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## Competences and guarantees

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DEKRA Testing and Certification is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

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DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

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## General Conditions

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2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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## Uncertainty

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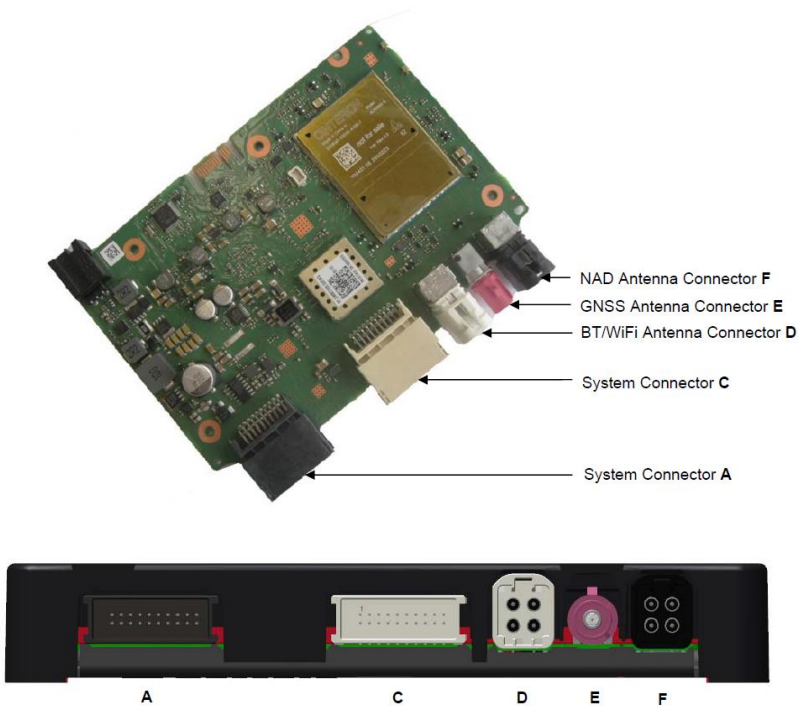
Uncertainty (factor  $k=2$ ) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

## Data provided by the client

---

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model ConBox HIGH RD is a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, GNSS, Wifi (a, b, g, n, ac), Bluetooth Low Energy (BTLE) and Bluetooth EDR.



### 3. Declaration of Comparability



## Declaration of Comparability

**HARMAN BECKER**  
Automotive Systems GmbH  
Becker-Göring-Str. 16  
D-76307 Karlsbad, Germany

declares under our sole responsibility, that the product

|                                    |                                                                                                                 |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Description of object</b>       | : Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE                                                          |
| <b>Brand/ Customer</b>             | : VW-Group / VW AG/ Audi                                                                                        |
| <b>Model name</b>                  | CONBOX-HIGH RD                                                                                                  |
| <b>Variant</b>                     | : A970, A971, A972, A973, A974, A975, A976, A977, A978, A979,<br>A980, A981, A982, A983, A984, P114, P115, P119 |
| <b>Hardware / Software version</b> | : 045 / 0489 (corresponds CL37)                                                                                 |

is comparable to:

|                              |                                                                                                                 |
|------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>Description of object</b> | : Telematic system with BT, WLAN, GNSS, GSM, UMTS, LTE                                                          |
| <b>Customer / Brand</b>      | : VW-Group / VW AG/ Audi                                                                                        |
| <b>Model</b>                 | CONBOX-HIGH RD                                                                                                  |
| <b>Variant</b>               | : A970, A971, A972, A973, A974, A975, A976, A977, A978, A979,<br>A980, A981, A982, A983, A984, P114, P115, P119 |
| <b>Hardware / SW</b>         | : 045 / 0494 (corresponds CL37)                                                                                 |

We declare as authorized responsible person, that the products above have HW and SW changes which have no impact for the certification activities.

The HW version used on CONBOX-HIGH RD will have the same schematics, the same layout, with the same BT/WLAN-Module and the same country specific NAD module and the HW index will remain 045.

The application SW will be changed to 0494 version. These SW changes do not impact the following parameters: used frequency ranges / used frequency bands, the used modulation type, the maximum RF power, the circumstances under which the transmitter operates, the basic frequency and/or stabilizing circuitry, frequency multiplication stages, the basic modulator circuitry or maximum RF power, the field strength ratings, slew rates for clocking of output pins and drivers.

More details about the HW/SW updates are included in: "CON-BOX-HIGH-RD\_temp\_test\_20230120".

In conclusion, we can say the new SW/HW configuration do not influence the type-approval for all variants (listed above) on CONBOX-High RD - Cluster 37 (045/0494).

**Declared by:**

**checked by: Thomas Roesch (S-PM) / 28.03.2023**

**Mr. STOICA Iulian, Product Compliance Expert**

Bucharest 28.03.2023

(Place) (Date) (Signature)

**Mr. OLTEANU Marius, Product Compliance Expert.**

Bucharest 28.03.2023

(Place) (Date) (Signature)

#### **HW Changes on TCU side**

From HW perspective, the main modifications are :

- replacing of unnecessary coupling capacitors C5940/C5941 220nF in PCIe bus with 0 Ohm resistors
- coupling capacitors are already on Qisda NXP module, therefore not needed on main PCB
- no change is made on the layout of main PCB.

The HW version used on CONBOX-HIGH RD will have the same schematics, the same layout, with the same BT/WLAN-Module and the same country specific NAD module and the HW index will remain 045.

#### **SW Changes on TCU side**

From SW perspective, the main updates are :

- change of BT/Wifi driver
- change of PCIe speed

There have been:

- No changes of the used frequency ranges / bands
- No changes of the used modulation type
- No changes of the maximum RF power
- No changes of the circumstances under which the transmitter operates
- No changes of the basic frequency and/or stabilizing circuitry
- No changes of the frequency multiplication stages
- No changes of the basic modulator circuitry or maximum RF power
- No changes of the field strength ratings
- No changes of slew rates for clocking of output pins and drivers

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

## Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

| Control No. | Description            | Model          | Serial No.      | Reception  |
|-------------|------------------------|----------------|-----------------|------------|
| 72779/002   | Telematic control unit | ConBox HIGH RD | 351998105026439 | 2022/10/17 |
| 72779/054   | Harness                | -              | -               | 2022/10/17 |

Auxiliary elements used with the Sample S/01:

| Control No. | Description              | Model | Serial No. | Reception  |
|-------------|--------------------------|-------|------------|------------|
| 72779/011   | Ethernet Cable           | -     | -          | 2022/10/17 |
| 72779/013   | OABR-Converter PCB Board | -     | -          | 2022/10/17 |
| 72779/014   | Power Cable              | -     | -          | 2022/10/17 |
| 72779/048   | Fakra 4 to 1 Cable       | -     | -          | 2022/10/17 |
| 72779/066   | Cable Antenna 4 to 1     | -     | -          | 2022/10/17 |

Sample S/01 has undergone the test(s): The Conducted tests indicated in the Appendixes A, B.

- Sample S/02 is composed of the following elements:

| Control No. | Description            | Model          | Serial No.      | Reception  |
|-------------|------------------------|----------------|-----------------|------------|
| 72779/002   | Telematic control unit | ConBox HIGH RD | 351998105026439 | 2022/10/17 |
| 72779/054   | Harness                | -              | -               | 2022/10/17 |
| 72779/067   | Antenna VW ConBox      | -              | -               | 2022/10/17 |
| 72779/068   | Antenna VW ConBox      | -              | -               | 2022/10/17 |
| 72779/069   | Antenna VW ConBox      | -              | -               | 2022/10/17 |
| 72779/070   | Antenna VW ConBox      | -              | -               | 2022/10/17 |

Auxiliary elements used with the Sample S/02:

| Control No. | Description              | Model | Serial No. | Reception  |
|-------------|--------------------------|-------|------------|------------|
| 72779/011   | Ethernet Cable           | -     | -          | 2022/10/17 |
| 72779/013   | OABR-Converter PCB Board | -     | -          | 2022/10/17 |
| 72779/014   | Power Cable              | -     | -          | 2022/10/17 |
| 72779/048   | Fakra 4 to 1 Cable       | -     | -          | 2022/10/17 |
| 72779/066   | Cable Antenna 4 to 1     | -     | -          | 2022/10/17 |

Sample S/02 has undergone the test(s): The Radiated tests indicated in the Appendixes A, B.

## Test sample description

|                                               |                                                                                 |                          |                                     |                                     |                                   |                          |
|-----------------------------------------------|---------------------------------------------------------------------------------|--------------------------|-------------------------------------|-------------------------------------|-----------------------------------|--------------------------|
| Ports.....:                                   | Port name and description                                                       | Cable                    |                                     |                                     |                                   |                          |
|                                               |                                                                                 | Specified max length [m] | Attached during test                | Shielded                            | Coupled to patient <sup>(3)</sup> |                          |
|                                               |                                                                                 | RF connector – code      | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <input type="checkbox"/>          |                          |
|                                               |                                                                                 | RF connector – code      | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>          |                          |
| Supplementary information to the ports.....:  |                                                                                 |                          |                                     |                                     |                                   |                          |
| Rated power supply .....                      | Voltage and Frequency                                                           |                          | Reference poles                     |                                     |                                   |                          |
|                                               |                                                                                 | L1                       | L2                                  | L3                                  | N                                 | PE                       |
|                                               | <input type="checkbox"/> AC:                                                    | <input type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/>          | <input type="checkbox"/> |
|                                               | <input checked="" type="checkbox"/> DC: 12V car battery (4.8 VDC inside of TCU) |                          |                                     |                                     |                                   |                          |
| Rated Power.....:                             | 12V DC                                                                          |                          |                                     |                                     |                                   |                          |
| Clock frequencies.....:                       | 25MHz; 26MHz; 32,768kHz; 49,58MHz;                                              |                          |                                     |                                     |                                   |                          |
| Other parameters .....                        | See Technical description                                                       |                          |                                     |                                     |                                   |                          |
| Software version.....:                        | 0494                                                                            |                          |                                     |                                     |                                   |                          |
| Hardware version .....                        | 045                                                                             |                          |                                     |                                     |                                   |                          |
| Dimensions in cm (W x H x D) ...:             | --                                                                              |                          |                                     |                                     |                                   |                          |
| Mounting position .....                       | <input type="checkbox"/> Table top equipment                                    |                          |                                     |                                     |                                   |                          |
|                                               | <input type="checkbox"/> Wall/Ceiling mounted equipment                         |                          |                                     |                                     |                                   |                          |
|                                               | <input type="checkbox"/> Floor standing equipment                               |                          |                                     |                                     |                                   |                          |
|                                               | <input type="checkbox"/> Hand-held equipment                                    |                          |                                     |                                     |                                   |                          |
|                                               | <input checked="" type="checkbox"/> Other: automotive telematics control unit   |                          |                                     |                                     |                                   |                          |
| Modules/parts.....:                           | Module/parts of test item                                                       |                          | Type                                |                                     | Manufacturer                      |                          |
|                                               | --                                                                              |                          | -                                   |                                     | -                                 |                          |
|                                               | --                                                                              |                          | -                                   |                                     | -                                 |                          |
| Accessories (not part of the test item) ..... | Description                                                                     |                          | Type                                |                                     | Manufacturer                      |                          |
|                                               | Cable Harness                                                                   |                          | -                                   |                                     | -                                 |                          |
|                                               | 2G/3G/4G/5G Antenna                                                             |                          | -                                   |                                     | Hirschmann/<br>Molex              |                          |
|                                               | eCall button/LED                                                                |                          | -                                   |                                     | -                                 |                          |
|                                               | SOS Loudspeaker                                                                 |                          | -                                   |                                     | -                                 |                          |
|                                               | Wake-up unit Box                                                                |                          | -                                   |                                     | -                                 |                          |
| Documents as provided by the applicant .....  | Description                                                                     |                          | File name                           |                                     | Issue date                        |                          |
|                                               | Technical Description                                                           |                          | -                                   |                                     | -                                 |                          |
|                                               |                                                                                 |                          |                                     |                                     |                                   |                          |
|                                               |                                                                                 |                          |                                     |                                     |                                   |                          |
|                                               |                                                                                 |                          |                                     |                                     |                                   |                          |

<sup>(3)</sup> Only for Medical Equipment

## Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH  
BECKER-GOERING-STR. 16; 76307 KARLSBAD GERMANY

## Testing period and place

|               |                                        |
|---------------|----------------------------------------|
| Test Location | DEKRA Testing and Certification S.A.U. |
| Date (start)  | 2022-11-01                             |
| Date (finish) | 2022-11-11                             |

## Document history

| Report number  | Date       | Description                                                                                                                 |
|----------------|------------|-----------------------------------------------------------------------------------------------------------------------------|
| 72779RRF.008   | 2022-12-12 | First release                                                                                                               |
| 72779RRF.008A1 | 2023-05-04 | Second release. Modification due to typos. This modification test report cancels and replaces the test report 72779RRF.008. |

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

In the semi-anechoic chamber, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

In the chamber for conducted measurements, the following limits were not exceeded during the test:

|                   |                              |
|-------------------|------------------------------|
| Temperature       | Min. = 15 °C<br>Max. = 35 °C |
| Relative humidity | Min. = 20 %<br>Max. = 75 %   |

## Remarks and comments

The tests have been performed by the technical personnel: Miguel Manuel López, Rafael Fernández, Pablo Redondo.

Used instrumentation:

| Control No. | Equipment                               | Model           | Manufacturer                 | Next Calibration |
|-------------|-----------------------------------------|-----------------|------------------------------|------------------|
| 6791        | SEMIANECHOIC ABSORBER LINED CHAMBER IV  | FACT 3 200 STP  | ETS LINDGREN                 | 2024-06-07       |
| 6792        | SHIELDED ROOM                           | S101            | ETS LINDGREN                 | N/A              |
| 7445        | DC POWER SUPPLY 30V/5A                  | U8002A          | KEYSIGHT TECHNOLOGIES        | --               |
| 7760        | DIGITAL MULTIMETER                      | 175             | FLUKE                        | 2023-11-14       |
| 7817        | EMI TEST RECEIVER 2Hz-44GHz             | ESW44           | ROHDE AND SCHWARZ            | 2023-12-30       |
| 6165        | EMI TEST RECEIVER 9kHz-7GHz             | ESR7            | ROHDE AND SCHWARZ            | 2023-11-08       |
| 4716        | SIGNAL AND SPECTRUM ANALYZER 2Hz-50GHz  | FSW50           | ROHDE AND SCHWARZ            | 2024-08-12       |
| 4611        | HORN ANTENNA 1-18GHz                    | BBHA 9120 D     | SCHWARZBECK MESS- ELEKTRONIK | 2022-11-18       |
| 6496        | HORN ANTENNA 1-18GHz                    | BBHA 9120 D     | SCHWARZBECK                  | 2023-08-24       |
| 4657        | HORN ANTENNA 18-40GHz                   | BBHA 9170       | SCHWARZBECK                  | 2023-05-05       |
| 6143        | HYBRID BILOG ANTENNA 30MHz-6GHz         | 3142E           | ETS LINDGREN                 | 2023-10-29       |
| 8856        | PRE-AMPLIFIER G>30dB 18-40GHz           | BLMA 1840-4A    | BONN ELEKTRONIK              | 2023-11-02       |
| 5705        | PRE-AMPLIFIER G>40dB 1-18 GHz           | BLMA 0118-1M    | BONN ELEKTRONIK              | 2023-07-21       |
| 3783        | PRE-AMPLIFIER G>30dB 1GHz-18GHz         | BLMA 0118-3A    | BONN ELEKTRONIK              | 2022-12-01       |
| 6144        | PRE-AMPLIFIER G>40dB 10MHz-6GHz         | BLNA 0160-01N   | BONN ELEKTRONIK              | 2023-03-17       |
| 4848        | SOFTWARE FOR EMC/RF TESTING             | EMC32           | ROHDE AND SCHWARZ            | N/A              |
| 6793        | SHIELDED ROOM                           | S101            | ETS LINDGREN                 | N/A              |
| 7794        | SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz | FSV40           | ROHDE AND SCHWARZ            | 2023-02-26       |
| 8848        | OPEN SWITCH UNIT UP TO 7.5 GHz          | OSP-B157W8 PLUS | ROHDE & SCHWARZ              | 2023-08-20       |
| 0922        | POWER SUPPLY DC 40 V / 40 A             | NGPE 40/40      | ROHDE AND SCHWARZ            | --               |
| 7798        | EMC/RF MEASUREMENT SOFTWARE             | WMS32           | ROHDE AND SCHWARZ            | N/A              |

## Testing verdicts

|                 |     |
|-----------------|-----|
| Not applicable: | N/A |
| Pass:           | P   |
| Fail:           | F   |
| Not measured:   | N/M |

## Summary

### A. Common requirements for all Bands:

| FCC PART 15 / RSS-247                                  |         |        |
|--------------------------------------------------------|---------|--------|
| Requirement – Test case                                | Verdict | Remark |
| Transmitter. Duty Cycle                                | P       |        |
| Transmitter. 99% Occupied Bandwidth                    | P       |        |
| Transmitter. 26 dB Emission Bandwidth (EBW)            | P       |        |
| <u>Supplementary information and remarks:</u><br>None. |         |        |

### B. U-NII-1: 5.15 GHz – 5.25 GHz Band

| FCC PART 15 / RSS-247                                  |                                            |        |
|--------------------------------------------------------|--------------------------------------------|--------|
| Requirement – Test case                                | Verdict                                    | Remark |
| FCC 15.407 (a)(1)(ii), (a)(1)(iv)<br>RSS-247 6.2.1.1   | Transmitter Maximum Conducted Output Power | P      |
| FCC 15.407 (a)(1)(ii), (a)(1)(iv)<br>RSS-247 6.2.1.1   | Transmitter Maximum Power Spectral Density | P      |
| FCC 15.407 (b)(1)<br>RSS-247 6.2.1.2                   | Transmitter Out of Band Radiated Emissions | P      |
| FCC 15.407 (b)(1)<br>RSS-247 6.2.1.2                   | Transmitter Band Edge Radiated Emissions   | P      |
| <u>Supplementary information and remarks:</u><br>None. |                                            |        |

## C. U-NII-3: 5.725 GHz – 5.85 GHz Band

| FCC PART 15 / RSS-247                         |                                            |         |        |
|-----------------------------------------------|--------------------------------------------|---------|--------|
| Requirement – Test case                       |                                            | Verdict | Remark |
| FCC 15.407 (e)<br>RSS-247 6.2.4.1             | 6 dB Bandwidth                             | P       |        |
| FCC 15.407 (a)(3)(i)<br>RSS-247 6.2.4.1       | Transmitter Maximum Conducted Output Power | P       |        |
| FCC 15.407 (a)(3)(i)<br>RSS-247 6.2.4.1       | Transmitter Maximum Power Spectral Density | P       |        |
| FCC 15.407 (b)(4)<br>RSS-247 6.2.4.2          | Transmitter Out of Band Radiated Emissions | P       |        |
| FCC 15.407 (b)(4)<br>RSS-247 6.2.4.2          | Transmitter Band Edge Radiated Emissions   | P       |        |
| <u>Supplementary information and remarks:</u> |                                            |         |        |
| None.                                         |                                            |         |        |

## Appendix A: Test Common requirements for all Bands

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## TEST CONDITIONS

(\*) Declared by the Client.

### POWER SUPPLY (\*):

Vnominal: 12 Vdc  
Type of Power Supply: External DC (Vehicle Battery).

### ANTENNA (\*):

Type of Antenna: External.  
Maximum Declared Antenna Gain U-NII-1: +2.38 dBi  
Maximum Declared Antenna Gain U-NII-3: +2.38 dBi

### TEST FREQUENCIES (\*):

|                              |                                                              |                         |
|------------------------------|--------------------------------------------------------------|-------------------------|
| Technology Tested:           | WLAN (IEEE 802.11 a20 / n2040 / ac204080 1x1) U-NII-1        |                         |
| Modes:                       | 802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO, with CDD) |                         |
|                              | 802.11n HT20: MCS0 to MCS23 (SISO, 1 spatial stream)         |                         |
|                              | 802.11n HT40: MCS0 to MCS23 (SISO, 1 spatial stream)         |                         |
|                              | 802.11ac VHT20: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
|                              | 802.11ac VHT40: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
|                              | 802.11ac VHT80: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
| Setting of cores / ports:    | One.                                                         |                         |
| Beamforming:                 | No.                                                          |                         |
| Frequency Range:             | 5150 - 5250 MHz                                              |                         |
| Operating Channel Bandwidth: | 20 MHz                                                       |                         |
| Transmission Channels:       | Channels                                                     | Channel Frequency (MHz) |
|                              | Low (36)                                                     | 5180                    |
|                              | 40                                                           | 5200                    |
|                              | High (48)                                                    | 5240                    |
| Operating Channel Bandwidth: | 40 MHz                                                       |                         |
| Transmission Channels:       | Channels                                                     | Channel Frequency (MHz) |
|                              | Low (38)                                                     | 5190                    |
|                              | High (46)                                                    | 5230                    |
| Operating Channel Bandwidth: | 80 MHz                                                       |                         |
| Transmission Channels:       | Channels                                                     | Channel Frequency (MHz) |
|                              | Single (42)                                                  | 5210                    |

|                              |                                                              |                         |
|------------------------------|--------------------------------------------------------------|-------------------------|
| Technology Tested:           | WLAN (IEEE 802.11 a20 / n2040 / ac204080 / 1x1) U-NII-3      |                         |
| Modes:                       | 802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps (SISO, with CDD) |                         |
|                              | 802.11n HT20: MCS0 to MCS23 (SISO, 1 spatial stream)         |                         |
|                              | 802.11n HT40: MCS0 to MCS23 (SISO, 1 spatial stream)         |                         |
|                              | 802.11ac VHT20: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
|                              | 802.11ac VHT40: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
|                              | 802.11ac VHT80: MCS0 to MCS9 (SISO, 1 spatial stream)        |                         |
| Setting of cores / ports:    | One.                                                         |                         |
| Beamforming:                 | No.                                                          |                         |
| Frequency Range:             | 5725 MHz to 5850 MHz                                         |                         |
| Operating Channel Bandwidth: | 20 MHz                                                       |                         |
| Transmission Channels:       | Channel                                                      | Channel Frequency (MHz) |
|                              | Low (149)                                                    | 5745                    |
|                              | Middle (157)                                                 | 5785                    |
|                              | High (165)                                                   | 5825                    |
| Operating Channel Bandwidth: | 40 MHz                                                       |                         |
| Transmission Channels:       | Channel                                                      | Channel Frequency (MHz) |
|                              | Low (151)                                                    | 5755                    |
|                              | High (159)                                                   | 5795                    |
| Operating Channel Bandwidth: | 80 MHz                                                       |                         |
| Transmission Channels:       | Single (155)                                                 | 5775                    |

#### POWER SETTINGS (\*):

The next power settings were used to configure the sample for the tests.

#### U-NII-1. FCC:

| Channel | Frequency | a  | n  | ac |
|---------|-----------|----|----|----|
| 36      | 5180 MHz  | 17 | 17 | 17 |
| 40      | 5200 MHz  | 17 | 17 | 17 |
| 48      | 5240 MHz  | 17 | 17 | 17 |
| 38      | 5190 MHz  |    | 17 | 17 |
| 46      | 5230 MHz  |    | 17 | 17 |
| 42      | 5210 MHz  |    |    | 17 |

#### U-NII-1. RSS:

| Channel | Frequency | a  | n  | ac |
|---------|-----------|----|----|----|
| 36      | 5180 MHz  | 13 | 13 | 13 |
| 40      | 5200 MHz  | 13 | 13 | 13 |
| 48      | 5240 MHz  | 13 | 13 | 13 |
| 38      | 5190 MHz  |    | 13 | 13 |
| 46      | 5230 MHz  |    | 13 | 13 |
| 42      | 5210 MHz  |    |    | 13 |

#### U-NII-3. FCC and RSS:

| Channel | Frequency | a  | n  | ac |
|---------|-----------|----|----|----|
| 149     | 5745 MHz  | 17 | 17 | 17 |
| 157     | 5785 MHz  | 17 | 17 | 17 |
| 165     | 5825 MHz  | 19 | 19 | 19 |
| 151     | 5755 MHz  |    | 17 | 17 |
| 159     | 5795 MHz  |    | 17 | 17 |
| 155     | 5775 MHz  |    |    | 17 |

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing. They correspond to the next data rates:

- 802.11a: 6 Mbps SISO 1Tx.
- 802.11n HT20: MCS0 SISO 1Tx.
- 802.11n HT40: MCS0 SISO 1Tx.
- 802.11ac VHT20: MCS0 SISO 1Tx.
- 802.11ac VHT40: MCS0 SISO 1Tx.
- 802.11ac VHT80: MCS0 SISO 1Tx.

#### CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low-loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:



## Transmitter Duty Cycle

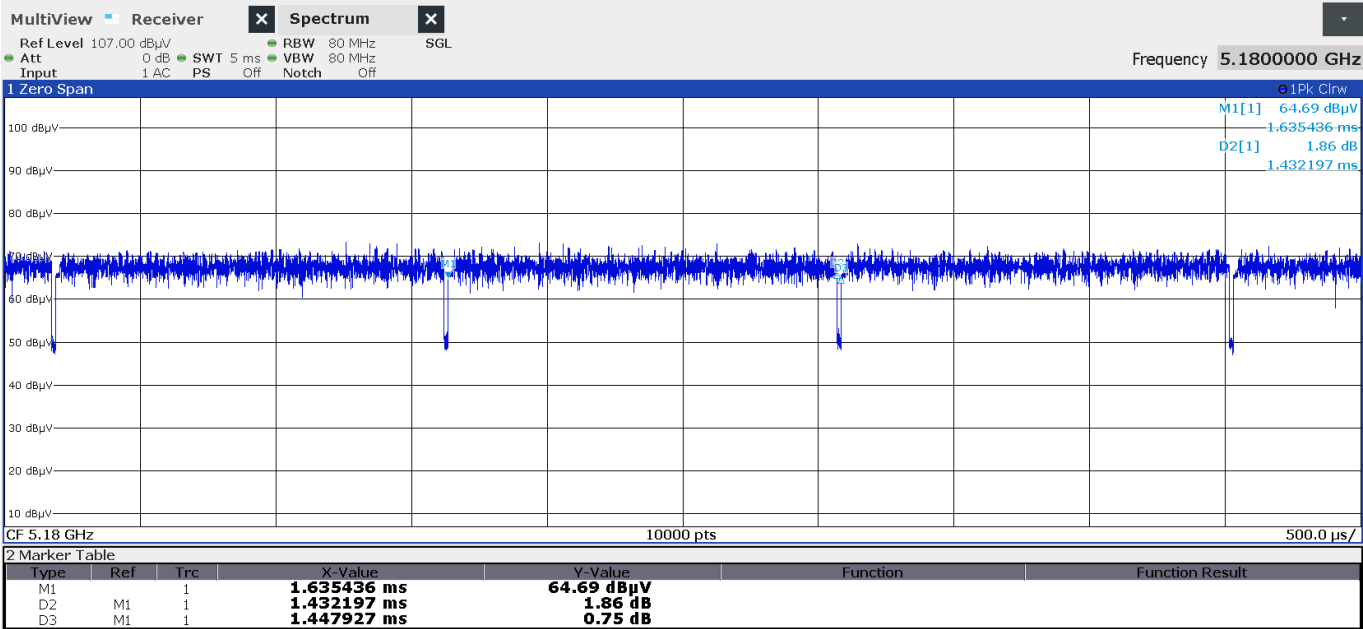
### Results

The results below are for data rates with a duty cycle lower than 98%, all the other modes not reported having a duty cycle  $\geq 98\%$ .

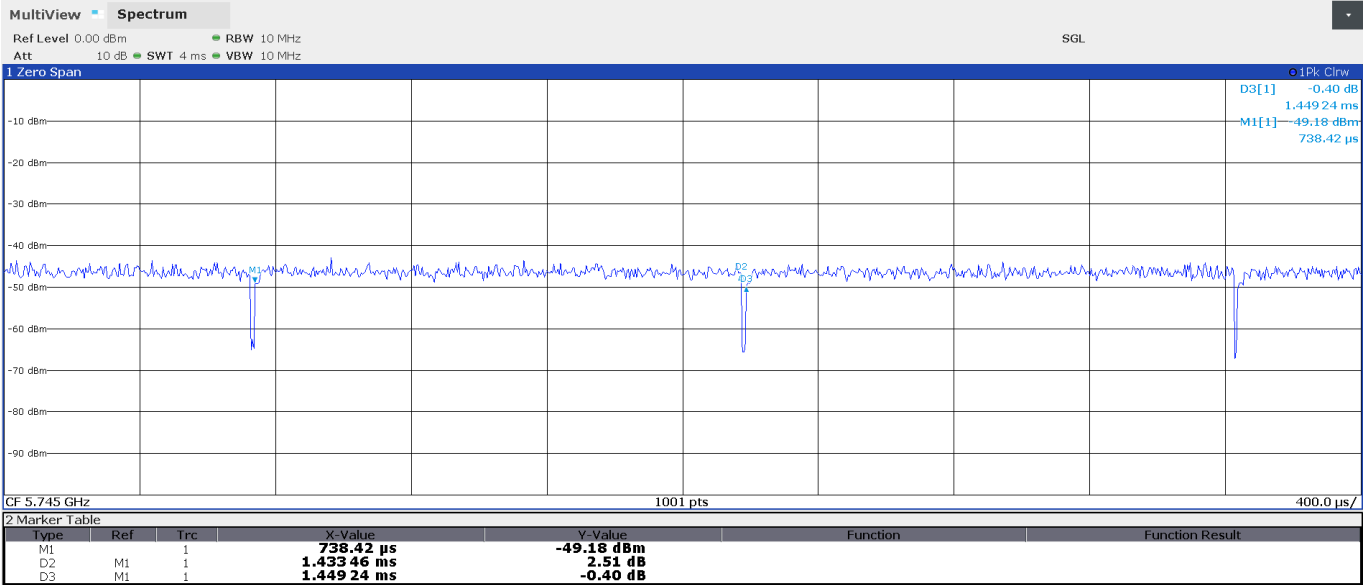
| Mode        | Sub-band U-NII-1    |             |                            | Sub-band U-NII-3    |             |                            |
|-------------|---------------------|-------------|----------------------------|---------------------|-------------|----------------------------|
|             | Pulse Duration (ms) | Period (ms) | Duty Cycle Correction (dB) | Pulse Duration (ms) | Period (ms) | Duty Cycle Correction (dB) |
| 802.11 ac80 | 0.331762            | 0.348037    | 0.21                       | 0.331268            | 0.347479    | 0.21                       |

Attachments

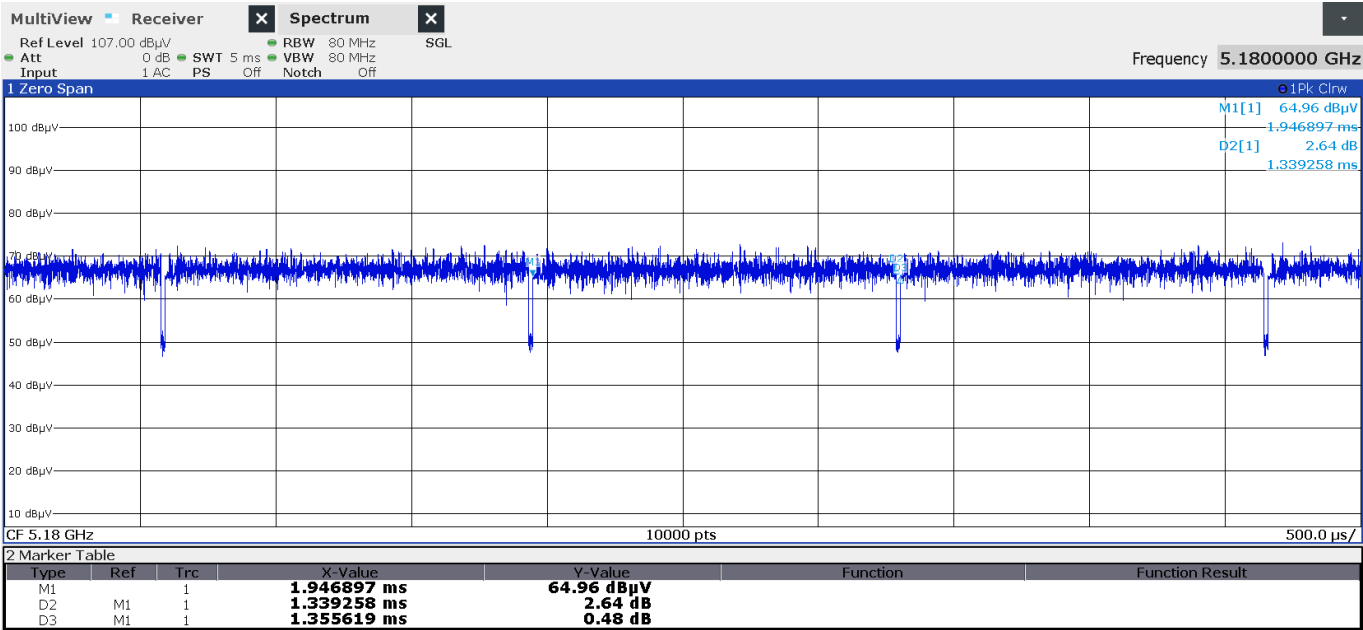
SISO 802.11 a20 (U-NII-1)



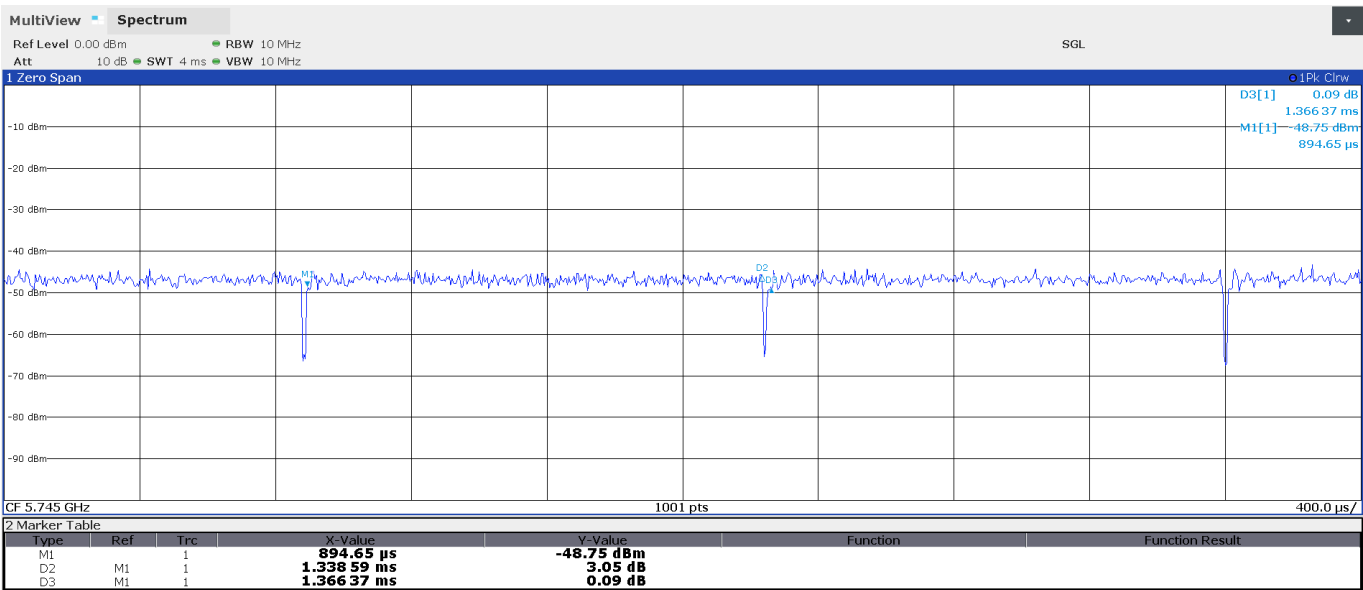
SISO 802.11 a20 (U-NII-3)



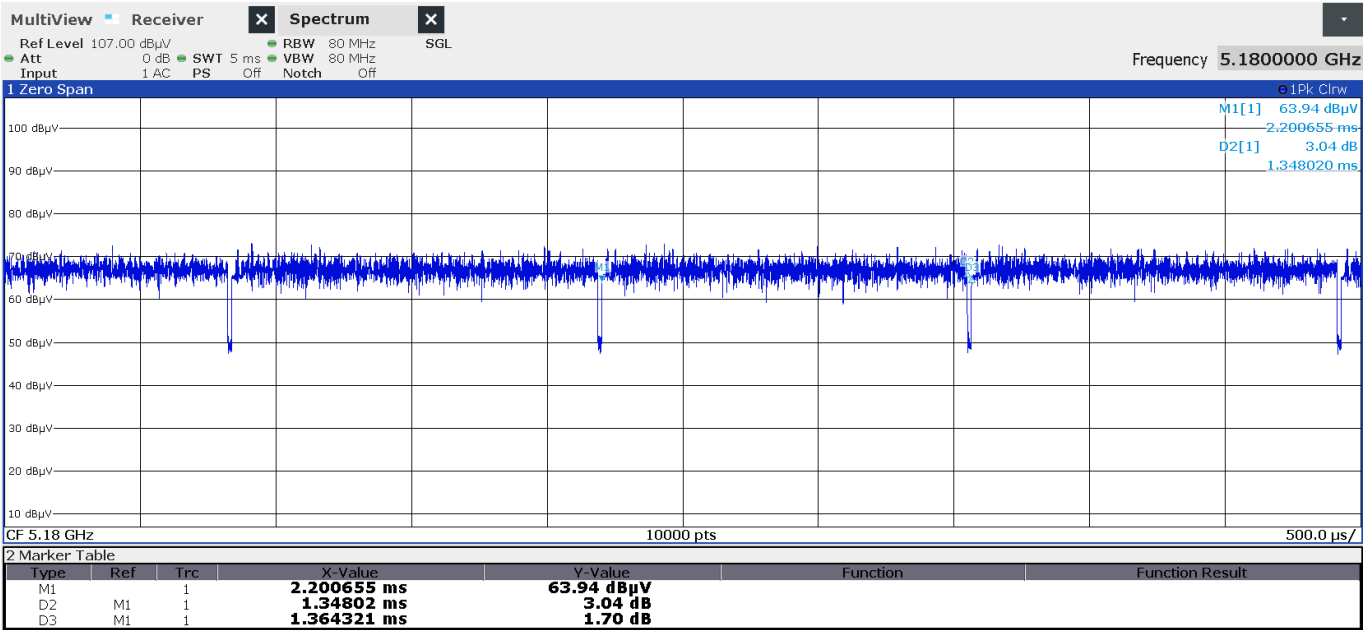
SISO 802.11 n20 (U-NII-1)



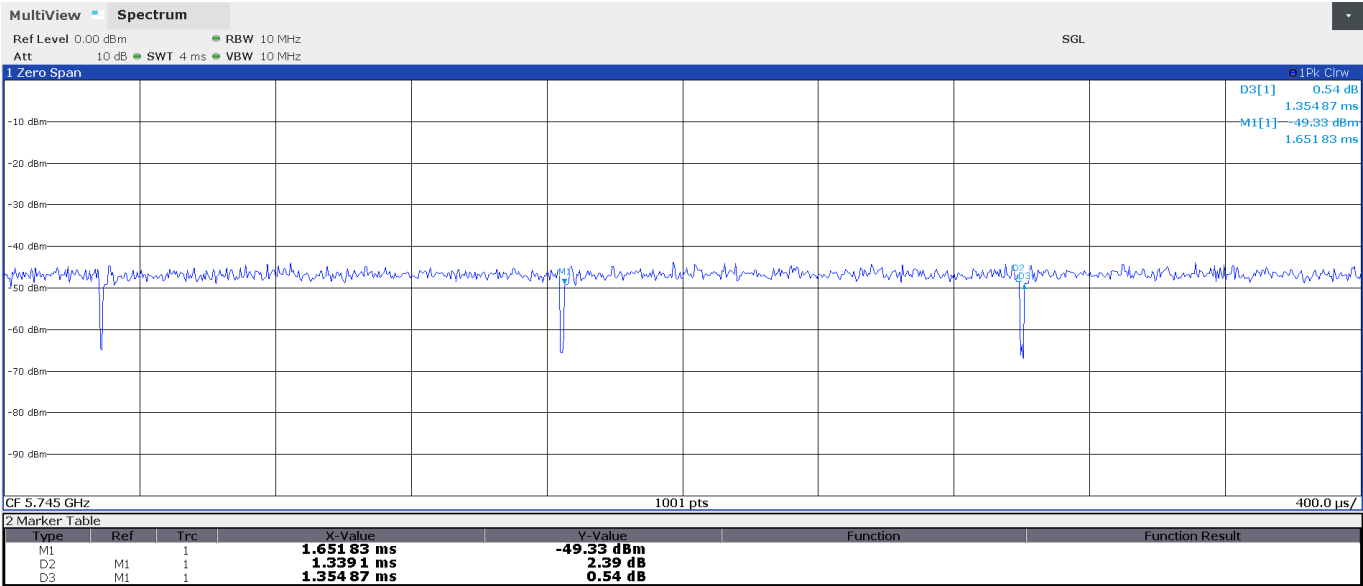
SISO 802.11 n20 (U-NII-3)



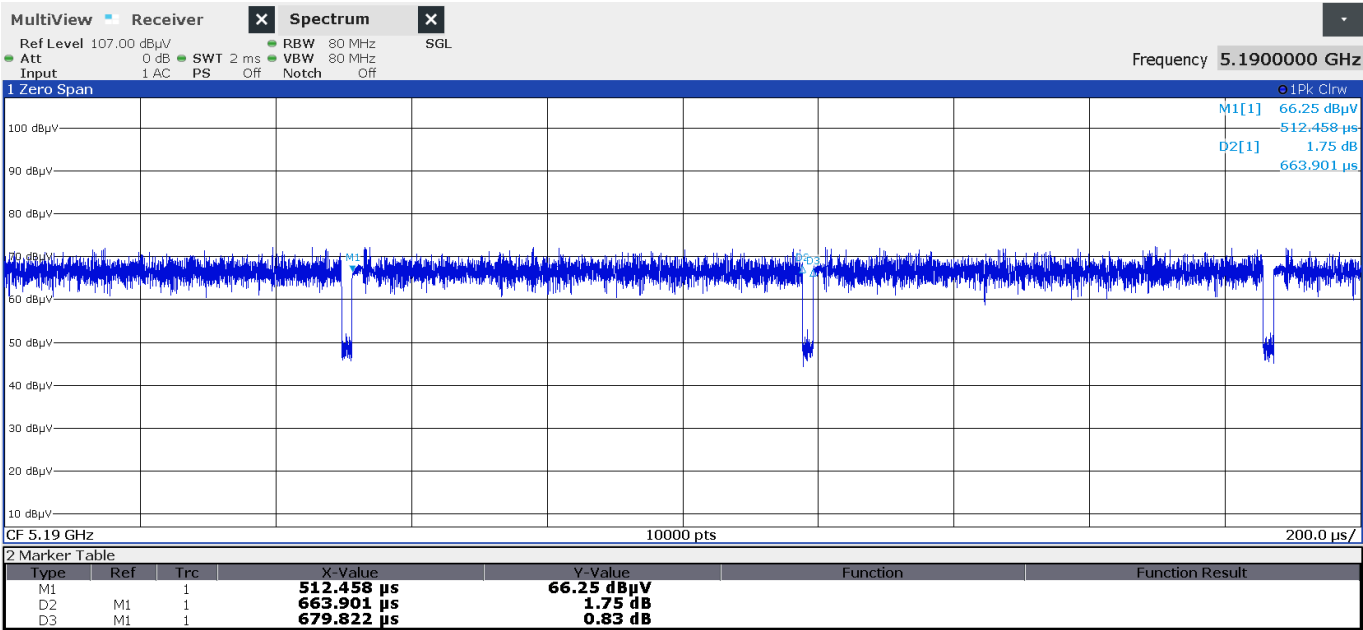
SISO 802.11 ac20 (U-NII-1)



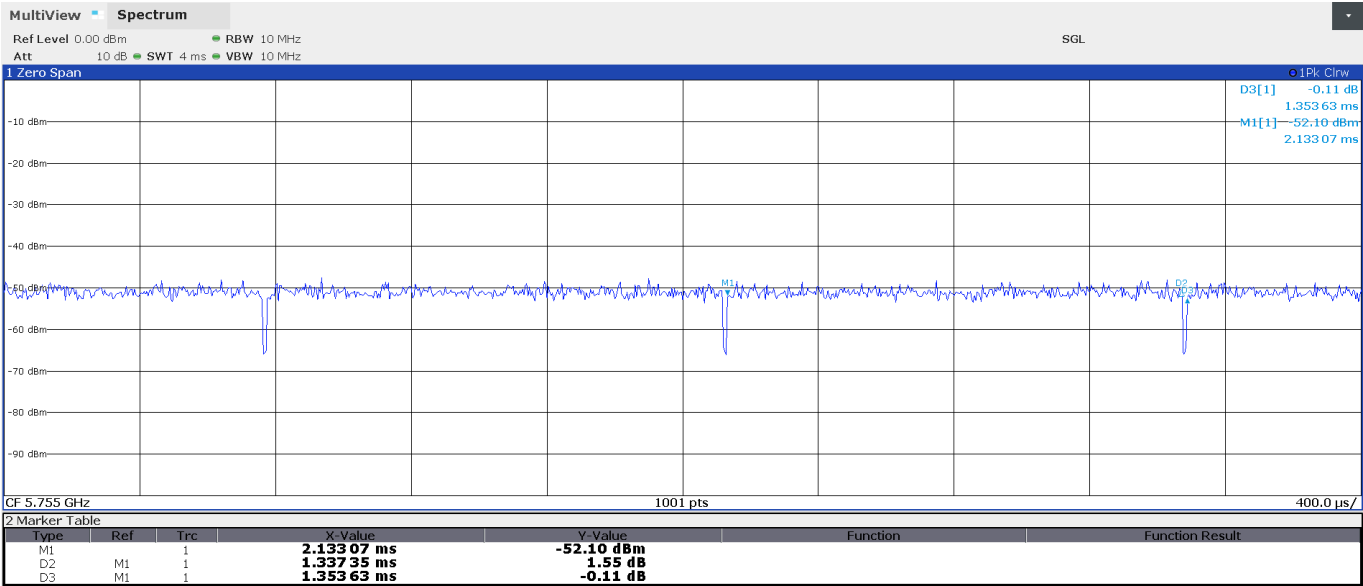
SISO 802.11 ac20 (U-NII-3)



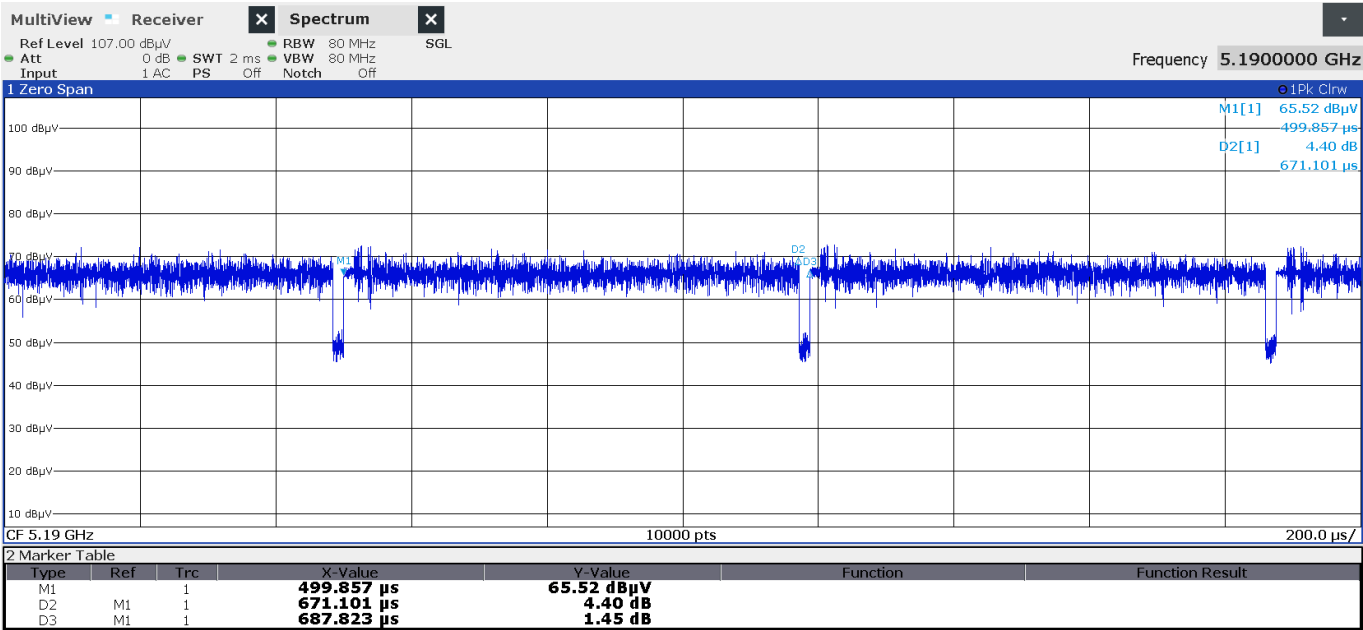
SISO 802.11 n40 (U-NII-1)



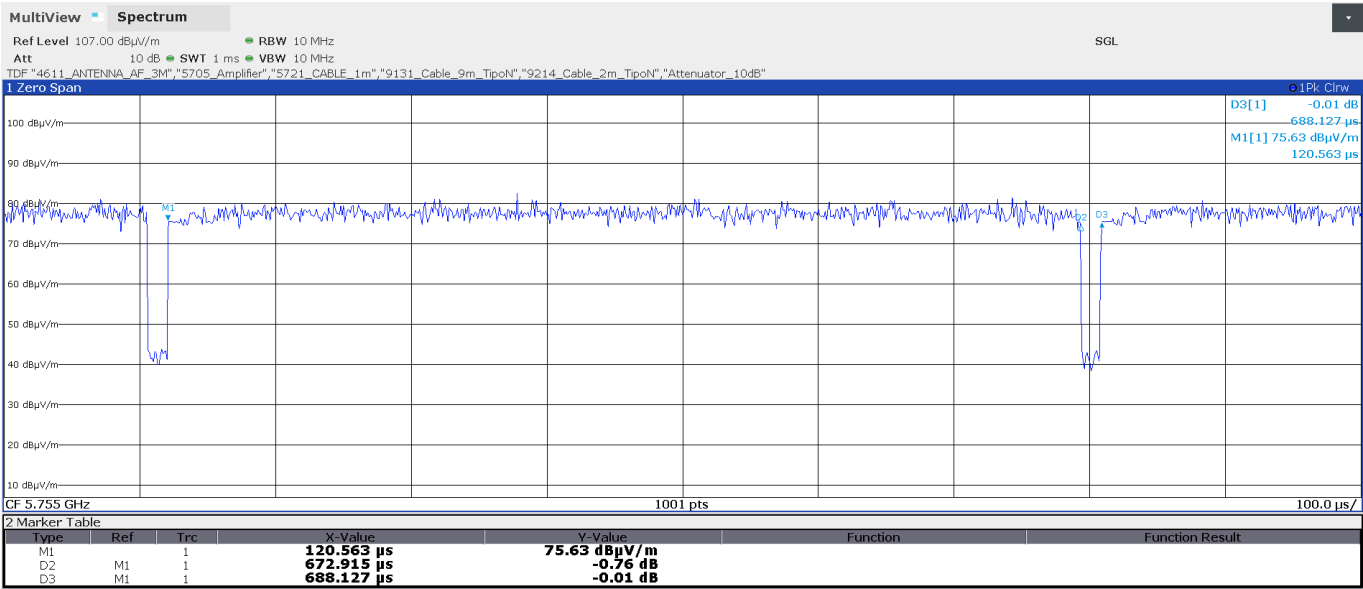
SISO 802.11 n40 (U-NII-3)



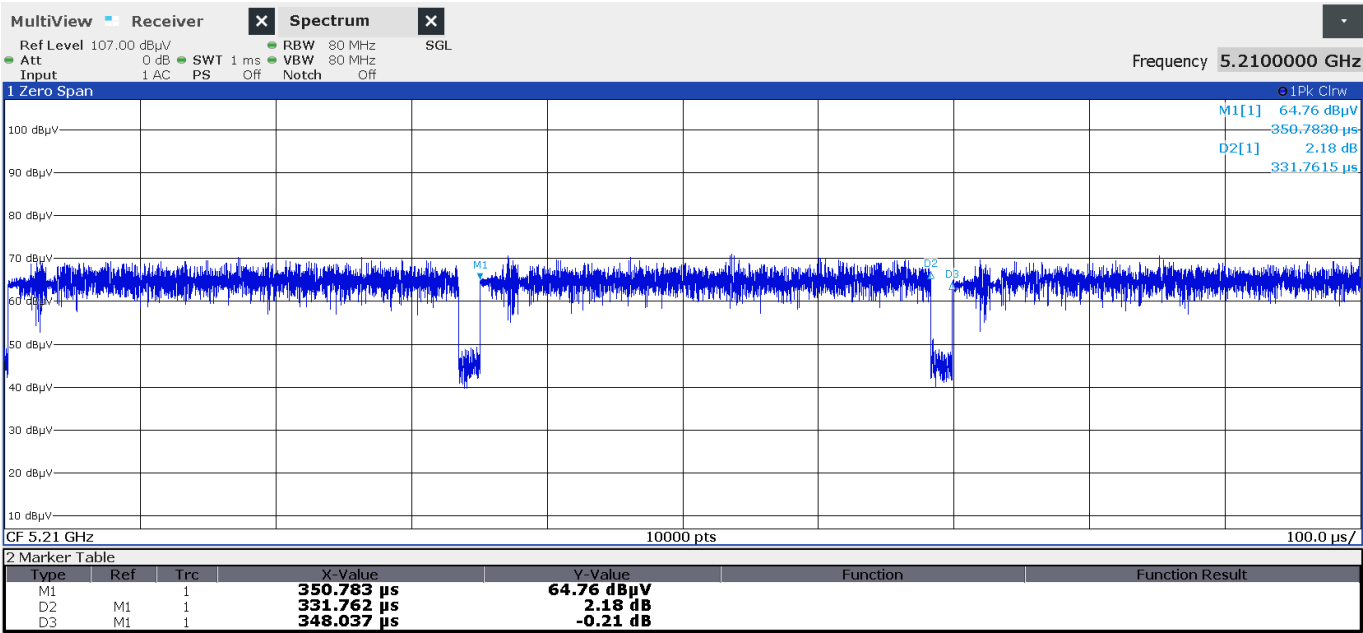
SISO 802.11 ac40 (U-NII-1)



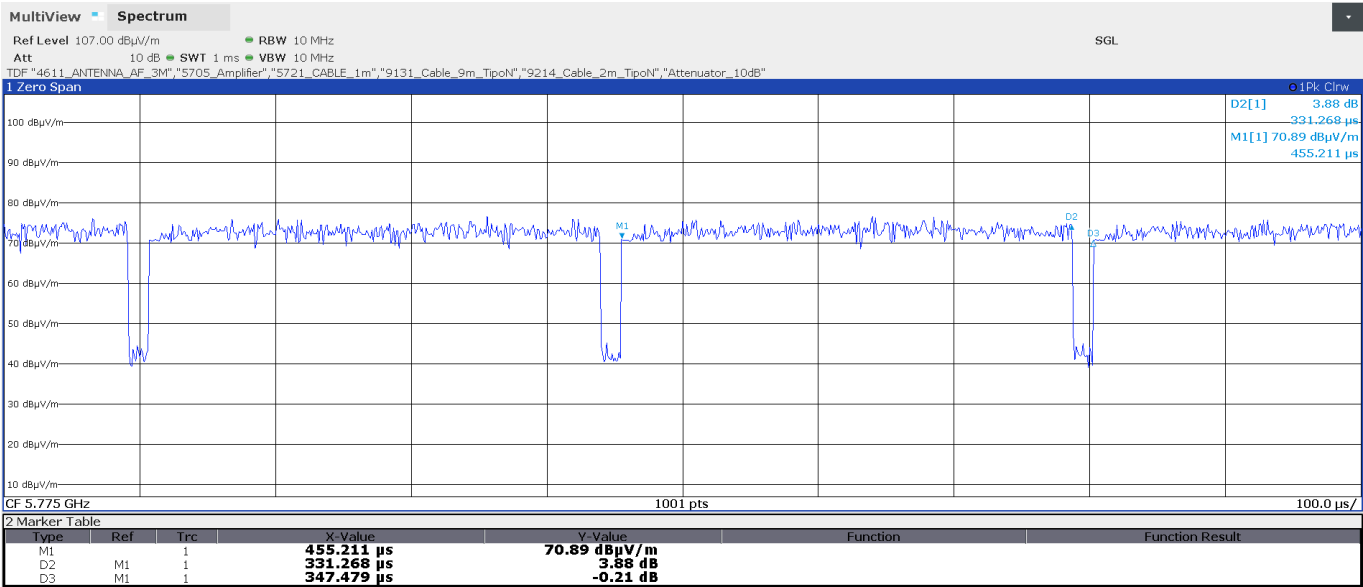
SISO 802.11 ac40 (U-NII-3)



SISO 802.11 ac80 (U-NII-1)



SISO 802.11 ac80 (U-NII-3)



## Transmitter. 99% Occupied Bandwidth

### Limits

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

The following conditions shall be observed for measuring the occupied bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

### Results

This test was performed on all the supported modes of the EUT, in the worst data rates after preliminary testing:

- 802.11a: 6 Mbps SISO 1Tx.
- 802.11n HT20: MCS0 SISO 1Tx.
- 802.11n HT40: MCS0 SISO 1Tx.
- 802.11ac VHT20: MCS0 SISO 1Tx.
- 802.11ac VHT40: MCS0 SISO 1Tx.
- 802.11ac VHT80: MCS0 SISO 1Tx.

## SISO 802.11 a20

### U-NII-1 FCC (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 16.600000                       | 16.600000                | 16.700000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-1 RSS (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 16.600000                       | 16.700000                | 16.600000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-3 (5725-5850 MHz):

| Channels                     | Low Channel<br>149<br>(5745 MHz) | Middle Channel<br>157<br>(5785 MHz) | High Channel<br>165<br>(5825 MHz) |
|------------------------------|----------------------------------|-------------------------------------|-----------------------------------|
| 99% Occupied Bandwidth (MHz) | 16.700000                        | 16.600000                           | 16.600000                         |
| Measurement uncertainty (%)  | < ±1.41                          |                                     |                                   |

## SISO 802.11 n20 (HT20)

### U-NII-1 FCC (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.600000                       | 17.600000                | 17.700000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-1 RSS (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.600000                       | 17.600000                | 17.600000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-3 (5725-5850 MHz):

| Channels                     | Low Channel<br>149<br>(5745 MHz) | Middle Channel<br>157<br>(5785 MHz) | High Channel<br>165<br>(5825 MHz) |
|------------------------------|----------------------------------|-------------------------------------|-----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.700000                        | 17.600000                           | 17.600000                         |
| Measurement uncertainty (%)  | < ±1.41                          |                                     |                                   |

## SISO 802.11 ac20 (VHT20)

### U-NII-1 FCC (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.600000                       | 17.600000                | 17.600000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-1 RSS (5150-5250 MHz):

| Channels                     | Low Channel<br>36<br>(5180 MHz) | Channel 40<br>(5200 MHz) | High Channel<br>48<br>(5240 MHz) |
|------------------------------|---------------------------------|--------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.600000                       | 17.600000                | 17.700000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                          |                                  |

### U-NII-3 (5725-5850 MHz):

| Channels                     | Low Channel<br>149<br>(5745 MHz) | Middle Channel<br>157<br>(5785 MHz) | High Channel<br>165<br>(5825 MHz) |
|------------------------------|----------------------------------|-------------------------------------|-----------------------------------|
| 99% Occupied Bandwidth (MHz) | 17.600000                        | 17.700000                           | 17.600000                         |
| Measurement uncertainty (%)  | < ±1.41                          |                                     |                                   |

## SISO 802.11 n40 (HT40)

### U-NII-1 FCC (5150-5250 MHz):

| Channels                     | Low Channel<br>38<br>(5190 MHz) | High Channel<br>46<br>(5230 MHz) |
|------------------------------|---------------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                       | 36.250000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                                  |

### U-NII-1 RSS (5150-5250 MHz):

| Channels                     | Low Channel<br>38<br>(5190 MHz) | High Channel<br>46<br>(5230 MHz) |
|------------------------------|---------------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                       | 36.250000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                                  |

### U-NII-3 (5725-5850 MHz):

| Channels                     | Low Channel<br>151<br>(5755 MHz) | High Channel<br>159<br>(5795 MHz) |
|------------------------------|----------------------------------|-----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                        | 36.250000                         |
| Measurement uncertainty (%)  | < ±1.41                          |                                   |

**SISO 802.11 ac40 (VHT40):**

**U-NII-1 FCC (5150-5250 MHz):**

| Channels                     | Low Channel<br>38<br>(5190 MHz) | High Channel<br>46<br>(5230 MHz) |
|------------------------------|---------------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                       | 36.250000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                                  |

**U-NII-1 RSS (5150-5250 MHz):**

| Channels                     | Low Channel<br>38<br>(5190 MHz) | High Channel<br>46<br>(5230 MHz) |
|------------------------------|---------------------------------|----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                       | 36.250000                        |
| Measurement uncertainty (%)  | < ±1.41                         |                                  |

**U-NII-3 (5725-5850 MHz):**

| Channels                     | Low Channel<br>151<br>(5755 MHz) | High Channel<br>159<br>(5795 MHz) |
|------------------------------|----------------------------------|-----------------------------------|
| 99% Occupied Bandwidth (MHz) | 36.250000                        | 36.250000                         |
| Measurement uncertainty (%)  | < ±1.41                          |                                   |

**SISO 802.11 ac80 (VHT80):**

**U-NII-1 FCC (5150-5250 MHz):**

| Channel                      | Single Channel<br>42<br>(5210 MHz) |
|------------------------------|------------------------------------|
| 99% Occupied Bandwidth (MHz) | 76.500000                          |
| Measurement uncertainty (%)  | < ±1.41                            |

**U-NII-1 RSS (5150-5250 MHz):**

| Channel                      | Single Channel<br>42<br>(5210 MHz) |
|------------------------------|------------------------------------|
| 99% Occupied Bandwidth (MHz) | 76.500000                          |
| Measurement uncertainty (%)  | < ±1.41                            |

**U-NII-3 (5725-5850 MHz):**

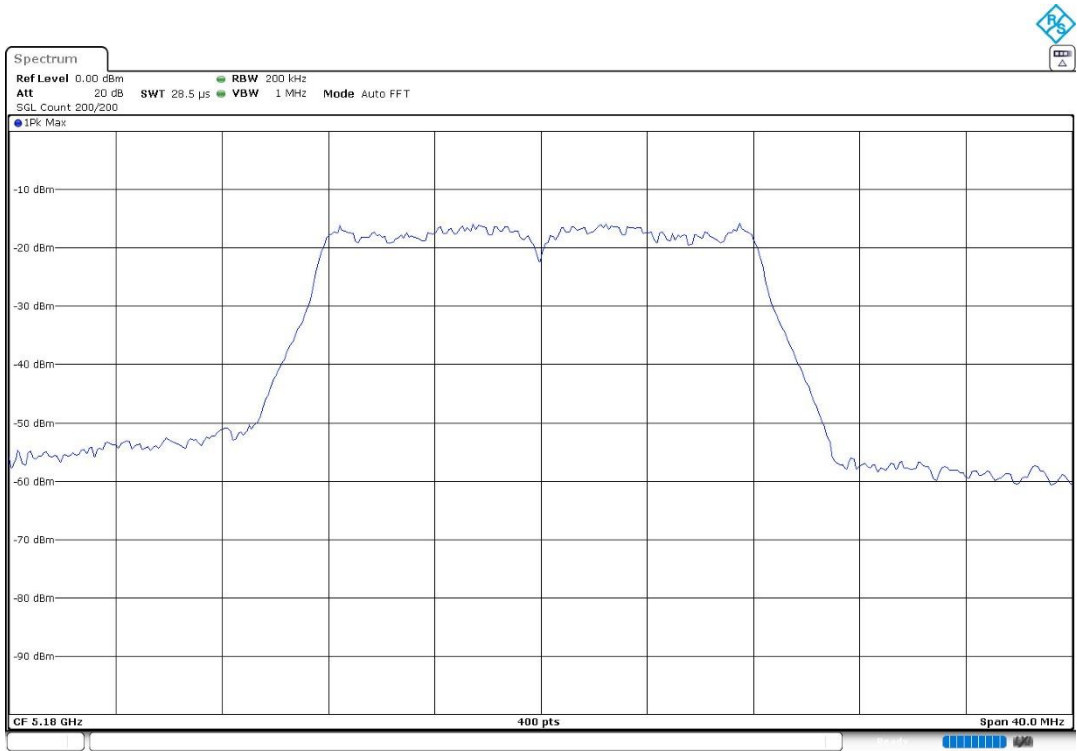
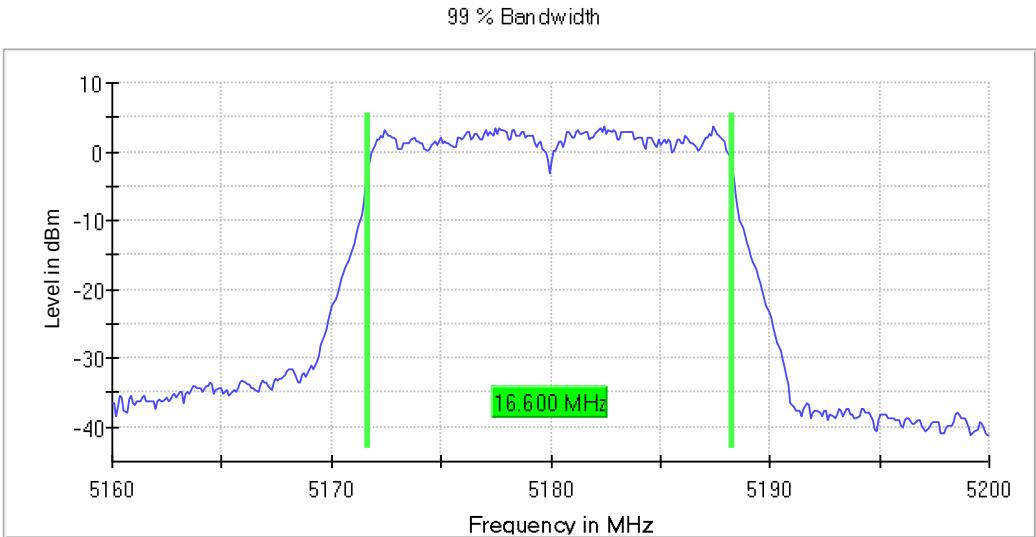
| Channel                      | Single Channel<br>155<br>(5775 MHz) |
|------------------------------|-------------------------------------|
| 99% Occupied Bandwidth (MHz) | 77.000000                           |
| Measurement uncertainty (%)  | < ±1.41                             |

Attachments

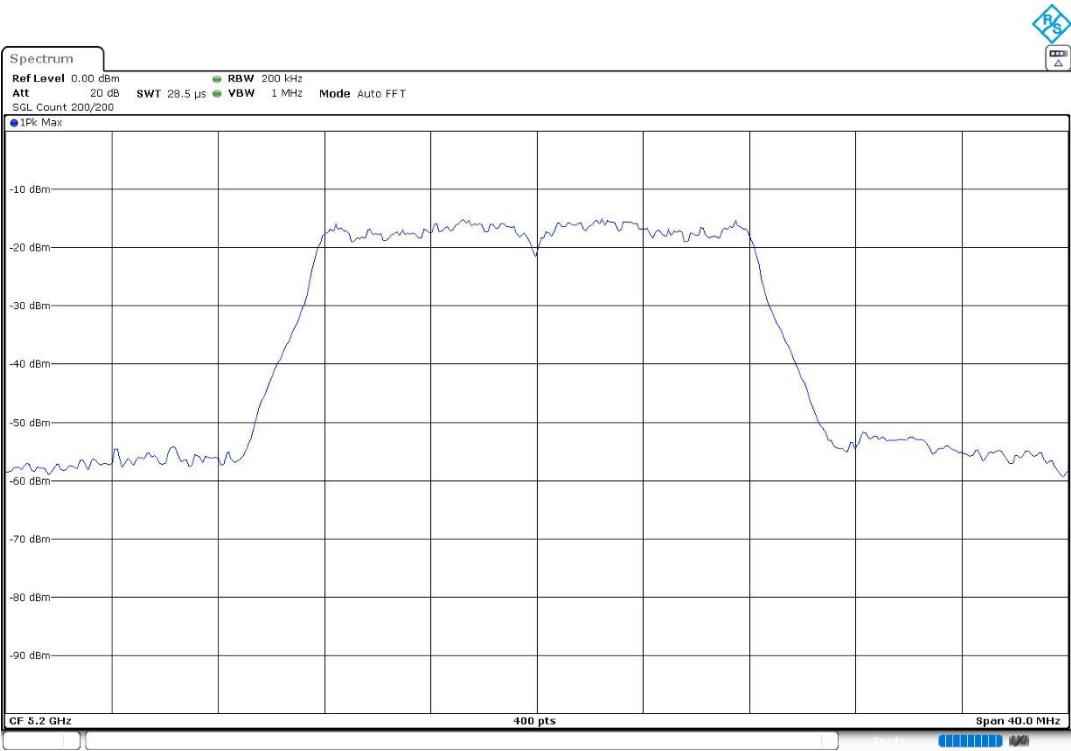
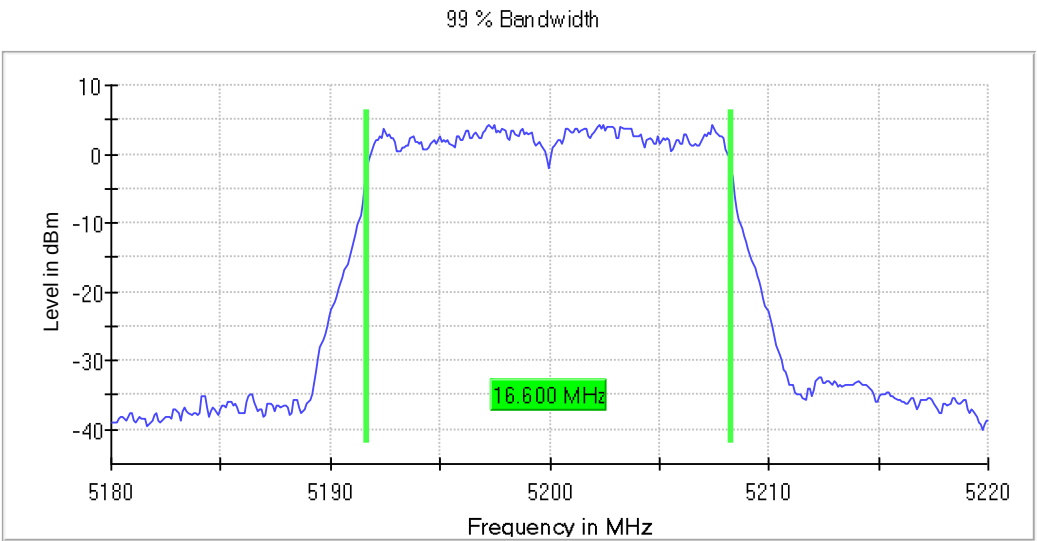
SISO 802.11 a20

U-NII-1 FCC (5150-5250 MHz)

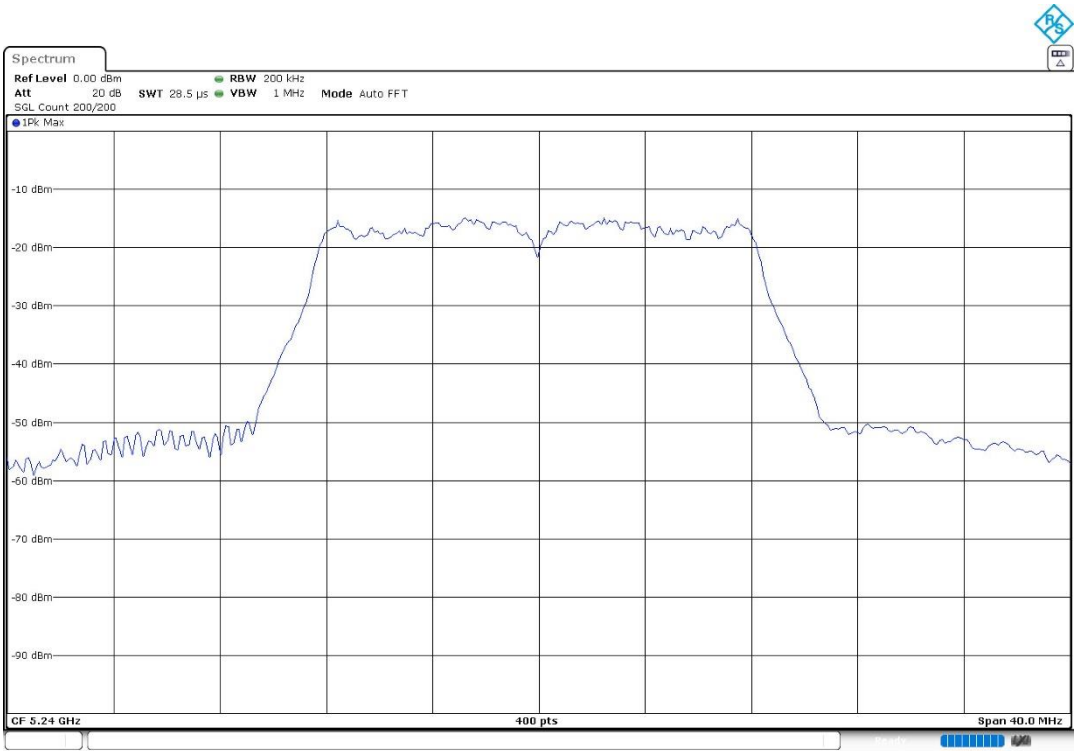
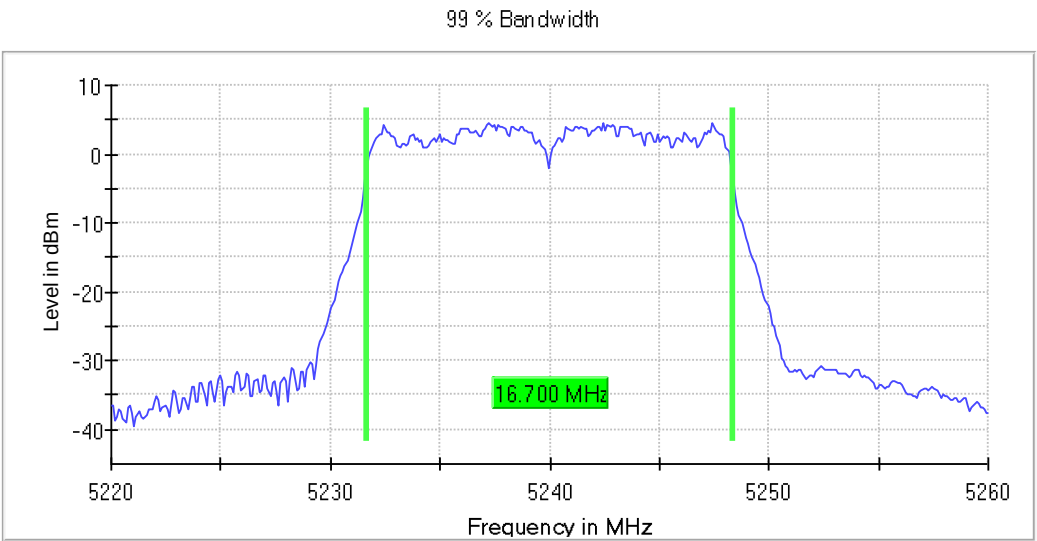
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

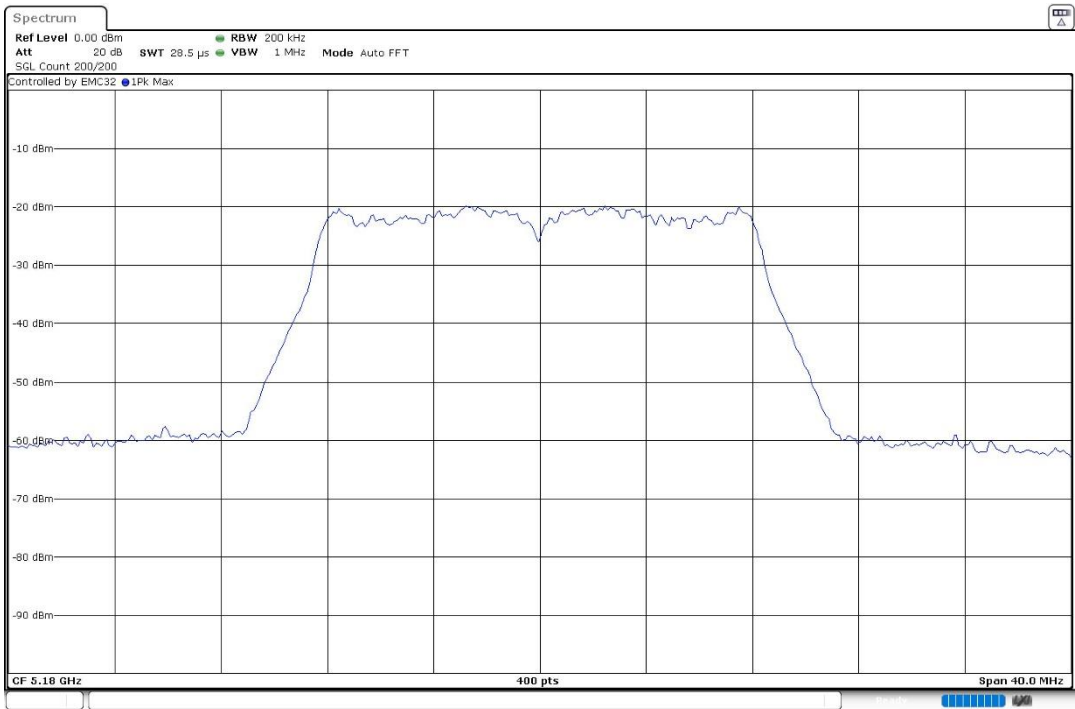
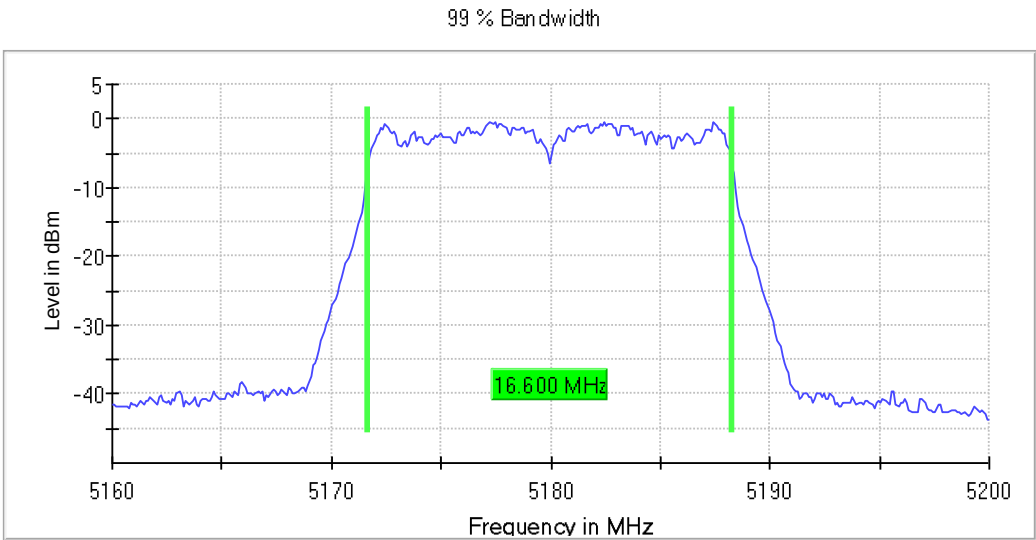


- High Channel 48 (5240 MHz):

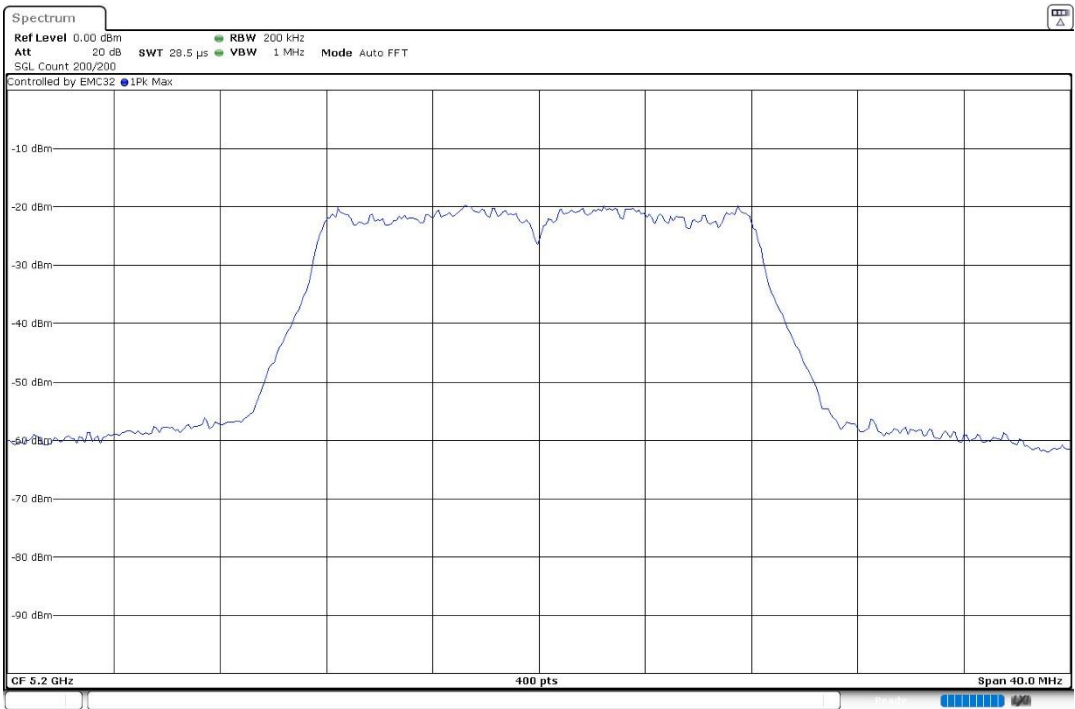
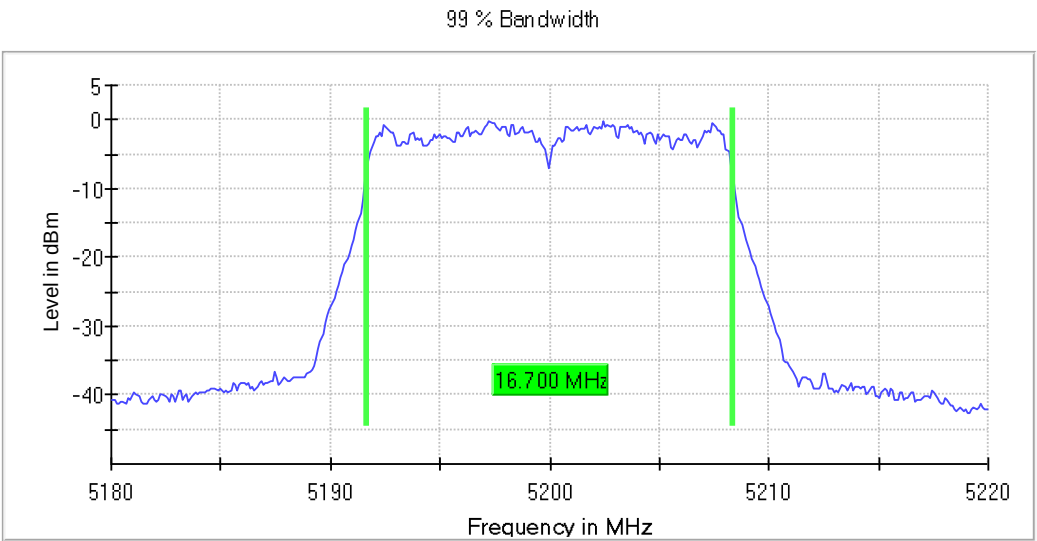


U-NII-1 RSS (5150-5250 MHz)

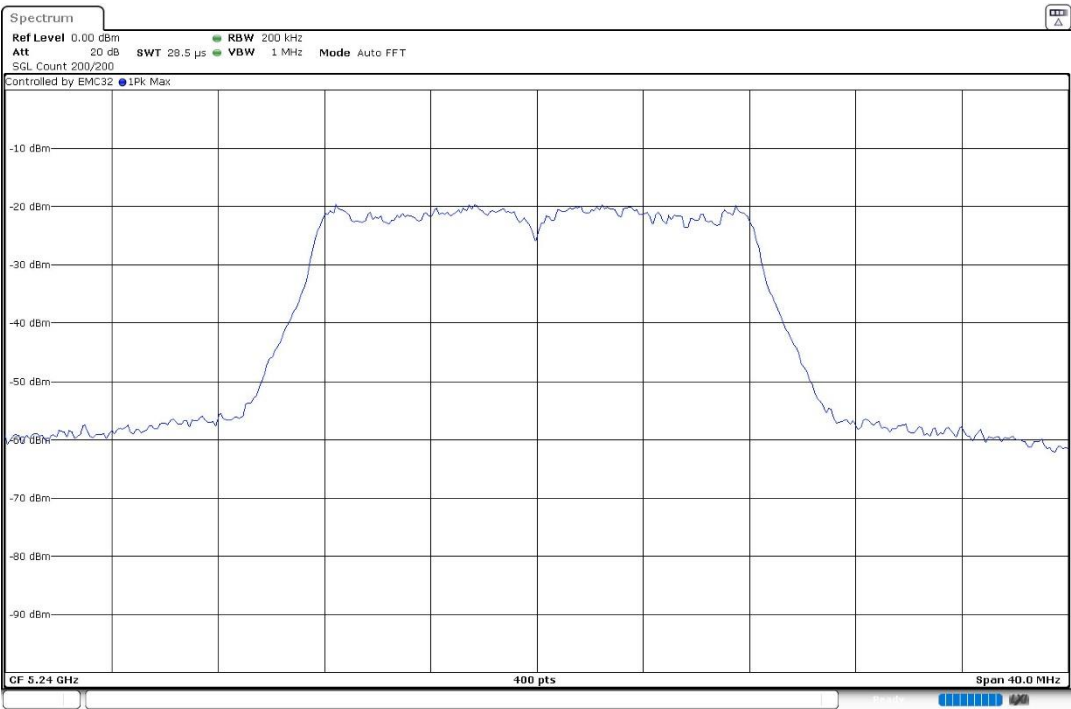
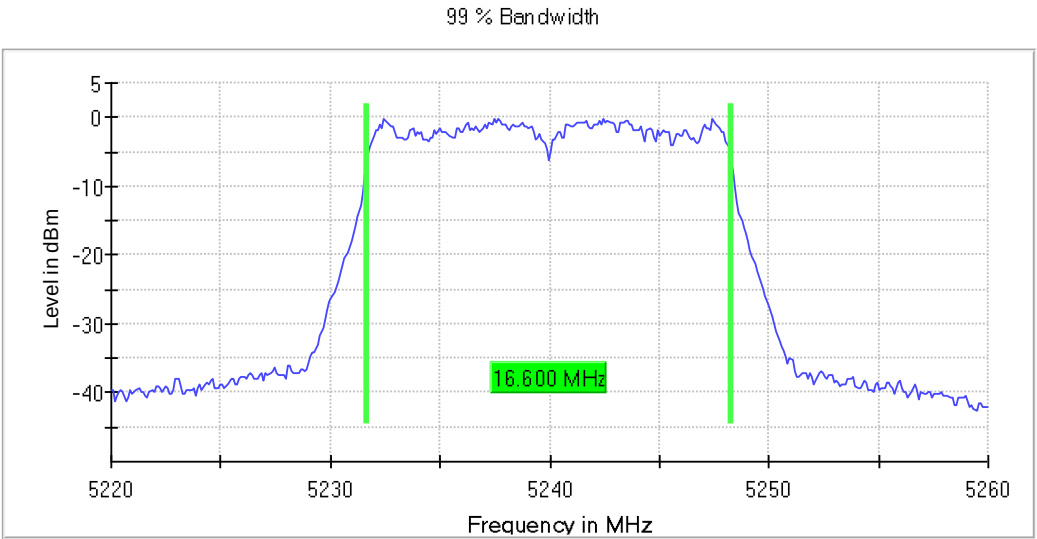
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

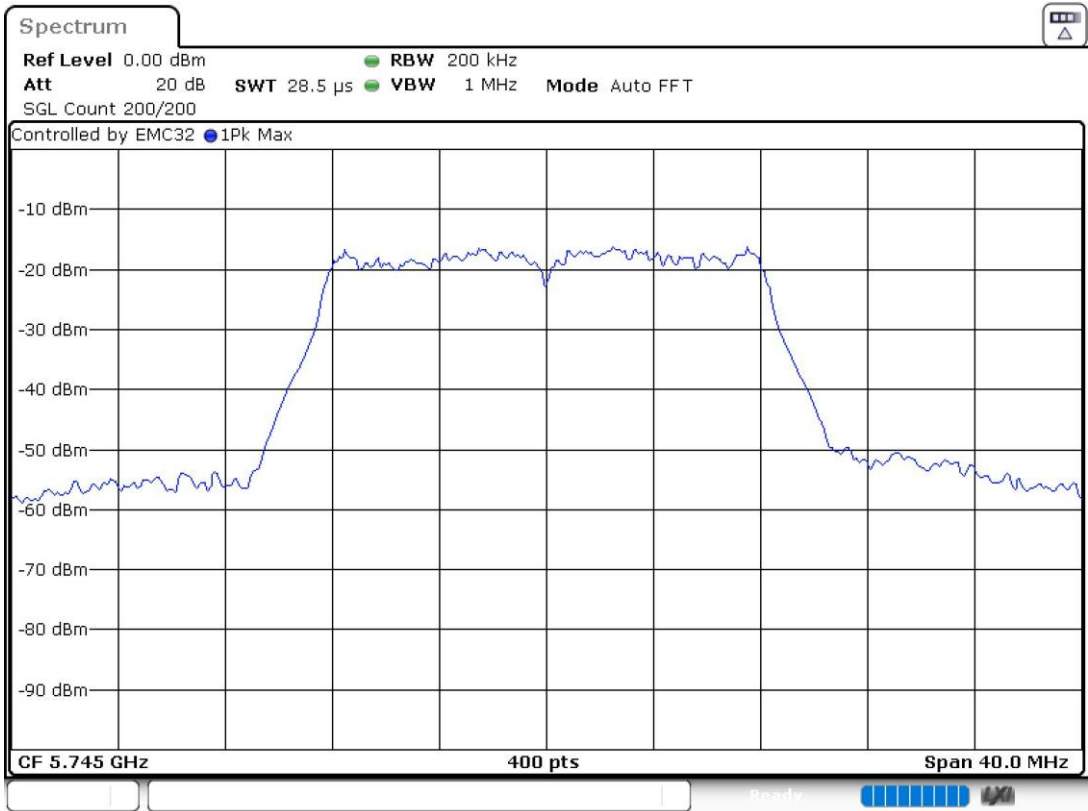
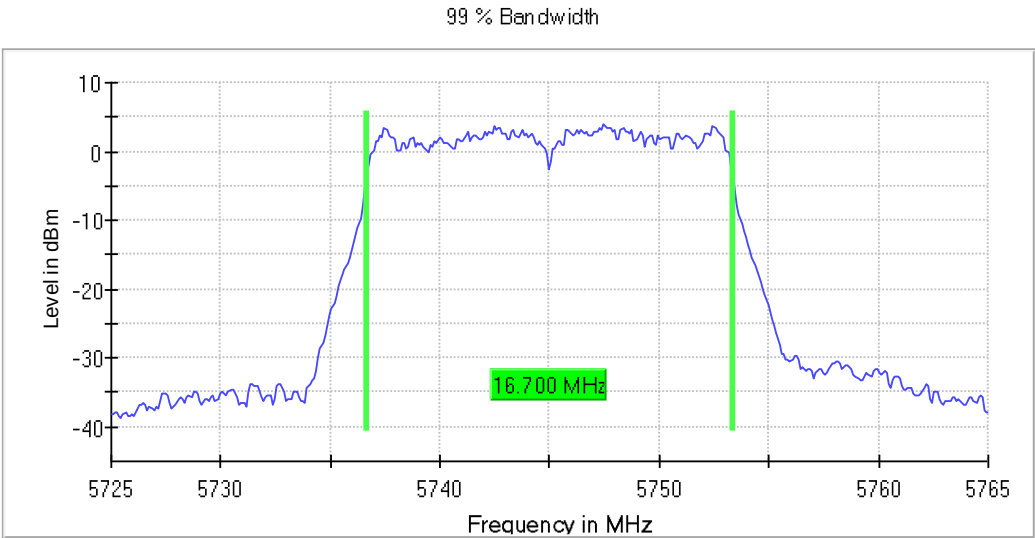


- High Channel 48 (5240 MHz):

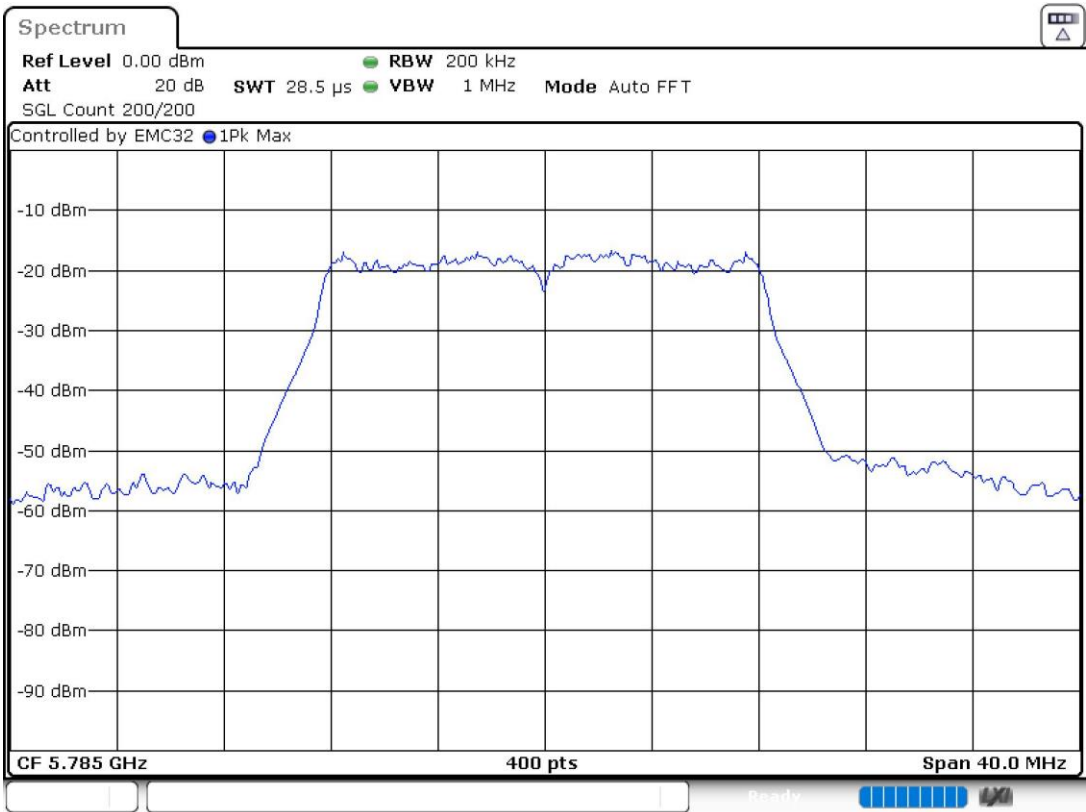
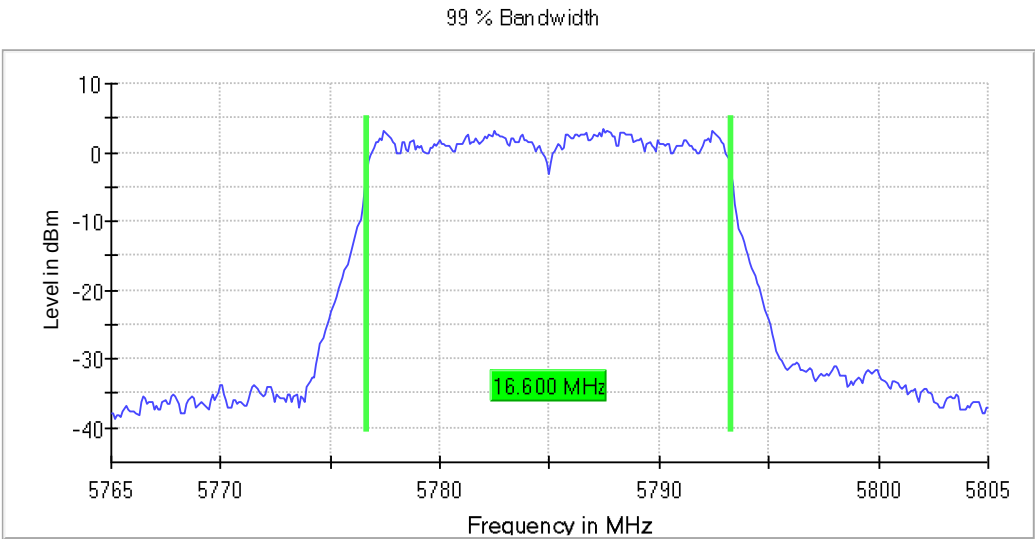


U-NII-3 (5725-5850 MHz)

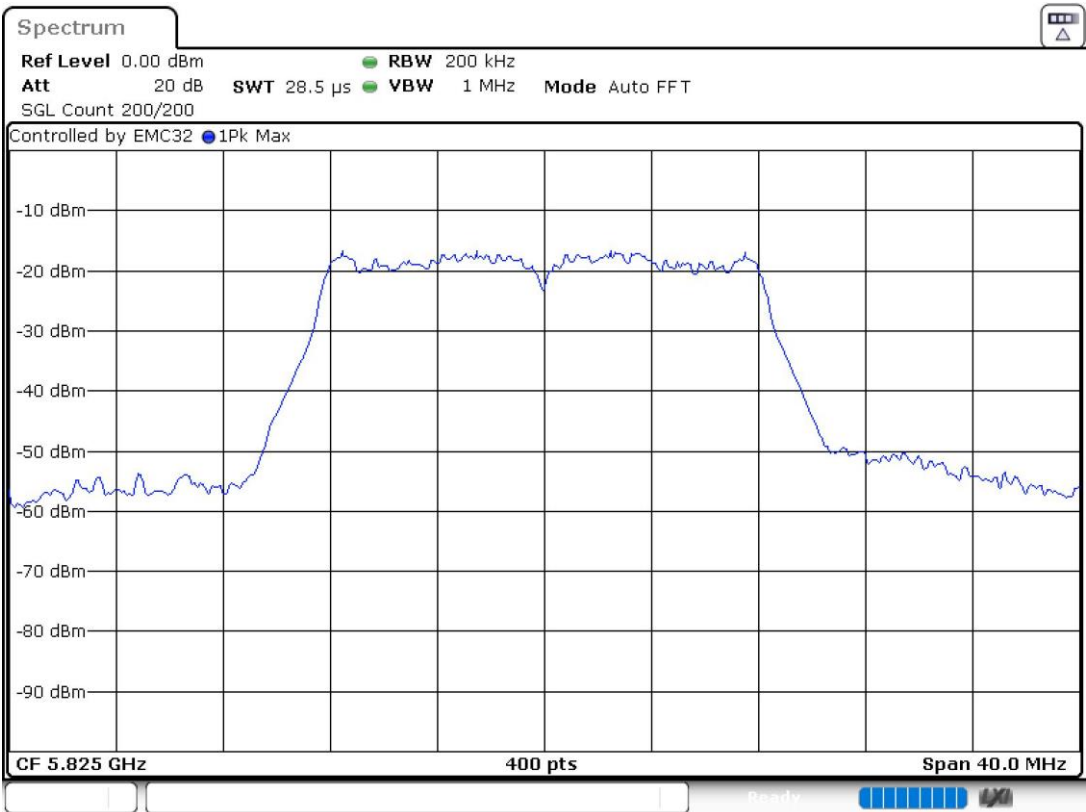
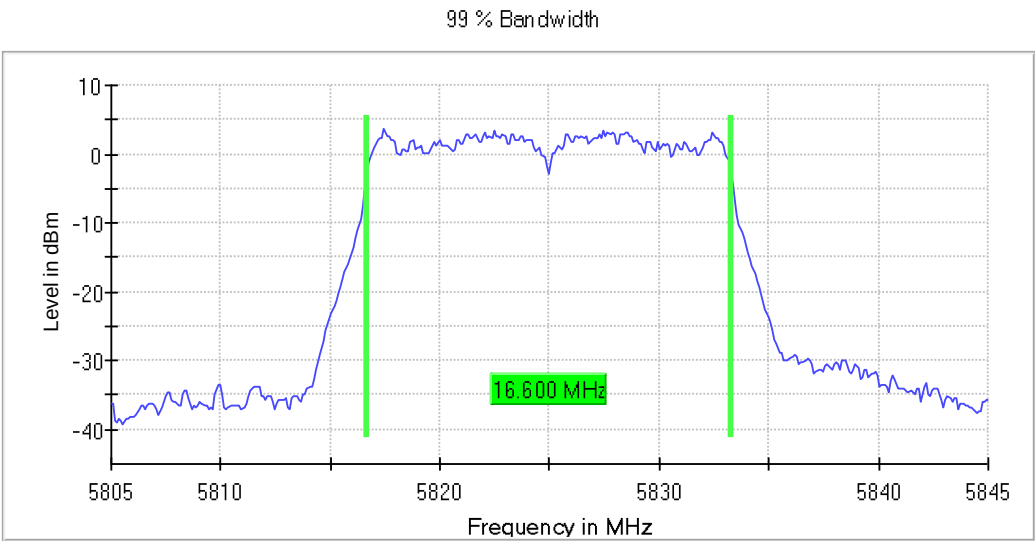
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



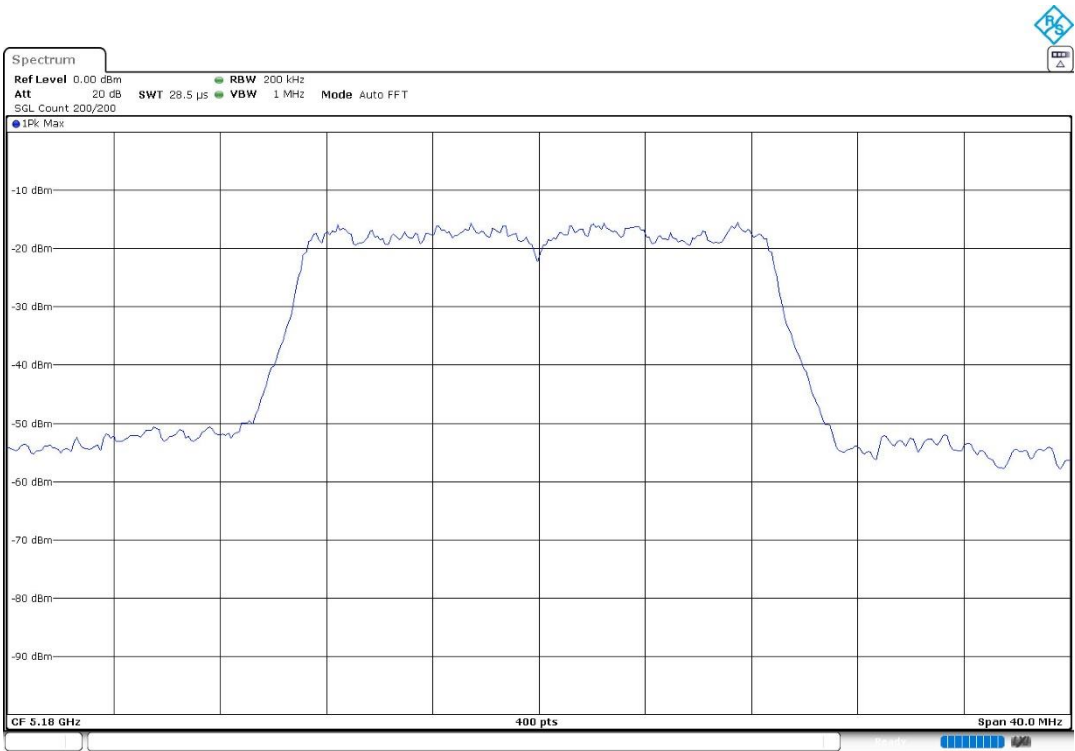
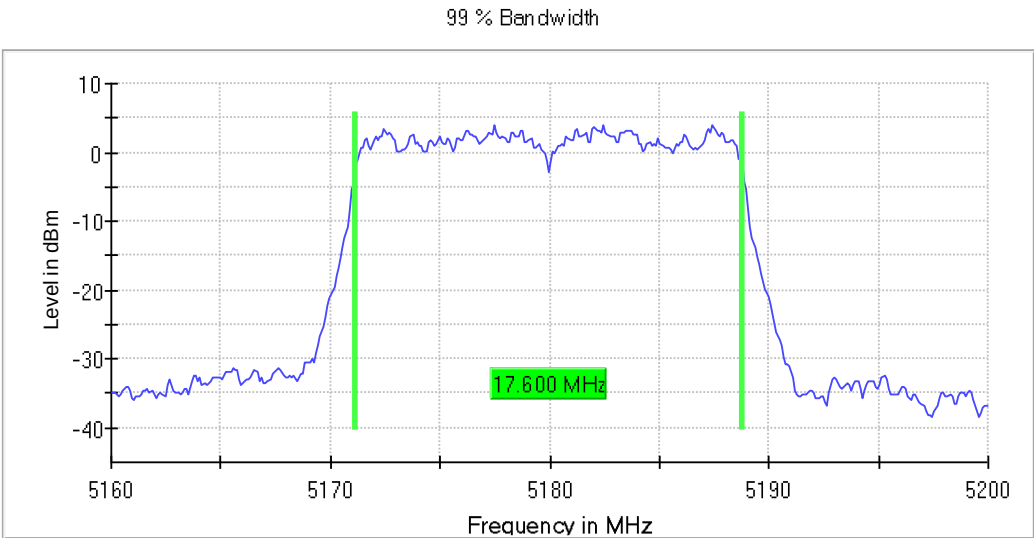
- High Channel 165 (5825 MHz):



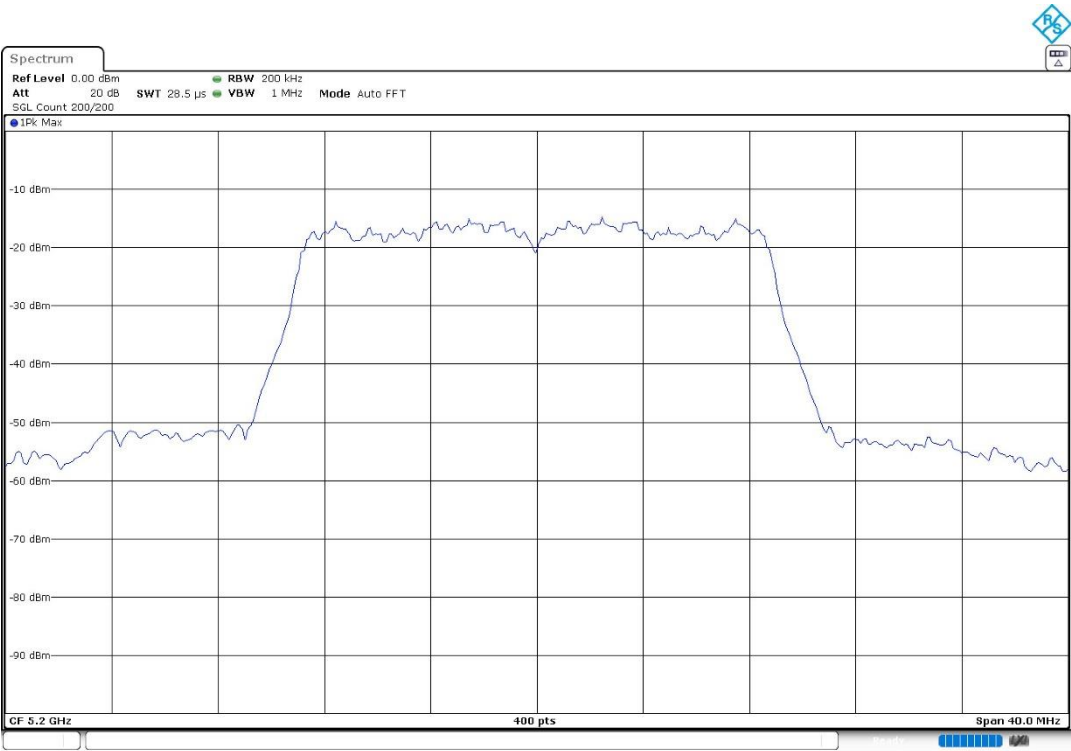
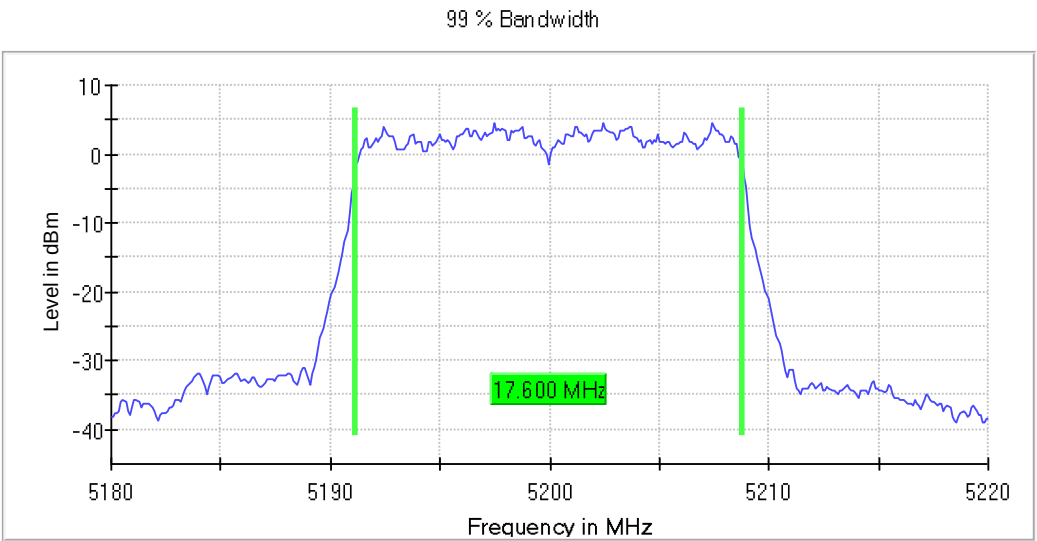
SISO 802.11 n20 (HT20)

U-NII-1 FCC (5150-5250 MHz)

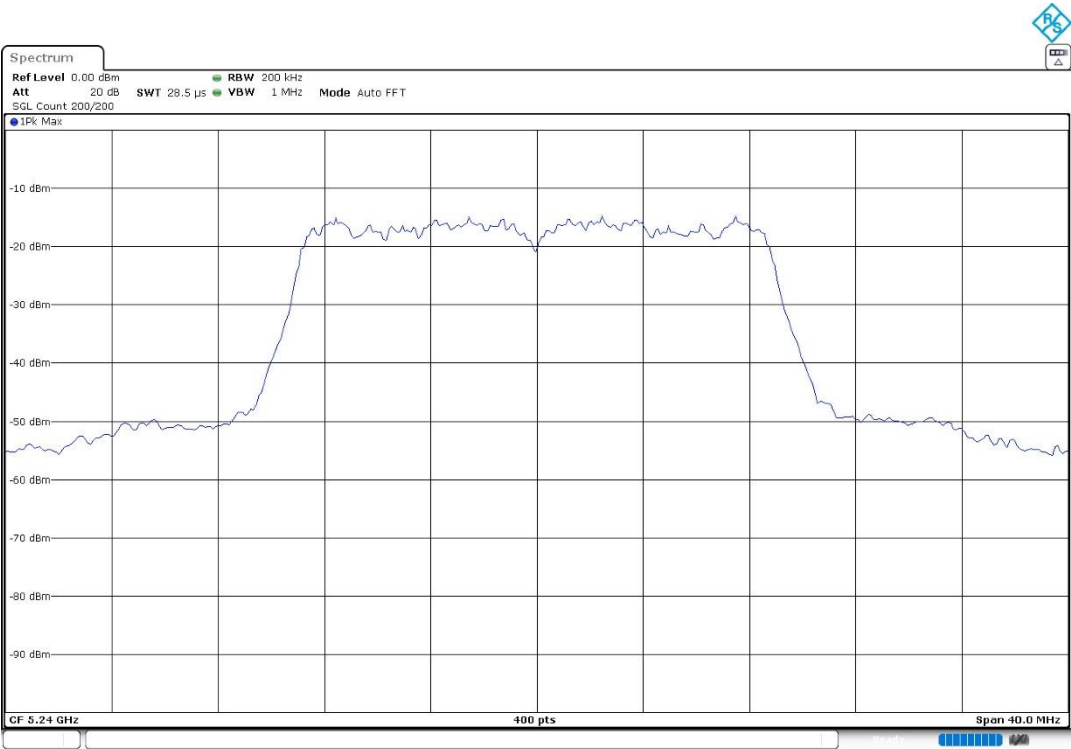
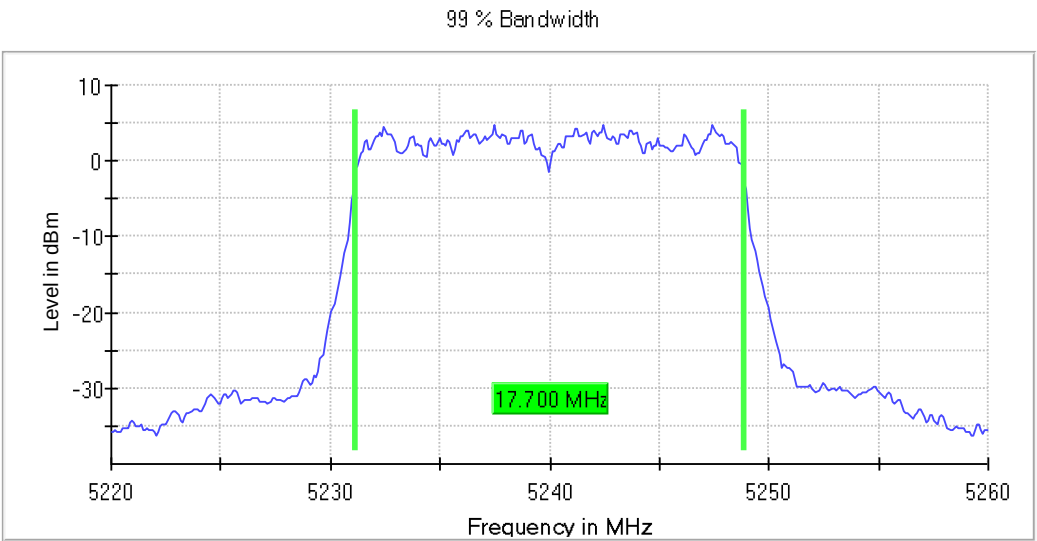
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

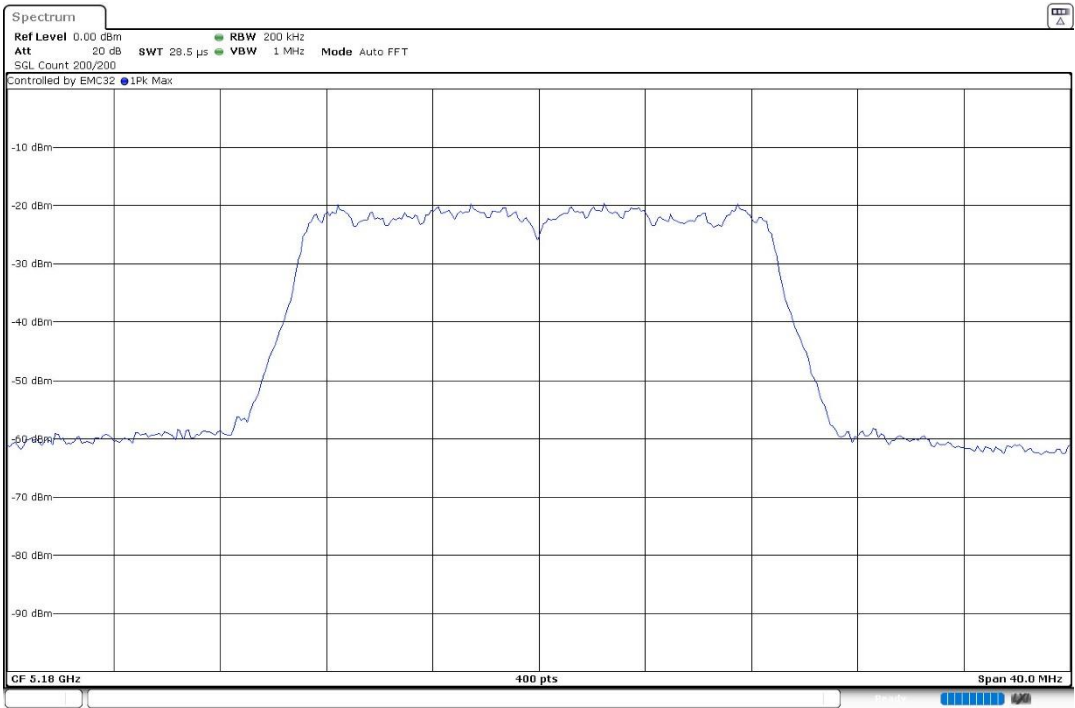
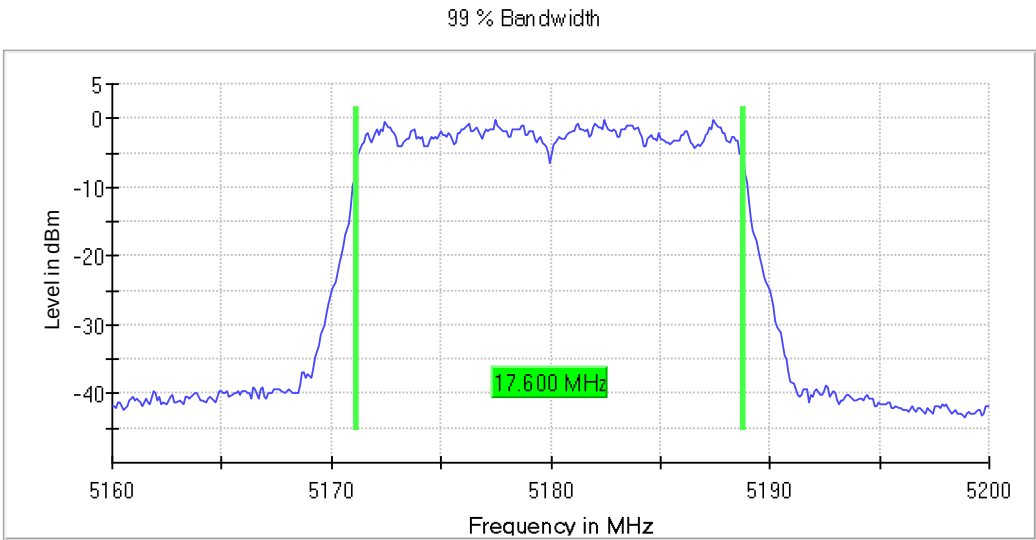


- High Channel 48 (5240 MHz):

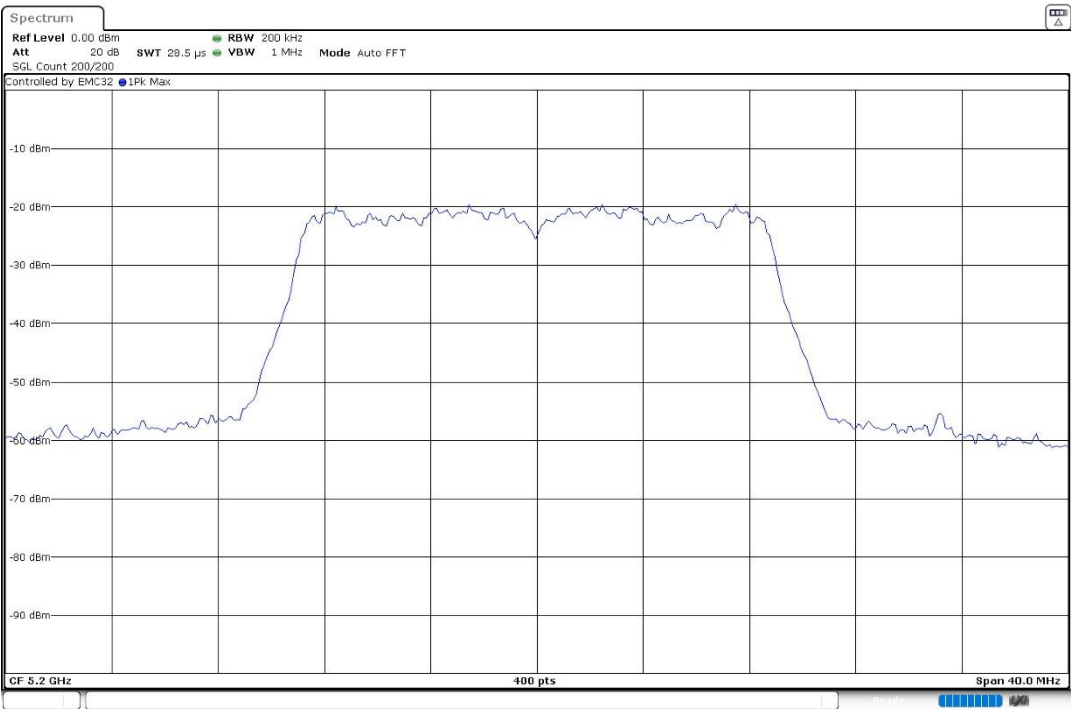
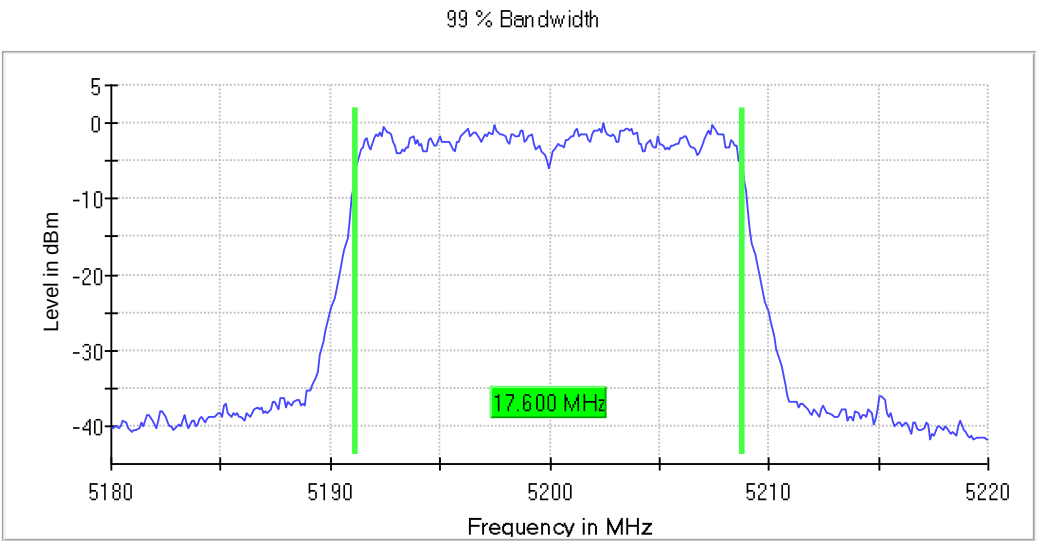


**U-NII-1 RSS (5150-5250 MHz)**

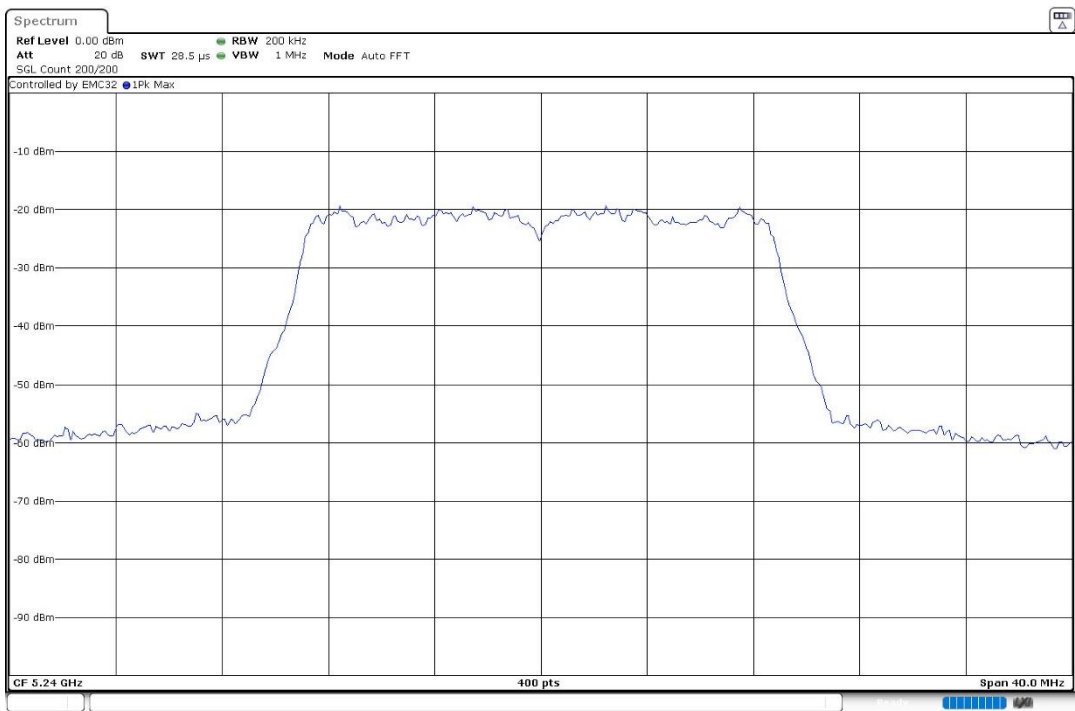
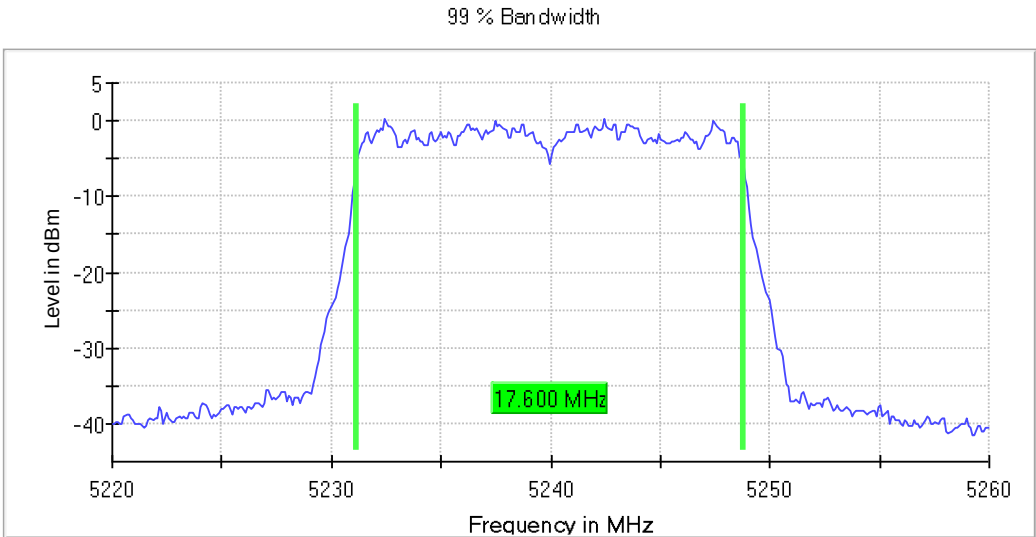
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

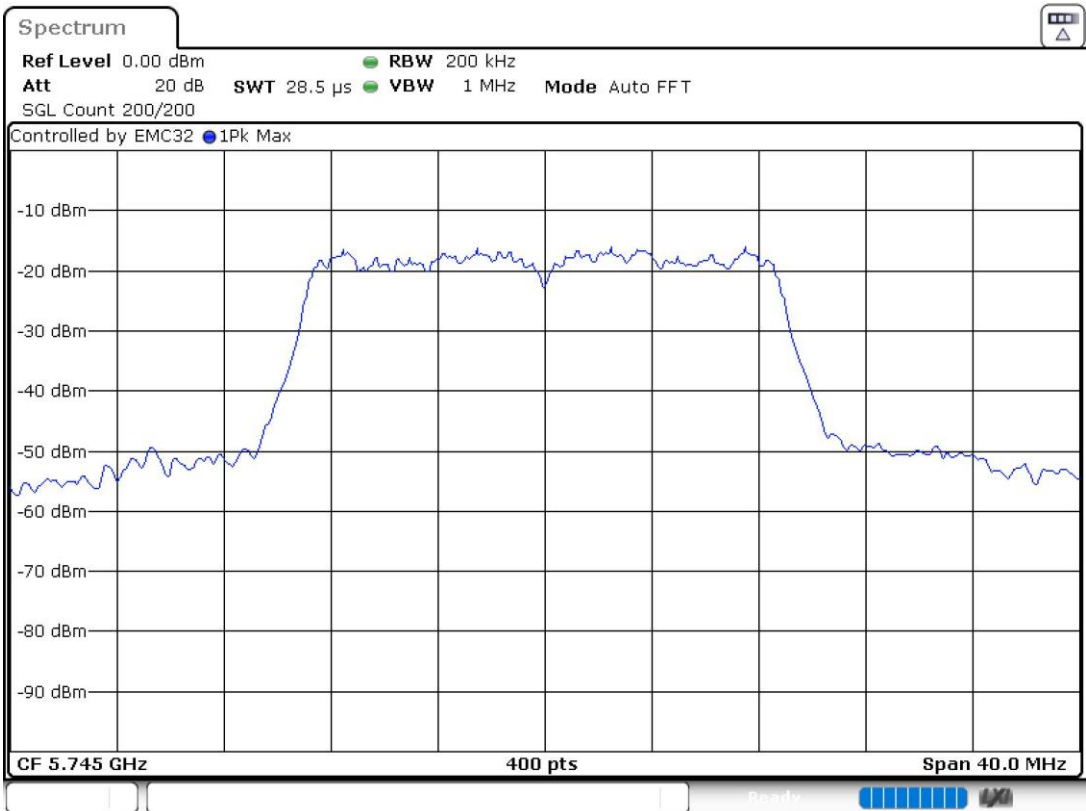
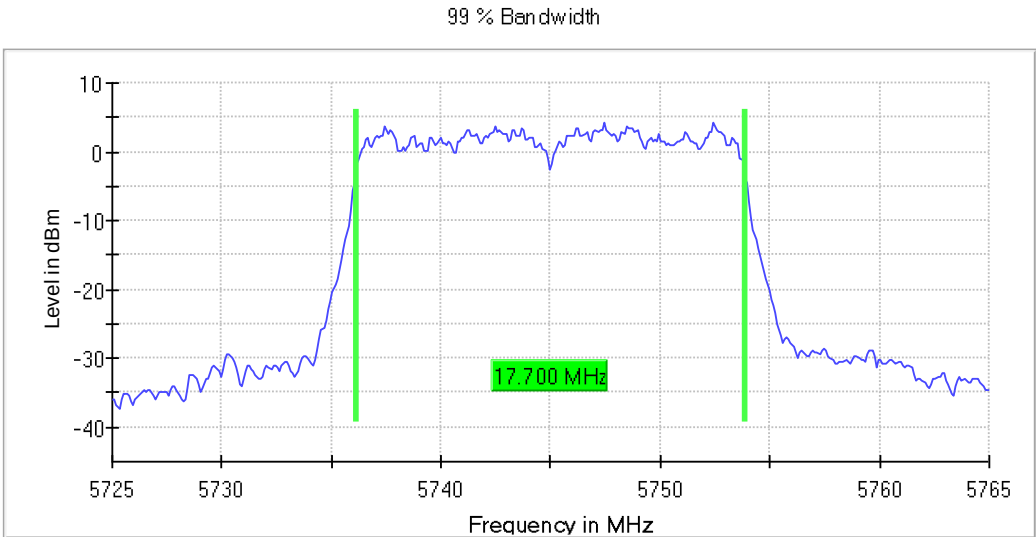


- High Channel 48 (5240 MHz):

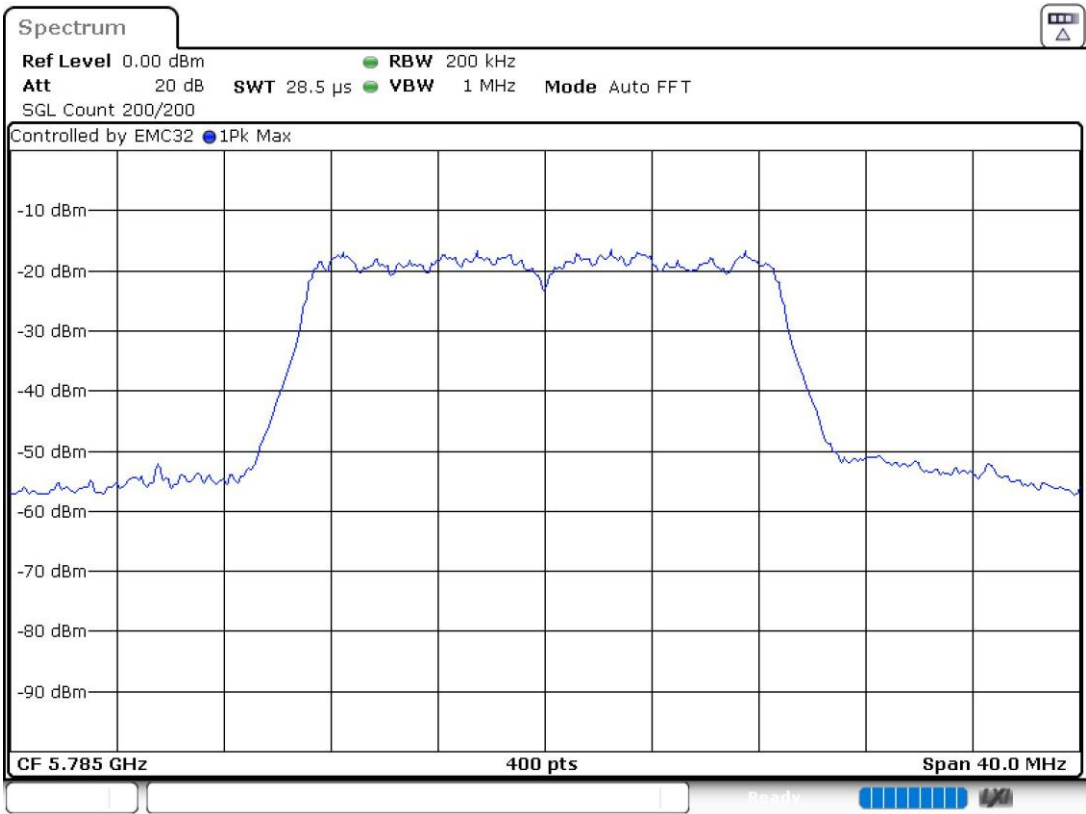
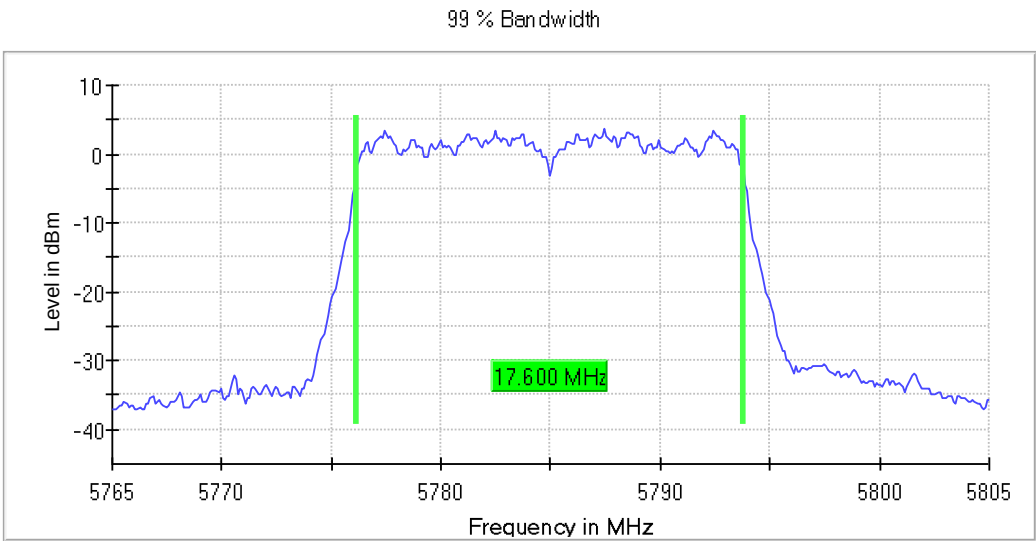


U-NII-3 (5725-5850 MHz)

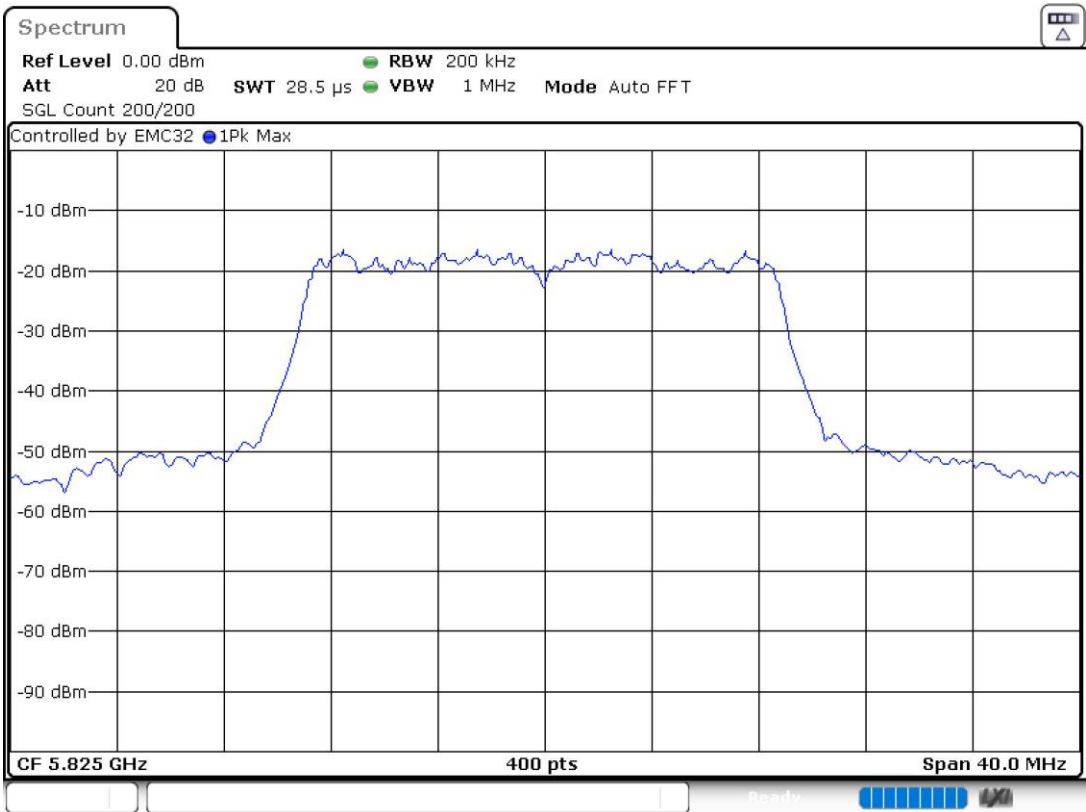
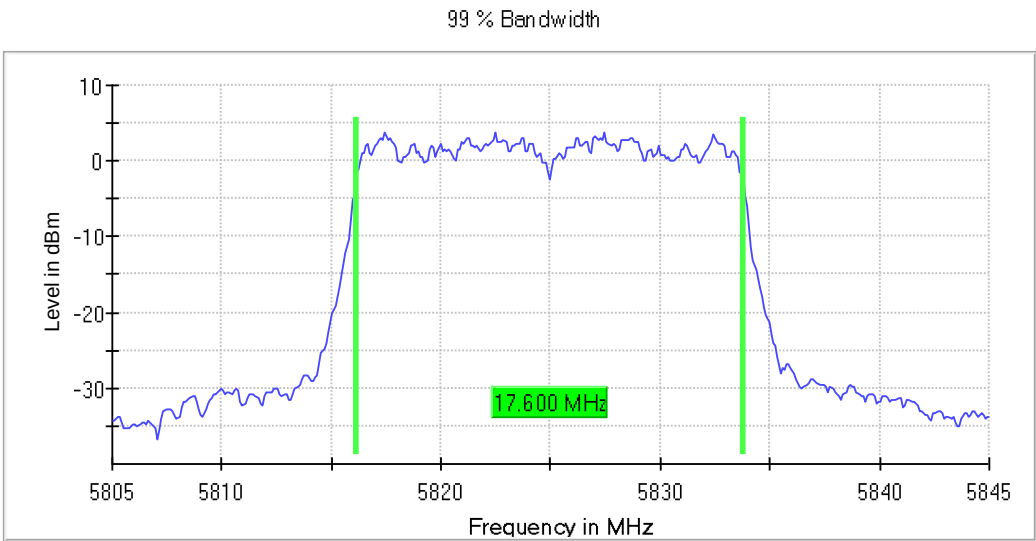
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



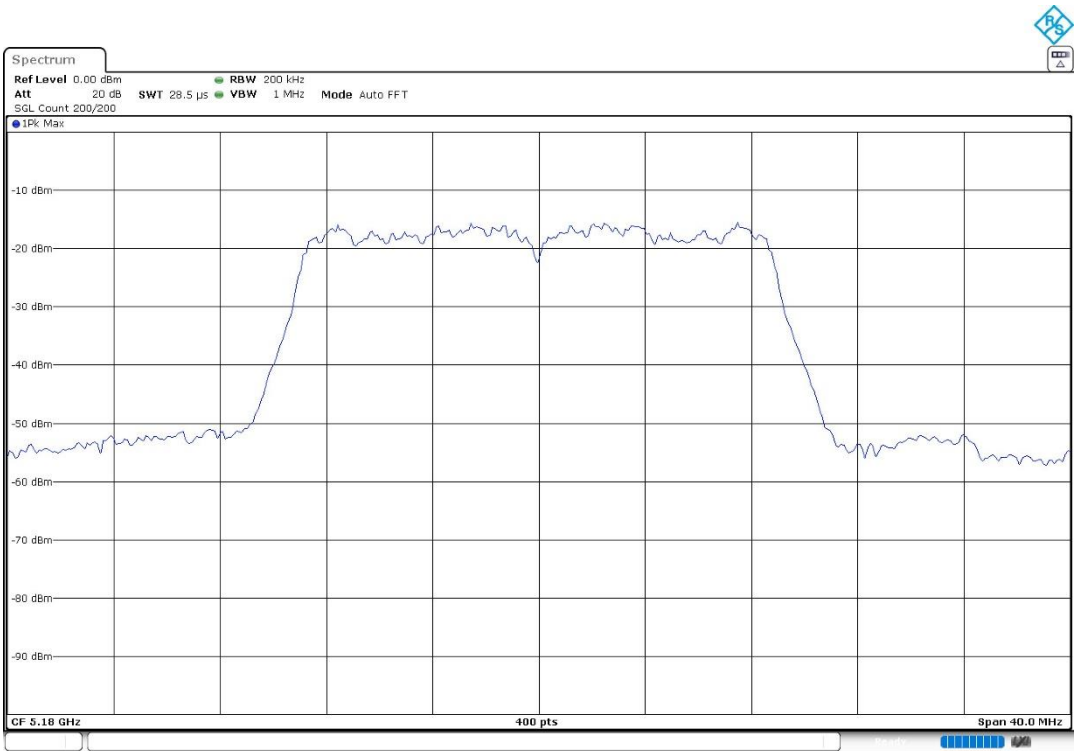
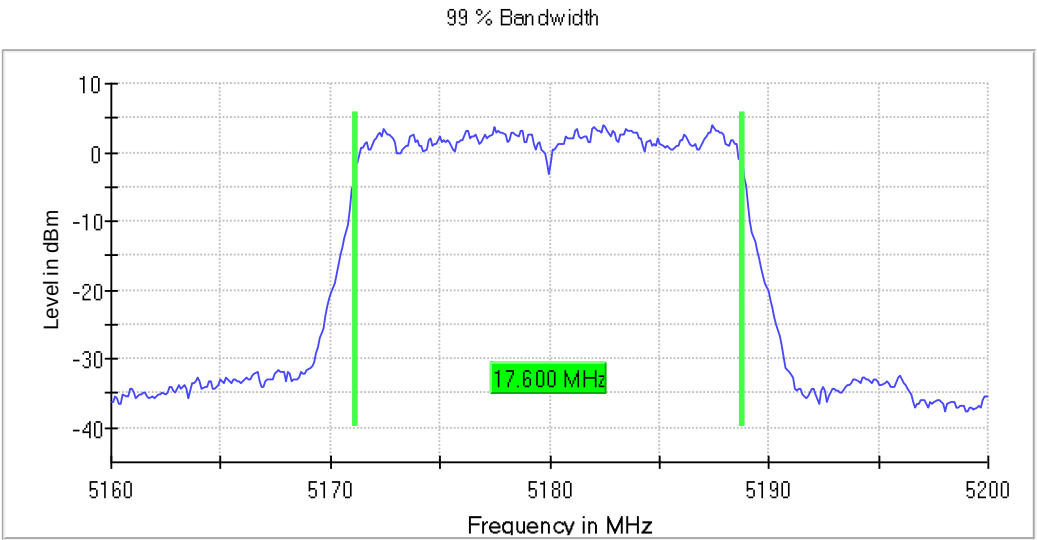
- High Channel 165 (5825 MHz):



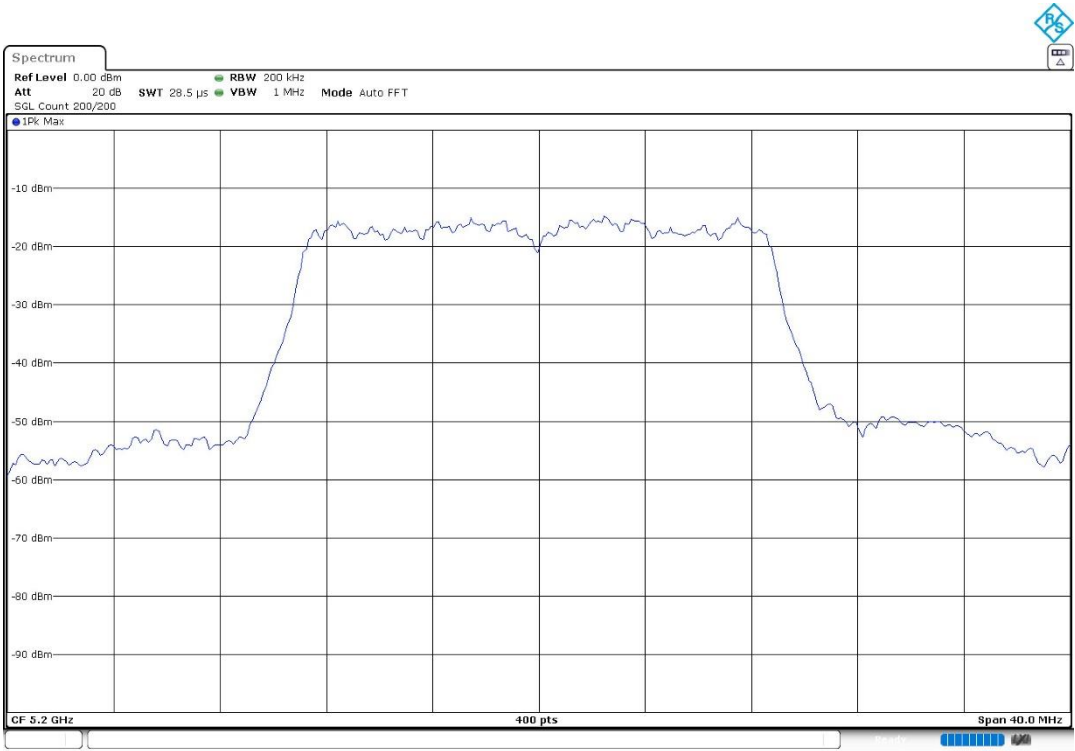
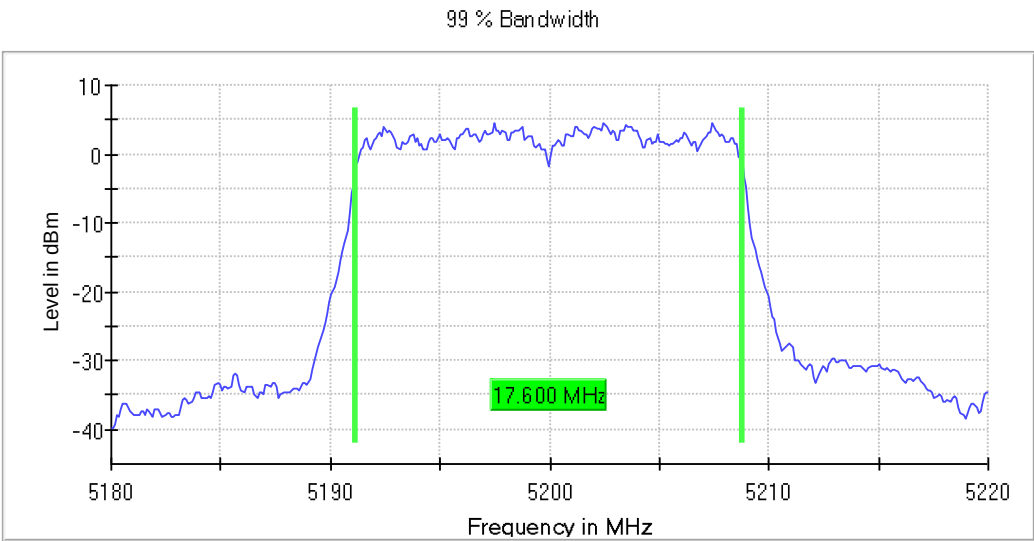
SISO 802.11 ac20 (VHT20)

U-NII-1 FCC (5150-5250 MHz)

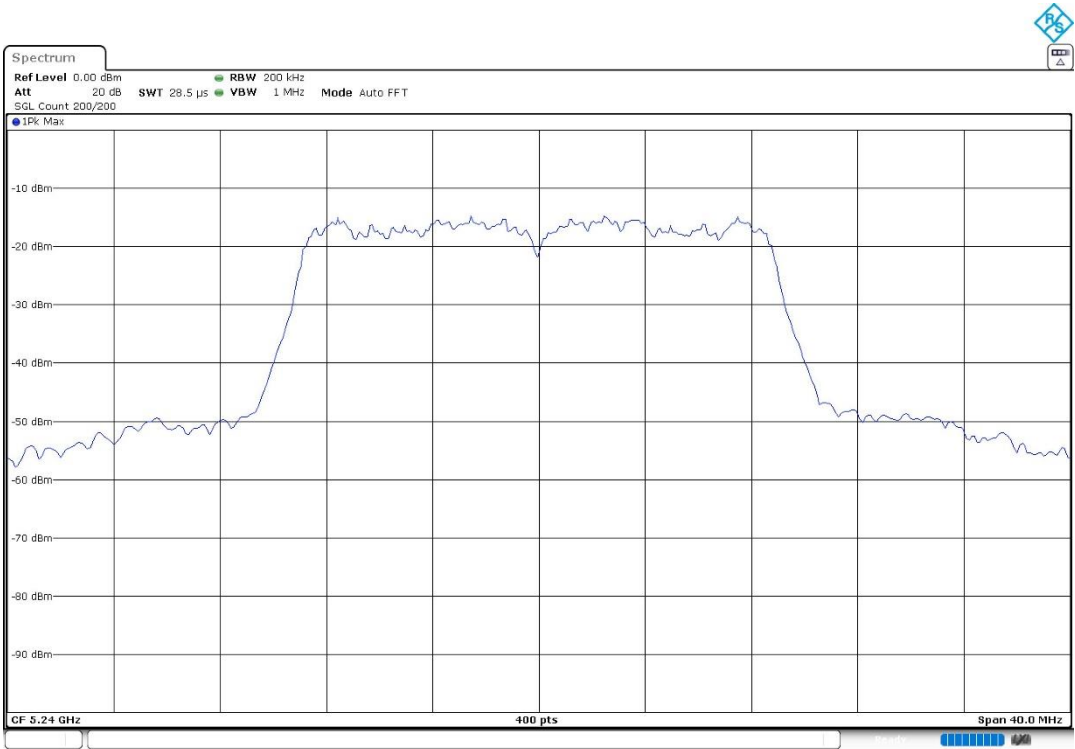
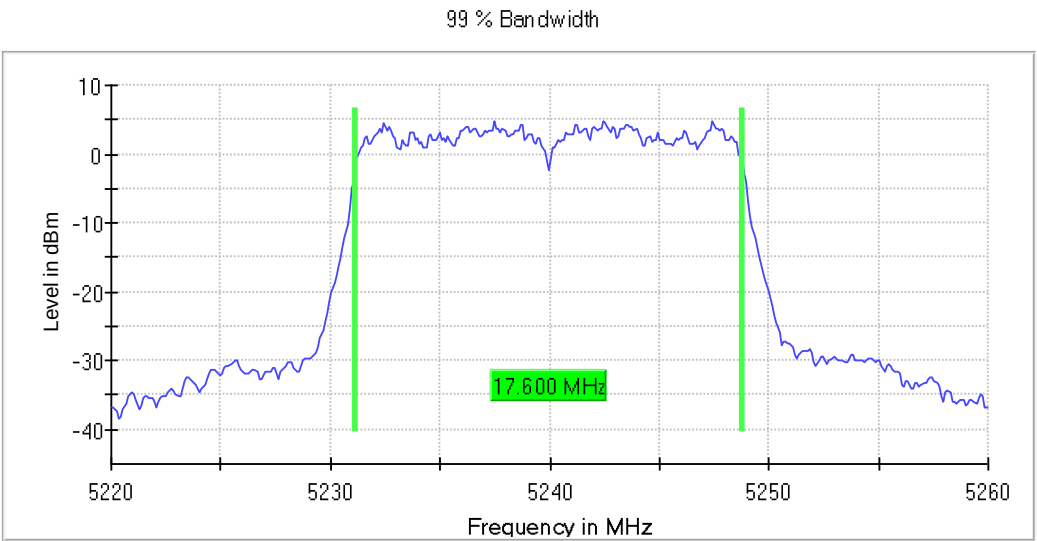
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

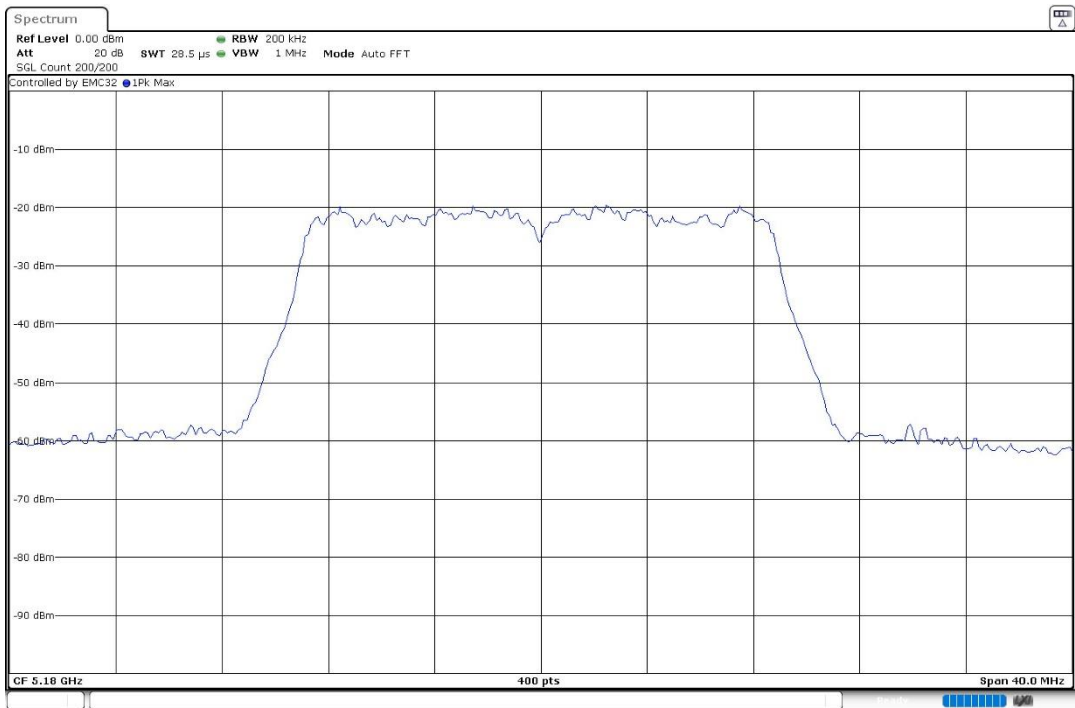
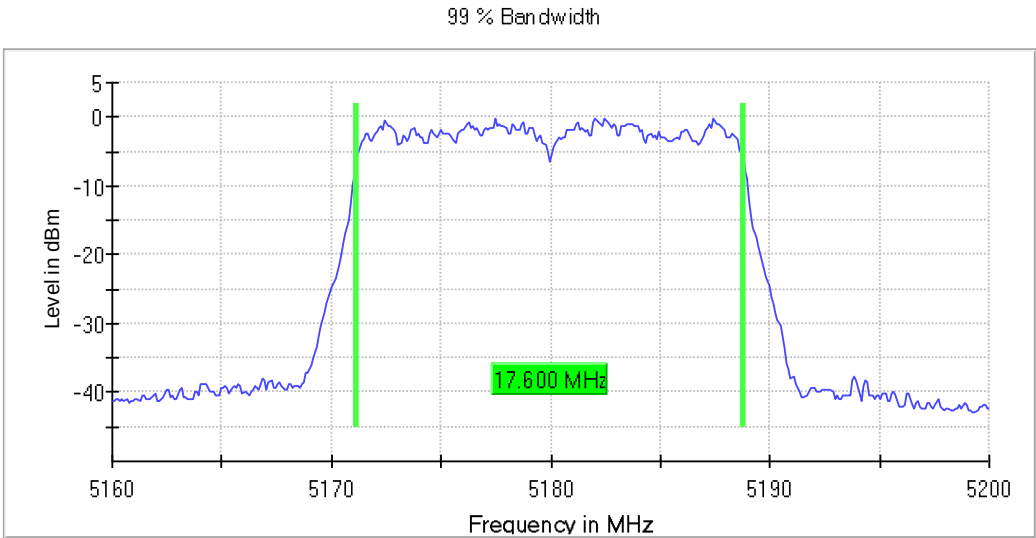


- High Channel 48 (5240 MHz):

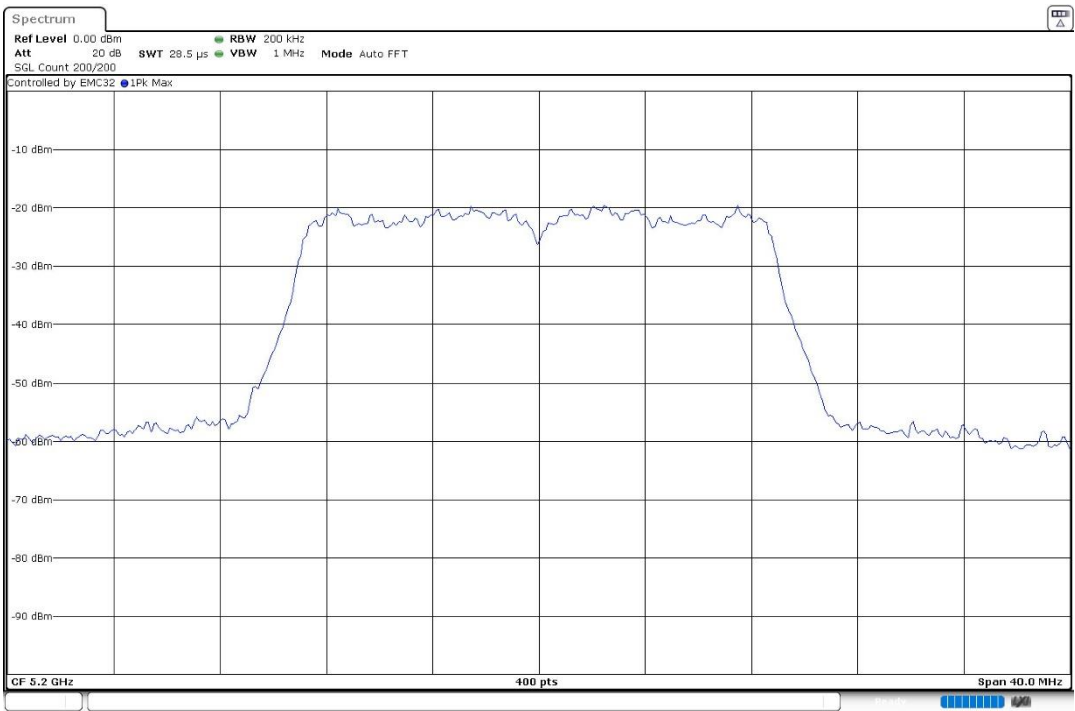
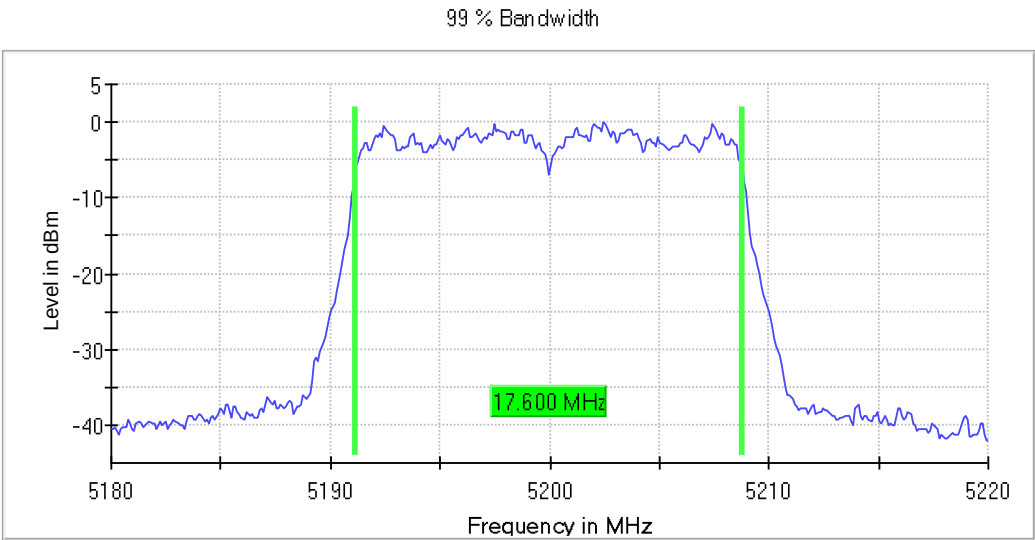


U-NII-1 RSS (5150-5250 MHz)

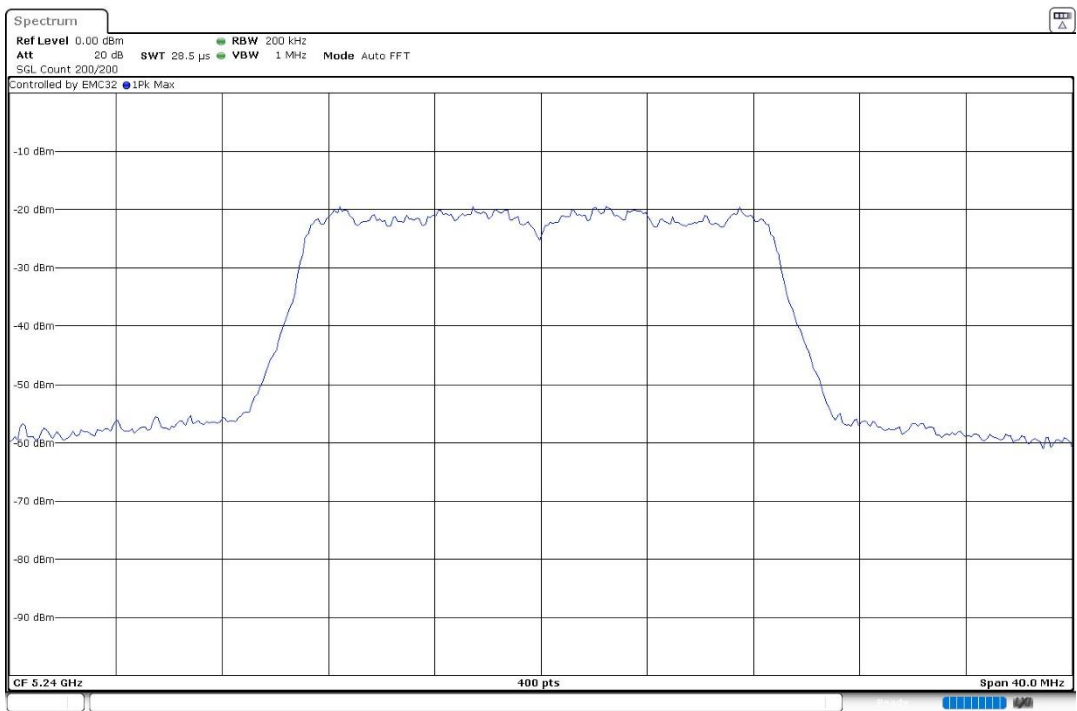
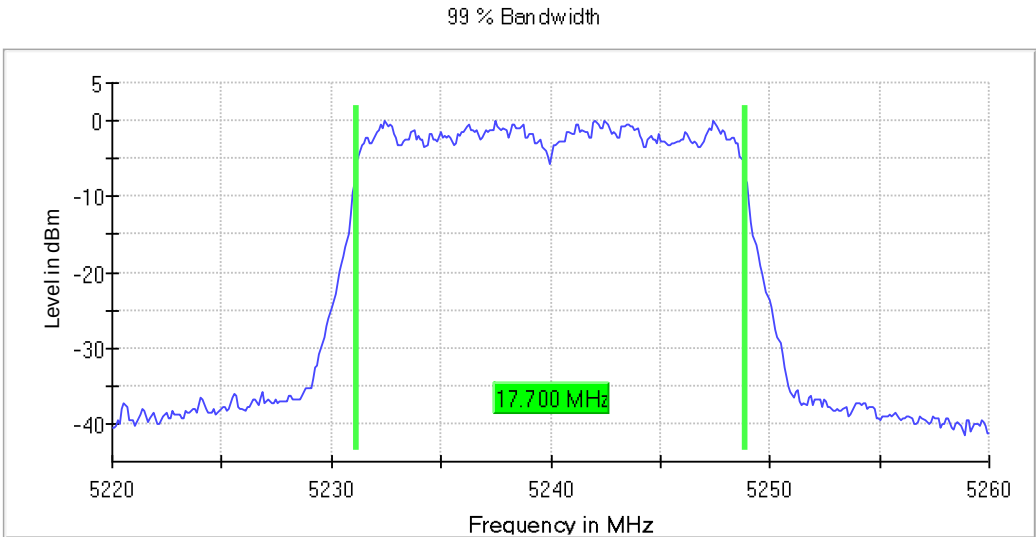
- Low Channel 36 (5180 MHz):



- Channel 40 (5200 MHz):

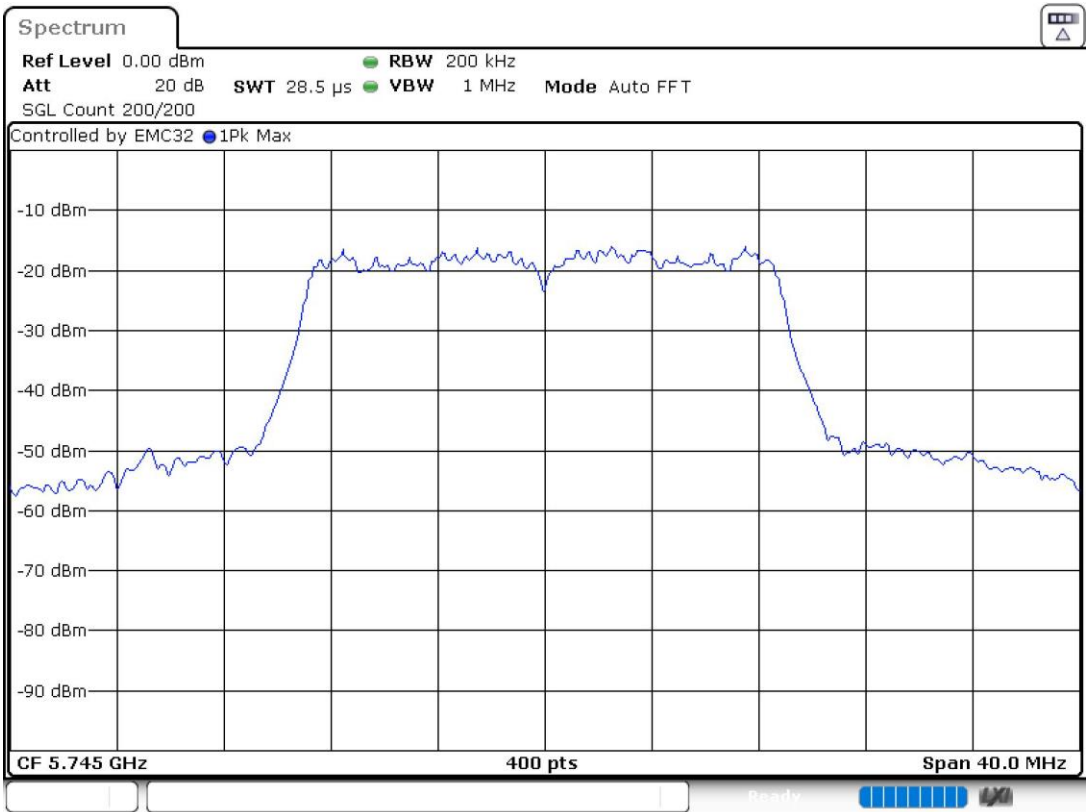
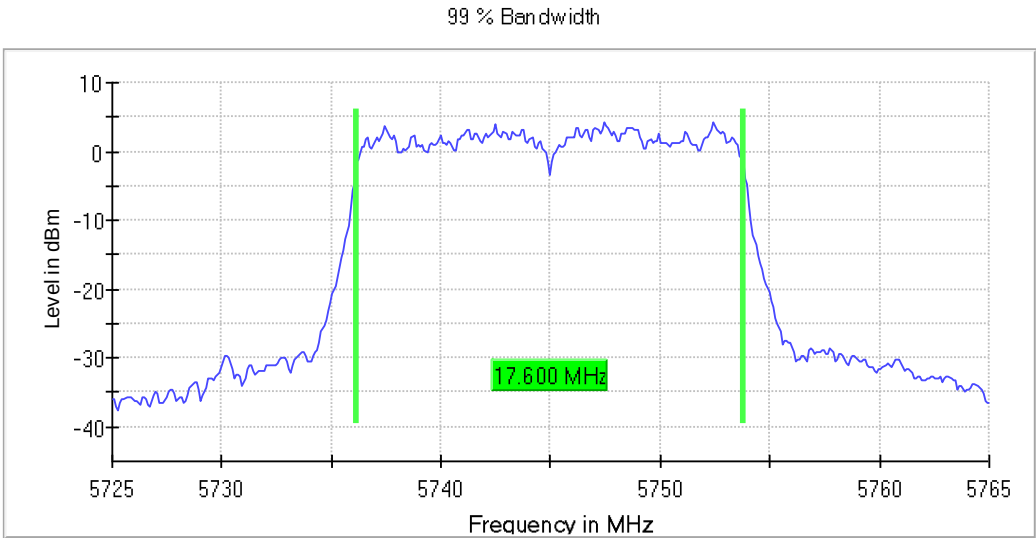


- High Channel 48 (5240 MHz):

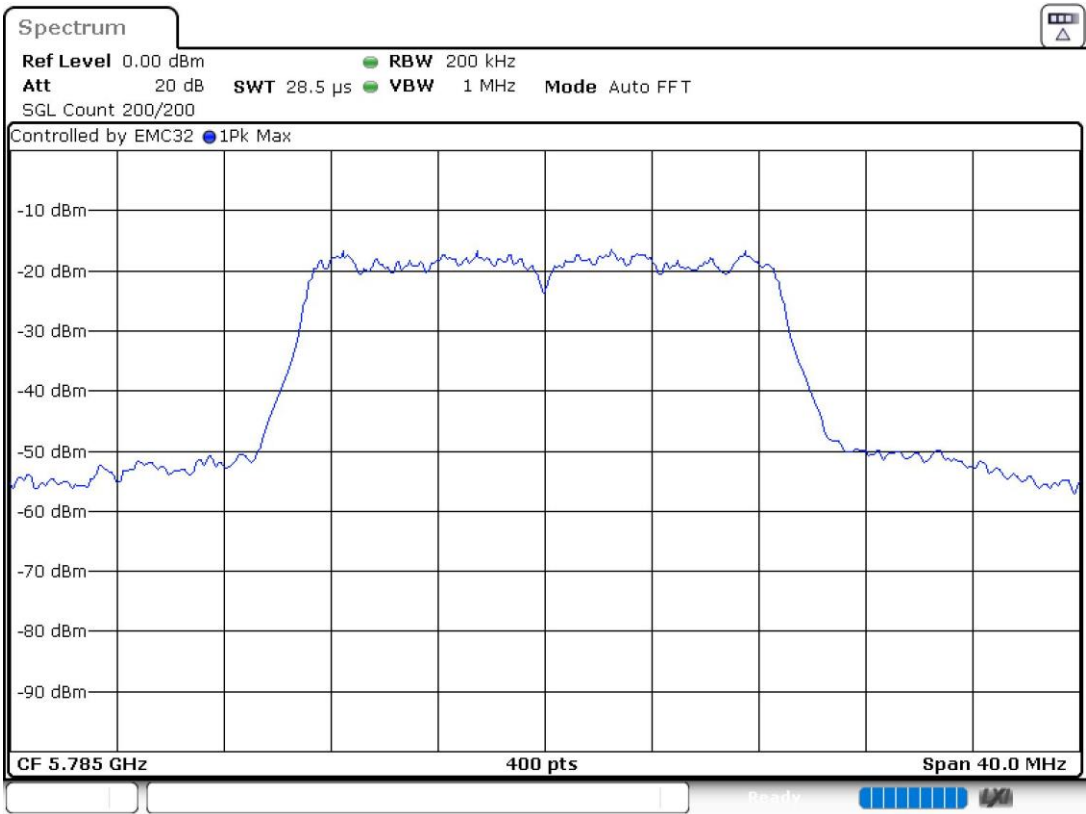
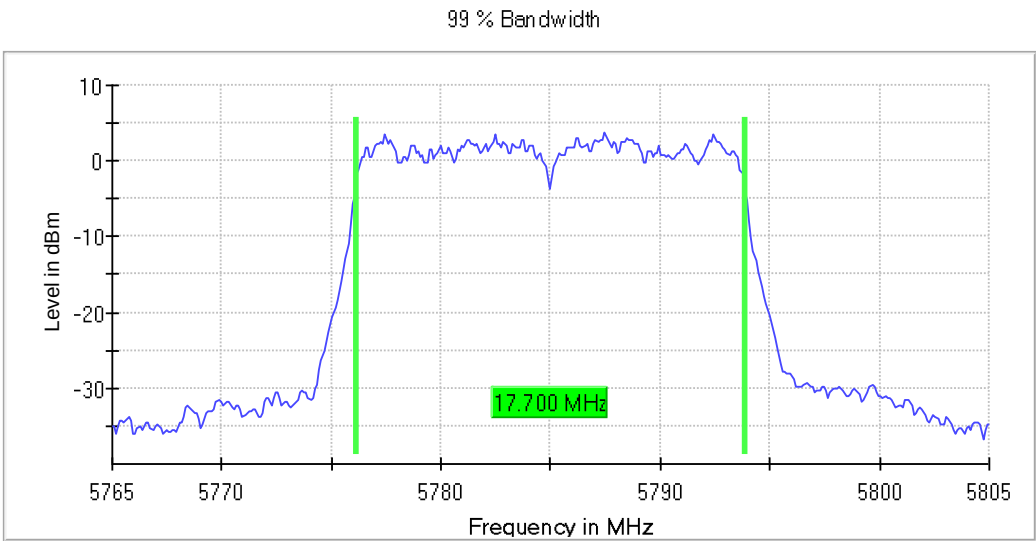


U-NII-3 (5725-5850 MHz)

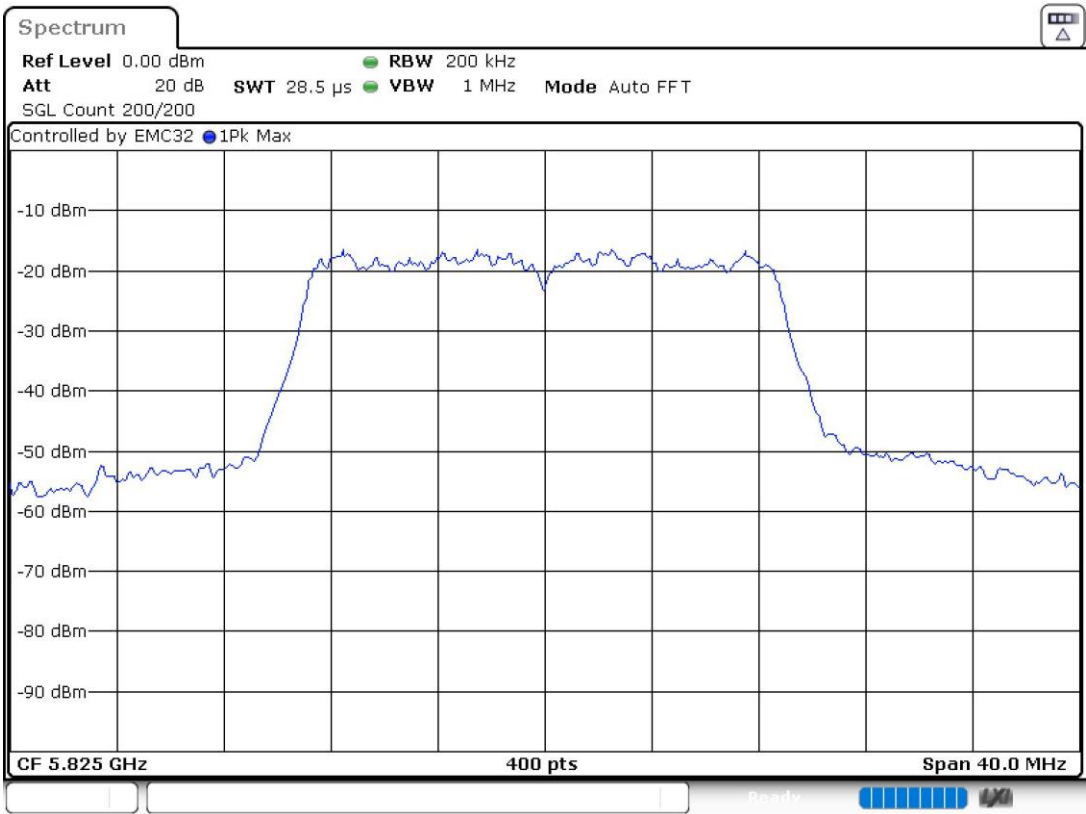
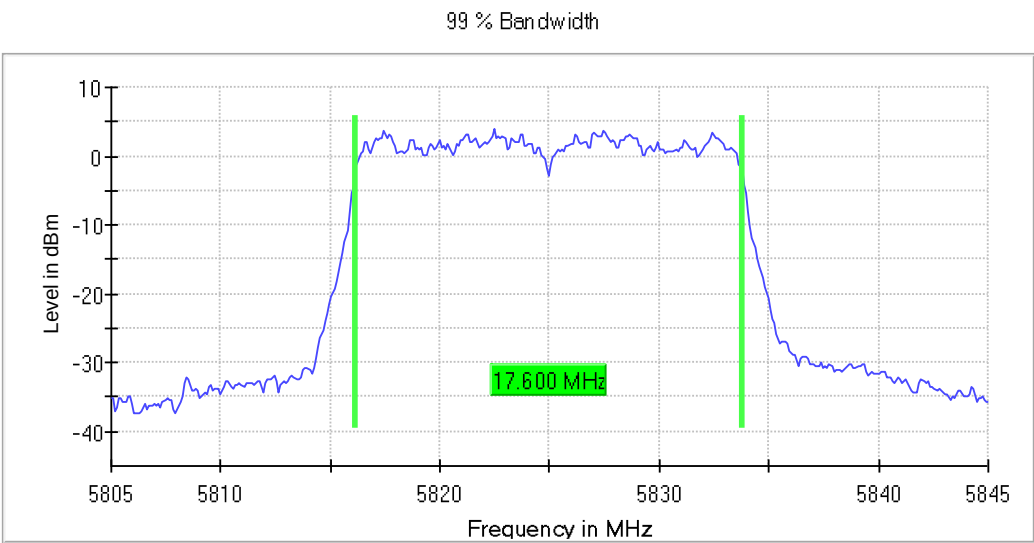
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



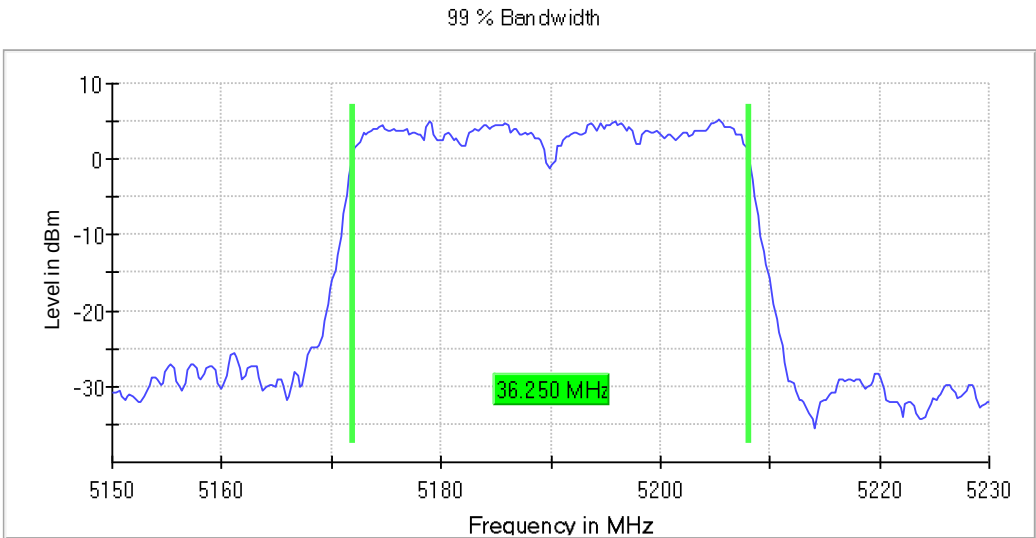
- High Channel 165 (5825 MHz):



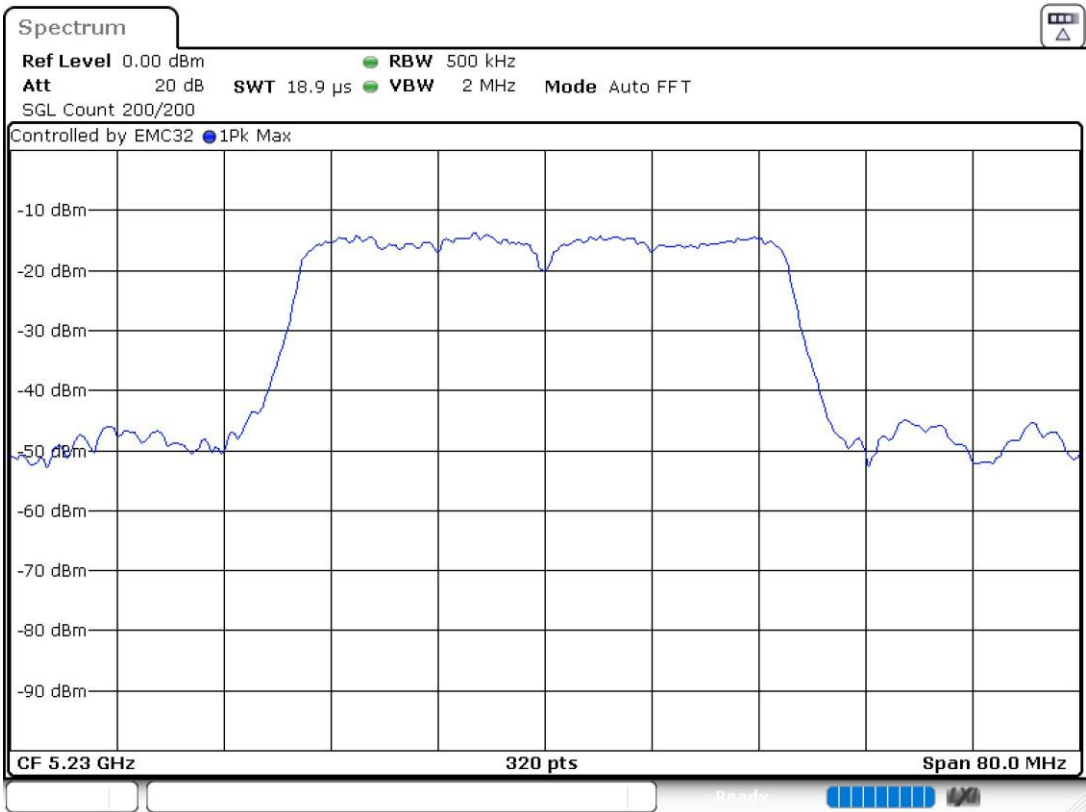
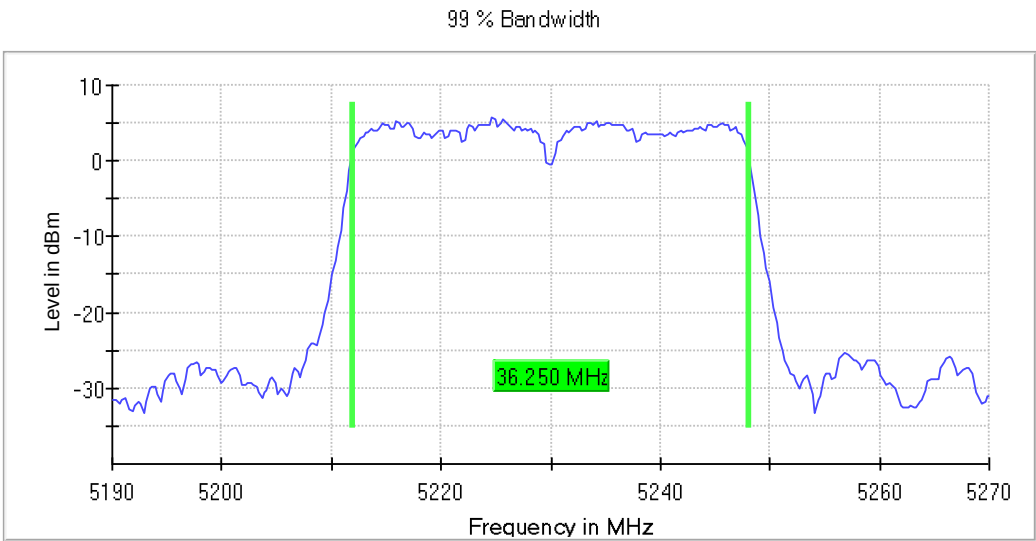
SISO 802.11 n40 (HT40)

U-NII-1 FCC (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

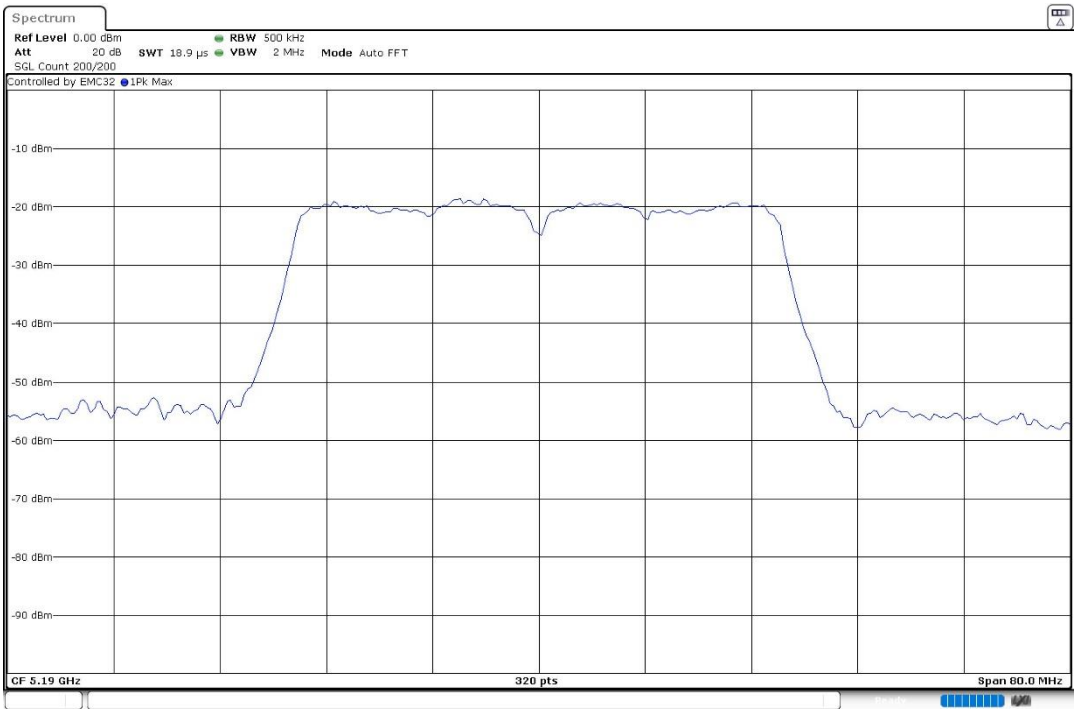
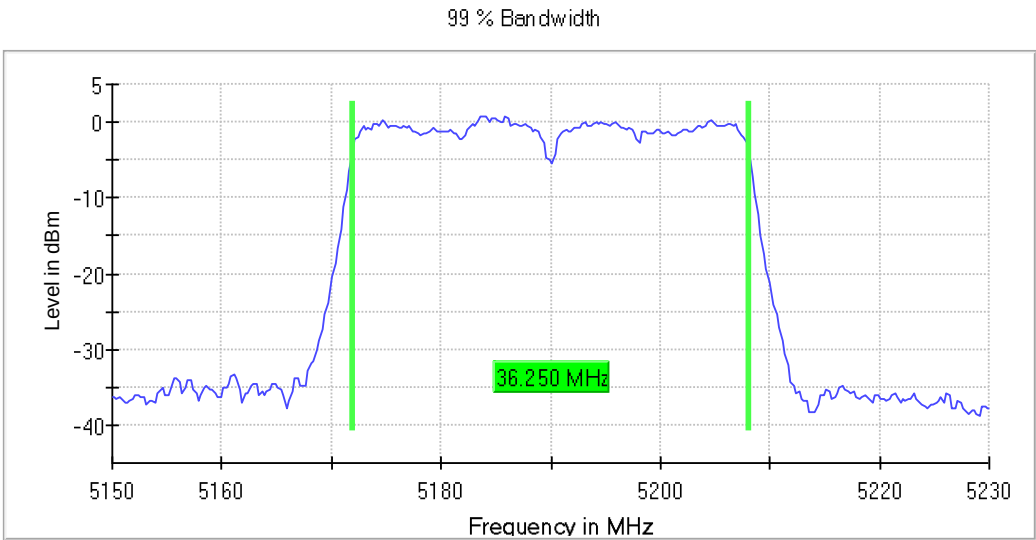


- High Channel 46 (5230 MHz):

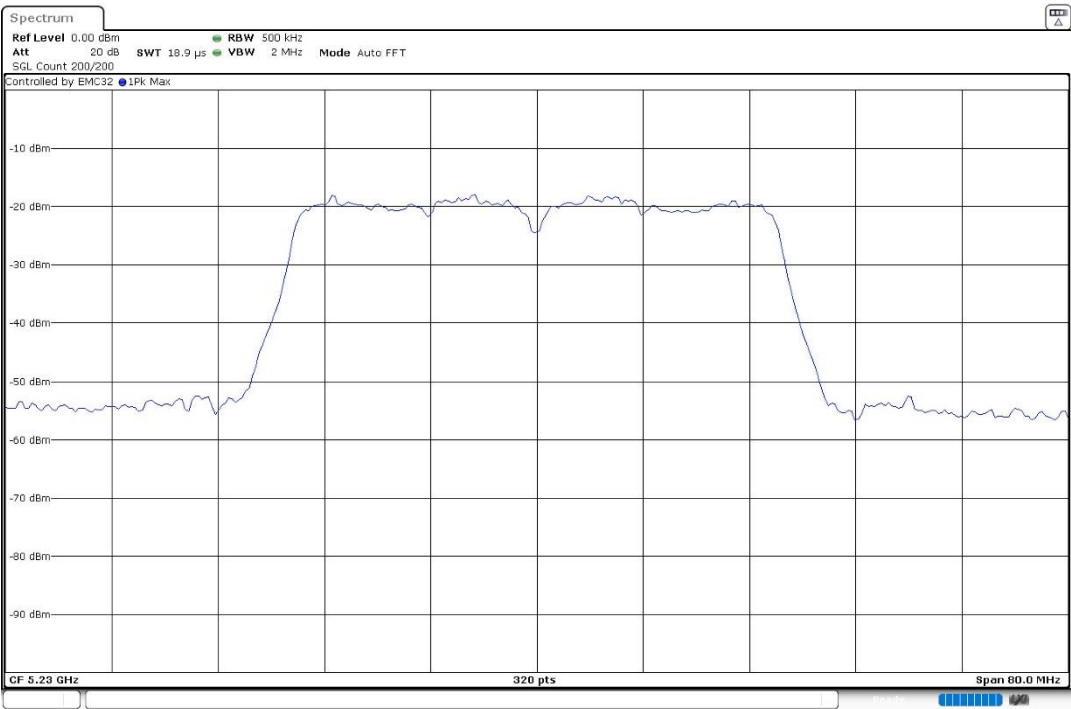
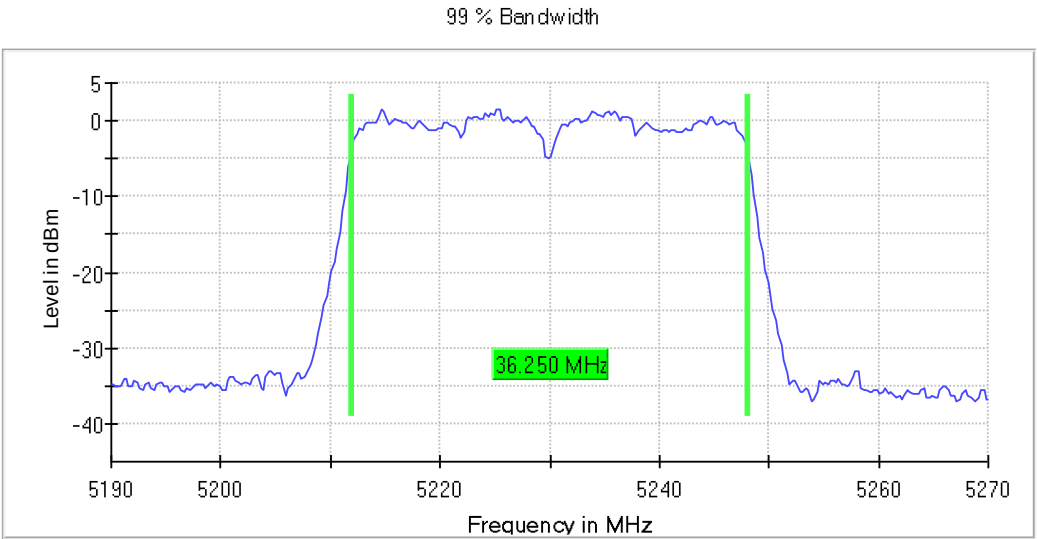


U-NII-1 RSS (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

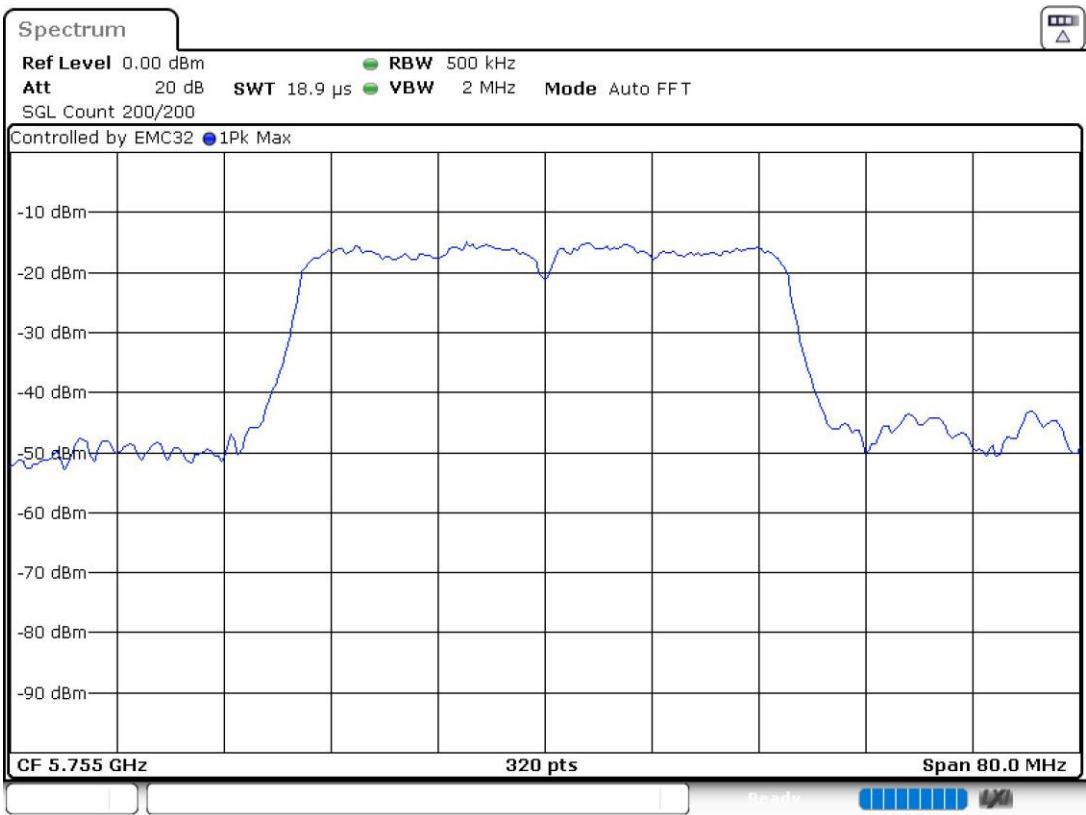
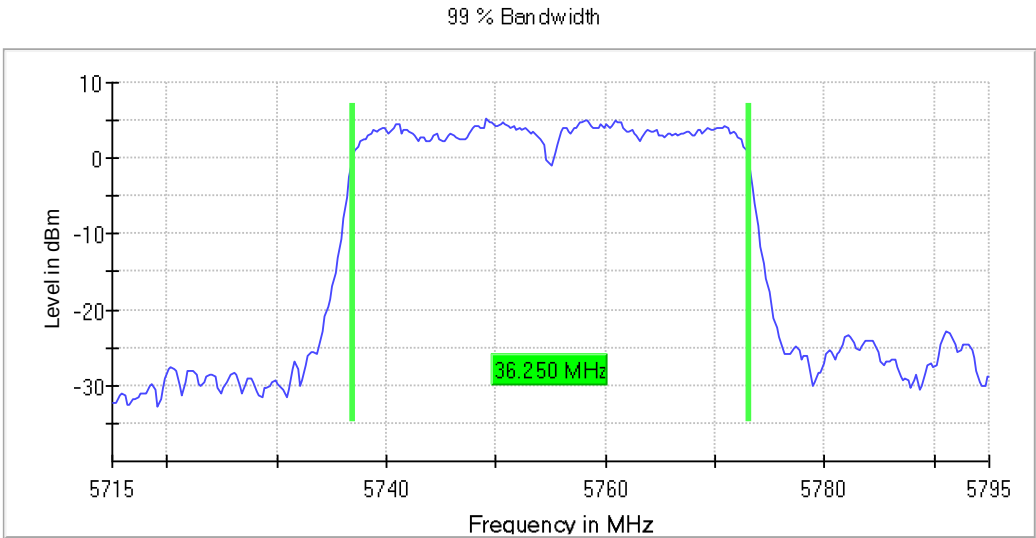


- High Channel 46 (5230 MHz):

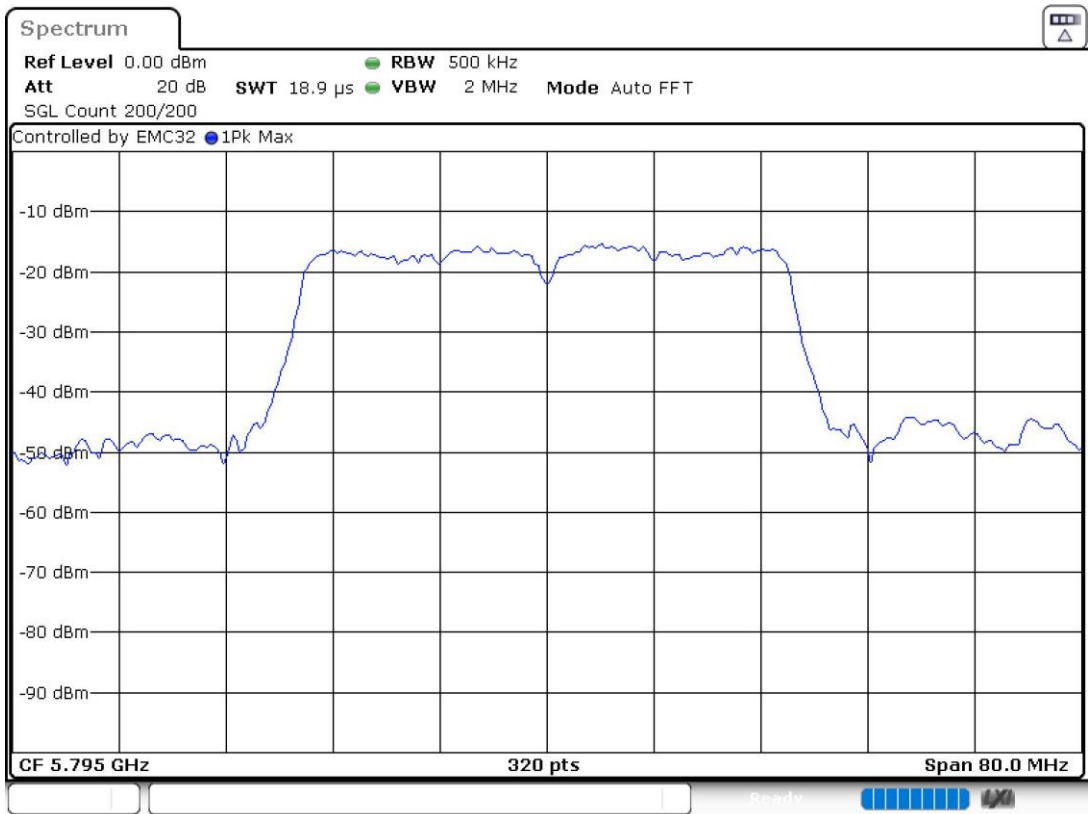
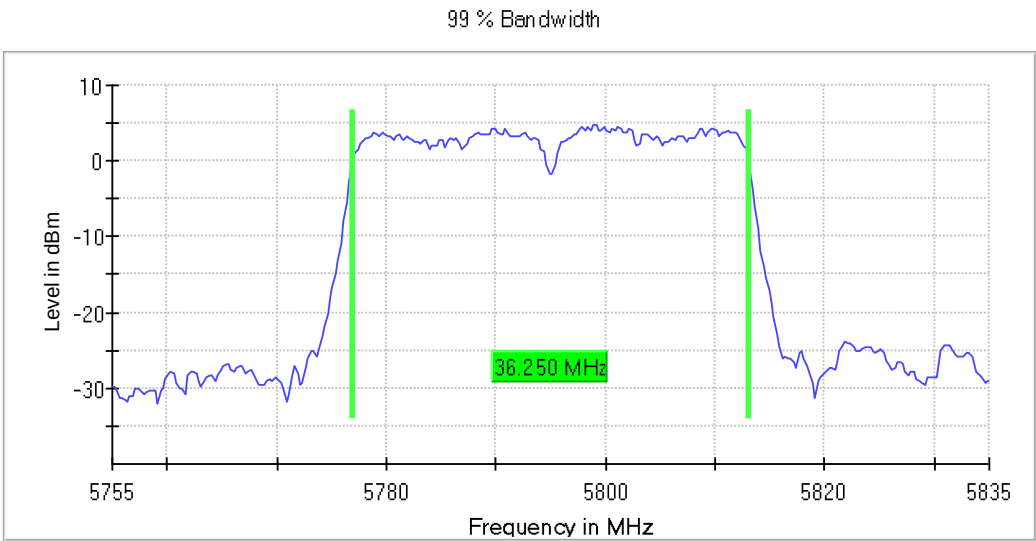


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



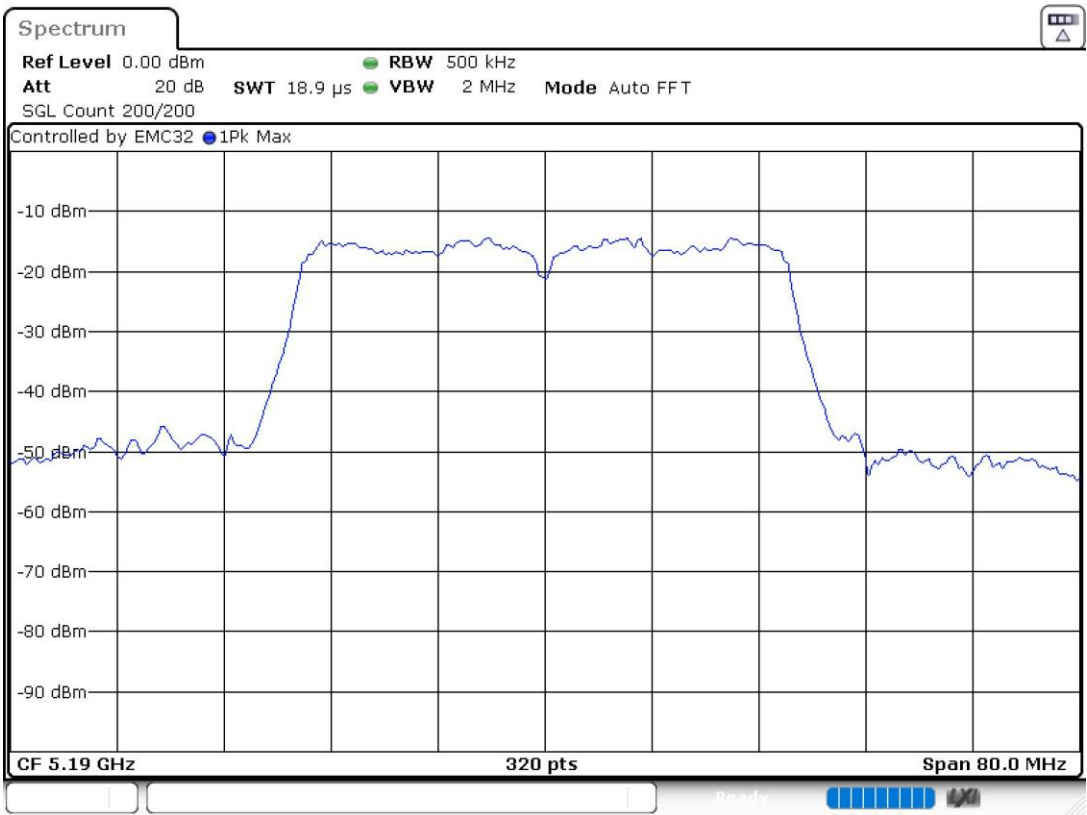
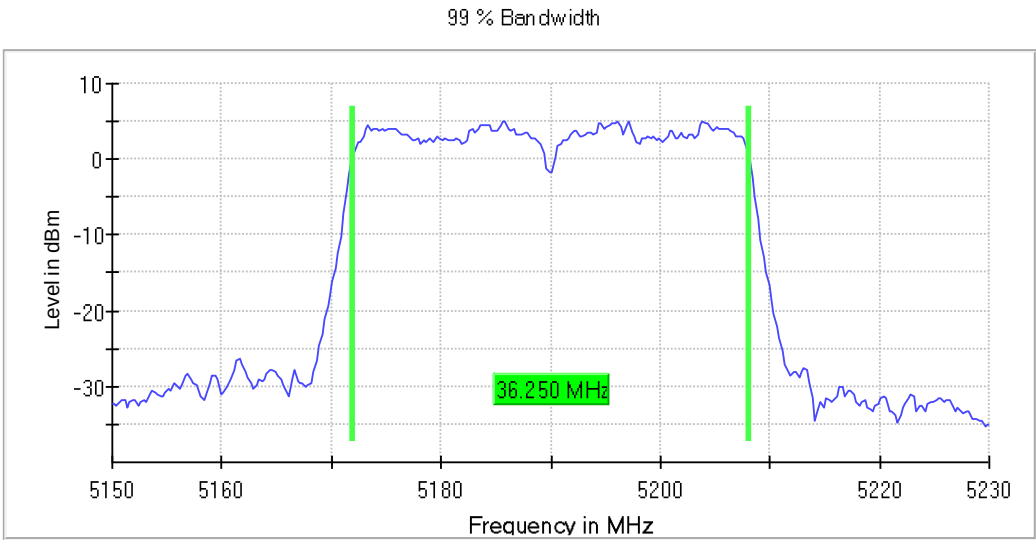
- High Channel 159 (5795 MHz):



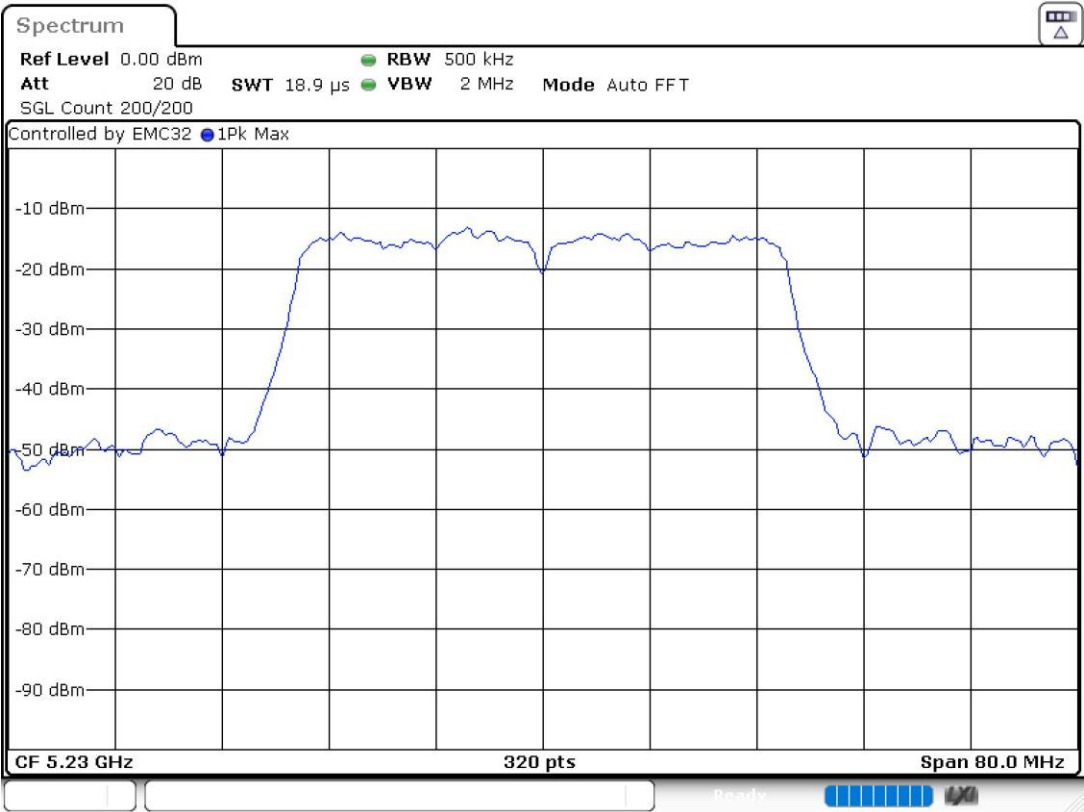
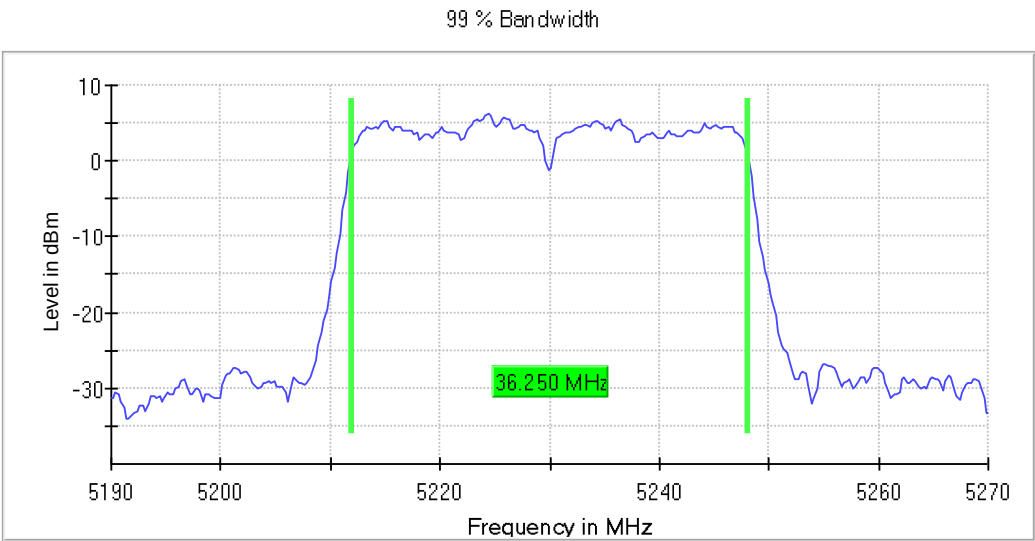
SISO 802.11 ac40 (VHT40)

U-NII-1 FCC (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

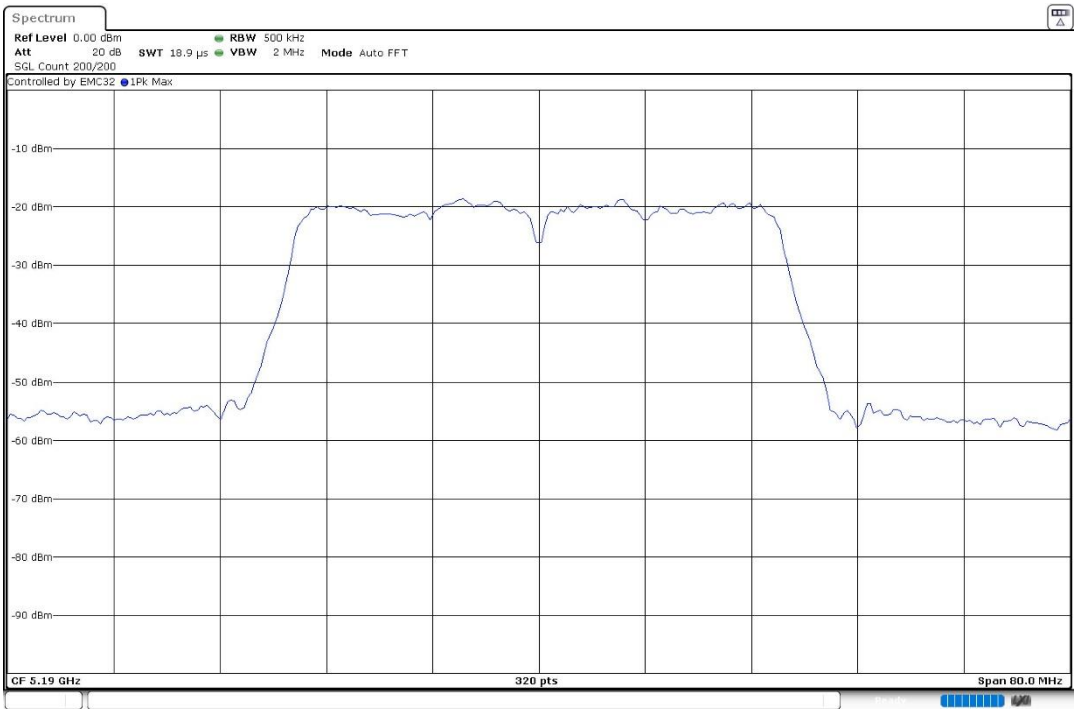
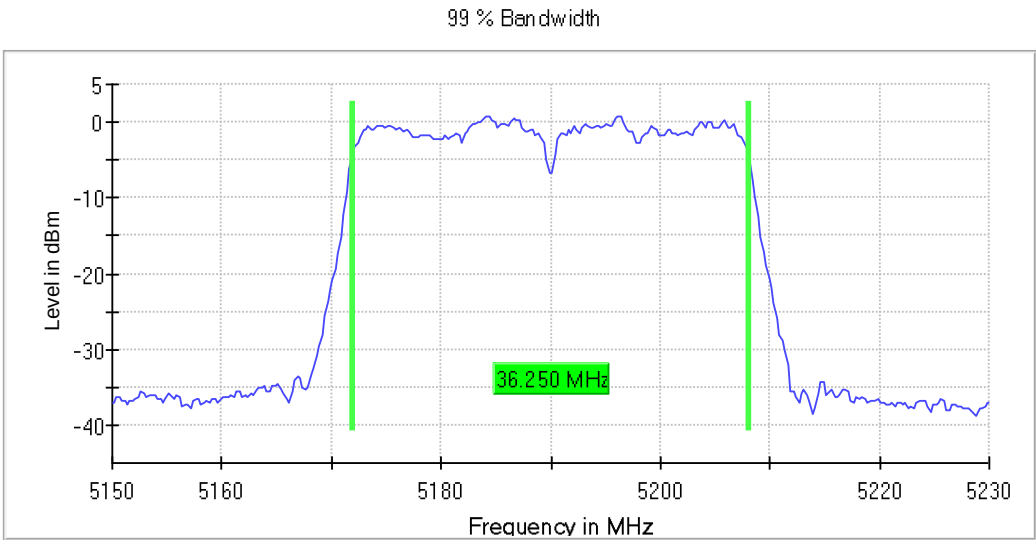


- High Channel 46 (5230 MHz):



U-NII-1 RSS (5150-5250 MHz)

- Low Channel 38 (5190 MHz):



- High Channel 46 (5230 MHz):

