

TEST REPORT

of

FCC Part 15 Subpart E §15.407

FCC ID: BEJTM05GTJN

Equipment Under Test : Car Telematics Device
Model Name : TA4HEB-N
Applicant : LG Electronics USA
Manufacturer : LG Electronics USA
Date of Receipt : 2018.08.01
Date of Test(s) : 2018.08.02 ~ 2019.03.22
Date of Issue : 2019.04.12

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

Tested By:



Nancy Park

Date:

2019.04.12

Technical
Manager:



Hyunchoe You

Date:

2019.04.12

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RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

- 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807
- Designation number: KR0150

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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-N
Power Supply	DC 12 V
Frequency Range	2 412 MHz ~ 2 462 MHz (11b/g/n_HT20), 2 422 MHz ~ 2 452 MHz (11n_HT40), 5 180 MHz ~ 5 240 MHz (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 MHz ~ 5 230 MHz (Band 1: 11n_HT40, 11ac_VHT40), 5 210 MHz (Band 1: 11ac_VHT80), 5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40), 5 775 MHz (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 MHz ~ 2 483.5 MHz: 2.55 dB i, 5 150 MHz ~ 5 250 MHz: 3.96 dB i, 5 725 MHz ~ 5 850 MHz: 6.31 dB i

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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	103102	Jun. 11, 2018	Annual	Jun. 11, 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
Low Pass Filter	Mini-Circuits	NLP-1200+	V 8979400903-1	May 24, 2018	Annual	May 24, 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	R&S	HMP2020	019258024	Nov. 06, 2018	Annual	Nov. 06, 2019
Preamplifier	H.P.	8447F	2944A03909	Aug. 07, 2018	Annual	Aug. 07, 2019
Preamplifier	Agilent	8449B	3008A01932	Feb. 22, 2019	Annual	Feb. 22, 2020
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	Jan. 31, 2019	Annual	Jan. 31, 2020
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	Jan. 04, 2019	Semi-annual	Jul. 04, 2019
Coaxial Cable	SUCOFLEX	104 (10 m)	MY3145814	Jan. 04, 2019	Semi-annual	Jul. 04, 2019
Coaxial Cable	Rosenberger	LA1-C006-1500	131014 01/20	Feb. 28, 2019	Semi-annual	Aug. 28, 2019

1.6. Declaration by the Manufacturer

- The EUT supported transmitter power control(TPC).

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1.7. Summary of Test Result

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15 Subpart E		
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)	Transmitter Radiated Spurious Emissions	Complied
15.407(a)	26 dB Bandwidth & 99 % Bandwidth	Complied
15.407(e)	6 dB Bandwidth	Complied
15.407(a)(1) 15.407(a)(2) 15.407(a)(3)	Maximum Conducted Output Power	Complied
15.407(a)(1) 15.407(a)(2) 15.407(a)(3)	Peak Power Spectral Density	Complied

1.8. 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.

1.9. Sample Calculation

Where relevant, the following sample calculation is provided:

1.9.1. Conducted Test

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

1.9.2. Radiation Test

Field strength level (dB μ V/m) = Measured level (dB μ V) + Antenna factor (dB) + Cable loss (dB) - Amplifier gain (dB)

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1.10. Measurement Uncertainty

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

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

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

1.11. Test Report Revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL013636	2019.03.28	Initial
1	F690501/RF-RTL013636-1	2019.04.12	Corrected the limit of power and PSD of U-NII 3, Added Declaration by the Manufacturer and Automatically Discontinue Transmission and Deleted IC standards.

1.12. Automatically Discontinue Transmission

1.12.1. 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.

1.12.2. 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 from remote device and verify whether it shall resend or discontinue transmission.

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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 $\geq$ EBW if possible; otherwise, set RBW to the largest available value, Set VBW $\geq$ 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.

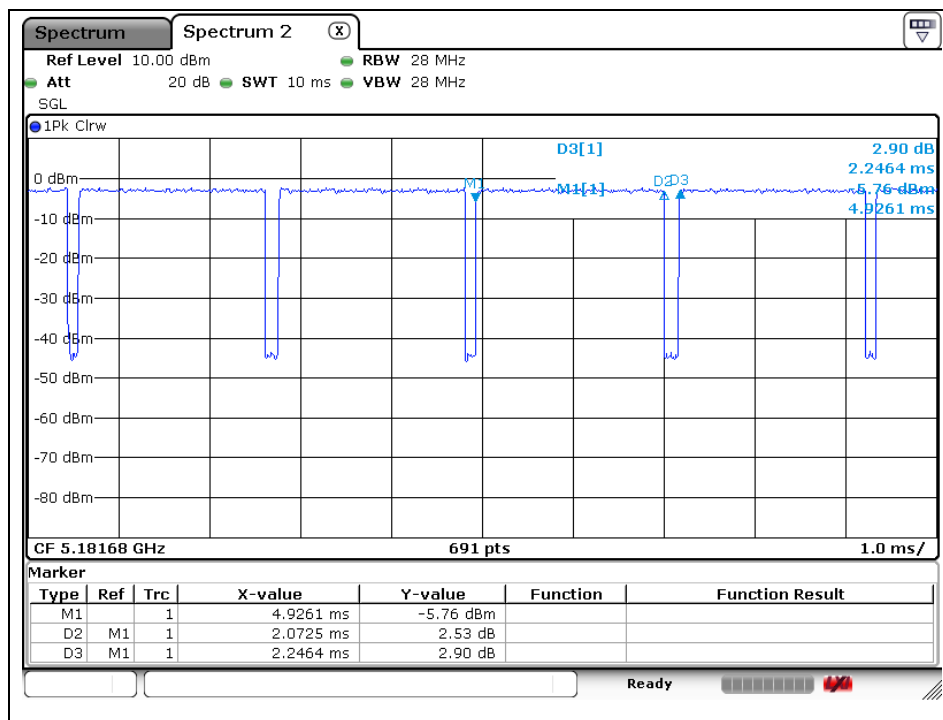
Mode	Data Rate (Mbps)	Duty Cycle (%)	Correction factor (dB)
11a	6	92.26	0.35
11n_HT20	MCS0	91.72	0.38
11n_HT40	MCS0	82.41	0.84
11ac_VHT80	MCS0	71.49	1.46

Remark;

- 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.
- Duty cycle (%) = (Tx on time / Tx on + off time) $\times$ 100
- Correction factor (dB) = 10 log (1 / Duty cycle)

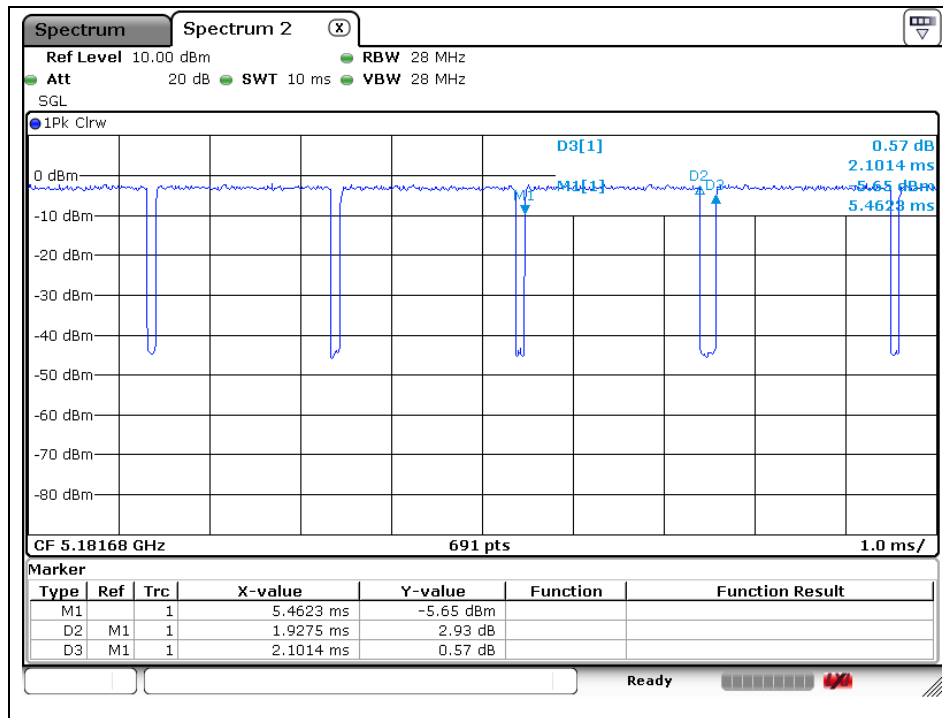
- Test plots

802.11a

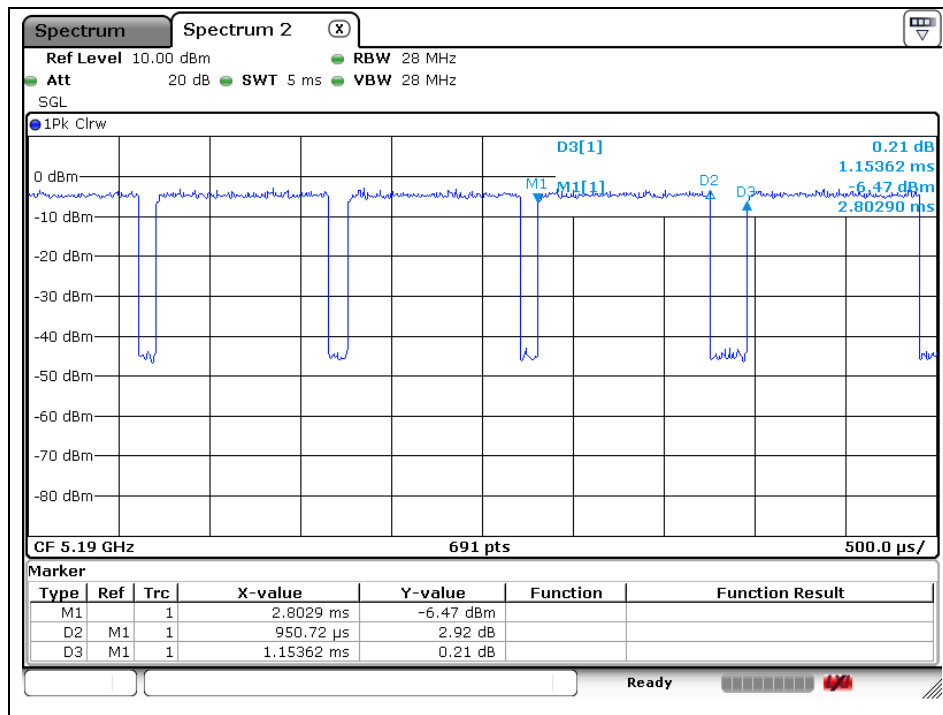


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802.11n_HT20

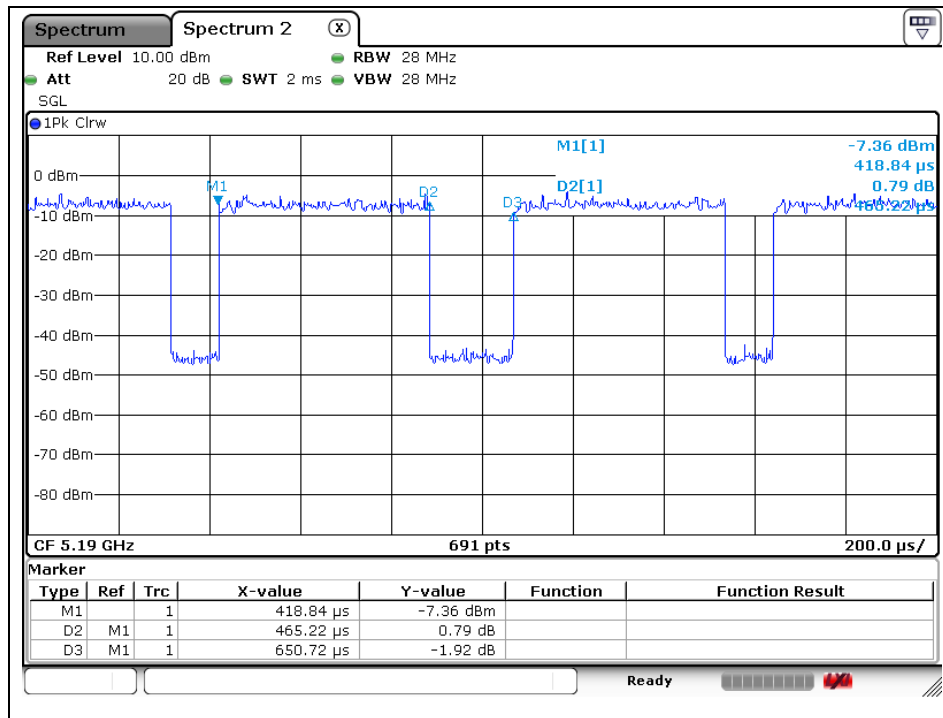


802.11n_HT40



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802.11ac_VHT80



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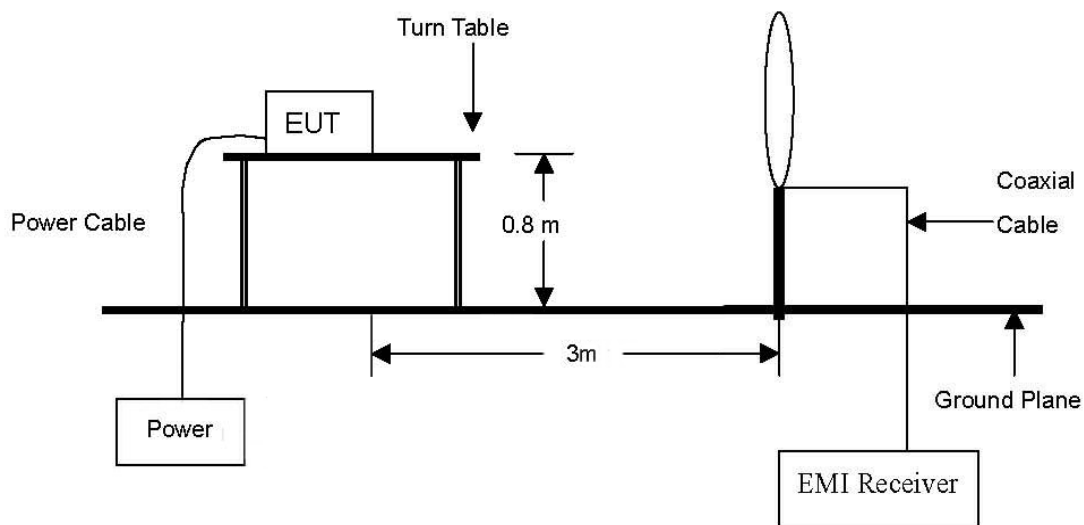
A4(210 mm x 297 mm)

2. Transmitter Radiated Spurious Emissions

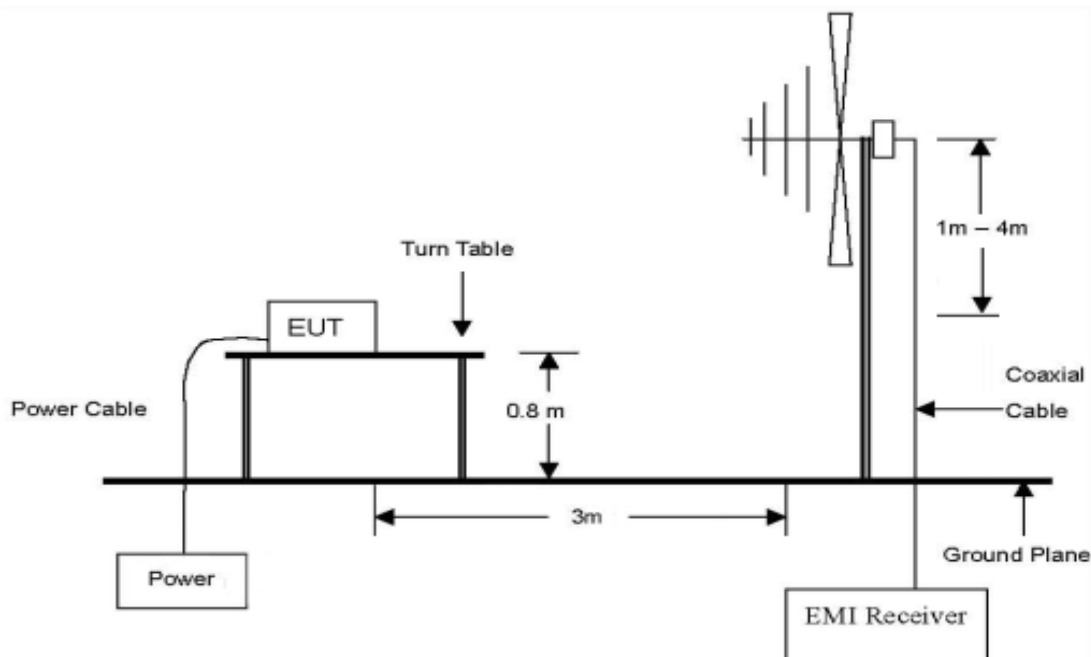
2.1. Test Setup

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 kHz to 30 MHz emissions.



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



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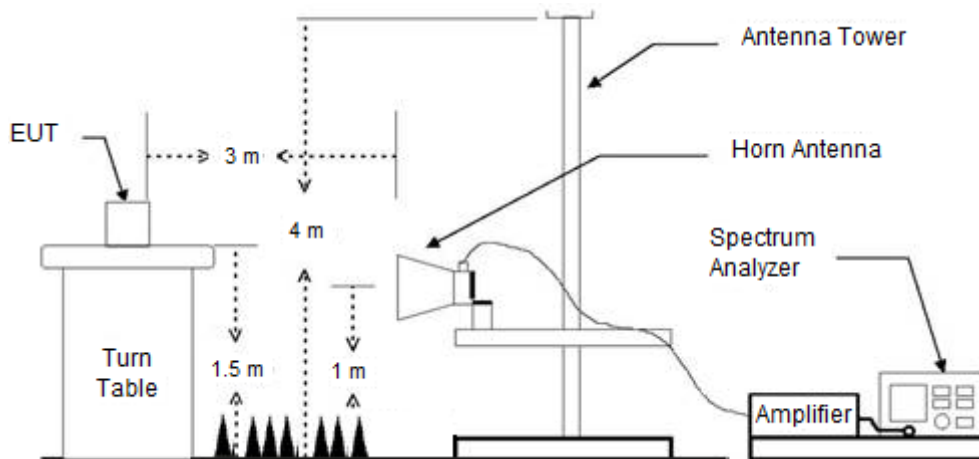
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The diagram below shows the test setup that is utilized to make the measurements for emission. The spurious emissions were investigated from 1 GHz to the 10th harmonic of the highest fundamental frequency or 40 GHz, whichever is lower.



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2.2. Limit

According to § 15.407(b)

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

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

(i) All emissions shall be limited to a level of -27 dB m/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dB m/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dB m/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dB m/MHz 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 (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement Distance (Meters)
0.009-0.490	2 400/F(kHz)	300
0.490-1.705	24 000/F(kHz)	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 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. 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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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 MHz

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 MHz

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 GHz and 1.5 meter above the ground at a 3 meter anechoic chamber test site above 1 GHz. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1 GHz, 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 GHz, 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 dB 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 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

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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 GHz.

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 GHz.

Peak emission levels are measured by setting the analyzer as follows:

Set to RBW = 1 MHz, VBW ≥ 3 MHz, Detector = Peak, Sweep time = auto, Trace mode= Max hold.

- II.G.6. Average unwanted emissions measurements above 1 GHz.

Set to RBW = 1 MHz, VBW ≥ 3 MHz, 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 dB 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.

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2.4. Test result

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

2.4.1. Radiated Spurious Emission below 1 000 MHz

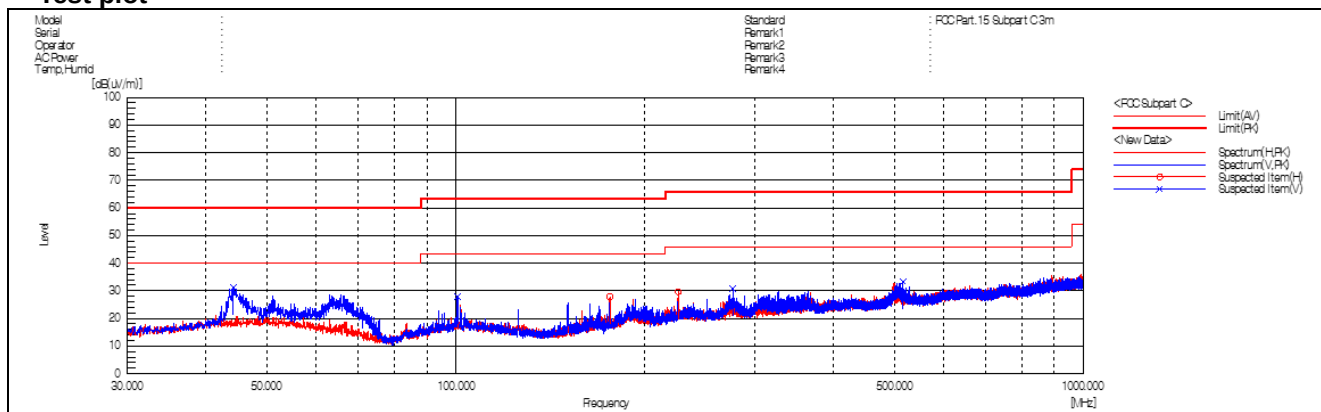
The frequency spectrum from 9 kHz to 1 000 MHz was investigated. All reading values are peak values.

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
44.23	43.80	Peak	V	14.19	-26.61	31.38	40.00	8.62
100.65	41.60	Peak	V	12.13	-25.48	28.25	43.50	15.25
176.19	42.20	Peak	H	9.25	-24.31	27.14	43.50	16.36
226.43	41.00	Peak	H	11.79	-24.05	28.74	46.00	17.26
276.78	40.80	Peak	V	12.94	-24.33	29.41	46.00	16.59
515.93	38.20	Peak	V	17.72	-22.68	33.24	46.00	12.76
Above 600.00	Not detected	-	-	-	-	-	-	-

Remark;

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

- Test plot



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2.4.2. Radiated Spurious Emission above 1 000 MHz

802.11a (Band 1)_6 Mbps

A. Low Channel (5 180 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 500.00	44.16	Peak	H	31.80	-23.20	-	52.76	74.00	21.24
*4 500.00	33.86	Average	H	31.80	-23.20	0.35	42.81	54.00	11.19
*5 149.16	51.64	Peak	H	33.30	-22.57	-	62.37	74.00	11.63
*5 138.38	34.80	Average	H	33.30	-22.55	0.35	45.90	54.00	8.10
*5 150.00	50.44	Peak	H	33.30	-22.57	-	61.17	74.00	12.83
*5 150.00	34.96	Average	H	33.30	-22.57	0.35	46.04	54.00	7.96

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

B. Middle Channel (5 220 MHz)

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

C. High Channel (5 240 MHz)

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

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802.11a (Band 3)_6 Mbps

Low Channel (5 745 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 645.11	43.11	Peak	H	33.70	-21.85	54.96	68.23	13.27
5 697.99	47.60	Peak	H	33.89	-21.53	59.96	103.74	43.78
5 718.42	55.64	Peak	H	33.90	-21.59	67.95	110.39	42.44
5 723.38	56.91	Peak	H	33.90	-21.61	69.20	118.53	49.33
5 725.00	54.49	Peak	H	33.90	-21.61	66.78	122.23	55.45

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

B. Middle Channel (5 785 MHz)

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

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SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

C. High Channel (5 825 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.00	46.98	Peak	H	34.00	-21.43	59.55	122.23	62.68
5 852.40	51.66	Peak	H	34.01	-21.40	64.27	116.76	52.49
5 855.73	50.00	Peak	H	34.03	-21.38	62.65	110.62	47.97
5 915.77	44.96	Peak	H	34.33	-21.11	58.18	75.06	16.88
5 946.90	45.14	Peak	H	34.39	-21.18	58.35	68.23	9.88

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

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802.11n_HT20 (Band 1)_MCS0

A. Low Channel (5 180 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 500.00	44.23	Peak	H	31.80	-23.20	-	52.83	74.00	21.17
*4 500.00	33.99	Average	H	31.80	-23.20	0.38	42.97	54.00	11.03
*5 148.39	48.67	Peak	H	33.30	-22.57	-	59.40	74.00	14.60
*5 109.89	34.18	Average	H	33.30	-22.49	0.38	45.37	54.00	8.63
*5 150.00	49.46	Peak	H	33.30	-22.57	-	60.19	74.00	13.81
*5 150.00	34.88	Average	H	33.30	-22.57	0.38	45.99	54.00	8.01

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

B. Middle Channel (5 220 MHz)

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

C. High Channel (5 240 MHz)

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

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802.11n_HT20 (Band 3)_MCS0

A. Low Channel (5 745 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 633.79	46.17	Peak	H	33.70	-21.82	58.05	68.23	10.18
5 697.99	47.83	Peak	H	33.89	-21.53	60.19	103.74	43.55
5 717.80	55.26	Peak	H	33.90	-21.59	67.57	110.21	42.64
5 724.78	55.13	Peak	H	33.90	-21.61	67.42	121.73	54.31
5 725.00	53.86	Peak	H	33.90	-21.61	66.15	122.23	56.08

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

B. Middle Channel (5 785 MHz)

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

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C. High Channel (5 825 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.00	52.00	Peak	H	34.00	-21.43	64.57	122.23	57.66
5 850.96	52.06	Peak	H	34.01	-21.41	64.66	120.04	55.38
5 855.73	49.45	Peak	H	34.03	-21.38	62.10	110.62	48.52
5 901.21	44.96	Peak	H	34.30	-21.07	58.19	85.83	27.64
5 972.66	45.47	Peak	H	34.40	-21.19	58.68	68.49	9.81

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

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802.11n_HT40 (Band 1)_MCS0

A. Low Channel (5 190 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 500.00	44.27	Peak	H	31.80	-23.20	-	52.87	74.00	21.13
*4 500.00	33.79	Average	H	31.80	-23.20	0.84	43.23	54.00	10.77
*5 148.39	50.05	Peak	H	33.30	-22.57	-	60.78	74.00	13.22
*5 137.61	34.44	Average	H	33.30	-22.55	0.84	46.03	54.00	7.97
*5 150.00	44.48	Peak	H	33.30	-22.57	-	55.21	74.00	18.79
*5 150.00	34.98	Average	H	33.30	-22.57	0.84	46.55	54.00	7.45

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

B. High Channel (5 230 MHz)

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

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802.11n_HT40 (Band 3)_MCS0

A. Low Channel (5 755 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 639.27	46.58	Peak	H	33.70	-21.84	58.44	68.23	9.79
5 696.05	50.83	Peak	H	33.88	-21.55	63.16	102.30	39.14
5 716.22	56.21	Peak	H	33.90	-21.58	68.53	109.77	41.24
5 721.68	59.05	Peak	H	33.90	-21.60	71.35	114.66	43.31
5 725.00	55.26	Peak	H	33.90	-21.61	67.55	122.23	54.68

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

B. High Channel (5 795 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
5 850.00	44.86	Peak	H	34.00	-21.43	57.43	122.23	64.80
5 850.16	45.98	Peak	H	34.00	-21.42	58.56	121.86	63.30
5 857.33	48.08	Peak	H	34.04	-21.37	60.75	110.18	49.43
5 918.01	45.64	Peak	H	34.34	-21.11	58.87	73.40	14.53
5 944.66	44.71	Peak	H	34.39	-21.18	57.92	68.23	10.31

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

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RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

802.11ac_VHT80 (Band 1)_MCS0

A. Low Channel (5 210 MHz)

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Duty (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
*4 500.00	42.96	Peak	H	31.80	-23.20	-	51.56	74.00	22.44
*4 500.00	33.44	Average	H	31.80	-23.20	1.46	43.50	54.00	10.50
*5 122.80	47.44	Peak	H	33.30	-22.52	-	58.22	74.00	15.78
*5 139.60	35.55	Average	H	33.30	-22.55	1.46	47.76	54.00	6.24
*5 150.00	44.23	Peak	H	33.30	-22.57	-	54.96	74.00	19.04
*5 150.00	35.21	Average	H	33.30	-22.57	1.46	47.40	54.00	6.60

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

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802.11ac_VHT80 (Band 3)_MCS0

A. Middle Channel (5 775 MHz)

Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detect Mode	Pol.	AF (dB/m)	AMP+CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
5 643.60	47.07	Peak	H	33.70	-21.85	58.92	68.23	9.31
5 695.80	53.71	Peak	H	33.88	-21.55	66.04	102.12	36.08
5 700.00	53.30	Peak	H	33.90	-21.52	65.68	105.23	39.55
5 724.20	53.64	Peak	H	33.90	-21.61	65.93	120.40	54.47
5 725.00	51.22	Peak	H	33.90	-21.61	63.51	122.23	58.72
5 850.00	46.25	Peak	H	34.00	-21.43	58.82	122.23	63.41
5 851.63	47.67	Peak	H	34.01	-21.41	60.27	118.51	58.24
5 868.55	46.50	Peak	H	34.11	-21.29	59.32	107.03	47.71
5 922.83	45.56	Peak	H	34.35	-21.12	58.79	69.83	11.04
5 940.46	45.31	Peak	H	34.38	-21.17	58.52	68.23	9.71

Radiated Emissions			Ant.	Correction Factors			Total	Limit	
Frequency (MHz)	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	-	-	-	-	-	-	-	-

Remark;

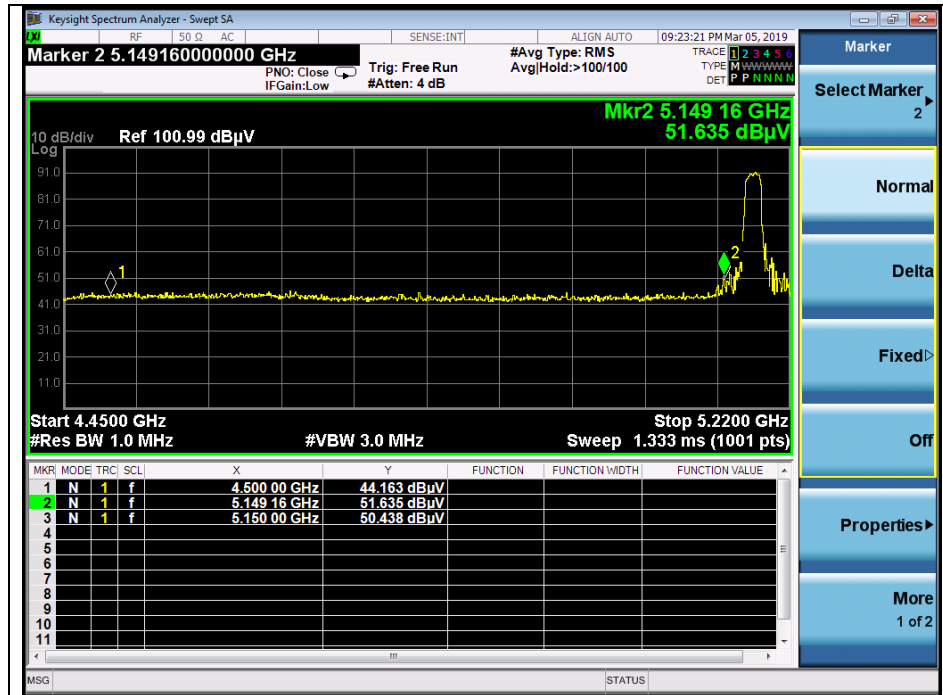
1. “*” means the restricted band.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using Peak / average detector mode if frequency was in restricted band. Otherwise the frequency was out of restricted band, only peak detector should be used.
3. Actual = Reading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

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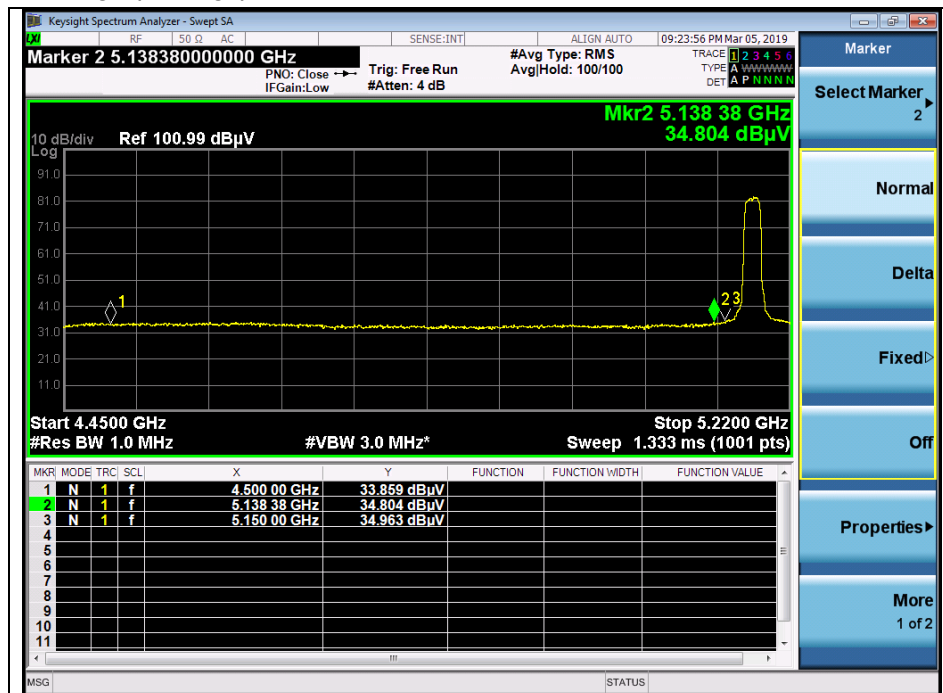
- Test plots

OFDM: 802.11a_(6 Mbps)

Low channel Band edge (Peak) - Band 1

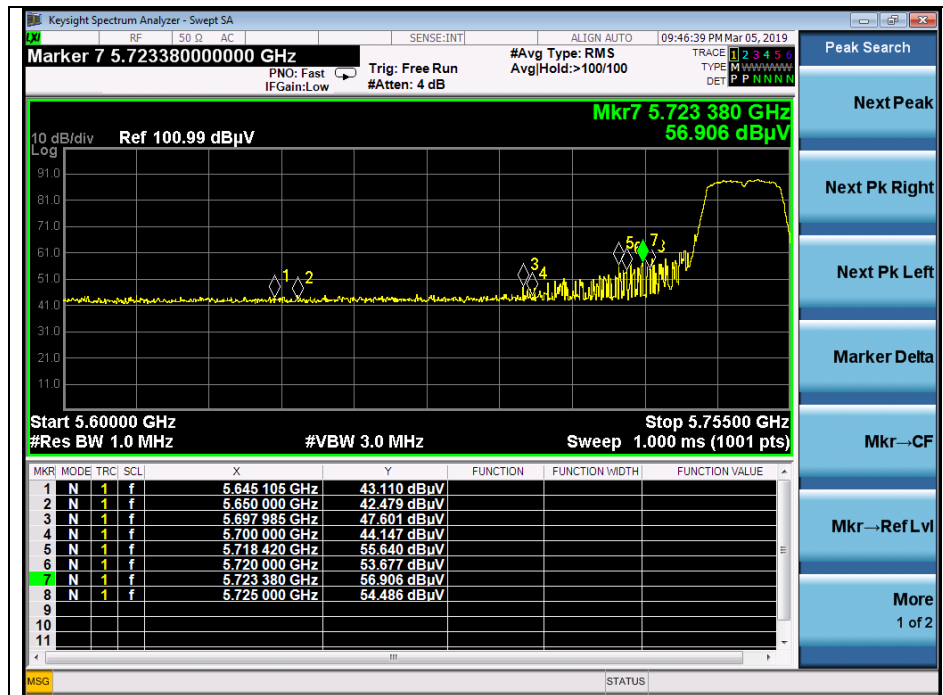


Low channel Band edge (Average) - Band 1

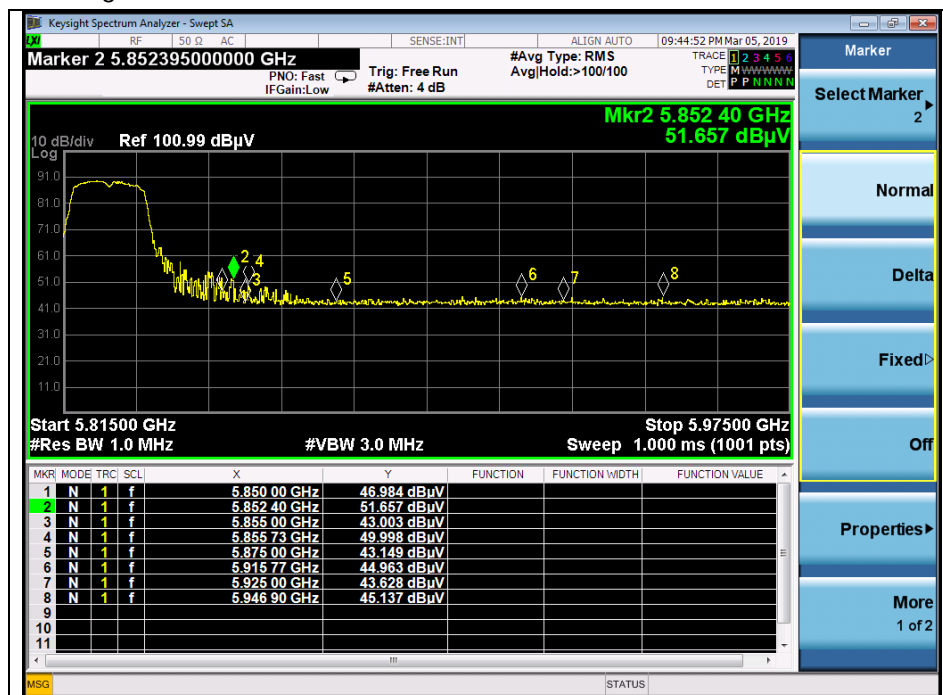


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Low channel Band edge - Band 3



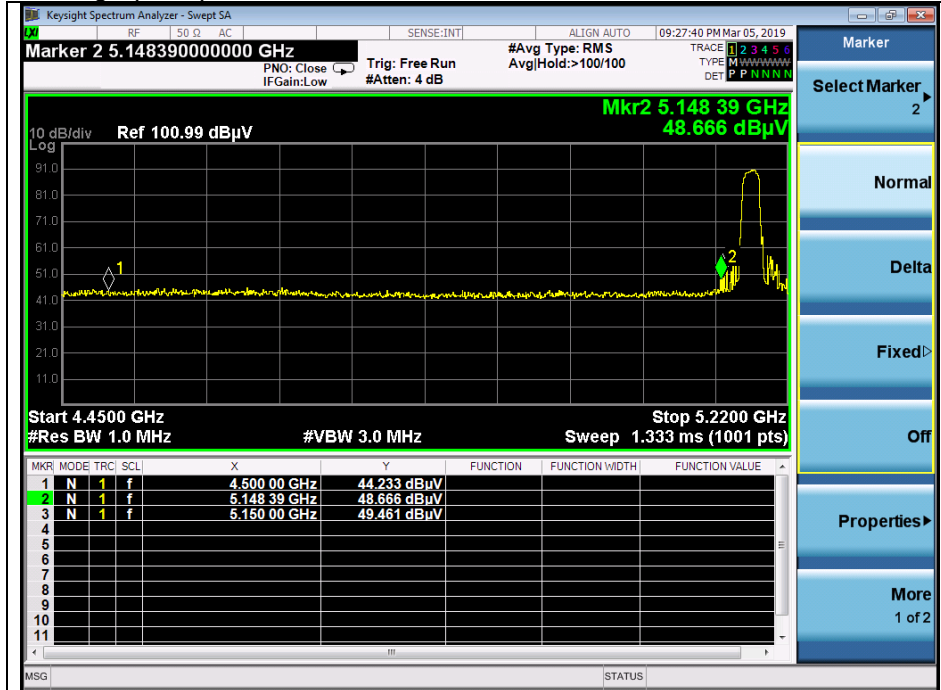
High channel Band edge - Band 3



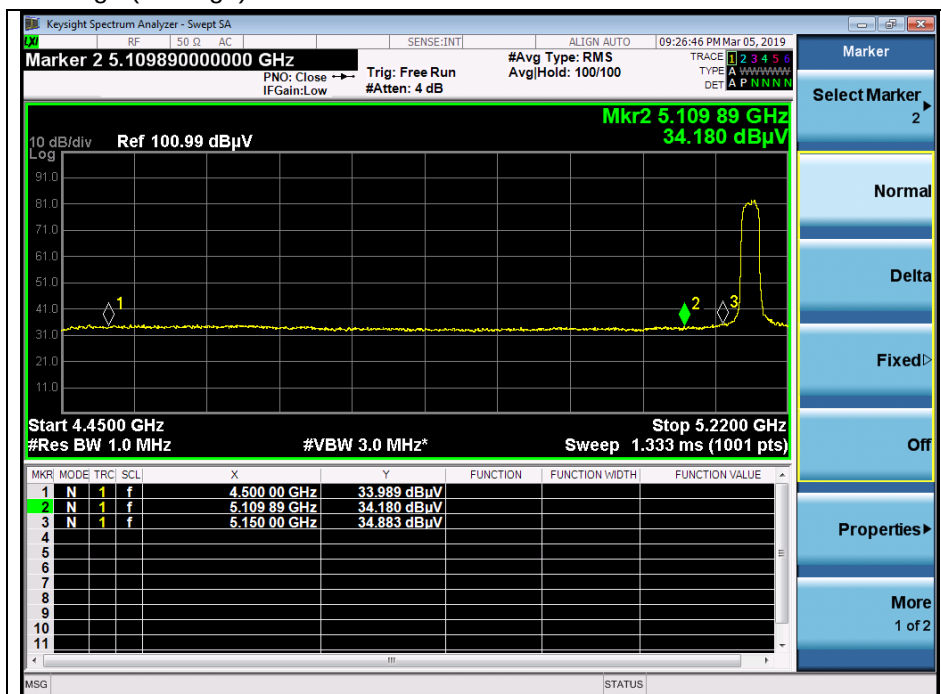
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OFDM: 802.11n_HT20_(MCS0)

Low channel Band edge (Peak) - Band 1

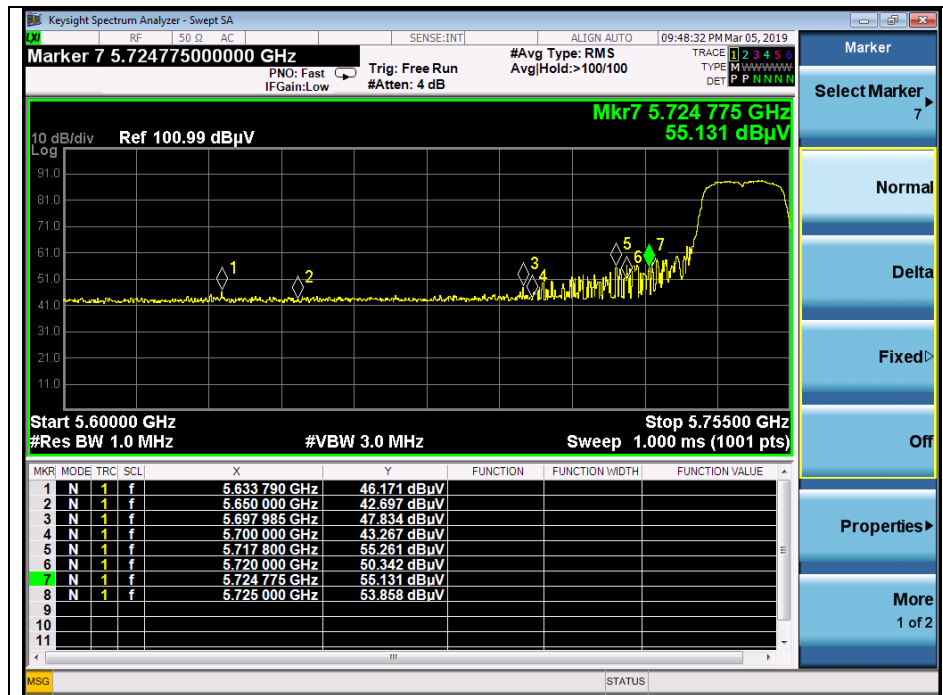


Low channel Band edge (Average) - Band 1

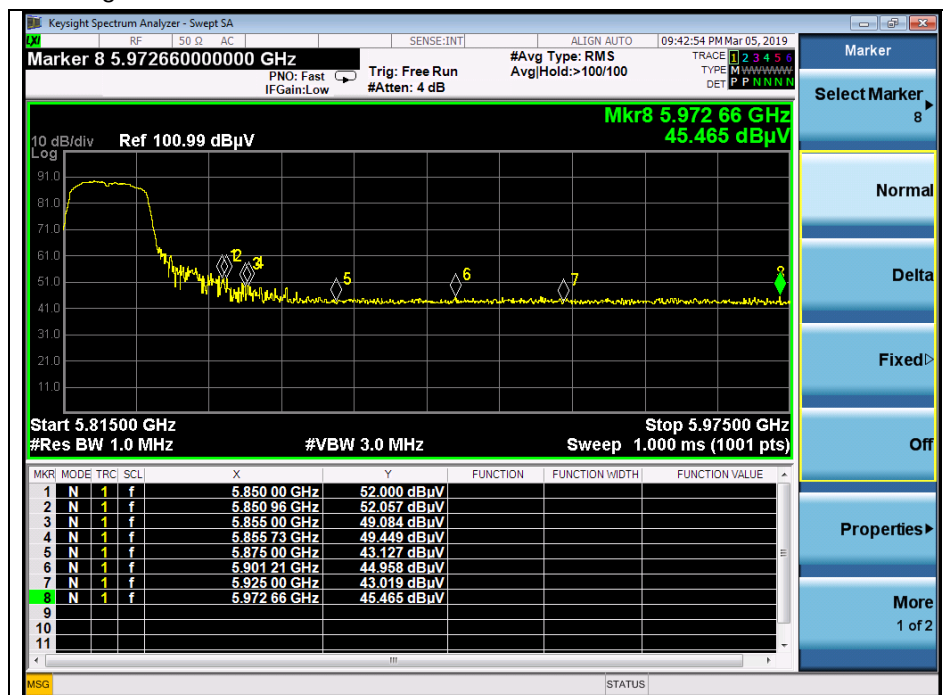


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Low channel Band edge - Band 3



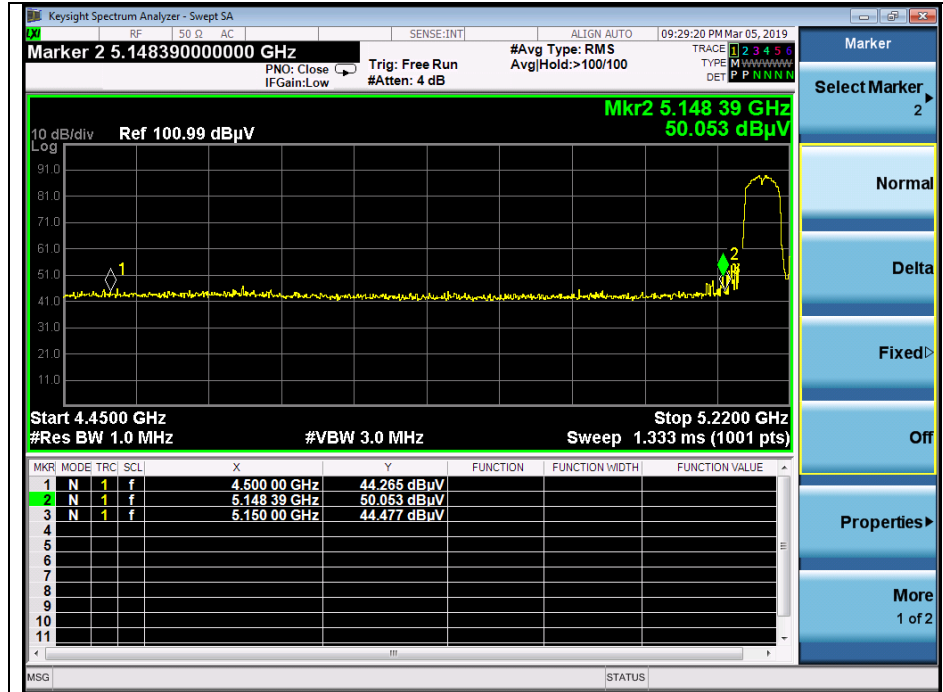
High channel Band edge - Band 3



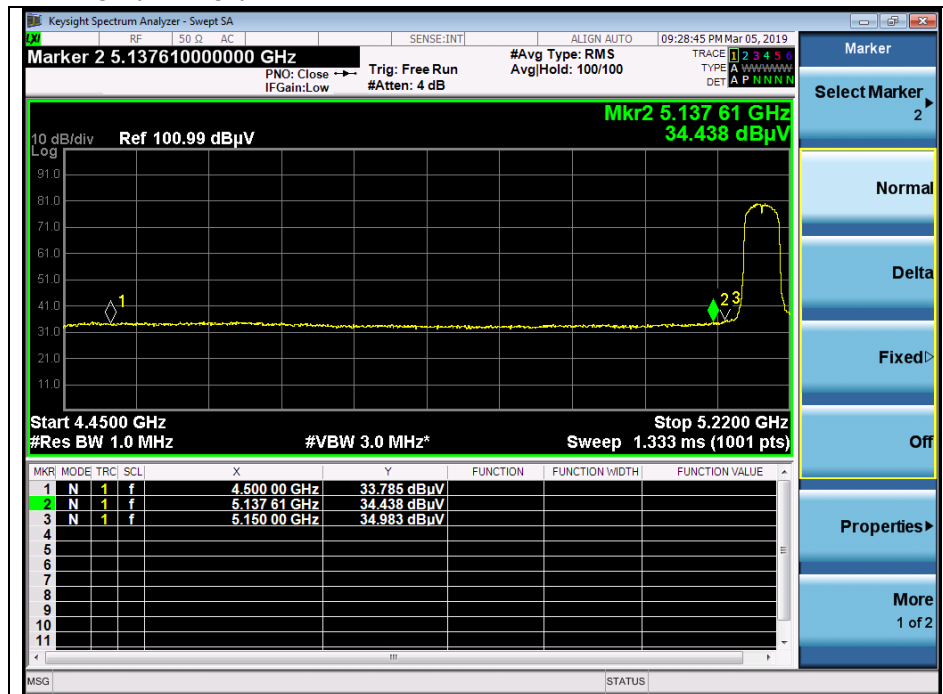
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OFDM: 802.11n_HT40_(MCS0)

Low channel Band edge (Peak) - Band 1

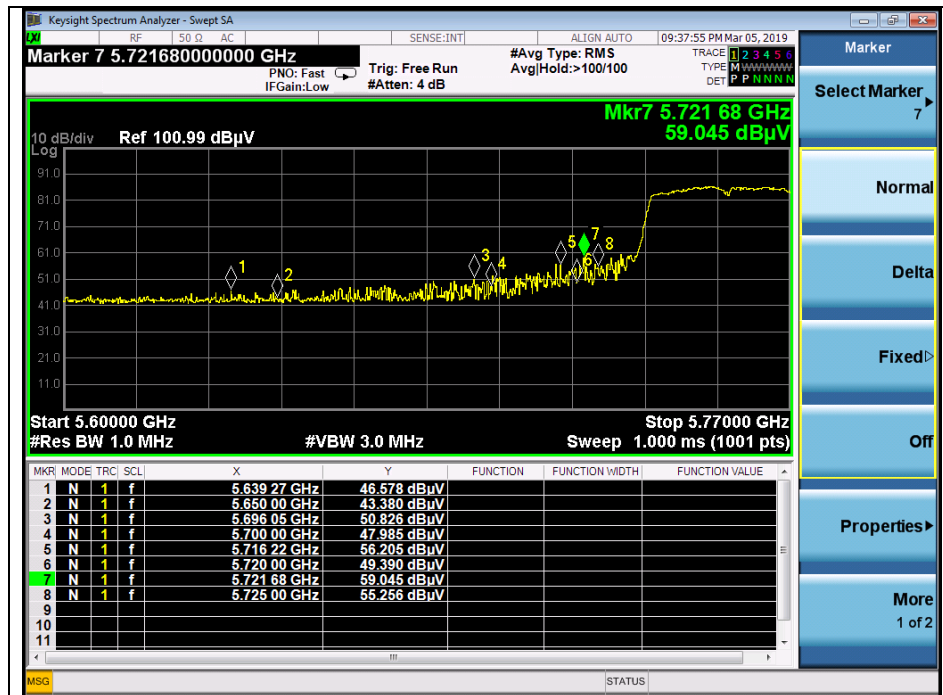


Low channel Band edge (Average) - Band 1



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Low channel Band edge - Band 3



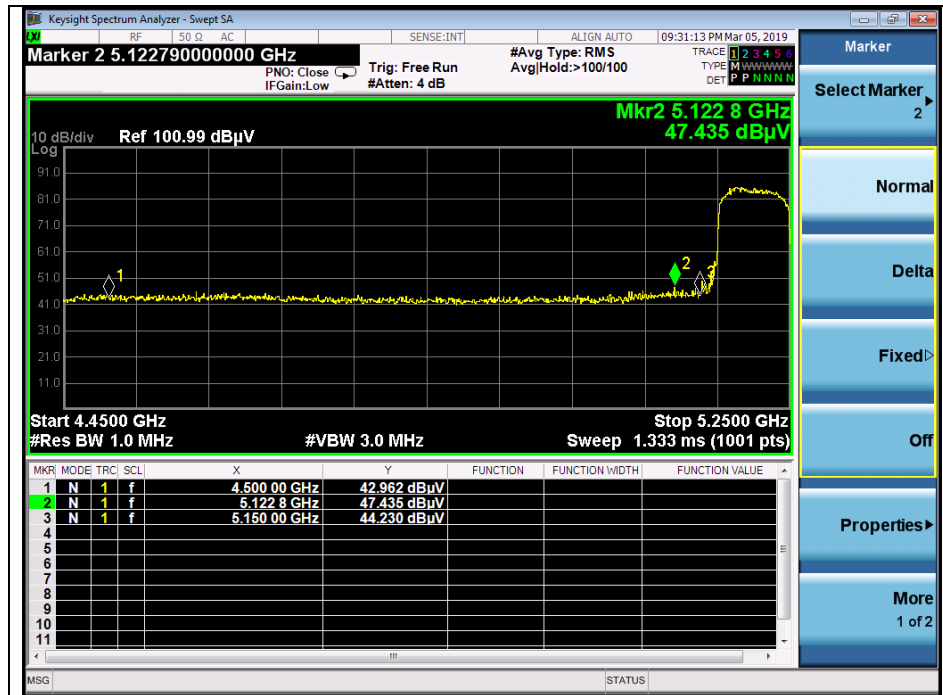
High channel Band edge - Band 3



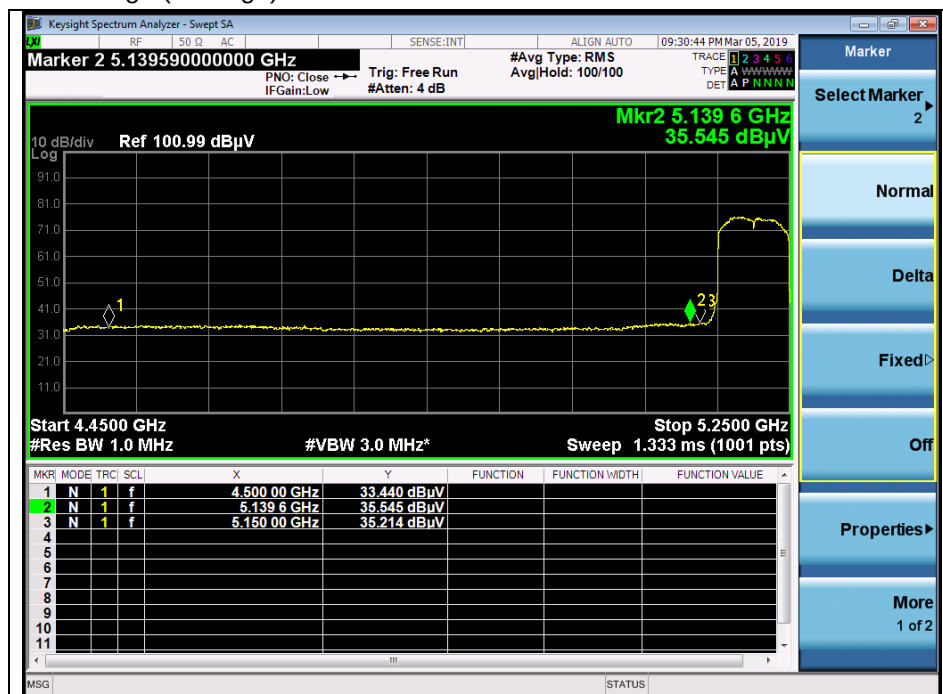
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OFDM: 802.11ac_VHT80_(MCS0)

Middle channel Band edge (Peak) - Band 1



Middle channel Band edge (Average) - Band 1



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Middle channel Band edge - Band 3



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3. 26 dB 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 dB 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 dB 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

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 $\geq$ 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 MHz ~ 5 250 MHz.

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3.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
11a	U-NII 1	5 180	36	6	19.103	16.324
		5 220	44		19.103	16.324
		5 240	48		19.594	16.324
	U-NII 3	5 745	149		19.971	16.266
		5 785	157		18.871	16.266
		5 825	165		19.334	16.266

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
11n_HT20	U-NII 1	5 180	36	MCS0	20.376	17.424
		5 220	44		20.000	17.424
		5 240	48		19.826	17.424
	U-NII 3	5 745	149		20.087	17.424
		5 785	157		19.682	17.424
		5 825	165		20.029	17.424

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
11n_HT40	U-NII 1	5 190	38	MCS0	47.810	36.006
		5 230	46		47.150	36.122
	U-NII 3	5 755	151		46.540	36.006
		5 795	159		45.900	36.006

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)
11ac_VHT80	U-NII 1	5 210	42	MCS0	81.360	74.790
	U-NII 3	5 775	155		81.940	75.022

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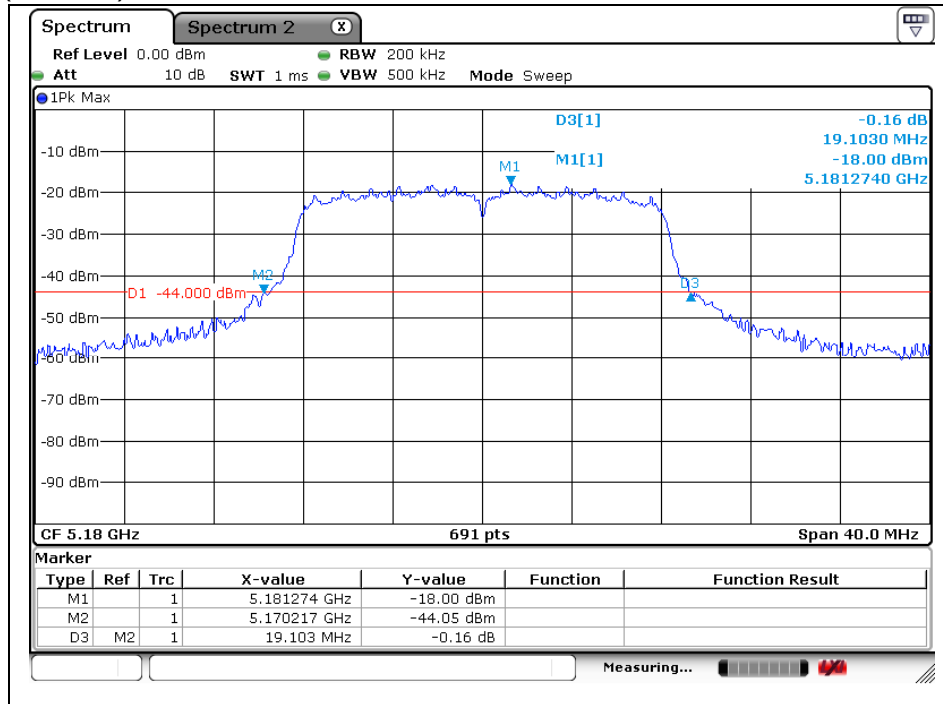
A4(210 mm x 297 mm)

- Test plots

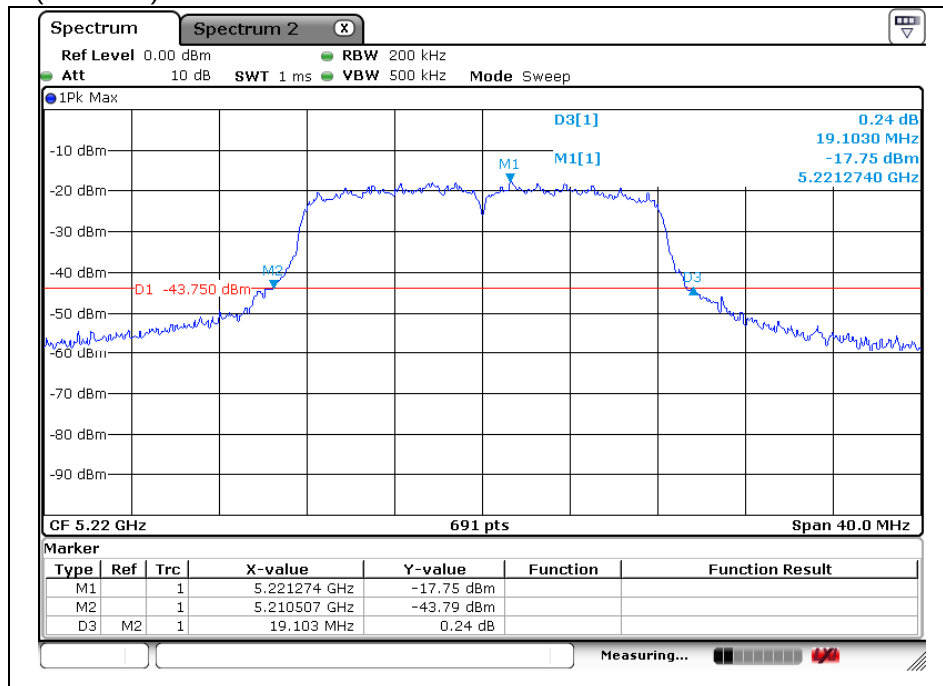
26 dB Bandwidth

802.11a (Band 1)

Low Channel (5 180 MHz)

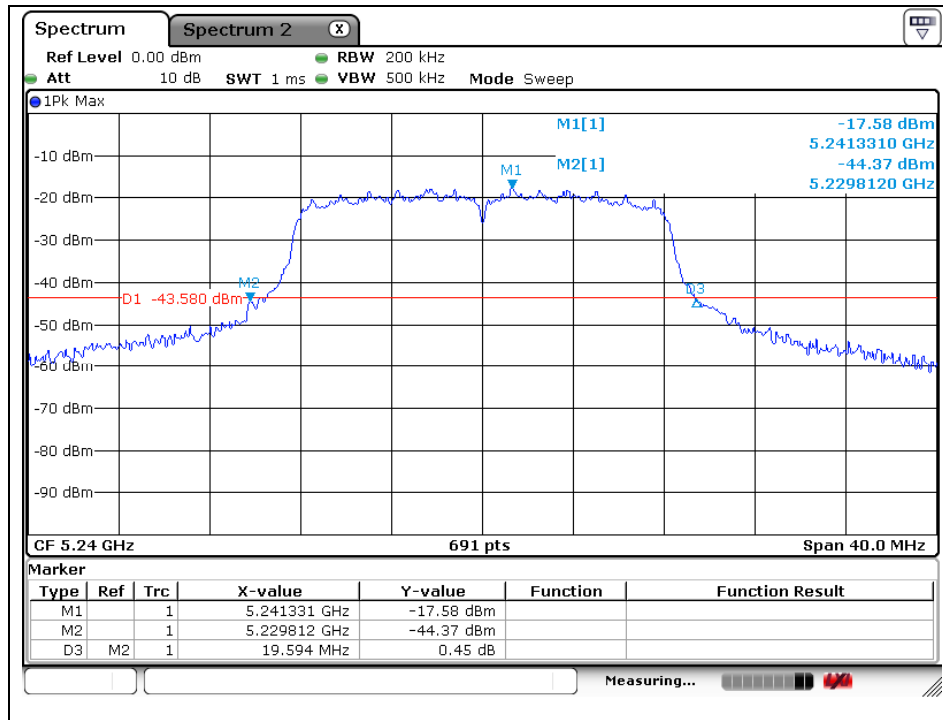


Middle Channel (5 220 MHz)



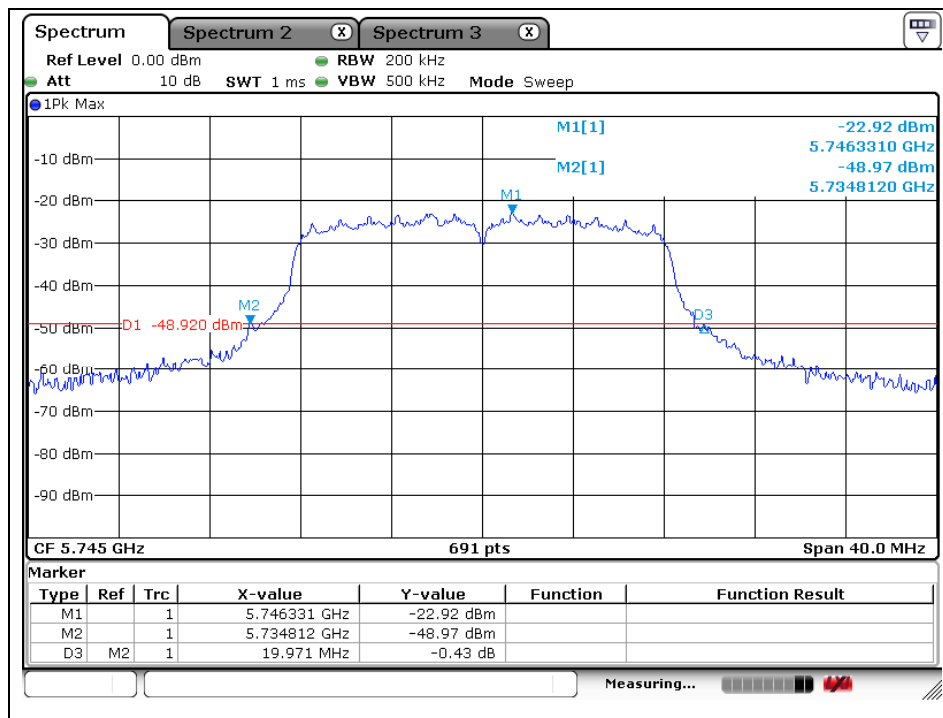
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High Channel (5 240 MHz)



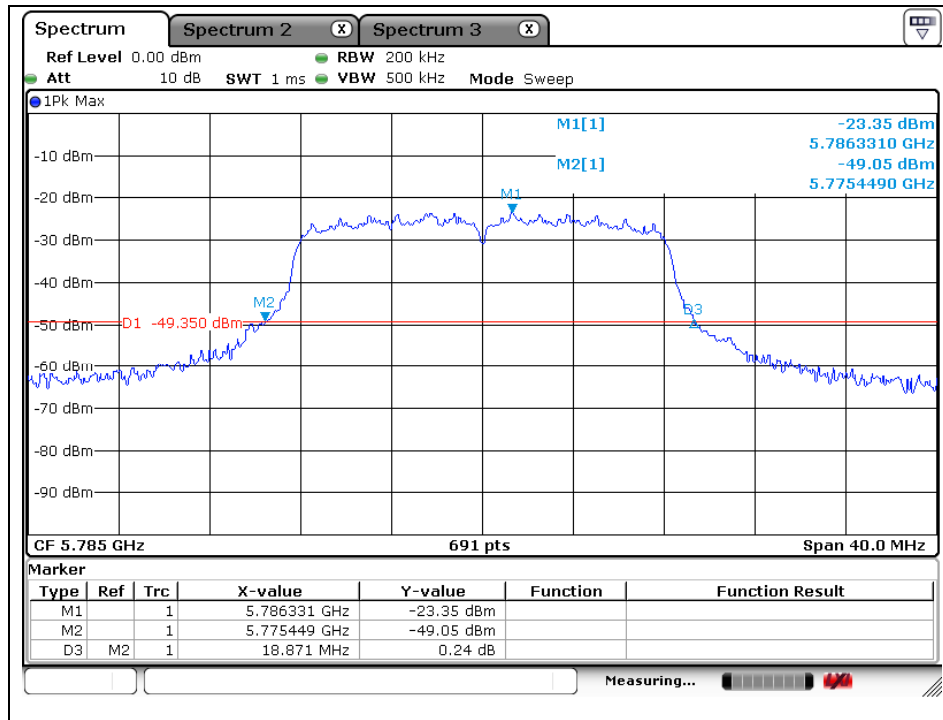
802.11a (Band 3)

Low Channel (5 745 MHz)

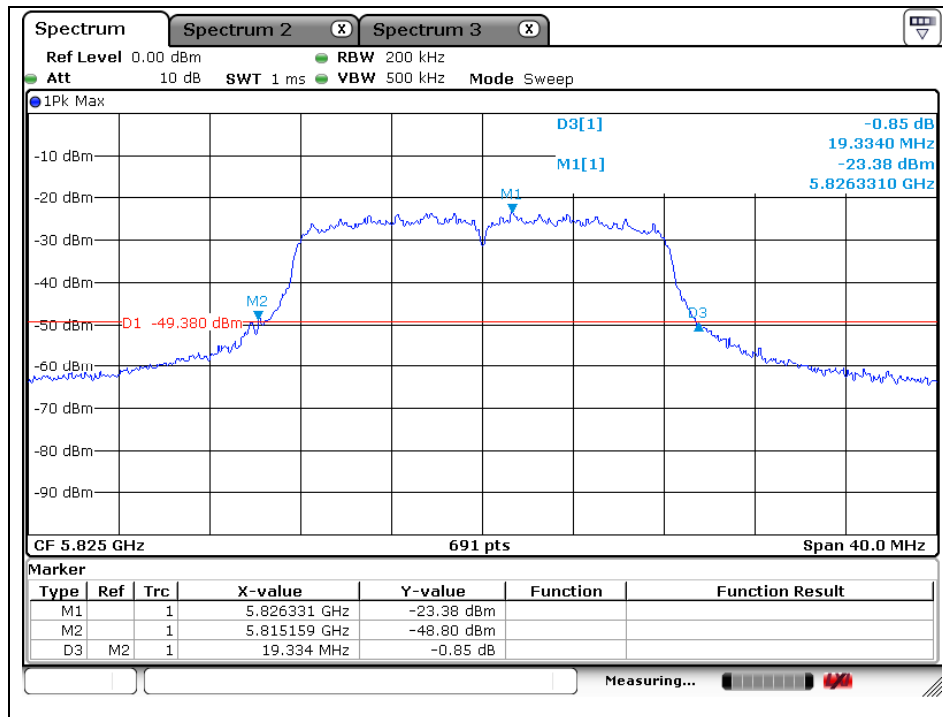


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Middle Channel (5 785 MHz)



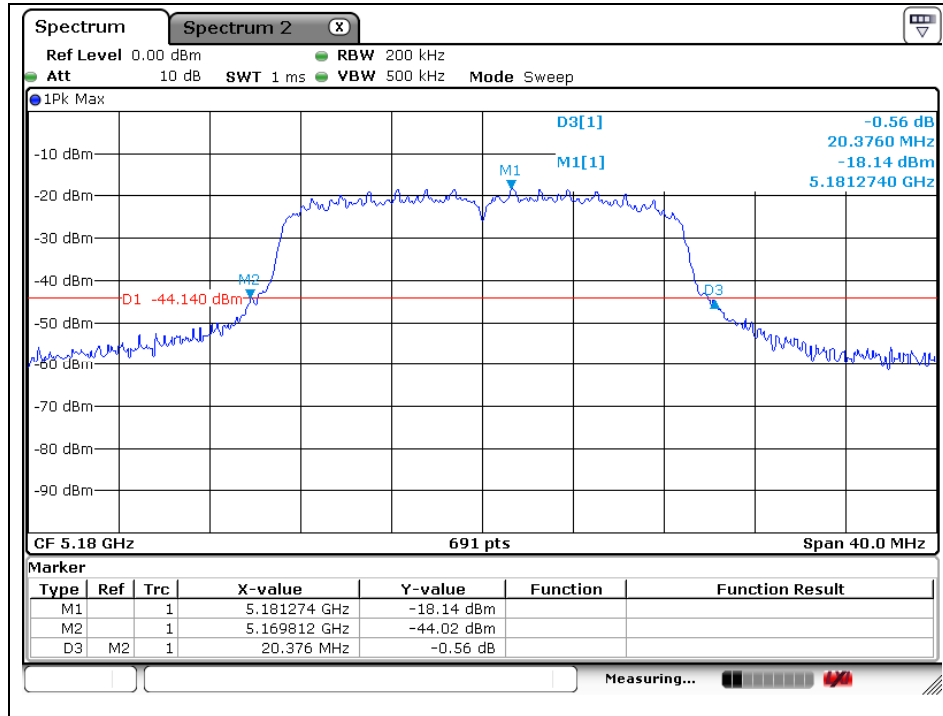
High Channel (5 825 MHz)



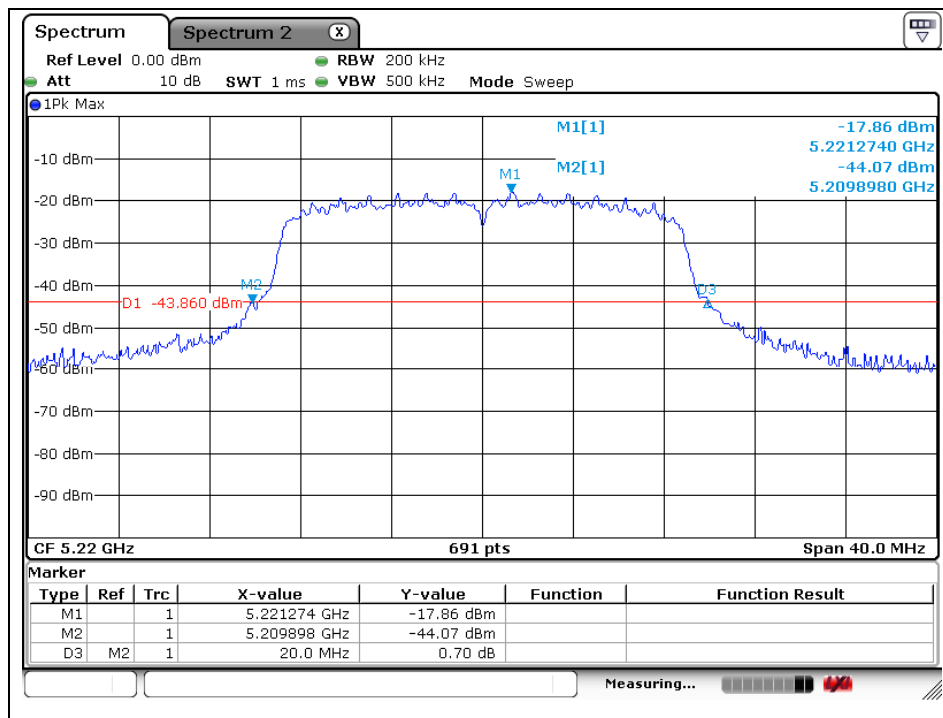
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802.11n_HT20 (Band 1)

Low Channel (5 180 MHz)

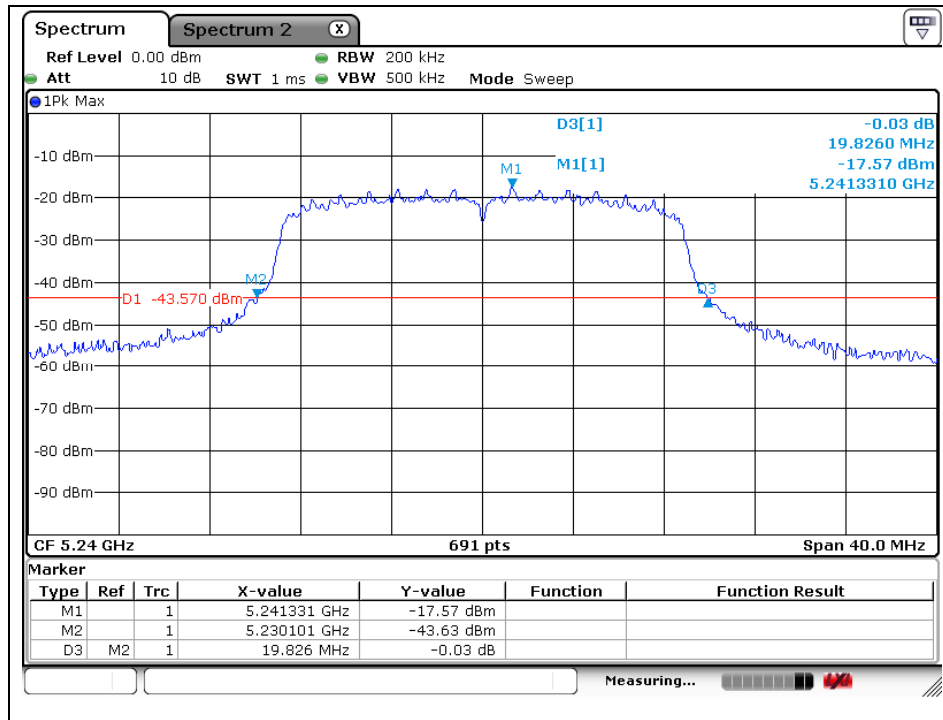


Middle Channel (5 220 MHz)



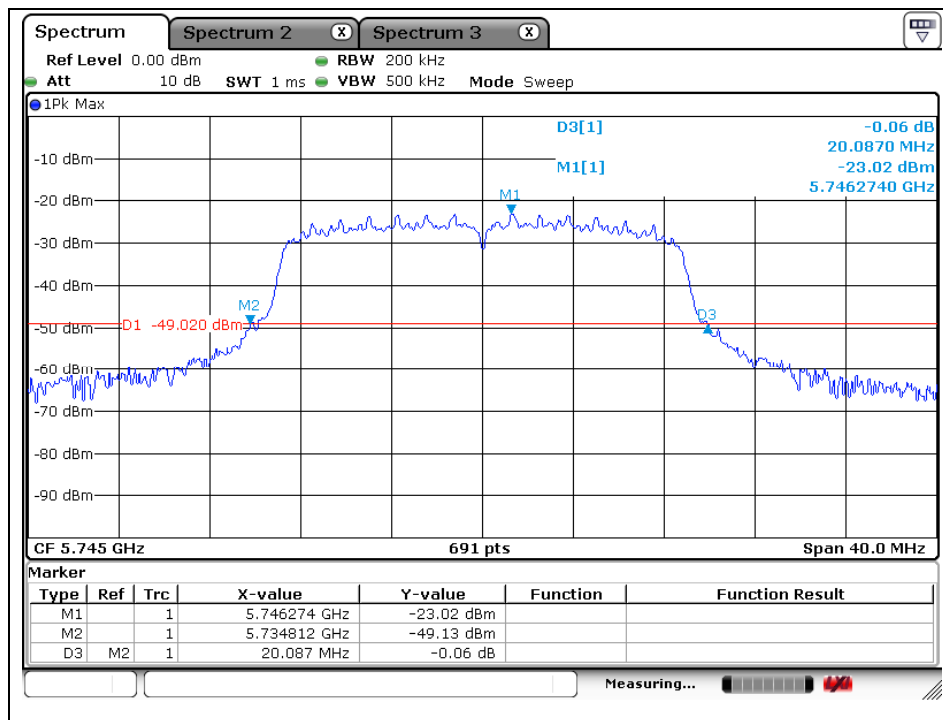
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

High Channel (5 240 MHz)



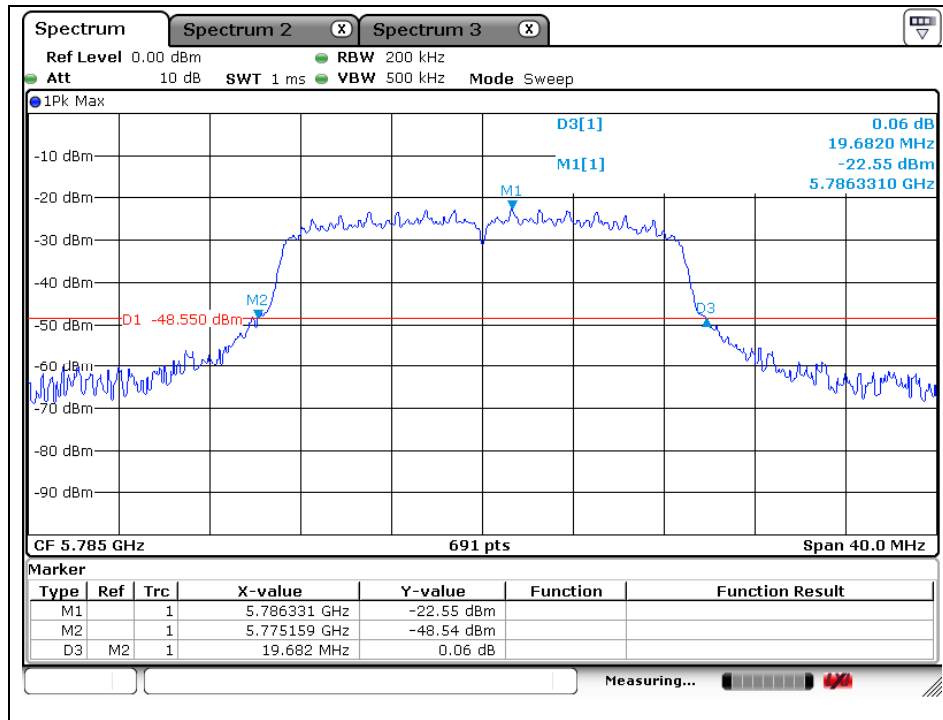
802.11n_HT20 (Band 3)

Low Channel (5 745 MHz)

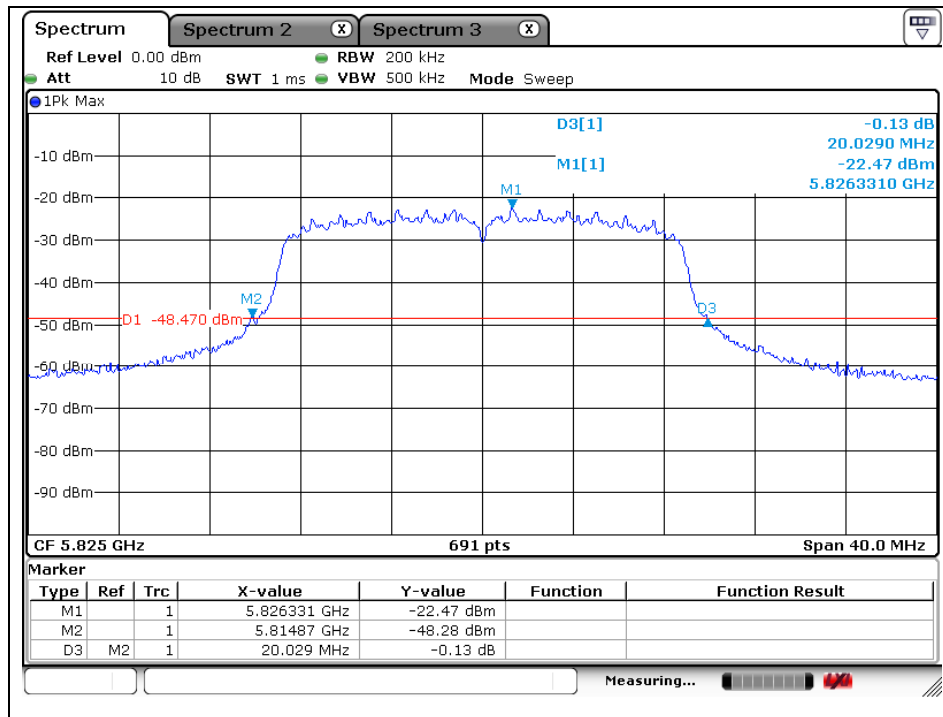


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Middle Channel (5 785 MHz)



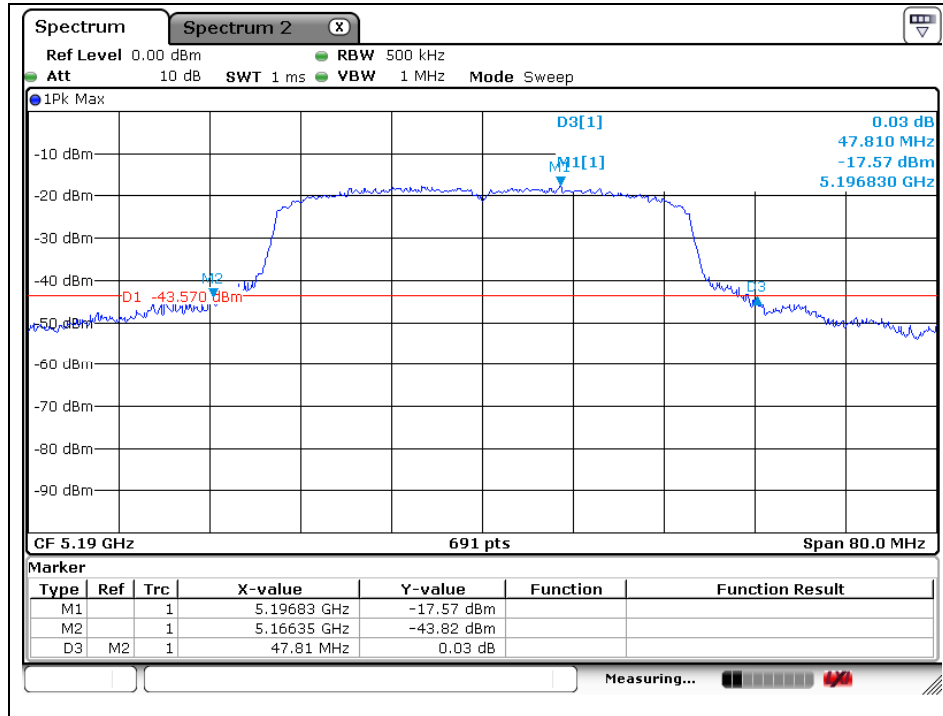
High Channel (5 825 MHz)



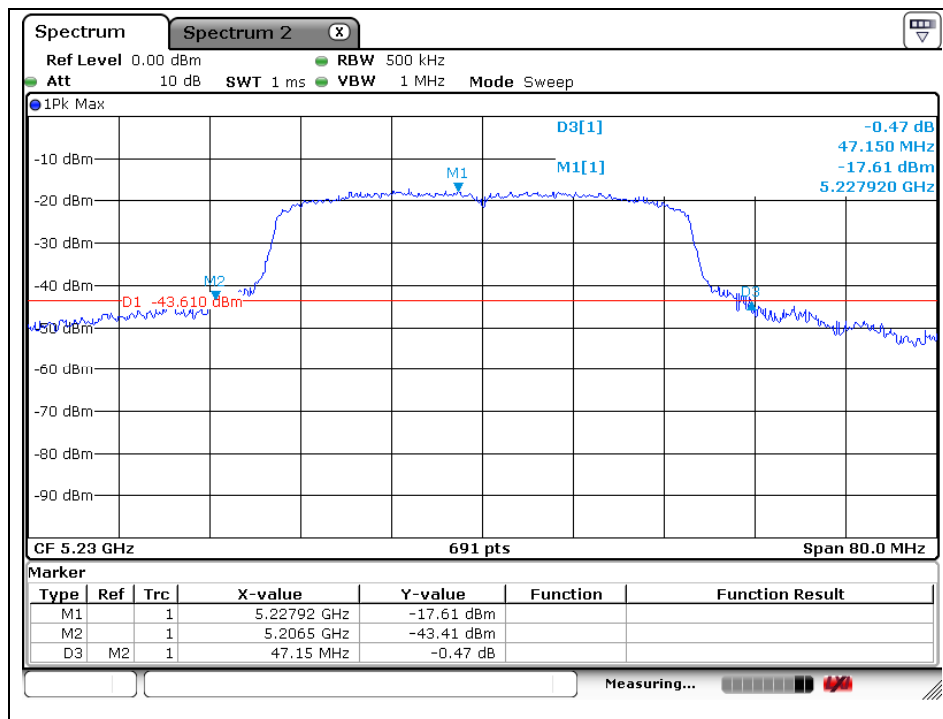
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802.11n_HT40 (Band 1)

Low Channel (5 190 MHz)



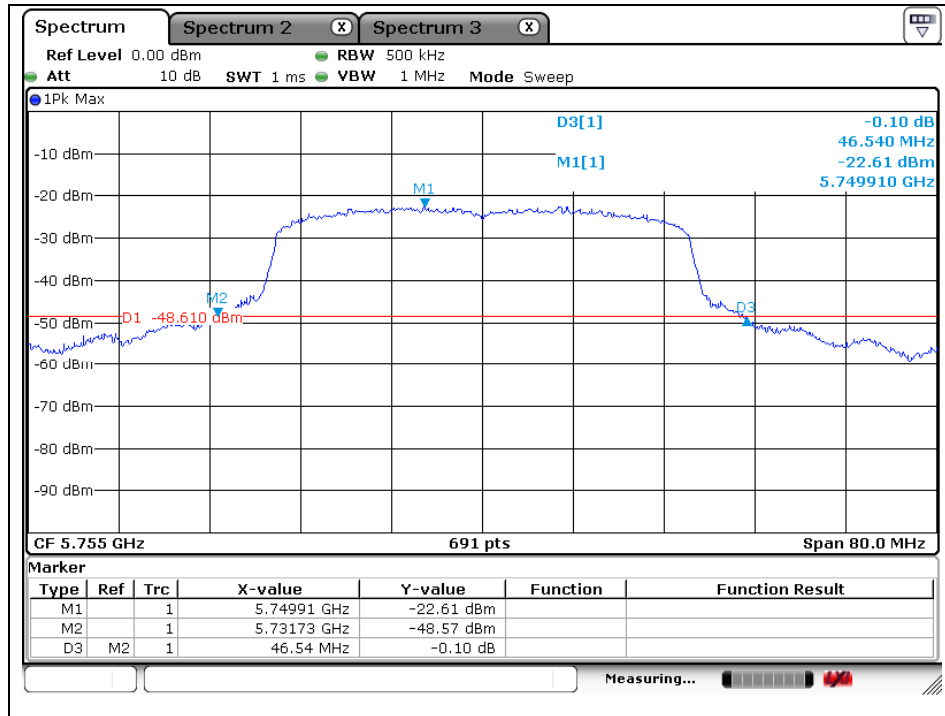
High Channel (5 230 MHz)



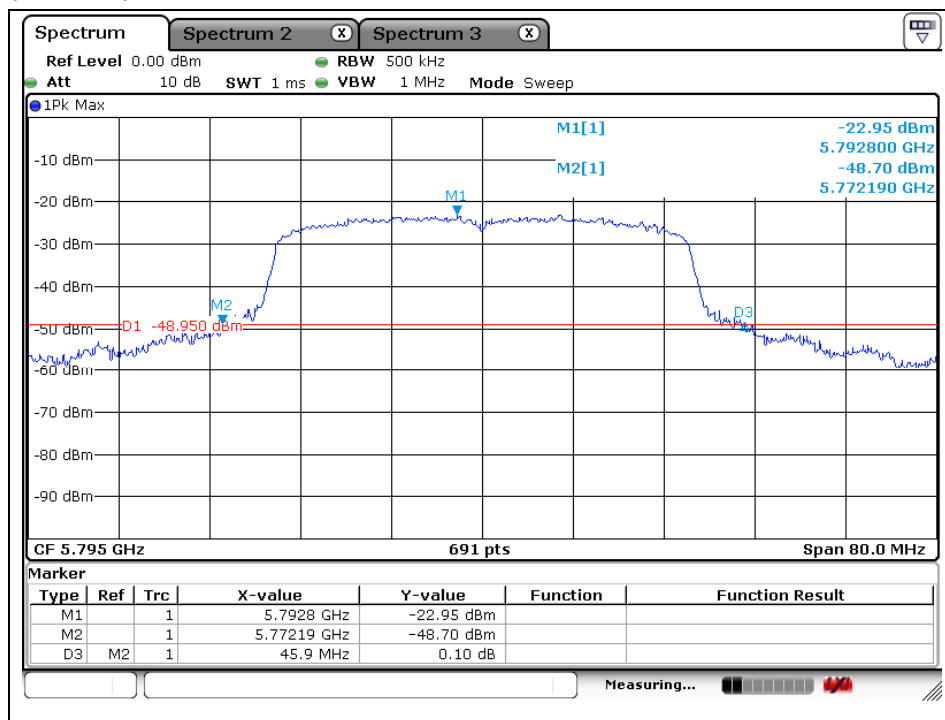
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802.11n_HT40 (Band 3)

Low Channel (5 755 MHz)



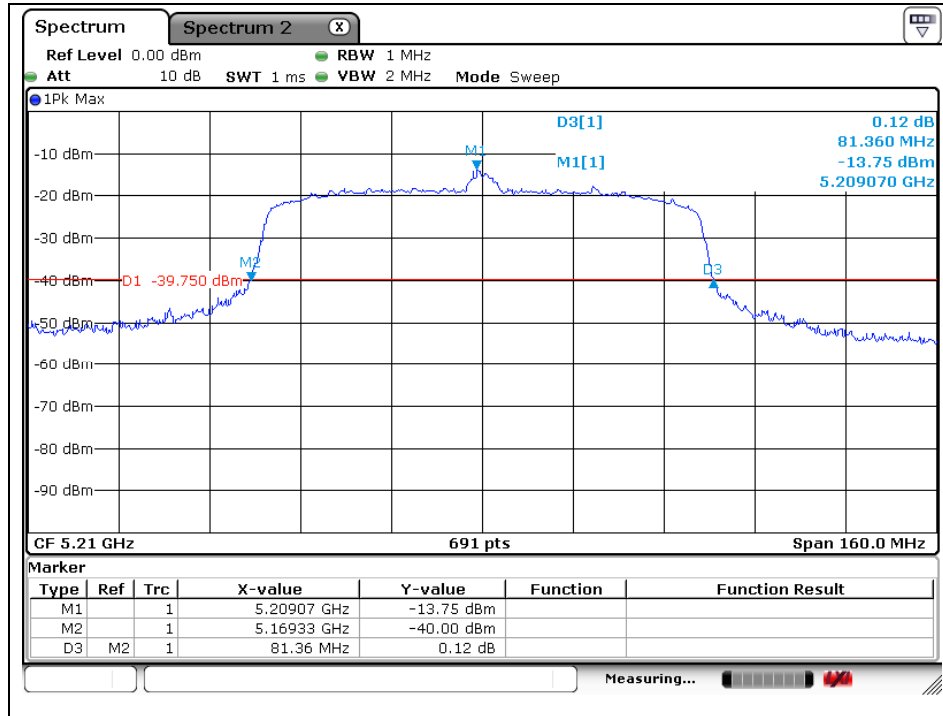
High Channel (5 795 MHz)



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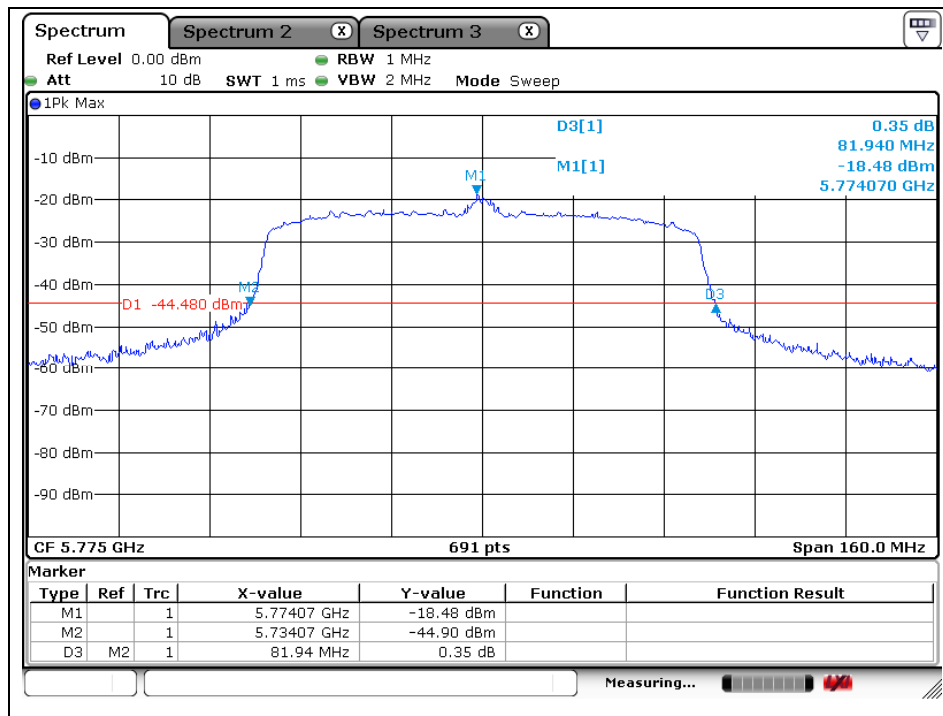
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)

Middle Channel (5 775 MHz)

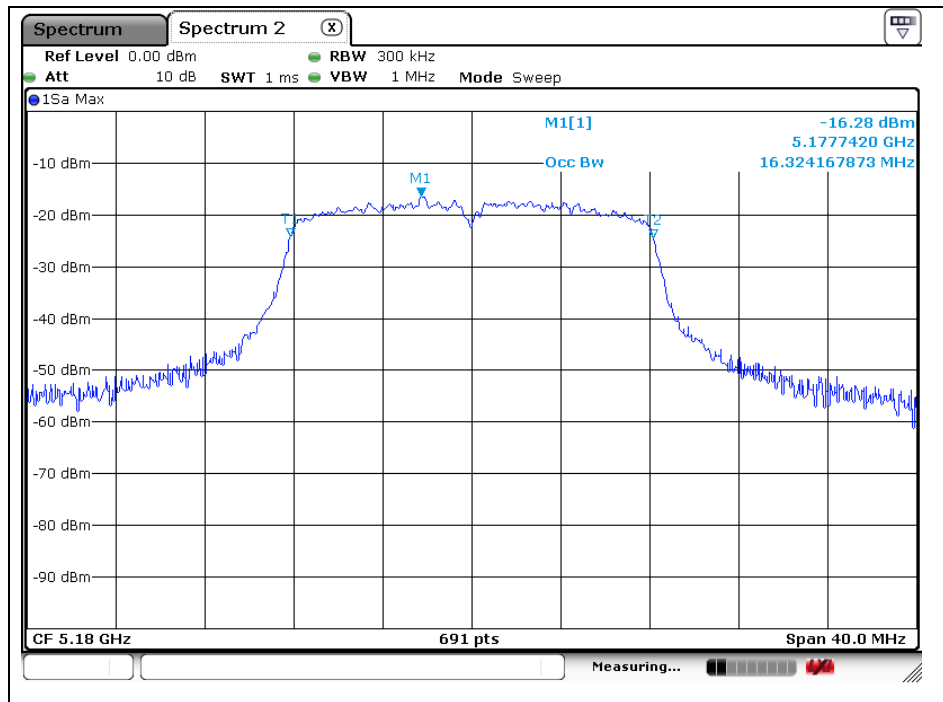


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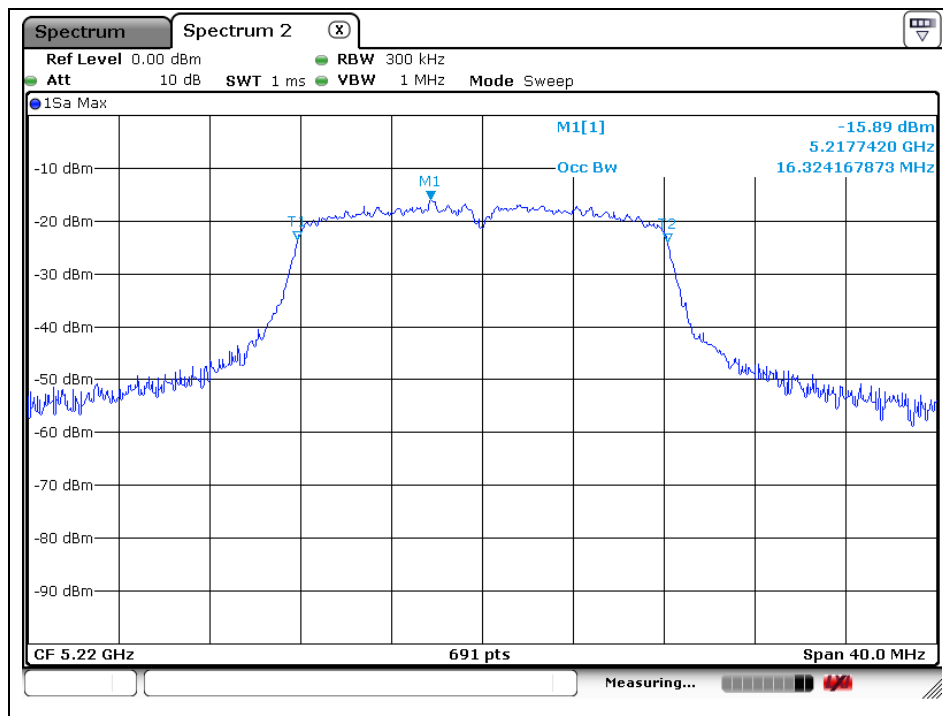
99 % Bandwidth

802.11a (Band 1)

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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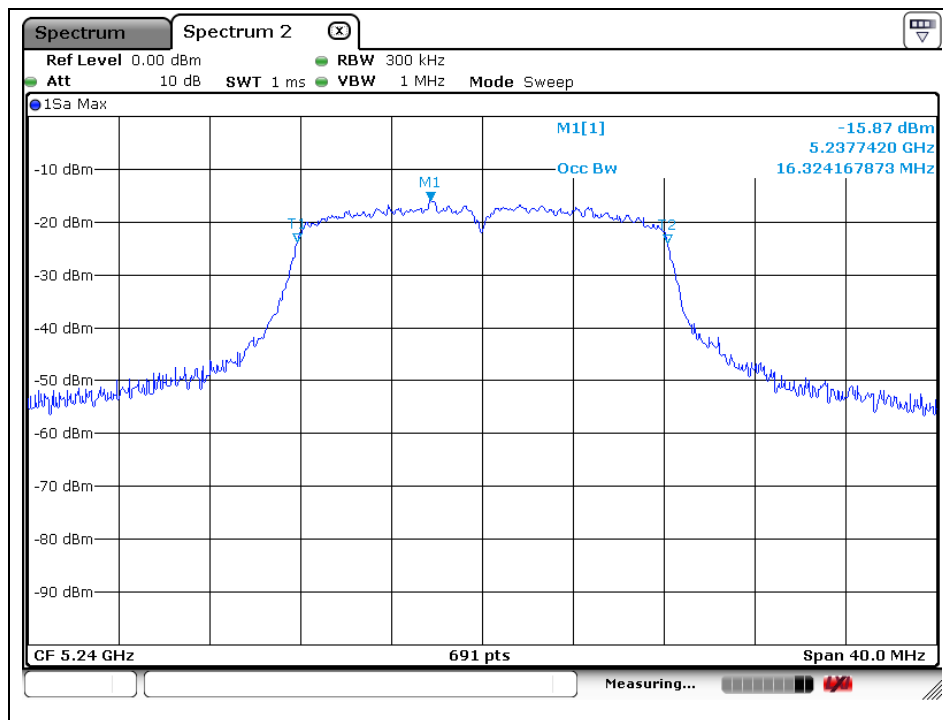
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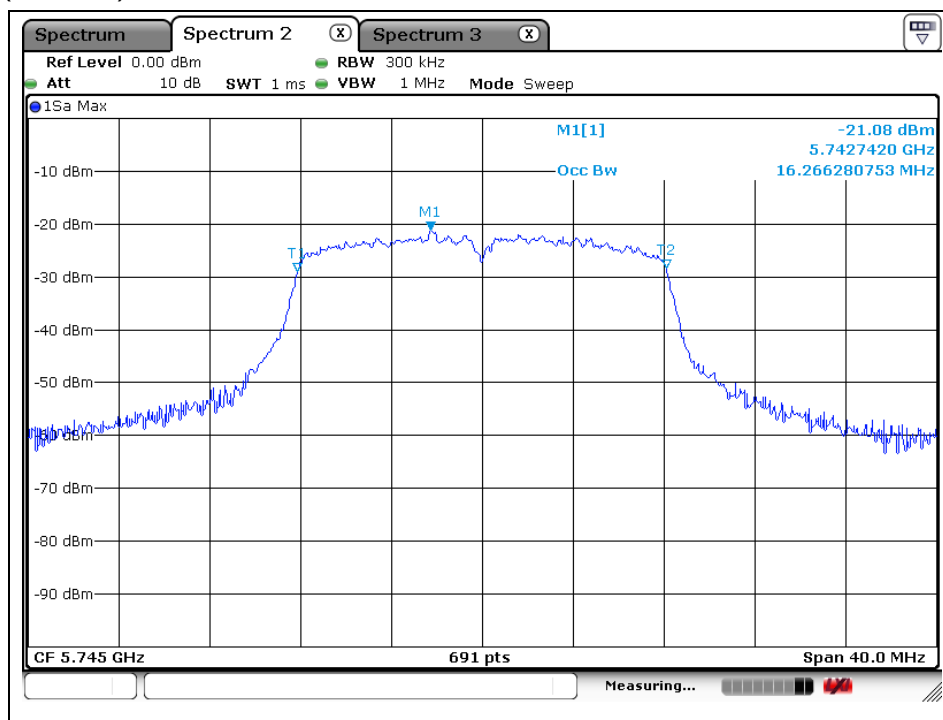
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



802.11a (Band 3)

Low Channel (5 745 MHz)



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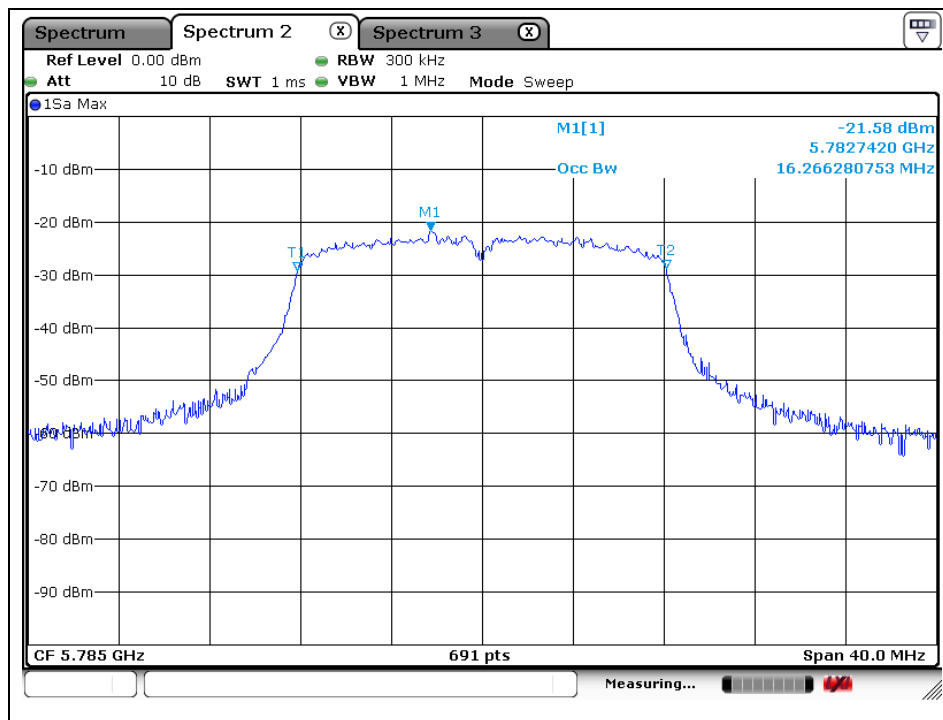
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

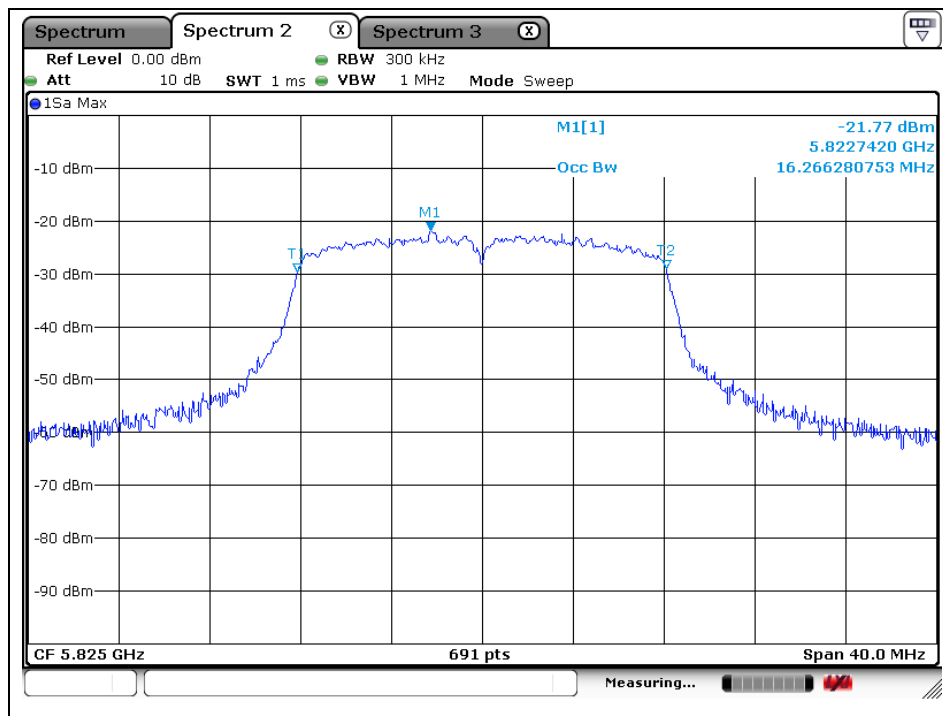
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



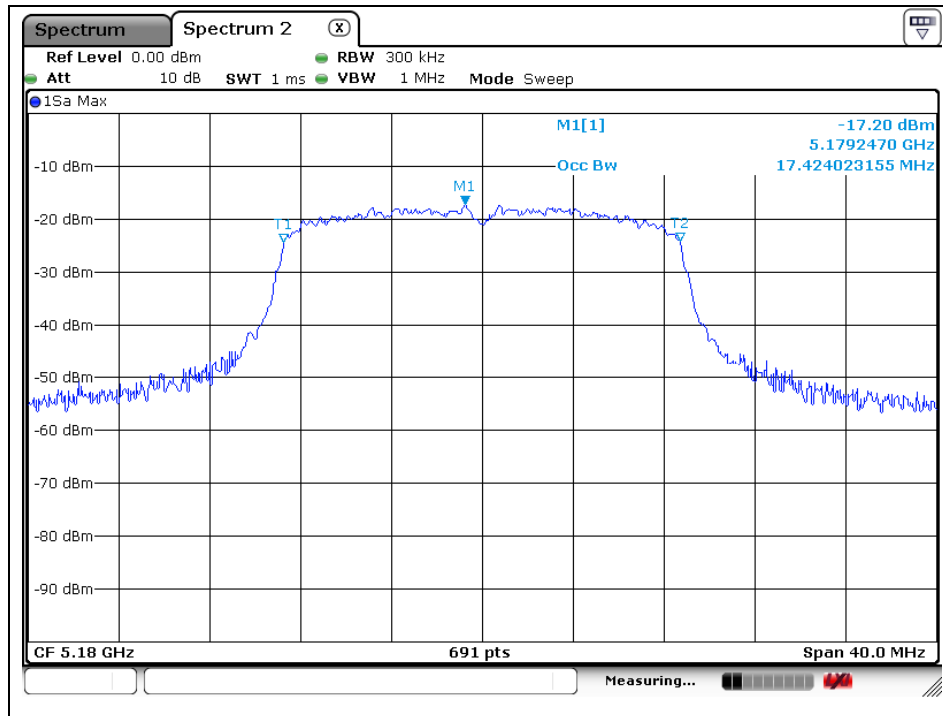
High Channel (5 825 MHz)



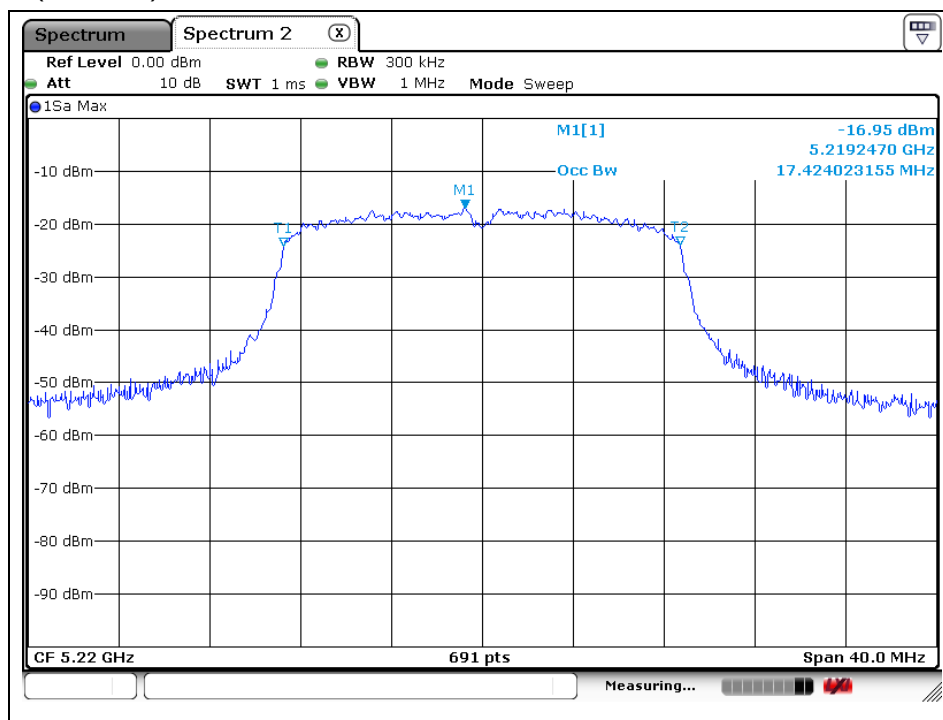
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802.11n_HT20 (Band 1)

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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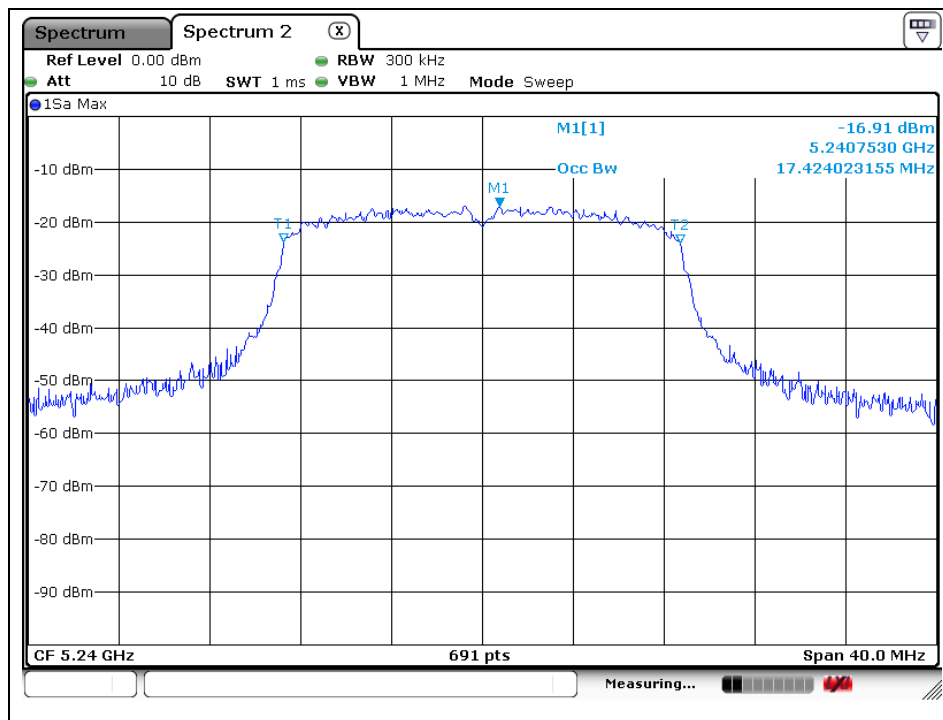
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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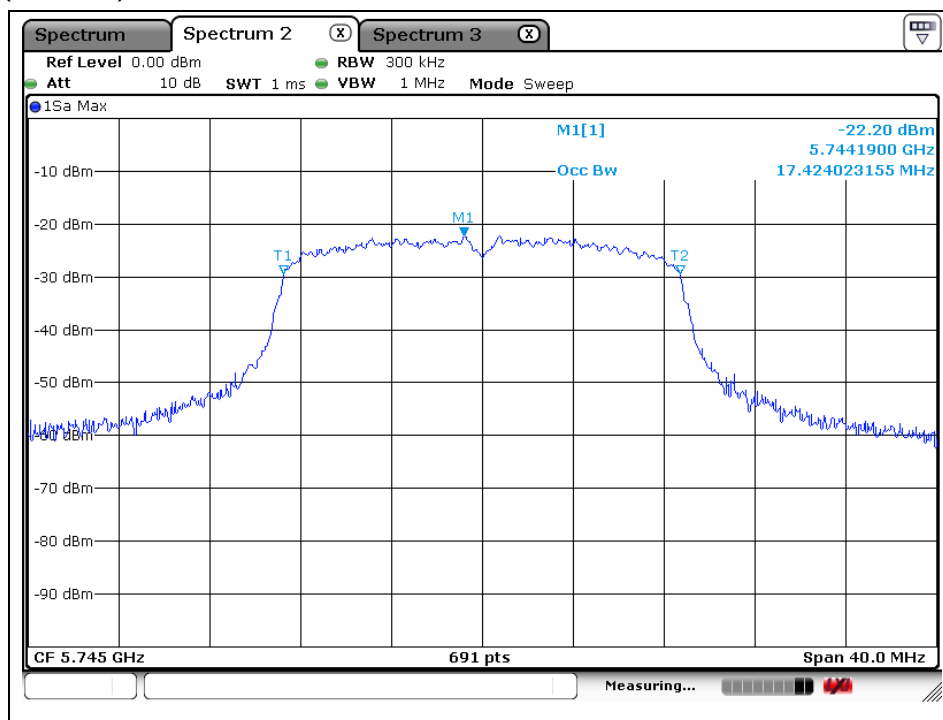
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



802.11n_HT20 (Band 3)

Low Channel (5 745 MHz)



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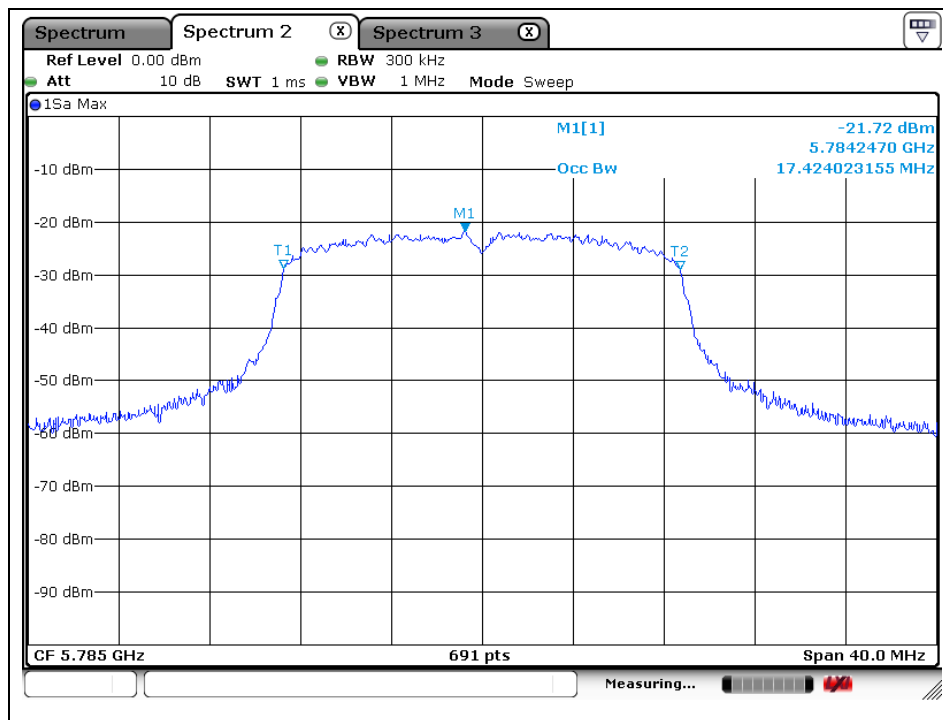
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2017.07.10)(0)

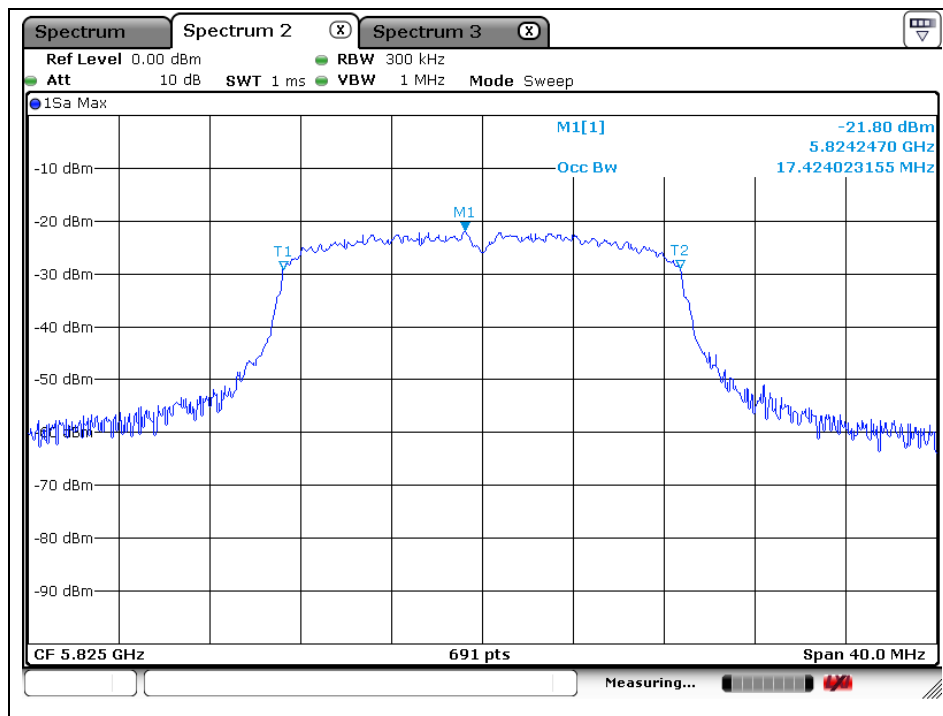
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



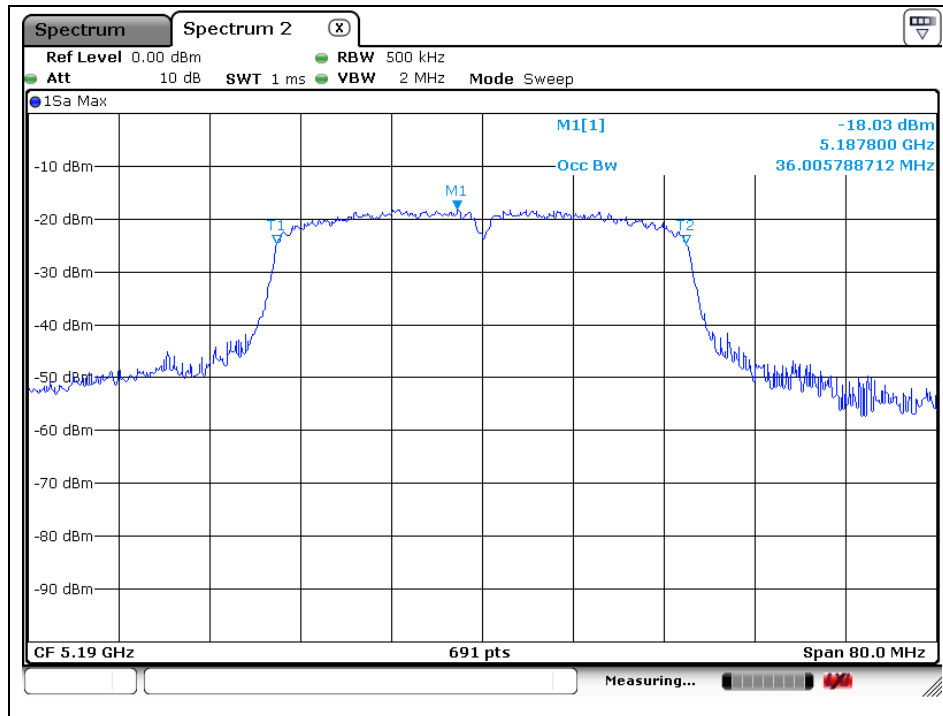
High Channel (5 825 MHz)



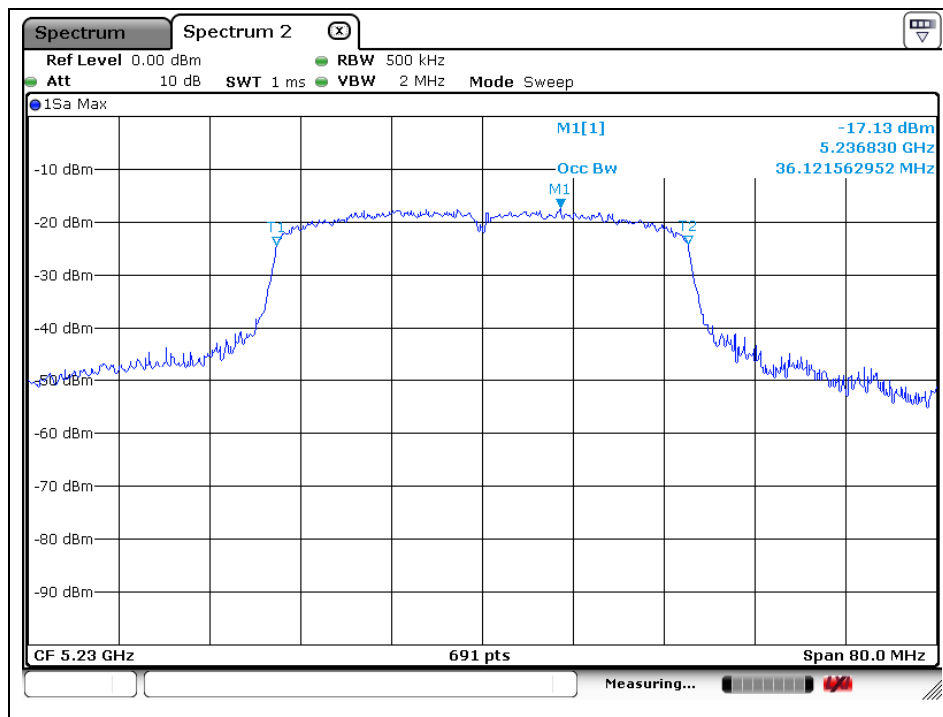
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802.11n_HT40 (Band 1)

Low Channel (5 190 MHz)



High Channel (5 230 MHz)



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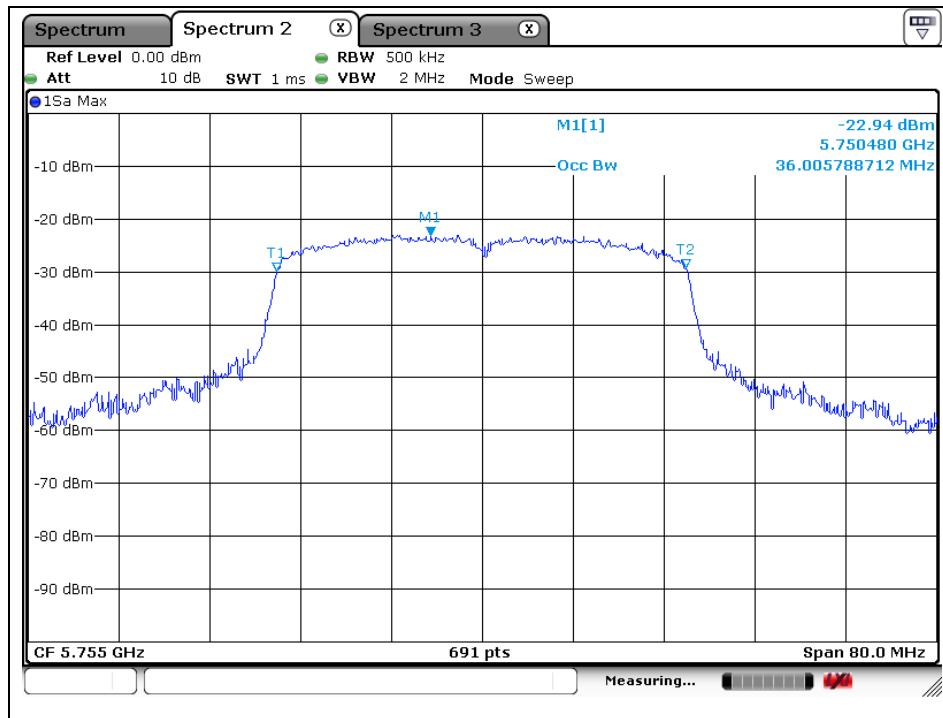
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

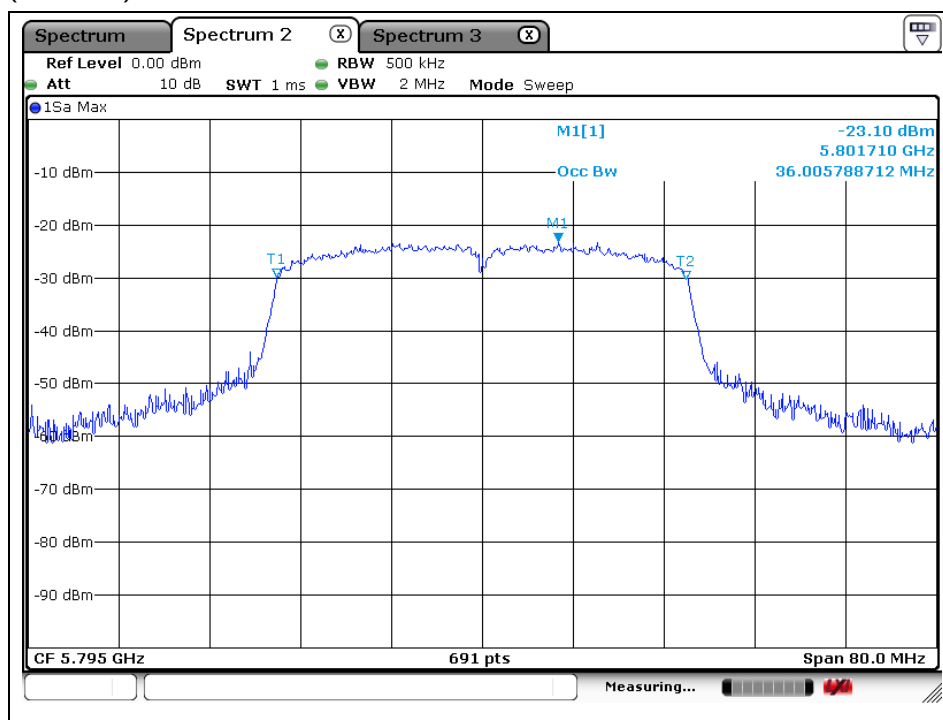
A4(210 mm x 297 mm)

802.11n_HT40 (Band 3)

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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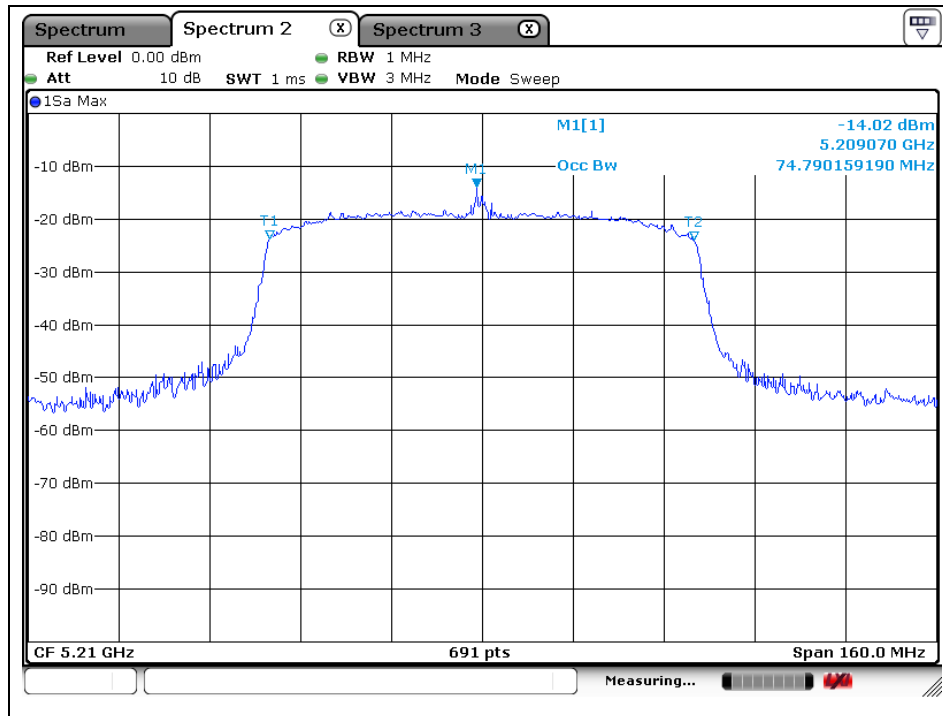
RTT5041-19(2017.07.10)(0)

Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

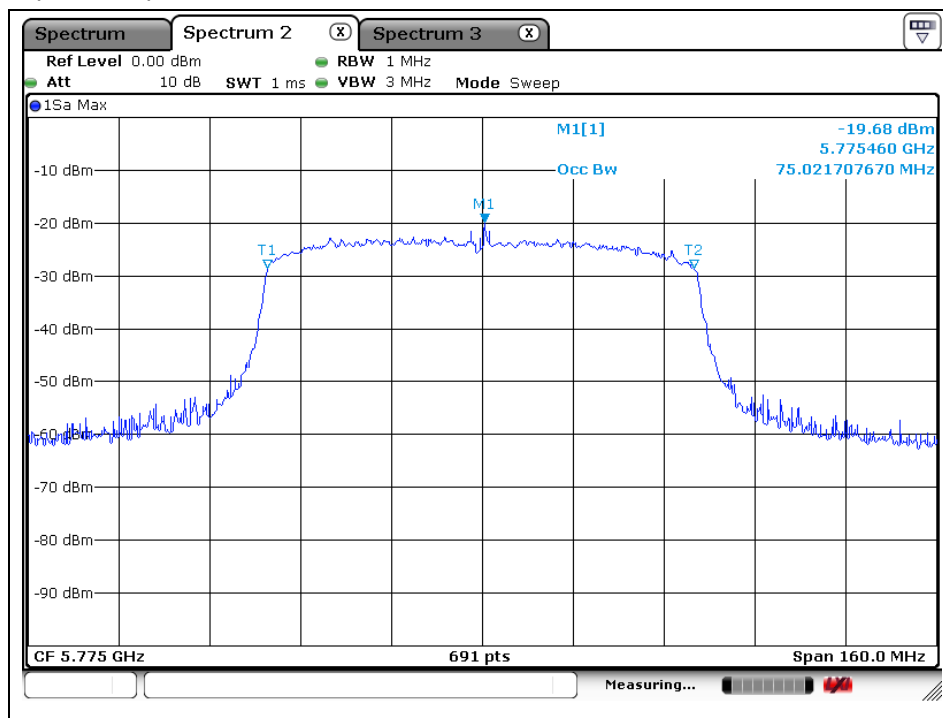
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)

Middle Channel (5 775 MHz)



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A4(210 mm x 297 mm)

4. 6 dB Bandwidth

4.1. Test Setup



4.2. Limit

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

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 kHz.
3. Set the video bandwidth (VBW) $\geq 3 \times$ 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 dB relative to the maximum level measured in the fundamental emission.

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4.4. Test result

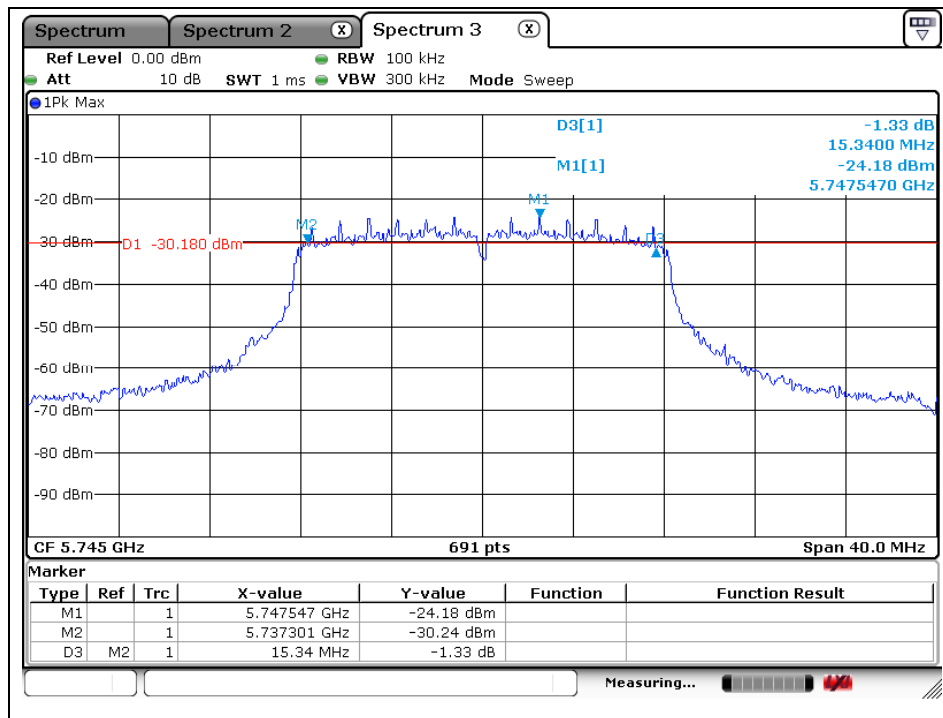
Ambient temperature : (23 ± 1) °C
Relative humidity : 47 % R.H.

Band	Mode	Frequency (MHz)	Ch.	Data Rate (Mbps)	6 dB Bandwidth (MHz)	Minimum Bandwidth (kHz)
U-NII 3	11a	5 745	149	6	15.340	500
		5 785	157		15.166	
		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	35.200	
		5 795	159		35.200	
	11ac_VHT80	5 775	155	MCS0	75.170	

- Test plots

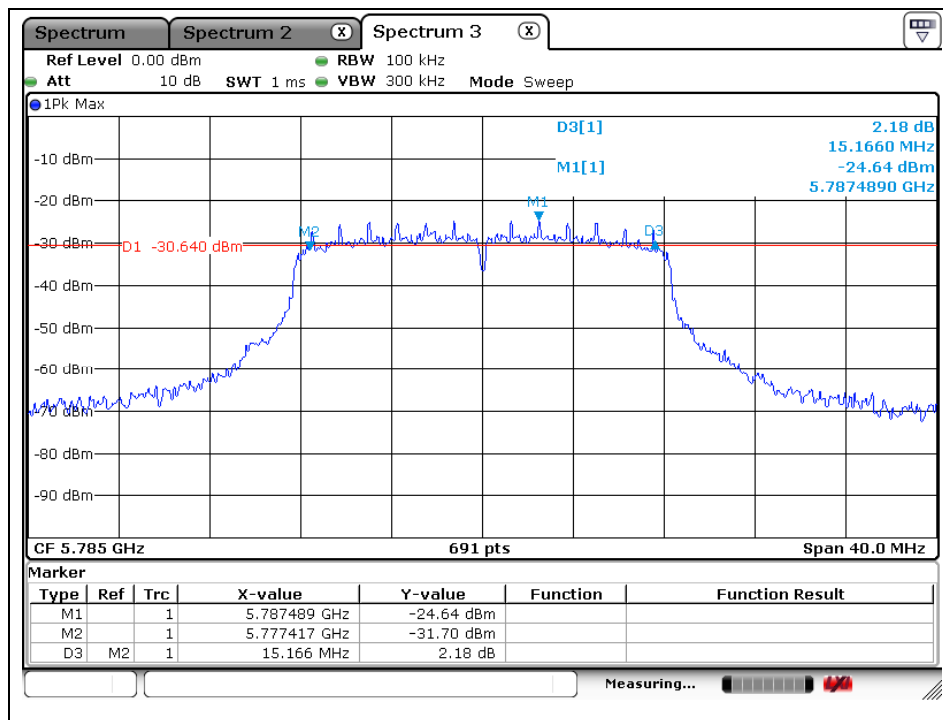
802.11a (Band 3)

Low Channel (5 745 MHz)

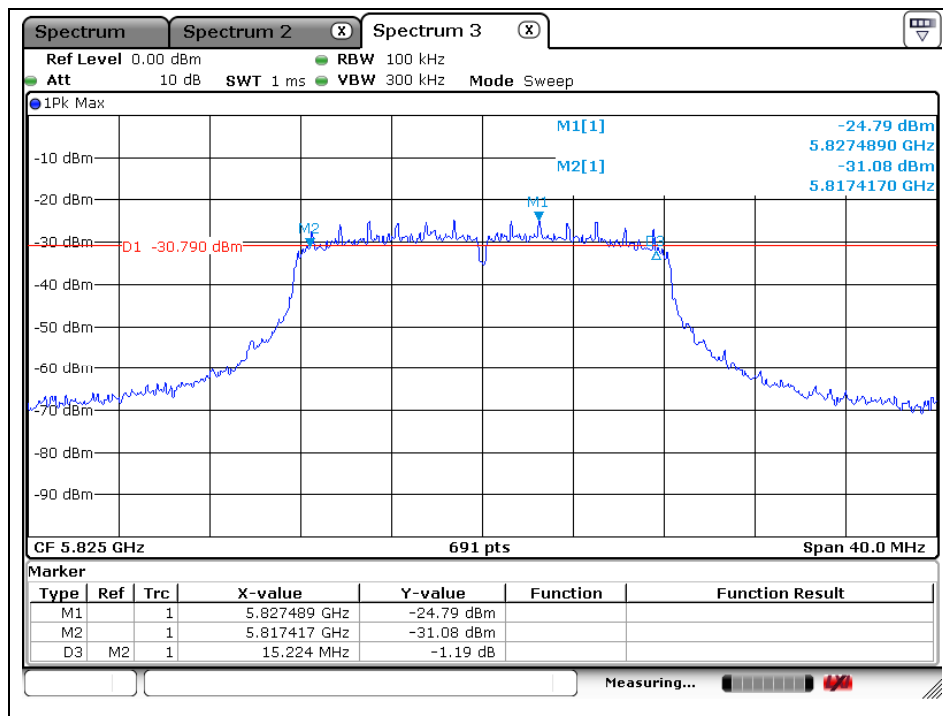


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Middle Channel (5 785 MHz)



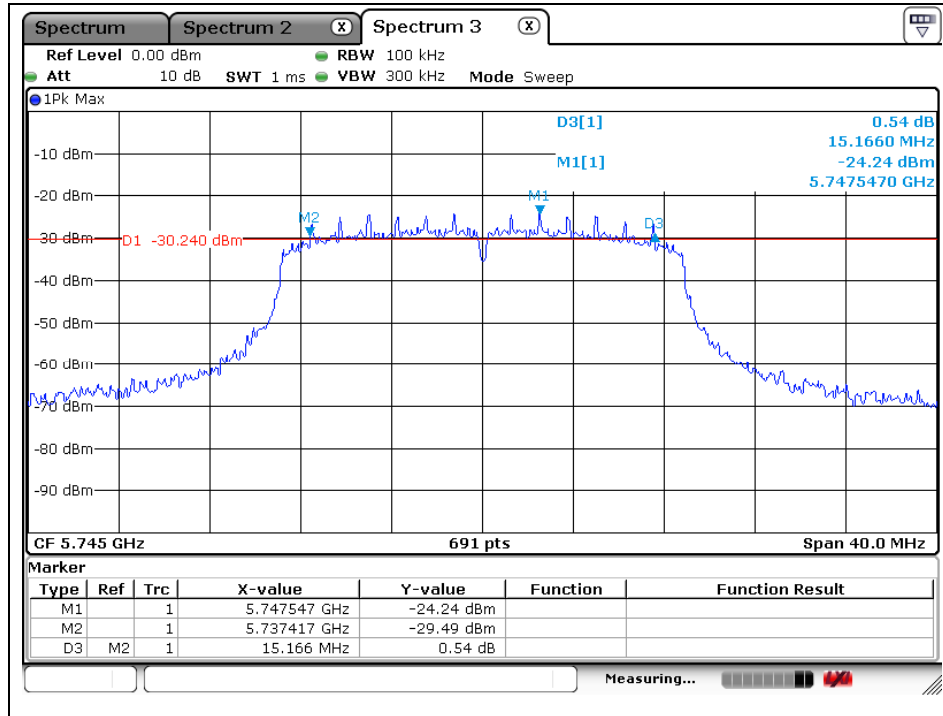
High Channel (5 825 MHz)



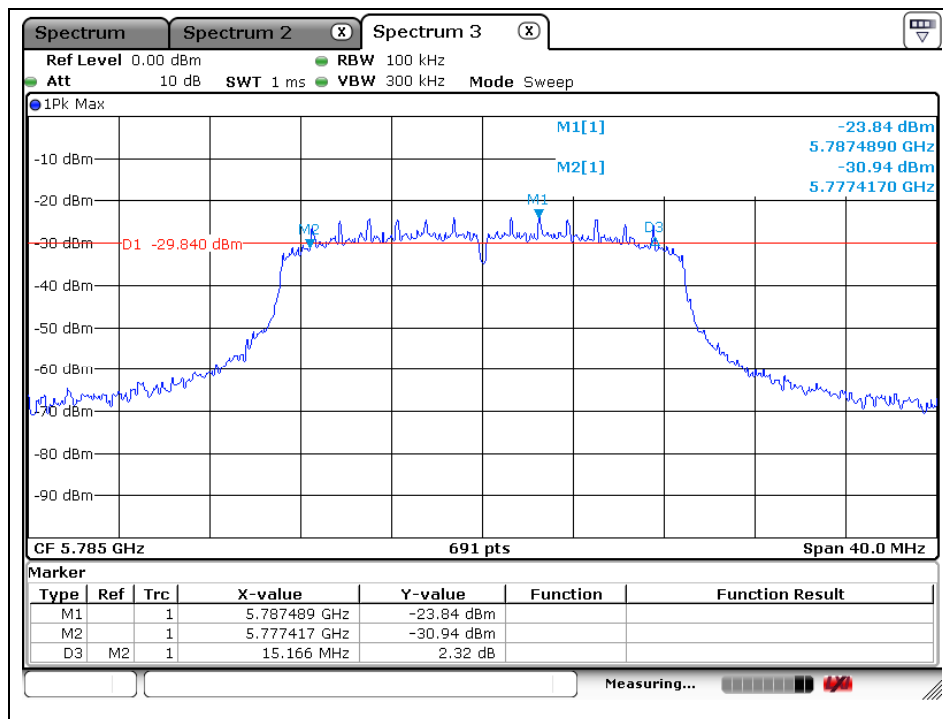
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802.11n_HT20 (Band 3)

Low Channel (5 745 MHz)

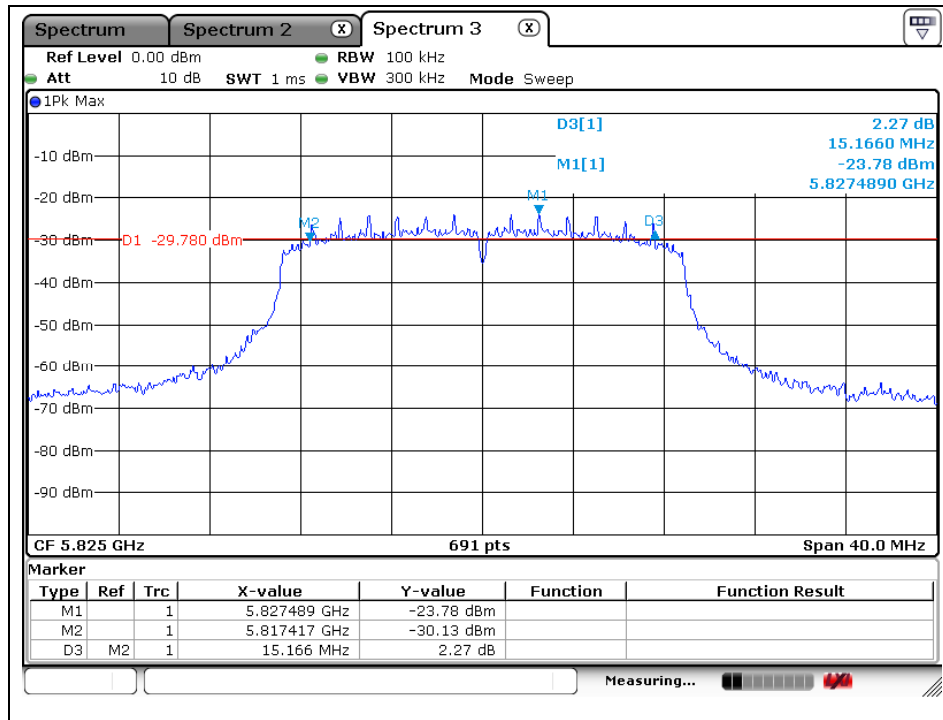


Middle Channel (5 785 MHz)



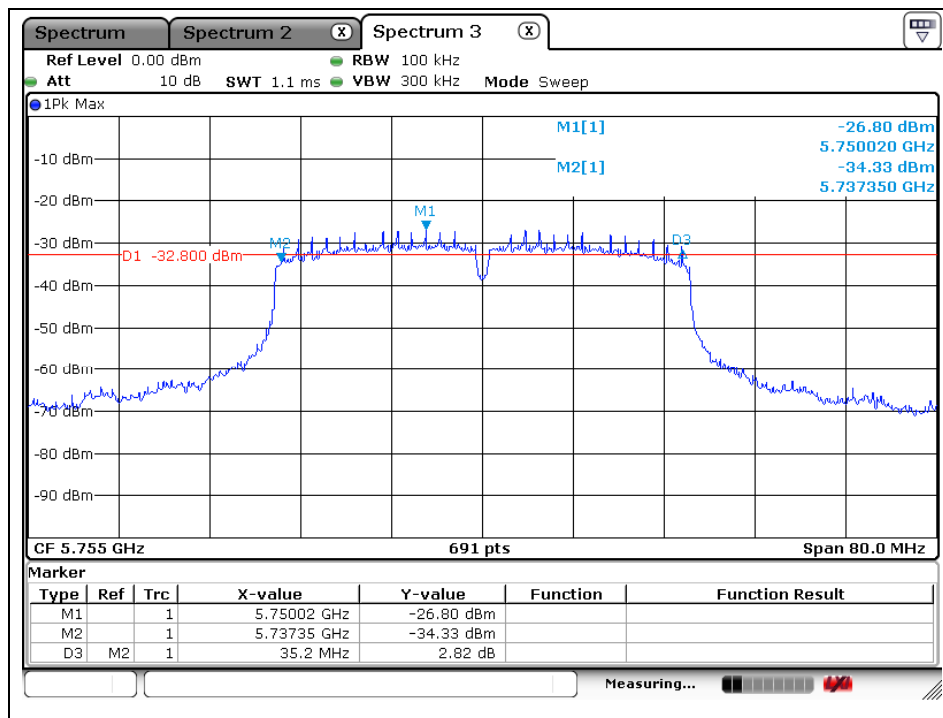
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High Channel (5 825 MHz)



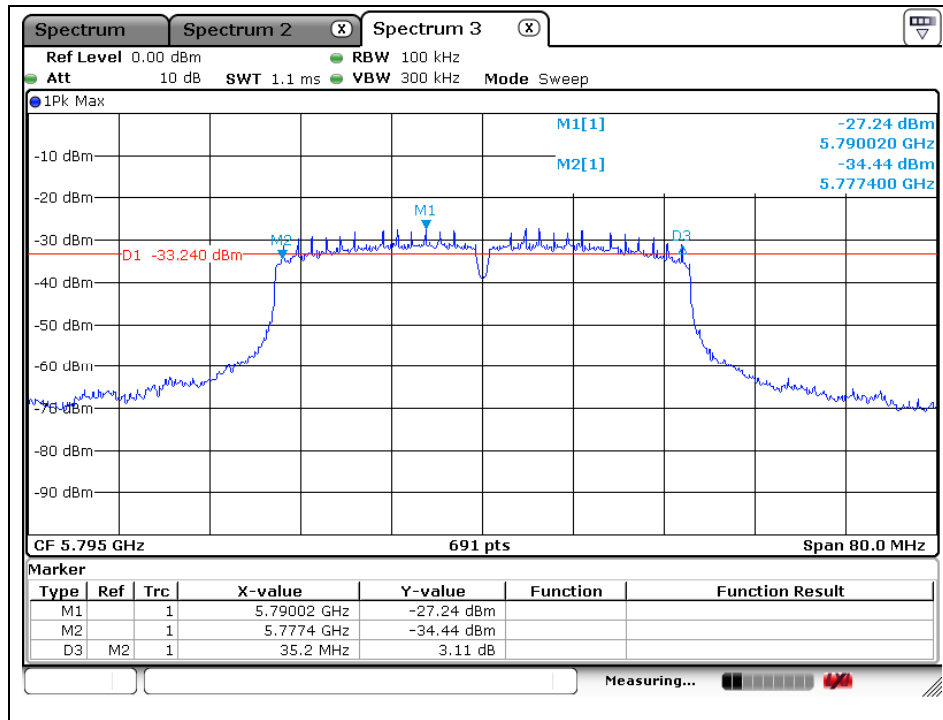
802.11n_HT40 (Band 3)

Low Channel (5 755 MHz)



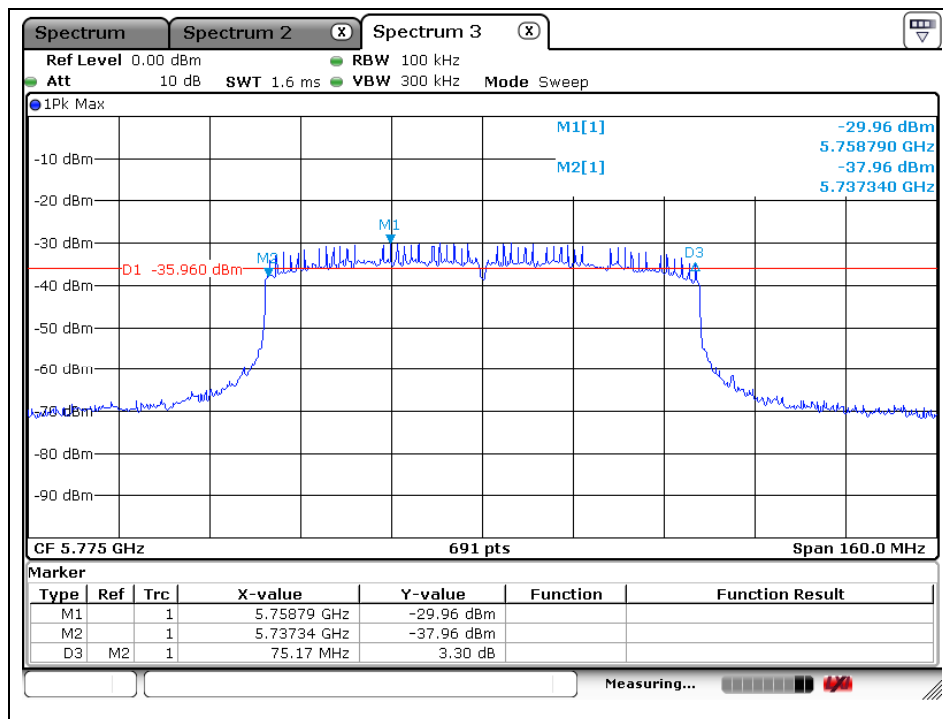
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High Channel (5 795 MHz)



802.11ac_VHT80 (Band 3)

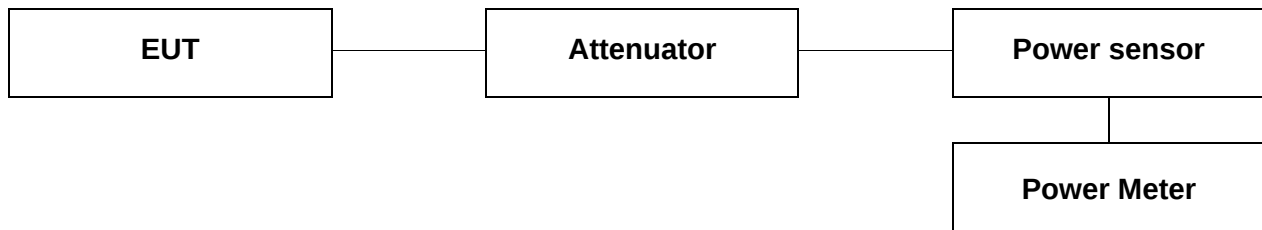
Middle Channel (5 775 MHz)



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5. Maximum Conducted Output Power

5.1. Test Setup



5.2. Limit

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

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

According to 15.407 (a)(3)

For the band 5.725-5.85 GHz, 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 dB m in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dB i 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 dB i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dB 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.

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RTT5041-19(2017.07.10)(0)

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A4(210 mm x 297 mm)

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 %).

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5.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Mode	Band	Frequency (MHz)	Conducted Power				
			Data Rate (Mbps)	Average Power (dB m)	Duty Correction Factor (dB)	Average Power Result (dB m)	E.I.R.P. (dB m)
11a	U-NII 1	5 180	6	8.84	0.35	9.19	13.15
		5 220		8.57		8.92	12.88
		5 240		8.40		8.75	12.71
	U-NII 3	5 745		8.56		8.91	
		5 785		8.54		8.89	
		5 825		8.95		9.30	

Band	Limit					
	Frequency (MHz)	Fixed Limit (dB m)	26 dB BW (MHz)	11+10LogB (dB m)	Antenna gain (dB i)	Limit (dB m)
U-NII 1	5 180	23.98			3.96	23.98
	5 220					
	5 240					
U-NII 3	5 745	30			6.31	29.69
	5 785					
	5 825					

Remark;

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

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A4(210 mm x 297 mm)

Mode	Band	Frequency (MHz)	Conducted Power				
			Data Rate (Mbps)	Average Power (dB m)	Duty Correction Factor (dB)	Average Power Result (dB m)	E.I.R.P. (dB m)
11n_HT20	U-NII 1	5 180	MCS0	8.67	0.38	9.05	13.01
		5 220		8.40		8.78	12.74
		5 240		8.21		8.59	12.55
	U-NII 3	5 745		8.24		8.62	
		5 785		8.41		8.79	
		5 825		8.63		9.01	

Band	Limit					
	Frequency (MHz)	Fixed Limit (dB m)	26 dB BW (MHz)	11+10LogB (dB m)	Antenna gain (dB i)	Limit (dB m)
U-NII 1	5 180	23.98			3.96	23.98
	5 220					
	5 240					
U-NII 3	5 745	30			6.31	29.69
	5 785					
	5 825					
	5 785					
	5 825					

Remark;

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

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Mode	Band	Frequency (MHz)	Conducted Power				
			Data Rate (Mbps)	Average Power (dB m)	Duty Correction Factor (dB)	Average Power Result (dB m)	E.I.R.P. (dB m)
11n_HT40	U-NII 1	5 190	MCS0	8.48	0.84	9.32	13.28
		5 230		8.38		9.22	13.18
	U-NII 3	5 755		8.38		9.22	
		5 795		8.50		9.34	

Band	Limit					
	Frequency (MHz)	Fixed Limit (dB m)	26 dB BW (MHz)	11+10LogB (dB m)	Antenna gain (dB i)	Limit (dB m)
U-NII 1	5 190	23.98			3.96	23.98
	5 230					
U-NII 3	5 755	30			6.31	29.69
	5 795					

Remark;

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

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Mode	Band	Frequency (MHz)	Conducted Power				
			Data Rate (Mbps)	Average Power (dB m)	Duty Correction Factor (dB)	Average Power Result (dB m)	E.I.R.P. (dB m)
11ac_VHT80	U-NII 1	5 210	MCS0	7.26	1.46	8.72	12.68
	U-NII 3	5 775		7.49		8.95	

Band	Limit					
	Frequency (MHz)	Fixed Limit (dB m)	26 dB BW (MHz)	11+10LogB (dB m)	Antenna gain (dB i)	Limit (dB m)
U-NII 1	5 210	23.98			3.96	23.98
U-NII 3	5 775	30			6.31	29.69

Remark;

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

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A4(210 mm x 297 mm)

6. Peak Power Spectral Density

6.1. Test Setup



6.2. Limit

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

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

According to 15.407 (a)(3)

For the band 5.725-5.85 GHz, 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 dB m in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dB i 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 dB i. However, fixed point-to point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dB 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.

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A4(210 mm x 297 mm)

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 dB to the final result to compensate for the difference between linear averaging and power averaging.
5. The result is the Maximum PSD over 1 MHz reference bandwidth.
6. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, "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 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:
 - a) Set $RBW \geq 1/T$, where T is defined in section II.B.1.a).
 - b) Set $VBW \geq 3$ RBW.
 - c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10\log(500 \text{ kHz}/RBW)$ to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
 - d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10\log(1 \text{ MHz}/RBW)$ to the measured result, whereas RBW (< 1 MHz) 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.

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6.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSP (dB m)	Duty Correction Factor (dB)	Final PPSP (dB m)
11a	U-NII 1	5 180	36	6	-1.83	0.35	-1.48
		5 220	44		-1.88		-1.53
		5 240	48		-2.02		-1.67

Mode	Band	Frequency (MHz)	Ch.	Final PPSP (dB m)	Antenna gain (dB i)	E.I.R.P. (dB m)	Limit (dB m/1 MHz)
11a	U-NII 1	5 180	36	-1.48	3.96	2.48	11
		5 220	44	-1.53		2.43	
		5 240	48	-1.67		2.29	

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSP (dB m)	Duty Correction Factor (dB)	Final PPSP (dB m)	Limit (dB m/500 kHz)
11a	U-NII 3	5 745	149	6	-6.16	0.35	-5.81	29.69
		5 785	157		-6.57		-6.22	
		5 825	165		-5.65		-5.30	

Remark;

1. Final PPSP (dB m) = Measured PPSP (dB m) + Duty Correction Factor (dB)
2. EIRP (dB m) = Final PPSP (dB m) + Antenna gain (dB i)

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A4(210 mm x 297 mm)

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)
11n_HT20	U-NII 1	5 180	36	MCS0	-2.15	0.38	-1.76
		5 220	44		-2.49		-2.10
		5 240	48		-2.51		-2.12

Mode	Band	Frequency (MHz)	Ch.	Final PPSD (dB m)	Antenna gain (dB i)	E.I.R.P. (dB m)	Limit (dB m/1 MHz)
11n_HT20	U-NII 1	5 180	36	-1.76	3.96	2.20	11
		5 220	44	-2.10		1.86	
		5 240	48	-2.12		1.84	

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)	Limit (dB m/500 kHz)
11n_HT20	U-NII 3	5 745	149	MCS0	-5.72	0.38	-5.33	29.69
		5 785	157		-5.27		-4.88	
		5 825	165		-5.18		-4.79	

Remark;

1. Final PPSD (dB m) = Measured PPSD (dB m) + Duty Correction Factor (dB)
2. EIRP (dB m) = Final PPSD (dB m) + Antenna gain (dB i)

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A4(210 mm x 297 mm)

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSP (dB m)	Duty Correction Factor (dB)	Final PPSP (dB m)
11n_HT40	U-NII 1	5 190	38	MCS0	-5.38	0.84	-4.54
		5 230	46		-5.59		-4.75

Mode	Band	Frequency (MHz)	Ch.	Final PPSP (dB m)	Antenna gain (dB i)	E.I.R.P. (dB m)	Limit (dB m/1 MHz)
11n_HT40	U-NII 1	5 190	38	-4.54	3.96	-0.58	11
		5 230	46	-4.75		-0.79	

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSP (dB m)	Duty Correction Factor (dB)	Final PPSP (dB m)	Limit (dB m/500 kHz)
11n_HT20	U-NII 3	5 755	151	MCS0	-8.32	0.84	-7.48	29.69
		5 795	159		-8.15		-7.31	

Remark;

1. Final PPSP (dB m) = Measured PPSP (dB m) + Duty Correction Factor (dB)
2. EIRP (dB m) = Final PPSP (dB m) + Antenna gain (dB i)

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Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)
11ac_VHT80	U-NII 1	5 210	42	MCS0	-9.38	1.46	-7.92

Mode	Band	Frequency (MHz)	Ch.	Final PPSD (dB m)	Antenna gain (dB i)	E.I.R.P. (dB m)	Limit (dB m/1 MHz)
11ac_VHT80	U-NII 1	5 190	38	-7.92	3.96	-3.96	11

Mode	Band	Frequency (MHz)	Ch.	Data Rate (Mbps)	Measured PPSD (dB m)	Duty Correction Factor (dB)	Final PPSD (dB m)	Limit (dB m/500 kHz)
11ac_VHT80	U-NII 3	5 775	155	MCS0	-11.65	1.46	-10.19	29.69

Remark;

1. Final PPSD (dB m) = Measured PPSD (dB m) + Duty Correction Factor (dB)
2. EIRP (dB m) = Final PPSD (dB m) + Antenna gain (dB i)

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RTT5041-19(2017.07.10)(0)

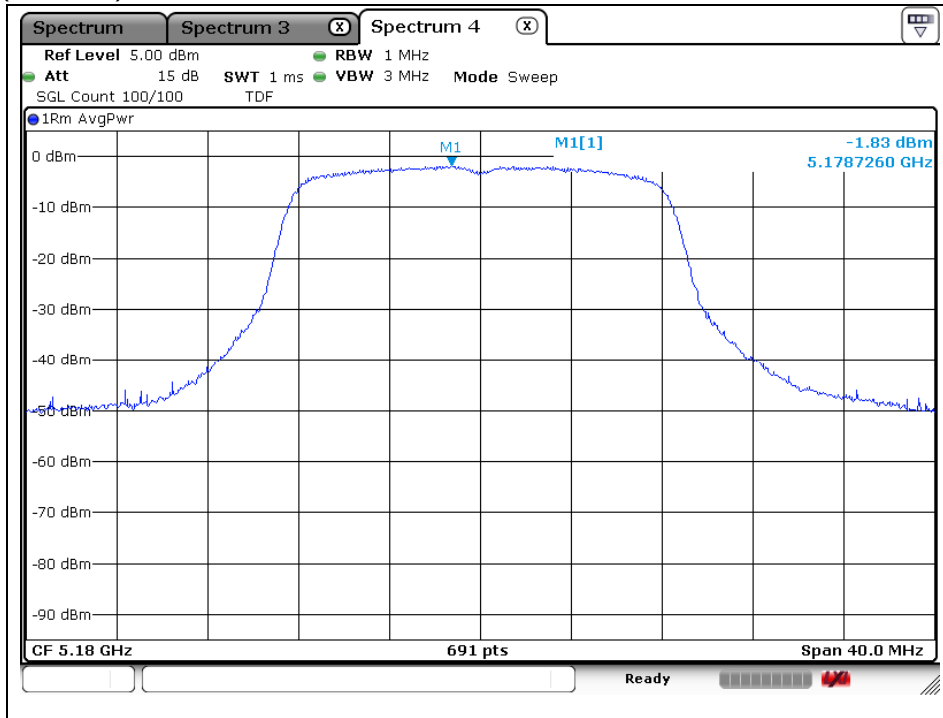
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

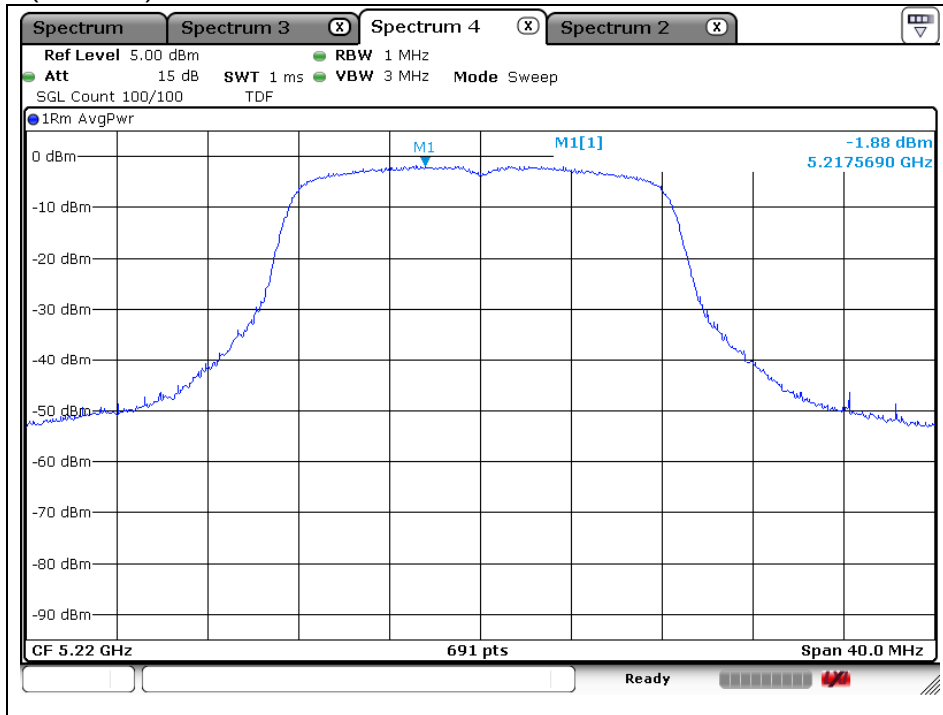
- Test plots

802.11a (Band 1)

Low Channel (5 180 MHz)

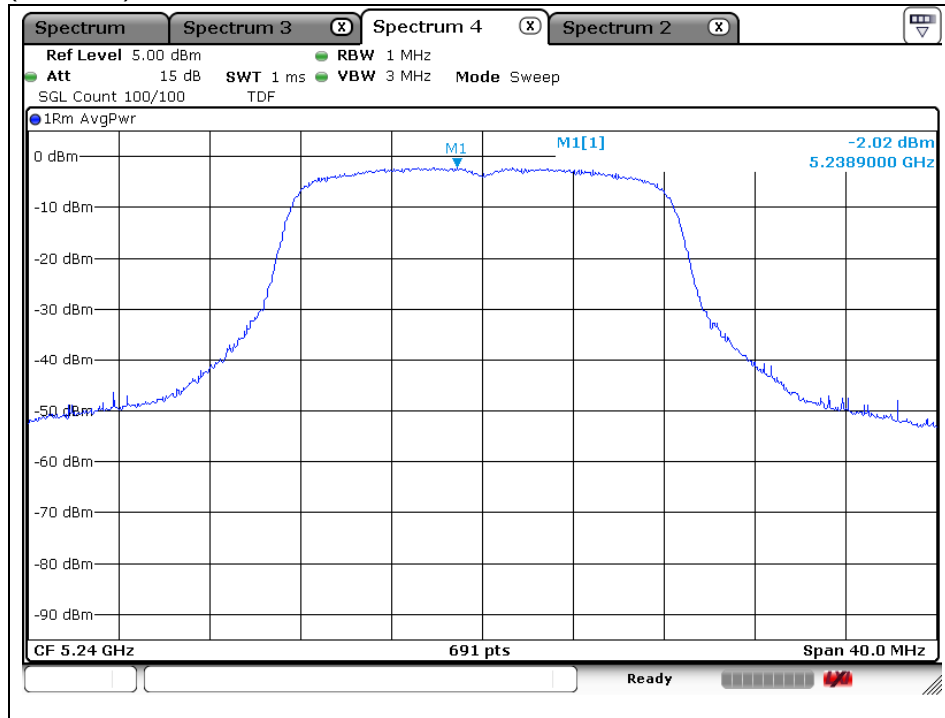


Middle Channel (5 220 MHz)



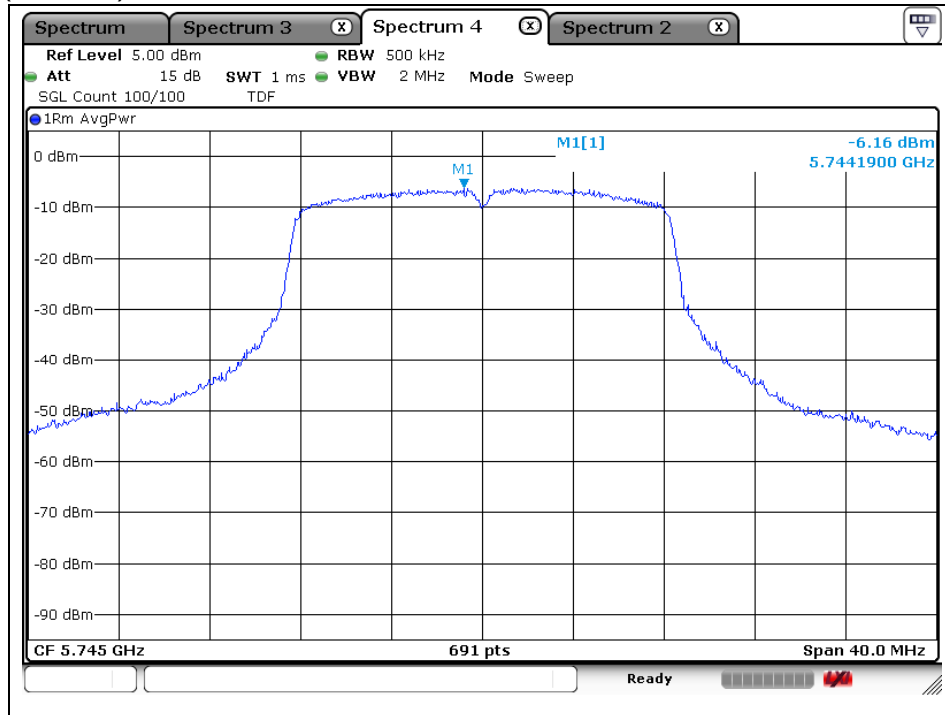
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High Channel (5 240 MHz)



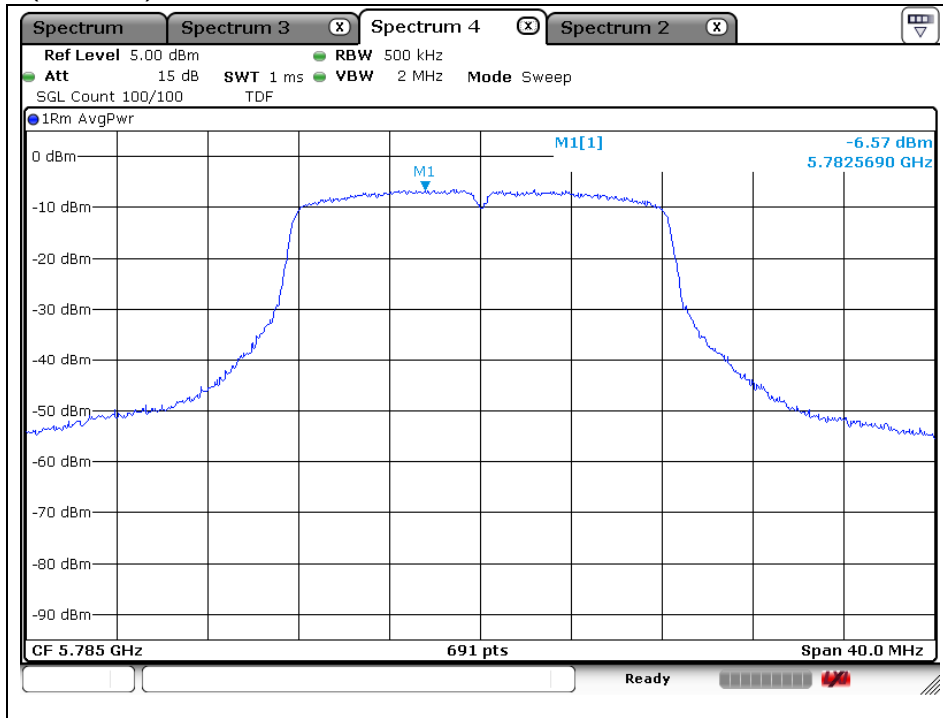
802.11a (Band 3)

Low Channel (5 745 MHz)

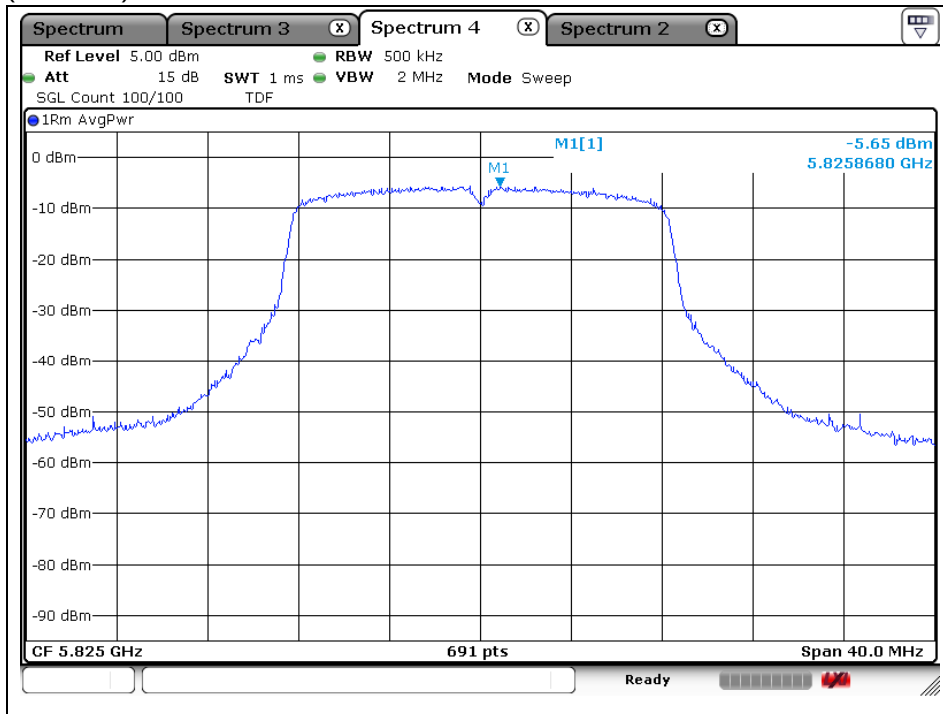


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Middle Channel (5 785 MHz)



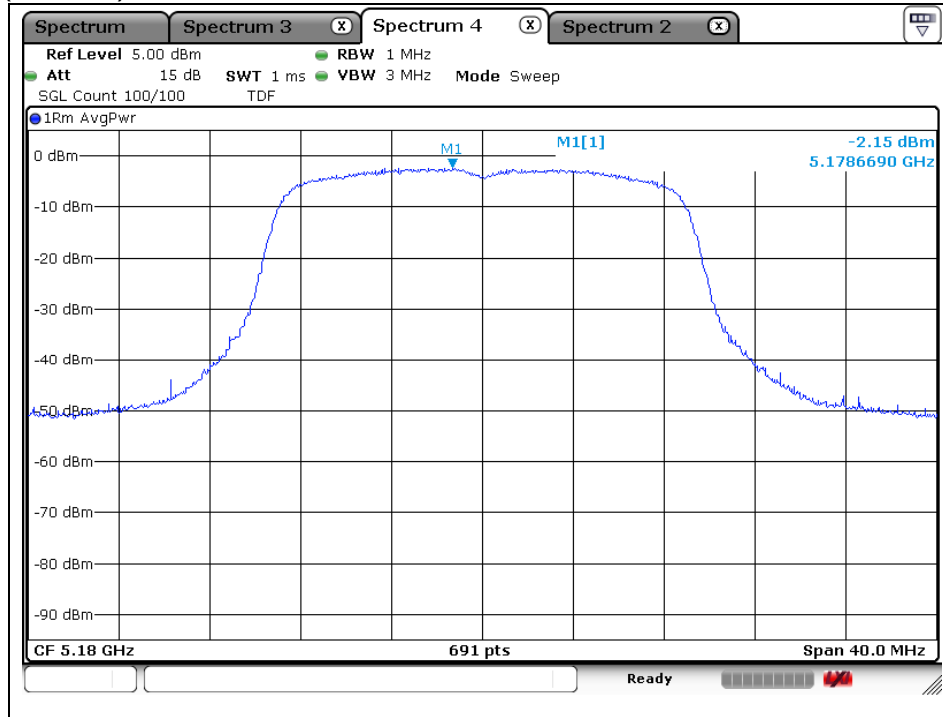
High Channel (5 825 MHz)



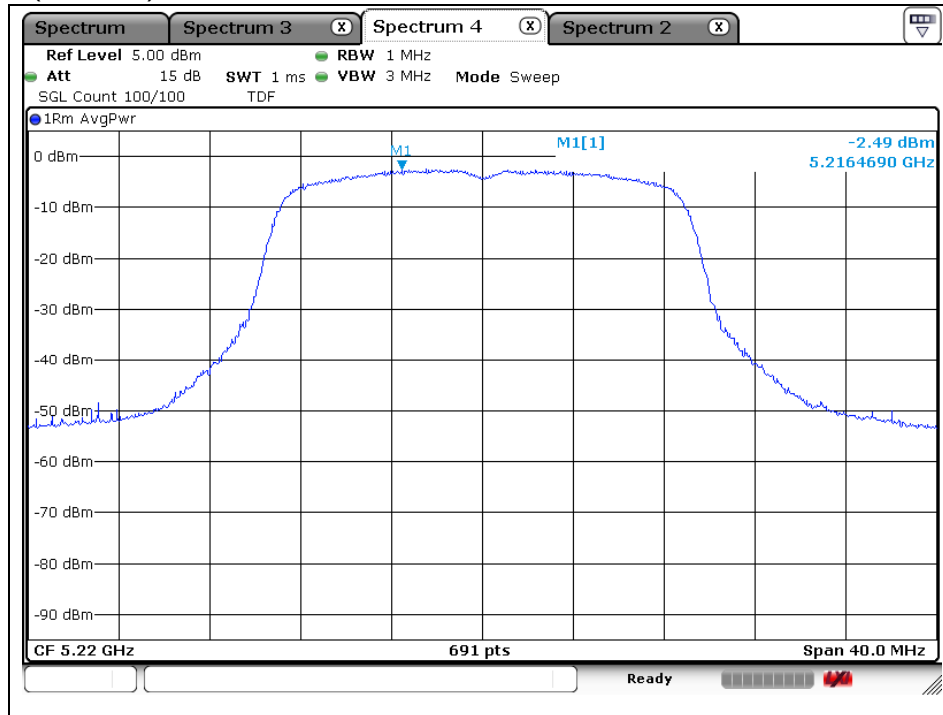
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802.11n_HT20 (Band 1)

Low Channel (5 180 MHz)

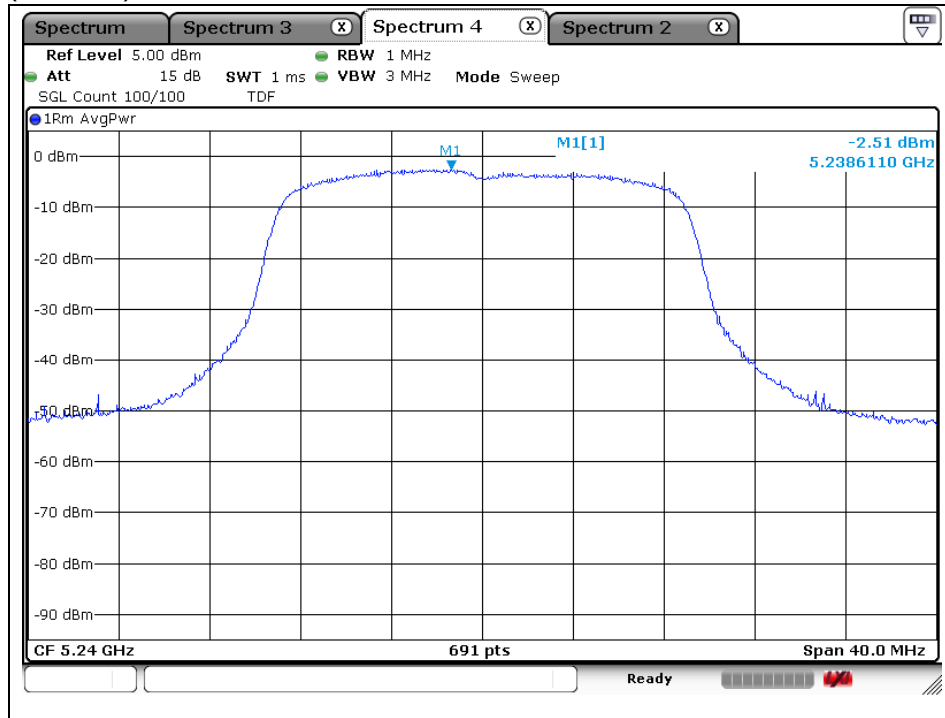


Middle Channel (5 220 MHz)



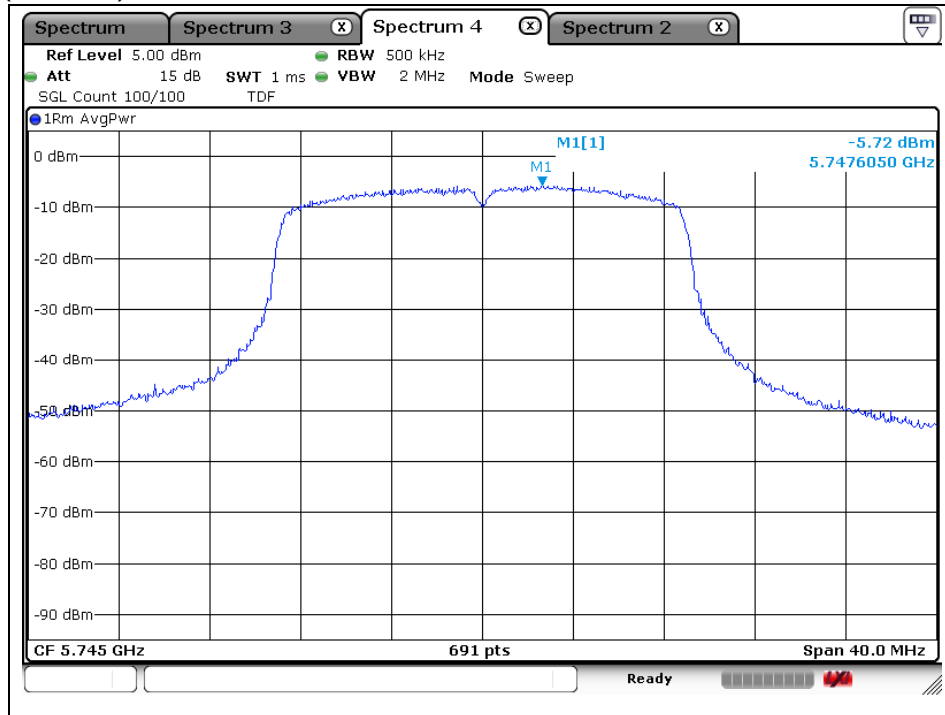
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High Channel (5 240 MHz)



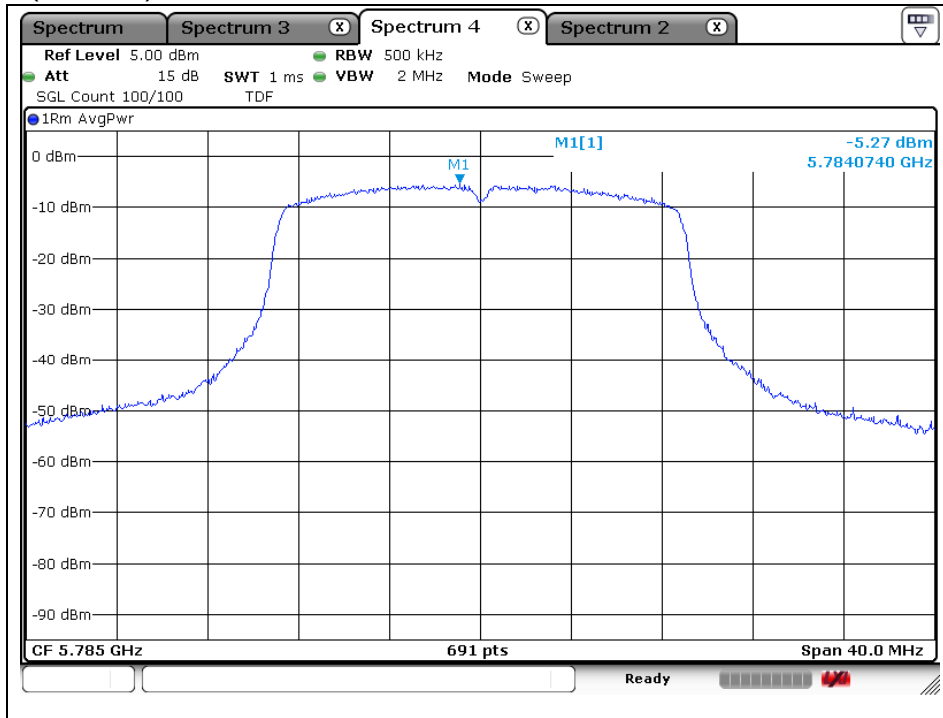
802.11n_HT20 (Band 3)

Low Channel (5 745 MHz)

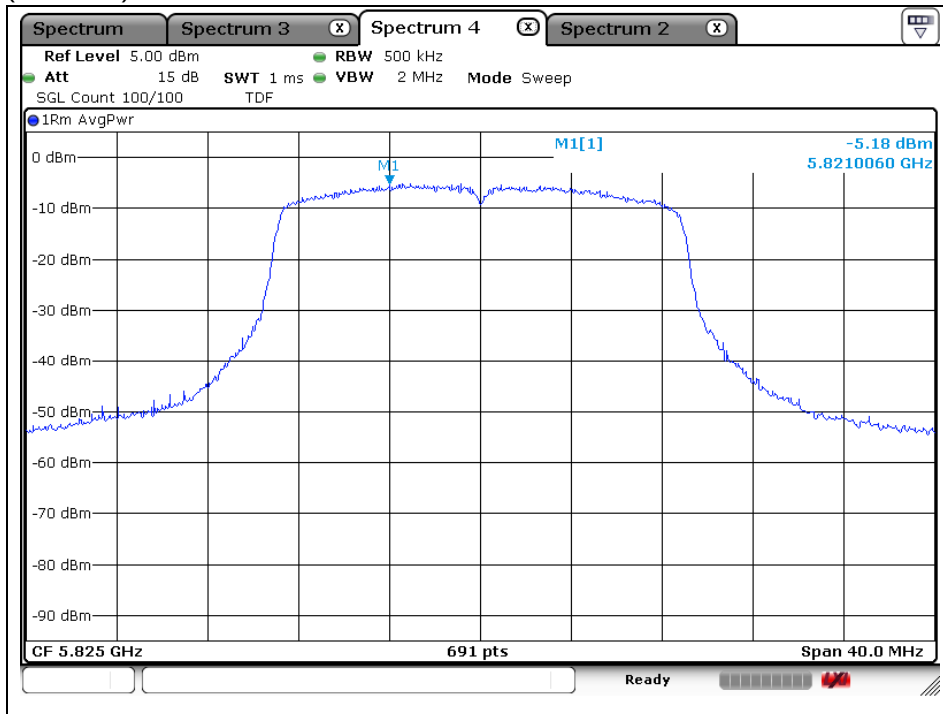


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Middle Channel (5 785 MHz)



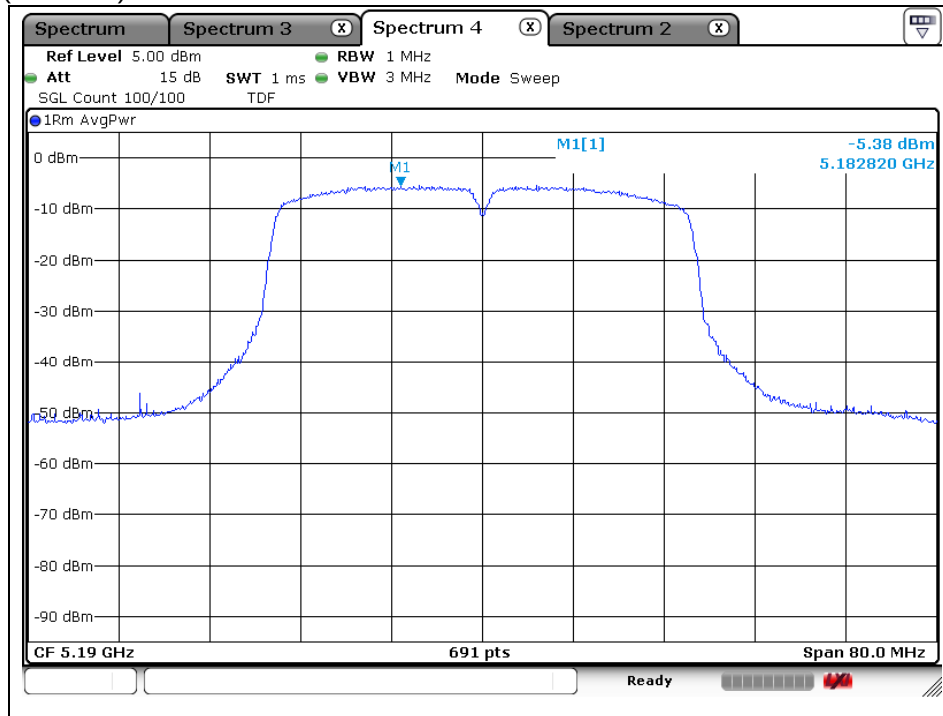
High Channel (5 825 MHz)



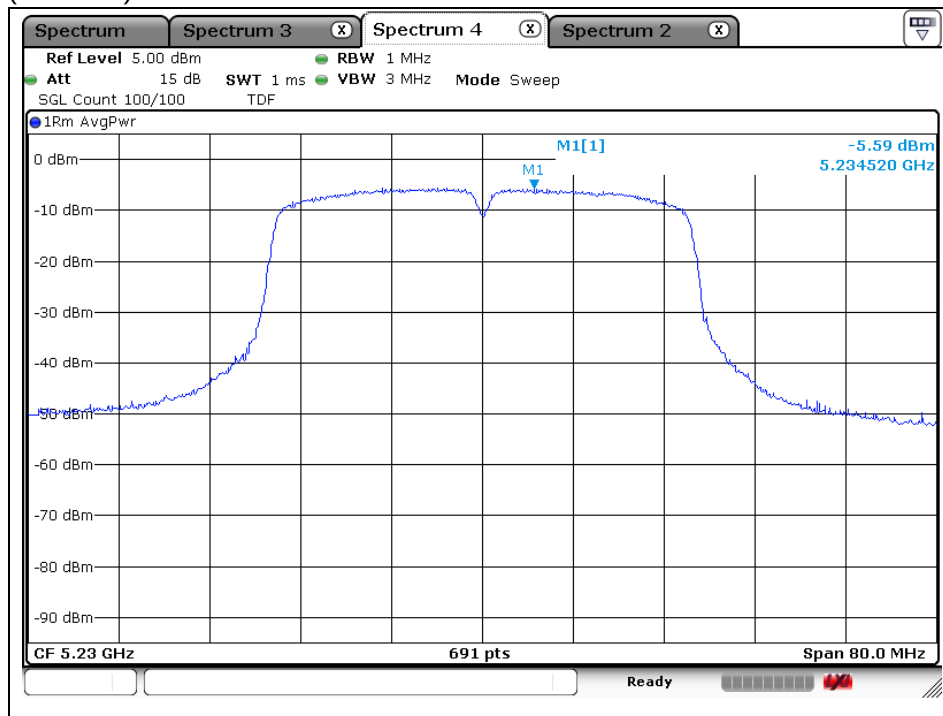
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

802.11n_HT40 (Band 1)

Low Channel (5 190 MHz)



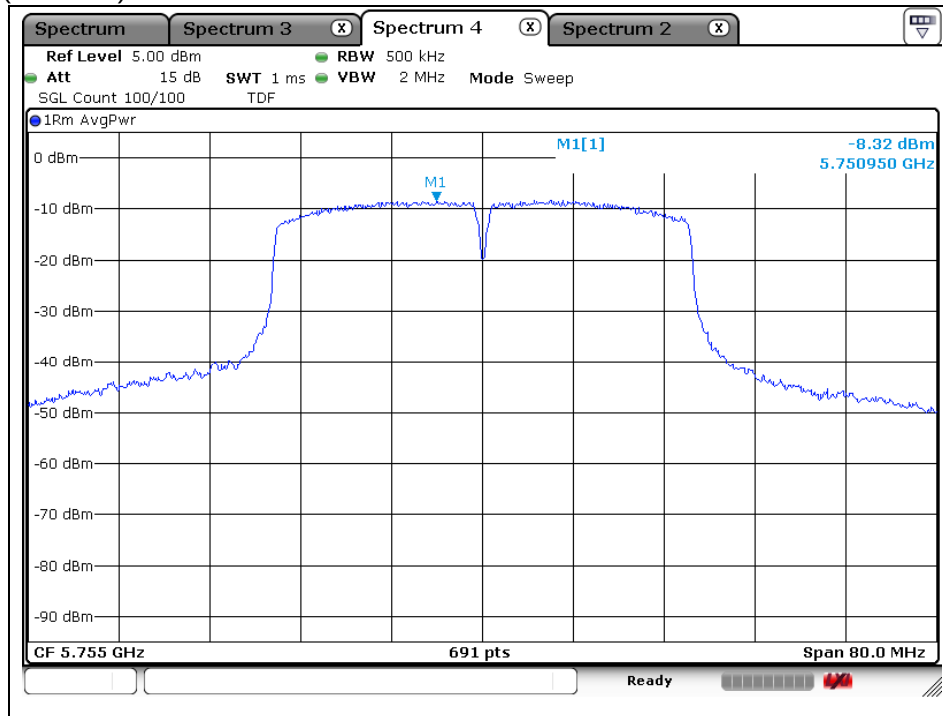
High Channel (5 230 MHz)



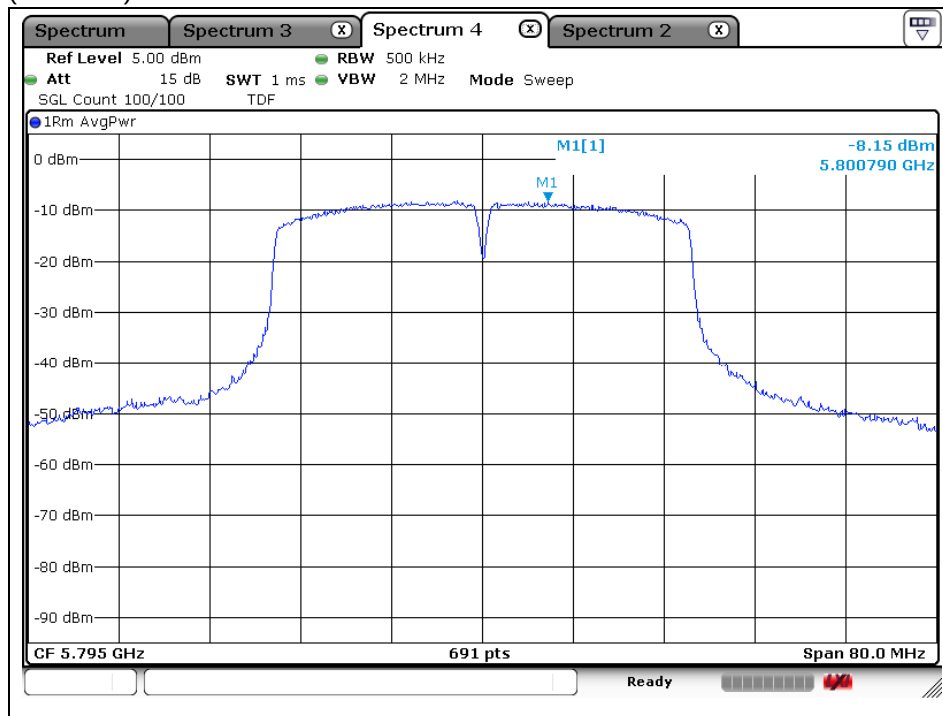
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802.11n_HT40 (Band 3)

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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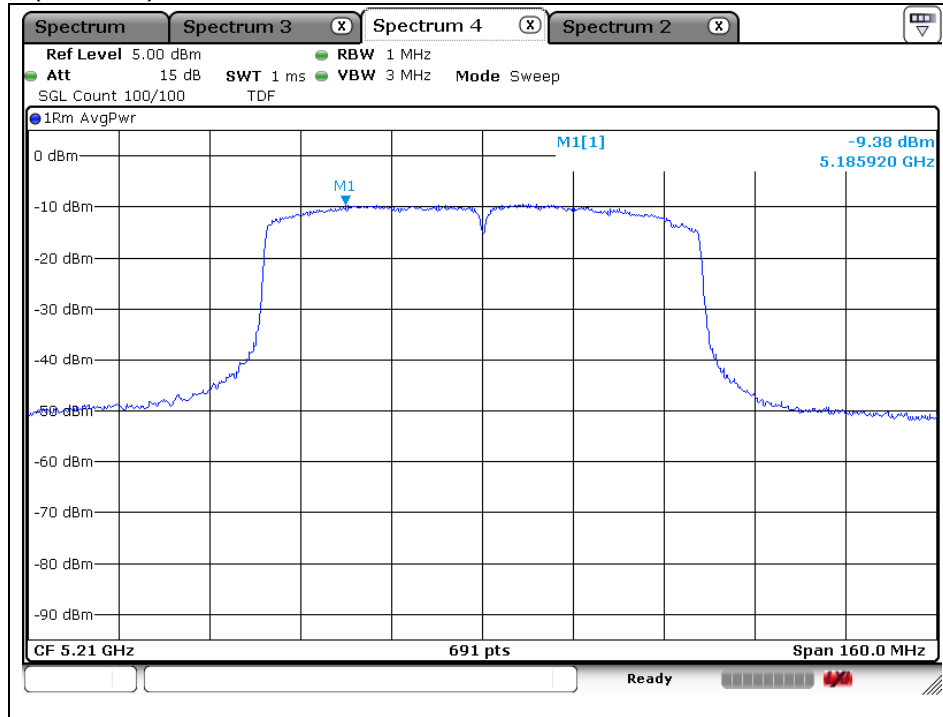
RTT5041-19(2017.07.10)(0)

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A4(210 mm x 297 mm)

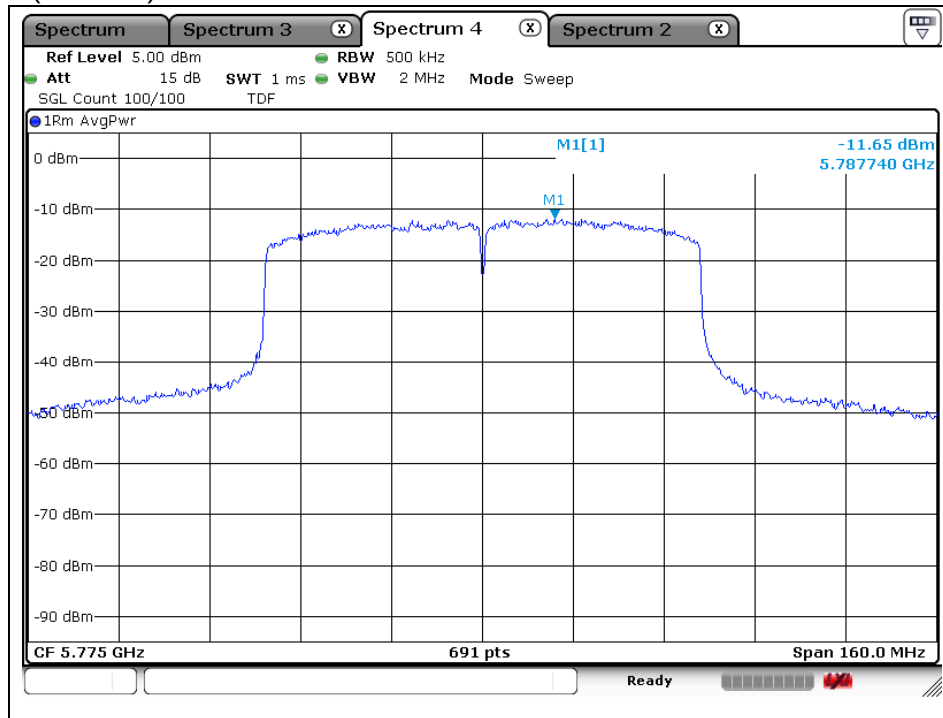
802.11ac_VHT80 (Band 1)

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)

Middle Channel (5 775 MHz)



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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 dB i are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dB i.

7.2. Antenna Connected Construction

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

Band	5 150 MHz ~ 5 250 MHz	5 725 MHz ~ 5 850 MHz
Mode	11a/n_HT20, HT40, 11ac_VHT20, VHT40, VHT80	
Gain	3.96 dB i	6.31 dB i

- End of the Test Report -

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