

TEST REPORT



CTK Co., Ltd.

(Ho-dong), 113, Yejik-ro, Cheoin-gu,
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Report No.:
CTK-2021-03772
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1. Client

- Name : CVT Co., Ltd.
- Address : 306, Building D, AI Yangjae Hub, 39 Maeheon-ro 8gil Seocho-gu, Seoul Rep. of Korea
- Date of Receipt : 2021-05-17

2. Manufacturer

- Name : CVT Co., Ltd.
- Address : 306, Building D, AI Yangjae Hub, 39 Maeheon-ro 8gil Seocho-gu, Seoul Rep. of Korea

3. Use of Report : For FCC Certification

4. Test Sample / Model : RFID Wireless Device (13.56MHz) / FA-1000, FA-2000

5. Date of Test : 2021-10-11 to 2021-10-15

6. Test Standard(method) used : FCC 47 CFR part 15 subpart C 15.225

7. Testing Environment: Temp.: (24 ± 1) °C, Humidity: (51 ± 5) % R.H.

8. Test Results : Compliance

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This Test Report cannot be reproduced, except in full.

Affirmation	Tested by	Technical Manager
	Ji-Hye, Kim: (Signature) 	Young-taek Lee: (Signature) 

2021-10-18

Republic of KOREA **CTK Co., Ltd.**

 CTK Co., Ltd. <small>The Prime Leader of Global Regulatory Compliance</small>	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-2021-03772 Page (2) / (24) Pages	
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REPORT REVISION HISTORY

Date	Revision	Page No
2021-10-18	Issued (CTK-2021-03772)	all

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1. General Product Description

1.1 Client Information

Company	CVT Co., Ltd.
Contact Point	306, Building D, AI Yangjae Hub, 39 Maeheon-ro 8gil Seocho-gu, Seoul Rep. of Korea
Contact Person	Name : Paul Chung E-mail : paulchung@cvtinc.co.kr Tel : +82-70-4490-9388

1.2 Product Information

FCC ID	2A3FR-FA1000
Product Description	RFID Wireless Device (13.56MHz)
Model name	FA-1000
Variant Model name	FA-2000
FVIN	-
Operating Frequency Range	13.56 MHz
RF Output Power	62.4 dBuV/m @ 3 m
Antenna Type	PCB antenna(Loop antenna)
Power Source	DC 12 V
Hardware Rev	Rev1.2
Software Rev	Rev1.10210916

1.3 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 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)

1.4 Model Differences

FA-1000 and FA-2000 are no technical difference from each model except for Model name and FOV of the lens because of marketing purposes.

Test model was FA-1000.

2. Facility and Accreditations

2.1 Test Facility

The radiated measurement facility is located at (Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea.

The another measurement facility is located at 5, Dongbu-ro 221beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea.

2.2 Laboratory Accreditations and Listings

Country	Agency	Registration Number
USA	FCC	805871
CANADA	ISED	8737A-2
KOREA	NRRA	KR0025

2.3 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

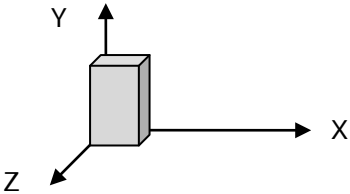
FCC Part Section(s)	Requirement(s)	Status (Note 1)	Report Clause
15.203	Antenna Requirement	C	1.3
15.215(c)	Emission Bandwidth	C	4.1
15.225 (a)(b)(c)(d)	Field strength emissions	C	4.2
15.225(e)	Frequency tolerance	C	4.3
15.207	AC Power line Conducted Emissions	C	4.4
<u>Note 1:</u> C=Complies NC=Not Complies 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: FCC Part 15, ANSI C63.10-2013.			

3.2 Mode of operation during the test

The EUT is operated in a manner representative of the typical of the equipments.
During at testing, system components were manipulated within the confines of typical usage to maximize each emission. All modulation modes were tests.
The results are only attached worst cases.

The Worst Case Measurement Configuration

Tests Item	AC power line conducted emissions
Condition	AC power line conducted measurement for line and neutral Test Voltage : 120 Vac/60 Hz
Operating Mode	AC Adapter mode

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.
Operating Mode	Continuous transmission
EUT faces identified relative to view from receiving antenna	

3.3 Peripheral Devices

Device	Manufacturer	Model No.	Serial No.
AC ADAPTER	Dongguan Jinhuasheng Power Technology Co., Ltd.	RS-200/120-S325	-

3.4 Maximum Measurement Uncertainty

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

Description	Uncertainty
Radiated Emissions (9 kHz to 30 MHz)	1.16 dB (C.L.: Approx. 95 %, $k = 2$)
Radiated Emissions (30 MHz to 1 GHz)	4.54 dB (C.L.: Approx. 95 %, $k = 2$)
Radiated Emissions (1 GHz Above)	4.98 dB (C.L.: Approx. 95 %, $k = 2$)
AC power-line conducted emissions (9 kHz to 150 kHz)	1.70 dB (C.L.: Approx. 95 %, $k=2$)
AC power-line conducted emissions (150 kHz to 30 MHz)	1.96 dB (C.L.: Approx. 95 %, $k=2$)

3.5 Test Software

Radiated Test	TOYO EMI software EP5RE Ver. 6.0.1.0
Line Conducted Test	ESCI7, ESCI3 : EMC32 Ver. 8.50.0 ESR7 : EMC32 Ver. 8.53.0

4. Technical Characteristic Test

4.1 Emission Bandwidth

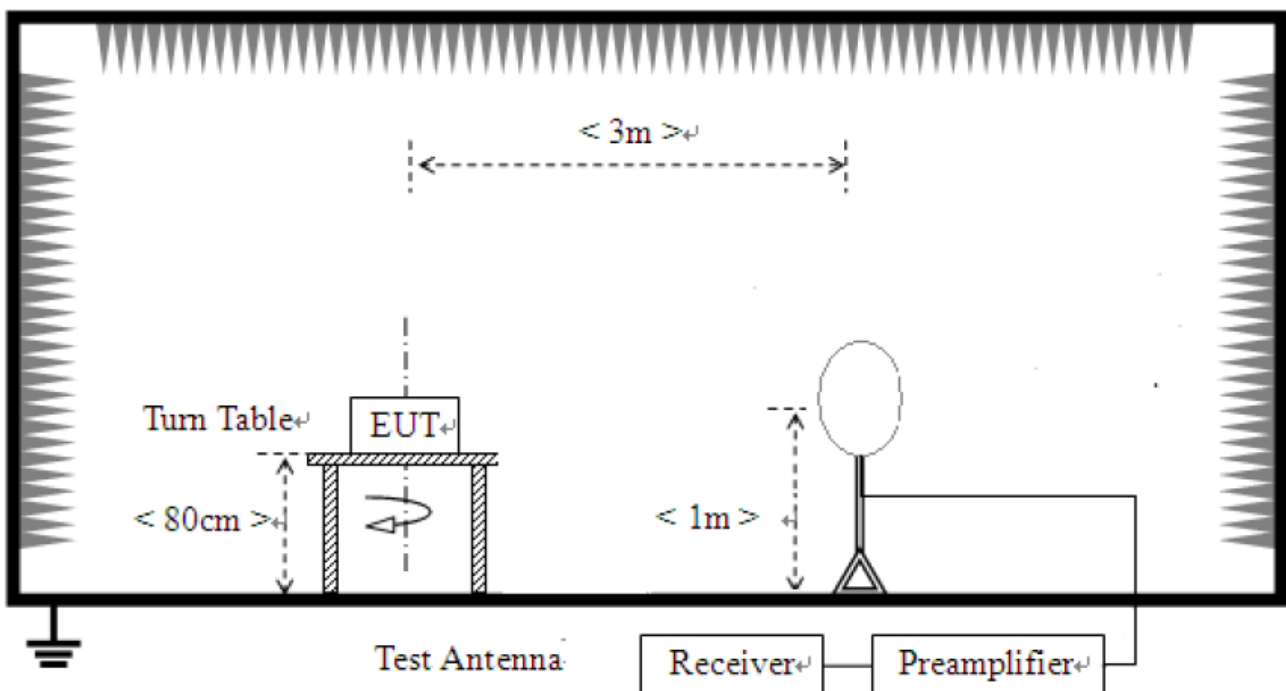
Requirement

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).

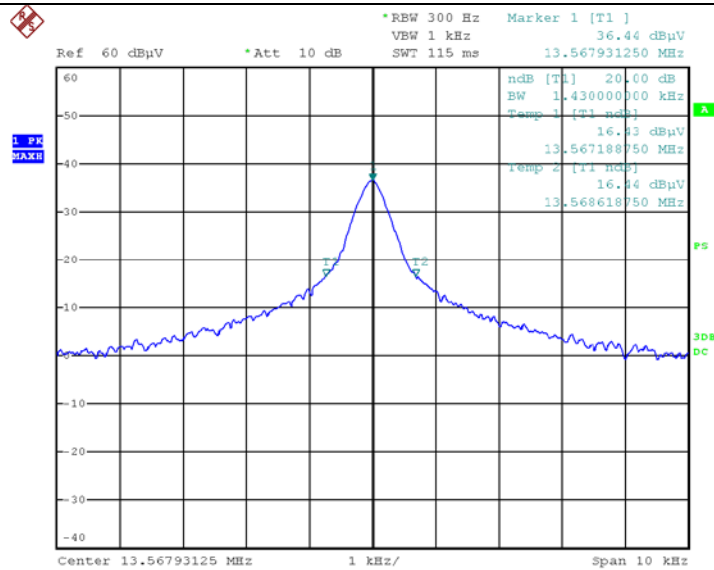
Test Setup



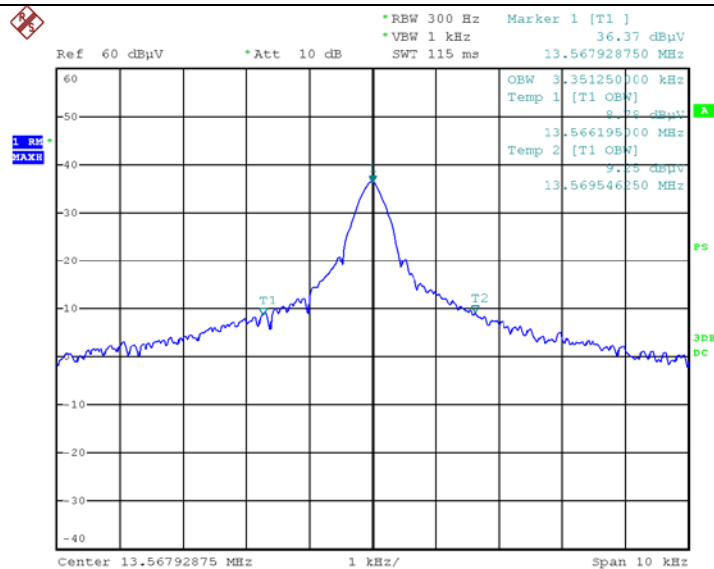
Test results

Emission Bandwidth	Result	Limit
20dB Bandwidth	1.43 kHz (F _L : 13.567 189 MHz, F _H : 13.568 619 MHz)	N/A
99% Bandwidth	3.35 kHz	N/A

Emission Bandwidth Plot 20dB Bandwidth



Emission Bandwidth Plot 99% Bandwidth



4.2 Field strength emissions

Requirement

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.553-13.567	15,848	84.0	124.0

- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.410-13.553	334	50.5	90.5
13.567-13.710	334	50.5	90.5

- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

Frequency(MHz)	Field Strength uV/m@30m	Field Strength dBuV/m@30m	Field Strength dBuV/m@3m
13.110-13.410	106	40.5	80.5
13.710-14.010	106	40.5	80.5

- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

Frequency(MHz)	Field Strength uV/m@3m	Field Strength dBuV/m@3m	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)

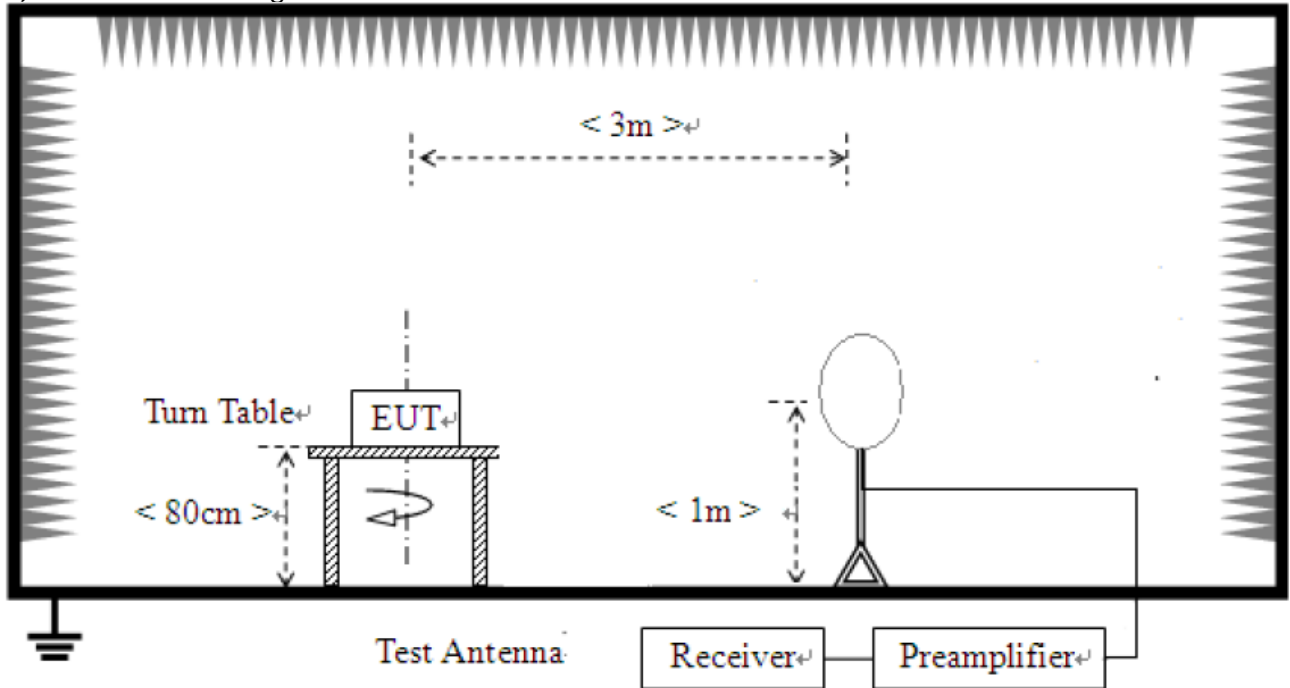
Test Procedures

Test Method	
<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. 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.
<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.

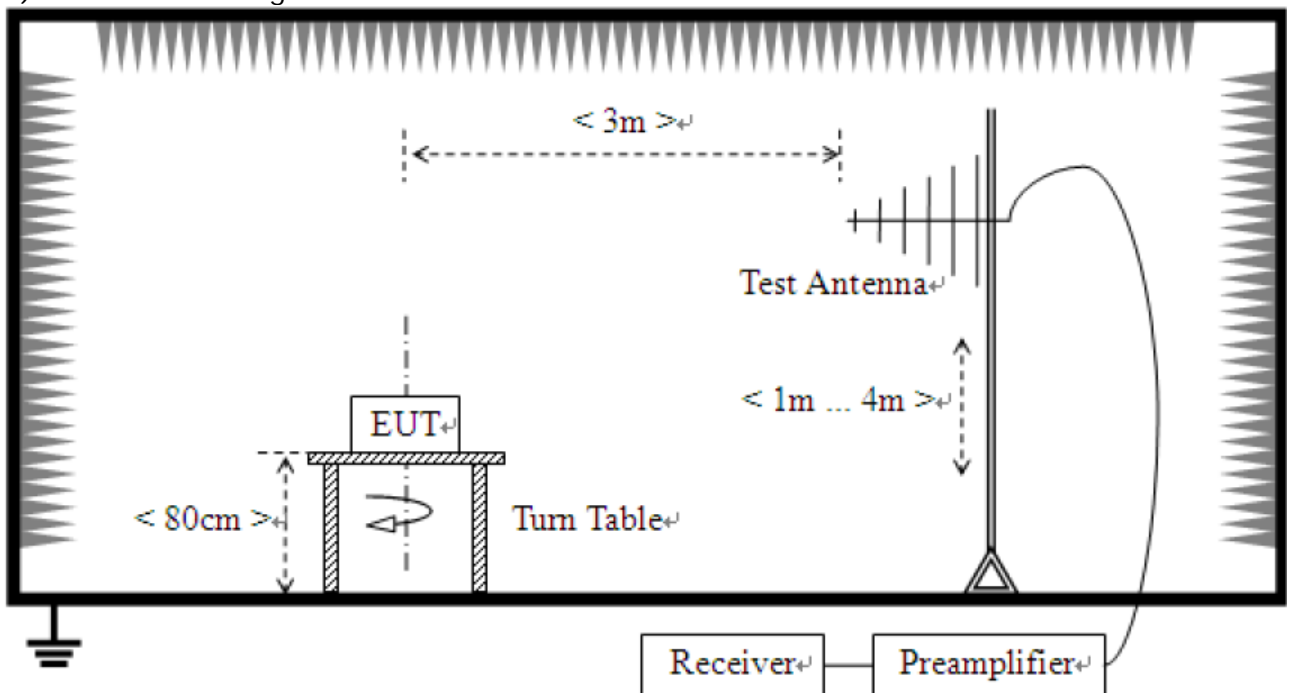
Measuring instrument Settings	
Frequency Range	9 kHz – 1 000 MHz
RBW	200 Hz (9 kHz – 150 kHz) 9 kHz (150 kHz – 30 MHz) 120 kHz (30 MHz – 1 000 MHz)
VBW	≥ RBW
Sweep time	auto couple
Detector function	CISPR quasi-peak(below 1 000 MHz)

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

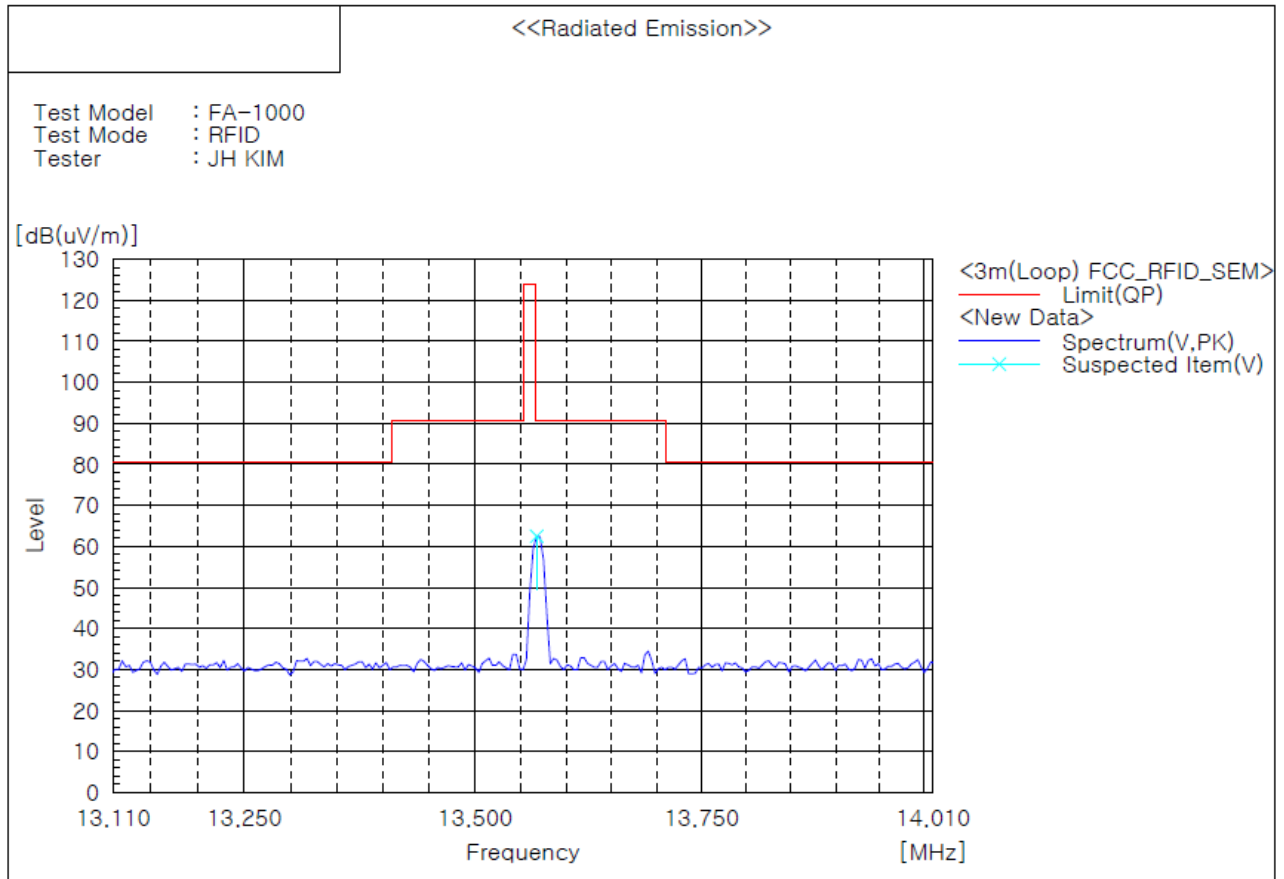


Test results

1) Radiated emissions within the band 13.110-14.010 MHz

The requirements are:

☒ Complies



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	13.568	V	36.2	26.2	62.4	90.5	28.1	101.0	196.0

Remark :

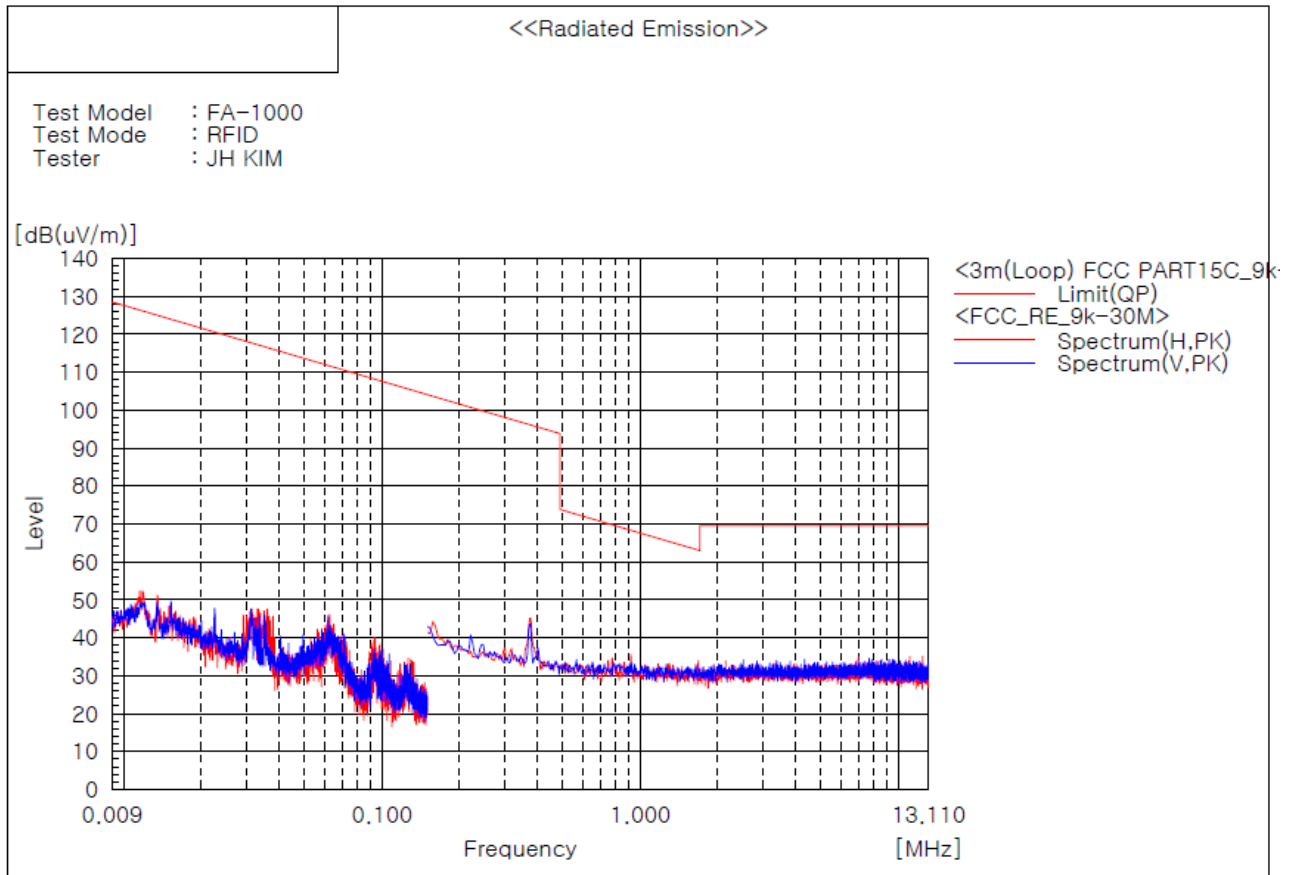
1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. The test result in peak detector is less than quasi-peak limit.

2) Field strength of any emissions appearing outside of the 13.110-14.010 MHz

Frequency range : 9 kHz – 13.110 MHz

The requirements are:

☒ Complies



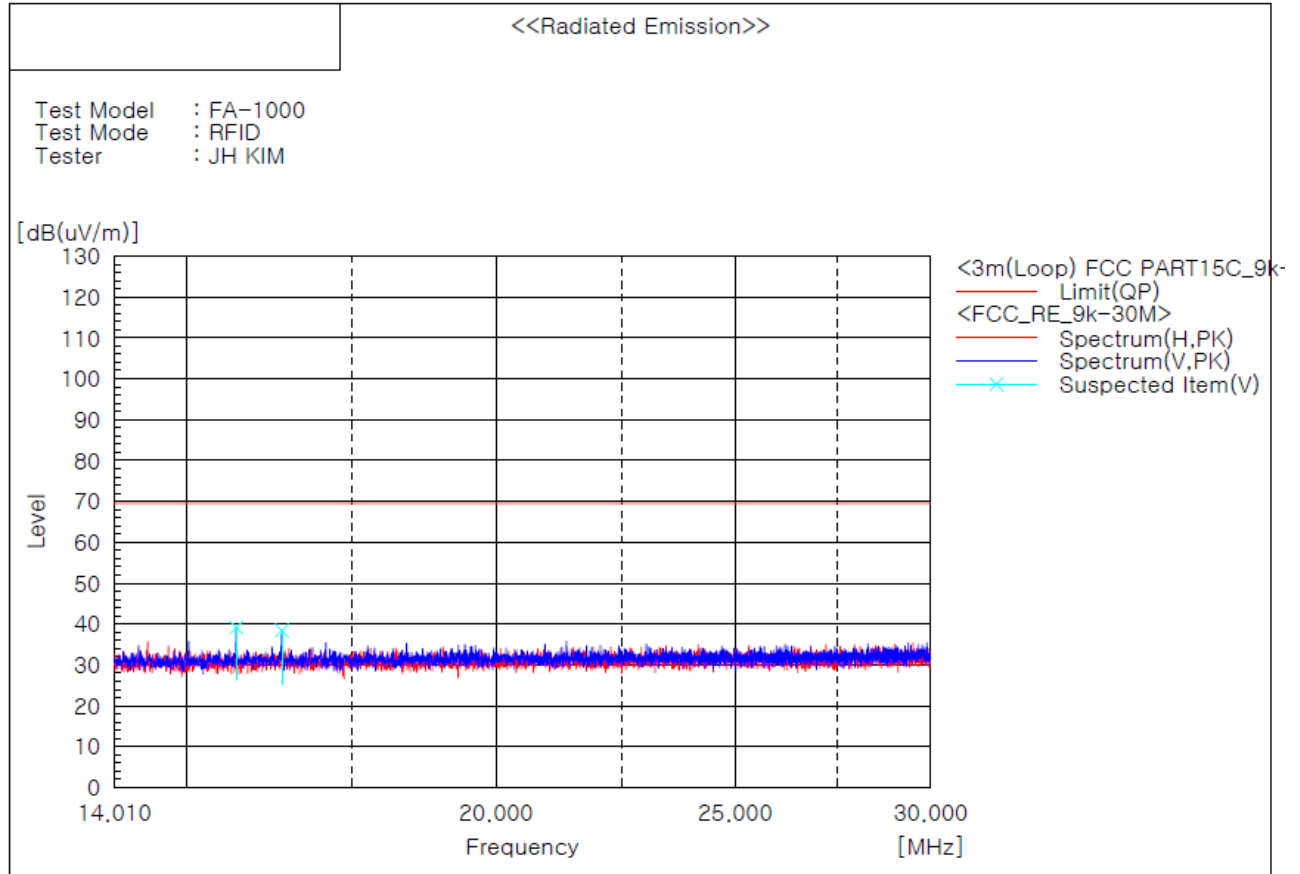
Remark :

1. Result = Reading + c.f(correction factor)
2. Correction factor = Antenna factor + Cable loss + 6 dB attenuator
3. Emissions more than 20 dB below the limit do not need to be reported.

Frequency range : 14.010 MHz – 30 MHz

The requirements are:

☒ Complies



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	15.702	V	12.9	26.3	39.2	69.5	30.3	101.0	159.0
2	16.385	V	12.0	26.4	38.4	69.5	31.1	101.0	324.0

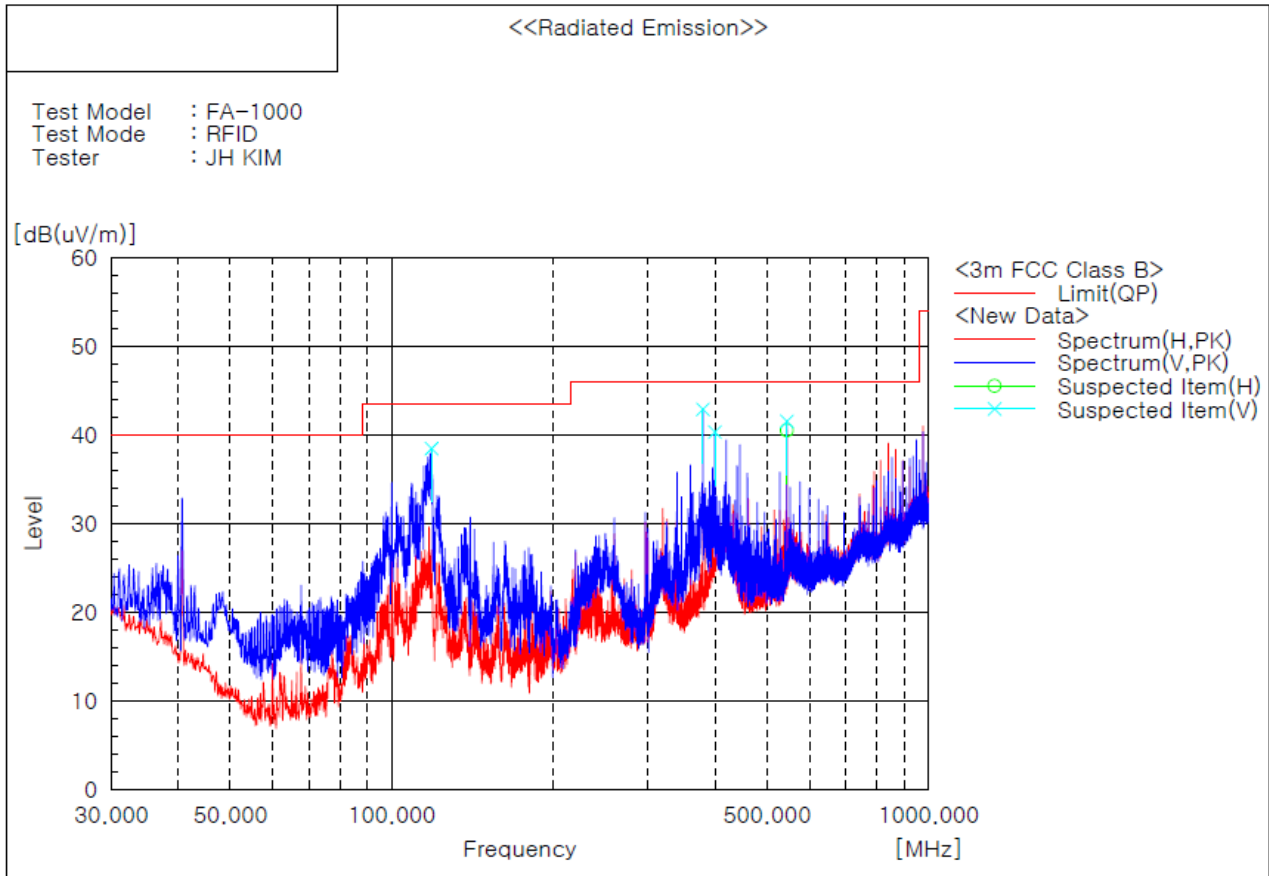
Remark :

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 range of 30 MHz to 1 000 MHz band

The requirements are:

☒ Complies



Spectrum Selection

No.	Frequency [MHz]	(P)	Reading [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]
1	118.634	V	50.9	-12.4	38.5	43.5	5.0	101.0	298.0
2	379.928	V	48.9	-6.0	42.9	46.0	3.1	101.0	357.0
3	399.934	V	45.2	-4.9	40.3	46.0	5.7	210.0	0.0
4	544.464	V	41.9	-0.4	41.5	46.0	4.5	101.0	181.0
5	544.464	H	40.9	-0.4	40.5	46.0	5.5	205.0	58.0

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 Frequency Stability

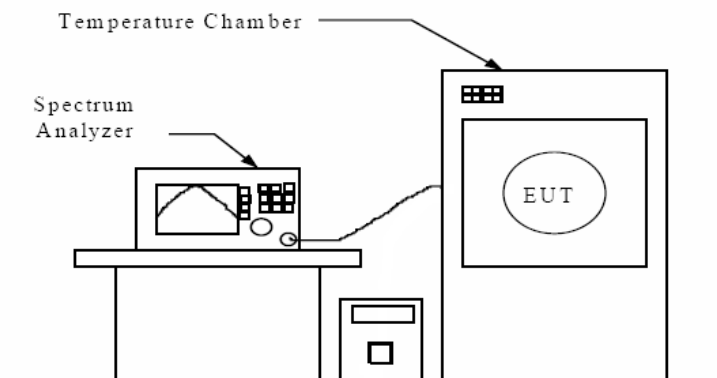
Requirement

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to $+50$ degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

Test Procedures

For the emission bandwidth refer ANSI C63.10-2013, clause 6.8(Frequency stability tests).

Test Setup





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Test Results

The requirements are:

☒ Complies

Condition	Measurement Frequency (MHz)				Frequency Stability (ppm)			
	Startup	2 min	5 min	10 min	Start-up	2 min	5 min	10 min
Temp. 50℃	13.567888	13.567882	13.567882	13.567882	-8.25	-8.70	-8.70	-8.70
Temp. 40℃	13.567918	13.567912	13.567910	13.567910	-6.04	-6.49	-6.63	-6.63
Temp. 30℃	13.567960	13.567950	13.567948	13.567948	-2.95	-3.69	-3.83	-3.83
Temp. 20℃	13.568000	13.567992	13.567990	13.567990	0.00	-0.59	-0.74	-0.74
Temp. 10℃	13.568034	13.568030	13.568030	13.568030	2.51	2.21	2.21	2.21
Temp. 0℃	13.568058	13.568056	13.568056	13.568056	4.27	4.13	4.13	4.13
Temp. -10℃	13.568058	13.568060	13.568060	13.568060	4.27	4.42	4.42	4.42
Temp. -20℃	13.568026	13.568034	13.568034	13.568036	1.92	2.51	2.51	2.65
Voltage 85%	13.567950	13.567944	13.567940	13.567936	-3.69	-4.13	-4.42	-4.72
Voltage 115%	13.567940	13.567936	13.567936	13.567934	-4.42	-4.72	-4.72	-4.86
Limit(ppm)	-				100			

4.4 AC Power line Conducted Emissions

Requirement

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 μ 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.

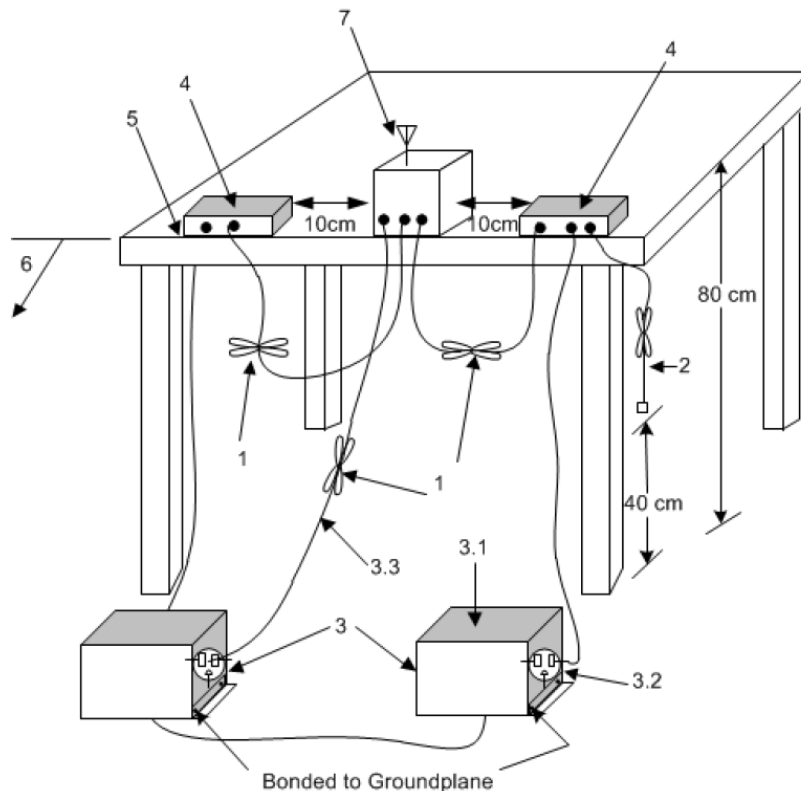
Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56*	56 to 46*
0.5 ~ 5	56	46
5 ~ 30	60	50

* 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 Setup



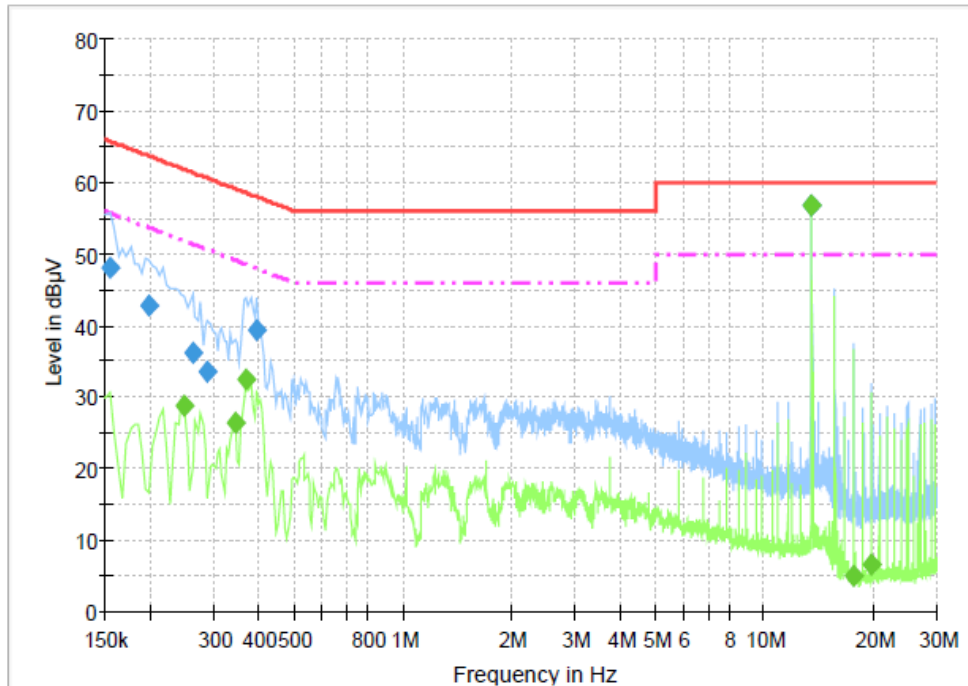
Test Results

The requirements are:

☒ Complies

[LINE]

3CE_Class B_L1



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	48.0	1000.0	9.000	On	L1	9.9	17.7	65.8
0.199500	42.9	1000.0	9.000	On	L1	9.9	20.8	63.6
0.262500	36.2	1000.0	9.000	On	L1	9.7	25.1	61.4
0.289500	33.6	1000.0	9.000	On	L1	9.7	27.0	60.5
0.393000	39.3	1000.0	9.000	On	L1	9.9	18.7	58.0
13.569000	56.6	1000.0	9.000	On	L1	9.9	3.4	60.0

Final Result 2

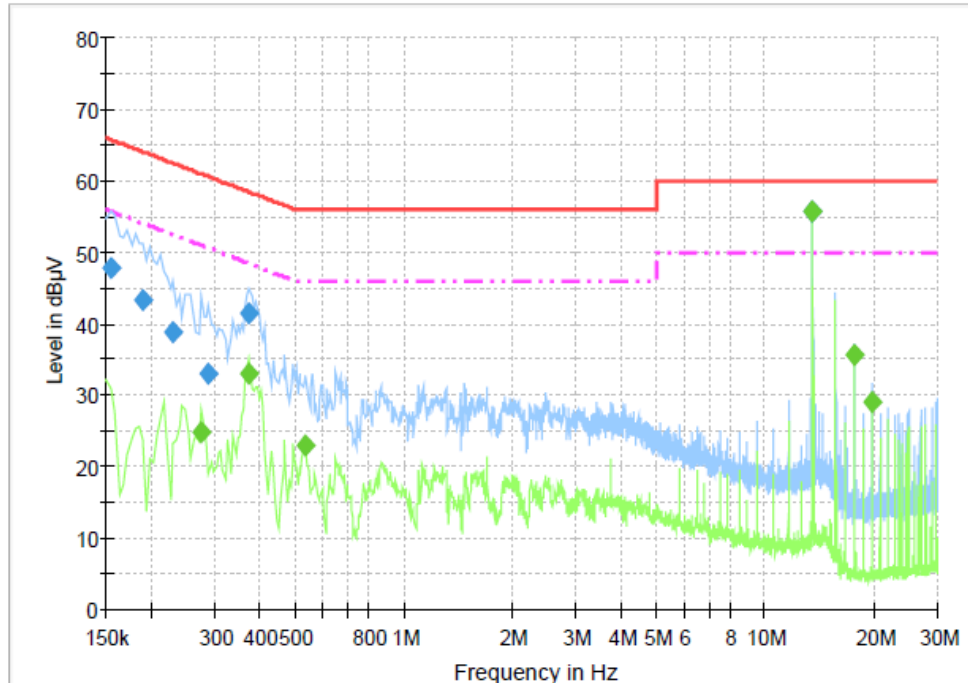
Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.249000	28.7	1000.0	9.000	On	L1	9.6	23.1	51.8
0.343500	26.5	1000.0	9.000	On	L1	9.8	22.6	49.1
0.370500	32.4	1000.0	9.000	On	L1	9.9	16.1	48.5
13.569000	56.8	1000.0	9.000	On	L1	9.9	-6.8	50.0
17.749500	4.9	1000.0	9.000	On	L1	10.0	45.1	50.0
19.797000	6.5	1000.0	9.000	On	L1	10.0	43.5	50.0

Remark :

1. 13.569 MHz is the carrier frequencies.

[NEUTRAL]

3CE_Class B_N



Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	47.9	1000.0	9.000	On	N	9.9	17.9	65.8
0.190500	43.2	1000.0	9.000	On	N	9.9	20.8	64.0
0.231000	38.7	1000.0	9.000	On	N	9.7	23.7	62.4
0.289500	33.1	1000.0	9.000	On	N	9.7	27.5	60.5
0.375000	41.4	1000.0	9.000	On	N	9.9	17.0	58.4
13.569000	55.7	1000.0	9.000	On	N	9.9	4.3	60.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.276000	24.9	1000.0	9.000	On	N	9.7	26.0	50.9
0.375000	33.0	1000.0	9.000	On	N	9.9	15.4	48.4
0.532500	22.9	1000.0	9.000	On	N	9.9	23.1	46.0
13.569000	55.8	1000.0	9.000	On	N	9.9	-5.8	50.0
17.749500	35.6	1000.0	9.000	On	N	10.0	14.4	50.0
19.797000	29.0	1000.0	9.000	On	N	10.1	21.0	50.0

Remark :

1. 13.569 MHz is the carrier frequencies.

APPENDIX A – Test Equipment Used For Tests

Instrument for Radiated emission

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2020-10-20	2021-10-20
2	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-126	2020-05-20	2022-05-20
3	Active Loop Antenna	SCHWARZBECK	FMZB 1513	1513-125	2020-04-16	2022-04-16
4	Bilog Antenna	Schaffner	CBL6111C	2551	2021-03-22	2023-03-22
5	AMPLIFIER	SONOMA	310	291721	2021-01-22	2022-01-22
6	6dB Attenuator	Rohde & Schwarz	DNF	272.4110.50-2	2020-10-23	2021-10-23
7	6dB Attenuator	BIRD	5W 6dB	1744	2020-12-17	2021-12-17
8	Spectrum Analyzer	Agilent	N9020A	MY49101016	2021-10-08	2022-10-08

Instrument for AC power line conducted emission

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date
1	LISN	Rohde & Schwarz	ENV216	101236	2020-10-20	2021-10-20
2	EMI Test Receiver	Rohde & Schwarz	ESCI3	100032	2021-01-15	2022-01-15

Cable

No.	Name of Equipment	Manufacturer	Model No.	Serial No.	Check Date
1	Cable	CANARE	3m loop	N/A	2020-06-01
2	Cable	HUBER+SUHNER	SUCOFLEX 104	MY27558/4	2021-06-01
3	Cable	CANARE	10m 1G below-1	N/A	2021-06-01
4	Cable	CANARE	10m 1G below-2	N/A	2021-06-01
5	Cable	CANARE	AC power line	N/A	2021-06-01