TEST REPORT

CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea
Tel: +82-31-339-9970
Fax: +82-31-624-9501

Report No.: CTK-2024-02327

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)

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

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

2024-08-29

CTK Co., Ltd.

REPORT REVISION HISTORY

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

CONTENTS

1. General Description

1.1 Client Information

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

1.2 Product Information

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

1.4 Antenna Information

☒	Integral antenna (antenna permanently attached)	
	☐	Temporary RF connector provided
	☒	No temporary RF connector provided 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.
☐	External antenna (dedicated antennas)	

2. Accreditations

2.1 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	CN : 8737A 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.

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
Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable			
Note 2: The data in this test report are traceable to the national or international standards.			
Note 3: The sample was tested according to the following specification: ANSI C63.10-2013.			

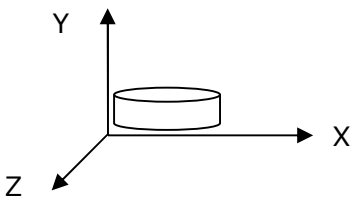
3.2 Mode of operation during the test

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	☒ EUT will be placed in fixed position.
	☐ EUT will be placed in mobile position and operating multiple positions.
	☐ 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	

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

4. Technical Characteristic Test

4.1 Emission Bandwidth

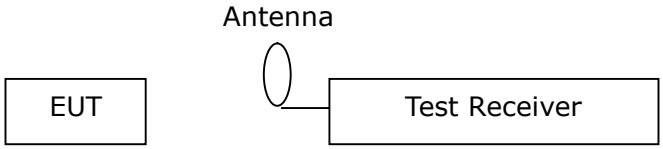
Requirement

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

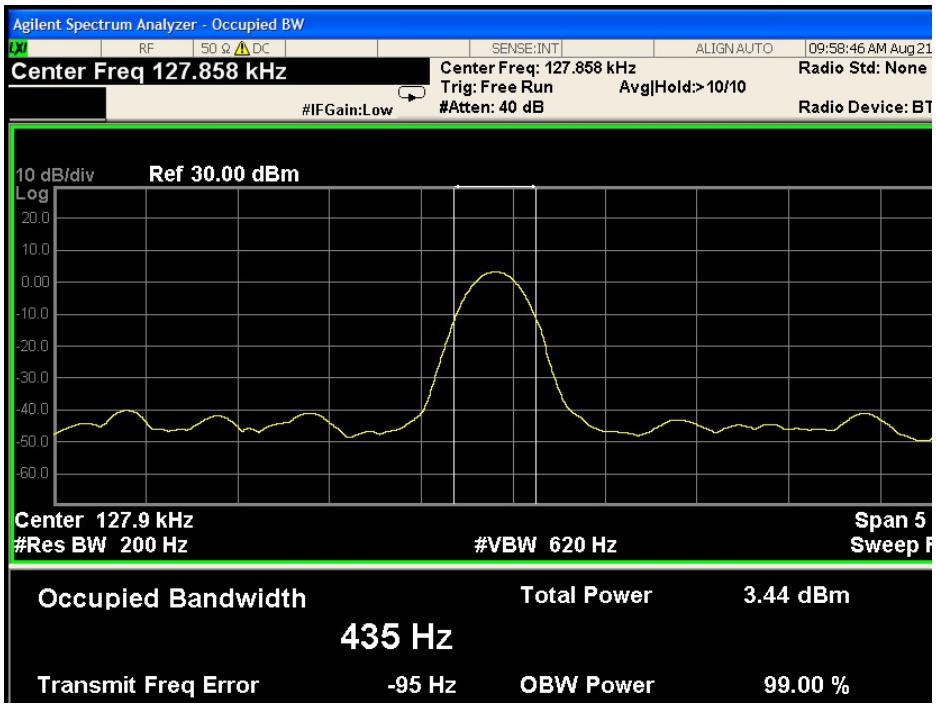


Test results

Test Date
2024-08-21

Testing Environment
Temperature: (24 ± 1) ℃
Relative Humidity: (32 ± 3) % R.H.

Emission Bandwidth
20 dB Bandwidth
513 Hz


Agilent Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
ALIGN AUTO
09:58:46 AM Aug 21
Center Freq 127.858 kHz
Center Freq: 127.858 kHz
Trig: Free Run
Avg|Hold:>10/10
#IFGain:Low
#Atten: 40 dB
Radio Std: None
Radio Device: BT
10 dB/div
Log
Ref 30.00 dBm
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
Center 127.9 kHz
#Res BW 200 Hz
#VBW 620 Hz
Span 5
Sweep
Occupied Bandwidth
435 Hz
Total Power
3.44 dBm
Transmit Freq Error
-95 Hz
OBW Power
99.00 %

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.

Test Location

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

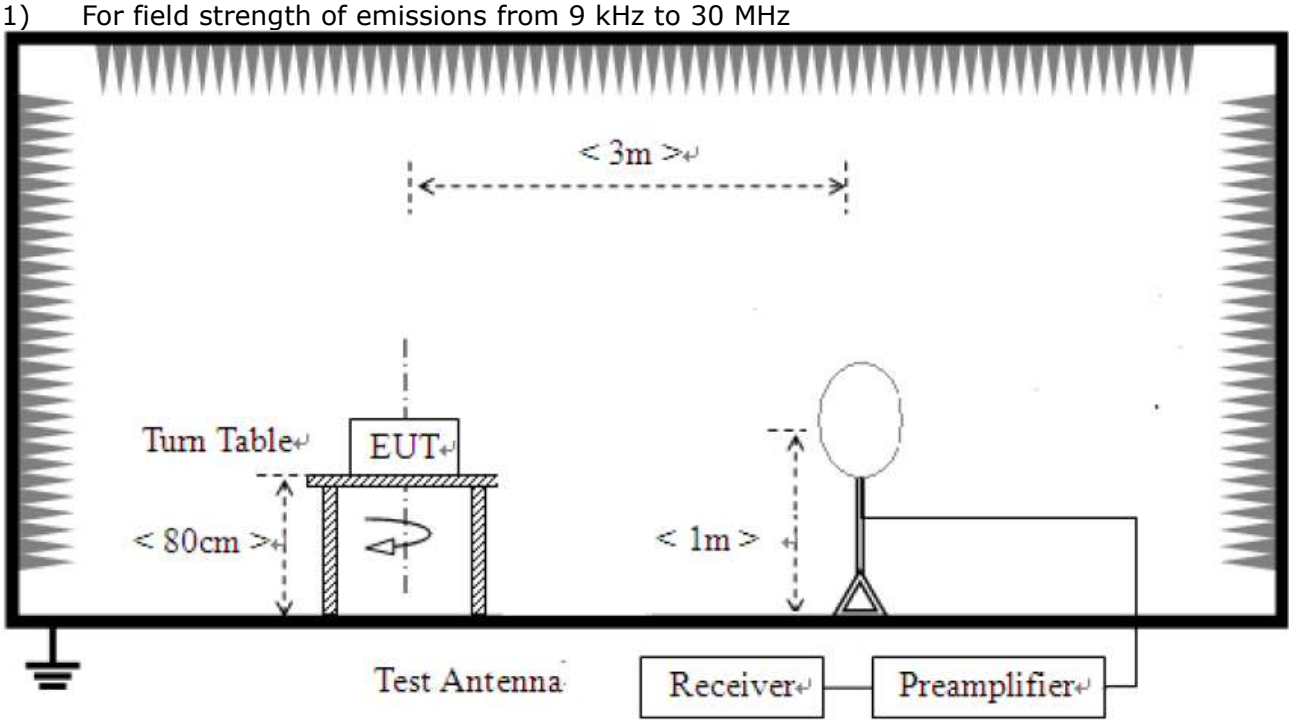
Test Procedures

Test Method	
☒	Refer as ANSI C63.10-2013, clause 6.4(Radiated emissions from unlicensed wireless devices below 30 MHz).
☒	Radiated emission tests shall be performed in the frequency range of 9 kHz to 30 MHz, using a calibrated loop antenna. 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. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.
	☒ The results shall be by using the square of an inverse linear distance extrapolation factor(40 dB/decade).
☒	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).
☒	In the frequency rage 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.
☒	Emissions more than 20 dB below the limit do not need to be reported.

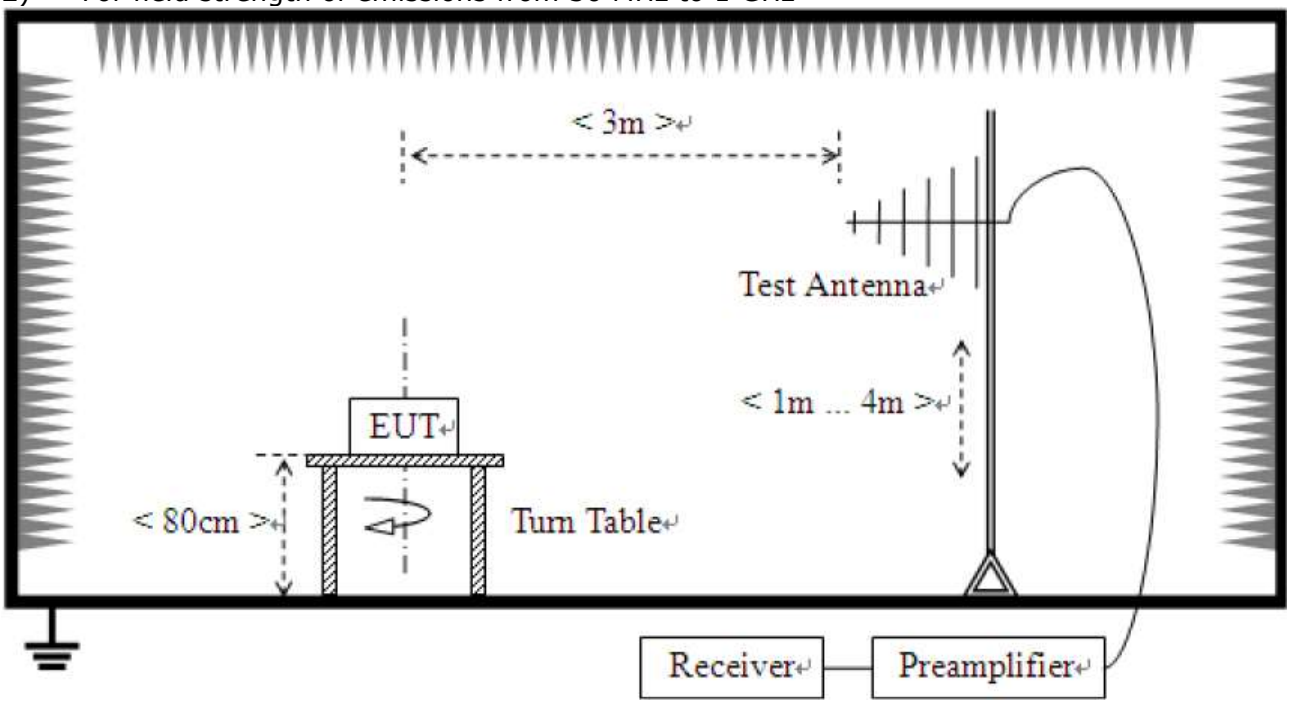
Measuring instrument Settings	
Frequency Range	9 kHz – 1 000 MHz
RBW	200 Hz (9 kHz – 150 kHz) 9 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1 000 MHz)
VBW	≥ RBW
Sweep time	auto couple
Detector function	CISPR quasi-peak(below 1 000 MHz)

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



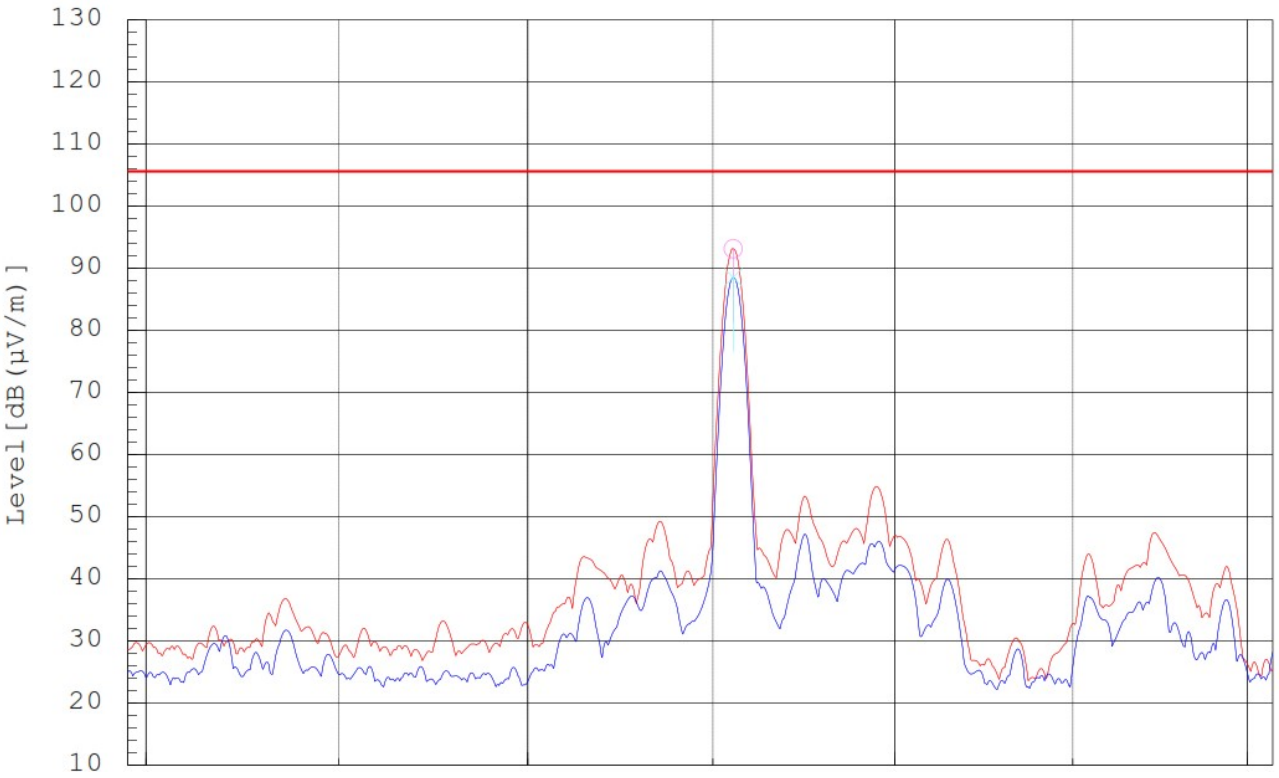
Test results

1) Radiated emissions of fundamental frequency

Test Date
2024-07-12

Testing Environment
Temperature: (25 ± 1) ℃
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 :

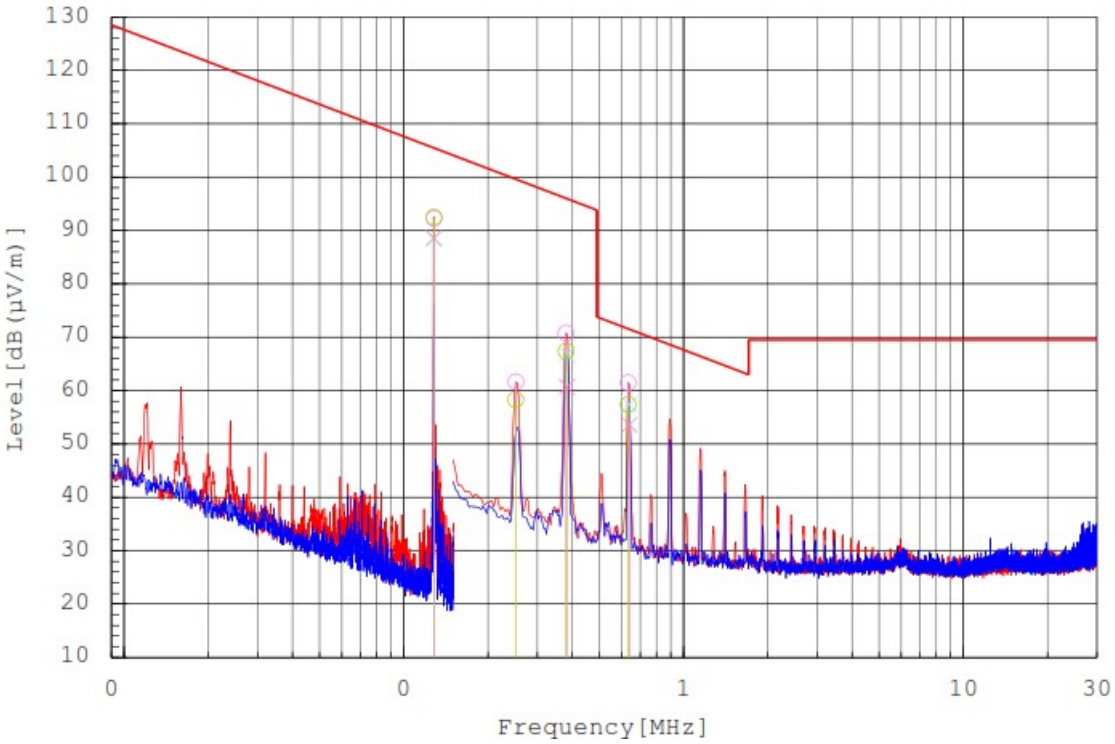
1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. FCC Limit : 20log(2400/145) + 40log(300/3) = 105.5 dBuV/m
4. The test result in peak detector is less than quasi-peak limit.

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

Test Date
2024-07-12

Testing Environment
Temperature: (25 ± 1) ℃
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 :

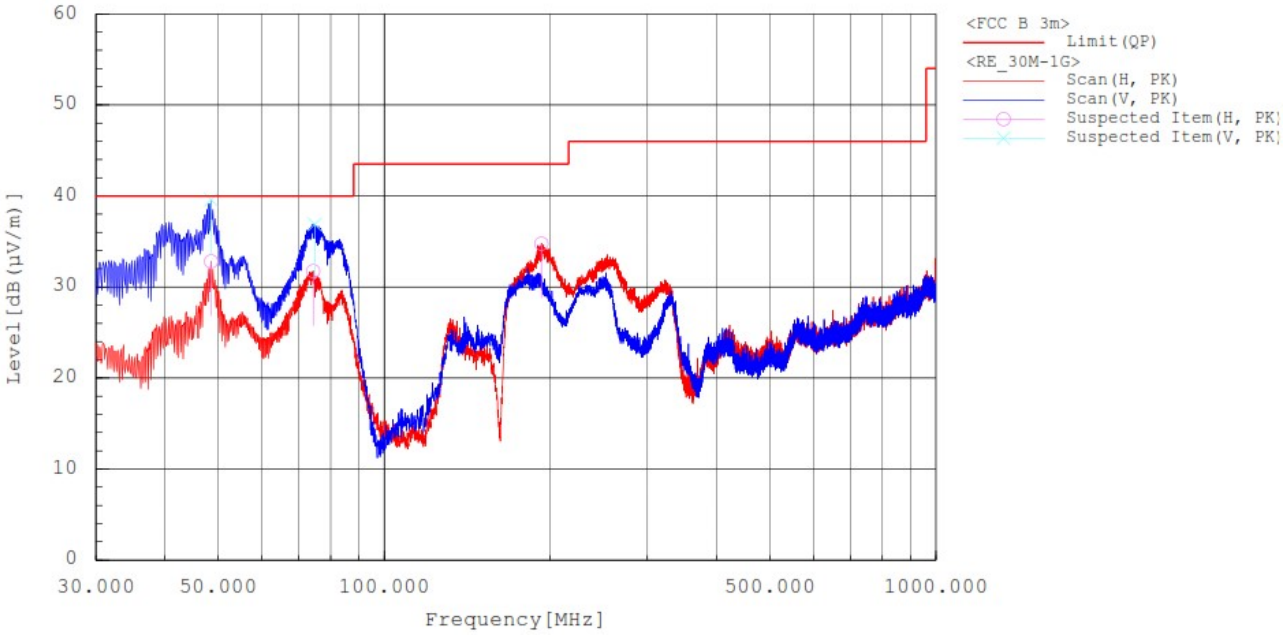
1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. The test result in peak detector is less than quasi-peak limit.

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

Test Date
2024-08-26

Testing Environment
Temperature: (25 ± 1) ℃
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 μH/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

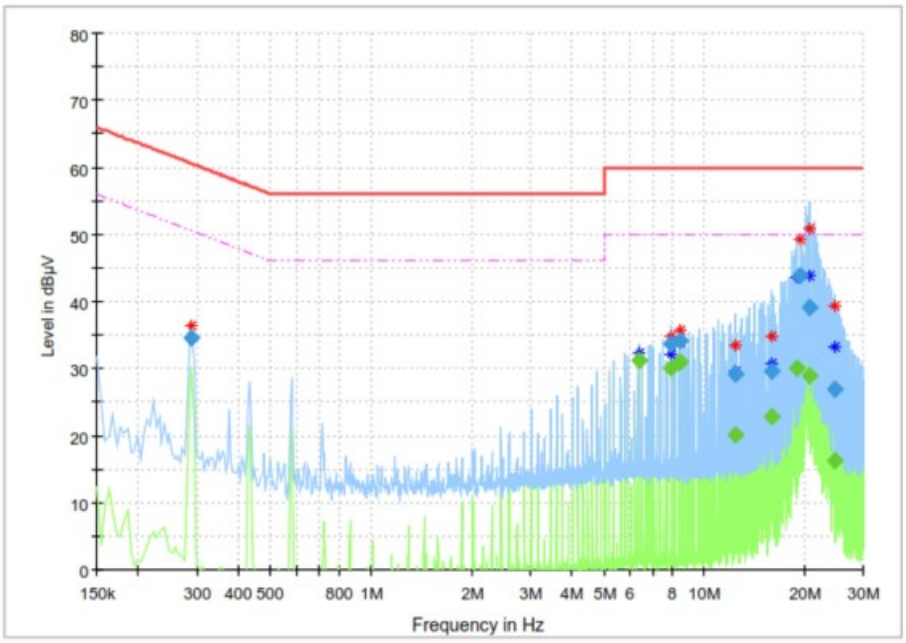
Refer as ANSI C63.10-2013, clause 6.2(Standard test method for ac power-line conducted emissions from unlicensed wireless devices).

Test Results

Test Date
2024-08-28

Testing Environment
Temperature: (25 ± 1) ℃
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

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	PASTERNACK	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 (9 kHz ~ 1 GHz, Radiated)	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2024-03-05
2	RF Cable (9 kHz ~ 30MHz, Radiated)	CANARE	L-5D2W	N/A	2024-03-05
3	RF Cable (30 MHz ~ 1 GHz, Radiated)	CANARE	L-5D2W	N/A	2024-03-05

-END-