RF TEST REPORT

FCC ID: 2BHC7-WAVESHAREN001

Product Name	:	NFC-POWERED E-PAPER MODULE
Brand Name	:	WAVESHARE
Test Model	:	NFC-Powered e-Paper Module
Series Model	:	NFC-Powered e-Paper, NFC e-Paper Eval Kit
Applicant	:	Shenzhen Waveshare Electronics Co., Ltd.
Address	:	202 2F, World Trade Plaza Funan Community Futian Street, Futian District, Shenzhen,China
Manufacturer	:	Shenzhen Waveshare Electronics Co., Ltd.
Address	:	202 2F, World Trade Plaza Funan Community Futian Street, Futian District, Shenzhen,China
Date of Receipt	:	2024.06.27
Date of Test	:	2024.06.27~2024.07.03
Issued Date	:	2024.07.03
Report Version	:	V1.0
Test Sample	:	Engineering Sample No.: AiTDG-240627002001
Standard(s)	:	FCC Part 15 Subpart C § 15.225

Lab: Guangdong Asia Hongke Test Technology Limited
Add: B1/F, Building 11, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Tel.: +86 0755-230967639 Fax.: +86 0755-230967639

This device described above has been tested by Guangdong Asia Hongke Test Technology Limited and the test results show that the equipment under test (EUT) is in compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

Reviewed by: Leon Yi
Leon.yi

Approved by: Sean She
Sean She

REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2024.07.03	Valid	Initial Release

TABLE OF CONTENTS

1. GENERAL INFORMATION

Items	Description
Equipment Name	NFC-POWERED E-PAPER MODULE
Trademark	WAVESHARE
Test Model Number	NFC-Powered e-Paper Module
Series Model	NFC-Powered e-Paper, NFC e-Paper Eval Kit
Difference Description	Only different of model name.
Power Supply	Power by phone
Antenna Type:	Loop antenna
Antenna Gain:	0dBi
Test Result	Pass

2. PRODUCT INFORMATION

2.1 PRODUCT TECHNICAL DESCRIPTION

Hardware Version	V1.0
Software Version	V1.0
Operation Frequency	13.56MHz
Modulation Type	ASK
Number of channels	1
Field Strength of Fundamental	75.42dBuV/m
Antenna Designation	Loop Antenna
Antenna Gain	0dBi

2.2 TEST FREQUENCY LIST

Frequency Band	Channel Number	Frequency
13.110~14.010 MHz	01	13.56 MHz

2.3 TEST METHODOLOGY

The tests were performed according to following standards:

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

2.4 SPECIAL ACCESSORIES

Not available for this EUT intended for grant.

2.5 EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

2.6 ANTENNA REQUIREMENT

Standard Requirement
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 antennathat uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a brokenantenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.
EUT Antenna:
The loop antenna inside the device cannot be replaced by the user at will. The gain of the antenna is 0dBi.

3. TEST ENVIRONMENT

3.1 ADDRESS OF THE TEST LABORATORY

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

FCC-Registration No.: 251906 Designation Number: CN1376

Guangdong Asia Hongke Test Technology Limited 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.

IC —Registration No.: 31737 CAB identifier: CN0165

The 3m Semi-anechoic chamber of Guangdong Asia Hongke Test Technology Limited has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 31737

A2LA-Lab Cert. No.: 7133.01

Guangdong Asia Hongke Test Technology Limited has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

3.3 ENVIRONMENTAL CONDITIONS

	NORMAL CONDITIONS	EXTREME CONDITIONS
Temperature range (℃)	15 - 35	-10℃~50℃
Relative humidty range	20 % - 75 %	20 % - 75 %
Pressure range (kPa)	86 - 106	86 - 106
Power supply	DC 3.8V	DC 3.42V or DC 4.18V
Note: The Extreme Temperature and Extreme Voltages declared by the manufacturer.		

3.4 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Item	Measurement Uncertainty
Uncertainty of Conducted Emission for AC Port	U_c = ±3.1 dB
Uncertainty of Radiated Emission below 150kHz	U_c = ±4.2 dB
Uncertainty of Radiated Emission below 30MHz	U_c = ±3.8 dB
Uncertainty of Radiated Emission below 1GHz	U_c = ±4.0 dB
Uncertainty of total RF power, conducted	U_c = ±0.8 dB
Uncertainty of RF power density, conducted	U_c = ±2.6 dB
Uncertainty of spurious emissions, conducted	U_c = ±2 %
Uncertainty of Occupied Channel Bandwidth	U_c = ±2 %

3.5 LIST OF EQUIPMENTS USED

No	Test Equipment	Manufacturer	Model No	Serial No	Cal. Date	Cal. Due Date
1	Spectrum Analyzer	R&S	FSV40	101470	2023.09.08	2024.09.07
2	Spectrum Analyzer	Keysight	N9020A	MY51280643	2023.09.08	2024.09.07
3	EMI Measuring Receiver	R&S	ESR	101660	2023.09.08	2024.09.07
4	Low Noise Pre-Amplifier	HP	HP8447E	1937A01855	2023.09.08	2024.09.07
5	Low Noise Pre-Amplifier	Tsj	MLA-0120-A02-34	2648A04738	2023.09.08	2024.09.07
6	Passive Loop	ETS	6512	00165355	2022.09.04	2024.09.03
7	TRILOG Super Broadband test Antenna	SCHWARZBECK	VULB9160	9160-3206	2021.08.29	2024.08.28
8	Broadband Horn Antenna	SCHWARZBECK	BBHA9120D	452	2021.08.29	2024.08.28
9	SHF-EHF Horn Antenna 15-40GHz	SCHWARZBECK	BBHA9170	BBHA9170367d	2021.08.29	2024.08.28
10	EMI Measuring Receiver	R&S	ESR	101160	2023.09.13	2024.09.12
11	LISN	R&S	ESH3-Z5	892785/016	2023.09.08	2024.09.07
12	Pulse Limiter	R&S	ESH3-Z2	102789	2023.09.13	2024.09.12
13	Pro.Temp&Humi.chamber	MENTEK	MHP-150-1C	MAA08112501	2023.09.08	2024.09.07
14	RF Automatic Test system	MW	MW100-RFCB	21033016	2023.09.08	2024.09.07
15	Signal Generator	Agilent	N5182A	MY50143009	2023.09.08	2024.09.07
16	Wideband Radio communication tester	R&S	CMW500	1201.0002K50	2023.09.08	2024.09.07
17	RF Automatic Test system	MW	MW100-RFCB	21033016	2023.09.08	2024.09.07
18	Switch	MFJ Rhinos	MFJ-2702	CZ3457	2023.09.08	2024.09.07
19	DC power supply	ZHAOXIN	RXN-305D-2	28070002559	N/A	N/A
20	RE Software	EZ	EZ-EMC_RE	Ver.AIT-03A	N/A	N/A
21	CE Software	EZ	EZ-EMC_CE	Ver.AIT-03A	N/A	N/A
22	RF Software	MW	MTS 8310	2.0.0.0	N/A	N/A
23	temporary antenna connector(Note)	NTS	R001	N/A	N/A	N/A
Note: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.						

4.SYSTEM TEST CONFIGURATION

4.1 EUT CONFIGURATION

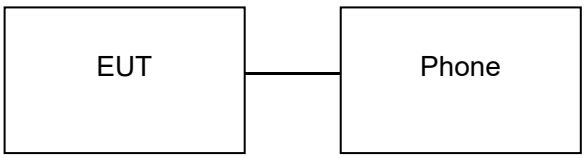
The EUT configuration for testing is installed on RF field strength measurement to meet the Commission's requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT EXERCISE

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

4.3 CONFIGURATION OF TESTED SYSTEM

Radiated Emission Configure:



4.4 EQUIPMENT USED IN TESTED SYSTEM

The Following Peripheral Devices And Interface Cables Were Connected During The Measurement:
☐ Test Accessories Come From The Laboratory
☒ Test Accessories Come From The Manufacturer

Item	Equipment	Model No.	Identifier	Note
1	Phone	iPhone 14	N/A	N/A

4.5 SUMMARY OF TEST RESULTS

Item	FCC Rules	Description Of Test	Result
1	§15.203	Antenna Equipment	Pass
2	15.225(a)(b)(c)	Field Strength of Fundamental	Pass
3	§15.209	Radiated Emission	Pass
4	§15.215(c)	20dB Bandwidth	Pass
5	§15.205(a)	Restricted Bands of Operation	Pass
6	§15.225(e)	Frequency Stability	Pass
7	§15.207	AC Power Line Conducted Emission	N/A

Note: 'N/A' means not applicable

5. DESCRIPTION OF TEST MODES

Summary table of Test Cases	
Test Item	Sepcification / Modulation
	NFC/ ASK
Radiated Test Cases	Mode 1: NFC Tx _13.56 MHz

Note:
1. Only the result of the worst case was recorded in the report, if no other cases.
2. For Radiated Emission, 3axis were chosen for testing for each applicable mode.

6. FIELD STRENGTH OF FUNDAMENTAL

6.1 PROVISIONS APPLICABLE

Rules and specifications	FCC CFR 47 Part 15 section 15.225			
Description	Compliance with the spectrum mask is tested with RBW set to 9kHz.			
Freq. of Emission (MHz)	Field Strength (μV/m) at 30m	Field Strength (dBμV/m) at 30m	Field Strength (dBμV/m) at 10m	Field Strength (dBμV/m) at 3m
1.705~13.110	30	29.5	48.58	69.5
13.110~13.410	106	40.5	59.58	80.5
13.410~13.553	334	50.5	69.58	90.5
13.553~13.567	15848	84.0	103.08	124.0
13.567~13.710	334	50.5	69.58	90.5
13.710~14.010	106	40.5	59.58	80.5
14.010~30.000	30	29.5	48.58	69.5

6.2 MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one

complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.

8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

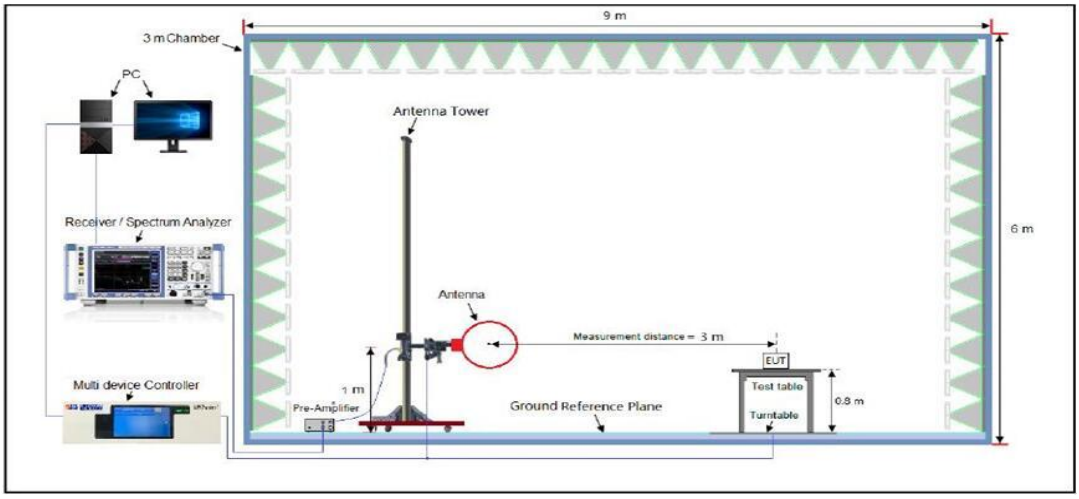
The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/3MHz for Peak, 1MHz/3MHz for Average

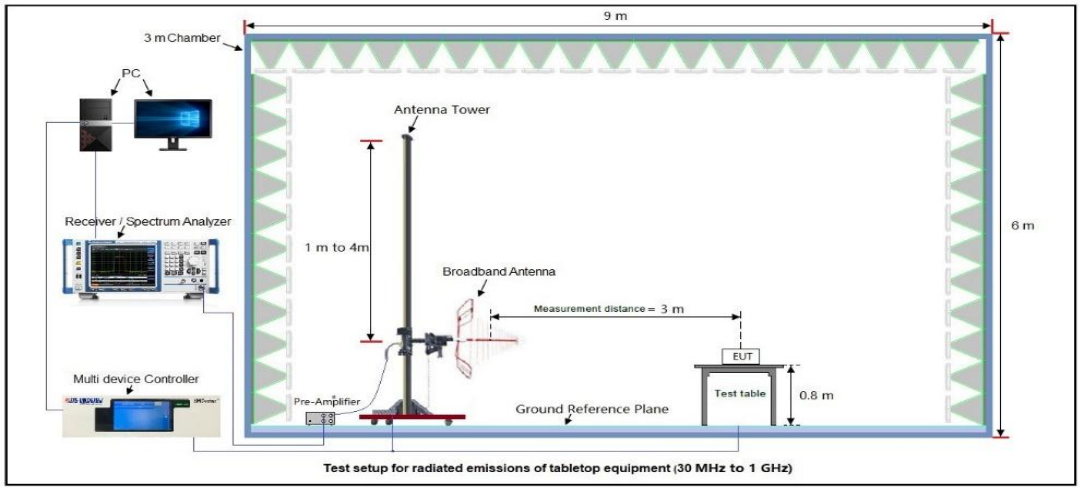
Receiver Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

6.3 MEASUREMENT SETUP (BLOCK DIAGRAM OF CONFIGURATION)

RADIATED EMISSION TEST SETUP 9KHz-30MHz



RADIATED EMISSION TEST SETUP 30MHz-1000MHz



Test setup for radiated emissions of tabletop equipment (30 MHz to 1 GHz)

6.4 MEASUREMENT RESULTS

Note: Horizontal is the worst polarization.

Freq.	Reading	Limit	Margin	Detector	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	(PK/QP/AV)	P/F
12.12	37.12	69.54	-32.42	QP	PASS
13.33	42.51	80.51	-38.0	QP	PASS
13.45	48.33	90.47	-42.14	QP	PASS
13.56	75.42	124.00	-48.58	QP	PASS
13.67	49.17	90.47	-41.3	QP	PASS
13.89	41.19	80.51	-39.32	QP	PASS
15.21	38.32	69.54	-31.22	QP	PASS

Note:15.31(f)(2) f < 30 MHz, extrapolation factor of 40 dB/decade of distance

7. RADIATED EMISSION

7.1 LIMITS OF RADIATED EMISSION TEST

According to 15.35, on any frequency or frequencies below or equal to 1000 MHz, the limits Shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, 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.

The field strength of any emissions which appear outside of 13.110 ~14.010MHz band shall not exceed the general radiated emissions limits.

15.209 Limit in the below table has to be followed:

Frequency (MHz)	Distance Meters	Field Strengths Limit	
		μV/m	dB(μV)/m
0.009 ~ 0.490	300	2400/F(kHz)	---
0.490 ~ 1.705	30	24000/F(kHz)	---
1.705 ~ 30	30	30	---
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	
Remark: (1) Emission level dB μV = 20 log Emission level μV/m (2) The smaller limit shall apply at the cross point between two frequency bands. (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.			

Note: All modes were tested for restricted band radiated emission, the test records reported below are the worst result compared to other modes.

7.2 MEASUREMENT PROCEDURE

1. The EUT was placed on the top of the turntable 0.8 or 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above

ground to find the maximum emissions field strength of both horizontal and vertical polarization.

4. For each suspected emission, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz RBW and 3MHz VBW for peak reading. Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
7. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum values.
8. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
9. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
10. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High - Low scan is not required in this case.

The following table is the setting of spectrum analyzer and receiver.

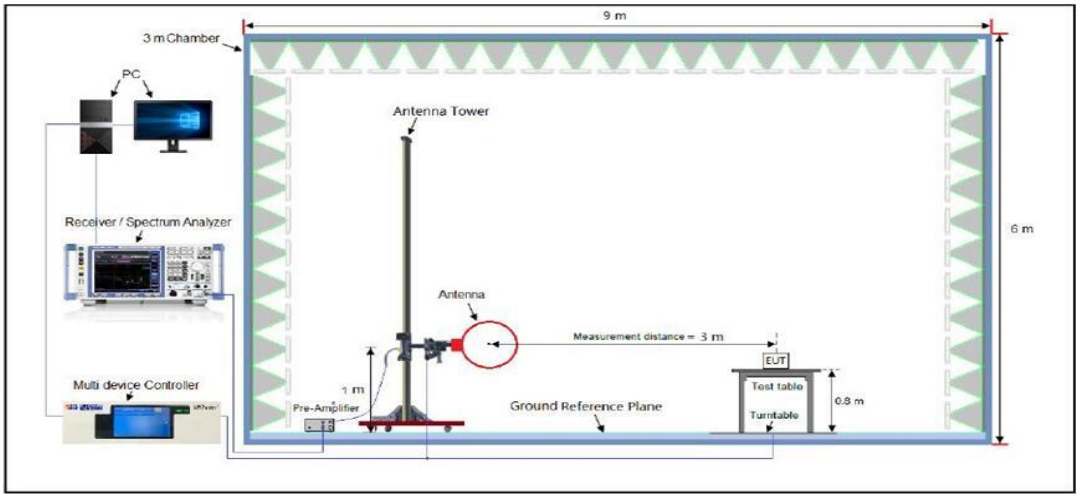
Spectrum Parameter	Setting
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP
Start ~Stop Frequency	1GHz~26.5GHz 1MHz/3MHz for Peak, 1MHz/3MHz for Average

Receiver Parameter	Setting

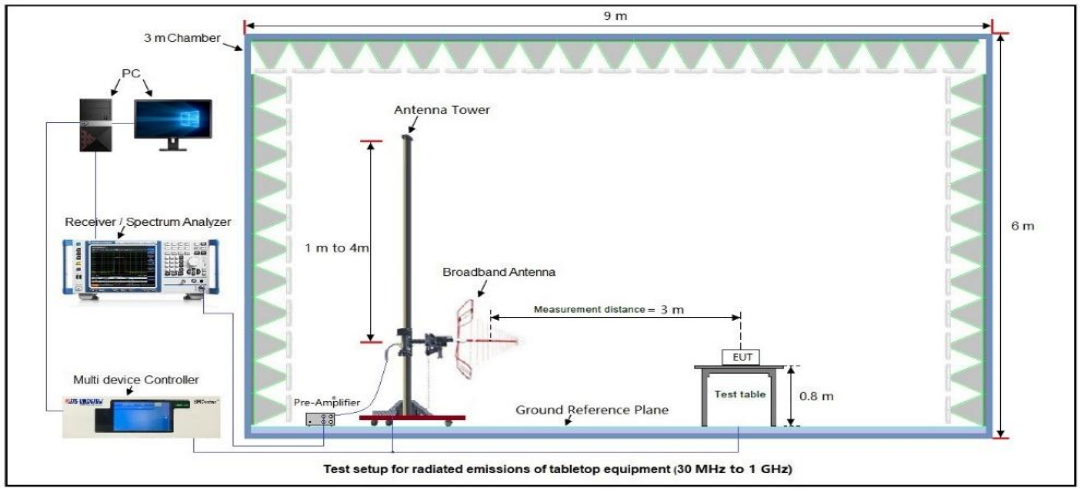
Start ~Stop Frequency	9KHz~150KHz/RB 200Hz for QP
Start ~Stop Frequency	150KHz~30MHz/RB 9KHz for QP
Start ~Stop Frequency	30MHz~1000MHz/RB 120KHz for QP

7.3 MEASUREMENT SETUP (BLOCK DIAGRAM OF CONFIGURATION)

RADIATED EMISSION TEST SETUP 9KHz-30MHz



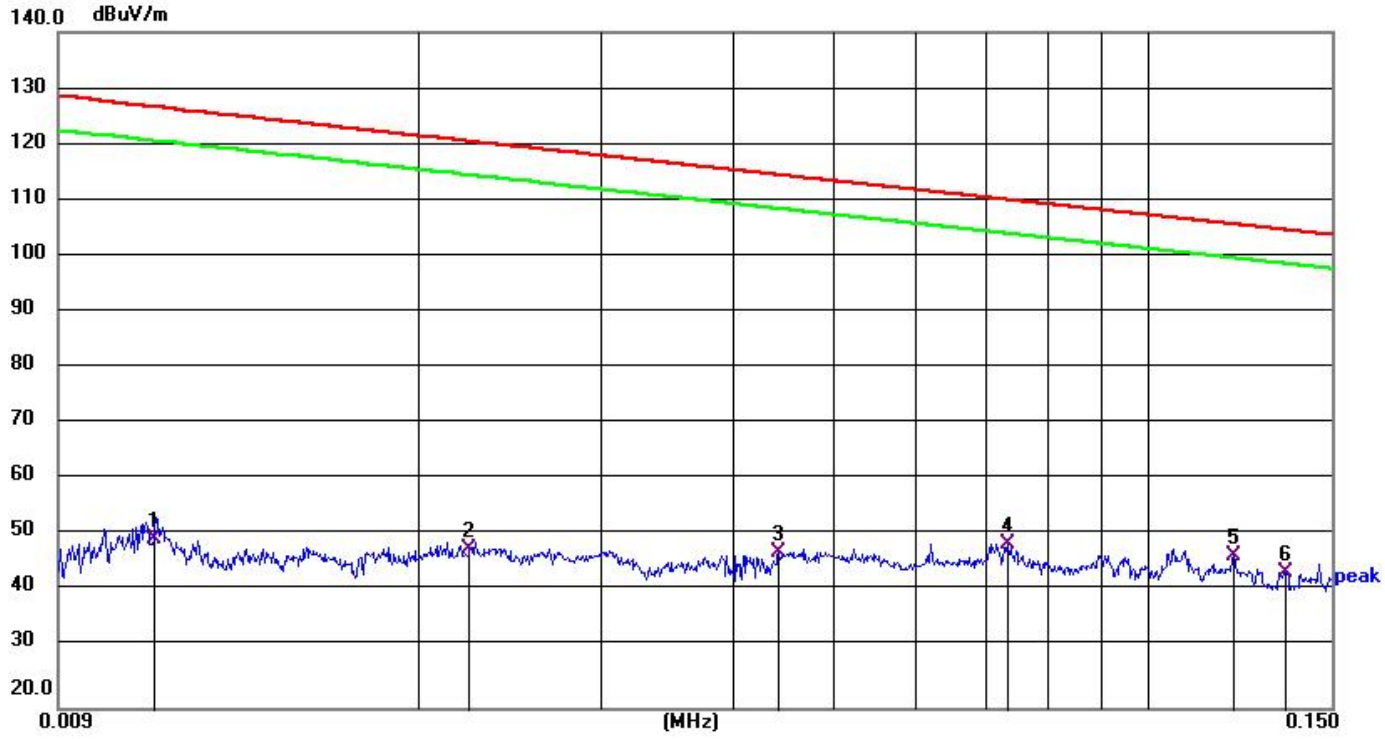
RADIATED EMISSION TEST SETUP 30MHz-1000MHz



7.4 MEASUREMENT RESULT

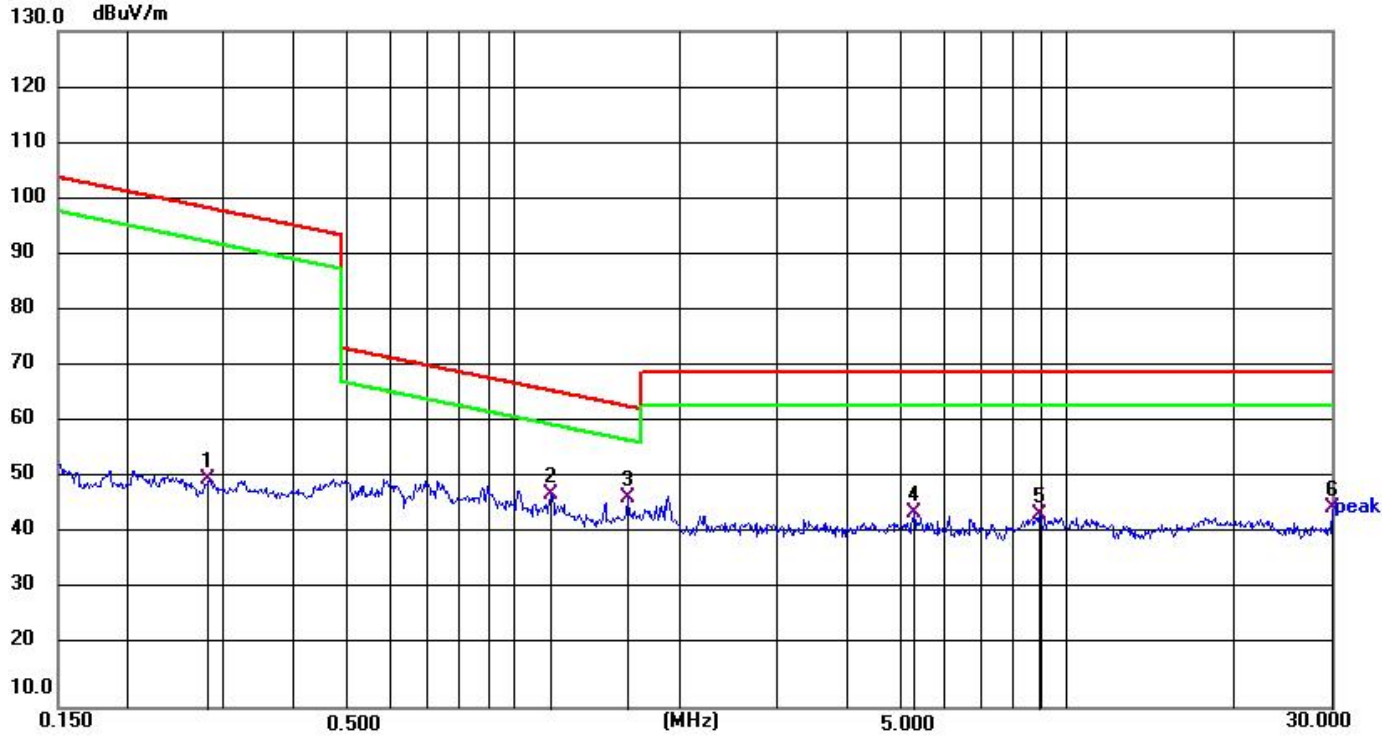
RADIATED EMISSION BELOW 30MHz

EUT	NFC-POWERED E-PAPER MODULE	Model Name	NFC-Powered e-Paper Module
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	/



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	0.0111	28.75	21.36	50.11	126.70	-76.59	QP
2	0.0223	27.54	20.94	48.48	120.64	-72.16	QP
3	0.0442	25.62	22.25	47.87	114.70	-66.83	QP
4	0.0734	26.62	22.68	49.30	110.29	-60.99	QP
5 *	0.1207	25.08	22.19	47.27	105.97	-58.70	QP
6	0.1355	22.16	22.04	44.20	104.97	-60.77	QP

EUT	NFC-POWERED E-PAPER MODULE	Model Name	NFC-Powered e-Paper Module
Temperature	25° C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	/



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	0.2816	29.08	21.45	50.53	98.61	-48.08	QP
2	1.1653	25.18	22.57	47.75	66.28	-18.53	QP
3 *	1.6104	24.82	22.48	47.30	63.47	-16.17	QP
4	5.2770	21.37	23.26	44.63	69.54	-24.91	QP
5	8.9161	21.47	22.75	44.22	69.54	-25.32	QP
6	30.0000	24.12	21.26	45.38	69.54	-24.16	QP

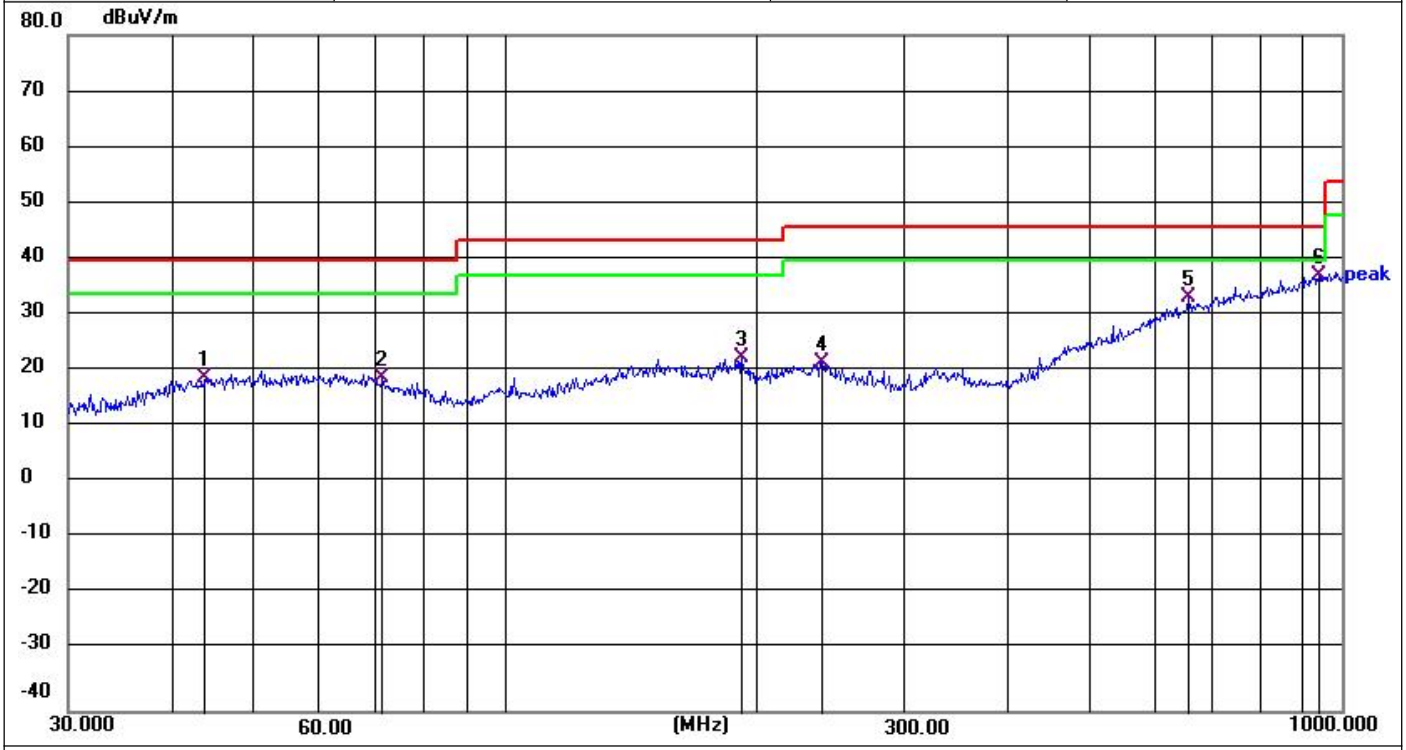
RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. All test modes had been pre-tested. The mode 1 is the worst case and recorded in the report.

RADIATED EMISSION FROM 30MHz ~1000MHz

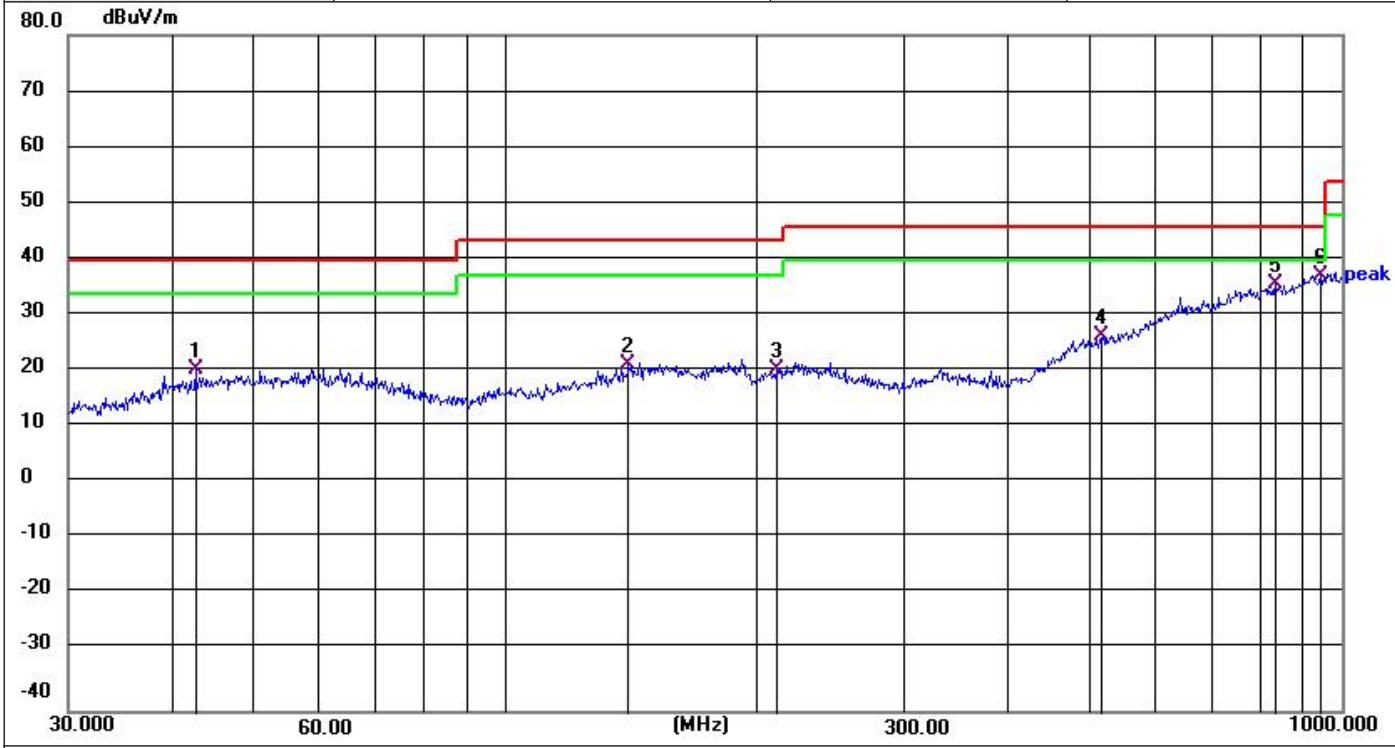
EUT	NFC-POWERED E-PAPER MODULE	Model Name	NFC-Powered e-Paper Module
Temperature	25°C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	43.8119	32.58	-13.33	19.25	40.00	-20.75	QP
2	71.3300	33.47	-14.08	19.39	40.00	-20.61	QP
3	191.7450	34.35	-11.63	22.72	43.50	-20.78	QP
4	239.1473	33.85	-11.79	22.06	46.00	-23.94	QP
5	656.5300	35.97	-2.49	33.48	46.00	-12.52	QP
6 *	938.8326	35.04	2.33	37.37	46.00	-8.63	QP

RESULT: PASS

EUT	NFC-POWERED E-PAPER MODULE	Model Name	NFC-Powered e-Paper Module
Temperature	25° C	Relative Humidity	55.4%
Pressure	960hPa	Test Voltage	Normal Voltage
Test Mode	Mode 1	Antenna	Vertical



No.	Frequency (MHz)	Reading (dBuV)	Factor (dB/m)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Det.
1	42.6000	33.22	-12.60	20.62	40.00	-19.38	QP
2	140.3421	35.76	-14.01	21.75	43.50	-21.75	QP
3	210.7860	36.39	-15.54	20.85	43.50	-22.65	QP
4	519.0649	32.44	-5.79	26.65	46.00	-19.35	QP
5	833.3171	36.36	-0.57	35.79	46.00	-10.21	QP
6 *	942.1305	35.98	1.37	37.35	46.00	-8.65	QP

RESULT: PASS

Note: 1. Factor=Antenna Factor + Cable loss, Margin=Measurement-Limit.

2. All test modes had been pre-tested. The mode 1 is the worst case and recorded in the report.

8. 20 dB BANDWIDTH

8.1 PROVISIONS APPLICABLE

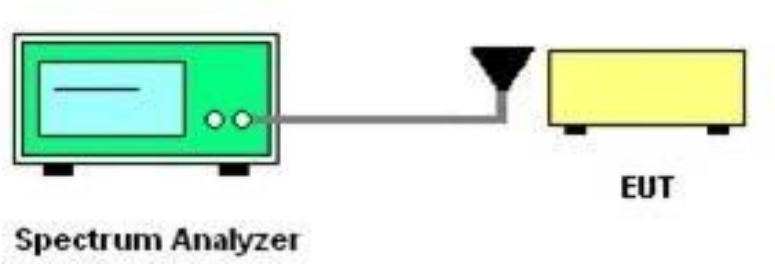
Intentional radiators must be designed to ensure that the 20dB and 99% emission bandwidth in the specific band 13.553~13.567MHz.

8.2 MEASUREMENT PROCEDURE

Set the parameters of SPA as below:

1. The spectrum analyzer connected via a receive antenna placed near the EUT in peak Max hold mode.
2. Centre frequency = Operation Frequency
3. The resolution bandwidth of 10 kHz and the video bandwidth of 30 kHz were used.
4. Span: 60kHz, Sweep time: Auto
5. Set the EUT to continue transmitting mode. Allow the trace to stabilize. Use the “N dB down” function of SPA to define the bandwidth.
6. Measured the spectrum width with power higher than 20dB below carrier.
7. Measured the 99% OBW.
8. Record the plots and Reported.

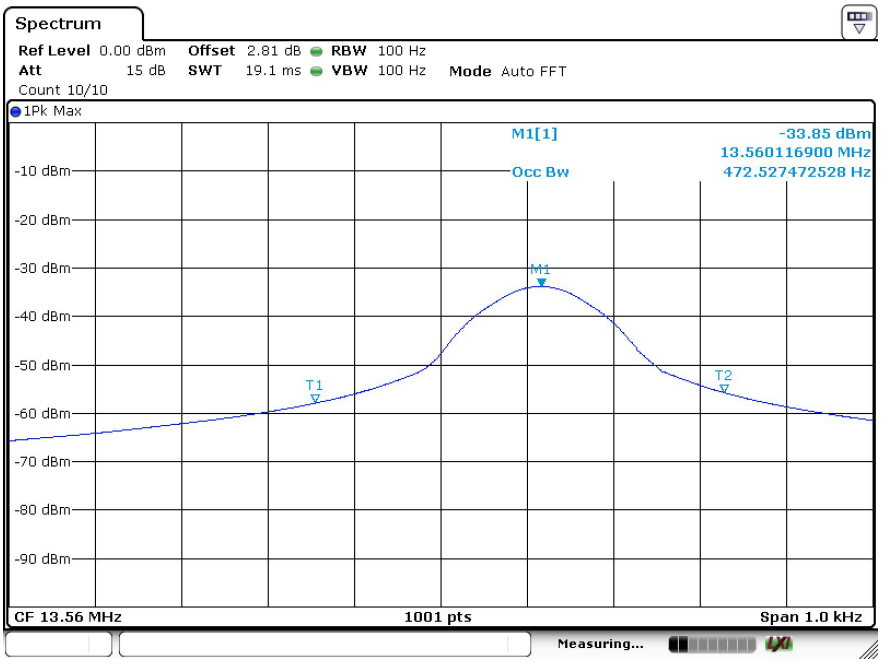
8.3 MEASUREMENT SETUP (BLOCK DIAGRAM OF CONFIGURATION)

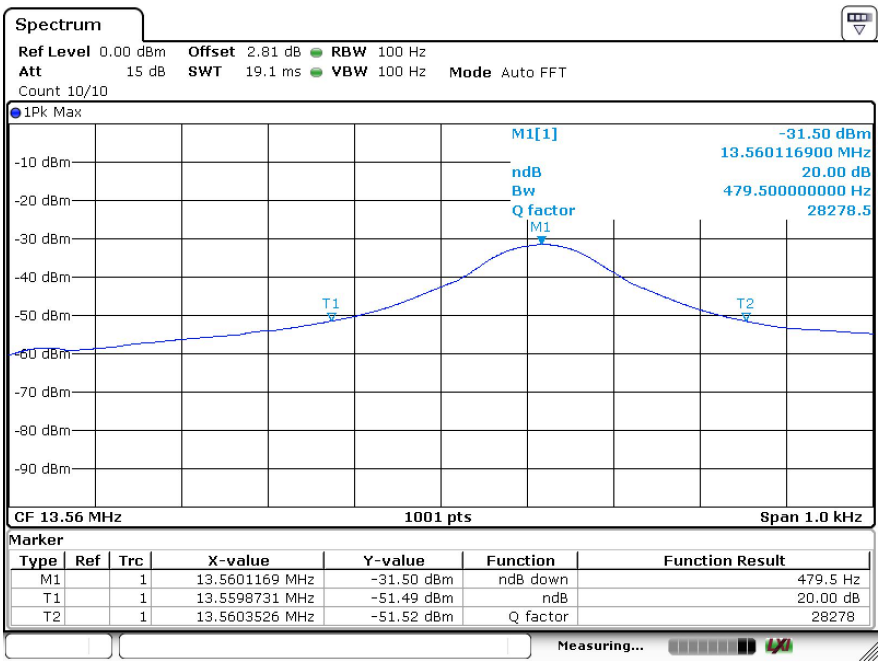


8.4 MEASUREMENT RESULTS

Test Data of Occupied Bandwidth and -20dB Bandwidth					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (Hz)	-20dB Bandwidth (Hz)	Limits (MHz)	Pass or Fail
ASK	13.56	472.53	479.50	N/A	Pass

Test Graphs of Occupied Bandwidth&-20dB Bandwidth




Spectrum
Ref Level 0.00 dBm Offset 2.81 dB RBW 100 Hz
Att 15 dB SWT 19.1 ms VBW 100 Hz Mode Auto FFT
Count 10/10
1Pk Max
M1[1] -31.50 dBm
13.560116900 MHz
ndB 20.00 dB
Bw 479.500000000 Hz
Q factor 28278.5
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
M1
T1
T2
CF 13.56 MHz
1001 pts
Span 1.0 kHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 13.5601169 MHz -31.50 dBm ndB down 479.5 Hz
T1 1 13.5598731 MHz -51.49 dBm ndB 20.00 dB
T2 1 13.5603526 MHz -51.52 dBm Q factor 28278
Measuring...

9. FREQUENCY STABILITY

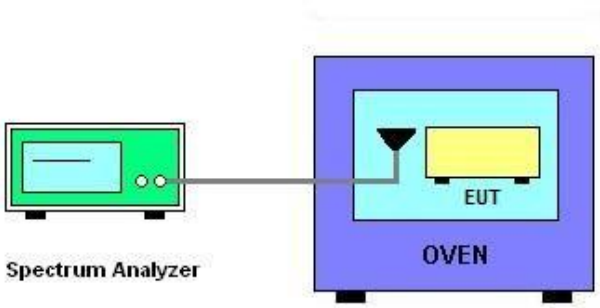
9.1 PROVISIONS APPLICABLE

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% (100ppm) of the operating frequency over a temperature variation of -30 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.

9.2 MEASUREMENT PROCEDURE

1. The spectrum analyzer connected via a receive antenna placed near the EUT.
2. EUT have transmitted signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire emissions bandwidth.
4. Set RBW = 1 kHz, VBW = 3 kHz with peak detector and maxhold settings.
5. The fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc × 106 ppm and the limit is less than ±100ppm.
6. Extreme temperature rule is -30°C~50°C.

9.3 MEASUREMENT SETUP (BLOCK DIAGRAM OF CONFIGURATION)



9.4 MEASUREMENT RESULTS

Operating frequency: 13.56MHz

Voltage vs. Frequency Stability (Test Temperature: 20℃)

Voltage(V)	Measurement Frequency (MHz)	Max. Deviation (ppm)	Limit(ppm)	Conclusion
3.87	13.560116	+8.92	±100	PASS
3.29	13.560121			
4.45	13.560119			

Temperature vs. Frequency Stability (Test Voltage: 3.87V)

Temperature	Measurement Frequency (MHz)	Max. Deviation (ppm)	Limit(ppm)	Conclusion
-30℃	13.560120	+9.37	±100	PASS
-20℃	13.560117			
-10℃	13.560125			
0℃	13.560119			
10℃	13.560122			
20℃	13.560127			
30℃	13.560118			
40℃	13.560118			
50℃	13.560125			

Note: The test voltage is the battery voltage of the auxiliary test phone.

10. AC POWER LINE CONDUCTED EMISSION TEST

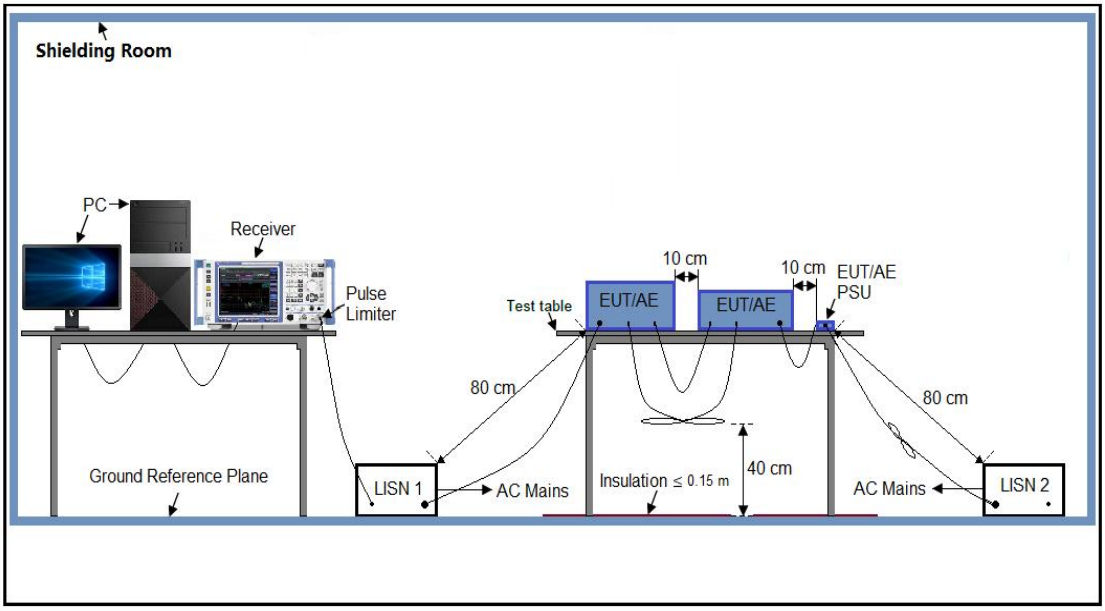
10.1 LIMITS OF LINE CONDUCTED EMISSION TEST

Frequency	Maximum RF Line Voltage	
	Q.P. (dBμV)	Average (dBμV)
150kHz~500kHz	66-56	56-46
500kHz~5MHz	56	46
5MHz~30MHz	60	50

Note:

1. The lower limit shall apply at the transition frequency.
2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

10.2 MEASUREMENT SETUP (BLOCK DIAGRAM OF CONFIGURATION)



10.3 PRELIMINARY PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. When 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 (see Test Facility for the dimensions of the ground plane used). When the EUT is a floor-standing equipment, it is placed on the ground plane which has a 3-12 mm non-conductive covering to insulate the EUT from the ground plane.
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. All support equipment received AC120V/60Hz power from a LISN, if any.
5. The EUT received DC 5V power from adapter which received AC120V/60Hz power from a LISN.
6. The 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 50ohm 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.
8. During the above scans, the emissions were maximized by cable manipulation.
9. The test mode(s) were scanned during the preliminary test.

Then, the EUT configuration and cable configuration of the above highest emission level were recorded for reference of final testing.

10.4 FINAL PROCEDURE OF LINE CONDUCTED EMISSION TEST

1. EUT and support equipment was set up on the test bench as per step 2 of the preliminary test.
2. A scan was taken on both power lines, Line 1 and Line 2, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. If EUT emission level was less –2dB to the A.V. limit in Peak mode, then the emission signal was re-checked using Q.P and Average detector.
3. The test data of the worst case condition(s) was reported on the Summary Data page.

10.5 MEASUREMENT RESULTS

Not applicable.

-----END OF REPORT-----