

TEST REPORT

Applicant: Shenzhen Jimi IoT Co., Ltd.
Address: 3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China
Equipment Type: LTE Vehicle Terminal
Model Name: VL111(refer to section 2.3)
Brand Name: JimiIoT
FCC ID: 2AMLF-VL111
Contains FCC ID: 2AMLFXQ600-LA
Test Standard: 47 CFR Part 15 Subpart B
ANSI C63.4-2014
Sample Arrival Date: Jan. 11, 2024
Test Date: Jan. 23, 2024
Date of Issue: Apr. 17, 2024

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Xin Liao**Checked by:** Zhenxiang Liu**Approved by:** Liao Jianming
(Technical Director)

Revision History

Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Apr. 01, 2024</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Apr. 17, 2024</u>	<u>Updated Section 2.5 Technical Information.</u>

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1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☒ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Shenzhen Jimi IoT Co., Ltd.
Address	3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China

2.2 Manufacturer Information

Manufacturer	Shenzhen Jimi IoT Co., Ltd.
Address	3-4/F, Block A, Building #7, Shenzhen International Innovation Valley, Dashi 1st Road, Nanshan District, Shenzhen, Guangdong, China

2.3 General Description for Equipment under Test (EUT)

EUT Name	LTE Vehicle Terminal
Model Name Under Test	VL111
Series Model Name	V1411, C45
Hardware Version	All models are same with electrical parameters and internal circuit structure, but only differ in model name. (this information provided by the customer)
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A
Note: Tested all mode on model VL111, other configuration tested the worst case of each item.	

2.4 Ancillary Equipment

Ancillary Equipment 1	Battery	
	Brand Name	N/A
	Model No.	HT422033
	Serial No.	N/A
	Capacitance	270 mAh
	Rated Voltage	3.70 V
	Limited Voltage	4.20 V

2.5 Technical Information

Network and Wireless connectivity	2G Network GSM/GPRS/EDGE 850/1900 MHz 4G Network FDD LTE Band 2/4/5/7 Bluetooth (BR+EDR+BLE)
Classification of equipment	Class B
The highest internal frequency of EUT	2690 MHz

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15 Subpart B	Unintentional Radiators
2	ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

3.2 Verdict

No.	Description	FCC Rule	Test Verdict	Remark
1	Radiated Emission	15.109	Pass	--
2	Conducted Emission, AC Ports	15.107	N/A	Note
Note: The EUT is used in vehicle environment. So the Conducted Emission, AC Port test is not applicable.				

3.3 Test Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Measurement	Value
Conducted emissions (9 kHz-30 MHz)	3.2 dB
Radiated emissions (30 MHz-1 GHz)-966#2	4.8 dB
Radiated emissions (1 GHz-18 GHz)-966#2	4.9 dB

4 GENERAL TEST CONFIGURATIONS

4.1 Test Enclosure List

Description	Manufacturer	Model	Serial No.	Length	Description	Use
Supple Line	Kingston	N/A	N/A	N/A	N/A	☒
Wireless Communications Test Set	R&S	CMW500	102318	N/A	Cal. Due 2024.05.15	☒
DC Power Supply	N/A	N/A	N/A	N/A	N/A	☒

4.2 Test Configurations

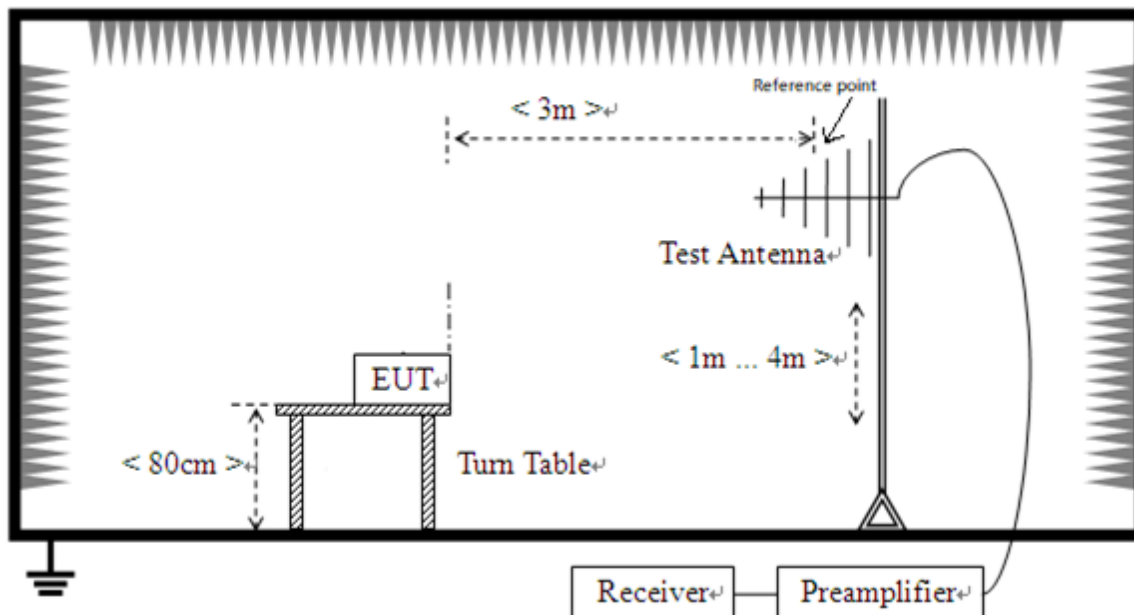
All test modes of EUT are listed in the table below.

Test Mode Configuration	Description
Mode 1	<u>The Standby Test Mode</u> EUT + DC Power Supply + Supple Line
Mode 2	<u>The GSM 850 RX Test Mode</u> EUT + DC Power Supply + Supple Line + GSM 850 RX
Mode 3	<u>The EGPRS 850 RX Test Mode</u> EUT + DC Power Supply + Supple Line + EGPRS 850 RX
Mode 4	<u>The FDD LTE Band 5 RX Test Mode</u> EUT + DC Power Supply + Supple Line + LTE Band 5 RX

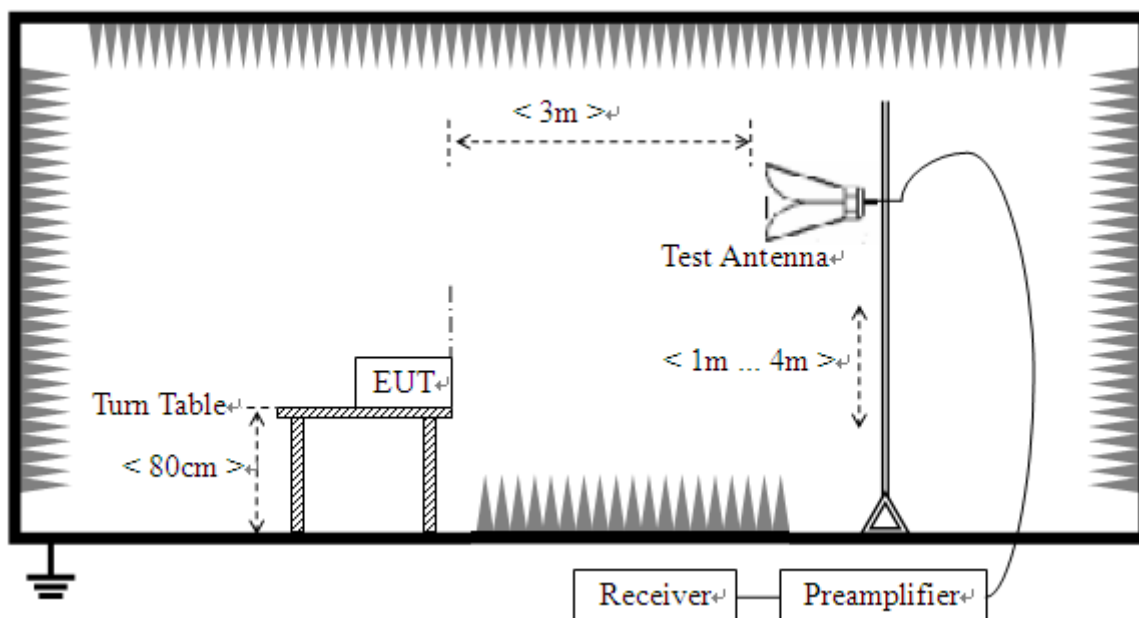
Test Case	Test Mode Configuration	Worst Mode
Radiated Emission	Mode 1~Mode 4	1

4.3 Test Setups

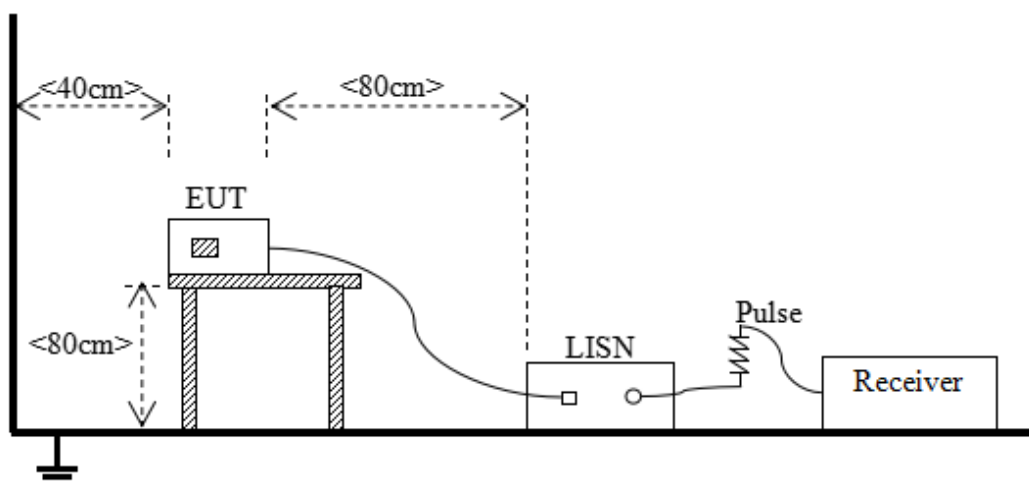
Test Setup 1



Radiated Emission (30 MHz-1 GHz)



Radiated Emission (above 1 GHz)

Test Setup 2

Conducted Emissions, AC Ports

5 TEST ITEMS

5.1 Emission Tests

5.1.1 Radiated Emission

5.1.1.1 Limit

Frequency range (MHz)	Class B (at 3 m)		Class A (at 3 m)
	Field Strength ($\mu\text{V/m}$)	Field Strength (dB $\mu\text{V/m}$)	Field Strength (dB $\mu\text{V/m}$)
30 - 88	100	40	49.5
88 - 216	150	43.5	54
216 - 960	200	46	56.9
Above 960	500	54	60

NOTE:

- 1) Field Strength (dB $\mu\text{V/m}$) = $20 \times \log [\text{Field Strength } (\mu\text{V/m})]$.
- 2) In the emission tables above, the tighter limit applies at the band edges.
- 3) The limits using ANSI C63.4.
- 4) For 30 MHz to 1000 MHz, the CISPR quasi-peak is employed.

For above 1000 MHz, according to the requirements of FCC 15.35, unless otherwise specified, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Frequency range (GHz)	Class B (at 3 m)			Class A (at 3 m)	
	Field Strength ($\mu\text{V/m}$)	Field Strength Average (dB $\mu\text{V/m}$)	Field Strength Peak (dB $\mu\text{V/m}$)	Field Strength Average (dB $\mu\text{V/m}$)	Field Strength Peak (dB $\mu\text{V/m}$)
1 - F_M	500	54	74	60	80

Note 1: The highest measurement frequency, F_M , in GHz, shall be determined as next Table.

Note 2: Average Class A limit at 3m L_{3m} is determined by the following conversion formula:

$$L_{3m} = L_{10m} + 20 \times \log(d_{10m}/d_{3m})$$

Where:

L_{3m} is Average Class A limit at 3m;

L_{10m} is Average Class A limit at 10m;

d_{10m} is Measurement distance in 10m;

d_{3m} is Measurement distance in 3m.

For this case: $L_{3m} = 49.5 + 20 \times \log(10/3) = 60$ (dB $\mu\text{V/m}$).

Highest internal frequency (F_X)	Highest measurement frequency (F_M)
$F_X \leq 108 \text{ MHz}$	1 GHz
$108 \text{ MHz} \leq F_X \leq 500 \text{ MHz}$	2 GHz
$500 \text{ MHz} \leq F_X \leq 1 \text{ GHz}$	5 GHz
$F_X \geq 1 \text{ GHz}$	$5 * F_X$ or 40 GHz, whichever is lower.
Note: F_X is Highest frequency generated or used in the device or on which the device operates or tunes.	

5.1.1.2 Test Setup

Refer to 4.3 section (test setup 1) for radiated emission test, the photo of test setup please refer to ANNEX B.

5.1.1.3 Test Procedure

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.

An initial pre-scan was performed in the chamber using the EMI Receiver in peak detection mode. Quasi-peak measurements were conducted based on the peak sweep graph. The EUT was measured by Bi-Log antenna with 2 orthogonal polarities.

The measurement frequency range is from 30 MHz to the 5th harmonic of the maximum frequency of the EUT internal source. The Turn Table is actuated to turn from 0° to 360° , and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1 \text{ GHz}$, 100 kHz for $f < 1 \text{ GHz}$

VBW $\geq$ RBW

Sweep = auto

Detector function = peak for $f < 1 \text{ GHz}$, peak & RMS Average for $f \geq 1 \text{ GHz}$

Trace = max hold

5.1.1.4 Test Result and Test Equipment List

Please refer to ANNEX A.1.

NOTE:

1. Results (dB μ V/m) = Reading (dB μ V/m) + Factor (dB/m)

The reading level is calculated by software which is not shown in the sheet

2. Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB) – Amplifier Gain (dB)

3. Margin = Limit - Results

5.1.2 Conducted Emission, AC Ports

5.1.2.1 Test Limit

Frequency range (MHz)	Class A	
	Quasi-peak (dB μ V)	Average (dB μ V)
0.15 - 0.50	79	66
0.50 - 30	73	60

Frequency range (MHz)	Class B	
	Quasi-peak (dB μ V)	Average (dB μ V)
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
5 - 30	60	50

NOTE:

- 1) The lower limit shall apply at the band edges.
- 2) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50 MHz.

5.1.2.2 Test Setup

Refer to 4.3 section test (test setup 2) for conducted emission, the photo of test setup please refer to ANNEX B.

5.1.2.3 Test Procedure

The EUT is connected to the power mains through a LISN which provides 50 Ω /50 μ H of coupling impedance for the measuring instrument. The test frequency range is from 150 kHz to 30 MHz. The maximum conducted interference is searched using Peak (PK), Quasi-peak (QP) and Average (AV) detectors; the emission levels that are 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.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

Use the following spectrum analyzer settings:

RBW = 9 kHz

VBW $\geq$ RBW

Sweep = 10ms

Detector function = peak & Average

Trace = max hold

5.1.2.4 Test Result and Test Equipment List

Please refer to ANNEX A.2.

NOTE:

1. Results (dB μ V) = Reading (dB μ V) + Factor (dB)

The reading level is calculated by software which is not shown in the sheet

2. Factor = Insertion loss + Cable loss

3. Margin = Limit - Results

ANNEX A TEST RESULTS

A.1 Radiated Emission

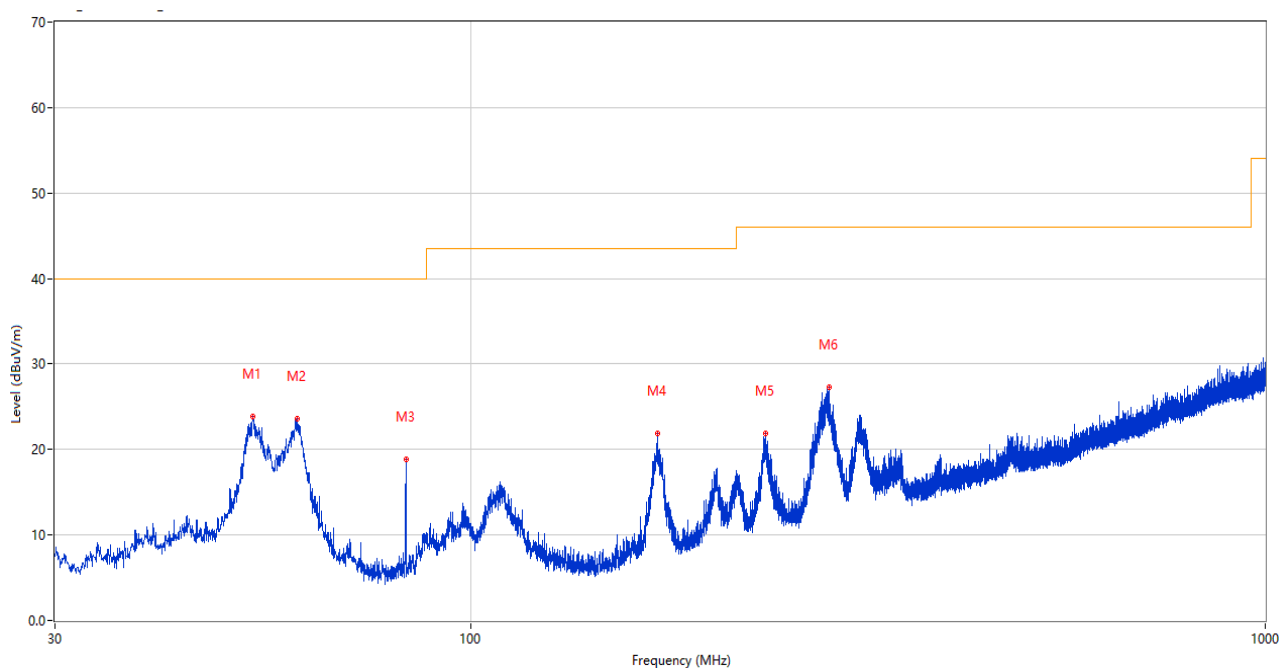
Note 1: The symbol of “--” in the table which means not application.

Note 2: For the test data above 1 GHz, according the ANSI C63.4-2014, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Sample No.	S08	Temperature	25.3℃
Humidity	44%RH	Pressure	101kPa
Test Engineer	He Shichang	Test Date	2024.01.23

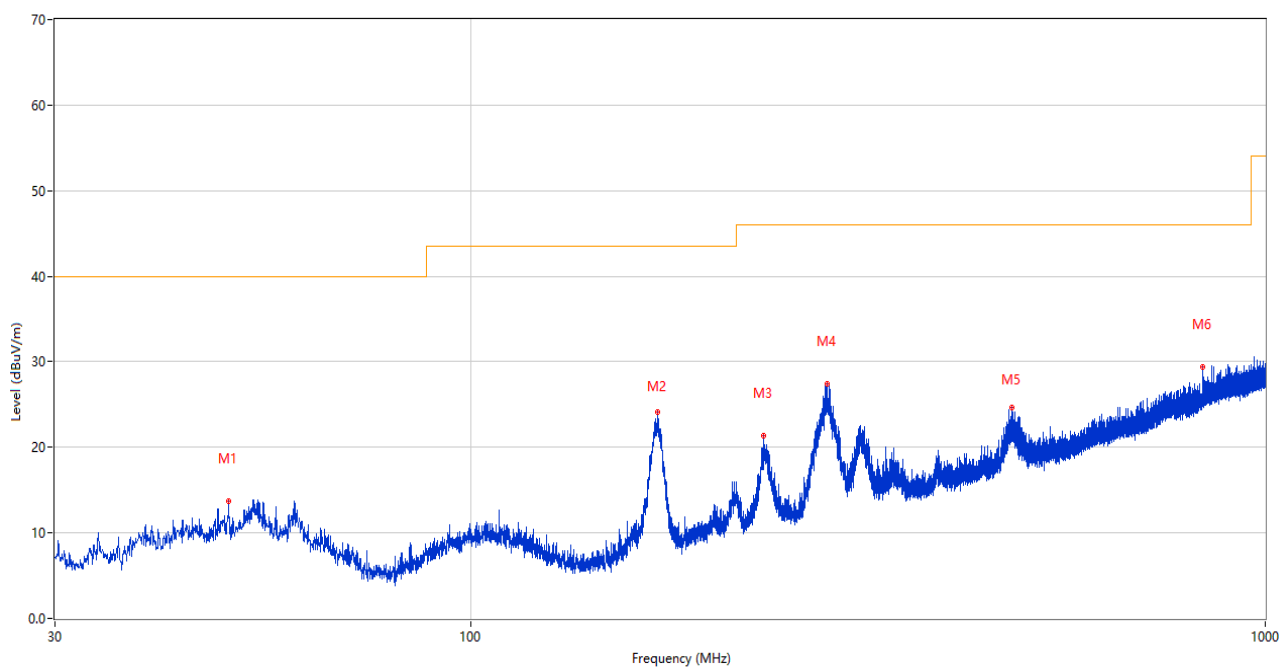
Test Mode 1

1) Test Antenna Vertical, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	53.231	23.82	-25.54	40.0	16.18	Peak	70.00	200	Vertical	Pass
2	60.458	23.57	-26.99	40.0	16.43	Peak	93.00	200	Vertical	Pass
3	82.962	18.81	-30.46	40.0	21.19	Peak	204.00	100	Vertical	Pass
4	171.911	21.95	-29.06	43.5	21.55	Peak	355.00	200	Vertical	Pass
5	235.204	21.86	-25.37	46.0	24.14	Peak	285.00	100	Vertical	Pass
6	282.346	27.27	-24.13	46.0	18.73	Peak	231.00	100	Vertical	Pass

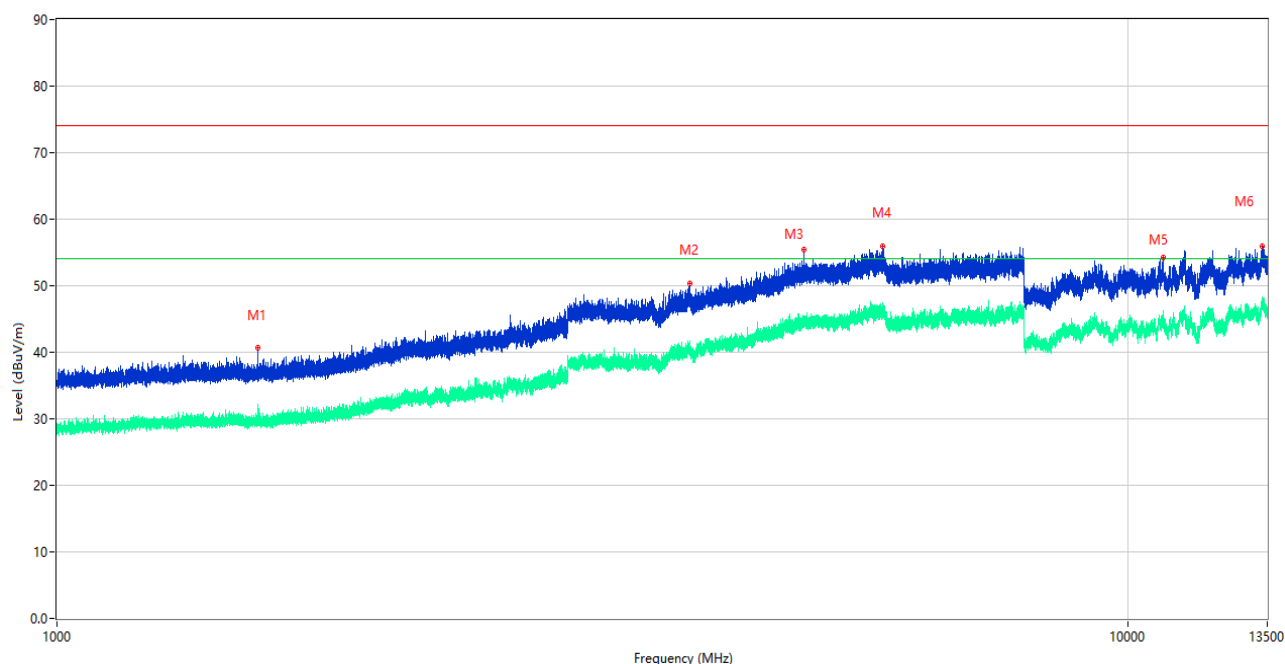
2) Test Antenna Horizontal, 30 MHz – 1 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	49.594	13.67	-25.54	40.0	26.33	Peak	195.00	100	Horizontal	Pass
2	171.911	24.16	-29.06	43.5	19.34	Peak	95.00	200	Horizontal	Pass
3	233.943	21.32	-25.39	46.0	24.68	Peak	246.00	100	Horizontal	Pass
4	281.230	27.39	-24.14	46.0	18.61	Peak	243.00	100	Horizontal	Pass
5	480.419	24.61	-19.15	46.0	21.39	Peak	244.00	200	Horizontal	Pass
6	834.712	29.37	-11.17	46.0	16.63	Peak	280.00	200	Horizontal	Pass

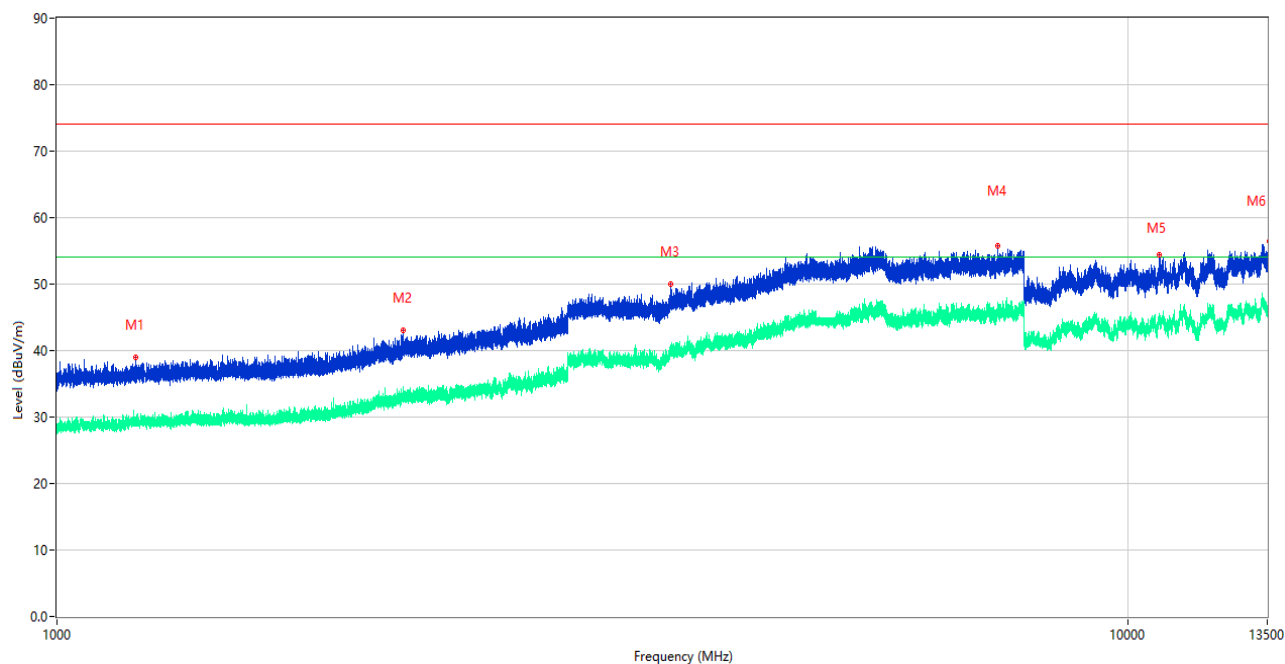
Equipment Information						
Equipment Name	Supplier	Model	Serial No.	Cal. Date	Cal. Due	Use
Frequency Below 1 GHz						
EMI Receiver	Keysight	N9038A	MY55330120	2023.09.05	2024.09.04	☒
Amplifier (30-1GHz)	COM-MV	ZT30-1000M	B2017119081	2023.12.05	2024.12.04	☒
Test Antenna-Bi-Log	SCHWARZB ECK	VULB 9168	9168-00867	2022.04.12	2025.04.11	☒
Anechoic Chamber (#2)	YiHeng	9m*6m*6m	142	2021.08.19	2024.08.18	☒
Description	Supplier	Name	Version	/		Use
Test Software	BALUN	BL410-E	V22.930	/		☒

3) Test Antenna Vertical, 1 GHz – 13.5 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1538.800	40.63	-15.92	74.0	33.37	Peak	300.00	100	Vertical	Pass
1**	1538.800	29.57	-15.92	54.0	24.43	AV	300.00	100	Vertical	Pass
2	3903.250	50.40	-1.15	74.0	23.60	Peak	100.00	100	Vertical	Pass
2**	3903.250	41.30	-1.15	54.0	12.70	AV	100.00	100	Vertical	Pass
3	4982.750	55.40	2.42	74.0	18.60	Peak	112.00	100	Vertical	Pass
3**	4982.750	44.68	2.42	54.0	9.32	AV	112.00	100	Vertical	Pass
4	5906.750	55.98	3.55	74.0	18.02	Peak	137.00	100	Vertical	Pass
4**	5906.750	45.28	3.55	54.0	8.72	AV	137.00	100	Vertical	Pass
5	10801.500	54.16	2.16	74.0	19.84	Peak	198.00	100	Vertical	Pass
5**	10801.500	45.31	2.16	54.0	8.69	AV	198.00	100	Vertical	Pass
6	13353.500	56.01	5.21	74.0	17.99	Peak	290.00	100	Vertical	Pass
6**	13353.500	47.63	5.21	54.0	6.37	AV	290.00	100	Vertical	Pass

4) Test Antenna Horizontal, 1 GHz – 13.5 GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1185.500	38.98	-16.31	74.0	35.02	Peak	352.00	100	Horizontal	Pass
1**	1185.500	28.76	-16.31	54.0	25.24	AV	352.00	100	Horizontal	Pass
2	2107.000	43.01	-12.63	74.0	30.99	Peak	261.00	100	Horizontal	Pass
2**	2107.000	34.63	-12.63	54.0	19.37	AV	261.00	100	Horizontal	Pass
3	3742.250	49.93	-2.10	74.0	24.07	Peak	43.00	100	Horizontal	Pass
3**	3742.250	39.64	-2.10	54.0	14.36	AV	43.00	100	Horizontal	Pass
4	7564.500	55.74	2.72	74.0	18.26	Peak	267.00	100	Horizontal	Pass
4**	7564.500	46.55	2.72	54.0	7.45	AV	267.00	100	Horizontal	Pass
5	10694.500	54.42	1.42	74.0	19.58	Peak	132.00	100	Horizontal	Pass
5**	10694.500	44.33	1.42	54.0	9.67	AV	132.00	100	Horizontal	Pass
6	13552.500	56.47	4.74	74.0	17.53	Peak	173.00	100	Horizontal	Pass
6**	13552.500	47.10	4.74	54.0	6.90	AV	173.00	100	Horizontal	Pass

Equipment Information						
Equipment Name	Supplier	Model	Serial No.	Cal. Date	Cal. Due	Use
Frequency Above 1 GHz						
EMI Receiver	Keysight	N9038A	MY55330120	2023.09.05	2024.09.04	☒
Amplifier (1-12GHz)	Advanced Microwave	WLA652A	1740103	2023.12.05	2024.12.04	☒
Amplifier (0.8-21GHz)	Mini-Circuits	ZVA-213-S+	225321316	2023.12.05	2024.12.04	☒
Amplifier (18-40GHz)	COM-MV	KA LNA18-40G-01	18050001	2023.12.05	2024.12.04	☒
Test Antenna-Horn	SCHWARZB ECK	BBHA 9120D	01917	2022.06.09	2025.06.08	☒
Test Antenna-Horn	A-INFOMW	LB-180400KF	J211060273	2021.07.02	2024.07.01	☒
Anechoic Chamber (#2)	YiHeng	9m*6m*6m	142	2021.08.19	2024.08.18	☒
Description	Supplier	Name	Version	/		Use
Test Software	BALUN	BL410-E	V22.930	/		☒

A.2 Conducted Emission, AC Ports

Note: Not applicable.

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2410367-AE-1.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2410367-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2410367-AI.PDF”.

Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
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