channel
Modulation Type	:	BPSK
Antenna Type	:	Inductive loop coil Antenna
Antenna Gain(Peak)	:	0 dBi

Remark: 1)For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.



1.3. Auxiliary Equipment Used During Test

Description	Rating(s)
/	/

1.4. Description of Test Configuration

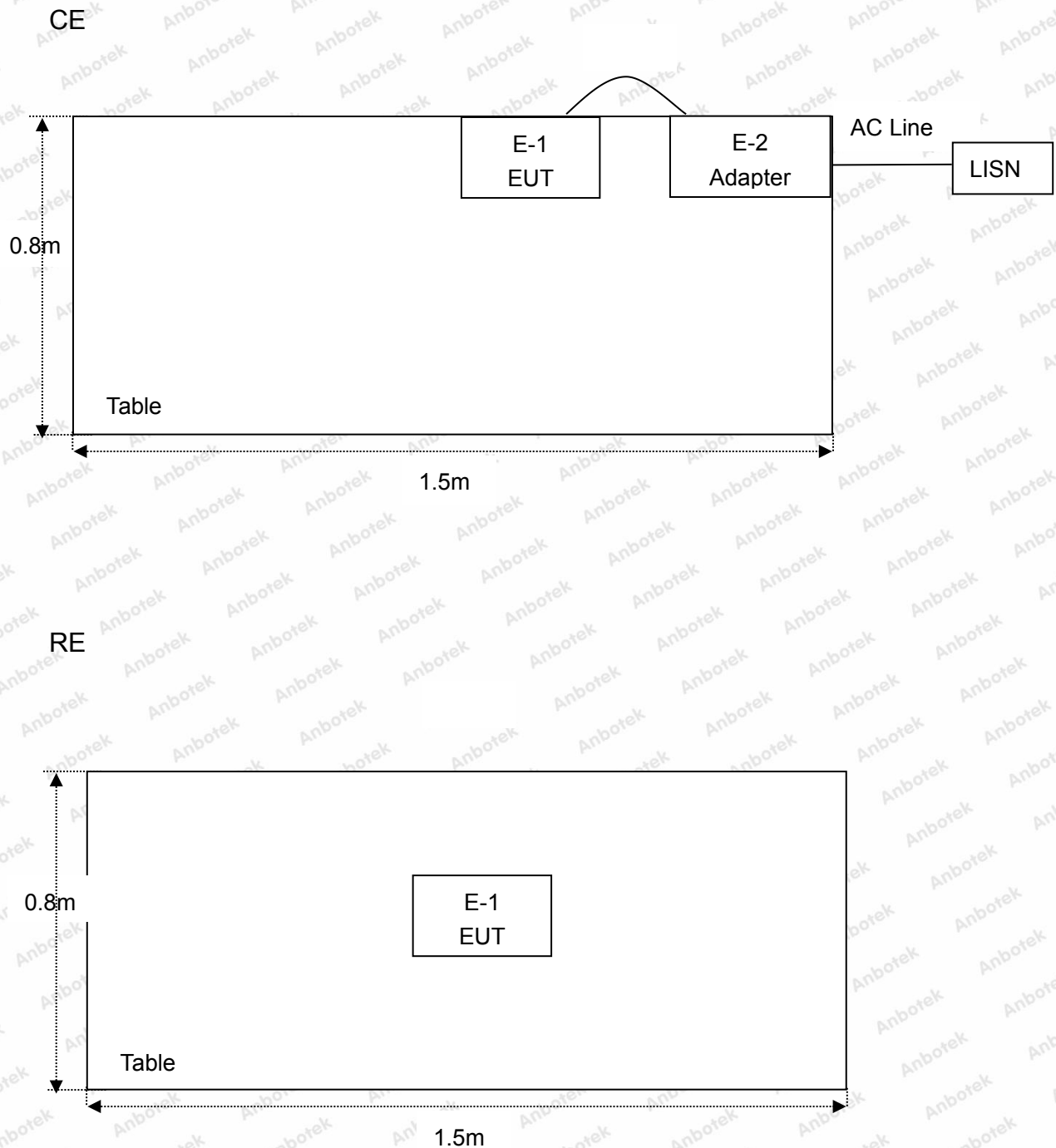
Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
01	13.56								

Note:

1. During the test, the EUT was keeping continuous transmission.



1.5. Description Of Test Setup



1.6. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Three Phase V-type Artificial Power Network	CYBERTEK	EM5040DT	E215040DT001	Jul 05, 2022	1 Year
2.	EMI Test Receiver	Rohde & Schwarz	ESCI	100627	Oct. 22, 2021	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESR26	101481	Oct. 22, 2021	1 Year
4.	RF Switching Unit	Compliance Direction	RSU-M2	38303	Oct. 22, 2021	1 Year
5.	MAX Spectrum Analysis	Agilent	N9020A	MY51170037	Oct. 22, 2021	1 Year
6.	Preamplifier	SKET Electronic	BK1G18G30 D	KD17503	Oct. 22, 2021	1 Year
7.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Oct. 22, 2021	2 Year
8.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Oct. 22, 2021	2 Year
9.	Loop Antenna	Schwarzbeck	FMZB1519B	00053	Oct. 22, 2021	2 Year
10.	Horn Antenna	A-INFO	LB-180400-K F	J211060628	Oct. 22, 2021	2 Year
11.	Pre-amplifier	SONOMA	310N	186860	Oct. 22, 2021	1 Year
12.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A
13.	RF Test Control System	YIHENG	YH3000	2017430	Oct. 22, 2021	1 Year
14.	Power Sensor	DAER	RPR3006W	15I00041SN045	Oct. 22, 2021	1 Year
15.	Power Sensor	DAER	RPR3006W	15I00041SN046	Oct. 22, 2021	1 Year
16.	MXA Spectrum Analysis	KEYSIGHT	N9020A	MY53280032	Oct. 22, 2021	1 Year
17.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Oct. 22, 2021	1 Year
18.	Signal Generator	Agilent	E4421B	MY41000743	Oct. 22, 2021	1 Year
19.	DC Power Supply	IVYTECH	IV3605	1804D360510	Oct. 22, 2021	1 Year
20.	Constant Temperature Humidity Chamber	ZHONGJIAN	ZJ-KHWS80 B	N/A	Oct. 22, 2021	1 Year



1.7. Measurement Uncertainty

Radiation Uncertainty	:	Ur = 3.9 dB (Horizontal)
		Ur = 3.8 dB (Vertical)
Conduction Uncertainty	:	Uc = 3.4 dB

1.8. Description of Test Facility

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

FCC-Registration No.: 184111

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No. 184111.

ISED-Registration No.: 8058A

Shenzhen Anbotek Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A.

Test Location

Shenzhen Anbotek Compliance Laboratory Limited.

1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong, China.518102



2. Summary of Test Results

Standard Section	Test Item	Result
15.203	Antenna Requirement	PASS
15.207	Conducted Emission	PASS
15.205/15.209/15.225	Spurious Emission	PASS
15.215(c)	20dB Occupied Bandwidth	PASS
15.225(e)	Frequency Tolerance	PASS
Remark: "N/A" is an abbreviation for Not Applicable.		



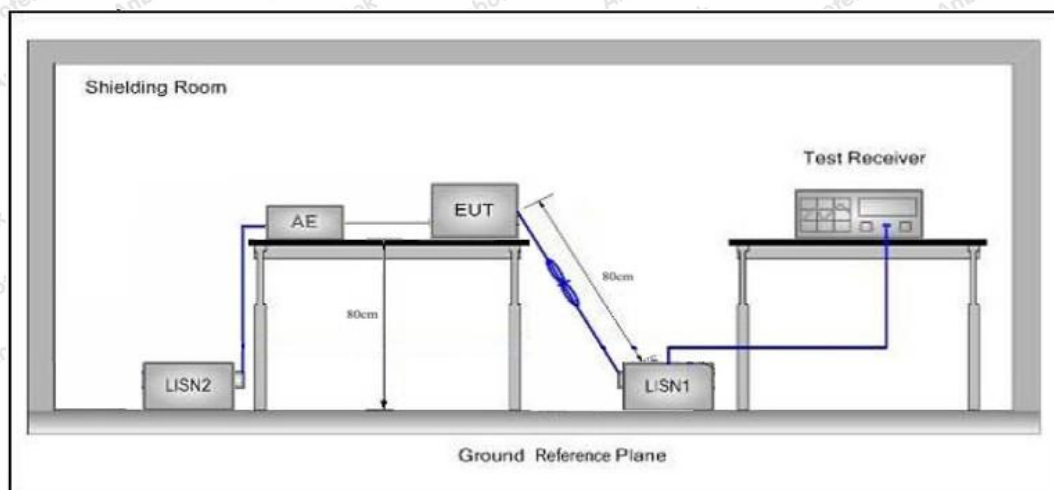
3. Conducted Emission Test

3.1. Test Standard and Limit

Test Standard	FCC Part15 Section 15.207		
Test Limit	Frequency	Maximum RF Line Voltage (dBuV)	
		Quasi-peak Level	Average Level
	150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
	500kHz~5MHz	56	46
	5MHz~30MHz	60	50

Remark: (1) *Decreasing linearly with logarithm of the frequency.
(2) The lower limit shall apply at the transition frequency.

3.2. Test Setup



3.3. Test Procedure

The EUT system is connected to the power mains through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm coupling impedance for the EUT system. Please refer the block diagram of the test setup and photographs. Both sides of AC line are checked to find out the maximum conducted emission. In order to find the maximum emission levels, the relative positions of equipment and all of the interface cables shall be changed according to FCC ANSI C63.10: 2020 on Conducted Emission Measurement.

The bandwidth of test receiver (ESCI) set at 9kHz.

The frequency range from 150kHz to 30MHz is checked.

3.4. Test Data

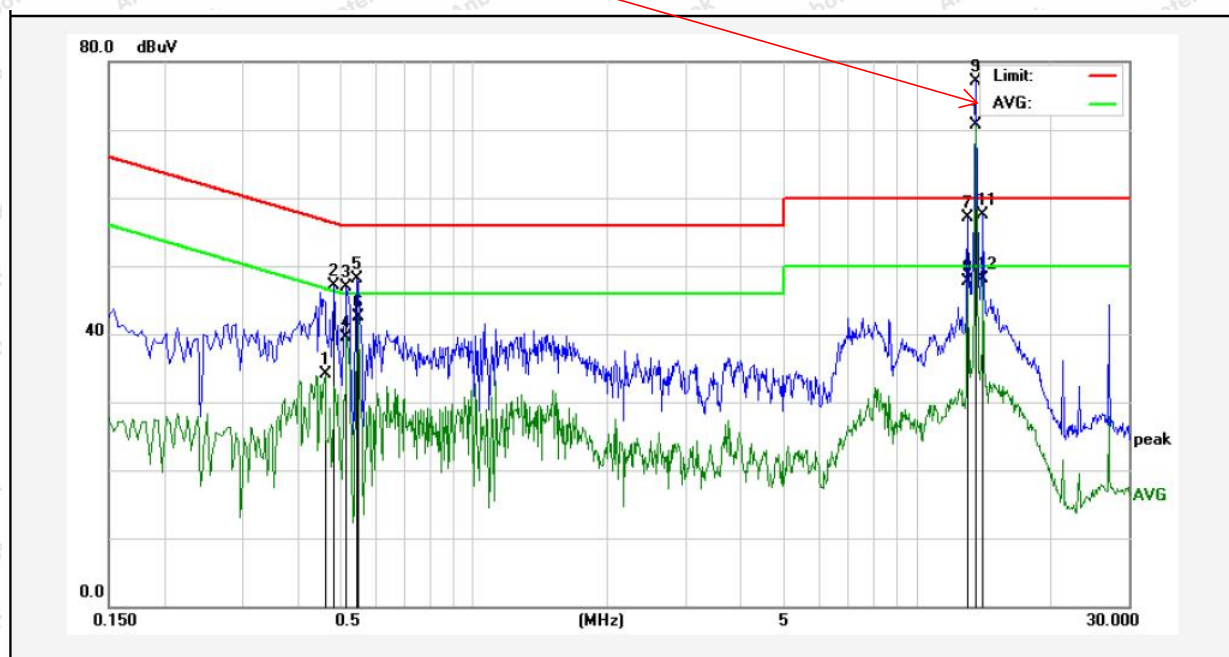
AC conducted emission pre-test at both at AC 120V/60Hz and AC 240V/60Hz modes, recorded worst case AC 120V/60Hz.

Please to see the following pages.



Conducted Emission Test Data

Test Site: 1# Shielded Room
 Operating Condition: 13.56MHz
 Test Specification: AC 120V, 60Hz for adapter
 Comment: Live Line
 Temp.(°C)/Hum.(%RH): 22.1°C/52%RH
 Fundamental

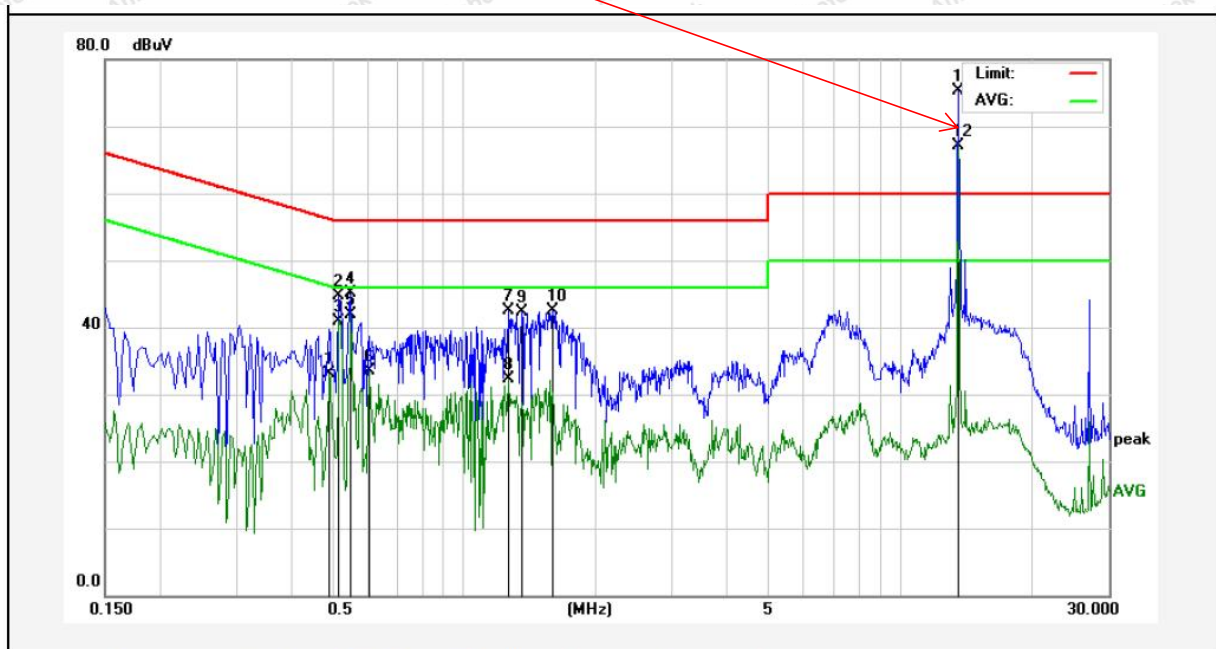


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Detector	Remark
1	0.4620	24.37	9.74	34.11	46.66	-12.55	AVG	
2	0.4860	37.37	9.75	47.12	56.24	-9.12	QP	
3	0.5180	37.24	9.76	47.00	56.00	-9.00	QP	
4	0.5180	29.83	9.76	39.59	46.00	-6.41	AVG	
5	0.5460	38.35	9.76	48.11	56.00	-7.89	QP	
6	0.5500	32.74	9.76	42.50	46.00	-3.50	AVG	
7	13.0060	47.18	9.93	57.11	60.00	-2.89	QP	
8	13.0060	37.70	9.93	47.63	50.00	-2.37	AVG	
9	13.5580	67.07	9.95	77.02	/	/	QP	
10	13.5580	60.68	9.95	70.63	/	/	AVG	
11	14.0780	47.64	9.96	57.60	60.00	-2.40	QP	
12	14.0780	38.24	9.96	48.20	50.00	-1.80	AVG	



Conducted Emission Test Data

Test Site: 1# Shielded Room
Operating Condition: 13.56MHz
Test Specification: AC 120V, 60Hz for adapter
Comment: Neutral Line
Temp.(°C)/Hum.(%RH): 22.1°C/52%RH
Fundamental



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB)	Result (dBuV)	Limit (dBuV)	Over Limit (dB)	Detector	Remark
1	0.4900	23.40	9.76	33.16	46.17	-13.01	AVG	
2	0.5180	34.97	9.76	44.73	56.00	-11.27	QP	
3	0.5180	31.20	9.76	40.96	46.00	-5.04	AVG	
4	0.5500	35.32	9.76	45.08	56.00	-10.92	QP	
5	0.5500	32.18	9.76	41.94	46.00	-4.06	AVG	
6	0.6060	23.83	9.76	33.59	46.00	-12.41	AVG	
7	1.2660	32.70	9.73	42.43	56.00	-13.57	QP	
8	1.2660	22.51	9.73	32.24	46.00	-13.76	AVG	
9	1.3540	32.57	9.73	42.30	56.00	-13.70	QP	
10	1.5940	32.85	9.73	42.58	56.00	-13.42	QP	
11	13.5580	65.42	9.95	75.37	/	/	QP	
12	13.5580	57.08	9.95	67.03	/	/	AVG	



4. Radiation Spurious Emission and Band Edge

4.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.205, 15.209 and 15.225				
Test Limit	Frequency (MHz)	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz~0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz~88MHz	100	40.0	Quasi-peak	3
	88MHz~216MHz	150	43.5	Quasi-peak	3
	216MHz~960MHz	200	46.0	Quasi-peak	3
	960MHz~1000MHz	500	54.0	Quasi-peak	3
	Above 1000MHz	500	54.0	Average	3
		-	74.0	Peak	3
Remark: (1)The lower limit shall apply at the transition frequency. (2) 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.					

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

Note:

(1) The tighter limit shall apply at the boundary between two frequency range.

(2) Limitation expressed in dBuV/m is calculated by $20\log$ Emission Level (uV/m).

(3) If measurement is made at 3m distance, then F.S Limitation at 3m distance is adjusted by using the formula of $Ld1 = Ld2 * (d2/d1)^2$.

Example:

F.S Limit at 30m distance is 30uV/m, then F.S Limitation at 3m distance is adjusted as



$$Ld1 = L1 = 30\mu V/m * (10)^2 = 100 * 30 \mu V/m$$

4.2. Test Setup

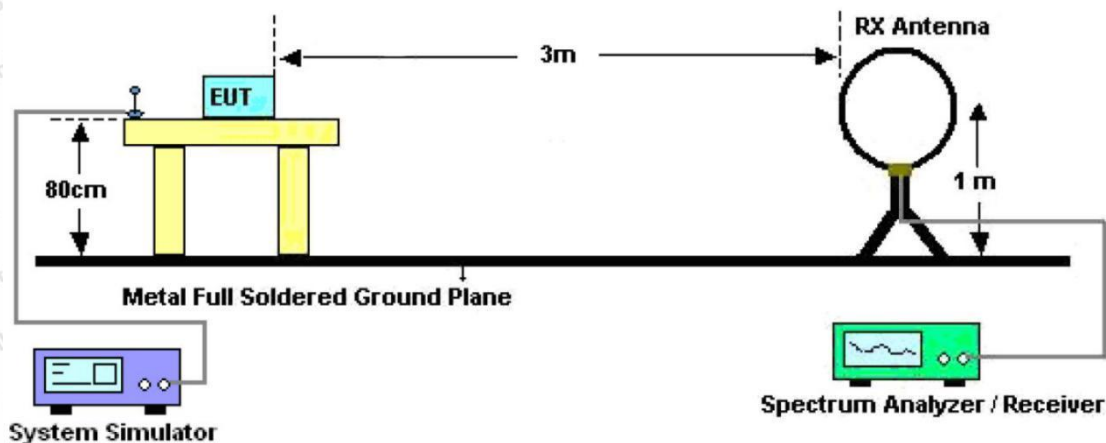


Figure 1. Below 30MHz

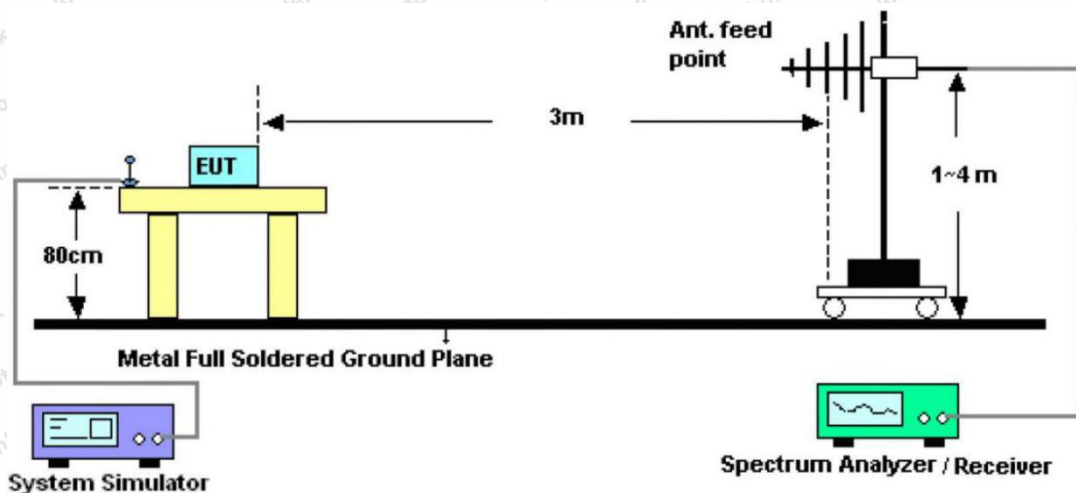


Figure 2. 30MHz to 1GHz

4.3. Test Procedure

For below 1GHz: The EUT is placed on a turntable, which is 0.8m above the ground plane.

The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT is set 3 meters away from the receiving antenna which is mounted on a antenna tower. The antenna can be moved up and down from 1 to 4 meters to find out the maximum emission level. Rotated the EUT through three orthogonal axes to determine the maximum emissions, both horizontal and vertical polarization of the antenna are set on test. The EUT is tested in 9*6*6 Chamber. The device is evaluated in xyz orientation.

For 9kHz to 150kHz, Set the spectrum analyzer as:

RBW = 200Hz, VBW = 1kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.

For 150kHz to 30MHz, Set the spectrum analyzer as:

RBW = 9KHz, VBW = 30kHz, Detector= Quasi-Peak, Trace mode= Max hold, Sweep- auto couple.



For 30MHz to 1000MHz, Set the spectrum analyzer as:

RBW = 100kHz, VBW = 300kHz, Detector = Quasi-Peak, Trace mode = Max hold, Sweep = auto couple.

4.4. Test Data

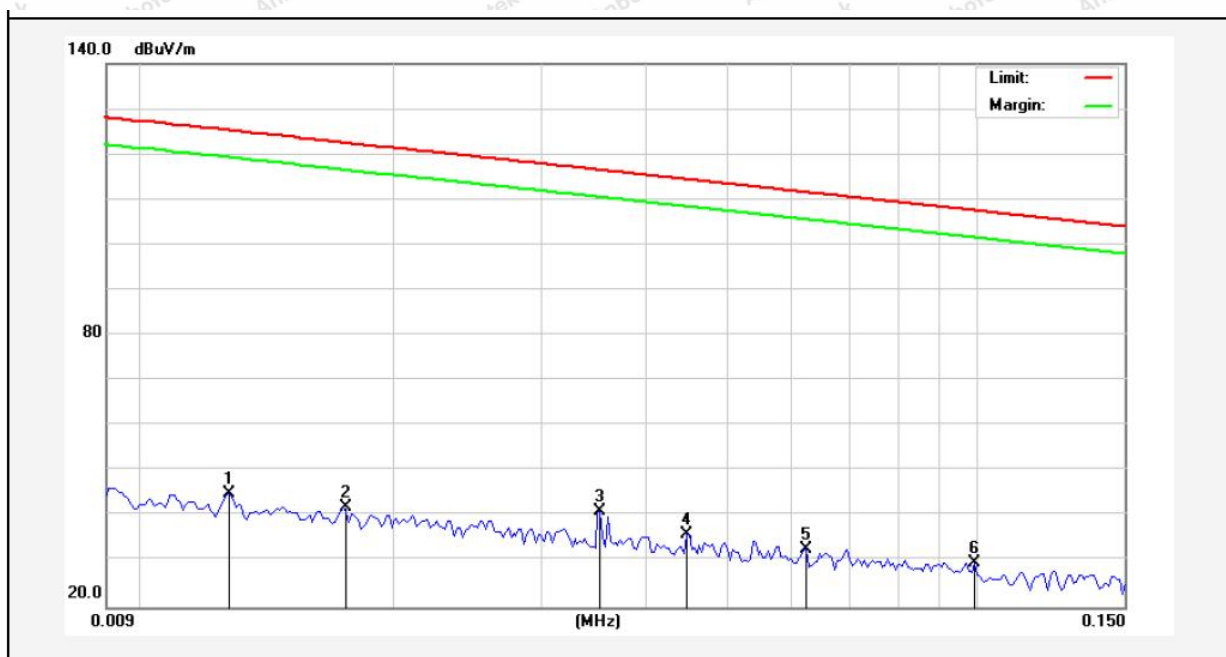
PASS

During the test, Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the X-axis is the worst case.



Test Results (9KHz~0.15MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: X
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH

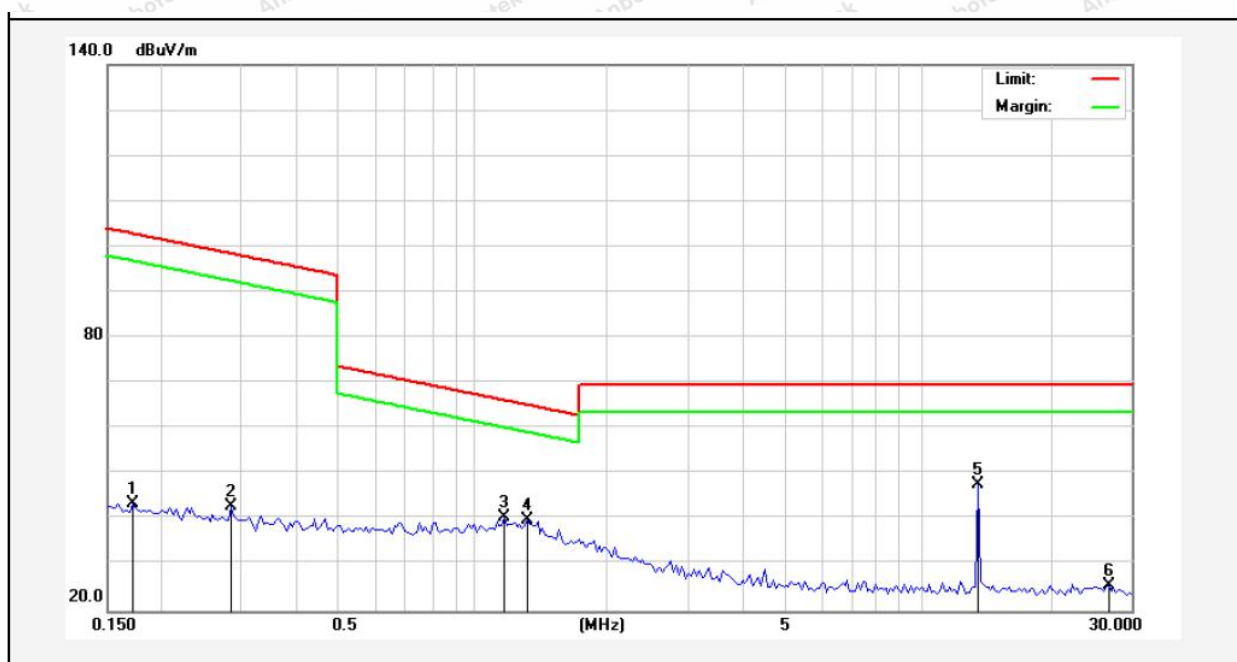


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	0.0126	24.91	20.14	45.05	125.40	-80.35	AVG			
2	0.0173	21.90	20.14	42.04	122.66	-80.62	AVG			
3	0.0352	20.73	20.48	41.21	116.53	-75.32	AVG			
4	0.0447	15.68	20.46	36.14	114.47	-78.33	AVG			
5	0.0623	12.53	20.37	32.90	111.60	-78.70	AVG			
6	0.0991	9.49	20.29	29.78	107.60	-77.82	AVG			



Test Results (0.15MHz~30MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: X
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH

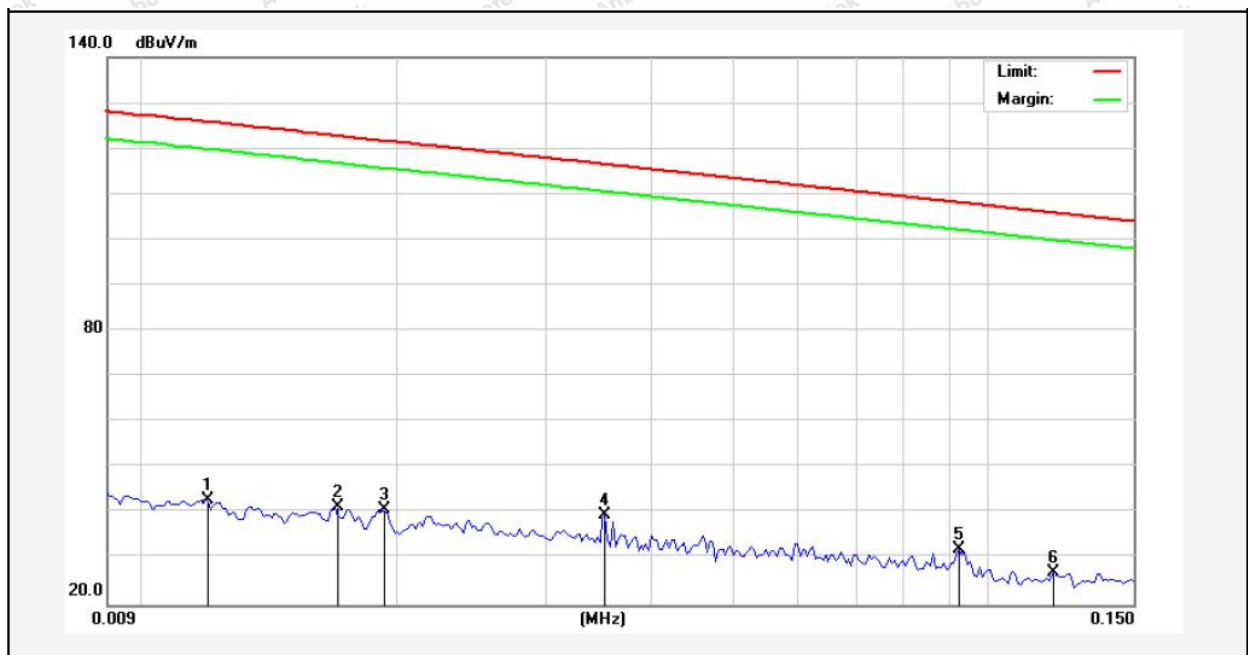


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	0.1712	23.21	20.32	43.53	102.88	-59.35	AVG			
2	0.2833	22.75	20.31	43.06	98.53	-55.47	AVG			
3	1.1688	20.40	20.26	40.66	66.27	-25.61	QP			
4	1.3168	19.56	20.26	39.82	65.24	-25.42	QP			
5	13.5509	27.30	20.53	47.83	69.50	-21.67	QP			
6	26.6286	5.02	20.68	25.70	69.50	-43.80	QP			



Test Results (9KHz~0.15MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: Y
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH

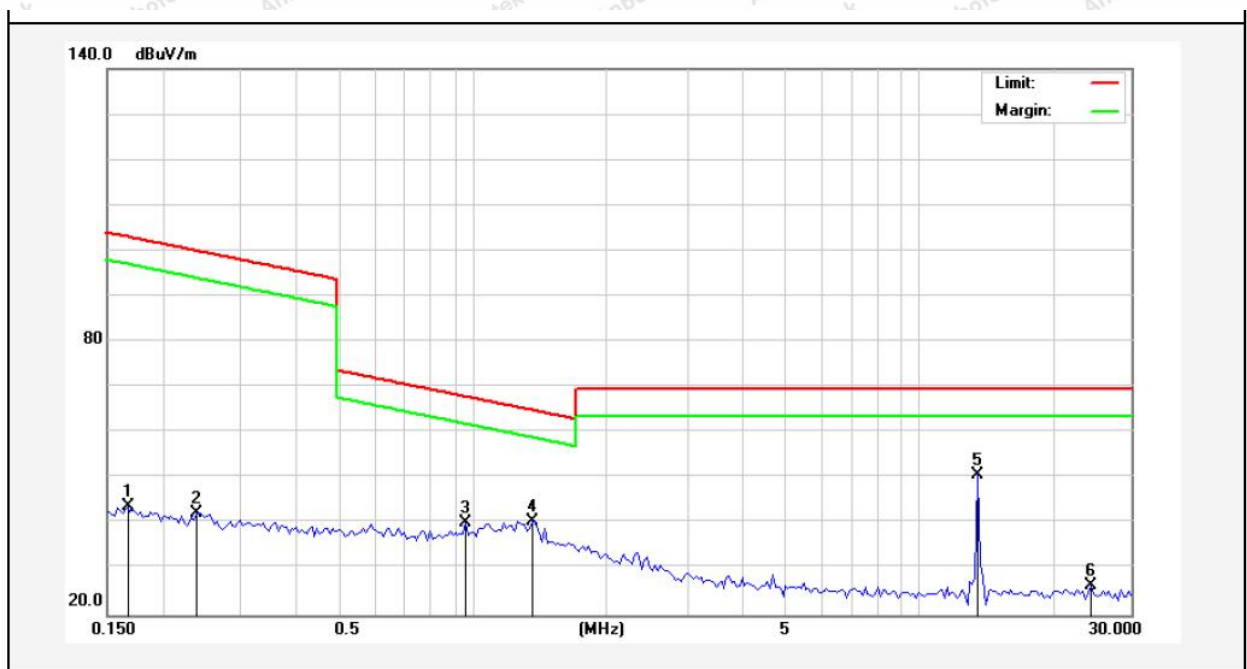


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	0.0118	22.94	20.10	43.04	125.97	-82.93	AVG			
2	0.0167	21.32	20.19	41.51	122.97	-81.46	AVG			
3	0.0190	20.43	20.31	40.74	121.86	-81.12	AVG			
4	0.0352	19.24	20.48	39.72	116.53	-76.81	AVG			
5	0.0930	11.80	20.32	32.12	108.14	-76.02	AVG			
6	0.1206	6.81	20.34	27.15	105.90	-78.75	AVG			



Test Results (0.15MHz~30MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: Y
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH

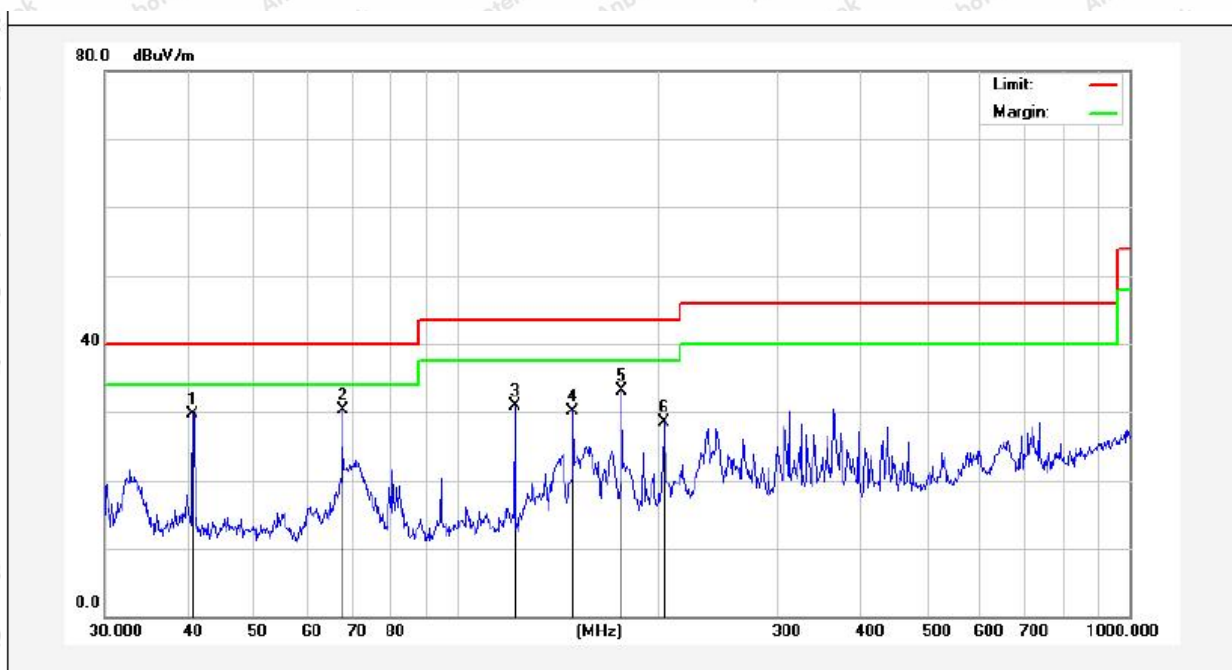


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	0.1668	23.52	20.32	43.84	103.10	-59.26	AVG			
2	0.2385	22.19	20.30	42.49	100.01	-57.52	AVG			
3	0.9582	20.05	20.26	40.31	67.99	-27.68	QP			
4	1.3521	20.25	20.26	40.51	65.01	-24.50	QP			
5	13.5509	30.17	20.53	50.70	69.50	-18.80	QP			
6	24.2706	5.75	20.65	26.40	69.50	-43.10	QP			



Test Results (30~1000MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: Horizontal
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH

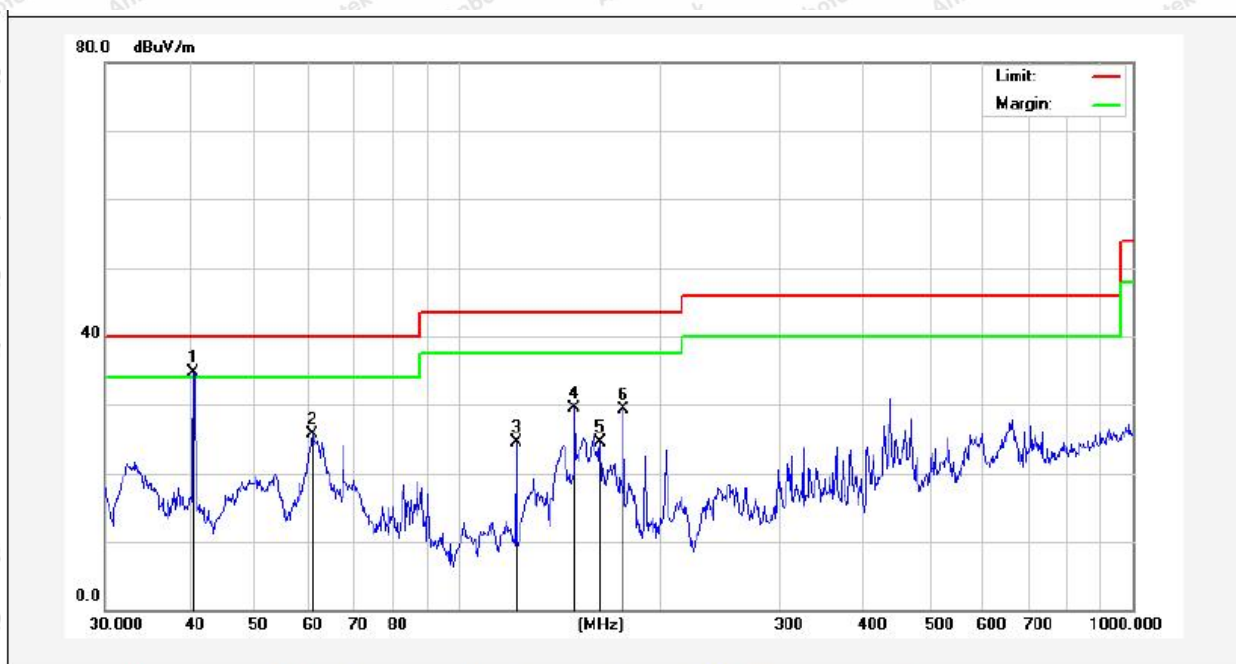


No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	40.5591	45.65	-15.94	29.71	40.00	-10.29	QP			
2	67.6751	51.14	-20.90	30.24	40.00	-9.76	QP			
3	121.9755	54.50	-23.66	30.84	43.50	-12.66	QP			
4	148.9625	52.94	-22.87	30.07	43.50	-13.43	QP			
5	176.2686	56.51	-23.33	33.18	43.50	-10.32	QP			
6	203.5228	50.73	-22.27	28.46	43.50	-15.04	QP			



Test Results (30~1000MHz)

Test Mode: 13.56MHz
Power Source: DC 3.7V Battery inside
Polarization: Vertical
Temp.(°C)/Hum.(%RH): 24.4°C/47%RH



No.	Freq. (MHz)	Reading (dBuV)	Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Height (cm)	degree (deg)	Remark
1	40.5591	49.39	-14.62	34.77	40.00	-5.23	QP			
2	60.9176	43.54	-17.82	25.72	40.00	-14.28	QP			
3	121.9755	44.66	-20.23	24.43	43.50	-19.07	QP			
4	148.9625	51.67	-22.10	29.57	43.50	-13.93	QP			
5	162.6106	46.05	-21.52	24.53	43.50	-18.97	QP			
6	176.2686	50.06	-20.79	29.27	43.50	-14.23	QP			



Test Results (Inband)

Indicated			Table Angle Degree	Antenna Height (m)	Detector	Correction Factor			Corrected Amplitude (dBuV/m) @3m	FCC part 15.225	
Frequency Range (MHz)	Mark Point (MHz)	Corrected Amplitude (dBuV/m) @3m				Ant. Factor (dB)	Cable Loss (dB)	Pre- Amp. Gain (dB)		Limit (dBuV/m) @3m	Result
13.110~13.410	13.387	75.80	0	1.0	QP	20.8	0.2	30.2	66.60	80.5	PASS
13.410~13.553	13.547	71.90	0	1.0	QP	20.9	0.2	30.2	62.80	90.5	PASS
13.553~13.567	13.558	97.16	0	1.0	QP	20.9	0.2	30.2	88.06	124	PASS
13.567~13.710	13.576	71.88	0	1.0	QP	21.1	0.2	30.2	62.98	90.5	PASS
13.710~14.010	13.889	70.03	0	1.0	QP	21.2	0.2	30.2	61.23	80.5	PASS

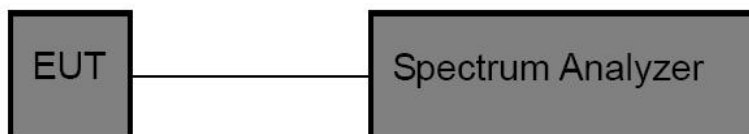


5. Frequency Tolerance

5.1. Test Requirement

Test Standard	FCC Part15 C Section 15.225(e)
Test Limit	±0.01% (100ppm)

5.2. Test Setup



5.3. Test Procedure

Let the EUT works on 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.

5.4. Test Data

Pass

Voltage (V)	Temperature (°C)	Frequency Measured (MHz)	Test data (ppm)	Limit (ppm)	Verdict
DC 3.7V	-20	13.560257	18.95	±100	PASS
	-10	13.560246	18.13	±100	PASS
	0	13.560237	17.49	±100	PASS
	+10	13.560261	19.27	±100	PASS
	+20	13.560259	19.11	±100	PASS
	+30	13.560220	16.19	±100	PASS
	+40	13.560246	18.13	±100	PASS
	+50	13.560262	19.35	±100	PASS
DC 3.33V	+20	13.560245	18.05	±100	PASS
DC 4.07V	+20	13.560204	15.05	±100	PASS

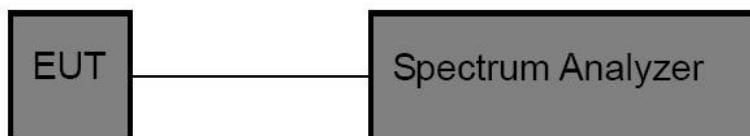


6. 20DB Occupy Bandwidth Test

6.1. Test Standard and Limit

Test Standard	FCC Part15 C Section 15.215(c)
Test Limit	N/A

6.2. Test Setup



6.3. Test Procedure

The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3kHz RBW and VBW $\geq$ 3*RBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

6.4. Test Data

Test Item	: 20dB Bandwidth	Test Mode	: Continuously transmitting
Test Voltage	: DC 3.7V Battery inside	Temperature	: 24℃
Test Result	: PASS	Humidity	: 55%RH



Freq. (MHz)	Modulation Type	Bandwidth (kHz)	Results
13.56	BPSK	32	PASS



7. Antenna Requirement

7.1. Test Standard and Requirement

Test Standard	FCC Part15 Section 15.203
Requirement	1) 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.

7.2. Antenna Connected Construction

The antenna is a Inductive loop coil Antenna which permanently attached, and the best case gain of the antenna is 0 dBi. It complies with the standard requirement.



APPENDIX I -- TEST SETUP PHOTOGRAPH

Please refer to separated files Appendix I -- Test Setup Photograph_RF ID

APPENDIX II -- EXTERNAL PHOTOGRAPH

Please refer to separated files Appendix II -- External Photograph

APPENDIX III -- INTERNAL PHOTOGRAPH

Please refer to separated files Appendix III -- Internal Photograph

----- End of Report -----

