8.5.4 Test data, continued

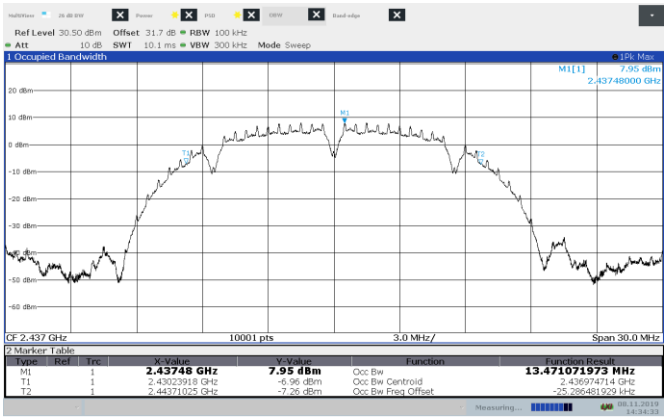

Figure 8.5-5: *99% occupied bandwidth on 802.11b, sample plot*

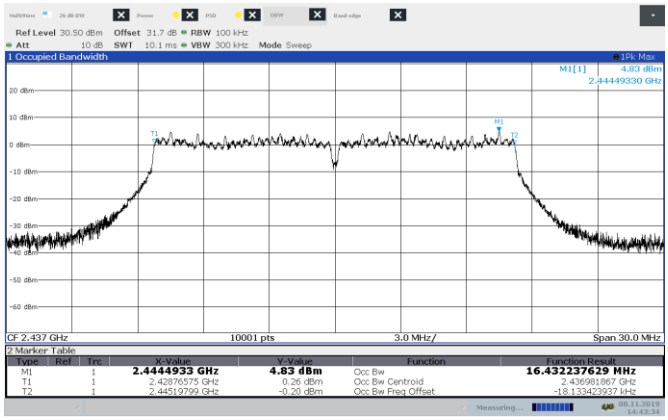

Figure 8.5-6: *99% occupied bandwidth on 802.11g, sample plot*

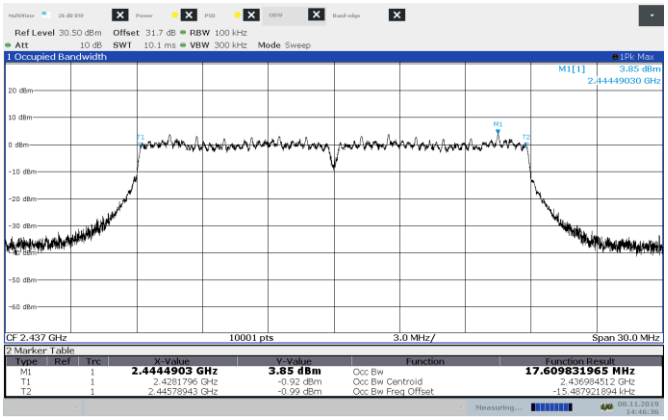

Figure 8.5-7: *99% occupied bandwidth on 802.11n HT20, sample plot*

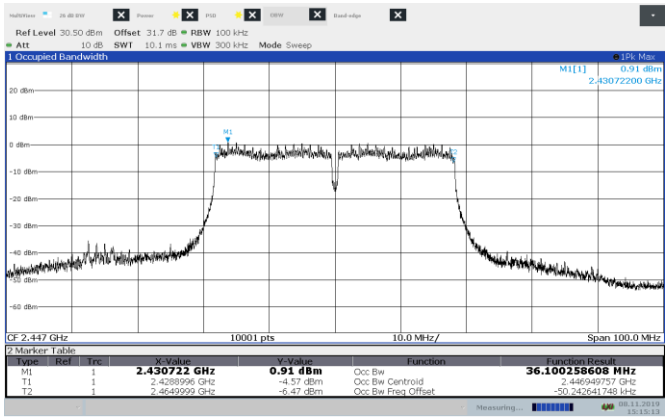

Figure 8.5-8: *99% occupied bandwidth on 802.11n HT40, sample plot*

8.6 FCC 15.247(b(3)(4)) Transmitter output power and e.i.r.p. requirements

8.6.1 Definitions and limits

FCC §15.247:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.6.2 Test date

Start date	October 17, 2019

8.6.3 Observations, settings and special notes

- The test was performed as per KDB 558074, section 8.3 with reference to ANSI C63.10 subclause 11.9.2 (average power)
- The test was performed using method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

Spectrum analyser settings:

Resolution bandwidth	1–5 % OBW
Video bandwidth	≥3 × RBW
Frequency span	30 MHz for 20 MHz channel; 60 MHz for 40 MHz channel
Detector mode	RMS
Trace mode	Average

8.6.4 Test data

Table 8.6-1: Output power measurements results - 802.11b modulation

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	16.40	30.00	13.60	3.96	20.36	36.00	15.64
2437	16.71	30.00	13.29	3.96	20.67	36.00	15.33
2462	15.75	30.00	14.25	3.96	19.71	36.00	16.29

Notes: EIRP = Output power + Antenna gain

Table 8.6-2: Output power measurements results - 802.11g modulation

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	11.57	30.00	18.43	3.96	15.53	36.00	20.47
2437	11.94	30.00	18.06	3.96	15.90	36.00	20.10
2462	11.03	30.00	18.97	3.96	14.99	36.00	21.01

Notes: EIRP = Output power + Antenna gain

Table 8.6-3: Output power measurements results - 802.11n HT20 modulation

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2412	10.54	30.00	19.46	3.96	14.50	36.00	21.50
2437	10.87	30.00	19.13	3.96	14.83	36.00	21.17
2462	10.08	30.00	19.92	3.96	14.04	36.00	21.96

Notes: EIRP = Output power + Antenna gain

Table 8.6-4: Output power measurements results - 802.11n HT40 modulation

Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2422	8.20	30.00	21.80	3.96	12.16	36.00	23.84
2447	8.12	30.00	21.88	3.96	12.08	36.00	23.92
2452	7.87	30.00	22.13	3.96	11.83	36.00	24.17

Notes: EIRP = Output power + Antenna gain

8.6.4 Test data, continued

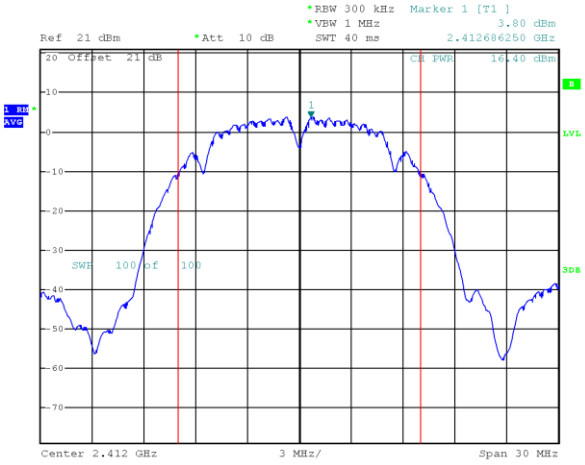

Figure 8.6-1: Conducted output power 802.11b, sample plot

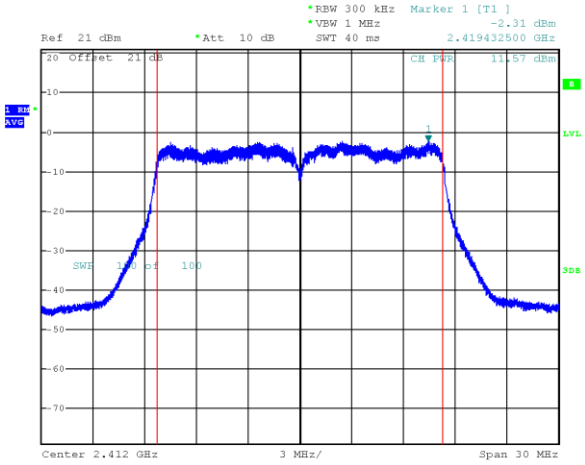

Figure 8.6-2: Conducted output power on 802.11g, sample plot

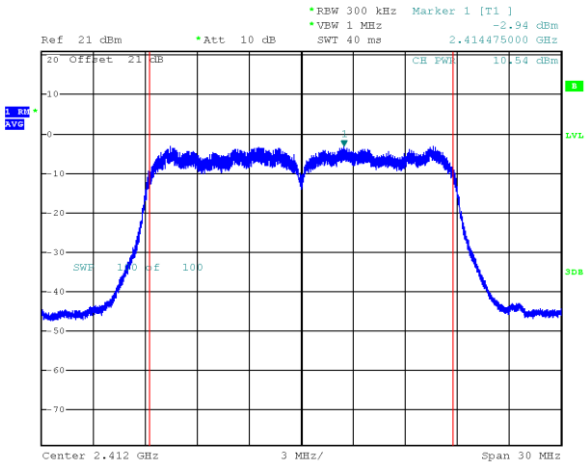

Figure 8.6-3: Conducted output power on 802.11n HT20, sample plot

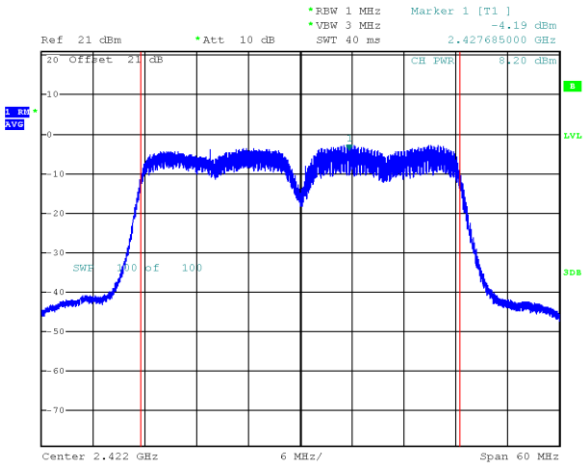

Figure 8.6-4: Conducted output power on 802.11n HT40, sample plot

8.7 FCC 15.247(d) Spurious (out-of-band) unwanted emissions

8.7.1 Definitions and limits

FCC §15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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)).

Table 8.7-1: FCC §15.209 – Radiated emission limits

Frequency, MHz	Field strength of emissions µV/m	Field strength of emissions dBµV/m	Measurement distance, m
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.7-2: FCC §15.205 – Restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

Notes: None

8.7.2 Test date

Start date	October 16, 2019

8.7.3 Observations, settings and special notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
  EUT was set to transmit with 100 % duty cycle.
- Radiated measurements from 1 – 18 GHz were performed at a distance of 3 m.
- Radiated measurements from 18 - 25 GHz were performed at a distance of 1 m.
- DTS emissions in non-restricted frequency bands test was performed as per KDB 558074, section 8.5 with reference to ANSI C63.10 subclause 11.11.
- Since fundamental power was tested using maximum conducted (average) output power procedure to demonstrate compliance, the spurious emissions limit is −30 dBc/100 kHz.
- DTS emissions in restricted frequency bands test was performed as per KDB 558074, section 8.6 with reference to ANSI C63.10 subclause 11.12.2.7.
- DTS band-edge emission measurements test was performed as per KDB 558074, section 8.7 with reference to ANSI C63.10 subclause 11.13.

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz or 120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Detector mode	RMS
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Average (100 Counts)

Spectrum analyser settings for conducted spurious emissions measurements:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

8.7.4 Test data

Table 8.7-3: Radiated field strength measurement results for 802.11b

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	67.38	74.00	6.62	42.88	54.00	11.12
High	2483.5	66.60	74.00	7.40	43.81	54.00	10.19
Low	4824.0	55.36	74.00	18.64	50.83	54.00	3.17
Mid	7311.0	55.57	74.00	18.43	48.20	54.00	5.8

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.7-4: Radiated field strength measurement results for 802.11g

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	70.73	74.00	3.27	48.51	54.00	5.49
High	2483.5	73.61	74.00	0.39	46.97	54.00	7.03
Mid	7311.0	56.65	74.00	17.35	43.32	54.00	10.68

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.7-5: Radiated field strength measurement results for 802.11n HT20

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	73.25	74.00	0.75	49.42	54.00	4.58
High	2483.5	72.75	74.00	1.25	48.08	54.00	5.92
Mid	7311.0	57.80	74.00	16.20	42.30	54.00	11.70

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.7-6: Radiated field strength measurement results for 802.11n HT40

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390.0	72.66	74.00	1.34	51.38	54.00	2.62
High	2483.5	71.21	74.00	2.79	51.97	54.00	2.03
Mid	7341.0	53.62	74.00	20.38	39.97	54.00	14.03

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

8.7.4 Test data, continued

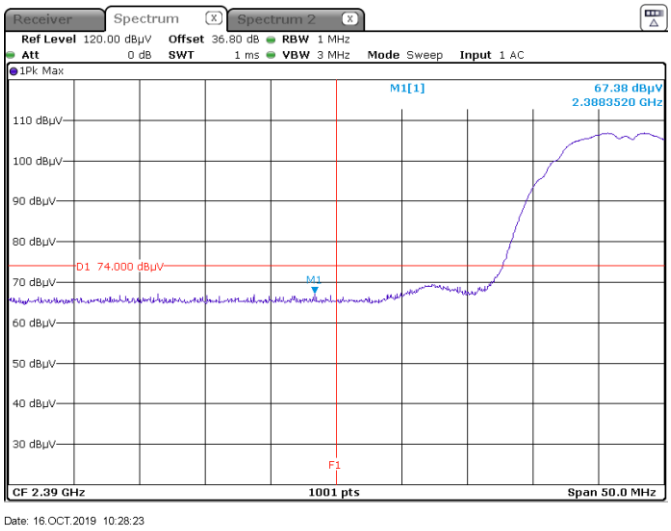

Figure 8.7-1: Unwanted emissions in restricted band 2390 MHz 802.11b, low channel, Peak

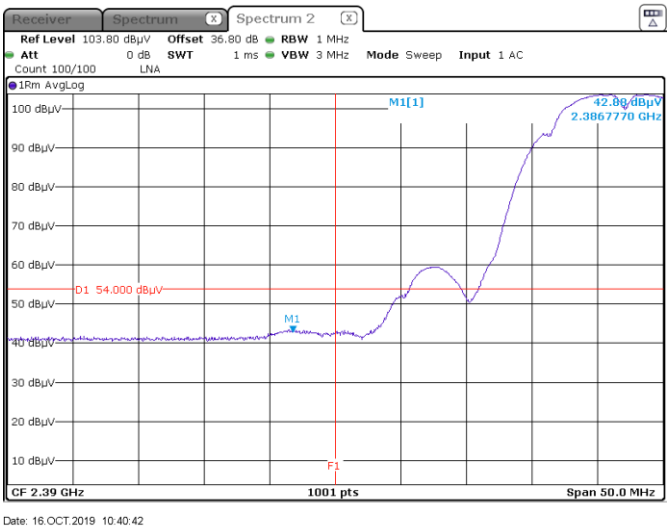

Figure 8.7-2: Unwanted emissions in restricted band 2390 MHz 802.11b, low channel, Average

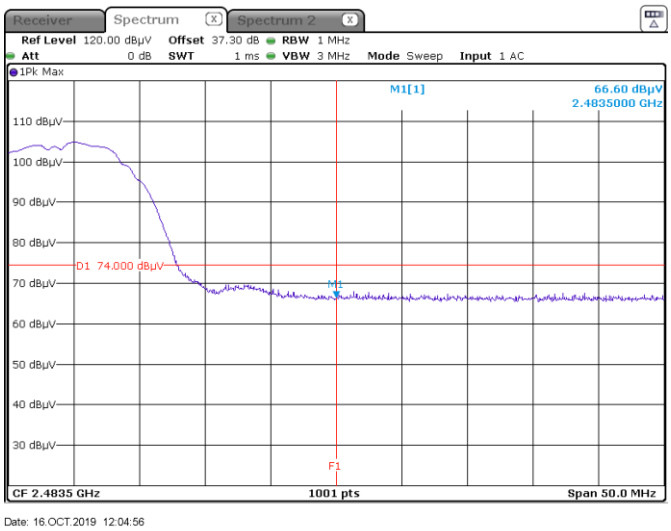

Figure 8.7-3: Unwanted emissions in restricted band 2483.5 MHz 802.11b, high channel, Peak

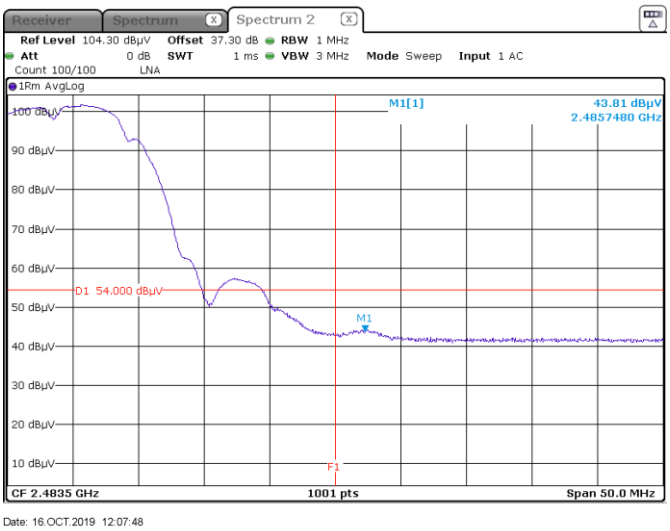

Figure 8.7-4: Unwanted emissions in restricted band 2483.5 MHz 802.11b, high channel, Average

8.7.4 Test data, continued

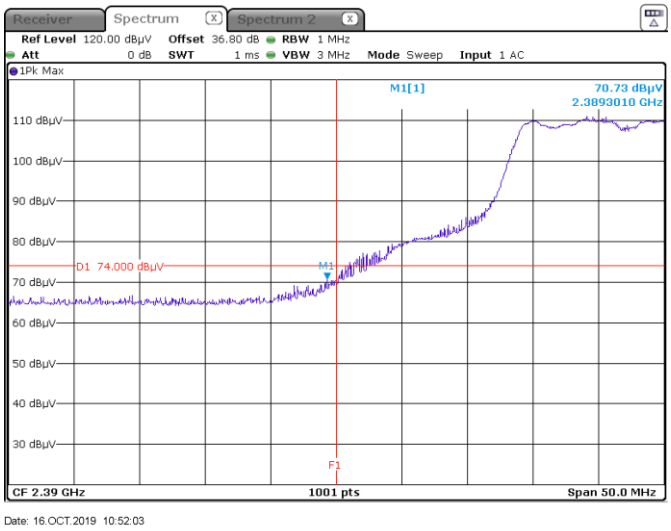

Figure 8.7-5: Unwanted emissions in restricted band 2390 MHz 802.11g, low channel, Peak

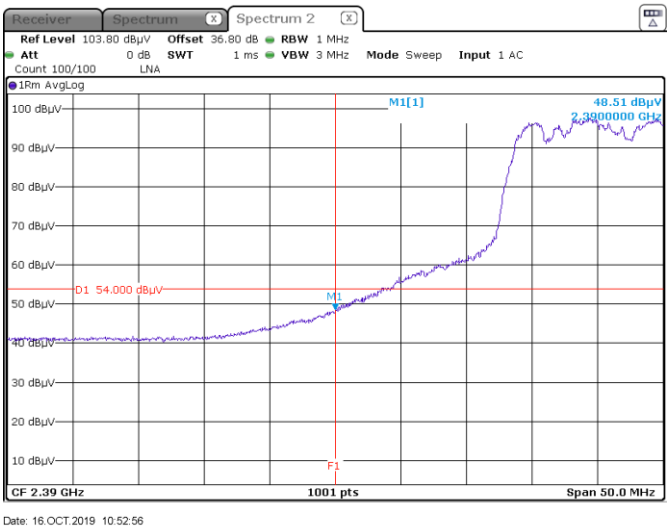

Figure 8.7-6: Unwanted emissions in restricted band 2390 MHz 802.11g, low channel, Average

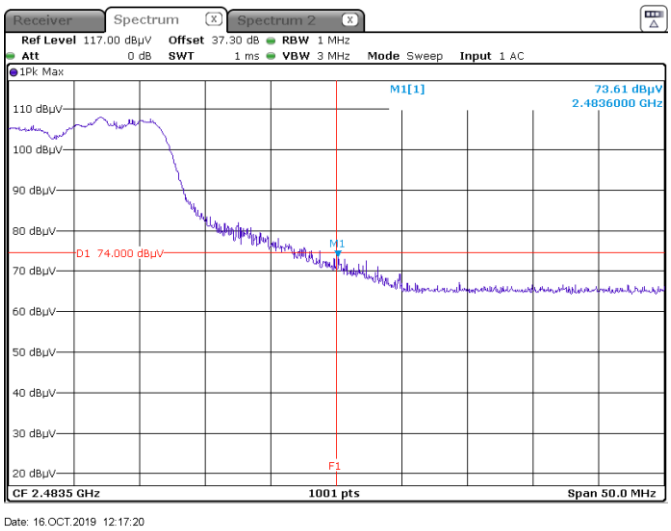

Figure 8.7-7: Unwanted emissions in restricted band 2483.5 MHz 802.11g, high channel, Peak

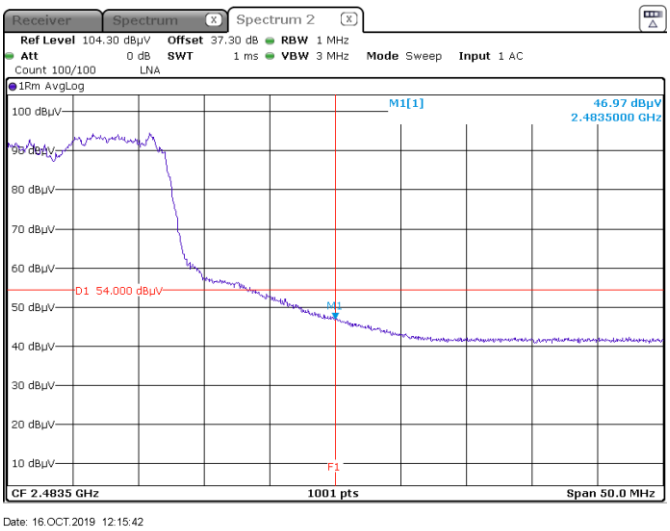

Figure 8.7-8: Unwanted emissions in restricted band 2483.5 MHz 802.11g, high channel, Average

8.7.4 Test data, continued

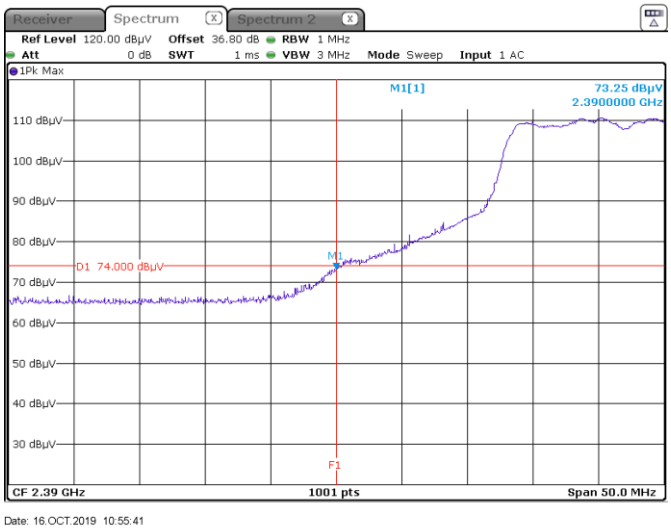

Figure 8.7-9: Unwanted emissions in restricted band 2390 MHz 802.11n HT20, low channel, Peak

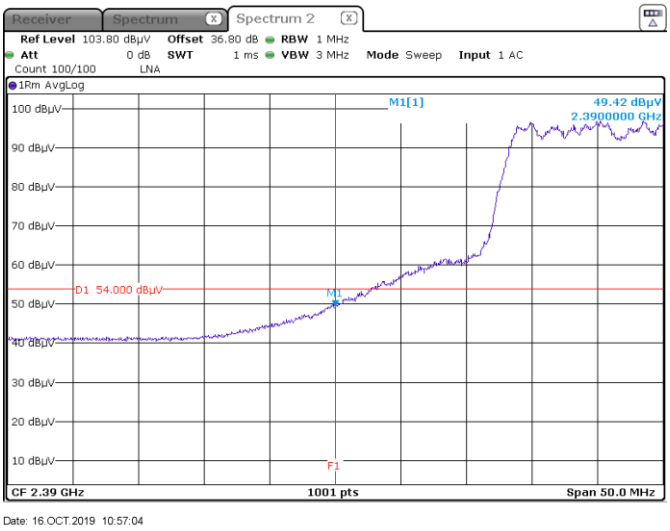

Figure 8.7-10: Unwanted emissions in restricted band 2390 MHz 802.11n HT20, low channel, Average

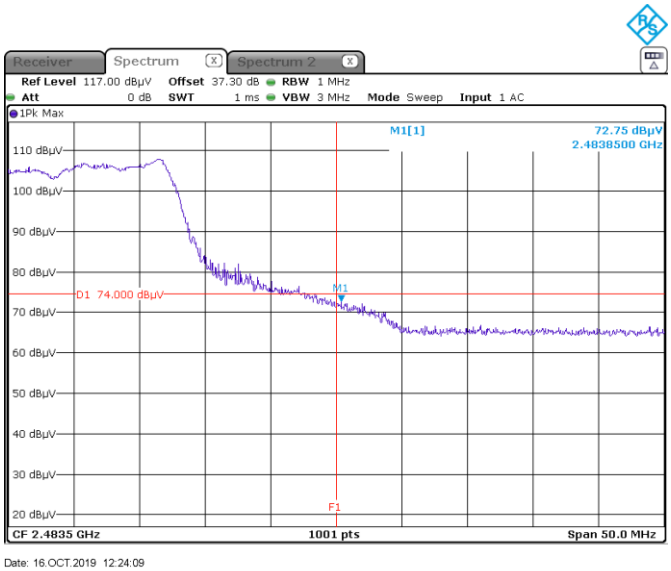

Figure 8.7-11: Unwanted emissions in restricted band 2483.5 MHz 802.11n HT20, high channel, Peak

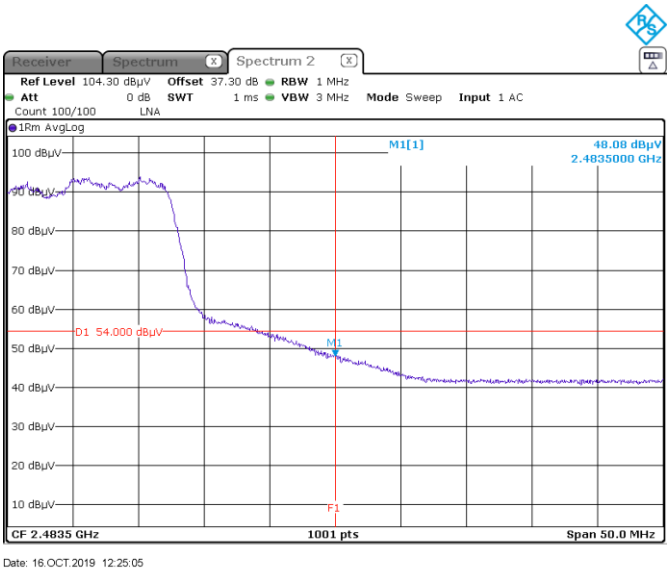

Figure 8.7-12: Unwanted emissions in restricted band 2483.5 MHz 802.11n HT20, high channel, Average

8.7.4 Test data, continued

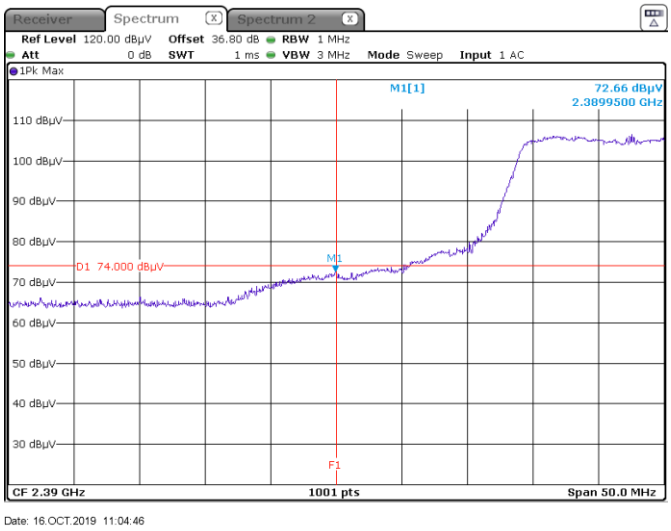

Figure 8.7-13: Unwanted emissions in restricted band 2390 MHz 802.11n HT40, low channel, Peak

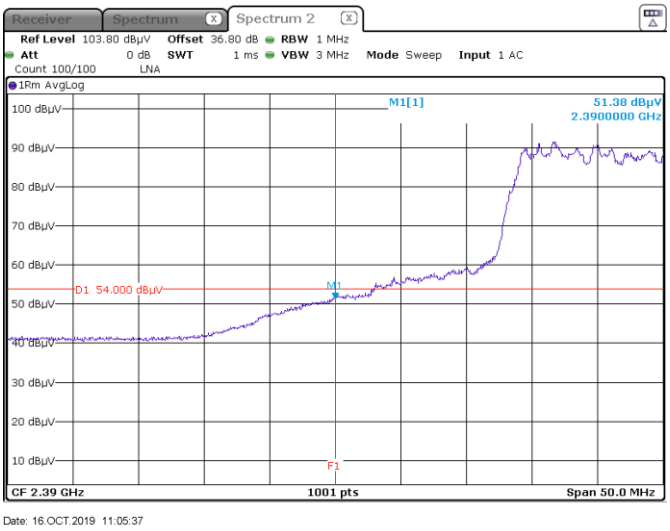

Figure 8.7-14: Unwanted emissions in restricted band 2390 MHz 802.11n HT40, low channel, Average

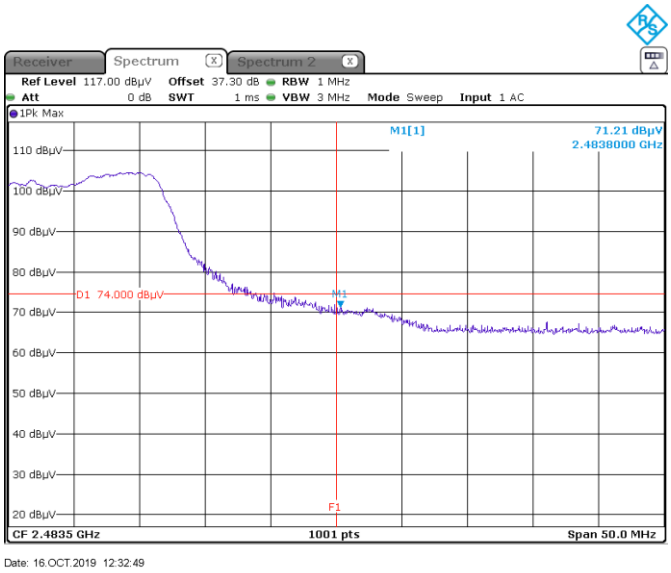

Figure 8.7-15: Unwanted emissions in restricted band 2483.5 MHz 802.11n HT40, high channel, Peak

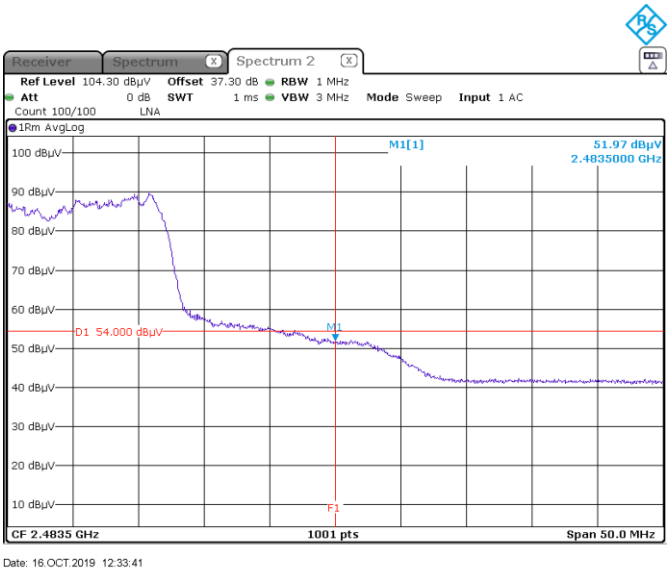

Figure 8.7-16: Unwanted emissions in restricted band 2483.5 MHz 802.11n HT40, high channel, Average

8.7.4 Test data, continued

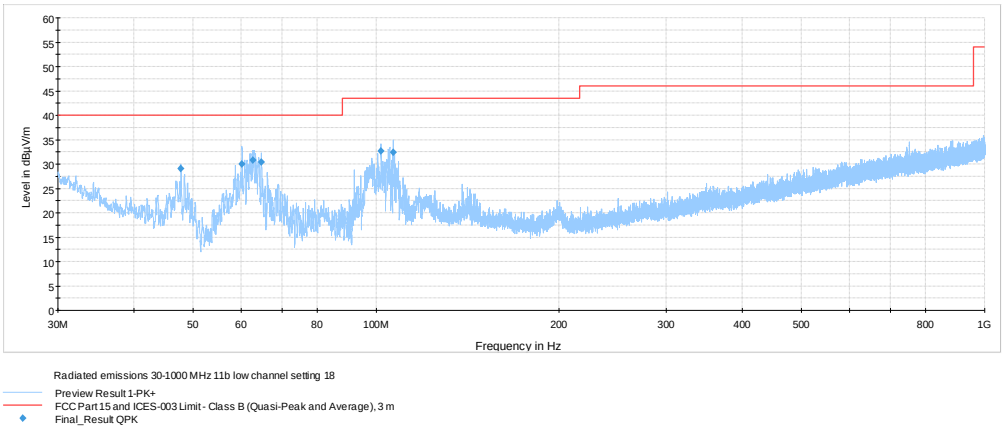

Figure 8.7-17: Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, low channel

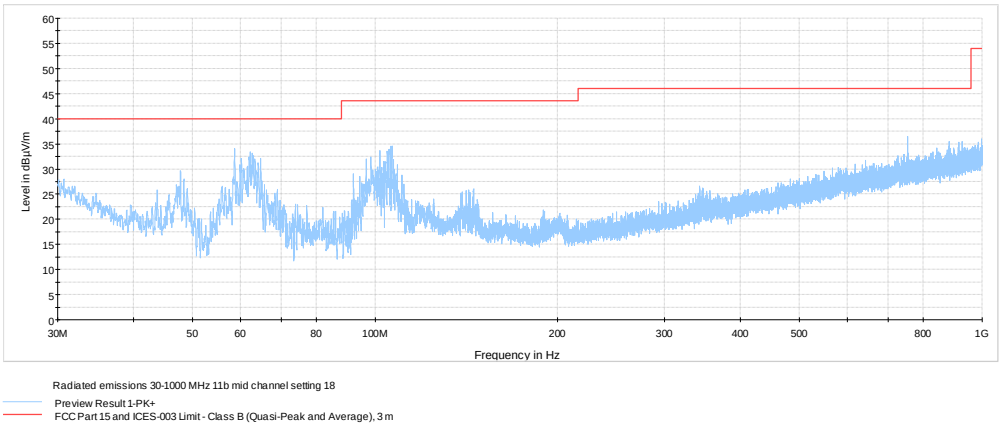

Figure 8.7-18: Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, mid channel

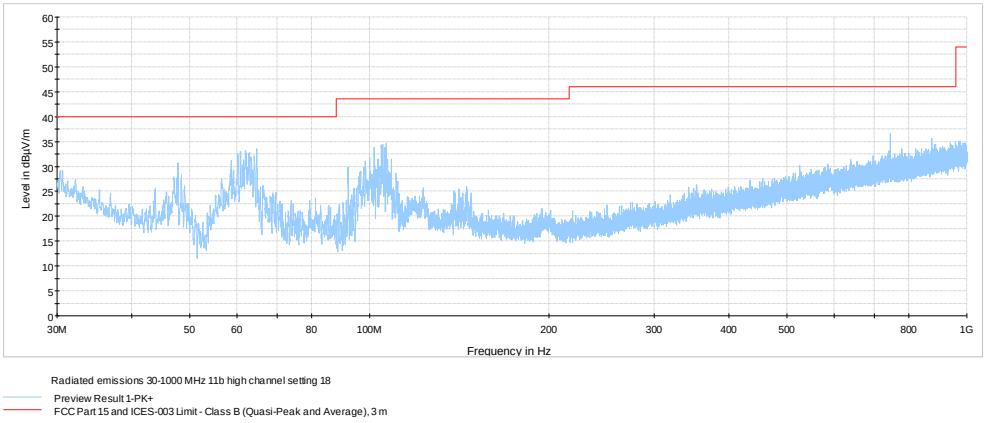

Figure 8.7-19: Radiated spurious emissions 30 MHz – 1 GHz for 802.11b, high channel

8.7.4 Test data, continued

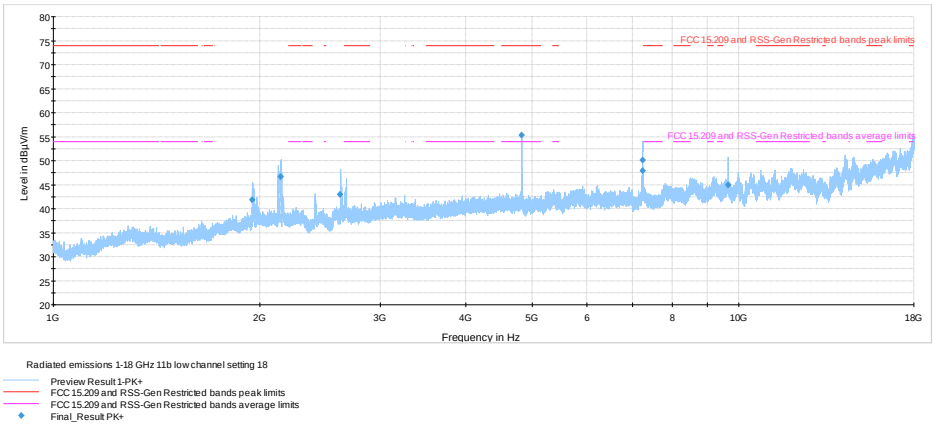

Figure 8.7-20: Radiated spurious emissions 1 - 18 GHz for 802.11b, low channel

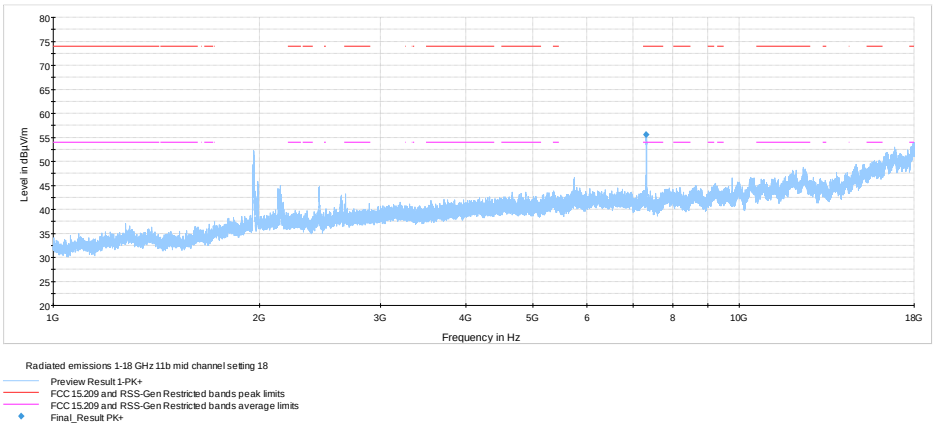

Figure 8.7-21: Radiated spurious emissions 1 - 18 GHz for 802.11b, mid channel

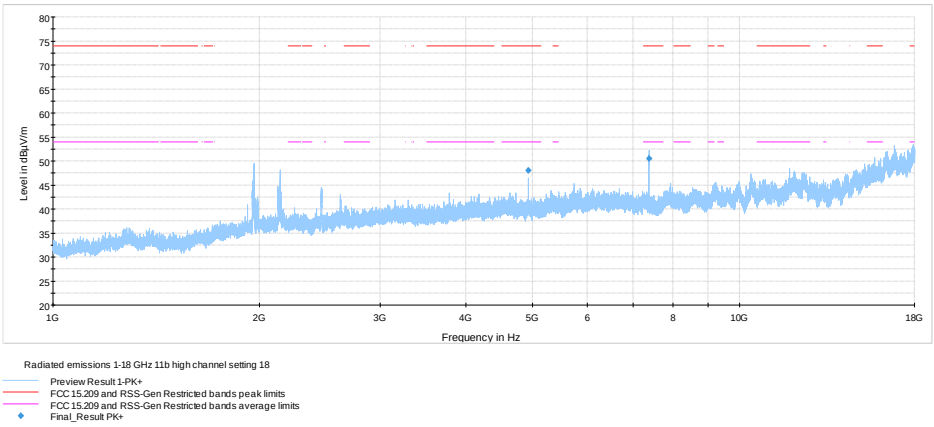

Figure 8.7-22: Radiated spurious emissions 1 - 18 GHz for 802.11b, high channel

8.7.4 Test data, continued

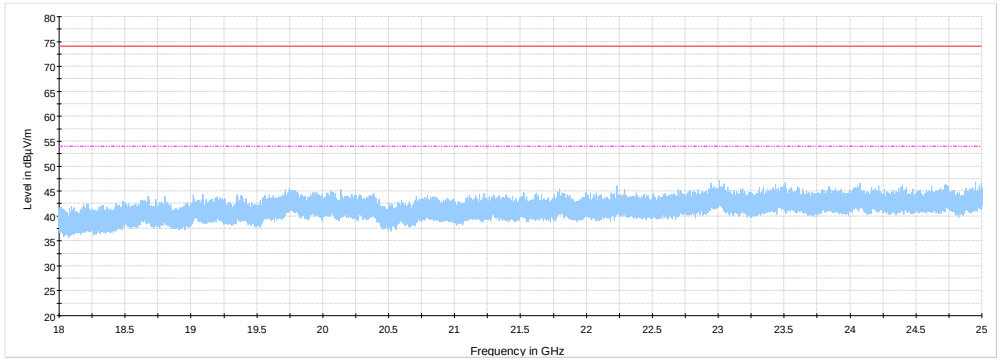

Figure 8.7-23: Radiated spurious emissions 18 - 25 GHz for 802.11b, low channel

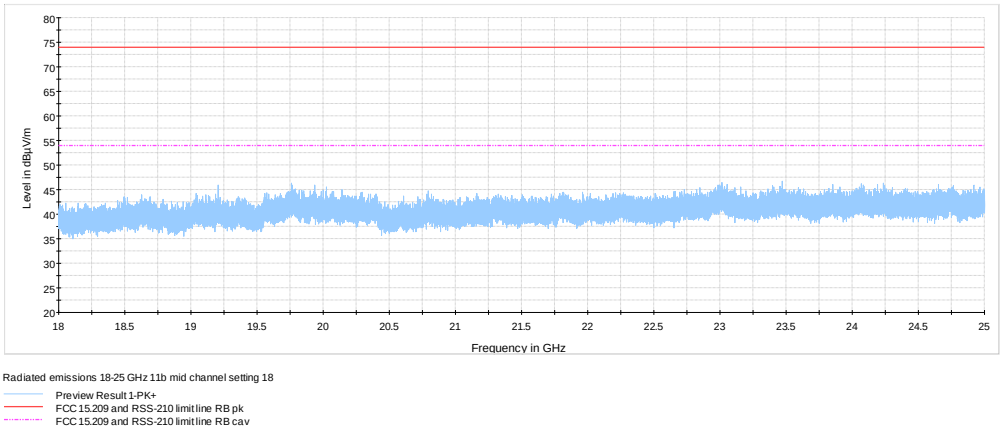

Figure 8.7-24: Radiated spurious emissions 18 - 25 GHz for 802.11b, mid channel

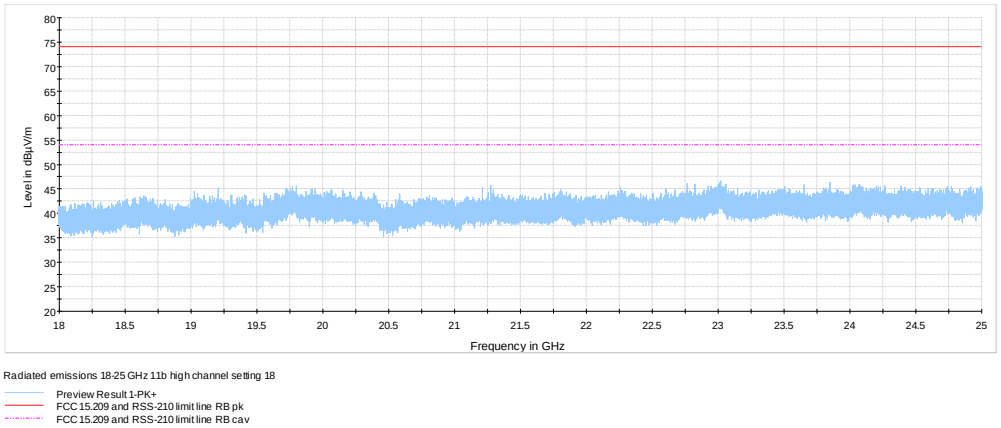

Figure 8.7-25: Radiated spurious emissions 18 - 25 GHz for 802.11b, high channel

8.7.4 Test data, continued

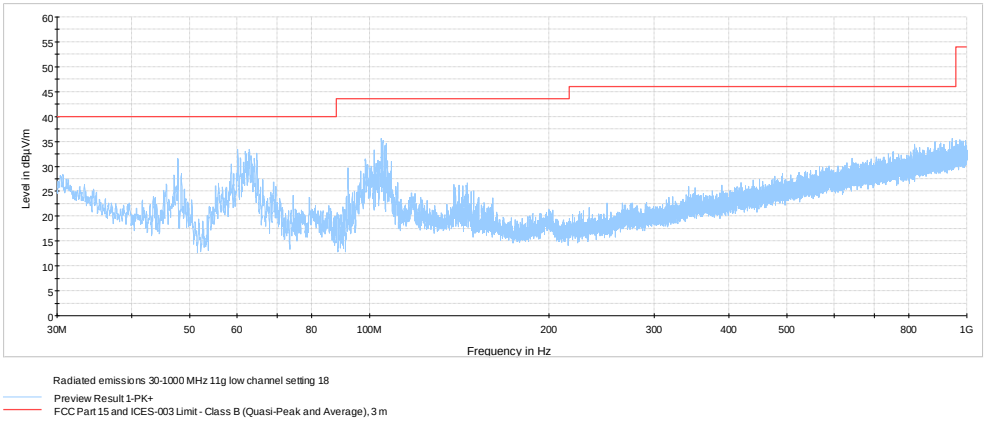

Figure 8.7-26: Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, low channel

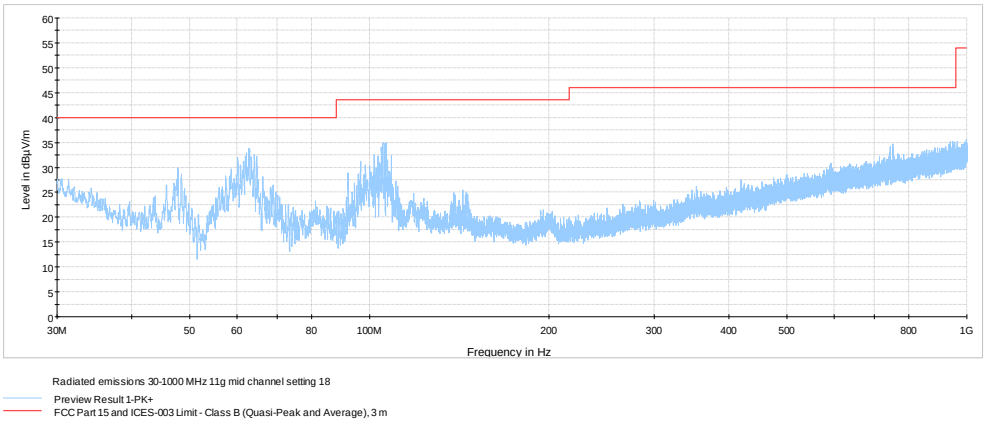

Figure 8.7-27: Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, mid channel

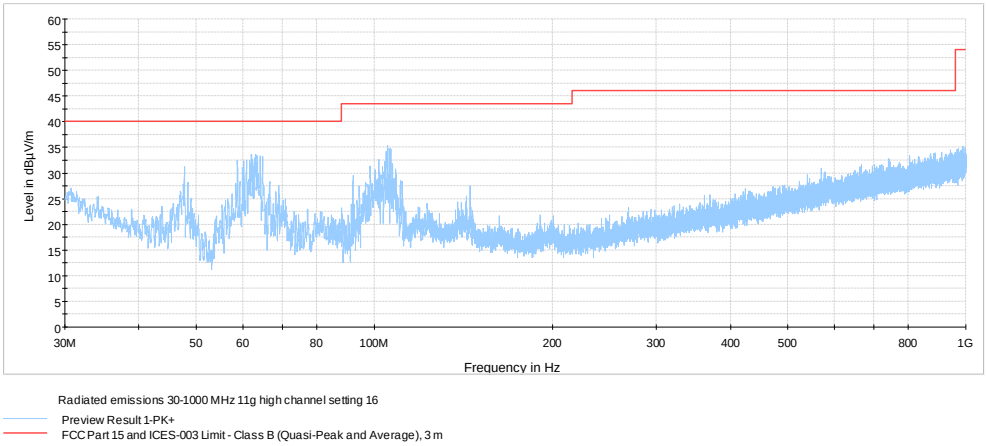

Figure 8.7-28: Radiated spurious emissions 30 MHz – 1 GHz for 802.11g, high channel

8.7.4 Test data, continued

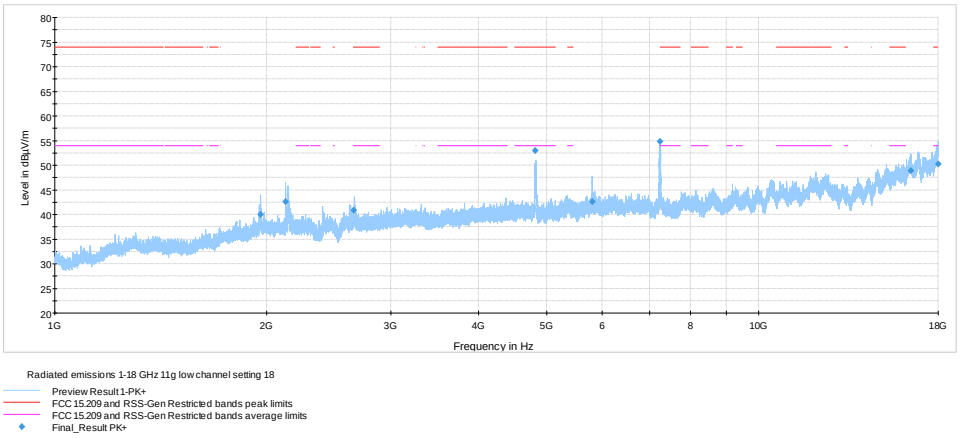

Figure 8.7-29: Radiated spurious emissions 1 - 18 GHz for 802.11g, low channel

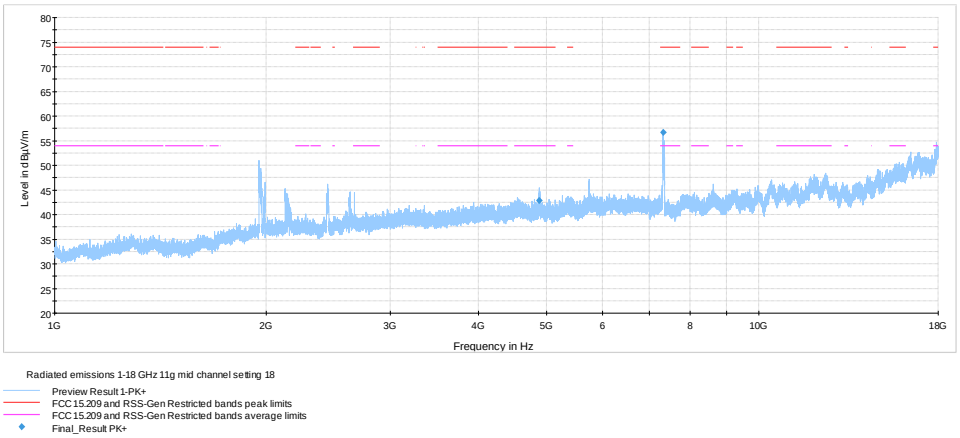

Figure 8.7-30: Radiated spurious emissions 1 - 18 GHz for 802.11g, mid channel

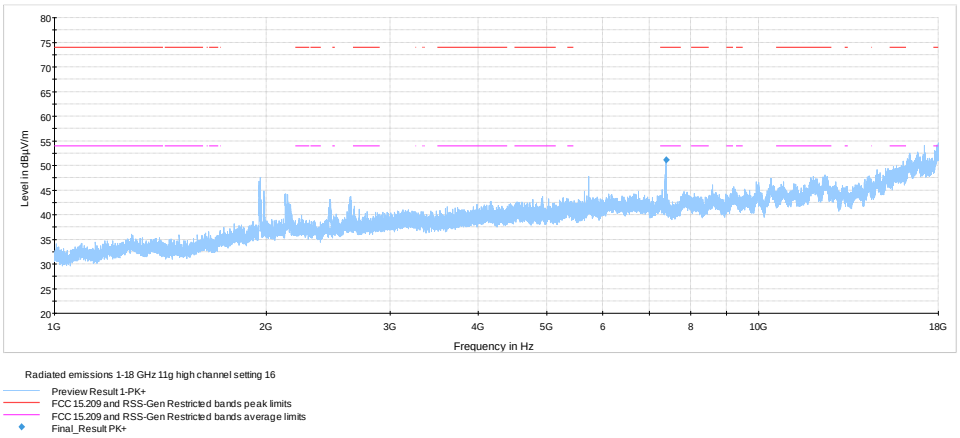

Figure 8.7-31: Radiated spurious emissions 1 - 18 GHz for 802.11g, high channel

8.7.4 Test data, continued

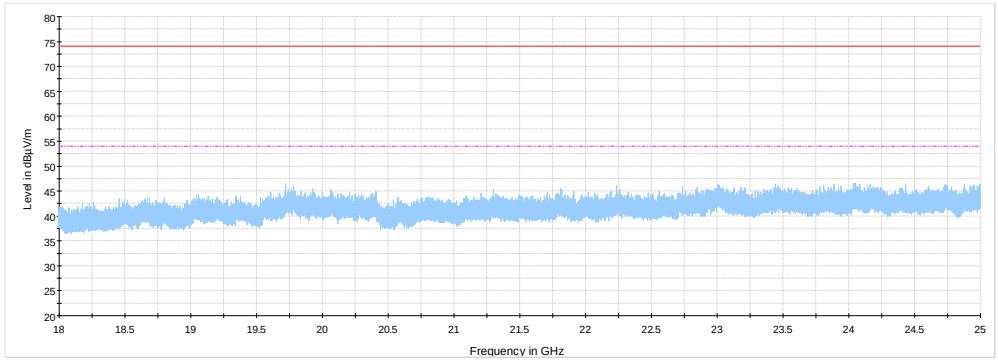

Figure 8.7-32: Radiated spurious emissions 18 - 25 GHz for 802.11g, low channel

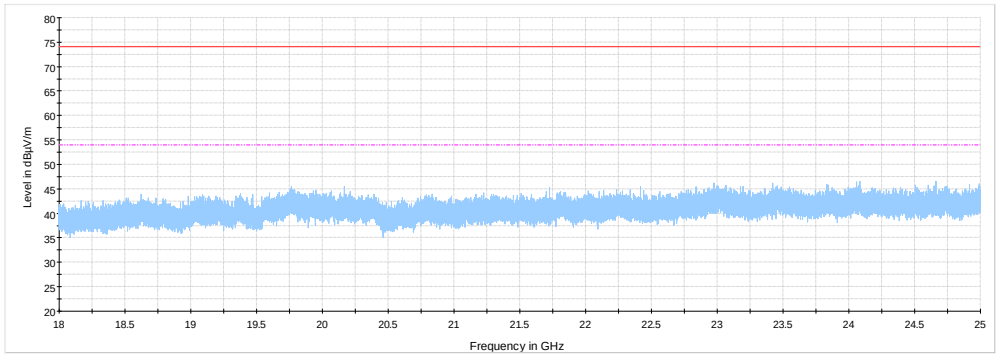

Figure 8.7-33: Radiated spurious emissions 18 - 25 GHz for 802.11g, mid channel

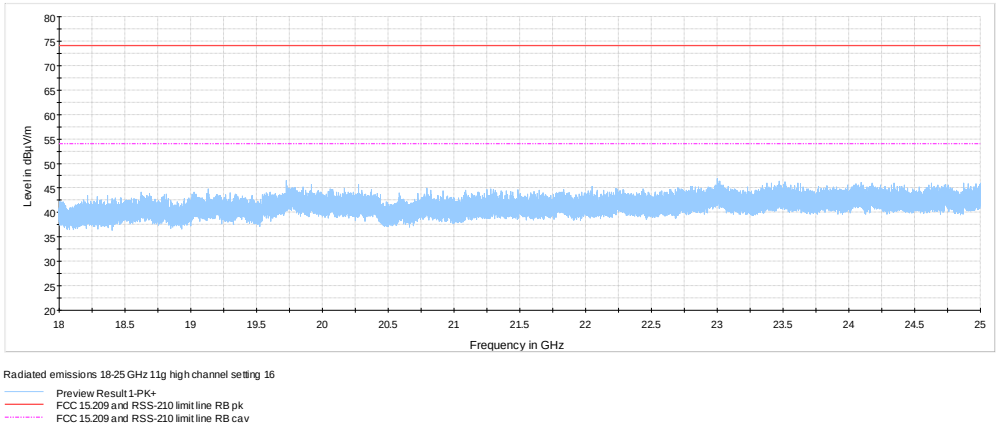

Figure 8.7-34: Radiated spurious emissions 18 - 25 GHz for 802.11g, high channel

8.7.4 Test data, continued

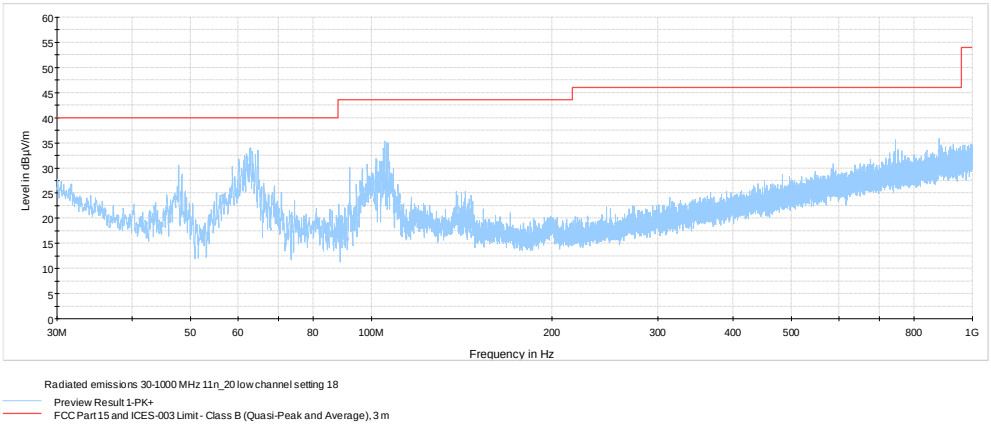

Figure 8.7-35: Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, low channel

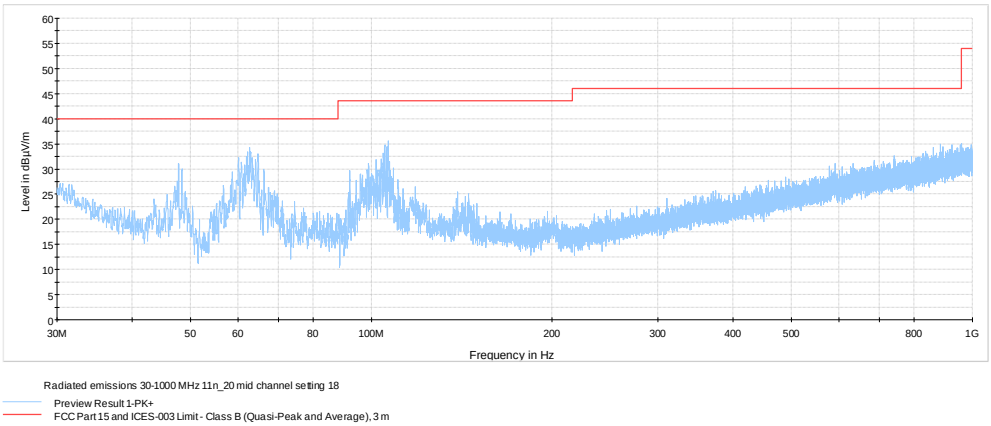

Figure 8.7-36: Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, mid channel

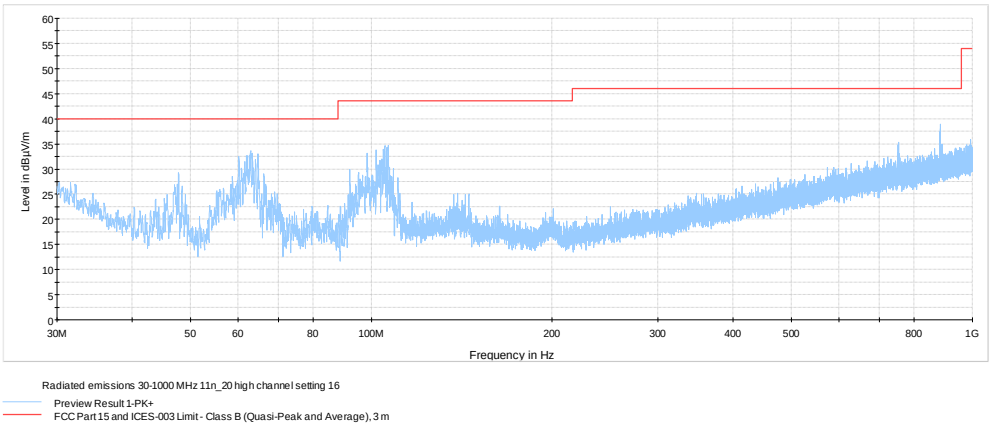

Figure 8.7-37: Radiated spurious emissions 30 MHz – 1 GHz for 802.11n HT20, high channel

8.7.4 Test data, continued

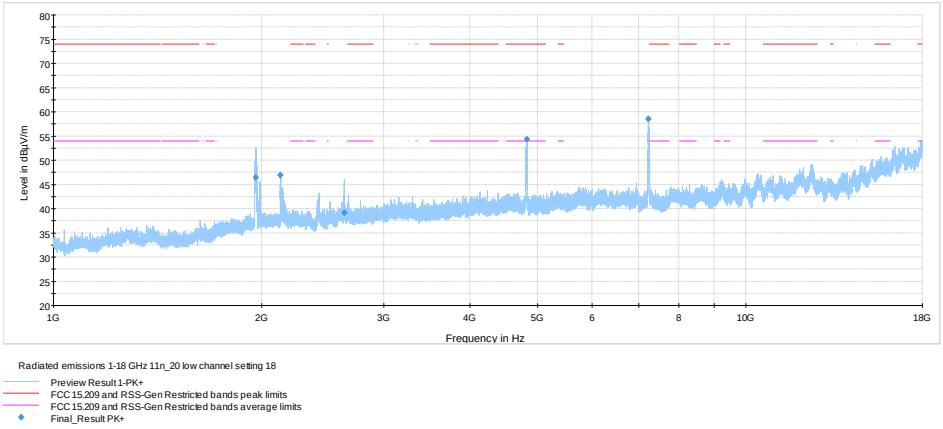

Figure 8.7-38: Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, low channel

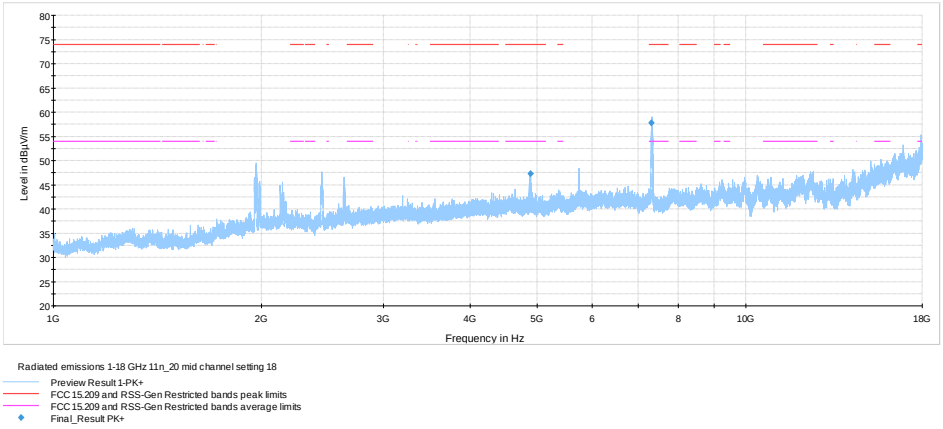

Figure 8.7-39: Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, mid channel

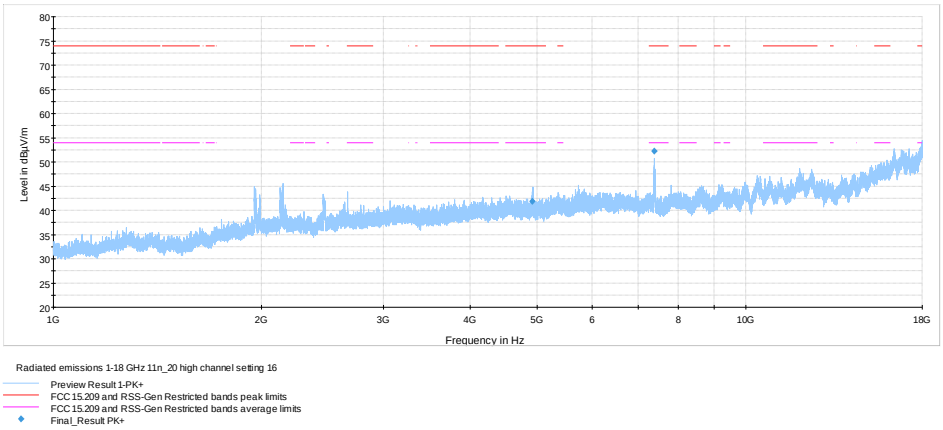

Figure 8.7-40: Radiated spurious emissions 1 - 18 GHz for 802.11n HT20, high channel

8.7.4 Test data, continued

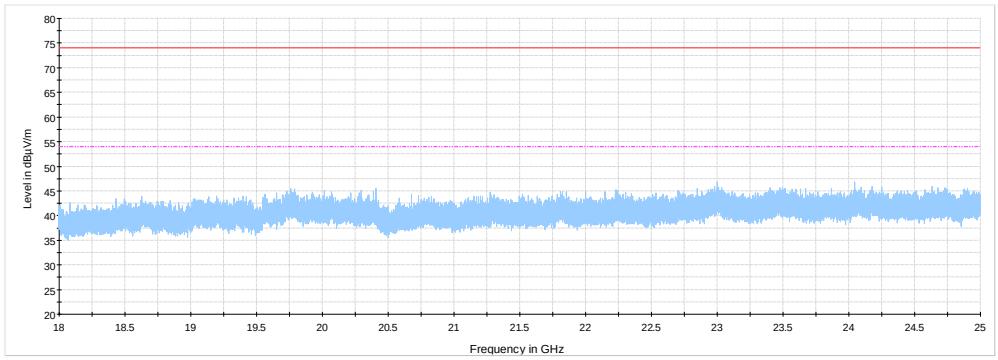

Figure 8.7-41: Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, low channel

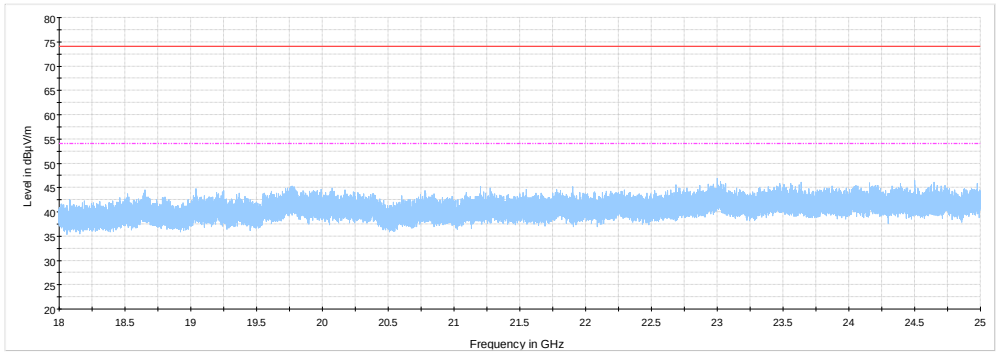

Figure 8.7-42: Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, mid channel

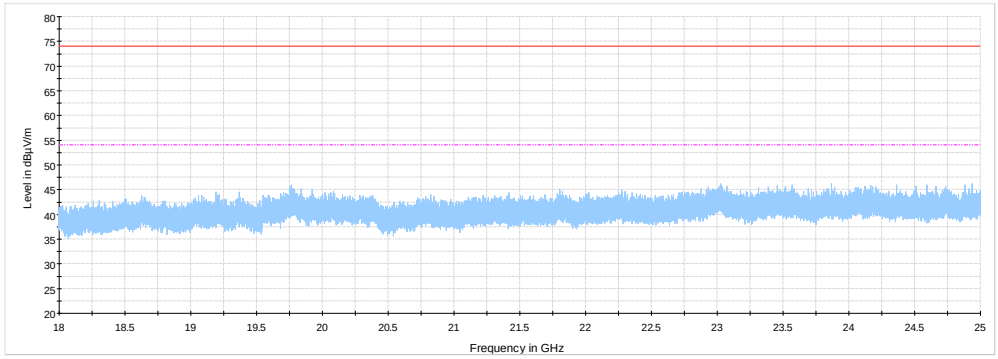

Figure 8.7-43: Radiated spurious emissions 18 - 25 GHz for 802.11n HT20, high channel