
2net Hub FCC/IC RF Exposure Report (MPE)

80-KA088-104 Rev. A

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1 Introduction

This Maximum Permissible Exposure (“MPE”) report demonstrates compliance for the 2net Hub with FCC CFR 47 §1.1310 and 2.1091 and RSS GEN for standalone and collocated simultaneous transmission in mobile exposure conditions. The MPE analysis is valid for transmitters operating within the parameters defined in Table 2 used for analysis.

The mobile classification applies when 20 cm or more separation distance is maintained between the end user and both Bluetooth® and WLAN transmission antennas.

The MPE calculations in the filing are based on measured radiated values extracted from the radiated emissions report for this filing.

1.1 Device Description

The 2net Hub is a small self contained radio communications unit that plugs into an AC electrical outlet. The Hub incorporates both short range and WWAN radios as follows:

- GSM/GPRS 850/900/1800/1900 MHz
- UMTS 850/1900 MHz
- 2.4 GHz 802.11 b/g
- 2.4 GHz Bluetooth 2.0 + EDR
- 2.4 GHz ANT+

The 2net Hub incorporates two PIFA antennas:

- WWAN TX/RX
- Unlicensed 2.4GHz TX/TX

2 Product Declarations

Table 1 Summarizes transmitter parameters associated with this application.

For WWAN, the EIRP was extracted from the appropriate Part 22/24 radiated test reports. WLAN EIRP was calculated from conducted test report data + 3.8dBi antenna gain.

Table 1 Nominal Transmitter Declarations

Technology	Frequency Band	Max Transmitter Duty Cycle	Transmit Frequency Range (MHz)	Receive Frequency Range (MHz)	Radiated Transmit Power (EIRP) Test Reports
GSM/EDGE/GPRS	850 MHz	25%	824-849	869-894	3,311 mW / 35.2dBm (Peak Power)
	900 MHz	25%	880-915	925-960	3,311 mW / 35.2dBm (Peak Power)
	1800 MHz	100%	1710-1785	1805-1880	1,738 mW / 32.4dBm (Peak Power)
	1900 MHz	100%	1850-1910	1930-1990	1,738 mW / 32.4dBm (Peak Power)
UMTS/HSDPA	850 MHz (Band II)	100%	824-849	869-894	316 mW / 25dBm (Average Power)
	1900 MHz (Band IV)	100%	1850-1910	1930-1990	479 mW / 26.8dBm (Average Power)
802.11b	2.4 GHz	100%	2400-2484		100 mW / 20dBm (Average Power)
802.11g	2.4 GHz	100%	2400-2484		38 mW / 15.85dBm (Average Power)
Bluetooth 2.1+EDR	2.4 GHz	100%	2402 - 2480		13 mW / 11.02dBm (Peak Power)
ANT+	2.4 GHz	100%			13 mW / 11.02dBm (Average Power)

2.1 Collocated Transmitters

The 2net Hub contains two antennas and does not support any form of MIMO (i.e. single TX antennas only).

- Antenna 1: 2G/3G TX/RX only
- Antenna 2: 802.11/ANT+/Bluetooth TX/RX only

The unlicensed and licensed radios can operate simultaneously as follows:

- WWAN + 802.11b
- WWAN + 802.11g
- WWAN + Bluetooth
- WWAN + ANT

The different unlicensed radios are not allowed to operate simultaneously.

3 RF Exposure Limits and Equations

According to FCC CFR 47 §1.1310, the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b).

Table 2 Limits for FCC Maximum Permissible Exposure (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (Minutes)
(A) Limits For Occupational / Control Exposures (f = frequency)				
30-300	61.4	0.163	1.0	6
300-1500	...	...	f/300	6
1500-100,000	...	...	5.0	6
(B) Limits For General Population / Uncontrolled Exposure (f = frequency)				
30-300	27.5	0.073	0.2	30
300-1500	...	...	f/1500	30
1500-100,000	...	...	1.0	30

The Industry Canada limits Safety Code 6, Section 2.2 Table 5 is 10 W/m². The Industry Canada limit is equivalent to the FCC limit although in different units. For the purposes of this document, results are reported in terms of mW/cm² but compliance with the FCC limit is equivalent to compliance with the Industry Canada limit.

Friis transmission formula:

$$P_d = \frac{P_{out} \times G}{4\pi R^2}$$

Where,

P_d = power density (mW/cm²)

P_{out} = output power to antenna (mW)

G = gain of antenna in linear scale

R = distance between observation point and center of the radiator (cm)

4 MPE Calculations

4.1 Stand Alone Transmitter Calculations

The power density calculations for standalone transmitters at an exposure separation distance of 20 cm are shown in [Table 3](#) per the transmit power and antenna gain values declared in [Table 1](#).

- For frequency dependent limits, the lowest transmitter frequency was used to represent the lowest MPE limit (e.g. 824MHz = 0.549 mW/cm²).
- For WWAN the EIRP was extracted from the appropriate Part 22/24 radiated test reports.
- For ANT+, the EIRP is converted from measured field strength
- WLAN EIRP was calculated from conducted test report data + 3.8dBi antenna gain.

Table 3 Standalone MPE Calculations

Technology	Frequency (MHz)	Measured Conducted Transmit Power (dBm)	Peak Antenna Gain (dBi)	Maximum EIRP (dBm)	Maximum EIRP (W)	Duty Cycle	Average EIRP (dBm)	Average EIRP (W)	Power Density @ 20cm (mW/cm ²)	FCC MPE Limit (mW/cm ²)
GPRS 2 UL	824	Not measured	N/A	35.1	3.20	0.25	29.0	0.80	0.159	0.549
GPRS 2 UL	1850	Not measured	N/A	32.5	1.79	0.25	26.5	0.45	0.089	1.000
UMTS	824	Not measured	N/A	25.0	0.316	1.00	25.0	0.32	0.063	0.549
UMTS	1850	Not measured	N/A	26.7	0.472	1.00	26.7	0.47	0.094	1.000
Bluetooth	2400	7.26	3.8	11.1	0.013	1.00	11.1	0.01	0.003	1.000
ANT+	2400	Not measured	N/A	-4.8	0.000	1.00	-4.8	0.00	0.000	1.000
802.11b	2400	16.22	3.8	20.0	0.100	1.00	20.0	0.10	0.020	1.000
802.11g	2400	12.05	3.8	15.9	0.038	1.00	15.9	0.04	0.008	1.000

4.2 Collocated MPE Calculations

Per OET 65, when RF sources have difference frequencies, the fraction of the FCC power density limit shall be determined and the sum of all fractional components shall be less than 1.

Table 4 Collocation Power Density Calculations

TX1	TX2	TX1 Pd (mW/cm ²)	TX1 FCC/IC MPE Limit (mW/cm ²)	(TX1 Pd) / (MPE Limit)	TX2 Pd (mW/cm ²)	TX2 FCC/IC MPE Limit (mW/cm ²)	(TX2 Pd) / (MPE Limit)	(TX1 fraction) + (TX2 fraction)	Limit	Pass/Fail
GPRS 2 UL	Bluetooth	0.159	0.549	0.290	0.003	1.00	0.003	0.292	1	Pass
GPRS 2 UL 824MHz	ANT+	0.159	0.549	0.290	0.000	1.00	0.000	0.290	1	Pass
GPRS 2 UL 824MHz	802.11b	0.159	0.549	0.290	0.020	1.00	0.020	0.310	1	Pass
GPRS 2 UL 824MHz	802.11g	0.159	0.549	0.290	0.008	1.00	0.008	0.297	1	Pass
GPRS 2 UL 1850MHz	Bluetooth	0.089	1.000	0.089	0.003	1.00	0.003	0.092	1	Pass
GPRS 2 UL 1850MHz	ANT+	0.089	1.000	0.089	0.000	1.00	0.000	0.089	1	Pass
GPRS 2 UL 1850MHz	802.11b	0.089	1.000	0.089	0.020	1.00	0.020	0.109	1	Pass
GPRS 2 UL 1850MHz	802.11g	0.089	1.000	0.089	0.008	1.00	0.008	0.097	1	Pass
UMTS 824MHz	Bluetooth	0.063	0.549	0.115	0.003	1.00	0.003	0.117	1	Pass
UMTS 824MHz	ANT+	0.063	0.549	0.115	0.000	1.00	0.000	0.115	1	Pass
UMTS 824MHz	802.11b	0.063	0.549	0.115	0.020	1.00	0.020	0.135	1	Pass
UMTS 824MHz	802.11g	0.063	0.549	0.115	0.008	1.00	0.008	0.122	1	Pass
UMTS 1850MHz	Bluetooth	0.094	1.000	0.094	0.003	1.00	0.003	0.096	1	Pass
UMTS 1850MHz	ANT+	0.094	1.000	0.094	0.000	1.00	0.000	0.094	1	Pass
UMTS 1850MHz	802.11b	0.094	1.000	0.094	0.020	1.00	0.020	0.114	1	Pass
UMTS 1850MHz	802.11g	0.094	1.000	0.094	0.008	1.00	0.008	0.102	1	Pass