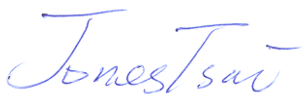
RF Exposure Evaluation Report

APPLICANT	**:**	**Advantech Co., Ltd.**
EQUIPMENT	**:**	**computer**
BRAND NAME	**:**	**Advantech**
MODEL NAME	**:**	**TREK-722, TREK-723**
FCC ID	**:**	**M82-TREK-72X-HB**
FILING TYPE	**:**	**Certification**
STANDARD	**:**	**OET Bulletin 65 Supplement C (Edition 01-01)**

We, SPORTON INTERNATIONAL INC., would like to declare that the device has been evaluated in accordance with FCC OET Bulletin 65 Supplement C (Edition 01-01), and pass the limit. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:



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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA291425	Rev. 01	Initial issue of report	Jan. 08, 2013
FA291425	Rev. 02	1. Update report ,The model TREK-722 and TREK-723 under this FCC ID, hardware are electronically identical; the main difference between these two models is the size of the LCD display (TREK-722: 5" and TREK-723: 7") 2. Update the power used in MPE calucation with maximum average power according to tune-up consideration, and update the test result of minimum separation distance accordingly.	Jan. 15, 2013

1. Administration Data

1.1. Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

1.2. Applicant

Company Name	Advantech Co., Ltd.
Address	No. 1, Alley 20, Lane 26, Rueiguang Road NeiHu District, Taipei 114, R.O.C.

1.3. Manufacturer

Company Name	Advantech Co., Ltd.
Address	No. 1, Alley 20, Lane 26, Rueiguang Road NeiHu District,Taipei 114, R.O.C.

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	computer
Brand Name	Advantech
Model Name	TREK-722, TREK-723
FCC ID	M82-TREK-72X-HB
Sample 1	TREK-722
Sample 2	TREK-723
Tx Frequency	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Antenna Type	WWAN: PCB Antenna Bluetooth: PCB Antenna
HW Version	PCM-8405 A101-3
SW Version	02.02.56
Uplink Modulation	GPRS: GMSK EDGE: GMSK / 8PSK WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK Bluetooth: GFSK Bluetooth +EDR: π/4-DQPSK / 8-DPSK
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. The models TREK-722 and TREK-723 under this FCC ID are hardware electronically identical. The main difference between these two models is the size of the LCD display (TREK-722: 5" and TREK-723: 7")

3. RF Exposure Limit Introduction

The FCC categorizes the RF exposure limit based on the intended usage of the device and the user's awareness and ability to exercise control over his or her exposure. This is a consumer product to be used in the home, hence this device was evaluated by mobile device with general population/uncontrolled exposure condition. The definition of these category are shown as follows:

▪ **Mobile Devices:**

A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to be generally used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters' radiating structures and the body of the user or nearby persons. Transmitters designed to be used by consumers or workers that can be easily re-located are considered mobile devices if they meet the 20 centimeter separation requirement. The FCC rules for evaluating mobile devices for RF compliance are found in 47 CFR 2.1091.

▪ **General Population/Uncontrolled Exposure:**

The general population / uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity. Warning labels placed on low-power consumer devices such as cellular telephones are not considered sufficient to allow the device to be considered under the occupational/controlled category and the general population/uncontrolled exposure limits apply to these devices.

Per OET Bulletin 65, the power density limit for General Population/Uncontrolled Exposure summary here:

Table: Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Power Density (S) (mW/cm2)
0.3–1.34	*(100)
1.34–30	*(180/f^2)
30–300	0.2
300–1500	f/1500
1500–100,000	1.0

f = frequency in MHz

* = Plane-wave equivalent power density

4. Conducted RF Output Power (Unit: dBm)

<GSM Conducted Power>

Burst Average Power (dBm)						
Band	**GSM850**			**GSM1900**		
Channel	**128**	**189**	**251**	**512**	**661**	**810**
Frequency (MHz)	**824.2**	**836.4**	**848.8**	**1850.2**	**1880.0**	**1909.8**
GPRS (GMSK, 1 Tx slot) – CS1	**32.83**	32.65	32.77	29.33	29.20	**29.67**
GPRS (GMSK, 2 Tx slots) – CS1	29.78	29.75	29.82	26.09	25.99	26.09
EDGE (GMSK, 1 Tx slot) – MCS1	32.77	32.60	32.72	29.20	29.11	29.59
EDGE (GMSK, 2 Tx slots) – MCS1	29.68	29.65	29.74	25.98	25.02	25.58
EDGE (8PSK, 1 Tx slot) – MCS5	26.80	26.71	26.62	25.12	24.93	25.03
EDGE (8PSK, 2 Tx slots) – MCS5	23.73	23.63	23.53	22.09	21.89	21.97
Frame-Average Power (dBm)						
Band	**GSM850**			**GSM1900**		
Channel	**128**	**189**	**251**	**512**	**661**	**810**
Frequency (MHz)	**824.2**	**836.4**	**848.8**	**1850.2**	**1880.0**	**1909.8**
GPRS (GMSK, 1 Tx slot) – CS1	23.83	23.65	23.77	20.33	20.20	20.67
GPRS (GMSK, 2 Tx slots) – CS1	23.78	23.75	23.82	20.09	19.99	20.09
EDGE (GMSK, 1 Tx slot) – MCS1	23.77	23.60	23.72	20.20	20.11	20.59
EDGE (GMSK, 2 Tx slots) – MCS1	23.68	23.65	23.74	19.98	19.02	19.58
EDGE (8PSK, 1 Tx slot) – MCS5	17.80	17.71	17.62	16.12	15.93	16.03
EDGE (8PSK, 2 Tx slots) – MCS5	17.73	17.63	17.53	16.09	15.89	15.97

Remark: The source-based time-averaged power is linearly scaled the maximum burst averaged power based on time slots. The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

<WCDMA Conducted Power >

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

WCDMA Setup Configuration:

a. The EUT was connected to Base Station referred to the drawing of Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting
   i. Data rates: Varied from RMC 12.2Kbps
   ii. RMC Test Loop = Loop Mode 1
   iii. Power Ctrl Mode = All Up bits
d. The transmitted maximum output power was recorded.

HSDPA Setup Configuration:

a. The EUT was connected to Base Station referred to the drawing of Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting:
   i. Set Gain Factors (β_c and β_d) and parameters were set according to each
   ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
   iii. Set RMC 12.2Kbps + HSDPA mode.
   iv. Set Cell Power = -86 dBm
   v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
   vi. Select HSDPA Uplink Parameters
   vii. Set Delta ACK, Delta NACK and Delta CQI = 8
   viii. Set Ack-Nack Repetition Factor to 3
   ix. Set CQI Feedback Cycle (k) to 4 ms
   x. Set CQI Repetition Factor to 2
   xi. Power Ctrl Mode = All Up bits
d. The transmitted maximum output power was recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d *(SF)*	β_c/β_d	β_{HS} *(Note1, Note 2)*	CM (dB) *(Note 3)*	MPR (dB) *(Note 3)*
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 *(Note 4)*	15/15 *(Note 4)*	64	12/15 *(Note 4)*	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with β_{hs} = 30/15 * β_c , and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_c .

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

Setup Configuration

HSUPA Setup Configuration:

a. The EUT was connected to Base Station referred to the drawing of Setup Configuration.
b. The RF path losses were compensated into the measurements.
c. A call was established between EUT and Base Station with following setting * :
   i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
   ii. Set the Gain Factors (β_c and β_d) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
   iii. Set Cell Power = -86 dBm
   iv. Set Channel Type = 12.2k + HSPA
   v. Set UE Target Power
   vi. Power Ctrl Mode= Alternating bits
   vii. Set and observe the E-TFCI
   viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
d. The transmitted maximum output power was recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1)	β_{ec}	β_{ed} (Note 5) (Note 6)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed}1$: 47/15 $\beta_{ed}2$: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .
Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.
Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.
Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.
Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.
Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

Setup Configuration

WCDMA Average Power (dBm)										
Band		WCDMA Band V			WCDMA Band II			WCDMA Band IV		
Channel		4132	4182	4233	9262	9400	9538	1312	1413	1513
Frequency (MHz)		826.4	836.4	846.6	1852.4	1880.0	1907.6	1712.4	1732.6	1752.6
3GPP Rel 99	RMC 12.2K	24.03	**24.10**	23.59	**24.44**	23.76	24.32	23.83	24.25	**24.30**
3GPP Rel 6	HSDPA Subtest-1	23.61	23.85	23.55	24.35	23.65	24.23	23.71	24.00	23.87
3GPP Rel 6	HSDPA Subtest-2	23.77	24.02	23.88	24.38	23.87	24.30	24.07	24.17	24.20
3GPP Rel 6	HSDPA Subtest-3	23.32	23.57	23.31	23.88	23.39	23.81	23.60	23.70	23.67
3GPP Rel 6	HSDPA Subtest-4	23.40	23.55	23.30	23.91	23.44	23.83	23.45	23.76	23.61
3GPP Rel 6	HSUPA Subtest-1	23.50	23.55	23.23	23.60	23.41	23.56	23.36	23.96	24.18
3GPP Rel 6	HSUPA Subtest-2	22.30	22.45	21.95	22.87	22.43	22.76	22.57	22.60	22.73
3GPP Rel 6	HSUPA Subtest-3	22.61	22.84	22.57	22.96	22.08	22.72	21.89	21.91	22.03
3GPP Rel 6	HSUPA Subtest-4	22.67	22.83	22.30	22.87	22.59	22.82	22.71	22.88	22.91
3GPP Rel 6	HSUPA Subtest-5	23.61	23.72	23.48	24.03	23.60	23.95	23.79	23.92	23.96

<Bluetooth Conducted Power>

Channel	Frequency (MHz)	Average power (dBm)		
		Mode		
		GFSK	π/4-DQPSK	8-DPSK
CH 0	2402	-0.06	-3.12	-3.20
CH 39	2441	**1.34**	-2.02	-2.04
CH 78	2480	-2.08	-5.76	-5.85

5. Radio Frequency Radiation Exposure Evaluation

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna (i.e., 20 cm for this product)

For this device, the calculation is as follows:

WWAN Operating frequency ≤ 1.5GHz

Function	Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Source-Based Time-Average Power (dBm)	Source-Based Time-Average Power (mW)	Source-Based Time-Average EIRP (mW)	Source-Based Time-Average ERP (mW)	Calculated RF Exposure (mW/cm^2)	Limit (mW/cm^2)
GPRS 850 (1 Tx slot)	824.20	4.62	2.90	24	251.19	727.78	443.61	0.14	0.55
GPRS 850 (2 Tx slots)	848.80	4.62	2.90	24	251.19	727.78	443.61	0.14	0.57
WCDMA Band 5	836.40	4.62	2.90	24.5	281.84	816.58	497.74	0.16	0.56

WWAN Operating frequency > 1.5GHz

Function	Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Source-Based Time-Average Power (dBm)	Source-Based Time-Average Power (mW)	Source-Based Time-Average EIRP (mW)	Calculated RF Exposure (mW/cm^2)	Limit (mW/cm^2)
GPRS 1900 (1 Tx slot)	1909.80	2.69	1.86	21	125.89	233.88	0.05	1.00
GPRS 1900 (2 Tx slots)	1909.80	2.69	1.86	21	125.89	233.88	0.05	1.00
WCDMA Band 2	1852.40	2.69	1.86	24.5	281.84	523.60	0.10	1.00
WCDMA Band 4	1752.60	2.69	1.86	24.5	281.84	523.60	0.10	1.00

Bluetooth Operating Frequency > 1.5GHz

Function	Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	Source-Based Time-Average Power (dBm)	Source-Based Time-Average Power (mW)	Source-Based Time-Average EIRP (mW)	Calculated RF Exposure (mW/cm^2)	Limit (mW/cm^2)
Bluetooth	2441.00	1.22	1.32	1.34	1.36	1.80	0.00	1.00

Conclusion:

Per part 2.1091(c), EUT source-based time-averaged ERP < 1.5W for RF operating frequency ≤ 1.5GHz, EUT source-based time-averaged EIRP < 3W for RF operating frequency > 1.5GHz, routine evaluation of MPE is not required; MPE calculation is sufficient to show compliance. The MPE calculation results indicate that the EUT complies with the RF exposure limit of FCC OET Bulletin 65 Supplement C (Edition 01-01).