

TEST REPORT

of

FCC CFR 47 part 1, 1.1307(b), 1.1310

FCC ID: TQ8-ADB200AAN

Equipment Under Test : DISPLAY CAR SYSTEM
Model Name : ADB200AAN
Variant Model Names : ADB400AAN, ADB401VAN, ADB100AAU,
ADB101VAN, ADB210AAN
Applicant : Hyundai Mobis Co., Ltd.
Manufacturer : Hyundai Mobis Co., Ltd.
Date of Receipt : 2019.11.12
Date of Test(s) : 2019.11.28 ~ 2019.12.26
Date of Issue : 2020.01.21

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Nancy Park

Date:

2020.01.21

Technical
Manager:



Jungmin Yang

Date:

2020.01.21

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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

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Telephone : +82 31 688 0901

FAX : +82 31 688 0921

1.2. Details of Applicant

Applicant : Hyundai Mobis Co., Ltd.

Address : 203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 135-977

Contact Person : Choe, Seung-hoon

Phone No. : +82 31 260 0098

1.3. Details of Manufacturer

Company : Same as applicant

Address : Same as applicant

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1.4. Description of EUT

Kind of Product	DISPLAY CAR SYSTEM
Model Name	ADB200AAN
Variant Model Names	ADB400AAN, ADB401VAN, ADB100AAU, ADB101VAN, ADB210AAN
Power Supply	DC 14.4 V
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth) 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20) 5 180 MHz ~ 5 240 MHz (Band 1: 11a/n_HT20, 11ac_VHT20) 5 190 MHz ~ 5 230 MHz (Band 1: 11n_HT40, 11ac_VHT40) 5 210 MHz (Band 1: 11ac_VHT80) 5 260 MHz ~ 5 320 MHz (Band 2A: 11a/n_HT20, 11ac_VHT20) 5 270 MHz ~ 5 310 MHz (Band 2A: 11n_HT40, 11ac_VHT40) 5 290 MHz (Band 2A: 11ac_VHT80) 5 500 MHz ~ 5 720 MHz (Band 2C: 11a/n_HT20, 11ac_VHT20) 5 510 MHz ~ 5 710 MHz (Band 2C: 11n_HT40, 11ac_VHT40) 5 530 MHz ~ 5 690 MHz (Band 2C: 11ac_VHT80) 5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20) 5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40) 5 775 MHz (Band 3: 11ac_VHT80)
Modulation Technique	DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK
Number of Channels	79 channels (Bluetooth) 11 channels (11b/g/n_HT20) 4 channels (Band 1: 11a/n_HT20, 11ac_VHT20) 2 channels (Band 1: 11n_HT40, 11ac_VHT40) 1 channel (Band 1: 11ac_VHT80) 4 channels (Band 2A: 11a/n_HT20, 11ac_VHT20) 2 channels (Band 2A: 11n_HT40, 11ac_VHT40) 1 channel (Band 2A: 11ac_VHT80) 9 channels (Band 2C: 11a/n_HT20, 11ac_VHT20) 4 channels (Band 2C: 11n_HT40, 11ac_VHT40) 2 channels (Band 2C: 11ac_VHT80) 5 channels (Band 3: 11a/n_HT20, 11ac_VHT20) 2 channels (Band 3: 11n_HT40, 11ac_VHT40) 1 channel (Band 3: 11ac_VHT80)
Antenna Type	Pattern antenna
Antenna Gain	2 400 MHz ~ 2 483.5 MHz: -0.18 dB i (Bluetooth) 2 400 MHz ~ 2 483.5 MHz: -0.01 dB i (WLAN 2.4 G) 5 150 MHz ~ 5 250 MHz: -0.61 dB i (WLAN 5G) 5 250 MHz ~ 5 350 MHz: -0.18 dB i (WLAN 5G) 5 470 MHz ~ 5 725 MHz: -0.77 dB i (WLAN 5G) 5 725 MHz ~ 5 850 MHz: -0.18 dB i (WLAN 5G)

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1.5. Information of Variant Models

Model Names			Description								
			BT/WIFI	FM/AM Code	INTERNAL /EXTERNAL	USB	RDS	DAB	SXM	HD	RHD/LHD
Basic Model	FCC	ADB200AAN	BT/WIFI	A2	INTERNAL	O	O	X	X	O	LHD
Variant Models	FCC	ADB400AAN	BT/WIFI/LTE	A2	INTERNAL	O	O	X	O	O	LHD
		ADB100AAU	BT/WIFI	A6	INTERNAL	O	O	X	X	X	LHD
		ADB210AAN	BT/WIFI	A2	INTERNAL	O	O	X	X	X	LHD
		ADB101VAN	BT/WIFI	A2	INTERNAL	O	O	X	X	O	LHD
		ADB401VAN	BT/WIFI/LTE	A2	INTERNAL	O	O	X	O	O	LHD

CODE	BAND	FREQUENCY RANGE	STEP	LOCAL
A2	FM	87.5-107.9 MHz	200 kHz	NA/GEN
	AM	530-1710 kHz	10 kHz	
A6	FM	87.5-107.9 MHz	200 kHz	GUAM
	AM	531-1701 kHz	9 kHz	

1.6. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL000157	2019.12.31	Initial
1	F690501-RF-RTL000157-1	2020.01.20	Removed the Variant Models

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2. RF Exposure Evaluation

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

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	*900/f ²	6
30-300	61.4	0.163	1.0	6
300-1 500	-	-	f/300	6
1 500-100 000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	*180/f ²	30
30-300	27.5	0.073	0.2	30
<u>300-1 500</u>	-	-	<u>f/1500</u>	<u>30</u>
<u>1 500-100 000</u>	-	-	<u>1.0</u>	<u>30</u>

2.1.1. Friis transmission formula: $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot R^2)$

Where P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

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RTT5041-19(2019.04.24)(1)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

2.1.2. Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data

Test Mode : Normal Operation

2.1.3. Test information of Cable Loss and Antenna Gain

Test Item	Frequency (MHz)	Cable Loss (dB)	Antenna Gain (dB i)	Final Antenna Gain (dB i)
CDMA - BC0	824 ~ 849	-1.79	4.26	2.47
CDMA - BC1	1 850 ~ 1 910	-2.62	4.20	1.58
LTE - Band 2	1 850 ~ 1 910	-2.62	4.20	1.58
LTE - Band 4	1 710 ~ 1 755	-2.62	3.28	0.66
LTE - Band 5	824 ~ 849	-1.79	4.26	2.47
LTE - Band 13	777 ~ 787	-1.79	3.10	1.31

Note;

- Final Antenna Gain (dB i) = Cable Loss (dB) + Antenna Gain (dB i)

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2.1.4. Output Power into Antenna & RF Exposure Evaluation Distance

Bluetooth

- Maximum tune up tolerance

Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 402 ~ 2 480	4	-0.18	0.000 479	1

WLAN (2.4G)

- Maximum tune up tolerance

Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 412 ~ 2 462	12	-0.01	0.003 146	1

WLAN (5G)

- Maximum tune up tolerance

Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
5 180 ~ 5 240	10	-0.61	0.001 729	1
5 260 ~ 5 320	10	-0.18	0.001 909	1
5 500 ~ 5 720	10	-0.77	0.001 666	1
5 745 ~ 5 825	10	-0.18	0.001 909	1

CDMA - BC0

- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
824 ~ 849	25	2.47	0.111 104	0.55

CDMA - BC1

- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
1 850 ~ 1 910	25	1.58	0.090 517	1

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LTE - Band 2
- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
1 850 ~ 1 910	24	1.58	0.071 900	1

LTE - Band 4
- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
1 710 ~ 1 755	24	0.66	0.058 174	1

LTE - Band 5
- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
824 ~ 849	24	2.47	0.088 253	0.55

LTE - Band 13
- Maximum Tune Up Tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Final Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
777 ~ 787	24	1.31	0.067 566	0.52

Note;

- The power density Pd (5th column) at a distance of 20 cm calculated from the friis transmission formula is far below the limit of 1 mW/cm².
- This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
- This equipment should be installed and operated with minimum 20 cm between the radiator and your body.
- The antenna gain of this transmitter is less than 6 dB i and must not be collocated or operating in conjunction with any other antenna or transmitter unless authorized to do so by the FCC.

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Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

Bluetooth: the ratio is 0.000 479 / 1

WLAN: the ratio is 0.003 146 / 1

WWLAN: the ratio is 0.111 104 / 0.55

Confirm the sum result of individual MPEs ratio is ≤ 1.0 ;

Bluetooth + WLAN + WWLAN: $(0.000\ 479 / 1) + (0.003\ 146 / 1) + (0.111\ 104 / 0.55)$
 $= 0.205\ 632 \leq 1.0$

- End of the Test Report -

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