

TEST REPORT

of

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

FCC ID: TQ8-VT230DJAN

Equipment Under Test : DIGITAL CAR AVN SYSTEM
 Model Name : VT230DJAN
 Variant Model Name(s) : Refer to the page 4
 Applicant : Hyundai Mobis Co., Ltd.
 Manufacturer : Hyundai Mobis Co., Ltd.
 Date of Receipt : 2020.10.12
 Date of Test(s) : 2020.10.13 ~ 2020.11.12
 Date of Issue : 2020.12.11

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-RTL001446

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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	DIGITAL CAR SYSTEM
Model Name	VT230DJAN
Variant Model Names	VT230DLAN, VT240DJAN, VT240DLAN
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: -0.38 dB i (Bluetooth) 2 400 MHz ~ 2 483.5 MHz: -1.19 dB i (WLAN 2.4 G) 5 150 MHz ~ 5 250 MHz: 0.59 dB i (WLAN 5 G) 5 250 MHz ~ 5 350 MHz: 2.00 dB i (WLAN 5 G) 5 470 MHz ~ 5 725 MHz: 4.58 dB i (WLAN 5 G) 5 725 MHz ~ 5 850 MHz: 4.19 dB i (WLAN 5 G)

1.5. Information of Variant Models

Model Names		Description						
		Local	AMP	SXM	HD	HANDLE	FM/AM Code	Vehicle
Basic Model	VT230DJAN	U.S.A	Internal	O	O	L	A2	5DR
Variant Models	VT230DLAN	U.S.A	Internal	O	O	L	A2	4DR
	VT240DJAN	U.S.A	External	O	O	L	A2	5DR
	VT240DLAN	U.S.A	External	O	O	L	A2	4DR

BAND	CODE	FREQUENCY RANGE	STEP	LOCAL
FM	A2	87.5-107.9 MHz	200 kHz	NA/GEN
AM		530-1 710 kHz	10 kHz	

1.6. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501-RF-RTL001446	2020.12.11	Initial

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>:</u>	<u>:</u>	<u>f/1500</u>	<u>30</u>
<u>1 500-100 000</u>	<u>-</u>	<u>-</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.

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	-1.71	4.76	3.05
CDMA - BC1	1 850 ~ 1 910	-3.30	4.70	1.40
LTE - Band 2	1 850 ~ 1 910	-3.30	4.70	1.40
LTE - Band 4	1 710 ~ 1 755	-3.30	0.62	-2.68
LTE - Band 5	824 ~ 849	-1.71	4.76	3.05
LTE - Band 13	777 ~ 787	-1.71	4.14	2.43

Note;

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

2.1.4. Output Power into Antenna & RF Exposure Evaluation Distance

Bluetooth

- Maximum tune up tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 400 ~ 2 483.5	4	-0.38	0.000 458	1

WLAN (2.4G)

- Maximum tune up tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
2 400 ~ 2 483.5	10	-1.19	0.001 513	1

WLAN (5G)

- Maximum tune up tolerance

Frequency Range (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
5 150 ~ 5 250	10	0.59	0.002 279	1
5 250 ~ 5 350	10	2.00	0.003 153	1
5 470 ~ 5 725	10	4.58	0.005 711	1
5 725 ~ 5 850	10	4.19	0.005 221	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	25.7	3.05	0.149 187	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	25.7	1.40	0.102 031	1

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	25.7	1.40	0.102 031	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	25.7	-2.68	0.039 878	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	25.7	3.05	0.149 187	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	25.7	2.43	0.129 339	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.
- According to KDB 447498 D01 RF Exposure Guidance 4.1.

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

Bluetooth: the ratio is 0.000 458 / 1

WLAN: the ratio is 0.005 711 / 1

WWAN: the radio is 0.149 187 / 0.55

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

Bluetooth + WLAN + WWAN: $(0.000\ 458 / 1) + (0.005\ 711 / 1) + (0.149\ 187 / 0.55) = 0.277\ 418 \leq 1.0$

- End of the Test Report -