Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.209(a) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.205:** Emissions outside the frequency band.

§15.205(a): 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	2655–2900	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	([2])

Table 1. Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 2.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

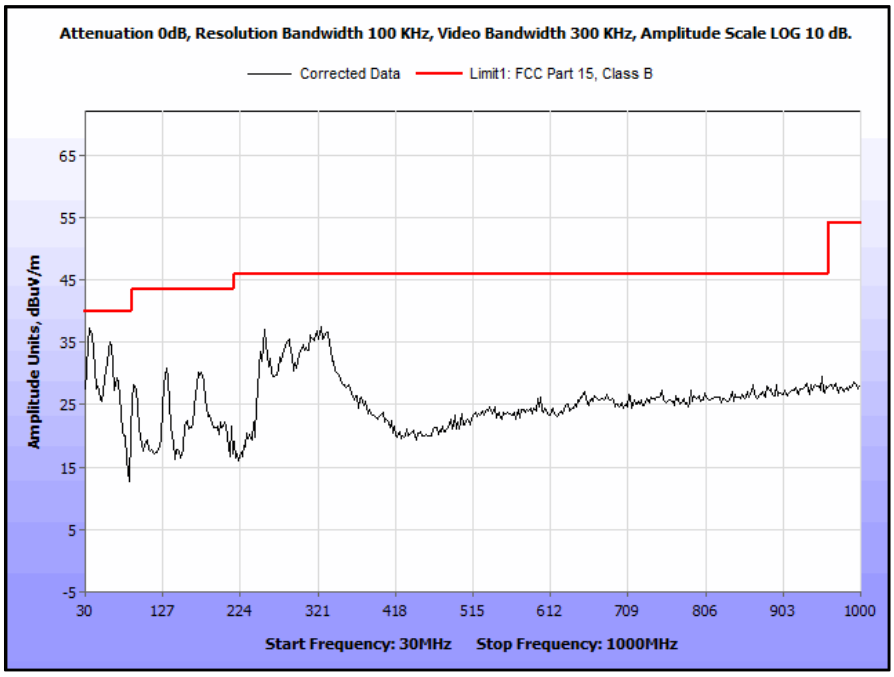
Table 2. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedures: The transmitter was turned on. A 2.4GHz and 5Ghz notch filter was use to filter out the transmitting signal. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

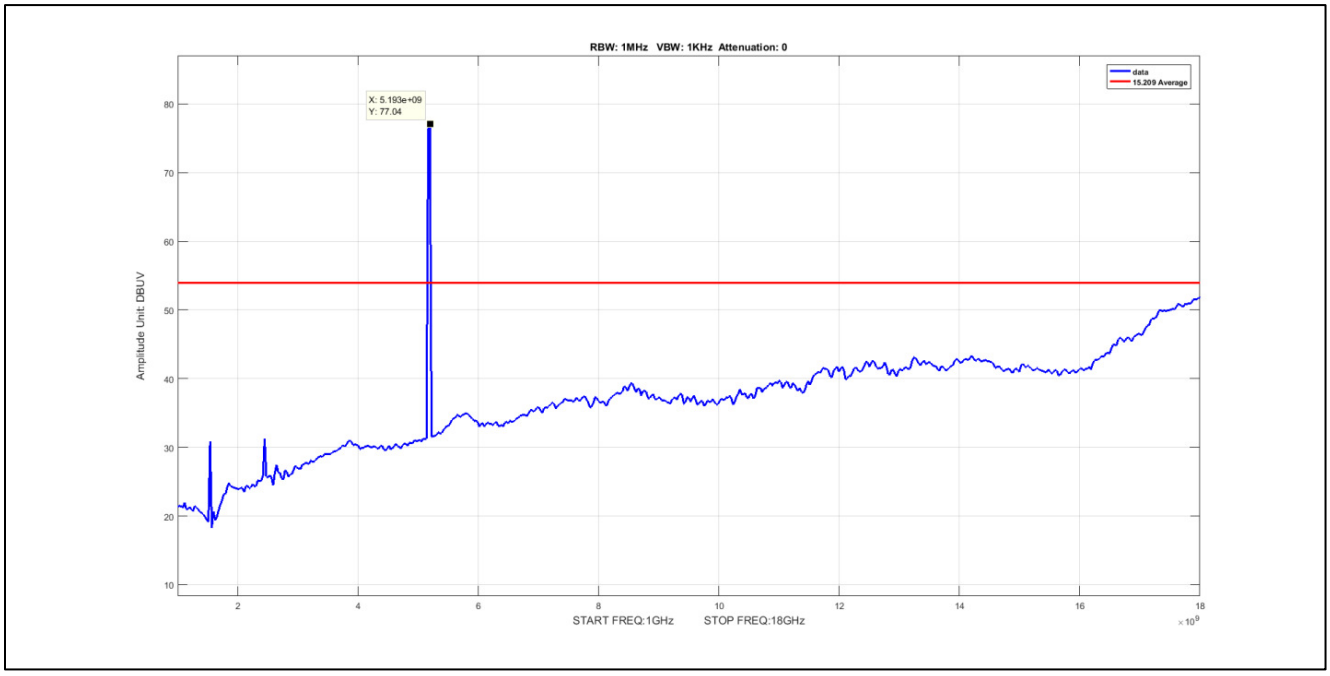
Test Results: The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

Test Engineer(s): Deepak Giri

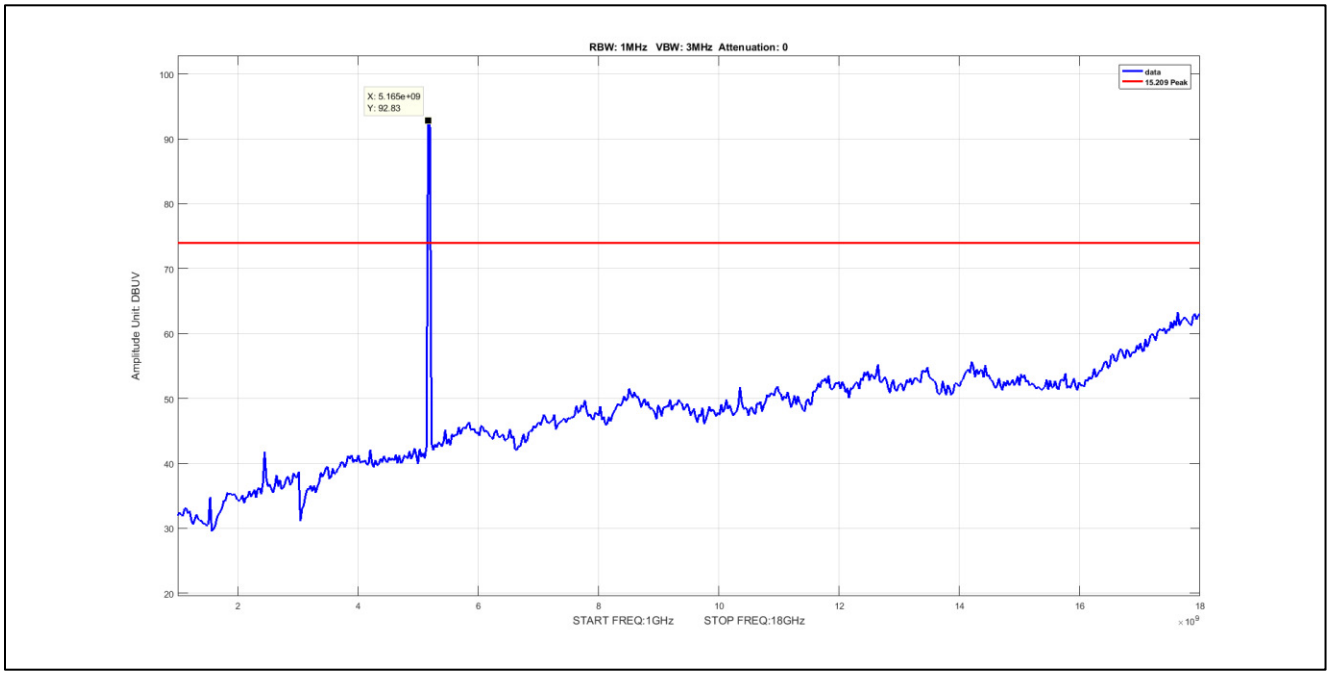
Test Date(s): 10/20/2016



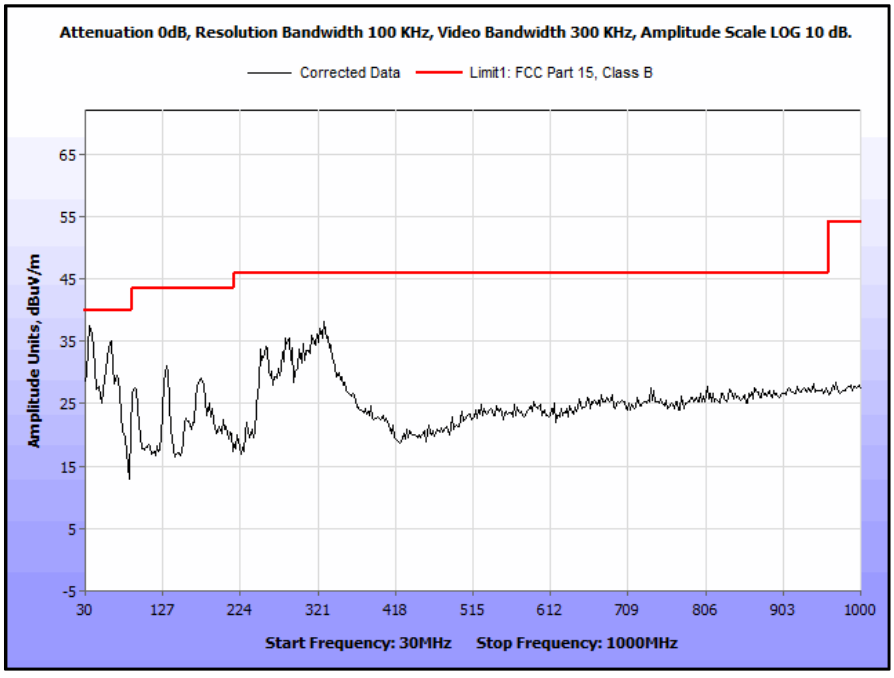
Plot 1. 2510 MHz Low Channel Port 1 QPSK, 802.11b Mid Channel 2442MHz, 802.11a Mid Channel 5200 MHz Port 1, 30-1 GHz plot



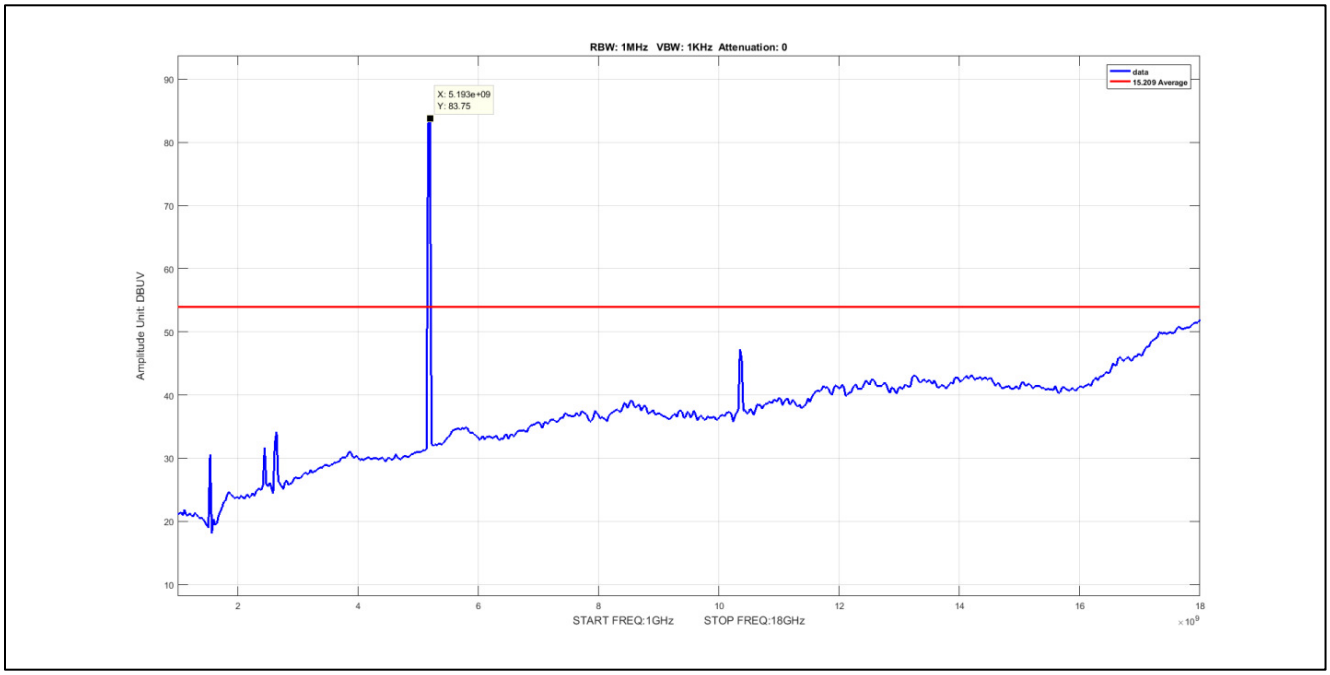
Plot 2. 2510 MHz Low Channel Port 1 QPSK, 802.11b Mid Channel 2442MHz, 802.11a Mid Channel 5200 MHz Port 1, 1GHz - 18 GHz Average Plot



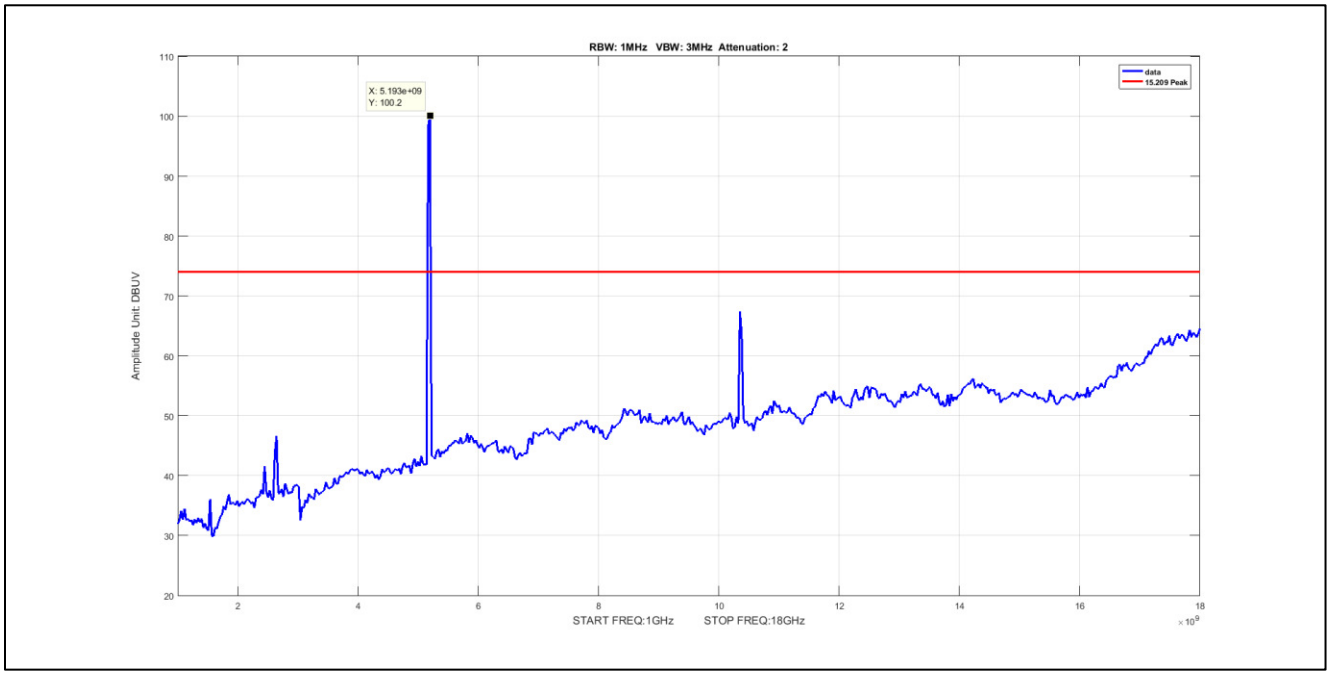
Plot 3. 2510 MHz Low Channel Port 1 QPSK, 802.11b Mid Channel 2442MHz, 802.11a Mid Channel 5200 MHz Port 1, 1GHz - 18 GHz Peak Plot



Plot 4. 2630 MHz Mid Channel Port 1 QPSK, 802.11g Mid Channel 2442 MHz, 802.11ac Mid Channel 5300 MHz Port 1, 30MHz – 1 GHz Plot



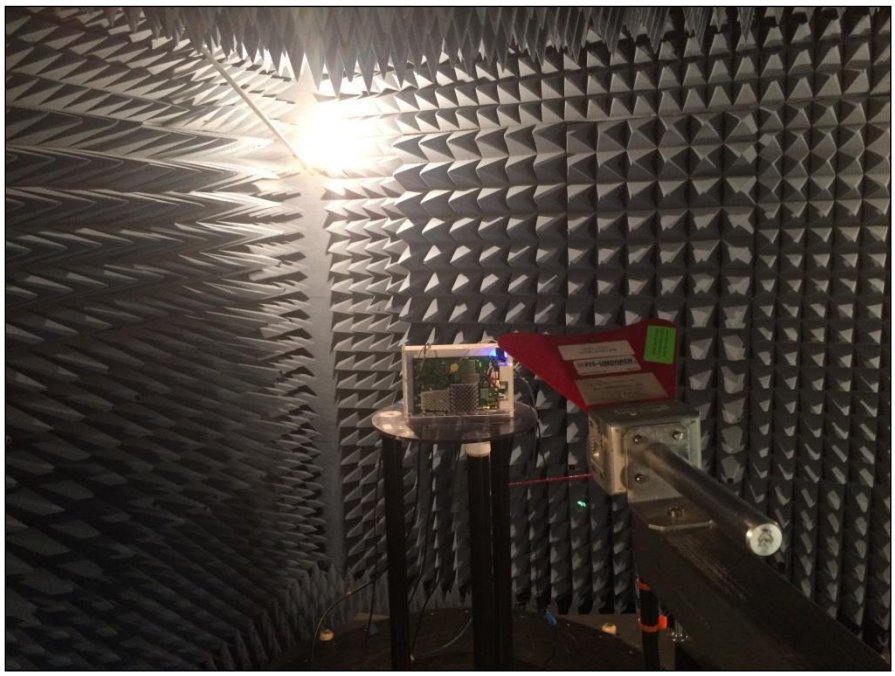
Plot 5. 2630 MHz Mid Channel Port 1 QPSK, 802.11g Mid Channel 2442 MHz, 802.11ac Mid Channel 5300 MHz Port 1, 1 GHz – 18 GHz Average Plot



Plot 6. 2630 MHz Mid Channel Port 1 QPSK, 802.11g Mid Channel 2442 MHz, 802.11ac Mid Channel 5300 MHz Port 1, 1 GHz – 18 GHz Peak Plot

Radiated Spurious Emissions Test Setup

Photograph 1. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 2. Radiated Spurious Emissions, Test Setup, Above 1 GHz

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.407(f) RF Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ UNI Bands, LTE Bands and 2.4 GHz Wi-Fi **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Equation from page 18 of OET 65, Edition 97-01

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where, S = Power Density
P = Power Input to antenna
G = Antenna Gain
R = Minimum Distance between User and Antenna (20 cm)

Total MPE = MPE (15.247) + MPE(UNI Bands) + MPE (LTE Radios)
= 0.366 + 0.243 + 0.1523
= 0.7613 mW/cm^2

Asset	Equipment	Manufacturer	Model	Calibration Date	Calibration Due Date
1S2607	SPECTRUM ANALYZER ESA-E	AGILENT/HEWLETT PACKARD	E4407B	3/23/2016	9/23/2017
1T4564	LISN (24 AMP)	SOLAR ELECTRONICS COMPANY	9252-50-R-24-BNC	7/22/2016	7/22/2017
1T4504	SHIELDED ROOM	UNIVERSAL SHIELDING CORP	N/A	NOT REQUIRED	
1T4859	DIGITAL BAROMETER, HYGROMETER, THERMOMETER	CONTROL COMPANY	15-078-198, FB70423, 245CD	2/10/2016	2/10/2018
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	12/31/2015	12/31/2016
1T4751	ANTENNA - BILOG	SUNOL SCIENCES	JB6	2/26/2016	8/26/2017
1T4771	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4446A	8/10/2016	2/10/2018
1T4483	ANTENNA; HORN	ETS-LINDGREN	3117	10/8/2015	4/8/2017
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS COMPANY	9252-50-R-24-BNC	7/25/2016	7/25/2017
1T4505	TEMPERATURE CHAMBER	TEST EQUITY	115	2/11/2016	2/11/2017

Table 3. Test Equipment List