

RADIO PERFORMANCE TEST REPORT

Test Report No. : OT-221-RWD-065

Reception No. : 2109004007

Applicant : LG Electronics USA

Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, 07632, United States

Manufacturer : LG Electronics Inc.

Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea

Type of Equipment : Silverbox RADIO ASM-RECEIVER

FCC ID. : BEJVCUEB

Model Name : VCUEB

Multiple Model Name : N/A

Serial number : N/A

Total page of Report : 176 pages (including this page)

Date of Incoming : November 25, 2021

Date of issue : January 26, 2022

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.

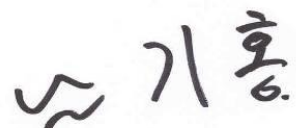
It is not a generally valid assessment of the features of the respective products of the mass-production.



Tested by
Si-eon Lee / Assistant Manager
ONETECH Corp.



Reviewed by
Tae-Ho, Kim / Senior Manager
ONETECH Corp.



Approved by
Ki-Hong, Nam / General Manager
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
5.3 MODE OF OPERATION DURING THE TEST	13
5.4 CONFIGURATION OF TEST SYSTEM.....	27
5.5 ANTENNA REQUIREMENT	27
6. PRELIMINARY TEST	27
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	27
6.2 GENERAL RADIATED EMISSIONS TESTS	27
7. MINIMUM 26 DB BANDWIDTH	28
7.1 OPERATING ENVIRONMENT	28
7.2 TEST SET-UP	28
7.3 TEST DATE	28
7.4 TEST DATA FOR 802.11A RLAN MODE.....	29
7.4.1 Test data for Internal Antenna.....	29
7.4.2 Test data for External Antenna.....	33
7.5 TEST DATA FOR 802.11N_HT20 RLAN MODE.....	37
7.5.1 Test data for Internal Antenna.....	37
7.5.2 Test data for External Antenna.....	41
7.6 TEST DATA FOR 802.11N_HT40 RLAN MODE.....	45
7.6.1 Test data for Internal Antenna.....	45

7.6.2 Test data for External Antenna	48
7.7 TEST DATA FOR 802.11AC_VHT80 RLAN MODE.....	51
7.7.1 Test data for Internal Antenna.....	51
7.7.2 Test data for External Antenna	53
8. 6 DB BANDWIDTH	55
8.1 OPERATING ENVIRONMENT	55
8.2 TEST SET-UP	55
8.3 TEST DATE	55
8.4 TEST DATA FOR 802.11A RLAN MODE.....	56
8.4.1 Test data for Internal Antenna	56
8.4.2 Test data for External Antenna	58
8.5 TEST DATA FOR 802.11N_HT20 RLAN MODE	60
8.5.1 Test data for Internal Antenna	60
8.5.2 Test data for External Antenna	62
8.6 TEST DATA FOR 802.11N_HT40 RLAN MODE	64
8.6.1 Test data for Internal Antenna	64
8.6.2 Test data for External Antenna	66
8.7 TEST DATA FOR 802.11AC_VHT80 RLAN MODE.....	68
8.7.1 Test data for Internal Antenna	68
8.7.2 Test data for External Antenna	69
9. MAXIMUM CONDUCTED OUTPUT POWER.....	70
9.1 OPERATING ENVIRONMENT	70
9.2 TEST SET-UP	70
9.3 TEST DATE	70
9.4 TEST DATA FOR 802.11A RLAN MODE.....	71
9.4.1 Test data for Internal Antenna	71
9.4.2 Test data for External Antenna	75
9.5 TEST DATA FOR 802.11N_HT20 RLAN MODE	79
9.5.1 Test data for Internal Antenna	79
9.5.2 Test data for External Antenna	83
9.6 TEST DATA FOR 802.11N_HT40 RLAN MODE	87
9.6.1 Test data for Internal Antenna	87
9.6.2 Test data for External Antenna	90
9.7 TEST DATA FOR 802.11AC_HT80 RLAN MODE.....	93
9.7.1 Test data for Internal Antenna	93
9.7.2 Test data for External Antenna	95
10. PEAK POWER SPECTRAL DENSITY	97

10.1 OPERATING ENVIRONMENT	97
10.2 TEST SET-UP	97
10.3 TEST DATE	97
10.4 TEST DATA FOR 802.11A RLAN MODE.....	98
<i>10.4.1 Test data for Internal Antenna</i>	<i>98</i>
<i>10.4.2 Test data for External Antenna</i>	<i>102</i>
10.5 TEST DATA FOR 802.11N_HT20 RLAN MODE	106
<i>10.5.1 Test data for Internal Antenna</i>	<i>106</i>
<i>10.5.2 Test data for External Antenna</i>	<i>110</i>
10.6 TEST DATA FOR 802.11N_HT40 RLAN MODE	114
<i>10.6.1 Test data for Internal Antenna</i>	<i>114</i>
<i>10.6.2 Test data for External Antenna</i>	<i>117</i>
10.7 TEST DATA FOR 802.11AC_HT80 RLAN MODE.....	120
<i>10.7.1 Test data for Internal Antenna</i>	<i>120</i>
<i>10.7.2 Test data for External Antenna</i>	<i>122</i>
11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION.....	124
11.1 OPERATING ENVIRONMENT	124
11.2 TEST SET-UP	124
11.3 TEST DATE	124
11.4 TEST DATA FOR U-NII-1	125
<i>11.4.1 Test data for Internal Antenna</i>	<i>125</i>
<i>11.4.2 Test data for External Antenna</i>	<i>126</i>
11.5 TEST DATA FOR U-NII-3	127
<i>11.5.1 Test data for Internal Antenna</i>	<i>127</i>
<i>11.5.2 Test data for External Antenna</i>	<i>128</i>
12. FREQUENCY STABILITY WITH VOLTAGE VARIATION.....	129
12.1 OPERATING ENVIRONMENT	129
12.2 TEST SET-UP	129
12.3 TEST DATE	129
12.4 TEST DATA FOR U-NII-1	130
<i>12.4.1 Test data for Internal Antenna</i>	<i>130</i>
<i>12.4.2 Test data for External Antenna</i>	<i>130</i>
12.5 TEST DATA FOR U-NII-3	131
<i>12.5.1 Test data for Internal Antenna</i>	<i>131</i>
<i>12.5.2 Test data for External Antenna</i>	<i>131</i>
13. RADIATED SPURIOUS EMISSIONS.....	132
13.1 OPERATING ENVIRONMENT	132

13.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	132
13.3 TEST DATE	133
13.4 TEST DATA FOR BELOW 30 MHz	134
13.5 TEST DATA FOR 30 MHz ~ 1 000 MHz	135
13.5.1 Test data for WLAN 5 GHz_Internal Antenna	135
13.5.2 Test data for WLAN 5 GHz_External Antenna	136
13.5.3 Test data for Intermodulation Mode(Bluetooth + WLAN 5 GHz)	137
13.5.4 Test data for Intermodulation Mode(WLAN 2.4 GHz + WLAN 5 GHz)	138
13.6 Test data for Above 1 GHz.....	139
13.6.1 Test data for Frequency UNII I	139
13.6.2 Test data for Frequency UNII 3.....	147
14. RADIATED RESTRICTED BAND EDGE MEASUREMENTS	155
14.1 OPERATING ENVIRONMENT	155
14.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	155
14.3 TEST DATE	156
14.4 TEST DATA FOR FREQUENCY UNII I.....	157
14.4.1 Test data for 802.11a RLAN Mode	157
14.4.2 Test data for 802.11n_HT20 RLAN Mode.....	158
14.4.3 Test data for 802.11n_HT40 RLAN Mode.....	159
14.4.4 Test data for 802.11ac_HT80 RLAN Mode	160
14.5 TEST DATA FOR FREQUENCY U-NII-3.....	161
14.5.1 Test data for 802.11a RLAN Mode	161
14.5.2 Test data for 802.11n_HT20 RLAN Mode.....	165
14.5.3 Test data for 802.11n_HT40 RLAN Mode.....	169
14.5.4 Test data for 802.11ac_HT80 RLAN Mode	173
14.6 U-NII-3 EMISSION LIMITS	175
14.6.1 Emission Mask Plots.....	175
15. LIST OF TEST EQUIPMENT	176

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-221-RWD-065	January 26, 2022	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA

Address : 111 Sylvan Avenue, North Building, Englewood Cliffs, New Jersey, 07632, United States

Contact Person : Sung Soo Kim / Director, Regulatory and Environmental Affairs

Telephone No. : +201-266-2215

FCC ID : BEJVCUEB

Model Name : VCUEB

Brand Name : -

Serial Number : N/A

Date : January 26, 2022

EQUIPMENT CLASS	Unlicensed National Information infrastructure(UNII)
E.U.T. DESCRIPTION	Silverbox RADIO ASM-RECEIVER
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
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 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(e)	6 dB Bandwidth	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	Conducted Limits	N/A (See Note)

Note: This test is not performed because the EUT is operated by DC Power.

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: 2020. 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-20122/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

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

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The LG Electronics USA, Model VCUEB (referred to as the EUT in this report) is a Silverbox RADIO ASM-RECEIVER. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Silverbox RADIO ASM-RECEIVER	
Temperature Range	-30 °C ~ 85 °C	
OPERATING FREQUENCY	Bluetooth	2 402 MHz ~ 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
	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))
		5 210 MHz (802.11ac(VHT80))
	5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
		5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))
		5 775 MHz (802.11ac(VHT80))
MODULATION TYPE	Bluetooth	GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
	WLAN 5 GHz	802.11a/n(HT20)/n(HT40)/ac(VHT80): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)

RF OUTPUT POWER	Bluetooth	1 Mbps	4.12 dBm
		2 Mbps	6.20 dBm
		3 Mbps	6.64 dBm
	WLAN 2.4 GHz	12.77 dBm(802.11b) 12.53 dBm(802.11g) 12.45 dBm(802.11n_HT20)	
	5 150 MHz ~ 5 250 MHz Band (UNII I)	Internal Antenna	14.58 dBm(802.11a) 15.54 dBm(802.11n_HT20) 12.50 dBm(802.11n_HT40) 10.36 dBm(802.11ac_VHT80)
			11.68 dBm(802.11a) 12.65 dBm(802.11n_HT20) 10.99 dBm(802.11n_HT40) 6.62 dBm(802.11ac_VHT80)
		External Antenna	13.94 dBm(802.11a) 14.97 dBm(802.11n_HT20) 13.89 dBm(802.11n_HT40) 9.87 dBm(802.11ac_VHT80)
			11.03 dBm(802.11a) 11.89 dBm(802.11n_HT20) 10.49 dBm(802.11n_HT40) 5.84 dBm(802.11ac_VHT80)
	5 725 MHz ~ 5 850 MHz Band (UNII 3)	Internal Antenna	13.94 dBm(802.11a) 14.97 dBm(802.11n_HT20) 13.89 dBm(802.11n_HT40) 9.87 dBm(802.11ac_VHT80)
			11.03 dBm(802.11a) 11.89 dBm(802.11n_HT20) 10.49 dBm(802.11n_HT40) 5.84 dBm(802.11ac_VHT80)
		External Antenna	13.94 dBm(802.11a) 14.97 dBm(802.11n_HT20) 13.89 dBm(802.11n_HT40) 9.87 dBm(802.11ac_VHT80)
			11.03 dBm(802.11a) 11.89 dBm(802.11n_HT20) 10.49 dBm(802.11n_HT40) 5.84 dBm(802.11ac_VHT80)

ANTENNA TYPE	Bluetooth	PCB Antenna	
	WLAN 2.4 GHz	PCB Antenna	
	WLAN 5 GHz	Internal Antenna	PCB Antenna
		External Antenna	PCB Antenna
ANTENNA GAIN	Bluetooth	4.73 dBi	
	WLAN 2.4 GHz	2.10 dBi	
	5 150 MHz ~	Internal Antenna	5.29 dBi
	5 250 MHz Band	External Antenna	2.60 dBi
	5 725 MHz ~	Internal Antenna	4.29 dBi
	5 850 MHz Band	External Antenna	2.80 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		37.4 MHz, 100 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	N/A	N/A	N/A
Module	N/A	N/A	N/A
Antenna	N/A	N/A	N/A

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
VCUEB	LG Electronics Inc.	Silverbox RADIO ASM-RECEIVER (EUT)	
GP-4303D	LG Precision Co.,Ltd	DC Power Supply (DC 30 V 3 A)	
ProBook 450 G7	HP	NoteBook	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]	
		Internal Antenna	External Antenna
802.11 a (Middle Channel)	6 Mbps	14.35	11.33
	9 Mbps	14.25	11.04
	12 Mbps	14.15	10.98
	18 Mbps	13.96	10.66
	24 Mbps	13.57	10.29
	36 Mbps	13.31	9.98
	48 Mbps	13.16	9.89
	54 Mbps	12.96	9.69
HT 20 (Middle Channel)	6.5 Mbps	15.15	12.35
	13 Mbps	15.08	12.25
	19.5 Mbps	14.95	11.98
	26 Mbps	14.56	11.69
	39 Mbps	14.36	11.36
	52 Mbps	14.06	11.08
	58.5 Mbps	13.96	10.99
	65 Mbps	13.75	10.89
HT 40 (Low Channel)	13.5 Mbps	12.06	10.50
	27 Mbps	11.70	9.99
	40.5 Mbps	11.32	9.75
	54 Mbps	10.92	9.28
	81 Mbps	10.41	8.98
	108 Mbps	10.17	8.66
	121.5 Mbps	10.03	8.42
	135 Mbps	9.77	8.26

VHT80 (Middle Channel)	29.3 Mbps	9.48	5.78
	58.5 Mbps	8.88	5.26
	87.8 Mbps	8.42	4.77
	117 Mbps	8.08	4.44
	175.5 Mbps	7.55	3.86
	234 Mbps	7.27	3.59
	263.3 Mbps	7.10	3.35
	292.5 Mbps	6.95	3.25
	351 Mbps	6.74	3.10
	390 Mbps	6.59	2.94

- . The worse case data rate for each modulation is determined 6 Mbps(Internal Antenna/External Antenna) for IEEE 802.11a, 6.5 Mbps(Internal Antenna/External Antenna) for HT20, 13.5 Mbps(Internal Antenna/External Antenna) for HT40, 29.3 Mbps(Internal Antenna/External Antenna) 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]	
		Internal Antenna	External Antenna
802.11 a (Middle Channel)	6 Mbps	13.58	10.75
	9 Mbps	13.46	10.65
	12 Mbps	13.35	10.60
	18 Mbps	13.16	10.23
	24 Mbps	12.82	9.94
	36 Mbps	12.50	9.58
	48 Mbps	12.24	9.48
	54 Mbps	12.10	9.21
HT 20 (Middle Channel)	6.5 Mbps	14.63	11.62
	13 Mbps	14.43	11.23
	19.5 Mbps	14.31	11.14
	26 Mbps	13.94	10.73
	39 Mbps	13.65	10.40
	52 Mbps	13.48	10.17
	58.5 Mbps	13.35	10.09
	65 Mbps	13.05	9.90
HT 40 (Low Channel)	13.5 Mbps	13.45	9.94
	27 Mbps	13.13	9.60
	40.5 Mbps	12.76	9.40
	54 Mbps	12.30	9.04
	81 Mbps	11.95	8.52
	108 Mbps	11.57	8.15
	121.5 Mbps	11.43	7.97
	135 Mbps	11.23	7.70

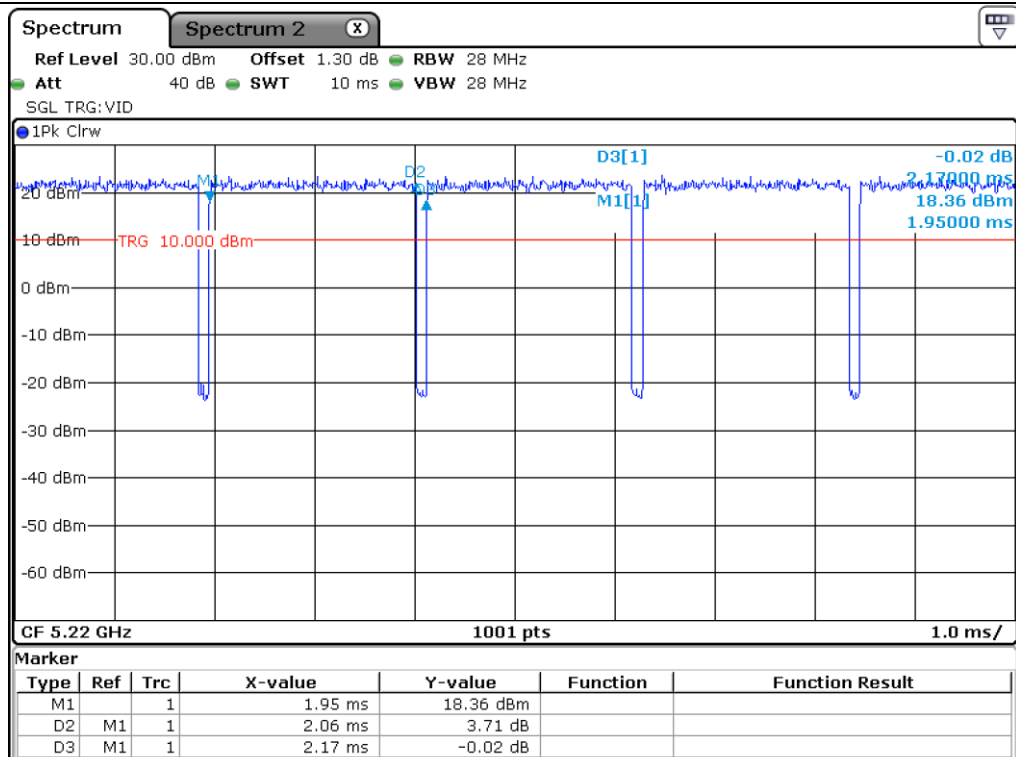
VHT80 (Middle Channel)	29.3 Mbps	8.98	4.98
	58.5 Mbps	8.36	4.38
	87.8 Mbps	7.88	4.11
	117 Mbps	7.45	3.71
	175.5 Mbps	7.00	3.25
	234 Mbps	6.67	2.83
	263.3 Mbps	6.50	2.73
	292.5 Mbps	6.36	2.66
	351 Mbps	6.14	2.26
	390 Mbps	6.00	2.20

- . The worse case data rate for each modulation is determined 6 Mbps(Internal Antenna/External Antenna) for IEEE 802.11a, 6.5 Mbps(Internal Antenna/External Antenna) for HT20, 13.5 Mbps(Internal Antenna/External Antenna) for HT40, 29.3 Mbps(Internal Antenna/External Antenna) 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.

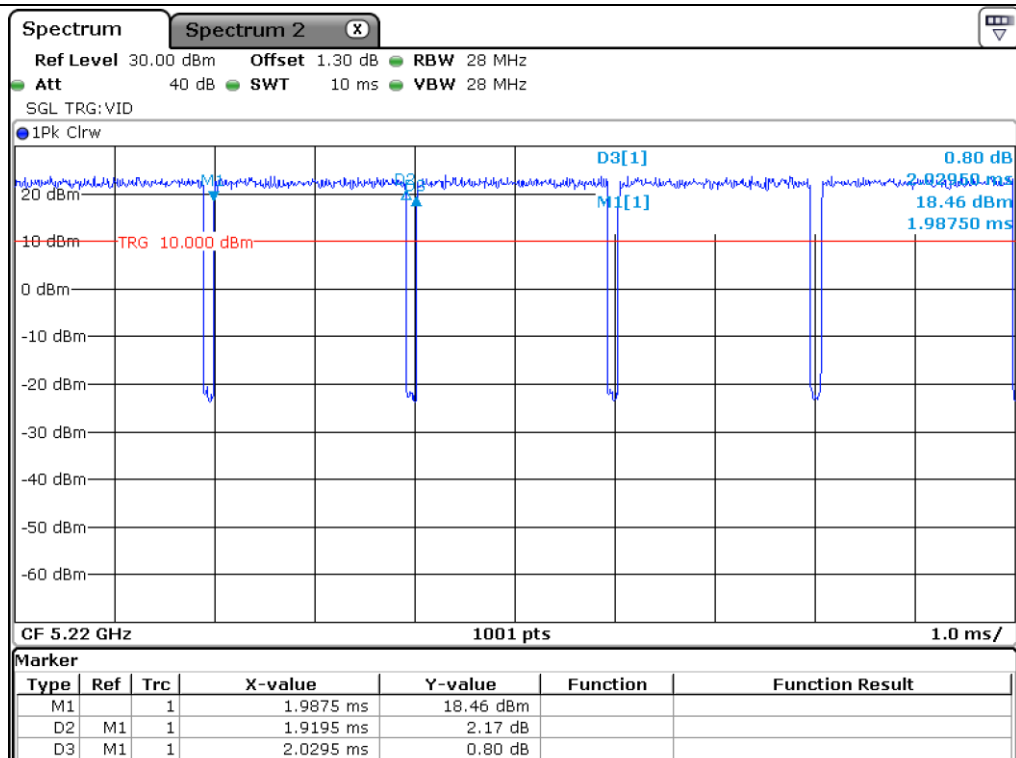
- Duty Cycle

	Band	Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Internal Antenna	UNII 1	802.11 a	2.06	0.11	94.93	0.23
		802.11 HT 20	1.92	0.11	94.58	0.24
		802.11 HT 40	0.95	0.10	90.37	0.44
		802.11 VHT 80	0.46	0.10	81.61	0.88
	UNII 3	802.11 a	2.05	0.11	94.91	0.23
		802.11 HT 20	1.91	0.11	94.51	0.25
		802.11 HT 40	0.95	0.10	90.41	0.44
		802.11 VHT 80	0.46	0.10	81.49	0.89
External Antenna	UNII 1	802.11 a	2.07	0.11	94.92	0.23
		802.11 HT 20	1.92	0.11	94.46	0.25
		802.11 HT 40	0.94	0.11	89.33	0.49
		802.11 VHT 80	0.46	0.10	82.39	0.84
	UNII 3	802.11 a	2.06	0.11	94.93	0.23
		802.11 HT 20	1.92	0.11	94.63	0.24
		802.11 HT 40	0.94	0.10	90.37	0.44
		802.11 VHT 80	0.46	0.10	82.01	0.86

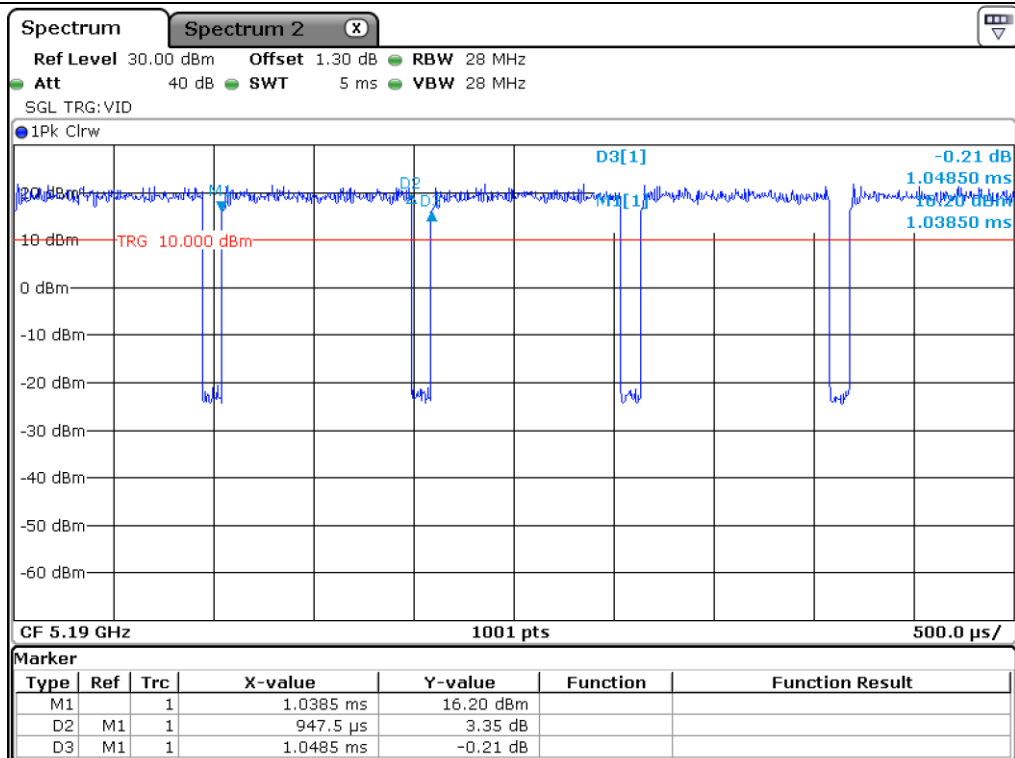
-. Test Plot_Internal Antenna



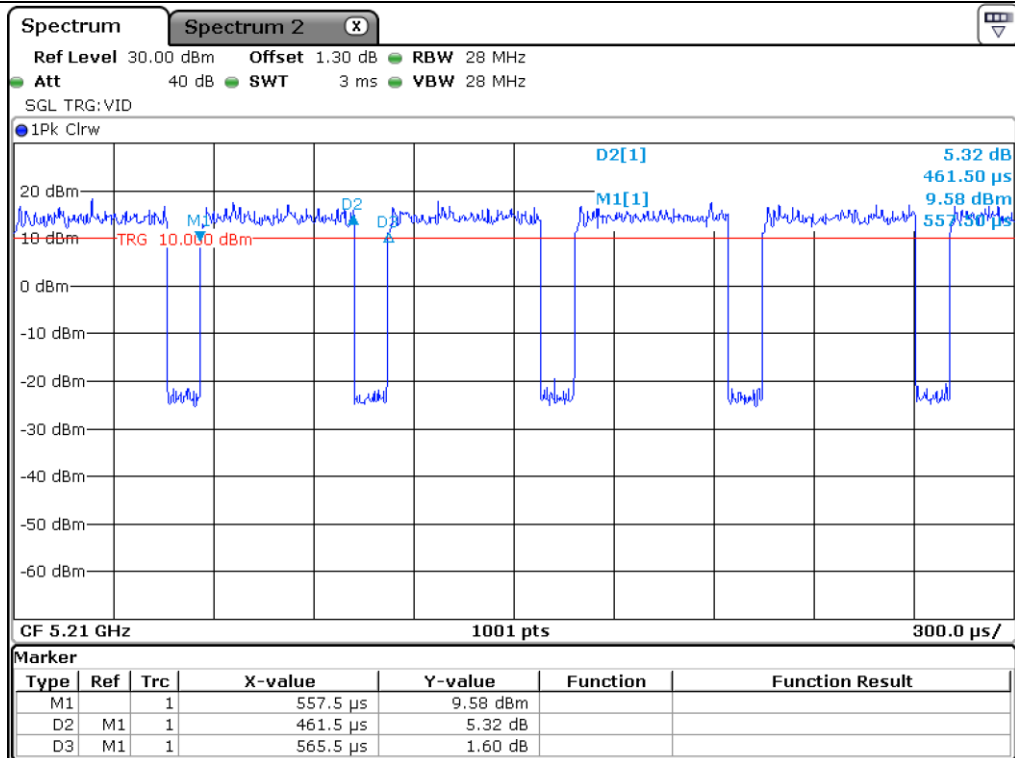
UNII 1_802.11 a



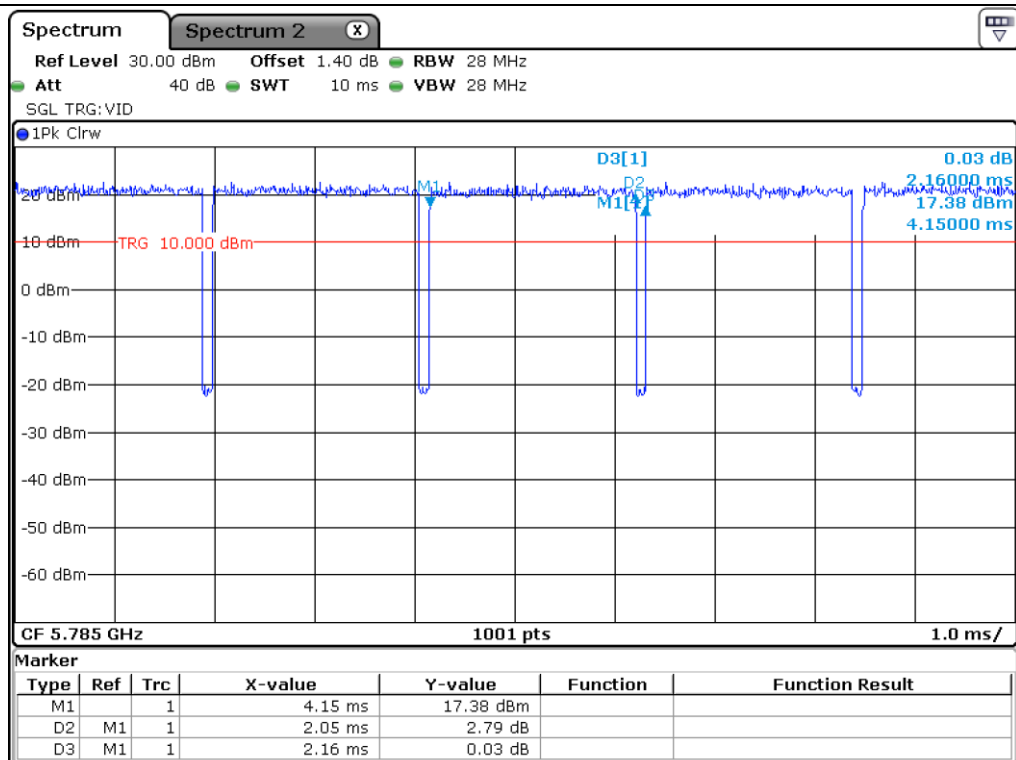
UNII 1_802.11 HT 20



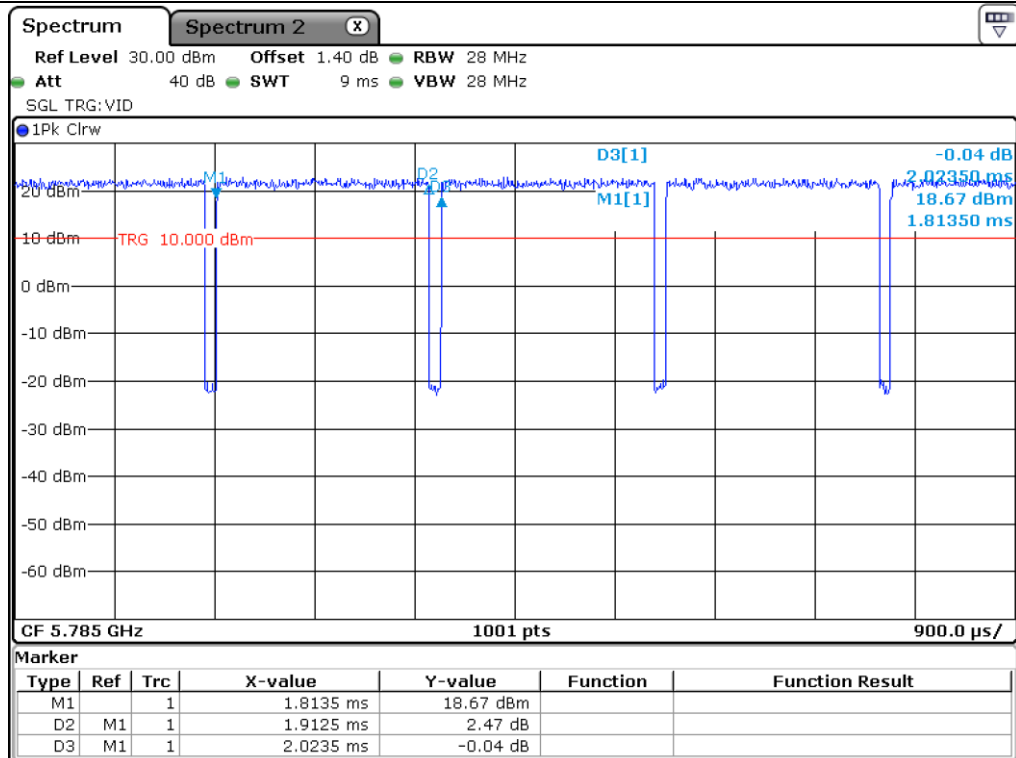
UNII 1_802.11 HT40



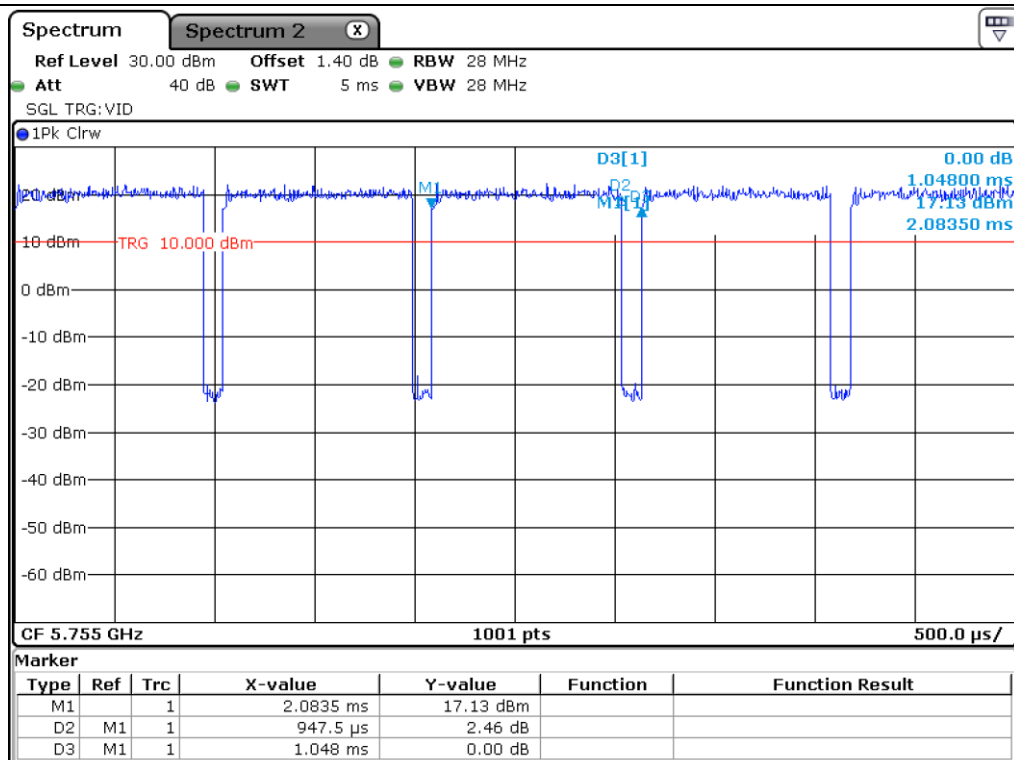
UNII 1_802.11 VHT 80



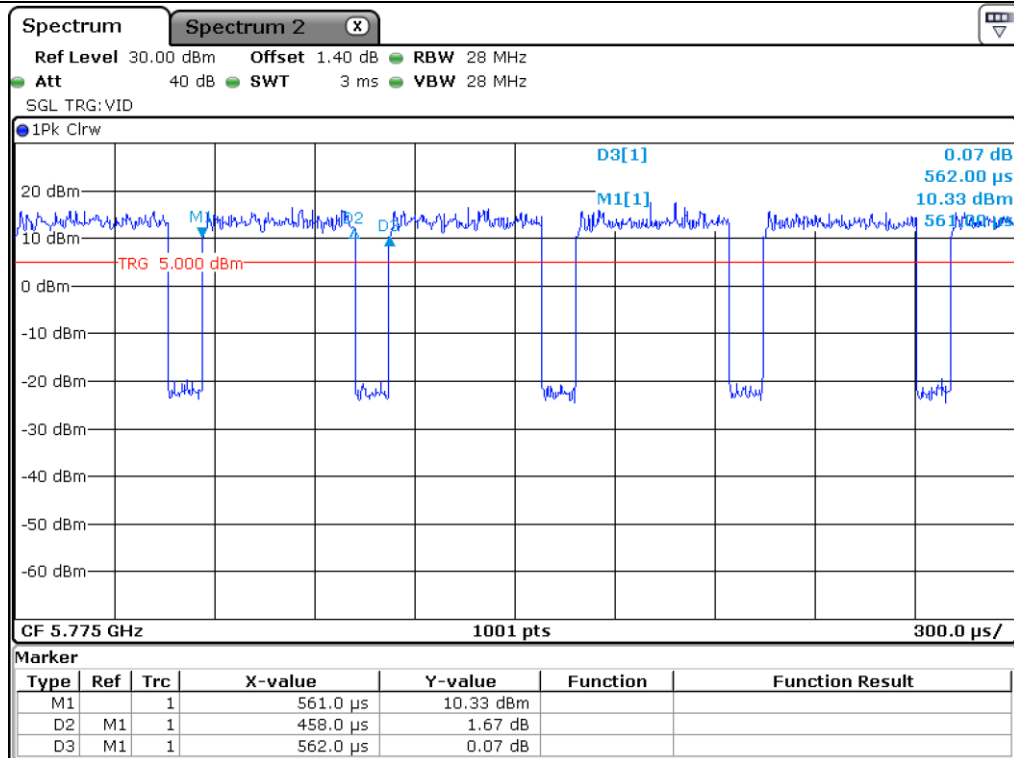
UNII 3_802.11 a



UNII 3_802.11 HT 20

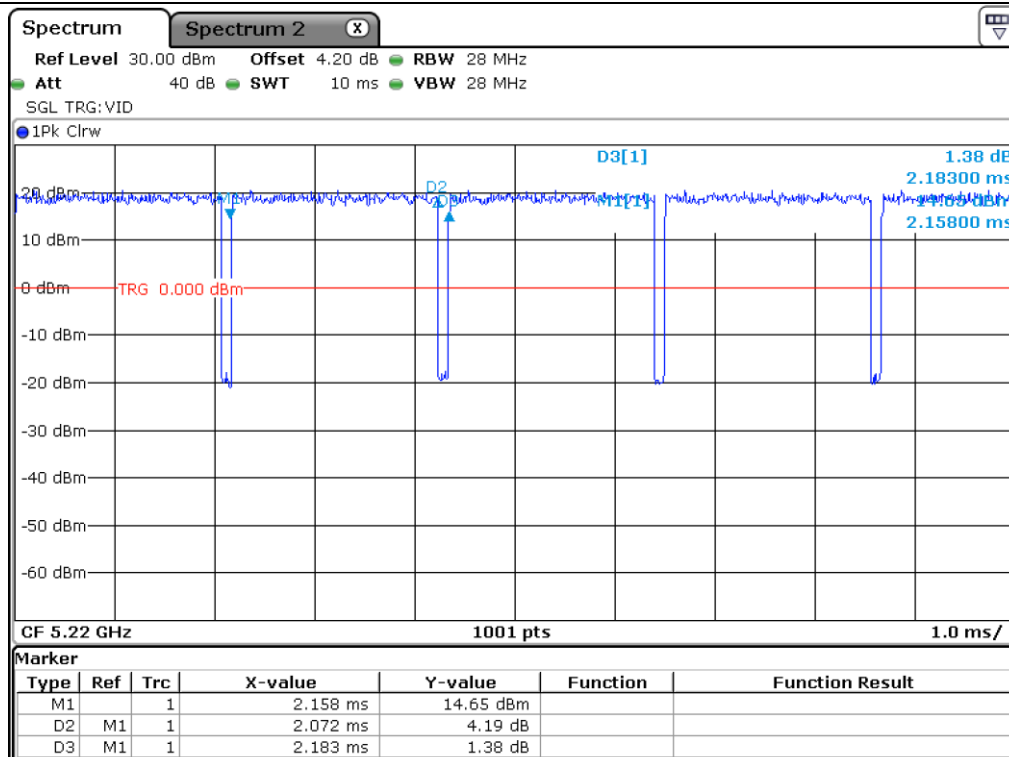


UNII 3_802.11 HT40

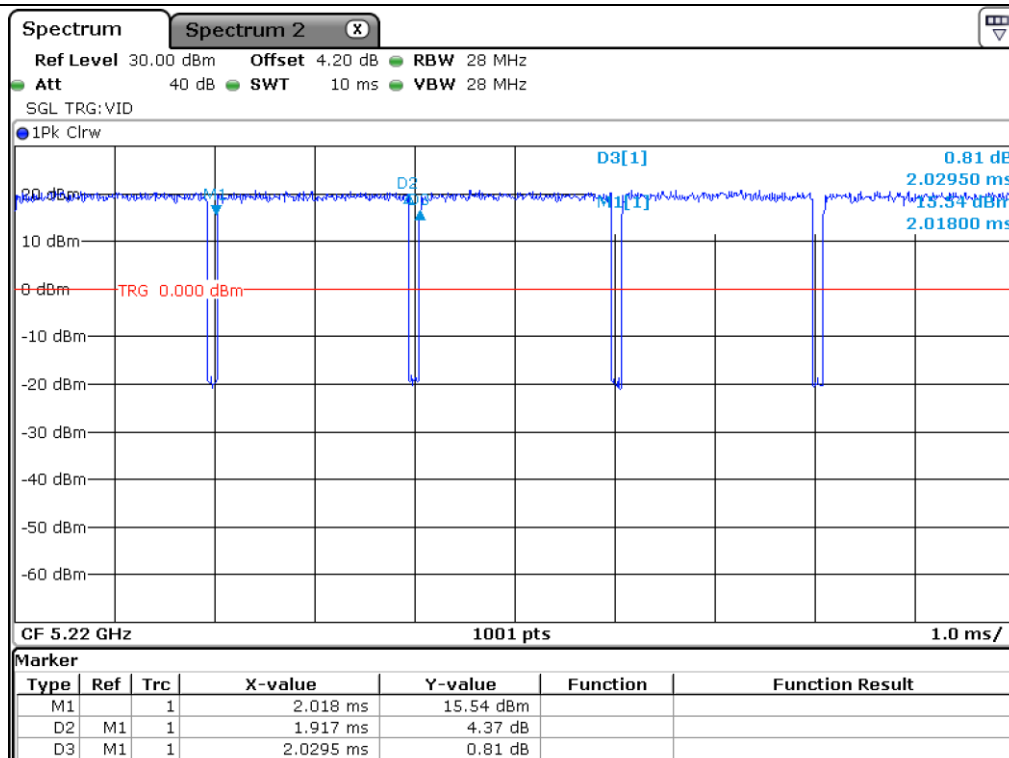


UNII 3_802.11 VHT 80

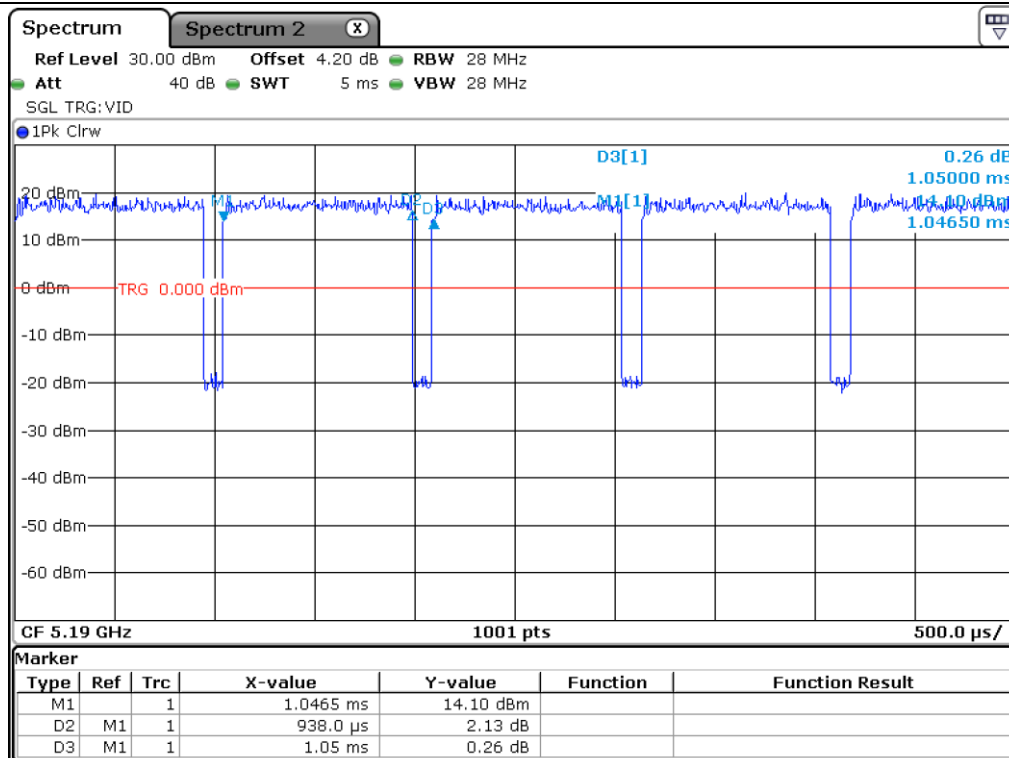
-. Test Plot_External Antenna



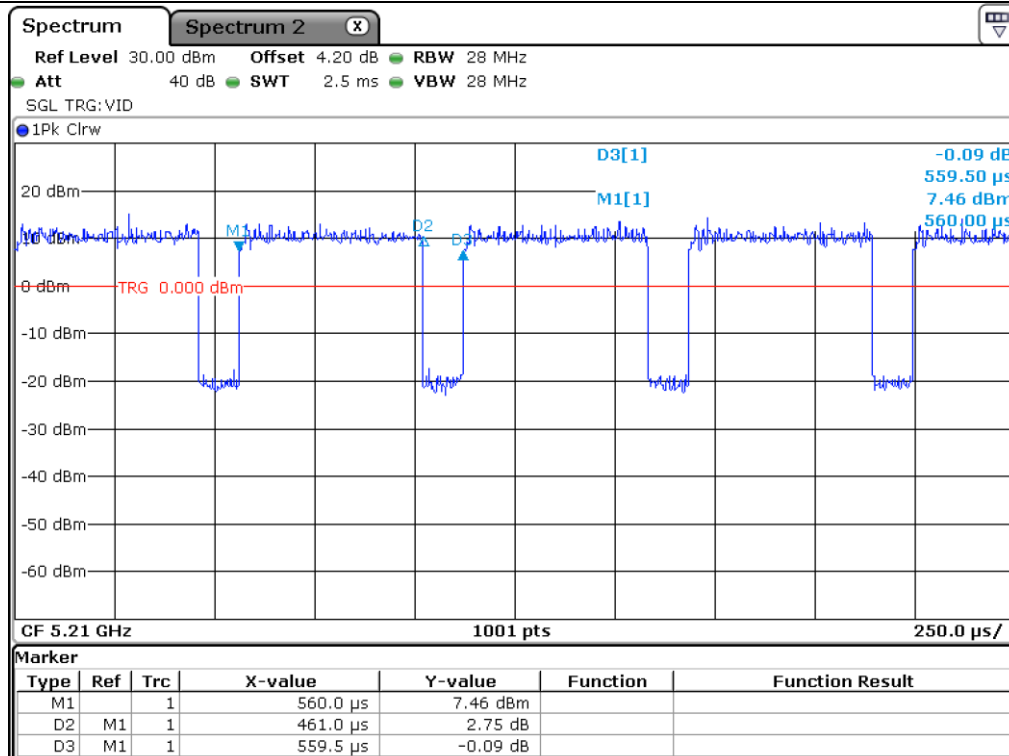
UNII 1_802.11 a



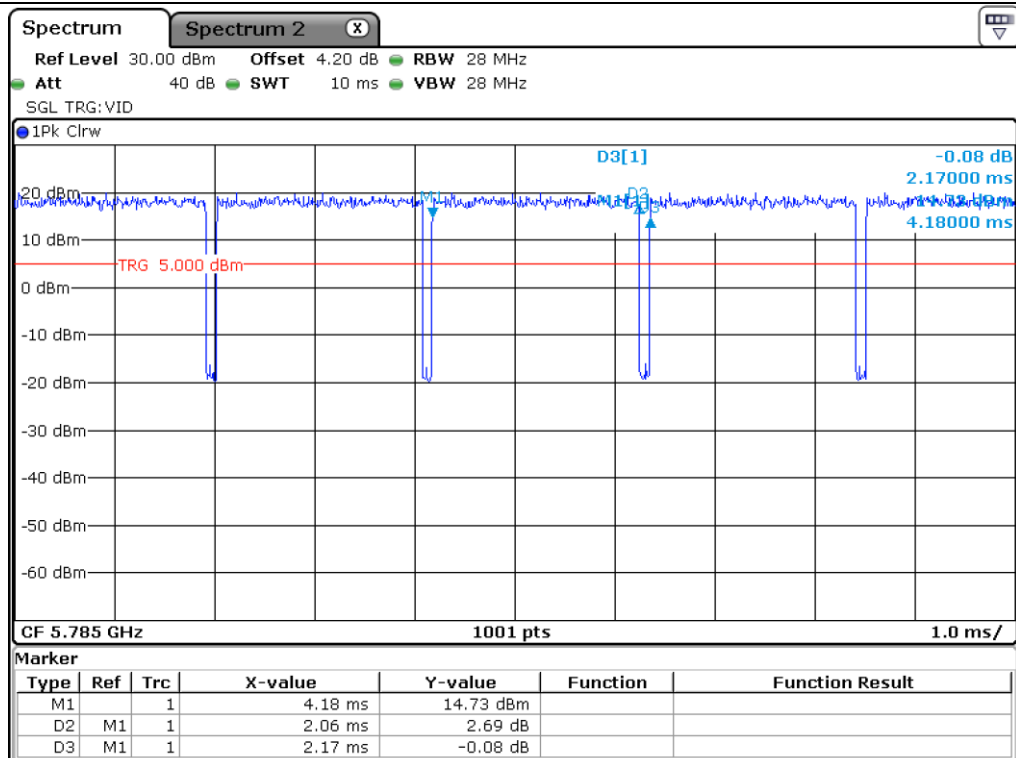
UNII 1_802.11 HT 20



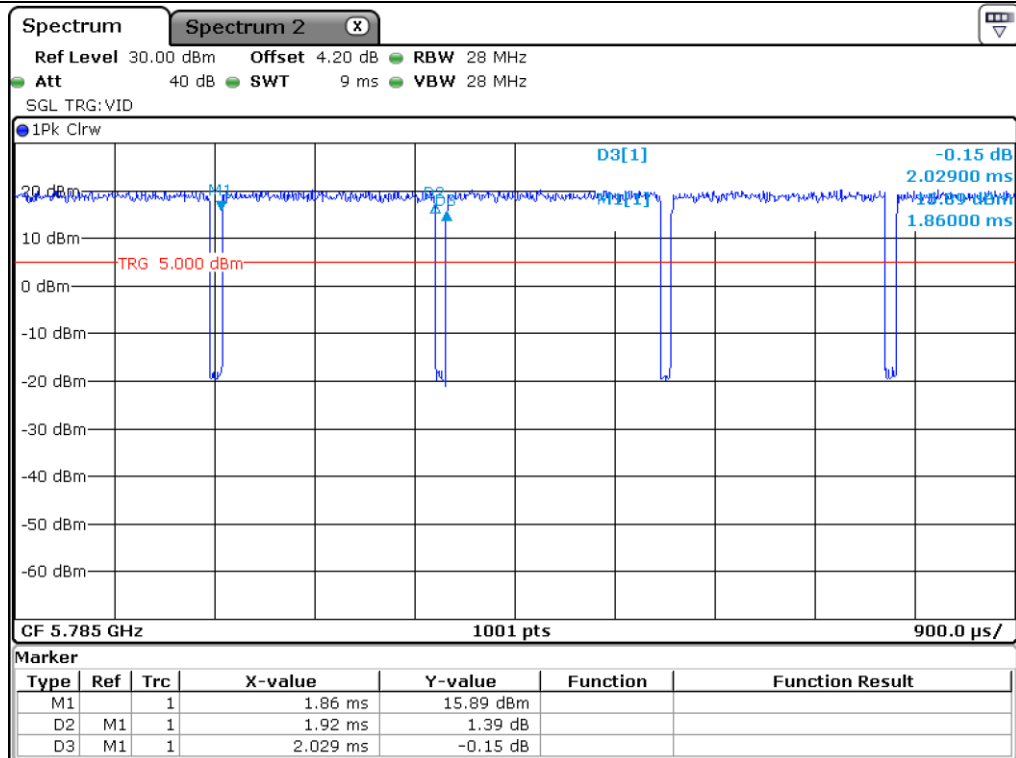
UNII 1_802.11 HT40



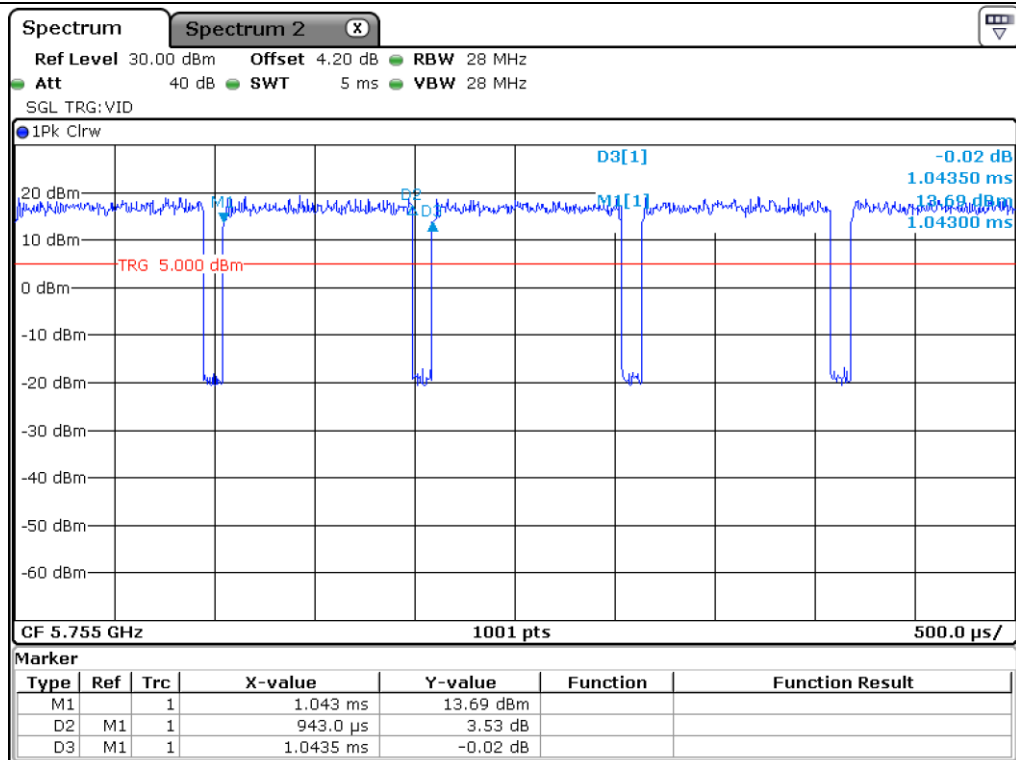
UNII 1_802.11 VHT 80



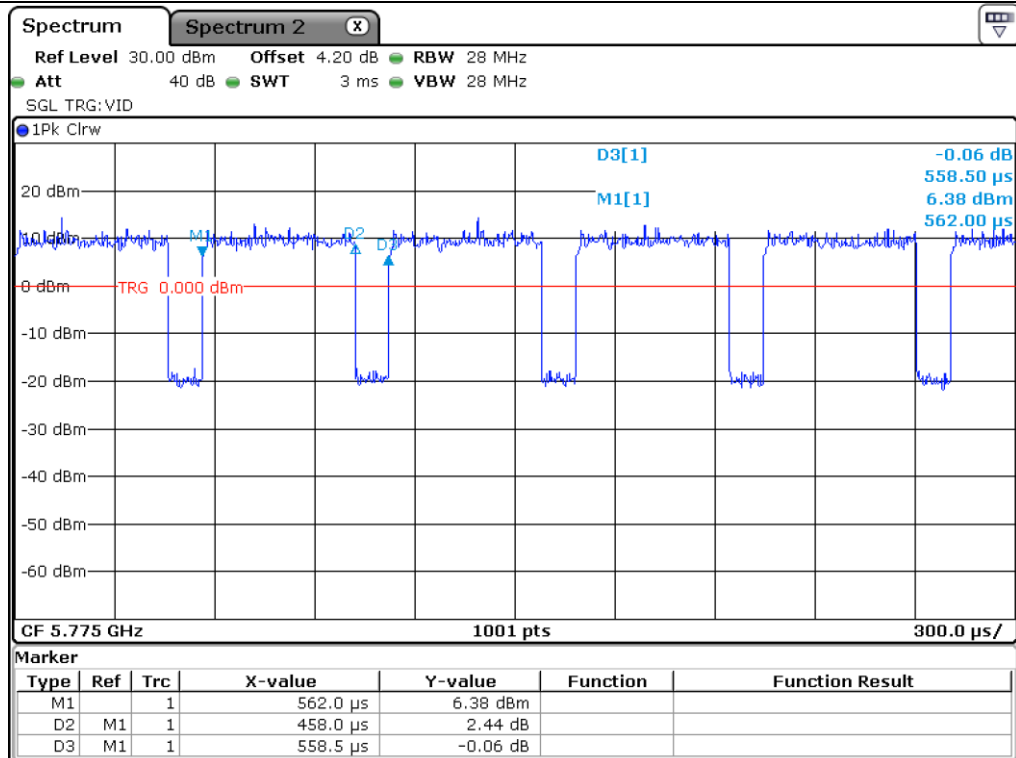
UNII 3_802.11 a



UNII 3_802.11 HT 20



UNII 3_802.11 HT40



UNII 3_802.11 VHT 80

-. Channel List (5 150 MHz ~ 5 250 MHz Band)

802.11a / n_HT20 / ac_VHT20		802.11n_HT40 / ac_VHT40		802.11ac_VHT80	
Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
36	5 180.00	38	5 190.00	42	5 210.00
40	5 200.00	46	5 230.00		
44	5 220.00				
48	5 240.00				

-. Channel List (5 725 MHz ~ 5 850 MHz Band)

802.11a / n_HT20 / ac_VHT20		802.11n_HT40 / ac_VHT40		802.11ac_VHT80	
Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
149	5 745.00	151	5 755.00	155	5 775.00
153	5 765.00	159	5 795.00		
157	5 785.00				
165	5 825.00				

5.4 Configuration of Test System

Line Conducted Test: It is not need to test this requirement, because the EUT shall be operated by DC Power.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2020 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

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

5.5 Antenna Requirement

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

Antenna Construction:

The antenna of the EUT is a PCB Antenna on the main board in the EUT and a PCB antenna connected to the outside of the EUT by a special connector 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)
It is not need to test this requirement, because the power of the EUT is supplied by DC Power.	

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 approximately 1% of the emission bandwidth, 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 Date

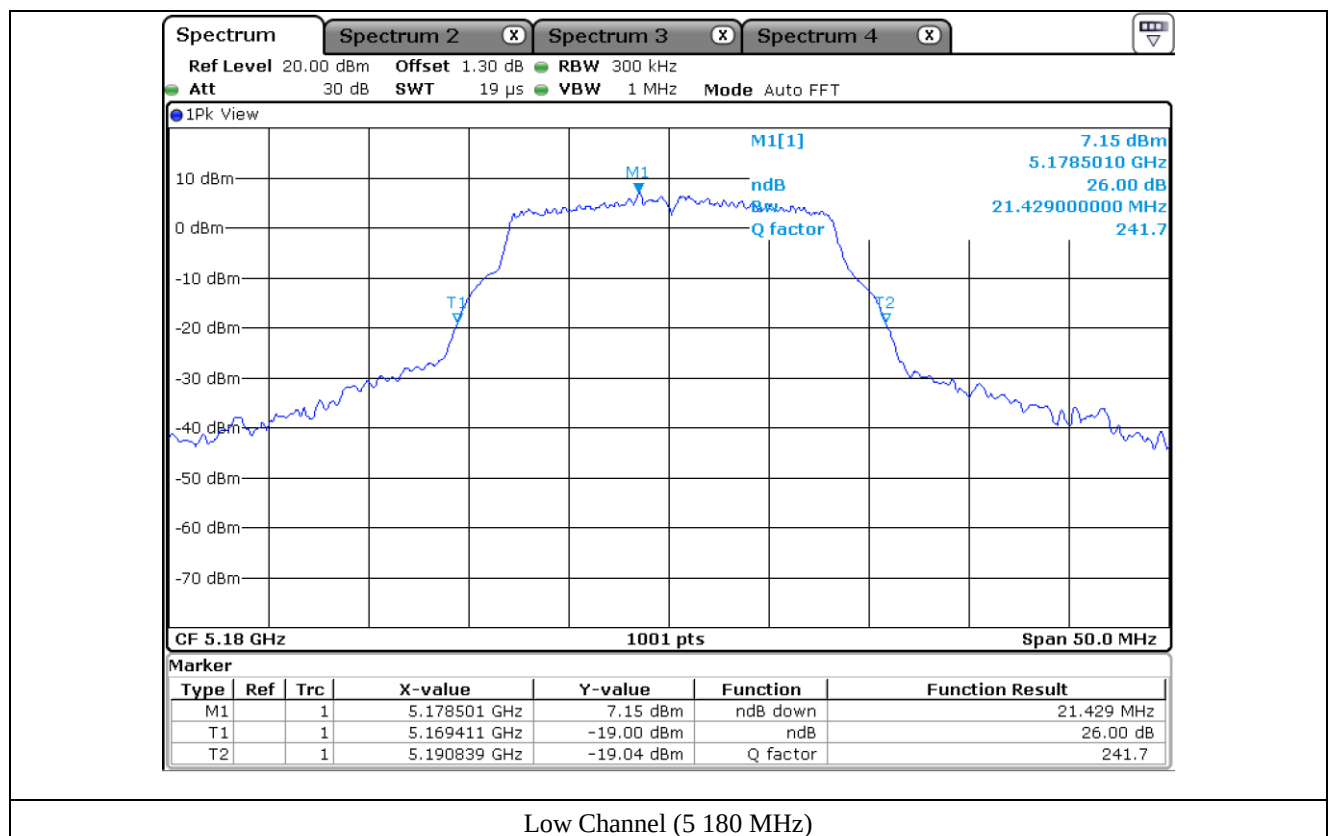
November 25, 2021 ~ January 18, 2022

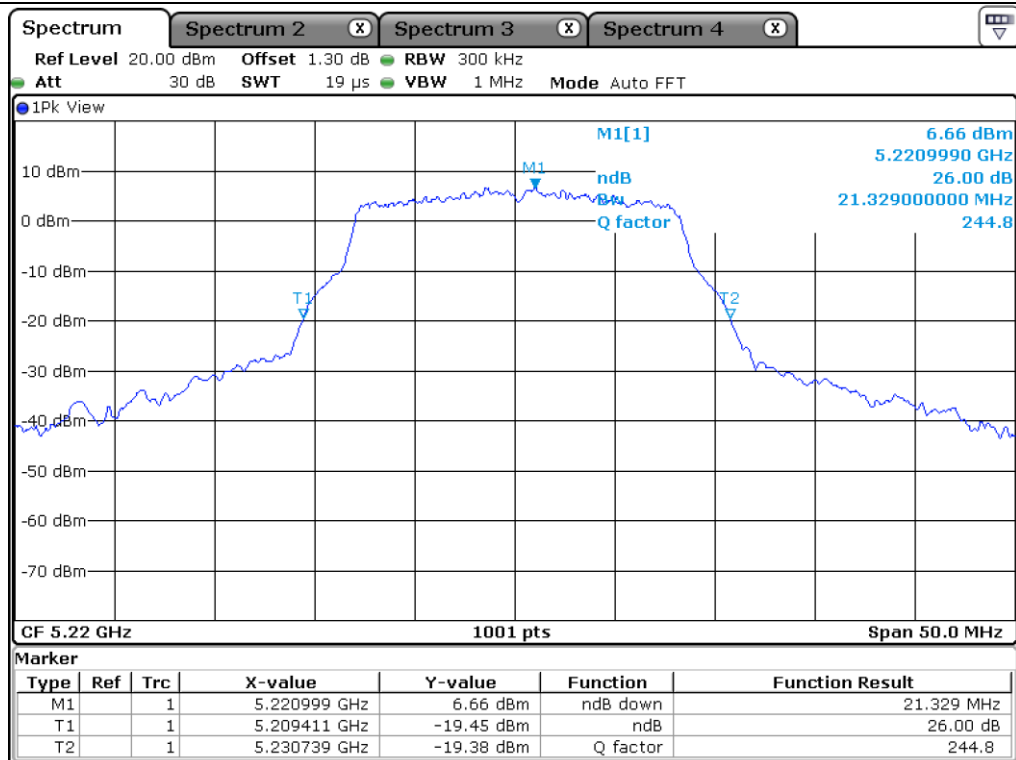
7.4 Test data for 802.11a RLAN Mode

7.4.1 Test data for Internal Antenna

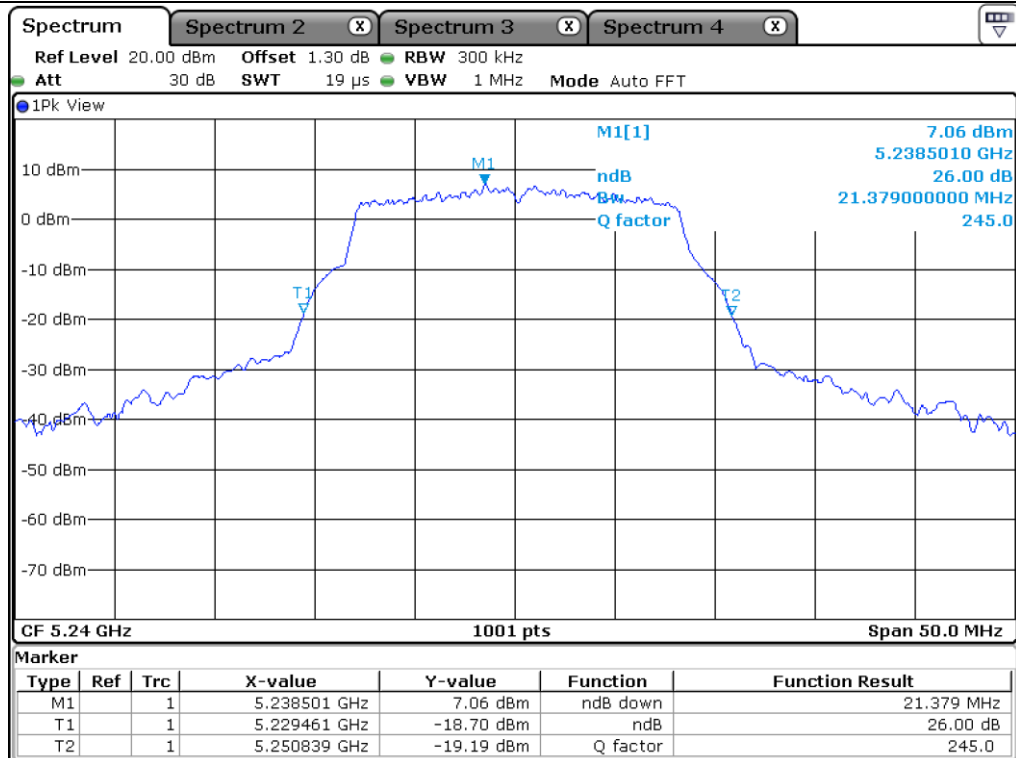
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.43
	Middle	5 220.00	21.33
	High	5 240.00	21.38
5 725 ~ 5 850	Low	5 745.00	21.33
	Middle	5 785.00	21.48
	High	5 825.00	21.38

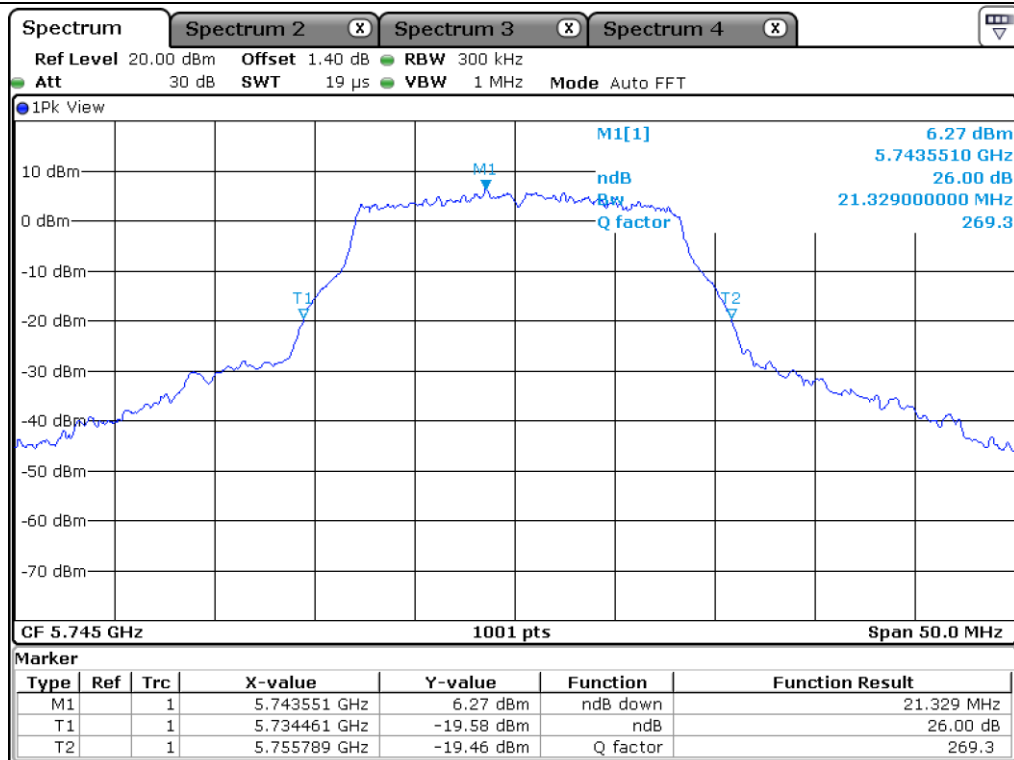




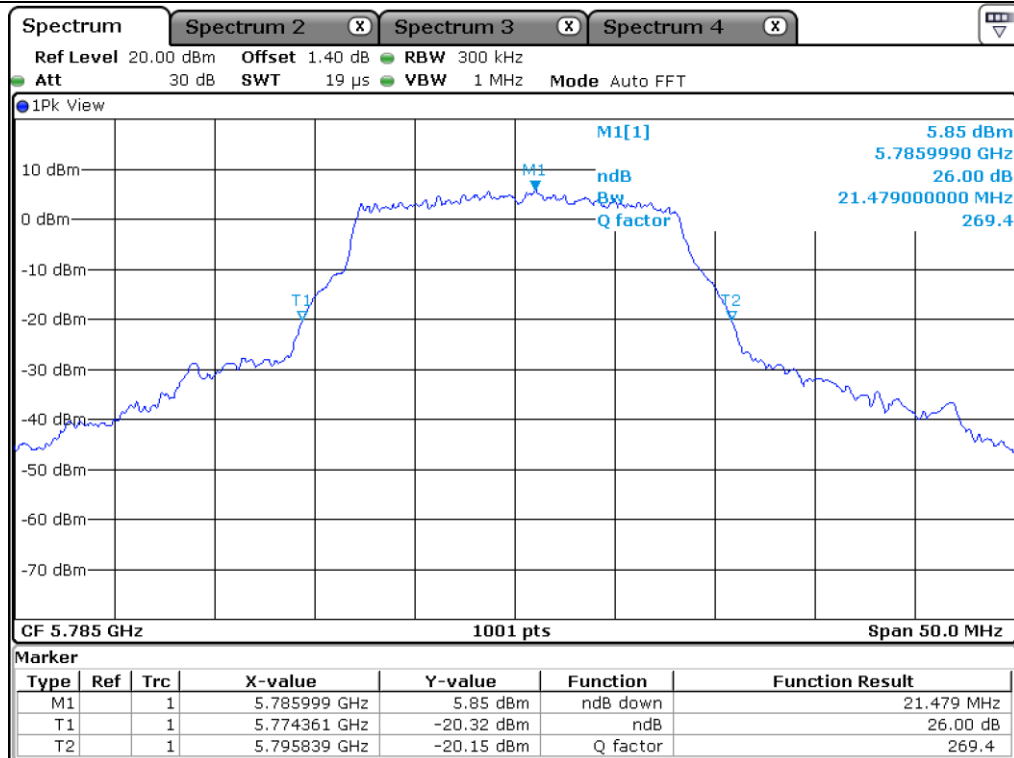
Middle Channel (5 220 MHz)



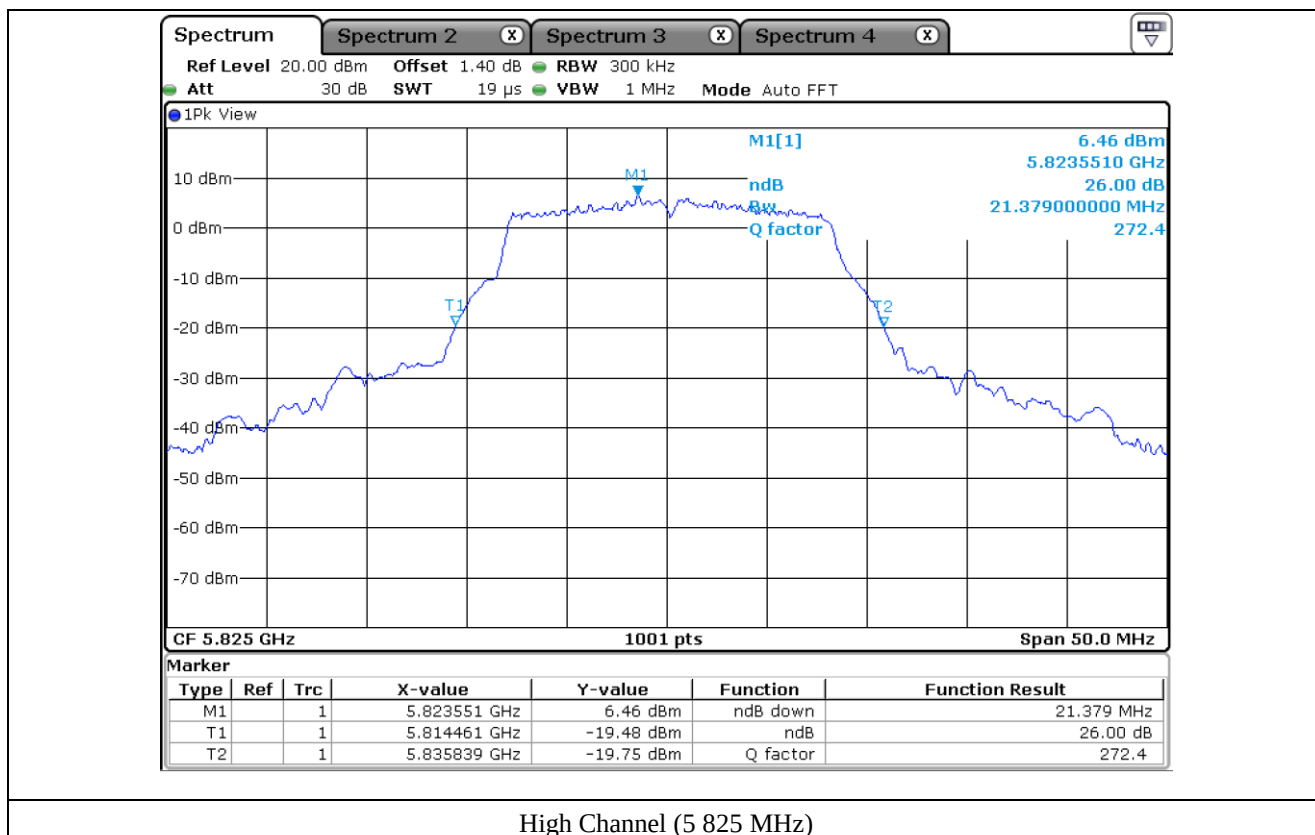
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



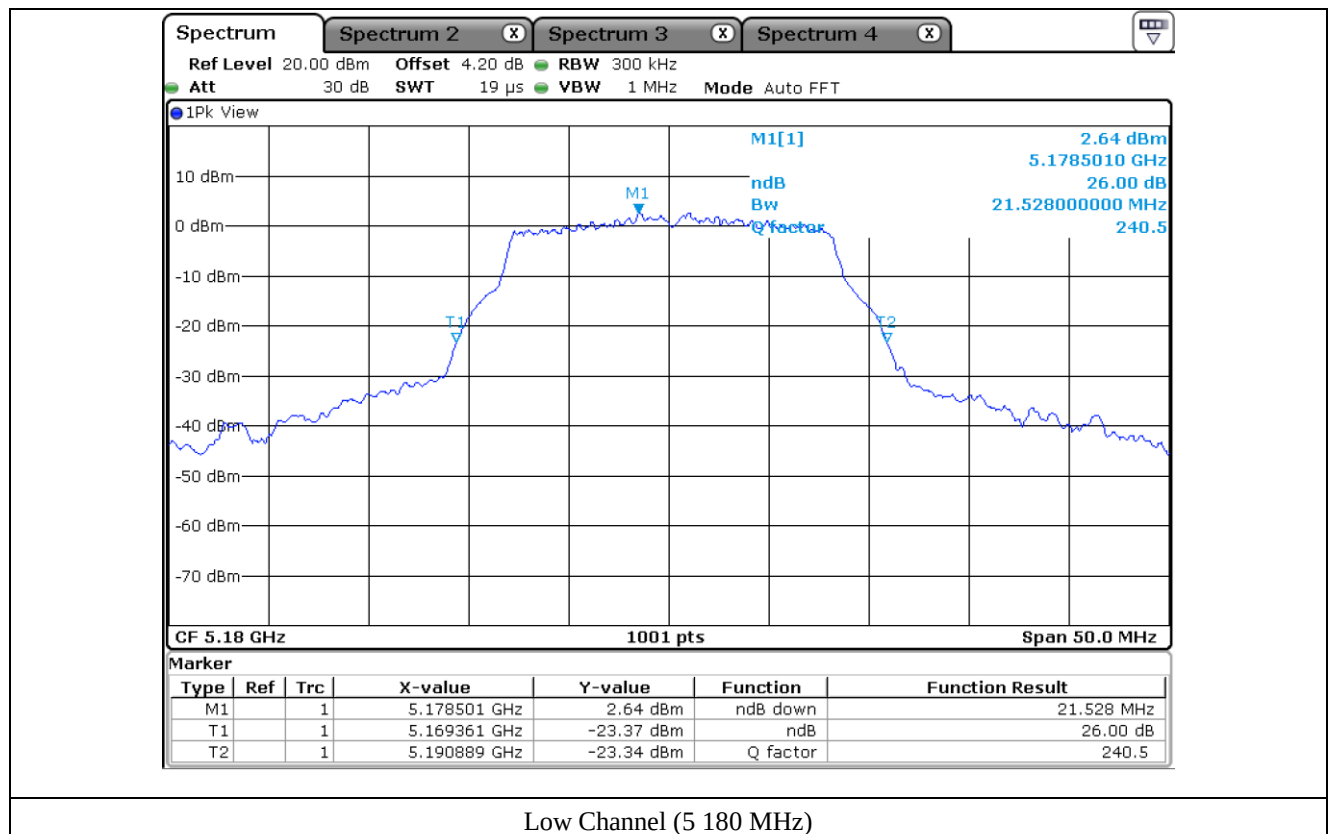
Middle Channel (5 785 MHz)

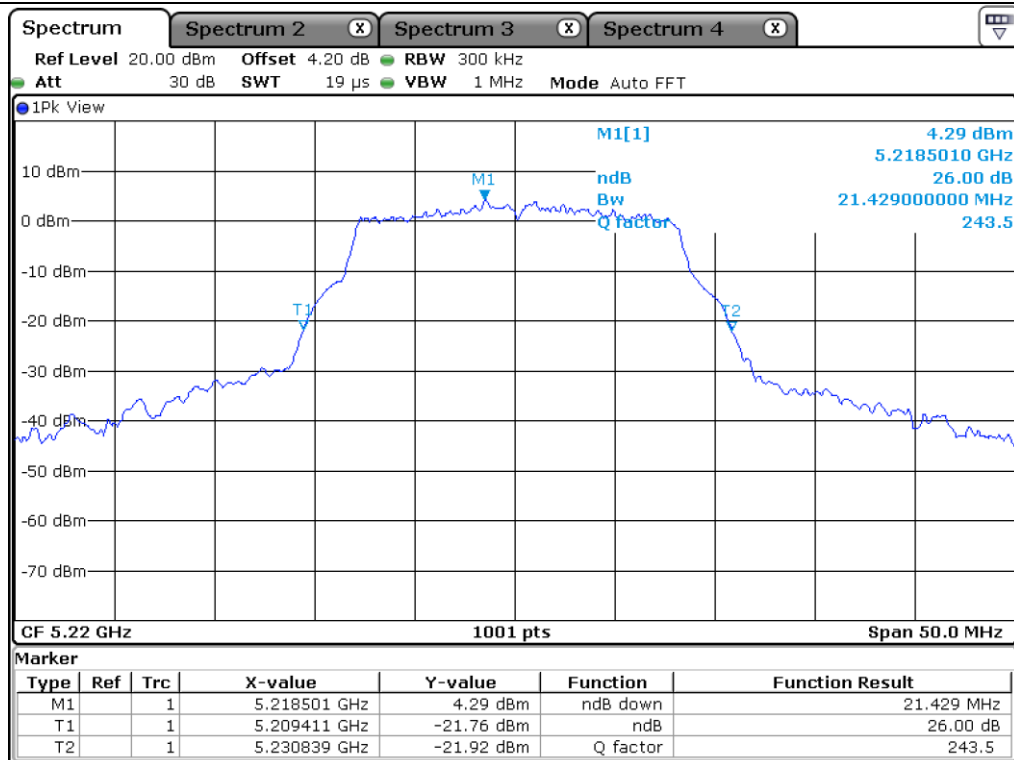


7.4.2 Test data for External Antenna

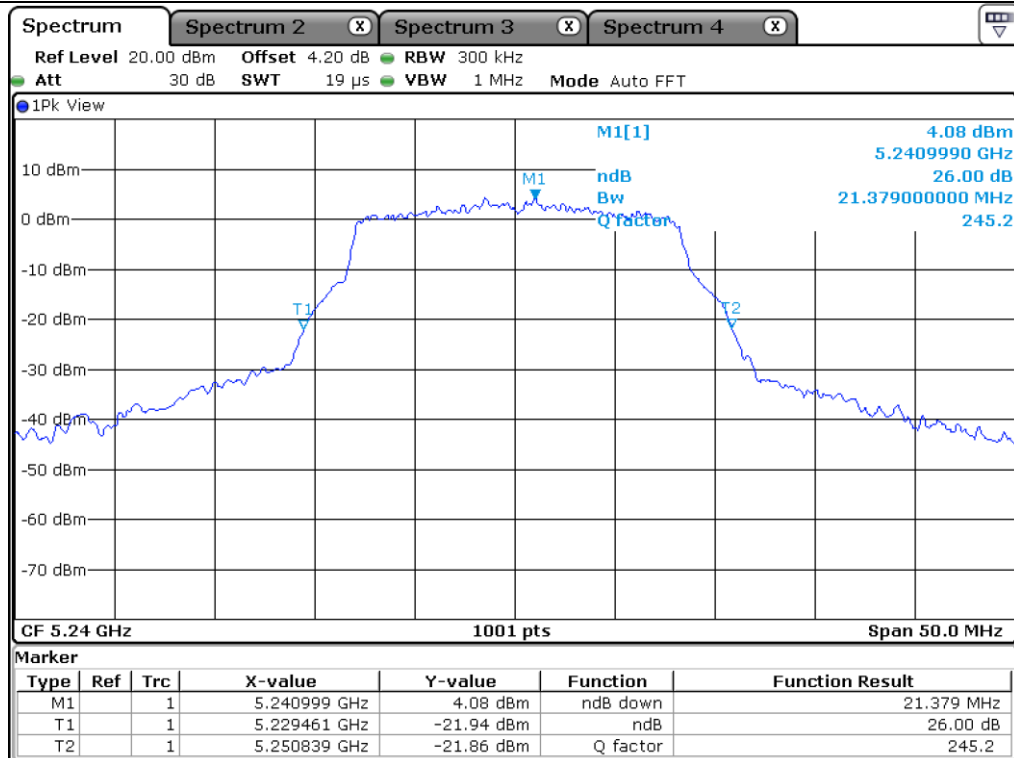
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.53
	Middle	5 220.00	21.43
	High	5 240.00	21.38
5 725 ~ 5 850	Low	5 745.00	21.38
	Middle	5 785.00	21.48
	High	5 825.00	21.33

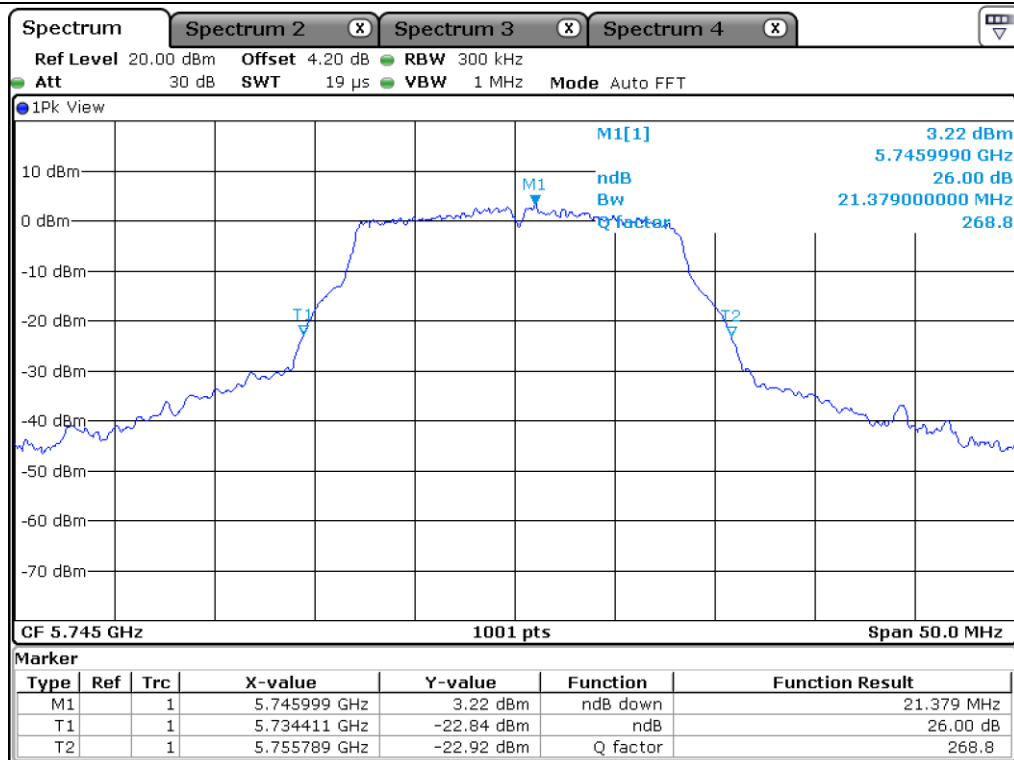




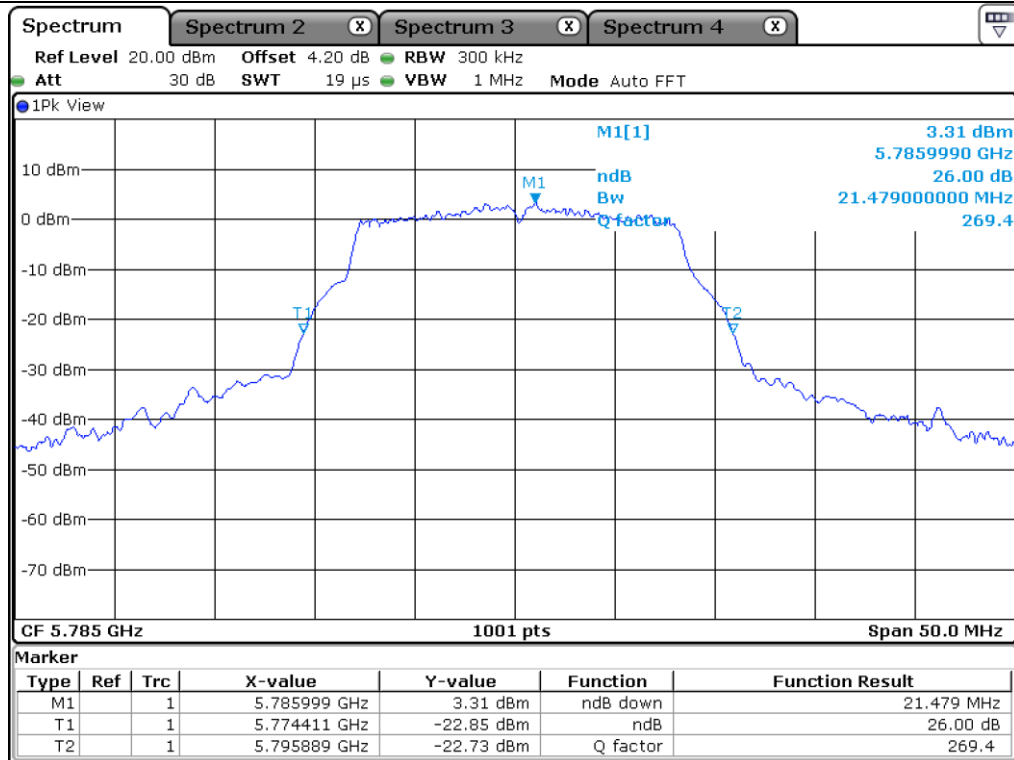
Middle Channel (5 220 MHz)



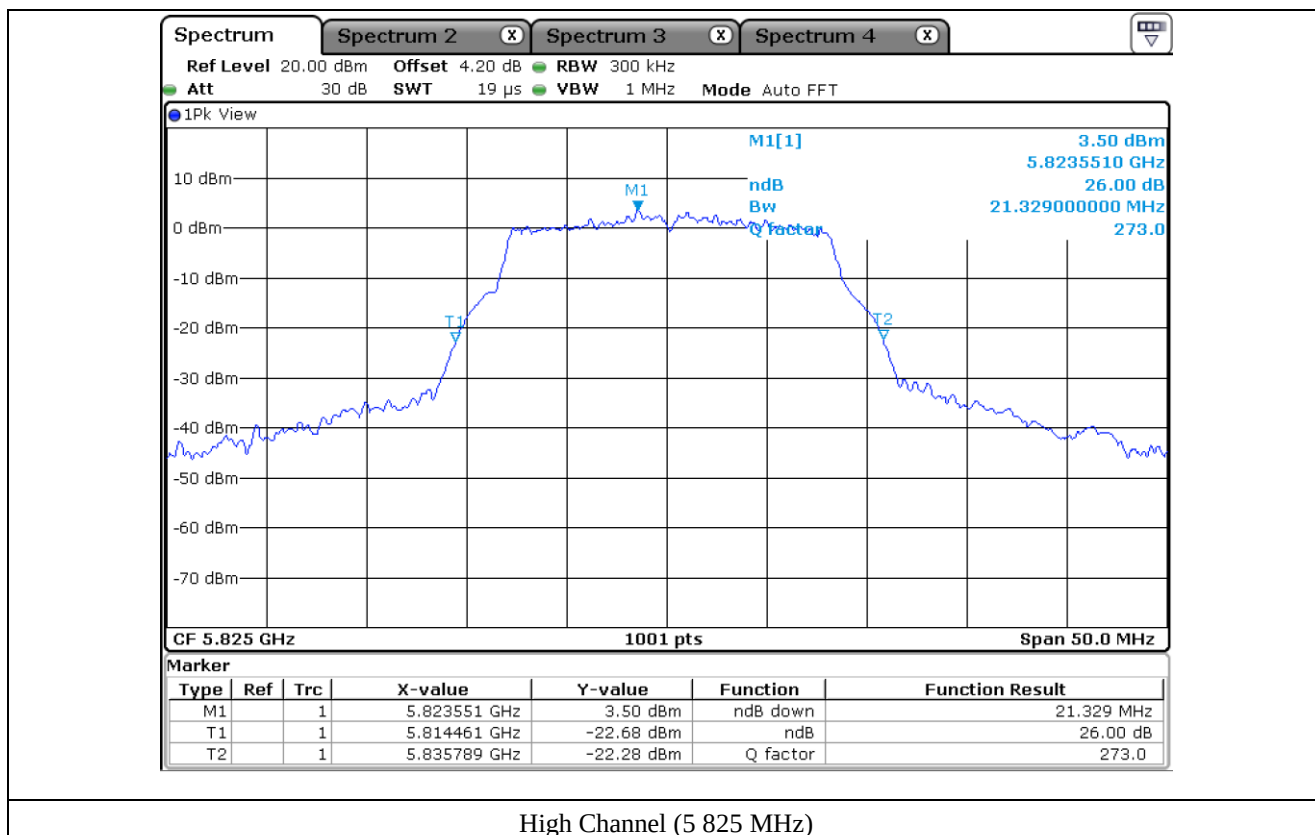
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)

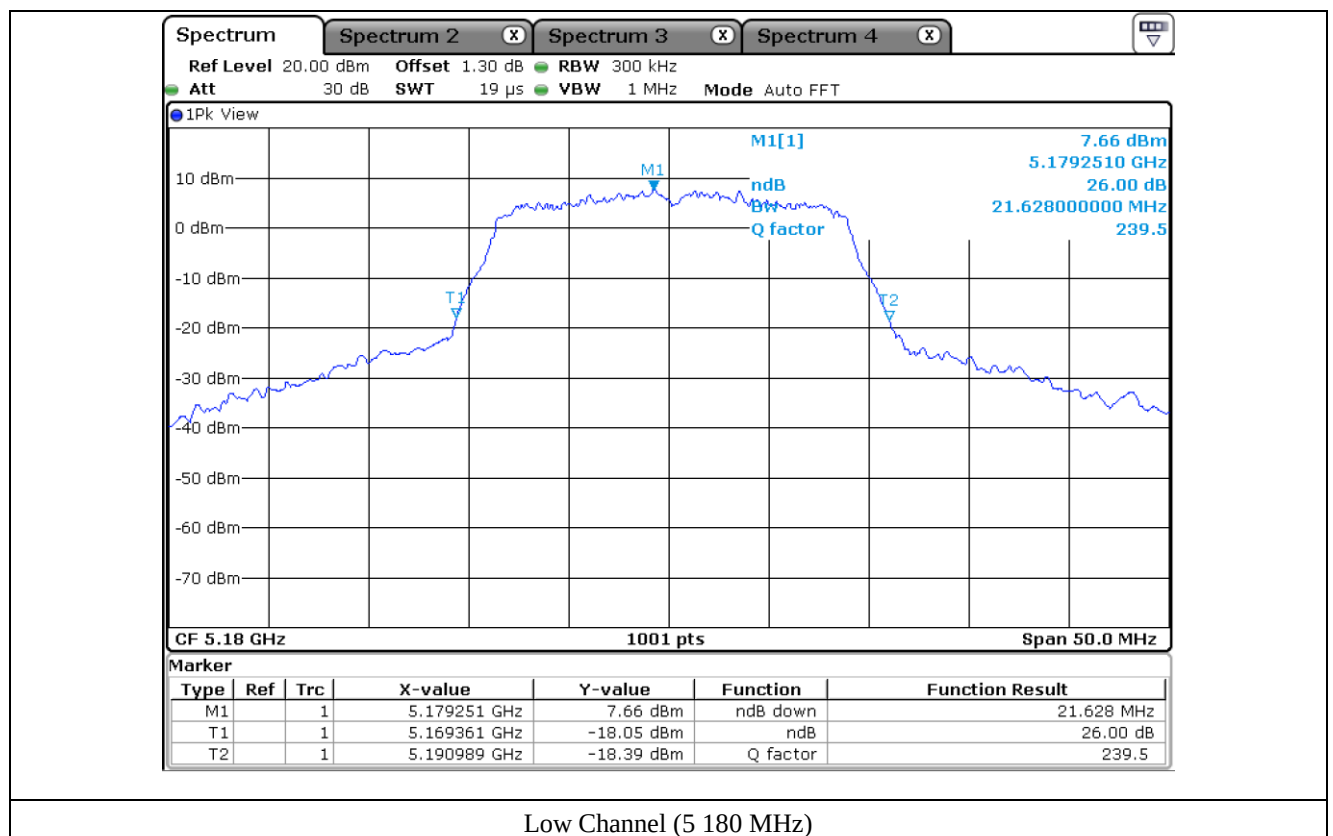


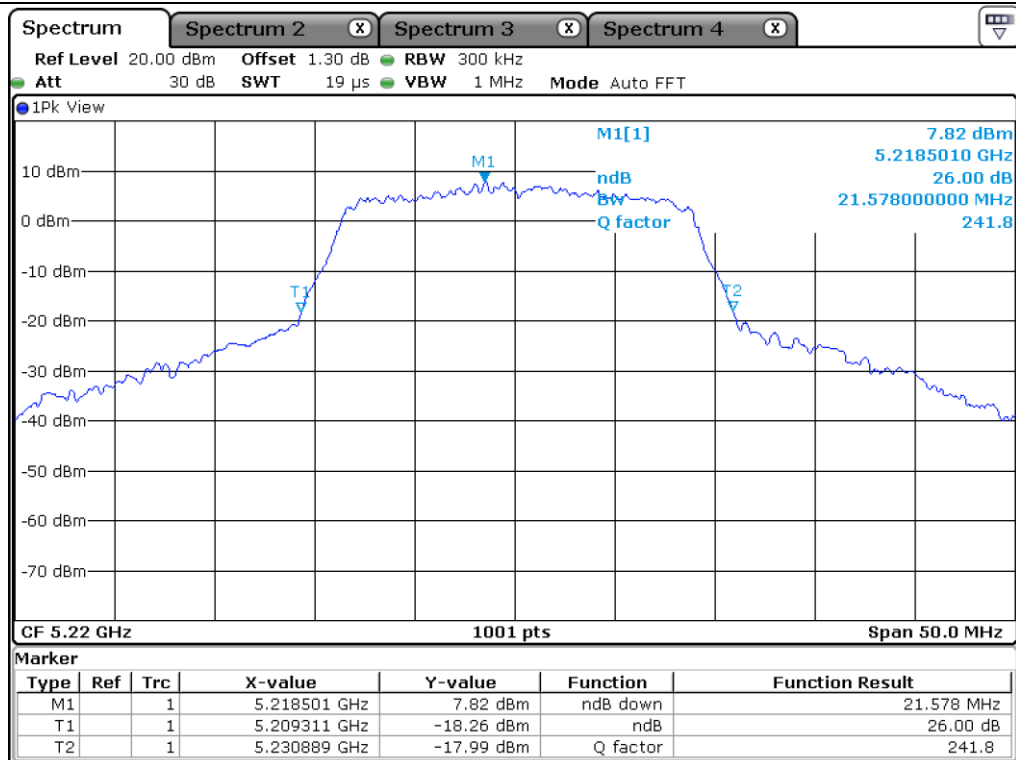
7.5 Test data for 802.11n_HT20 RLAN Mode

7.5.1 Test data for Internal Antenna

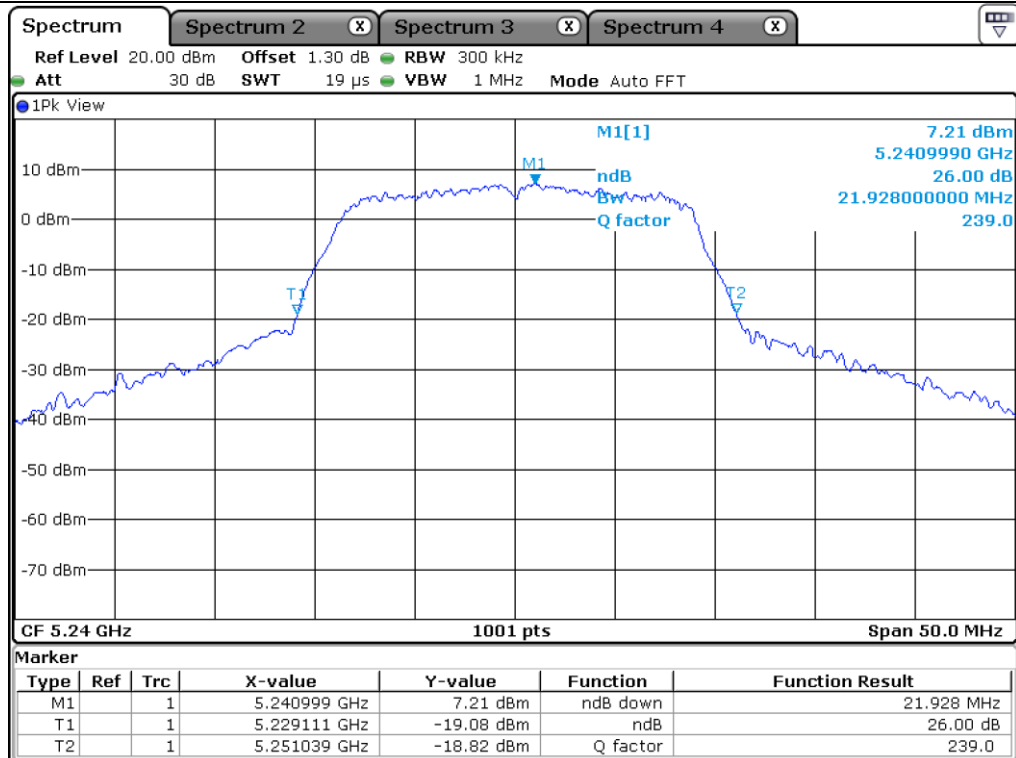
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.63
	Middle	5 220.00	21.58
	High	5 240.00	21.93
5 725 ~ 5 850	Low	5 745.00	21.78
	Middle	5 785.00	21.93
	High	5 825.00	21.93

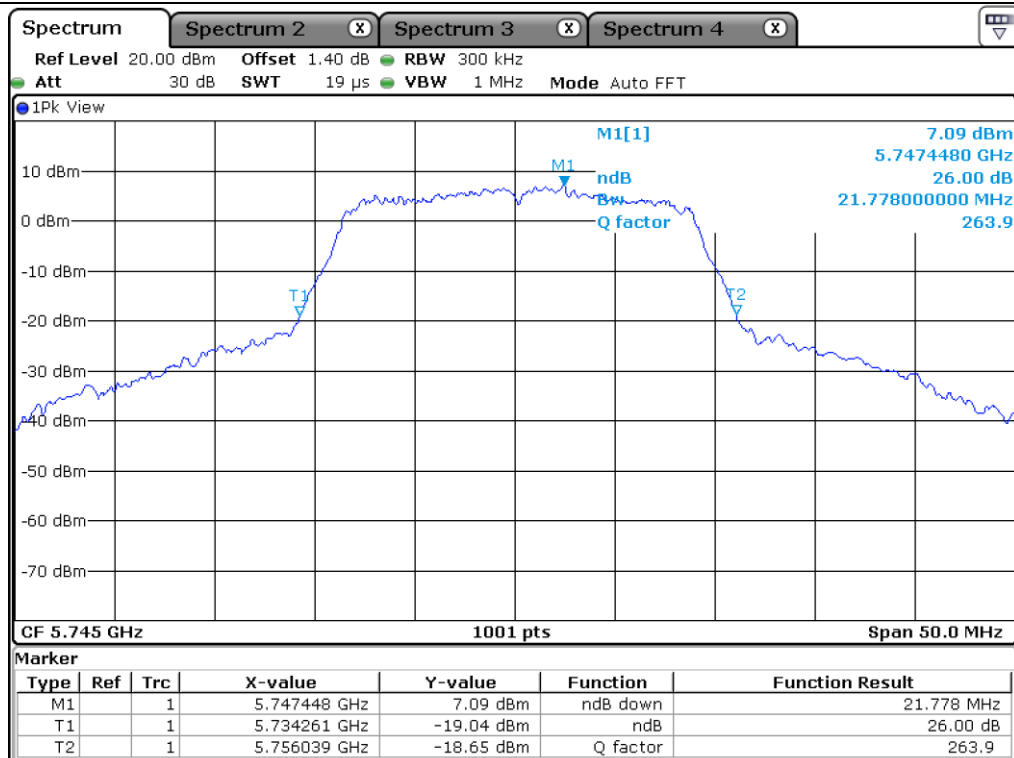




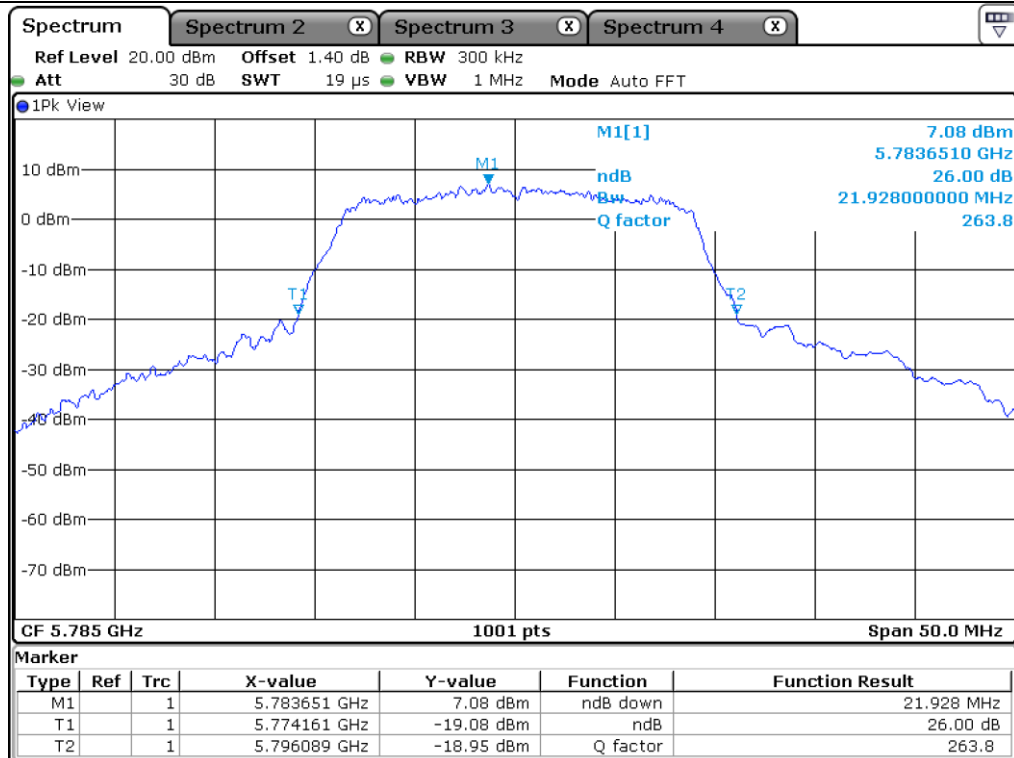
Middle Channel (5 220 MHz)



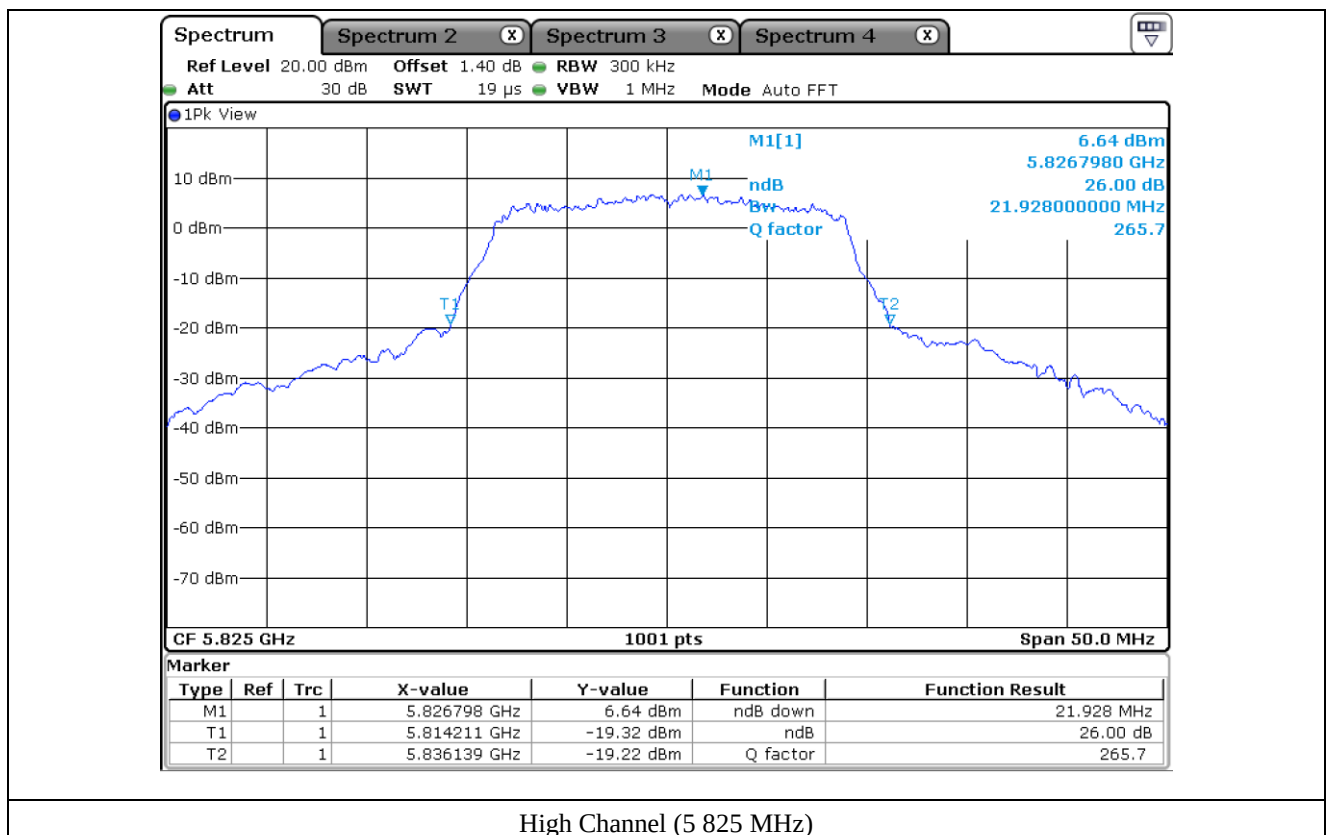
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



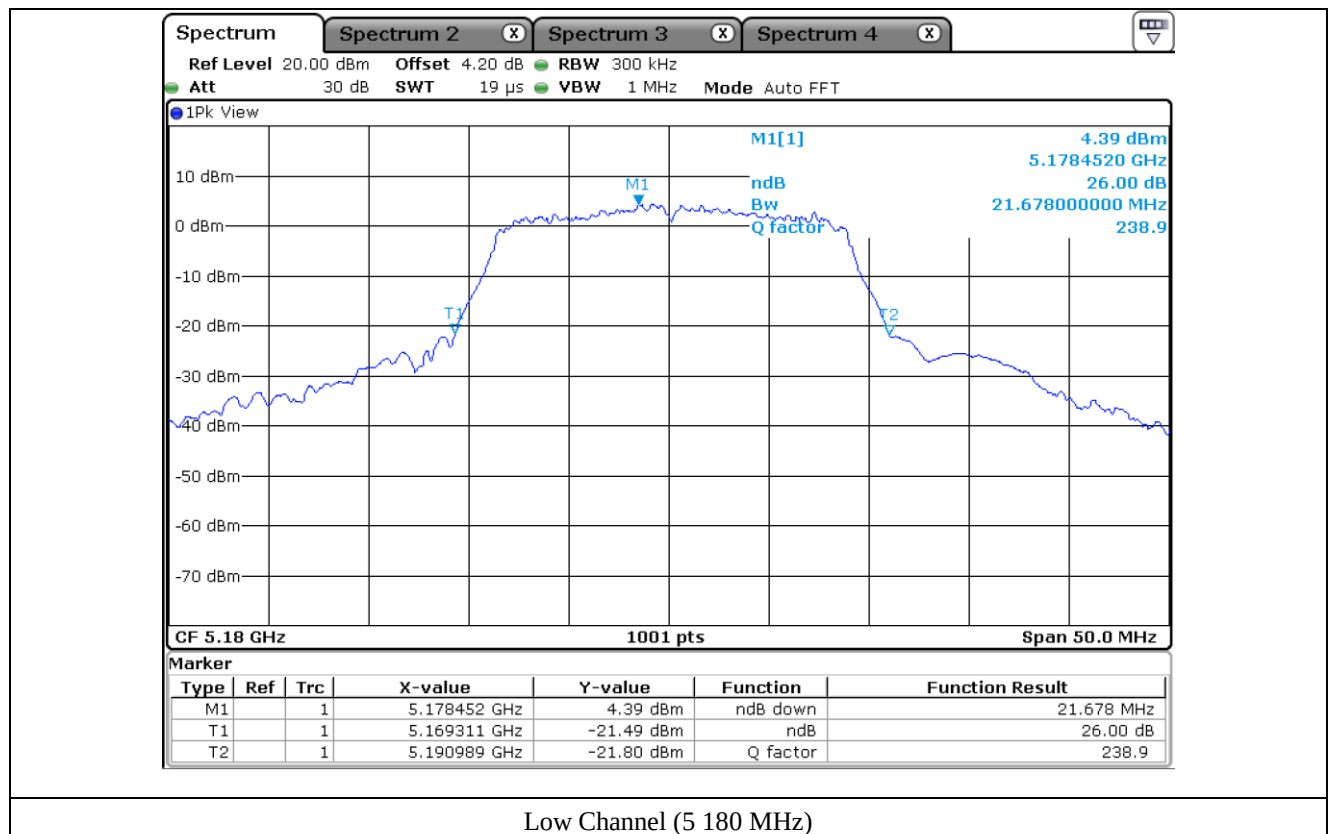
Middle Channel (5 785 MHz)

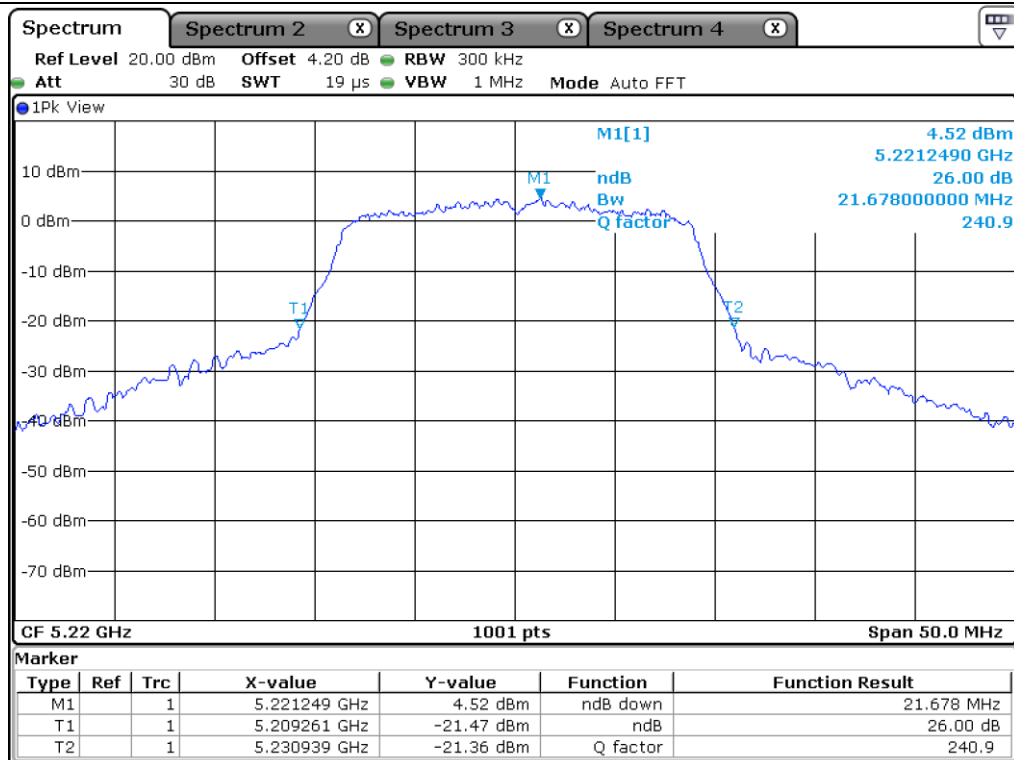


7.5.2 Test data for External Antenna

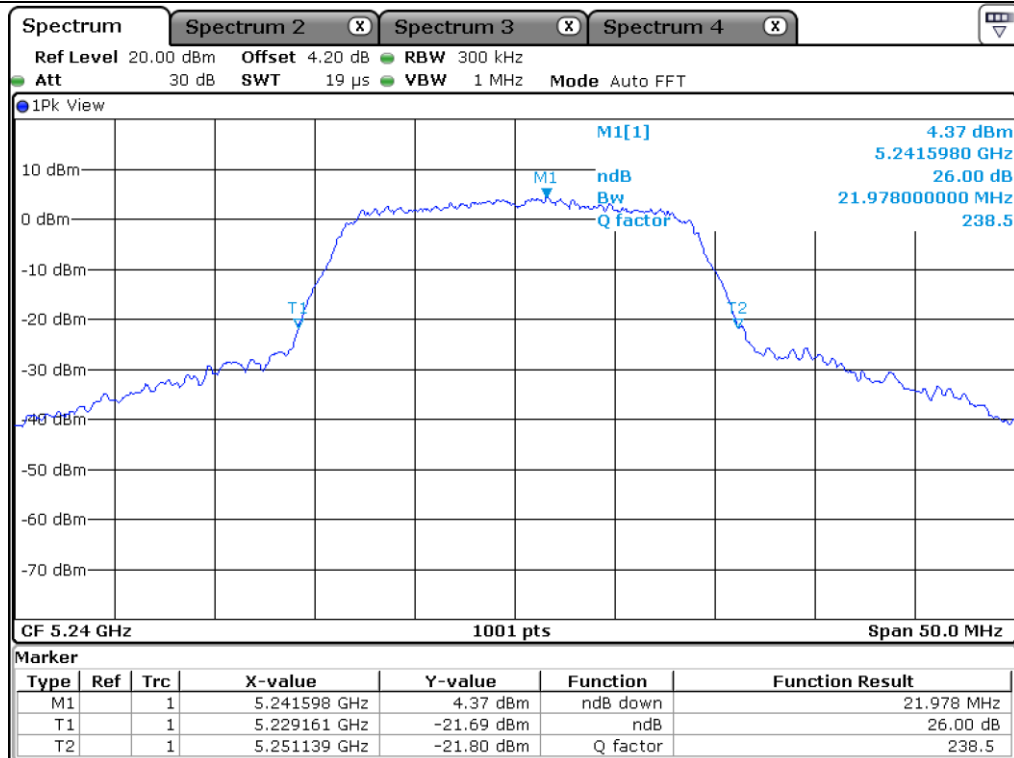
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 180.00	21.68
	Middle	5 220.00	21.68
	High	5 240.00	21.98
5 725 ~ 5 850	Low	5 745.00	21.68
	Middle	5 785.00	21.83
	High	5 825.00	21.83

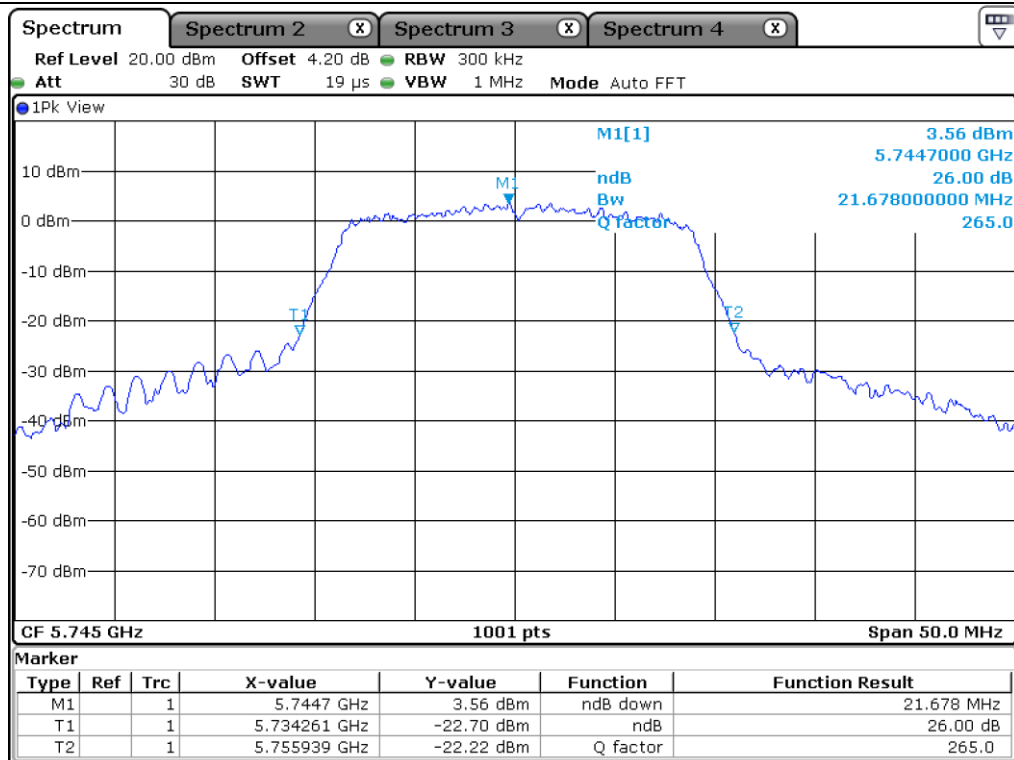




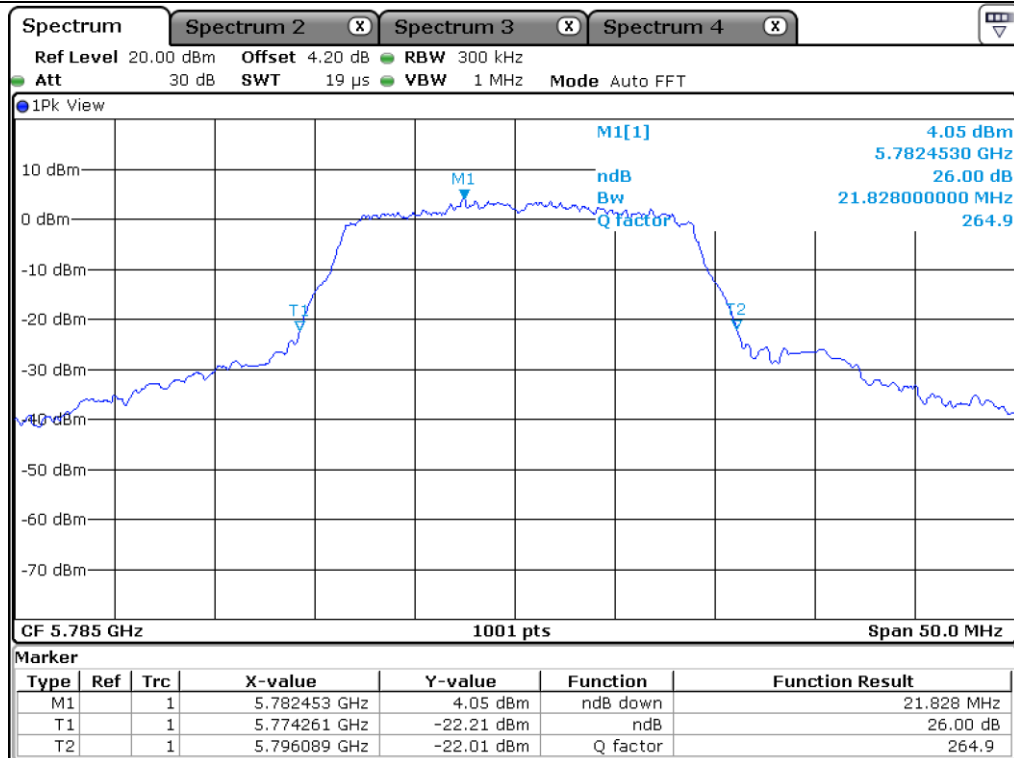
Middle Channel (5 220 MHz)



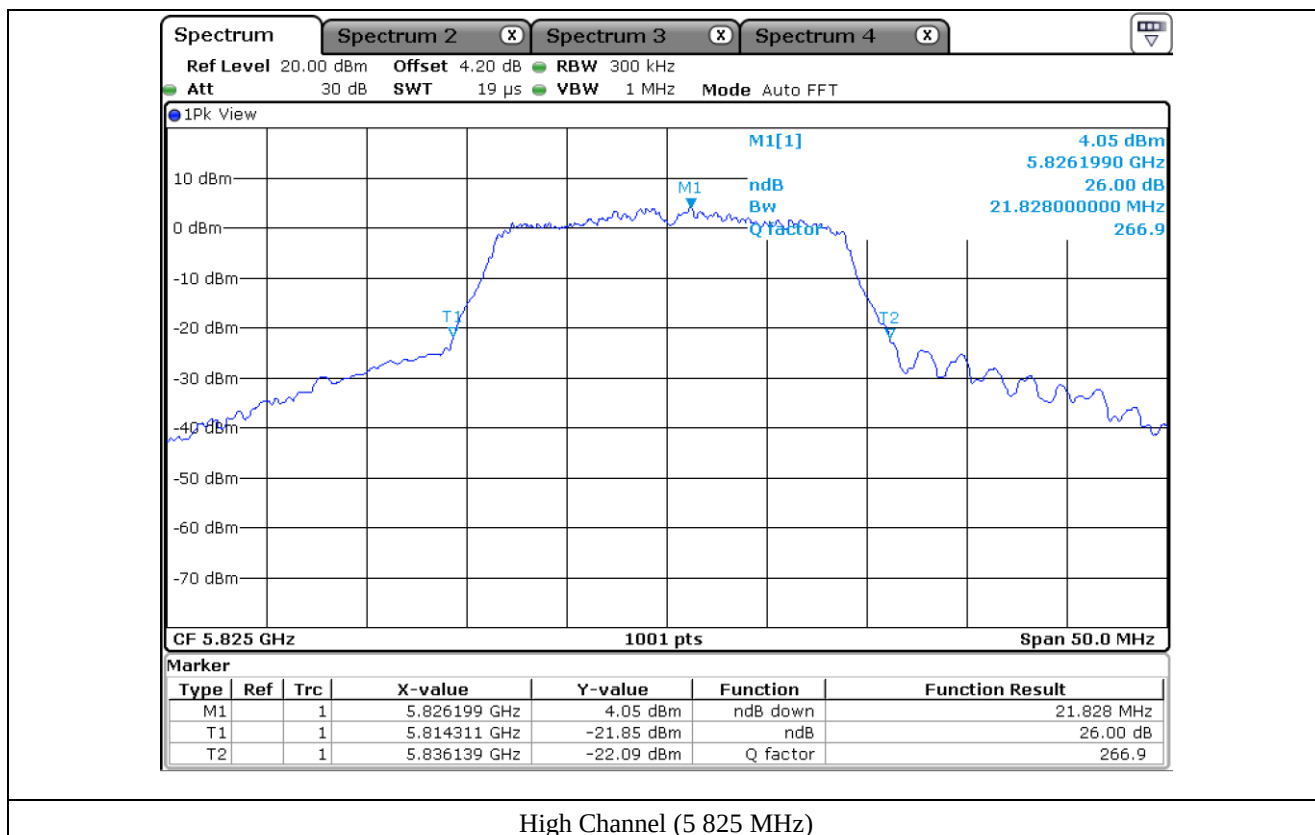
High Channel (5 240 MHz)



Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



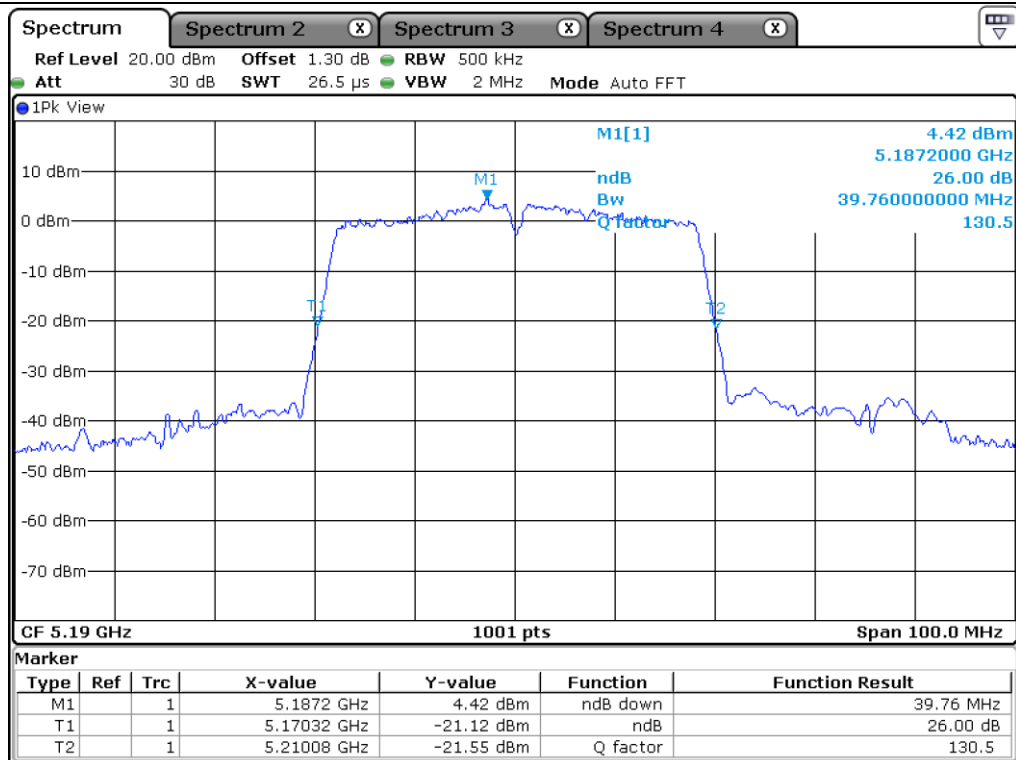
7.6 Test data for 802.11n_HT40 RLAN Mode

7.6.1 Test data for Internal Antenna

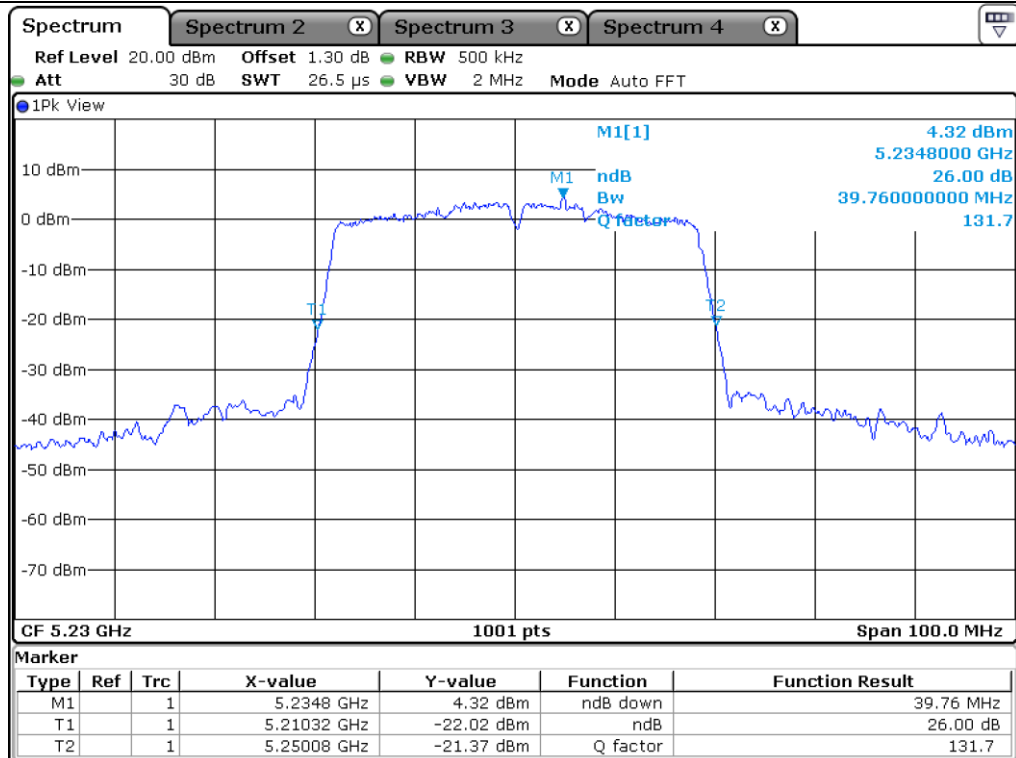
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	39.76
	High	5 230.00	39.76
5 725 ~ 5 850	Low	5 755.00	39.86
	High	5 795.00	39.76

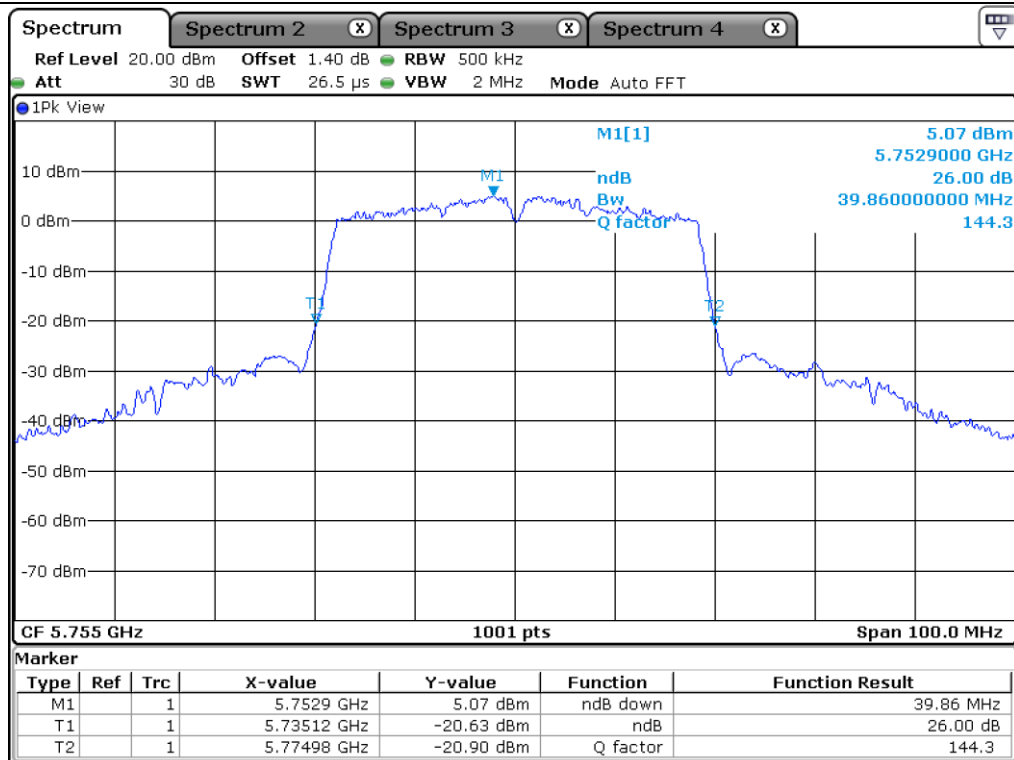
Remark: See next page for measurement data.



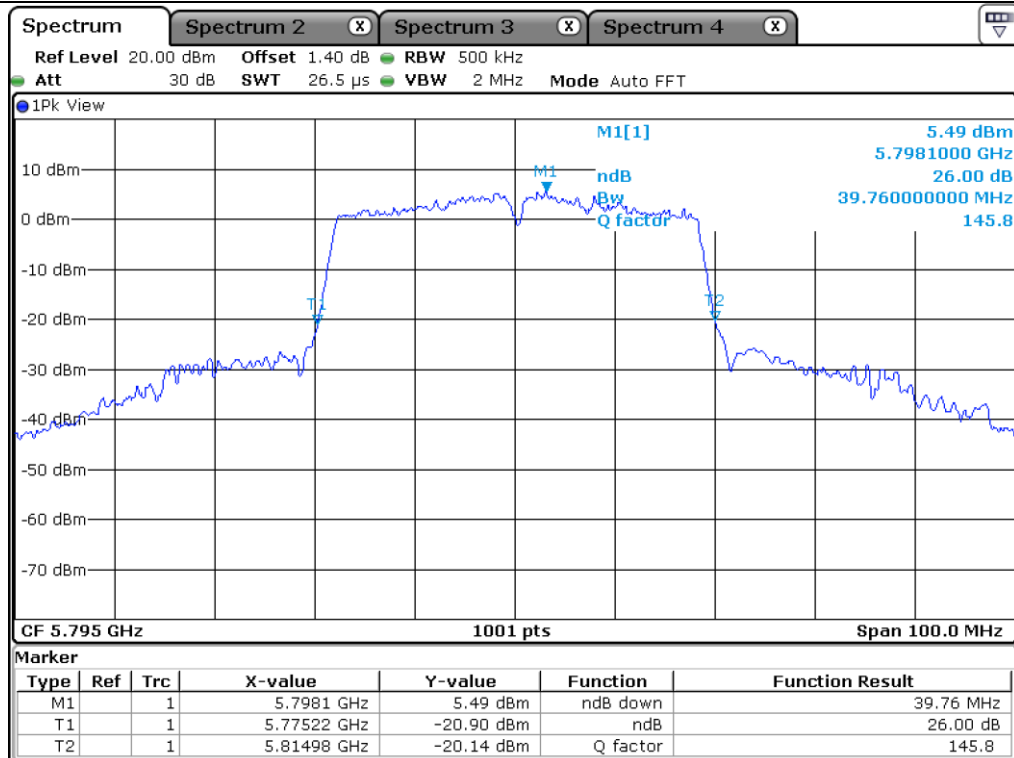
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



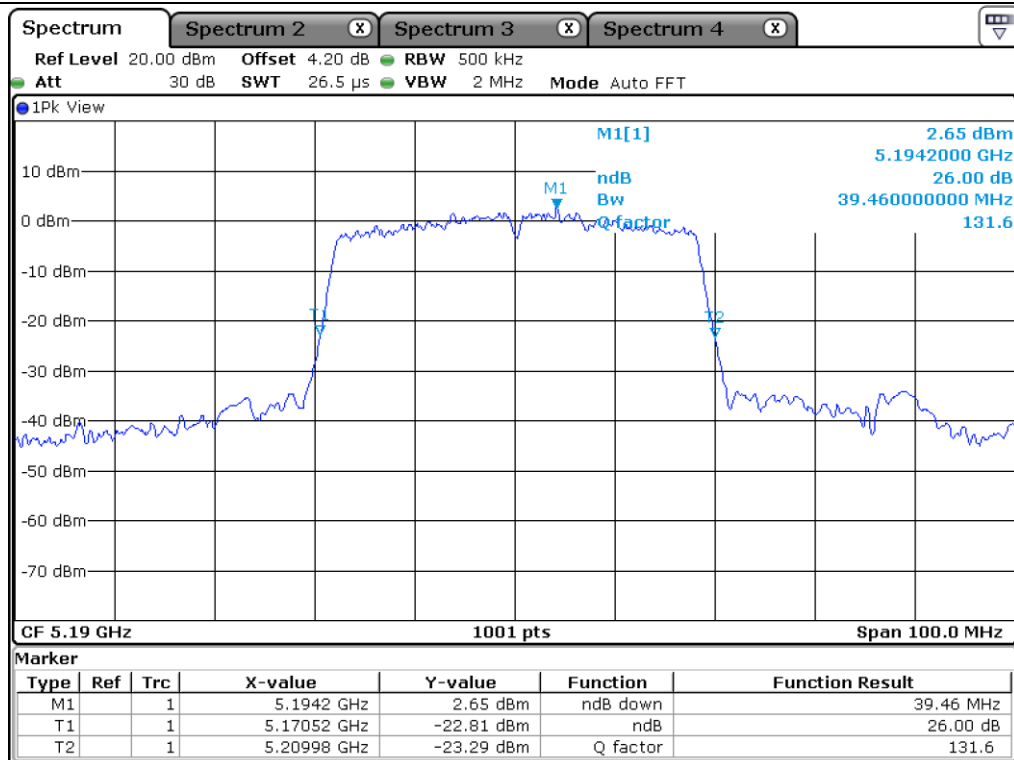
High Channel (5 795 MHz)

7.6.2 Test data for External Antenna

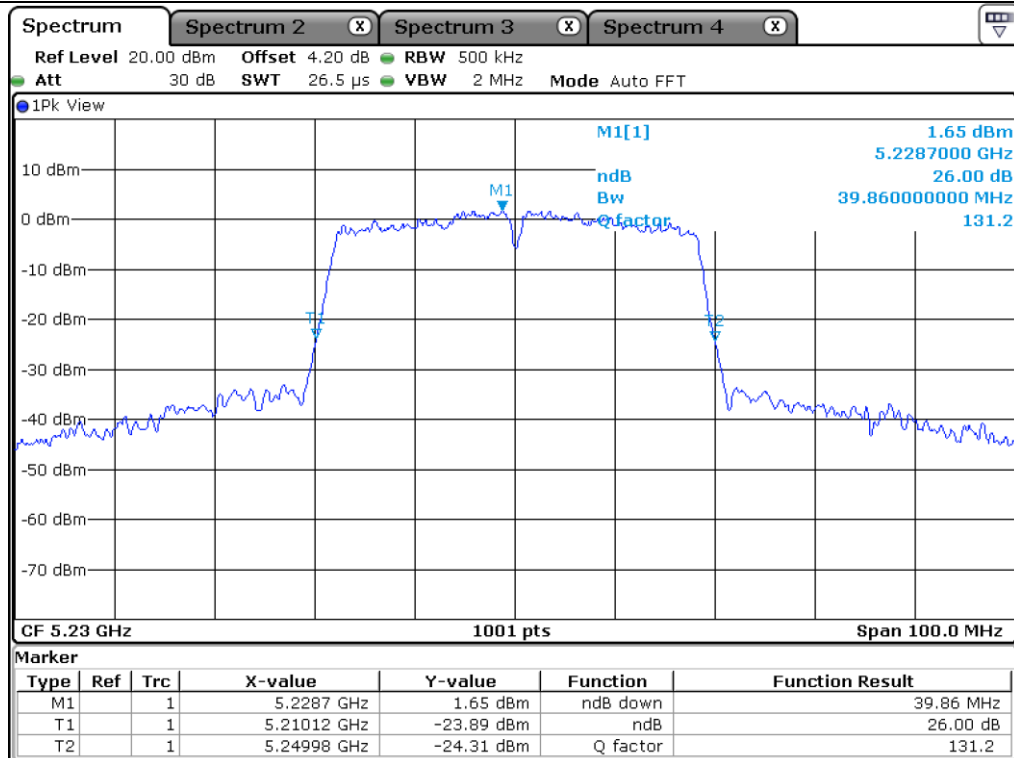
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Low	5 190.00	39.46
	High	5 230.00	39.86
5 725 ~ 5 850	Low	5 755.00	39.86
	High	5 795.00	39.66

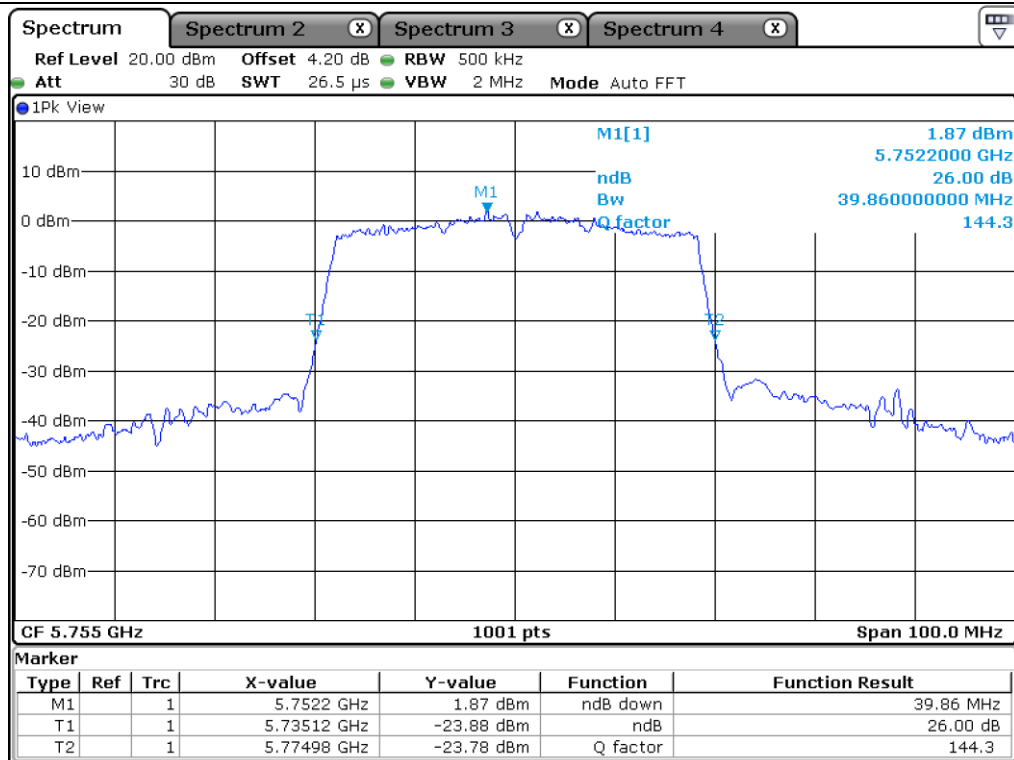
Remark: See next page for measurement data.



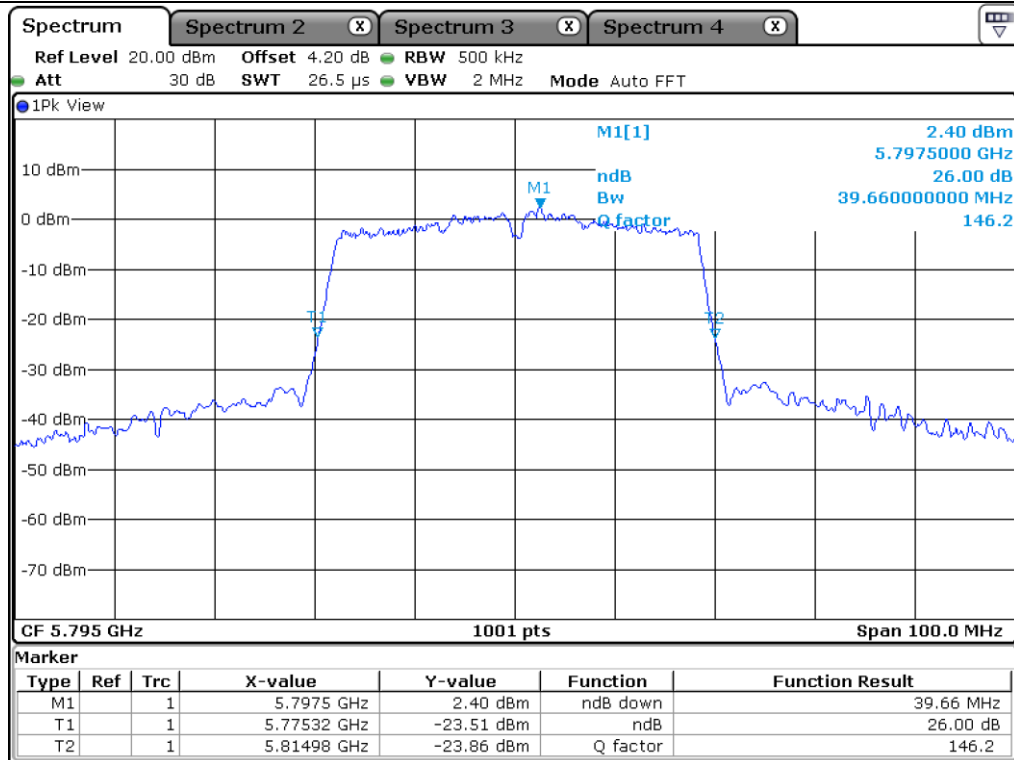
Low Channel (5 190 MHz)



High Channel (5 230 MHz)



Low Channel (5 755 MHz)



High Channel (5 795 MHz)

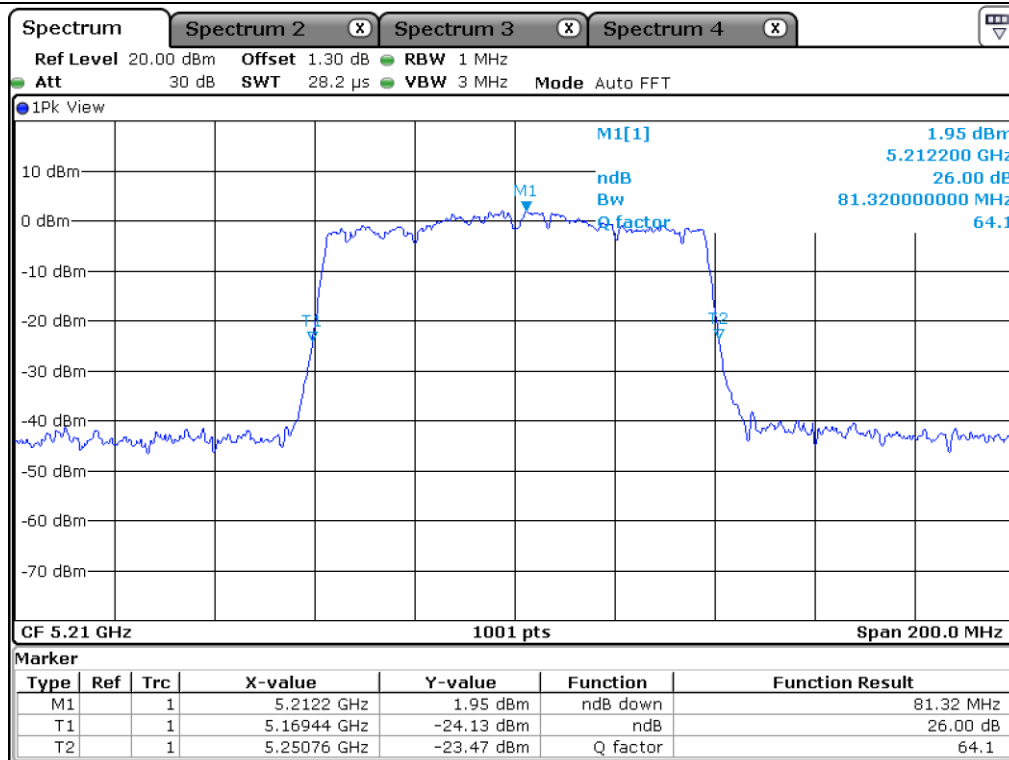
7.7 Test data for 802.11ac_VHT80 RLAN Mode

7.7.1 Test data for Internal Antenna

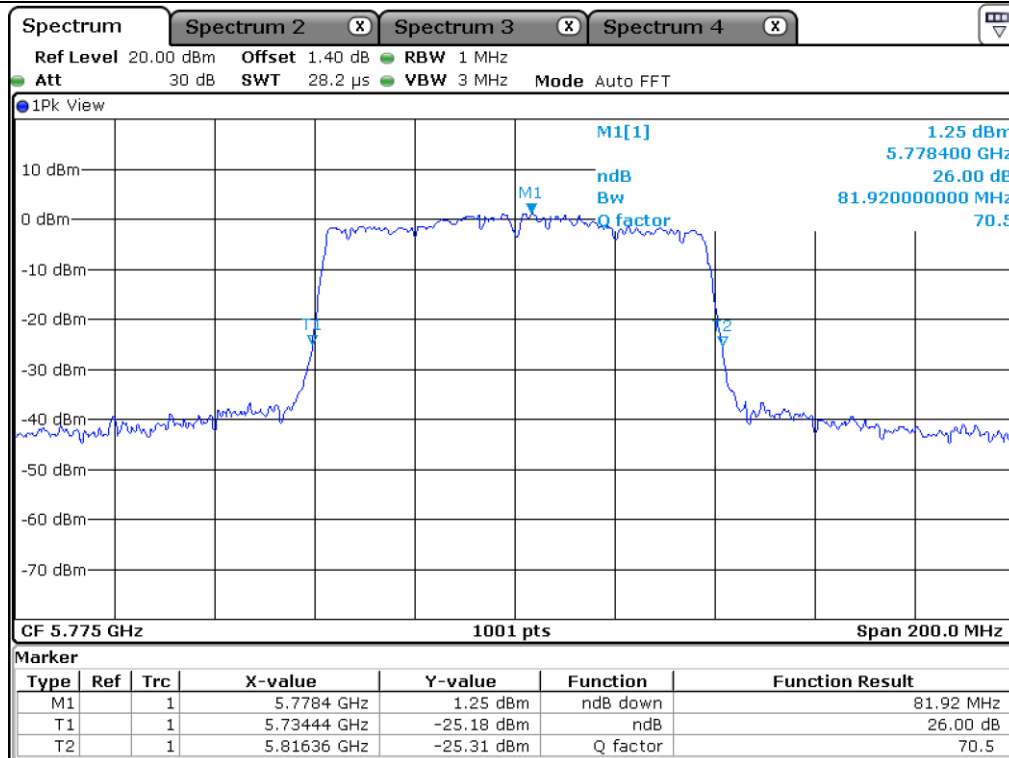
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	81.32
5 725 ~ 5 850	Middle	5 775.00	81.92

Remark: See next page for measurement data.



Middle Channel (5 210 MHz)



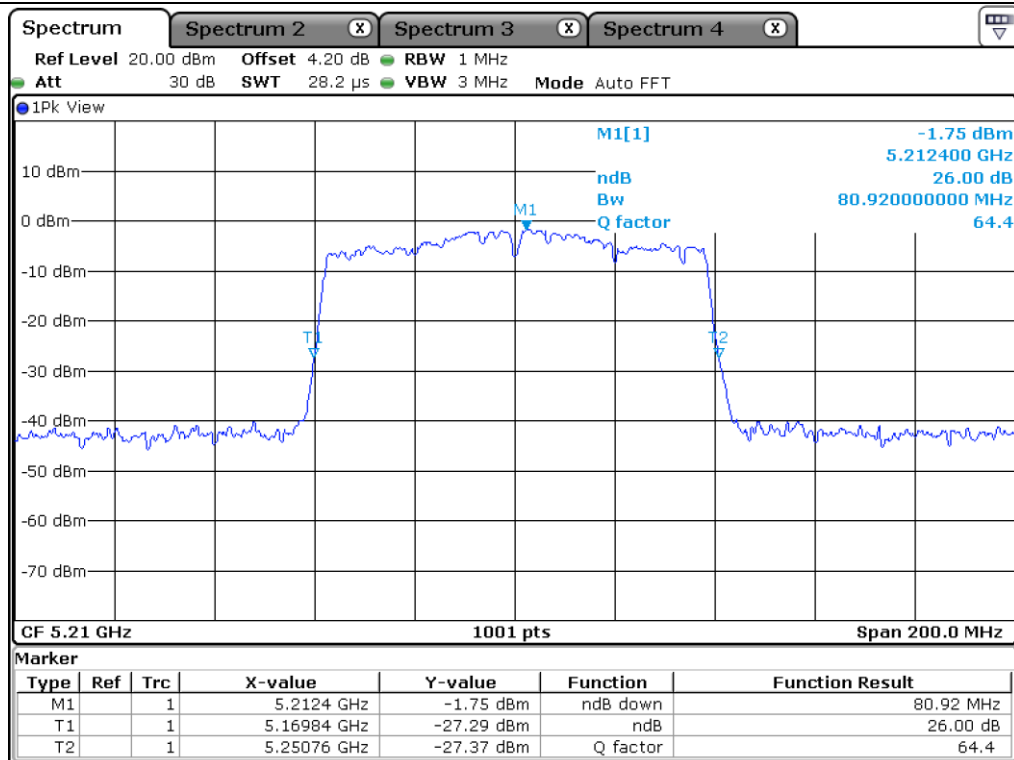
Middle Channel (5 775 MHz)

7.7.2 Test data for External Antenna

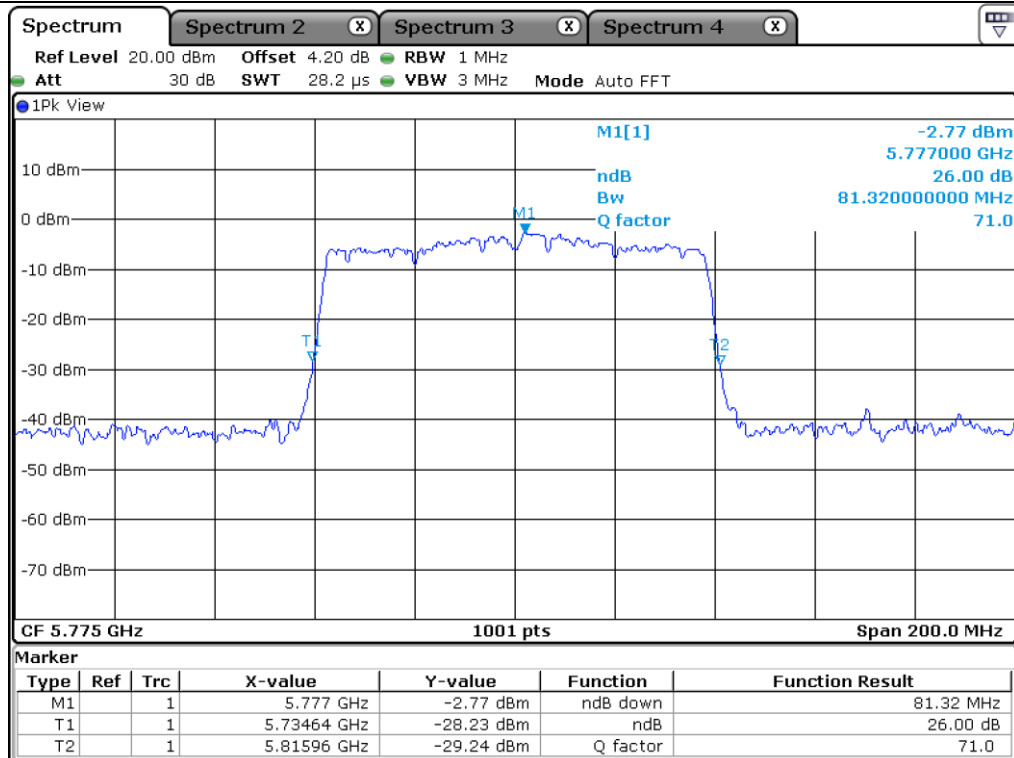
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	26 dB Bandwidth (MHz)
5 150 ~ 5 250	Middle	5 210.00	80.92
5 725 ~ 5 850	Middle	5 775.00	81.32

Remark: See next page for measurement data.



Middle Channel (5 210 MHz)



Middle Channel (5 775 MHz)

8. 6 dB BANDWIDTH

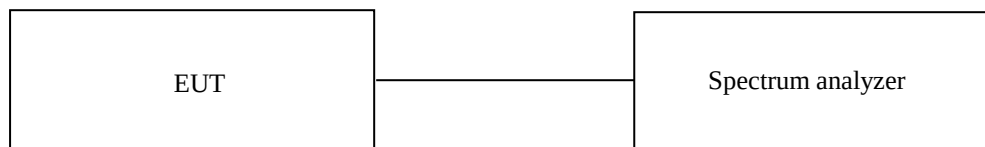
8.1 Operating environment

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 Date

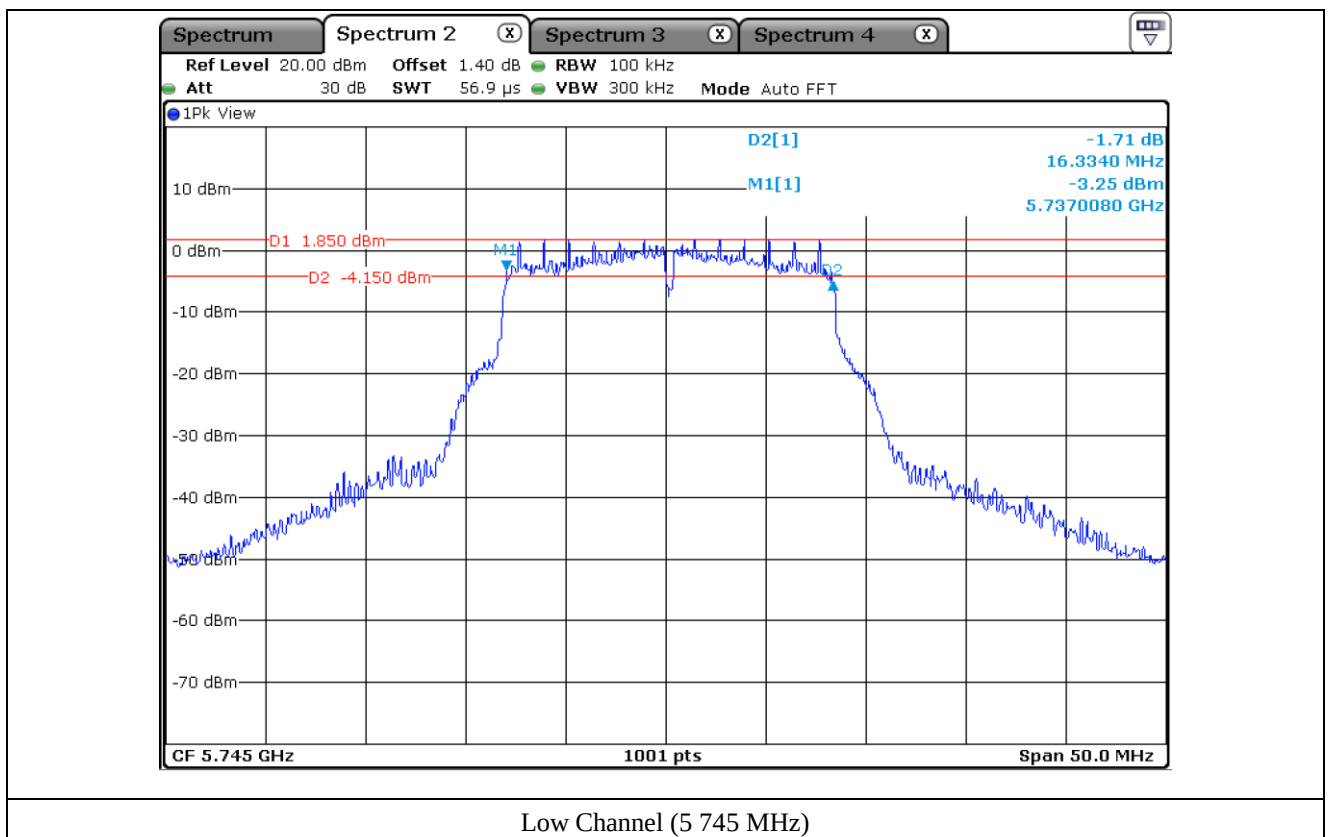
November 25, 2021 ~ January 18, 2022

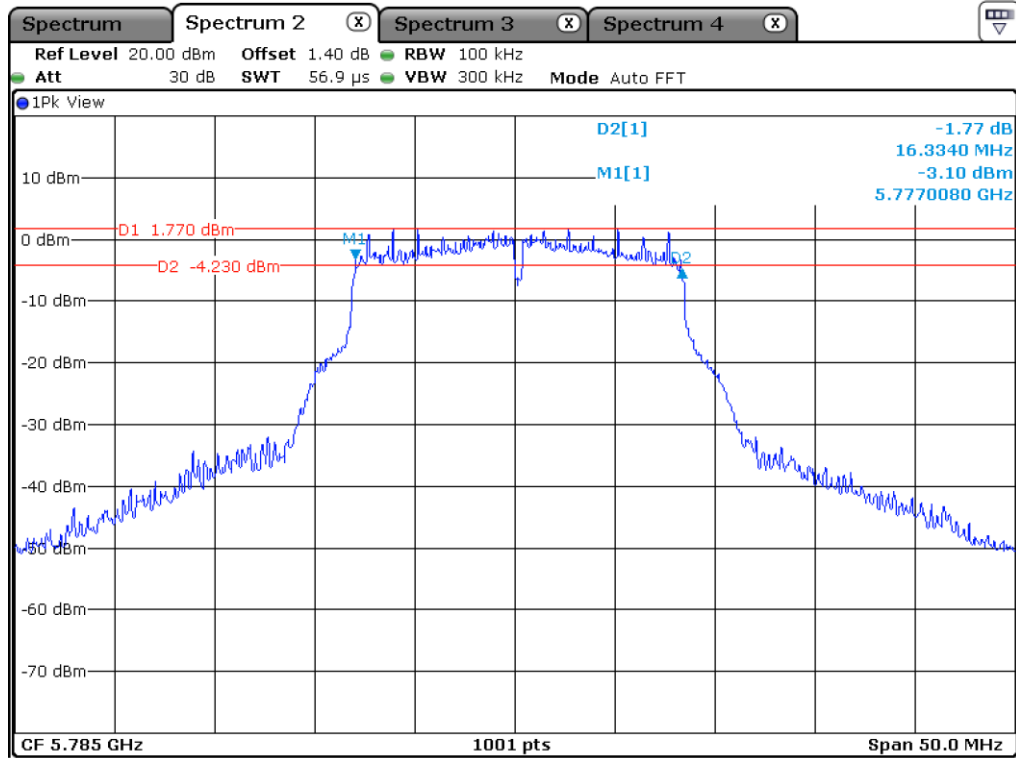
8.4 Test data for 802.11a RLAN Mode

8.4.1 Test data for Internal Antenna

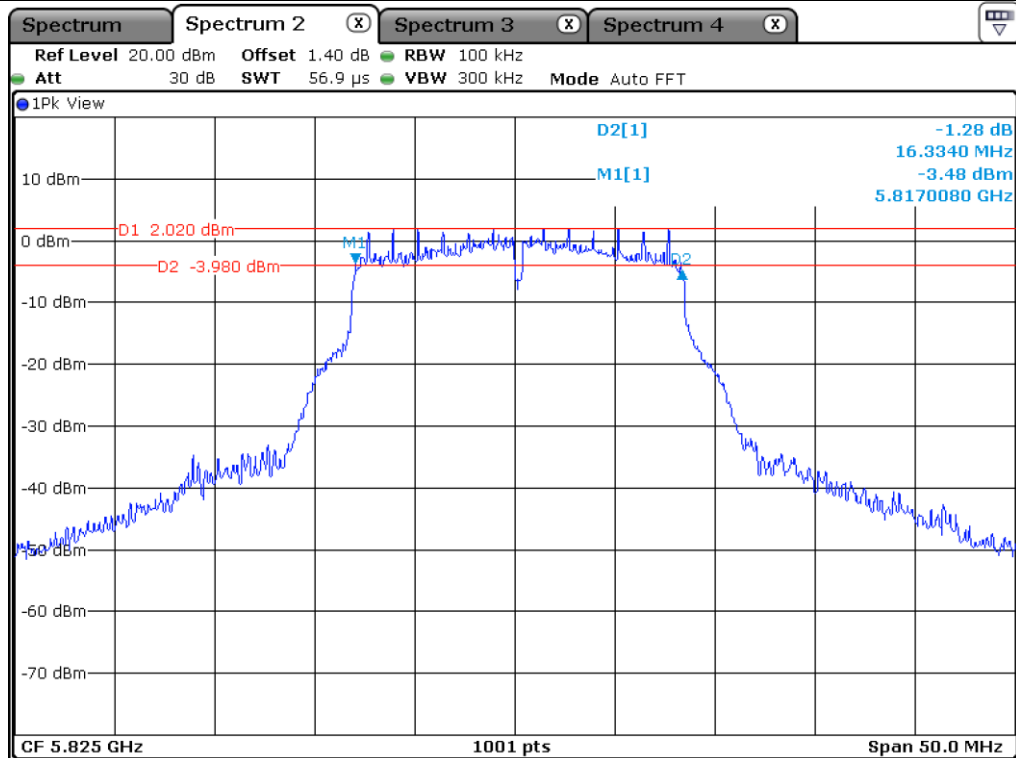
-. Test Result : Pass

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





Middle Channel (5 785 MHz)

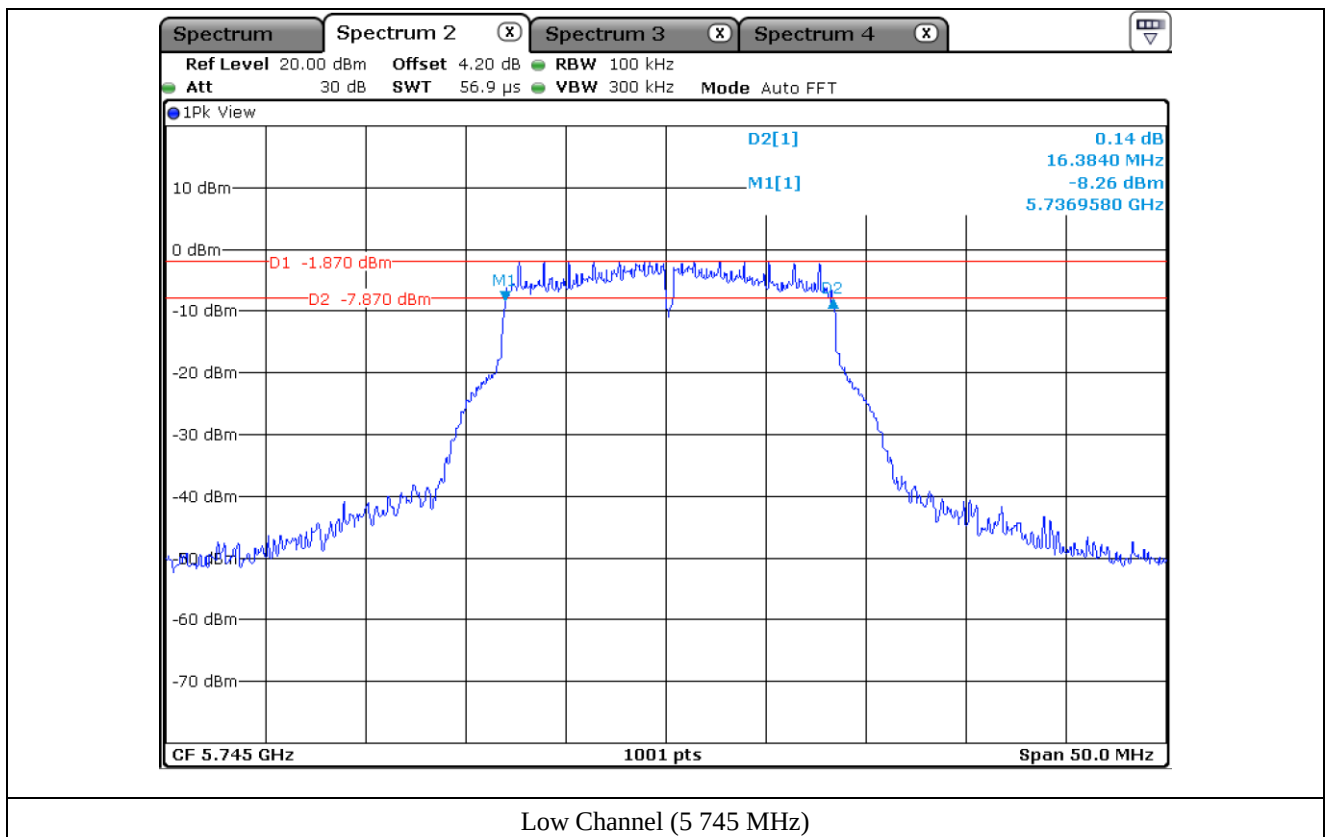


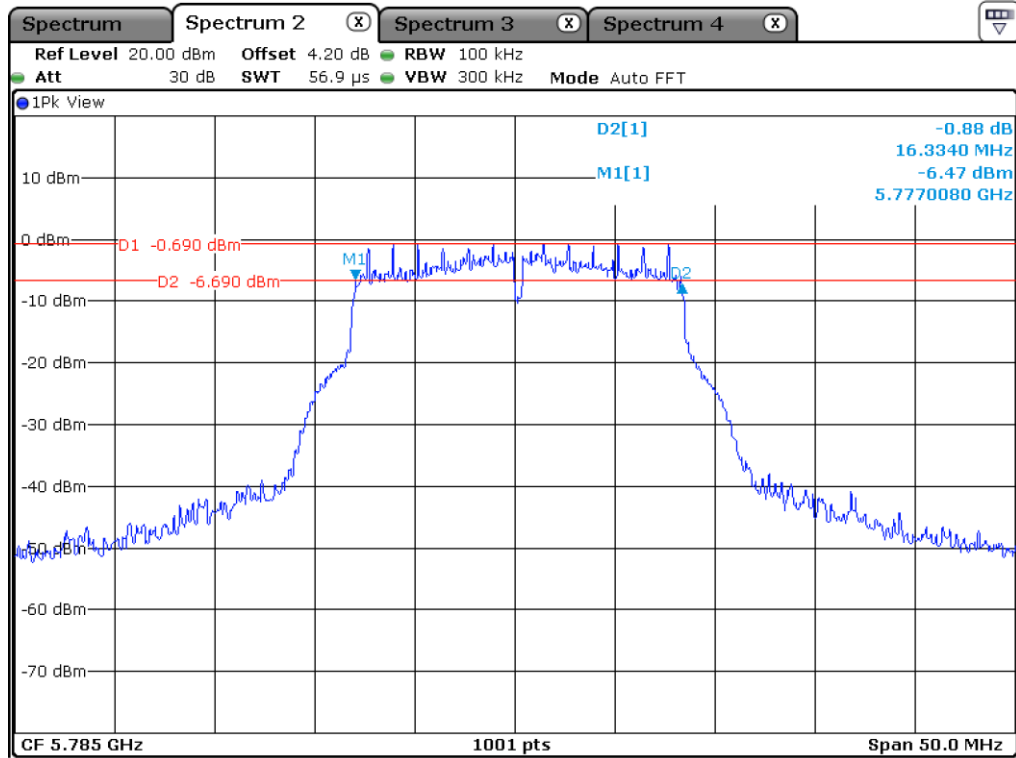
High Channel (5 825 MHz)

8.4.2 Test data for External Antenna

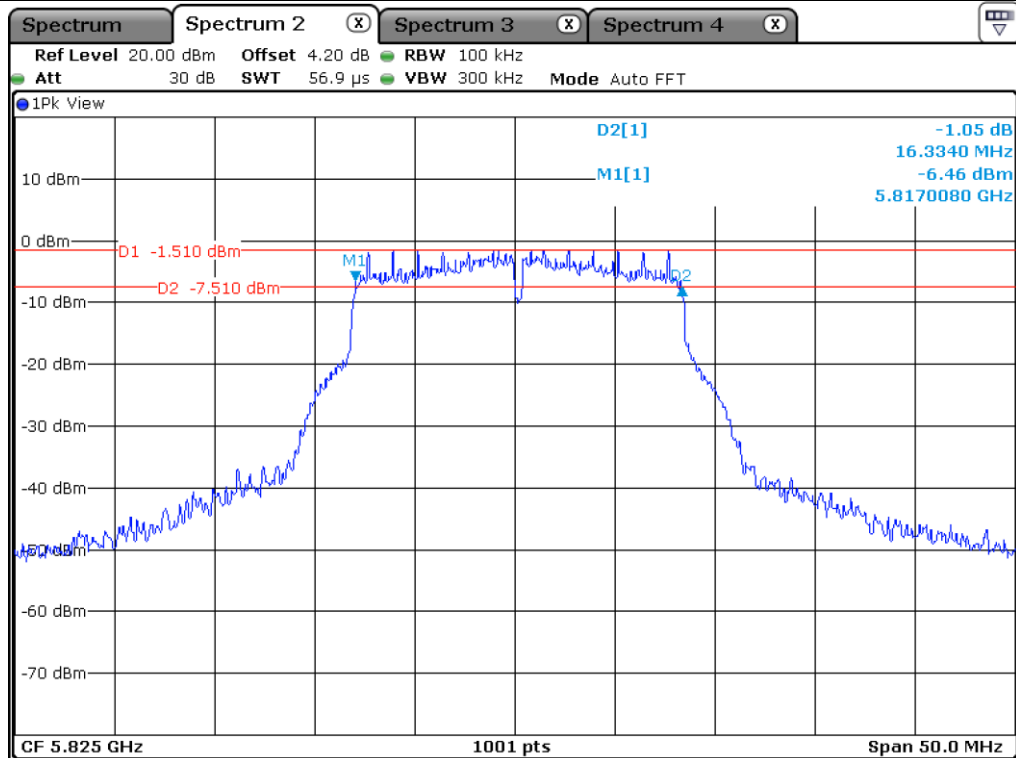
-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 745.00	16.38
	Middle	5 785.00	16.33
	High	5 825.00	16.33





Middle Channel (5 785 MHz)



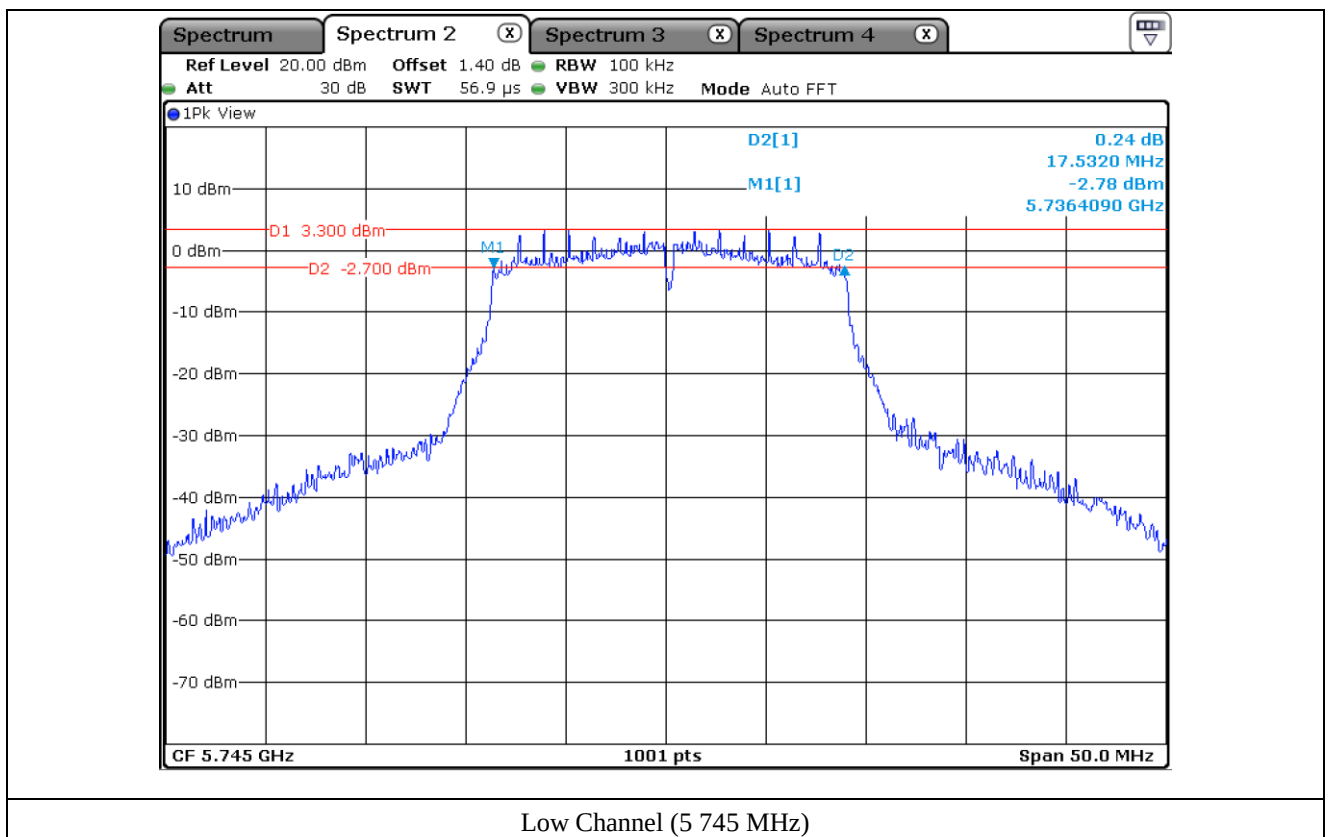
High Channel (5 825 MHz)

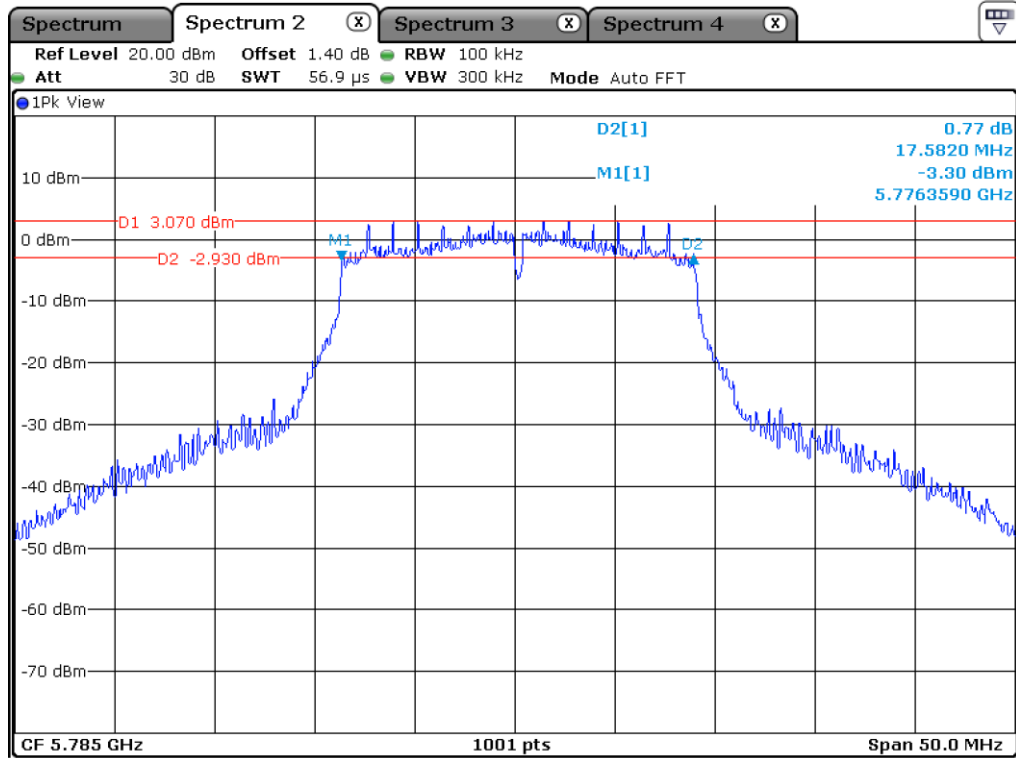
8.5 Test data for 802.11n_HT20 RLAN Mode

8.5.1 Test data for Internal Antenna

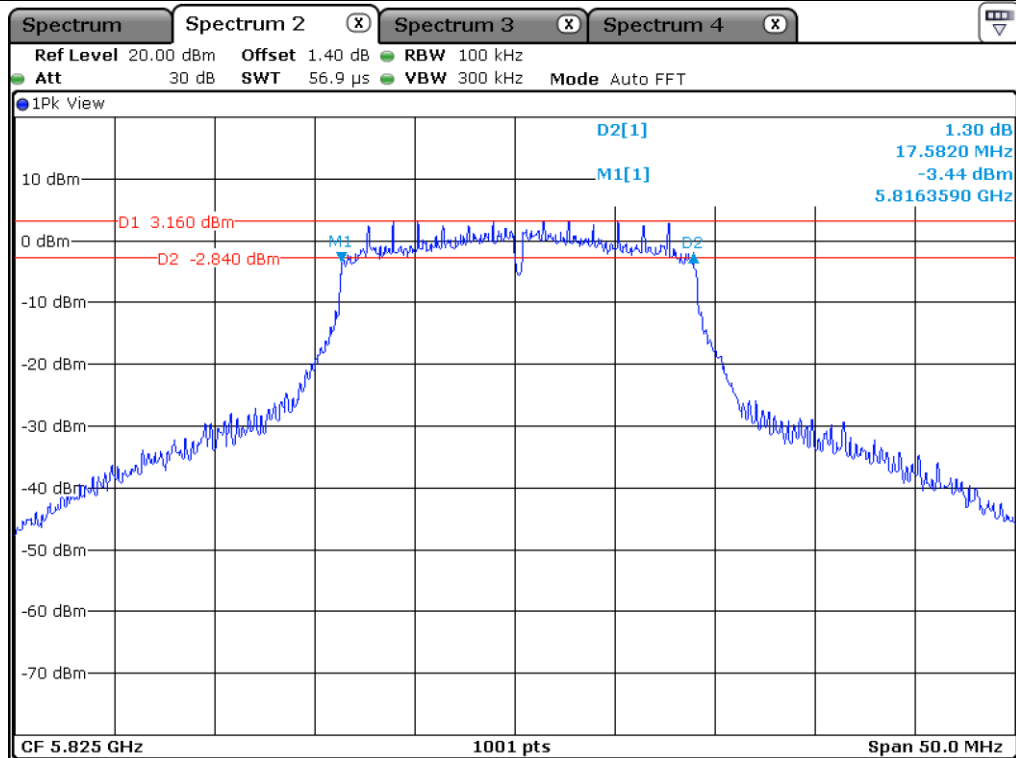
-. Test Result : Pass

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





Middle Channel (5 785 MHz)

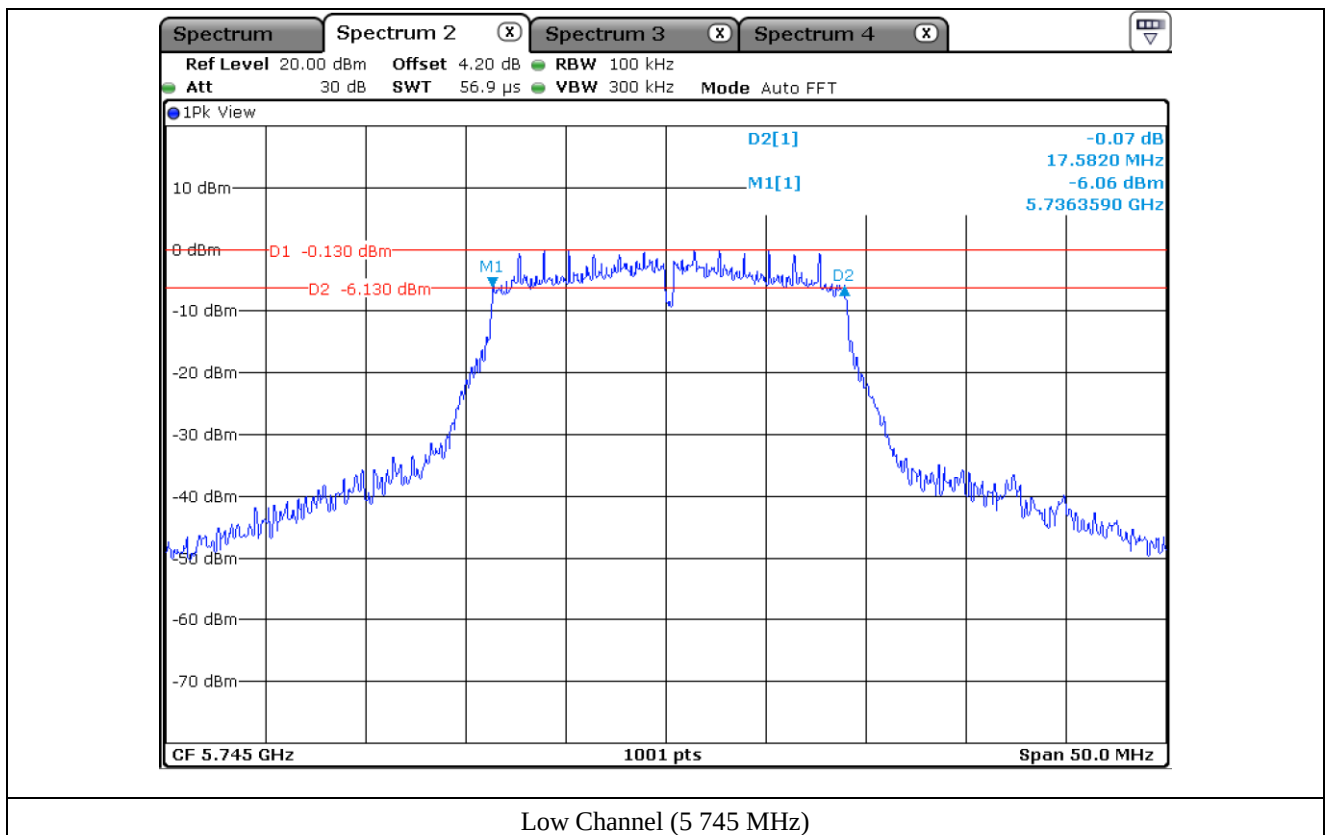


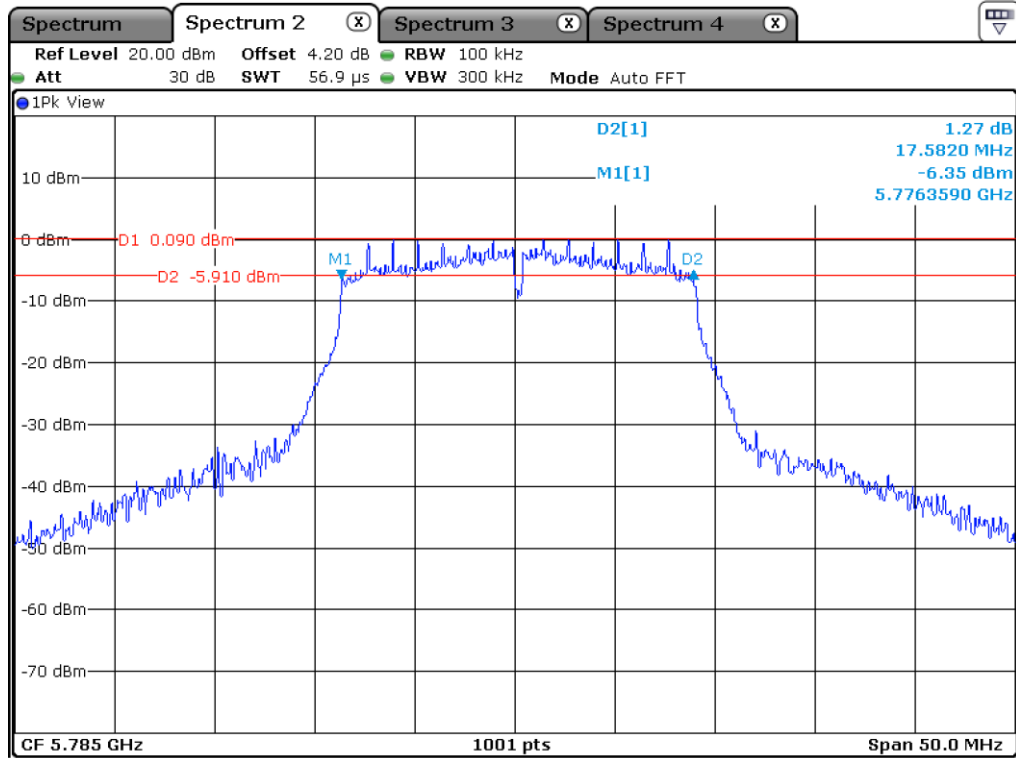
High Channel (5 825 MHz)

8.5.2 Test data for External Antenna

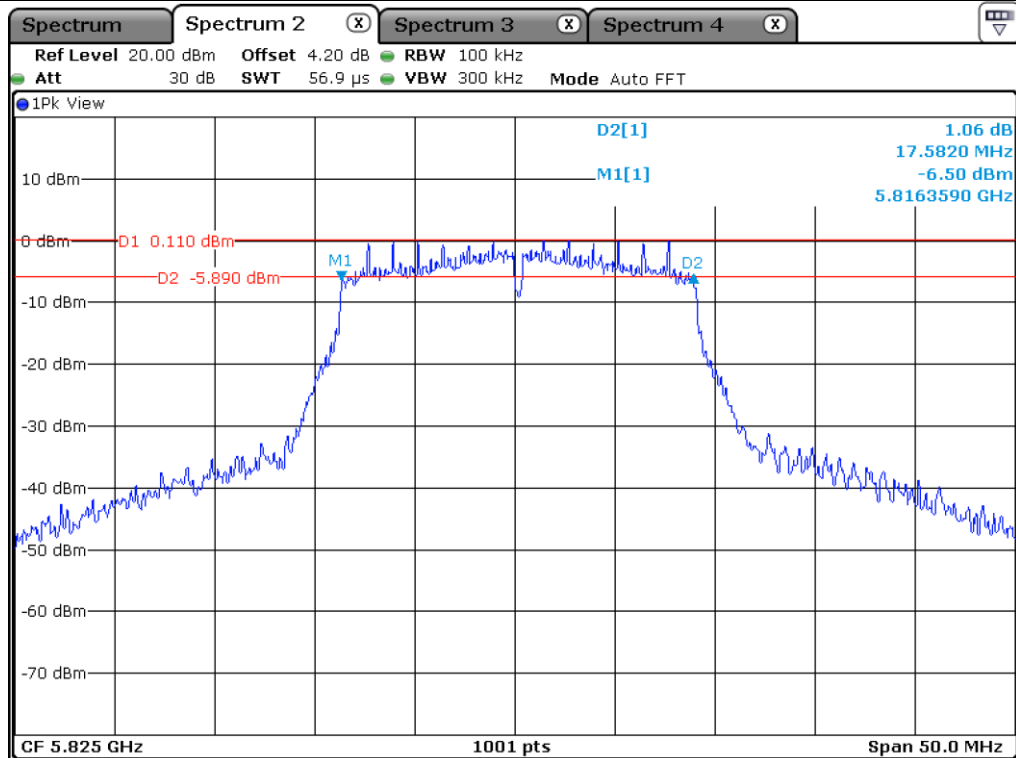
-. Test Result : Pass

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





Middle Channel (5 785 MHz)



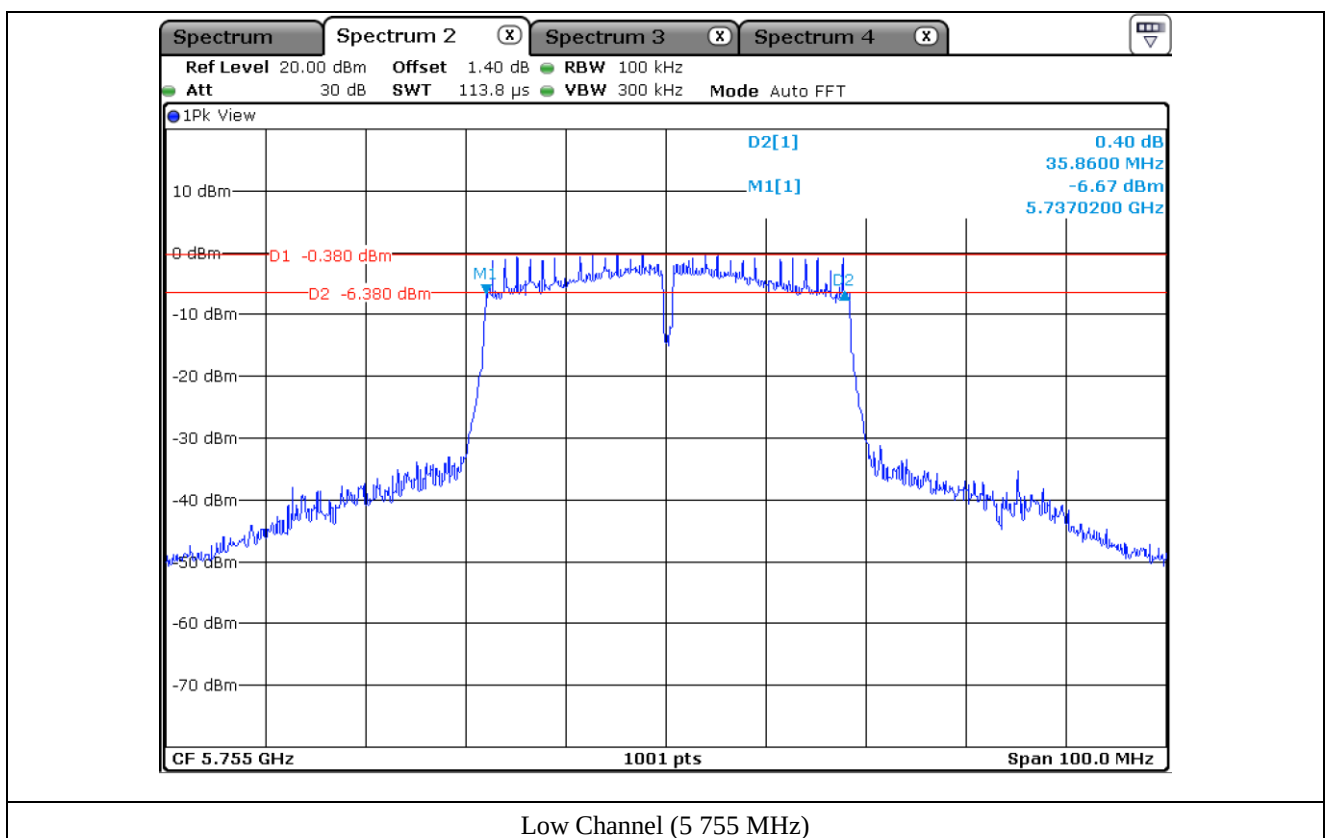
High Channel (5 825 MHz)

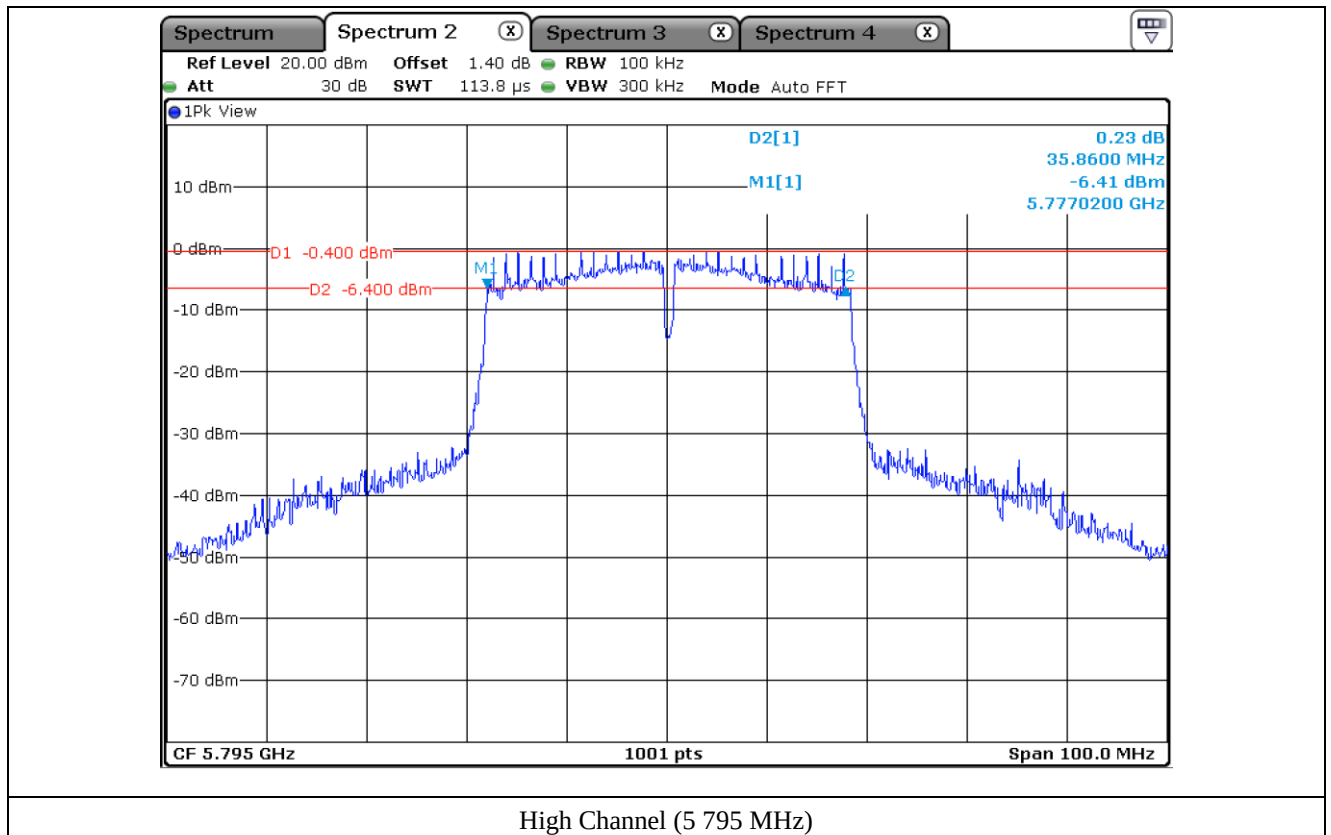
8.6 Test data for 802.11n_HT40 RLAN Mode

8.6.1 Test data for Internal Antenna

-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 755.00	35.86
	High	5 795.00	35.86

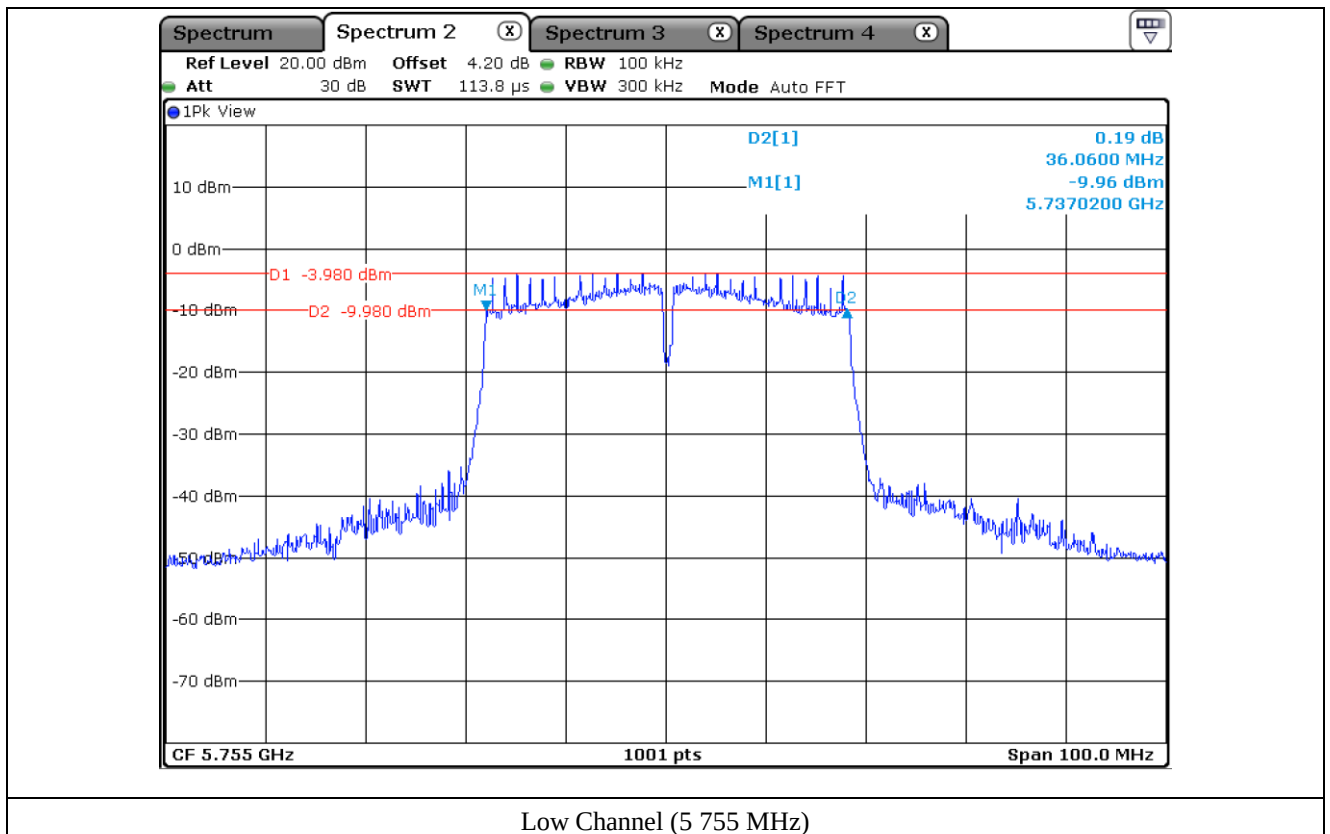


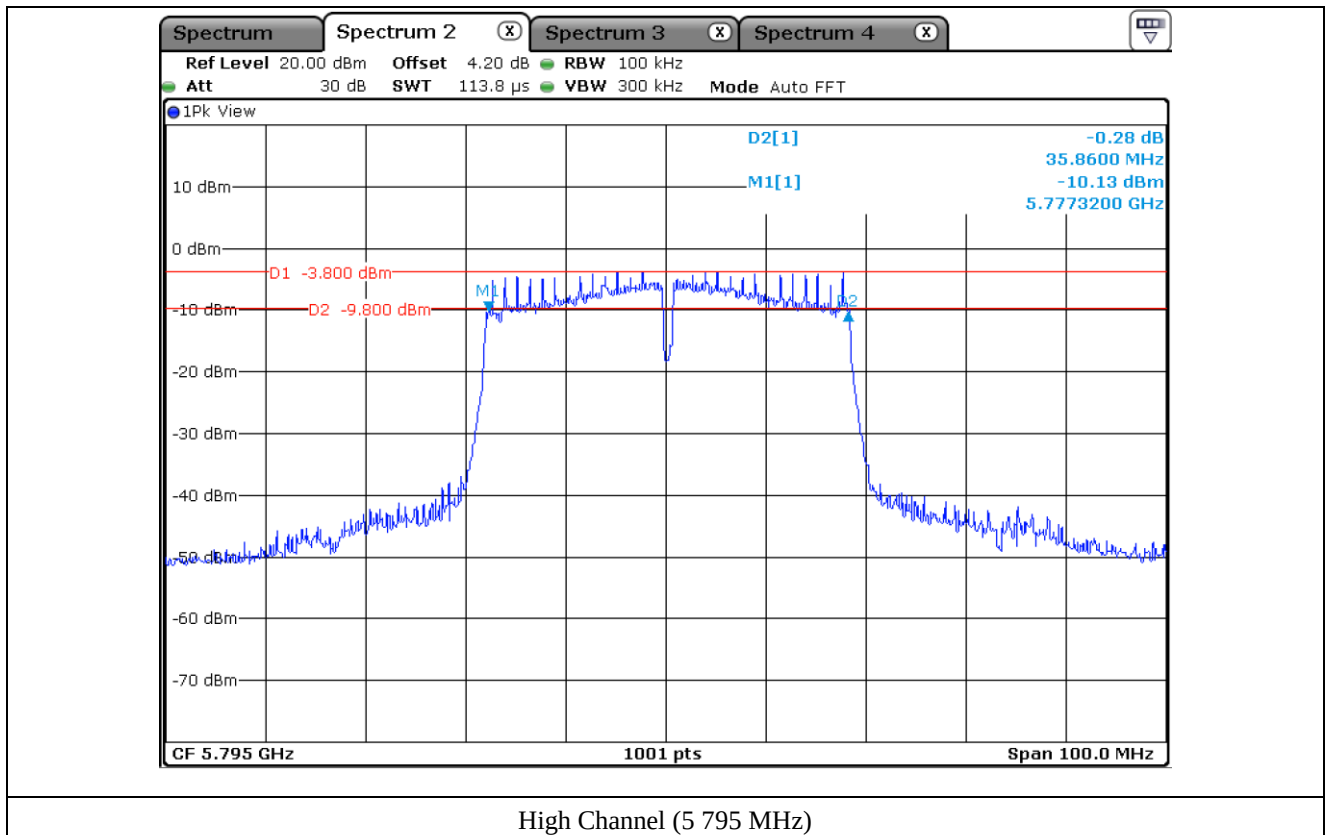


8.6.2 Test data for External Antenna

-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Low	5 755.00	36.06
	High	5 795.00	35.86



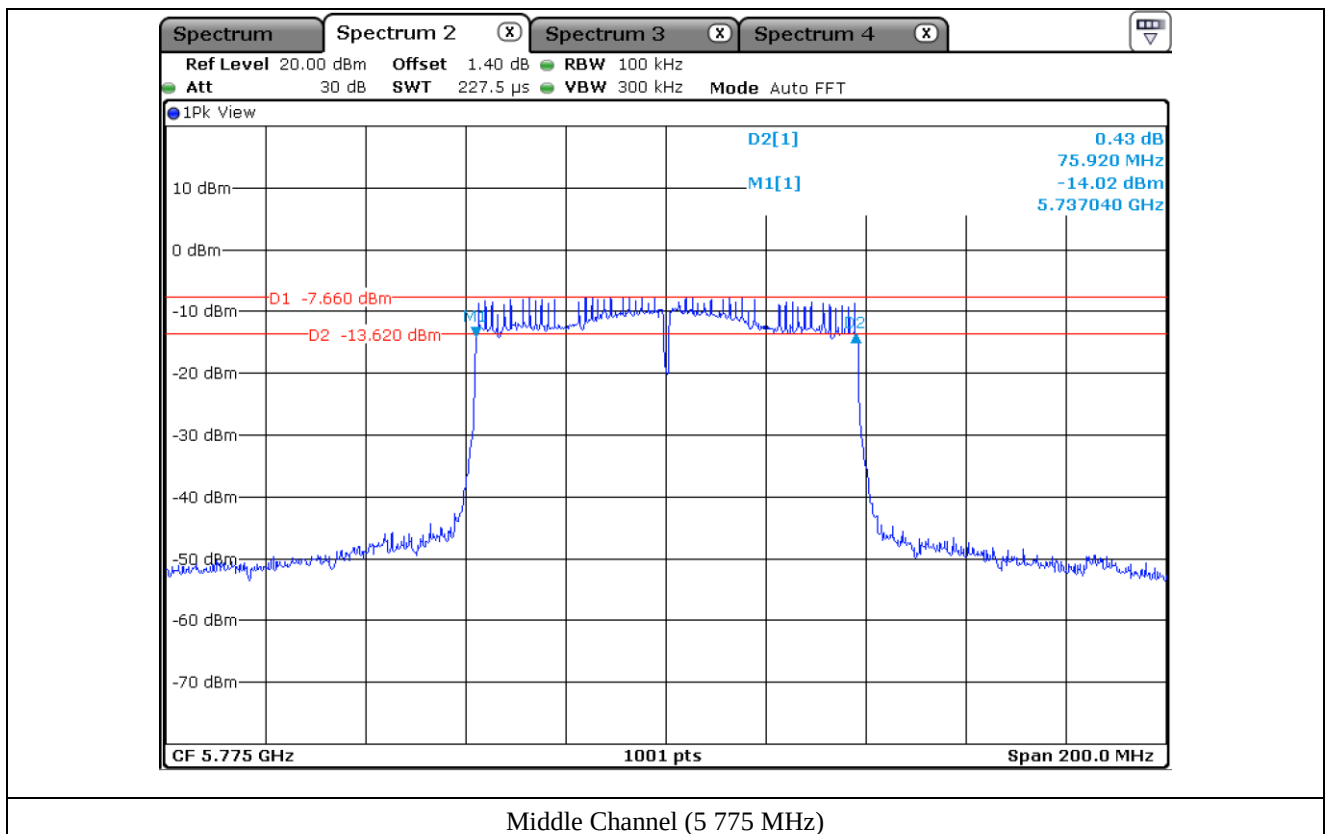


8.7 Test data for 802.11ac_VHT80 RLAN Mode

8.7.1 Test data for Internal Antenna

-. Test Result : Pass

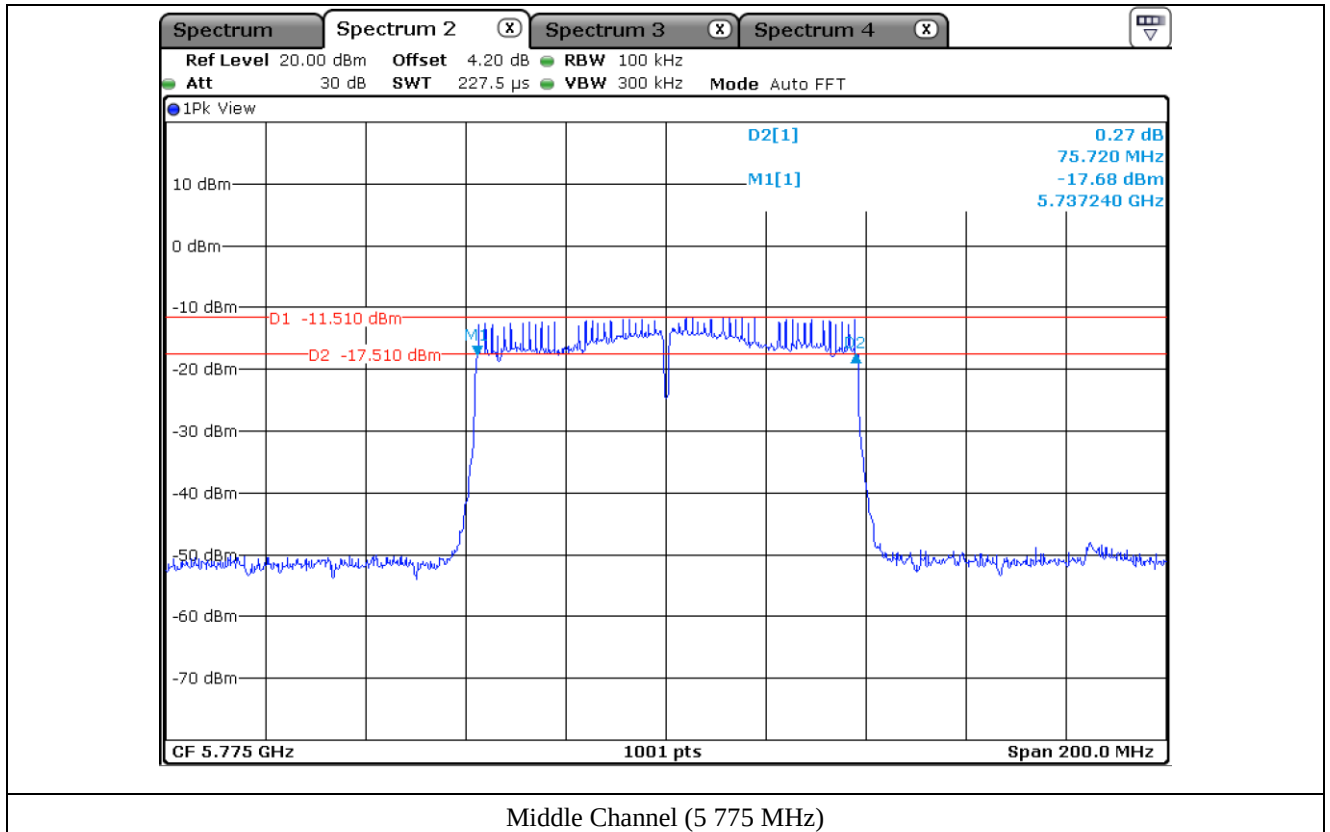
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	75.92



8.7.2 Test data for External Antenna

-. Test Result : Pass

FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)
5 725 ~ 5 850	Middle	5 775.00	75.72



9. MAXIMUM CONDUCTED OUTPUT POWER

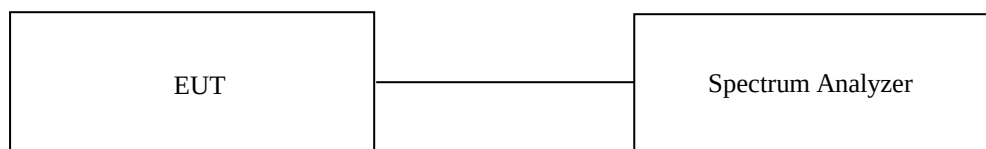
9.1 Operating environment

Temperature : 23 °C

Relative humidity : 41 % R.H.

9.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 26 dB & 6 dB bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



9.3 Test Date

November 25, 2021 ~ January 18, 2022

9.4 Test data for 802.11a RLAN Mode

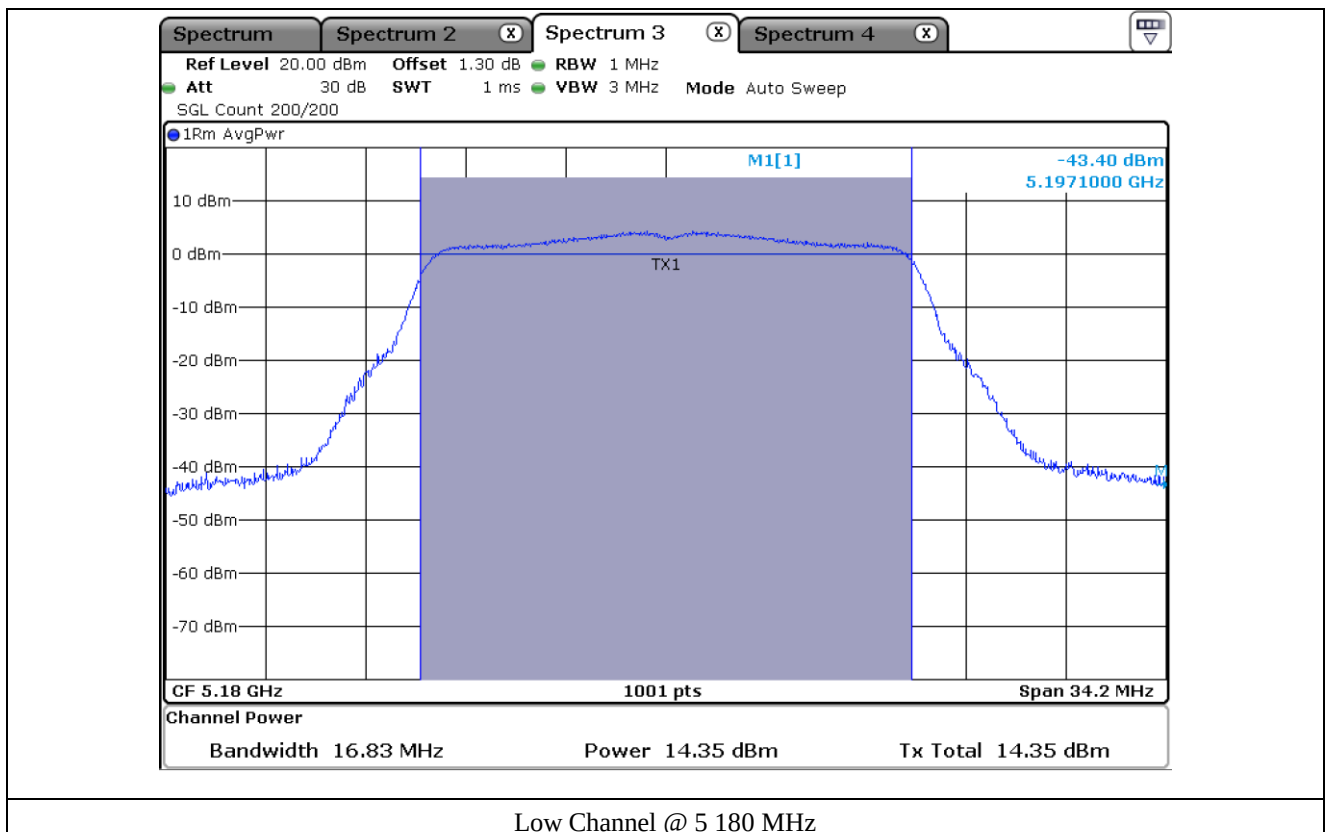
9.4.1 Test data for Internal Antenna

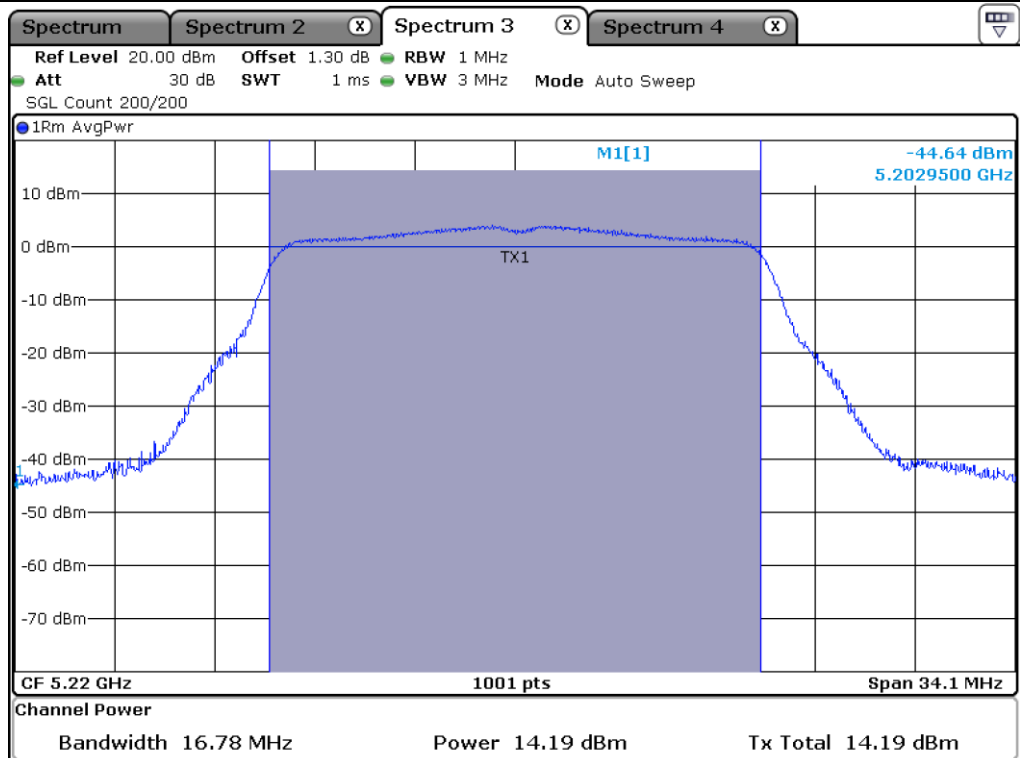
-. Test Result : Pass

-. Duty Cycle : 94.93 % (UNII 1), 94.91 % (UNII 3)

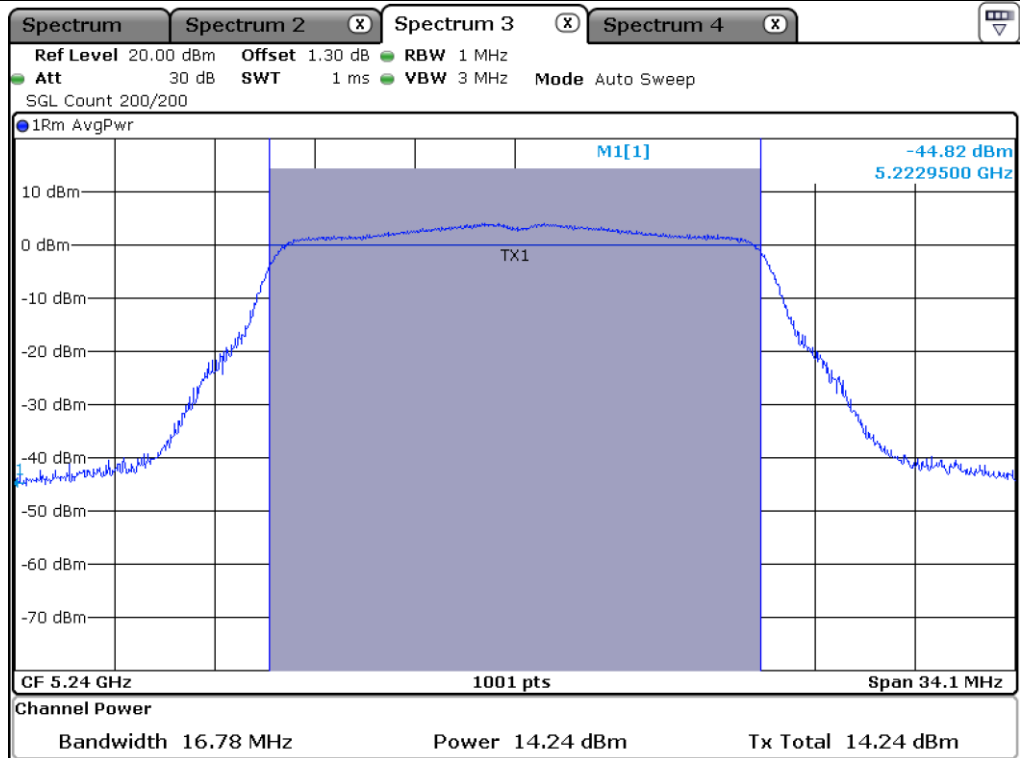
FREQUENCY RANGE (MHz)	CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	C.F. (dB)	RESULT (dBm)	LIMIT (dBm)	MARGIN (dB)
5 150 ~ 5 250	Low	5 180.00	14.35	0.23	14.58	24.00	9.42
	Middle	5 220.00	14.19	0.23	14.42	24.00	9.58
	High	5 240.00	14.24	0.23	14.47	24.00	9.53
5 725 ~ 5 850	Low	5 745.00	13.68	0.23	13.91	30.00	16.09
	Middle	5 785.00	13.58	0.23	13.81	30.00	16.19
	High	5 825.00	13.71	0.23	13.94	30.00	16.06

Remark. Margin = Limit – Result (=Measured Value + C.F.)





Middle Channel @ 5 220 MHz



High Channel @ 5 240 MHz