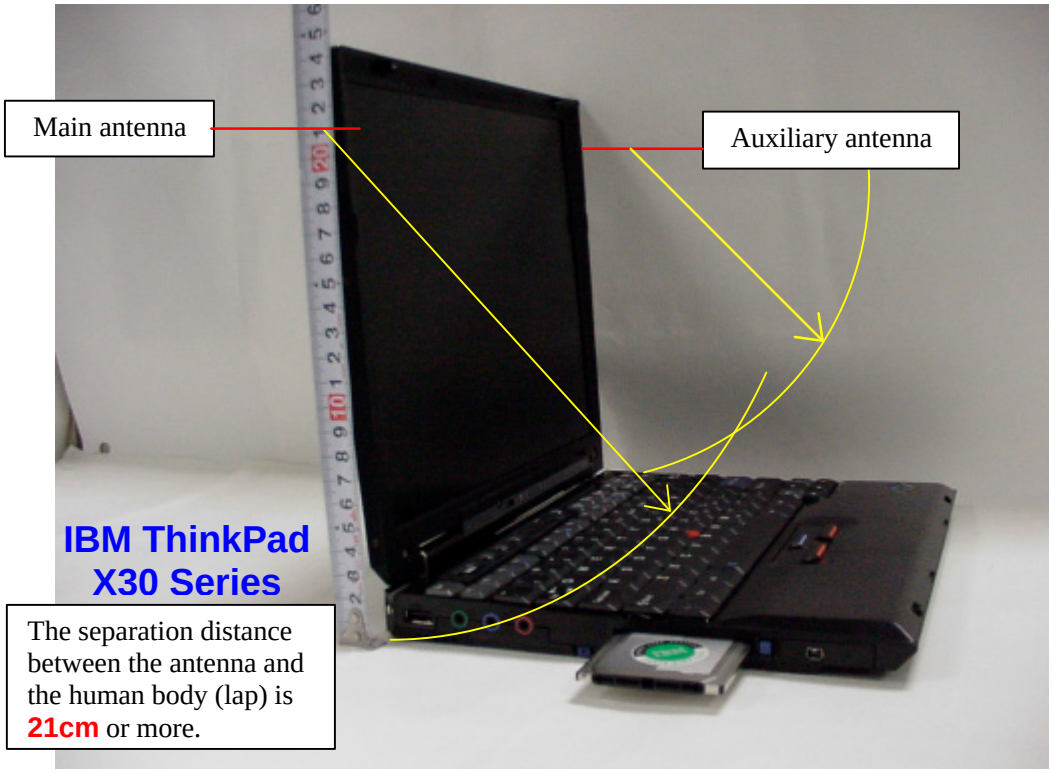
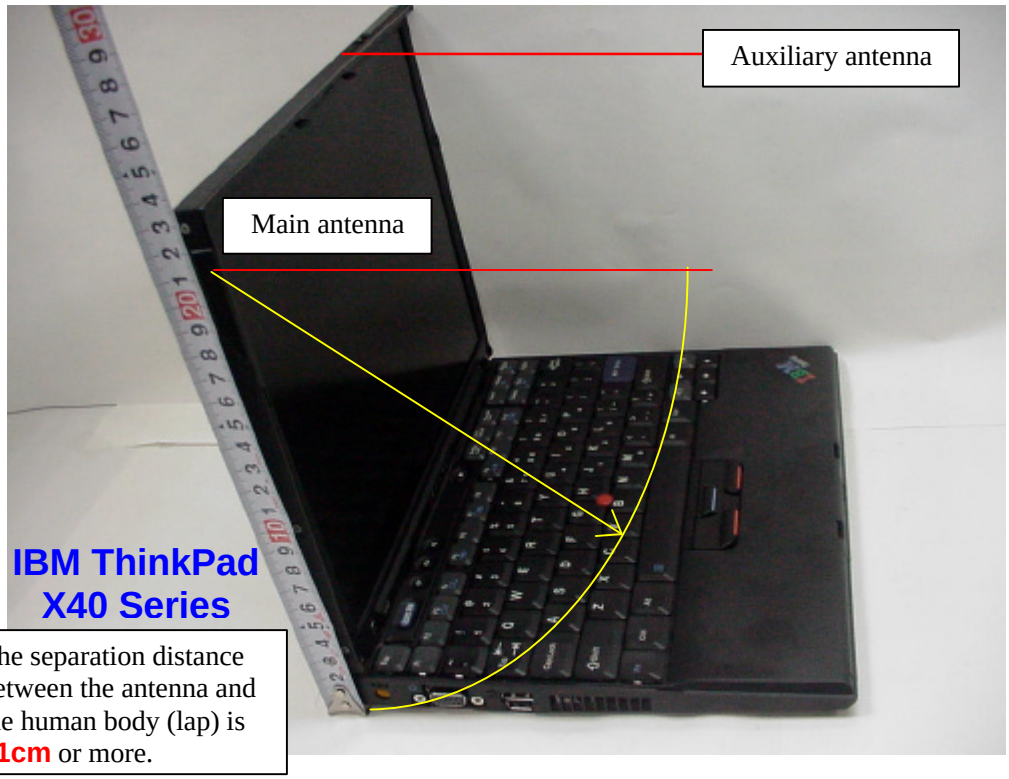
RF Exposure evaluation

1. RF Exposure evaluation for the applying LMA transmitter

As shown below, the all transmission antennas of the new host PC devices (IBM ThinkPad X30 and X40 Series) are located at the upper portions of each display (LCD) section, and the separation distance between each antenna and the human body is 20cm or more. Therefore the applying LMA transmitter and each antenna system is categorized as a mobile device by FCC CFR 47 Section 2.1091.





[MPE evaluation]

The following table shows the highest conducted peak output power values of the applying modular device, and the maximum peak antenna gains of each host device.

Transmission mode	**P**: conducted peak output power
2.4GHz band DSSS	22.10 dBm (162.2 mW)
2.4GHz band OFDM	21.32 dBm (135.5 mW)
5.8GHz band OFDM	24.24 dBm (265.5 mW)

Host PC model	**G**: peak antenna gain	
ThinkPad X30 Series	2.4GHz band	1.28 dBi (Auxiliary antenna)
	5.8GHz band	0.32 dBi (Main antenna)
ThinkPad X40 Series	2.4GHz band	1.67 dBi (Auxiliary antenna)
	5.8GHz band	2.04 dBi (Auxiliary antenna)

With those results, the maximum power density at 20cm distance is calculated as follows.

IBM ThinkPad X30 Series

Transmission mode	EIRP = P + G (dBm)	EIRP (mW)	Max. power density $S = EIRP/(4 \times \pi \times 20^2)$
2.4GHz band DSSS	23.38	217.8	0.0433mW/ cm^2
2.4GHz band OFDM	22.60	182.0	0.0362 mW/ cm^2
5.8GHz band OFDM	24.56	287.1	0.0571 mW/ cm^2

IBM ThinkPad X40 Series

Transmission mode	EIRP = P + G (dBm)	EIRP (mW)	Max. power density $S = EIRP/(4 \times \pi \times 20^2)$
2.4GHz band DSSS	23.77	238.2	0.0474 mW/ cm^2
2.4GHz band OFDM	22.99	199.1	0.0396 mW/ cm^2
2.4GHz band OFDM	26.28	424.6	0.0845 mW/ cm^2

Since the applying modular transmitter device does not function to emit the radio frequency from both diversity antennas simultaneously, the above results are the maximum values of RF exposure to the persons, and are far below the MPE limit (1.0 mW/cm^2). Therefore the LMA transmitter meets the MPE requirements for general Population/Uncontrolled exposure.

2. RF Exposure evaluation with co-located WLAN transmitters

The applying transmitter co-locates with one of the following two Bluetooth modules.

Option type	FCC ID	Grantee Name	Product Name	Granted Date	Conducted Tx power
Built-in LMA Transmitter	**ANO20040700HER**	**IBM Japan, Ltd.**	**IBM integrated Blutooth IV with 56K Modem**	**Under certification process separately with this application**	**2.0mW**
Built-in LMA Transmitter	**ANO20020100MTN**	**IBM Japan, Ltd.**	**IBM integrated Blutooth III with 56K Modem**	**Feb/26/2003 (T40 14", X30)**	**2.5mW**
				Sep/29/2003 (R50)	
				Dec/17/2003 (X40)	
				May/04/2004 (T40 15")	

The main and auxiliary antennas located at LCD section of each host device (ThinkPad R50, T40, X30 or X40 Series) are assembled apart from each Bluetooth antenna shown in the next pages with 20 cm or more.

Therefore, those co-located Bluetooth transmitters are allowed to evaluate the RF exposure compliance independently of the applying modular transmitter. In other word, the SAR testing for the applying transmitter in co-locating with those Bluetooth transmitters is not required, when the Bluetooth transmitters could satisfy the RF exposure requirement with those own transmission powers.

When a customer operates the applying PC on one's lap, the sufficient separation distance (minimum 20cm) between the above Bluetooth antennas 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] …… 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."

The output power of the Bluetooth transmitters does not exceed 5mW (far below 50mW). Therefore these transmitters also satisfy the RF exposure requirement regarding CFR 47 Part 15.247(b)(4) without a SAR compliance test report, and can operate with the applying transmitter simultaneously.

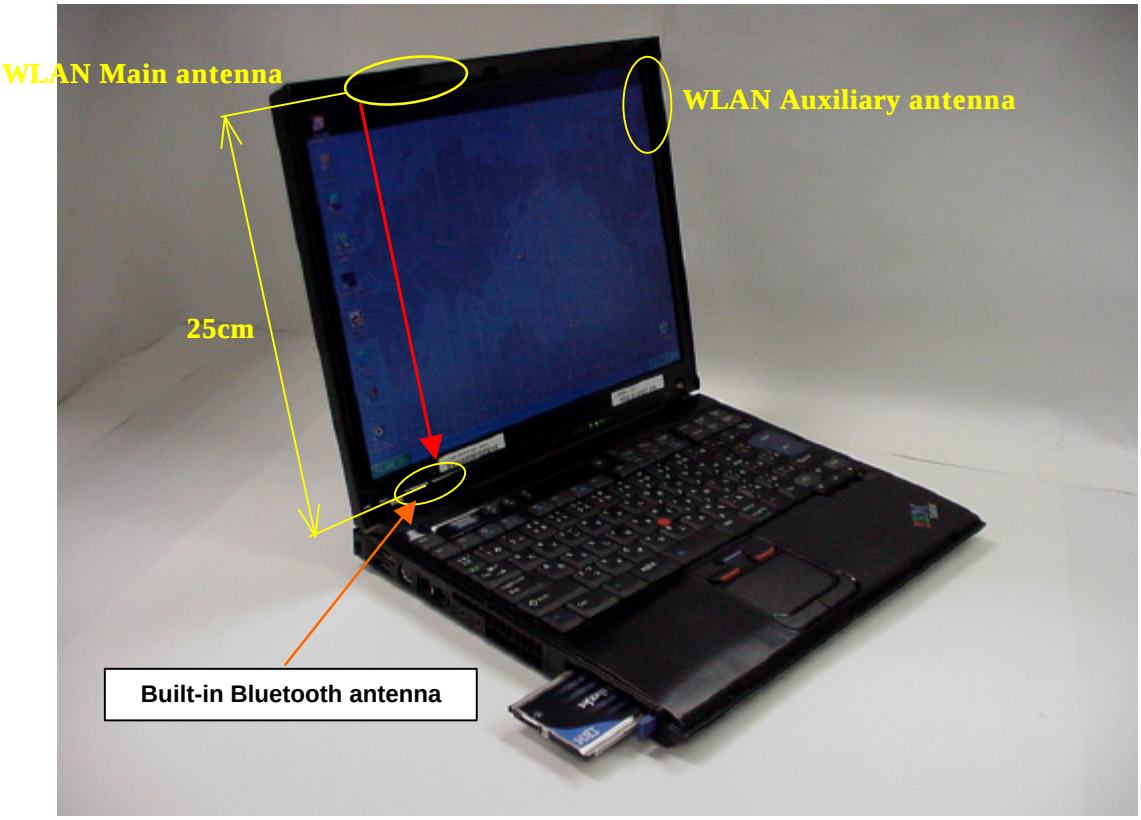
The user's manual provides the instruction to customers in use of multiple transmission with the applying transmitter and co-locating Bluetooth devices as follows.

Use of wireless options

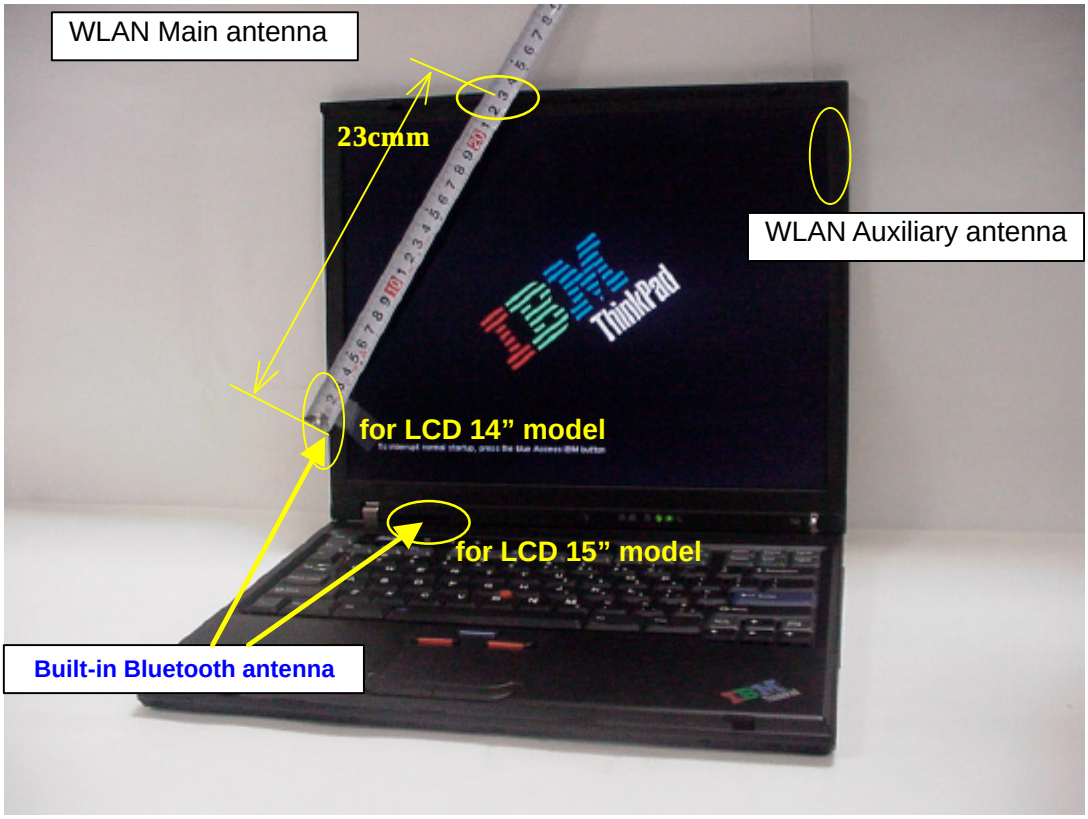
Your ThinkPad computer is approved for use of one of the granted Wireless LAN Mini-PCI Cards together with one of the granted *Bluetooth* modules (FCC ID: ANO20040700HER or ANO20020100MTN) in the CDC slot simultaneously. Make sure of the following conditions on use of these wireless features.

1. When you use any other RF option device, all other wireless features including the integrated Wireless LAN Mini-PCI Card and *Bluetooth* transmitters in your ThinkPad computer are required to be turned off.
2. Users must follow the RF Safety instructions on wireless option devices that are included in the RF option device's user's manual.

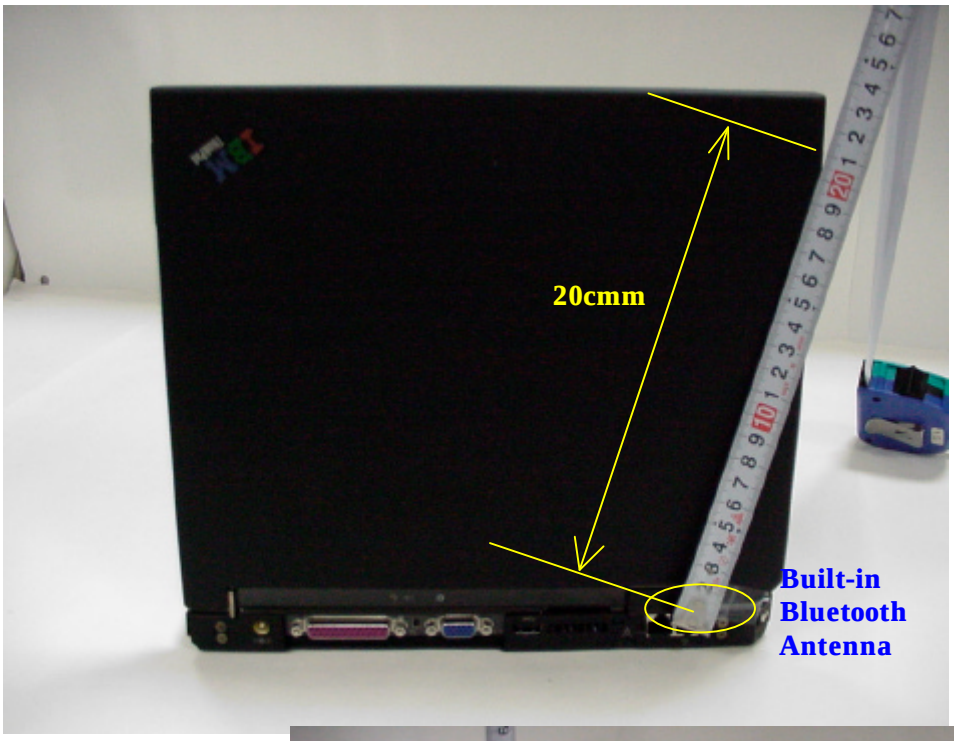
Antenna separation of ThinkPad R50 Series

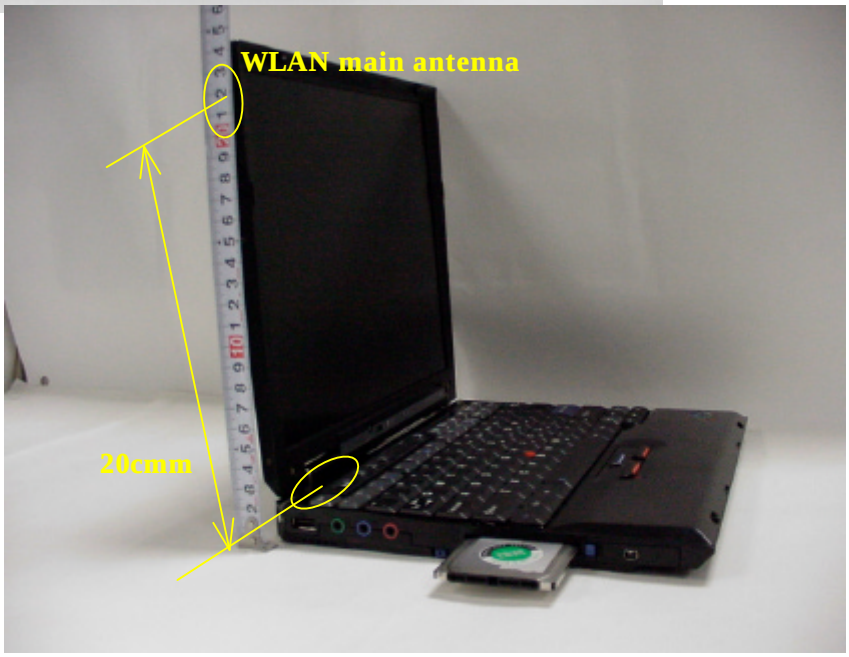


Antenna separation of ThinkPad T40 Series



Antenna separation of ThinkPad X30 Series





Antenna separation of ThinkPad X40 Series