

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

Test Report No. : OT-185-RWD-046
AGR No. : A183A-213
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 : WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module
FCC ID. : YZP-TWFS-B005D
Model Name : TWFS-B005D
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 144 pages (including this page)
Date of Incoming : May 02, 2018
Date of issue : May 23, 2018

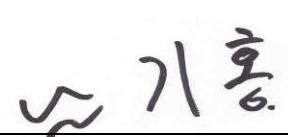
SUMMARY

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

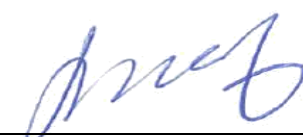
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:


 Ki-Hong, Nam / Chief Engineer
 ONETECH Corp.

Approved by:


 Keun-Young, Choi / Vice President
 ONETECH Corp.

CONTENTS

PAGE

1. VERIFICATION OF COMPLIANCE	7
2. TEST SUMMARY.....	8
2.1 TEST ITEMS AND RESULTS	8
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....	8
2.3 RELATED SUBMITTAL(S) / GRANT(S)	8
2.4 PURPOSE OF THE TEST	8
2.5 TEST METHODOLOGY.....	8
2.6 TEST FACILITY.....	8
3. GENERAL INFORMATION.....	9
3.1 PRODUCT DESCRIPTION.....	9
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.....	11
4. EUT MODIFICATIONS.....	11
5. SYSTEM TEST CONFIGURATION	12
5.1 JUSTIFICATION.....	12
5.2 PERIPHERAL EQUIPMENT	12
5.4 CONFIGURATION OF TEST SYSTEM	17
5.5 ANTENNA REQUIREMENT	17
6. PRELIMINARY TEST	18
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	18
6.2 GENERAL RADIATED EMISSIONS TESTS	18
7. MIMIMUM 26 DB BANDWIDTH	19
7.1 OPERATING ENVIRONMENT	19
7.2 TEST SET-UP	19
7.3 TEST EQUIPMENT USED	19
7.4 TEST DATA FOR 802.11A RLAN MODE.....	20
7.4.1 Test data for Antenna 0	20
7.4.2 Test data for Antenna 1	25
7.5 TEST DATA FOR 802.11N_HT20 RLAN MODE	30
7.5.1 Test data for Antenna 0	30
7.5.2 Test data for Antenna 1	35
7.6 TEST DATA FOR 802.11N_HT40 RLAN MODE	40
7.6.1 Test data for Antenna 0	40
7.6.2 Test data for Antenna 1	43

7.7 TEST DATA FOR 802.11AC_VHT80 RLAN MODE.....	46
7.7.1 Test data for Antenna 0	46
7.7.2 Test data for Antenna 1	48
8. 6 DB BANDWIDTH	50
8.1 OPERATING ENVIRONMENT	50
8.2 TEST SET-UP	50
8.3 TEST EQUIPMENT USED	50
8.4 TEST DATA FOR 802.11A RLAN MODE.....	51
8.4.1 Test data for Antenna 0	51
8.4.2 Test data for Antenna 1	53
8.5 TEST DATA FOR 802.11N_HT20 RLAN MODE.....	55
8.5.1 Test data for Antenna 0	55
8.5.2 Test data for Antenna 1	57
8.6 TEST DATA FOR 802.11N_HT40 RLAN MODE.....	59
8.6.1 Test data for Antenna 0	59
8.6.2 Test data for Antenna 1	61
8.7 TEST DATA FOR 802.11AC_VHT80 RLAN MODE.....	63
8.7.1 Test data for Antenna 0	63
8.7.2 Test data for Antenna 1	64
9. MAXIMUM PEAK OUTPUT POWER.....	65
9.1 OPERATING ENVIRONMENT	65
9.2 TEST SET-UP	65
9.3 TEST EQUIPMENT USED	65
9.4 TEST DATA FOR 802.11A RLAN MODE.....	66
9.4.1 Test data for Antenna 0	66
9.5 TEST DATA FOR 802.11N_HT20 RLAN MODE.....	67
9.5.1 Test data for Antenna 0	67
9.5.2 Test data for Antenna 1	67
9.5.3 Test data for Multiple Transmit	68
9.6 TEST DATA FOR 802.11N_HT40 RLAN MODE.....	69
9.6.1 Test data for Antenna 0	69
9.6.2 Test data for Antenna 1	69
9.6.3 Test data for Multiple Transmit	70
9.7 TEST DATA FOR 802.11AC_HT80 RLAN MODE.....	71
9.7.1 Test data for Antenna 0	71
9.7.2 Test data for Antenna 1	71
9.7.3 Test data for Multiple Transmit	72

10. PEAK POWER SPECTRUL DENSITY	73
10.1 OPERATING ENVIRONMENT	73
10.2 TEST SET-UP	73
10.3 TEST EQUIPMENT USED	73
10.4 TEST DATA FOR 802.11A RLAN MODE.....	74
10.4.1 Test data for Antenna 0	74
10.4.2 Test data for Antenna 1	79
10.5 TEST DATA FOR 802.11N_HT20 RLAN MODE.....	84
10.5.1 Test data for Antenna 0	84
10.5.2 Test data for Antenna 1	89
10.5.3 Test data for Multiple Transmit	94
10.6 TEST DATA FOR 802.11N_HT40 RLAN MODE.....	95
10.6.1 Test data for Antenna 0	95
10.6.2 Test data for Antenna 1	98
10.6.3 Test data for Multiple Transmit	101
10.7 TEST DATA FOR 802.11AC_HT80 RLAN MODE.....	102
10.7.1 Test data for Antenna 0	102
10.7.2 Test data for Antenna 1	104
10.7.3 Test data for Multiple Transmit	106
11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION.....	107
11.1 OPERATING ENVIRONMENT	107
11.2 TEST SET-UP	107
11.3 TEST EQUIPMENT USED	107
11.4 TEST DATA FOR U-NII-1	108
11.5 TEST DATA FOR U-NII-3	110
12. FREQUENCY STABILITY WITH VOLTAGE VARIATION.....	112
12.1 OPERATING ENVIRONMENT	112
12.2 TEST SET-UP	112
12.3 TEST EQUIPMENT USED	112
12.4 TEST DATA FOR U-NII-1	113
12.5 TEST DATA FOR U-NII-3	113
13. RADIATED SPURIOUS EMISSIONS.....	114
13.1 OPERATING ENVIRONMENT	114
13.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	114
13.3 TEST EQUIPMENT USED	114
13.4 TEST DATA FOR BELOW 30 MHz	115
13.5 TEST DATA FOR 30 MHz ~ 1 000 MHz	116

13.5.1 Test data for Frequency U-NII-1	116
13.5.2 Test data for Frequency U-NII-3	117
13.6 TEST DATA FOR ABOVE 1 GHz.....	118
13.6.1 Test data for Frequency U-NII-1	118
13.6.2 Test data for Frequency U-NII-3	123
14. RADIATED RESTRICTED BAND EDGE MEASUREMENTS	128
14.1 OPERATING ENVIRONMENT	128
14.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	128
14.3 TEST EQUIPMENT USED	128
14.4 TEST DATA FOR FREQUENCY U-NII-1.....	129
14.4.1 Test data for 802.11a RLAN Mode	129
14.4.2 Test data for 802.11n_HT20 RLAN Mode.....	131
14.4.3 Test data for 802.11n_HT40 RLAN Mode.....	132
14.4.4 Test data for 802.11ac_HT80 RLAN Mode	133
14.5 TEST DATA FOR FREQUENCY U-NII-3.....	134
14.5.1 Test data for 802.11a RLAN Mode	134
14.5.2 Test data for 802.11n_HT20 RLAN Mode.....	136
14.5.3 Test data for 802.11n_HT40 RLAN Mode.....	137
14.5.4 Test data for 802.11ac_HT80 RLAN Mode	138
14.5.5 U-NII-3 Emission Limits	139
15. CONDUCTED EMISSION TEST.....	140
15.1 OPERATING ENVIRONMENT	140
15.2 TEST SET-UP	140
15.3 TEST EQUIPMENT USED	140
15.4 TEST DATA FOR FREQUENCY U-NII-1.....	141
15.5 TEST DATA FOR FREQUENCY U-NII-3.....	143

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-185-RWD-046	2018.05.23	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.
 Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea
 Contact Person : Jeong Inchang / Senior Research Engineer
 Telephone No. : +82-62-950-0332
 FCC ID : YZP-TWFS-B005D
 Model Name : TWFS-B005D
 Serial Number : N/A
 Date : May 23, 2018

EQUIPMENT CLASS	Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Modular Transmitter, WLAN(802.11a/b/g/n/ac) 2x2 MIMO 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 D02 General UNII Test Procedures New Rules V02r01
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-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 Innotek Co., Ltd., Model TWFS-B005D (referred to as the EUT in this report) is a WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module		
Operating Frequency	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
		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 (12.32 dBm) Wi-Fi 802.11n(HT20) (12.08 dBm) Wi-Fi 802.11n(HT40) (11.15 dBm)
		Antenna 1	Wi-Fi 802.11b (14.07 dBm) Wi-Fi 802.11g (12.41 dBm) Wi-Fi 802.11n(HT20) (12.21 dBm) Wi-Fi 802.11n(HT40) (11.14 dBm)
		Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (15.08 dBm) Wi-Fi 802.11n(HT40) (14.11 dBm)

RF Output Power	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (13.19 dBm) Wi-Fi 802.11n(HT20) (12.91 dBm) Wi-Fi 802.11n(HT40) (11.45 dBm) Wi-Fi 802.11ac(HT80) (6.48 dBm)
			Antenna 1	Wi-Fi 802.11a (13.84 dBm) Wi-Fi 802.11n(HT20) (13.71 dBm) Wi-Fi 802.11n(HT40) (12.71 dBm) Wi-Fi 802.11ac(HT80) (7.16 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (16.34 dBm) Wi-Fi 802.11n(HT40) (15.09 dBm) Wi-Fi 802.11ac(HT80) (9.84 dBm)
		5 725 MHz ~ 5 850 MHz Band	Antenna 0	Wi-Fi 802.11a (12.52 dBm) Wi-Fi 802.11n(HT20) (12.17 dBm) Wi-Fi 802.11n(HT40) (11.45 dBm) Wi-Fi 802.11ac(HT80) (8.36 dBm)
			Antenna 1	Wi-Fi 802.11a (12.56 dBm) Wi-Fi 802.11n(HT20) (12.85 dBm) Wi-Fi 802.11n(HT40) (11.87 dBm) Wi-Fi 802.11ac(HT80) (7.14 dBm)
			Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (15.53 dBm) Wi-Fi 802.11n(HT40) (14.91 dBm) Wi-Fi 802.11ac(HT80) (10.80 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	3.39 dBi
		Antenna 1	3.56 dBi
		Antenna 0 + Antenna 1	6.49 dBi
	5 150 MHz ~ 5 250 MHz Band	Antenna 0	2.56 dBi
		Antenna 1	2.01 dBi
		Antenna 0 + Antenna 1	5.30 dBi
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	2.39 dBi
		Antenna 1	1.70 dBi
		Antenna 0 + Antenna 1	5.07 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32.768 kHz, 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 Innotek Co., Ltd.	TWFS-B005D_RDK_Rev0.1	-

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
TWFS-B005D	LG Innotek Co., Ltd.	WLAN(802.11a/b/g/n/ac) 2x2 MIMO Module (EUT)	-
N/A	N/A	Jig Board	EUT
Ideapad 110	Lenovo	Notebook	-

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]	
		Antenna 0	Antenna 1
802.11 a (Middle Channel)	6 Mbps	13.19	12.46
	9 Mbps	13.15	12.37
	12 Mbps	13.09	12.27
	18 Mbps	13.04	12.20
	24 Mbps	12.98	12.16
	36 Mbps	12.88	12.08
	48 Mbps	12.83	12.07
	54 Mbps	12.82	12.01
HT 20 (Middle Channel)	6.5 Mbps	12.43	12.91
	13 Mbps	12.41	12.89
	19.5 Mbps	12.36	12.88
	26 Mbps	12.34	12.82
	39 Mbps	12.32	12.80
	52 Mbps	12.27	12.78
	58.5 Mbps	12.24	12.72
	65 Mbps	12.19	12.68
HT 40 (Low Channel)	13.5 Mbps	11.35	12.71
	27 Mbps	11.30	12.66
	40.5 Mbps	11.26	12.62
	54 Mbps	11.20	12.54
	81 Mbps	11.16	12.49
	108 Mbps	11.09	12.42
	121.5 Mbps	11.01	12.37
	135 Mbps	10.93	12.31

VHT80 (Middle Channel)	29.3 Mbps	6.48	7.16
	58.5 Mbps	6.40	7.09
	87.8 Mbps	6.36	7.02
	117 Mbps	6.31	6.99
	175.5 Mbps	6.24	6.92
	234 Mbps	6.20	6.85
	263.3 Mbps	6.11	6.81
	292.5 Mbps	6.05	6.78
	351 Mbps	6.01	6.71
	390 Mbps	5.89	6.65

- . 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]	
		Antenna 0	Antenna 1
802.11 a (Middle Channel)	6 Mbps	12.52	12.56
	9 Mbps	12.50	12.53
	12 Mbps	12.42	12.47
	18 Mbps	12.33	12.39
	24 Mbps	12.25	12.31
	36 Mbps	12.20	12.23
	48 Mbps	12.15	12.19
	54 Mbps	12.13	12.12
HT 20 (Middle Channel)	6.5 Mbps	12.17	12.85
	13 Mbps	12.08	12.82
	19.5 Mbps	12.00	12.81
	26 Mbps	11.96	12.75
	39 Mbps	11.87	12.72
	52 Mbps	11.83	12.71
	58.5 Mbps	11.76	12.64
	65 Mbps	11.68	12.57
HT 40 (Low Channel)	13.5 Mbps	11.45	11.50
	27 Mbps	11.44	11.43
	40.5 Mbps	11.34	11.39
	54 Mbps	11.27	11.30
	81 Mbps	11.25	11.26
	108 Mbps	11.21	11.17
	121.5 Mbps	11.18	11.16
	135 Mbps	11.16	11.12

VHT80 (Middle Channel)	29.3 Mbps	8.36	7.14
	58.5 Mbps	8.34	7.12
	87.8 Mbps	8.25	7.10
	117 Mbps	8.23	7.02
	175.5 Mbps	8.21	7.01
	234 Mbps	8.14	6.98
	263.3 Mbps	8.13	6.89
	292.5 Mbps	8.03	6.84
	351 Mbps	8.01	6.81
	390 Mbps	7.96	6.76

- 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.

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 transmitter external antenna of the EUT is WLAN 2.4 GHz Band & WLAN 5 GHz Band is Metal Antenna(Antenna 0, Antenna 1). The manufacturer has designed a structure that connects to the antenna using a unique coupling connector of the MMCX type. 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. 14, 2018 (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

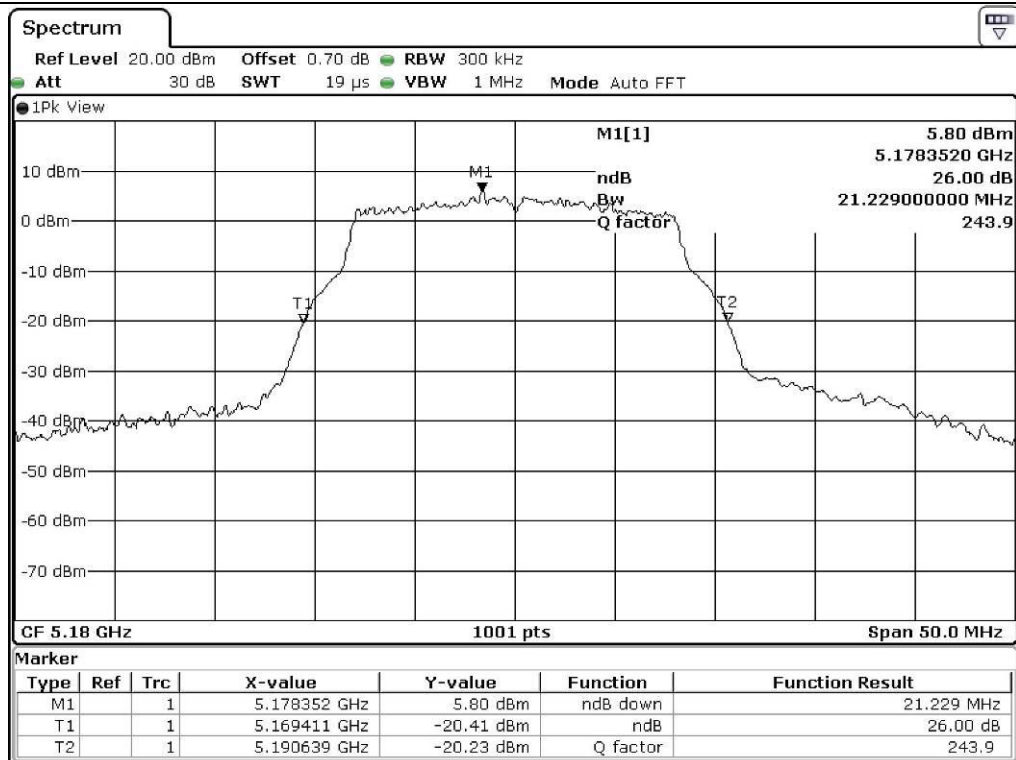
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

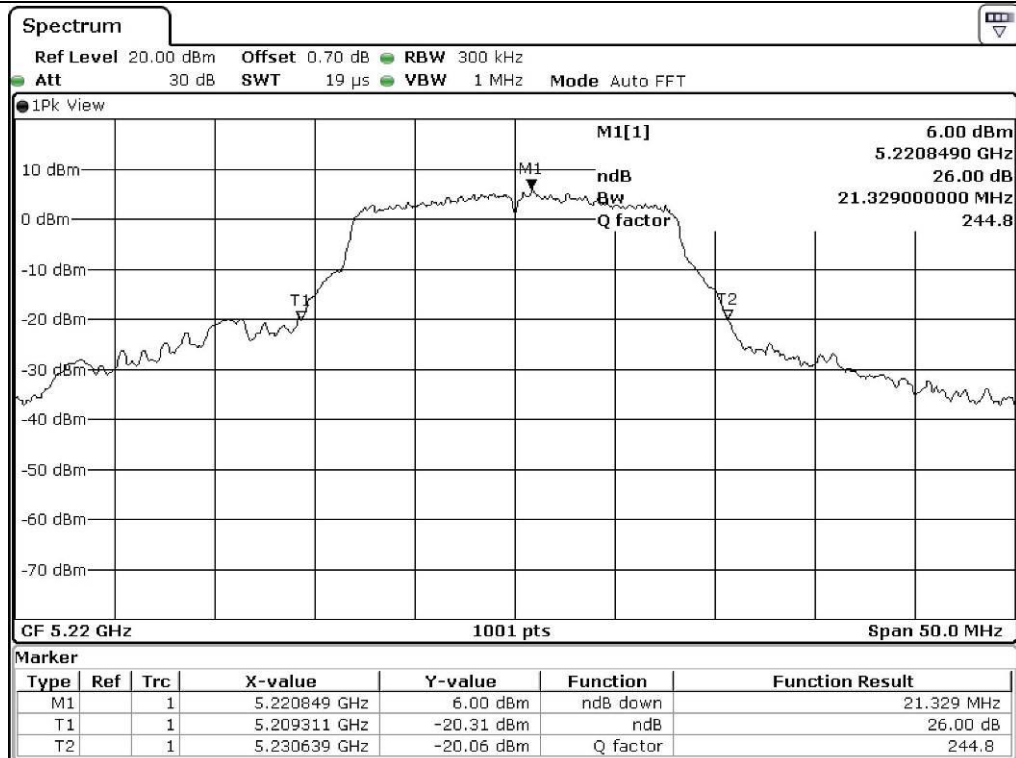
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.23
	Middle	5 220.00	21.33
	High	5 240.00	21.58
5 725 ~ 5 850	Low	5 745.00	21.73
	Middle	5 785.00	21.53
	High	5 825.00	21.78



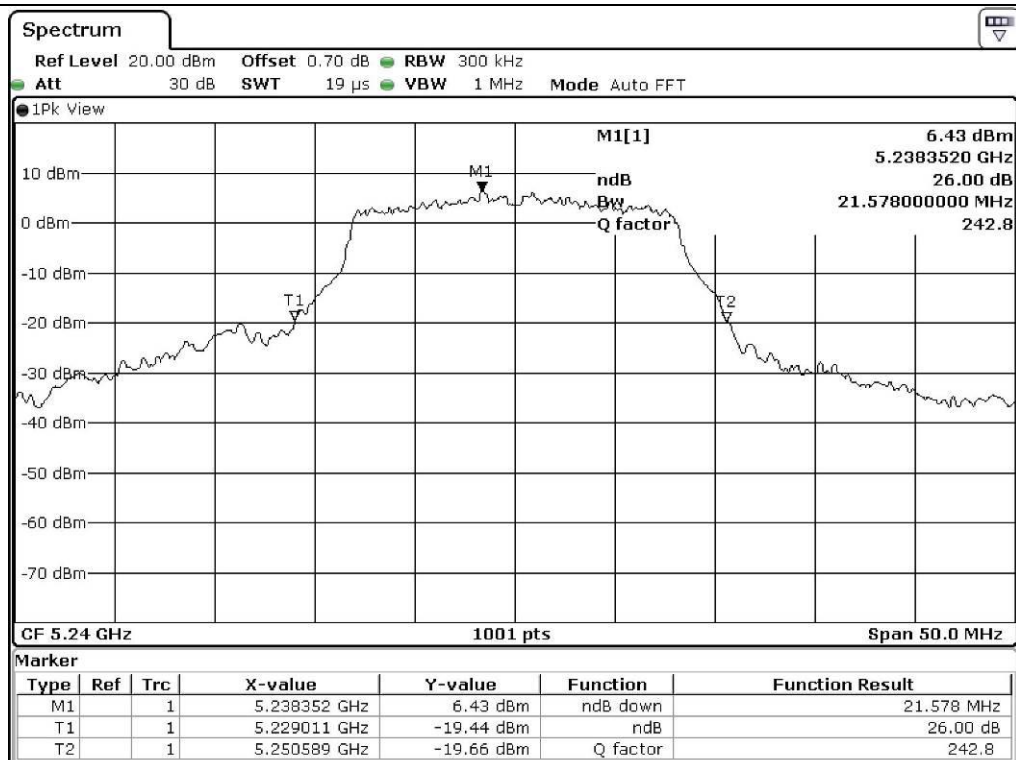
Tested by: Hyung-Kwon, Oh / Assistant Manager



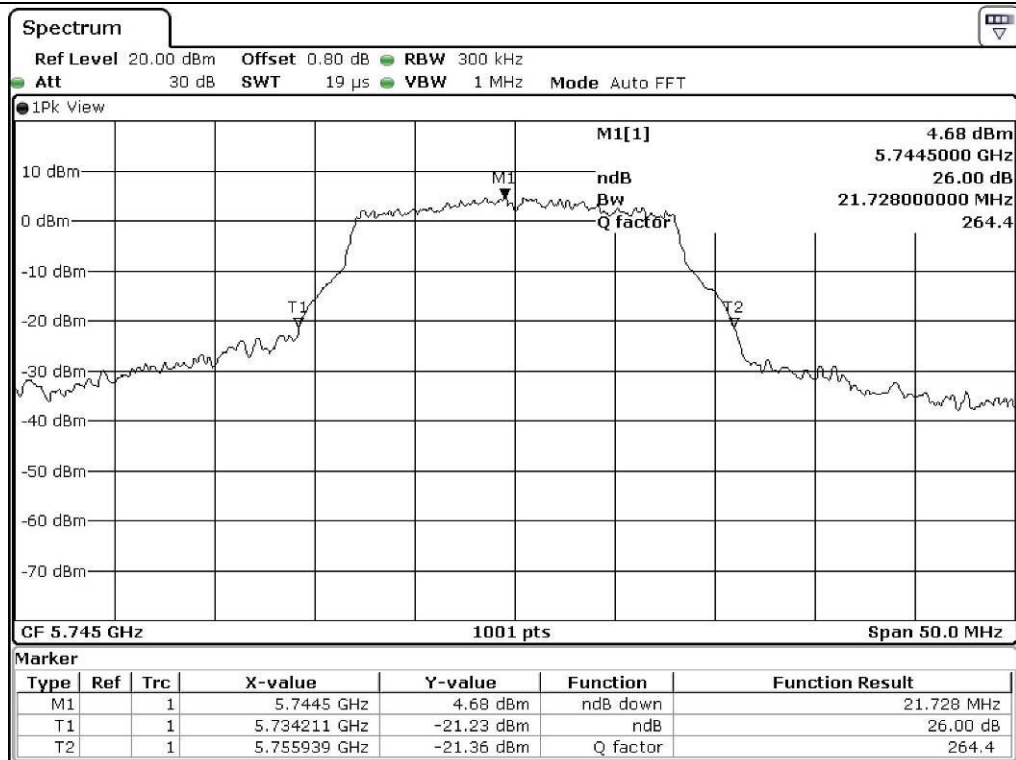
Low Channel (5 180 MHz)



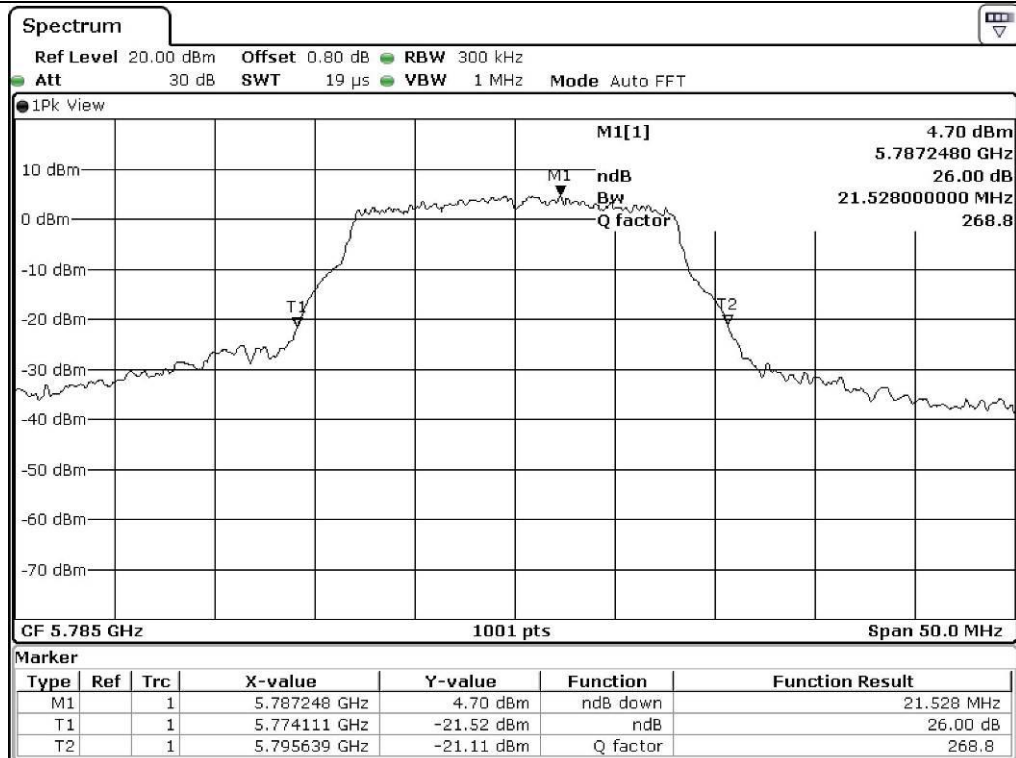
Middle Channel (5 220 MHz)



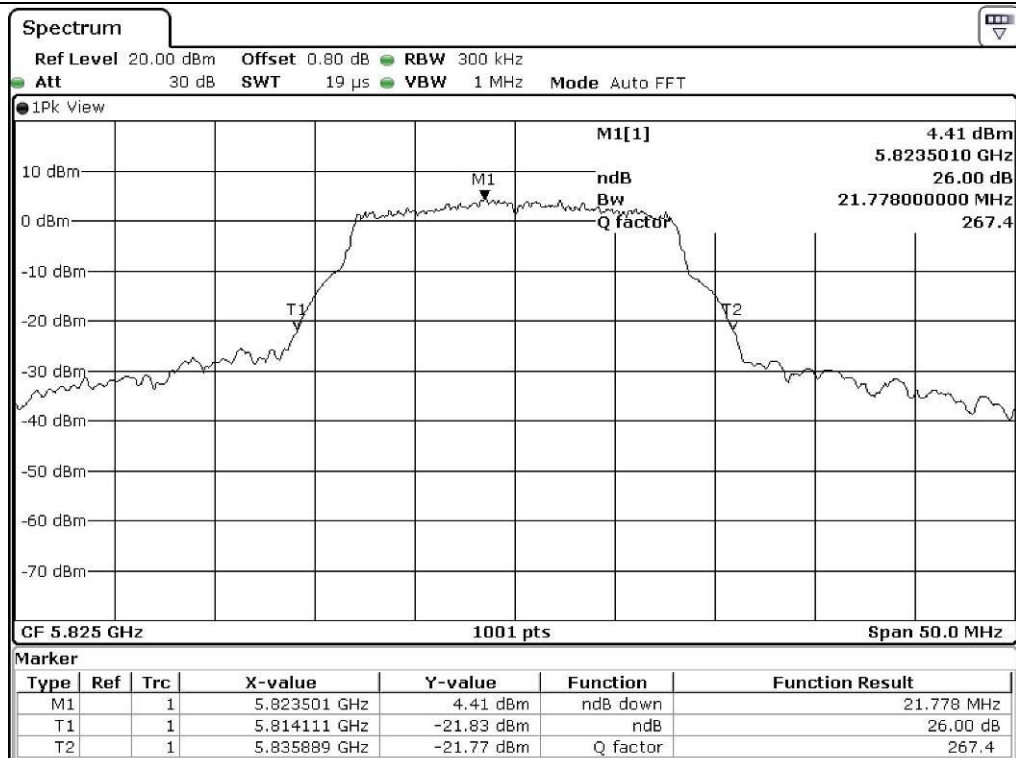
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

7.4.2 Test data for Antenna 1

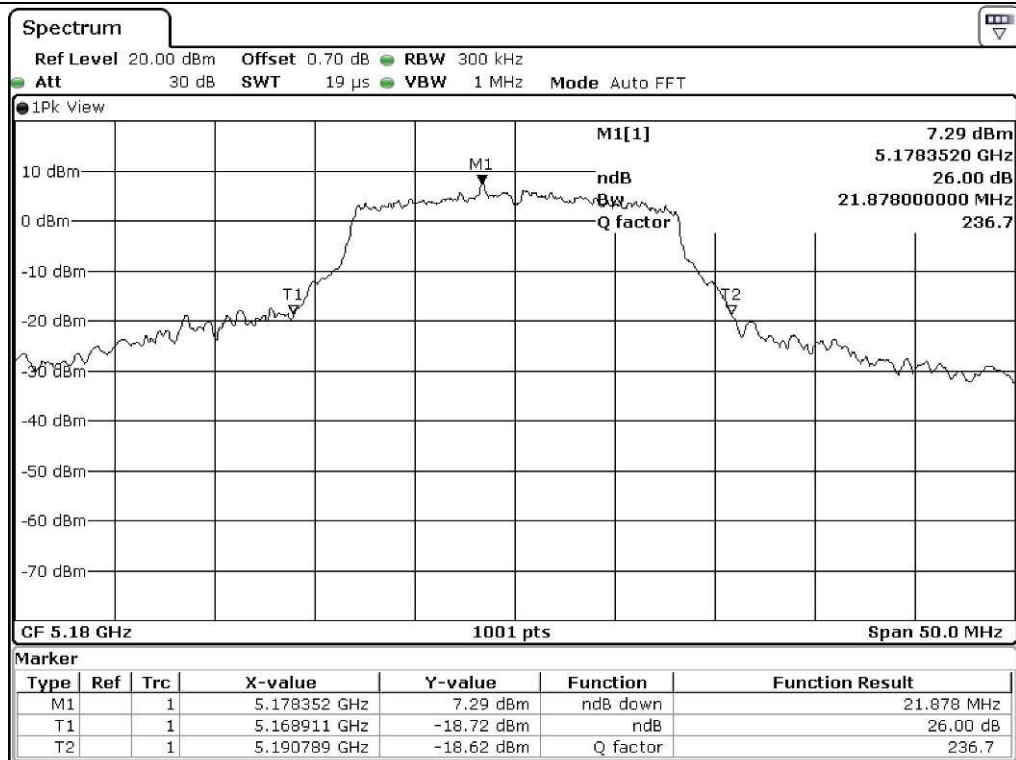
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

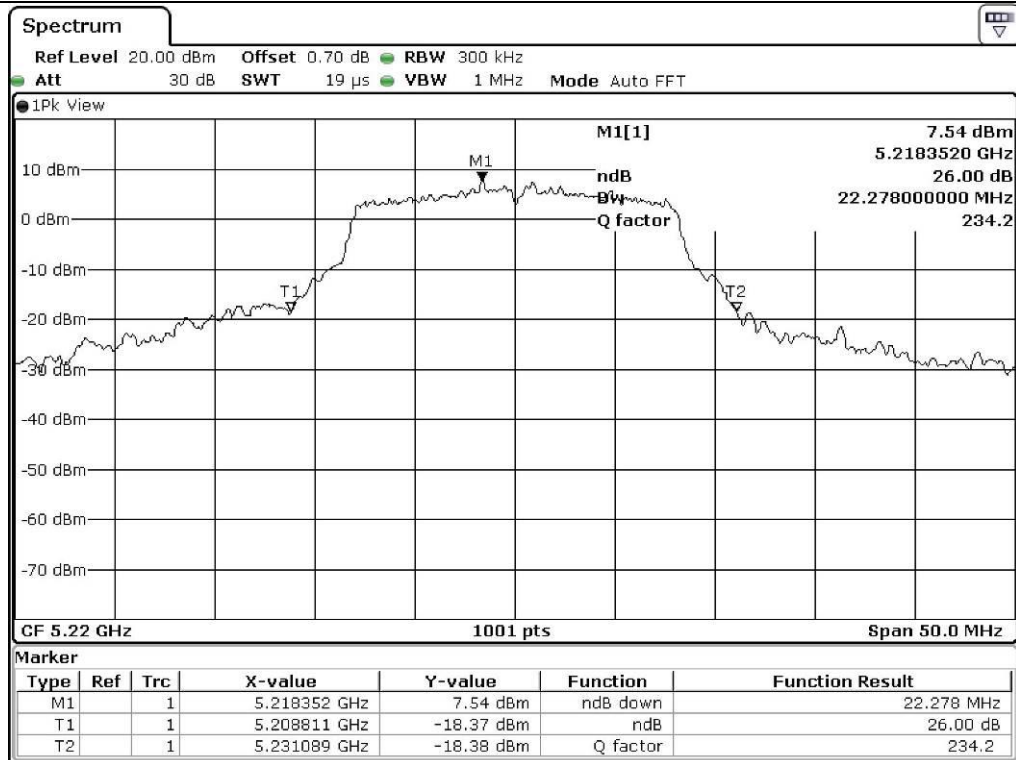
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.88
	Middle	5 220.00	22.28
	High	5 240.00	21.38
5 725 ~ 5 850	Low	5 745.00	21.88
	Middle	5 785.00	21.28
	High	5 825.00	21.28



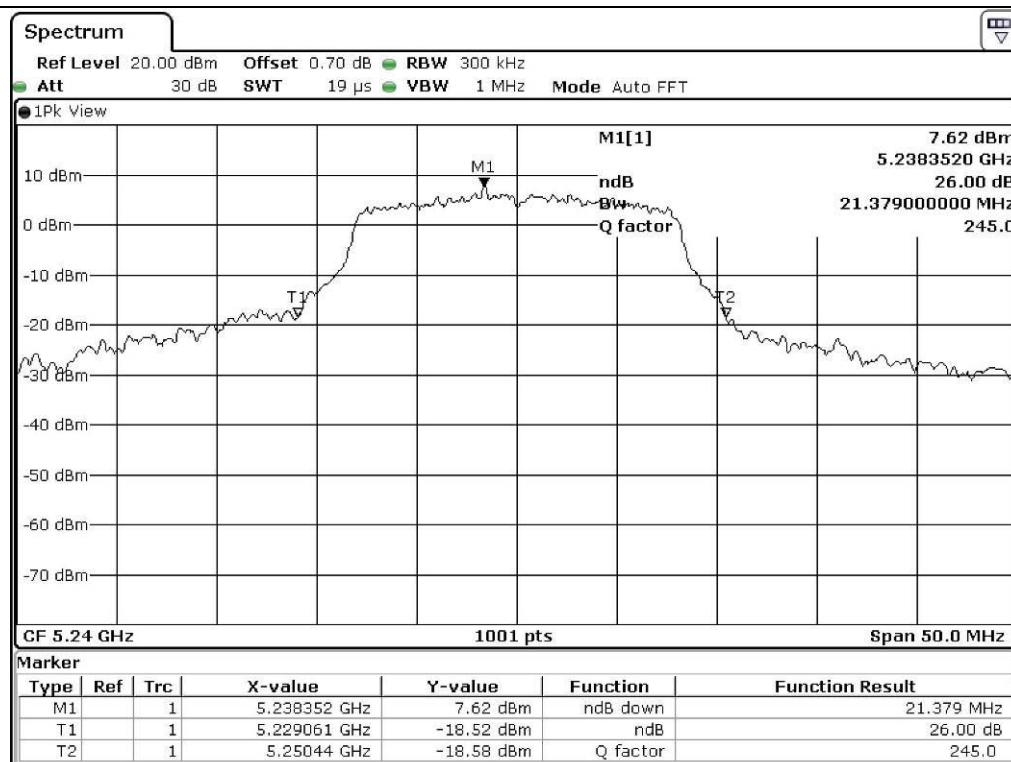
Tested by: Hyung-Kwon, Oh / Assistant Manager



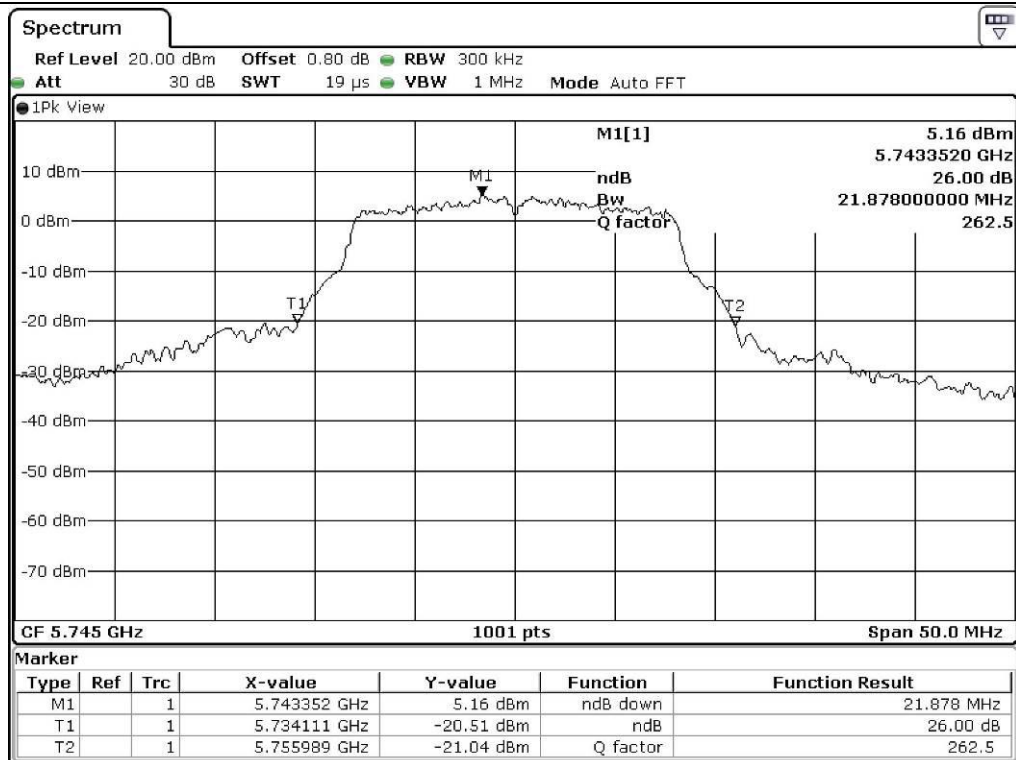
Low Channel (5 180 MHz)



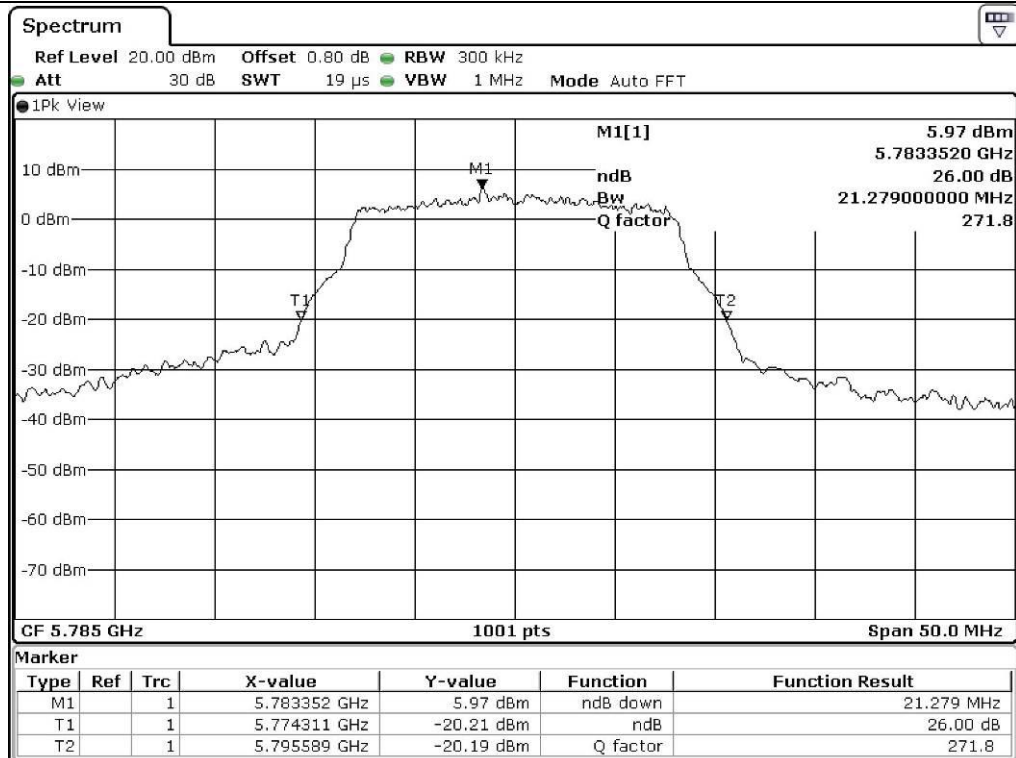
Middle Channel (5 220 MHz)



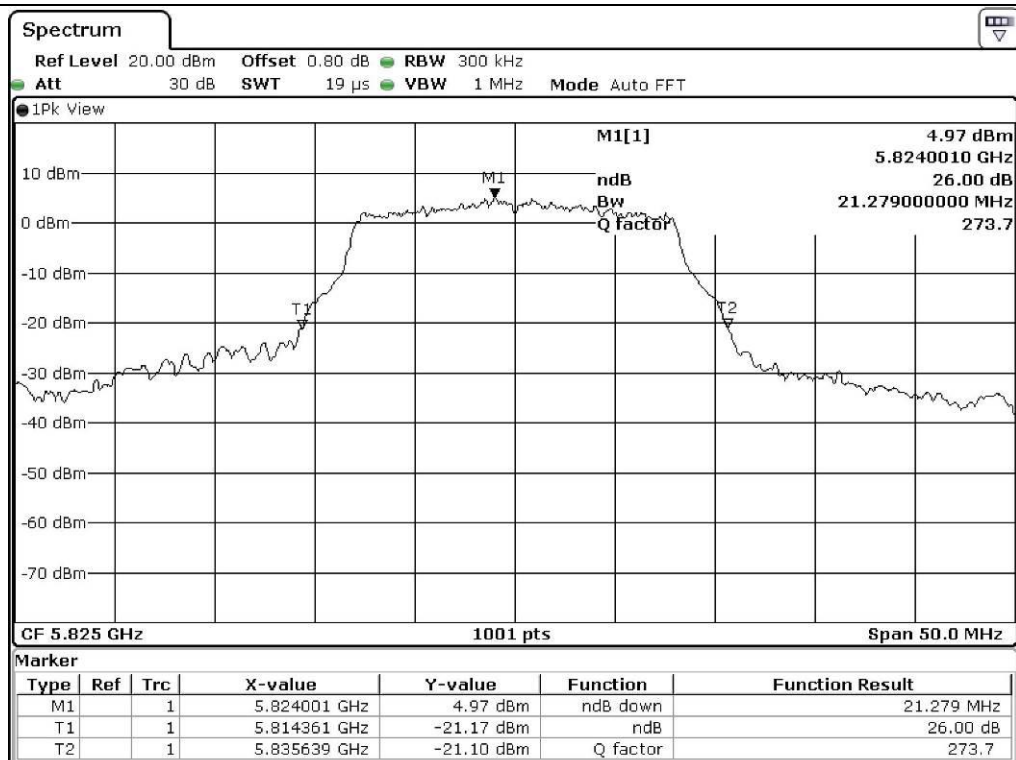
High Channel (5 240 MHz)



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

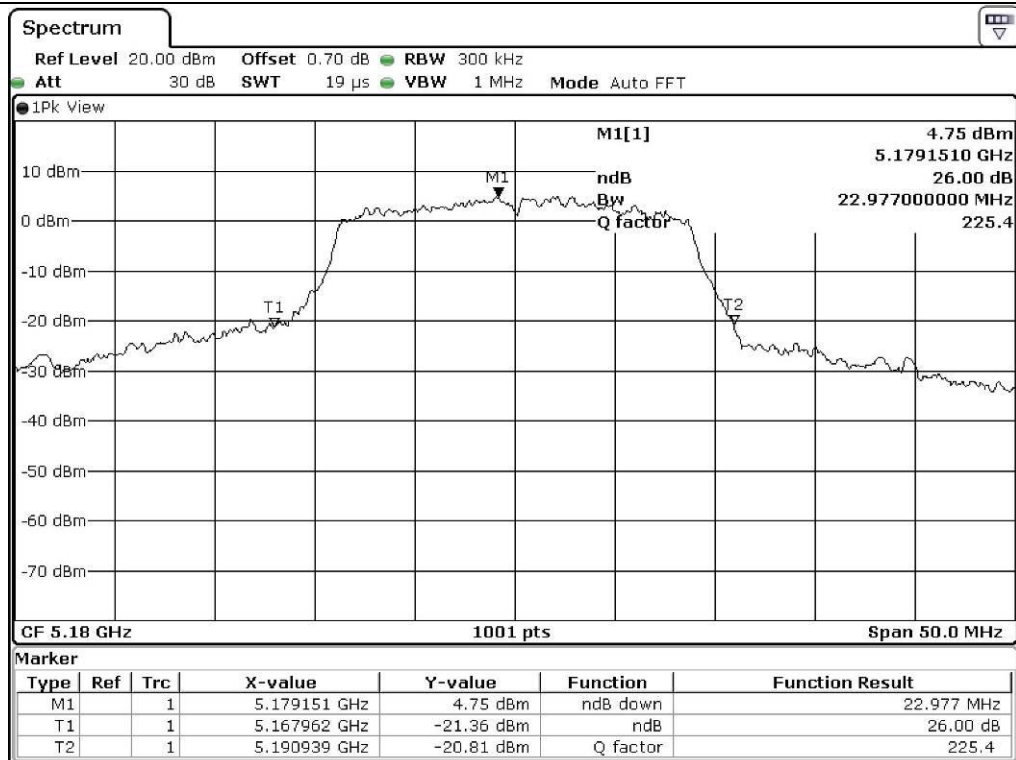
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

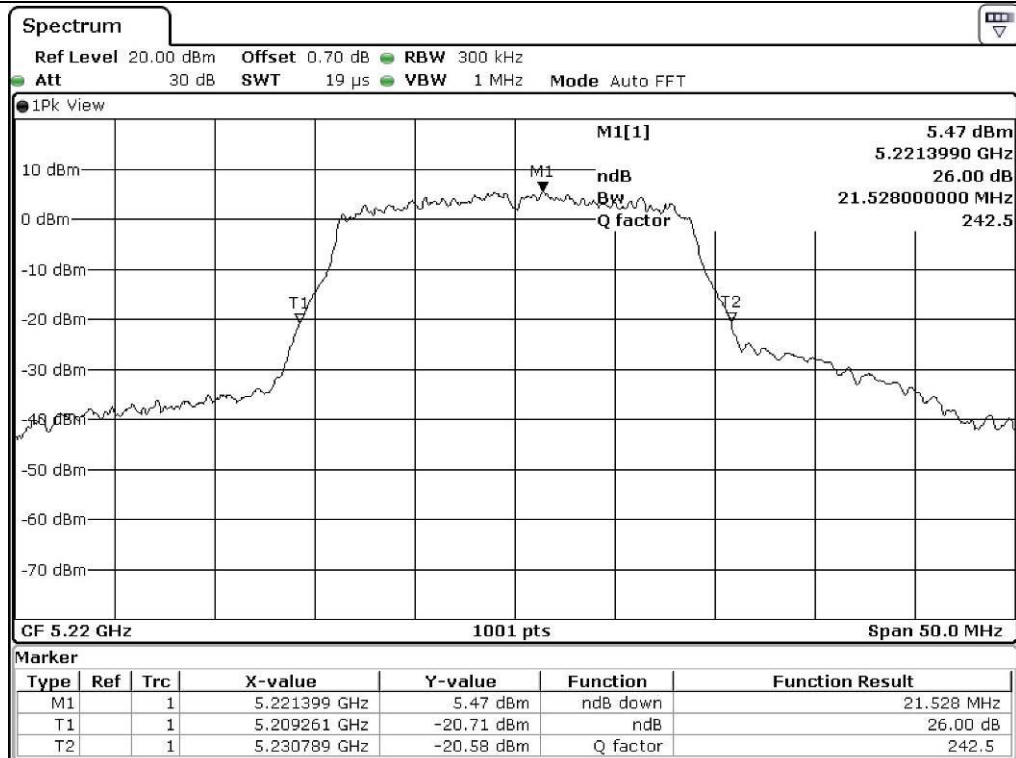
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	22.98
	Middle	5 220.00	21.53
	High	5 240.00	21.63
5 725 ~ 5 850	Low	5 745.00	22.38
	Middle	5 785.00	22.73
	High	5 825.00	21.53



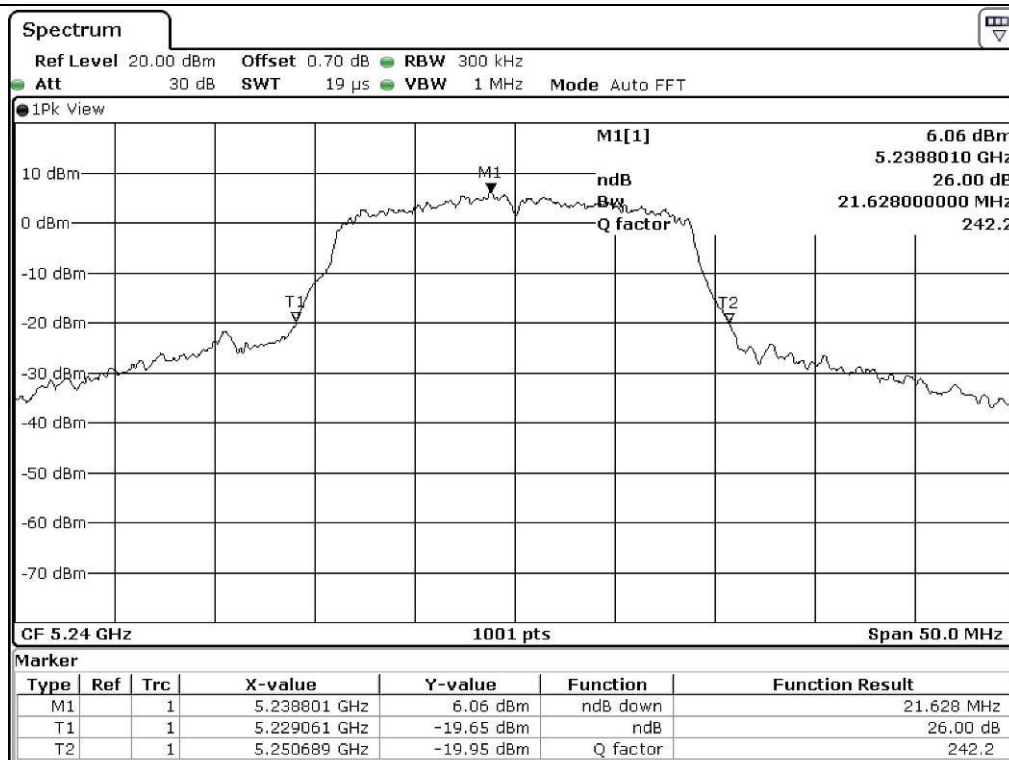
Tested by: Hyung-Kwon, Oh / Assistant Manager



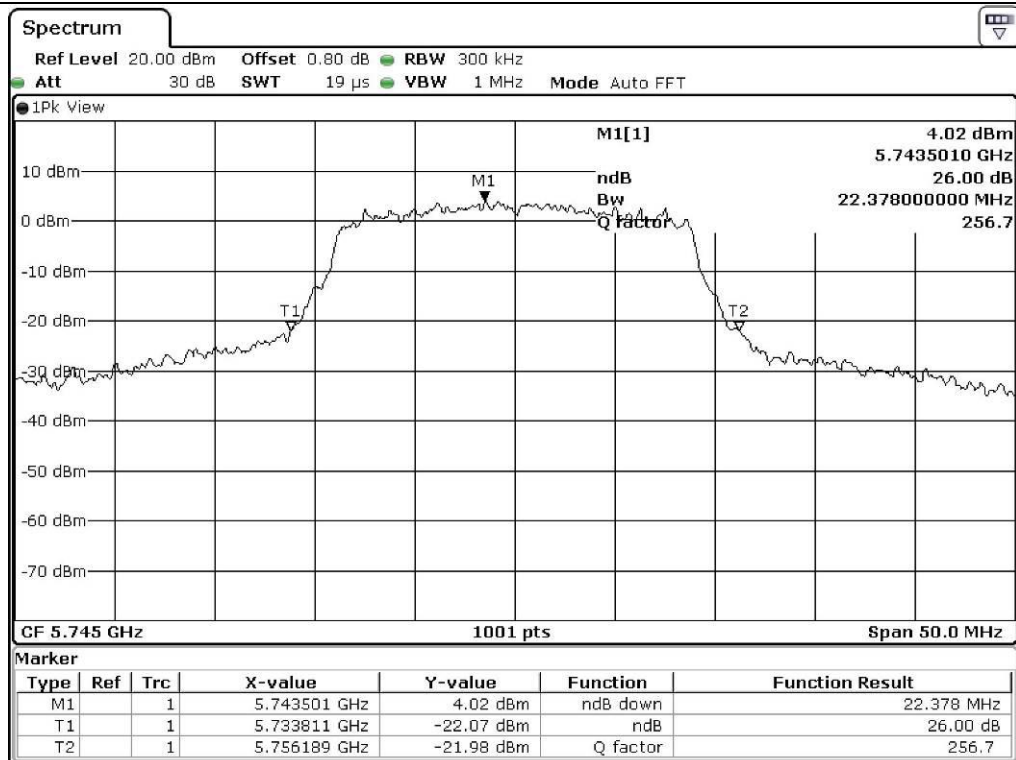
Low Channel (5 180 MHz)



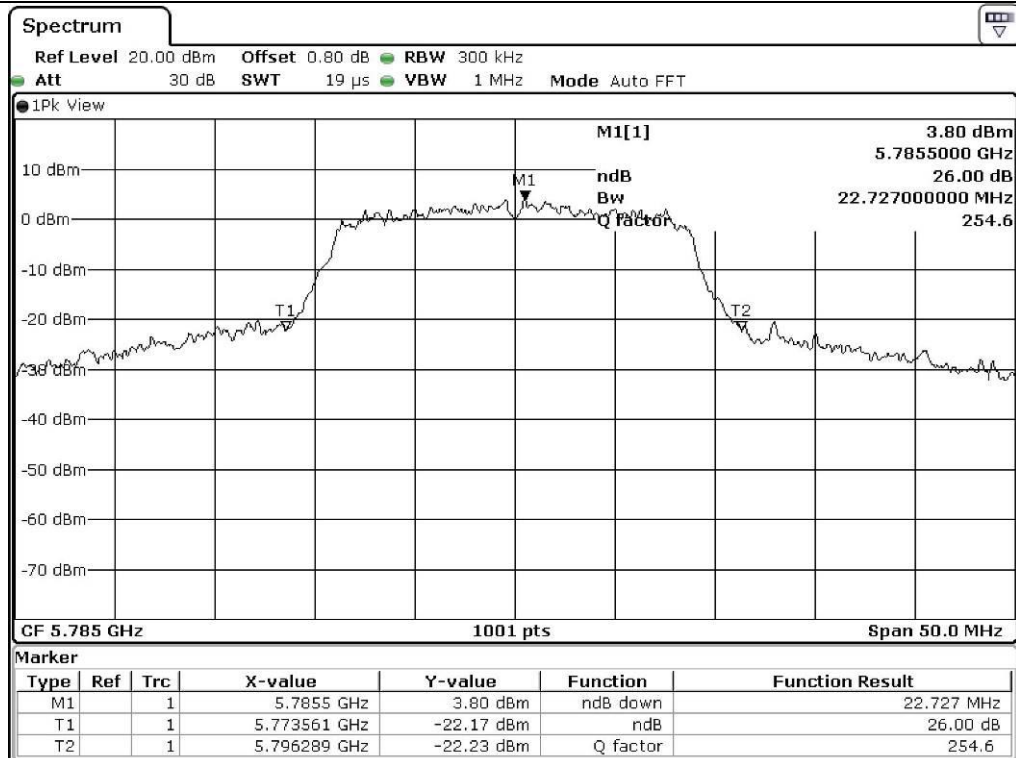
Middle Channel (5 220 MHz)



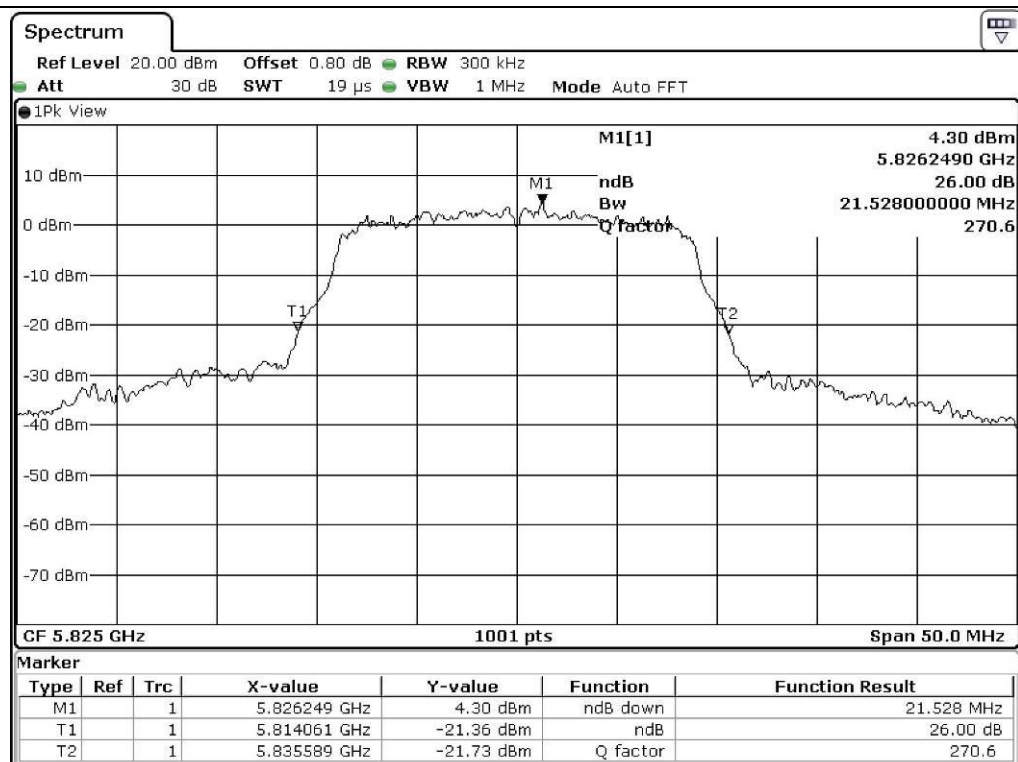
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

7.5.2 Test data for Antenna 1

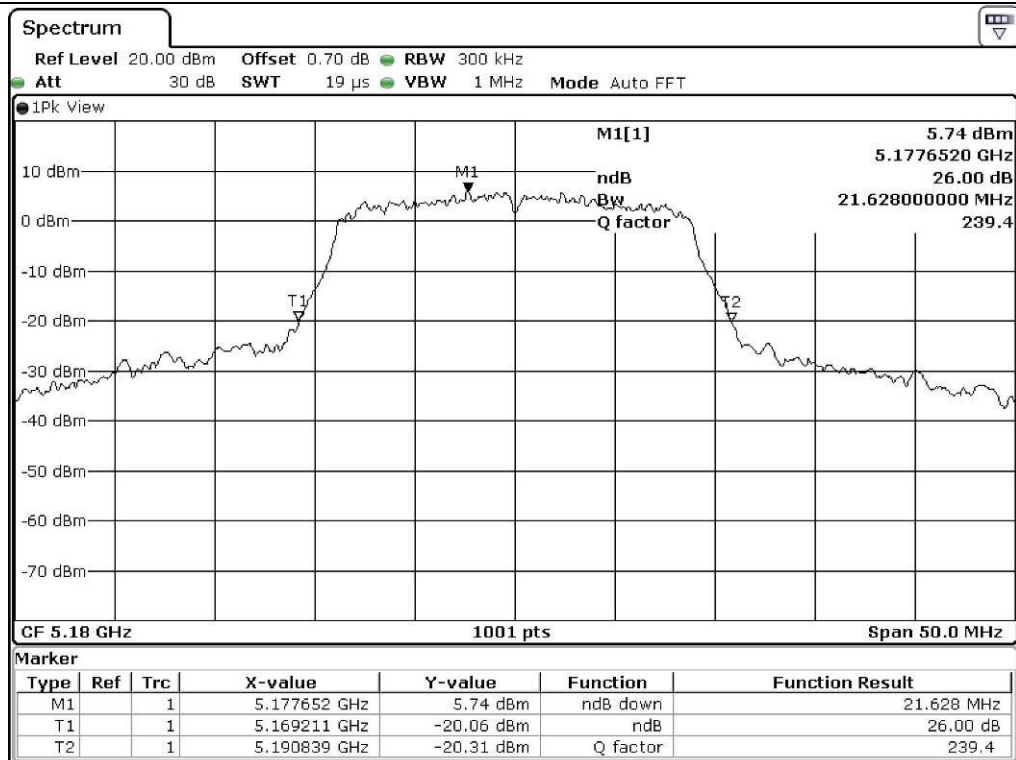
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

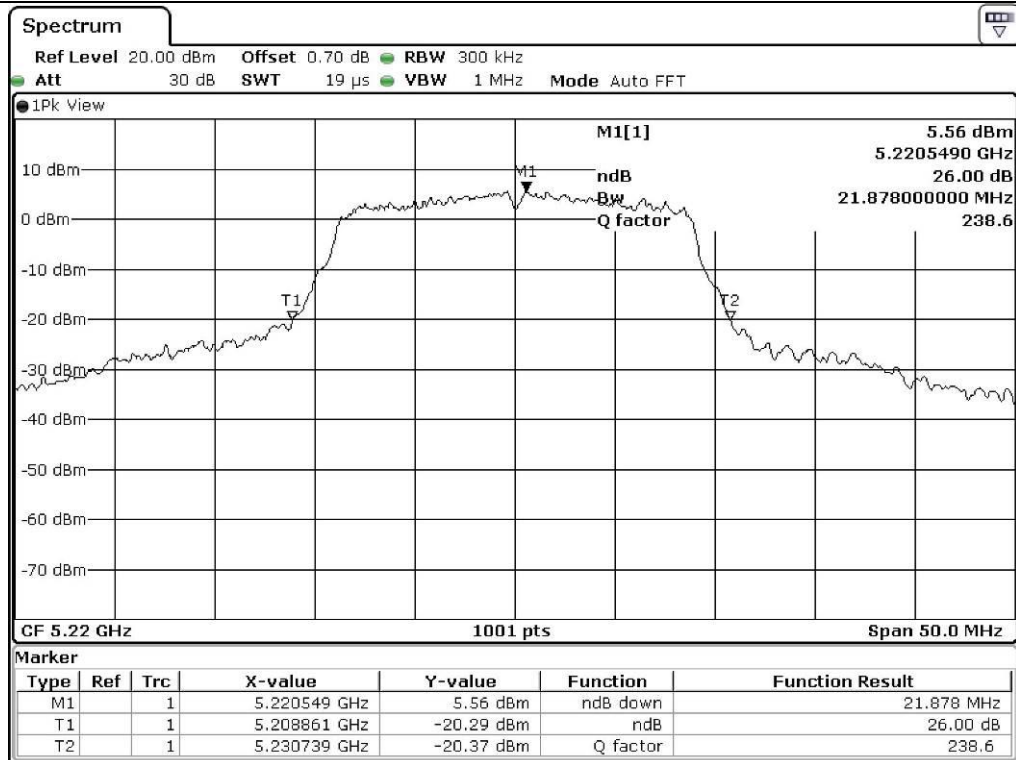
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.63
	Middle	5 220.00	21.88
	High	5 240.00	21.53
5 725 ~ 5 850	Low	5 745.00	21.78
	Middle	5 785.00	21.58
	High	5 825.00	21.63



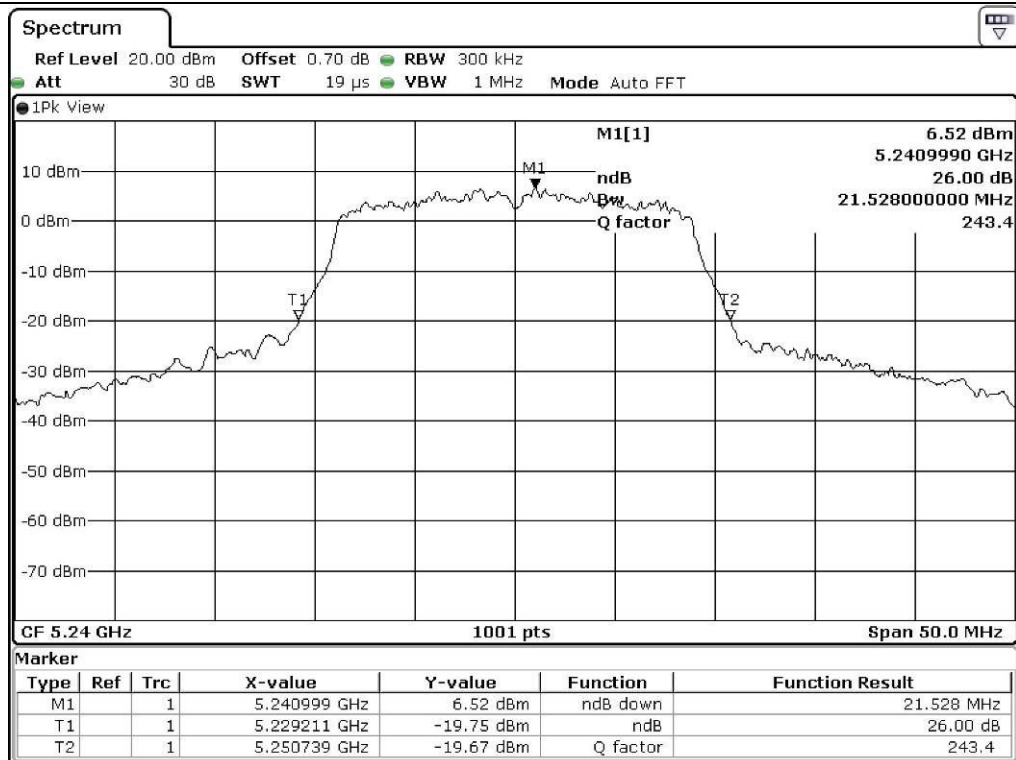
Tested by: Hyung-Kwon, Oh / Assistant Manager



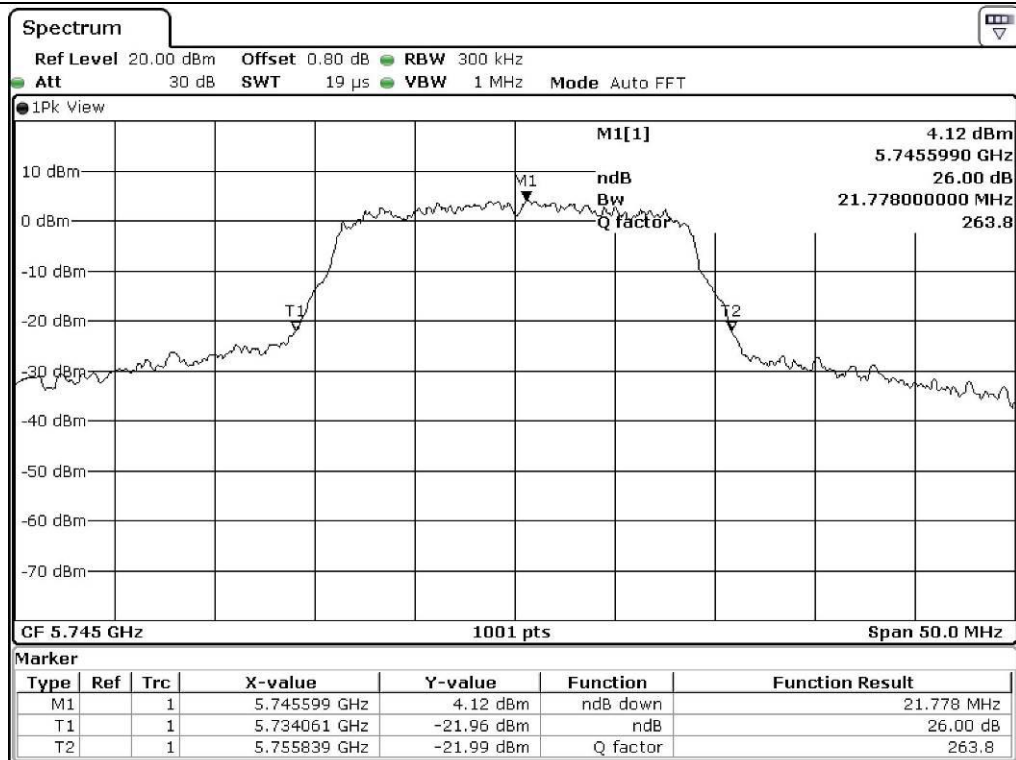
Low Channel (5 180 MHz)



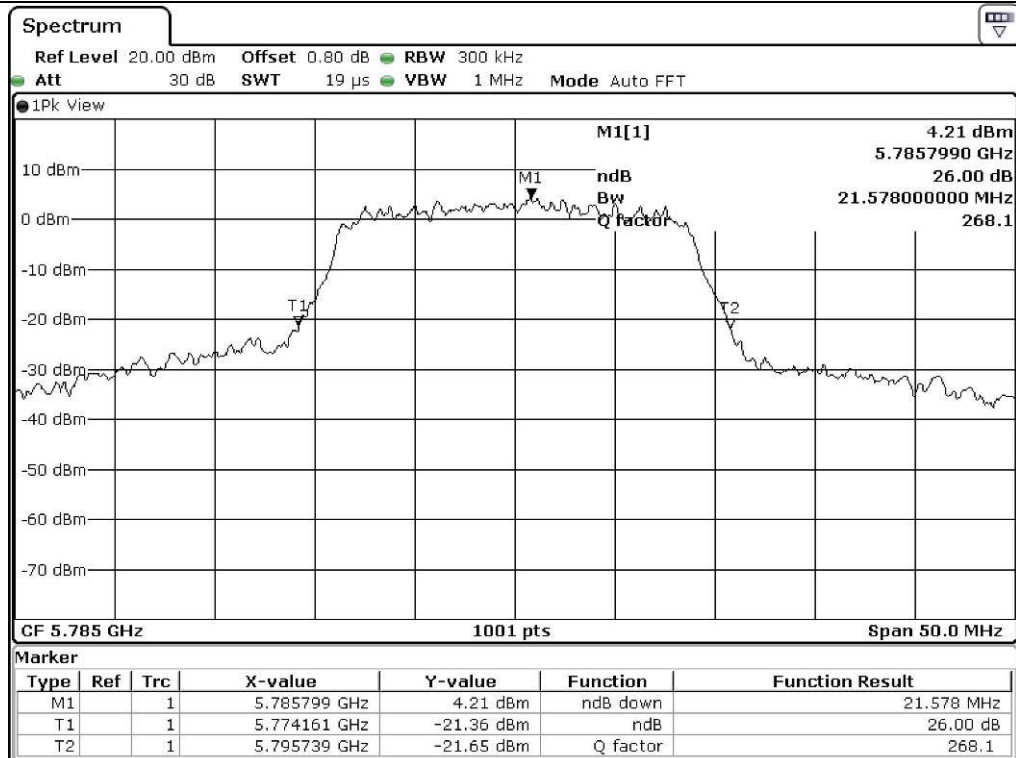
Middle Channel (5 220 MHz)



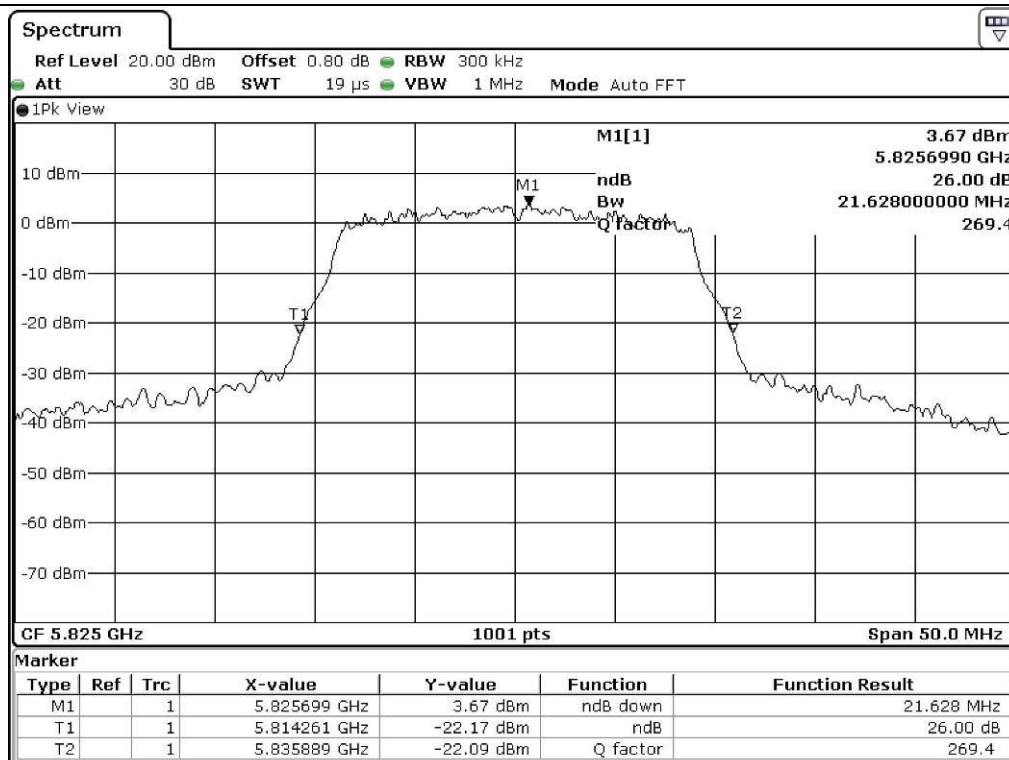
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



High Channel (5 825 MHz)

7.6 Test data for 802.11n_HT40 RLAN Mode

7.6.1 Test data for Antenna 0

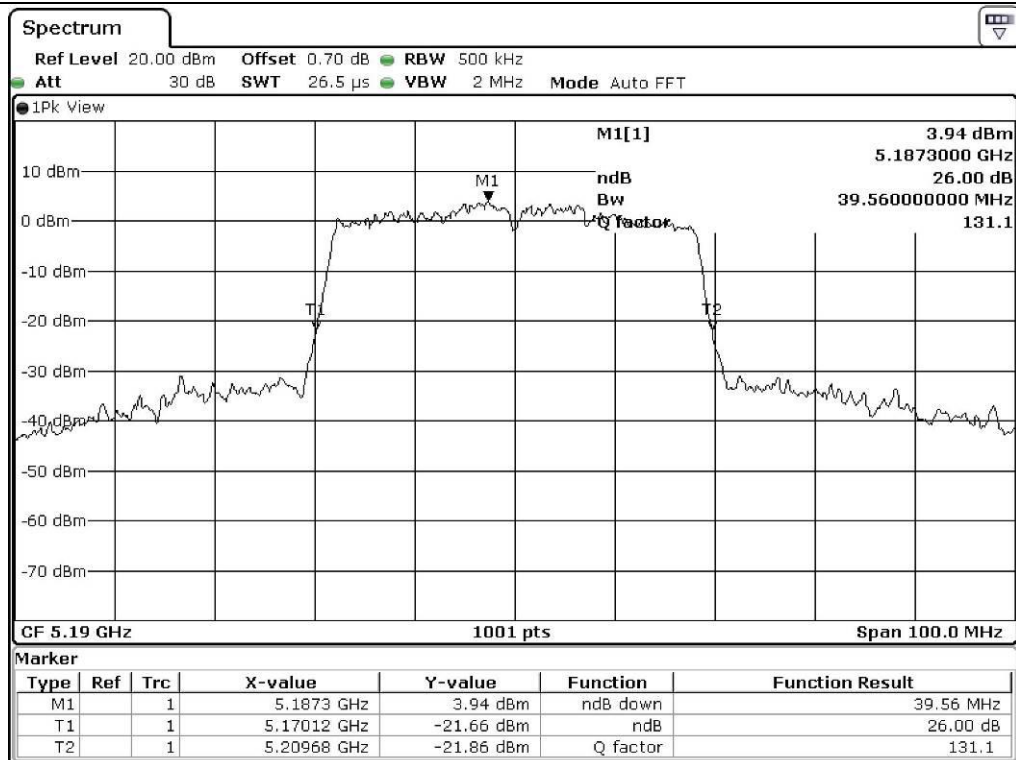
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

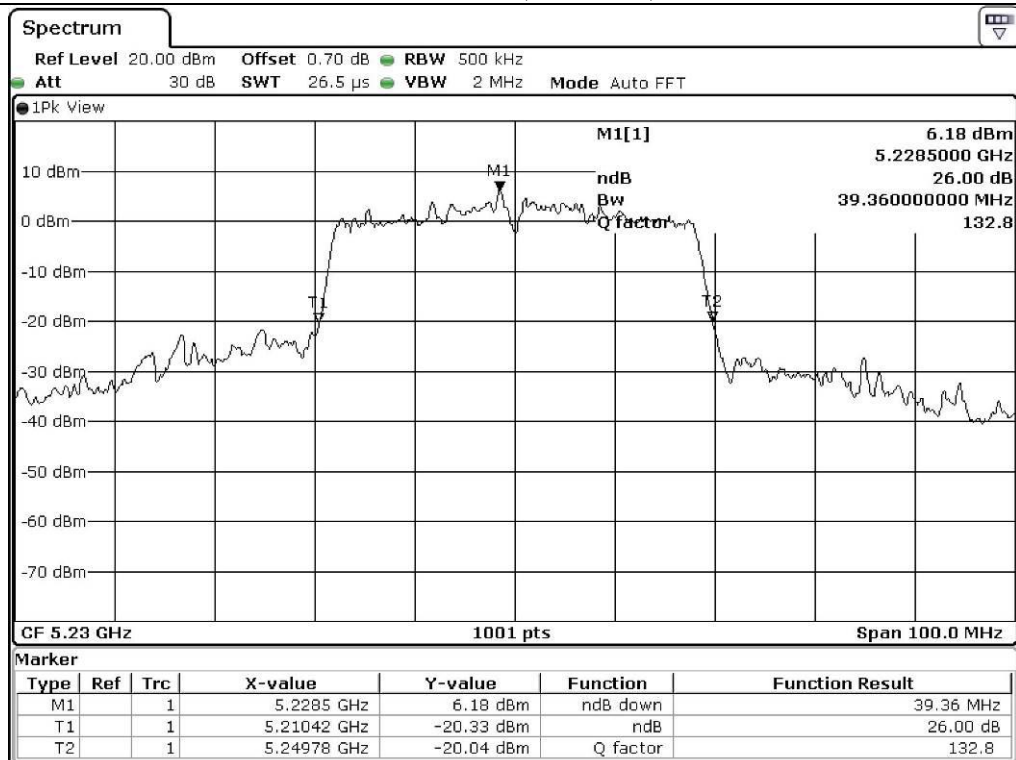
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	39.56
	High	5 230.00	39.36
5 725 ~ 5 850	Low	5 755.00	40.36
	High	5 795.00	40.66



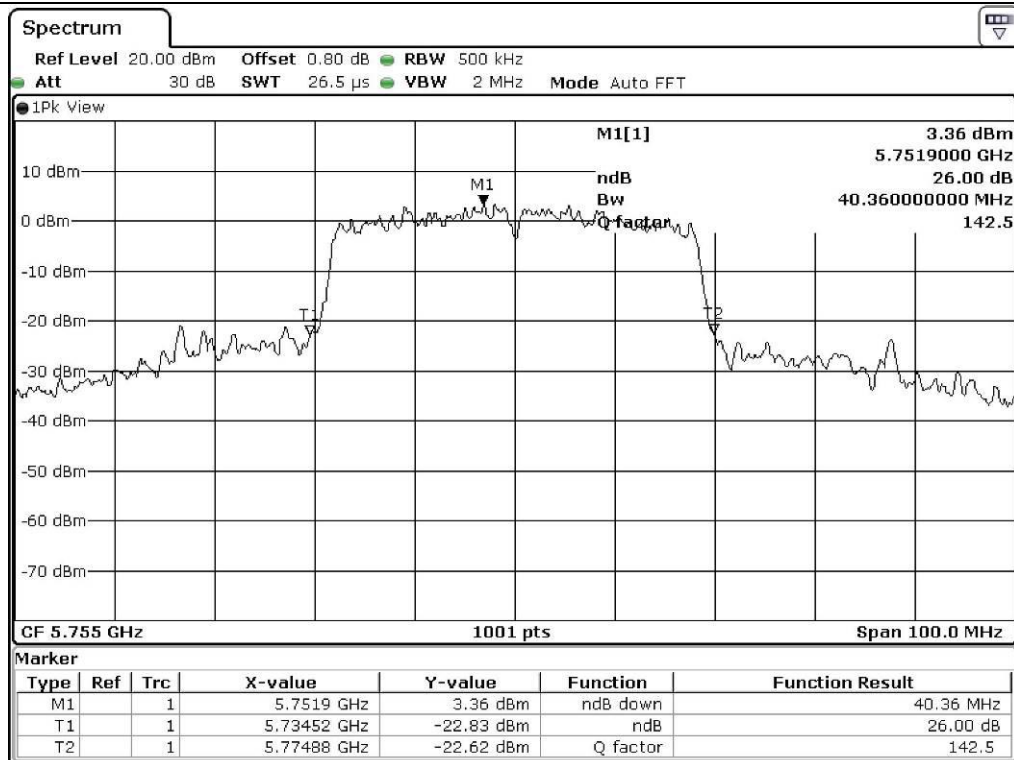
Tested by: Hyung-Kwon, Oh / Assistant Manager



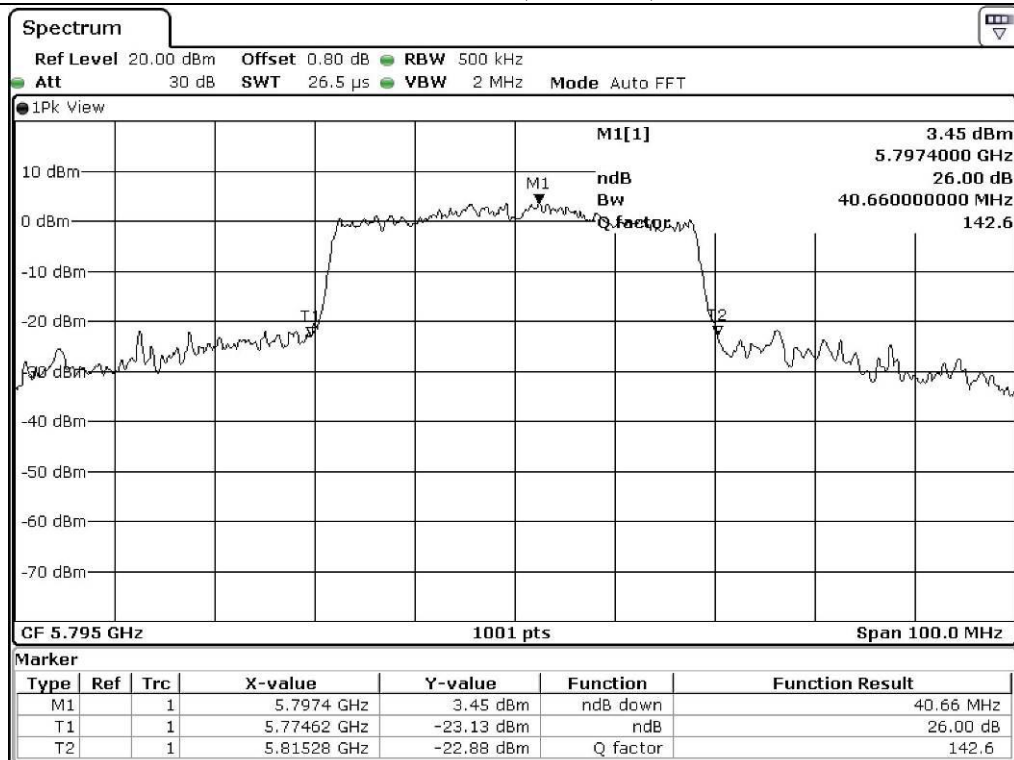
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

7.6.2 Test data for Antenna 1

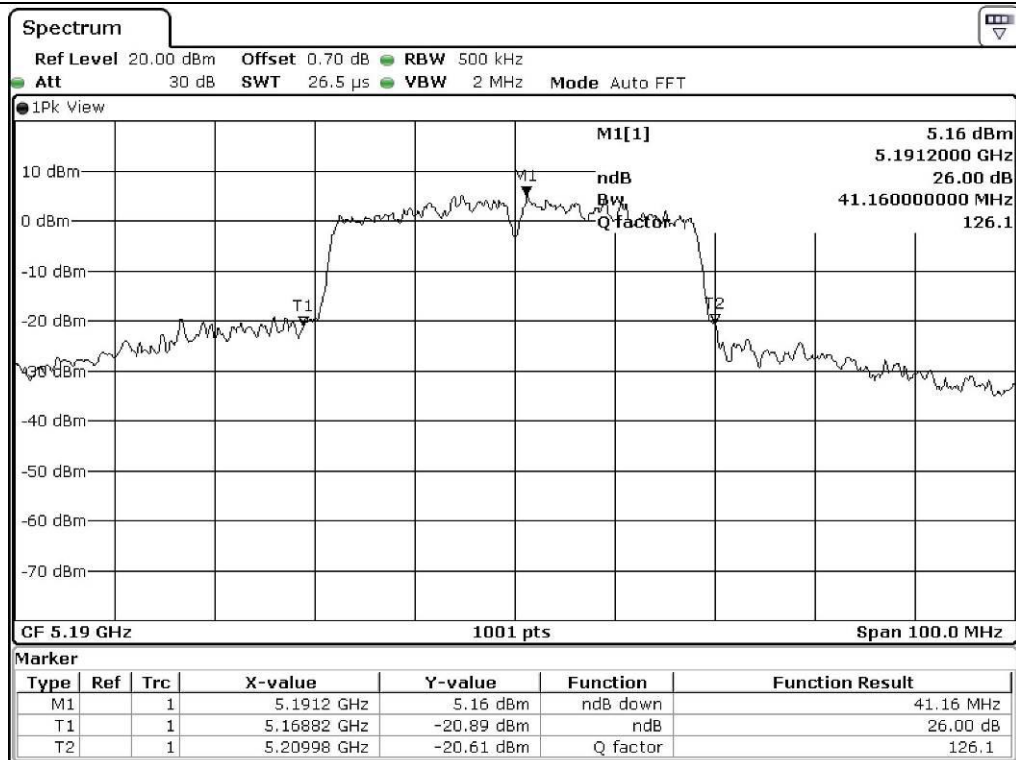
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

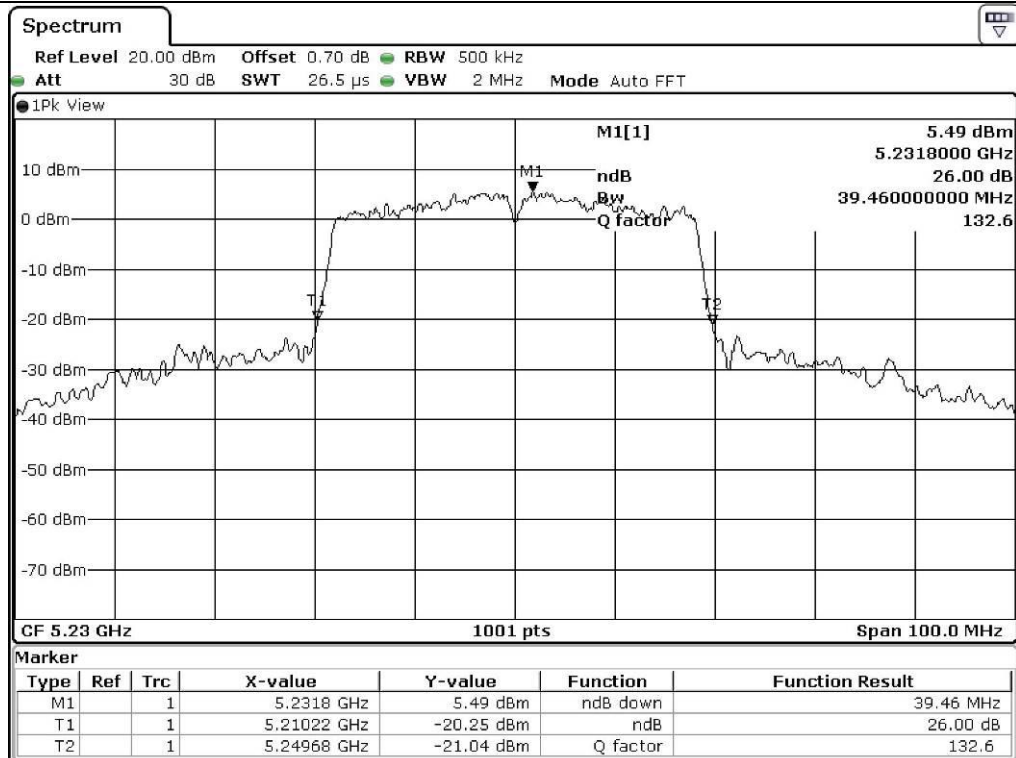
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	41.16
	High	5 230.00	39.46
5 725 ~ 5 850	Low	5 755.00	39.96
	High	5 795.00	39.56



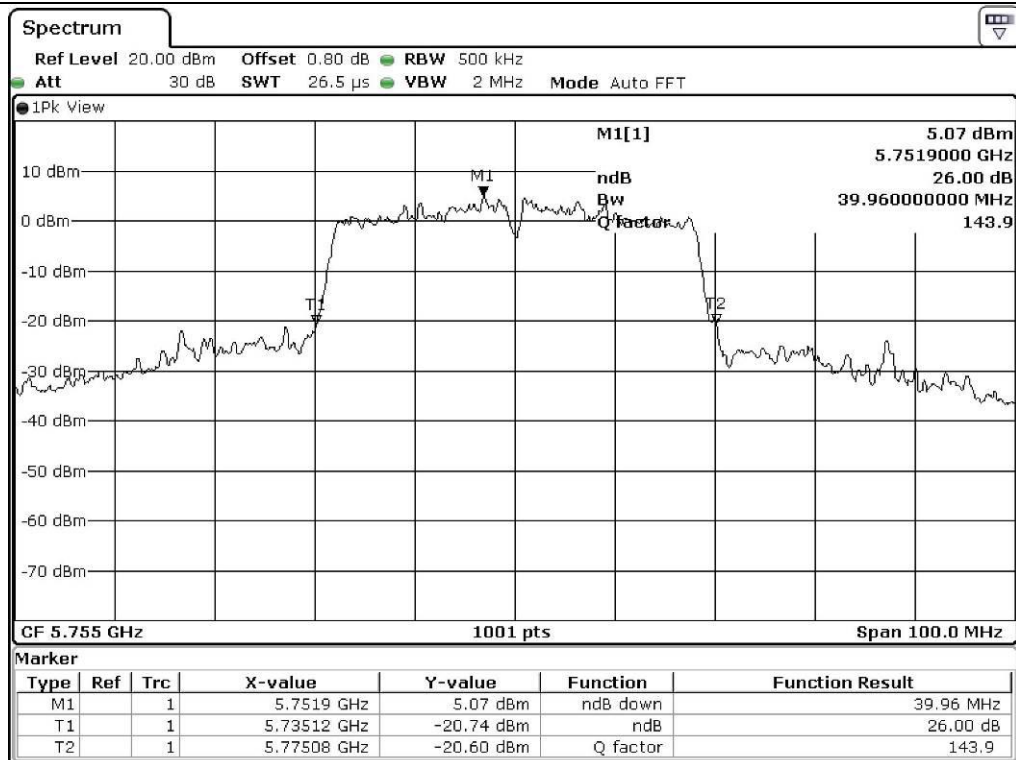
Tested by: Hyung-Kwon, Oh / Assistant Manager



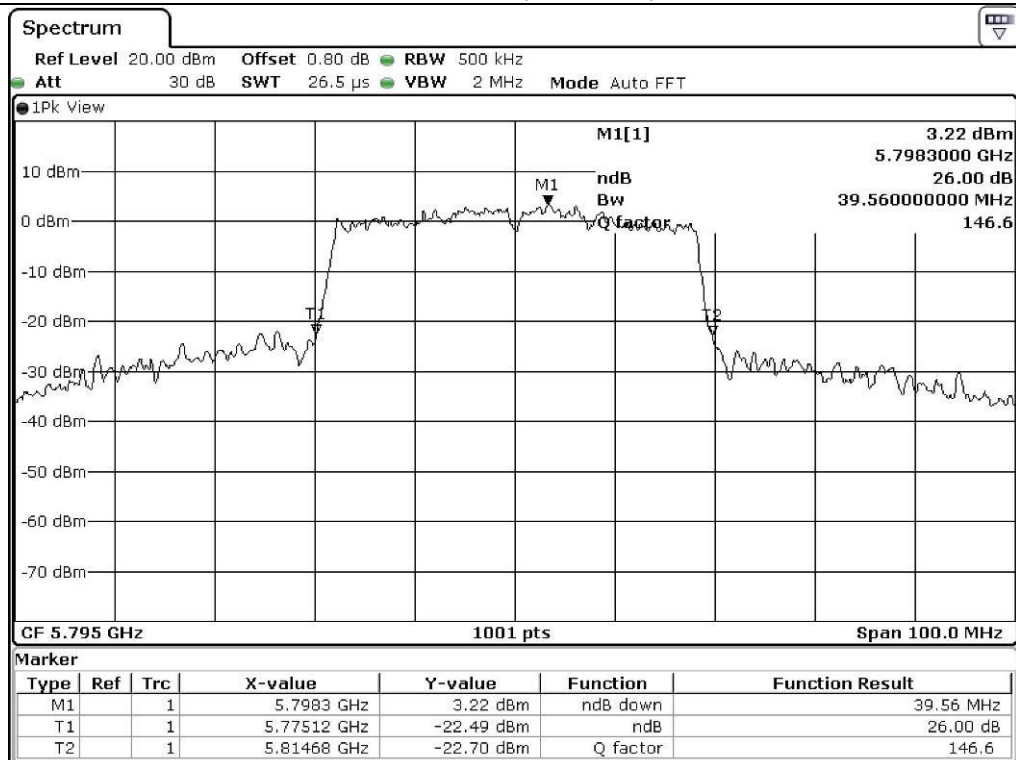
Low Channel (5 190 MHz)



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

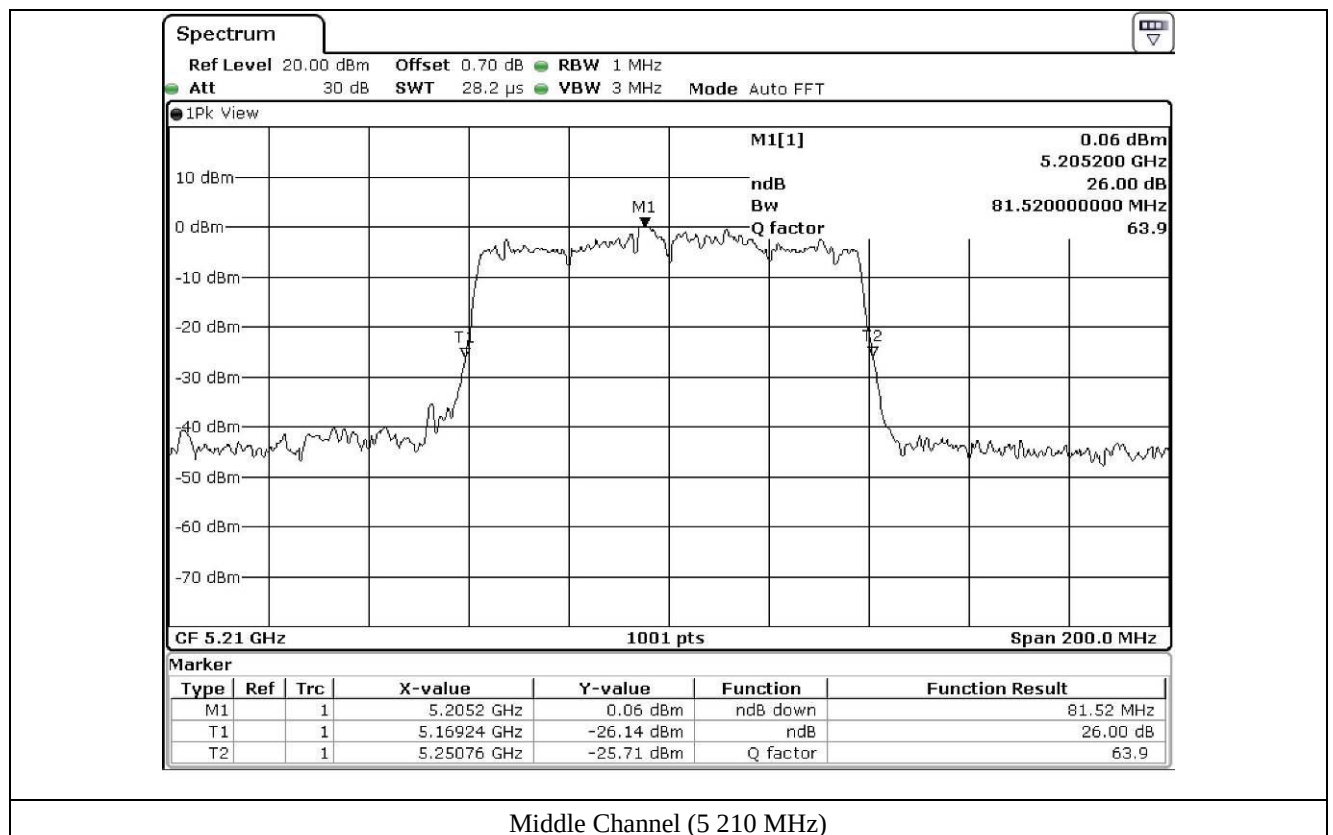
-. Test Date : May 10, 2018 ~ May 17, 2018

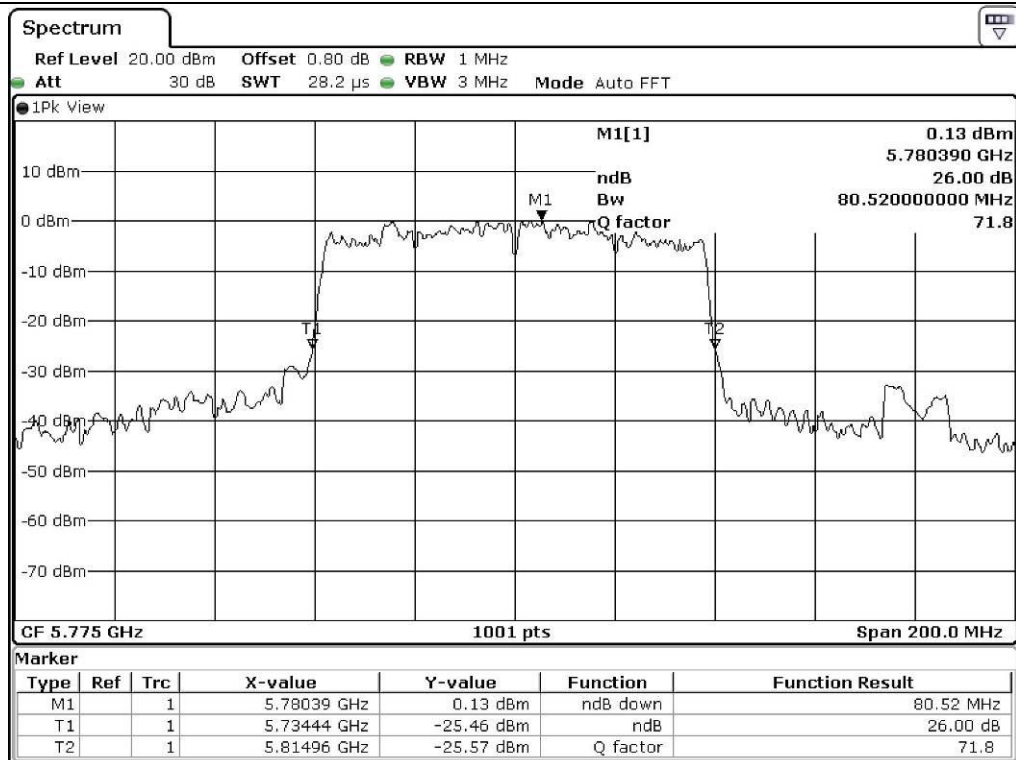
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	81.52
5 725 ~ 5 850	Middle	5 775.00	80.52



Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5 775 MHz)

7.7.2 Test data for Antenna 1

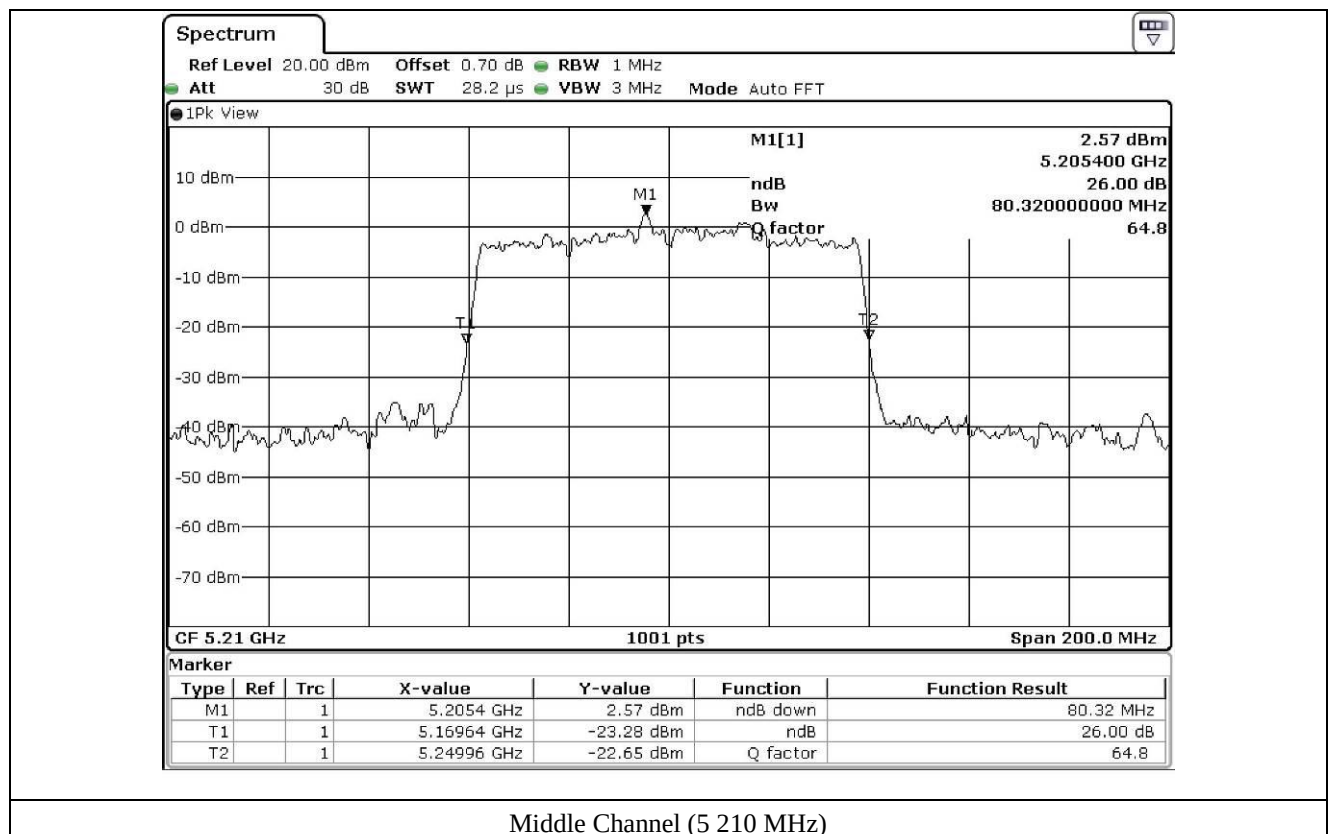
-. Test Date : May 10, 2018 ~ May 17, 2018

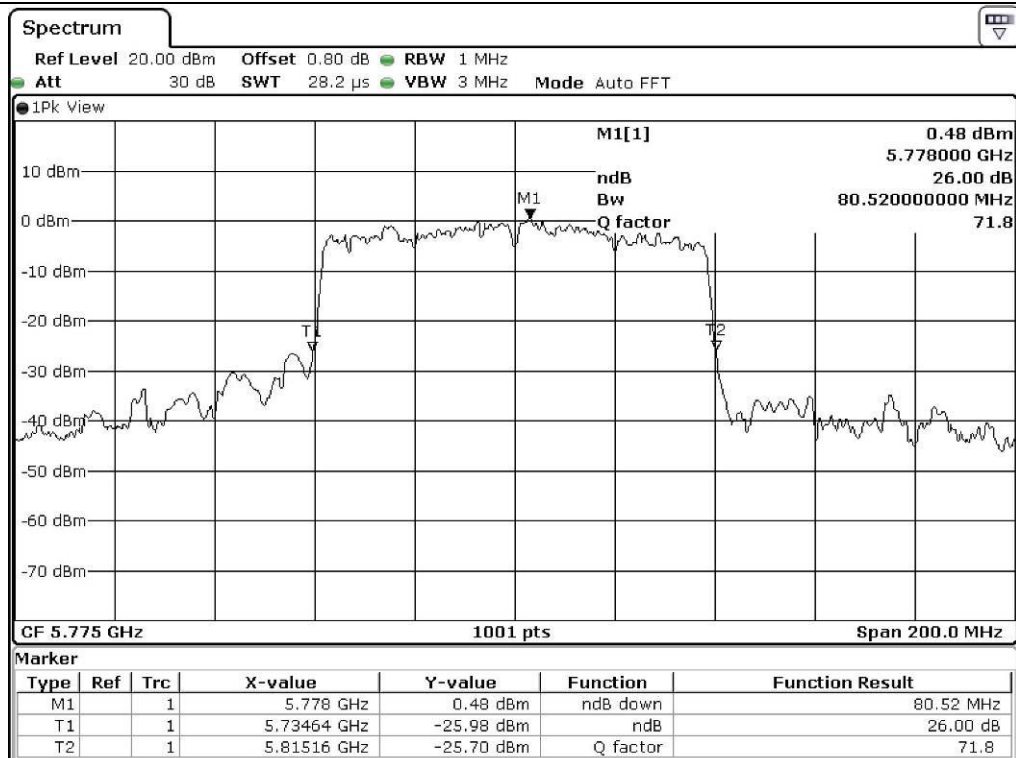
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	80.32
5 725 ~ 5 850	Middle	5 775.00	80.52



Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel (5 775 MHz)

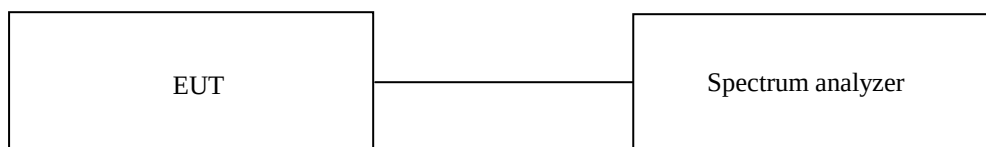
8. 6 dB BANDWIDTH

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. 14, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11a RLAN Mode

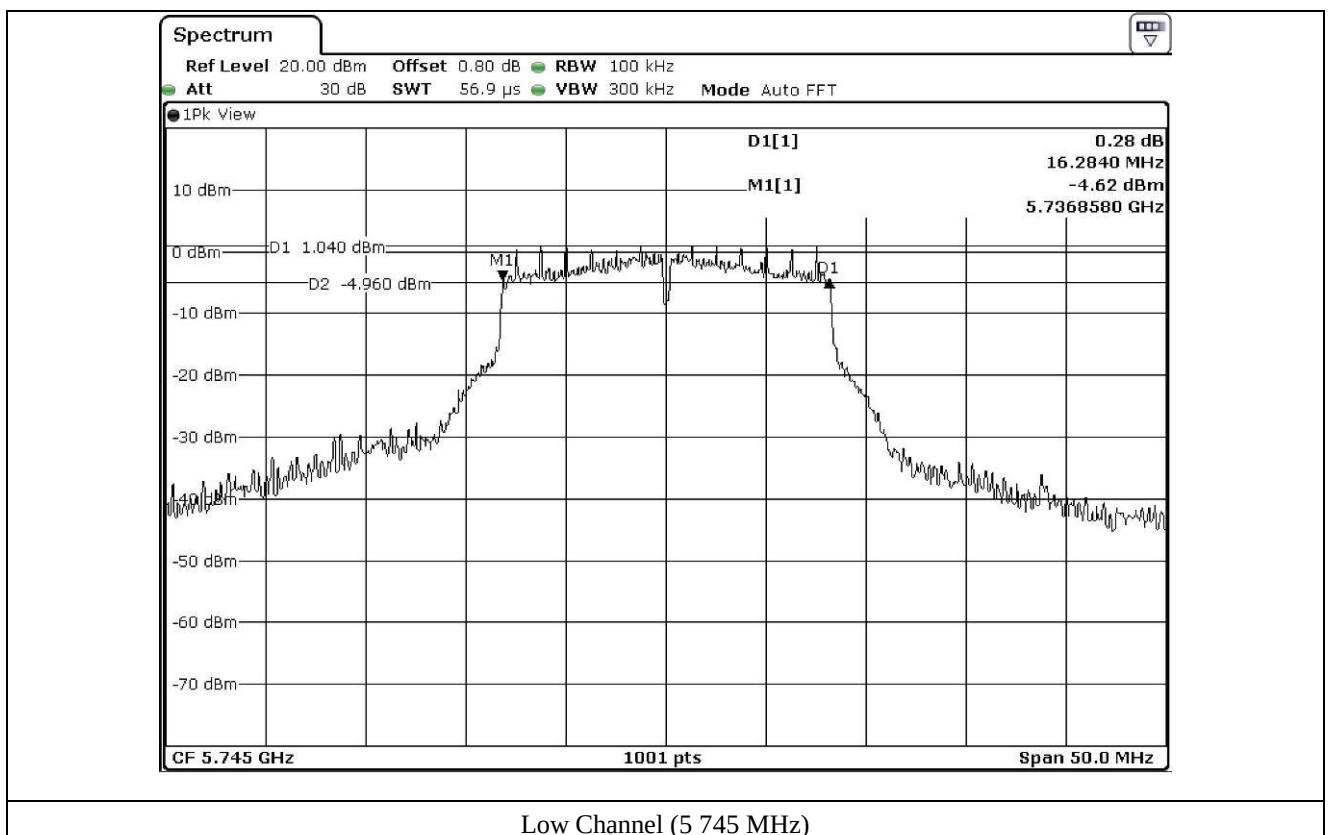
8.4.1 Test data for Antenna 0

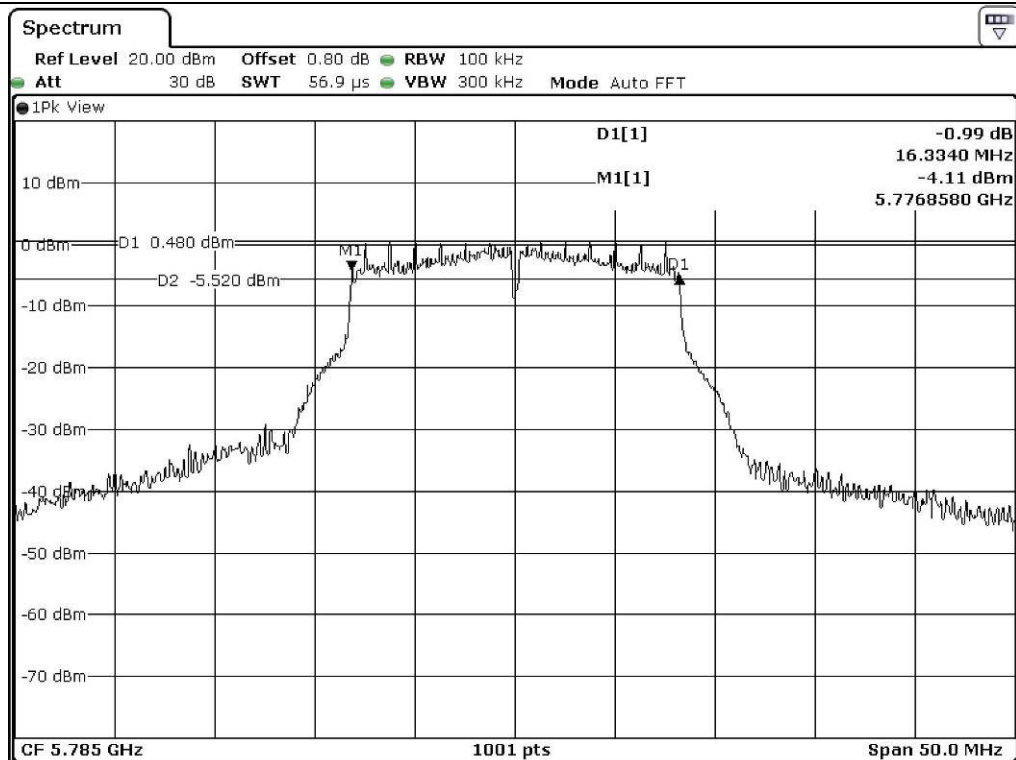
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

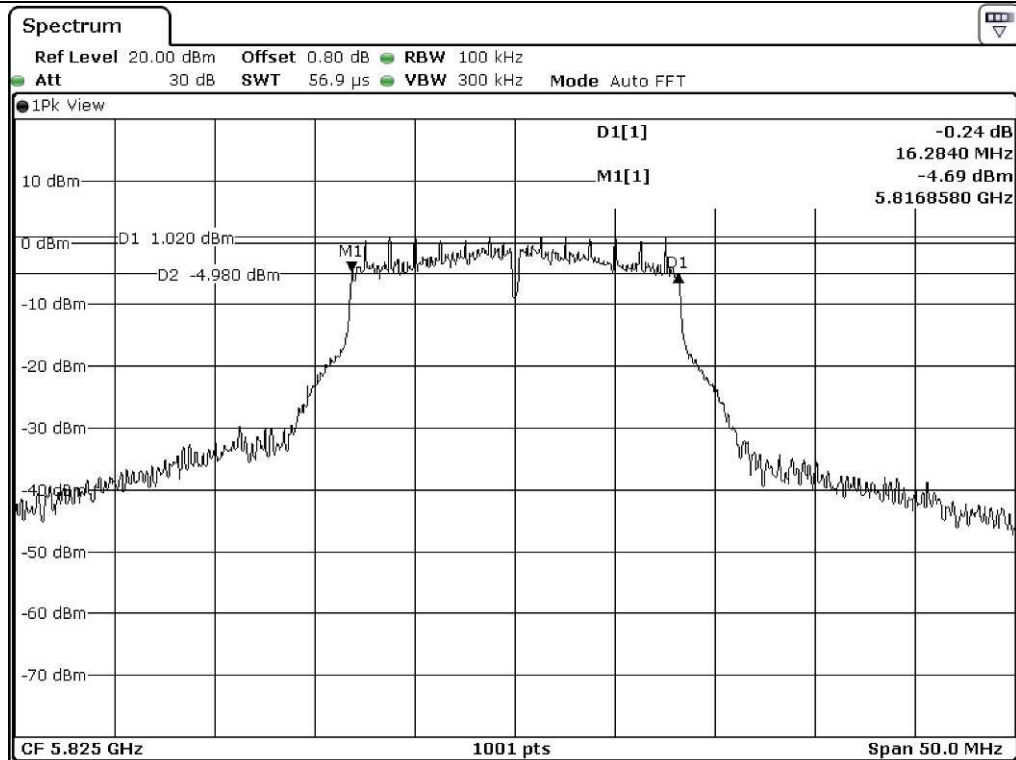
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.28
	Middle	5 785.00	16.33
	High	5 825.00	16.28


Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5 785 MHz)

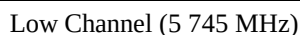


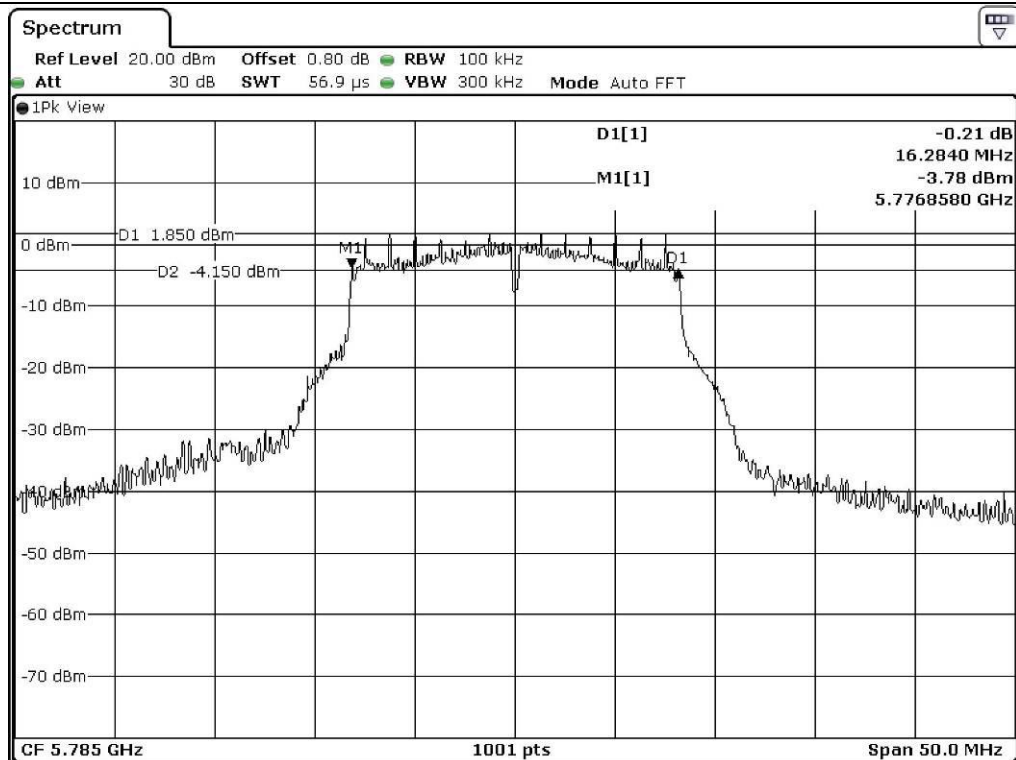
High Channel (5 825 MHz)

- Test Result : Pass

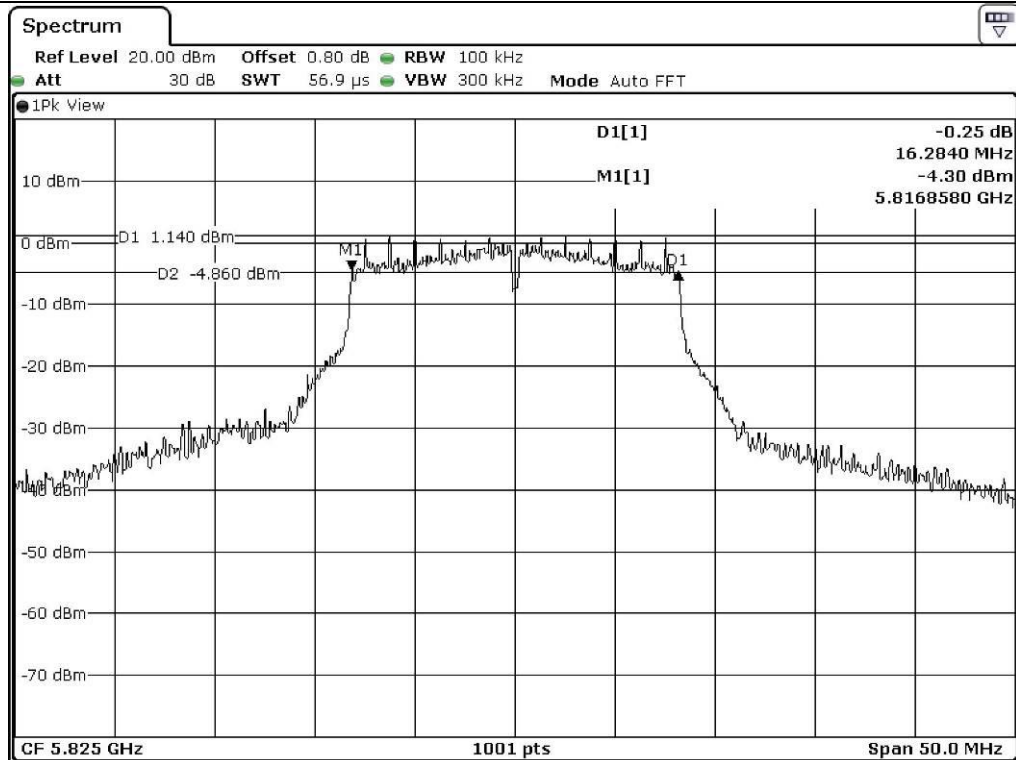
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.33
	Middle	5 785.00	16.28
	High	5 825.00	16.28

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

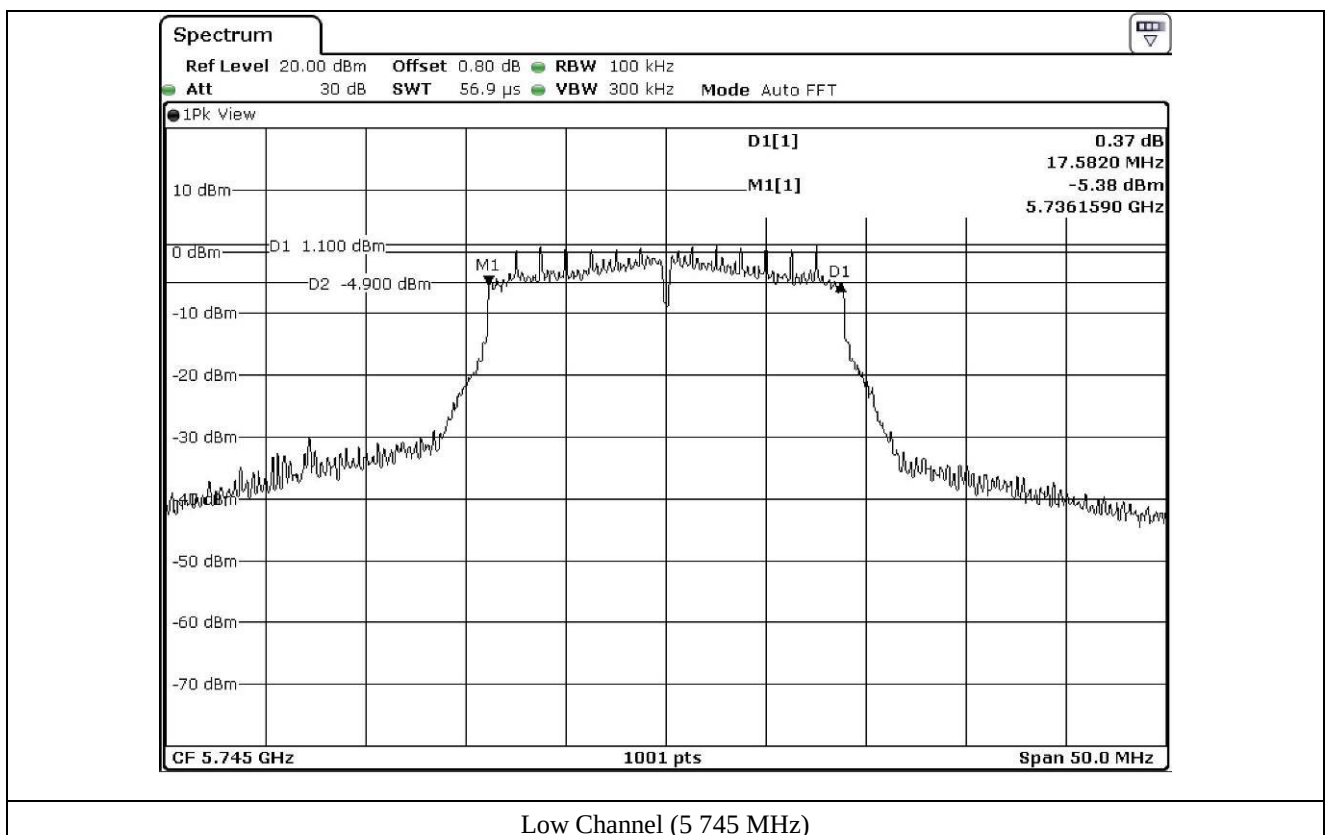
8.5.1 Test data for Antenna 0

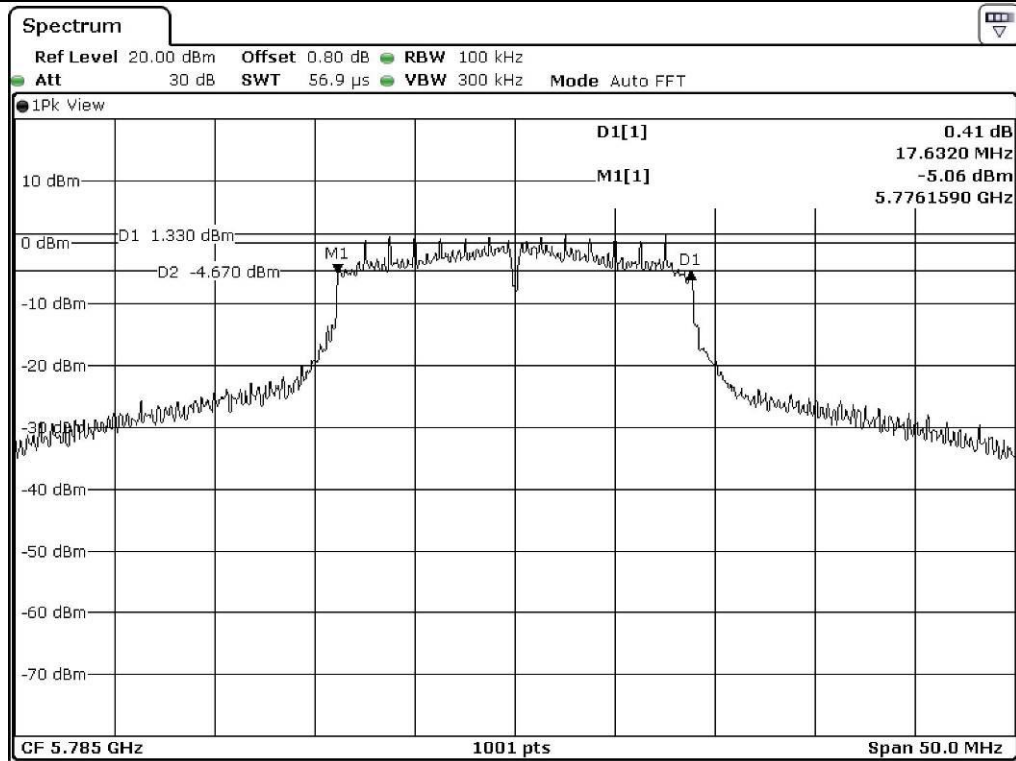
-. Test Date : May 10, 2018 ~ May 17, 2018

-. Test Result : Pass

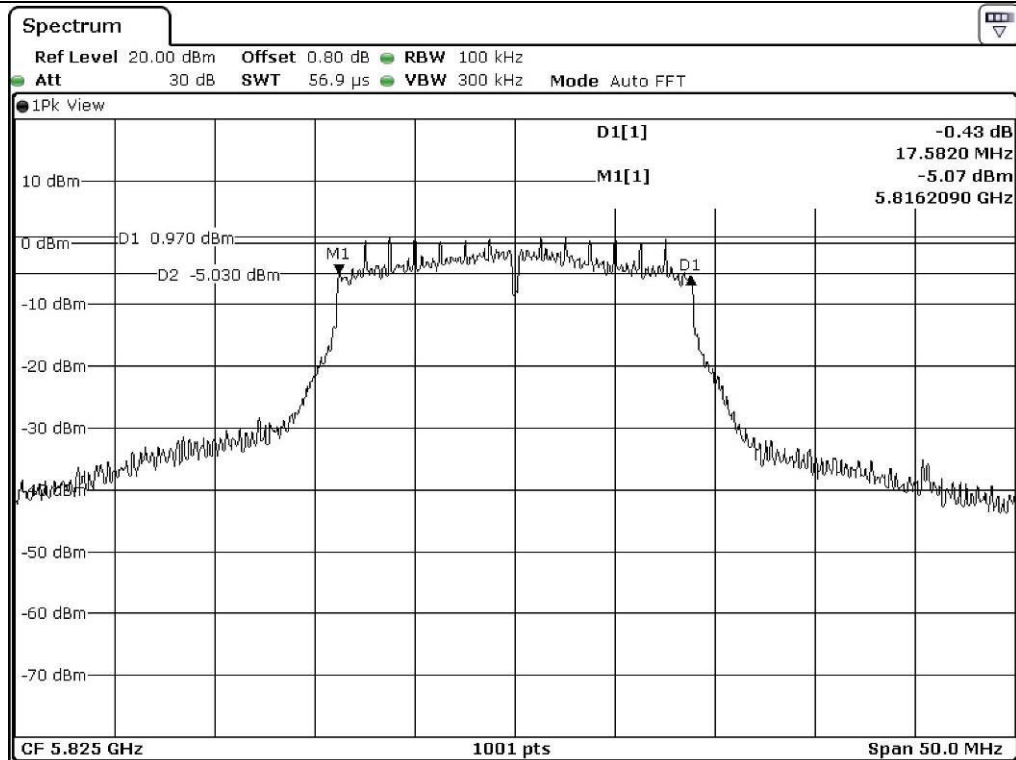
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	17.58
	Middle	5 785.00	17.63
	High	5 825.00	17.58


Tested by: Hyung-Kwon, Oh / Engineer





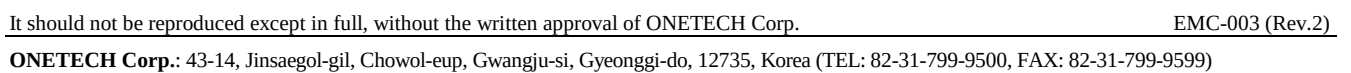
Middle Channel (5 785 MHz)

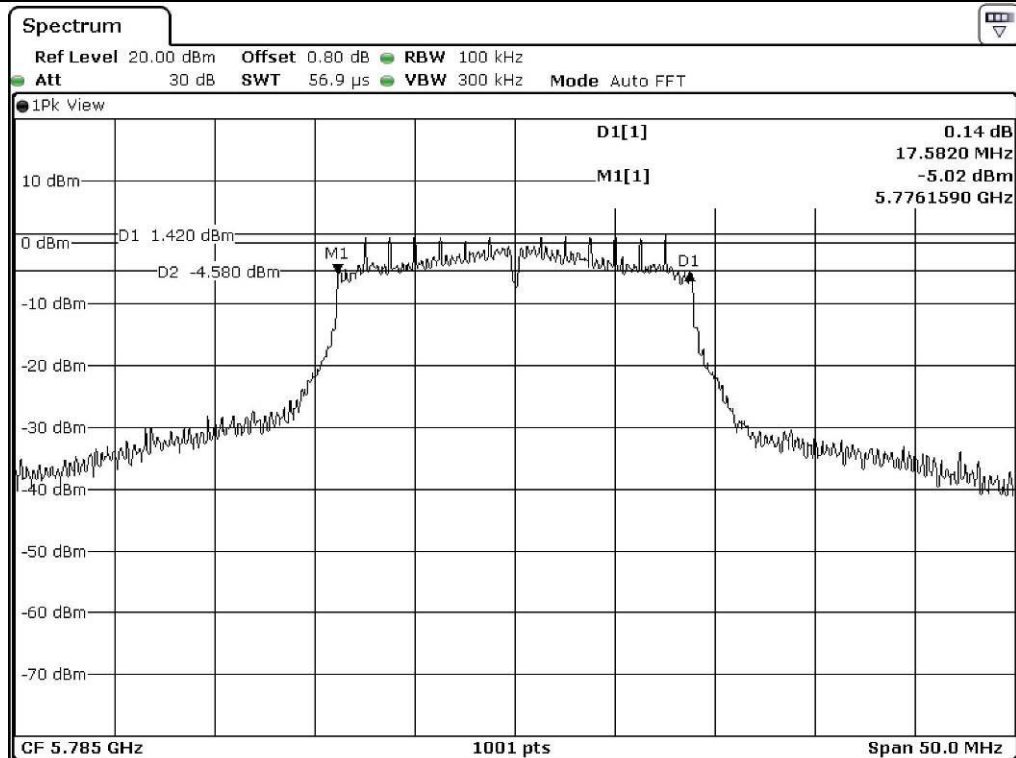


High Channel (5 825 MHz)

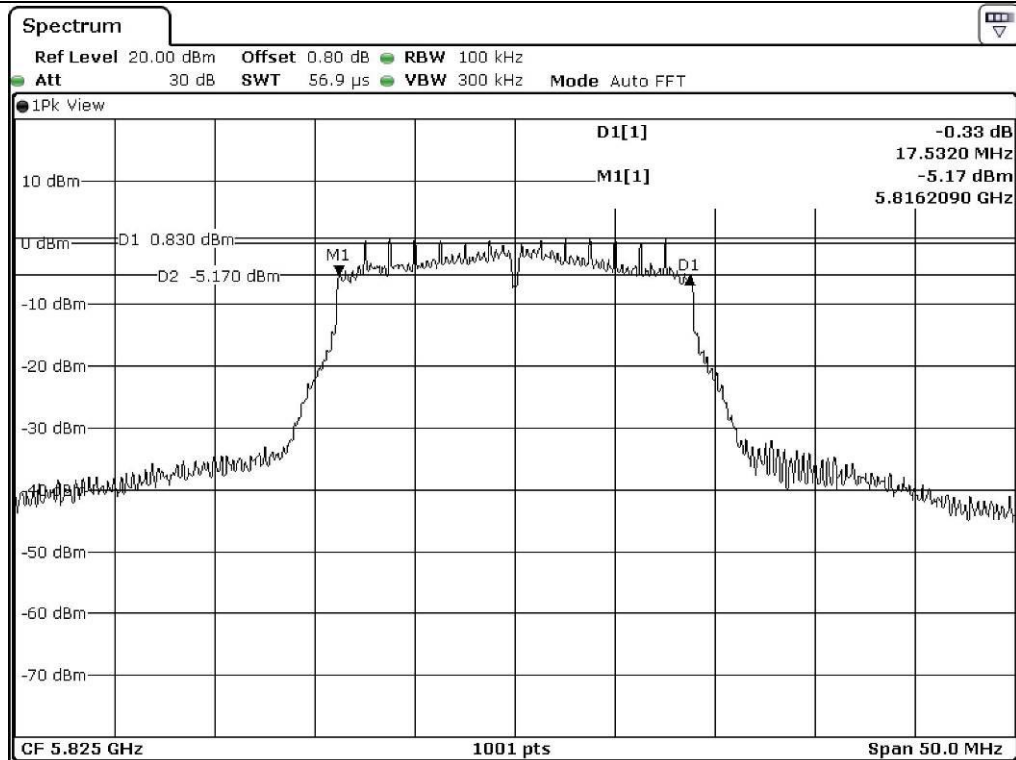
- Test Date : May 10, 2018 ~ May 17, 2018
- Test Result : Pass

Tested by: Hyung-Kwon, Oh / Engineer





Middle Channel (5 785 MHz)



High Channel (5 825 MHz)