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REPORT ON Maximum Permissible Exposure Estimation For HUAWEI CDMA Radio Frequency Unit

M/N: CRFU-AWS

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1 INTRODUCTION

This describes the logical structure of the BTS. Logically, the BTS consists of the baseband system, RF system, power system, and antenna system.

Baseband System

The baseband system consists mainly of BBU3900s and performs the following functions:
Providing the physical interface for data exchange between the BTS and the BSC Modulating and demodulating baseband data and CDMA channel signals providing system synchronization clock signals Implementing resource management, operation and maintenance, and environment monitoring

RF System

The RF system consists mainly of CRFU and performs the following functions: on the forward links, implementing up-conversion and power amplification for modulated transmitted signals and filtering the transmitted signals to make them meet the requirements of the Um interface protocol on the reverse link, filtering the signals received by the antenna to suppress out-band, interference and performing low noise amplification, channel division, down-conversion, and channel-selective filtering

Power Supply System

The power supply system consists mainly of DC DU and performs the following functions: The DCDU is a DC power distribution unit and provides -48 V DC power input for the components in the cabinet.

Antenna System

The antenna system consists of the RF antenna system and satellite antenna system. The antenna system performs the following functions:
Satellite antenna system
Through the satellite synchronization antenna, the BTS receives signals from the GPS or GLONASS system and performs wireless synchronization.
RF antenna system
The RF antenna system transmits modulated RF signals and receives the signals from the MS.

2 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure, given the scientific research to date. It is broken down into two categories, Controlled and Uncontrolled.

Controlled limits are used for persons such as installers and designers that are in control of the hazard and exposed to energy for limited amounts of time per day. Occupational/controlled limits apply in situations in which are 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.

Uncontrolled limits are used for general public. General population/uncontrolled exposure apply in situations is 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 exposure levels can be expressed in terms of power density, electric field strength, or magnetic field strength, as averaged over 30 minutes for the general public and 6 minutes for trained personnel. The exposure criterion is frequency dependent, and a chart covering the range from 3 kHz to 100 GHz can be found in NCRP No.86 (references IEEE C95.1-1991).

Below are the limits:

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)
0.3-3.0 3.0-30 30-300 300-1500 15,00-100,000	614 1842/f 61.4 -- --	16.3/f 16.3/f 0.163 -- --	(100)* ($900/f^2$)* 1.0 f/300 5

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)
0.3-1.34 1.34-30 30-300 300-15,00 15,00-100,000	614 824/f 27.5 -- --	1.63 2.19/f 0.073 -- --	(100)* ($180/f^2$)* 0.2 f/1500 1.0

For example,

- Power density S [mW/cm^2] for controlled area at 1960 MHz S = 5 mW/cm^2
- Power density S [mW/cm^2] for uncontrolled area at 1960 MHz S = 1 mW/cm^2

3 PREDICTION OF THE EXPOSURE TO ELECTROMAGNETIC FIELDS

Calculations can be made on a site by site basis to ensure the power density is below the limits given above, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning. The calculations are based on FCC OET 65 Appendix B.

3.1 Calculation of the Safe Distance

Below method describes a theoretical approach to calculate possible exposure to electromagnetic radiation around a base station transceiver 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 base station 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. The calculations are based on FCC OET 65 Appendix B.

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * p}$$

Whereas:

P = Maximum output power in W of the site

$G_{numeric}$ = Numeric gain of the antenna relative to isotropic antenna

r = distance between the antenna and the point of exposure in meters

3.2 Technical Description of the EUT

The technical specification of the CRFU-AWS (see RF test report and product manual for more detailed):

Transmitter frequency band:	AWS Band (see 47CFR part 27.5(h))
Frequency range:	AWS Band: Uplink: 1710MHz to 1755MHz Downlink: 2110MHz to 2155MHz
Max. measured mean power at antenna output port (P_0):	AWS Band: a) one carrier: 43.48dBm (for cdma2000 1X) 43.40dBm (for cdma2000 1X EV-DO) b) two carriers:46.48dBm (for cdma2000 1X)

	46.45dBm (for cdma2000 1X EV-DO) c) three carriers:48.35dBm (for cdma2000 1X) 48.21dBm (for cdma2000 1X EV-DO) d) Four carriers:49.47dBm (for cdma2000 1X) 49.56dBm (for cdma2000 1X EV-DO) Note: The maximum 49.56dBm is used for the RF exposure evaluation.
Number of antenna ports:	2
Antenna system and type:	KATHREIN 742215 (typical)
Antenna Gain (G):	AWS Band: 18 dBi max.
Antenna-cable attenuation (P_{factor}):	AWS Band: 3.71 dB (per 100m)
Mechanical specification (Height):	AWS Band: 1386 mm

3.3 Estimation of Compliance Boundary for the EUT

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary for the CRFU-AWS, which is classified as uncontrolled area, should be rather more conservative and on the safe side.

Calculations can be made on a site by site basis to ensure the power density is below the limits given in 3.1, or guidelines can be done before hand to ensure the minimum distances from the antenna is maintained through the site planning.

$$r(m) = \sqrt{\frac{P(W) * G_{numeric}}{4 * p * S}}$$

Whereas:

P = Maximum output power in W of the site

$G_{numeric}$ = Numeric gain of the antenna relative to isotropic antenna

r = distance between the antenna and the point of exposure in meters

S = Power density in W/m^2 (see also MPE limits)

For AWS Band:

For the EUT for uncontrolled area, according to 3.2,

P = P_0 - P_{factor} = 49.56dBm - 3.71 dB * (0 m / 100 m) = 49.56dBm (90.36W)

(Notes: here it calculates the 0 m antenna feed line loss at worst)

$G_{numeric}$ = $10^{(G/10)}$ = 63.10

S = 10 W/m^2 (1 mW/cm^2)

So, the safe distance is calculated as:

r = $\sqrt{\frac{90.36 * 63.10}{4 * p * 10}}$ =6.74 m

3.4 Final Conclusion

The equipment of CRFU-AWS should be used under the safety distance of at least 6.74m.