

# TEST REPORT

of

FCC CFR 47 part1, 1.1307(b), 1.1310

FCC ID: 2AV76-NMOK-350W

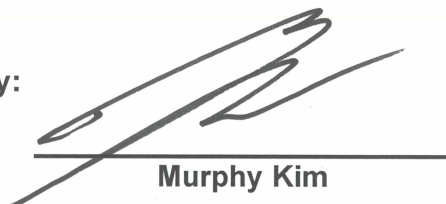
Equipment Under Test : WIRELESS POWER CHARGING SYSTEM  
Model Name : NMOK-350W  
Variant Model Name(s) : -  
Applicant : NIDEC MOBILITY KOREA CORPORATION  
Manufacturer : NIDEC MOBILITY KOREA CORPORATION  
Date of Receipt : 2023.05.02  
Date of Test(s) : 2023.05.03 ~ 2023.11.14  
Date of Issue : 2023.11.14

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

- 1) The results of this test report are effective only to the items tested.
- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
- 3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by:



Murphy Kim

Technical  
Manager:



Inho Park

**SGS Korea Co., Ltd. Gunpo Laboratory**



# INDEX

## Table of Contents

1. General Information .....	3
2. Test Result .....	6

## 1. General Information

### 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +82 31 688 0901

Fax No. : +82 31 688 0921

### 1.2. Details of Applicant

Applicant : NIDEC MOBILITY KOREA CORPORATION  
 Address : 790-12, Bogaewonsam-ro, Bogae-myeon, Anseong-si, Gyeonggi-do, South Korea, 17507  
 Contact Person : Nam, Sang-il  
 Phone No. : +82 2 850 5789

### 1.3. Details of Manufacturer

Company : Same as applicant  
 Address : Same as applicant

### 1.4. Description of EUT

<b>Kind of Product</b>	WIRELESS POWER CHARGING SYSTEM	
<b>Model Name</b>	NMOK-350W	
<b>Serial Number</b>	0001	
<b>Power Supply</b>	DC 12 V	
<b>Operation Mode</b>	5 W, 10 W, Idle	
<b>Frequency Range</b>	5 W	127 ~ 129 kHz
	10 W	127 ~ 129 kHz
	Idle	127 ~ 129 kHz
<b>Antenna Type</b>	Coil Antenna	
<b>Antenna Part Number</b>	N/A	
<b>H/W Version</b>	1.00	
<b>S/W Version</b>	1.00	

### 1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Electric and Magnetic field Probe analyzer	NARDA	EHP 200AC	170WX91017	Dec. 19, 2022	Annual	Dec. 19, 2023
DC Power Supply	Agilent	U8002A	MY50020026	Nov. 30, 2022	Annual	Nov. 30, 2023
Anechoic Chamber	SY Corporation	L x W x H (9.6 m x 6.4 m x 6.6 m)	N/A	N.C.R.	N/A	N.C.R.

► **Support Equipment**

Description	Manufacturer	Model	FCC ID
SAMSUNG Mobile Phone	Samsung Electronics Co., Ltd.	SM-N975U	A3LSMN975U
Lap top	Dell	Latitude 3510	-

### 1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 1 Subpart I		
Section	Test Item(s)	Result
1.1307(b) 1.1310(e)(1)	Electronic Field, Magnetic Field	Complied

### 1.7. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL004553	2023.11.14	Initial

### 1.8. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty
Electric Field	19.44 %
Magnetic Field	19.86 %

All measurement uncertainty values are shown with a coverage factor of  $k=2$  to indicate a 95 % level of confidence.

### 1.9. Worst Case of Test Configurations

In order to check all kinds of possible configurations, EUT was evaluated with appropriate client and under each charging condition as below table.

Charging mode with client device	Mode		Description
Model: SM-N975U FCC ID: A3LSMN975U	5 W	10 W	1 % of battery 50 % of battery 99 % of battery
	127 ~ 129 kHz	127 ~ 129 kHz	

Mode	Battery	Frequency (kHz)	E-field Strength (V/m)	H-field Strength (A/m)
5 W	1 %	127 ~ 129	<b><u>75.666</u></b>	<b><u>1.240</u></b>
	50 %		75.568	1.224
	99 %		75.502	1.207
10 W	1 %	127 ~ 129	<b><u>76.406</u></b>	<b><u>1.245</u></b>
	50 %		76.085	1.205
	99 %		75.409	1.194

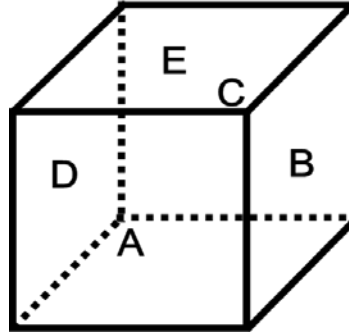
**Note;**

- EUT was investigated with client device under normal charging condition as above then worst value was only reported.

## 2. Test Result

### 2.1. Isotropic Probe Test Setup

The measurement probe (EHP-200AC) is a regular hexahedron and supports 3-axis isotropic probe.



A: Front of measurement probe  
 B: Right of measurement probe  
 C: Rear of measurement probe  
 D: Left of measurement probe  
 E: Top of measurement probe

\*Bottom of measurement probe is not used to measure RF exposure condition owing to connection with a stick.

- Measurement isotropic probe was investigated by rotating the probe through various angles for one of the EUT's sides as below.

Measurement Point	A	B	C	D	E
Direction	Front	Right	Rear	Left	Top
Measurement Point	A to B	B to C	C to D	D to A	N/A
Direction	Front to Right	Right to Rear	Rear to Left	Left to Front	-
Measurement Point	A to E	B to E	C to E	D to E	N/A
Direction	Front to Top	Right to Top	Rear to Top	Left to Top	-

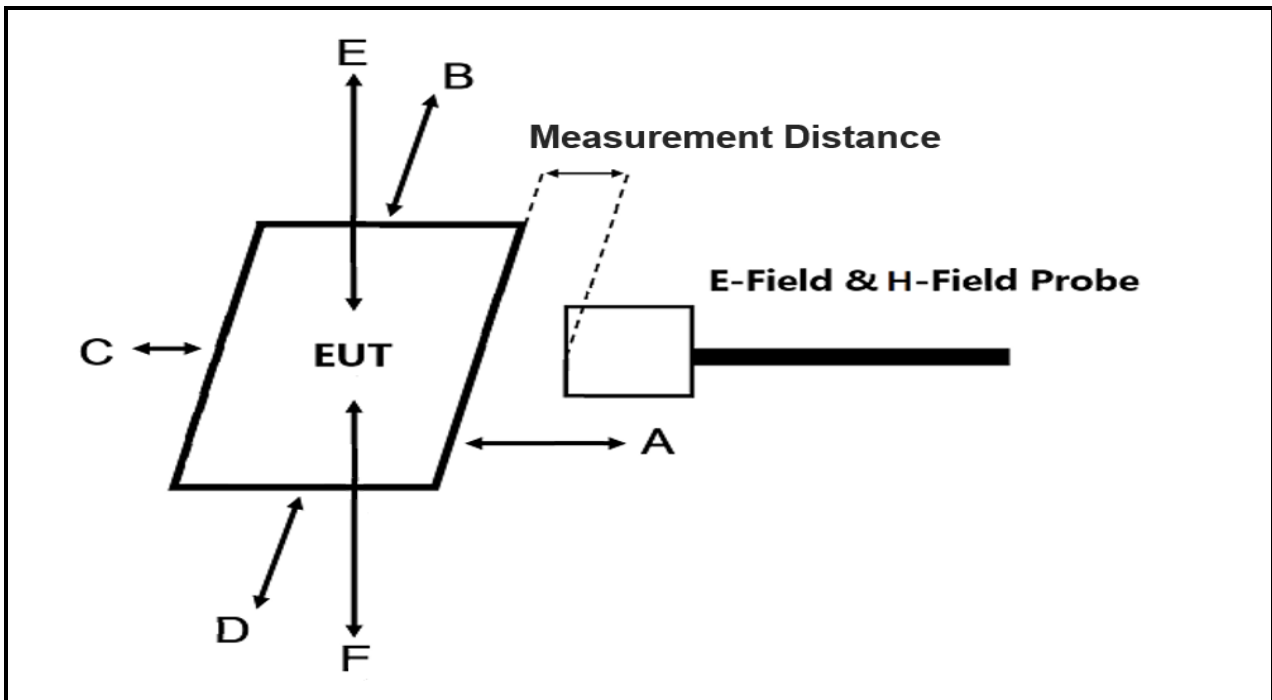
- When the worst angle among all angles was found, RF exposure measurement should be adjusted from worst angle.

- Worst Case

E-field: One of the several angles was found as **Side D** of isotropic probe.

H-field: One of the several angles was found as **Side E** of isotropic probe.

## 2.2. EUT Test Setup



## 2.3. Measurement procedure

- The RF exposure test was performed in anechoic chamber.
- The measurement probe was placed at test distance (0, 2, 4, 6, 8, 10, 15 cm) which is between the edge of the charger and the edge of probe.
- Measurement was performed on each side of the EUT as described above picture (A, B, C, D, E, F).
- The EUT was measured according to the dictates of KDB 680106 D01 Wireless Power Transfer v 04.

### Note;

- Each sensing element of probe is located 8 mm below the external surface.

**2.4. Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310.**

§1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of FCC part 2.1093 of this chapter.

**Table 1 to § 1.1310(e)(1) - Limits for Maximum Permissible Exposure (MPE)**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
(i) Limits for Occupational /Control Exposures				
0.3-3.0	614	1.63	*(100)	≤ 6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	<6
30-300	61.4	0.163	1.0	<6
300-1 500	-	-	f/300	<6
1 500-100 000	-	-	5	<6
(ii) Limits for General Population/Uncontrolled Exposures				
<b><u>0.3-1.34</u></b>	<b><u>614</u></b>	<b><u>1.63</u></b>	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	<30
30-300	27.5	0.073	0.2	<30
300-1 500	-	-	f/1 500	<30
1 500-100 000	-	-	1.0	<30

f = frequency in MHz. \* = Plane wave equivalent power density.



## 2.5. E and H field strength

Ambient temperature : (23 ± 1) °C  
 Relative humidity : 47 % R.H.

### 2.5.1. E-Field Strength at from the edges surrounding the EUT

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (V/m)
		A (V/m)	B (V/m)	C (V/m)	D (V/m)	E (V/m)	F (V/m)	
127 ~ 129	15	2.057	2.080	1.715	1.840	4.651	1.063	614
	10	4.931	3.913	3.092	4.283	9.617	1.399	
	8	6.229	5.432	4.404	6.518	14.321	1.843	
	6	9.319	9.215	6.722	9.626	19.336	1.878	
	4	12.825	14.811	10.643	14.036	31.790	1.748	
	2	17.698	26.124	15.513	26.095	64.543	2.351	
	Contact	30.666	42.921	21.659	42.784	<b>75.666</b>	3.706	

Test Condition: 10 W Operating mode with client device (1 % battery status of client device)

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (V/m)
		A (V/m)	B (V/m)	C (V/m)	D (V/m)	E (V/m)	F (V/m)	
127 ~ 129	15	1.819	2.237	1.226	1.893	4.748	0.721	614
	10	3.975	4.596	2.155	4.003	10.964	1.598	
	8	5.875	6.756	3.202	6.203	16.168	2.069	
	6	7.863	9.915	4.092	8.863	21.608	1.429	
	4	11.817	10.737	4.845	14.907	33.863	0.993	
	2	21.985	28.204	10.383	22.924	64.626	2.464	
	Contact	32.116	43.461	12.477	40.081	<b>76.406</b>	4.486	

Test Condition: Idle

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (V/m)
		A (V/m)	B (V/m)	C (V/m)	D (V/m)	E (V/m)	F (V/m)	
127 ~ 129	15	0.652	0.621	0.601	0.622	4.257	0.487	614
	10	0.953	0.807	0.730	0.693	6.288	1.086	
	8	1.847	1.566	0.789	0.951	8.457	1.300	
	6	3.809	2.353	0.851	1.417	11.050	1.752	
	4	4.977	4.386	1.141	2.950	15.580	2.037	
	2	7.022	5.600	3.605	4.555	22.267	2.442	
	Contact	15.266	12.471	4.615	6.527	<b>35.103</b>	2.731	

### 2.5.2. H-Field Strength at from the edges surrounding the EUT

Test Condition: 5 W Operating mode with client device (1 % battery status of client device)

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (A/m)
		A (A/m)	B (A/m)	C (A/m)	D (A/m)	E (A/m)	F (A/m)	
127 ~ 129	15	0.159	0.156	0.159	0.159	0.156	0.164	1.63
	10	0.187	0.163	0.161	0.161	0.163	0.189	
	8	0.252	0.201	0.164	0.166	0.224	0.262	
	6	0.301	0.265	0.176	0.171	0.283	0.307	
	4	0.625	0.484	0.268	0.227	0.425	0.478	
	2	0.911	0.849	0.461	0.438	0.574	0.751	
	Contact	<b>1.240</b>	1.068	0.669	0.608	0.783	1.208	

Test Condition: 10 W Operating mode with client device (1 % battery status of client device)

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (A/m)
		A (A/m)	B (A/m)	C (A/m)	D (A/m)	E (A/m)	F (A/m)	
127 ~ 129	15	0.171	0.156	0.156	0.154	0.164	0.154	1.63
	10	0.269	0.161	0.159	0.159	0.166	0.159	
	8	0.274	0.234	0.163	0.163	0.181	0.161	
	6	0.438	0.268	0.164	0.169	0.195	0.196	
	4	0.716	0.330	0.219	0.181	0.367	0.200	
	2	0.783	0.734	0.265	0.274	0.440	0.443	
	Contact	<b>1.245</b>	1.028	0.383	0.401	0.547	0.606	

Test Condition: Idle

Frequency (kHz)	Distance (cm)	EUT Sides						Limits (A/m)
		A (A/m)	B (A/m)	C (A/m)	D (A/m)	E (A/m)	F (A/m)	
127 ~ 129	15	0.154	0.161	0.156	0.159	0.159	0.158	1.63
	10	0.159	0.161	0.159	0.163	0.163	0.161	
	8	0.161	0.164	0.161	0.164	0.240	0.164	
	6	0.166	0.281	0.166	0.166	0.360	0.171	
	4	0.362	0.490	0.258	0.286	0.635	0.177	
	2	0.459	0.597	0.289	0.434	0.771	0.317	
	Contact	0.678	0.623	0.430	0.604	<b><u>0.855</u></b>	0.494	

## 2.6. H-Field Strength Calculation of the EUT

### 2.6.1. Calculation of $\mu_r$ (relative permeability)

According to the self-inductance formula,  $\mu_r$ (relative permeability) can be obtained.

$$x = \sqrt{1 + \left(\frac{d}{2l}\right)^2}$$

$$L = 2l \left[ \ln\left\{\left(\frac{2l}{d}\right)(1+x)\right\} - x + \frac{\mu_r}{4} + \frac{d}{2l} \right]$$

$$\mu_r = 4 \left[ \frac{L}{2l} - \ln\left\{\left(\frac{2l}{d}\right)(1+x)\right\} + x - \frac{d}{2l} \right]$$

Where;

L: self inductance [nH], Qi specification of WIRELESS POWER CONSORTIUM

d: diameter of the wire [cm]

l: length of the wire in [cm]

$\mu_r$ : relative permeability

L [nH]	d [cm]	l [cm]	$\mu_r$
11 500	0.115	153	120.01

**2.6.2. Calculation of theoretical H-field strength with Biot-Savart's law**

According to Biot-Savart law, the value of the B-field at the distance z from the coil is expressed as follows.

$$B_z = \frac{\mu_0 IR^2}{2(R^2 + z^2)^{3/2}}$$

Convert the value of the B-field to the H-field.

$$B_z = \mu_0 \times H_z,$$

$$H_z = \frac{IR^2}{2(R^2 + z^2)^{3/2}}$$

Considering the number of turns and relative permeability of coil, it is expressed as follows.

$$H_z = \frac{IR^2}{2(R^2 + z^2)^{3/2}} \times \frac{N}{\mu_r}$$

Where;

I: the maximum current to the EUT during charging can be obtained from the power supply equipment [A]

R: the radial of EUT' coil antenna [m]

z: the distance from the coil antenna to the point to be measured [m]

N: the number of turns in the coil

$\mu_r$ : relative permeability

Test Condition	I [A]	R [m]	$\mu_r$	N	z [m]	Actual measuring distance <sup>3)</sup> [m]	Theoretical H-field value [A/m]
5 W	1	0.027	120.01	12	0.020 <sup>1)</sup>	0.008	0.961
					0.012 <sup>2)</sup>	0	1.413
10 W	1	0.027	120.01	12	0.020 <sup>1)</sup>	0.008	0.961
					0.012 <sup>2)</sup>	0	1.413

**Note;**

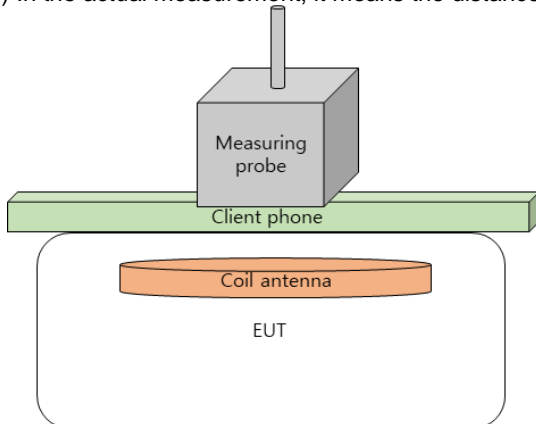
1) Distance z is from the EUT's coil antenna to the measurement point and includes all of the following.

- 4 mm, the gap from EUT's coil antenna to edge of the EUT
- 8 mm, the client phone thickness
- 8 mm, the gap from edge of measuring probe to sensing elements of measuring probe

2) Distance z is from the EUT's coil antenna to the measurement point and includes all of the following.

- 4 mm, the gap from EUT's coil antenna to edge of the EUT
- 8 mm, the client phone thickness

3) In the actual measurement, it means the distance between the EUT and the sensing elements of the probe.



8 mm, the gap from edge of measuring probe to sensing material
8 mm, the client phone thickness
4 mm, the gap from EUT's coil antenna to edge of the EUT

**2.6.3. The validation of H-field strength**

Frequency (kHz)	Test Condition	Distance (cm)	Theoretical H-field value [A/m]	30 % tolerance of theoretical H-field value [A/m]		EUT Sides E	Limits [A/m]
				Min.	Max	Measured value [A/m]	
127 ~ 129	5 W (1 % battery status of client device)	Contact <sup>1)</sup>	0.961	0.673	1.249	1.240	1.63
127 ~ 129	10 W (1 % battery status of client device)	Contact <sup>1)</sup>	0.961	0.673	1.249	1.245	

**Note;**

1) Probe has 4 cm radius enclosure but each sensing element is located 8 mm from the probe edge. Therefore, actual distance in measurement is 8 mm.

**2.6.4. The estimation of H-field strength**

Frequency (kHz)	Test Condition	Distance (cm)	EUT Sides E	Limits [A/m]
			Theoretical H-field value [A/m]	
127 ~ 129	5 W (1 % battery status of client device)	0	1.413	1.63
127 ~ 129	10 W (1 % battery status of client device)	0	1.413	

Estimation formula and theoretical value have 30% agreement with actual measurement. Estimation for 0mm field strength with validated formula complies limit.

**- End of the Test Report -**