

# TEST REPORT

of

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

FCC ID: TQ8LI99700020

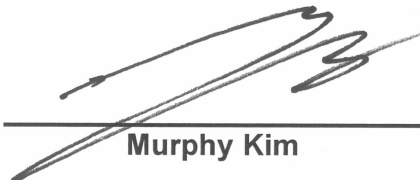
Equipment Under Test : Remote Vehicle Assistance  
Model Name : LI99700020  
Variant Model Name(s) : -  
Applicant : HYUNDAI MOBIS CO., LTD.  
Manufacturer : HYUNDAI MOBIS CO., LTD.  
Date of Receipt : 2022.07.11  
Date of Test(s) : 2022.07.11 ~ 2023.02.03  
Date of Issue : 2023.02.03

In the configuration tested, the EUT complied with the standards specified above. This test report does not assure KOLAS accreditation.

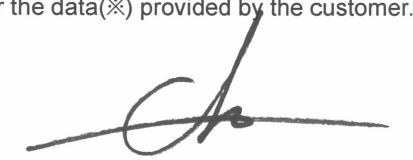
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- 2) The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received.
- 3) This test report cannot be reproduced, except in full, without prior written permission of the Company.
- 4) The data marked ※ in this report was provided by the customer and may affect the validity of the test results.

We are responsible for all the information of this test report except for the data(※) provided by the customer.

Tested by:

  
Murphy Kim

Technical  
Manager:

  
Jinhyoung Cho

**SGS Korea Co., Ltd. Gunpo Laboratory**



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Report Number: F690501-RF-RTL003928

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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
- CAB Identifier: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

Phone No. : +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

### 1.4. Description of EUT

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Kind of Product</b>      | Remote Vehicle Assistance                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Model Name</b>           | LI99700020                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Serial Number</b>        | 863789050196050                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Power Supply</b>         | DC 12.7 V                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Rated Power</b>          | LTE Band 2, 4, 5, 7, 12, 13, 14, 25, 26, 66, 71: 23 dBm                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Frequency Range</b>      | LTE Band 2: 1 850 MHz ~ 1 910 MHz<br>LTE Band 4: 1 710 MHz ~ 1 755 MHz<br>LTE Band 5: 824 MHz ~ 849 MHz<br>LTE Band 7: 2 500 MHz ~ 2 570 MHz<br>LTE Band 12: 699 MHz ~ 716 MHz<br>LTE Band 13: 777 MHz ~ 787 MHz<br>LTE Band 14: 788 MHz ~ 798 MHz<br>LTE Band 25: 1 850 MHz ~ 1 915 MHz<br>LTE Band 26(FCC Only): 814 MHz ~ 824 MHz<br>LTE Band 26: 824 MHz ~ 849 MHz<br>LTE Band 66: 1 710 MHz ~ 1 780 MHz<br>LTE Band 71: 663 MHz ~ 698 MHz |
| <b>Uplink CA Bands</b>      | 5B, 7C, 66B, 66C                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Modulation Technique</b> | QPSK, 16QAM, 64QAM                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Antenna Type</b>         | Monopole antenna                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Antenna Gain*</b>        | Refer to the clause 1.5                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>H/W Version</b>          | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>S/W Version</b>          | 1.0                                                                                                                                                                                                                                                                                                                                                                                                                                            |

## 1.5. Antenna Information

| Operating Frequency (MHz) |               | Antenna Peak Gain (dB i) |           |                          |                          |
|---------------------------|---------------|--------------------------|-----------|--------------------------|--------------------------|
|                           |               | Ant. No                  | Ant. Gain | Cable Loss <sup>1)</sup> | Final Gain <sup>2)</sup> |
| Band 71                   | 663 ~ 698     | Ant. 1                   | 3.91      | 1.23                     | 2.68                     |
|                           |               | Ant. 2                   | 3.91      | 1.23                     | 2.68                     |
|                           |               | Ant. 3                   | 5.36      | 1.23                     | 4.13                     |
|                           |               | Ant. 4                   | 5.07      | 1.23                     | 3.84                     |
|                           |               | Ant. 5                   | 4.21      | 1.23                     | 2.98                     |
| Band 12                   | 699 ~ 716     | Ant. 1                   | 3.91      | 1.23                     | 2.68                     |
|                           |               | Ant. 2                   | 3.91      | 1.23                     | 2.68                     |
|                           |               | Ant. 3                   | 5.36      | 1.23                     | 4.13                     |
|                           |               | Ant. 4                   | 5.07      | 1.23                     | 3.84                     |
|                           |               | Ant. 5                   | 4.21      | 1.23                     | 2.98                     |
| Band 13                   | 777 ~ 787     | Ant. 1                   | 4.19      | 1.40                     | 2.79                     |
|                           |               | Ant. 2                   | 2.99      | 1.40                     | 1.59                     |
|                           |               | Ant. 3                   | 4.95      | 1.40                     | 3.55                     |
|                           |               | Ant. 4                   | 3.03      | 1.40                     | 1.63                     |
|                           |               | Ant. 5                   | 4.13      | 1.40                     | 2.73                     |
| Band 14                   | 788 ~ 798     | Ant. 1                   | 4.19      | 1.40                     | 2.79                     |
|                           |               | Ant. 2                   | 2.99      | 1.40                     | 1.59                     |
|                           |               | Ant. 3                   | 4.95      | 1.40                     | 3.55                     |
|                           |               | Ant. 4                   | 3.03      | 1.40                     | 1.63                     |
|                           |               | Ant. 5                   | 4.13      | 1.40                     | 2.73                     |
| Band 26<br>Part 90        | 814 ~ 824     | Ant. 1                   | 4.88      | 1.40                     | 3.48                     |
|                           |               | Ant. 2                   | 3.67      | 1.40                     | 2.27                     |
|                           |               | Ant. 3                   | 4.69      | 1.40                     | 3.29                     |
|                           |               | Ant. 4                   | 4.26      | 1.40                     | 2.86                     |
|                           |               | Ant. 5                   | 5.48      | 1.40                     | 4.08                     |
| Band 26/5<br>Part 22      | 824 ~ 849     | Ant. 1                   | 6.49      | 1.40                     | 5.09                     |
|                           |               | Ant. 2                   | 5.31      | 1.40                     | 3.91                     |
|                           |               | Ant. 3                   | 6.53      | 1.40                     | 5.13                     |
|                           |               | Ant. 4                   | 5.21      | 1.40                     | 3.81                     |
|                           |               | Ant. 5                   | 5.83      | 1.40                     | 4.43                     |
| Band 66/4                 | 1 710 ~ 1 780 | Ant. 1                   | -0.26     | 2.10                     | -2.36                    |
|                           |               | Ant. 2                   | -1.88     | 2.10                     | -3.98                    |
|                           |               | Ant. 3                   | -0.34     | 2.10                     | -2.44                    |
|                           |               | Ant. 4                   | -0.97     | 2.10                     | -3.07                    |
|                           |               | Ant. 5                   | -0.32     | 2.10                     | -2.42                    |
| Band 25/2                 | 1 850 ~ 1 915 | Ant. 1                   | -0.90     | 2.10                     | -3.00                    |
|                           |               | Ant. 2                   | -0.31     | 2.10                     | -2.41                    |
|                           |               | Ant. 3                   | -0.40     | 2.10                     | -2.50                    |
|                           |               | Ant. 4                   | 1.79      | 2.10                     | -0.31                    |
|                           |               | Ant. 5                   | 1.64      | 2.10                     | -0.46                    |
| Band 7                    | 2 500 ~ 2 570 | Ant. 1                   | 5.03      | 2.35                     | 2.68                     |
|                           |               | Ant. 2                   | 4.63      | 2.35                     | 2.28                     |
|                           |               | Ant. 3                   | 3.34      | 2.35                     | 0.99                     |
|                           |               | Ant. 4                   | 4.54      | 2.35                     | 2.19                     |
|                           |               | Ant. 5                   | 3.44      | 2.35                     | 1.09                     |

Note;

1) It is a cable that is permanently connected between the antenna and the EUT

2) In this report, Final gain reflecting the cable loss was used.

## 1.6. Summary of Test Results

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part 1 |                        |          |
|------------------------------|------------------------|----------|
| Section                      | Test Item(s)           | Result   |
| 1.1307(b)(3)                 | RF Exposure Evaluation | Complied |

## 1.7. Test Report Revision

| Revision | Report Number        | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0        | F690501-RF-RTL003928 | 2023.02.03    | Initial     |

One telematics unit contains five independent LTE modules that can operate simultaneously. Only one type of LTE module is fitted to the device via internal USB communication. All five independent modules have the electrically equivalent. Since all five ports are the electrically equivalent module, representatively, all test items were performed on port 1. Radiated spurious emissions were tested separately because the antennas are all different.

## 2. SAR-based Exemption

A more comprehensive exemption, considering a variable power threshold that depends on both the separation distance and power, is provided in § 1.1307(b)(3)(i)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with test separation distances between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions. Accordingly, a RF source is considered an RF exempt device if its available maximum time-averaged (matched conducted) power or its effective radiated power (ERP), whichever is greater, are below a specified threshold. This exemption threshold was derived based on general population 1-g SAR requirements and is detailed in Appendix C.

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left( \frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

$d$  = the separation distance (cm);

### 3. Test Result

| Mode          | Frequency Range (MHz) | Maximum Average Power (dB m) | Antenna Gain (dB i) | Minimum Separation Distance (cm) | Maximum Average Power (mW) | ERP (mW) | Limits $P_{th}$ (mW) | Ratio | Result |
|---------------|-----------------------|------------------------------|---------------------|----------------------------------|----------------------------|----------|----------------------|-------|--------|
| LTE Band 71   | 663 ~ 698             | 24.0                         | 4.13                | 8.5                              | 251.19                     | 396.28   | 458.69               | 0.864 | Pass   |
| LTE Band 12   | 699 ~ 716             | 24.0                         | 4.13                | 8.5                              | 251.19                     | 396.28   | 469.55               | 0.844 | Pass   |
| LTE Band 13   | 777 ~ 787             | 24.0                         | 3.55                | 8.5                              | 251.19                     | 346.74   | 492.06               | 0.705 | Pass   |
| LTE Band 14   | 788 ~ 798             | 24.0                         | 3.55                | 8.5                              | 251.19                     | 346.74   | 495.13               | 0.700 | Pass   |
| LTE Band 26   | 814 ~ 824             | 23.7                         | 4.08                | 8.5                              | 234.42                     | 365.59   | 502.30               | 0.728 | Pass   |
| LTE Band 26/5 | 824 ~ 849             | 23.7                         | 5.13                | 8.5                              | 234.42                     | 465.59   | 505.02               | 0.922 | Pass   |
| LTE Band 66/4 | 1 710 ~ 1 780         | 24.0                         | -2.36               | 8.5                              | 251.19                     | 88.92    | 642.51               | 0.138 | Pass   |
| LTE Band 25/2 | 1 850 ~ 1915          | 24.0                         | -0.31               | 8.5                              | 251.19                     | 142.56   | 633.18               | 0.225 | Pass   |
| LTE Band 7    | 2 500 ~2 570          | 24.0                         | 2.68                | 8.5                              | 251.19                     | 283.79   | 598.73               | 0.474 | Pass   |

## 4. RF Exposure Evaluation Plan - Total Exposure Ratio (TER)

The worst  $P_{\max}/P_{\text{th}}$  ratio is 0.922 at 824 MHz (LTE 26/5).

5 Simultaneous operations of the worst case would exceed the routine evaluation exemption threshold.

TER                       $0.922 \times 5 = 4.610 > 1$   
Additional evaluation is needed

## 5. RF Exposure Evaluation Plan - Estimated SAR method

**KDB 447498 D04 Interim General RF Exposure Guidance v01**

**Appendix E, SAR Estimations for Simultaneous Transmission Test Exemptions**

### 5.1. Estimated SAR

When an antenna qualifies for test exemption in single transmitter/antenna mode, its actual SAR value may not be available, because it was not required to be measured. In this case, the SAR contribution of that antenna to simultaneous transmission must be estimated relative to the SAR or MPE based exemption criteria for the applicable terms in the equation of § 1.1307(b)(3)(ii)(B) (see also Appendix C), by multiplying the corresponding ratio by the SAR limit of 1.6 W/kg for 1-g SAR. This is referred to as estimated SAR. For instance, a given antenna may qualify for a SAR-based exemption according to Section B.4, with  $P_{\text{ant}} < P_{\text{th}}$ , where  $P_{\text{ant}}$  is maximum time-averaged power or effective radiated power (ERP), whichever is greater, and  $P_{\text{th}}$  is defined in Formula (B.2). Then, per the preceding paragraph, the estimated SAR is computed as  $\text{SAR}_{\text{est}} = 1.6 \cdot P_{\text{ant}} / P_{\text{th}}$  [W/kg]. When SAR is estimated, the peak SAR location is assumed to be at the feed-point or geometric center of the antenna, whichever provides a smaller antenna separation distance, and this location must be clearly identified in test reports. The estimated SAR is used only to determine simultaneous transmission SAR test exemption; it shall not be reported as the standalone SAR.

| Mode | Band      | Frequency Range (MHz) | ERP / Maximum Average Power (mW) | $P_{\text{th}}$ (mW) | $P_{\max}/P_{\text{th}}$ [B] | SAR Limit [A] | Estimated SAR [A] x [B] |
|------|-----------|-----------------------|----------------------------------|----------------------|------------------------------|---------------|-------------------------|
| LTE  | Band 71   | 663 ~ 698             | 396.28                           | 458.69               | 0.864                        | 1.600         | 1.382                   |
| LTE  | Band 12   | 699 ~ 716             | 396.28                           | 469.55               | 0.844                        | 1.600         | 1.350                   |
| LTE  | Band 13   | 777 ~ 787             | 346.74                           | 492.06               | 0.705                        | 1.600         | 1.127                   |
| LTE  | Band 14   | 788 ~ 798             | 346.74                           | 495.13               | 0.700                        | 1.600         | 1.120                   |
| LTE  | Band 26   | 814 ~ 824             | 365.59                           | 502.30               | 0.728                        | 1.600         | 1.165                   |
| LTE  | Band 26/5 | 824 ~ 849             | 465.59                           | 505.02               | 0.922                        | 1.600         | 1.475                   |
| LTE  | Band 66/4 | 1 710 ~ 1 780         | 88.92                            | 642.51               | 0.138                        | 1.600         | 0.221                   |
| LTE  | Band 25/2 | 1 850 ~ 1915          | 142.56                           | 633.18               | 0.225                        | 1.600         | 0.360                   |
| LTE  | Band 7    | 2 500 ~2 570          | 283.79                           | 598.73               | 0.474                        | 1.600         | 0.758                   |

The worst estimated SAR value is 1.475 W/kg and does not exceed the limit 1.6 W/kg.



## 5.2 RF Exposure Evaluation Plan - SAR to Peak Location Separation Ratio (SPLSR)

### KDB 447498 D04 Interim General RF Exposure Guidance v01

#### 2.2.3 Test Exemption Based on the SAR to Peak Location Separation Ratio

When the ERP-based condition in the previous section does not apply, a test exemption may be still applicable based on the SAR to peak location separation ratio (SPLSR) [Glossary] procedure, discussed in more detail in Appendix E. In this case, the simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SPLSR that qualifies for the additional test exemption. This ratio is defined as  $SPLSR = (SAR_1 + SAR_2) 1.5 / R_i$ , where  $SAR_1$  and  $SAR_2$  are the highest reported SAR or estimated SAR [Glossary] values for the two sources in the pair  $i$ , and  $R_i$  is their distance in millimeters. When  $SPLSR \leq 0.04$  (rounded to two decimal digits), for all antenna pairs in the configuration, then the device qualifies for 1-g SAR test exemption. When 10-g SAR applies, the corresponding test exemption condition is  $SPLSR \leq 0.10$ . If any antenna pair does not qualify for simultaneous transmission SAR test exemption, then the device must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Pub. 865664 D01.

### KDB 447498 D04 Interim General RF Exposure Guidance v01

#### Appendix E, SAR Estimations for Simultaneous Transmission Test Exemptions

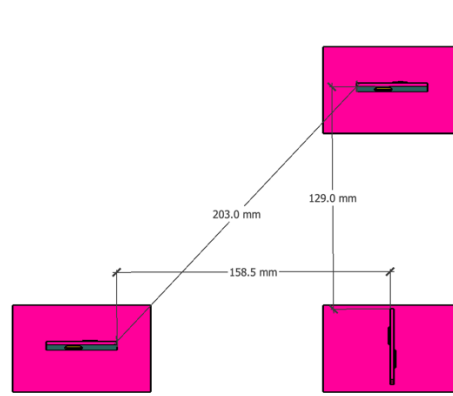
When standalone SAR is measured, the peak location is determined by the x, y, z coordinates of the results reported by the zoom scan measurement, or area scan measurement when area scan based 1-g SAR estimation is applicable (these results in general way need extrapolation and/or interpolation to identify the actual peak locations). Some SAR systems may have provisions to compute peak location separation distance automatically. however, it must be verified that the peak location separation distance is determined according to the correct 1-g peak SAR locations to avoid errors in noisy SAR distributions with several relative peaks near each other. When SAR is estimated for both antennas considered in a pairwise SPLSR analysis, the peak location separation shall be determined by the closest physical separation of the antennas, according to the feed-point or geometric center of the antennas, whichever is more conservative.

The closest distance between transmit antennas is 129 mm.

$$SPLSR = \frac{(SAR_1 + SAR_2)^{1.5}}{R}$$

$$(1.475 + 1.475)^{1.5} / 129 = 0.03928 < 0.04$$

No simultaneous evaluation is necessary



## Conclusion

The product has 5 simultaneous operational transmitters. Considering all antennas, cable loss, output power and distance between antenna and human body, 5 transmitters can be operational without exceeding FCC RF Exposure limits.

- End of the Test Report -