

TEST REPORT

of

FCC Part 15 Subpart E §15.407

FCC ID: TQ8-AT140C2AN

Equipment Under Test : DISPLAY AUDIO SYSTEM
Model Name : AT140C2AN
Applicant : Hyundai MOBIS Co., Ltd.
Manufacturer : Hyundai MOBIS Co., Ltd.
Date of Test(s) : 2015.02.06 ~ 2015.02.11
Date of Issue : 2015.02.27

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

Tested By:



Jungmin Yang

Date:

2015.02.27

Approved By:



Hyunchae You

Date:

2015.02.27

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1. General information

1.1 Testing laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-837

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1.2 Details of applicant

Applicant : Hyundai MOBIS Co., Ltd.

Address : 203, Teheran-ro, Gangnam-gu, Seoul, 135-977, Korea

Contact Person : Choi, Seung-Hoon

Phone No. : + 82 31 260 0098

1.3. Description of EUT

| | |
|-----------------------|---|
| Kind of Product | DISPLAY AUDIO SYSTEM |
| Model Name | AT140C2AN |
| Power Supply | DC 14.4 V (Vehicle Battery) |
| Frequency Range | 2 402 MHz ~ 2 480 MHz (BT), 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20), 5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40), 5 775 MHz (Band 3: 11ac_VHT80), 5 180 MHz ~ 5 240 MHz (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 MHz ~ 5 230 MHz (Band 1: 11n_HT40, 11ac_VHT40), 5 210 MHz (Band 1: 11ac_VHT80), 5 260 MHz ~ 5 320 MHz (Band 2A: 11a/n_HT20, 11ac_VHT20), 5 270 MHz ~ 5 310 MHz (Band 2A: 11n_HT40, 11ac_VHT40), 5 290 MHz (Band 2A: 11ac_VHT80), 5 500 MHz ~ 5 700 MHz (Band 2C: 11a/n_HT20, 11ac_VHT20), 5 510 MHz ~ 5 670 MHz (Band 2C: 11n_HT40, 11ac_VHT40), 5 530 MHz (Band 2C: 11ac_VHT80) |
| Modulation Technique | DSSS, OFDM, GFSK, π/4DQPSK, 8DPSK |
| Number of Channels | 79 channel (BT), 11 channel (11b/g/n_HT20), 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: 11n_HT40, 11ac_VHT40), 1 channel (Band 2A: 11ac_VHT80), 8 channel (Band 2C: 11a/n_HT20, 11ac_VHT20), 3 channel (Band 2C: 11n_HT40, 11ac_VHT40), 1 channel (Band 2C: 11ac_VHT80) |
| Operation Temperature | -20 °C ~ 70 °C |
| Antenna Type | Internal type |
| Antenna Gain | 2 402 MHz ~ 2 480 MHz: 2.29 dB i, 2 412 MHz ~ 2 472 MHz: -0.09 dB i, 5 180 MHz ~ 5 320 MHz: 4.77 dB i, 5 500 MHz ~ 5 700 MHz: 1.68 dB i, 5 745 MHz ~ 5 805 MHz: 2.78 dB i |

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1.4. Declaration by the manufacturer

- Client without Radar Detection and TPC.

1.5. Test equipment list

| Equipment | Manufacturer | Model | S/N | Cal Date | Cal Interval | Cal Due. |
|-------------------|---------------|------------|------------|---------------|--------------|---------------|
| Spectrum Analyzer | R&S | FSW43 | 100637 | Jul. 24, 2014 | Annual | Jul. 24, 2015 |
| Signal Generator | R&S | SMBV100A | 255834 | Jun. 25, 2014 | Annual | Jun. 25, 2015 |
| Attenuator | Agilent | 8490D | 50449 | Dec. 08, 2014 | Annual | Dec. 08, 2015 |
| Power Splitter | Mini-Circuits | ZFSC-2-10G | 001 | Jun. 10, 2014 | Annual | Jun. 10, 2015 |
| Power Splitter | Mini-Circuits | ZFSC-2-10G | 002 | Jun. 10, 2014 | Annual | Jun. 10, 2015 |
| DC Power Supply | Agilent | U8002A | MY50060028 | Mar. 27, 2014 | Annual | Mar. 27, 2015 |

► Support equipment

| Description | Manufacturer | Model | Serial Number / FCC ID |
|-----------------------|---------------------|-------------|------------------------|
| Access Point (Master) | Buffalo | WZR-1750DHP | 20062631158240 |
| Notebook | LG Electronics Inc. | LGE-DMLGA51 | 012QTHL022697 |

1.6. Summary of test result

The EUT has been tested according to the following specifications:

| APPLIED STANDARD:FCC Part15 subpart E | | |
|---------------------------------------|---|----------|
| Section in FCC 15 | Test Item | Result |
| 15.407(h) | DFS -Channel closing transmission time -Channel move time -Non occupied period | Complied |

1.7. Test report revision

| Revision | Report number | Date of Issue | Description |
|----------|----------------------|---------------|-------------|
| 0 | F690501/RF-RTL008455 | 2015.02.27 | Initial |

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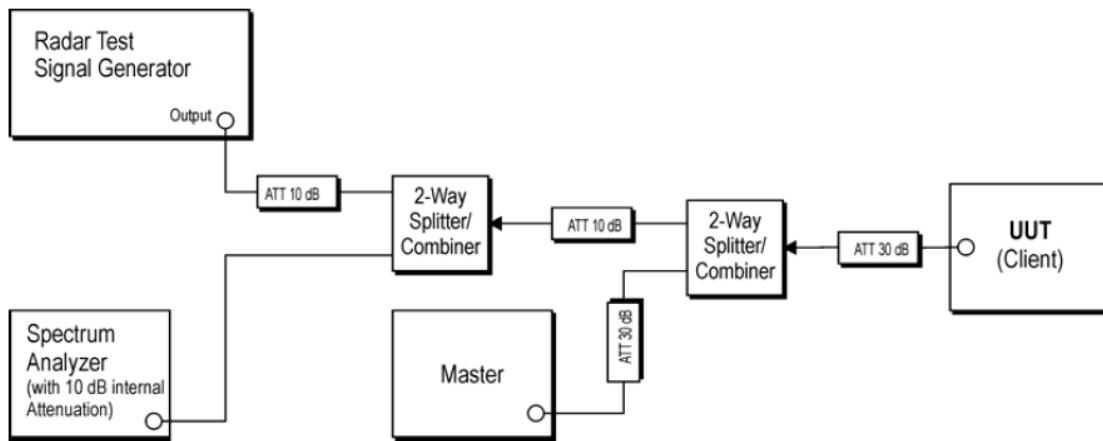
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RTT5041-20(2014.01.20)(2) Tel. +82 31 428 5700 / Fax. +82 31 427 2370 A4(210 mm x 297 mm)

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 8001 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 MHz and 5 530 MHz. Measurements were performed using conducted test methods.

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2.2 Limit

§15.407 (h) and FCC 06-96 APPENDIX "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVCIES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION

Table 1: Applicability of DFS requirements prior to use of a channel

| Requirement | Operational Mode | | |
|---------------------------------|------------------|--|----------------------------------|
| | 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 |
| Uniform Spreading | Yes | Not required | Yes |

Table 2: Applicability of DFS requirements during normal operation

| Requirement | Operational Mode | |
|-----------------------------------|---|--------------------------------|
| | Master Device or Client with Radar Detection | Client without Radar 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 |

Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring

| Maximum Transmit Power | Value (See Notes 1,2, and 3) |
|---|---------------------------------|
| EIRP \geq 200 milliwatt | -64 dB m |
| EIRP < 200 milliwatt and Power spectral density < 10 dB m/MHz | -62 dB m |
| EIRP < 200 milliwatt that do not meet the Power spectral density requirement | -64 dB m |

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.

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KDB 905462 D03 : Non-Occupancy Period for Client Device without radar detection

- Test results demonstrating an associated client link is established with the master on a test frequency;
- 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.

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. |
| Channel Closing Transmission Time | 200 milliseconds + an aggregate of 60 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. |

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: 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 facilitate 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.

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Table 5 – Short Pulse Radar Test Waveforms

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Number of Pulses | Minimum Percentage of Successful Detection | Minimum Trials |
|--|--------------------|---|--|--|----------------|
| 0 | 1 | 1428 | 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 Table 5a | $\text{Roundup} \left(\left(\frac{1}{360} \right) \left(\frac{19 \cdot 10^6}{\text{PRI}_{\mu\text{sec}}} \right) \right)$ | 60% | 30 |
| | | Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A | | | |
| 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 (Radar Types 1-4) | | | | 80% | 120 |
| Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests. | | | | | |

Table 6 – Long Pulse Radar Test Waveform

| Radar Type | Pulse Width (μsec) | Chirp Width (MHz) | PRI (μsec) | Number of Pulses per Burst | Number Burst | Minimum Percentage of Successful Detection | Minimum Trials |
|------------|--------------------|-------------------|------------|----------------------------|--------------|--|----------------|
| 5 | 50-100 | 5-20 | 1000-2000 | 1-3 | 8-20 | 80% | 30 |

Table 7 – Frequency Hopping Radar Test Waveform

| Radar Type | Pulse Width (μsec) | PRI (μsec) | Pulses per Hop | Hopping Rate (kHz) | Hopping Sequence Length (msec) | Minimum Percentage of Successful Detection | Minimum Number of Trials |
|------------|--------------------|------------|----------------|--------------------|--------------------------------|--|--------------------------|
| 6 | 1 | 333 | 9 | 0.333 | 300 | 70% | 30 |

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2.3. Description of EUT

The EUT operates over the band 2A “5 260 MHz ~ 5 320 MHz (11a/n_HT20, 11ac_VHT20), 5 270 MHz ~ 5 310 MHz (11n_HT40, 11ac_VHT40), 5 290 MHz (11ac_VHT80)” and band 2C “5 500 MHz ~ 5 700 MHz (11a/n_HT20, 11ac_VHT20), 5 510 MHz ~ 5 670 MHz (11n_HT40, 11ac_VHT40), 5 530 MHz (11ac_VHT80)” ranges.

The rated output power of the client unit is < 200 milliwatt. Therefore the required interference threshold level is -62 dB m.

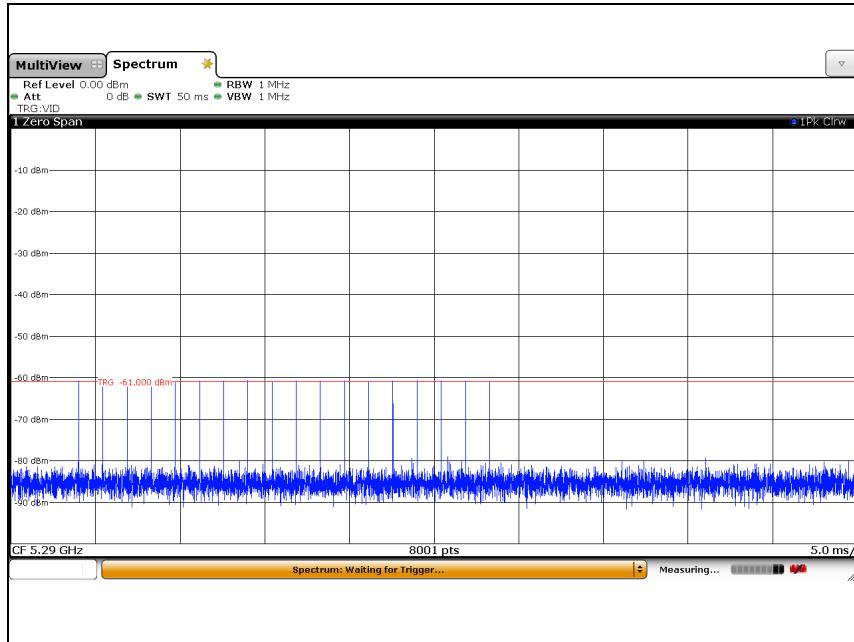
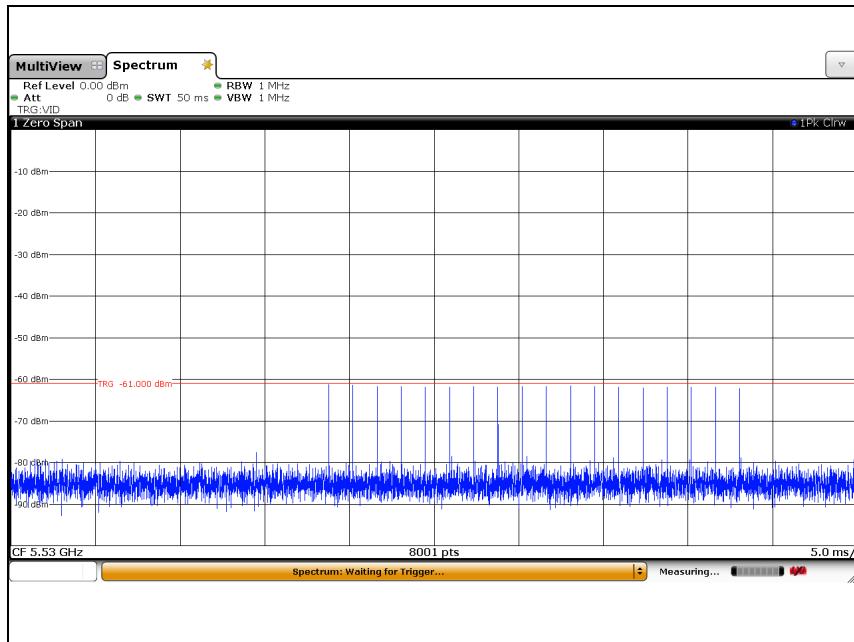
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A4(210 mm x 297 mm)

PLOTS OF RADAR WAVEFORMS AND WLAN TRAFFIC**Plot of radar waveform type 1****5 290 MHz****5 530 MHz**

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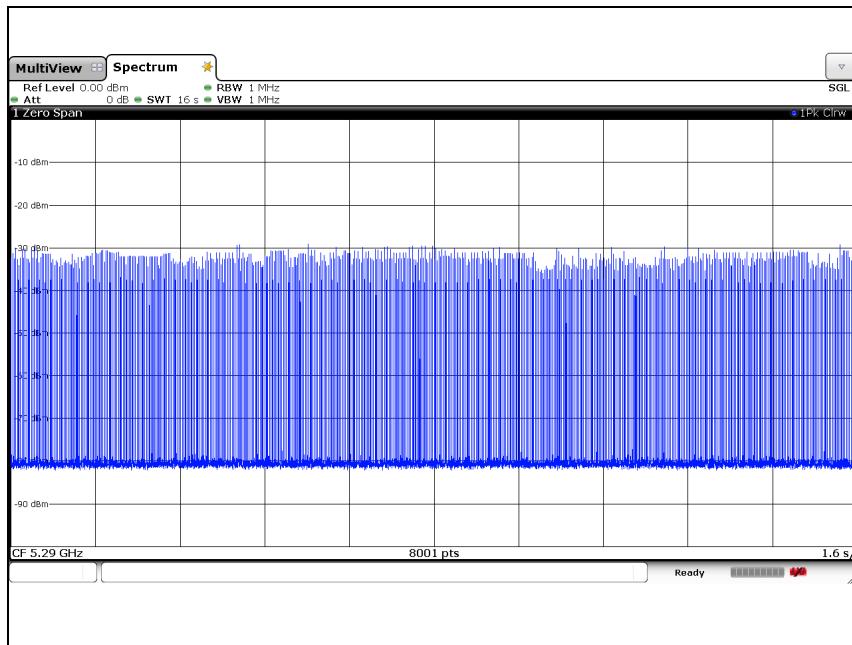
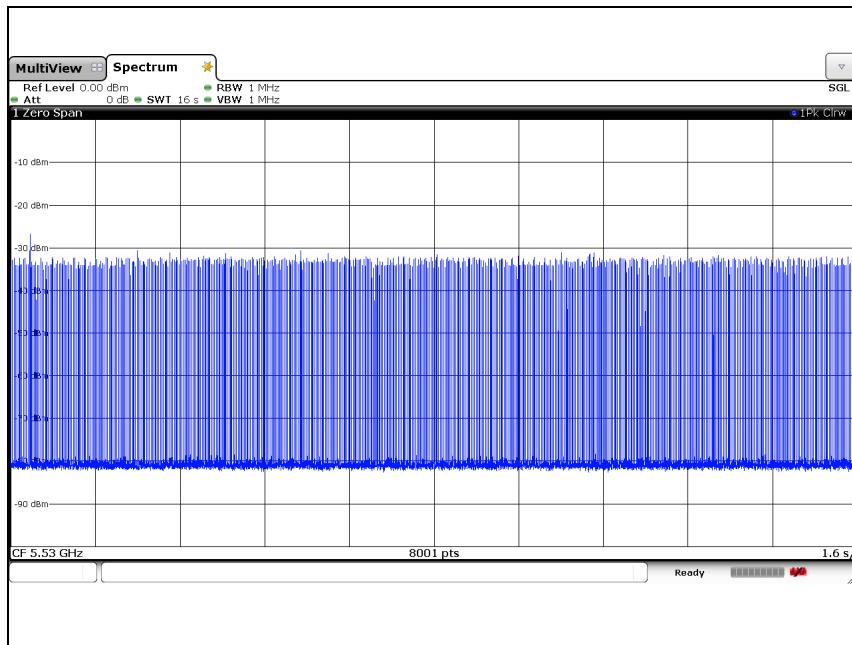
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Plot of LAN traffic**5 290 MHz****5 530 MHz**

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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)

2.3. Test result

| Frequency (MHz) | Channel Move Time (sec) | Limit |
|-----------------|--|--------------------|
| 5 290 | 2.07 | Not exceed 10 sec |
| 5 530 | 1.86 | |
| Frequency (MHz) | Aggregate channel closing transmission time (msec) | Limit |
| 5 290 | 38 | Not exceed 60 msec |
| 5 530 | 44 | |

Aggregate channel closing transmission time

[16s (sweep time) / 8001 (sweep point)] × The number of channel bin from 200 ms at the end of radar pulse.

5 290 MHz: $(16 / 8001) \times 19 = 38$ ms

5 530 MHz: $(16 / 8001) \times 22 = 44$ ms

| Frequency (MHz) | Non-occupancy period (min) | Limit |
|-----------------|----------------------------|----------------------------|
| 5 290 | Above 30 | Not be less than 30 minute |
| 5 530 | Above 30 | |

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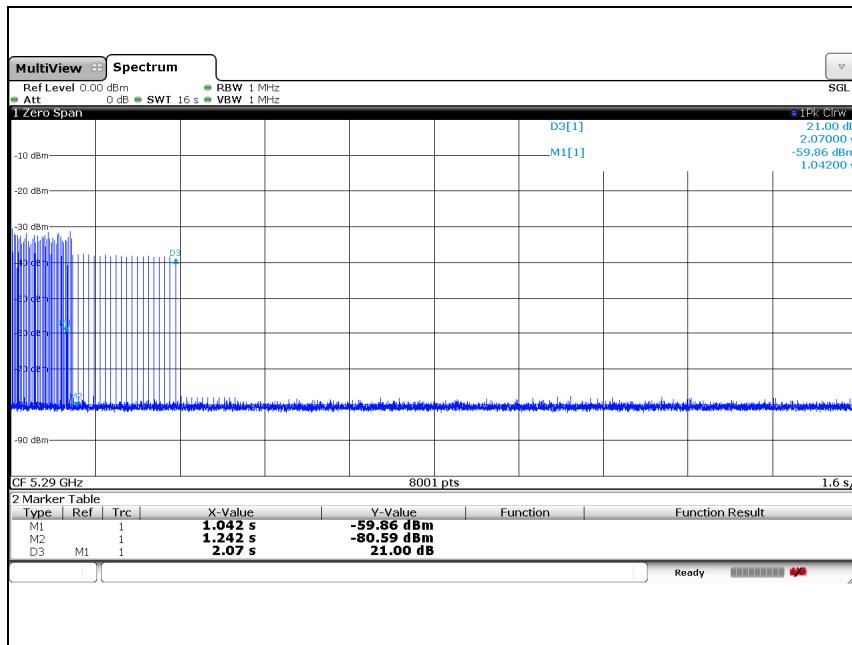
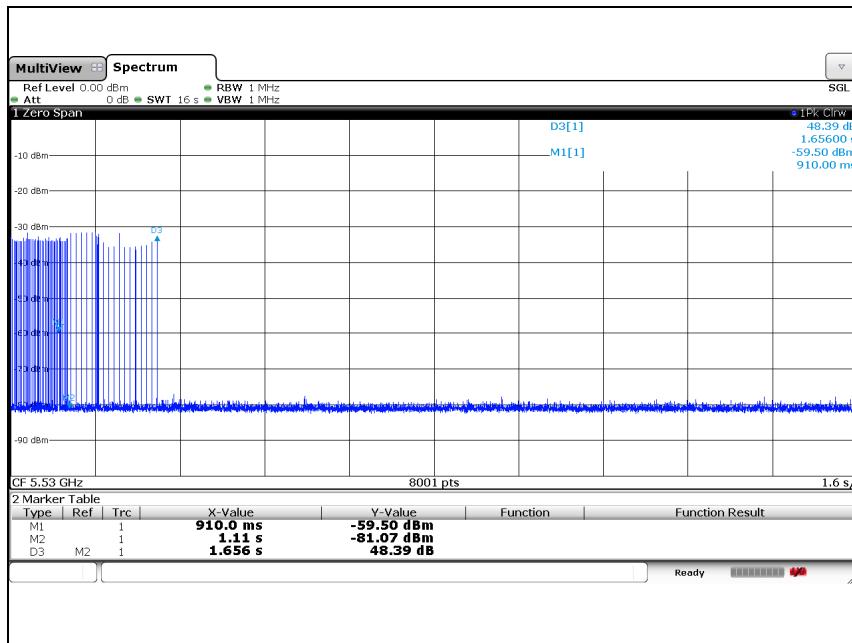
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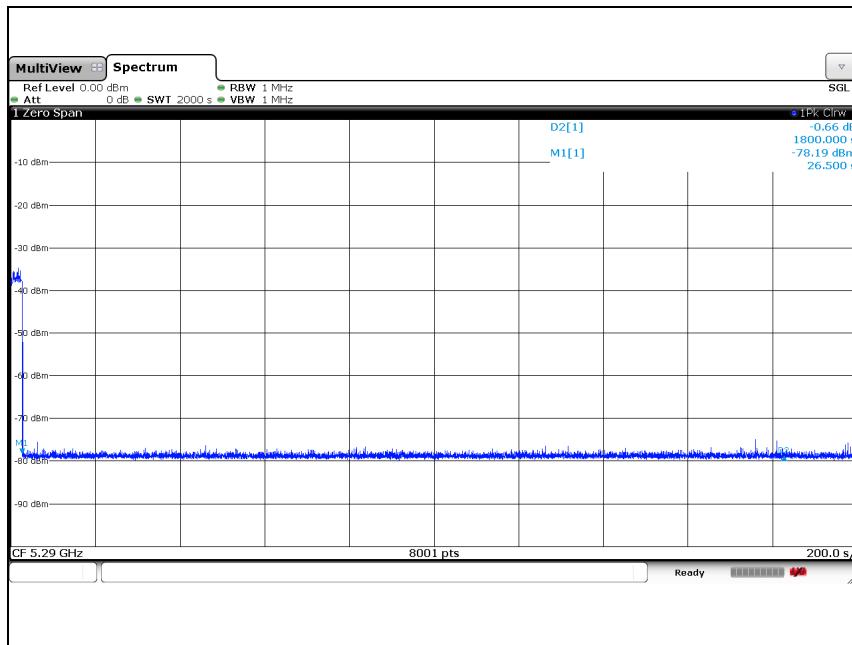
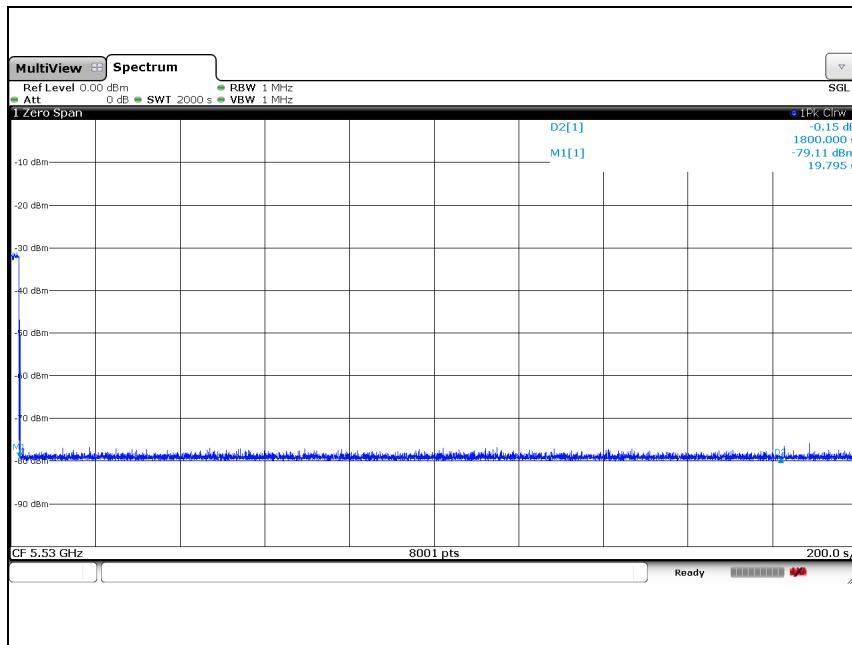
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Plot of channel move time & aggregate channel closing transmission time**5 290 MHz****5 530 MHz**

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Plot of Non-occupancy period**5 290 MHz****5 530 MHz**

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