FCC Maximum Permissible Exposure (MPE) Estimation Report

Product Name: CDMA Radio Frequency Unit
Model Number: CRFU-800AB

Report No: SYBH(R) 001122010 EB-2

FCC ID: QISCRFU-800AB

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REPORT ON	FCC Maximum Permissible Exposure (MPE) Estimation of CDMA Radio Frequency Unit Model Number: CRFU-800AB Report No: SYBH(R) 001122010 EB-2 FCC ID: QIS CRFU-800AB
REGULATION	**FCC 47CFR Part 1 (10-1-07 Edition)** **OET Bulletin 65 (Edition 97-01)**
CONCLUSION	**COMPLIANT**

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Contents

1 EUT Information

1.1 Product Description

CRFU is used for up-conversion and down-conversion of signals and for power amplification. The CRFU performs the following functions:

- On the forward link, implementing up-conversion and power amplification for modulated transmitted signals and filtering the transmitted signals to make them meet the requirements of the air interface protocol
- On the reverse link, filtering the signals received by the antenna to suppress out-band interference and then performing low noise amplification, down-conversion, and channel-selective filtering.

1.2 Technical Description of EUT

Table 1. Service and Test Mode List

Operating frequency band:	Band Class 0: Uplink (RX): 824 to 849 MHz Downlink (TX): 869 to 894 MHz
Maximum power input to the antenna:	Band Class 0: a) one carrier: 42.25dBm (for cdma2000 1X) 42.57dBm (for cdma2000 1X EV-DO) b) two carriers:45.45 dBm (for cdma2000 1X) 45.15 dBm (for cdma2000 1X EV-DO) c) three carriers:47.08 dBm (for cdma2000 1X) 46.92 dBm (for cdma2000 1X EV-DO) b) three carriers:48.44 dBm (for cdma2000 1X) 48.42 dBm (for cdma2000 1X EV-DO) Note: The maximum 48.44 dBm is used for the RF exposure evaluation. (Note: refer to FCC/RF test report for the measured output power)
Antenna Information:	Band Class 0: Antenna gain (typical): 15.5 dBi

2 FCC RF Exposure Requirements

2.1 FCC Routine Environmental Evaluation

The EUT (CDMA Radio Frequency Unit, CRFU) emit RF radiation (Radiation Hazard). Although there is no scientific evidence of possible health risks to persons living near to BTS some recommendations are giving below for the installation and operation of BTS. Operators of BTSs are required to obey the local regulation for erecting base station transceivers.

The Federal Communications Commission (FCC) 47CFR §1.1307 requires operator to perform an Environmental Assessment. The objective of the Environmental Evaluation is to ensure that human exposure to RF energy does not go beyond the maximum permissible levels stated in the standard.

As specified in 47CFR §1.1307 and OET Bulletin 65, the Environmental Evaluations are required if the BTS fall into the categories listed in Table 1 of 47CFR §1.1307 and Table 2 of OET Bulletin 65, also summarized and listed in Table 2 below. Other BTS s are categorically excluded from making such studies or preparing an EA, except as indicated in paragraphs (c) and (d) of §1.1307.

Table 2. BTS Subject To Routine Environmental Evaluation

Service (title 47 CFR rule part)	Evaluation required if:
Cellular Radiotelephone Service (subpart H of part 22)	Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP). Building-mounted antennas: total power of all channels > 1000 W ERP (1640 W EIRP).
Personal Communications Services (part 24)	(1) Narrowband PCS (subpart D): Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP). Building-mounted antennas: total power of all channels > 1000 W ERP (1640 W EIRP). (2) Broadband PCS (subpart E): Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP). Building-mounted antennas: total power of all channels > 2000 W ERP (3280 W EIRP).
Miscellaneous Wireless Communications Services (part 27 except subpart M).	(1) For the 1390–1392 MHz, 1392–1395 MHz, 1432–1435 MHz, 1670–1675 MHz, and 2385–2390 MHz bands: Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP). Building-mounted antennas: total power of all channels > 2000 W ERP (3280 W EIRP). (2) For the 698–746 MHz, 746–764 MHz, 776–794 MHz, 2305–2320 MHz, and 2345–2360 MHz bands: Total power of all channels > 1000 W ERP (1640 W EIRP).
Broadband Radio Service and Educational Broadband Service (subpart M of part 27).	Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1640 W EIRP. Building-mounted antennas: power > 1640 W EIRP. BRS and EBS licensees are required to attach a label to subscriber transceiver or transverter antennas that: (1) provides adequate notice regarding potential radiofrequency safety hazards, e.g., information regarding the safe minimum separation distance required between users and transceiver antennas; and (2) references the applicable FCC-adopted limits for radiofrequency exposure specified in § 1.1310.

Note 1:	“Building-mounted antennas” means antennas mounted in or on a building structure that is occupied as a workplace or residence.
Note 2:	The term “power” refers to total operating power of the transmitting operation in question in terms of ERP, EIRP or PEP.
Note 3:	For the case of the Cellular Radiotelephone Service (47CFR Part 22 subpart H), the Personal Communications Service (47CFR Part 24) and the Specialized Mobile Radio Service (47CFR Part 90), the phrase “total power of all channels” means the sum of the ERP or EIRP of all co-located simultaneously operating transmitters owned and operated by a single licensee.
Note 4:	When applying the criteria of this table, radiation in all directions should be considered. For the case of transmitting facilities using sectorized transmitting antennas, applicants and licensees should apply the criteria to all transmitting channels in a given sector, noting that for a highly directional antenna there is relatively little contribution to ERP or EIRP summation for other directions.

2.2 Maximum Permissible Exposure (MPE)

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

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 can not exercise control over their exposure.

The FCC's MPE limits for field strength and power density are given in 47CFR §1.1310 (also in Table 1 of OET Bulletin 65). These limits (also list in Table 3 below) are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

Table 3. Limits For Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled 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)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300 1500			f/300	6
1500-100,000	--	--	5	6

(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

3 RF Exposure Evaluation

3.1 Prediction of the Exposure to Electromagnetic Fields

As mentioned in OET Bulletin 65, a theoretical approach to calculate possible exposure to electromagnetic radiation around BTS antenna. Precise statements are basically only possible either with measurements or complex calculations considering the complexity of the environment (e.g. soil conditions, near buildings and other obstacles) which causes reflections, scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a BTS is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P \times G}{4 \times p \times R^2} \quad (1)$$

Where:

S = power density
P = power input to the antenna
G = numeric gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the centre of radiation of the antenna

3.2 Calculation of the Safe Distance

Calculations can be made on a site by site basis to ensure the power density is below the limits given in section 2.2, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning.

According the equation in 3.1, the distance to the centre of radiation of the antenna:

$$R = \sqrt{\frac{P \times G}{4 \times p \times S}} \quad (2)$$

Refer to Figure 1, for the beamed antennas, the mostly safe way is that the cylindrical boundary model is chosen for simple description of the compliance boundaries of the site. In the case, the power usually is focused into a main beam and the remaining power goes into the weaker beams on both side of the main beam. For the up and down direction (r_{up} and r_{down}), the antenna is considered to have no gain as derived from the vertical pattern of the antenna (i.e. the antenna gain could be looked as 1.0).

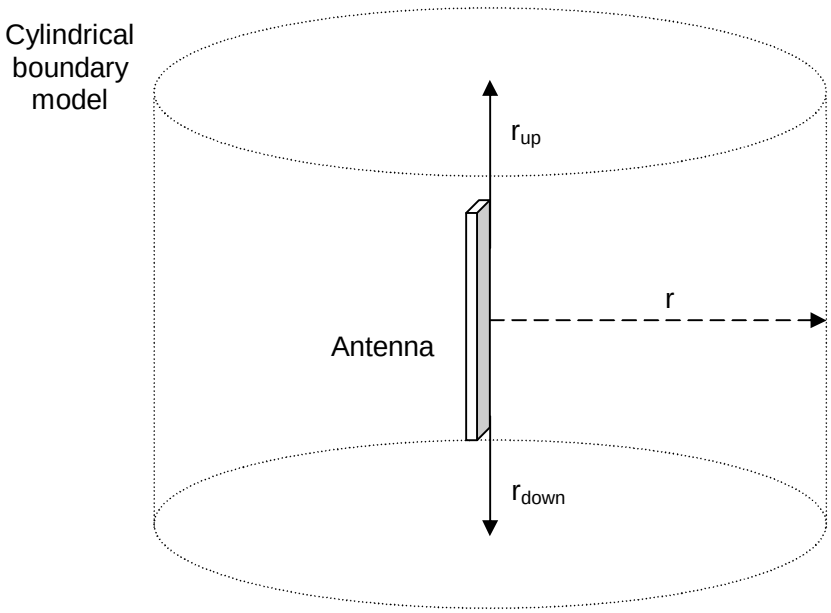


Figure 1 Cylindrical boundary model for the compliance boundary

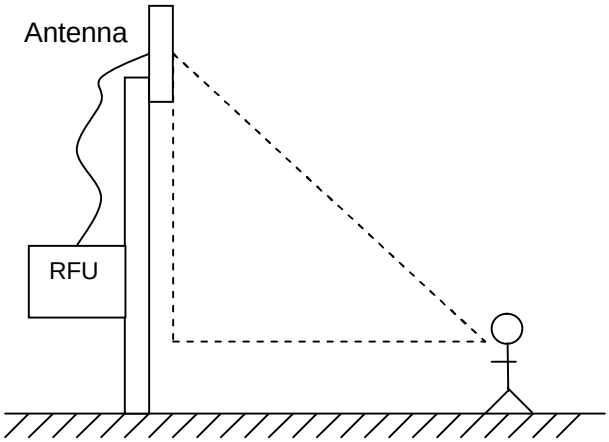
For the EUT (refer to section 1), the safe distance R can be calculated as Table 4:

Table 4. Safe distance calculation

Band Class 0:	f(TX) =869~894 MHz P =48.44dBm =69.82=W G = 15.5dBi = 35.48numeric Population/uncontrolled exposure: S = f/1500 mW/cm^2 =0.58 mW/cm$^{2=}$ 5.8 W/m^2 R = 5.83m
Note 1: The minimum antenna feed line loss is taken into account. Note 2: It is assumed that the RF exposure evaluation is base on the far-field and the MPE is over-estimated. Note 3: MPE limits that are provided to the customer and only serve as a guideline. The site license holder is ultimately responsible for MPE compliance at a given site.	

4 Location of BTS Antennas

The BTSs antennas, the source of the radiation, are usually mounted on freestanding towers, with a height up to 30 m or on a tower on the top of buildings or in less case to the side of the building. Generally the height of the antenna position does not fall below 10 m. The power usually is focused into a horizontal main beam and slightly downward tilted. The remaining power goes into the weaker beams on both side of the main beam. The main beam however does not reach ground level until the distance from the antenna position is around 50 - 200 m.



The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

4.1 Exclusions Zones

1. The antenna location should be designed so that the public cannot access areas where the RF radiation exceeds the exposure levels as described above.
2. If there are areas accessible to workers where RF radiation exceeds the levels as described above make sure that workers know where these areas are, and that they can (and do) power-down (or shut down) the transmitters when entering these areas. Such areas may not exist; but if they do, they will be confined to areas within 10 m of the antennas
3. Each Exclusion zone should be defined by a physical barrier and by an easy recognizable sign warning the public or workers that inside the exclusion zone the RF radiation might exceed exposure limits.

4.2 Guidelines on Arranging Antenna Sites

1. For roof-mounted antennas, elevate the transmitting antennas above the height of people who may have to be on the roof.
2. For roof-mounted antennas, keep the transmitting antennas away from the areas where people are most likely to be (e.g., roof access points, telephone service points, HVAC equipment).
3. For roof-mounted directional antennas, place the antennas near the periphery and point them

away from the building.

4. Consider the trade off between large aperture antennas (lower maximum RF) and small aperture antennas (lower visual impact).
5. Take special precautions to keep higher-power antennas away from accessible areas.
6. Keep antennas at a site as for apart as possible; although this may run contrary to local zoning requirements.
7. Take special precautions when designing "co-location" sites, where multiple antennas owned by different operators are on the same structure. This applies particularly to sites that include high-power broadcast (FM/TV) antennas and for example co-sitting of GSM and CDMA antennas. Local zoning often favors co-location, but co-location can provide "challenging" RF safety problems.
8. Take special precautions for antenna sites near hospital and schools.