# RF Exposure

The applying equipment is a standard fullsize laptop computer which is categorized as a mobile device by FCC CFR 47 Section 2.1091.   Therefore the separation distance between the antenna and the human body is 20cm or more.   As shown in the following photos, the applying equipment satisfies the requirement of antenna separation.

1. IBM ThinkPad 802.11b Wireless LAN Mini-PCI Adapter

> The separation distance between the antenna and the human body is 36cm or longer.
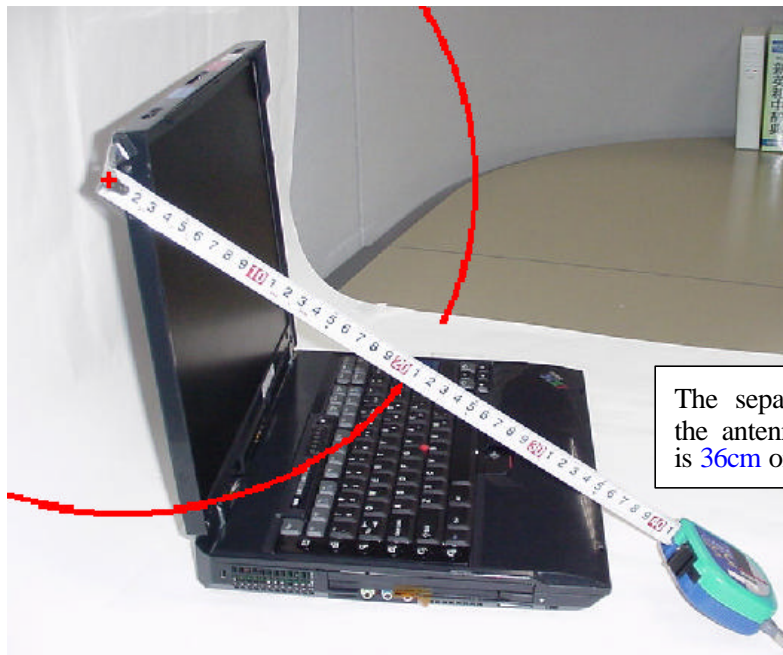
The peak conducted output power of the IEEE802.11b Wireless LAN Adapter is 15.7dBm and the maximum antenna gain is 1.35dBi as shown below.

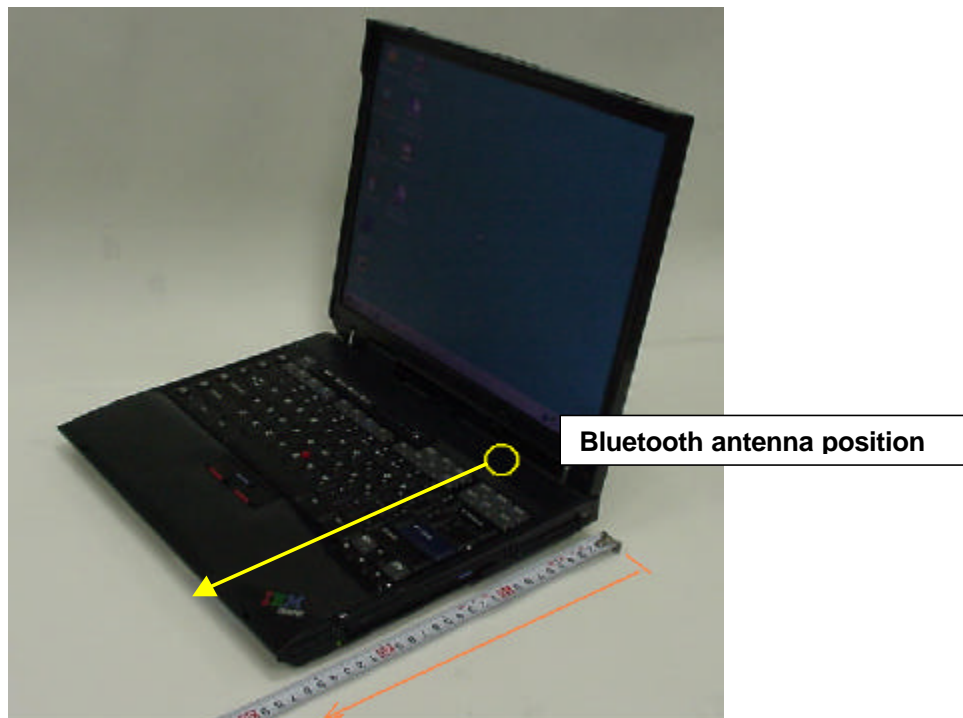Fifure A: Antenna Gain of IEEE802.11b Wireless LAN Adapter
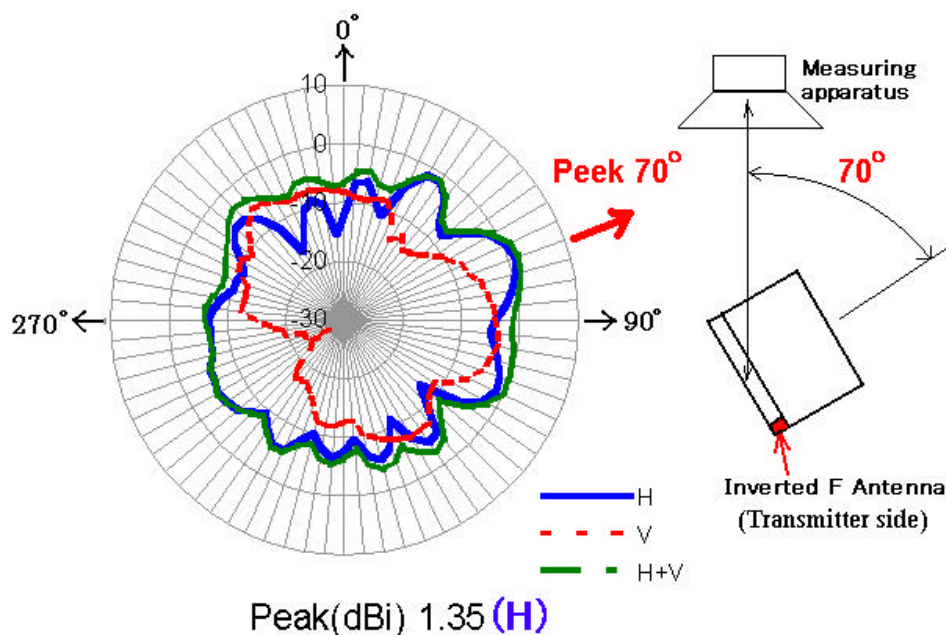
Therefore the peak radiated output power(EIRP) is calculated as follows.

$$EIRP = P + G = 15.7 \text{ dBm} + 1.35 \text{ dBi} = 17.05 \text{ dBm (50.7 mW)}$$

Then, the maximum power density at 20cm distance is calculated as :

$$S_1 = EIRP/(4 \times R^2 \times \pi) = 0.010 \text{ mW/cm}^2$$

2. IBM Bluetooth Daughter Card

Bluetooth antenna position

The separation distance between the antenna and the human body is 26cm or longer.

The peak conducted output power of the Bluetooth Daughter Card is 2.4 dBm and the maximum antenna gain is 0.28dBi as shown in the Figure B.
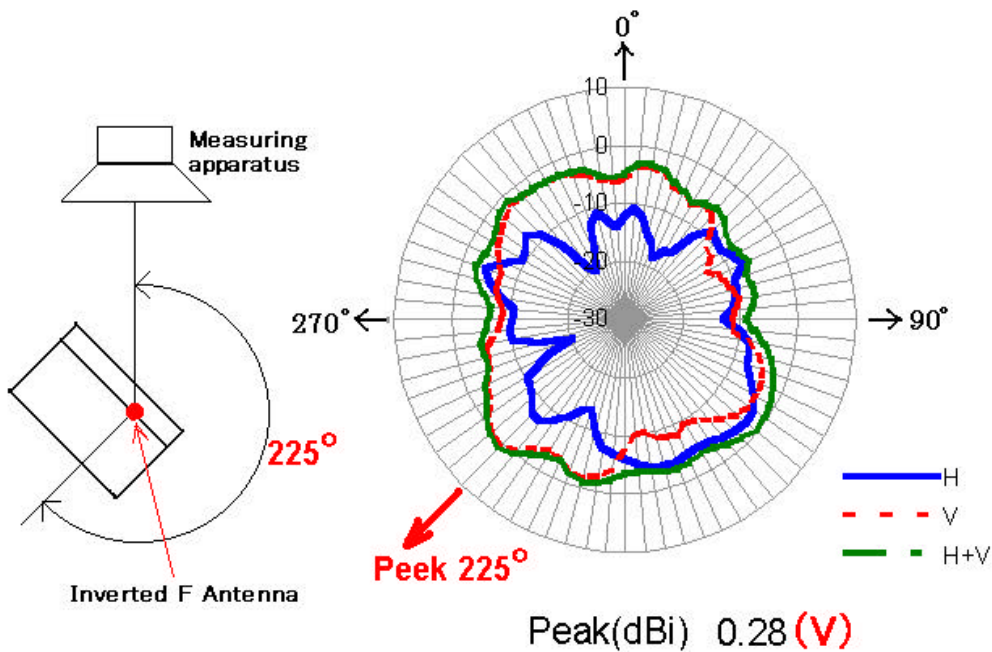
Therefore the peak radiated output power(EIRP) is calculated as follows.

$$EIRP = P + G = 2.4 \text{ dBm} + 0.28 \text{ dBi} = 2.68 \text{ dBm (1.86 mW)}$$

Then, the maximum power density at 20cm distance is calculated as :

$$S_2 = EIRP/(4 \times R^2 \times \pi) = 0.00037 \text{ mW/cm}^2$$

Fifure B: Antenna Gain of Bluetooth Daughter Card

Peak(dBi) 0.28 (V)

3. User option Wireless cards

The applying equipment has two interfaces to connect user's option wireless cards. The following wireless cards are used in the PC slot or USB port of the equipment.

FCC ID   :   **PI4BT-ULTRA**
Grantee Name :   **TDK Systems Europe Ltd.**
Product Name   :   **Bluetooth Ultraport Module**
EIRP in FCC test report : **1.4 mW**
Granted Date   :   **May/22/2001**

FCC ID   :   **O2OBTPCM101**
Grantee Name :   **Deigianswer A/S**
Product Name :   **Motorola Bluetooth 0dBm PC-Card**
                            (type no.: BTPCM100)
EIRP in FCC test report :   **2.7mW**
Granted Date :   **October/18/2000**

FCC ID   :   **PI4BT-IBM-PCII**
Grantee Name :   **TDK Systems Europe Ltd.**
Product Name :   **Bluetooth PC Card II**
EIRP in FCC test report :   **1.0mW**
Granted Date :   **August/21/2001**

The separation distance between the antenna and the human body is longer than 20cm.

The minimum antenna separation to satisfy the MPE limits ($1mW/cm^2$) and the maximum power density at 20cm distance of each card are :

Interface	FCC ID	EIRP	Min. separation to satisfy the MPE limits *1	Max. power density at 20cm *2
USB port	**PI4BT-ULTRA**	1.4mW	0.34cm	$S_3 = 0.00028$ mW/cm^2
PCMCIA slot	**O2OBTPCM101**	2.7mW	0.47cm	$S_4 = 0.00054$ mW/cm^2
	PI4BT-IBM-PCII	1.0mW	0.28cm	$S_5 = 0.00020$ mW/cm^2

$$*1 = \sqrt{EIRP / (1mW/cm^2 \times 4 \times \pi)}$$
$$*2 = EIRP/(4 \times 20cm^2 \times \pi)$$

When an operator will use the four transmitters simultaneously during 30 minutes continuously in normal operation, the time-averaging exposure is : $(S_1 + S_2 + S_3 + S_4) \times 30 = 0.34$
So the source-based time-averaging duty factor is considered as 100% duty.

Therefore the applying equipment meets the MPE requirements for general Population/ Uncontrolled exposure.