FCC / ISED Test Report

FOR:

Astronautics

Model Name:

AEC115

Product Description:

The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground.

FCC ID: RYK-WPEQ256ACN
ISED ID: 6158A-WPEQ256ACN

Applied Rules and Standards:
47 CFR Part 15.407 (NII) & 5 GHz (UNII)
RSS-247 Issue 2 (DTSs) & (LE-LAN), and RSS-Gen Issue 5

REPORT #: EMC_ASTRO-019-22001_15.407_Rev3

DATE: 2-2-2023

A2LA Accredited

IC recognized # 3462B-1

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1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.407 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

Company	Description	Model #
Astronautics	The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground. The UNII1 band 5150-5250 is disabled for ISED.	AEC115

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2-2-2023	Compliance	Arndt Stoecker (Director of Regulatory Services)	Arndt Stoecker Digitally signed by: Arndt Stoecker DN: CN = Arndt Stoecker email = arndt.stoecker@cetecom.com C = US O = CETECOM Inc. Date: 2023.02.03 10:43:39 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2-2-2023	Compliance	Kris Lazarov (Senior EMC Engineer)	Kris Lazarov Digitally signed by Kris Lazarov Date: 2023.02.02 10:40:16 -08'00'

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Director of Regulatory Services:	Arndt Stoecker
Responsible Project Leader:	Cathy Palacios

2.2 Identification of the Client

Applicant's Name:	Astronautics
Street Address:	135 W Forest Hill Avenue
City/Zip Code	Oak Creek, WI 53154-0121
Country	United States

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code	
Country	

3 Equipment Under Test (EUT)

3.1 EUT Specifications

Model No:	AEC115
HW Version :	282300
SW Version :	282283
FCC-ID :	RYK-WPEQ256ACN
ISED ID:	6158A-WPEQ256ACN
FWIN:	N/A
HVIN:	AEC115
PMN:	mini-wACS
Product Description:	The AEC115 is an air vehicle equipment for recording and transferring of collected data via cellular and Wi-Fi radio while the vehicle is on the ground.
Radio Module:	Sparklan WPEQ-256ACNRBI
Frequency Range / number of channels:	Frequency Range (MHz) / Channel Number 5150-5250 – See note / 36-48 [4] 5725-5850 / 149-161 [4]
Modes of Operation / Type(s) of Modulation:	WiFi 802.11a/n/ac / BPSK
Antenna Information as declared:	Max Gain 6.11 dBi
Max. Output Power:	16 dBm
Power Supply/ Rated Operating Voltage Range:	28VDC
Operating Temperature Range	-40 ºC to 55 ºC
Other Radios included in the device:	UMTS / LTE / 802.11b/g/n
Sample Revision	☐Prototype Unit; ■Production Unit; ☐Pre-Production

Note: The UNII1 band 5150-5250 is disabled for ISED.

3.2 EUT Sample details

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	101220052	282300	282283	

3.3 Accessory Equipment (AE) details

AE #	Type	Model	Manufacturer	Serial Number
1	Radio Certification Tester	PN 284438	Astronautics	N/A
2	Cable	PN 283704	Astronautics	N/A
3	Ultra Wide Band Antenna	FXUB66	Taoglas	N/A
4	Dipole Antenna	FXP830	Taoglas	N/A

3.4 Test Sample Configuration

EUT Set-up #	Combination of AE used for test set up	Comments
1	EUT#1 + AE#1 +AE#2+ AE#3 +AE#4	

3.5 Mode of Operation details

Mode of Operation	Description of Operating modes	Additional Information
1	802.11a	The EUT was configured to a fixed channel transmission using software that is not available to the end user.

3.6 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and highest power in 802.11n mode. For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.407 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 of ISED Canada.

5 Measurement Results Summary

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	NA	NP	Result
§15.407(e) RSS-247 6.2.4.1	Emission Bandwidth	Nominal	802.11a/n	☐	☐	■	Note 2
§15.407(a) RSS-247 6	Power Spectral Density	Nominal	802.11a/n	☐	☐	■	Note 2
§15.407(a) RSS-247 6	Maximum Output Power	Nominal	802.11a/n	■	☐	☐	Note 2 Note 3
§15.407; 15.205 RSS-247 6; RSS-Gen 8.10	Band Edge Compliance	Nominal	802.11a/n	☐	☐	■	Note 2
§15.407(b); §15.209; 15.205 RSS-247 6; RSS-Gen 8.9; 8.10	Radiated TX Spurious Emissions	Nominal	802.11a/n	■	☐	☐	Pass
§15.207(a) RSS Gen 8.8	AC Conducted Emissions	Nominal	802.11a/n	☐	■	☐	Note 1

Note 1: NA= Not Applicable; NP= Not Performed.
Note 2: Leveraged from module certification for Sparklan FCC ID: RYK-WPEQ256ACN.
Note 3: Limited power verification testing was conducted only on middle channel.

6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=2.

Measurement System		EMC 1	EMC 2
Conducted emissions (mains port)		1.12 dB	0.46 dB
Radiated emissions	(< 30 MHz)	3.66 dB	3.88 dB
	(30 MHz – 1GHz)	3.17 dB	3.34 dB
	(1 GHz – 3 GHz)	5.01 dB	4.45 dB
	(>3 GHz)	4.0 dB	4.79 dB

6.1 Environmental Conditions During Testing:

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25° C
- Relative humidity: 40-60%

6.2 Dates of Testing:

05/10/2022 - 05/16/2022

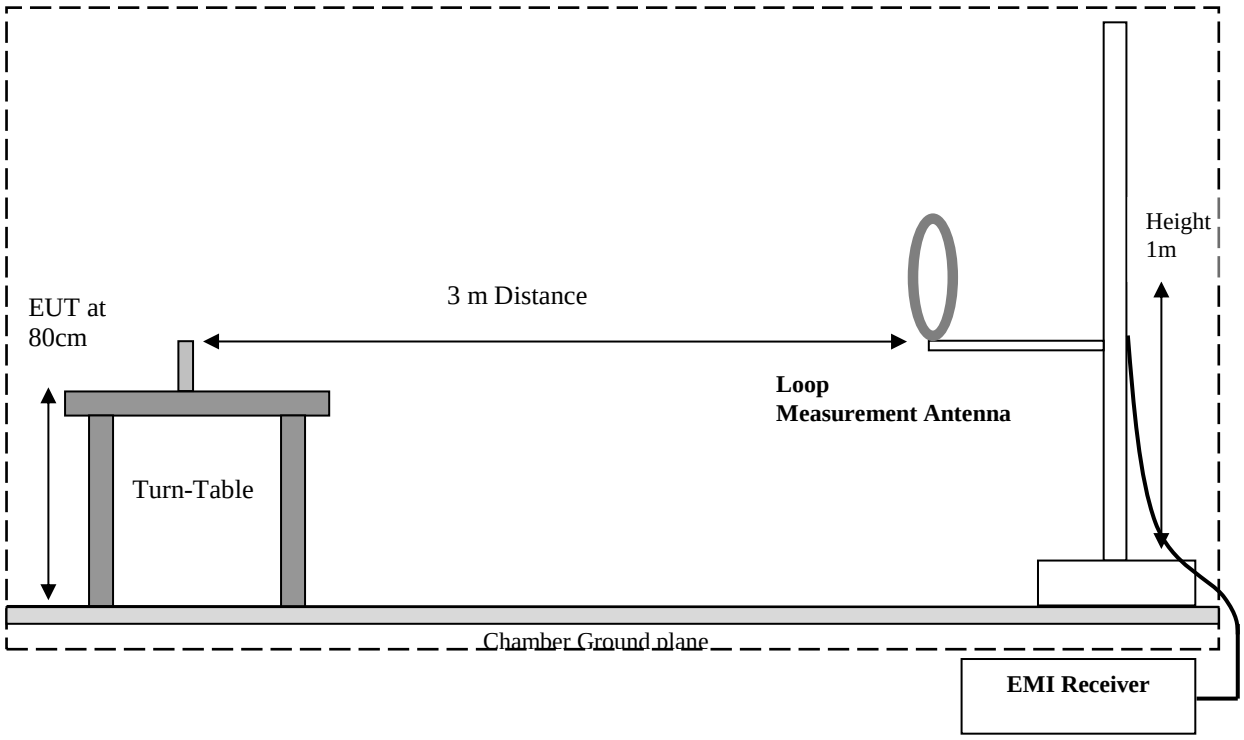
7 Measurement Procedures

7.1 Radiated Measurement

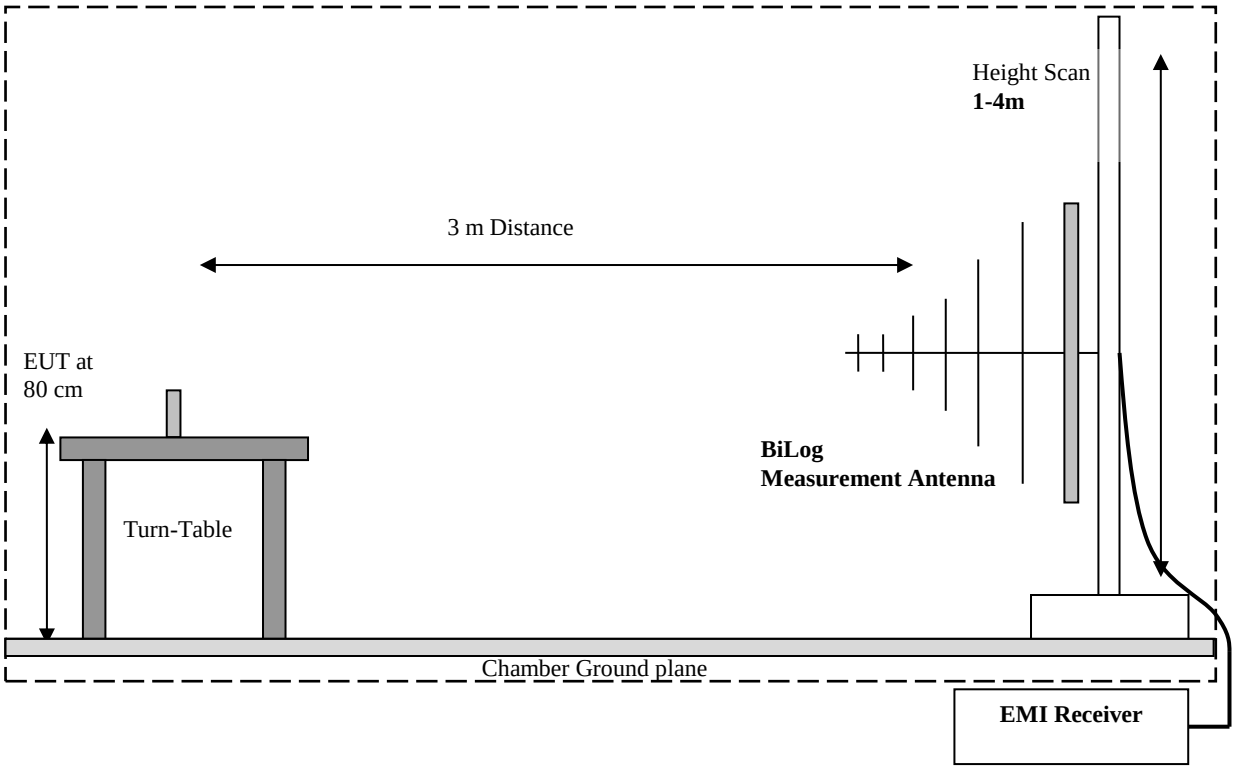
The radiated measurement is performed according to ANSI C63.10 (2013)

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

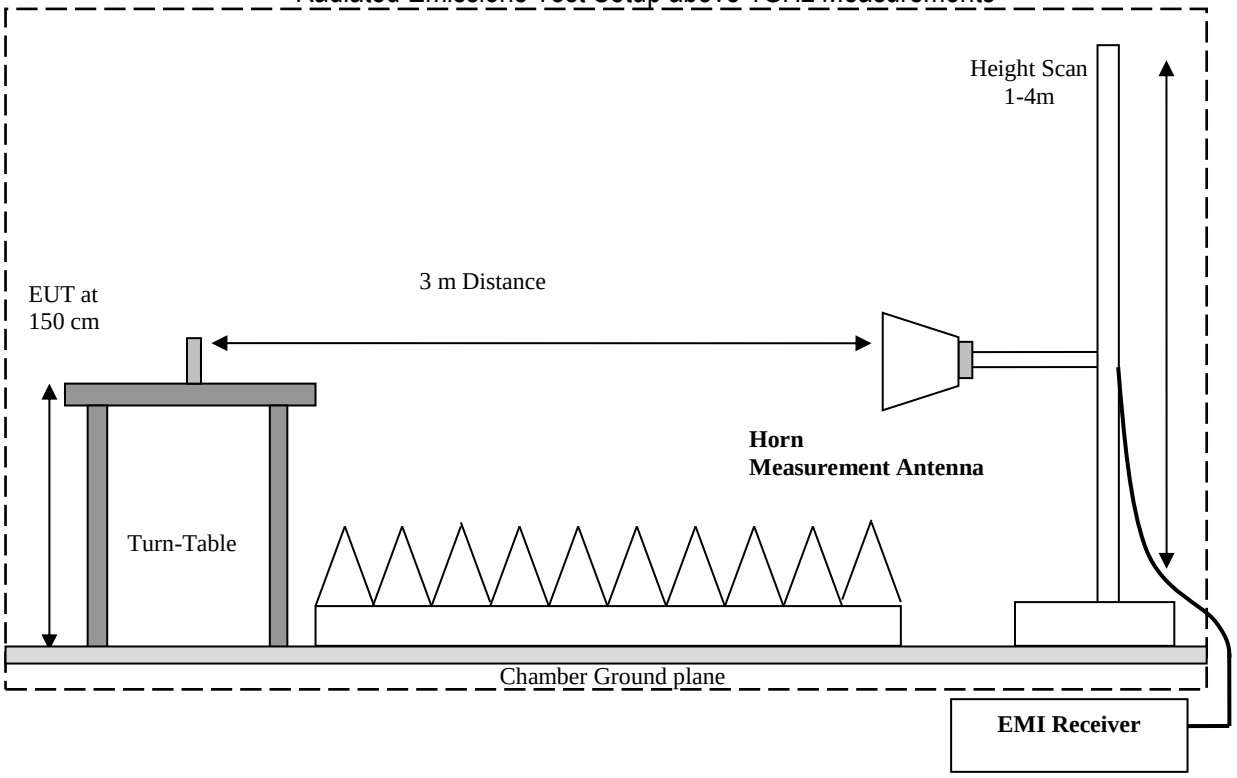
Radiated Emissions Test Setup below 30MHz Measurements



Radiated Emissions Test Setup 30MHz-1GHz Measurements



Radiated Emissions Test Setup above 1GHz Measurements



7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dBµV
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

FS (dBµV/m) = Measured Value on SA (dBµV)+ Cable Loss (dB)+ Antenna Factor (dB/m)

Example:

Frequency (MHz)	Measured SA (dBµV)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dBµV/m)
1000	80.5	3.5	14	98.0

8 Test Result Data

8.1 Output Power Verification Measurement

8.1.1 Measurement according to FCC 789033 D02 General UNII Test Procedures New Rules v02r01

Spectrum Analyzer settings:

- Set span to encompass the entire emission bandwidth (EBW) (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- Set RBW = 1 MHz
- Set the VBW ≥ 3 MHz
- Detector = RMS
- Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = Auto Couple
- Trace mode = Trace average at least 100 traces in power averaging (i.e., RMS mode).
- If transmit duty cycle < 98%, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98%, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run."

Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument's band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

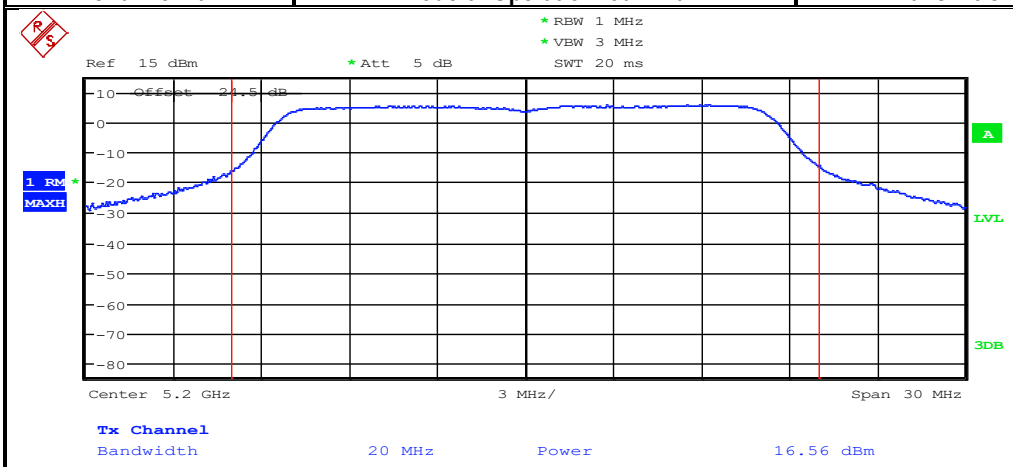
8.1.2 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22°C	1	802.11a	28 VDC

8.1.3 Measurement result:

Plot #	Channel #	RF Output Power (dBm)	Target power (dBm)	Result
1	40	16.56	16 ± 2	Pass
2	153	17.93	16 ± 2	Pass

Plot 1		
Channel 40	**Mode of Operation: 802.11a**	**Transmit Chain A**



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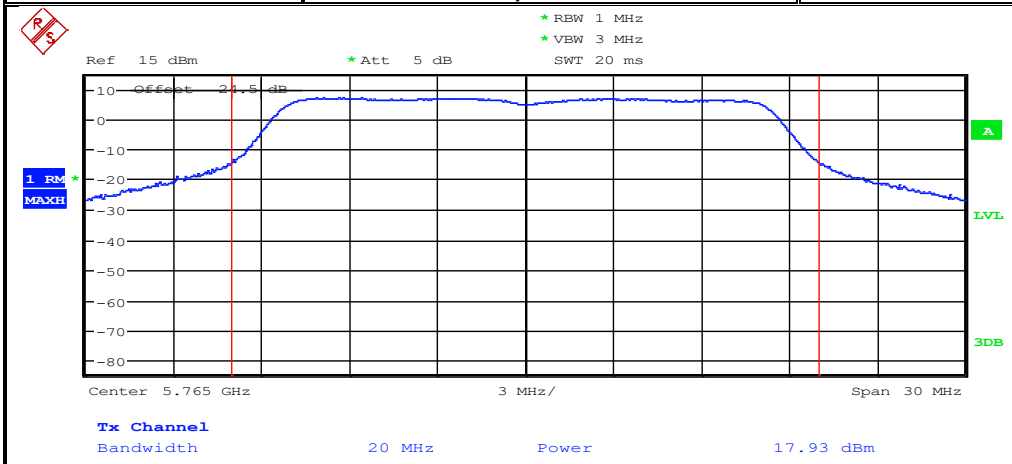
Plot 2		
Channel 153	**Mode of Operation: 802.11a**	**Transmit Chain A**



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8.2 Radiated Transmitter Spurious Emissions

8.2.1 Measurement according to ANSI C63.10 (2013)

Spectrum Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector: Peak

- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW= 120 KHz (<1GHz)

- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1 MHz

- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing at distance other than the specified in the standard, the limit conversion is calculated by using 40 dB/decade extrapolation factor as follow: Conversion factor (CF) = 40 log (D/d) = 40 log (300m / 3m) = 80dB

8.2.2 Limits:

FCC §15.407

- Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.
- The provisions of §15.205 apply to intentional radiators operating under this section.

FCC §15.209 & RSS-Gen 8.9

- Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency of emission (MHz)	Field strength (µV/m)	Measurement Distance (m)	Field strength @ 3m (dBµV/m)
0.009–0.490	2400/F(kHz) / ---------	300	-
0.490–1.705	24000/F(kHz) / --------	30	-
1.705–30.0	30 / (29.5)	30	-
30–88	100	3	40 dBµV/m
88–216	150	3	43.5 dBµV/m
216–960	200	3	46 dBµV/m
Above 960	500	3	54 dBµV/m

FCC §15.205 & RSS-Gen 8.10

- Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]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			

- 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)).

8.2.3 Test conditions and setup:

Ambient Temperature	EUT Set-Up #	EUT operating mode	Power Input
22° C	1	802.11a	28 VDC

8.2.4 Measurement result:

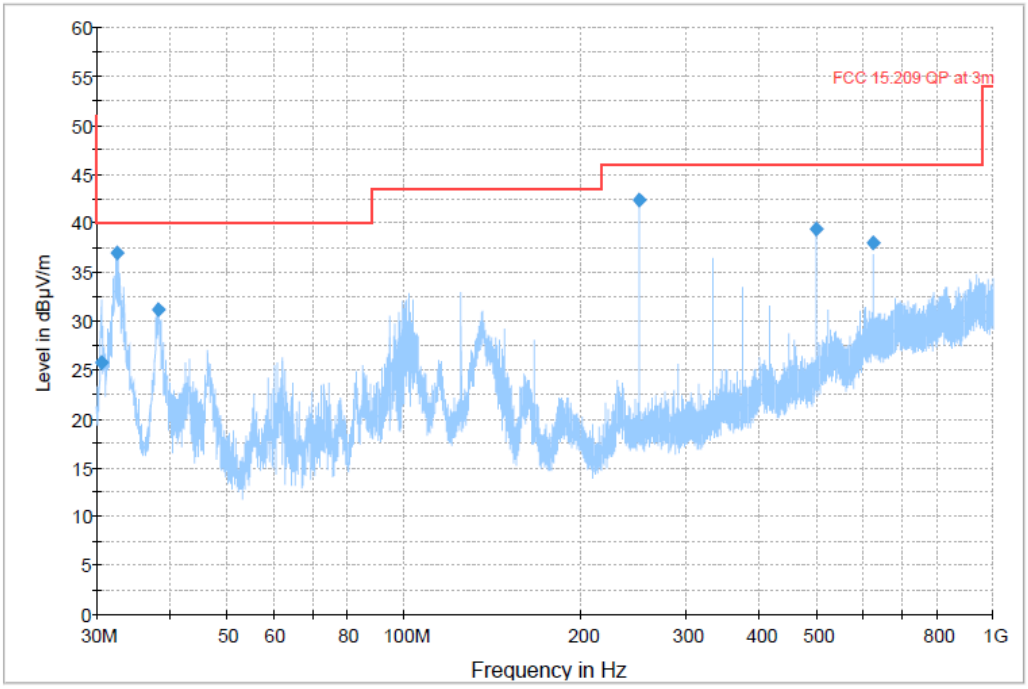
Plot #	EUT Operating Mode	Channel #	Scan Frequency	Limit	Result
1-3	802.11a	Low (36)	30 MHz – 18 GHz	See section 8.2.2	Pass
4-9	802.11a	Mid (40)	9 kHz – 40 GHz	See section 8.2.2	Pass
10-13	802.11a	High (48)	30 MHz – 18 GHz	See section 8.2.2	Pass
14-16	802.11a	Low (149)	30 MHz – 18 GHz	See section 8.2.2	Pass
17-22	802.11a	Mid (153)	9 kHz – 40 GHz	See section 8.2.2	Pass
23-25	802.11a	High (161)	30 MHz – 18 GHz	See section 8.2.2	Pass

8.2.5 Measurement Plots:

Plot #1 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | Low (36)

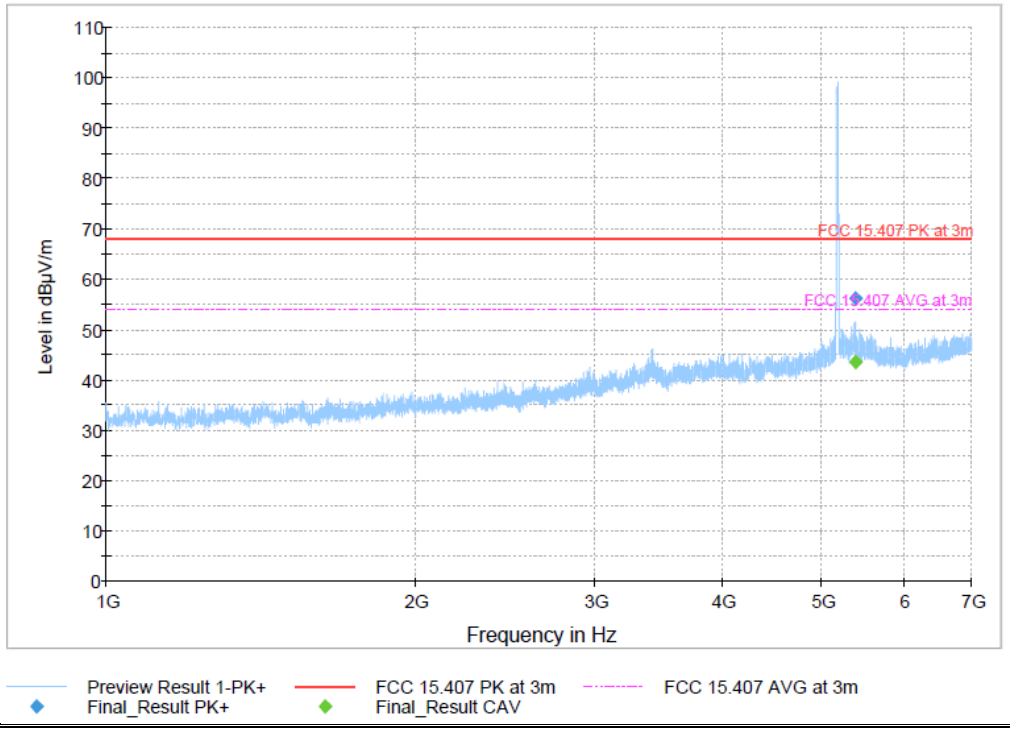
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.582	25.73	40.00	14.27	500.0	120.000	312.0	V	22.0	18.7
32.587	36.89	40.00	3.11	500.0	120.000	186.0	V	-45.0	17.4
38.148	31.16	40.00	8.84	500.0	120.000	149.0	V	15.0	14.5
249.996	42.39	46.02	3.64	500.0	120.000	163.0	H	315.0	17.5
499.997	39.46	46.02	6.56	500.0	120.000	150.0	V	89.0	23.5
625.030	38.00	46.02	8.02	500.0	120.000	150.0	H	-12.0	26.9



Plot #2 Radiated Emissions: 1-7 GHz

Mode: 802.11a | Low (36)

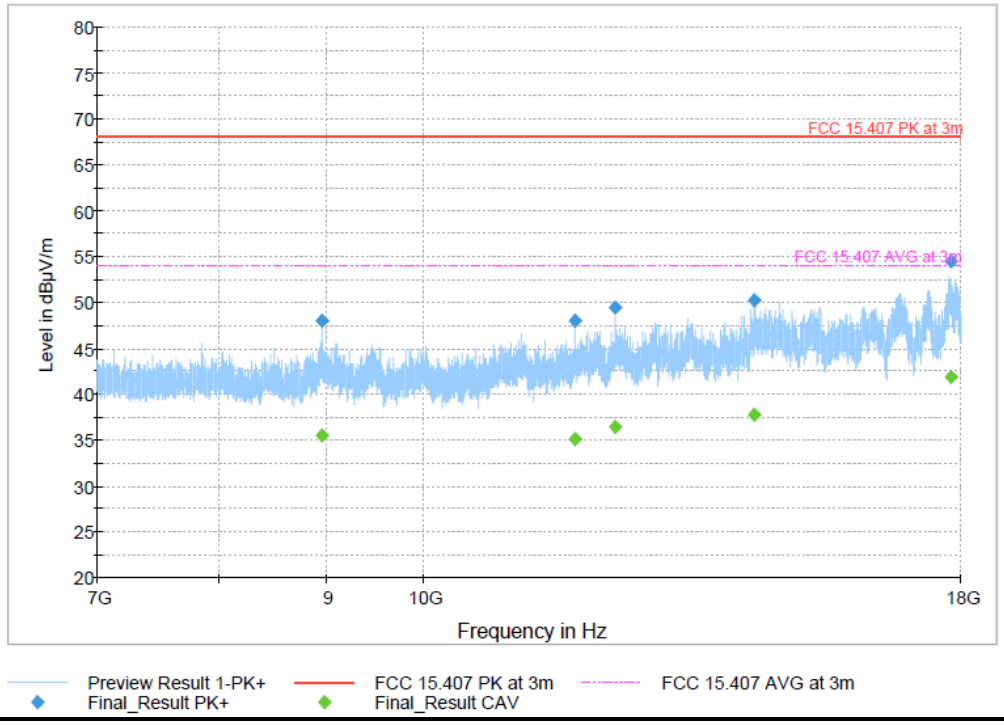
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5388.00	---	43.45	53.98	10.53	500.0	1000.0	107.0	H	320.0	15.7
5388.00	56.20	---	68.00	11.80	500.0	1000.0	107.0	H	320.0	15.7



Plot #3 Radiated Emissions: 7-18 GHz

Mode: 802.11a | Low (36)

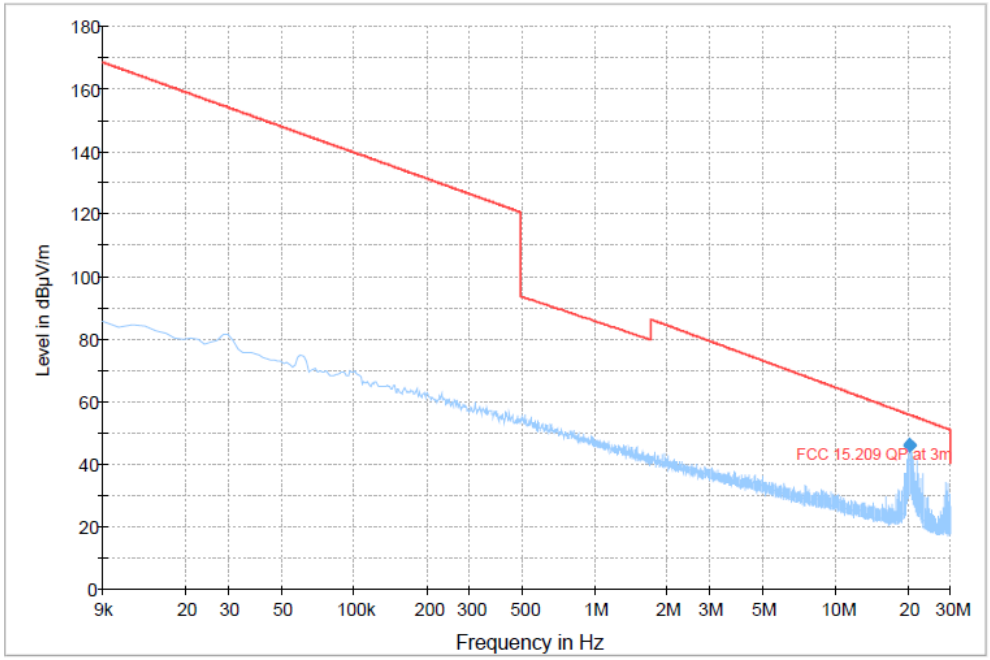
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
8940.89	48.07	---	68.00	19.93	500.0	1000.0	241.0	V	19.0	1.1
8940.89	---	35.51	53.98	18.47	500.0	1000.0	241.0	V	19.0	1.1
11807.98	47.97	---	68.00	20.03	500.0	1000.0	305.0	V	120.0	4.6
11807.98	---	35.15	53.98	18.83	500.0	1000.0	305.0	V	120.0	4.6
12334.27	49.41	---	68.00	18.59	500.0	1000.0	159.0	V	28.0	6.6
12334.27	---	36.44	53.98	17.53	500.0	1000.0	159.0	V	28.0	6.6
14355.33	---	37.77	53.98	16.21	500.0	1000.0	247.0	V	-10.0	9.1
14355.33	50.28	---	68.00	17.72	500.0	1000.0	247.0	V	-10.0	9.1
17802.24	54.55	---	68.00	13.45	500.0	1000.0	283.0	V	200.0	17.8
17802.24	---	41.97	53.98	12.01	500.0	1000.0	324.0	V	175.0	17.8



Plot #4 Radiated Emissions: 9 KHz – 30 MHz

Mode: 802.11a | Mid (40)

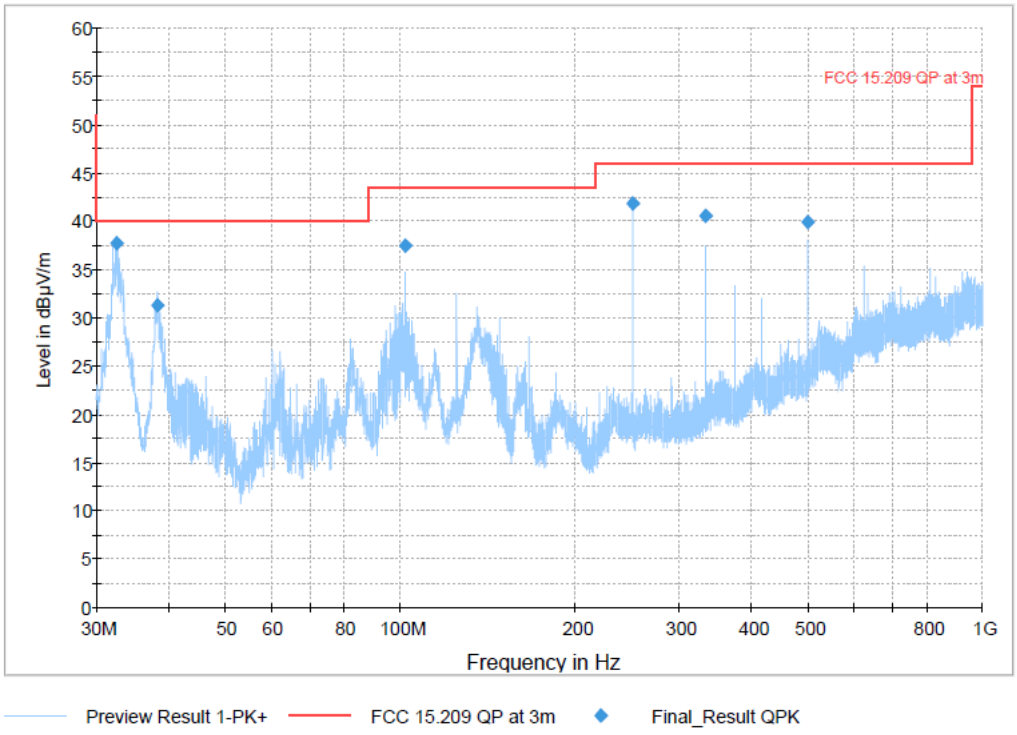
Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
20.22	46.39	---	55.90	9.51	500.0	3.0	100.0	H	149.0	16.5
20.26	46.00	---	55.87	9.87	500.0	3.0	100.0	H	35.0	16.5



Plot #5 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | Mid (40)

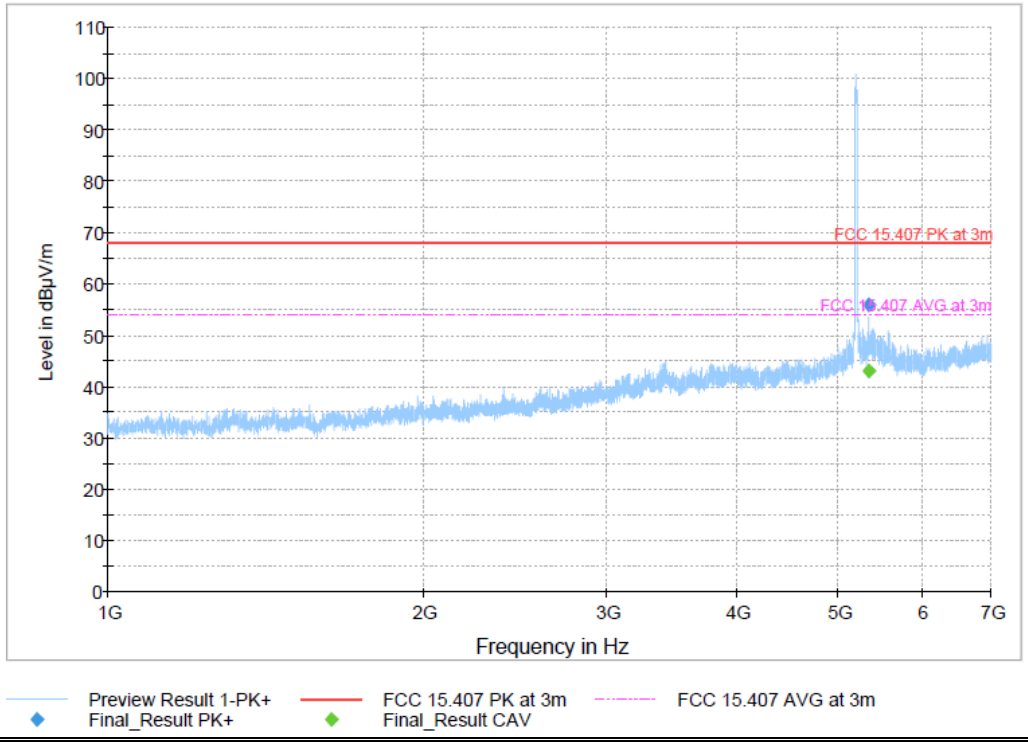
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.587	37.68	40.00	2.32	500.0	120.000	150.0	V	16.0	17.4
38.310	31.31	40.00	8.69	500.0	120.000	150.0	V	260.0	14.4
101.877	37.48	43.50	6.02	500.0	120.000	284.0	H	-1.0	12.5
249.996	41.83	46.02	4.19	500.0	120.000	162.0	H	312.0	17.5
333.319	40.54	46.02	5.48	500.0	120.000	289.0	H	25.0	19.7
499.997	39.92	46.02	6.10	500.0	120.000	197.0	H	255.0	23.6



Plot #6 Radiated Emissions: 1-7 GHz

Mode: 802.11a | Mid (40)

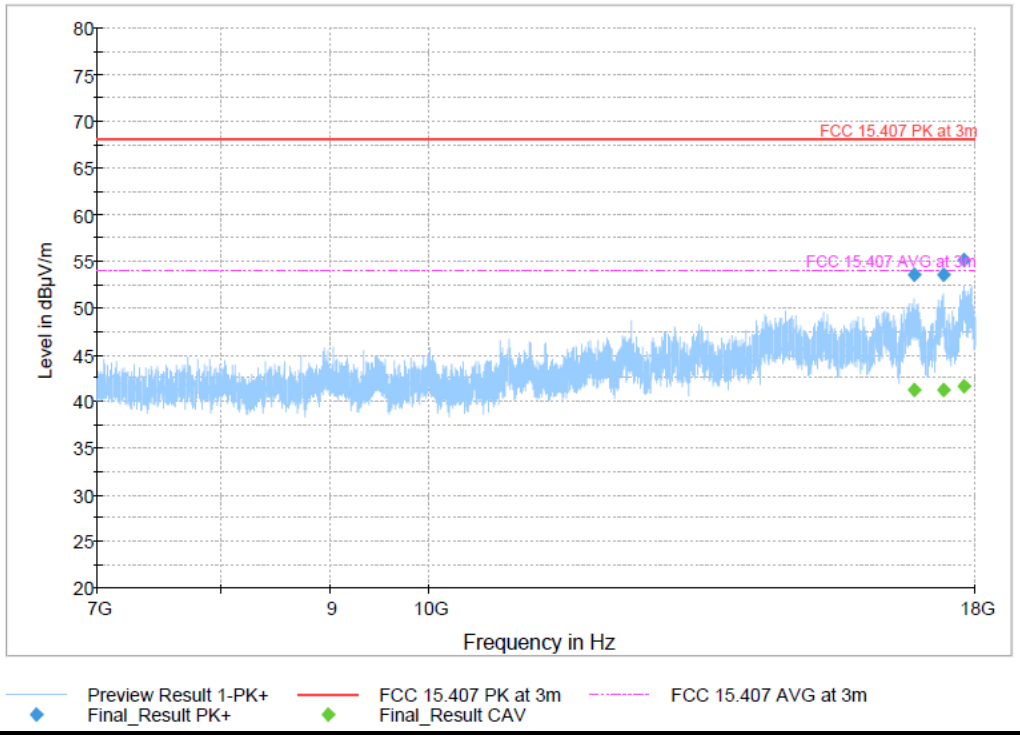
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5346.50	---	43.16	53.98	10.82	500.0	1000.0	107.0	H	321.0	15.8
5346.50	55.98	---	68.00	12.02	500.0	1000.0	107.0	H	321.0	15.8



Plot #7 Radiated Emissions: 7-18 GHz

Mode: 802.11a | Mid (40)

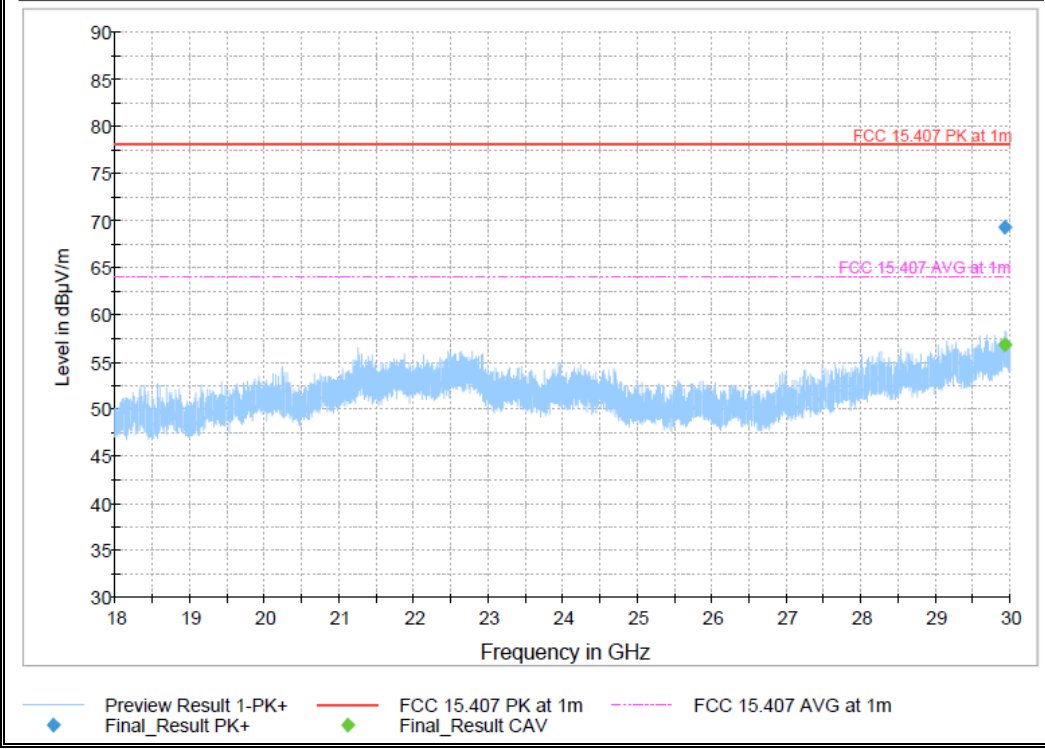
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16857.96	53.57	---	68.00	14.43	500.0	1000.0	203.0	H	347.0	14.3
16857.96	---	41.28	53.98	12.70	500.0	1000.0	203.0	H	347.0	14.3
17391.33	53.62	---	68.00	14.38	500.0	1000.0	197.0	V	235.0	16.0
17391.33	---	41.30	53.98	12.68	500.0	1000.0	197.0	V	235.0	16.0
17786.84	---	41.68	53.98	12.30	500.0	1000.0	252.0	H	-63.0	17.5
17786.84	55.24	---	68.00	12.76	500.0	1000.0	252.0	H	-63.0	17.5



Plot #8 Radiated Emissions: 18-30 GHz

Mode: 802.11a | Mid (40)

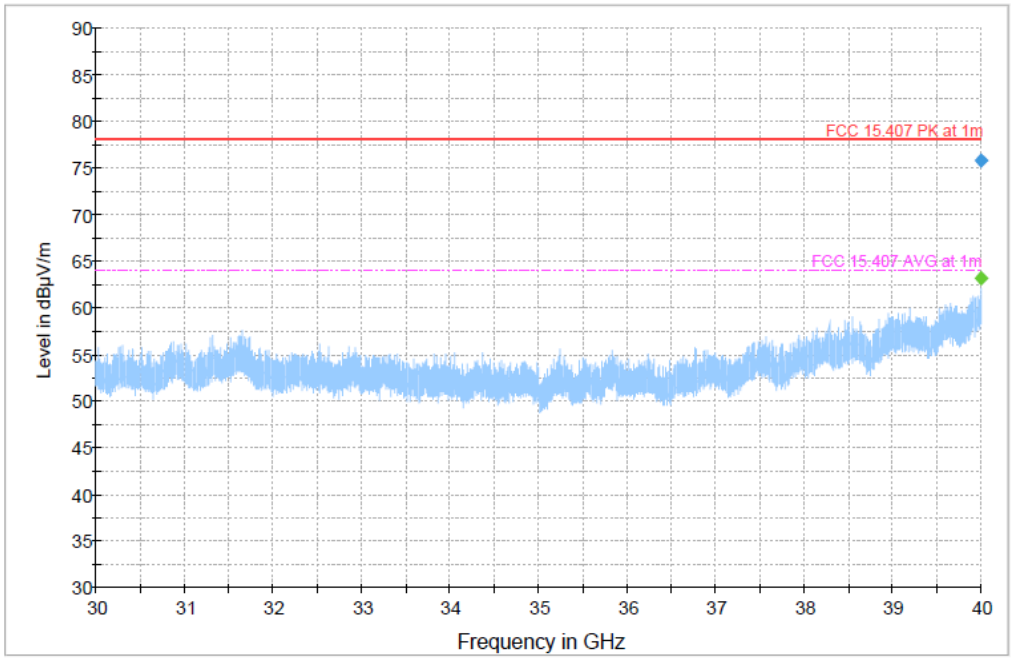
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
29935.50	---	56.87	63.98	7.11	500.0	1000.0	100.0	V	111.0	22.8
29935.50	69.27	---	78.00	8.73	500.0	1000.0	100.0	V	111.0	22.8



Plot #9 Radiated Emissions: 30-40 GHz

Mode: 802.11a | Mid (40)

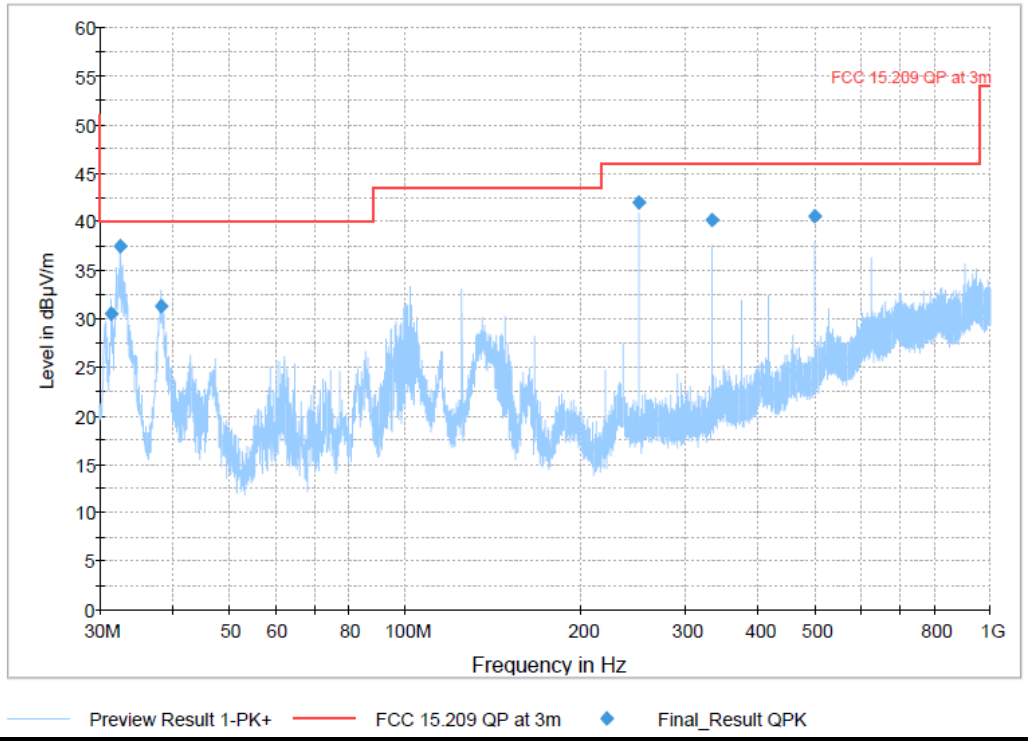
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
39999.69	---	63.18	63.98	0.80	500.0	1000.0	100.0	H	98.0	25.0
39999.69	75.73	---	78.00	2.27	500.0	1000.0	100.0	H	98.0	25.0



Plot #10 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | High (48)

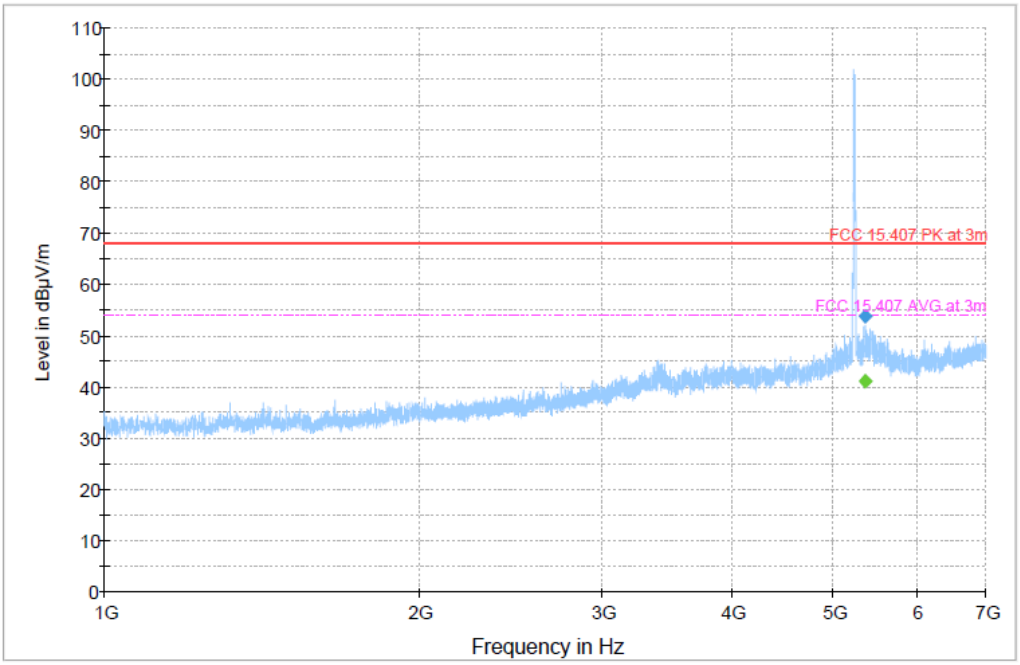
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
31.423	30.49	40.00	9.51	500.0	120.000	163.0	V	-45.0	18.1
32.587	37.50	40.00	2.50	500.0	120.000	150.0	V	-45.0	17.4
38.180	31.28	40.00	8.72	500.0	120.000	149.0	V	327.0	14.5
249.996	42.00	46.02	4.02	500.0	120.000	194.0	H	306.0	17.5
333.351	40.11	46.02	5.91	500.0	120.000	271.0	H	19.0	19.7
499.997	40.50	46.02	5.52	500.0	120.000	163.0	H	272.0	23.6



Plot #11 Radiated Emissions: 1-7 GHz

Mode: 802.11a | High (48)

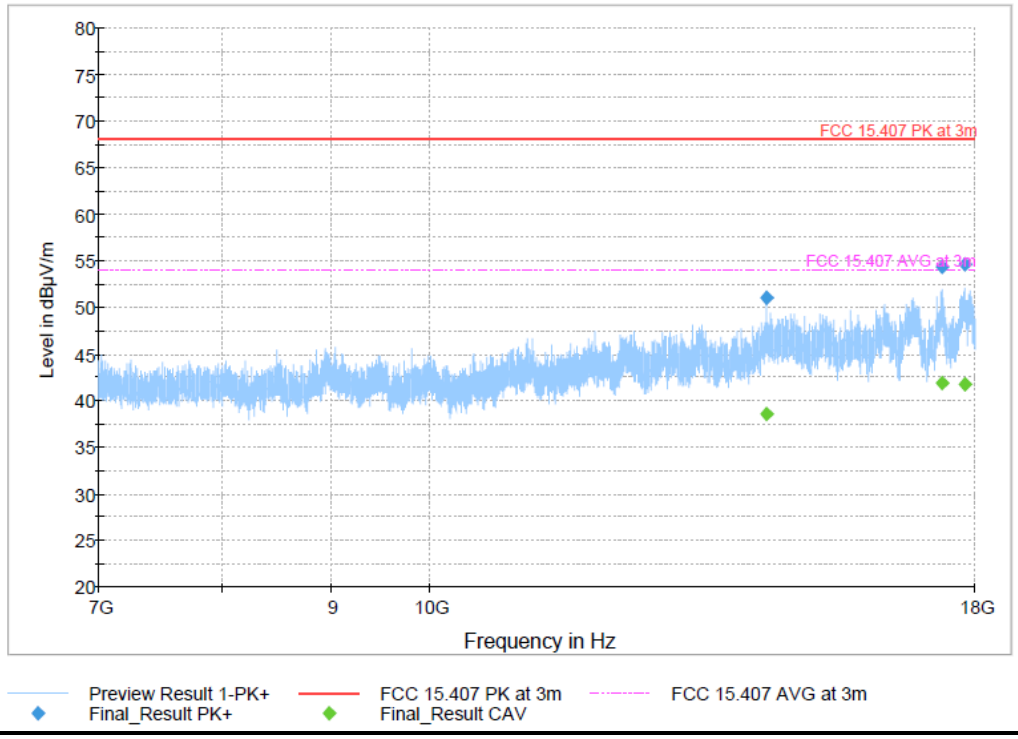
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5362.25	---	41.11	53.98	12.87	500.0	1000.0	210.0	H	186.0	15.8
5362.25	53.85	---	68.00	14.15	500.0	1000.0	210.0	H	186.0	15.8



Plot #12 Radiated Emissions: 7-18 GHz

Mode: 802.11a | High (48)

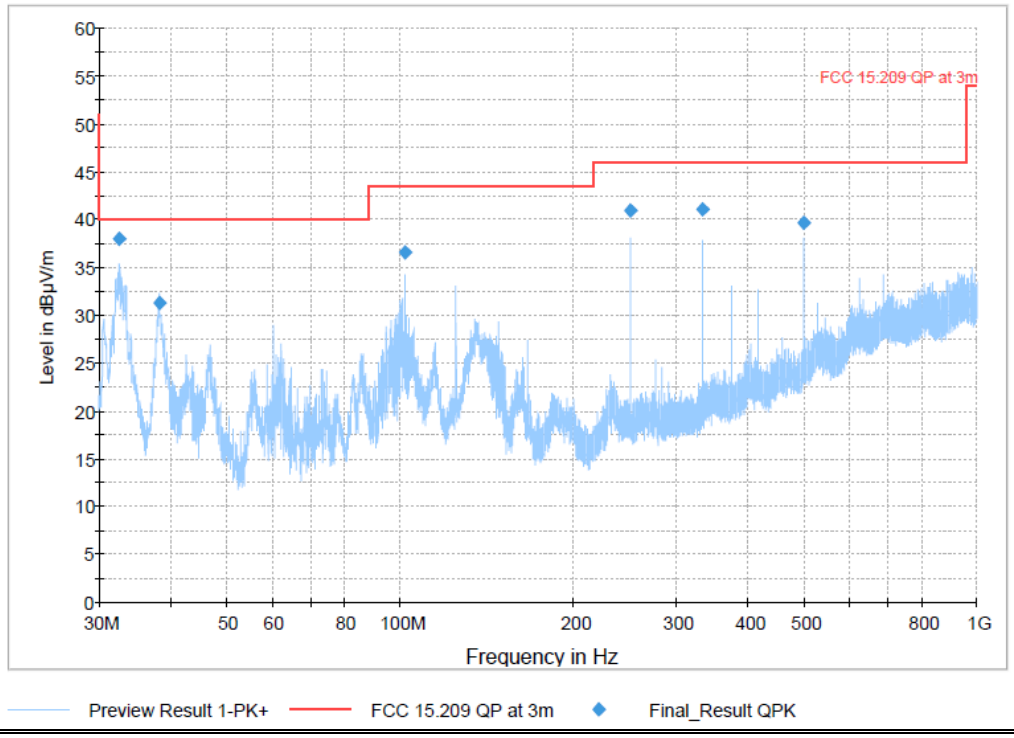
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
14379.53	---	38.54	53.98	15.44	500.0	1000.0	180.0	V	332.0	9.2
14379.53	51.02	---	68.00	16.98	500.0	1000.0	180.0	V	332.0	9.2
17376.42	54.42	---	68.00	13.58	500.0	1000.0	209.0	V	-80.0	15.9
17376.42	---	41.90	53.98	12.08	500.0	1000.0	209.0	V	-80.0	15.9
17798.58	54.63	---	68.00	13.37	500.0	1000.0	308.0	V	222.0	17.7
17798.58	---	41.78	53.98	12.20	500.0	1000.0	308.0	V	222.0	17.7



Plot #13 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | Low (149)

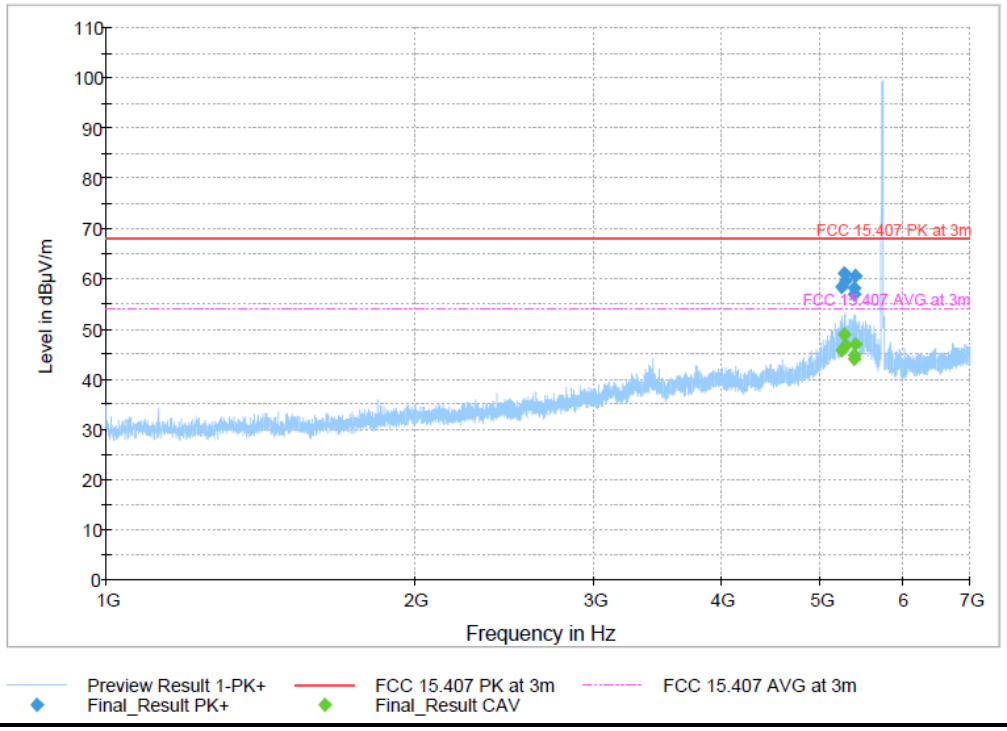
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.587	37.93	40.00	2.07	500.0	120.000	150.0	V	-10.0	17.4
38.213	31.27	40.00	8.73	500.0	120.000	150.0	V	44.0	14.5
101.845	36.57	43.50	6.93	500.0	120.000	242.0	H	1.0	12.5
249.996	40.99	46.02	5.04	500.0	120.000	149.0	H	324.0	17.5
333.351	41.09	46.02	4.93	500.0	120.000	279.0	H	24.0	19.7
499.997	39.70	46.02	6.32	500.0	120.000	185.0	H	251.0	23.6



Plot #14 Radiated Emissions: 1-7 GHz

Mode: 802.11a | Low (149)

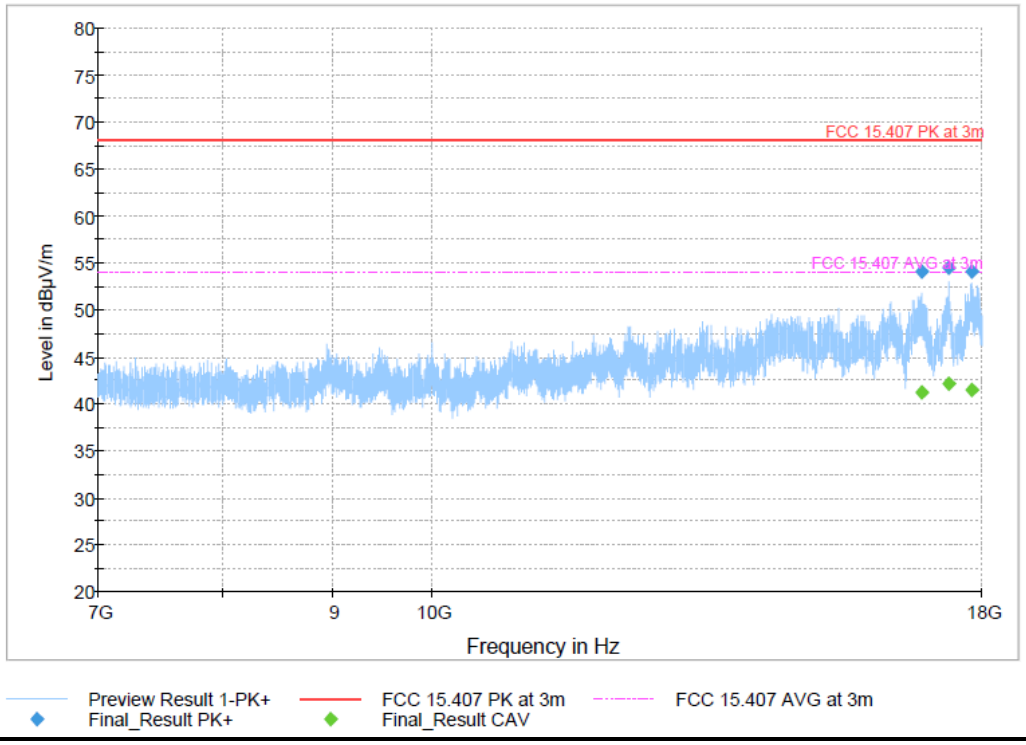
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5237.50	58.30	---	68.00	9.70	500.0	1000.0	246.0	V	260.0	15.8
5237.50	---	45.67	53.98	8.31	500.0	1000.0	246.0	V	260.0	15.8
5280.00	---	48.82	53.98	5.16	500.0	1000.0	151.0	V	273.0	15.6
5280.00	61.10	---	68.00	6.90	500.0	1000.0	151.0	V	273.0	15.6
5286.00	---	46.66	53.98	7.32	500.0	1000.0	169.0	V	273.0	15.5
5286.00	59.73	---	68.00	8.27	500.0	1000.0	169.0	V	273.0	15.5
5396.50	58.06	---	68.00	9.94	500.0	1000.0	222.0	H	193.0	15.7
5396.50	---	44.86	53.98	9.12	500.0	1000.0	222.0	H	193.0	15.7
5401.50	56.87	---	68.00	11.13	500.0	1000.0	264.0	V	269.0	15.7
5401.50	---	44.15	53.98	9.83	500.0	1000.0	264.0	V	269.0	15.7
5413.50	60.57	---	68.00	7.43	500.0	1000.0	100.0	H	329.0	15.7
5413.50	---	46.97	53.98	7.01	500.0	1000.0	100.0	H	329.0	15.7



Plot #15 Radiated Emissions: 7-18 GHz

Mode: 802.11a | Low (149)

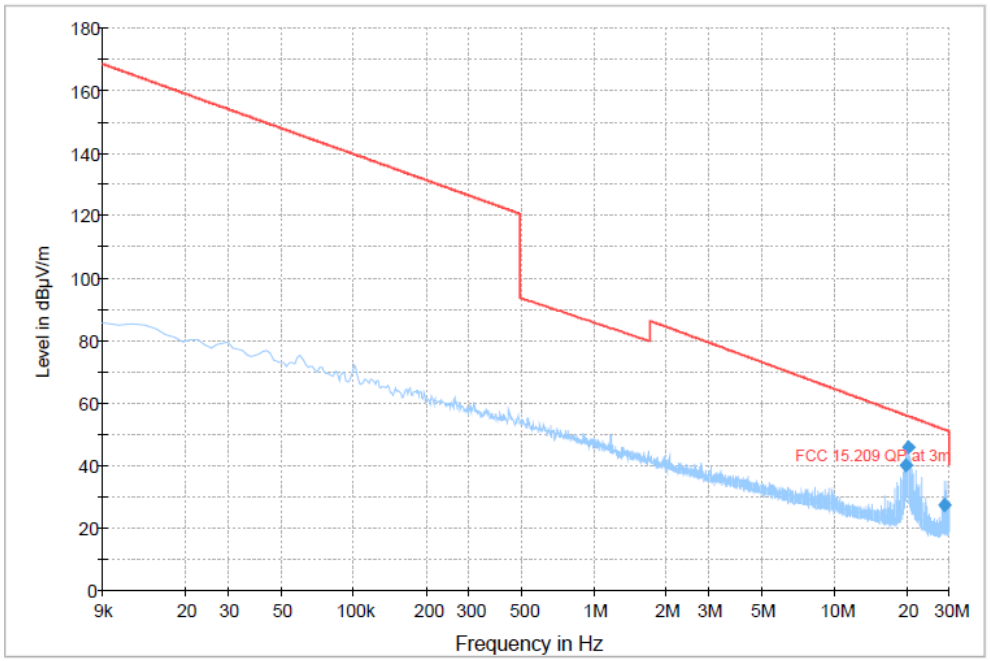
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16878.73	---	41.26	53.98	12.72	500.0	1000.0	158.0	H	255.0	14.3
16878.73	54.13	---	68.00	13.87	500.0	1000.0	158.0	H	255.0	14.3
17373.24	---	42.19	53.98	11.79	500.0	1000.0	246.0	V	69.0	15.9
17373.24	54.48	---	68.00	13.52	500.0	1000.0	246.0	V	69.0	15.9
17810.07	---	41.50	53.98	12.48	500.0	1000.0	116.0	V	196.0	17.8
17810.07	54.18	---	68.00	13.82	500.0	1000.0	116.0	V	196.0	17.8



Plot # 16 Radiated Emissions: 9 KHz – 30 MHz

Mode: 802.11a | Mid (153)

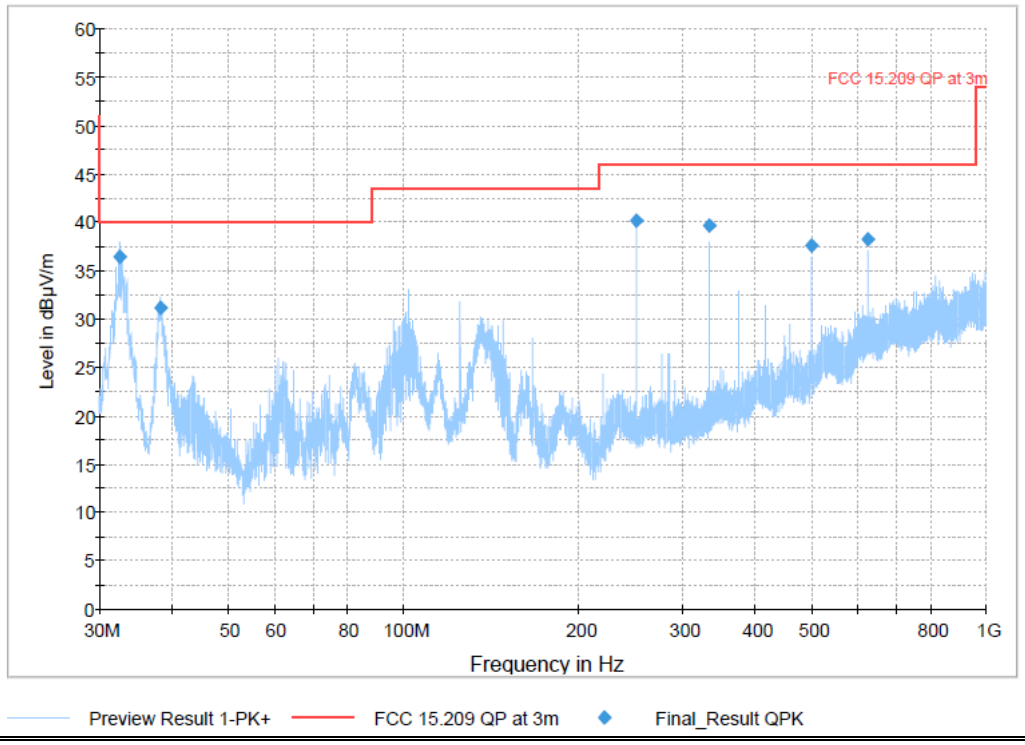
Frequency (MHz)	MaxPeak (dBµV/m)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19.71	40.05	---	56.21	16.16	500.0	3.0	107.0	H	-7.0	16.5
20.22	45.97	---	55.90	9.93	500.0	3.0	100.0	H	144.0	16.5
28.69	27.32	---	51.59	24.27	500.0	3.0	116.0	H	295.0	15.9



Plot #17 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | Mid (153)

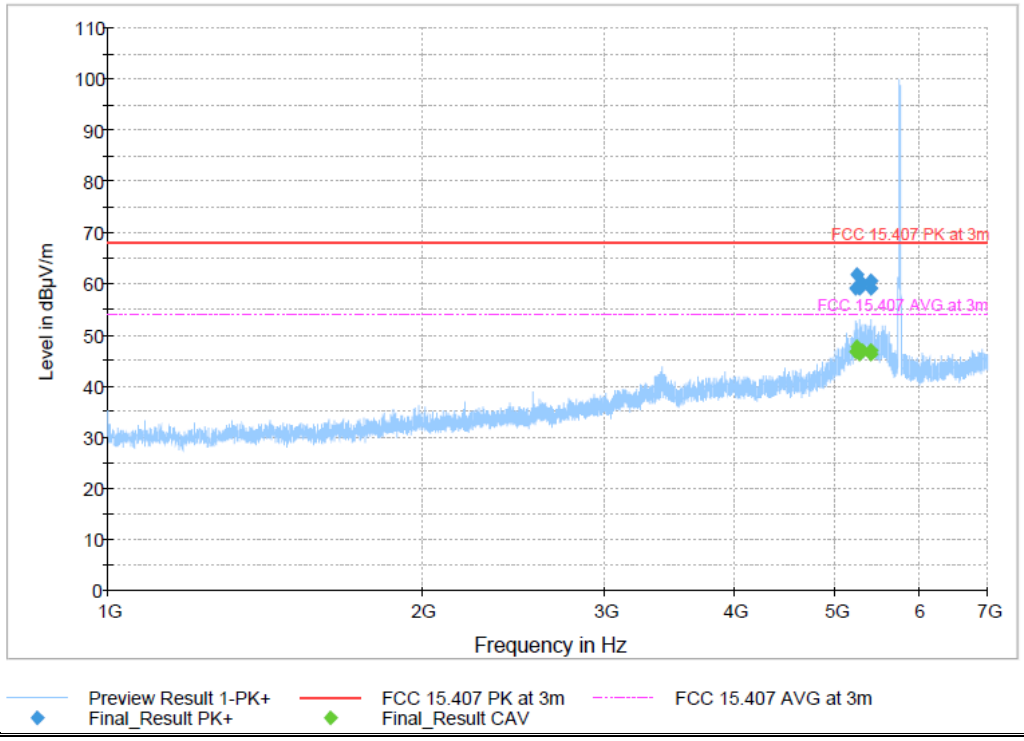
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.587	36.41	40.00	3.59	500.0	120.000	162.0	V	236.0	17.4
38.213	31.13	40.00	8.87	500.0	120.000	150.0	V	207.0	14.5
249.996	40.24	46.02	5.78	500.0	120.000	149.0	V	110.0	17.1
333.319	39.70	46.02	6.32	500.0	120.000	286.0	H	17.0	19.7
499.997	37.64	46.02	8.38	500.0	120.000	149.0	V	321.0	23.5
625.030	38.20	46.02	7.82	500.0	120.000	150.0	H	2.0	26.9



Plot #18 Radiated Emissions: 1-7 GHz

Mode: 802.11a | Mid (153)

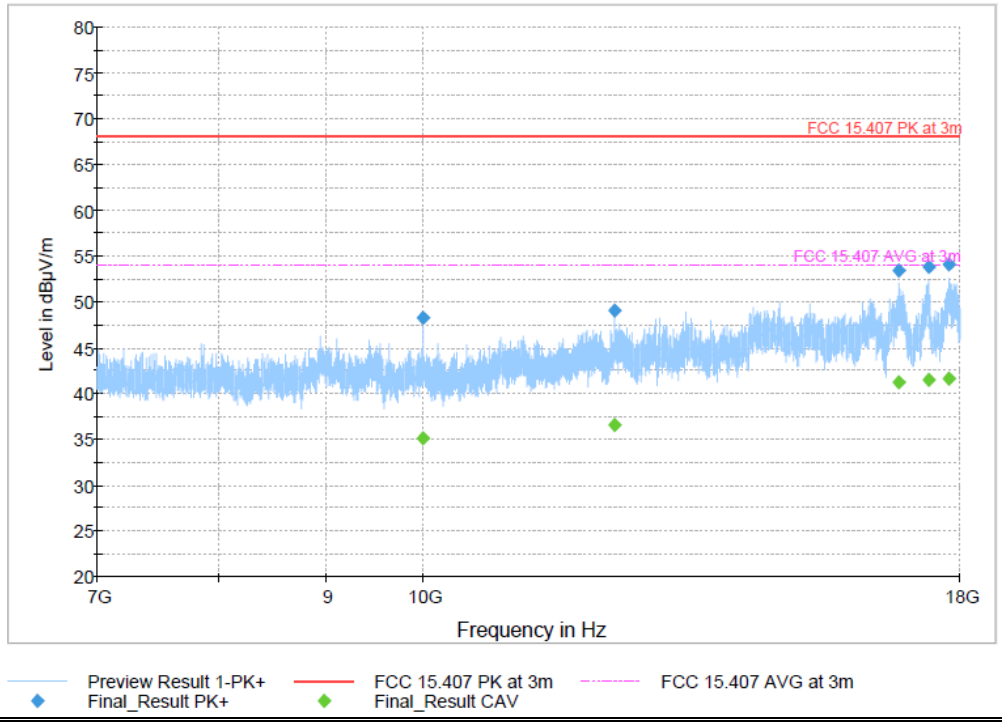
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5232.25	59.23	---	68.00	8.77	500.0	1000.0	202.0	V	273.0	15.7
5232.25	---	46.74	53.98	7.24	500.0	1000.0	202.0	V	273.0	15.7
5248.00	61.93	---	68.00	6.07	500.0	1000.0	228.0	H	229.0	15.7
5248.00	---	47.75	53.98	6.23	500.0	1000.0	228.0	H	229.0	15.7
5275.00	59.06	---	68.00	8.94	500.0	1000.0	142.0	V	273.0	15.6
5275.00	---	46.33	53.98	7.65	500.0	1000.0	142.0	V	273.0	15.6
5298.50	60.20	---	68.00	7.80	500.0	1000.0	117.0	H	342.0	15.6
5298.50	---	46.87	53.98	7.11	500.0	1000.0	117.0	H	342.0	15.6
5402.50	---	46.32	53.98	7.66	500.0	1000.0	142.0	H	330.0	15.7
5402.50	59.23	---	68.00	8.77	500.0	1000.0	142.0	H	330.0	15.7
5407.25	---	46.94	53.98	7.04	500.0	1000.0	134.0	V	274.0	15.7
5407.25	60.65	---	68.00	7.35	500.0	1000.0	134.0	V	274.0	15.7



Plot #19 Radiated Emissions: 7-18 GHz

Mode: 802.11a | Mid (153)

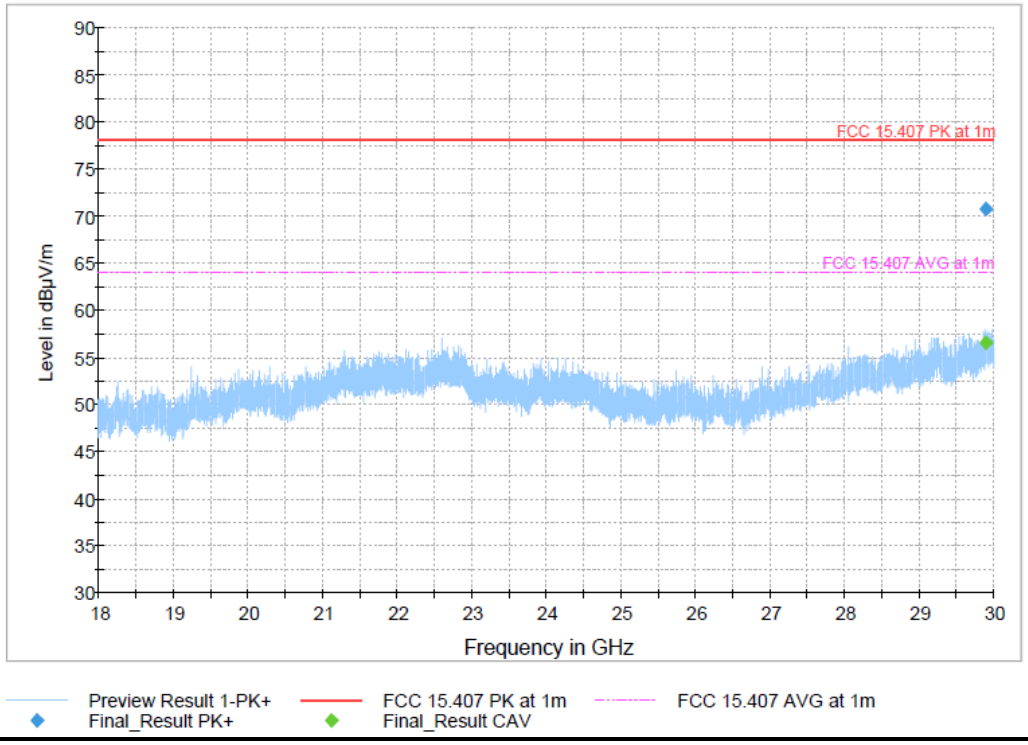
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
9992.73	48.22	---	68.00	19.78	500.0	1000.0	202.0	H	28.0	3.3
9992.73	---	35.16	53.98	18.82	500.0	1000.0	202.0	H	28.0	3.3
12335.24	---	36.58	53.98	17.40	500.0	1000.0	340.0	H	125.0	6.6
12335.24	49.03	---	68.00	18.97	500.0	1000.0	340.0	H	125.0	6.6
16834.73	53.42	---	68.00	14.58	500.0	1000.0	263.0	V	56.0	14.4
16834.73	---	41.30	53.98	12.68	500.0	1000.0	263.0	V	56.0	14.4
17391.58	53.88	---	68.00	14.12	500.0	1000.0	235.0	H	78.0	16.0
17391.58	---	41.47	53.98	12.51	500.0	1000.0	235.0	H	78.0	16.0
17773.64	54.16	---	68.00	13.84	500.0	1000.0	160.0	V	-29.0	17.1
17773.64	---	41.63	53.98	12.35	500.0	1000.0	160.0	V	-29.0	17.1



Plot #20 Radiated Emissions: 18-30 GHz

Mode: 802.11a | Mid (153)

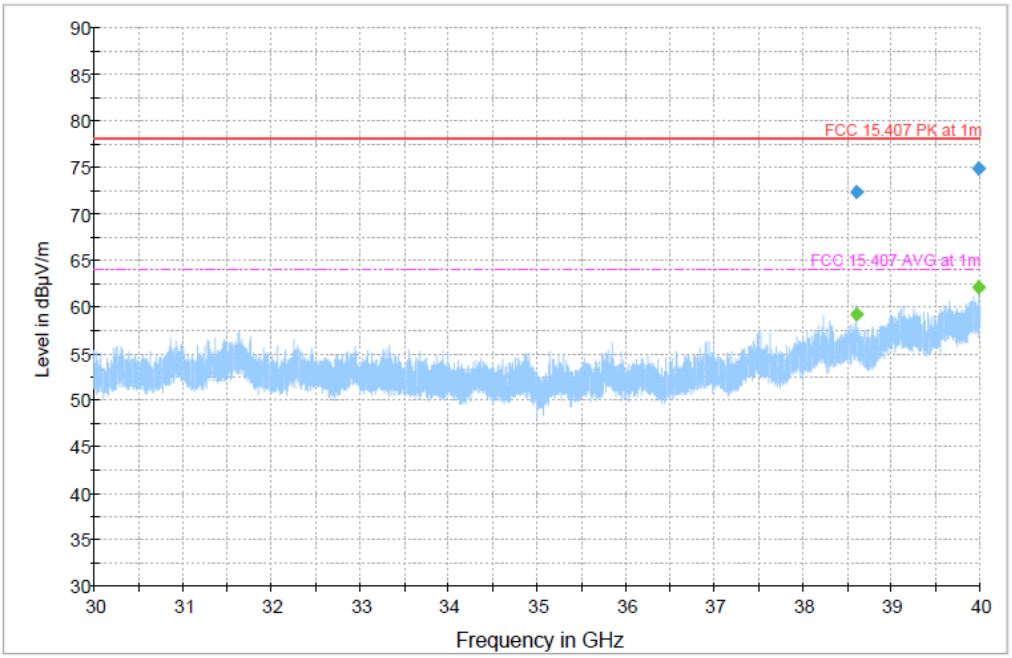
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
29902.50	---	56.61	63.98	7.37	500.0	1000.0	100.0	H	247.0	22.6
29902.50	70.78	---	78.00	7.22	500.0	1000.0	100.0	H	247.0	22.6



Plot #22 Radiated Emissions: 30-40 GHz

Mode: 802.11a | Mid (153)

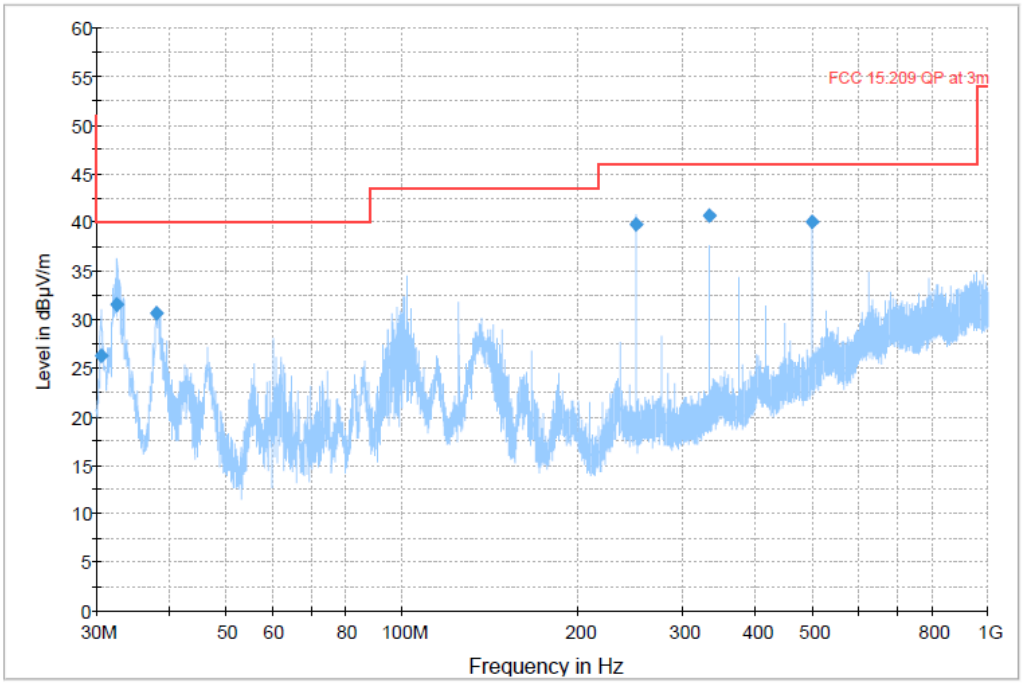
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38600.31	---	59.21	63.98	4.77	500.0	1000.0	325.0	H	124.0	22.9
38600.31	72.35	---	78.00	5.65	500.0	1000.0	325.0	H	124.0	22.9
39990.63	---	62.10	63.98	1.88	500.0	1000.0	100.0	H	348.0	24.9
39990.63	74.89	---	78.00	3.11	500.0	1000.0	100.0	H	348.0	24.9



Plot #23 Radiated Emissions: 30 MHz – 1GHz

Mode: 802.11a | High (161)

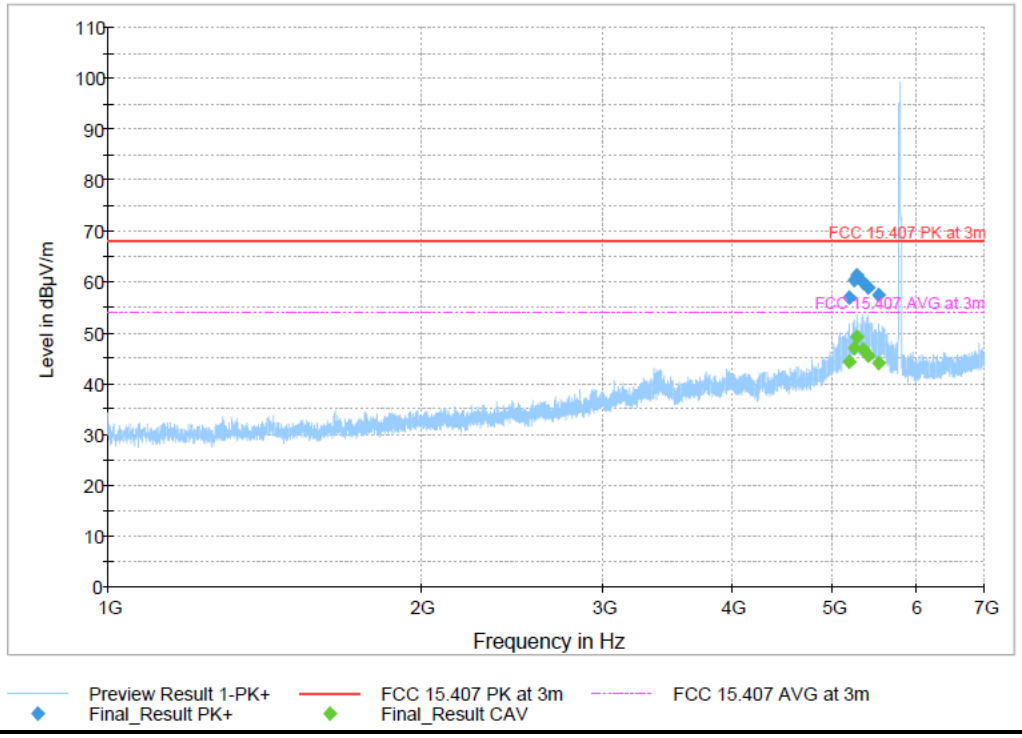
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.614	26.22	40.00	13.78	500.0	120.000	149.0	V	111.0	18.7
32.587	31.51	40.00	8.49	500.0	120.000	162.0	V	183.0	17.4
38.051	30.69	40.00	9.31	500.0	120.000	150.0	V	21.0	14.6
249.996	39.81	46.02	6.22	500.0	120.000	149.0	V	106.0	17.1
333.319	40.64	46.02	5.38	500.0	120.000	262.0	H	26.0	19.7
499.997	40.01	46.02	6.01	500.0	120.000	150.0	H	265.0	23.6



Plot #24 Radiated Emissions: 1-7 GHz

Mode: 802.11a | High (161)

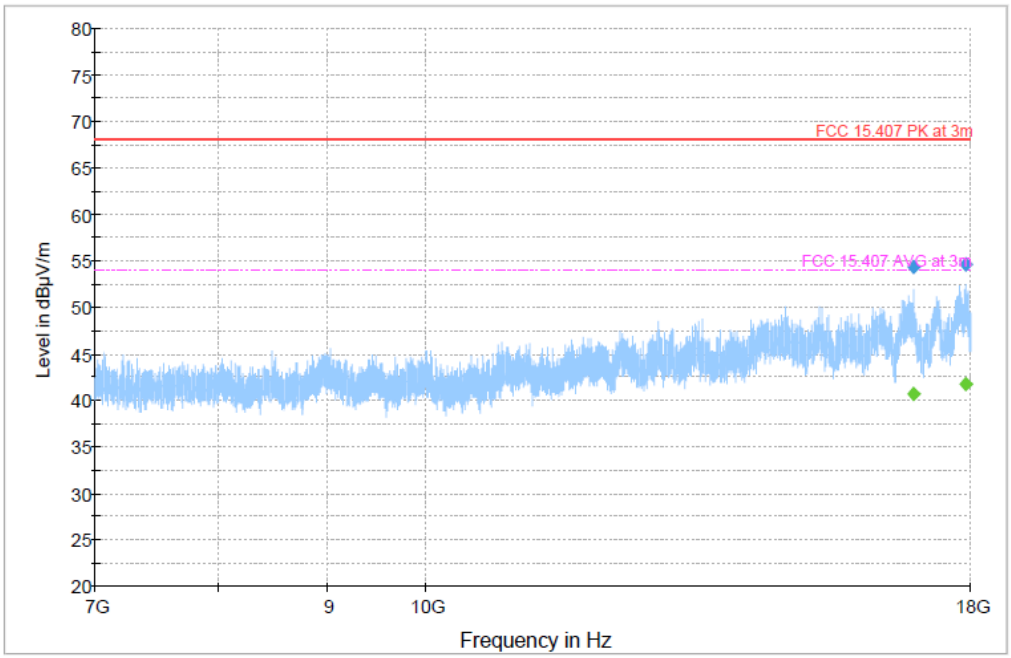
Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
5182.75	56.99	---	68.00	11.01	500.0	1000.0	248.0	V	273.0	15.2
5182.75	---	44.31	53.98	9.67	500.0	1000.0	248.0	V	273.0	15.2
5237.00	---	47.01	53.98	6.97	500.0	1000.0	186.0	V	274.0	15.8
5237.00	60.44	---	68.00	7.56	500.0	1000.0	186.0	V	274.0	15.8
5279.75	---	49.13	53.98	4.85	500.0	1000.0	151.0	V	274.0	15.6
5279.75	61.32	---	68.00	6.68	500.0	1000.0	151.0	V	274.0	15.6
5342.25	59.79	---	68.00	8.21	500.0	1000.0	100.0	H	319.0	15.8
5342.25	---	46.73	53.98	7.25	500.0	1000.0	100.0	H	319.0	15.8
5404.00	58.95	---	68.00	9.05	500.0	1000.0	245.0	V	270.0	15.7
5404.00	---	45.60	53.98	8.38	500.0	1000.0	245.0	V	270.0	15.7
5539.75	57.46	---	68.00	10.54	500.0	1000.0	245.0	V	269.0	15.9
5539.75	---	44.16	53.98	9.81	500.0	1000.0	245.0	V	269.0	15.9



Plot #25 Radiated Emissions: 7-18 GHz

Mode: 802.11a | High (161)

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
16929.58	---	40.65	53.98	13.33	500.0	1000.0	175.0	V	-88.0	13.8
16929.58	54.37	---	68.00	13.63	500.0	1000.0	175.0	V	-88.0	13.8
17905.40	---	41.83	53.98	12.15	500.0	1000.0	100.0	V	302.0	18.2
17905.40	54.66	---	68.00	13.34	500.0	1000.0	100.0	V	302.0	18.2



9 Test setup photos

Setup photos are included in supporting file name: "EMC_ASTRO-019-22001_15.407_Setup_Photos.pdf"

10 Test Equipment And Ancillaries Used For Testing

Equipment Name/Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	3 Years	9/13/2021
Biconlog Antenna	EMCO	3142E	166067	3 years	3/12/2020
Horn Antenna	EMCO	3115	35114	3 years	8/10/2020
Horn Antenna	ETS Lindgren	3117-PA	215984	3 years	1/31/2021
Horn Antenna	ETS Lindgren	3116C-PA	169535	3 years	9/30/2020
Digital Thermometer	Control Company	36934-164	191871986	3 Years	10/20/2021
Signal Analyzer	Rohde & Schwarz	FSV40	101022	3 Years	9/14/2021

Note : Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

11 History

Date	Report Name	Changes to report	Report prepared by
6-10-2022	EMC_ASTRO-019-22001_15.407	Initial Version	Kris Lazarov
11-28-2022	EMC_ASTRO-019-22001_15.407_Rev1	Updated Section 5, Note2; Updated Section 6;	Kris Lazarov
1-27-2023	EMC_ASTRO-019-22001_15.407_Rev2	Added note that UNII1 is disabled for ISED	Kris Lazarov
2-2-2023	EMC_ASTRO-019-22001_15.407_Rev3	Corrected the antenna gain in Section 3.1	Kris Lazarov

<<< The End >>>