

TEST REPORT

of

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

FCC ID: TQ8-VN470ZZZAN

Equipment Under Test : Car infotainment system

Model Name : VN470ZZZAN

Variant Model Name(s) : Refer to the page 4

Applicant : Hyundai Mobis Co., Ltd.

Manufacturer : Hyundai Mobis Co., Ltd.

Date of Receipt : 2022.08.10

Date of Test(s) : 2022.09.16 ~ 2022.10.04

Date of Issue : 2022.12.07

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

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Tested by:



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Report Number: F690501-RF-RTL003495-1

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

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- Designation number: KR0150

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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

1.4. Description of EUT

Kind of Product		Car infotainment system
Model Name		VN470ZZZAN
Variant Model Name		VN450ZZZAN
Power Supply		DC 14.4 V
Frequency Range		2 402 MHz ~ 2 480 MHz (Bluetooth) 2 402 MHz ~ 2 480 MHz (Bluetooth Low Energy) 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) 40 channels (Bluetooth Low Energy) 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*	Port 1	2 400 MHz ~ 2 483.5 MHz: -1.34 dB i (Bluetooth) 2 400 MHz ~ 2 483.5 MHz: -1.34 dB i (Bluetooth Low Energy) 5 150 MHz ~ 5 250 MHz: 2.15 dB i (WLAN 5 G) 5 250 MHz ~ 5 350 MHz: 2.15 dB i (WLAN 5 G) 5 470 MHz ~ 5 725 MHz: 2.39 dB i (WLAN 5 G) 5 725 MHz ~ 5 850 MHz: 2.76 dB i (WLAN 5 G)
	Port 2	2 400 MHz ~ 2 483.5 MHz: 0.19 dB i (WLAN 2.4 G) 5 150 MHz ~ 5 250 MHz: 0.77 dB i (WLAN 5 G) 5 250 MHz ~ 5 350 MHz: 1.89 dB i (WLAN 5 G) 5 470 MHz ~ 5 725 MHz: 2.41 dB i (WLAN 5 G) 5 725 MHz ~ 5 850 MHz: 2.39 dB i (WLAN 5 G)
H/W Version		1.0
S/W Version		1.0
FVIN		N/A

1.5. Declaration by the Manufacturer

- Bluetooth and Bluetooth Low Energy work only on Port 1.
- WLAN 2.4G transmits only on Port 2.
- WLAN 5G transmits on both Port 1 and Port 2.
- Bluetooth and WLAN 2.4G Can Transmit simultaneously.
- Bluetooth Low Energy and WLAN 2.4G Can Transmit simultaneously.
- Bluetooth and WLAN 5G Can Transmit simultaneously.
- Bluetooth Low Energy and WLAN 5G Can Transmit simultaneously.

1.6. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL003495	2022.10.21	Initial
1	F690501-RF-RTL003495-1	2022.12.07	Added information about modes that can transmit simultaneously on page 5

1.7. Information of Variant Models

Model Names			Description							
			Marketing Area	BT	WLAN	Speaker ch.	RVM Camera	Built-in Camera	SVM Camera	ICC Camera
Basic Model	FCC	VN470ZZZAN	U.S.A	O	O	10	O	O	O	O
	IC	VN470ZZZKN	Canada	O	O	10	O	O	O	O
Variant Model	FCC	VN450ZZZAN	U.S.A	O	O	6	O	X	X	X
	IC	VN450ZZZKN	Canada	O	O	6	O	X	X	X

Note;

All the test was performed with basic model.

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
300-1 500	-	-	f/1500	30
<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

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.

2.1.2. Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data
Test Mode : Normal Operation

2.1.4. Output Power into Antenna & RF Exposure Evaluation Distance

Bluetooth_ Ant.1

- Maximum tune up tolerance

Frequency Range (MHz)	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 400 ~ 2 483.5	4	-1.34	0.000 367	1

Bluetooth Low Energy_ Ant.1

- Maximum tune up tolerance

Frequency Range (MHz)	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 400 ~ 2 483.5	8.5	-1.34	0.001 034	1

WLAN (2.4G)_ Ant.2

- Maximum tune up tolerance

Frequency Range (MHz)	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 400 ~ 2 483.5	14	0.19	0.005 221	1

WLAN (5G)_ Ant.1

- Maximum tune up tolerance

Frequency Range (MHz)	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
5 150 ~ 5 250	10	2.15	0.003 264	1
5 250 ~ 5 350	10	2.15	0.003 264	1
5 470 ~ 5 725	10	2.39	0.003 449	1
5 725 ~ 5 850	10	2.76	0.003 756	1

WLAN (5G)_ Ant.2

- Maximum tune up tolerance

Frequency Range (MHz)	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
5 150 ~ 5 250	10	0.77	0.002 375	1
5 250 ~ 5 350	10	1.89	0.003 074	1
5 470 ~ 5 725	10	2.41	0.003 465	1
5 725 ~ 5 850	10	2.39	0.003 449	1

WLAN (5G)_ Ant.1+Ant.2

- Maximum tune up tolerance

Frequency Range (MHz)	Port	Maximum Tune up Average Output Power (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Combined Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
5 150 ~ 5 250	1	10	2.15	0.003 264	0.005 639	1
	2	10	0.77	0.002 375		
5 250 ~ 5 350	1	10	2.15	0.003 264	0.006 338	1
	2	10	1.89	0.003 074		
5 470 ~ 5 725	1	10	2.39	0.003 449	0.006 914	1
	2	10	2.41	0.003 465		
5 725 ~ 5 850	1	10	2.76	0.003 756	0.007 205	1
	2	10	2.39	0.003 449		

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.
- According to KDB 447498 D01 RF Exposure Guidance 4.1.
- The RF exposure was evaluated by output average power of tune-up procedure considering tolerance. So, Maximum peak conducted power may exceed the power mentioned in this report.
- WLAN (2.4G) and WLAN (5G) do not transmit simultaneously.

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

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

Bluetooth Low Energy_Ant.1 + WLAN2_Ant.2 : $(0.001\ 034 / 1) + (0.005\ 221 / 1) = 0.006\ 255 \leq 1.0$

WLAN5_Ant.1 + WLAN5_Ant.2 : $(0.003\ 756 / 1) + (0.003\ 449 / 1) = 0.007\ 205 \leq 1.0$

- End of the Test Report -