

| | |
|-------------------------------------|-------------------------------|
| Product Name: Pillow speaker | Report No:ITEZA2-202400326RF |
| Product Model: SE-EU-001, SE-EU-002 | Security Classification: Open |
| Version: V1.0 | Total Page:67 |

TIRT Testing Report

| Prepared By: | Checked By: | Approved By: |  |
|-------------------|-------------------|------------------|---|
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FCC Radio Test Report

FCC ID: 2AXKB-SE-EU-001

According to

47 CFR FCC Part 15, Subpart C(Section 15.247)

ANSI C63.10:2013

| | |
|---------------|---|
| Applicant: | Cambridge Sleep Sciences Ltd |
| Address: | 115B Innovation Drive, Milton Park, Abingdon, Oxfordshire, OX14 4RZ.United Kingdom |
| Manufacturer: | Vistron (Dong Guan) Audio Equipment Co.,Ltd |
| Address: | NO.17 Ji Cai Street, Song Gang District, Qing Xi Town, Dong Guan City, Guang Dong Province, China |
| Sample No: | 1000045442 |
| Product Name: | Pillow speaker |
| Brand Name: | N/A |
| Model No.: | SE-EU-001, SE-EU-002 |
| Different: | There is no difference except the name of the model |
| Test No.: | SE-EU-001 |

| | |
|------------------|-----------------------|
| Date of Receipt: | 2024/08/31 |
| Date of Test: | 2024/08/31~2024/11/04 |
| Issued Date: | 2024/11/28 |
| Testing Lab: | TIRT |

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Table of Contents**Page**

| | |
|---|-----------|
| REPORT ISSUED HISTORY | 6 |
| 1 . SUMMARY OF TEST RESULTS | 7 |
| 1.1 TEST FACILITY | 8 |
| 1.2 MEASUREMENT UNCERTAINTY | 8 |
| 1.3 TEST ENVIRONMENT CONDITIONS | 9 |
| 2 . GENERAL INFORMATION | 10 |
| 2.1 GENERAL DESCRIPTION OF EUT | 10 |
| 2.2 DESCRIPTION OF TEST MODES | 11 |
| 2.3 PARAMETERS OF TEST SOFTWARE | 12 |
| 2.4. ACCESSORIES OF DEVICE (EUT) | 12 |
| 2.5 BLOCKDIAGRAMSHOWINGTHECONFIGURATIONOFSYSTEMTESTED | 12 |
| 2.6 SUPPORT UNITS | 12 |
| 3 .AC POWER LINE CONDUCTED EMISSIONS | 13 |
| 3.1 LIMIT | 13 |
| 3.2 TEST PROCEDURE | 13 |
| 3.3 DEVIATIONFROMTESTSTANDARD | 13 |
| 3.4 TESTSETUP | 14 |
| 3.5 EUT OPERATING CONDITIONS | 14 |
| 3.6 TEST RESULTS | 14 |
| 4 . RADIATED EMISSIONS | 15 |
| 4.1 LIMIT | 15 |
| 4.2 TEST PROCEDURE | 16 |
| 4.3 DEVIATIONFROMTESTSTANDARD | 17 |
| 4.4 TESTSETUP | 17 |
| 4.5 EUT OPERATING CONDITIONS | 19 |
| 4.6 TEST RESULT- 9KHZ TO 30MHZ | 19 |
| 4.7 TEST RESULT- 30MHZ TO 1000MHZ | 19 |
| 4.8 TEST RESULT- ABOVE 1000MHZ | 19 |
| 5 .BANDWIDTH | 20 |
| 5.1 LIMIT | 20 |
| 5.2 TEST PROCEDURE | 20 |
| 5.3 DEVIATION FROM STANDARD | 20 |
| 5.4 TEST SETUP | 20 |
| 5.5 EUT OPERATION CONDITIONS | 20 |

Table of Contents**Page**

| | |
|--|-----------|
| 5.6 TESTRESULTS | 20 |
| 6 .MAXIMUM OUTPUT POWER | 21 |
| 6.1 LIMIT | 21 |
| 6.2 TEST PROCEDURE | 21 |
| 6.3 DEVIATION FROM STANDARD | 21 |
| 6.4 TEST SETUP | 21 |
| 6.5 EUT OPERATION CONDITIONS | 21 |
| 6.6 TESTRESULTS | 21 |
| 7 .CONDUCTED SPURIOUS EMISSION | 22 |
| 7.1 LIMIT | 22 |
| 7.2 TEST PROCEDURE | 22 |
| 7.3 DEVIATION FROM STANDARD | 22 |
| 7.4 TEST SETUP | 22 |
| 7.5 EUT OPERATION CONDITIONS | 22 |
| 7.6 TEST RESULTS | 22 |
| 8 .POWER SPECTRAL DENSITY | 23 |
| 8.1 LIMIT | 23 |
| 8.2 TEST PROCEDURE | 23 |
| 8.3 DEVIATION FROM STANDARD | 23 |
| 8.4 TEST SETUP | 23 |
| 8.5 EUT OPERATION CONDITIONS | 23 |
| 8.6 TEST RESULTS | 23 |
| 9. ANTENNA REQUIREMENT | 24 |
| 9.1STANDARD REQUIREMENT | 24 |
| 9.2ANTENNA CONNECTED CONSTRUCTION | 24 |
| 9.3RESULTS | 24 |
| 10. MEASUREMENT INSTRUMENTS LIST | 25 |
| 11. PHOTOS OF TEST SETUP | 26 |
| 12. PHOTOS OF EUT | 28 |
| APPENDIX A - AC POWER LINE CONDUCTED EMISSIONS | 35 |
| APPENDIX B - RADIATED EMISSION -9 KHZ TO 30 MHZ | 37 |
| APPENDIX C - RADIATED EMISSION-30 MHZ TO 1000 MHZ | 38 |
| APPENDIX D - RADIATED EMISSION - ABOVE 1000 MHZ | 40 |

Table of Contents**Page**

| | |
|---|-----------|
| APPENDIX E - BANDWIDTH | 42 |
| APPENDIX F - MAXIMUM OUTPUT POWER | 48 |
| APPENDIX G - CONDUCTED SPURIOUS EMISSION | 51 |
| APPENDIX H- POWER SPECTRAL DENSITY | 62 |
| APPENDIX I DUTY CYCLE | 65 |

REPORT ISSUED HISTORY

| Report No. | Version | Description | Issued Date | Note |
|---------------------|---------|------------------|-------------|-------|
| ITEZA2-202400326RF1 | V1.0 | Original Report. | 2024.11.28 | Valid |

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

| FCC CFR Title 47, Part 15, Subpart C | | | | |
|--------------------------------------|-----------------------------------|--|----------|---------|
| Standard(s) Section | Test Item | Test Result | Judgment | Remark |
| 15.207 | AC Power Line Conducted Emissions | APPENDIX A | PASS | ----- |
| 15.247(d) 15.205(a) 15.209(a) | Radiated Emissions | APPENDIX B APPENDIX C APPENDIX D | PASS | ----- |
| 15.247(a)(2) | Bandwidth | APPENDIX E | PASS | ----- |
| 15.247(b)(3) | Maximum Output Power | APPENDIX F | PASS | ----- |
| 15.247(d) | Conducted Spurious Emission | APPENDIX G | PASS | ----- |
| 15.247(e) | Power Spectral Density | APPENDIX H | PASS | ----- |
| 15.203 | Antenna Requirement | ----- | PASS | Note(2) |

Note:

- (1) "N/A" denotes test is not applicable to this device.
- (2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.

1.1 TEST FACILITY

| | |
|--|---|
| Company: | Beijing TIRT Technology Service Co.,Ltd Shenzhen |
| Address: | 104 Building C, Xinmingsheng Industrial Park No.132, Zhangge Old Village East Zone, Zhangge Community, Fucheng Street, Longhua District, Shenzhen, Guangdong, P. R. China |
| CNAS Registration Number: | CNAS L14158 |
| A2LA Registration Number: | 6049.01 |
| FCC Accredited Lab.Designation Number: | CN1366 |
| FCC Test Firm Registration Number: | 820690 |
| Telephone: | +86-0755-27087573 |

1.2 MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

The measurement uncertainty as below table:

| Uncertainty | |
|---|-------------|
| Parameter | Uncertainty |
| Occupied Channel Bandwidth | ±142.12 KHz |
| RF power conducted | ±0.74 dB |
| RF power radiated | ±3.25dB |
| Spurious emissions, conducted | ±1.78dB |
| Spurious emissions, radiated (30MHz~1GHz) | ±4.6dB |
| Spurious emissions, radiated (1GHz ~ 18GHz) | ±4.9dB |
| Conduction Emissions(150kHz~30MHz) | ±3.1 dB |
| Humidity | ±4.6% |
| Temprature | ±0.7°C |
| Time | ±1.25% |

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

1.3 TEST ENVIRONMENT CONDITIONS

| Test Item | Temperature | Humidity | Test Voltage | Tested By |
|---------------------------------------|-------------|----------|---------------------------|------------|
| AC Power Line Conducted Emissions | 24.5°C | 50% | DC 5V from AC/DC Adapter | Aaron Long |
| Radiated Emissions-9 kHz to 30 MHz | 24.5°C | 50% | DC 5V from AC/DC Adapter | Aaron Long |
| Radiated Emissions-30 MHz to 1000 MHz | 24°C | 53% | DC 5V from AC/DC Adapter | Aaron Long |
| Radiated Emissions-Above 1000 MHz | 26°C | 53% | DC 5V from AC/DC Adapter | Aaron Long |
| Bandwidth | 25°C | 56% | DC 5V from AC/DC Adapter | Aaron Long |
| Maximum Output Power | 24°C | 54% | AC 120V/60Hz from Adapter | Aaron Long |
| ConductedSpurious Emission | 25°C | 62% | DC 5V from AC/DC Adapter | Aaron Long |
| Power Spectral Density | 26°C | 60% | DC 5V from AC/DC Adapter | Aaron Long |

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

| | |
|-------------------------|---|
| Equipment | Pillow speaker |
| Brand Name | N/A |
| Test Model | SE-EU-001 |
| Series Model | SE-EU-001, SE-EU-002 |
| Model Difference(s) | There is no difference except the name of the model |
| Software Version | V1.0 |
| Hardware Version | V1.0 |
| Power Rating | DC 5V from AC/DC Adapter |
| Operation Frequency | 2402 MHz ~ 2480 MHz |
| Modulation Type | GFSK |
| Bit Rate of Transmitter | 1Mbps, 2Mbps |
| Max. Output Power | 1Mbps: -2.65dBm (0.000543W) |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

2.2 DESCRIPTION OF TEST MODES

The test software was used to control EUT work in Continuous TX mode, and select test channel, wireless mode

| Tested mode, channel, and data rate information | | |
|---|--------------|-----------------|
| Mode | Channel | Frequency (MHz) |
| GFSK (1M/2M) | Low :CH00 | 2402 |
| | Middle: CH19 | 2440 |
| | High: CH39 | 2480 |

Channel List:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 00 | 2402 | 20 | 2442 |
| 01 | 2404 | 21 | 2444 |
| 02 | 2406 | 22 | 2446 |
| 03 | 2408 | 23 | 2448 |
| 04 | 2410 | 24 | 2450 |
| 05 | 2412 | 25 | 2452 |
| 06 | 2414 | 26 | 2454 |
| 07 | 2416 | 27 | 2456 |
| 08 | 2418 | 28 | 2458 |
| 09 | 2420 | 29 | 2460 |
| 10 | 2422 | 30 | 2462 |
| 11 | 2424 | 31 | 2464 |
| 12 | 2426 | 32 | 2466 |
| 13 | 2428 | 33 | 2468 |
| 14 | 2430 | 34 | 2470 |
| 15 | 2432 | 35 | 2472 |
| 16 | 2434 | 36 | 2474 |
| 17 | 2436 | 37 | 2476 |
| 18 | 2438 | 38 | 2478 |
| 19 | 2440 | 39 | 2480 |

Table for Filed Antenna:

| Ant. | Manufactured | Model Name | Antenna Type | Connector | Gain (dBi) |
|------|--|------------|--------------|-----------|------------|
| 1 | Shenzhen Yishengbang Technology Co., Ltd | RF205E | PIFA | N/A | 1.90 |

Note: Antenna information is provided by applicant.
The antenna is for testing and fixation purposes.

2.3 PARAMETERS OF TEST SOFTWARE

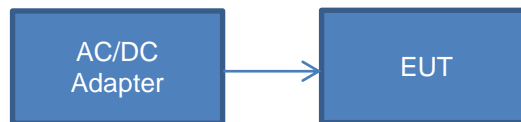
During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

| Test Software Version | CMD | | |
|-----------------------|---------|---------|---------|
| Frequency (MHz) | 2402 | 2440 | 2480 |
| 1Mbps, 2 Mbps | default | default | default |

2.4. ACCESSORIES OF DEVICE (EUT)

Accessories : AC/DC Adapter
 Manufacturer : Shenzhen Meryking Electronics Co., Ltd
 Model : MKD-0503000DEXU
 Ratings : INPUT:100-240V~50/60Hz 0.5A
 OUTPUT:5.0V=3.0A 15.0W

2.5 BLOCKDIAGRAMSHOWINGTHECONFIGURATIONOFSYSTEMTESTED



2.6 SUPPORT UNITS

| No. | Description | Manufacturer | Model | Ratings | Serial Number | Certification or SDoC |
|-----|-------------|--------------|-------|---------|---------------|-----------------------|
| 1 | N/A | N/A | N/A | N/A | N/A | N/A |

3.AC POWER LINE CONDUCTED EMISSIONS

3.1LIMIT

| Frequency of Emission (MHz) | Limit (dBμV) | |
|-----------------------------|--------------|-----------|
| | Quasi-peak | Average |
| 0.15 -0.5 | 66 to 56* | 56 to 46* |
| 0.5-5.0 | 56 | 6 |
| 5.0 -30.0 | 60 | 50 |

Note:

- (1) The tighter limit applies at the band edges.
- (2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

3.2TEST PROCEDURE

- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipment powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.
- e. For the actual test configuration, please refer to the related Item –EUT Test Photos.

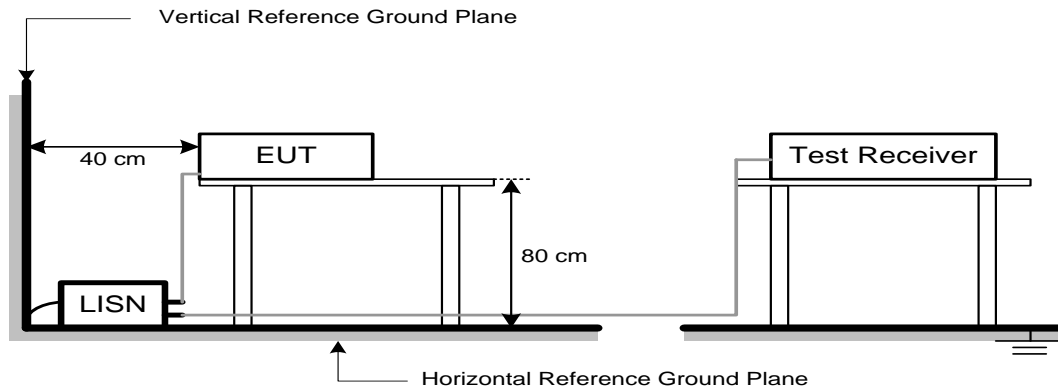
The following table is the setting of the receiver:

| Receiver Parameters | Setting |
|---------------------|----------|
| Start Frequency | 0.15 MHz |
| Stop Frequency | 30 MHz |
| IF Bandwidth | 9 kHz |

3.3DEVIATIONFROMTESTSTANDARD

No deviation.

3.4 TEST SETUP



The LISN edge is arranged parallel to the edge of the test table
The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT

3.5 EUT OPERATING CONDITIONS

The EUT was configured for testing in a typical fashion -GFSK (1M/2M) mode, The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.6 TEST RESULTS

Please refer to the APPENDIX-A

4. RADIATED EMISSIONS

4.1 LIMIT

In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-1000MHz)

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|--------------------|--------------------------------------|----------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.490-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100 | 3 |
| 88-216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

| Frequency (MHz) | (dBuV/m at 3 m) | |
|-----------------|-----------------|---------|
| | Peak | Average |
| Above 1000 | 74 | 54 |

Note:

- (1) The limit for radiated test was performed according to FCC CFR Title 47, Part 15, Subpart C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

4.2 TEST PROCEDURE

- a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
- c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
- e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.
- f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform.
(below 1GHz)
- h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform. (above 1GHz)
- i. For the actual test configuration, please refer to the related Item –EUT Test Photos.

The following table is the setting of the receiver:

| Spectrum Parameters | Setting |
|------------------------|---------------------------------|
| Start ~ Stop Frequency | 9 kHz~150 kHz for RBW 200 Hz |
| Start ~ Stop Frequency | 0.15 MHz~30 MHz for RBW 9 kHz |
| Start ~ Stop Frequency | 30 MHz~1000 MHz for RBW 100 kHz |

| Spectrum Parameters | Setting |
|--|--|
| Start Frequency | 1000 MHz |
| Stop Frequency | 10th carrier harmonic |
| RBW / VBW (Emission in restricted band) | 1MHz / 3MHz for PK value 1MHz / 1/THz for AVG value |

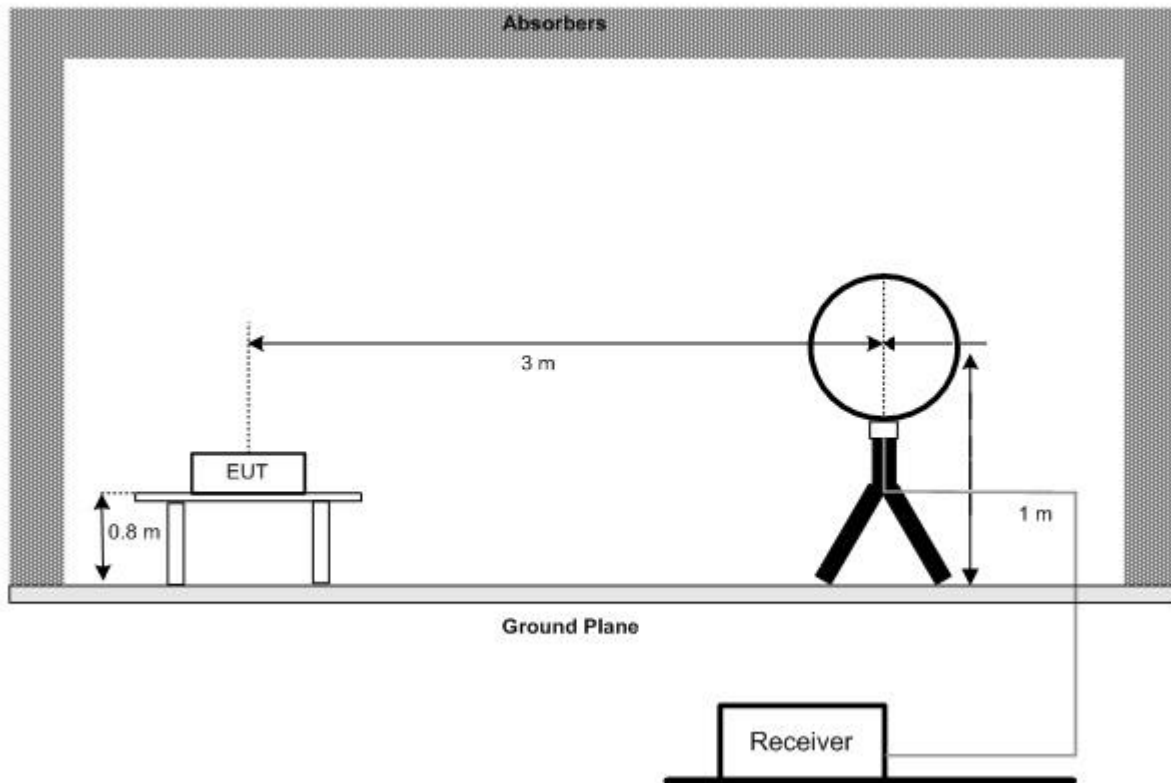
| Spectrum Parameters | Setting |
|------------------------|-------------------------------------|
| Start ~ Stop Frequency | 9 kHz~90 kHz for PK/AVG detector |
| Start ~ Stop Frequency | 90 kHz~110 kHz for QP detector |
| Start ~ Stop Frequency | 110 kHz~490 kHz for PK/AVG detector |
| Start ~ Stop Frequency | 490 kHz~30 MHz for QP detector |
| Start ~ Stop Frequency | 30MHz~1000MHz for QP detector |
| Start ~ Stop Frequency | 1 GHz~26.5GHz for PK/AVG detector |

4.3 DEVIATION FROM TEST STANDARD

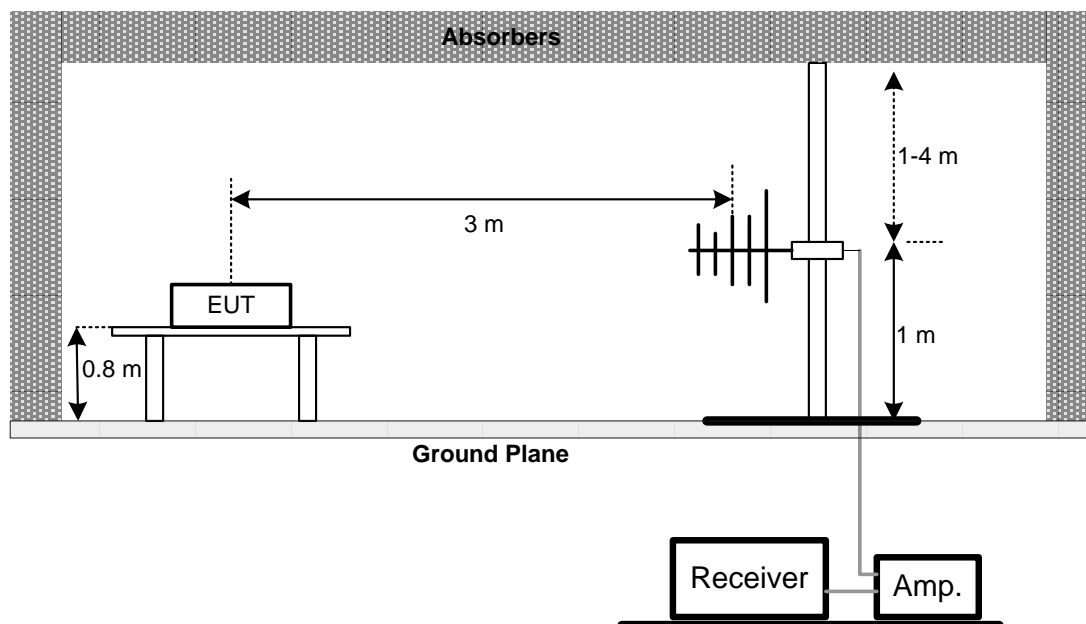
No deviation.

4.4 TEST SETUP

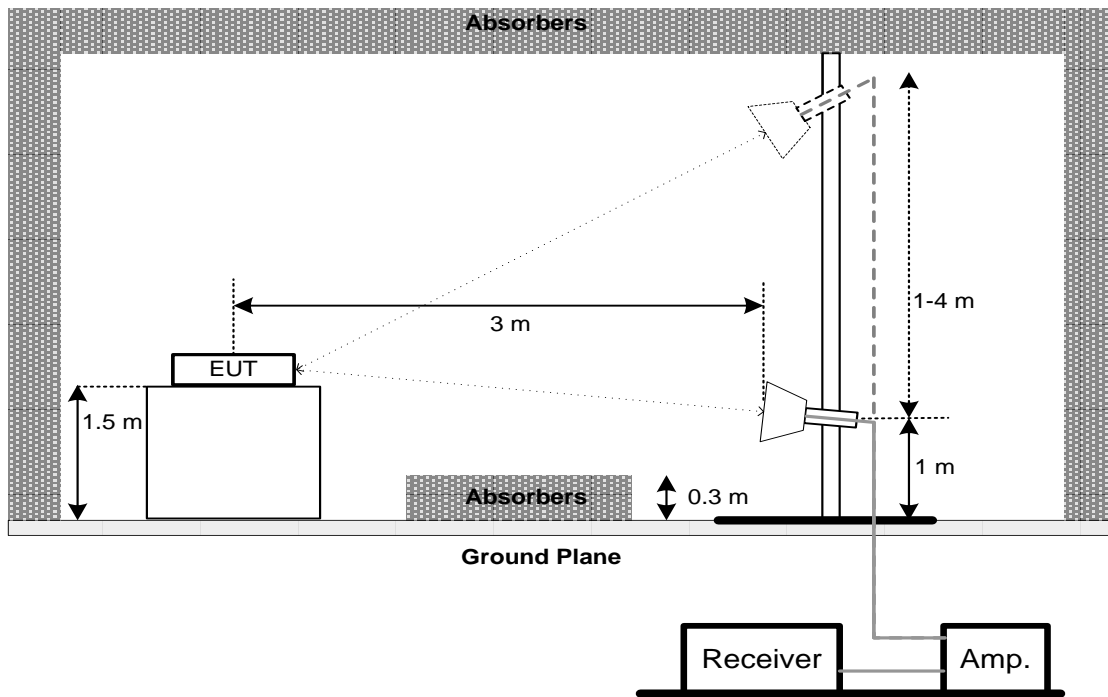
9 kHz to 30 MHz



30 MHz to 1 GHz



Above 1 GHz



4.5 EUT OPERATING CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

4.6 TEST RESULT- 9kHz TO 30MHz

Please refer to the APPENDIX-B

Remark:

- (1) Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB).
- (2) Limit line = specific limits (dBuV) + distance extrapolation factor.

4.7 TEST RESULT- 30MHz TO 1000MHz

Please refer to the APPENDIX-C

4.8 TEST RESULT- ABOVE 1000MHz

Please refer to the APPENDIX-D

Remark:

- (1) No limit: This is fundamental signal, the judgment is not applicable.
For fundamental signal judgment was referred to Peak output test.

5.BANDWIDTH

5.1LIMIT

| Section | Test Item | Limit |
|------------------|------------------------|----------------|
| FCC 15.247(a)(2) | 6dB Bandwidth | ≥ 500 kHz |
| | 99% Emission Bandwidth | - |

5.2TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- The following table is the setting of the spectrum analyzer:

For 6 dB Bandwidth:

| Spectrum Parameters | Setting |
|---------------------|-------------------------|
| Span Frequency | > Measurement Bandwidth |
| RBW | 100 kHz |
| VBW | 300kHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

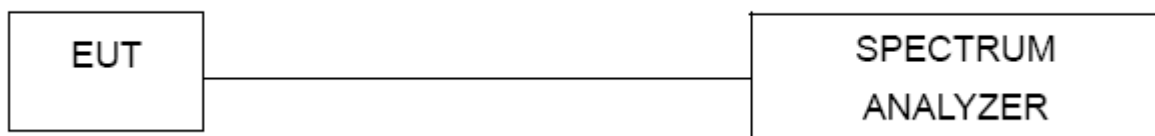
For 99% Emission Bandwidth:

| Spectrum Parameters | Setting |
|---------------------|---|
| Span Frequency | Between 1.5 times and 5.0 times the OBW |
| RBW | 50kHz |
| VBW | 200kHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

5.3DEVIATION FROM STANDARD

No deviation.

5.4TEST SETUP



5.5EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

5.6TESTRESULTS

Please refer to the APPENDIX-E

6.MAXIMUM OUTPUT POWER

6.1LIMIT

| Section | Test Item | Limit |
|------------------|----------------------|-------------------------|
| FCC 15.247(b)(3) | Maximum Output Power | 1.0000 watt or 30.00dBm |

6.2TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- The following table is the setting of the spectrum analyzer:

| Spectrum Parameters | Setting |
|---------------------|----------------------------|
| Span Frequency | $\geq 3 \times \text{RBW}$ |
| RBW | 2 MHz |
| VBW | 5 MHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

6.3DEVIATION FROM STANDARD

No deviation.

6.4TEST SETUP



6.5EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

6.6TESTRESULTS

Please refer to the APPENDIX-F

7.CONDUCTED SPURIOUS EMISSION

7.1LIMIT

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output Power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required.

7.2TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- The following table is the setting of the spectrum analyzer:

| Spectrum Parameters | Setting |
|---------------------|----------|
| Start Frequency | 30 MHz |
| Stop Frequency | 26.5 GHz |
| RBW | 100 kHz |
| VBW | 300 kHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

7.3DEVIATION FROM STANDARD

No deviation.

7.4TEST SETUP



7.5EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

7.6 TEST RESULTS

Please refer to the APPENDIX-G

8. POWER SPECTRAL DENSITY

8.1 LIMIT

| Section | Test Item | Limit |
|---------------|------------------------|-------------------------|
| FCC 15.247(e) | Power Spectral Density | 8 dBm (in any 3 kHz) |

8.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- The following table is the setting of the spectrum analyzer:

| Spectrum Parameters | Setting |
|---------------------|---------------------------------|
| Span Frequency | 2 MHz (1 Mbps) / 4 MHz (2 Mbps) |
| RBW | 3 kHz |
| VBW | 10 kHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP



8.5 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.

8.6 TEST RESULTS

Please refer to the APPENDIX-H

9. ANTENNA REQUIREMENT**9.1 STANDARD 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 shall be considered sufficient to comply with the provisions of this Section. 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.

9.2 ANTENNA CONNECTED CONSTRUCTION

The antenna connector is unique antenna and no consideration of replacement. Please see EUT photo for details.

9.3 RESULTS

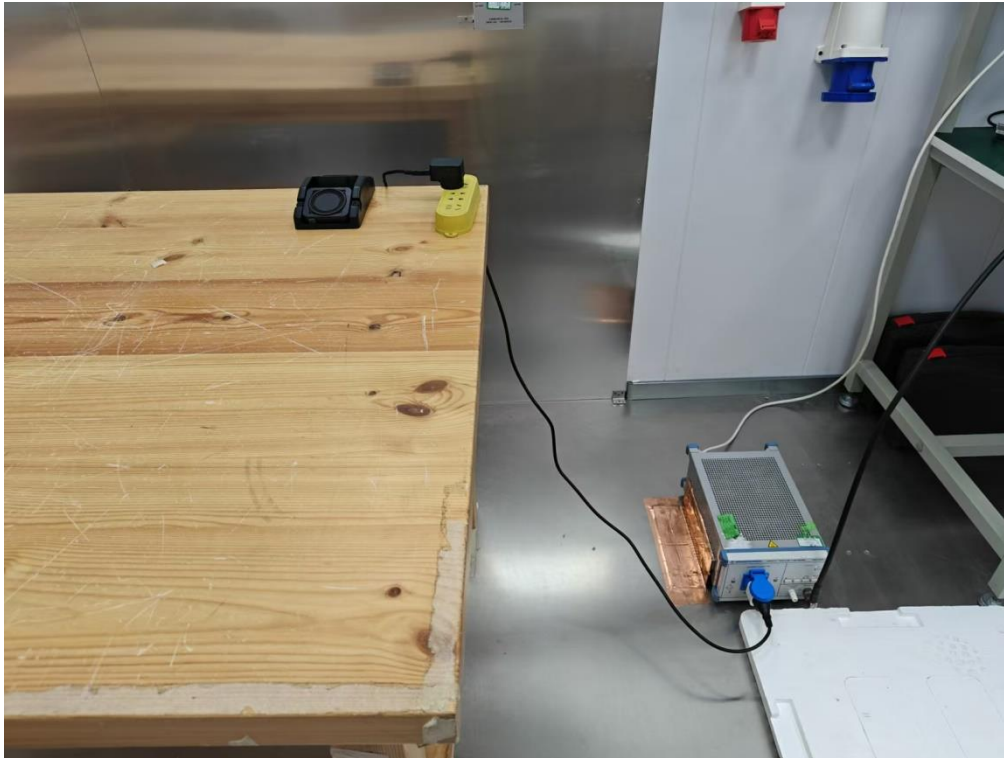
The EUT antenna is PIFA antenna. It complies with the standard requirement.

10. MEASUREMENT INSTRUMENTS LIST

| Name of Equipment | Manufacturer | Model Number | Serial Number | Last Calibration | Due Calibration |
|-------------------|-----------------|----------------------|--------------------------|------------------|-----------------|
| EMI Receiver | Rohde&Schwarz | ESIB 40 | YH-TIRT-SAC-966-20220911 | 2024/01/05 | 2025/01/04 |
| Integral Antenna | Schwarzbeck | VULB 9163 | 01314 | 2022.12.11 | 2024.12.10 |
| Integral Antenna | Rohde&Schwarz | HF907 | RSM2991424 | 2022.12.11 | 2024.12.10 |
| Preamplifier | Emtrace | RP01A | '02017 | 2024/01/05 | 2025/01/04 |
| Preamplifier | Schwarzbeck | BBV9744 | 00143 | 2024/01/05 | 2025/01/04 |
| Loop Antenna | ZHINAN | ZN30900A | 12024 | 2024/01/05 | 2025/01/04 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 00956 | 2024/01/05 | 2025/01/04 |
| RF Cable | / | LMR400UF-NMNM-7.0M | / | 2024/01/05 | 2025/01/04 |
| RF Cable | / | SFT2050PUR-NMNM-7.0M | / | 2024/01/05 | 2025/01/04 |
| EMI Receiver | Rohde&Schwarz | ESR7 | 1316.3003K07-102611-mk | 2024/11/02 | 2025/11/01 |
| LISN | Rohde&Schwarz | ENV216 | 3560.655.12-102915-Bp | 2024/11/02 | 2025/11/01 |
| RF Cable | \ | SFT2050PUR-NMNM-2.0M | \ | 2024/01/05 | 2025/01/04 |
| Spectrum analyzer | ROHDE&SCHWARZ | FSU26 | 200732 | 2024/01/05 | 2025/01/04 |
| Spectrum analyzer | ROHDE&SCHWARZ | FSV40-N | 101722 | 2024/01/05 | 2025/01/04 |
| Filter | HEWLETT PACKARD | JS0806-F | 19K8060209 | 2024/01/05 | 2025/01/04 |

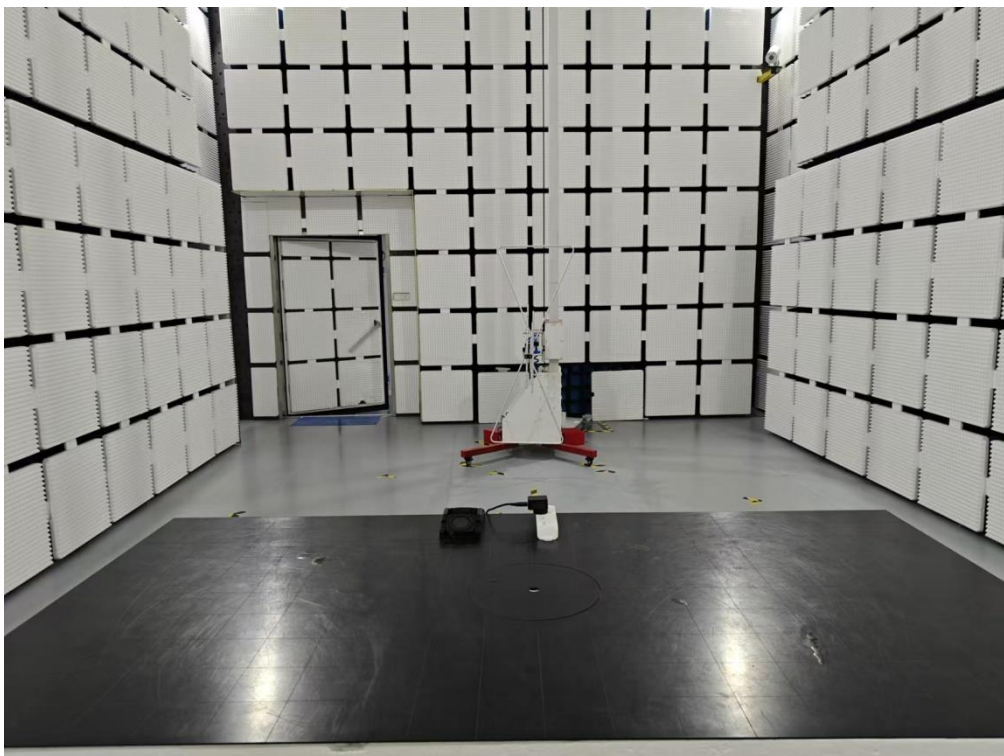
11. PHOTOS OF TEST SETUP

AC Power Line Conducted Emissions Test Photos



Radiated Emissions Test Photos

30 MHz to 1 GHz



Radiated Emissions Test Photos**Above 1 GHz****Conducted Test Photos**

12. PHOTOS OF EUT









