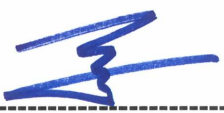



FCC TEST REPORT

Job No. : GPWE2303000030EC
Applicant : Hyundai Mobis Co., Ltd.
Equipment Under Test (EUT) :
 Product Name : DISPLAY CAR SYSTEM
 Model Name : ADB10SWEN
 Alt. Model Name : ADB12SWEN
FCC Authorization Type : Certification
Applied Standards : FCC Part 15 Subpart B, Class B
FCC ID : TQ8-ADB10SWEN
Date of Receipt : March 10, 2023
Date of Test : March 28, 2023
Date of Issue : April 21, 2023
Test Results : Complied

Tested by	:		 ----- DoHyeon Lee
Reviewed by	:		 ----- Paul Kang

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.

Remarks :

This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at www.sgs.com/terms_e-document.htm.

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.

Contents

1. General Information.....	4
1.1 Client Information.....	4
1.2 Test Laboratory.....	4
1.3 General Information of E.U.T.	4
1.4 Operating Modes and Conditions.....	5
1.5 Peripheral Equipments.....	5
1.6 Cable List.....	5
1.7 System Configurations.....	5
1.8 Test System Layout	6
1.9 Modifications/Notes.....	7
1.10 Applicable Standards for Testing	7
1.11 Summary of Test Results.....	7
2. Emission Test.....	8
2.1 Test Results	8
2.2 Test Method and Limits.....	8
2.2.1 Test Method	8
2.2.2 Test Limits.....	8
2.3 Radiated Emission	9
2.3.1 Test Equipments	9
2.3.2 Test Site.....	9
2.3.3 Environment Conditions	9
2.3.4 Test Results	10
Appendix A : Measurement Uncertainty	16

Revision History

Revision	Report number	Description
0	F690501-RF-EMC001264	Initial
1		

1. General Information

1.1 Client Information

Applicant	Hyundai Mobis Co., Ltd.
Applicant Address	203, Teheran-ro, Gangnam-gu, Seoul, 06141, Republic of Korea
Manufacturer	Hyundai Mobis Co., Ltd.
Manufacturer Address	203, Teheran-ro, Gangnam-gu, Seoul, 06141, Republic of Korea
Factory	MOBIS India Ltd.
Factory Address	Plot No. G-1, SIPCOT Industrial Park, Irrungattukottai, Sriperumbudur Taluk, Kancheepuram Dist., Tamil Nadu, 602117, India

1.2 Test Laboratory

Name and Address	SGS Korea Co., Ltd.
- Giheung Laboratory	35, Giheungdanji-ro 121beon-gil, Giheung-gu, Yongin-si, Gyeonggi-do, Republic of Korea
- Gunpo Laboratory	4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, 15807, Republic of Korea
- Dongtan Laboratory	12, Dongtansandan 10-gil, Hwaseong-si, Gyeonggi-do, 18487, Republic of Korea
FCC Registration No.	KR0150
Phone	+ 82 31 428 5719
Fax	+ 82 31 427 2371
e-mail	paul.kang@sgs.com

1.3 General Information of E.U.T.

Classification	Specification
Product Name	DISPLAY CAR SYSTEM
Model Name	ADB10SWEN
Alt. Model Name	ADB12SWEN
Model Differences	Refer to Note1.
Serial No.	-
Brand	Hyundai Mobis
EMI Classification	Class B
Internal Clock Frequency	55.4667 MHz (Wireless Frequency : 5.825 MHz)
Rated Power	14.4 Vd.c. (9 ~ 16 Vd.c.)
Test Voltage	12 Vd.c.
H/W Version	1.0
S/W Version	1.0
Port	73 PIN CONNECTOR, USB CONNECTOR, RADIO ANT CONNECTOR, GPS ANT CONNECTOR
Components	-
Function	Multimedia system for vehicle

Note1. Model differences

Model Name	BT	Area	Frequency code	ADM	DAB	RDS	RHD/LHD	ARKAMYS	USB
Basic Model ADB10SWEN	O	Europe (Central and South America)	A2	O	X	X	LHD	X	O
Alt. Model ADB12SWEN	O	Europe (Central and South America)	A2	O	X	X	RHD	X	O

Code	Band	Freq. Range	Step
A2	FM	87.5-107.9 MHz	200 kHz
	AM	530-1710 kHz	10 kHz

1.4 Operating Modes and Conditions

Operating mode	Operating Condition
1) FM	FM Radio signal receiving status
2) AM	AM Radio signal receiving status

1.5 Peripheral Equipments

Description	Model	Serial No.	Manufacturer	Note.
Speaker	-	-	-	-
FM+AM+GNSS Antenna	96220-N9400	-	Hyundai Mobis	-
MIC	-	-	-	-
Rear Camera	99240-Q0000	2206246385	Hyundai Mobis	-
USB ASSY	96120-00AA0	-	-	-
USB Memory	BI161024450B	-	SanDisk	-
Car Battery	-	-	-	-
DC Power Supply	U8002A	MY51270011	Agilent	-

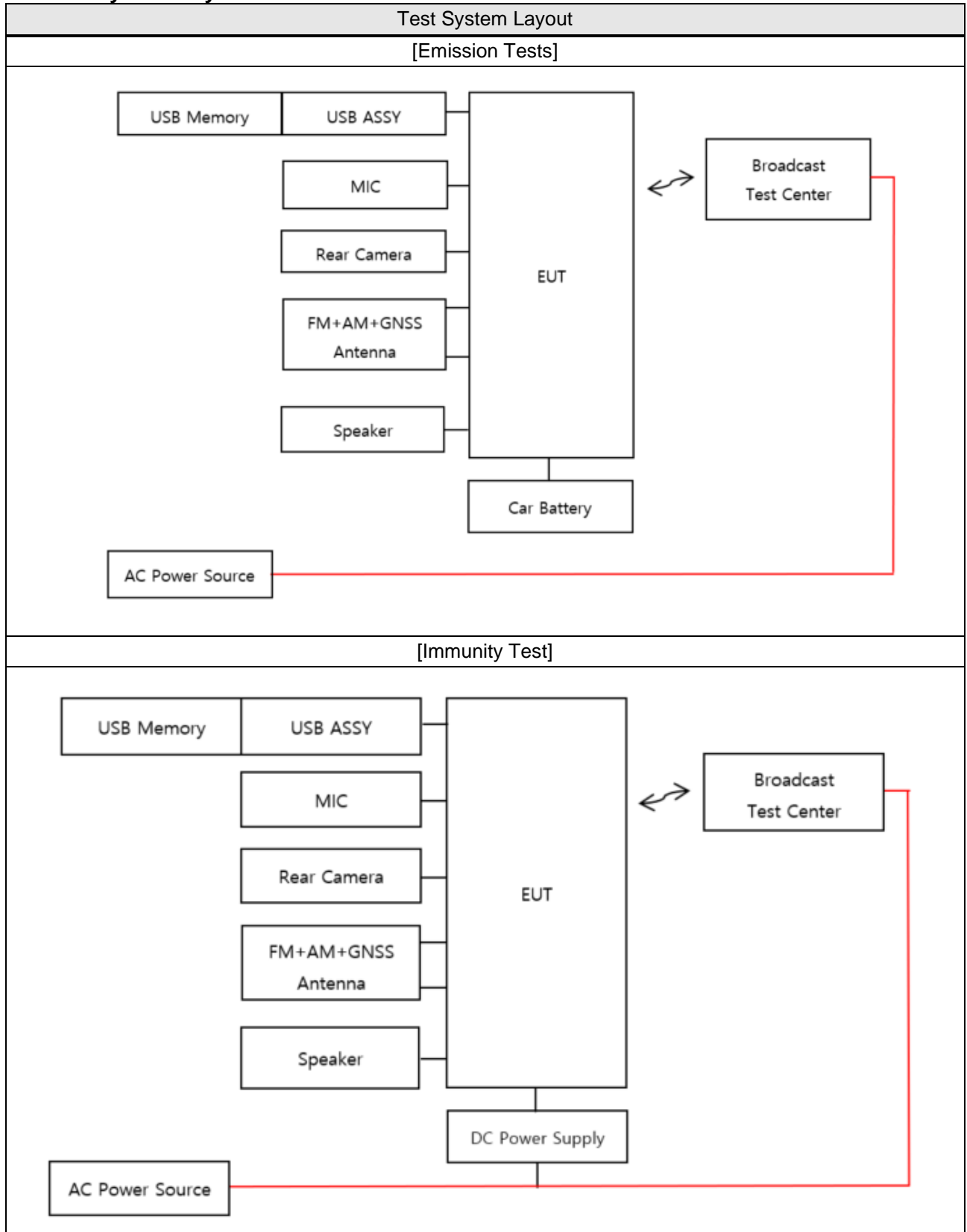
1.6 Cable List

Start		END		Cable Spec.		Used core
Name	I/O Port	Name	I/O Port	Length (m)	Shield	
[Emission Tests]						
EUT	73 PIN CONNECTOR	Car Battery	-	1.0	Unshield	-
		MIC	-	1.0	Unshield	-
		Rear Camera	-	1.2	Unshield	-
		Speaker	-	2.0	Unshield	-
	USB CONNECTOR	USB ASSY	-	1.0	Unshield	-
	RADIO ANT CONNECTOR	FM+AM+GNSS Antenna	-	4.5	Unshield	-
	GPS ANT CONNECTOR		-	4.5	Unshield	-
-	Broadcast Test Center	-	-	-	-	
USB ASSY	USB	USB Memory	-	-	-	-
AC Power Source	AC OUT	Broadcast Test Center	AC IN	-	-	-
[Immunity Test]						
EUT	73 PIN CONNECTOR	DC Power Supply	-	1.0	Unshield	-
		MIC	-	1.0	Unshield	-
		Rear Camera	-	1.2	Unshield	-
		Speaker	-	2.0	Unshield	-
	USB CONNECTOR	USB ASSY	-	1.0	Unshield	-
	RADIO ANT CONNECTOR	FM+AM+GNSS Antenna	-	4.5	Unshield	-
	GPS ANT CONNECTOR		-	4.5	Unshield	-
-	Broadcast Test Center	-	-	-	-	
USB ASSY	USB	USB Memory	-	-	-	-
AC Power Source	AC OUT	Broadcast Test Center	AC IN	-	-	-

1.7 System Configurations

Description	Model	Serial No.	Manufacturer	Note
Main Board	D.AUDIO GEN2 Value	M30420019338	Hyundai Mobis	-
Sub Board	D.AUDIO GEN2 Value PE SUB PATTERN	M30420019356	Hyundai Mobis	-
Front Board	D_AUDIO_SV_LHD_FRT (BI3)	M3061001164	Hyundai Mobis	-
LCD	-	M3330500723	Hyundai Mobis	-

1.8 Test System Layout



1.9 Modifications/Notes

- There was no modified item during the test.

1.10 Applicable Standards for Testing

Standards	Status	Deviation
FCC Part 15 : Subpart B	Applicable	No Deviation

1.11 Summary of Test Results

Test Item	Standards	Results
Conducted Emission	FCC Part 15 Subpart B Section 15.107 ANSI C63.4a:2017	N/A
Radiated Emission	FCC Part 15 Subpart B Section 15.109 ANSI C63.4a:2017	Complied

Note : Test methods of all test items are performed according to the basic standards in this table.

EMISSION

2.1 Test Results

Test Items	Standards	Test Results
Conducted Emission	FCC Part 15 Subpart B Section 15.107 ANSI C63.4a:2017	N/A
Radiated Emission	FCC Part 15 Subpart B Section 15.109 ANSI C63.4a:2017	Complied

2.2 Test Method and Limits

2.2.1 Test Method

Test Items	Measuring Frequency Range	RBW	Measuring Distance
Conducted Emission	0.15 MHz ~ 30 MHz	9 kHz	-
Radiated Emission	30 MHz ~ 1 GHz	120 kHz	10 m & 3 m
	Above 1 GHz	1 MHz	3 m

Note : 10 m method of radiated emission measurement is only applied to Class A equipment over the frequency range of 30 MHz ~ 1 GHz. Except this, 3 m method is applied to Class B equipment over the frequency range of 30 MHz ~ 1 GHz and Class A and Class B equipment above 1 GHz.

2.2.2 Test Limits

-Conducted Emission Limits

Frequency Range	Limits(dB μ V)		Class
	Quasi-peak	Average	
0.15 MHz ~ 0.5 MHz	79	66	Class A
0.5 MHz ~ 30 MHz	73	60	
0.15 MHz ~ 0.5 MHz	66 to 56	56 to 46	Class B
0.5 MHz ~ 5 MHz	56	46	
5 MHz ~ 30 MHz	60	50	

Note : The lower limit shall apply at the transition frequencies. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

-Radiated Emission Limits below 1 GHz

Frequency Range	Limits(dB μ V/m)	Class
	Quasi-peak	
30 MHz ~ 88 MHz	39.0	Class A (10 m method)
88 MHz ~ 216 MHz	43.5	
216 MHz ~ 960 MHz	46.4	
960 MHz ~ 1 GHz	49.5	
30 MHz ~ 88 MHz	40.0	Class B (3 m method)
88 MHz ~ 216 MHz	43.5	
216 MHz ~ 960 MHz	46.0	
960 MHz ~ 1 GHz	54.0	

-Radiated Emission Limits above 1 GHz (3 m method)

Frequency Range	Limits(dB μ V/m)		Class
	Average	Peak	
Above 1 GHz	59.5	79.5	Class A
Above 1 GHz	54.0	74.0	Class B

Note : The limits of class A equipment is extrapolated using an extrapolation factor of 20 dB/decade because it was measured at 3 m distance not 10 m distance.

2.3 Radiated Emission

The initial preliminary exploratory scans were performed over the measuring frequency range (30 MHz to 13 GHz) using a max hold mode incorporating a Peak detector by using the EMI measuring software. The final test data was measured using a Quasi-Peak detector below 1 GHz, Peak and CISPR Average detector above 1 GHz. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency.

Note. Measuring software

- Giheung Lab.: EMC32(V10.40.10) from R&S
- Gunpo Lab.: EP5RE(V5.3.70) from TOYO
- Dongtan Lab.: EMC32(V10.40.10) from R&S

2.3.1 Test Equipments

Equipment	Model	Manufacturer	Serial No	Cal Due. Date
Horn Antenna	HF906	R & S	100326	2024.02.18
Signal Conditioning Unit	SCU 18	R & S	10117	2023.06.13
Test Receiver	ESU26	R & S	100109	2024.01.18
Hybrid Antenna	VULB9163	SCHWARZBECK	01126	2024.02.09
Amplifier	8447F	HP	2944A03909	2023.08.04
EMI TEST RECEIVER	ESU40	R&S	100075	2024.01.19
Pre Amplifier	TK-PA1840H	TESTEK	130016	2024.01.11
Horn Antenna	BBHA 9170	SCHWARZBECK	9170-540	2023.11.30
RF Cable(CA-04)	-	-	-	2023.04.04
RF Cable(CA-05)	-	-	-	2023.04.04
RF Cable(CA-06)	MWX221-NMSNMS (4m)	RF ONE	J023142	2023.04.04
RF Cable(CA-07)	PL520-NMNM-10M (10m)	RF ONE	0200324001	2023.04.04

Note: The calibration period of every equipment is 1 year.

2.3.2 Test Site

3 m SEMI-ANECHOIC CHAMBER in Gunpo Laboratory

2.3.3 Environment Conditions

Below 1 GHz

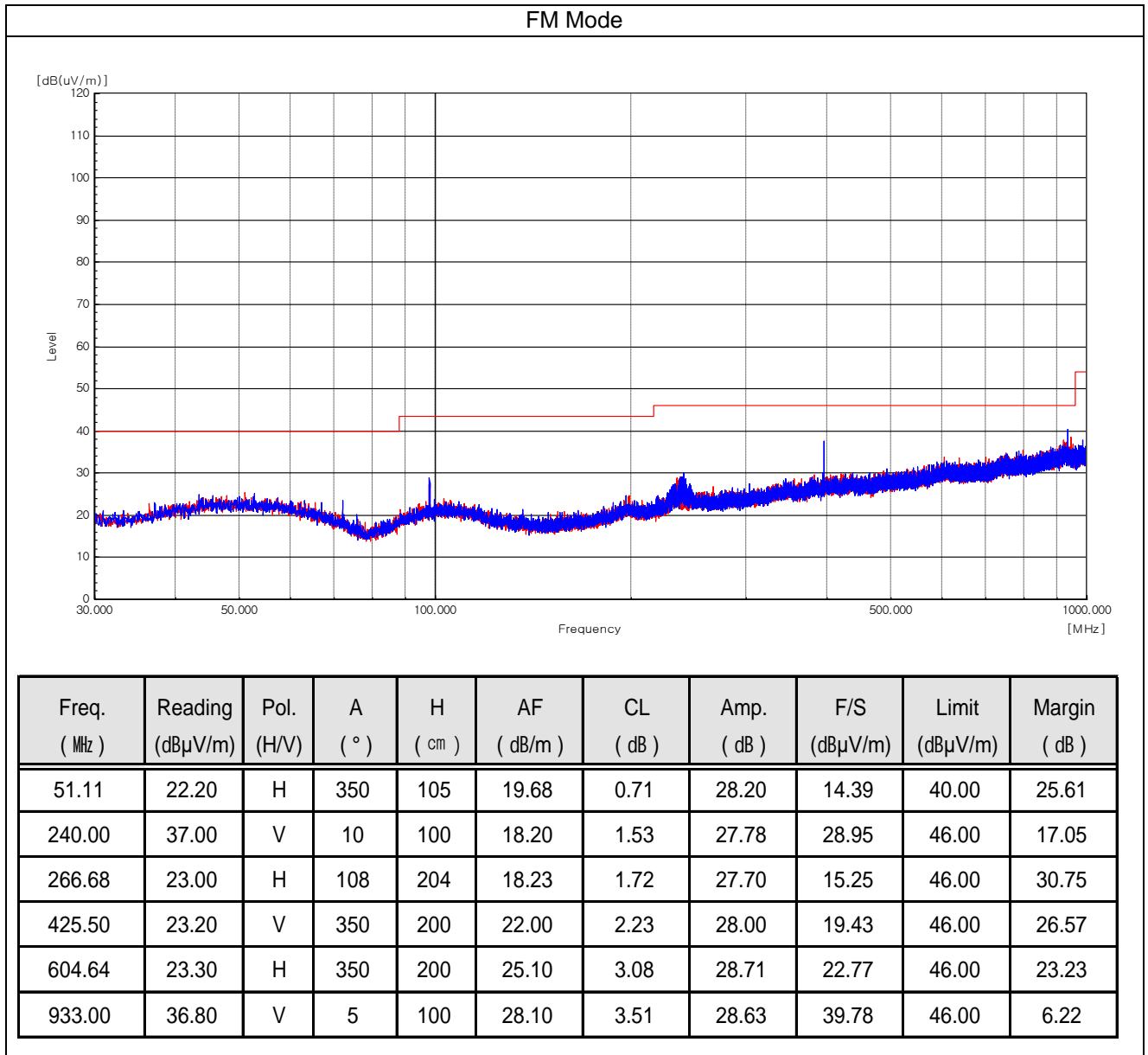
Temperature	(Minimum 19.4, Maximum 19.8) °C
Humidity	(Minimum 27.0, Maximum 28.0) % R.H.
Atmospheric Pressure	(Minimum 101.6, Maximum 101.6) kPa
Test Date	March 28, 2023

Above 1 GHz

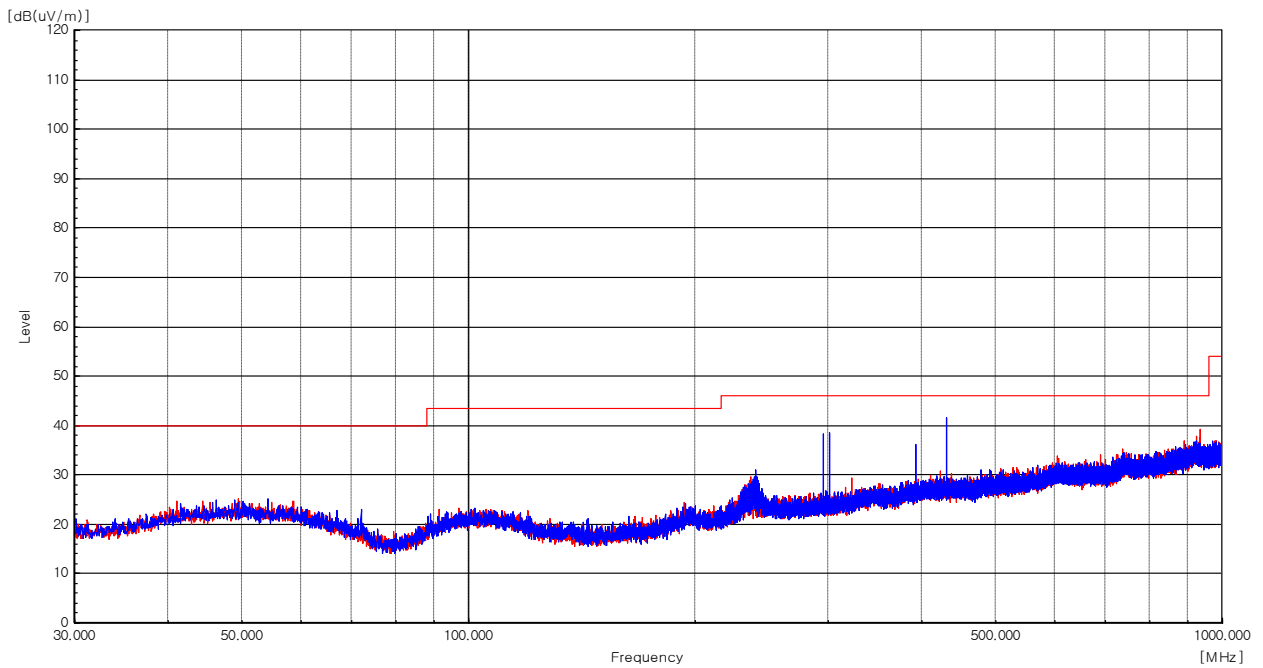
Temperature	(Minimum 19.4, Maximum 19.8) °C
Humidity	(Minimum 27.0, Maximum 28.0) % R.H.
Atmospheric Pressure	(Minimum 101.6, Maximum 101.6) kPa
Test Date	March 28, 2023

2.3.4 Test Results

Below 1 GHz (3 m method)



AM Mode



Freq. (MHz)	Reading (dBμV/m)	Pol. (H/V)	A (°)	H (cm)	AF (dB/m)	CL (dB)	Amp. (dB)	F/S (dBμV/m)	Limit (dBμV/m)	Margin (dB)
240.00	37.10	V	305	105	18.20	1.53	27.78	29.05	46.00	16.95
295.86	23.00	V	15	112	19.00	1.77	27.61	16.16	46.00	29.84
301.24	22.80	V	100	107	19.00	1.82	27.60	16.02	46.00	29.98
429.96	23.30	V	5	100	22.00	2.39	28.04	19.65	46.00	26.35
739.64	23.30	V	350	205	26.58	3.08	28.96	24.00	46.00	22.00
933.00	39.40	H	360	100	28.10	3.51	28.63	42.38	46.00	3.62

Measurement Uncertainty: See the Appendix A

- Note:
- AF = Antenna Factor
 - Pol.(H) = Horizontal
 - Margin = Limit – F/S
 - A: Angle

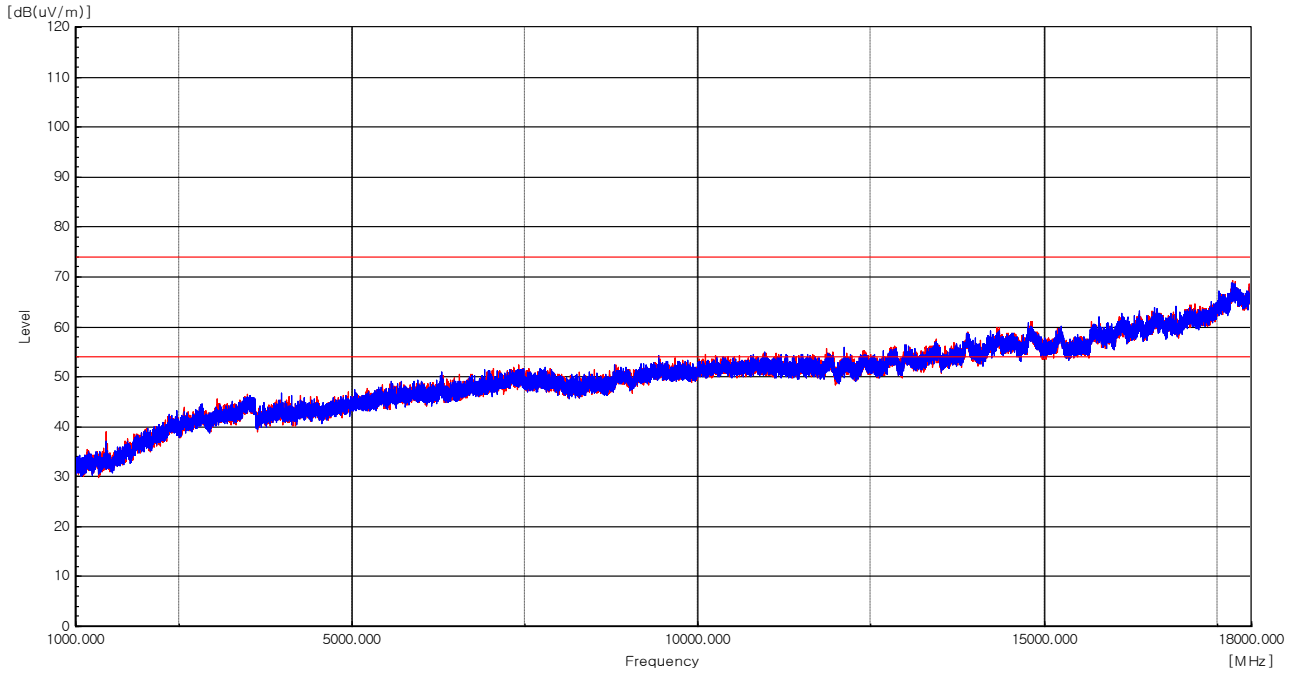
- CL = Cable Loss
- Pol.(V) = Vertical
- F/S = Reading + AF + CL – Amp.
- H: Height

- F/S = Field Strength
- Amp. = Amplifier Gain

Above 1 GHz (3 m method)

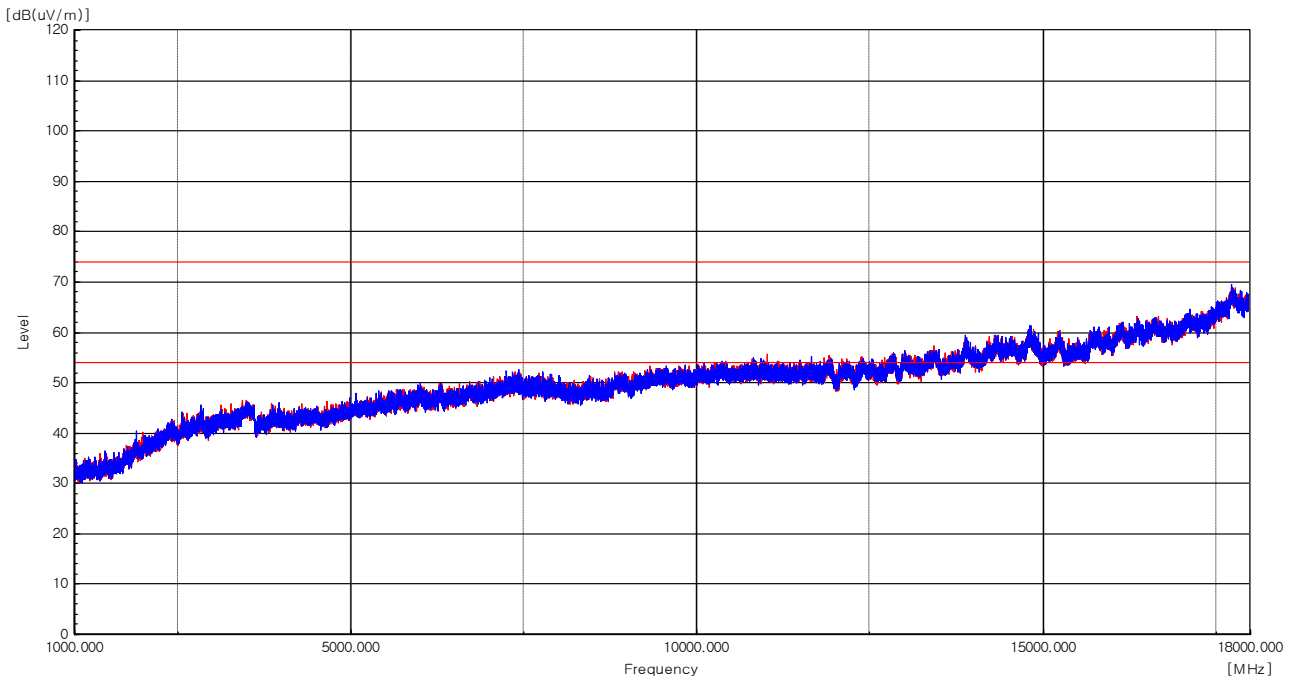
① 1 GHz - 18 GHz

FM Mode



Freq. (MHz)	Level(dBμV/m)		Pol. (H/V)	A (°)	H (cm)	AF (dB)	CL (dB)	Amp. (dB)	CF (dB)	F/S (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Peak	C-AV										
1 439.17	48.30	-	V	10	105	25.54	6.28	45.40	0.00	34.72	74.00	39.28
1 439.17	-	34.60	V	10	105	25.54	6.28	45.40	0.00	21.02	54.00	32.98
3 479.88	45.50	-	H	350	100	31.20	8.68	45.44	0.00	39.94	74.00	34.06
3 479.88	-	31.90	H	350	100	31.20	8.68	45.44	0.00	26.34	54.00	27.66
11 847.42	42.90	-	H	345	120	38.31	15.22	45.32	0.00	51.11	74.00	22.89
11 847.42	-	29.00	H	345	120	38.31	15.22	45.32	0.00	37.21	54.00	16.79
14 776.37	42.40	-	V	50	115	40.99	19.59	43.66	0.00	59.32	74.00	14.68
14 776.37	-	28.80	V	50	115	40.99	19.59	43.66	0.00	45.72	54.00	8.28
15 682.33	42.90	-	H	360	100	40.10	19.84	43.70	0.00	59.14	74.00	14.86
15 682.33	-	28.80	H	360	100	40.10	19.84	43.70	0.00	45.04	54.00	8.96
17 717.37	43.30	-	V	20	110	44.03	22.94	45.07	0.00	65.20	74.00	8.80
17 717.37	-	28.00	V	20	110	44.03	22.94	45.07	0.00	49.90	54.00	4.10

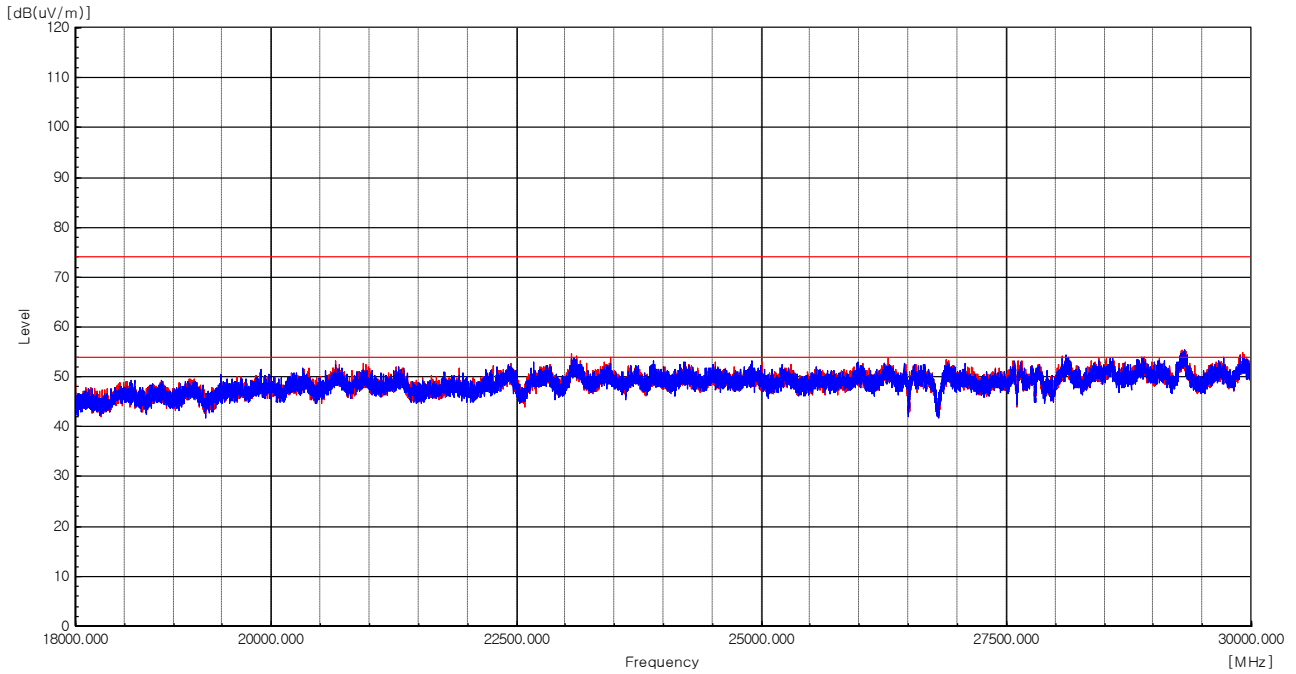
AM Mode



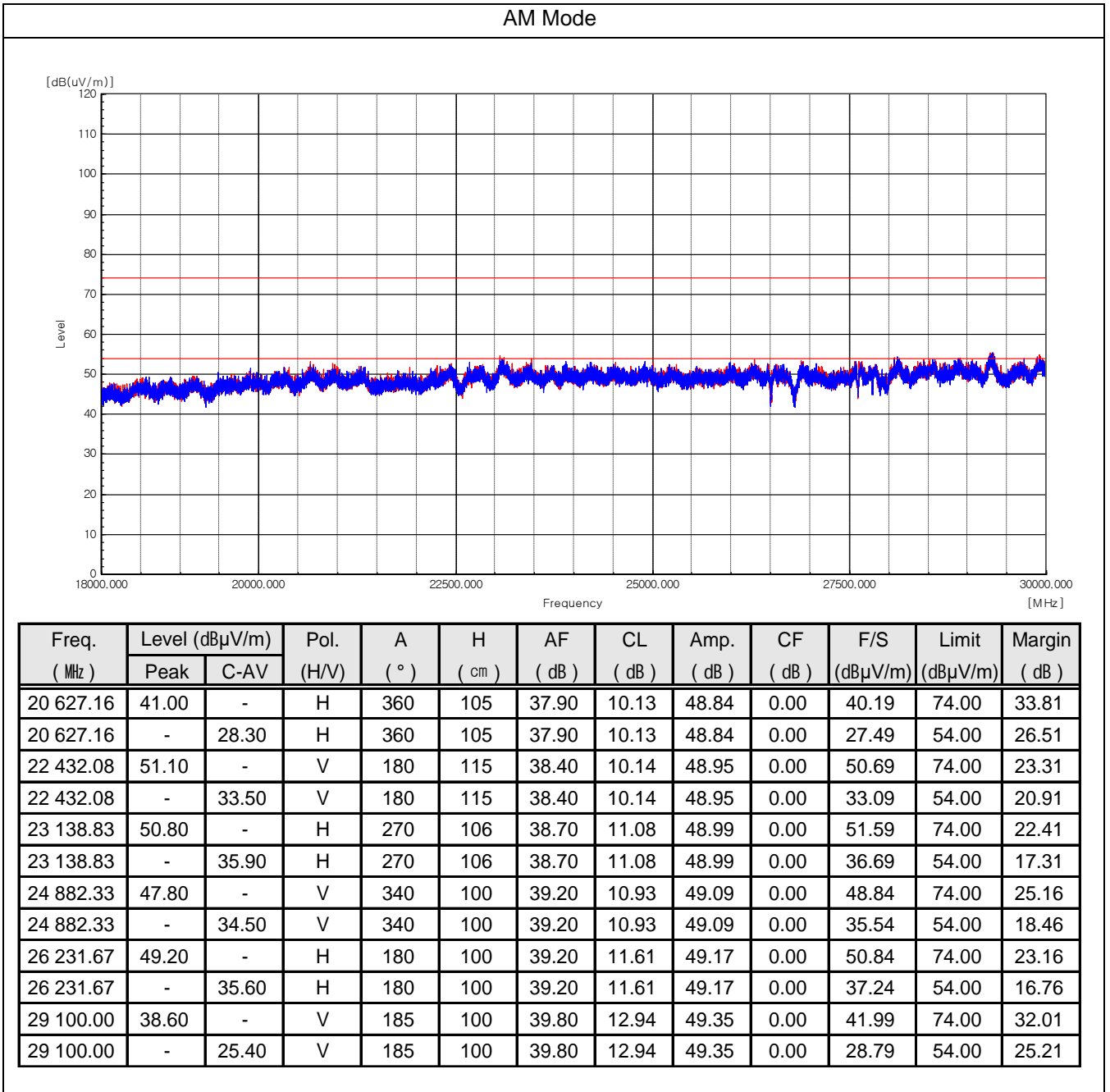
Freq. (MHz)	Level (dB μ V/m)		Pol. (H/V)	A ($^{\circ}$)	H (cm)	AF (dB)	CL (dB)	Amp. (dB)	CF (dB)	F/S (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
	Peak	C-AV										
3 496.17	45.41	-	V	10	105	31.20	8.77	45.45	0.00	39.93	74.00	34.07
3 496.17	-	31.60	V	10	105	31.20	8.77	45.45	0.00	26.12	54.00	27.88
11 012.29	43.30	-	H	350	100	38.20	15.33	45.40	0.00	51.43	74.00	22.57
11 012.29	-	29.30	H	350	100	38.20	15.33	45.40	0.00	37.43	54.00	16.57
13 417.08	42.50	-	H	360	102	39.93	16.88	44.37	0.00	54.94	74.00	19.06
13 417.08	-	28.80	H	360	102	39.93	16.88	44.37	0.00	41.24	54.00	12.76
13 885.29	43.00	-	V	10	100	40.70	18.57	44.23	0.00	58.04	74.00	15.96
13 885.29	-	28.90	V	10	100	40.70	18.57	44.23	0.00	43.94	54.00	10.06
14 819.58	42.50	-	V	60	100	40.80	20.08	43.63	0.00	59.75	74.00	14.25
14 819.58	-	28.80	V	60	100	40.80	20.08	43.63	0.00	46.05	54.00	7.95
17 719.50	43.50	-	V	35	107	44.04	22.94	45.08	0.00	65.40	74.00	8.60
17 719.50	-	27.50	V	35	107	44.04	22.94	45.08	0.00	49.40	54.00	4.60

② 18 GHz - 30 GHz

FM Mode



Freq. (MHz)	Level(dBμV/m)		Pol. (H/V)	A (°)	H (cm)	AF (dB)	CL (dB)	Amp. (dB)	CF (dB)	F/S (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Peak	C-AV										
19 874.58	40.80	-	H	215	105	37.87	9.74	48.86	0.00	39.55	74.00	34.45
19 874.58	-	28.00	H	215	105	37.87	9.74	48.86	0.00	26.75	54.00	27.25
20 650.08	41.10	-	V	200	110	37.90	10.18	48.84	0.00	40.34	74.00	33.66
20 650.08	-	28.20	V	200	110	37.90	10.18	48.84	0.00	27.44	54.00	26.56
23 088.42	50.60	-	V	10	102	38.70	10.86	48.99	0.00	51.17	74.00	22.83
23 088.42	-	35.20	V	10	102	38.70	10.86	48.99	0.00	35.77	54.00	18.23
26 287.58	49.10	-	H	90	100	39.20	11.79	49.18	0.00	50.91	74.00	23.09
26 287.58	-	35.40	H	90	100	39.20	11.79	49.18	0.00	37.21	54.00	16.79
28 072.33	39.80	-	H	180	104	39.37	13.84	49.28	0.00	43.73	74.00	30.27
28 072.33	-	25.50	H	180	104	39.37	13.84	49.28	0.00	29.43	54.00	24.57
29 000.40	38.50	-	V	210	100	39.80	11.96	49.34	0.00	40.92	74.00	33.08
29 000.40	-	25.20	V	210	100	39.80	11.96	49.34	0.00	27.62	54.00	26.38



Measurement Uncertainty: See the Appendix A

- Note:
- AF = Antenna Factor
 - Pol.(H) = Horizontal
 - Margin = Limit – F/S
 - A: Angle
 - CL = Cable Loss
 - Pol.(V) = Vertical
 - F/S = Level + AF + CL – Amp.
 - H: Height
 - F/S = Field Strength
 - Amp. = Amplifier Gain

Ex) In case

Freq ; 100 Mhz, level ; 30 dB(μV/m), AF ; 10 dB/m, CL ; 4 dB, Amp ; 25 dB

$$\begin{aligned} \text{Result} &= \text{Level} + \text{AF} + \text{CL} - \text{Amp} \\ &= 30 + 10 + 4 - 25 \\ &= 19 \end{aligned}$$

$$\begin{aligned} \text{Margin} &= \text{Limit} - \text{Result} \\ &= 43.5 - 19 \\ &= 24.5 \end{aligned}$$

Appendix A : Measurement Uncertainty

- Giheung Laboratory

Test Method		Measurement Uncertainty	
Conducted Emission	ENV216	3.7 dB	(The confidential level is 95 %, $k=2$)
	ESH2-Z5	3.2 dB	(The confidential level is 95 %, $k=2$)
	ESH3-Z6	3.2 dB	(The confidential level is 95 %, $k=2$)
	NNLK8129	3.1 dB	(The confidential level is 95 %, $k=2$)
Conducted Emission - Signal	ISN T800	5.4 dB	(The confidential level is 95 %, $k=2$)
	ISN ST08	6.6 dB	(The confidential level is 95 %, $k=2$)
Discontinuous		2.7 dB (The confidential level is 95 %, $k=2$)	
Radiated Emission	9 kHz ~30 MHz	Horizontal	3.3 dB (The confidential level is 95 %, $k=2$)
		Vertical	3.3 dB (The confidential level is 95 %, $k=2$)
	30 MHz ~ 1 000 MHz	Horizontal	4.3 dB (The confidential level is 95 %, $k=2$)
		Vertical	4.6 dB (The confidential level is 95 %, $k=2$)
	1 GHz ~ 18 GHz	Horizontal	3.9 dB (The confidential level is 95 %, $k=2$)
		Vertical	4.0 dB (The confidential level is 95 %, $k=2$)

- Gunpo Laboratory

Test Method		Measurement Uncertainty	
Conducted Emission	ENV216	4.0 dB	(The confidential level is 95 %, $k=2$)
	ESH2-Z5	3.6 dB	(The confidential level is 95 %, $k=2$)
	ESH3-Z6	3.8 dB	(The confidential level is 95 %, $k=2$)
Conducted Emission - Signal	ISN T800	5.8 dB	(The confidential level is 95 %, $k=2$)
	ISNT8-Cat6	5.8 dB	(The confidential level is 95 %, $k=2$)
	ISN S751	7.5 dB	(The confidential level is 95 %, $k=2$)
Disturbance Voltage at Antenna Terminal		2.9 dB (The confidential level is 95 %, $k=2$)	
Radiated Emission	9 kHz ~30 MHz	Horizontal	3.4 dB (The confidential level is 95 %, $k=2$)
		Vertical	3.4 dB (The confidential level is 95 %, $k=2$)
	30 MHz ~ 1 000 MHz	Horizontal	4.5 dB (The confidential level is 95 %, $k=2$)
		Vertical	5.1 dB (The confidential level is 95 %, $k=2$)
	1 GHz ~ 18 GHz	Horizontal	3.7 dB (The confidential level is 95 %, $k=2$)
		Vertical	3.9 dB (The confidential level is 95 %, $k=2$)

- Dongtan Laboratory

Test Method		Measurement Uncertainty	
Conducted Emission	ENV216	3.5 dB (The confidential level is 95 %, $k=2$)	
	ESH2-Z5	3.3 dB (The confidential level is 95 %, $k=2$)	
	ESH3-Z6	3.3 dB (The confidential level is 95 %, $k=2$)	
	NNLK8129	3.4 dB (The confidential level is 95 %, $k=2$)	
Conducted Emission - Signal	ISN T800	5.7 dB (The confidential level is 95 %, $k=2$)	
	ISN ST08	5.5 dB (The confidential level is 95 %, $k=2$)	
Discontinuous		2.9 dB (The confidential level is 95 %, $k=2$)	
disturbance Power		3.9 dB (The confidential level is 95 %, $k=2$)	
Radiated Emission	9 kHz ~30 MHz (Triple Loop Ant.)	3.4 dB (The confidential level is 95 %, $k=2$)	
	9 kHz ~30 MHz (Loop Ant.)	Horizontal	3.8 dB (The confidential level is 95 %, $k=2$)
		Vertical	3.8 dB (The confidential level is 95 %, $k=2$)
	30 MHz ~ 1 000 MHz	Horizontal	4.8 dB (The confidential level is 95 %, $k=2$)
		Vertical	5.4 dB (The confidential level is 95 %, $k=2$)
	1 GHz ~ 18 GHz	Horizontal	4.1 dB (The confidential level is 95 %, $k=2$)
Vertical		4.2 dB (The confidential level is 95 %, $k=2$)	

- End of Test Report -