Maximum Permissible Exposure (MPE) Estimation for EC121

1   Introduction

HUAWEI EC121 CDMA 1X USB Stick is a subscriber equipment in the CDMA 1X system, Supporting 800 MHz frequency band. The USB Stick implements such functions as RF signal receiving / Transmitting, CDMA protocol processing, CDMA2000 protocol processing, high-rate packet data services etc. The USB Stick uses QSC6020 chipset and Zero-IF technologies.

2   Limits and Guidelines on Maximum Permissible Exposure Fields

According to the FCC Part 2.1091, we know: mobile device (transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters radiating structure(s) and the body of the user or nearby persons). And the Cellular radiotelephone service is subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.

The maximum radiated power of Cellular measured for the EC121 is 0.277W, (see FCC test report), so the EC121 is excluded from routine environmental evaluation for RF exposure according to the requirement of FCC Part 2.1091. The present document is given just only for reference.

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 C95.1-1999). 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/cm2)
0.003-0.1	614	163	(100)*
0.1-3.0	614	16.3/f	(100)*
3.0-30	1842/f	16.3/f	(900/f2)*
30-100	61.4	16.3/f	1.0
100-300	61.4	0.163	1.0
300-3000	--	--	f/300
3000-15,000	--	--	10
15,000-100,000	--	--	10

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/cm2)
0.003-0.1	614	163	(100)*
0.1-1.34	614	16.3/f	(100)*
1.34-3.0	823.8/f	16.3/f	(180/f2)*
3.0-30	823.8/f	16.3/f	((180/f2)*
30-100	27.5	158.3 / f	0.2
100-300	27.5	0.0729	0.2
300-3000	--	--	f/1500
3000-15,000	--	--	f/1500
15,000-100,000	--	--	10

For Cellular (TX: 824MHz – 849MHz),

Power density S [mW/cm2] for controlled area at 824 MHz

$$S = \frac{f(MHz)}{300} = \frac{824}{300} = 2.75 \text{ mW/cm}^2$$

Power density S [mW/cm2] for uncontrolled area at 824 MHz

$$S = \frac{f(MHz)}{1500} = \frac{824}{1500} = 0.55 \text{ mW/cm}^2$$

S= 0.55 mW/ cm2 = 5.5 W/m2 for uncontrolled exposure

Reference levels are provided for exposure assessment to determine whether the basic restrictions on exposure of humans to electromagnetic fields are exceeded. The basic restrictions on exposure to electromagnetic fields are based directly on established health effects and biological considerations.

3 Location of EUT

The EUT uses one monopole antenna. The source of the radiation is mounted on terminal; generally the direction of the antenna position is uprightness tabletop. The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

4 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.

4.1 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.

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

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

4.2 Technical Description EC121

Technical Specification:

Output power (measured maximum):	24.42 dBm for Cellular
Transmitter frequency band	Cellular; PCS
Number of antenna ports:	1
Frequency range:	Cellular 850M： Uplink:824 M~849M； Downlink:869 M~894M
Gain:	<1dBi (Cellular)
Mechanical specification (Height)	19.2mm for Cellular

4.3 Estimation of compliance boundary for indoor antenna

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 should be rather more conservative and on the safe side. For EUT the following compliance boundary is calculated:

Cellular:
Power at antenna connector BTS: 24.42 dBm(0.277W)
Antenna-cable attenuation: 0 dB
Input power to antenna: 24 .42dBm (0.277W)
Antenna gain: 1 dBi (1.26)

Compliance boundary
For Cellular band:
When r=20cm

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

$$S = \frac{0.277 * 1.26}{4 * 0.2^2 * \pi} = 0.69 \text{ W/m}^2 < 5.66 \text{ W/m}^2$$

Conslusion

The S at the position which is 20cm far from the EUT is smaller than the uncontrolled exposure limit line. So the EUT also complies with the Limits for Occupational/Controlled Exposure.