



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		Report No.: KR20-SRF0046-A Page (1) of (13)	
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 / ATC31HYAN			
4. Manufacturer and Country of Origin : Hyundai Mobis Co., Ltd. / Korea			
5. FCC ID : TQ8-ATC31HYAN			
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 		Technical Manager
	Name : Euijung Kim (Signature)		Name : Heesu Ahn (Signature)
			2020-02-21
KCTL Inc.			
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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 The report No. KR20-SRF0046 is superseded by the report No. KR20-SRF0046-A.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 : ATC31HYAN
 Derivative model : ATC31HCAN, ATC34HCAN
 Frequency range : 2 402 MHz ~ 2 480 MHz (Bluetooth(BDR/EDR))
 2 412 MHz ~ 2 462 MHz (802.11b/g/n_HT20)
 UNII-1: 5 180 MHz ~ 5 240 MHz (802.11a/n_HT20/ac_VHT20)
 UNII-1: 5 190 MHz ~ 5 230 MHz (802.11n_HT40/ac_VHT40)
 UNII-1: 5 210 MHz (802.11ac_VHT80)
 UNII-2A: 5 260 MHz ~ 5 320 MHz (802.11a/n_HT20/ac_VHT20)
 UNII-2A: 5 270 MHz ~ 5 310 MHz (802.11n_HT40/ac_VHT40)
 UNII-2A: 5 290 MHz (802.11ac_VHT80)
 UNII-2C: 5 500 MHz ~ 5 720 MHz (802.11a/n_HT20/ac_VHT20)
 UNII-2C: 5 510 MHz ~ 5 710 MHz (802.11n_HT40/ac_VHT40)
 UNII-2C: 5 530 MHz ~ 5 690 MHz (802.11ac_VHT80)
 UNII-3: 5 745 MHz ~ 5 825 MHz (802.11a/n_HT20/ac_VHT20)
 UNII-3: 5 755 MHz ~ 5 795 MHz (802.11n_HT40/ac_VHT40)
 UNII-3: 5 775 MHz (802.11ac_VHT80)
 Modulation technique : Bluetooth(BDR/EDR)_GFSK, $\pi/4$ DQPSK, 8DPSK
 WIFI(802.11a/b/g/n20/n40/ac20/ac40/ac80)_DSSS, OFDM
 Number of channels : Bluetooth(BDR/EDR)_79ch
 2.4GHz WIFI (802.11b/g/n_HT20)_11ch
 UNII-1: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
 UNII-2A: 4 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
 UNII-2C: 9 ch (20 MHz), 5 ch (40 MHz), 2 ch (80 MHz)
 UNII-3: 5 ch (20 MHz), 2 ch (40 MHz), 1 ch (80 MHz)
 Power source : DC 14.4 V

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

Table 2.2.2. 802.11b/g/n HT20 mode

UNII-1

Ch.	Frequency (MHz)
36	5 180
40	5 200
48	5 240

UNII-2A

Ch.	Frequency (MHz)
52	5 260
56	5 280
64	5 320

UNII-2C

Ch.	Frequency (MHz)
100	5 500
116	5 580
144	5 720

UNII-3

Ch.	Frequency (MHz)
149	5 745
157	5 785
165	5 825

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

UNII-1

Ch.	Frequency (MHz)
38	5 190
46	5 230

UNII-2A

Ch.	Frequency (MHz)
54	5 270
62	5 310

UNII-2C

Ch.	Frequency (MHz)
102	5 510
110	5 550
142	5 710

UNII-3

Ch.	Frequency (MHz)
151	5 755
159	5 795

Table 2.2.4. 802.11n/ac_HT40/VHT40 mode

UNII-1

Ch.	Frequency (MHz)
42	5 210

UNII-2A

Ch.	Frequency (MHz)
58	5 290

UNII-2C

Ch.	Frequency (MHz)
106	5 530
138	5 690

UNII-3

Ch.	Frequency (MHz)
155	5 775

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 or 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 ($\pm$)
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 (MHz)	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm ²]	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/f ²	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/f ²	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 MHz, * = 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 kHz

4.1. Test results

MPE (Maximum Permissible Exposure) Prediction

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

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

S = power density [mW/cm^2]

P = Power input to antenna [mW]

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 [cm]

Calculation Result of RF exposure

Maximum tune-up tolerance

- 2.4GHz

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
GFSK	2 441	3.50	2.24	0.29	1.07	0.000 48	1.000 00
802.11g	2 412	9.50	8.91	-0.70	0.85	0.001 51	1.000 00

- UNII-1

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11a	5 180	10.00	10.00	3.51	2.24	0.004 46	1.000 00
802.11an(HT20)	5 240	10.00	10.00	3.51	2.24	0.004 46	1.000 00
802.11an(HT40)	5 230	6.00	3.98	3.51	2.24	0.001 78	1.000 00
802.11ac(VHT20)	5 240	10.00	10.00	3.51	2.24	0.004 46	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	7.00	5.01	3.51	2.24	0.002 24	1.000 00

- UNII-2A

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11a	5 320	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11an(HT20)	5 320	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11an(HT40)	5 310	11.00	12.59	3.12	2.05	0.005 14	1.000 00
802.11ac(VHT20)	5 280	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	11.00	12.59	3.12	2.05	0.005 14	1.000 00

- UNII-2C

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11a	5 580	11.00	12.59	2.28	1.69	0.004 23	1.000 00
802.11an(HT20)	5 580	11.00	12.59	2.28	1.69	0.004 23	1.000 00
802.11an(HT40)	5 510	11.00	12.59	2.28	1.69	0.004 23	1.000 00
802.11ac(VHT20)	5 580	11.00	12.59	2.28	1.69	0.004 23	1.000 00
802.11ac(VHT40)	5 550	11.00	12.59	2.28	1.69	0.004 23	1.000 00
802.11ac(VHT80)	5 690	11.00	12.59	2.28	1.69	0.004 23	1.000 00

- UNII-3

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11a	5 785	11.00	12.59	-0.84	0.82	0.002 06	1.000 00
802.11an(HT20)	5 785	11.00	12.59	-0.84	0.82	0.002 06	1.000 00
802.11an(HT40)	5 795	11.00	12.59	-0.84	0.82	0.002 06	1.000 00
802.11ac(VHT20)	5 785	11.00	12.59	-0.84	0.82	0.002 06	1.000 00
802.11ac(VHT40)	5 755	11.00	12.59	-0.84	0.82	0.002 06	1.000 00
802.11ac(VHT80)	5 775	11.00	12.59	-0.84	0.82	0.002 06	1.000 00

- Simultaneous Transmission

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 320 MHz) + BT,GFSK (2 441 MHz)						0.007 13	1.000 00

Note.

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

2.4G WIFI: the ratio is 0.001 51 / 1

Bluetooth: the ratio is 0.000 48 / 1

5G WIFI: the ratio is 0.005 14 / 1

2.4G WIFI + Bluetooth + 5G WIFI Power density: (0.001 51 / 1 + 0.000 48 / 1 + 0.005 14 / 1)

- CDMA

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
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 [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
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 [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 320 MHz) + BT,GFSK (2 441 MHz) + LTE Band 5 (824.70 MHz)						0.386 114	1.000 000
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 320 MHz) + BT,GFSK (2 441 MHz) + CDMA BC0 (824.70 MHz)						0.386 114	1.000 000

Note.

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

2.4G WIFI: the ratio is 0.001 51 / 1

Bluetooth: the ratio is 0.000 48 / 1

5G WIFI: the ratio is 0.005 14 / 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:

(0.001 51 / 1 + 0.000 48 / 1 + 0.005 14 / 1 + 0.208 441 / 0.55)

2.4G WIFI + Bluetooth + 5G WIFI + CDMA Power density:

(0.001 51 / 1 + 0.000 48 / 1 + 0.005 14 / 1 + 0.208 441 / 0.55)

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	102398	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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