

# TEST REPORT

of

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

FCC ID: TQ8-ADC400AAN

Equipment Under Test : DISPLAY CAR SYSTEM  
 Model Name : ADC400AAN  
 Variant Model Name : ADC401VAN  
 Applicant : Hyundai Mobis Co., Ltd.  
 Manufacturer : Hyundai Mobis Co., Ltd.  
 Date of Receipt : 2019.11.12  
 Date of Test(s) : 2019.11.28 ~ 2019.12.26  
 Date of Issue : 2019.12.31

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



Date:

2019.12.31

Murphy Kim

Technical  
Manager:



Date:

2019.12.31

Jungmin Yang

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RTT5041-19(2019.04.24)(1)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

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## 1. General Information

### 1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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Telephone : +82 31 688 0901

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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

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#### 1.4. Description of EUT

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Kind of Product      | DISPLAY CAR SYSTEM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Model Name           | ADC400AAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Variant Model Name   | ADC401VAN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Power Supply         | DC 14.4 V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Frequency Range      | 2 402 MHz ~ 2 480 MHz (Bluetooth)<br>2 412 MHz ~ 2 462 MHz (11b/g/n_HT20)<br>5 180 MHz ~ 5 240 MHz (Band 1: 11a/n_HT20, 11ac_VHT20)<br>5 190 MHz ~ 5 230 MHz (Band 1: 11n_HT40, 11ac_VHT40)<br>5 210 MHz (Band 1: 11ac_VHT80)<br>5 260 MHz ~ 5 320 MHz (Band 2A: 11a/n_HT20, 11ac_VHT20)<br>5 270 MHz ~ 5 310 MHz (Band 2A: 11n_HT40, 11ac_VHT40)<br>5 290 MHz (Band 2A: 11ac_VHT80)<br>5 500 MHz ~ 5 720 MHz (Band 2C: 11a/n_HT20, 11ac_VHT20)<br>5 510 MHz ~ 5 710 MHz (Band 2C: 11n_HT40, 11ac_VHT40)<br>5 530 MHz ~ 5 690 MHz (Band 2C: 11ac_VHT80)<br>5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20)<br>5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40)<br>5 775 MHz (Band 3: 11ac_VHT80) |
| Modulation Technique | DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Number of Channels   | 79 channels (Bluetooth)<br>11 channels (11b/g/n_HT20)<br>4 channels (Band 1: 11a/n_HT20, 11ac_VHT20)<br>2 channels (Band 1: 11n_HT40, 11ac_VHT40)<br>1 channel (Band 1: 11ac_VHT80)<br>4 channels (Band 2A: 11a/n_HT20, 11ac_VHT20)<br>2 channels (Band 2A: 11n_HT40, 11ac_VHT40)<br>1 channel (Band 2A: 11ac_VHT80)<br>9 channels (Band 2C: 11a/n_HT20, 11ac_VHT20)<br>4 channels (Band 2C: 11n_HT40, 11ac_VHT40)<br>2 channels (Band 2C: 11ac_VHT80)<br>5 channels (Band 3: 11a/n_HT20, 11ac_VHT20)<br>2 channels (Band 3: 11n_HT40, 11ac_VHT40)<br>1 channel (Band 3: 11ac_VHT80)                                                                                                                        |
| Antenna Type         | Pattern antenna                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Antenna Gain         | 2 400 MHz ~ 2 483.5 MHz: -0.18 dBi (Bluetooth)<br>2 400 MHz ~ 2 483.5 MHz: -0.01 dBi (WLAN 2.4 G)<br>5 150 MHz ~ 5 250 MHz: -0.61 dBi (WLAN 5G)<br>5 250 MHz ~ 5 350 MHz: -0.18 dBi (WLAN 5G)<br>5 470 MHz ~ 5 725 MHz: -0.77 dBi (WLAN 5G)<br>5 725 MHz ~ 5 850 MHz: -0.18 dBi (WLAN 5G)                                                                                                                                                                                                                                                                                                                                                                                                                   |

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### 1.5. Information of Variant Model

| Model Names   |           | Description |            |                    |     |     |     |     |    |         |
|---------------|-----------|-------------|------------|--------------------|-----|-----|-----|-----|----|---------|
|               |           | BT/WIFI     | FM/AM Code | INTERNAL /EXTERNAL | USB | RDS | DAB | SXM | HD | RHD/LHD |
| Basic Model   | ADC400AAN | BT/WIFI/LTE | A2         | EXTERNAL           | O   | O   | X   | O   | O  | LHD     |
| Variant Model | ADC401VAN | BT/WIFI/LTE | A2         | EXTERNAL           | O   | O   | X   | O   | O  | LHD     |

| CODE | BAND | FREQUENCY RANGE | STEP    | LOCAL  |
|------|------|-----------------|---------|--------|
| A2   | FM   | 87.5-107.9 MHz  | 200 kHz | NA/GEN |
|      | AM   | 530-1710 kHz    | 10 kHz  |        |

### 1.6. Test Report Revision

| Revision | Report Number        | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501-RF-RTL000162 | 2019.12.31    | Initial     |

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## 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<br>(MHz)                                | Electric Field<br>Strength<br>(V/m) | Magnetic Field<br>Strength<br>(A/m) | Power Density<br>(mW/cm <sup>2</sup> ) | 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 <sup>2</sup>                    | 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 <sup>2</sup>                    | 30               |
| 30-300                                                  | 27.5                                | 0.073                               | 0.2                                    | 30               |
| <b><u>300-1 500</u></b>                                 | -                                   | -                                   | <b><u>f/1500</u></b>                   | <b><u>30</u></b> |
| <b><u>1 500-100 000</u></b>                             | -                                   | -                                   | <b><u>1.0</u></b>                      | <b><u>30</u></b> |

#### 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/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

G = gain of antenna in linear scale

$\pi$  = 3.1416

R = distance between observation point and center of the radiator in cm

$P_d$  the limit of MPE, 1 mW/cm<sup>2</sup>. 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.

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### 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<br>(MHz) | Cable Loss<br>(dB) | Antenna Gain<br>(dB i) | Final Antenna Gain<br>(dB i) |
|---------------|--------------------|--------------------|------------------------|------------------------------|
| CDMA - BC0    | 824 ~ 849          | -1.79              | 4.26                   | 2.47                         |
| CDMA - BC1    | 1 850 ~ 1 910      | -2.62              | 4.20                   | 1.58                         |
| LTE - Band 2  | 1 850 ~ 1 910      | -2.62              | 4.20                   | 1.58                         |
| LTE - Band 4  | 1 710 ~ 1 755      | -2.62              | 3.28                   | 0.66                         |
| LTE - Band 5  | 824 ~ 849          | -1.79              | 4.26                   | 2.47                         |
| LTE - Band 13 | 777 ~ 787          | -1.79              | 3.10                   | 1.31                         |

**Note;**

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

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## 2.1.4. Output Power into Antenna & RF Exposure Evaluation Distance

### Bluetooth

#### - Maximum tune up tolerance

| Frequency (MHz) | Output Average Power to Antenna (dB m) | Antenna Gain (dB i) | Power Density at 20 cm (mW/cm <sup>2</sup> ) | Limits (mW/cm <sup>2</sup> ) |
|-----------------|----------------------------------------|---------------------|----------------------------------------------|------------------------------|
| 2 402 ~ 2 480   | 4                                      | -0.18               | 0.000 479                                    | 1                            |

### WLAN (2.4G)

#### - Maximum tune up tolerance

| Frequency (MHz) | Output Average Power to Antenna (dB m) | Antenna Gain (dB i) | Power Density at 20 cm (mW/cm <sup>2</sup> ) | Limits (mW/cm <sup>2</sup> ) |
|-----------------|----------------------------------------|---------------------|----------------------------------------------|------------------------------|
| 2 412 ~ 2 462   | 12                                     | -0.01               | 0.003 146                                    | 1                            |

### WLAN (5G)

#### - Maximum tune up tolerance

| Frequency (MHz) | Output Average Power to Antenna (dB m) | Antenna Gain (dB i) | Power Density at 20 cm (mW/cm <sup>2</sup> ) | Limits (mW/cm <sup>2</sup> ) |
|-----------------|----------------------------------------|---------------------|----------------------------------------------|------------------------------|
| 5 180 ~ 5 240   | 10                                     | -0.61               | 0.001 729                                    | 1                            |
| 5 260 ~ 5 320   | 10                                     | -0.18               | 0.001 909                                    | 1                            |
| 5 500 ~ 5 720   | 10                                     | -0.77               | 0.001 666                                    | 1                            |
| 5 745 ~ 5 825   | 10                                     | -0.18               | 0.001 909                                    | 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 <sup>2</sup> ) | Limits (mW/cm <sup>2</sup> ) |
|-----------------------|----------------------------------------|---------------------------|----------------------------------------------|------------------------------|
| 824 ~ 849             | 25                                     | 2.47                      | 0.111 104                                    | 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 <sup>2</sup> ) | Limits (mW/cm <sup>2</sup> ) |
|-----------------------|----------------------------------------|---------------------------|----------------------------------------------|------------------------------|
| 1 850 ~ 1 910         | 25                                     | 1.58                      | 0.090 517                                    | 1                            |

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#### LTE - Band 2

##### - Maximum Tune Up Tolerance

| Frequency Range<br>(MHz) | Output Average<br>Power to Antenna<br>(dB m) | Final Antenna<br>Gain<br>(dB i) | Power Density<br>at 20 cm<br>(mW/cm <sup>2</sup> ) | Limits<br>(mW/cm <sup>2</sup> ) |
|--------------------------|----------------------------------------------|---------------------------------|----------------------------------------------------|---------------------------------|
| 1 850 ~ 1 910            | 24                                           | 1.58                            | 0.071 900                                          | 1                               |

#### LTE - Band 4

##### - Maximum Tune Up Tolerance

| Frequency Range<br>(MHz) | Output Average<br>Power to Antenna<br>(dB m) | Final Antenna<br>Gain<br>(dB i) | Power Density<br>at 20 cm<br>(mW/cm <sup>2</sup> ) | Limits<br>(mW/cm <sup>2</sup> ) |
|--------------------------|----------------------------------------------|---------------------------------|----------------------------------------------------|---------------------------------|
| 1 710 ~ 1 755            | 24                                           | 0.66                            | 0.058 174                                          | 1                               |

#### LTE - Band 5

##### - Maximum Tune Up Tolerance

| Frequency Range<br>(MHz) | Output Average<br>Power to Antenna<br>(dB m) | Final Antenna<br>Gain<br>(dB i) | Power Density<br>at 20 cm<br>(mW/cm <sup>2</sup> ) | Limits<br>(mW/cm <sup>2</sup> ) |
|--------------------------|----------------------------------------------|---------------------------------|----------------------------------------------------|---------------------------------|
| 824 ~ 849                | 24                                           | 2.47                            | 0.088 253                                          | 0.55                            |

#### LTE - Band 13

##### - Maximum Tune Up Tolerance

| Frequency Range<br>(MHz) | Output Average<br>Power to Antenna<br>(dB m) | Final Antenna<br>Gain<br>(dB i) | Power Density<br>at 20 cm<br>(mW/cm <sup>2</sup> ) | Limits<br>(mW/cm <sup>2</sup> ) |
|--------------------------|----------------------------------------------|---------------------------------|----------------------------------------------------|---------------------------------|
| 777 ~ 787                | 24                                           | 1.31                            | 0.067 566                                          | 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/cm<sup>2</sup>.
- 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 colocated or operating in conjunction with any other antenna or transmitter unless authorized to do so by the FCC.

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

Bluetooth: the ratio is 0.000 479 / 1

WLAN: the ratio is 0.003 146 / 1

WWLAN: the ratio is 0.111 104 / 0.55

Confirm the sum result of individual MPEs ratio is  $\leq 1.0$ ;

Bluetooth + WLAN + WWLAN:  $(0.000\ 479 / 1) + (0.003\ 146 / 1) + (0.111\ 104 / 0.55)$   
 $= 0.205\ 632 \leq 1.0$

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**- End of the Test Report -**

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