

# ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

**Test Report No.** : OT-197-RWD-054  
**AGR No.** : A195A-120  
**Applicant** : LG Electronics USA  
**Address** : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States  
**Manufacturer** : LG Electronics Inc.  
**Address** : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea  
**Type of Equipment** : Wireless module  
**FCC ID.** : BEJRBHP-B213B  
**Model Name** : RBHP-B213B  
**Multiple Model Name** : N/A  
**Serial number** : N/A  
**Total page of Report** : 142 pages (including this page)  
**Date of Incoming** : June 20, 2019  
**Date of issue** : July 22, 2019

## SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART E Section 15.407**

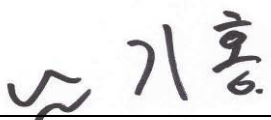
This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by:

  
 Tae-Ho, Kim / Senior Manager  
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Approved by:

  
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 ONETECH Corp.

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**Revision History**

| Rev. No. | Issue Report No. | Issued Date   | Revisions       | Section Affected |
|----------|------------------|---------------|-----------------|------------------|
| 0        | OT-197-RWD-054   | July 22, 2019 | Initial Release | All              |
|          |                  |               |                 |                  |
|          |                  |               |                 |                  |

## 1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA  
 Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States  
 Contact Person : Kyung-Su, Han / Director, Standards & Compliance  
 Telephone No. : +201-472-2623  
 FCC ID : BEJRBHP-B213B  
 Model Name : RBHP-B213B  
 Brand Name : N/A  
 Serial Number : N/A  
 Date : July 22, 2019

|                                                         |                                                                                                                                                           |
|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| EQUIPMENT CLASS                                         | Unlicensed National Information infrastructure(UNII)                                                                                                      |
| E.U.T. DESCRIPTION                                      | Modular Transmitter, Wireless module                                                                                                                      |
| THIS REPORT CONCERNS                                    | Original Grant                                                                                                                                            |
| MEASUREMENT PROCEDURES                                  | ANSI C63.10: 2013                                                                                                                                         |
| TYPE OF EQUIPMENT TESTED                                | Pre-Production                                                                                                                                            |
| KIND OF EQUIPMENT<br>AUTHORIZATION REQUESTED            | Certification                                                                                                                                             |
| EQUIPMENT WILL BE OPERATED<br>UNDER FCC RULES PART(S)   | FCC PART 15 SUBPART E Section 15.407<br>KDB 789033 D02 General UNII Test Procedures New Rules v02r01<br>KDB 662911 D01 Multiple Transmitter Output v02r01 |
| Modifications on the Equipment to<br>Achieve Compliance | None                                                                                                                                                      |
| Final Test was Conducted On                             | 3 m, Semi Anechoic Chamber                                                                                                                                |

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

## 2. TEST SUMMARY

### 2.1 Test items and results

| SECTION           | TEST ITEMS                                                                    | RESULTS              |
|-------------------|-------------------------------------------------------------------------------|----------------------|
| 15.407(a)         | 26 dB Bandwidth                                                               | PASS                 |
| 15.407(a)         | Maximum Conducted Output Power                                                | Met the Limit / PASS |
| 15.407(a)         | Peak Power Spectral Density                                                   | Met the Limit / PASS |
| 15.407(a)         | Peak Excursion                                                                | Met the Limit / PASS |
| 15.407(g)         | Frequency Stability                                                           | Met the Limit / PASS |
| 15.407(b)         | Undesirable Emissions                                                         | Met the Limit / PASS |
| 15.205, 15.407(b) | General Field Strength Limits (Restricted Bands and Radiated Emission Limits) | Met the Limit / PASS |
| 15.207            | AC Conducted Emissions 150 kHz-30 MHz                                         | Met the Limit / PASS |

### 2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

### 2.3 Related Submittal(s) / Grant(s)

Original submittal only

### 2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART E Section 15.407

### 2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

### 2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

### 3. GENERAL INFORMATION

#### 3.1 Product Description

The LG Electronics USA, Model RBHP-B213B (referred to as the EUT in this report) is a Wireless module. Product specification information described herein was obtained from product data sheet or user's manual.

|                        |                               |                                                                            |                           |
|------------------------|-------------------------------|----------------------------------------------------------------------------|---------------------------|
| DEVICE TYPE            | Wireless module               |                                                                            |                           |
| Temperature Range      | -20 °C ~ 55 °C                |                                                                            |                           |
| OPERATING<br>FREQUENCY | Bluetooth                     | 2 402 MHz ~ 2 480 MHz                                                      |                           |
|                        | WLAN 2.4 GHz                  | 2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))                                  |                           |
|                        | 5 725 MHz ~<br>5 850 MHz Band | 5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))                          |                           |
|                        |                               | 5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))                            |                           |
|                        |                               | 5 775 MHz (802.11ac(VHT80))                                                |                           |
| MODULATION<br>TYPE     | Bluetooth                     | GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps                 |                           |
|                        | WLAN 2.4 GHz                  | DSSS Modulation(DBPSK/DQPSK/CCK)<br>OFDM Modulation(BPSK/QPSK/16QAM/64QAM) |                           |
|                        | WLAN 5 GHz                    | OFDM Modulation(BPSK/QPSK/16QAM/64QAM)                                     |                           |
| RF OUTPUT<br>POWER'    | Bluetooth                     | 1 Mbps                                                                     | 1.03 dBm                  |
|                        |                               | 2 Mbps                                                                     | -2.27 dBm                 |
|                        |                               | 3 Mbps                                                                     | -1.91 dBm                 |
|                        | WLAN 2.4 GHz                  | 14.56 dBm(802.11b)                                                         |                           |
|                        |                               | 9.90 dBm(802.11g)                                                          |                           |
|                        |                               | 9.30 dBm(802.11n_HT20)                                                     |                           |
|                        | 5 725 MHz ~<br>5 850 MHz Band | Antenna 0                                                                  | 6.28 dBm(802.11a)         |
|                        |                               |                                                                            | 6.22 dBm(802.11n_HT20)    |
|                        |                               |                                                                            | 6.07 dBm(802.11n_HT40)    |
|                        |                               |                                                                            | 5.74 dBm(802.11ac_VHT80)  |
|                        |                               | Antenna 1                                                                  | 10.07 dBm(802.11a)        |
|                        |                               |                                                                            | 9.99 dBm(802.11n_HT20)    |
|                        |                               | Multiple Antenna                                                           | 10.29 dBm(802.11n_HT40)   |
|                        |                               |                                                                            | 9.62 dBm(802.11ac_VHT80)  |
|                        |                               |                                                                            | 11.51 dBm(802.11n_HT20)   |
|                        |                               |                                                                            | 11.68 dBm(802.11n_HT40)   |
|                        |                               |                                                                            | 11.11 dBm(802.11ac_VHT80) |

|                                                            |                      |                                                                            |                                       |          |
|------------------------------------------------------------|----------------------|----------------------------------------------------------------------------|---------------------------------------|----------|
| MODULATION<br>TYPE                                         | Bluetooth            | GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps                 |                                       |          |
|                                                            | WLAN 2.4 G           | DSSS Modulation(DBPSK/DQPSK/CCK)<br>OFDM Modulation(BPSK/QPSK/16QAM/64QAM) |                                       |          |
|                                                            | WLAN 5 G             | OFDM Modulation(BPSK/QPSK/16QAM/64QAM)                                     |                                       |          |
| Antenna Type                                               | PCB Antenna          |                                                                            |                                       |          |
| ANTENNA GAIN                                               | 2.4 GHz Band         | Antenna 0 (Bluetooth + 5 GHz WiFi)                                         |                                       | 5.28 dBi |
|                                                            |                      | Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi)                                      |                                       | 2.29 dBi |
|                                                            | 5 GHz Band           | 5 725 MHz ~<br>5 850 MHz                                                   | Antenna 0 (Bluetooth + 5 GHz WiFi)    | 2.47 dBi |
|                                                            |                      |                                                                            | Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi) | 2.28 dBi |
|                                                            |                      |                                                                            | Antenna 0 + 1                         | 5.39 dBi |
|                                                            | Intermodulation Mode | Bluetooth + 2.4 GHz WiFi<br>(Antenna 0 + Antenna 1)                        |                                       | 7.05 dBi |
|                                                            |                      | Bluetooth + 5 GHz WiFi<br>(Antenna 0 + Antenna 1)                          |                                       | 7.04 dBi |
| List of each Osc. or crystal Freq.<br>(Freq. $\geq 1$ MHz) |                      | 37.4 MHz                                                                   |                                       |          |

### 3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

### 4. EUT MODIFICATIONS

-. None

## 5. SYSTEM TEST CONFIGURATION

### 5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

| DEVICE TYPE | MANUFACTURER        | MODEL/PART NUMBER | FCC ID |
|-------------|---------------------|-------------------|--------|
| MAIN BOARD  | LG Electronics Inc. | GWANG_SMD         | -      |

### 5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

| Model                | Manufacturer                             | Description           | Connected to |
|----------------------|------------------------------------------|-----------------------|--------------|
| RBHP-B213B           | LG Electronics Inc.                      | Wireless module (EUT) | -            |
| N/A                  | N/A                                      | Jig Board             | EUT          |
| HP Pavilion g series | HP                                       | Notebook PC           | -            |
| PPP009C              | LIE-ON TECHNOLOGY<br>(CHANGZHOU)CO.,LTD. | AC Adapter            | -            |

### 5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.

#### UNII 3

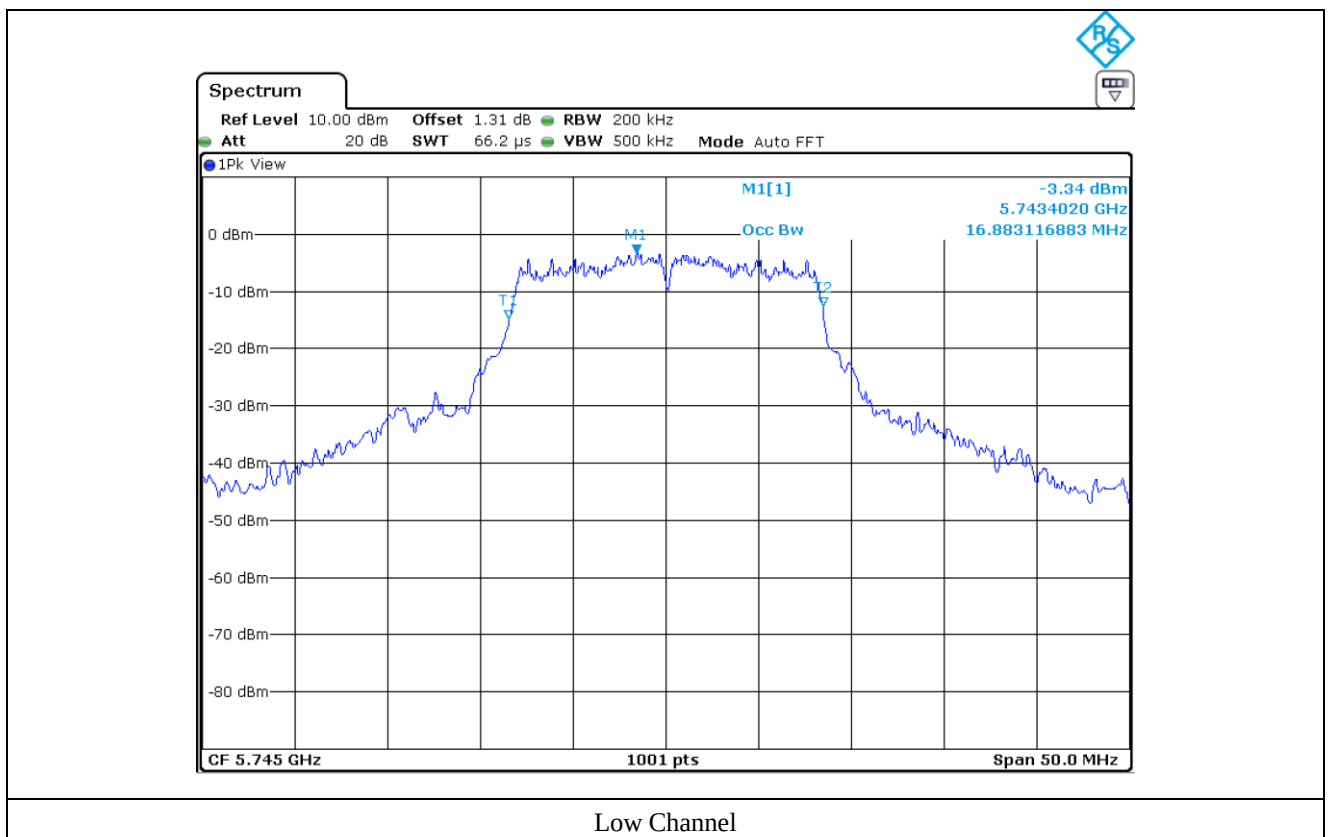
| Modulation                         | DATA RATE  | OUTPUT POWER[dBm] |           |
|------------------------------------|------------|-------------------|-----------|
|                                    |            | Antenna 0         | Antenna 1 |
| 802.11 a<br>(Middle Channel)       | 6 Mbps     | 5.89              | 9.68      |
|                                    | 9 Mbps     | 5.83              | 9.63      |
|                                    | 12 Mbps    | 5.78              | 9.60      |
|                                    | 18 Mbps    | 5.81              | 9.47      |
|                                    | 24 Mbps    | 5.56              | 9.50      |
|                                    | 36 Mbps    | 5.47              | 9.43      |
|                                    | 48 Mbps    | 5.26              | 9.27      |
|                                    | 54 Mbps    | 5.03              | 9.14      |
| 802.11 n_HT 20<br>(Middle Channel) | 6.5 Mbps   | 5.48              | 9.25      |
|                                    | 13 Mbps    | 5.43              | 9.13      |
|                                    | 19.5 Mbps  | 5.40              | 9.10      |
|                                    | 26 Mbps    | 5.24              | 9.02      |
|                                    | 39 Mbps    | 5.17              | 8.97      |
|                                    | 52 Mbps    | 5.06              | 8.84      |
|                                    | 58.5 Mbps  | 4.89              | 8.79      |
|                                    | 65 Mbps    | 4.83              | 8.56      |
| 802.11 n_HT 40<br>(Low Channel)    | 13.5 Mbps  | 4.43              | 8.69      |
|                                    | 27 Mbps    | 4.40              | 8.63      |
|                                    | 40.5 Mbps  | 4.35              | 8.57      |
|                                    | 54 Mbps    | 4.26              | 8.22      |
|                                    | 81 Mbps    | 4.20              | 8.03      |
|                                    | 108 Mbps   | 4.08              | 8.07      |
|                                    | 121.5 Mbps | 3.81              | 7.94      |
|                                    | 135 Mbps   | 4.76              | 7.69      |

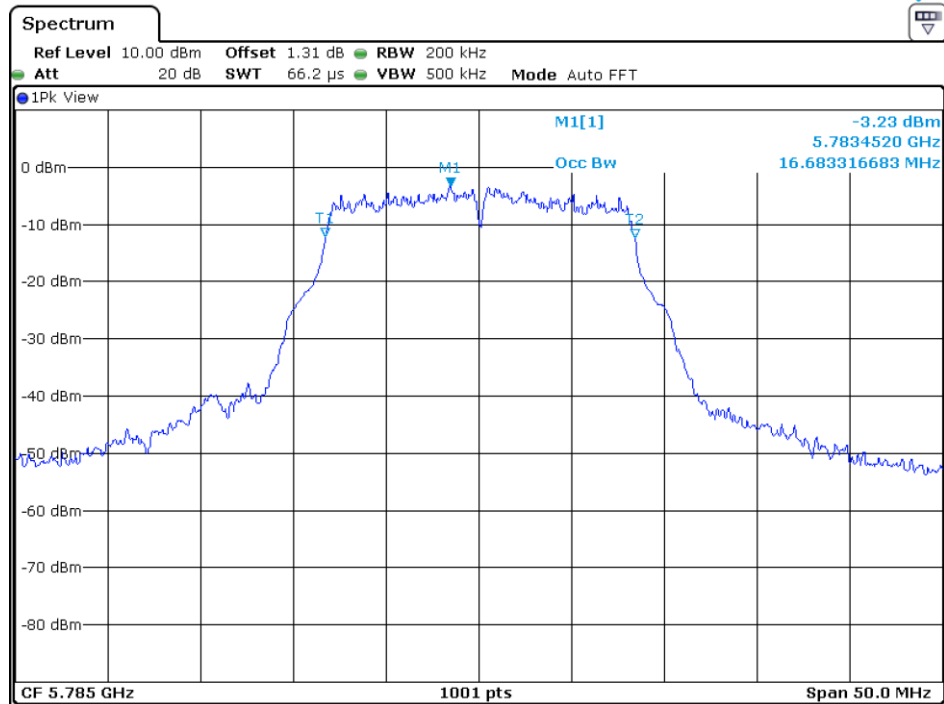
|                                     |            |      |      |
|-------------------------------------|------------|------|------|
| 802.11 ac_VHT80<br>(Middle Channel) | 29.3 Mbps  | 3.68 | 7.56 |
|                                     | 58.5 Mbps  | 3.51 | 7.29 |
|                                     | 87.8 Mbps  | 3.44 | 7.18 |
|                                     | 117 Mbps   | 3.40 | 6.75 |
|                                     | 175.5 Mbps | 3.29 | 6.89 |
|                                     | 234 Mbps   | 3.25 | 6.56 |
|                                     | 263.3 Mbps | 3.13 | 6.50 |
|                                     | 292.5 Mbps | 2.89 | 6.43 |
|                                     | 351 Mbps   | 2.85 | 6.40 |
|                                     | 390 Mbps   | 2.86 | 6.45 |

- The worse case data rate for each modulation is determined 6 Mbps(Ant.0/Ant.1) for IEEE 802.11a, 6.5 Mbps(Ant.0/Ant.1) for HT20, 13.5 Mbps(Ant.0/Ant.1) for HT40, 29.3 Mbps(Ant.0/Ant.1) for VHT80.
- To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XY” axis.

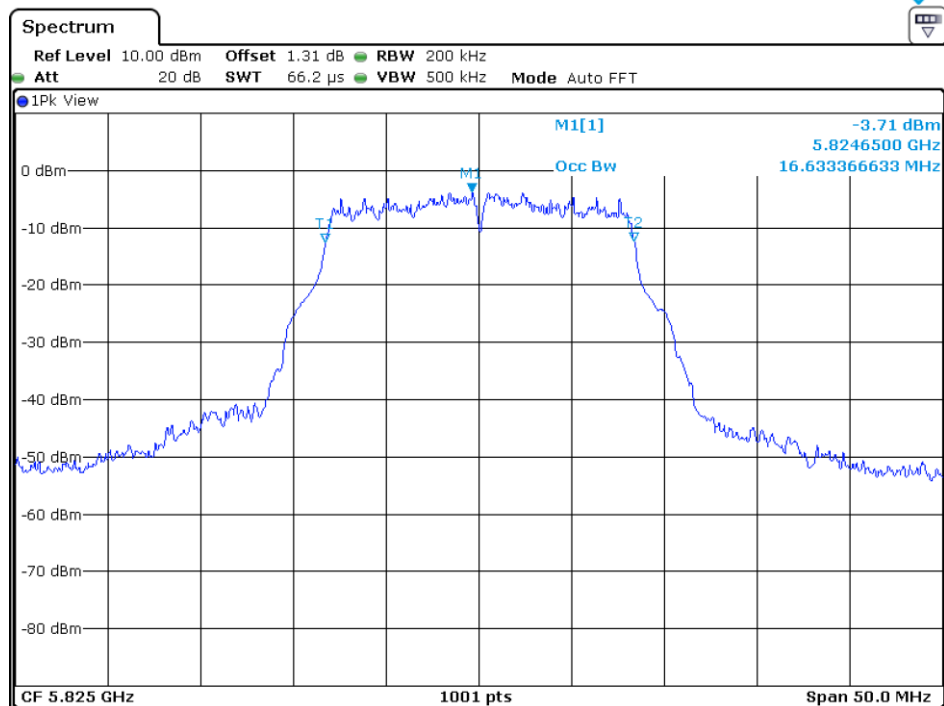
-. Occupied Bandwidth(99 %)

| Modulation            | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|-----------------------|---------|-----------------|-------------------------|
| 802.11 a<br>Antenna 0 | Low     | 5 745.00        | 16.88                   |
|                       | Middle  | 5 785.00        | 16.68                   |
|                       | High    | 5 825.00        | 16.63                   |



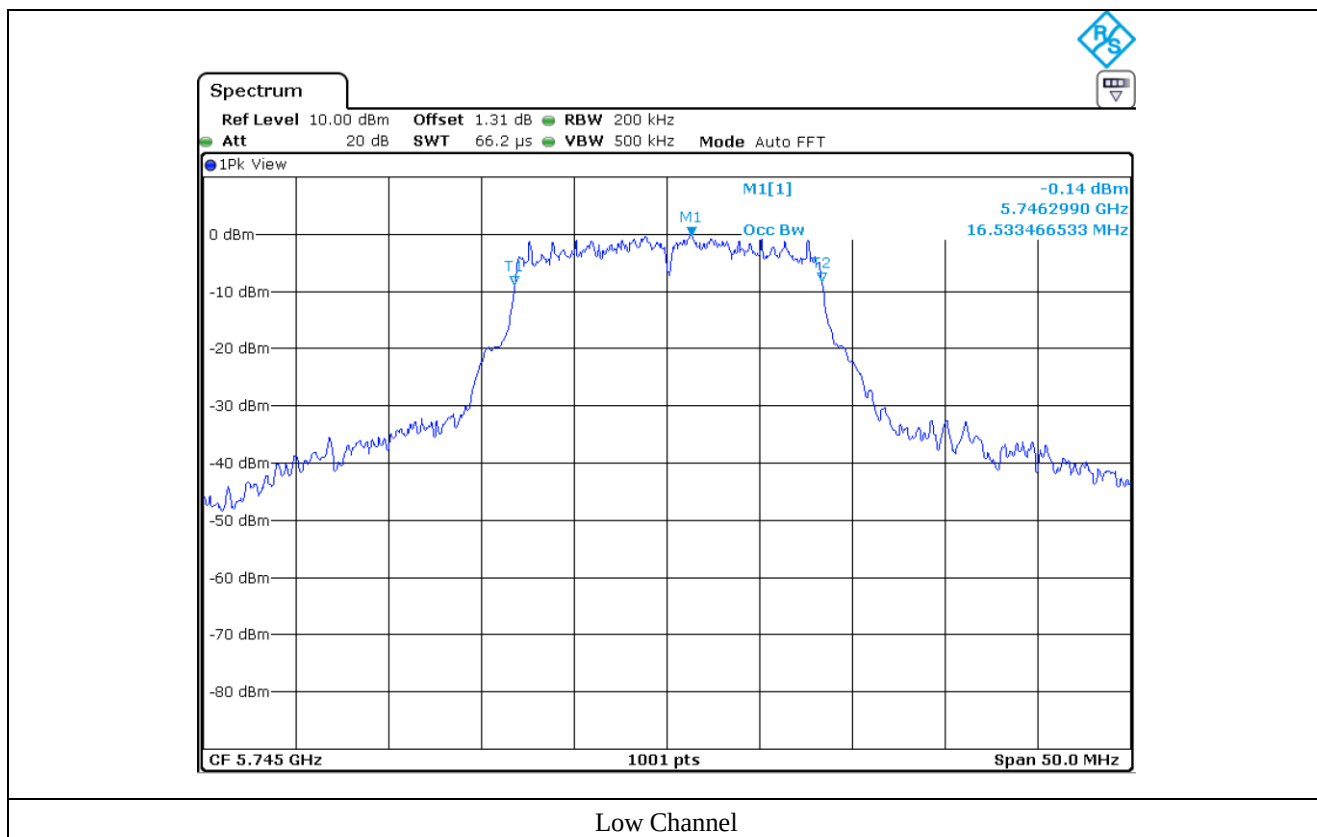


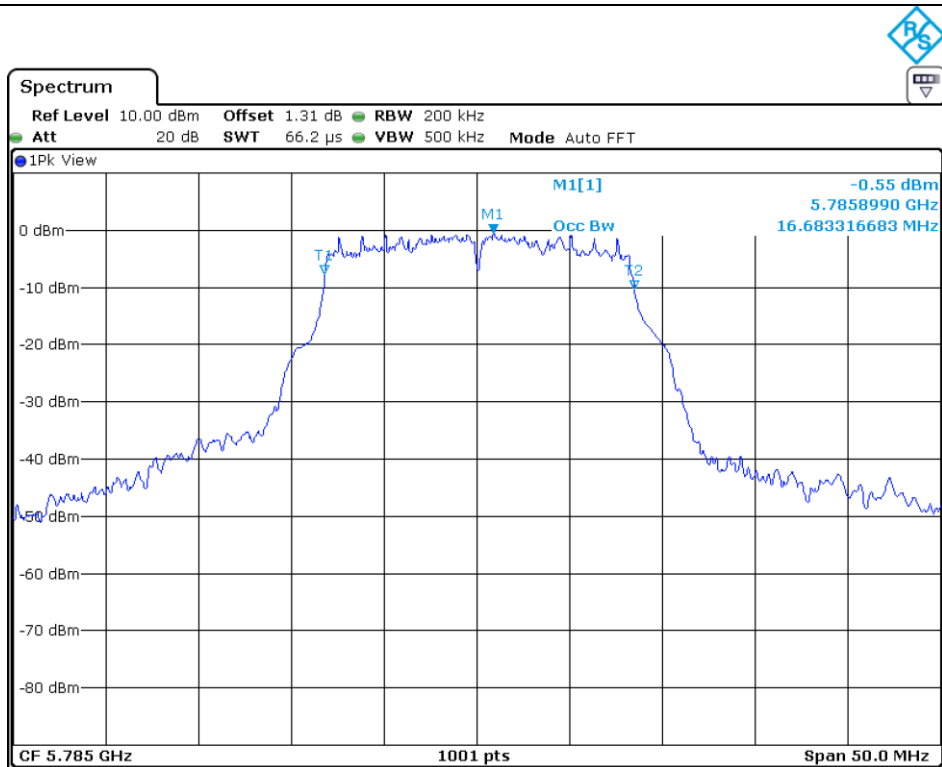
Middle Channel



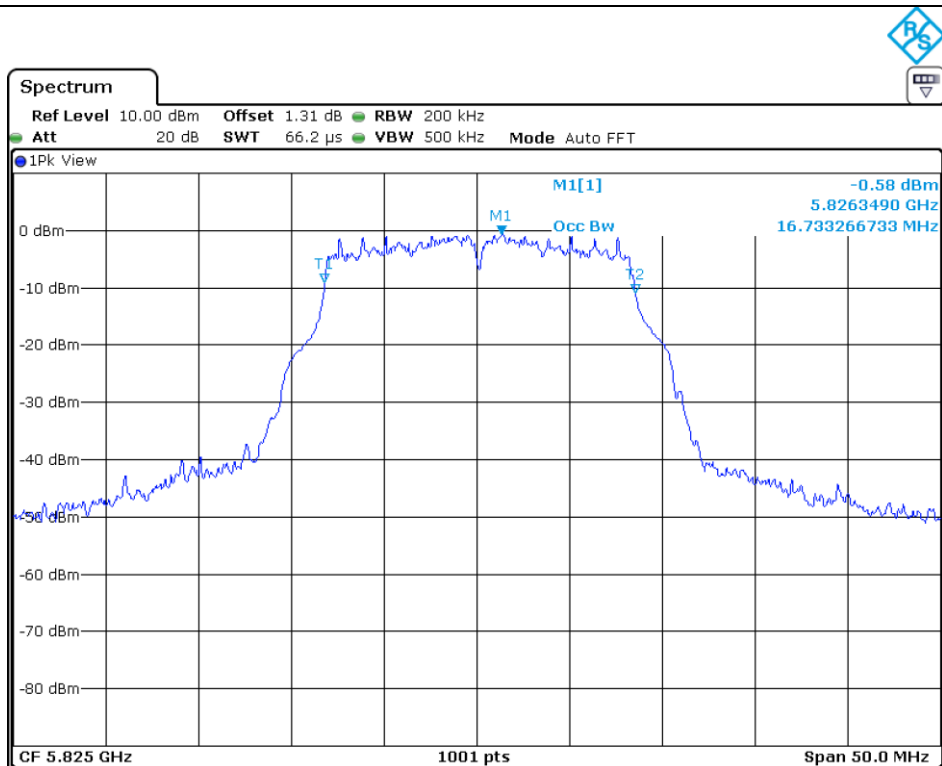
High Channel

| Modulation            | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|-----------------------|---------|-----------------|-------------------------|
| 802.11 a<br>Antenna 1 | Low     | 5 745.00        | 16.53                   |
|                       | Middle  | 5 785.00        | 16.68                   |
|                       | High    | 5 825.00        | 16.73                   |



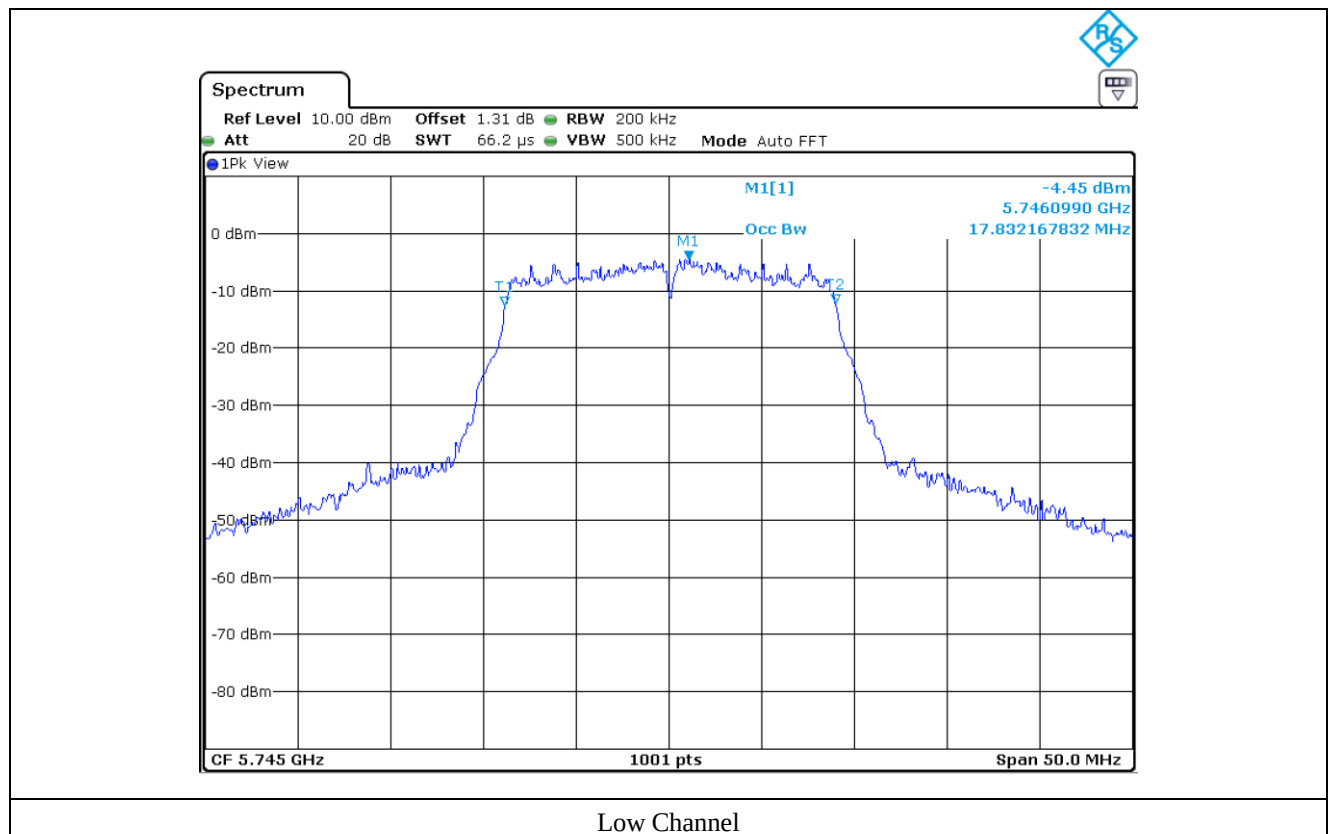


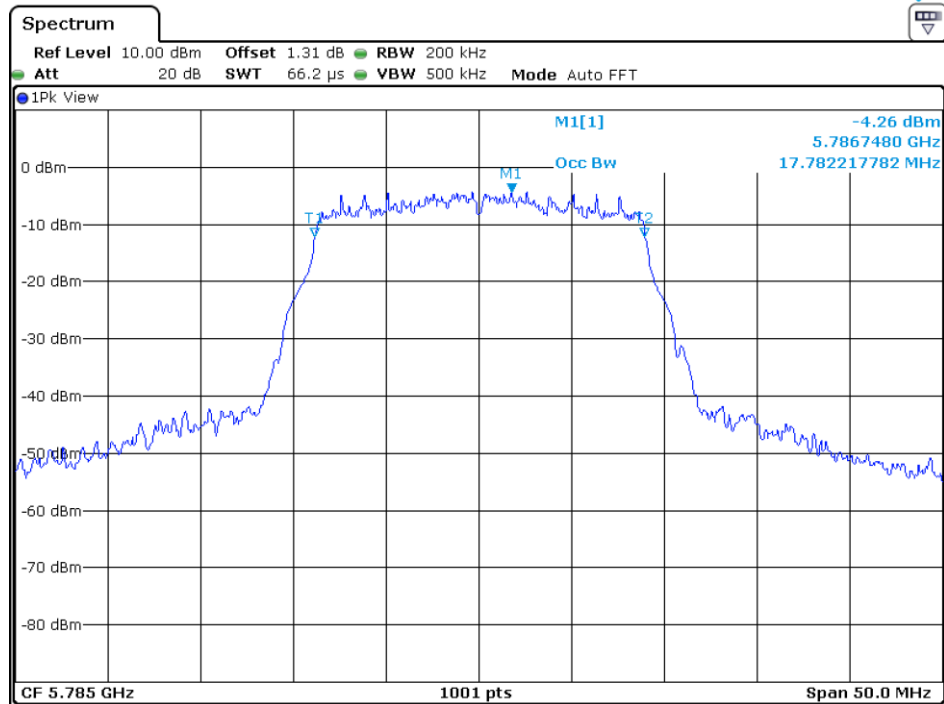
Middle Channel



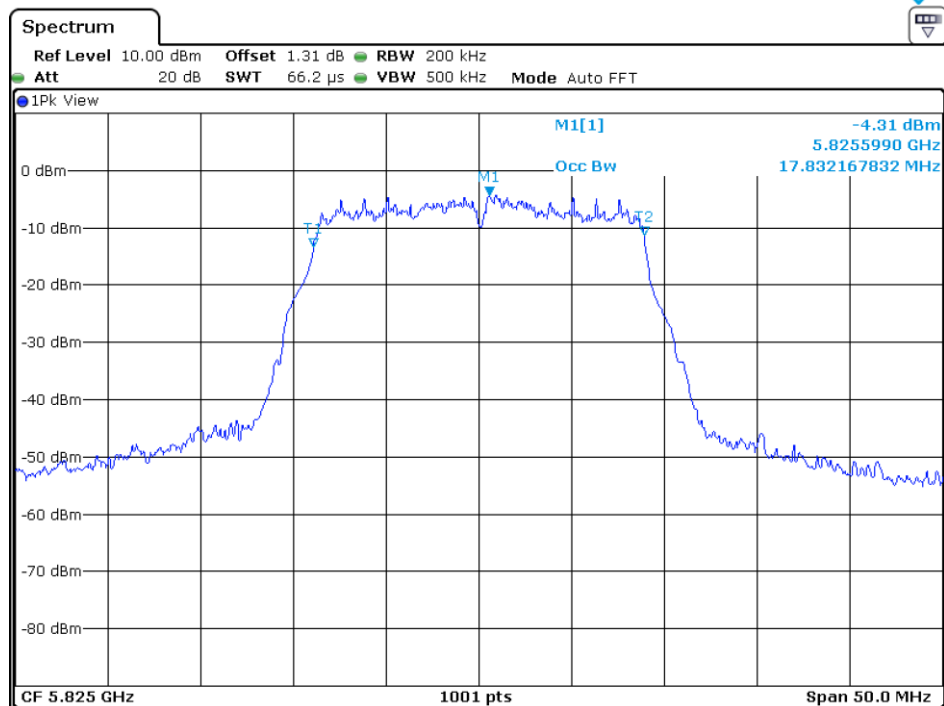
High Channel

| Modulation                 | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|----------------------------|---------|-----------------|-------------------------|
| 802.11 n_HT20<br>Antenna 0 | Low     | 5 745.00        | 17.83                   |
|                            | Middle  | 5 785.00        | 17.78                   |
|                            | High    | 5 825.00        | 17.83                   |



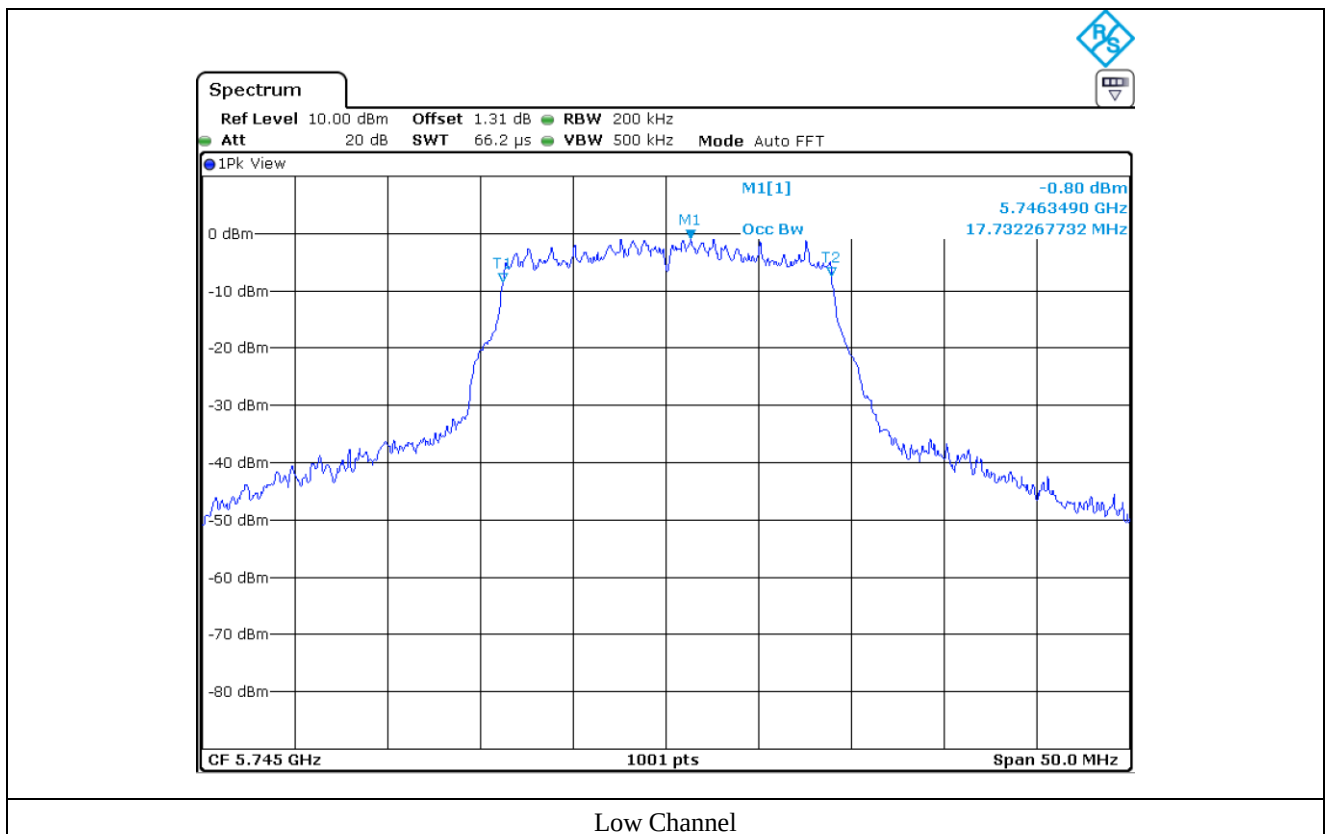


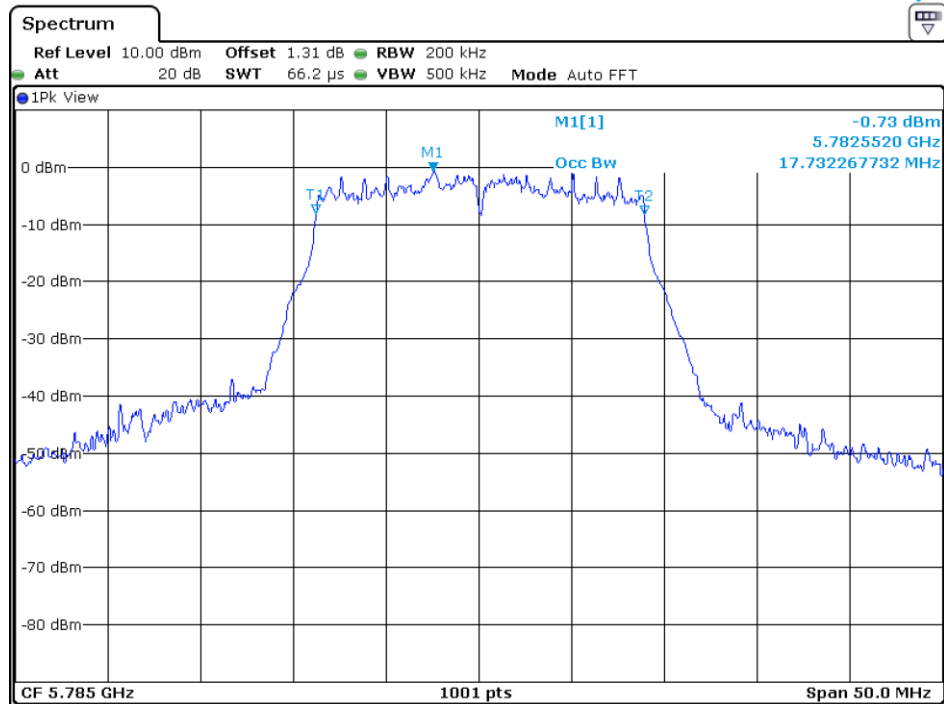
Middle Channel



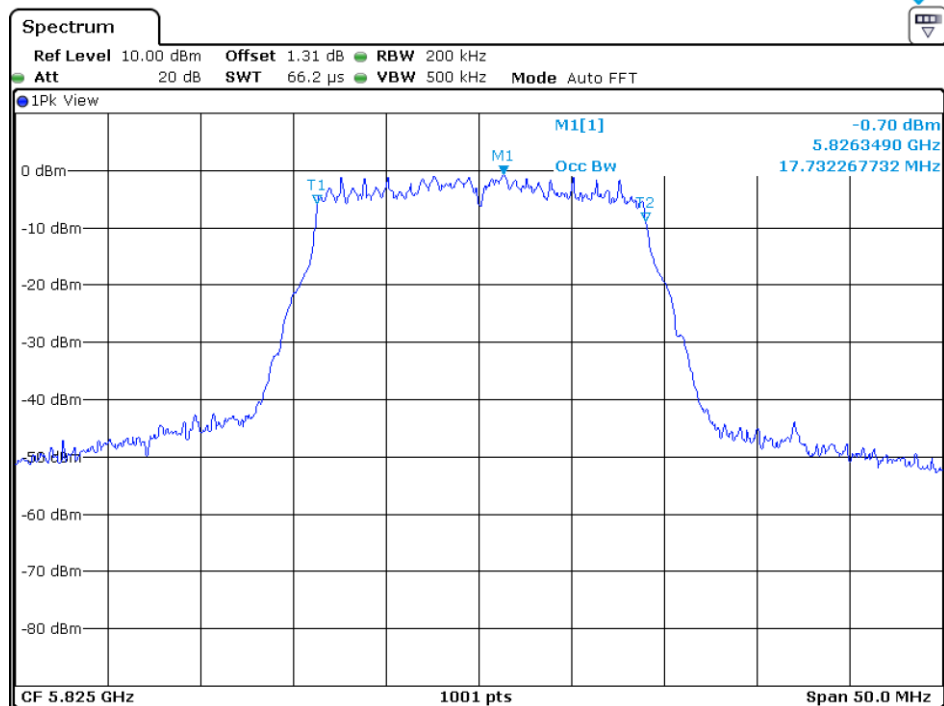
High Channel

| Modulation                 | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|----------------------------|---------|-----------------|-------------------------|
| 802.11 n_HT20<br>Antenna 1 | Low     | 5 745.00        | 17.73                   |
|                            | Middle  | 5 785.00        | 17.73                   |
|                            | High    | 5 825.00        | 17.73                   |



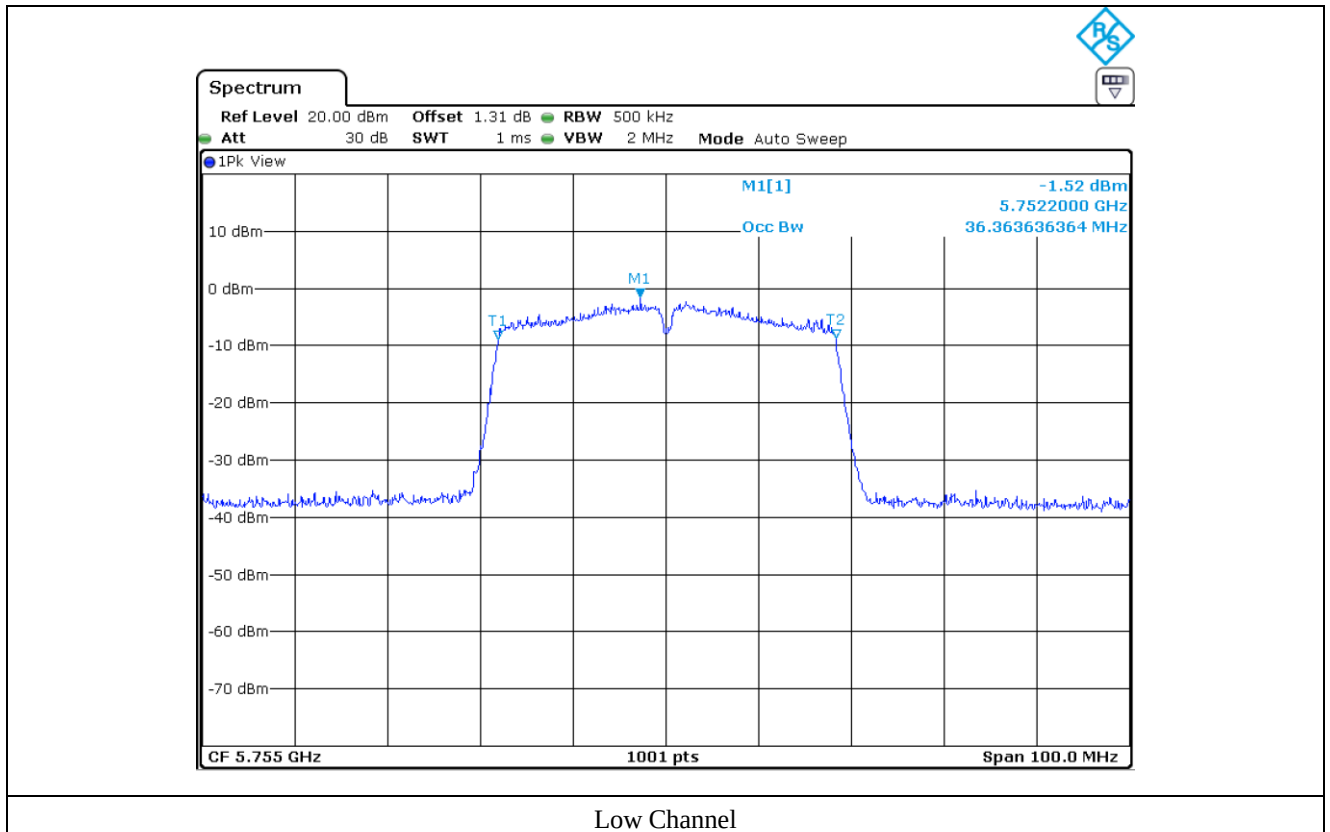


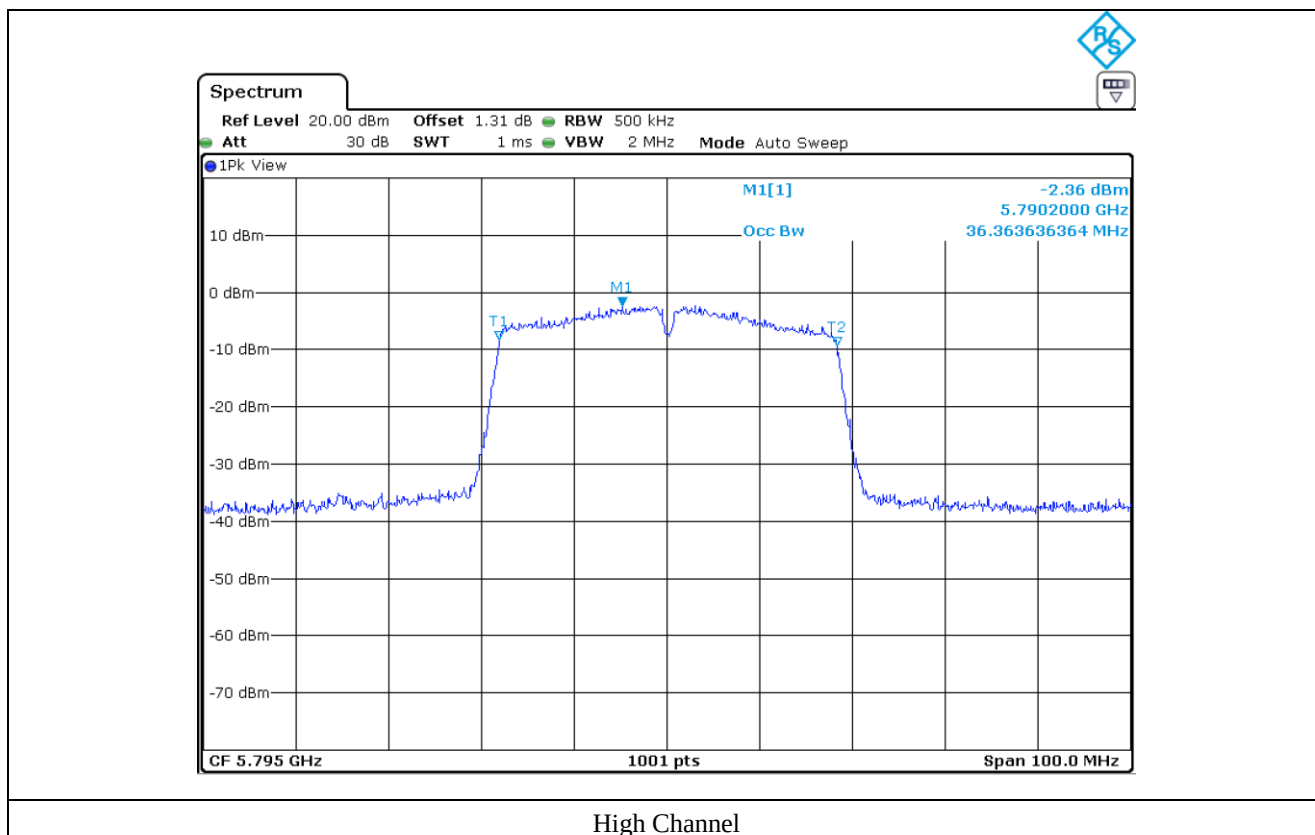
Middle Channel



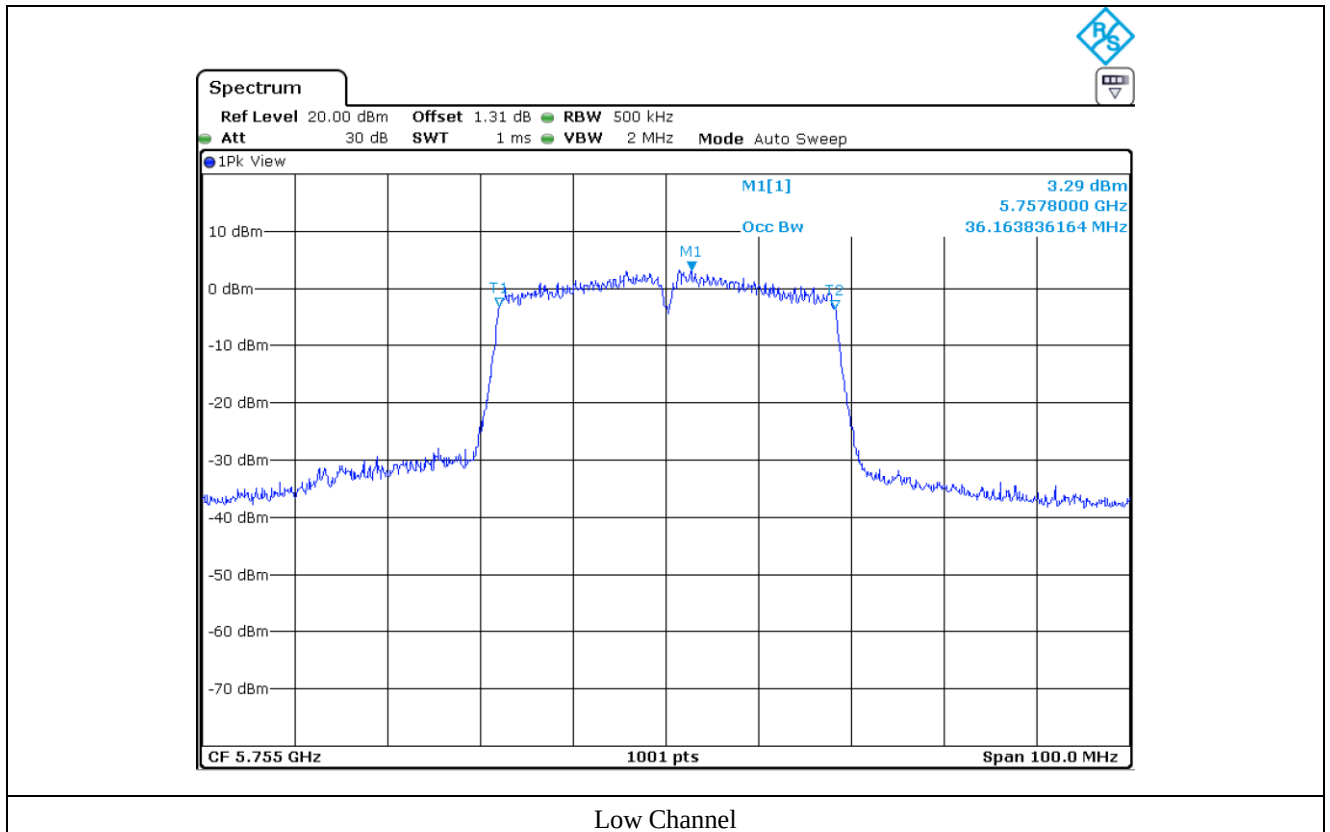
High Channel

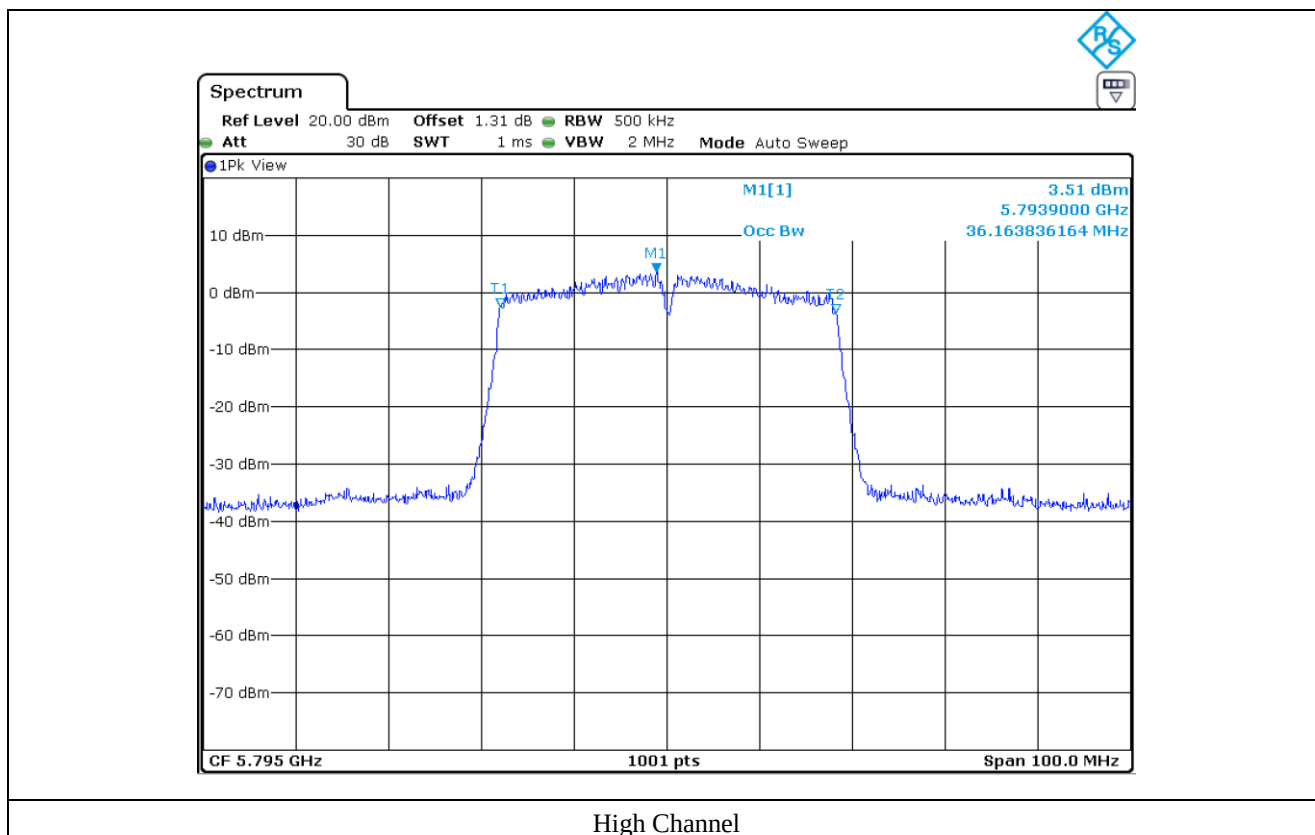
| Modulation                  | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|-----------------------------|---------|-----------------|-------------------------|
| 802.11 n_HT 40<br>Antenna 0 | Low     | 5 755.00        | 36.36                   |
|                             | High    | 5 795.00        | 36.36                   |



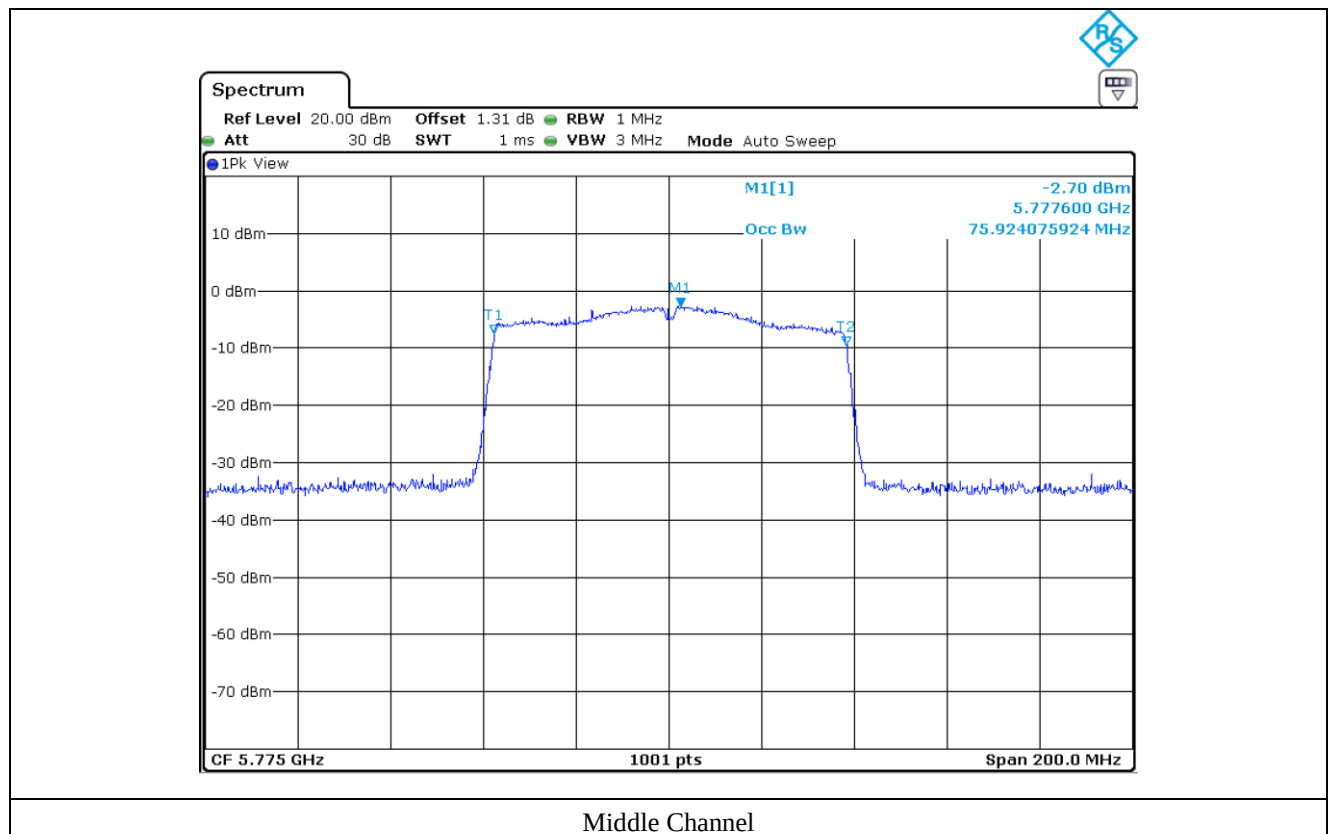


| Modulation                  | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|-----------------------------|---------|-----------------|-------------------------|
| 802.11 n_HT 40<br>Antenna 1 | Low     | 5 755.00        | 36.16                   |
|                             | High    | 5 795.00        | 36.16                   |

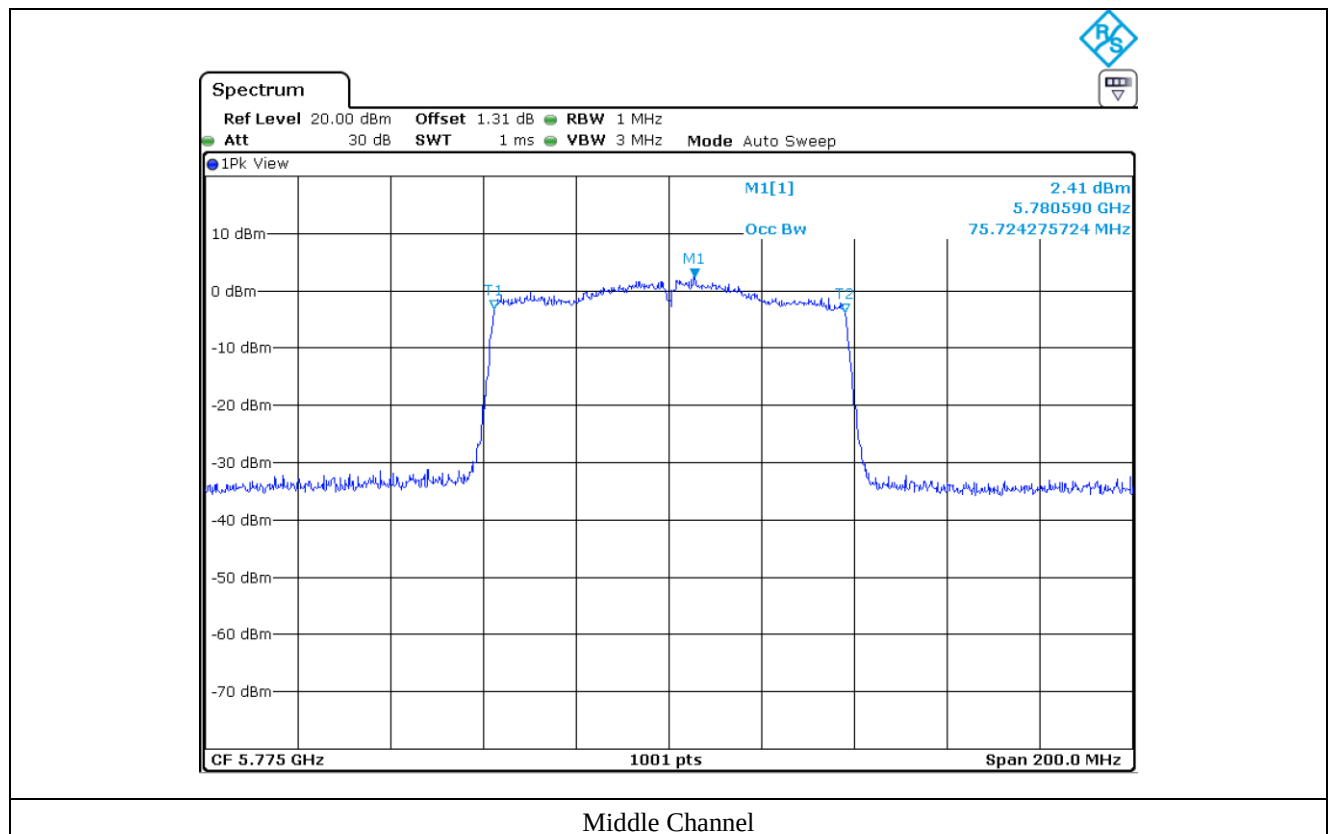




| Modulation                       | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|----------------------------------|---------|-----------------|-------------------------|
| 802.11 ac<br>_VHT80<br>Antenna 0 | Middle  | 5 775.00        | 75.92                   |



| Modulation                       | CHANNEL | FREQUENCY (MHz) | Occupied Bandwidth(MHz) |
|----------------------------------|---------|-----------------|-------------------------|
| 802.11 ac<br>_VHT80<br>Antenna 1 | Middle  | 5 775.00        | 75.72                   |



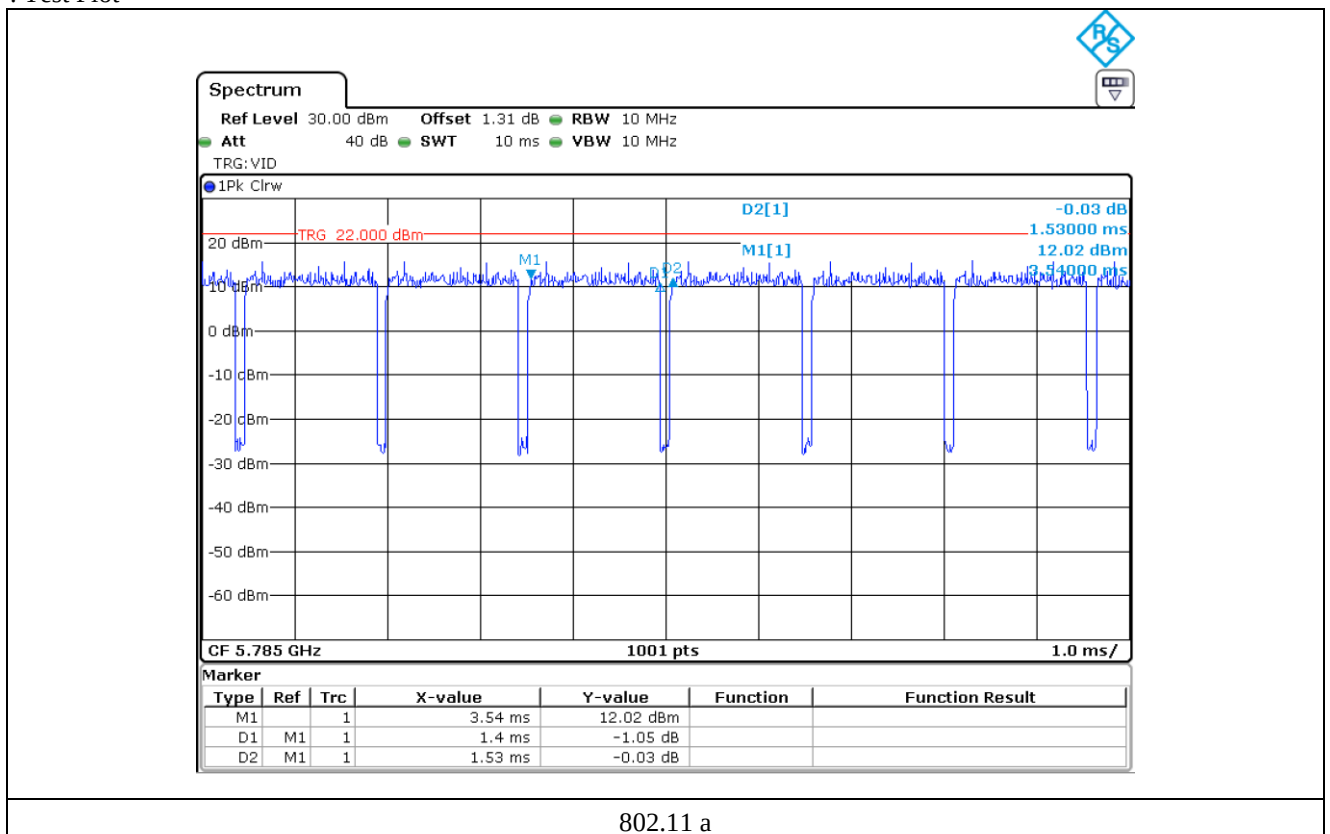
### -. Duty Cycle(UNII 3)

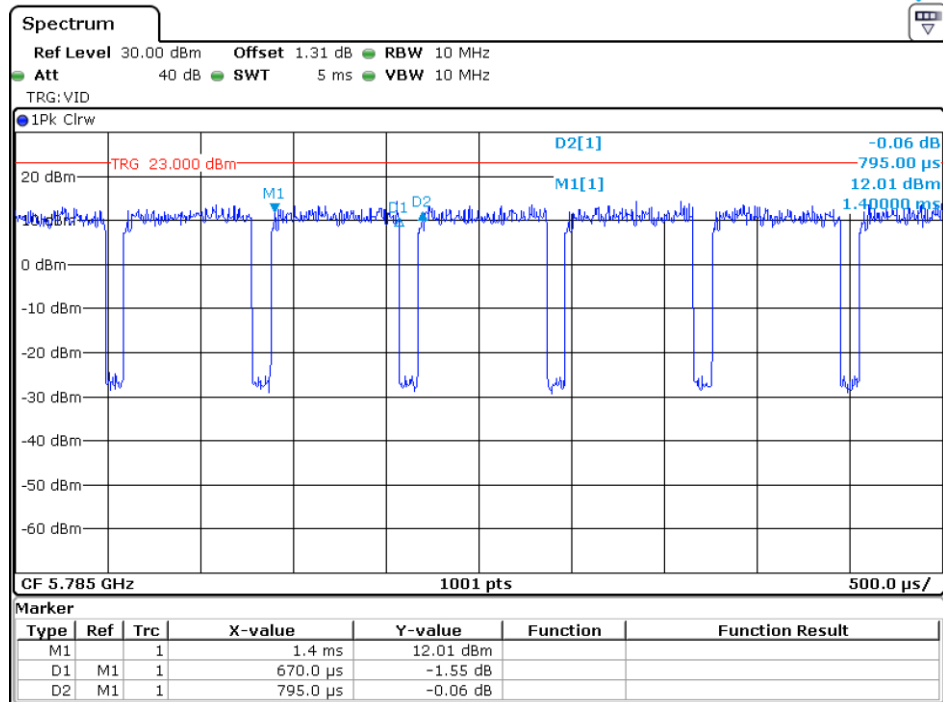
| Mode            | Duty Cycle [%] | Correction Factor [dB] |
|-----------------|----------------|------------------------|
| 802.11 a        | 91.50          | 0.39                   |
| 802.11 n(HT20)  | 84.28          | 0.74                   |
| 802.11 n(HT40)  | 73.91          | 1.31                   |
| 802.11 ac(HT80) | 62.24          | 2.06                   |

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) \* 100

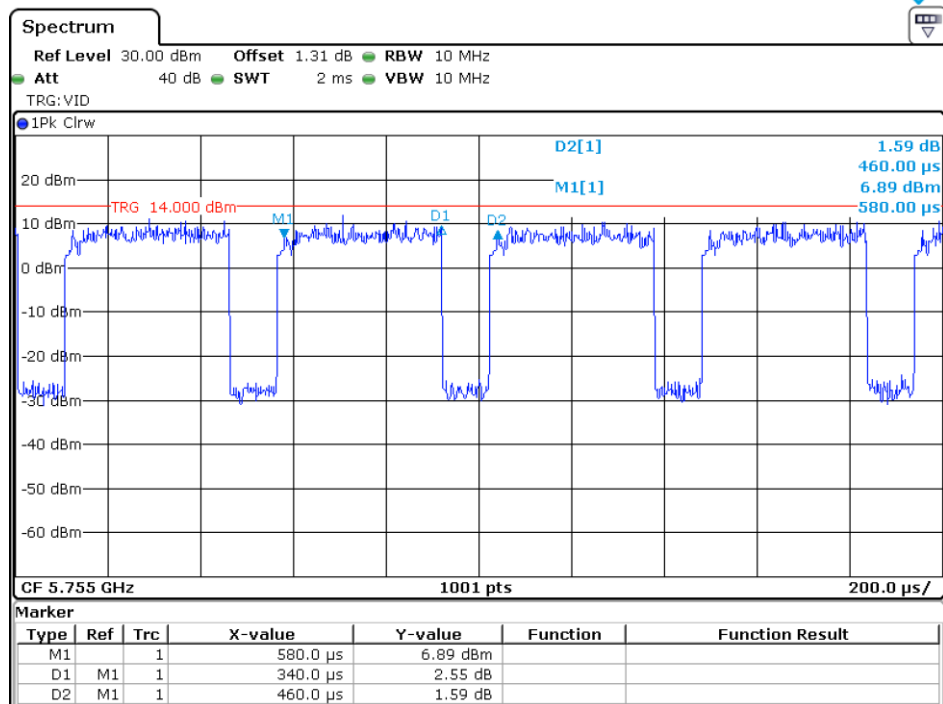
Correction Factor : 10 \* Log(1 / (Duty Cycle / 100))

### -. Test Plot

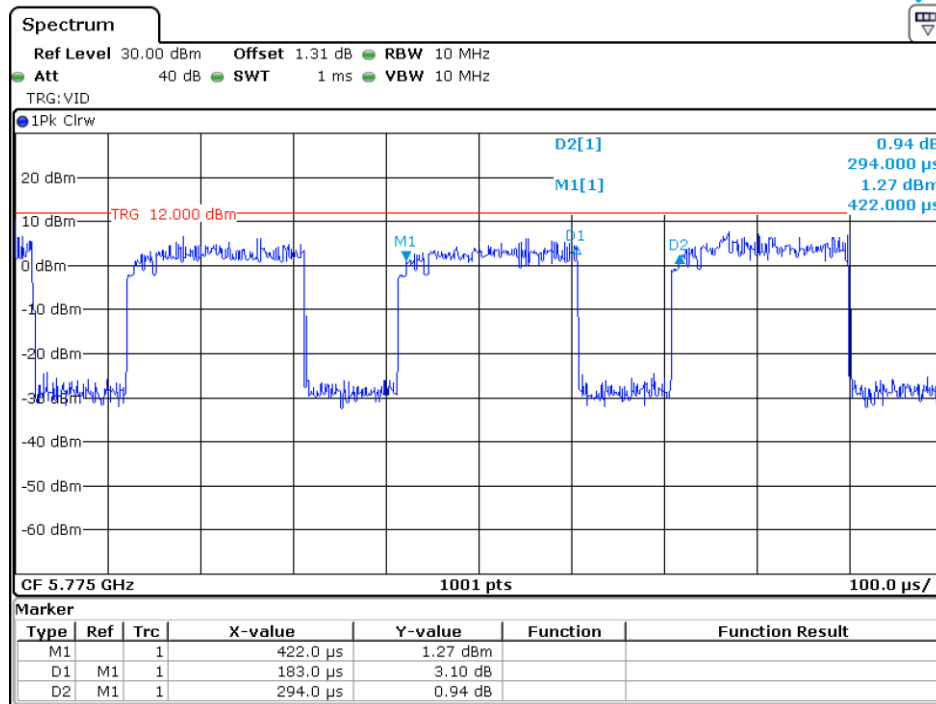




802.11 n(HT20)



802.11 n(HT40)



802.11 ac(HT80)

## 5.4 Configuration of Test System

**Line Conducted Test:** The EUT was connected to Jig Board and the power was connected to DC Power Supply. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

**Radiated Emission Test:** Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

## 5.5 Antenna Requirement

For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

### Antenna Construction:

The antenna of the EUT is a PCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

## 6. PRELIMINARY TEST

### 6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

| Operation Mode    | The Worse operating condition (Please check one only) |
|-------------------|-------------------------------------------------------|
| Transmitting Mode | X                                                     |

### 6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

| Operation Mode    | The Worse operating condition (Please check one only) |
|-------------------|-------------------------------------------------------|
| Transmitting Mode | X                                                     |

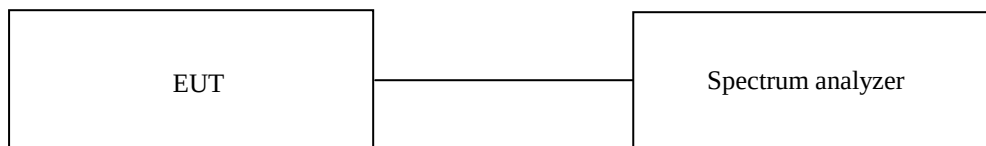
## 7. MINIMUM 26 dB BANDWIDTH

### 7.1 Operating environment

Temperature : 23 °C  
Relative humidity : 41 % R.H.

### 7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 26 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 26 dB.



### 7.3 Test equipment used

|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 7.4 Test data for 802.11a RLAN Mode

### 7.4.1 Test data for Antenna 0

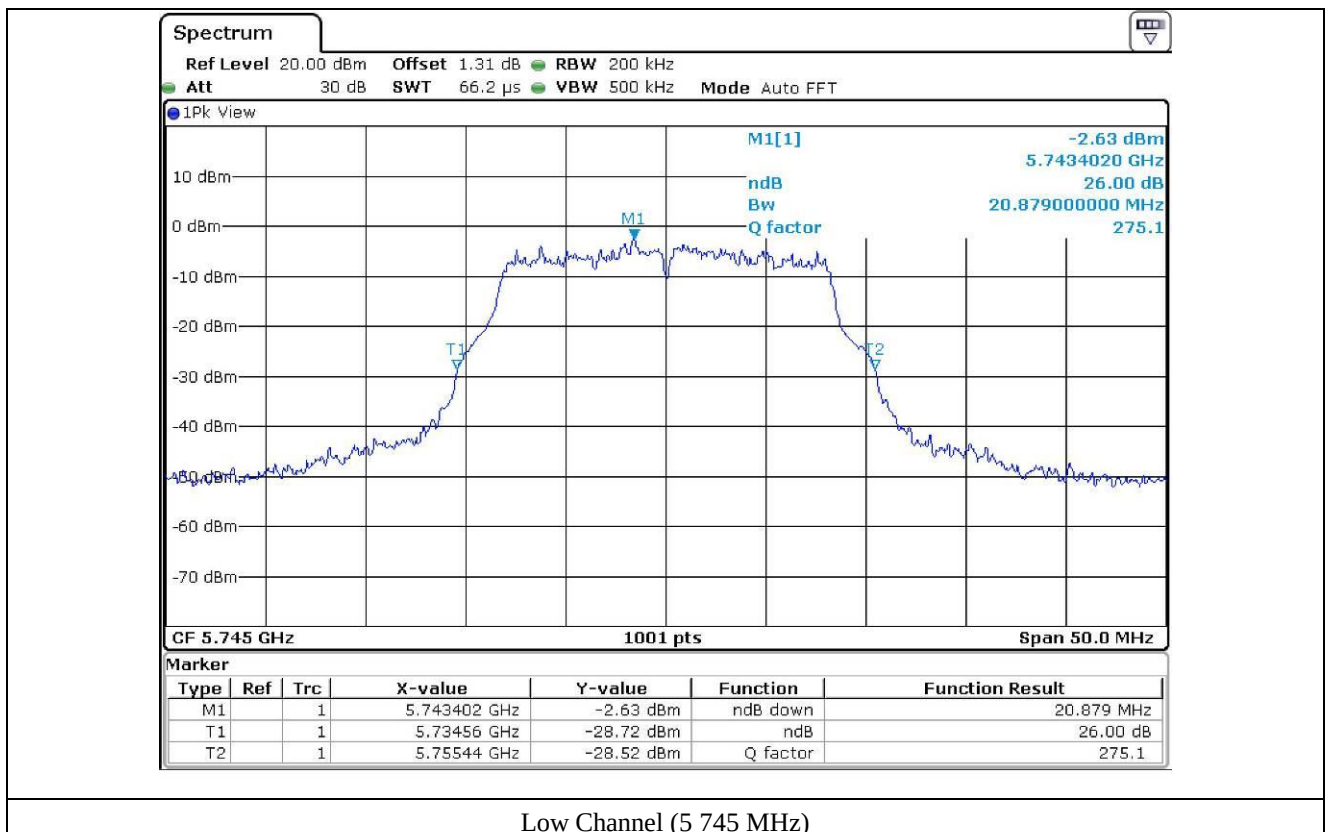
-. Test Date : June 20, 2019 ~ June 26, 2019

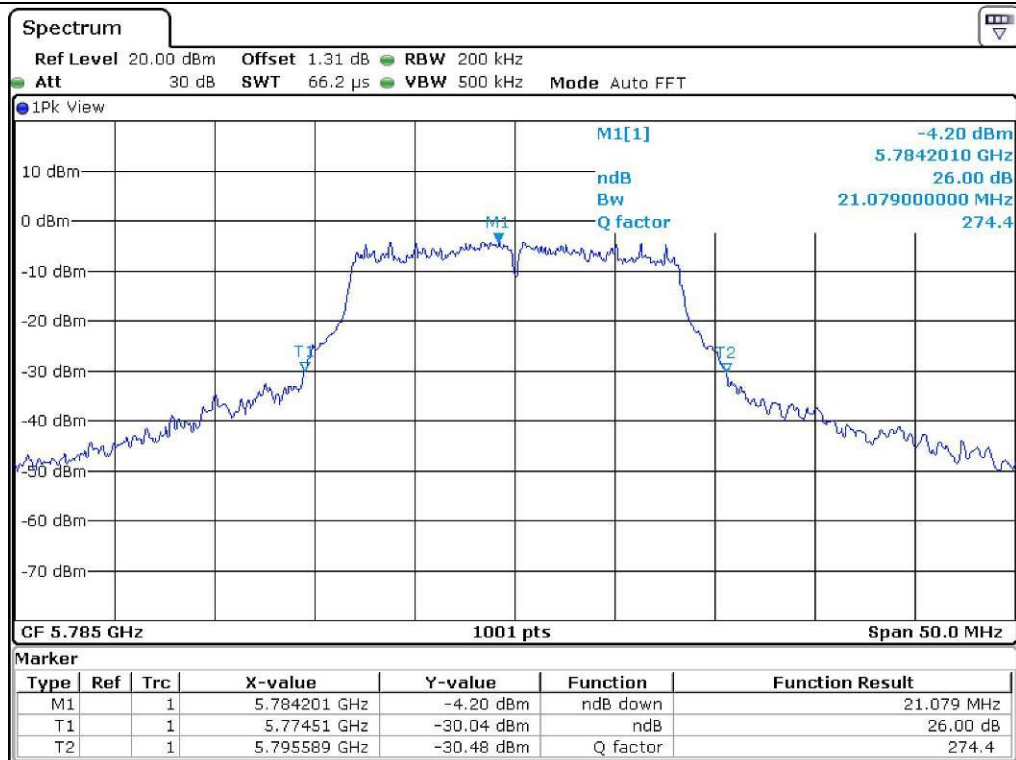
-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 20.88                    |
|                          | Middle  | 5 785.00           | 21.08                    |
|                          | High    | 5 825.00           | 20.88                    |

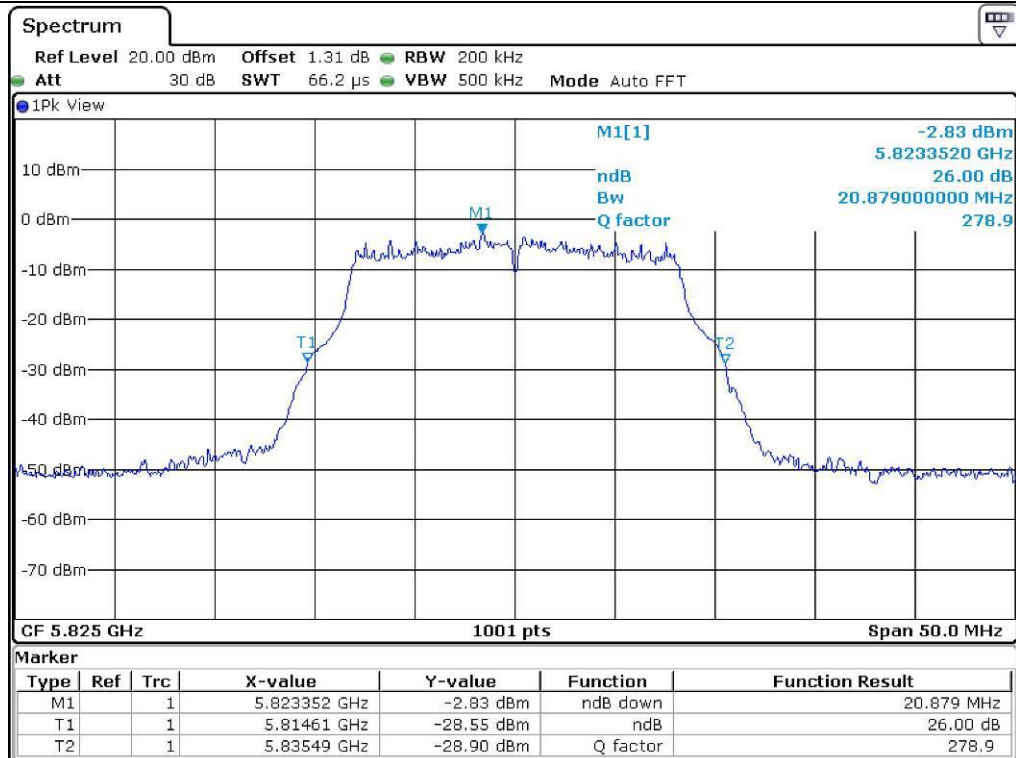


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

## 7.4.2 Test data for Antenna 1

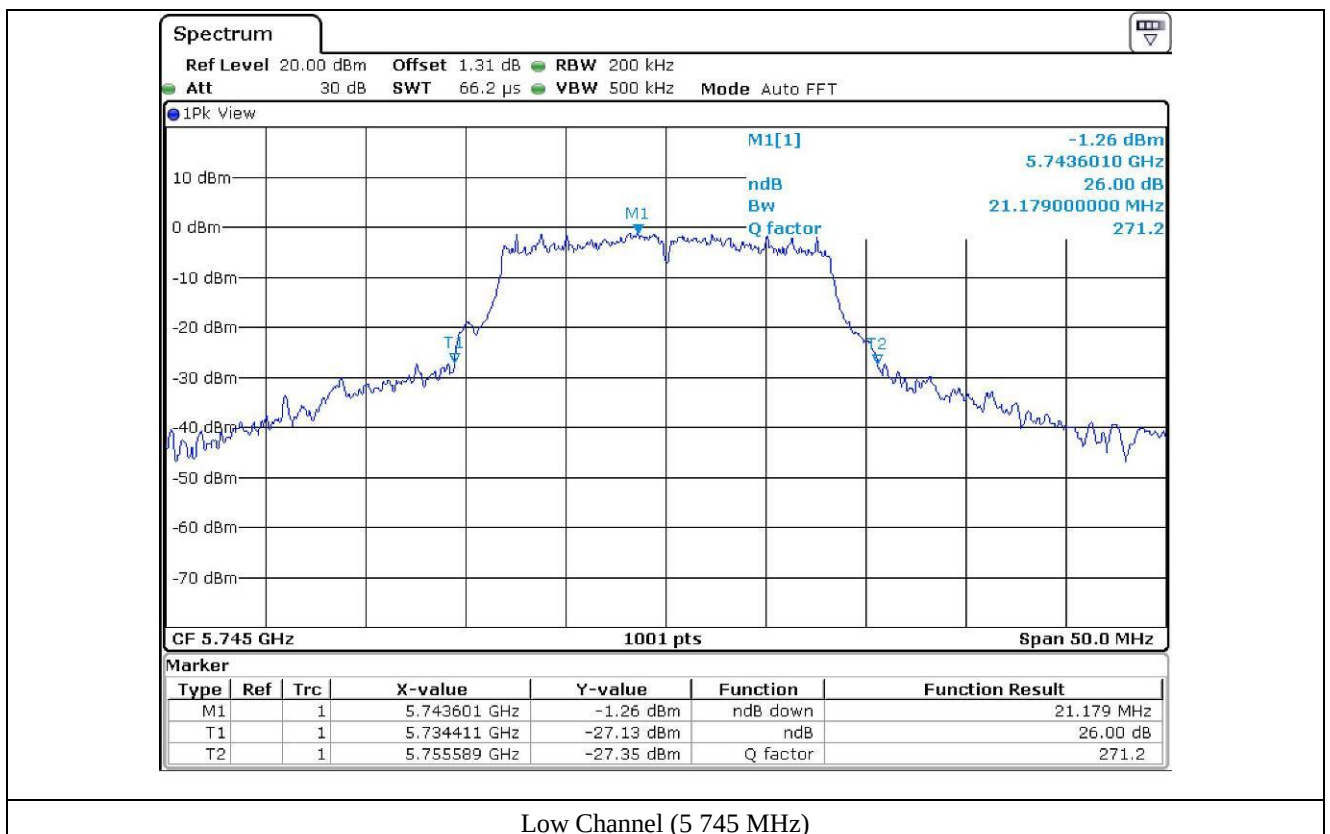
-. Test Date : June 20, 2019 ~ June 26, 2019

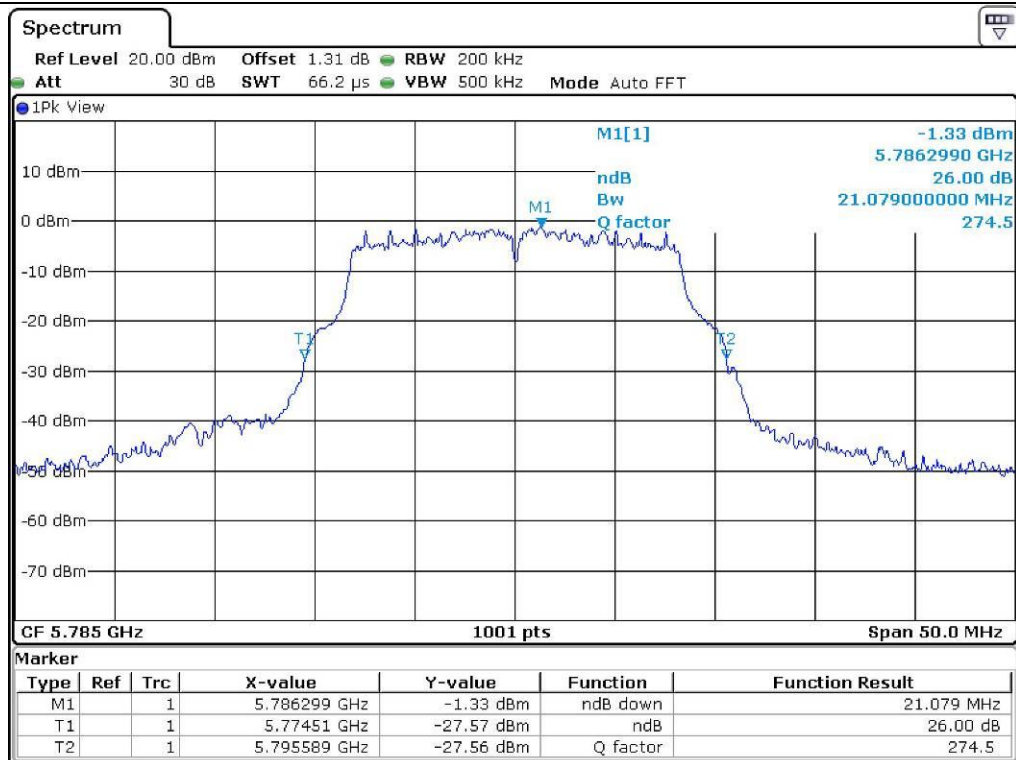
-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 21.18                    |
|                          | Middle  | 5 785.00           | 21.08                    |
|                          | High    | 5 825.00           | 20.88                    |

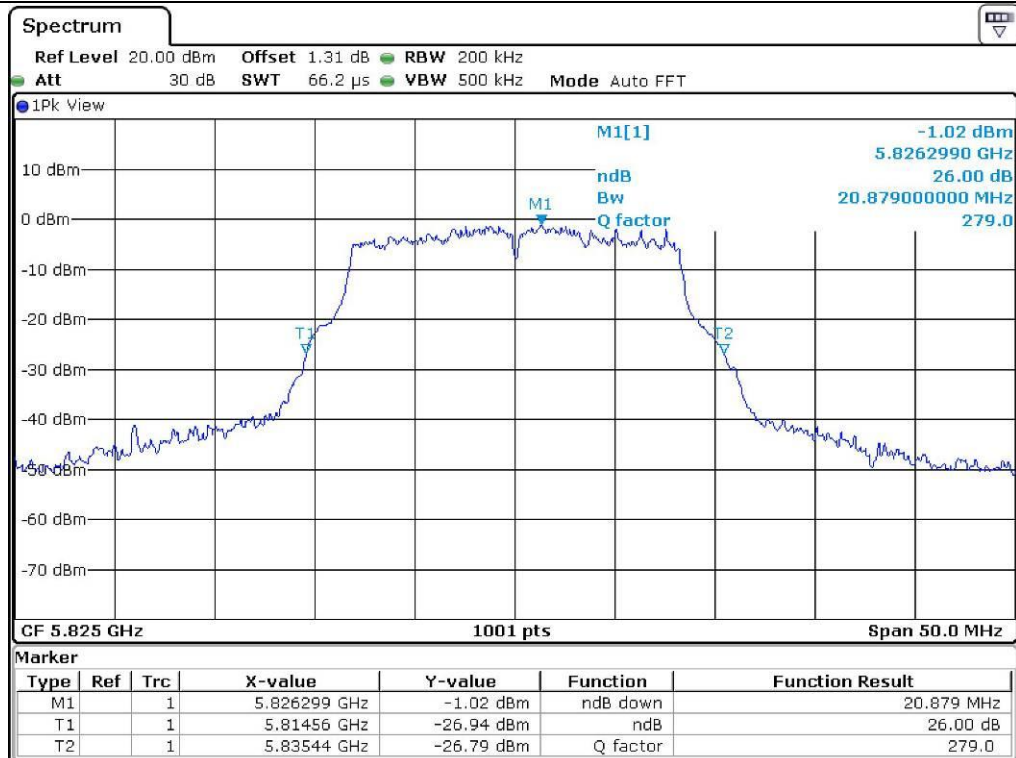


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

## 7.5 Test data for 802.11n\_HT20 RLAN Mode

### 7.5.1 Test data for Antenna 0

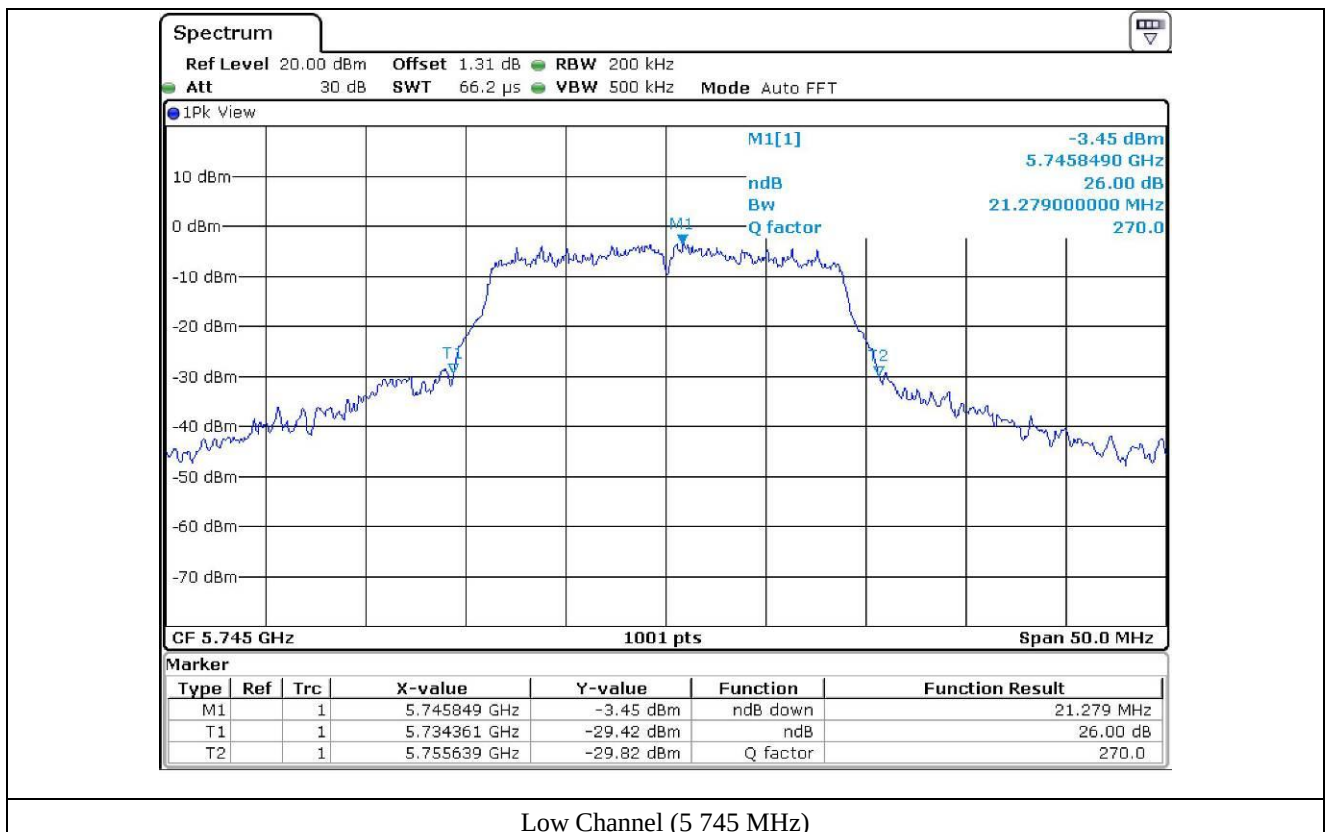
-. Test Date : June 20, 2019 ~ June 26, 2019

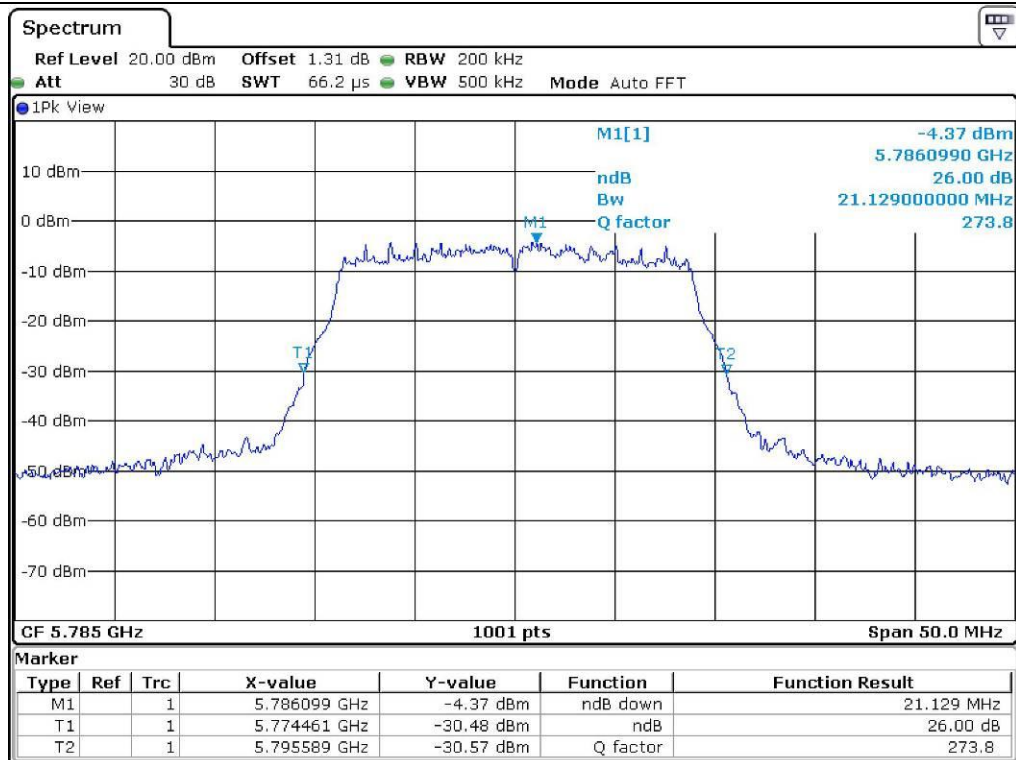
-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 21.28                    |
|                          | Middle  | 5 785.00           | 21.13                    |
|                          | High    | 5 825.00           | 21.13                    |

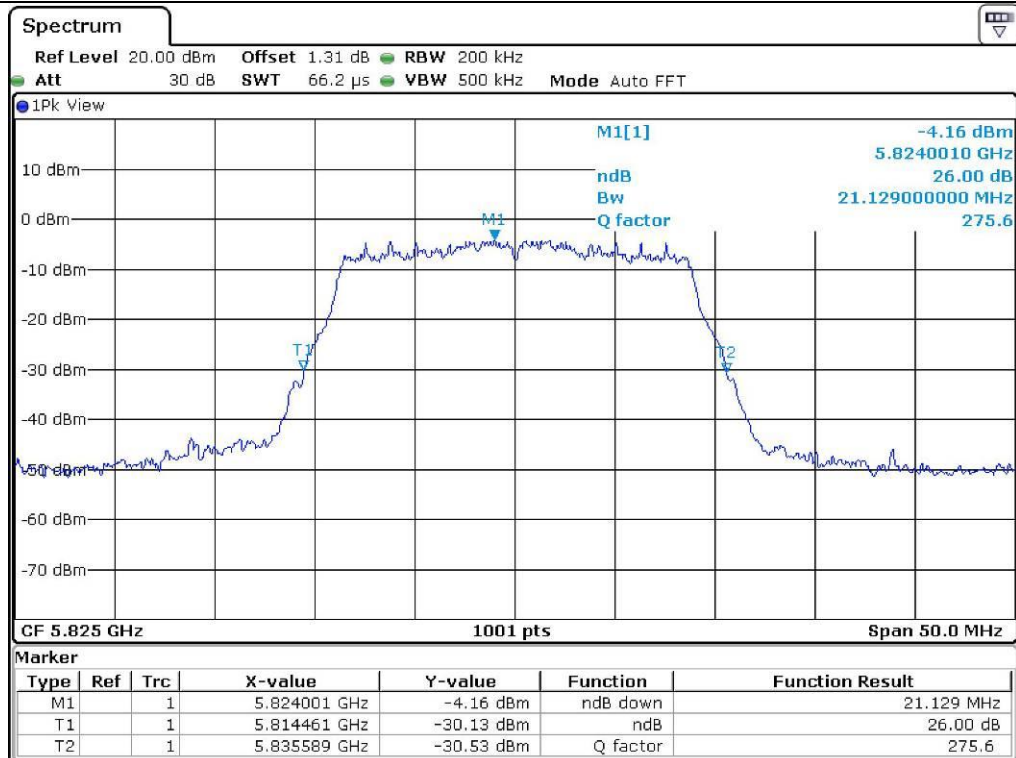


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5.785 MHz)



High Channel (5.825 MHz)

## 7.5.2 Test data for Antenna 1

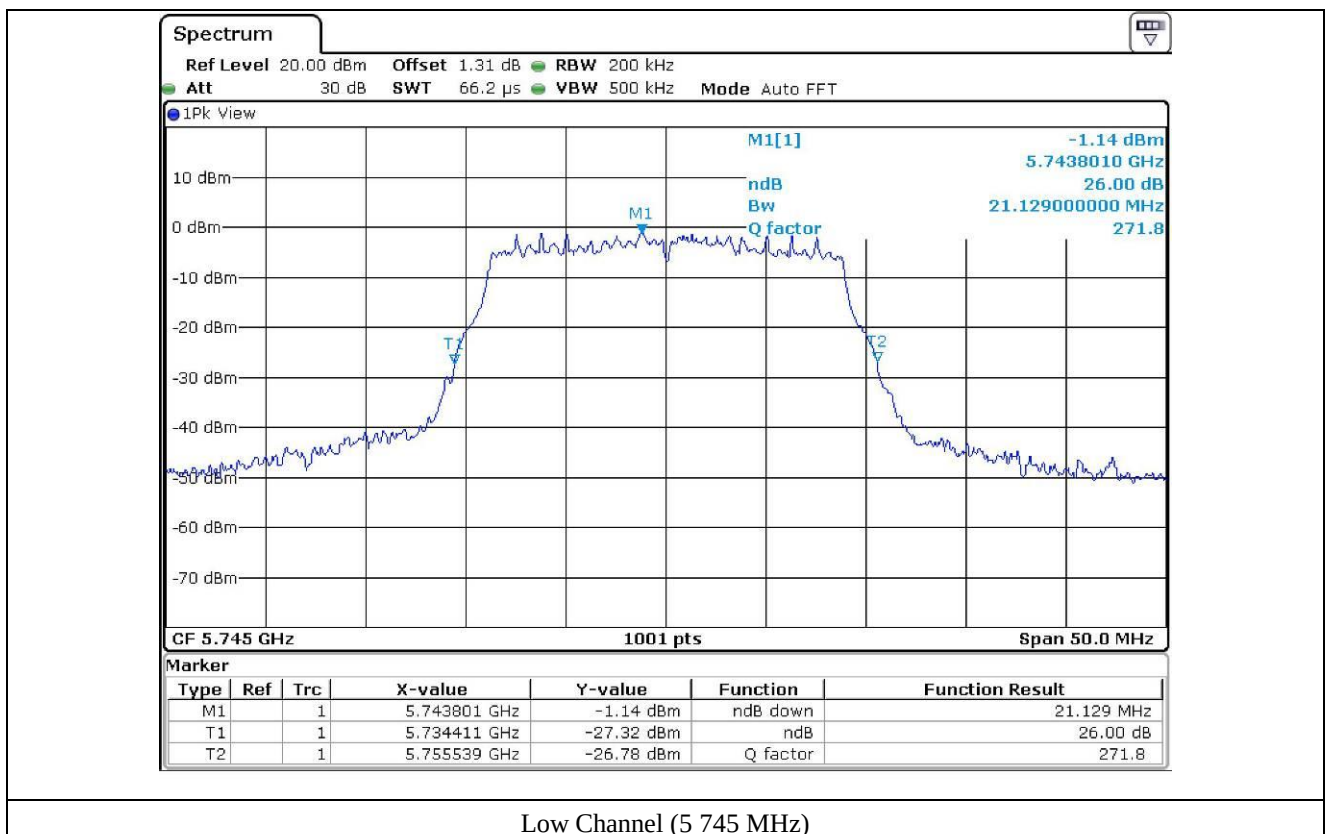
-. Test Date : June 20, 2019 ~ June 26, 2019

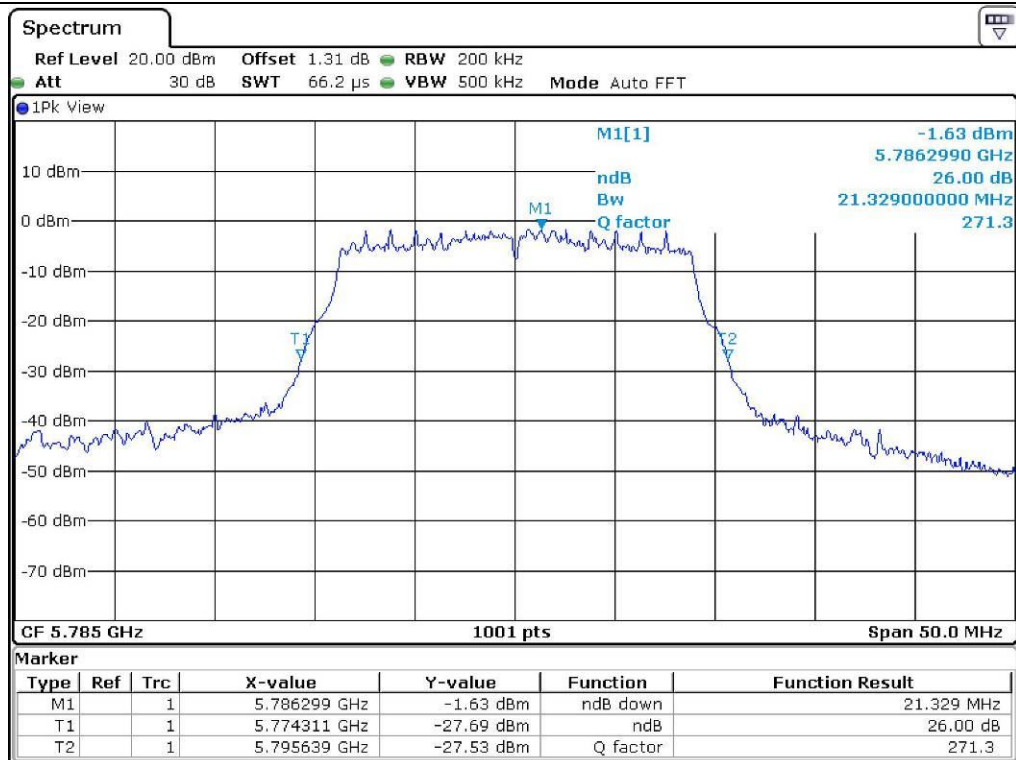
-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 21.13                    |
|                          | Middle  | 5 785.00           | 21.33                    |
|                          | High    | 5 825.00           | 21.03                    |

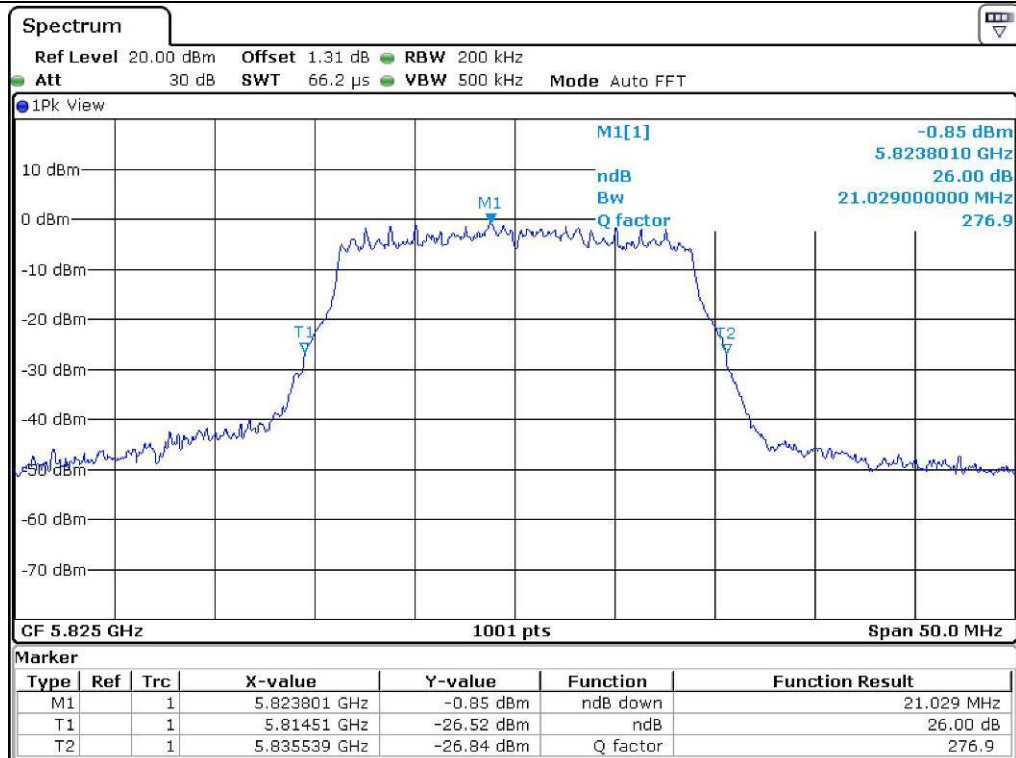


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

## 7.6 Test data for 802.11n\_HT40 RLAN Mode

### 7.6.1 Test data for Antenna 0

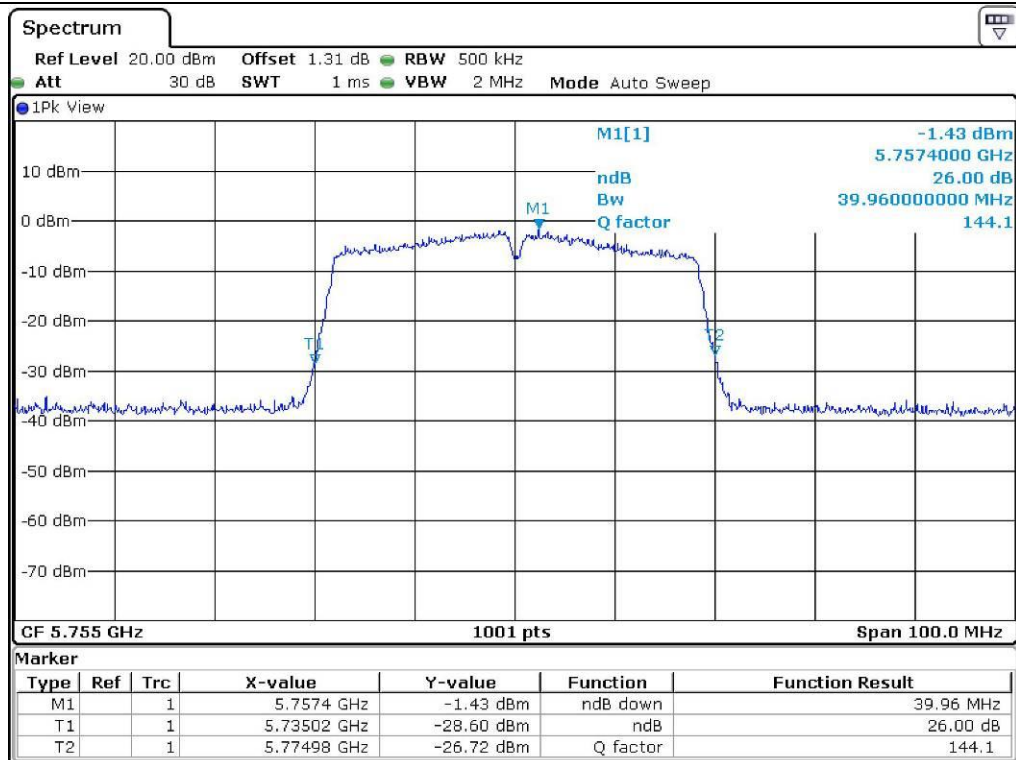
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

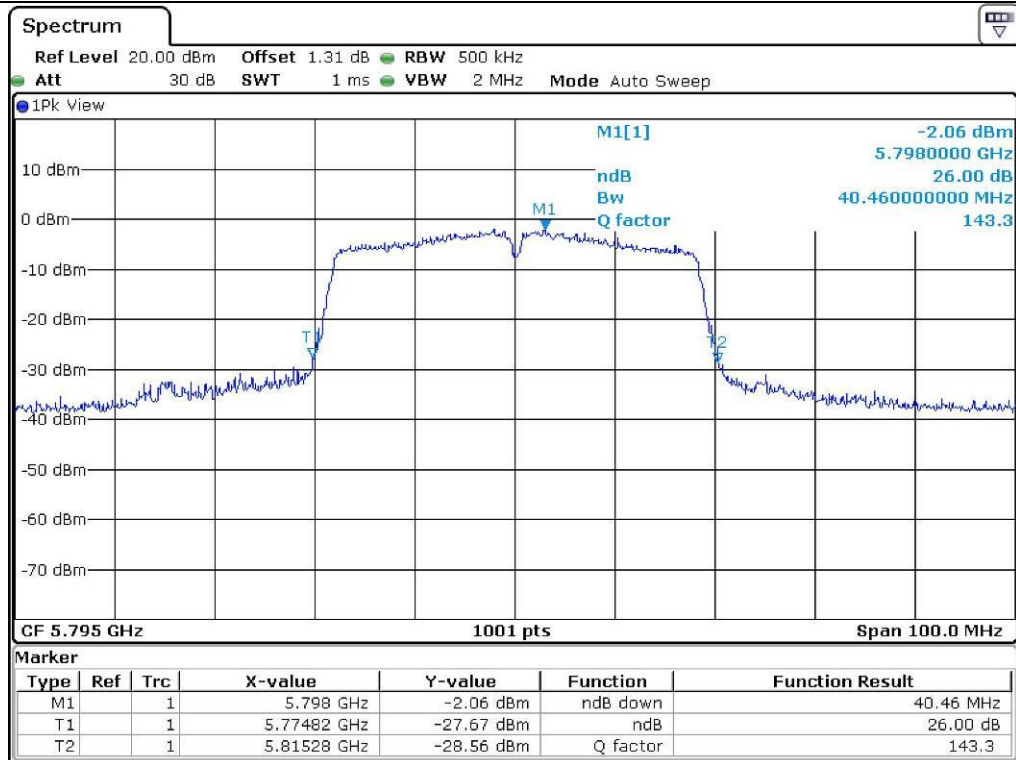
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 755.00           | 39.96                    |
|                          | High    | 5 795.00           | 40.46                    |



Tested by: Hyung-Kwon, Oh / Assistant Manager



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

### 7.6.2 Test data for Antenna 1

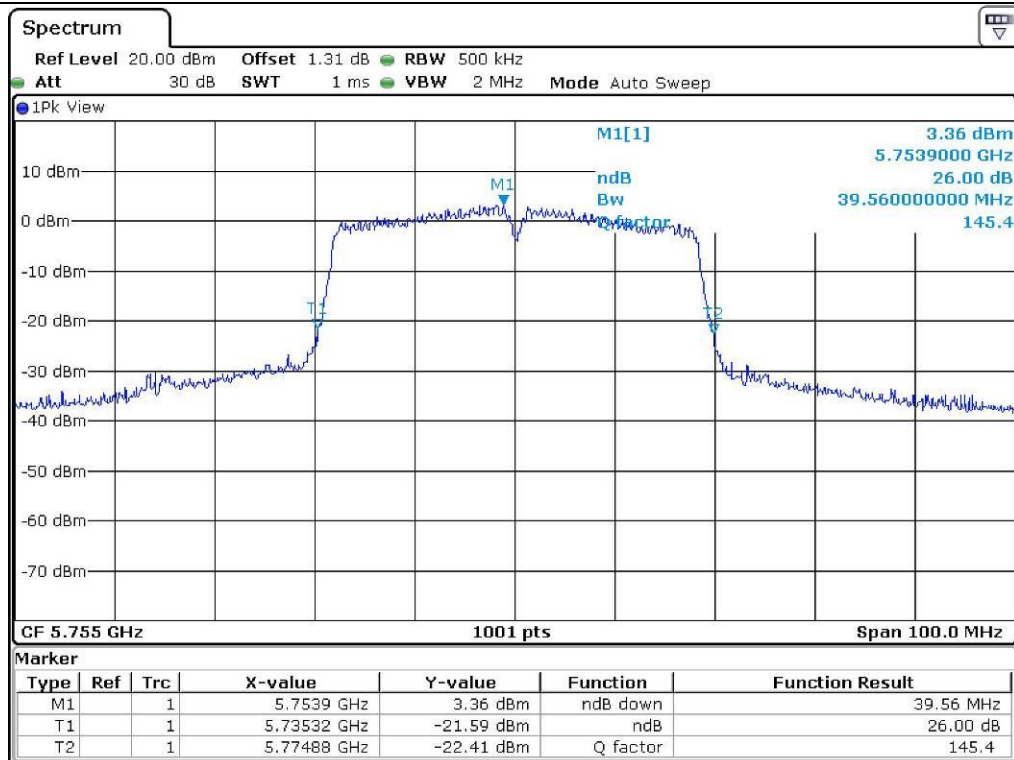
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

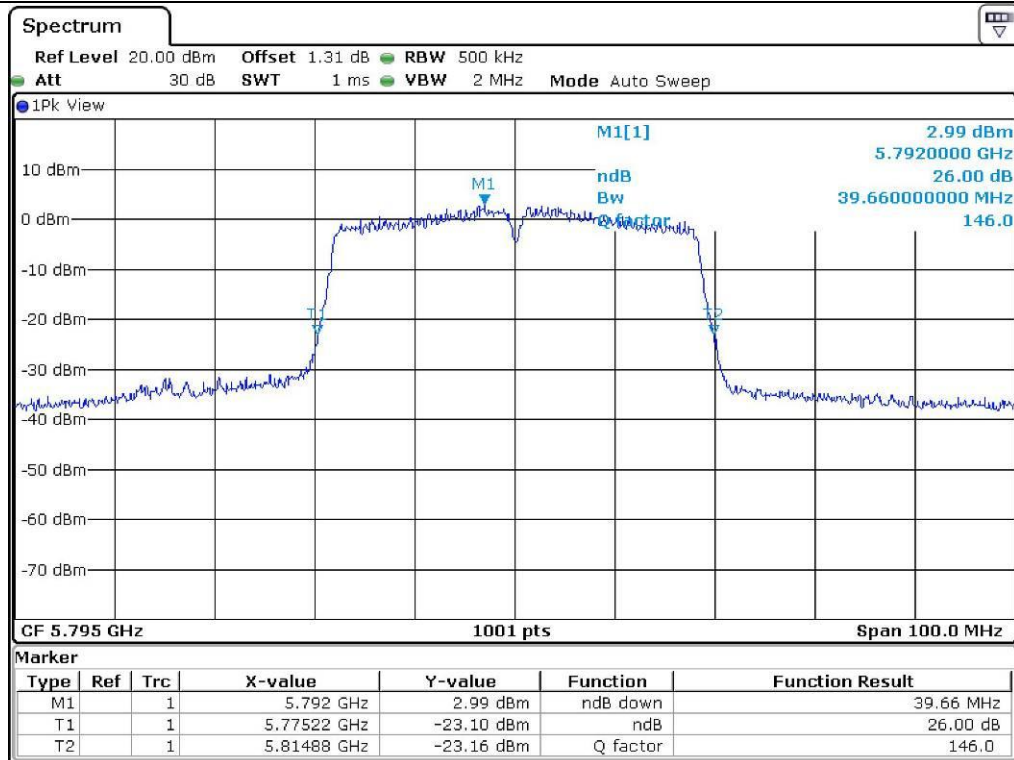
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(MHz) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Low     | 5 755.00           | 39.56                    |
|                          | High    | 5 795.00           | 39.66                    |



**Tested by: Hyung-Kwon, Oh / Assistant Manager**



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

## 7.7 Test data for 802.11ac\_VHT80 RLAN Mode

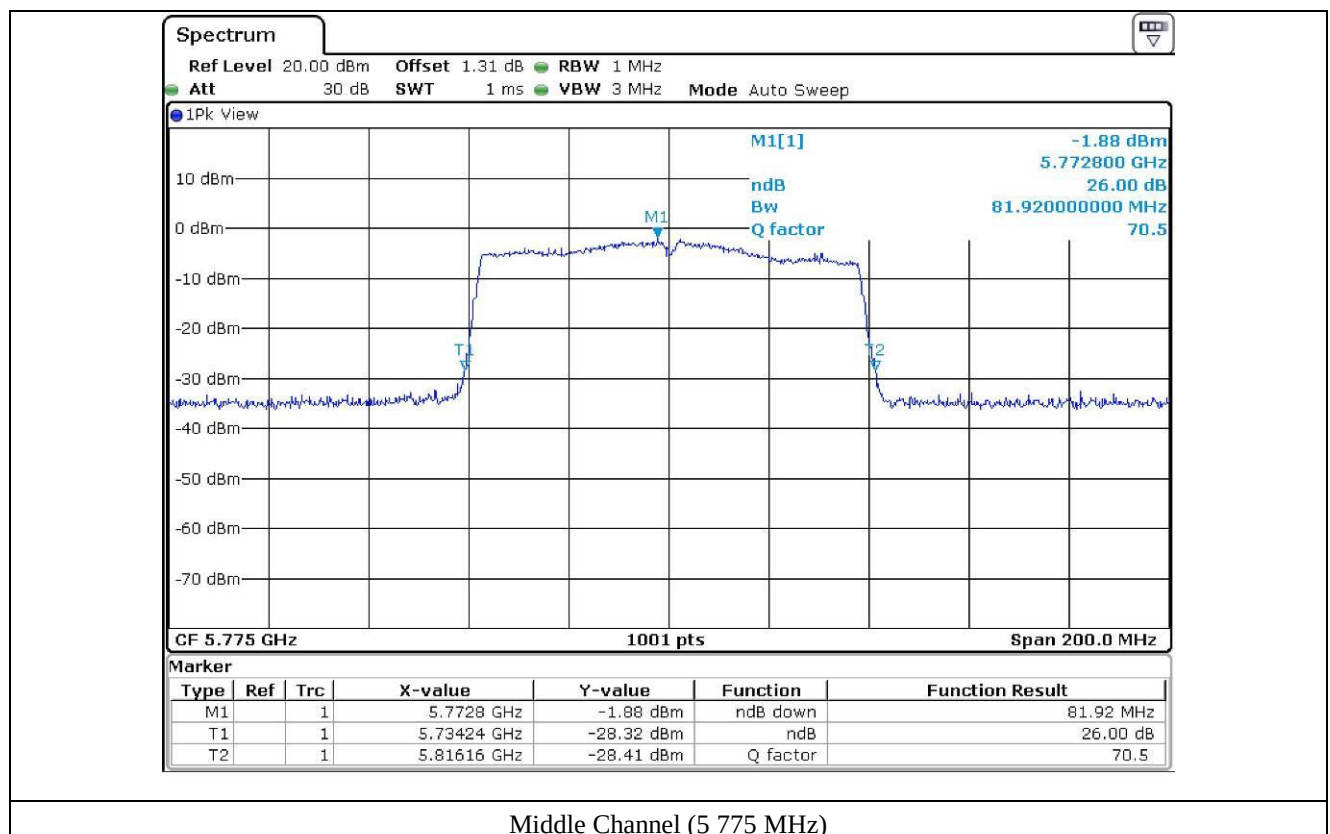
### 7.7.1 Test data for Antenna 0

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Middle  | 5 775.00           | 81.92                    |

Tested by: Hyung-Kwon, Oh / Assistant Manager



### 7.7.2 Test data for Antenna 1

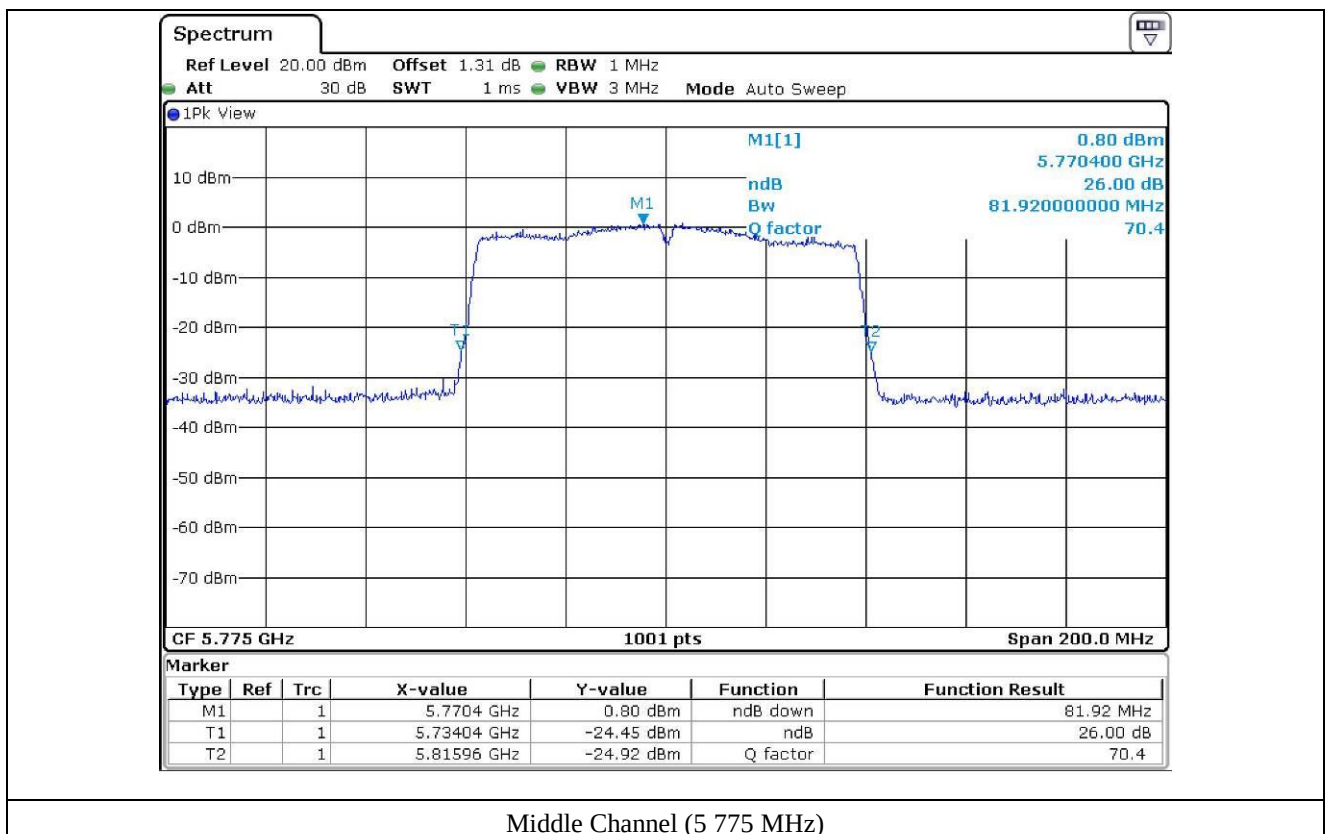
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 26 dB Bandwidth<br>(dBm) |
|--------------------------|---------|--------------------|--------------------------|
| 5 725 ~ 5 850            | Middle  | 5 775.00           | 81.92                    |



Tested by: Hyung-Kwon, Oh / Assistant Manager



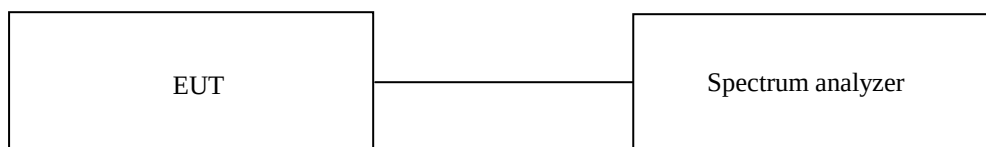
## 8. 6 dB BANDWIDTH

### 8.1 Operating environment

Temperature : 23 °C  
Relative humidity : 41 % R.H.

### 8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



### 8.3 Test equipment used

|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 8.4 Test data for 802.11a RLAN Mode

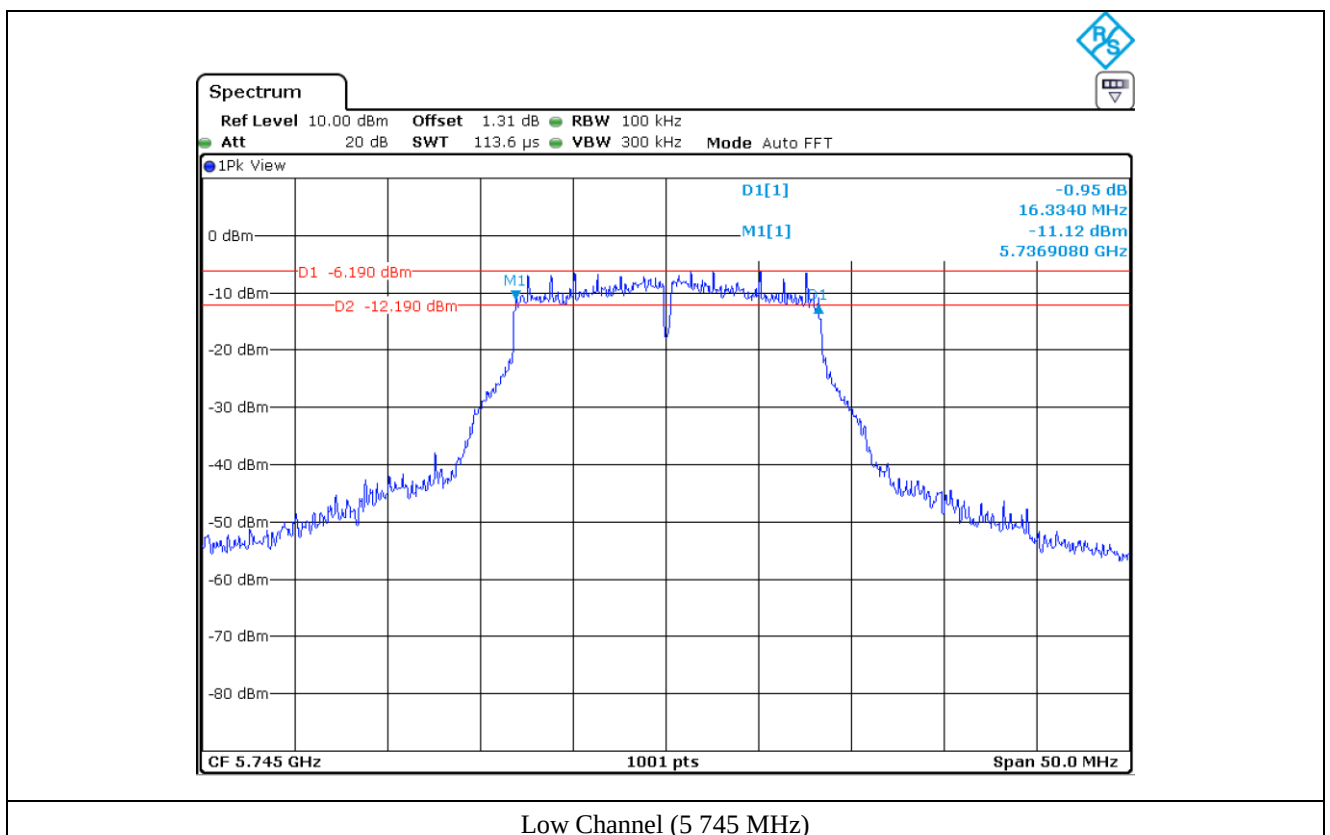
### 8.4.1 Test data for Antenna 0

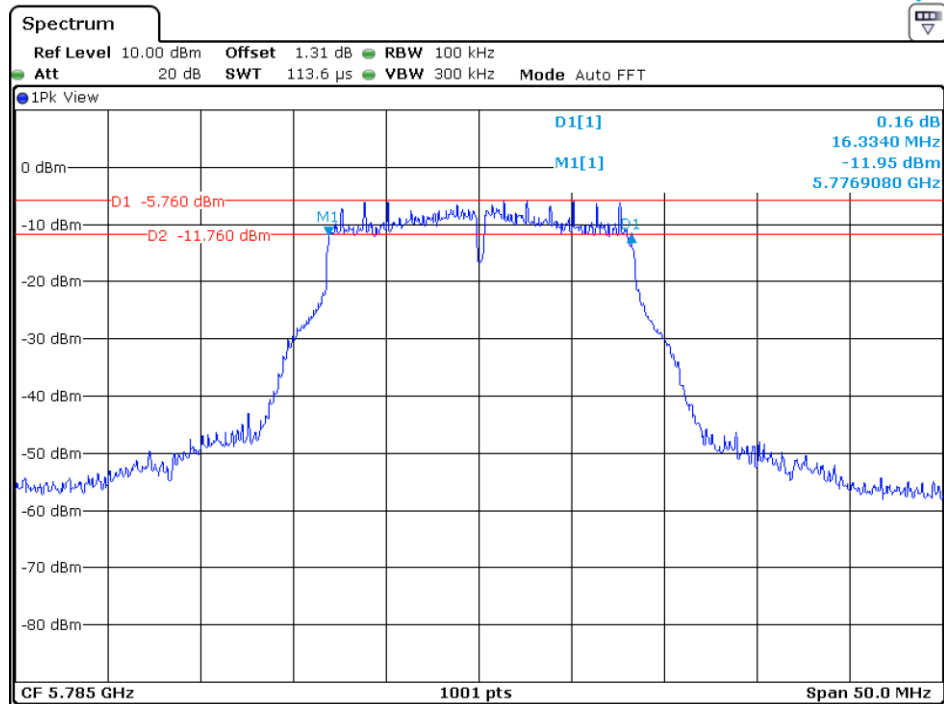
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

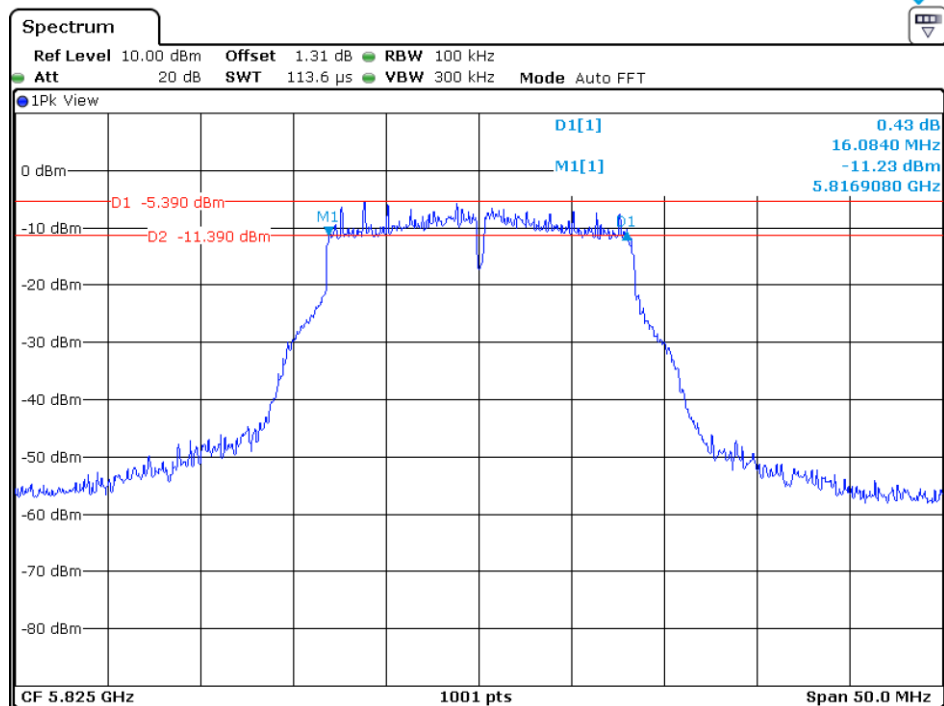
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 16.33                |
|                          | Middle  | 5 785.00           | 16.33                |
|                          | High    | 5 825.00           | 16.08                |

  
Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

### 8.4.2 Test data for Antenna 1

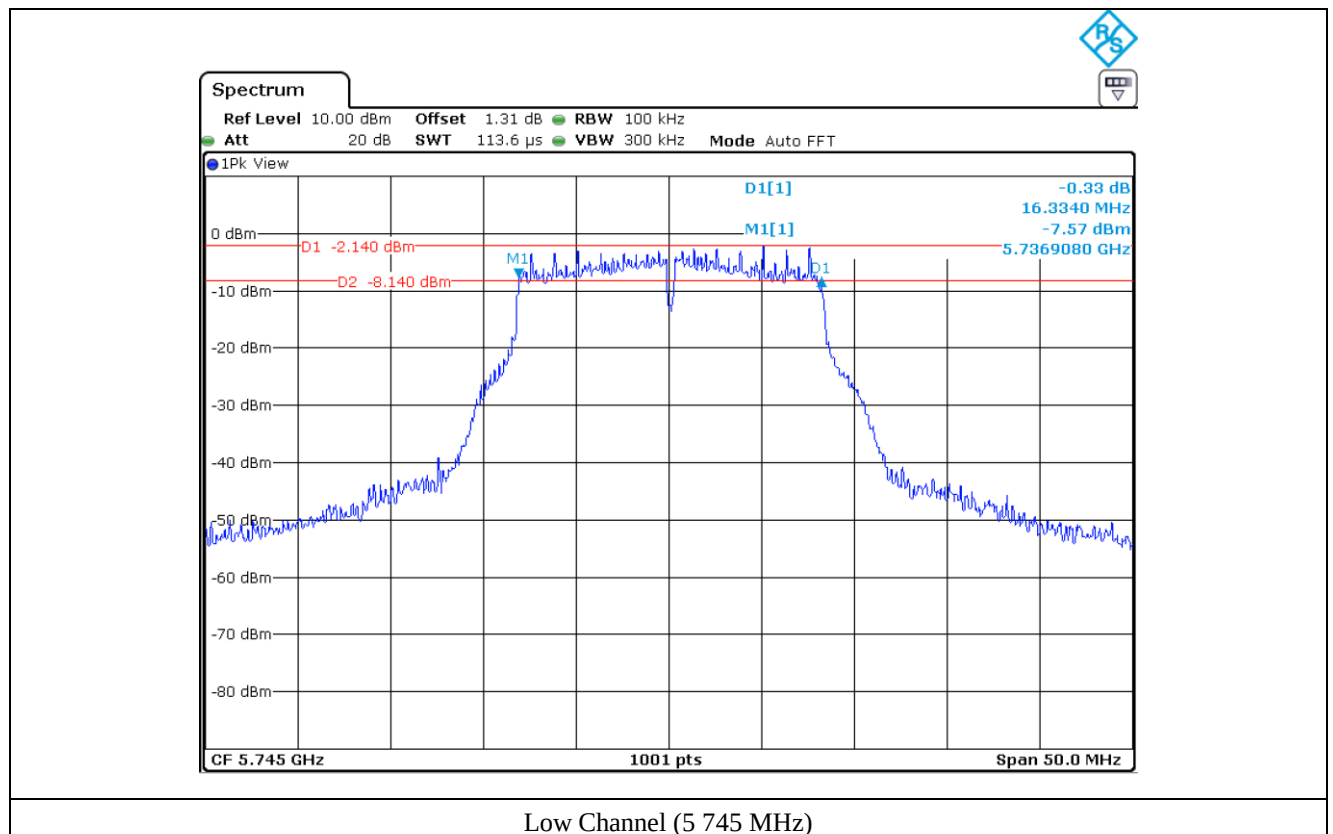
-. Test Date : June 20, 2019 ~ June 26, 2019

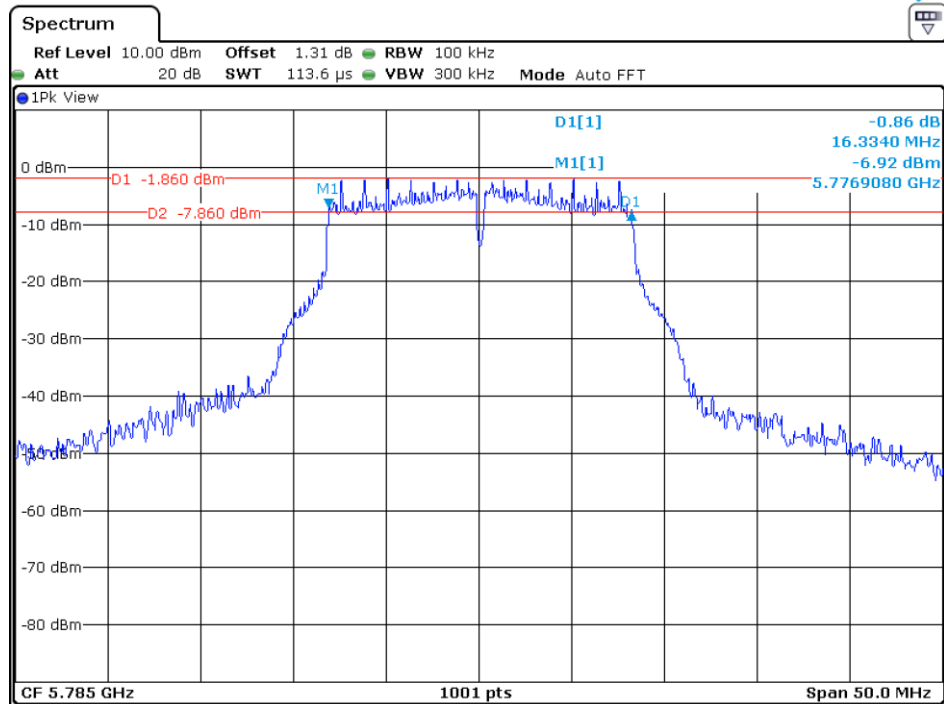
-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 16.33                |
|                          | Middle  | 5 785.00           | 16.33                |
|                          | High    | 5 825.00           | 16.33                |

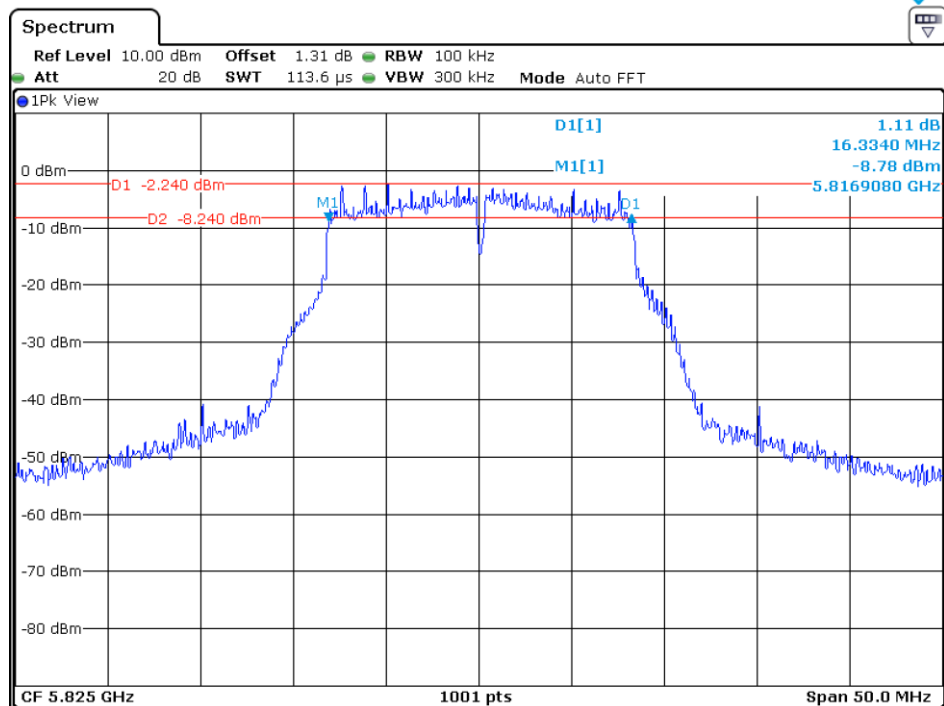


Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5.785 MHz)



High Channel (5.825 MHz)

## 8.5 Test data for 802.11n\_HT20 RLAN Mode

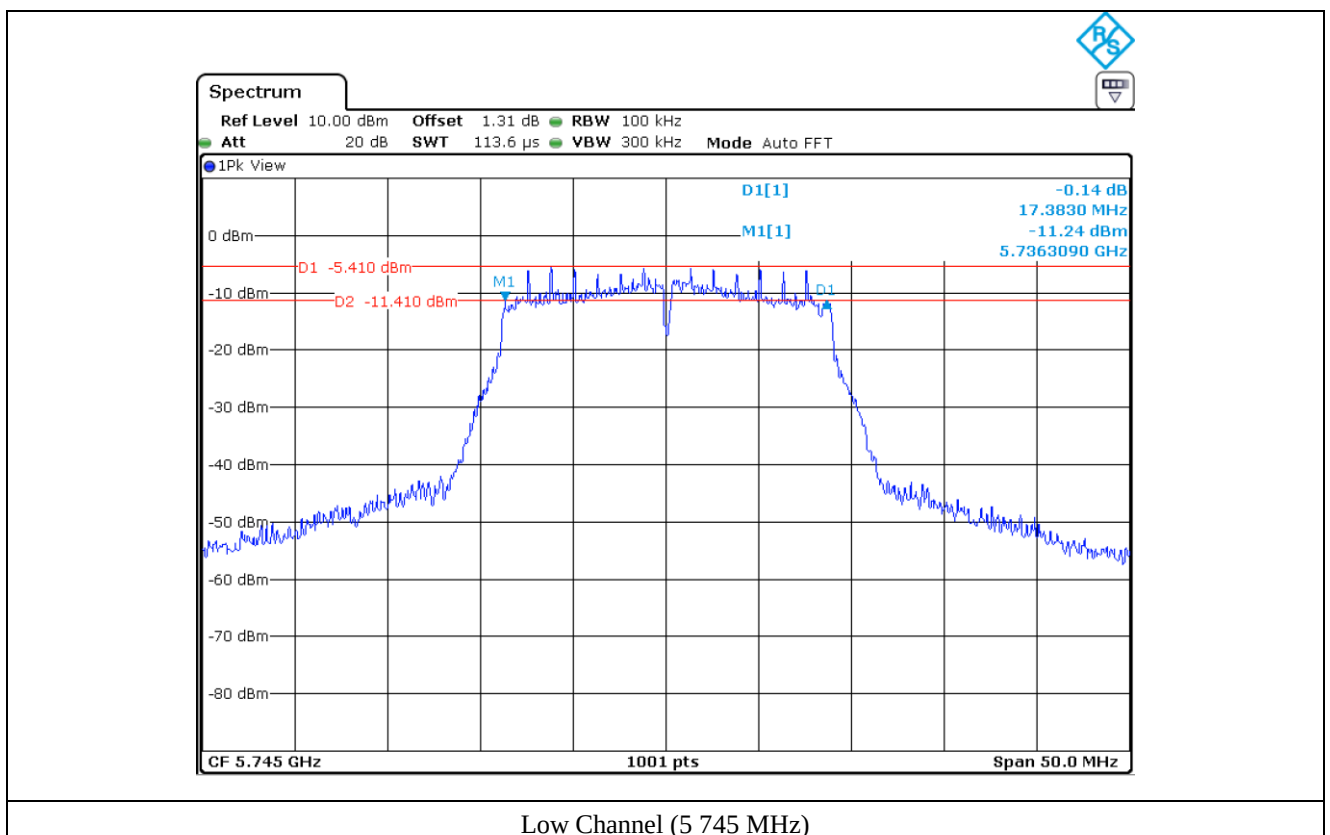
### 8.5.1 Test data for Antenna 0

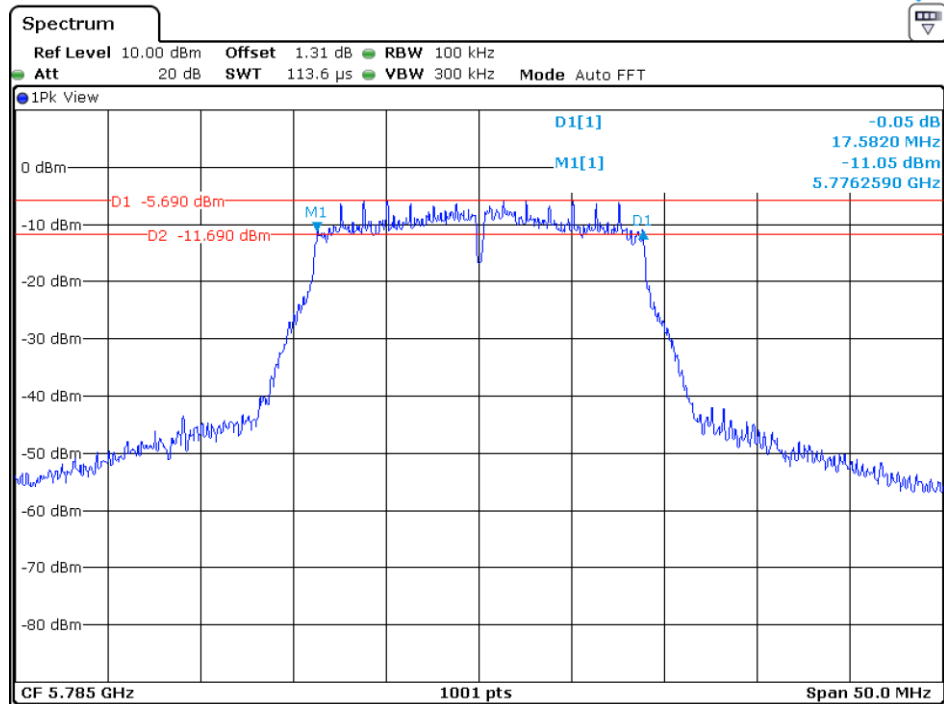
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

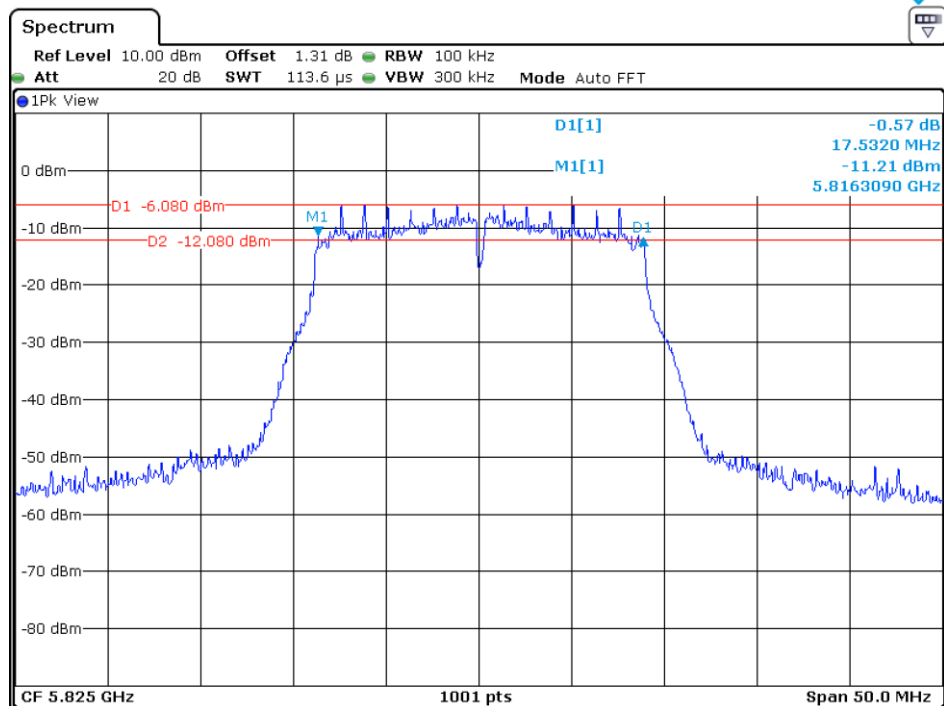
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 17.38                |
|                          | Middle  | 5 785.00           | 17.58                |
|                          | High    | 5 825.00           | 17.53                |

  
Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

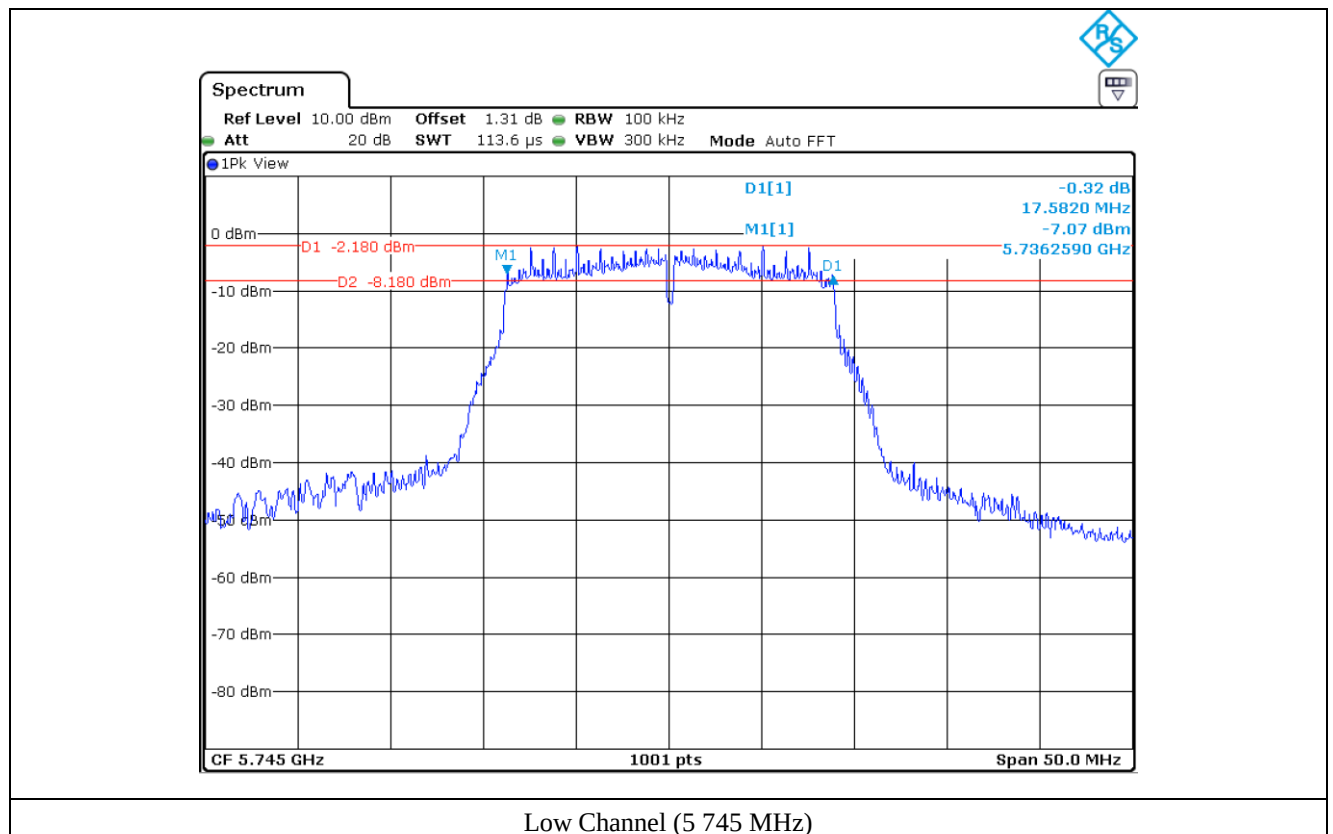
### 8.5.2 Test data for Antenna 1

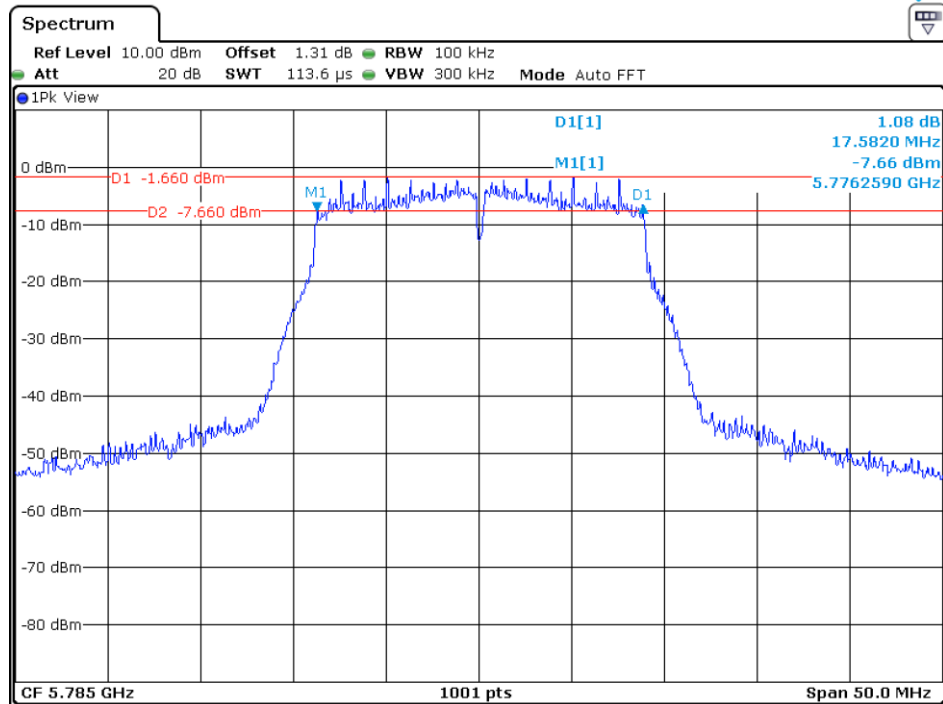
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

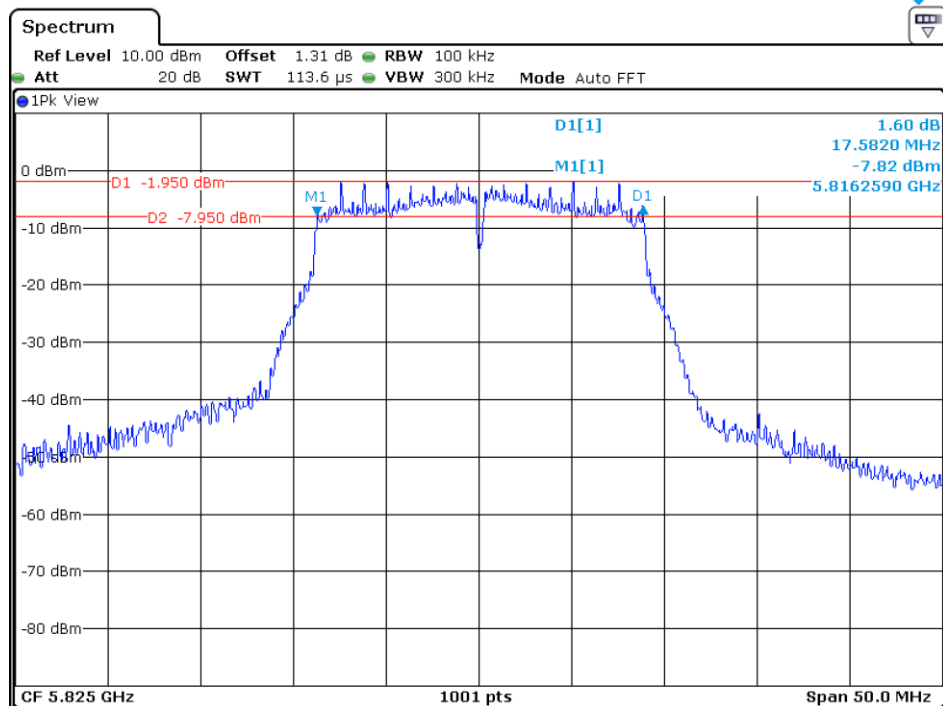
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 745.00           | 17.58                |
|                          | Middle  | 5 785.00           | 17.58                |
|                          | High    | 5 825.00           | 17.58                |

Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5.785 MHz)



High Channel (5.825 MHz)

## 8.6 Test data for 802.11n\_HT40 RLAN Mode

### 8.6.1 Test data for Antenna 0

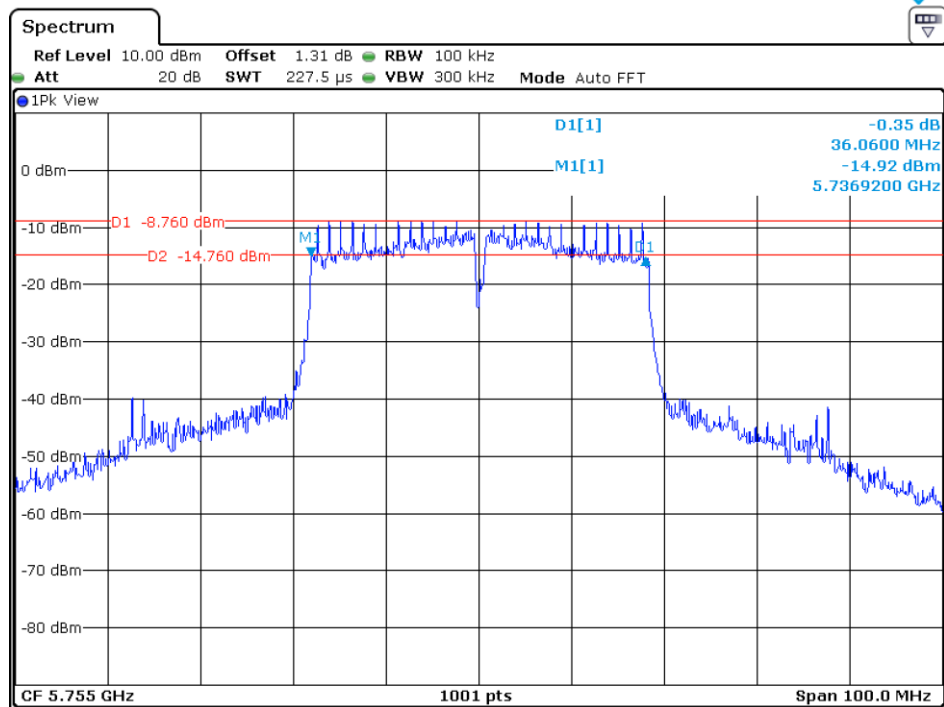
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

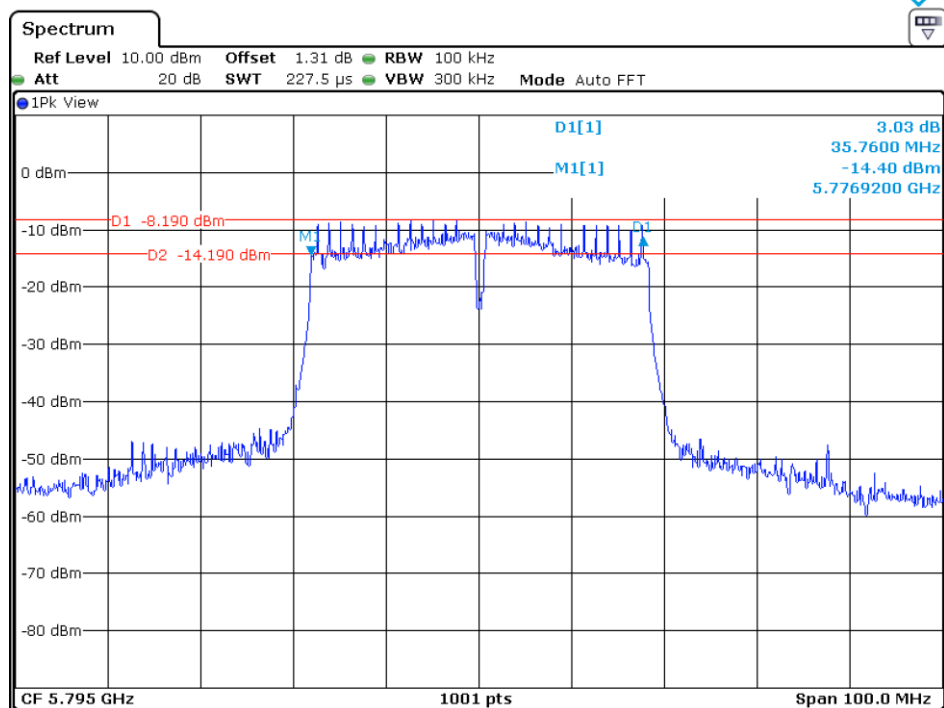
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 755.00           | 36.06                |
|                          | High    | 5 795.00           | 35.76                |



Tested by: Hyung-Kwon, Oh / Engineer



Low Channel (5.755 MHz)



High Channel (5.795 MHz)

### 8.6.2 Test data for Antenna 1

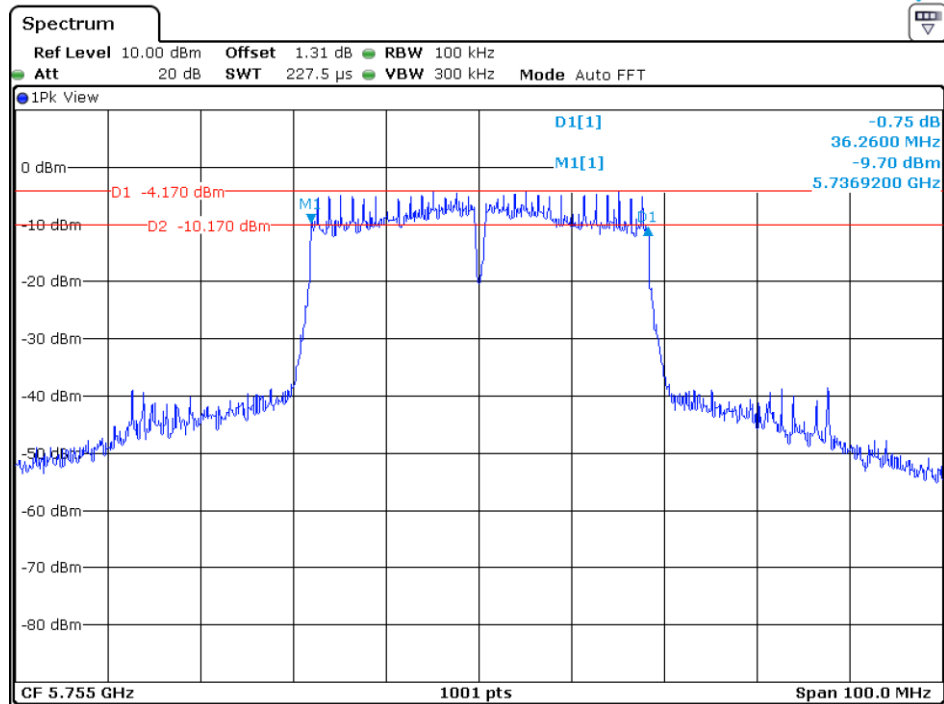
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

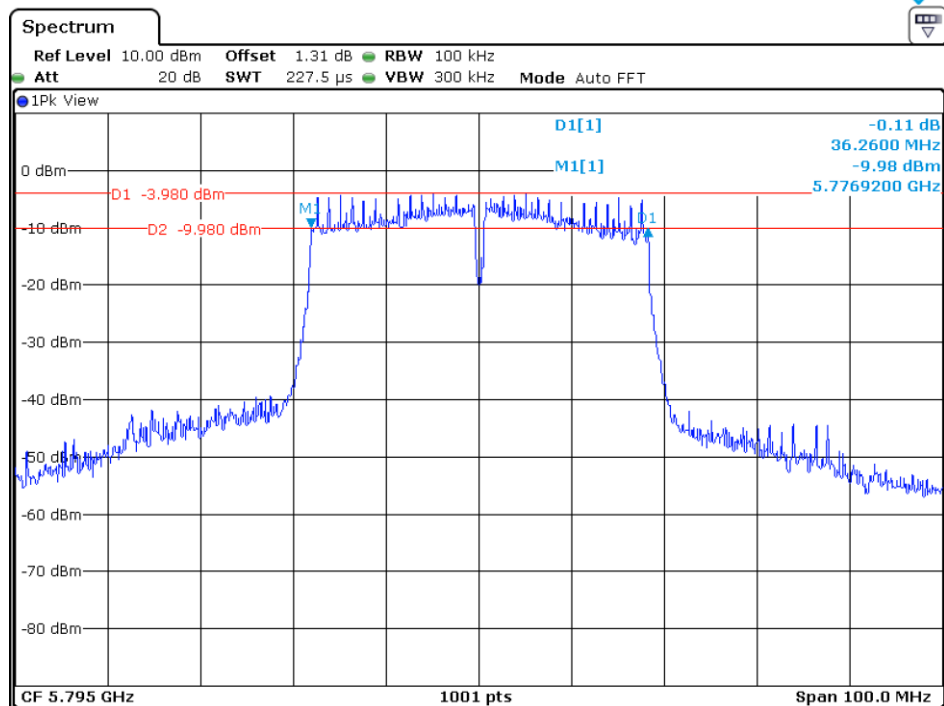
| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Low     | 5 755.00           | 36.26                |
|                          | High    | 5 795.00           | 36.26                |



Tested by: Hyung-Kwon, Oh / Engineer



Low Channel (5.755 MHz)



High Channel (5.795 MHz)

## 8.7 Test data for 802.11ac\_VHT80 RLAN Mode

### 8.7.1 Test data for Antenna 0

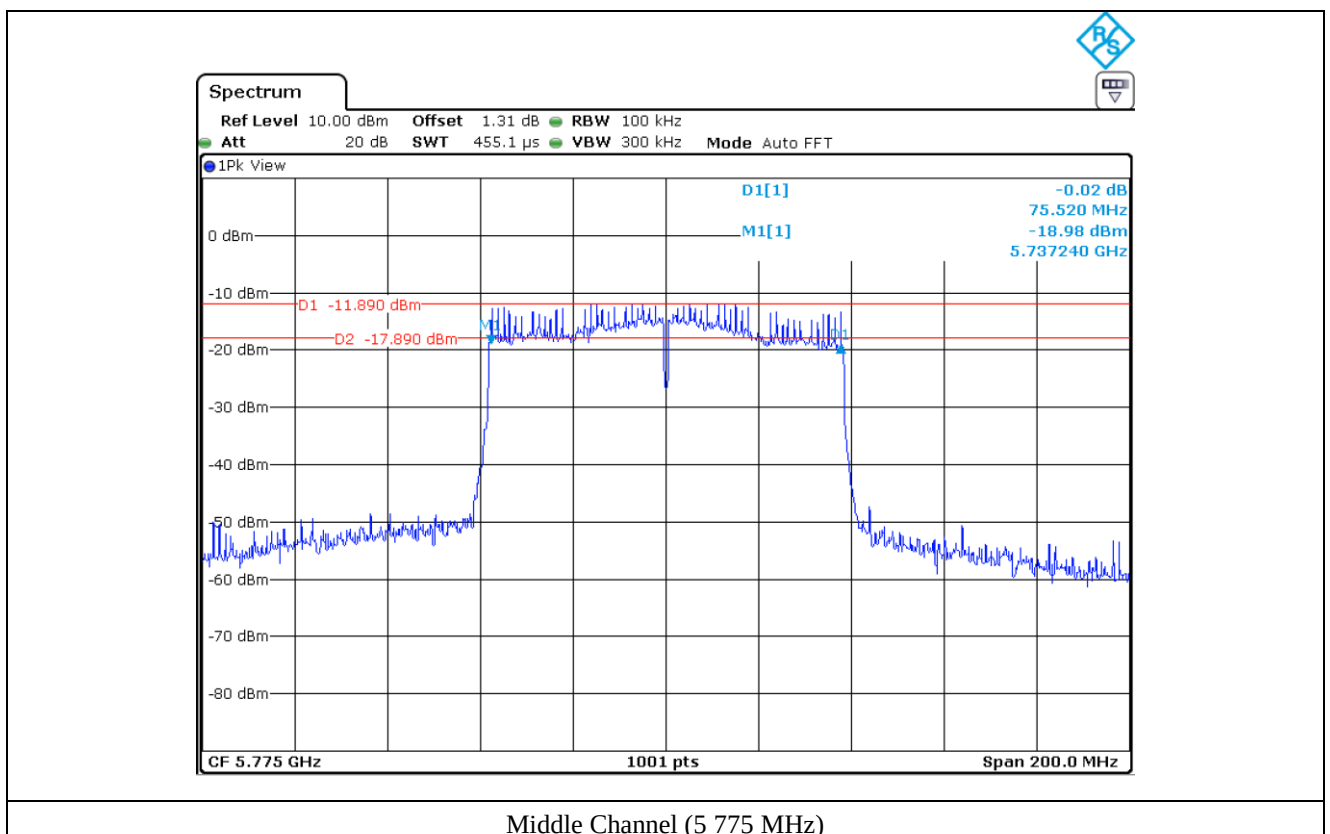
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Middle  | 5 775.00           | 75.52                |



Tested by: Hyung-Kwon, Oh / Assistant Manager



### 8.7.2 Test data for Antenna 1

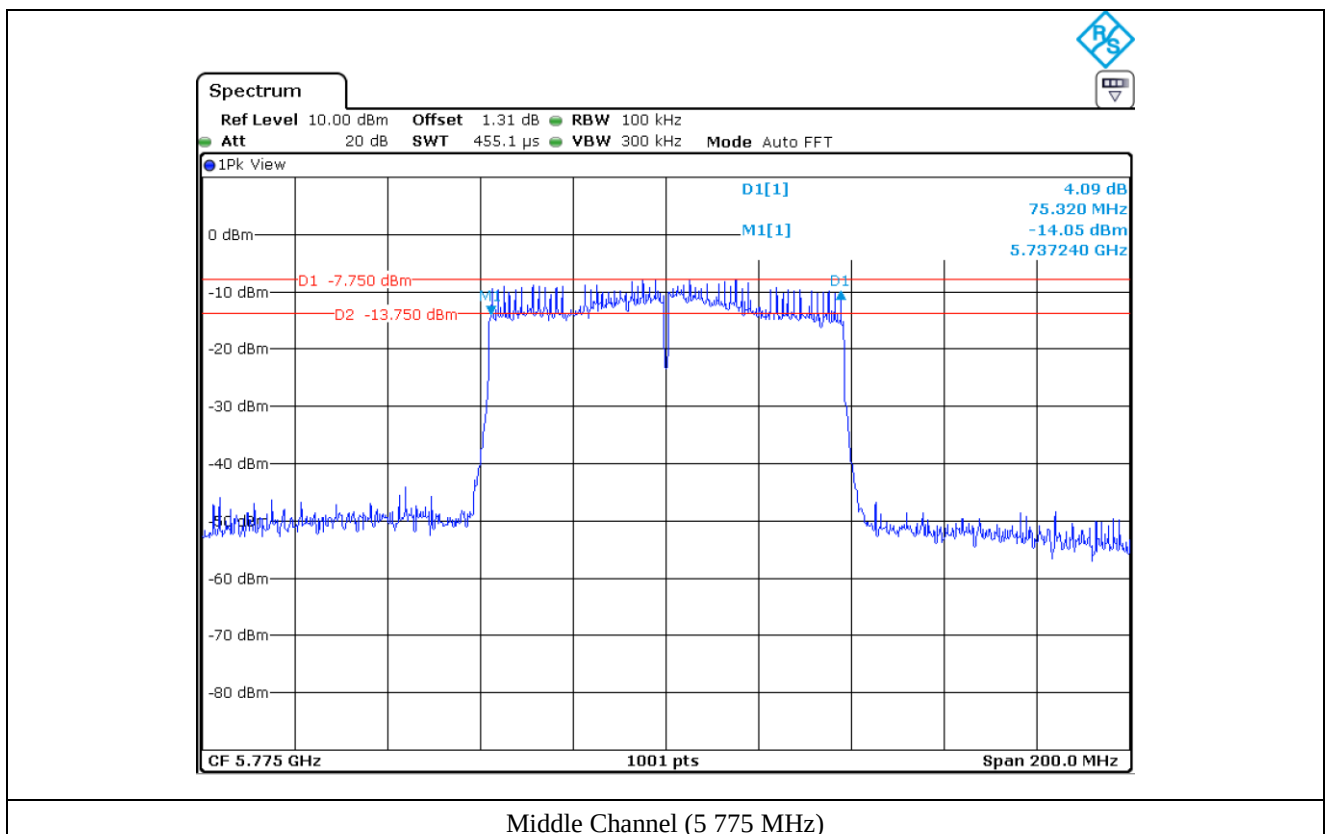
-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

| FREQUENCY RANGE<br>(MHz) | CHANNEL | FREQUENCY<br>(MHz) | 6 dB Bandwidth (dBm) |
|--------------------------|---------|--------------------|----------------------|
| 5 725 ~ 5 850            | Middle  | 5 775.00           | 75.32                |



Tested by: Hyung-Kwon, Oh / Assistant Manager



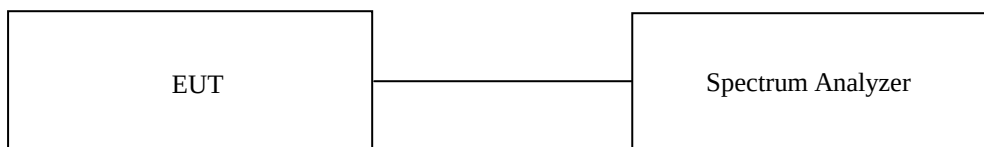
## 9. MAXIMUM PEAK OUTPUT POWER

### 9.1 Operating environment

Temperature : 22 °C  
Relative humidity : 41 % R.H.

### 9.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over at a minimum, either the EBW or the 99% occupied bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



### 9.3 Test equipment used

|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 9.4 Test data for 802.11a RLAN Mode

### 9.4.1 Test data for Antenna 0

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 91.50 %

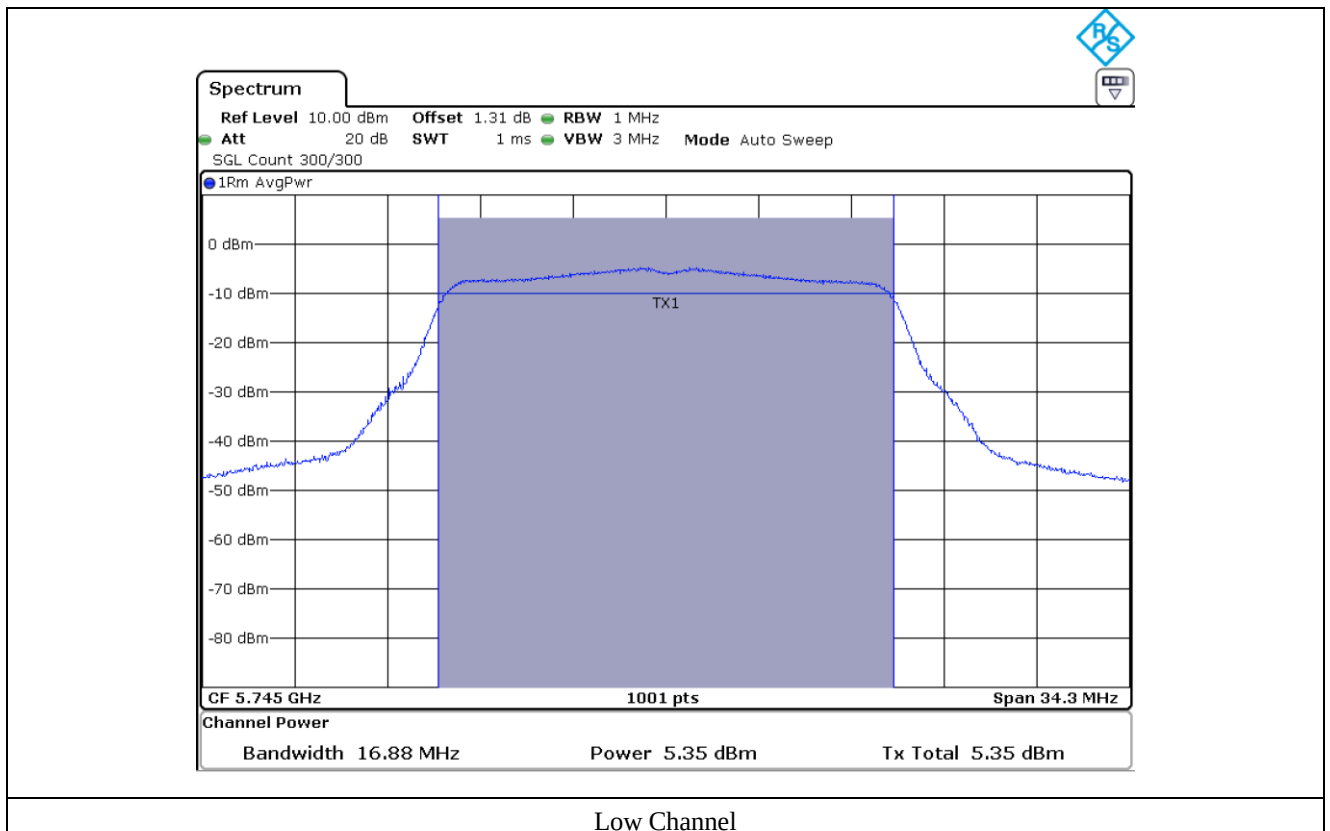
| FREQUENCY RANGE (MHz) | CHANNEL | FREQUENCY (MHz) | MEASURED VALUE (dBm) | Correction Factor (dB) | Result (dBm) | LIMIT (dBm) | MARGIN (dB) |
|-----------------------|---------|-----------------|----------------------|------------------------|--------------|-------------|-------------|
| 5 725 ~ 5 850         | Low     | 5 745.00        | 5.35                 | 0.39                   | 5.74         | 30.00       | 24.26       |
|                       | Middle  | 5 785.00        | 5.89                 | 0.39                   | 6.28         | 30.00       | 23.72       |
|                       | High    | 5 825.00        | 5.50                 | 0.39                   | 5.89         | 30.00       | 24.11       |

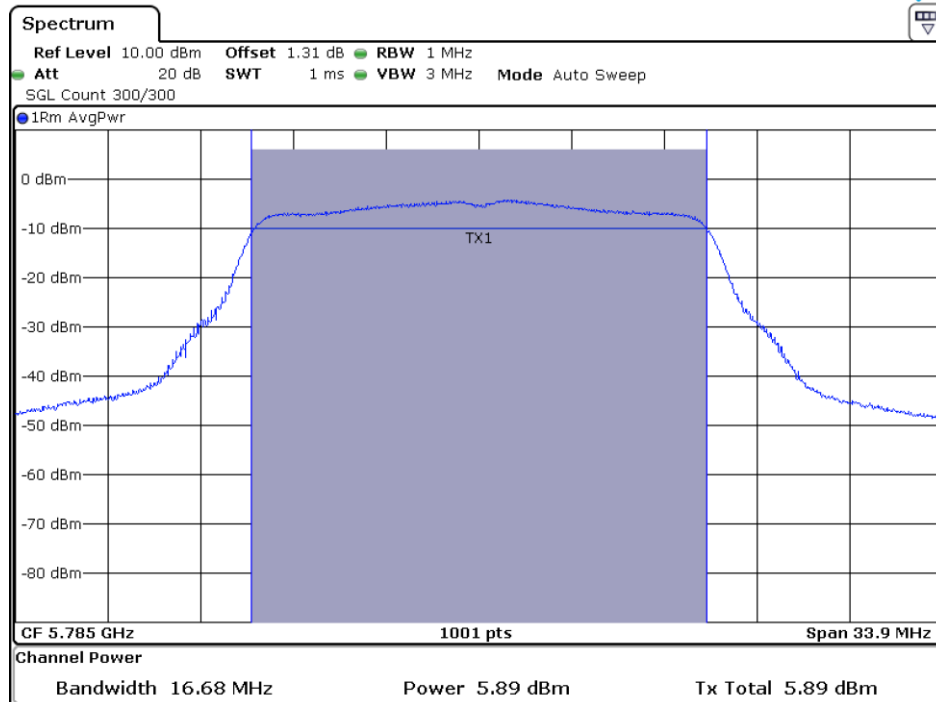
Remark :  $\text{Margin(dB)} = \text{Limit(dBm)} - \text{Result(dBm)}$

$\text{Result(dBm)} = \text{Measured Value} + \text{Correction Factor}$

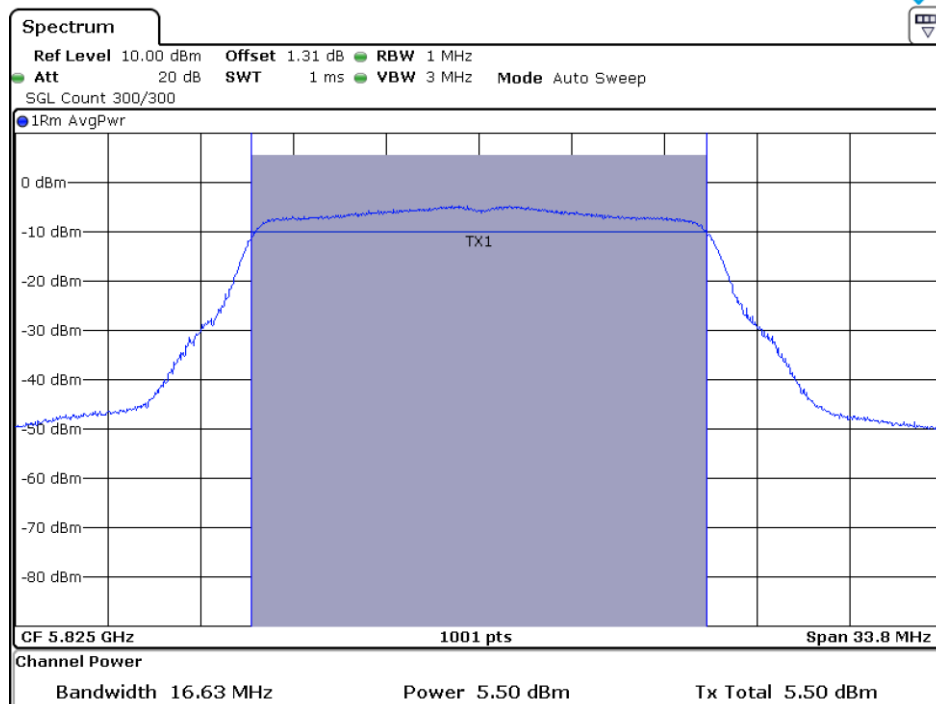


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

### 9.4.2 Test data for Antenna 1

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 91.50 %

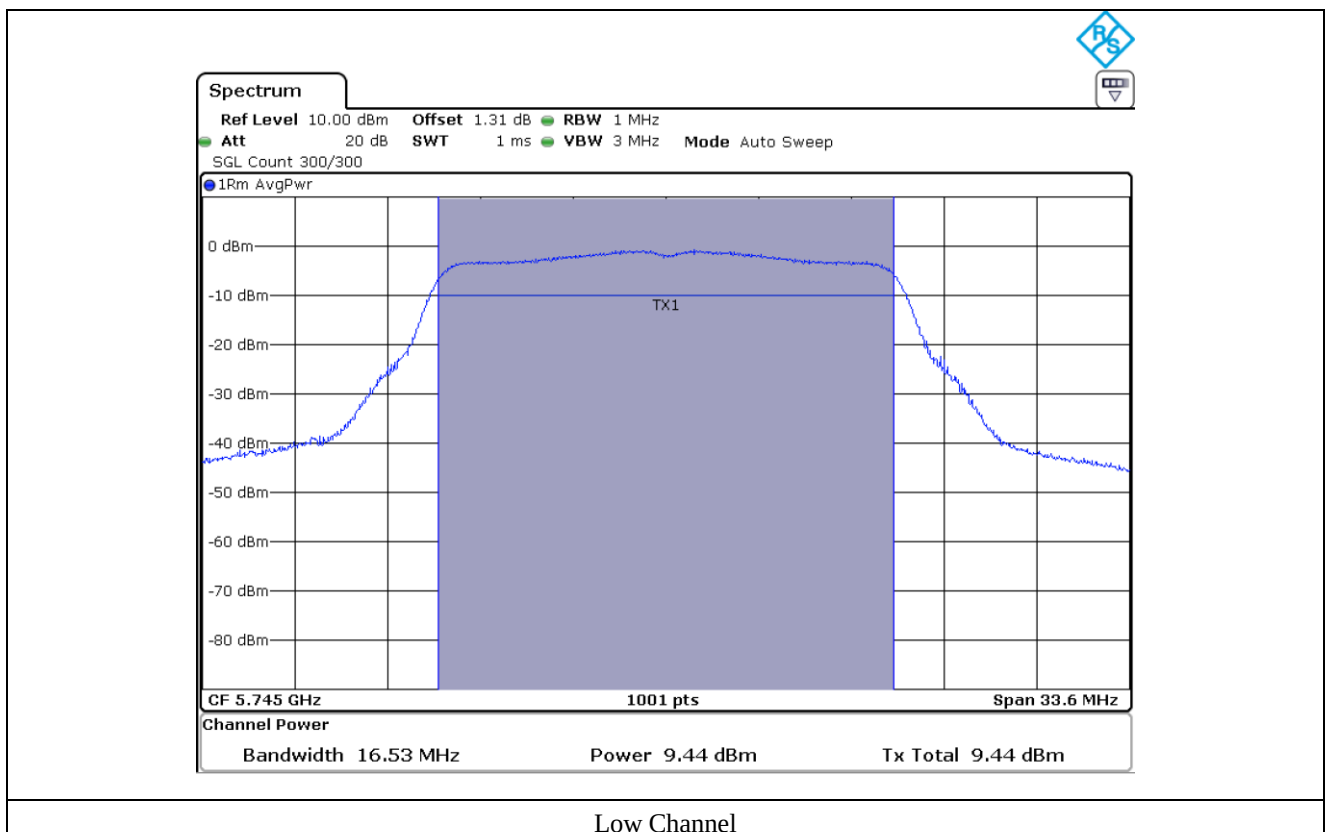
| FREQUENCY RANGE (MHz) | CHANNEL | FREQUENCY (MHz) | MEASURED VALUE (dBm) | Correction Factor (dB) | Result (dBm) | LIMIT (dBm) | MARGIN (dB) |
|-----------------------|---------|-----------------|----------------------|------------------------|--------------|-------------|-------------|
| 5 725 ~ 5 850         | Low     | 5 745.00        | 9.44                 | 0.39                   | 9.83         | 30.00       | 20.17       |
|                       | Middle  | 5 785.00        | 9.68                 | 0.39                   | 10.07        | 30.00       | 19.93       |
|                       | High    | 5 825.00        | 9.36                 | 0.39                   | 9.75         | 30.00       | 20.25       |

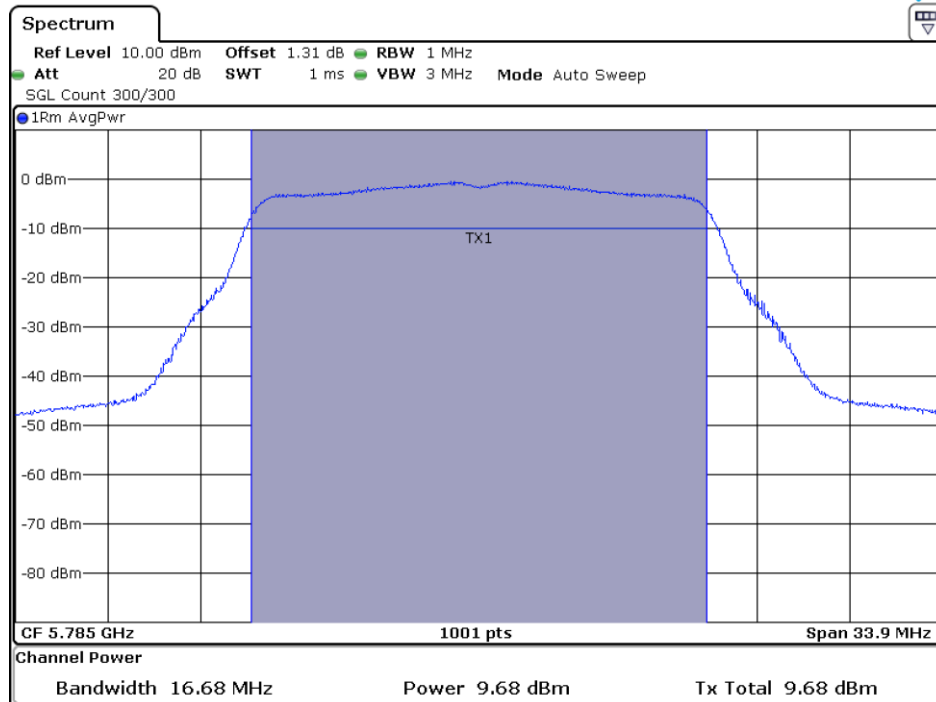
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

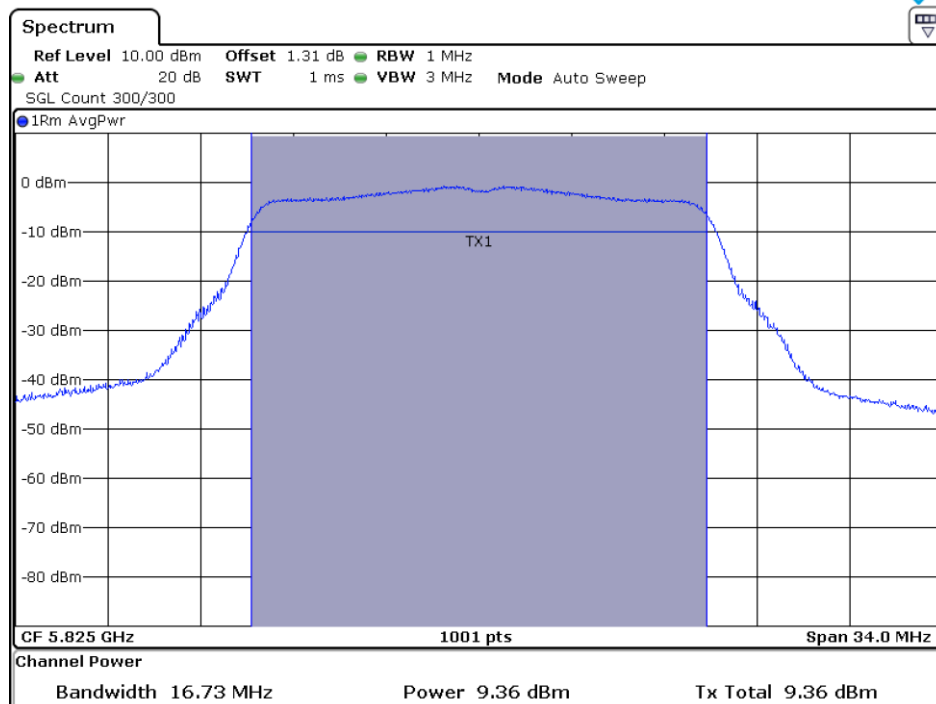


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

## 9.5 Test data for 802.11n\_HT20 RLAN Mode

### 9.5.1 Test data for Antenna 0

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 84.28 %

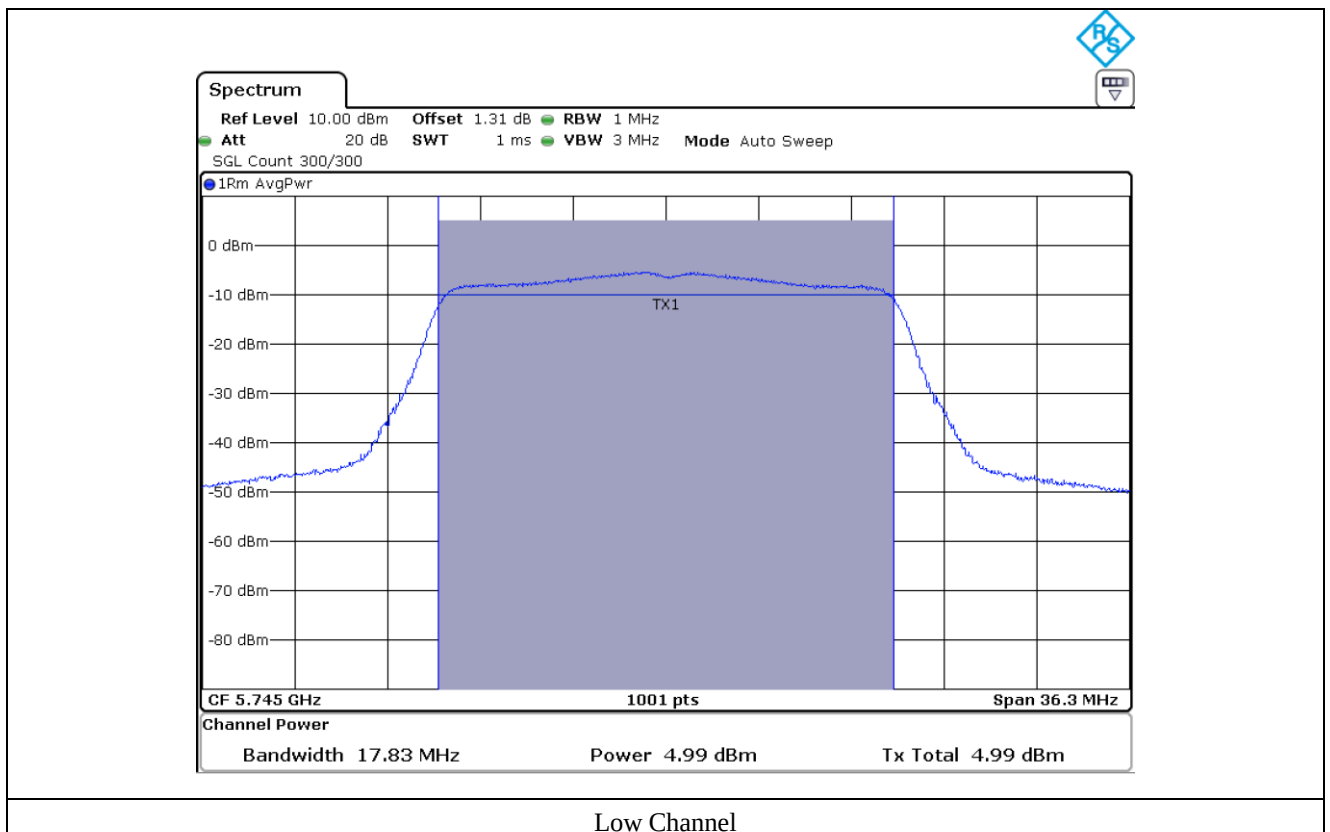
| FREQUENCY RANGE (MHz) | CHANNEL | FREQUENCY (MHz) | MEASURED VALUE (dBm) | Correction Factor (dB) | Result (dBm) | LIMIT (dBm) | MARGIN (dB) |
|-----------------------|---------|-----------------|----------------------|------------------------|--------------|-------------|-------------|
| 5 725 ~ 5 850         | Low     | 5 745.00        | 4.99                 | 0.74                   | 5.73         | 30.00       | 24.27       |
|                       | Middle  | 5 785.00        | 5.48                 | 0.74                   | 6.22         | 30.00       | 23.78       |
|                       | High    | 5 825.00        | 5.16                 | 0.74                   | 5.90         | 30.00       | 24.10       |

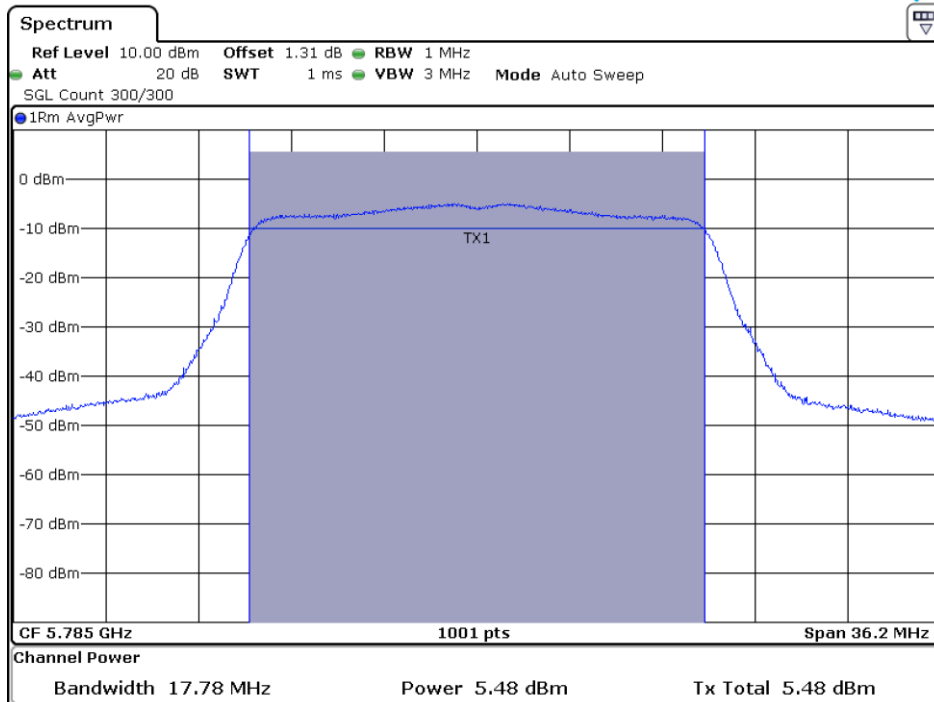
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

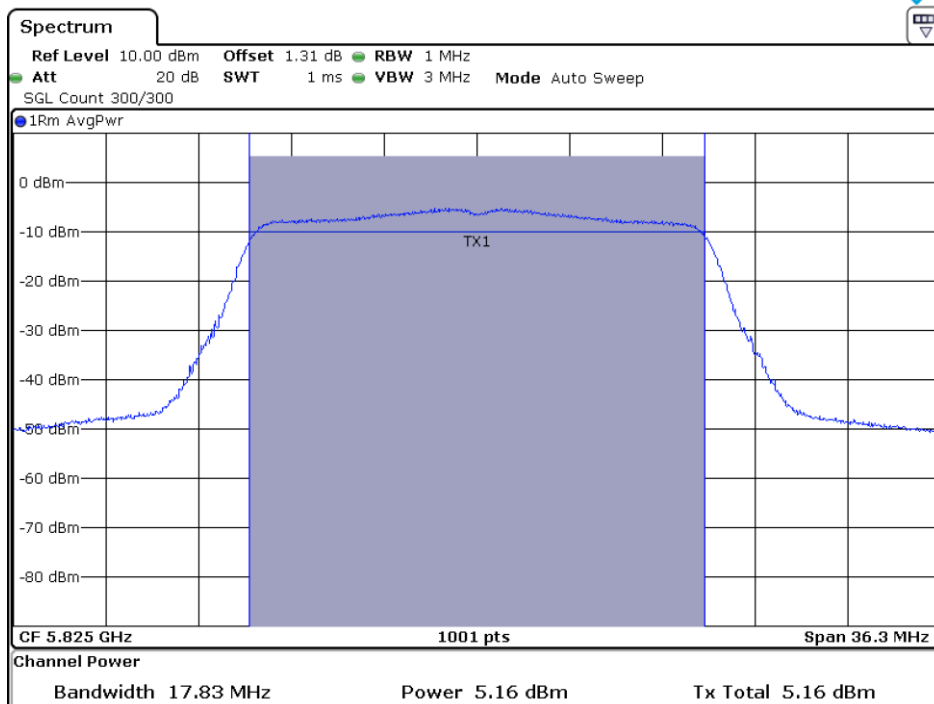


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

### 9.5.2 Test data for Antenna 1

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 84.28 %

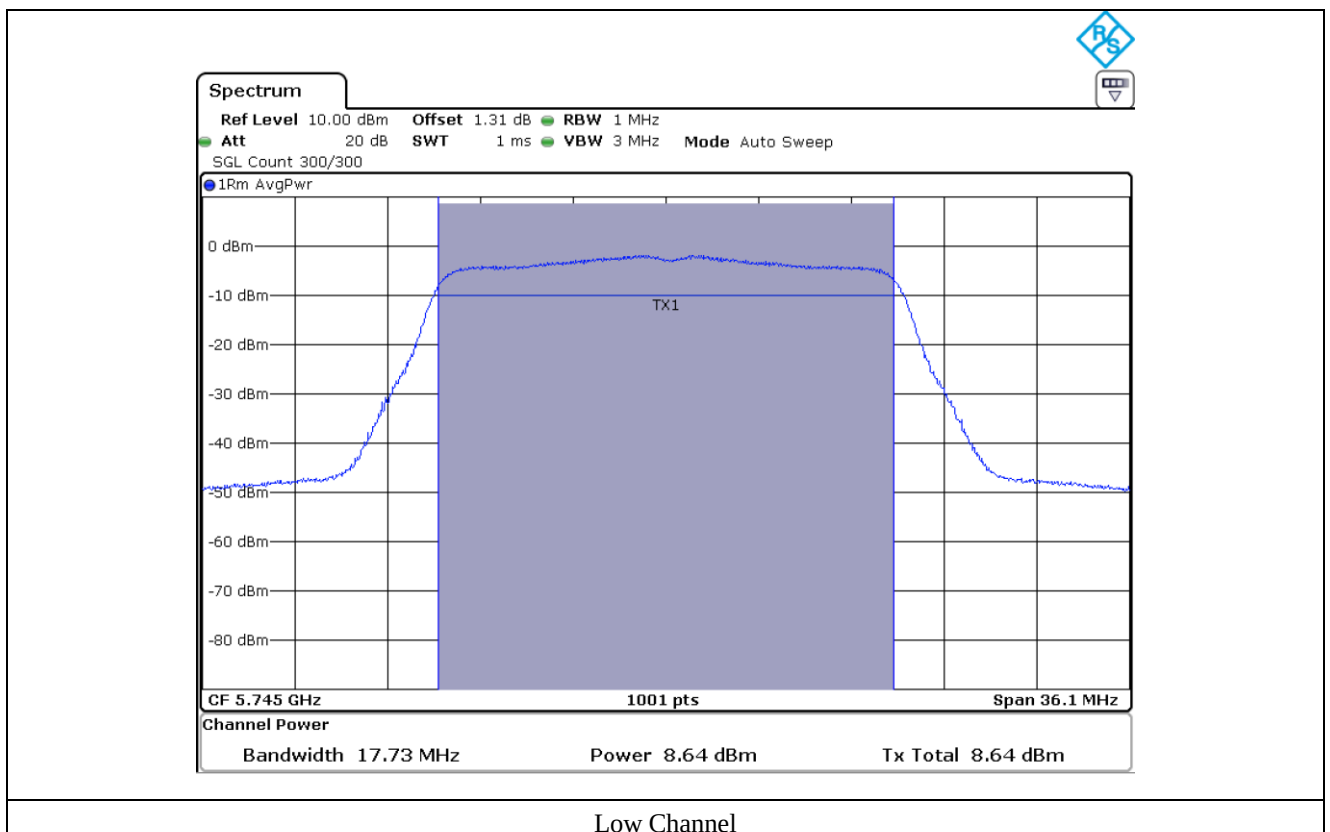
| FREQUENCY RANGE (MHz) | CHANNEL | FREQUENCY (MHz) | MEASURED VALUE (dBm) | Correction Factor (dB) | Result (dBm) | LIMIT (dBm) | MARGIN (dB) |
|-----------------------|---------|-----------------|----------------------|------------------------|--------------|-------------|-------------|
| 5 725 ~ 5 850         | Low     | 5 745.00        | 8.64                 | 0.74                   | 9.38         | 30.00       | 20.62       |
|                       | Middle  | 5 785.00        | 9.25                 | 0.74                   | 9.99         | 30.00       | 20.01       |
|                       | High    | 5 825.00        | 9.01                 | 0.74                   | 9.75         | 30.00       | 20.25       |

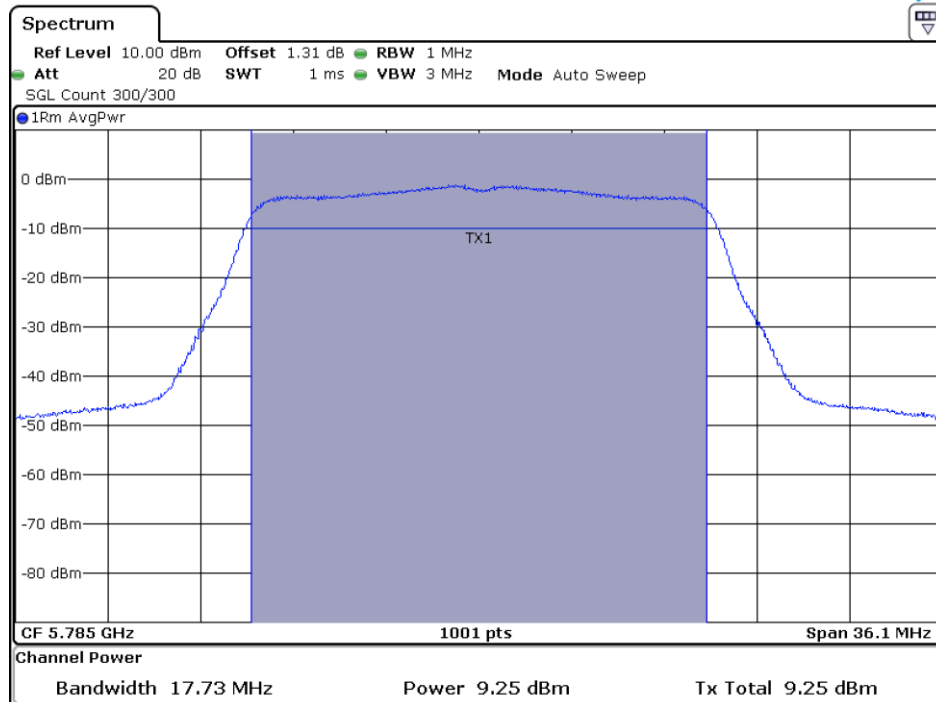
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

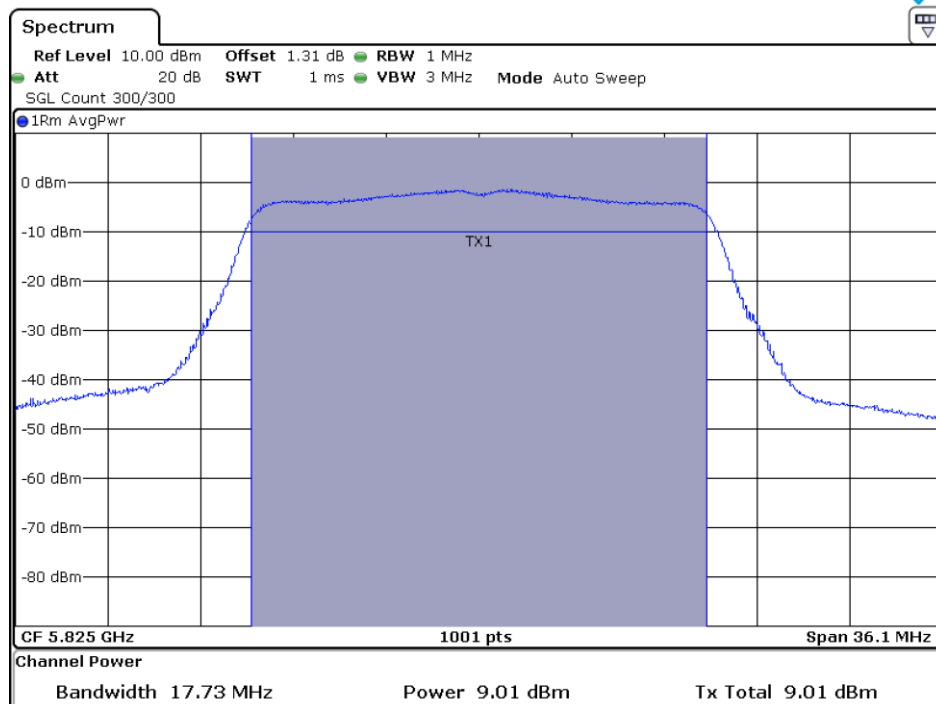


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

### 9.5.3 Test data for Multiple Transmit

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 84.28 %

| FREQUENCY RANGE (MHz) | CHANNEL | FREQUENCY (MHz) | MEASURED VALUE (dBm) | Correction Factor (dB) | Result (dBm) | LIMIT (dBm) | MARGIN (dB) |
|-----------------------|---------|-----------------|----------------------|------------------------|--------------|-------------|-------------|
| 5 725 ~ 5 850         | Low     | 5 745.00        | 10.20                | 0.74                   | 10.94        | 30.00       | 19.06       |
|                       | Middle  | 5 785.00        | 10.77                | 0.74                   | 11.51        | 30.00       | 18.49       |
|                       | High    | 5 825.00        | 10.51                | 0.74                   | 11.25        | 30.00       | 18.75       |

Remark 1: Margin = Limit – Result(= Measured Value + Correction Factor)

Remark 2: Calculated Output Power=  $10\log(10^{(\text{Antenna0 Output Power}/10)} + 10^{(\text{Antenna1 Output Power}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager