FCC Part 15, Subpart C (Intentional Radiator)

Product Name: ThinkPad X22
(2662-9Dx/9Ex)

FCC ID: ANOSY3W26629DX

May 30, 2001

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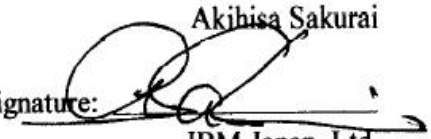
Signature: 

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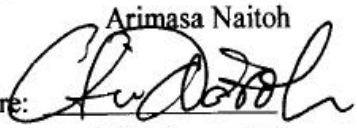
Signature: 

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Yellow Sheet : No. EM567

MEASUREMENT/TECHNICAL REPORT – Part 15 Subpart C
(Intentional Radiator)

ThinkPad X22
(2662-9Dx/9Ex)

FCC ID : ANOSY3W26629DX

May 30, 2001

This report concerns: (check one)
Original Grant ✓
Class I change
Class II change

Equipment type: Wireless LAN device in Computer (computer, printer, modem, etc.)

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The measurement results contained in this report relate only to the item which was tested.

Measurement procedure used is ANSI C63.4-1992 unless otherwise specified.
Other test procedure: _____

The FCC has issued provisional acceptance of this test laboratory for Declaration of Conformity testing per letter dated June 30, 2000.

APPLICANT ANTI-DRUG ABUSE CERTIFICATION:
By checking yes, the applicant certifies that, in the case of an individual applicant, he or she is not subject to a denial of federal benefits, that includes FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse of 1988, 21 U.S.C. 853(a), or, in the case of a non-individual applicant (e.g. corporation, partnership or other unincorporated association), no party to the application is subject to a denial of federal benefits, that includes FCC benefits, pursuant to that section. For the definition of a "party" for these purposes, see 47 CFR 1.2002(b).

(Yes) or No

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Operational Description

1. Objective

This is a Certification Compliance Report for FCC Part 15, Subpart C (Intentional Radiator).

- The applying equipment : ThinkPad X22
- FCC ID : ANOSY3W23329DX

2. Product Description

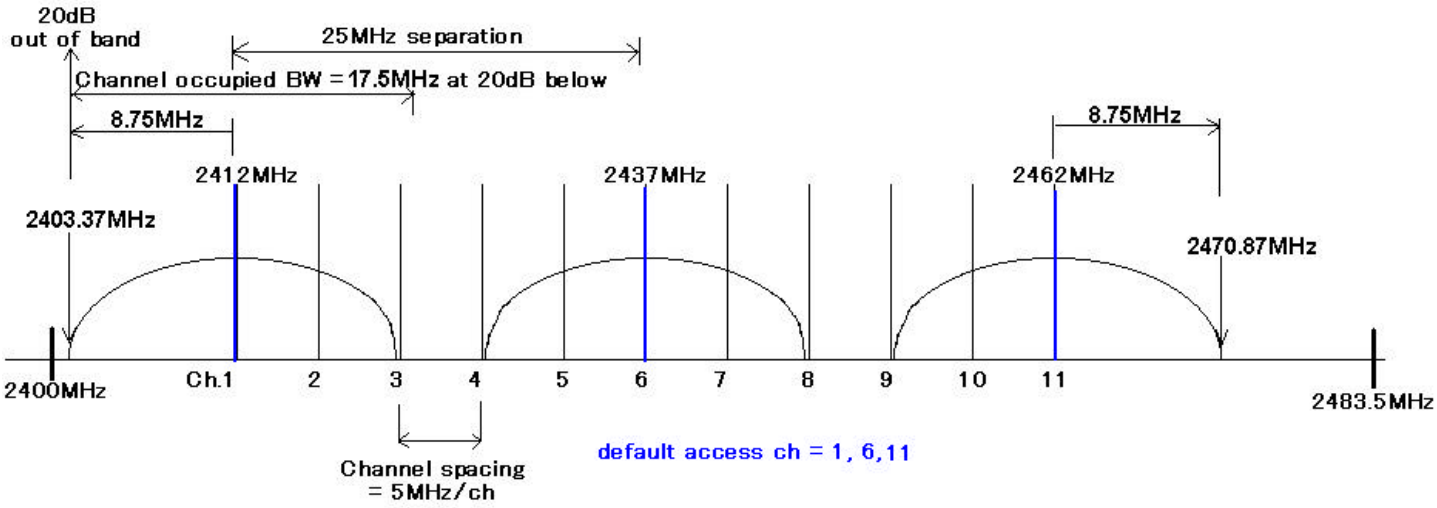
The applying equipment is a portable type notebook personal computer integrating IEEE 802.11b Wireless LAN function inside. The wireless module consists of an OEM card(Actiontec, IEEE802.11b Wireless LAN Mini-PCI card) and IBM original integrated 2 antennas (Inverted F-figure type antennas).
The feature of the applying equipment is as follows :

Table 1 : Specification of PC main body

Model Identification		ThinkPad X22	
Product number (Order code)		**2662-9Dx**	**2662-9Ex**
PC Functions	Max. size	279mm(11.0")(W) : 226mm(8.9")(D) : 30.2mm(1.19")(H)	
	Max.Weight	3.7 lbs	
	Hard disk	2.5" 20 GB	
	Memory	128MB	
	Bay Device (DVD, CD etc.)	None	
	Power	AC adapter, Battery (Li-Ion)	
	Ports & Slots	CRT, Headphone, Microphone, Line In, USBx2, 4M IR, Port Replicator, Slicer Modem, PCMCIA slot (type-2 x 1), CF Slot(type-2x1)	
	CPU	Intel® Mobile Geyserville® 800MHz LV	
	LCD	12.1" TFT XGA	
	Keyboard	US English, French, Spanish, UK English, Japanese, Chinese, Korean, Thailand	
	Pre installed Software	W2K w/W-NT	Windows XP-Pro

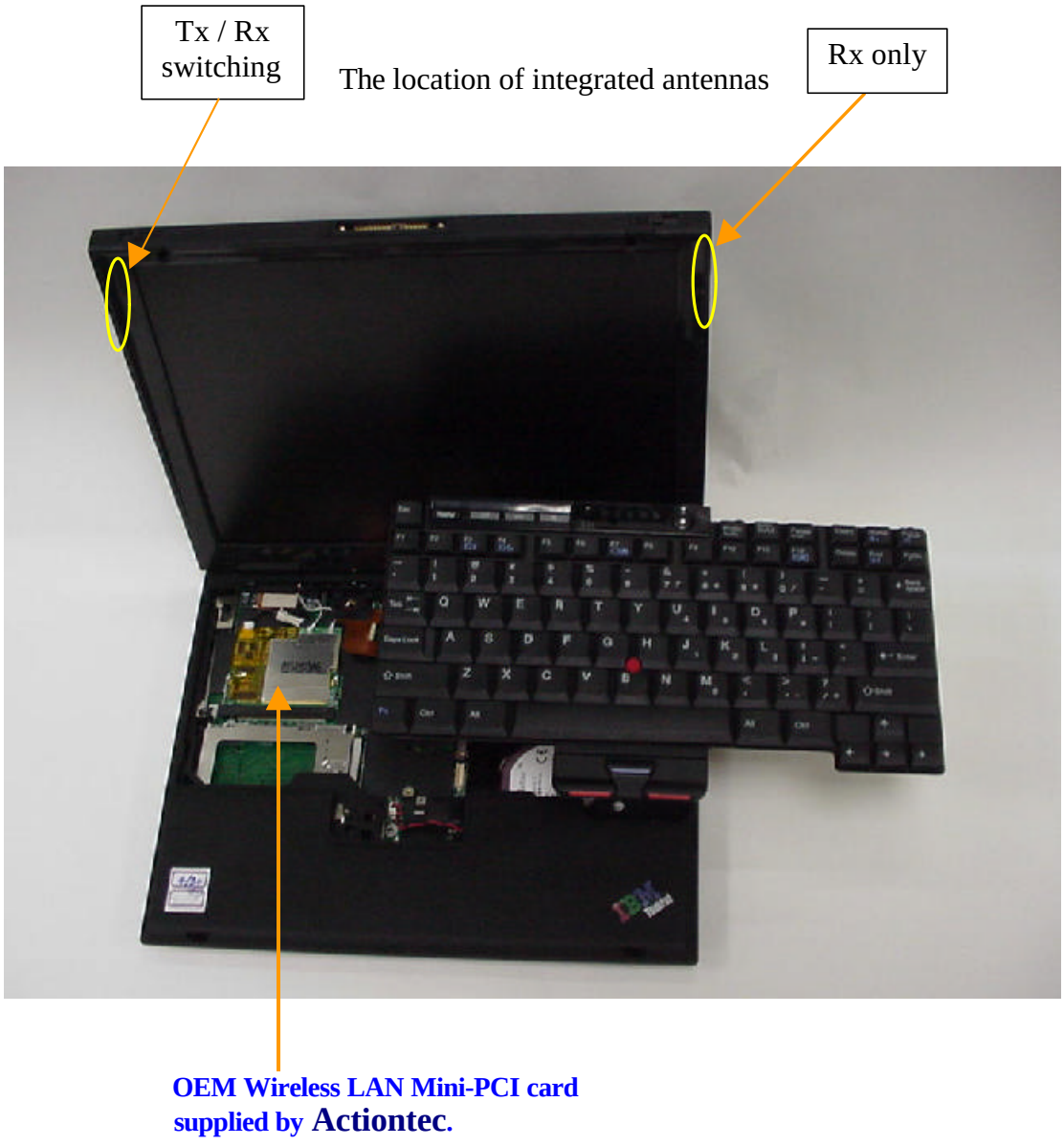
Table 2 : Specification of Wireless-LAN feature

Carrier Frequencies	2412MHz - 2462MHz			
Occupied BW at 20dB below (Band-edge)	2403.37MHz – 2470.87MHz			
Channels	Total 11 channels (default setting ch. # : 1, 6, 11)			
Channel BW at 20dB below	Max. 17.50MHz / ch			
Channal spacing	5 MHz			
Conducted emission Power	15.3 dBm			
Antenna gain	-0.38 dBi			
Antenna type	Inverted F-figure type antenna (IBM P/N: 26P9340)			
Antenna cable type and length	Tx/Rx switching antenna : coax 355mm Rx antenna : coax 498mm			
Bit rate	1 Mbit/sec	2 Mbit/sec	5.5 Mbit/sec	11 Mbit/sec
Chip/symbol rate	11	11	8	8
Bit/symbol rate	1 (DBPSK)	2 (DQPSK)	4 (CCK)	8 (CCK)
Chip/bit rate	11	5.5	2	1



3. Mounting structure of Wireless LAN PC card and Antenna

note) The left side of inverted F-figure type antenna is used for both RF transmission and receiving with half duplex switching mode. The right side one is used for RF receiver only. When the Wireless PC card is in RF receiving state, one of the antennas is selected automatically to have a good quality of radiocommunication.



4. Related Submittal(s)/Grant(s)/Notes

- The device without Wireless LAN function is classified as a digital device under Part 15 Subpart B and subject to DoC.

5. Circuitry description of the Wireless LAN PC card

Basic Operation Principle of 802MIP

by Actiontec Electronics, Inc. 4/2001

The Wireless LAN portion of 802MIP combo card is a 2.4GHz ISM Band DSSS Radio. It is designed to operate using IEEE 802.11b WLAN Standard for use in wireless networking systems. The Radio consists of 4 major ICs, which are ISL3685, HFA3783, ISL3984, ISL3874, and few support ICs. It operates at maximum transmit rate 11Mb/s, back off rates 5.5, 2 and 1 Mb/s. The modulation schemes include CCK (Complementary Code Keying), DQPSK and DBPSK depending on what transmit bit rate it operates at. The radio card interfaces to PC through a MiniPCI bus.

Transmitter path

The Ethernet data comes through the MiniPCI interface, the Host I/O interface to the MAC section of ISL3874. The signal then flows into the data router where it is converted from Ethernet to 802.11b protocol. After the signal is converted, a radio preamble and header is added to it and passed to the I/O of BBP (Base Band Processor) section of ISL3874 via PHY I/O, RADIO I/O. There is also support circuitry, such as outboard SRAM and flash ROM, which contains the firmware controlling the radio.

In TX modulator of BBP section, differential phase shift keying modulation schemes DBPSK, DQPSK and CCK, with data scrambling capability, are fulfilled to provide a variety of data rates--DBPSK for 1 Mb/s, DQPSK for 2 Mb/s and CCK for 5.5 and 11Mb/s. The signal, which now is two separate quadrature components I and Q, then flows to the quad IF chip HFA3783 through D/A converters.

At TX side of BBP, there is also TX ALC (Automatic Level Control) circuitry, which is part of the TX ALC loop. The loop keeps TX output power to be consistent so that prevent the power spectrum from regrowth.
HFA3783 is now the dual up conversion mixers (dual down conversion mixers for RX). The signal upconverts to an IF frequency of 374 MHz and passes into a variable gain amplifier, which is also a part of the ALC loop. Next, it passes through the switched TX/RX shared SAW filter into ISL3685 and then upconverts again to a RF frequency from 2.412~2.462 GHz, depending on the channel selection. The signal flows through a pre-amplifier, two band pass filters, which block all the unwanted emissions such as image components, harmonics and spurious stuff, into ISL3984 power amplifier. The output of the power amplifier is then fed through another band pass filter that is about 85 MHz bandwidth to one of the antennas.

Receiver path

The receive signal traveling through the air is received by the dual diversity antennas. The circuits will switch to the antenna which provides better RSSI (Received Signal Strength Indication). The RF signal then feeds into an 85 MHz band pass filter, which blocks all the unwanted components such as image frequency. The signal again is amplified using the LNA within ISL3685 and mixed

down to the IF frequency of 374 MHz. The PLL and synthesizer select the channel frequency using Low Side Injection. The mixer outputs are then fed through the IF SAW filter that provides image rejection into HFA3783, which is now a quad down converter. HFA3783 also provides RSSI to BBP of ISL3874. There is a two stage analog AGC (Automatic Gain Control) circuit which adjusts the gain to compensate the signal strength differences. The output of the twin AGC's provides a constant level signal to the I and Q down converters, which convert the IF to both I and Q signals to BBP. A second frequency synthesizer, which uses ISL3183 as its VCO, feeds the I and Q mixers with a same frequency signal that is phase shifted by 90°.

The I and Q signals that are fed into BBP of ISL3874 are converted into digital signals via a dual A/D converters then flow through the digital AGC control circuit followed by the digital demodulator. The correlation codes that BBP generates properly detect the transmitted complimentary codes. In here the automatic antenna selection is also done by taking RSSI as the reference. The output of the digital demodulator is sent into an I/O interface of MAC section. The digital codes then flow into the PHY I/O interface and into the MAC protocol engine. The MAC of ISL3874 converts the signal protocol from 802.11b to Ethernet and finally passes that data through the HOST I/O interface to the PC.