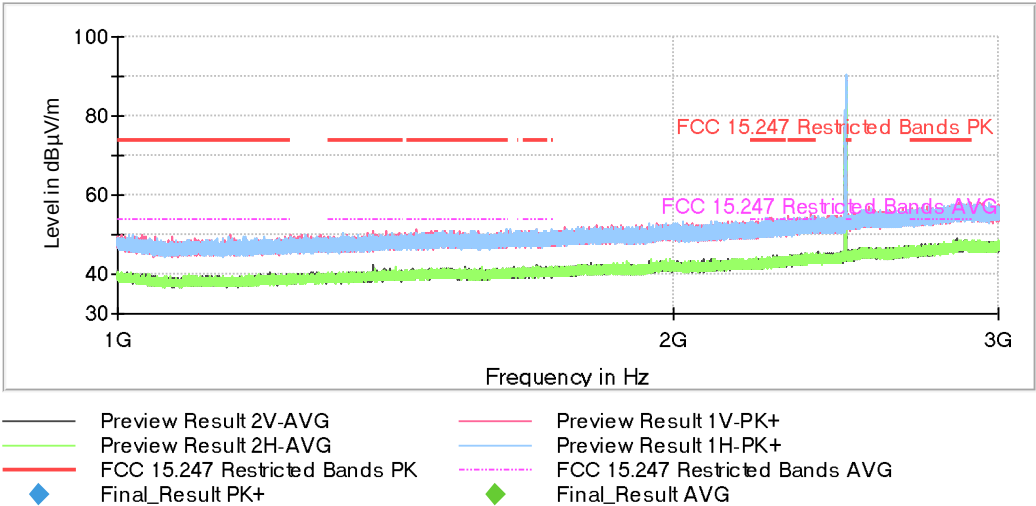
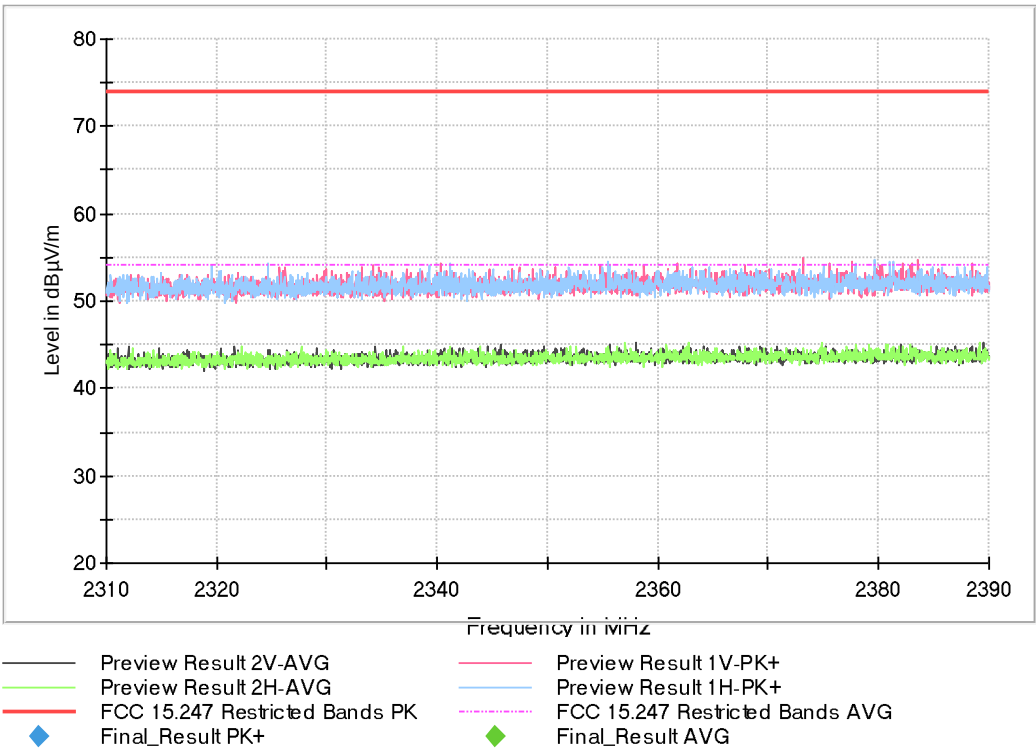


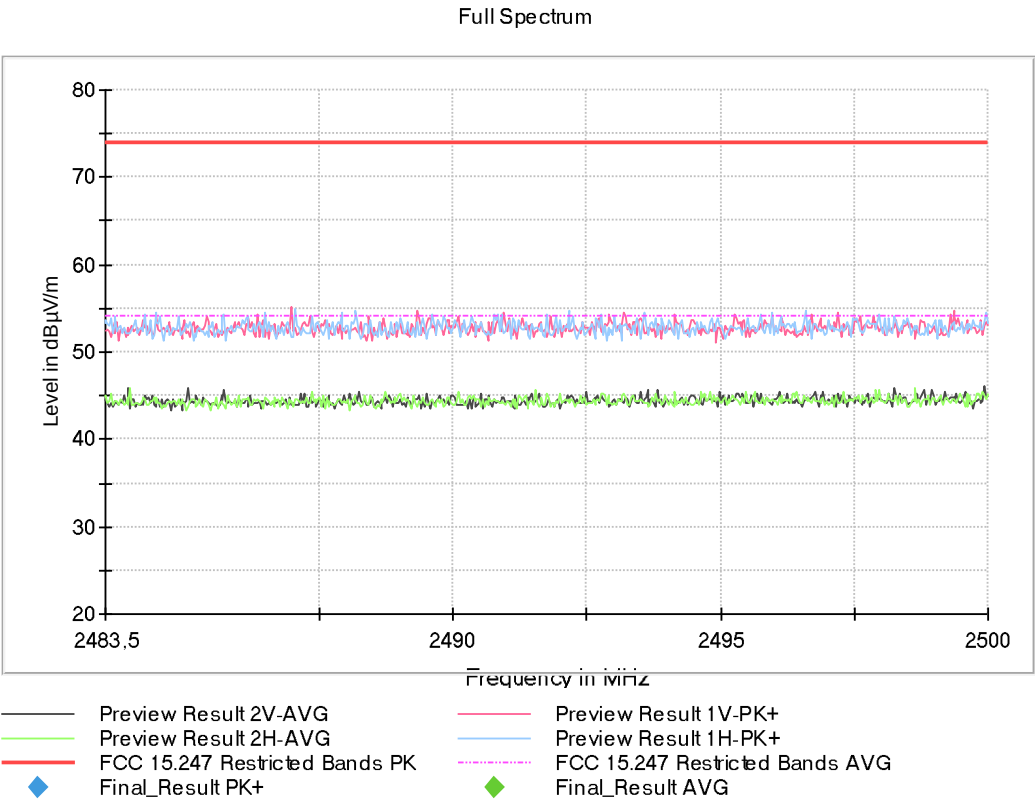
Frequency (MHz) = 2480.00000, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.1 (GFSK 2 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

Plots:



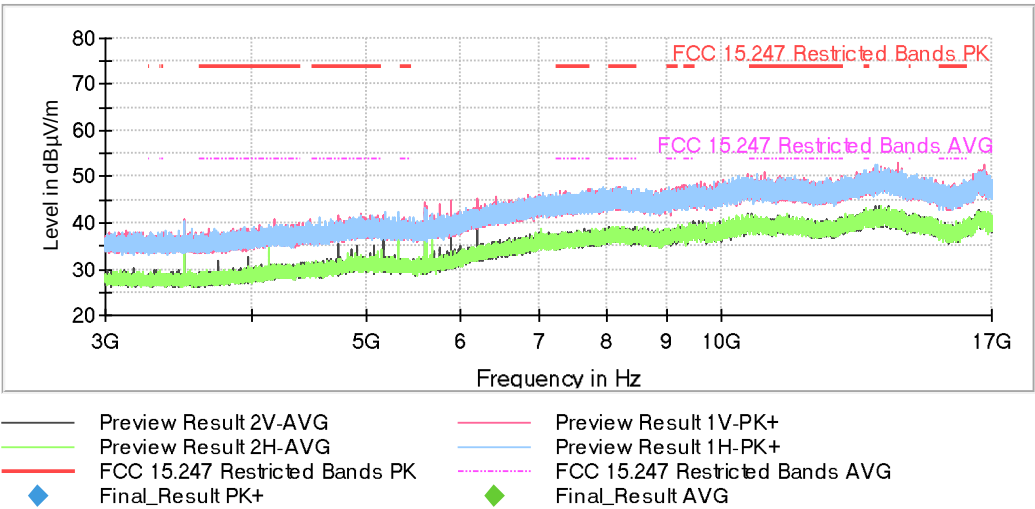
Full Spectrum





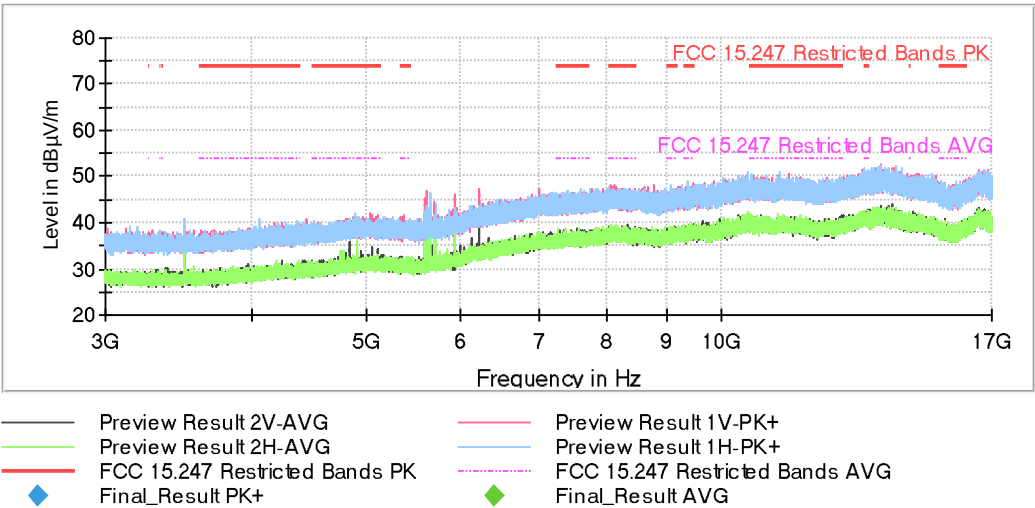
Frequency (MHz) = 2402.00000, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.1 (GFSK 2 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:



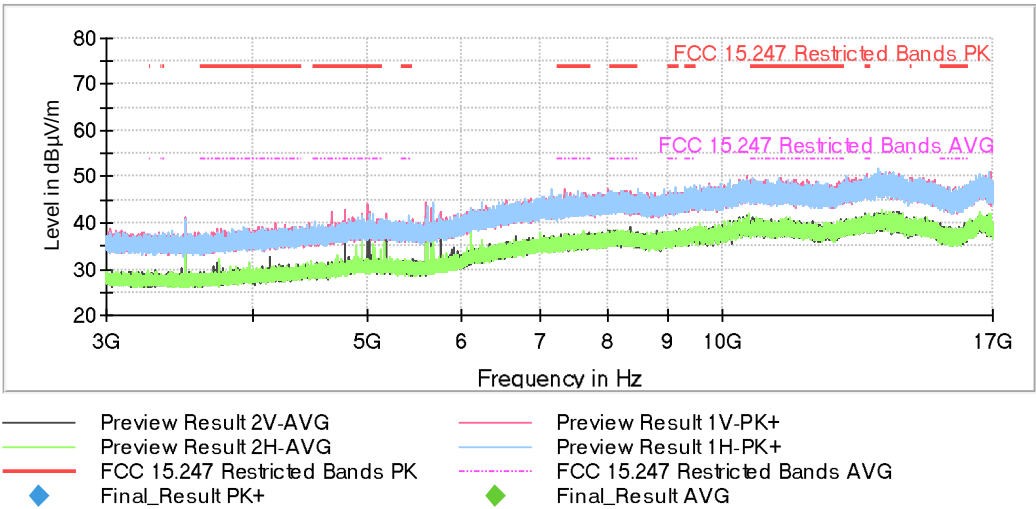
Frequency (MHz) = 2440.00000, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.1 (GFSK 2 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:



Frequency (MHz) = 2480.00000, Equipment Type: Digital Transmission System (DTS), Modulation: BTLE 5.1 (GFSK 2 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

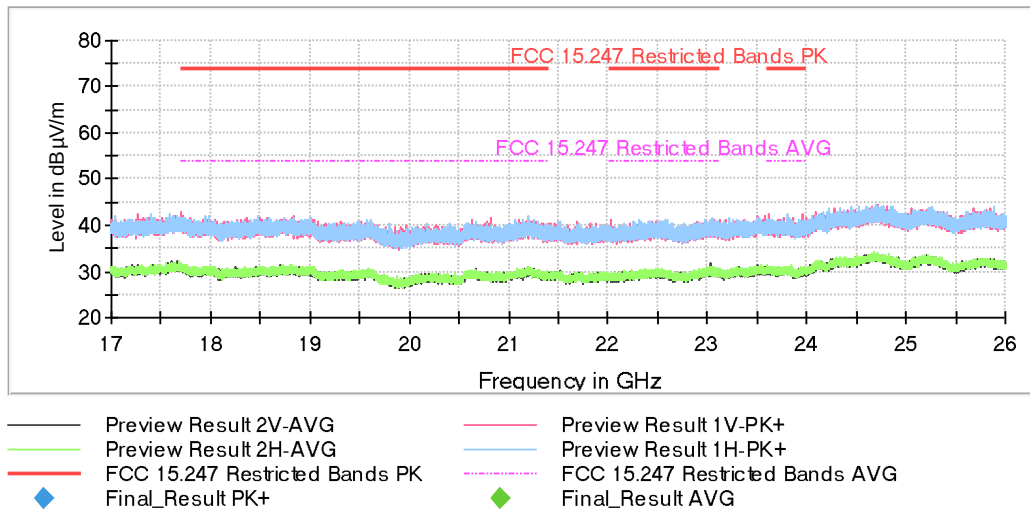
Plots:



Modulations: BTLE 5.1 (GFSK 1 Mbit/s), BTLE 5.1 (GFSK 2 Mbit/s)

Equipment Type: Digital Transmission System (DTS), Frequency Range (GHz) = [17, 26], Number of Transmission Chains = 1

Plots:



This plot is valid for Low, Middle and High Channels and all modulations

Appendix E: Test results. WLAN 802.11 b/g/n20/ax20

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	12Vdc
Type of Power Supply:	External

ANTENNA (*):

Type of Antenna:	External antenna
Maximum Declared Antenna Gain:	2 dBi
RF Output Port:	4

TEST FREQUENCIES (*):

Low Channel:	2412 MHz
Middle Channel:	2437 MHz
High Channel:	2462 MHz

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

The data rates below were selected as the worst-case ones in terms of spurious emissions for each modulation scheme, based on preliminary testing:

802.11b:	1 Mbit/s
802.11g:	6 Mbit/s
802.11n:	HT20 MCS0 6.5 Mbit/s
802.11ax20 OFDM / OFDMA:	HE20 (OFDM / OFDMA MCS0 index)

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (bilog antenna for the range from 30 MHz to 1000 MHz and 1 – 17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz – 26 GHz (17 GHz – 40 GHz horn antenna).

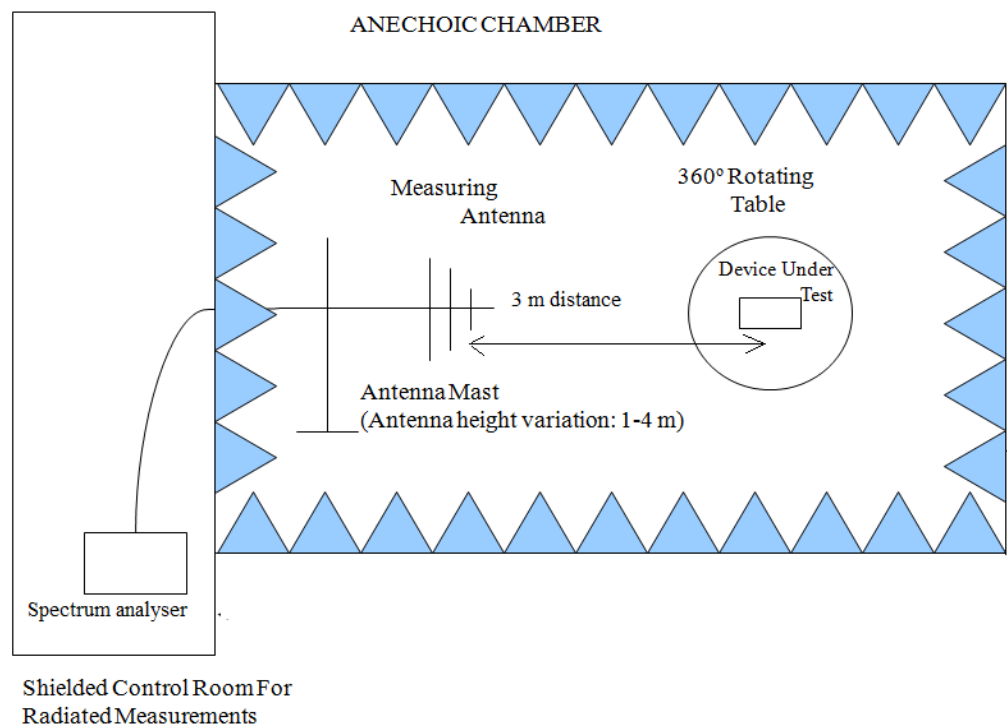
For radiated emissions in the range 17 GHz – 26 GHz performed at a distance closer than the distance specified in standard, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters (up to 17GHz) to find the maximum radiated emission.

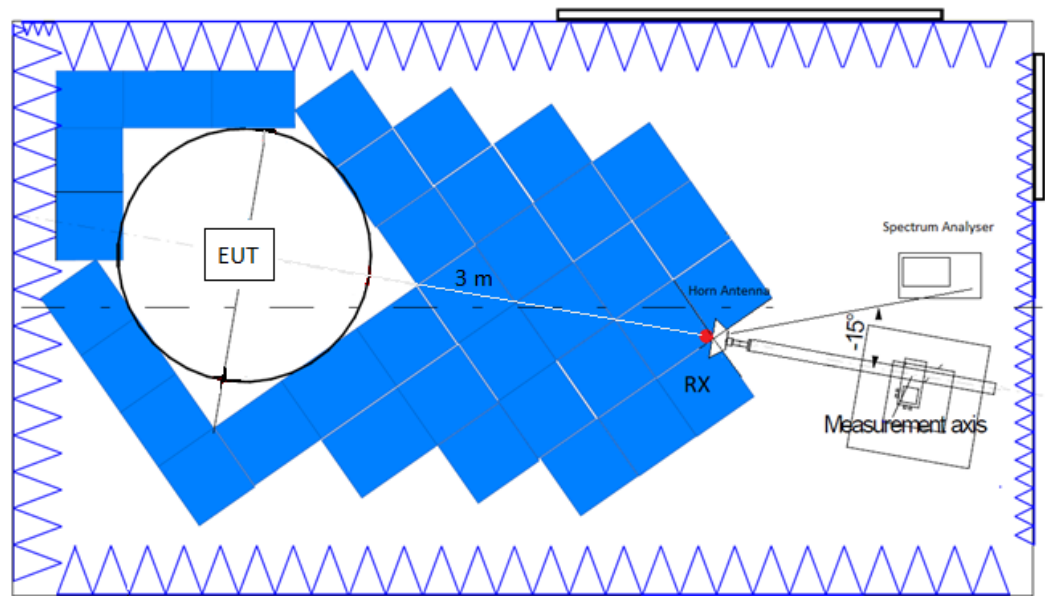
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

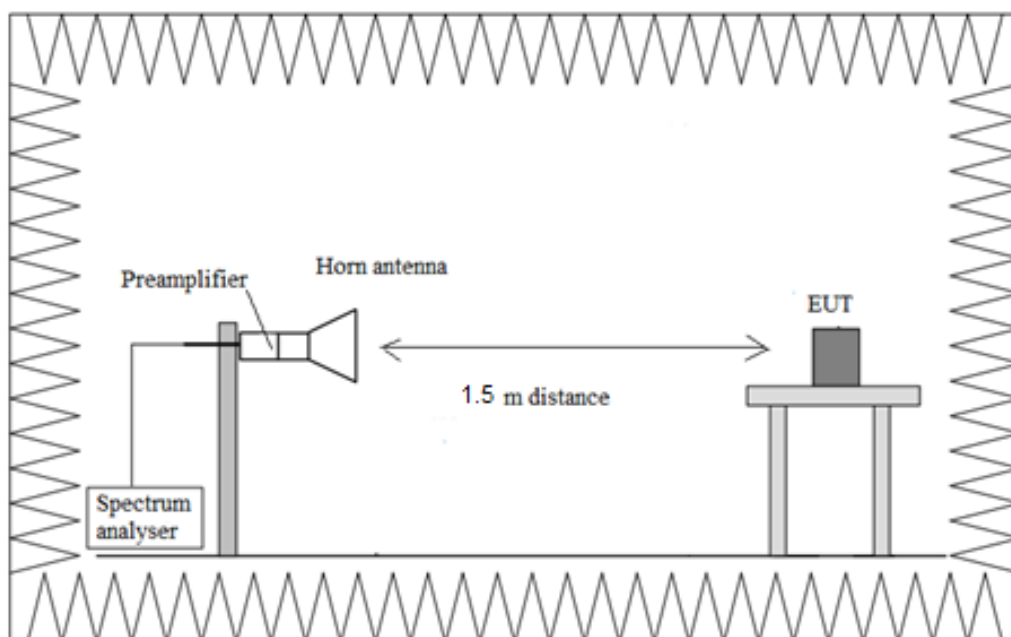
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



TEST CASES DETAILS

FCC 15.247 (d) Emission limitations radiated (Transmitter)

Limits

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

Frequency Range (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	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 specified when measuring with peak detector function.

Results

Frequency range 30 MHz – 1 GHz:

The spurious frequencies detected do not depend on either the modulation or the operating channel.

Spurious frequencies detected at less than 20 dB below the limit:

Freq Rng (GHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	Pol	Detector
[0.03, 1]	600.027	35.26	V	QP
	874.991	28.78	H	QP

Frequency range 1 GHz – 26 GHz:

Modulation: 802.11b (DSSS 1 Mbit/s)

Spurious frequencies detected at less than 20 dB below the limit:

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	Pol	Detector
[3, 17]	2412.0000	3960.120	42.06	V	Peak
		5050.300	42.91	V	Peak
		4752.520	42.48	H	Peak
		4901.200	43.05	H	Peak
	2437.0000	3961.520	40.00	V	Peak
		4824.480	42.50	V	Peak
		4944.460	47.57	H	Peak
	2462.0000	3960.120	39.94	V	Peak
		5016.280	43.34	V	Peak

Modulation: 802.11g (OFDM 6 Mbit/s)

Spurious frequencies detected at less than 20 dB below the limit:

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	Pol	Detector
[3, 17]	2412.0000	3960.120	40.82	V	Peak
		4963.640	43.27	H	Peak
		5404.920	43.69	H	Peak
	2437.0000	3960.540	40.08	V	Peak
		4848.140	42.43	V	Peak
		5029.440	43.91	V	Peak
		5442.020	42.61	V	Peak
	2462.0000	3960.120	40.77	V	Peak
		4789.760	43.63	V	Peak
		4905.960	43.53	H	Peak
		5020.900	45.11	H	Peak

Modulation: 802.11n HT20 (OFDM MCS0 6.5 Mbit/s)

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	Pol	Detector
[3, 17]	2412.0000	3960.260	40.65	V	Peak
		4737.960	41.99	V	Peak
		4982.960	47.38	H	Peak
		5079.280	42.30	H	Peak
	2437.0000	3772.380	38.35	H	Peak
		3960.400	39.37	V	Peak
		4126.580	39.68	V	Peak
		4789.760	40.70	H	Peak
		4810.060	41.11	V	Peak
		4949.780	41.97	V	Peak
		5131.360	43.17	V	Peak
	2462.0000	3959.840	41.21	V	Peak
		4058.400	38.58	V	Peak
		4762.320	44.17	V	Peak
		4997.520	42.98	V	Peak
		5122.820	41.04	V	Peak

Modulation: 802.11ax20 HE20 (OFDM MCS0 index) – SU Full-channel allocation

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	Pol	Detector
[3, 17]	2412.0000	3960.120	40.24	V	Peak
		4766.940	43.89	V	Peak
		4823.220	42.01	H	Peak
		5016.560	42.69	H	Peak
		5126.600	42.33	H	Peak
	2437.0000	3959.980	39.82	V	Peak
		4829.800	44.46	V	Peak
		4973.580	41.45	H	Peak
		5098.600	45.51	H	Peak
		5136.680	42.86	V	Peak
	2462.0000	3960.120	40.64	V	Peak
		4126.720	39.98	H	Peak
		4733.480	42.76	H	Peak
		4953.840	44.03	H	Peak
		5131.920	42.52	H	Peak

Modulation: 802.11ax20 HE20 (OFDMA MCS0 index) – RU Subcarrier allocation (Single User)

Preliminary measurements determined 26 tones as the worst-case RU (Resource Unit) carrier allocation in terms of spurious emissions. Results below are for this worst-case allocation.

No spurious emissions found.

Verdict

Pass

Attachments

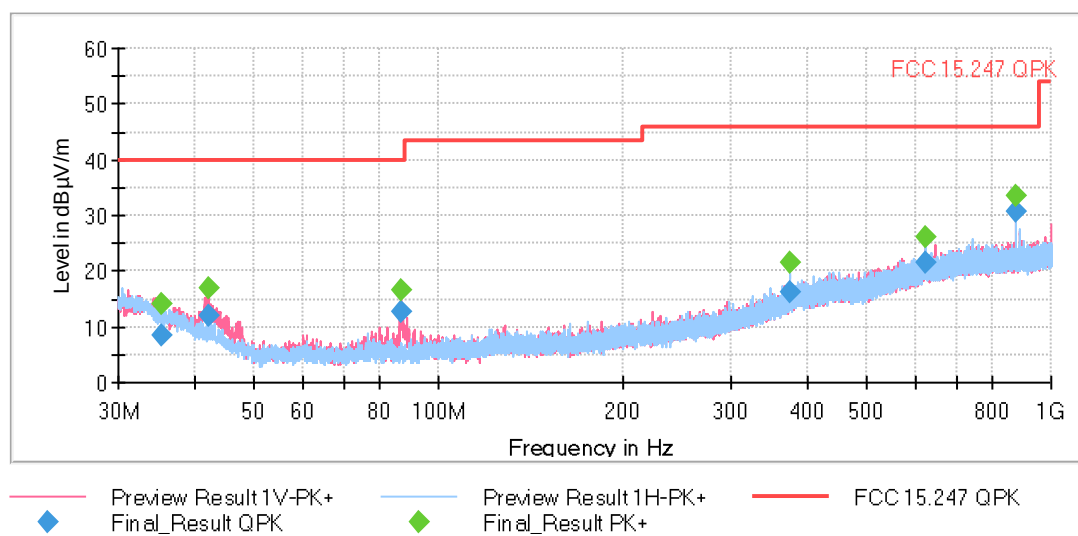
The setting for each range of frequency is indicated in the tables below:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 30 MHz - 1 GHz	30,312 kHz	PK+	100 kHz	1 s	0 dB
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 1 GHz - 3 GHz	30,769 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 3 GHz - 17 GHz	140 kHz	PK+ ; AVG	1 MHz	1 s	30 dB
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44] 17 GHz - 26 GHz	300 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Modulations: 802.11b (DSSS 1 Mbit/s), 802.11g (OFDM 6 Mbit/s), 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), 802.11ax20 HE20 (OFDM / OFDMA MCS0 index)

Equipment Type: Digital Transmission System (DTS), Frequency Range (GHz) = [0.03, 1], Number of Transmission Chains = 1

Plots:

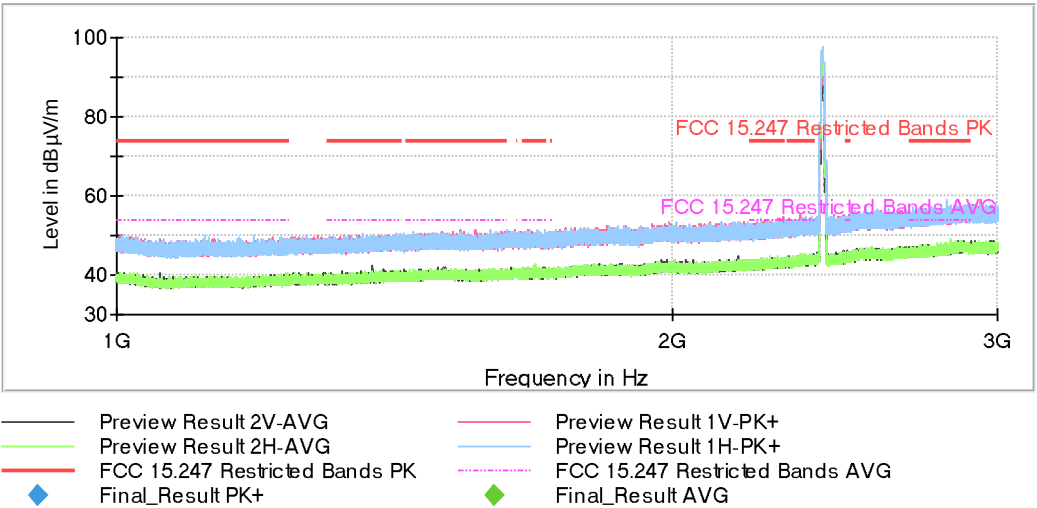


This plot is valid for Low, Middle and High Channels and all modulations

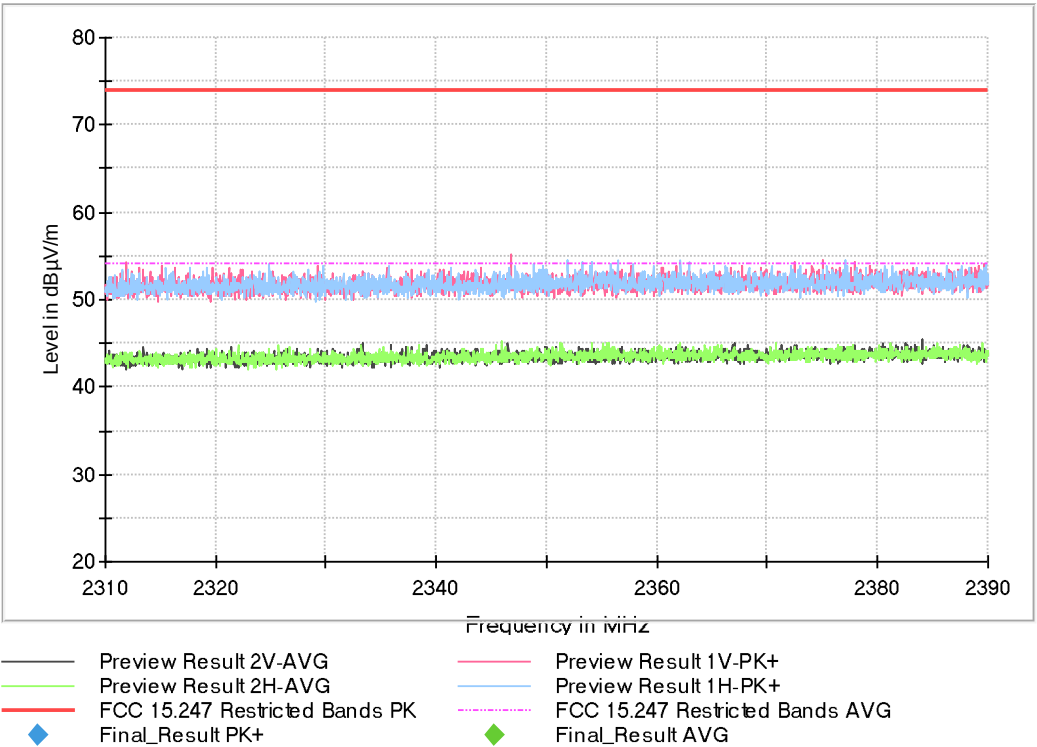
Modulation: 802.11b (DSSS 1 Mbit/s)

Frequency (MHz) = 2412.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

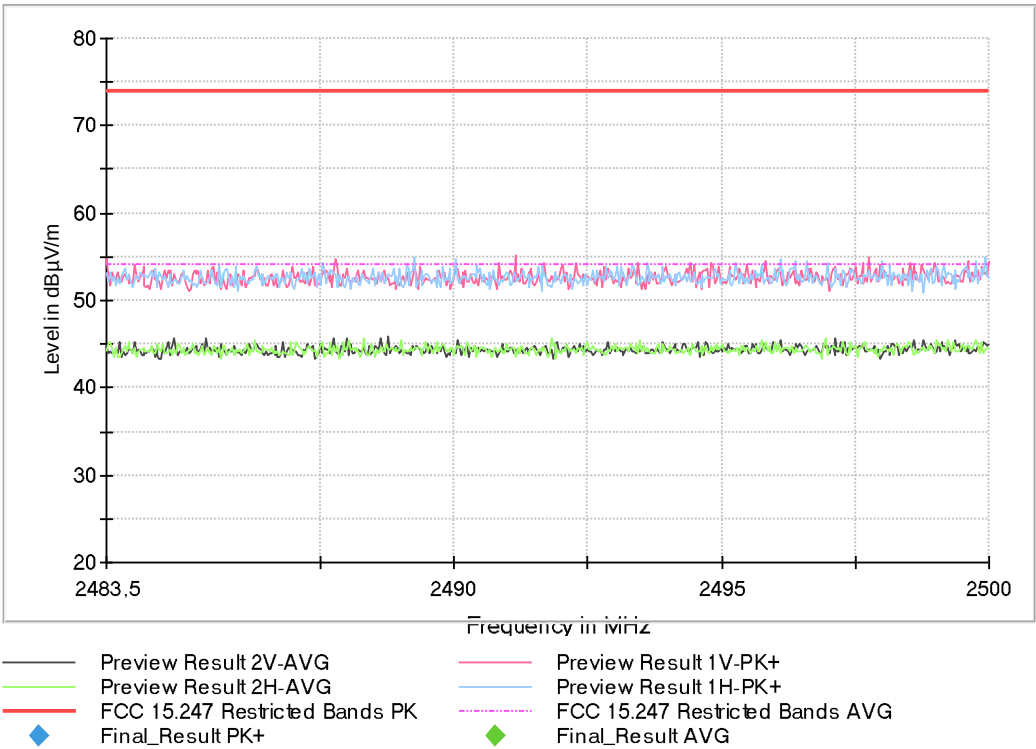
Plots:



Full Spectrum

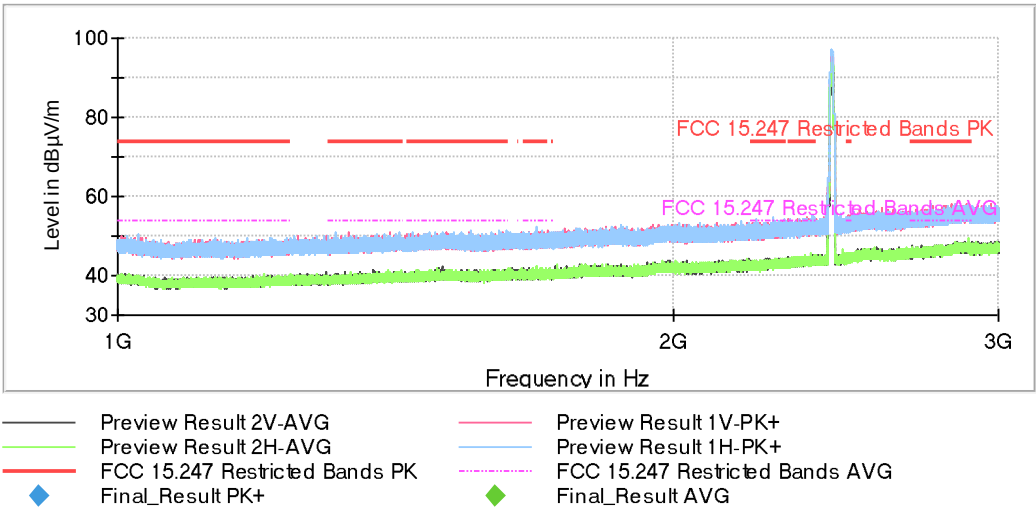


Full Spectrum

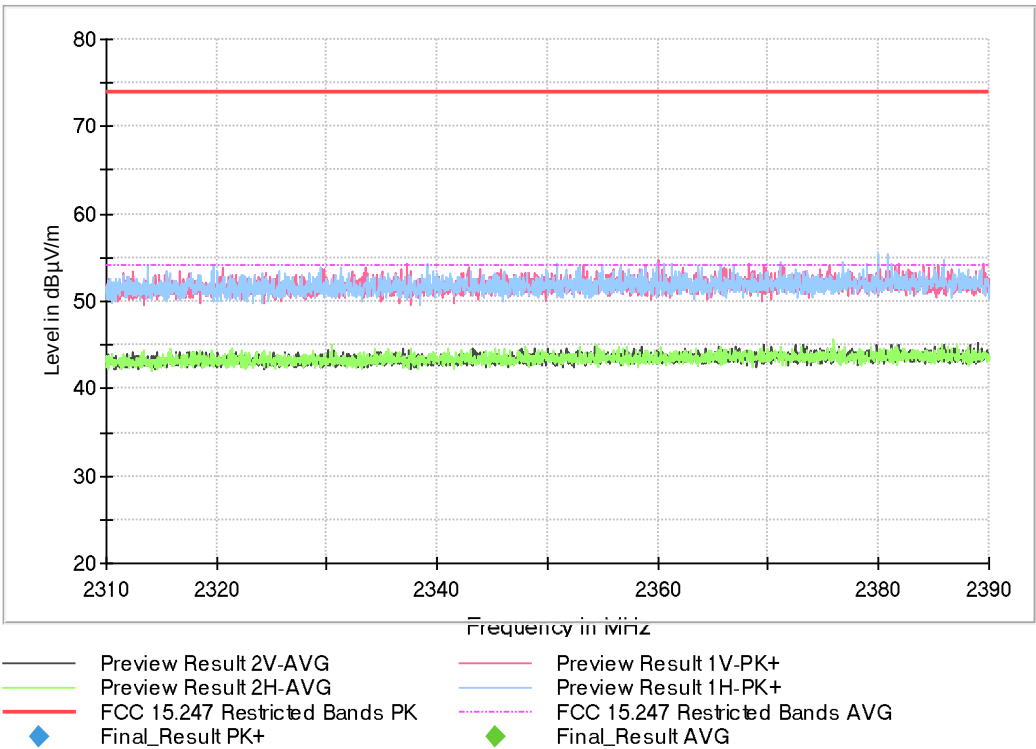


Frequency (MHz) = 2437.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

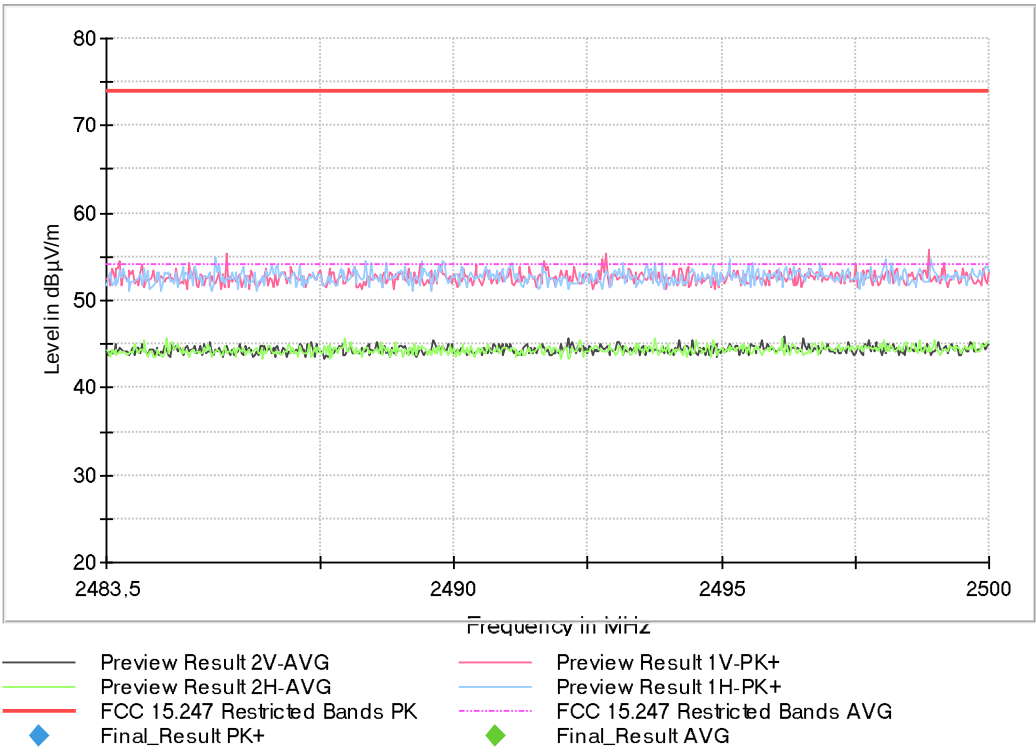
Plots:



Full Spectrum

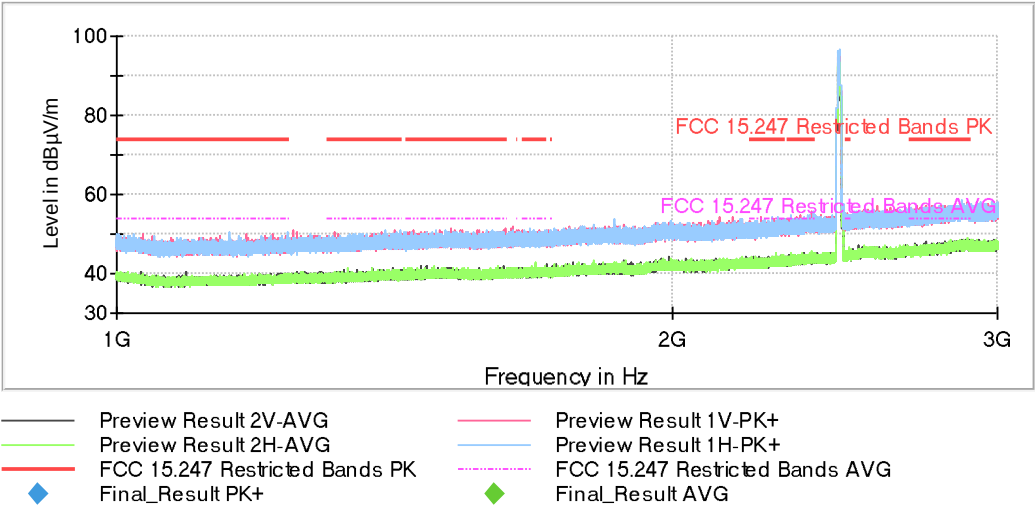


Full Spectrum

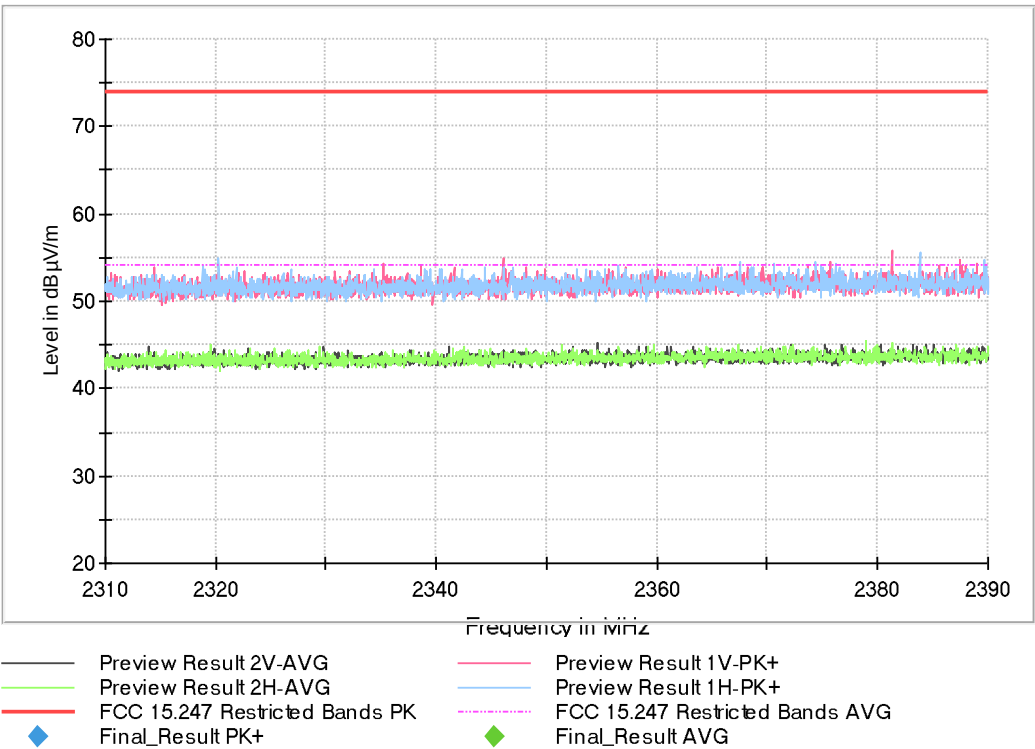


Frequency (MHz) = 2462.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

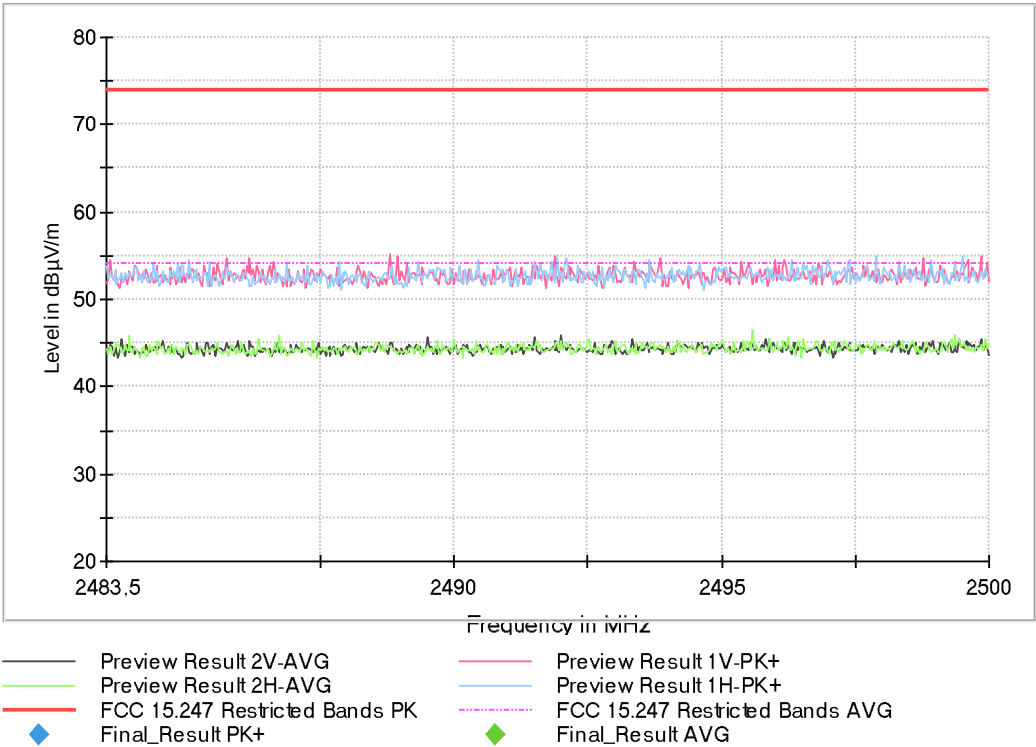
Plots:



Full Spectrum

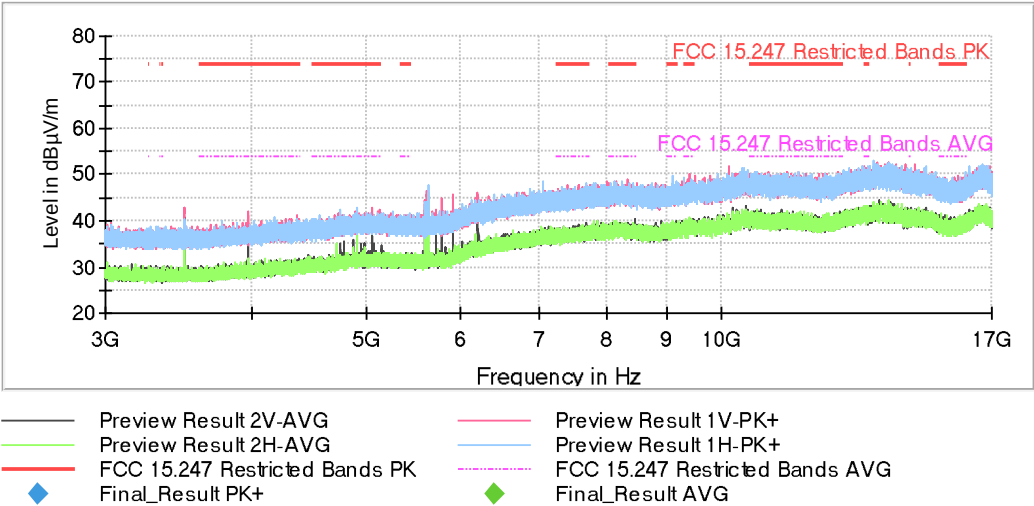


Full Spectrum



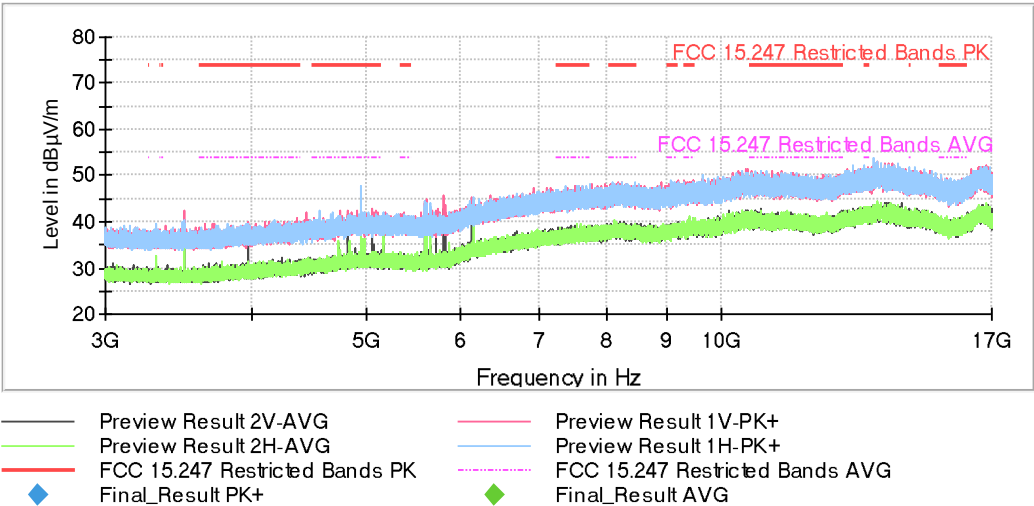
Frequency (MHz) = 2412.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:



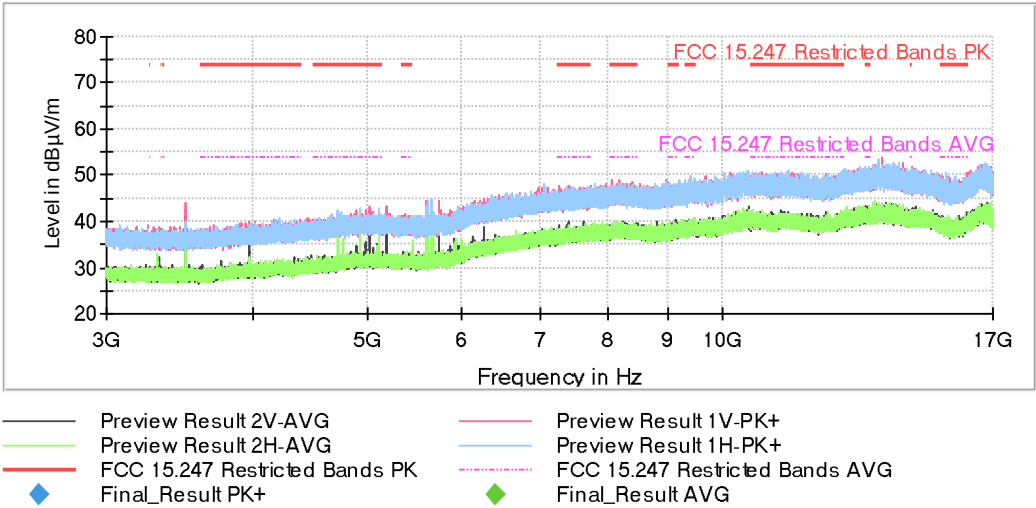
Frequency (MHz) = 2437.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:



Frequency (MHz) = 2462.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11b (DSSS 1 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

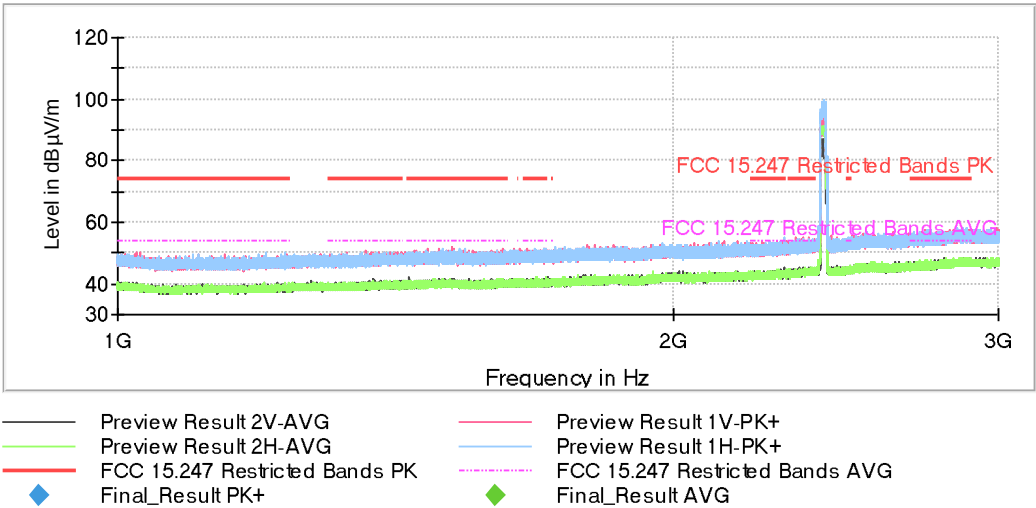
Plots:



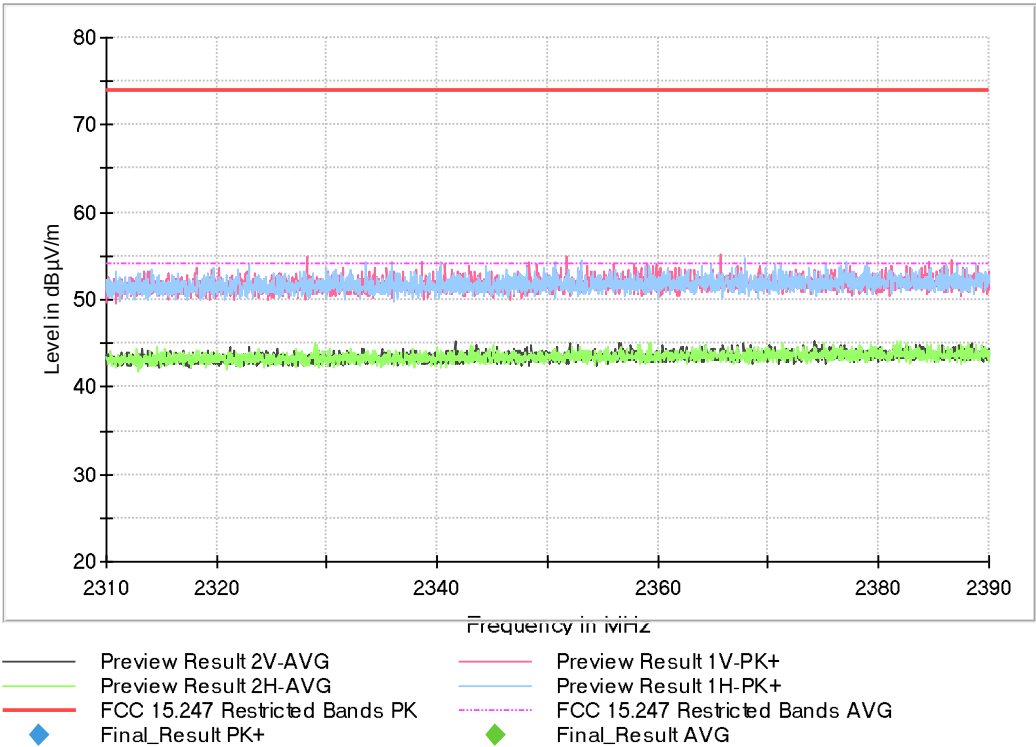
Modulation: 802.11g (OFDM 6 Mbit/s)

Frequency (MHz) = 2412.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

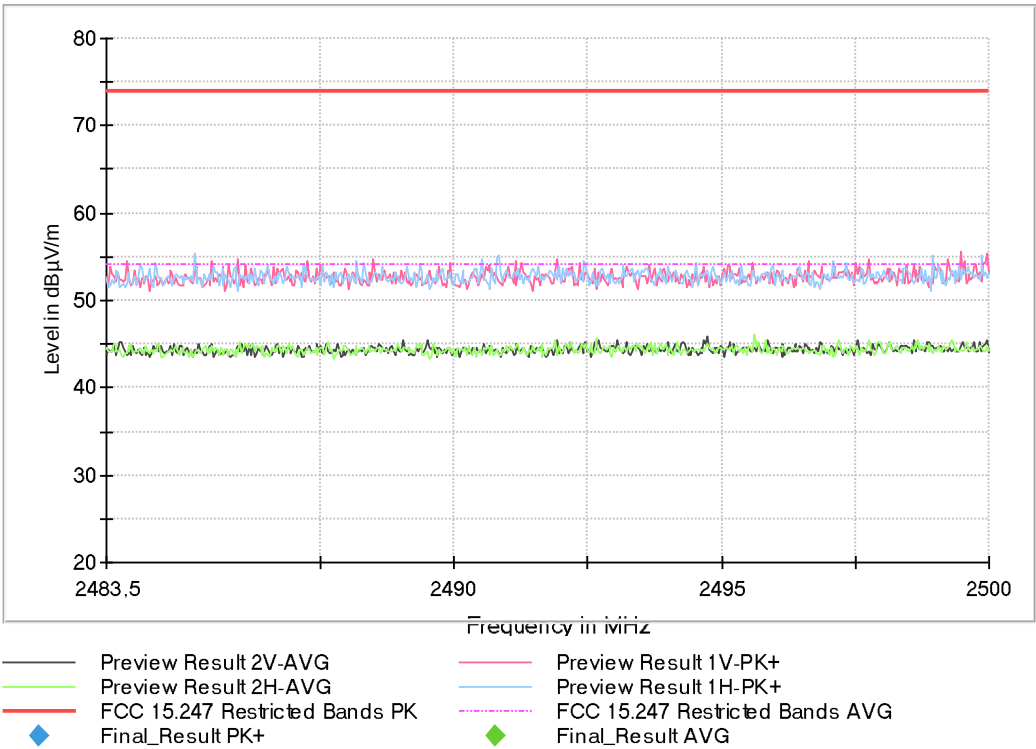
Plots:



Full Spectrum

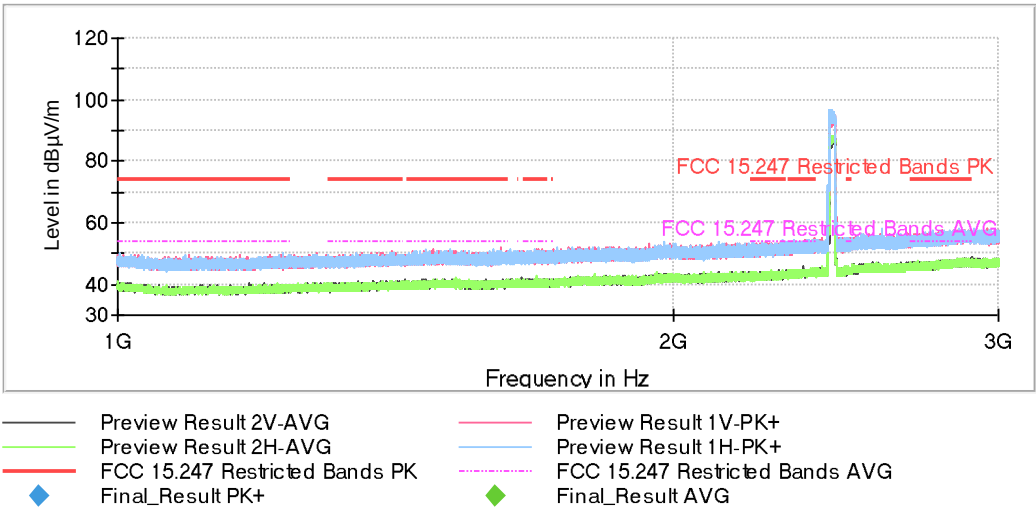


Full Spectrum

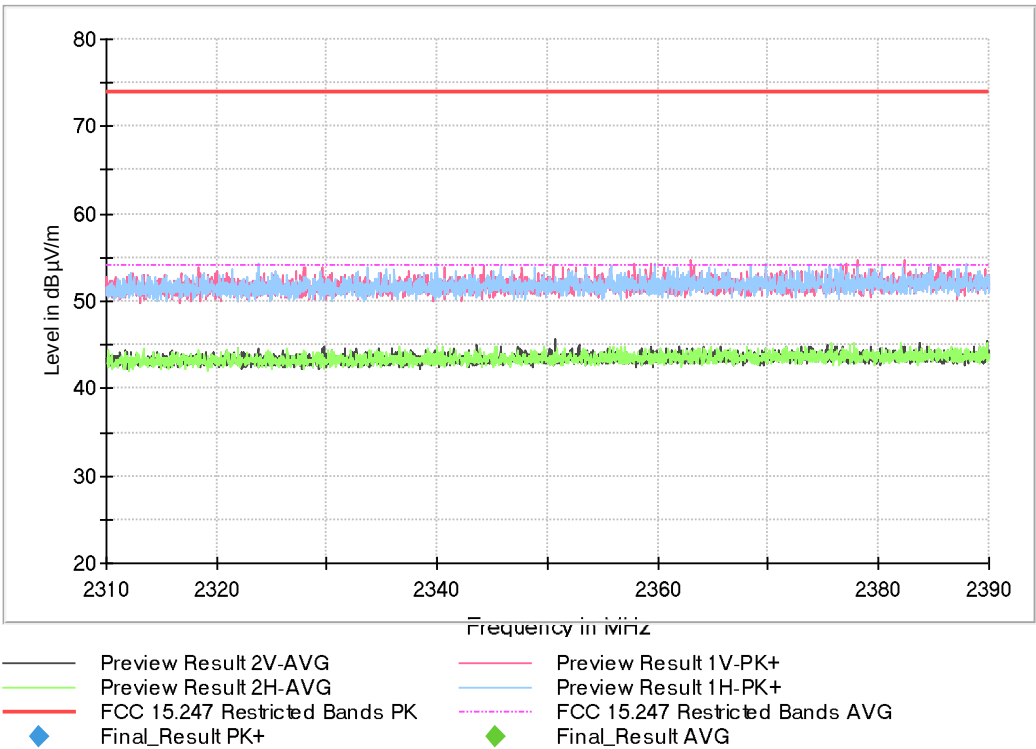


Frequency (MHz) = 2437.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

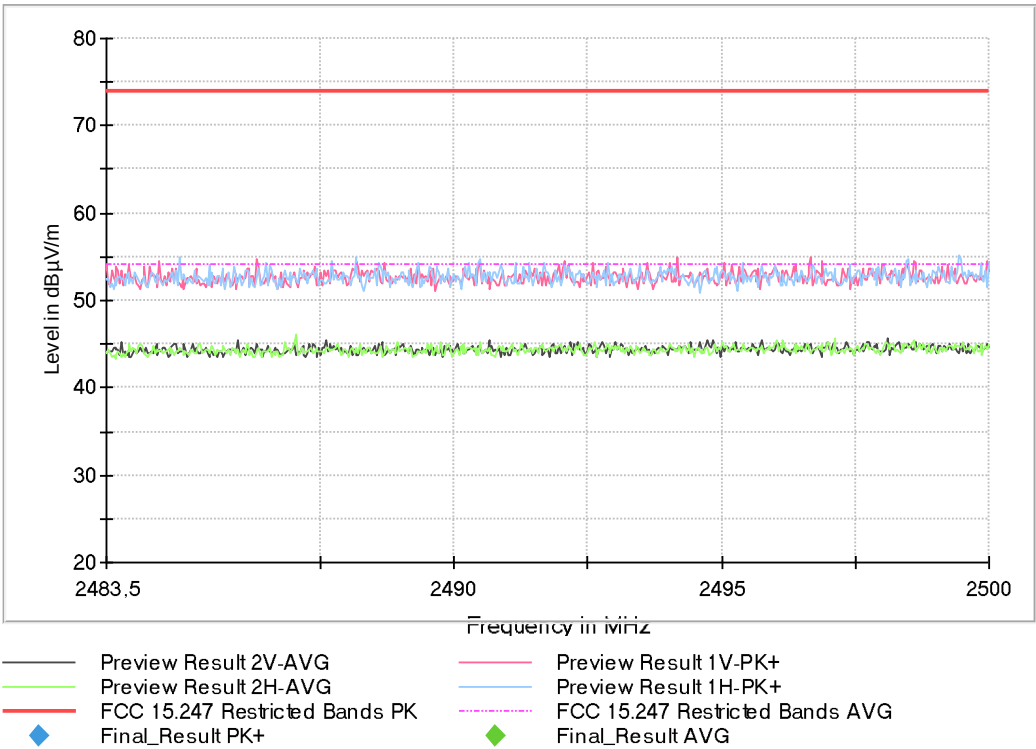
Plots:



Full Spectrum

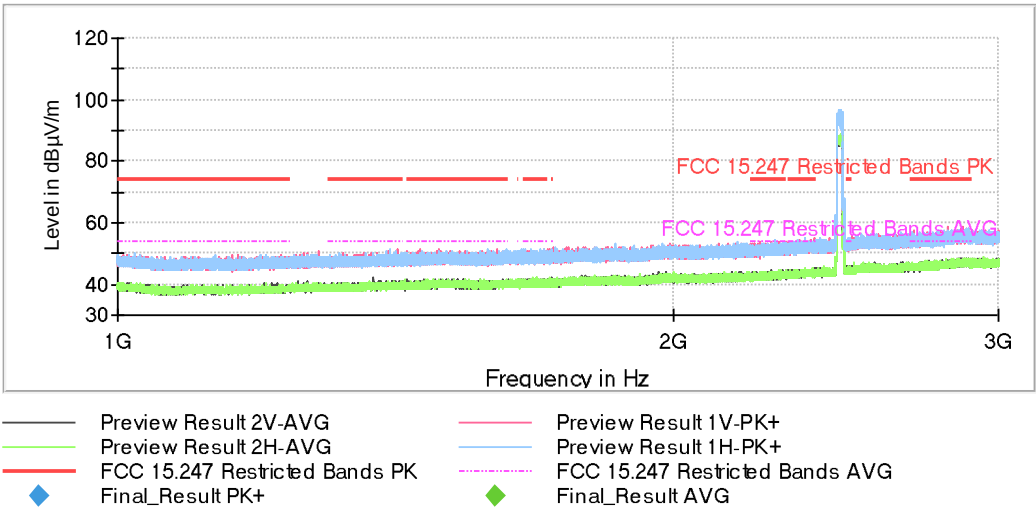


Full Spectrum

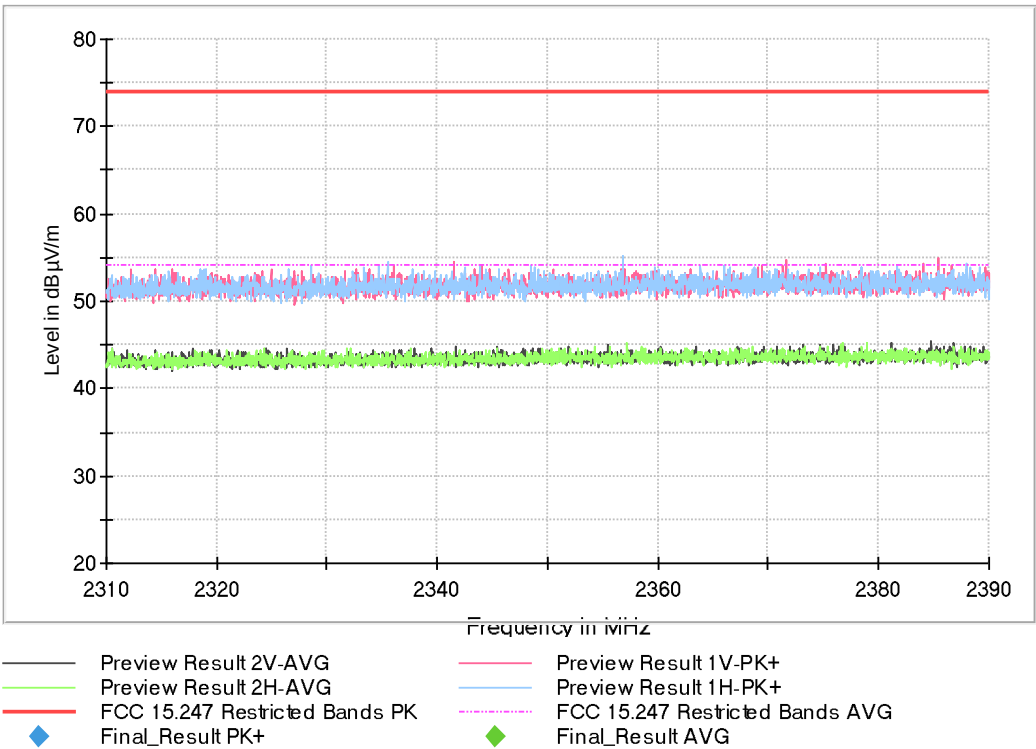


Frequency (MHz) = 2462.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s), Frequency Range (GHz) = [1, 3], Number of Transmission Chains = 1

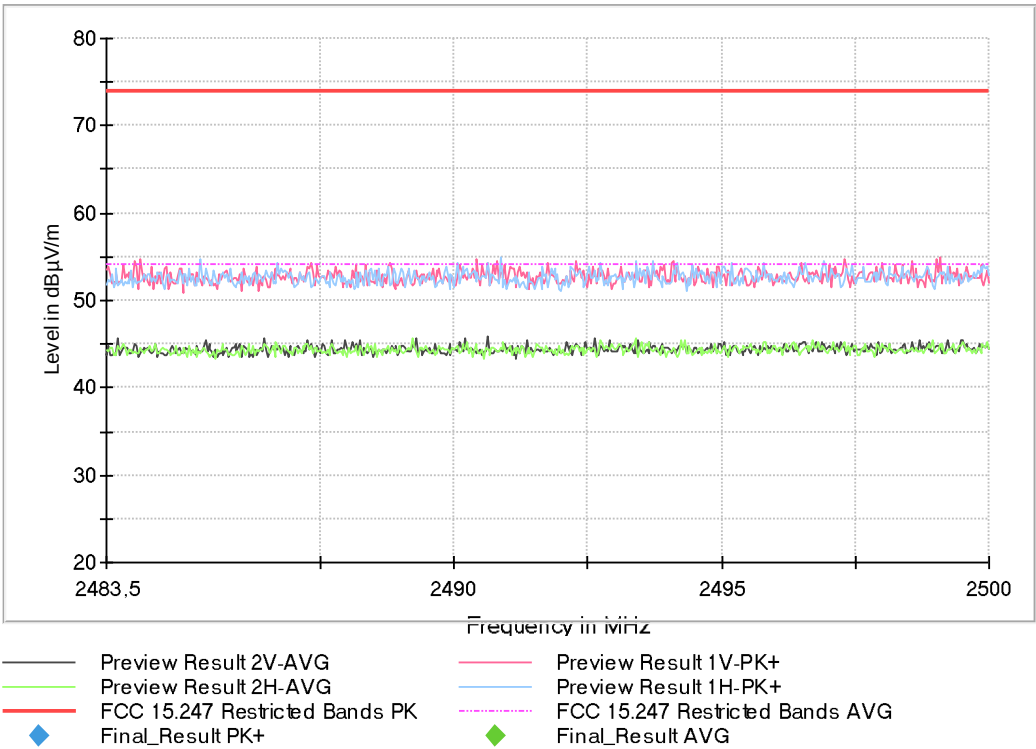
Plots:



Full Spectrum

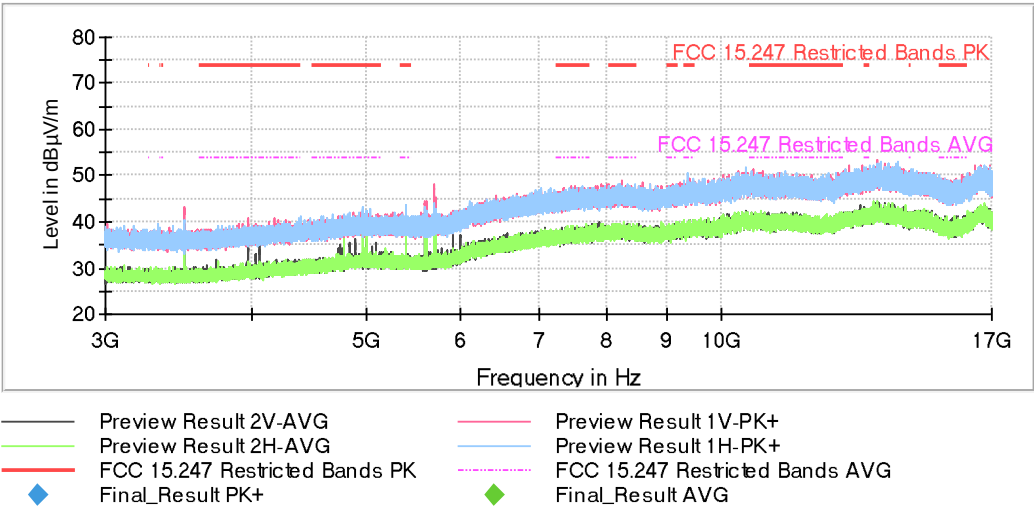


Full Spectrum



Frequency (MHz) = 2412.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:



Frequency (MHz) = 2437.00000, Equipment Type: Digital Transmission System (DTS), Modulation: 802.11g (OFDM 6 Mbit/s), Frequency Range (GHz) = [3, 17], Number of Transmission Chains = 1

Plots:

