



# TEST REPORT

|                                                                                                                                                                                           |  |                                                          |                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------------------------------|-------------------------------------------------------------------------------------|
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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------------------------------------------------|-------------------------------------------------------------------------------------|

  

**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                                                                                                                | Technical Manager                                                                                    |
|             | Name : Euijung Kim<br><br>(Signature) | <br>(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 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  $U_{\text{CISPR}}$  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                        |

*KCTL*

## 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<br>(MHz)                                  | Electric Field<br>Strength<br>[V/m] | Magnetic Field<br>Strength<br>[A/m] | Power Density<br>[mW/cm <sup>2</sup> ] | Averaging<br>Time<br>[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<br>[MHz] | Max<br>Tune-up<br>Power<br>[dBm] | Max<br>Tune-up<br>Power<br>[mW] | Ant<br>Gain<br>[dBi] | Ant<br>Gain<br>[mW] | Power<br>density<br>at 20 cm<br>[mW/cm <sup>2</sup> ] | Limit<br>[mW/cm <sup>2</sup> ] |
|---------|--------------------|----------------------------------|---------------------------------|----------------------|---------------------|-------------------------------------------------------|--------------------------------|
| 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<br>[MHz] | Max<br>Tune-up<br>Power<br>[dBm] | Max<br>Tune-up<br>Power<br>[mW] | Ant<br>Gain<br>[dBi] | Ant<br>Gain<br>[mW] | Power<br>density<br>at 20 cm<br>[mW/cm <sup>2</sup> ] | Limit<br>[mW/cm <sup>2</sup> ] |
|-----------------|--------------------|----------------------------------|---------------------------------|----------------------|---------------------|-------------------------------------------------------|--------------------------------|
| 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                       |

#### - UNII-2A

| Mode            | Frequency<br>[MHz] | Max<br>Tune-up<br>Power<br>[dBm] | Max<br>Tune-up<br>Power<br>[mW] | Ant<br>Gain<br>[dBi] | Ant<br>Gain<br>[mW] | Power<br>density<br>at 20 cm<br>[mW/cm <sup>2</sup> ] | Limit<br>[mW/cm <sup>2</sup> ] |
|-----------------|--------------------|----------------------------------|---------------------------------|----------------------|---------------------|-------------------------------------------------------|--------------------------------|
| 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<br>[MHz] | Max<br>Tune-up<br>Power<br>[dBm] | Max<br>Tune-up<br>Power<br>[mW] | Ant<br>Gain<br>[dBi] | Ant<br>Gain<br>[mW] | Power<br>density<br>at 20 cm<br>[mW/cm <sup>2</sup> ] | Limit<br>[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)   | 5 500              | 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                       |

### - 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         | 5 825           | 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 [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 (5 180 MHz)<br>+ BT,GFSK (2 480 MHz) |                 |                         |                        |                |               | 0.008 23                                     | 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 0.002 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)

#### - 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 (5 180 MHz)<br>+ BT,GFSK (2 480 MHz) + LTE Band 5 (824.70 MHz) |                 |                         |                        |                |               | 0.387 214                                    | 1.000 000                   |
| 802.11g (2 412 MHz) + 802.11a / UNII-1 (5 180 MHz)<br>+ BT,GFSK (2 480 MHz) + CDMA BC0 (824.70 MHz)   |                 |                         |                        |                |               | 0.387 214                                    | 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 0.002 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)

## 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<br>ENGINEERING | 21-10     | 0005       | 20.01.25       |
| Attenuator            | API Inmet                | 40AH2W-10 | 17         | 20.05.15       |

**End of test report**

*KCTL*