Frequency Stability

§15.407(g)

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY:	5,260,000,000	Hz
CHANNEL:	52	
REFERENCE VOLTAGE:	3.30	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.30	+ 20 (Ref)	5,259,999,800	-200	-0.00000380
100 %		- 40	5,259,999,934	-66	-0.00000125
100 %		- 30	5,259,999,972	-28	-0.00000053
100 %		- 20	5,260,000,032	32	0.00000061
100 %		- 10	5,260,000,041	41	0.00000078
100 %		0	5,260,000,042	42	0.00000080
100 %		+ 10	5,260,000,203	203	0.00000386
100 %		+ 20	5,259,999,974	-26	-0.00000049
100 %		+ 30	5,260,000,271	271	0.00000515
100 %		+ 40	5,259,999,982	-18	-0.00000034
100 %		+ 50	5,260,000,049	49	0.00000093
100 %		+ 60	5,260,000,030	30	0.00000057
100 %		+ 70	5,259,999,850	-150	-0.00000285
100 %		+ 85	5,259,999,688	-312	-0.00000593
BATT. ENDPOINT	2.90	+ 20	5,259,999,999	-1	-0.00000002

Table 7-10. Frequency Stability Measurements for UNII Band 2A (Ch. 52)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Frequency Stability

§15.407(g)

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY:	5,500,000,000	Hz
CHANNEL:	100	
REFERENCE VOLTAGE:	3.30	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.30	+ 20 (Ref)	5,500,000,187	187	0.00000340
100 %		- 40	5,500,000,050	50	0.00000091
100 %		- 30	5,499,999,900	-100	-0.00000182
100 %		- 20	5,499,999,834	-166	-0.00000302
100 %		- 10	5,499,999,809	-191	-0.00000347
100 %		0	5,500,000,116	116	0.00000211
100 %		+ 10	5,499,999,832	-168	-0.00000305
100 %		+ 20	5,499,999,889	-111	-0.00000202
100 %		+ 30	5,500,000,151	151	0.00000275
100 %		+ 40	5,500,000,157	157	0.00000285
100 %		+ 50	5,499,999,947	-53	-0.00000096
100 %		+ 60	5,499,999,906	-94	-0.00000171
100 %		+ 70	5,500,000,027	27	0.00000049
100 %		+ 85	5,499,999,623	-377	-0.00000685
BATT. ENDPOINT	2.90	+ 20	5,499,999,976	-24	-0.00000044

Table 7-11. Frequency Stability Measurements for UNII Band 2C (Ch. 100)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Frequency Stability

§15.407(g)

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between -30°C and +50°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

OPERATING FREQUENCY:	5,745,000,000	Hz
CHANNEL:	149	
REFERENCE VOLTAGE:	3.30	VDC

VOLTAGE (%)	POWER (VDC)	TEMP (°C)	FREQUENCY (Hz)	Freq. Dev. (Hz)	Deviation (%)
100 %	3.30	+ 20 (Ref)	5,744,999,887	-113	-0.00000197
100 %		- 40	5,744,999,602	-398	-0.00000693
100 %		- 30	5,744,999,789	-211	-0.00000367
100 %		- 20	5,745,000,027	27	0.00000047
100 %		- 10	5,744,999,943	-57	-0.00000099
100 %		0	5,745,000,176	176	0.00000306
100 %		+ 10	5,744,999,831	-169	-0.00000294
100 %		+ 20	5,744,999,670	-330	-0.00000574
100 %		+ 30	5,744,999,949	-51	-0.00000089
100 %		+ 40	5,745,000,259	259	0.00000451
100 %		+ 50	5,744,999,946	-54	-0.00000094
100 %		+ 60	5,744,999,892	-108	-0.00000188
100 %		+ 70	5,745,000,048	48	0.00000084
100 %		+ 85	5,744,999,812	-188	-0.00000327
BATT. ENDPOINT	2.90	+ 20	5,745,000,200	200	0.00000348

Table 7-12. Frequency Stability Measurements for UNII Band 3 (Ch. 149)

Note:

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency deviation noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

7.7 Radiated Spurious Emission Measurements – Above 1GHz

§15.407(b.1)(b.6) §15.205 §15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at its maximum power control level, as defined in KDB 789033 D02 v01r02, and at the appropriate frequencies. All channels, modes (e.g. 802.11a, 802.11n (20MHz BW), 802.11n (40MHz BW), and 802.11ac (80MHz)), and modulations/data rates were investigated among all UNII bands. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-13 per Section 15.209.

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
Above 960.0 MHz	500	3

Table 7-13. Radiated Limits

Test Procedures Used

KDB 789033 D02 v01r02 – Section G

Test Settings

Average Measurements above 1GHz (Method AD)

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be ≥ 2 x span/RBW)
6. Averaging type = power (RMS)
7. Sweep time = auto couple
8. Trace was averaged over 100 sweeps

Peak Measurements above 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Peak Measurements below 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = 120kHz
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

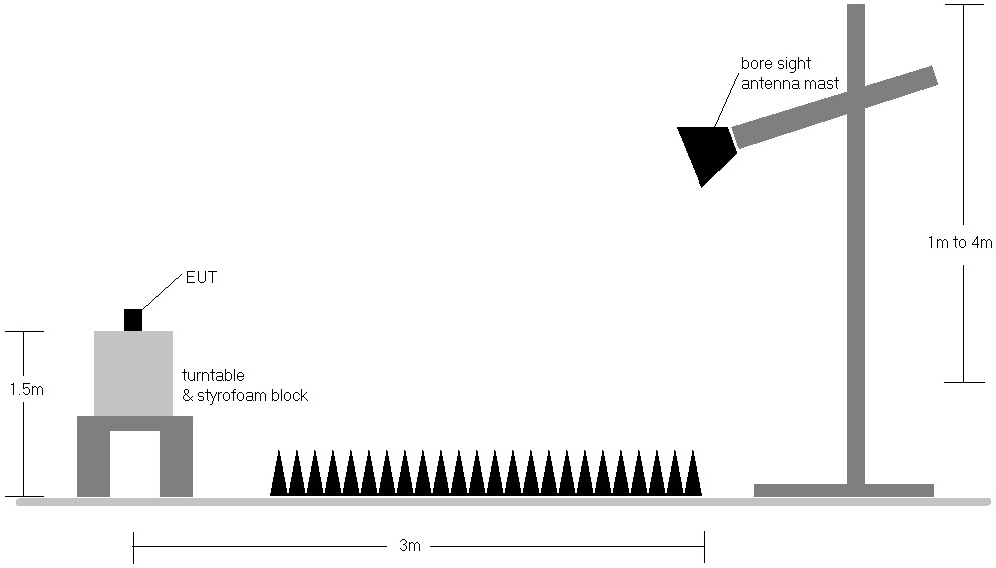


Figure 7-5. Test Instrument & Measurement Setup

Test Notes

1. All radiated spurious emissions levels were measured in a radiated test setup per the guidance of KDB 789033 D02 v01r02 Section H.
2. All emissions that lie in the restricted bands (denoted by a * next to the frequency) specified in §15.205 are below the limit shown in Table 7-13.
3. All spurious emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 6-11. All spurious emissions that do not lie in a restricted band are subject to a peak limit of -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions of 68.2dBμV/m.

4. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
5. This unit was tested while powered by an DC power source.
6. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
7. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
8. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. Any emissions found to be within 20dB of the limit are fully investigated and the results are shown in this section. Rohde & Schwarz EMC32, Version 9.15.00 automated test software was used to perform the Radiated Spurious Emissions Pre-Scan testing.

Sample Calculations

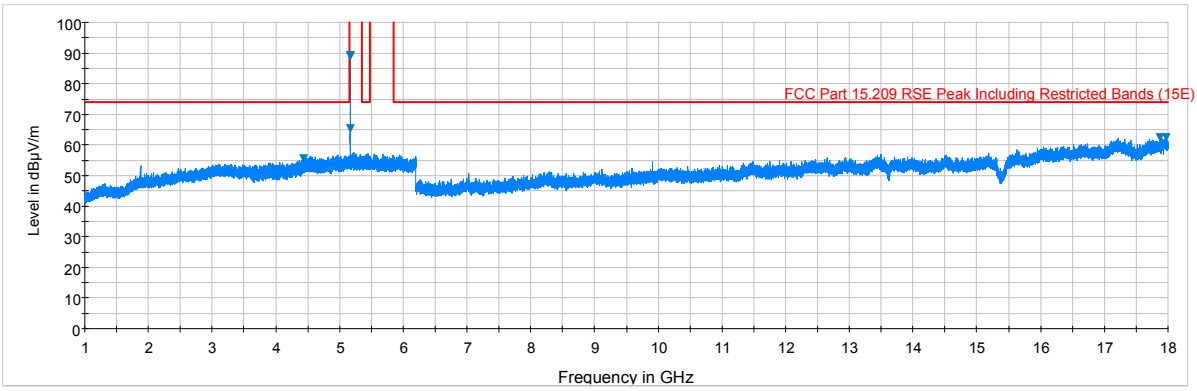
Determining Spurious Emissions Levels

- Field Strength Level $_{[dB\mu V/m]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB\mu V/m]}$ – Limit $_{[dB\mu V/m]}$

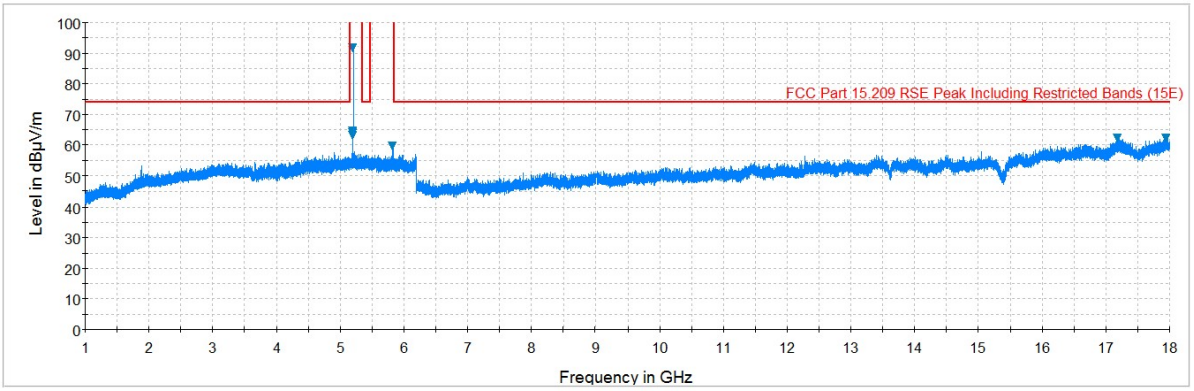
Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 6.8 was calculated using the formula:
  Offset (dB) = (Antenna Factor + Cable Loss + 10 dB Attenuator) – Preamplifier Gain

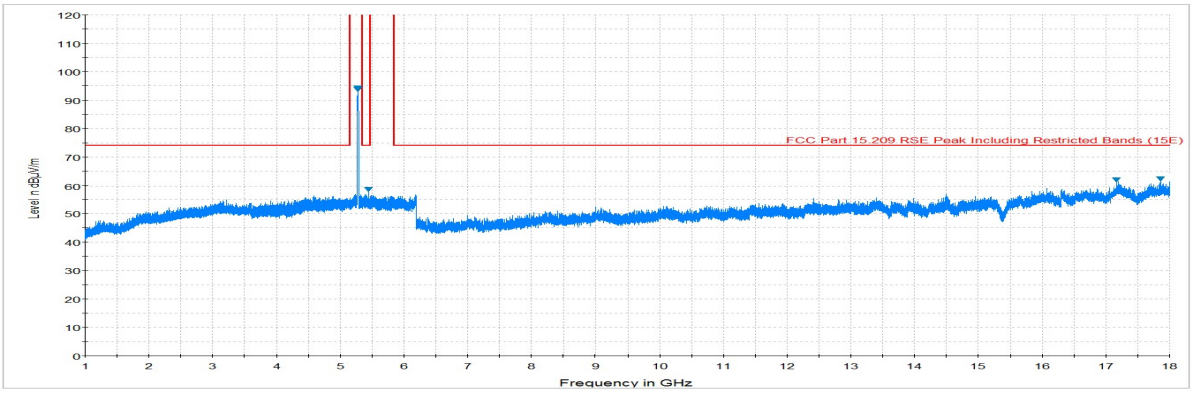
7.7.1 Radiated Spurious Emission Measurements



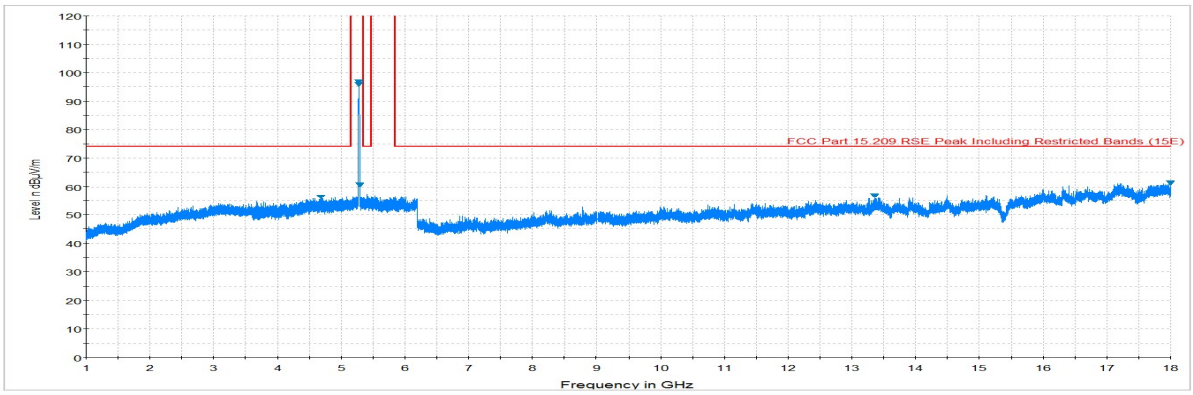
Plot 7-77. Radiated Spurious Plot above 1GHz (802.11a – U1 Ch. 40, Ant. Pol. H)



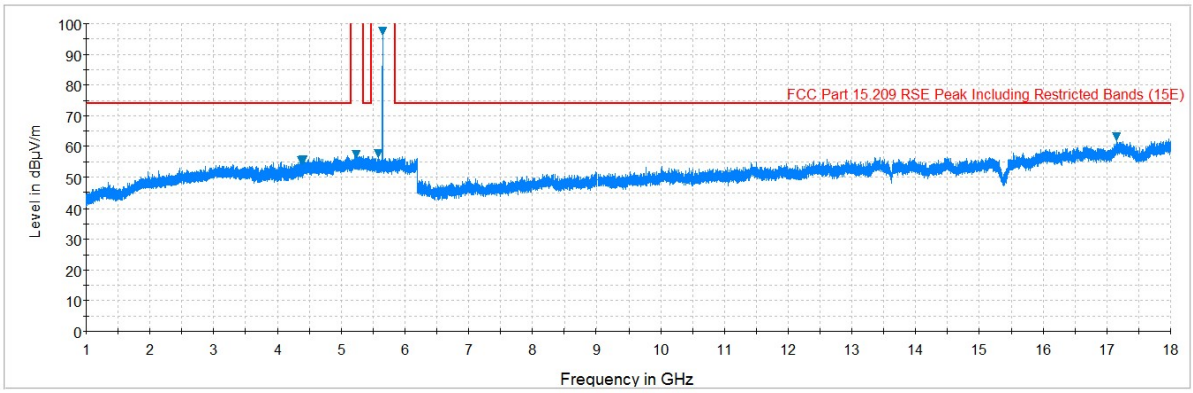
Plot 7-78. Radiated Spurious Plot above 1GHz (802.11a – U1 Ch. 40, Ant. Pol. V)



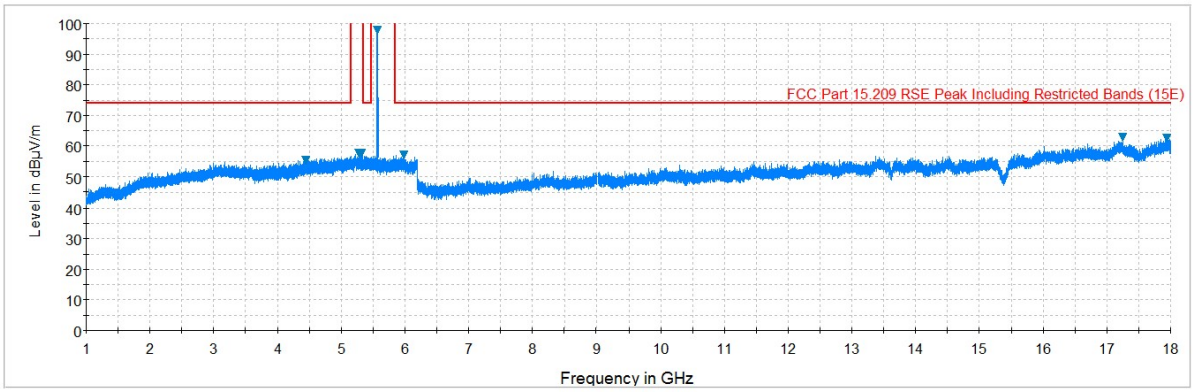
Plot 7-79. Radiated Spurious Plot above 1GHz (802.11a – U2A Ch. 56, Ant. Pol. H)



Plot 7-80. Radiated Spurious Plot above 1GHz (802.11a – U2A Ch. 56, Ant. Pol. V)



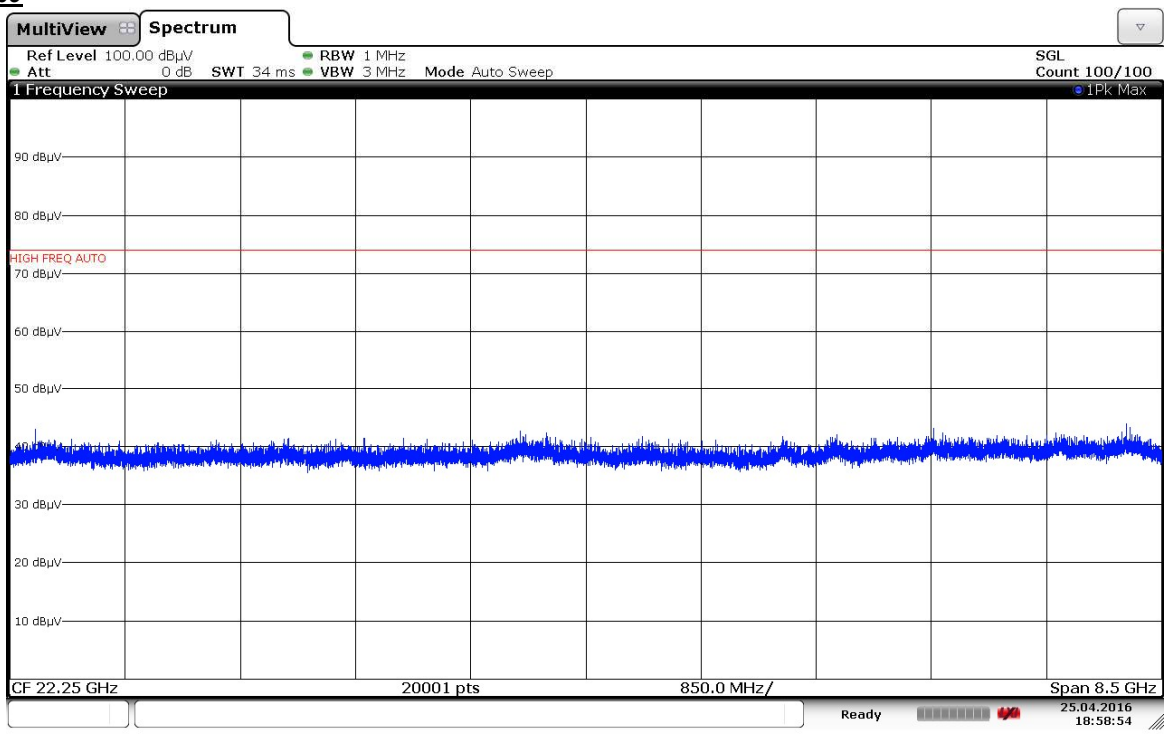
Plot 7-81. Radiated Spurious Plot above 1GHz (802.11a – U2C Ch. 116, Ant. Pol. H)



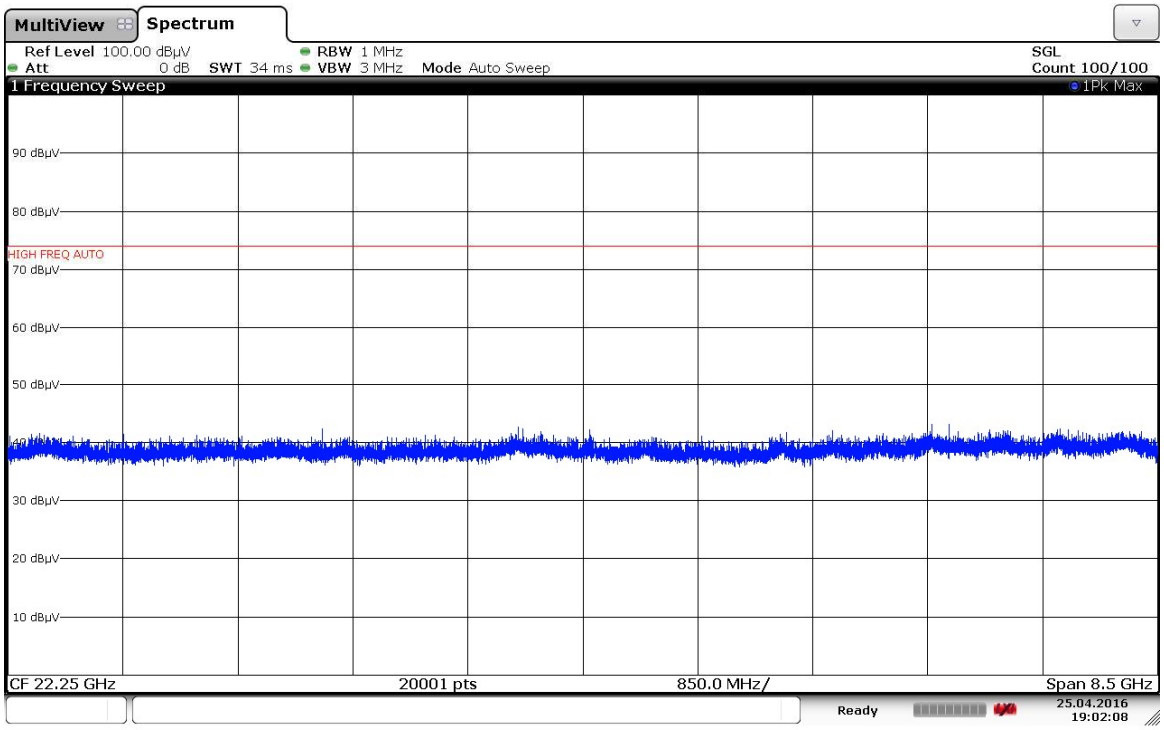
Plot 7-82. Radiated Spurious Plot above 1GHz (802.11a – U2C Ch. 116, Ant. Pol. V)

Radiated Spurious Emissions Measurements (Above 18GHz)

§15.209



Plot 7-83. Radiated Spurious Plot above 18GHz (802.11a – Ant. Pol. H)



Plot 7-84. Radiated Spurious Plot above 18GHz (802.11a – Ant. Pol. V)

Radiated Spurious Emission Measurements

§15.247(d) §15.205 & §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5180MHz
Channel:	36

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10360.00	Peak	H	-	-	-93.79	47.84	0.00	61.05	68.20	-7.15
*	15540.00	Average	H	-	-	-111.76	55.31	0.00	50.55	53.98	-3.43
*	15540.00	Peak	H	-	-	-94.96	55.31	0.00	67.35	73.98	-6.63
*	20720.00	Average	H	-	-	-107.52	44.39	-9.54	34.32	53.98	-19.66
*	20720.00	Peak	H	-	-	-95.58	44.39	-9.54	46.26	73.98	-27.72
	25900.00	Peak	H	-	-	-94.15	45.11	-9.54	48.42	68.20	-19.78

Table 7-14. Radiated Measurements

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	1 & 3 Meters
Operating Frequency:	5200MHz
Channel:	40

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10400.00	Peak	H	-	-	-93.48	47.98	0.00	61.50	68.20	-6.70
*	15600.00	Average	H	-	-	-112.57	55.62	0.00	50.06	53.98	-3.92
*	15600.00	Peak	H	-	-	-94.94	55.62	0.00	67.69	73.98	-6.29
*	20800.00	Average	H	-	-	-107.46	44.39	-9.54	34.39	53.98	-19.59
*	20800.00	Peak	H	-	-	-95.51	44.39	-9.54	46.34	73.98	-27.64
	26000.00	Peak	H	-	-	-94.47	45.12	-9.54	48.10	68.20	-20.10

Table 7-15. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5240MHz
Channel: 48

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10480.00	Peak	H	-	-	-93.76	48.49	0.00	61.73	68.20	-6.47
*	15720.00	Average	H	-	-	-111.53	54.63	0.00	50.10	53.98	-3.88
*	15720.00	Peak	H	-	-	-94.34	54.63	0.00	67.29	73.98	-6.69
*	20960.00	Average	H	-	-	-107.88	44.31	-9.54	33.89	53.98	-20.09
*	20960.00	Peak	H	-	-	-96.20	44.31	-9.54	45.57	73.98	-28.41
	26200.00	Peak	H	-	-	-93.72	45.01	-9.54	48.75	68.20	-19.45

Table 7-16. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5260MHz
Channel: 52

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10520.00	Peak	H	-	-	-94.11	48.56	0.00	61.46	68.20	-6.74
*	15780.00	Average	H	-	-	-111.43	54.68	0.00	50.25	53.98	-3.73
*	15780.00	Peak	H	-	-	-95.65	54.68	0.00	66.03	73.98	-7.95
*	21040.00	Average	H	-	-	-107.55	44.29	-9.54	34.20	53.98	-19.78
*	21040.00	Peak	H	-	-	-96.71	44.29	-9.54	45.04	73.98	-28.94
	26300.00	Peak	H	-	-	-92.59	45.00	-9.54	49.86	68.20	-18.34

Table 7-17. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5280MHz
Channel: 56

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
	10560.00	Peak	H	-	-	-97.36	48.47	0.00	58.11	68.20	-10.09
*	15840.00	Average	H	-	-	-111.52	54.71	0.00	50.19	53.98	-3.79
*	15840.00	Peak	H	-	-	-94.78	54.71	0.00	66.93	73.98	-7.05
*	21120.00	Average	H	-	-	-106.58	44.28	-9.54	35.15	53.98	-18.83
*	21120.00	Peak	H	-	-	-96.52	44.28	-9.54	45.21	73.98	-28.77
	26400.00	Peak	H	-	-	-92.99	45.02	-9.54	49.49	68.20	-18.71

Table 7-18. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5320MHz
Channel: 64

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	10640.00	Average	H	-	-	-108.35	48.31	0.00	46.96	53.98	-7.02
*	10640.00	Peak	H	-	-	-97.03	48.31	0.00	58.28	73.98	-15.70
*	15960.00	Average	H	-	-	-111.78	55.08	0.00	50.30	53.98	-3.68
*	15960.00	Peak	H	-	-	-94.41	55.08	0.00	67.67	73.98	-6.31
*	21280.00	Average	H	-	-	-106.85	44.26	-9.54	34.87	53.98	-19.10
*	21280.00	Peak	H	-	-	-95.60	44.26	-9.54	46.12	73.98	-27.85
	26600.00	Peak	H	-	-	-114.96	47.61	-9.54	30.10	68.20	-38.10

Table 7-19. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5500MHz
Channel: 100

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11000.00	Average	H	-	-	-106.21	48.61	0.00	49.40	53.98	-4.58
*	11000.00	Peak	H	-	-	-94.12	48.61	0.00	61.49	73.98	-12.49
	16500.00	Peak	H	-	-	-104.57	55.34	0.00	57.77	68.20	-10.43
	22000.00	Peak	H	-	-	-93.64	44.50	-9.54	48.32	68.20	-19.88
	27500.00	Peak	H	-	-	-103.71	47.97	-9.54	41.72	68.20	-26.48

Table 7-20. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5580MHz
Channel: 116

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11160.00	Average	H	-	-	-106.04	48.34	0.00	49.30	53.98	-4.68
*	11160.00	Peak	H	-	-	-93.67	48.34	0.00	61.67	73.98	-12.31
	16740.00	Peak	H	-	-	-104.67	56.87	0.00	59.20	68.20	-9.00
*	22320.00	Average	H	-	-	-106.74	44.57	-9.54	35.29	53.98	-18.69
*	22320.00	Peak	H	-	-	-95.96	44.57	-9.54	46.07	73.98	-27.91
	27900.00	Peak	H	-	-	-102.85	48.11	-9.54	42.72	68.20	-25.48

Table 7-21. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5720MHz
Channel: 144

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11440.00	Average	H	-	-	-105.48	49.21	0.00	50.73	53.98	-3.25
*	11440.00	Peak	H	-	-	-93.65	49.21	0.00	62.56	73.98	-11.42
	17160.00	Peak	H	-	-	-104.63	57.84	0.00	60.21	68.20	-7.99
*	22880.00	Average	H	-	-	-107.95	44.61	-9.54	34.12	53.98	-19.86
*	22880.00	Peak	H	-	-	-96.76	44.61	-9.54	45.31	73.98	-28.67
	28600.00	Peak	H	-	-	-101.93	48.29	-9.54	43.82	68.20	-24.38

Table 7-22. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5745MHz
Channel: 149

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11490.00	Average	H	-	-	-106.06	49.47	0.00	50.41	53.98	-3.57
*	11490.00	Peak	H	-	-	-93.36	49.47	0.00	63.11	73.98	-10.87
	17235.00	Peak	H	-	-	-105.00	57.93	0.00	59.93	68.20	-8.27
*	22980.00	Average	H	-	-	-108.08	44.68	-9.54	34.06	53.98	-19.92
*	22980.00	Peak	H	-	-	-96.64	44.68	-9.54	45.50	73.98	-28.48
	28725.00	Peak	H	-	-	-102.96	48.26	-9.54	42.76	68.20	-25.44

Table 7-23. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5785MHz
Channel: 157

	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11570.00	Average	H	-	-	-105.50	49.31	0.00	50.81	53.98	-3.17
*	11570.00	Peak	H	-	-	-93.59	49.31	0.00	62.72	73.98	-11.26
	17355.00	Peak	H	-	-	-104.93	59.31	0.00	61.37	68.20	-6.83
	23140.00	Peak	H	-	-	-95.71	44.75	-9.54	46.50	68.20	-21.70
	28925.00	Peak	H	-	-	-102.18	48.29	-9.54	43.57	68.20	-24.63

Table 7-24. Radiated Measurements

Worst Case Mode: 802.11a
Worst Case Transfer Rate: 6 Mbps
Distance of Measurements: 1 & 3 Meters
Operating Frequency: 5825MHz
Channel: 165

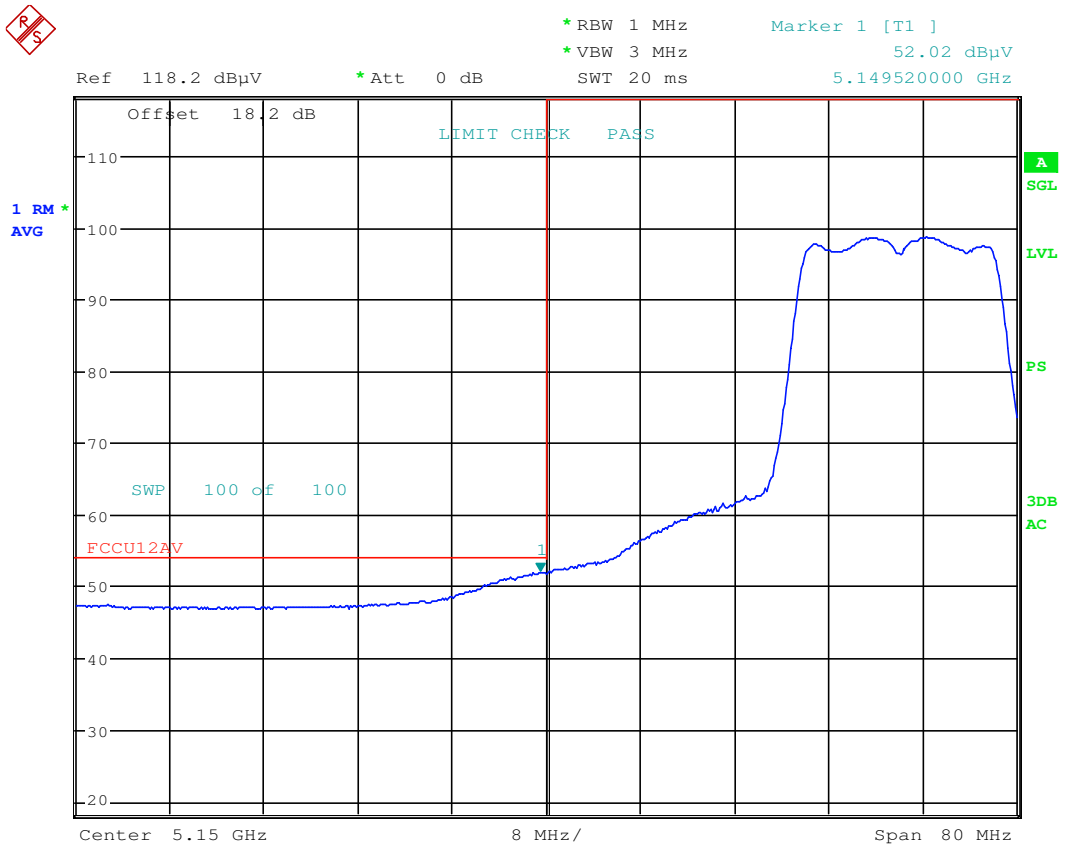
	Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Distance Correction Factor [dB]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
*	11650.00	Average	H	-	-	-105.64	49.33	0.00	50.69	53.98	-3.29
*	11650.00	Peak	H	-	-	-92.60	49.33	0.00	63.73	73.98	-10.25
	17475.00	Peak	H	-	-	-104.69	60.35	0.00	62.66	68.20	-5.54
	23300.00	Peak	H	-	-	-96.24	44.75	-9.54	45.97	68.20	-22.23
	29125.00	Peak	H	-	-	-102.78	48.28	-9.54	42.96	68.20	-25.24

Table 7-25. Radiated Measurements

7.7.2 Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5180MHz
Channel:	36

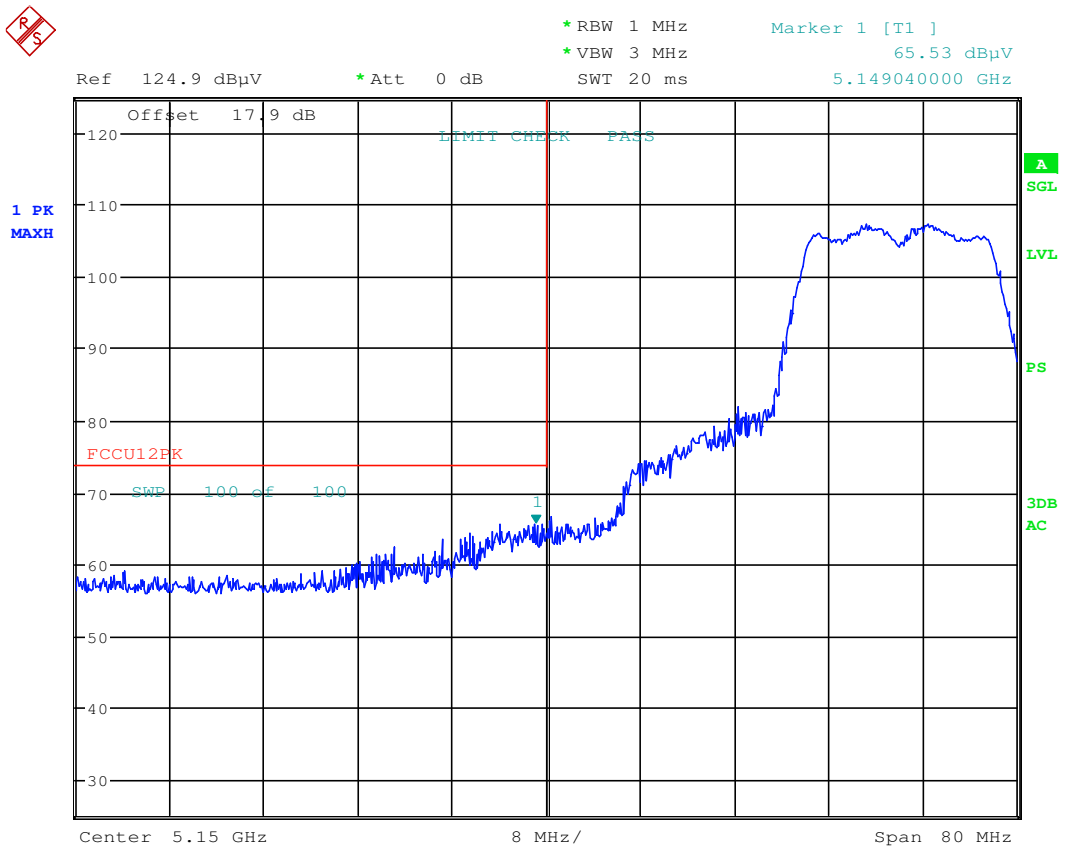


Date: 4.MAY.2016 17:56:20

Plot 7-85. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 1)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

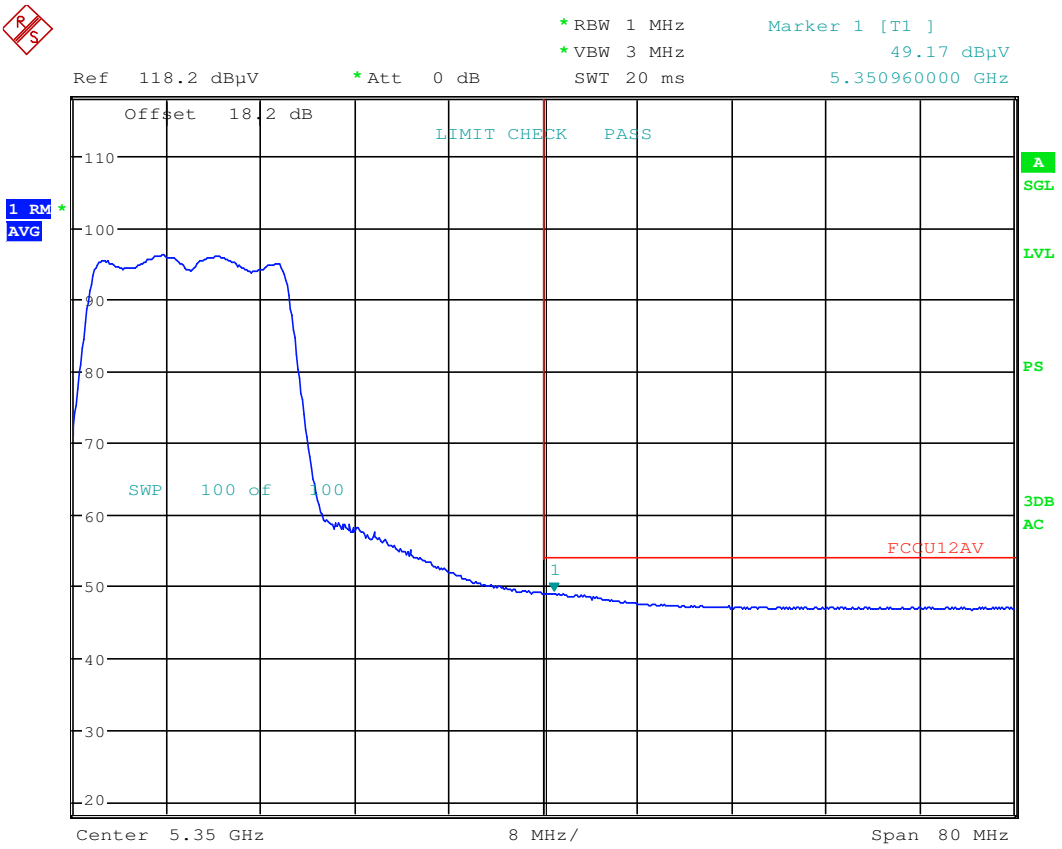


Plot 7-86. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 1)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5320MHz
Channel:	64

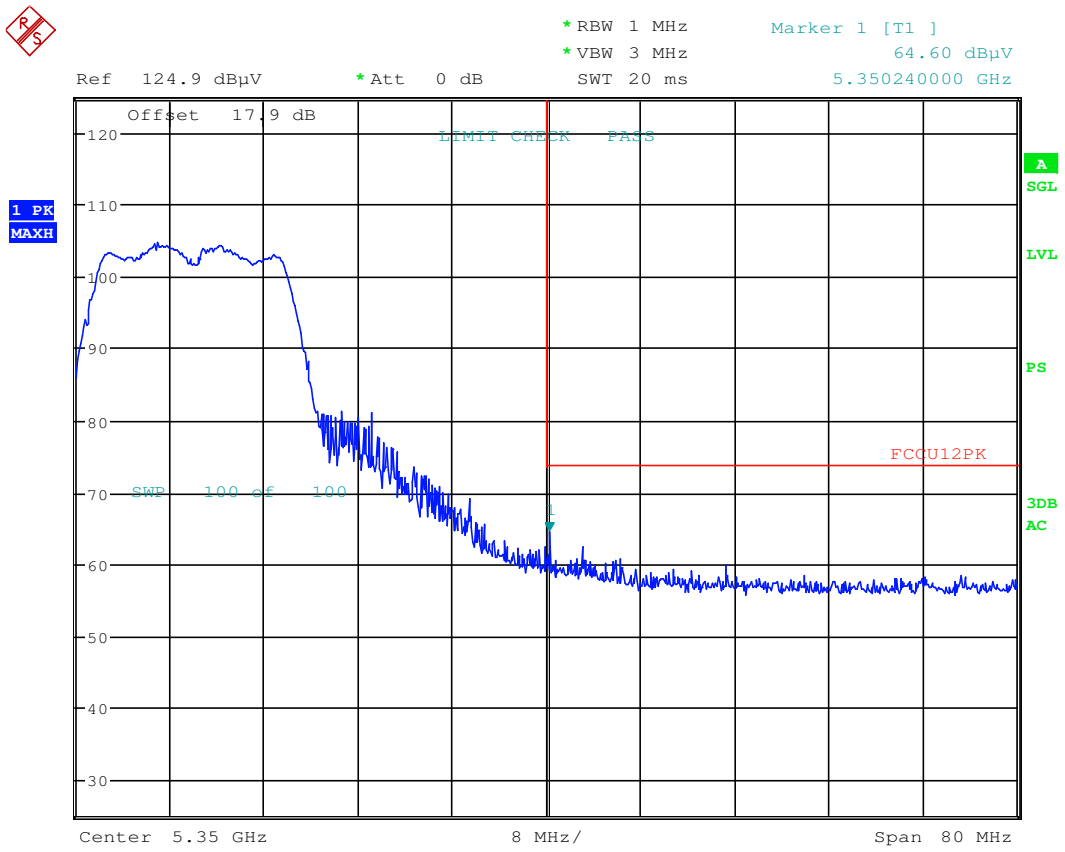


Date: 4.MAY.2016 18:50:43

Plot 7-87. Radiated Restricted Upper Band Edge Plot (Average – UNII Band 2A)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

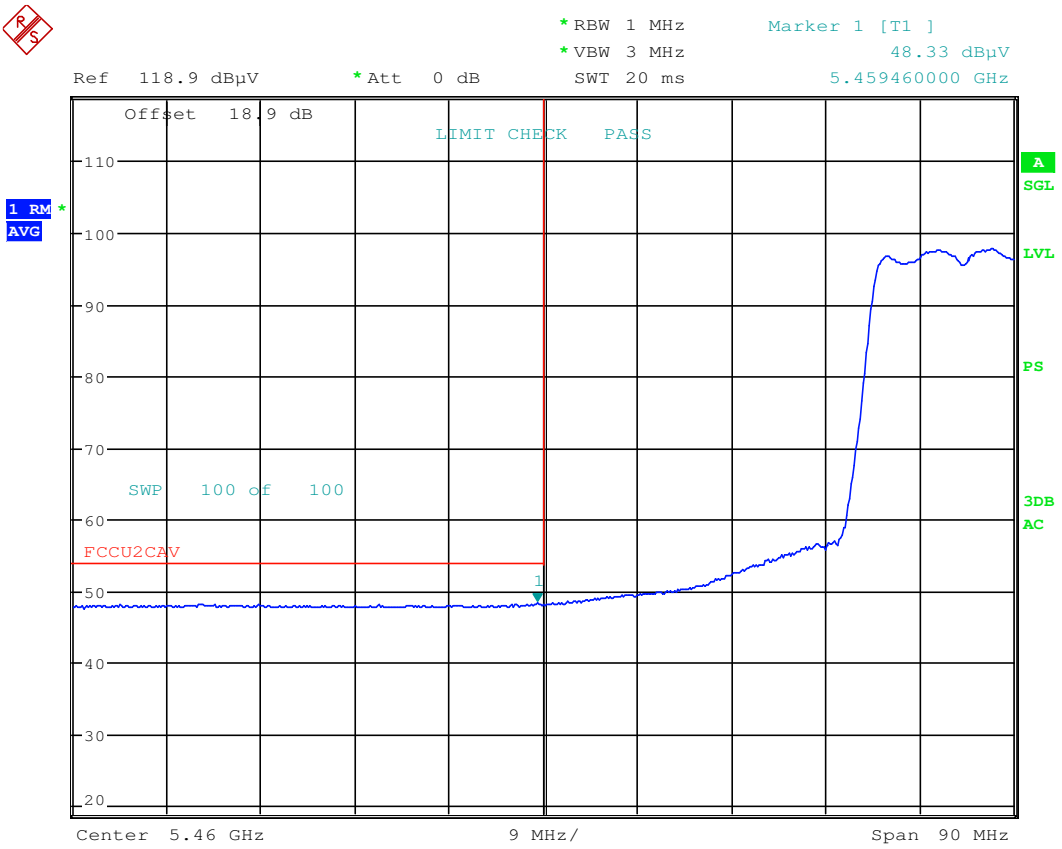


Plot 7-88. Radiated Restricted Upper Band Edge Plot (Peak – UNII Band 2A)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5500MHz
Channel:	100

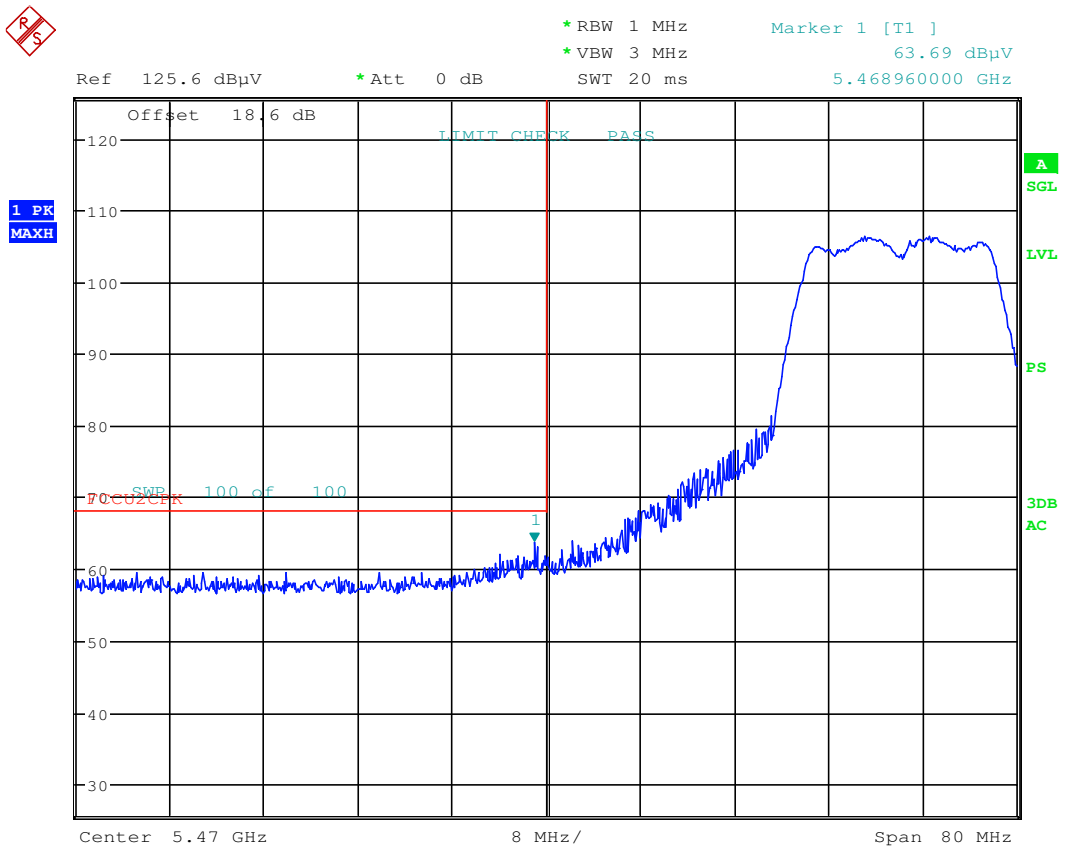


Date: 4.MAY.2016 19:18:02

Plot 7-89. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 2C)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

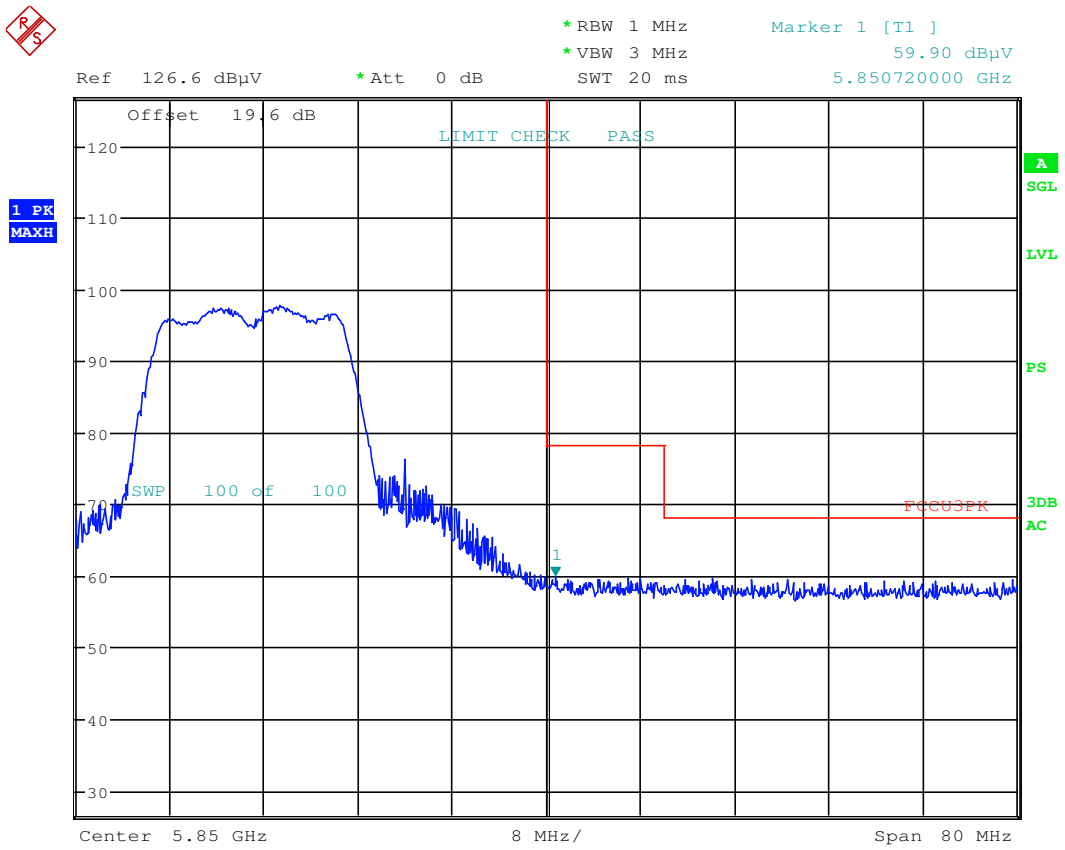


Plot 7-90. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 2C)

Radiated Band Edge Measurements (20MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11a
Worst Case Transfer Rate:	6 Mbps
Distance of Measurements:	3 Meters
Operating Frequency:	5825MHz
Channel:	165



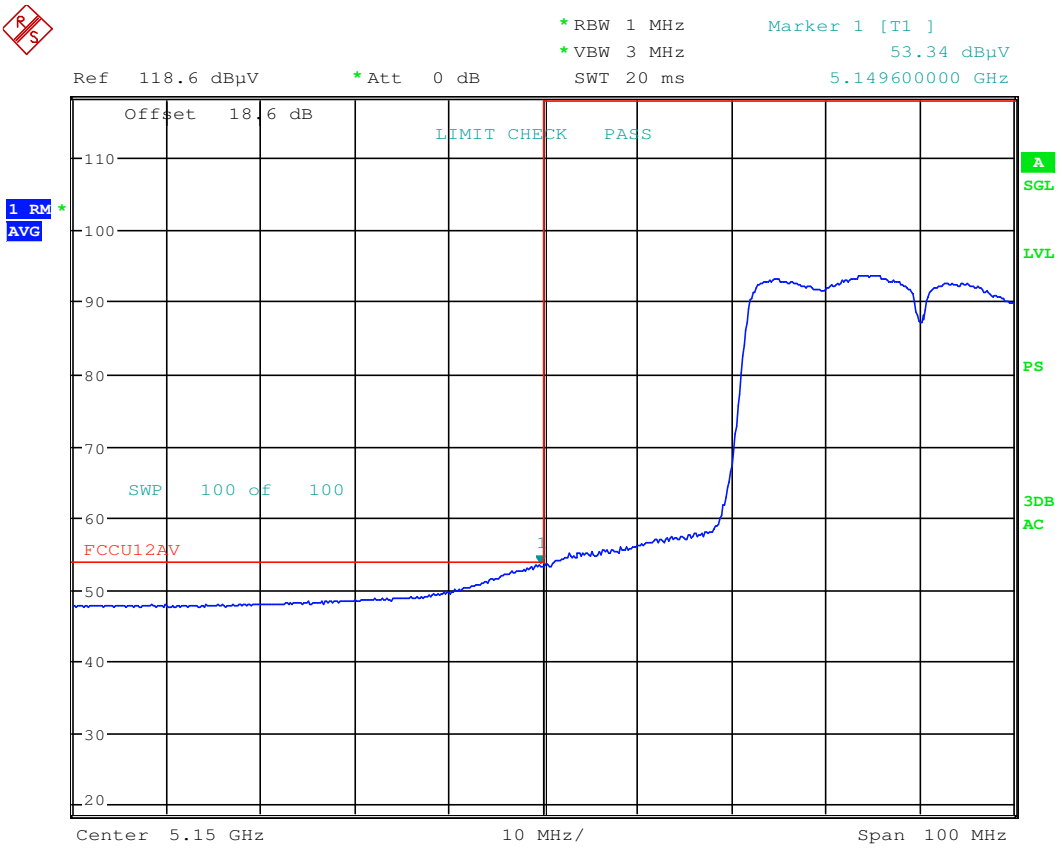
Date: 4.MAY.2016 19:58:17

Plot 7-91. Radiated Upper Band Edge Plot (Peak – UNII Band 3)

7.7.3 Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n (40MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5190MHz
Channel:	38

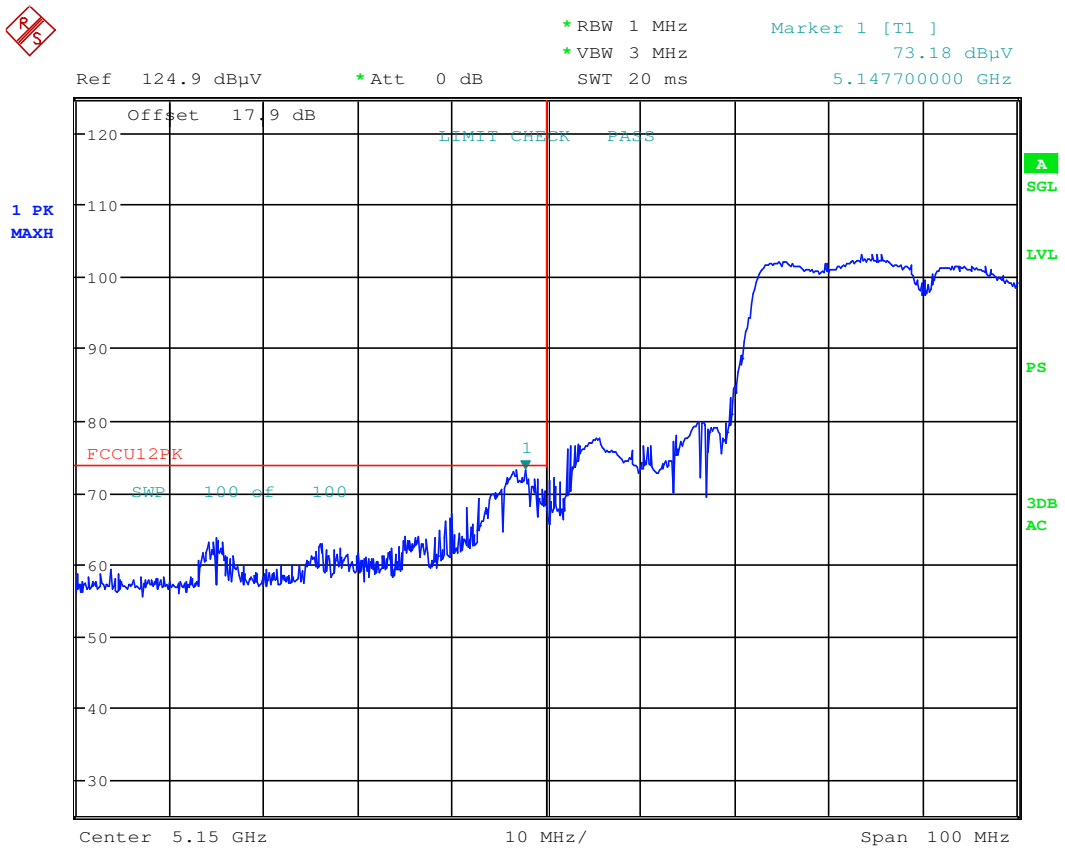


Date: 4.MAY.2016 18:07:08

Plot 7-92. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 1)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

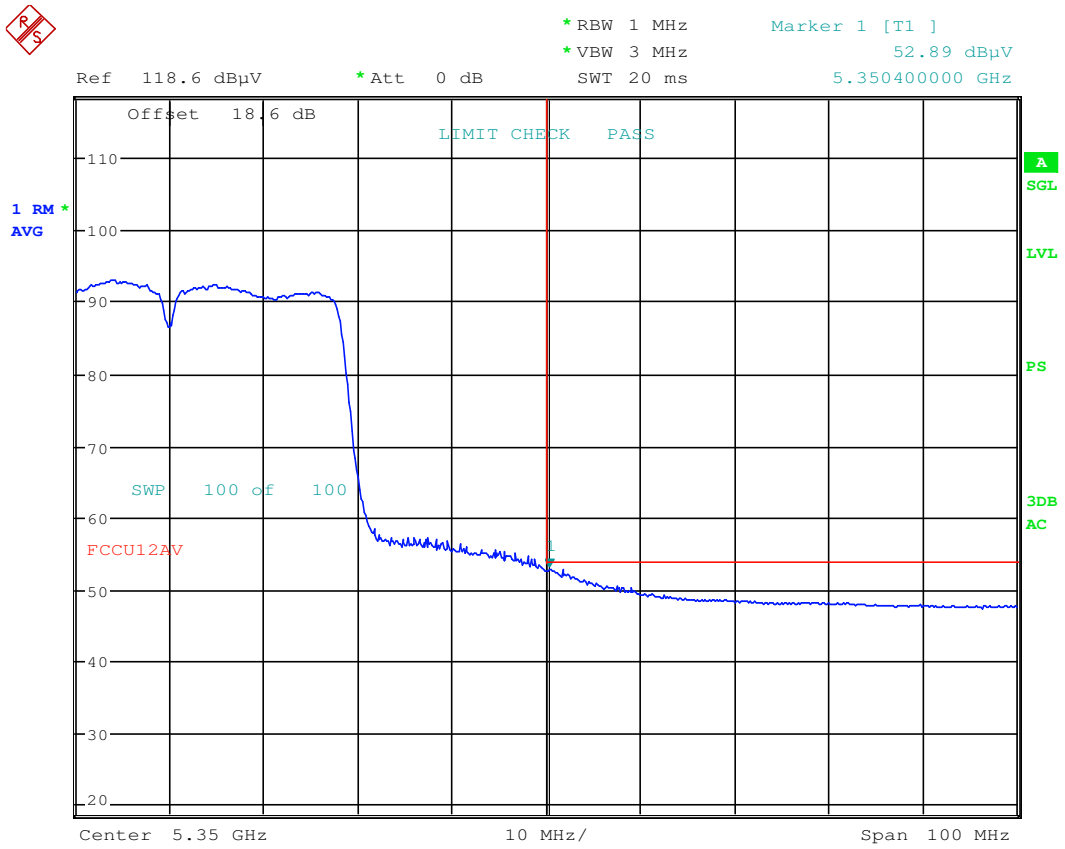


Plot 7-93. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 1)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n (40MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5310MHz
Channel:	62

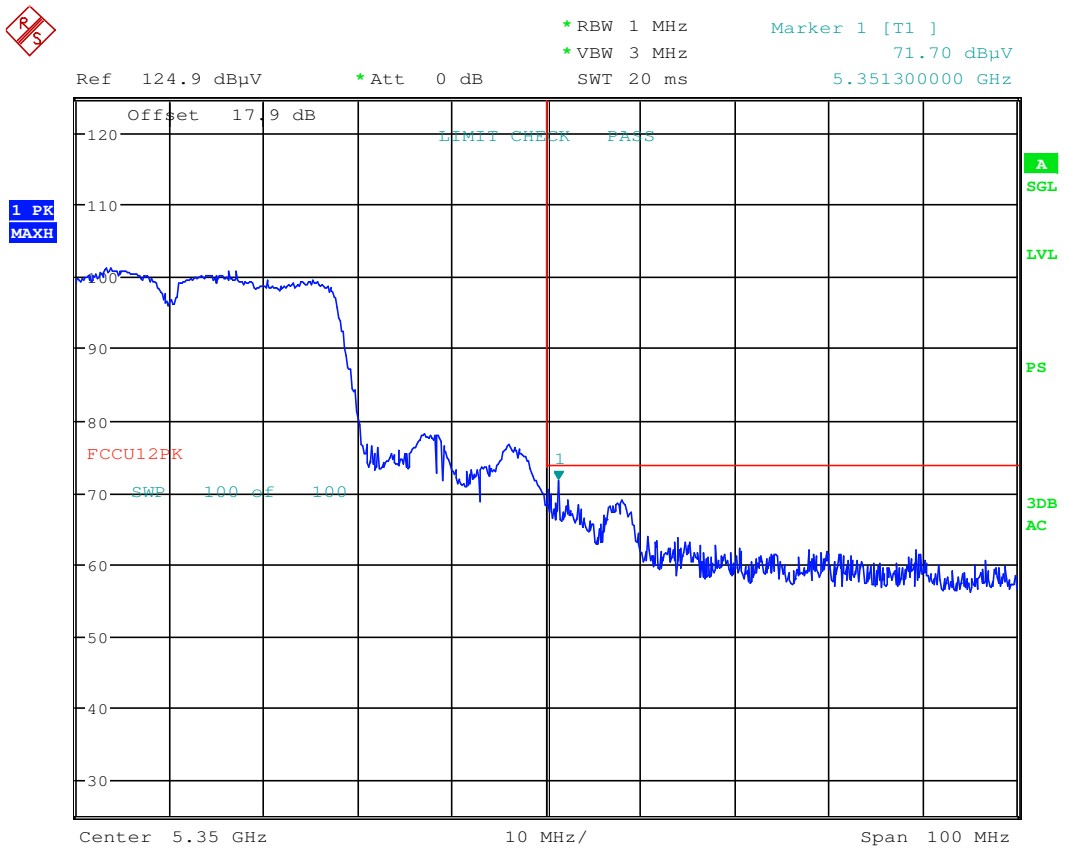


Date: 4.MAY.2016 18:57:09

Plot 7-94. Radiated Restricted Upper Band Edge Plot (Average – UNII Band 2A)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

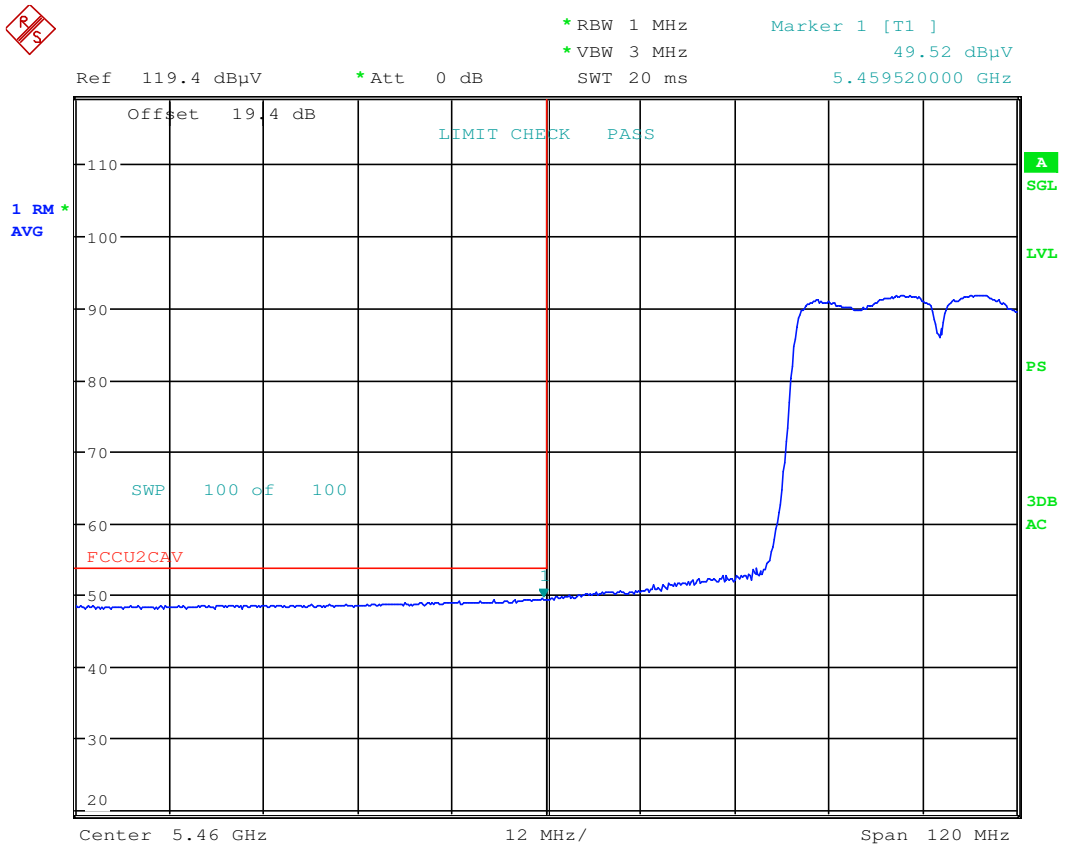


Plot 7-95. Radiated Restricted Upper Band Edge Plot (Peak – UNII Band 2A)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n (40MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5510MHz
Channel:	102

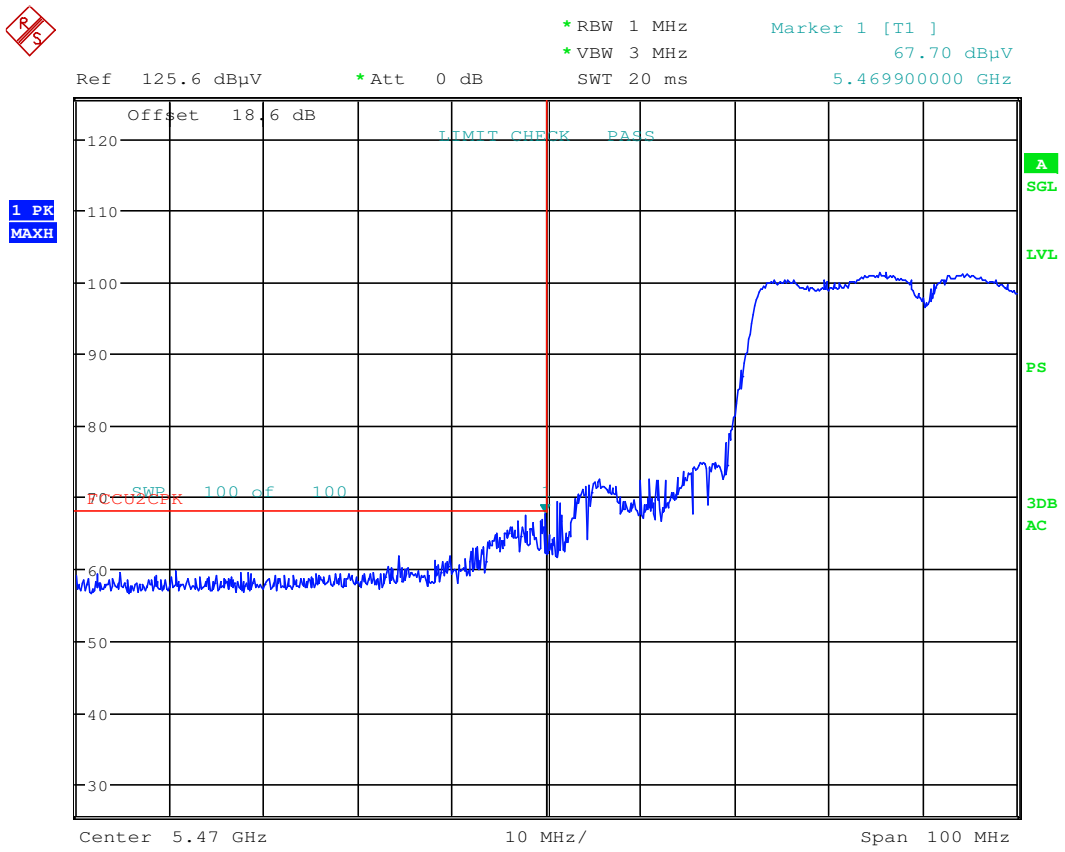


Date: 4.MAY.2016 19:25:50

Plot 7-96. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 2C)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209



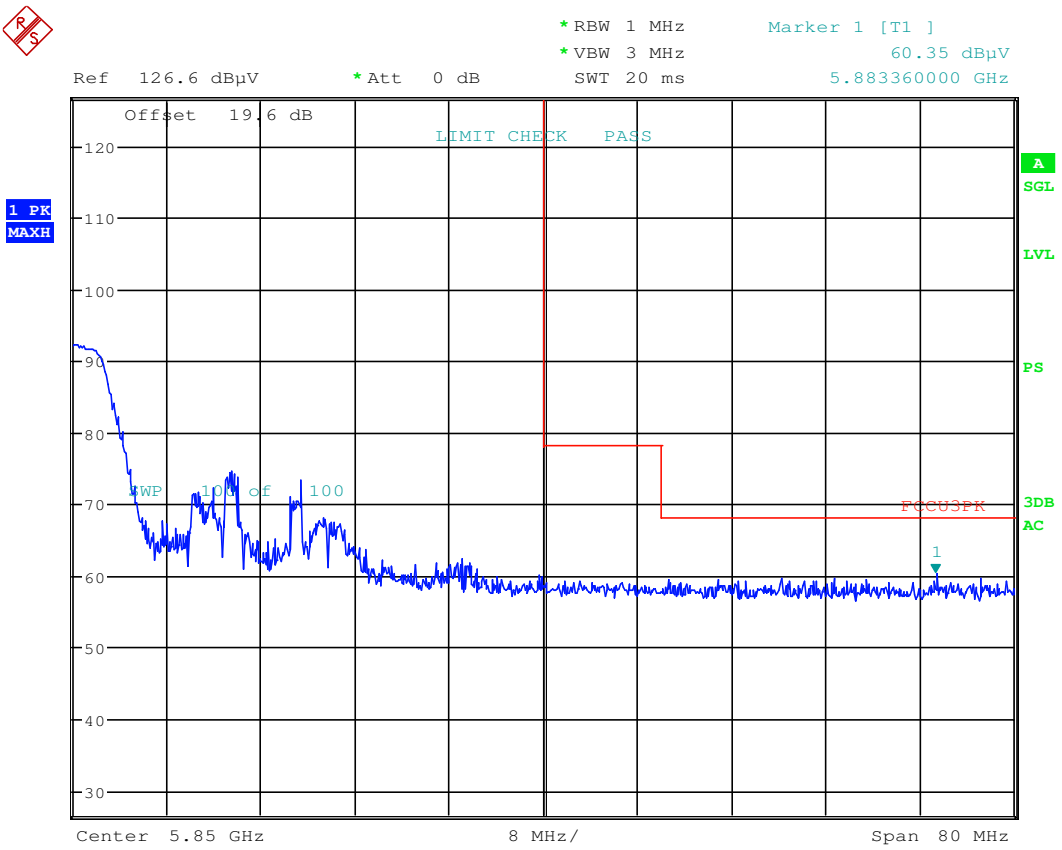
Date: 4.MAY.2016 19:23:30

Plot 7-97. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 2C)

Radiated Band Edge Measurements (40MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n (40MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5795MHz
Channel:	159

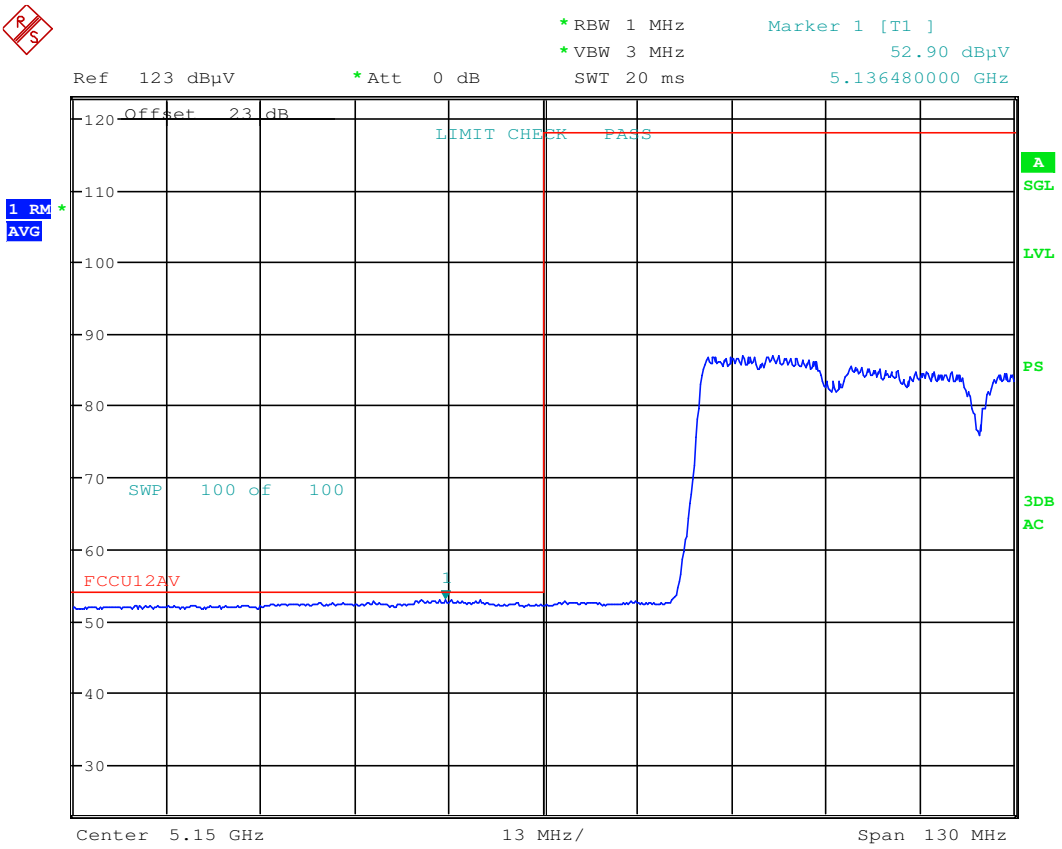


Plot 7-98. Radiated Upper Band Edge Plot (Peak – UNII Band 3)

7.7.4 Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11n (80MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5210MHz
Channel:	42

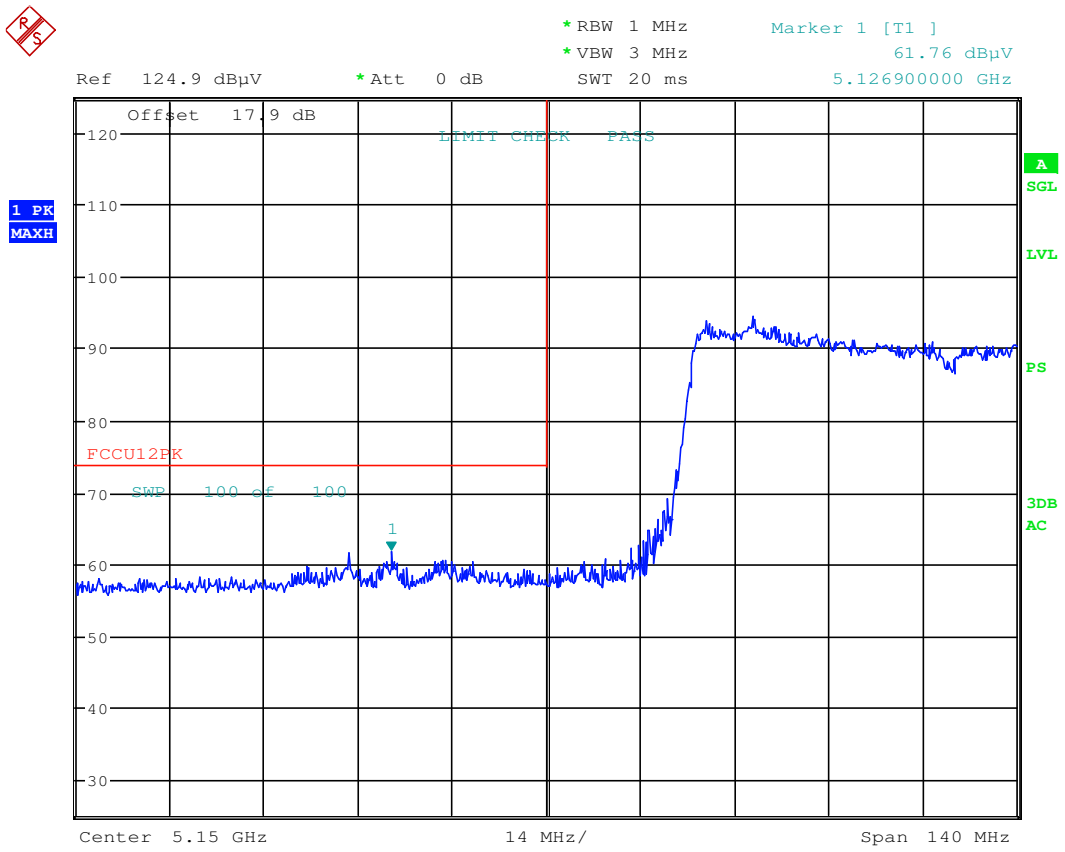


Date: 4.MAY.2016 18:12:17

Plot 7-99. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 1)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

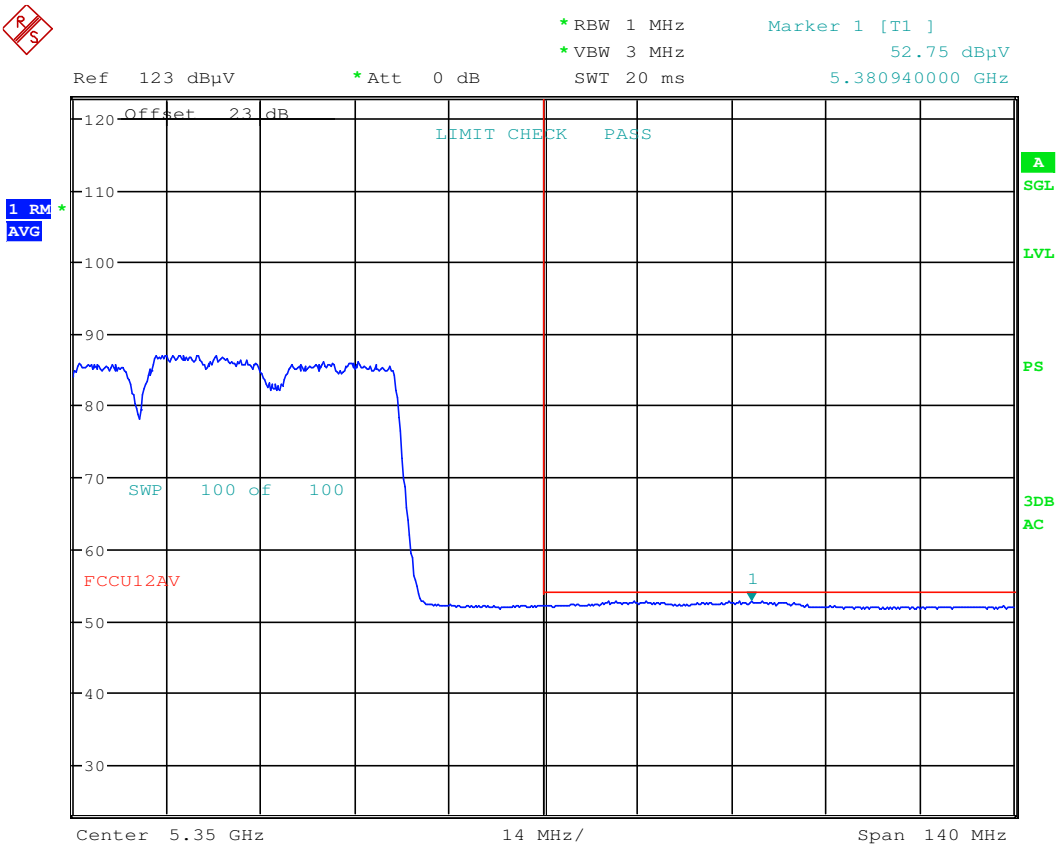


Plot 7-100. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 1)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11ac (80MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5290MHz
Channel:	58

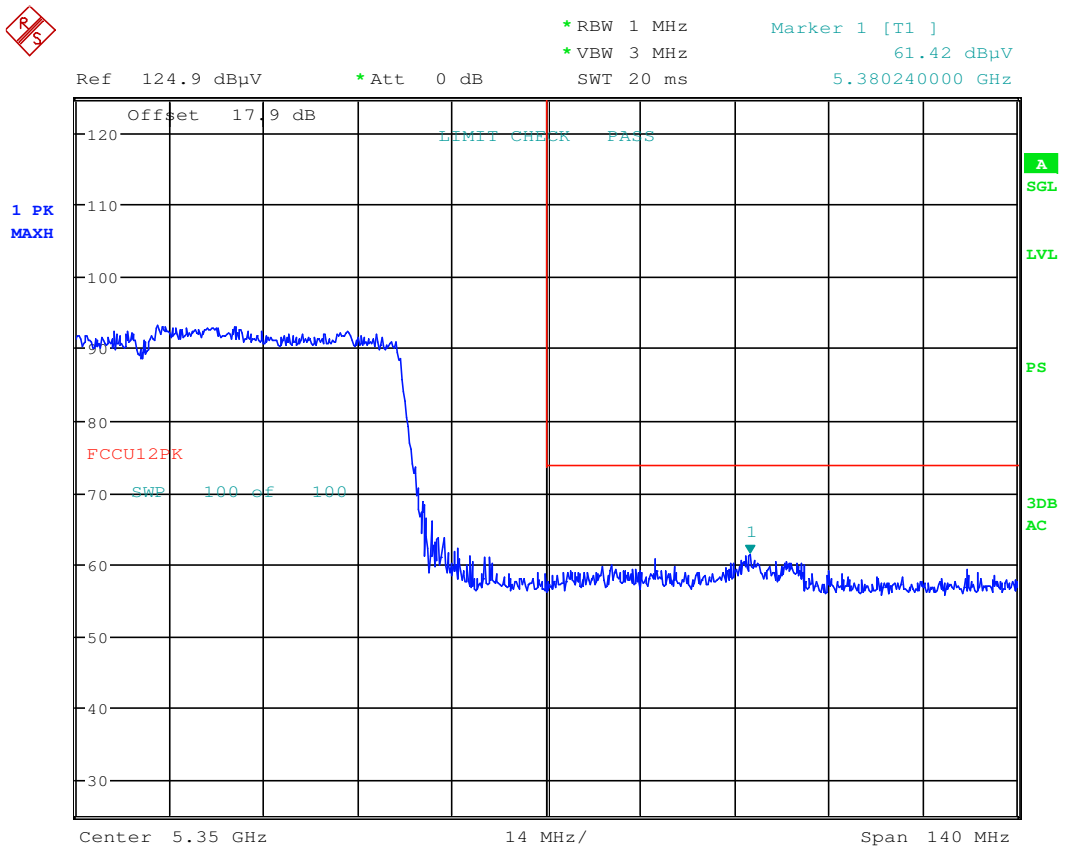


Date: 4.MAY.2016 19:09:01

Plot 7-101. Radiated Restricted Upper Band Edge Plot (Average – UNII Band 2A)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

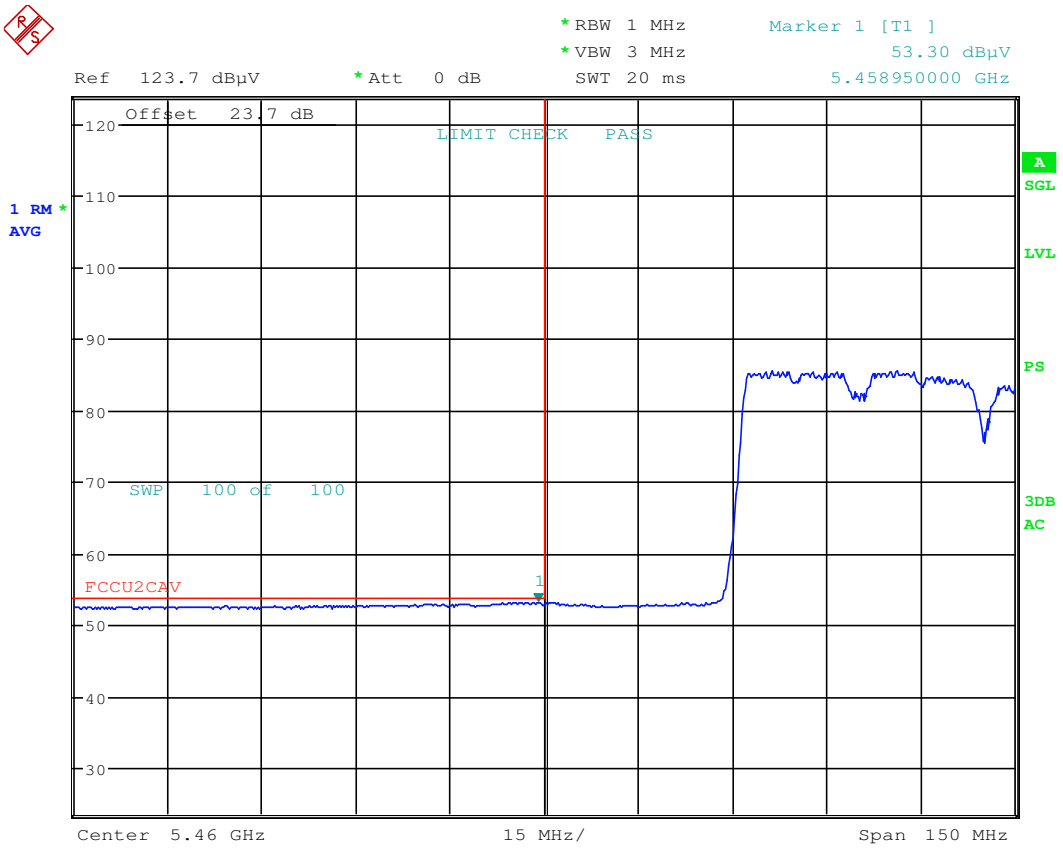


Plot 7-102. Radiated Restricted Upper Band Edge Plot (Peak – UNII Band 2A)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11ac (80MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5530MHz
Channel:	106

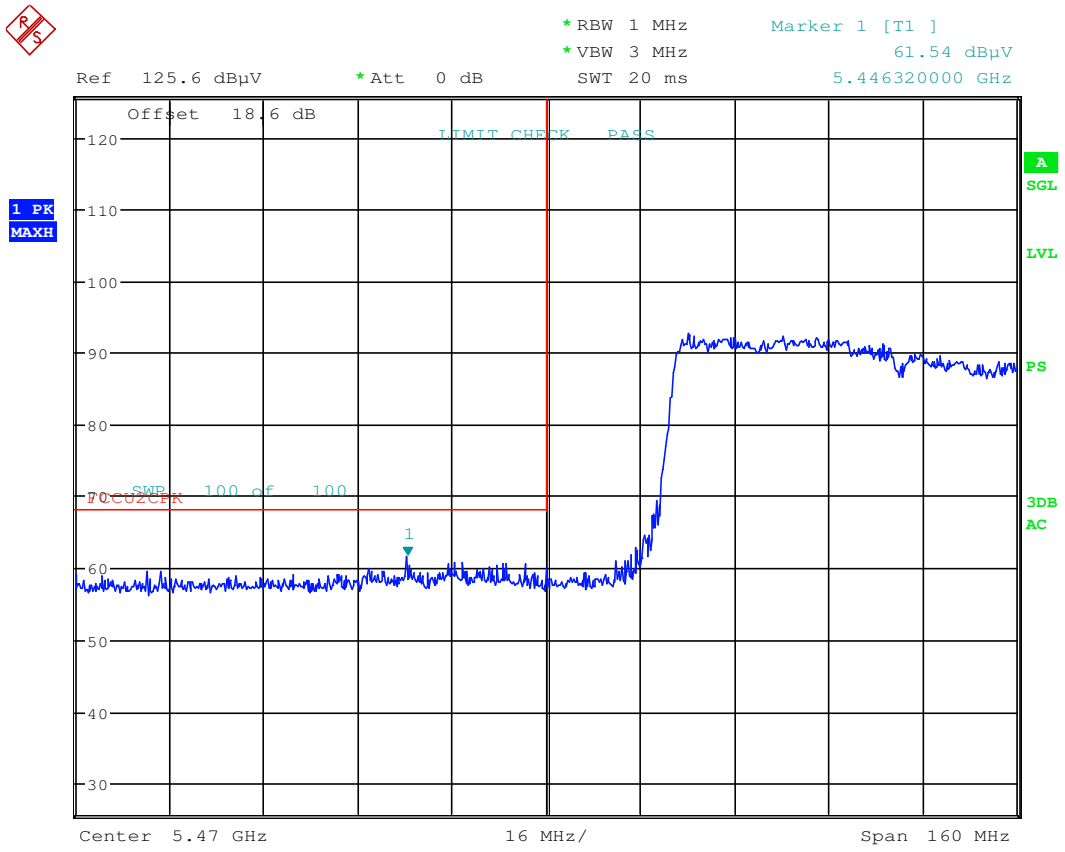


Date: 4.MAY.2016 19:30:59

Plot 7-103. Radiated Restricted Lower Band Edge Plot (Average – UNII Band 2C)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209



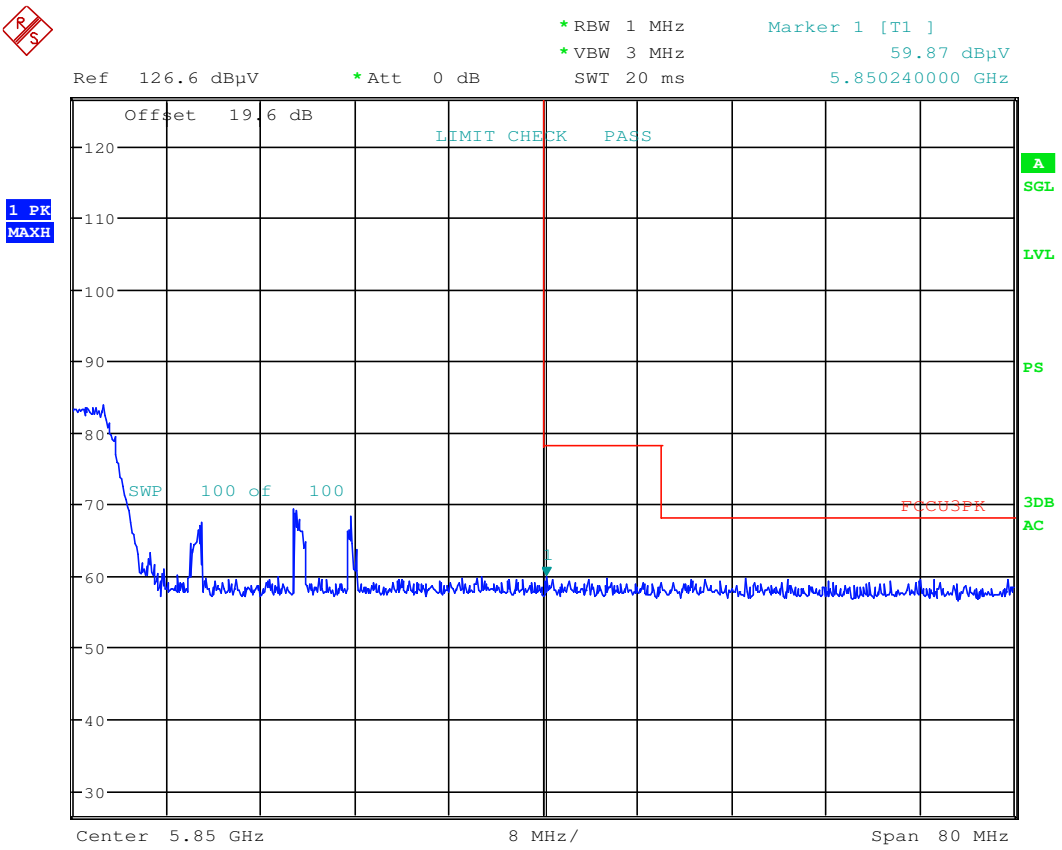
Date: 4.MAY.2016 19:34:10

Plot 7-104. Radiated Restricted Lower Band Edge Plot (Peak – UNII Band 2C)

Radiated Band Edge Measurements (80MHz BW)

§15.407(b.1)(b.2) §15.205 §15.209

Worst Case Mode:	802.11ac (80MHz)
Worst Case Transfer Rate:	MCS0
Distance of Measurements:	3 Meters
Operating Frequency:	5775MHz
Channel:	155



Date: 4.MAY.2016 20:02:56

Plot 7-105. Radiated Upper Band Edge Plot (Peak – UNII Band 3)

7.8 Radiated Spurious Emissions Measurements – Below 1GHz

§15.209

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 7-26 per Section 15.209.

Frequency	Field Strength [µV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-26. Radiated Limits

Test Procedures Used

ANSI C63.4-2014

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

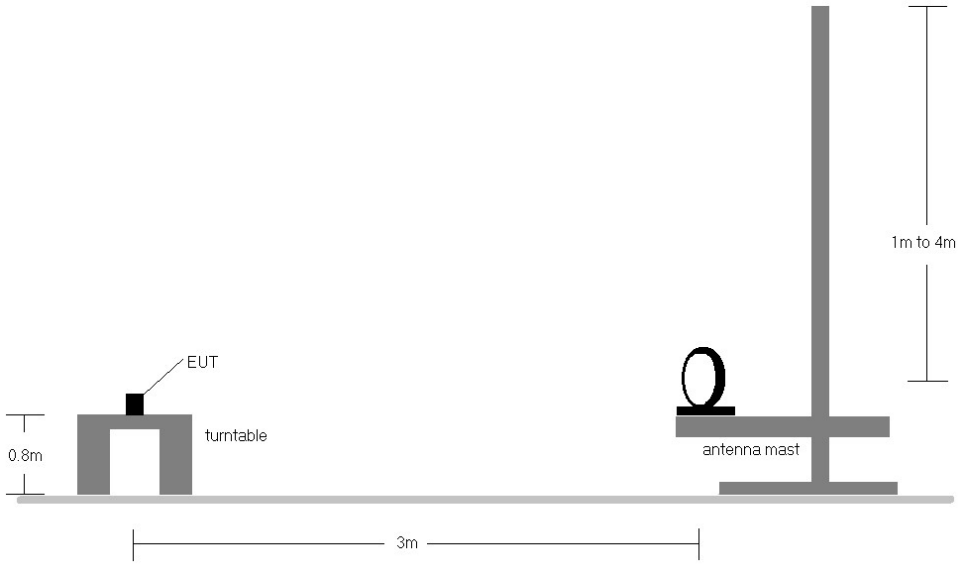


Figure 7-6. Radiated Test Setup < 30MHz

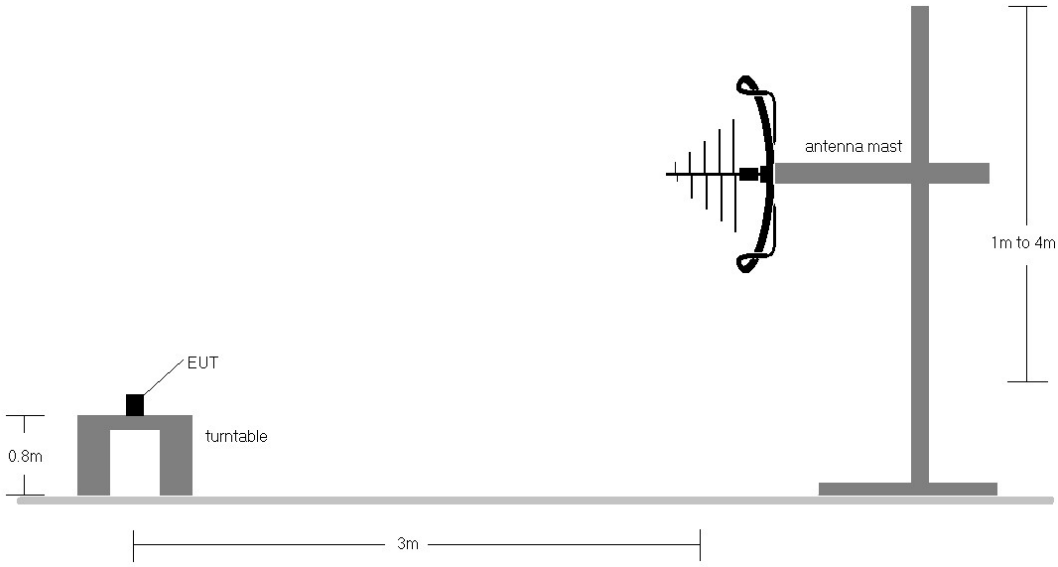


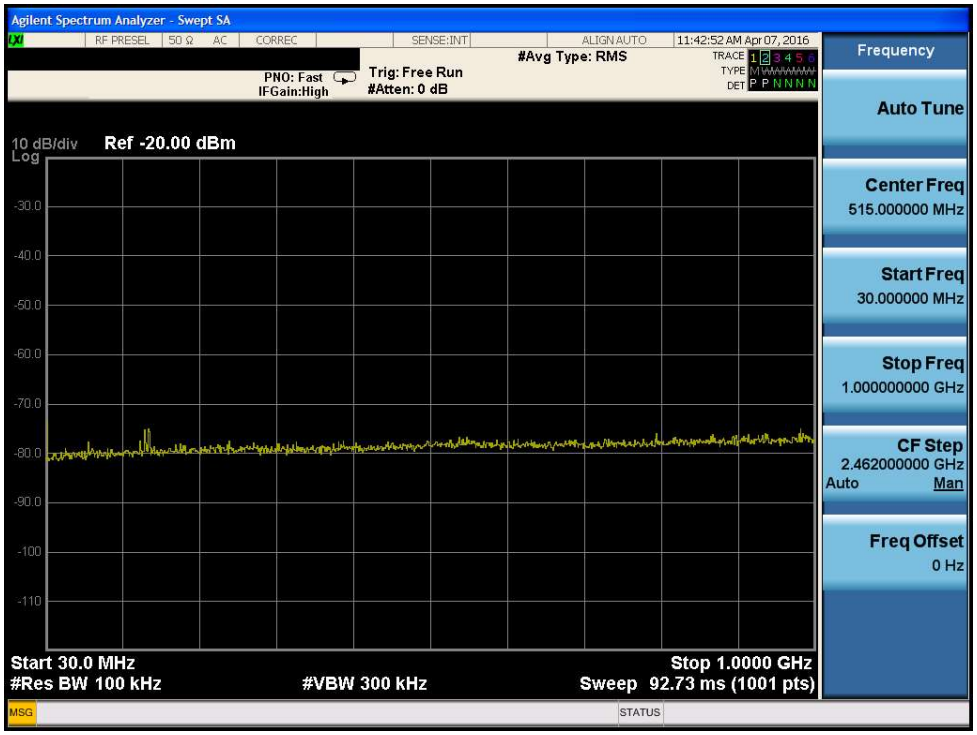
Figure 7-7. Radiated Test Setup < 1GHz

Test Notes

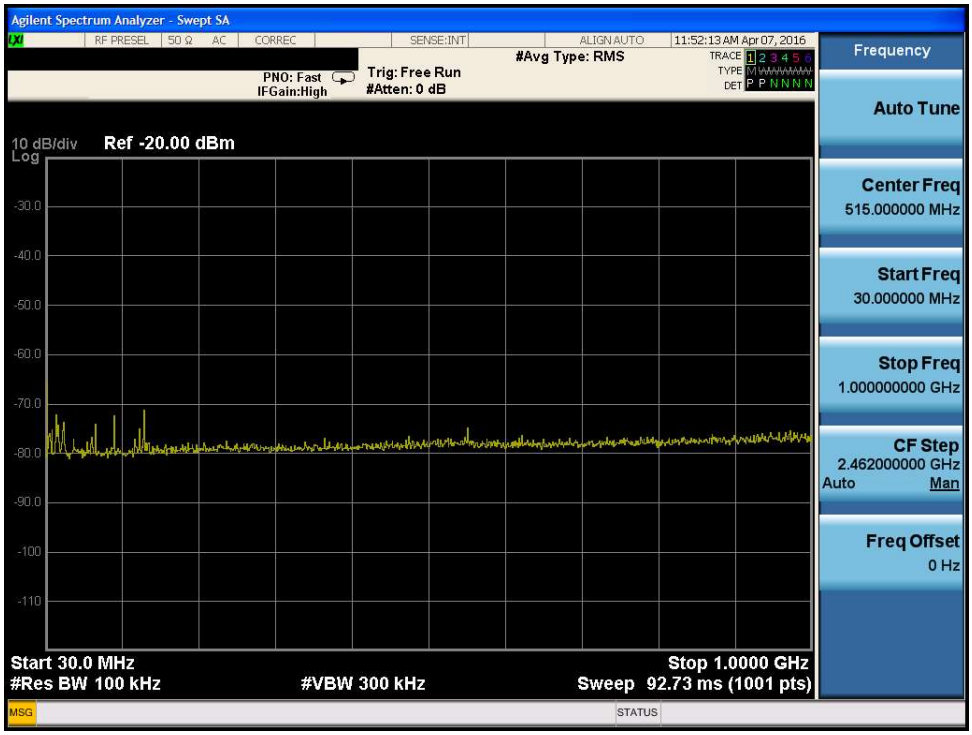
1. All emissions lying in restricted bands specified in §15.205 are below the limit shown in Table 7-13.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested while powered by an DC power source.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209



Plot 7-106. Radiated Spurious Plot below 1GHz (802.11a – U3 Ch. 157, Ant. Pol. H)



Plot 7-107. Radiated Spurious Plot below 1GHz (802.11a – U3 Ch. 157, Ant. Pol. V)

7.9 Line-Conducted Test Data

§15.407

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207.

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-27. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10-2013, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

7. Analyzer center frequency was set to the frequency of the spurious emission of interest
8. RBW = 9kHz (for emissions from 150kHz – 30MHz)
9. Detector = quasi-peak
10. Sweep time = auto couple
11. Trace mode = max hold
12. Trace was allowed to stabilize

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

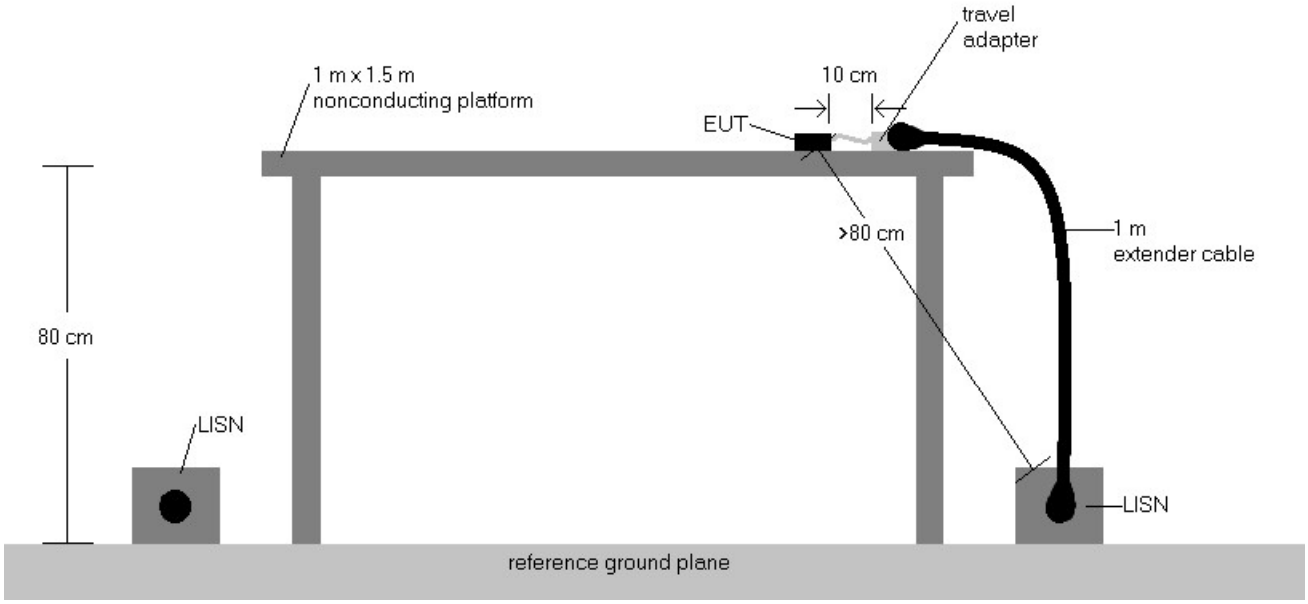


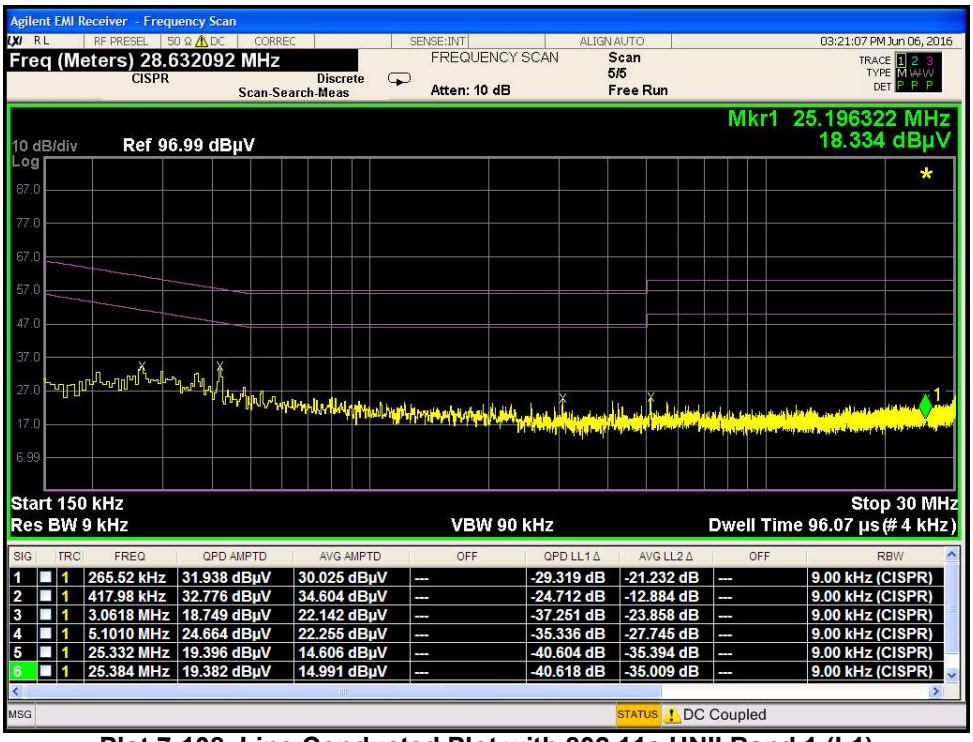
Figure 7-8. Test Instrument & Measurement Setup

Test Notes

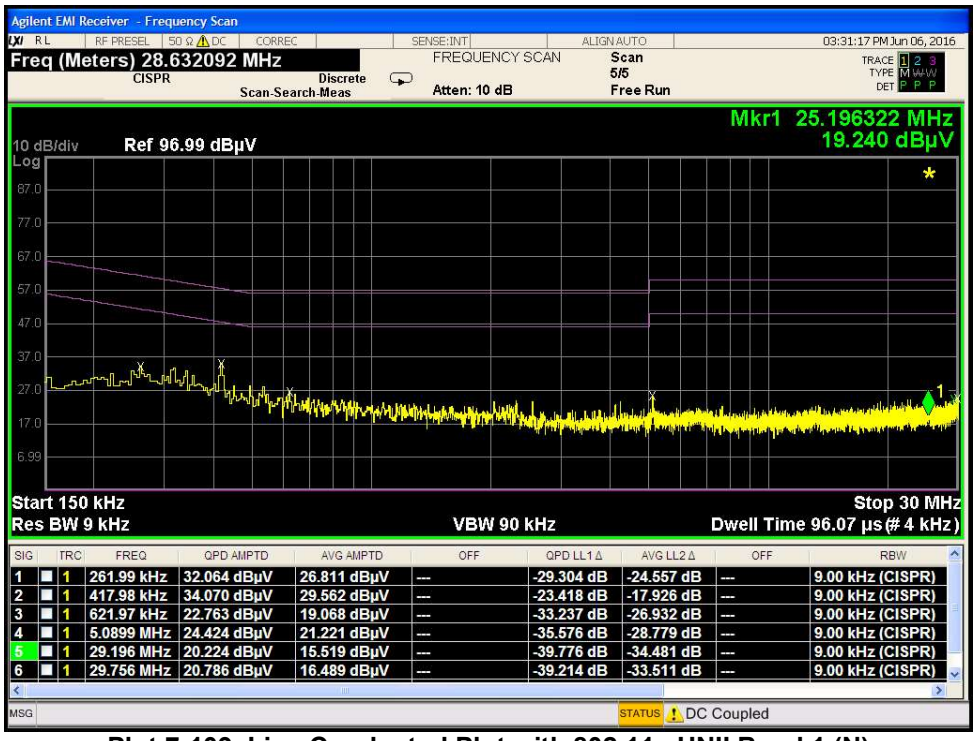
1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in 15.207.
3. Corr. (dB) = Cable loss (dB) + LISN insertion factor (dB)
4. QP/AV Level (dBμV) = QP/AV Analyzer/Receiver Level (dBμV) + Corr. (dB)
5. Margin (dB) = QP/AV Limit (dBμV) - QP/AV Level (dBμV)
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

Line-Conducted Test Data

§15.407



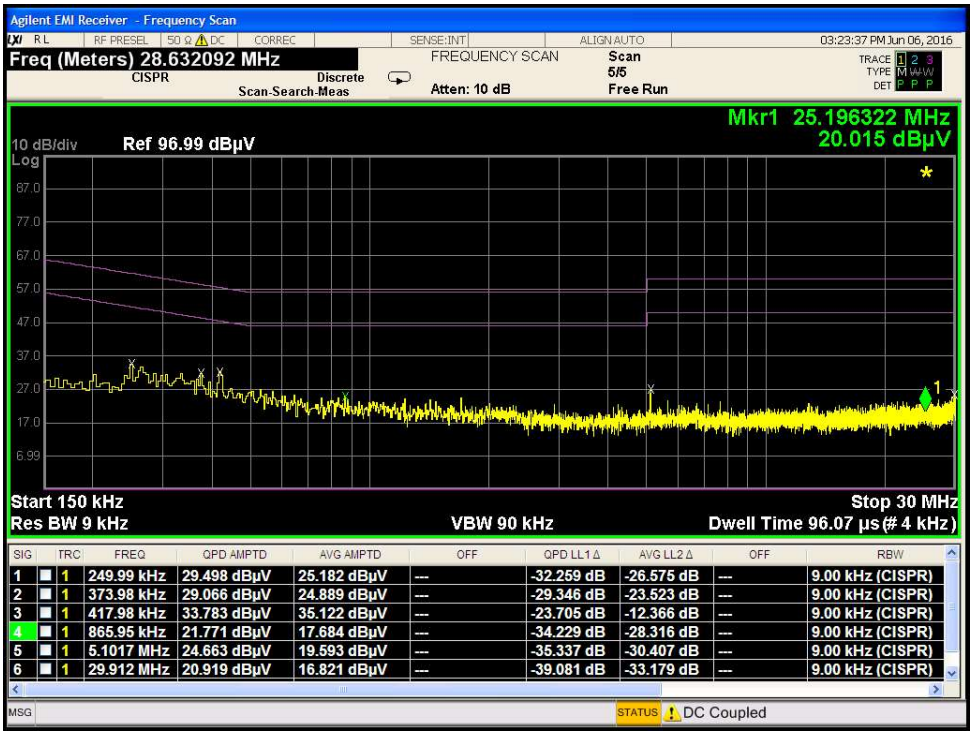
Plot 7-108. Line Conducted Plot with 802.11a UNII Band 1 (L1)



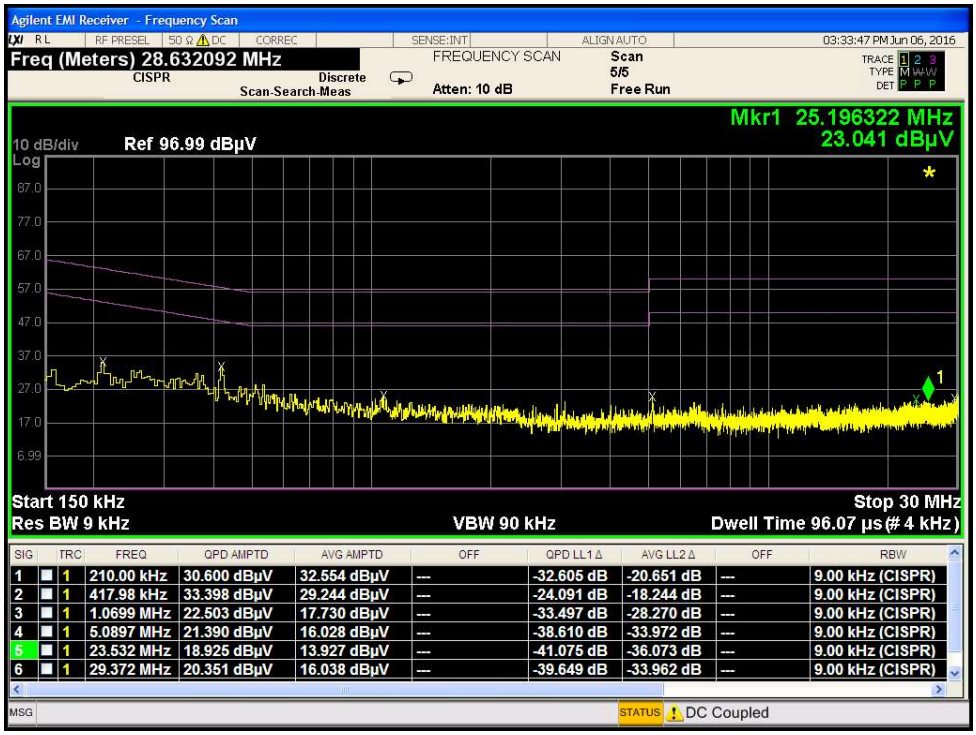
Plot 7-109. Line Conducted Plot with 802.11a UNII Band 1 (N)

Line-Conducted Test Data

§15.407



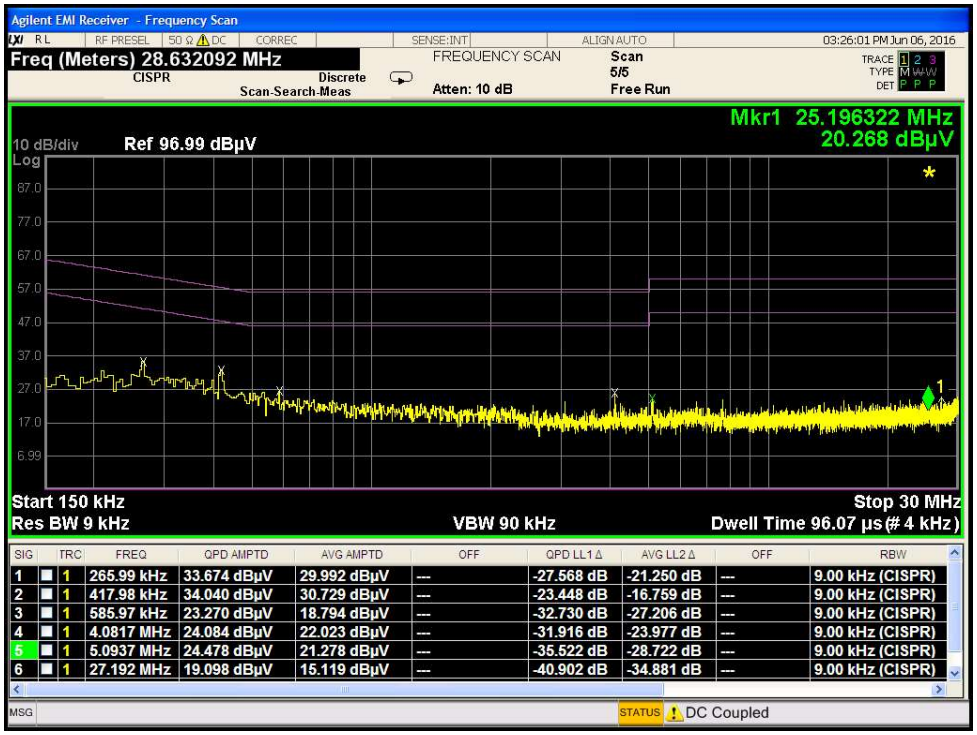
Plot 7-110. Line Conducted Plot with 802.11a UNII Band 2A (L1)



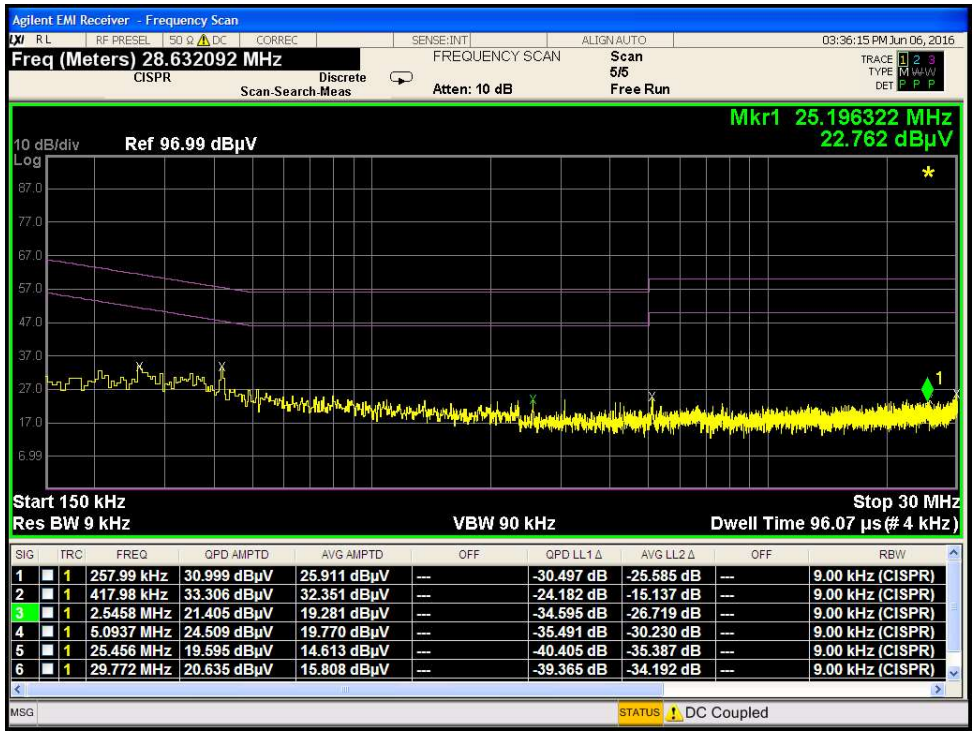
Plot 7-111. Line Conducted Plot with 802.11a UNII Band 2A (N)

Line-Conducted Test Data

§15.407



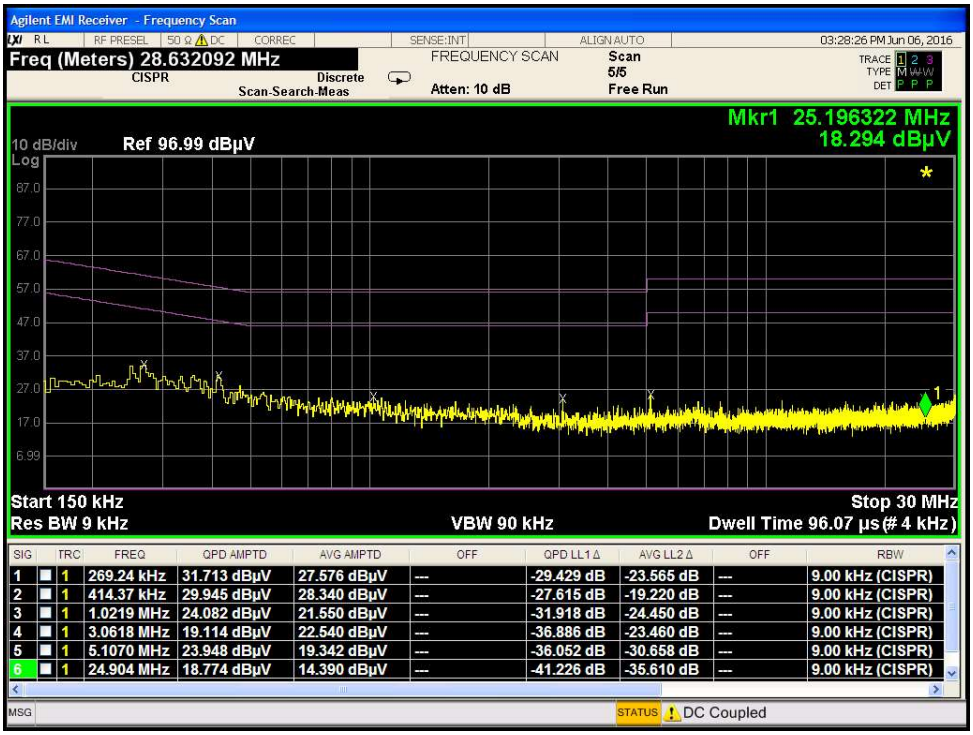
Plot 7-112. Line Conducted Plot with 802.11a UNII Band 2C (L1)



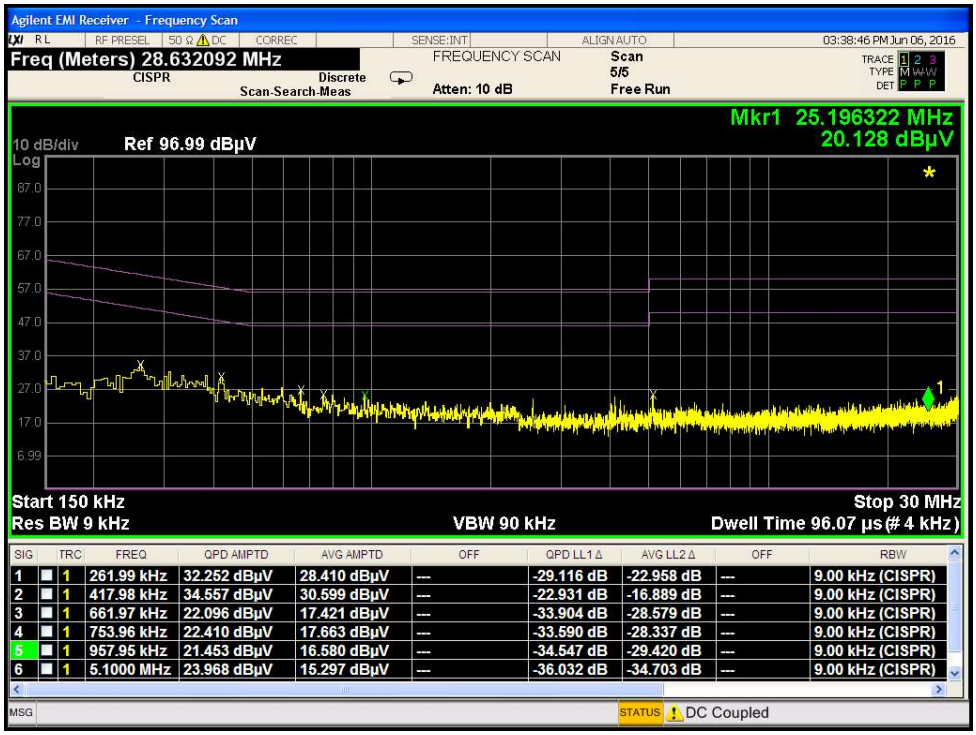
Plot 7-113. Line Conducted Plot with 802.11a UNII Band 2C (N)

Line-Conducted Test Data

§15.407



Plot 7-114. Line Conducted Plot with 802.11a UNII Band 3 (L1)



Plot 7-115. Line Conducted Plot with 802.11a UNII Band 3 (N)

8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **H&D Wireless AB Wifi/BT/NFC Module FCC ID: XO2SPB209A** is in compliance with Part 15E of the FCC Rules.