

King Electrical Manufacturing Company

TEST REPORT

Model:
KRF-REPEATER

REPORT NUMBER
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Radio Spectrum TEST REPORT

| | |
|-------------------------------|---|
| Applicant: | King Electrical Manufacturing Company 9131 10th Avenue South Seattle,WA 98108 USA |
| Product: | RF REPEATER |
| Model No.: | KRF-REPEATER |
| FCC ID: | 2BH5BKRF-REPEATER |
| Test Method/ Standard: | 47 CFR FCC Part 15.249 & ANSI C63.10 2013 |
| Test By: | Intertek Testing Services Taiwan Ltd., Hsinchu Laboratory No. 17, Ln. 246, Niupu S. Rd., Xiangshan Dist, Hsinchu City 300075, Taiwan |



A handwritten signature in black ink that reads 'Rich Nien'.

Rich Nien
Engineer

A handwritten signature in black ink that reads 'Zero Chen'.

Zero Chen
Reviewer

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Revision History

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| 240800013THC-001 | Oct. 17, 2024 | Original report |

Table of Contents

| | |
|---|----|
| Summary of Tests | 4 |
| 1. General Information | 5 |
| 1.1 Identification of the EUT | 5 |
| 1.2 Antenna description | 5 |
| 2. Test specifications..... | 6 |
| 2.1 Test standard | 6 |
| 2.2 Operation mode | 6 |
| 2.3 Peripherals equipment | 6 |
| 3. Radiated emission test FCC 15.249 (C)..... | 7 |
| 3.1 Test setup & procedure | 7 |
| 3.2 Emission limit | 9 |
| 3.2.1 Fundamental and harmonics emission limits | 9 |
| 3.2.2 General radiated emission limits..... | 10 |
| 3.3 Radiated spurious emission test data | 11 |
| 3.3.1 Measurement results: frequency range from 9 kHz to 30 MHz..... | 11 |
| 3.3.2 Measurement results: frequencies equal to or less than 1 GHz..... | 12 |
| 3.3.3 Measurement results: frequency above 1GHz..... | 13 |
| 3.3.4 Measurement results: Fundamental..... | 14 |
| 4. Conducted emission test FCC 15.207 | 15 |
| 4.1 Measuring instrument setting..... | 15 |
| 4.2 Test Procedure..... | 15 |
| 4.3 Test Diagram | 15 |
| 4.4 Limit..... | 16 |
| 4.5 Test Results | 17 |
| Appendix A: Test equipment list..... | 19 |
| Appendix B: Measurement Uncertainty..... | 21 |

Summary of Tests

| Test | Reference | Results |
|--------------------------------|-------------------|---------|
| Radiated Emission test | 15.249(c), 15.209 | Pass |
| Conducted Emission of AC Power | 15.207 | Pass |
| Antenna Requirement | 15.203 | Pass |

Note: Please note that the test results with statement of conformity, the decision rules which are based on: Safety Testing: the specification, standard or IEC Guide 115.

Other Testing: the specification, standard and not taking into account the measurement uncertainty.

1. General Information

1.1 Identification of the EUT

| | |
|-------------------------------|-------------------------|
| Product: | RF REPEATER |
| Model No.: | KRF-REPEATER |
| Operating Frequency: | 915.055 MHz |
| Channel Number: | Single channel |
| Rating: | DC 5V |
| Power Cord: | N/A |
| Sample receiving date: | 2024/09/13 |
| Sample condition: | Workable |
| Test Date(s): | 2024/09/25 ~ 2024/09/30 |

1.2 Antenna description

Antenna Type: Spring Antenna
Connector Type: Fixed
Antenna Gain: 2.5 dB ± 2dB

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

Power on the EUT and it will transmit continuously.

| Mode | Frequency (MHz) | Signal on time (ms) | Signal on & off time (ms) | Duty cycle | Duty Cycle factor |
|------|-----------------|---------------------|---------------------------|------------|-------------------|
| FSK | 915.055 | 9.8 | 100 | 9.80% | 20.18 |

2.3 Peripherals equipment

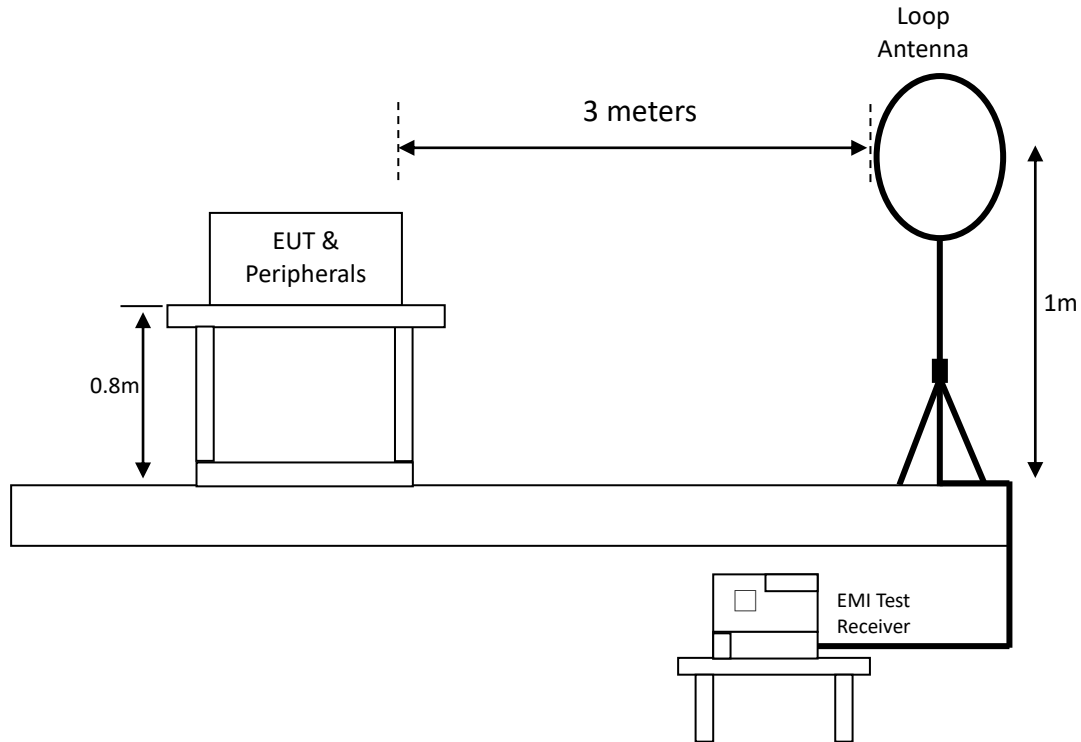
| Peripherals | Brand | Model No. | Serial No. | Description of Data Cable |
|-------------|--------|-----------|------------|---------------------------|
| Adapter | UGREEN | CD170 | N/A | N/A |

| Peripherals name | Length | Shielded(Y/N) | Brand | Model No. |
|------------------|--------|---------------|--------|-----------|
| Type-C Cable | 2.0m | Y | AINOPE | AP544-2M |

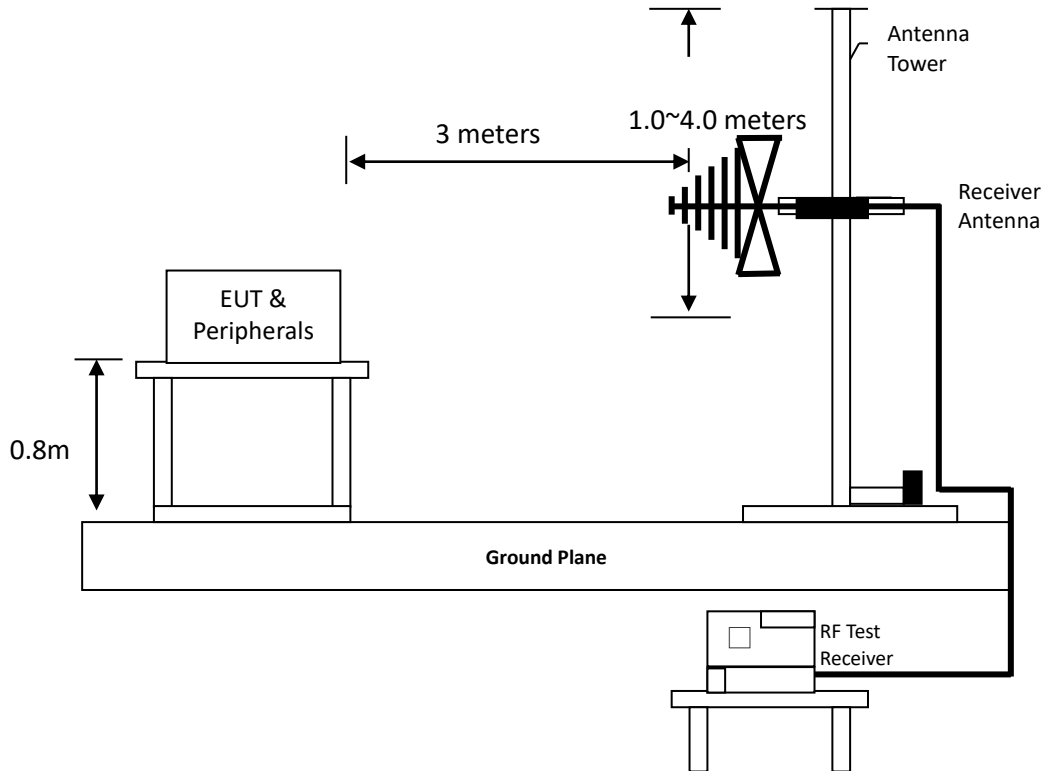
3. Radiated emission test FCC 15.249 (C)

3.1 Test setup & procedure

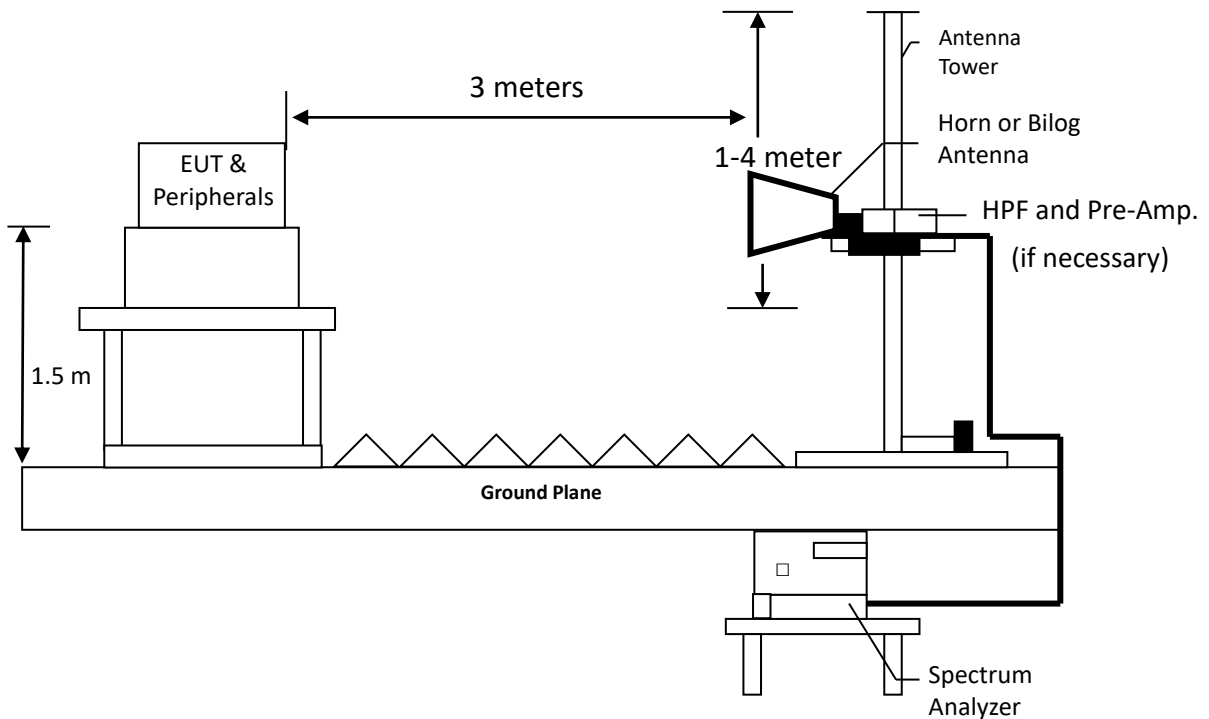
Radiated emission from 9kHz to 30MHz uses Loop Antenna:



Radiated emission below 1GHz using Bilog Antenna



Radiated emission above 1GHz using Horn Antenna



TEST REPORT

Radiated emissions were investigated cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 10Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1 MHz RBW/ 3 MHz VBW) recorded also on the report.

The EUT for testing is arranged on a turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

3.2 Emission limit

3.2.1 Fundamental and harmonics emission limits

| Frequency (MHz) | Field Strength of Fundamental | | Field Strength of Harmonics | |
|-----------------|-------------------------------|-------------|-----------------------------|-------------|
| | (mV/m@3m) | (dBuV/m@3m) | (uV/m@3m) | (dBuV/m@3m) |
| 902-928 | 50 | 94 | 500 | 54 |

3.2.2 General radiated emission limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

| Frequency MHz | 15.209 Limits (dBμV/m@3m) |
|--------------------------|---|
| 30-88 | 40 |
| 88-216 | 43.5 |
| 216-960 | 46 |
| Above 960 | 54 |

Remark:

1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

TEST REPORT

3.3 Radiated spurious emission test data

3.3.1 Measurement results: frequency range from 9 kHz to 30 MHz

| | |
|-------------------------|------------|
| Temperature (°C) : | 26 |
| Relative Humidity (%) : | 73 |
| Test date : | 2024/09/27 |

| Antenna Polarization | Frequency (MHz) | Detector | Correction Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3 m (dBµV/m) | Margin (dB) |
|----------------------|-----------------|----------|--------------------------|----------------|----------------------------|----------------------|-------------|
| Perpendicular | 0.519 | PK | 17.92 | 23.71 | 41.63 | 73.30 | -31.67 |
| Perpendicular | 1.599 | PK | 17.94 | 16.59 | 34.53 | 63.53 | -29.00 |
| Perpendicular | 5.947 | PK | 19.84 | 9.05 | 28.89 | 69.54 | -40.65 |
| Perpendicular | 8.406 | PK | 19.69 | 10.79 | 30.48 | 69.54 | -39.06 |
| Perpendicular | 9.906 | PK | 19.95 | 9.32 | 29.27 | 69.54 | -40.27 |
| Perpendicular | 18.633 | PK | 21.08 | 8.72 | 29.80 | 69.54 | -39.74 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

| Antenna Polarization | Frequency (MHz) | Detector | Correction Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3 m (dBµV/m) | Margin (dB) |
|----------------------|-----------------|----------|--------------------------|----------------|----------------------------|----------------------|-------------|
| Parallel | 0.519 | PK | 17.92 | 24.32 | 42.24 | 73.30 | -31.06 |
| Parallel | 1.419 | PK | 17.96 | 17.68 | 35.64 | 64.56 | -28.92 |
| Parallel | 1.898 | PK | 17.91 | 17.65 | 35.56 | 69.54 | -33.98 |
| Parallel | 6.187 | PK | 19.90 | 10.76 | 30.66 | 69.54 | -38.88 |
| Parallel | 7.087 | PK | 19.87 | 11.08 | 30.95 | 69.54 | -38.59 |
| Parallel | 8.766 | PK | 19.68 | 9.71 | 29.39 | 69.54 | -40.15 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

| Antenna Polarization | Frequency (MHz) | Detector | Correction Factor (dB/m) | Reading (dBµV) | Corrected Reading (dBµV/m) | Limit @ 3 m (dBµV/m) | Margin (dB) |
|----------------------|-----------------|----------|--------------------------|----------------|----------------------------|----------------------|-------------|
| Ground-parallel | 0.519 | PK | 17.92 | 24.38 | 42.30 | 73.30 | -31.00 |
| Ground-parallel | 1.329 | PK | 17.97 | 16.81 | 34.78 | 65.13 | -30.35 |
| Ground-parallel | 1.898 | PK | 17.91 | 17.27 | 35.18 | 69.54 | -34.36 |
| Ground-parallel | 2.138 | PK | 17.91 | 14.64 | 32.55 | 69.54 | -36.99 |
| Ground-parallel | 10.086 | PK | 20.00 | 9.67 | 29.67 | 69.54 | -39.87 |
| Ground-parallel | 17.734 | PK | 20.96 | 9.31 | 30.27 | 69.54 | -39.27 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

TEST REPORT

3.3.2 Measurement results: frequencies equal to or less than 1 GHz

| | |
|-------------------------|------------|
| Temperature (°C) : | 27 |
| Relative Humidity (%) : | 71 |
| Test date : | 2024/09/25 |

| Antenna Polarized | Frequency (MHz) | Spectrum Analyzer Detector | Correction Factor (dB/m) | Reading (dBμV) | Corrected Reading (dBμV/m) | Limit @ 3 m (dBμV/m) | Margin (dB) |
|-------------------|-----------------|----------------------------|--------------------------|----------------|----------------------------|----------------------|-------------|
| Horizontal | 57.16 | PK | 20.43 | 5.99 | 26.42 | 40.00 | -13.58 |
| Horizontal | 93.05 | PK | 15.03 | 11.39 | 26.42 | 43.50 | -17.08 |
| Horizontal | 134.76 | PK | 19.45 | 5.20 | 24.65 | 43.50 | -18.85 |
| Horizontal | 544.10 | PK | 27.21 | 4.39 | 31.60 | 46.00 | -14.40 |
| Horizontal | 695.42 | PK | 30.27 | 4.81 | 35.08 | 46.00 | -10.92 |
| Horizontal | 843.83 | PK | 32.61 | 6.31 | 38.92 | 46.00 | -7.08 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

| Antenna Polarized | Frequency (MHz) | Spectrum Analyzer Detector | Correction Factor (dB/m) | Reading (dBμV) | Corrected Reading (dBμV/m) | Limit @ 3 m (dBμV/m) | Margin (dB) |
|-------------------|-----------------|----------------------------|--------------------------|----------------|----------------------------|----------------------|-------------|
| Vertical | 56.19 | QP | 20.55 | 14.80 | 35.35 | 40.00 | -4.65 |
| Vertical | 96.93 | PK | 15.54 | 22.09 | 37.63 | 43.50 | -5.87 |
| Vertical | 122.15 | PK | 18.01 | 14.21 | 32.22 | 43.50 | -11.28 |
| Vertical | 140.58 | PK | 19.87 | 12.03 | 31.90 | 43.50 | -11.60 |
| Vertical | 191.02 | PK | 18.00 | 7.29 | 25.29 | 43.50 | -18.21 |
| Vertical | 761.38 | PK | 31.76 | 5.67 | 37.43 | 46.00 | -8.57 |

Remark: Corr. Factor = Antenna Factor + Cable Loss

TEST REPORT

3.3.3 Measurement results: frequency above 1GHz

| | |
|-------------------------|------------|
| Temperature (°C) : | 27 |
| Relative Humidity (%) : | 71 |
| Test date : | 2024/09/25 |

| Mode | Frequency (MHz) | Spectrum Analyzer Detector | Ant. Pol. (H/V) | Correction Factor (dB/m) | Reading (dBμV) | Corrected Reading (dBμV/m) | Limit @ 3 m (dBμV/m) | Margin (dB) |
|------|-----------------|----------------------------|-----------------|--------------------------|----------------|----------------------------|----------------------|-------------|
| TX | 1830.11 | PK | H | -19.67 | 92.59 | 72.92 | 74.00 | -1.08 |
| | 1830.11 | AV | H | --- | --- | 52.74 | 54.00 | -1.26 |
| | 2745.16 | PK | H | -15.33 | 62.19 | 46.86 | 74.00 | -27.14 |
| | 3660.22 | PK | H | -12.86 | 60.01 | 47.15 | 74.00 | -26.85 |
| | 4575.27 | PK | H | -8.81 | 66.51 | 57.70 | 74.00 | -16.30 |
| | 4575.27 | AV | H | --- | --- | 37.52 | 54.00 | -16.48 |
| | 5490.33 | PK | H | -5.78 | 58.82 | 53.04 | 74.00 | -20.96 |
| | 6405.38 | PK | H | -1.98 | 45.89 | 43.91 | 74.00 | -30.09 |
| | 1765.00 | PK | V | -20.36 | 62.48 | 42.12 | 74.00 | -31.88 |
| | 1830.11 | PK | V | -19.67 | 93.22 | 73.55 | 74.00 | -0.45 |
| | 1830.11 | AV | V | --- | --- | 53.37 | 54.00 | -0.63 |
| | 2745.16 | PK | V | -15.33 | 66.76 | 51.43 | 74.00 | -22.57 |
| | 3660.22 | PK | V | -12.86 | 62.20 | 49.34 | 74.00 | -24.66 |
| | 4575.27 | PK | V | -8.81 | 63.95 | 55.14 | 74.00 | -18.86 |
| | 4575.27 | AV | V | --- | --- | 34.96 | 54.00 | -19.04 |
| | 5490.33 | PK | V | -5.78 | 53.64 | 47.86 | 74.00 | -26.14 |

Remark: 1. Correction Factor = Antenna Factor + Cable Loss - Pre_Amplifier Gain
 2. AV Corrected Reading = PK Corrected Reading + Duty cycle correction factor (-20.18)

TEST REPORT

3.3.4 Measurement results: Fundamental

| | |
|-------------------------|------------|
| Temperature (°C) : | 27 |
| Relative Humidity (%) : | 71 |
| Test date : | 2024/09/25 |

| Frequency (MHz) | Spectrum Analyzer Detector | Ant. Pol. (H/V) | Correction Factor (dB/m) | Reading (dBμV) | Corrected Reading (dBμV/m) | Limit @ 3 m (dBμV/m) | Margin (dB) |
|-----------------|----------------------------|-----------------|--------------------------|----------------|----------------------------|----------------------|-------------|
| 915.055 | PK | H | 33.68 | 66.70 | 100.38 | 114.00 | -13.62 |
| | AV | H | --- | --- | 80.20 | 94.00 | -13.80 |
| | PK | V | 33.68 | 65.04 | 98.72 | 114.00 | -15.28 |
| | AV | V | --- | --- | 78.54 | 94.00 | -15.46 |

Remark: 1. Correction Factor = Antenna Factor + Cable Loss

2. AV Corrected Reading = PK Corrected Reading + Duty cycle correction factor (-20.18)

4. Conducted emission test FCC 15.207

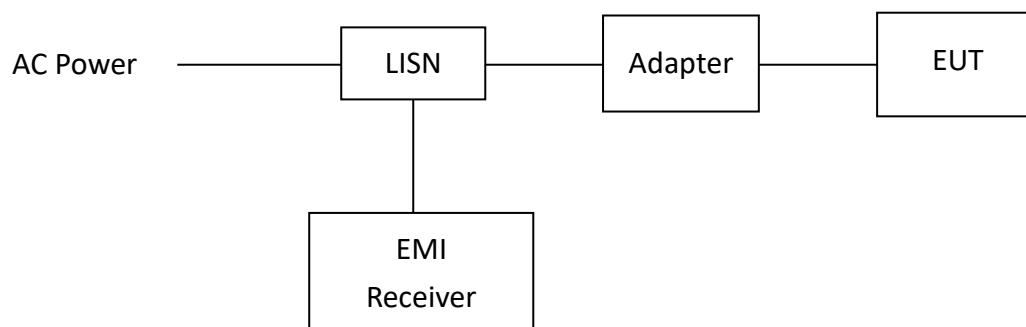
4.1 Measuring instrument setting

| Receiver Function | Setting |
|-------------------|---------|
| Detector | QP |
| Start frequency | 0.15MHz |
| Stop frequency | 30MHz |
| IF bandwidth | 9 kHz |
| Attenuation | 10dB |

4.2 Test Procedure

| | |
|--------|---|
| Step 1 | Configure the EUT according to ANSI C63.10:2013. The EUT or host of EHT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface. |
| Step 2 | Connect EUT or host of EUT to the power mains through a line impedance stabilization network. |
| Step 3 | All the companion devices are connected to the other LISN. The LISN should provide 50Uh/50ohms coupling impedance. |
| Step 4 | The frequency range from 150 kHz to 30MHz was searched. |
| Step 5 | Set the test-receiver system to peak detector and specified bandwidth with maximum hold mode. |
| Step 6 | The measurement has to be done between each power line and ground at the power terminal. |

4.3 Test Diagram

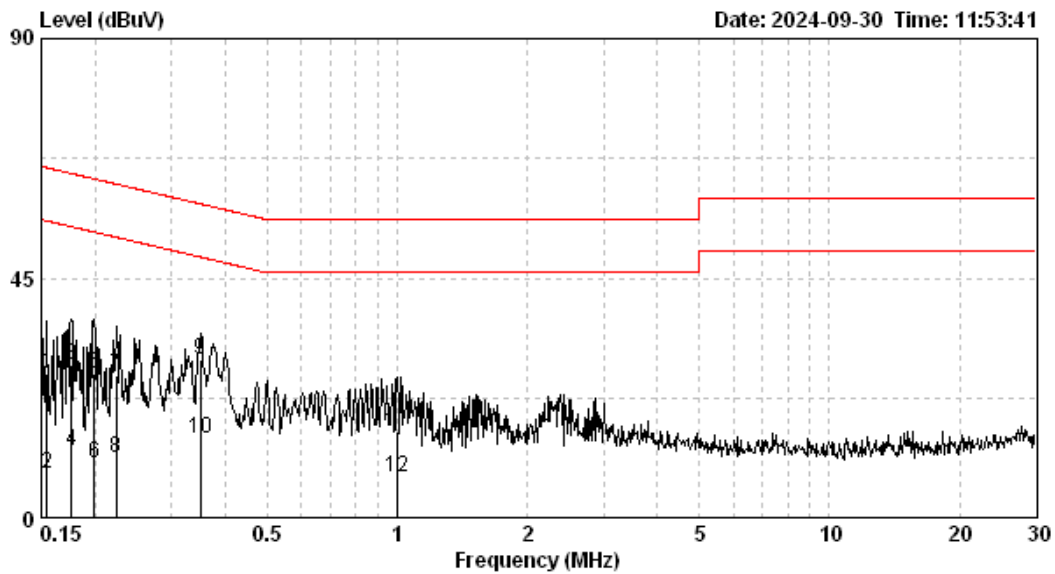


4.4 Limit

| Frequency (MHz) | Conducted Limit (dBuV) | |
|--------------------|------------------------|---------|
| | Q.P. | Ave. |
| 0.15~0.50 | 66 – 56 | 56 – 46 |
| 0.50~5.00 | 56 | 46 |
| 5.00~30.0 | 60 | 50 |

TEST REPORT

4.5 Test Results



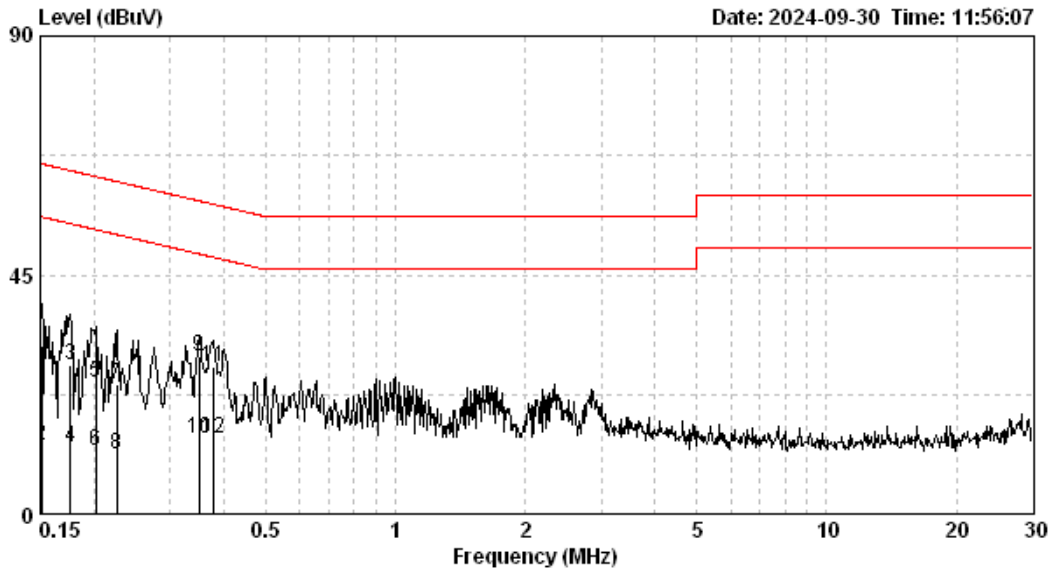
Test voltage : AC 120V 60Hz
 Temp. / R.H. : 25°C / 66%RH
 Atmospheric pressure : 1007 hPa

| Phase | Frequency (MHz) | Corr. Factor (dB) | Reading QP (dBuV) | Level QP (dBuV) | Limit QP (dBuV) | Reading AV (dBuV) | Level AV (dBuV) | Limit AV (dBuV) | Margin (dB) | |
|-------|-----------------|-------------------|-------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------|--------|
| | | | | | | | | | QP | AV |
| LINE | 0.155 | 9.55 | 17.56 | 27.11 | 65.74 | -1.34 | 8.21 | 55.74 | -38.62 | -47.52 |
| LINE | 0.176 | 9.57 | 19.20 | 28.76 | 64.68 | 2.94 | 12.51 | 54.68 | -35.92 | -42.17 |
| LINE | 0.199 | 9.58 | 17.52 | 27.10 | 63.67 | 0.64 | 10.22 | 53.67 | -36.57 | -43.45 |
| LINE | 0.223 | 9.58 | 17.09 | 26.67 | 62.70 | 1.65 | 11.23 | 52.70 | -36.03 | -41.47 |
| LINE | 0.350 | 9.57 | 20.00 | 29.57 | 58.96 | 5.28 | 14.85 | 48.96 | -29.39 | -34.11 |
| LINE | 1.000 | 9.59 | 6.65 | 16.24 | 56.00 | -1.90 | 7.69 | 46.00 | -39.76 | -38.31 |

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

TEST REPORT



Test voltage : AC 120V 60Hz
 Temp. / R.H. : 25°C / 66%RH
 Atmospheric pressure : 1007 hPa

| Phase | Frequency (MHz) | Corr. Factor (dB) | Reading QP (dBuV) | Level QP (dBuV) | Limit QP (dBuV) | Reading AV (dBuV) | Level AV (dBuV) | Limit AV (dBuV) | Margin (dB) | |
|---------|-----------------|-------------------|-------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------|--------|
| | | | | | | | | | QP | AV |
| NEUTRAL | 0.151 | 9.57 | 21.96 | 31.53 | 65.96 | 3.29 | 12.86 | 55.96 | -34.42 | -43.09 |
| NEUTRAL | 0.176 | 9.58 | 18.35 | 27.92 | 64.68 | 2.97 | 12.54 | 54.68 | -36.76 | -42.14 |
| NEUTRAL | 0.202 | 9.58 | 15.03 | 24.61 | 63.54 | 2.39 | 11.97 | 53.54 | -38.93 | -41.57 |
| NEUTRAL | 0.226 | 9.58 | 14.87 | 24.45 | 62.61 | 1.63 | 11.21 | 52.61 | -38.16 | -41.40 |
| NEUTRAL | 0.350 | 9.59 | 20.15 | 29.74 | 58.96 | 4.47 | 14.06 | 48.96 | -29.22 | -34.90 |
| NEUTRAL | 0.377 | 9.59 | 18.10 | 27.69 | 58.34 | 4.68 | 14.27 | 48.34 | -30.66 | -34.08 |

Remark:

1. Corr. Factor (dB) = LISN Factor (dB) + Cable Loss (dB)
2. Level (dBuV) = Corr. Factor (dB) + Reading (dBuV)
3. Margin (dB) = Level (dBuV) – Limit (dBuV)

TEST REPORT

Appendix A: Test equipment list

| Test Equipment | Brand | Model No. | Serial No. | Calibration Date | Next Calibration Date |
|--------------------------------|-------------|---------------|------------|------------------|-----------------------|
| EMI Test Receiver | KEYSIGHT | N9038B | MY63060107 | 2024/03/06 | 2025/03/05 |
| Spectrum analyzer | KEYSIGHT | N9020B | MY63450146 | 2024/03/05 | 2025/03/04 |
| Signal Analyzer | R&S | FSV40 | 101532 | 2024/07/12 | 2025/07/11 |
| Active Loop Antenna | SCHWARZBECK | FMZB1519 | 1519-067 | 2024/01/16 | 2025/01/15 |
| Broadband Antenna | SCHWARZBECK | VULB 9168 | 9168-172 | 2024/01/02 | 2025/01/01 |
| Horn Antenna | SCHWARZBECK | BBHA 9120 D | 9120D-456 | 2023/12/27 | 2024/12/26 |
| Pre-Amplifier | SGH | SGH118(45dB) | 20220105-1 | 2024/01/23 | 2025/01/22 |
| Cable | SUHNER | SUCOFLEX 104 | 295105/4 | 2024/03/02 | 2025/03/02 |
| Cable | SUHNER | SUCOFLEX 104P | CB0005 | 2024/06/14 | 2025/06/13 |
| RF Cable | SUHNER | SUCOFLEX 104P | 9403 / 4P | 2023/11/24 | 2024/11/23 |
| Power Meter | Anritsu | ML2495A | 0844001 | 2024/01/08 | 2025/01/07 |
| Power Sensor | Anritsu | MA2491A | 031543 | 2024/01/08 | 2025/01/07 |
| 20dB Attenuator | PE | PE7001-20 | N/A | 2024/05/23 | 2025/05/22 |
| 966-2_3m Semi-Anechoic Chamber | CHANCE MOST | CEM-966_2 | N/A | 2024/07/30 | 2025/07/29 |
| Test software | Audix | e3 | V9 | NCR | NCR |

Note: No Calibration Required (NCR).

TEST REPORT

| Test Equipment | Brand | Model No. | Serial No. | Calibration Date | Next Calibration Date |
|-------------------|----------|--------------------------|--------------|------------------|-----------------------|
| EMI Test Receiver | R&S | ESCI | 100018 | 2024/07/23 | 2025/07/22 |
| LISN | R&S | ENV216 | 101160 | 2024/06/26 | 2025/06/25 |
| Cable | SUHNER | EMCCFD300-B M-NM-6000 | 170502 | 2024/06/25 | 2025/06/24 |
| Test software | Audix | e3 | V4.20040112L | NCR | NCR |
| Test site | Intertek | Con-2 | N/A | NCR | NCR |

Note: No Calibration Required (NCR).

Appendix B: Measurement Uncertainty

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2.0$.

| Item | Uncertainty |
|---|-------------|
| Radiated disturbances from 9kHz~30MHz in a semi-anechoic chamber at a distance of 3m | 2.73 dB |
| Vertically polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m | 3.91 dB |
| Horizontally polarized radiated disturbances from 30MHz~1GHz in a semi-anechoic chamber at a distance of 3m | 3.49 dB |
| Vertically polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m | 3.71 dB |
| Horizontally polarized Radiated disturbances from 1GHz~18GHz in a semi-anechoic chamber at a distance of 3m | 3.71 dB |
| Conducted Measurement | 0.69 dB |
| AC Power Line Conducted Emission | 1.31 dB |