Certificate of Test

NCT CO., LTD. 211-71, Geumgok-ro, Hwaseong-si, Gyeonggi-do, 18511, Republic of Korea (Tel: +82-31-323-6070 / Fax: +82-31-323-6071)	Report No.: NW2109-F012-1 Page (1) / (89)	Your business' success starts with NCT

1. **Client**
   - ○ Name : SENA TECHNOLOGIES.Inc
   - ○ Address : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
   - ○ Date of Receipt : 2021-08-05

2. **Use of Report :** FCC & IC Approval

3. **Test Sample**
   - ○ Description / Model : 50C / SP98
   - ○ FCC ID : S7A-SP98 / IC : 8154A-SP98

4. **Place of Test :** ■ Fixed test □ Field test
   (Address:211-71, Geumgok-ro, Hwaseong-si, Gyeonggi-do, 18511, Republic of Korea)

5. **Date of Test :** 2021-08-23 ~ 2021-09-16

6. **Test method used :** FCC Part 15 Subpart C 15.407
   RSS-247 Issue 2(2017-02), RSS-GEN Issue 5(2019-03)

7. **Testing Environment :**
   - ○ Temperature: (25 ± 5) °C, Humidity: Less than 75 % R.H.
   - * Unless specified otherwise in the individual methods, the tests were conducted on ambient conditions.

8. **Test Results :** Refer to the test results

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This Test Report cannot be reproduced, except in full
This test report is not related to KOLAS recognition and RRA designation.

Affirmation	**Tested by** Jong-Myoung, Shin (signature)	**Technical Manager** Changmin, Kim (signature)

Oct 12, 2021

NCT CO., LTD. (seal)

Contact us at report@nct.re.kr to confirm the authenticity of this report

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1. General Information's

1.1 Test Performed

Laboratory	:	NCT Co., Ltd.
Address	:	211-71, Geumgok-ro, Hwaseong-si, Gyeonggi-do, 18511, Korea
Telephone	:	+82-31-323-6070
Facsimile	:	+82-31-323-6071
FCC Designation No.	:	KR0166
FCC Registration Number	:	409631
IC Site Registration No.	:	25897

2. Information's about Test Item

2.1 Applicant Information

Company name	:	SENA TECHNOLOGIES.Inc
Address	:	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
Telephone / Facsimile	:	+82-2-571-8283 / +82-2-573-7710

2.2 Equipment Under Test (EUT) description

Test item particulars	:	50C
Model and/or type reference	:	SP98
Additional model name	:	-
Serial number	:	Identification
Antenna type and gain	:	Chiip Antenna(M/N: AA077) with Max gain: 2.3 dBi for U-NII 1 / Max gain: 2.6 dBi for U-NII 3
Date (s) of performance of tests:	:	2021-08-23 ~ 2021-09-16
Date of receipt of test item	:	2021-08-05
EUT condition	:	Pre-production, not damaged
EUT Power Source	:	DC 3.8 V
Type of Modulation	:	OFDM for 802.11a/n_HT20/n_HT40
Firmware version	:	1.0
Hardware version	:	1.0
Test software name(version)	:	Tera Term V4.79

2.3 Tested Frequency

5㎓ Band	802.11a/n_HT20		802.11n_HT40		Remark
	Channel	Frequency (㎒)	Channel	Frequency (㎒)	
U-NII 1	36	5 180	38	5 190	
	44	5 220			
	48	5 240	46	5 230	
U-NII 3	149	5 745	151	5 755	
	157	5 785			
	165	5 825	159	5 795	

2.4 Transmitting Configuration of EUT

Test Mode	Data rate
802.11a	6 ~ 54 Mbps
802.11n_HT20	MCS 0 ~ 7
802.11n_HT40	MCS 0 ~ 7

3. Test Report

3.1 Test Summary

Applied	FCC	IC	Test Items	Limit	Test Condition	Result
☒	15.203	-	Antenna Requirement	FCC 15.203	Conducted	C
☒	15.407(a)	-	Emission Bandwidth (26 ㏈ Bandwidth)	N/A		C
☒	15.407(e)	RSS-247(6.2.4)	Minimum Emission Bandwidth (6 ㏈ Bandwidth)	> 500 ㎑ in 5725 ~ 5850 ㎒		C
☒	-	RSS-GEN(6.7)	Occupied Bandwidth (99%)	N/A		C
☒	15.407(a)	RSS-247(6.2)	Maximum Conducted Output Power	5150 ~ 5250 ㎒ : < 23.97 ㏈m 5250 ~ 5350 & 5470 ~ 5725 ㎒ : < 250 ㎽ or < 11 + 10 log10(B) ㏈m, whichever power is less. (B is the 26㏈ BW.) 5725 ~ 5850 ㎒ : < 30 ㏈m		C
☒	15.407(a)	RSS-247(6.2)	Peak Power Spectral Density	5150 ~ 5250 ㎒ : 11 ㏈m/㎒ 5250 ~ 5350 ㎒ : 11 ㏈m/㎒ 5470 ~ 5725 ㎒ : 11 ㏈m/㎒ 5725 ~ 5850 ㎒ : 30 ㏈m/500㎑		C
☐	15.407(h)	RSS-GEN(6.3)	Dynamic Frequency Selection	FCC 15.407(h)		NA note2
☒	15.407(b)	RSS-247(6.2) RSS-GEN(8.9) RSS-GEN(8.10)	Undesirable Emissions	5150 ~ 5725 ㎒: < -27 ㏈m/㎒ EIRP 5725 ~ 5850 ㎒: < -27 ㏈m/㎒ or < 10 ㏈m/㎒ or 15.6 ㏈m/㎒ < 27㏈m/㎒ EIRP	Radiated	C
☒	15.205 15.209 15.407(b)	RSS-247(6.2) RSS-GEN(8.9) RSS-GEN(8.10)	General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		C
☒	15.207	RSS-GEN(8.8)	Conducted Emissions	FCC 15.207	AC Line Conducted	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: This product was not used the U-NII 2A and U-NII 2C.

The sample was tested according to the following specification: ANSI C63.10:2013, KDB789033 D02 V01, KDB644545 D03

Compliance was determined by specification limits of the applicable standard according to customer requirements.

3.2 Test Report Version

Test Report No.	Date	Description
NW2109-F012	2021-09-17	Initial issue
NW2109-F012-1	2021-10-12	Added the test result for radiated spurious emission.

3.3 Transmitter Requirements

3.3.1 Antenna Requirement

Accoding to §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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

3.3.1.1 Result

Complies
(The transmitter has a Chip Antenna. The directional peak gain of the antenna is 2.3 ㏈i for U-NII 1 and 2.6 ㏈i for U-NII 3.)

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3.3.2 26 ㏈ Bandwidth & Occupied Bandwidth

3.3.2.1 Test Setup

Refer to the APPENDIX I.

3.3.2.2 Limit

N/A
(The 26 ㏈ bandwidth is used to determine the conducted output power limit.)

3.3.2.3 Test Procedure

The bandwidth at 26 ㏈ down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

1. Set resolution bandwidth (RBW) = approximately 1 % of the EBW.
2. Set the video bandwidth (VBW) > RBW.
3. Detector = Peak.
4. Trace mode = Max Hold.
5. Sweep = Auto
6. Allow the trace to stabilize.
7. 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%.

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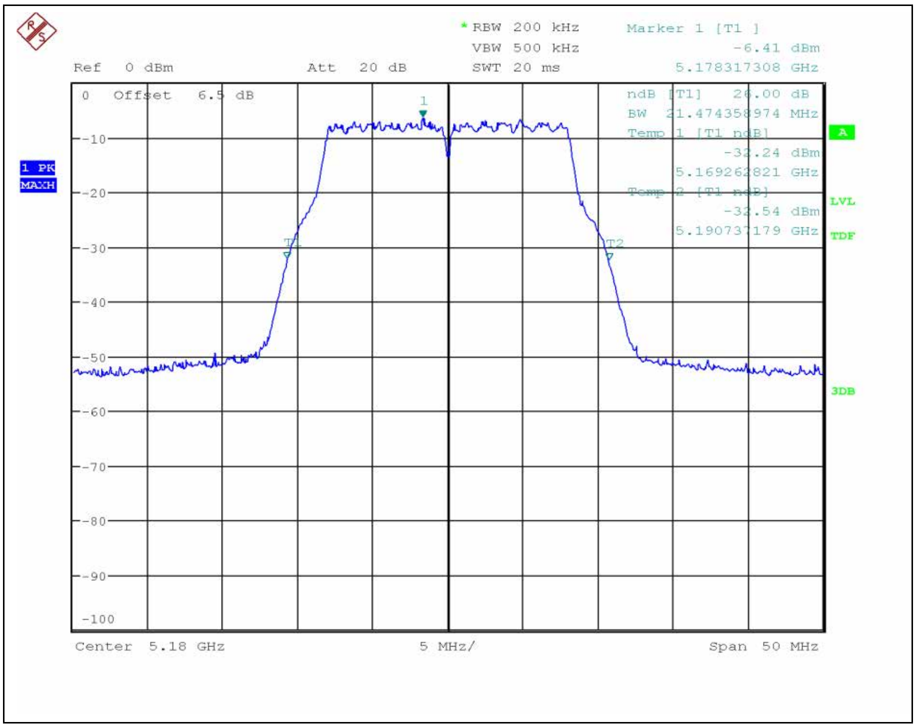
3.3.2.4 Test Result

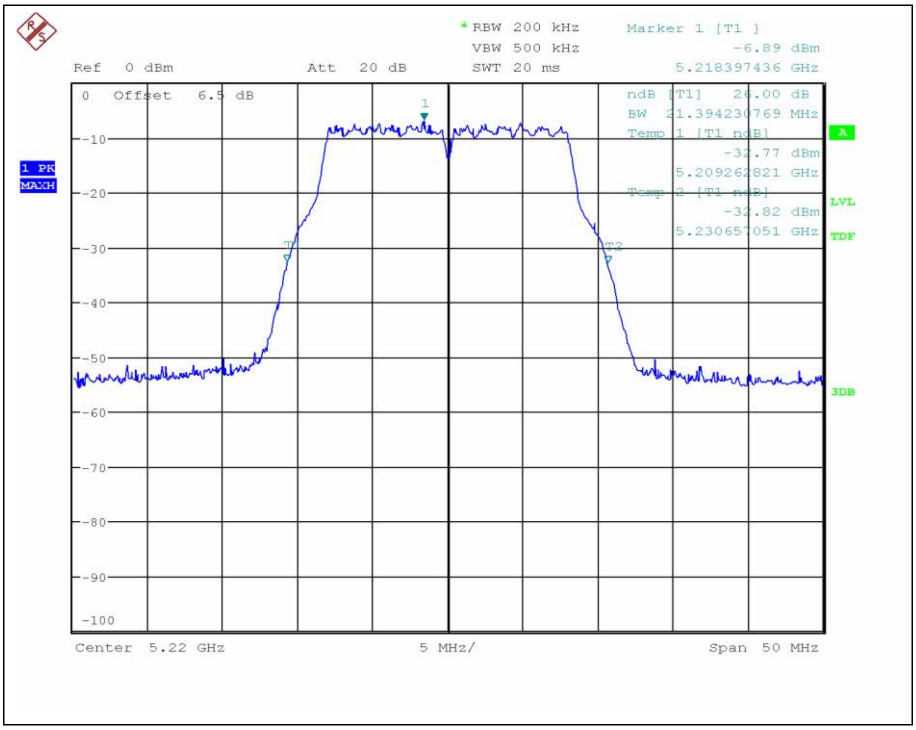
Test Mode	Band	Test Channel	26 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
802.11a	**U-NII 1**	**36**	21.474	16.781
		44	21.394	16.781
		48	21.394	16.781
802.11n _HT20	**U-NII 1**	**36**	21.955	18.000
		44	21.875	18.063
		48	21.795	17.938
802.11n _HT40	**U-NII 1**	**38**	39.744	36.125
		46	39.744	36.250

3.3.2.5 Test Plot

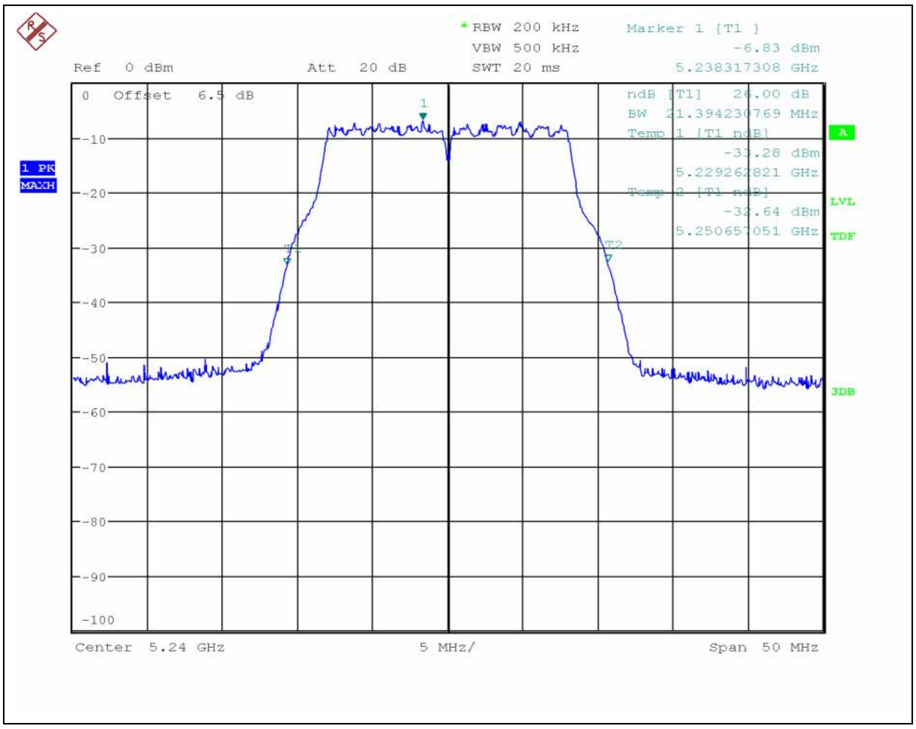
802.11a _ ch.36 **26 ㏈ Bandwidth**



802.11a _ ch.44 **26 ㏈ Bandwidth**



802.11a _ ch.48 26 ㏈ Bandwidth



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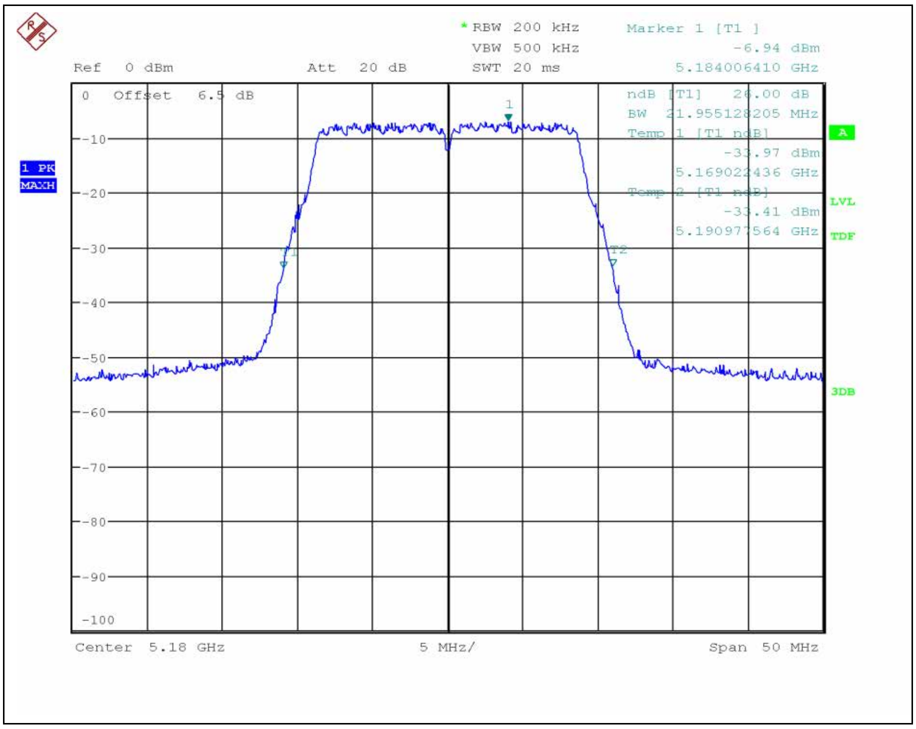
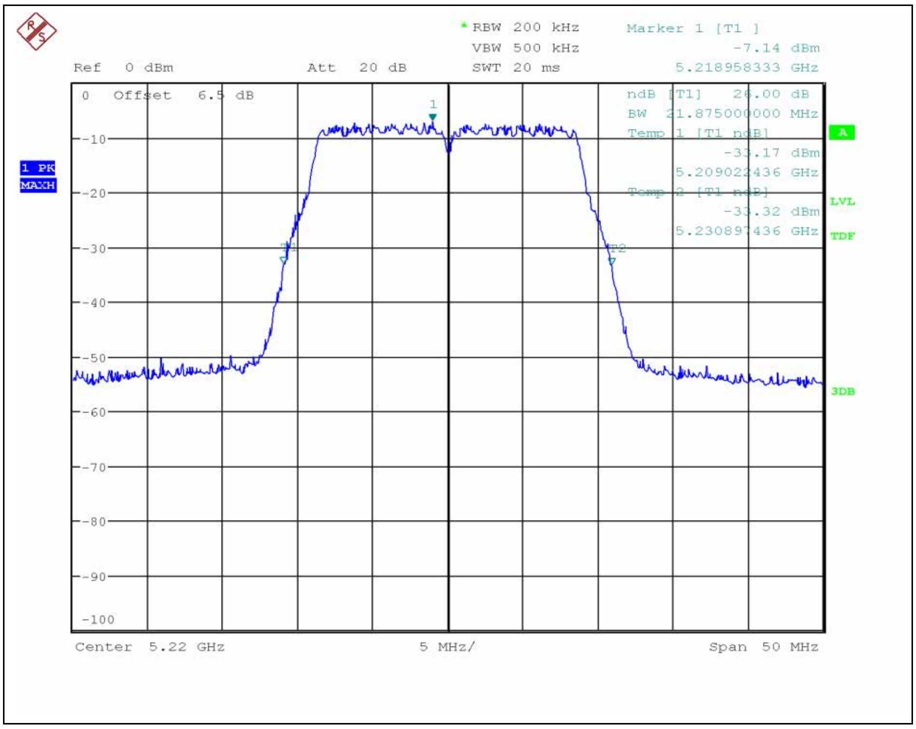
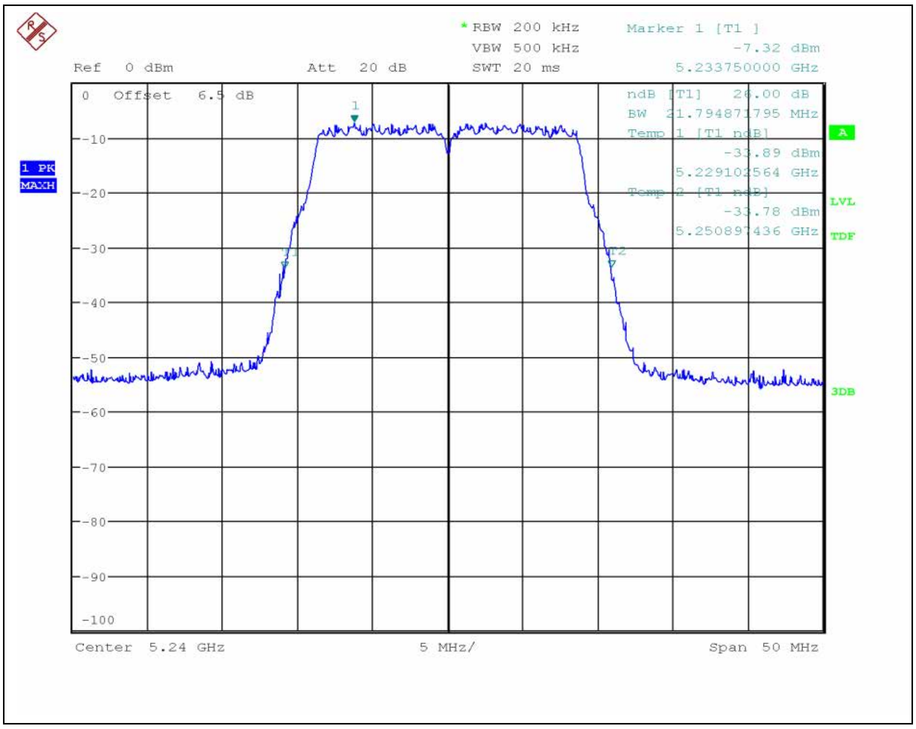
802.11n_HT20 _ ch.36 **26 ㏈ Bandwidth**



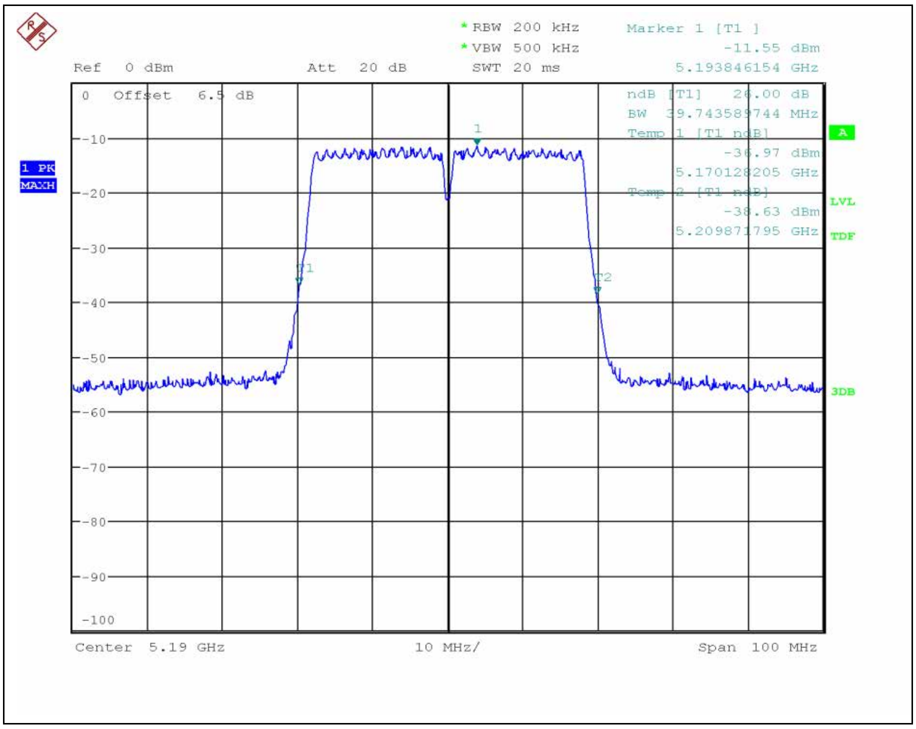
802.11n_HT20 _ ch.44 **26 ㏈ Bandwidth**



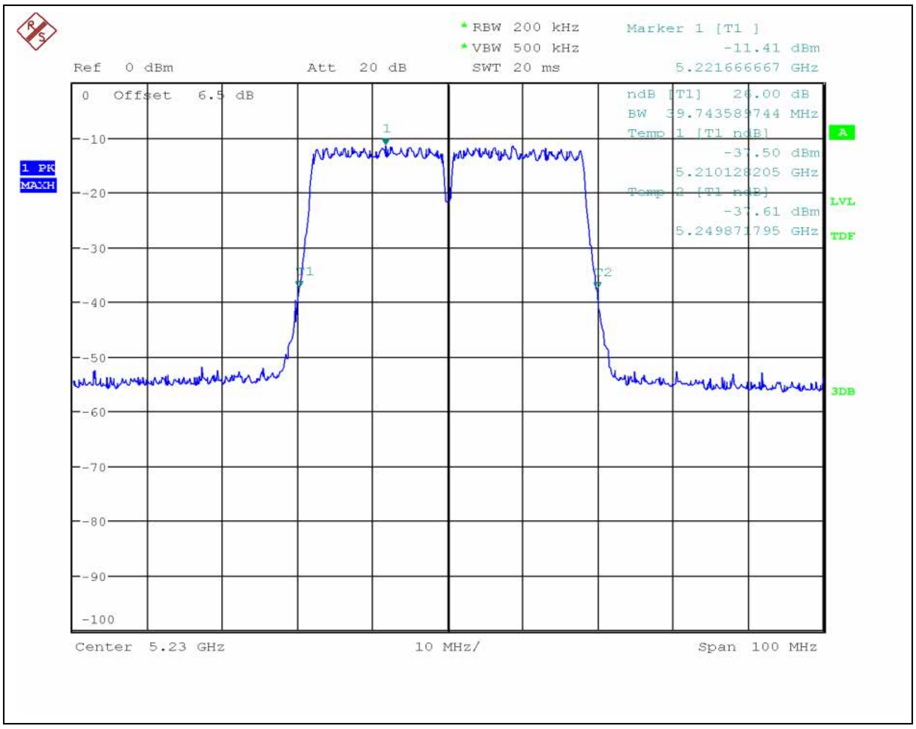
802.11n_HT20 _ ch.48 **26 ㏈ Bandwidth**



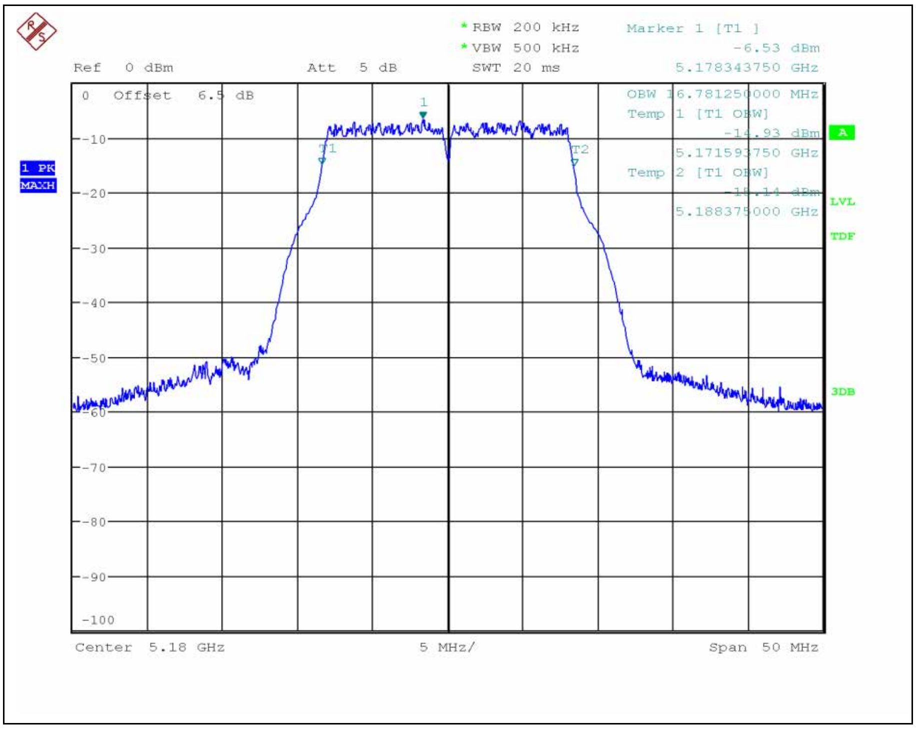
802.11n_HT40 _ ch.38 — 26 ㏈ Bandwidth



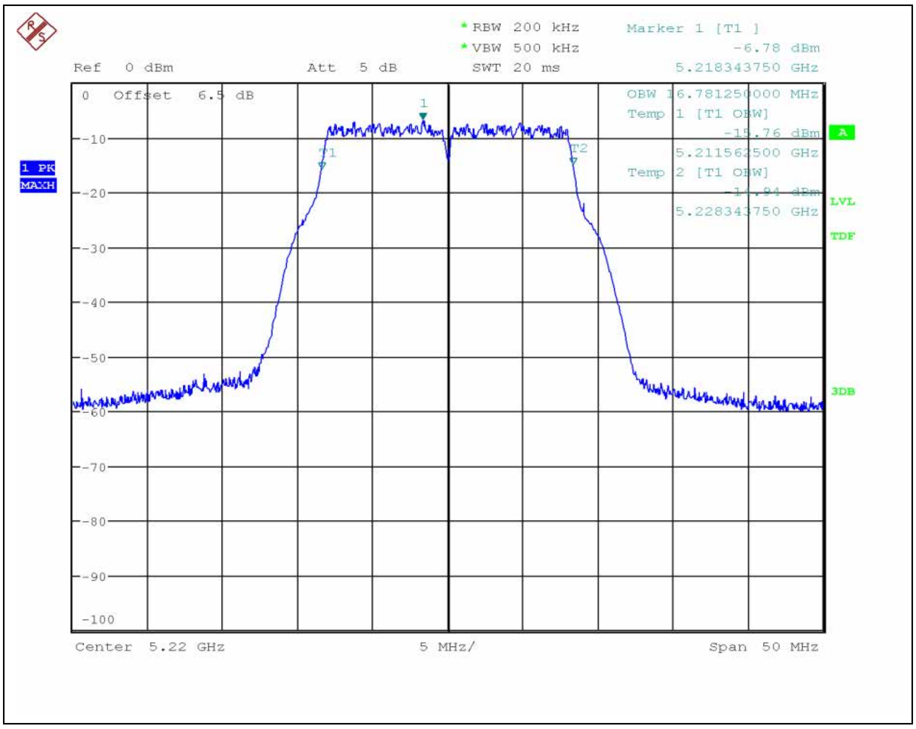
802.11n_HT40 _ ch.46 — 26 ㏈ Bandwidth



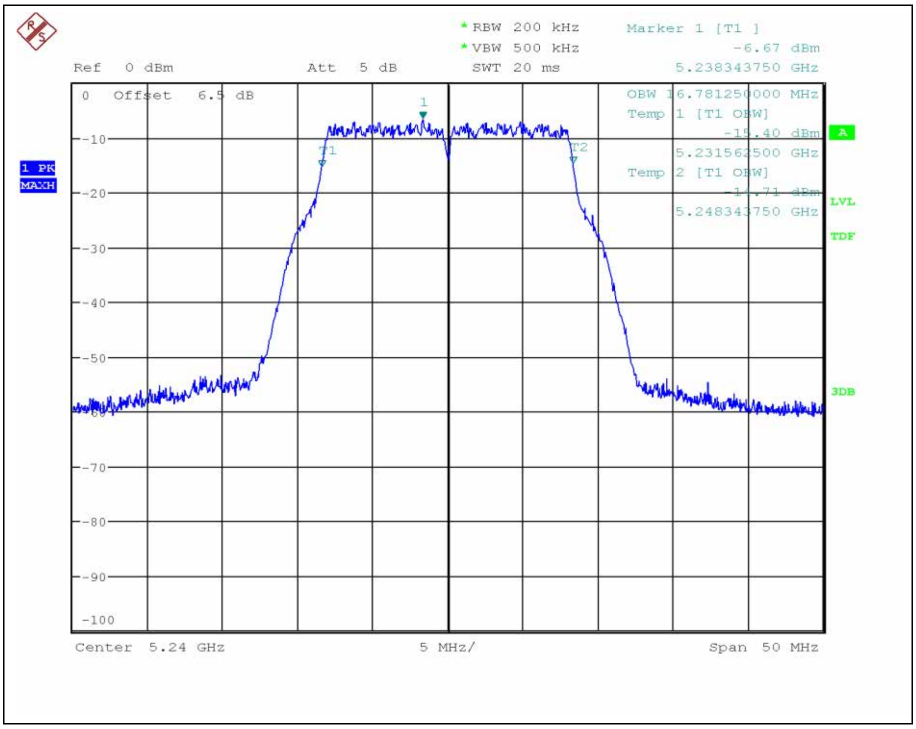
802.11a _ ch.36 **Occupied Bandwidth**



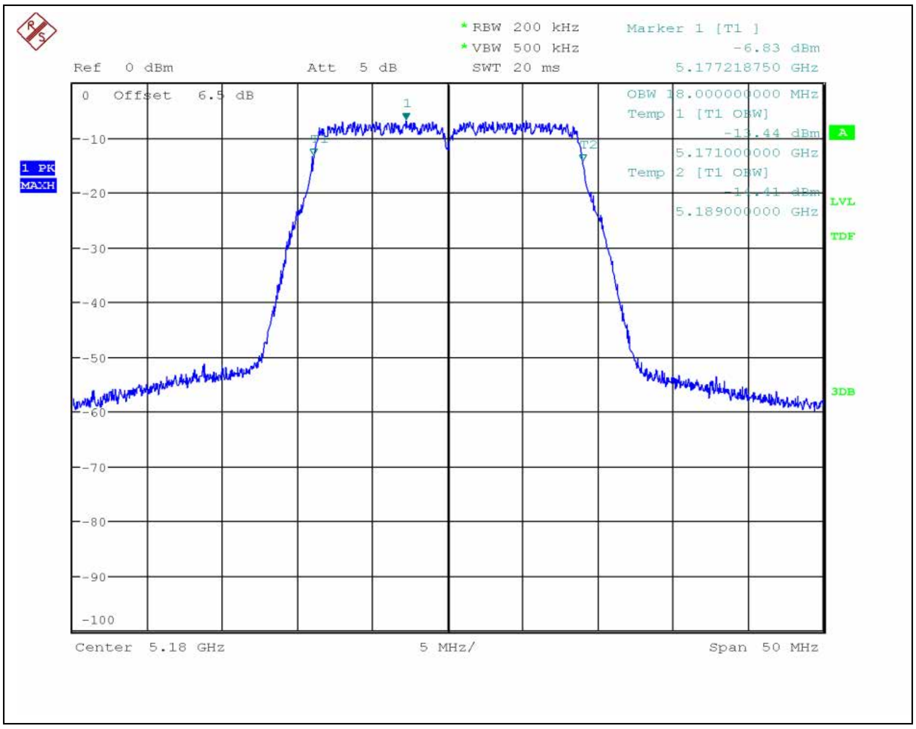
802.11a _ ch.44 **Occupied Bandwidth**



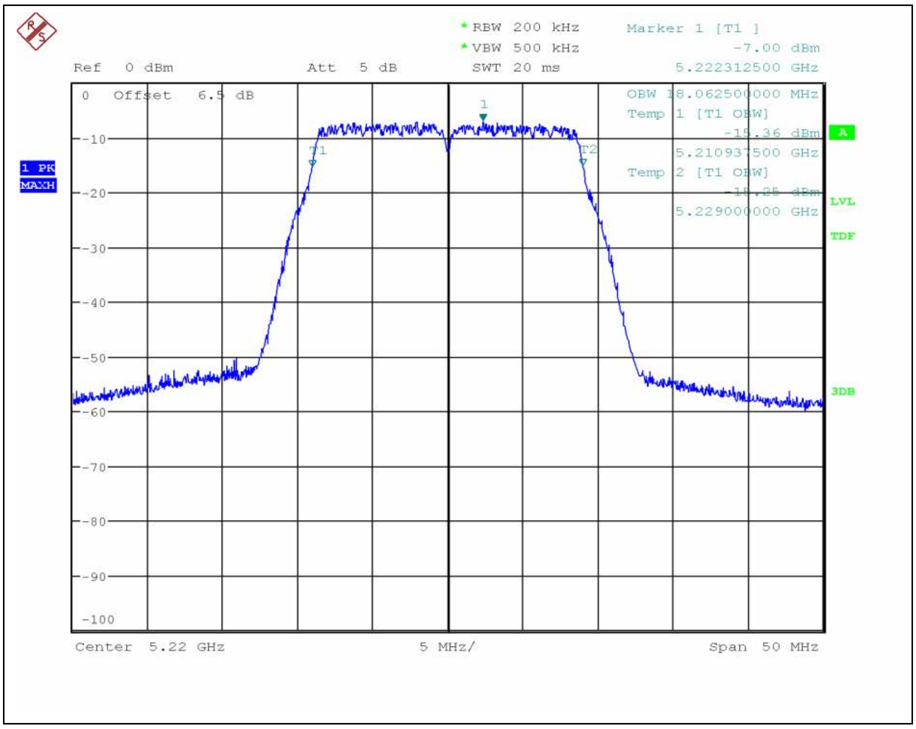
802.11a _ ch.48 **Occupied Bandwidth**



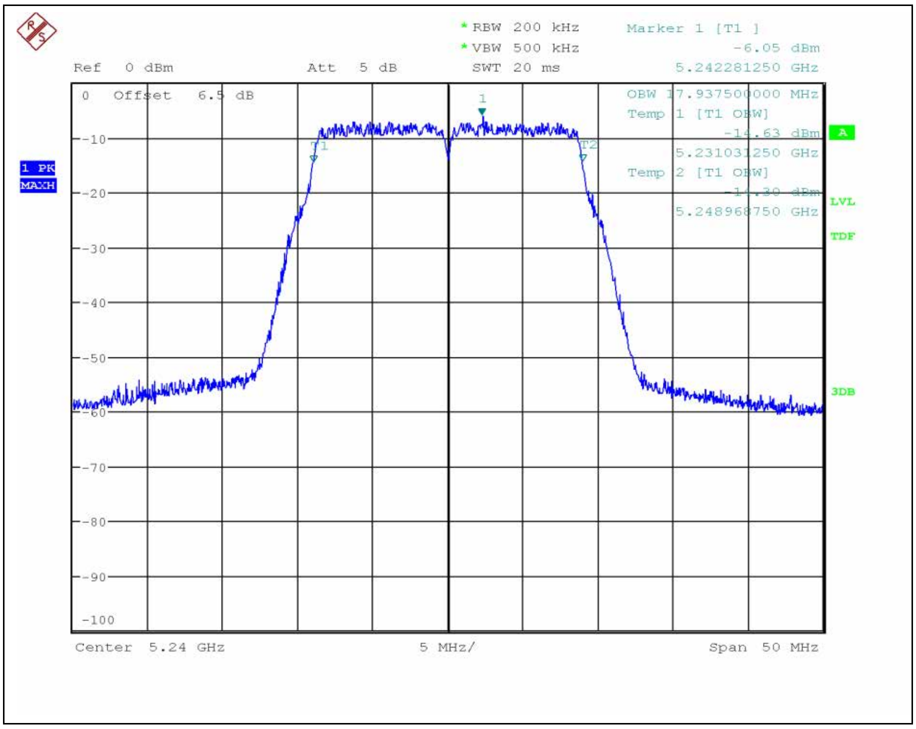
802.11n_HT20 _ ch.36 **Occupied Bandwidth**



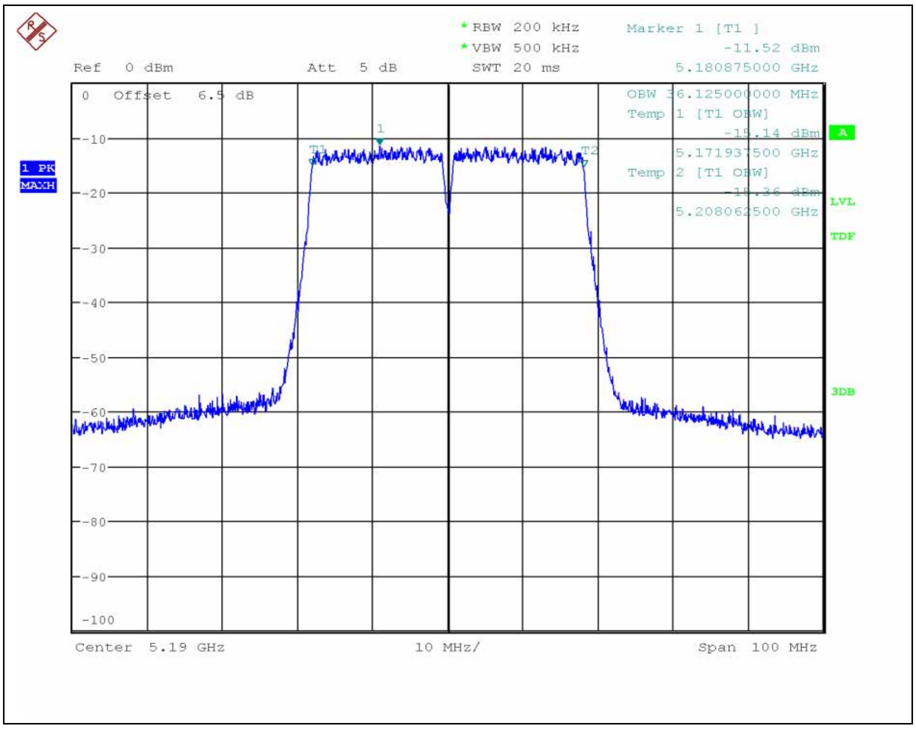
802.11n_HT20 _ ch.44 **Occupied Bandwidth**



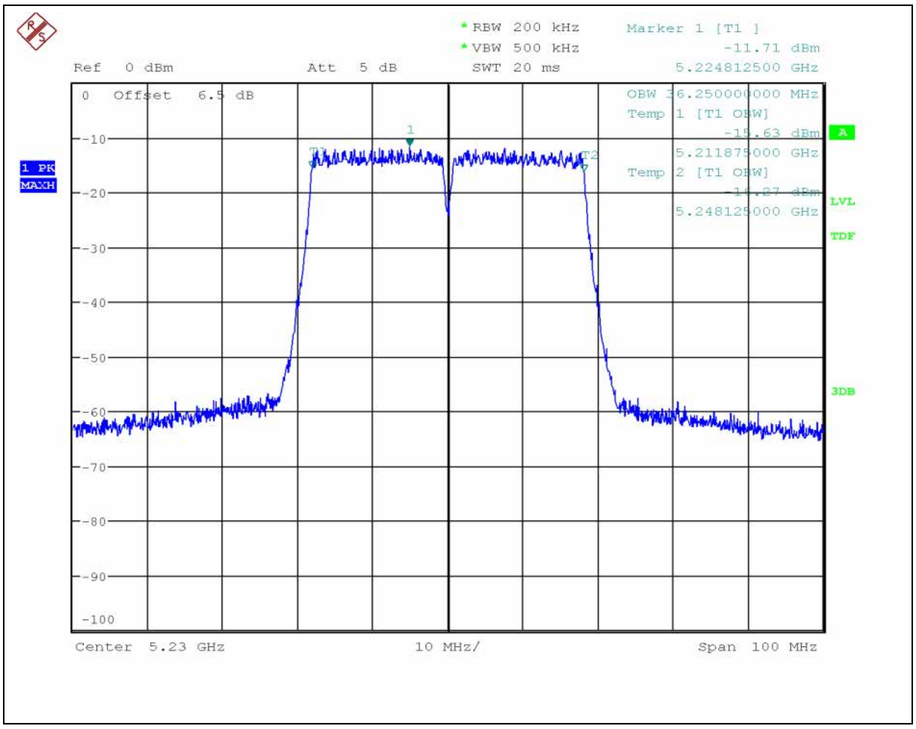
802.11n_HT20 _ ch.48 **Occupied Bandwidth**



802.11n_HT40 _ ch.38 **Occupied Bandwidth**



802.11n_HT40 _ ch.46 **Occupied Bandwidth**



3.3.3 6 ㏈ Bandwidth & Occupied Bandwidth

3.3.3.1 Test Setup

Refer to the APPENDIX I.

3.3.3.2 Limit

Within the 5.725-5.85 ㎓ band, the minimum permissible 6 ㏈ bandwidth is 500 ㎑.

3.3.3.3 Test Procedure

The bandwidth at 6 ㏈ down from the highest in-band spectral density is measured with a spectrum analyzer connected to the EUT's antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

1. Set resolution bandwidth (RBW) = 100 ㎑
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max Hold.
5. Sweep = Auto
6. Allow the trace to stabilize.
7. Option 1 - Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

   Option 2 - The automatic bandwidth measurement capability of an instrument may be employed using the X ㏈ bandwidth mode with X set to 6 ㏈, if the functionality described above (i.e., RBW = 100 ㎑, VBW ≥ 3 x RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 ㏈.

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3.3.3.4 Test Result

Test Mode	Band	Test Channel	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
802.11a	**U-NII 3**	**149**	16.346	16.781
		157	16.410	16.781
		165	16.409	16.781
802.11n _HT20	**U-NII 3**	**149**	17.676	17.906
		157	17.548	17.938
		165	17.612	18.000
802.11n _HT40	**U-NII 3**	**151**	36.603	36.188
		159	36.442	36.188

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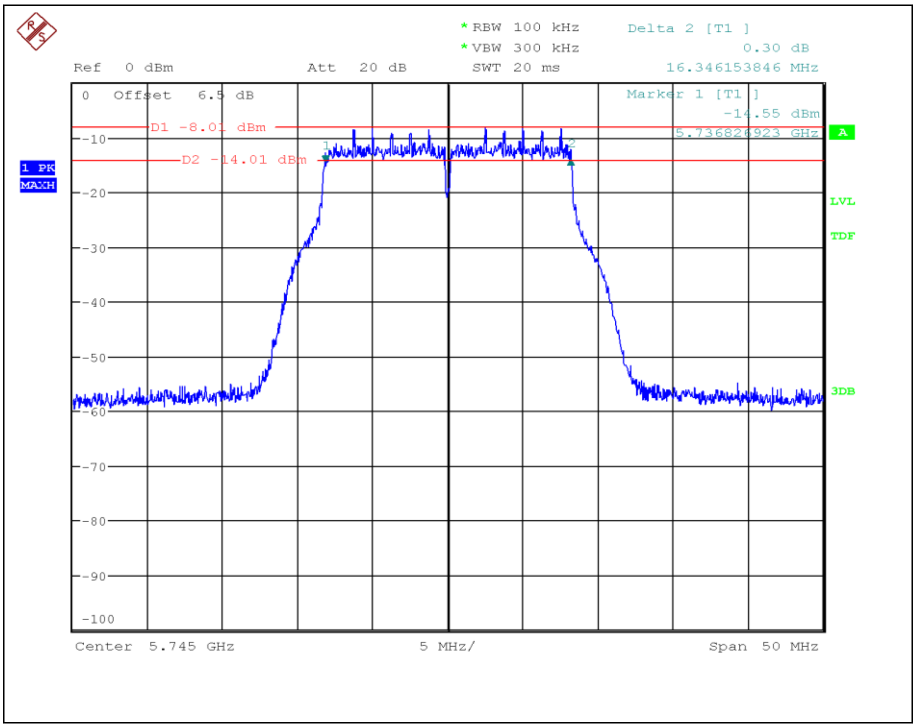
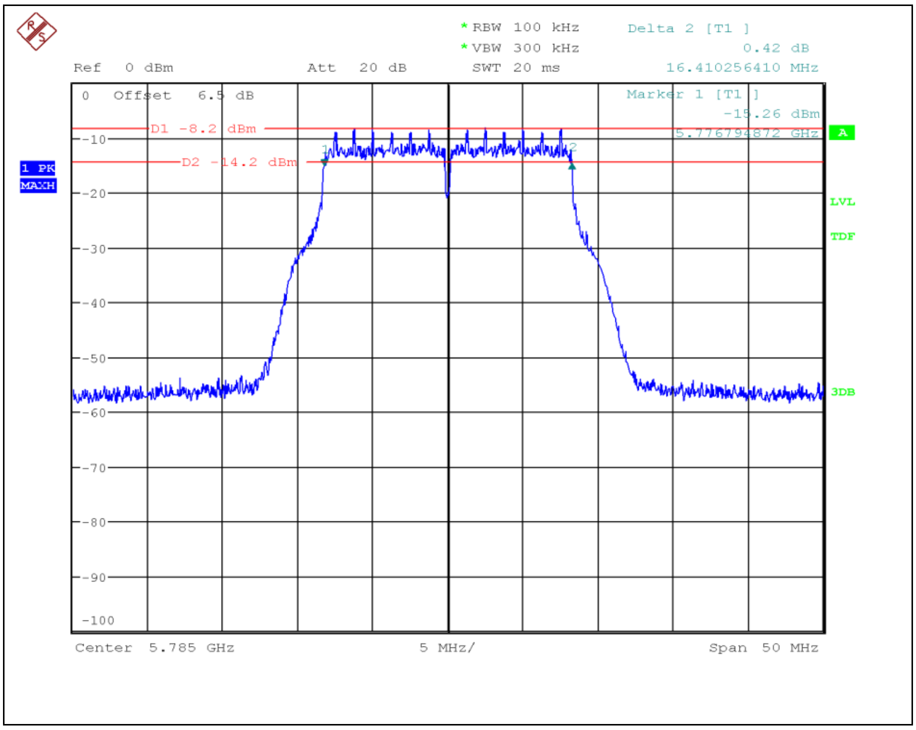
3.3.3.5 Test Plot

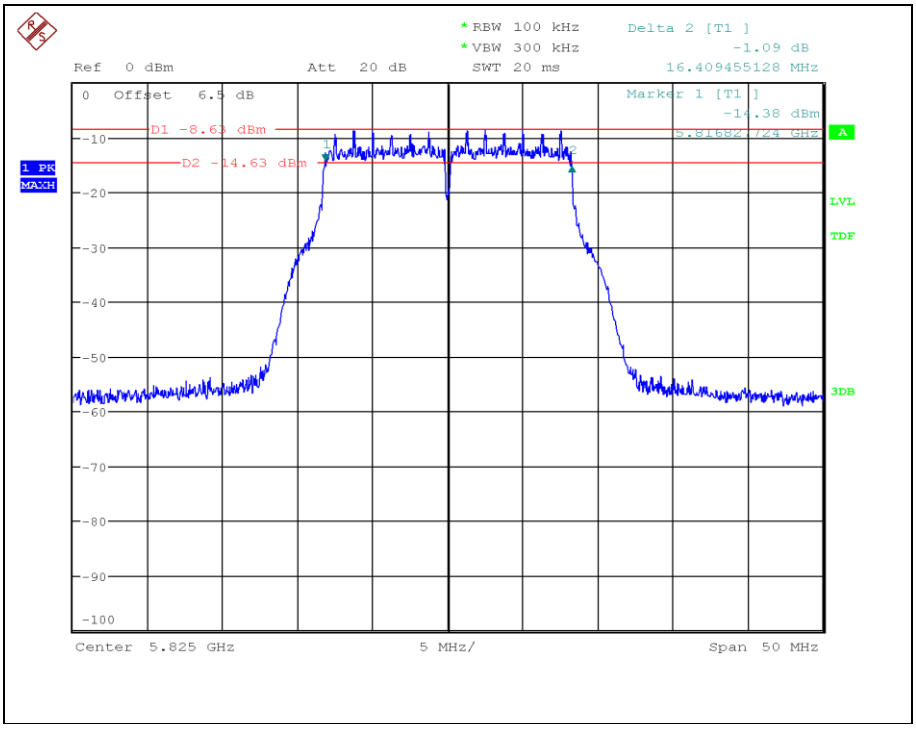
802.11a _ ch.149 **6 dB Bandwidth**



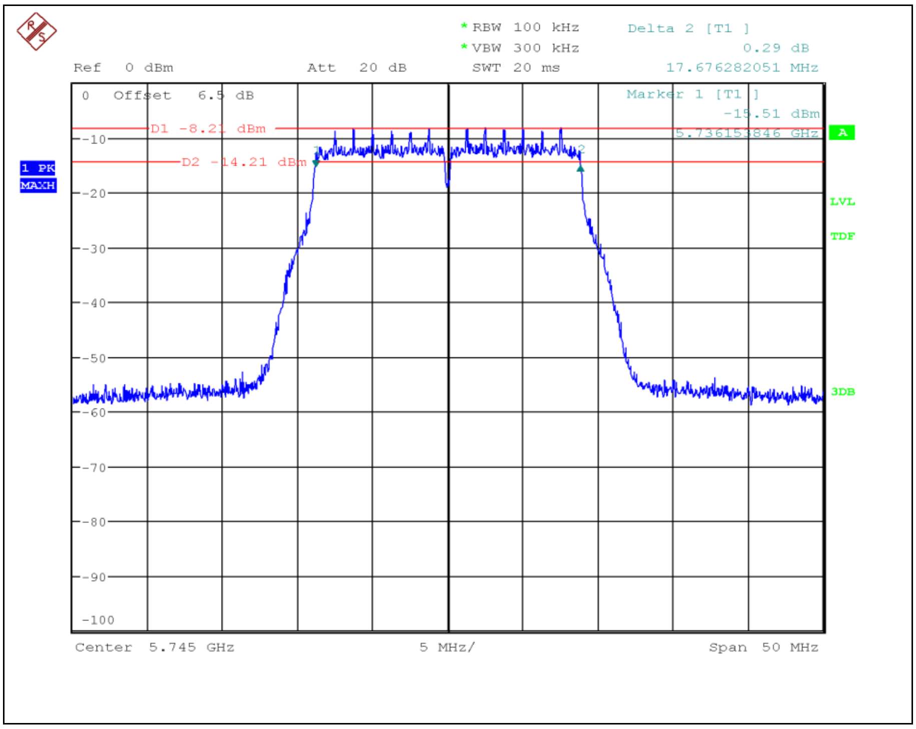
802.11a _ ch.157 **6 dB Bandwidth**



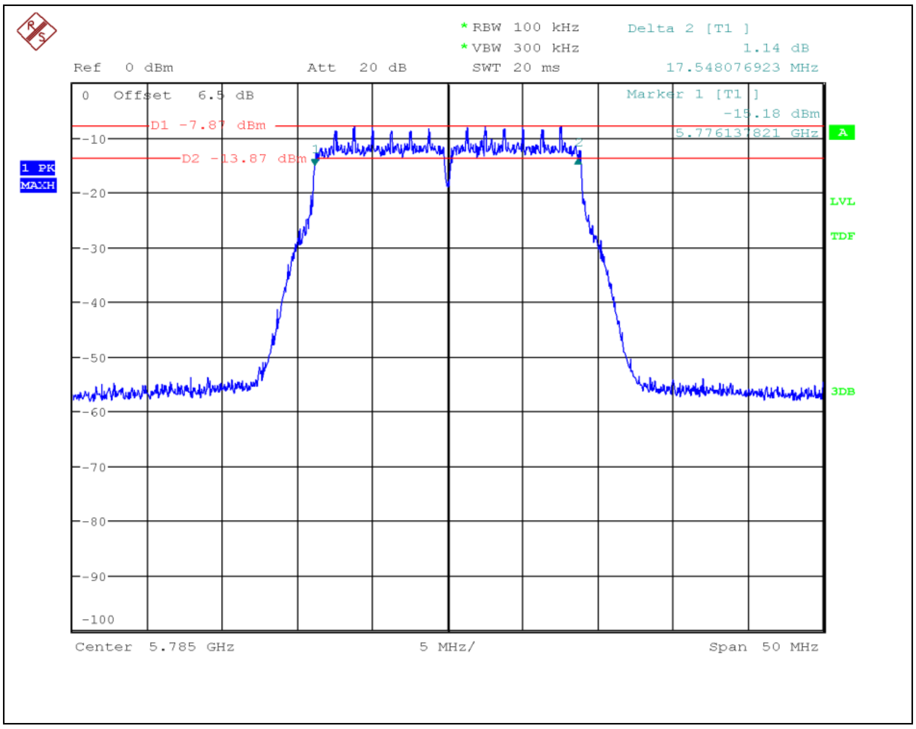
802.11a _ ch.165 **6 ㏈ Bandwidth**



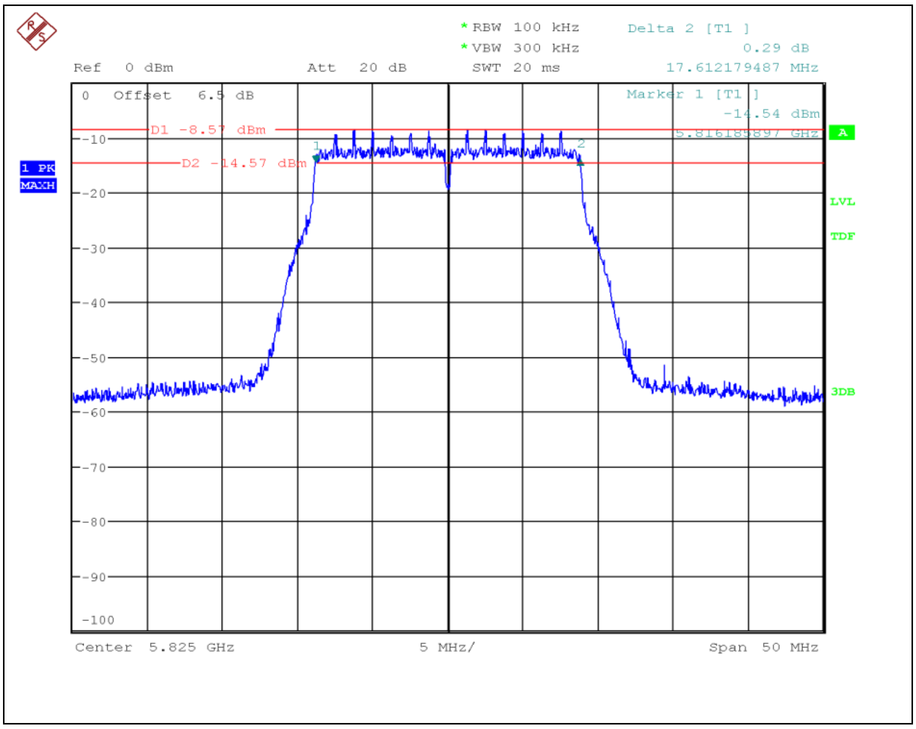
802.11n_HT20 _ ch.149 **6 dB Bandwidth**



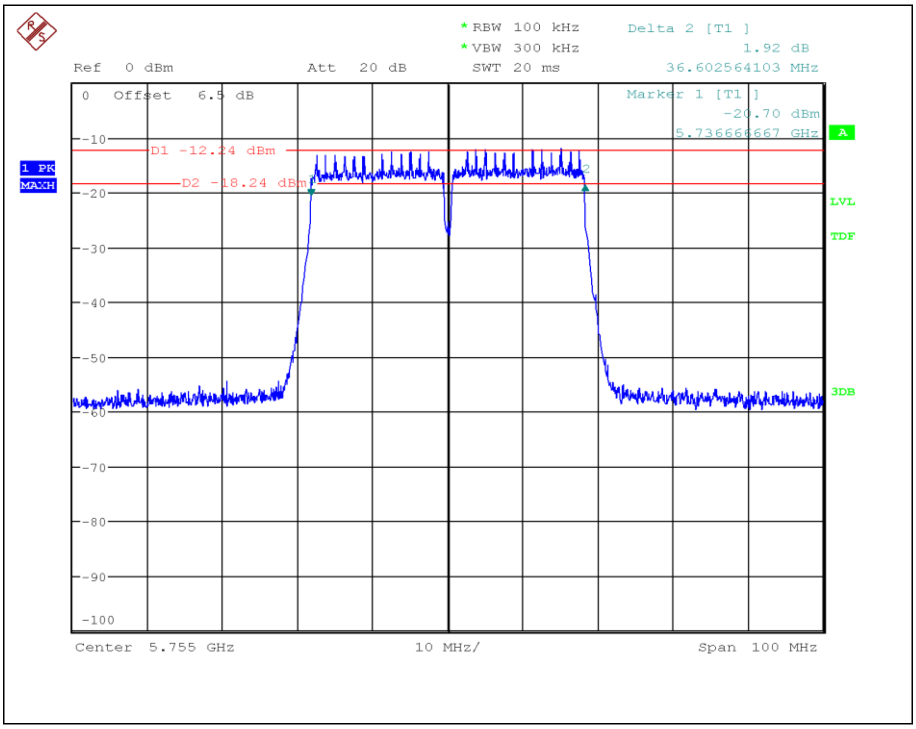
802.11n_HT20 _ ch.157 **6 dB Bandwidth**



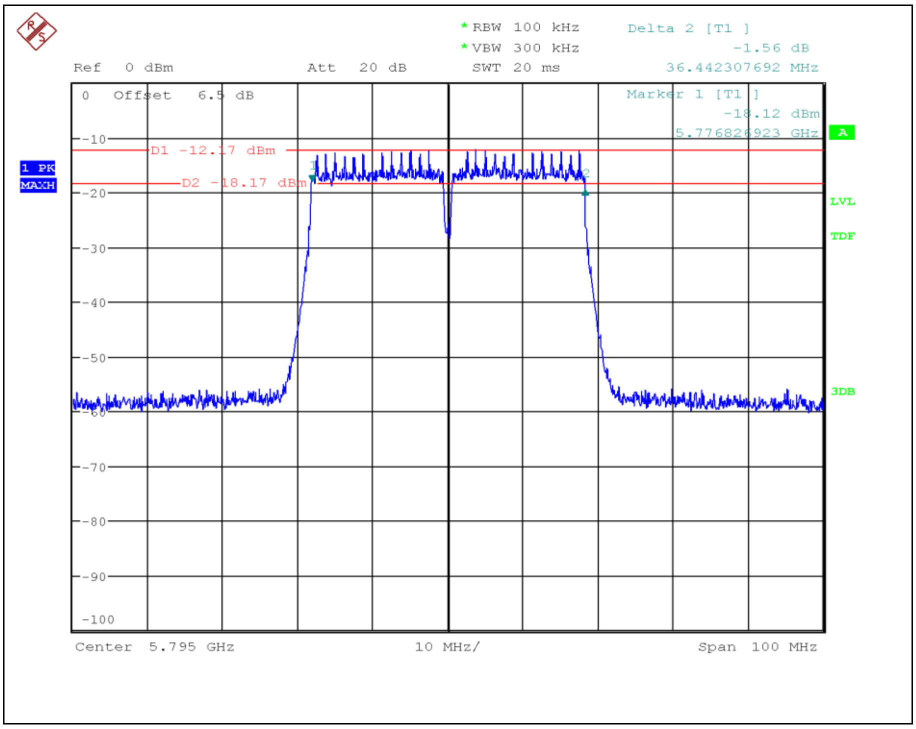
802.11n_HT20 _ ch.165 6 ㏈ Bandwidth



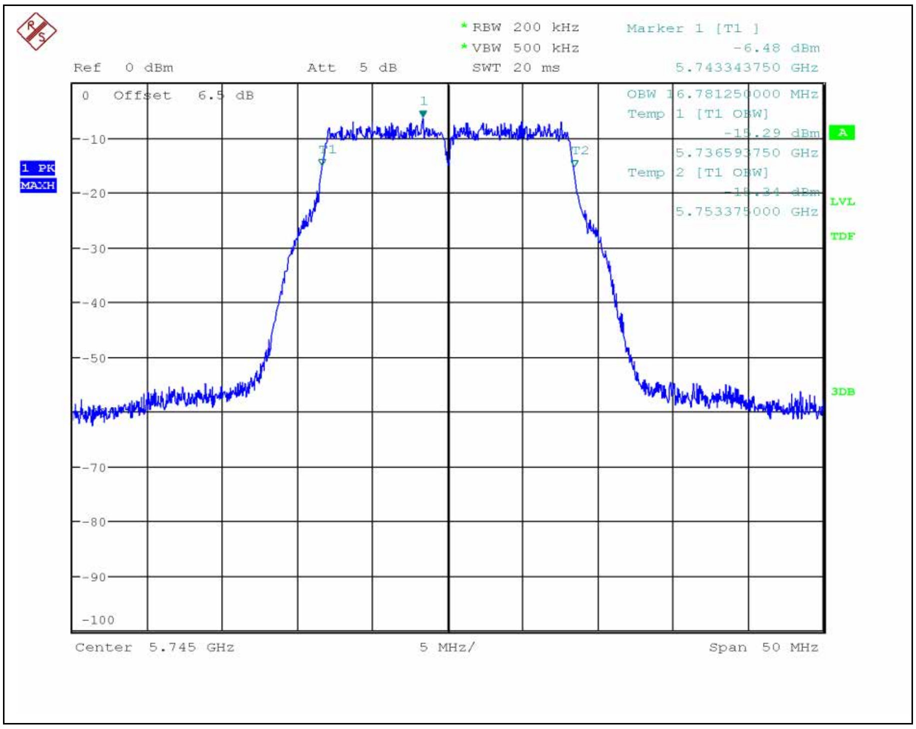
802.11n_HT40 _ ch.151 **6 dB Bandwidth**



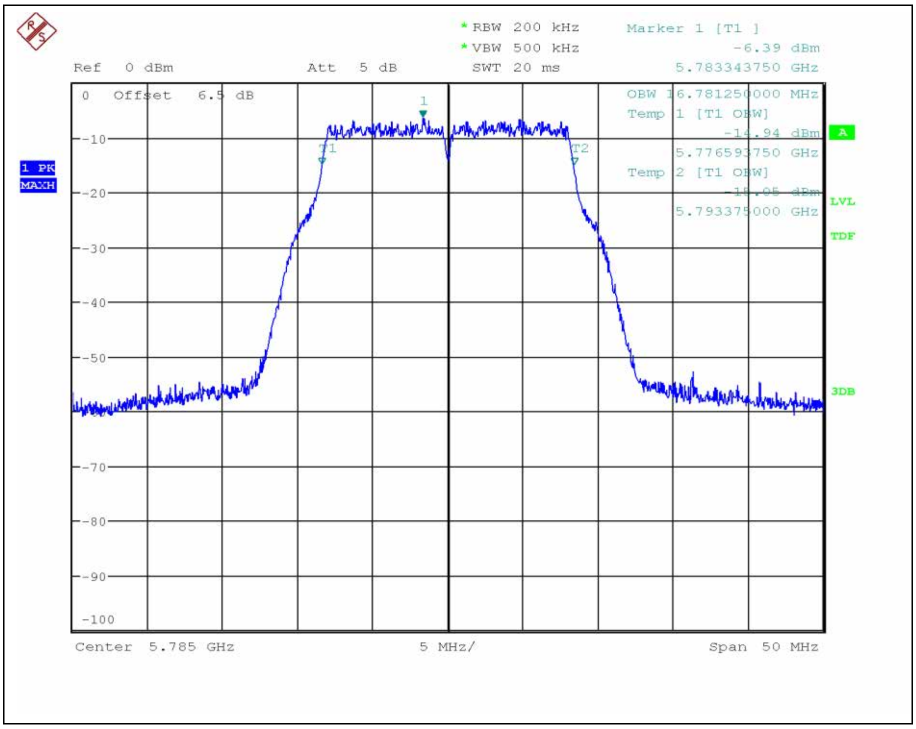
802.11n_HT40 _ ch.159 **6 dB Bandwidth**



802.11a _ ch.149 **Occupied Bandwidth**



802.11a _ ch.157 **Occupied Bandwidth**



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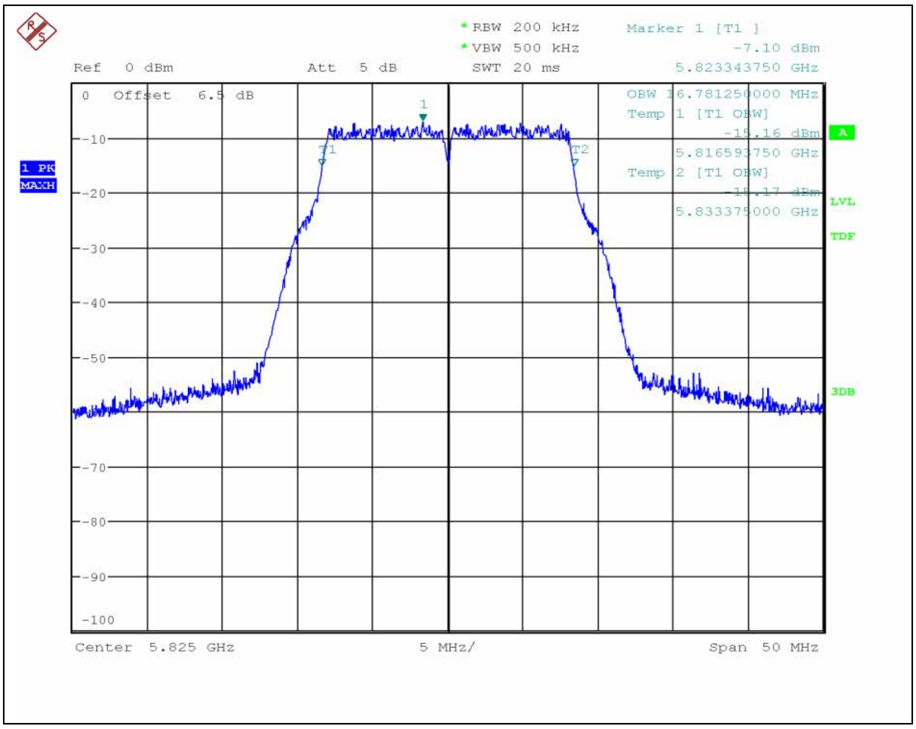
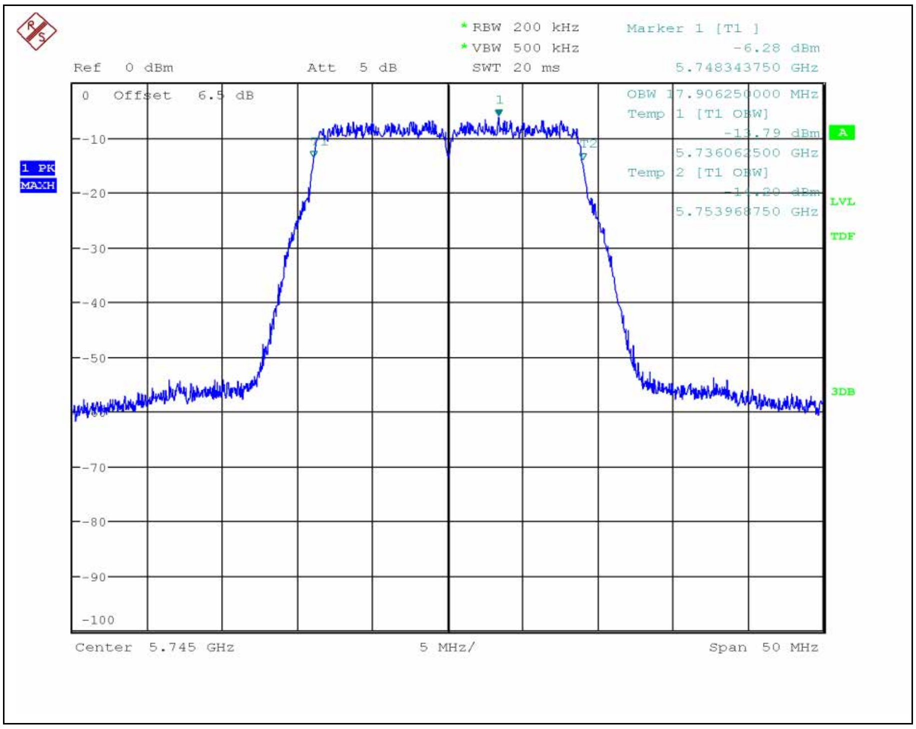
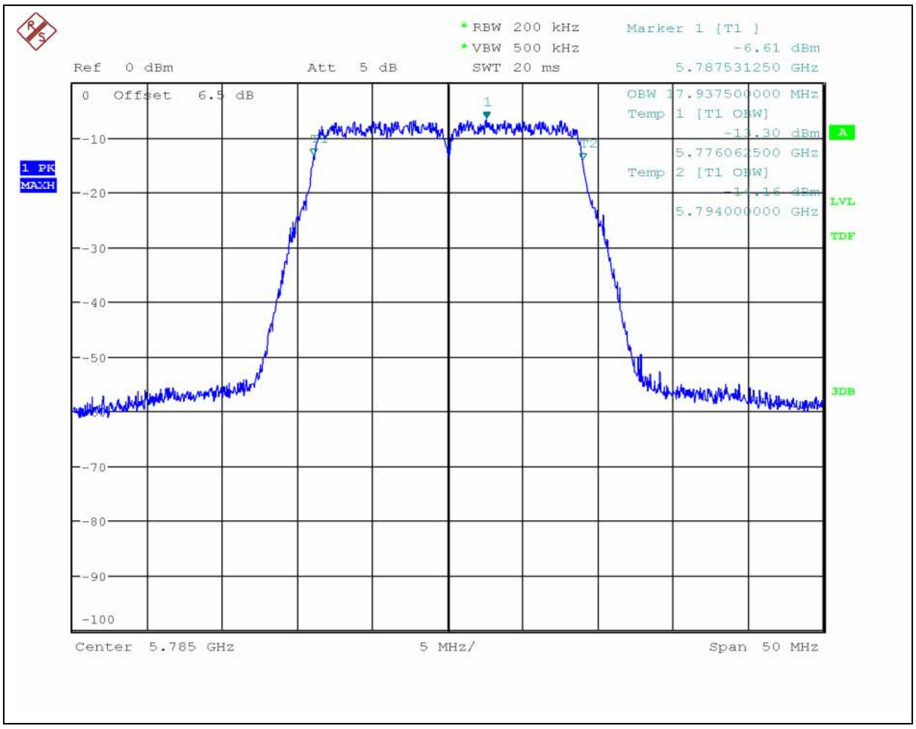
802.11a _ ch.165 **Occupied Bandwidth**



802.11n_HT20 _ ch.149 **Occupied Bandwidth**



802.11n_HT20 _ ch.157 **Occupied Bandwidth**



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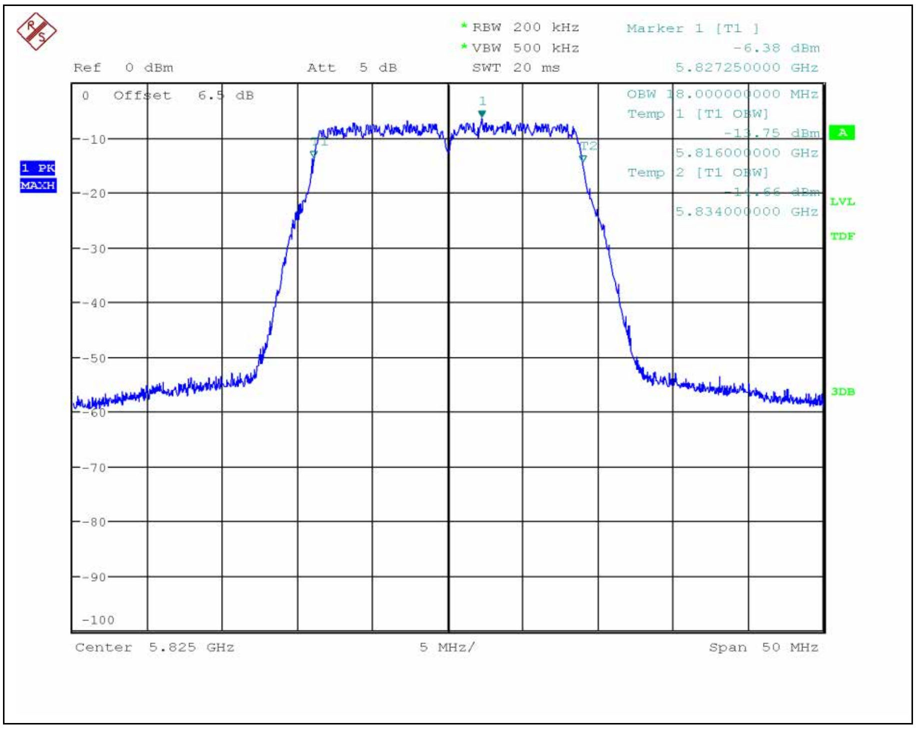
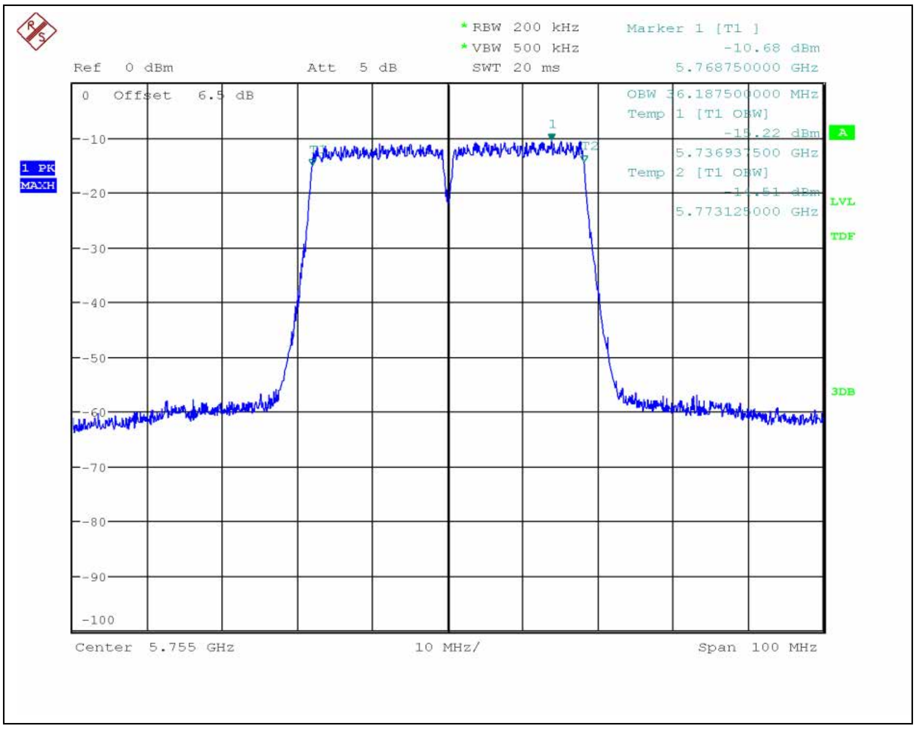
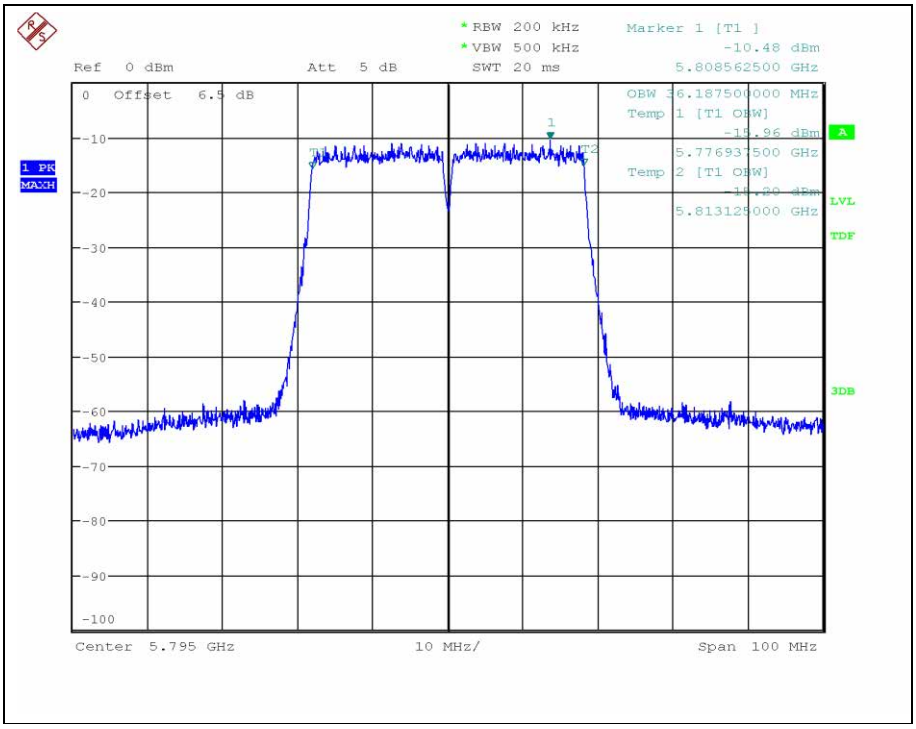
802.11n_HT20 _ ch.165 **Occupied Bandwidth**



802.11n_HT40 _ ch.151 **Occupied Bandwidth**



802.11n_HT40 _ ch.159 **Occupied Bandwidth**



3.3.4 Maximum Conducted Output Power

3.3.4.1 Test Setup

Refer to the APPENDIX I.

3.3.4.2 Limit

Part. 15.407(a)

(1) For the band 5.15 - 5.25 ㎓.

(i) For an outdoor access point operating in the band 5.15 - 5.25 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 ㎽ (21 dBm).

(ii) For an indoor access point operating in the band 5.15 - 5.25 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

(iv) For mobile and portable 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 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25 - 5.35 ㎓ and 5.47 - 5.725 ㎓ bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 ㎽ or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725 - 5.85 ㎓, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than

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6 dBi 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.

Band	Power Limit (mW)	Calculated Limit (dBm)	Antenna Gain (Worst case) (dBi)	Determined Limit (dBm)
U-NII 1	250	23.97	3.60	23.97

Band	Power Limit (mW) Least 26 dBc BW (MHz)	Calculated Limit (dBm)	Antenna Gain (Worst case) (dBi)	Determined Limit (dBm)
U-NII 2A	250	23.97	NA	NA
	NA	NA		
U-NII 2C	250	23.97	NA	NA
	NA	NA		

Band	Power Limit (mW)	Calculated Limit (dBm)	Antenna Gain (Worst case) (dBi)	Determined Limit (dBm)
U-NII 3	1000	30.00	3.60	30.00

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(1) For the band 5.15 - 5.25 GHz.

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or 1.76 + 10 log10B, dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

For other devices, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

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(2) For the band 5.25 - 5.35 ㎓.

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 ㎽ or 1.76 + 10 log10B, ㏈m, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 ㏈ below the maximum permitted e.i.r.p. of 30 ㎽.

Devices, other than devices installed in vehicles, shall comply with the following:

- The maximum conducted output power shall not exceed 250 ㎽ or 11 + 10 log10B, ㏈m, whichever is less. The power spectral density shall not exceed 11 ㏈m in any 1.0 ㎒ band;
- The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, ㏈m, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 ㎽ shall implement TPC in order to have the capability to operate at least 6 ㏈ below the maximum permitted e.i.r.p. of 1 W.

(3) For the band 5.47 - 5.60 ㎓ and 5.65 - 5.725 ㎓.

The maximum conducted output power shall not exceed 250 ㎽ or 11 + 10 log10B, ㏈m, whichever is less. The power spectral density shall not exceed 11 ㏈m in any 1.0 ㎒ band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, ㏈m, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 ㎽ shall implement TPC in order to have the capability to operate at least 6 ㏈ below the maximum permitted e.i.r.p. of 1 W.

(4) For the band 5.725 - 5.85 ㎓.

For equipment operating in the band 5725-5850 ㎒, 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-multipointFootnote3 systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

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3.3.4.3 Test Procedure

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer.
Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

1. Measure the duty cycle D of the transmitter output signal
2. Set span to encompass the entire 26 ㏈ EBW or 99% OBW of the signal
3. Set RBW = 1 ㎒
4. Set VBW ≥ 3 ㎒
5. Number of points in sweep ≥ [2 × span / RBW]. (This gives bin-to-bin spacing ≤ RBW / 2, so that narrowband signals are not lost between frequency bins.)
6. Sweep time = auto.
7. Detector = RMS (power averaging)
8. Do not use sweep triggering. Allow the sweep to “free run.”
9. Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the ON and OFF periods of the transmitter.
10. Compute power by integrating the spectrum across the 26 ㏈ EBW or 99% OBW of the signal using the instrument’s band power measurement function with band limits set equal to the EBW or OBW band edges. If the instrument does not have a band power function, then sum the spectrum levels (in power units) at 1 ㎒ intervals extending across the 26 ㏈ EBW or 99% OBW of the spectrum.
11. Add [10 log (1 / D)], where D is the duty cycle, to the measured power to compute the average power during the actual transmission times (because the measurement represents an average over both the ON and OFF times of the transmission). For example, add [10 log (1 / 0.25)] = 6 ㏈ if the duty cycle is 25%.

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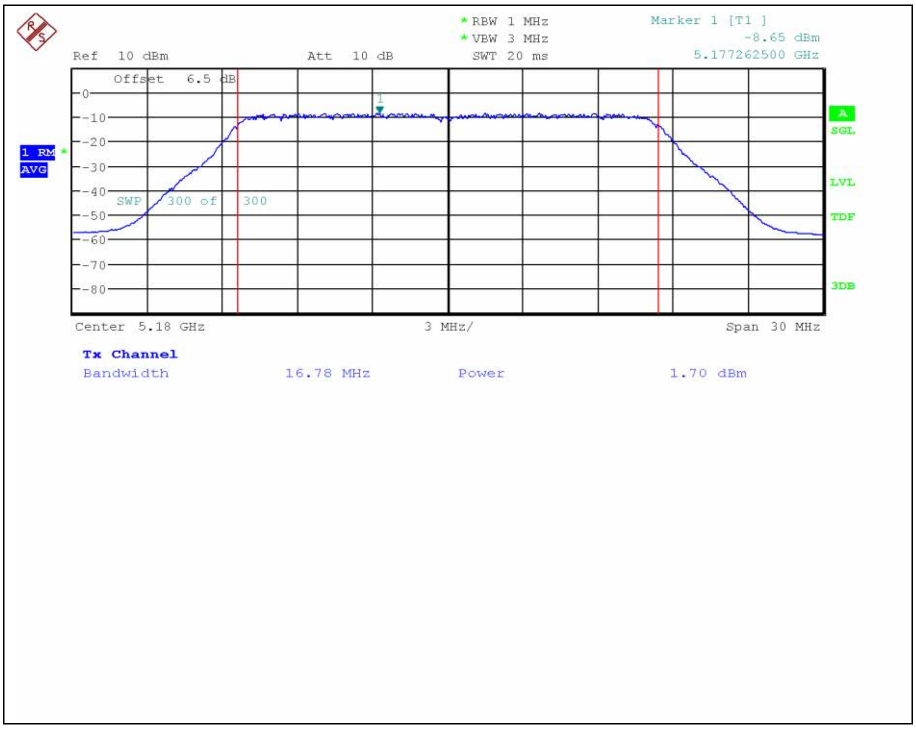
3.3.4.4 Test Result

Test Mode	Band	Test Channel	Maximum Conducted Output Power			
			Reading	C.F	Test Result	
			(dBm)	(dB)	(dBm)	(mW)
802.11a	U-NII 1	36	1.70	0.19	1.89	1.55
		44	1.34	0.19	1.53	1.42
		48	1.63	0.19	1.82	1.52
	U-NII 3	149	2.02	0.29	2.31	1.70
		157	1.91	0.29	2.20	1.66
		165	1.59	0.29	1.88	1.54
802.11n _HT20	U-NII 1	36	1.69	0.20	1.89	1.55
		44	1.31	0.20	1.51	1.42
		48	1.54	0.20	1.74	1.49
	U-NII 3	149	2.02	0.16	2.18	1.65
		157	1.88	0.16	2.04	1.60
		165	1.37	0.16	1.53	1.42
802.11n _HT40	U-NII 1	38	-0.95	0.24	-0.71	0.85
		46	-1.08	0.24	-0.84	0.83
	U-NII 3	151	2.17	0.32	2.49	1.78
		159	2.10	0.32	2.42	1.75

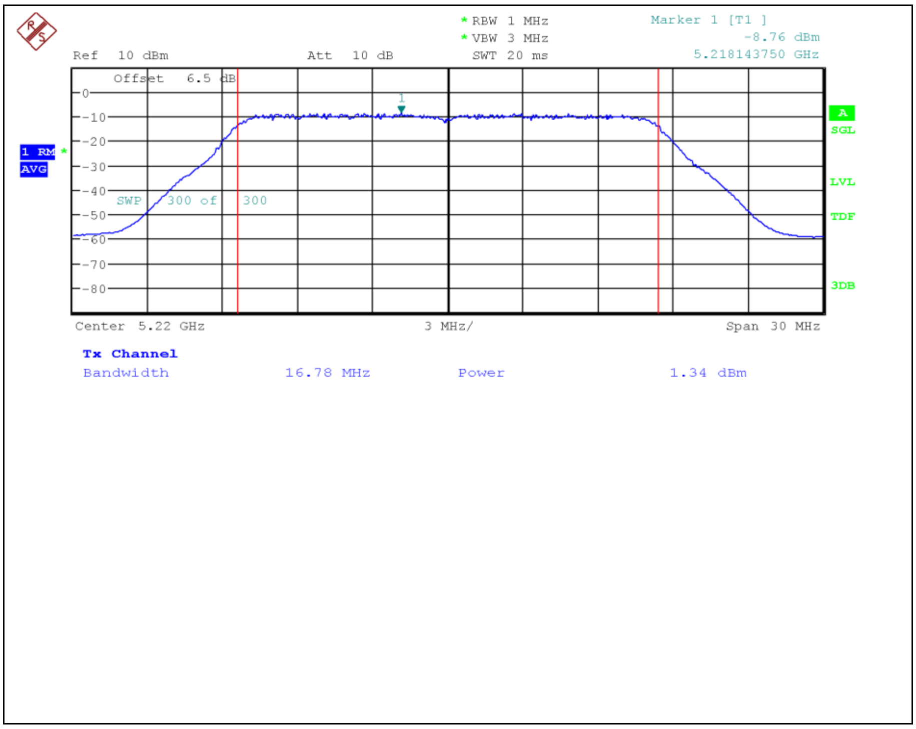
Note 1: C.F(Correction Factor)
Correction Factor = DCCF
For DCCF(Duty Cycle Correction Factor) please refer to appendix III.
Note 2: Sample Calculation.
Test Result = Reading + C.F

3.3.4.5 Test Plot

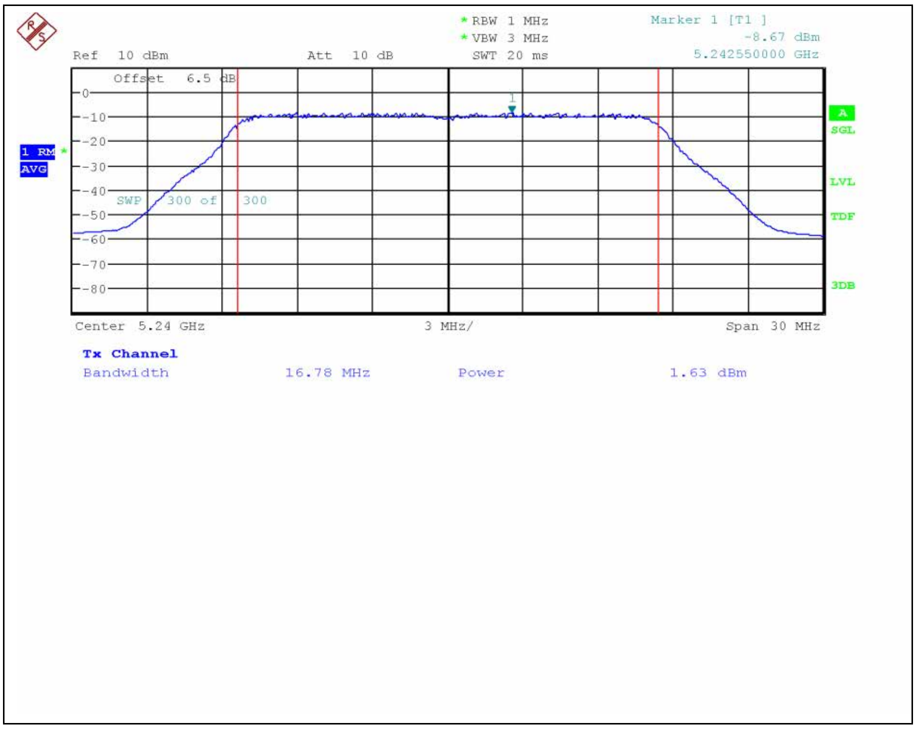
802.11a _ ch.36 **Maximum Conducted Output Power**



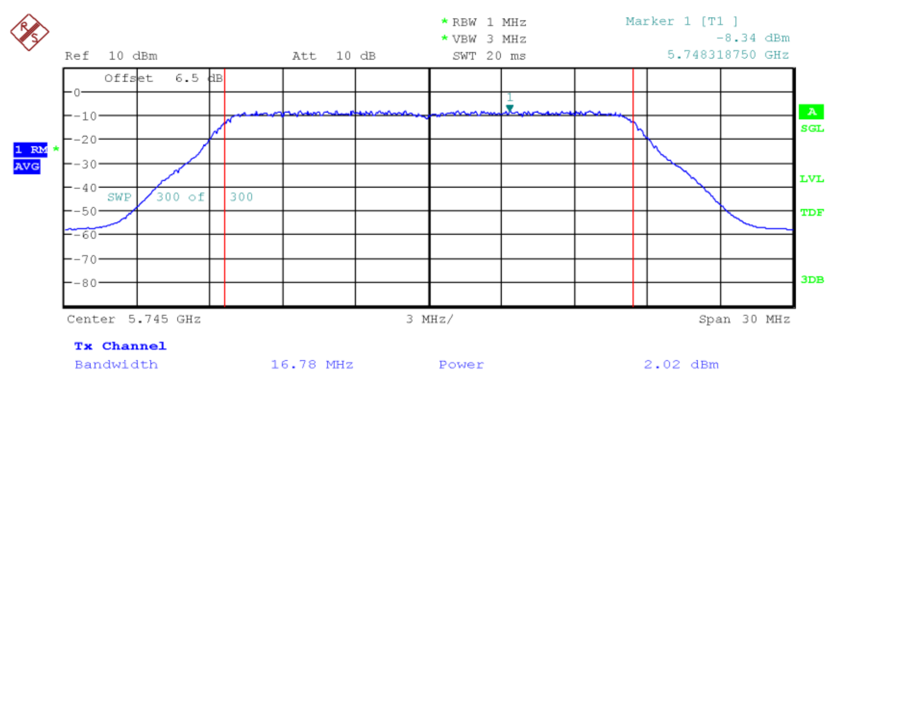
802.11a _ ch.44 **Maximum Conducted Output Power**



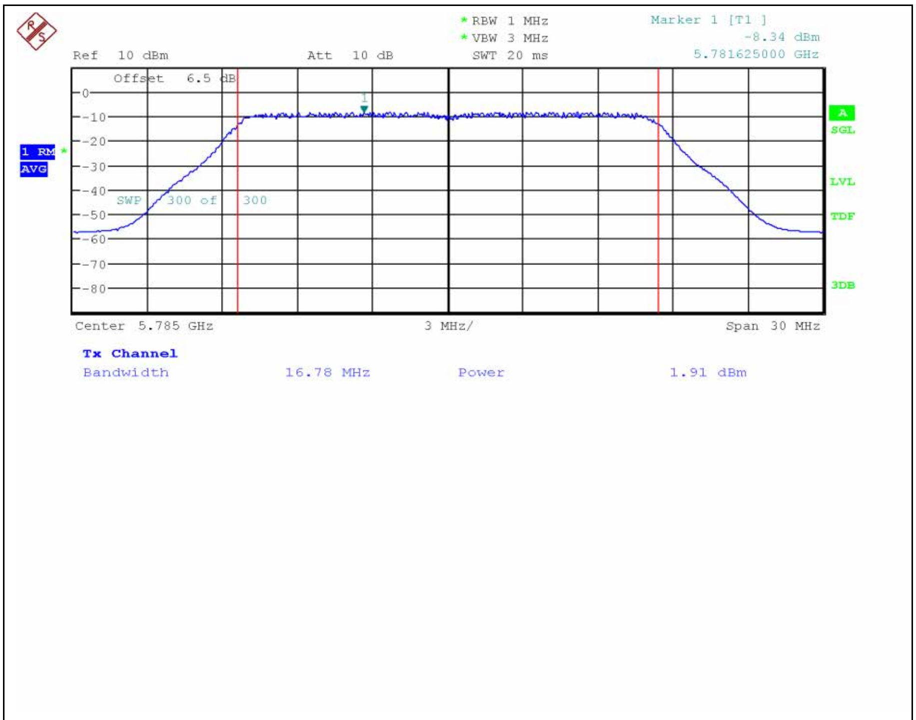
802.11a _ ch.48 **Maximum Conducted Output Power**



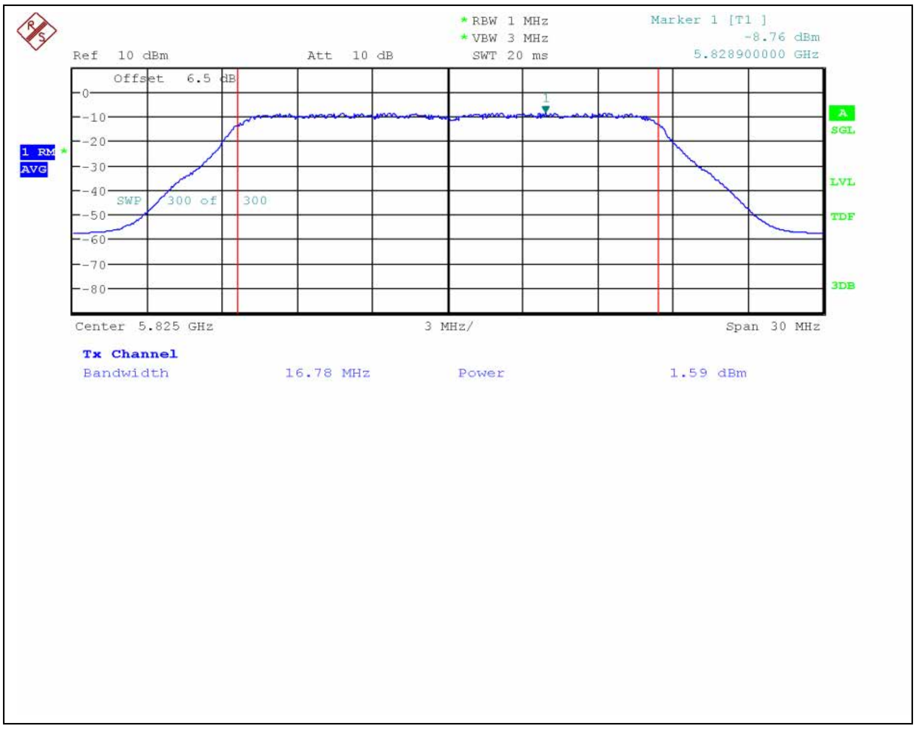
802.11a _ ch.149 **Maximum Conducted Output Power**



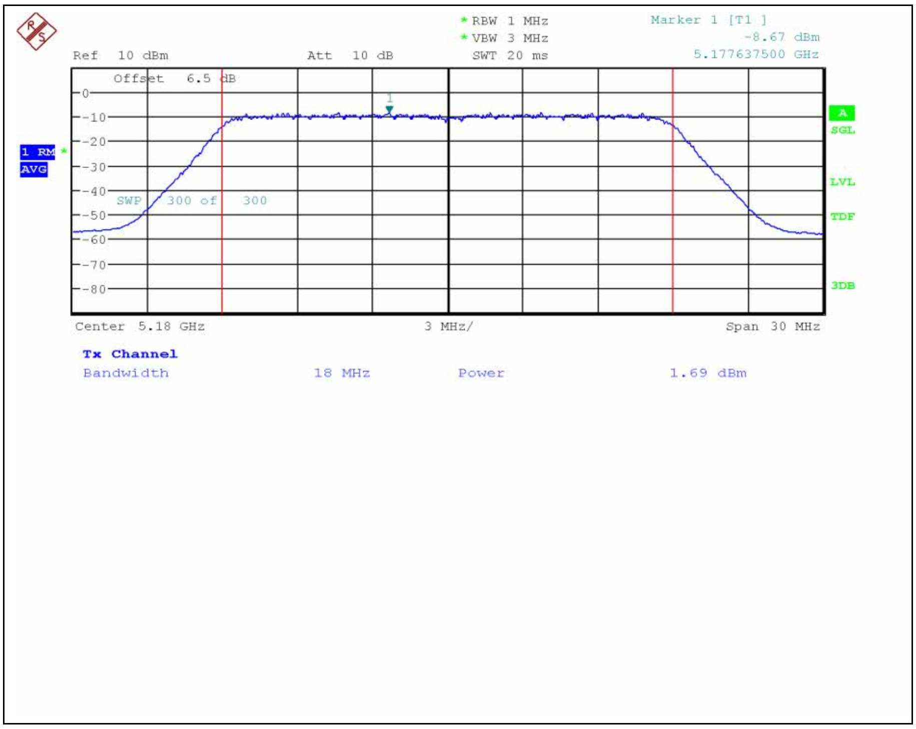
802.11a _ ch.157 **Maximum Conducted Output Power**



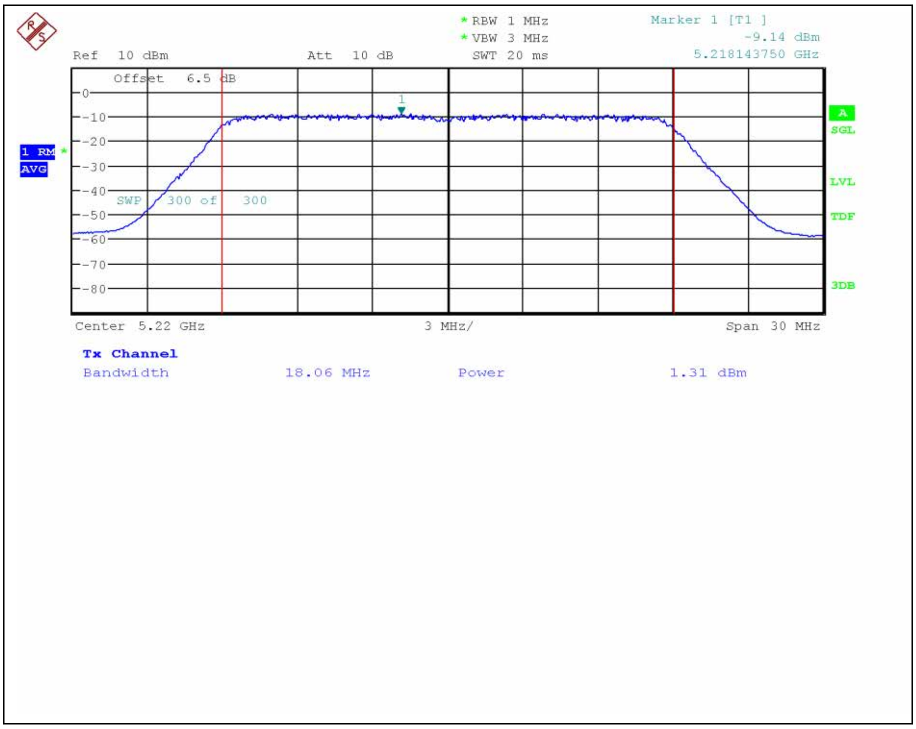
802.11a _ ch.165 **Maximum Conducted Output Power**



802.11n_HT20 _ ch.36 Maximum Conducted Output Power



802.11n_HT20 _ ch.44 Maximum Conducted Output Power



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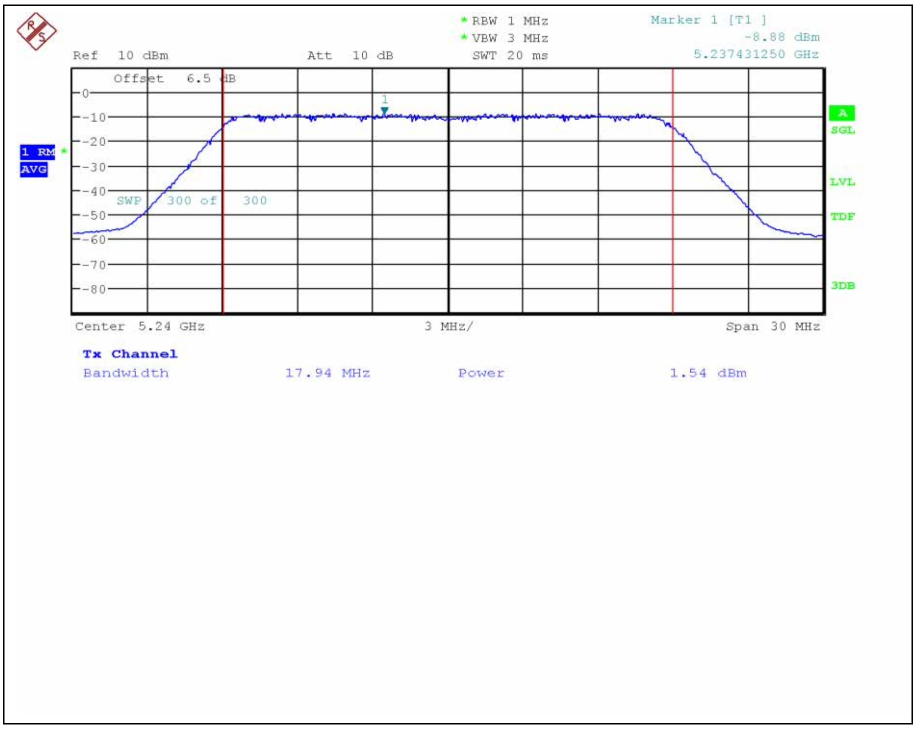
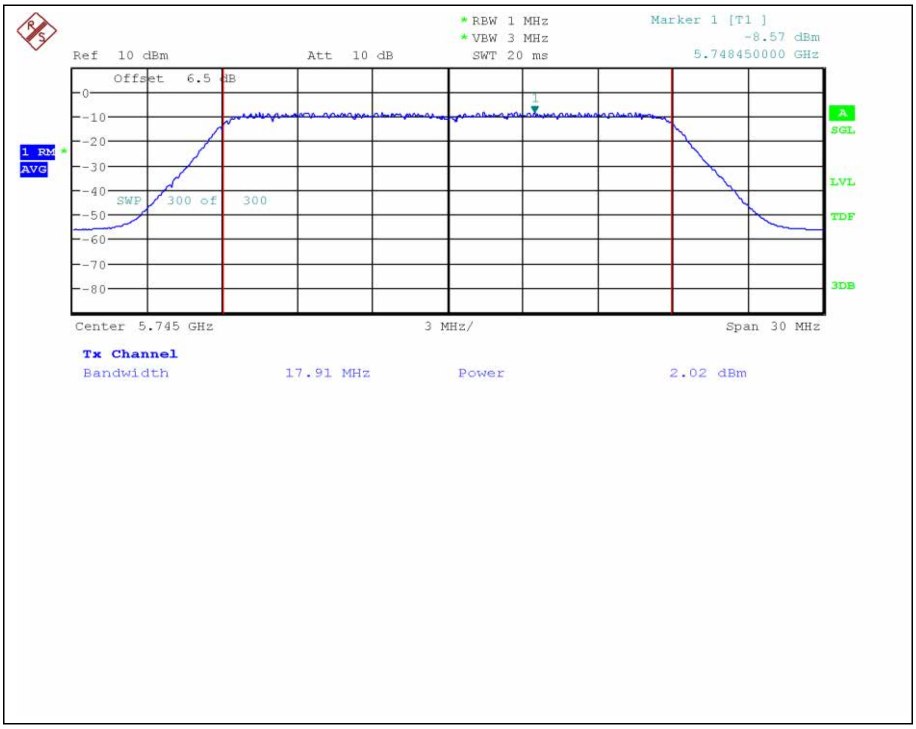
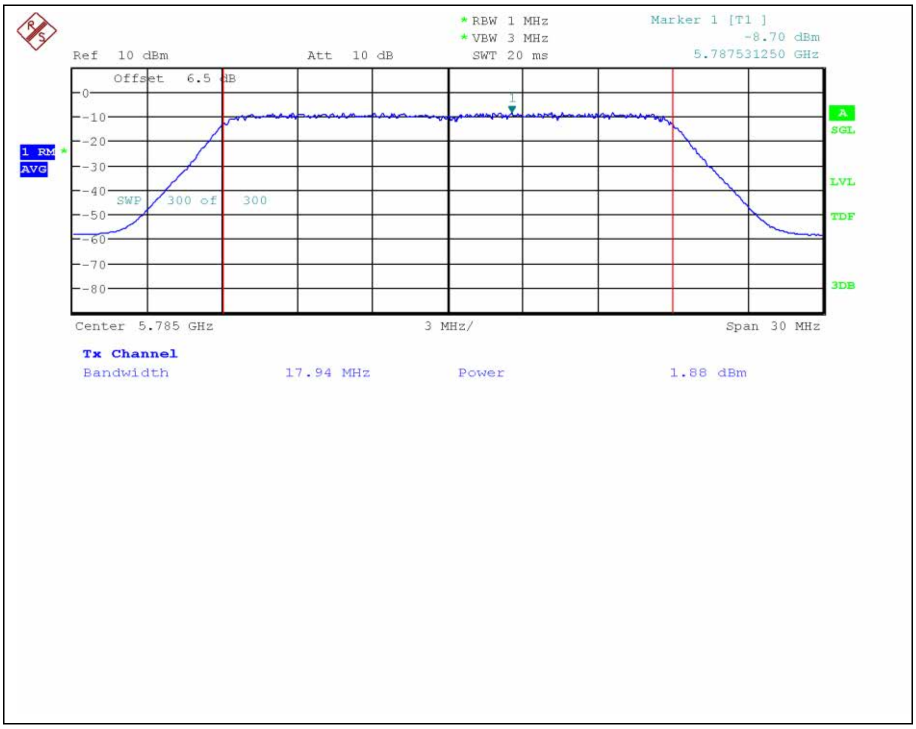
802.11n_HT20 _ ch.48 Maximum Conducted Output Power



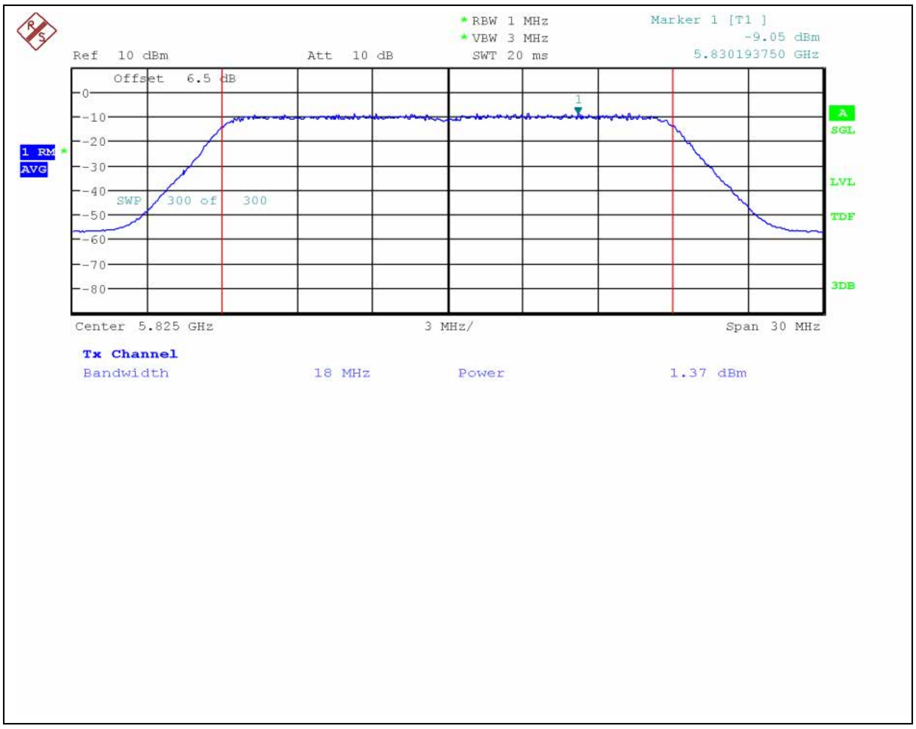
802.11n_HT20 _ ch.149 Maximum Conducted Output Power



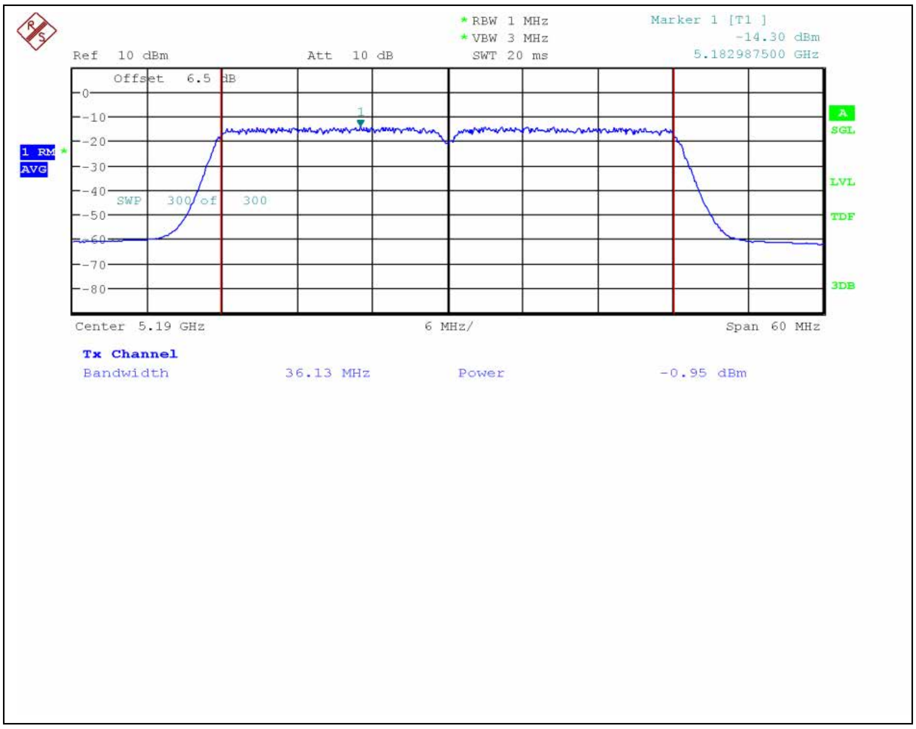
802.11n_HT20 _ ch.157 Maximum Conducted Output Power



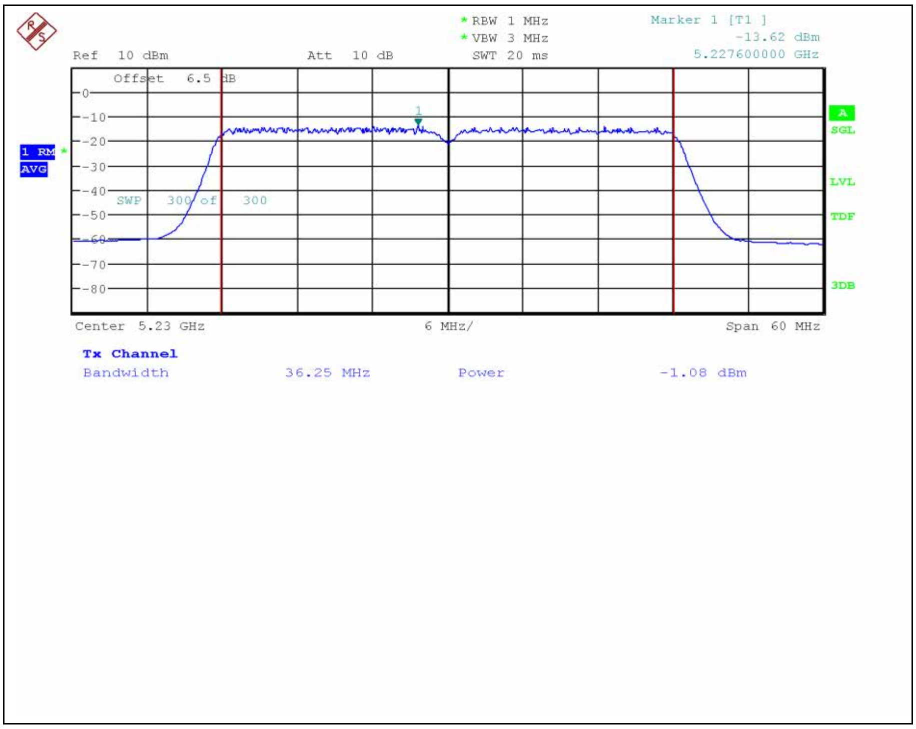
802.11n_HT20 _ ch.165 Maximum Conducted Output Power



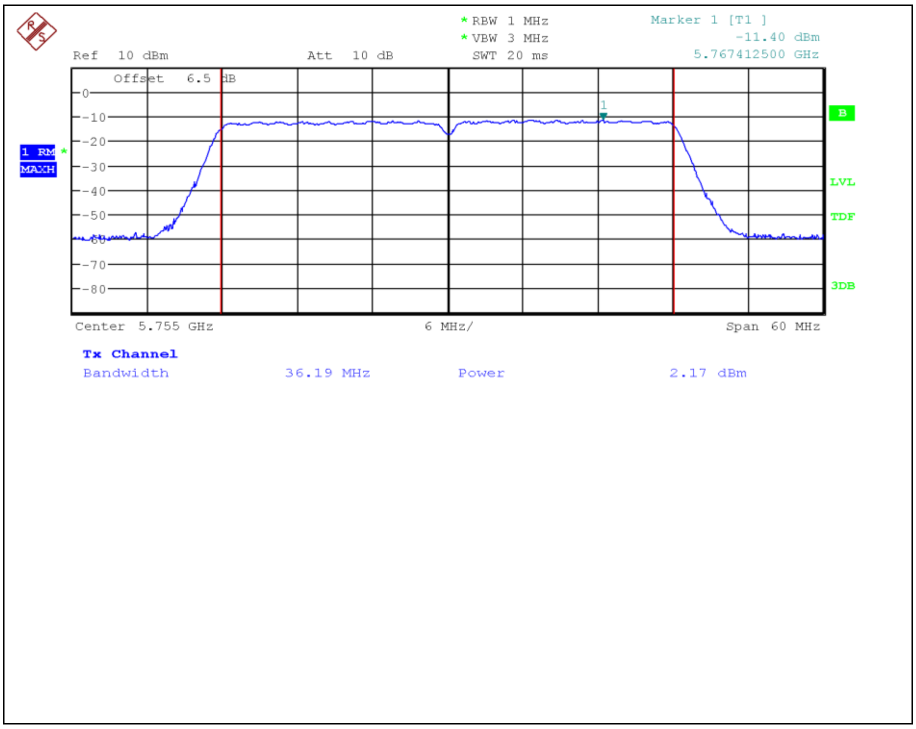
802.11n_HT40 _ ch.38 **Maximum Conducted Output Power**



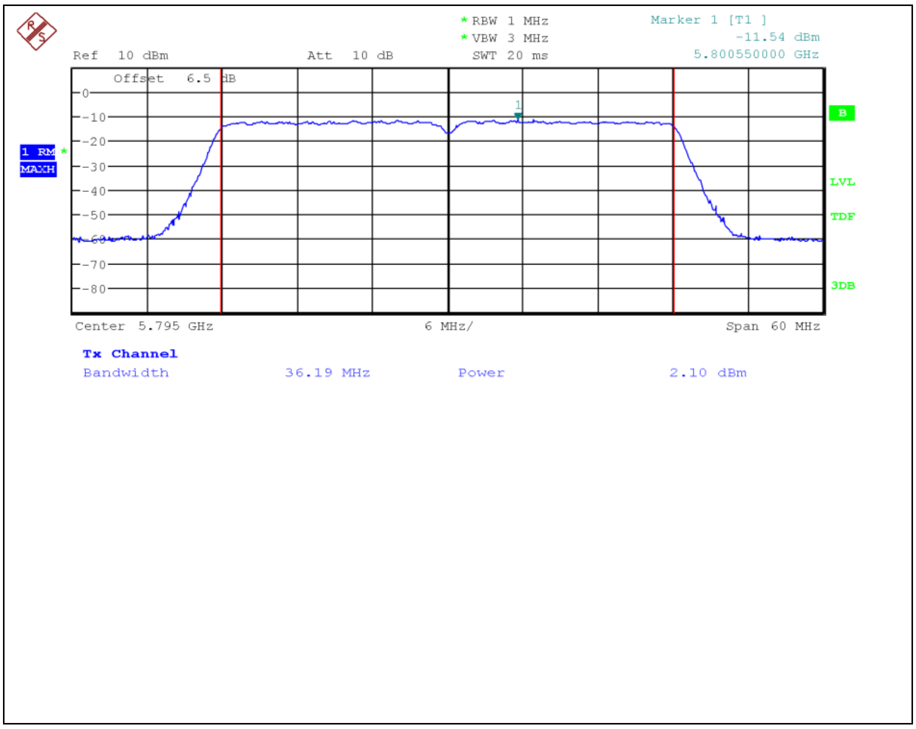
802.11n_HT40 _ ch.46 **Maximum Conducted Output Power**



802.11n_HT40 _ ch.151 **Maximum Conducted Output Power**



802.11n_HT40 _ ch.159 **Maximum Conducted Output Power**



3.3.5 Peak Power Spectral Density

3.3.5.1 Test Setup

Refer to the APPENDIX I.

3.3.5.2 Limit

Part. 15.407(a)

(1) For the band 5.15 - 5.25 ㎓.
  (i) For an outdoor access point operating in the band 5.15 - 5.25 ㎓, the maximum power spectral density shall not exceed 17 ㏈m in any 1 ㎒ band. [note1]
  (ii) For an indoor access point operating in the band 5.15 - 5.25 ㎓, the maximum power spectral density shall not exceed 17 ㏈m in any 1 ㎒ band. [note1]
  (iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 ㎓, transmitters that employ a directional antenna gain greater than 23 ㏈i, a 1 ㏈ reduction in maximum power spectral density is required for each 1 ㏈ of antenna gain in excess of 23 ㏈i.
  (iv) For mobile and portable client devices in the 5.15 - 5.25 ㎓ band, the maximum power spectral density shall not exceed 11 ㏈m in any 1 ㎒ band. [note1]

(2) For the 5.25 - 5.35 ㎓ and 5.47 - 5.725 ㎓ bands, the peak power spectral density shall not exceed 11 ㏈m in any 1 ㎒ band. [note1]

(3) For the band 5.725 - 5.85 ㎓, the maximum power spectral density shall not exceed 30 ㏈m in any 500 ㎑ band.[note1,note2]

Note1: If transmitting antennas of directional gain greater than 6 ㏈i are used, the peak power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.
Note2: 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-topoint operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

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(1) For the band 5.15 - 5.25 ㎓.
For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 ㎽ or 1.76 + 10 log10B, ㏈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 + 10 log10B, ㏈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.

(2) For the band 5.25 - 5.35 ㎓.

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 ㎽ or 1.76 + 10 log10B, ㏈m, whichever is less. Devices shall implement TPC in order to have the capability to operate at least 3 ㏈ below the maximum permitted e.i.r.p. of 30 ㎽.

Devices, other than devices installed in vehicles, shall comply with the following:

- The maximum conducted output power shall not exceed 250 ㎽ or 11 + 10 log10B, ㏈m, whichever is less. The power spectral density shall not exceed 11 ㏈m in any 1.0 ㎒ band;
- The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, ㏈m, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 ㎽ shall implement TPC in order to have the capability to operate at least 6 ㏈ below the maximum permitted e.i.r.p. of 1 W.

(3) For the band 5.47 - 5.60 ㎓ and 5.65 - 5.725 ㎓.

The maximum conducted output power shall not exceed 250 ㎽ or 11 + 10 log10B, ㏈m, whichever is less. The power spectral density shall not exceed 11 ㏈m in any 1.0 ㎒ band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10B, ㏈m, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 ㎽ shall implement TPC in order to have the capability to operate at least 6 ㏈ below the maximum permitted e.i.r.p. of 1 W.

(4) For the band 5.725 - 5.85 ㎓.

For equipment operating in the band 5725-5850 ㎒, 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-multipointFootnote3 systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

3.3.5.3 Test Procedure

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

1) 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.)

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

3) 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 peak of the spectrum.
   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.

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

5) 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 ㎑.

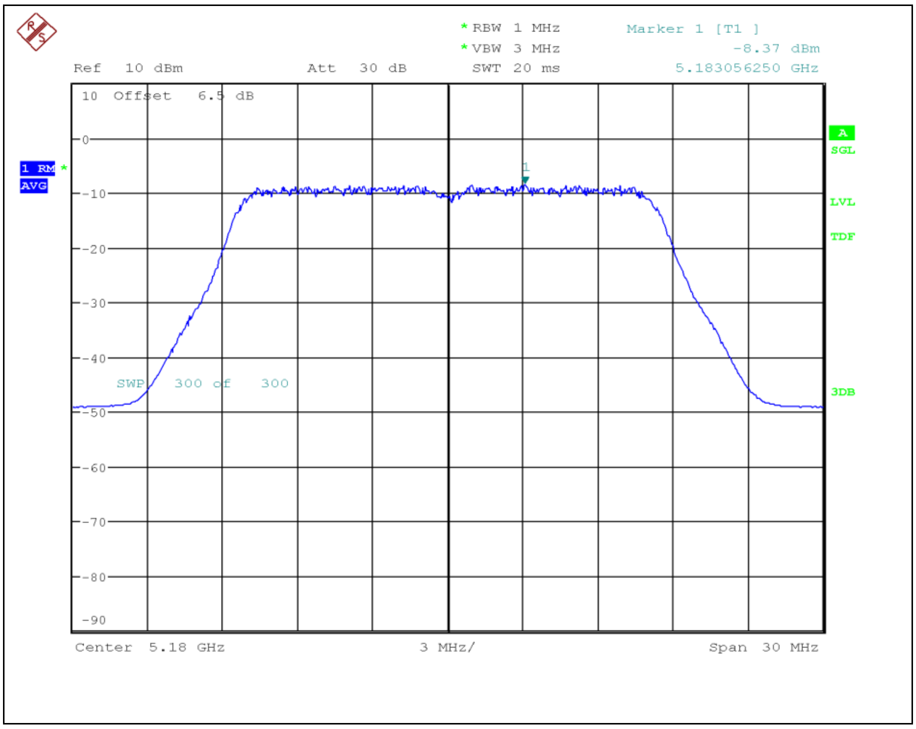
3.3.5.4 Test Result

Test Mode	Band	Test Channel	Peak Power Spectral Density					Limit	
			Reading	C.F	Ant Gain	Test Result		15.407	RSS-247
			(dBm)	(dB)	(dBi)	(dBm)	(dBm e.i.r.p)	(dBm)	(dBm e.i.r.p)
802.11a	U-NII 1	36	-8.37	0.19	2.3	-8.18	-5.88	11.00	10.00
		44	-8.82	0.19	2.3	-8.63	-6.33	11.00	10.00
		48	-8.79	0.19	2.3	-8.60	-6.30	11.00	10.00
	U-NII 3	149	-8.46	0.29	2.6	-8.17	-5.57	30.00	30.00
		157	-8.36	0.29	2.6	-8.07	-5.47	30.00	30.00
		165	-8.65	0.29	2.6	-8.36	-5.76	30.00	30.00
802.11n _HT20	U-NII 1	36	-8.99	0.20	2.3	-8.79	-6.49	11.00	10.00
		44	-9.07	0.20	2.3	-8.87	-6.57	11.00	10.00
		48	-9.18	0.20	2.3	-8.98	-6.68	11.00	10.00
	U-NII 3	149	-8.35	0.16	2.6	-8.19	-5.59	30.00	30.00
		157	-8.52	0.16	2.6	-8.36	-5.76	30.00	30.00
		165	-8.91	0.16	2.6	-8.75	-6.15	30.00	30.00
802.11n _HT40	U-NII 1	38	-13.82	0.24	2.3	-13.58	-11.28	11.00	10.00
		46	-13.63	0.24	2.3	-13.39	-11.09	11.00	10.00
	U-NII 3	151	-12.80	0.32	2.6	-12.48	-9.88	30.00	30.00
		159	-13.31	0.32	2.6	-12.99	-10.39	30.00	30.00

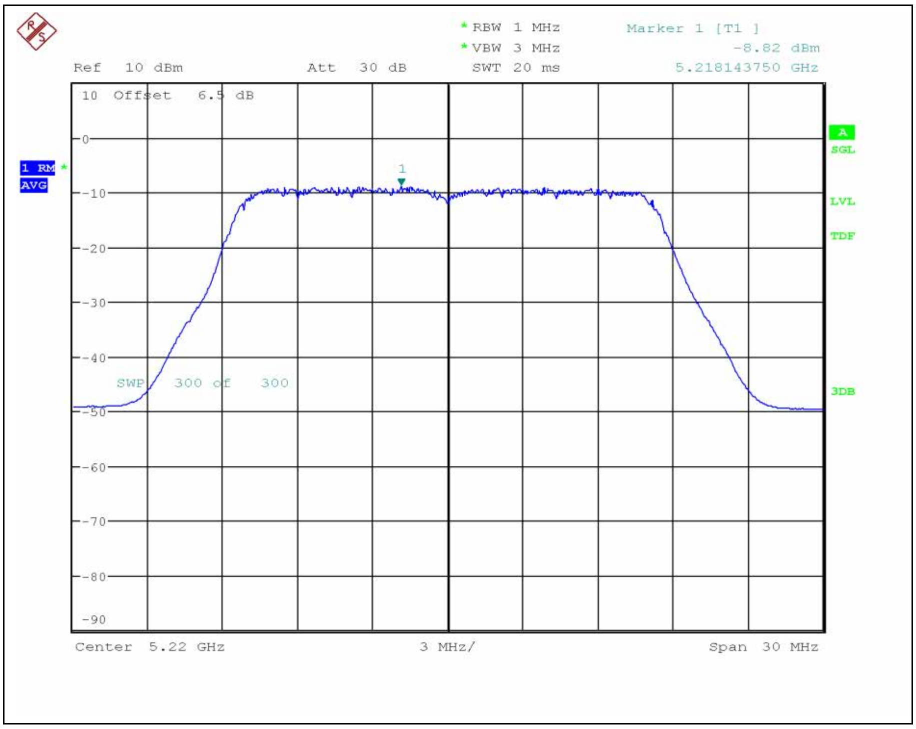
Note 1: C.F(Correction Factor)
Correction Factor = DCCF
For DCCF(Duty Cycle Correction Factor) please refer to appendix III.
Note 2: Sample Calculation.
Test Result = Reading + C.F

3.3.5.5 Test Plot

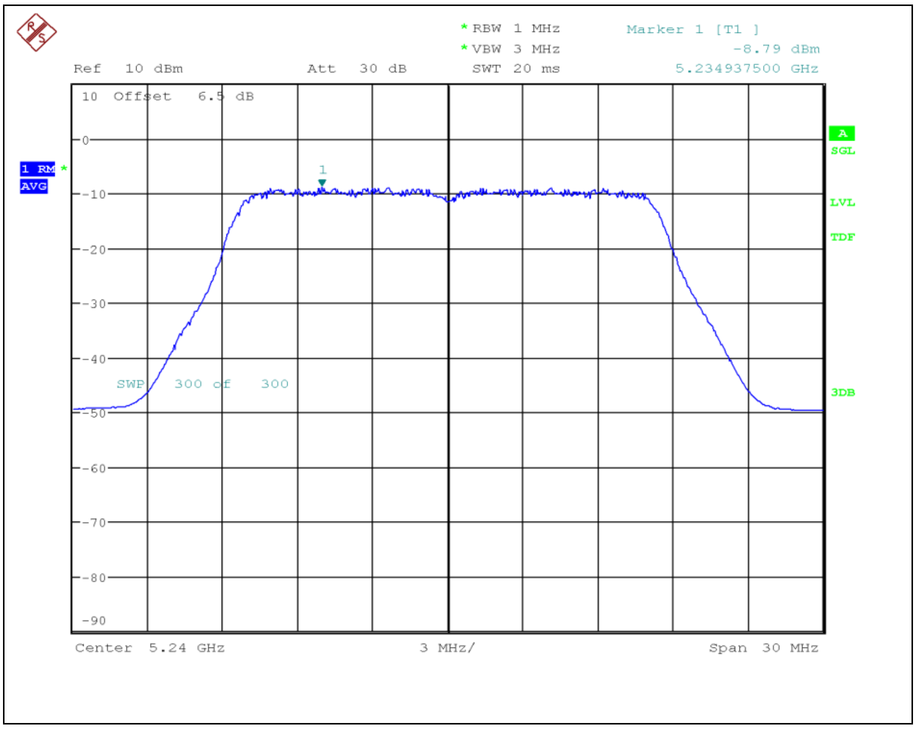
802.11a _ ch.36 Peak Power Spectral Density



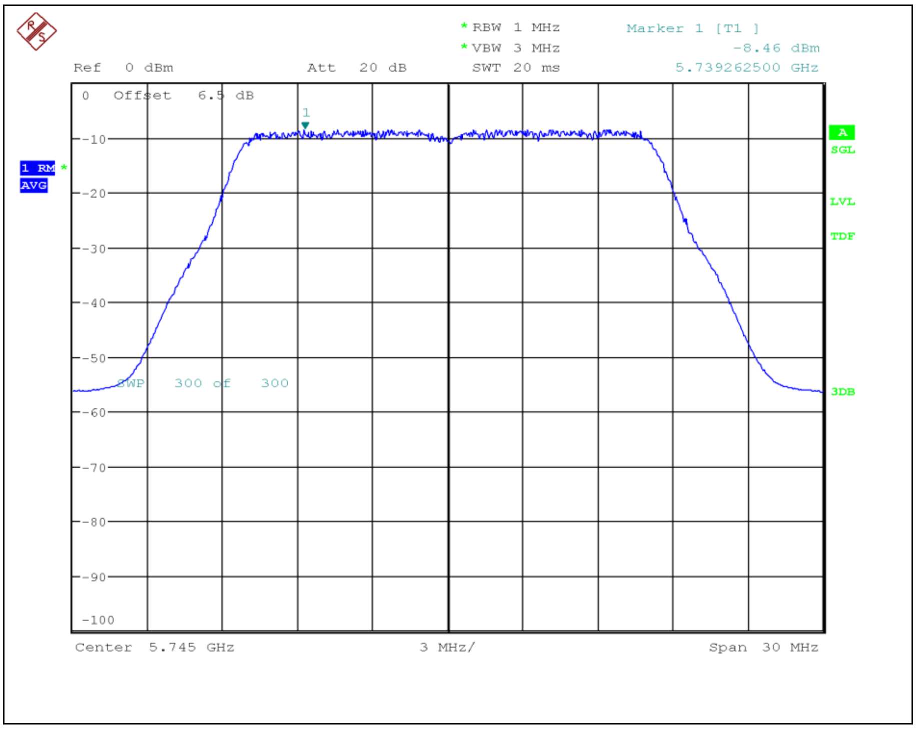
802.11a _ ch.44 Peak Power Spectral Density



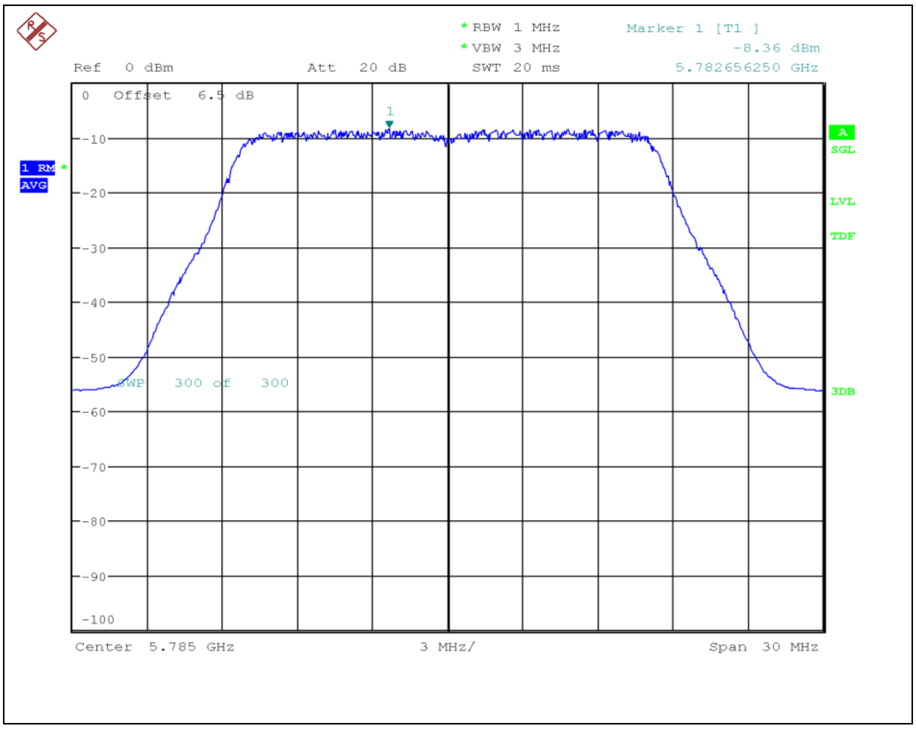
802.11a _ ch.48 **Peak Power Spectral Density**



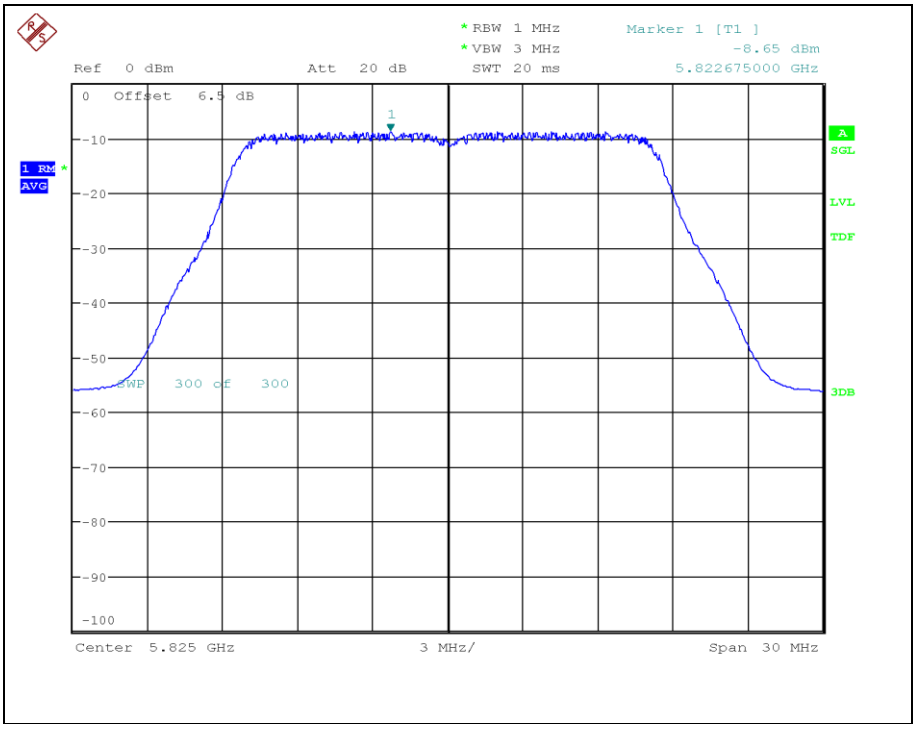
802.11a _ ch.149 Peak Power Spectral Density



802.11a _ ch.157 Peak Power Spectral Density



802.11a _ ch.165 **Peak Power Spectral Density**



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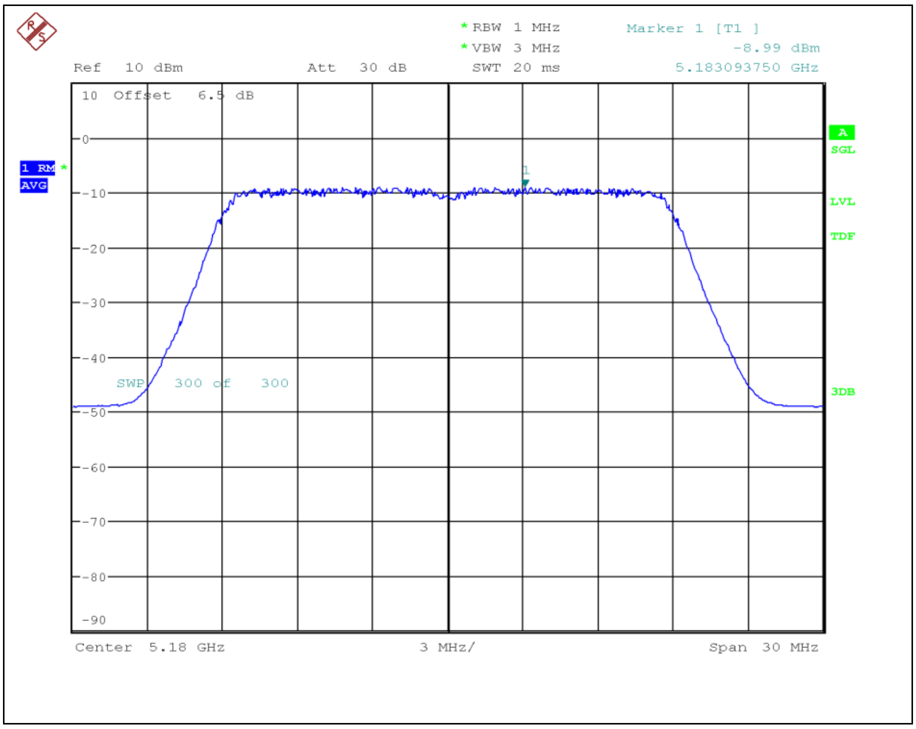
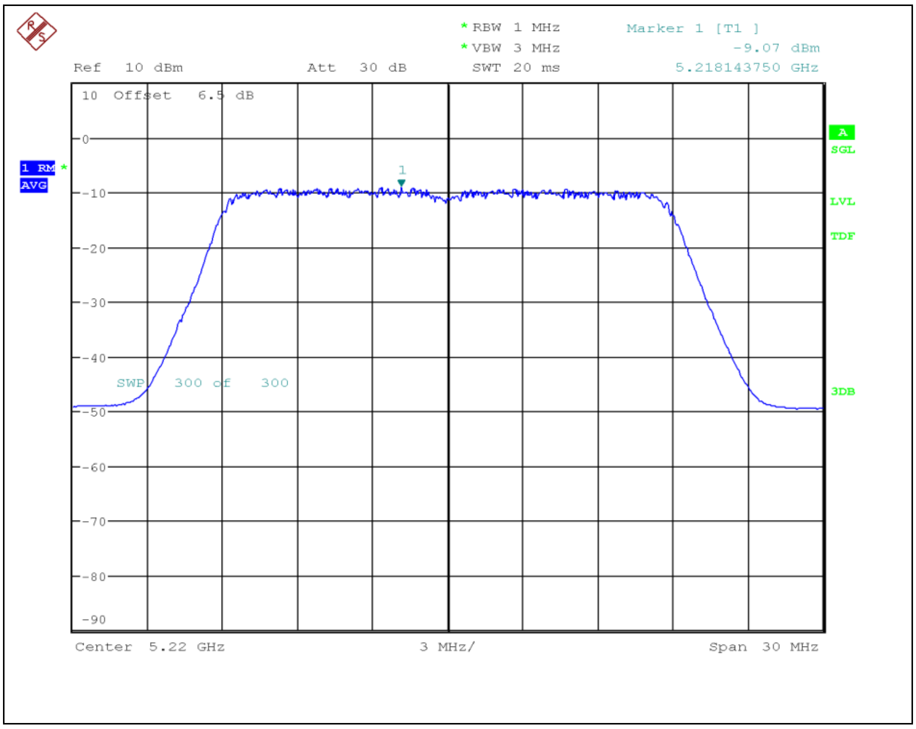
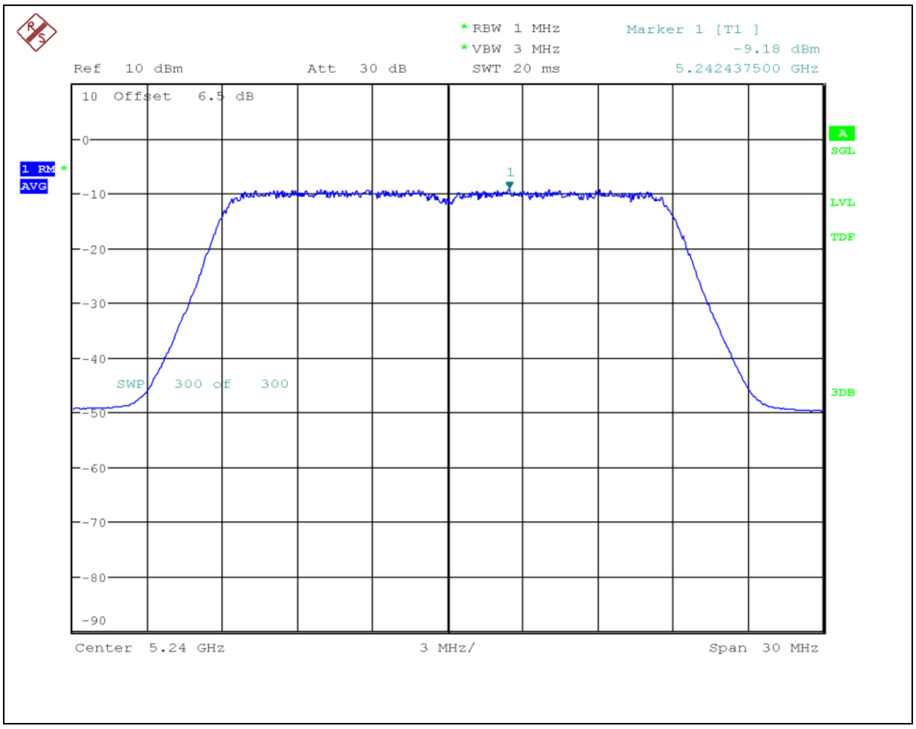
802.11n_HT20 _ ch.36 **Peak Power Spectral Density**



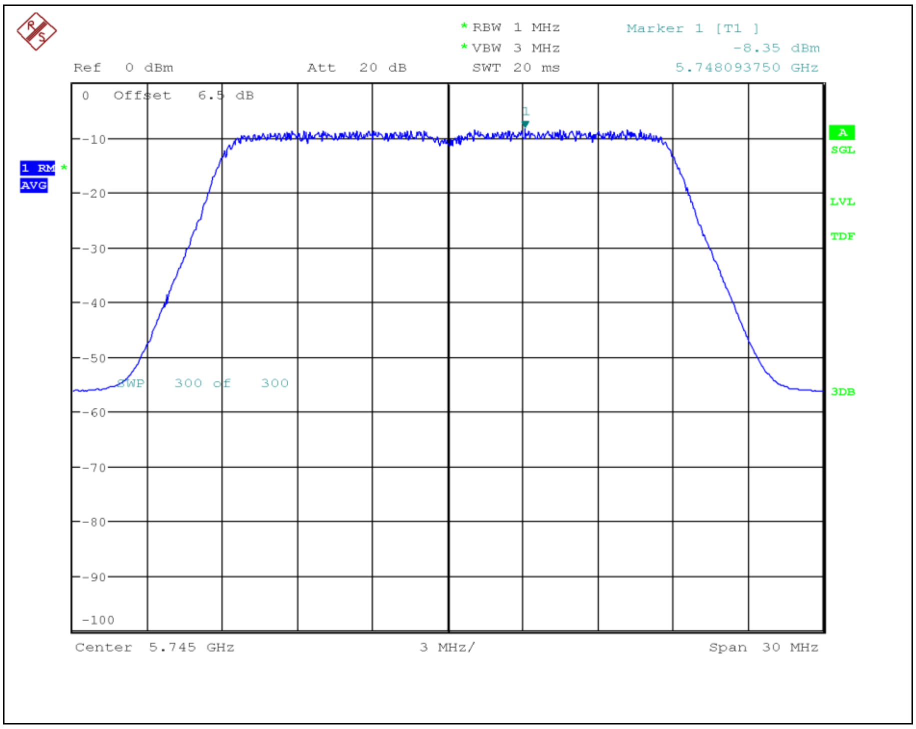
802.11n_HT20 _ ch.44 **Peak Power Spectral Density**



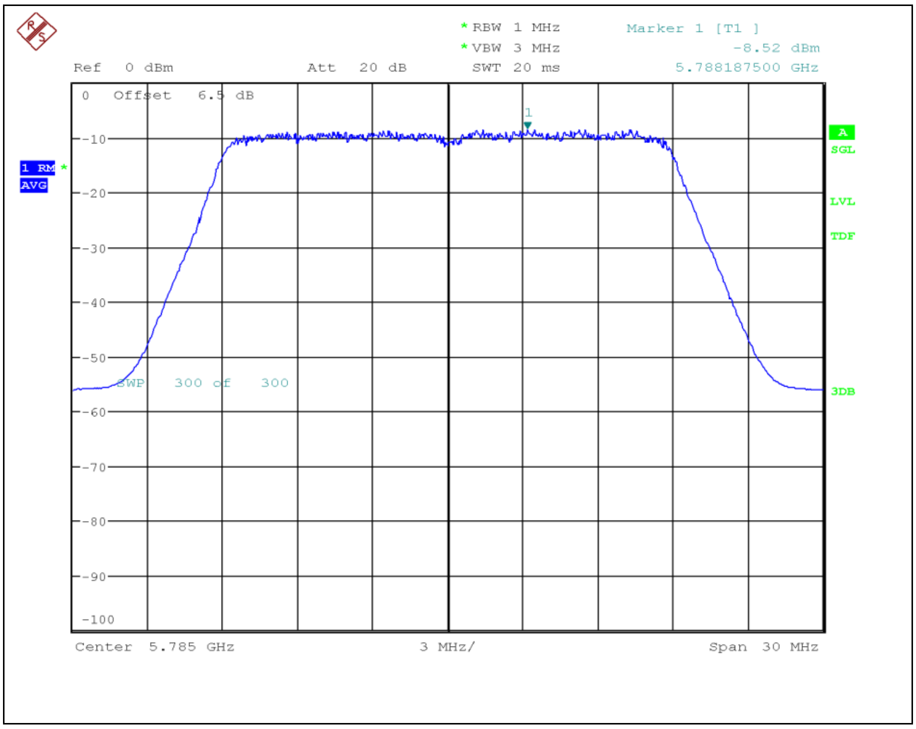
802.11n_HT20 _ ch.48 **Peak Power Spectral Density**



802.11n_HT20 _ ch.149 **Peak Power Spectral Density**



802.11n_HT20 _ ch.157 **Peak Power Spectral Density**



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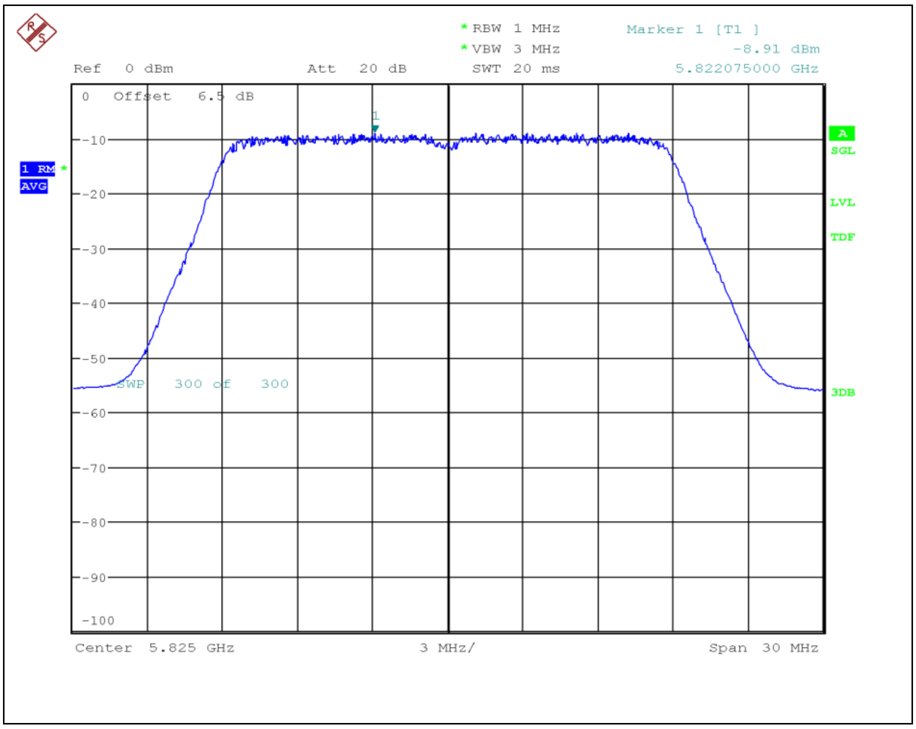
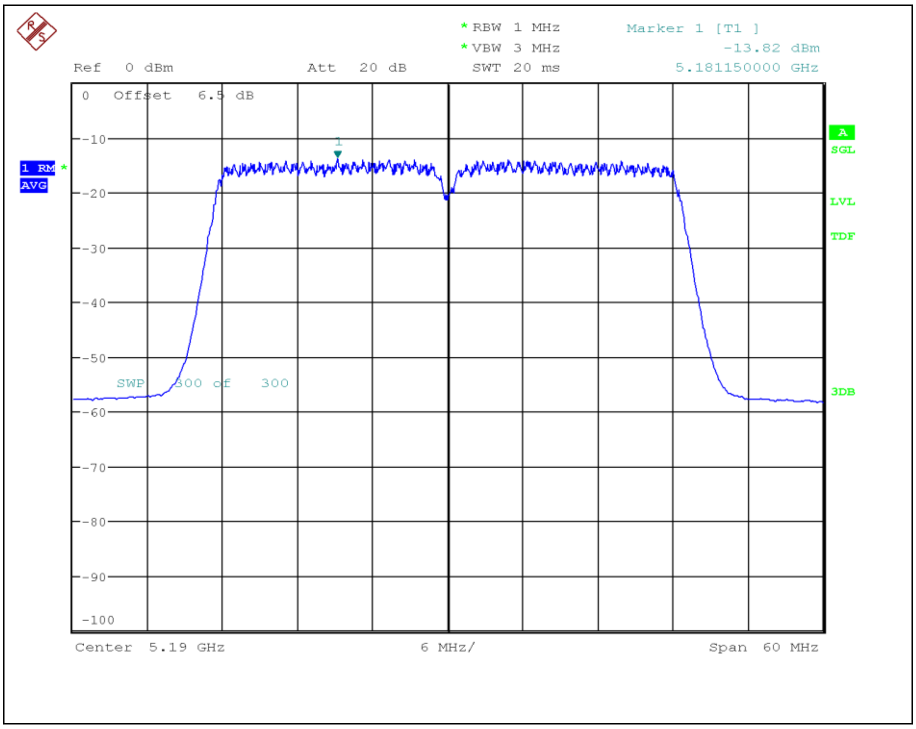
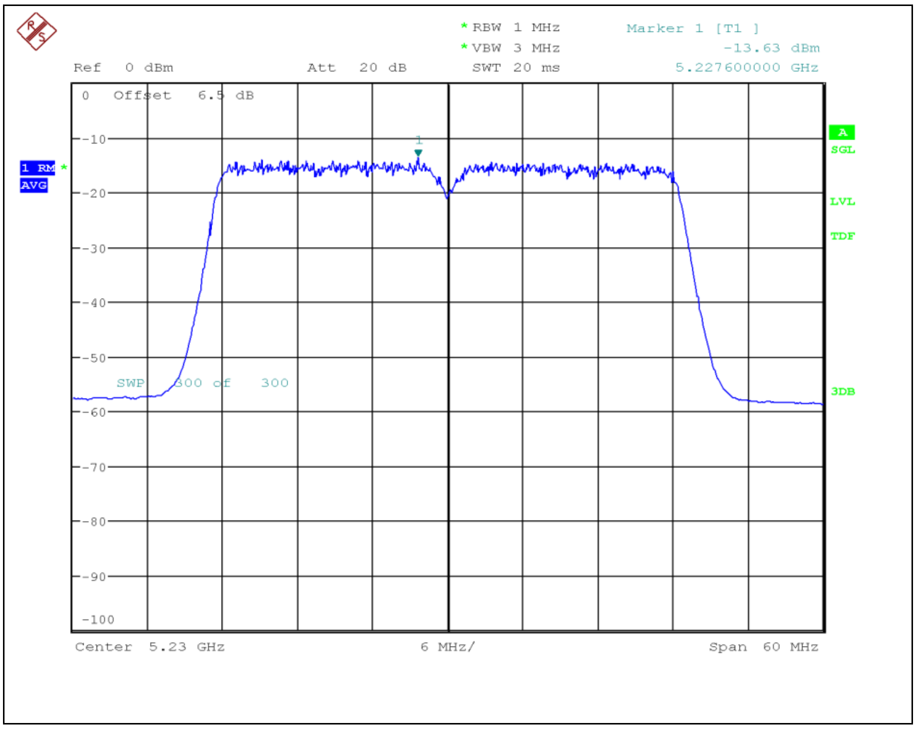
802.11n_HT20 _ ch.165 Peak Power Spectral Density



802.11n_HT40 _ ch.38 **Peak Power Spectral Density**



802.11n_HT40 _ ch.46 **Peak Power Spectral Density**



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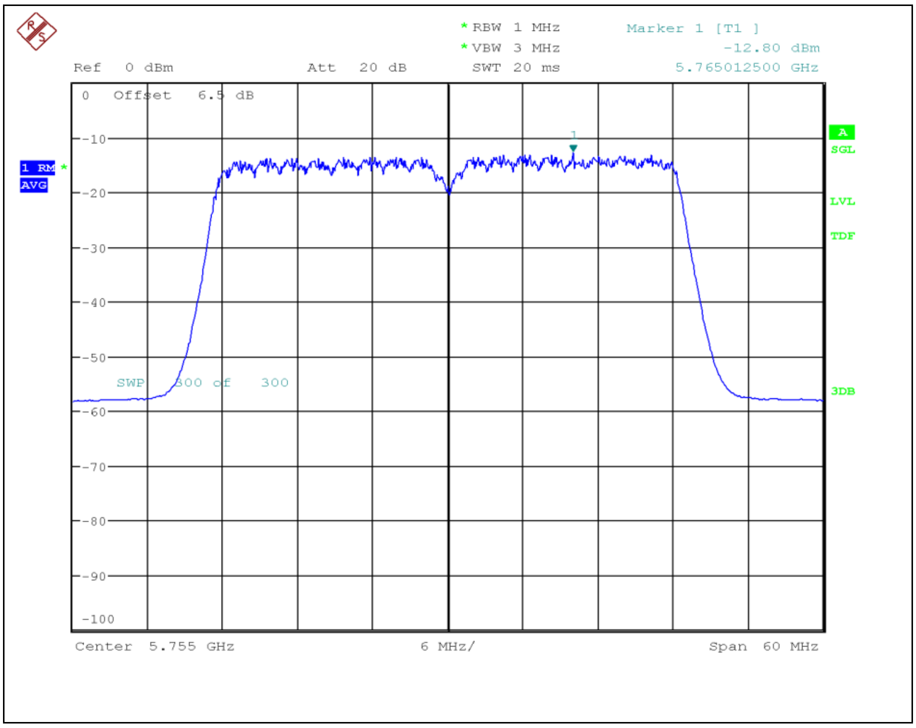
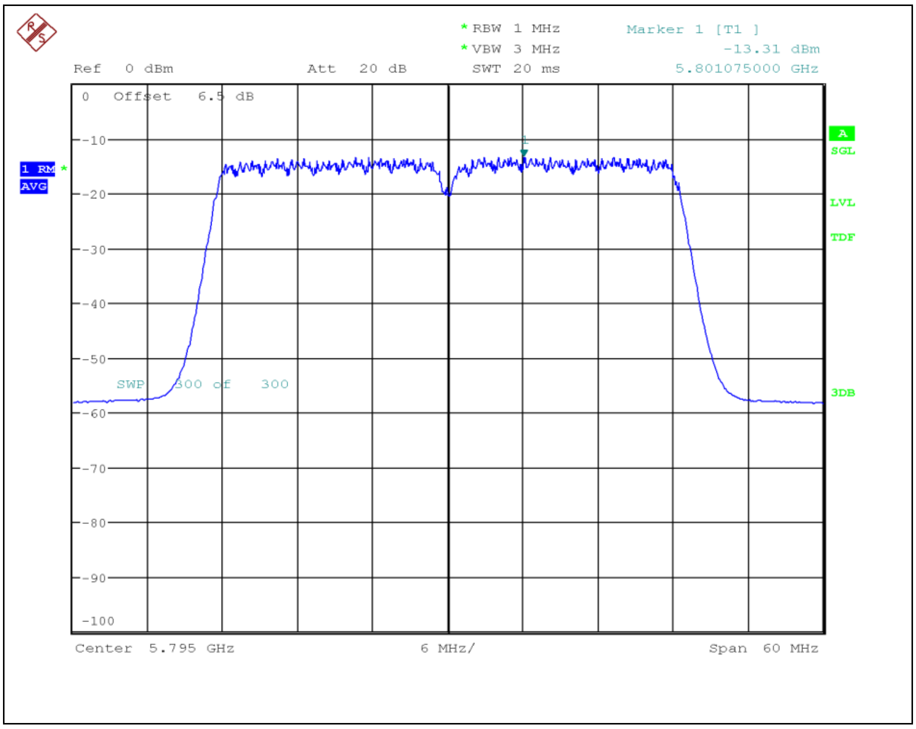
802.11n_HT40 _ ch.151 **Peak Power Spectral Density**



802.11n_HT40 _ ch.159 **Peak Power Spectral Density**



3.3.6 TX Radiated Spurious Emission

3.3.6.1 Test Setup

Refer to the APPENDIX I.

3.3.6.2 Limit

FCC Part 15.407 (b): Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(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 EIRP of -27 ㏈m/㎒.
(2) For transmitters operating in the 5.25-5.35 ㎓ band: all emissions outside of the 5.15-5.35 ㎓ band shall not exceed an EIRP of -27 ㏈m/㎒.
(3) For transmitters operating in the 5.47-5.725 ㎓ band: all emissions outside of the 5.47-5.725 ㎓ band shall not exceed an EIRP of -27 ㏈m/㎒.
(4) For transmitters operating in the 5.725-5.85 ㎓ band: 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.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 ㎒. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 ㎒.
(6) Unwanted emissions below 1 ㎓ must comply with the general field strength limits set forth in Section 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section 15.207.
(7) The provisions of §15.205 apply to intentional radiators operating under this section
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

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 (㎒)	Limit (㎶/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (㎑)	300
0.490 ~ 1705	24000/F (㎑)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

** Except as provided in 15.209(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.

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According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	25 73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
4.17725 ~ 4.17775	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.215 ~ 6.218	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.26775 ~ 6.26825	149.9 ~ 150.05	2200 ~ 2300	14.47 ~ 14.5
6.31175 ~ 6.31225	156.52475 ~ 156.52525	2310 ~ 2390	15.35 ~ 16.2
8.291 ~ 8.294	156.7 ~ 156.9	2483.5 ~ 2500	17.7 ~ 21.4
8.362 ~ 8.366	162.0125 ~ 167.17	2690 ~ 2900	22.01 ~ 23.12
8.37625 ~ 8.38675	3345.8 ~ 3358	3260 ~ 3267	23.6 ~ 24.0
8.41425 ~ 8.41475	3600 ~ 4400	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	3345.8 ~ 3358	240 ~ 285	36.43 ~ 36.5
12.57675 ~ 12.57725	3600 ~ 4400	322 ~ 335.4	Above 38.6
13.36 ~ 13.41			

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 ㎒, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 ㎒, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

3.3.6.3 Test Procedure

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 ㎓, the table height is 80 cm. For emission measurements above 1 ㎓, the table height is 1.5 m. 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 1 or 3 meter away from the interference-receiving antenna.

3. For measurements above 1 ㎓ absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 ㎓, the absorbers are removed.

4. The antenna is a Broadband 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.

5. 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.
   (The EUT was pre-tested with three axes (X, Y, Z) and the final test was performed at the worst case.)

6. Repeat above procedures until the measurements for all frequencies are complete.

Radiated spurious emission measured using following Measurement Procedure of **KDB789033 D02v02r01**

General Requirements for Unwanted Emissions Measurements

The following requirements apply to all unwanted emissions measurements, both in and outside of the restricted bands:

▪ EUT Duty Cycle

(1) The EUT shall be configured or modified to transmit continuously except as stated in (ii), below. The intent is to test at 100 percent duty cycle; however a small reduction in duty cycle (to no lower than 98 percent) is permitted if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

(2) If continuous transmission (or at least 98 percent duty cycle) cannot be achieved due to hardware limitations of the EUT (e.g., overheating), the following additions to the measurement and reporting procedures are required:

- The EUT shall be configured to operate at the maximum achievable duty cycle.
- Measure the duty cycle, x, of the transmitter output signal.
- Adjustments to measurement procedures (e.g., increasing test time and number of traces averaged) shall be performed as described in the procedures below.
- The test report shall include the following additional information:
  - The reason for the duty cycle limitation.
  - The duty cycle achieved for testing and the associated transmit duration and interval between transmissions.
  - The sweep time and the amount of time used for trace stabilization during max-hold measurements for peak emission measurements.

(3) Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Measurements below 1 ㎓

a) Follow the requirements in section II.G.3, “General Requirements for Unwanted Emissions Measurements”.
b) Compliance shall be demonstrated using CISPR quasi-peak detection; however, peak detection is permitted as an alternative to quasi-peak detection.

Measurements above 1 ㎓ (Peak)

a) Follow the requirements in section II.G.3, “General Requirements for Unwanted Emissions Measurements”.
b) Peak emission levels are measured by setting the analyzer as follows:
(i) RBW = 1 ㎒.
(ii) VBW ≥ 3 ㎒.
(iii) Detector = Peak.
(iv) Sweep time = Auto.
(v) Trace mode = Max hold.
(vi) Allow sweeps to continue until the trace stabilizes. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

For example, at 50 percent duty cycle, the measurement time will increase by a factor of two relative to measurement time for continuous transmission.

Measurements above 1 ㎓ (Method AD)

(i) RBW = 1 ㎒.
(ii) VBW ≥ 3 ㎒.
(iii) Detector = RMS, if span / (# of points in sweep) ≤ RBW / 2. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If the condition is not satisfied, the detector mode shall be set to peak.
(iv) Averaging type = power (i.e., RMS)
- As an alternative, the detector and averaging type may be set for linear voltage averaging. Some analyzers require linear display mode in order to use linear voltage averaging. Log or ㏈ averaging shall not be used.

(v) Sweep time = Auto.
(vi) 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 percent duty cycle, at least 200 traces shall be averaged.
(vii) If tests are performed with the EUT transmitting at a duty cycle less than 98 percent, 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 percent duty cycle. The correction factor is computed as follows:
- If power averaging (RMS) mode was used in step (iv) above, the correction factor is 10 log(1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 3 ㏈ must be added to the measured emission levels.
- If linear voltage averaging mode was used in step (iv) above, the correction factor is 20 log (1/x), where x is the duty cycle. For example, if the transmit duty cycle was 50 percent, then 6 ㏈ must be added to the measured emission levels.
- If a specific emission is demonstrated to be continuous (100 percent duty cycle) rather than turning on and off with the transmit cycle, no duty cycle correction is required for that emission.

Please refer to Appendix III for the duty cycle correction factor

3.3.6.4 Test Result

9 ㎑ ~ 40 ㎓ Data for 802.11a

Band	Tested Channel	Freq.	Reading (dBμV/m)		Pol.	T.F (dB)	DCCF (dB)	Limits (dBμV/m)		Result (dBμV/m)		Margin (dB)	
		(㎒)	AV	Peak				AV	Peak	AV	Peak	AV	Peak
U-NII 1	36	4 527.08	21.93	34.63	H	24.21	0.19	54.0	74.0	46.3	59.0	7.7	15.0
	44	-	-	-	-	-	-	-	-	-	-	-	-
	48	5 372.55	20.53	31.81	H	26.63	0.19	54.0	74.0	47.3	58.6	6.7	15.4
U-NII 3	149	709.19	N/A	2.61	V	25.20	N/A	N/A	46.0	N/A	27.8	N/A	18.2
		844.80	N/A	2.09	H	27.30	N/A	N/A	46.0	N/A	29.4	N/A	16.6
	157	-	-	-	-	-	-	-	-	-	-	-	-
	165	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: No other spurious and harmonic emissions were found greater than listed emissions on above table.
Note 2: DCCF(Duty Cycle Correction Factor)
For DCCF(Duty Cycle Correction Factor) please refer to appendix III.
Note 3: Sample Calculation.
Margin = Limit – Result / Peak Result = Peak Reading + TF / Average Result = Average Reading + TF + DCCF
TF = Ant factor + Cable Loss + Filter Loss – Amp Gain
Note 4: The limit is converted to field strength
E[dBμV/m] = EIRP[dBm] + 95.2 dB = -27 dBm + 95.2 dB = 68.2 dBμV/m

9 ㎑ ~ 40 ㎓ Data for 802.11n_HT20

Band	Tested Channel	Freq. (㎒)	Reading (㏈㎶/m) AV	Reading (㏈㎶/m) Peak	Pol.	T.F (㏈)	DCCF (㏈)	Limits (㏈㎶/m) AV	Limits (㏈㎶/m) Peak	Result (㏈㎶/m) AV	Result (㏈㎶/m) Peak	Margin (㏈) AV	Margin (㏈) Peak
U-NII 1	36	4 950.67	20.81	32.32	H	25.3	0.20	54.0	74.0	46.3	57.8	7.7	16.2
	44	-	-	-	-	-	-	-	-	-	-	-	-
	48	5 370.90	20.57	31.86	H	26.63	0.20	54.0	74.0	47.4	58.7	6.6	15.3
U-NII 3	149	729.18	N/A	6.04	H	25.60	N/A	N/A	46.0	N/A	31.6	N/A	14.4
		844.99	N/A	2.14	H	27.30	N/A	N/A	46.0	N/A	29.4	N/A	16.6
	157	-	-	-	-	-	-	-	-	-	-	-	-
	165	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: No other spurious and harmonic emissions were found greater than listed emissions on above table.
Note 2: DCCF(Duty Cycle Correction Factor)
For DCCF(Duty Cycle Correction Factor) please refer to appendix III.
Note 3: Sample Calculation.
Margin = Limit – Result / Peak Result = Peak Reading + TF / Average Result = Average Reading + TF + DCCF
TF = Ant factor + Cable Loss + Filter Loss – Amp Gain
Note 4: The limit is converted to field strength
E[㏈㎶/m] = EIRP[㏈m] + 95.2 ㏈ = -27 ㏈m + 95.2 ㏈ = 68.2 ㏈㎶/m

9 ㎑ ~ 40 ㎓ Data for 802.11n_HT40

Band	Tested Channel	Freq.	Reading (㏈㎶/m)		Pol.	T.F (㏈)	DCCF (㏈)	Limits (㏈㎶/m)		Result (㏈㎶/m)		Margin (㏈)	
		(㎒)	AV	Peak				AV	Peak	AV	Peak	AV	Peak
U-NII 1	38	4 730.75	20.75	32.30	H	24.86	0.24	54.0	74.0	45.9	57.2	8.1	16.8
	46	5 364.48	20.49	32.00	H	26.63	0.24	54.0	74.0	47.4	58.6	6.6	15.4
U-NII 3	151	709.10	N/A	2.51	H	25.20	N/A	N/A	46.0	N/A	27.7	N/A	18.3
		845.19	N/A	2.26	V	27.30	N/A	N/A	46.0	N/A	29.6	N/A	16.4
	159	-	-	-	-	-	-	-	-	-	-	-	-

Note 1: No other spurious and harmonic emissions were found greater than listed emissions on above table.
Note 2: DCCF(Duty Cycle Correction Factor)
For DCCF(Duty Cycle Correction Factor) please refer to appendix III.
Note 3: Sample Calculation.
Margin = Limit – Result / Peak Result = Peak Reading + TF / Average Result = Average Reading + TF + DCCF
TF = Ant factor + Cable Loss + Filter Loss – Amp Gain
Note 4: The limit is converted to field strength
E[㏈㎶/m] = EIRP[㏈m] + 95.2 ㏈ = -27 ㏈m + 95.2 ㏈ = 68.2 ㏈㎶/m

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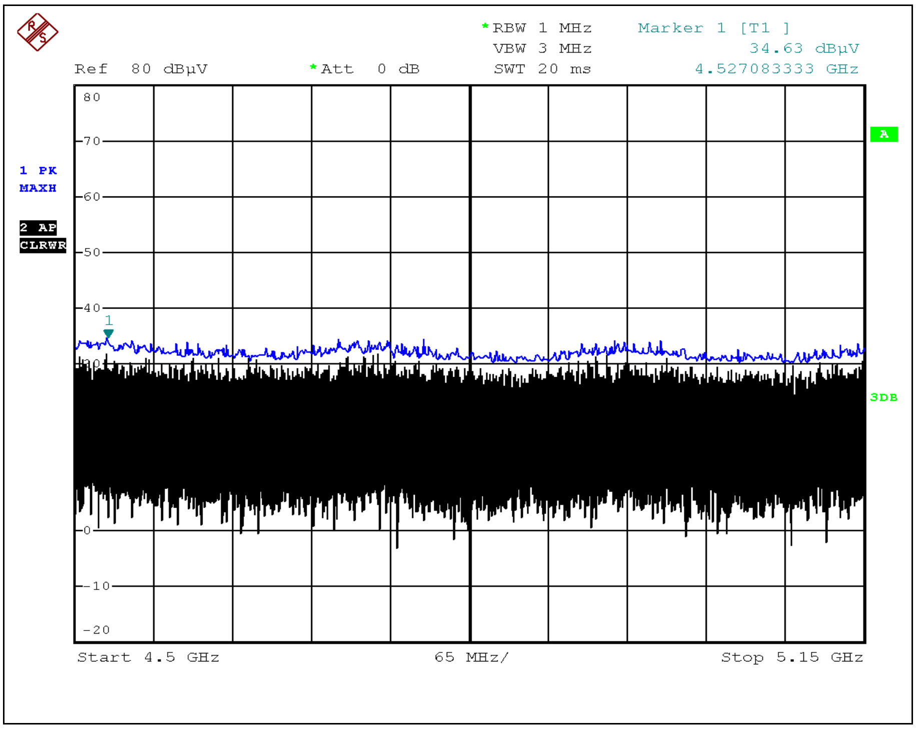
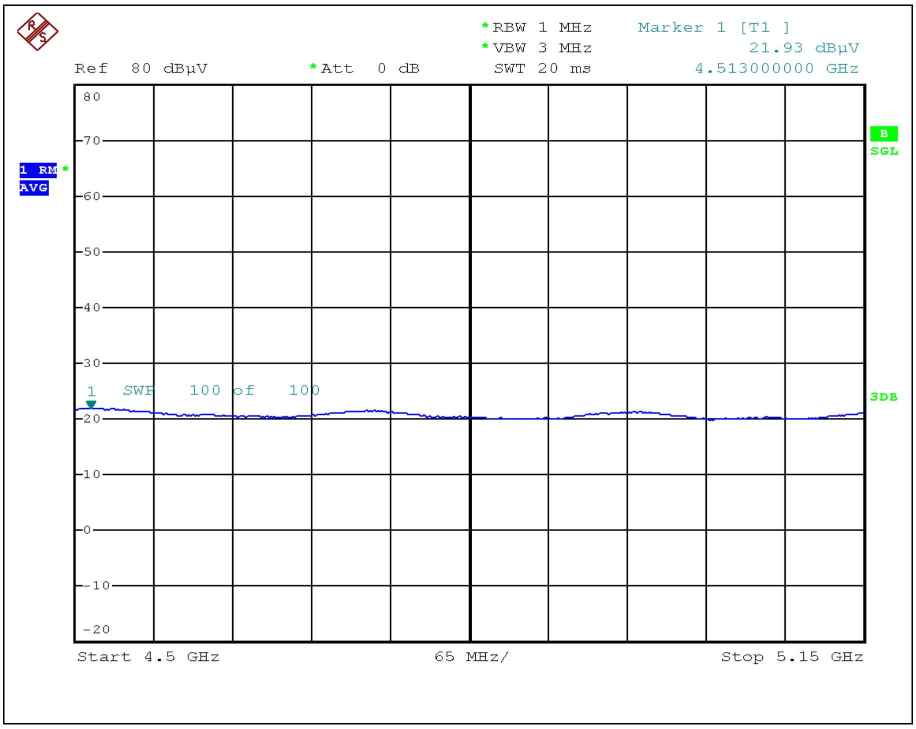
3.3.5.5 Test Plot for Radiated Spurious Emission

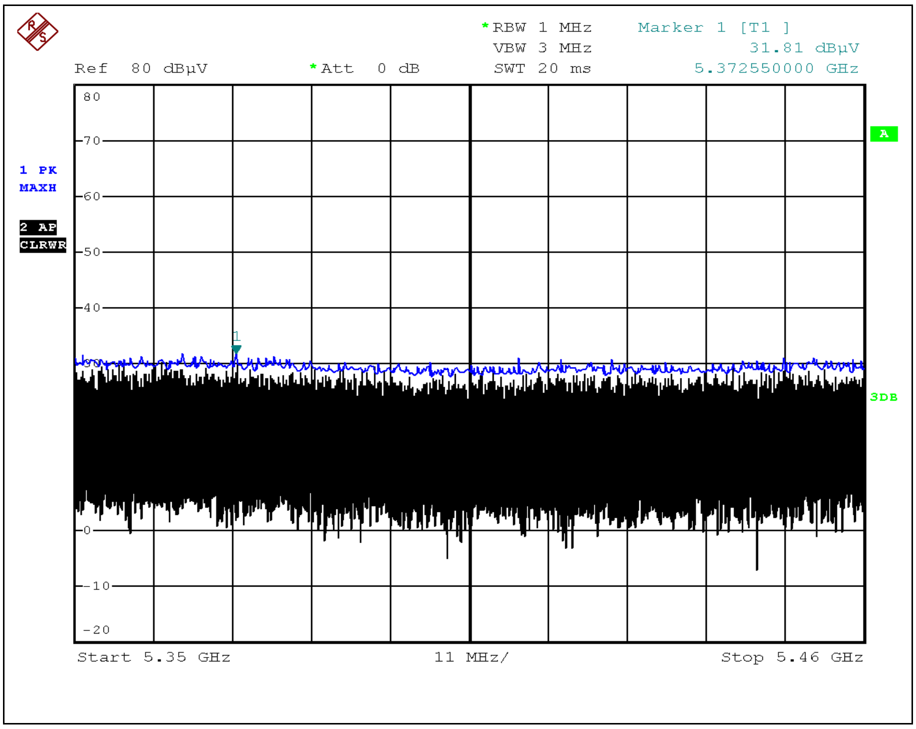
802.11a _ CH 36 Restricted Band - Peak



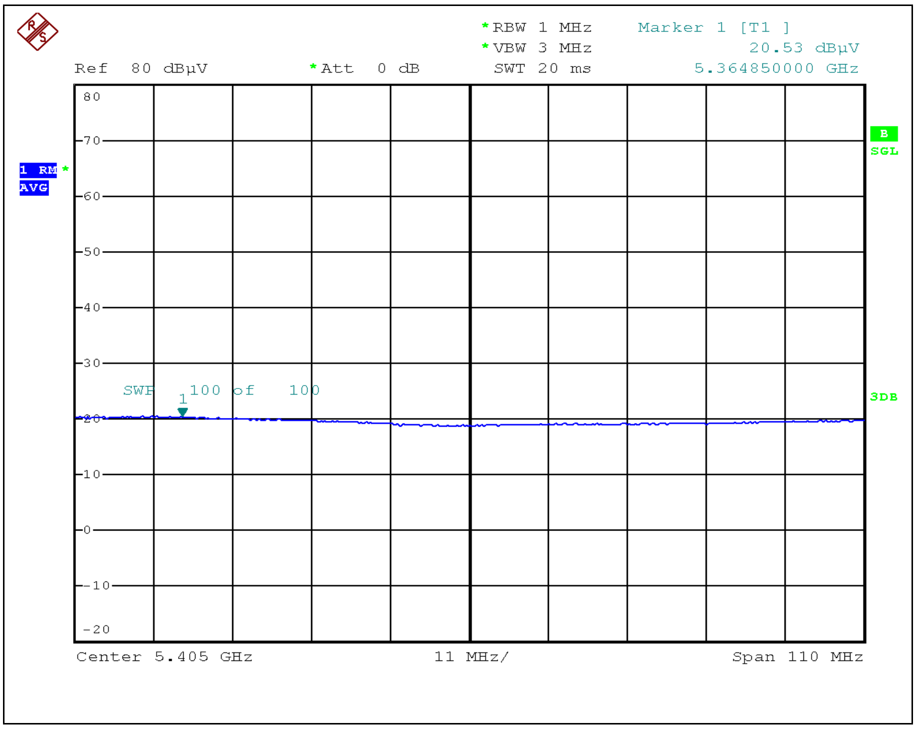
802.11a _ CH 36 Restricted Band - Average



802.11a _ CH 48 **Restricted Band - Peak**



802.11a _ CH 48 **Restricted Band - Average**



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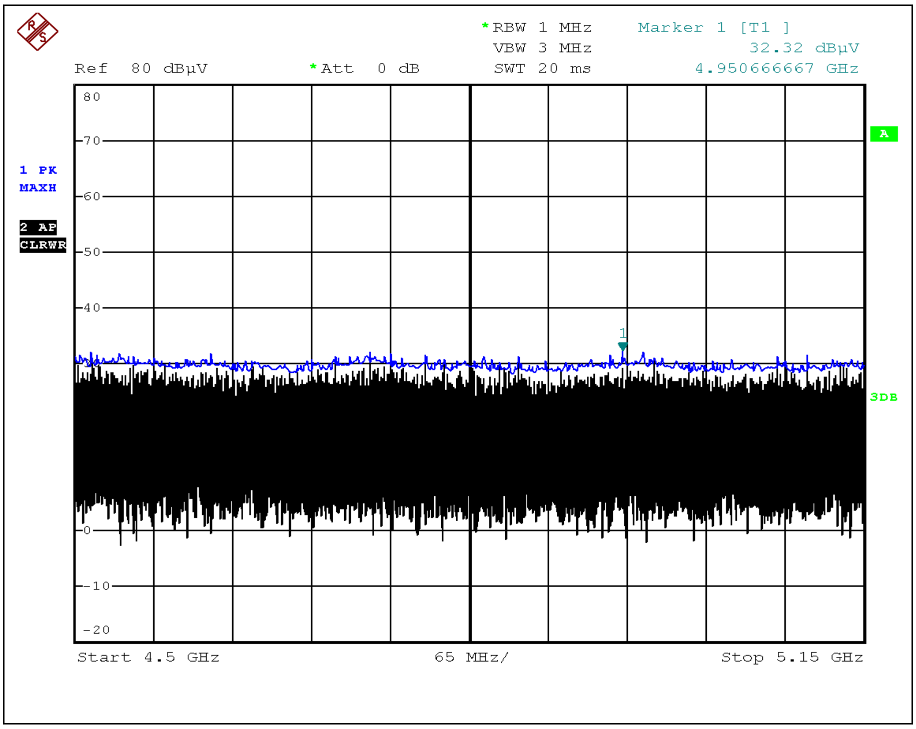
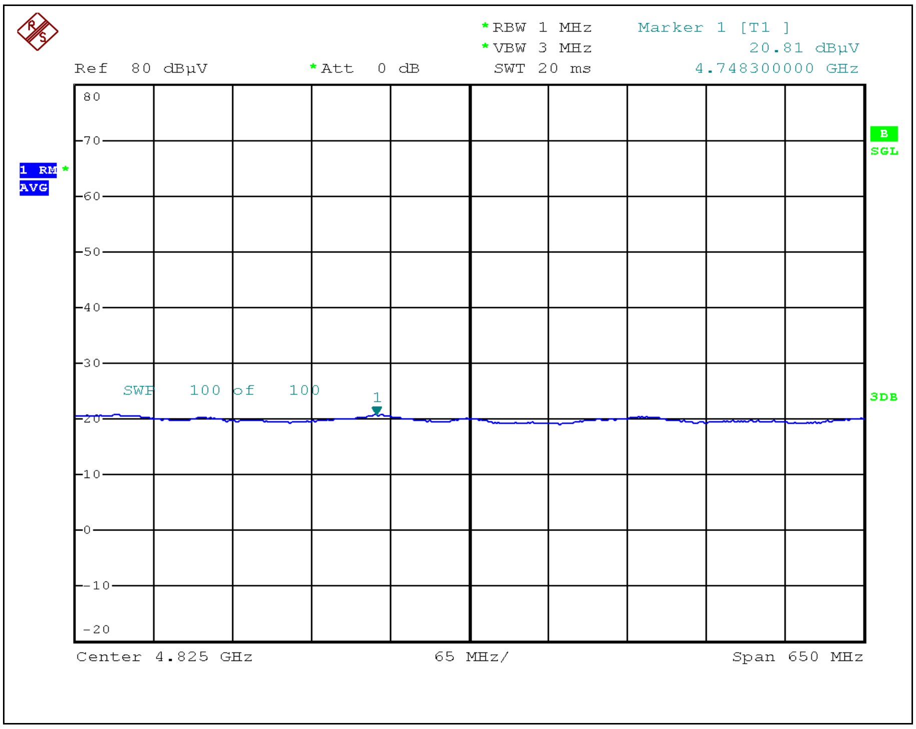
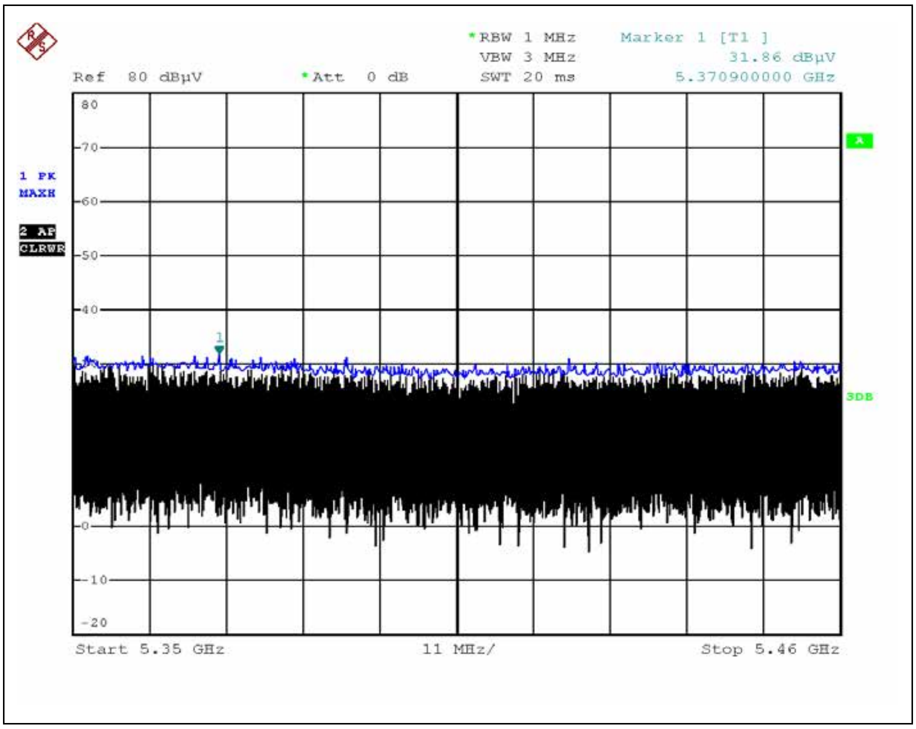
802.11n_HT20 _ CH 36 **Restricted Band - Peak**



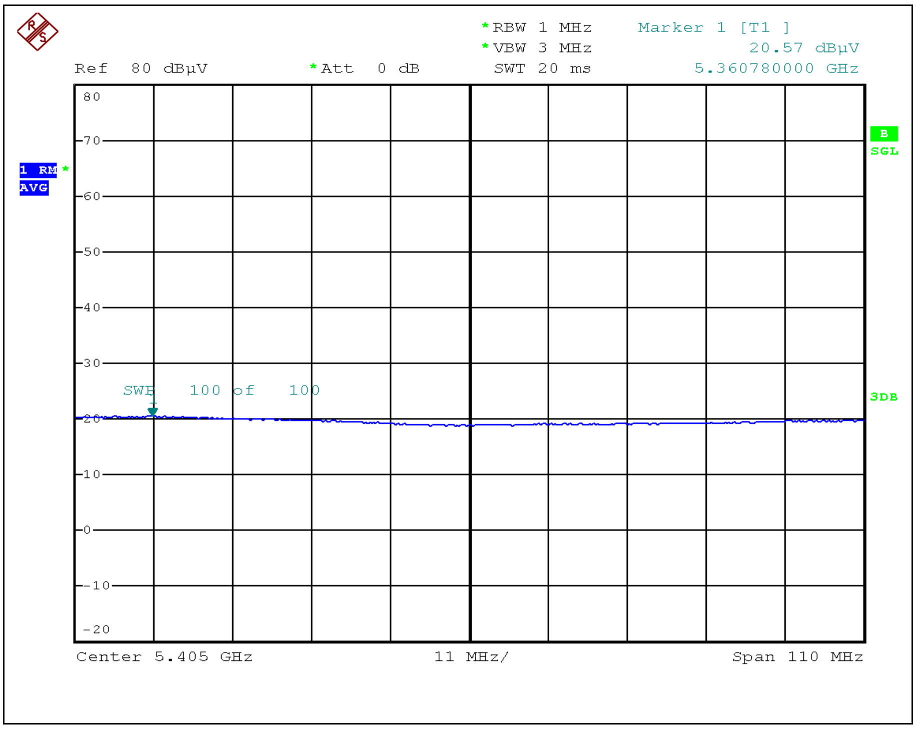
802.11n_HT20 _ CH 36 **Restricted Band - Average**



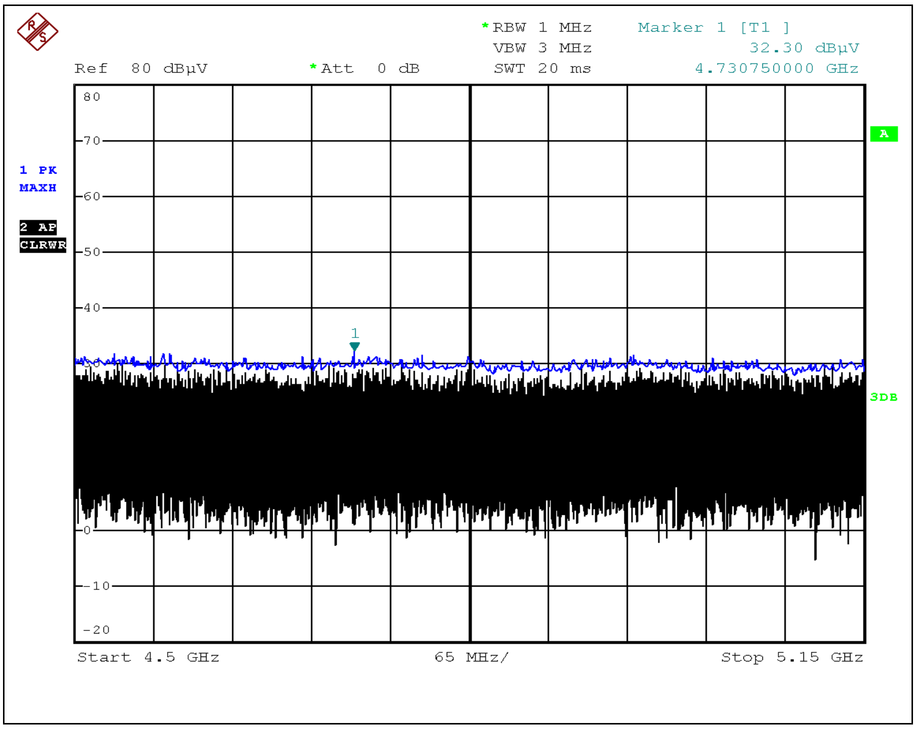
802.11n_HT20 _ CH 48 Restricted Band - Peak



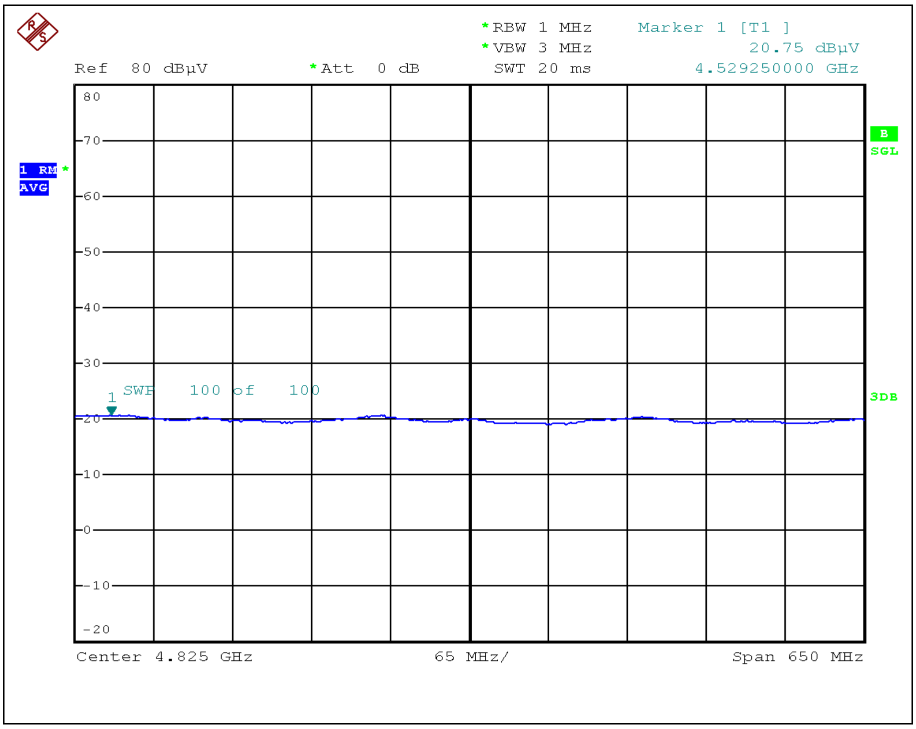
802.11n_HT20 _ CH 48 Restricted Band - Average



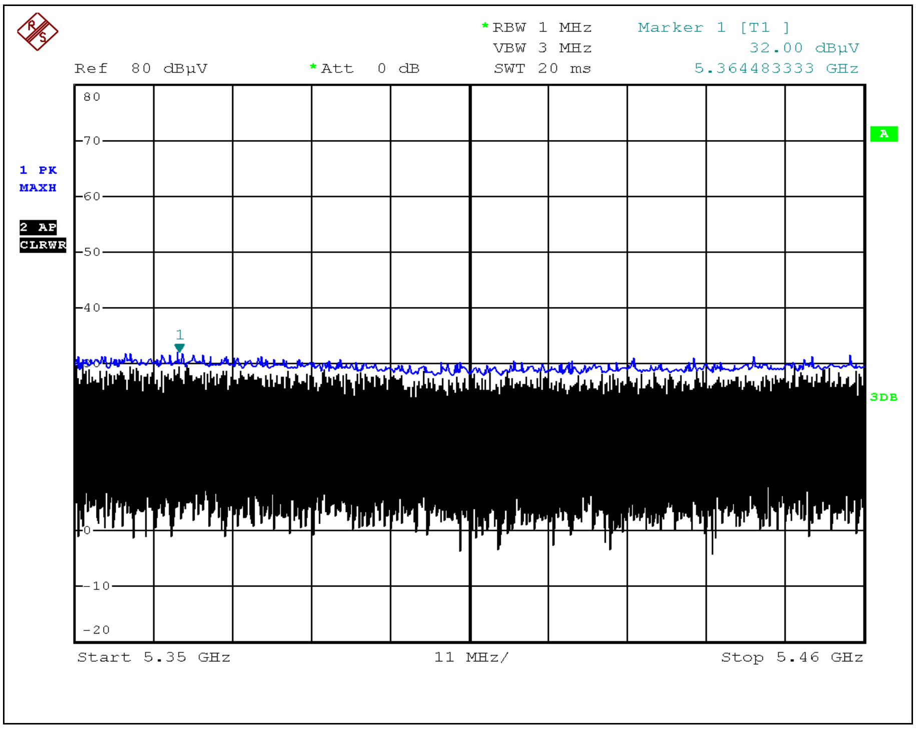
802.11n_HT40 _ CH 38 **Restricted Band - Peak**



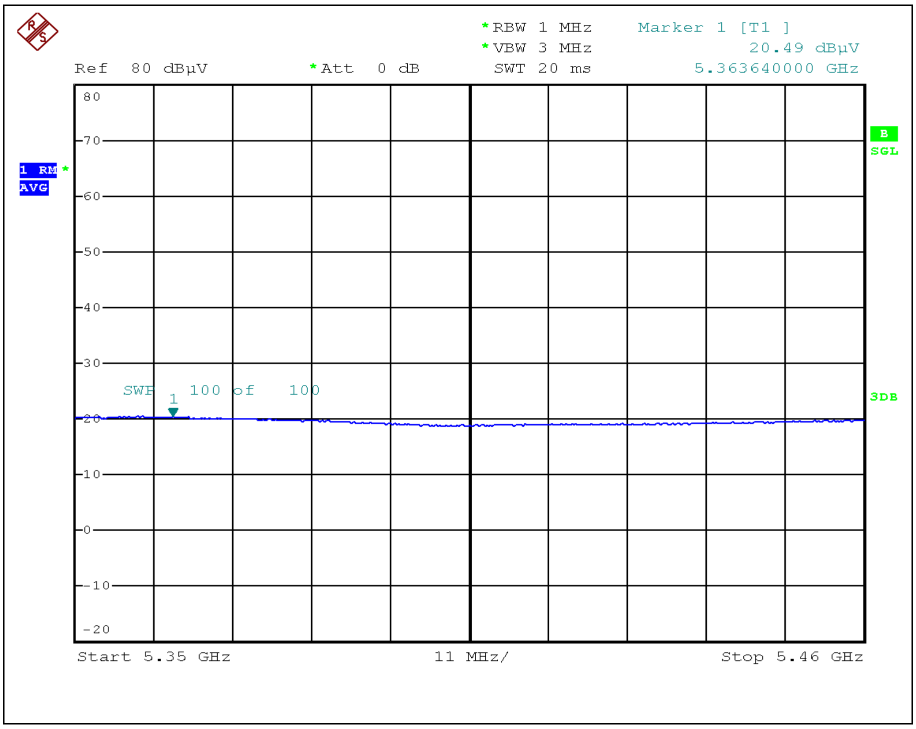
802.11n_HT40 _ CH 38 **Restricted Band - Average**



802.11n_HT40 _ CH 46 **Restricted Band – Peak**



802.11n_HT40 _ CH 46 **Restricted Band - Average**

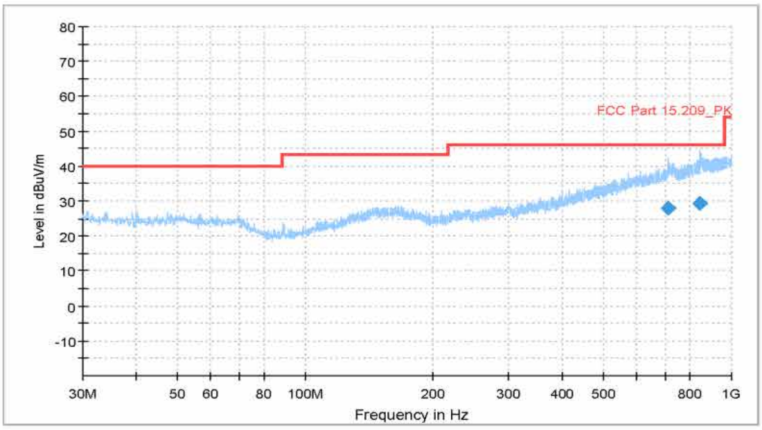


- **802.11a _ CH 149**

Test Report

Common Information

Model Name:	SP98
Test Standard:	FCC Part 15.209
Operator Name:	JongMyoung, Shin
Comment:	U-NII 3 _ 802.11a _ LOW



Final Result

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
709.194000	27.81	46.00	18.19	120.000	250.0	V	260.0	25.2
844.800000	29.39	46.00	16.61	120.000	230.0	H	42.0	27.3

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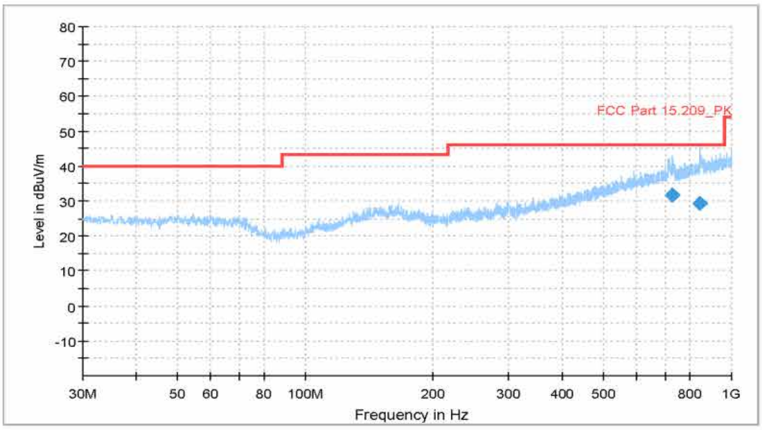
- **802.11n_HT20 _ CH 149**

Test Report

Common Information

Model Name: SP98
Test Standard: FCC Part 15.209
Operator Name: JongMyoung, Shin
Comment: U-NII 3 _ 802.11an_(HT20) _ LOW



Final Result

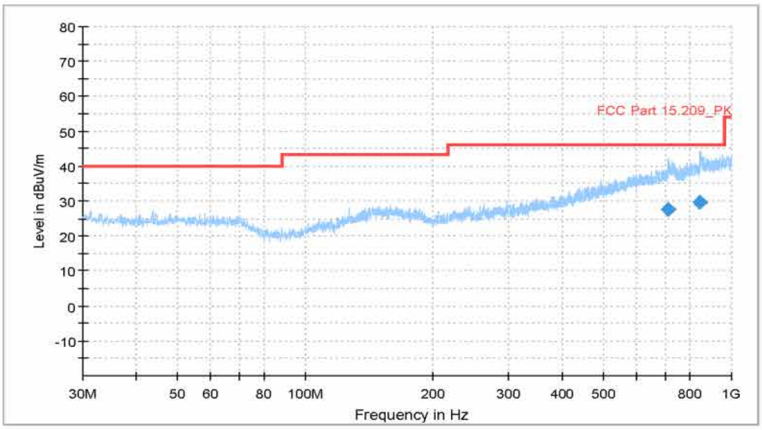
Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
729.176000	31.64	46.00	14.36	120.000	150.0	H	331.0	25.6
844.994000	29.44	46.00	16.56	120.000	150.0	H	276.0	27.3

- **802.11n_HT40 _ CH 151**

Test Report

Common Information

Model Name:	SP98
Test Standard:	FCC Part 15.209
Operator Name:	JongMyoung, Shin
Comment:	U-NII 3 _ 802.11an_(HT40) _ LOW



Final Result

Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
709.097000	27.71	46.00	18.29	120.000	400.0	H	121.0	25.2
845.188000	29.56	46.00	16.44	120.000	228.0	V	206.0	27.3

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3.3.7 Conducted Emission

3.3.7.1 Test Setup

See test photographs for the actual connections between EUT and support equipment.

3.3.7.2 Limit

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 uH/50 ohm line impedance stabilization network (LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (㎒)	Conducted Limit (dB㎶)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

3.3.7.3 Test Procedure

Conducted emissions from the EUT were measured according to the ANSI C63.10.

1. The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

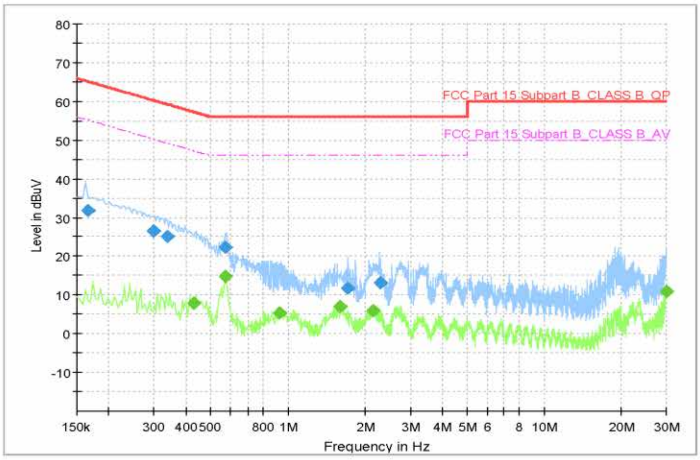
3.3.7.4 Test Result

- **AC Line Conducted Emission (Graph)**

Test Report

Common Information

Test Model:	SP98
Test Standard:	FCC Part 15 Subpart B
Test Mode:	WLAN
Test Conditions:	AC 120 V, 60 Hz / 25.5 'C, 49.4 % R. H.
Operator Name:	JongMyoung, Shin
Comment:	LINE
Order Number:	-



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.166000	31.68	---	65.16	33.47	1000.0	9.000	L1	10.4
0.300000	26.47	---	60.24	33.77	1000.0	9.000	L1	10.5
0.338000	25.12	---	59.25	34.14	1000.0	9.000	L1	10.4
0.432000	---	7.94	47.21	39.28	1000.0	9.000	L1	10.4
0.572000	---	14.93	46.00	31.07	1000.0	9.000	L1	10.4
0.572000	22.47	---	56.00	33.53	1000.0	9.000	L1	10.4
0.932000	---	5.30	46.00	40.70	1000.0	9.000	L1	10.4
1.596000	---	6.90	46.00	39.10	1000.0	9.000	L1	10.6
1.708000	11.62	---	56.00	44.38	1000.0	9.000	L1	10.6
2.156000	---	5.89	46.00	40.11	1000.0	9.000	L1	10.6
2.284000	13.28	---	56.00	42.72	1000.0	9.000	L1	10.6
29.968000	---	10.79	50.00	39.21	1000.0	9.000	L1	12.1

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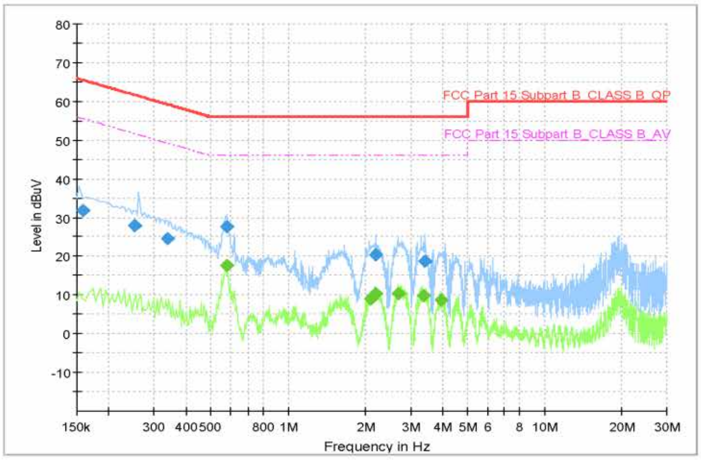
Test Report

Common Information

Test Model:	SP98
Test Standard:	FCC Part 15 Subpart B
Test Mode:	WLAN
Test Conditions:	AC 120 V, 60 Hz / 25.5 'C, 49.4 % R. H.
Operator Name:	JongMyoung, Shin
Comment:	NEUTRAL
Order Number:	-



Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.158000	31.68	---	65.57	33.89	1000.0	9.000	N	10.4
0.252000	27.96	---	61.69	33.73	1000.0	9.000	N	10.4
0.340000	24.70	---	59.20	34.51	1000.0	9.000	N	10.4
0.574000	---	17.48	46.00	28.52	1000.0	9.000	N	10.4
0.578000	27.56	---	56.00	28.44	1000.0	9.000	N	10.4
2.096000	---	9.10	46.00	36.90	1000.0	9.000	N	10.6
2.190000	---	10.39	46.00	35.61	1000.0	9.000	N	10.6
2.192000	20.30	---	56.00	35.70	1000.0	9.000	N	10.6
2.692000	---	10.33	46.00	35.67	1000.0	9.000	N	10.6
3.358000	---	9.86	46.00	36.14	1000.0	9.000	N	10.6
3.408000	18.85	---	56.00	37.15	1000.0	9.000	N	10.6
3.952000	---	8.57	46.00	37.43	1000.0	9.000	N	10.7

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APPENDIX I

TEST SETUP

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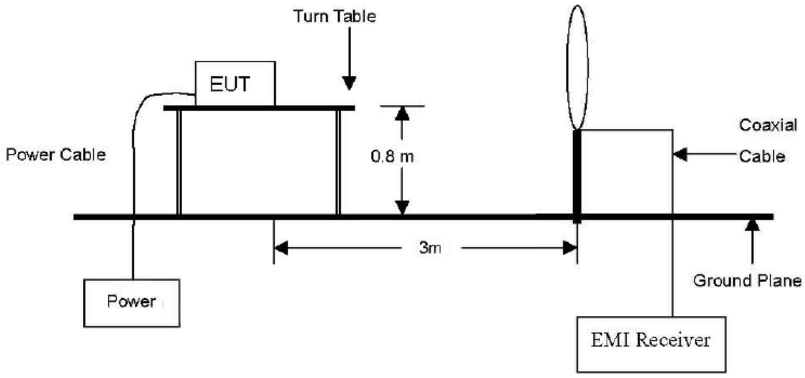
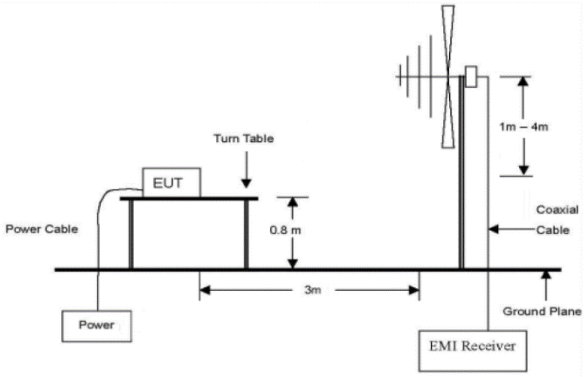
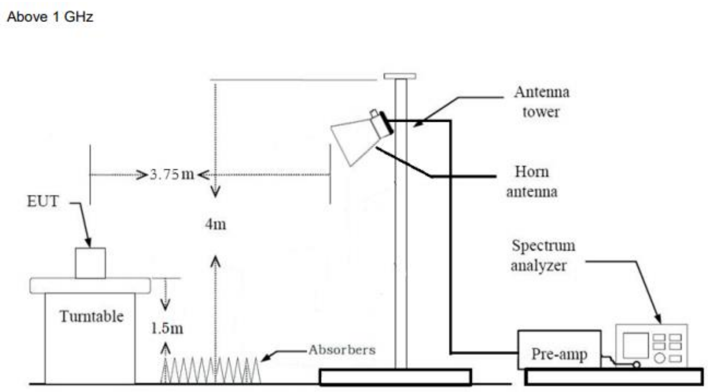
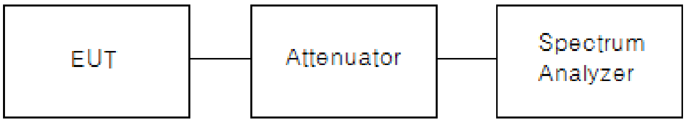
- Radiated Measurement

below 30 ㎒	
below 1 ㎓	
above 1 ㎓	

- Conducted Measurement

Conducted	

APPENDIX II

TEST EQUIPMENT USED FOR TESTS

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	Description	Manufacturer	Serial No.	Model No.	Cal. Date	Next Cal. Date
1	SPECTRUM ANALYZER	R&S	100617	FSP40	2021-03-09	2022-03-09
2	SPECTRUM ANALYZER	R&S	100250	FSU26	2020-09-22	2021-09-22
3	Triple Output DC Power Supply	Agilent	MY40038816	E3631A	2021-03-09	2022-03-09
4	Power supply	GWInstek	EH120798	PST-3202	2021-03-09	2022-03-09
5	Humi./Baro/Temp. data recorder	Lutron	38420	MHB-382SD	2020-11-13	2021-11-13
6	USB Peak & Average Power Sensor	KEYSIGHT	MY58140003	U2044XA	2021-09-03	2022-09-03
7	8360B SERIES SWEPT SIGNAL GENERATOR	HP	3614A00312	83640B	2020-12-30	2021-12-30
8	LOOP-ANTENNA	Schwarzbeck	00124	FMZB1519 B	2021-06-01	2023-06-01
9	TRILOG Broadband Antenna	Schwarzbeck	01027	VULB 9168	2021-06-08	2023-06-08
10	Double Ridged Broadband Horn Antenna	Schwarzbeck	02087	BBHA 9120D	2021-06-02	2022-06-02
11	Broadband Horn Antenna	Schwarzbeck	00938	BBHA 9170	2021-06-01	2022-06-01
12	AMPIIFIER	TESTEK	160011-L	TK-PA18M	2021-05-24	2022-05-24
13	Amplifier	TESTEK	190008-L	TK-PA1840H	2021-05-28	2022-05-28
14	ATTENUATOR	INMET	279465	40AH2W	2021-07-27	2022-07-27
15	ATTENUATOR	Weinschel	none	WA41/12-30-12	2021-03-09	2022-03-09
16	High Pass Filter	Mini-Circuits	1741	VHF-3100+	2021-03-09	2022-03-09
17	High Pass Filter	Mini-Circuits	1732	VHF-8400+	2021-03-09	2022-03-09
18	LISN	Schwarzbeck	00984	NSLK 8127	2021-05-27	2022-05-27
19	EMI Test Receiver	R&S	102116	ESRP3	2021-05-27	2022-05-27

APPENDIX III

DUTY CYCLE CORRECTION FACTOR

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Test Procedure

Duty Cycle [X = On Time / (On + Off time)] is measured using Measurement Procedure of KDB789033 D02v02r01

1. Set the center frequency of the spectrum analyzer to the center frequency of the transmission.
2. Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value.
3. Set VBW ≥ RBW. Set detector = peak.
4. Note : The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T, where T is defined in section II.B.1.a), and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 ㎒, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)
   T : The minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
   (T = On time of the above table since the EUT operates with above fixed Duty Cycle and it is the minimum On time)

Test Result

Test Mode		Data Rate	Test Channel	Maximum Achievable Duty Cycle (x) = On / (On+Off)			Duty Cycle Correction Factor (㏈)	50/T (㎑)
				On Time (ms)	(On+Off) Time (ms)	Duty Cycle (x)		
U-NII 1	802.11a	6 Mbps	36	1.438	1.502	0.957	0.19	34.78
	802.11n_HT20	MCS 0	36	1.350	1.414	0.955	0.20	37.05
	802.11n_HT40	MCS 0	38	0.691	0.731	0.945	0.24	72.37
U-NII 3	802.11a	6 Mbps	149	0.643	0.688	0.935	0.29	77.79
	802.11an(HT20)	MCS 0	149	1.388	1.441	0.963	0.16	36.02
	802.11an(HT40)	MCS 0	151	0.644	0.694	0.928	0.32	77.59

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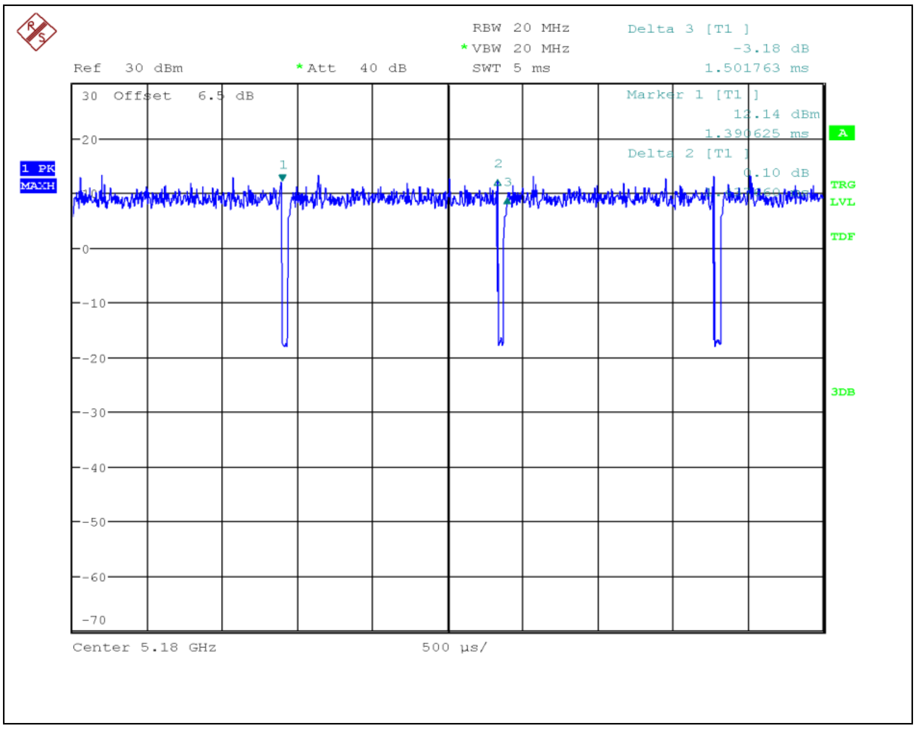
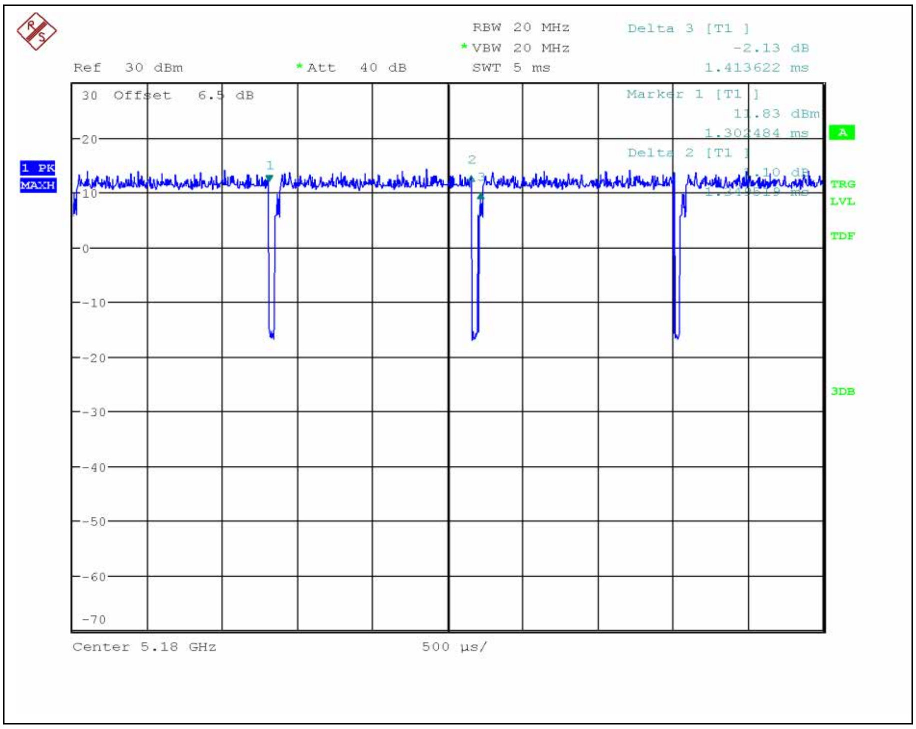
Test Plot

802.11a _ ch.36 **Duty Cycle**



802.11n_HT20 _ ch.36 **Duty Cycle**



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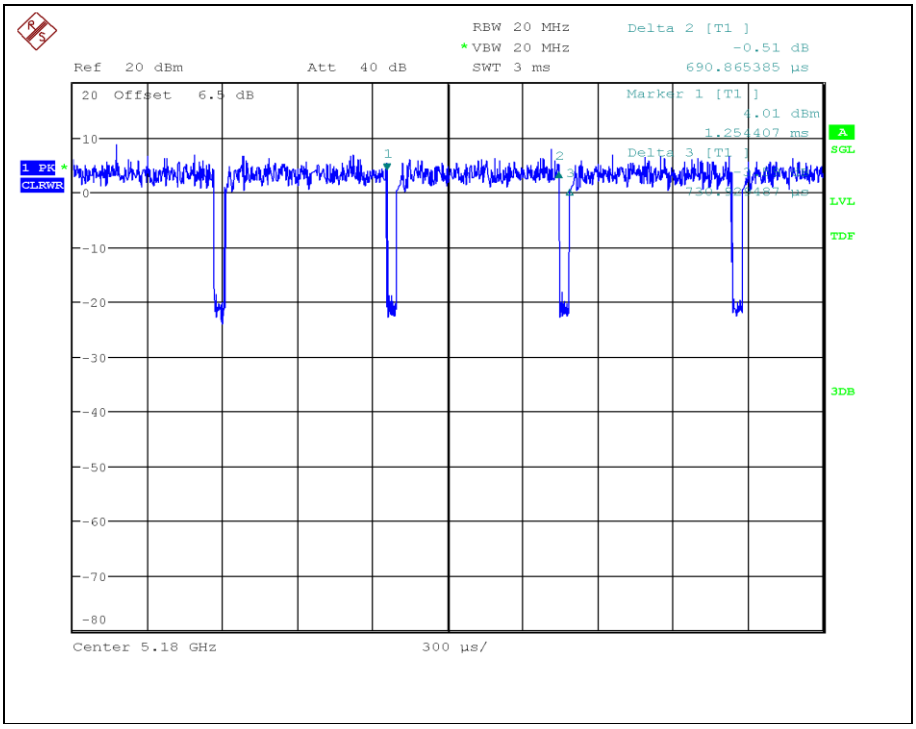
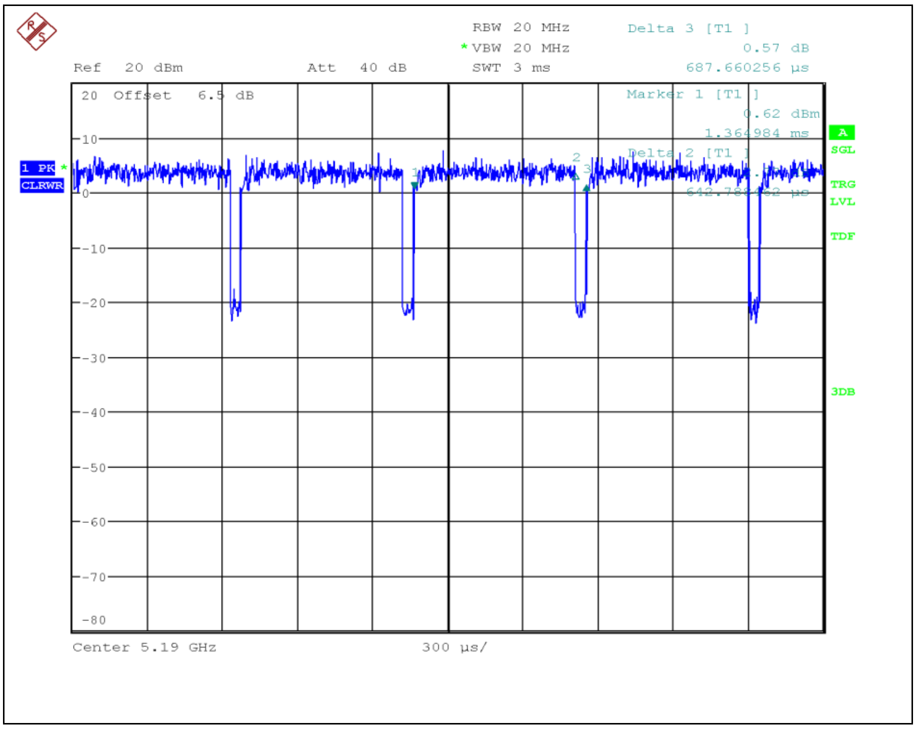
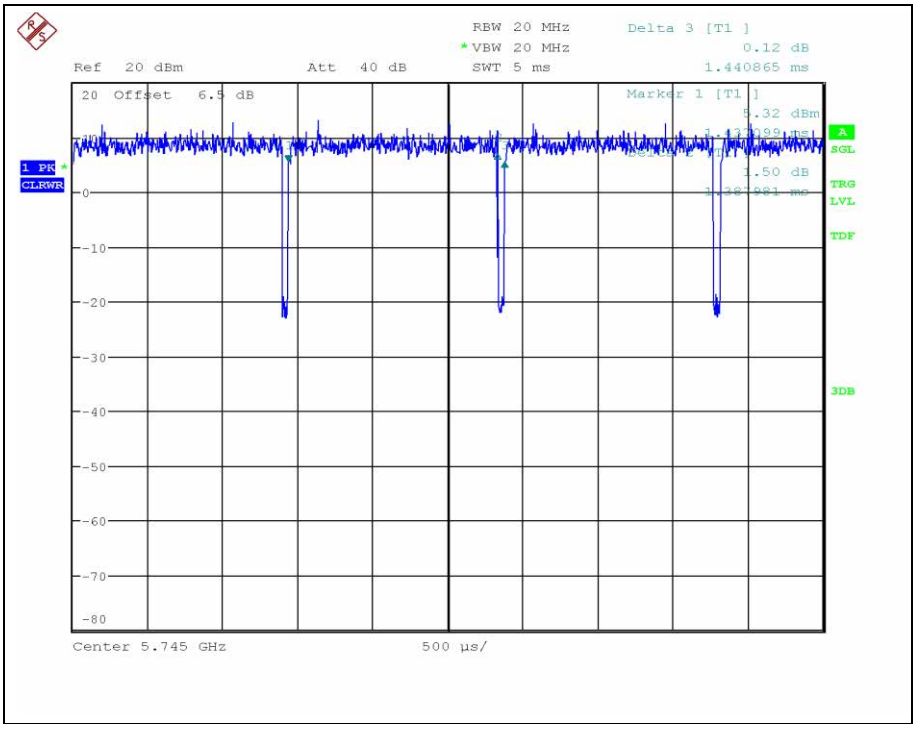
802.11n_HT40 _ ch.38 **Duty Cycle**



802.11a _ ch.149 **Duty Cycle**



802.11n_HT20 _ ch.149 **Duty Cycle**



802.11n_HT40 _ ch.151 **Duty Cycle**