Test Report

1. Client

- Name : Phoenixdarts Co., Ltd.
- Address : Gurodong-306, JNK Digital Tower, 111, Digital-ro 26-gil, Guro-gu, Seoul, Republic of korea

2. Use of Report : FCC & IC Approval

3. Sample Description

- Product Name : RFID Card
- Model Name : Phoenixdarts RFID Card

4. Date of Receipt : 2023-01-02

5. Date of Test : 2023-01-16 ~ 2023-01-31

6. Test Method : FCC Part 15 Subpart C 15.225
RSS-210 Issue 10(2019-12), RSS-GEN Issue 5(2019-03)

7. Test Results : Refer to the test results

This test report must not be reproduced or reproduced in any way.
The results shown in this test report are the results of testing the samples provided.
This test report is prepared according to the requirements of ISO / IEC 17025.

Affirmation	Tested by Jong-Myoung, Shin (signature)	Technical Manager Kyung-Taek, Lee (signature)

Mar 21, 2023

EMC Labs Co., Ltd. (seal)

Contents

Version

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2303-001	Mar 07, 2023	Initial Issue
KR0140-RF2303-001-R1	Mar 21, 2023	Fixed the typo and added the serial number

1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant Information

Applicant	Phoenixdarts Co., Ltd.
Applicant Address	Gurodong-306, JNK Digital Tower, 111, Digital-ro 26-gil, Guro-gu, Seoul, Republic of korea
Contact Person	Choong Jae, Lee
Telephone No.	+82-10-5517-9048
Fax No.	-
E-mail	choongjae.lee@phoenixdarts.com

1.2. Manufacturer Information

Manufacturer	Phoenixdarts Co., Ltd.
Manufacturer Address	Gurodong-306, JNK Digital Tower, 111, Digital-ro 26-gil, Guro-gu, Seoul, Republic of korea

1.3 Test Laboratory Information

Laboratory	EMC Labs Co., Ltd.
Laboratory Address	100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of Korea
Contact Person	Jong-Myoung, Shin
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Fax No.	+82-505-116-8895
FCC Designation No.	KR0140
FCC Registration No.	580000
IC Site Registration No.	28751

2. Equipment under Test(EUT) Information

2.1 General Information

Product Name	RFID Card
Model Name	Phoenixdarts RFID Card
FCC ID	2BAB8-PHRFIDCARD
IC	30096- PHRFIDCARD
Rated Voltage	DC 12.0 V

2.2 Additional Information

Operating Frequency	13.56 MHz
Number of channel	1
Modulation Type	ASK
Antenna Type	PCB Pattern Antenna
Serial Number	XRF221205001
Firmware Version	1.0
Hardware Version	1.0
Test software	None

2.3 Test Frequency

Test mode	Test Frequency (MHz)		
	Low Frequency	Middle Frequency	High Frequency
RFID	13.56	-	-

2.4 Used Test Software Setting Value

Test Mode	Setting Item
	Power
RFID	None

2.7 Mode of operation during the test

- The EUT continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

2.8 Modifications of EUT

- None

3. Test Summary

Applied	FCC Rule	IC Rule	Test Items	Test Condition	Result
☒	15.203	-	Antenna Requirement	-	C
☒	15.215 (c)	-	20 dB Bandwidth	Radiated	C
☒	-	RSS GEN [6.7]	Occupied Bandwidth (99%)		C
☒	15.225 (a)	RSS-210 [B6(a)]	In-Band Emissions (13.553 - 13.567 MHz)		C
☒	15.225 (b)	RSS-210 [B6(b)]	In-Band Emissions (13.410 - 13.553 MHz, 13.567 - 13.710 MHz)		C
☒	15.225 (c)	RSS-210 [B6(c)]	In-Band Emissions (13.110 - 13.410 MHz, 13.710 - 14.010 MHz)		C
☒	15.225 (d) 15.209	RSS-210 [B6(d)] RSS-GEN [8.9]	Out-of-Band Emissions		C
☒	15.225 (e)	RSS-210 [B6]	Frequency Stability		C
☐	15.207	RSS-GEN [8.8]	Conducted Emissions	AC Line Conducted	NA[Note 2]

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable
Note 2: This product is only using DC Power. So, AC conducted emission test has not been performed.

The sample was tested according to the following specification: ANSI C63.10:2013.
Compliance was determined by specification limits of the applicable standard according to customer requirements.

4. Used equipment on test

	Description	Manufacturer	Model Name	Serial Name	Next Cal.
■	TEMP & HUMID CHAMBER	JFM	JFMA-001	20200929-01	2023.12.15
■	CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2023.12.15
■	PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2023.12.15
■	MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2023.12.14
■	SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2023.12.14
□	VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2023.12.14
□	BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	2023.12.14
□	DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2023.12.14
□	ATTENUATOR	AGILENT	8493C	73193	2023.12.14
□	TERMINATIOM	HEWLETT PACKARD	909D	07492	2023.12.14
□	POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2023.12.14
□	SLIDE-AC	DAEKWANG TECH	SV-1023	NONE	2023.11.15
□	DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2023.12.14
□	ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2023.04.11
■	DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2024.02.23
□	USB Peak Power Sensor	Anritsu	MA24408A	12321	2023.11.15
□	High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	2023.12.14
□	High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	2023.12.14
■	ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2024.12.22
■	Biconilog ANT	Schwarzbeck	VULB 9160	3260	2025.01.09
□	Biconilog ANT	Schwarzbeck	VULB9168	902	2024.11.30
□	Horn Ant.	Schwarzbeck	BBHA9120D	974	2023.11.29
□	Horn Ant.	S/B	BBHA9120D	1497	2024.01.09
□	Amplifier	TESTEK	TK-PA18H	200104-L	2023.03.17
■	EMI TEST RECEIVER	ROHDE& SCHWARZ	ESW44	101952	2023.04.07
■	Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2023.06.28
□	LISN	ROHDE & SCHWARZ	ENV216	100409	2024.01.09
□	PULSE LIMITER	lignex1	EPL-30	NONE	2024.01.09

5. Antenna Requirement

According to §15.203 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.

According to §15.247(b)(4) e conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1 Result

Complies
(The transmitter has a PCB Pattern Antenna.)

6. 20 dB Bandwidth & Occupied Bandwidth (99%)

6.1 Test Setup

Refer to the APPENDIX I.

6.2 Limit

N/A

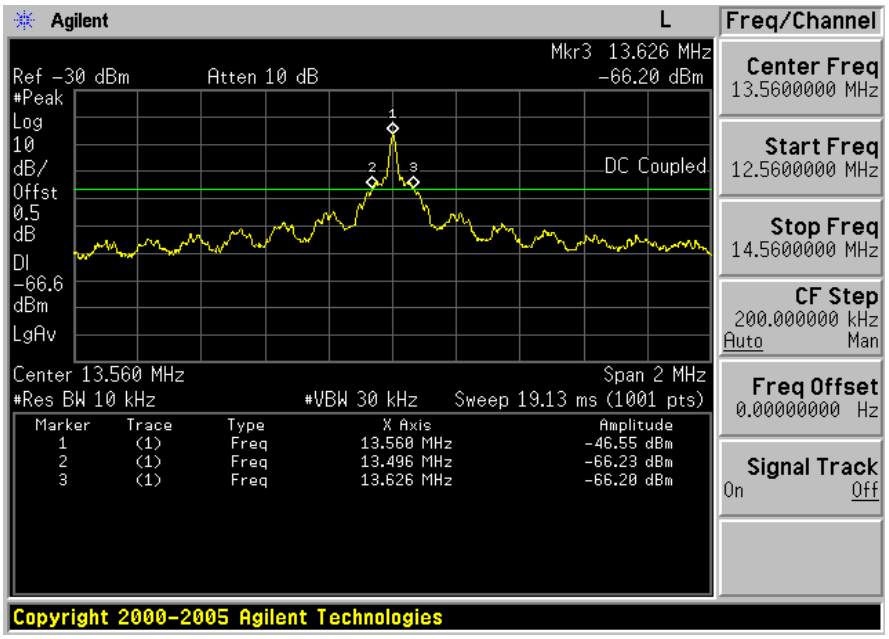
6.3 Test Procedure

1. The 20 dB Bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

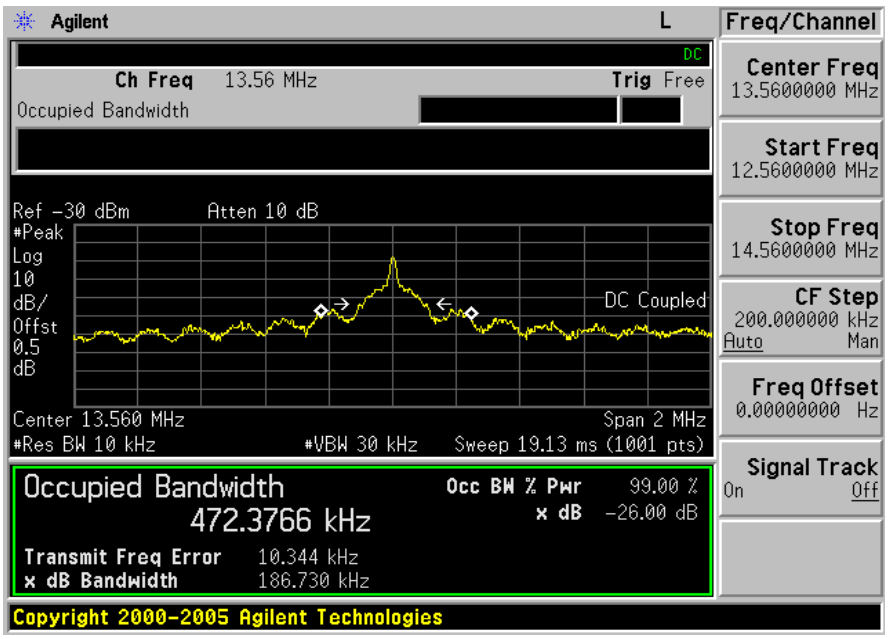
2. Spectrum analyzer setting use following test procedure
   RBW = 1 % ~ 5 % OBW
   VBW ≥ 3 × RBW
   Span = Span = 2 ~ 5 times the OBW
   Sweep = Auto
   Detector = Peak
   Trace = Max hold
3. The trace was allowed to stabilize
4. Determine the reference value = Set the spectrum analyzer marker to the highest level of the displayed trace
5. Using the marker-delta function of the instrument, determine the "-xx dB down amplitude" using [(reference value) - xx].
6. Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

6.4 Test Result

	20 dB Bandwidth



	Occupied Bandwidth



7. In-Band Emissions

7.1 Test Setup

Refer to the APPENDIX I.

7.2 Limit

Part 15.225(a),(b),(c) & RSS-210 [B6(a),(b),(c)]

Frequency Band (MHz)	Limit at 30 m measurement distance	
	(uV/m)	(dBuV/m)
13.553-13.567	15,848	84.00
13.410-13.553 13.567-13.710	334	50.47
13.110-13.410 13.710-14.010	106	40.51

7.3 Test Procedure

The radiated emission was tested according to the section 6.4 of the ANSI C63.10-2013.

The EUT was placed on a 0.8 m high non-conductive table and it was placed at 3m distance from the antenna.
Measurements were performed for each of the three antenna orientations. (ie. parallel, perpendicular, and ground-parallel)
Also, measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

RBW = As specified in below table
VBW ≥ 3 x RBW
Sweep = Auto
Detector = Peak
Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
>1 000 MHz	1 MHz

7.4 Test Result

- Test Frequency: 13.56 MHz
- Measurement Distance: 3 m

Test Frequency Band (MHz)	Freq. (MHz)	Reading Value (dB μV)	Ant	T.F (dB/m)	Field Strength @3m (dB μV/m)	Field Strength @30m (dB μV/m)	Limit (dB μV/m)	Margin (dB)
13.110-13.410	13.348	15.13	P	21.79	36.92	-3.08	40.51	43.59
13.410-13.553	13.553	29.08	P	21.79	50.87	10.87	50.47	39.60
13.553-13.567	13.560	44.95	P	21.79	66.74	26.74	84.00	57.26
13.567-13.710	13.567	31.84	P	21.79	53.63	13.63	50.47	36.84
13.710-14.010	13.772	18.01	P	21.79	39.80	-0.20	40.51	40.71
13.110-13.410	13.364	12.91	V	21.79	34.70	-5.30	40.51	45.81
13.410-13.553	13.553	29.04	V	21.79	50.83	10.83	50.47	39.64
13.553-13.567	13.560	41.97	V	21.79	63.76	23.76	84.00	60.24
13.567-13.710	13.567	28.37	V	21.79	50.16	10.16	50.47	40.31
13.710-14.010	13.773	14.71	V	21.79	36.50	-3.50	40.51	44.01

Note 1: Loop antenna orientation
"P": Parallel, "V": Perpendicular, "G": Ground-parallel
Note 2: This test item was performed at 3 m and the data were extrapolated to the specified measurement distance of 30 m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)2.
▪ Extrapolation Factor = 20 $\log_{10}(30/3)^2$ = 40 dB
Note 3: All data were recorded using a spectrum analyzer employing a peak detector.
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.
Note 4: Sample Calculation.
Margin = Limit - Field Strength @ 30 m / Field Strength @ 30 m = Field Strength @ 3 m - 40 dB
Field Strength @ 3 m = Reading + T.F / T.F = AF + CL
Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss

8. Out-of-Band Emissions

8.1 Test Setup

Refer to the APPENDIX I.

8.2 Limit

Part 15.209, 15.225(d) & RSS-210[B6(d)], RSS-GEN[8.9]

FCC Part 15.209(a):

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	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 – 72 MHz, 76 – 88 MHz, 174 – 216 MHz or 470 – 806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

FCC Part 15.209(b): In the emission table above, the tighter limit applies at the band edges.

8.3 Test Procedure

The radiated emission was tested according to the section 6.4 of the ANSI C63.10-2013.

The EUT was tested from 9 kHz up to the 1 GHz excluding the band 13.110-14.010 MHz.
The EUT was placed on a 0.8 m high non-conductive table and it was placed at 3m distance from the antenna.
For measurements below 30MHz were performed for each of the three antenna orientations. (ie. parallel, perpendicular, and ground-parallel)
For measurements above 30MHz were performed for each of the both horizontal and vertical polarizations.
Also, measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions.

RBW = As specified in below table
VBW ≥ 3 x RBW
Sweep = Auto
Detector = Peak
Trace mode = Max Hold until the trace stabilizes.

Frequency	RBW
9–150 kHz	200–300 Hz
0.15–30 MHz	9–10 kHz
30–1000 MHz	100–120 kHz
>1 000 MHz	1 MHz

8.4 Test Result

- Test Frequency: 13.56 MHz
- Measurement Distance: 3 m

Frequency (MHz)	Ant	Reading Value (dB μV)	T.F (dB/m)	Distance Factor (dB μV/m)	Field Strength (dB μV/m)	Limit (dB μV/m)	Margin (dB)
82.81	V	21.47	9.58	N/A	31.05	40.00	8.95
175.84	V	19.52	15.38	N/A	34.90	43.52	8.62

Note 1: The radiated emissions were inverstigated 9 kHz to 1 ㎓. And no other spurious and harmonic emissions were found above listed frequencies.
Note 2: Loop antenna orientation (below 30 MHz)
"P": Parallel, "V": Perpendicular, "G": Ground-parallel
Bilog antenna polarization (above 30 MHz)
"H": Horizontal, "V": Vertical
Note 3: All data were recorded using a spectrum analyzer employing a peak detector.
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.
Note 4: Sample Calculation.
Margin = Limit – Field Strength
Field Strength = Reading + T.F – Distance factor
Distance factor = 20log(Measurement distance / The measured distance)^2 = 20log(30/3)^2 = 40 dB
T.F = AF + CL –AG
Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

9. Frequency Stability

9.1 Test Setup

Refer to the APPENDIX I.

9.2 Limit

Part 15.225(e) & RSS-210[B6]

The frequency tolerance of the carrier signal shall be maintained within ±0.01 % of the operating frequency.

9.3 Test Procedure

Part 15.225 requires that devices operating in the 13.553 – 13.567 MHz shall maintain the carrier frequency within 0.01 % of the operating frequency over the temperature variation of –20 degrees to + 50 degrees C at normal supply voltage.

9.4 Test Result

Voltage		Temp	Frequency	Deviation	
(%)	(Vdc)	(℃)	(Hz)	(Hz)	(%)
100	3.70	-20	13 560 257	257	0.001 9
100		-10	13 560 250	250	0.001 8
100		0	13 560 247	247	0.001 8
100		10	13 560 245	245	0.001 8
100		+20	13 560 244	244	0.001 8
100		30	13 560 242	242	0.001 8
100		40	13 560 242	242	0.001 8
100		50	13 560 241	241	0.001 8
115	4.07	20	13 560 244	244	0.001 8
85	3.33	20	13 560 243	243	0.001 8

10. Conducted Emission

10.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

10.2 Limit

According to §15.207(a) 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 uH/50 ohm line impedance stabilization network (LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (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

10.3 Test Procedure

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

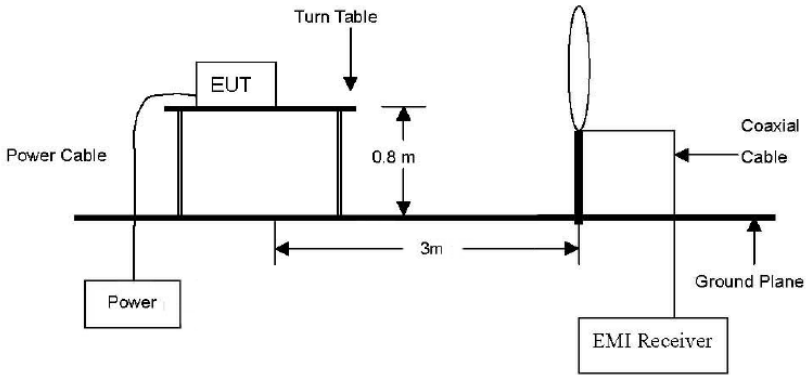
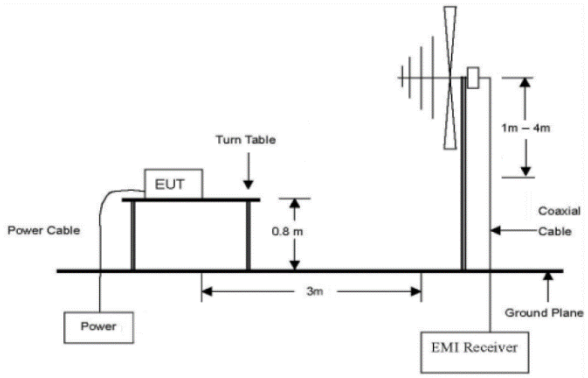
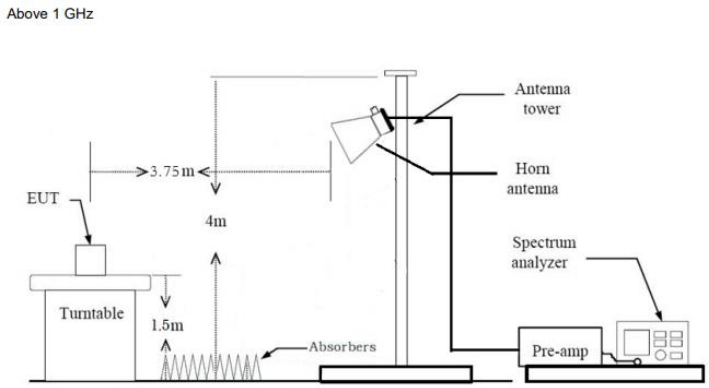
10.4 Test Result

Not Applicable
(This product is only using DC Power. So, AC conducted emission test has not been performed.)

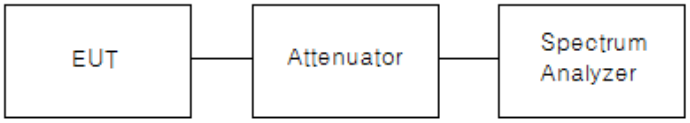
APPENDIX I

TEST SETUP

- Radiated Measurement

below 30 MHz	
below 1 GHz	
above 1 GHz	

- Conducted Measurement

Conducted	

APPENDIX II

UNCERTAINTY

Measurement Item	Expanded Uncertainty U = *k*Uc (*k*=2)
Radiated Spurious Emissions	6.34 dB
Conducted Emissions	1.74 dB