



MPE Evaluation for AirCard 313U Wireless Modem

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1. Introduction

The AC313U wireless modem offers internet access through GPRS/EDGE/UMTS/LTE network. The MPE report demonstrates compliance for AC313U with FCC CFR 47 §2.1091 and IC RSS-102 in usage of external antenna under mobile exposure conditions. The MPE analysis is valid for device operating with the parameters defined in Table 3 and limited for Canada / US bands only.

2. RF Exposure Limits and Equations

The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure.

FCC RULES:

According to FCC CFR 47 §1.310, the criteria listed in the Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1307.

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

Table 1: Limits for Maximum Permissible Exposure (MPE)

IC RULES:

IC has adopted the RF field strength limits established in Health Canada's RF exposure guideline. The limits are shown in Table 2 below per RSS-102

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/ <i>f</i>	2.19/ <i>f</i>	-	6
10-30	28	2.19/ <i>f</i>	-	6
30-300	28	0.073	2*	6
300-1500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}

Note: *f* is frequency in MHz.

* Power density limit is applicable at frequencies greater than 100 MHz.

Table 2: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

EQUATIONS:

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * D^2)$$

where

S = Power density (mW/cm²)

EIRP = Equivalent Isotropic Radiated Power (mW)

D = Separation distance (cm)

3. Product Declarations

Mode	Equipment Category	Max Transmitter Duty Cycle	Band Name	Available in US	Transmitter Range (MHz)	Maximum Conducted Power		Max External Antenna Gain (dBi)
						(dBm)	(W)	
GPRS	Class 10	25.0%	850 MHz - US Cellular	Yes	824 - 849	33.0	1.995	6.50
			1900 MHz - US PCS	Yes	1850 - 1910	30.0	1.000	3.00
EDGE	Class 10	25.0%	850 MHz - US Cellular	Yes	824 - 849	27.0	0.501	6.50
			1900 MHz - US PCS	Yes	1850 - 1910	26.0	0.398	3.00
EDGE	Class 11	37.5%	850 MHz - US Cellular	Yes	824 - 849	27.0	0.501	6.50
			1900 MHz - US PCS	Yes	1850 - 1910	25.0	0.316	3.00
EDGE	Class 12	50.0%	850 MHz - US Cellular	Yes	824 - 849	27.0	0.501	6.50
			1900 MHz - US PCS	Yes	850 - 1910	24.0	0.251	3.00
UMTS	Band 2 Band 5	100.0%	Band 2 - 1900 MHz	Yes	1850 - 1910	24.0	0.251	3.00
			Band 5 - 850 MHz	Yes	824 - 849	24.0	0.251	6.50
LTE	Band 4 Band 17	100.0%	Band 4 - 1700 MHz (AWS)	Yes	1710 - 1755	24.0	0.251	5.50
			Band 17 - 700 MHz	Yes	704 - 716	24.0	0.251	9.00

Table 3: WWAN Transmitter and Maximum Antenna Gain Declarations

4. MPE Calculations

The WWAN MPE calculations are based on conservative conducted transmit power exceeding those listed in the FCC ID N7NAC313U filing. The higher transmit power levels are used to present a worst case assessment. Exceeding the declared maximum transmit power and antenna gain parameters, requires a new FCC authorization or permissive change application. A separation distance of at least 20cm shall be maintained between the end user and the device.

Table 3 summarizes transmitter parameters associated with this analysis

4.1. Individual Transmitter Calculations

4.1.1. Maximum Output Power

The maximum power calculations for the individual transmitter per wireless technology are shown in Table 4.

Technology	Frequency (MHz)	Maximum Measured Average Conducted Power (dBm)	Conducted Power (W)	Duty Cycle	S-B-T-A Power (W)	S-B-T-A Power (dBm)	Maximum Antenna Gain (dBi)	Max EIRP (dBm)	Max EIRP (mW)	Max ERP (dBm)	Max ERP (mW)
GPRS 2 UL	824 - 849	33.0	1.995	0.25	0.4988	26.98	6.50	33.48	2228.13	31.33	1358.13
EDGE 2 UL	824 - 849	27.0	0.501	0.25	0.1253	20.98	6.50	27.48	559.68	25.33	341.15
UMTS	824 - 849	24.0	0.251	1	0.2512	24.00	6.50	30.50	1122.02	28.35	683.91
GPRS 2 UL	1850 - 1910	30.0	1.000	0.25	0.2500	23.98	3.00	26.98	498.82	24.83	304.05
EDGE 2 UL	1850 - 1910	26.0	0.398	0.25	0.0995	19.98	3.00	22.98	198.58	20.83	121.04
EDGE 3 UL	1850 - 1910	25.0	0.316	0.375	0.1186	20.74	3.00	23.74	236.61	21.59	144.22
EDGE 4 UL	1850 - 1910	24.0	0.251	0.5	0.1256	20.99	3.00	23.99	250.59	21.84	152.75
UMTS	1850 - 1910	24.0	0.251	1	0.2512	24.00	3.00	27.00	501.19	24.85	305.49
LTE	704 - 716	24.0	0.251	1	0.2512	24.00	9.00	33.00	1995.26	30.85	1216.19
LTE	1710 - 1755	24.0	0.251	1	0.2512	24.00	5.50	29.50	891.25	27.35	543.25

Table 4: WWAN Maximum Output Power Calculation

Per FCC OET Bulletin 65 Supplement C, mobile devices identified in 47 CFR §2.1091 that operate at 1.5GHz or below with an effective radiated power (ERP) of 1.5watts or more, or those that operate at frequencies above 1.5GHz with an ERP of 3.0 watts or more are required to perform routine environmental evaluation for RF exposure prior to equipment authorization or use; otherwise, they are categorically excluded.

Based on calculated ERP results of Table 4, AC313U is categorically excluded.

4.1.2. Power Density

The power density calculations for individual transmitters per wireless technology at an exposure separation distance of 20cm are shown in Table 5. For frequency dependent limit, the lowest transmitter frequency was used to represent the lowest MPE limit in this analysis (eg. 824MHz = 0.549mW/cm²)

The WWAN power levels listed represent the worse-case scenario for corresponding frequency ranges given.

Technology	Frequency (MHz)	Maximum Measured Average Conducted Power (dBm)	Conducted Power (W)	Duty Cycle	S-B-T-A Power (W)	S-B-T-A Power (dBm)	Maximum Antenna Gain (dBi)	Max EIRP (dBm)	Max Average EIRP (mW)	Power Density @ 20cm (mW/cm ²)	FCC MPE Limit (mW/cm ²)
GPRS 2 UL	824 - 849	33.0	1.995	0.25	0.4988	26.98	6.50	33.48	2228.13	0.443	0.549
EDGE 2 UL	824 - 849	27.0	0.501	0.25	0.1253	20.98	6.50	27.48	559.68	0.111	0.549
UMTS	824 - 849	24.0	0.251	1	0.2512	24.00	6.50	30.50	1122.02	0.223	0.549
GPRS 2 UL	1850 - 1910	30.0	1.000	0.25	0.2500	23.98	3.00	26.98	498.82	0.099	1.000
EDGE 2 UL	1850 - 1910	26.0	0.398	0.25	0.0995	19.98	3.00	22.98	198.58	0.040	1.000
EDGE 3 UL	1850 - 1910	25.0	0.316	0.375	0.1186	20.74	3.00	23.74	236.61	0.047	1.000
EDGE 4 UL	1850 - 1910	24.0	0.251	0.5	0.1256	20.99	3.00	23.99	250.59	0.050	1.000
UMTS	1850 - 1910	24.0	0.251	1	0.2512	24.00	3.00	27.00	501.19	0.100	1.000
LTE	704 - 716	24.0	0.251	1	0.2512	24.00	9.00	33.00	1995.26	0.397	0.469
LTE	1710 - 1755	24.0	0.251	1	0.2512	24.00	5.50	29.50	891.25	0.177	1.000

Table 5: WWAN Individual transmitter MPE Calculation

Conclusion

The analysis concludes that the AC313U wireless modem complies with the FCC/IC RF exposure requirements in mobile exposure condition using external antennas, provided the maximum antenna gain does not exceed 6.5dBi in Cellular band, 3dBi in PCS band, 5.5dBi in LTE band 4 and 9.0dBi in band 17.

Mode	Transmitter Range (MHz)	Maximum Conducted Power (dBm)	Max External Antenna Gain (dBi)
GPRS/EDGE	824 - 849	33	6.50
	1850 - 1910	30	3.00
UMTS	824 - 849	24	6.50
	1850 - 1910	24	3.00
LTE	1710 - 1755	24	5.50
	704 - 716	24	9.00

Table 6: Summary of Maximum Conducted Power and Antenna Gain