

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

**Test Report No.** : W178R-D011  
**AGR No.** : A178A-003  
**Applicant** : LG Innotek Co., Ltd.  
**Address** : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea  
**Manufacturer** : LG Innotek Co., Ltd.  
**Address** : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea  
**Type of Equipment** : 802.11 a/b/g/n/ac WiFi Module  
**FCC ID.** : YZP-TWFMR003D  
**Model Name** : TWFM-R003D  
**Multiple Model Name** : TWFM-R003D(A)  
**Serial number** : N/A  
**Total page of Report** : 136 pages (including this page)  
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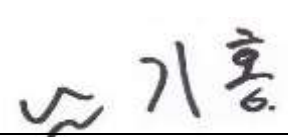
## SUMMARY

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.

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### REVISION HISTORY

Issued Report No.	Issued Date	Revisions	Effect Section
W178R-D011	August 07, 2017	Initial Issue	All

### 1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.  
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 FCC ID : YZP-TWFMR003D  
 Model Name : TWFM-R003D  
 Serial Number : N/A  
 Date : August 07, 2017

EQUIPMENT CLASS	Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Modular Transmitter, 802.11 a/b/g/n/ac WiFi Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART E Section 15.407 KDB 789033 D01 General UNII Test Procedures
Modifications on the Equipment to 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-4617/ 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 Innotek Co., Ltd., Model TWFM-R003D (referred to as the EUT in this report) is a 802.11 a/b/g/n/ac WiFi Module. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	802.11 a/b/g/n/ac WiFi Module		
Operating Frequency	WLAN	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
	2.4 GHz Band	2 422 MHz ~ 2 452 MHz (802.11n(HT40))	
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
			5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
		5 725 MHz ~ 5 850 MHz Band	5 210 MHz (802.11ac(VHT80))
			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))	
RF Output Power	WLAN 2.4 GHz Band	Antenna 0	Wi-Fi 802.11b (13.19 dBm) Wi-Fi 802.11g (12.53 dBm) Wi-Fi 802.11n(HT20) (11.20 dBm) Wi-Fi 802.11n(HT40) (11.16 dBm)
		Antenna 1	Wi-Fi 802.11b (14.32 dBm) Wi-Fi 802.11g (12.84 dBm) Wi-Fi 802.11n(HT20) (10.83 dBm) Wi-Fi 802.11n(HT40) (10.77 dBm)
		Antenna 0 + Antenna 1	Wi-Fi 802.11b (16.80 dBm) Wi-Fi 802.11g (15.57 dBm) Wi-Fi 802.11n(HT20) (13.99 dBm) Wi-Fi 802.11n(HT40) (13.98 dBm)

RF Output Power	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (10.03 dBm) Wi-Fi 802.11n(HT20) (7.77 dBm) Wi-Fi 802.11n(HT40) (7.80 dBm) Wi-Fi 802.11ac(HT80) (6.25 dBm)
			Antenna 1	Wi-Fi 802.11a (10.14 dBm) Wi-Fi 802.11n(HT20) (8.00 dBm) Wi-Fi 802.11n(HT40) (8.43 dBm) Wi-Fi 802.11ac(HT80) (6.10 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11a (13.09 dBm) Wi-Fi 802.11n(HT20) (10.90 dBm) Wi-Fi 802.11n(HT40) (11.13 dBm) Wi-Fi 802.11ac(HT80) (9.19 dBm)
		5 725 MHz ~ 5 850 MHz Band	Antenna 0	Wi-Fi 802.11a (9.89 dBm) Wi-Fi 802.11n(HT20) (7.78 dBm) Wi-Fi 802.11n(HT40) (7.73 dBm) Wi-Fi 802.11ac(HT80) (6.17 dBm)
			Antenna 1	Wi-Fi 802.11a (9.80 dBm) Wi-Fi 802.11n(HT20) (7.71 dBm) Wi-Fi 802.11n(HT40) (7.72 dBm) Wi-Fi 802.11ac(HT80) (5.84 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11a (12.86 dBm) Wi-Fi 802.11n(HT20) (10.76 dBm) Wi-Fi 802.11n(HT40) (10.74 dBm) Wi-Fi 802.11ac(HT80) (9.02 dBm)

Modulation Type	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
Antenna Type	WLAN 2.4 GHz Band	Antenna 0	1.61 dBi
		Antenna 1	2.13 dBi
		Antenna 0 + Antenna 1	4.89 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	1.63 dBi
		Antenna 1	1.01 dBi
		Antenna 0 + Antenna 1	4.34 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	3.32 dBi
		Antenna 1	2.04 dBi
		Antenna 0 + Antenna 1	5.74 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 MHz		

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

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
TWFM-R003D	Basic Model	<input checked="" type="checkbox"/>
TWFM-R003D(A)	The difference between this model and the basic model is the PDN function added (Main IC Wake-up) and resistance component R6 added.	<input type="checkbox"/>

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.  
 2. The Applicant/manufacturer is responsible for the compliance of all variants.

**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 Innotek Co., Ltd.	TWFM-R003D	-

### 5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
TWFM-R003D	LG Innotek Co., Ltd.	802.11 a/b/g/n/ac WiFi Module (EUT)	Notebook PC
PP11L	DELL	Notebook PC	EUT
WEA504i	Samsung Electronics Co Ltd	WLAN Access Point	EUT

### 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 1

Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Ant 0	Ant 1
802.11 a	6 Mbps	10.03	10.14
	9 Mbps	9.85	9.94
	12 Mbps	9.66	9.84
	18 Mbps	9.55	9.67
	24 Mbps	9.38	9.56
	36 Mbps	9.19	9.39
	48 Mbps	8.99	9.21
	54 Mbps	8.79	9.09
HT 20	6.5 Mbps	7.77	8.00
	13 Mbps	7.65	7.81
	19.5 Mbps	7.46	7.64
	26 Mbps	7.30	7.46
	39 Mbps	7.18	7.36
	52 Mbps	7.02	7.18
	58.5 Mbps	6.92	7.03
	65 Mbps	6.81	6.88
HT 40	13.5 Mbps	7.80	8.43
	27 Mbps	7.66	8.32
	40.5 Mbps	7.51	8.22
	54 Mbps	7.38	8.02
	81 Mbps	7.21	7.83
	108 Mbps	7.09	7.70
	121.5 Mbps	6.95	7.51
	135 Mbps	6.84	7.38

VHT80	29.3 Mbps	6.25	6.10
	58.5 Mbps	6.09	5.98
	87.8 Mbps	5.94	5.79
	117 Mbps	5.80	5.66
	175.5 Mbps	5.68	5.49
	234 Mbps	5.55	5.36
	263.3 Mbps	5.44	5.26
	292.5 Mbps	5.25	5.07
	351 Mbps	5.13	4.87
	390 Mbps	5.02	4.76

- 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.

**UNII 3**

Modulation	DATA RATE	OUTPUT POWER[dBm]	
		Ant 0	Ant 1
802.11 a	6 Mbps	9.89	9.80
	9 Mbps	9.73	9.65
	12 Mbps	9.60	9.47
	18 Mbps	9.41	9.30
	24 Mbps	9.28	9.15
	36 Mbps	9.17	9.00
	48 Mbps	9.05	8.88
	54 Mbps	8.85	8.75
HT 20	6.5 Mbps	7.78	7.71
	13 Mbps	7.63	7.53
	19.5 Mbps	7.49	7.40
	26 Mbps	7.38	7.26
	39 Mbps	7.19	7.15
	52 Mbps	7.03	6.96
	58.5 Mbps	6.88	6.79
	65 Mbps	6.70	6.59
HT 40	13.5 Mbps	7.73	7.72
	27 Mbps	7.58	7.60
	40.5 Mbps	7.48	7.44
	54 Mbps	7.31	7.32
	81 Mbps	7.17	7.13
	108 Mbps	7.01	7.03
	121.5 Mbps	6.88	6.85
	135 Mbps	6.75	6.68

VHT80	29.3 Mbps	6.17	5.84
	58.5 Mbps	6.07	5.70
	87.8 Mbps	5.91	5.51
	117 Mbps	5.72	5.38
	175.5 Mbps	5.54	5.19
	234 Mbps	5.36	5.09
	263.3 Mbps	5.24	4.89
	292.5 Mbps	5.06	4.71
	351 Mbps	4.91	4.57
	390 Mbps	4.73	4.44

- 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.



## 5.4 Configuration of Test System

**Line Conducted Test:** The jig board of the EUT was connected to LISN. 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 transmitter antenna of the EUT is WLAN 2.4 GHz Band & WLAN 5 GHz Band is PCB antenna 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

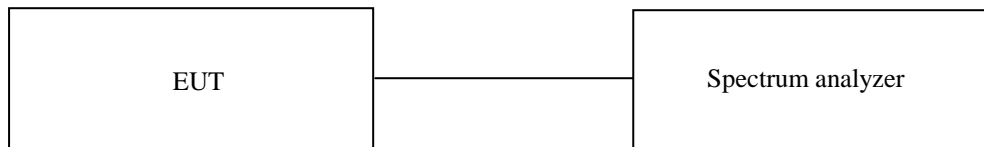
## 7. MIMIMUM 26 dB BANDWIDTH

### 7.1 Operating environment

Temperature : 22 °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	Apr. 05, 2017 (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**

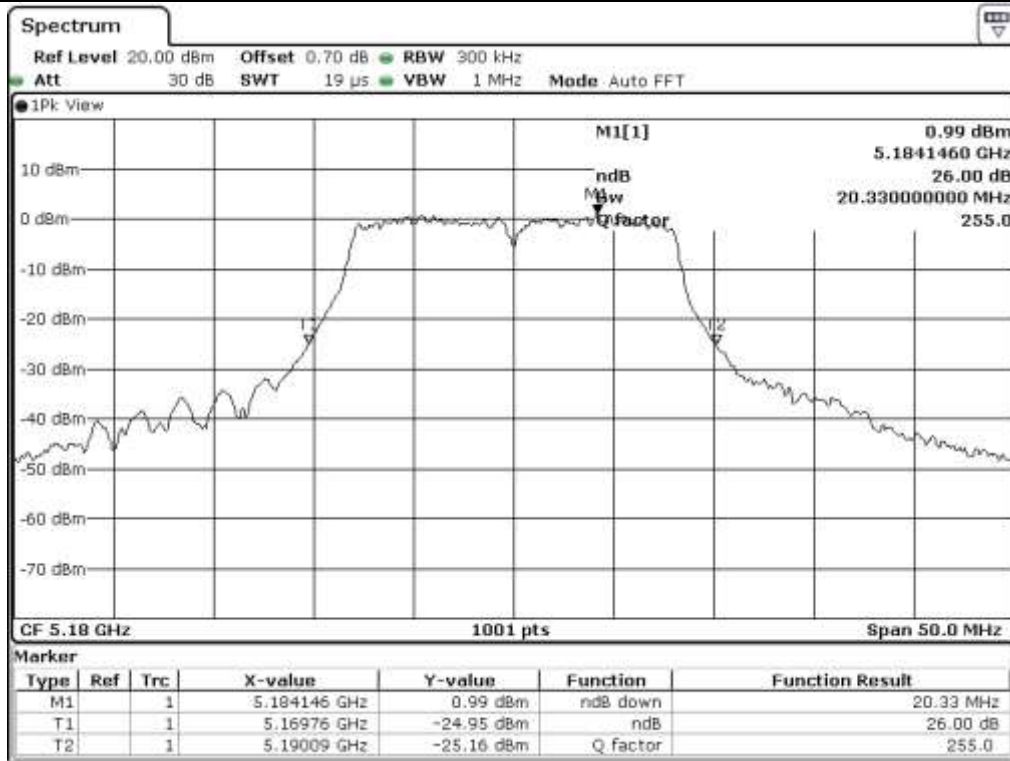
-. Test Date : July 18, 2017

-. Test Result : Pass

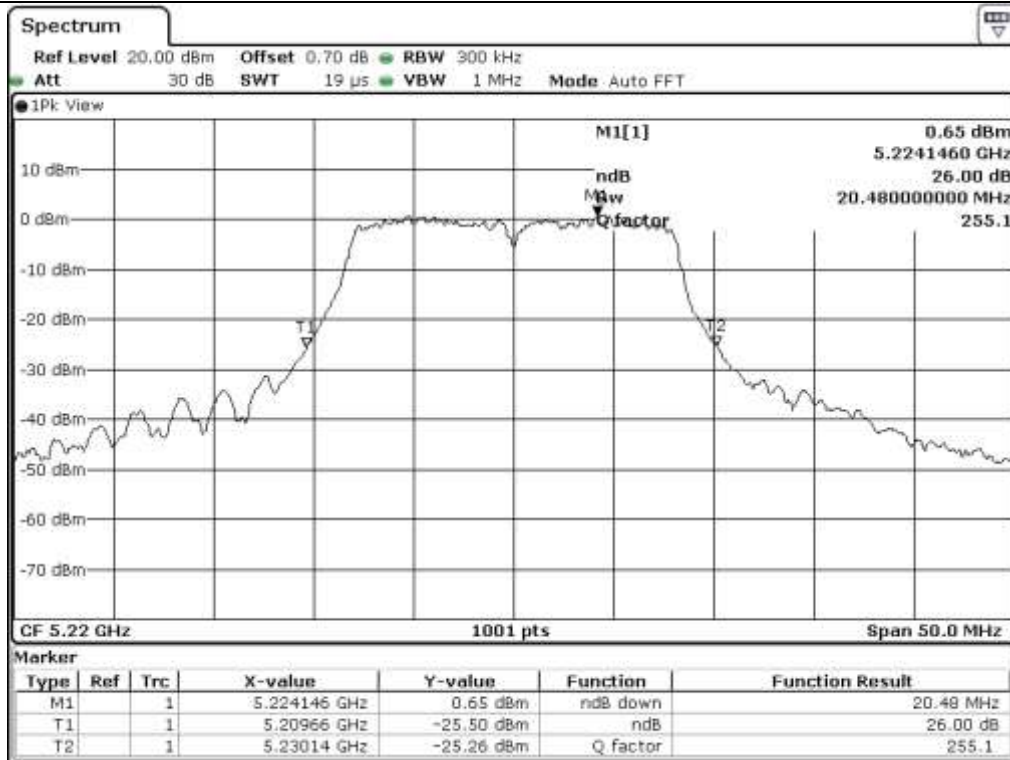
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	20.33
	Middle	5 220.00	20.48
	High	5 240.00	20.28
5 725 ~ 5 850	Low	5 745.00	20.23
	Middle	5 785.00	20.23
	High	5 825.00	20.28



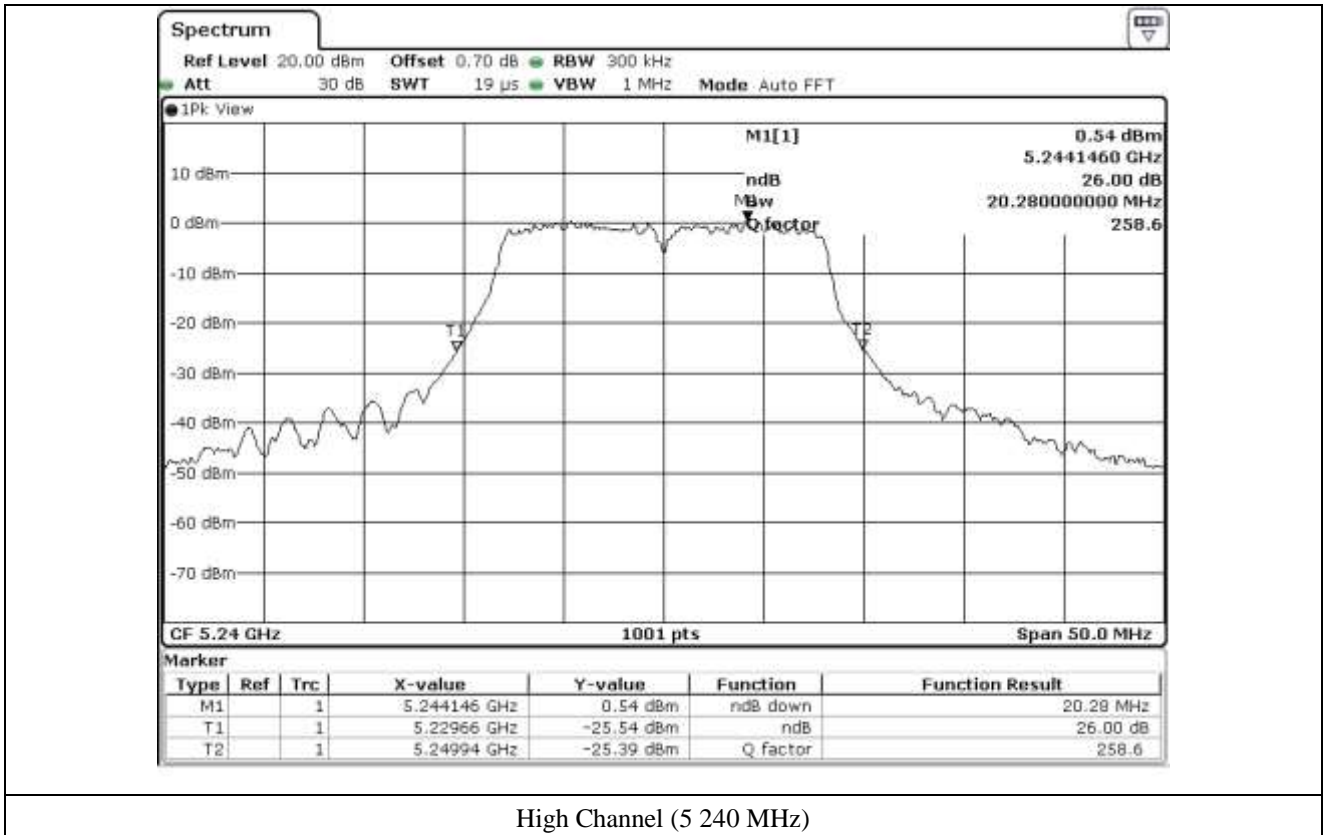
**Tested by: Hyung-Kwon, Oh / Assistant Manager**

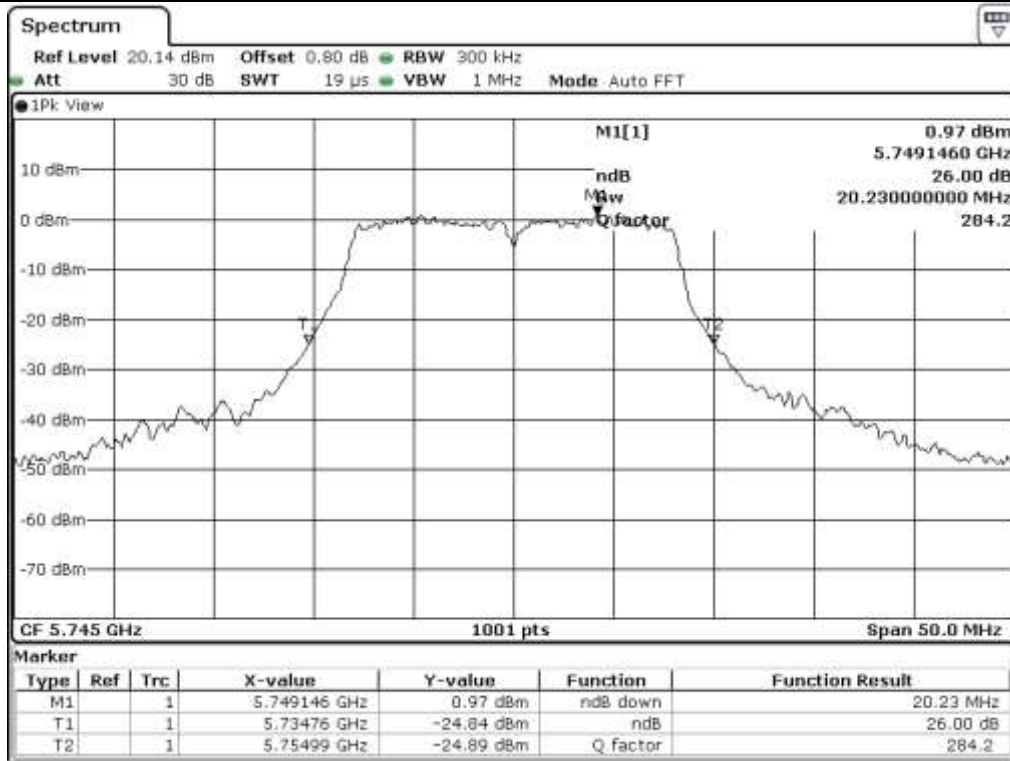


Low Channel (5 180 MHz)

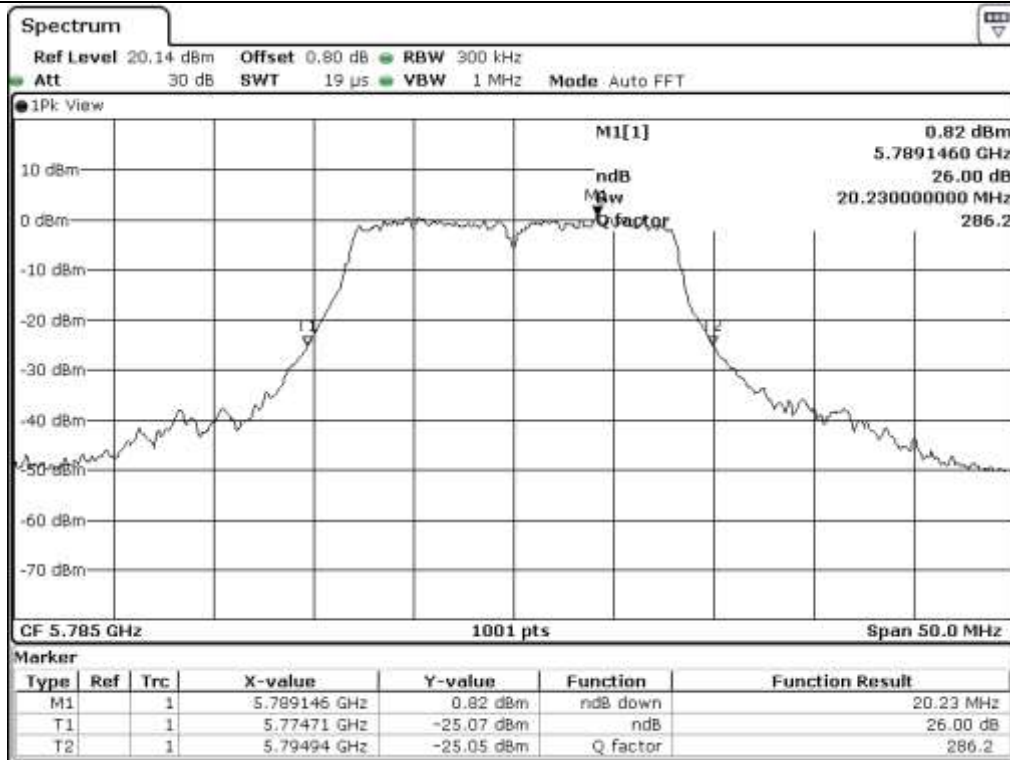


Middle Channel (5 220 MHz)

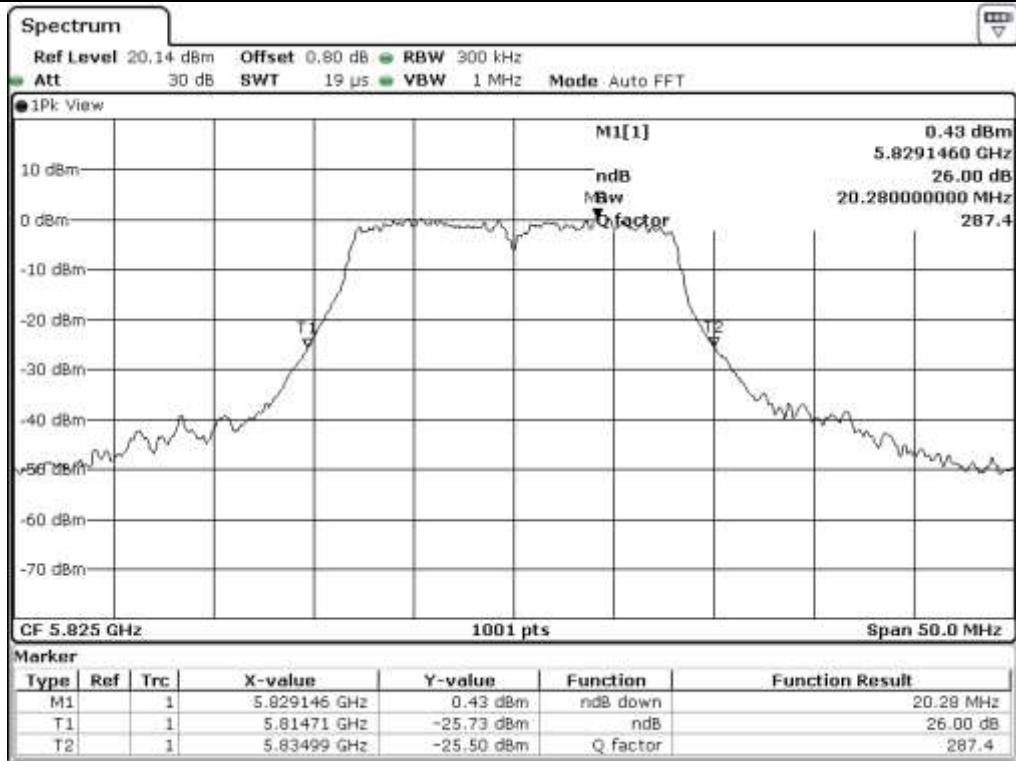




Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



High Channel (5 825 MHz)



**7.4.2 Test data for Antenna 1**

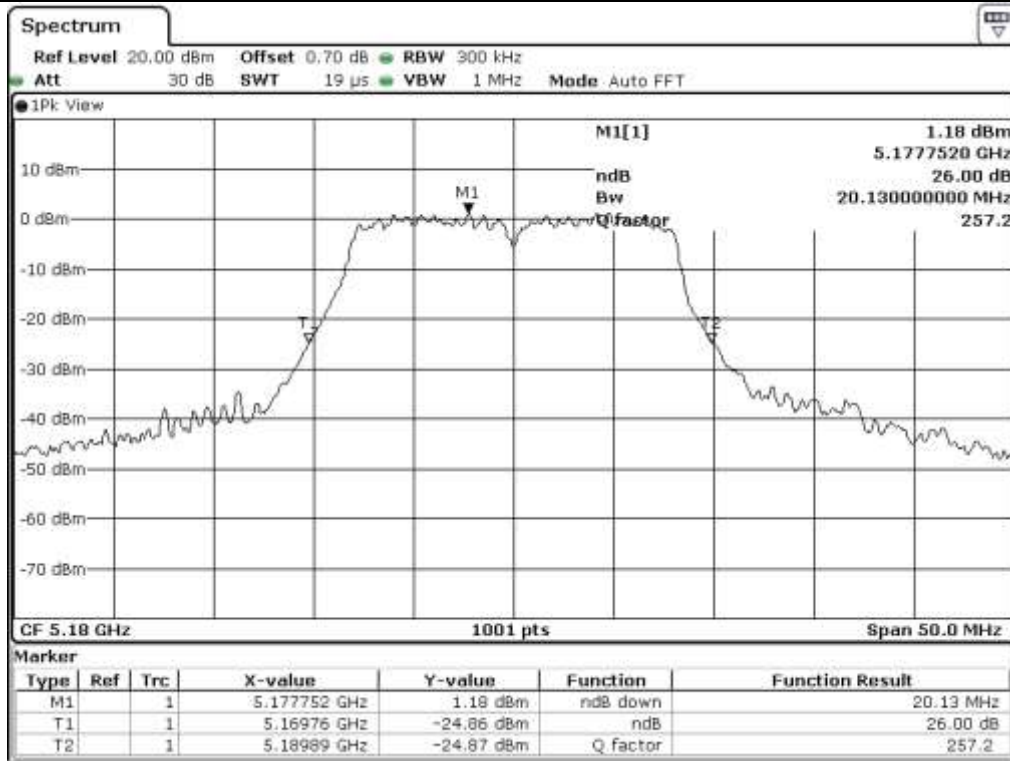
-. Test Date : July 18, 2017

-. Test Result : Pass

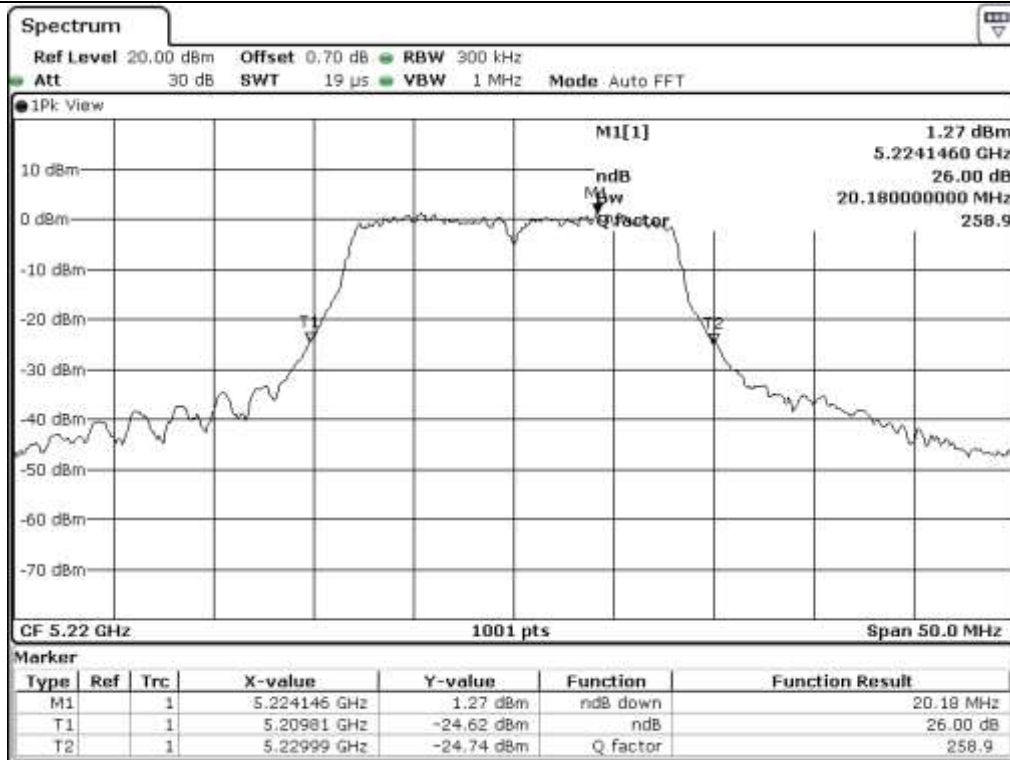
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	20.13
	Middle	5 220.00	20.18
	High	5 240.00	20.03
5 725 ~ 5 850	Low	5 745.00	20.08
	Middle	5 785.00	19.98
	High	5 825.00	20.13



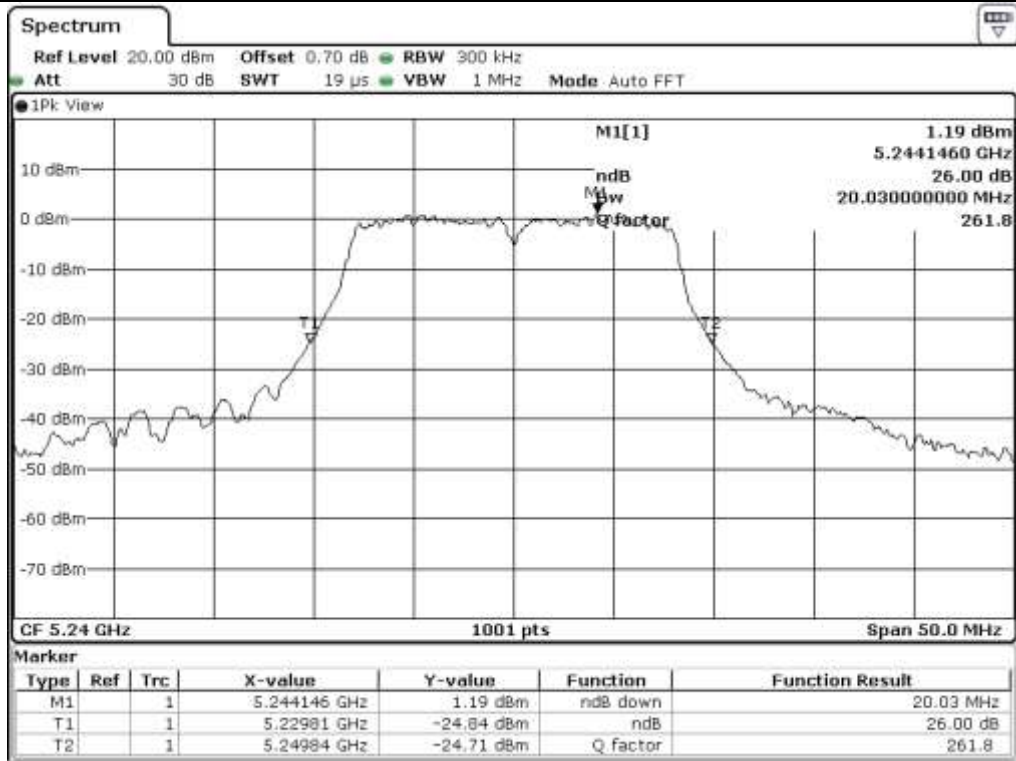
**Tested by: Hyung-Kwon, Oh / Assistant Manager**



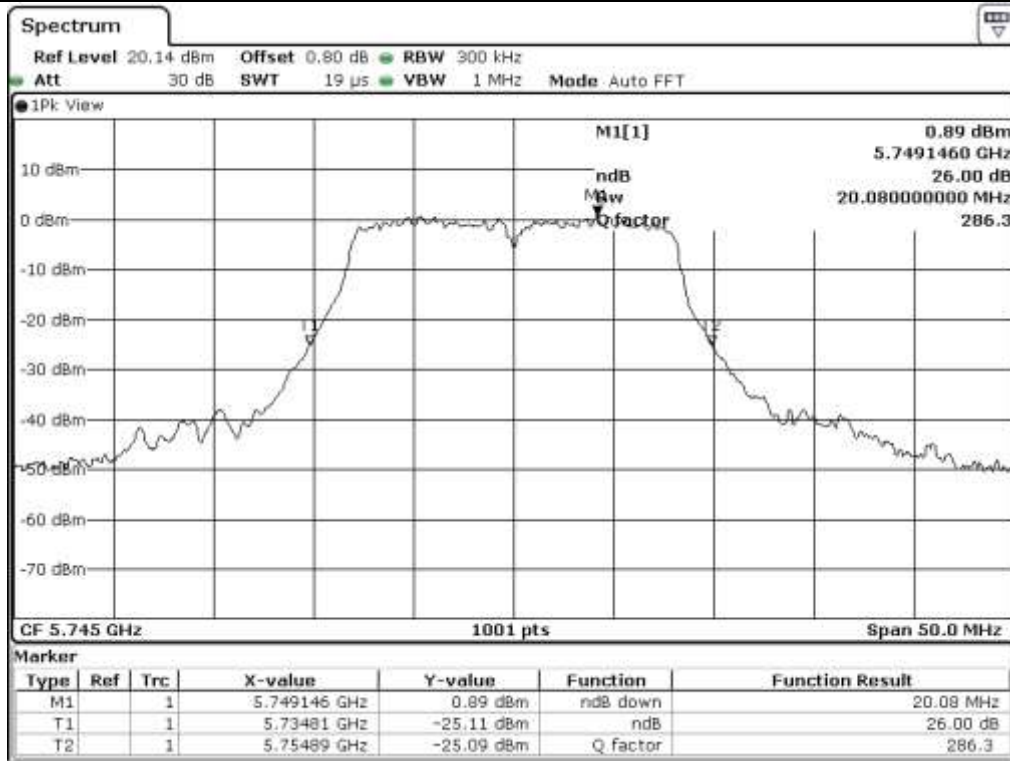
Low Channel (5 180 MHz)



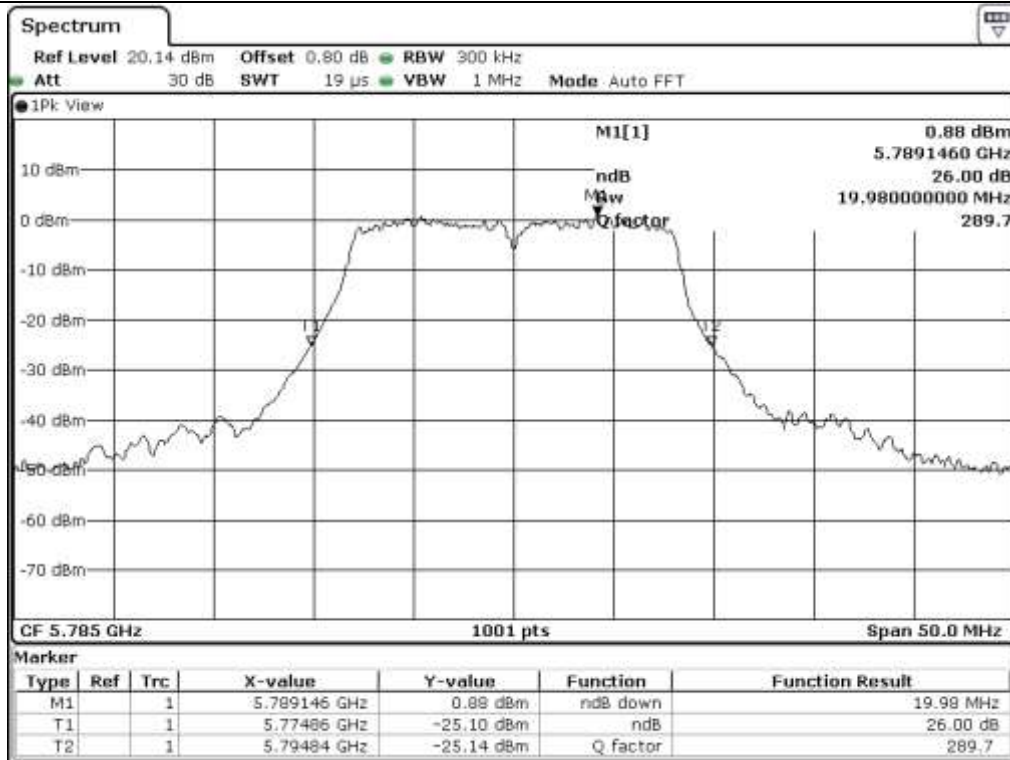
Middle Channel (5 220 MHz)



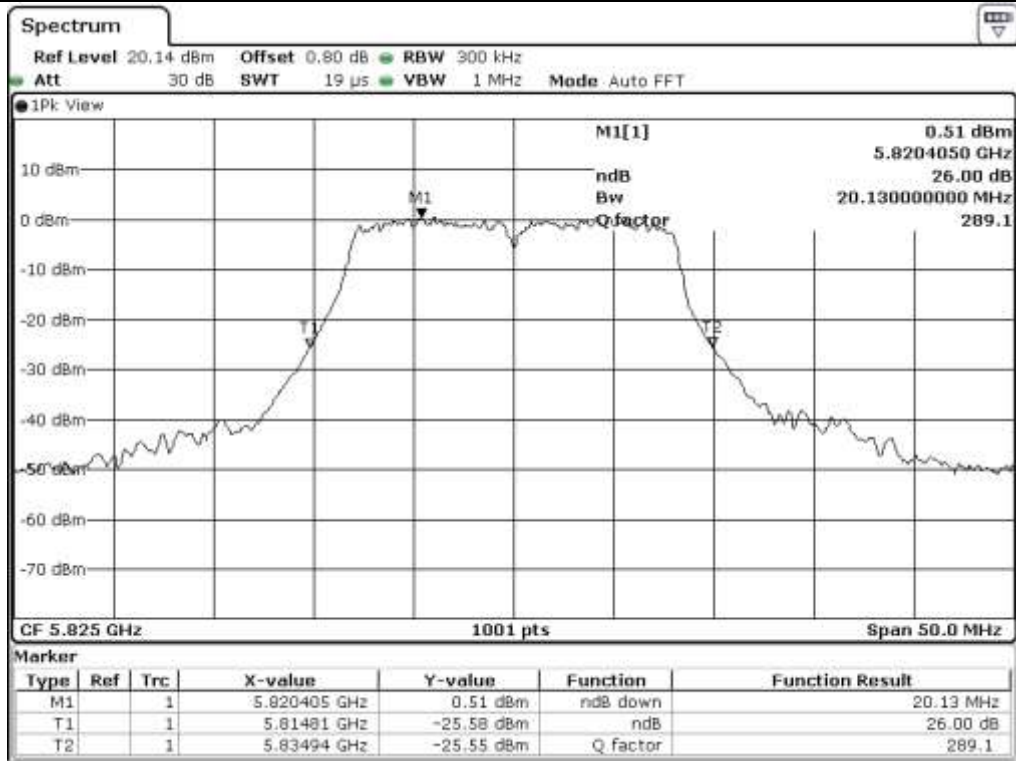
High Channel (5 240 MHz)



Low Channel (5.745 MHz)



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**

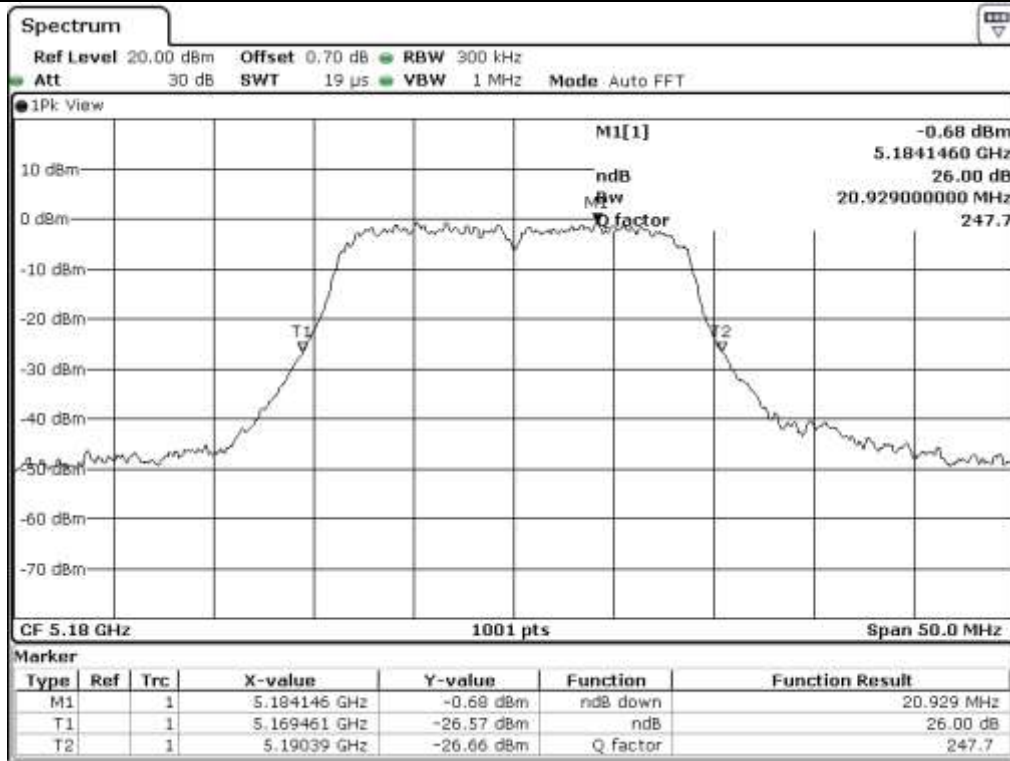
-. Test Date : July 18, 2017

-. Test Result : Pass

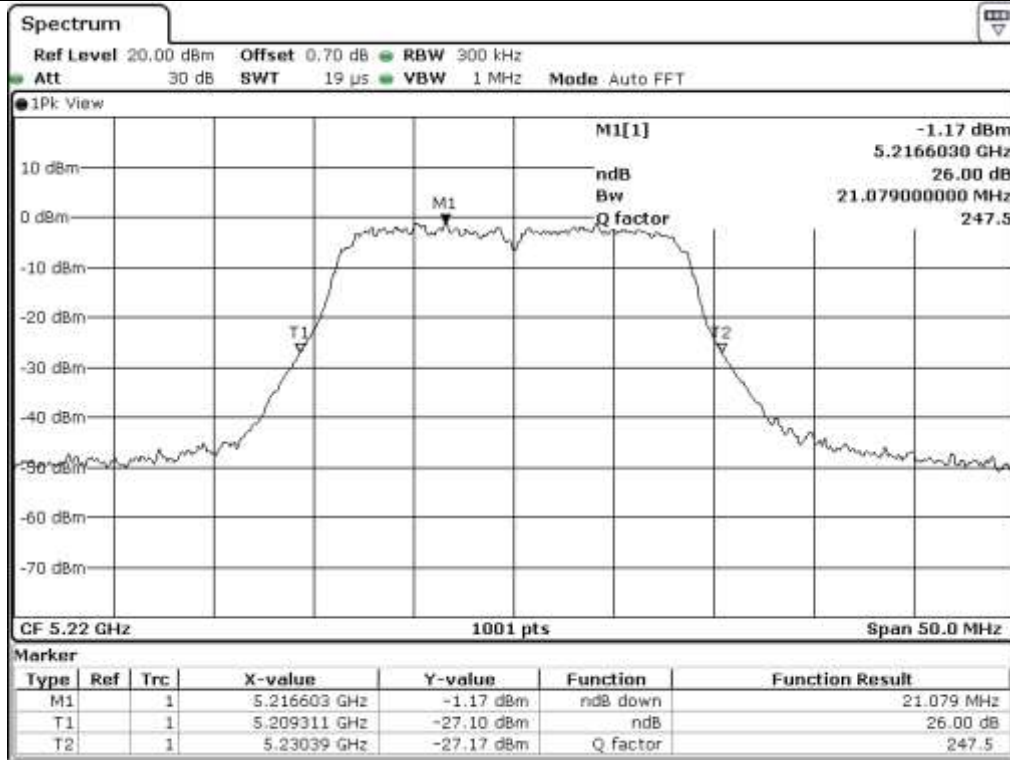
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	20.93
	Middle	5 220.00	21.08
	High	5 240.00	20.88
5 725 ~ 5 850	Low	5 745.00	20.98
	Middle	5 785.00	21.18
	High	5 825.00	21.03



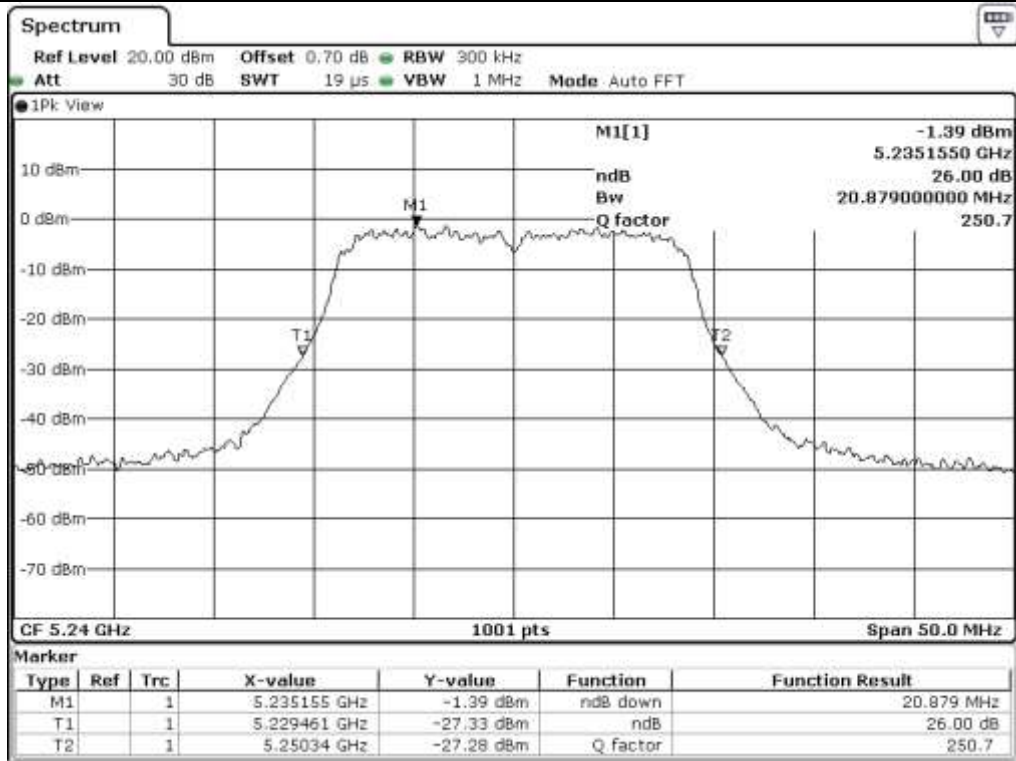
Tested by: Hyung-Kwon, Oh / Assistant Manager



Low Channel (5 180 MHz)

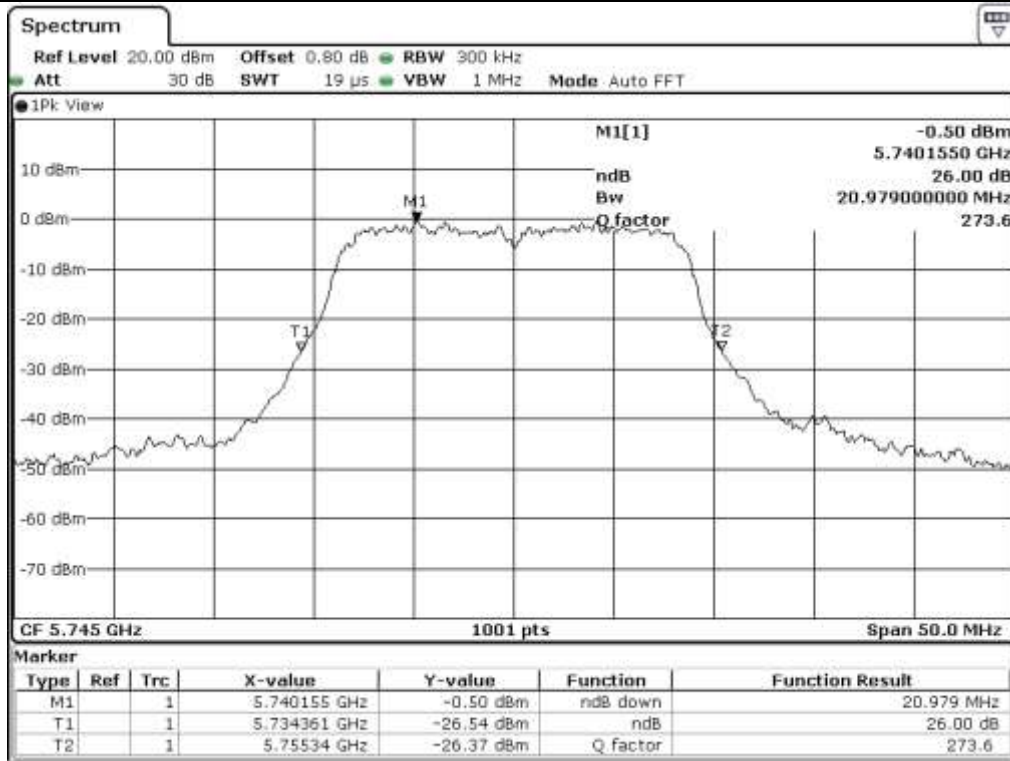


Middle Channel (5 220 MHz)

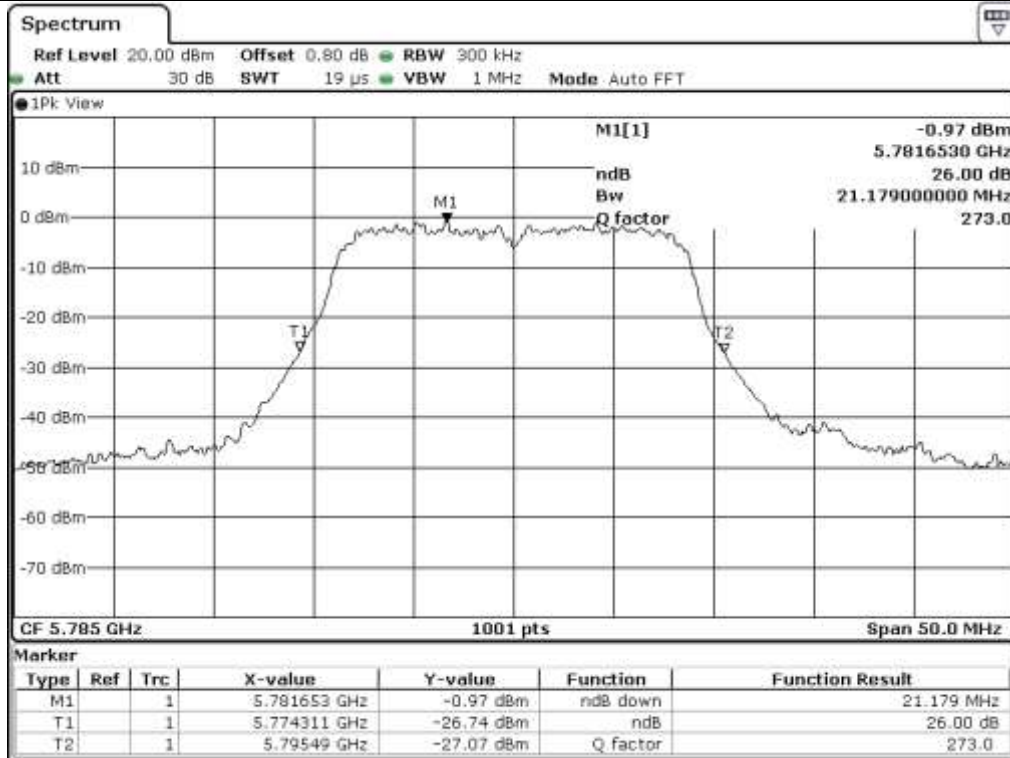


High Channel (5 240 MHz)

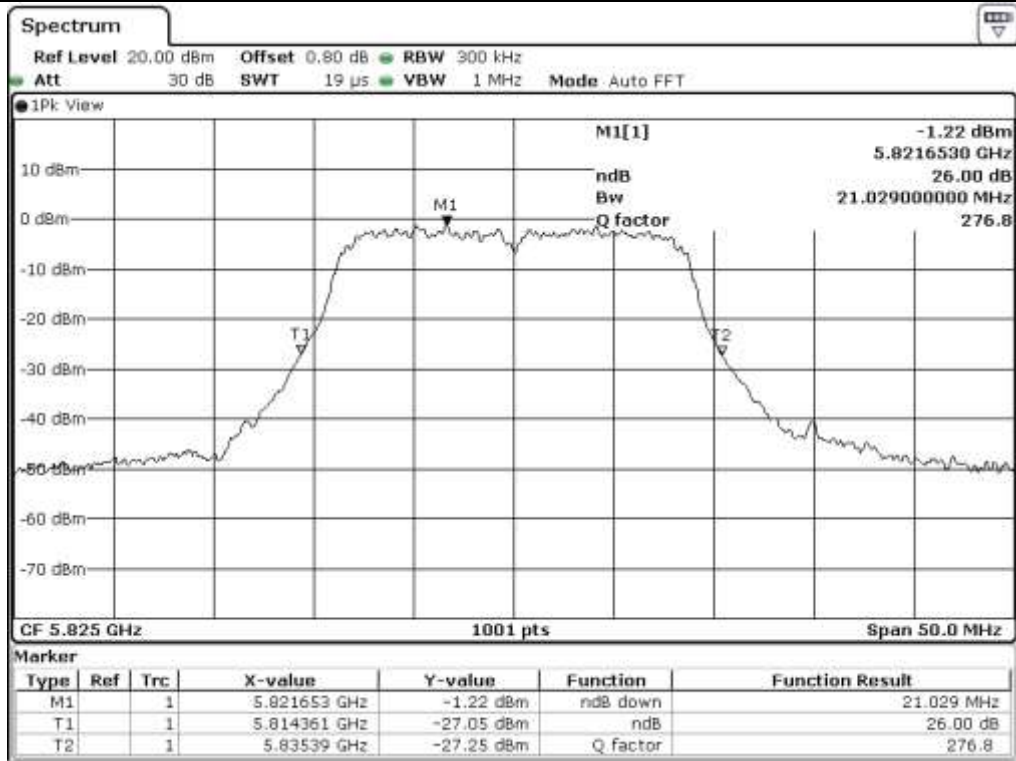




Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



High Channel (5 825 MHz)

**7.5.2 Test data for Antenna 1**

-. Test Date : July 18, 2017

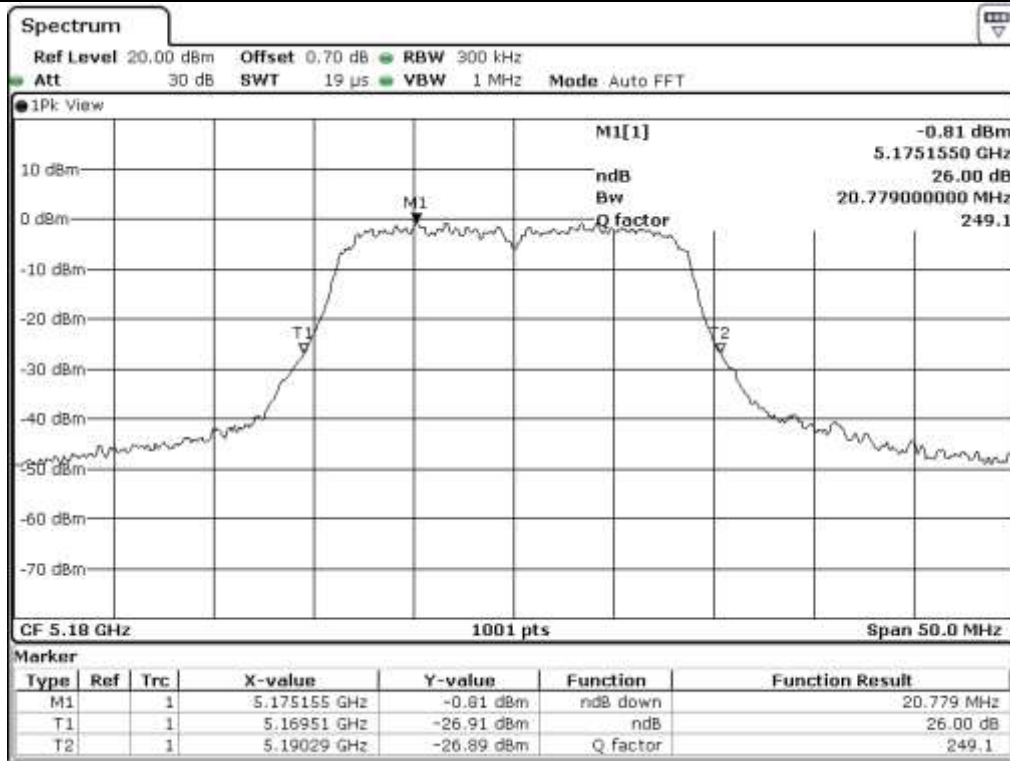
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	20.78
	Middle	5 220.00	20.83
	High	5 240.00	20.78
5 725 ~ 5 850	Low	5 745.00	20.78
	Middle	5 785.00	20.93
	High	5 825.00	20.88

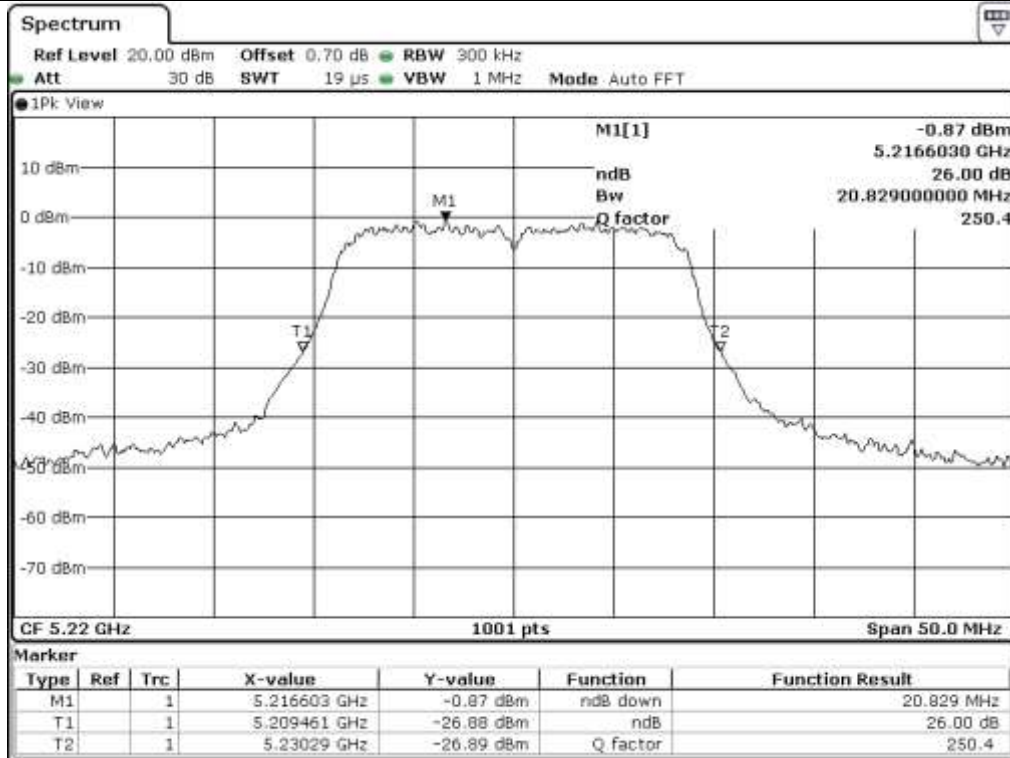



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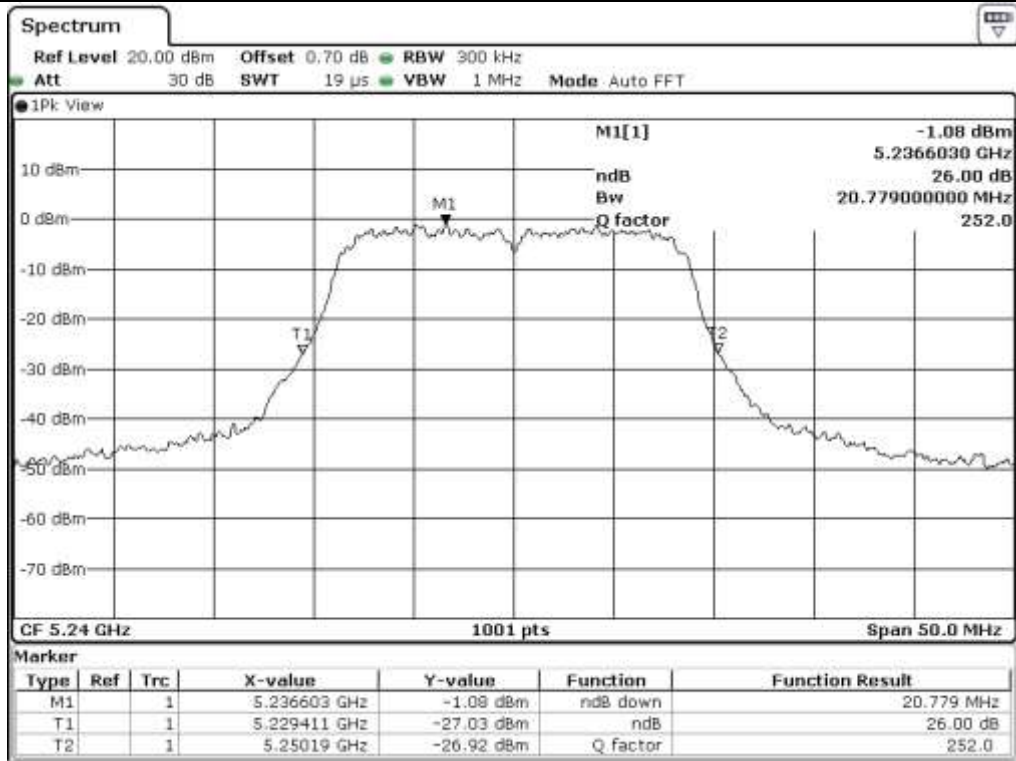
**Tested by: Hyung-Kwon, Oh / Assistant Manager**



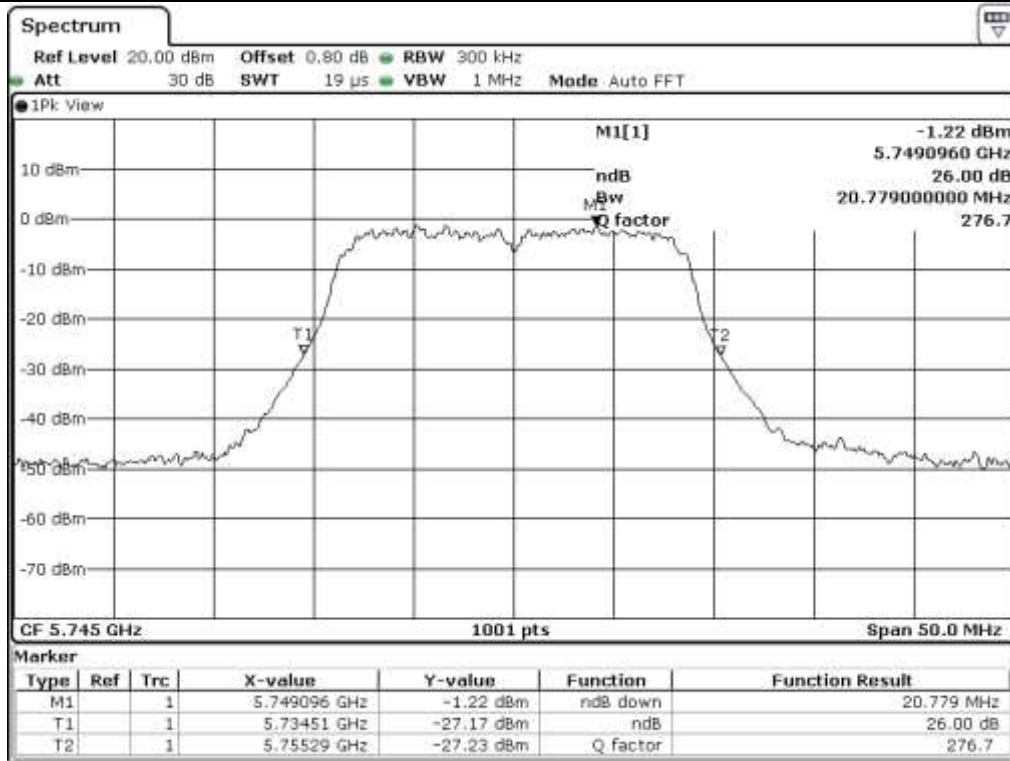
Low Channel (5 180 MHz)



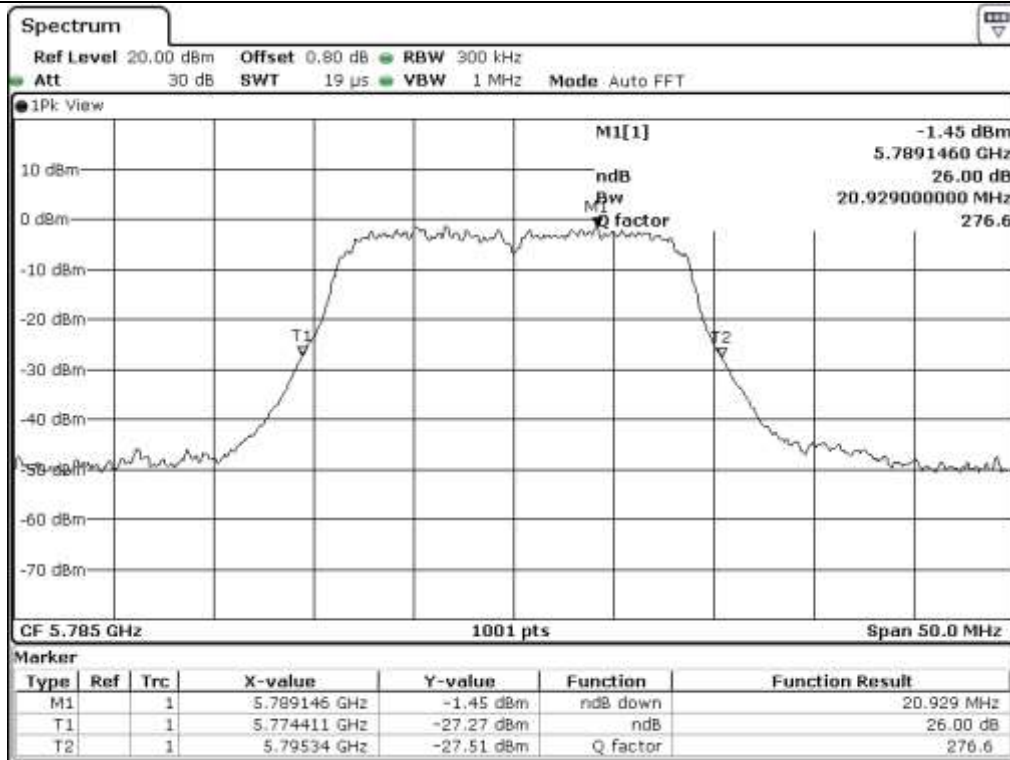
Middle Channel (5 220 MHz)



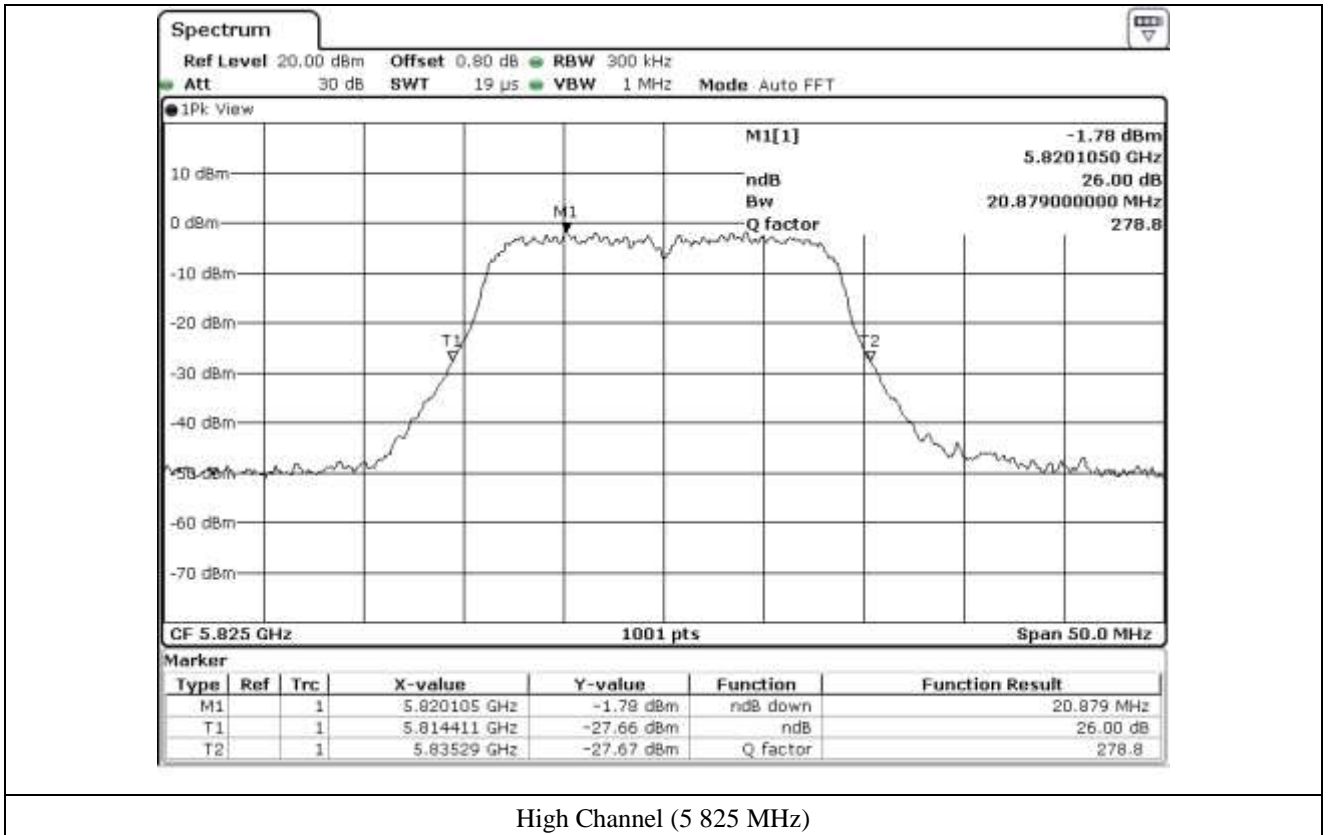
High Channel (5 240 MHz)



Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



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

**7.6.1 Test data for Antenna 0**

-. Test Date : July 18, 2017

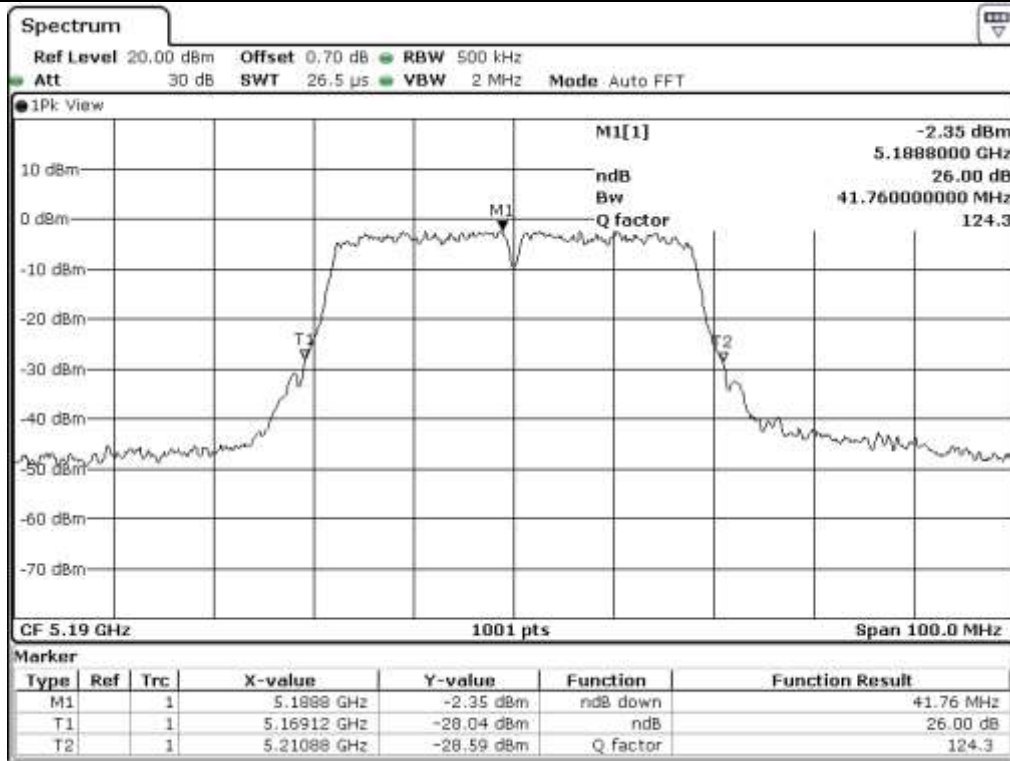
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	41.76
	High	5 230.00	41.56
5 725 ~ 5 850	Low	5 755.00	41.76
	High	5 795.00	41.96

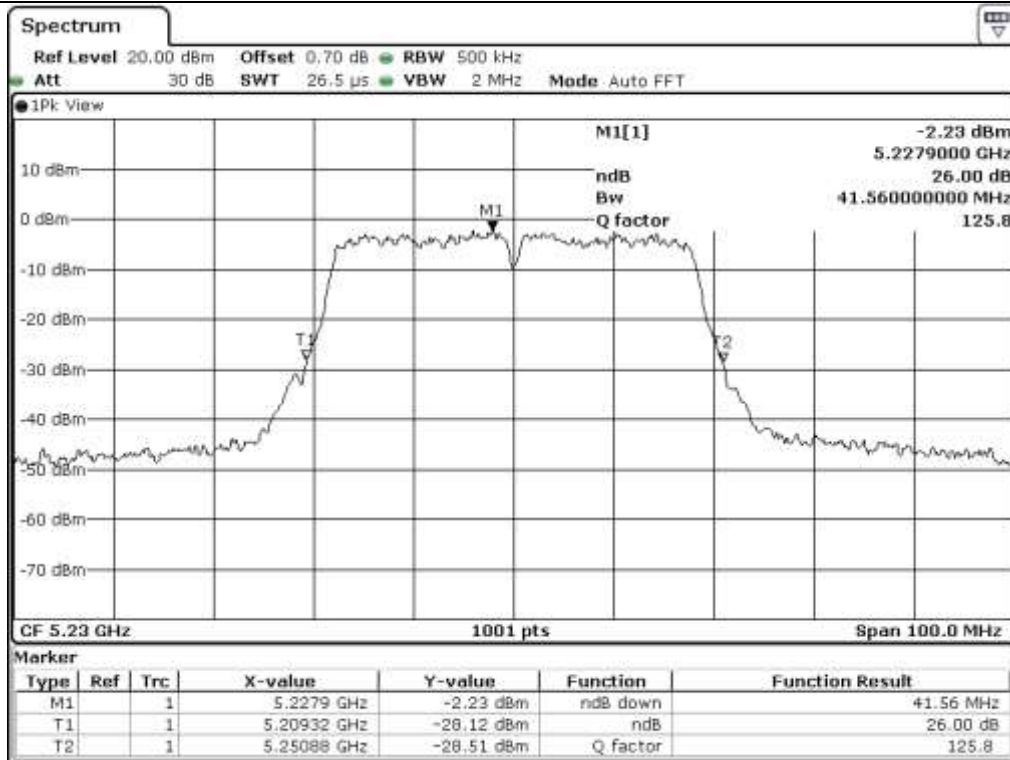


**Tested by: Hyung-Kwon, Oh / Assistant Manager**

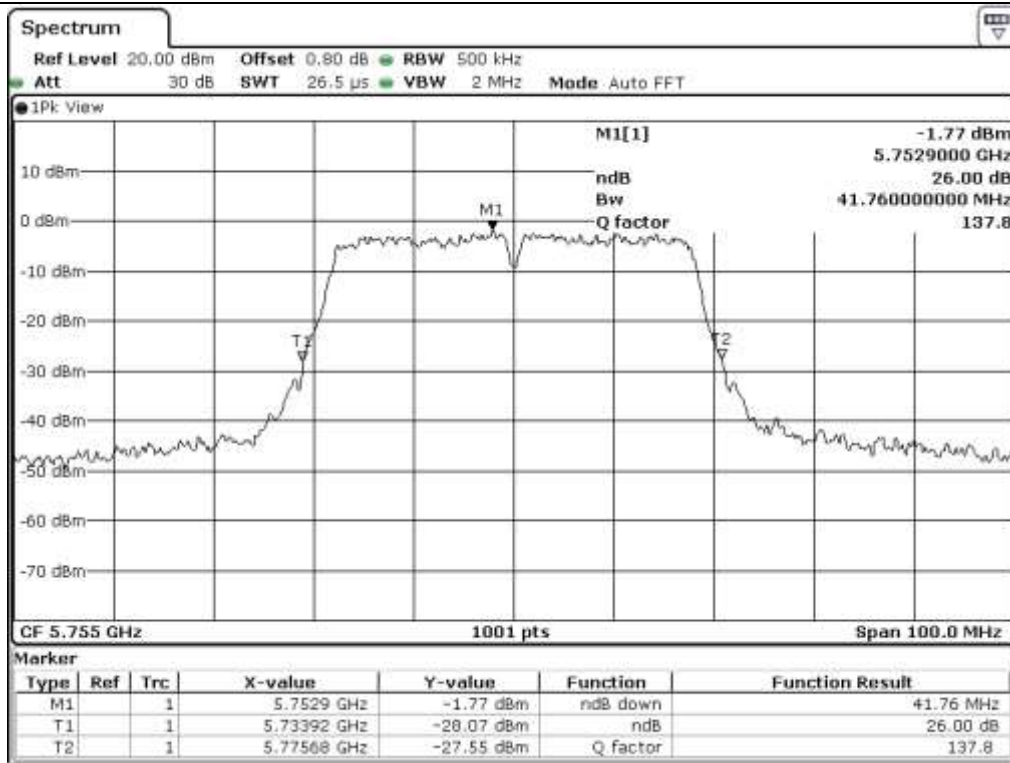




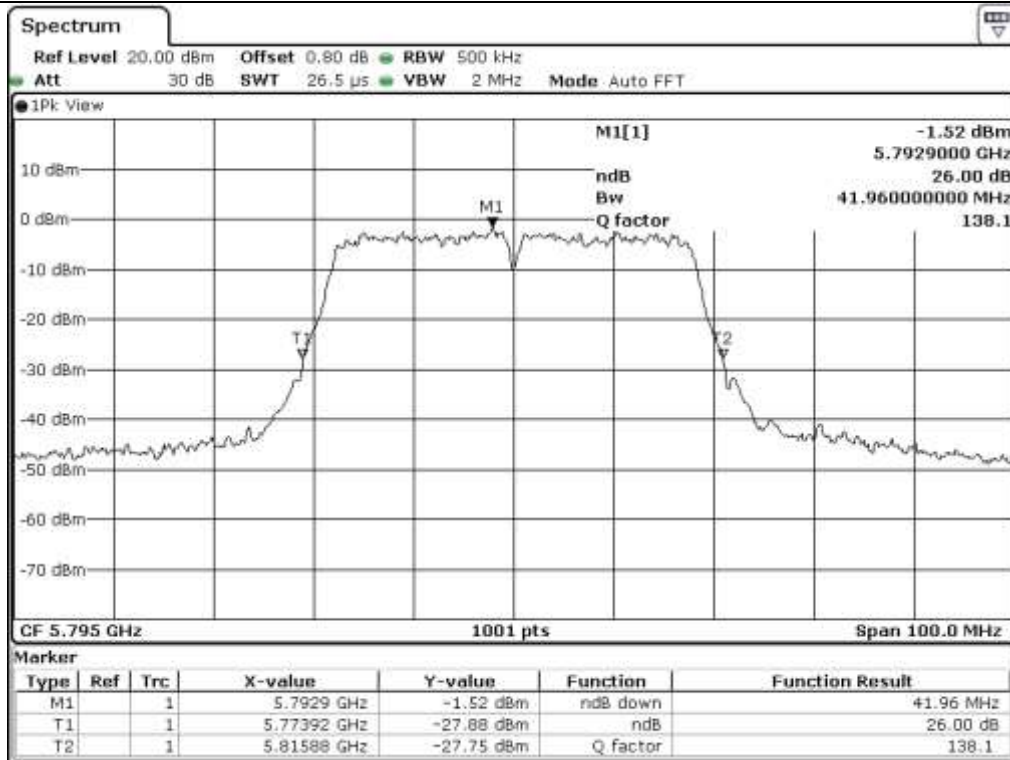
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

**7.6.2 Test data for Antenna 1**

-. Test Date : July 18, 2017

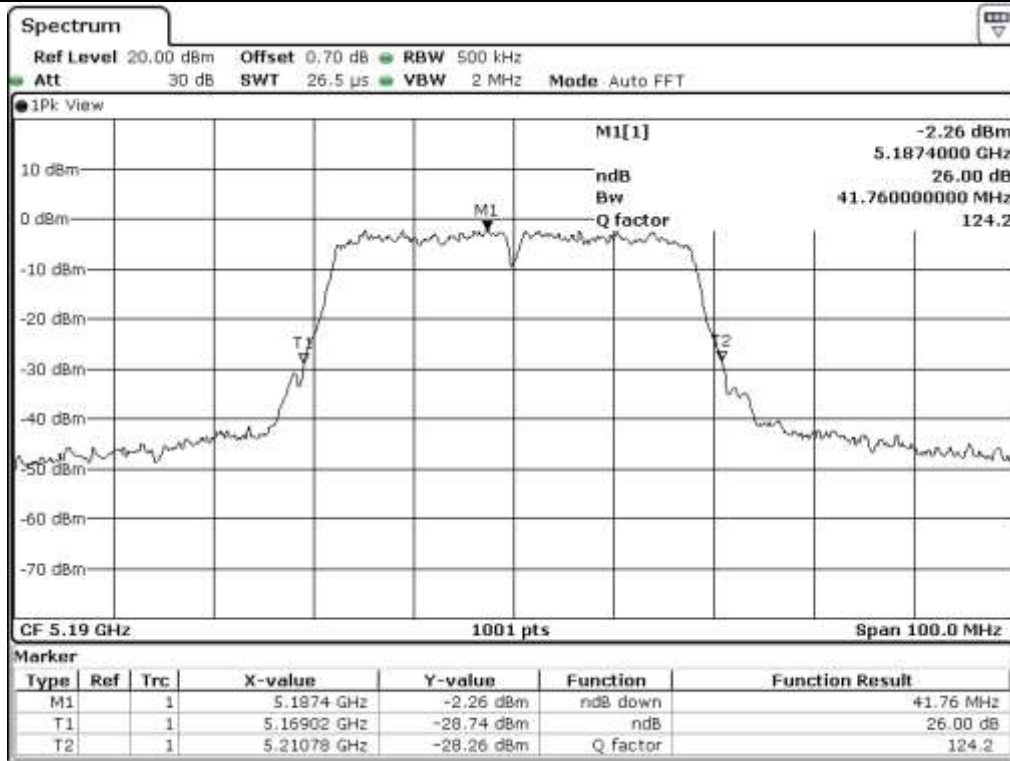
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	41.76
	High	5 230.00	41.26
5 725 ~ 5 850	Low	5 755.00	41.86
	High	5 795.00	41.86

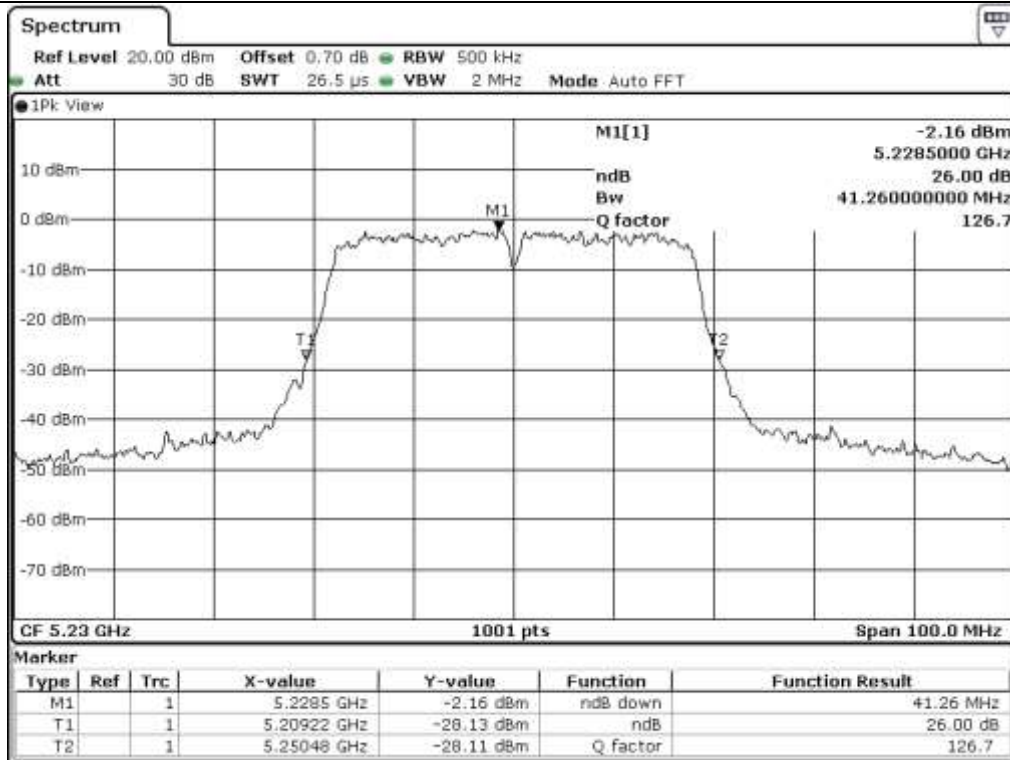



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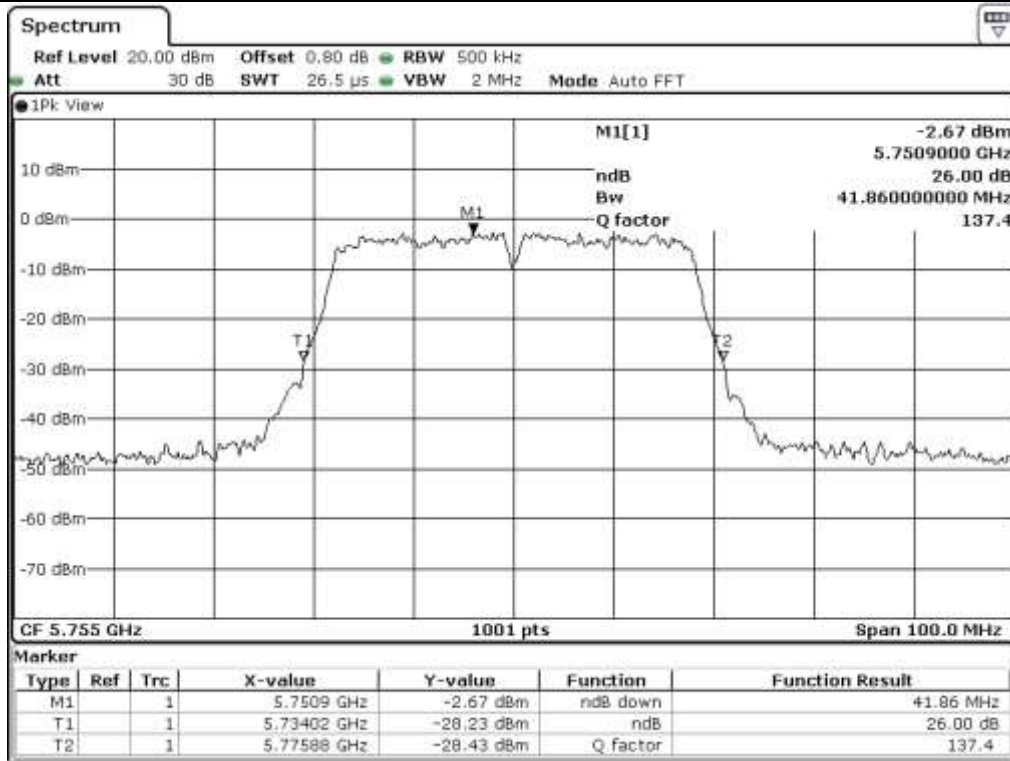
**Tested by: Hyung-Kwon, Oh / Assistant Manager**



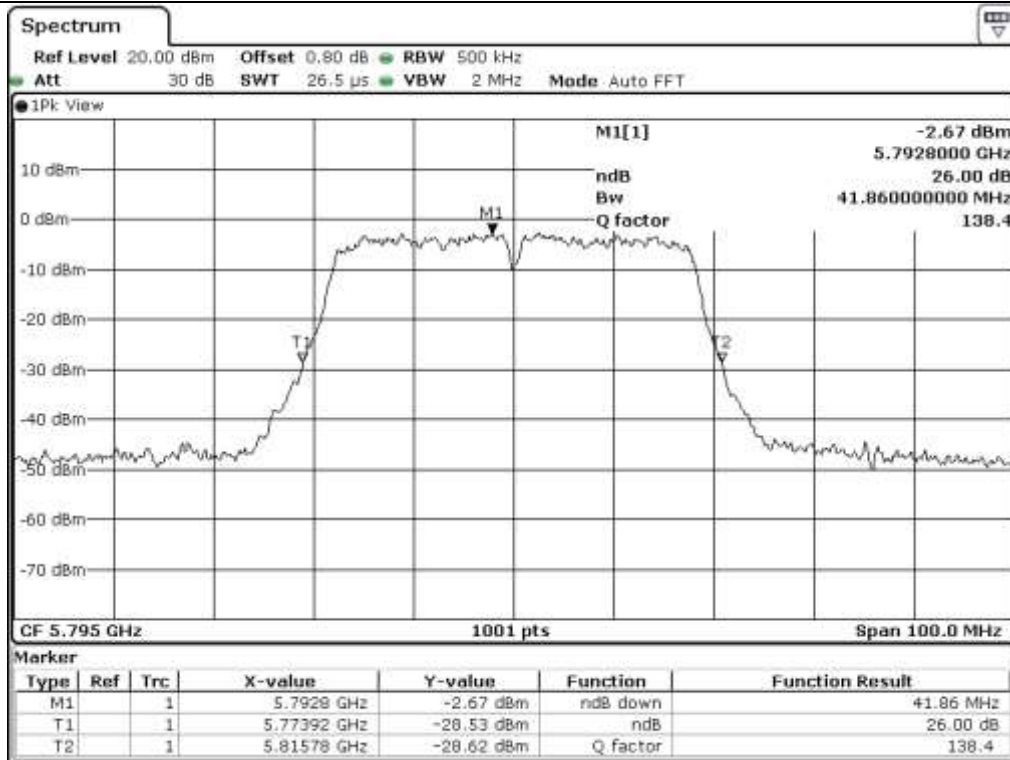
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

7.7 Test data for 802.11ac\_VHT80 RLAN Mode

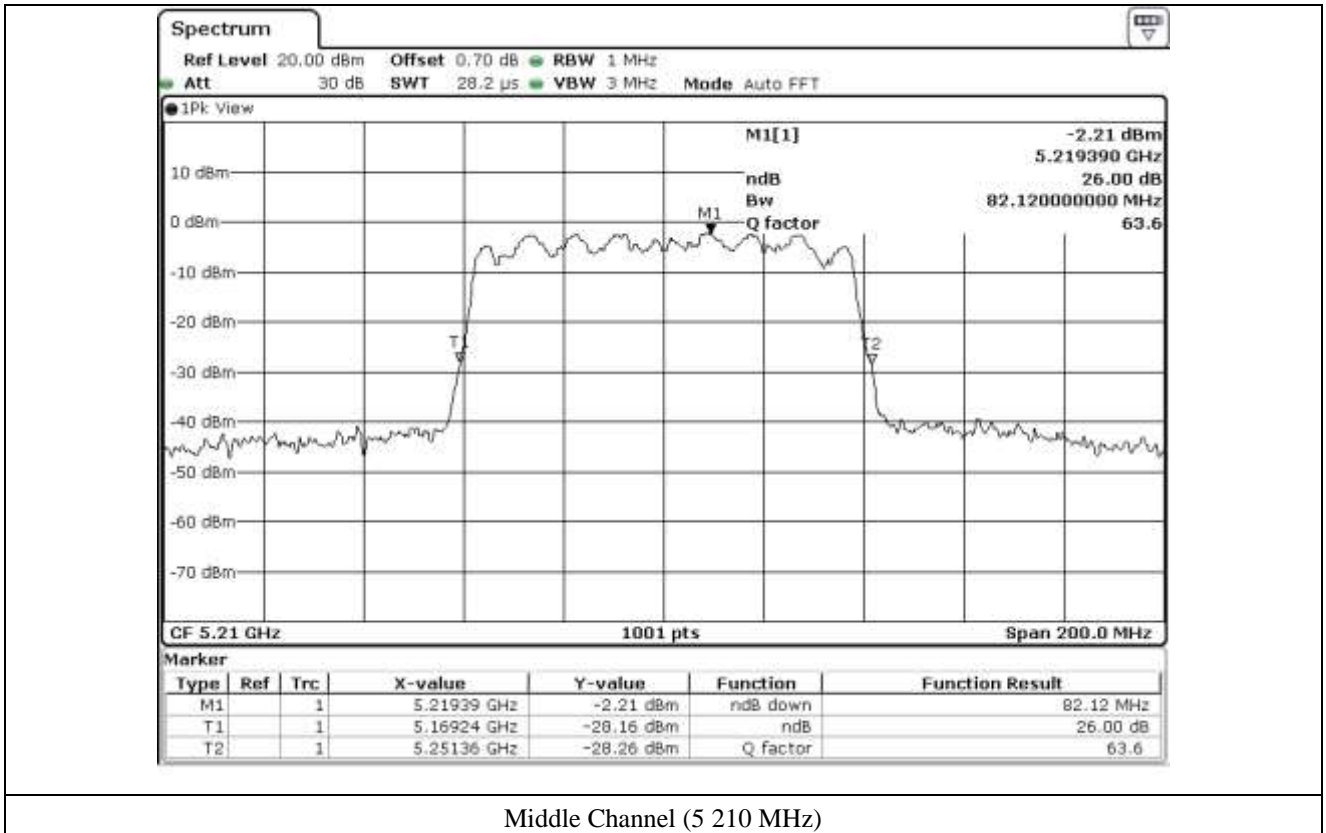
7.7.1 Test data for Antenna 0

- Test Date : July 18, 2017
- Test Result : Pass

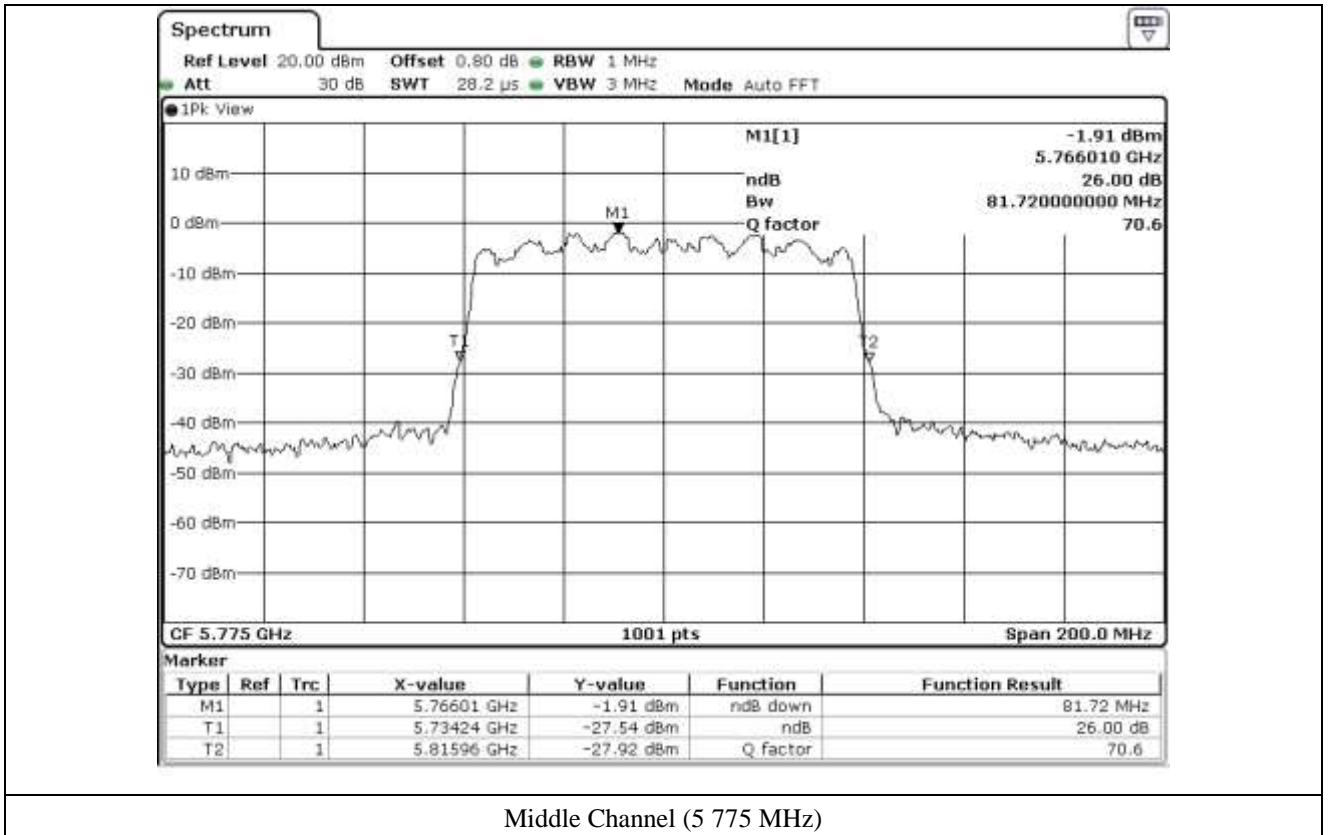
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	82.12
5 725 ~ 5 850	Middle	5 775.00	81.72



Tested by: Hyung-Kwon, Oh / Assistant Manager



Middle Channel (5 210 MHz)





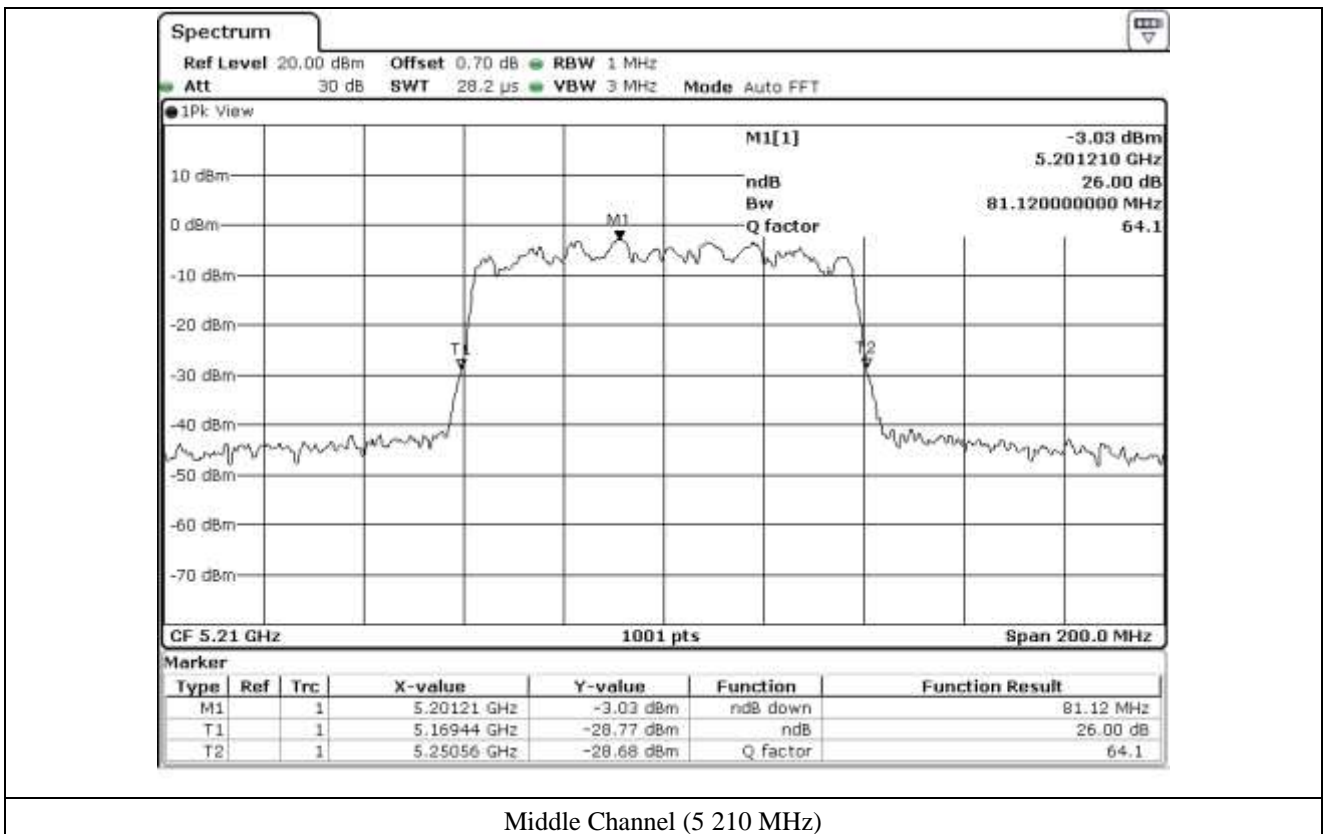
7.7.2 Test data for Antenna 1

- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	81.12
5 725 ~ 5 850	Middle	5 775.00	80.92

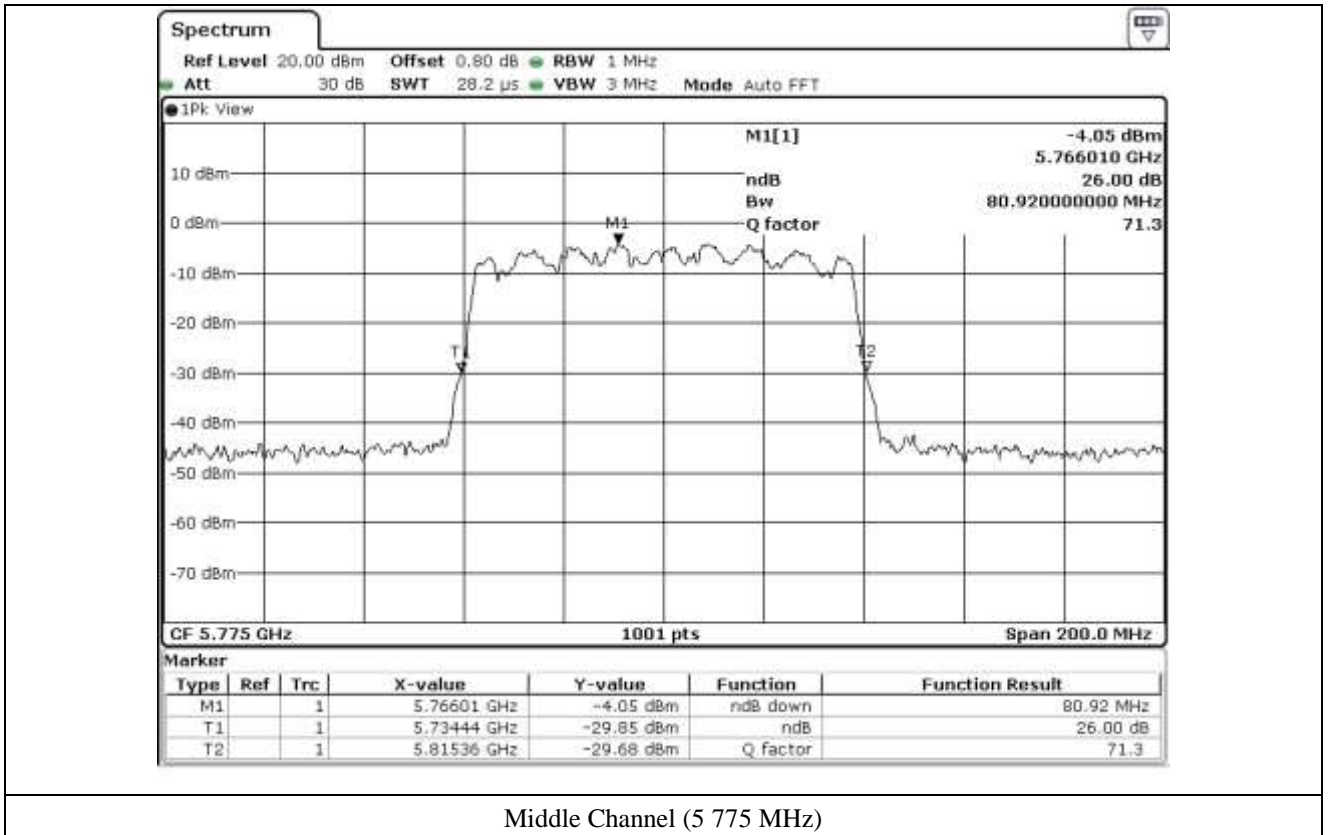


Tested by: Hyung-Kwon, Oh / Assistant Manager



Middle Channel (5 210 MHz)





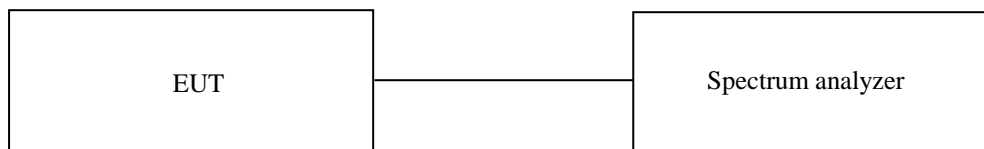
## 8. 6 dB BANDWIDTH

### 8.1 Operating environment

Temperature : 22 °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	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11a RLAN Mode

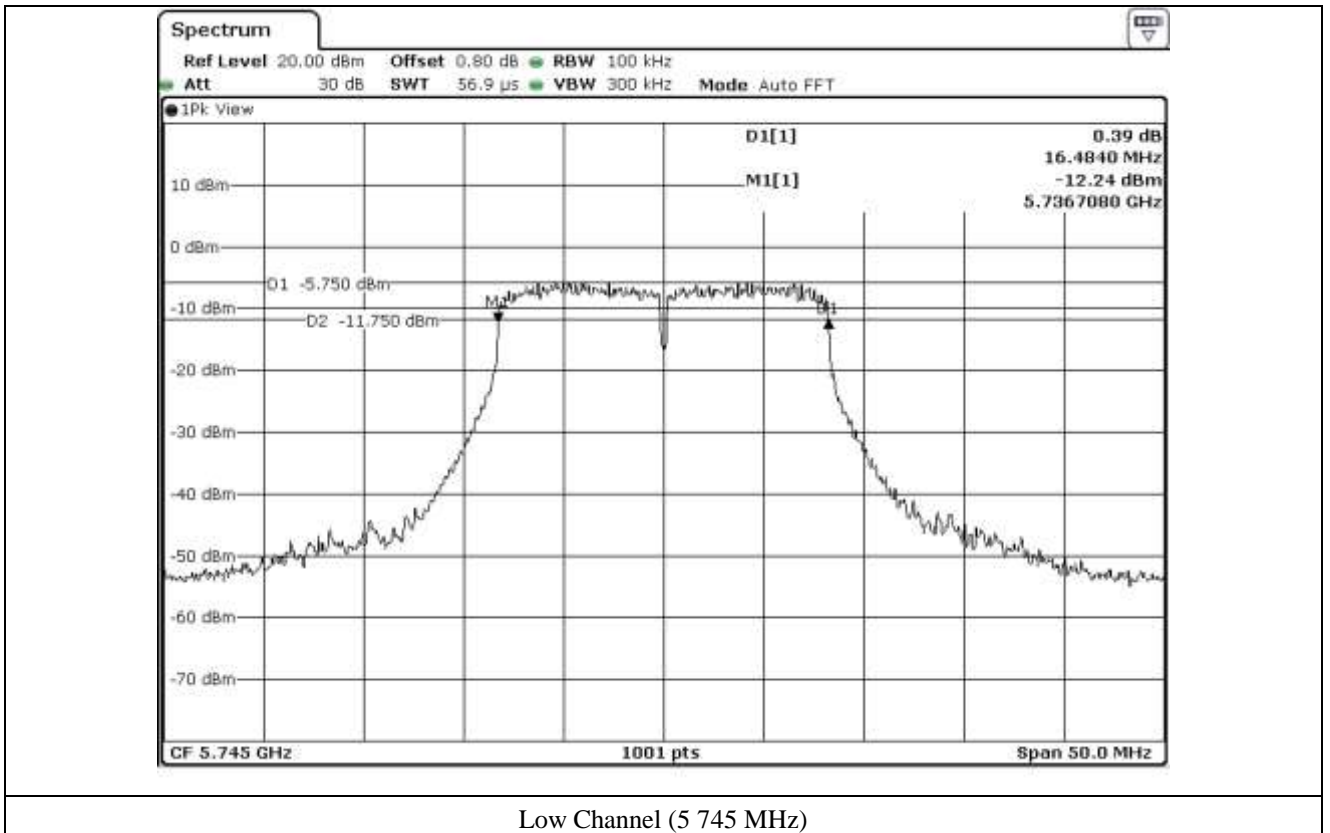
8.4.1 Test data for Antenna 0

- Test Date : July 18, 2017
- Test Result : Pass

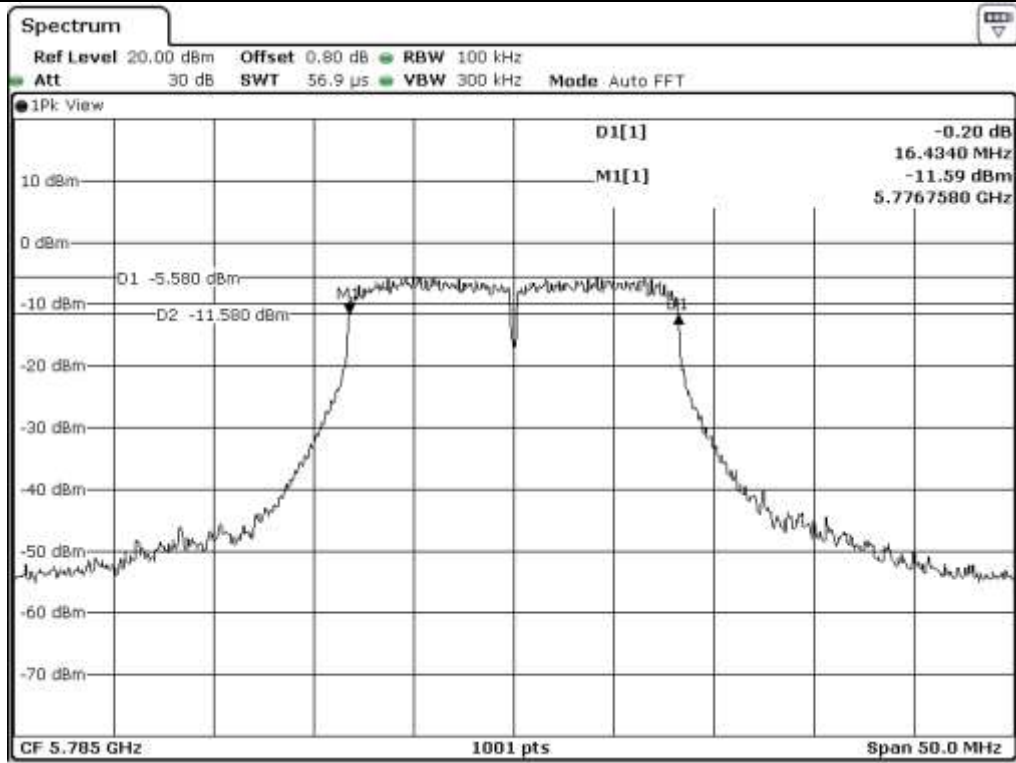
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.48
	Middle	5 785.00	16.43
	High	5 825.00	16.43



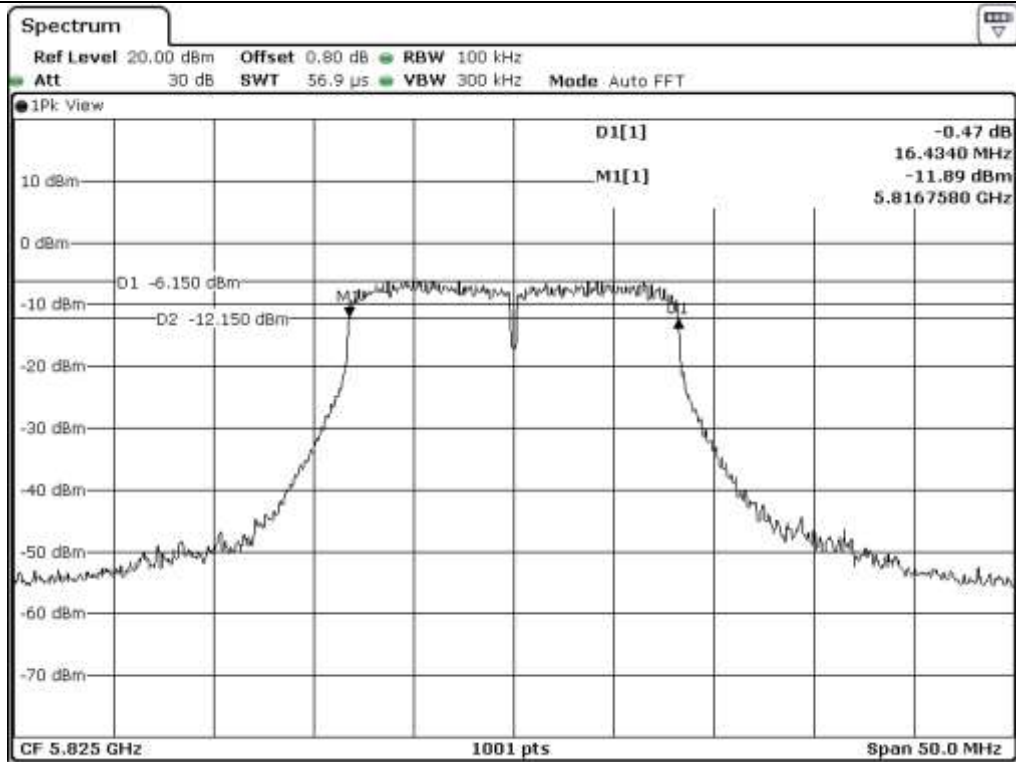
Tested by: Hyung-Kwon, Oh / Engineer



Low Channel (5 745 MHz)



Middle Channel (5.785 MHz)



High Channel (5.825 MHz)

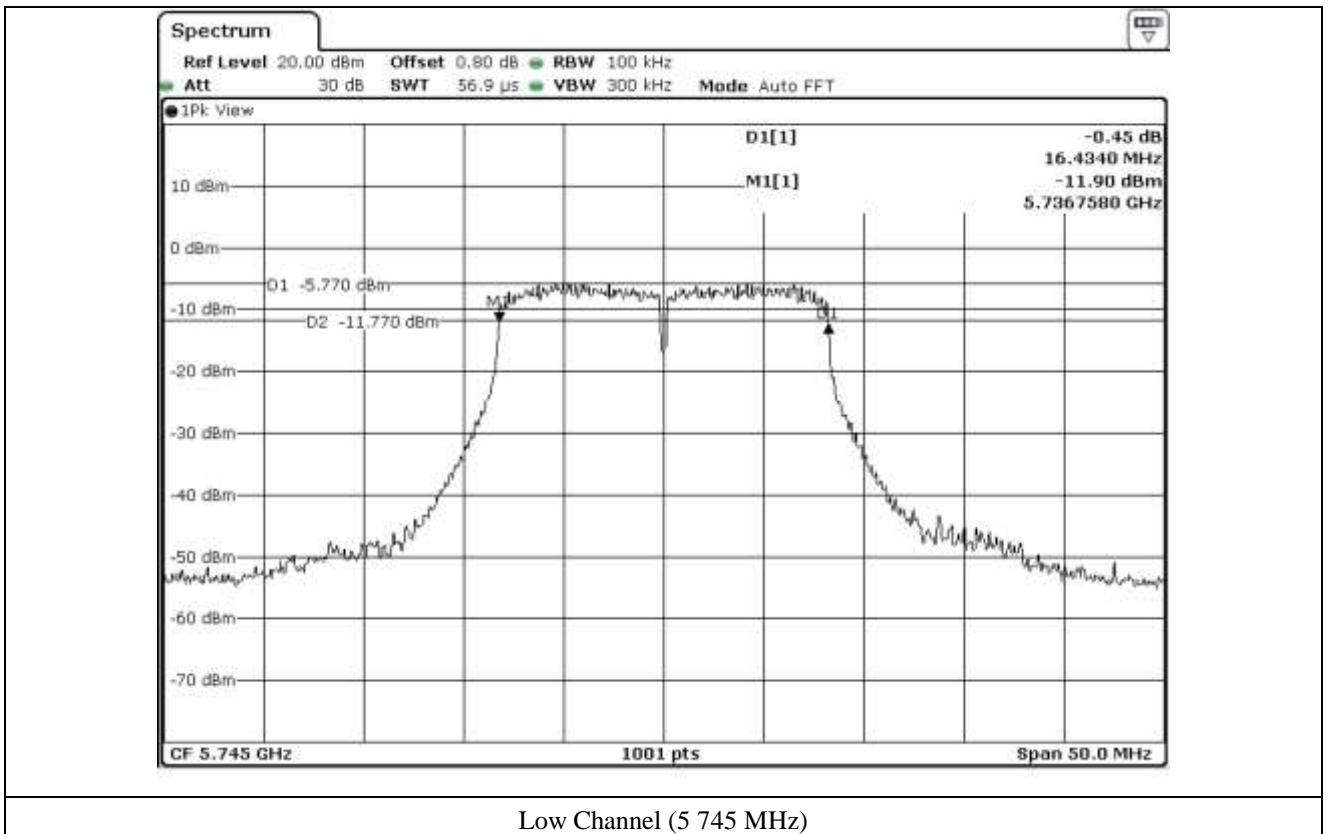
**8.4.2 Test data for Antenna 1**

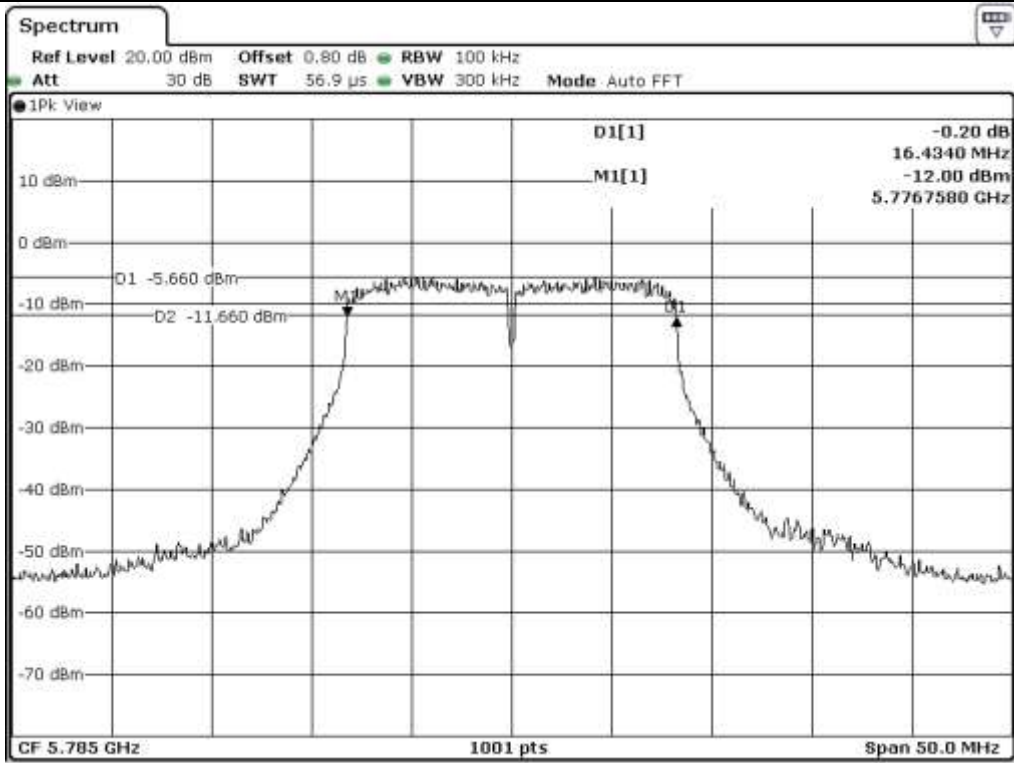
- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.43
	Middle	5 785.00	16.43
	High	5 825.00	16.43

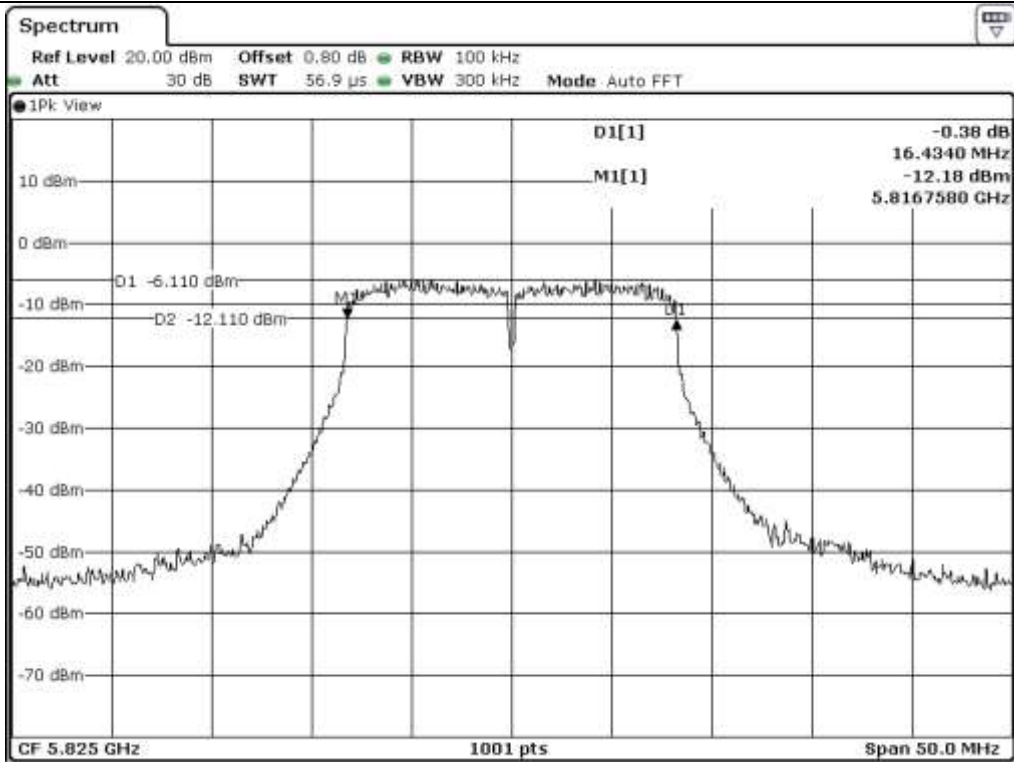


Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

8.5 Test data for 802.11n\_HT20 RLAN Mode

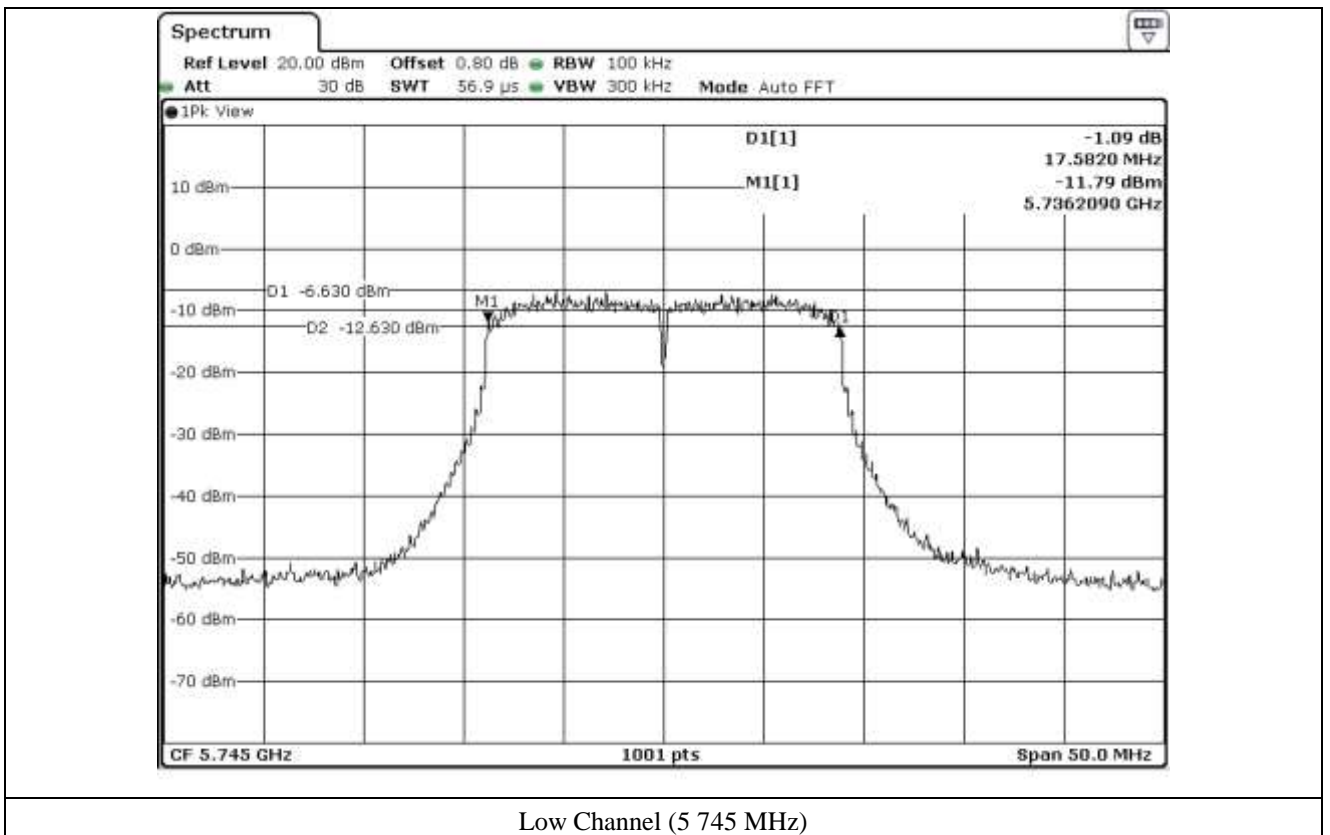
8.5.1 Test data for Antenna 0

- Test Date : July 18, 2017
- Test Result : Pass

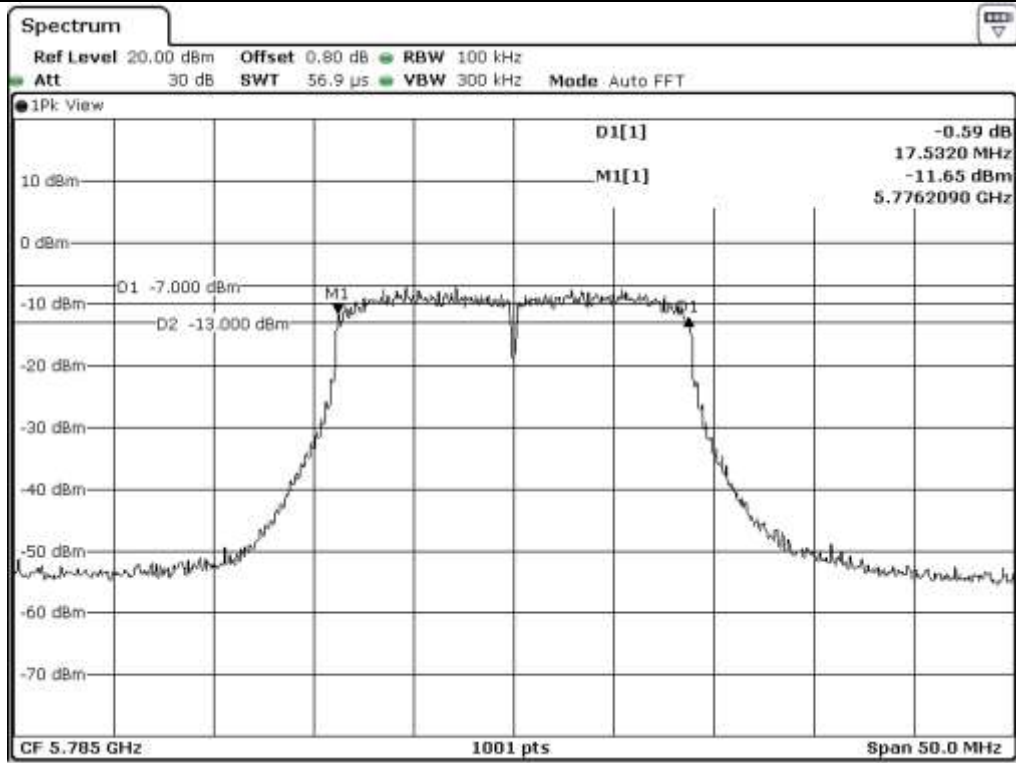
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	17.58
	Middle	5 785.00	17.53
	High	5 825.00	17.53



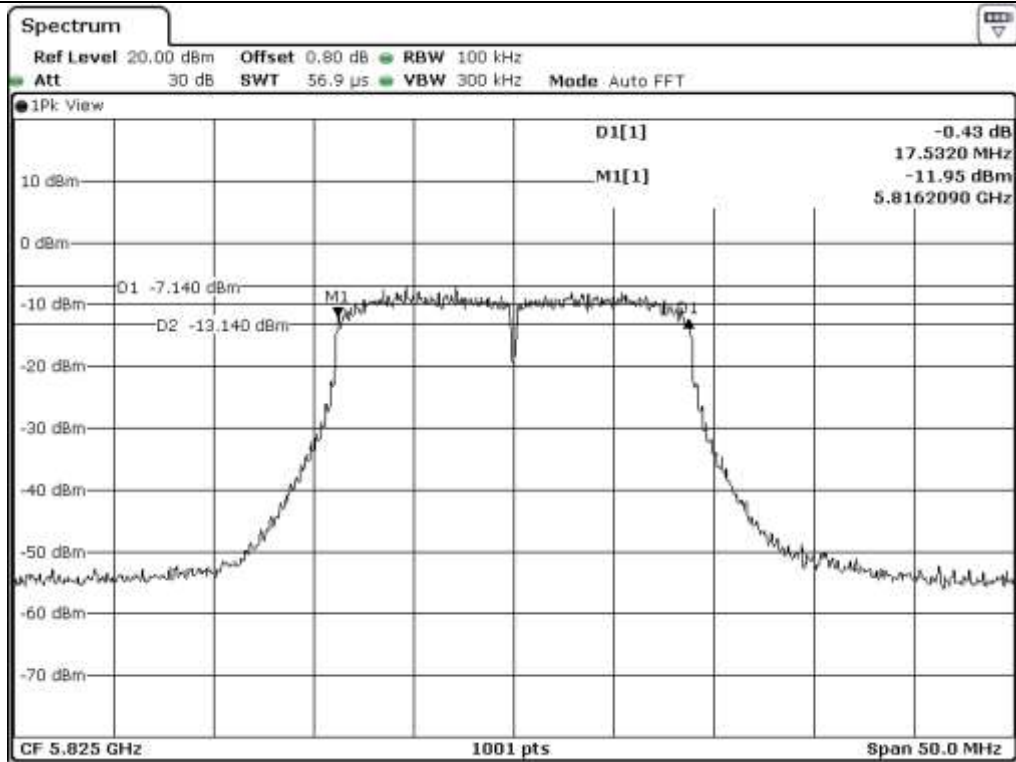
Tested by: Hyung-Kwon, Oh / Engineer



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



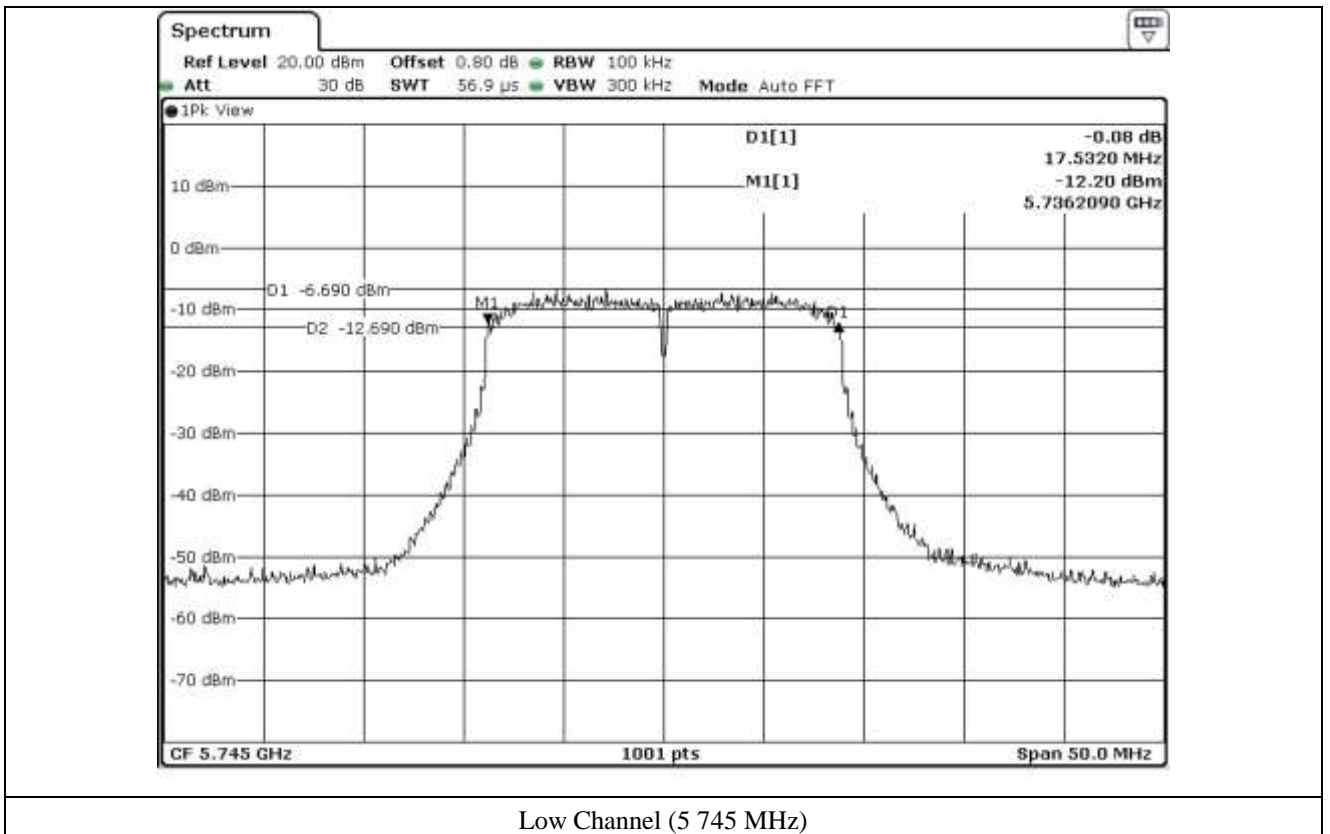
**8.5.2 Test data for Antenna 1**

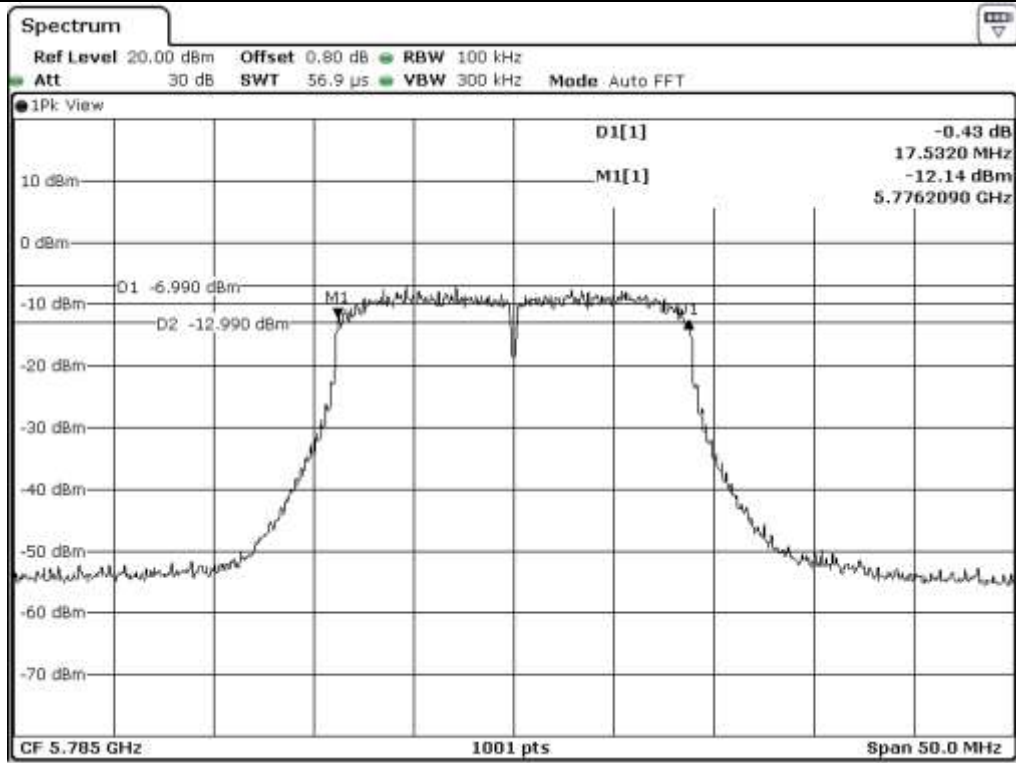
- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	17.53
	Middle	5 785.00	17.53
	High	5 825.00	17.53

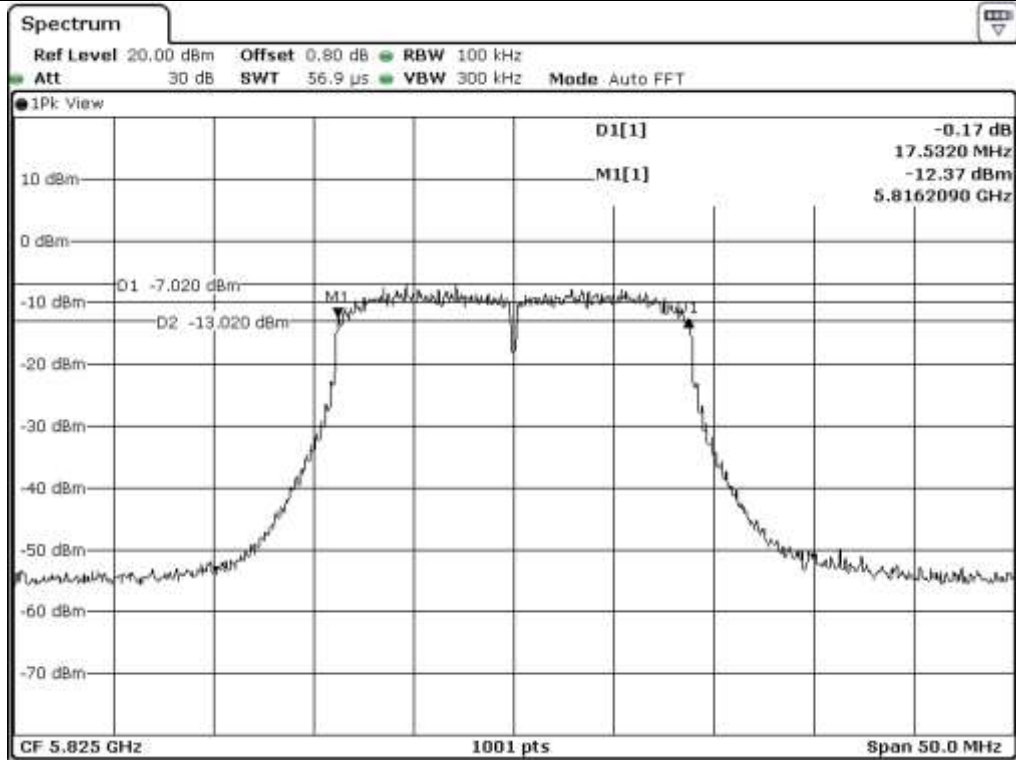


Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5.785 MHz)



High Channel (5.825 MHz)

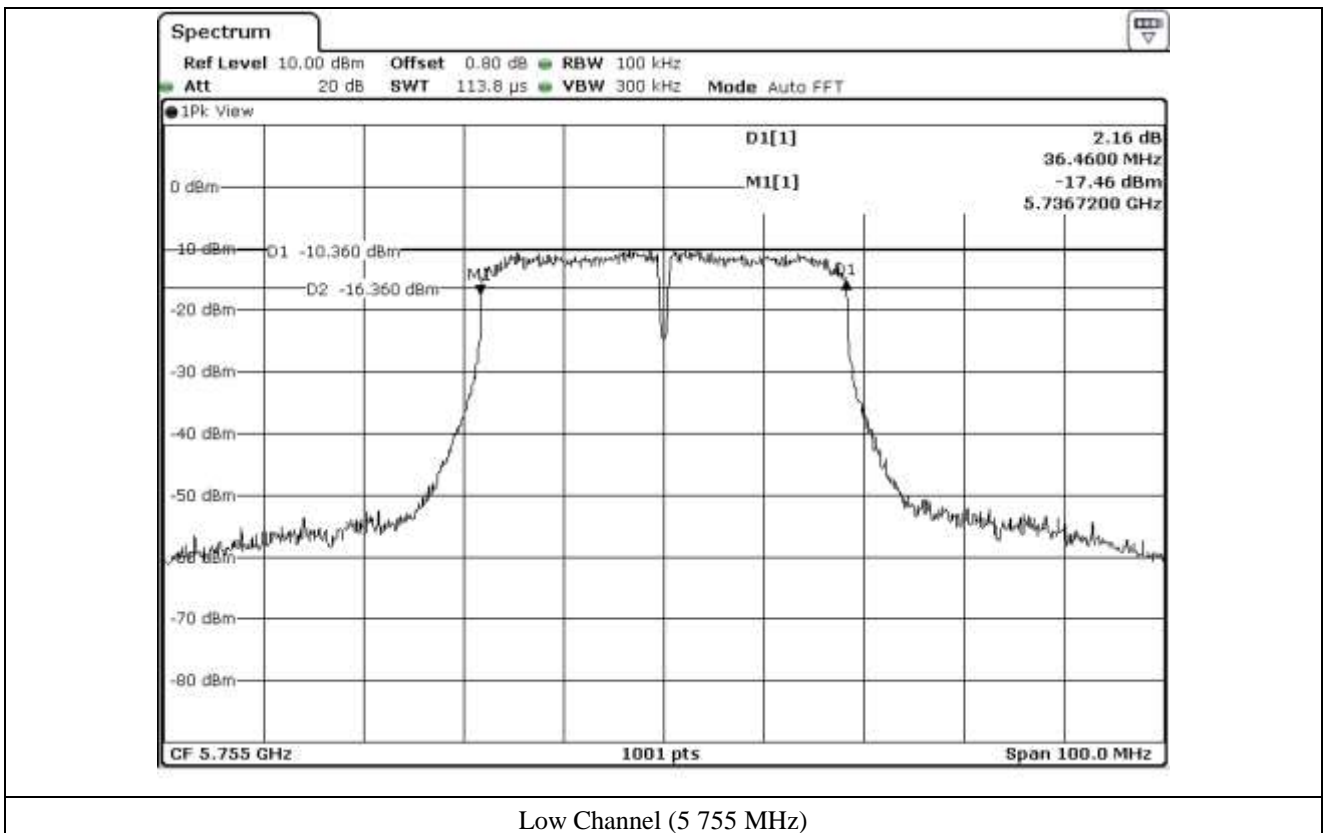
### 8.6 Test data for 802.11n\_HT40 RLAN Mode

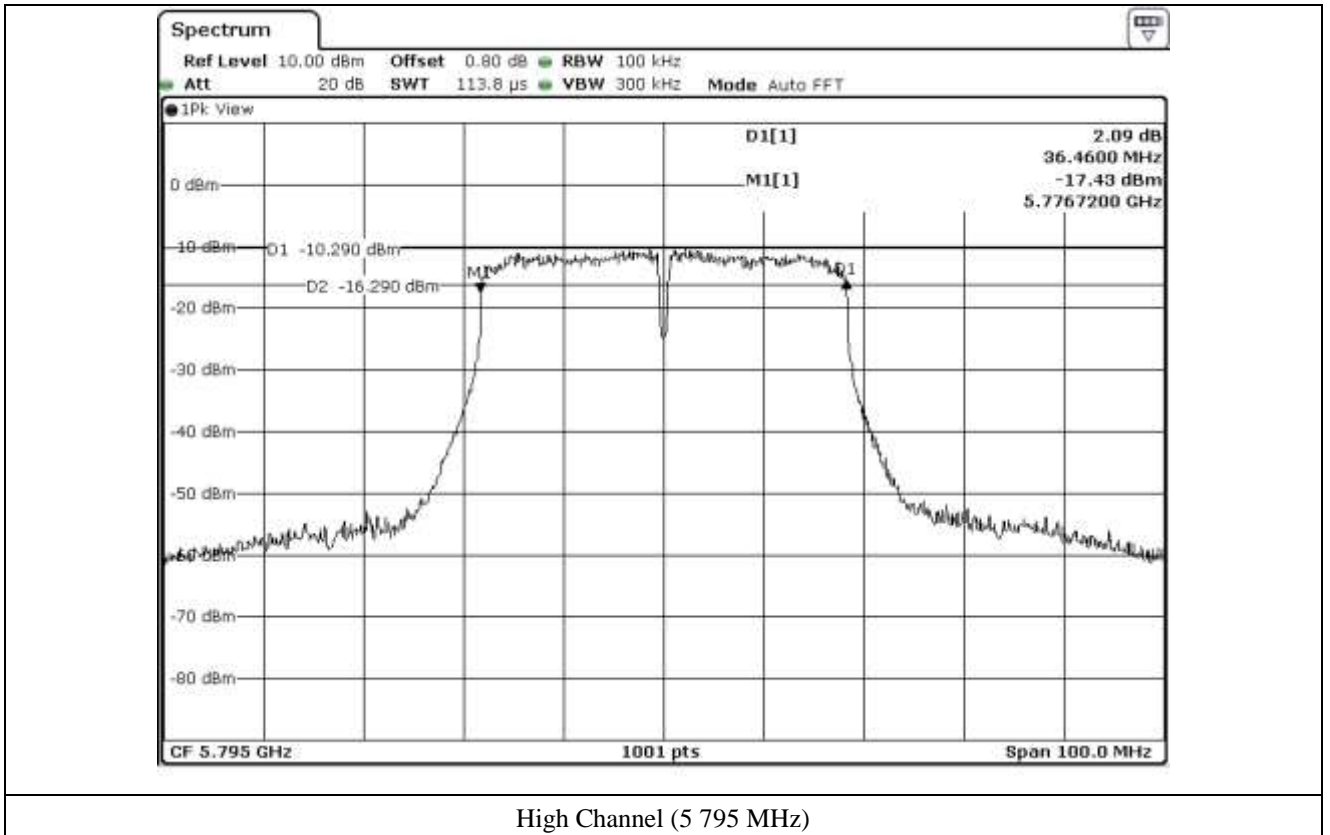
#### 8.6.1 Test data for Antenna 0

- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 755.00	36.46
	High	5 795.00	36.46

Tested by: Hyung-Kwon, Oh / Engineer



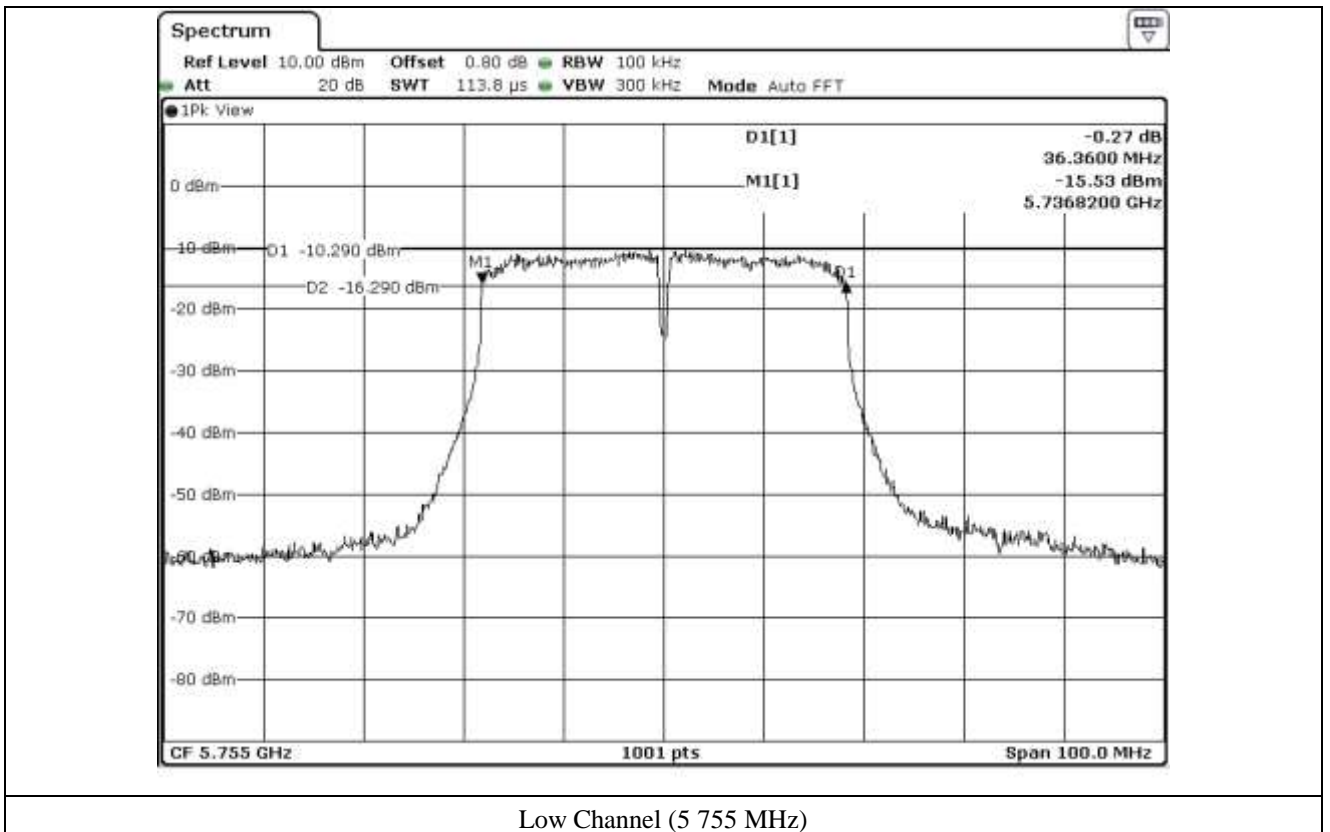


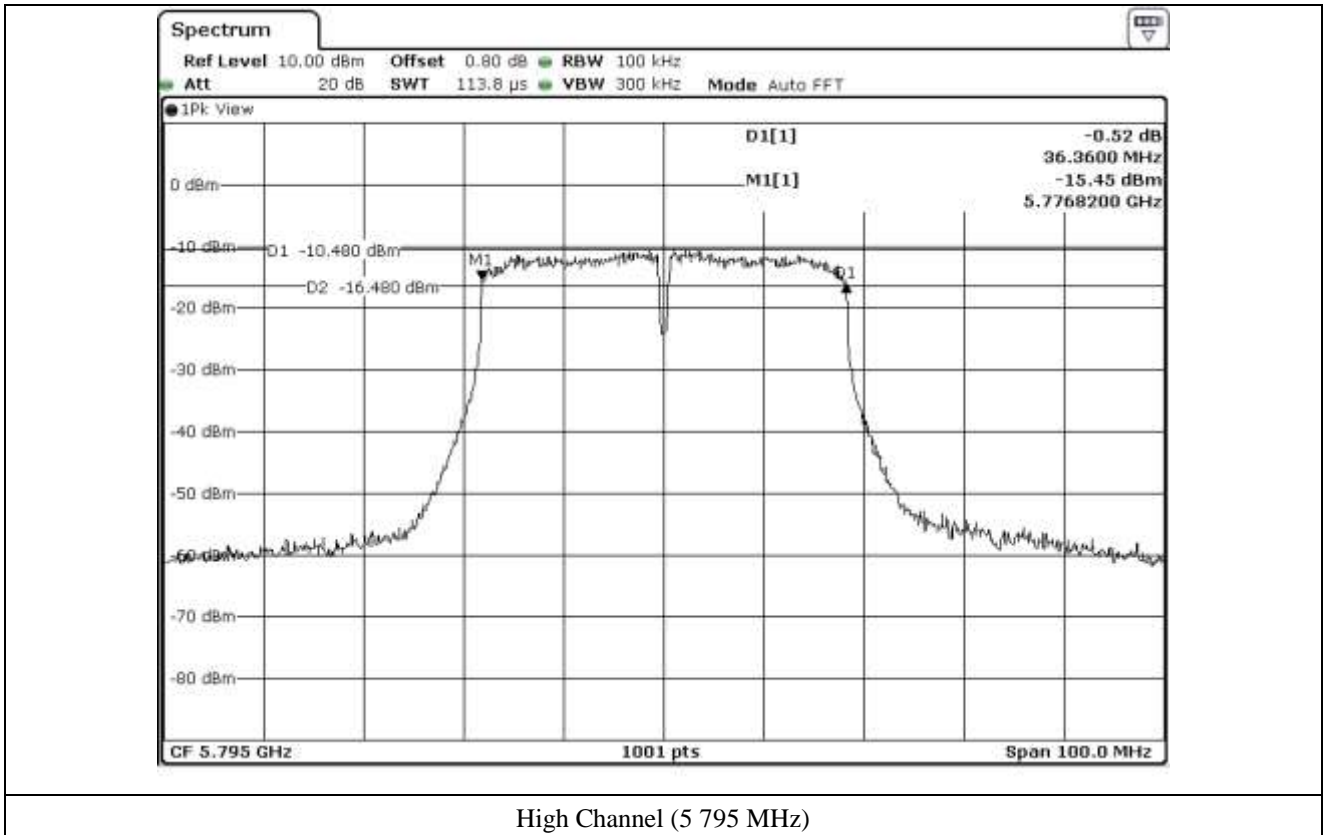
**8.6.2 Test data for Antenna 1**

- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 755.00	36.36
	High	5 795.00	36.36

Tested by: Hyung-Kwon, Oh / Engineer





8.7 Test data for 802.11ac\_VHT80 RLAN Mode

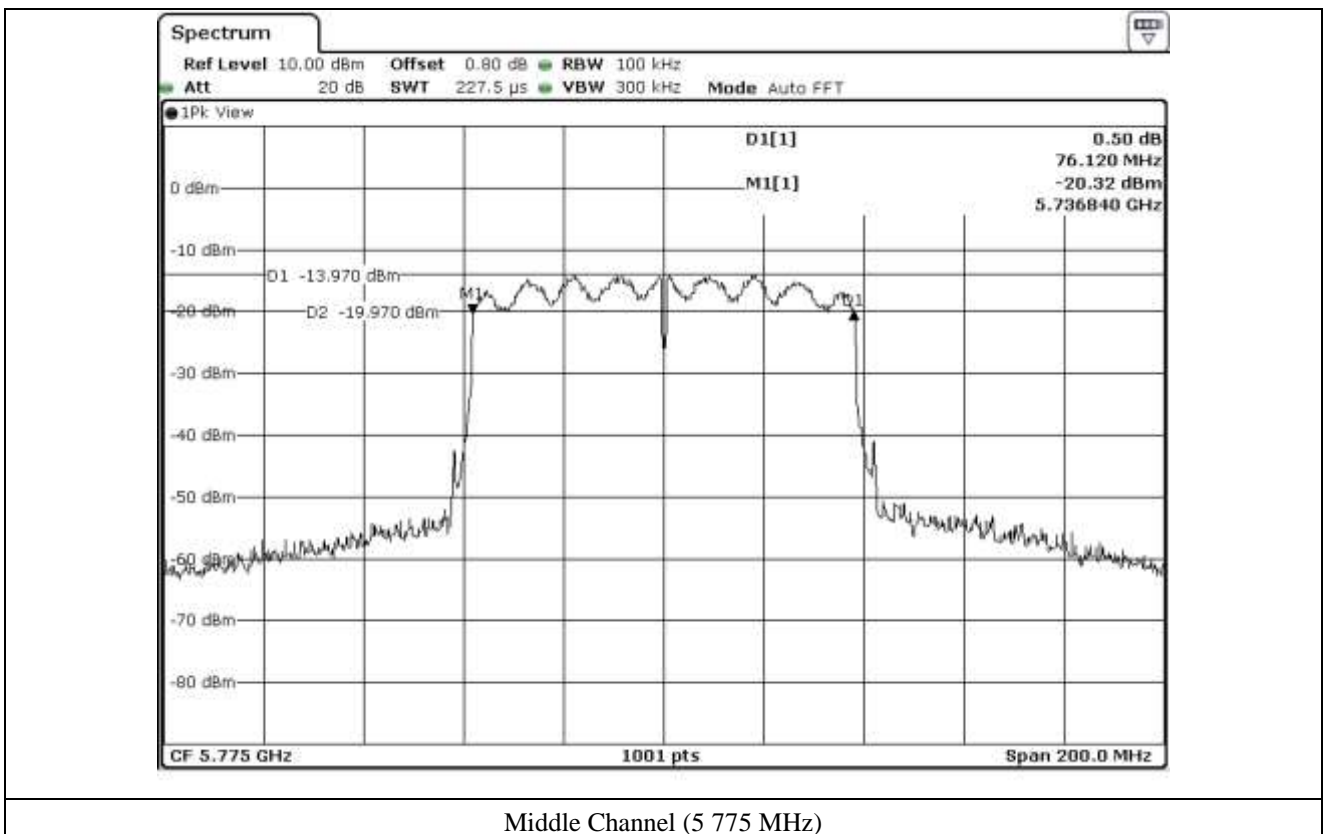
8.7.1 Test data for Antenna 0

- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	76.12



Tested by: Hyung-Kwon, Oh / Assistant Manager



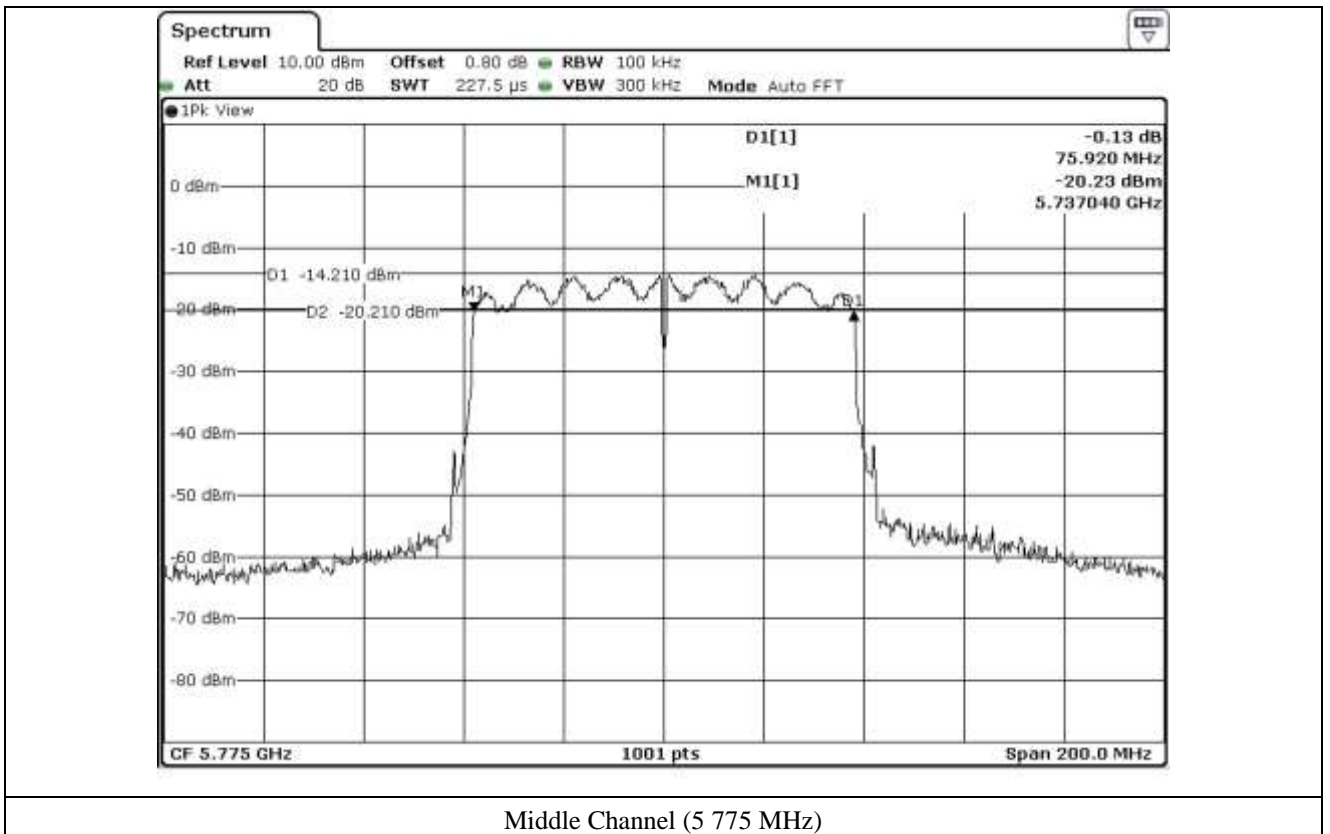
**8.7.2 Test data for Antenna 1**

- Test Date : July 18, 2017
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	75.92



Tested by: Hyung-Kwon, Oh / Assistant Manager





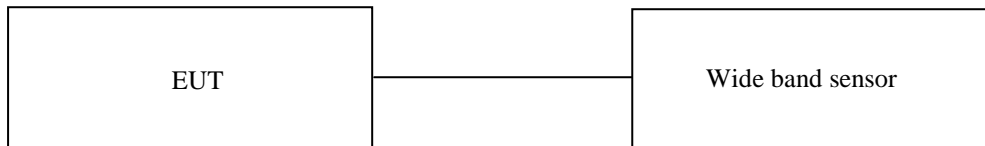
## 9. MAXIMUM PEAK OUTPUT POWER

### 9.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 42 % R.H.

### 9.2 Test set-up

The maximum peak output power was measured with the wide band sensor connected to the antenna output of the EUT. The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section E. 3.(KDB 789033 D02 General UNII Test Procedures New Rules v01r04). Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



### 9.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - NRP-Z81	Rohde & Schwarz	Wide band Sensor	101975	Apr. 04, 2017 (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 : July 19, 2017  
 - Test Result : Pass  
 - Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	10.03	30.00	19.97
	Middle	5 220.00	10.02	30.00	19.98
	High	5 240.00	9.88	30.00	20.12
5 725 ~ 5 850	Low	5 745.00	9.89	30.00	20.11
	Middle	5 785.00	9.79	30.00	20.21
	High	5 825.00	9.53	30.00	20.47

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

**9.4.2 Test data for Antenna 1**

- Test Date : July 19, 2017  
 - Test Result : Pass  
 - Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	9.95	30.00	20.05
	Middle	5 220.00	10.14	30.00	19.86
	High	5 240.00	10.07	30.00	19.93
5 725 ~ 5 850	Low	5 745.00	9.80	30.00	20.20
	Middle	5 785.00	9.62	30.00	20.38
	High	5 825.00	9.34	30.00	20.66

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



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

**9.4.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	13.00	30.00	17.00
	Middle	5 220.00	13.09	30.00	16.91
	High	5 240.00	12.99	30.00	17.01
5 725 ~ 5 850	Low	5 745.00	12.86	30.00	17.14
	Middle	5 785.00	12.72	30.00	17.28
	High	5 825.00	12.45	30.00	17.55

Remark 1: Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

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**

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

**9.5.1 Test data for Antenna 0**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	7.58	30.00	22.42
	Middle	5 220.00	7.77	30.00	22.23
	High	5 240.00	7.76	30.00	22.24
5 725 ~ 5 850	Low	5 745.00	7.78	30.00	22.22
	Middle	5 785.00	7.78	30.00	22.22
	High	5 825.00	7.44	30.00	22.56

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

**9.5.2 Test data for Antenna 1**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	7.71	30.00	22.29
	Middle	5 220.00	8.00	30.00	22.00
	High	5 240.00	7.90	30.00	22.10
5 725 ~ 5 850	Low	5 745.00	7.71	30.00	22.29
	Middle	5 785.00	7.58	30.00	22.42
	High	5 825.00	7.19	30.00	22.81

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



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

**9.5.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	10.66	30.00	19.34
	Middle	5 220.00	10.90	30.00	19.10
	High	5 240.00	10.84	30.00	19.16
5 725 ~ 5 850	Low	5 745.00	10.76	30.00	19.24
	Middle	5 785.00	10.69	30.00	19.31
	High	5 825.00	10.33	30.00	19.67

Remark 1: Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

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**

**9.6 Test data for 802.11n\_HT40 RLAN Mode**

**9.6.1 Test data for Antenna 0**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	7.78	30.00	22.22
	High	5 230.00	7.80	30.00	22.20
5 725 ~ 5 850	Low	5 755.00	7.73	30.00	22.27
	High	5 795.00	7.68	30.00	22.32

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

**9.6.2 Test data for Antenna 1**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	8.43	30.00	21.57
	High	5 230.00	8.24	30.00	21.76
5 725 ~ 5 850	Low	5 755.00	7.72	30.00	22.28
	High	5 795.00	7.50	30.00	22.50

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



**Tested by: Hyung-Kwon, Oh / Engineer**

**9.6.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	11.13	30.00	18.87
	High	5 230.00	11.04	30.00	18.96
5 725 ~ 5 850	Low	5 755.00	10.74	30.00	19.26
	High	5 795.00	10.60	30.00	19.40

Remark 1: Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

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**

**9.7 Test data for 802.11ac\_HT80 RLAN Mode**

**9.7.1 Test data for Antenna 0**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	6.25	30.00	23.75
5 725 ~ 5 850	Middle	5 775.00	6.17	30.00	23.83

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

**9.7.2 Test data for Antenna 1**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	6.10	30.00	23.90
5 725 ~ 5 850	Middle	5 775.00	5.84	30.00	24.16

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



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



**9.7.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Test Result : Pass
- Duty Cycle : > 98 %

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	9.19	30.00	20.81
5 725 ~ 5 850	Middle	5 775.00	9.02	30.00	20.98

Remark 1: Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

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**

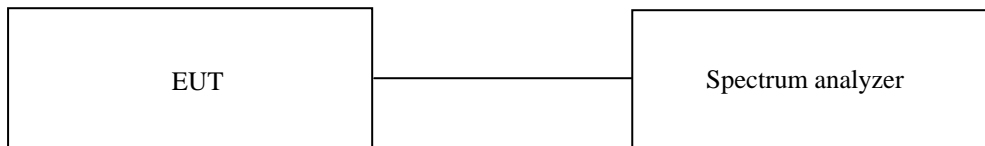
## 10. PEAK POWER SPECTRUL DENSITY

### 10.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 42 % R.H.

### 10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 times the resolution bandwidth. The maximum level form the EUT in 1 MHz bandwidth was measured with above condition.



### 10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

**10.4 Test data for 802.11a RLAN Mode**

**10.4.1 Test data for Antenna 0**

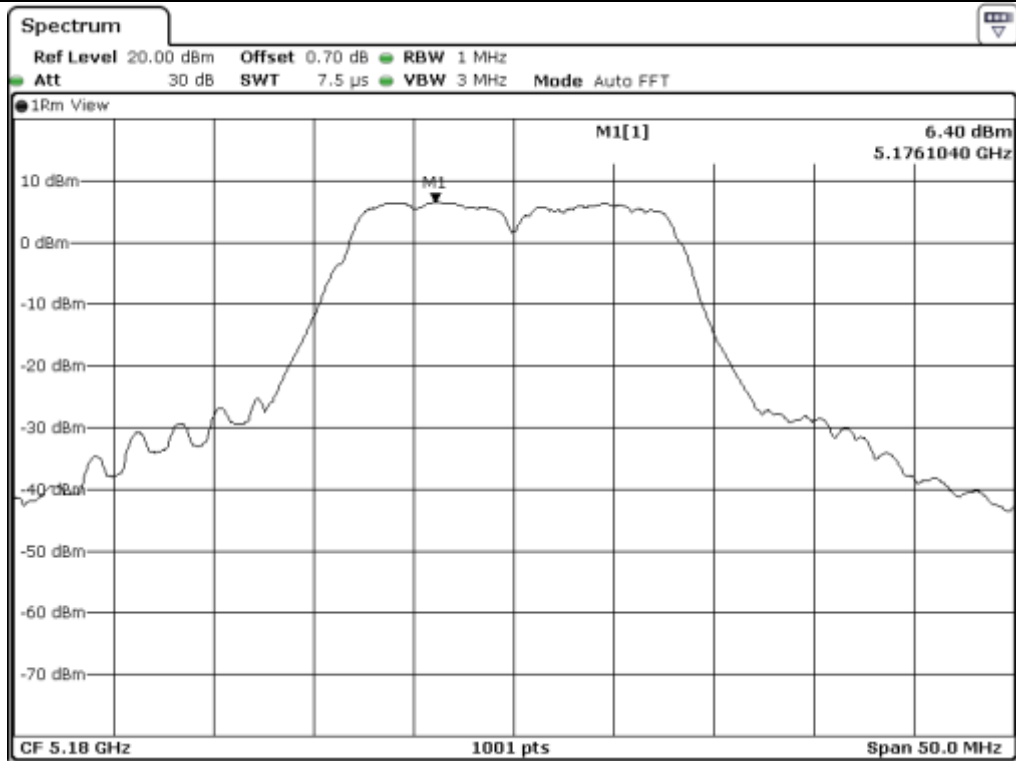
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	6.40	17.00	10.60
	Middle	5 220.00	6.08	17.00	10.92
	High	5 240.00	5.72	17.00	11.28
5 725 ~ 5 850	Low	5 745.00	2.57	30.00	27.43
	Middle	5 785.00	2.46	30.00	27.54
	High	5 825.00	2.17	30.00	27.83

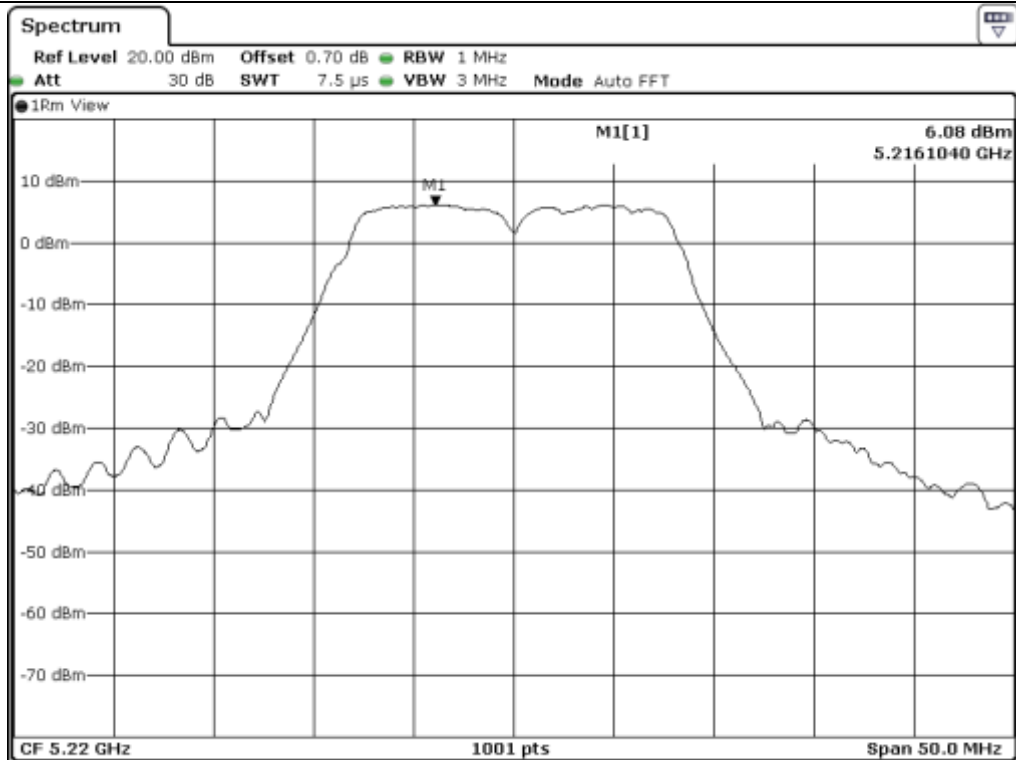
Remark: See next page for measurement data.



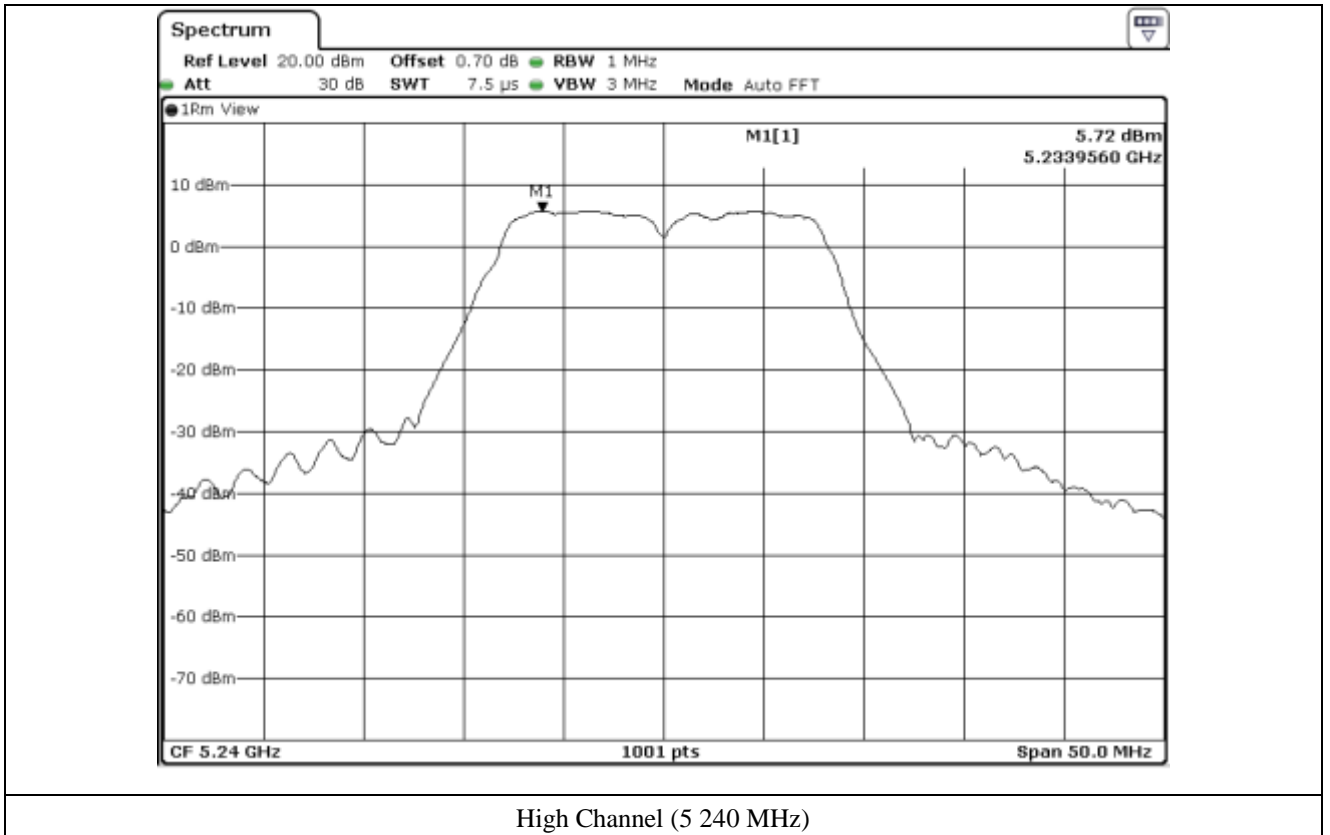
**Tested by: Hyung-Kwon, Oh / Engineer**



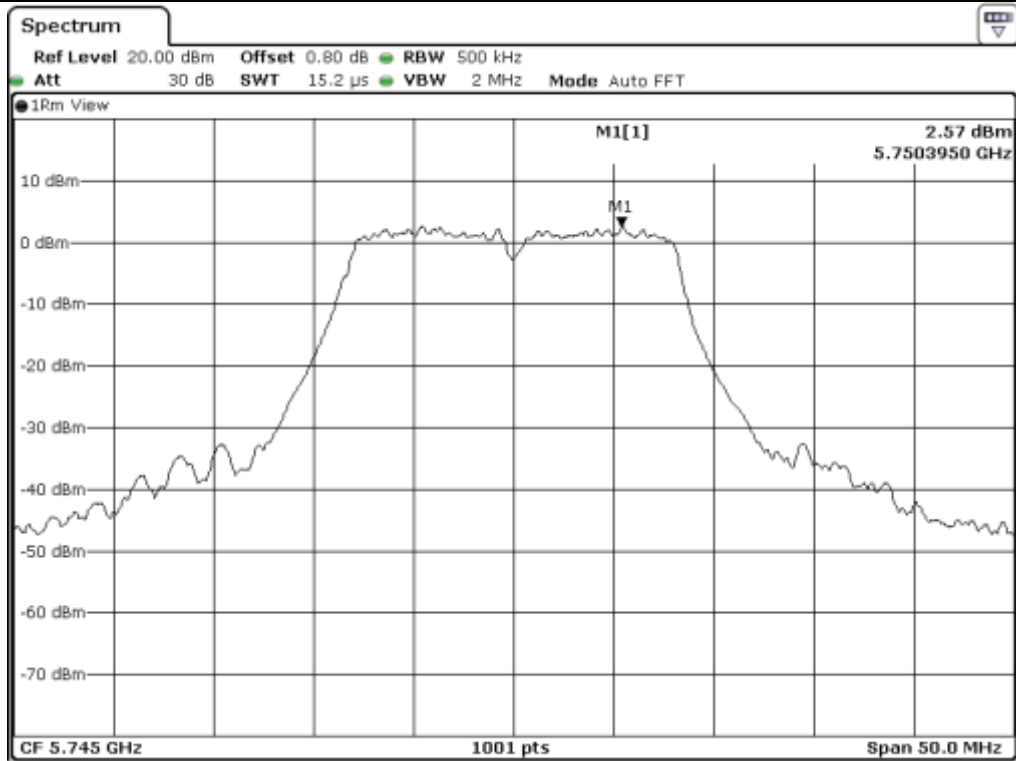
Low Channel (5 180 MHz)



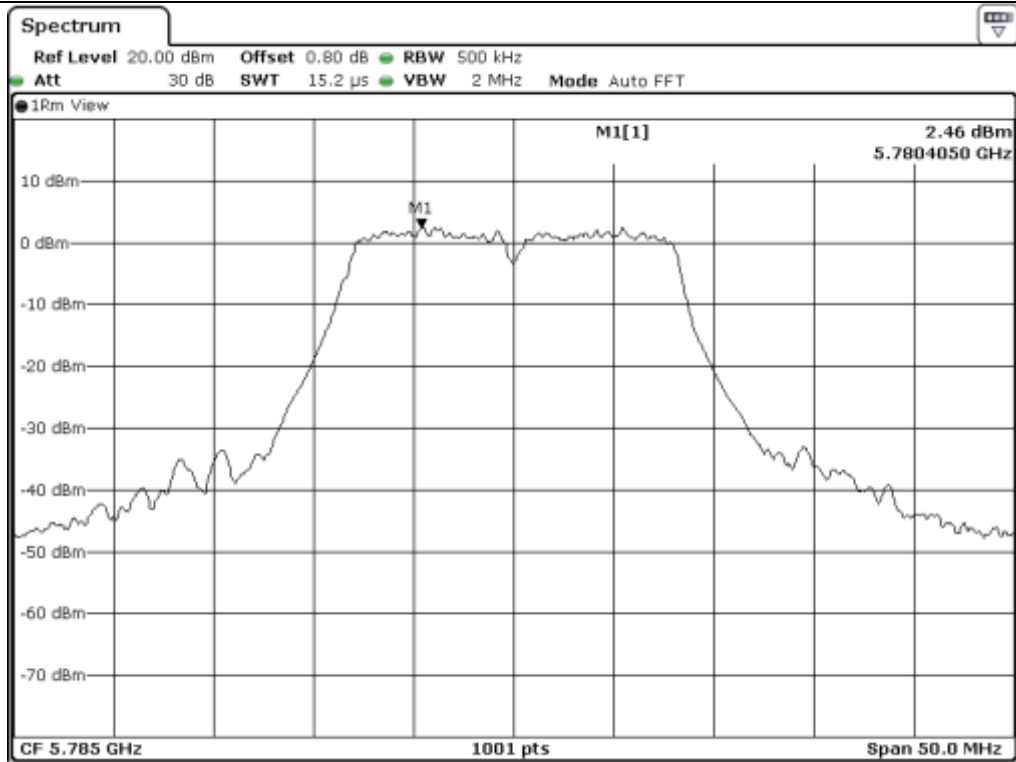
Middle Channel (5 220 MHz)



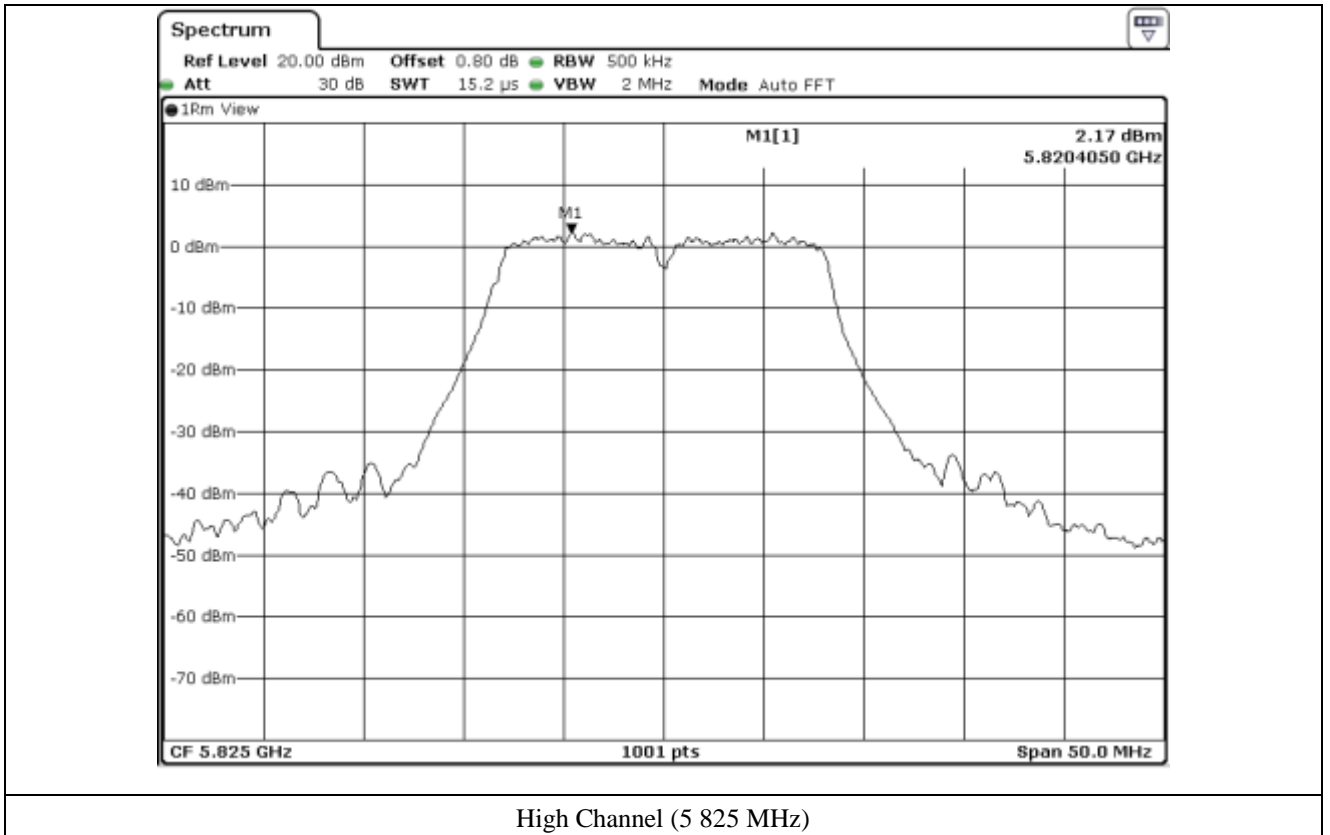
High Channel (5 240 MHz)



Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



**10.4.2 Test data for Antenna 1**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

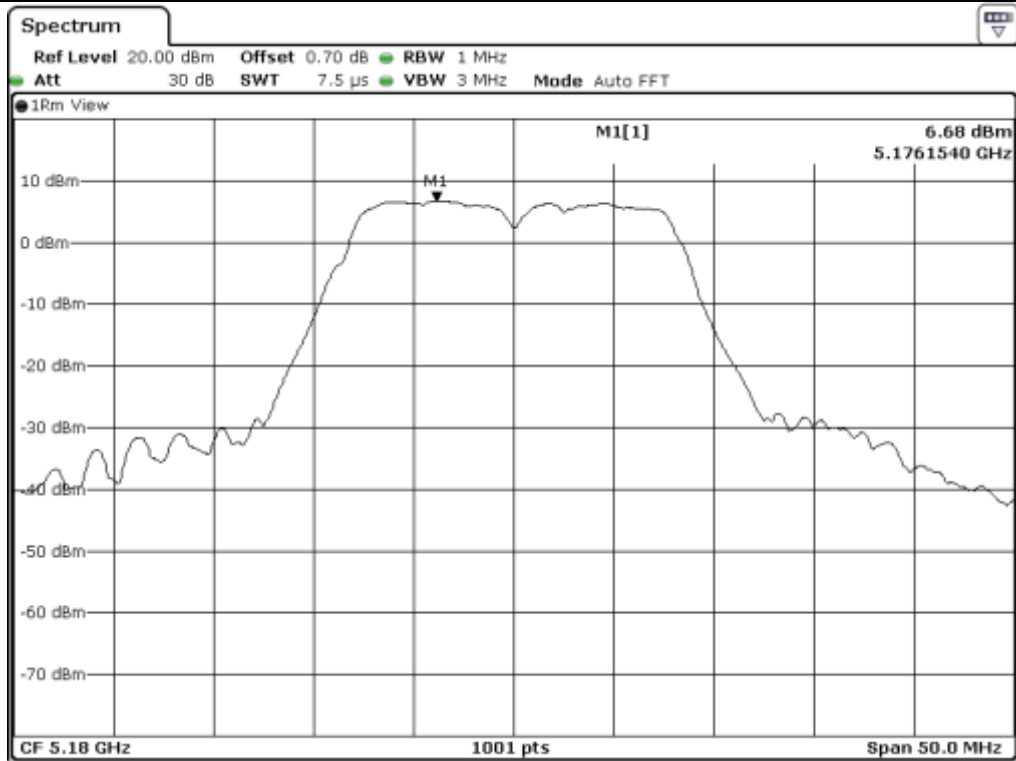
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	6.68	17.00	10.32
	Middle	5 220.00	6.40	17.00	10.60
	High	5 240.00	6.39	17.00	10.61
5 725 ~ 5 850	Low	5 745.00	2.86	30.00	27.14
	Middle	5 785.00	2.24	30.00	27.76
	High	5 825.00	2.10	30.00	27.90

Remark: See next page for measurement data.

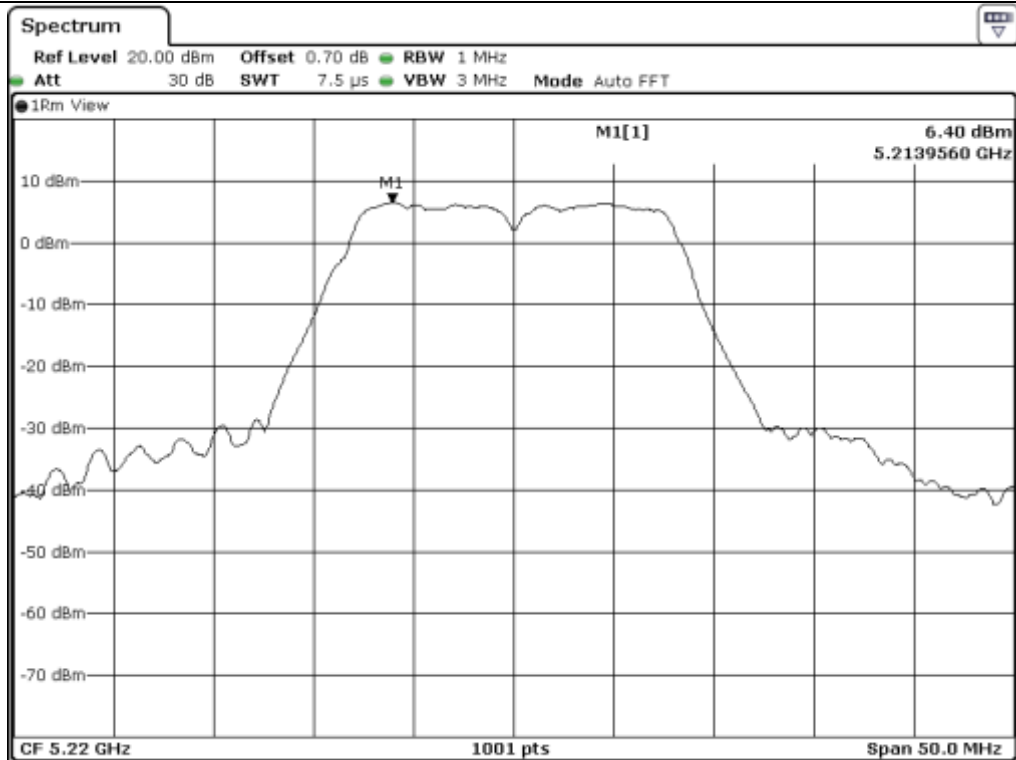


**Tested by: Hyung-Kwon, Oh / Engineer**

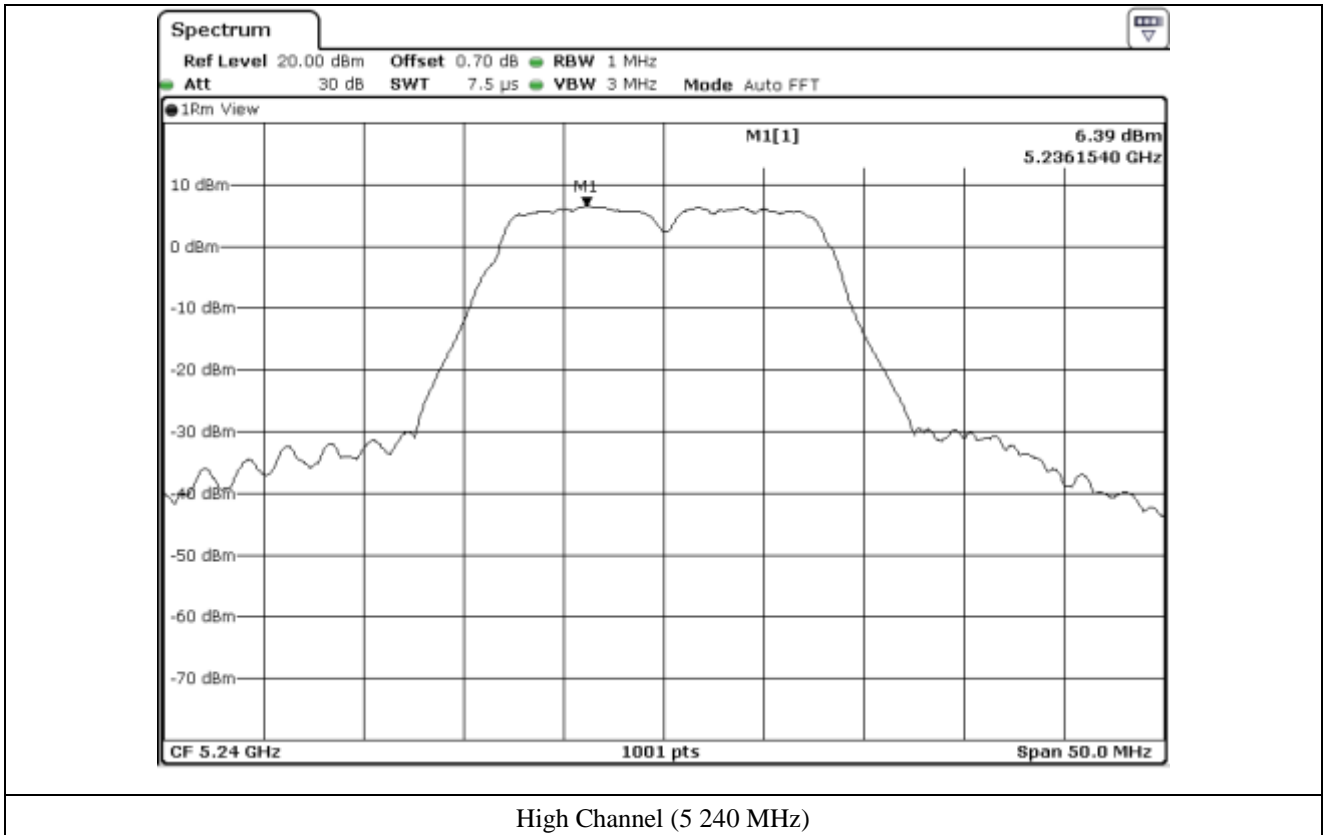




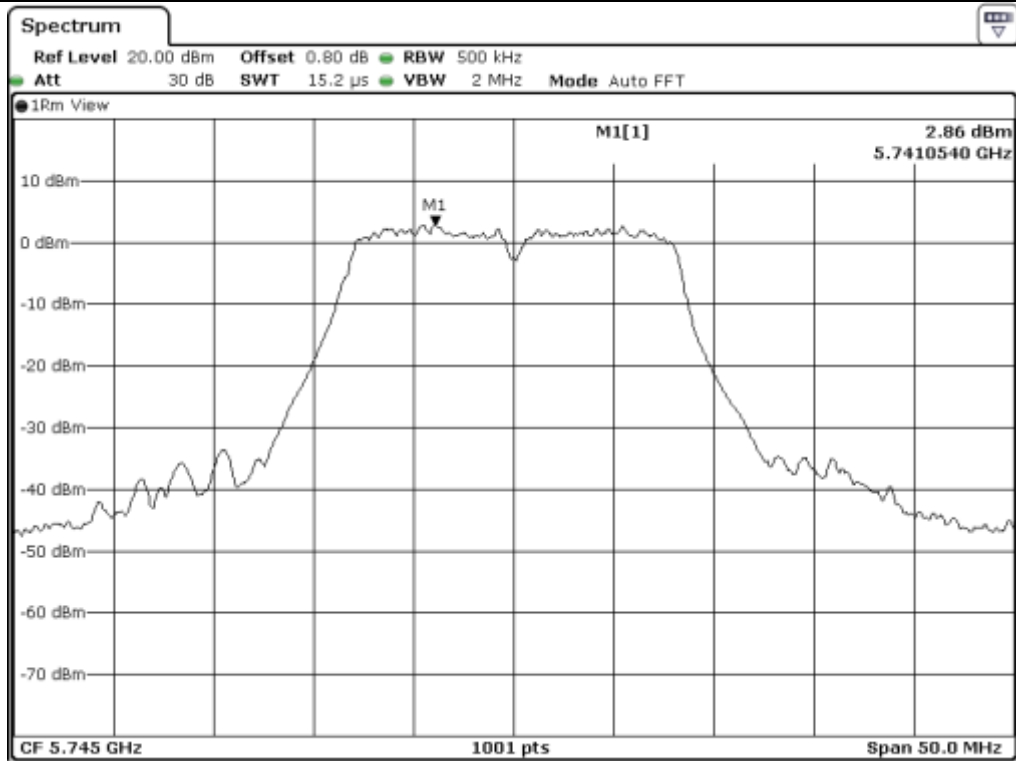
Low Channel (5 180 MHz)



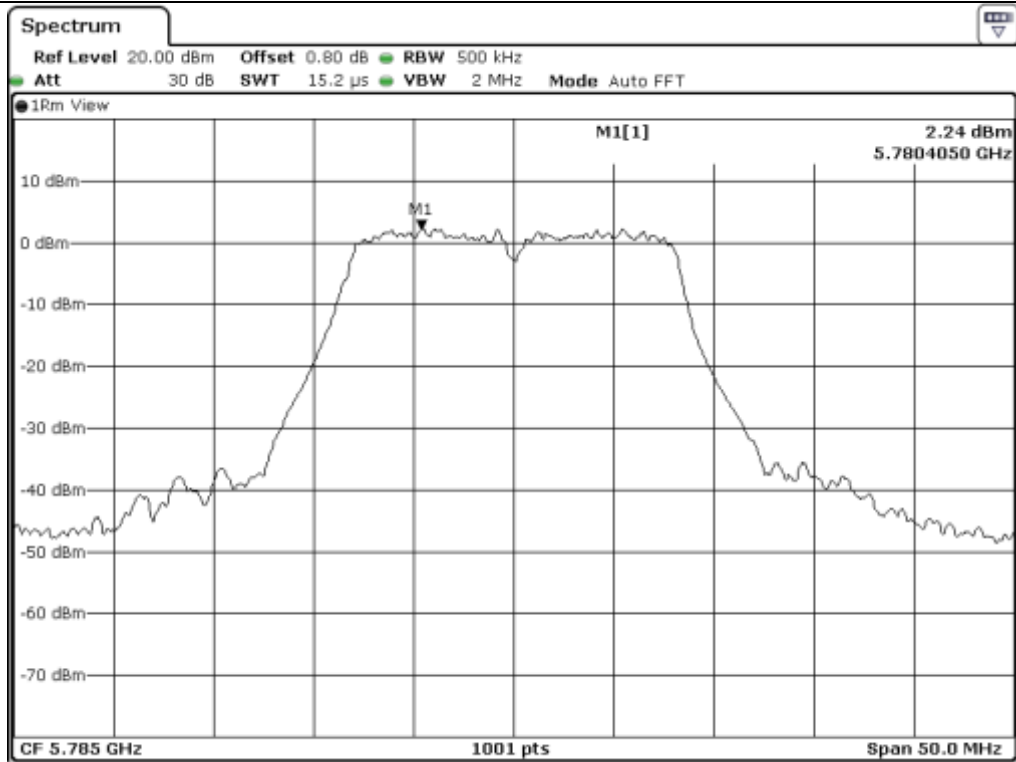
Middle Channel (5 220 MHz)



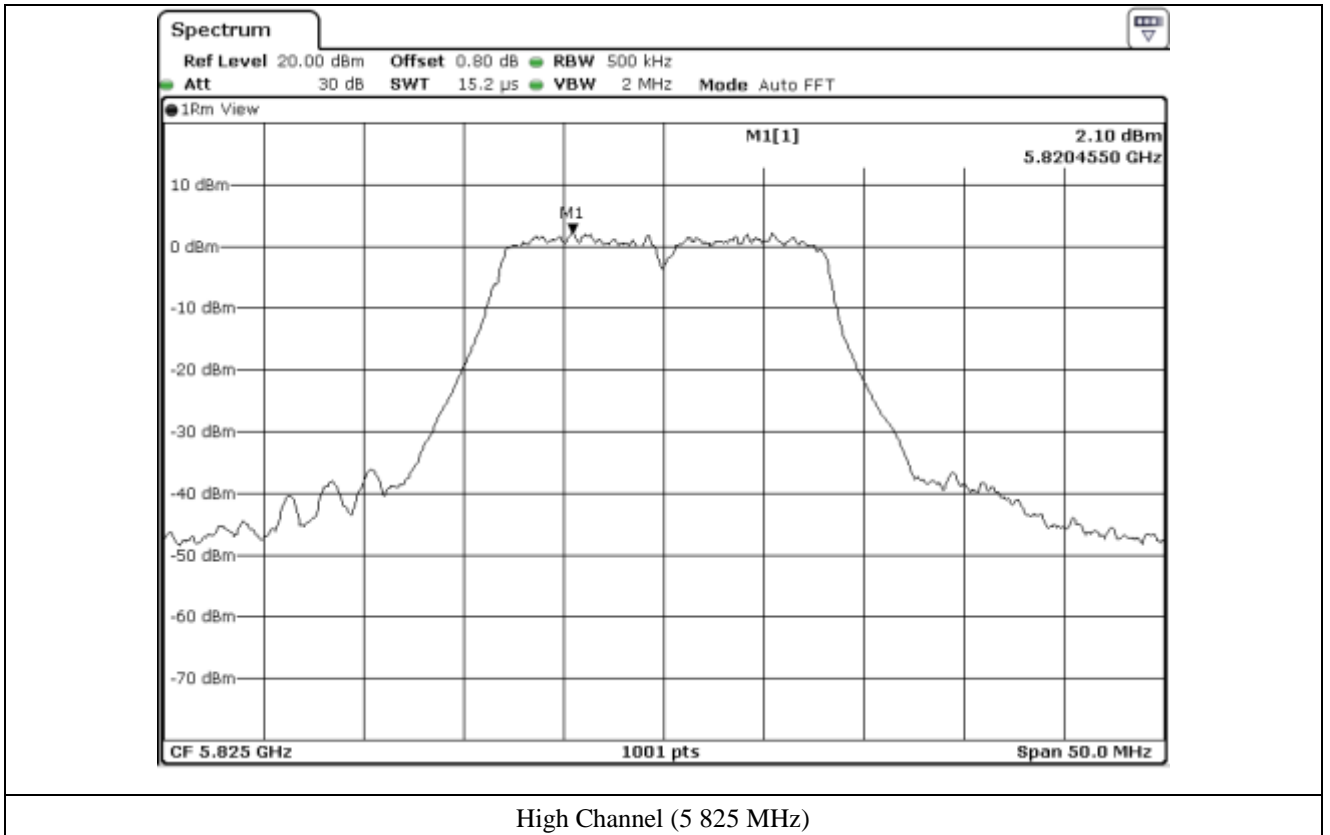
High Channel (5 240 MHz)



Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



**10.4.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	9.55	17.00	7.45
	Middle	5 220.00	9.25	17.00	7.75
	High	5 240.00	9.08	17.00	7.92
5 725 ~ 5 850	Low	5 745.00	5.73	30.00	24.27
	Middle	5 785.00	5.36	30.00	24.64
	High	5 825.00	5.15	30.00	24.85

Remark 1 : Margin = Limit – Measured value

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



**Tested by: Hyung-Kwon, Oh / Engineer**

**10.5 Test data for 802.11n\_HT20 RLAN Mode**

**10.5.1 Test data for Antenna 0**

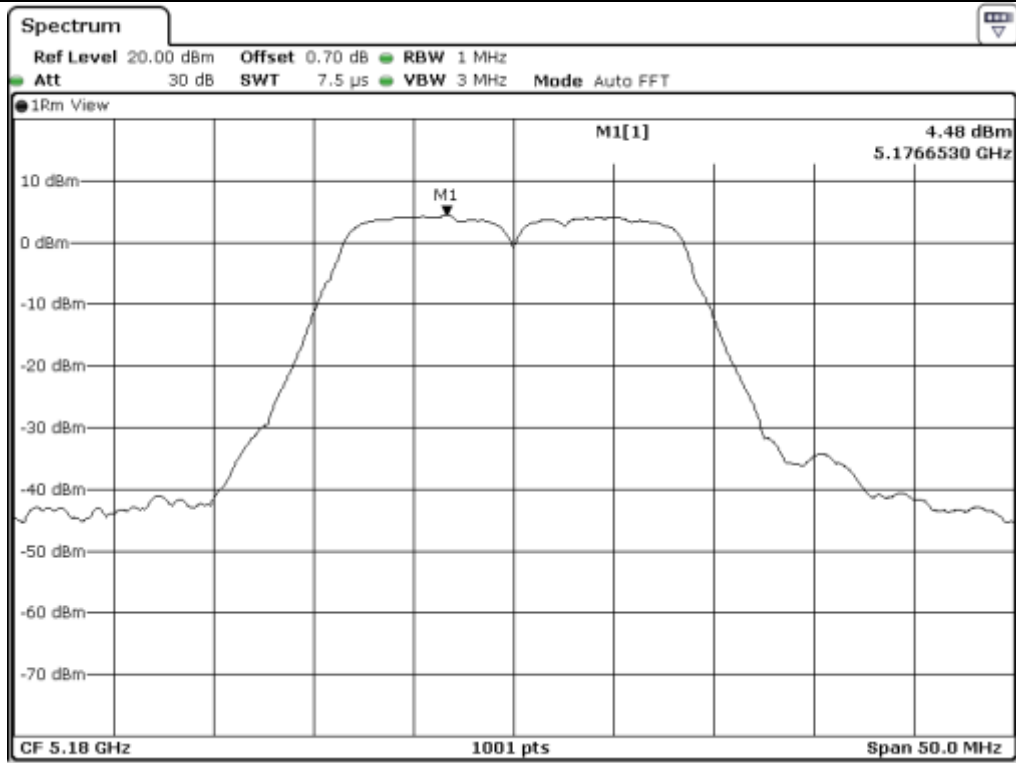
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	4.48	17.00	12.52
	Middle	5 220.00	4.21	17.00	12.79
	High	5 240.00	3.96	17.00	13.04
5 725 ~ 5 850	Low	5 745.00	1.29	30.00	28.71
	Middle	5 785.00	1.00	30.00	29.00
	High	5 825.00	0.68	30.00	29.32

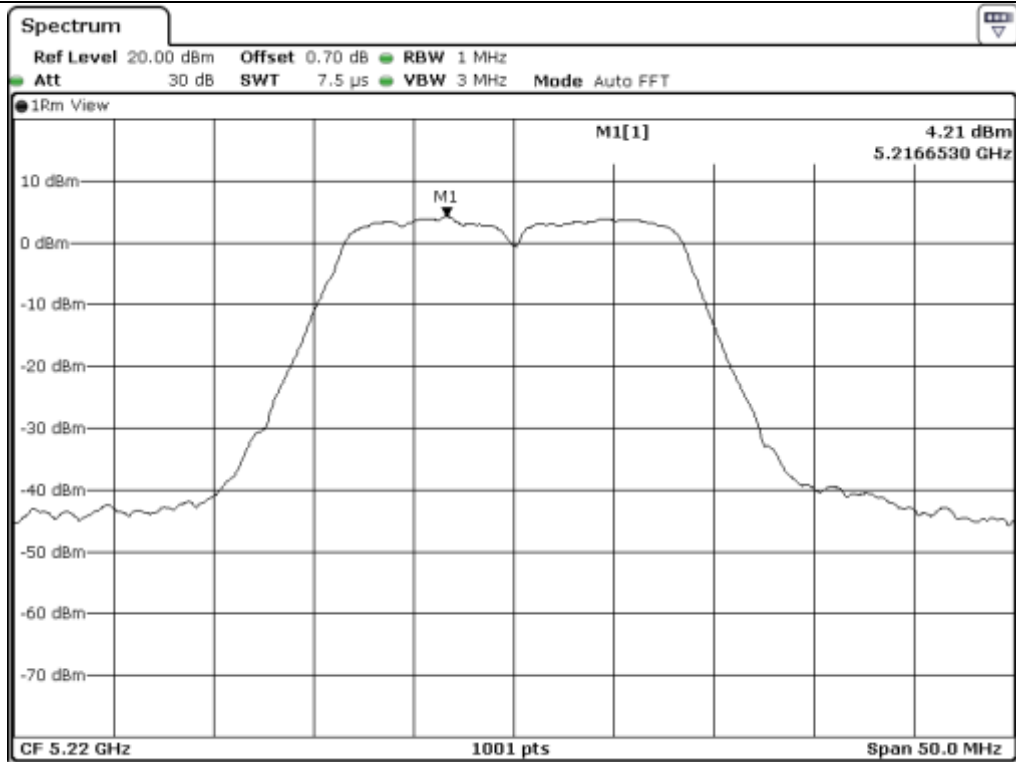
Remark: See next page for measurement data.



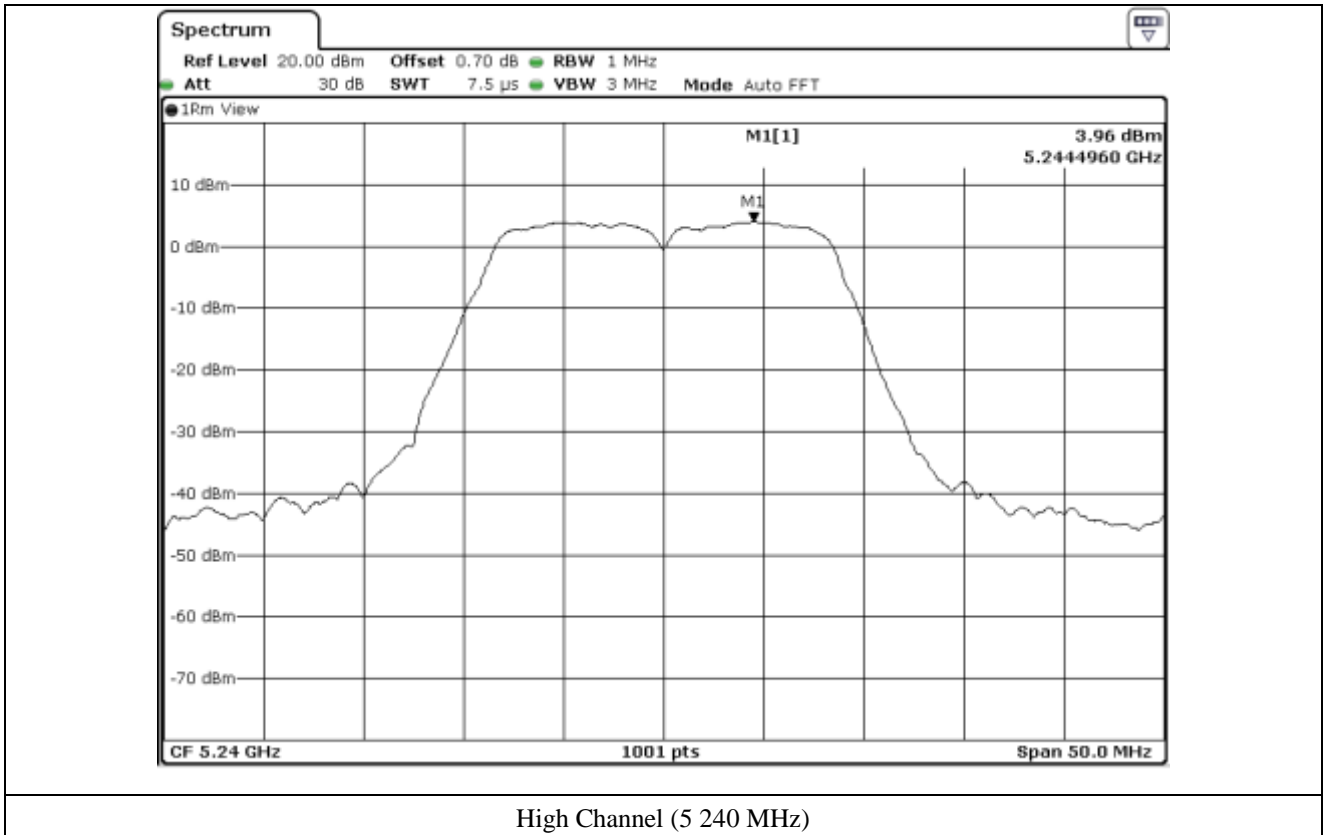
**Tested by: Hyung-Kwon, Oh / Engineer**



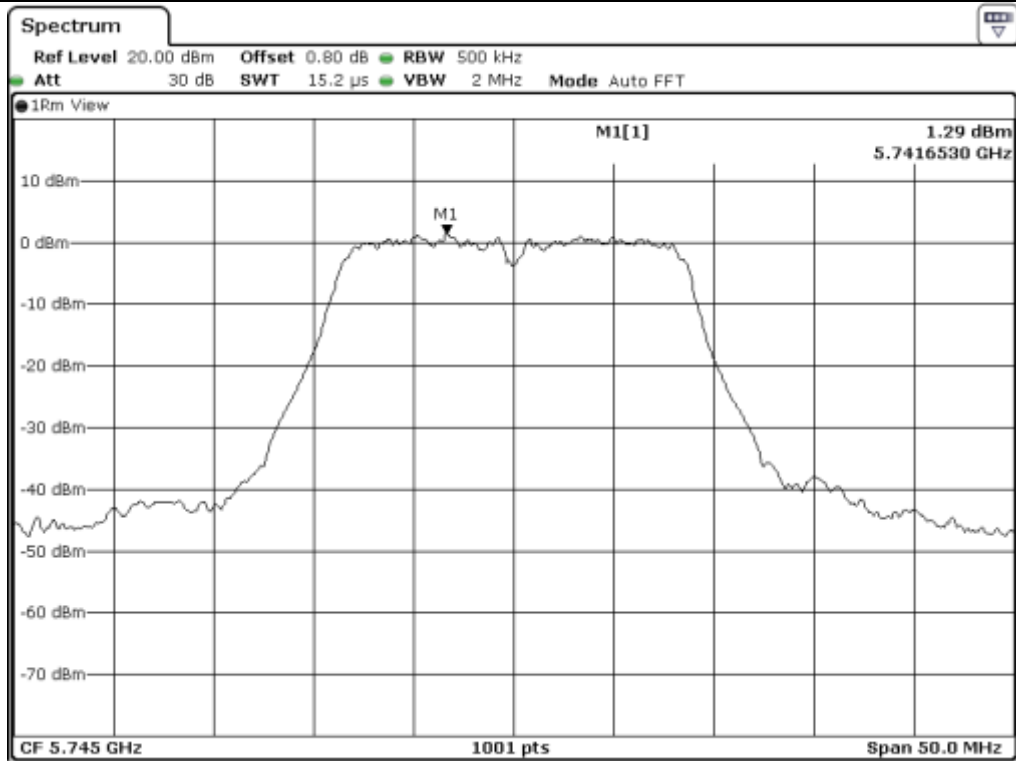
Low Channel (5 180 MHz)



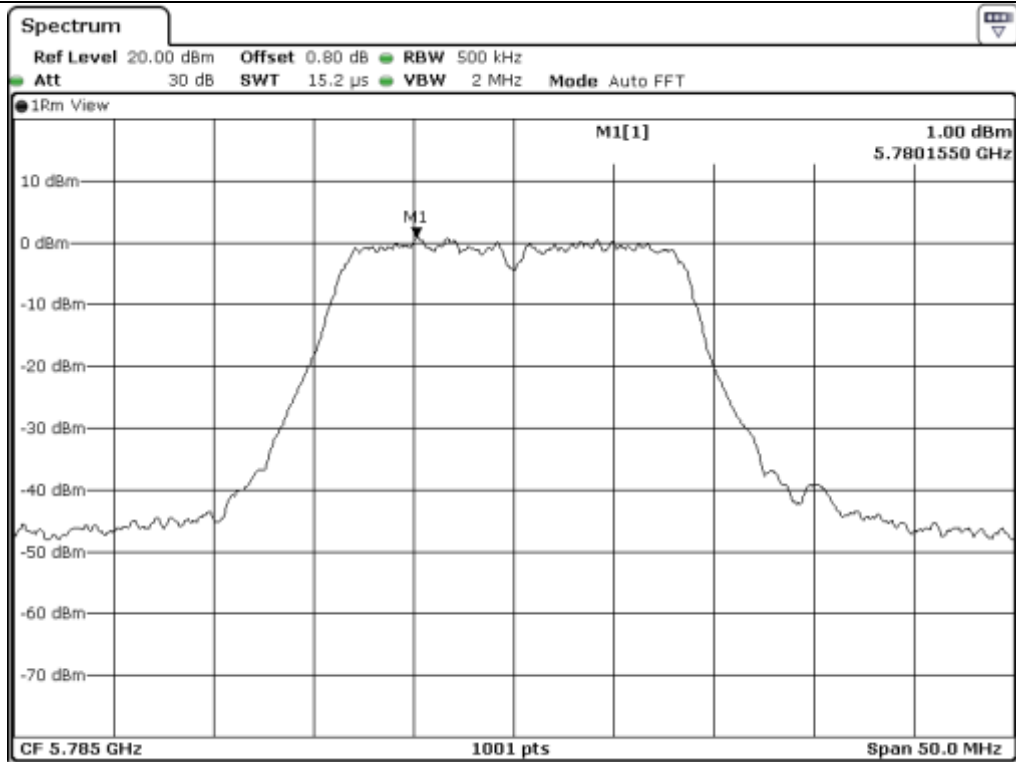
Middle Channel (5 220 MHz)



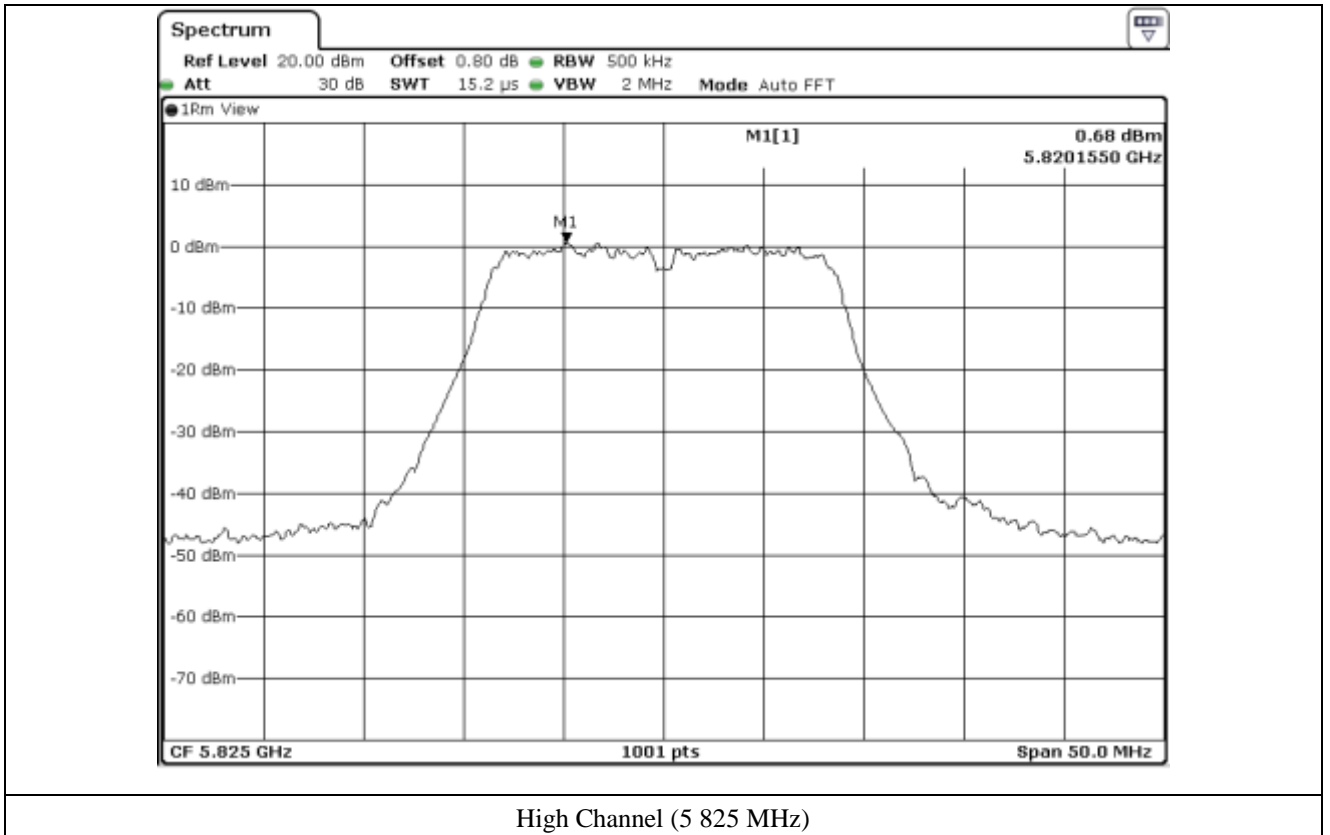




Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



**10.5.2 Test data for Antenna 1**

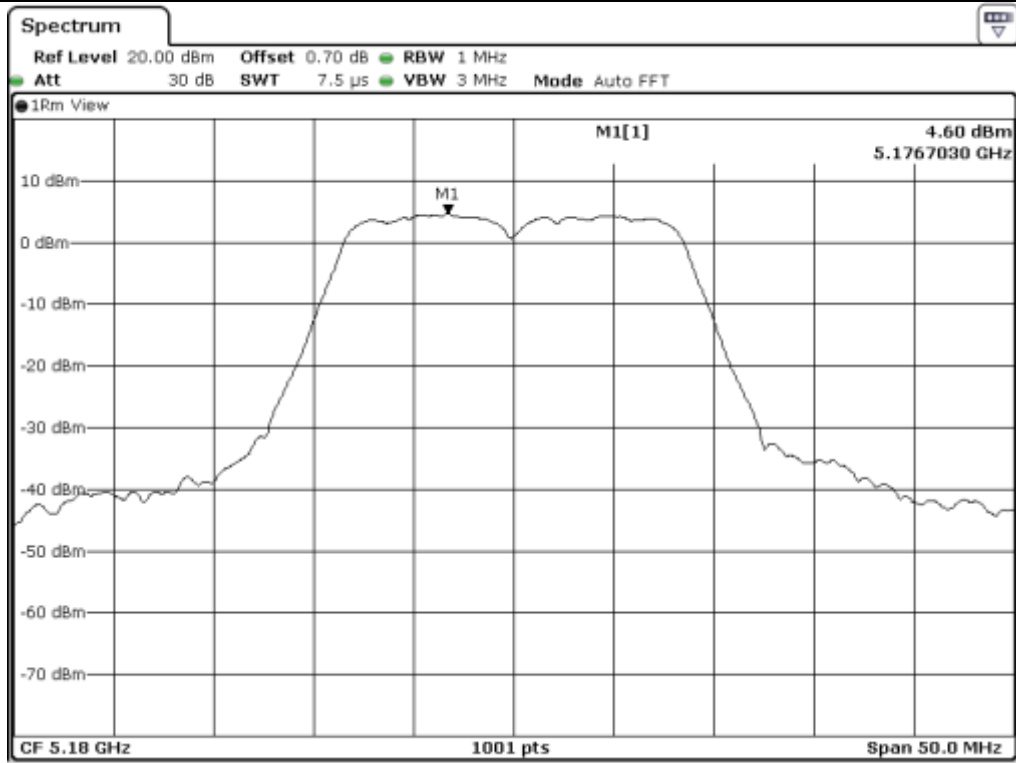
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	4.60	17.00	12.40
	Middle	5 220.00	4.52	17.00	12.48
	High	5 240.00	4.46	17.00	12.54
5 725 ~ 5 850	Low	5 745.00	1.17	30.00	28.83
	Middle	5 785.00	0.90	30.00	29.10
	High	5 825.00	0.40	30.00	29.60

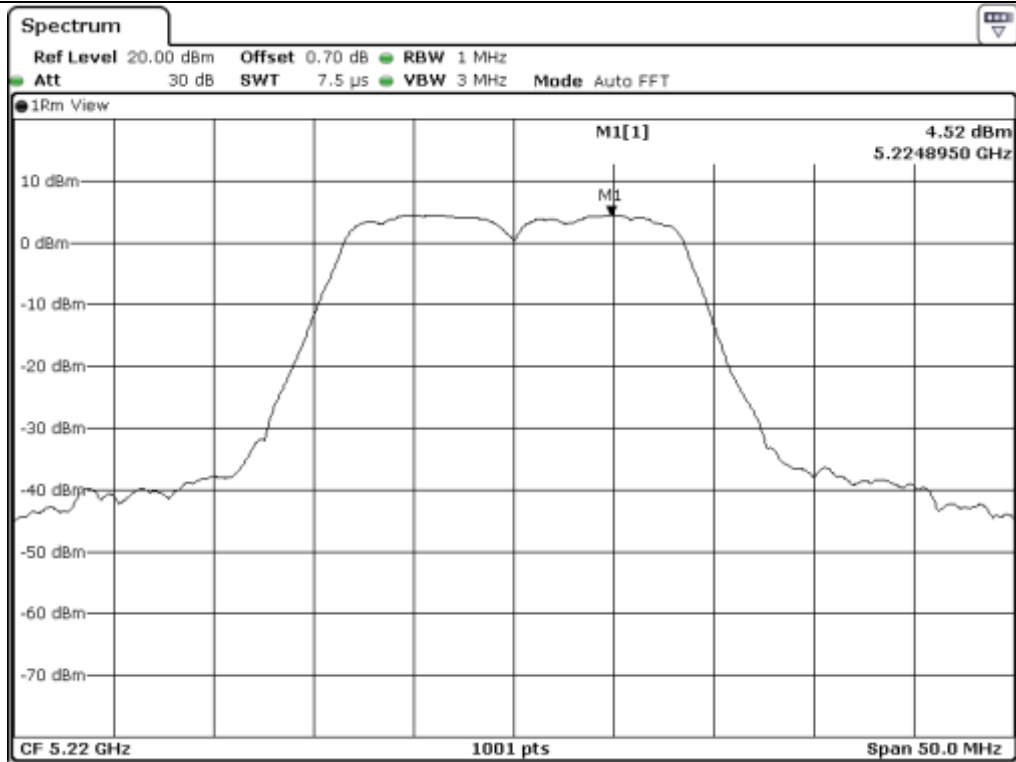
Remark: See next page for measurement data.



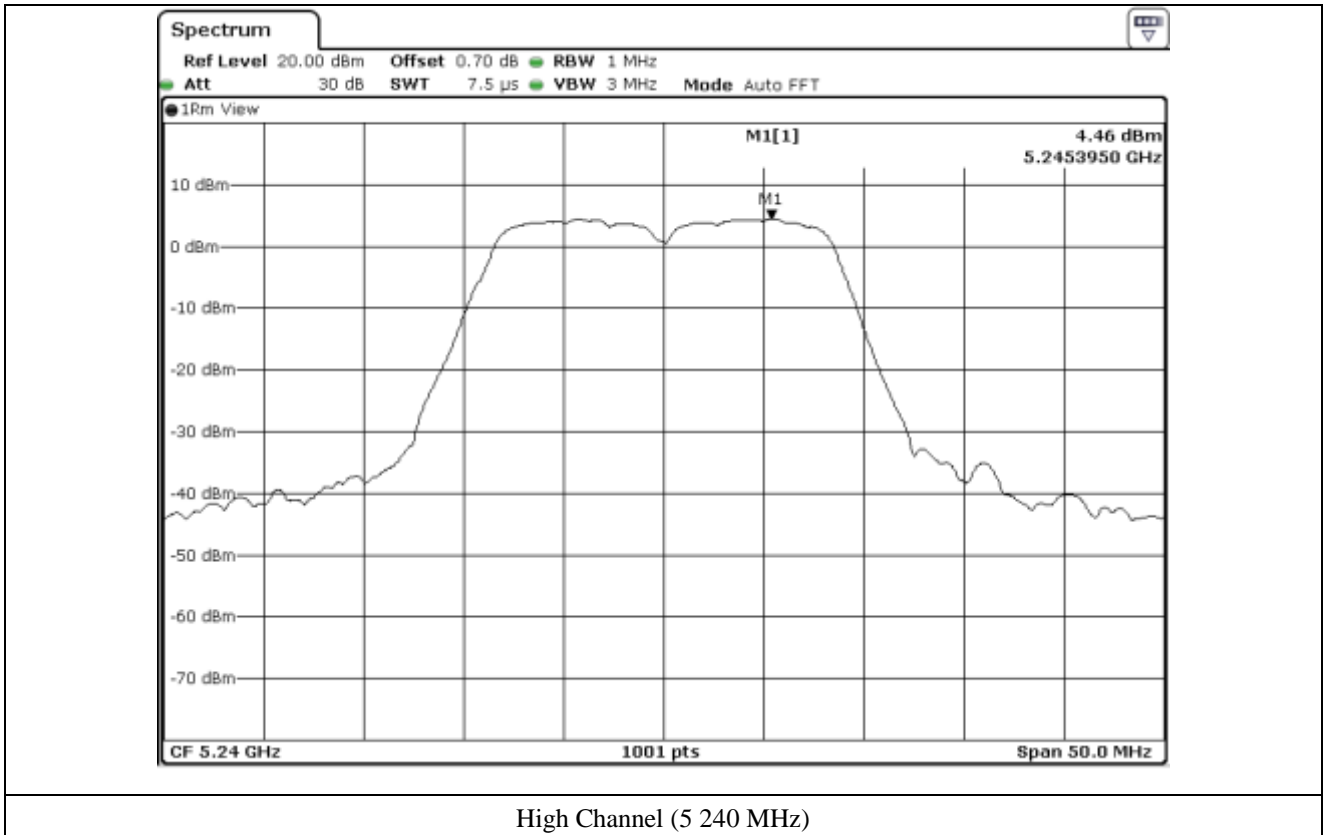
**Tested by: Hyung-Kwon, Oh / Engineer**

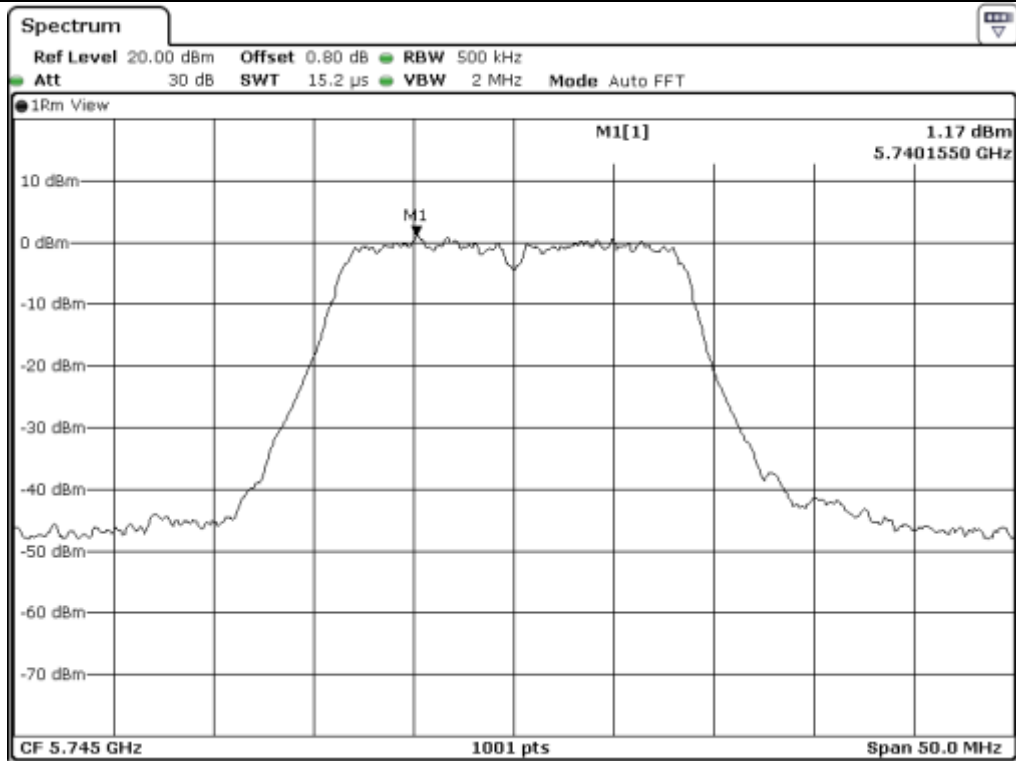


Low Channel (5 180 MHz)

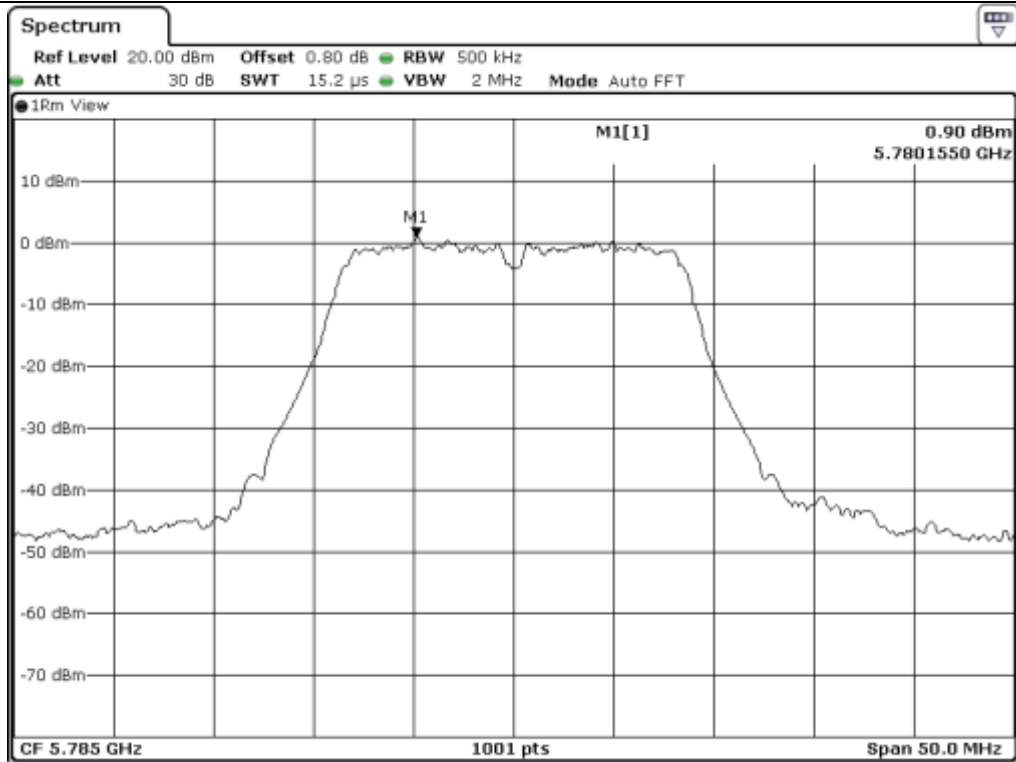


Middle Channel (5 220 MHz)

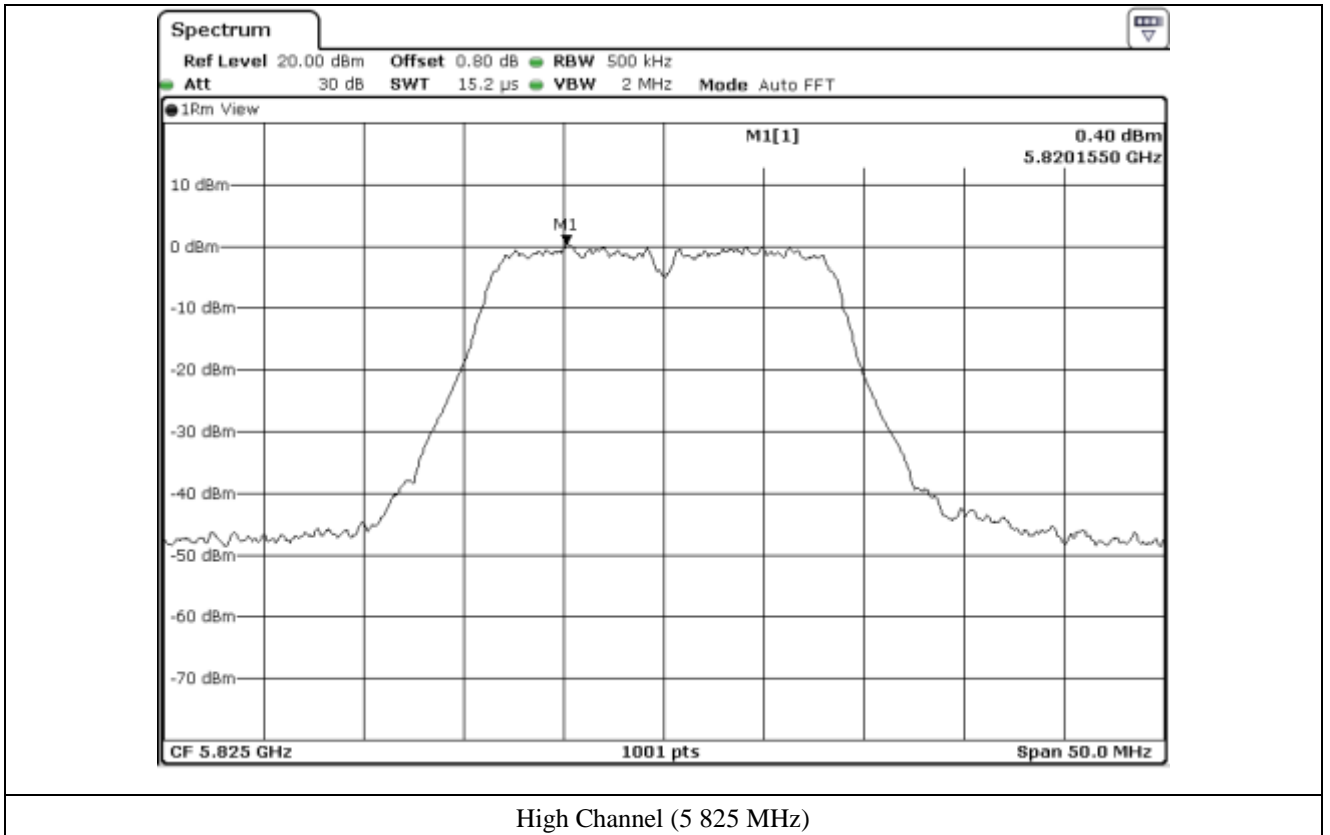




Low Channel (5.745 MHz)



Middle Channel (5.785 MHz)



**10.5.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	7.55	17.00	9.45
	Middle	5 220.00	7.38	17.00	9.62
	High	5 240.00	7.23	17.00	9.77
5 725 ~ 5 850	Low	5 745.00	4.24	30.00	25.76
	Middle	5 785.00	3.96	30.00	26.04
	High	5 825.00	3.55	30.00	26.45

Remark 1 : Margin = Limit – Measured value

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



**Tested by: Hyung-Kwon, Oh / Engineer**



**10.6 Test data for 802.11n\_HT40 RLAN Mode**

**10.6.1 Test data for Antenna 0**

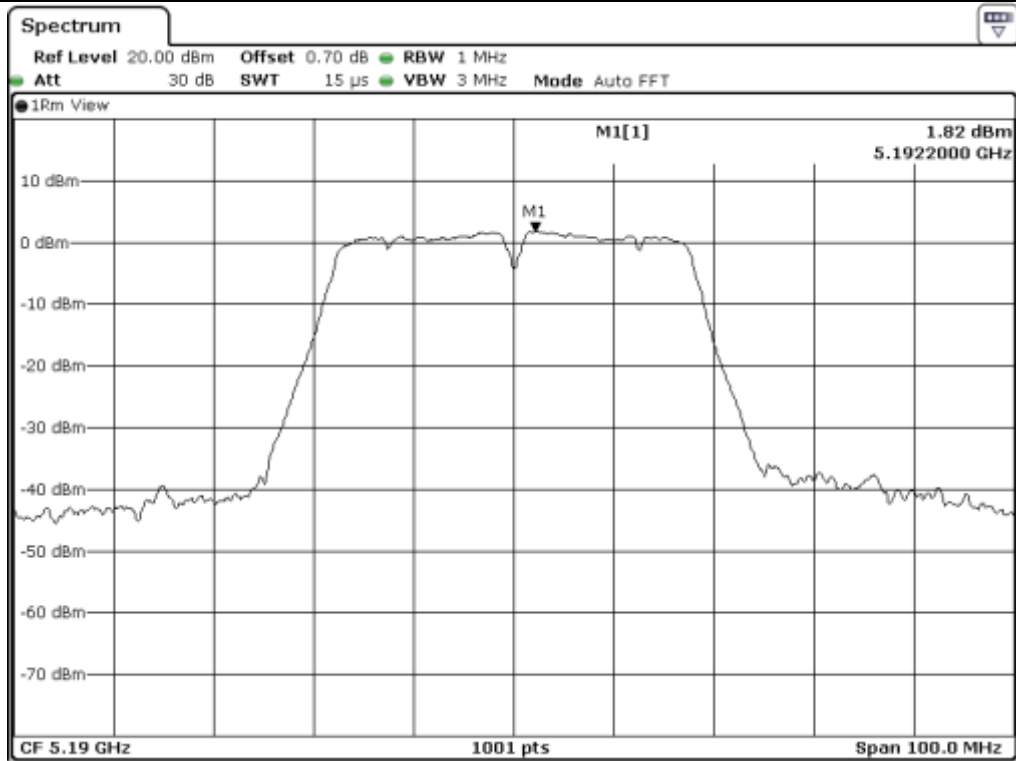
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	1.82	17.00	15.18
	High	5 230.00	1.37	17.00	15.63
5 725 ~ 5 850	Low	5 755.00	-2.32	30.00	32.32
	High	5 795.00	-1.85	30.00	31.85

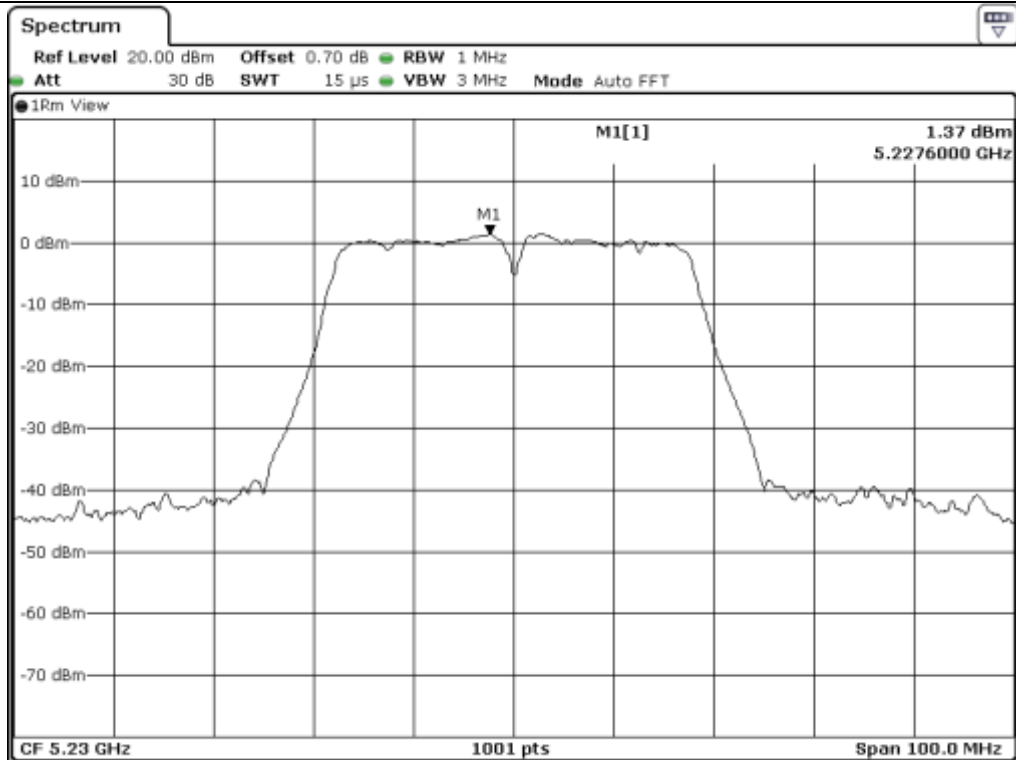
Remark: See next page for measurement data.



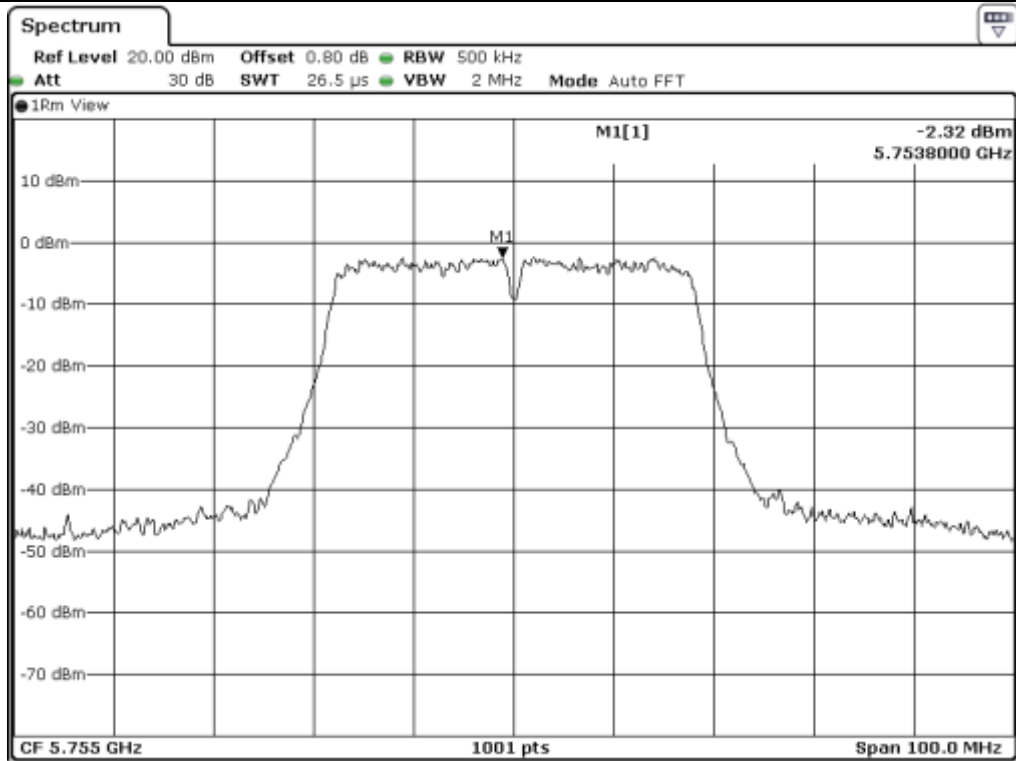
**Tested by: Hyung-Kwon, Oh / Engineer**



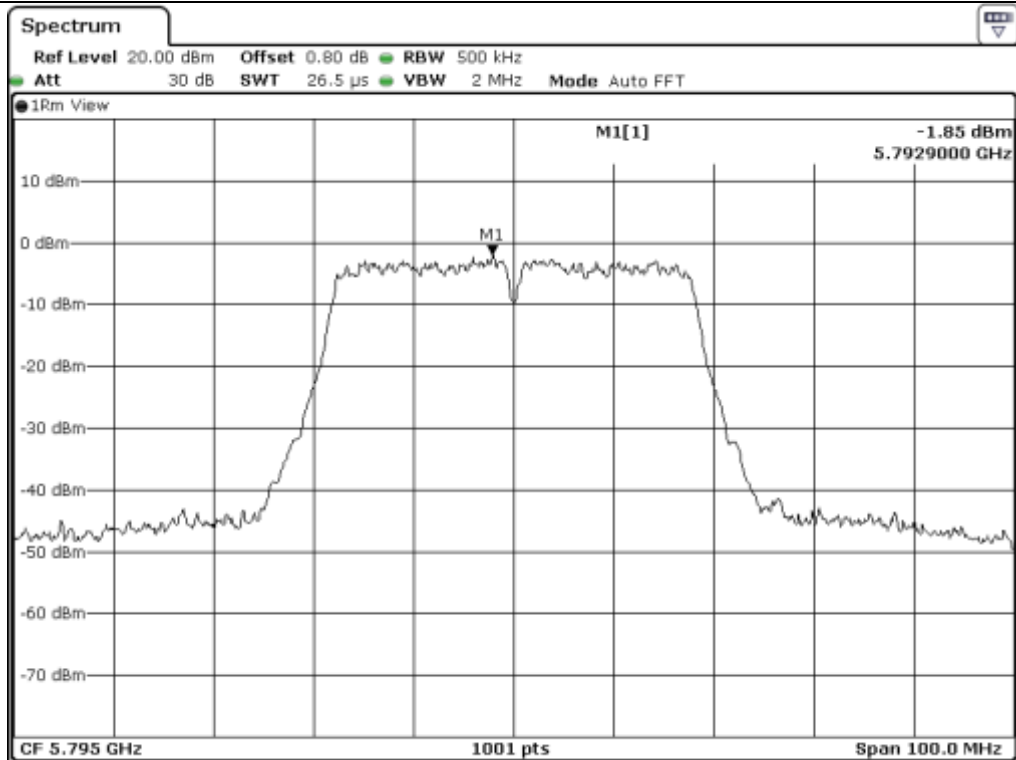
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

**10.6.2 Test data for Antenna 1**

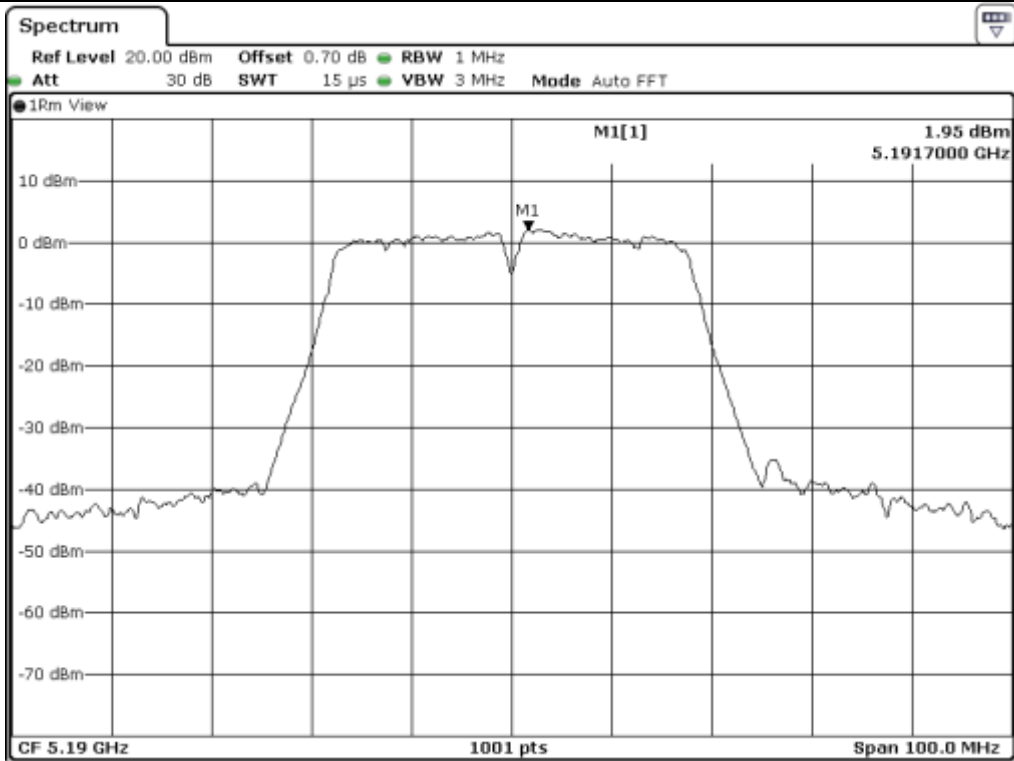
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	1.95	17.00	15.05
	High	5 230.00	1.78	17.00	15.22
5 725 ~ 5 850	Low	5 755.00	-2.08	30.00	32.08
	High	5 795.00	-2.10	30.00	32.10

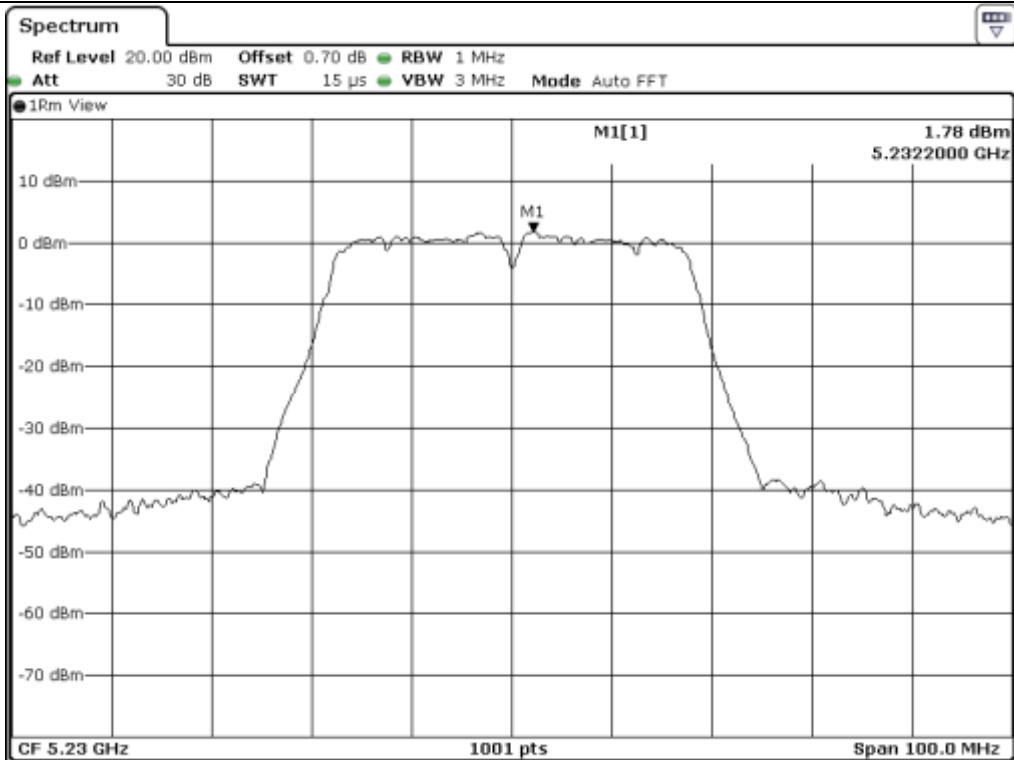
Remark: See next page for measurement data.



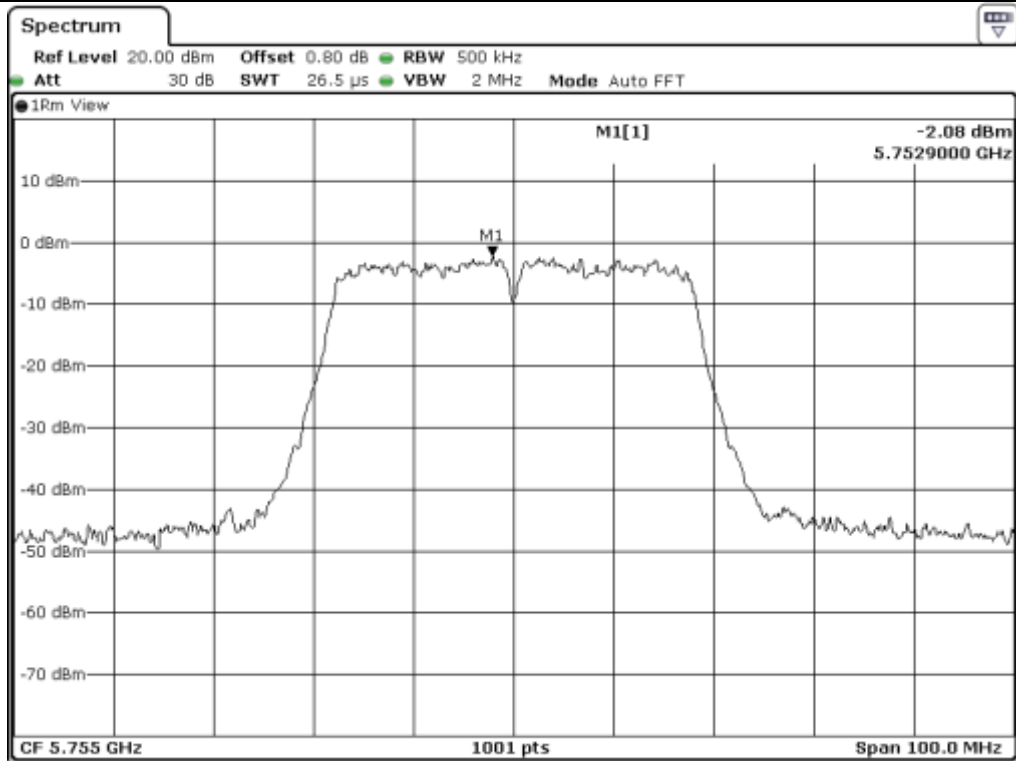
**Tested by: Hyung-Kwon, Oh / Engineer**



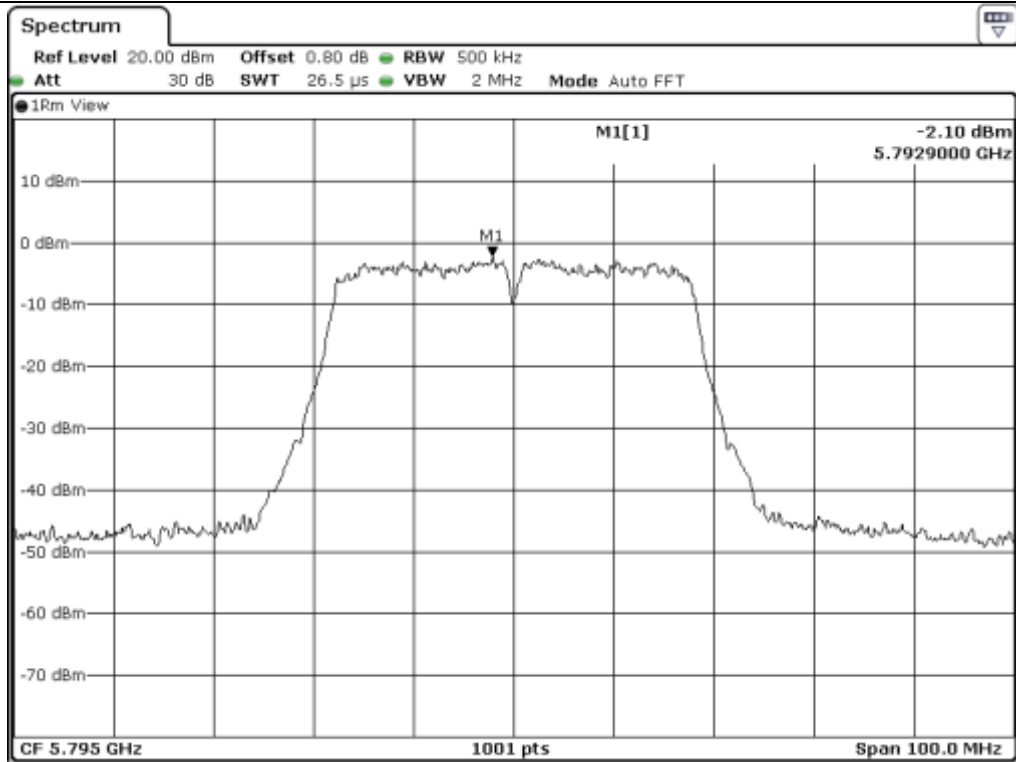
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

**10.6.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 190.00	4.90	17.00	12.10
	High	5 230.00	4.59	17.00	12.41
5 725 ~ 5 850	Low	5 755.00	0.81	30.00	29.19
	High	5 795.00	1.04	30.00	28.96

Remark 1 : Margin = Limit – Measured value

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



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

**10.7 Test data for 802.11ac\_HT80 RLAN Mode**

**10.7.1 Test data for Antenna 0**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

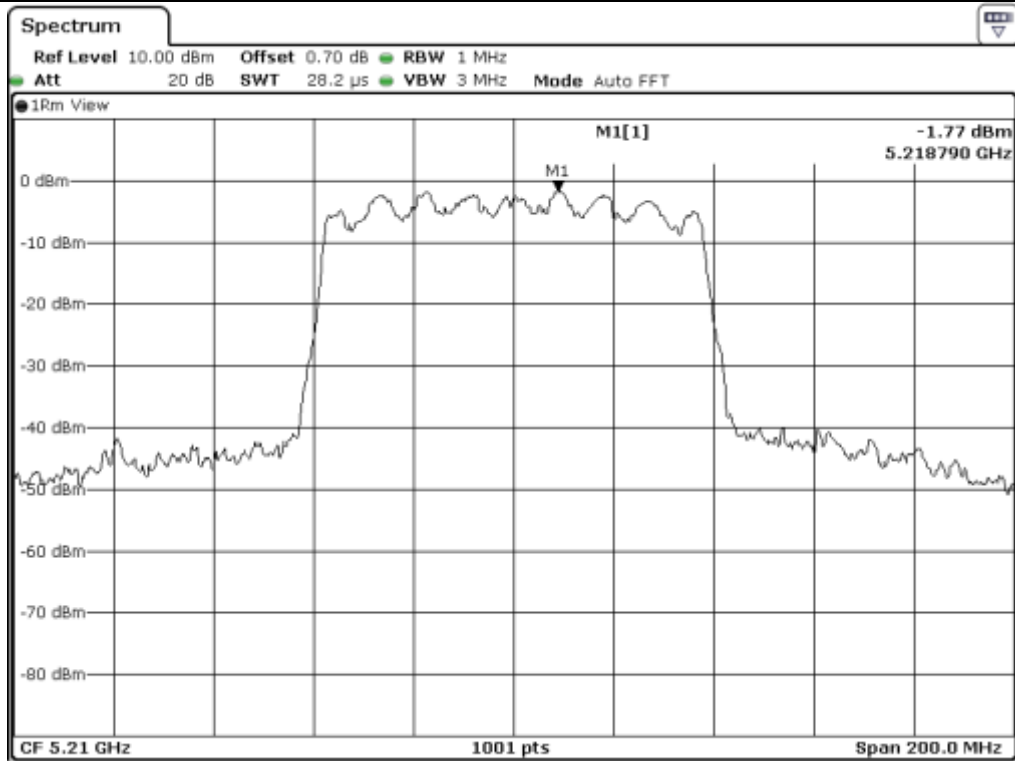
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	-1.77	17.00	18.77
5 725 ~ 5 850	Middle	5 775.00	-5.39	30.00	35.39

Remark: See next page for measurement data.

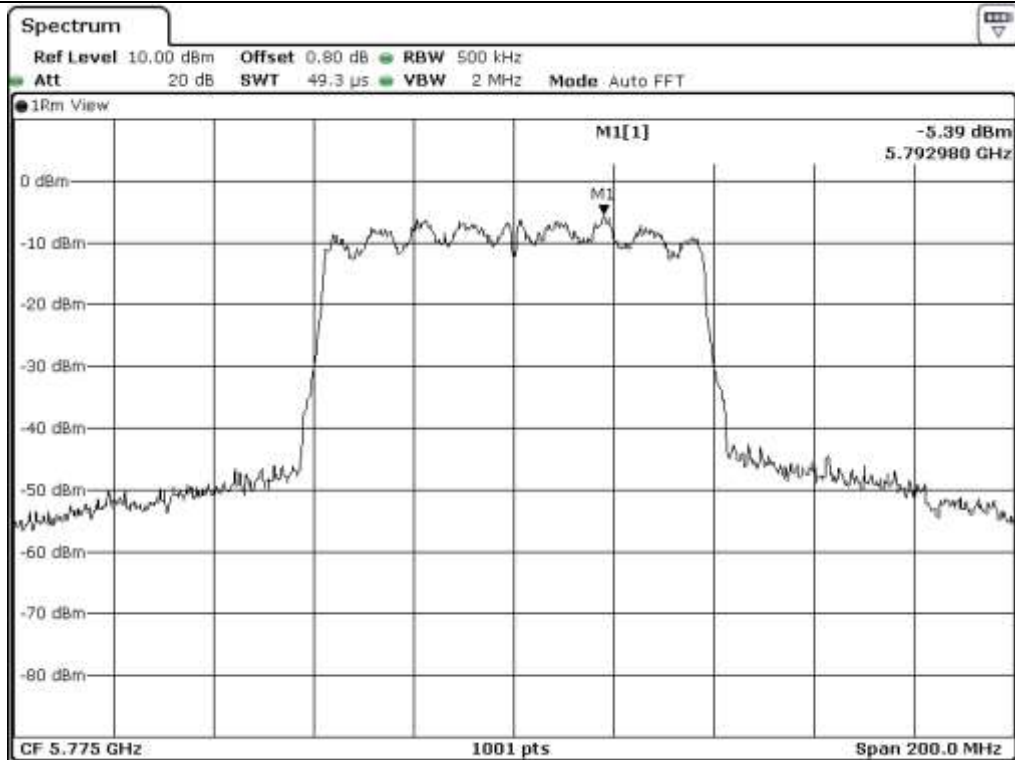


**Tested by: Hyung-Kwon, Oh / Engineer**





Middle Channel (5 210 MHz)



Middle Channel (5 775 MHz)

**10.7.2 Test data for Antenna 1**

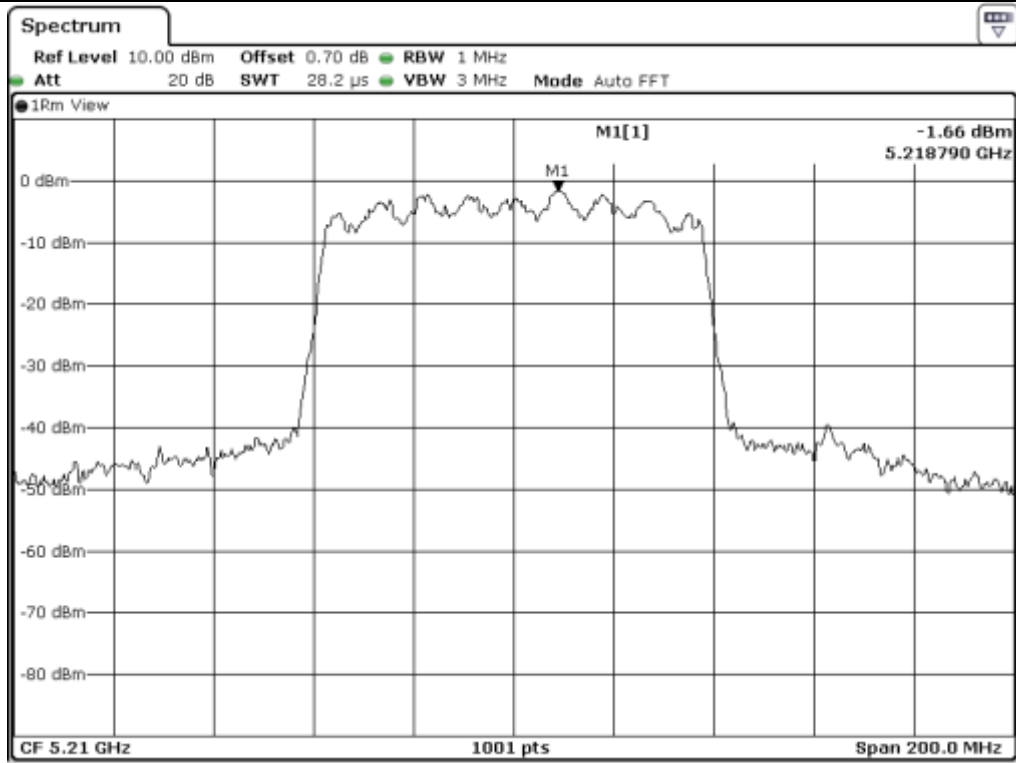
- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	-1.66	17.00	18.66
5 725 ~ 5 850	Middle	5 775.00	-5.82	30.00	35.82

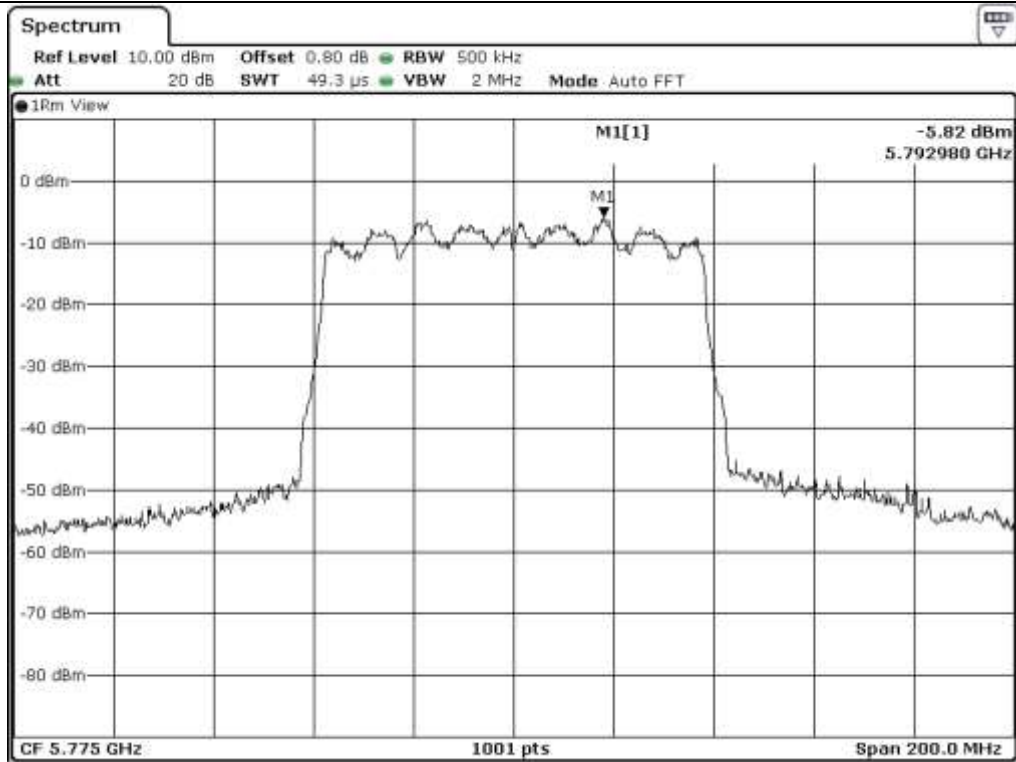
Remark: See next page for measurement data.



**Tested by: Hyung-Kwon, Oh / Engineer**



Middle Channel (5 210 MHz)



Middle Channel (5 775 MHz)

**10.7.3 Test data for Multiple Transmit**

- Test Date : July 19, 2017
- Operating condition : Highest Output Power Transmitting Mode
- Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Middle	5 210.00	1.30	17.00	15.70
5 725 ~ 5 850	Middle	5 775.00	-2.59	30.00	32.59

Remark 1 : Margin = Limit – Measured value

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



**Tested by: Hyung-Kwon, Oh / Engineer**

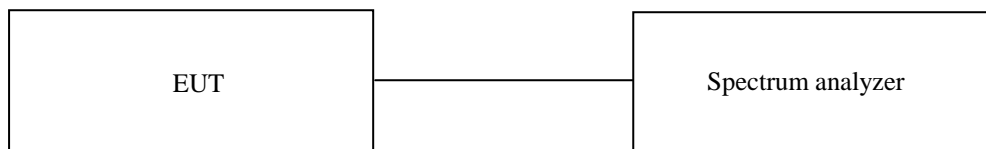
## 11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION

### 11.1 Operating environment

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

### 11.2 Test set-up

Turn EUT off and set chamber temperature to -20 °C and then allow sufficient time (approximately 20 min to 30 min after chamber reach the assigned temperature) for EUT to stabilize. Turn on the EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 °C step from -20 °C to +50 °C. Repeat above method for frequency measurements every 10 °C step and then record all measured frequencies on each temperature step.



### 11.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - SSE-43CI-A	Samkun Tech	Humidity Chamber	60712	Apr. 06, 2017 (1Y)
■ - DRP-305DN	DIGITAL Elec.	DC Power supply	4030195	Sep. 02, 2016 (1Y)

All test equipment used is calibrated on a regular basis.

**11.4 Test Data for U-NII-1**

-. Test Date : July 18, 2017

-. Result : Pass

Temperature (°C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
-20	5 180 000 000	5 179 982 720	-17.280
-10		5 179 981 567	-18.433
0		5 179 981 406	-18.594
10		5 179 980 761	-19.239
20		5 179 980 142	-19.858
30		5 179 978 328	-21.672
40		5 179 976 957	-23.043
50		5 179 974 145	-25.855
-20		5 220 000 000	5 219 982 477
-10	5 219 981 974		-18.026
0	5 219 981 360		-18.640
10	5 219 980 544		-19.456
20	5 219 980 154		-19.846
30	5 219 978 766		-21.234
40	5 219 977 765		-22.235
50	5 219 974 913		-25.087
-20	5 240 000 000		5 239 982 703
-10		5 239 981 545	-18.455
0		5 239 981 131	-18.869
10		5 239 980 571	-19.429
20		5 239 980 289	-19.711
30		5 239 979 382	-20.618
40		5 239 976 059	-23.941
50		5 239 975 157	-24.843

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized.

Four measurements in total are made.(ANSI C63.10-2013)



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

**11.5 Test Data for U-NII-3**

-. Test Date : July 18, 2017

-. Result : Pass

Temperature (°C)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
-20	5 745 000 000	5 744 982 078	-17.922
-10		5 744 981 870	-18.130
0		5 744 981 246	-18.754
10		5 744 980 956	-19.044
20		5 744 980 243	-19.757
30		5 744 978 045	-21.955
40		5 744 977 943	-22.057
50		5 744 974 244	-25.756
-20		5 785 000 000	5 784 982 980
-10	5 784 981 718		-18.282
0	5 784 981 233		-18.767
10	5 784 980 960		-19.040
20	5 784 980 373		-19.627
30	5 784 978 856		-21.144
40	5 784 977 894		-22.106
50	5 784 974 492		-25.508
-20	5 825 000 000		5 824 982 975
-10		5 824 981 987	-18.013
0		5 824 981 363	-18.637
10		5 824 980 763	-19.237
20		5 824 980 008	-19.992
30		5 824 979 523	-20.477
40		5 824 977 553	-22.447
50		5 824 974 080	-25.920

Note : While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized.

Four measurements in total are made.(ANSI C63.10-2013)



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

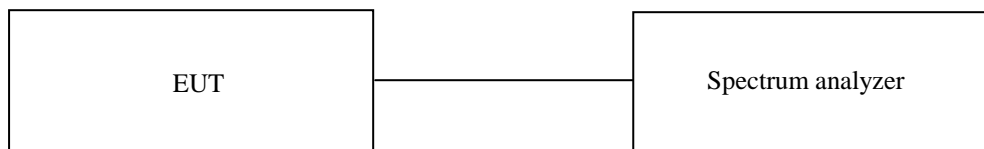
## 12. FREQUENCY STABILITY WITH VOLTAGE VARIATION

### 12.1 Operating environment

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

### 12.2 Test set-up

An external DC power supply was connected to the input of the EUT. The voltage of EUT set to 115 % of the nominal value and then was reduced to 85 % of nominal voltage. The output frequency was recorded at each step.



### 12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ -	DRP-305DN	DIGITAL Elec.	DC Power supply	4030195	Sep. 02, 2016 (1Y)

All test equipment used is calibrated on a regular basis.



**12.4 Test Data for U-NII-1**

-. Test Date : July 18, 2017

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
2.81	5 180 000 000	5 179 978 905	-21.095
3.30		5 179 976 848	-23.152
3.80		5 179 975 241	-24.759
2.81	5 220 000 000	5 219 979 211	-20.789
3.30		5 219 977 702	-22.298
3.80		5 219 975 157	-24.843
2.81	5 240 000 000	5 239 979 289	-20.711
3.30		5 239 976 543	-23.457
3.80		5 239 976 495	-23.505

**12.5 Test Data for U-NII-3**

-. Test Date : July 18, 2017

-. Result : Pass

Voltage (VDC)	Carrier Freq. (Hz)	Measured Freq. (Hz)	Frequency Error (kHz)
2.81	5 745 000 000	5 744 978 039	-21.961
3.30		5 744 977 689	-22.311
3.80		5 744 975 220	-24.780
2.81	5 785 000 000	5 784 978 009	-21.991
3.30		5 784 976 715	-23.285
3.80		5 784 976 417	-23.583
2.81	5 825 000 000	5 824 979 629	-20.371
3.30		5 824 977 825	-22.175
3.80		5 824 975 185	-24.815



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

### 13. RADIATED SPURIOUS EMISSIONS

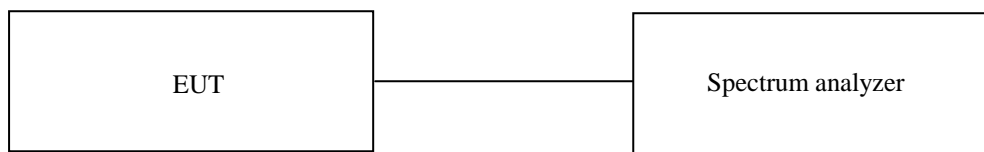
#### 13.1 Operating environment

Temperature : 21 °C  
 Relative humidity : 44 % R.H.

#### 13.2 Test set-up for conducted measurement

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 40 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.



#### 13.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ - ESCI	Rohde & Schwarz	Test Receiver	101012	Nov. 01, 2016 (1Y)
■ - 310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ - BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2016 (1Y)
■ - DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ - MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Aug. 31, 2015 (2Y)
■ - HFH2-Z2	Rohde & Schwarz	Loop Antenna	879285/26	Dec. 09, 2016 (2Y)
■ - SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Apr. 04, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

**13.4 Test data for Below 30 MHz**

- Test Date : July 21, 2017
- Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- Frequency range : 9 kHz ~ 30 MHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)
It was not observed any emissions from the EUT.									



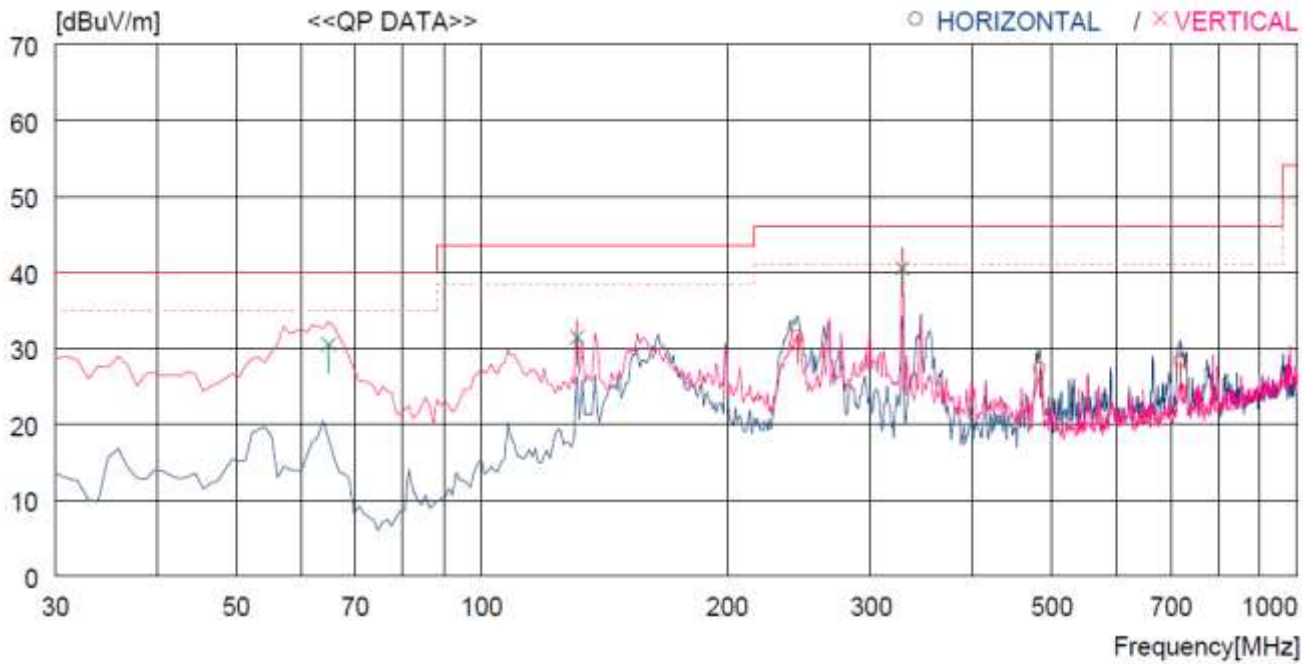
Tested by: Hyung-Kwon, Oh / Assistant Manager

**13.5 Test data for 30 MHz ~ 1 000 MHz**

Humidity Level : 44 % R.H. Temperature: 21 °C  
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247  
 Result : PASSED

EUT : 802.11 a/b/g/n/ac WiFi Module Date: July 21, 2017  
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

-Ant0, Ant1 and Multiple transmit tested, but the worst data were recorded.



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	243.400	48.9	12.2	3.6	33.1	31.6	46.0	14.4	100	120
2	482.991	38.8	16.7	5.1	33.3	27.3	46.0	18.7	100	120
3	718.694	35.7	19.9	6.2	33.5	28.3	46.0	17.7	128	0
----- Vertical -----										
4	64.920	50.4	11.3	1.9	33.1	30.5	40.0	9.5	100	141
5	130.880	52.7	9.0	2.7	33.0	31.4	43.5	12.1	100	229
6	327.790	55.2	14.2	4.2	33.1	40.5	46.0	5.5	100	334

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

**13.6 Test data for Above 1 GHz**

**13.6.1 Test data for Frequency U-NII-1**

**13.6.1.1 Test data for 802.11a RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
10 360.00	30.71	Peak	H	39.66	26.38	34.74	62.01	68.20	6.19
	29.62	Peak	V				60.92	68.20	7.28
<b>Middle Channel</b>									
10 440.00	30.47	Peak	H	39.84	26.74	34.76	62.29	68.20	5.91
	29.81	Peak	V				61.63	68.20	6.57
<b>High Channel</b>									
10 480.00	30.69	Peak	H	40.02	27.09	34.77	63.03	68.20	5.17
	29.94	Peak	V				62.28	68.20	5.92

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

**13.6.1.2 Test data for 802.11n\_HT20 RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 40 GHz
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
10 360.00	30.54	Peak	H	39.66	26.38	34.74	61.84	68.20	6.36
	29.44	Peak	V				60.74	68.20	7.46
<b>Middle Channel</b>									
10 400.00	30.92	Peak	H	39.84	26.74	34.76	62.74	68.20	5.46
	29.85	Peak	V				61.67	68.20	6.53
<b>High Channel</b>									
10 480.00	30.84	Peak	H	40.02	27.09	34.77	63.18	68.20	5.02
	29.78	Peak	V				62.12	68.20	6.08

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

**13.6.1.3 Test data for 802.11n\_HT40 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
10 380.00	30.26	Peak	H	39.93	26.88	34.74	62.33	68.20	5.87
	29.31	Peak	V				61.38	68.20	6.82
<b>High Channel</b>									
10 460.00	30.46	Peak	H	40.02	27.05	34.76	62.77	68.20	5.43
	29.63	Peak	V				61.93	68.20	6.27

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



Tested by: Hyung-Kwon, Oh / Assistant Manager

**13.6.1.4 Test data for 802.11ac\_HT80 RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 40 GHz
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Middle Channel</b>									
10 420.00	30.77	Peak	H	39.98	26.97	34.76	62.96	68.20	5.24
	29.61	Peak	V				61.80	68.20	6.40

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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



**13.6.2 Test data for Frequency U-NII-3**

**13.6.2.1 Test data for 802.11a RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 40 GHz
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
11 490.00	21.48	Peak	H	40.07	28.32	33.75	56.12	73.98	17.86
	15.00	Average	H				49.64	53.98	4.34
	20.17	Peak	V				54.81	73.98	19.17
	13.84	Average	V				48.48	53.98	5.50
<b>Middle Channel</b>									
11 570.00	21.52	Peak	H	39.78	28.94	33.64	56.60	73.98	17.38
	14.98	Average	H				50.06	53.98	3.92
	20.11	Peak	V				55.19	73.98	18.79
	13.91	Average	V				48.99	53.98	4.99
<b>High Channel</b>									
11 650.00	21.26	Peak	H	39.49	29.56	33.61	56.70	73.98	17.28
	14.89	Average	H				50.33	53.98	3.65
	20.07	Peak	V				55.51	73.98	18.47
	12.77	Average	V				48.21	53.98	5.77

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

**13.6.2.2 Test data for 802.11n\_HT20 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
11 490.00	21.16	Peak	H	40.07	28.32	33.75	55.80	73.98	18.18
	14.79	Average	H				49.43	53.98	4.55
	20.12	Peak	V				54.76	73.98	19.22
	13.92	Average	V				48.56	53.98	5.42
<b>Middle Channel</b>									
11 570.00	21.38	Peak	H	39.78	28.94	33.64	56.46	73.98	17.52
	14.83	Average	H				49.91	53.98	4.07
	20.19	Peak	V				55.27	73.98	18.71
	14.04	Average	V				49.12	53.98	4.86
<b>High Channel</b>									
11 650.00	21.16	Peak	H	39.49	29.56	33.61	56.60	73.98	17.38
	14.78	Average	H				50.22	53.98	3.76
	20.75	Peak	V				56.19	73.98	17.79
	12.89	Average	V				48.33	53.98	5.65

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

**13.6.2.3 Test data for 802.11n\_HT40 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
11 510.00	21.22	Peak	H	39.78	28.94	33.63	56.31	73.98	17.67
	14.79	Average	H				49.88	53.98	4.10
	20.24	Peak	V				55.33	73.98	18.65
	14.02	Average	V				49.11	53.98	4.87
<b>High Channel</b>									
11 590.00	20.99	Peak	H	39.66	29.19	33.62	56.22	73.98	17.76
	14.24	Average	H				49.47	53.98	4.51
	20.73	Peak	V				55.96	73.98	18.02
	13.96	Average	V				49.19	53.98	4.79

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

**13.6.2.4 Test data for 802.11ac\_HT80 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 1 GHz ~ 40 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Middle Channel</b>									
11 550.00	21.07	Peak	H	39.78	28.94	33.63	56.16	73.98	17.82
	14.52	Average	H				49.61	53.98	4.37
	20.56	Peak	V				55.65	73.98	18.33
	14.11	Average	V				49.20	53.98	4.78

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Emission Level (dBμV/m)



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

## 14. RADIATED RESTRICTED BAND EDGE MEASUREMENTS

### 14.1 Operating environment

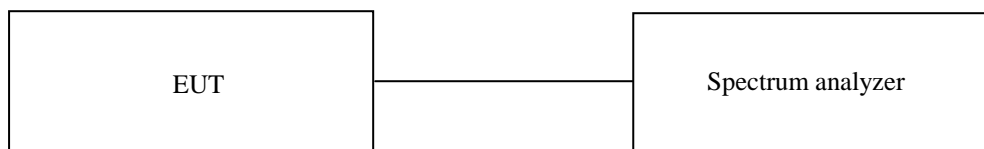
Temperature : 21 °C

Relative humidity : 44 % R.H.

### 14.2 Test set-up for conducted measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable above the ground plane.

The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.



### 14.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Apr. 05, 2017 (1Y)
■ -	ESCI	Rohde & Schwarz	Test Receiver	101012	Nov. 01, 2016 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Apr. 05, 2017 (1Y)
■ -	BBV9718	Schwarzbeck	Amplifier	310	Sep. 01, 2016 (1Y)
■ -	DT3000	Innco System	Turn Table	930611	N/A
■ -	MA4000-EP	Innco System	Antenna Master	3320611	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Apr. 15, 2016 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 31, 2015 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Aug. 31, 2015 (2Y)

All test equipment used is calibrated on a regular basis.

**14.4 Test data for Frequency U-NII-1**

**14.4.1 Test data for 802.11a RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
5 150.00	37.59	Peak	H	31.28	12.65	36.01	45.51	74.00	28.49
	34.38	Average	H				42.30	54.00	11.70
	36.81	Peak	V				44.73	74.00	29.27
	33.95	Average	V				41.87	54.00	12.13

Tabulated test data for Restricted Band

Remark - "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBµV/m) - Emission Level (dBµV/m)



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

**14.4.2 Test data for 802.11n\_HT20 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : Pass

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
5 150.00	38.08	Peak	H	31.28	12.65	36.01	46.00	74.00	28.00
	35.24	Average	H				43.16	54.00	10.84
	37.39	Peak	V				45.31	74.00	28.69
	34.21	Average	V				42.13	54.00	11.87

Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dBµV/m)} - \text{Emission Level (dBµV/m)}$$



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

**14.4.3 Test data for 802.11n\_HT40 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
5 150.00	39.14	Peak	H	31.28	12.65	36.01	47.06	74.00	26.94
	36.31	Average	H				44.23	54.00	9.77
	38.18	Peak	V				46.10	74.00	27.90
	35.20	Average	V				43.12	54.00	10.88

Tabulated test data for Restricted Band

Remark - "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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



**14.4.4 Test data for 802.11ac\_HT80 RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
5 150.00	43.46	Peak	H	31.28	12.65	36.01	51.38	74.00	22.62
	38.57	Average	H				46.49	54.00	7.51
	42.38	Peak	V				50.30	74.00	23.70
	37.61	Average	V				45.53	54.00	8.47

Tabulated test data for Restricted Band

Remark - "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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

**14.5 Test data for Frequency U-NII-3**

**14.5.1 Test data for 802.11a RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
5 725.00	39.82	Peak	H	32.17	12.09	35.59	48.49	124.38	75.89
	38.76	Peak	V				47.43	124.38	76.95
5 715.00	38.69	Peak	H				47.36	111.58	64.22
	37.52	Peak	V				46.19	111.58	65.39
<b>High Channel</b>									
5 850.00	41.25	Peak	H	32.17	12.09	35.43	50.08	124.38	74.30
	39.77	Peak	V				48.60	124.38	75.78
5 860.00	39.18	Peak	H				48.01	111.58	63.57
	38.53	Peak	V				47.36	111.58	64.22

Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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

**14.5.2 Test data for 802.11n\_HT20 RLAN Mode**

- Test Date : July 21, 2017
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
5 725.00	40.06	Peak	H	32.17	12.09	35.59	48.73	124.38	75.65
	39.30	Peak	V				47.97	124.38	76.41
5 715.00	39.71	Peak	H				48.38	111.58	63.20
	38.99	Peak	V				47.66	111.58	63.92
<b>High Channel</b>									
5 850.00	42.71	Peak	H	32.17	12.09	35.43	51.54	124.38	72.84
	40.76	Peak	V				49.59	124.38	74.79
5 860.00	40.91	Peak	H				49.74	111.58	61.84
	39.76	Peak	V				48.59	111.58	62.99

Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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

**14.5.3 Test data for 802.11n\_HT40 RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
5 725.00	41.41	Peak	H	32.17	12.09	35.59	50.08	124.38	74.30
	40.32	Peak	V				48.99	124.38	75.39
5 715.00	40.94	Peak	H				49.61	111.58	61.97
	39.30	Peak	V				47.97	111.58	63.61
<b>High Channel</b>									
5 850.00	43.16	Peak	H	32.17	12.09	35.43	51.99	124.38	72.39
	41.99	Peak	V				50.82	124.38	73.56
5 860.00	41.43	Peak	H				50.26	111.58	61.32
	40.71	Peak	V				49.54	111.58	62.04

Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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

**14.5.4 Test data for 802.11ac\_HT80 RLAN Mode**

- . Test Date : July 21, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
100 kHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . Result : Pass

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
<b>Low Channel</b>									
5 725.00	43.18	Peak	H	32.17	12.09	35.59	51.85	124.38	72.53
	42.72	Peak	V				51.39	124.38	72.99
5 715.00	41.63	Peak	H				50.30	111.58	61.28
	40.75	Peak	V				49.42	111.58	62.16
<b>High Channel</b>									
5 850.00	45.79	Peak	H	32.17	12.09	35.43	54.62	124.38	69.76
	44.51	Peak	V				53.34	124.38	71.04
5 860.00	43.86	Peak	H				52.69	111.58	58.89
	42.18	Peak	V				51.01	111.58	60.57

Tabulated test data for Restricted Band

Remark - “H”: Horizontal, “V”: Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Emission Level (dB}\mu\text{V/m)}$$



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

## 15. CONDUCTED EMISSION TEST

### 15.1 Operating environment

Temperature : (24 ~ 25) °C  
 Relative humidity : (42 ~ 43) % R.H.

### 15.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

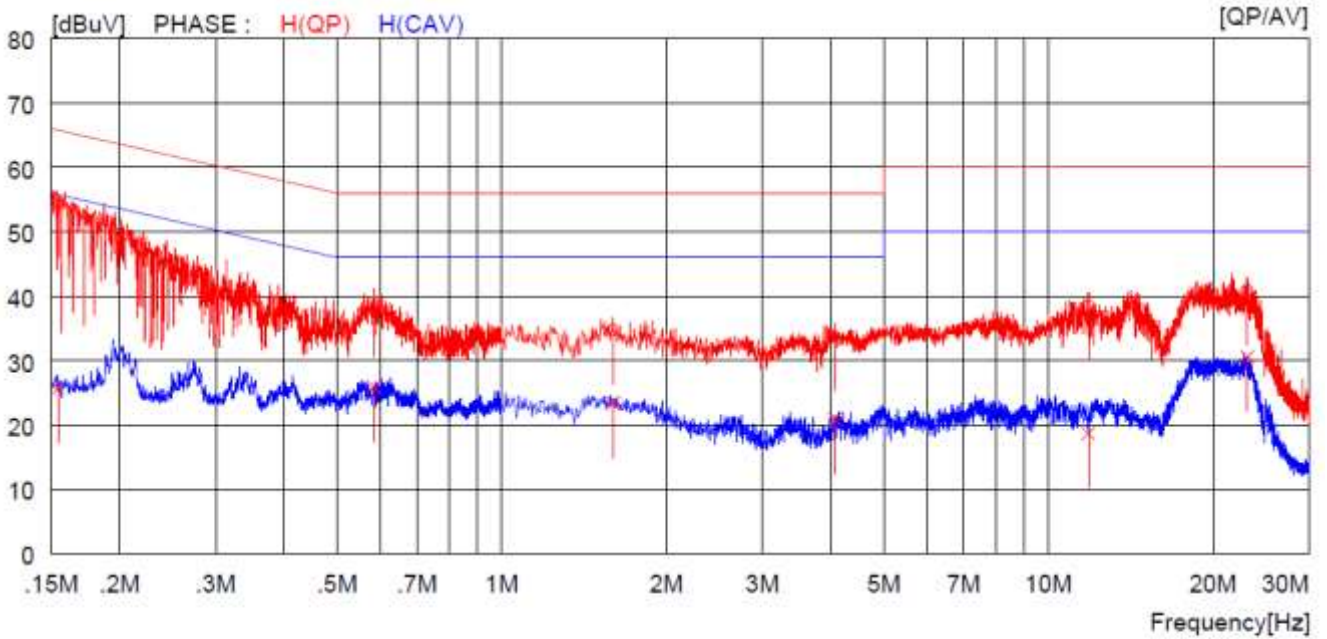
### 15.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ - ESPI	Rohde & Schwarz	Test Receiver	101012	Nov. 01, 2016 (1Y)
□ - ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Apr. 05, 2017 (1Y)
□ - NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 06, 2017 (1Y)
■ - NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 05, 2017 (1Y)
□ - 3825/2	EMCO	AMN	9109-1869	Apr. 06, 2017 (1Y)
■ - 3825/2	EMCO	AMN	9109-1867	Apr. 06, 2017 (1Y)

All test equipment used is calibrated on a regular basis.

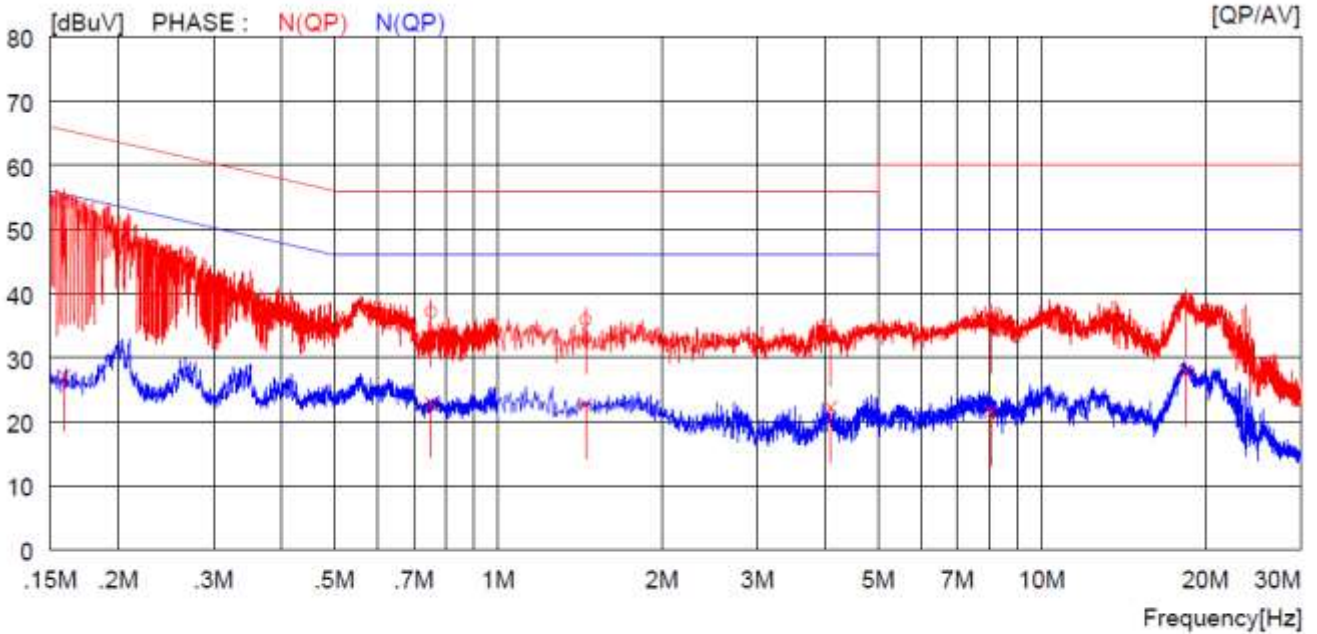
**15.4 Test data**

- Test Date : July 19, 2017
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE
- Ant0, Ant1 and Multiple transmit tested, but the worst data were recorded.



NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15400	44.4	----	10.0	54.4	----	65.8	----	11.4	----	H (QP)
2	0.58400	29.0	----	10.1	39.1	----	56.0	----	16.9	----	H (QP)
3	1.59600	24.7	----	10.1	34.8	----	56.0	----	21.2	----	H (QP)
4	4.06400	23.6	----	10.2	33.8	----	56.0	----	22.2	----	H (QP)
5	11.82000	28.1	----	10.4	38.5	----	60.0	----	21.5	----	H (QP)
6	23.13000	30.1	----	10.8	40.9	----	60.0	----	19.1	----	H (QP)
7	0.15400	----	15.6	10.0	----	25.6	----	55.8	----	30.2	H (CAV)
8	0.58400	----	15.8	10.1	----	25.9	----	46.0	----	20.1	H (CAV)
9	1.59600	----	13.3	10.1	----	23.4	----	46.0	----	22.6	H (CAV)
10	4.06400	----	10.7	10.2	----	20.9	----	46.0	----	25.1	H (CAV)
11	11.82000	----	8.3	10.4	----	18.7	----	50.0	----	31.3	H (CAV)
12	23.13000	----	19.8	10.8	----	30.6	----	50.0	----	19.4	H (CAV)

- Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15900	44.1	----	10.0	54.1	----	65.5	----	11.4	----	N(QP)
2	0.75300	27.0	----	10.1	37.1	----	56.0	----	18.9	----	N(QP)
3	1.44800	25.8	----	10.1	35.9	----	56.0	----	20.1	----	N(QP)
4	4.08400	23.8	----	10.2	34.0	----	56.0	----	22.0	----	N(QP)
5	8.05500	25.7	----	10.3	36.0	----	60.0	----	24.0	----	N(QP)
6	18.38000	27.8	----	10.7	38.5	----	60.0	----	21.5	----	N(QP)
7	0.15900	----	17.1	10.0	----	27.1	----	55.5	----	28.4	N(CAV)
8	0.75300	----	12.8	10.1	----	22.9	----	46.0	----	23.1	N(CAV)
9	1.44800	----	12.6	10.1	----	22.7	----	46.0	----	23.3	N(CAV)
10	4.08400	----	12.0	10.2	----	22.2	----	46.0	----	23.8	N(CAV)
11	8.05500	----	11.3	10.3	----	21.6	----	50.0	----	28.4	N(CAV)
12	18.38000	----	17.1	10.7	----	27.8	----	50.0	----	22.2	N(CAV)

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

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: Hyung-Kwon, Oh / Assistant Manager