

# **TEST REPORT**

of

FCC Part 15 Subpart E §15.407 RSS-247 Issue 2

## FCC ID: TQ8-ATC31F6AN IC Certification: 5041A-ATC31F6KN

Equipment Under Test	:	DIGITAL CAR AVN SYSTEM
FCC Model Name	:	ATC31F6AN
IC Model Name	:	ATC31F6KN
FCC Variant Model Name	:	ATC30F6AN
IC Variant Model Name	:	ATC30F6KN
Applicant	:	Hyundai Mobis Co., Ltd.
Manufacturer	:	Hyundai Mobis Co., Ltd.
Date of Receipt	:	2019.03.20
Date of Test(s)	:	2019.03.21 ~ 2019.05.14
Date of Issue	:	2019.05.29

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

Tested By:	0 32	Date:	2019.05.29	
-	Murphy Kim			
Technical Manager: –	Jungmin Yang	Date:	2019.05.29	



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 A4(210 mm × 297 mm)



## **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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## 1.2. Details of Applicant

Applicant	:	Hyundai Mobis Co., Ltd.
Address	:	203, Teheran-ro, Gangnam-gu, Seoul, South Korea, 06141
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

Kind of Product	DIGITAL CAR AVN SYSTEM		
Model Name	FCC : ATC31F6AN IC : ATC31F6KN		
Variant Model Name	FCC : ATC30F6AN IC : ATC30F6KN		
Power Supply	DC 14.4 V		
Frequency Range	5 745 Mb       ~ 5 825 Mb       (Band 3: 11a/n_HT20, 11ac_VHT20),         5 755 Mb       ~ 5 795 Mb       (Band 3: 11n_HT40, 11ac_VHT40),         5 775 Mb       (Band 3: 11ac_VHT80),         5 180 Mb       ~ 5 240 Mb       (Band 1: 11a/n_HT20, 11ac_VHT20),         5 190 Mb       ~ 5 230 Mb       (Band 1: 11n_HT40, 11ac_VHT40),         5 210 Mb       ~ 5 230 Mb       (Band 2A: 11n_HT40, 11ac_VHT40),         5 260 Mb       ~ 5 320 Mb       (Band 2A: 11a/n_HT20, 11ac_VHT20),         5 270 Mb       ~ 5 310 Mb       (Band 2A: 11a/n_HT20, 11ac_VHT20),         5 290 Mb       (Band 2A: 11a/n_HT40, 11ac_VHT40),       5 290 Mb         5 500 Mb       ~ 5 720 Mb       (Band 2C: 11a/n_HT20, 11ac_VHT20),         5 510 Mb       ~ 5 710 Mb       (Band 2C: 11a/n_HT40, 11ac_VHT40),         5 530 Mb       ~ 5 690 Mb       (Band 2C: 11a/n_HT40, 11ac_VHT40),         5 530 Mb       ~ 5 690 Mb       (Band 2C: 11a/n_HT40, 11ac_VHT40),		
Modulation Technique	OFDM		

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Number of Channels	5 channel (Band 3: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 3: 11n_HT40, 11ac_VHT40), 1 channel (Band 3: 11ac_VHT80), 4 channel (Band 1: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 1: 11n_HT40, 11ac_VHT40), 1 channel (Band 1: 11ac_VHT80), 4 channel (Band 2A: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 2A: 11a/n_HT20, 11ac_VHT20), 1 channel (Band 2A: 11n_HT40, 11ac_VHT40), 1 channel (Band 2A: 11ac_VHT80), 9 channel (Band 2C: 11a/n_HT20, 11ac_VHT20), 4 channel (Band 2C: 11a/n_HT40, 11ac_VHT40), 2 channel (Band 2C: 11n_HT40, 11ac_VHT40), 2 channel (Band 2C: 11n_HT40, 11ac_VHT40), 2 channel (Band 2C: 11ac_VHT80)
Antenna Type	PCB pattern antenna
Antenna Gain	5 150 Mtz       ~ 5 250 Mtz: 2.75 dB i,         5 250 Mtz       ~ 5 350 Mtz: 2.75 dB i,         5 470 Mtz       ~ 5 725 Mtz: -0.80 dB i,         5 725 Mtz       ~ 5 850 Mtz: -1.24 dB i

#### 1.5. Declaration by the Manufacturer

- The EUT is a slave without radar detection and TPC.

- The EUT is not supported TDWR(5.6 - 5.65 GHz) band.

#### **1.6. Test Equipment List**

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	255834	Jun. 15, 2018	Annual	Jun. 15, 2019
Spectrum Analyzer	R&S	FSV30	103210	Dec. 05, 2019	Annual	Dec. 05, 2020
Attenuator	MCLI	FAS-23-20	23834	Jun. 12, 2018	Annual	Jun. 12, 2019
Power Splitter	Mini-Circuits	ZFSC-2-10G	001	Jun. 12, 2018	Annual	Jun. 12, 2019
Power Splitter	Mini-Circuits	ZFSC-2-10G	002	Jun. 12, 2018	Annual	Jun. 12, 2019
DC Power Supply	R&S	HMP2020	019258024	Nov. 06, 2018	Annual	Nov. 06, 2019

#### Support Equipment

Description	Manufacturer	Model	FCC ID	
Access Point	Cisco system Inc.	AIR-RM3000AC-A-K9	LDK102086	
Notebook	LG Electronics Inc.	LGE-DMLGA51	-	



#### 1.7. Summary of Test Result

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart E, RSS-247 Issue 2				
Se	ection	Test Item	Result	
15.407(h)	RSS-247 Issue 2 6.3	DFS -Channel closing transmission time -Channel move time -Non occupied period	Complied	

#### 1.8. Test Report Revision

Revision	Report Number	Date of Issue	Description
0	F690501/RF-RTL013877	2019.05.29	Initial

#### **1.9. Information of Variant Models**

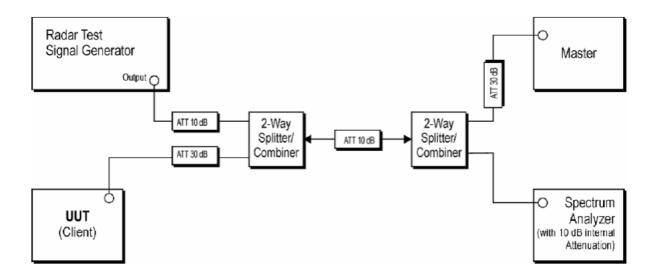
Model Name		Description
FCC basic model	ATC31F6AN	<ul> <li>Basic model</li> <li>SVM camera(Surround View) is installed</li> </ul>
FCC variant model	ATC30F6AN	<ul> <li>Same to basic model except the specification of camera</li> <li>RVM camera(Rear View) is installed</li> </ul>
IC basic model	ATC31F6KN	<ul> <li>Basic model</li> <li>SVM camera(Surround View) is installed</li> </ul>
IC variant model	ATC30F6KN	<ul> <li>Same to basic model except the specification of camera</li> <li>RVM camera(Rear View) is installed</li> </ul>



## 2. DFS (Dynamic Frequency Selection)

## 2.1. System overview

## 2.1.1. Set up of EUT



The radar signal generation equipment consists of a vector signal generator

The signal monitoring equipment consists of a spectrum analyzer set to display 8 001 bins on the horizontal axis. The time domain resolution is 2 msec/bin with a 16 second sweep time, meeting the 10 second short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

The Slave is tested separately for compliance with the Channel Shutdown requirements, for the situation when the Slave device vacates the channel in response to detection of a radar by the Master.

All tests were performed at a channel center frequency of 5 290 Mb and 5 530 Mb. Measurements were performed using conducted test methods.



## 2.2 Limit

§15.407 (h) and FCC 06-96 APPENDIX "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVCIES OPERATING IN THE 5 250 - 5 350 M₂ AND 5 470 - 5 725 M₂ BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION

RSS-247 Issue 2 6.3 AND FCC 06-96 APPENDIX "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVCIES OPERATING IN THE 5 250-5 350 Mz AND 5 470-5 725 Mz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION"

Industry Canada requires the use of either the FCC KDB Procedure 905462 or the procedure in the ETSI EN 301 893 for demonstrating compliance with the DFS radar detection requirements set out in this section.

#### Table 1: Applicability of DFS Requirements Prior to Use of a Channel

		Operational Mode			
Requirement	Master	Client Without Radar Detection	Client With Radar Detection		
Non-Occupancy Period	Yes	Not required	Yes		
DFS Detection Threshold	Yes	Not required	Yes		
Channel Availability Check Time	Yes	Not required	Not required		
U-NII Detection Bandwidth	Yes	Not required	Yes		

#### Table 2: Applicability of DFS requirements during normal operation

	Operational Mode			
Requirement	Master Device or Client with	Client Without Rader		
	Radar Detection	Detection		
DFS Detection Threshold	Yes	Not required		
Channel Closing Transmission Time	Yes	Yes		
Channel Move Time	Yes	Yes		
U-NII Detection Bandwidth	Yes	Not required		



Additional requirement for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Rader Detection			
U-NII Detection Bandwidth and Statistical Performance Check	All BT modes must be tested	Not required			
Channel Move Time and Channel	Test using widest BT mode	Test using the widest			
Closing Transmission Time	available	BW mode available for the link			
All other tests	Any single BW mode	Not required			
<b>Note:</b> Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded					

20 MHz channels and the channel center frequency.

#### Table 3: DFS Detection Thresholds for Master Devices and Client Devices With Radar Detection

Maximum Transmit Power	Value (See Note 1, 2, and 3)	
$EIRP \ge 200 \text{ milliwatt}$	<b>-64</b> dB <b>m</b>	
EIRP < 200 milliwatt and	-62 dB m	
power spectral density < 10 dB m/MHz	-02 ub m	
EIRP < 200 milliwatt that do not meet the power spectral	-64 dB m	
density requirement		

**Note 1:** This is the level at the input of the receiver assuming a 0 dB i receive antenna.

**Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.

**Note 3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.

#### KDB 905462 D03 Client Without DFS New Rules v01r02: UNII client devices without radar detection

• The guidance provided in Section 8 (DFS Test Report Guidelines) in the appropriate DFS Test Procedure specified in KDB Publication 905462 D02.

 $\cdot$  Test results demonstrating an associated client link is established with the master on a test frequency; if a client device operates in a "listen only" mode to a master without formally "associating" with it the test report must include tests for such modes.

• The devices must be tested with a master device operating in the same band and operation modes.

• If two client devices can communicate directly with each other while maintaining an association with a master or if the client operates on a frequency band while "listening" to a master, such modes must be tested with the master device active.

• The client and DFS-certified master device are associated, and a movie can be streamed as specified in the DFS Order for a non-occupancy period test.

• The test frequency has been monitored to ensure no transmission of any type has occurred for 30 minutes. Note: If the client moves with the master, the device is considered compliant if nothing appears in the client non-occupancy period test. For devices that shut down (rather than moving channels), no beacons should appear.

• An analyzer plot that contains a single 30-minute sweep on the original channel.

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Table 4: DFS Response Requirement values				
Parameter	Value			
Non-occupancy period	Minimum 30 minutes			
Channel Availability Check Time	60 seconds			
Channel Move Time	10 seconds See Note 1.			
	200 milliseconds + an aggregate of 60			
Channel Closing Transmission Time	milliseconds over remaining 10 second period.			
	See Notes 1 and 2.			
U-NII Detection Bandwidth	Minimum 100 % of the U-NII 99 % transmission			
	power bandwidth. See Note 3.			
ote 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar				

#### Table 4: DFS Response Requirement Values

**Note 1:** Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

**Note 2:** The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facililate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

**Note 3:** During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.



Radar Type	Pulse Width (µsec)	PRI (µsec)	Number of Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1 428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in <u>Table 5a</u> Test B: 15 unique PRI values randomly selected within the range of 518-3 066 µsec, with a minimum increment of 1 µsec, excluding PRI values selected in Test A	$\left(\left(\frac{19\cdot10^{\circ}}{\mathrm{PRI}_{\mu\mathrm{sec}}}\right)\right)$	60 %	30
2	1-5	150-230	23-29	60 %	30
3	6-10	200-500	16-18	60 %	30
4	11-20	200-500	12-16	60 %	30
Aggregate (Rad	dar Types 1-4)	1	1	80 %	120
<b>Note 1:</b> Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

#### Table 5 – Short Pulse Radar Test Waveforms

Table 6 – Long Pulse Radar Test Waveform

Radar Type	Pulse Width (µsec)	Chirp Width (₩z)	PRI	Number of Pulses per Burst	Number	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1 000- 2 000	1-3	8-20	80 %	30

#### Table 7 – Frequency Hopping Radar Test Waveform

Radar Type	Pulse Width (µsec)	PRI (µsec)		Hopping Rate (朏)	Sequence	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70 %	30



#### 2.3. Description of EUT

The EUT operates over the band 2A "5 260 Mb ~ 5 320 Mb (11a/n\_HT20, 11ac\_VHT20), 5 270 Mb ~ 5 310 Mb (11n\_HT40, 11ac\_VHT40), 5 290 Mb (11ac\_VHT80)" and band 2C "5 500 Mb ~ 5 720 Mb (11a/n\_HT20, 11ac\_VHT20), 5 510 Mb ~ 5 710 Mb (11n\_HT40, 11ac\_VHT40), 5 530 Mb ~ 5 690 Mb (11ac\_VHT80)" ranges.

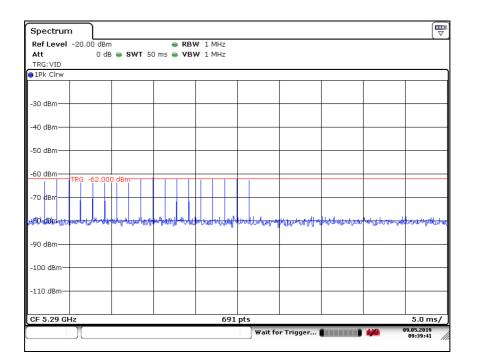
The rated output power of the client unit is < 200 milliwatt. Therefore the required interference threshold level is -62  $\,\mathrm{dB}$  m.



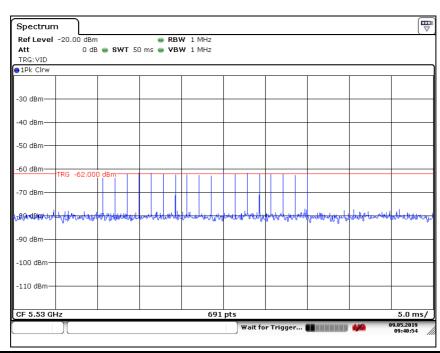
#### **Plots Of Radar Waveforms and WLAN Traffic**

#### Plot of radar waveform type 0

11ac VHT80 5 290 Mtz



#### 5 530 MHz

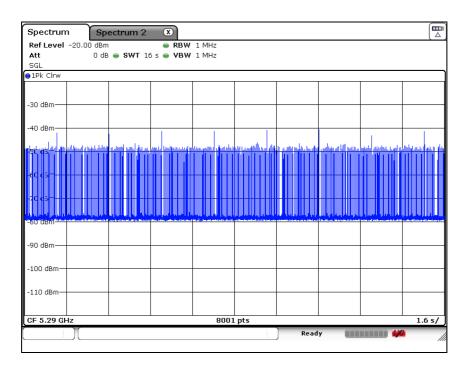


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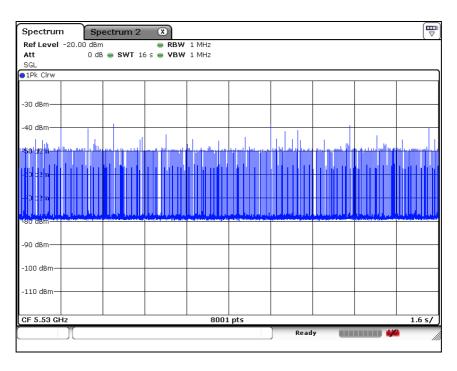
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#### Plot of LAN traffic



#### 5 530 Mb





The reference maker is set after 200 ms from the end of Last radar pulse.

The delta is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time within the 10 sec.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = (Number of analyzer bins showing transmission)\*(dwell time per bin)

The observation period over which the aggregated time is calculated begins at (Reference Maker) and ends no earlier than (Reference Maker +10 sec)

#### 2.4. Test Result

Frequency (Mb)	Channel Move Time (sec)	Limit
5 290	0.182	Not exceed 10 sec
5 530	0.540	Not exceed to sec
Frequency (账)	Aggregate Channel Closing Transmission Time (msec)	Limit
5 290	10	Not exceed 60 msec
5 530	20	NOT EXCEED OUTISEC

Aggregate channel closing transmission time

[16s (sweep time) / 8 001 (sweep point)] × The number of channel bin from 200 ms at the end of radar pulse. 5 290 Mb:  $(16 / 8 001) \times 5 = 10$  ms

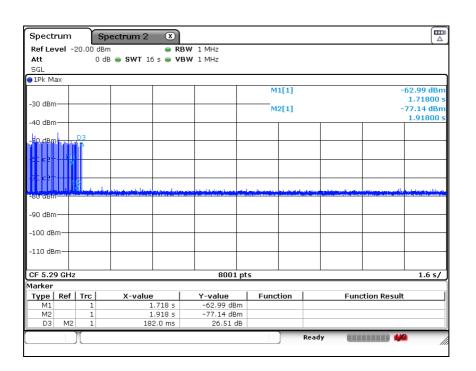
5 530 MHz: (16 / 8 001) × 10 = 20 ms

Frequency (Mz)	Non-occupancy Period (min)	Limit
5 290	Above 30	Not be less than 30 minute
5 530	Above 30	

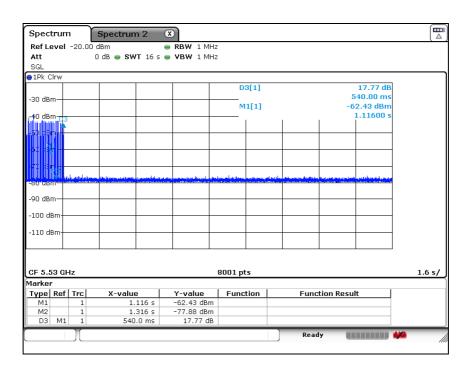


#### Plot of Channel Move Time & Aggregate Channel Closing Transmission Time

#### 



#### 5 530 Mb



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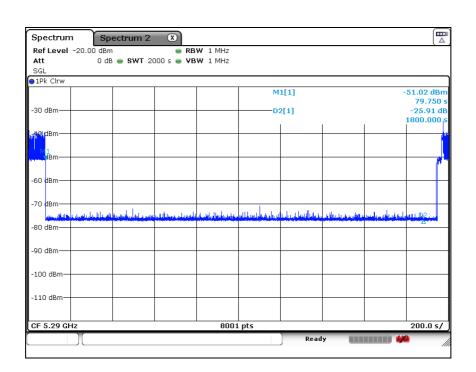
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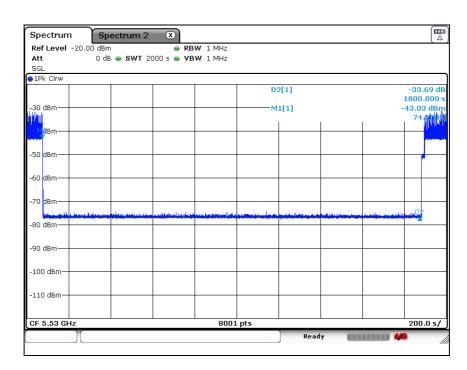
#### Plot of Non-occupancy Period

## 11ac\_VHT80

5 290 MHz



#### 5 530 Mb



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