

# TEST REPORT

**CTK Co., Ltd.**

(Ho-dong), 113, Yejik-ro, Cheoin-gu,  
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Report No.:  
CTK-2024-02327  
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**1. Applicant**

- Name : Hyundai Autoever Corp.
- Address : 510, Teheran-ro, Gangnam-gu, Seoul, Republic of Korea
- Date of Receipt : 2024-06-28

**2. Manufacturer**

- Name : TEIA Co.,Ltd
- Address : Suite B-303/304, 33 Gwacheon-daero 7-gil, Gwacheon-si, Gyeonggi-do,  
Republic of Korea

**3. Use of Report** : For FCC Certification**4. Test Sample / Model** : Wireless Charging Module for Smart Tag  
/ CVN-T10 (HAE-CM-WL-ST-02)**5. Date of Test** : 2024-07-12 to 2024-08-28**6. Test Standard(method) used** : FCC 47 CFR part 15 subpart C 15.209**7. Testing Environment:** refer to 8 pages to 17 pages**8. Test Results** : Compliance**9. Location of Test** : ☒ Permanent Testing Lab ☐ On Site Testing  
(Address : 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea)

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This report cannot be reproduced or copied without the written consent of CTK.

|          |                            |                             |
|----------|----------------------------|-----------------------------|
| Approval | Tested by                  | Technical Manager           |
|          | Bong-jun Jang: (Signature) | Young-taek Lee: (Signature) |

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2024-08-29

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## REPORT REVISION HISTORY

| Date       | Revision                | Page No |
|------------|-------------------------|---------|
| 2024-08-29 | Issued (CTK-2024-02327) | all     |
|            |                         |         |

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## 1. General Description

### 1.1 Client Information

|                       |                                                            |
|-----------------------|------------------------------------------------------------|
| <b>Company</b>        | Hyundai Autoever Corp.                                     |
| <b>Contact Point</b>  | 510 Teheran-ro, Gangnam-gu, Seoul, Republic of Korea       |
| <b>Contact Person</b> | Name : Yun Su Shim<br>E-mail : ysshim@hyundai-autoever.com |

### 1.2 Product Information

|                                             |                                                                         |
|---------------------------------------------|-------------------------------------------------------------------------|
| <b>FCC ID</b>                               | 2BFPQ-CVN-T10                                                           |
| <b>Product Description</b>                  | Wireless Charging Module for Smart Tag                                  |
| <b>Model name</b>                           | CVN-T10 (HAE-CM-WL-ST-02)                                               |
| <b>Variant Model name</b>                   | -                                                                       |
| <b>Charging Frequency</b>                   | 128 kHz                                                                 |
| <b>RF Output Power</b>                      | 93.1 dBuV/m @ 3m                                                        |
| <b>Power Transfer Method</b>                | Magnetic induction and only single primary coil coupling secondary coil |
| <b>Output power from each primary coil</b>  | 8 W                                                                     |
| <b>That may have multiple primary coils</b> | No                                                                      |
| <b>Antenna Type</b>                         | Loop Coil                                                               |
| <b>Charging Method</b>                      | Directly contact                                                        |
| <b>Power Source</b>                         | DC 12 V                                                                 |

### 1.4 Antenna Information

|                                     |                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | Integral antenna (antenna permanently attached)                                                                                                                                                                                                                                                                   |
| <input type="checkbox"/>            | Temporary RF connector provided                                                                                                                                                                                                                                                                                   |
| <input checked="" type="checkbox"/> | No temporary RF connector provided<br>Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path. |
| <input type="checkbox"/>            | External antenna (dedicated antennas)                                                                                                                                                                                                                                                                             |



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## 2. Accreditations

### 2.1 Laboratory Accreditations and Listings

| Country | Agency | Registration Number           |
|---------|--------|-------------------------------|
| USA     | FCC    | 805871                        |
| CANADA  | ISED   | CN : 8737A<br>CAB ID : KR0025 |
| KOREA   | NRRA   | KR0025                        |

### 2.2 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less. All test equipment calibrations are traceable to the Korea Research Institute of Standards and Science (KRISS), therefore, all test data recorded in this report is traceable to KRISS.

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### 3. Test Specifications

#### 3.1 Standards

| FCC Part Section(s)                                                                                   | Requirement(s)                    | Status (Note 1) | Report Clause |
|-------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------|---------------|
| 15.203                                                                                                | Antenna Requirement               | C               | 1.4           |
| 15.215(c)                                                                                             | Emission Bandwidth                | C               | 4.1           |
| 15.209                                                                                                | Radiated Emissions                | C               | 4.2           |
| 15.207                                                                                                | AC Power Line Conducted Emissions | C               | 4.3           |
| <u>Note 1:</u> C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable                             |                                   |                 |               |
| <u>Note 2:</u> The data in this test report are traceable to the national or international standards. |                                   |                 |               |
| <u>Note 3:</u> The sample was tested according to the following specification: ANSI C63.10-2013.      |                                   |                 |               |

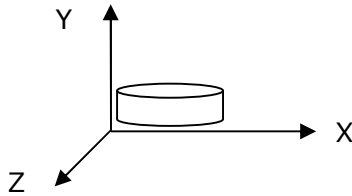
#### 3.2 Mode of operation during the test

Wireless charger were performed all charging conditions including variable loading and non-charging operation. It only contains data for worst case conditions.

##### Test Frequency

| Charging Frequencies |
|----------------------|
| 128 kHz              |

##### Worst Case Measurement Configuration

|                                                              |                                                                                                                         |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Tests Item                                                   | Transmitter Radiated Emissions, Emission Bandwidth                                                                      |
| Condition                                                    | Radiated measurement                                                                                                    |
| User Position                                                | <input checked="" type="checkbox"/> EUT will be placed in fixed position.                                               |
|                                                              | <input type="checkbox"/> EUT will be placed in mobile position and operating multiple positions.                        |
|                                                              | <input type="checkbox"/> EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions. |
| EUT faces identified relative to view from receiving antenna |                                     |



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### 3.3 Peripheral Devices

| No. | Device   | Manufacturer | Model No. | Serial No. |
|-----|----------|--------------|-----------|------------|
| 1   | WPT Load | -            | -         | -          |

Note : WPT load was provided by manufacturer.

### 3.4 Measurement Uncertainty

The value of the measurement uncertainty for the measurement of each parameter.  
Coverage factor  $k = 2$ , Confidence levels of 95 %

| Test Item          | Uncertainty                           |
|--------------------|---------------------------------------|
| Radiated emissions | 3.88 dB(C.L. : Approx. 95%, $k = 2$ ) |

### 3.5 Test Software

|               |                       |
|---------------|-----------------------|
| Radiated Test | ES10 Ver. 2022.04.000 |
|---------------|-----------------------|



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## 4. Technical Characteristic Test

### 4.1 Emission Bandwidth

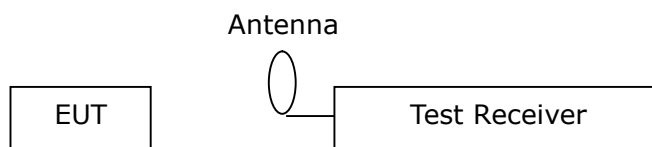
#### Requirement

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

#### Test Procedures

For the emission bandwidth refer ANSI C63.10-2013, clause 6.9(Occupied bandwidth).

#### Test Setup



#### Test results

##### Test Date

2024-08-21

##### Testing Environment

Temperature:  $(24 \pm 1) ^\circ\text{C}$

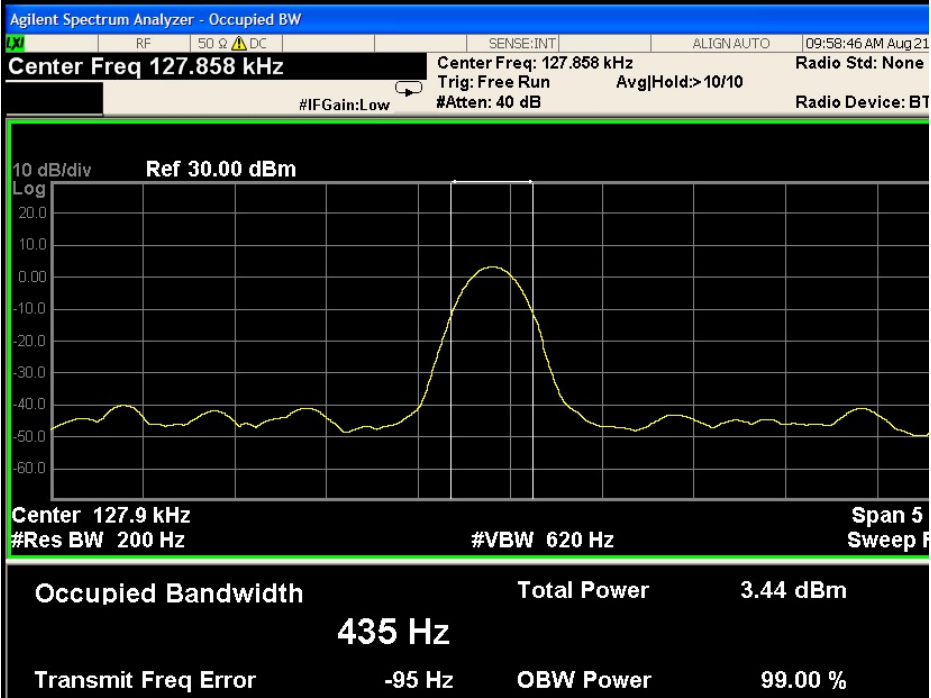
Relative Humidity:  $(32 \pm 3) \% \text{ R.H.}$

| Emission Bandwidth |
|--------------------|
| 20 dB Bandwidth    |
| 513 Hz             |



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## 4.2 Radiated emissions

FCC Part 15 § 15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency [MHz] | Field Strength [uV/m] | Field Strength [dBuV/m] | Measurement Distance [meters] |
|-----------------|-----------------------|-------------------------|-------------------------------|
| 0.009-0.490     | 2400/F(kHz)           | 48.5 – 13.8             | 300                           |
| 0.490-1.705     | 24000/F(kHz)          | 33.8 – 23               | 30                            |
| 1.705-30        | 30                    | 29.5                    | 30                            |
| 30-88           | 100**                 | 40                      | 3                             |
| 88-216          | 150**                 | 43.5                    | 3                             |
| 216-960         | 200**                 | 46                      | 3                             |
| Above 960       | 500                   | 54                      | 3                             |

\*\* Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72MHz, 76-88MHz, 174-216MHz, 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g.15.231 and 15.241.

Note : The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.



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## Test Location

☒ 10 m SAC (test distance : ☐ 10 m, ☒ 3 m)

## Test Procedures

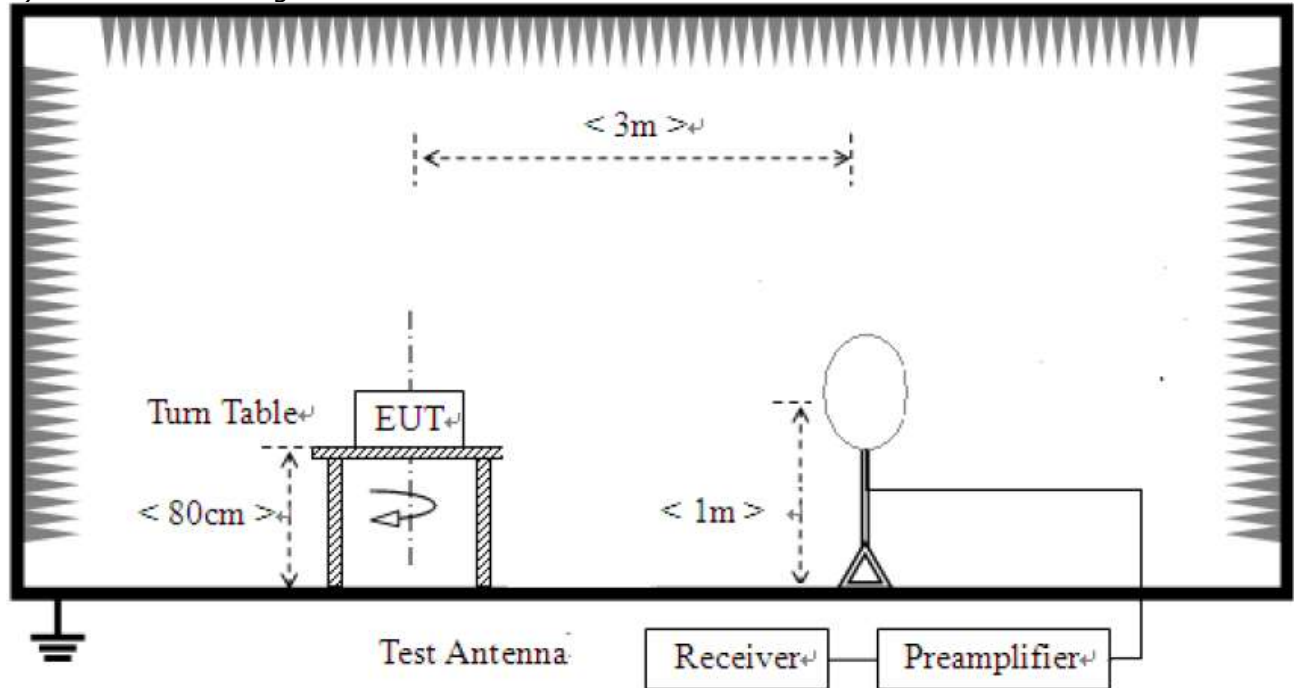
| Test Method                         |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10-2013, clause 6.4(Radiated emissions from unlicensed wireless devices below 30 MHz).                                                                                                                                                                                                                                                                                                                                      |
| <input checked="" type="checkbox"/> | Radiated emission tests shall be performed in the frequency range of 9 kHz to 30 MHz, using a calibrated loop antenna.<br>When perpendicular to the ground plane, the lowest height of the magnetic antenna shall be 1 m above the ground and shall be positioned at the specified distance from the EUT.<br>During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT. |
| <input checked="" type="checkbox"/> | The results shall be by using the square of an inverse linear distance extrapolation factor(40 dB/decade).                                                                                                                                                                                                                                                                                                                                    |
| <input checked="" type="checkbox"/> | Refer as ANSI C63.10-2013, clause 6.5(Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz).                                                                                                                                                                                                                                                                                                      |
| <input checked="" type="checkbox"/> | In the frequency range above 30 MHz, Bi-Log Test Antenna(30 MHz to 1 GHz) is used. Test Antenna height is carried from 1m to 4m above the ground to determine the maximum value of the field strength. The emissions levels at both horizontal and vertical polarizations should be tested.                                                                                                                                                   |
| <input checked="" type="checkbox"/> | Emissions more than 20 dB below the limit do not need to be reported.                                                                                                                                                                                                                                                                                                                                                                         |

| Measuring instrument Settings |                                                                                      |
|-------------------------------|--------------------------------------------------------------------------------------|
| Frequency Range               | 9 kHz – 1 000 MHz                                                                    |
| RBW                           | 200 Hz (9 kHz – 150 kHz)<br>9 kHz (150 kHz – 30 MHz)<br>120 kHz (30 MHz – 1 000 MHz) |
| VBW                           | ≥ RBW                                                                                |
| Sweep time                    | auto couple                                                                          |
| Detector function             | CISPR quasi-peak(below 1 000 MHz)                                                    |

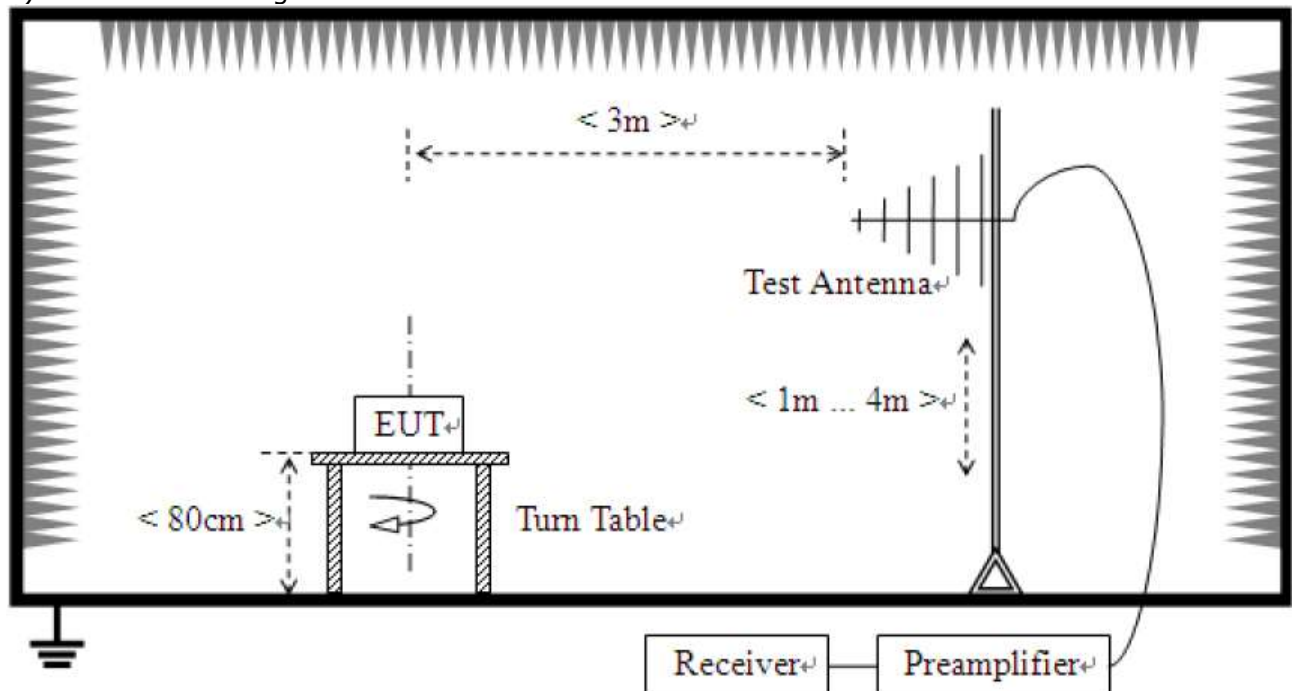


## Test Setup

- 1) For field strength of emissions from 9 kHz to 30 MHz



- 2) For field strength of emissions from 30 MHz to 1 GHz



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**Test results****1) Radiated emissions of fundamental frequency****Test Date**

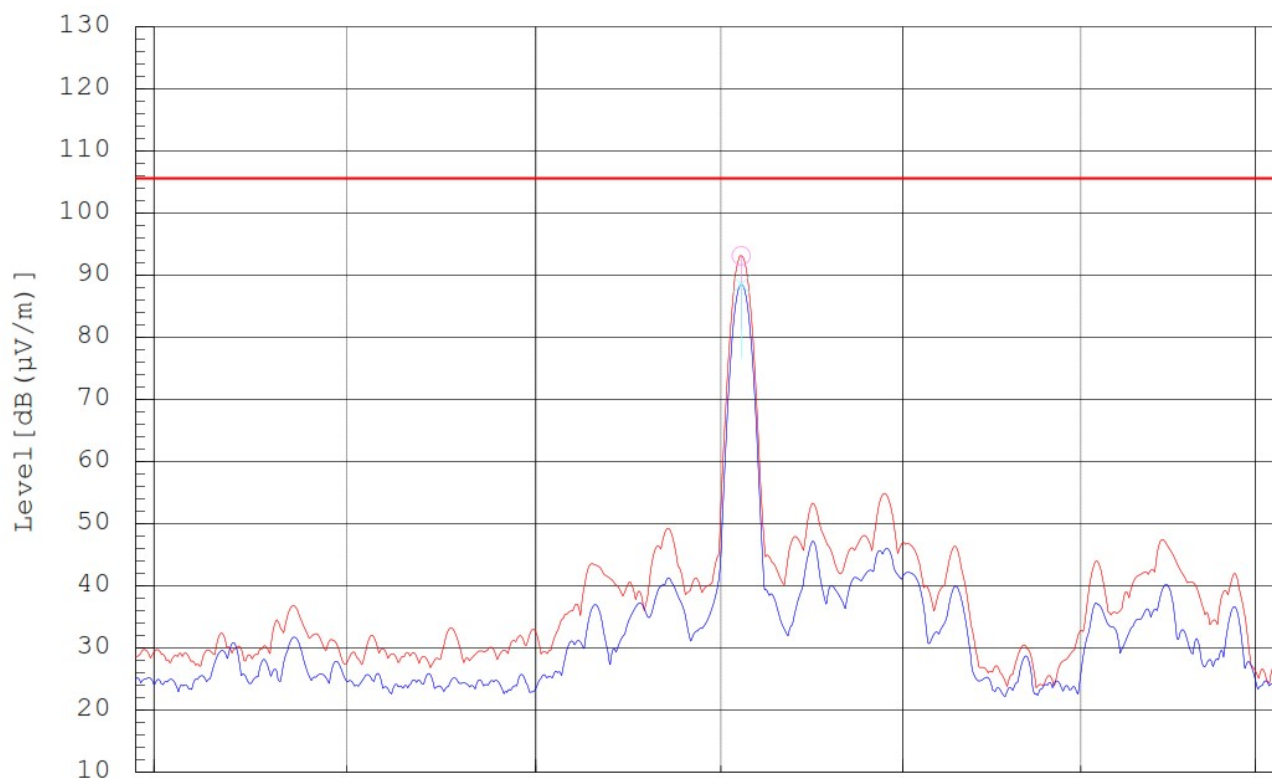
2024-07-12

**Testing Environment**

Temperature: (25 ± 1) °C

Relative Humidity: (42 ± 3) % R.H.

The requirements are:

☒ Complies

| Frequency [kHz] | Reading [dBuV] | c.f [dB/m] | Result [dBuV/m] |
|-----------------|----------------|------------|-----------------|
| 128             | 68.3           | 24.8       | 93.1            |

**Remark :**

1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. FCC Limit :  $20\log(2400/145) + 40\log(300/3) = 105.5 \text{ dBuV/m}$
4. The test result in peak detector is less than quasi-peak limit.



## 2) Radiated emissions in the frequency range of 9 kHz to 30 MHz

### Test Date

2024-07-12

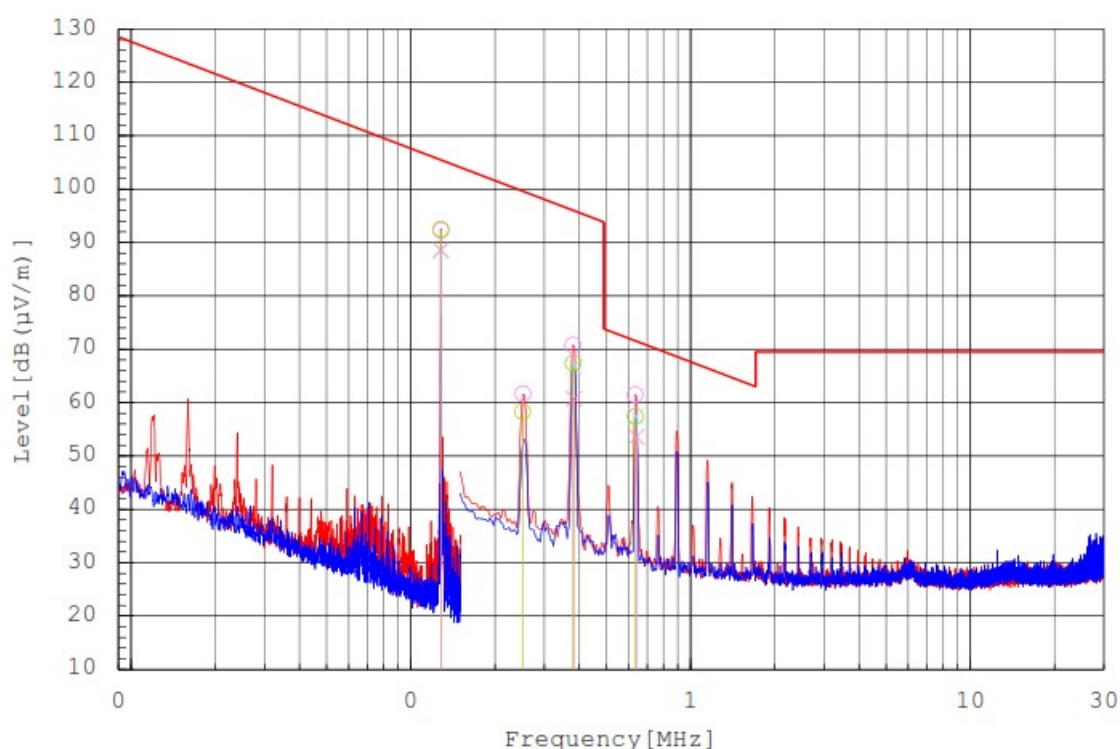
### Testing Environment

Temperature: (25 ± 1) °C

Relative Humidity: (42 ± 3) % R.H.

The requirements are:

☒ Complies



| No. | Frequency [MHz] | Reading [dBuV] | c.f [dB/m] | Result [dBuV/m] | Limit [dBuV/m] | Margin[dB] | Remark                |
|-----|-----------------|----------------|------------|-----------------|----------------|------------|-----------------------|
| 1   | 0.128           | 67.7           | 24.8       | 92.5            | 105.5          | 13.0       | Fundamental frequency |
| 2   | 0.251           | 33.5           | 24.8       | 58.3            | 99.6           | 41.3       |                       |
| 3   | 0.380           | 42.6           | 24.8       | 67.4            | 96.0           | 28.6       |                       |
| 4   | 0.634           | 32.5           | 24.9       | 57.4            | 71.6           | 14.2       |                       |

### Remark :

1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. The test result in peak detector is less than quasi-peak limit.



### 3) Radiated emissions in the frequency range of 30 MHz to 1 000 MHz

#### Test Date

2024-08-26

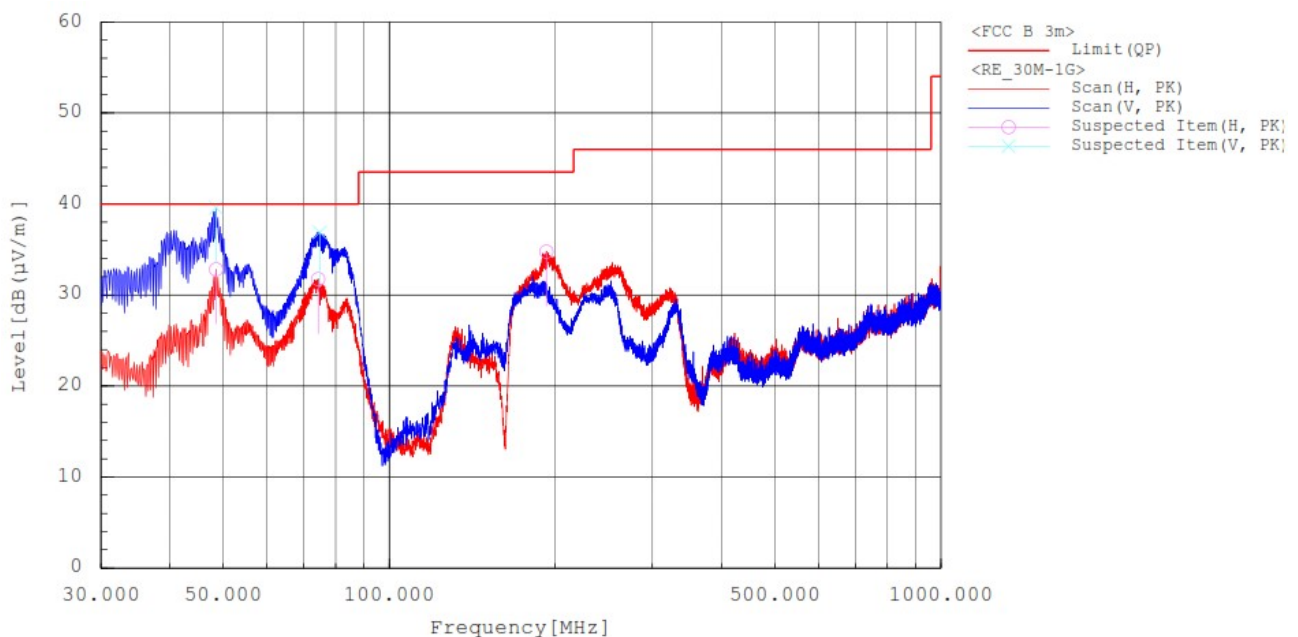
#### Testing Environment

Temperature: (25 ± 1) °C

Relative Humidity: (42 ± 3) % R.H.

The requirements are:

☒ Complies



| No. | Frequency [MHz] | Pol. | Reading [dBuV] | c.f [dB/m] | Result [dBuV/m] | Limit [dBuV/m] | Margin[dB] | Remark |
|-----|-----------------|------|----------------|------------|-----------------|----------------|------------|--------|
| 1   | 48.527          | H    | 49.7           | -16.9      | 32.8            | 40.0           | 7.2        |        |
| 2   | 48.527          | V    | 56.5           | -16.9      | 39.6            | 40.0           | 0.4        |        |
| 3   | 74.329          | H    | 50.3           | -18.6      | 31.7            | 40.0           | 8.3        |        |
| 4   | 74.814          | V    | 55.5           | -18.6      | 36.9            | 40.0           | 3.1        |        |
| 5   | 192.669         | H    | 50.0           | -15.2      | 34.8            | 43.5           | 8.7        |        |

#### Remark :

1. Result = Reading + c.f(Correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator - Amp Gain
3. The test result in peak detector is less than quasi-peak limit.



### 4.3 AC Power Line Conducted Emissions

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency (MHz) | Conducted Limit (dBuV) |           |
|-----------------|------------------------|-----------|
|                 | Quasi-peak             | Average   |
| 0.15 ~ 0.5      | 66 to 56*              | 56 to 46* |
| 0.5 ~ 5         | 56                     | 46        |
| 5 ~ 30          | 60                     | 50        |

\* Decreases with the logarithm of the frequency.

#### Test Procedures

Refer as ANSI C63.10-2013, clause 6.2(Standard test method for ac power-line conducted emissions from unlicensed wireless devices).



## Test Results

### Test Date

2024-08-28

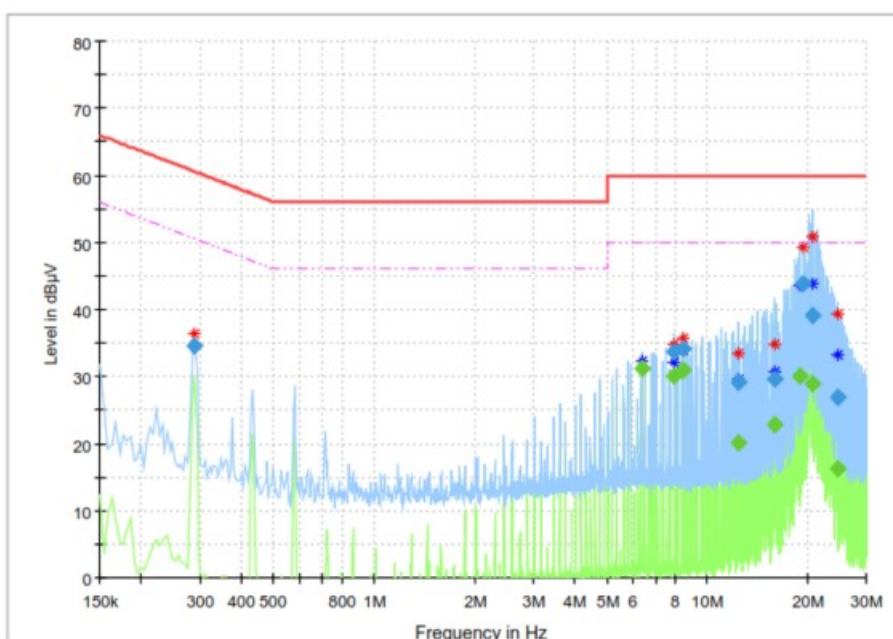
### Testing Environment

Temperature: (25 ± 1) °C

Relative Humidity: (45 ± 3) % R.H.

The requirements are:

☒ Complies



## Final Result

| Frequency (MHz) | QuasiPeak (dBµV) | CAverage (dBµV) | Limit (dBµV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | Filter | Corr. (dB) |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|--------|------------|
| 0.289500        | 34.54            | ---             | 60.54        | 26.00       | 15000.0         | 9.000           | L1   | ON     | 9.8        |
| 6.346500        | ---              | 31.25           | 50.00        | 18.75       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 7.935000        | ---              | 30.11           | 50.00        | 19.89       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 7.935000        | 33.59            | ---             | 60.00        | 26.41       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 8.511000        | 34.15            | ---             | 60.00        | 25.85       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 8.511000        | ---              | 30.86           | 50.00        | 19.14       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 12.408000       | ---              | 20.10           | 50.00        | 29.90       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 12.408000       | 29.08            | ---             | 60.00        | 30.92       | 15000.0         | 9.000           | N    | ON     | 9.9        |
| 15.868500       | 29.58            | ---             | 60.00        | 30.42       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 15.868500       | ---              | 22.76           | 50.00        | 27.24       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 19.041000       | ---              | 30.13           | 50.00        | 19.87       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 19.473000       | 43.74            | ---             | 60.00        | 16.26       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 20.629500       | 39.08            | ---             | 60.00        | 20.92       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 20.629500       | ---              | 28.82           | 50.00        | 21.18       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 24.522000       | ---              | 16.16           | 50.00        | 33.84       | 15000.0         | 9.000           | N    | ON     | 10.0       |
| 24.522000       | 26.96            | ---             | 60.00        | 33.04       | 15000.0         | 9.000           | N    | ON     | 10.0       |



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## APPENDIX A – Test Equipment Used For Tests

| No. | Name of Equipment             | Manufacturer                          | Model No.   | Serial No.      | Date of Calibration | Due Date   |
|-----|-------------------------------|---------------------------------------|-------------|-----------------|---------------------|------------|
| 1   | EMI Test Receiver             | R&S                                   | ESW44       | 102039          | 2024-04-29          | 2025-04-29 |
| 2   | Active Loop Antenna           | SCHWARZBECK                           | FMZB 1513   | 1513-125        | 2024-04-15          | 2026-04-15 |
| 3   | BILOG ANTENNA                 | TESEQ                                 | CBL6111D    | 60654           | 2023-08-21          | 2025-08-21 |
| 4   | AMPLIFIER                     | SONOMA INSTRUMENT                     | 310N        | 411011          | 2023-08-04          | 2024-08-04 |
| 5   | 6dB Attenuator                | PASTERNAK                             | PE7AP006-06 | L20210504000023 | 2023-08-04          | 2024-08-04 |
| 6   | ATTENUATOR                    | NONE                                  | 6dB         | 190557          | 2023-09-25          | 2024-09-25 |
| 7   | Signal Analyzer               | Agilent                               | N9020A      | US46470483      | 2023-12-05          | 2024-12-05 |
| 8   | EMI Receiver                  | R&S                                   | ESR3        | 102826          | 2024-04-29          | 2025-04-29 |
| 9   | LISN                          | R&S                                   | ENV216      | 102698          | 2024-04-29          | 2025-04-29 |
| 10  | Signal Analyzer               | Agilent                               | N9020A      | MY50510324      | 2023-12-05          | 2024-12-05 |
| 11  | Dual-Tracking DC Power Supply | Topward Electric Instruments Co.,Ltd. | 6303D       | 711196          | 2024-03-20          | 2025-03-20 |

| No. | Cable                                  | Manufacturer | Model No.    | Serial No. | Check Date |
|-----|----------------------------------------|--------------|--------------|------------|------------|
| 1   | RF Cable<br>(9 kHz ~ 1 GHz, Radiated)  | HUBER+SUHNER | SUCOFLEX 104 | MY27558/4  | 2024-03-05 |
| 2   | RF Cable<br>(9 kHz ~ 30MHz, Radiated)  | CANARE       | L-5D2W       | N/A        | 2024-03-05 |
| 3   | RF Cable<br>(30 MHz ~ 1 GHz, Radiated) | CANARE       | L-5D2W       | N/A        | 2024-03-05 |

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