Emission Test Report Standard: FCC Part 15 Subpart E / IC RSS-210 (Class II Permissive Change)

Document Number : FCC 19-0283-0

Model Number: AR5BMB-44

FCC ID: ANO20040600BTL IC: 349E-AR5BMB44

November 25, 2004

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

FCC ID : ANO20040600BTL

Model: AR5BMB-44 (802.11a/b/g Wireless LAN Adapter) with

IBM ThinkPad T40 Series

(Machine Type: 1871, 1875, 1873, 1874, 1875, 1876, 2373, 2374, 2375, 2376, 2378, 2379, 2668, 2669, 2678, 2679, 2686, 2687)

IBM ThinkPad R50 Series

(Machine Type: 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1840, 1841, 1842, 2883, 2887, 2888, 2889, 2894, 2895)

IBM ThinkPad X30 Series

(Machine Type: 2672, 2673, 2884, 2885, 2890, 2891)

IBM ThinkPad X40 Series

(Machine Type: 2369, 2370, 2371, 2372, 2382, 2386)

November 25, 2004

This report concerns: (check one)

Original Grant

Class I change _____ Class II change _____

Equipment type: Wireless LAN device

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

Measurement procedure used is ANSI C63.4-2003 unless otherwise specified.

Other test procedure:

The FCC has issued provisional acceptance of this test laboratory for Declaration of Conformity testing per letter dated 1997.

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).

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Prepared by: Takeshi Asano

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A. General Information

APPLICANT	: IBM Japan, Ltd.
TEST SITE	: IBM Japan, Ltd., Yamato Semi-anechoic chamber #1
TEST SITE ADDRESS	: 1623 – 14 Shimotsuruma, Yamato-shi, Kanagawa 242-8502 Japan Tel: +81-46-215-4779, Fax: +81-46-273-7420
REGULATION	: FCC Part 15 Subpart E Industry Canada RSS-210 (Issue No.5)
MODEL NUMBER (Advertising Name)	: AR5BMB-44 (IBM 11a/b/g Wireless LAN Mini PCI Adapter II)
FCC ID IC Certification Number	: ANO20040600BTL : 349E-AR5BMB44
SERIAL NUMBER	: 00S0SIT004
PYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a IEEE802.11a, 11b & 11g Wireless LAN Mini-PCI Combo Card (Composite application)
TESTED DATE	: November 2, 4, 8, 17 and 24, 2004

A.1 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4-2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

A.2 Test Facility / NVLAP Accreditation

The semi-anechoic chamber #1 used to correct the data are located in Yamato Laboratory, IBM Japan.

- This facility has been fully described in a report dated September 1998, submitted to the FCC office, and accepted in a letter, dated Nov. 2, 1998(31040/SIT).
- IBM Yamato EMC Engineering is recognized under the National Voluntary Laboratory Accreditation Program for satisfactory compliance with Criteria established in Title 15, Part 285 Code of Federal Regulations.(NVLAP Lab code: 200198-0)
- Theses facilities are accepted by **Industry Canada** as number **IC 4221** for chamber #1 (expiry date: January 25, 2005), and as number **IC 4221-1** for chamber #2 (expiry date: February 16, 2007).

A.3 EUT details

Table A EUT details

Model and S/N	FCC ID IC Certification Number	Description
AR5BMB-44 (s/n 00S0SIT004)	FCC ID: ANO20040600BTL IC: 349E-AR5BMB44	Applying modular transmitter Built_in type IEEE802.11a/b/g Wireless LAN Mini-PCI card without antenna
ThinkPad R50 Series M/T 1829-62x (15 inch) (s/n ZZ-08233)		IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.5GHz
J07M067 (s/n 05S5ARM4SIT023)	FCC ID: ANO20040700HER IC:349E-J07M067	Co-located built-in type Bluetooth modular transmitter device without antenna
P/N 02K6746		Universal AC adapter 72W, Unshielded power cord for ThinkPad R50 Series

B. Summary of Test Results

Table-B presents the list of the measurement items for U-NII devices under FCC Part 15 Subpart E, and for LELAN devices under Industry Canada RSS-210.

The section numbers of upper portion are showing FCC codes, and the lower ones are for IC RSS-210.

Section(s)	Test Items		Condition	Dogult
	Tran	Condition	Result	
	Bandwidth at 26 dB below	26dB BW was also taken for IC instead of 99% BW, according to RSS-210 6.2.2q(iv)(b).		Pass
		5150-5250MHz: FCC: 50mW or (4+10logB)dBm		Pass
	Peak conducted transmit	IC : 200mW* or (10+10logB)dBm* *: EIRP		
15.407 (a)(1), (2)	or EIRP for IC	5250-5350MHz: FCC: 250mW or (11+10logB)dBm		Pass
6.2.2 (q1)(i)(ii)		IC : 250mW or (11+10logB)dBm IC : 1W* or (17+10logB)dBm* *: EIRP B: 26dB BW in MHz		
	Peak Power Spectral Density	5150-5250MHz: FCC: 4 dBm in any 1MHz IC : 10 dBm in any 1MHz (EIRP) 5250-5350MHz: FCC: 11 dBm in any 1MHz IC : 11 dBm in any 1MHz	Conducted	Pass
N/A 6.2.2 (q1)(iv)(b)	Peak Spectral Density	IC: 3 + 10logB dBm/MHz		Pass
15.407(a)(6) N/A Peak Excursion		The ratio of the peak excursion of the modulation envelope to the peak transmit shall not exceed 13 dB across any 1 MHz.		Pass
15.207 / 407(b)(5) 6.2.2 (q1)(v) / 6.6	AC Wireline Conducted Emissions 150kHz- 30MHz	Class B: Freq.(MHz) QP(dB μ V) Ave.(dB μ V) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50		Pass
15.205 & 209 / 407(b)(1)(2)(5)(6)	General Field Strength	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3.	Radiated (30MHz - 1GHz)	Pass
6.2.1 / 6.2.2(q1)(i)(ii)(v) / 6.3	Limits (Restricted Bands and Radiated Emission Limits)Ave. 54dBµV/m, peak 74dBµV/m and FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP -27dBm/MHz		Radiated (1G - 40GHz)	Pass

Table-B List of the measurements

	Receiv	ve mode (RX):		
15.207 / 407(b)(5) 6.2.2(q1)(v) / 7.4	AC Wireline Conducted Emissions 150kHz - 30MHz	Class B: Freq.(MHz) QP(dB μ V) Ave.(dB μ V) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Conducted	Pass
15.205 & 209 / 407(b)(1)(2)(5)(6)	General Field Strength	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3. Ave. $54dBuV/m$ peak $74dBuV/m$	Radiated (30MHz - 1GHz)	Pass
6.2.1 / 6.2.2(q1)(i)(ii)(v) / 7.3	Limits (Radiated Emission Limits)	and FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP -27dBm/MHz	Radiated (1G - 25GHz)	Pass

	Ot	her general requirements	Result
15.407(a)(1)(2) N/A	Antenna gain	Peak gain of the device : 2.84dBi in 5.2GHz band	N/A
N/A 5.2	Supply Voltage	Main power source: Universal AC adapter 72W Mini-PCI PC bus to applying card : DC 3.3V ± 0.3V	N/A
N/A 6.2.2(q1)(iv)(a)	Digital modulation	Applying equipment employs IEEE802.11a, 11g(OFDM) or 11b(DSSS) digital modulation technology.	complies
15.407(c) 6.2.2(q1)(iv)(d)	Automatic link disconnection in no transaction state	Refer to "Limited Modular Approval and U-NII Qualifications" or "Module Construction and LELAN Qualifications" documents.	complies
N/A 6.2.2(q1)(i)	Integral antenna in the 5150M -5250MHz band	The device employs an unique electronic connector so called Electronic Handshake .	complies
15.407(e) 6.2.2(q1)(i) (q1)(iv)(g)	Indoor use in the 5150M - 5250MHz band, and interference from radars.	Refer to the manual (Regulatory Notice).	complies
15.407(f) 6.2.2(q1)(iv)(g)	RF Exposure Requirement	Refer to "RF Exposure Evaluation" or "Exposure of Humans to Radio Frequency Fields" documents.	complies
15.407(g) 6.2.2(q1)(iv)(e)	Frequency stability	Refer to "Limited Modular Approval and U-NII Qualifications" or "Module Construction and LELAN Qualifications" documents.	complies

C. Operation Mode of EUT

- 1. All tests were performed using the "Atheros Radio Test" program. This tool supports the continuous transmission mode for the testing purpose.
- 2. Three kinds of frequencies were chosen for the measurement. i.e. 5180MHz (lowest), 5260MHz(middle), and 5320MHz (highest).
- 3. As for the RF receiving test, the middle channels (5260MHz) were selected representatively.

Table-C Transmission mode of EUT

Note) The table shows the specification of **average** power for the applying device in 'dBm'.

Operation	Designed average output power (conducted) [dBm]							
Frequency [GHz]	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
5.180 (Ch. 36)	14	14	14	14	14	14	14	13
5.200 (Ch. 40)	15	15	15	15	15	15	14	13
5.220 (Ch. 44)	15	15	15	15	15	15	14	13
5.240 (Ch. 48)	15	15	15	15	15	15	14	13
5.260 (Ch. 52)	17	17	17	17	17	17	14	13
5.280 (Ch. 56)	17	17	17	17	17	17	14	13
5.300 (Ch. 60)	17	17	17	17	17	17	14	13
5.320 (Ch. 64)	14	14	14	14	14	14	14	13

D. Justification

- 1. The full testing results were already certified at the previous grants on July/26/2004 and September/10/2004 (Class II change). The results for conducted measurements and AC wireline conducted emissions are entirely the same as the certified values because neither hardware nor electrical modification was made to the applying modular transmitter itself.
- This test report is a supplementary document that contains only the radiated emission results to examine the compliance for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO 20040700HER).
- 2. Pursuant to the ET Docket 03–201; FCC 04–165, July 12/2004, and Federal Register / Vol. 69, No. 172, September 7/2004, the test was performed with the highest gain antenna among the supported host devices. The EUTs used in this test report are shown by Table-D in shading below.

5.2Ghz band Granted date Host PC models Main Aux. 14" 0.83 dBi 0.36 dBi ThinkPad T40 Series 15' 2.00 dBi 0.82 dBi July/26/2004 14" 2.66 dBi 1.37 dBi ThinkPad R50 Series 15' 1.68 dBi 2.84 dBi ThinkPad X30 Series 1.42 dBi 0.19 dBi September/10/2004 ThinkPad X40 Series 1.45 dBi 2.15 dBi

Table-D Peak Antenna Gains of EUT

3. The representative worse cases in the previous applications were selected and examined for the compliance of the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO2004 0700HER) for each Tx mode. As for the Rx mode, the tests were performed with the middle bands (i.e. 5260MHz).

E. Test Instruments

Table-E	List of Measuring	Instruments
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Description	Model	Serial Number	Calibration	Calibration
			Date	Interval
Computer	IBM 6868-30J	97-901X3	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2732A03651	07/21/04	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2841A04254	08/25/04	1 year
Spectrum Analyzer Display	HP 85662A	2648A15255	07/21/04	1 vear
Spectrum Analyzer Display	HP 85662A	2816A16831	08/25/04	1 year
Ouasi-Peak Adapter	HP 85650A	2521A00968	07/20/04	1 vear
Quasi-Peak Adapter	HP 85650A	2811A01156	08/25/04	1 year
Amplifier (100KHz - 1.3GHz)				•
- for 30-200MHz	MITEO AM-3A	898433	04/23/04	1 year
- for 200-1000MHz	MITEO AM-3A	898432	04/23/04	1 vear
Amplifier (1GHz - 18GHz)	HP 8449B	3008A00582	06/01/04	1 year
Amplifier $(18 - 40 \text{GHz})$	Agilent 83051A	3950M00193	01/27/04	1 year
Spectrum Analyzer FMI Test Receiver	R&S FSI26	836119/003	05/10/04	1 year
Spectrum Analyzer Livit Test Receiver	LD 8563E	3416402248	09/10/04	1 year
Harmonic Mixer	Agilent 11970A	011269_001	08/04/04	1 year
Dessiver (20MHz 1 2CHz)	D & C E CVD	011207-001 002202/019	00/04/04	1 year
	Ras ESVF	093202/010	02/10/04	1 year
Biconical Antenna (30-200MHZ)	EMCO 3108	2536	04/23/04	1 year
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849	04/23/04	1 year
Horn Antenna (1- 18GHz)	EMCO 3115	9903-5774	07/20/04	1 year
Horn Antenna (3.95- 5.85GHz)	EMCO 3160-5	1099	07/20/04	1 year
Horn Antenna (5.85- 8.20GHz)	EMCO 3160-6	9712-1044	07/20/04	1 year
Horn Antenna (8.20- 12.4GHz)	EMCO 3160-7	1156	07/20/04	1 year
Horn Antenna (12.4- 18GHz)	EMCO 3160-8	1143	07/20/04	1 year
Horn Antenna (18- 26.5GHz)	EMCO 3160-9	0004-1202	07/20/04	1 year
Horn Antenna (26.5- 40GHz)	EMCO 3160-10	1175	07/20/04	1 year
Switch/control unit	HP 3488A	2719A17226	N/A	N/A
Coaxial cables (1 – 18GHz):	Length:			
- Horn Ant <=> RF Amp.	6 m	- EM206SCO	03/25/04	1 year
- RF Amp.<=>Spectrum Analyzer(<12GHz)	16m	- GEM0101	03/25/04	1 year
- RF Amp.<=>Spectrum Analyzer(>12GHz)	3m	- SF102-20166	04/08/04	1 year
Coaxialcables (18 – 40GHz):				
- Horn Ant <=> RF Amp.	3m	- SF102-20167	04/08/04	1 year
- RF Amp. <=>Spectrum Analyzer	1m	- SF102-21105	04/08/04	1 year
N-Coax cables:				
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01	04/23/04	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103L02	04/23/04	I year
- Shield Panel <=> RF Amp	7 m	- EM103L03	04/23/04	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103L04	04/23/04	1 year
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01	04/23/04	1 year
- 10m Cable <=> Shield Panel	10 m	- EM103H02	04/23/04	1 year
- Shield Panel <=> RF Amp	7 m	- EM103H03	04/23/04	1 year
- RF Amp <=> Power Splitter	0.5m	- EM103H04	04/23/04	1 year

Coax cables:				
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05	04/23/04	1 year
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06	04/23/04	1 year
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05	04/23/04	1 year
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06	04/23/04	1 year
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV	04/23/04	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for	2 m	- EM1SPL	04/23/04	1 year
30- 200MHz				
- SW/Con.unit <=> Spe Ana.(Signal In) for	2 m	- EM1SPH	04/23/04	1 year
200-1000MHz				

Notes. - The above equipment calibration is traceable to National standards.

- HP: Hewlett Packard, R&S: Rohde & Schwarz

F. Measurement Uncertainty

Uncertainties of the both, the Yamato EMI radiated test facilities (EMI chambers, #1 and #2) and the Yamato EMI conducted test facility are derived with the NIS 81 " Treatment of uncertainty in EMC measurements" 1994.

Estimated site uncertainty values are as follows.

EMI chamber #1 : 4.39dB EMI chamber #2 : 4.40dB EMI conducted measurement system : 2.4dB

Detail should be referred to "Treatment of Uncertainty, Calculations and Policy" report, document number TCR 10-0015.

G. Temperature and Humidity

The temperature is controlled within range of 17° to 28° The relative humidity is controlled within range of 40% to 70%.

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

During the applying modular device stops RF transmission, the host unit with full peripheral devices including the applying modular device is classified as an unintentional radiator, Digital Device under the FCC Part 15 Subpart B or the Industry Canada Class B Emission Compliance (ICES-003), and subject to DoC.

1. Restricted Bands Radiation (30MHz – 1GHz) [FCC 15.205 / 209, RSS-210 6.3 / 7.3]

1.1 Test Procedure

Preliminary radiated emissions are measured in the semi-anechoic chamber at a 3 meter distance on every azimuth in both horizontal and vertical polarity. The antennas are also scanned in height. The emissions are recorded with a spectrum analyzer in peak hold mode. The identified emissions are further maximized by a cable manipulation. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120kHz. The highest emissions relative to the limit are listed.

1.2 Test Instruments and Measurement Setup

Description	Model	Serial Number
Computer	IBM 6868-30J	97-901X3
Spectrum Analyzer (100Hz-1.5GHz) for 30-200MHz	HP 85680B	2732A03651
Spectrum Analyzer Display for 30-200MHz	HP 85662A	2648A15255
Quasi-Peak Adapter for 30-200MHz	HP 85650A	2521A00968
Spectrum Analyzer (100Hz-1.5GHz) for 200-1000MHz	HP 85680B	2841A04254
Spectrum Analyzer Display for 200-1000MHz	HP 85662A	2816A16831
Quasi-Peak Adapter for 200-1000MHz	HP 85650A	2811A01156
Amplifier (100KHz-1.3GHz)		
- for 30-200MHz	MITEQ AM-3A	898433
- for 200-1000MHz	MITEQ AM-3A	898432
Biconical Antenna (30-200MHz)	EMCO 3108	2536
Log-Periodic Antenna (200-1000MHz)	EMCO 3146	2849
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018
Switch/control unit	HP 3488A	2719A17226
N-Coax cables:	Length:	
- Bi-coni Ant <=> 10m Cable	9 m	- EM103L01
- 10m Cable <=> Shield Panel	10 m	- EM103L02
- Shield Panel <=> RF Amp	7 m	- EM103L03
- RF Amp <=> Power Splitter	0.5m	- EM103L04
- Log-peri Ant <=> 10m Cable	9 m	- EM103H01
- 10m Cable <=> Shield Panel	10 m	- EM103H02
- Shield Panel <=> RF Amp	7 m	- EM103H03
- RF Amp <=> Power Splitter	0.5m	- EM103H04
Coax cables:		
- Power Splitter <=> SW/Con.unit (SW110)	1 m	- EM103L05
- Power Splitter <=> SW/Con.unit (SW300)	1 m	- EM103L06
- Power Splitter <=> SW/Con.unit (SW100)	1 m	- EM103H05
- Power Splitter <=> SW/Con.unit (SW301)	1 m	- EM103H06
- SW/Con.unit <=> Receiver (Input)	2 m	- EM1RCV
- SW/Con.unit <=> Spe Ana.(Signal In) for 30- 200MHz	2 m	- EM1SPL
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH

Table 1-1 Radiated Emission Test Instrumentation

Notes: HP: Hewlett Packard, R&S: Rohde & Schwarz



Figure 1 Cables for Radiated Emission Test

1.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver. All factors are included in the reported data.

FS = R + AF + CORR

where:

FS	=	Field Strength
R	=	Measured Receiver Input Amplitude
AF	=	Antenna Factor
CORR	=	Correction Factor $=$ CL - AG
CL	=	Cable Loss
AG	=	Amplifier Gain

For example :

Given a Receiver input reading of 51.5dBµV; Antenna Factor of 8.5dB/m; Cable Loss of 1.3dB; and an Amplifier Gain of 26dB. The Field Strength of the measured emission is:

 $FS = 51.5 + 8.5 + 1.3 - 26.0 = 35.3 dB\mu V/m$

Conversion between $dB\mu V/m$ (or $dB\mu V$) and $\mu V/m$ (or μV) are done as:

 $\text{Level}(dB\mu V/m) = 20 \times \text{Log}(\text{Level}(\mu V/m))$

 $40 dB\mu V/m = 100\mu V/m$ $48 dB\mu V/m = 250\mu V/m$

1.4 Measurement Results

Pursuant to the ET Docket 03–201; FCC 04–165, July 12/2004, and Federal Register / Vol. 69, No. 172, September 7/2004, the test was performed with the highest gain antenna among the supported host devices. i.e. IBM ThinkPad R50 Series, LCD 15" model, auxiliary antenna

The representative worse cases in the previous applications were selected and examined for the compliance of the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700HER) for each Tx mode. As for the Rx mode, the tests were performed with the middle band (i.e. 5260MHz). The tested Tx/Rx modes are as follows.

Table 1-2	Radiated	Emission	.Tested	Tx/Rx	modes
	Radiated	Linission	, I Colou	1 // 1 //	moues

5.18G - 5.32GHz	OEDM	Tx	Ch.52 (5260MHz), 6Mb/s	Previous granted date		
	OFDM	Rx	Ch.52 (5260MHz)	T40/R50 Series: July/26/2004		

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 2.3dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: November 4, 2004

EUT in 5.2GHz OFDM transmission mode with ThinkPad R50 Series, LCD 15" model, Auxiliary antenna

Frequency	Polarity	Measured	Antenna	Corr.	Field Limit		Margin	Field	Limit
			Factor	Factor	Strength		to limit	Strength	
(MHz)	(H/V)	(dBµV)	(dB/m)	(dB)	$(dB\mu V/m)$	$(dB\mu V/m)$	(dB)	(µV/m)	(µV/m)
196.605	Н	52.7	13.6	-26.7	39.6	43.5	3.9	95.5	150
341.999	V	47.9	14.3	-22.8	39.4	46.0	6.6	93.3	200
353.999	V	52.0	14.4	-22.7	43.7	46.0	2.3	153.1	200
365.999	V	48.6	14.4	-22.3	40.7	46.0	5.3	108.4	200
600.459	Н	36.1	18.7	-19.8	35.0	46.0	11.0	56.2	200
729.014	Н	39.2	21.1	-19.0	41.3	46.0	4.7	116.1	200

Table 1-3-2. Ch.52 (5260MHz) OFDM **RX** mode with the co-located Bluetooth device in active

Frequency	Polarity	Measured	Antenna	Corr.	Field	Limit	Margin	Field	Limit
(MHz)	(H/V)	(dBµV)	Factor (dB/m)	Factor (dB)	Strength (dBµV/m)	(dBµV/m)	to limit (dB)	Strength (µV/m)	(µV/m)
143.180	V	45.3	12.2	-27.3	30.2	43.5	13.3	32.4	150
200.453	Н	50.3	11.4	-25.1	36.6	43.5	6.9	67.6	150
341.998	V	50.5	14.3	-22.8	42.0	46.0	4.0	125.9	200
353.998	V	51.8	14.4	-22.7	43.5	46.0	2.5	149.6	200
365.997	V	49.5	14.4	-22.3	41.6	46.0	4.4	120.2	200
729.015	Н	39.7	21.1	-19.0	41.8	46.0	4.2	123.0	200

2. Restricted Bands Radiatio (1GHz – 40GHz) [FCC 15.205 / 209, RSS-210 6.3 / 7.3]

2.1 Test Procedure

Radiated emissions were measured in the frequency range with 1 GHz to 40GHz in transmitting mode and 1 GHz to 25GHz in receiving mode. All tests were performed in the semi-anechoic chamber at a 3-meter distance (except for the frequency range with 18 GHz to 40 GHz where test distance was reduced to 1 meter) on both horizontal and vertical polarities. The antenna was also scanned in height. The emissions are recorded with a spectrum analyzer in peak hold mode. The identified emissions are further maximized as a function of cable manipulation, azimuth, and antenna height. The emissions closest to the limits are measured in the peak mode with the tuned spectrum analyzer using resolution bandwidth of 1MHz / video bandwidth of 1MHz, and the average setting mode with the tuned spectrum analyzer using resolution bandwidth of 1MHz / video bandwidth of 100Hz or 10Hz. The highest emissions relative to the limit are listed.

2.2 Test Instruments and Measurement Setup

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Spectrum Analyzer	HP 8563E	3416A02248
Harmonic Mixer (26.5 – 40GHz)	Agilent 11970A	011269-001
Amplifier (1 - 18GHz)	HP 8449B	3008A00582
Amplifier (18 – 40GHz)	Agilent 83051A	3950M00193
Horn Antenna (1 - 18GHz)	EMCO 3115	9903-5774
Horn Antenna (3.95 – 5.85GHz)	EMCO 3160-5	1099
Horn Antenna (5.85 – 8.2GHz)	EMCO 3160-6	9712-1044
Horn Antenna (8.2 – 12.4GHz)	EMCO 3160-7	1156
Horn Antenna (12.4 – 18GHz)	EMCO 3160-8	1143
Horn Antenna (18 - 26.5GHz)	EMCO 3160-9	0004-1202
Horn Antenna (26.5 - 40GHz)	EMCO 3160-10	1175
Coaxial cables:	Length:	
- Horn Ant <=> RF Amp. (1-18GHz)	6 m	- EM206SCO
- RF Amp. <=>Spectrum Analyzer (1-12.4GHz)	16 m	- GEM0101
- RF Amp. <=>Spectrum Analyzer (12.4-18GHz)	3m	- SF102-20166
- Horn Ant <=> RF Amp. (18-40GHz)	3m	- SF102-20167
- RF Amp. <=>Spectrum Analyzer (18-40GHz)	1m	- SF102-21105

Table 2 Radiated Emission Test Instrumentation (1GHz – 40GHz)

Notes: HP: Hewlett Packard, R&S: Rohde & Schwarz



Figure 2-1. Cables for Radiated Emission Test (1 – 12.4 GHz)

EMI SEMIANECHOIC CHAMBER



Antenna

Figure 2-2. Cables for Radiated Emission Test (12.4 - 18GHz)

EMI SEMIANECHOIC CHAMBER



Antenna

Figure 2-3. Cables for Radiated Emission Test (18 – 26.5GHz)

EMI SEMIANECHOIC CHAMBER



Figure 2-4. Cables for Radiated Emission Test (26.5 - 40GHz)

2.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where:

FS =	Field Strength
R =	Measured Spectrum analyzer Input Amplitude
AF =	Antenna Factor
CORR=	Correction Factor = CL-AG
CL =	Cable Loss
AG =	Amplifier Gain
FO =	Distance Falloff Factor

For example :

Given a Spectrum Analyzer input reading of 51.5 dBµV; Antenna Factor of 8.5 dB/m; Cable Loss of 1.3 dB; Falloff Factor of 0 dB; and an Amplifier Gain of 26 dB. The Field Strength of the measured emission is:

FS = $51.5 + 8.5 + 1.3 - 26 - 0.0 = 35.6 \, dB\mu V/m$

Conversions between dBµV/m (or dBµV) and µV/m (or µV) are done as :

Level(dBµV/m)	=	$20 \times \text{Log} (\text{Level}(\mu V/m))$
$40 \text{ dB}\mu\text{V/m}$	=	$100 \ \mu V/m$
$48 \text{ dB}\mu\text{V/m}$	=	$250 \mu\text{V/m}$

2.4 Limits

Table 2-1. Limits for EIRP emissions

Limit for emissions in restricted bands FCC 15.205&209 / RSS-210 6.3&7.3	54 dB μ V/m (average)	74 dB μ V/m (peak)		
Limit for emissions in non_restricted bands FCC 15.407(b)(1)&(2) / RSS-210 (g1)(i)&(ii)	EIRP 68.2 dB μ V/m (-27 dBm/MHz)			

2.5 Measure ment Results

Pursuant to the ET Docket 03–201; FCC 04–165, July 12/2004, and Federal Register / Vol. 69, No. 172, September 7/2004, the test was performed with the highest gain antenna among the supported host devices. i.e. IBM ThinkPad R50 Series, LCD 15" model, auxiliary antenna

The representative worse cases in the previous applications were selected and examined for the compliance of the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700HER) for each Tx mode. As for the Rx mode, the tests were performed with the middle band (i.e. 5260MHz). The tested Tx/Rx modes are as follows.

Table 2-2	Radiated Emission	Tested Tx/Rx n	nodes
$1 ao 10 2^{-2}$	Radiated Linission	, I COLCU I A/IXA II	noucs

5.18G - 5.32GHz	OFDM	Tx	Ch.36 (5180MHz), 6Mb/s	Previous granted date		
	OPDM	Rx	Ch.52 (5260MHz)	T40/R50 Series: July/26/2004		

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 2.7 dB. The measurement was done for the frequency range of 1 GHz to 40 GHz in TX mode and 1 GHz to 25GHz in RX mode.

Test Date: November 2, 8, 17 and 24, 2004

EUT in 5.2GHz OFDM transmission mode with ThinkPad R50 Series, LCD 15" model, Auxiliary antenna

*Note: OB means "operation band" (5150-5250MHz). NRB means "non restricted band": The limit of FCC Part 15.407(b)(1),(2) and RSS-210 6.2.2(q1)(I),(ii) apply.

Frequency	Polarity	Measured	Measured	Antenna	Corr.	Falloff	Field	FCC	M argin	Field	FCC	Margin	
				Factor	Factor	Factor	Strength	Limit	to limit	Strength	Limit	to limit	
(GHz)	(H/V)	(dBµV)	(dBµV)	(dB/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	$(dB\mu V/m)$	$(dB\mu V/m)$	(dB)	
		(peak)	(average)					(peak)		•	(average)		
OB													
5.182	Н	101.3	90.7	33.7	-26.1	0.0	108.9	N/A	-	98.3	N/A	_	
bandedge													
5.148	Н	59.7	42.8	33.6	-26.1	0.0	67.2	74.0	6.8	50.3	54.0	3.7	
5.149	Н	60.3	43.2	33.6	-26.1	0.0	67.8	74.0	6.2	50.7	54.0	3.3	
5.150	Н	58.8	43.8	33.6	-26.1	0.0	66.3	74.0	7.7	51.3	54.0	2.7	
1.094	V	49.4	-	24.4	-31.5	0.0	42.3	74.0	31.7	-	54.0	-	
1.126	V	50.9	-	24.5	-31.6	0.0	43.8	74.0	30.2	-	54.0	-	
1.160	V	49.9	-	24.6	-31.3	0.0	43.2	74.0	30.8	-	54.0	-	
1.196	V	50.5	-	25.2	-31.3	0.0	44.4	74.0	29.6	-	54.0	-	
4.819	Н	45.2	-	27.1	-26.6	0.0	45.7	74.0	28.3	-	54.0	-	
4.836	Н	48.0	-	27.0	-26.5	0.0	48.5	74.0	25.5	-	54.0	-	
4.896	Н	47.2	-	27.0	-26.6	0.0	47.6	74.0	26.4	-	54.0	-	
4.934	Н	45.8	-	27.1	-26.4	0.0	46.5	74.0	27.5	-	54.0	-	
7.275	Н	41.0	-	29.9	-24.6	0.0	46.3	74.0	27.7	-	54.0	-	
7.347	Н	38.8	-	29.8	-24.5	0.0	44.1	74.0	29.9	-	54.0	-	
7.387	Н	41.3	-	29.8	-24.5	0.0	46.6	74.0	27.4	-	54.0	-	
10.361	V	45.9	-	33.5	-21.2	0.0	58.2	68.2	10.0	-	NRB	-	
15.543	V	40.3	28.8	37.2	-23.6	0.0	53.9	74.0	20.1	42.4	54.0	11.6	

Table 2-3-1. Ch.36 (5180MHz) 6Mb/s OFDM **TX** mode with the co-located Bluetooth device in active

Frequency	Polarity	Measured	Measured	Antenna	Corr.	Falloff	Field	FCC	Margin	Field	FCC	Margin
				Factor	Factor	Factor	Strength	Limit	to limit	Strength	Limit	to limit
(GHz)	(H/V)	(dBµV)	(dBµV)	(dB/m)	(dB)	(dB)	(dBµV/m)	(dBµV/m)	(dB)	$(dB\mu V/m)$	$(dB\mu V/m)$	(dB)
		(peak)	(average)				(peak)			(average)		
1.094	V	50.8	-	24.4	-31.5	0.0	43.7	74.0	30.3	-	54.0	-
1.108	V	48.8	-	24.4	-31.5	0.0	41.7	74.0	32.3	-	54.0	-
1.158	V	49.6	-	24.6	-31.3	0.0	42.9	74.0	31.1	-	54.0	-
1.194	V	48.4	-	25.2	-31.3	0.0	42.3	74.0	31.7	-	54.0	-

Table 2-3-2. Ch.52 (5260MHz) OFDM **RX** mode with the co-located Bluetooth transmitter

2.6 Bandedge Plots measured with the highest antenna gain

Measured host device: ThinkPad R50 Series, LCD 15" model, Auxiliary antenna

Table 2-4.	Ch.36	(5180MHz)	and	Ch.64	(5320MHz)	with the	co-located	Bluetooth	transmitter
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	Frequency (GHz)	Polarity (H/V)	Reading (dBµV)	Rading (dBµV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBµV/m)	Margin to Limit (dB) (<i>neak</i>)	Field Strength (dBµV/m)	Margin to Limit (dB) (average)
Ch.36	5.150	Н	(<i>peuk</i>) 58.8	43.8	33.6	-26.1	0.0	(<i>peak</i>) 66.3	7.7	51.3	2.7
Ch.64	5.350	Н	59.8	41.8	33.9	-25.6	0.0	68.1	5.9	50.1	3.9







Plot -2 5180MHz TX mode (Average) with the co-located Bluetooth transmitter



Plot-3 5320MHz TX mode (Peak) with the co-located Bluetooth transmitter

Plot-4 5320MHz TX mode (Average) with the co-located Bluetooth transmitter