TEST REPORT

of

FCC Part 15 Subpart E §15.407
RSS-247 Issue 2, RSS-Gen Issue 5

FCC ID: BEJTA4HEBW
IC Certification: 2703H-TA4HEBW

Equipment Under Test	:	Car Telematics
Model Name	:	TA4HEB-W
Variant Model Name	:	TA4LEN-W
Applicant	:	LG Electronics USA
Manufacturer	:	LG Electronics USA
Date of Receipt	:	2018.08.01
Date of Test(s)	:	2018.08.02 ~ 2018.11.15
Date of Issue	:	2019.02.19

In the configuration tested, the EUT complied with the standards specified above.

Tested By: **Date:** **2019.02.19**

Nancy Park

Technical Manager: **Date:** **2019.02.19**

Harim Lee

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.

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1.2. Details of Applicant

Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 07632
Contact Person : Han, Kyung-su
Phone No. : +2 201 472 2623

1.3. Details of Manufacturer

Company : LG Electronics Inc.
Address : 10, Magokjungang 10-ro, Gangseo-gu, Seoul, Korea, 07796

1.4. Description of EUT

Kind of Product	Car Telematics
Model Name	TA4HEB-W
Variant Model Name	TA4LEN-W
Power Supply	DC 12 V
Frequency Range	2 412 ㎒ ~ 2 462 ㎒ (11b/g/n_HT20), 2 422 ㎒ ~ 2 452 ㎒ (11n_HT40), 5 180 ㎒ ~ 5 240 ㎒ (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 ㎒ ~ 5 230 ㎒ (Band 1: 11n_HT40, 11ac_VHT40), 5 210 ㎒ (Band 1: 11ac_VHT80), 5 745 ㎒ ~ 5 825 ㎒ (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 ㎒ ~ 5 795 ㎒ (Band 3: 11n_HT40, 11ac_VHT40), 5 775 ㎒ (Band 3: 11ac_VHT80)
Modulation Technique	DSSS, OFDM
Number of Channels	11 channel (11b/g/n_HT20), 7 channel (11n_HT40), 4 channel (Band 1: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 1: 11n_HT40, 11ac_VHT40), 1 channel (Band 1: 11ac_VHT80), 5 channel (Band 3: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 3: 11n_HT40, 11ac_VHT40), 1 channel (Band 3: 11ac_VHT80)
Antenna Type	External antenna
Antenna Gain	2 400 ㎒ ~ 2 483.5 ㎒: 0.94 ㏈i, 5 150 ㎒ ~ 5 350 ㎒: 5.71 ㏈i, 5 725 ㎒ ~ 5 875 ㎒: 3.82 ㏈i

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	Agilent	E8257D	MY51501169	Jul. 03, 2018	Annual	Jul. 03, 2019
Signal Generator	R&S	SMBV100A	255834	Jun. 15, 2018	Annual	Jun. 15, 2019
Spectrum Analyzer	R&S	FSV30	100955	Mar. 12, 2018	Annual	Mar. 12, 2019
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 21, 2018	Annual	Sep. 21, 2019
Spectrum Analyzer	Agilent	N9030A	US51350132	Sep. 21, 2018	Annual	Sep. 21, 2019
Power Meter	Anritsu	ML2495A	1223004	Jun. 12, 2018	Annual	Jun. 12, 2019
Power Sensor	Anritsu	MA2411B	1207272	Jun. 12, 2018	Annual	Jun. 12, 2019
Attenuator	MCLI	FAS-23-20	23834	Jun. 12, 2018	Annual	Jun. 12, 2019
Coaxial Fixed Attenuator	Agilent	8491A-006	MY39264893	Jan. 15, 2018	Annual	Jan. 15, 2019
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-2	Feb. 22, 2018	Annual	Feb. 22, 2019
High Pass Filter	Wainwright Instrument GmbH	WHKX6.0/18G-10SS	51	Jun. 11, 2018	Annual	Jun. 11, 2019
High Pass Filter	Wainwright Instrument GmbH	WHNX7.5/26.5G-6SS	11	May 27, 2018	Annual	May 27, 2019
DC Power Supply	Agilent	U8002A	MY50060028	Mar. 15, 2018	Annual	Mar. 15, 2019
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2018	Annual	Aug. 07, 2019
Preamplifier	R&S	SCU-18	10117	Aug. 07, 2018	Annual	Aug. 07, 2019
Preamplifier	MITEQ Inc.	JS44-18004000-35-8P	1546891	May 13, 2018	Annual	May 13, 2019
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-039	Aug. 23, 2017	Biennial	Aug. 23, 2019
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB 9163	01126	Mar. 26, 2018	Biennial	Mar. 26, 2020
Horn Antenna	R&S	HF906	100326	Feb. 14, 2018	Biennial	Feb. 14, 2020
Horn Antenna	Schwarzbeck Mess-Elektronik	BBHA 9170	BBHA9170431	Sep. 10, 2018	Biennial	Sep. 10, 2020
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/383 30516/L	N.C.R.	N/A	N.C.R.
Antenna Mast	Innco systems GmbH	MA4640-XP-ET	MA4640/536/383 30516/L	N.C.R.	N/A	N.C.R.
Test Receiver	R&S	ESU26	100109	Feb. 07, 2018	Annual	Feb. 07, 2019
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Coaxial Cable	SUCOFLEX	104 (3 m)	MY3258414	Jul. 04, 2018	Semi-annual	Jan. 04, 2019
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jul. 04, 2018	Semi-annual	Jan. 04, 2019
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 01/20	Sep. 04, 2018	Semi-annual	Mar. 04, 2019

1.6. Automatically Discontinue Transmission

1.6.1. Limit of Automatically Discontinue Transmission

The device shall automatically discontinue transmission in case of either absence of information to transmit or operating failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization to describe how this requirement is met.

1.6.2. Test Result of Automatically Discontinue Transmission

While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ACK message transmitting form remote device and verify whether it shall resend or discontinue transmission.

1.7. Information of Variant Model

Model Name	Description
TA4HEB-W	Basic Model
TA4LEN-W	Variant model is the same RF module and circuit, except the as below part and function. - De-populated to Audio amp, DSP part - De-populated to BUB(Backup battery) part

1.8. Summary of Test Result

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart E, RSS-247 Issue 2, RSS-Gen Issue 5			
Section		**Test Item(s)**	**Result**
15.205(a) 15.209(a) 15.407(b)(1) 15.407(b)(2) 15.407(b)(3) 15.407(b)(4)	RSS-Gen Issue 5 8.9 RSS-247 Issue 2 6.2.1.2 RSS-247 Issue 2 6.2.2.2 RSS-247 Issue 2 6.2.3.2 RSS-247 Issue 2 6.2.4.2	Transmitter radiated spurious emissions	Complied
15.407(a)	RSS-Gen Issue 5 6.7	26 ㏈ Bandwidth & 99 % Bandwidth	Complied
15.407(e)	RSS-247 Issue 2 6.2.4.1	6 ㏈ Bandwidth	Complied
15.407(a)(1) 15.407(a)(2) 15.407(a)(3)	RSS-247 Issue 2 6.2.1.1 RSS-247 Issue 2 6.2.2.1 RSS-247 Issue 2 6.2.3.1 RSS-247 Issue 2 6.2.4.1	Maximum Conducted Output Power	Complied
15.407(a)(1) 15.407(a)(2) 15.407(a)(3)	RSS-247 Issue 2 6.2.1.1 RSS-247 Issue 2 6.2.2.1 RSS-247 Issue 2 6.2.3.1 RSS-247 Issue 2 6.2.4.1	Peak Power Spectral Density	Complied

1.9. Test Procedure(s)

The measurement procedures described in the American National Standard of Procedures for Compliance Testing of unlicensed Wireless Devices (ANSI C63.10-2013) and the guidance provided in KDB789033 D02 v02r01 were used in the measurement of the DUT.

1.10. Sample Calculation

Where relevant, the following sample calculation is provided:

1.10.1. Conducted Test

Offset value (㏈) = Attenuator (㏈) + Cable loss (㏈)

1.10.2. Radiation Test

Field strength level (㏈㎶/㎧) = Measured level (㏈㎶) + Antenna factor (㏈) + Cable loss (㏈) - Amplifier gain (㏈)

1.11. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Parameter	Uncertainty (㏈)
Radiated Disturbance, 9 ㎑ to 30 ㎒	±3.59
Radiated Disturbance, below 1 ㎓	±5.88
Radiated Disturbance, above 1 ㎓	±5.94

Uncertainty figures are valid to a confidence level of 95 %.

1.12. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL013184	2018.11.29	Initial
1	F690501/RF-RTL013184-1	2019.02.19	Added 802.11n_HT40 in the 2.4 GHz band information at Description of EUT

1.13. Duty Cycle of EUT

Regarding to KDB789033 D02 v02r01, B, the maximum duty cycles of all modes were investigated and set the spectrum analyzer as below.
Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value, Set VBW ≥ RBW.
Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100.

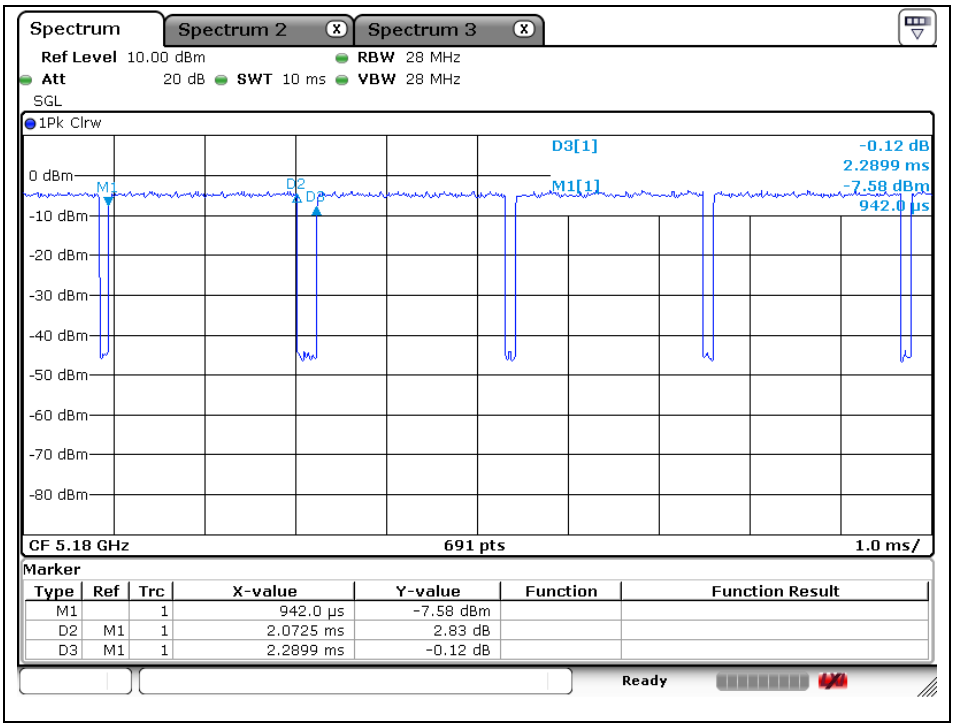
Mode	Data Rate (Mbps)	Mode	Data Rate (Mbps)	Mode	Data Rate (Mbps)	Mode	Data Rate (Mbps)
11a	**6**	**11n_HT20**	**MCS0**	**11n_HT40**	**MCS0**	**11ac_VHT80**	**MCS0**
Duty Cycle (%)	91	Duty Cycle (%)	89	Duty Cycle (%)	85	Duty Cycle (%)	72
Correction factor (dB)	0.41	Correction factor (dB)	0.51	Correction factor (dB)	0.71	Correction factor (dB)	1.42

Remark;

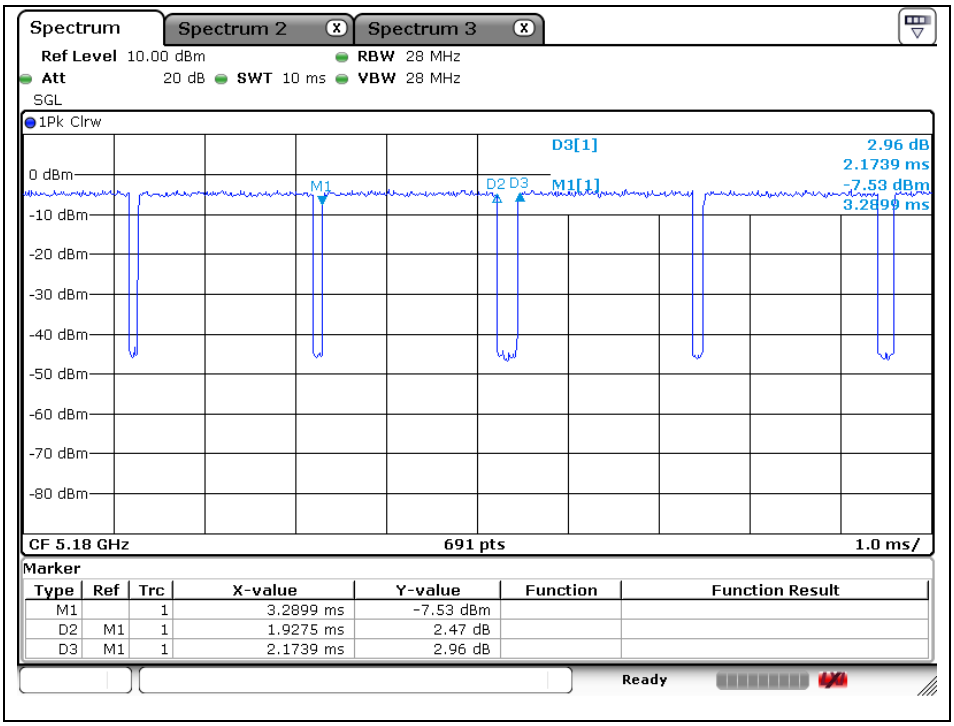
1. As measured duty cycles of EUT, all of mode and data rate keep constant period and are converted to log scale (power averaging) to compensate correction factor to result of average test items.
2. Duty cycle (%) = (Tx on time / Tx on + off time) x 100
3. Correction factor (dB) = 10 log (1 / Duty cycle)

- Test plots

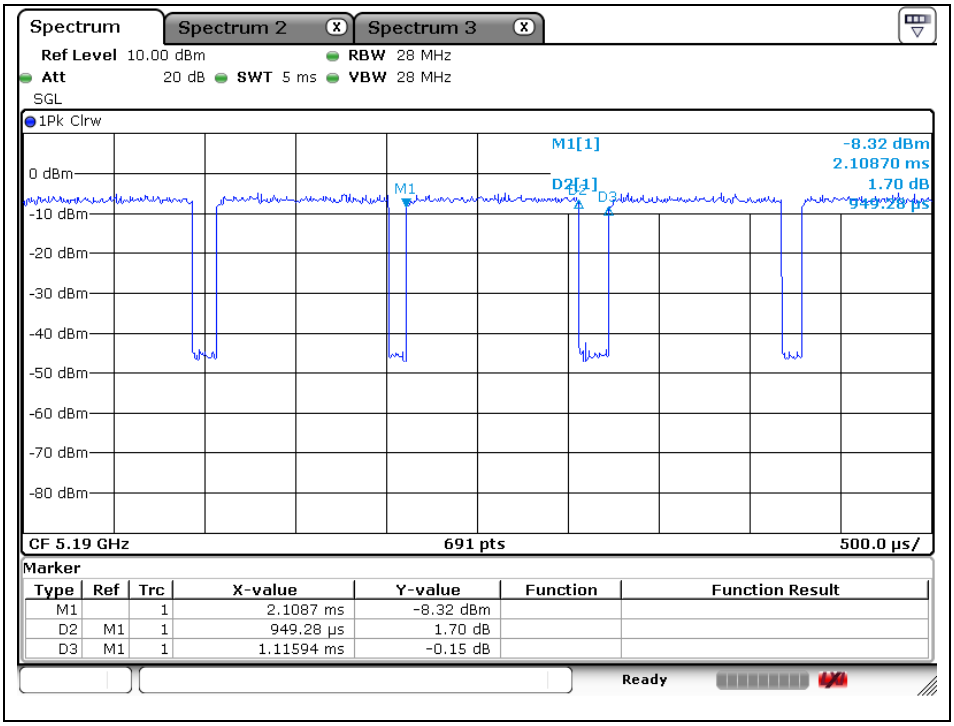
802.11a



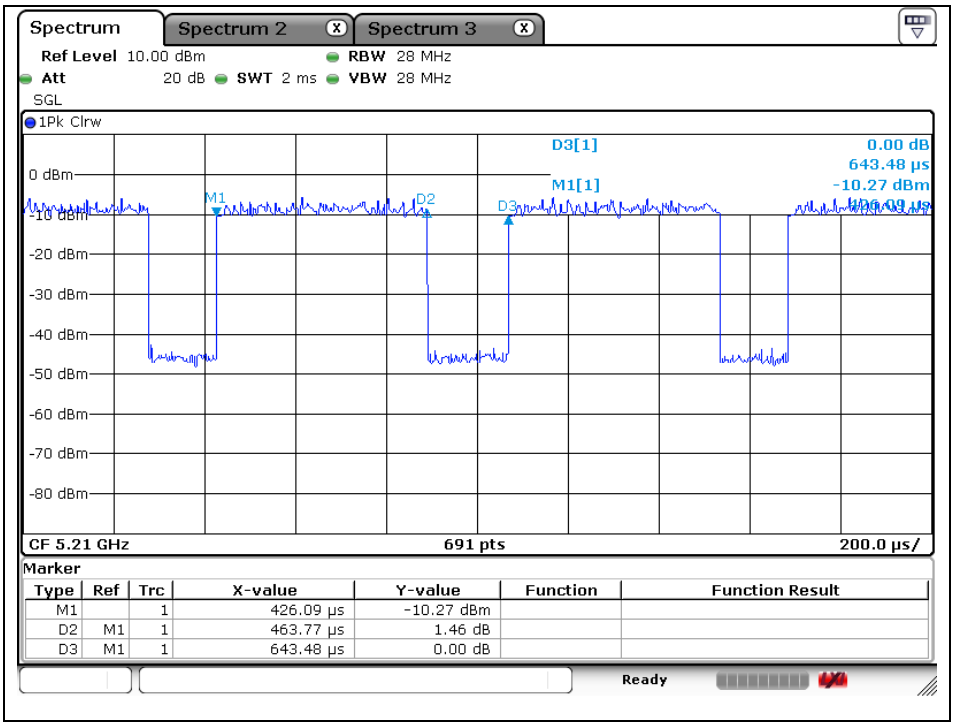
802.11n_HT20



802.11n_HT40



802.11ac_VHT80

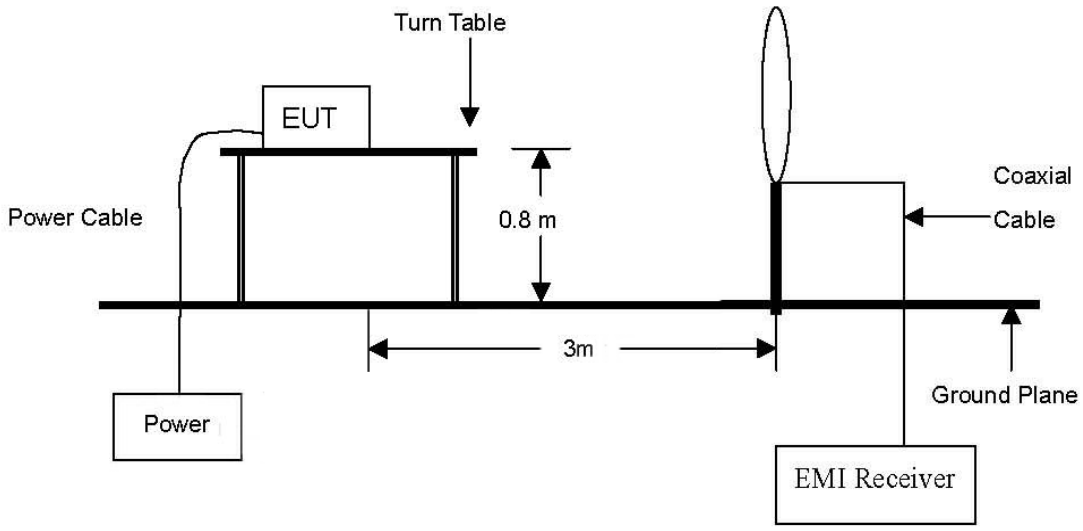


2. Transmitter Radiated Spurious Emissions

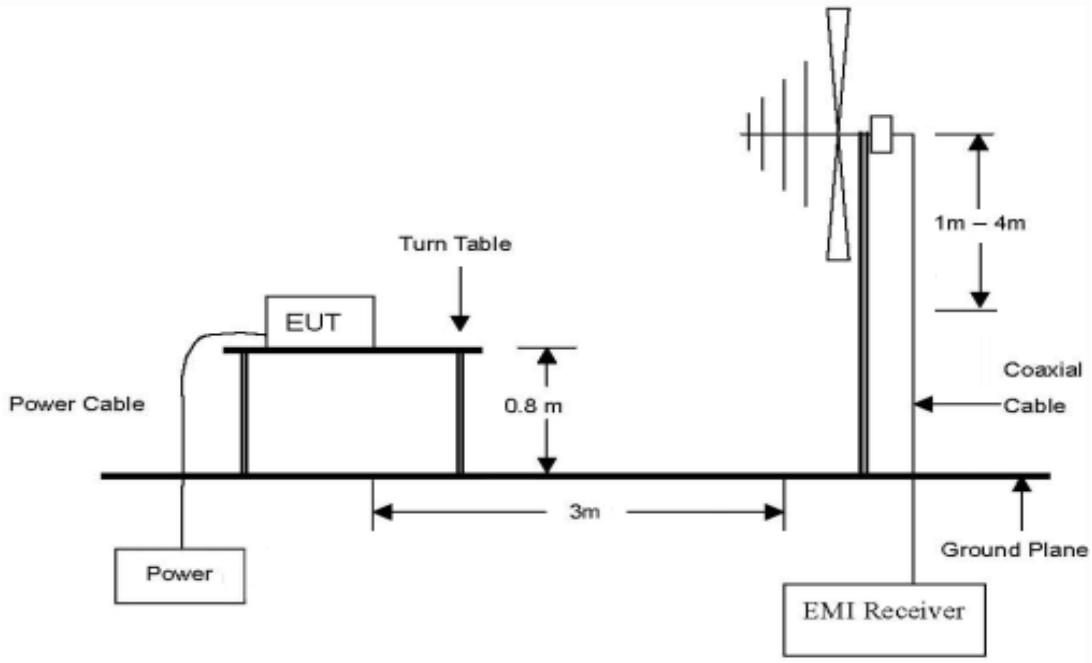
2.1. Test Setup

2.1.1. Transmitter radiated spurious emissions

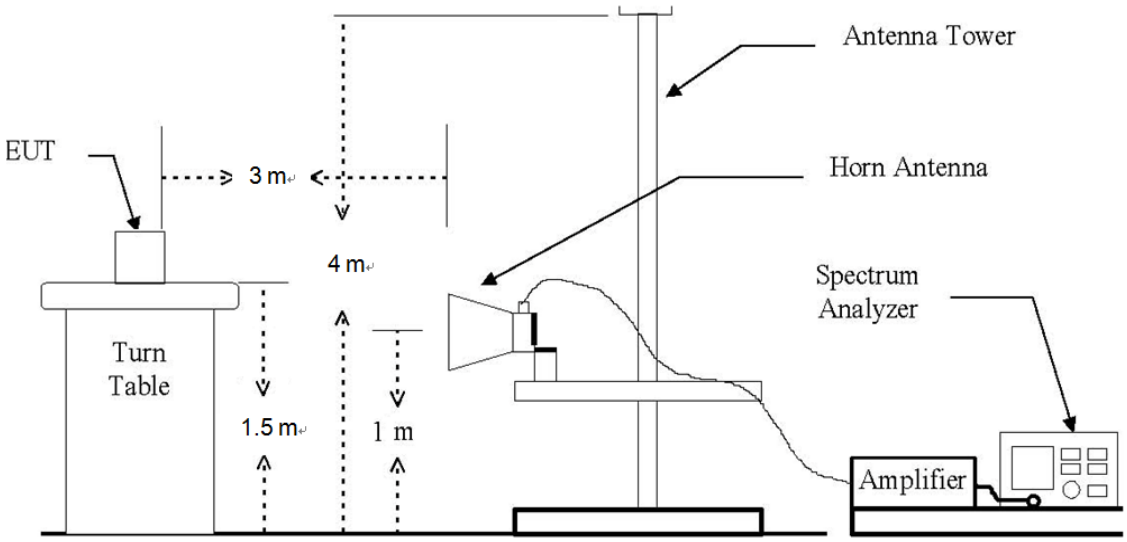
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

2.2.1. FCC

According to § 15.407(b)

(1) For transmitters operating in the 5.15-5.25 ㎓ band: All emissions outside of the 5.15-5.35 ㎓ band shall not exceed an e.i.r.p. of -27 ㏈m/㎒.

(4) For transmitters operating in the 5.725-5.85 ㎓ band:

(i) All emissions shall be limited to a level of -27 ㏈m/㎒ at 75 ㎒ or more above or below the band edge increasing linearly to 10 ㏈m/㎒ at 25 ㎒ above or below the band edge, and from 25 ㎒ above or below the band edge increasing linearly to a level of 15.6 ㏈m/㎒ at 5 ㎒ above or below the band edge, and from 5 ㎒ above or below the band edge increasing linearly to a level of 27 ㏈m/㎒ at the band edge.

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (㎒)	Field Strength (㎛V/m)	Measurement Distance (Meters)
0.009-0.490	2 400/F(㎑)	300
0.490-1.705	24 000/F(㎑)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

2.2.2. IC

According to RSS-247 issue2,

6.2.1.2 Frequency band 5 150-5 250 ㎒

For transmitters with operating frequencies in the band 5 150-5 250 ㎒, all emissions outside the band 5 150-5 350 ㎒ shall not exceed -27 ㏈m/㎒ e.i.r.p. Any unwanted emissions that fall into the band 5 250-5 350 ㎒ shall be attenuated below the channel power by at least 26 ㏈, when measured using a resolution bandwidth between 1 and 5 % of the occupied bandwidth (i.e. 99% bandwidth), above 5 250 ㎒. The 26 ㏈ bandwidth may fall into the 5 250-5 350 ㎒ band; however, if the occupied bandwidth also falls within the 5 250- 5350 ㎒ band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5 250-5 350 ㎒ including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5 250-5 350 ㎒ band.

6.2.4.2 Frequency band 5 725-5 850 ㎒

Devices operating in the band 5 725-5 850 ㎒ with antenna gain greater than 10 ㏈i can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.

Devices operating in the band 5 725-5 850 ㎒ with antenna gain of 10 ㏈i or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.

Devices operating in the band 5 725-5 850 ㎒ shall have e.i.r.p. of unwanted emissions comply with the following:

a) 27 ㏈m/㎒ at frequencies from the band edges decreasing linearly to 15.6 ㏈m/㎒ at 5 ㎒ above or below the band edges;

b) 15.6 ㏈m/㎒ at 5 ㎒ above or below the band edges decreasing linearly to 10 ㏈m/㎒ at 25 ㎒ above or below the band edges;

c) 10 ㏈m/㎒ at 25 ㎒ above or below the band edges decreasing linearly to -27 ㏈m/㎒ at 75 ㎒ above or below the band edges; and

d) -27 ㏈m/㎒ at frequencies more than 75 ㎒ above or below the band edges.

2.3. Test Procedures

Radiated spurious emissions from the EUT were measured according to the dictates in section G of KDB 789033 D02 v02r01 and ANSI C63.10-2013.

2.3.1. Test Procedures for emission below 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
3. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
4. The test-receiver system was set to average or quasi peak detect function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from above 30 ㎒

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site below 1 ㎓ and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 ㎓. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
3. The antenna is a bi-log antenna, a horn antenna and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Note;

All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

- II.G.4. Unwanted emissions measurements below 1 ㎓.
Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

- II.G.5. Unwanted maximum emissions measurements above 1 ㎓.
Peak emission levels are measured by setting the analyzer as follows:
Set to RBW = 1 ㎒, VBW ≥ 3 ㎒, Detector = Peak, Sweep time = auto, Trace mode= Max hold.

- II.G.6. Average unwanted emissions measurements above 1 ㎓.
Set to RBW = 1 ㎒, VBW ≥ 3 ㎒, Detector = power averaging (rms), Averaging type = power averaging (rms), Sweep time = auto, Perform a trace average of at least 100 traces If the transmission is continuous, If the transmission is not continuous, the number of traces shall be increased by a factor of 1/x, where x is the duty cycle. For example, with 50 % duty cycle, at least 200 traces shall be averaged.

If tests are performed with the EUT transmitting at a duty cycle less than 98 %, a correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 % duty cycle. The correction factor is computed as follows:

- If power averaging (rms) mode was used in II.G.6.c)(iv), the correction factor is 10 log (1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 %, then 3 ㏈ must be added to the measured emission levels.

- Definition of the test orthogonal plan for EUT was described in the test setup photo.
The test orthogonal plan of EUT is **X – axis** during radiation test.

2.4. Test result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

2.4.1. Radiated Spurious Emission below 1 000 ㎒

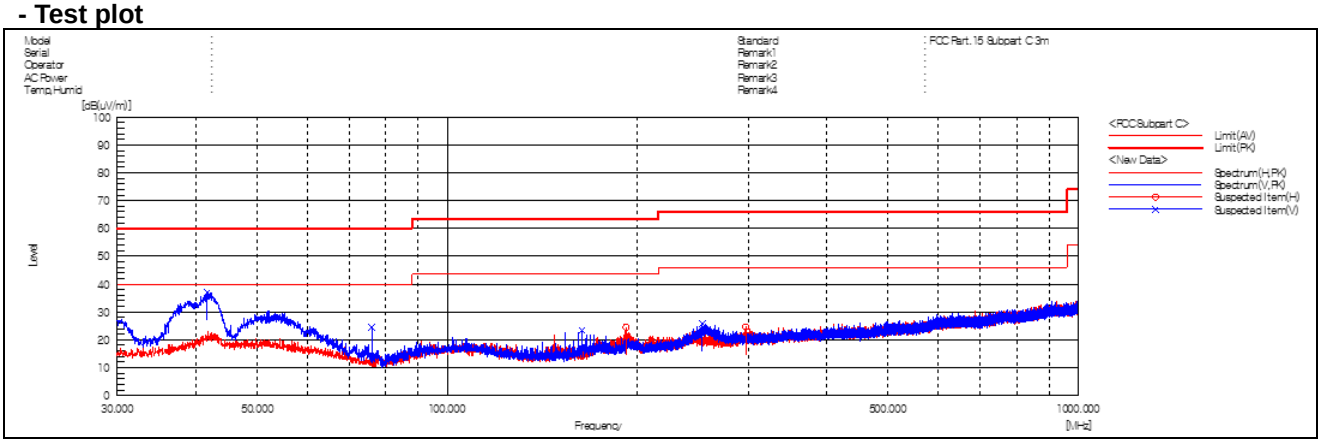
The frequency spectrum from 9 ㎑ to 1 000 ㎒ was investigated. All reading values are peak values.

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
41.68	49.60	Peak	V	13.84	-26.61	36.83	40.00	3.17
75.95	43.20	Peak	V	7.61	-26.03	24.78	40.00	15.22
Above 100.00	Not detected	-	-	-	-	-	-	-

Remark;

1. Spurious emissions for all channels and modes were investigated and almost the same below 1 ㎓.
2. Reported spurious emissions are in **11a (Band 1) / 6 Mbps / Middle channel** as worst case among other modes.
3. Radiated spurious emission measurement as below.
   (Actual = Reading + AF + AMP + CL)
4. According to §15.31(o), emission levels are not report much lower than the limits by over 20 ㏈.

- Test plot



2.4.2. Radiated Spurious Emission above 1 000 ㎒

802.11a (Band 1)_6 Mbps

A. Low Channel (5 180 ㎒)

Radiated Emissions			Ant.	Correction Factors				Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*5 147.60	54.91	Peak	V	33.30	6.16	-32.14	-	62.23	74.00	11.77
*5 147.60	32.64	Average	V	33.30	6.16	-32.14	0.41	40.37	54.00	13.63
*5 150.00	50.56	Peak	V	33.30	6.16	-32.14	-	57.88	74.00	16.12
*5 150.00	32.60	Average	V	33.30	6.16	-32.14	0.41	40.33	54.00	13.67

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 220 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 240 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11a (Band 3)_6 Mbps

A. Low Channel (5 745 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 620.20	35.00	Peak	V	24.98	6.18	-31.40	34.76	68.23	33.47
5 698.43	45.71	Peak	V	24.96	6.18	-30.97	45.88	104.07	58.19
5 718.27	56.94	Peak	V	24.96	6.19	-30.99	57.10	110.34	53.24
5 724.47	59.24	Peak	V	24.96	6.19	-31.00	59.39	121.02	61.63
5 725.00	59.09	Peak	V	24.96	6.19	-31.00	59.24	122.23	62.99

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 785 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 825 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 850.00	48.44	Peak	V	24.93	6.19	-31.26	48.30	122.23	73.93
5 850.60	53.50	Peak	V	24.93	6.19	-31.26	53.36	120.86	67.50
5 855.00	52.01	Peak	V	24.93	6.19	-31.26	51.87	110.83	58.96
5 875.61	41.94	Peak	V	24.92	6.19	-31.29	41.76	104.78	63.02
5 951.77	34.32	Peak	V	24.91	6.20	-31.18	34.25	68.25	34.00

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11n_HT20 (Band 1)_MCS0

A. Low Channel (5 180 ㎒)

Radiated Emissions			Ant.	Correction Factors				Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*5 149.20	54.60	Peak	V	33.30	6.16	-32.14	-	61.92	74.00	12.08
*5 146.80	32.93	Average	V	33.30	6.16	-32.14	0.51	40.76	54.00	13.24
*5 150.00	51.92	Peak	V	33.30	6.16	-32.14	-	59.24	74.00	14.76
*5 150.00	33.04	Average	V	33.30	6.16	-32.14	0.51	40.87	54.00	13.13

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 220 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 240 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11n_HT20 (Band 3)_MCS0

A. Low Channel (5 745 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 617.55	34.98	Peak	V	24.98	6.18	-31.38	34.76	68.23	33.47
5 700.00	45.59	Peak	V	24.96	6.19	-30.95	45.79	105.23	59.44
5 720.00	56.60	Peak	V	24.96	6.19	-30.99	56.76	110.83	54.07
5 724.16	58.64	Peak	V	24.96	6.19	-31.00	58.79	120.31	61.52
5 725.00	59.66	Peak	V	24.96	6.19	-31.00	59.81	122.23	62.42

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. Middle Channel (5 785 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

C. High Channel (5 825 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 850.00	50.51	Peak	V	24.93	6.19	-31.26	50.37	122.23	71.86
5 851.36	53.02	Peak	V	24.93	6.19	-31.26	52.88	119.13	66.25
5 658.32	51.45	Peak	V	24.97	6.18	-31.46	51.14	74.38	23.24
5 875.61	41.54	Peak	V	24.92	6.19	-31.29	41.36	104.78	63.42
5 941.13	35.77	Peak	V	24.91	6.20	-31.20	35.68	68.23	32.55

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11n_HT40 (Band 1)_MCS0

A. Low Channel (5 190 ㎒)

Radiated Emissions			Ant.	Correction Factors				Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*5 149.20	56.07	Peak	V	33.30	6.16	-32.14	-	63.39	74.00	10.61
*5 148.39	38.56	Average	V	33.30	6.16	-32.14	0.71	46.59	54.00	7.41
*5 150.00	55.53	Peak	V	33.30	6.16	-32.14	-	62.85	74.00	11.15
*5 150.00	39.69	Average	V	33.30	6.16	-32.14	0.71	47.72	54.00	6.28

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. High Channel (5 230 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11n_HT40 (Band 3)_MCS0

A. Low Channel (5 755 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 622.32	44.07	Peak	V	24.98	6.18	-31.41	43.82	68.23	24.41
5 695.89	49.80	Peak	V	24.96	6.18	-31.00	49.94	102.19	52.25
5 720.00	58.59	Peak	V	24.96	6.19	-30.99	58.75	110.83	52.08
5 721.44	60.45	Peak	V	24.96	6.19	-30.99	60.61	114.11	53.50
5 725.00	58.46	Peak	V	24.96	6.19	-31.00	58.61	122.23	63.62

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

B. High Channel (5 795 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 850.00	46.01	Peak	V	24.93	6.19	-31.26	45.87	122.23	76.36
5 853.06	48.29	Peak	V	24.93	6.19	-31.26	48.15	115.25	67.10
5 855.67	47.74	Peak	V	24.93	6.19	-31.26	47.60	110.64	63.04
5 876.75	44.18	Peak	V	24.92	6.19	-31.29	44.00	103.93	59.93
5 927.64	40.45	Peak	V	24.91	6.20	-31.24	40.32	68.23	27.91

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11ac_VHT80 (Band 1)_MCS0

A. Low Channel (5 210 ㎒)

Radiated Emissions			Ant.	Correction Factors				Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
*5 131.30	53.61	Peak	V	33.30	6.16	-32.18	-	60.89	74.00	13.11
*5 149.15	39.94	Average	V	33.30	6.16	-32.14	1.42	48.68	54.00	5.32
*5 150.00	50.98	Peak	V	33.30	6.16	-32.14	-	58.30	74.00	15.70
*5 150.00	40.27	Average	V	33.30	6.16	-32.14	1.42	49.01	54.00	4.99

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

802.11ac_VHT80 (Band 3)_MCS0

A. Middle Channel (5 775 ㎒)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	Atten. (dB)	AMP+CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 620.99	44.69	Peak	V	24.98	6.18	-31.40	44.45	68.23	23.78
5 695.32	50.05	Peak	V	24.96	6.18	-31.01	50.18	101.76	51.58
5 717.58	53.67	Peak	V	24.96	6.19	-30.99	53.83	110.15	56.32
5 724.67	55.72	Peak	V	24.96	6.19	-31.00	55.87	121.48	65.61
5 725.00	53.76	Peak	V	24.96	6.19	-31.00	53.91	122.23	68.32
5 850.00	48.53	Peak	V	24.93	6.19	-31.26	48.39	122.23	73.84
5 853.98	49.23	Peak	V	24.93	6.19	-31.26	49.09	113.15	64.06
5 855.21	48.09	Peak	V	24.93	6.19	-31.26	47.95	110.77	62.82
5 876.52	44.72	Peak	V	24.92	6.19	-31.29	44.54	104.10	59.56
5 937.53	39.73	Peak	V	24.91	6.20	-31.21	39.63	68.23	28.60

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
Above 1 000.00	Not detected	-	-	-	-	-	-	-	-

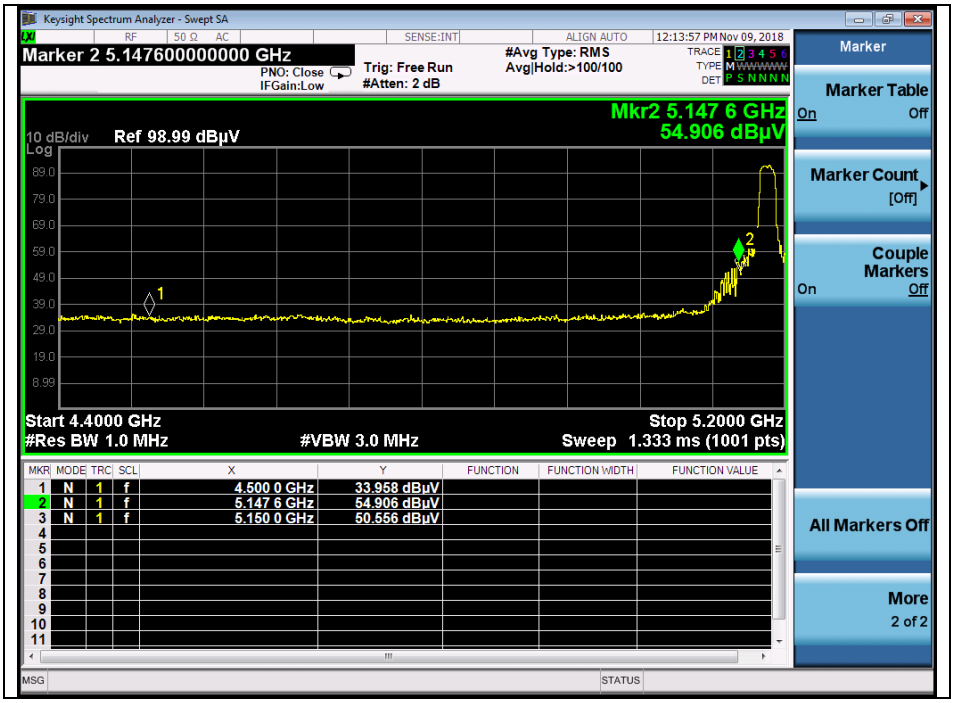
Remark;

1. "*" means the restricted band.
2. Radiated emissions measured in frequency above 1 000 ㎒ were made with an instrument using Peak / average detector mode if frequency was in restricted band. Otherwise the frequency was out of restricted band, only peak detector should be used.
3. Band edge measurement.
   (Actual = Reading + AF + Atten. + AMP + CL + Duty cycle)
4. Radiated spurious emission measurement.
   (Actual = Reading + AF + AMP + CL + Duty cycle)
5. If frequency was out of restricted band, the calculation method for peak limit is same as below.
   68.23 dB㎶/m = EIRP - 20 log(d) + 104.77 = -27 - 20 log (3) + 104.77
6. In case of the emissions within ±75 ㎒ from band edge of band 3, limit should be adjusted to emission mask of 15.407(4)(i).
7. According to § 15.31(o), emission levels are not reported much lower than the limits by over 20 ㏈.
8. The maximized peak measured value complies with the average limit, to perform an average measurement is unnecessary.

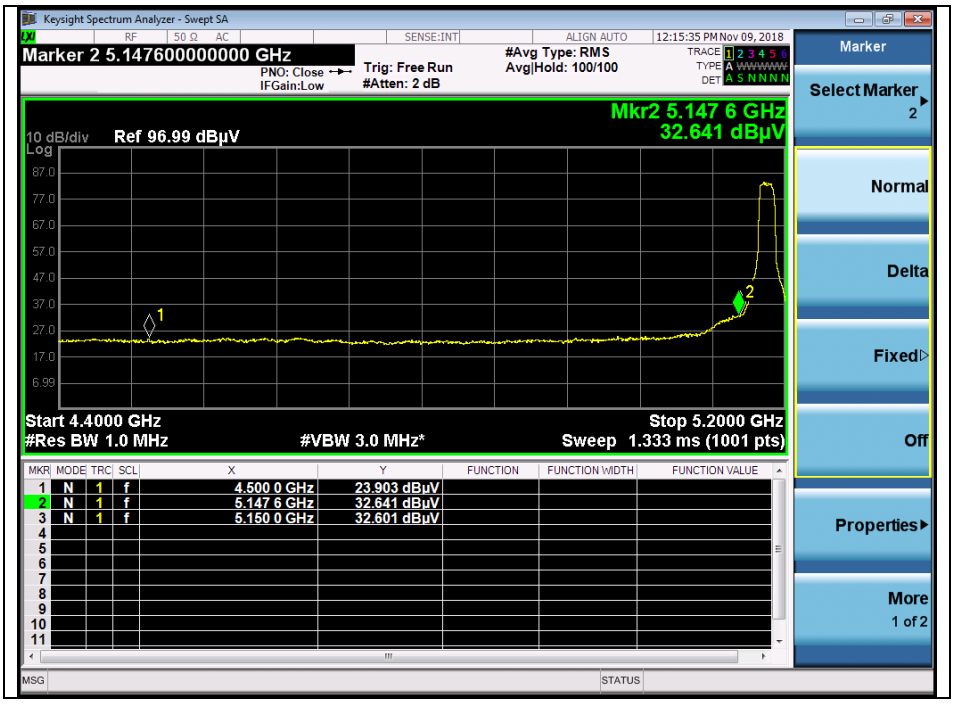
- Test plots

OFDM: 802.11a(6 Mbps)

Low channel Band edge (Peak) - Band 1



Low channel Band edge (Average) - Band 1

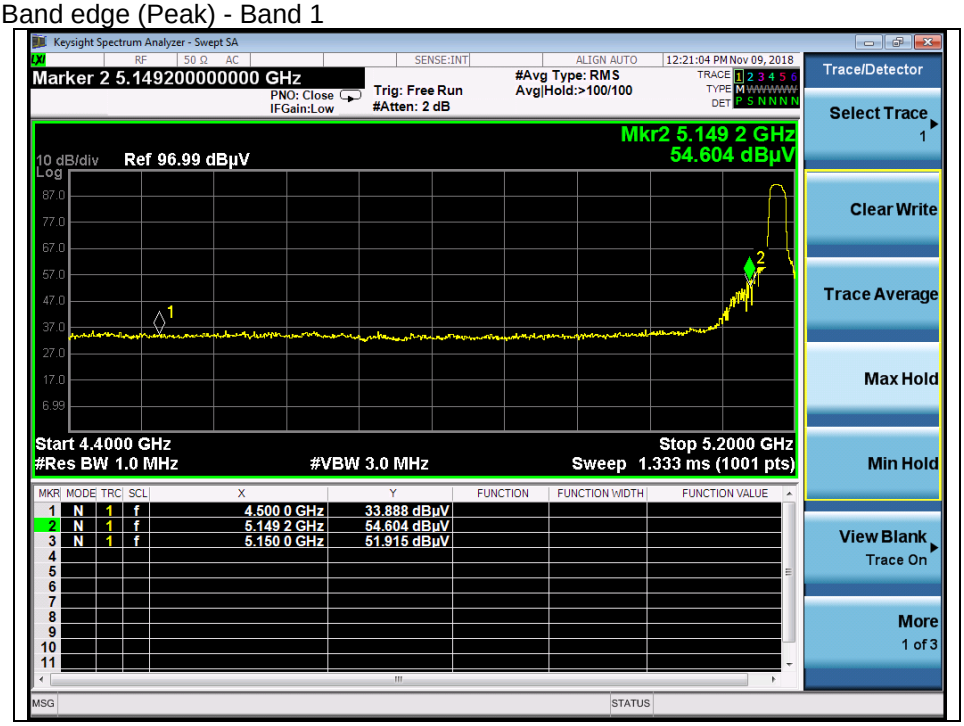


Low channel Band edge - Band 3

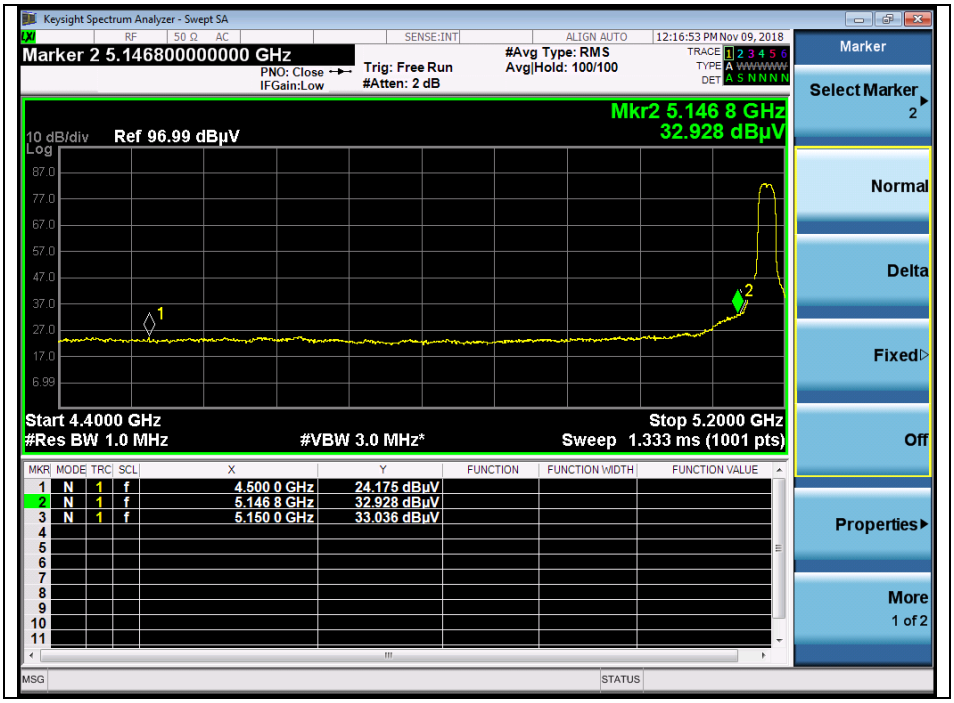
High channel Band edge - Band 3

OFDM: 802.11n_HT20(MCS0)

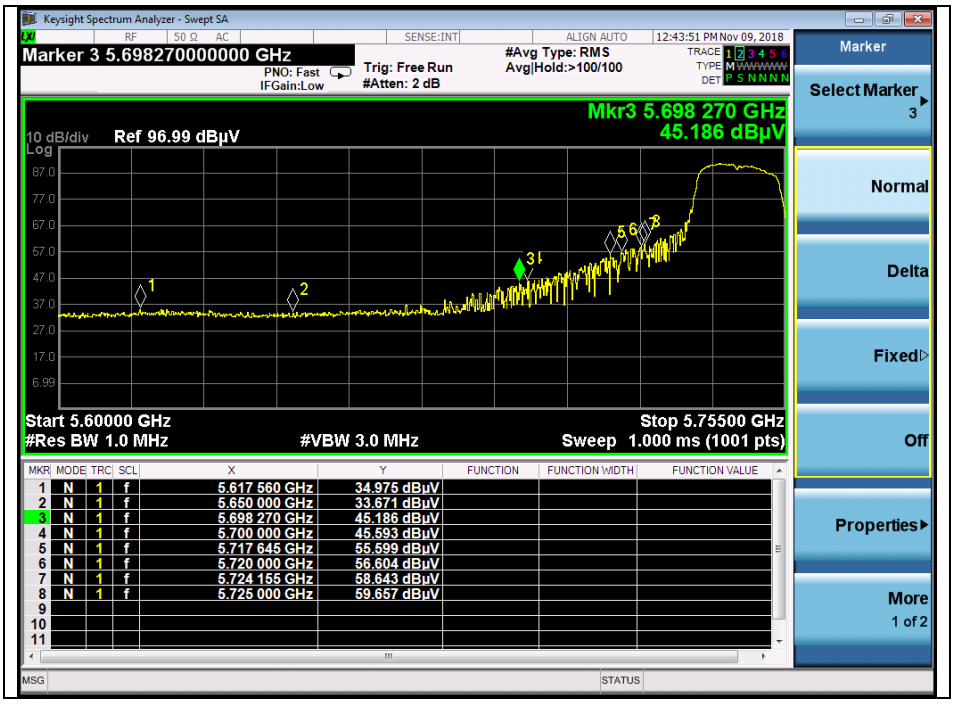
Low channel Band edge (Peak) - Band 1



Low channel Band edge (Average) - Band 1



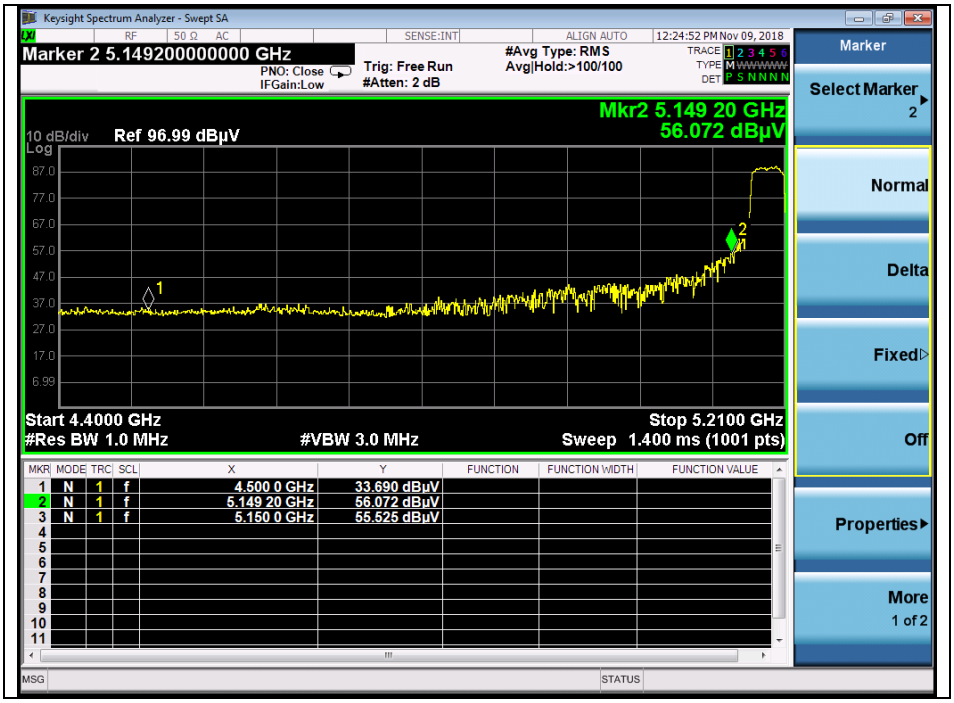
Low channel Band edge - Band 3



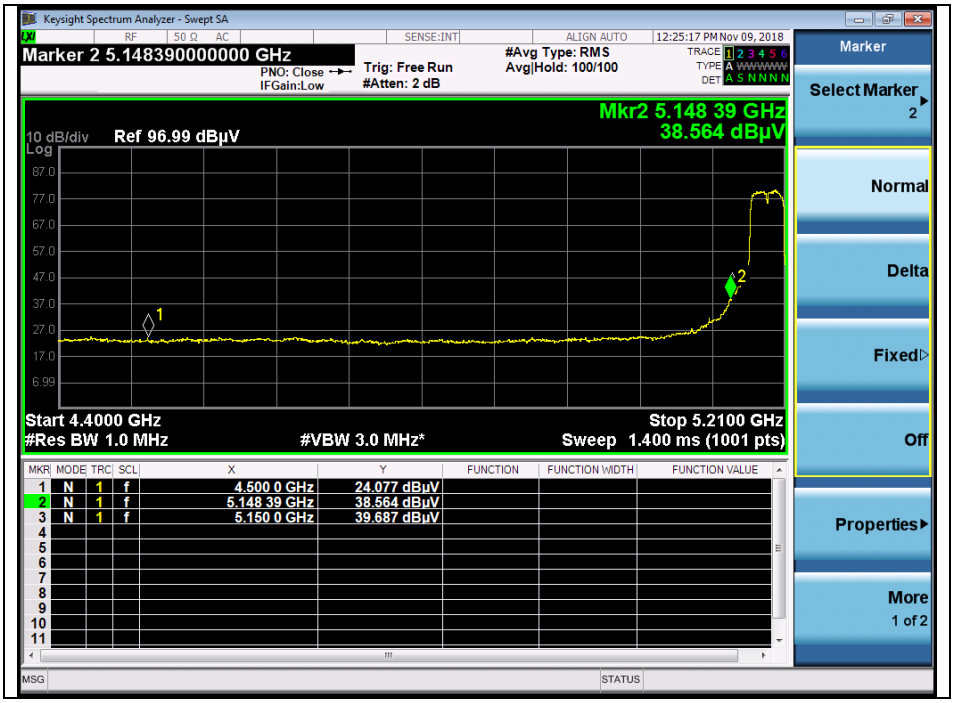
High channel Band edge - Band 3

OFDM: 802.11n_HT40(MCS0)

Low channel Band edge (Peak) - Band 1



Low channel Band edge (Average) - Band 1



Low channel Band edge - Band 3

High channel Band edge - Band 3

OFDM: 802.11ac_VHT80(MCS0)

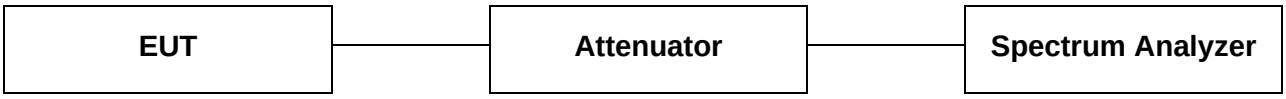
Middle channel Band edge (Peak) - Band 1

Middle channel Band edge (Average) - Band 1

Middle channel Band edge - Band 3

3. 26 ㏈ Bandwidth & 99 % Bandwidth

3.1. Test Setup



3.2. Limit

None; for reporting purpose only.

3.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

3.3.1. 26 ㏈ Bandwidth

1. This measurement settings are specified in section C.1 of KDB 789033 D02 v02r01.
2. Set RBW: approximately 1 % of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Measure the maximum width of the emission that is 26 ㏈ down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

3.2.2. 99 % Bandwidth

3.2.2.1 FCC

1. This measurement settings are specified in section D of KDB 789033 D02 v02r01.
2. Set center frequency to the nominal EUT channel center frequency.
3. Set span = 1.5 times to 5.0 times the OBW.
4. Set RBW = 1 % to 5 % of the OBW.
5. Set VBW ≥ 3 x RBW.
6. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
7. Use the 99 % power bandwidth function of the instrument (if available).
8. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99 % occupied bandwidth is the difference between these two frequencies.

In the result,

- DFS requirements are not applicable in the 5 150 ㎒ ~ 5 250 ㎒.

3.2.2.2 IC

● The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

● The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

● The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

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

3.4. Test result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Mode	Band	Frequency (㎒)	Ch.	Data Rate (Mbps)	26 ㏈ Bandwidth (㎒)	99 % Bandwidth (㎒)
11a	U-NII 1	5 180	36	6	19.276	16.324
		5 220	44		19.450	16.324
		5 240	48		18.959	16.324
	U-NII 3	5 745	149		19.624	16.324
		5 785	157		19.508	16.382
		5 825	165		19.855	16.266

Mode	Band	Frequency (㎒)	Ch.	Data Rate (Mbps)	26 ㏈ Bandwidth (㎒)	99 % Bandwidth (㎒)
11n_HT20	U-NII 1	5 180	36	MCS0	20.087	17.424
		5 220	44		20.087	17.424
		5 240	48		20.000	17.424
	U-NII 3	5 745	149		20.087	17.424
		5 785	157		20.087	17.424
		5 825	165		20.029	17.424

Mode	Band	Frequency (㎒)	Ch.	Data Rate (Mbps)	26 ㏈ Bandwidth (㎒)	99 % Bandwidth (㎒)
11n_HT40	U-NII 1	5 190	38	MCS0	46.310	36.006
		5 230	46		46.110	36.122
	U-NII 3	5 755	151		46.450	36.006
		5 795	159		46.130	36.006

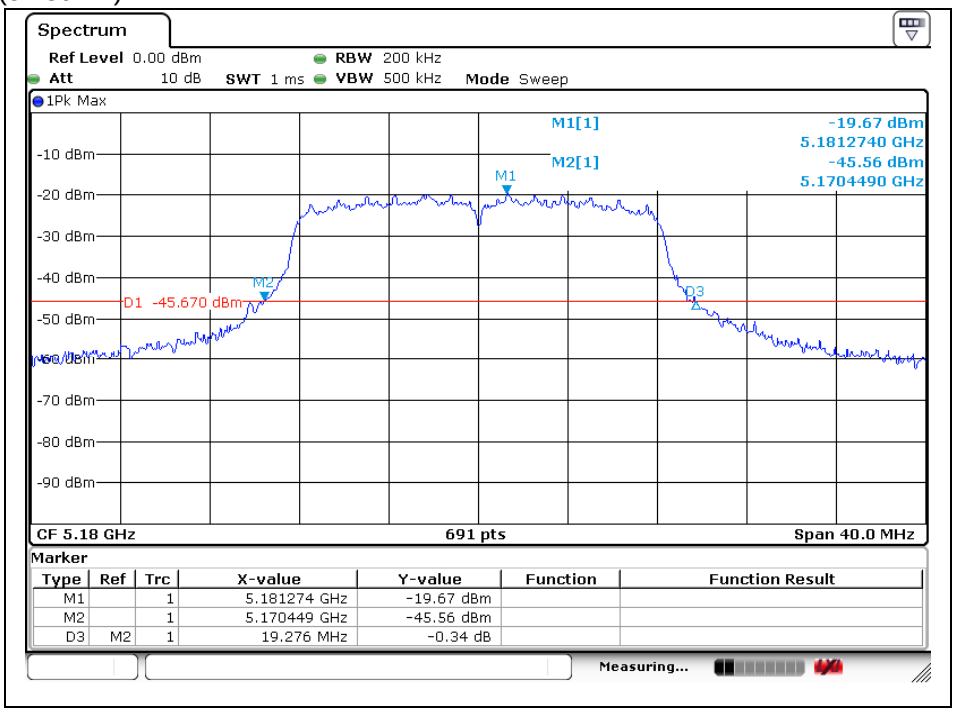
Mode	Band	Frequency (㎒)	Ch.	Data Rate (Mbps)	26 ㏈ Bandwidth (㎒)	99 % Bandwidth (㎒)
11ac_VHT80	U-NII 1	5 210	42	MCS0	81.820	74.790
	U-NII 3	5 775	155		81.970	74.790

- Test plots

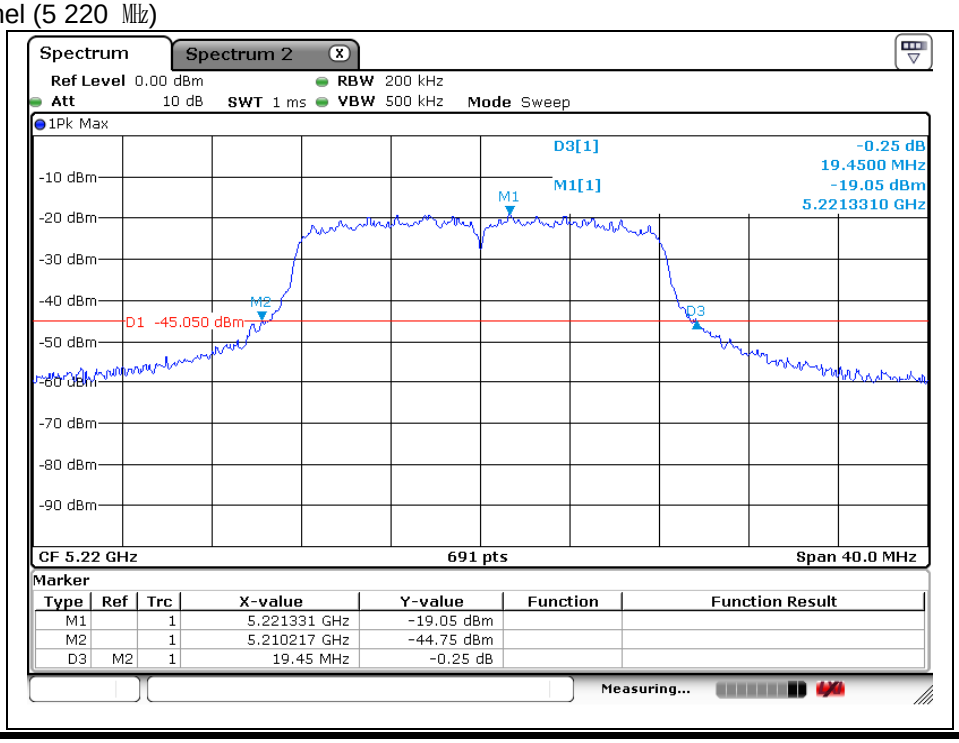
26 dB Bandwidth

802.11a (Band 1)

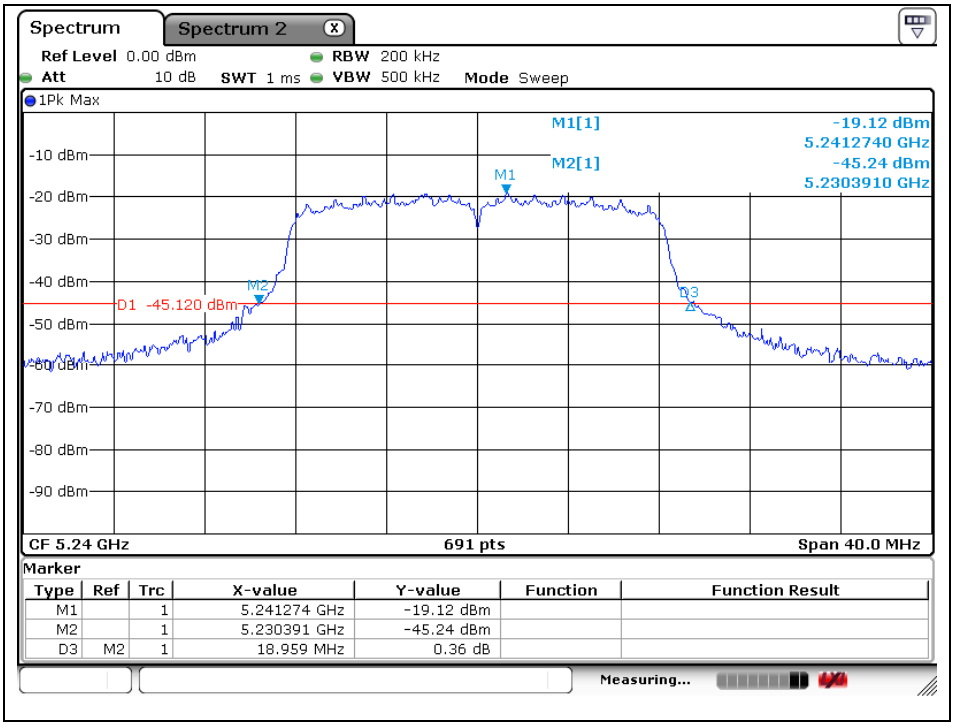
Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)

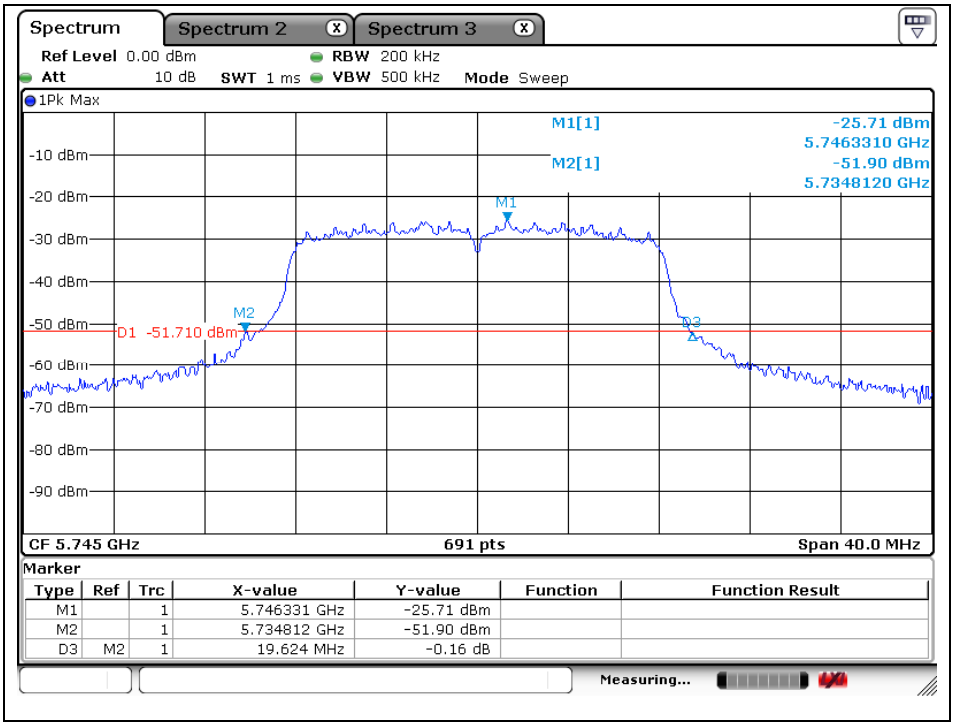


High Channel (5 240 ㎒)

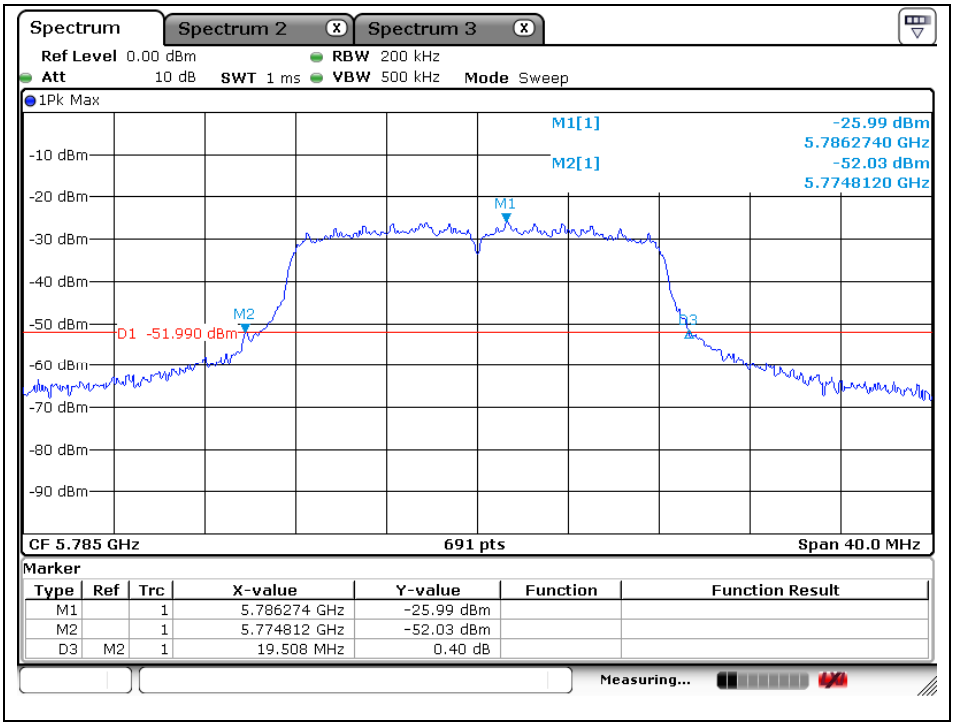


802.11a (Band 3)

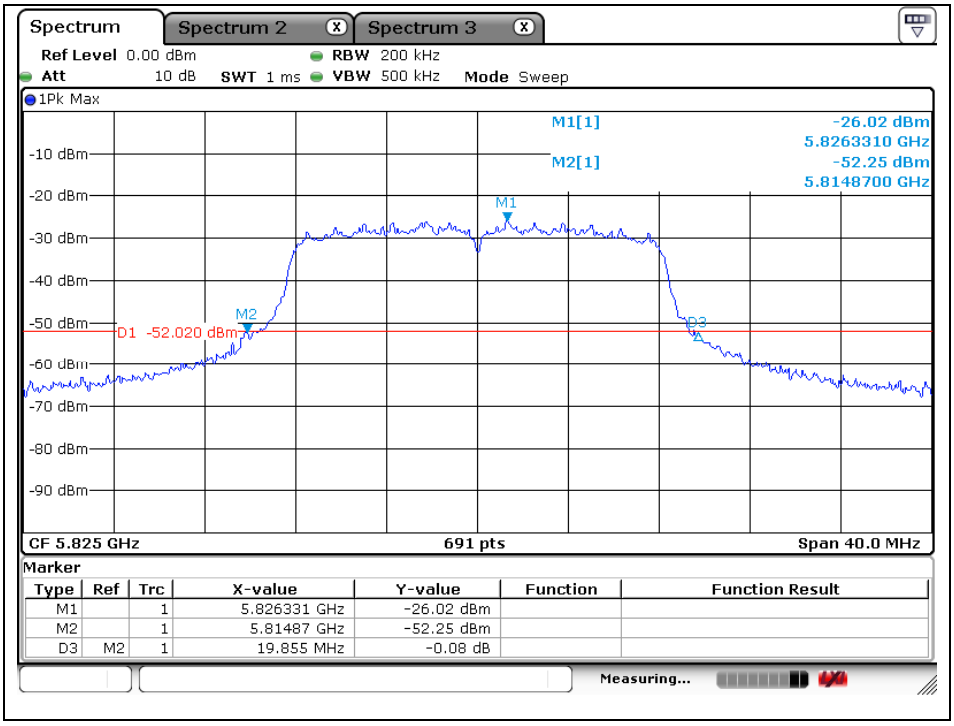
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

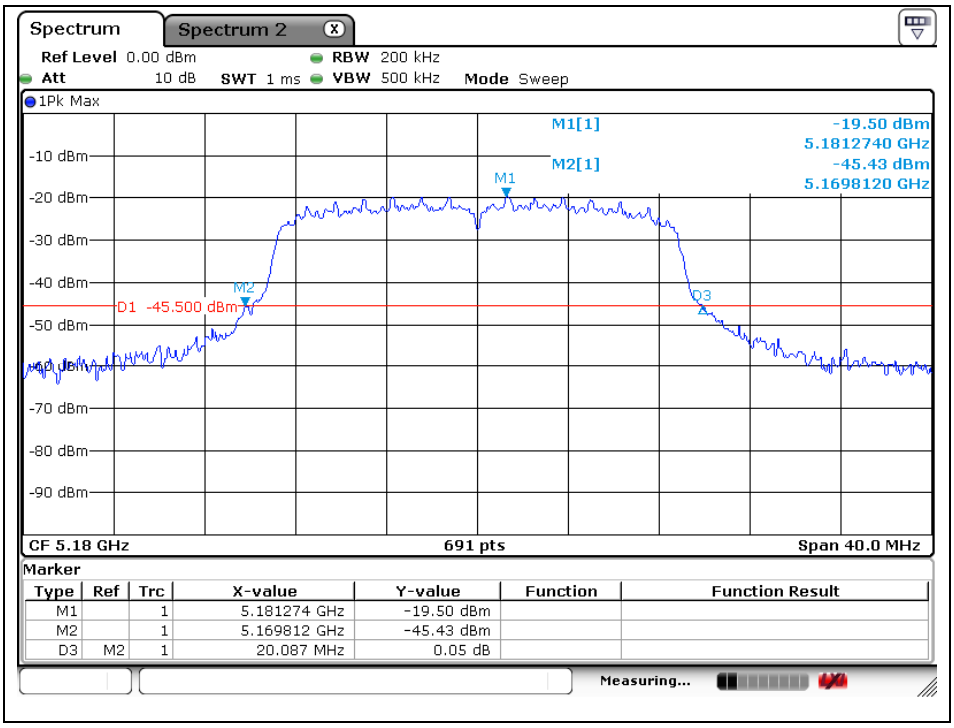


High Channel (5 825 ㎒)

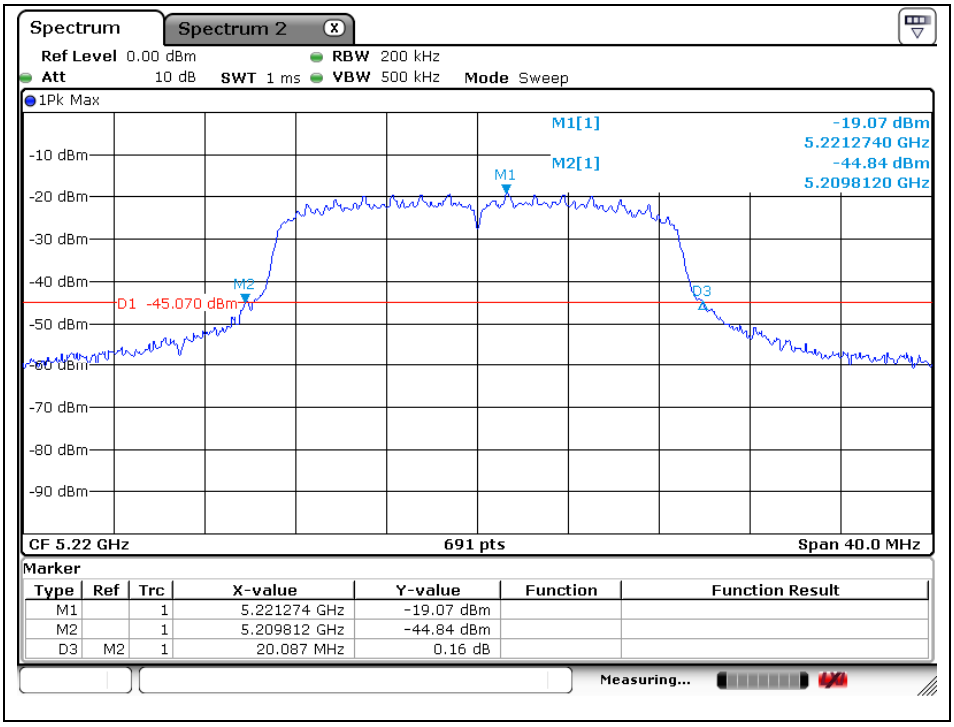


802.11n_HT20 (Band 1)

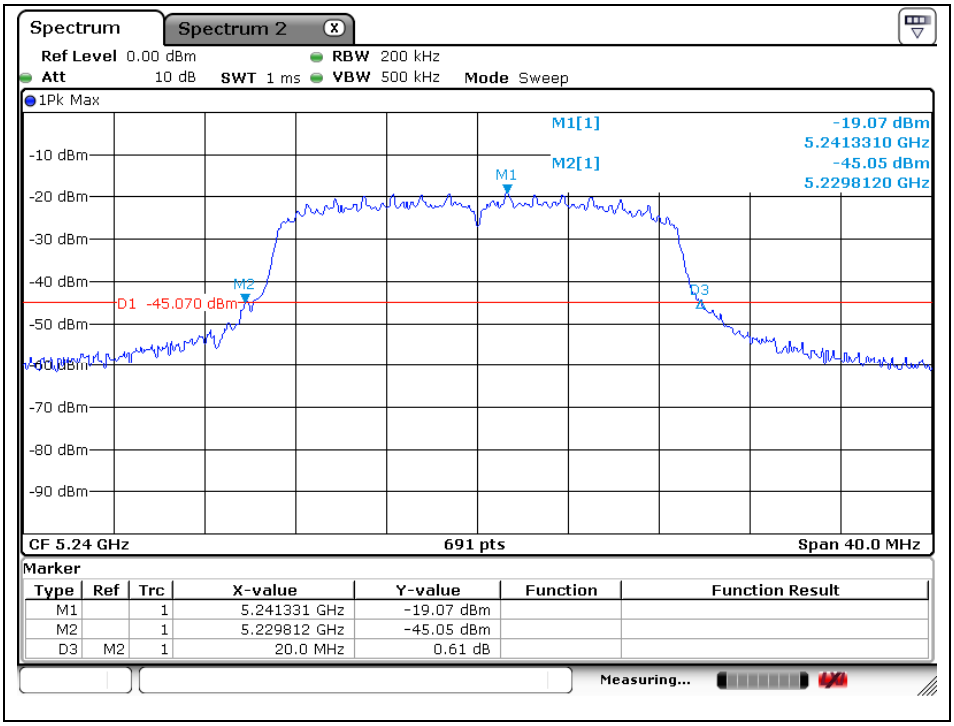
Low Channel (5 180 ㎒)



Middle Channel (5 220 ㎒)

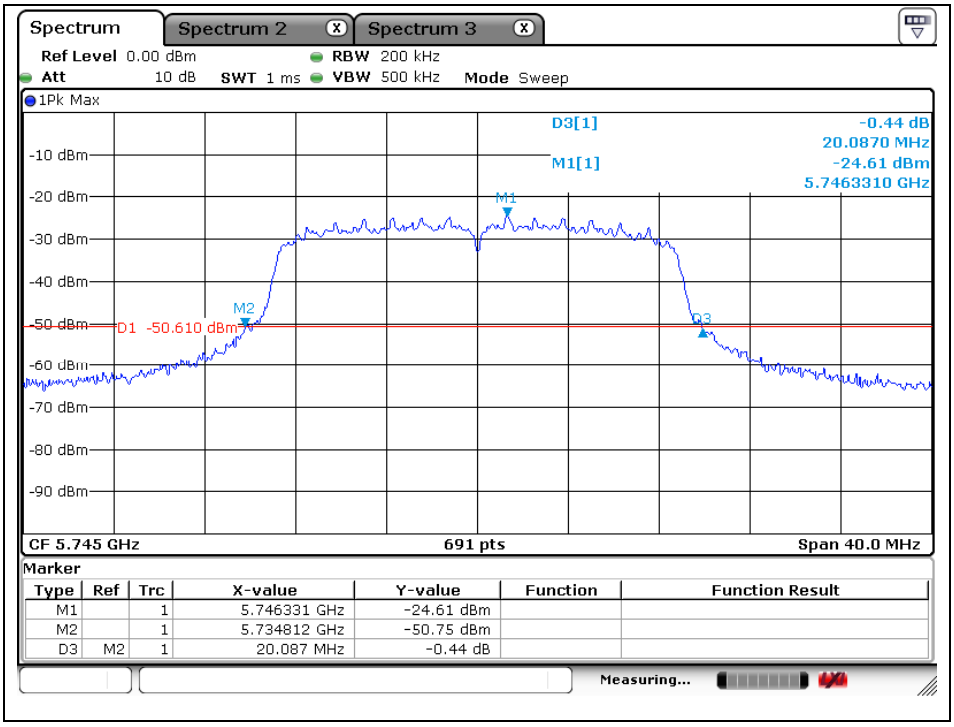


High Channel (5 240 ㎒)

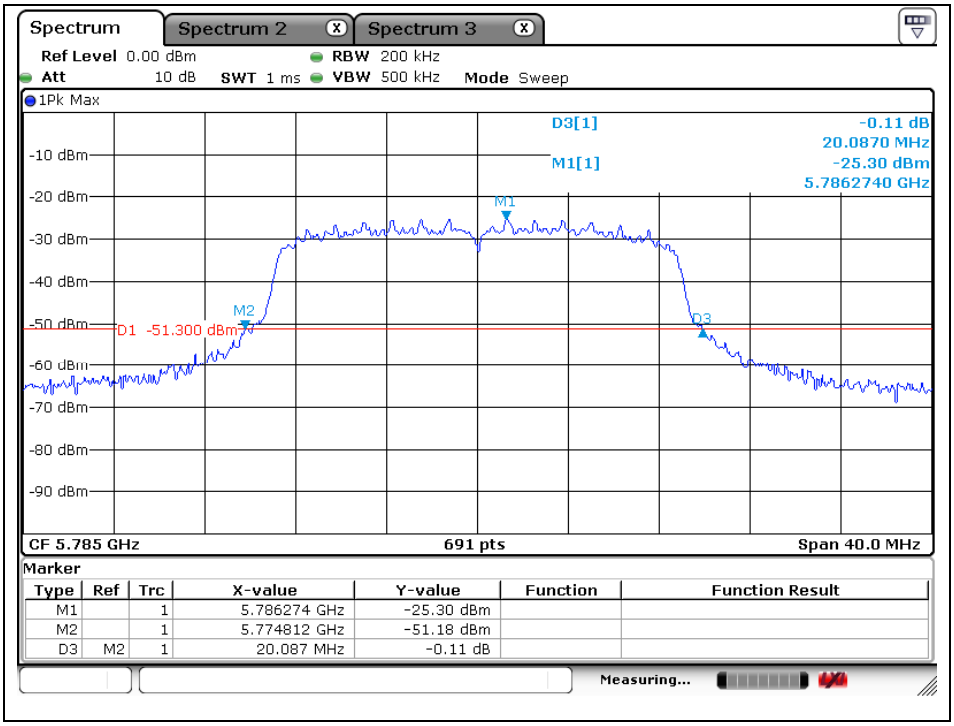


802.11n_HT20 (Band 3)

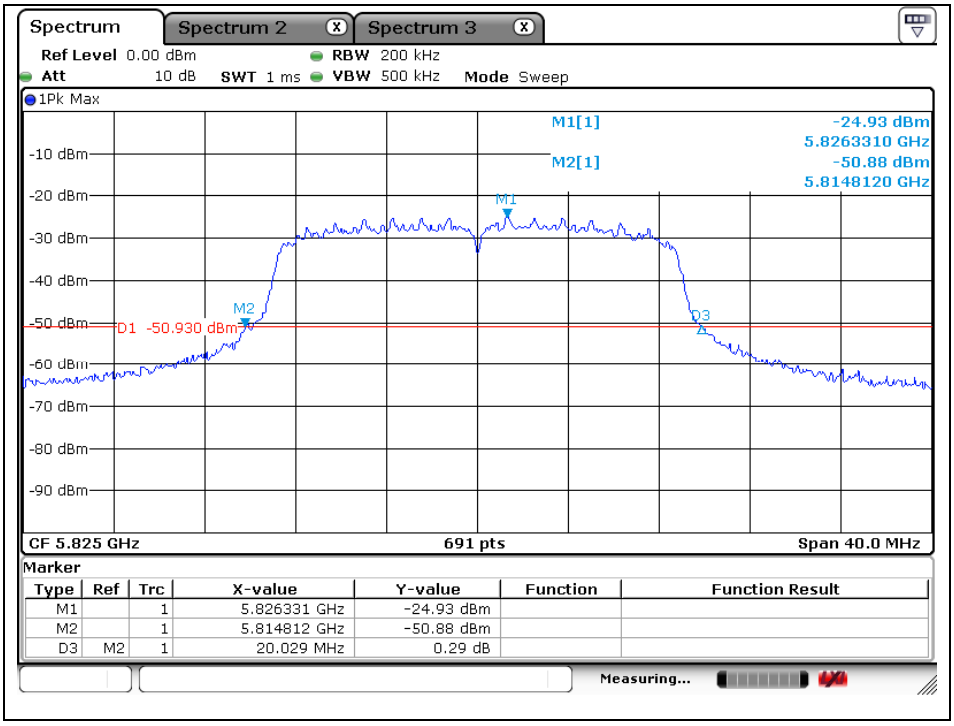
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

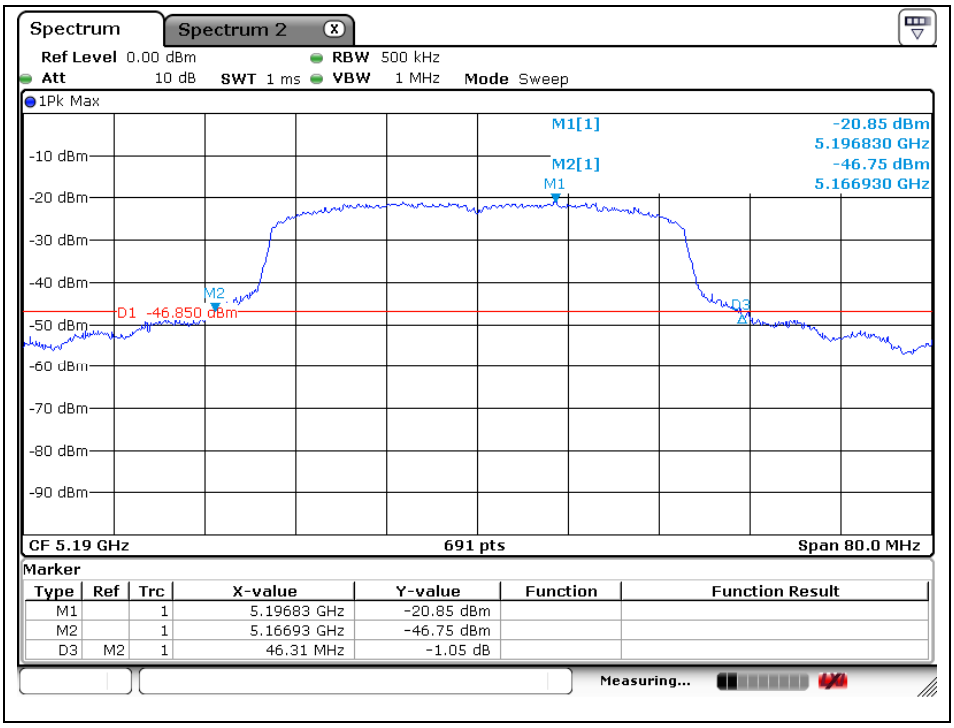


High Channel (5 825 ㎒)

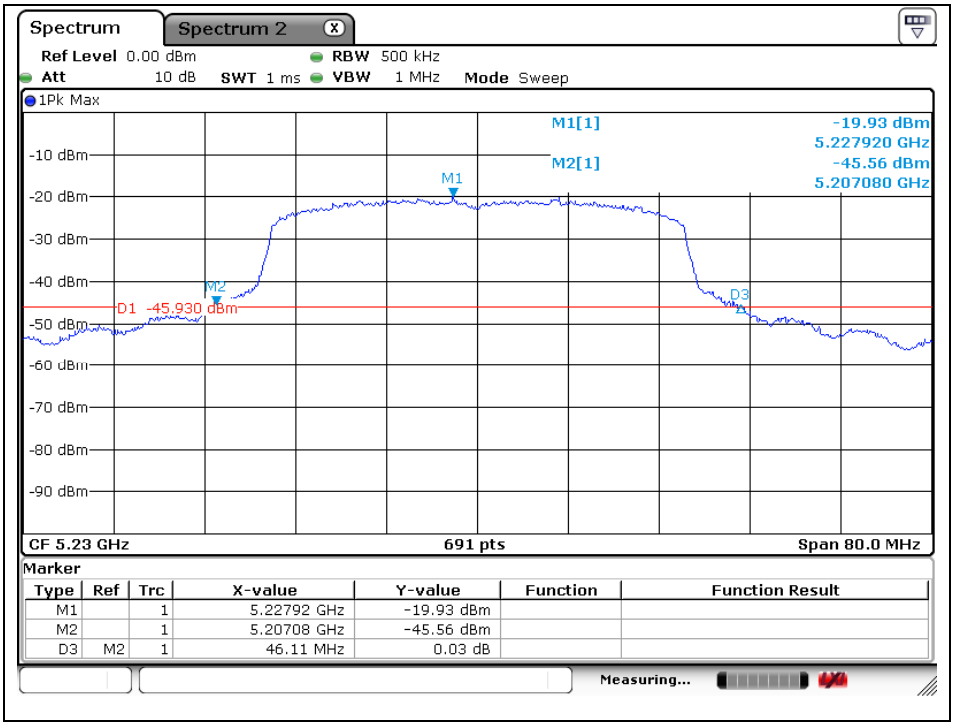


802.11n_HT40 (Band 1)

Low Channel (5 190 ㎒)

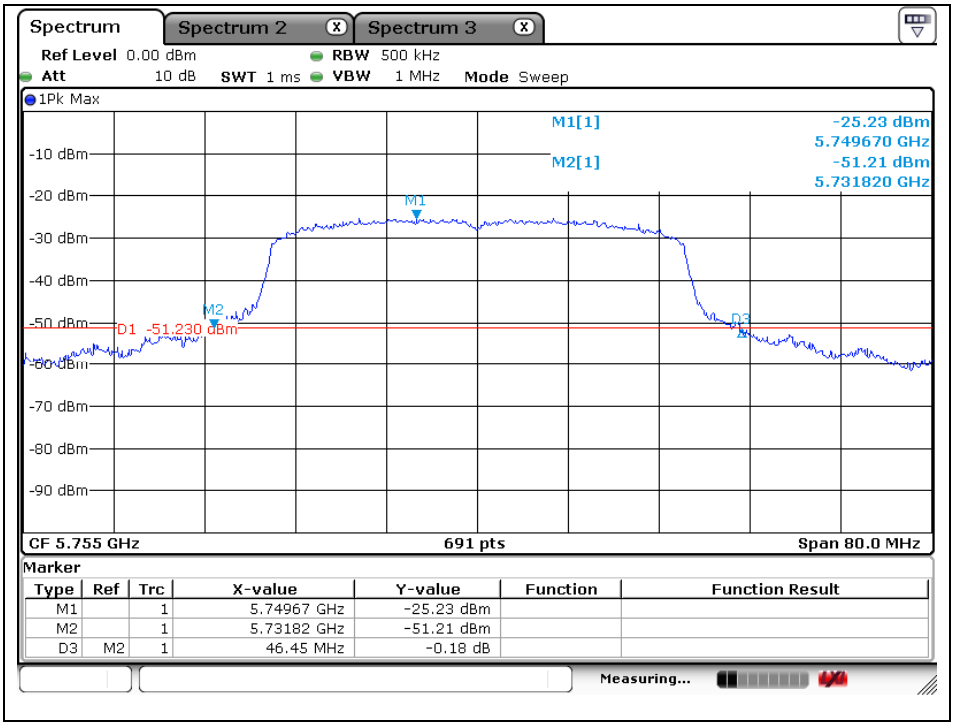


High Channel (5 230 ㎒)

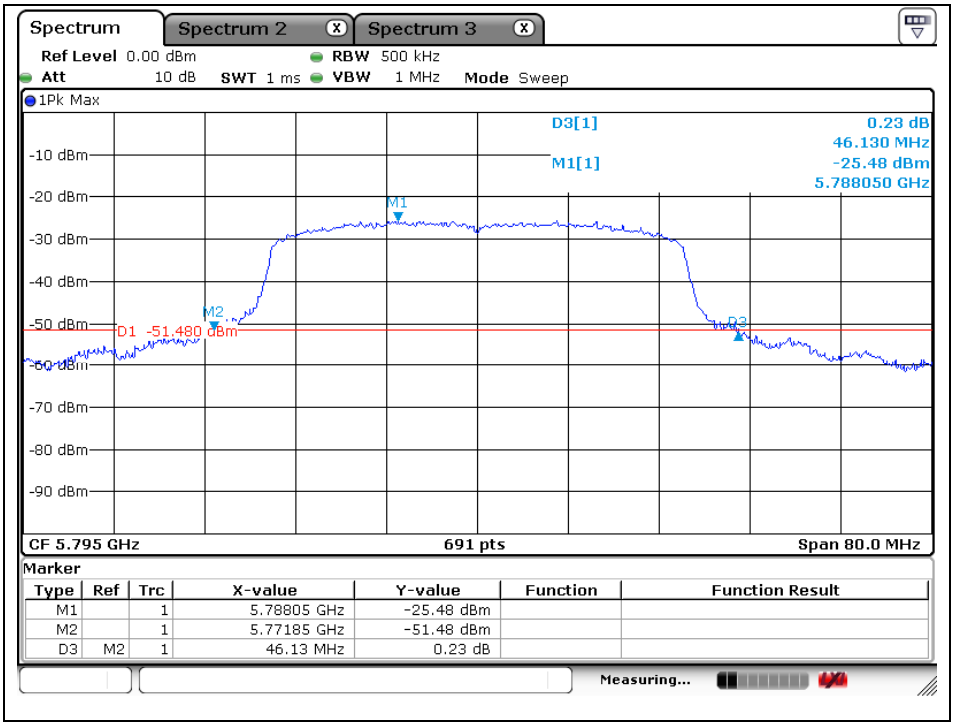


802.11n_HT40 (Band 3)

Low Channel (5 755 ㎒)

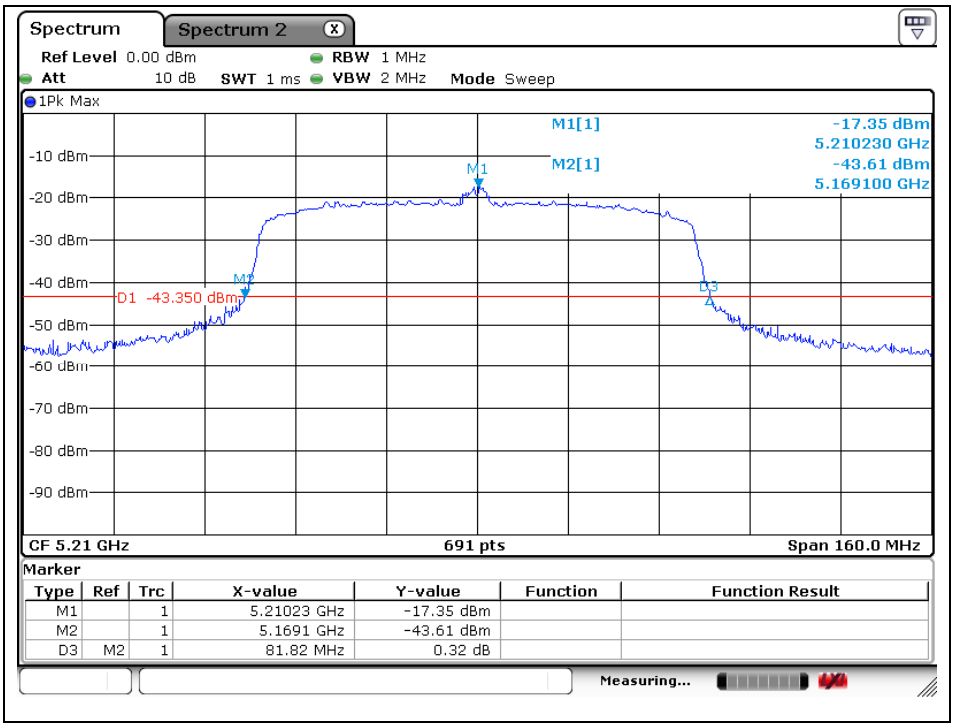


High Channel (5 795 ㎒)



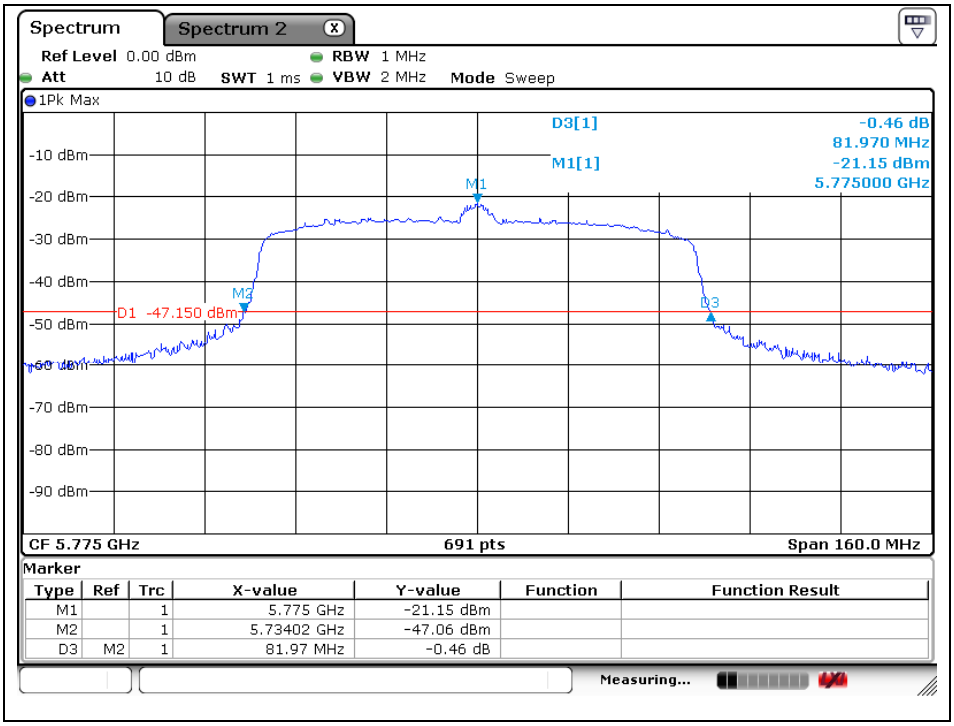
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 ㎒)



802. 11ac_VHT80 (Band 3)

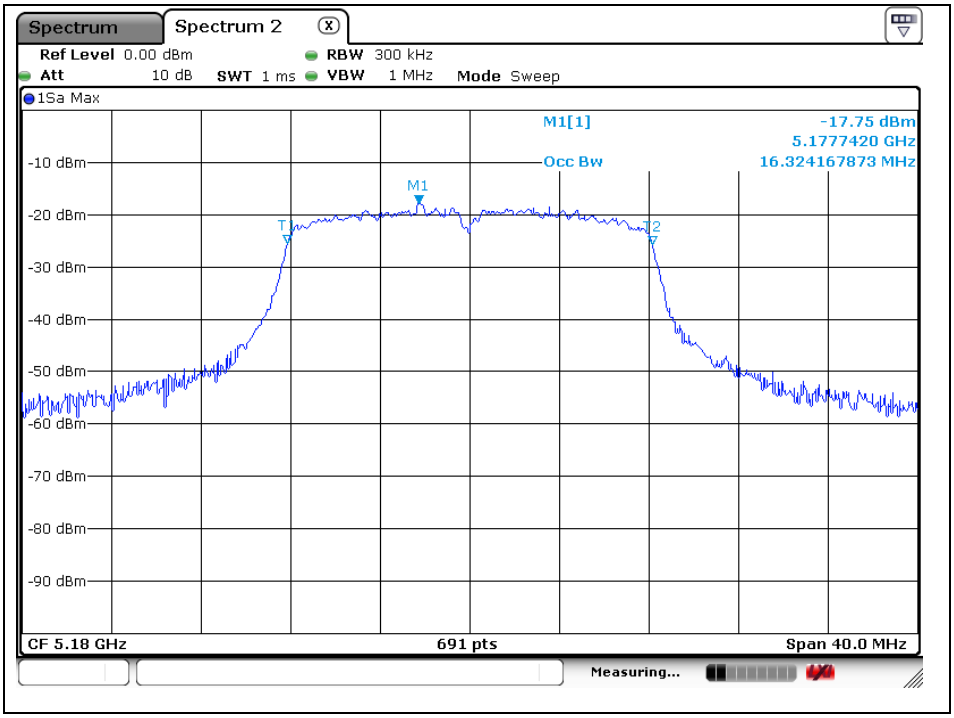
Middle Channel (5 775 ㎒)



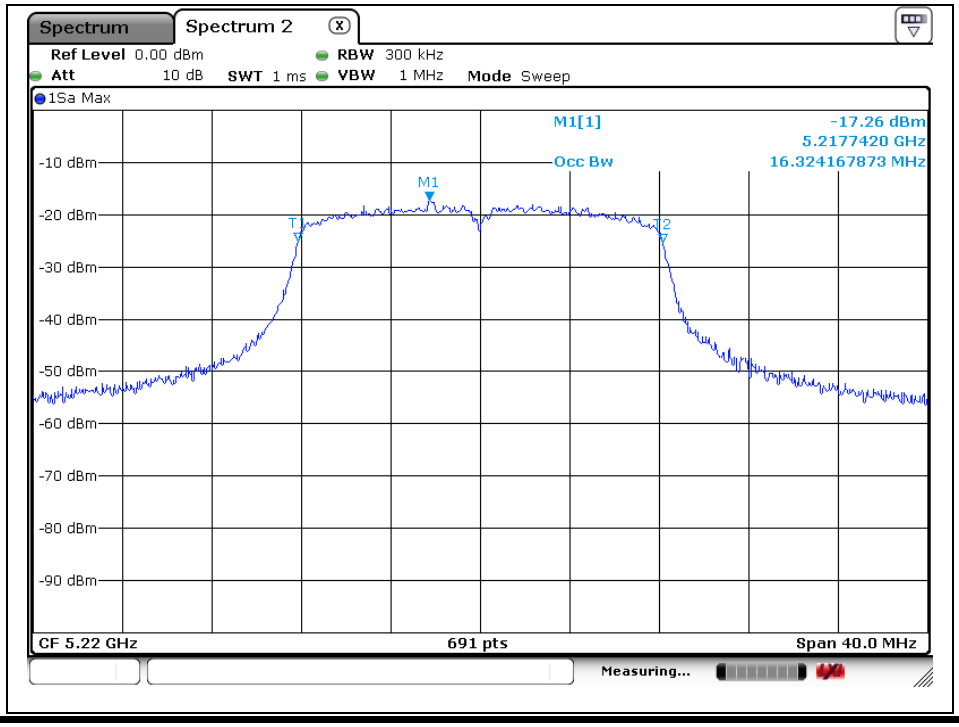
99 % Bandwidth

802.11a (Band 1)

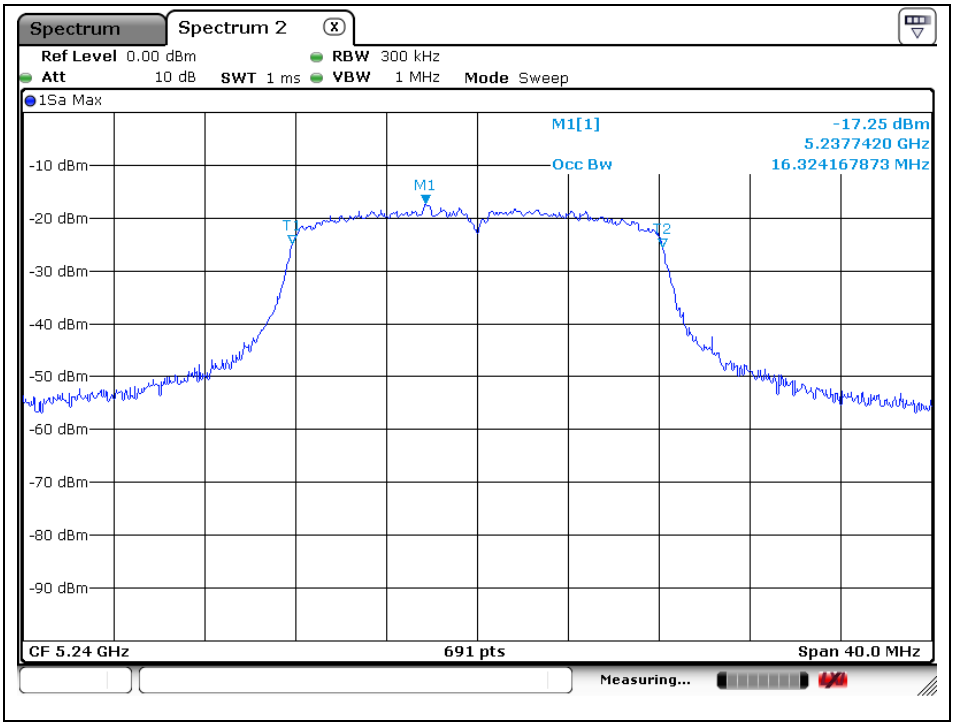
Low Channel (5 180 ㎒)



Middle Channel (5 220 ㎒)

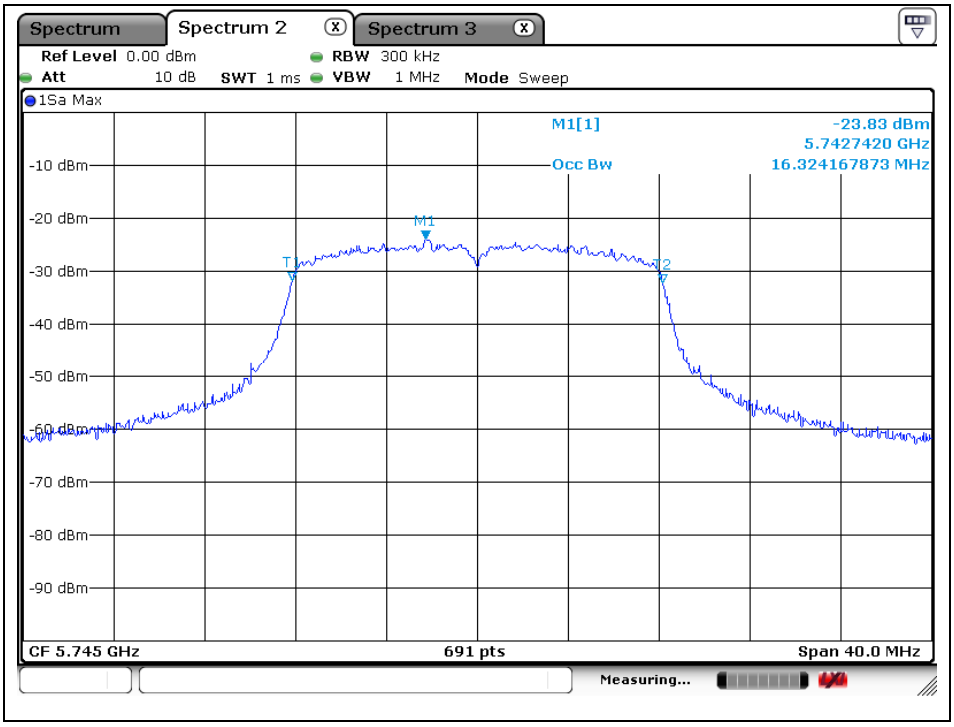


High Channel (5 240 ㎒)

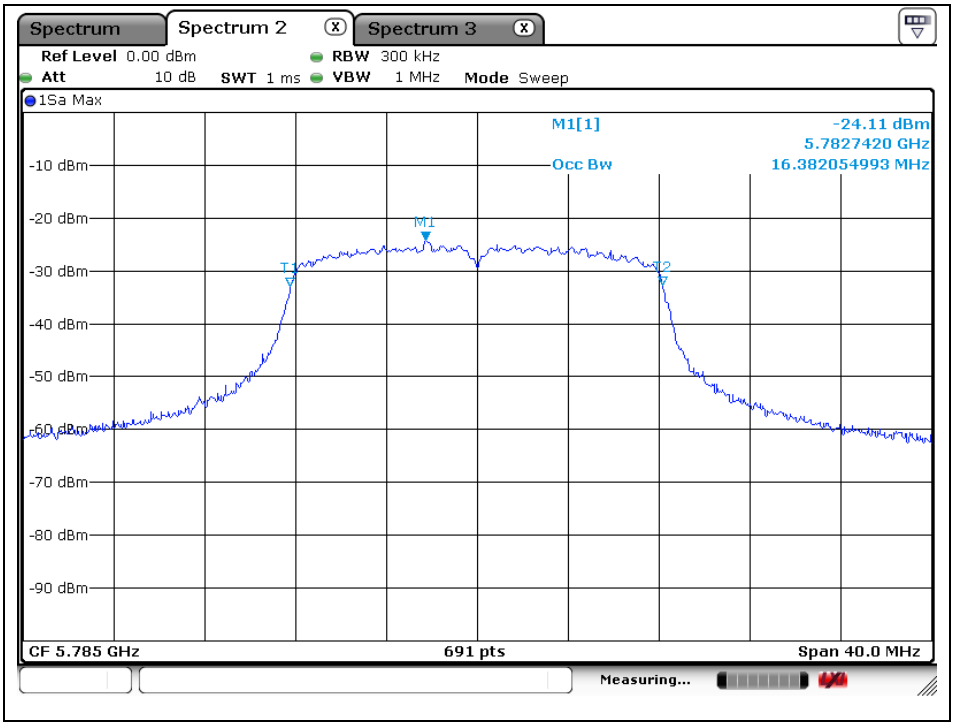


802.11a (Band 3)

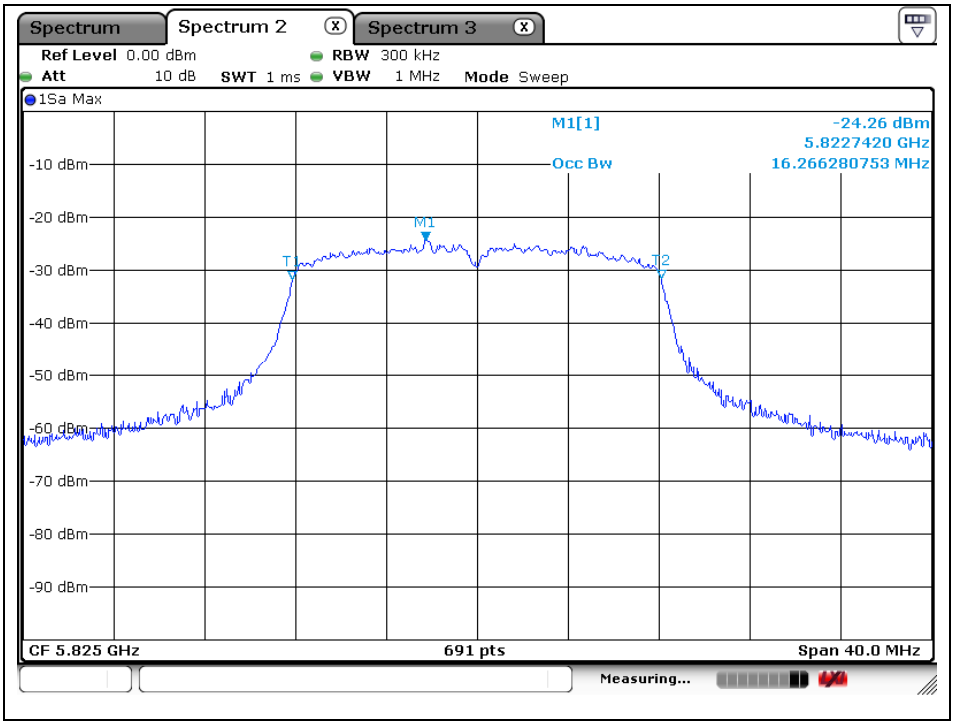
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

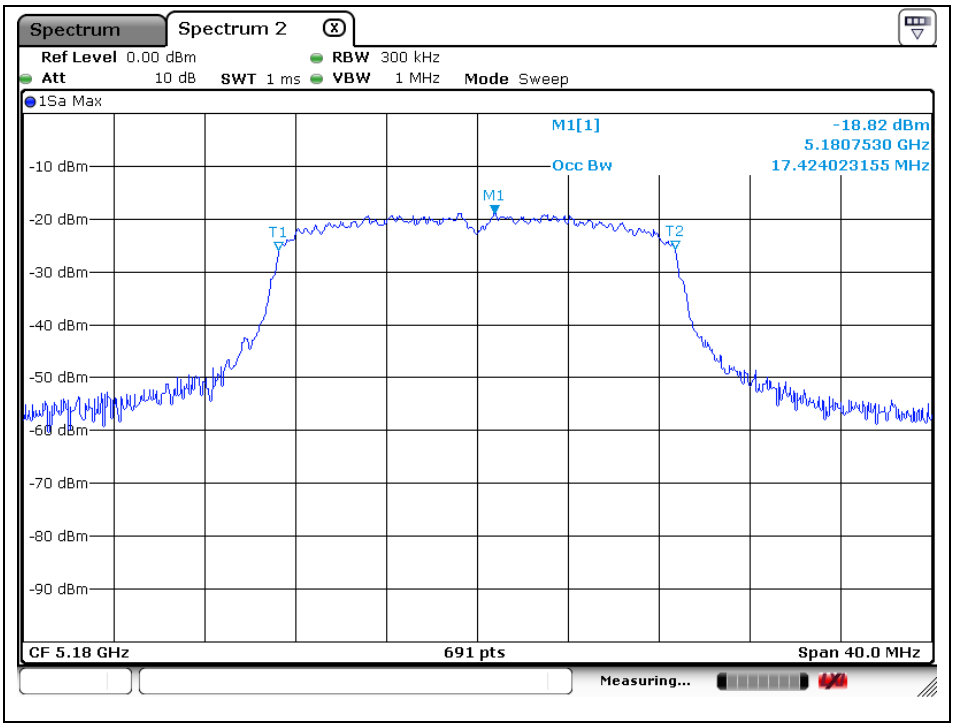


High Channel (5 825 ㎒)

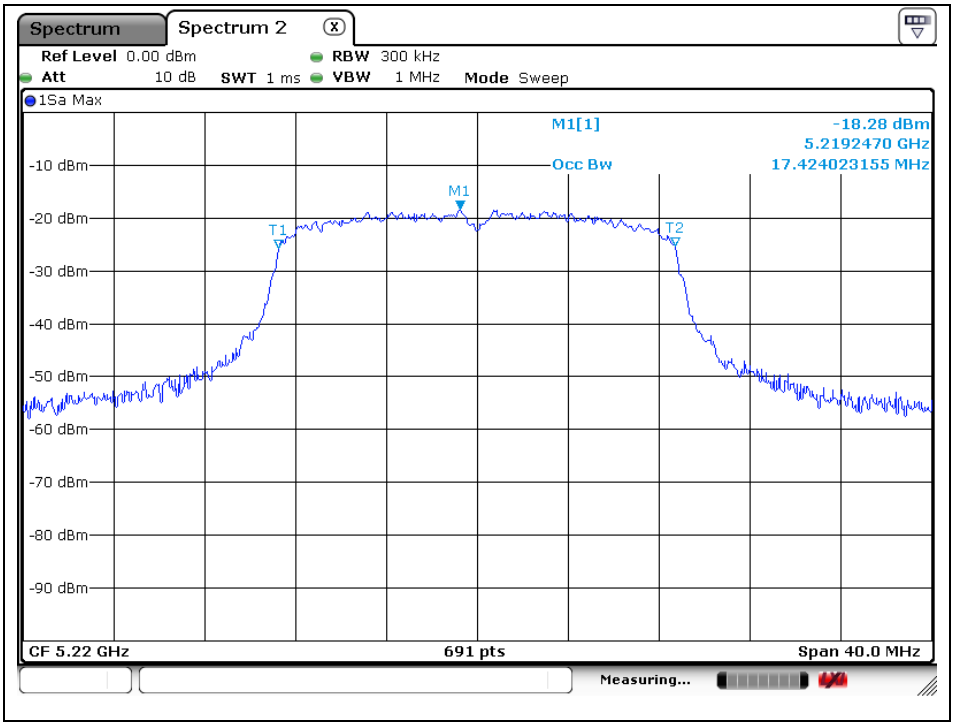


802.11n_HT20 (Band 1)

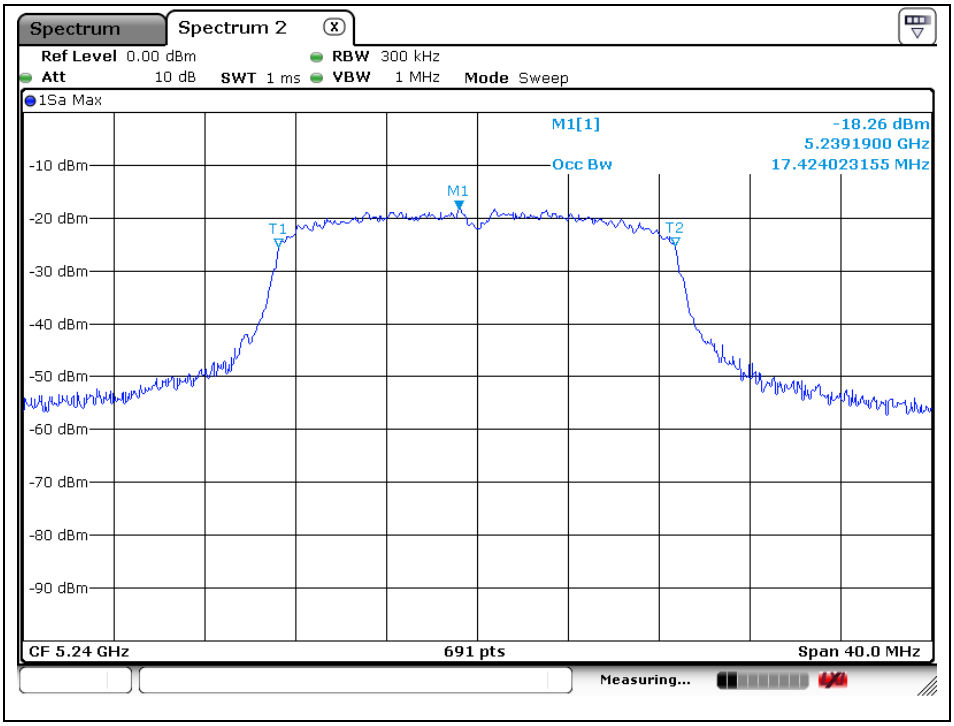
Low Channel (5 180 ㎒)



Middle Channel (5 220 ㎒)

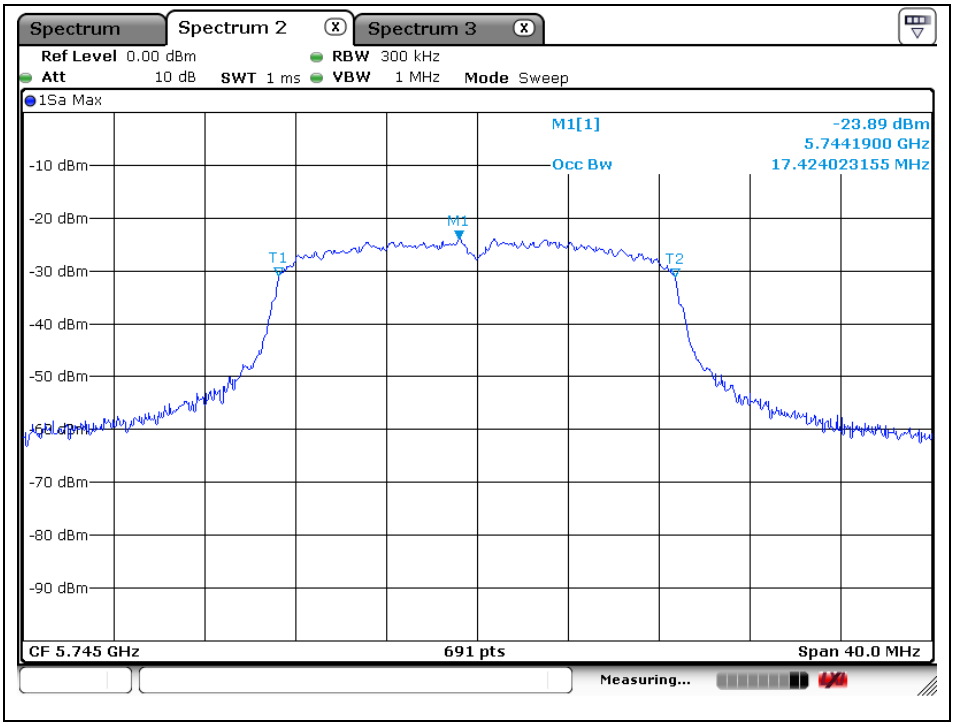


High Channel (5 240 ㎒)

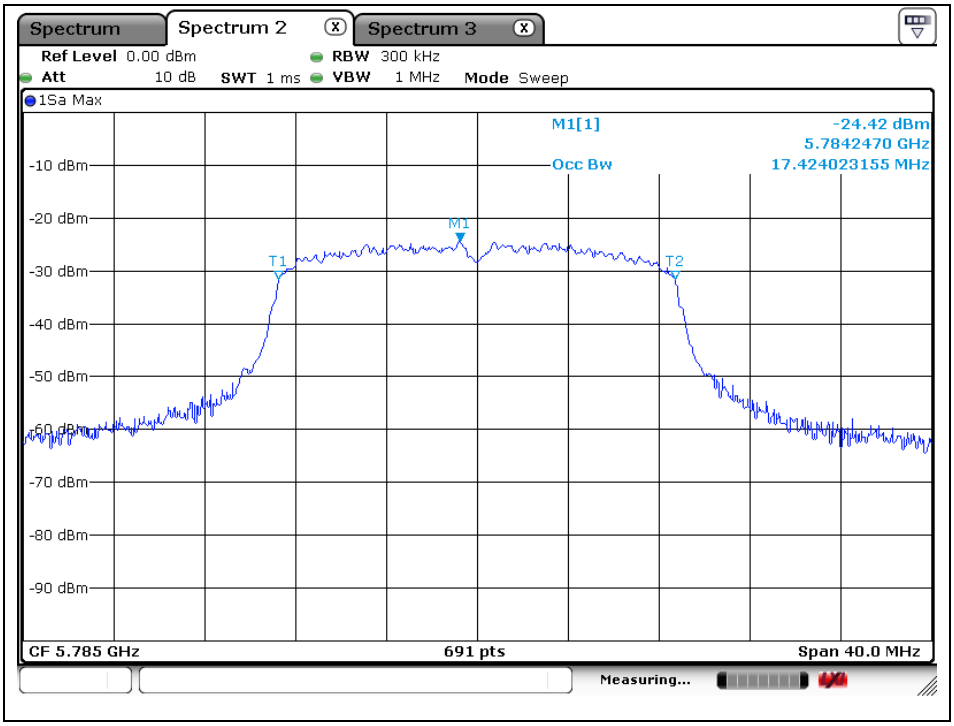


802.11n_HT20 (Band 3)

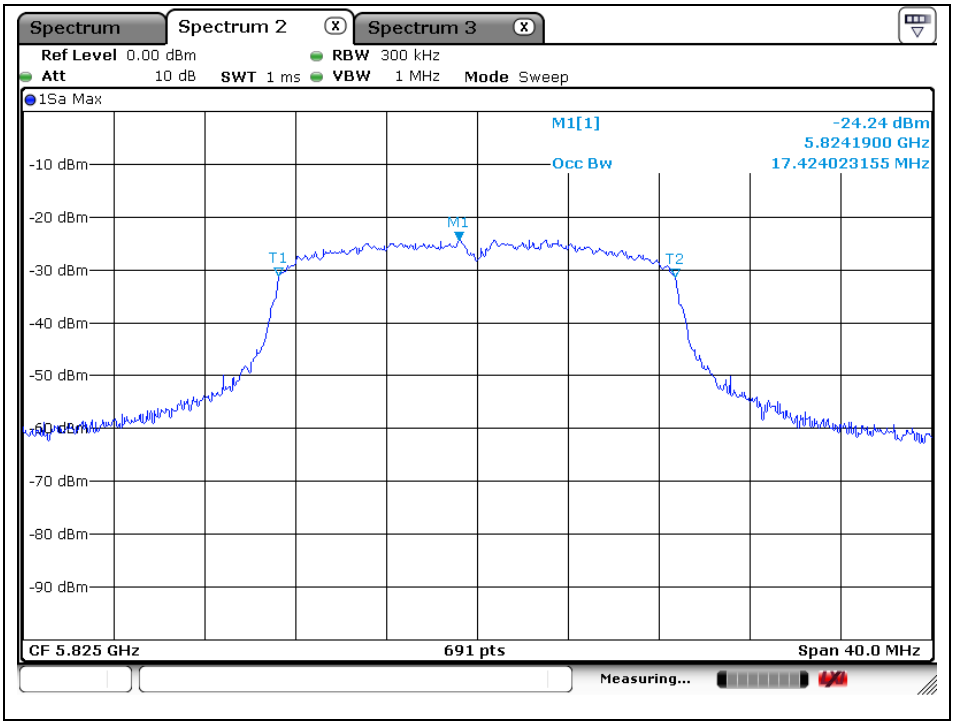
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

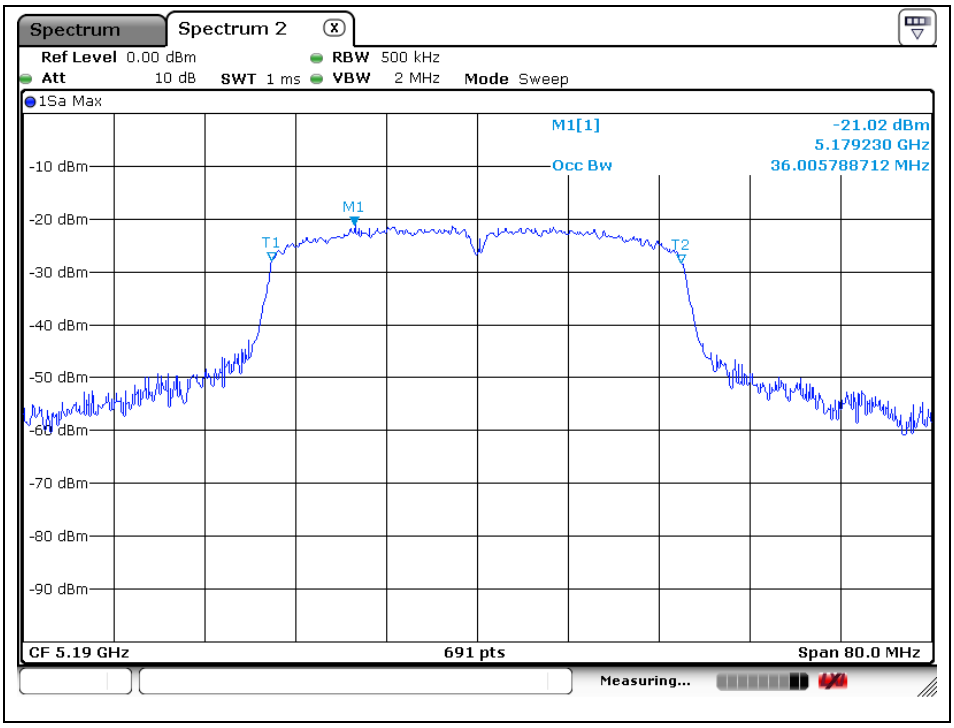


High Channel (5 825 ㎒)

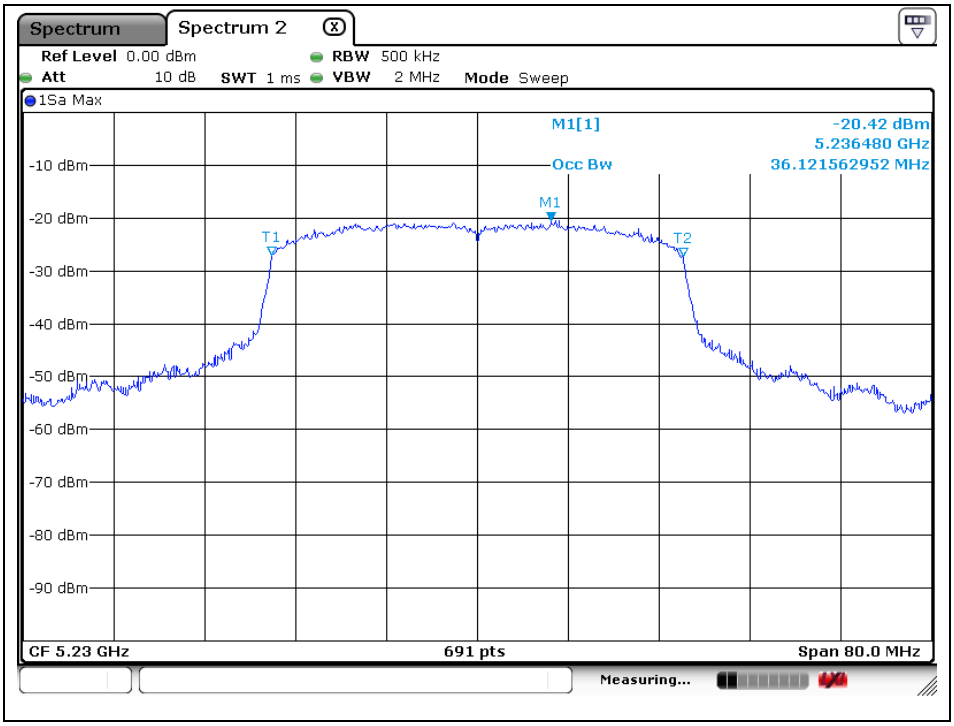


802.11n_HT40 (Band 1)

Low Channel (5 190 ㎒)

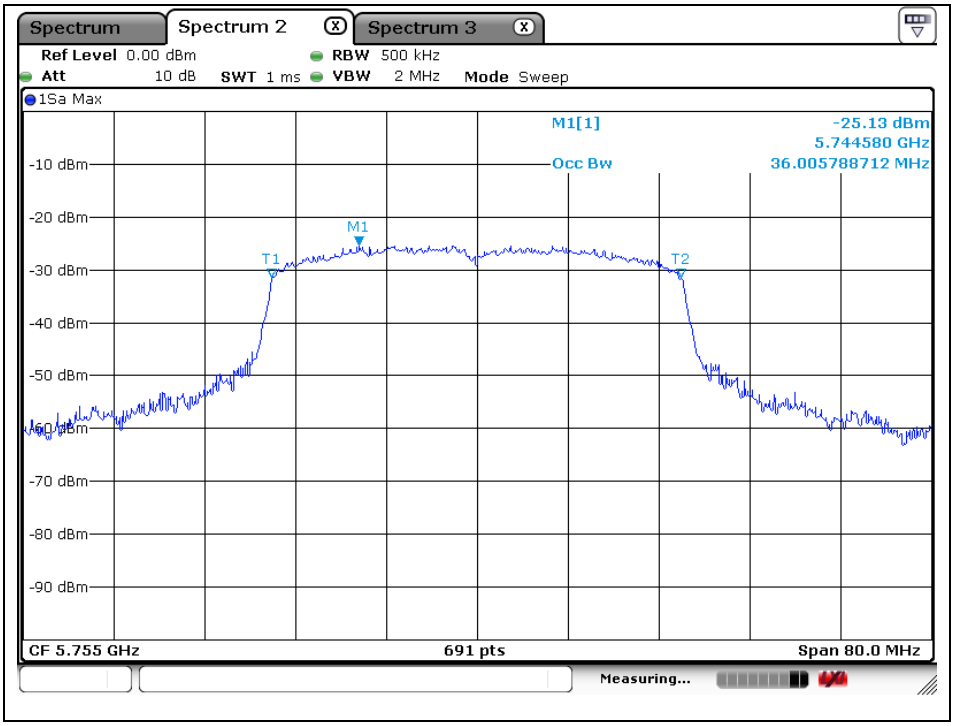


High Channel (5 230 ㎒)

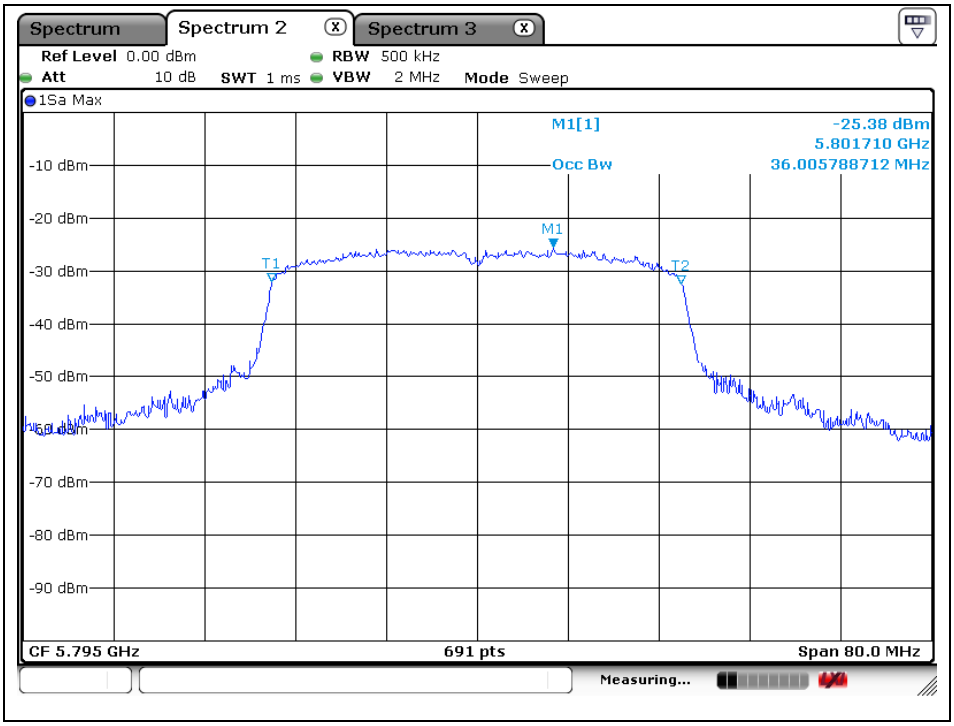


802.11n_HT40 (Band 3)

Low Channel (5 755 ㎒)

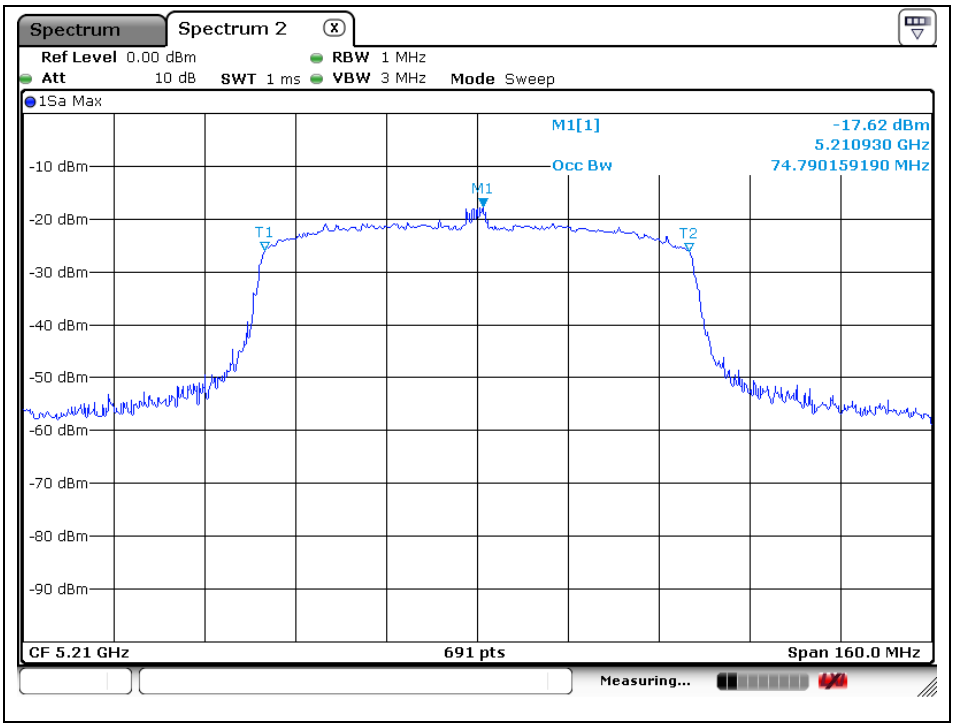


High Channel (5 795 ㎒)



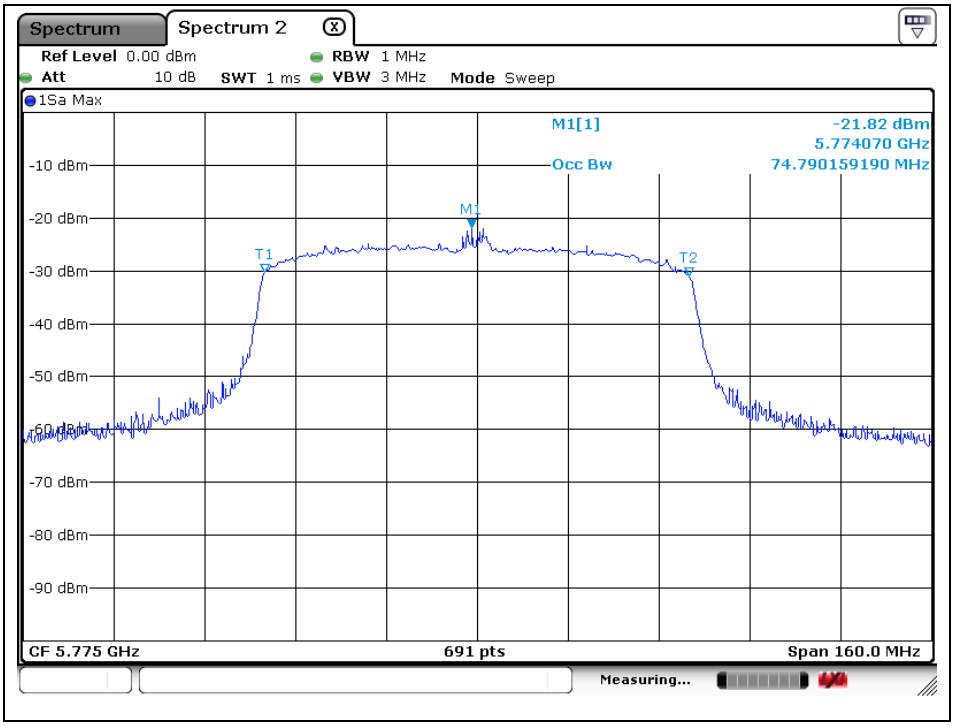
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 ㎒)



802. 11ac_VHT80 (Band 3)

Middle Channel (5 775 ㎒)



4. 6 ㎧ Bandwidth

4.1. Test Setup

EUT	—	Attenuator	—	Spectrum Analyzer

4.2. Limit

4.2.1. FCC

According to §15.407(e), within the 5.725-5.85 ㎓ band, the minimum 6 ㎧ bandwidth of U-NII devices shall be at least 500 ㎑.

4.2.2. IC

According to RSS-247 Issue 2, 6.2.4.1, the minimum -6 ㎧ Bandwidth shall be at least 500 ㎑.

4.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section C.2 of KDB 789033 D02 v02r01.
2. Set RBW = 100 ㎑.
3. Set the video bandwidth (VBW) ≥ 3 x RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 ㎧ relative to the maximum level measured in the fundamental emission.

4.4. Test result

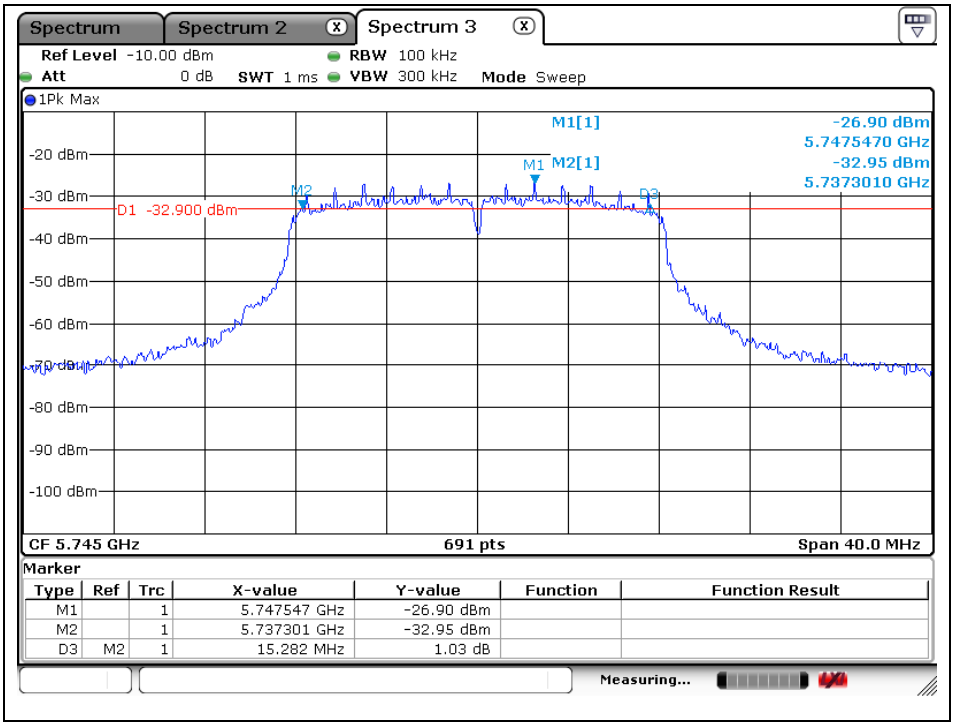
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Band	Mode	Frequency (㎒)	Ch.	Data Rate (Mbps)	6 ㏈ Bandwidth (㎒)	Minimum Bandwidth (㎑)
U-NII 3	11a	5 745	149	6	15.282	500
		5 785	157		15.340	
		5 825	165		15.224	
	11n_HT20	5 745	149	MCS0	15.166	
		5 785	157		15.166	
		5 825	165		15.166	
	11n_HT40	5 755	151	MCS0	35.220	
		5 795	159		35.250	
	11ac_VHT80	5 775	155	MCS0	75.250	

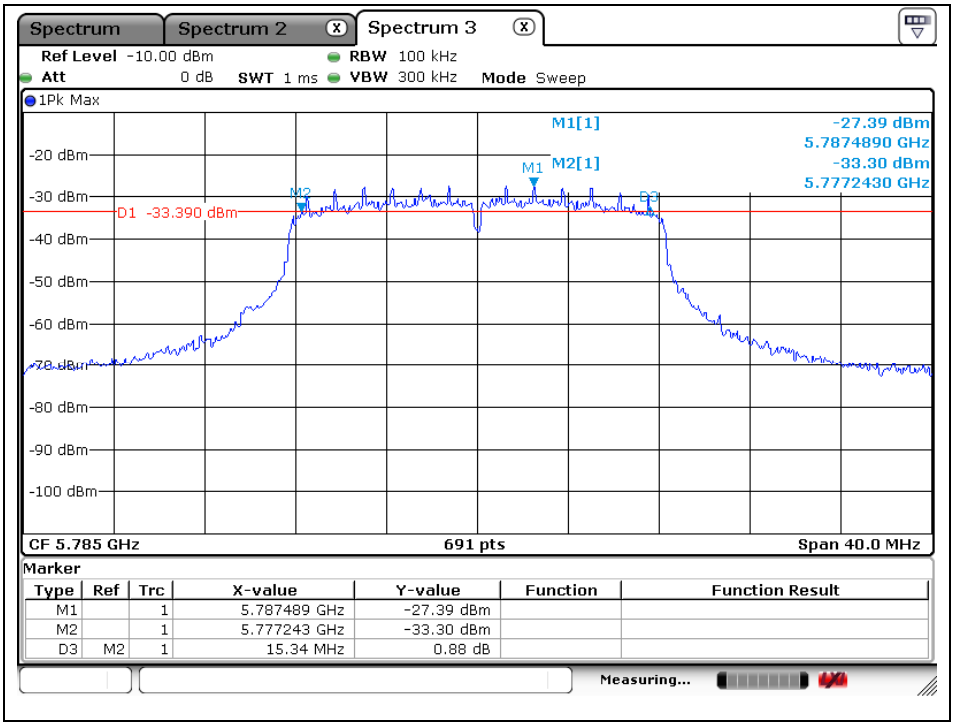
- Test plots

802.11a (Band 3)

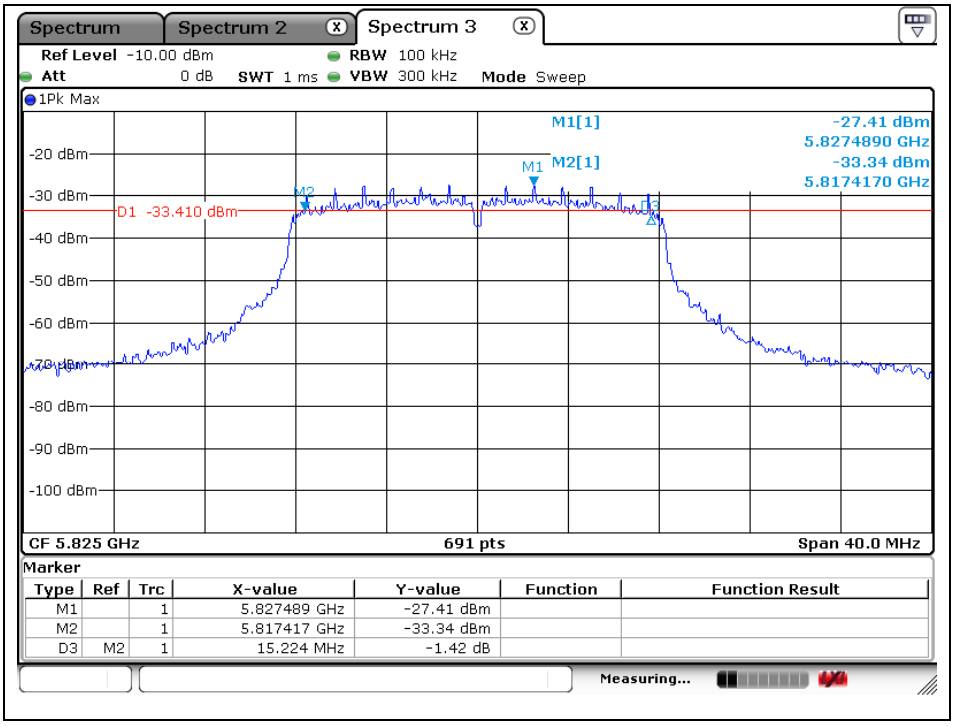
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

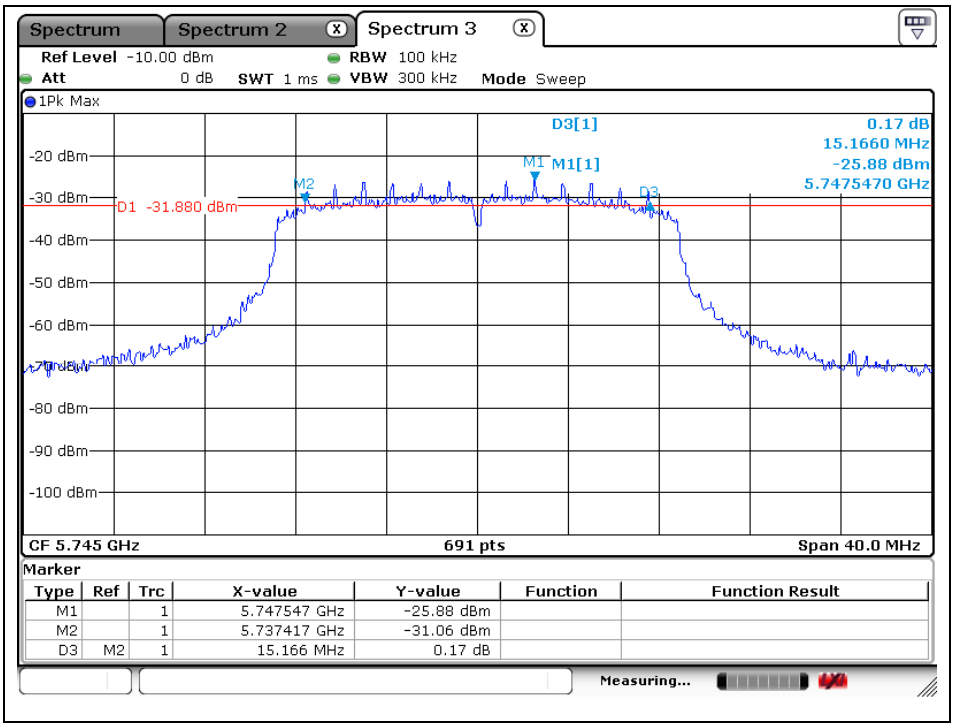


High Channel (5 825 ㎒)

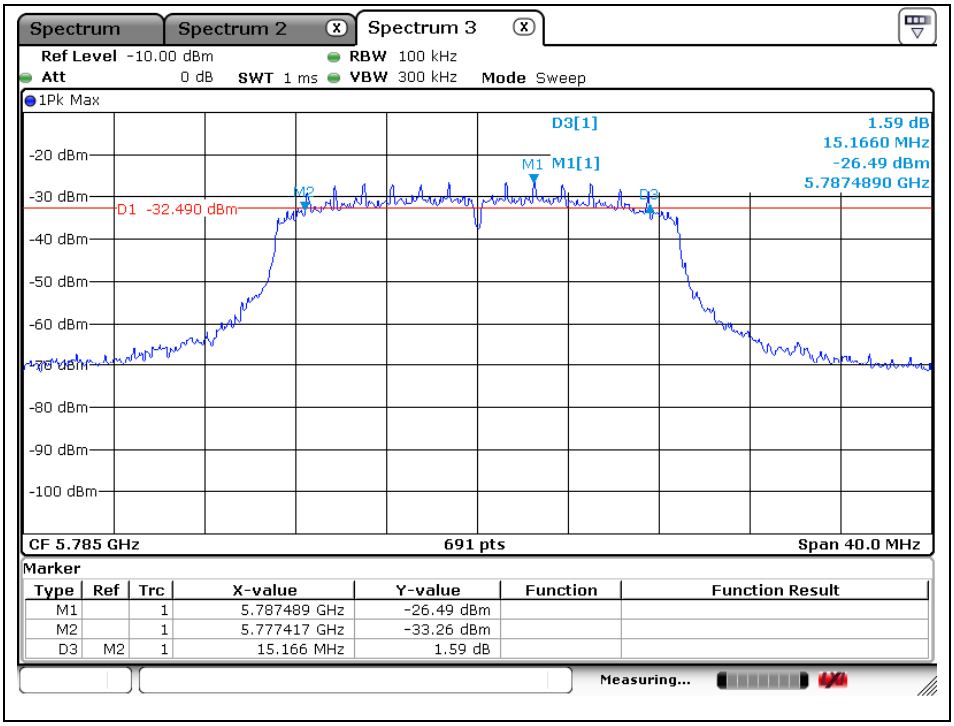


802.11n_HT20 (Band 3)

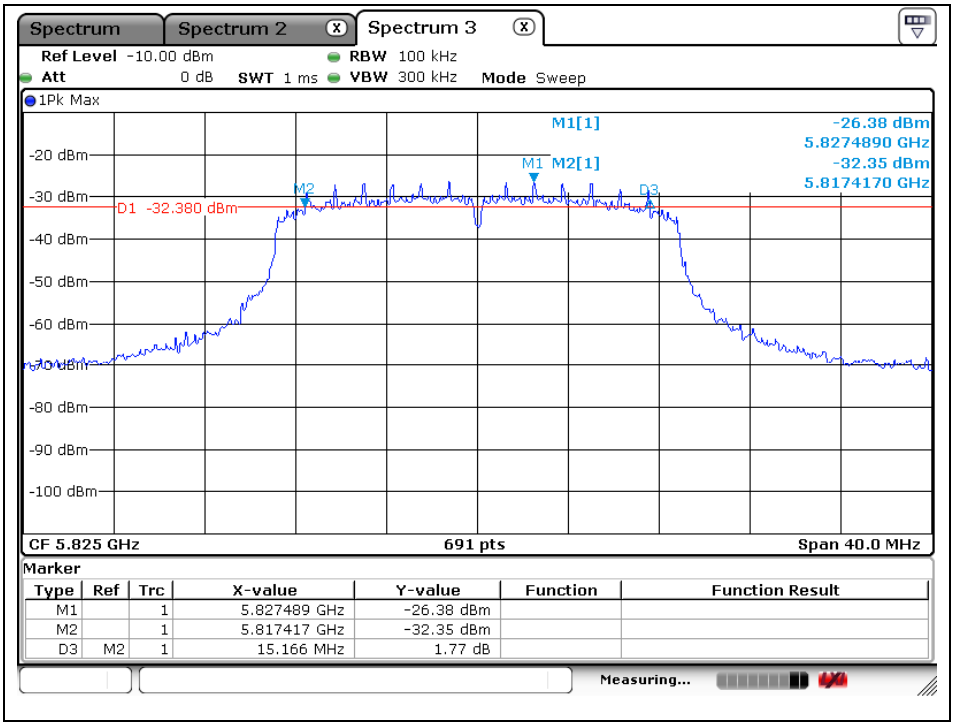
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

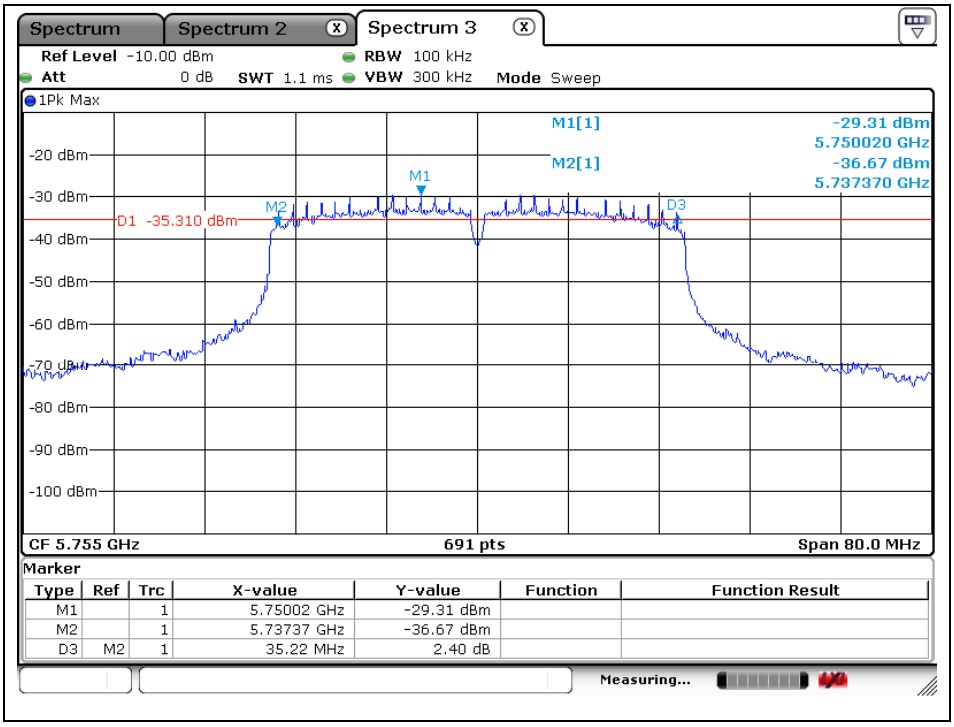


High Channel (5 825 ㎒)

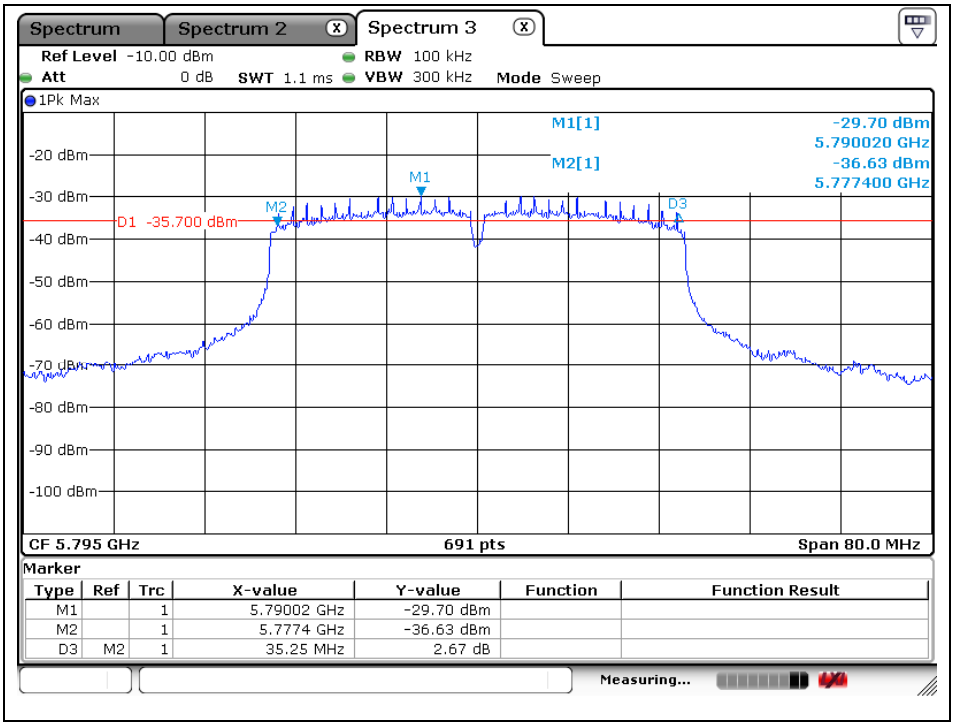


802.11n_HT40 (Band 3)

Low Channel (5 755 ㎒)

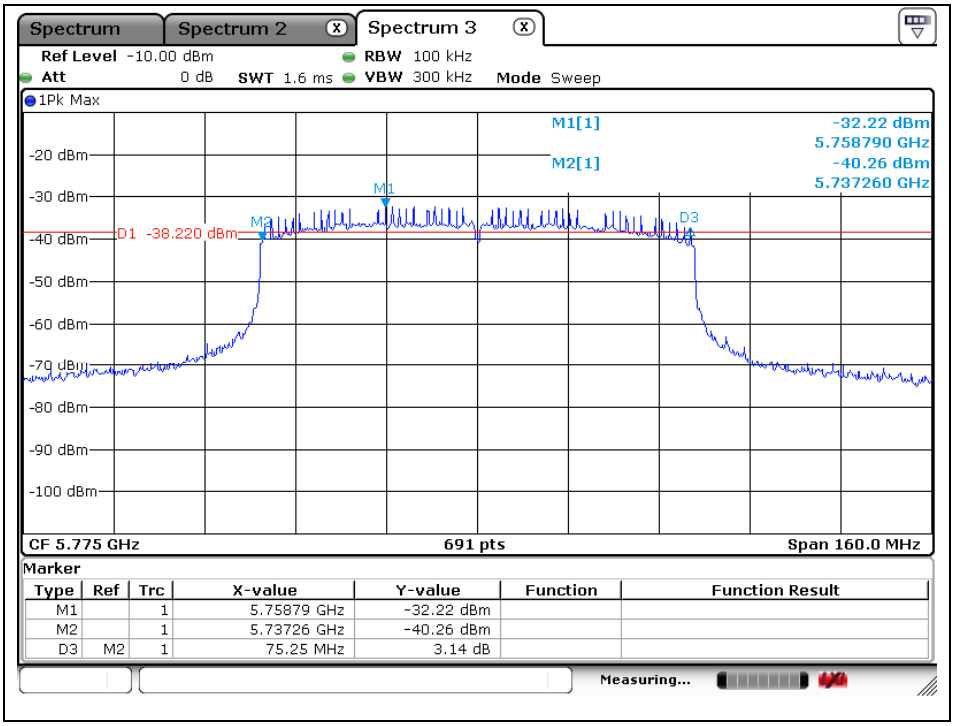


High Channel (5 795 ㎒)



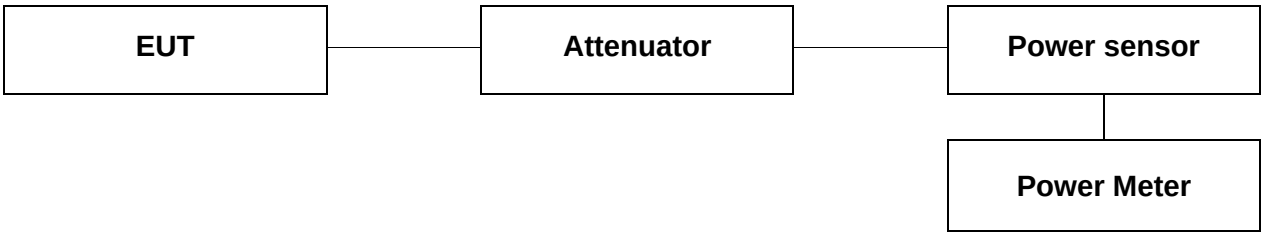
802.11ac_VHT80 (Band 3)

Middle Channel (5 775 ㎒)



5. Maximum Conducted Output Power

5.1. Test Setup



5.2. Limit

5.2.1. FCC

According to 15.407 (a)(1)(iv)

For client devices in the 5.15-5.25 ㎓ band, the maximum conducted output power over the frequency band of operation shall not exceed 250 ㎽ provided the maximum antenna gain does not exceed 6 ㏈ i. In addition, the maximum power spectral density shall not exceed 11 ㏈ m in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 ㏈ i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈ i.

According to 15.407 (a)(3)

For the band 5.725-5.85 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 ㏈ m in any 500-㎑ band. If transmitting antennas of directional gain greater than 6 ㏈ i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈ i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈ i without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

5.2.2. IC

According to RSS-247 issue2,

6.2.1.1 Frequency band 5 150-5 250 ㎒

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 ㎽ or 1.76 + 10log$_{10}$B, ㏈m, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 ㏈ below the maximum permitted e.i.r.p. of 30 ㎽.

For other devices, the maximum e.i.r.p. shall not exceed 200 ㎽ or 10 + 10log$_{10}$B, ㏈m, whichever power is less. B is the 99 % emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 ㏈m in any 1.0 ㎒ band.

6.2.4.1 Frequency band 5 725-5 850 ㎒

For equipment operating in the band 5 725-5 850 ㎒, the minimum 6 ㏈ bandwidth shall be at least 500 ㎑. The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 ㏈m in any 500 ㎑ band. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈i without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint[3] systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

5.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section E.3.a of KDB 789033 D02 v02r01.
2. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
   - The EUT is configured to transmit continuously or to transmit with a consistent duty cycle.
   - At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
   - The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
3. If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in section II.B.
4. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
5. Adjust the measurement in dBm by adding 10 log (1/x) where x is the duty cycle (e.g., 10 log(1/0.25) if the duty cycle is 25 %).

5.4. Test result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Mode	Band	Frequency (㎒)	Conducted Power				
			Data Rate (Mbps)	Average Power (㏈ m)	Duty Correction Factor (㏈)	Average Power Result (㏈ m)	E.I.R.P. (㏈ m)
11a	U-NII 1	5 180	6	7.16	0.41	7.57	13.28
		5 220		7.34		7.75	13.46
		5 240		7.33		7.74	13.45
	U-NII 3	5 745		7.91		8.32	
		5 785		7.53		7.94	
		5 825		7.45		7.86	

Band	FCC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	26 ㏈ BW (㎒)	11+10LogB (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 1	5 180	23.98			5.71	23.98
	5 220					
	5 240					
U-NII 3	5 745	30			3.82	30
	5 785					
	5 825					

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	99 % BW (㎒)	1.76+10Log$_{10}$B (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 1	5 180	14.77	16.324	13.89	5.71	13.89
	5 220		16.382	13.90		13.90
	5 240		16.266	13.87		13.87

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	99 % BW (㎒)	11+10Log$_{10}$B (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 3	5 745	30			3.82	30
	5 785					
	5 825					

Remark;

1. Average Power Result (㏈ m) = Average Power (㏈ m) + Duty Correction Factor (㏈)
2 EIRP (㏈ m) = Average Power Result (㏈ m) + Antenna gain (㏈ i)

Mode	Band	Frequency (㎒)	Conducted Power				
			Data Rate (Mbps)	Average Power (㏈m)	Duty Correction Factor (㏈)	Average Power Result (㏈m)	E.I.R.P. (㏈m)
11n_HT20	U-NII 1	5 180	MCS0	6.90	0.51	7.41	13.12
		5 220		7.16		7.67	13.38
		5 240		7.05		7.56	13.27
	U-NII 3	5 745		7.74		8.25	
		5 785		7.32		7.83	
		5 825		7.31		7.82	

Band	FCC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	26 ㏈ BW (㎒)	11+10LogB (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 1	5 180	23.98			5.71	23.98
	5 220					
	5 240					
U-NII 3	5 745	30			3.82	30
	5 785					
	5 825					

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	99 % BW (㎒)	1.76+10Log$_{10}$B (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 1	5 180	14.77	17.424	14.17	5.71	14.17
	5 220		17.424	14.17		14.17
	5 240		17.424	14.17		14.17

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	99 % BW (㎒)	11+10Log$_{10}$B (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 3	5 745	30			3.82	30
	5 785					
	5 825					

Remark;

1. Average Power Result (㏈m) = Average Power (㏈m) + Duty Correction Factor (㏈)
2 EIRP (㏈m) = Average Power Result (㏈m) + Antenna gain (㏈i)

Mode	Band	Frequency (㎒)	Conducted Power				
			Data Rate (Mbps)	Average Power (㏈ m)	Duty Correction Factor (㏈)	Average Power Result (㏈ m)	E.I.R.P. (㏈ m)
11n_HT40	U-NII 1	5 190	MCS0	7.24	0.71	7.95	13.66
		5 230		7.51		8.22	13.93
	U-NII 3	5 755		8.11		8.82	
		5 795		7.46		8.17	

Band	FCC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	26 ㏈ BW (㎒)	11+10LogB (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 1	5 190	23.98			5.71	23.98
	5 230					
U-NII 3	5 755	30			3.82	30
	5 795					

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	99 % BW (㎒)	1.76+10Log$_{10}$B (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 1	5 190	14.77	36.006	17.32	5.71	14.77
	5 230		36.122	17.34		

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈ m)	99 % BW (㎒)	11+10Log$_{10}$B (㏈ m)	Antenna gain (㏈ i)	Limit (㏈ m)
U-NII 3	5 755	30			3.82	30
	5 795					

Remark;

1. Average Power Result (㏈ m) = Average Power (㏈ m) + Duty Correction Factor (㏈)
2 EIRP (㏈ m) = Average Power Result (㏈ m) + Antenna gain (㏈ i)

Mode	Band	Frequency (㎒)	Conducted Power				
			Data Rate (Mbps)	Average Power (㏈m)	Duty Correction Factor (㏈)	Average Power Result (㏈m)	E.I.R.P. (㏈m)
11ac_VHT80	U-NII 1	5 210	MCS0	6.62	1.42	8.04	13.75
	U-NII 3	5 775		7.15		8.57	

Band	FCC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	26 ㏈ BW (㎒)	11+10LogB (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 1	5 210	23.98			5.71	23.98
U-NII 3	5 775	30			3.82	30

Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	99 % BW (㎒)	$1.76+10Log_{10}B$ (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 1	5 210	14.77	74.790	20.50	5.71	14.77

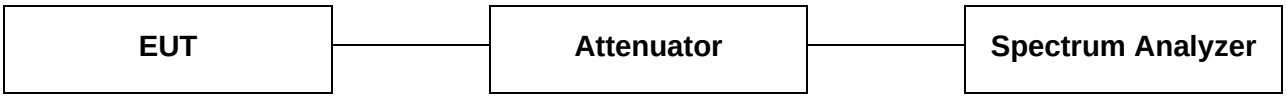
Band	IC Limit					
	Frequency (㎒)	Fixed Limit (㏈m)	99 % BW (㎒)	$11+10Log_{10}B$ (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
U-NII 3	5 775	30			3.82	30

Remark;

1. Average Power Result (㏈m) = Average Power (㏈m) + Duty Correction Factor (㏈)
2 EIRP (㏈m) = Average Power Result (㏈m) + Antenna gain (㏈i)

6. Peak Power Spectral Density

6.1. Test Setup



6.2. Limit

6.2.1 FCC

According to 15.407 (a)(1)(iv)

For client devices in the 5.15-5.25 ㎓ band, the maximum conducted output power over the frequency band of operation shall not exceed 250 ㎽ provided the maximum antenna gain does not exceed 6 ㏈ i. In addition, the maximum power spectral density shall not exceed 11 ㏈ m in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 ㏈ i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈ i.

According to 15.407 (a)(3)

For the band 5.725-5.85 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 ㏈ m in any 500-㎑ band. If transmitting antennas of directional gain greater than 6 ㏈ i are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈ i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈ i without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

6.2.2 IC

According to RSS-247 issue2,

6.2.1.1 Frequency band 5 150-5 250 ㎒

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 ㎽ or 1.76 + 10log$_{10}$B, ㏈m, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 ㏈ below the maximum permitted e.i.r.p. of 30 ㎽.

For other devices, the maximum e.i.r.p. shall not exceed 200 ㎽ or 10 + 10log$_{10}$B, ㏈m, whichever power is less. B is the 99 % emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 ㏈m in any 1.0 ㎒ band.

6.2.4.1 Frequency band 5 725-5 850 ㎒

For equipment operating in the band 5 725-5 850 ㎒, the minimum 6 ㏈ bandwidth shall be at least 500 ㎑. The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 ㏈m in any 500 ㎑ band. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the maximum conducted output power and the output power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 ㏈i without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint[3] systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

6.3. Test Procedure

All data rates and modes were investigated for this test. The full data for the worst case data rate are reported in this section.

1. This measurement settings are specified in section F of KDB 789033 D02 v02r01.

2. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, "Compute power…". (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)

3. Use the peak search function on the instrument to find the peak of the spectrum and record its value.

4. Make the following adjustments to the peak value of the spectrum, if applicable:

   a) **If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.**
   b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 ㎲ to the final result to compensate for the difference between linear averaging and power averaging.

5. The result is the Maximum PSD over 1 ㎒ reference bandwidth.

6. For devices operating in the bands 5.15-5.25 ㎓, 5.25-5.35 ㎓, and 5.47-5.725 ㎓, the above procedures make use of 1 ㎒ RBW to satisfy directly the 1 ㎒ reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 ㎓, the rules specify a measurement bandwidth of 500 ㎑. Many spectrum analyzers do not have 500 ㎑ RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 ㎒, or 500 ㎑, "provided that the measured power is integrated over the full reference bandwidth" to show the total power over the specified measurement bandwidth (*i.e.,* 1 ㎒, or 500 ㎑). If measurements are performed using a reduced resolution bandwidth (< 1 ㎒, or < 500 ㎑) and integrated over 1 ㎒, or 500 ㎑ bandwidth, the following adjustments to the procedures apply:

   a) Set RBW ≥ 1/*T*, where *T* is defined in section II.B.1.a).
   b) Set VBW ≥ 3 RBW.
   c) If measurement bandwidth of Maximum PSD is specified in 500 ㎑, add 10log(500 ㎑/RBW) to the measured result, whereas RBW (< 500 ㎑) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
   d) If measurement bandwidth of Maximum PSD is specified in 1 ㎒, add 10log(1 ㎒/RBW) to the measured result, whereas RBW (< 1 ㎒) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
   e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

6.4. Test result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)	Limit (dB m/1 MHz)
11a	U-NII 1	5 180	36	6	-4.73	0.41	-4.32	10
		5 220	44		-4.85		-4.44	
		5 240	48		-4.76		-4.35	
	Band	**Frequency (MHz)**	**Ch.**	**Data Rate (Mbps)**	**Measured PPSD (dB m)**	**Duty Correction Factor (dB)**	**Final PPSD (dB m)**	**Limit (dB m/500 kHz)**
	U-NII 3	5 745	149	6	-6.45	0.41	-6.04	30
		5 785	157		-6.60		-6.19	
		5 825	165		-6.86		-6.45	

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)	Limit (dB m/1 MHz)
11n_HT20	U-NII 1	5 180	36	MCS0	-4.95	0.51	-4.44	10
		5 220	44		-4.85		-4.34	
		5 240	48		-5.20		-4.69	
	Band	**Frequency (MHz)**	**Ch.**	**Data Rate (Mbps)**	**Measured PPSD (dB m)**	**Duty Correction Factor (dB)**	**Final PPSD (dB m)**	**Limit (dB m/500 kHz)**
	U-NII 3	5 745	149	MCS0	-6.80	0.51	-6.29	30
		5 785	157		-7.23		-6.72	
		5 825	165		-7.30		-6.79	

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)	Limit (dB m/1 MHz)
11n_HT40	U-NII 1	5 190	38	MCS0	-7.92	0.71	-7.21	10
		5 230	46		-7.69		-6.98	
	Band	**Frequency (MHz)**	**Ch.**	**Data Rate (Mbps)**	**Measured PPSD (dB m)**	**Duty Correction Factor (dB)**	**Final PPSD (dB m)**	**Limit (dB m/500 kHz)**
	U-NII 3	5 755	151	MCS0	-9.38	0.71	-8.67	30
		5 795	159		-10.08		-9.37	

Mode	Band	Frequency (㎒)	Ch.	Data Rate (Mbps)	Measured PPSD (㏈ m)	Duty Correction Factor (㏈)	Final PPSD (㏈ m)	Limit (㏈ m/1 ㎒)
11ac_VHT80	U-NII 1	5 210	42	MCS0	-11.68	1.42	-10.26	10
	Band	**Frequency (㎒)**	**Ch.**	**Data Rate (Mbps)**	**Measured PPSD (㏈ m)**	**Duty Correction Factor (㏈)**	**Final PPSD (㏈ m)**	**Limit (㏈ m/500 ㎑)**
	U-NII 3	5 775	155	MCS0	-13.50	1.42	-12.08	30

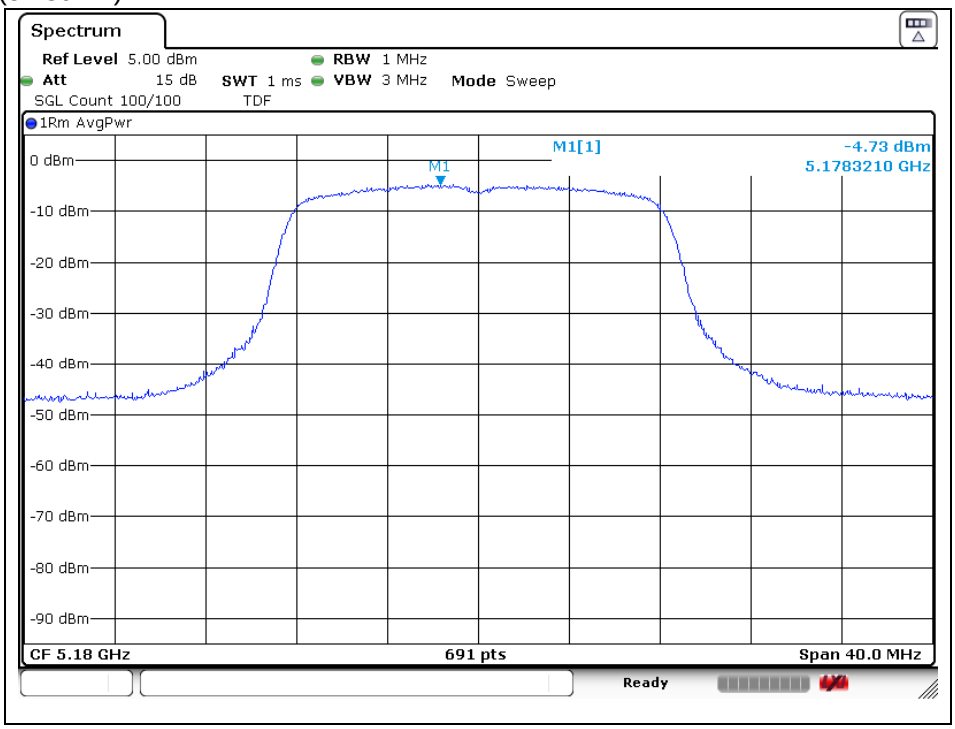
Remark;

1. Final PPSD (㏈ m) = Measured PPSD (㏈ m) + Duty Correction Factor (㏈)

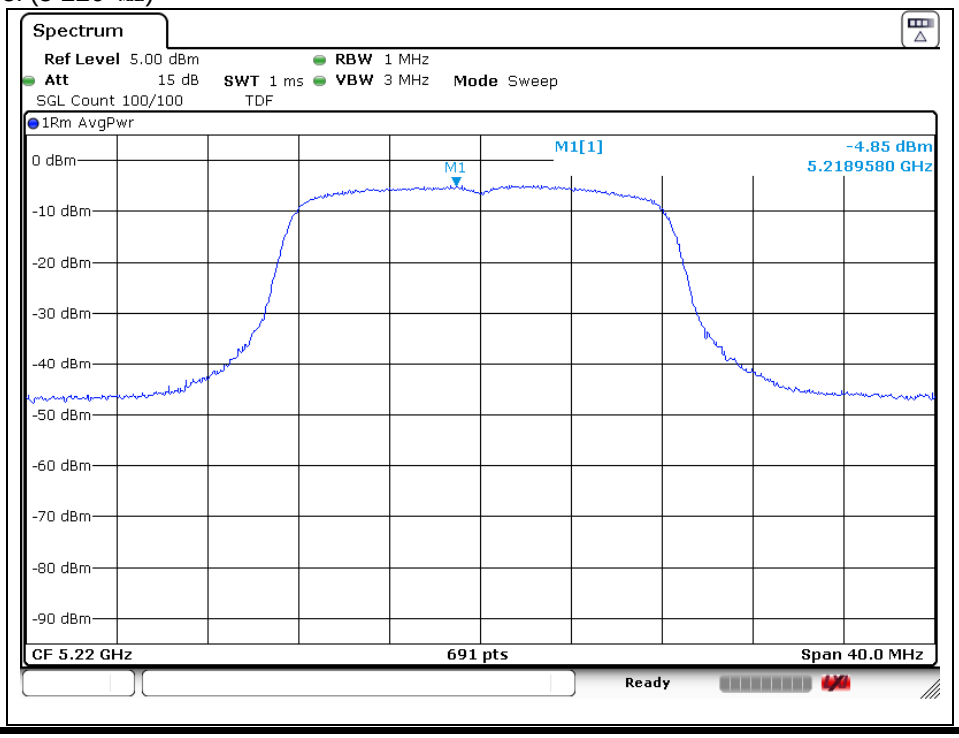
- Test plots

802.11a (Band 1)

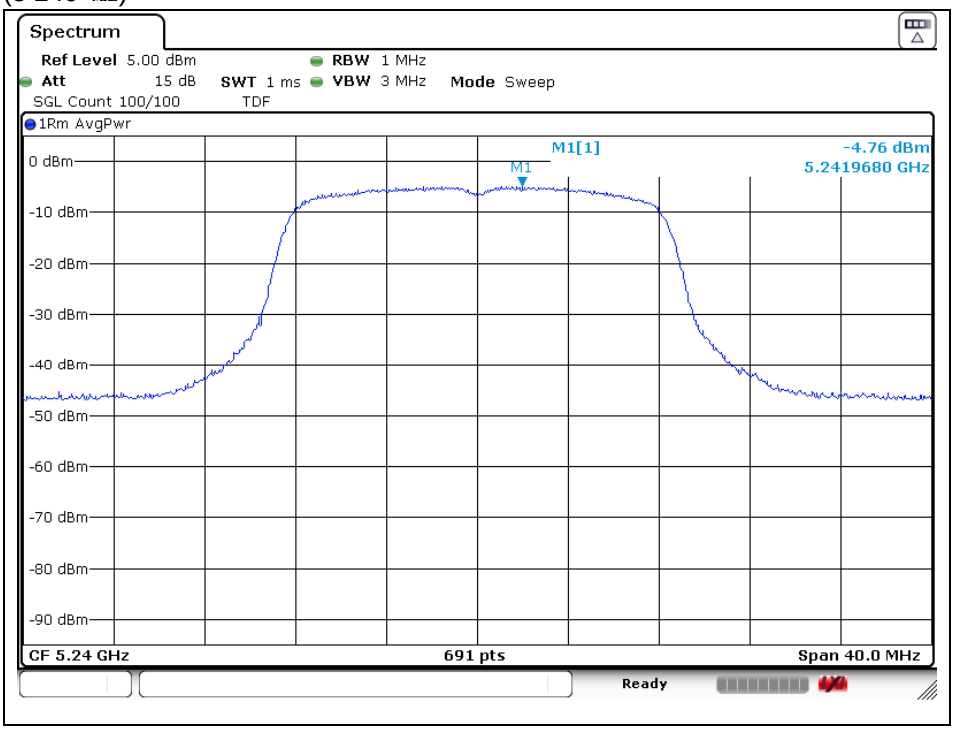
Low Channel (5 180 ㎒)



Middle Channel (5 220 ㎒)

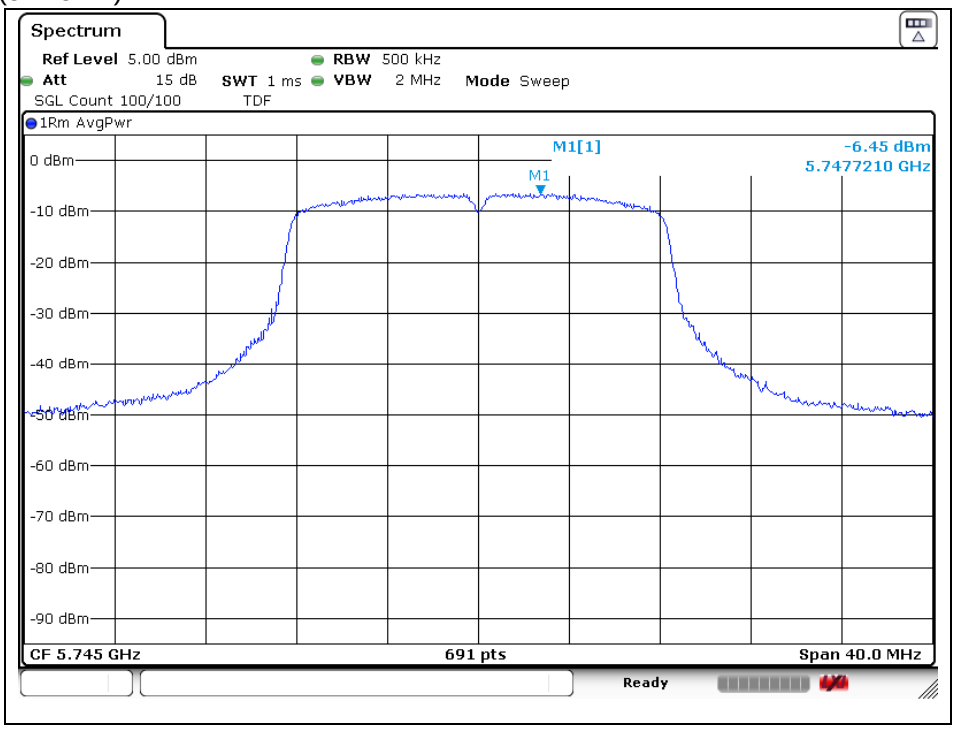


High Channel (5 240 ㎒)

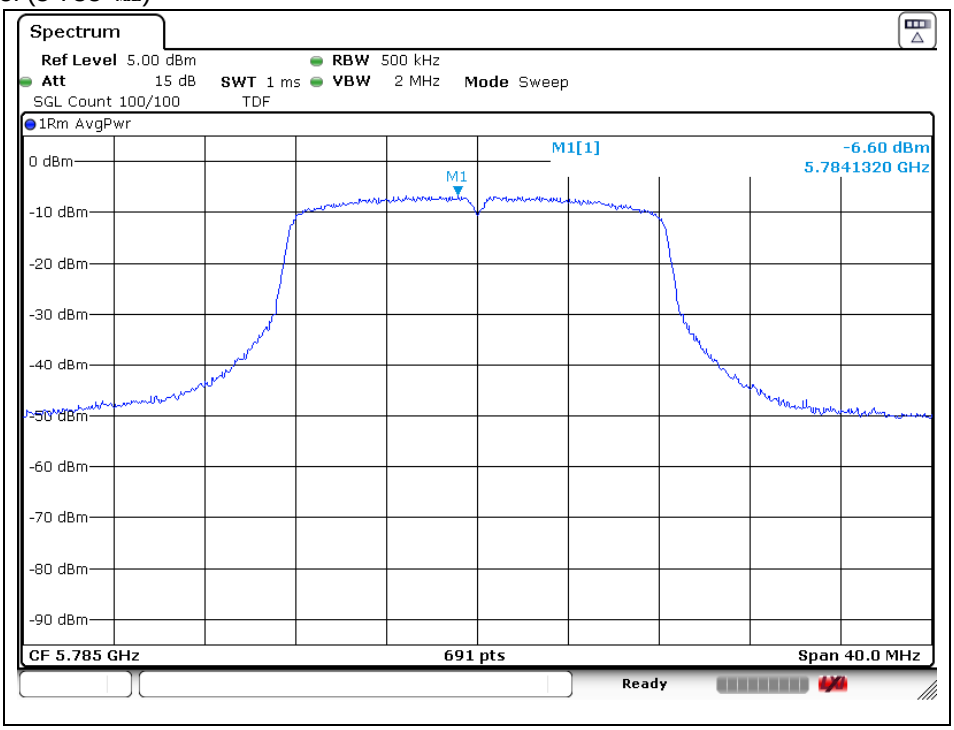


802.11a (Band 3)

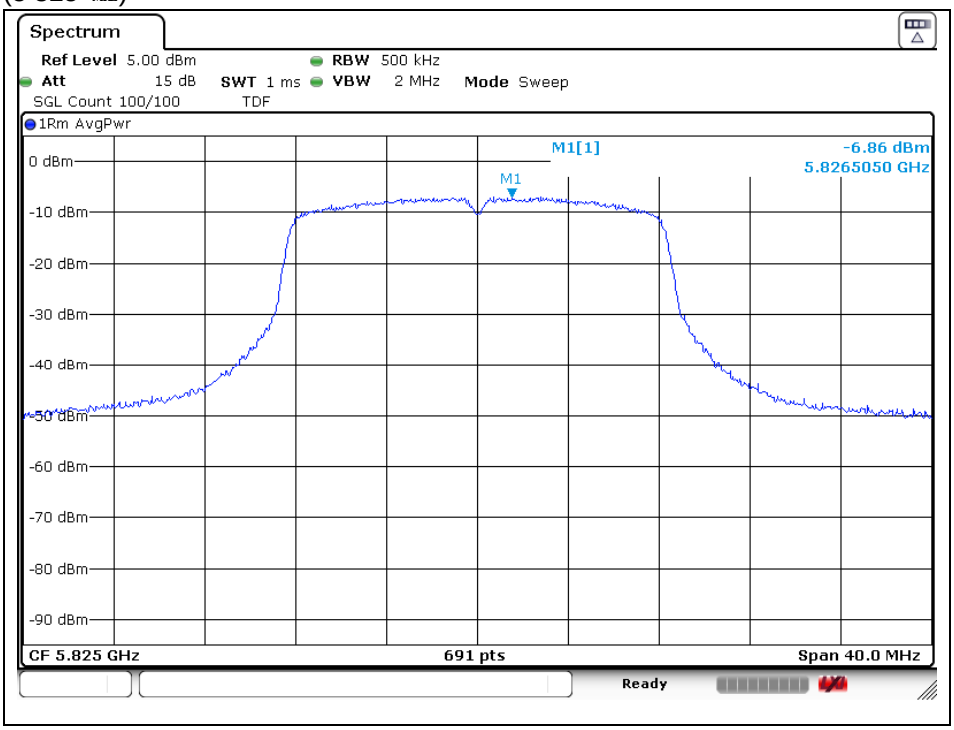
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

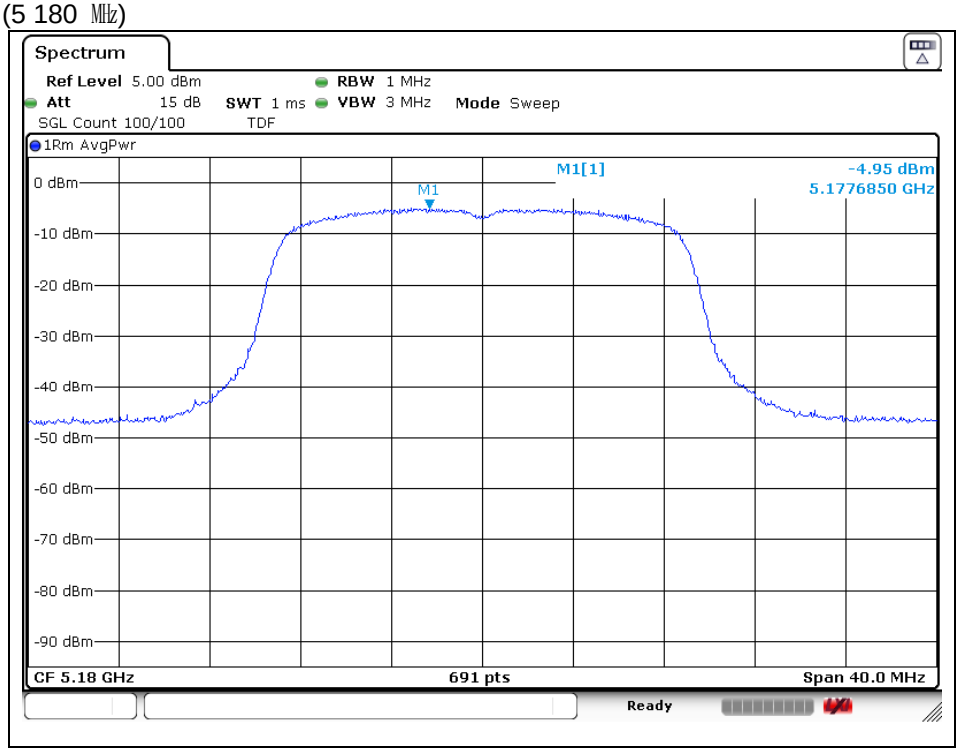


High Channel (5 825 ㎒)

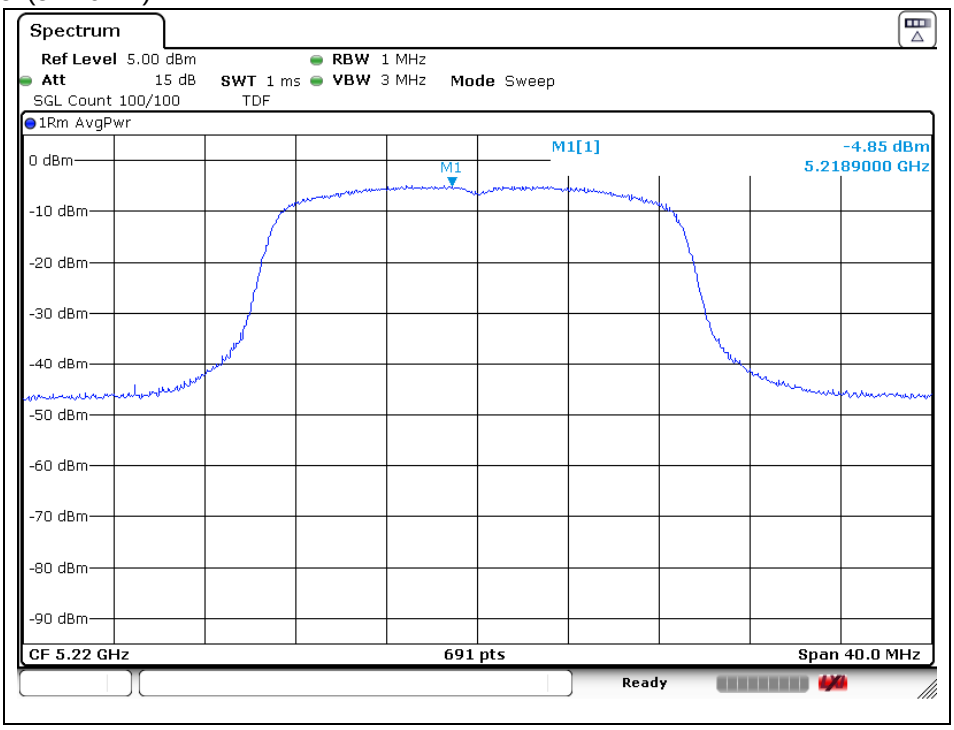


802.11n_HT20 (Band 1)

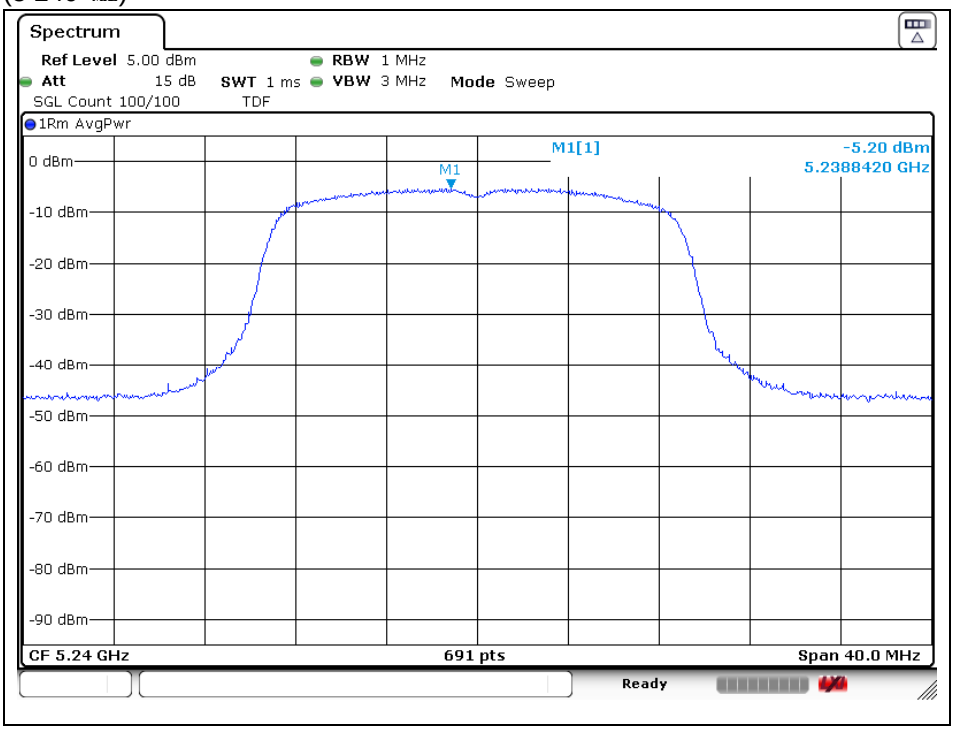
Low Channel (5 180 ㎒)



Middle Channel (5 220 ㎒)

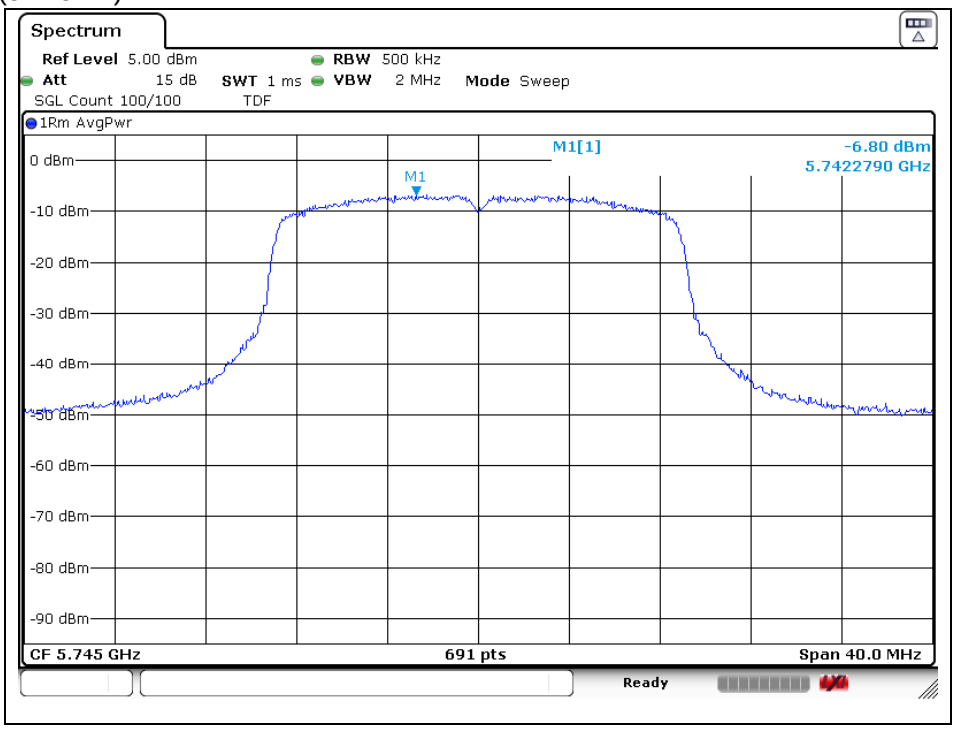


High Channel (5 240 ㎒)

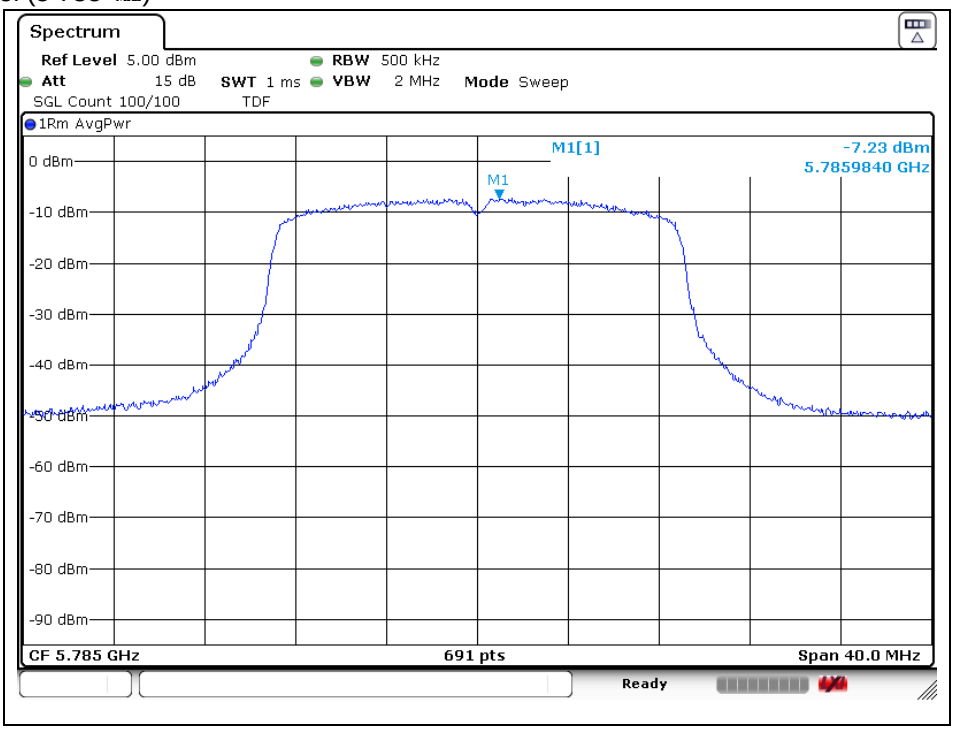


802.11n_HT20 (Band 3)

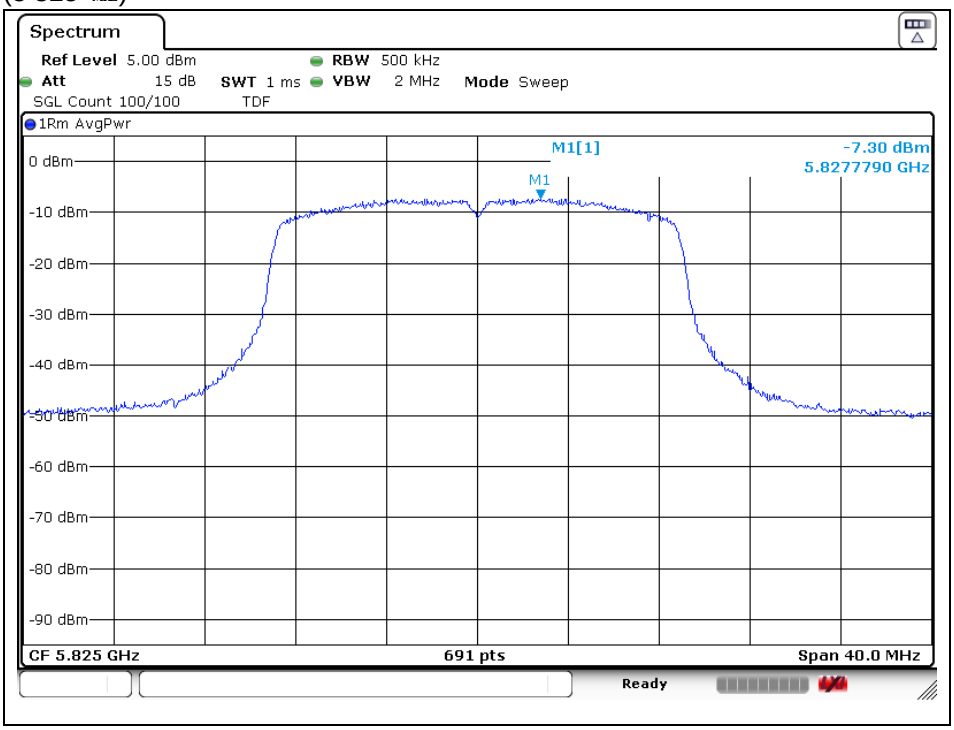
Low Channel (5 745 ㎒)



Middle Channel (5 785 ㎒)

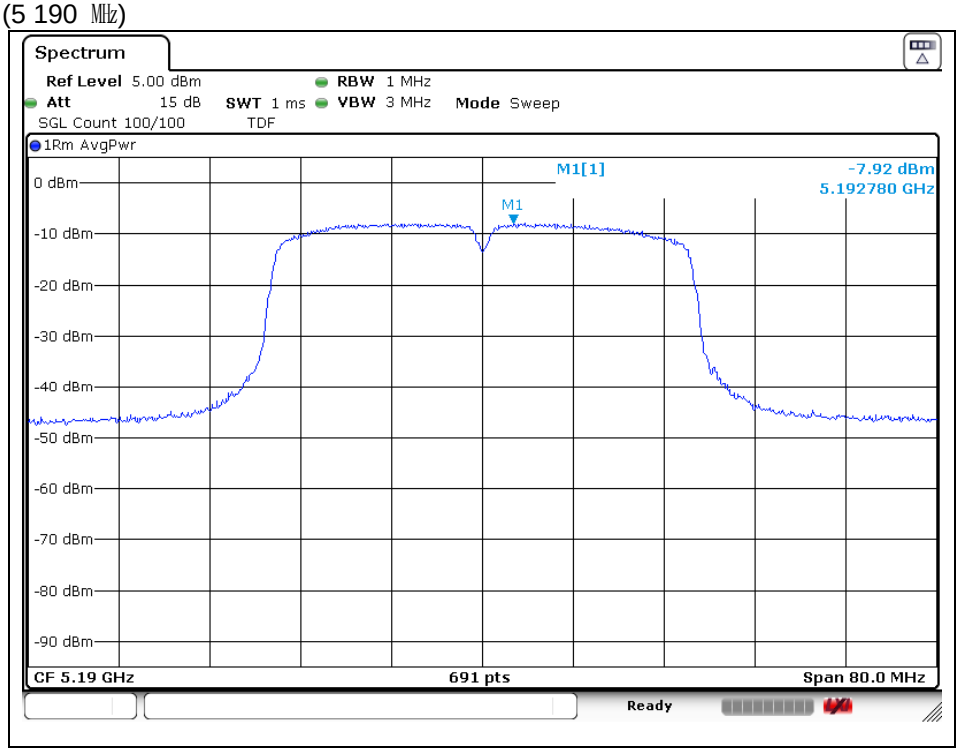


High Channel (5 825 ㎒)

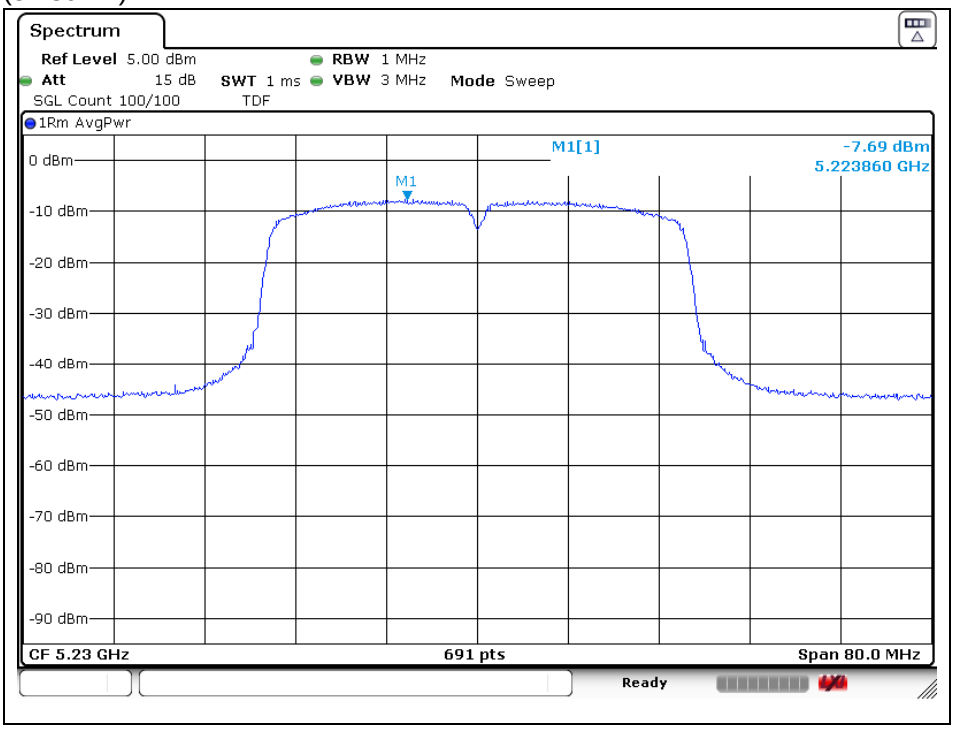


802.11n_HT40 (Band 1)

Low Channel (5 190 ㎒)

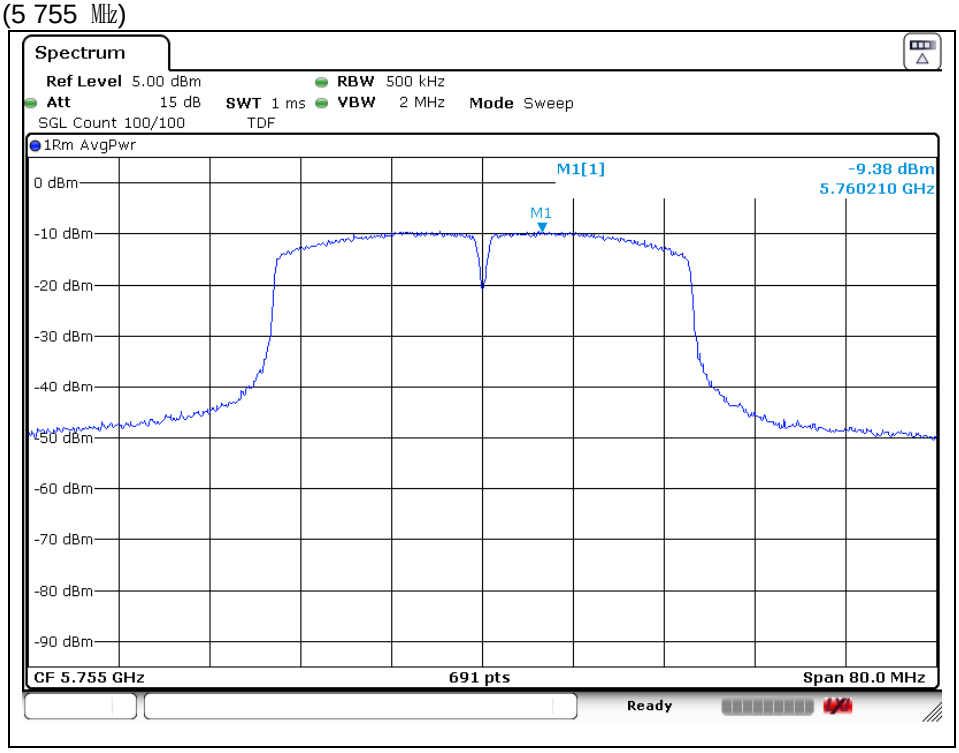


High Channel (5 230 ㎒)

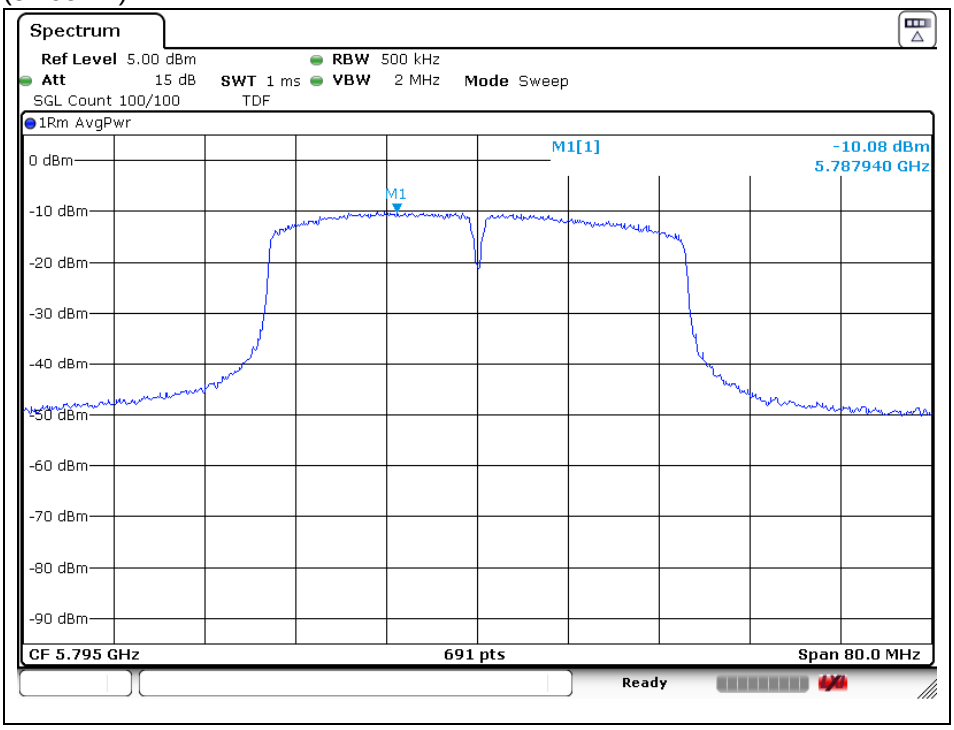


802.11n_HT40 (Band 3)

Low Channel (5 755 ㎒)

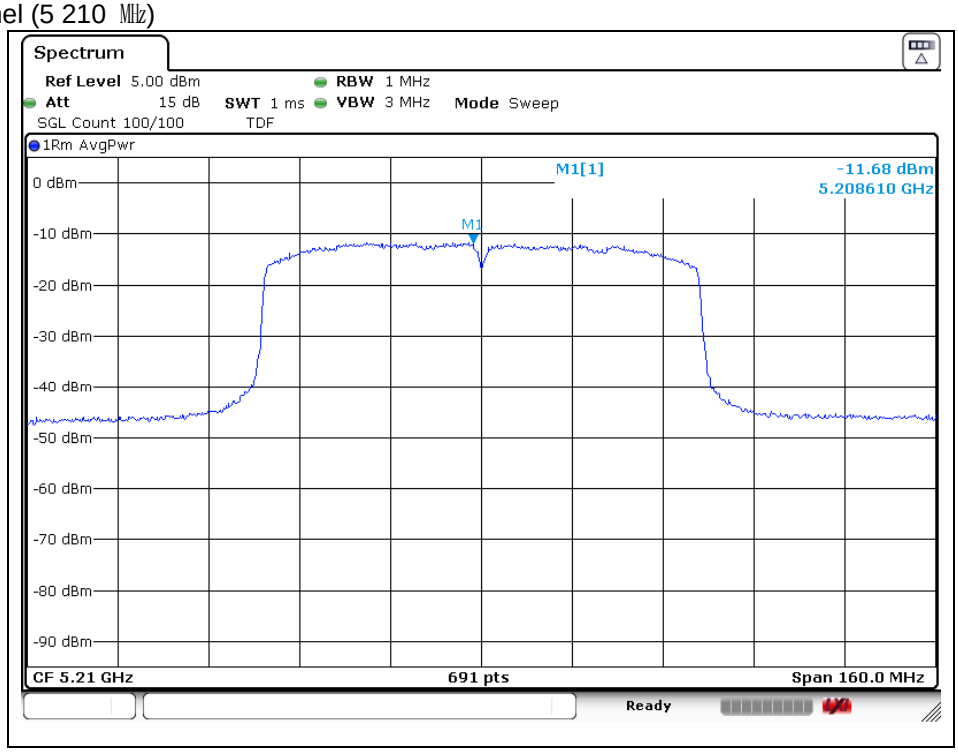


High Channel (5 795 ㎒)



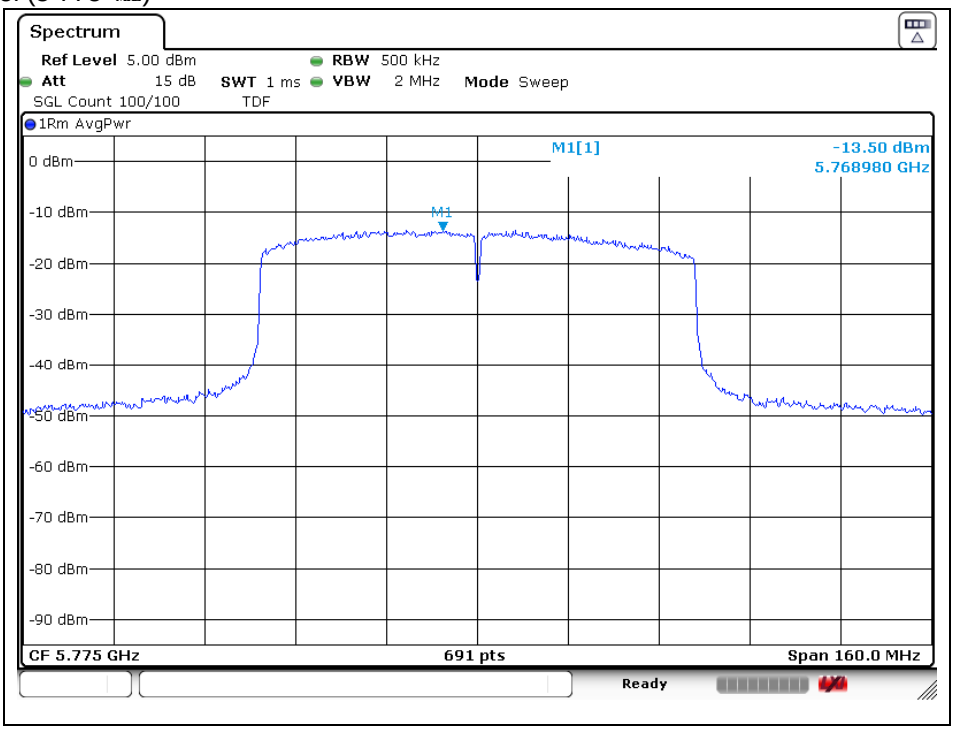
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 ㎒)



802.11ac_VHT80 (Band 3)

Middle Channel (5 775 ㎒)



7. Antenna Requirement

7.1. Standard Applicable

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section §15.407 (a) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

7.2. Antenna Connected Construction

Antenna used in this product is External antenna and peak max gain of antenna as below.

Band	5 150 ㎒ ~ 5 250 ㎒	5 725 ㎒ ~ 5 850 ㎒
Mode	11a/n_HT20, HT40, 11ac_VHT20, VHT40, VHT80	
Gain	5.71 dBi	3.82 dBi

- End of the Test Report -