



# 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](http://www.kctl.co.kr)

Report No.:  
KR20-SRF0053-A

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# KCTL

### 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 / ATC32HYAN

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

5. FCC ID : TQ8-ATC32HYAN

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

7. Test Standards : FCC Part 15 Subpart C, 15.247

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.

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 The report No. KR20-SRF0053 is superseded by the report No. KR20-SRF0053-A.*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 : ATC32HYAN  
Derivative model : ATC32HCAN, ATC35HCAN  
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

Antenna specification : WIFI/Bluetooth(BDR/EDR)\_Pattern Antenna  
Antenna gain : 2.4GHz 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 °C ~ 70 °C

## 2.1. Information about derivative model

The difference between basic model and derivative models is:

The derivative models have a different product identification number.

ATC32HCAN(96560 P4720), ATC35HCAN(96560 P4920)

## 2.2. Frequency/channel operations

This device contains the following capabilities:

WIFI(2.4 GHz band 802.11b/g/n(HT20), 5 GHz band 802.11a/n(HT20/HT40)/ac(VHT/20/40/80)),  
Bluetooth(BDR/EDR)

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

Table 2.2.1. Bluetooth(BDR/EDR) mode

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  $U_{\text{CISPR}}$  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 <sup>2</sup> ]	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 <sup>2</sup>	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 <sup>2</sup>	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 [ $\text{mW}/\text{cm}^2$ ]

P = Power input to antenna [ $\text{mW}$ ]

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 [ $\text{cm}$ ]

### 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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
GFSK	2 441	4.00	2.51	0.29	1.07	0.000 53	1.000 00
802.11g	2 412	8.50	7.08	-0.70	0.85	0.001 20	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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11a	5 240	10.00	10.00	3.51	2.24	0.004 46	1.000 00
802.11n(HT20)	5 180	10.00	10.00	3.51	2.24	0.004 46	1.000 00
802.11n(HT40)	5 190	6.00	3.98	3.51	2.24	0.001 78	1.000 00
802.11ac(VHT20)	5 200	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	6.00	3.98	3.51	2.24	0.001 78	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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11a	5 280	10.00	10.00	3.12	2.05	0.004 08	1.000 00
802.11n(HT20)	5 280	10.00	10.00	3.12	2.05	0.004 08	1.000 00
802.11n(HT40)	5 270	10.00	10.00	3.12	2.05	0.004 08	1.000 00
802.11ac(VHT20)	5 280	10.00	10.00	3.12	2.05	0.004 08	1.000 00
802.11ac(VHT40)	5 310	10.00	10.00	3.12	2.05	0.004 08	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 [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11a	5 500	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11n(HT20)	5 580	10.00	10.00	2.28	1.69	0.003 36	1.000 00
802.11n(HT40)	5 550	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)	5 550	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

### - 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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11a	5 745	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11an(HT20)	5 745	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11an(HT40)	5 755	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11ac(VHT20)	5 785	10.00	10.00	-0.84	0.82	0.001 64	1.000 00
802.11ac(VHT40)	5 755	10.00	10.00	-0.84	0.82	0.001 64	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 [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Ant Gain [mW]	Power density at 20 cm [mW/cm <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 240 MHz) + BT,GFSK (2 441 MHz)						0.006 19	1.000 00

#### 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/cm<sup>2</sup>.
- Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

2.4G WIFI: the ratio is 0.001 20 / 1

Bluetooth: the ratio is 0.000 53 / 1

5G WIFI: the ratio is 0.004 46 / 1

2.4G WIFI + Bluetooth + 5G WIFI Power density: (0.001 20 / 1 + 0.000 53 / 1 + 0.004 46 / 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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
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 <sup>2</sup> ]	Limit [mW/cm <sup>2</sup> ]
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 240 MHz) + BT,GFSK (2 441 MHz) + LTE Band 5 (824.70 MHz)						0.385 174	1.000 000
802.11g (2 412 MHz) + 802.11a / UNII-1 (5 240 MHz) + BT,GFSK (2 441 MHz) + CDMA BC0 (824.70 MHz)						0.385 174	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/cm<sup>2</sup>.
- Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

2.4G WIFI: the ratio is 0.001 20 / 1

Bluetooth: the ratio is 0.000 53 / 1

5G WIFI: the ratio is 0.004 46 / 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 20 / 1 + 0.000 53 / 1 + 0.004 46 / 1 + 0.208 441 / 0.55)

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

(0.001 20 / 1 + 0.000 53 / 1 + 0.004 46 / 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**

*KCTL*