

1. RF Exposure Evaluation for ThinkPad R32

a) Built_in Antenna Gains of ThinkPad R32

Figure A: Main Antenna Gain

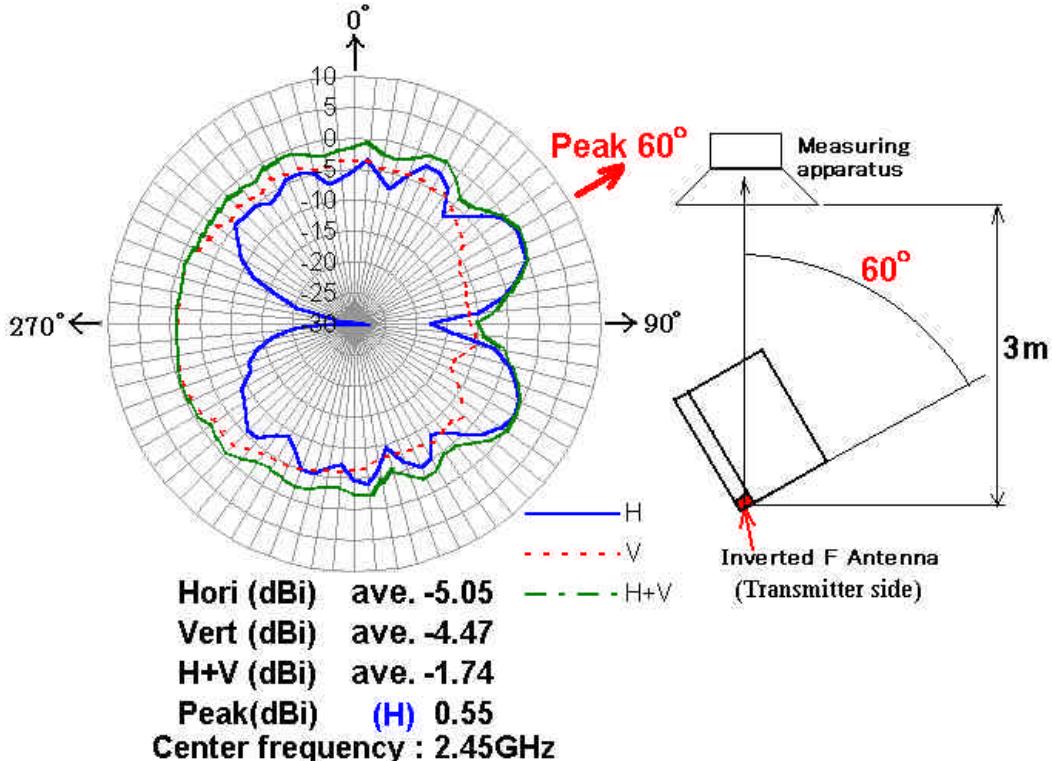
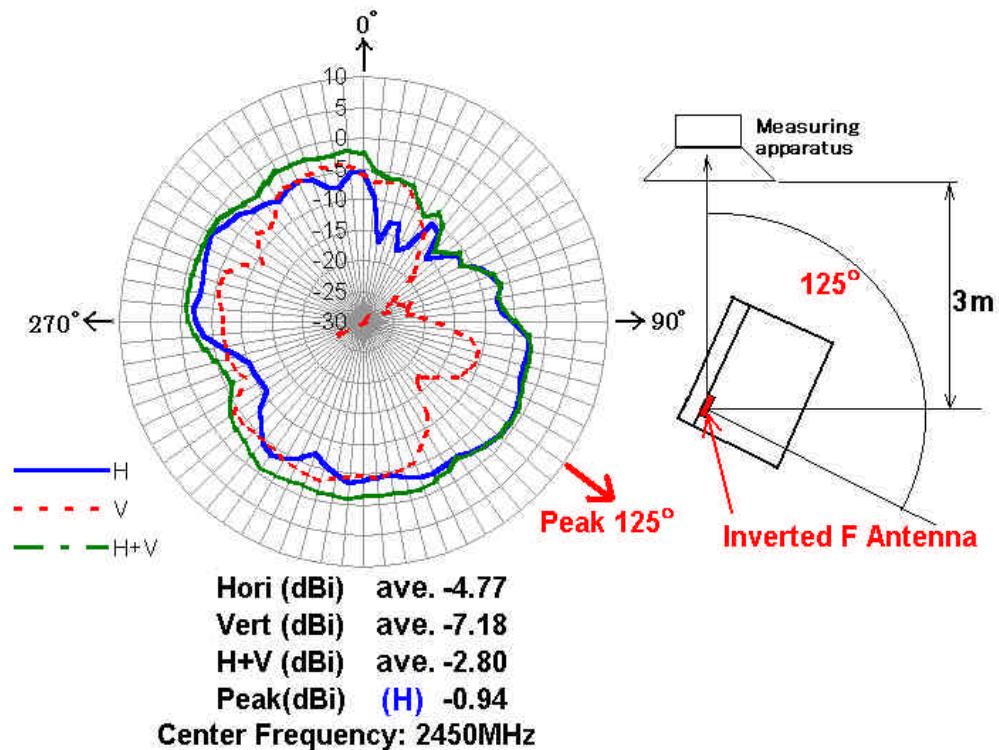


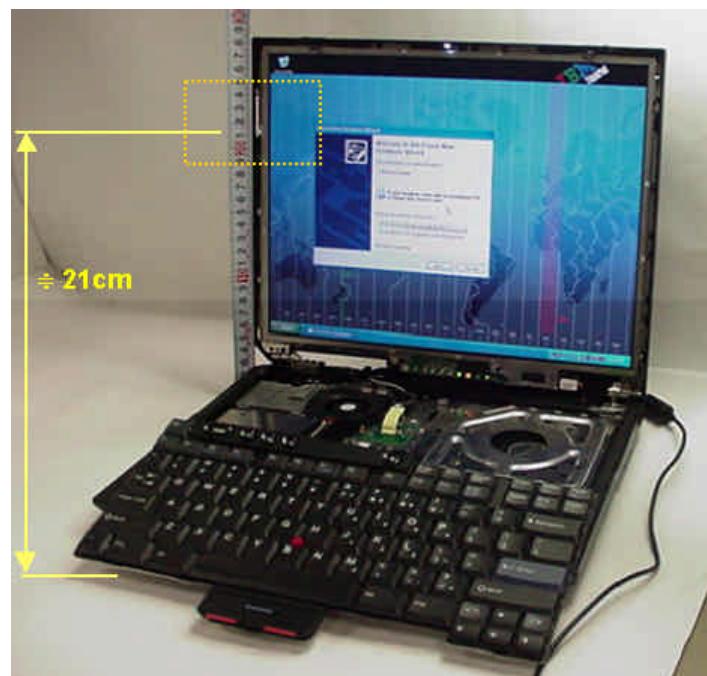
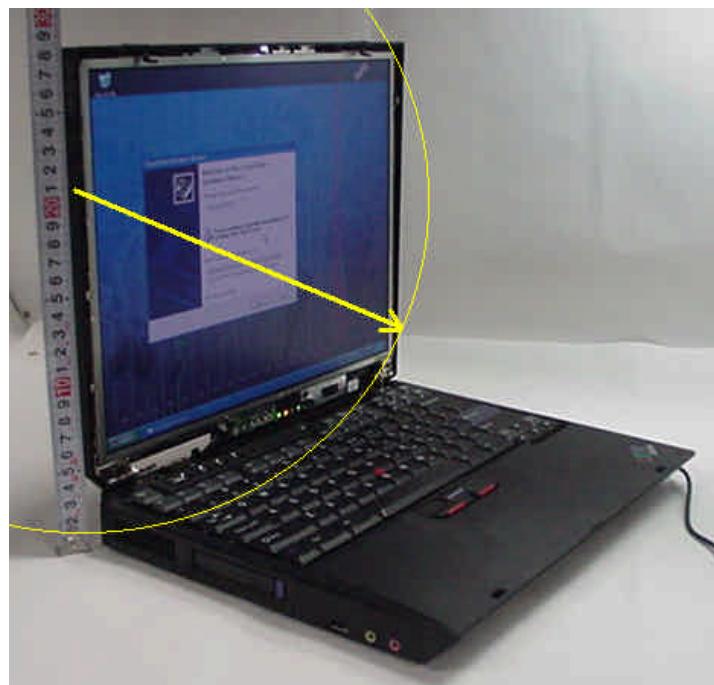
Figure B: Auxiliary Antenna Gain



b) RF Exposure evaluation with the R32 Main antenna

The applying equipment is a standard size laptop computer. The separation distance between the main antenna built in the LCD section and the person's body is 21cm or more. So the applying transmitter with the main antenna is categorized as a mobile device by FCC CFR 47 section 2.1091

[Figure C. Separation distance of the main antenna from human body](#)



The separation distance between the antenna and the human body is **21cm** or more.

The conducted peak output power of the IEEE802.11b Wireless LAN Adapter is 19.9 dBm and the maximum antenna gain is 0.55dBi as shown in the Figure A.

Therefore the peak radiated output power(EIRP) is calculated as follows.

$$\text{EIRP} = P + G = 19.9 \text{ dBm} + 0.55 \text{ dBi} = 20.45 \text{ dBm (110.92 mW)}$$

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

$$S_1 = \text{EIRP}/(4 \times R^2 \times \pi) = 0.022 \text{ mW/cm}^2$$

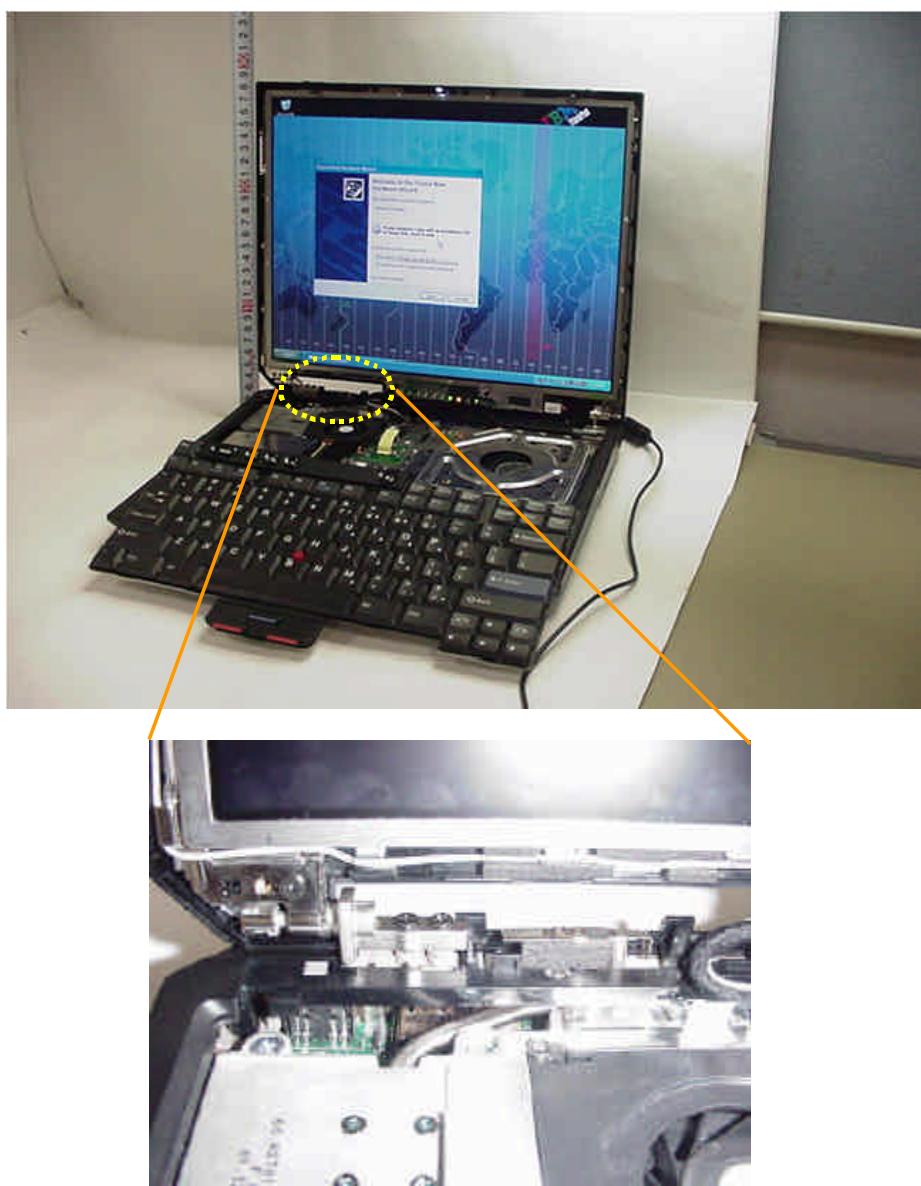
When an operator will use the transmitter during 30 minutes continuously in normal operation, the time-averaging of exposure is : $S_1 \times 30 = 0.66 < (1\text{mW/cm}^2) \times 30$
So the source-based time-averaging duty factor is considered as 100% duty.

c) RF Exposure evaluation with the R32 Auxiliary antenna

The RF exposure energy from the auxiliary antenna in the hinge location meets the limit of SAR compliance according FCC CFR 47 section 2.1093. Please refer the measurement result of the separated SAR test report (**R32 Series – IDX SAR.pdf**).

Therefore the applying transmitter and both built-in antennas of ThinkPad R32 Series conform to the RF Exposure requirement.

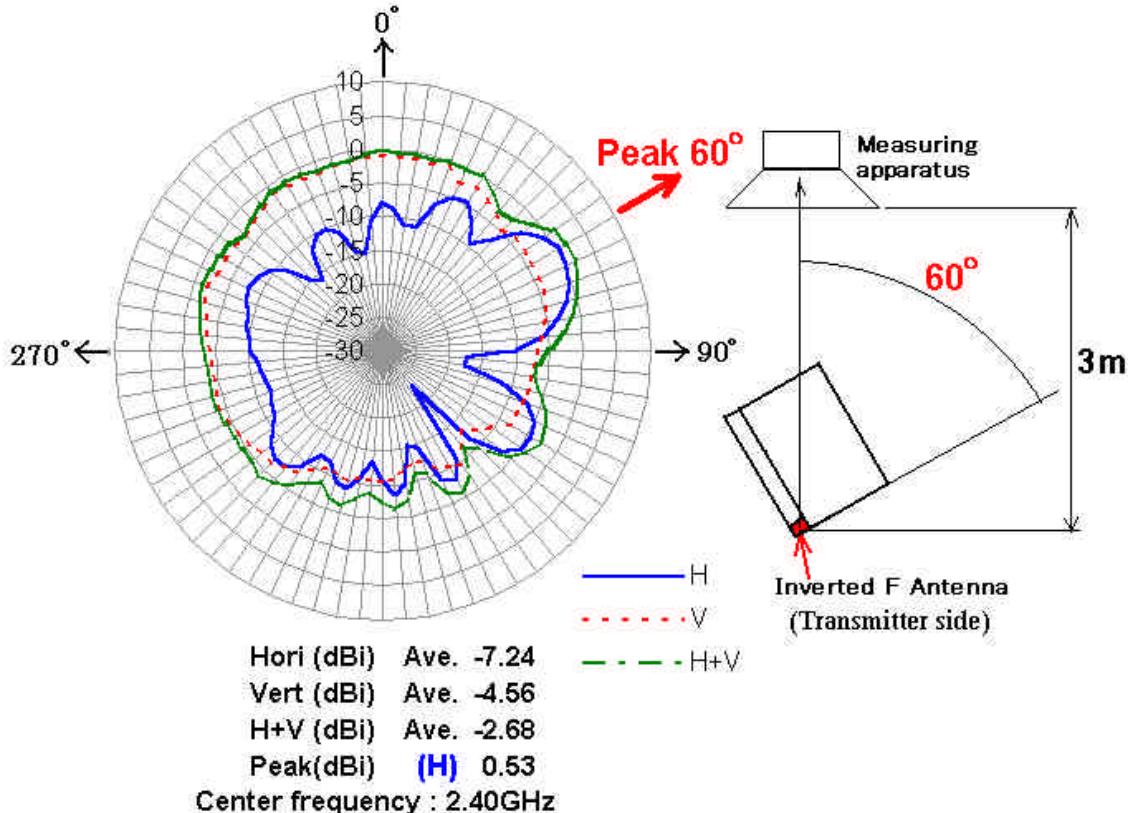
[Figure D. The auxiliary antenna location](#)



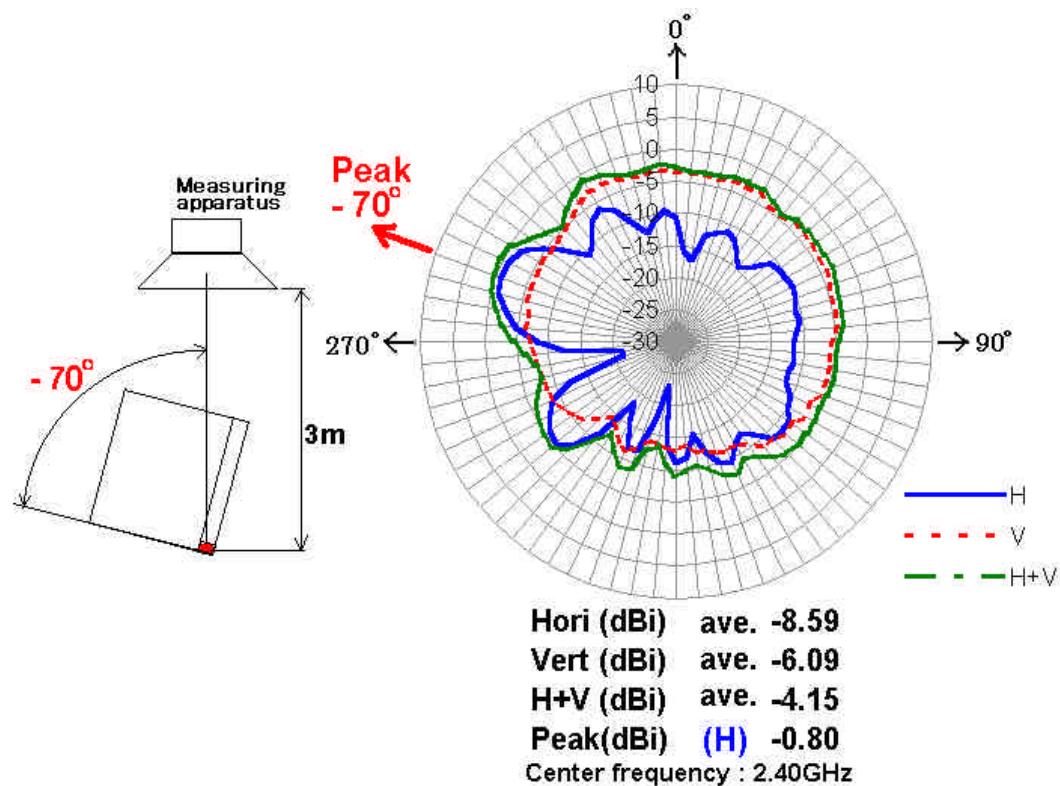
2. RF Exposure Evaluation for ThinkPad T30

a) Built_in Antenna Gains of ThinkPad T30

[Figure E: Main Antenna Gain](#)

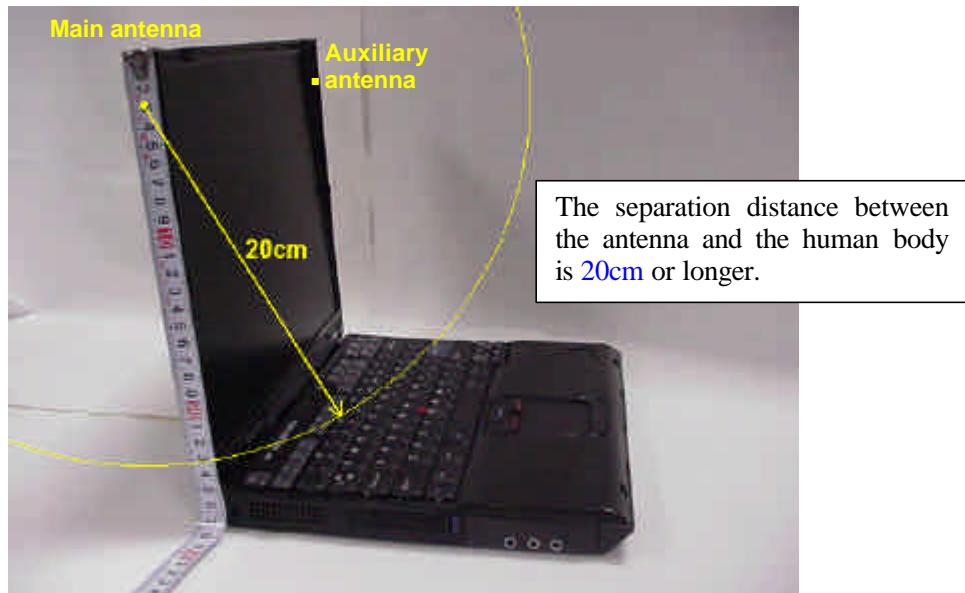


[Figure F: Auxiliary Antenna Gain](#)



b) RF Exposure evaluation with the T30 antennas

As shown in the following photos, the WLAN's antenna positions of IBM ThinkPad T30 Series are located at the top of display (LCD) bezel for both the main and auxiliary antennas. The separation distances between the antennas and the human body are 20cm or more. Therefore the equipment of this configuration can be categorized as a mobile device by FCC CFR 47 Section 2.1091.



The highest conducted peak output power of the Test Report is 93.3mW(19.7dBm) and the maximum antenna gain is 0.53dBi. (See the previous Figure E.)

Therefore the peak radiated output power(EIRP) is calculated as follows.

$$\text{EIRP} = P + G = 19.7 \text{ dBm} + 0.53 \text{ dBi} = 20.23 \text{ dBm (105.44 mW)}$$

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

$$S = \text{EIRP}/(4 \times R^2 \times \pi) = 0.021 \text{ mW/cm}^2$$

Since the applying WLAN transmitter does not function to emit the radio frequency from the both diversity antennas simultaneously, the above value is the maximum RF exposure to the persons.

When an operator will use the transmitter during 30 minutes continuously in normal operation, the time-averaging of exposure is : $S \times 30 = 0.63 < (1\text{mW/cm}^2) \times 30$

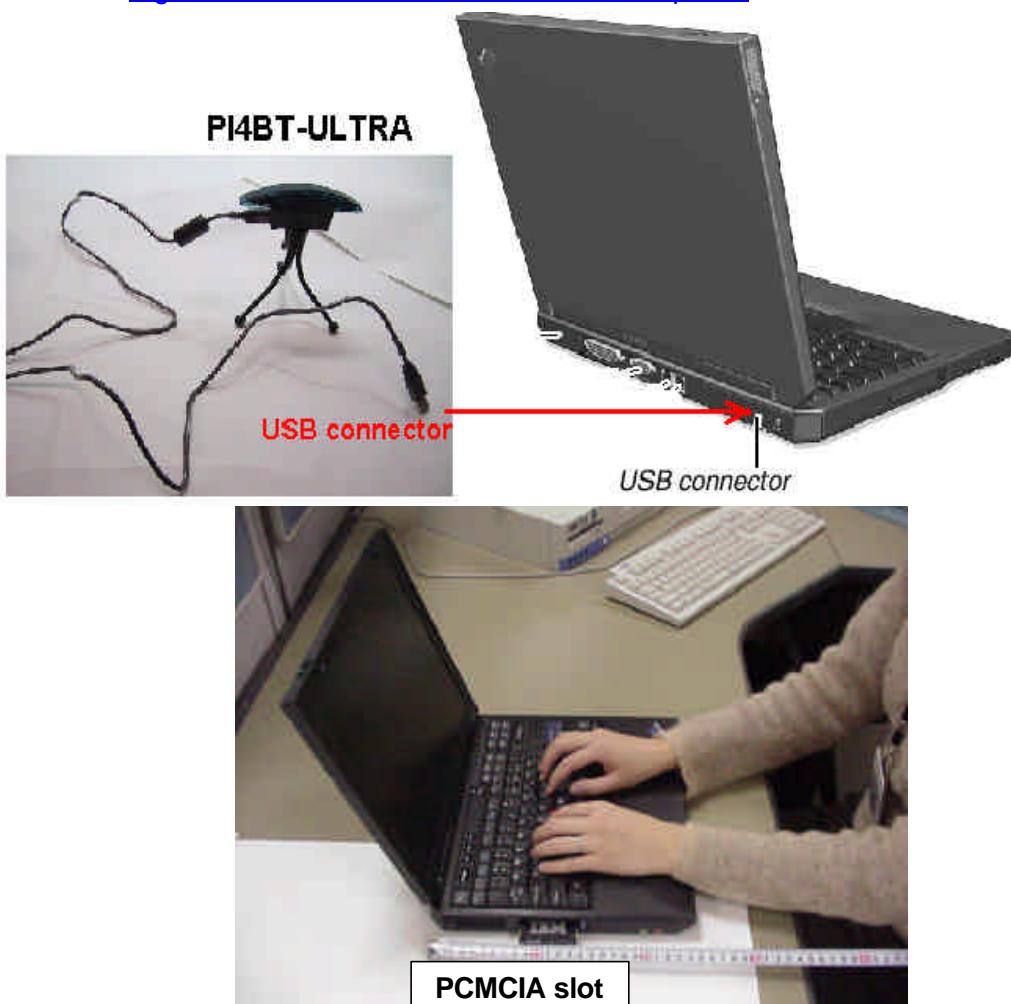
So the source-based time-averaging duty factor is considered as 100% duty. Therefore the WLAN transmitter meets the MPE requirements for general Population/Uncontrolled exposure.

3. RF Exposure evaluation of option Bluetooth transmitters regarding 'http://hraunfoss.fcc.gov/eas_public/LSI_GET/37'

The applying laptop PC (ThinkPad R32 Series) supports the following two Bluetooth PC options which function with the applying transmitter simultaneously.

Interface	FCC ID	Grantee Name	Product Name	Granted Date	EIRP in FCC test report
USB port	PI4BT-ULTRA	TDK Systems Europe Ltd.	Bluetooth Ultraport Module	May/22/2001	1.4 mW
PC card slot	PI4BT-IBM-PCII		Bluetooth PC Card II	August/21/2001	1.0mW

[Figure E. Interfaces to connect Wireless options](#)



When a customer operates the applying PC on his lap, the sufficient separation distance (min. 20cm) between the antennas of above transmitters and the person's body (lap) can not be maintained.

But the footnote of the Section 3 in Supplement C to OET Bulletin 65 states ^{“14} Both conducted and radiated output power should be considered in near-field exposure conditions. The output indicated in the above (500 mW) is appropriate when the device and its antenna are both operating at more than 2.5 – 3.0 cm from a person's body, such as certain hand-held terminals. If a device, its

antenna or other radiating structures are operating at closer than 2.5 cm from a person's body or in contact with the body, SAR evaluation may be necessary when the output is more than 50 – 100 mW, depending on the device operating configurations and exposure conditions."

Also the latest conditions for co-located transmitters in Web guidance (http://hraunfoss.fcc.gov/eas_public/LSI_GET/37) states "SAR compliance for co- located transmitters in standalone independently operated product – when SAR evaluation is required for TCB approval, except for the transmitter(s) with the highest output (non- simultaneously transmitting dominant transmitters – AMPS/ TDMA/ CDMA), the output of other co-located transmitters should be less than 2% of the source- based time-averaged conducted and radiated output power levels of the dominant transmitter or 5 mW, whichever is higher."

When the antenna separation from a person's body is closer than 2.5 cm, the near field estimation which is used for the calculation of EIRP to estimate the source- based time-averaged MPE limit is not proper method for the RF exposure evaluation.

So 5 mW should be considered as the criteria of SAR evaluation for the co-location of transmitters.

The total output power of the two Bluetooth transmitters in the previous table is 2.4mW. Therefore those transmitters can co-locate with the dominant transmitter(WLAN) without SAR evaluation.

4. Other supported PCMCIA cards with SAR compliance

The applying equipment supports the following option wireless PCMCIA card plugged in the PC card slot, which complies to the SAR requirement. (FCC ID: J30WCB5000A)

FEDERAL COMMUNICATIONS COMMISSION WASHINGTON, D.C. 20554				
GRANT OF EQUIPMENT AUTHORIZATION Certification				
Xircom 2300 Corporate Center Drive Thousand Oaks, CA 91320				
Attention: Robert Paxman NOT TRANSFERABLE EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.				
FCC IDENTIFIER J30WCB5000A Name of Grantee Xircom				
Equipment Class: Unlicensed National Information Infrastructure TX Notes: Intel PRO/ Wireless 5000 Cardbus Adapter				
Grant Notes	FCC Rule Parts	Frequency Range (MHz)	Output Watts	Frequency Tolerance
	15	5180 - 5320	0.1	
Output power is conducted. Device is approved for mobile and laptop computer use with similar installation and operating configurations as tested in this filing only. Device with specific antenna has been tested stand-alone for SAR compliance in a typical laptop computer with side PCMCIA slot, as described in this filing. Device has not been tested in a host product for RF exposure compliance in combination with other transmitters. Users and installers must be informed of the installation and operating requirements and configurations for satisfying RF exposure compliance. The highest reported SAR value is 0.67 W/kg.				