



TEST REPORT

APPLICANT : OnePlus Technology (Shenzhen) Co., Ltd.
PRODUCT NAME : Wireless Earbuds
MODEL NAME : E512A
BRAND NAME : ONEPLUS
FCC ID : 2ABZ2-E512A
STANDARD(S) : 47 CFR Part 15 Subpart B
RECEIPT DATE : 2024-03-06
TEST DATE : 2024-03-18 to 2024-04-17
ISSUE DATE : 2024-08-15



Edited by: Chen Bilian
Chen Bilian(Rapporteur)
Approved by: Xiao Xiong
Xiao Xiong(Supervisor)

NOTE: This document is issued by Shenzhen Morlab Communications Technology Co., Ltd., the test report shall not be reproduced except in full without prior written permission of the company. The test results apply only to the particular sample(s) tested and to the specific tests carried out which is available on request for validation and information confirmed at our website.





DIRECTORY

- 1. Technical Information..... 3**
- 1.1. Applicant and Manufacturer Information 3**
- 1.2. Equipment Under Test (EUT) Description 3**
- 2. Test Results 5**
- 2.1. Applied Reference Documents 5**
- 2.2. EUT Setup and Operating Conditions 6**
- 3. 47 CFR Part 15B Requirements 7**
- 3.1. Conducted Emission 7**
- 3.2. Radiated Emission 11**
- Annex A Test Uncertainty 18**
- Annex B Testing Laboratory Information 19**

Change History		
Version	Date	Reason for change
1.0	2024-08-15	First edition



1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

Applicant:	OnePlus Technology (Shenzhen) Co., Ltd.
Applicant Address:	18C02, 18C03, 18C04, and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen, Guangdong, P.R. China
Manufacturer:	OnePlus Technology (Shenzhen) Co., Ltd.
Manufacturer Address:	18C02, 18C03, 18C04, and 18C05, Shum Yip Terra Building, Binhe Avenue North, Futian District, Shenzhen, Guangdong, P.R. China

1.2. Equipment Under Test (EUT) Description

Product Name:	Wireless Earbuds	
EUT No.:	3#, 9#	
Hardware Version:	X23E3_06	
Software Version:	V.2.6	
Frequency Range:	Bluetooth: 2402 MHz ~ 2480 MHz Wireless charging : 110 kHz ~ 205 kHz	
Accessory:	Battery 1 (for earphone)	
	Brand Name:	N/A
	Model No.:	112570
	Serial No.:	(N/A, marked #1 by test site)
	Capacity:	58mAh
	Rated Voltage:	3.85V
	Charge Limit:	4.40V
	Manufacturer:	XINYU GANFENG ELECTRONICS CO., LTD.
	Battery 2 (for charging case)	
	Brand Name:	N/A
	Model No.:	SZS601826-2P
	Serial No.:	(N/A, marked #1 by test site)
	Capacity:	566mAh
	Rated Voltage:	3.85V



	Charge Limit:	4.40V
	Manufacturer:	Chongqing VDL Electronics Co., Ltd.

Note:

1. For a more detailed description, please refer to specification or user's manual supplied by the applicant and/or manufacturer.



2. Test Results

2.1. Applied Reference Documents

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart B:

No.	Identity	Document Title
1	47 CFR Part 15	Radio Frequency Devices

Test detailed items/section required by FCC rules and results are as below:

No.	Section	Description	Test Date	Test Engineer	Result	Method Determination Remark
1	15.107	Conducted Emission	2024.03.27 to 2024.04.17	Wang Deyong	PASS	No deviation
2	15.109	Radiated Emission	2024.03.18 to 2024.03.28	Zhang Bangyi	PASS	No deviation

Note 1:The tests were performed according to the method of measurements prescribed in ANSI C63.4-2014.

Note 2:Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

Note 3:When the test result is a critical value,we will use the measurement uncertainty give the judgment result based on the 95% confidence intervals.



2.2. EUT Setup and Operating Conditions

Test Item	
Radiated Emission	
Mode 1 :	EUT + Bluetooth Idle + Battery 1 + Battery 2 + USB Cable + Adapter + Charging Mode
Mode 2 :	EUT + Bluetooth Link + Battery 1 + Mobile Phone + Working Mode
Conducted Emission	
Mode 1 :	EUT + Bluetooth Idle + Battery 1 + Battery 2 + USB Cable + Adapter + Charging Mode
Remark: The above test mode in boldface (Mode 1) was the worst case of conducted emission test, only the test data of these modes were reported. The above test mode in boldface (Mode 2) was the worst case of radiated emission test, only the test data of these modes were reported.	

During the measurement, the environmental conditions were within the listed ranges:

Temperature (°C):	15 - 35
Relative Humidity (%):	30 - 60
Atmospheric Pressure (kPa):	86 - 106

3. 47 CFR Part 15B Requirements

3.1. Conducted Emission

3.1.1. Requirement

According to FCC section 15.107, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

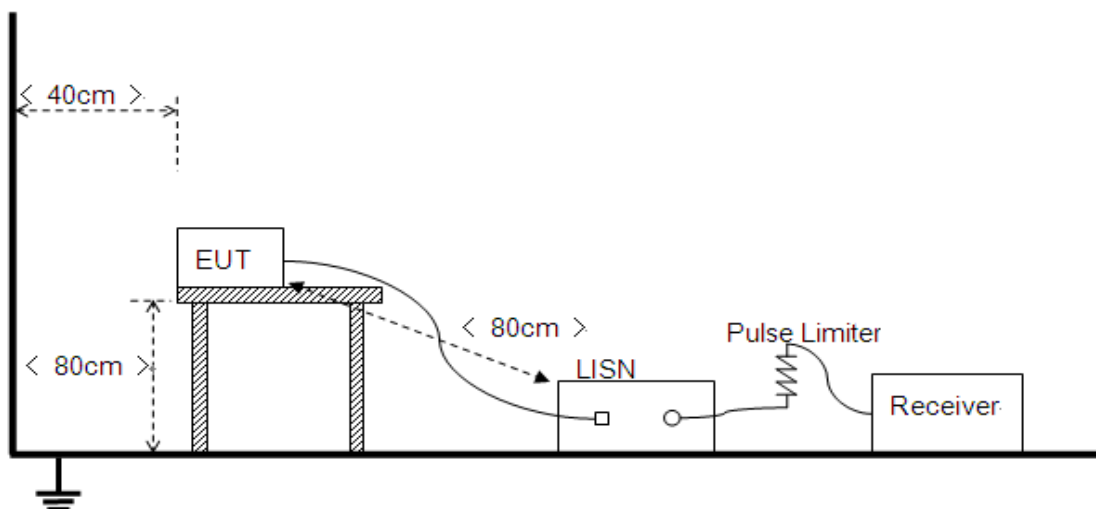
Frequency Range (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

Note:

- The limit subjects to the Class B digital device.
- The lower limit shall apply at the band edges.
- The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

3.1.2. Test Setup

Please refer to Annex A for the photographs of the Test Configuration.





The EUT is placed on a 0.8m high insulating table, which stands on the grounded conducting floor, and keeps 0.4m away from the grounded conducting wall. The EUT is connected to the power mains through a LISN which provides 50Ω/50μH of coupling impedance for the measuring instrument. A Pulse Limiter is used to protect the measuring instrument. The factors of the whole test system are calibrated to correct the reading.

The power strip or extension cord has been investigated to make sure that the LISN integrity is maintained with respect to the impedance characteristics as prescribed in ANSI C63.4-2014 at Clause 4.3.

3.1.3. Test Result

Set RBW=9 kHz, VBW=30 kHz. The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. All test modes are considered, refer to recorded points and plots below.

The measurement results are obtained as below:

$$E [\text{dB}\mu\text{V}] = U_R [\text{dB}\mu\text{V}] + L_{\text{Cable loss}} [\text{dB}] + A_{\text{Factor}} [\text{dB}]$$

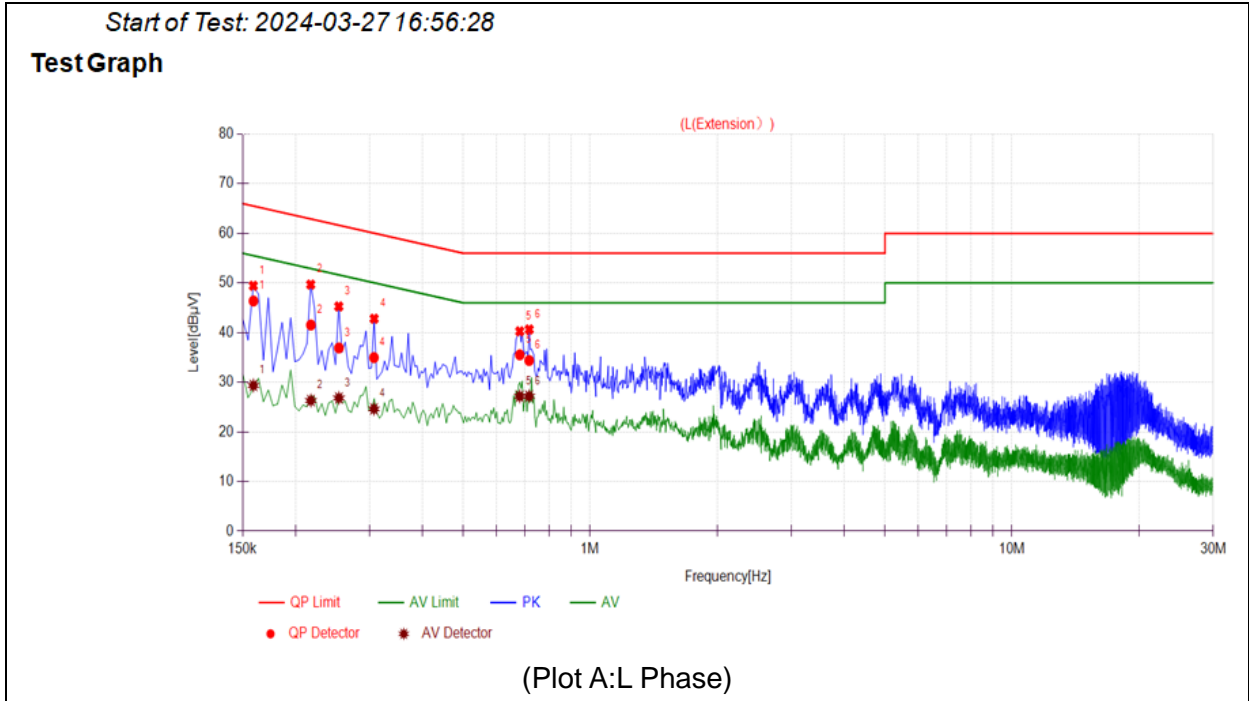
U_R : Receiver Reading

A_{Factor} : Voltage Division Factor of LISN

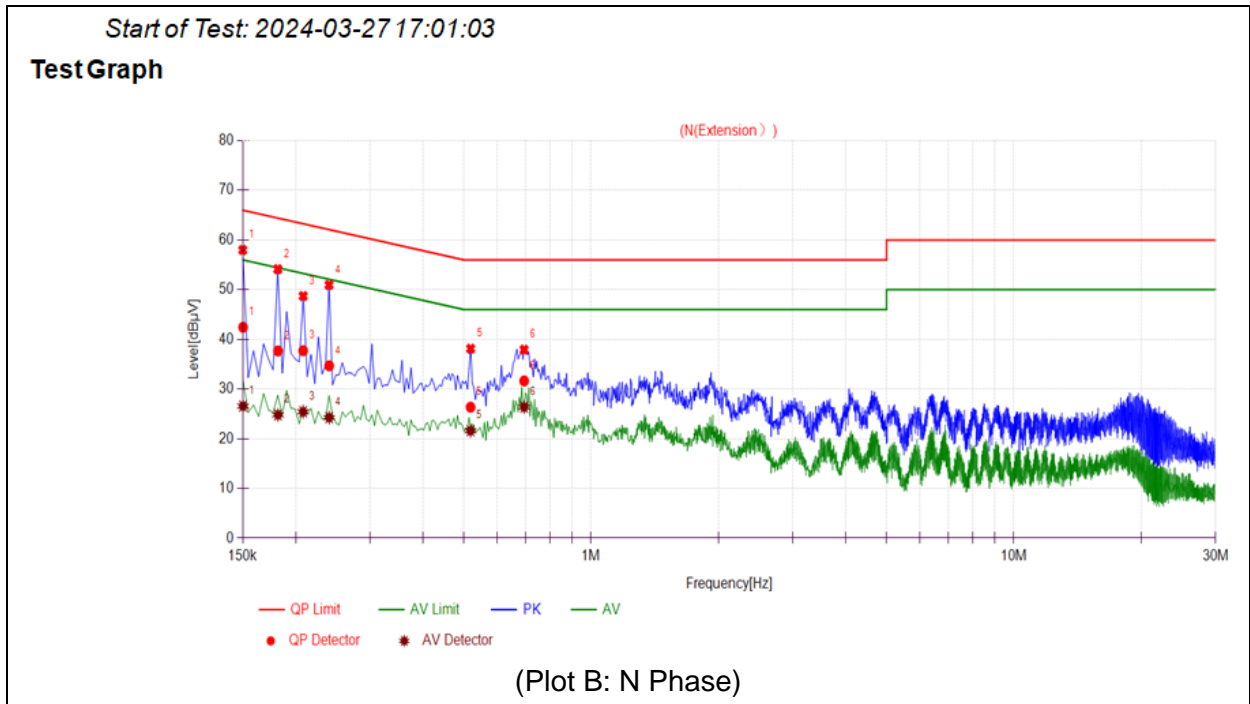
$L_{\text{Cable loss}}$: Correction Factor Contains Pulse Limiter and Cable

During the test, the total correction Factor $L_{\text{Cable loss}}$ and A_{Factor} were built in test software.

A. Test Plot and Suspicious Points:



No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quasi-peak	Average	Quasi-peak	Average		
1	0.1591	46.38	29.35	65.51	55.51	Line	PASS
2	0.2177	41.53	26.31	62.91	52.91		PASS
3	0.2537	36.93	26.83	61.64	51.64		PASS
4	0.3072	34.97	24.62	60.05	50.05		PASS
5	0.6808	35.52	27.17	56.00	46.00		PASS
6	0.7164	34.39	27.20	56.00	46.00		PASS



No.	Fre. (MHz)	Emission Level (dBµV)		Limit (dBµV)		Power-line	Verdict
		Quasi-peak	Average	Quasi-peak	Average		
1	0.1502	42.45	26.57	65.99	55.99	Neutral	PASS
2	0.1817	37.67	24.80	64.41	54.41		PASS
3	0.2084	37.72	25.43	63.27	53.27		PASS
4	0.2401	34.68	24.25	62.09	52.09		PASS
5	0.5186	26.35	21.61	56.00	46.00		PASS
6	0.6944	31.64	26.36	56.00	46.00		PASS



3.2. Radiated Emission

3.2.1. Requirement

According to FCC section 15.109 (a), the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency Range (MHz)	Field Strength Limitation at 3m Measurement Dist	
	($\mu\text{V/m}$)	($\text{dB}\mu\text{V/m}$)
30.0 - 88.0	100	20log 100
88.0 - 216.0	150	20log 150
216.0 - 960.0	200	20log 200
Above 960.0	500	20log 500

As shown in FCC section 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector. When average radiated emission measurements are specified in this part, including emission measurements below 1000MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

Note:

- 1) The tighter limit shall apply at the boundary between two frequency range.
- 2) Limitation expressed in $\text{dB}\mu\text{V/m}$ is calculated by $20\log$ Emission Level($\mu\text{V/m}$).

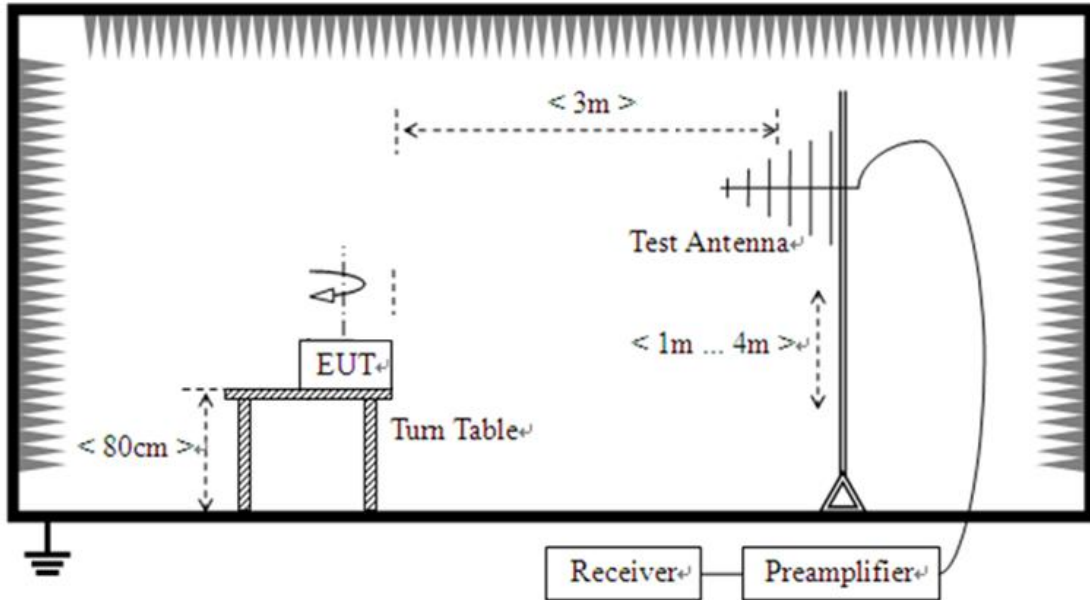
3.2.2. Frequency Range of Measurement

According to 15.33(b)(1), the frequency range of radiated measurement for the EUT is listed in the following table:

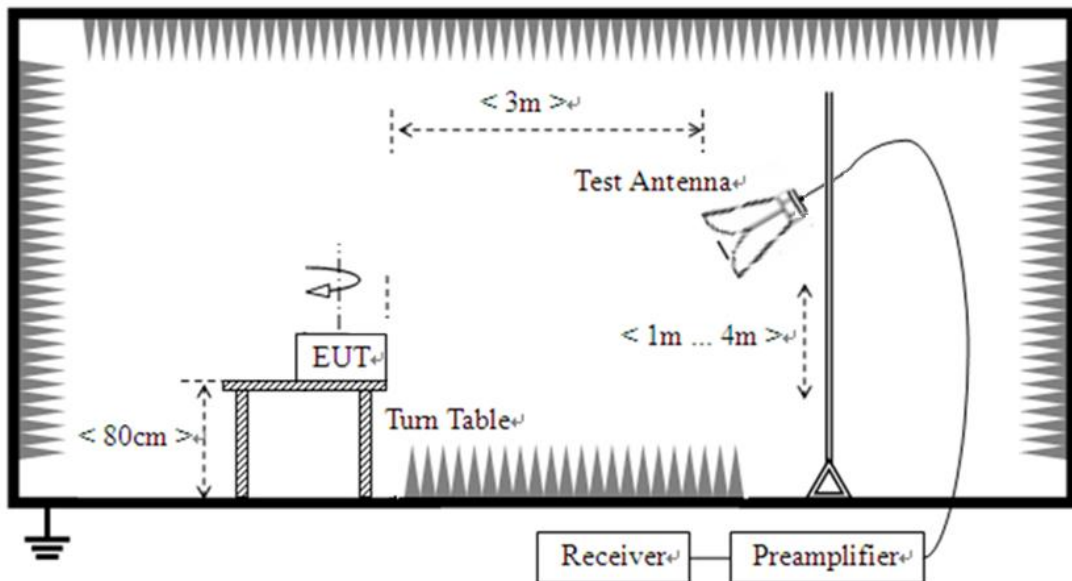
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)
Below 1.705	30.
1.705-108	1000.
108-500	2000.
500-1000	5000.
Above 1000	5th harmonic of the highest frequency or 40 GHz, whichever is lower.

3.2.3. Test Setup

- 1) For radiated emissions from 30MHz to 1GHz



- 2) For radiated emissions above 1GHz





The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading. The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from the Test Antenna, which is mounted on a variable-height antenna master tower.

For the test Antenna:

In the frequency range above 30MHz, Bi-Log Test Antenna (30MHz to 1GHz) and Horn Test Antenna (above 1GHz) are used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested. For measurements above 1 GHz, keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response.

For measurements below 1GHz the resolution bandwidth is set to 120 kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video bandwidth is set to 3MHz for peak measurements and as applicable for average measurements.

3.2.4. Test Result

The maximum radiated emission is searched using PK, QP and AV detectors; the emission levels more than the limits, and that have narrow margins from the limits will be re-measured with AV and QP detectors. Both the vertical and the horizontal polarizations of the Test Antenna are considered to perform the tests. All test modes are considered, refer to recorded points and plots below.

The amplitude of emissions (6GHz-12.5GHz) which are attenuated more than 20 dB below the permissible value need not be reported.

The measurement results are obtained as below:

$$E \text{ [dB}\mu\text{V/m]} = U_R \text{ [dB}\mu\text{V]} + A_T \text{ [dB]} + A_{\text{Factor}} \text{ [dB]}; A_T = L_{\text{Cable loss}} \text{ [dB]} - G_{\text{preamp}} \text{ [dB]}$$

A_T : Total correction Factor except Antenna

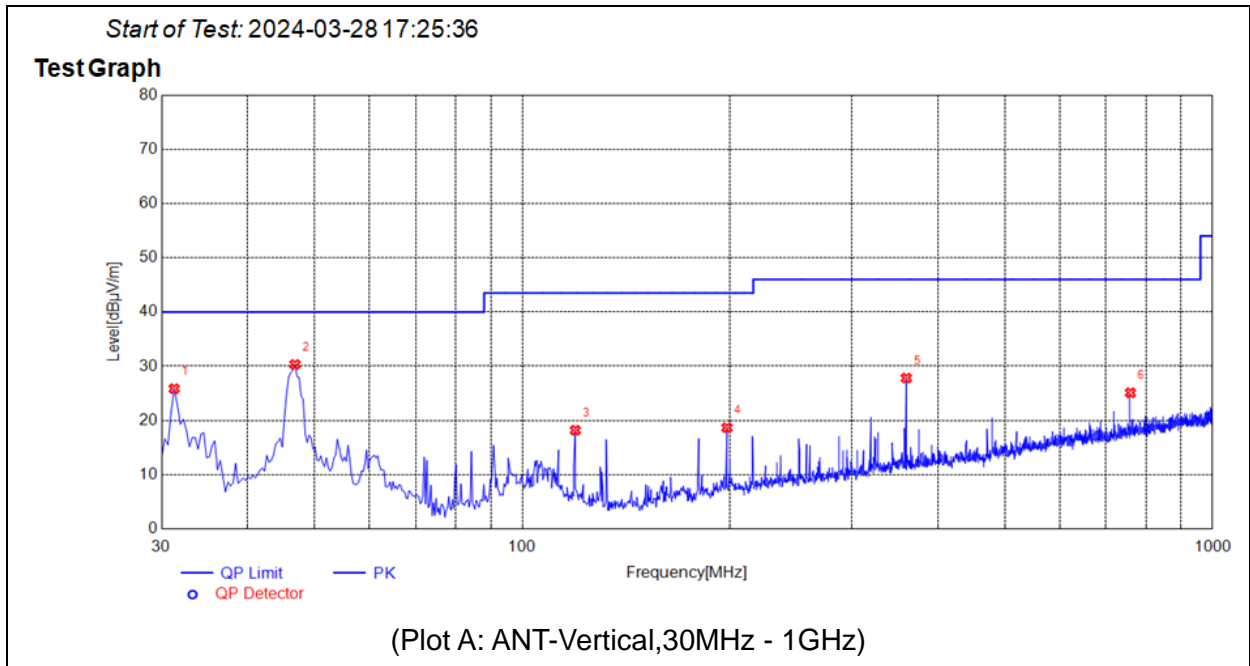
U_R : Receiver Reading

G_{preamp} : Preamplifier Gain

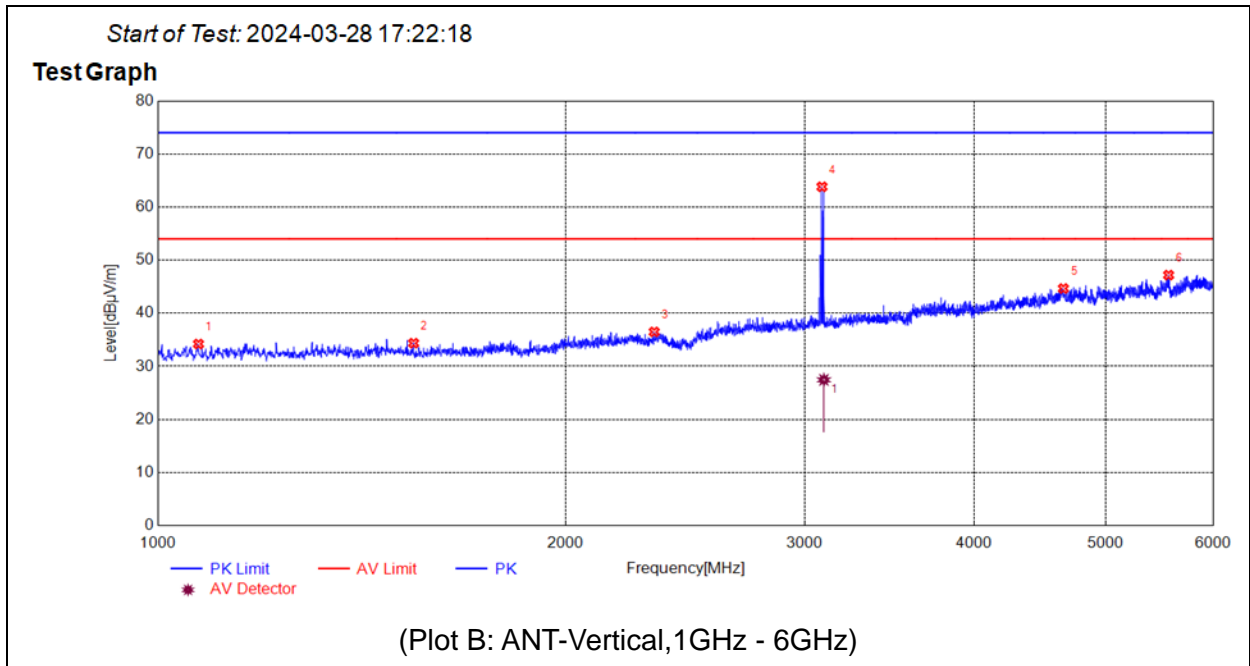
A_{Factor} : Antenna Factor at 3m

During the test, the total correction Factor A_T and A_{Factor} were built in test software.

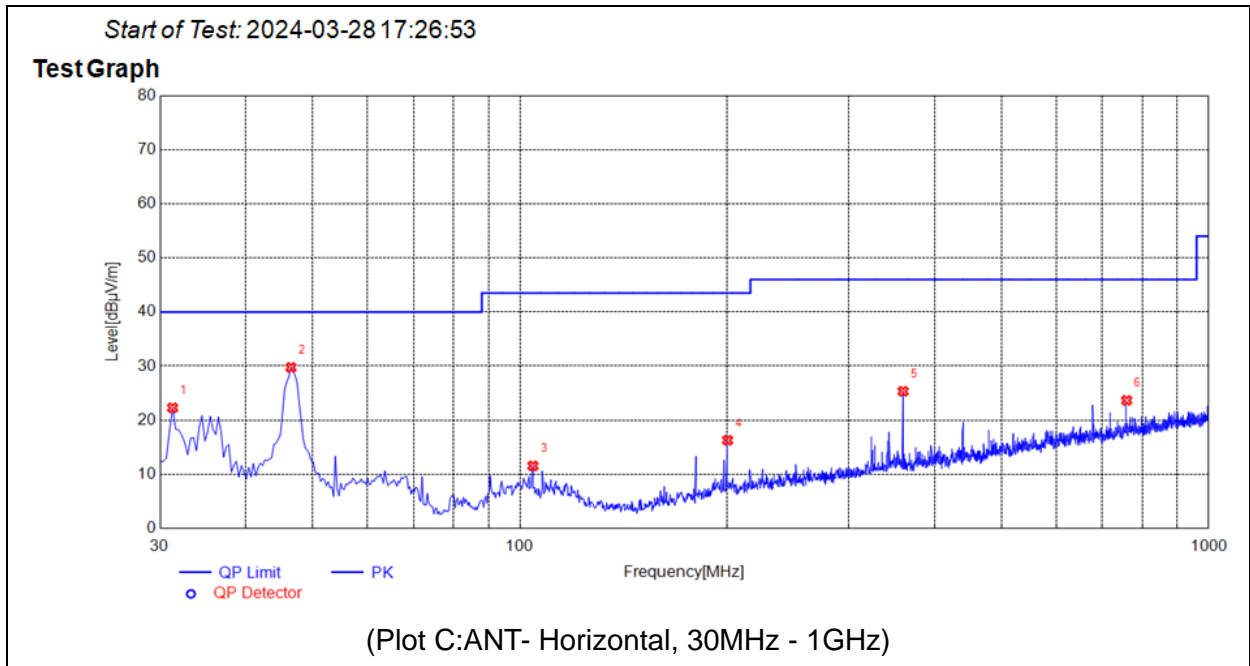
Note: All radiated emission tests were performed in X, Y, Z axis direction, and only the worst axis test condition was recorded in this test report.



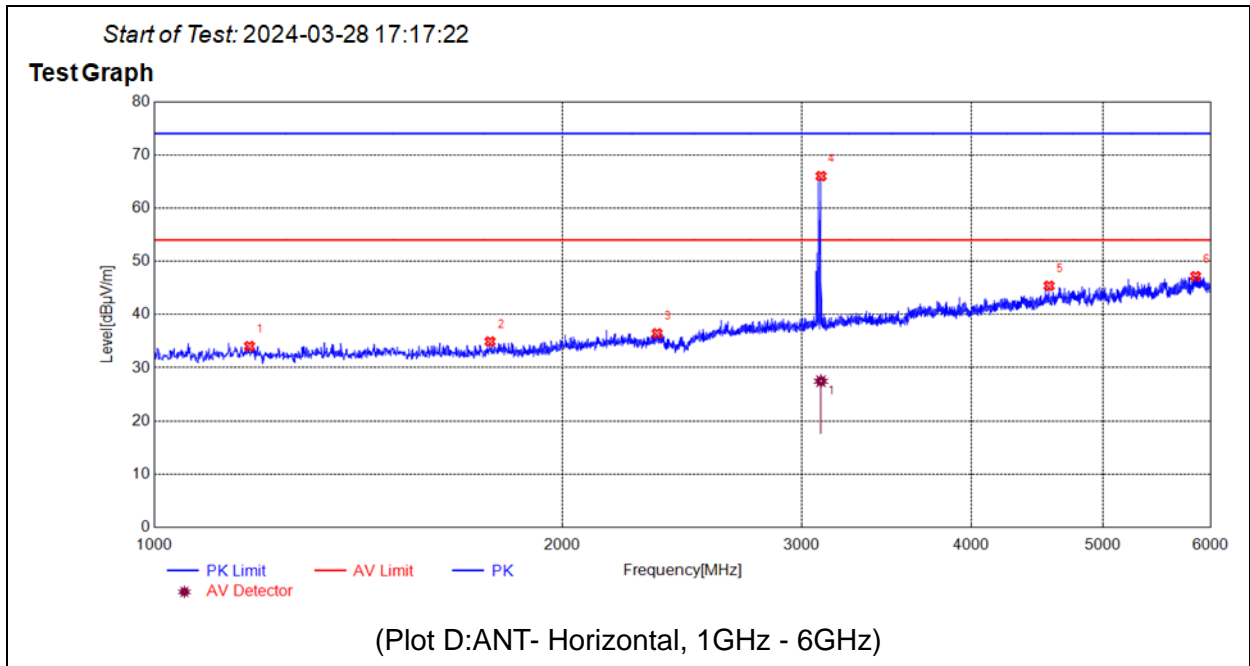
No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	31.2938	25.86	N.A.	N.A.	N.A.	40.00	N.A.	V	PASS
2	46.8189	30.32	N.A.	N.A.	N.A.	40.00	N.A.	V	PASS
3	119.2698	18.19	N.A.	N.A.	N.A.	43.50	N.A.	V	PASS
4	197.8660	18.67	N.A.	N.A.	N.A.	43.50	N.A.	V	PASS
5	359.9100	27.81	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS
6	760.0067	25.10	N.A.	N.A.	N.A.	46.00	N.A.	V	PASS



No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	1071.6786	34.21	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
2	1544.2574	34.36	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
3	2323.5539	36.49	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
4	3089.5149	63.82	N.A.	27.45	74.00	N.A.	54.00	V	PASS
5	4654.7758	44.66	N.A.	N.A.	74.00	N.A.	54.00	V	PASS
6	5565.7610	47.19	N.A.	N.A.	74.00	N.A.	54.00	V	PASS



No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	31.2938	22.29	N.A.	N.A.	N.A.	40.00	N.A.	H	PASS
2	46.4955	29.75	N.A.	N.A.	N.A.	40.00	N.A.	H	PASS
3	104.3915	11.55	N.A.	N.A.	N.A.	43.50	N.A.	H	PASS
4	200.1300	16.29	N.A.	N.A.	N.A.	43.50	N.A.	H	PASS
5	359.9100	25.34	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS
6	760.0067	23.66	N.A.	N.A.	N.A.	46.00	N.A.	H	PASS



No.	Fre. MHz	PK dBµV/m	QP dBµV/m	AV dBµV/m	Limit-PK dBµV/m	Limit-QP dBµV/m	Limit-AV dBµV/m	ANT	Verdict
1	1175.8626	34.05	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
2	1768.4614	34.92	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
3	2347.7246	36.45	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
4	3100.3501	66.00	N.A.	27.47	74.00	N.A.	54.00	H	PASS
5	4564.7608	45.40	N.A.	N.A.	74.00	N.A.	54.00	H	PASS
6	5852.4754	47.19	N.A.	N.A.	74.00	N.A.	54.00	H	PASS



Annex A Test Uncertainty

The uncertainty is calculated using the methods suggested in the "Guide to the Expression of Uncertainty in Measurement" (GUM) published by ISO.

Uncertainty of Conducted Emission Measurement

Measuring Uncertainty for a Level of Confidence of 95%(U=2Uc(y))	9kHz-150kHz	±3.3dB
	150kHz-30MHz	±2.8dB

Uncertainty of Radiated Emission Measurement

Measuring Uncertainty for a Level of Confidence of 95%(U=2Uc(y))	30MHz-200MHz	±5.06dB
	200MHz-1000MHz	±5.04dB
	1GHz-6GHz	±5.18dB
	6GHz-18GHz	±5.48dB



Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Accreditation Certificate

Accredited Testing Laboratory:	The FCC designation number is CN1192. Test firm registration number is 226174. (Shenzhen Morlab Communications Technology Co., Ltd.)
---------------------------------------	--

4. Test Software Utilized

Model	Version Number	Producer
TS+ -[JS32-RE]	Version 2.5.0.6	Tonscend
TS+ -[JS32-CE]	Version 2.5.0.0	Tonscend

**5. Test Equipments Utilized**

Description	Model	Serial No.	Manufacturer	Cal. Date	Due. Date
Bi-Log Antenna	VULB 9163	9163-519	SCHWARZBECK	2023/7/1	2024/6/30
Horn Antenna	BBHA 9120D	01774	SCHWARZBECK	2023/7/1	2024/6/30
Receiver	N9038A	MY564000 93	KEYSIGHT	2024/1/25	2025/1/24
6db Attenuator	BW-N6W5+	E191001	Mini-circuits	2023/9/19	2024/9/18
Preamplifier	S020180L3203	61171/611 72	LUCIX CORP.	2023/6/27	2024/6/26
Preamplifier	S10M100L3802	46732	LUCIX CORP.	2023/6/27	2024/6/26
RF Coaxial Cable	PE330	MRE001	Pasternack	N/A	N/A
RF Coaxial Cable	CLU18	MRE002	Pasternack	N/A	N/A
RF Coaxial Cable	CLU18	MRE003	Pasternack	N/A	N/A
RF Coaxial Cable	QA360-40-KK-0.5	22290045	Qualwave	N/A	N/A
RF Coaxial Cable	QA360-40-KKF-2	22290046	Qualwave	N/A	N/A
RF Coaxial Cable	QA500-18-NN-5	22120181	Qualwave	N/A	N/A
RF Coaxial Cable	BNC	MRE04	Qualwave	N/A	N/A
Receiver	ESPI	101052	R&S	2023/6/21	2024/6/20
LISN	NSLK 8127	8127449	Schwarzbeck	2024/2/2	2025/2/1
10dB Pulse Limiter	VTSD 9561-F	VTSD 9561 F-B #206	SCHWARZBECK	2023/6/27	2024/6/26
System Simulator	CMW500	152038	R&S	2023/9/19	2024/9/18

6. Ancillary Equipment Utilized

Description	Manufacturer	Model	Serial No.
adapter	HUAWEI	HW-050200C01	H785LBJBY16392
Mobile Phone	Realme	RMX3193	VGSKUKT85TLFBMPJ

————— END OF REPORT —————