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TEST REPORT

KCTL Inc.
65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
www.kctl.co.kr

1. Client

- Name : HYUNDAI MOBIS CO., LTD.
- Address : 203, Teheran-ro, Gangnam-gu, Seoul, 06141, Korea
- Date of Receipt : 2019-09-20

2. Use of Report : Certification

3. Name of Product and Model : WIDE AVN / ATBA0HYAN

4. Manufacturer and Country of Origin : Hyundai Mobis Co., Ltd. / Korea

5. FCC ID : TQ8-ATBA0HYAN

6. Date of Test : 2019-10-01 to 2019-10-31

7. Test Standards : 47 CFR Part 1.1310

8. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Heesu Ahn (Signature)

2020-02-21

KCTL Inc.

As a test result of the sample which was submitted from the client, this report does not guarantee the whole product quality. This test report should not be used and copied without a written agreement by KCTL Inc.

Report revision history

Date	Revision	Page No
2020-02-09	Initial report	-
2020-02-21	Updated	3, 5,12

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Note. The report No. KR20-SRF0039 is superseded by the report No. KR20-SRF0039-A.

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1. General information

Client	:	HYUNDAI MOBIS CO., LTD.
Address	:	203, Teheran-ro, Gangnam-gu, Seoul, 06141, Korea
Manufacturer	:	Hyundai Mobis Co., Ltd.
Address	:	95, Sayang 2-Gil, Munbaek-Myeon, Jincheon-Gun, Chungcheongbuk-Do 27862 Korea
Laboratory	:	KCTL Inc.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 Industry Canada Registration No. : 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	WIDE AVN
Model	:	ATBA0HYAN
Derivative model	:	ATBA0HCAN, ATBA3HCAN
Frequency range	:	2 402 ㎒ ~ 2 480 ㎒ (Bluetooth(BDR/EDR)) 2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20) UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n_HT40/ac_VHT40) UNII-1: 5 210 ㎒ (802.11ac_VHT80) UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n_HT40/ac_VHT40) UNII-2A: 5 290 ㎒ (802.11ac_VHT80) UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n_HT40/ac_VHT40) UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80) UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n_HT20/ac_VHT20) UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n_HT40/ac_VHT40) UNII-3: 5 775 ㎒ (802.11ac_VHT80)
Modulation technique	:	Bluetooth(BDR/EDR)_ GFSK, π/4DQPSK, 8DPSK WIFI(802.11a/b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM
Number of channels	:	Bluetooth(BDR/EDR)_79ch 2.4㎓ WIFI (802.11b/g/n_HT20)_11ch UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2A: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2C: 9 ch (20 ㎒), 5 ch (40 ㎒), 2 ch (80 ㎒) UNII-3: 5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
Power source	:	DC 14.4 V

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Antenna specification	:	WIFI/Bluetooth(BDR/EDR)_Pattern Antenna
Antenna gain	:	2.4㎓ WIFI (802.11b/g/n_HT20) : -0.70 dBi
		Bluetooth(BDR/EDR) : 0.29 dBi
		UNII-1 :3.51 dBi, UNII-2A : 3.12 dBi
		UNII-2C : 2.28 dBI, UNII-3 : -0.84 dBi
Software version	:	MQ4.USA.0000.V028.001.190821
Hardware version	:	MQ4.USA.STD_AVN_G5_WIDE.004.001
Test device serial No.	:	N/A
Operation temperature	:	-20 ℃ ~ 70 ℃

2.1. Information about derivative model

The difference between basic model and derivative models is:

The derivative models have a different product identification number.

ATBA0HCAN(96560 P4700), ATBA3HCAN(96560 P4900)

2.2. Frequency/channel operations

This device contains the following capabilities:
WIFI(2.4 ㎓ band 802.11b/g/n(HT20), 5 ㎓ band 802.11a/n(HT20/HT40)/ac(VHT/20/40/80)), Bluetooth(BDR/EDR)

Ch.	Frequency (㎒)
00	2 402
.	.
39	2 441
.	.
78	2 480

Table 2.2.1. Bluetooth(BDR/EDR) mode

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Ch.	Frequency (㎒)
01	2 412
.	.
06	2 437
.	.
11	2 462

Table 2.2.2. 802.11b/g/n HT20 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
36	5 180	52	5 260	100	5 500	149	5 745
40	5 200	56	5 280	116	5 580	157	5 785
48	5 240	64	5 320	144	5 720	165	5 825

Table 2.2.3. 802.11a/n/ac_HT20/VHT20 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
38	5 190	54	5 270	102	5 510	151	5 755
46	5 230	62	5 310	110	5 550	159	5 795
				142	5 710		

Table 2.2.4. 802.11n/ac_HT40/VHT40 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
42	5 210	58	5 290	106	5 530	155	5 775
				138	5 690		

Table 2.2.5. 802.11ac_VHT80 mode

3. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)
Conducted RF power	1.76 dB

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4. RF Exposure

Regulation

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC rules and Regulations.
The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1.
According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Table 1 – Limits for Maximum Permissible Exposure (MPE)

Frequency Range (㎒)	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [㎽/㎠]	Averaging Time [minute]
(A) Limits for Occupational / Controlled Exposure				
0.3 ~ 3.0	614	1.63	*100	6
3.0 ~ 30	1842/f	4.89/f	*900/f²	6
30 ~ 300	61.4	0.163	1.0	6
300 ~ 1 500	/	/	f/300	6
1 500 ~ 15 000	/	/	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/f²	30
30 ~ 300	27.5	0.073	0.2	30
300 ~ 1 500	/	/	f/1 500	30
1 500 ~ 15 000	/	/	1.0	30

*f=frequency in ㎒, *= plane-wave equivalent power density*

Per the guidance of KDB 680106, the E-field and H-field limits shown in the table above are extended down to 100 ㎑

4.1. Test results

MPE (Maximum Permissive Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$$

S = power density [㎽/㎠]

P = Power input to antenna [㎽]

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna [㎝]

Calculation Result of RF exposure

Maximum tune-up tolerance

- 2.4㎓

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
GFSK	2 480	3.50	2.24	0.29	1.07	0.000 48	1.000 00
802.11g	2 412	11.00	12.59	-0.70	0.85	0.002 13	1.000 00

- UNII-1

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11a	5 180	11.00	12.59	3.51	2.24	0.005 62	1.000 00
802.11n(HT20)	5 240	11.00	12.59	3.51	2.24	0.005 62	1.000 00
802.11n(HT40)	5 230	6.00	3.98	3.51	2.24	0.001 78	1.000 00
802.11ac(VHT20)	5 240	11.00	12.59	3.51	2.24	0.005 62	1.000 00
802.11ac(VHT40)	5 190	6.00	3.98	3.51	2.24	0.001 78	1.000 00
802.11ac(VHT80)	5 210	6.00	3.98	3.51	2.24	0.001 78	1.000 00

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- UNII-2A

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11a	5 320	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11n(HT20)	5 320	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11n(HT40)	5 270	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11ac(VHT20)	5 320	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11ac(VHT40)	5 270	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11ac(VHT80)	5 290	10.00	10.00	3.12	2.05	0.004 08	1.000 00

- UNII-2C

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11a	5 500	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11n(HT20)	5 500	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11n(HT40)	5 510	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11ac(VHT20)	5 500	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11ac(VHT40)	5 510	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11ac(VHT80)	5 530	10.00	10.00	2.28	1.69	0.003 36	1.000 00

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- UNII-3

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11a	5 825	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11n(HT20)	5 825	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11n(HT40)	5 755	9.00	7.94	-0.84	0.82	0.001 30	1.000 00
802.11ac(VHT20)	5 825	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11ac(VHT40)	5 755	9.00	7.94	-0.84	0.82	0.001 30	1.000 00
802.11ac(VHT80)	5 775	10.00	10.00	-0.84	0.82	0.001 64	1.000 00

- Simultaneous Transmission

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11g (2 412 ㎒) + 802.11a / UNII-1 (5 180 ㎒) + BT,GFSK (2 480 ㎒)						0.008 23	1.000 00

Note.

1. The power density P_d (5th column) at a distance of 20 ㎝ calculated from the friis transmission Formula is far below the limit of 1 ㎽/㎠.
2. Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

2.4G WIFI: the ratio is 0.002 13 / 1
Bluetooth: the ratio is 0.000 48 / 1
5G WIFI: the ratio is 0.005 62 / 1

2.4G WIFI + Bluetooth + 5G WIFI Power density: (0.002 13 / 1 + 0.000 48 / 1 + 0.005 62 / 1)

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- CDMA

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
BC0	824.70	25.70	371.54	4.50	2.82	0.208 441	0.549 800
BC1	1 851.25	25.70	371.54	2.00	1.58	0.117 147	1.000 000

- LTE

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
Band 2	1 850.70	25.70	371.54	2.00	1.58	0.117 147	1.000 000
Band 4	1 710.70	25.70	371.54	2.00	1.58	0.117 147	1.000 000
Band 5	824.70	25.70	371.54	4.50	2.82	0.208 441	0.549 800
Band 13	779.50	25.70	371.54	4.50	2.82	0.208 441	0.549 800

- Simultaneous Transmission

Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Max Tune-up Power [㎽]	Ant Gain [dBi]	Ant Gain [㎽]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
802.11g (2 412 ㎒) + 802.11a / UNII-1 (5 180 ㎒) + BT,GFSK (2 480 ㎒) + LTE Band 5 (824.70 ㎒)						0.387 214	1.000 000
802.11g (2 412 ㎒) + 802.11a / UNII-1 (5 180 ㎒) + BT,GFSK (2 480 ㎒) + CDMA BC0 (824.70 ㎒)						0.387 214	1.000 000

Note.

1. The power density P_d (5th column) at a distance of 20 ㎝ calculated from the friis transmission Formula is far below the limit of 1 ㎽/㎠.
2. Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

2.4G WIFI: the ratio is 0.002 13 / 1
Bluetooth: the ratio is 0.000 48 / 1
5G WIFI: the ratio is 0.005 62 / 1
CDMA BC0: the ratio is 0.208 441 / 0.55
LTE Band5: the ratio is 0.208 441 / 0.55

2.4G WIFI + Bluetooth + 5G WIFI + LTE Power density:
(0.002 13 / 1 + 0.000 48 / 1 + 0.005 62 / 1 + 0.208 441 / 0.55)
2.4G WIFI + Bluetooth + 5G WIFI + CDMA Power density:
(0.002 13 / 1 + 0.000 48 / 1 + 0.005 62 / 1 + 0.208 441 / 0.55)

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5. Measurement Equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV40	100898	20.01.14
Wideband Power Sensor	R&S	NRP-Z81	10239d8	20.01.25
Attenuator	Weinschel ENGINEERING	21-10	0005	20.01.25
Attenuator	API Inmet	40AH2W-10	17	20.05.15

End of test report

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