

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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EMC R&D Staff Engineer

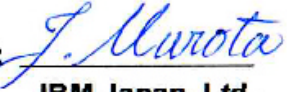
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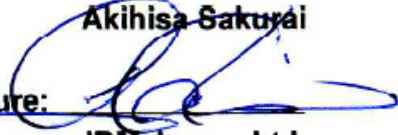
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MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart E

(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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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 : AR5BMB-44
 (Advertising Name) (IBM 11a/b/g Wireless LAN Mini PCI Adapter II)
 FCC ID : ANO20040600BTL
 IC Certification Number : 349E-AR5BMB44
 SERIAL NUMBER : 00S0SIT004
 PHYSICAL 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](#))
- These 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.

Table-B List of the measurements

Section(s)	Test Items		Condition	Result
	Transmit mode (TX):			
15.407(a)(1), (2) 6.2.2 (q1)(i)(ii)	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).	Conducted	Pass
	Peak conducted transmit output power or EIRP for IC	5150-5250MHz: FCC: 50mW or (4+10logB)dBm IC : 200mW* or (10+10logB)dBm* *: EIRP		Pass
		5250-5350MHz: FCC: 250mW or (11+10logB)dBm IC : 250mW or (11+10logB)dBm IC : 1W* or (17+10logB)dBm* *: EIRP B: 26dB BW in MHz		Pass
		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
	N/A 6.2.2 (q1)(iv)(b)	Peak Spectral Density		IC: 3 + 10logB dBm/MHz
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(dBμV) Ave.(dBμV) 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) 6.2.1 / 6.2.2(q1)(i)(ii)(v) / 6.3	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3. Ave. 54dBμV/m, peak 74dBμV/m and	Radiated (30MHz - 1GHz)	Pass
		FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP –27dBm/MHz	Radiated (1G - 40GHz)	Pass

	Receive 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(dBμV) Ave.(dBμV) 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) 6.2.1 / 6.2.2(q1)(i)(ii)(v) / 7.3	General Field Strength Limits (Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3. 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 (30MHz - 1GHz)	Pass
			Radiated (1G - 25GHz)	Pass

	Other 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 Frequency [GHz]	Designed average output power (conducted) [dBm]							
	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.

Table-D Peak Antenna Gains of EUT

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

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

Description	Model	Serial Number	Calibration Date	Calibration 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 year
Spectrum Analyzer Display	HP 85662A	2816A16831	08/25/04	1 year
Quasi-Peak Adapter	HP 85650A	2521A00968	07/20/04	1 year
Quasi-Peak Adapter	HP 85650A	2811A01156	08/25/04	1 year
Amplifier (100KHz - 1.3GHz)				
- for 30-200MHz	MITEQ AM-3A	898433	04/23/04	1 year
- for 200-1000MHz	MITEQ AM-3A	898432	04/23/04	1 year
Amplifier (1GHz - 18GHz)	HP 8449B	3008A00582	06/01/04	1 year
Amplifier (18 – 40GHz)	Agilent 83051A	3950M00193	01/27/04	1 year
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003	05/10/04	1 year
Spectrum Analyzer	HP 8563E	3416A02248	09/10/04	1 year
Harmonic Mixer	Agilent 11970A	011269-001	08/04/04	1 year
Receiver (20MHz-1.3GHz)	R&S ESVP	893202/018	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
Coaxial cables (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	1 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 30- 200MHz	2 m	- EM1SPL	04/23/04	1 year
- SW/Con.unit <=> Spe Ana.(Signal In) for 200-1000MHz	2 m	- EM1SPH	04/23/04	1 year

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

Table 1-1 Radiated Emission Test Instrumentation

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

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

Prepared by T. Asano

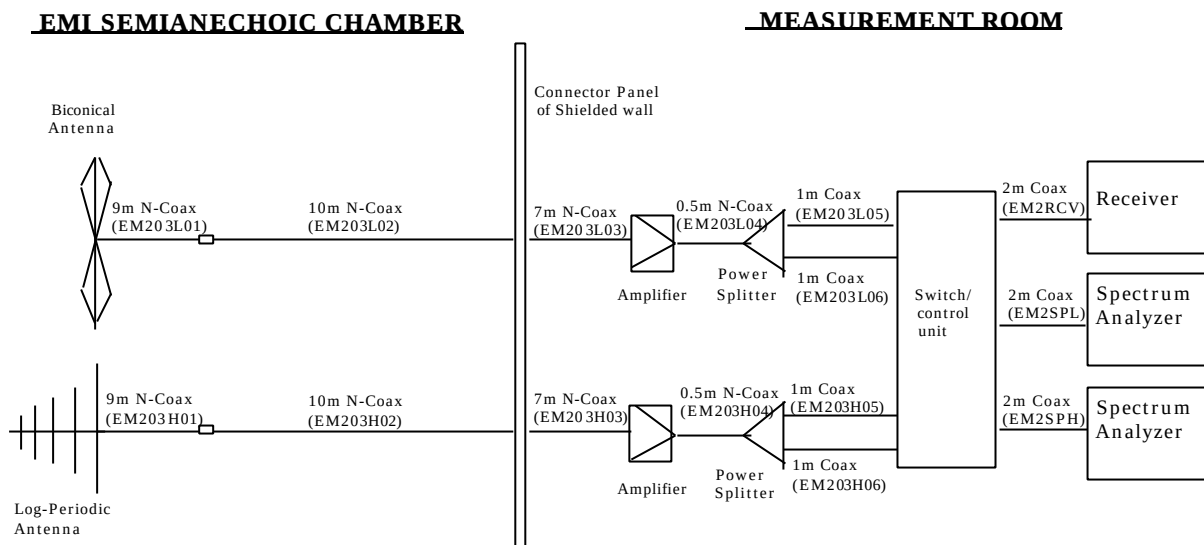


Figure 1 Cables for Radiated Emission Test

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 51.5dB μ V; 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:

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

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

$$40\text{dB}\mu\text{V/m} = 100\mu\text{V/m}$$

$$48\text{dB}\mu\text{V/m} = 250\mu\text{V/m}$$

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

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

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

Table 1-3-1. Ch.52 (5260MHz) 6Mb/s OFDM **TX** mode with the co-located Bluetooth device in active

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin to limit (dB)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	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	H	36.1	18.7	-19.8	35.0	46.0	11.0	56.2	200
729.014	H	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 (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin to limit (dB)	Field Strength (μV/m)	Limit (μV/m)
143.180	V	45.3	12.2	-27.3	30.2	43.5	13.3	32.4	150
200.453	H	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	H	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

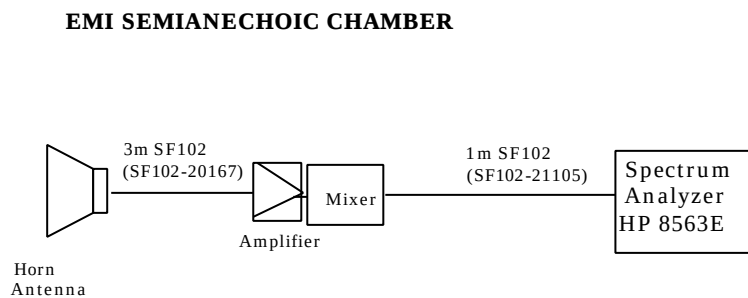
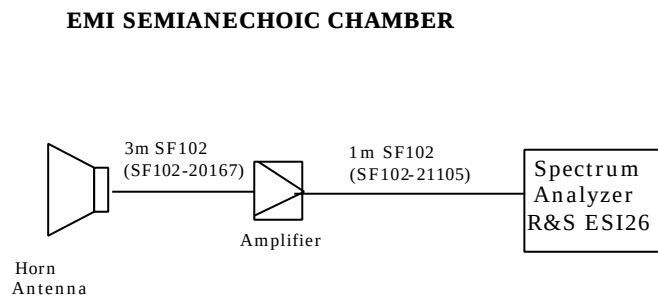
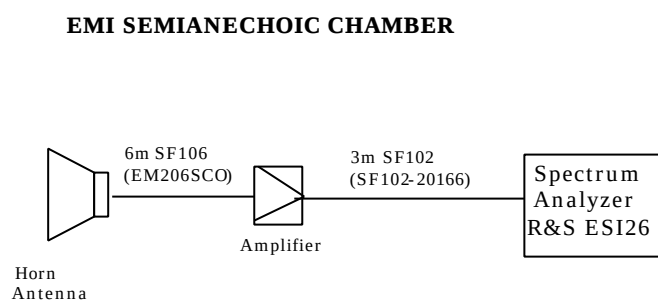
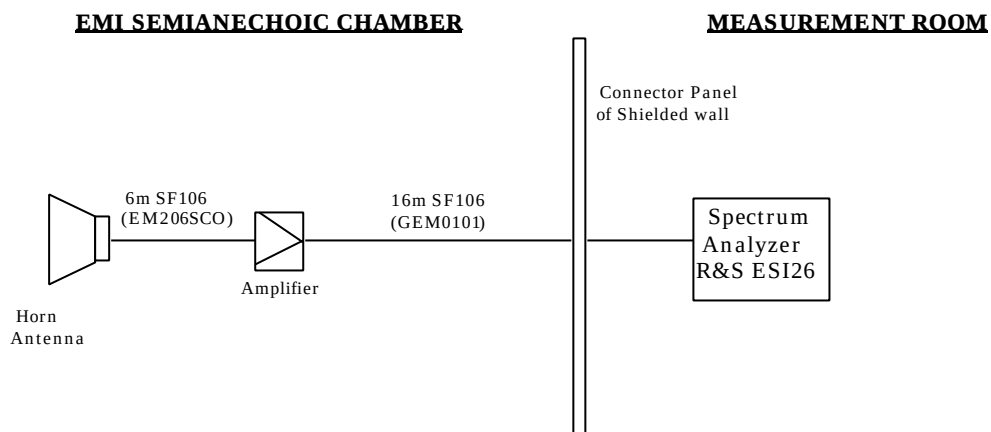
Radiated emissions were measured in the frequency range with 1 GHz to 40GHz in transmitting mode and 1 GHz to 25GHz in receiving mode. All tests were performed in the semi-anechoic chamber at a 3-meter distance (except for the frequency range with 18 GHz to 40 GHz where test distance was reduced to 1 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

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

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: - Horn Ant <=> RF Amp. (1-18GHz) - RF Amp. <=> Spectrum Analyzer (1-12.4GHz) - RF Amp. <=> Spectrum Analyzer (12.4-18GHz) - Horn Ant <=> RF Amp. (18-40GHz) - RF Amp. <=> Spectrum Analyzer (18-40GHz)	Length: 6 m 16 m 3m 3m 1m	- EM206SCO - GEM0101 - SF102-20166 - SF102-20167 - SF102-21105

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



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:

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

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

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

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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 dBμV/m (average)	74 dBμV/m (peak)
Limit for emissions in non_restricted bands FCC 15.407(b)(1)&(2) / RSS-210 (q1)(i)&(ii)	EIRP 68.2 dBμV/m (-27 dBm/MHz)	

2.5 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 2-2 Radiated Emission ,Tested Tx/Rx modes

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

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.

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

Frequency (GHz)	Polarity (H/V)	Measured (dBμV) (peak)	Measured (dBμV) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m)	FCC Limit (dBμV/m)	Margin to limit (dB)	Field Strength (dBμV/m)	FCC Limit (dBμV/m)	Margin to limit (dB)
							(peak)			(average)		
OB												
5.182 bandedge	H	101.3	90.7	33.7	-26.1	0.0	108.9	N/A	-	98.3	N/A	-
5.148	H	59.7	42.8	33.6	-26.1	0.0	67.2	74.0	6.8	50.3	54.0	3.7
5.149	H	60.3	43.2	33.6	-26.1	0.0	67.8	74.0	6.2	50.7	54.0	3.3
5.150	H	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	H	45.2	-	27.1	-26.6	0.0	45.7	74.0	28.3	-	54.0	-
4.836	H	48.0	-	27.0	-26.5	0.0	48.5	74.0	25.5	-	54.0	-
4.896	H	47.2	-	27.0	-26.6	0.0	47.6	74.0	26.4	-	54.0	-
4.934	H	45.8	-	27.1	-26.4	0.0	46.5	74.0	27.5	-	54.0	-
7.275	H	41.0	-	29.9	-24.6	0.0	46.3	74.0	27.7	-	54.0	-
7.347	H	38.8	-	29.8	-24.5	0.0	44.1	74.0	29.9	-	54.0	-
7.387	H	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 2-3-2. Ch.52 (5260MHz) OFDM **RX** mode with the co-located Bluetooth transmitter

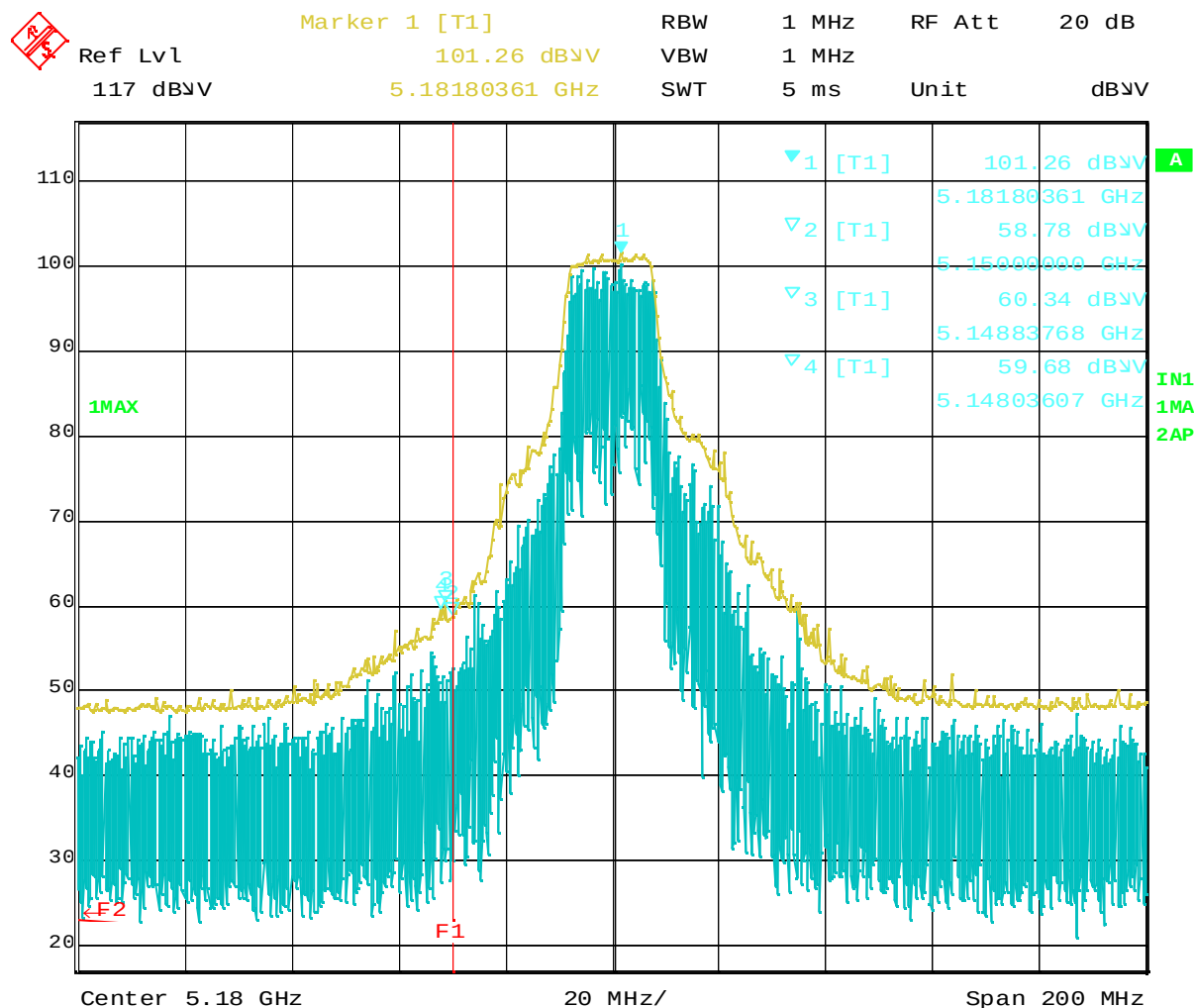
Frequency (GHz)	Polarity (H/V)	Measured (dBμV) <i>(peak)</i>	Measured (dBμV) <i>(average)</i>	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m)	FCC Limit (dBμV/m)	Margin to limit (dB)	Field Strength (dBμV/m)	FCC Limit (dBμV/m)	Margin to limit (dB)
							<i>(peak)</i>			<i>(average)</i>		
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	-

2.6 Bandedge Plots measured with the highest antenna gain

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

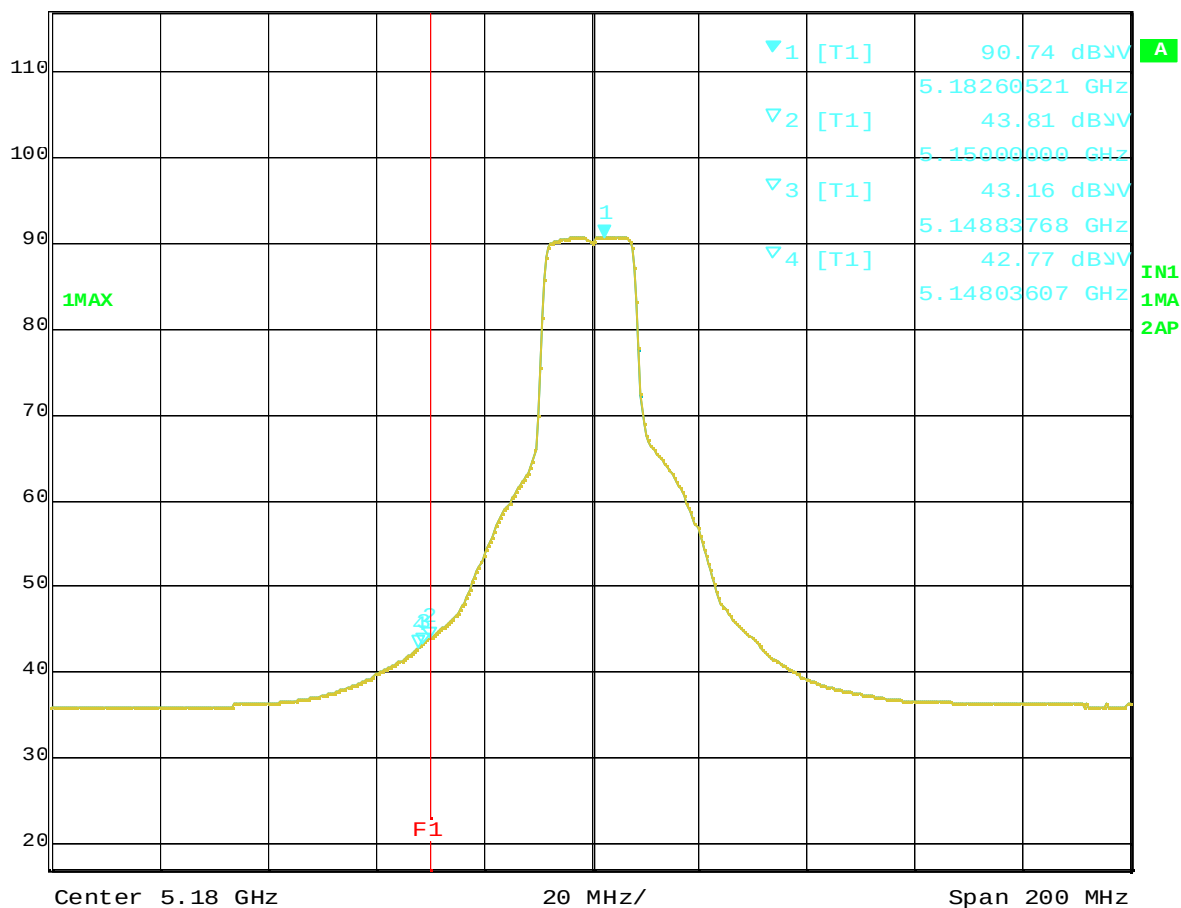
Table 2-4. Ch.36 (5180MHz) and Ch.64 (5320MHz) with the co-located Bluetooth transmitter

	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) (peak)	Reading (dBμV) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) (peak)	Margin to Limit (dB) (peak)	Field Strength (dBμV/m) (average)	Margin to Limit (dB) (average)
Ch.36	5.150	H	58.8	43.8	33.6	-26.1	0.0	66.3	7.7	51.3	2.7
Ch.64	5.350	H	59.8	41.8	33.9	-25.6	0.0	68.1	5.9	50.1	3.9



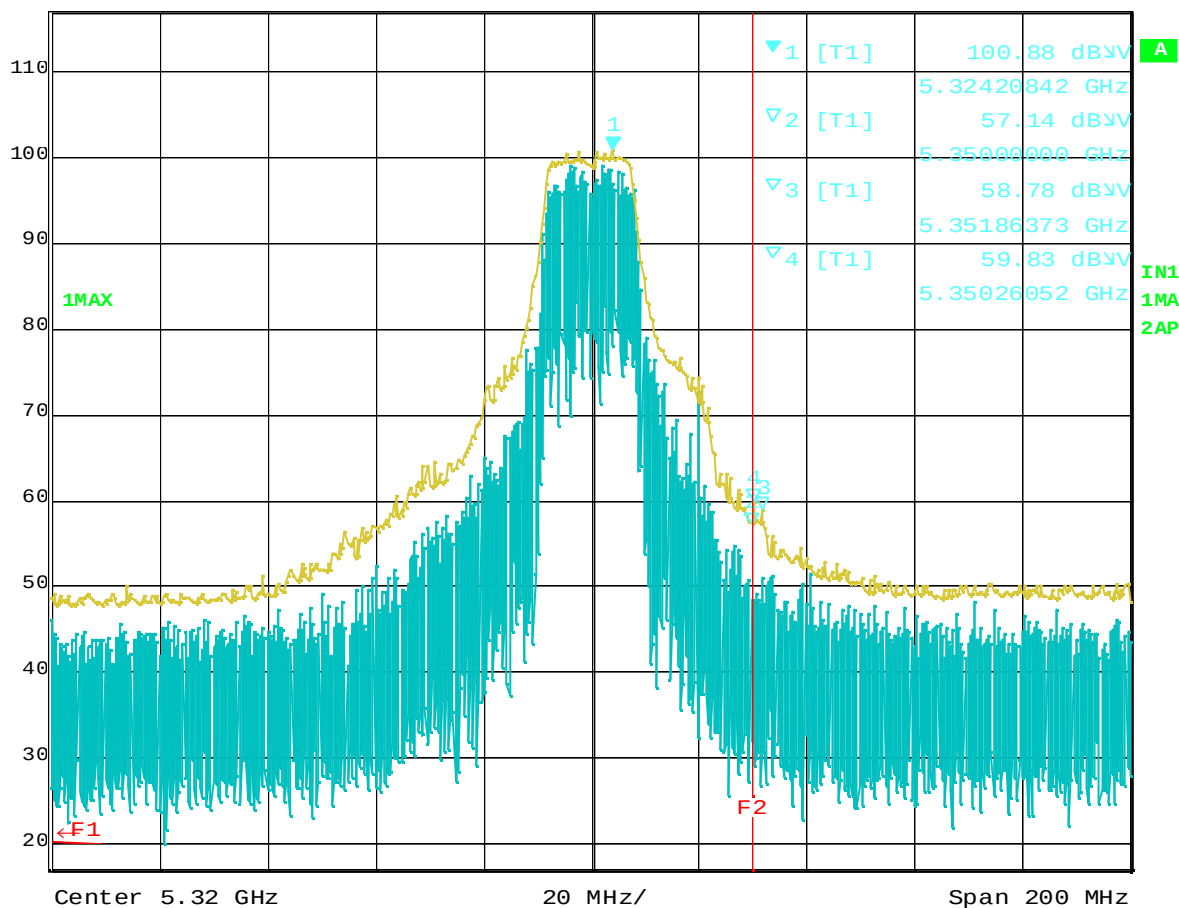
Date: 2.NOV.2004 16:23:58

Plot -1 5180MHz TX mode (Peak) with the co-located Bluetooth transmitter

Ref Lvl
117 dBμVMarker 1 [T1]
90.74 dBμV
5.18260521 GHzRBW 1 MHz RF Att 20 dB
VBW 10 Hz
SWT 50 s Unit dBμV

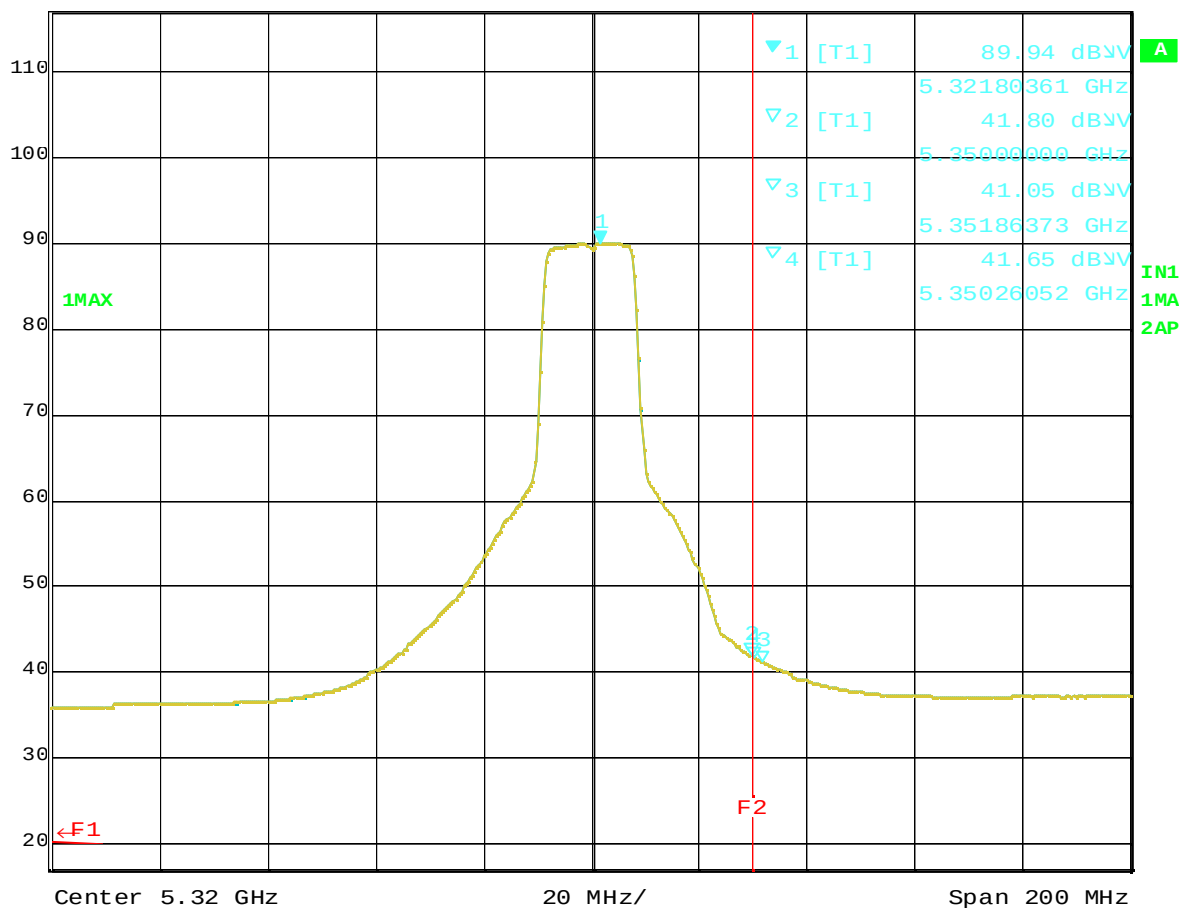
Date: 2.NOV.2004 16:25:14

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

Ref Lvl
117 dBμVMarker 1 [T1]
100.88 dBμV
5.32420842 GHzRBW 1 MHz RF Att 20 dB
VBW 1 MHz
SWT 5 ms Unit dBμV

Date: 2.NOV.2004 16:29:46

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

Ref Lvl
117 dBμVMarker 1 [T1]
89.94 dBμV
5.32180361 GHzRBW 1 MHz RF Att 20 dB
VBW 10 Hz
SWT 50 s Unit dBμV

Date: 2.NOV.2004 16:31:10

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