

FCC Section 15.407 Subclause (a) (3) / RSS-247 Clause 6.2.4.1. Transmitter Maximum Power Spectral Density

FCC 15.407/RSS-247: The maximum 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 maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RESULTS

The maximum power spectral density (PSD) was measured using the method according to point F) referencing E.2.b) (Method SA-1) and E.2.b) (Method SA-2) of Guidance 789033 D02 General UNII Test Procedures New Rules v02r01.

In accordance with ANSI C63.10 Section 4.1.4.1, use of bandwidths greater than those specified can produce higher readings. Compliance against the applicable limits is shown using a 1 MHz resolution bandwidth. This was deemed worst case.

For all SISO and MIMO modes of operation, the antenna gain is < 6 dBi.

The PSD test uses the same setup than the transmitter maximum conducted output power test. The result of the Peak PSD was measured by collocation a meter on the peak of the signal and the results are in the tables below.

WLAN 0 - CORE 0 – SISO - Antenna port 2

Declared antenna gain: +3.2 dBi

Mode: 802.11a 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	-2.38	-2.84	-2.58
Duty Cycle Correction Factor (dB)	0.96		
PSD Corrected (dBm/MHz)	-1.42	-1.88	-1.62
e.i.r.p PSD (dBm/MHz)	1.78	1.32	1.58
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT20 - 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	-2.98	-3.24	-3.47
Duty Cycle Correction Factor (dB)	1.03		
PSD Corrected (dBm/MHz)	-1.95	-2.21	-2.44
e.i.r.p PSD (dBm/MHz)	1.25	0.99	0.76
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT40 - 40MHz

	Channel 151 5755 MHz	Channel 159 5795 MHz
PSD (dBm/MHz)	-7.43	-7.70
Duty Cycle Correction Factor (dB)	1.84	
PSD Corrected (dBm/MHz)	-5.59	-5.86
e.i.r.p PSD (dBm/MHz)	-2.39	-2.66
Measurement uncertainty (dB)	<±1.20	

Mode : 802.11ac VHT80 - 80MHz

	Channel 155 5775 MHz
PSD (dBm/MHz)	-10.92
Duty Cycle Correction Factor (dB)	3.18
PSD Corrected (dBm/MHz)	-7.74
e.i.r.p PSD (dBm/MHz)	-4.54
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

WLAN 1 - CORE 0 – SISO - Antenna port 3

Declared antenna gain: +0.9 dBi

Mode: 802.11a 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	0.84	0.95	1.32
Duty Cycle Correction Factor (dB)	0.96		
PSD Corrected (dBm/MHz)	1.80	1.91	2.28
e.i.r.p PSD (dBm/MHz)	2.70	2.81	3.18
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT20 - 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	1.13	0.89	1.24
Duty Cycle Correction Factor (dB)	1.03		
PSD Corrected (dBm/MHz)	2.16	1.92	2.27
e.i.r.p PSD (dBm/MHz)	3.06	2.82	3.17
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT40 - 40MHz

	Channel 151 5755 MHz	Channel 159 5795 MHz
PSD (dBm/MHz)	-4.32	-3.18
Duty Cycle Correction Factor (dB)	1.88	
PSD Corrected (dBm/MHz)	-2.44	-1.30
e.i.r.p PSD (dBm/MHz)	-1.54	-0.40
Measurement uncertainty (dB)	<±1.20	

Mode : 802.11ac VHT80 - 80MHz

	Channel 155 5775 MHz
PSD (dBm/MHz)	-7.26
Duty Cycle Correction Factor (dB)	3.19
PSD Corrected (dBm/MHz)	-4.07
e.i.r.p PSD (dBm/MHz)	-3.17
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

WLAN 1 - CORE 1 – SISO - Antenna port 4

Declared antenna gain: +2.3 dBi

Mode: 802.11a 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	-1.06	-1.47	-2.49
Duty Cycle Correction Factor (dB)	0.96		
PSD Corrected (dBm/MHz)	-0.1	-0.51	-1.53
e.i.r.p PSD (dBm/MHz)	2.2	1.79	0.77
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT20 - 20MHz

	Channel 149 5745 MHz	Channel 157 5785 MHz	Channel 165 5825 MHz
PSD (dBm/MHz)	-2.18	-2.87	-2.39
Duty Cycle Correction Factor (dB)	1.03		
PSD Corrected (dBm/MHz)	-1.15	-1.84	-1.36
e.i.r.p PSD (dBm/MHz)	1.15	0.46	0.94
Measurement uncertainty (dB)	<±1.20		

Mode : 802.11n HT40 - 40MHz

	Channel 151 5755 MHz	Channel 159 5795 MHz
PSD (dBm/MHz)	-5.33	-6.01
Duty Cycle Correction Factor (dB)	1.84	
PSD Corrected (dBm/MHz)	-3.49	-4.17
e.i.r.p PSD (dBm/MHz)	-1.19	-1.87
Measurement uncertainty (dB)	<±1.20	

Mode : 802.11ac VHT80 - 80MHz

	Channel 155 5775 MHz
PSD (dBm/MHz)	-9.90
Duty Cycle Correction Factor (dB)	3.17
PSD Corrected (dBm/MHz)	-6.73
e.i.r.p PSD (dBm/MHz)	-5.83
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

WLAN 1 – CORE2 (CORE0+CORE1) - MIMO – Antenna ports 1 - 4

Mode : 802.11n HT20 - 20MHz

Antenna 1 gain: +3.2 dBi

Antenna 4 gain: +2.3 dBi

	Channel 149 5745 MHz		Channel 157 5785 MHz		Channel 165 5825 MHz	
	Port 1	Port 4	Port 1	Port 4	Port 1	Port 4
PSD/1MHz (dBm)	-3.73	-5.38	-3.62	-5.12	-4.11	-5.72
Duty Cycle Correction Factor (dB)	1.03		1.03		1.03	
PSD/1MHz Corrected (dBm)	-2.70	-4.35	-2.59	-4.09	-3.08	-4.69
Total PSD/1MHz (dBm)	0.31	-1.34	0.42	-1.08	-0.07	-1.68
Total PSD/1MHz e.i.r.p (dBm)	3.51	0.96	3.62	1.22	3.13	0.62
Measurement uncertainty (dB)	<±1.20					

Note 1: The quantity $10 \cdot \log 2$ (two antennas) is added to the spectrum peak value according to document 662911 D01.

Mode : 802.11n HT40 - 40MHz

Antenna 1 gain: +3.2 dBi

Antenna 4 gain: +2.3 dBi

	Channel 151 5755 MHz		Channel 159 5795 MHz	
	Port 1	Port 4	Port 1	Port 4
PSD/1MHz (dBm)	-6.44	-8.09	-6.70	-7.08
Duty Cycle Correction Factor (dB)	1.84		1.84	
PSD/1MHz Corrected (dBm)	-4.60	-6.25	-4.86	-5.24
Total PSD/1MHz (dBm)	-1.59	-3.24	-1.85	-2.23
Total PSD/1MHz e.i.r.p (dBm)	1.61	-0.94	1.35	0.07
Measurement uncertainty (dB)	<±1.20			

Note 1: The quantity $10 \cdot \log 2$ (two antennas) is added to the spectrum peak value according to document 662911 D01.

Mode : 802.11ac VHT80 - 80MHz

Antenna 1 gain: +3.2 dBi

Antenna 4 gain: +2.3 dBi

	Channel 155 5775 MHz	
	Port 1	Port 4
PSD/1MHz (dBm)	-11.22	-12.67
Duty Cycle Correction Factor (dB)	3.18	
PSD/1MHz Corrected (dBm)	-8.04	-9.49
Total PSD/1MHz (dBm)	-5.03	-7.19
Total PSD/1MHz e.i.r.p (dBm)	-2.02	-4.18
Measurement uncertainty (dB)	<±1.20	

Note 1: The quantity $10 \cdot \log 2$ (two antennas) is added to the spectrum peak value according to document 662911 D01.

Verdict: PASS

FCC Section 15.407(b)(4)(6) /RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions

SPECIFICATION

For transmitters operating in the 5.725–5.85 GHz band:

All emissions shall be limited to a level of –27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/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 dBm/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 dBm/MHz at the band edge.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-25 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

The worst case SISO between all combinations of interfaces for WLAN1-CORE1 antenna port 4, WLAN0-CORE0 antenna port 2 and WLAN1-CORE0 antenna port 3 was WLAN0-CORE0 antenna port 2.

Frequency range 30 MHz-1000 MHz.

Note: The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Mode : 802.11n HT20 – 20MHz – WLAN 0-CORE 0 – SISO - Antenna port RF 2 (worst case)

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Uncertainty (dB)
41.5430	Vertical	Quasi-Peak	22.1	40	17.9	± 3.88
786.4706	Vertical	Quasi-Peak	28.5	46	17.5	± 3.88
884.7963	Horizontal	Quasi-Peak	29.1	46	16.9	± 3.88

Mode : 802.11n HT20 – 20MHz – WLAN 1-CORE2 (CORE0+CORE1) - MIMO - Antenna port RF 1 + 4

Spurious levels operating (radiated) closest to limit.

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Uncertainty (dB)
38.520	Vertical	Quasi-Peak	29.10	40	10.90	± 3.88
688.161	Vertical	Quasi-Peak	27.60	46	18.40	± 3.88
786.455	Horizontal	Quasi-Peak	32.80	46	13.20	± 3.88
884.780	Horizontal	Quasi-Peak	30.95	46	15.50	± 3.88

Frequency range 1 GHz-40 GHz

The results in the next tables show the maximum measured levels in the 1-40 GHz range except the 5.65-5.725 GHz and 5.85-5.925GHz adjacent bands. The results in the adjacent bands was evaluated on the next section.

The lowest, middle and highest channels were measured for out-of-band emissions for the worst mode.

Spurious signals with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with an average detector for checking compliance with the average limit.

Mode : 802.11n HT20 – 20MHz – WLAN 0-CORE 0 – SISO - Antenna port RF 2 (worst case)

Channel 149 (5745MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Measurement Uncertainty (dB)
11.49398	Vertical	Peak	64.95	68.23	3.28	± 3.70
		Average	53.09	54	0.91	± 3.70

Channel 157 (5785MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Measurement Uncertainty (dB)
11.5696	Vertical	Peak	60.97	68.23	7.26	± 3.70
		Average	53.23	54	0.77	± 3.70

Channel 165 (5825MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Measurement Uncertainty (dB)
11.64658	Vertical	Peak	59.81	68.23	8.42	± 3.70
		Average	49.13	54	4.87	± 3.70

Verdict: PASS

Mode : 802.11n HT20 – 20MHz – WLAN 1-CORE2 (CORE0+CORE1) - MIMO - Antenna port RF 1 + 4

Channel 149 (5745MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Uncertainty (dB)
11.49888	Vertical	Peak	58.51	68.23	9.72	± 3.70
		Average	48.76	54	5.24	± 3.70

Channel 157 (5785MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Uncertainty (dB)
11.57133	Horizontal	Peak	57.49	68.23	10.74	± 3.70
		Average	47.80	54	6.20	± 3.70

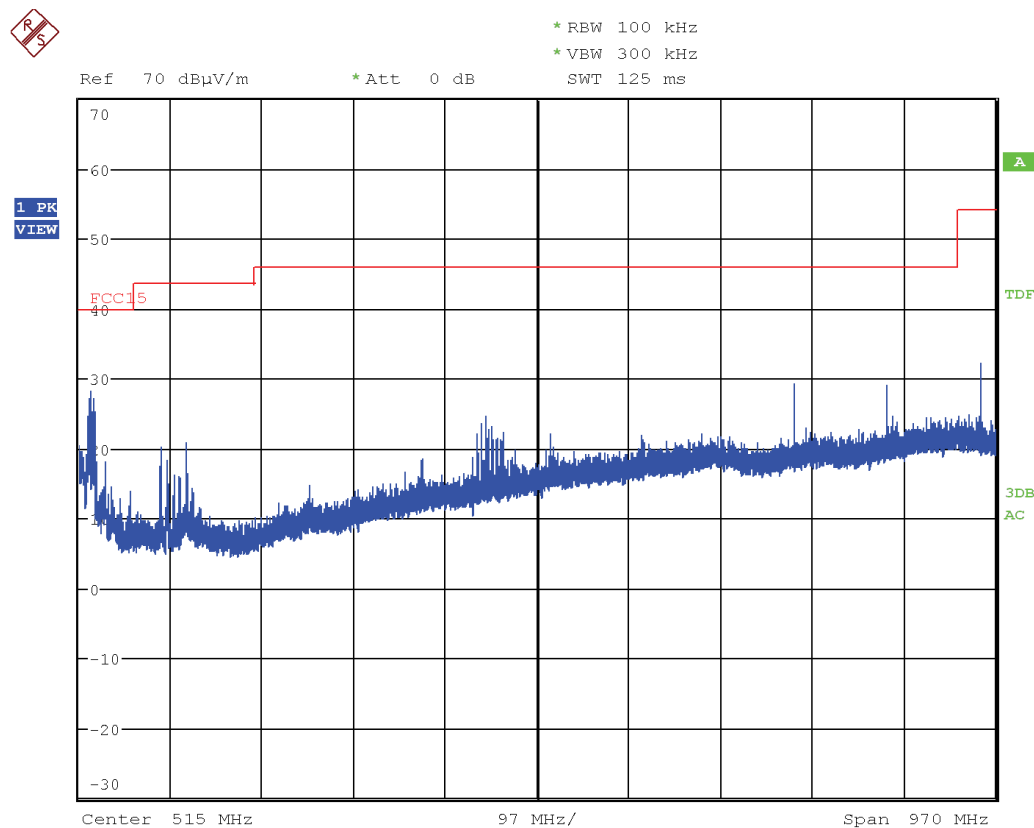
Channel 165 (5825MHz): Out-of-band spurious emissions in the 1-40 GHz range.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Measurement Uncertainty (dB)
11.65218	Horizontal	Peak	58.29	68.23	9.94	± 3.70
		Average	46.47	54	7.53	± 3.70

Verdict: PASS

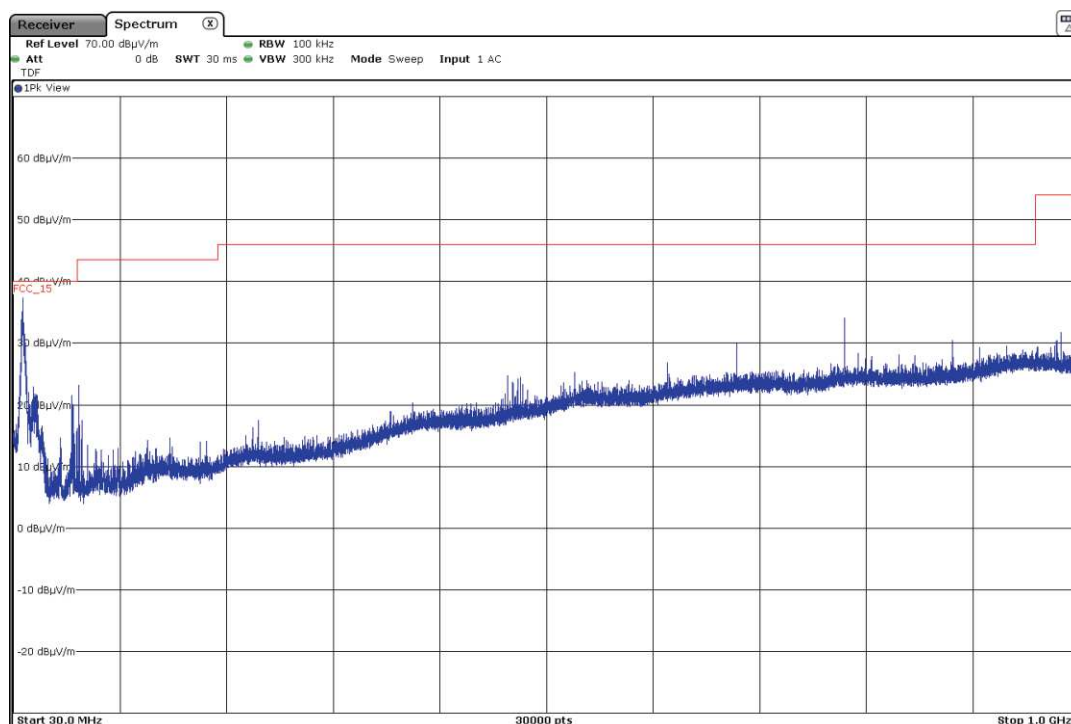
FREQUENCY RANGE 30 MHz-1000 MHz.

Mode : 802.11n HT20 – 20MHz – Antenna RF 2 (worst case)



Note: This plot is valid for all channels and all modulation modes.

Mode : 802.11n HT20 – 20MHz –Mimo Antenna RF 1 + 4 (worst case)

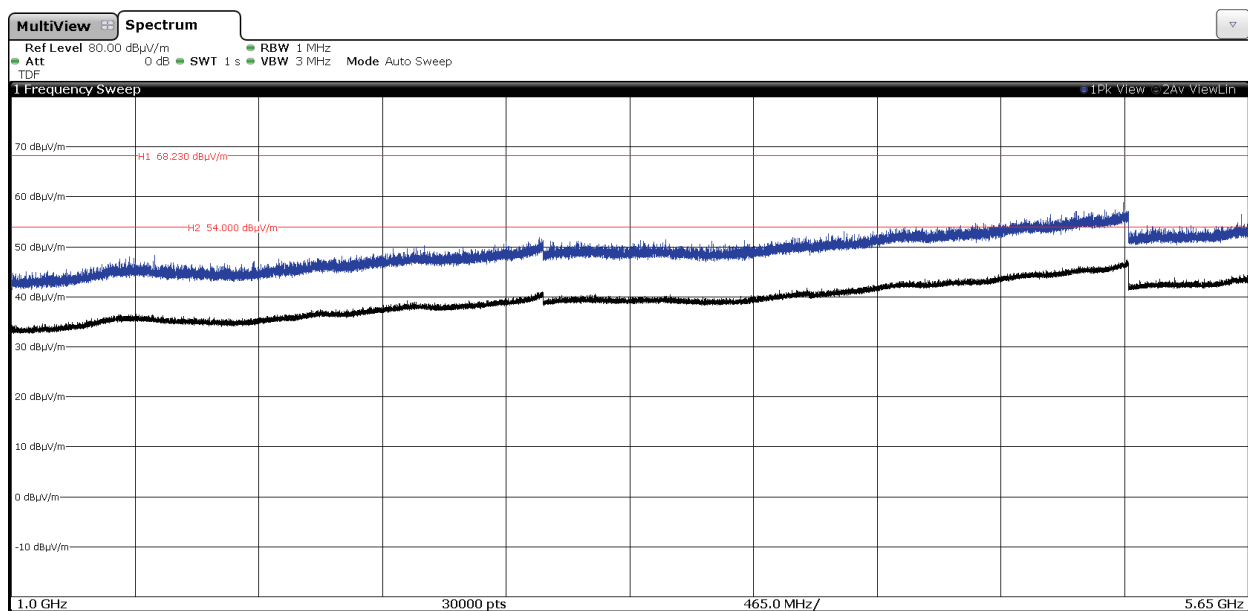


Note: This plot is valid for all channels and all modulation modes.

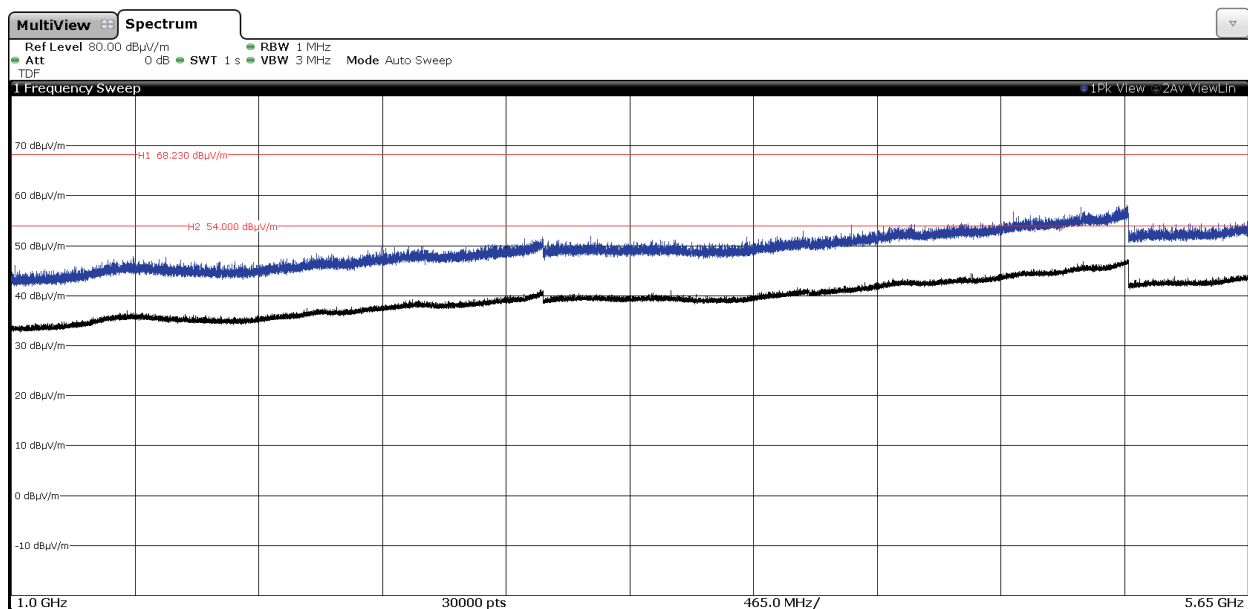
FREQUENCY RANGE 1 GHz to 5.65 GHz.

Mode : 802.11n HT20 – 20MHz – Antenna RF 2 (worst case)

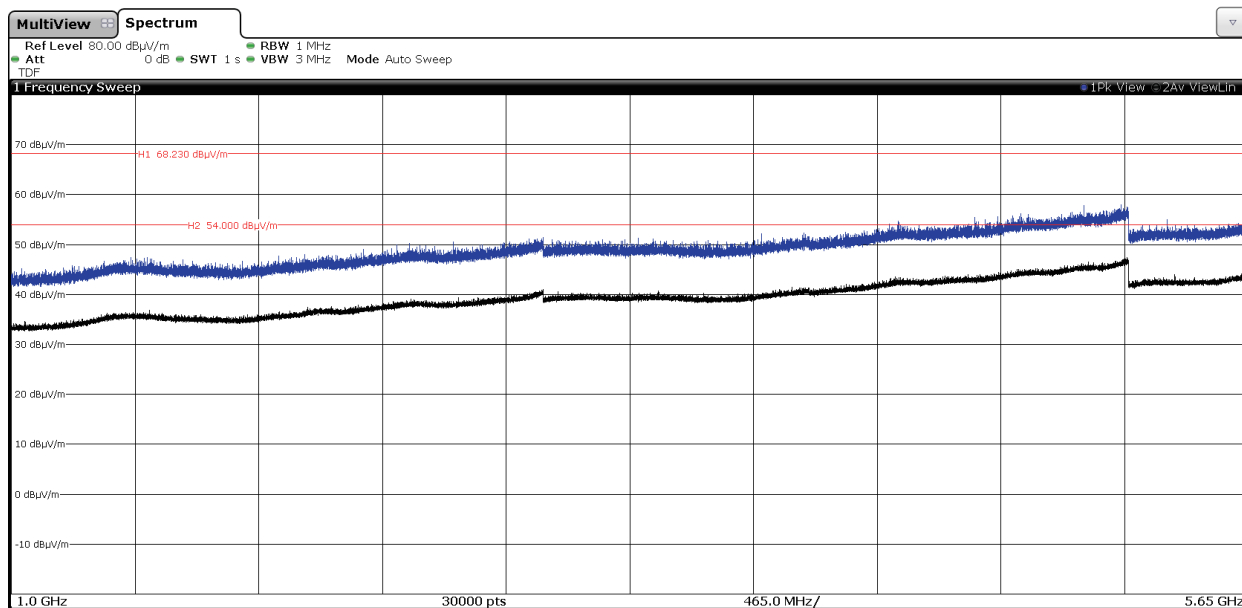
Channel 149 (5745MHz):



Channel 157 (5785MHz):

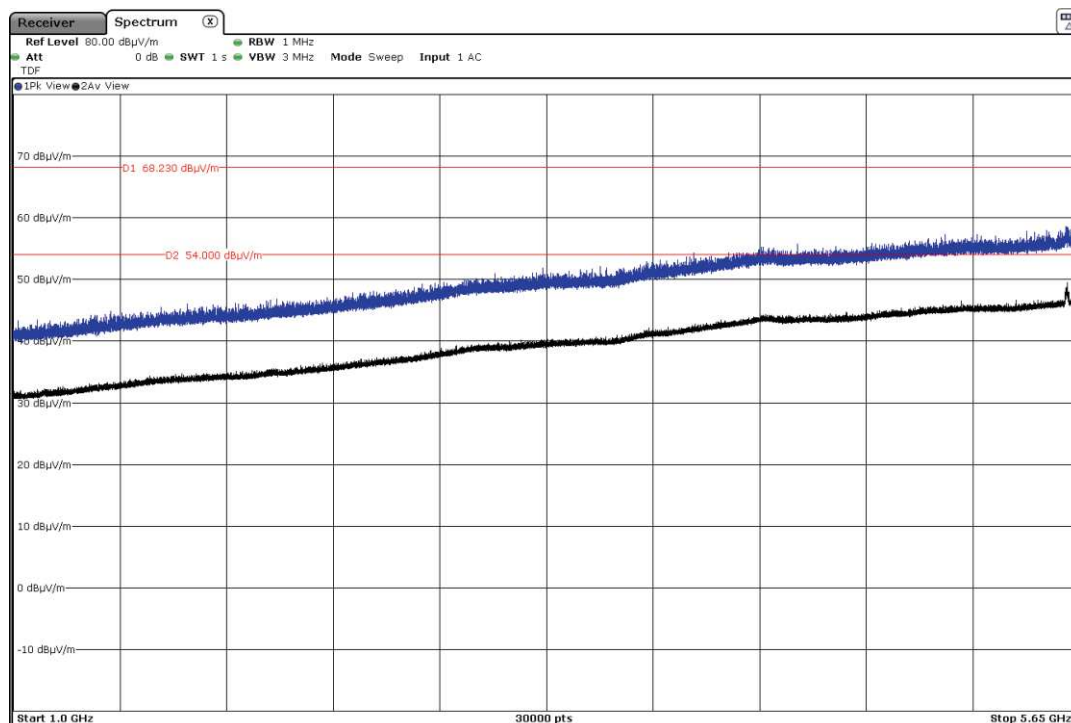


Channel 165 (5825MHz):

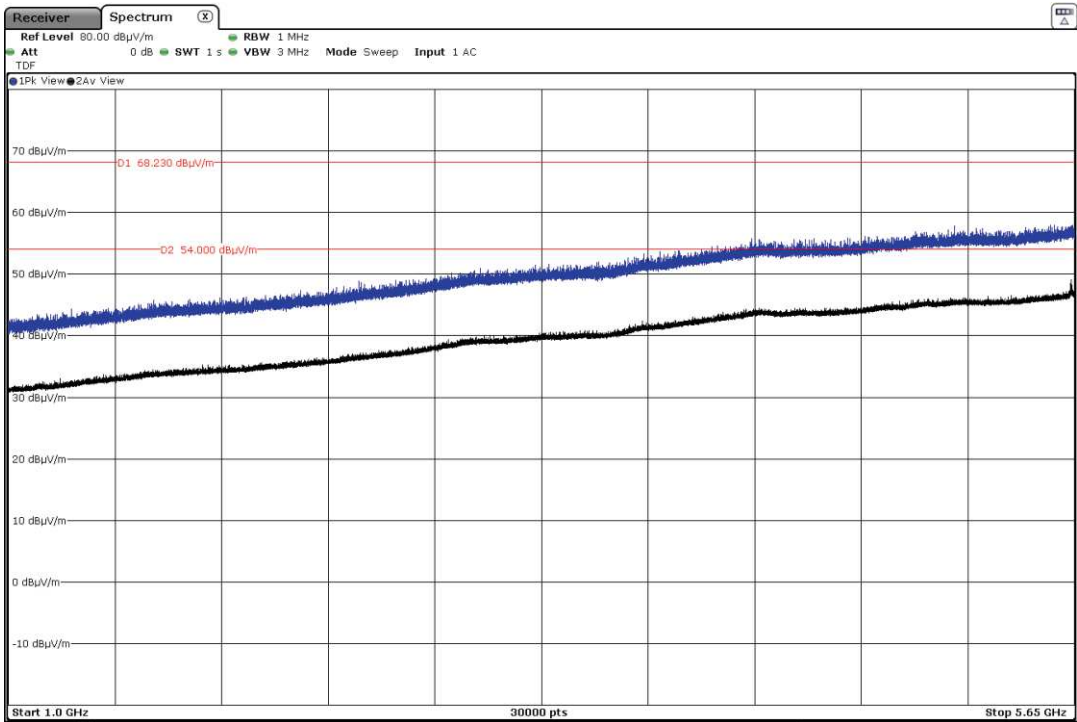


Mode : 802.11n HT20 – 20MHz –Mimo Antenna RF 1 + 4 (worst case)

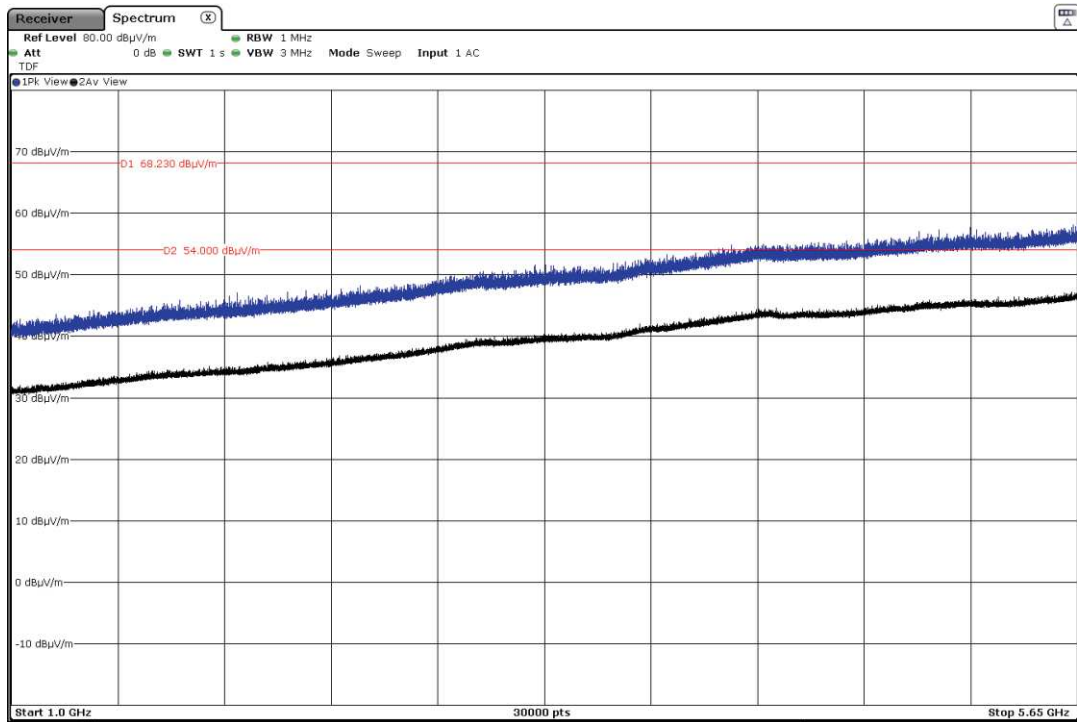
Channel 149 (5745MHz):



Channel 157 (5785MHz):



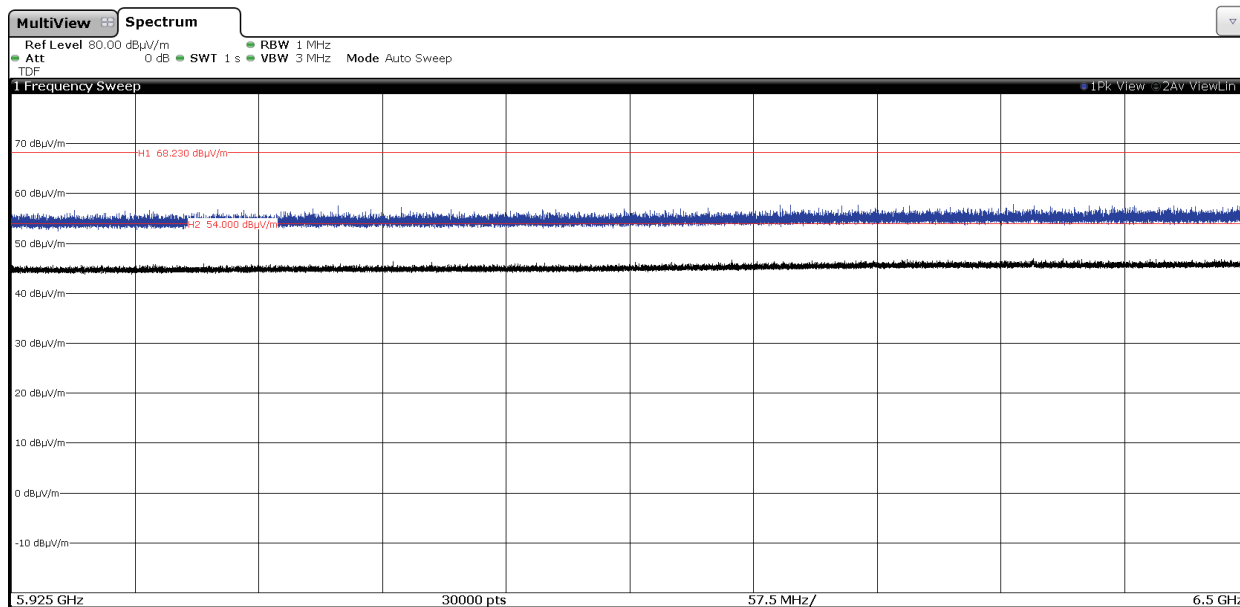
Channel 165 (5825MHz):



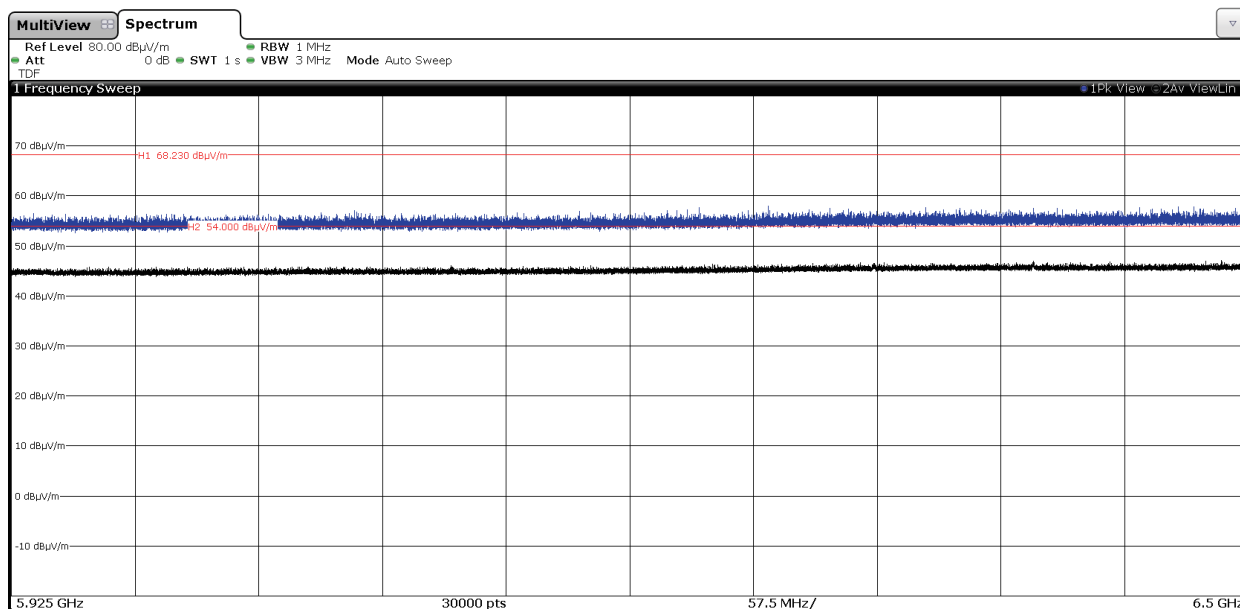
FREQUENCY RANGE 5.925 GHz to 7 GHz.

Mode : 802.11n HT20 – 20MHz – Antenna RF 2 (worst case)

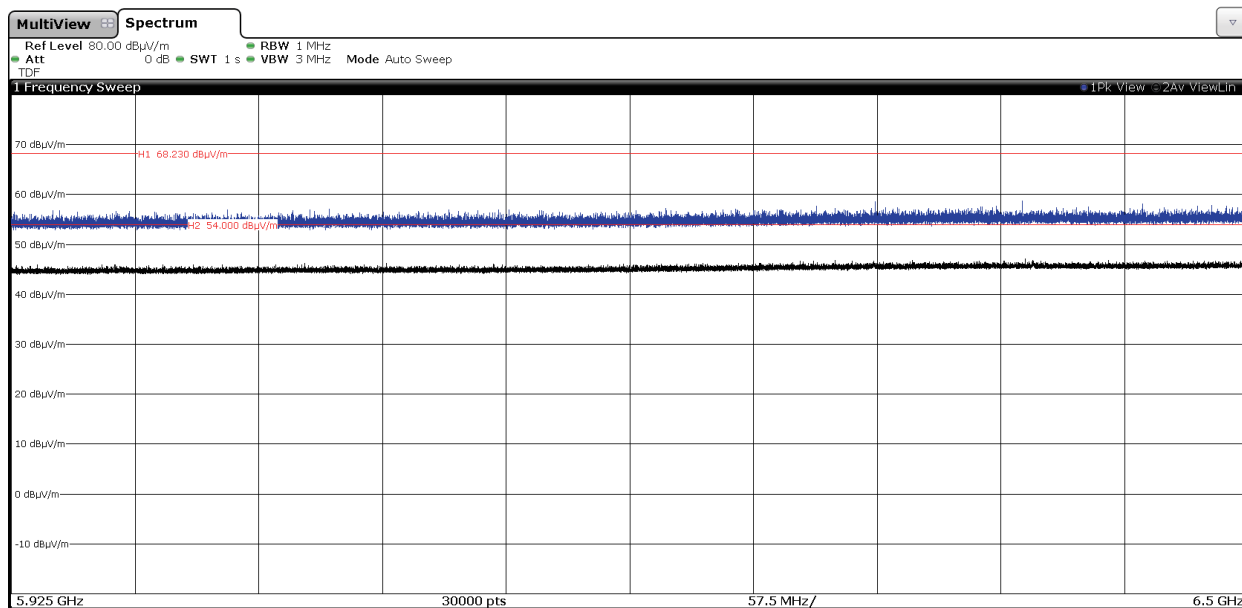
Channel 149 (5745MHz):



Channel 157 (5785MHz):

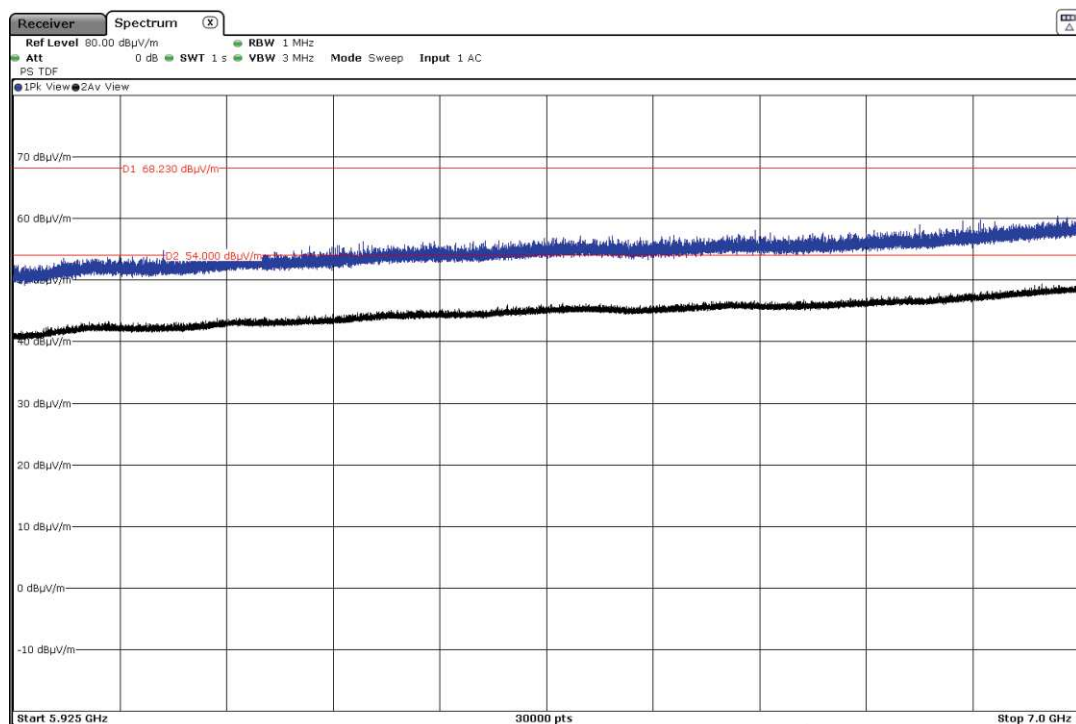


Channel 165 (5825MHz):

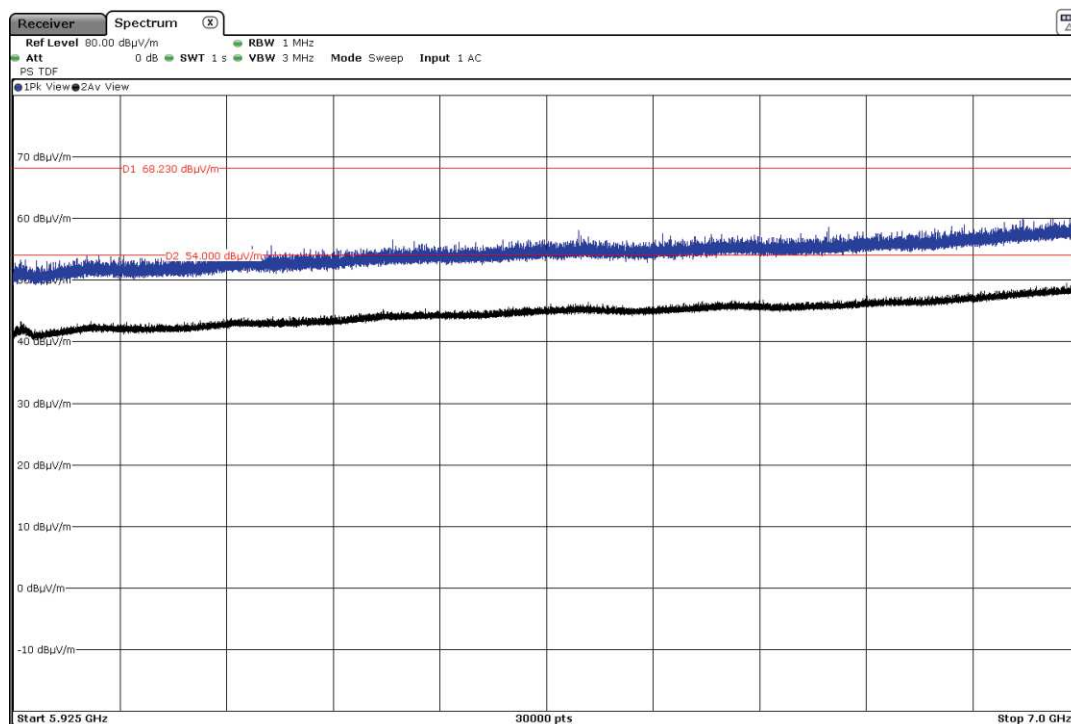


Mode : 802.11n HT20 – 20MHz –Mimo Antenna RF 1 + 4 (worst case)

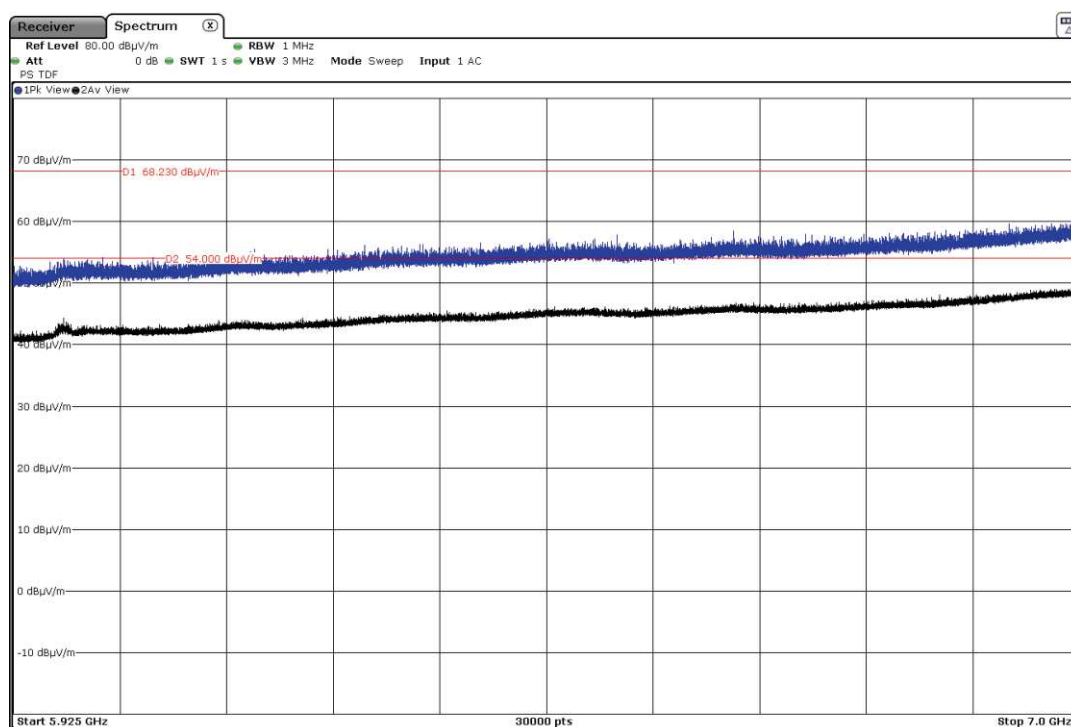
Channel 149 (5745MHz):



Channel 157 (5785MHz):



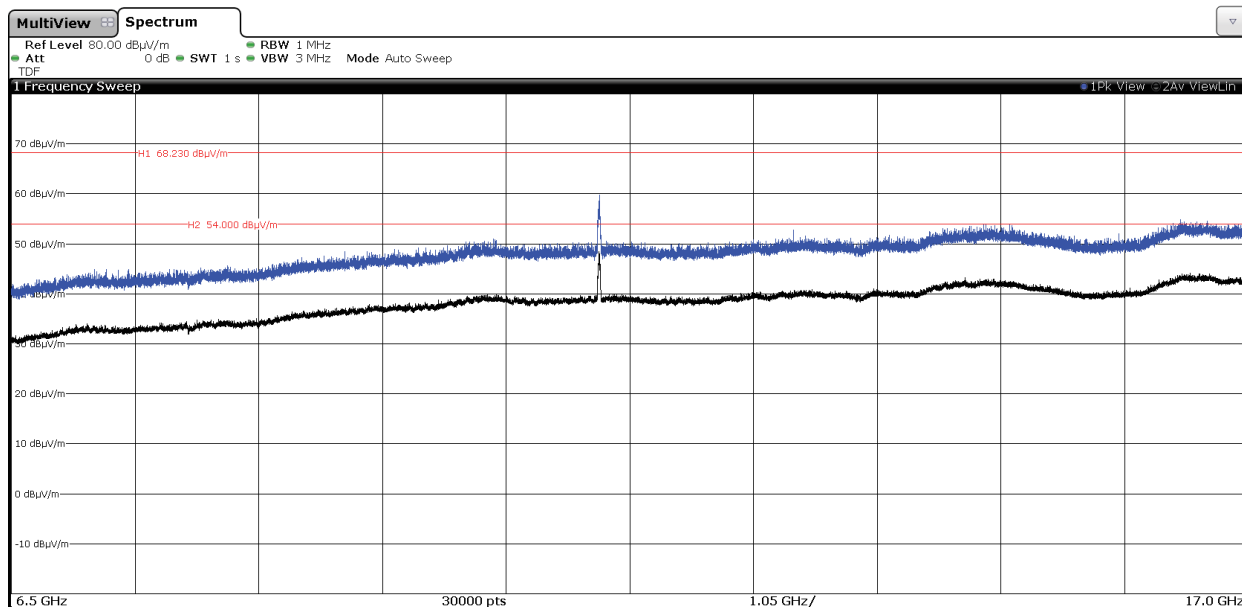
Channel 165 (5825MHz):



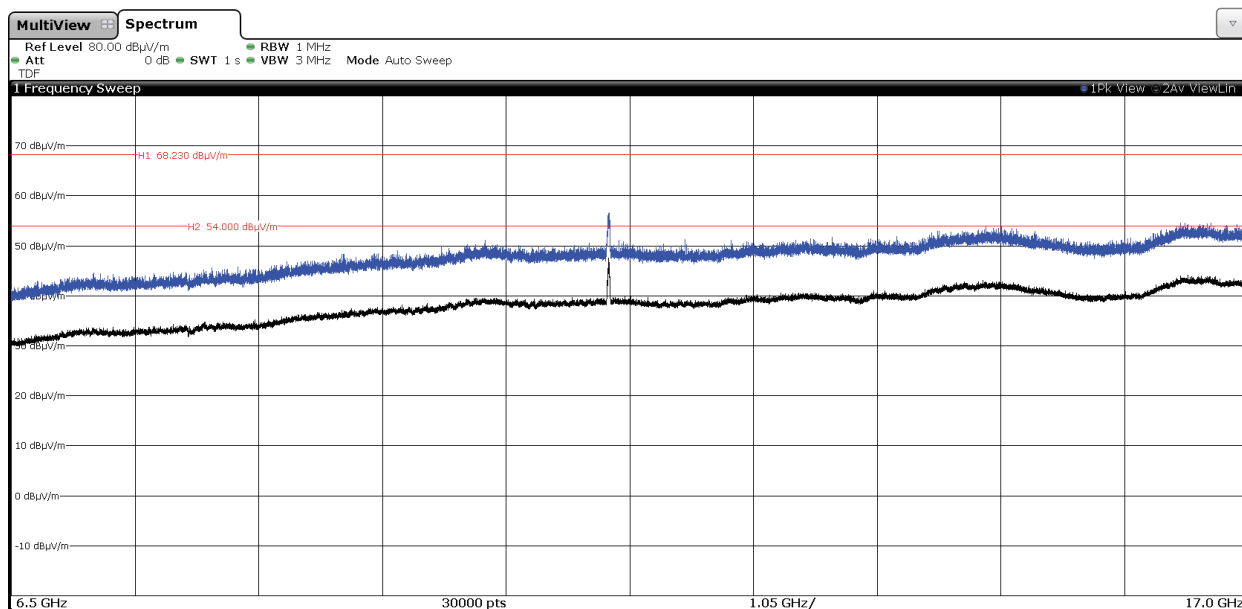
FREQUENCY RANGE 6.5 GHz to 17 GHz.

Mode : 802.11n HT20 – 20MHz – Antenna RF 2 (worst case)

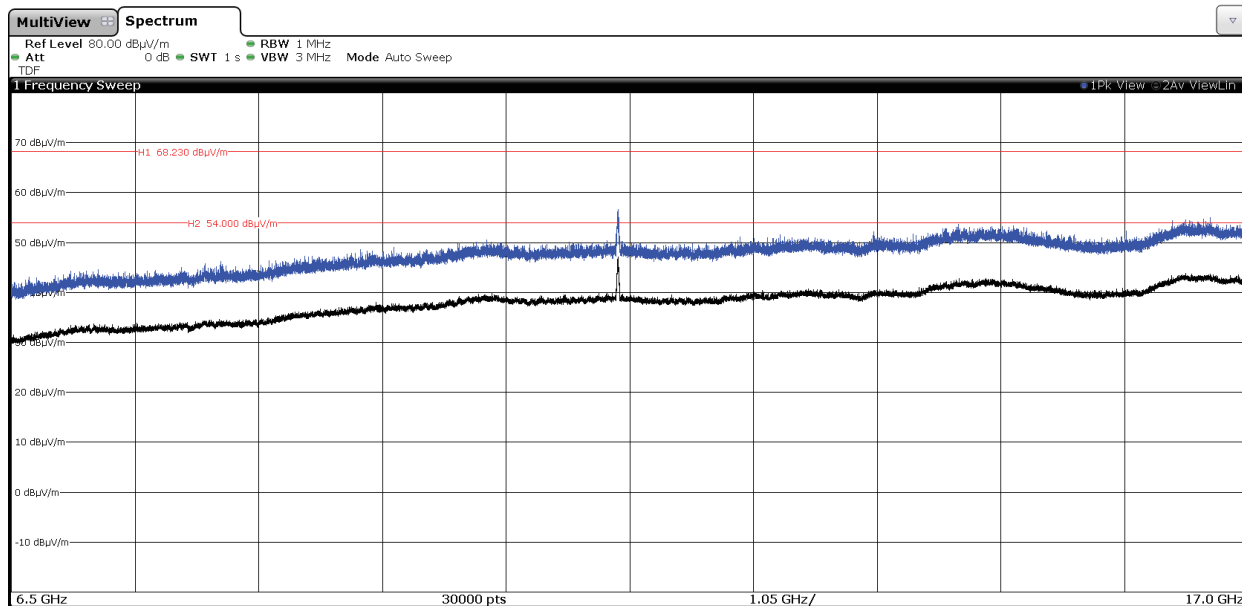
Channel 149 (5745MHz):



Channel 157 (5785MHz):

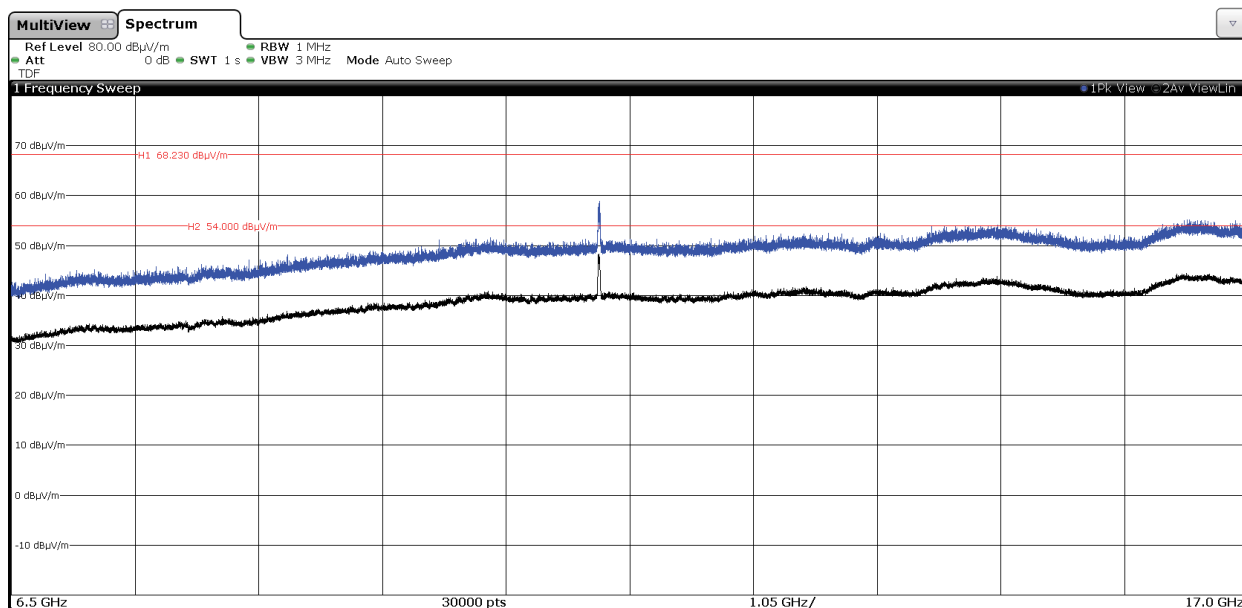


Channel 165 (5825MHz):

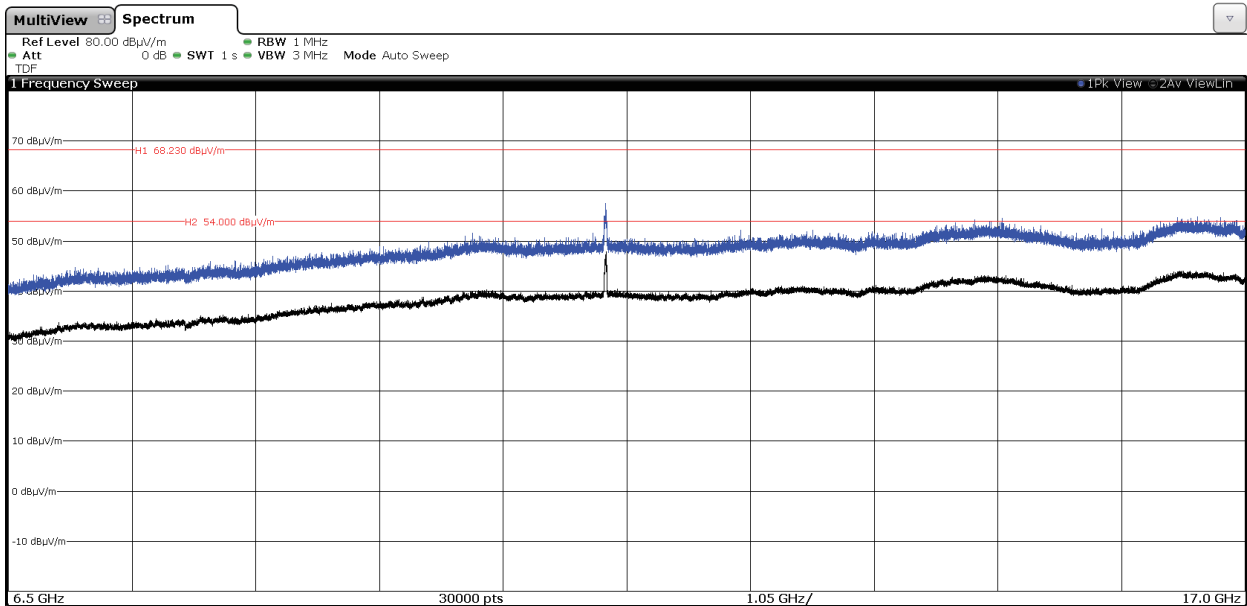


Mode : 802.11n HT20 – 20MHz –Mimo Antenna RF 1 + 4 (worst case)

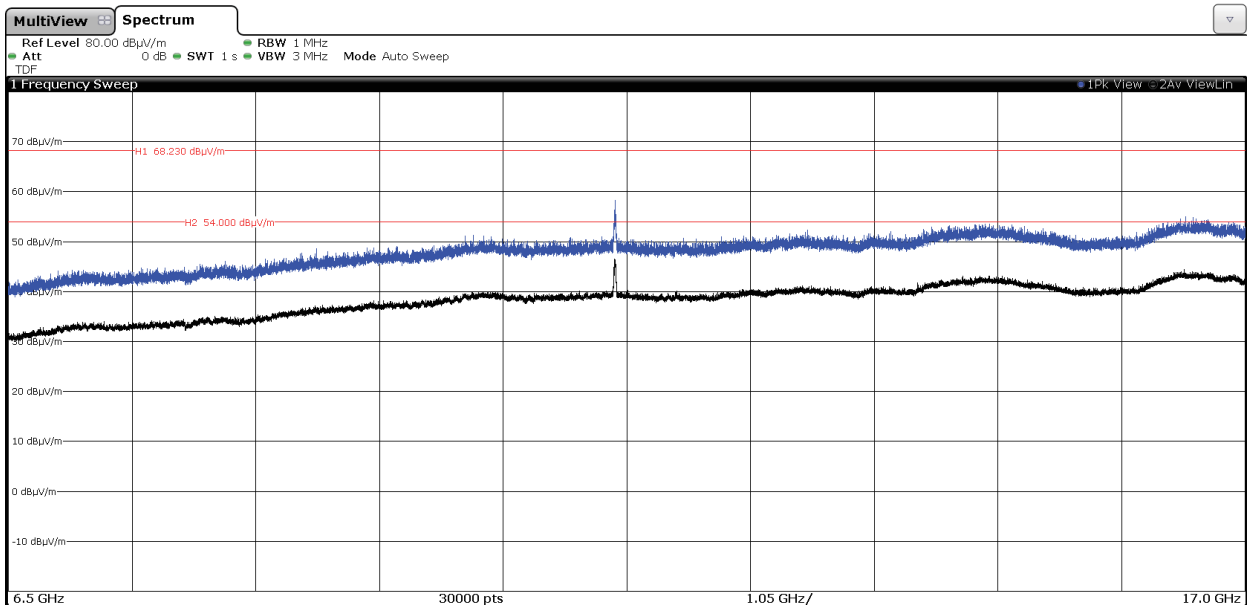
Channel 149 (5745MHz):



Channel 157 (5785MHz):

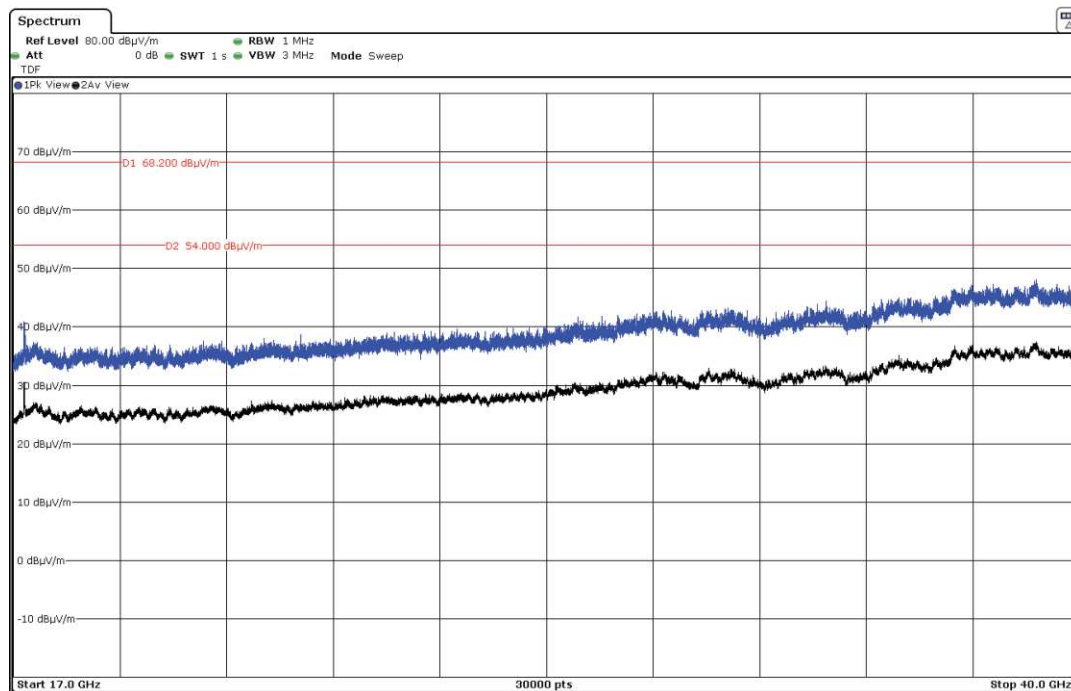


Channel 165 (5825MHz):



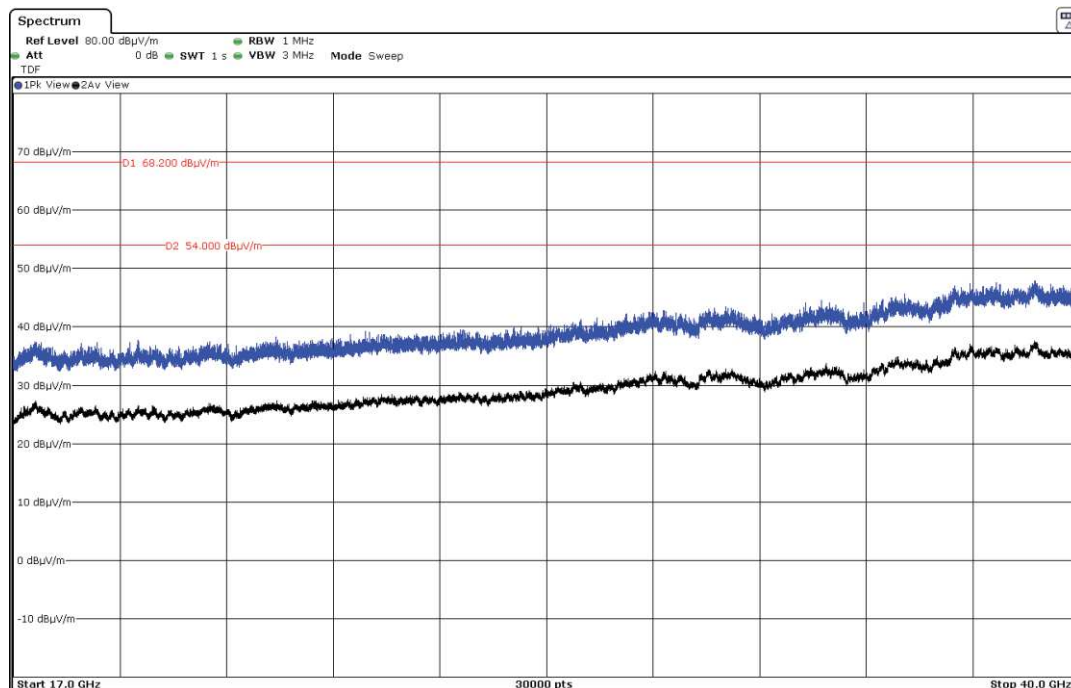
FREQUENCY RANGE 17 GHz to 40 GHz.

Mode : 802.11n HT20 – 20MHz – Antenna RF 2 (worst case)



Note: This plot is valid for all channels and all modulation modes.

Mode : 802.11n HT20 – 20MHz –Mimo Antenna RF 1 + 4 (worst case)



Note: This plot is valid for all channels and all modulation modes.