METEORCOMM LLC

RF Exposure Calculations - MCC-545C Packet Data Transceiver

Applicant FCC ID: BIB54505003-01

Revision History

Revision	Date	Summary of Changes	Comments
1	2/14/2012	Original	

RF Exposure Calculations
MCC-545C Transceiver

1. Determination of Need for Routine Environmental Evaluation for RF Exposure per §2.1091(c)

It is the view of Meteorcomm LLC that the MCC-545C Packet Data Radio Transceiver is not subject to routine environmental evaluation for RF exposure. This model is intended for use in Part 90 mobile and fixed data applications but is not designed for use in the Specialized Mobile Radio Service.

2. RF Exposure Environment

Per FCC OET Bulletin 65, there are two environments relevant to RF exposure analysis:

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/ controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

The MCC-545C model can be deployed in fixed base and mobile vehicular installations, so it is possible for both environments to apply. The radio operator may be considered to be in an occupational/controlled exposure environment if she or he is properly trained to be aware of exposures and to control emissions. Vehicle passengers and bystanders are generally considered to be in a general population/uncontrolled exposure environment. This being the case, vehicular antenna installation must take into account both environments, or, at the least, the more restrictive requirement, that being the general population/uncontrolled environment.

The occupational/controlled exposure limits generally apply to base station applications.

Vertical polarization is used with all antennas in the accompanying tables.

3. RF Exposure Limit Calculations

Per Table 1 of OET Bulletin 65, Appendix A, the FCC limits for Maximum Permitted Exposure (MPE) in terms of power density, S, are shown below.

For an Occupational/Controlled Exposure environment:

S = 1.0mW/cm^2 for the frequency range of 30-300 MHz,

For a General Population/Uncontrolled Exposure environment:

S = 0.2mW/cm^2 for the frequency range of 30-300 MHz,

The minimum separation required between a human and an antenna connected to an active antenna can be determined by use of the power density expression:

$$S = \frac{PG}{4\pi(R\string^2)}$$

Where

S = power density in mW/cm^2

P = Average RF power into the antenna in mW

G = antenna gain - isotropic (unitless, linear)

R = separation/distance between antenna and point of interest in cm

Solved for R, the formula becomes:

$$R = \sqrt{\frac{PG}{4\pi S}}$$

The charts below show the maximum transmit power levels converted to average including the 10% duty cycle limit imposed by the radio firmware, maximum power densities and R, the calculated minimum human separation. Several example antenna types are shown. Antenna gains shown are relative to an isotropic radiator. The gain relative to a dipole (dBd) is 2.15 dB less in each case.

Calculation of P for all cases:

Rated power = P_{rated} = 100 W average.

Maximum conducted power condition P_{meas} = 50.9 dBm = 123 W average.

Average power reduced to 10% duty ratio, P = 0.1*123 = 12.3 W = 12300 mW.

Example calculation for first and second entries in table of Section 4 below:

Gain factor for 2.15 dBi is 10^(2.15/10) = 1.64

S = 0.2 mW/cm2 (uncontrolled exposure environment)

R = ((12300*1.64)/(4*3.14159*0.2))^0.5 = 89.6 cm.

Radiated power calculation.

Antenna gain in dBd = 2.15 dBi – 2.15 dBi to dBd conversion = 0 dBd = 1 numeric

$P_{radiated}$ = P_{meas}*Antenna Gain (numeric dBd) = 123W*1.00 = 123 Watts ERP

Example calculation for first entry in table of Section 5 (fixed antennas):

Gain factor for 4.1 dBi is 10^(4.1/10) = 2.57

S = 1.0 mW/cm2 (controlled exposure environment)

R = ((12300*2.57)/(4*3.14159*1.0))^0.5 = 50.2 cm.

Radiated power calculation.

Antenna gain in dBd = 4.1 dBi – 2.15 dBi to dBd conversion = 1.95 dBd = 1.57 numeric

$P_{radiated} = P_{meas}$*Antenna Gain (numeric dBd) = 123W*1.57 = 193 Watts ERP

4. Calculated Limits Applied to Mobile Installations (Uncontrolled Exposure 0.2 mW/cm^2)

Radio Type	Antenna Type	Antenna gain (dBi)	Maximum power (watts)	Maximum Duty Cycle	Recommended minimum lateral distance from transmitting antenna	
					cm	in.
MCC-545C	Base-loaded ¼-wave vertical whip antenna roof-mounted on car or truck	2.15	123	10%	89.6	35.3
MCC-545C	0 dBd gain antenna roof-mounted on locomotive cab	2.15	123	10%	89.6	35.3

5. Calculated Limits Applied to Fixed Installations (Controlled Exposure 1.0 mW/cm^2)

Radio Type	Antenna Type	Antenna gain (dBi)	Maximum Power (watts)	Maximum Duty Cycle	Recommended minimum lateral distance from transmitting antenna	
					cm	in.
MCC-545C	2.0dBd exposed dipole fixed to tower leg	4.1	123	10%	50.2	19.7
MCC-545C	5.5dBd exposed dipole fixed to tower leg	7.6	123	10%	75.0	29.5
MCC-545C	7.8 dBd Yagi fixed to tower top	9.95	123	10%	98.4	38.7