

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

**Document Number : FCC 19-0281-1**

**Model Number: WM3B2915ABG**

**FCC ID: ANO20040601CX2**

**IC: 349E-WM3B29AG**

**December 16, 2004**

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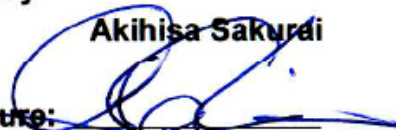
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**Revision History**

<b>Revision</b>	<b>By Whom</b>	<b>Comment</b>	<b>Date</b>
FCC 19-0281-0	Takeshi Asano	The original document for FCC Class II certification approval	November 29, 2004,
FCC 19-0281-1	Takeshi Asano	Update of the Table 3-2-3 in page 24 due to the missing measurement results of average field strength levels at the 4950MHz and 4957MHz.	December 16, 2004

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

**FCC ID : ANO20040601CX2**

**Model: WM3B2915ABG (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 29, 2004**

This report concerns: (check one)

Original Grant ☐

Class I change ☐

Class II change ☒

Equipment type: Bluetooth modular 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).

☒ Yes or No

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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)	: WM3B2915ABG (Intel PRO/Wireless 2915 ABG Mini-PCI Adapter)
FCC ID IC Certification Number	: ANO20040601CX2 : 349E-WM3B29AG
SERIAL NUMBER	: Z9H949X050
PHYSICAL CONDITION	: Preproduction
KIND OF EQUIPMENT	: Personal computer with a IEEE802.11a, 11b & 11g Wireless LAN Mini-PCI Combo Card ( <a href="#">Composite application</a> )
TESTED DATE	: November 12, 15, 16, 17, 18, 22, 24 and 25, 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
WM3B2915ABG (s/n Z9H949X050)	FCC ID: ANO20040601CX2 IC: 349E-WM3B29AG	<b>Applying modular transmitter</b> Built_in type IEEE802.11a/b/g Wireless LAN Mini-PCI card without antenna
ThinkPad T40 Series M/T 2373-92U (14 inch) (s/n ZZ-00129)	N/A	Host equipment  IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.7GHz
ThinkPad X40 Series M/T : 2371-SD1 (s/n SIT#15023)		IBM Notebook PC with built-in antenna CPU: Intel® Pentium M Processor, 1.4 GHz
J07M067 (s/n 0020E04A4982)	FCC ID: ANO20040700HER IC:349E-J07M067	Co-located built-in type Bluetooth modular transmitter device without antenna
P/N 02K6810	N/A	Universal AC adapter 56W, Unshielded power cord for ThinkPad X40 Series
P/N 02K6746		Universal AC adapter 72W, Unshielded power cord for ThinkPad T40 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		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(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 FCC 15.407(b)(1)(2) or RSS-210 6.2.2(q1)(i)(ii) : EIRP –27dBm/MHz	Radiated (30MHz - 1GHz)	Pass
			Radiated (1G - 40GHz)	Pass

	<b>Receive mode (RX):</b>			
<b>15.207 / 407(b)(5) 6.2.2(q1)(v) / 7.4</b>	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
<b>15.205 &amp; 209 / 407(b)(1)(2)(5)(6)  6.2.1 / 6.2.2(q1)(i)(ii)(v) / 7.3</b>	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

	<b>Other general requirements</b>		<b>Result</b>
<b>15.407(a)(1)(2) N/A</b>	Antenna gain	Peak gain of the device : 2.84dBi in 5.2GHz band	N/A
<b>N/A 5.2</b>	Supply Voltage	Main power source: Universal AC adapter 72W Mini-PCI PC bus to applying card : DC 3.3V ± 0.3V	N/A
<b>N/A 6.2.2(q1)(iv)(a)</b>	Digital modulation	Applying equipment employs IEEE802.11a, 11g(OFDM) or 11b(DSSS) digital modulation technology.	complies
<b>15.407(c) 6.2.2(q1)(iv)(d)</b>	Automatic link disconnection in no transaction state	Refer to “Limited Modular Approval and U-NII Qualifications” or “Module Construction and LELAN Qualifications” documents.	complies
<b>N/A 6.2.2(q1)(i)</b>	Integral antenna in the 5150M -5250MHz band	The device employs an unique electronic connector so called <b>Electronic Handshake</b> .	complies
<b>15.407(e) 6.2.2(q1)(i) (q1)(iv)(g)</b>	Indoor use in the 5150M - 5250MHz band, and interference from radars.	Refer to the manual (Regulatory Notice).	complies
<b>15.407(f) 6.2.2(q1)(iv)(g)</b>	RF Exposure Requirement	Refer to “RF Exposure Evaluation” or “Exposure of Humans to Radio Frequency Fields“ documents.	complies
<b>15.407(g) 6.2.2(q1)(iv)(e)</b>	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 “CRTU III, version 3.2.15.0000” test program provided by Intel Corporation. This tool supports the continuous or burst transmission mode for the testing purpose. The parameter GAIN of the test software was set to the Intel’s power specification shown in Table-C below.
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)	12	12	12	12	12	12	12	12 11
5.200 (Ch. 40)	12	12	12	12	12	12	12	12 11
5.220 (Ch. 44)	12	12	12	12	12	12	12	12 11
5.240 (Ch. 48)	12	12	12	12	12	12	12	12 11
5.260 (Ch. 52)	16	16	16	16	16	16 13	16 13	16 11
5.280 (Ch. 56)	16	16	16	16	16	16 13	16 13	16 11
5.300 (Ch. 60)	16	16	16	16	16	16 13	16 13	16 11
5.320 (Ch. 64)	16	16	16	16	16	16 13	16 13	16 11

Note) The power values of some higher transmission rates are reduced by the driver for best performance according EVM (Error Vector Magnitude) factor.

## D. Justification

Pursuant to the ET Docket 03–201; FCC 04–165, July 12/2004, and Federal Register / Vol. 69, No. 172, September 7/2004, the testing is required to the highest peak antenna gain among the supported host devices. The highest gain is shown in shading of Table-D below.

Based on the rule, this report includes the following contents.

- **AC wireline conducted emissions**

The antenna of the highest gain was already certified at the previous grant.

The representative worst case in the previous application was selected and examined to confirm the compliance for the new antenna systems. The highest gain among the new antenna systems was used for the test . i.e. ThinkPad X40 Series, auxiliary antenna.

- **Radiated emissions**

The antenna of the highest gain was already certified at the previous grant.

The representative worst case in the previous application was selected and examined to confirm the compliance for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO 20040700HER). Also the highest gain among the new antenna systems ( . i.e. ThinkPad X40 Series, auxiliary antenna) was measured with the same test cases.

Table-D Peak Antenna Gains of EUT

Host PC models		Granted date	5.2Ghz band	
			Main	Aux.
ThinkPad T40 Series	14"	October/07/2004	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		(new application)	1.42 dBi	0.19 dBi
ThinkPad X40 Series			1.45 dBi	2.15 dBi

- **Conducted measurements**

The representative worse cases in the previous application (granted on October/07/2004) were selected and examined to prove no electrical change was made to the EUT after the slight modification of applying modular transmitter device.

## E. Test Instruments

Table-C List of Measuring Instruments

Description	Model	Serial Number	Calibration Date	Calibration Interval
Computer	IBM 6868-30J	97-901X3	N/A	N/A
Computer	IBM 6589-13J	97-15613	N/A	N/A
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	2732A03651	07/21/04	1 year
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05156	08/05/04	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	3026A19366	08/05/04	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	2811A01433	08/05/04	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 (9kHz-30MHz)	R&S ESH3	891806/012	11/04/04	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
LISN	EMCO 3810/2NM	00022007	06/15/04	1 year
Switch/control unit	HP 3488A	2719A17226	N/A	N/A
		2719A17228	N/A	N/A
Plotter	HP 7550A	2631A33619	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:				
- Lisn-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/23/04	1 year
- Lisn-N <=> SW/Con.unit (SW101)	4 m	- EMIC-N	04/23/04	1 year
- SW/Con.unit <=> RCVR (Input)	1 m	- EMIC-R	04/23/04	1 year
- SW/Con.unit<=> Spe Ana.(Signal In)	1 m	- EMIC-S	04/23/04	1 year
- 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°C to 28°C.

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. AC Wireline Conducted Emissions (150KHz – 30MHz)

[ FCC 15.207/ 15.407(b)(5) ]  
[ RSS-210 6.2.2(q1)(v) / 6.6 / 7.4 ]

## 1.1 Test Procedure

The conducted emissions are measured in the IBM shielded room with a spectrum analyzer in peak hold. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9KHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

## 1.2 Test Instruments and Measurement Setup

Table 1-1. Conducted Emission Test Instrumentation

Description	Model	Serial Number
Computer	IBM 6589-13J	97-15613
Spectrum Analyzer (100Hz-1.5GHz)	HP 85680B	3019A05156
Spectrum Analyzer Display	HP 85662A	3026A19366
Quasi-Peak Adapter	HP 85650A	2811A01433
Receiver (9kHz-30MHz)	R&S ESH3	891806/012
LISN	EMCO 3810/2NM	00022007
Switch/control unit	HP 3488A	2719A17228
Plotter	HP 7550A	2631A33619
Coax cables: - Lisen-L <=> SW/Con.unit (SW100) - Lisen-N <=> SW/Con.unit (SW101) - SW/Con.unit <=> RCVR (Input) - SW/Con.unit<=> Spe Ana.(Signal In)	Length: 4 m 4 m 1 m 1 m	- EMIC-L - EMIC-N - EMIC-R - EMIC-S

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

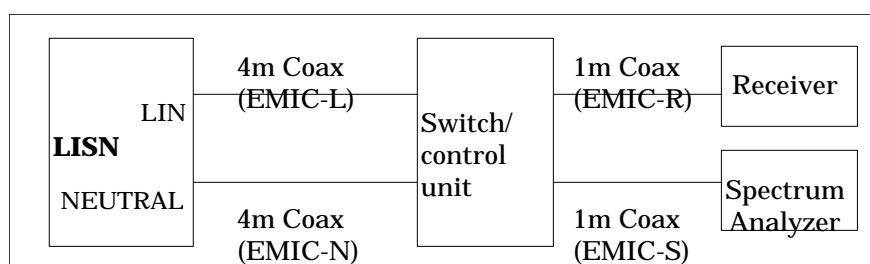


Figure 1. Cables for Conducted Emission Test

### 1.3 Powerline Voltage Calculation

The powerline voltage is calculated by adding insertion losses of LISN, Cable, Switch control unit and Pulse limiter to the measured reading. All factors are included in the reported data.

$$PV = R + CORR$$

where:

$$PV = \text{Powerline Voltage (dB}\mu\text{V)}$$

$$R = \text{Measured Receiver Input Amplitude (dB}\mu\text{V)}$$

$$CORR = \text{Correction Factor (dB) = LL+CL+SWL+PLL}$$

$$LL = \text{Insertion loss of LISN (dB)}$$

$$CL = \text{Insertion loss of Cable (dB)}$$

$$SWL = \text{Insertion loss of Switch control unit (dB)}$$

$$PLL = \text{Insertion loss of Pulse Limiter (dB)}$$

Given a Receiver input reading of 50.0 dB $\mu$ V, LISN loss of 0.6 dB, Cable loss of 0.1dB, Switch control unit loss of 0.1dB and Pulse limiter loss of 0.2dB. The Powerline Voltage of the measured emission is:

$$CORR = 0.6 + 0.1 + 0.1 + 0.2 = 1.0 \text{ (dB)}$$

$$PV = 50.0 + 1.0 = 51.0 \text{ (dB}\mu\text{V)}$$

## 1.4 Measurement Results

The antenna of the highest gain was already certified at the previous grant. The representative worst case in the previous application was selected and examined to confirm the compliance for the new antenna systems. The highest gain among the new antenna systems was used for the test.  
i.e. ThinkPad X40 Series, auxiliary antenna.

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 14.8dB. The 6 highest emissions relative to the limits are reported.

Test Date: November 18, 2004

Table 1-2-1. Ch.36 (5180MHz) 6Mbps OFDM mode (ThinkPad X40 Series, Auxiliary antenna)

Frq. (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	Margin to limit (dB)	CISPR22 AV Limit (dBμV)	Margin to limit (dB)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)					
0.2705	37.3	0.6	37.9	31.4	0.6	32.0	61.1	23.2	51.1	19.1	Neutral
0.3371	32.2	0.6	32.8	25.2	0.6	25.8	59.3	26.5	49.3	23.5	Line
0.4740	32.9	0.6	33.5	29.7	0.6	30.3	56.4	22.9	46.4	16.1	Neutral
0.5365	27.3	0.6	27.9	23.3	0.6	23.9	56.0	28.1	46.0	22.1	Line
0.6062	24.1	0.6	24.7	21.3	0.6	21.9	56.0	31.3	46.0	24.1	Line
1.8848	22.8	0.7	23.5	20.9	0.7	21.6	56.0	32.5	46.0	24.4	Neutral

Table 1-2-2. Ch.52 (5260MHz) OFDM **RX** mode (ThinkPad X40 Series, Auxiliary antenna)

Frq. (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	Margin to limit (dB)	CISPR22 AV Limit (dBμV)	Margin to limit (dB)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)					
0.2041	45.8	0.5	46.3	38.1	0.5	<b>38.6</b>	63.4	17.1	53.4	14.8	Neutral
0.2732	33.8	0.6	34.4	27.6	0.6	28.2	61.0	26.6	51.0	22.8	Neutral
0.4736	33.2	0.6	33.8	29.9	0.6	30.5	56.5	22.7	46.5	16.0	Neutral
0.5401	26.5	0.6	27.1	22.4	0.6	23.0	56.0	28.9	46.0	23.0	Line
0.6052	24.0	0.6	24.6	21.3	0.6	21.9	56.0	31.4	46.0	24.1	Line
1.9520	22.3	0.7	23.0	19.9	0.7	20.6	56.0	33.0	46.0	25.4	Neutral

## 2. Restricted Bands Radiations (30MHz – 1GHz)

[ FCC 15.205&209 / 15.407(b)(1),(2),(5),(6) ]

[ RSS-210 6.2.1 / 6.2.2(q1)(i),(ii),(v) / 6.3 / 7.3 ]

### 2.1 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.

### 2.2 Test Instruments and Measurement Setup

Table 2-1 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



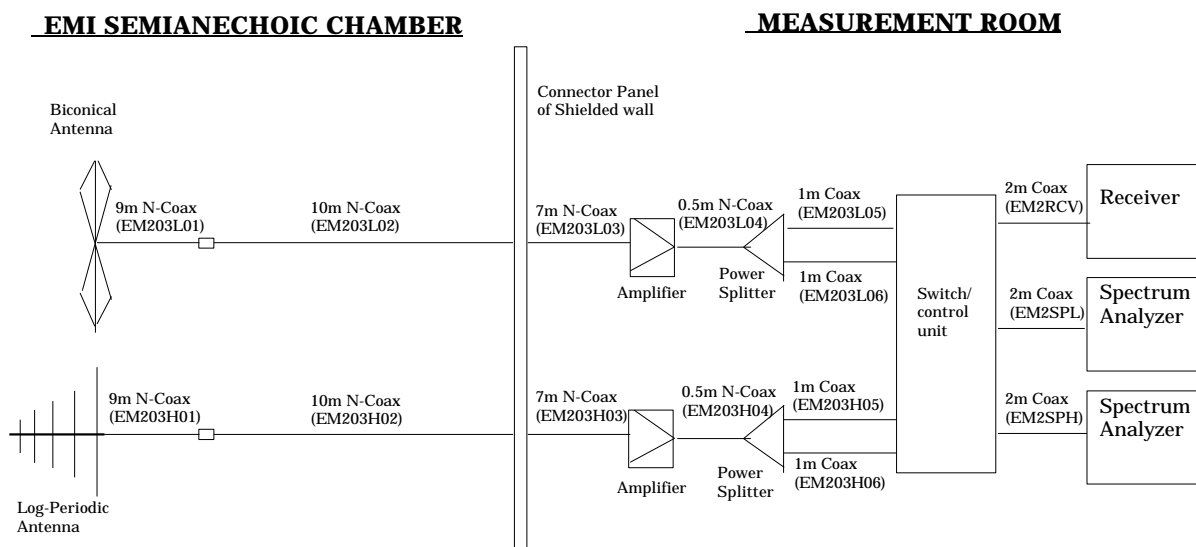


Figure 2 Cables for Radiated Emission Test

## 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. 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 $\mu$ 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 $\mu$ V/m (or dB $\mu$ V) and  $\mu$ V/m (or  $\mu$ V) are done as:

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

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

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

## 2.4 Measurement Results

The antenna of the highest gain was already certified at the previous grant. The representative worst case in the previous application was selected and examined to confirm the compliance for the multiple transmissions with the new co-located Bluetooth device (FCC ID: ANO20040700HER). Also the highest gain among the new antenna systems (i.e. ThinkPad X40 Series, auxiliary antenna) was measured with the same test cases.

The EUT was found to comply to the limits of FCC Part 15 Subpart E and RSS-210 with a margin of 6.5 dB at 30MHz - 1000MHz band. The 6 highest emissions relative to the limits are reported.

Test Date: November 16 and 25, 2004

Table 2-2-1. Ch.64 (5320MHz) 6Mbps ODFM mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad T40 Series, LCD 14" model, Main antenna

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	43.4	13.6	-26.7	30.3	43.5	13.2	32.7	150
400.505	V	43.5	15.3	-22.4	36.4	46.0	9.6	66.1	200
413.998	V	41.8	15.5	-22.2	35.1	46.0	10.9	56.9	200
425.999	V	43.9	15.7	-21.5	38.1	46.0	7.9	80.4	200
438.001	V	41.6	16.1	-21.2	36.5	46.0	9.5	66.8	200
801.009	V	34.4	21.2	-18.5	37.1	46.0	8.9	71.6	200

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

Host device: IBM ThinkPad T40 Series, LCD 14" model, Main antenna

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	43.9	13.6	-26.7	30.8	43.5	12.7	34.7	150
400.505	V	43.4	15.3	-22.4	36.3	46.0	9.7	65.3	200
413.998	V	41.2	15.5	-22.2	34.5	46.0	11.5	53.1	200
425.995	V	43.6	15.7	-21.5	37.8	46.0	8.2	77.6	200
437.998	V	41.0	16.1	-21.2	35.9	46.0	10.1	62.4	200
801.009	V	34.1	21.2	-18.5	36.8	46.0	9.2	69.2	200

Table 2-2-3. Ch.64 (5320MHz) 6Mbps ODFM mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary antenna

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)
48.000	V	49.2	10.9	-28.9	31.2	40.0	8.8	36.3	100
54.000	V	49.2	10.1	-28.8	30.5	40.0	9.5	33.5	100
60.000	V	52.7	9.3	-28.7	33.3	40.0	6.7	46.2	100
72.000	V	49.5	8.7	-28.3	29.9	40.0	10.1	31.3	100
78.001	V	49.8	7.8	-28.5	29.1	40.0	10.9	28.5	100
83.999	V	52.5	7.9	-28.5	31.9	40.0	8.1	39.4	100

Table 2-2-4. Ch.52 (5260MHz) OFDM **RX** mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary antenna

Frequency (MHz)	Polarity (H/V)	Measured (dB $\mu$ V)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin to limit (dB)	Field Strength ( $\mu$ V/m)	Limit ( $\mu$ V/m)
48.000	V	49.0	10.9	-28.9	31.0	40.0	9.0	35.5	100
54.000	V	49.2	10.1	-28.8	30.5	40.0	9.5	33.5	100
60.000	V	52.9	9.3	-28.7	<b>33.5</b>	40.0	6.5	47.3	100
78.001	V	49.8	7.8	-28.5	29.1	40.0	10.9	28.5	100
84.000	V	52.3	7.9	-28.5	31.7	40.0	8.3	38.5	100
379.476	V	45.6	14.7	-22.5	37.8	46.0	8.2	77.6	200

### 3. Restricted Bands Radiations (1GHz – 40GHz)

[ FCC 15.205&209 / 15.407(b)(1),(2),(5),(6) ]

[ RSS-210 6.2.1 / 6.2.2(q1)(i),(ii),(v) / 6.3 / 7.3 ]

#### 3.1 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.

#### 3.2 Test Instruments and Measurement Setup

Table 3 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 - 26.5GHz)	HP 8449B	3008A00582
Amplifier (26.5 – 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

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

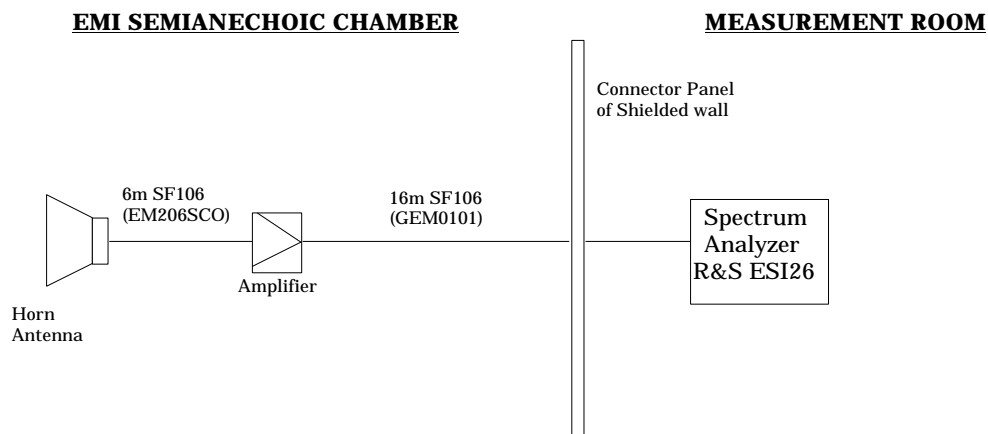


Figure 3-1. Cables for Radiated Emission Test (1 – 12.4 GHz)

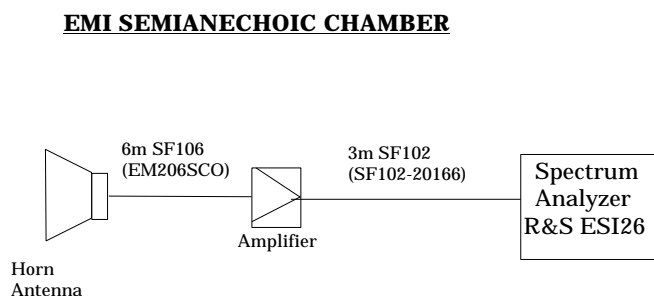


Figure 3-2. Cables for Radiated Emission Test (12.4 - 18GHz)

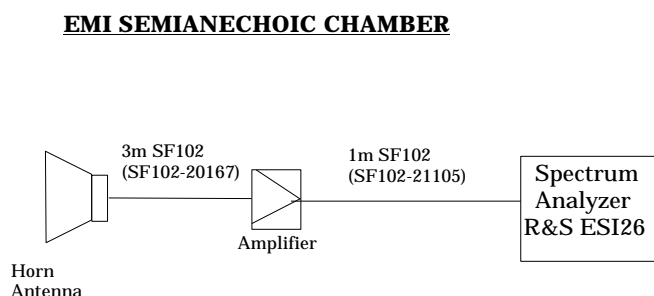


Figure 3-3. Cables for Radiated Emission Test (18 - 26.5GHz)

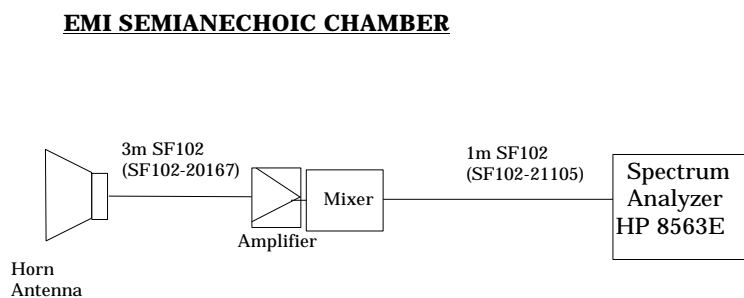


Figure 3-4. Cables for Radiated Emission Test (26.5 - 40GHz)

### 3.3 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 :

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

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

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

### 3.4 Limits

Table 3-1. Limits for EIRP emissions

Limit for emissions in restricted bands <b>FCC 15.205&amp;209 / RSS-210 6.3&amp;7.3</b>	54 dBμV/m (average)	74 dBμV/m (peak)
Limit for emissions in non_restricted bands <b>FCC 15.407(b)(1)&amp;(2) / RSS-210 (q1)(i)&amp;(ii)</b>	EIRP 68.2 dBμV/m ( -27 dBm/MHz )	

### 3.5 Measurement Results

The antenna of the highest gain was already certified at the previous grant. The representative worst case in the previous application was selected and examined to confirm the compliance for the multiple transmissions with the new co-located Bluetooth device (FCC ID: ANO20040700HER). Also the highest gain among the new antenna systems (i.e. ThinkPad X40 Series, auxiliary antenna) was measured with the same test cases.

The EUT was found to comply to the limits of FCC Part 15 Subpart E 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 15, 17, 22 and 24, 2004

Table 3-2-1. Ch.64 (5320MHz) 6Mbps OFDM mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad T40 Series, LCD 14" model, Main antenna

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												
5.315	H	102.1	91.7	33.7	-25.7	0.0	110.1	N/A	-	99.7	N/A	-
5.350	H	55.9	41.8	33.9	-25.6	0.0	64.2	74.0	9.8	50.1	54.0	3.9
5.352	H	56.6	41.0	33.9	-25.6	0.0	64.9	74.0	9.1	49.3	54.0	4.7
5.354	H	55.2	40.6	33.9	-25.6	0.0	63.5	74.0	10.5	48.9	54.0	5.1
1.002	V	51.3	-	24.1	-31.9	0.0	43.5	74.0	30.5	-	54.0	-
1.136	V	51.3	-	24.6	-31.4	0.0	44.5	74.0	29.5	-	54.0	-
1.198	V	52.8	-	25.2	-31.3	0.0	46.7	74.0	27.3	-	54.0	-
1.331	V	56.7	-	25.6	-31.0	0.0	51.3	74.0	22.7	-	54.0	-
4.810	V	53.6	26.7	27.1	-26.7	0.0	54.0	74.0	20.0	27.1	54.0	26.9
4.830	V	54.8	26.8	27.1	-26.6	0.0	55.3	74.0	18.7	27.3	54.0	26.7
4.872	V	50.1	-	27.0	-26.6	0.0	50.5	74.0	23.5	-	54.0	-
4.994	H	44.6	-	27.1	-26.1	0.0	45.6	74.0	28.4	-	54.0	-
5.417	H	52.2	40.5	34.1	-25.6	0.0	60.7	74.0	13.3	49.0	54.0	5.0
7.331	H	41.5	-	29.8	-24.4	0.0	46.9	68.2	21.3	-	54.0	-
7.383	H	45.2	-	29.8	-24.5	0.0	50.5	74.0	23.5	-	54.0	-
7.399	H	44.6	-	29.8	-24.5	0.0	49.9	74.0	24.1	-	54.0	-

\*Note: OB means "operation band" (5250-5350MHz).

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

Host device: IBM ThinkPad T40 Series, LCD 14" model, Main antenna

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)		
1.002	V	48.3	-	24.1	-31.9	0.0	40.5	74.0	33.5	-	54.0	-
1.136	V	50.3	-	24.6	-31.4	0.0	43.5	74.0	30.5	-	54.0	-
1.202	V	52.4	-	25.2	-31.3	0.0	46.3	74.0	27.7	-	54.0	-
1.335	V	53.6	-	25.2	-30.9	0.0	47.9	74.0	26.1	-	54.0	-

Table 3-2-3. Ch.64 (5320MHz) 6Mbps OFDM mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary antenna

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>		
OB												
5.315	H	99.0	88.8	33.7	-25.7	0.0	107.0	N/A	-	96.8	N/A	-
5.350	H	58.9	43.0	33.9	-25.6	0.0	67.2	74.0	6.8	<b>51.3</b>	54.0	2.7
5.353	H	59.7	42.0	33.9	-25.6	0.0	68.0	74.0	6.0	50.3	54.0	3.7
5.355	H	59.1	41.4	33.9	-25.6	0.0	67.4	74.0	6.6	49.7	54.0	4.3
1.140	V	52.1		24.6	-31.4	0.0	45.3	74.0	28.7	-	54.0	-
1.196	V	48.1		25.2	-31.3	0.0	42.0	74.0	32.0	-	54.0	-
1.329	V	51.4		25.6	-31.0	0.0	46.0	74.0	28.0	-	54.0	-
1.517	V	51.3		25.5	-30.4	0.0	46.4	74.0	27.6	-	54.0	-
4.916	V	60.0	29.0	27.0	-26.4	0.0	60.6	74.0	13.4	29.6	54.0	24.4
4.930	V	60.6	29.5	27.0	-26.4	0.0	61.2	74.0	12.8	30.1	54.0	23.9
4.950	V	61.8	29.9	27.1	-26.4	0.0	62.5	74.0	11.5	30.6	54.0	23.4
4.957	V	62.3	29.7	27.1	-26.6	0.0	62.8	74.0	11.2	30.2	54.0	23.8
5.389	H	49.8	39.0	33.9	-25.6	0.0	58.1	74.0	15.9	47.3	54.0	6.7
7.255	V	41.3		30.0	-24.5	0.0	46.8	68.2	21.4	-	54.0	-
7.299	V	39.4		29.9	-24.4	0.0	44.9	74.0	29.1	-	54.0	-
7.319	V	39.9		29.8	-24.4	0.0	45.3	74.0	28.7	-	54.0	-

\*Note: OB means “operation band” (5250-5350MHz).

Table 3-2-4. Ch.52 (5260MHz) OFDM **RX** mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary antenna

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>		
1.138	V	53.4	-	24.6	-31.4	0.0	46.6	74.0	27.4	-	54.0	-
1.218	V	48.3	-	25.2	-31.3	0.0	42.2	74.0	31.8	-	54.0	-
1.329	V	47.3	-	25.6	-31.0	0.0	41.9	74.0	32.1	-	54.0	-
1.517	V	52.6	-	25.5	-30.4	0.0	47.7	74.0	26.3	-	54.0	-



### 3.6 Bandedge Measurement plots

(The worse cases only)

Measured host device: IBM ThinkPad **T40** Series, 14 inch LCD model, main antenna  
IBM ThinkPad **X40** Series, auxiliary antenna

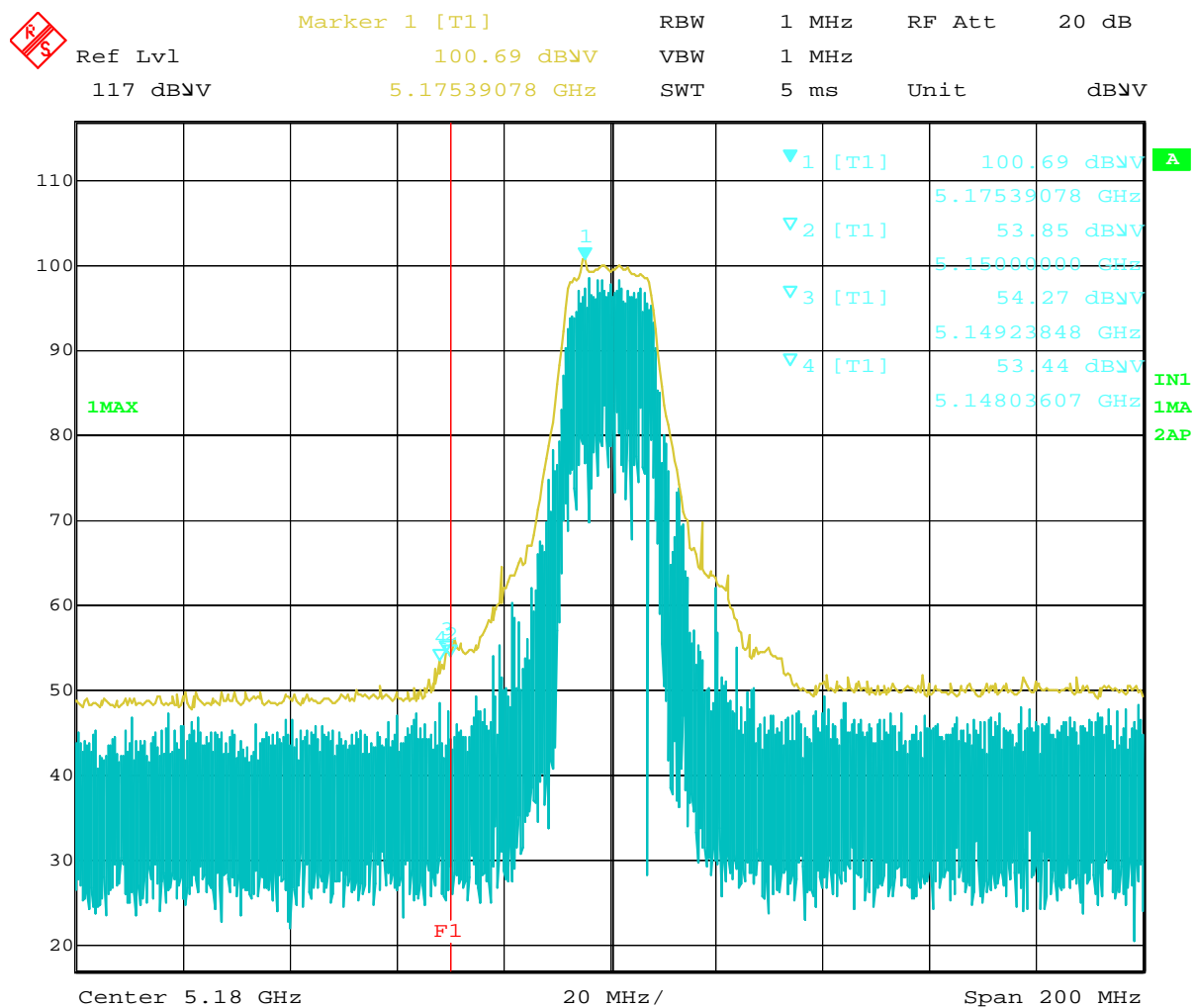
Table 3-3-1. Ch.36 (5180MHz) 6Mbps OFDM mode with the co-located Bluetooth transmitter

Host device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) ( <i>peak</i> )	Rading (dBμV) ( <i>average</i> )	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ( <i>peak</i> )	Margin to Limit (dB) ( <i>peak</i> )	Field Strength (dBμV/m) ( <i>average</i> )	Margin to Limit (dB) ( <i>average</i> )
T40 14"	5.150	H	53.9	37.3	33.6	-26.1	0.0	61.4	12.6	44.8	9.2
X40	5.150	H	50.9	36.3	33.6	-26.1	0.0	58.4	15.6	43.8	10.2

Table 3-3-2. Ch.64 (5320MHz) 6Mbps OFDM mode with the co-located Bluetooth transmitter

Host device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) ( <i>peak</i> )	Rading (dBμV) ( <i>average</i> )	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) ( <i>peak</i> )	Margin to Limit (dB) ( <i>peak</i> )	Field Strength (dBμV/m) ( <i>average</i> )	Margin to Limit (dB) ( <i>average</i> )
T40 14"	5.350	H	55.9	41.8	33.9	-25.6	0.0	64.2	9.8	50.1	<b>3.9</b>
X40	5.350	H	58.9	43.0	33.9	-25.6	0.0	67.2	6.8	51.3	<b>2.7</b>

The traces hereafter are the worst cases in each Table 3-3-1 or Table 3-3-2.

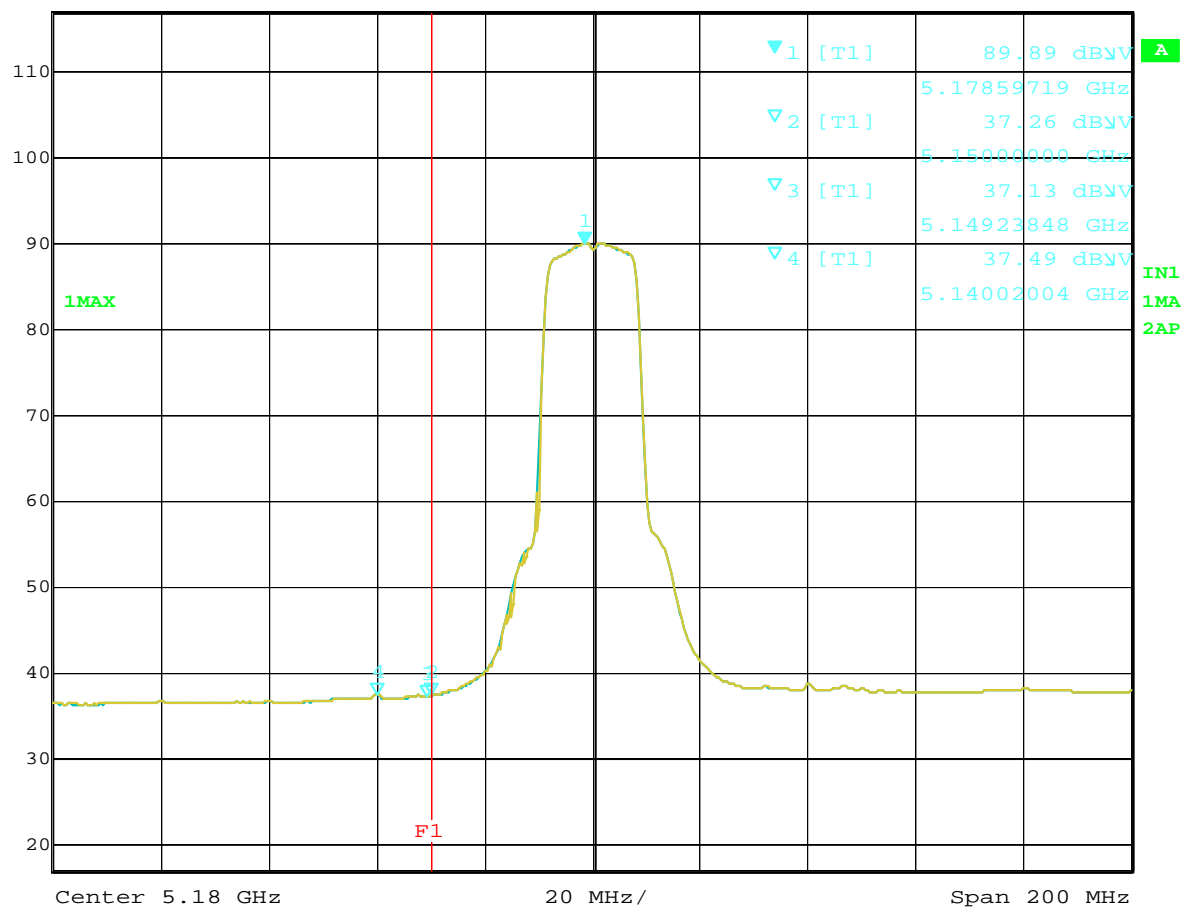


Date: 22.NOV.2004 14:53:39

Plot 3-1 5180MHz, 6Mb/s OFDM mode (Peak)



Ref Lvl 117 dBV  
Marker 1 [T1] 89.89 dBV  
5.17859719 GHz  
RBW 1 MHz  
VBW 10 Hz  
SWT 50 s  
RF Att 20 dB  
Unit dBV

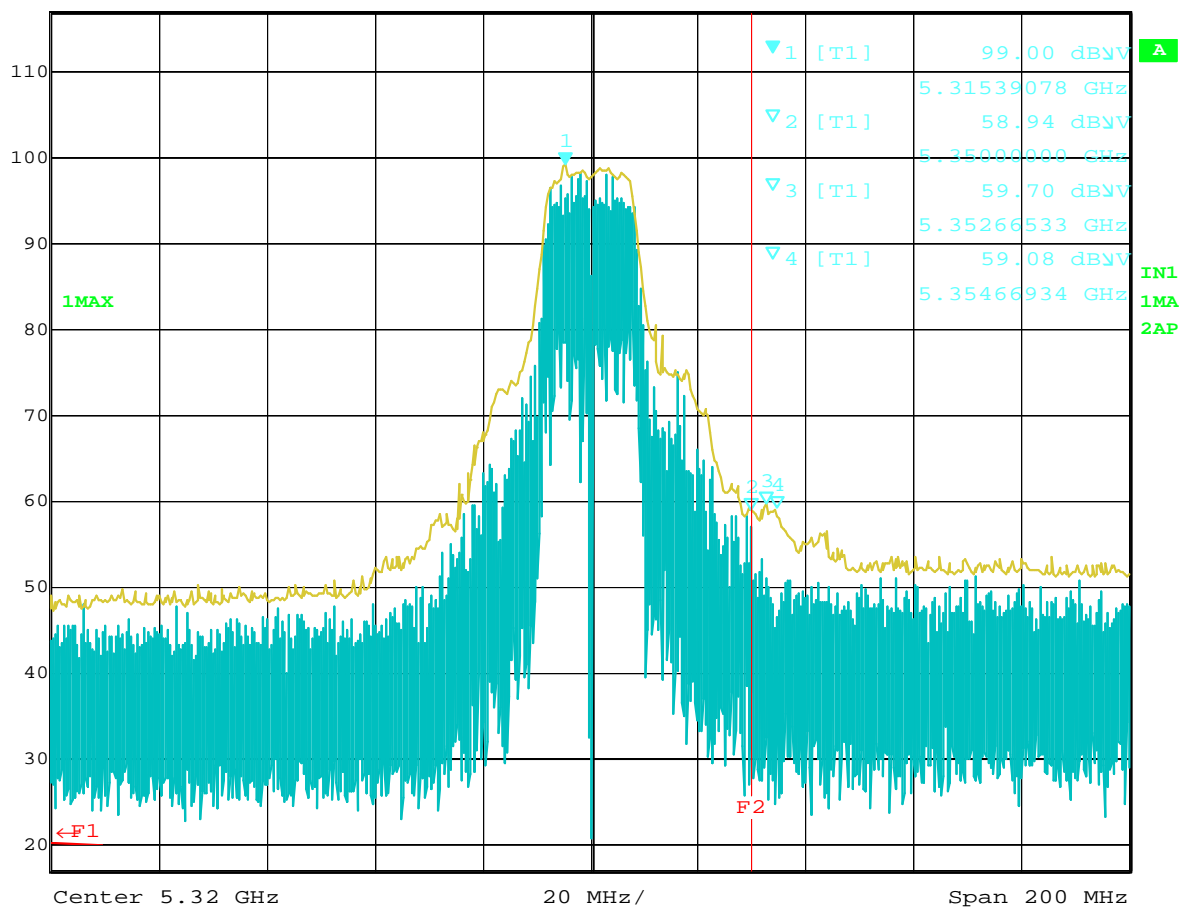


Date: 22.NOV.2004 14:55:30

Plot 3-2 5180MHz, 6Mb/s OFDM mode (Average)



Ref Lvl 117 dBV  
Marker 1 [T1] 99.00 dBV  
5.31539078 GHz  
RBW 1 MHz  
RF Att 20 dB  
VBW 1 MHz  
SWT 5 ms  
Unit dBV

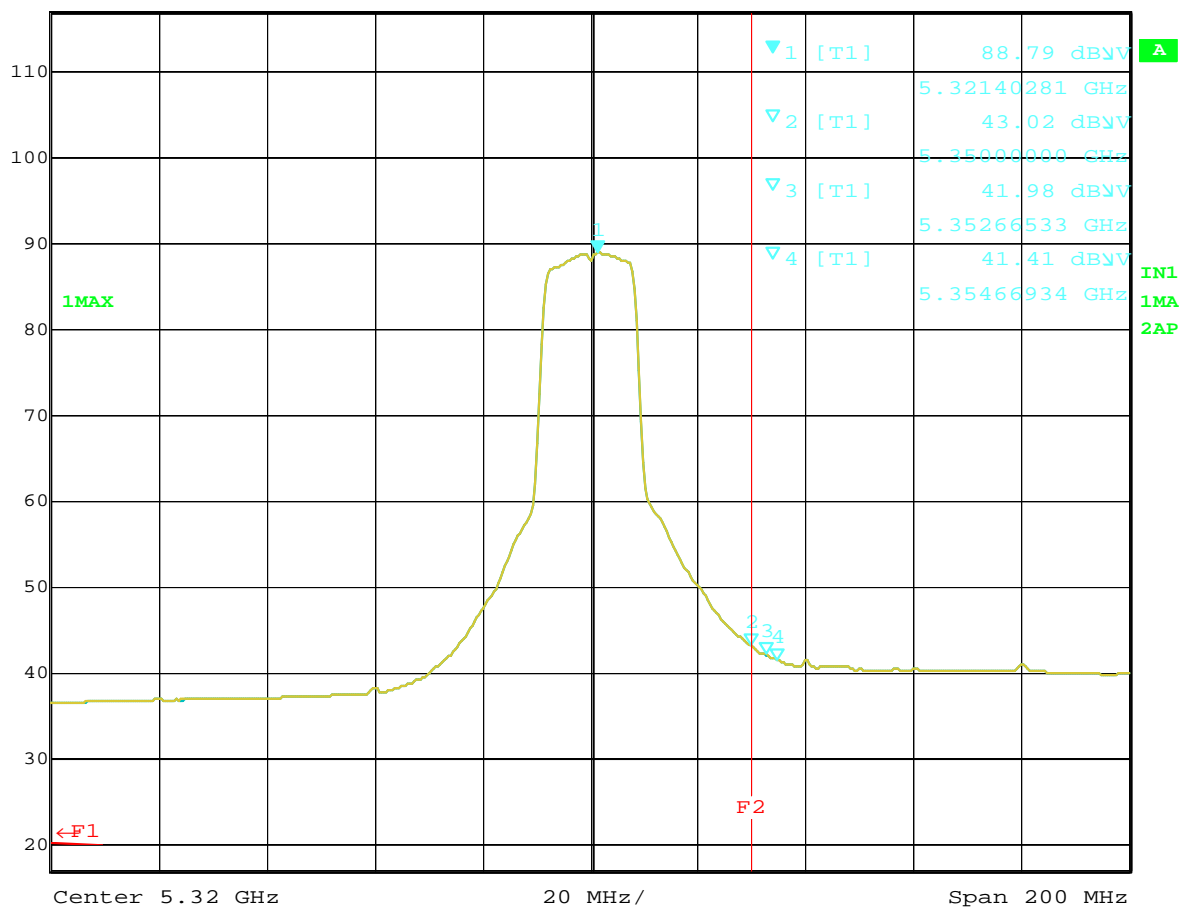


Date: 15.NOV.2004 16:02:53

Plot 3-3 5320MHz, 6Mb/s OFDM mode (Peak)



Ref Lvl 117 dBV  
Marker 1 [T1] 88.79 dBV  
5.32140281 GHz  
RBW 1 MHz  
VBW 10 Hz  
SWT 50 s  
RF Att 20 dB  
Unit dBV



Date: 15.NOV.2004 16:04:14

Plot 3-4 5320MHz, 6Mb/s OFDM mode (Average)

## 4. Conducted Measurements

The representative worse cases in the previous application (granted on October/07/2004) were selected and examined to prove no electrical change was made to the EUT after the slight modification of applying module transmitter device.

### 4.1 Bandwidth at 26 dB below / Bandedge

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i) / q1(iV)(b)]

[5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii) / q1(iV)(b)]

#### 4.1.1 Test Procedure

The bandwidth at 26 dB down from the peak of the RF emission was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in continuous transmission mode at the appropriate center frequencies.

The spectrum analyzer was set to:

RBW=300kHz<sup>\*1</sup>, VBW=1MHz<sup>\*2</sup>, Span=50MHz, Sweep= 50ms, Mode= Peak detector

\*1: approximately 1% of the emission bandwidth (§15.403(c))

\*2: VBW > RBW (To be adjusted accordingly based on the spectrum stability.)

Table 4-1-1 : 26 dB Bandwidth Test Instruments

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: 110 cm Loss: 2.2 dB	

Notes: - R&S: Rohde & Schwarz

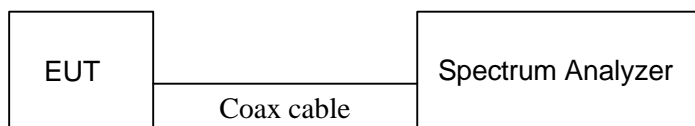


Figure 4-1: Measurement setup for 26dB bandwidth test

#### 4.1.2 Measurement Results

Test Date: November 12, 2004

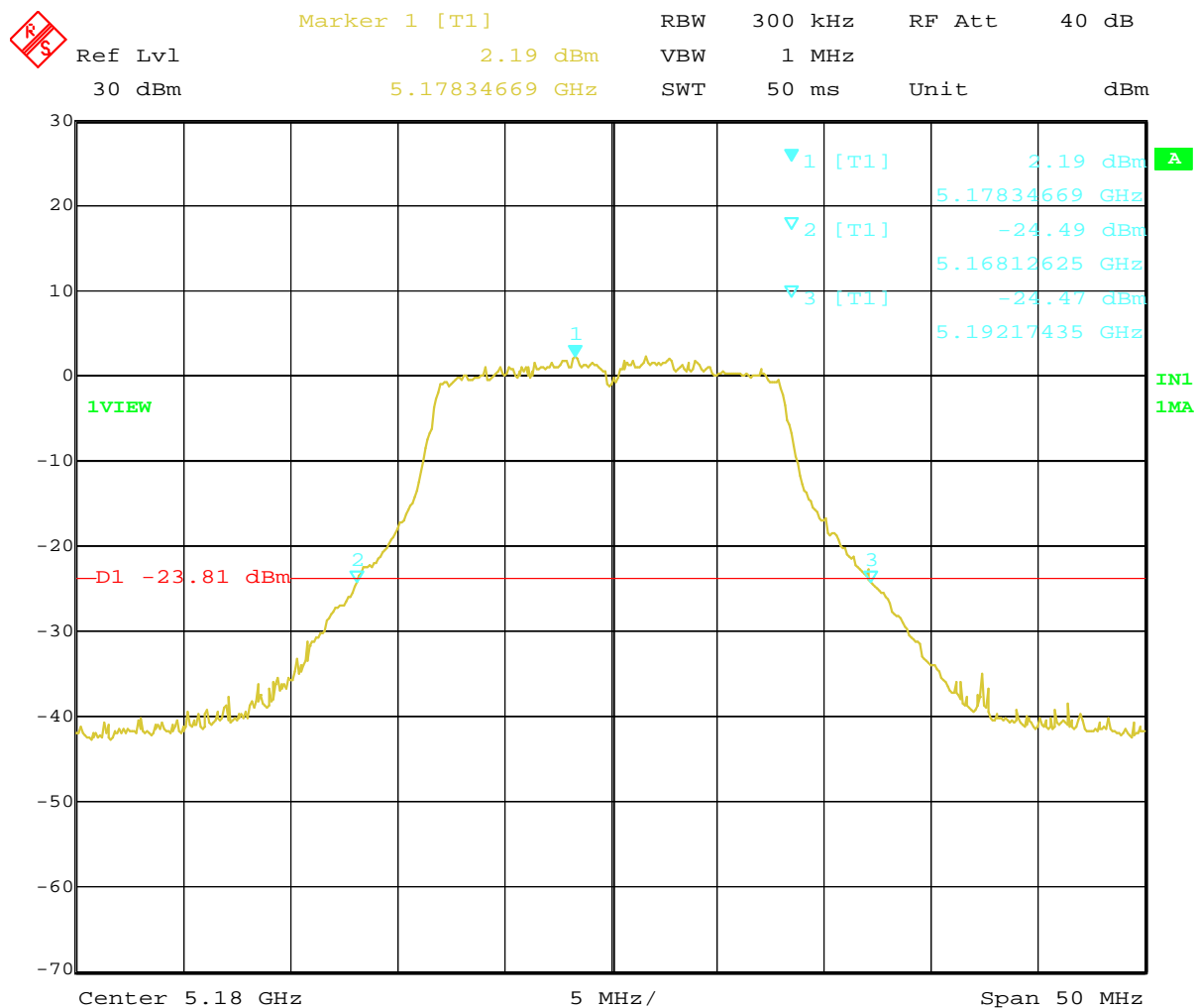
: the closest frequencies to the bandedge

: the widest bandedge plot in middle channels

Table 4-1-2. 26dB bandwidth, TX mode 6Mbps

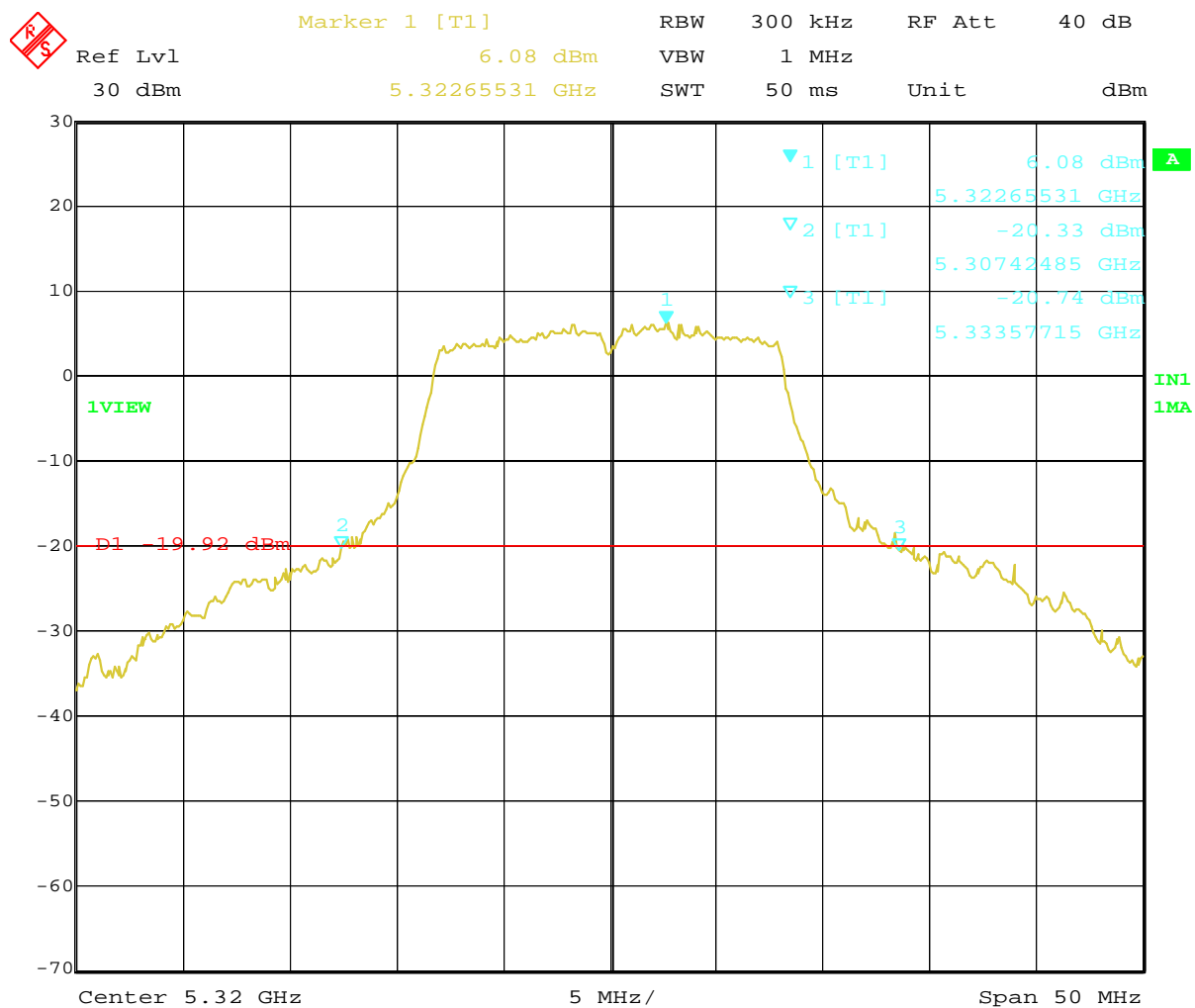
Center Frequency (MHz)	Trace Number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 26 dB below (MHz)	Previous results (MHz)
5180 (ch. 36)	Plot 4-1	5168.126	5192.174	24.05	23.74
5240 (ch. 48)		5228.226	5252.074	23.85	24.04
5260 (ch. 52)		5248.226	5273.317	25.09	25.29
5320 (ch. 64)	Plot 4-2	5307.425	5333.577	26.15	29.56

### 4.1.3 Trace Data



Date: 12.NOV.2004 20:03:49

Plot 4-1-1. 26dB BW at 5180MHz (OFDM, 6Mbps)



Date: 12.NOV.2004 20:12:27

Plot 4-1-2. 26dB BW at 5320MHz (OFDM, 6Mbps)



## 4.2 Peak Conducted Transmit Output Power

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i) / q1(iV)(b)]

[5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii) / q1(iV)(b)]

### 4.2.1 Test Procedure

The test was performed with a spectrum analyzer in accordance with the Method #3 of the FCC Public Notice, DA 02-2138, August/30/2002. The spectrum analyzer was connected to the antenna terminal, while EUT was operating in continuous transmission mode at the appropriate center frequencies.

The spectrum analyzer was set to :

VBW= 30kHz = 1/T, where T is transmission pulse duration =182.4μs (same as the previous application),

RBW=1MHz, Span= 50MHz encompassing the entire 26dB emission bandwidth of the transmission signal,

Mode= sample detector, Trigger= free run

The band power measurement function was used to measure the peak power for each transmission mode. The analyzer computed the peak power by integrating the spectrum across the 26 dB emission bandwidth given by the previous chapter 4.1.

Table 4-2-1: Test instruments of spectrum analyzer method

Description	Model	Serial Number
Spectrum Analyzer EMI Test Receiver	R&S ESI26	836119/003
Coax cables: - Spectrum Analyzer <=> EUT	Length: 110 cm Loss: 2.2 dB	

Notes: - R&S: Rohde & Schwarz

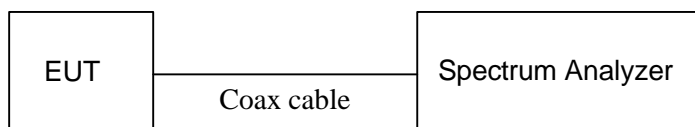


Figure 4-2 : Measurement setup of spectrum analyzer method

### 4.2.2 Measurement Results

Test Date: November 12, 2004

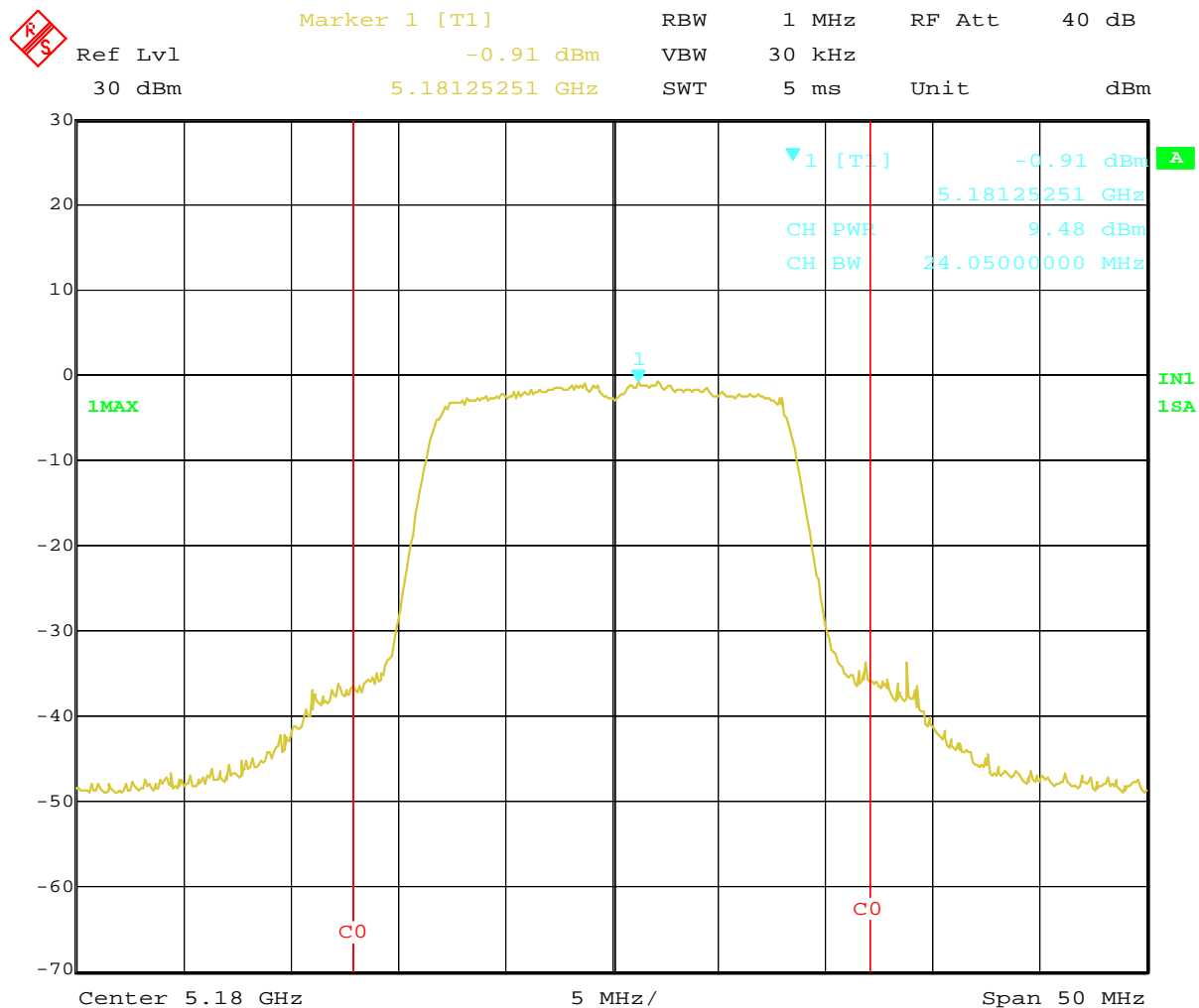
Table 4-2-2. Measurement results of peak conducted transmit output power in 5180-5240MHz

Measured Frequency (MHz)	Tx Rate (Mb/s)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Peak antenna gain of EUT (dBi)	EIRP (dBm)	IC limit (dBm)
						FCC (dBm)	IC (dBm)			
5180	6	9.48	Plot 4-3	2.2	<b>11.68</b>	17	N/A	2.84	<b>14.52</b>	23
	(Previous results)	9.46		2.2	11.66	17	N/A		14.50	23
5240	6	9.58	Plot 4-4	2.2	<b>11.78</b>	17	N/A		<b>14.62</b>	23
	(Previous results)	9.57		2.2	11.77	17	N/A		14.61	23

Table 4-2-3. Measurement results of peak conducted transmit output power in 5260-5320MHz

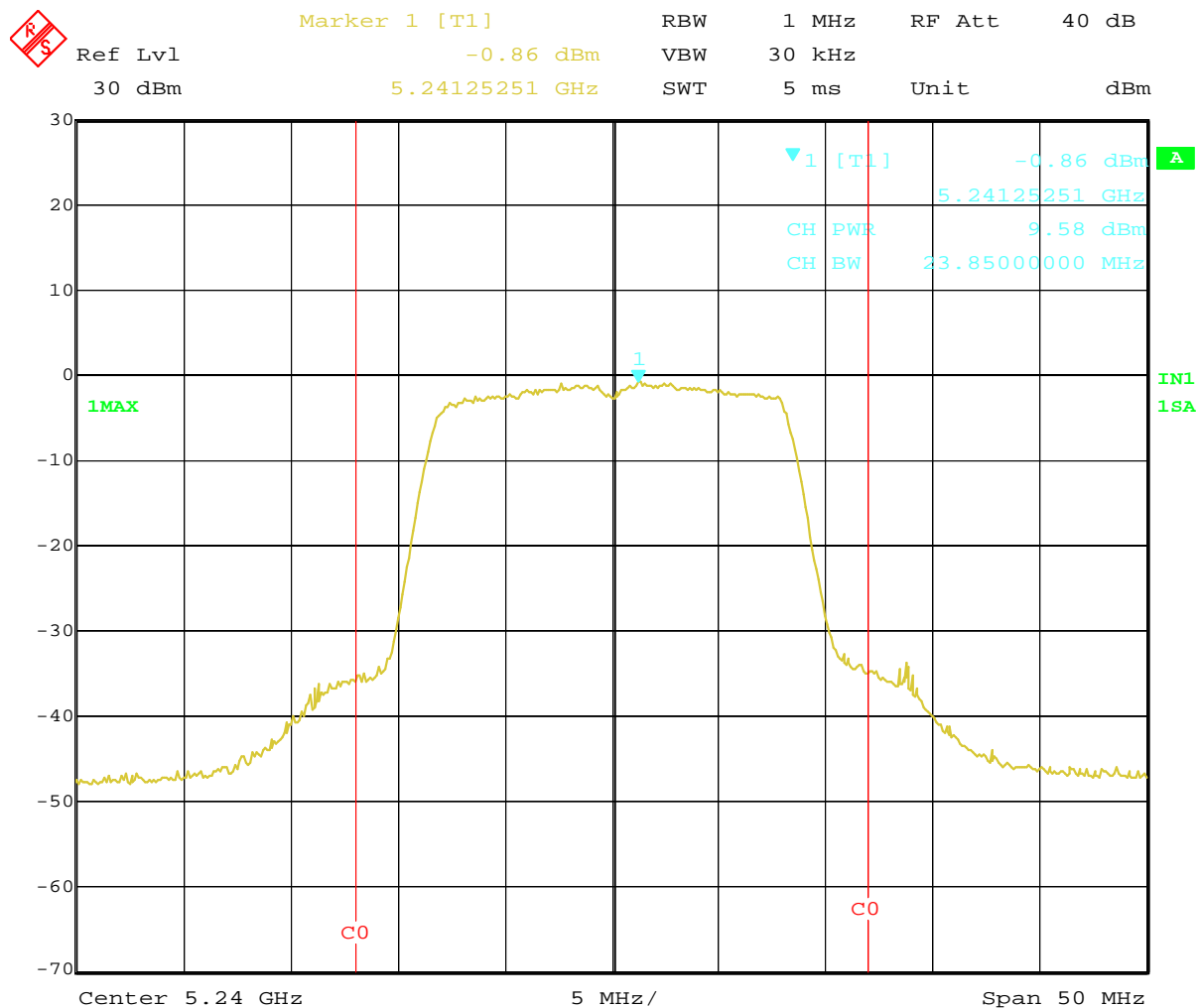
Measured Frequency (MHz)	Tx Rate (Mb/s)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Peak antenna gain of EUT (dBi)	EIRP (dBm)	IC limit (dBm)
						FCC (dBm)	IC (dBm)			
5260	6	13.30	Plot 4-5	2.2	<b>15.50</b>	24	24	2.84	<b>18.34</b>	30
	(Previous results)	13.27		2.2	15.47	24	24		18.31	30
5320	6	13.57	Plot 4-6	2.2	<b>15.77</b>	24	24		<b>18.61</b>	30
	(Previous results)	13.56		2.2	15.76	24	24		18.60	30

### 4.2.3 Trace Data



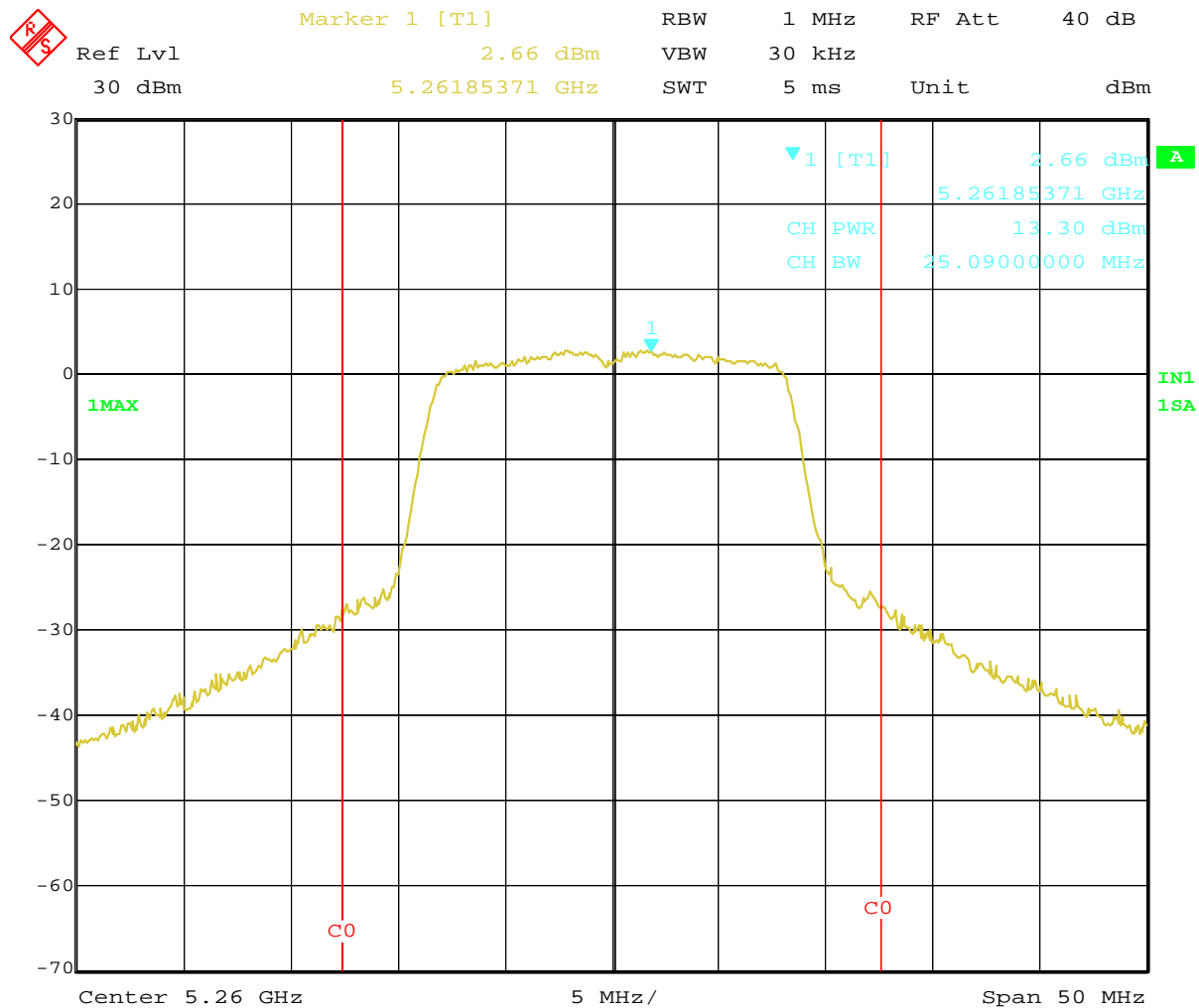
Date: 12.NOV.2004 20:14:28

Plot 4-3 Conducted Peak Power at 5180MHz (OFDM, 6Mbps)



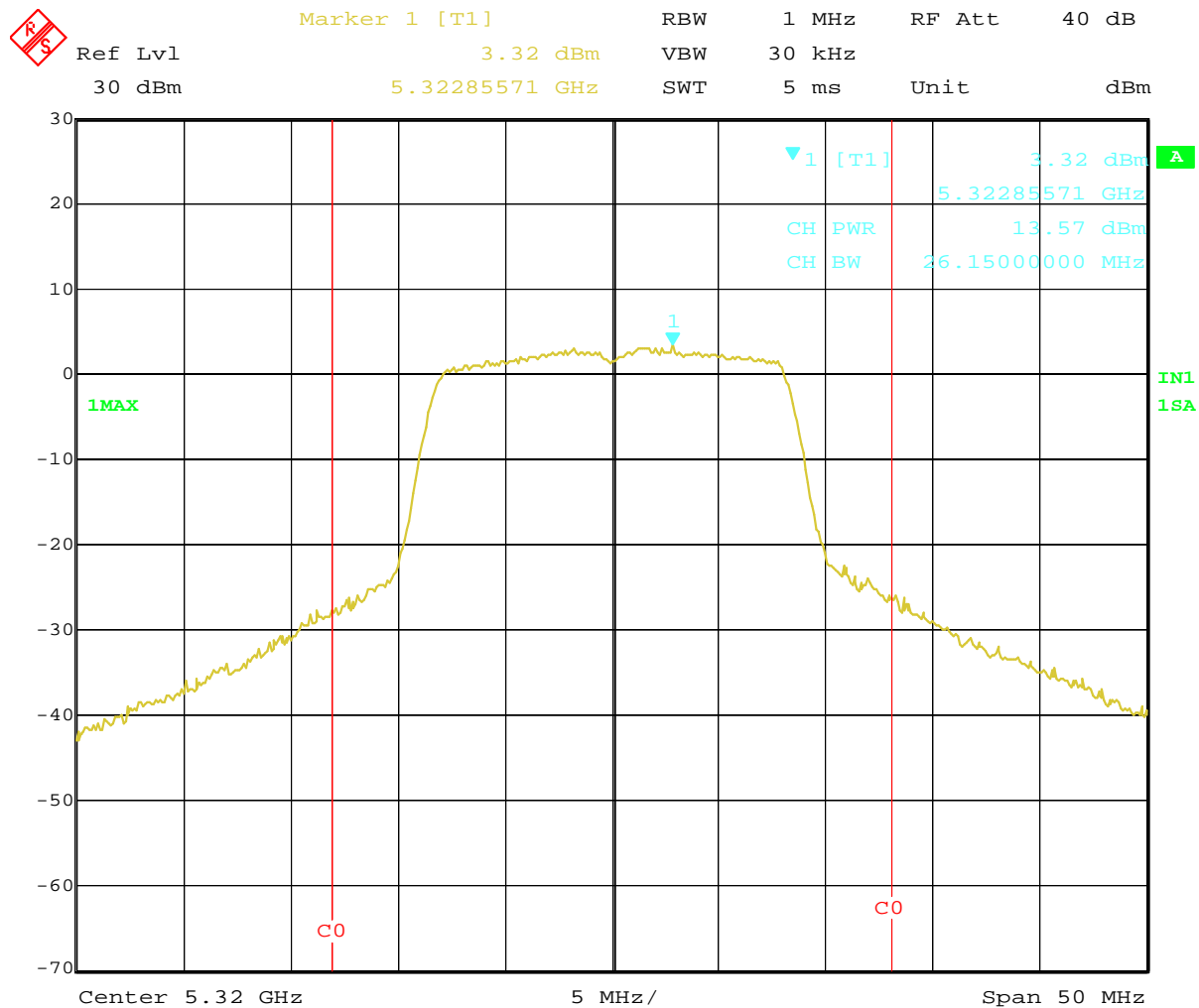
Date: 12.NOV.2004 20:17:40

Plot 4-4 Conducted Peak Power at 5240MHz (OFDM, 6Mbps)



Date: 12.NOV.2004 20:19:26

Plot 4-5 Conducted Peak Power at 5260MHz (OFDM, 6Mbps)



Date: 12.NOV.2004 20:22:06

Plot 4-6 Conducted Peak Power at 5320MHz (OFDM, 6Mbps)

### 4.3 Peak Power Spectral Density

[5150-5250MHz: FCC 15.407(a)(1), RSS 6.2.2q1(i), (iv)(b) ]

[5250-5350MHz: FCC 15.407(a)(2), RSS 6.2.2q1(ii), (iv)(b) ]

#### 4.3.1 Test Procedure

The peak power spectral density was measured in accordance with the Method 2 shown in FCC Public Notice DA 02-2138.

The spectrum analyzer was connected to the antenna terminal, while EUT was operating in continuous transmission mode at the appropriate center frequencies.

The spectrum analyzer was set to :

RBW= 1MHz, VBW=3MHz, Span=20MHz, Mode= sample detector,

The analyzer averaged 100 traces in power averaging mode, then the marker was set to the highest position in the spectrum.

Also the Canadian PPSD was examined with the following spectrum analyzer setting.

RBW= 1MHz, VBW=1MHz, Span=20MHz, Mode= sample detector, averaging off

The test instruments and setup configuration are the same as the Table 4-2-1 and Figure 4-2.

#### 4.3.2 Measurement Results

Only the same worst case as the previous application was re-tested.

i.e. 6Mbps at 5240MHz or 5260MHz was the worst in each 5180-5240MHz or 5260-5320MHz band.

Test Date: November 15, 2004

Table 4-3-1. Measurement results of PPSD

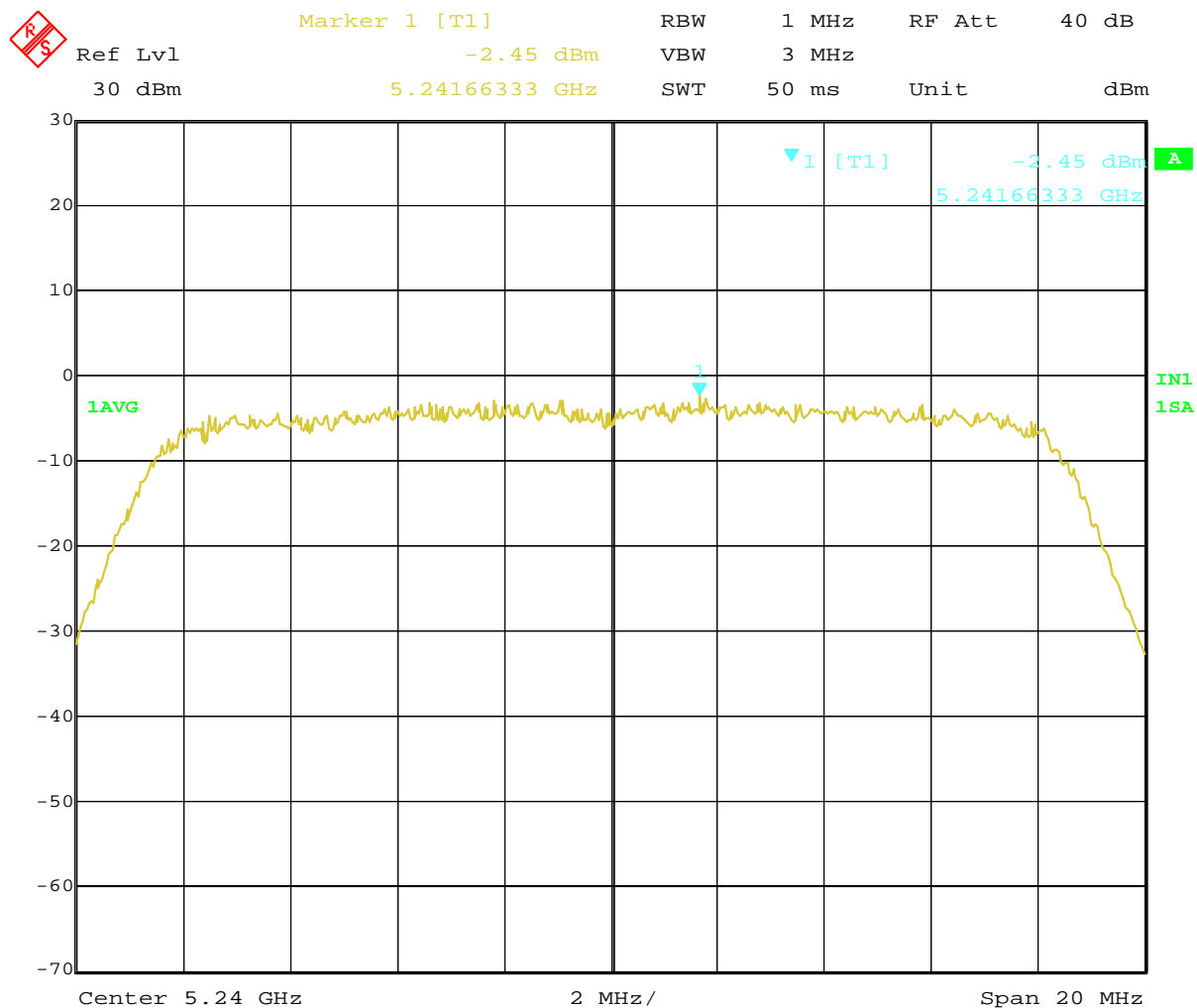
Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	FCC Limit (dBm)	IC Limit q1(ii) (dBm)	Peak Antenna Gain (dBm)	IC EIRP (dBm)	IC Limit q1(i) (dBm)
5241.66	-2.45	Plot 4-7	2.2	<b>-0.3</b>	4.0	N/A	2.84	<b>2.5</b>	10
(Previous results)				-0.7				2.1	
5259.06	1.30	Plot 4-8	2.2	<b>3.5</b>	11.0	11.0			N/A
(Previous results)				3.1					

Table 4-3-2. Measurement results of Canadian PPSD

Measured Frequency (MHz)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	IC Limit q1(iv)(b) 3 + 10logB* (dBm)
5235.21	6.78	Plot 4-9	2.2	<b>9.0</b>	16.77
(Previous results)				8.6	16.81
5255.17	10.24	Plot 4-10	2.2	<b>12.4</b>	17.00
(Previous results)				12.2	17.03

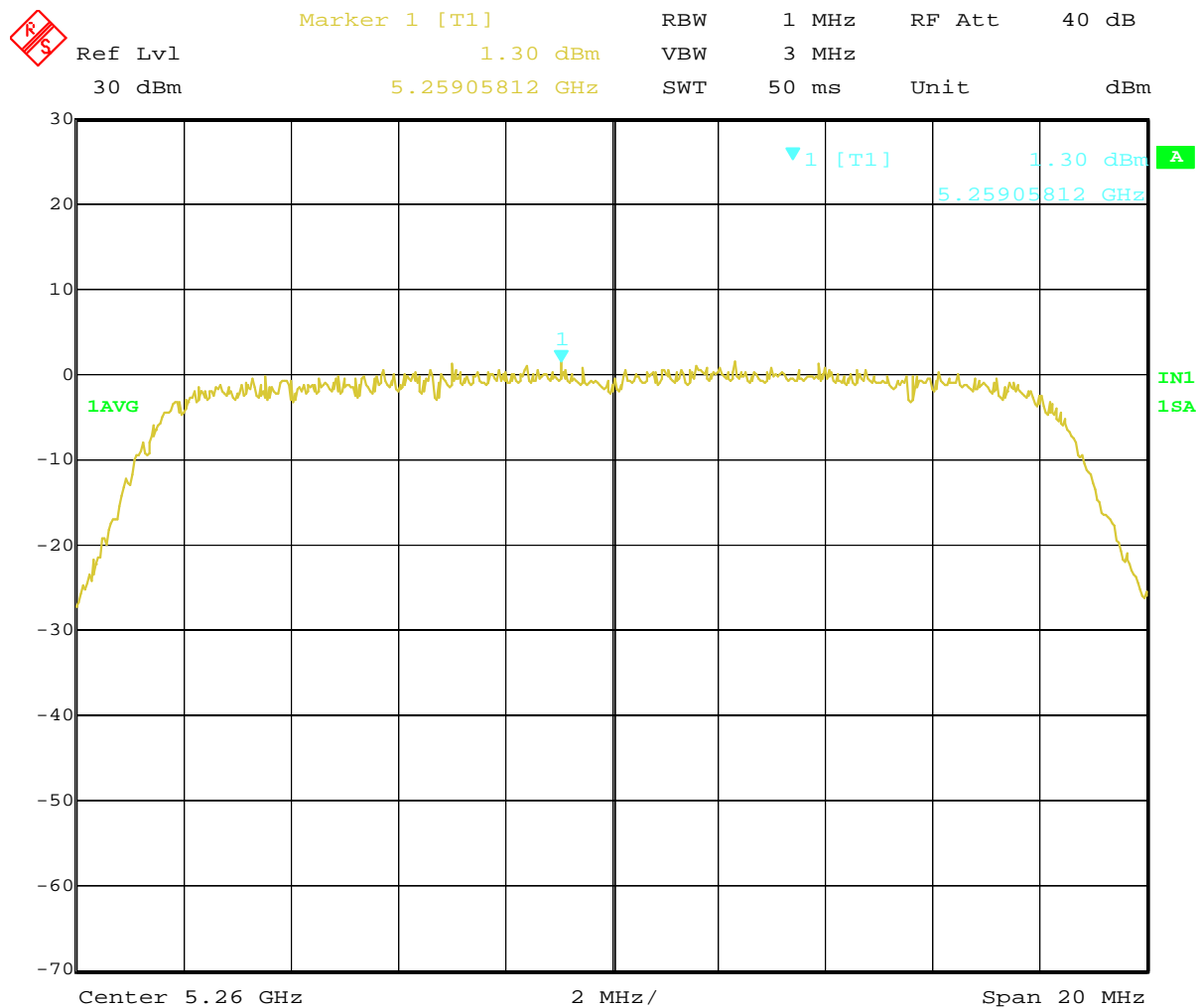
\* B = 26dB Bandwidth

### 4.3.3 Trace Data



Date: 15.NOV.2004 12:54:51

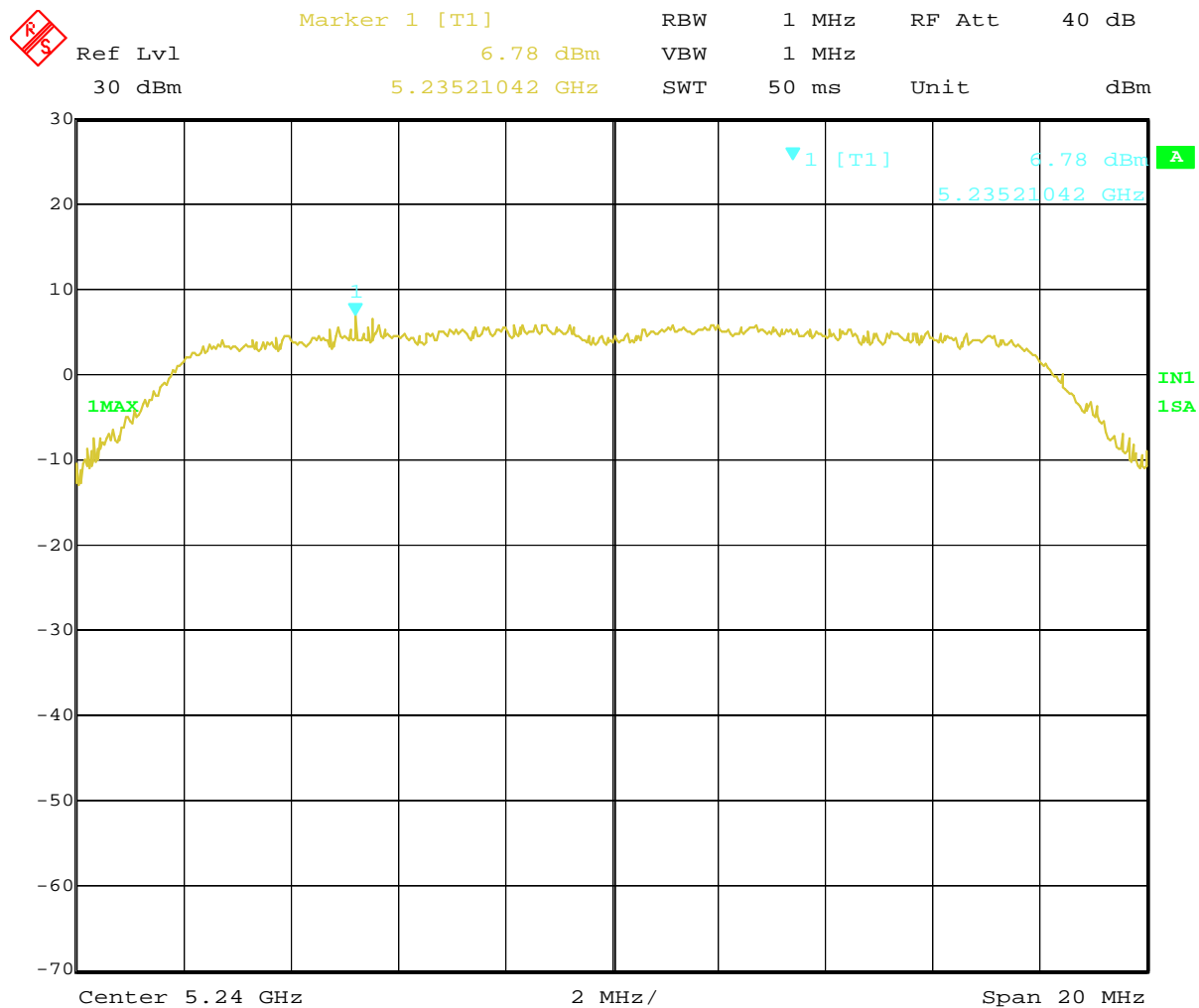
Plot 4-7 Peak Power Spectral Density at 5240MHz



Date: 15.NOV.2004 12:55:58

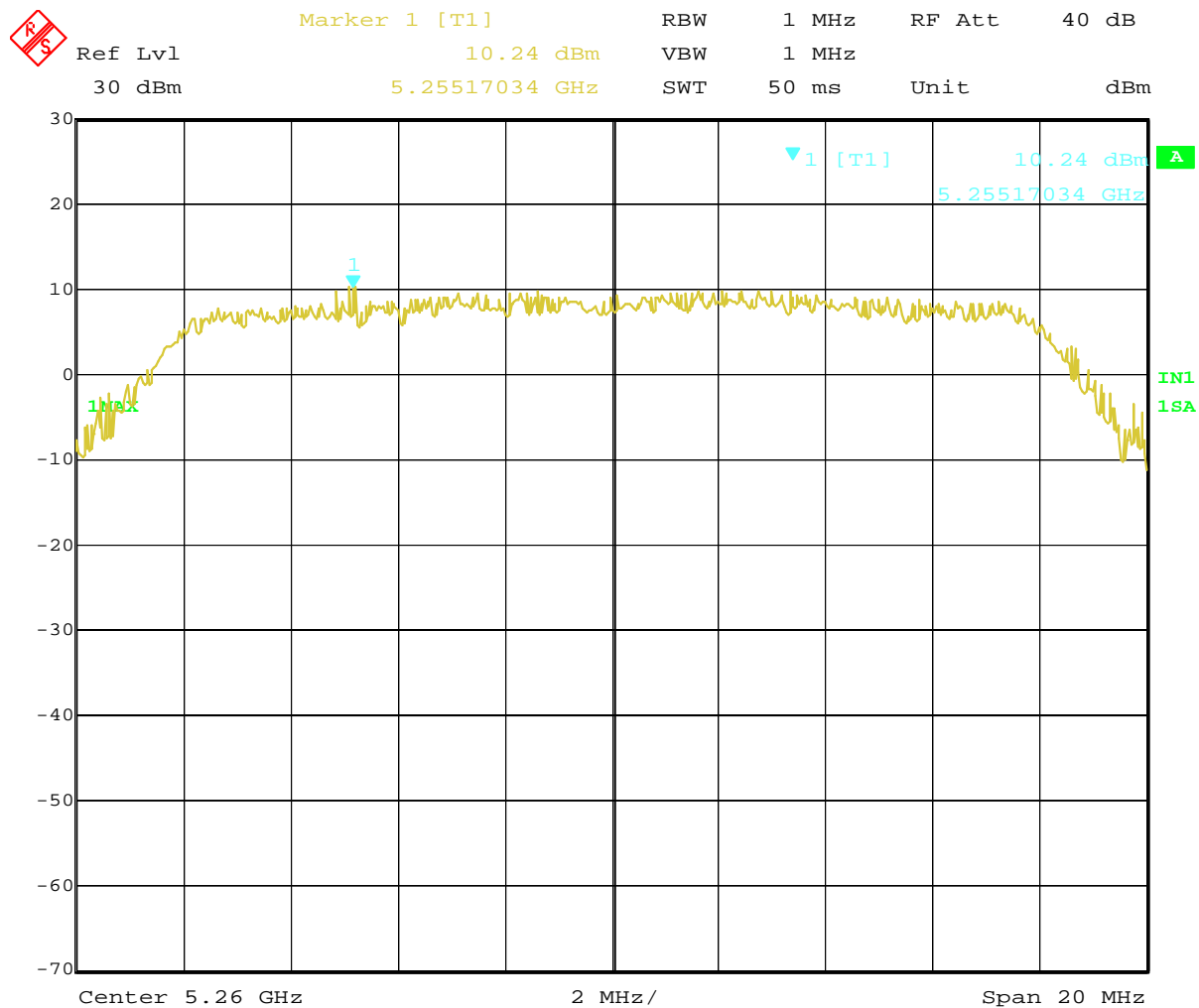
Plot 4-8 Peak Power Spectral Density at 5260MHz





Date: 15.NOV.2004 13:02:47

Plot 4-9 Peak Power Spectral Density at 5240MHz (IC RSS-210)



Date: 15.NOV.2004 13:05:42

Plot 4-10 Peak Power Spectral Density at 5260MHz (IC RSS-210)

## 4.4 Peak Excursion Ratio

[ FCC 15.407(a)(6) ]

### 4.4.1 Test Procedure

The spectrum analyzer was connected to the antenna terminal, while EUT was operating in continuous transmission mode at the appropriate center frequencies.

- 1<sup>st</sup> trace :  
The spectrum analyzer was set to :  
RBW= 1MHz, VBW=3MHz, Mode= peak detector and max hold  
then to view.
- 2<sup>nd</sup> trace :  
The same setting of spectrum analyzer as Clause 4.2.1 for the measurement of peak conducted transmit output power was used for the 2<sup>nd</sup> trace.  
i.e. VBW= 30kHz, RBW=1MHz, Span=30-40MHz, Trigger= free run,  
Mode= sample detector

The largest difference of amplitude delta between the two trances is the peak excursion.

The test instruments and setup configuration are the same as the Table 4-2-1 and Figure 4-2.

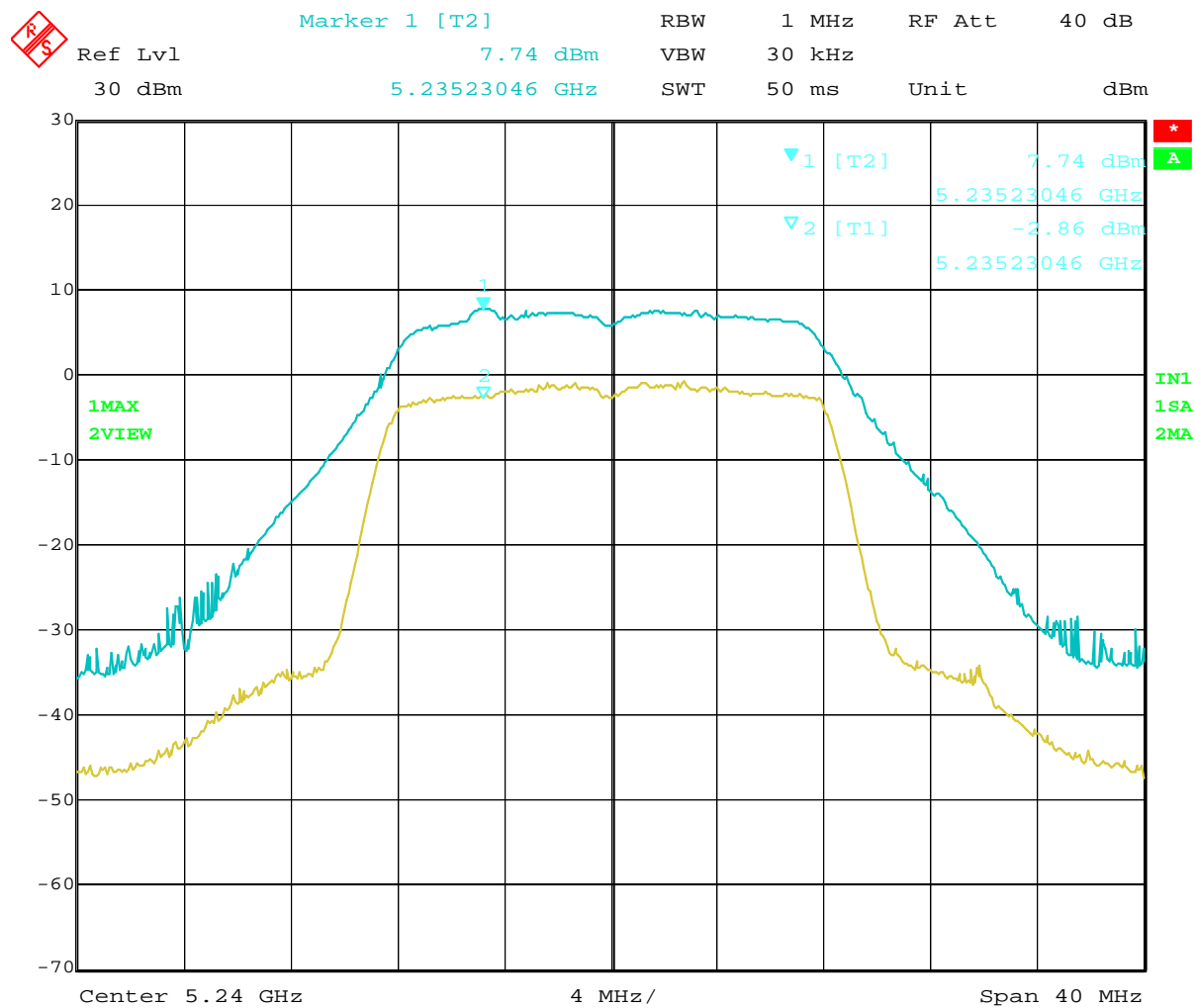
### 4.4.2 Measurement Results

Only the same worst case as the previous application was re-tested.  
i.e. 6Mbps at 5240MHz or 5260MHz was the worst in each 5180-5240MHz or 5260-5320MHz band.

Test Date: November 15, 2004

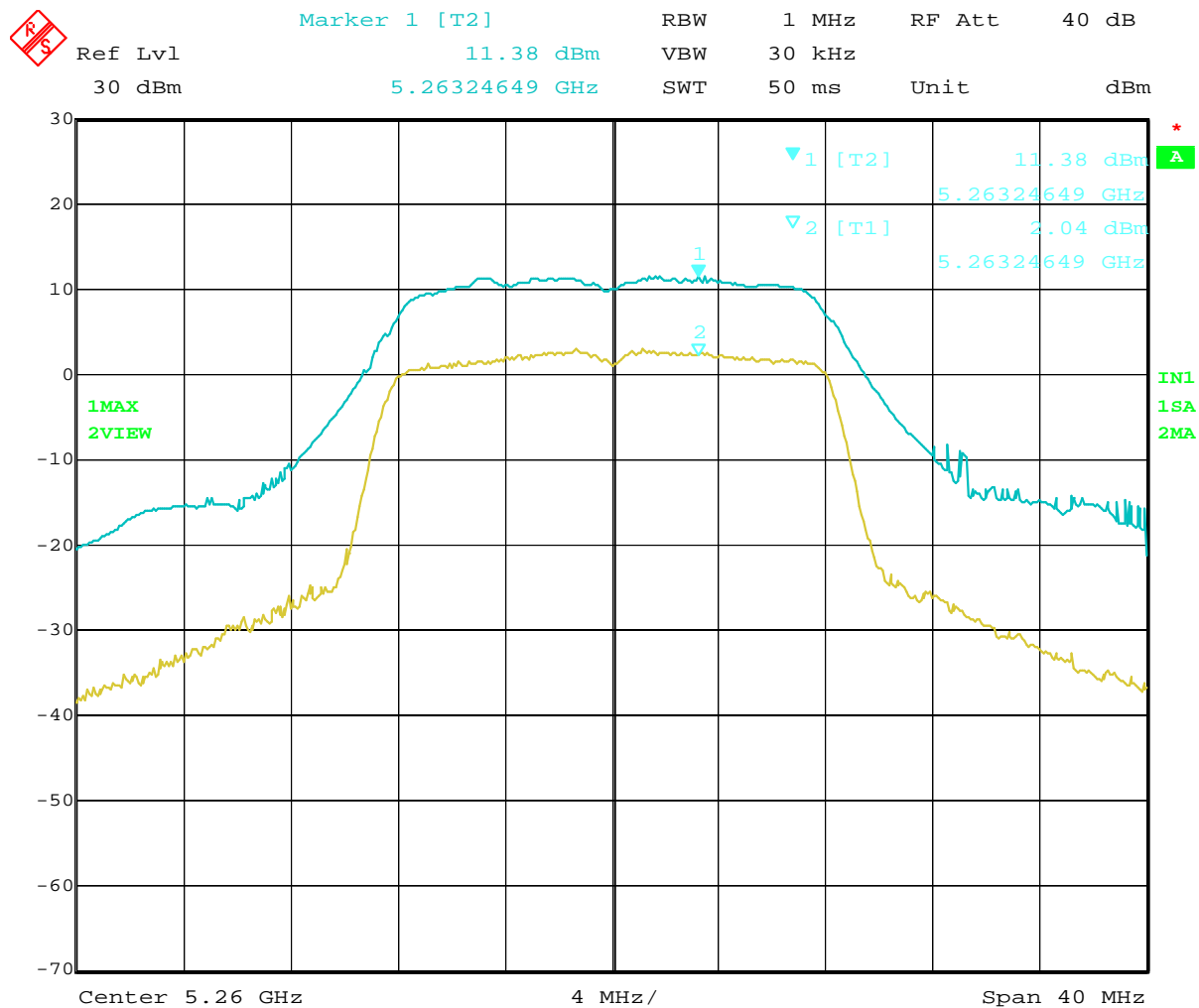
Table 4-4-1. Measurement results of Peak Excursion Ratio

Measured Frequency (MHz)	Analyzer Reading delta (dB)	FCC Limit (dB)	Margin (dB)	Trace number
5235.23	<b>10.60</b>	13	2.40	Plot 4-11
(Previous results)	10.09		2.91	
5263.25	<b>9.34</b>		3.66	Plot 4-12
(Previous results)	9.91		3.09	

**4.4.3 Trace Data**

Date: 15.NOV.2004 13:21:51

**Plot 4-11 Peak Excursion Ratio at 5240MHz**



Date: 15.NOV.2004 13:24:32

Plot 4-12 Peak Excursion Ratio at 5260MHz