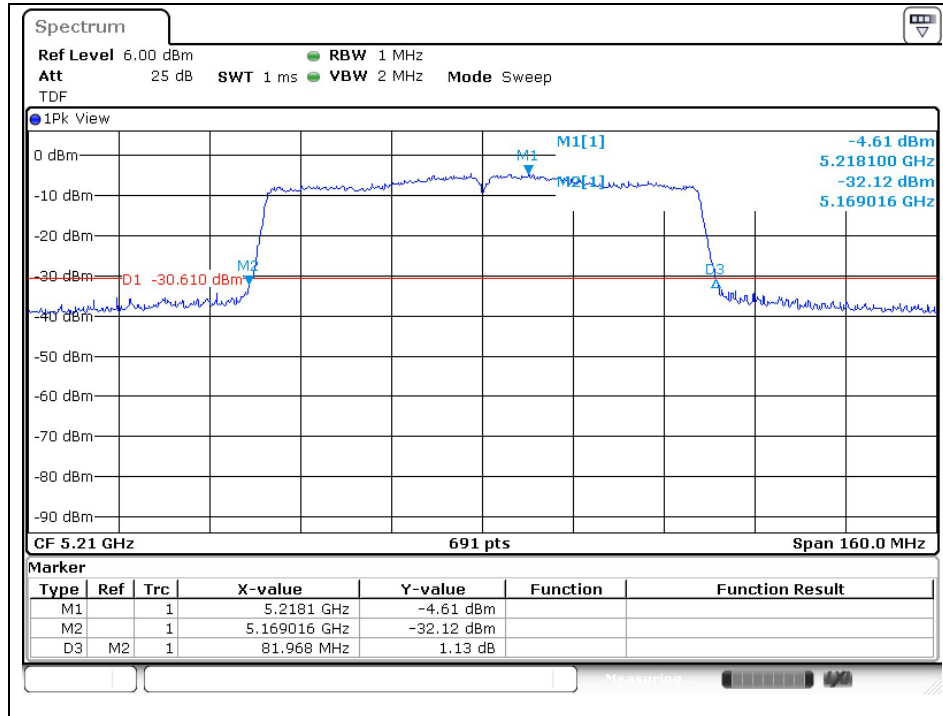


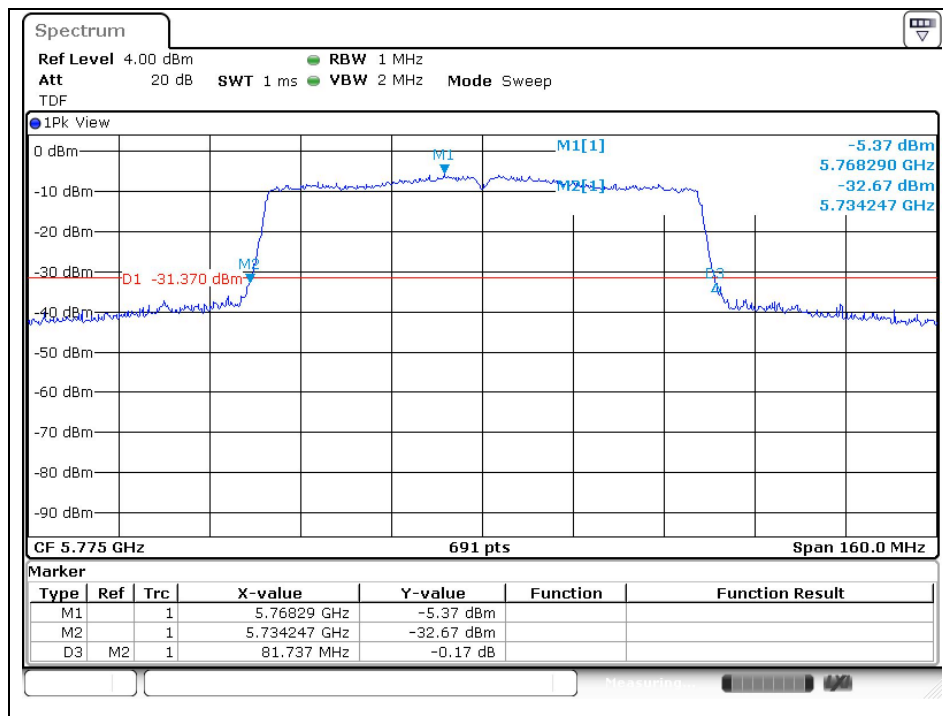
802.11ac_VHT80 (Band 1)_ANT 2

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)_ANT 2

Middle Channel (5 775 MHz)



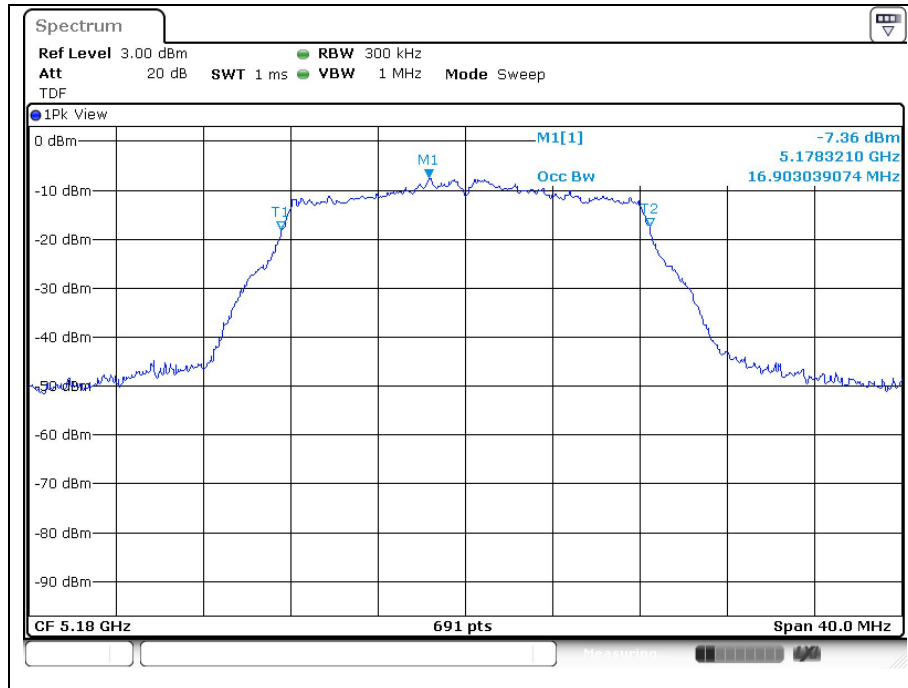
The results of this test report are effective only to the items tested. The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

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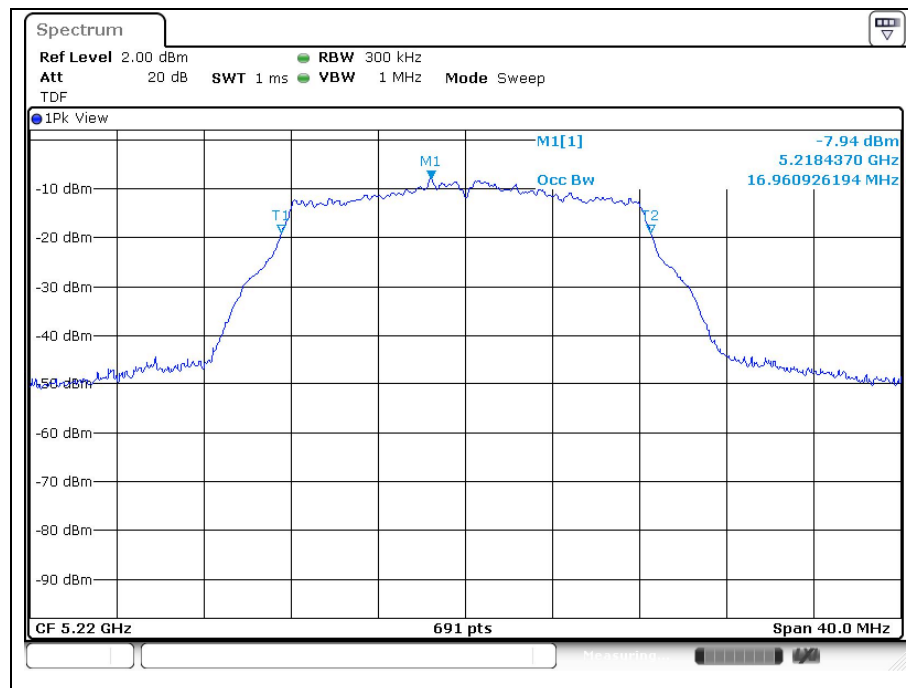
99 % Bandwidth

802.11a (Band 1)_ANT 1

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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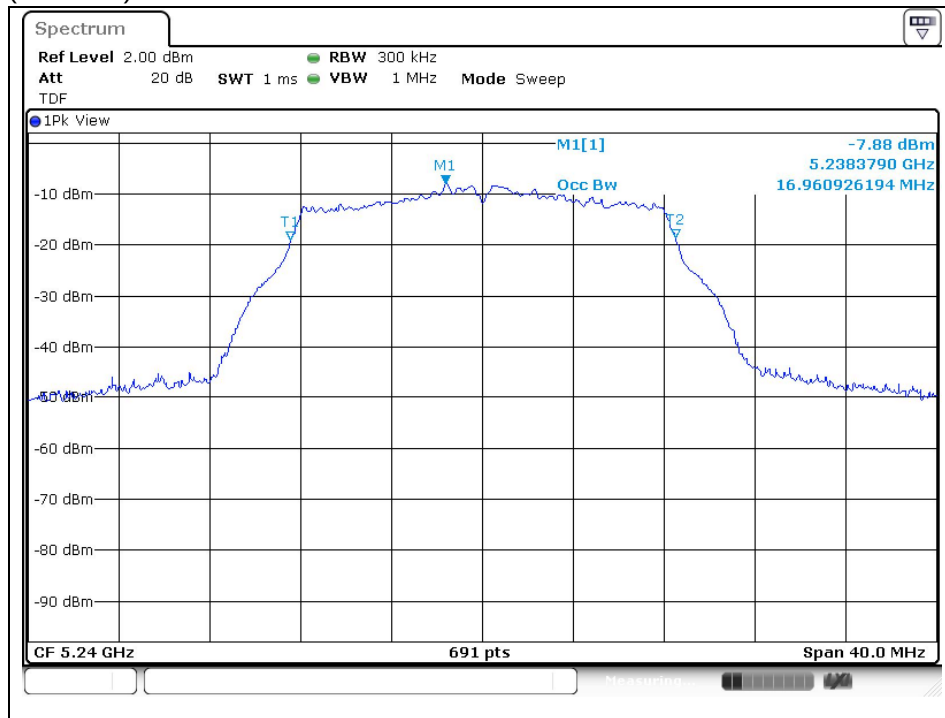
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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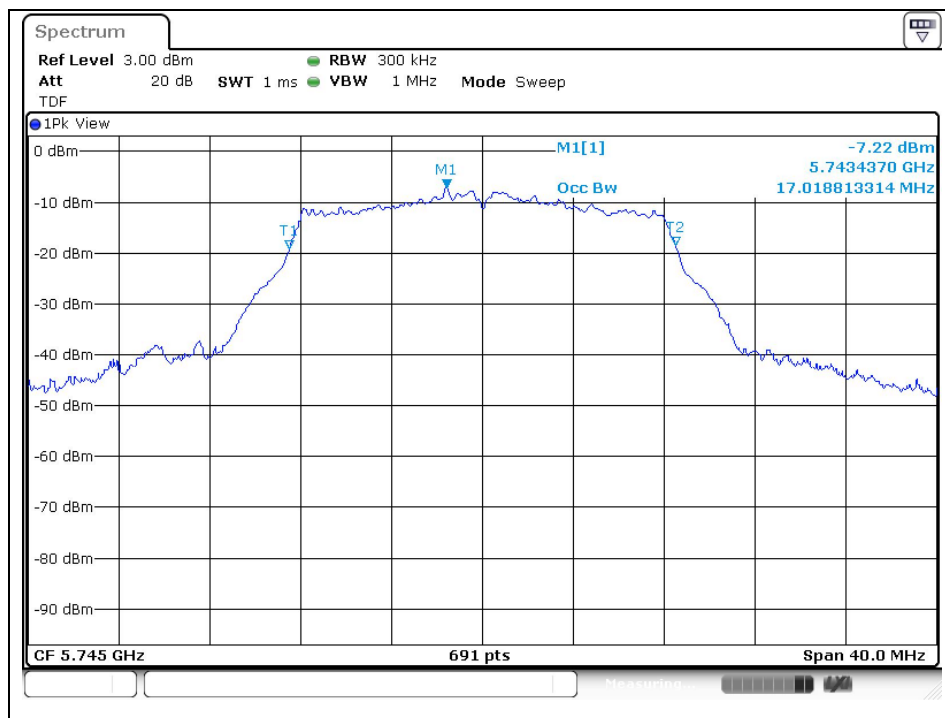
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



802.11a (Band 3)_ANT 1

Low Channel (5 745 MHz)



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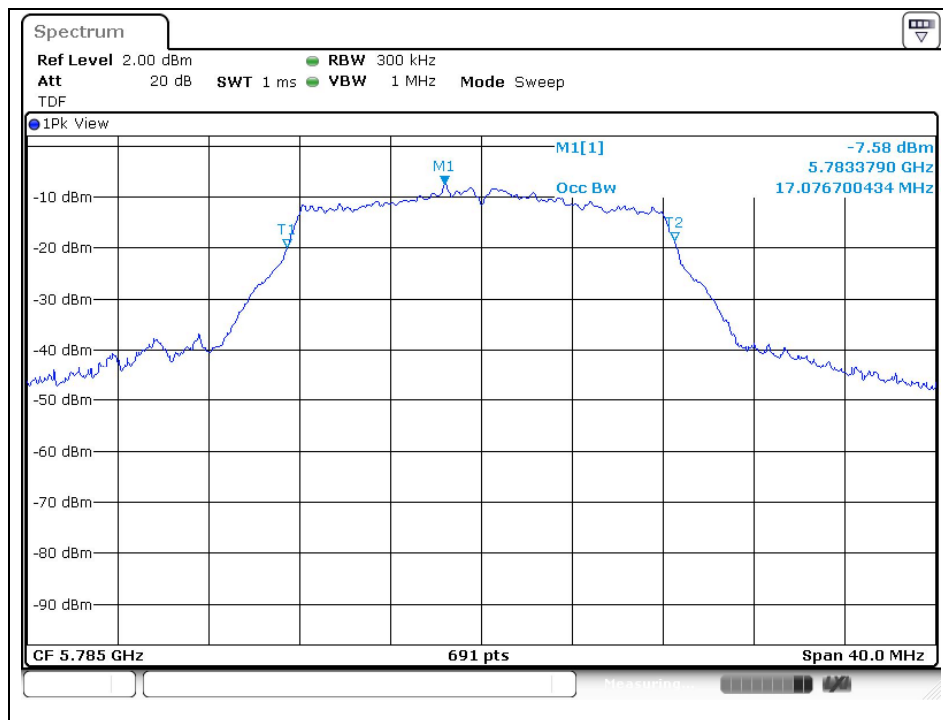
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

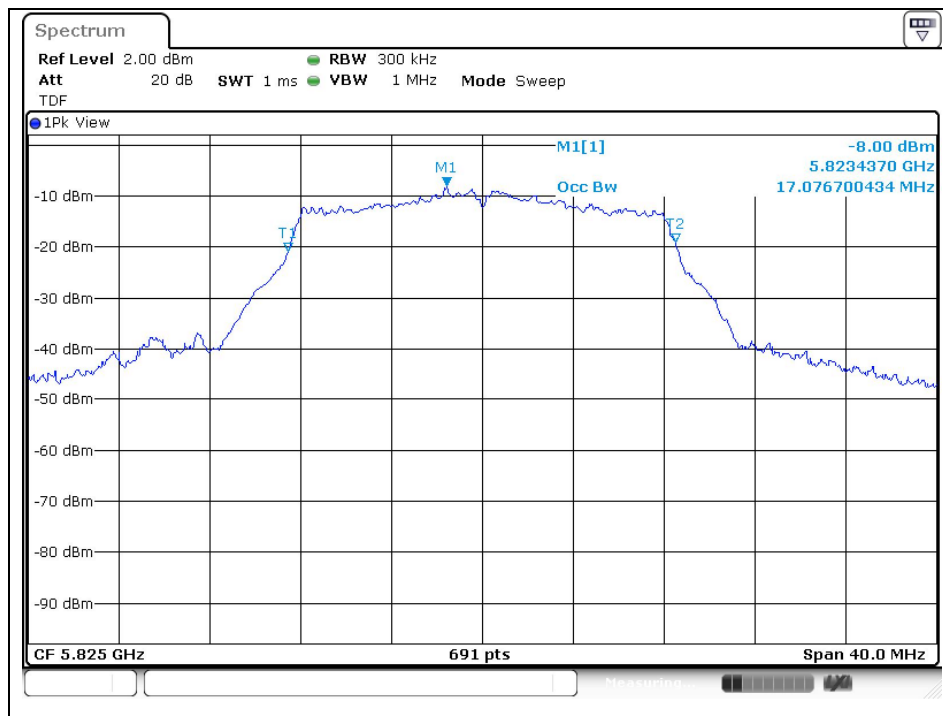
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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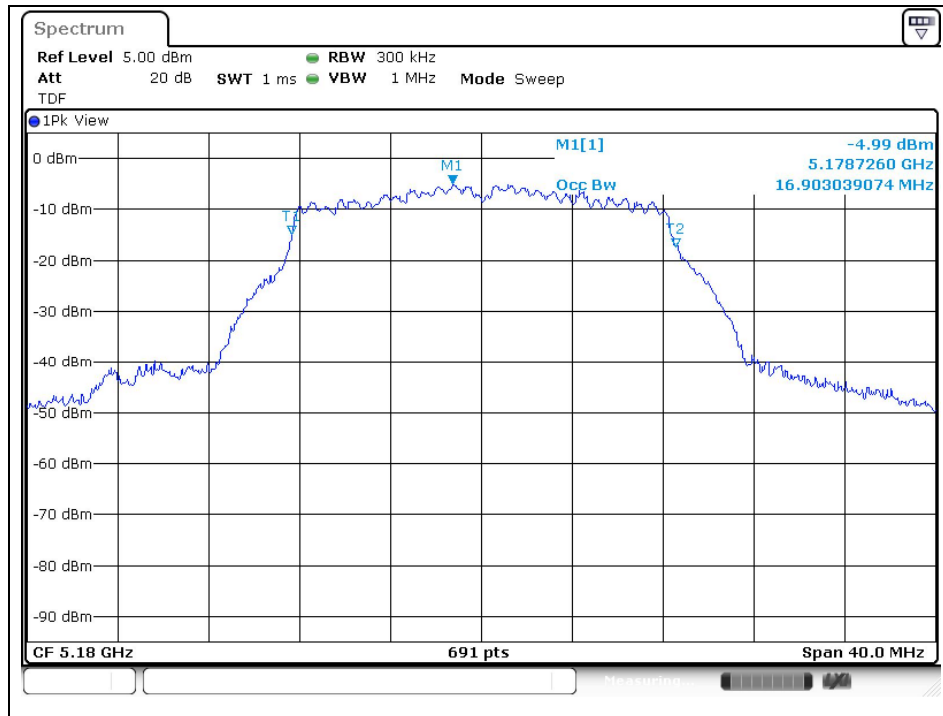
RTT5041-19(2019.04.24)(1)

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

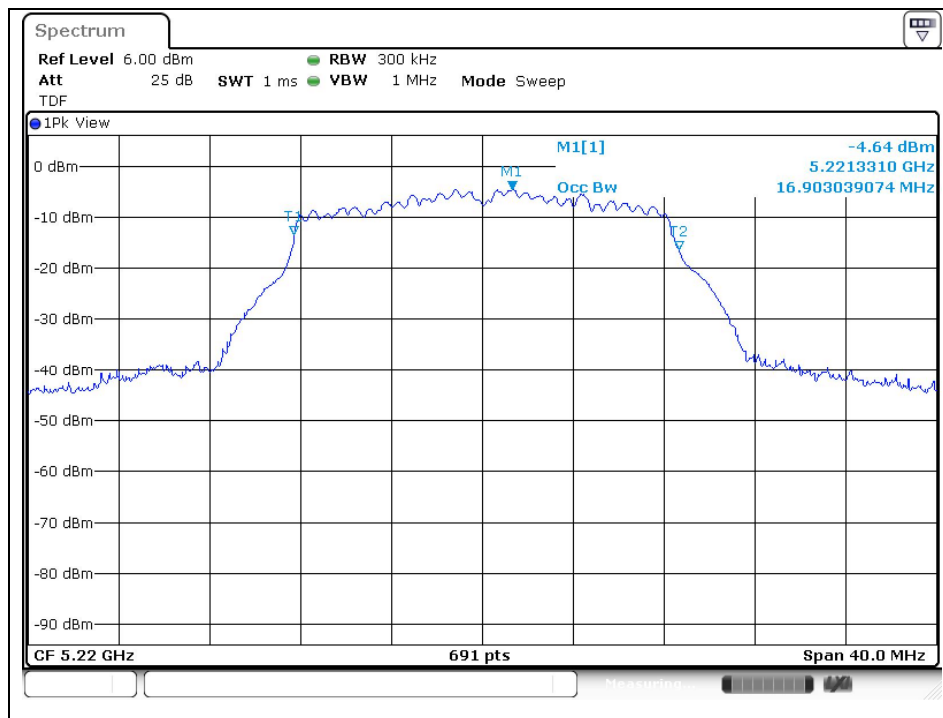
A4(210 mm x 297 mm)

802.11a (Band 1)_ANT 2

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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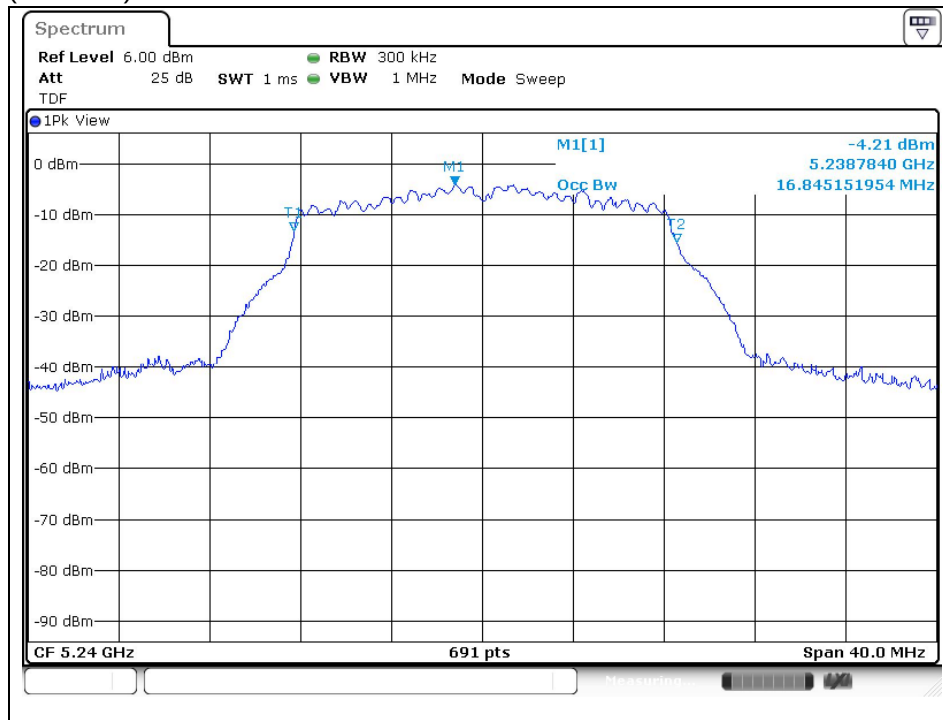
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

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

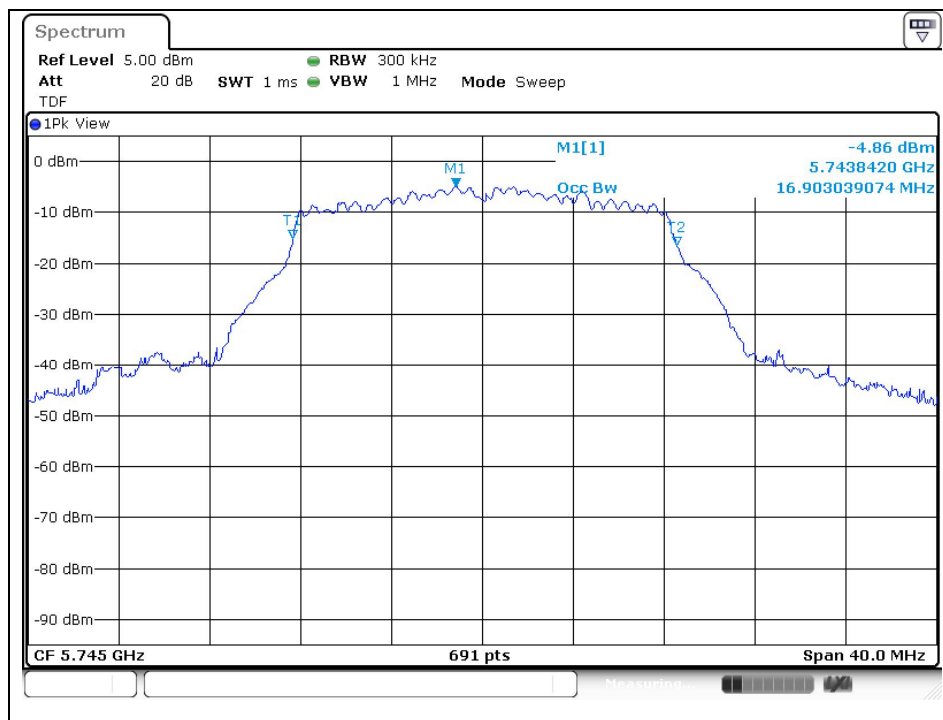
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



802.11a (Band 3)_ANT 2

Low Channel (5 745 MHz)



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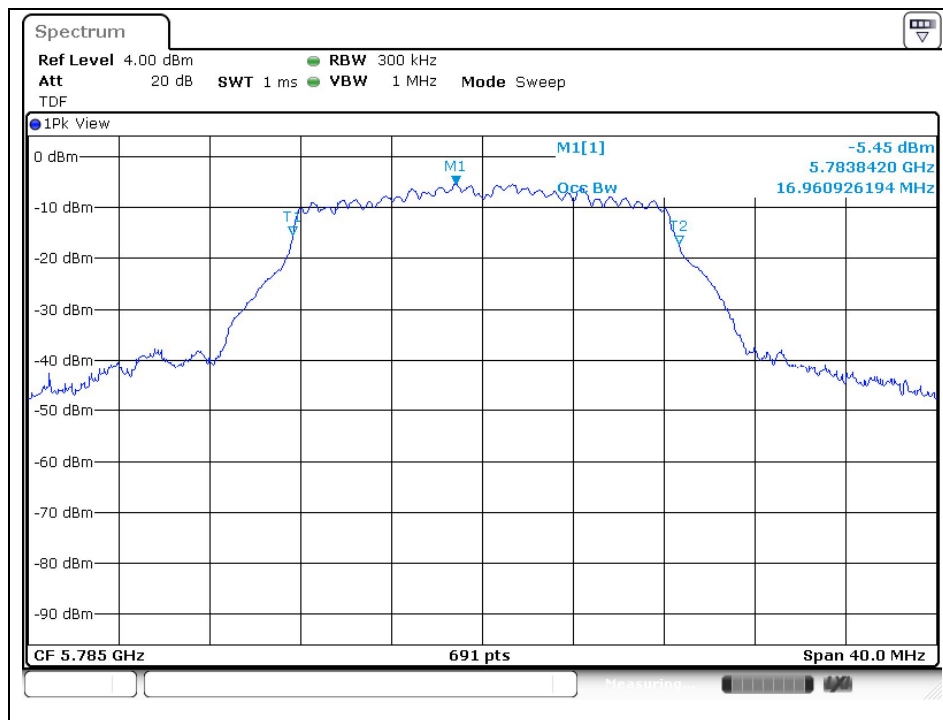
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

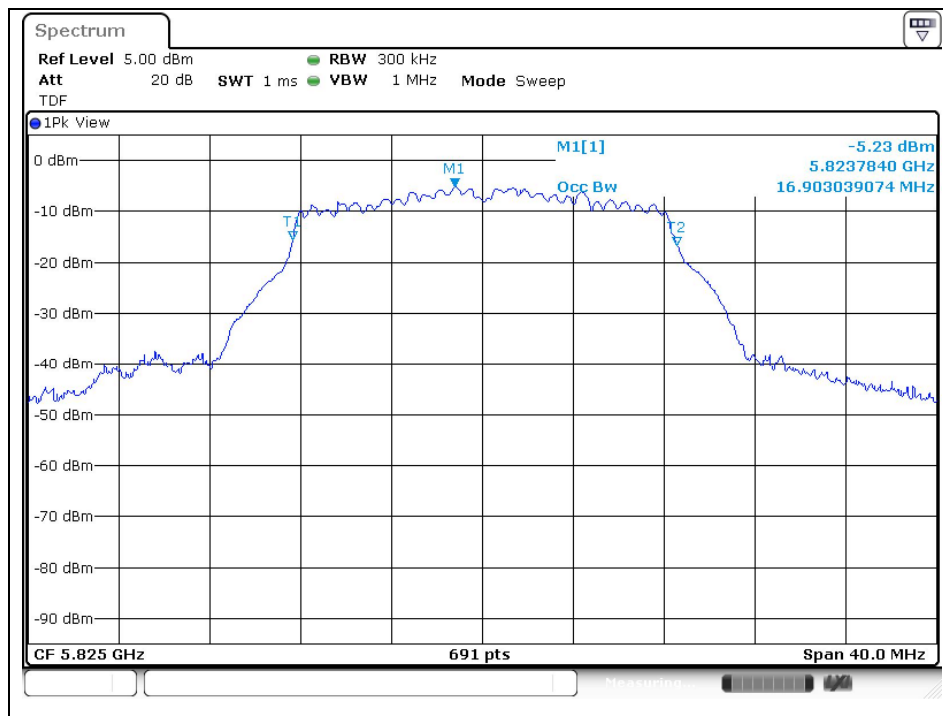
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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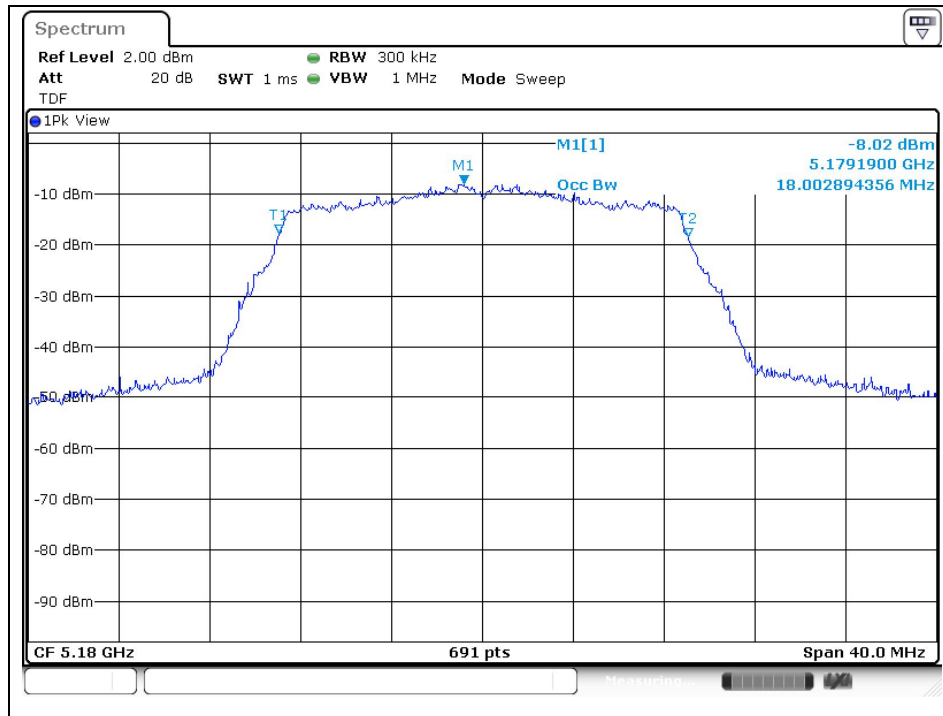
RTT5041-19(2019.04.24)(1)

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

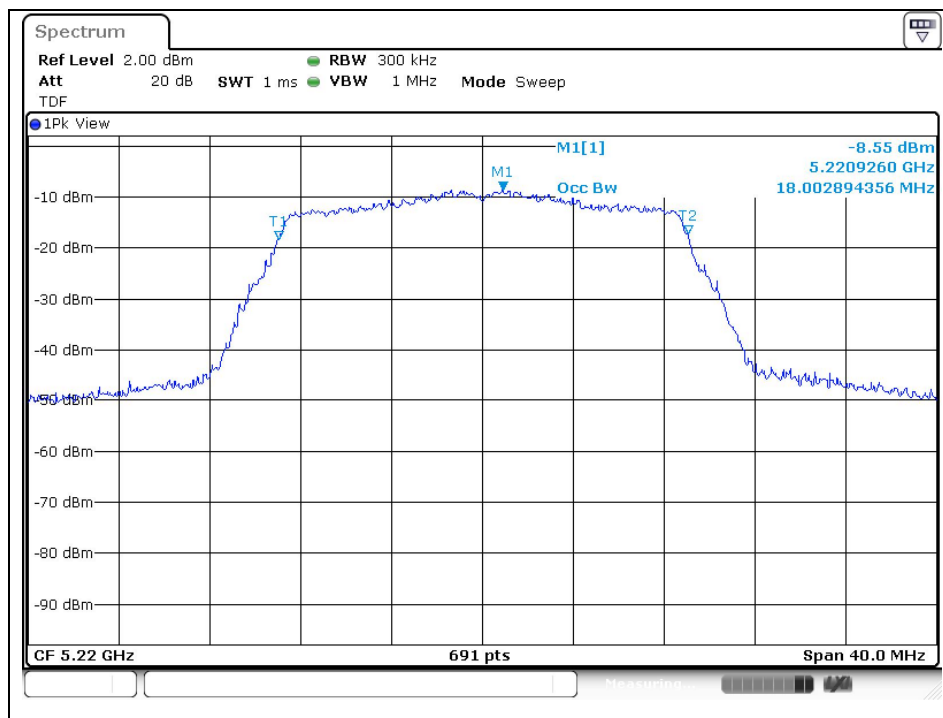
A4(210 mm x 297 mm)

802.11n_HT20 (Band 1)_ANT 1

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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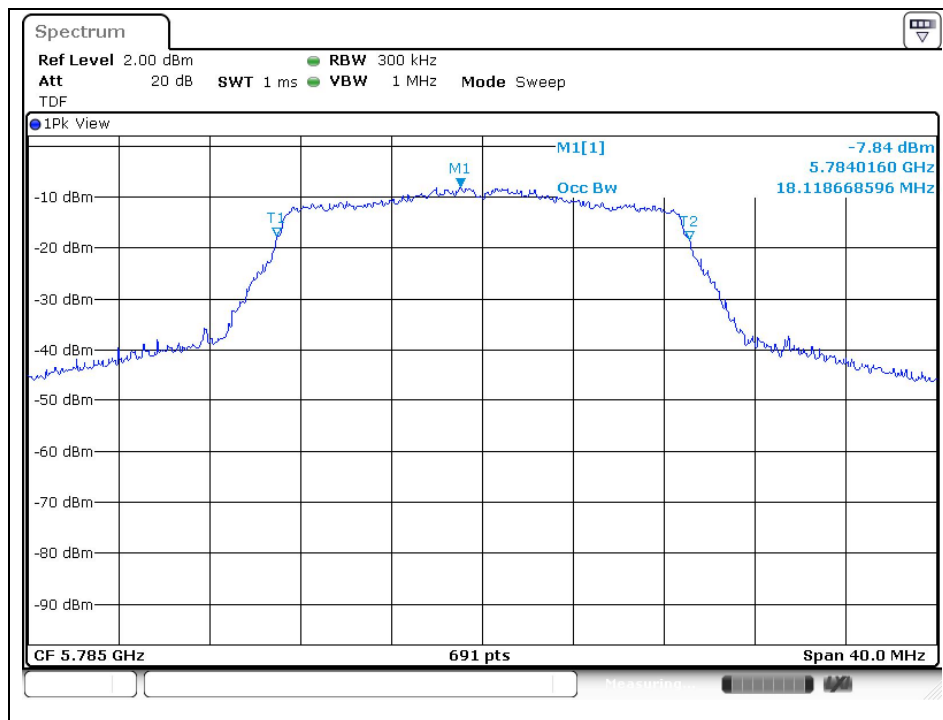
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

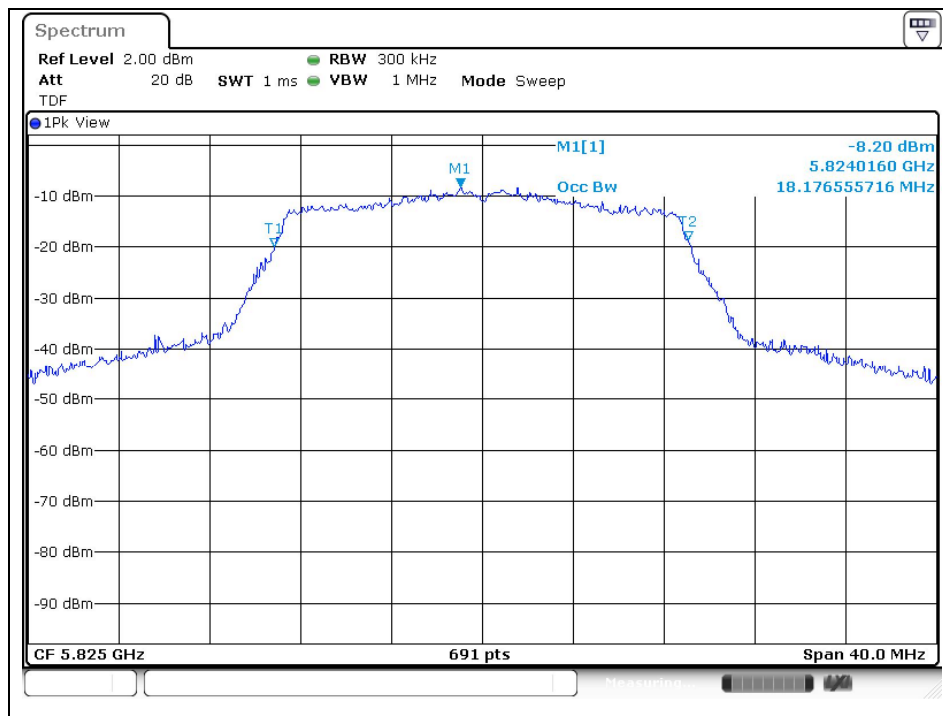
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



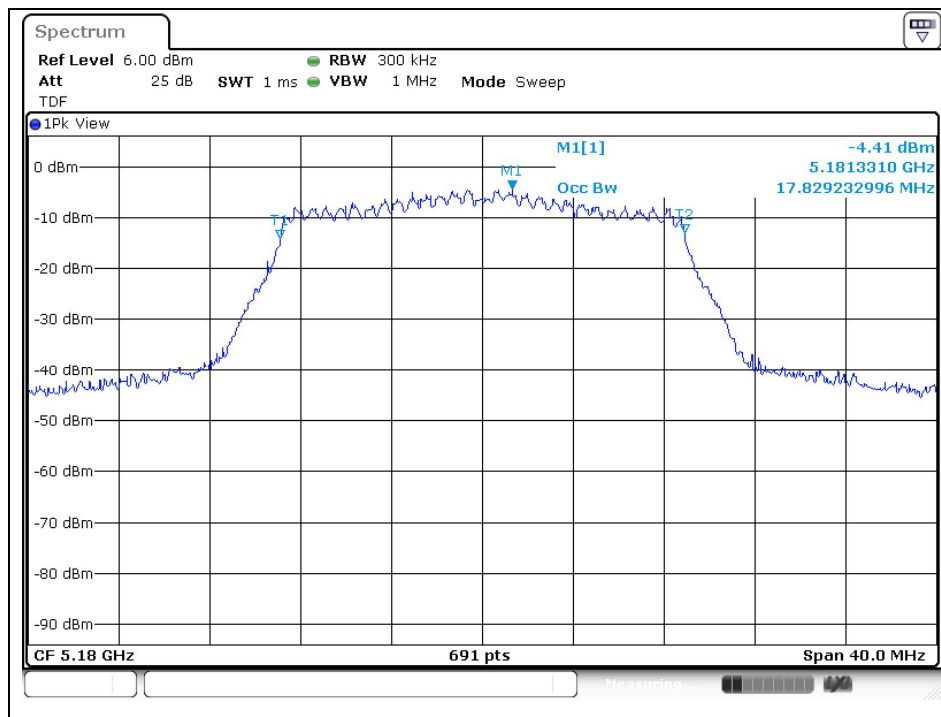
High Channel (5 825 MHz)



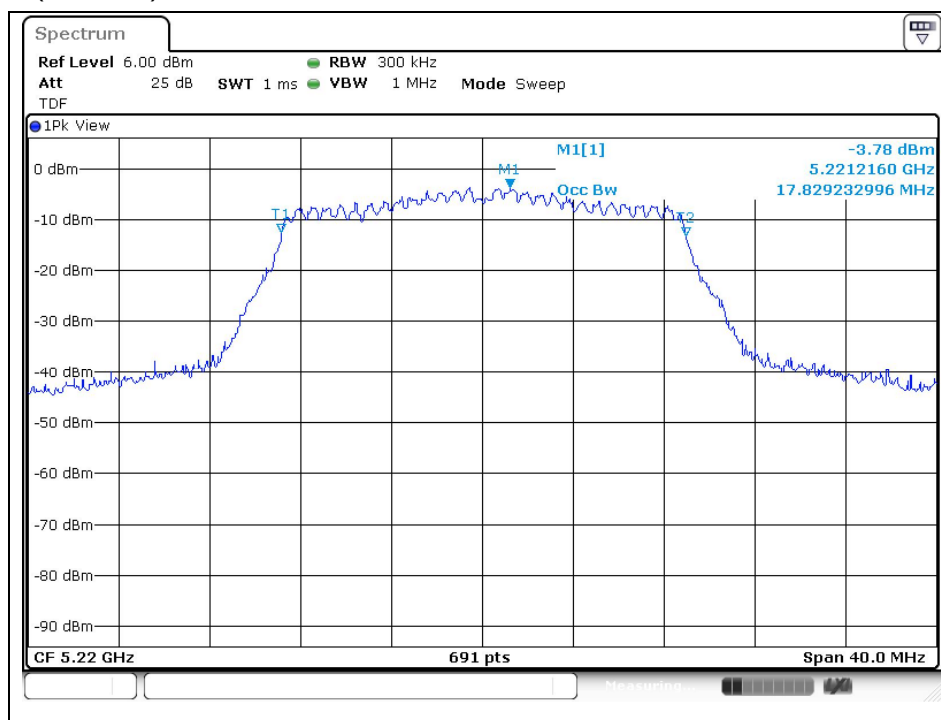
The results of this test report are effective only to the items tested. The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

802.11n_HT20 (Band 1)_ANT 2

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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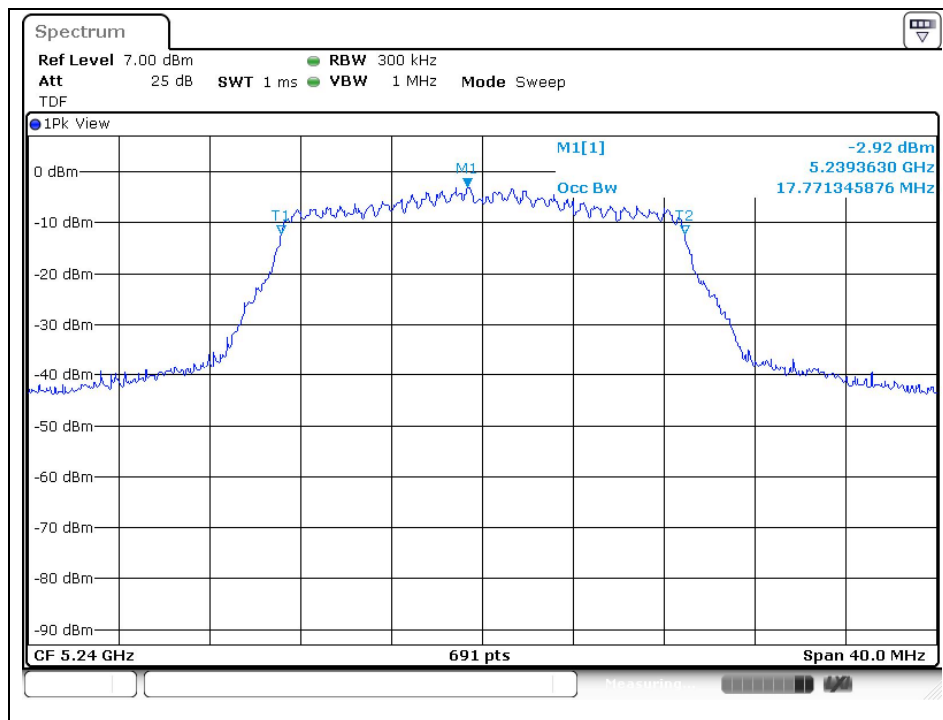
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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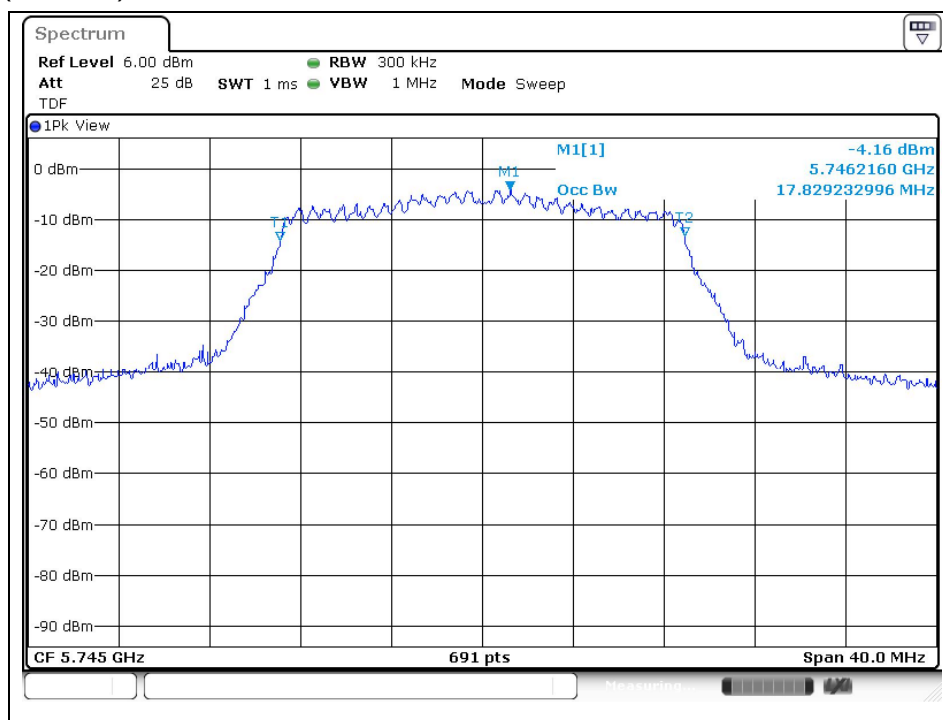
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



802.11n_HT20 (Band 3)_ANT 2

Low Channel (5 745 MHz)



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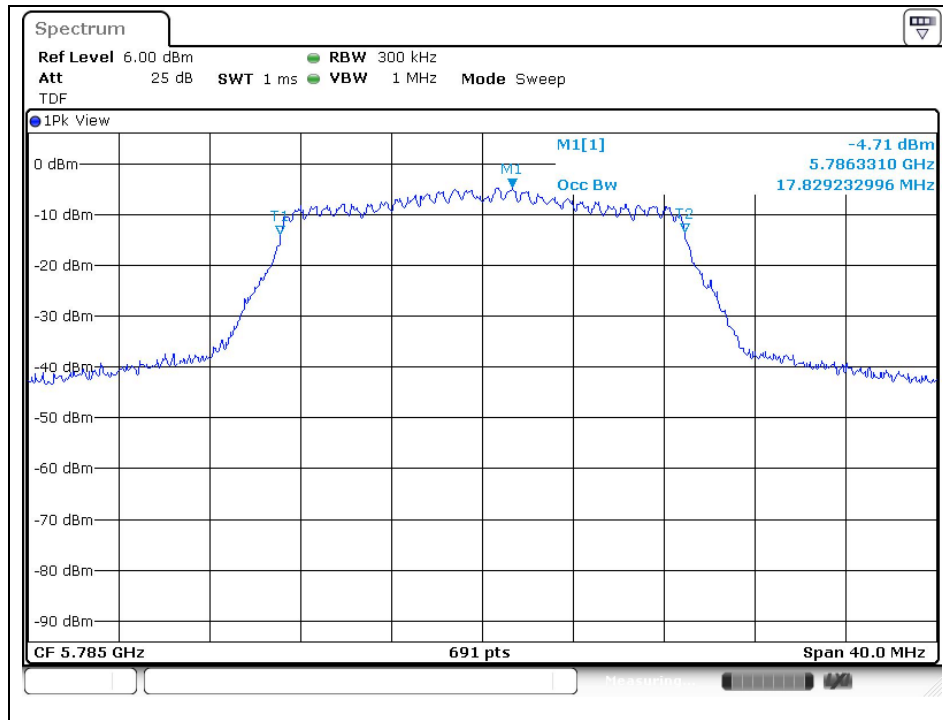
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

RTT5041-19(2019.04.24)(1)

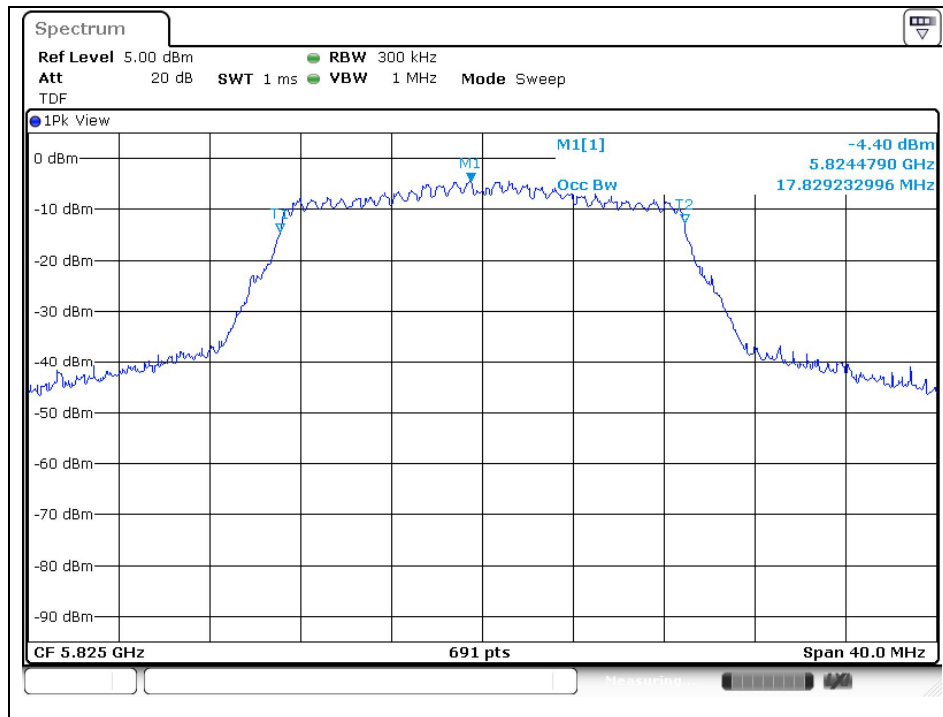
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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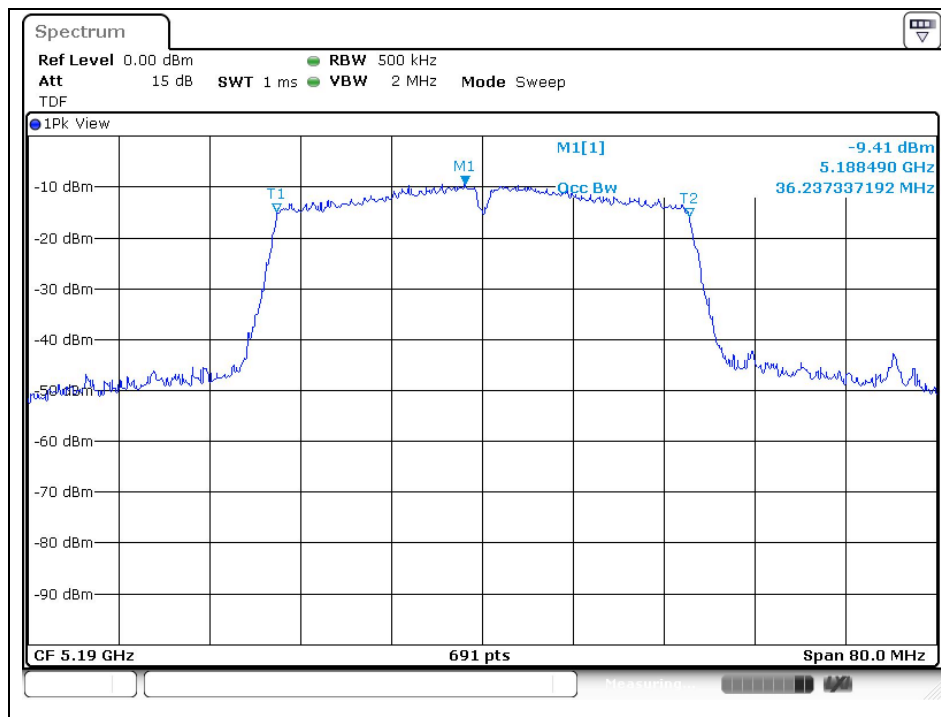
RTT5041-19(2019.04.24)(1)

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

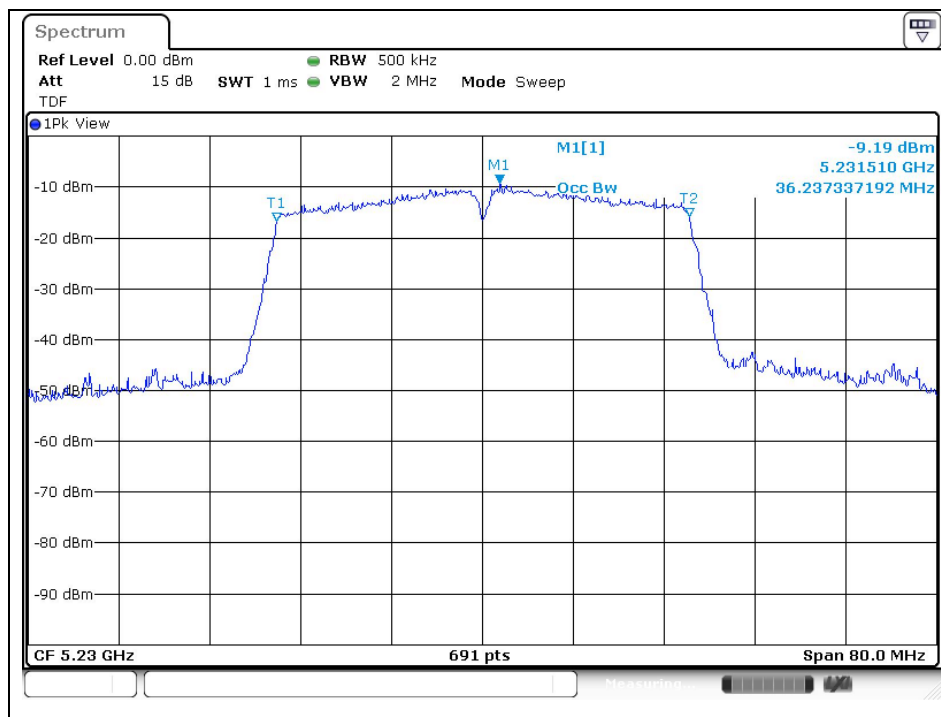
A4(210 mm x 297 mm)

802.11n_HT40 (Band 1)_ANT 1

Low Channel (5 190 MHz)



High Channel (5 230 MHz)



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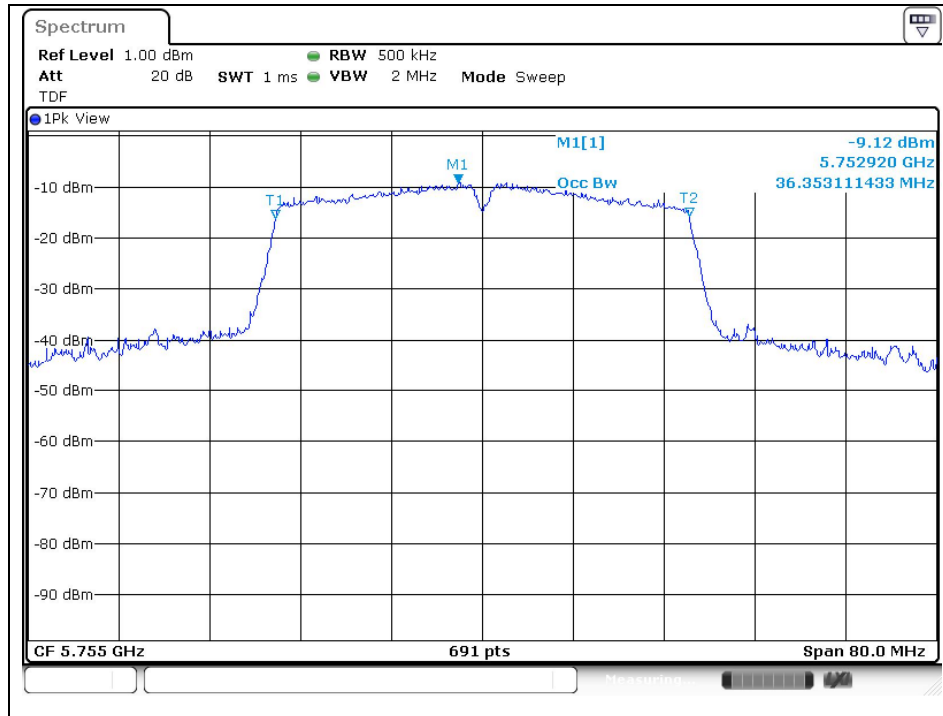
RTT5041-19(2019.04.24)(1)

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

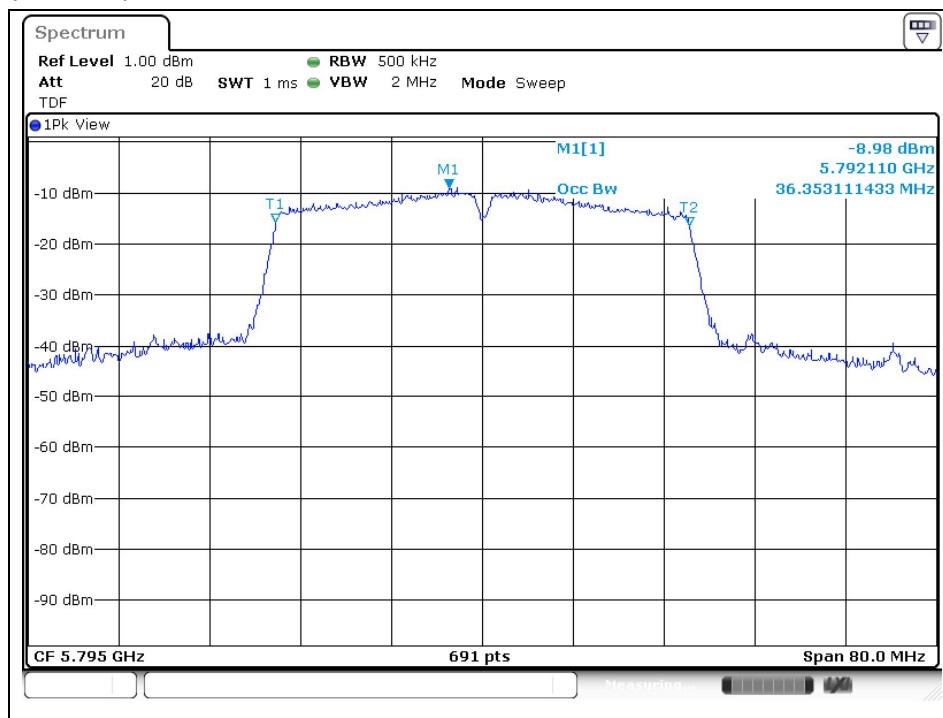
A4(210 mm x 297 mm)

802.11n_HT40 (Band 3)_ANT 1

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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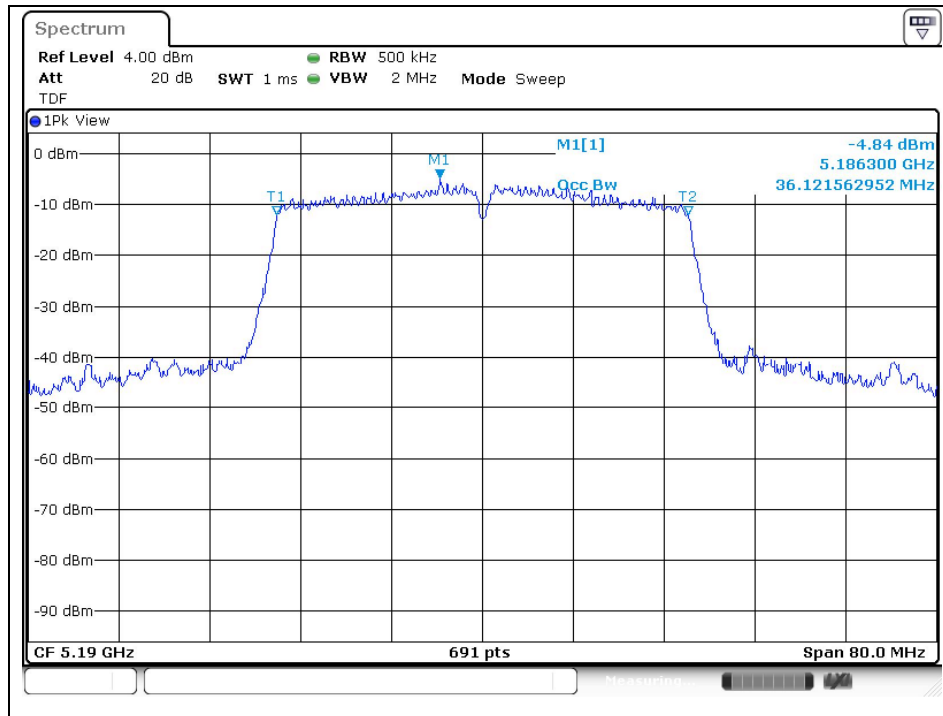
RTT5041-19(2019.04.24)(1)

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

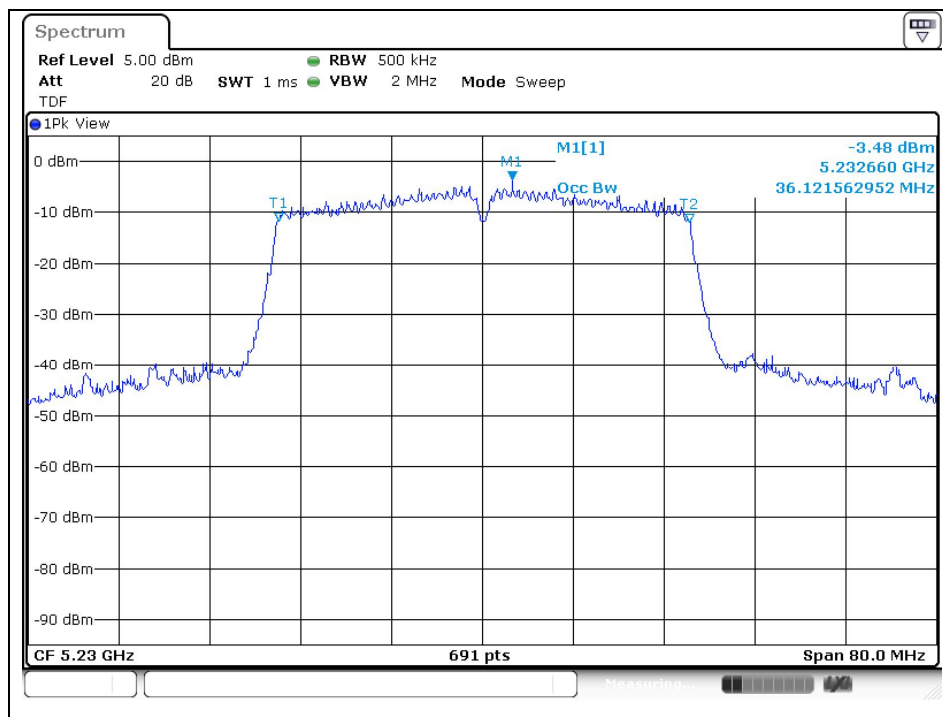
A4(210 mm x 297 mm)

802.11n_HT40 (Band 1)_ANT 2

Low Channel (5 190 MHz)



High Channel (5 230 MHz)



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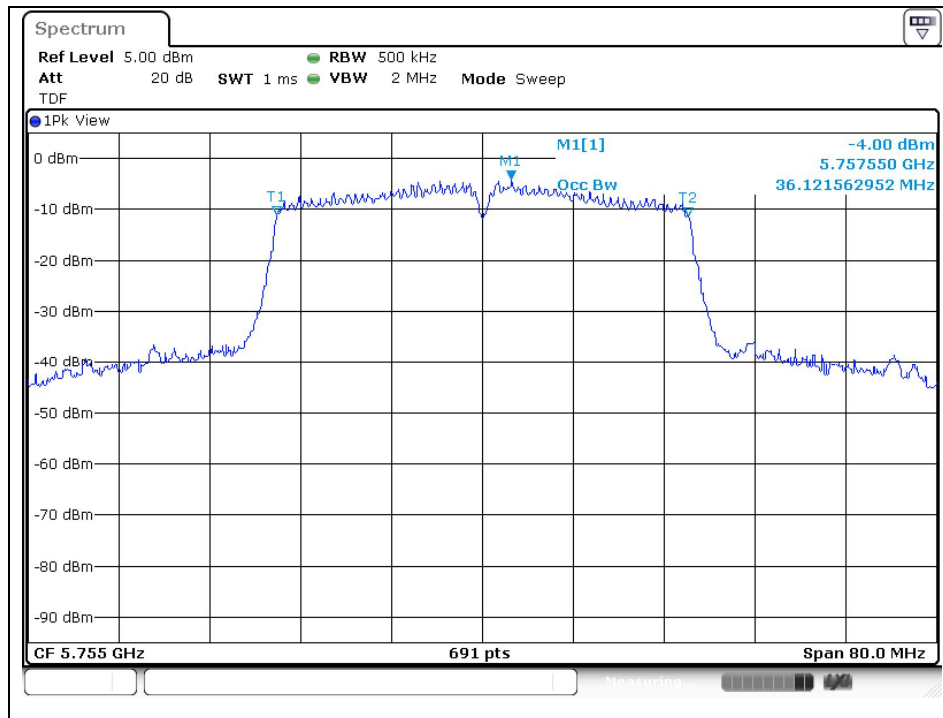
RTT5041-19(2019.04.24)(1)

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

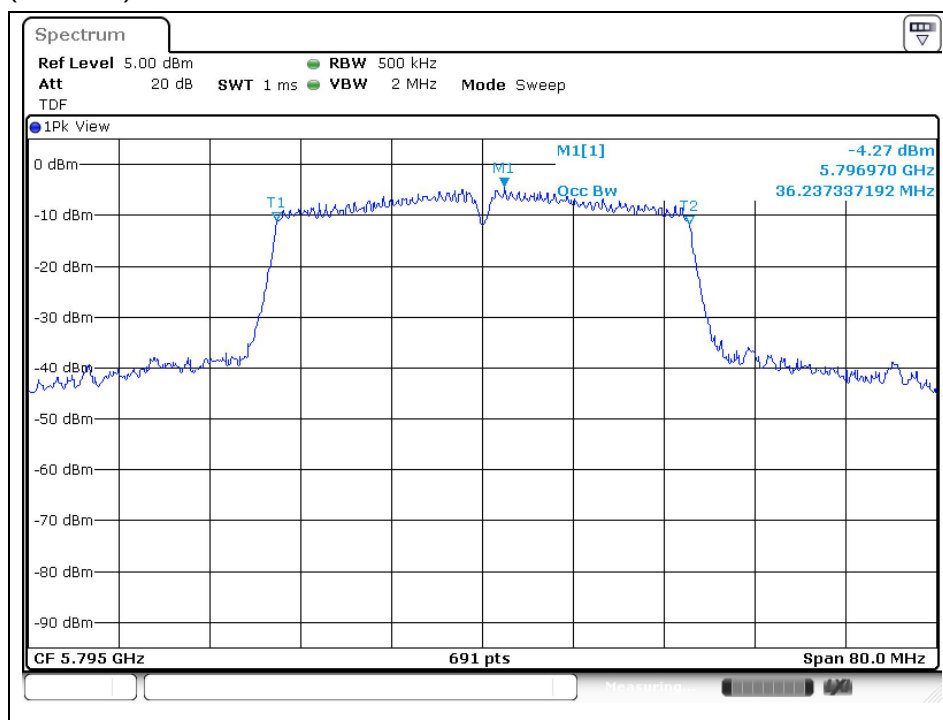
A4(210 mm x 297 mm)

802.11n_HT40 (Band 3)_ANT 2

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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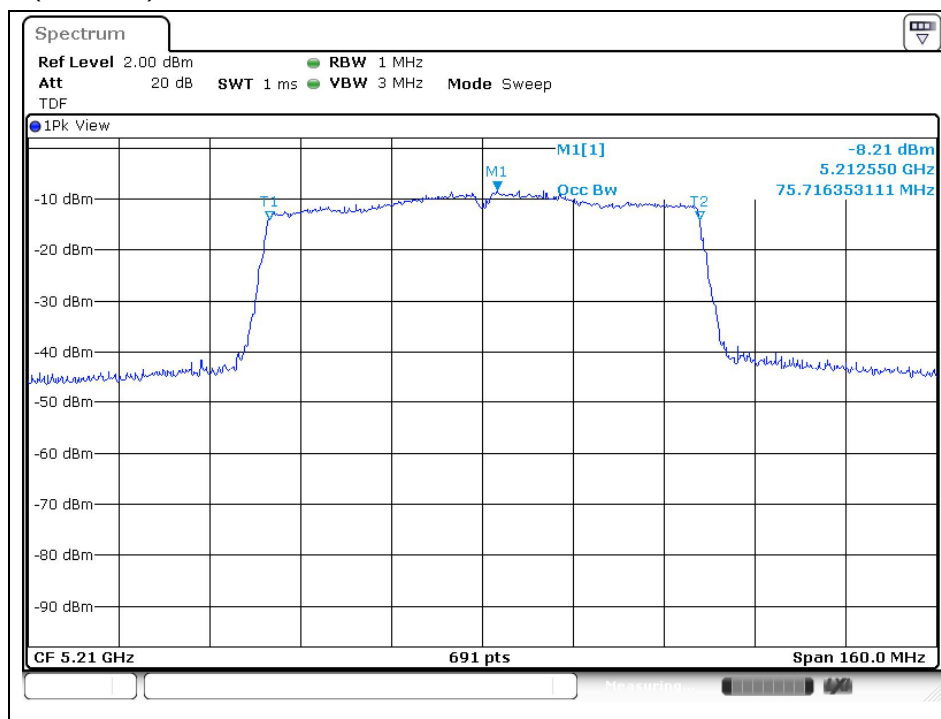
RTT5041-19(2019.04.24)(1)

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

A4(210 mm x 297 mm)

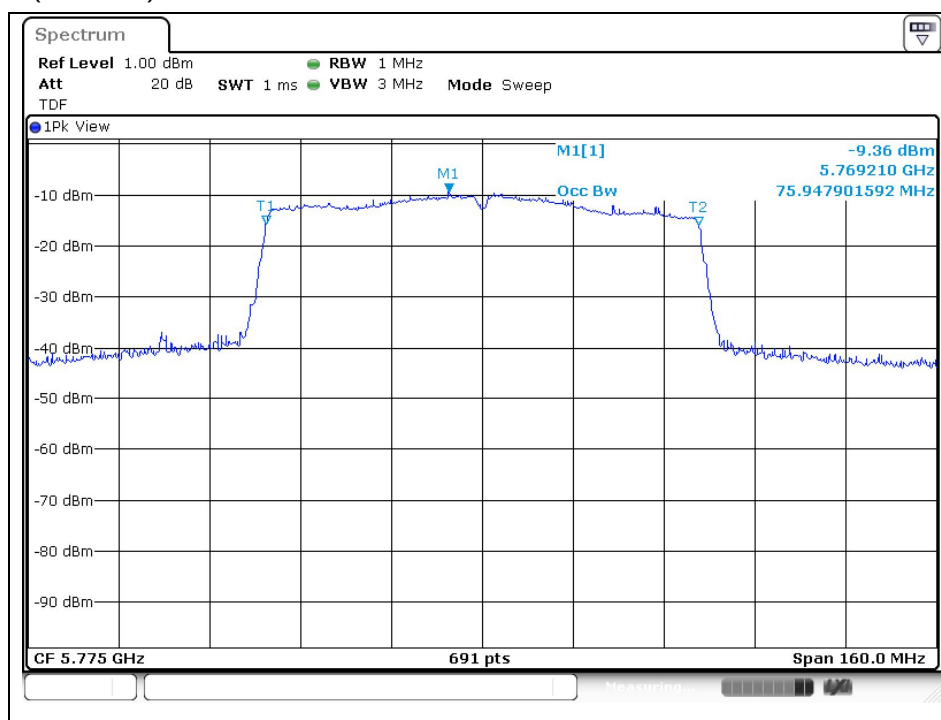
802.11ac_VHT80 (Band 1)_ANT 1

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)_ANT 1

Middle Channel (5 775 MHz)



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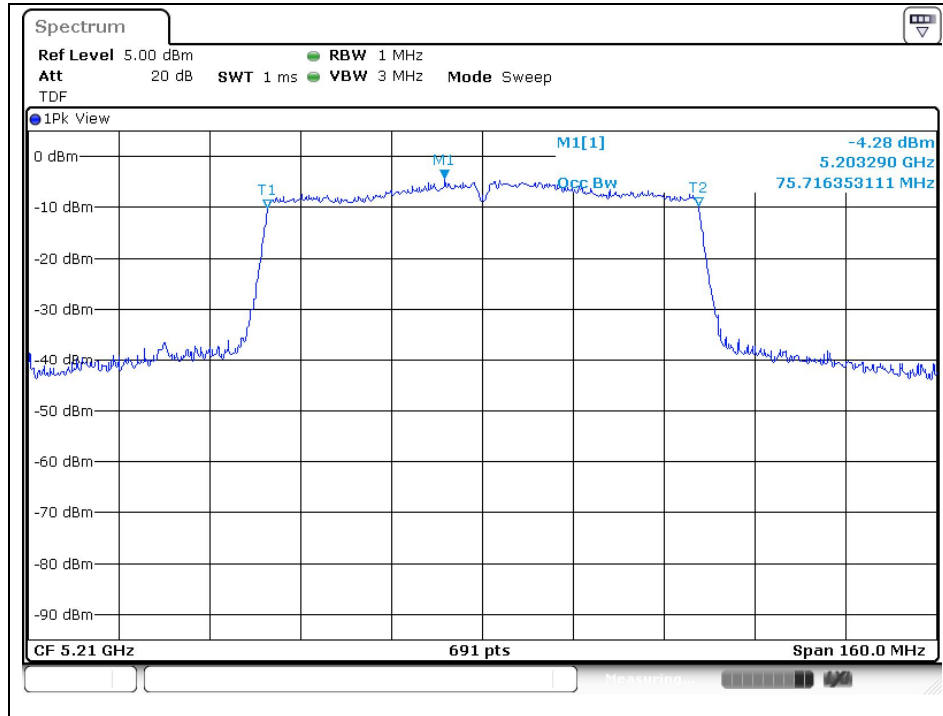
RTT5041-19(2019.04.24)(1)

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

A4(210 mm x 297 mm)

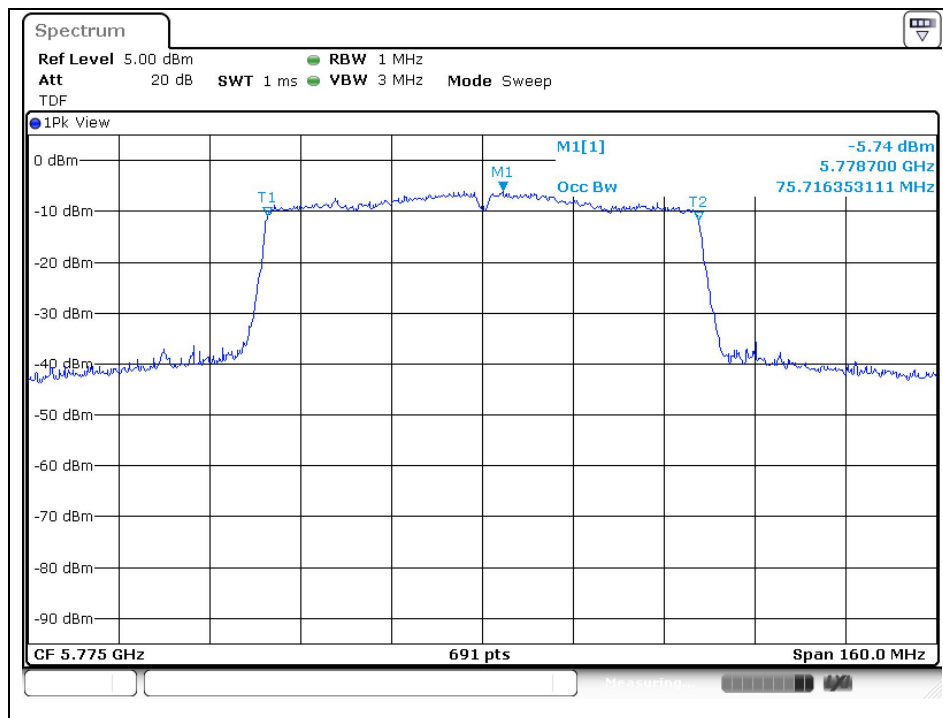
802.11ac_VHT80 (Band 1)_ANT 2

Middle Channel (5 210 MHz)



802.11ac_VHT80 (Band 3)_ANT 2

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

4.2.1. FCC

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.

4.2.2. IC

According to RSS-247 Issue 2, 6.2.4.1, the minimum -6 dB Bandwidth 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 General UNII Test Procedures New Rules 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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A4(210 mm x 297 mm)

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)
					ANT 1	ANT 2	
U-NII 3	11a	5 745	149	6	16.151	16.440	500
		5 785	157		16.151	16.382	
		5 825	165		16.382	16.440	
	11n_HT20	5 745	149	MCS0	17.366	17.250	
		5 785	157		17.366	17.656	
		5 825	165		16.556	17.656	
	11n_HT40	5 755	151	MCS0	36.006	36.006	
		5 795	159		35.658	36.353	
	11ac_VHT80	5 775	155	MCS0	75.948	75.716	

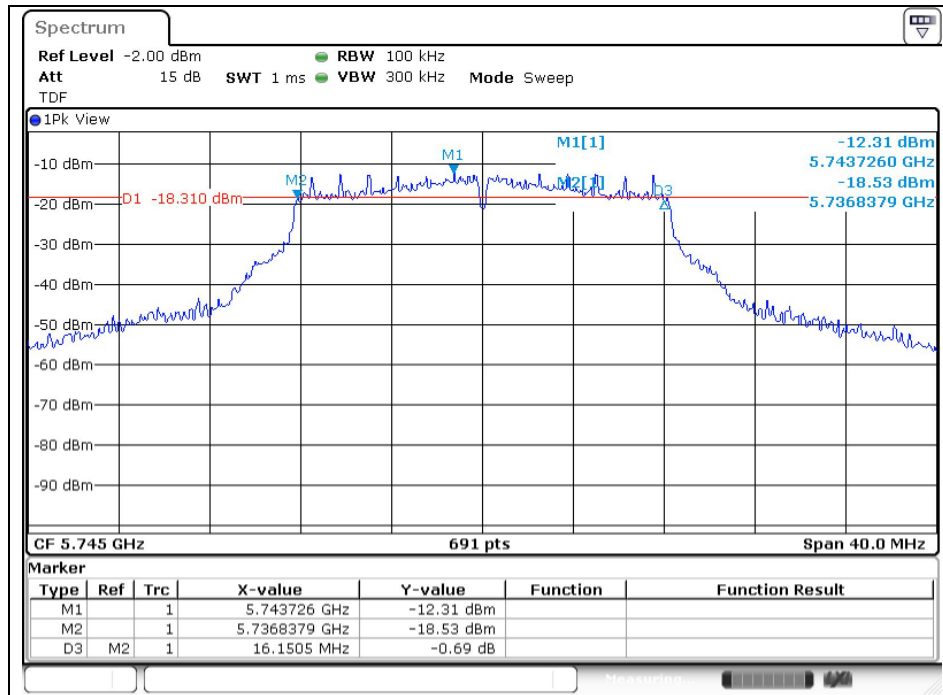
The results of this test report are effective only to the items tested. The SGS Korea is not responsible for the sampling, the results of this test report apply to the sample as received. This test report cannot be reproduced, except in full, without prior written permission of the Company. This test report does not assure KOLAS accreditation.

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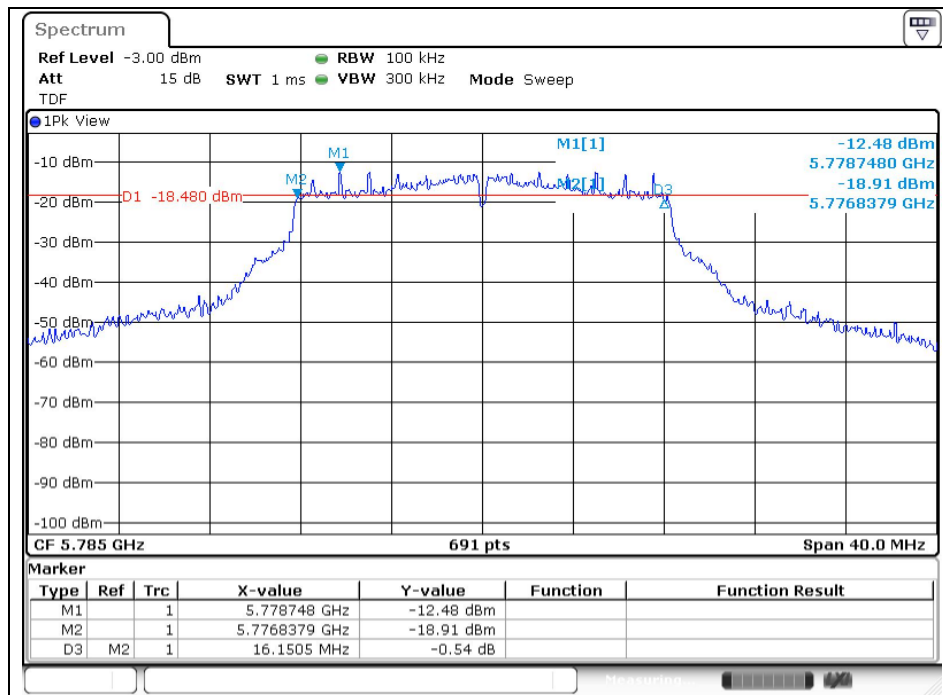
- Test plots

802.11a (Band 3)_ANT 1

Low Channel (5 745 MHz)



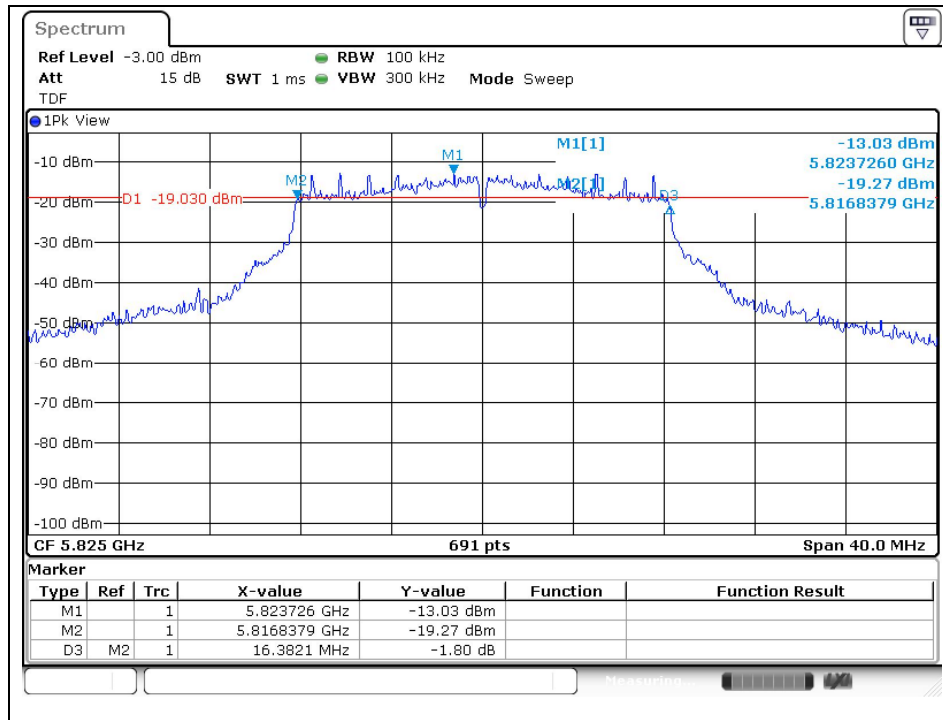
Middle Channel (5 785 MHz)



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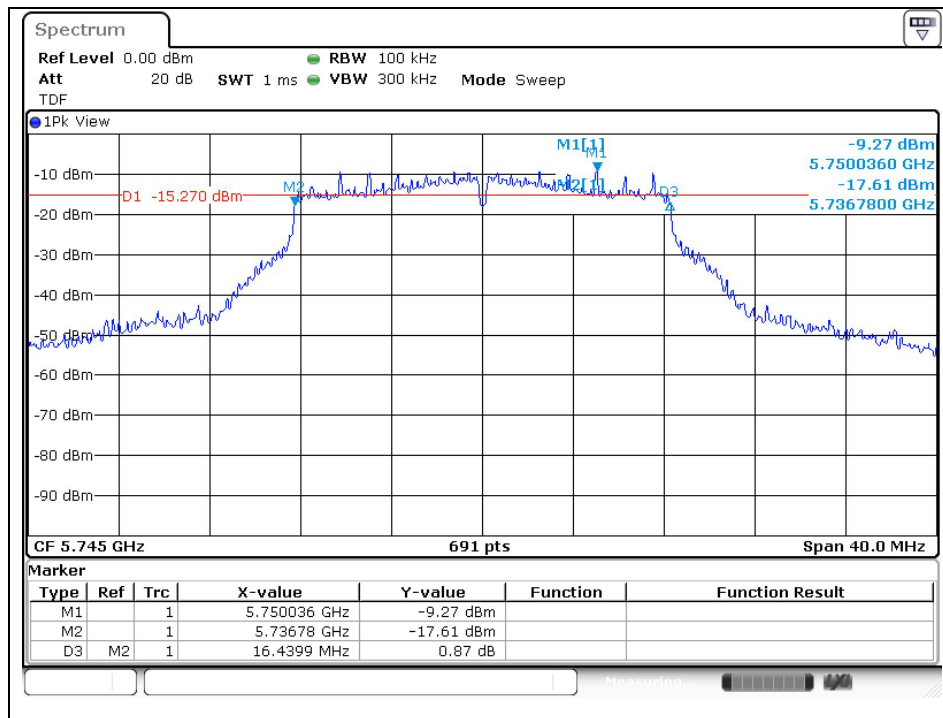
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

High Channel (5 825 MHz)



802.11a (Band 3)_ANT 2

Low Channel (5 745 MHz)



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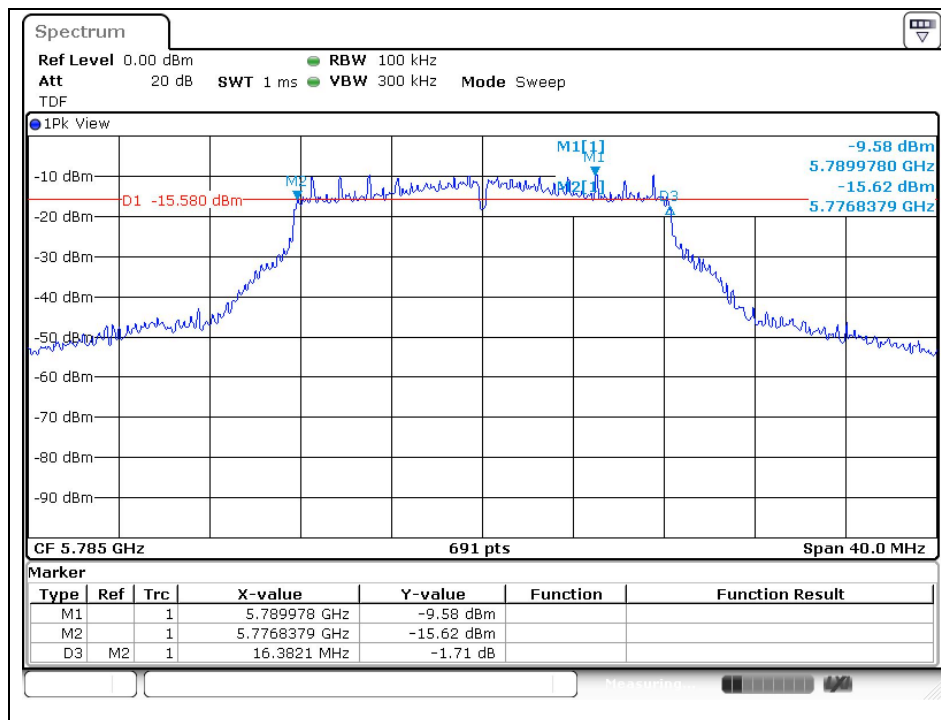
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RTT5041-19(2019.04.24)(1)

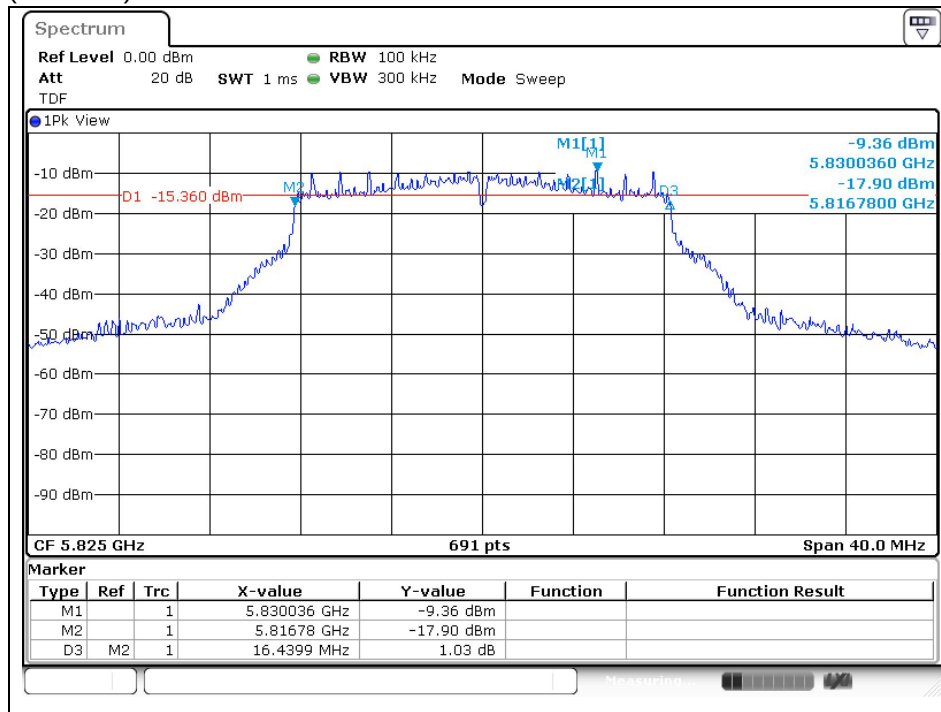
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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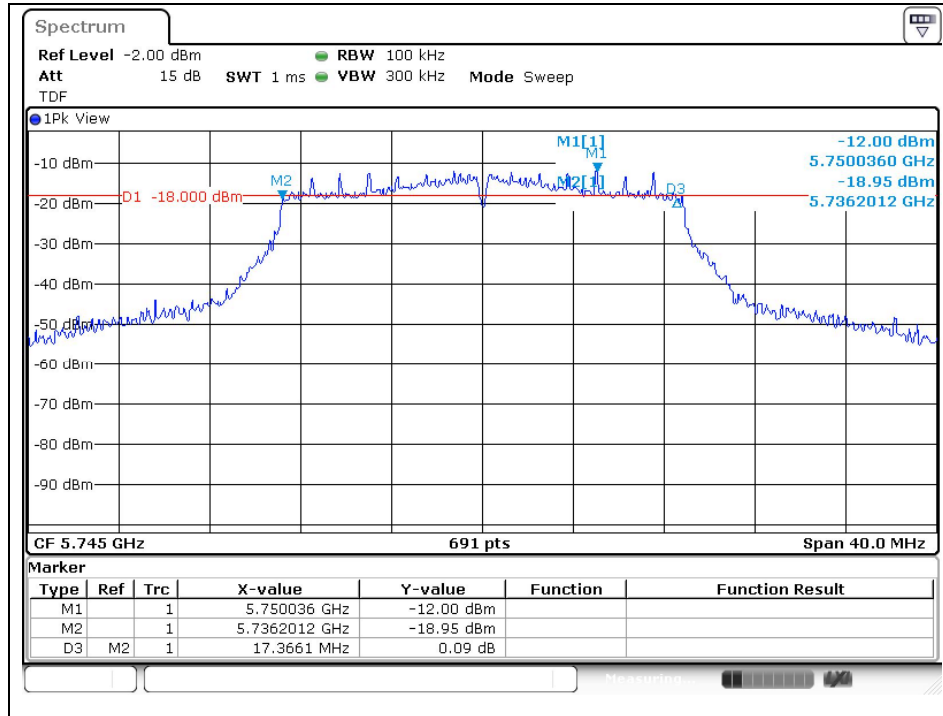
RTT5041-19(2019.04.24)(1)

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

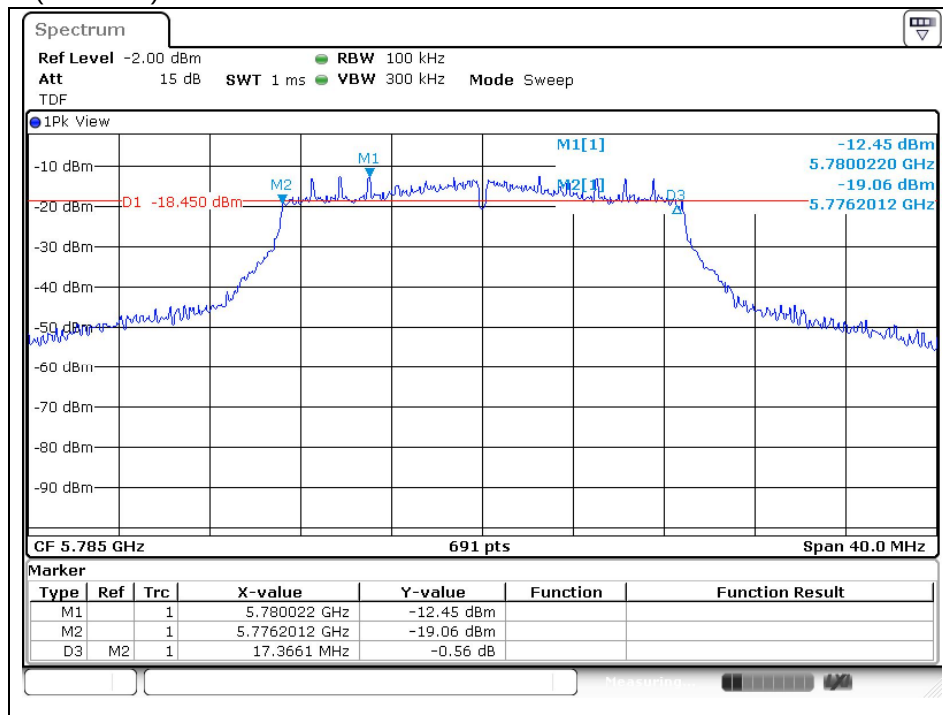
A4(210 mm x 297 mm)

802.11n_HT20 (Band 3)_ANT 1

Low Channel (5 745 MHz)



Middle Channel (5 785 MHz)



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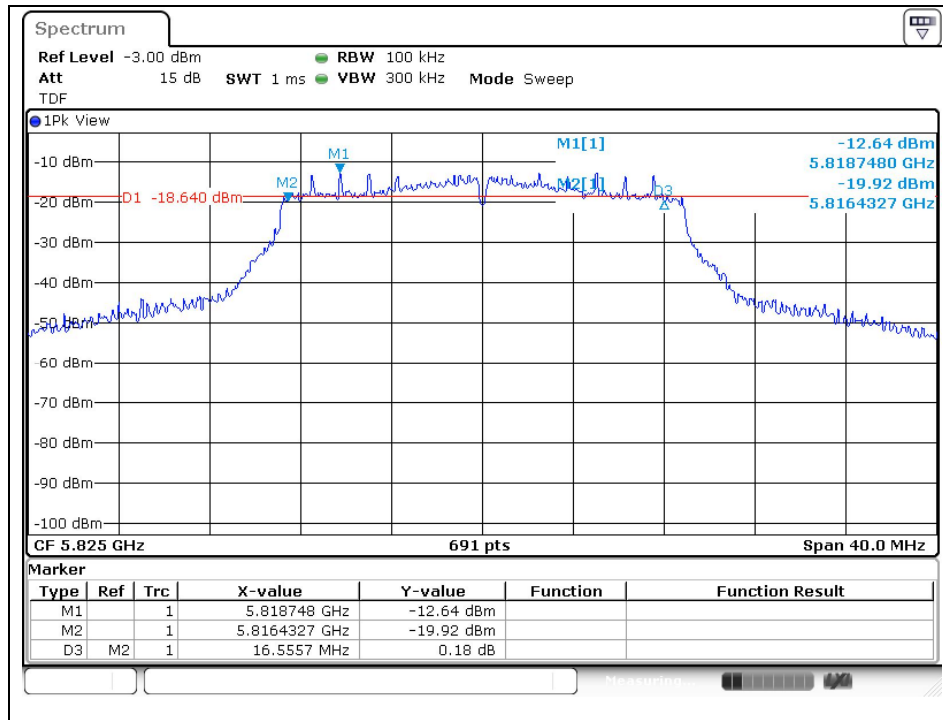
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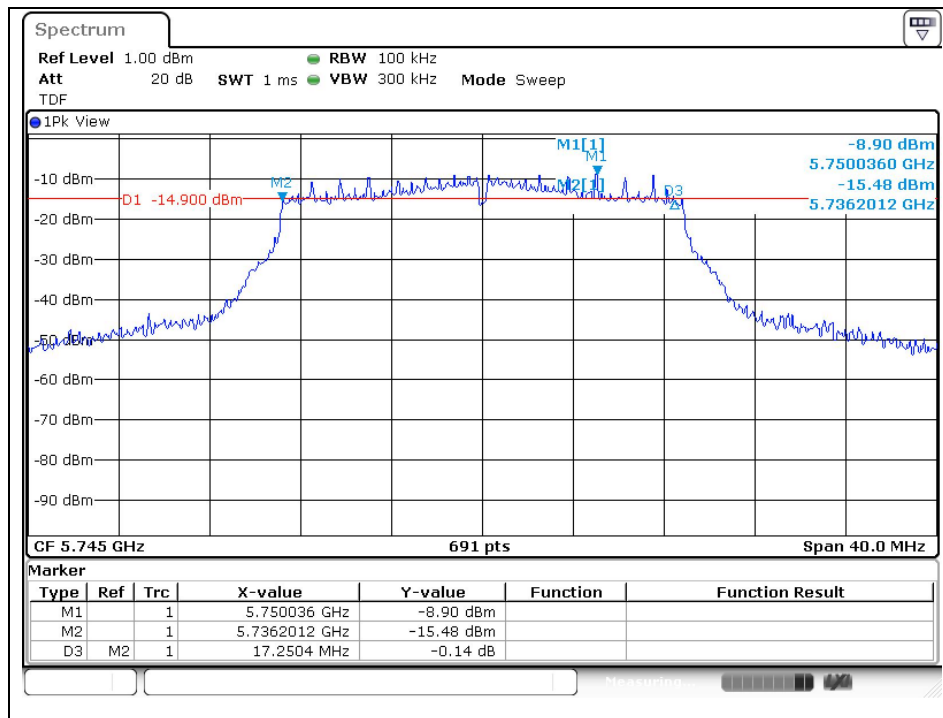
A4(210 mm x 297 mm)

High Channel (5 825 MHz)



802.11n_HT20 (Band 3)_ANT 2

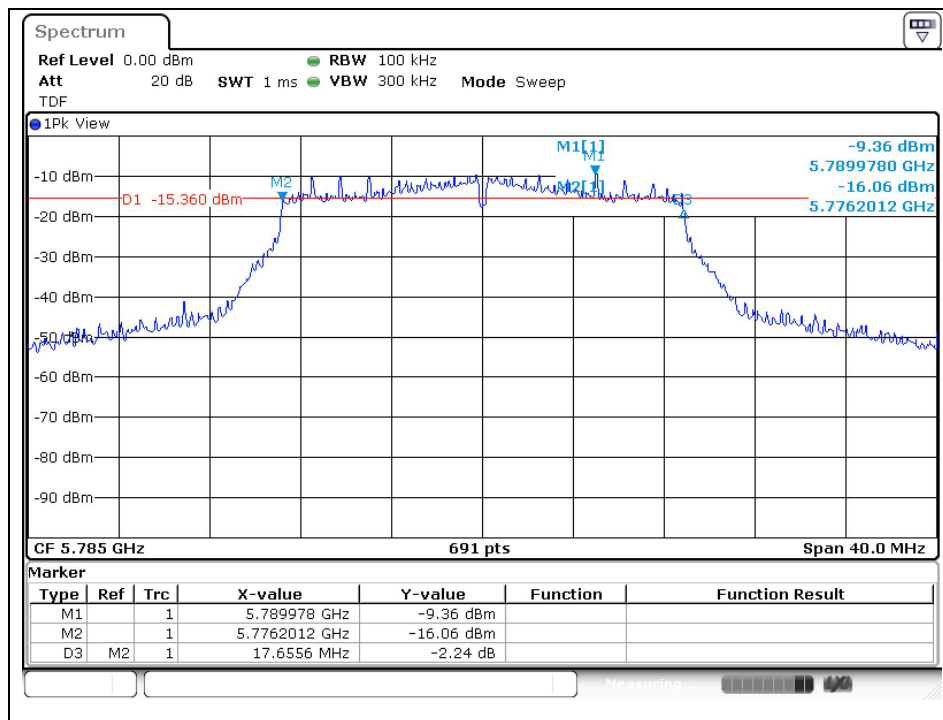
Low Channel (5 745 MHz)



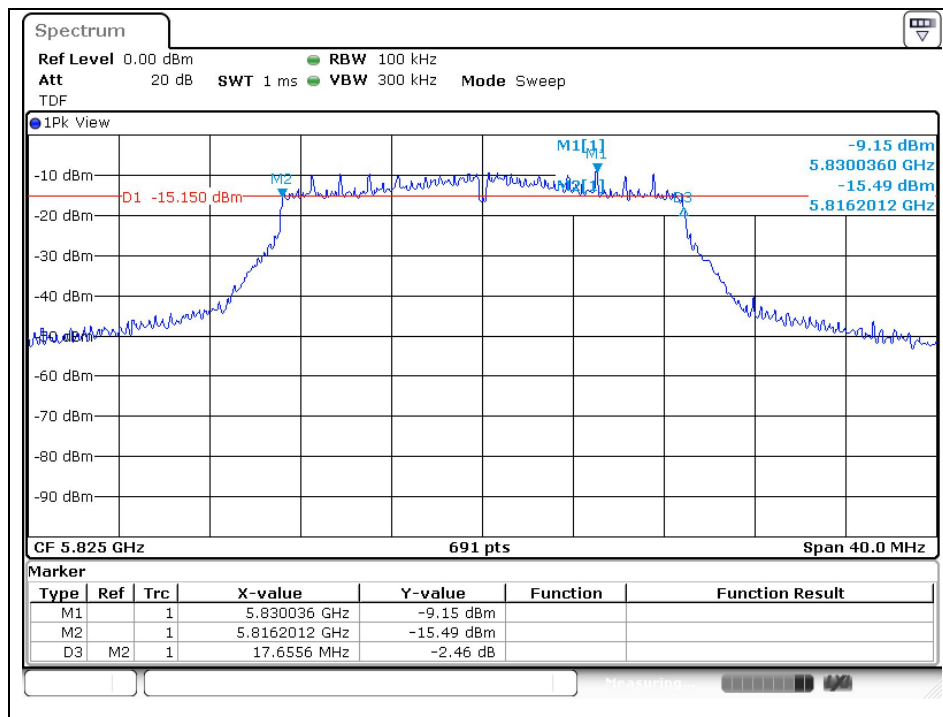
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Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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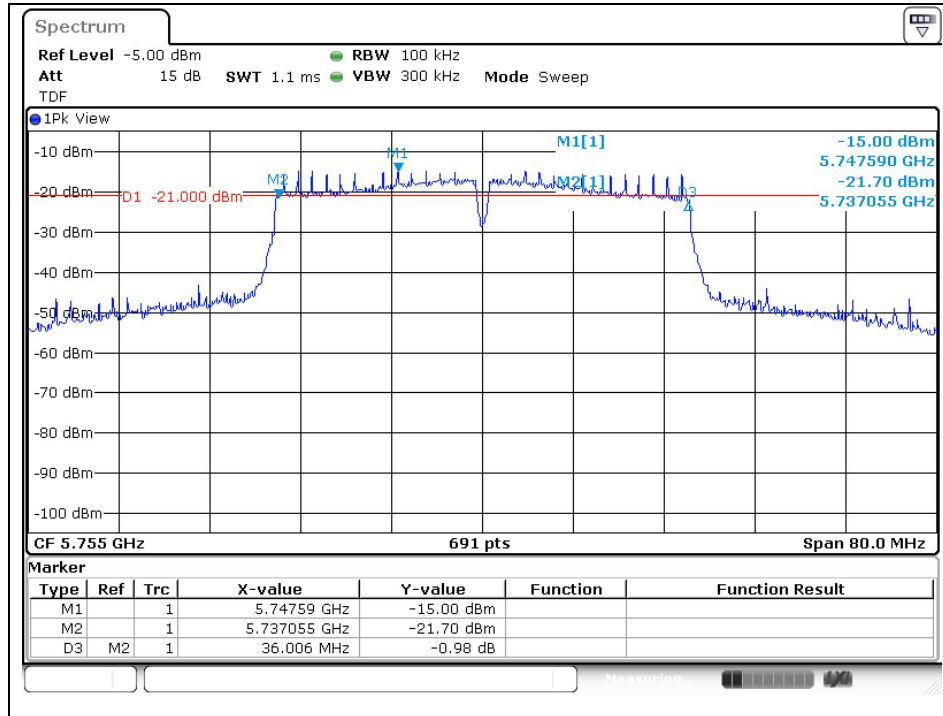
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Tel. +82 31 428 5700 / Fax. +82 31 427 2370

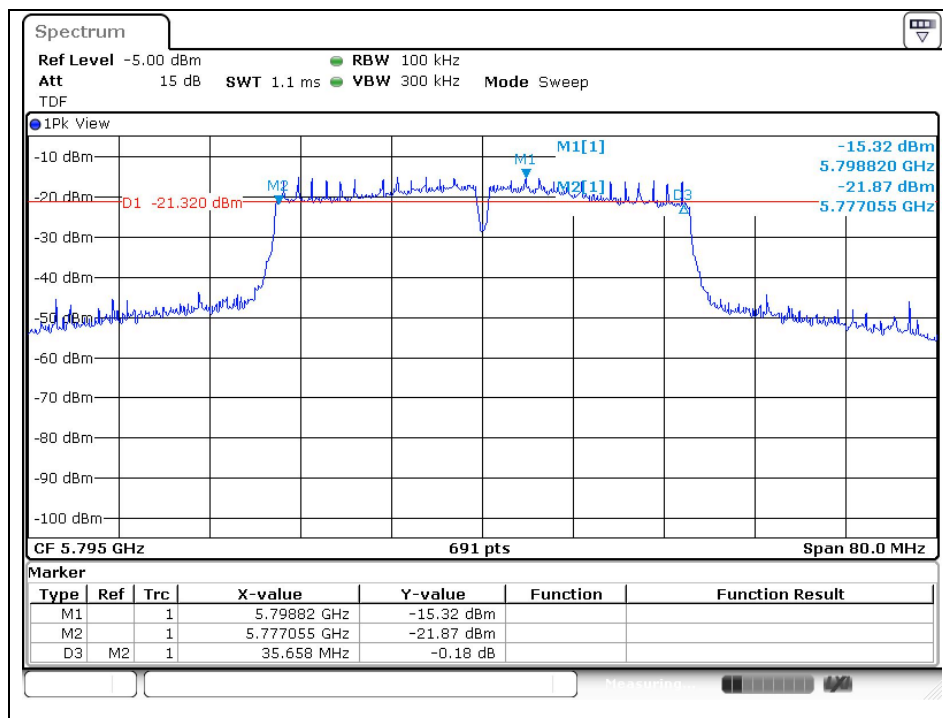
A4(210 mm x 297 mm)

802.11n_HT40 (Band 3)_ANT 1

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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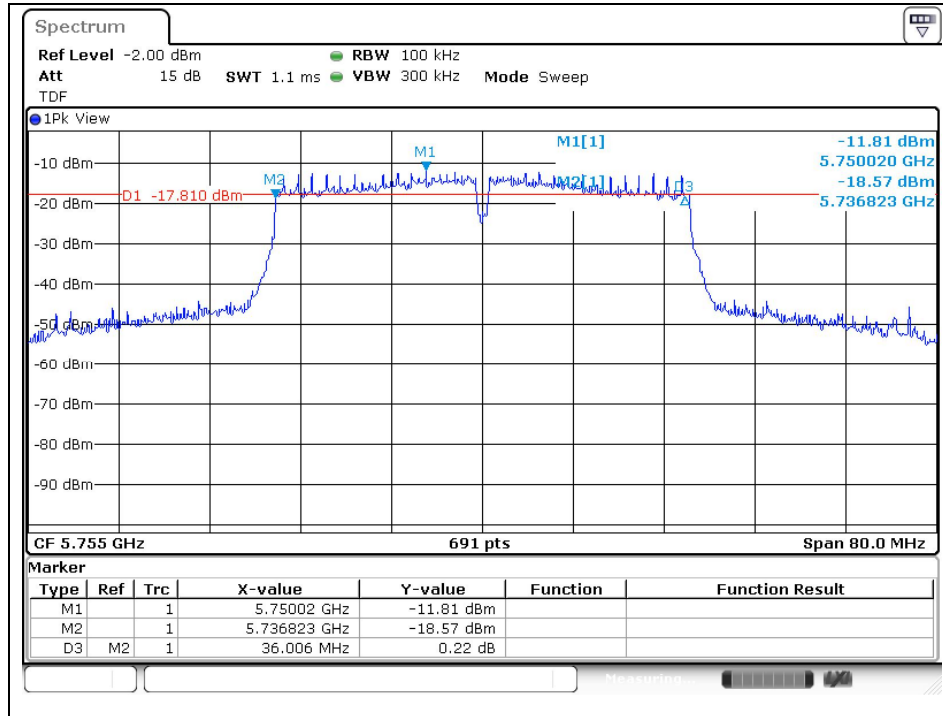
RTT5041-19(2019.04.24)(1)

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

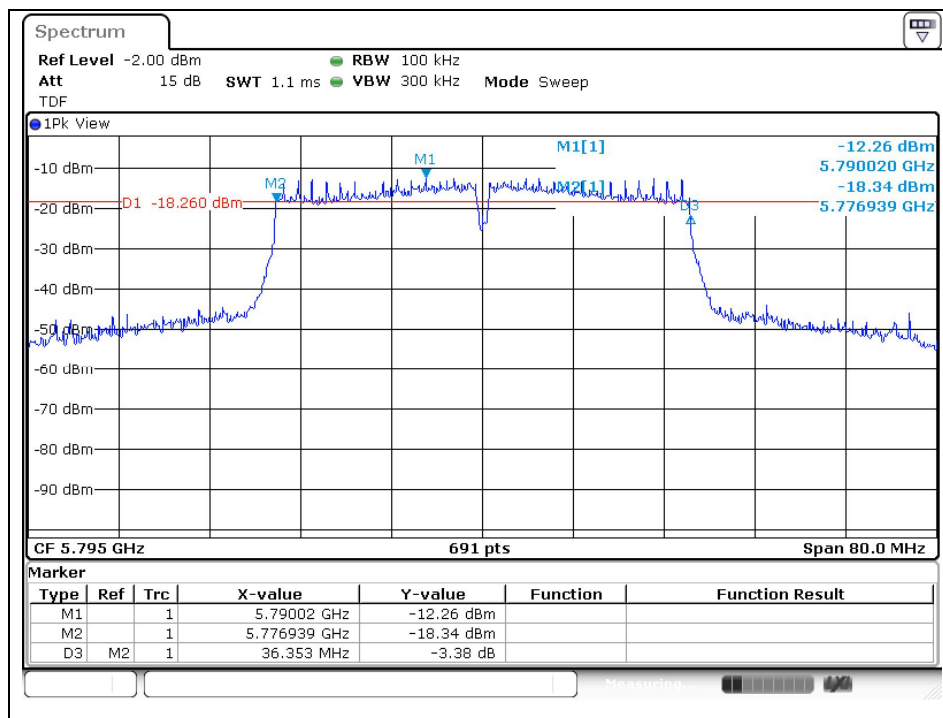
A4(210 mm x 297 mm)

802.11n_HT40 (Band 3)_ANT 2

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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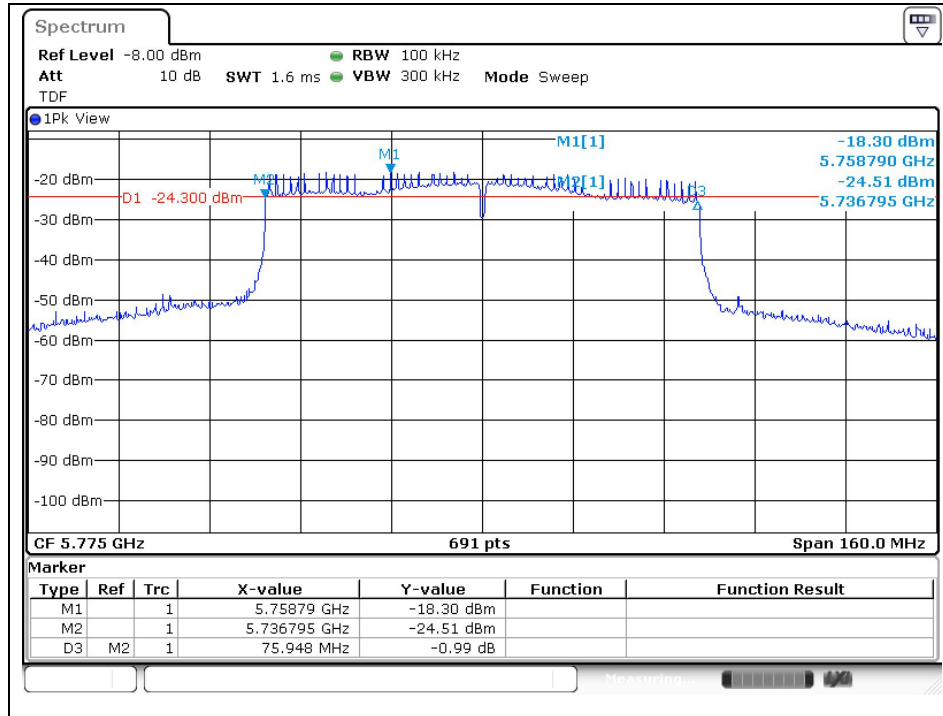
RTT5041-19(2019.04.24)(1)

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

A4(210 mm x 297 mm)

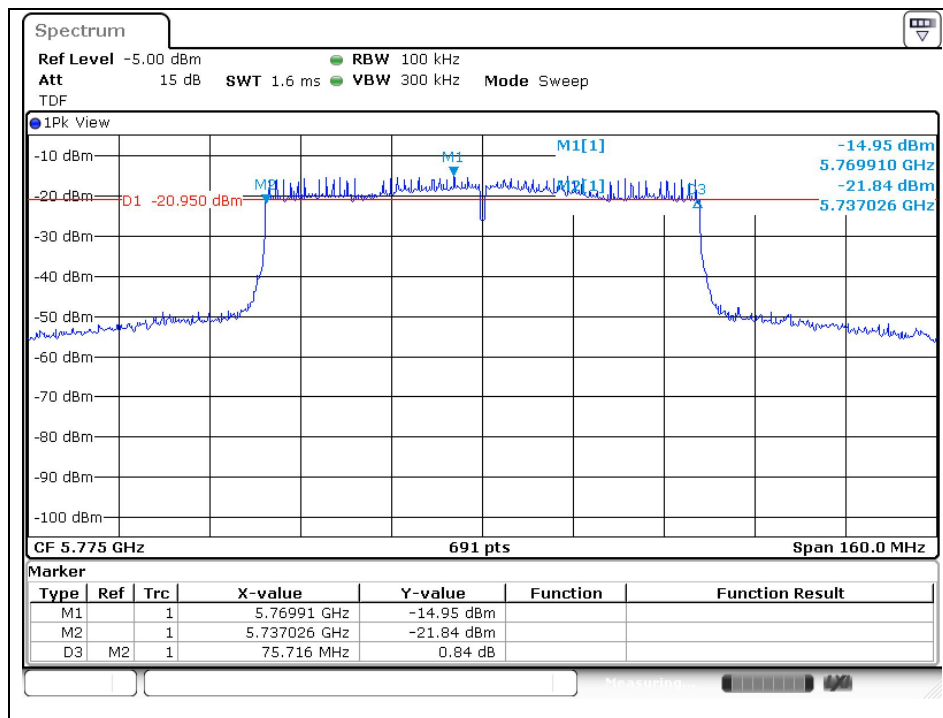
802.11ac_VHT80 (Band 3)_ANT 1

Middle Channel (5 775 MHz)



802.11ac_VHT80 (Band 3)_ANT 2

Middle Channel (5 775 MHz)

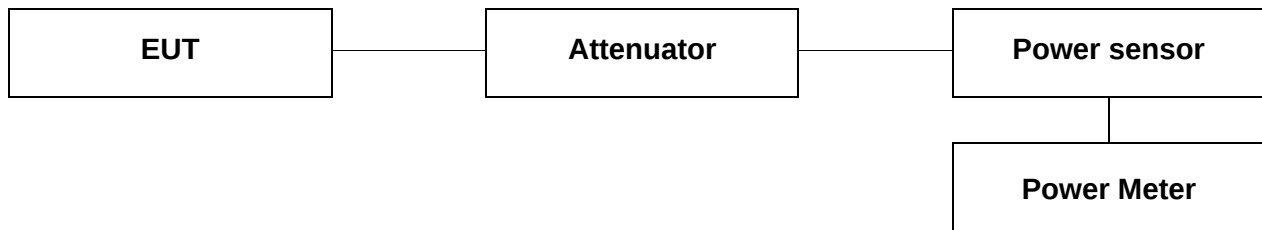


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5. Maximum Conducted Output Power

5.1. Test Setup



5.2. Limit

5.2.1. FCC

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

For client devices in the 5.15-5.25 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)

5.2.2. IC

According to RSS-247 Issue 2,

6.2.1.1 Frequency band 5 150-5 250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10\log_{10}B$, 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 $10 + 10\log_{10}B$, 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.

6.2.4.1 Frequency band 5 725-5 850 MHz

For equipment operating in the band 5 725-5 850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz. The maximum conducted output power shall not exceed 1 W. The output power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the output 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 devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint³ systems, omnidirectional applications and multiple colocated transmitters transmitting the same information.

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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 General UNII Test Procedures New Rules 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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A4(210 mm x 297 mm)

5.4. Test result

Ambient temperature : (23 ± 1) °C

Relative humidity : 47 % R.H.

Test mode: 11a

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 180	6	0.91	2.48	4.78
	5 220		0.67	2.91	4.94
	5 240		0.09	2.74	4.62
U-NII 3	5 745		1.51	3.33	5.52
	5 785		1.11	3.29	5.35
	5 825		0.29	3.28	5.05

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
U-NII 1	5 180	6	4.78	0.30	5.08
	5 220		4.94		5.24
	5 240		4.62		4.92
U-NII 3	5 745		5.52		5.82
	5 785		5.35		5.65
	5 825		5.05		5.35

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power Result (dB m)	Antenna Gain (dB i)	E.I.R.P. (dB m)
U-NII 1	5 180	6	5.08	8.01	13.09
	5 220		5.24		13.25
	5 240		4.92		12.93

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Band	FCC 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			8.01	21.97
	5 220					
	5 240					
U-NII 3	5 745	30			8.01	27.99
	5 785					
	5 825					

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	1.76+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 1	5 180	14.77	16.903	14.04	8.01	14.04
	5 220		16.903	14.04		14.04
	5 240		16.845	14.02		14.02

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	11+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 3	5 745	30			8.01	27.99
	5 785					
	5 825					

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

A4(210 mm x 297 mm)

Test mode: 11n_HT20

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 180	MCS0	0.08	2.41	4.41
	5 220		0.02	2.43	4.40
	5 240		-0.17	2.53	4.40
U-NII 3	5 745		1.34	3.55	5.59
	5 785		1.44	3.22	5.43
	5 825		0.52	2.96	4.92

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
U-NII 1	5 180	MCS0	4.41	0.32	4.73
	5 220		4.40		4.72
	5 240		4.40		4.72
U-NII 3	5 745		5.59		5.91
	5 785		5.43		5.75
	5 825		4.92		5.24

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power Result (dB m)	Antenna Gain (dB i)	E.I.R.P. (dB m)
U-NII 1	5 180	MCS0	4.73	8.01	12.74
	5 220		4.72		12.73
	5 240		4.72		12.73

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A4(210 mm x 297 mm)

Band	FCC 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			8.01	21.97
	5 220					
	5 240					
U-NII 3	5 745	30			8.01	27.99
	5 785					
	5 825					

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	1.76+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 1	5 180	14.77	17.829	14.27	8.01	14.27
	5 220		17.829	14.27		14.27
	5 240		17.771	14.26		14.26

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	11+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 3	5 745	30			8.01	27.99
	5 785					
	5 825					

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A4(210 mm x 297 mm)

Test mode: 11n_HT40

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 190	MCS0	-0.35	1.20	3.50
	5 230		-0.59	1.77	3.76
U-NII 3	5 755		0.81	2.64	4.83
	5 795		0.39	2.76	4.75

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
U-NII 1	5 190	MCS0	3.50	0.62	4.12
	5 230		3.76		4.38
U-NII 3	5 755		4.83		5.45
	5 795		4.75		5.37

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power Result (dB m)	Antenna Gain (dB i)	E.I.R.P. (dB m)
U-NII 1	5 190	MCS0	4.12	8.01	12.13
	5 230		4.38		12.39

Band	FCC 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			8.01	21.97
	5 230					
U-NII 3	5 755	30			8.01	27.99
	5 795					

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	1.76+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 1	5 190	14.77	36.122	17.34	8.01	14.77
	5 230		36.122	17.34		14.77

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	11+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 3	5 755	30			8.01	27.99
	5 795					

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Test mode: 11ac_VHT80

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 210	MCS0	-0.19	1.68	3.86
U-NII 3	5 775		-0.47	1.87	3.87

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power (dB m)	Duty Cycle Correction Factor (dB)	Average Power Result (dB m)
U-NII 1	5 190	MCS0	3.86	1.16	5.02
U-NII 3	5 755		3.87		5.03

Band	Frequency (MHz)	Data Rate (Mbps)	Average Power Result (dB m)	Antenna Gain (dB i)	E.I.R.P. (dB m)
U-NII 1	5 190	MCS0	5.02	8.01	13.03

Band	FCC 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			8.01	21.97
U-NII 3	5 755	30			8.01	27.99

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	1.76+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 1	5 190	14.77	75.716	20.55	8.01	14.77

Band	IC Limit					
	Frequency (MHz)	Fixed Limit (dB m)	99 % BW (MHz)	11+10Log ₁₀ B (dB m)	Antenna Gain (dB i)	Limit (dB m)
U-NII 3	5 755	30			8.01	27.99

Remark;

Attenuator and cable offset was compensated in test program (R&S Power Viewer) before measuring.

According to KDB 662911 D01 v02r01, average power of each port (ANT 1+ANT 2) and antenna gain was combined by using below calculation.

Average power: $10 \log \{10^{(\text{ANT 1 power} / 10)} + 10^{(\text{ANT 2 power} / 10)}\}$

Antenna gain: $10 \log \{[10^{(\text{ANT 1 gain} / 20)} + 10^{(\text{ANT 2 gain} / 20)}]^2 / 2\}$

Average Power Result(dB m) = Average Power (dB m) + Duty Cycle Correction Factor (dB)

E.I.R.P. (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

6.2.1 FCC

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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6.2.2 IC

According to RSS-247 Issue 2,

6.2.1.1 Frequency band 5 150-5 250 MHz

For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or $1.76 + 10\log_{10}B$, dB m, 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 $10 + 10\log_{10}B$, dB m, whichever power is less. B is the 99 % emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dB m in any 1.0 MHz band.

6.2.4.1 Frequency band 5 725-5 850 MHz

For equipment operating in the band 5 725-5 850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz. The maximum conducted output power shall not exceed 1 W. The output 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 output 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 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-multipoint³ systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

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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 General UNII Test Procedures New Rules 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 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 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 $RBW (< 500 \text{ kHz})$ 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 $RBW (< 1 \text{ MHz})$ 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.

Test mode: 11a

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 180	6	-10.12	-8.05	-5.95
	5 220		-10.08	-8.29	-6.08
	5 240		-10.37	-8.04	-6.04
U-NII 3	5 745		-11.45	-10.11	-7.72
	5 785		-11.98	-10.21	-8.00
	5 825		-12.51	-10.69	-8.50

Band	Frequency (MHz)	Data Rate (Mbps)	PPSD (dB m)	Duty Cycle Correction Factor (dB)	Final PPSD (dB m)
U-NII 1	5 180	6	-5.95	0.30	-5.65
	5 220		-6.08		-5.78
	5 240		-6.04		-5.74
U-NII 3	5 745		-7.72		-7.42
	5 785		-8.00		-7.70
	5 825		-8.50		-8.20

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	FCC Limit (dB m/1 MHz)
U-NII 1	5 180	6	-5.65	8.01	8.99
	5 220		-5.78		
	5 240		-5.74		

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	E.I.R.P. PPSD (dB m)	IC Limit (dB m/1 MHz)
U-NII 1	5 180	6	-5.65	8.01	2.36	10
	5 220		-5.78		2.23	
	5 240		-5.74		2.27	

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	Limit (dB m/500 kHz)
U-NII 3	5 745	6	-7.42	8.01	27.99
	5 785		-7.70		
	5 825		-8.20		

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Test mode: 11n_HT20

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 180	MCS0	-10.46	-8.30	-6.24
	5 220		-10.42	-8.39	-6.28
	5 240		-10.78	-8.36	-6.39
U-NII 3	5 745		-11.76	-10.66	-8.16
	5 785		-12.27	-10.71	-8.41
	5 825		-12.60	-10.42	-8.36

Band	Frequency (MHz)	Data Rate (Mbps)	PPSD (dB m)	Duty Cycle Correction Factor (dB)	Final PPSD (dB m)
U-NII 1	5 180	MCS0	-6.24	0.32	-5.92
	5 220		-6.28		-5.96
	5 240		-6.39		-6.07
U-NII 3	5 745		-8.16		-7.84
	5 785		-8.41		-8.09
	5 825		-8.36		-8.04

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	FCC Limit (dB m/1 MHz)
U-NII 1	5 180	MCS0	-5.92	8.01	8.99
	5 220		-5.96		
	5 240		-6.07		

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	E.I.R.P. PPSD (dB m)	IC Limit (dB m/1 MHz)
U-NII 1	5 180	MCS0	-5.92	8.01	2.09	10
	5 220		-5.96		2.05	
	5 240		-6.07		1.94	

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	Limit (dB m/500 kHz)
U-NII 3	5 745	MCS0	-7.84	8.01	27.99
	5 785		-8.09		
	5 825		-8.04		

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Test mode: 11n_HT40

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 190	MCS0	-14.21	-11.91	-9.90
	5 230		-14.52	-12.38	-10.31
U-NII 3	5 755		-15.86	-13.47	-11.49
	5 795		-16.42	-14.18	-12.15

Band	Frequency (MHz)	Data Rate (Mbps)	PPSD (dB m)	Duty Cycle Correction Factor (dB)	Final PPSD (dB m)
U-NII 1	5 190	MCS0	-9.90	0.62	-9.28
	5 230		-10.31		-9.69
U-NII 3	5 755		-11.49		-10.87
	5 795		-12.15		-11.53

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	FCC Limit (dB m/1 MHz)
U-NII 1	5 190	MCS0	-9.28	8.01	8.99
	5 230		-9.69		

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	E.I.R.P. PPSD (dB m)	IC Limit (dB m/1 MHz)
U-NII 1	5 190	MCS0	-9.28	8.01	-1.27	10
	5 230		-9.69		-1.68	

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	Limit (dB m/500 kHz)
U-NII 3	5 755	MCS0	-10.87	8.01	27.99
	5 795		-11.53		

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Test mode: 11ac_VHT80

Band	Frequency (MHz)	Data Rate (Mbps)	ANT 1 (dB m)	ANT 2 (dB m)	ANT 1+ANT 2 (dB m)
U-NII 1	5 210	MCS0	-16.73	-14.54	-12.49
U-NII 3	5 775		-20.01	-17.74	-15.72

Band	Frequency (MHz)	Data Rate (Mbps)	PPSD (dB m)	Duty Cycle Correction Factor (dB)	Final PPSD (dB m)
U-NII 1	5 210	MCS0	-12.49	1.16	-11.33
U-NII 3	5 775		-15.72		-14.56

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	FCC Limit (dB m/1 MHz)
U-NII 1	5 210	MCS0	-11.33	8.01	8.99

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	E.I.R.P. PPSD (dB m)	IC Limit (dB m/1 MHz)
U-NII 1	5 210	MCS0	-11.33	8.01	-3.32	10

Band	Frequency (MHz)	Data Rate (Mbps)	Final PPSD (dB m)	Antenna Gain (dB i)	Limit (dB m/500 kHz)
U-NII 3	5 775	MCS0	-14.56	8.01	27.99

Remark;

According to KDB 662911 D01 v02r01, power spectral density of each port (ANT 1+ANT 2) was combined by using below calculation.

PPSD: $10 \log \{10^{(ANT\ 1\ PSD / 10)} + 10^{(ANT\ 2\ PSD / 10)}\}$

Antenna Gain: $10 \log \{[10^{(ANT\ 1\ gain / 20)} + 10^{(ANT\ 2\ gain / 20)}]^{2 / 2}\}$

Final PPSD (dB m) = PPSD (dB m) + Duty Correction Correction Factor (dB)

E.I.R.P. PPSD (dB m) = Final PPSD (dB m) + Antenna Gain (dB i)

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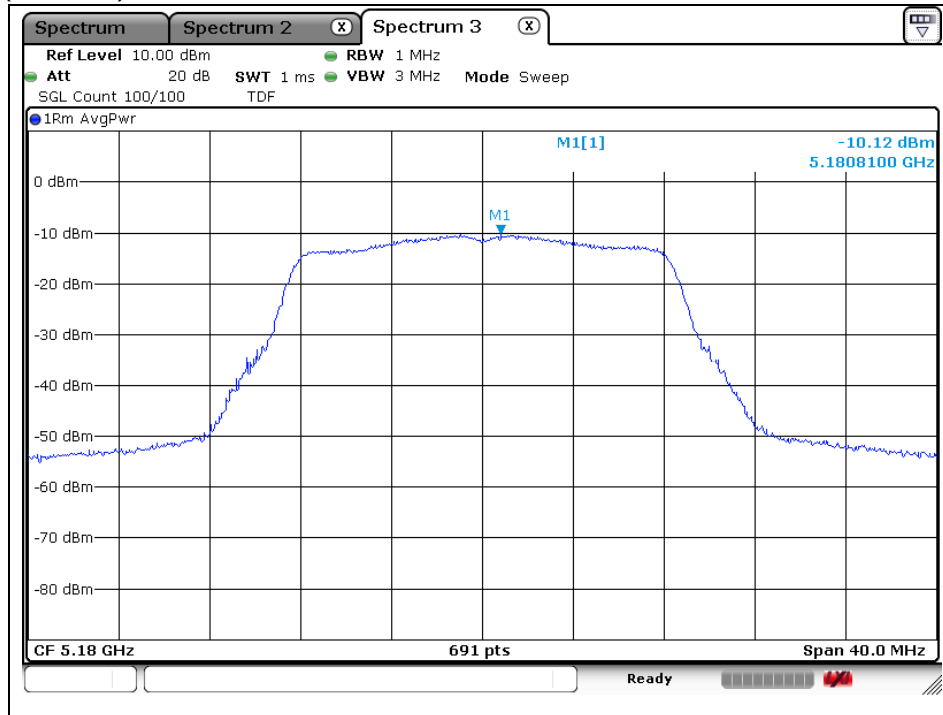
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

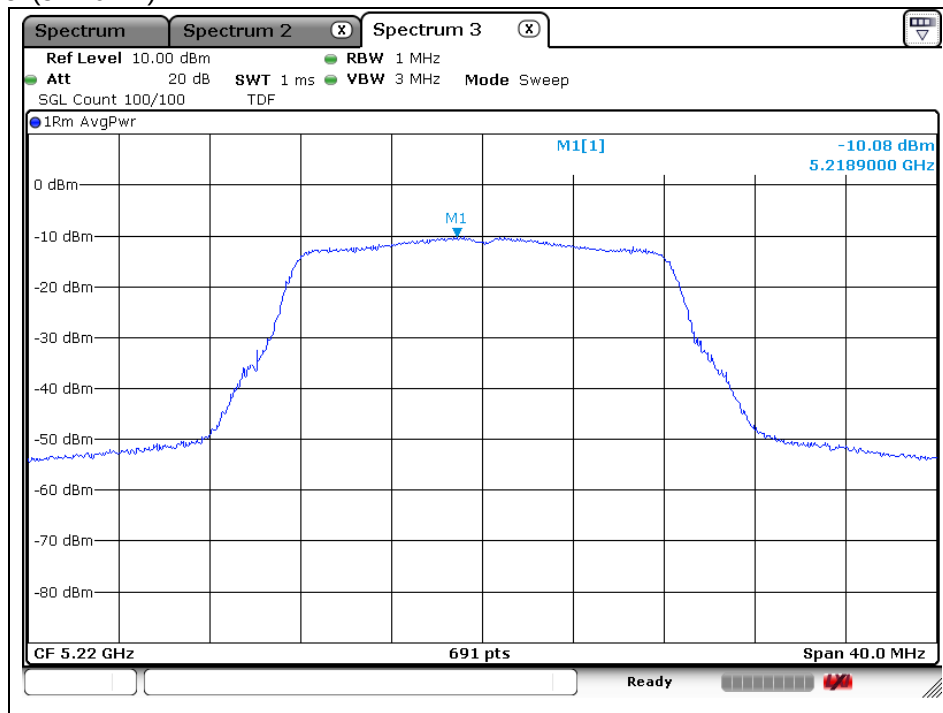
- Test plots

OFDM: 802.11a (Band 1)_ANT 1

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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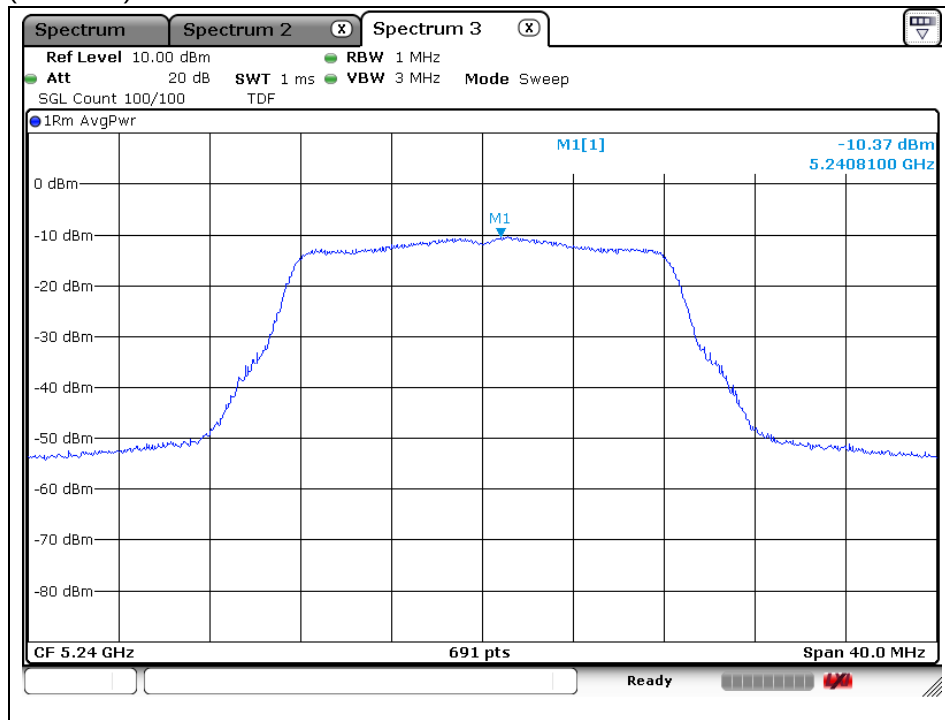
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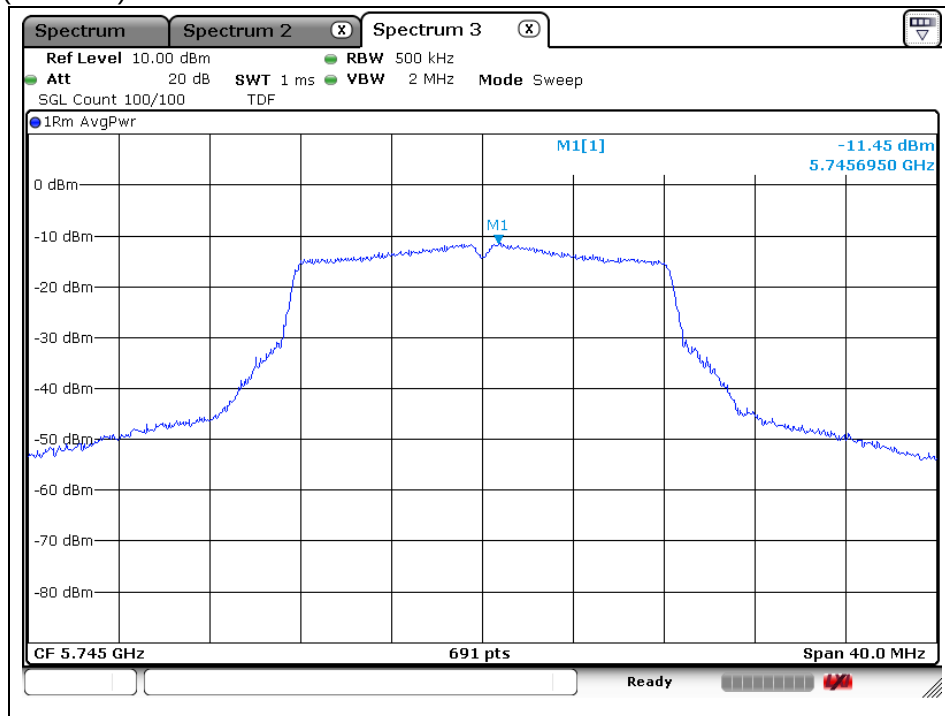
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



OFDM: 802.11a (Band 3)_ANT 1

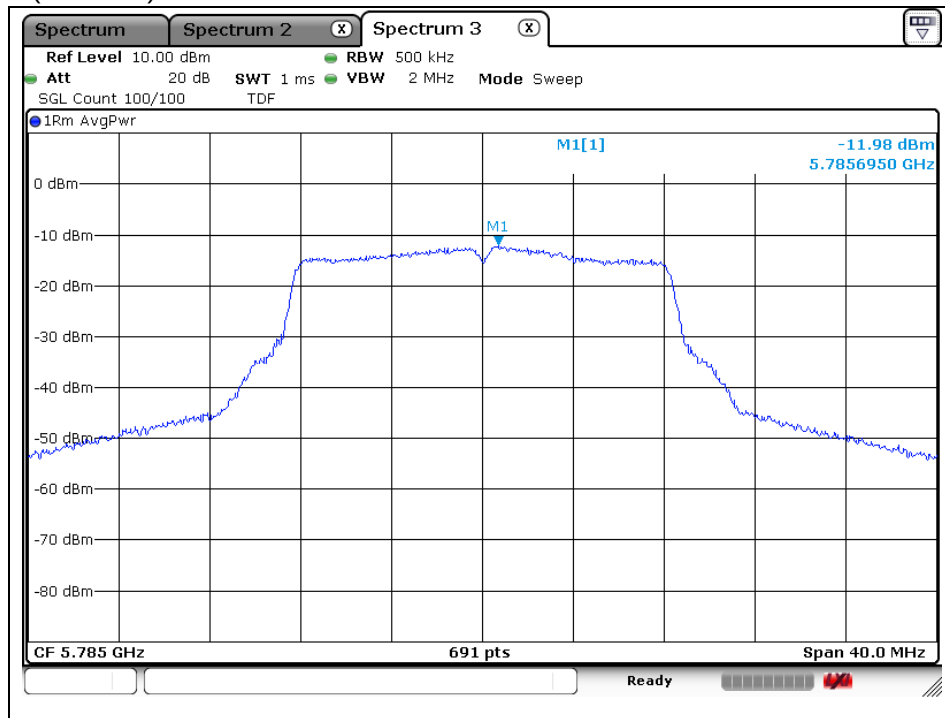
Low Channel (5 745 MHz)



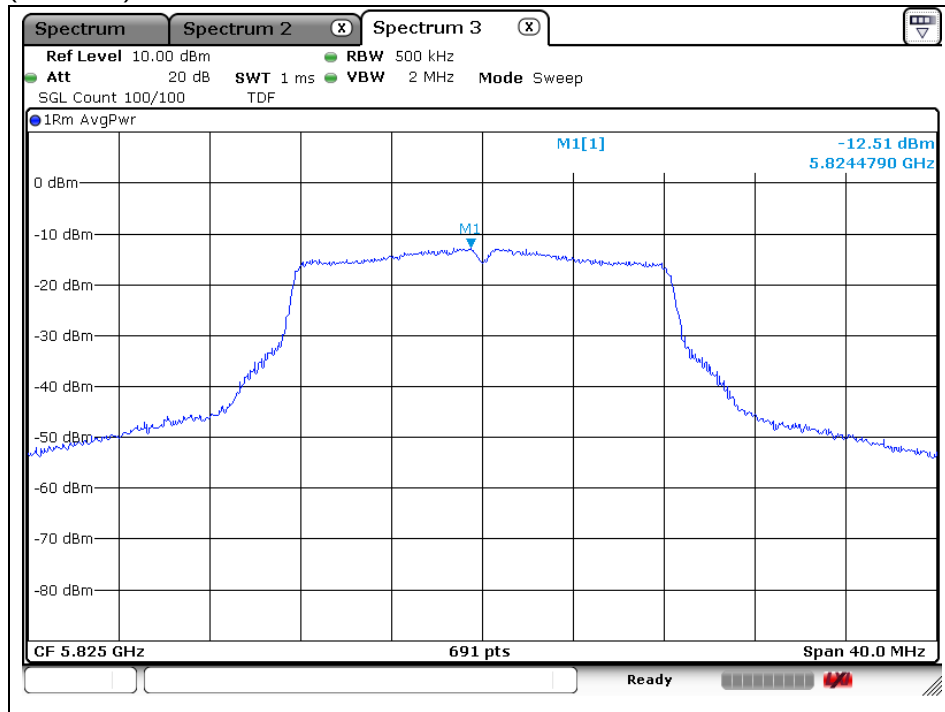
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Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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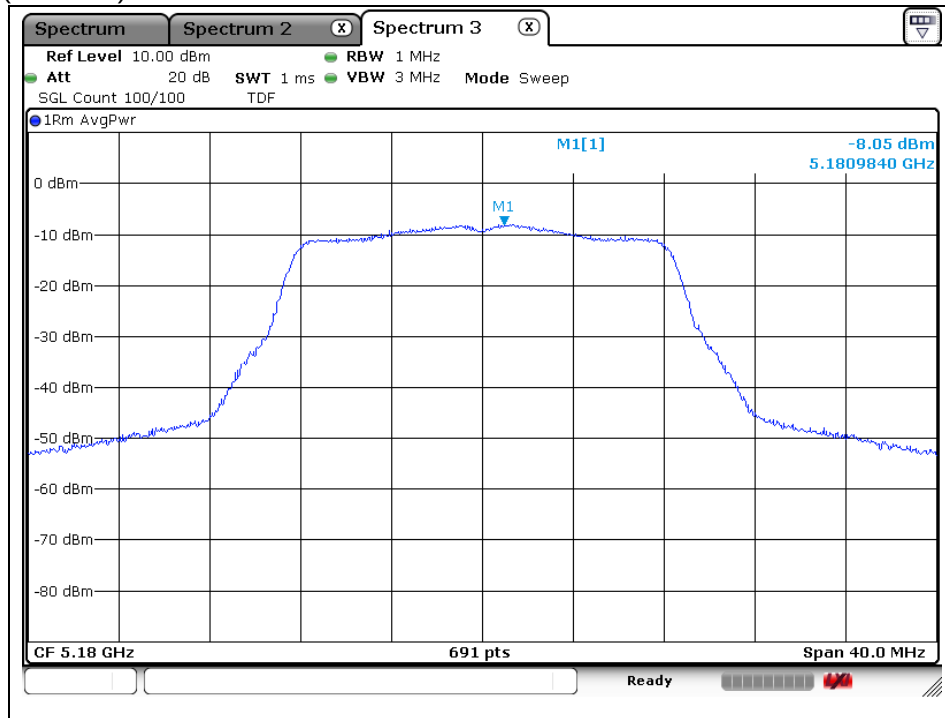
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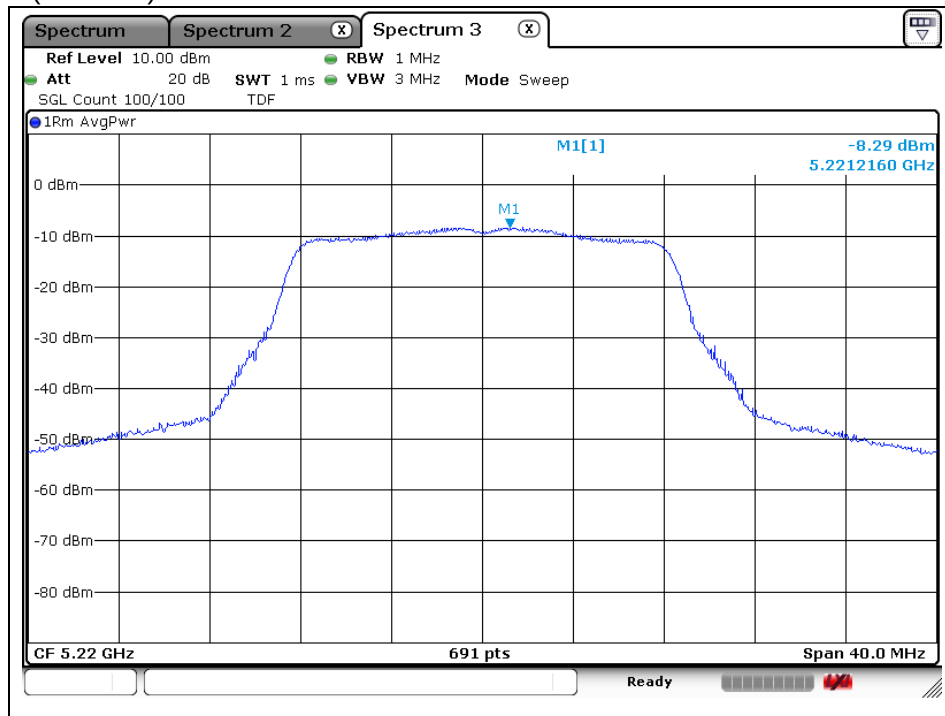
A4(210 mm x 297 mm)

OFDM: 802.11a (Band 1)_ANT 2

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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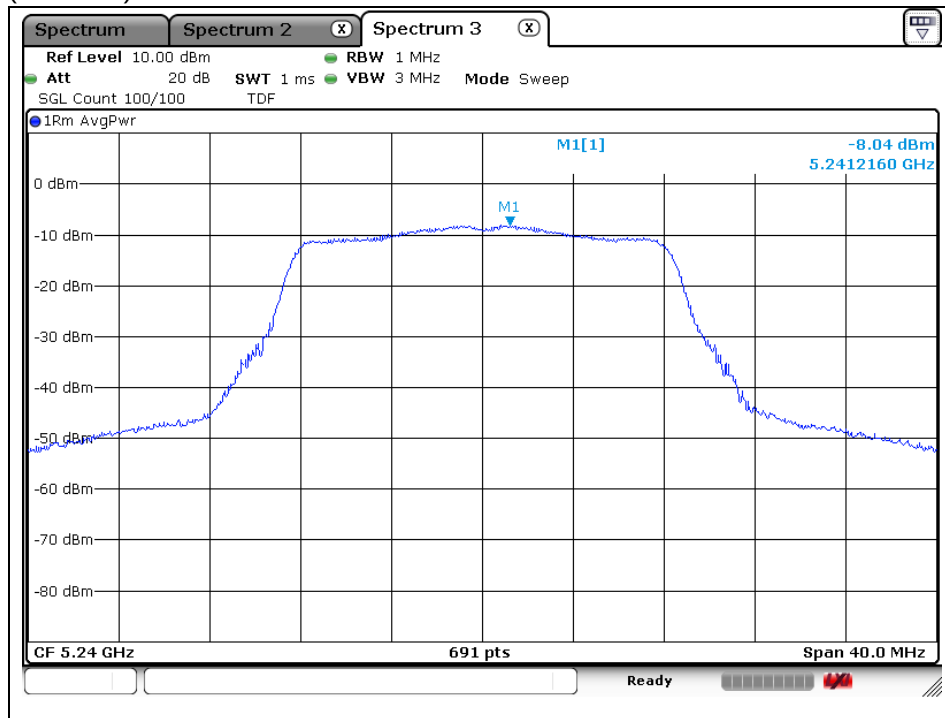
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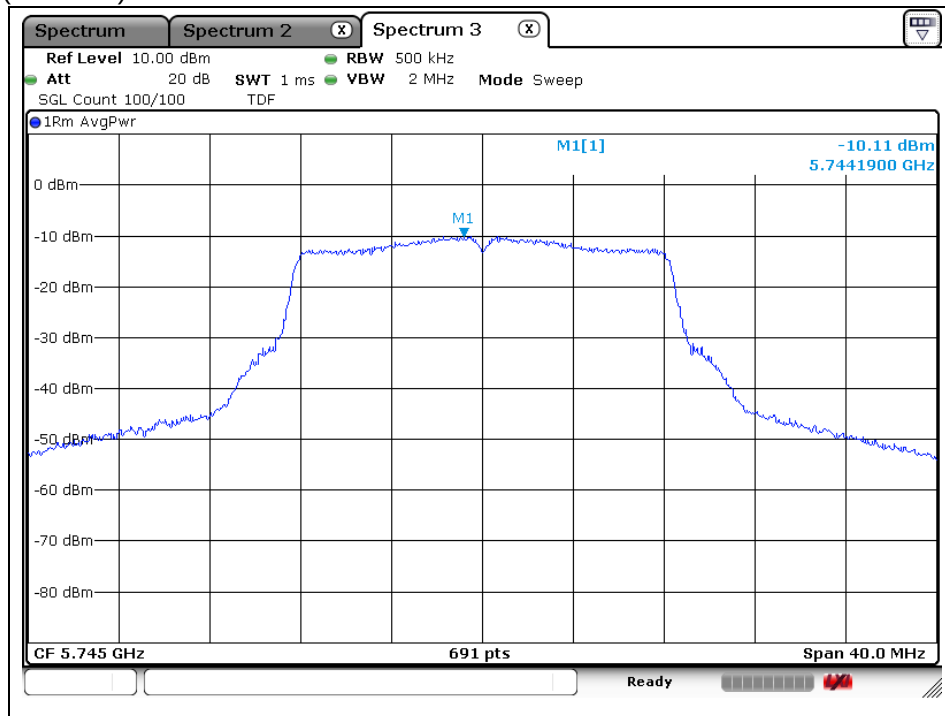
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



OFDM: 802.11a (Band 3)_ANT 2

Low Channel (5 745 MHz)



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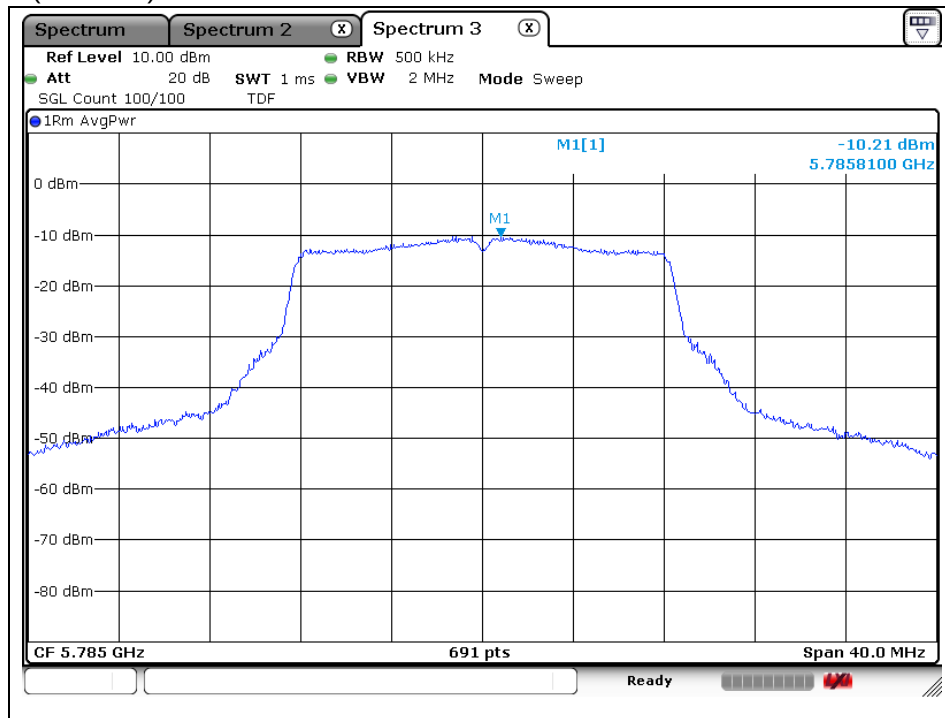
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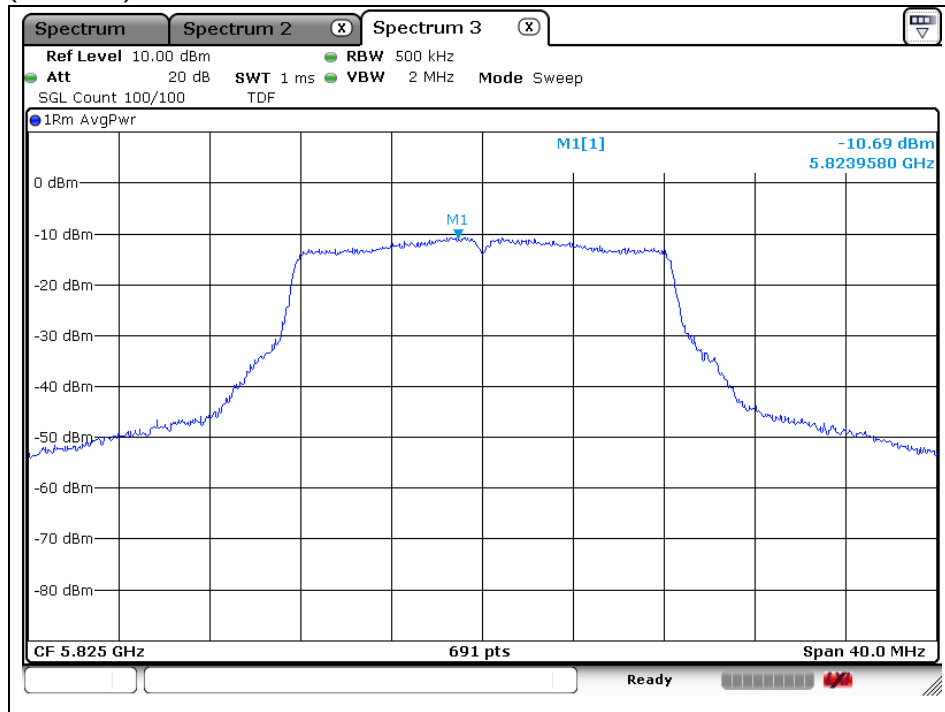
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A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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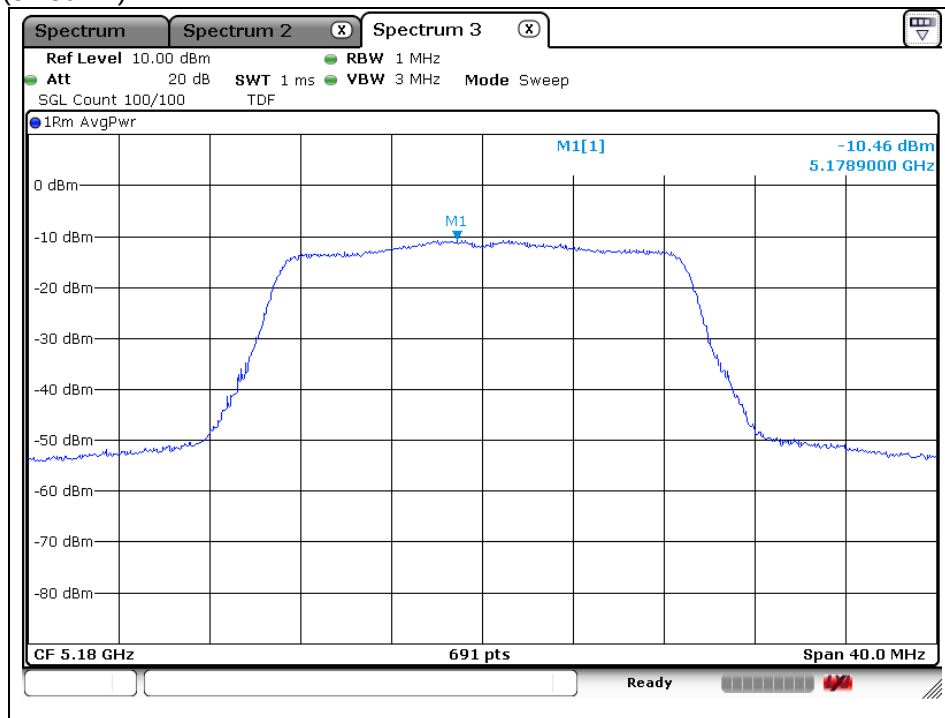
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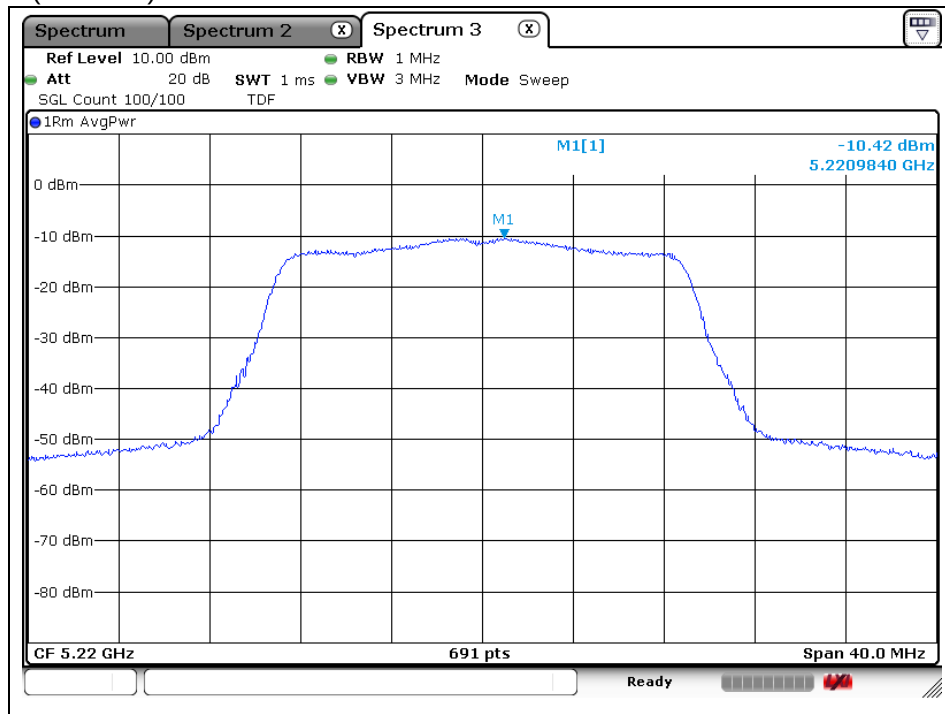
A4(210 mm x 297 mm)

OFDM: 802.11n_HT20 (Band 1)_ANT 1

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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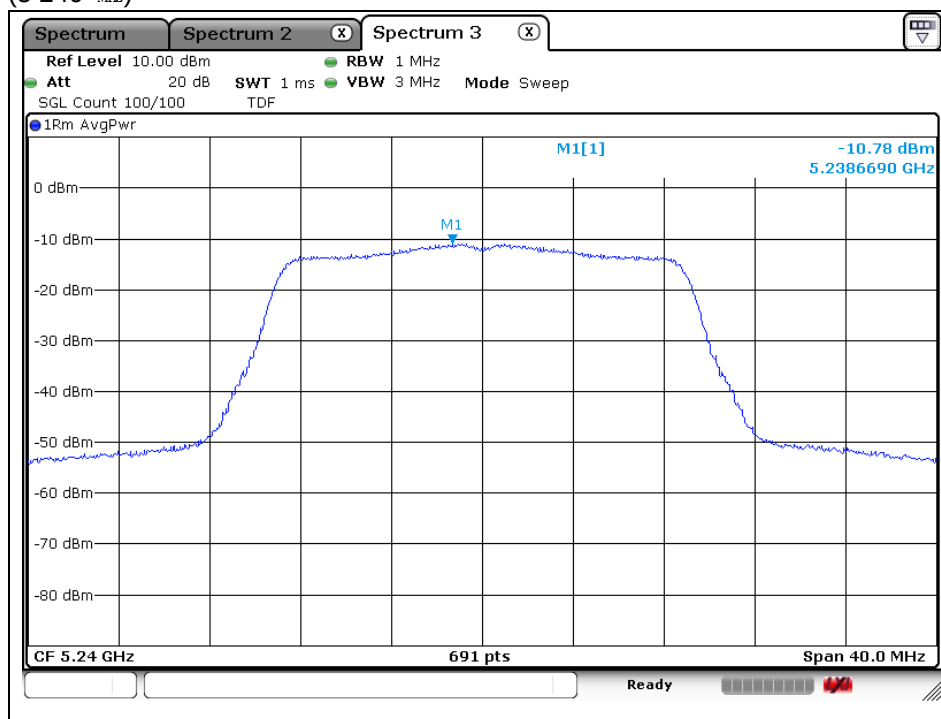
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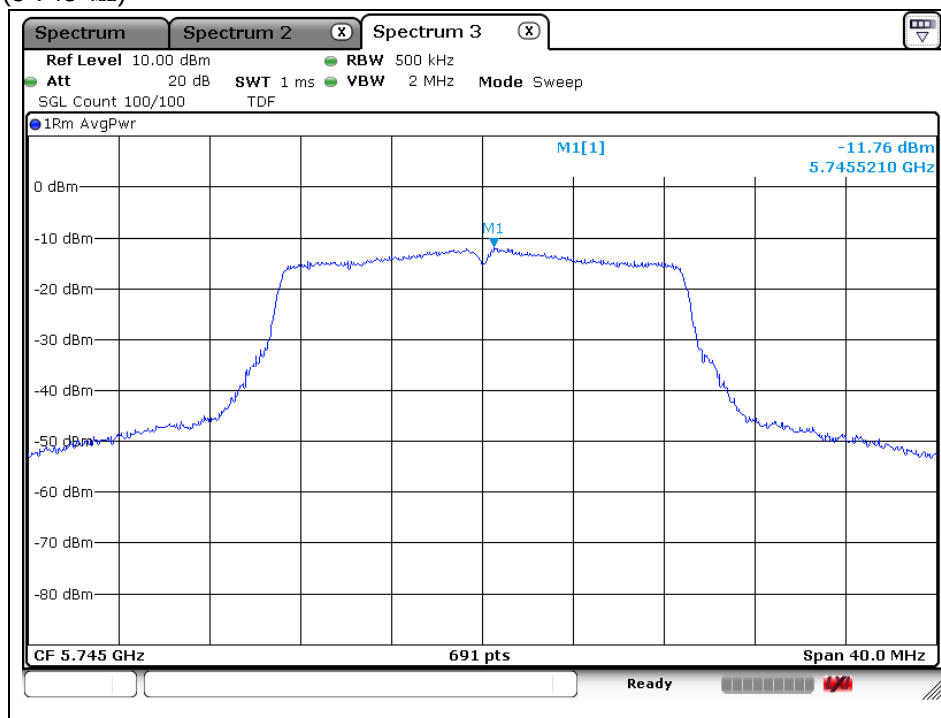
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



OFDM: 802.11n_HT20 (Band 3)_ANT 1

Low Channel (5 745 MHz)



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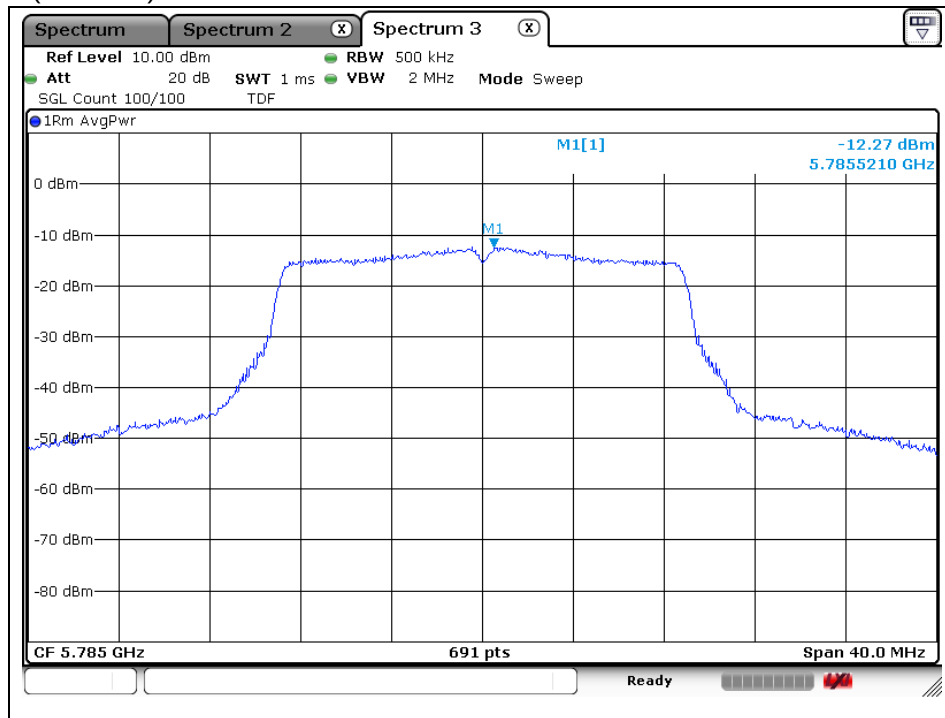
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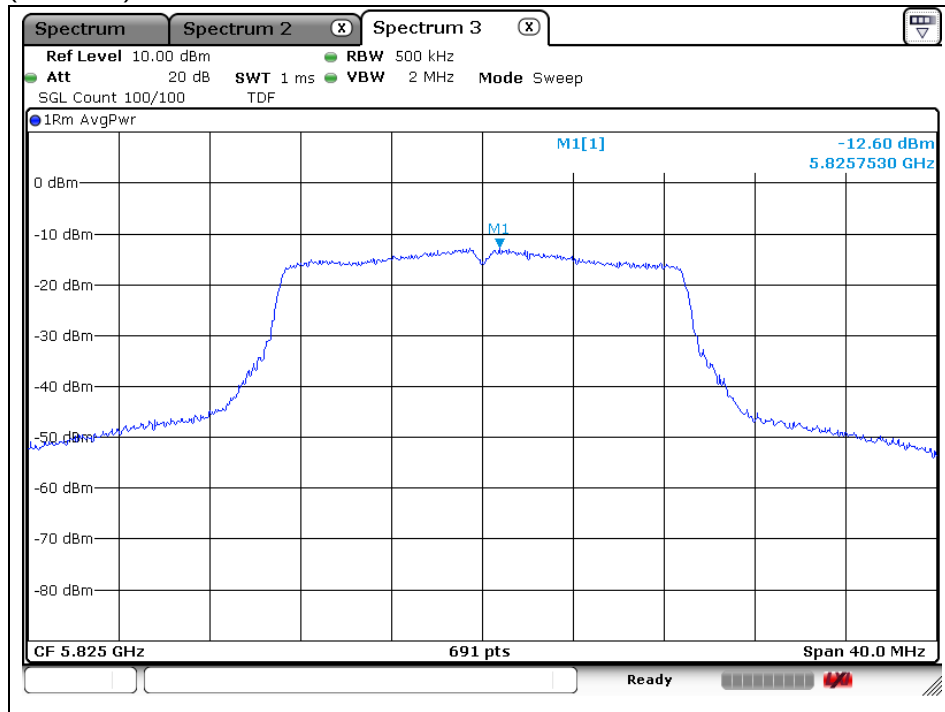
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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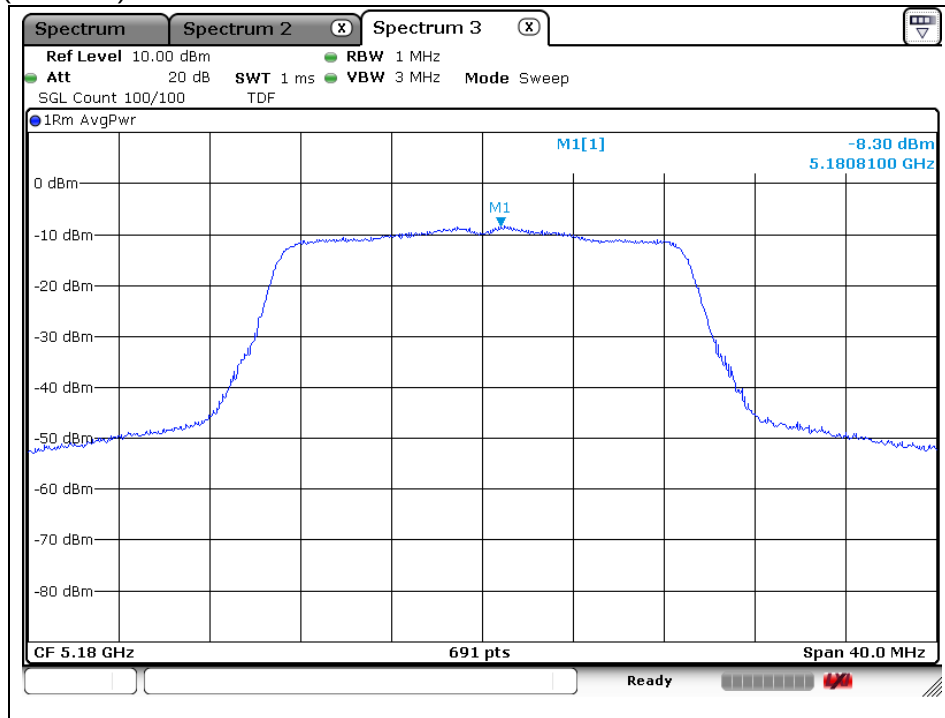
RTT5041-19(2019.04.24)(1)

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

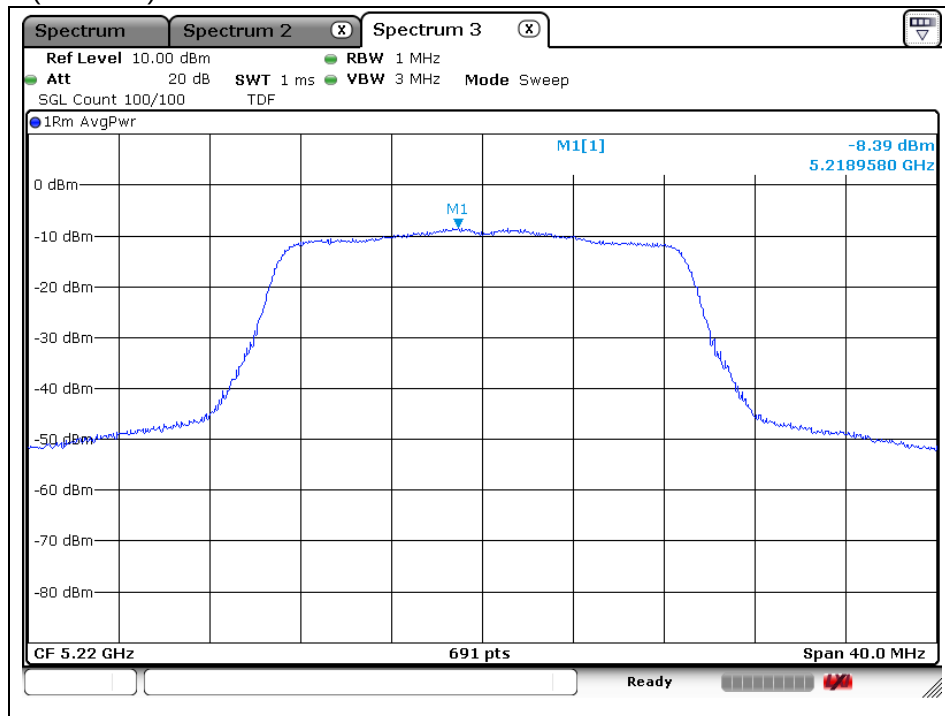
A4(210 mm x 297 mm)

OFDM: 802.11n_HT20 (Band 1)_ANT 2

Low Channel (5 180 MHz)



Middle Channel (5 220 MHz)



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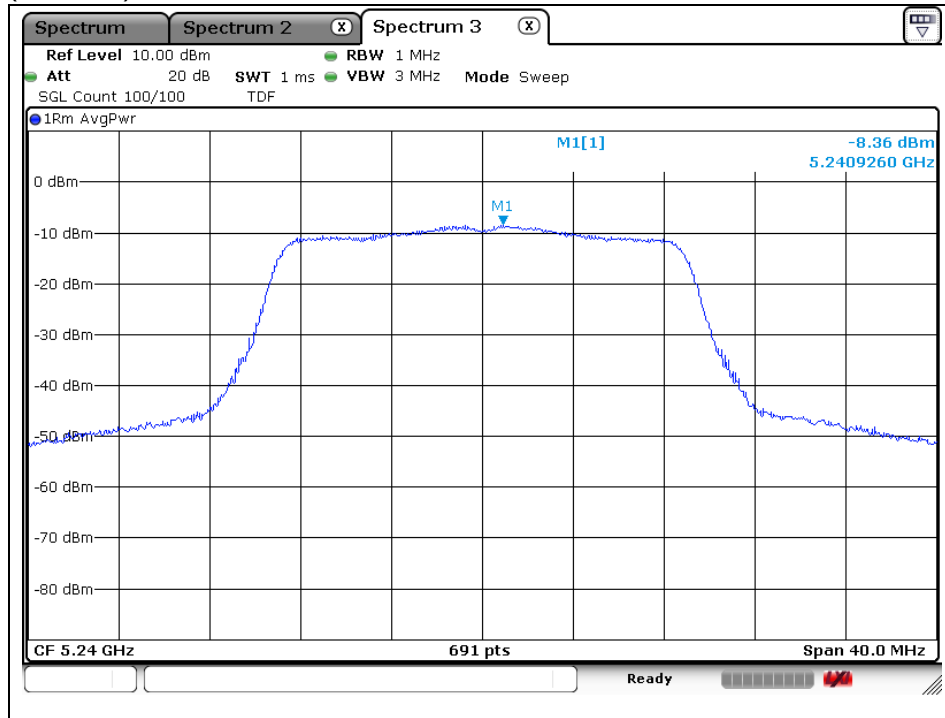
SGS Korea Co., Ltd. (Gunpo Laboratory) 4, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807 <http://www.sgsgroup.kr>

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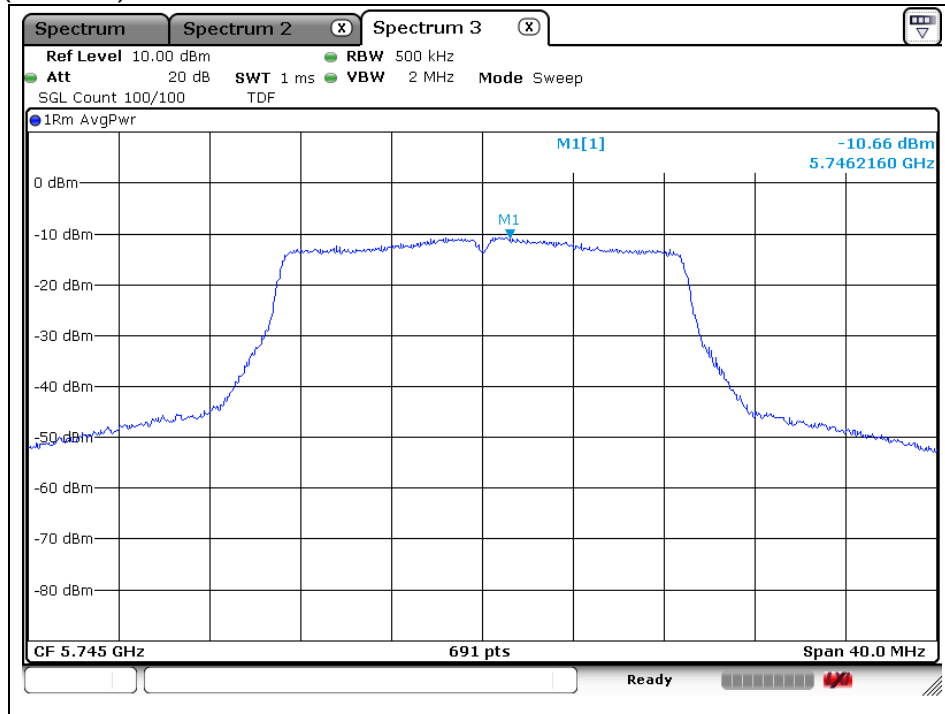
A4(210 mm x 297 mm)

High Channel (5 240 MHz)



OFDM: 802.11n_HT20 (Band 3)_ANT 2

Low Channel (5 745 MHz)



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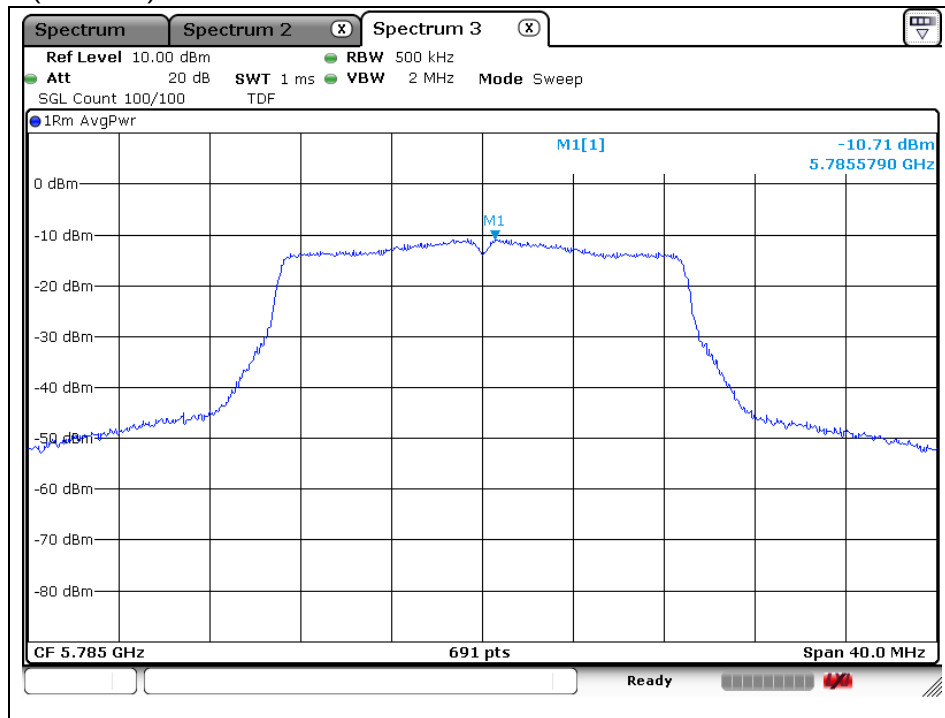
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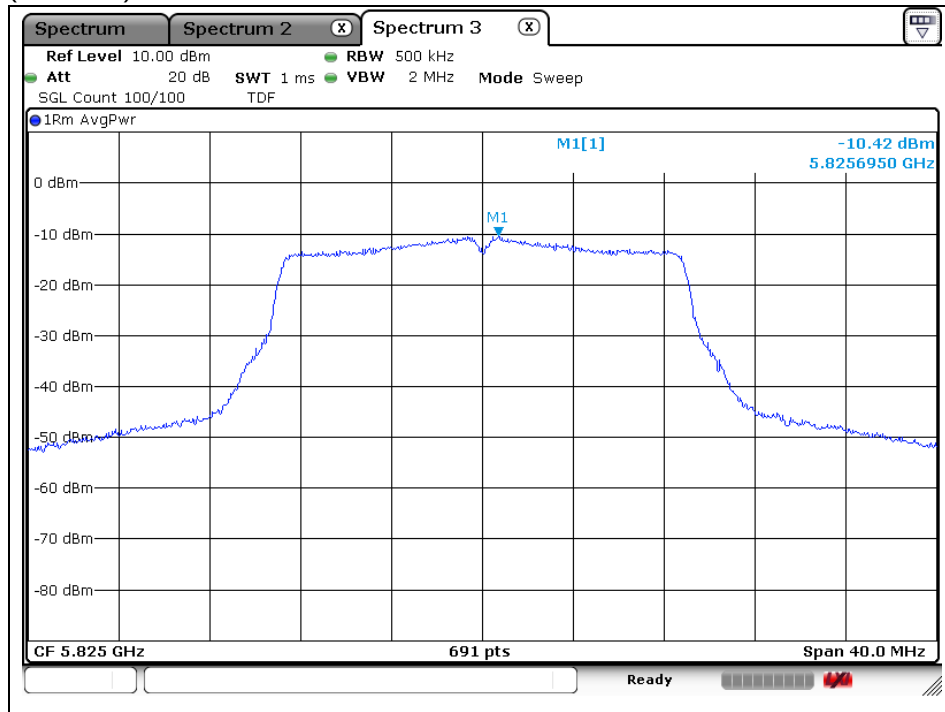
Tel. +82 31 428 5700 / Fax. +82 31 427 2370

A4(210 mm x 297 mm)

Middle Channel (5 785 MHz)



High Channel (5 825 MHz)



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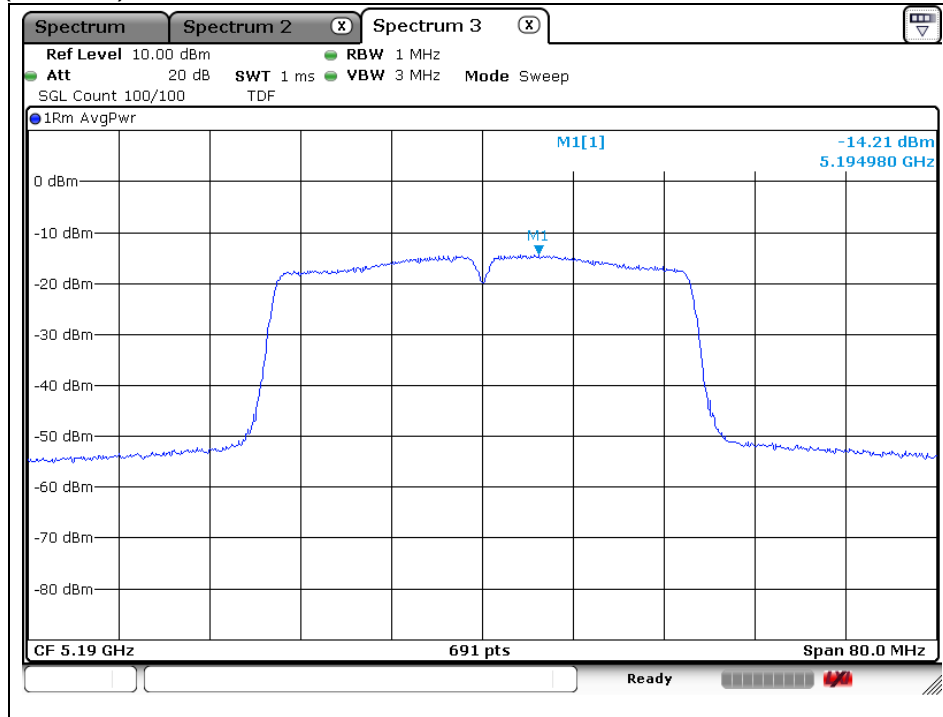
RTT5041-19(2019.04.24)(1)

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

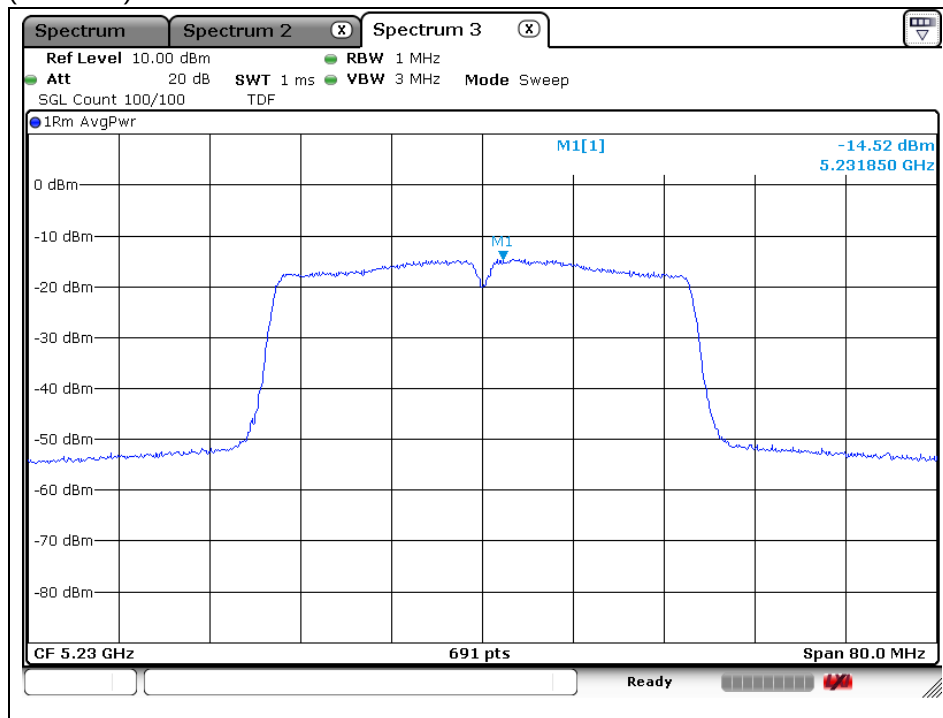
A4(210 mm x 297 mm)

OFDM: 802.11n_HT40 (Band 1)_ANT 1

Low Channel (5 190 MHz)



High Channel (5 230 MHz)



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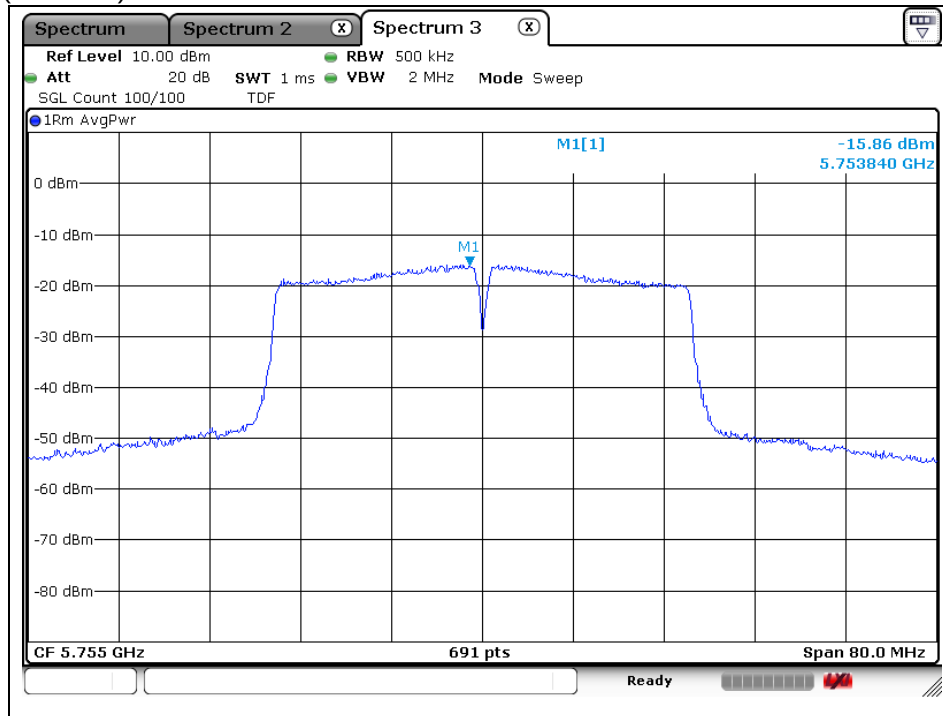
RTT5041-19(2019.04.24)(1)

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

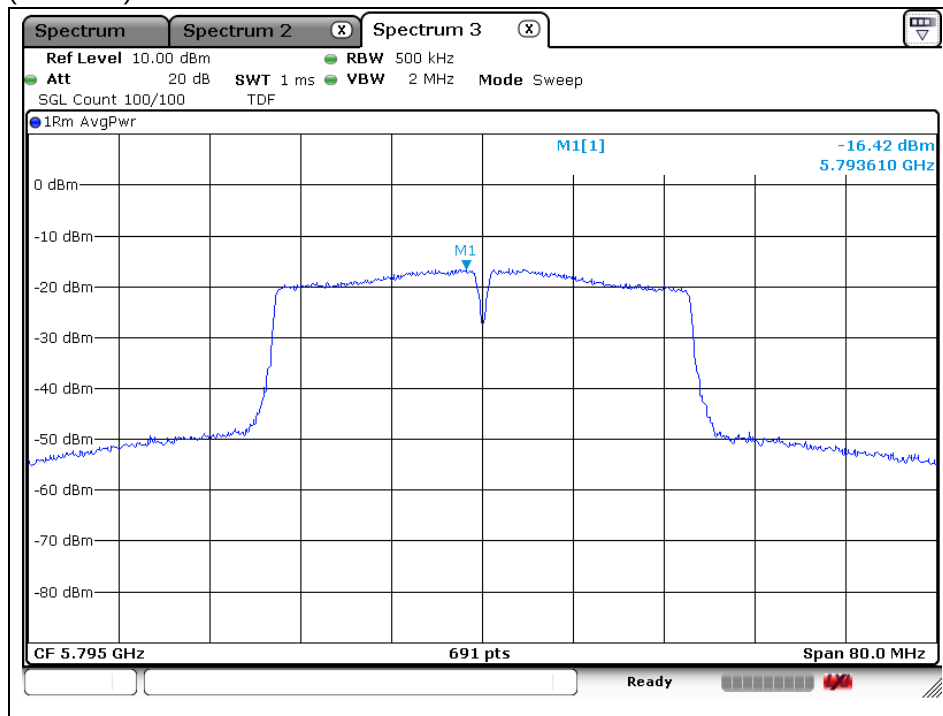
A4(210 mm x 297 mm)

OFDM: 802.11n_HT40 (Band 3)_ANT 1

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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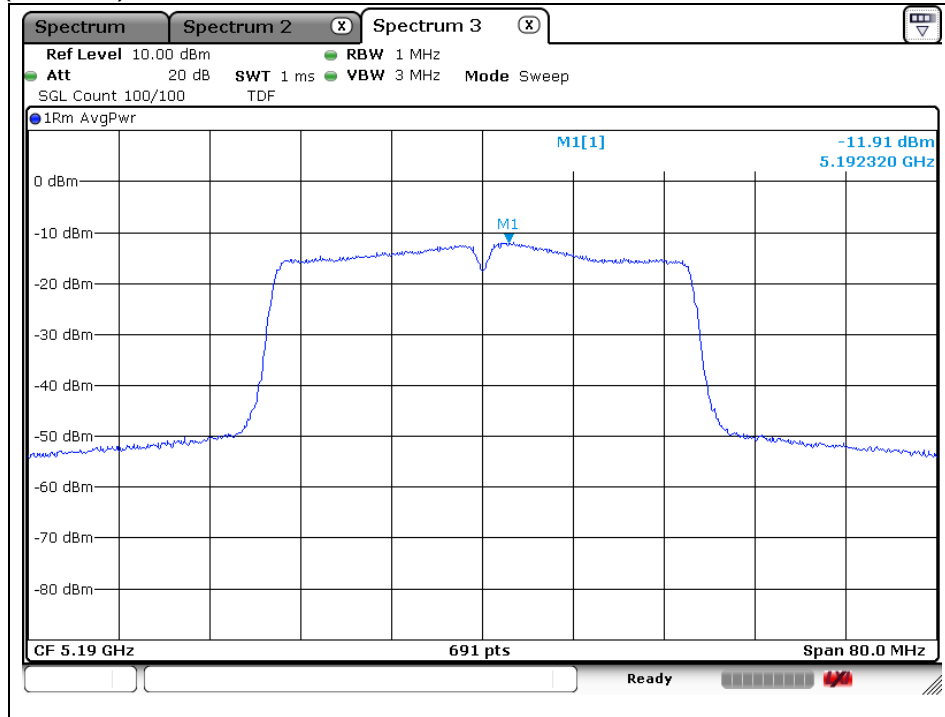
RTT5041-19(2019.04.24)(1)

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

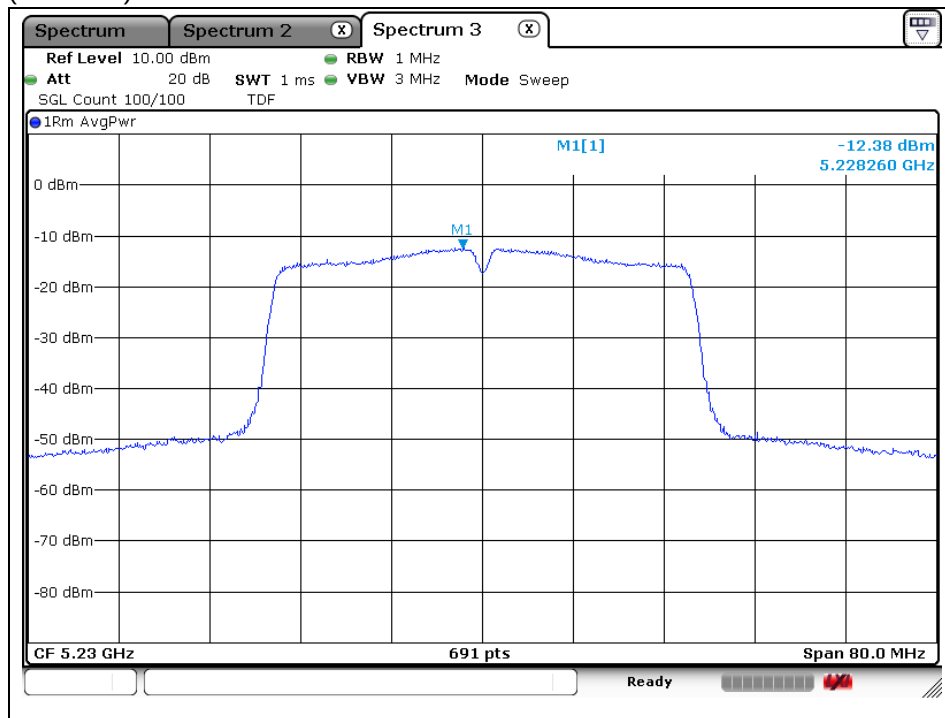
A4(210 mm x 297 mm)

OFDM: 802.11n_HT40 (Band 1)_ANT 2

Low Channel (5 190 MHz)



High Channel (5 230 MHz)



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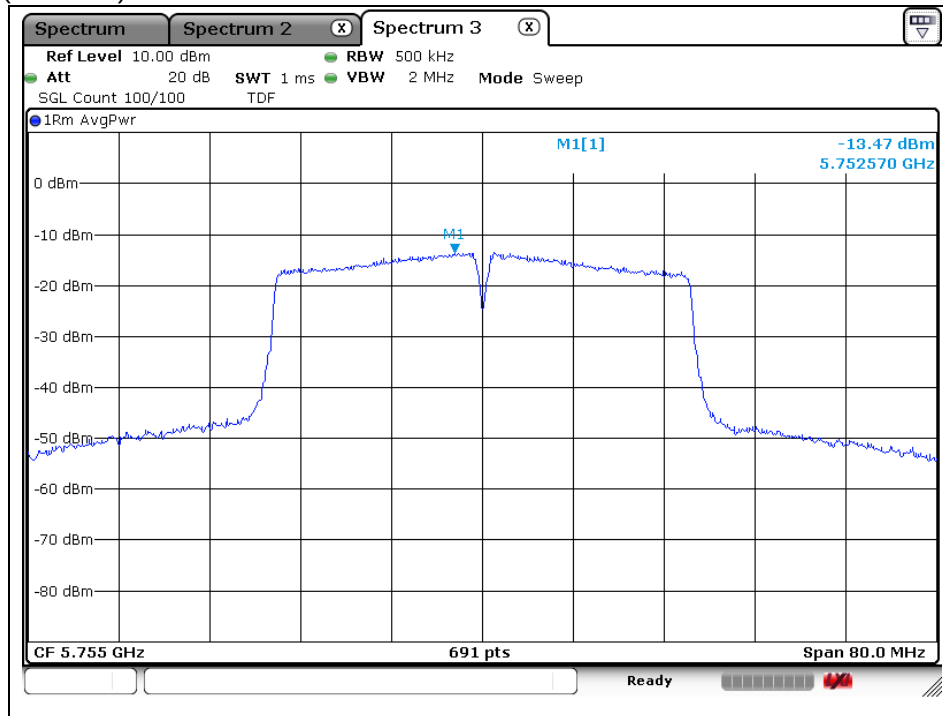
RTT5041-19(2019.04.24)(1)

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

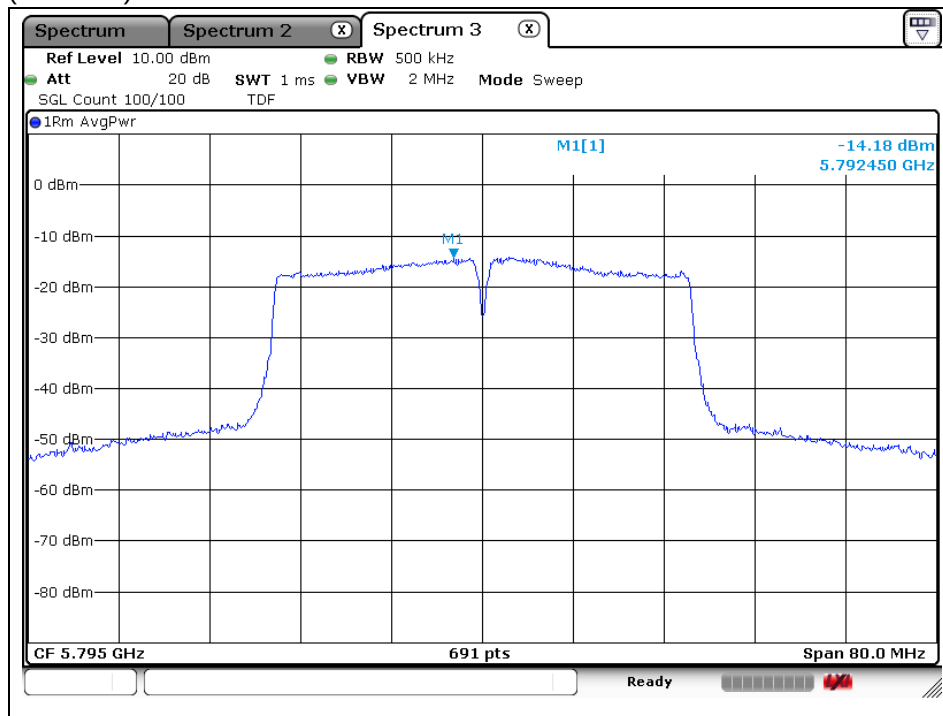
A4(210 mm x 297 mm)

OFDM: 802.11n_HT40 (Band 3)_ANT 2

Low Channel (5 755 MHz)



High Channel (5 795 MHz)



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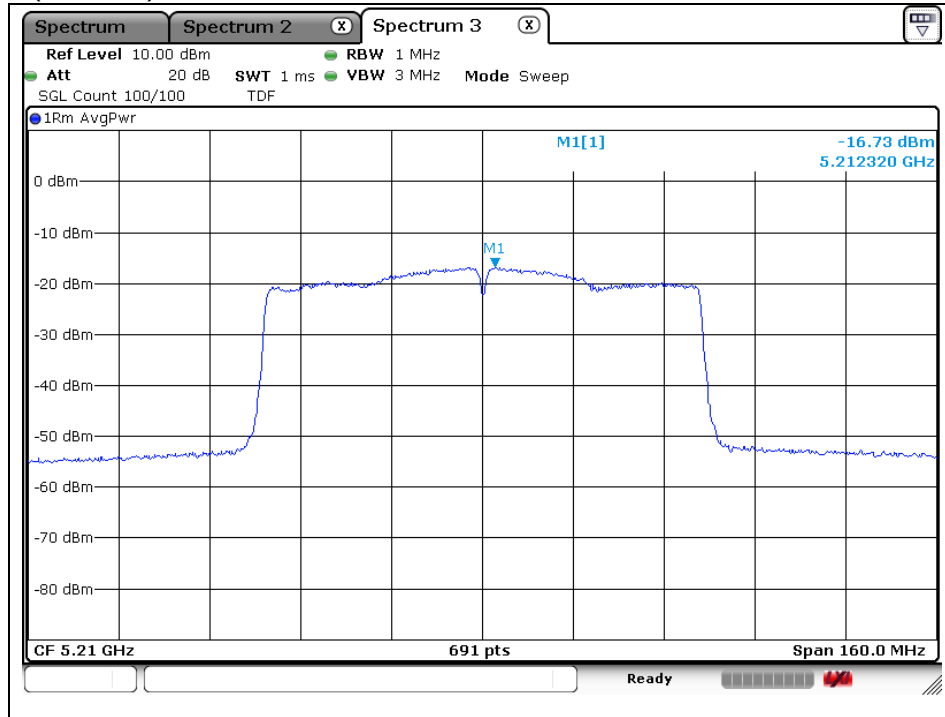
RTT5041-19(2019.04.24)(1)

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

A4(210 mm x 297 mm)

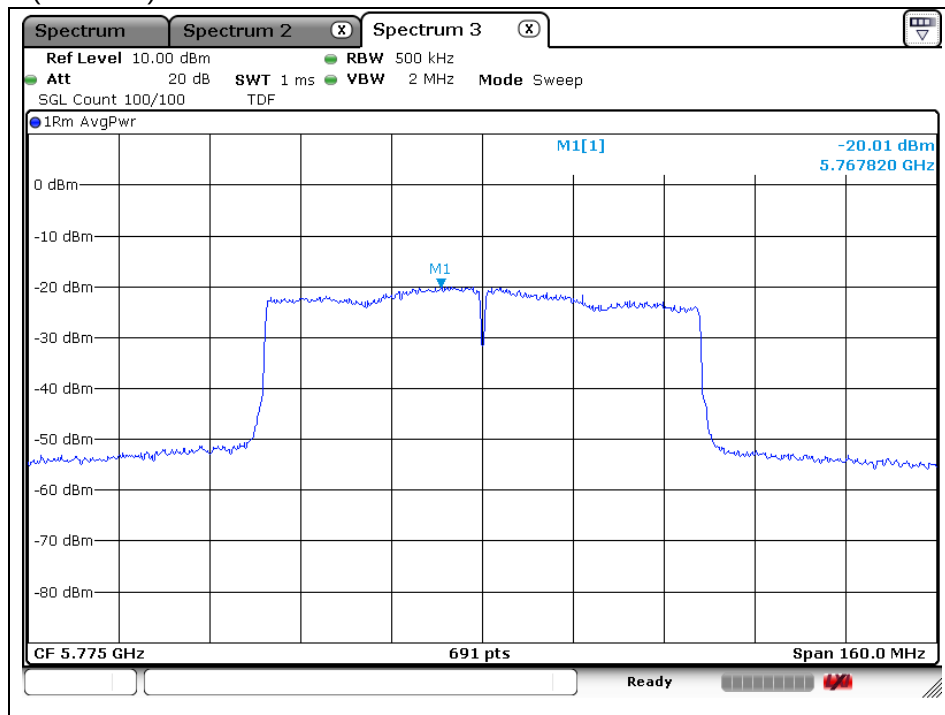
OFDM: 802.11ac_VHT80 (Band 1)_ANT 1

Middle Channel (5 210 MHz)



OFDM: 802.11ac_VHT80 (Band 3)_ANT 1

Middle Channel (5 775 MHz)



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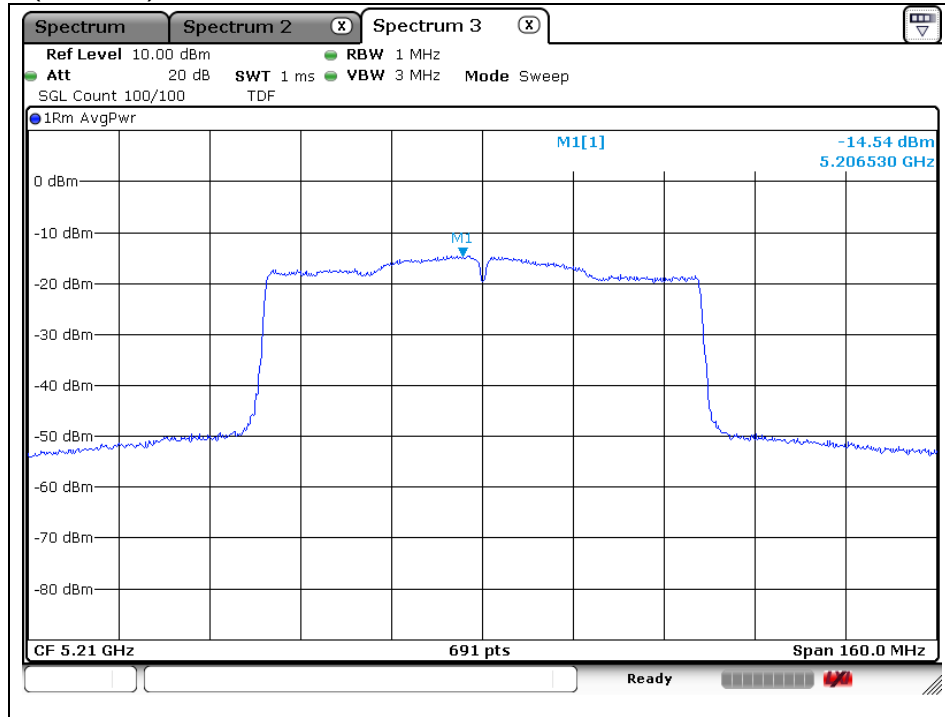
RTT5041-19(2019.04.24)(1)

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

A4(210 mm x 297 mm)

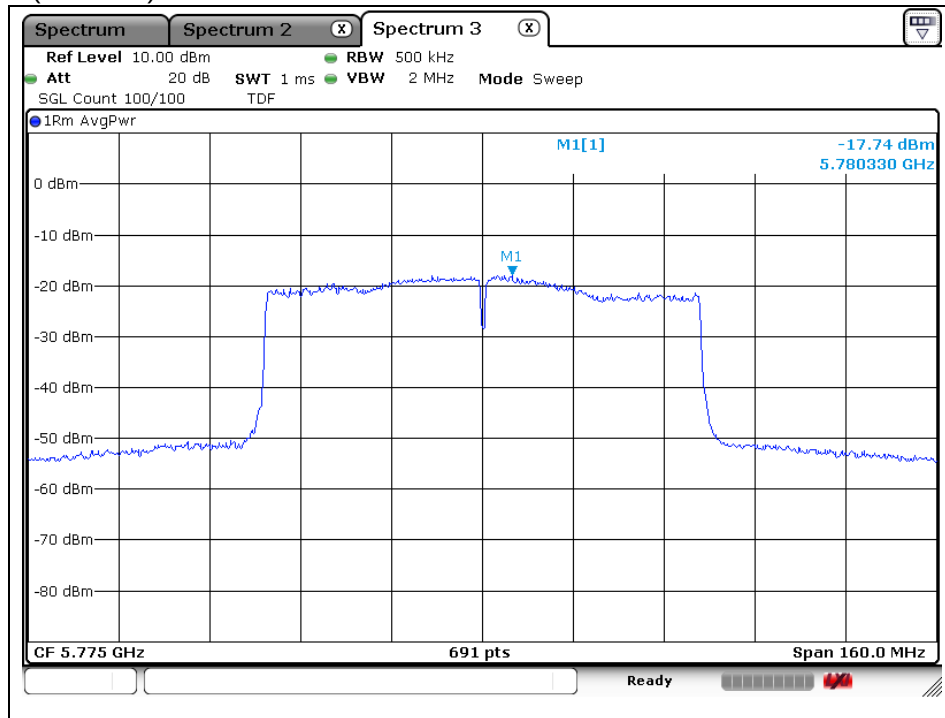
OFDM: 802.11ac_VHT80 (Band 1)_ANT 2

Middle Channel (5 210 MHz)



OFDM: 802.11ac_VHT80 (Band 3)_ANT 2

Middle Channel (5 775 MHz)



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

A4(210 mm x 297 mm)

7. Antenna Requirement

7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section §15.407 (a) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dBi that the gain of the antenna exceeds 6 dBi.

7.2. Antenna Connected Construction

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

Band	5 150 MHz – 5 250 MHz, 5 725 MHz – 5 850 MHz
Mode	11a/n_HT20, HT40, 11ac_VHT20, VHT40, VHT80
ANT1 Gain	5 dBi
ANT2 Gain	5 dBi
ANT1+ANT2 Gain	8.01 dBi

Unequal antenna gains, with equal transmit powers. For antenna gains given by $G_1, G_2, \dots, G_N$ dBi

(i) If transmit signals are correlated, then

Directional gain = $10 \log[(10^{G_1/20} + 10^{G_2/20} + \dots + 10^{G_N/20})^2 / N_{ANT}]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

- End of the Test Report -

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A4(210 mm x 297 mm)