EMF Exposure Estimation for K2540/EG162G

1   Introduction

HUAWEI EG162G EDGE/GPRS/GSM DUALMODE 4BAND USB STICK is subscriber equipment in the GSM system. The GSM/GPRS/EDGE frequency band includes GSM850, EGSM900, DCS1800 and PCS1900, EG162G implements such functions as RF signal receiving/transmitting, EDGE/GPRS/GSM protocol processing, data service etc. Externally it provides USB interface (to connect to the notebook etc.), USIM card interface and antenna interface.

K2540 is the model name for Vodafone. Between these K2540 and EG162G, the PCB and antenna are all the same, the differences are:

1. Lens of EG162G is different from K2540.

2. Nameplate of EG162G is different from K2540.

3. There are 3 kinds of external color of EG162G, they are red, white and black. The external color of K2540 is only white.

2   Limits and Guidelines on Exposure to Electromagnetic 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 and PCS services are 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 radiated power of 850M/1900M for K2540/EG162G is 2W/1W, so for K2540/EG162G only the 850M band is need to be subjected to routine the environmental evaluation for RF 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 C95.1-1999). 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 / f1.668	0.2
100-300	27.5	0.0729	0.2
300-3000	--	--	f/1500
3000-15,000	--	--	f/1500
15,000-100,000	--	--	10

Power density S [mW/cm2] for controlled area at 850 MHz

$$S = \frac{f(MHz)}{300} = \frac{850}{300} = 2.83 \ \text{mW/cm}^2$$

Power density S [mW/cm2] for uncontrolled area at 850 MHz

$$S = \frac{f(MHz)}{1500} = \frac{850}{1500} = 0.566 \ \text{mW/cm}^2$$

S= 0.566 mW/ cm^2 = 5.66 W/m^2 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 K2540/EG162G

Technical Specification:

Output power:	2W (33 dBm) for GSM850MHz
Transmitter frequency band	GSM850
Number of antenna ports:	1
Frequency range:	850M Uplink:824 M~849M Downlink:869 M~894M
Gain:	<1dBi GSM850
Mechanical specification (Height)	19.2mm for GSM850

4.3   Estimation of compliance boundary for indoor antenna

GSM 850M:
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:

Power at antenna connector BTS: **33 dBm**

Antenna-cable attenuation: **0 dB**

Input power to antenna: **33 dBm (2W)**

Antenna gain: **1 dBi (1.26)**

Compliance boundary

For GSM 850MHz band:

When r=20cm

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

$$S = \frac{2 * 1.26}{4 * 0.2^2 * \pi} = 5.02 \text{W/m}^2 < 5.66 \text{ W/m}^2$$

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.