



# APPENDIX I RADIO FREQUENCY EXPOSURE

## LIMIT

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this chapter.

## EUT Specification

<b>EUT</b>	Computer
<b>Model</b>	TREK-520 ; TREK-520XXXXXXXXXXXXXXXXXX; TREK520XXXXXXXXXXXXXXXXXX (where "X" may be any alphanumeric character, "-", "_" or blank)
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> GSM 850MHz: 824.2MHz ~ 848.8MHz <input checked="" type="checkbox"/> GSM 1900MHz: 1850.2MHz ~ 1909.8MHz <input checked="" type="checkbox"/> WCDMA Band II: 1852.4MHz ~ 1907.6MHz <input checked="" type="checkbox"/> WCDMA Band IV: 1712.4MHz ~ 1752.6MHz <input checked="" type="checkbox"/> WCDMA Band V: 826.4MHz ~ 846.6MHz <input checked="" type="checkbox"/> Bluetooth 2.1 + EDR / 4.0: 2402 ~ 2480 MHz 802.11b/g/n HT20: 2.412GHz ~ 2.462GHz <input type="checkbox"/> Others
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others
<b>Exposure classification</b>	<input type="checkbox"/> Occupational/Controlled exposure (S = 5mW/cm <sup>2</sup> ) <input checked="" type="checkbox"/> General Population/Uncontrolled exposure (S=1mW/cm <sup>2</sup> )
<b>Antenna Specification</b>	GSM 850:                   Antenna Gain : 1.00 dBi (Numeric gain 1.26) GSM 1900:                 Antenna Gain : 2.50 dBi (Numeric gain 1.78) WCDMA Band II:         Antenna Gain : 2.50 dBi (Numeric gain 1.78) WCDMA Band IV:        Antenna Gain : 2.00 dBi (Numeric gain 1.58) WCDMA Band V:         Antenna Gain : 1.00 dBi (Numeric gain 1.26) 2.4GHz:                  Antenna1 Gain : -3.03 dBi (Numeric gain 0.50)



<b>Measurement Average output power</b>	<b>System</b>	<b>Power</b>	
	GSM850	32.50 dBm	(1778.28 mW)
	GPRS850_1Slot	32.80 dBm	(1905.46 mW)
	GPRS850_2Slot	32.30 dBm	(1698.24 mW)
	GPRS850_3Slot	31.70 dBm	(1479.11 mW)
	GPRS850_4Slot	30.60 dBm	(1148.15 mW)
	EDGE850_1Slot	27.40 dBm	(549.54 mW)
	EDGE850_2Slot	26.90 dBm	(489.78 mW)
	EDGE850_3Slot	26.20 dBm	(416.87 mW)
	EDGE850_4Slot	25.50 dBm	(354.81 mW)
	GSM1900	29.50 dBm	(891.25 mW)
	GPRS1900_1Slot	29.70 dBm	(933.25 mW)
	GPRS1900_2Slot	29.20 dBm	(831.76 mW)
	GPRS1900_3Slot	28.80 dBm	(758.58 mW)
	GPRS1900_4Slot	27.70 dBm	(588.84 mW)
	EDGE1900_1Slot	25.80 dBm	(380.19 mW)
	EDGE1900_2Slot	25.60 dBm	(363.08 mW)
	EDGE1900_3Slot	25.00 dBm	(316.23 mW)
	EDGE1900_4Slot	24.40 dBm	(275.42 mW)
	WCDMA Band II	23.85 dBm	(242.66 mW)
	WCDMA Band IV	23.54 dBm	(225.94 mW)
	WCDMA Band V	23.82 dBm	(240.99 mW)
	Bluetooth	7.50 dBm	(5.62 mW)
	IEEE 802.11b Mode	17.07 dBm	(50.93 mW)
IEEE 802.11g Mode	15.00 dBm	(31.62 mW)	
IEEE 802.11n HT 20 Mode	14.66 dBm	(29.24 mW)	



**Power Target /  
Tolerance**

<b>System</b>	<b>Target Power</b>	<b>Tolerance</b>
GSM850	32.5 dBm	-1 / +0.5 dB
GPRS850_1Slot	32.5 dBm	-1 / +0.5 dB
GPRS850_2Slot	32.5 dBm	-1 / +0.5 dB
GPRS850_3Slot	32.5 dBm	-1 / +0.5 dB
GPRS850_4Slot	32.5 dBm	-1 / +0.5 dB
EGPRS850_1Slot	27.5 dBm	-1 / +0.5 dB
EGPRS850_2Slot	27.5 dBm	-1 / +0.5 dB
EGPRS850_3Slot	27.5 dBm	-1 / +0.5 dB
EGPRS850_4Slot	27.5 dBm	-1 / +0.5 dB
GSM1900	29.5 dBm	-1 / +0.5 dB
GPRS1900_1Slot	29.5 dBm	-1 / +0.5 dB
GPRS1900_2Slot	29.5 dBm	-1 / +0.5 dB
GPRS1900_3Slot	29.5 dBm	-1 / +0.5 dB
GPRS1900_4Slot	29.5 dBm	-1 / +0.5 dB
EGPRS1900_1Slot	25.5 dBm	-1 / +0.5 dB
EGPRS1900_2Slot	25.5 dBm	-1 / +0.5 dB
EGPRS1900_3Slot	25.5 dBm	-1 / +0.5 dB
EGPRS1900_4Slot	25.5 dBm	-1 / +0.5 dB
WCDMA Band II	23.0 dBm	± 0.5 dB
WCDMA Band IV	23.0 dBm	± 0.5 dB
WCDMA Band V	23.0 dBm	± 0.5 dB
Bluetooth	6.0 dBm	± 1.5 dB
IEEE 802.11b Mode	16.0 dBm	± 1.5 dB
IEEE 802.11g Mode	13.5 dBm	± 1.5 dB
IEEE 802.11n HT 20 Mode	13.5 dBm	± 1.5 dB



	System	Max Tune up Power	Time Average Power
	<b>Max tune up Power / Max time Average Power</b>	GSM850	33.0dBm (1995.262mW)
GPRS850_1Slot		33.0dBm (1995.262mW)	24.0dBm (251.189mW)
GPRS850_2Slot		33.0dBm (1995.262mW)	27.0dBm (501.187mW)
GPRS850_3Slot		33.0dBm (1995.262mW)	28.7dBm (741.310mW)
GPRS850_4Slot		33.0dBm (1995.262mW)	30.0dBm (1000.000mW)
EGPRS850_1Slot		28.0dBm (630.957mW)	19.0dBm (79.433mW)
EGPRS850_2Slot		28.0dBm (630.957mW)	22.0dBm (158.489mW)
EGPRS850_3Slot		28.0dBm (630.957mW)	23.7dBm (234.423mW)
EGPRS850_4Slot		28.0dBm (630.957mW)	25.0dBm (316.228mW)
GSM1900		30.0dBm (1000.000mW)	21.0dBm (125.893mW)
GPRS1900_1Slot		30.0dBm (1000.000mW)	21.0dBm (125.893mW)
GPRS1900_2Slot		30.0dBm (1000.000mW)	24.0dBm (251.189mW)
GPRS1900_3Slot		30.0dBm (1000.000mW)	25.7dBm (371.535mW)
GPRS1900_4Slot		30.0dBm (1000.000mW)	27.0dBm (501.187mW)
EGPRS1900_1Slot		26.0dBm (398.107mW)	17.0dBm (50.119mW)
EGPRS1900_2Slot		26.0dBm (398.107mW)	20.0dBm (100.000mW)
EGPRS1900_3Slot		26.0dBm (398.107mW)	21.7dBm (147.911mW)
EGPRS1900_4Slot		26.0dBm (398.107mW)	23.0dBm (199.526mW)
WCDMA Band II		23.5dBm (223.872mW)	23.5dBm (223.872mW)
WCDMA Band IV		23.5dBm (223.872mW)	23.5dBm (223.872mW)
WCDMA Band V	23.5dBm (223.872mW)	23.5dBm (223.872mW)	
Bluetooth	7.5dBm (5.623mW)	7.5dBm (5.623mW)	
IEEE 802.11b	17.5dBm (56.234mW)	17.5dBm (56.234mW)	
IEEE 802.11g	15.0dBm (31.623mW)	15.0dBm (31.623mW)	
IEEE 802.11n HT 20	15.0dBm (31.623mW)	15.0dBm (31.623mW)	
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation* <input type="checkbox"/> SAR Evaluation <input type="checkbox"/> N/A		



### Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	2014/05/23	Initial Issue	ALL	Scott Hsu
01	2014/07/16	Add other slot for GPRS and EGPRS, Bluetooth.	2,3,4,7,8,9,10	Scott Hsu
02	2014/08/29	Revise Power Target/Tolerance, Max tune up Power, WCDMA Band V Limit. Remove 802.11n HT40 power.	2,3,4,8	Scott Hsu



## **TEST RESULTS**

**No non-compliance noted.**

### **Calculation**

Given  $E = \frac{\sqrt{30 \times P \times G}}{d}$  &  $S = \frac{E^2}{377}$

Where  $E =$  Field strength in Volts / meter

$P =$  Power in Watts

$G =$  Numeric antenna gain

$d =$  Distance in meters

$S =$  Power density in milliwatts / square centimeter

Combining equations and re-arranging the terms to express the distance as a function of the remaining variables yields:

$$S = \frac{30 \times P \times G}{377d^2}$$

Changing to units of mW and cm, using:

$$P \text{ (mW)} = P \text{ (W)} / 1000 \text{ and}$$

$$d \text{ (cm)} = d \text{ (m)} / 100$$

Yields

$$S = \frac{30 \times (P/1000) \times G}{377 \times (d/100)^2} = 0.0796 \times \frac{P \times G}{d^2} \quad \text{Equation 1}$$

Where  $d =$  Distance in cm

$P =$  Power in mW

$G =$  Numeric antenna gain

$S =$  Power density in mW / cm<sup>2</sup>



**Maximum Permissible Exposure**

Substituting the MPE safe distance using  $d = 20$  cm into Equation 1:

$$S = 0.000199 \times P \times G$$

Where  $P =$  Power in mW

$G =$  Numeric antenna gain

$S =$  Power density in mW / cm<sup>2</sup>

**GSM850 mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
190	836.6	251.189	1.26	20	0.0630	0.558

**GPRS850\_1Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
190	836.6	251.189	1.26	20	0.0630	0.558

**GPRS850\_2Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
190	836.6	501.187	1.26	20	0.1257	0.558

**GPRS850\_3Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
190	836.6	741.310	1.26	20	0.1859	0.558

**GPRS850\_4Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
190	836.6	1000.000	1.26	20	0.2507	0.558

**EGPRS850\_1Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
251	848.8	79.433	1.26	20	0.0199	0.566

**EGPRS850\_2Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
251	848.8	158.489	1.26	20	0.0397	0.566

**EGPRS850\_3Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
251	848.8	234.423	1.26	20	0.0588	0.566

**EGPRS850\_4Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
251	848.8	316.228	1.26	20	0.0793	0.566



**GSM1900 mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	125.893	1.78	20	0.0446	1.000

**GPRS1900\_1Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	125.893	1.78	20	0.0446	1.000

**GPRS1900\_2Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	251.189	1.78	20	0.0890	1.000

**GPRS1900\_3Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	371.535	1.78	20	0.1316	1.000

**GPRS1900\_4Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	501.187	1.78	20	0.1775	1.000

**EGPRS1900\_1Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	50.119	1.78	20	0.0178	1.000

**EGPRS1900\_2Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	100.000	1.78	20	0.0354	1.000

**EGPRS1900\_3Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	147.911	1.78	20	0.0524	1.000

**EGPRS1900\_4Slot mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
810	1909.8	199.526	1.78	20	0.0707	1.000

**WCDMA Band II mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
9262	1852.4	223.872	1.78	20	0.0793	1.000

**WCDMA Band IV mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
1427	1735.4	223.872	1.58	20	0.0704	1.000

**WCDMA Band V mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm <sup>2</sup> )
4132	826.4	223.872	1.26	20	0.0561	0.551





**Bluetooth:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm2)
39	2441	5.263	0.5	20	0.0005	1

**IEEE 802.11b mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm2)
11	2462	56.234	0.5	20	0.0056	1

**IEEE 802.11g mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm2)
6	2437	31.623	0.5	20	0.0031	1

**IEEE 802.11n HT20 mode:**

Ch.	Frq.(MHz)	P (mW)	Gain (num.)	D (cm)	Power density in mW / cm <sup>2</sup>	Limit (mW/cm2)
6	2437	31.623	0.5	20	0.0031	1



**Simultaneously MPE**

Simultaneously MPE = MPE1/Limit1 + MPE2/Limit2

**2G + WiFi**

$$\text{Simultaneously MPE} = (0.2507 \text{ mW/cm}^2 / 0.558) + (0.0056 \text{ mW/cm}^2 / 1) = 0.2563$$

**3G + WiFi**

$$\text{Simultaneously MPE} = (0.0890 \text{ mW/cm}^2 / 1) + (0.0056 \text{ mW/cm}^2 / 1) = 0.0946$$