



Test Report No.: NK-17-E-0176

FCC Verification

Nemko Korea Co., Ltd.

155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPUBLIC OF
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FCC EVALUATION REPORT FOR VERIFICATION

Applicant :

Rynan Technologies Pte Ltd

8 Cross Street, #24-03/04 PWC Building,
Singapore 048424
Attn : Mr. Brian Nguyen

Dates of Issue : April 21, 2017

Test Report No. : NK-17-E-0176

Test Site : Nemko Korea Co., Ltd.

EMC site, Korea

Model

S2

Variant Model

S1, S3

Trade Mark

Clever

Contact Person

Rynan Technologies Pte Ltd
8 Cross Street, #24-03/04 PWC Building,
Singapore 048424
Mr. Brian Nguyen
Telephone No. : +65 6871 8922

Applied Standard : FCC Part 15 Subpart B & Part 2, ICES-003
Classification : FCC Class B Device
EUT Type : Lock

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.4-2014.

The test results of this report are deemed satisfactory evidence of compliance with Industry Canada Interference-causing Equipment Standard ICES-003.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Apr 21, 2017
Tested By : SangKyu Lee
Engineer

Apr. 21, 2017
Reviewed By : Changsoo Choi
Technical Manager

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SCOPE

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15.

Responsible Party :

Rynan Technologies Pte Ltd

Contact Person :

Mr. Brian Nguyen

Tel No.: +65 6871 8922

Manufacturer :

RYNAN TECHNOLOGIES – VIETNAM JSC

LONGTRI HAMLET, LONGDUC COMMUNE, TRAVINH CITY
TRAVINH PROVINCE, VIETNAM

- Model: S2
- Variant Model: S1, S3
- EUT Type: Lock
- Trade Mark: Clever
- Rating: d.c. 3.7 V, 250 mA
- Test Voltage & Power Frequency: a.c. 120 V, 60 Hz
- I/O Port: Micro USB x 1 EA
- Classification: FCC Class B Device
- Applied Standard: FCC Part 15 Subpart B & Part 2, ICES-003
- Test Procedure(s): ANSI C63.4-2014
- Dates of Test: February 23, 2017 to March 13, 2017
- Place of Tests: Nemko Korea Co., Ltd. EMC Site
- Test Report No.: NK-17-E-0176

INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014) was used in determining radiated and conducted emissions emanating from **Rynan Technologies Pte Ltd.**

MODEL : **S2, Lock.**

These measurement tests were conducted at **Nemko Korea Co., Ltd. EMC Laboratory.** The site address is 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPUBLIC OF

The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at 80 kilometers (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 Kilometers (18 miles) south-southeast from central Seoul.

The Nemko Korea Co., Ltd. Has been accredited as a Conformity Assessment Body (CAB).



Nemko Korea Co., Ltd.
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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab and Incheon Airport.

TEST CONDITIONS & EUT INFORMATION

Operating During Test

Test Item	Test Mode
Conducted Emission	Bluetooth + Charging mode
Radiated Emission (Below 1 GHz, Above 1 GHz)	Bluetooth + Charging mode, Bluetooth Only mode

Support Equipment

► Bluetooth Only mode

Lock (EUT)	RYNAN TECHNOLOGIES – VIETNAM JSC Model : S2	FCC Verification FCC ID : 2ALPA305001BF S/N : N/A
Tablet PC	Samsung Electronics Co., Ltd. Model : SM-P900	S/N : R34F30144BR

► Bluetooth + Charging mode

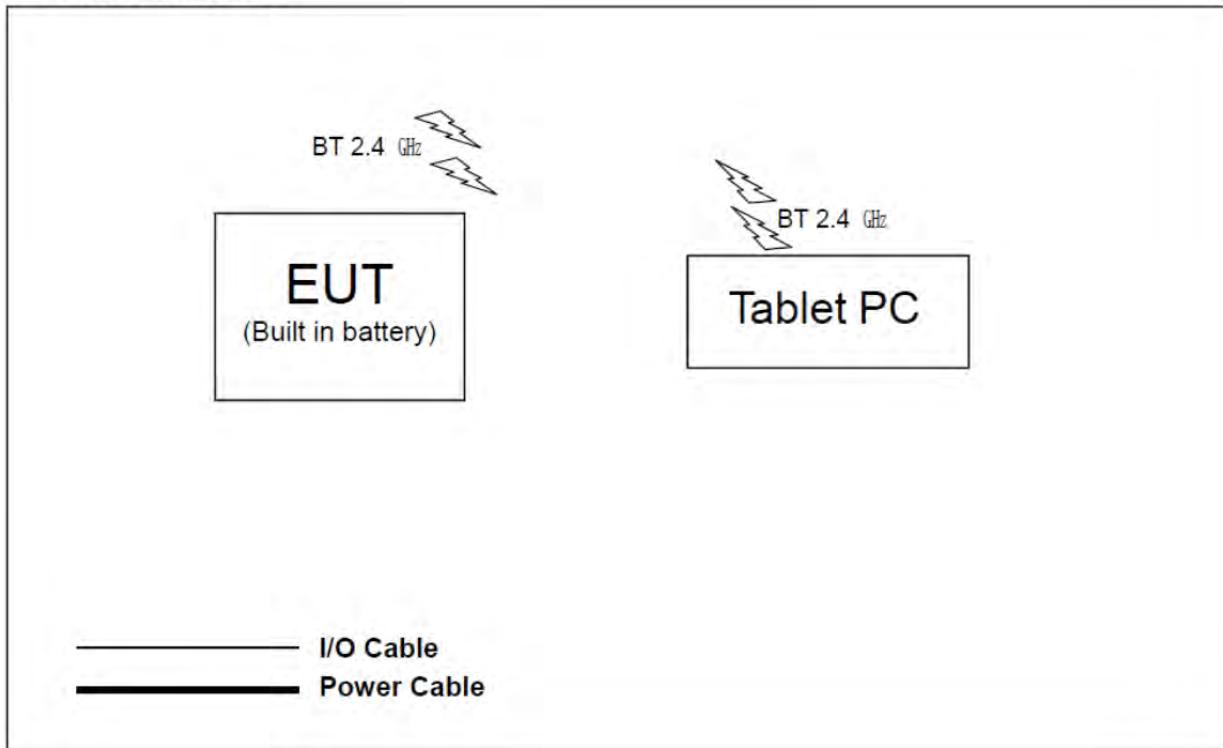
Lock (EUT)	RYNAN TECHNOLOGIES – VIETNAM JSC Model : S2 1.2 m shielded USB 1 cable	FCC Verification FCC ID : 2ALPA305001BF S/N : N/A
Tablet PC	Samsung Electronics Co., Ltd. Model : SM-P900	S/N : R34F30144BR
Laptop computer	Samsung Electronics Co., Ltd. Model : NT-RF510	S/N : N/A
Adapter	Chicony Power Technology co., Ltd Model : A10-090P1A 1.7 m unshielded power cable	S/N : N/A
Mouse	Anzyet Model : ANY-MU5029 1.5 m shielded USB 2 cable	S/N : 11010004071

Component List

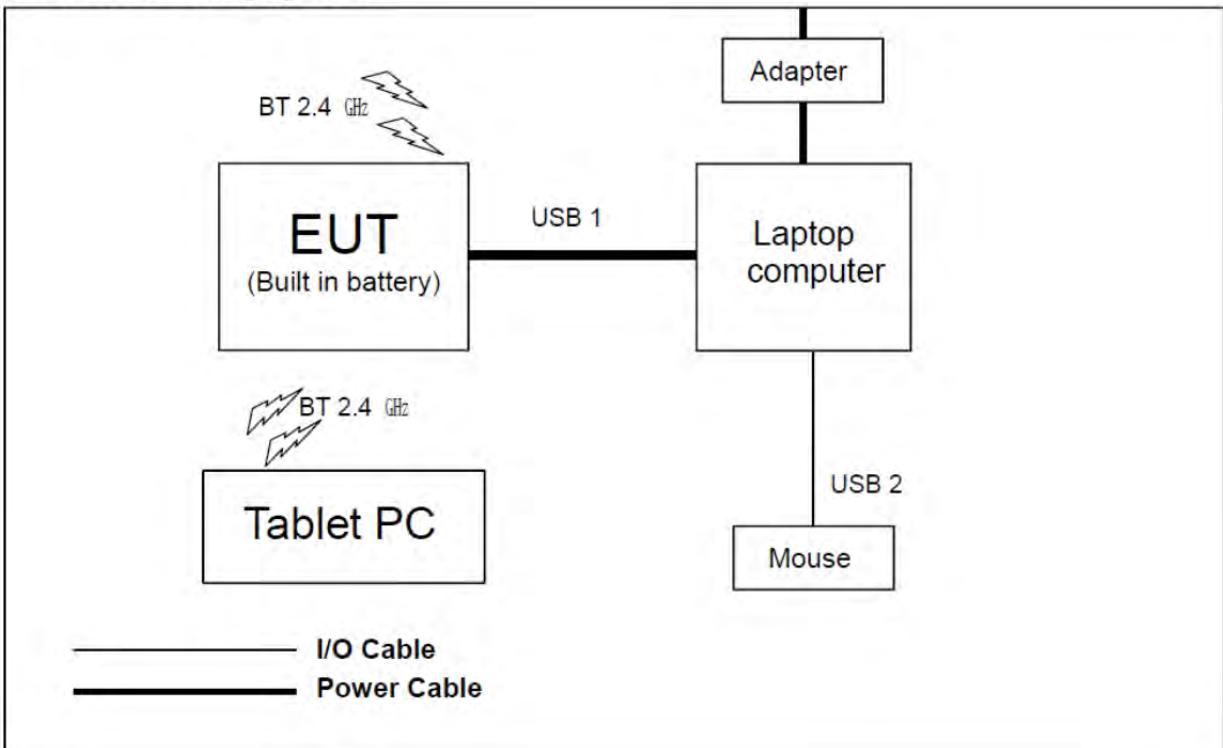
Item	Model	Manufacturer	Serial Number
Main Board	SPL-S-V1.5	Rynan Technologies / USA	N/A
Lithium Battery	LP502030	Blue Taiyang / China	N/A
DC Motor	N/A	N/A	N/A

Setup Drawing

► Bluetooth Only mode



► Bluetooth + Charging mode



SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	Paragraph No.	Result	Remark
Conducted Emission	15.107(a)	Complies	
Radiated Emission	15.109(g)	Complies	Below 1 GHz
Radiated Emission	15.109(a)	Complies	Above 1 GHz

RECOMMENDATION/CONCLUSION

The data collected shows that the **Rynan Technologies Pte Ltd.**

MODEL : S2, Lock.

The highest emission observed was at **0.16 MHz** for conducted emissions with a QP margin of **3.4 dB**, at **562.53 MHz** for radiated emissions with a QP margin of **9.9 dB**.

SAMPLE CALCULATION

$$\text{dB}\mu\text{V} = 20 \log_{10} (\mu\text{V}/\text{m})$$

$$\mu\text{V} = 10^{(\text{dB}\mu\text{V}/20)}$$

EX. 1.

@165.0 MHz

Class B limit = 40.0 dB μ V/m

Reading = 38.2 dB μ V(calibrated level)

Antenna factor + Cable Loss + Amplifier Gain = -12.9 dB

Total = 25.30 dB μ V/m

Margin = 40.0 – 25.30 = 14.70

14.70 dB below the limit

DESCRIPTION OF TESTS

Conducted Emissions

The Line conducted emission test facility is located inside a 5.1 x 8.1 x 4.6 m shielded enclosure.

It is manufactured by SY corporation. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6.

A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 0.5 m away from the side of wall of the shielded room Rohde & Schwarz (ENV216) and Rohde & Schwarz (ESH2-Z5) of the 50 ohm / 50 uH Line Impedance Stabilization Network(LISN) are bonded to the shielded room.

The EUT is powered from the Rohde & Schwarz (ENV216) LISN and the support equipment is powered from the Rohde & Schwarz (ESH2-Z5) LISN.

Power to the LISNs are filtered by high-current high insertion loss power line filters.

The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1/2 ".

If d.c. power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs,

All interconnecting cables more than 1 m were shortened by non-inductive bundling (serpentine fashion) to a 1 m length.

Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 20 ms sweep time.

The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCI).

The detector functions were set to quasi-peak mode & average mode.

The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux a.c. outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

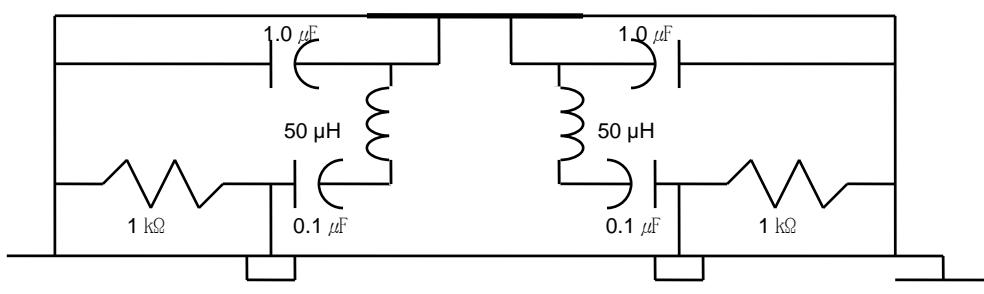


Fig. 2. LISN Schematic Diagram

DESCRIPTION OF TESTS

Radiated Emissions

Measurement were made indoors at 10 m & 3 m using antenna, signal conditioning unit and EMI test receiver to determine the frequency producing the maximum EME.

Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The Technology configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna was note for each frequency found.

The test receiver was scanned from 30 MHz to 1 000 MHz using TRILOG Broadband Test Antenna (Schwarzbeck, VULB 9163). Above 1 GHz, Double Ridged Broadband Horn Antenna (Schwarzbeck, HF907) was used.

The test equipment was placed on a wooden table.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition.

Each frequency found during scan measurements was reexamined and investigated using EMI test receiver. (ESU 40)

The detector function were set to CISPR quasi-peak and peak mode & average mode and the bandwidth of the receiver were set to 120 kHz and 1 MHz depending on the frequency or type of signal.

The EUT support equipment and interconnecting cables were re configured to the setup producing the maximum emission for the frequency and were placed on top of a 0.8 m high non- metallic 1.0 m x 1.5 m table.

The EUT, support equipment and interconnecting cables were re-arranged and manipulated to maximize each EME emission.

The turn table containing the Technology was rotated; the antenna height was varied 1 to 4 meter and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by : switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux a.c. outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R/S signal generator.

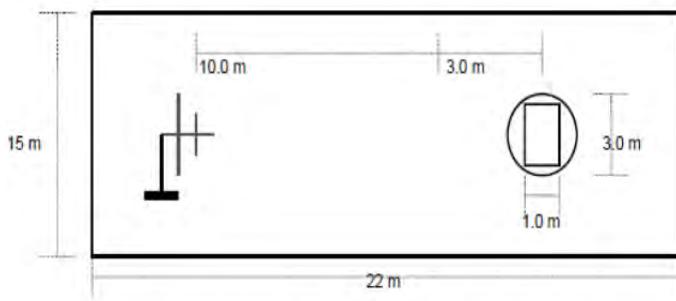


Fig. 3. Dimensions of 10 semi anechoic chamber

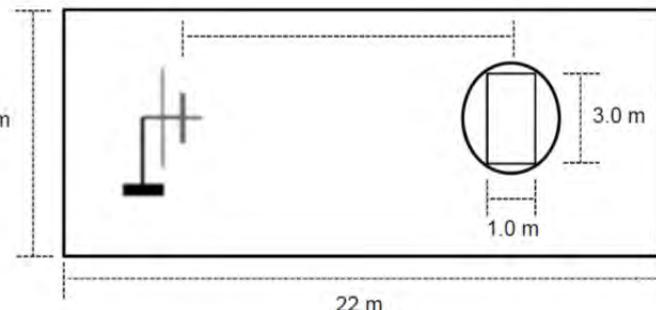


Fig. 4. Dimensions of 10 semi anechoic chamber

TEST DATA

Conducted Emissions

EMI Auto Test(1) 1 / 2

Test Report

Common Information

Test Site: Nemko Korea(NK-17-E-0176)
Test Description: Conducted emission
Test Standard: FCC Part 15 Subpart B Class B
Environment Conditions: a.c. 120 V, 60 Hz
Operator Name: Sangkyu.lee
Model: S2
Mode: BT + Charging

1.EMI Auto Test_2-Line Voltage LISN

1.EMI Auto Test_2-Line Voltage LISN

Level in dB μ V

Frequency in Hz

QP Class B

AV Class B

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EMI Auto Test(1)

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Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.161194	61.9	15000.0	9.000	On	L1	9.9	3.4	65.4	
0.179850	58.1	15000.0	9.000	On	L1	10.0	6.3	64.4	
0.205969	55.5	15000.0	9.000	On	N	9.8	7.7	63.2	
0.288056	44.9	15000.0	9.000	On	N	9.7	15.5	60.4	
0.530588	36.7	15000.0	9.000	On	L1	9.9	19.3	56.0	
20.104725	33.1	15000.0	9.000	On	N	10.1	26.9	60.0	

Final Result 2

Frequency (MHz)	CAverage (dB μ V)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.161194	43.3	15000.0	9.000	On	L1	9.9	12.1	55.3	
0.179850	39.2	15000.0	9.000	On	L1	10.0	15.2	54.4	
0.205969	38.9	15000.0	9.000	On	N	9.8	14.3	53.2	
0.288056	32.0	15000.0	9.000	On	N	9.7	18.4	50.3	
0.530588	31.6	15000.0	9.000	On	L1	9.9	14.4	46.0	
20.104725	28.0	15000.0	9.000	On	N	10.1	22.0	50.0	

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Table 1. Line Conducted Emissions Tabulated Data

NOTES:

1. Measurements using quasi-peak mode & average mode.
2. All modes of operation were investigated and the worst -case emission are reported.
3. LINE : L1 = Line , N = Neutral
4. The limit for Class B device is on the FCC Part section 15.107(a).

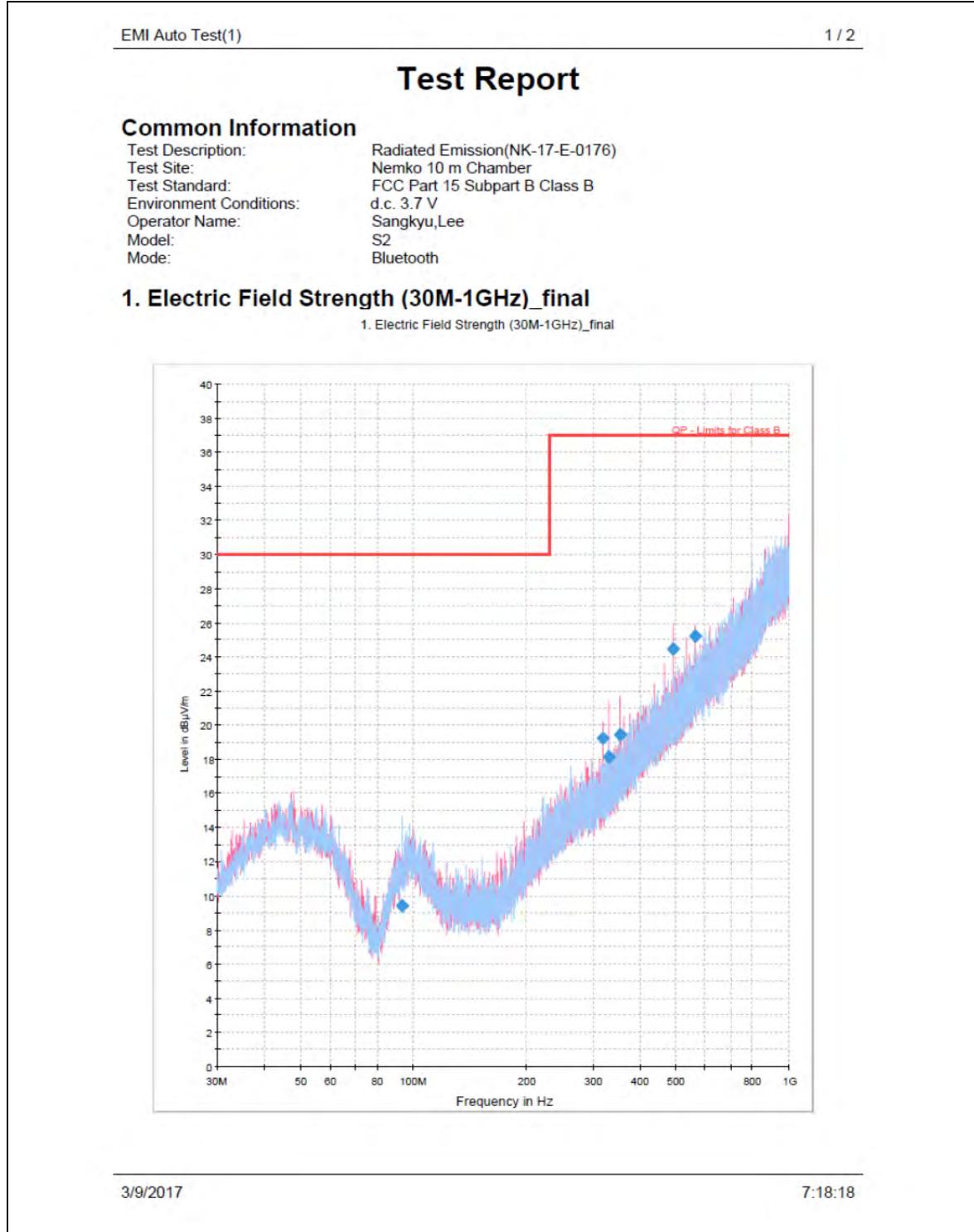


Tested by : SangKyu Lee

TEST DATA

Radiated Emissions (Below 1 GHz)

► Bluetooth Only mode



EMI Auto Test(1)

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Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)
93.147000	9.4	15000.0	120.000	330.0	H	255.0	-23.6	20.6
319.060000	19.3	15000.0	120.000	312.0	V	161.0	-17.8	17.7
331.330500	18.1	15000.0	120.000	400.0	V	198.0	-17.3	18.9
355.871500	19.4	15000.0	120.000	400.0	V	143.0	-16.4	17.6
490.895500	24.5	15000.0	120.000	100.0	V	240.0	-12.2	12.5
562.530000	25.2	15000.0	120.000	100.0	V	20.0	-10.3	11.8

(continuation of the "Final Result 1" table from column 9 ...)

Frequency (MHz)	Limit (dB μ V/m)	Comment
93.147000	30.0	
319.060000	37.0	
331.330500	37.0	
355.871500	37.0	
490.895500	37.0	
562.530000	37.0	

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Table 2. Radiated Measurements at 10 meters

► Bluetooth + Charging mode

EMI Auto Test(1)

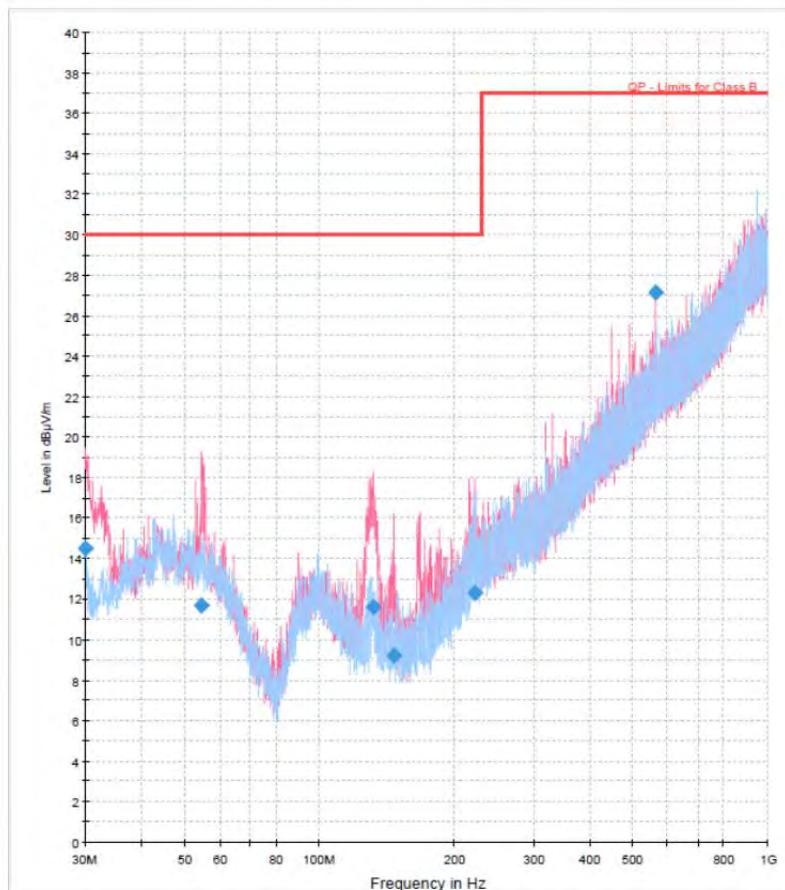
1 / 2

Test Report**Common Information**

Test Description: Radiated Emission(NK-17-E-0176)
Test Site: Nemko 10 m Chamber
Test Standard: FCC Part 15 Subpart B Class B
Environment Conditions: a.c. 120 V, 60 Hz
Operator Name: Sangkyu,Lee
Model: S2
Mode: BT + Charging

1. Electric Field Strength (30M-1GHz)_final

1. Electric Field Strength (30M-1GHz)_final



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EMI Auto Test(1)

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Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)
30.097000	14.5	15000.0	120.000	120.0	V	30.0	-24.7	15.5
54.444000	11.7	15000.0	120.000	370.0	V	350.0	-21.8	18.3
131.656000	11.6	15000.0	120.000	212.0	V	-24.0	-25.8	18.4
146.933500	9.2	15000.0	120.000	120.0	V	296.0	-25.7	20.8
222.399500	12.3	15000.0	120.000	130.0	V	-23.0	-21.6	17.7
562.530000	27.1	15000.0	120.000	100.0	V	207.0	-10.3	9.9

(continuation of the "Final Result 1" table from column 9 ...)

Frequency (MHz)	Limit (dB μ V/m)	Comment
30.097000	30.0	
54.444000	30.0	
131.656000	30.0	
146.933500	30.0	
222.399500	30.0	
562.530000	37.0	

Table 3. Radiated Measurements at 10 meters

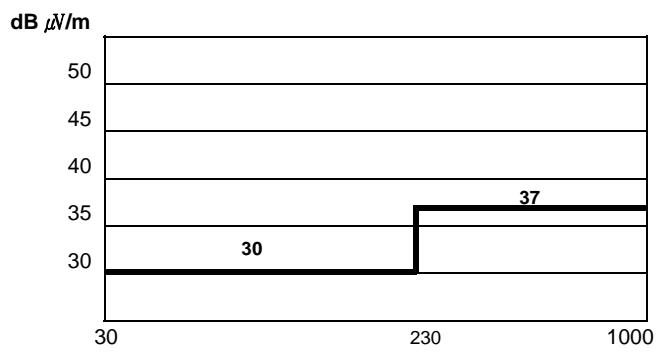


Fig. 5. Limits at 10 meters

NOTES:

1. All modes were measured and the worst-case emission was reported.
2. Below 1 GHz, the radiated limits are shown on Figure 5.
3. CISPR 22 limit will be applied for radiated emission test

NOTES:

1. *Pol. H = Horizontal V = Vertical
2. **Corr. = Antenna Factor + Cable Loss + Amplifier.
3. Measurements using Quasi-peak mode below 1 GHz.
4. The limit for Class B device is on the FCC Part section 15.109(g).



Tested by : SangKyu Lee

TEST DATA

Radiated Emissions (Above 1 GHz)

► Bluetooth Only mode

EMI Auto Test(3)

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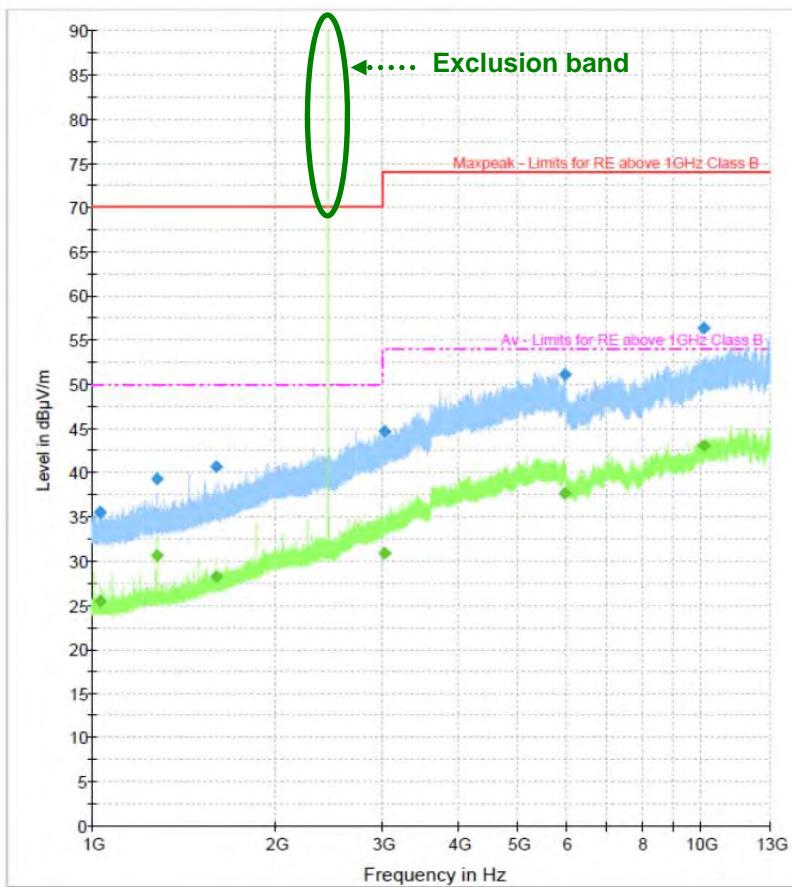
Test Report

Common Information

Test Description: Radiated Emission(NK-17-E-0176)
Test Site: Nemko 3 m Chamber
Test Standard: FCC Part 15 Subpart B Class B
Environment Conditions: d.c. 3.7 V
Operator Name: Sangkyu,Lee
Model : S2
Mode : Bluetooth

2. Electric Field Strength (1G-18GHz)

2. Electric Field Strength (1G-18GHz)



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EMI Auto Test(3)

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Final Result 1

Frequency (MHz)	MaxPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1033.800000	35.5	15000.0	1000.000	400.0	V	90.0	-9.7	34.5	70.0
1279.866667	39.3	15000.0	1000.000	300.0	V	180.0	-8.4	30.7	70.0
1598.400000	40.7	15000.0	1000.000	200.0	V	135.0	-6.5	29.3	70.0
3023.300000	44.6	15000.0	1000.000	300.0	H	0.0	0.7	29.4	74.0
5984.000000	51.1	15000.0	1000.000	400.0	V	90.0	7.4	22.9	74.0
10120.200000	56.3	15000.0	1000.000	200.0	V	90.0	13.3	17.7	74.0

(continuation of the "Final Result 1" table from column 10 ...)

Frequency (MHz)	Comment
1033.800000	
1279.866667	
1598.400000	
3023.300000	
5984.000000	
10120.200000	

Final Result 2

Frequency (MHz)	CAverage (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1030.133333	25.5	15000.0	1000.000	100.0	H	270.0	-9.7	24.5	50.0
1280.000000	30.6	15000.0	1000.000	300.0	V	270.0	-8.4	19.4	50.0
1599.933333	28.2	15000.0	1000.000	300.0	H	270.0	-6.5	21.8	50.0
3024.000000	30.9	15000.0	1000.000	400.0	H	90.0	0.7	23.1	54.0
5984.100000	37.6	15000.0	1000.000	200.0	V	180.0	7.4	16.4	54.0
10119.966667	43.0	15000.0	1000.000	100.0	V	0.0	13.3	11.0	54.0

(continuation of the "Final Result 2" table from column 10 ...)

Frequency (MHz)	Comment
1030.133333	
1280.000000	
1599.933333	
3024.000000	
5984.100000	
10119.966667	

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Table 4. Radiated Measurements at 3 meters

► Bluetooth + Charging mode

EMI Auto Test(3)

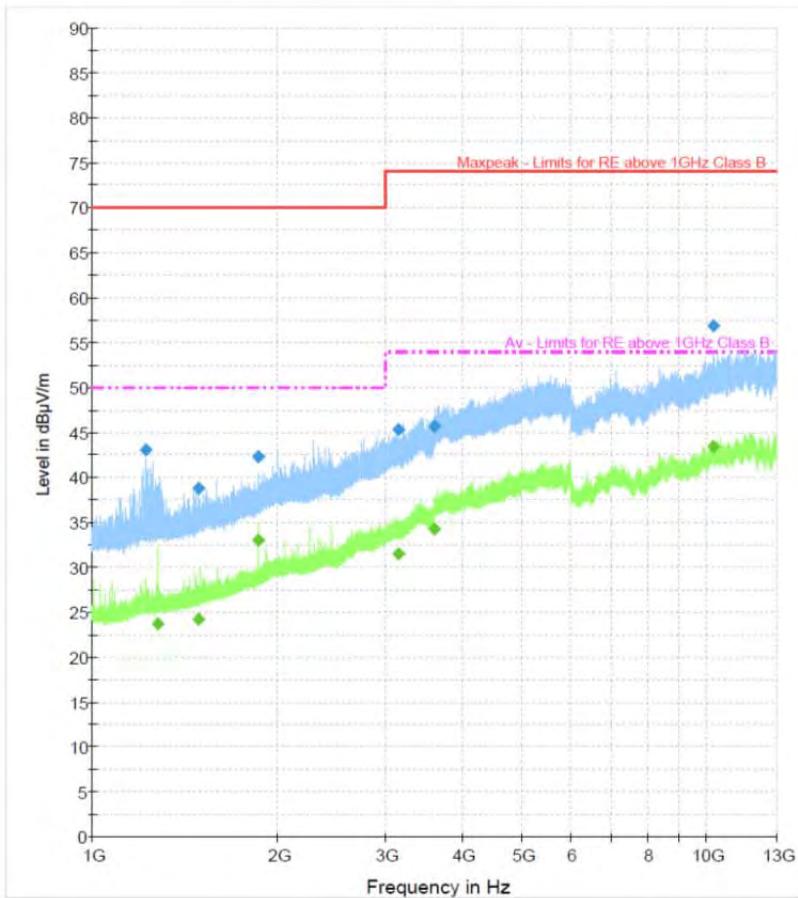
1 / 2

Test Report**Common Information**

Test Description: Radiated Emission(NK-17-E-0176)
Test Site: Nemko 3 m Chamber
Test Standard: FCC Part 15 Subpart B Class B
Environment Conditions: a.c. 120 V, 60 Hz
Operator Name: Sangkyu,Lee
Model : S2
Mode : BT + Charging

2. Electric Field Strength (1G-18GHz)

2. Electric Field Strength (1G-18GHz)



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EMI Auto Test(3)

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Final Result 1

Frequency (MHz)	Max Peak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1224.000000	43.1	15000.0	1000.000	300.0	V	0.0	-8.7	26.9	70.0
1488.266667	38.8	15000.0	1000.000	400.0	H	135.0	-7.4	31.2	70.0
1865.333333	42.3	15000.0	1000.000	400.0	V	0.0	-4.7	27.7	70.0
3150.400000	45.3	15000.0	1000.000	400.0	H	45.0	1.0	28.7	74.0
3598.400000	45.7	15000.0	1000.000	300.0	V	45.0	2.9	28.3	74.0
10250.633333	56.9	15000.0	1000.000	300.0	V	315.0	13.7	17.1	74.0

(continuation of the "Final Result 1" table from column 10 ...)

Frequency (MHz)	Comment
1224.000000	
1488.266667	
1865.333333	
3150.400000	
3598.400000	
10250.633333	

Final Result 2

Frequency (MHz)	CAverage (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1279.866667	23.7	15000.0	1000.000	300.0	V	0.0	-8.4	26.3	50.0
1488.533333	24.2	15000.0	1000.000	400.0	H	135.0	-7.4	25.8	50.0
1865.533333	33.0	15000.0	1000.000	400.0	V	315.0	-4.7	17.0	50.0
3150.600000	31.5	15000.0	1000.000	400.0	V	225.0	1.0	22.5	54.0
3600.700000	34.2	15000.0	1000.000	200.0	V	0.0	2.9	19.8	54.0
10248.533333	43.5	15000.0	1000.000	400.0	H	90.0	13.7	10.5	54.0

(continuation of the "Final Result 2" table from column 10 ...)

Frequency (MHz)	Comment
1279.866667	
1488.533333	
1865.533333	
3150.600000	
3600.700000	
10248.533333	

3/13/2017

10:53:22

Table 5. Radiated Measurements at 3 meters

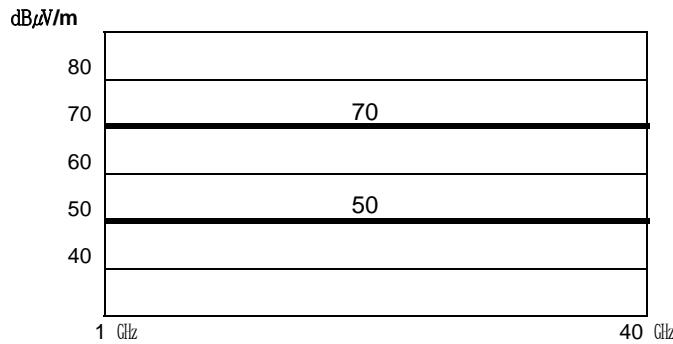


Fig. 6. Limits at 3 meters

NOTES:

1. All modes were measured and the worst-case emission was reported.
2. Above 1 GHz, the radiated limits are shown on Figure 6.
3. CISPR 22 limit will be applied for radiated emission test

NOTES:

1. **Polarization H = Horizontal V = Vertical**
 2. **Corr. = Antenna Factor + Cable Loss + Amplifier.**
 3. **The limit for Class B device is on the FCC Part section 15.109(a).**
 4. **Above 1 GHz, peak detector function mode is used using a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz, average detector function mode is used using a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz.**
- Peak mode is used with linearly polarized horn antenna and low-loss microwave cable.**



Tested by : SangKyu Lee

ACCURACY OF MEASUREMENT

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95 %

1. Conducted Uncertainty Calculation

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	RS	0.88	normal 1	1.00	0.88	1	0.88
Receiver reading	Ri	± 0.02	normal 2	2.00	0.01	1	0.01
Attenuation AMN-Receiver	LC	± 0.10	rectangular	$\sqrt{3}$	0.06	1	0.06
AMN Voltage division factor	$LAMN$	± 0.09	normal 2	2.00	0.05	1	0.05
Sine wave voltage	$dVSW$	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	$dVPA$	± 0.92	normal 2	2.00	0.50	1	0.50
Pulse repetition rate response	$dVPR$	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	$dVNF$	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
AMN Impedance	dZ	± 2.00	normal 2	2.00	1.00	1	1.00
Mismatch	M	+ 0.80 - 0.89	U-Shaped	$\sqrt{2}$	0.60	1	0.60
Remark	Using 50 Ω / 50 uH AMN						
Combined Standard Uncertainty	Normal			$uc = 1.56$ dB			
Expended Uncertainty U	Normal ($k = 2$)			$U = 3.1$ dB (CL is 95 %)			

2. Radiation Uncertainty Calculation (Below 1 GHz)

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	RS	0.67	normal 1	1.00	0.67	1	0.67
Receiver reading	Ri	± 0.02	normal 2	2.00	0.01	1	0.01
Sine wave voltage	$dVsw$	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	$dVpa$	± 0.92	normal 2	2.00	0.46	1	0.46
Pulse repetition rate response	$dVpr$	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	$dVnf$	± 0.50	normal 2	2.00	0.25	1	0.25
Antenna Factor Calibration	A_F	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Cable Loss	C_L	± 1.00	normal 2	2.00	0.50	1	0.50
Antenna Directivity	A_D	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Antenna Factor Height Dependence	A_H	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Antenna Phase Centre Variation	A_P	± 0.20	rectangular	$\sqrt{3}$	0.12	1	0.12
Antenna Factor Frequency Interpolation	A_i	± 0.25	rectangular	$\sqrt{3}$	0.14	1	0.14
Site Imperfections	S_i	± 4.00	triangular	$\sqrt{6}$	1.63	1	1.63
Measurement Distance Variation	D_V	± 0.60	rectangular	$\sqrt{3}$	0.35	1	0.35
Antenna Balance	$d\beta_{al}$	± 0.90	rectangular	$\sqrt{3}$	0.52	1	0.52
Cross Polarization	D_{Cross}	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Mismatch	M	+ 0.98 - 1.11	U-Shaped	$\sqrt{2}$	0.74	1	0.74
EUT Volume Diameter	Vd	0.33	Normal 1	1.00	0.33	1	0.11
Combined Standard Uncertainty		Normal			$uc = 2.72 \text{ dB}$		
Expedited Uncertainty U		Normal ($k = 2$)			$U = 5.4 \text{ dB}$ (CL is 95 %)		

3. Radiation Uncertainty Calculation (Above 1 GHz)

Source of Uncertainty	X_i	Uncertainty of X_i		Coverage factor k	$u(X_i)$ (dB)	C_i	$C_i u(X_i)$ (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	RS	0.21	normal 1	1.00	0.21	1	0.21
Receiver Reading	Ri	± 0.02	normal 2	2	0.01	1	0.01
Attenuation (antenna-receiver)	a_c	± 0.30	normal 2	2	0.15	1	0.15
Preamplifier gain	G_p	± 0.21	normal 2	2	0.11	1	0.11
Receiver Sine Wave	$dVsw$	± 0.17	normal 2	2	0.09	1	0.09
Instability of preamp gain	dG_p	± 1.2	rectangular	$\sqrt{3}$	0.70	1	0.70
Noise Floor Proximity	$dVnf$	± 0.70	rectangular	$\sqrt{3}$	0.40	1	0.40
Antenna Factor Calibration	AF	± 1.00	normal 2	2	0.50	1	0.50
Directivity difference	$DFadir$	± 1.00	rectangular	$\sqrt{3}$	0.58	1	0.58
Phase Centre location	AP	± 0.30	rectangular	$\sqrt{3}$	0.17	1	0.17
Antenna Factor Frequency Interpolation	Ai	± 0.30	rectangular	$\sqrt{3}$	0.17	1	0.17
Site Imperfections	Si	± 6.00	triangular	$\sqrt{6}$	2.45	1	2.45
Effect of setup table material	$dANT$	± 1.21	rectangular	$\sqrt{3}$	0.70	1	0.70
Separation distance	dD	± 0.50	rectangular	$\sqrt{3}$	0.29	1	0.29
Cross Polarization	$DCross$	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Table height	dh	± 0.00	normal 2	2	0.00	1	0.00
Mismatch (antenna-Preamplifier)	M	+ 1.30 - 1.50	U-Shaped	$\sqrt{2}$	1.00	1	1.00
Mismatch (preamplifier-antenna)	M	+ 1.20 - 1.40	U-Shaped	$\sqrt{2}$	0.92	1	0.92
Combined Standard Uncertainty	Normal			$uc = 3.13 \text{ dB}$			
Expended Uncertainty U	Normal ($k = 2$)			$U = 6.3 \text{ dB}$ (CL is 95 %)			

LIST OF TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Due to Calibration	Calibration Interval
1	EMI Test Receiver	Rohde & Schwarz	ESCI	101041	Apr. 04 2017	1 year
2	Software	Rohde & Schwarz	EMC32	Version 8.53.0	-	-
3	TWO-LINE V-NETWORK	Rohde & Schwarz	ENV216	101156	Apr. 04 2017	1 year
4	EMI Test Receiver	Rohde & Schwarz	ESU 40	100202	Apr. 04 2017	1 year
5	Software	Rohde & Schwarz	EMC32	Version 8.53.0	-	-
6	TRILOG Broadband Test Antenna	SCHWARZBECK	VULB 9163	9163-423	Nov. 04 2017	2 year
7	ATTENUATOR	FAIRVIEW	SA3N5W-06	N/A	Apr. 03 2017	1 year
8	Controller	innco systems GmbH	CO2000-G	CO2000/562/23890210/L	-	-
9	Open Switch and Control Unit	Rohde & Schwarz	OSP-120	100015	-	-
10	Antenna Mast (Left)	innco systems GmbH	MA4000-EP	N/A	-	-
11	Turn Table	innco systems GmbH	DT3000-3T	N/A	-	-
12	Signal Conditioning Unit	Rohde & Schwarz	SCU 01	10030	Apr. 03 2018	1 year
13	DOUBLE RIDGED HORN ANTENNA	SCHWARZBECK	HF907	100197	Jul. 11 2017	2 year
14	Signal Conditioning Unit	Rohde & Schwarz	SCU 18	10065	Apr. 04 2017	1 year
15	TIILT ANTENNA MAST	innco systems GmbH	MA4640-XP-EP	N/A	-	-
16	CONTROLLER	innco systems GmbH	CO3000	CO3000/937/3 8330516/L	-	-

APPENDIX A – SAMPLE LABEL

Labeling Requirements

The sample label shown shall be *permanently affixed* at a conspicuous location on the device and be readily visible to the user at the time of purchase.



- **Label Location of EUT**



APPENDIX B – PHOTOGRAPHS OF TEST SET-UP

The **Conducted Test Picture** and **Radiated Test Picture** and show the worst-case configuration and cable placement.

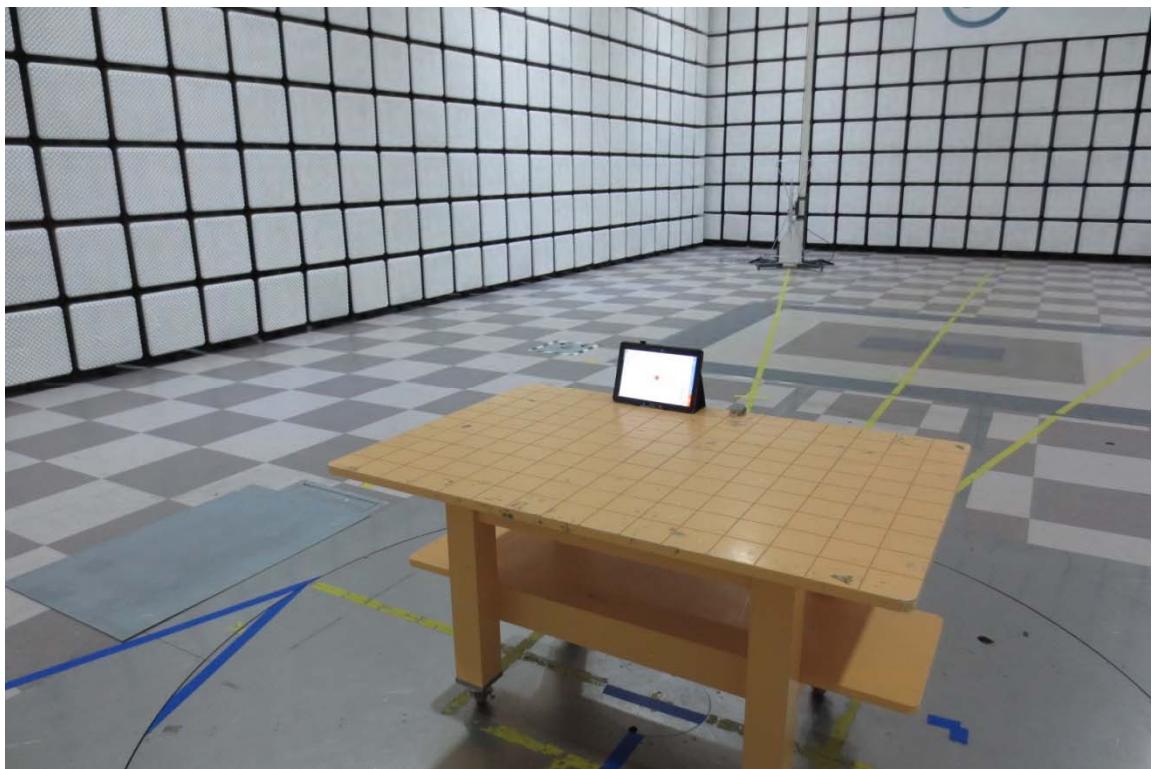
- **Conducted Test Picture(Front)**



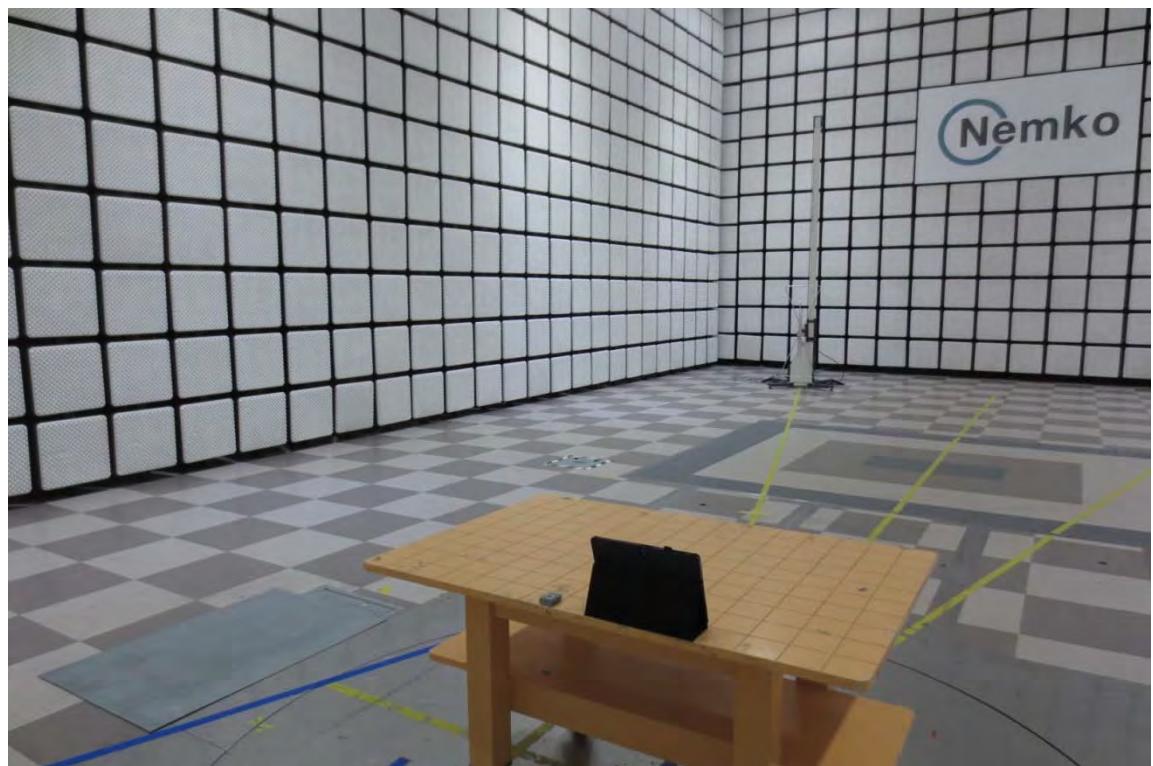
- **Conducted Test Picture(Side)**



- Radiated Test Picture(Below 1 GHz_Front_Bluetooth Only mode)



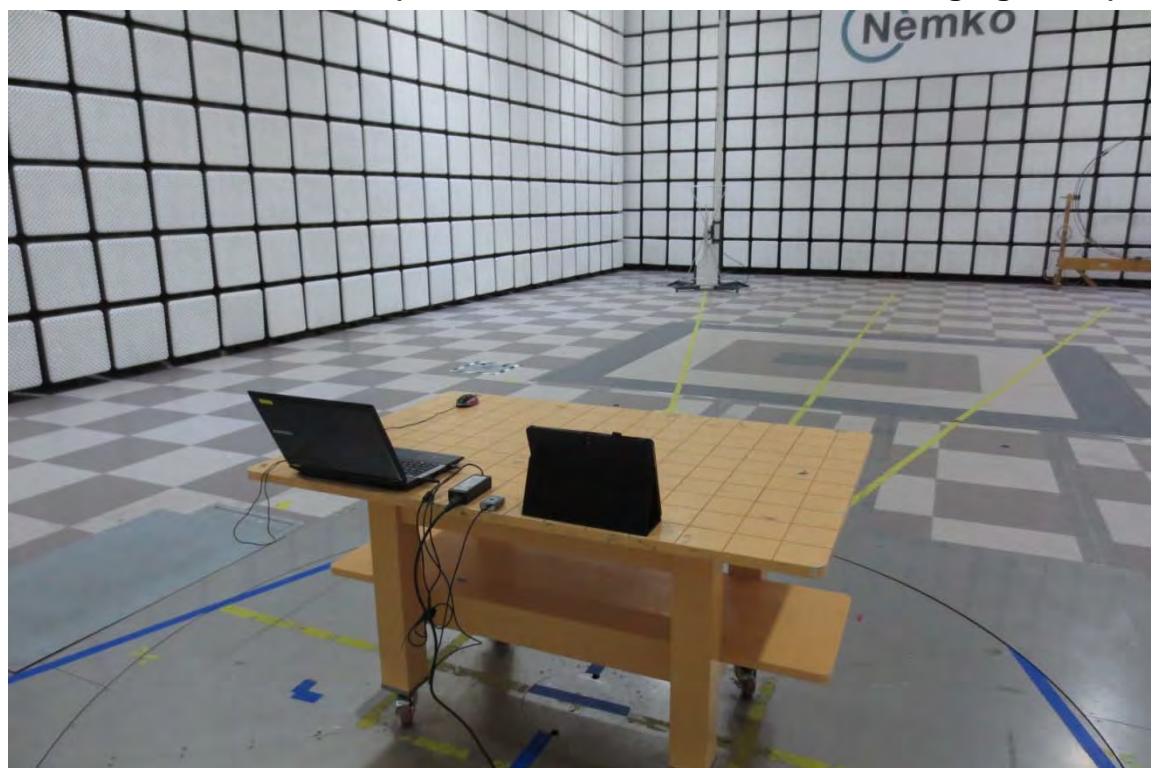
- Radiated Test Picture(Below 1 GHz_Rear_Bluetooth Only mode)



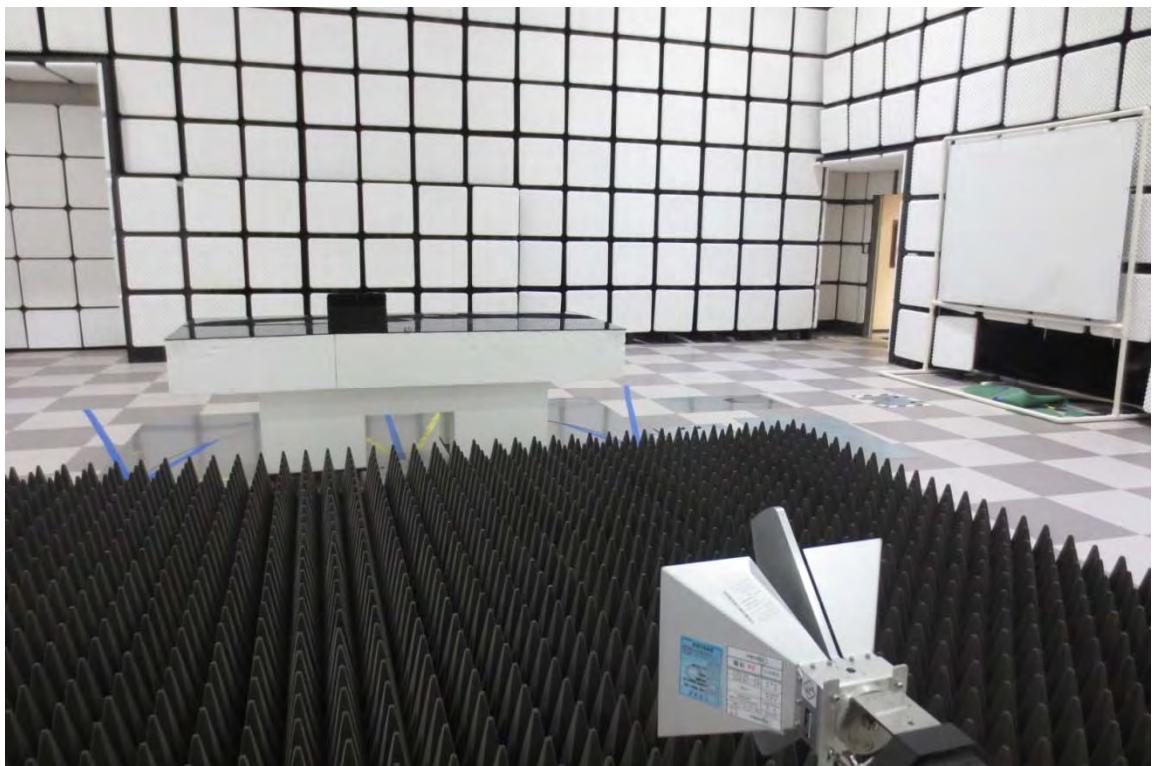
- Radiated Test Picture(Below 1 GHz_Front_ Bluetooth + Charging mode)



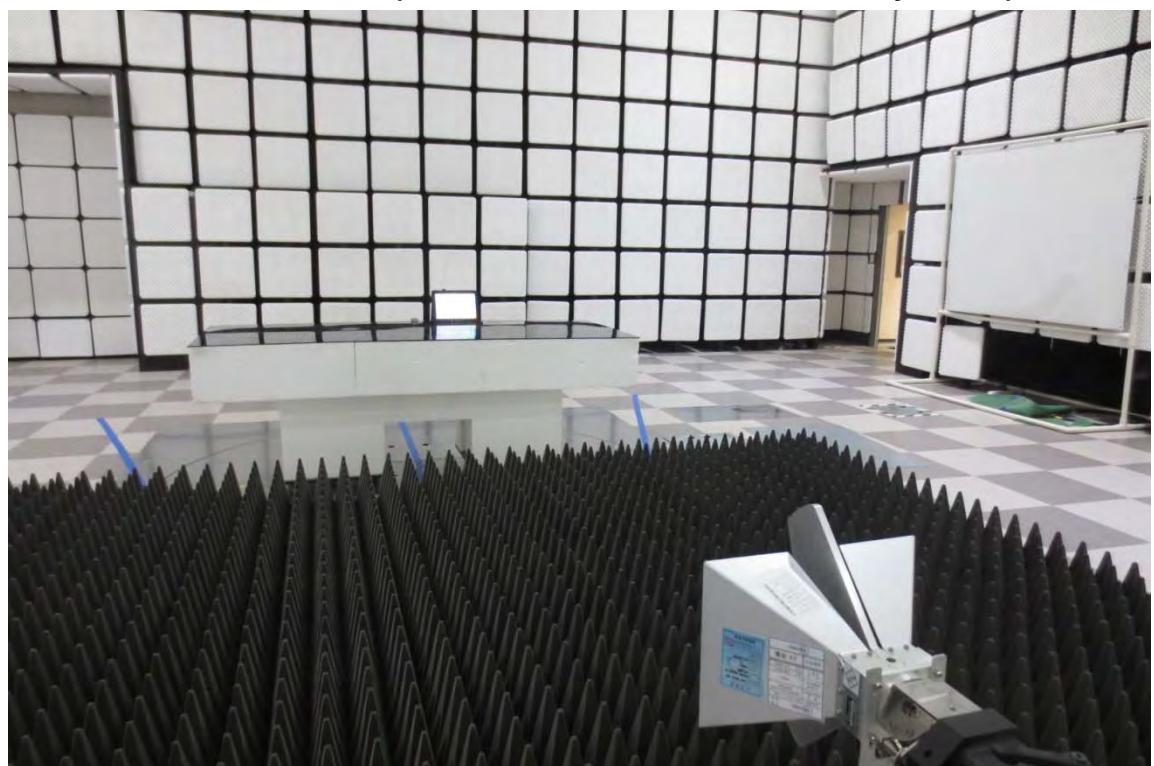
- Radiated Test Picture(Below 1 GHz_Rear_ Bluetooth + Charging mode)



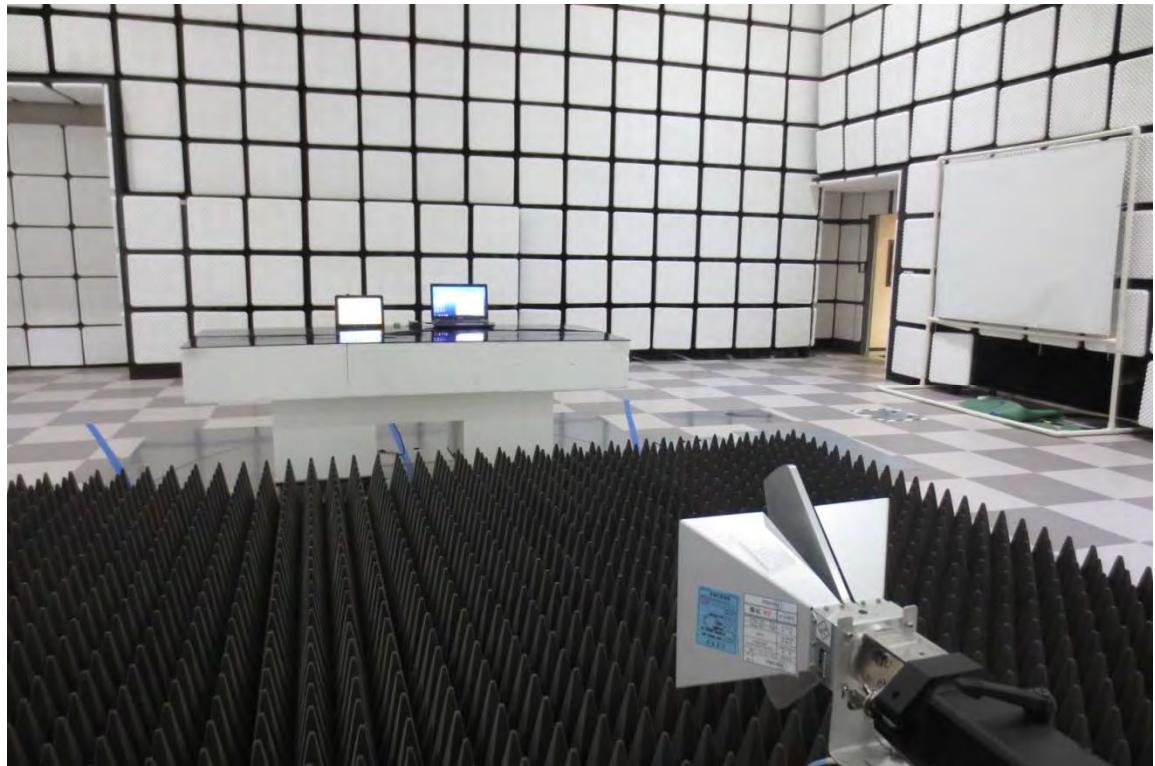
- Radiated Test Picture(Above 1 GHz_Front_Bluetooth Only mode)



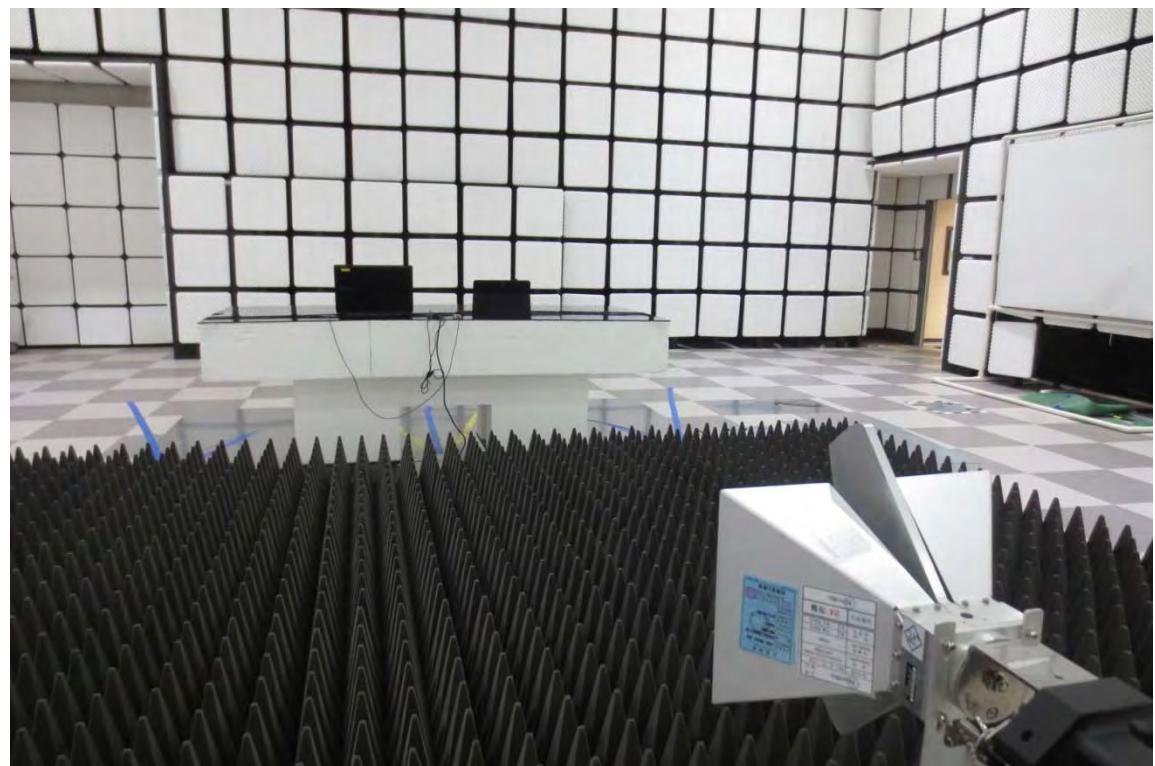
- Radiated Test Picture(Above 1 GHz_Rear_Bluetooth Only mode)



- Radiated Test Picture(Above 1 GHz_Front_ Bluetooth + Charging mode)



- Radiated Test Picture(Above 1 GHz_Rear_ Bluetooth + Charging mode)

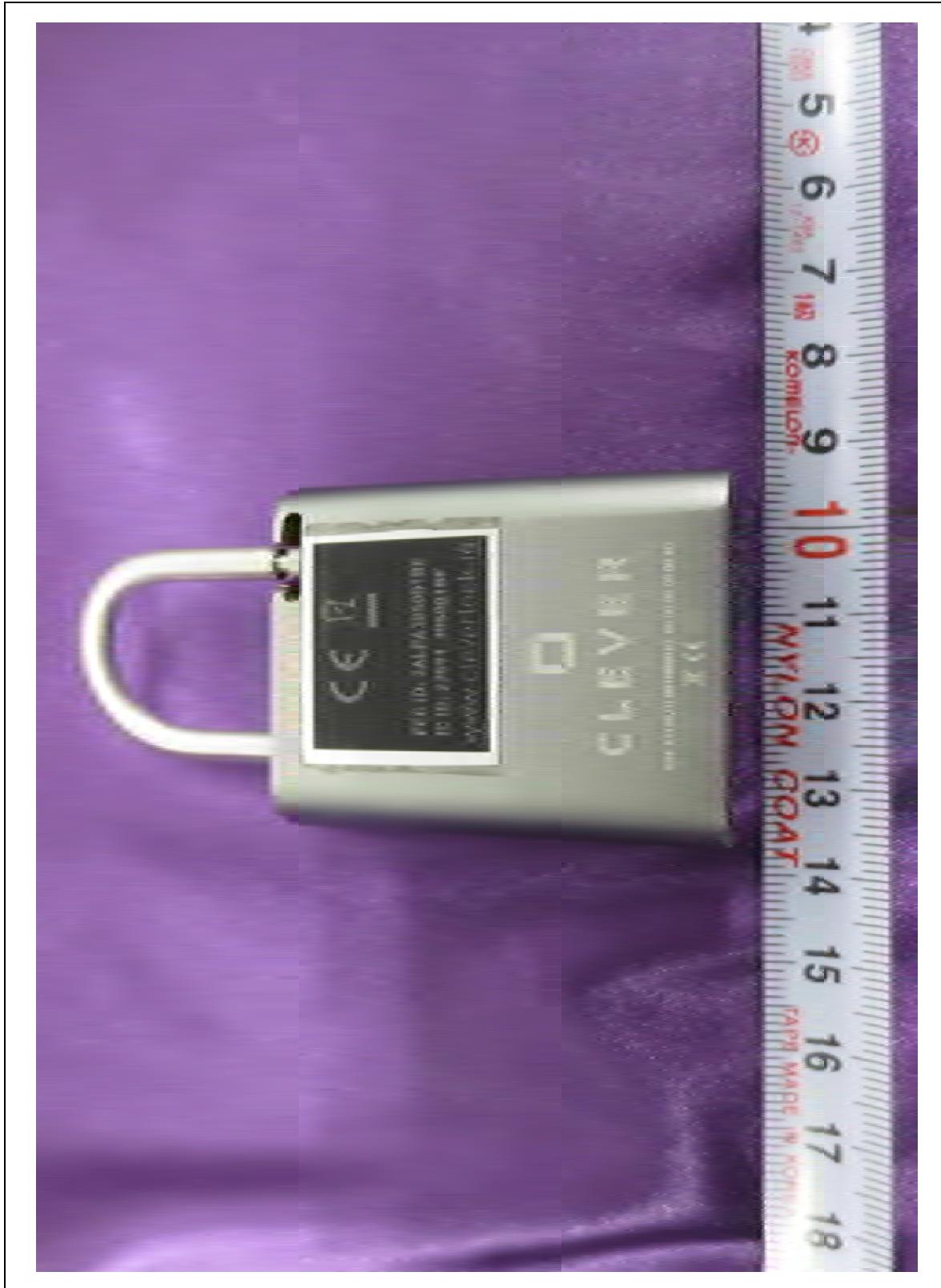


APPENDIX C – EUT PHOTOGRAPHS

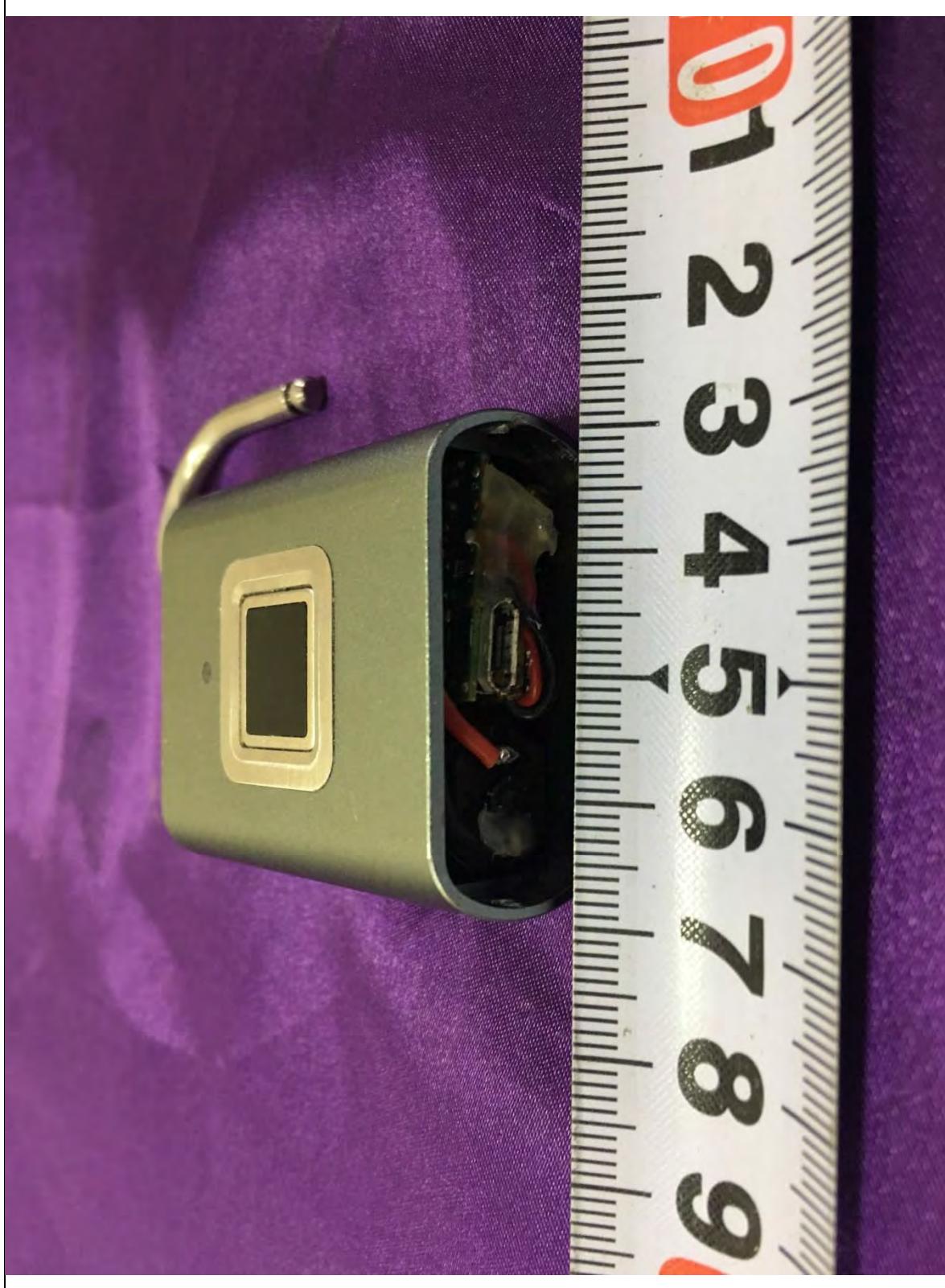
Front View of EUT



Rear View of EUT

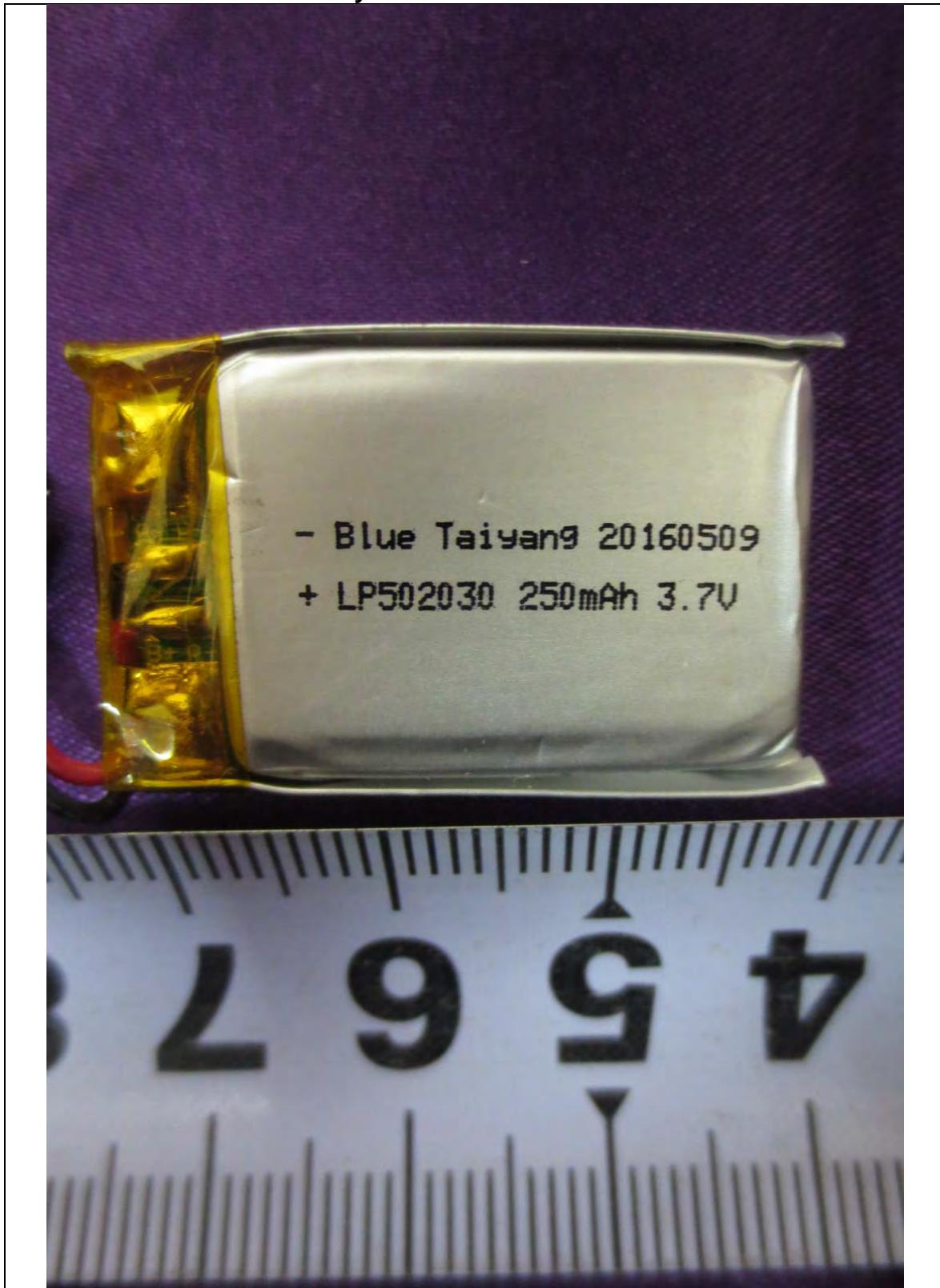


Inside View of EUT

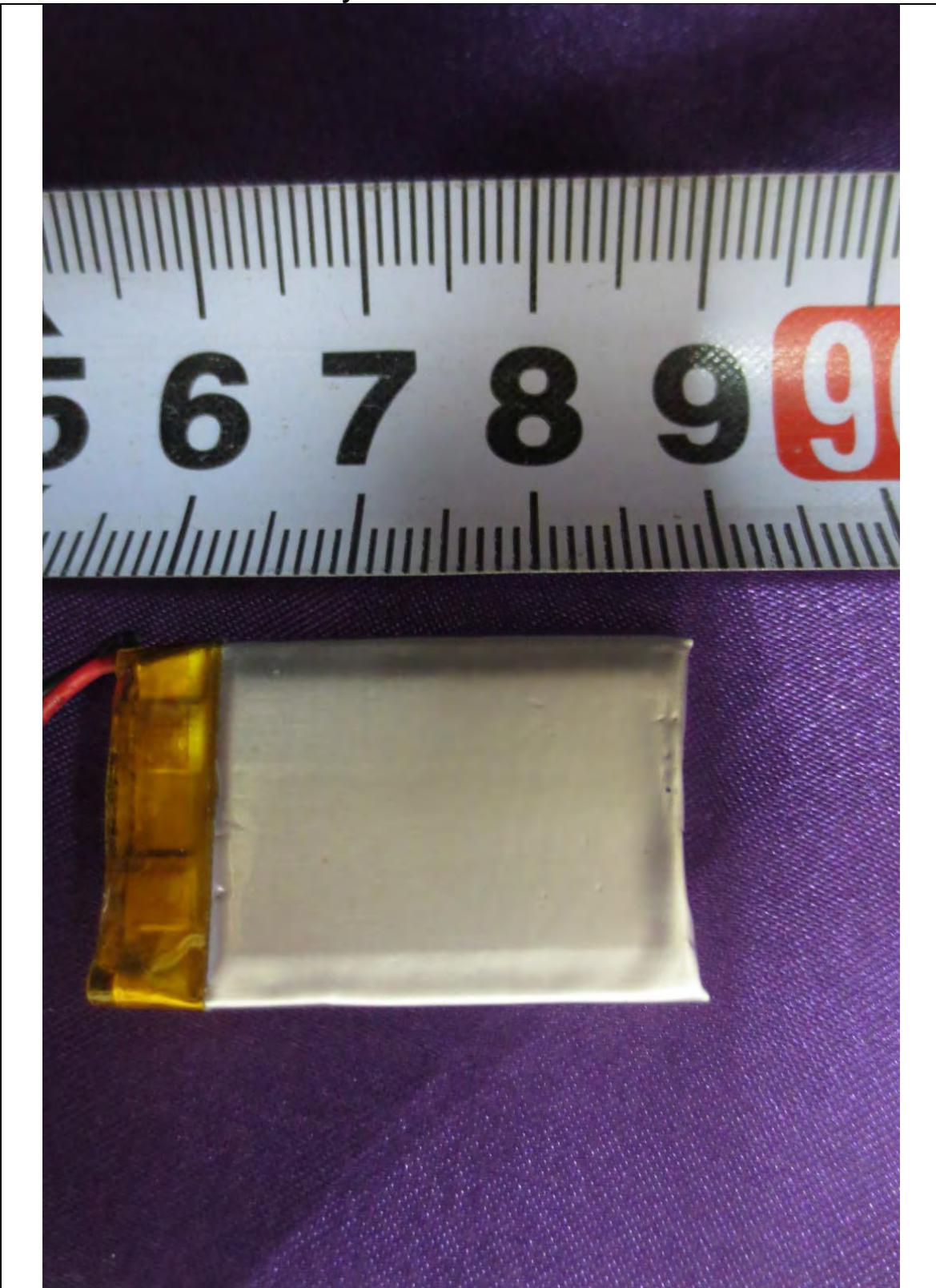


Front View of Main Board

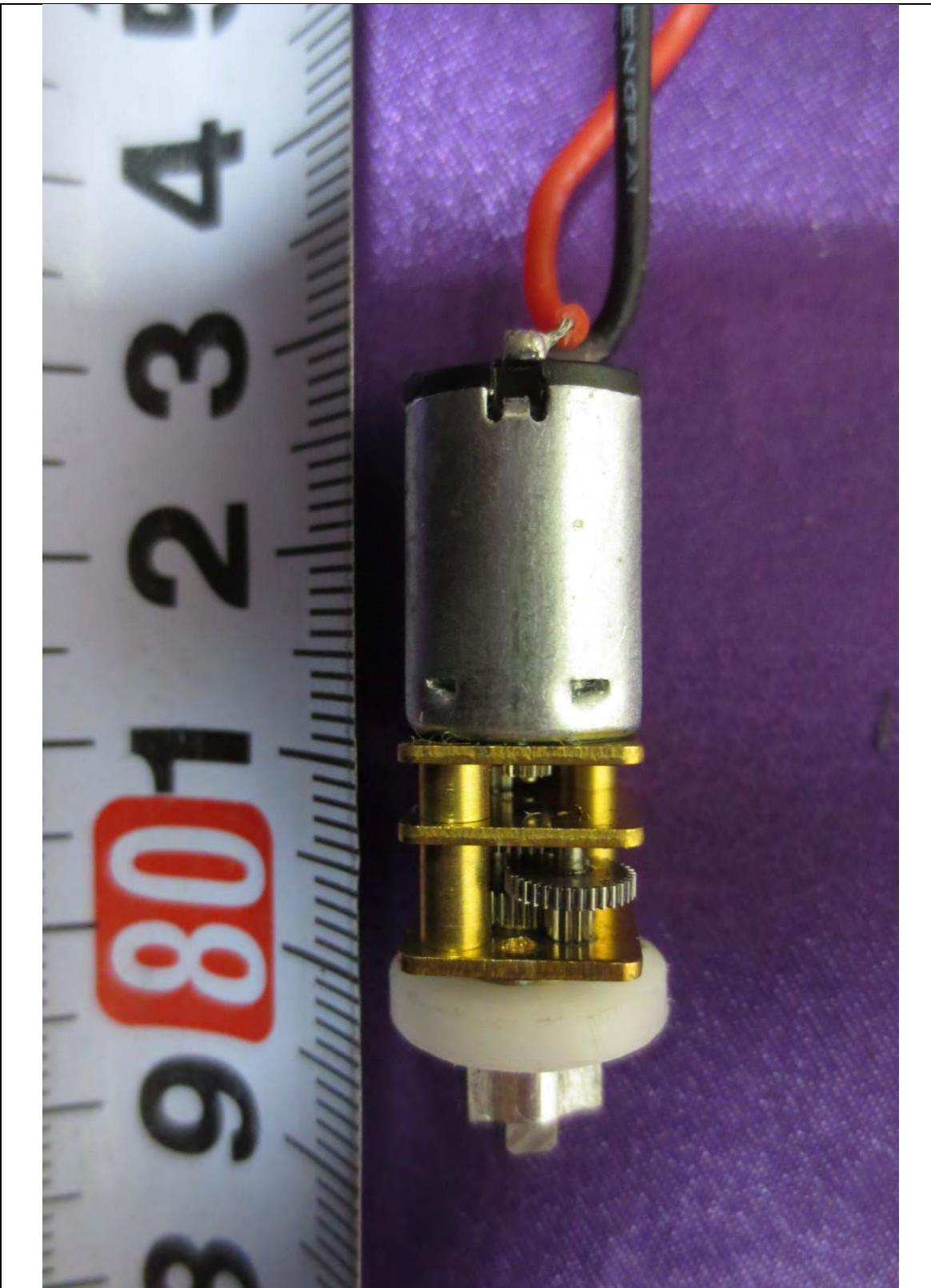
Rear View of Main Board

Front View of Lithium Battery

Rear View of Lithium Battery



Front View of DC Motor



APPENDIX D – BLOCK DIAGRAM



Test Report No.: NK-17-E-0176

FCC Verification

APPENDIX E – USER'S MANUAL

APPENDIX F – SCHEMATIC DIAGRAM
