Collocated MPE Calculations
PD9512ANMU with N7NMC8775-H

Systems operating under the provision of 47 CFR 1.1307(b)(1) shall be operated in a manor that ensures that the public is not exposed to radio frequency energy levels in excess of the FCC guidelines.

The EUT will only be used with a separation of 20 centimeters or greater between the antennas and the body of the user or nearby persons and can therefore be considered a mobile transmitter per 47 CFR 2.1091(b).

The EUT contains a PCS Licensed Transmitter, FCC Identifier N7NMC8775-H, covered under FCC parts 24E and 22H of CFR part 47.

The details for this transmitter are shown in Table 1 below.

FCC Rule Parts	Range (MHz)	Maximum Conducted Output, Watts	Duty Cycle	Peak Antenna Gain to be used for collocated MPE, dBi
24E	1850.2 – 1909.8	0.468	0.5	4.0
22H	824.2 – 848.8	1.57	0.25	6.5

Table 1

The EUT contains a transmitter, with FCC Identifier PD9512ANM, operating in the Unlicensed UNII bands covered under parts 15E of CFR part 47 and also in the Unlicensed IMS bands covered under part 15C of CFR part 47. The details for this transmitter are shown below in Table 2.

FCC Rule Parts	Range (MHz)	Max Output, Watts	Duty Cycle	Peak Antenna Gain to be used for collocated MPE, dBi
15C	2412.0 – 2462.0	0.091	1.0	3.00
15C	2422.0 – 2452.0	0.037	1.0	3.00
15E	5180.0 – 5320.0	0.028	1.0	5.00
15E	5190.0 – 5310.0	0.025	1.0	5.00
15E	5500.0 – 5700.0	0.054	1.0	5.00
15E	5510.0 – 5670.0	0.025	1.0	5.00
15C	5745.0 – 5825.0	0.018	1.0	5.00
15C	5755.0 – 5795.0	0.021	1.0	5.00

Table 2

Equations

The equations used are based on methods described in OET Bulletin 65 and appendices.

Given

$$E = \sqrt{(30 * P * DC * G) / d}$$

And

$$S = E^2 / 3770$$

Where

E = Field Strength in Volts/meter
P = Power in Watts
DC = Duty cycle, dimensionless
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milli-watts/square centimeter

Combining equations and rearranging the terms to express the Power Density in terms of the other variables yields,

$$S = (30 * P * DC * G) / (3770 * d^2)$$

Changing the units of Power to mW and Distance to cm, using,

P (mW) = 1000 * P (W)
d (cm) =100 * d (m)

Yields,

$$S = (30 * (P/1000) * DC * G) / (3770 * (d/100)^2)$$

Or,

$$S = (0.0795756 * P * DC * G) / (d^2)$$

Where

d = distance in cm
P = Power in mW
DC = Duty cycle, dimensionless
G = Numeric antenna gain
S = Power Density in mW/cm^2

FCC Limits for Maximum Permissible Exposure (MPE)

(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

The MPE calculations for d = 20cm are shown below for the possible combinations of transmit frequency bands.

Per OET Bulletin 65, for frequency bands with the same MPE limits, the Power Densities produced by each transmitter are summed. The summation must be under the limit for the band.

Per OET Bulletin 65, for frequency bands with different limits the Power Densities are calculated separately for each band, divided by the limit for the band and the results are then summed. The summation must be less than 1.

For the frequency band 824.2 – 848.8 MHz the worst case (lowest) limit is used. The limit is calculated as follows,

$$824.2 / 1500 = 0.55 \text{ mW/cm}^2$$

The worse case conducted power, in the 824.2 – 848.8 MHz band, is for GPRS multi-slot class 12 operation, supporting 2 uplink transmission time slots, with a Duty Cycle of 0.25.

The worse case, in the 1850.2 – 1909.8 MHz band, is for EGPRS multi-slot class 12 operation, supporting 4 uplink transmission time slots, with a Duty Cycle of 0.50.

For the 2.4 GHz frequency bands the worse case (highest) conducted power level of 0.091 Watts is used.

For the 5 GHz frequency bands the worse case (highest) conducted power level of 0.054 Watts is used.

Collocated MPE Calculations

Transmitter Frequency Band, MHz	Power, Watts	Power, milli-Watts	Duty Cycle	Peak Antenna Gain, dBi	Peak Antenna Gain, Dimensionless	Power Density at 20cm, mW/cm^2 $(0.0795756*P*DC*G) / (d^2)$	Fraction of Limit, Dimensionless
824.2 – 848.8	1.57	1570	0.25	6.5	4.47	NA	0.349/0.55 = 0.635
1850.2 – 1909.8	0.468	468	0.50	4.0	2.51	0.117	NA
2412.0 – 2462.0 2422.0 – 2452.0	0.091	91	1.00	3.00	2.00	0.036	0.036/1 = 0.036
5180.0 – 5320.0 5190.0 – 5310.0 5500.0 – 5700.0 5510.0 – 5670.0 5745.0 – 5825.0 5755.0 – 5795.0	0.054	54	1.00	5.00	3.16	0.034	0.034/1 = 0.034

Active Transmitter Bands, MHz	2412.0 – 2462.0 2422.0 – 2452.0	5180.0 – 5320.0 5190.0 – 5310.0 5500.0 – 5700.0 5510.0 – 5670.0 5745.0 – 5825.0 5755.0 – 5795.0	Unit	Limit
824.2 – 848.8	0.635 + 0.036 = 0.671	0.635 + 0.034 = 0.670	**Dimensionless**	**1**
1850.2 – 1908.8	0.117 + 0.036 = 0.153	0.117 + 0.034 = 0.151	**mW/cm2**	**1**

Calculated worse case MPE numbers are below required limits.