

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

Document Number : FCC 19-0282-0

Model Number: WM3B2915ABG

FCC ID: ANO20040601CX2

IC: 349E-WM3B29AG

November 29, 2004

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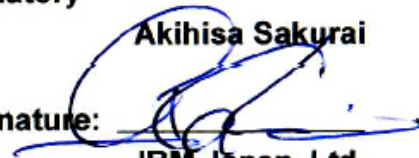
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MEASUREMENT / TECHNICAL REPORT – Part 15 Subpart C (Intentional Radiator)

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 <u> ✓ </u> Equipment type: <u>Bluetooth modular device</u>
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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.
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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 C 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 (Composite application)
TESTED DATE	: November 9, 11, 15, 16, 17, 18, 19, 22, 24, 25 and 29, 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).
- 1. ● 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	Applying modular transmitter 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 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
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/R50 Series

B. Summary of Test Results

Table-B presents the list of the measurement items for DTS (Digital Transmissions System) devices under FCC Part 15 Subpart C and Industry Canada RSS-210.

The section numbers of upper portion are showing FCC number, and the other (lower) ones are for IC.

Table-B List of the measurements

Section(s)	Test Items : Transmit mode (TX):		Condition	Result
15.247(a)(2) 6.2.2(o) *1	Bandwidth at 6 dB below	At least 500kHz. (*1: RSS-210 Issue5: Amendment)	Conducted	Pass
15.215(c) 5.9.1	Occupied BW (Bandwidth at 20 dB below)	20 dB bandwidth of the emission to be within the allocation band.		Pass
15.247(c) 6.2.2(o)(e1)	Out of Band Emissions	The radiated emission in any 100kHz of outband shall be at least 20dB below the highest inband spectral density.		Pass
15.247(b)(3) 6.2.2(o)(b)	Conducted Peak Transmit Output Power	Shall not exceed 1.0 W.		Pass
15.247(d) 6.2.2(o)(b)	Transmitter power spectral Density	Shall not be greater than 8 dBm in any 3kHz band.		Pass
15.207 6.2.2(o)(e3) / 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 6.2.1 /6.2.2(o)(e3) /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.	Radiated (30MHz-1GHz)	Pass
			Radiated (1– 25GHz)	Pass

	Test Items : Receive mode (RX):			
15.207 6.2.2(o)(e3) / 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 6.2.1 /6.2.2(o)(e3) /7.3	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Shall not exceed the limits specified in FCC 15.209 or RSS-210 Table3.	Radiated (30MHz -1GHz)	Pass
			Radiated (1– 25GHz)	Pass

	Other requirements		Result
15.247(b)(4)(i) –	Antenna gain	Peak gain of the device : 1.84 dBi in 2.4GHz band, and 2.04 dBi in 5.8GHz band	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
15.203 6.2.2(o)(e2)	Unique antenna connector	The device employs an unique electronic connector so called Electronic Handshake . Refer to “Confidential_e-Handshake” exhibit.	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. The following frequencies were chosen for the measurements of each 2.4GHz or 5.8GHz band.
 - 2412MHz (lowest), 2437MHz(middle), and 2462MHz (highest) for 2.4GHz band
 - 5745MHz (lowest), 5785MHz(middle), and 5825MHz (highest) for 5.8GHz band
3. As for the RF receiving test, the middle channels (2437MHz or 5785MHz) 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]										
	IEEE802.11b			IEEE802.11g							
	1/2M bps	5.5M bps	11M bps	6M bps	9M bps	12M bps	18M bps	24M bps	36M bps	48M bps	54M bps
2.412 (Ch. 1)	15	15	15	15	15	15	15	15	15	15	15
2.417 (Ch. 2)	15	15	15	15	15	15	15	15	15	15	15
2.422 (Ch. 3)	16	16	16	15	15	15	15	15	15	15	15
2.427 (Ch. 4)	17	17	17	15	15	15	15	15	15	15	15
2.432 (Ch. 5)	17	17	17	15	15	15	15	15	15	15	15
2.437 (Ch. 6)	17	17	17	15	15	15	15	15	15	15	15
2.442 (Ch. 7)	17	17	17	15	15	15	15	15	15	15	15
2.447 (Ch. 8)	17	17	17	15	15	15	15	15	15	15	15
2.452 (Ch. 9)	17	17	17	15	15	15	15	15	15	15	15
2.457 (Ch. 10)	17	17	17	15	15	15	15	15	15	15	15
2.462 (Ch. 11)	17	17	17	15	15	15	15	15	15	15	15
				IEEE802.11a							
5.745 (Ch.149)	N/A			17	17	17	17	17	17	17	17
				14	14	14	14	14	13	13	11
5.765 (Ch.153)				17	17	17	17	17	17	17	17
				14	14	14	14	14	13	13	11
5.785 (Ch.157)				17	17	17	17	17	17	17	17
				14	14	14	14	14	13	13	11
5.805 (Ch.161)				17	17	17	17	17	17	17	17
				14	14	14	14	14	13	13	11
5.825 (Ch.165)				17	17	17	17	17	17	17	17
				14	14	14	14	14	13	13	11

Note) The power values on 5.8GHz band 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**

2.4GHz band: The full testing with the highest gain antenna was already certified at the previous grant. The worse cases were selected from the previous application and tested with the new antenna systems. The highest gain among the new antenna systems was used for this test report. i.e. ThinkPad X40 Series, auxiliary antenna.

5.8GHz band: The full testing was performed with the auxiliary antenna of ThinkPad X40 Series.

- **Radiated emissions**

2.4GHz band: The full testing with the highest gain antenna was already certified at the previous grant. The worse cases were selected from the previous application and tested for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO2004 0700HER). Also the highest gain among the new antenna systems (. i.e. ThinkPad X40 Series, auxiliary antenna) was measured with the same test cases.

5.8GHz band: The representative worst case in the previous application was examined to confirm the compliance for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700HER). Also the full testing with the auxiliary antenna of ThinkPad X40 Series were performed for the co-location with the new Bluetooth device.

Table-D Peak Antenna Gains of EUT

Host PC models		Granted date	2.4GHz band		5.8Ghz band	
			Main	Aux.	Main	Aux.
ThinkPad T40 Series	14"	October/07/2004	0.99 dBi	-0.48 dBi	-0.23 dBi	-0.37 dBi
	15"		1.24 dBi	0.38 dBi	1.04 dBi	-0.23 dBi
ThinkPad R50 Series	14"		1.52 dBi	1.84 dBi	0.02 dBi	0.19 dBi
	15"		1.18 dBi	1.71 dBi	1.78 dBi	1.51 dBi
ThinkPad X30 Series		(new application)	0.62 dBi	1.28 dBi	0.32 dBi	-0.87 dBi
ThinkPad X40 Series			0.39 dBi	1.67 dBi	1.74 dBi	2.04 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-E 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° 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. AC Wireline Conducted Emissions (150KHz – 30MHz)

[FCC 15.207, RSS-210 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

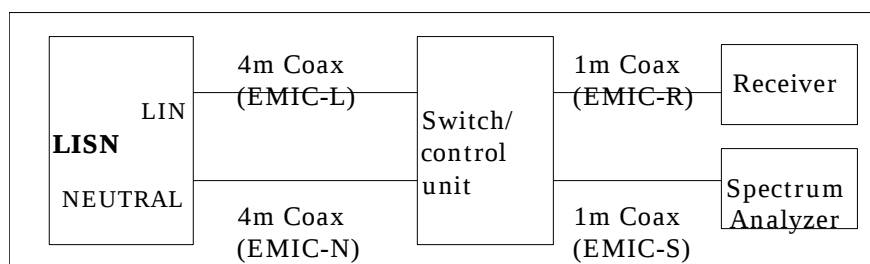


Figure 1. Cables for Conducted Emission Test

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 = Powerline Voltage (dBμV)

R = Measured Receiver Input Amplitude (dBμV)

CORR = Correction Factor (dB) = LL+CL+SWL+PLL

LL = Insertion loss of LISN (dB)

CL = Insertion loss of Cable (dB)

SWL = Insertion loss of Switch control unit (dB)

PLL = Insertion loss of Pulse Limiter (dB)

Given a Receiver input reading of 50.0 dBμV, 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:

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

$$PV = 50.0 + 1.0 = 51.0 \text{ (dBμV)}$$

1.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 13.3dB. The 6 highest emissions relative to the limits are reported.

Test Date: November 18, 2004

1.3.1 EUT in 2.4GHz DSSS/OFDM transmission modes

The full testing with the highest gain antenna was already certified at the previous grant. The worse cases were selected from the previous application and tested with the new antenna systems. The highest gain among the new antenna systems was used for the test.

Table 1-2-1. Ch.1 (2412MHz) 11Mbps DSSS 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)					
0.2051	47.9	0.5	48.4	39.6	0.5	40.1	63.4	15.0	53.4	13.3	Neutral
0.2718	39.5	0.6	40.1	32.5	0.6	33.1	61.1	21.0	51.1	18.0	Line
0.3374	34.5	0.6	35.1	26.6	0.6	27.2	59.3	24.2	49.3	22.1	Line
0.4066	27.4	0.6	28.0	22.9	0.6	23.5	57.7	29.7	47.7	24.2	Line
0.4682	32.6	0.6	33.2	29.3	0.6	29.9	56.5	23.3	46.5	16.6	Neutral
0.5380	26.9	0.6	27.5	22.8	0.6	23.4	56.0	28.5	46.0	22.6	Line

Table 1-2-2. Ch.6 (2437MHz) DSSS **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)					
0.2028	47.1	0.5	47.6	39.2	0.5	39.7	63.5	15.9	53.5	13.8	Neutral
0.2729	35.0	0.6	35.6	28.7	0.6	29.3	61.0	25.4	51.0	21.7	Neutral
0.3391	29.9	0.6	30.5	23.2	0.6	23.8	59.2	28.7	49.2	25.4	Neutral
0.4041	27.0	0.6	27.6	23.1	0.6	23.7	57.8	30.2	47.8	24.1	Line
0.4726	33.7	0.6	34.3	30.4	0.6	31.0	56.5	22.2	46.5	15.5	Neutral
0.5381	26.0	0.6	26.6	22.4	0.6	23.0	56.0	29.4	46.0	23.0	Line

Table 1-2-3. Ch.6 (2437MHz) 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)					
0.2047	45.4	0.5	45.9	37.3	0.5	37.8	63.4	17.5	53.4	15.6	Neutral
0.2708	37.5	0.6	38.1	31.5	0.6	32.1	61.1	23.0	51.1	19.0	Neutral
0.3343	31.8	0.6	32.4	24.5	0.6	25.1	59.3	26.9	49.3	24.2	Line
0.4717	34.0	0.6	34.6	31.0	0.6	31.6	56.5	21.9	46.5	14.9	Neutral
0.5361	26.2	0.6	26.8	22.0	0.6	22.6	56.0	29.2	46.0	23.4	Neutral
0.6073	23.6	0.6	24.2	20.5	0.6	21.1	56.0	31.8	46.0	24.9	Line

Table 1-2-4. Ch.6 (2437MHz) 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)					
0.2040	45.9	0.5	46.4	38.1	0.5	38.6	63.4	17.0	53.4	14.8	Neutral
0.2713	37.3	0.6	37.9	31.2	0.6	31.8	61.1	23.2	51.1	19.3	Neutral
0.3393	30.5	0.6	31.1	23.1	0.6	23.7	59.2	28.1	49.2	25.5	Line
0.4727	33.9	0.6	34.5	30.6	0.6	31.2	56.5	22.0	46.5	15.3	Neutral
0.5355	25.5	0.6	26.1	21.4	0.6	22.0	56.0	29.9	46.0	24.0	Line
0.6079	23.2	0.6	23.8	19.9	0.6	20.5	56.0	32.2	46.0	25.5	Neutral

1.3.2 EUT in 5.8GHz OFDM transmission mode (ThinkPad X40 Series, Auxiliary antenna)

The full testing was performed with the auxiliary antenna of ThinkPad X40 Series that has the highest gain in 5.8GHz band in the all host PC devices.

Table 1-2-5. Ch.149 (5745MHz) **TX** mode 6Mbps

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)					
0.2710	37.2	0.6	37.8	31.3	0.6	31.9	61.1	23.3	51.1	19.2	Neutral
0.3391	30.8	0.6	31.4	24.4	0.6	25.0	59.2	27.8	49.2	24.2	Neutral
0.4725	33.9	0.6	34.5	30.8	0.6	31.4	56.5	22.0	46.5	15.1	Neutral
0.5411	27.3	0.6	27.9	23.4	0.6	24.0	56.0	28.1	46.0	22.0	Neutral
0.6060	24.3	0.6	24.9	21.4	0.6	22.0	56.0	31.1	46.0	24.0	Line
1.8885	22.7	0.7	23.4	20.7	0.7	21.4	56.0	32.6	46.0	24.6	Neutral

Table 1-2-6. Ch.157 (5785MHz) **TX** mode 6Mbps

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)					
0.2063	41.5	0.5	42.0	33.7	0.5	34.2	63.4	21.4	53.4	19.2	Neutral
0.2717	36.5	0.6	37.1	30.6	0.6	31.2	61.1	24.0	51.1	19.9	Neutral
0.3381	31.9	0.6	32.5	24.9	0.6	25.5	59.3	26.8	49.3	23.8	Line
0.4727	33.9	0.6	34.5	30.7	0.6	31.3	56.5	22.0	46.5	15.2	Neutral
0.5389	27.8	0.6	28.4	24.5	0.6	25.1	56.0	27.6	46.0	20.9	Neutral
0.6067	24.3	0.6	24.9	21.3	0.6	21.9	56.0	31.1	46.0	24.1	Line

Table 1-2-7. Ch.165 (5825MHz) **TX** mode 6Mbps

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)					
0.2060	43.1	0.5	43.6	35.5	0.5	36.0	63.4	19.8	53.4	17.4	Neutral
0.2711	36.9	0.6	37.5	31.1	0.6	31.7	61.1	23.6	51.1	19.4	Neutral
0.4725	33.9	0.6	34.5	30.9	0.6	31.5	56.5	22.0	46.5	15.0	Neutral
0.5385	27.7	0.6	28.3	24.3	0.6	24.9	56.0	27.7	46.0	21.1	Neutral
0.6033	23.4	0.6	24.0	20.1	0.6	20.7	56.0	32.0	46.0	25.3	Line
1.8858	23.1	0.7	23.8	21.4	0.7	22.1	56.0	32.2	46.0	23.9	Neutral

Table 1-2-8. Ch.157 (5875MHz) **RX** mode

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)					
0.2081	33.3	0.5	33.8	20.6	0.5	21.1	63.3	29.5	53.3	32.2	Line
0.2710	37.2	0.6	37.8	31.3	0.6	31.9	61.1	23.3	51.1	19.2	Neutral
0.4722	34.1	0.6	34.7	30.9	0.6	31.5	56.5	21.8	46.5	15.0	Neutral
0.5405	26.3	0.6	26.9	22.2	0.6	22.8	56.0	29.1	46.0	23.2	Line
0.6054	23.7	0.6	24.3	21.1	0.6	21.7	56.0	31.7	46.0	24.3	Line
1.8846	22.9	0.7	23.6	20.6	0.7	21.3	56.0	32.4	46.0	24.7	Neutral

2. Restricted Bands Radiation (30MHz – 1GHz)

[FCC 15.205 / 209, RSS-210 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

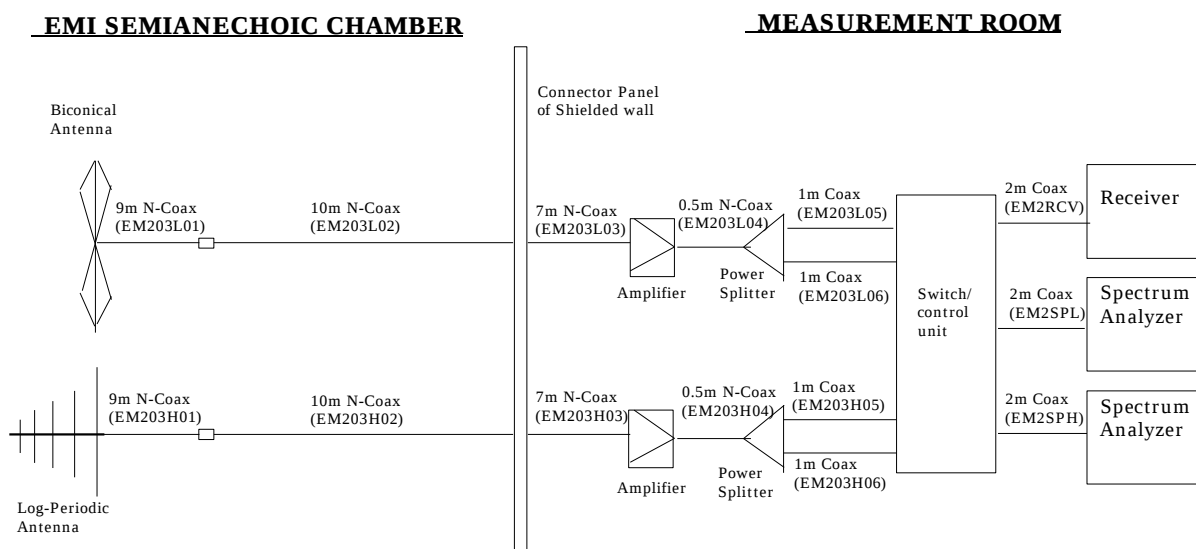


Figure 2 Cables for Radiated Emission Test

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 51.5dBμV; 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:

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

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

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

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

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

2.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 2.0dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: November 16, 25 and 29, 2004

2.4.1 EUT in 2.4GHz DSSS/OFDM transmission modes

The full testing with the highest gain antenna was already certified at the previous grant. The worse cases were selected from the previous application (i.e. ThinkPad T40 Series, LCD 14" model, Main antenna) and tested for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700 HER). Also the highest gain among the new antenna systems (i.e. ThinkPad X40 Series, auxiliary antenna) was measured with the same test cases.

Table 2-2-1. Ch.11 (2462MHz) DSSS mode 11Mbps 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)
107.999	V	46.4	9.9	-27.9	28.4	43.5	15.1	26.3	150
196.605	H	43.1	13.6	-26.7	30.0	43.5	13.5	31.6	150
400.505	V	42.3	15.3	-22.4	35.2	46.0	10.8	57.5	200
425.998	V	44.7	15.7	-21.5	38.9	46.0	7.1	88.1	200
437.997	V	42.0	16.1	-21.2	36.9	46.0	9.1	70.0	200
801.009	V	33.1	21.2	-18.5	35.8	46.0	10.2	61.7	200

Table 2-2-2. Ch.11 (2462MHz) DSSS mode 11Mbps 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	48.7	10.9	-28.9	30.7	40.0	9.3	34.3	100
54.000	V	47.9	10.1	-28.8	29.2	40.0	10.8	28.8	100
60.000	V	54.3	9.3	-28.7	34.9	40.0	5.1	55.6	100
72.000	V	49.4	8.7	-28.3	29.8	40.0	10.2	30.9	100
83.999	V	53.3	7.9	-28.5	32.7	40.0	7.3	43.2	100
379.325	V	43.8	14.7	-22.5	36.0	46.0	10.0	63.1	200

Table 2-2-3. Ch.6 (2437MHz) DSSS **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	44.1	13.6	-26.7	31.0	43.5	12.5	35.5	150
400.505	V	43.5	15.3	-22.4	36.4	46.0	9.6	66.1	200
413.997	V	41.9	15.5	-22.2	35.2	46.0	10.8	57.5	200
425.997	V	44.7	15.7	-21.5	38.9	46.0	7.1	88.1	200
437.998	V	41.9	16.1	-21.2	36.8	46.0	9.2	69.2	200
801.009	V	33.7	21.2	-18.5	36.4	46.0	9.6	66.1	200

Table 2-2-4. Ch.6 (2437MHz) DSSS **RX** 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	48.1	10.9	-28.9	30.1	40.0	9.9	32.0	100
54.000	V	48.7	10.1	-28.8	30.0	40.0	10.0	31.6	100
60.000	V	53.3	9.3	-28.7	33.9	40.0	6.1	49.5	100
71.999	V	51.3	8.7	-28.3	31.7	40.0	8.3	38.5	100
78.000	V	49.3	7.8	-28.5	28.6	40.0	11.4	26.9	100
84.000	V	52.1	7.9	-28.5	31.5	40.0	8.5	37.6	100

Table 2-2-5. Ch.11 (2462MHz) OFDM mode 6Mbps 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)
108.000	V	46.0	9.9	-27.9	28.0	43.5	15.5	25.1	150
196.605	H	46.3	13.6	-26.7	33.2	43.5	10.3	45.7	150
400.505	V	43.5	15.3	-22.4	36.4	46.0	9.6	66.1	200
425.999	V	44.5	15.7	-21.5	38.7	46.0	7.3	86.1	200
437.997	V	41.9	16.1	-21.2	36.8	46.0	9.2	69.2	200
801.008	V	34.1	21.2	-18.5	36.8	46.0	9.2	69.2	200

Table 2-2-6. Ch.11 (2462MHz) OFDM mode 6Mbps 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	48.7	10.9	-28.9	30.7	40.0	9.3	34.3	100
54.000	V	48.9	10.1	-28.8	30.2	40.0	9.8	32.4	100
60.000	V	53.8	9.3	-28.7	34.4	40.0	5.6	52.5	100
72.000	V	50.9	8.7	-28.3	31.3	40.0	8.7	36.7	100
84.000	V	51.6	7.9	-28.5	31.0	40.0	9.0	35.5	100
378.406	V	43.1	14.7	-22.5	35.3	46.0	10.7	58.2	200

Table 2-2-7. Ch.6 (2437MHz) 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	43.0	13.6	-26.7	29.9	43.5	13.6	31.3	150
400.505	V	43.5	15.3	-22.4	36.4	46.0	9.6	66.1	200
413.997	V	41.7	15.5	-22.2	35.0	46.0	11.0	56.2	200
425.999	V	44.4	15.7	-21.5	38.6	46.0	7.4	85.1	200
437.997	V	41.6	16.1	-21.2	36.5	46.0	9.5	66.8	200
801.009	V	34.3	21.2	-18.5	37.0	46.0	9.0	70.8	200

Table 2-2-8. Ch.6 (2437MHz) OFDM **RX** 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)
47.999	V	47.9	10.9	-28.9	29.9	40.0	10.1	31.3	100
54.000	V	48.2	10.1	-28.8	29.5	40.0	10.5	29.9	100
60.000	V	54.3	9.3	-28.7	34.9	40.0	5.1	55.6	100
72.000	V	51.3	8.7	-28.3	31.7	40.0	8.3	38.5	100
84.000	V	51.6	7.9	-28.5	31.0	40.0	9.0	35.5	100
379.178	V	43.1	14.7	-22.5	35.3	46.0	10.7	58.2	200

2.4.2 EUT in 5.8GHz OFDM transmission mode

The representative worst case in the previous application (i.e. ThinkPad R50 Series, LCD 15" model, Main antenna) was examined to confirm the compliance for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700HER). Also the full testing with the auxiliary antenna of ThinkPad X40 Series were performed for the co-location with the new Bluetooth device.

Table 2-2-9. Ch.157 (5785MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter

Host device: IBM ThinkPad R50 Series, LCD 15" 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)
199.686	H	49.4	13.8	-26.6	36.6	43.5	6.9	67.6	150
222.001	H	46.9	10.5	-24.5	32.9	46.0	13.1	44.2	200
341.998	V	51.6	14.3	-22.8	43.1	46.0	2.9	142.9	200
354.001	V	52.3	14.4	-22.7	44.0	46.0	2.0	158.5	200
365.998	V	48.9	14.4	-22.3	41.0	46.0	5.0	112.2	200
729.015	V	39.5	21.1	-19.0	41.6	46.0	4.4	120.2	200

Table 2-2-10. Ch.157 (5785MHz) OFDM **RX** mode with the co-located Bluetooth transmitter

Host device: IBM ThinkPad R50 Series, LCD 15" 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)
108.000	V	48.4	9.9	-27.9	30.4	43.5	13.1	33.1	150
198.018	H	49.9	13.7	-26.6	37.0	43.5	6.5	70.8	150
341.998	V	51.6	14.3	-22.8	43.1	46.0	2.9	142.9	200
354.001	V	52.0	14.4	-22.7	43.7	46.0	2.3	153.1	200
365.998	V	48.9	14.4	-22.3	41.0	46.0	5.0	112.2	200
729.015	V	41.0	21.1	-19.0	43.1	46.0	2.9	142.9	200

Table 2-2-11. Ch.149 (5745MHz) OFDM mode 6Mbps 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	48.1	10.9	-28.9	30.1	40.0	9.9	32.0	100
54.000	V	48.0	10.1	-28.8	29.3	40.0	10.7	29.2	100
60.000	V	54.2	9.3	-28.7	34.8	40.0	5.2	55.0	100
72.000	V	51.1	8.7	-28.3	31.5	40.0	8.5	37.6	100
83.999	V	51.6	7.9	-28.5	31.0	40.0	9.0	35.5	100
379.190	V	43.4	14.7	-22.5	35.6	46.0	10.4	60.3	200

Table 2-2-12. Ch.157 (5785MHz) OFDM mode 6Mbps 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	48.4	10.9	-28.9	30.4	40.0	9.6	33.1	100
54.000	V	48.1	10.1	-28.8	29.4	40.0	10.6	29.5	100
60.000	V	54.0	9.3	-28.7	34.6	40.0	5.4	53.7	100
72.000	V	50.9	8.7	-28.3	31.3	40.0	8.7	36.7	100
84.000	V	52.6	7.9	-28.5	32.0	40.0	8.0	39.8	100
379.448	V	44.8	14.7	-22.5	37.0	46.0	9.0	70.8	200

Table 2-2-13. Ch.165 (5825MHz) OFDM mode 6Mbps 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	48.5	10.9	-28.9	30.5	40.0	9.5	33.5	100
54.001	V	49.6	10.1	-28.8	30.9	40.0	9.1	35.1	100
60.000	V	50.9	9.3	-28.7	31.5	40.0	8.5	37.6	100
72.000	V	50.6	8.7	-28.3	31.0	40.0	9.0	35.5	100
84.000	V	52.8	7.9	-28.5	32.2	40.0	7.8	40.7	100
379.458	V	45.2	14.7	-22.5	37.4	46.0	8.6	74.1	200

Table 2-2-14. Ch.157 (5785MHz) OFDM **RX** 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	49.0	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	52.7	9.3	-28.7	33.3	40.0	6.7	46.2	100
72.000	V	49.6	8.7	-28.3	30.0	40.0	10.0	31.6	100
84.000	V	52.5	7.9	-28.5	31.9	40.0	8.1	39.4	100
379.320	V	44.5	14.7	-22.5	36.7	46.0	9.3	68.4	200

3. Restricted Bands Radiation (1GHz – 40GHz)

[FCC 15.205 / 209, RSS-210 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 - 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

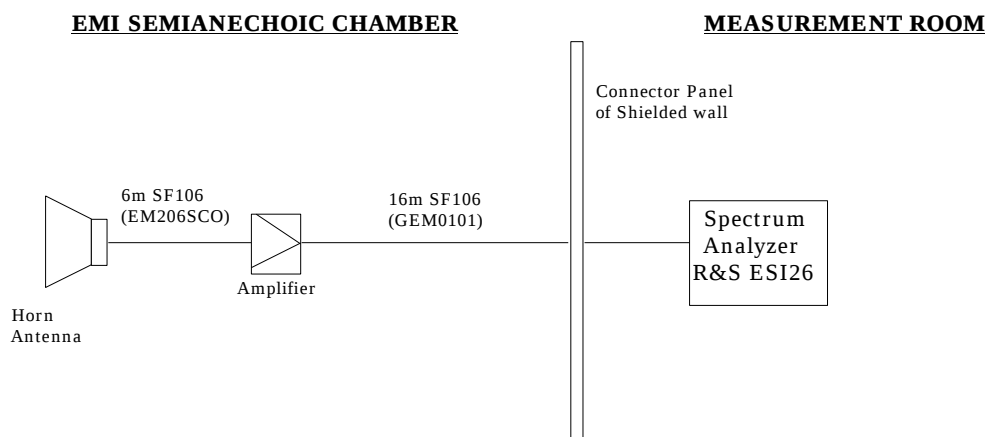


Figure 3-1. Cables for Radiated Emission Test (1 – 12.4 GHz)

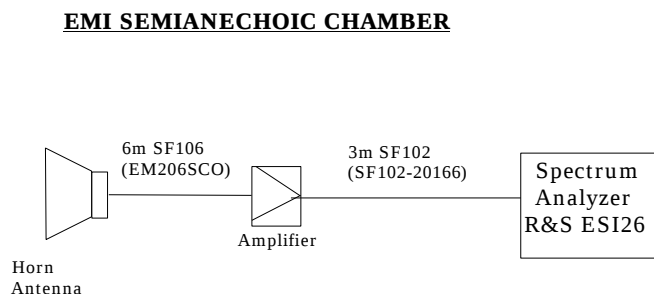


Figure 3-2. Cables for Radiated Emission Test (12.4 - 18GHz)

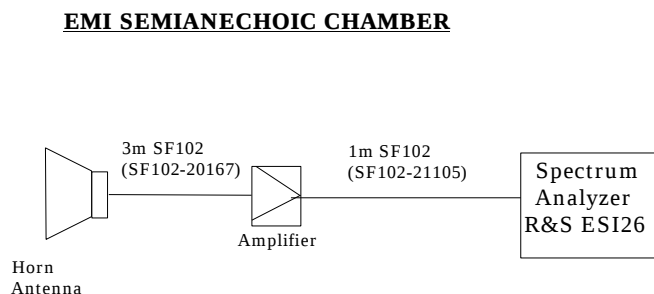


Figure 3-3. Cables for Radiated Emission Test (18 – 26.5GHz)

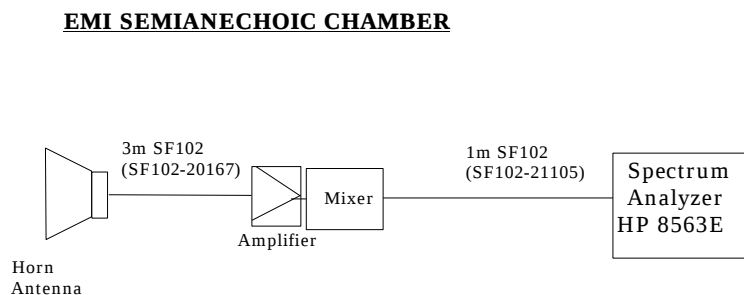


Figure 3-4. Cables for Radiated Emission Test (26.5 - 40GHz)

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 λV/m (or μV) are done as :

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

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

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

3.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 0.9 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, 18, 19, 22, 24 and 29, 2004

3.4.1 EUT in 2.4GHz DSSS/OFDM transmission modes

The full testing with the highest gain antenna was already certified at the previous grant. The worse cases were selected from the previous application (i.e. ThinkPad T40 Series, LCD 14" model, Main antenna) and tested for the multiple transmission 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.

*Note1: OB means "operation band" (2400-2483.5MHz); in this case limit is 1W (measured conducted with power meter)

*Note2: NR means "Non-Restricted band" (just reference only for EU compliance)

Table 3-2-1. Ch.11 (2462MHz) DSSS mode 11Mbps 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)		
Inband												
2.462	H	115.9	106.7	28.4	-29.2	0.0	115.1	OB*1	-	105.9	OB*1	-
bandedge												
2.484	H	61.2	48.1	28.4	-29.1	0.0	60.5	74.0	13.5	47.4	54.0	6.6
2.487	H	59.9	48.7	28.4	-29.1	0.0	59.2	74.0	14.8	48.0	54.0	6.0
1.001	V	50.8	-	24.1	-31.9	0.0	43.0	74.0	31.0	-	54.0	-
1.160	V	51.6	-	24.6	-31.3	0.0	44.9	74.0	29.1	-	54.0	-
1.202	V	51.8	-	25.2	-31.3	0.0	45.7	74.0	28.3	-	54.0	-
1.330	V	55.8	-	25.6	-31.0	0.0	50.4	74.0	23.6	-	54.0	-
1.821	H	49.3	36.0	26.9	-29.9	0.0	46.3	NR*2	-	33.0	NR*2	-
1.855	H	49.0	35.7	27.4	-29.9	0.0	46.5	NR*2	-	33.2	NR*2	-
2.289	H	49.3	-	27.8	-29.3	0.0	47.8	74.0	26.2	-	54.0	-
2.344	H	49.3	-	28.1	-29.3	0.0	48.1	74.0	25.9	-	54.0	-
2.361	H	54.7	-	28.1	-29.2	0.0	53.6	74.0	20.4	-	54.0	-
2.387	H	54.0	-	28.2	-29.2	0.0	53.0	74.0	21.0	-	54.0	-
4.806	V	53.2	-	27.1	-26.7	0.0	53.6	74.0	20.4	-	54.0	-
4.822	V	54.5	25.4	27.1	-26.6	0.0	55.0	74.0	19.0	25.9	54.0	28.1
4.834	V	54.8	25.5	27.0	-26.5	0.0	55.3	74.0	18.7	26.0	54.0	28.0
4.934	V	46.3	-	27.1	-26.6	0.0	46.8	74.0	-	-	54.0	-
5.198	V	38.3	24.8	27.1	-26.1	0.0	39.3	NR*2	-	25.8	NR*2	-
5.237	V	37.0	24.9	27.1	-26.0	0.0	38.1	NR*2	-	26.0	NR*2	-
7.363	H	44.2	-	29.8	-24.5	0.0	49.5	74.0	24.5	-	54.0	-
7.381	H	46.4	-	29.8	-24.5	0.0	51.7	74.0	22.3	-	54.0	-
7.387	H	41.1	-	29.8	-24.5	0.0	46.4	74.0	27.6	-	54.0	-
7.434	H	43.1	-	29.8	-24.3	0.0	48.6	74.0	25.4	-	54.0	-

Table 3-2-2. Ch.11 (2462MHz) DSSS mode 11Mbps with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
Inband												
2.462	H	114.0	105.6	28.4	-29.2	0.0	113.2	OB*1	-	104.8	OB*1	-
bandedge												
2.484	H	58.8	47.2	28.4	-29.1	0.0	58.1	74.0	15.9	46.5	54.0	7.5
2.487	H	60.2	49.2	28.4	-29.1	0.0	59.5	74.0	14.5	48.5	54.0	5.5
1.010	V	49.2	-	24.1	-31.9	0.0	41.4	74.0	32.6	-	54.0	-
1.135	V	53.2	-	24.6	-31.4	0.0	46.4	74.0	27.6	-	54.0	-
1.194	V	47.6	-	25.2	-31.3	0.0	41.5	74.0	32.5	-	54.0	-
1.516	V	52.8	-	25.5	-30.4	0.0	47.9	74.0	26.1	-	54.0	-
1.813	V	50.3	36.0	26.9	-29.9	0.0	47.3	NR*2	-	33.0	NR*2	-
2.289	H	48.7	-	27.8	-29.3	0.0	47.2	74.0	26.8	-	54.0	-
2.347	H	49.7	-	28.1	-29.3	0.0	48.5	74.0	25.5	-	54.0	-
2.361	H	53.0	-	28.1	-29.2	0.0	51.9	74.0	22.1	-	54.0	-
2.383	H	51.5	-	28.2	-29.2	0.0	50.5	74.0	23.5	-	54.0	-
4.908	V	59.5	25.2	27.0	-26.6	0.0	59.9	74.0	14.1	25.6	54.0	28.4
4.924	V	60.6	30.9	27.0	-26.4	0.0	61.2	74.0	12.8	31.5	54.0	22.5
4.944	V	61.8	26.7	27.1	-26.4	0.0	62.5	74.0	11.5	27.4	54.0	26.6
4.957	V	62.3	25.5	27.1	-26.6	0.0	62.8	74.0	11.2	26.0	54.0	28.0
5.191	H	38.3	24.9	27.1	-26.1	0.0	39.3	NR*2	-	25.9	NR*2	-
5.250	H	39.5	24.8	27.1	-26.0	0.0	40.6	NR*2	-	25.9	NR*2	-
7.260	V	42.4	-	30.0	-24.5	0.0	47.9	74.0	26.1	-	54.0	-
7.315	V	41.7	-	29.8	-24.4	0.0	47.1	74.0	26.9	-	54.0	-
7.386	H	42.0	-	29.8	-24.5	0.0	47.3	74.0	26.7	-	54.0	-
7.435	V	40.3	-	29.8	-24.4	0.0	45.7	74.0	28.3	-	54.0	-

Table 3-2-3. Ch.6 (2437MHz) DSSS **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)		
1.001	V	50.5	-	24.1	-31.9	0.0	42.7	74.0	31.3	-	54.0	-
1.167	V	49.6	-	24.6	-31.3	0.0	42.9	74.0	31.1	-	54.0	-
1.202	V	51.6	-	25.2	-31.3	0.0	45.5	74.0	28.5	-	54.0	-
1.332	V	53.8	-	25.2	-30.9	0.0	48.1	74.0	25.9	-	54.0	-
1.853	V	42.4	28.9	27.5	-29.7	0.0	40.2	NR*2	-	26.7	NR*2	-
1.890	V	42.0	29.1	27.5	-29.7	0.0	39.8	NR*2	-	26.9	NR*2	-
5.201	H	38.6	24.8	27.1	-26.1	0.0	39.6	NR*2	-	25.8	NR*2	-
5.237	H	39.8	24.8	27.1	-26.0	0.0	40.9	NR*2	-	25.9	NR*2	-

Table 3-2-4. Ch.6 (2437MHz) DSSS **RX** mode with the co-located Bluetooth transmitter
Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
1.001	V	47.7	-	24.1	-31.9	0.0	39.9	74.0	34.1	-	54.0	-
1.133	V	51.6	-	24.6	-31.4	0.0	44.8	74.0	29.2	-	54.0	-
1.194	V	47.5	-	25.2	-31.3	0.0	41.4	74.0	32.6	-	54.0	-
1.511	V	52.1	-	25.5	-30.4	0.0	47.2	74.0	26.8	-	54.0	-
1.891	V	43.3	29.7	27.5	-29.7	0.0	41.1	NR*2	-	27.5	NR*2	-
5.192	H	38.9	24.9	27.1	-26.1	0.0	39.9	NR*2	-	25.9	NR*2	-
5.264	H	38.3	24.9	27.1	-25.9	0.0	39.5	NR*2	-	26.1	NR*2	-

Table 3-2-5. Ch.1 (2412MHz) OFDM mode 6Mbps 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)		
Inband 2.407 bandedge	H	113.3	101.8	28.3	-29.1	0.0	112.5	OB*	-	101.0	OB*	-
2.388	H	70.6	50.0	28.2	-29.2	0.0	69.6	74.0	4.4	49.0	54.0	5.0
2.389	H	70.6	51.4	28.2	-29.2	0.0	69.6	74.0	4.4	50.4	54.0	3.6
2.390	H	72.1	53.6	28.2	-29.2	0.0	71.1	74.0	2.9	52.6	54.0	1.4
1.001	V	48.8	-	24.1	-31.9	0.0	41.0	74.0	33.0	-	54.0	-
1.161	V	50.0	-	24.6	-31.3	0.0	43.3	74.0	30.7	-	54.0	-
1.198	V	50.9	-	25.2	-31.3	0.0	44.8	74.0	29.2	-	54.0	-
1.331	V	51.0	-	25.2	-30.9	0.0	45.3	74.0	28.7	-	54.0	-
1.825	V	49.3	35.9	26.9	-29.9	0.0	46.3	NR*2	-	32.9	NR*2	-
1.855	V	46.9	35.7	27.4	-29.9	0.0	44.4	NR*2	-	33.2	NR*2	-
2.313	H	52.3	-	28.0	-29.3	0.0	51.0	74.0	23.0	-	54.0	-
2.376	H	59.1	42.0	28.2	-29.2	0.0	58.1	74.0	15.9	41.0	54.0	13.0
2.386	H	65.2	45.8	28.2	-29.2	0.0	64.2	74.0	9.8	44.8	54.0	9.2
4.820	V	55.1	25.5	27.1	-26.6	0.0	55.6	74.0	18.4	26.0	54.0	28.0
4.826	V	55.1	25.5	27.1	-26.6	0.0	55.6	74.0	18.4	26.0	54.0	28.0
4.840	V	54.6	25.6	27.0	-26.5	0.0	55.1	74.0	18.9	26.1	54.0	27.9
4.944	V	44.7	-	27.1	-26.4	0.0	45.4	74.0	28.6	-	54.0	-
5.195	H	39.0	24.9	27.1	-26.1	0.0	40.0	NR*2	-	25.9	NR*2	-
5.258	H	39.5	24.9	27.1	-26.0	0.0	40.6	NR*2	-	26.0	NR*2	-
7.345	V	42.5	-	29.8	-24.5	0.0	47.8	74.0	26.2	-	54.0	-
7.375	V	44.6	-	29.8	-24.5	0.0	49.9	74.0	24.1	-	54.0	-
7.399	V	43.8	-	29.8	-24.5	0.0	49.1	74.0	24.9	-	54.0	-
7.429	V	43.5	-	29.8	-24.4	0.0	48.9	74.0	25.1	-	54.0	-

Table 3-2-6. Ch.1 (2412MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter

Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
Inband												
2.407	H	112.7	101.9	28.3	-29.1	0.0	111.9	OB*	-	101.1	OB*	-
bandedge												
2.389	H	69.2	52.3	28.2	-29.2	0.0	68.2	74.0	5.8	51.3	54.0	2.7
2.390	H	69.8	54.1	28.2	-29.2	0.0	68.8	74.0	5.2	53.1	54.0	0.9
1.003	V	47.9	-	24.1	-31.9	0.0	40.1	74.0	33.9	-	54.0	-
1.135	V	52.6	-	24.6	-31.4	0.0	45.8	74.0	28.2	-	54.0	-
1.213	V	49.7	-	25.2	-31.3	0.0	43.6	74.0	30.4	-	54.0	-
1.513	V	51.5	-	25.5	-30.4	0.0	46.6	74.0	27.4	-	54.0	-
1.868	H	49.5	35.4	27.4	-29.9	0.0	47.0	NR*2	-	32.9	NR*2	-
2.313	H	53.1	-	28.0	-29.3	0.0	51.8	74.0	22.2	-	54.0	-
2.380	H	56.6	40.6	28.2	-29.2	0.0	55.6	74.0	18.4	39.6	54.0	14.4
2.383	H	58.1	41.2	28.2	-29.2	0.0	57.1	74.0	16.9	40.2	54.0	13.8
4.924	V	60.2	25.4	27.0	-26.4	0.0	60.8	74.0	13.2	26.0	54.0	28.0
4.936	V	61.0	25.3	27.1	-26.4	0.0	61.7	74.0	12.3	26.0	54.0	28.0
4.948	V	61.6	25.1	27.1	-26.4	0.0	62.3	74.0	11.7	25.8	54.0	28.2
4.961	V	62.0	25.2	27.1	-26.6	0.0	62.5	74.0	11.5	25.7	54.0	28.3
5.202	V	38.7	24.7	27.1	-26.1	0.0	39.7	NR*2	-	25.7	NR*2	-
5.226	V	39.4	24.9	27.1	-26.0	0.0	40.5	NR*2	-	26.0	NR*2	-
7.255	V	42.7	-	30.0	-24.5	0.0	48.2	74.0	25.8	-	54.0	-
7.270	V	41.6	-	29.9	-24.6	0.0	46.9	74.0	27.1	-	54.0	-
7.288	V	41.7	-	29.9	-24.4	0.0	47.2	74.0	26.8	-	54.0	-
7.383	V	40.9	-	29.8	-24.5	0.0	46.2	74.0	27.8	-	54.0	-

Table 3-2-7. Ch.6 (2437MHz) 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)		
1.001	V	49.9	-	24.1	-31.9	0.0	42.1	74.0	31.9	-	54.0	-
1.163	V	51.0	-	24.6	-31.3	0.0	44.3	74.0	29.7	-	54.0	-
1.199	V	53.0	-	25.2	-31.3	0.0	46.9	74.0	27.1	-	54.0	-
1.328	V	54.5	-	25.6	-31.0	0.0	49.1	74.0	24.9	-	54.0	-
1.853	V	42.0	28.9	27.4	-29.9	0.0	39.5	NR*2	-	26.4	NR*2	-
1.891	V	42.6	29.0	27.5	-29.7	0.0	40.4	NR*2	-	26.8	NR*2	-
5.195	H	37.9	24.9	27.1	-26.1	0.0	38.9	NR*2	-	25.9	NR*2	-
5.258	H	37.8	24.9	27.1	-26.0	0.0	38.9	NR*2	-	26.0	NR*2	-

Table 3-2-8. Ch.6 (2437MHz) OFDM **RX** mode with the co-located Bluetooth transmitter
Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
1.001	V	49.0	-	24.1	-31.9	0.0	41.2	74.0	32.8	-	54.0	-
1.135	V	52.2	-	24.6	-31.4	0.0	45.4	74.0	28.6	-	54.0	-
1.194	V	49.8	-	25.2	-31.3	0.0	43.7	74.0	30.3	-	54.0	-
1.519	V	52.1	-	25.5	-30.4	0.0	47.2	74.0	26.8	-	54.0	-
1.857	H	43.9	28.9	27.4	-29.9	0.0	41.4	NR*2	-	26.4	NR*2	-
1.893	H	43.4	29.3	27.5	-29.7	0.0	41.2	NR*2	-	27.1	NR*2	-
5.191	H	38.3	24.9	27.1	-26.1	0.0	39.3	NR*2	-	25.9	NR*2	-
5.253	H	38.9	24.8	27.1	-26.0	0.0	40.0	NR*2	-	25.9	NR*2	-

3.4.2 EUT in 5.8GHz OFDM transmission mode

The representative worst case in the previous application (i.e. ThinkPad R50 Series, LCD 15" model, Main antenna) was examined to confirm the compliance for the multiple transmission with the new co-located Bluetooth device (FCC ID: ANO20040700HER). Also the full testing with the auxiliary antenna of ThinkPad X40 Series were performed for the co-location with the new Bluetooth device.

*Note: OB means "operation band" (5725-5850MHz); in this case limit is 1W (measured conducted with peak power meter)

Table 3-2-9. Ch.165 (5825MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad R50 Series, LCD 15" 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)		
Inband 5.820	H	104.6	93.7	34.0	-25.6	0.0	113.0	OB*	-	102.1	OB*	-
1.094	V	52.2	-	24.4	-31.5	0.0	45.1	74.0	28.9	-	54.0	-
1.140	V	49.6	-	24.6	-31.4	0.0	42.8	74.0	31.2	-	54.0	-
1.162	V	50.0	-	24.6	-31.3	0.0	43.3	74.0	30.7	-	54.0	-
1.196	V	49.6	-	25.2	-31.3	0.0	43.5	74.0	30.5	-	54.0	-
4.822	H	50.9	-	27.1	-26.6	0.0	51.4	74.0	22.6	-	54.0	-
4.836	H	48.4	-	27.0	-26.5	0.0	48.9	74.0	25.1	-	54.0	-
4.948	H	47.5	-	27.1	-26.4	0.0	48.2	74.0	25.8	-	54.0	-
4.978	H	46.0	-	27.1	-26.7	0.0	46.4	74.0	27.6	-	54.0	-
5.353	H	52.8	39.1	33.9	-25.6	0.0	61.1	74.0	12.9	47.4	54.0	6.6
5.437	H	52.4	39.9	34.1	-25.6	0.0	60.9	74.0	13.1	48.4	54.0	5.6
7.307	H	42.6	-	29.9	-24.4	0.0	48.1	74.0	25.9	-	54.0	-
7.367	H	42.4	-	29.8	-24.5	0.0	47.7	74.0	26.3	-	54.0	-
7.407	H	42.6	-	29.8	-24.5	0.0	47.9	74.0	26.1	-	54.0	-
11.647	V	35.9	-	33.6	-20.0	0.0	49.5	74.0	24.5	-	54.0	-

Table 3-2-10. Ch.157 (5785MHz) OFDM **RX** mode with the co-located Bluetooth transmitter
Host device: IBM ThinkPad R50 Series, LCD 15" 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)		
1.092	V	52.3	-	24.4	-31.5	0.0	45.2	74.0	28.8	-	54.0	-
1.132	V	48.9	-	24.6	-31.4	0.0	42.1	74.0	31.9	-	54.0	-
1.162	V	49.9	-	24.6	-31.3	0.0	43.2	74.0	30.8	-	54.0	-
1.194	V	50.0	-	25.2	-31.3	0.0	43.9	74.0	30.1	-	54.0	-

Table 3-2-11. Ch.149 (5745MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
Inband 5.740	H	101.9	91.2	34.0	-25.6	0.0	110.3	OB*	-	99.6	OB*	-
1.080	V	48.9	-	24.5	-31.5	0.0	41.9	74.0	32.1	-	54.0	-
1.136	V	52.0	-	24.6	-31.4	0.0	45.2	74.0	28.8	-	54.0	-
1.164	V	51.4	-	24.6	-31.3	0.0	44.7	74.0	29.3	-	54.0	-
1.519	V	53.0	-	25.5	-30.4	0.0	48.1	74.0	25.9	-	54.0	-
4.904	V	58.9	28.5	27.0	-26.6	0.0	59.3	74.0	14.7	28.9	54.0	25.1
4.924	V	60.5	29.1	27.0	-26.4	0.0	61.1	74.0	12.9	29.7	54.0	24.3
4.944	V	61.3	30.4	27.1	-26.4	0.0	62.0	74.0	12.0	31.1	54.0	22.9
4.955	V	62.2	30.4	27.1	-26.6	0.0	62.7	74.0	11.3	30.9	54.0	23.1
5.367	H	50.9	38.3	33.9	-25.8	0.0	59.0	74.0	15.0	46.4	54.0	7.6
5.437	H	51.6	39.3	34.1	-25.6	0.0	60.1	74.0	13.9	47.8	54.0	6.2
7.251	V	42.7	-	30.0	-24.5	0.0	48.2	74.0	25.8	-	54.0	-
7.275	V	41.2	-	29.9	-24.6	0.0	46.5	74.0	27.5	-	54.0	-
7.287	V	41.4	-	29.9	-24.6	0.0	46.7	74.0	27.3	-	54.0	-
7.663	H	41.6	-	30.0	-24.3	0.0	47.3	74.0	26.7	-	54.0	-
11.489	H	36.1	-	33.5	-20.2	0.0	49.4	74.0	24.6	-	54.0	-

Table 3-2-12. Ch.157 (5785MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
Inband 5.780	H	102.0	91.2	34.0	-25.5	0.0	110.5	OB*	-	99.7	OB*	-
1.072	V	47.4	-	24.5	-31.5	0.0	40.4	74.0	33.6	-	54.0	-
1.138	V	52.7	-	24.6	-31.4	0.0	45.9	74.0	28.1	-	54.0	-
1.162	V	49.5	-	24.6	-31.3	0.0	42.8	74.0	31.2	-	54.0	-
1.517	V	53.3	-	25.5	-30.4	0.0	48.4	74.0	25.6	-	54.0	-
4.904	V	59.7	28.8	27.0	-26.6	0.0	60.1	74.0	13.9	29.2	54.0	24.8
4.932	V	60.6	29.6	27.1	-26.4	0.0	61.3	74.0	12.7	30.3	54.0	23.7
4.944	V	61.7	30.9	27.1	-26.4	0.0	62.4	74.0	11.6	31.6	54.0	22.4
4.955	V	62.3	31.0	27.1	-26.6	0.0	62.8	74.0	11.2	31.5	54.0	22.5
5.381	H	50.7	38.5	33.9	-25.8	0.0	58.8	74.0	15.2	46.6	54.0	7.4
5.430	H	50.7	39.0	34.1	-25.6	0.0	59.2	74.0	14.8	47.5	54.0	6.5
7.251	V	40.1	-	30.0	-24.5	0.0	45.6	74.0	28.4	-	54.0	-
7.299	V	40.4	-	29.9	-24.4	0.0	45.9	74.0	28.1	-	54.0	-
7.335	V	39.0	-	29.8	-24.4	0.0	44.4	74.0	29.6	-	54.0	-
7.715	H	43.8	-	30.0	-24.2	0.0	49.6	74.0	24.4	-	54.0	-
11.561	H	37.5	-	33.5	-19.5	0.0	51.5	74.0	22.5	-	54.0	-

Table 3-2-13. Ch.165 (5825MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad X40 Series, Auxiliary 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)		
Inband 5.820	H	101.2	90.6	34.0	-25.6	0.0	109.6	OB*	-	99.0	OB*	-
1.080	V	48.9	-	24.4	-31.5	0.0	41.8	74.0	32.2	-	54.0	-
1.138	V	51.6	-	24.6	-31.4	0.0	44.8	74.0	29.2	-	54.0	-
1.163	V	50.1	-	24.6	-31.3	0.0	43.4	74.0	30.6	-	54.0	-
1.515	V	52.9	-	25.5	-30.4	0.0	48.0	74.0	26.0	-	54.0	-
4.924	V	59.8	29.3	27.0	-26.4	0.0	60.4	74.0	13.6	29.9	54.0	24.1
4.936	V	61.3	30.0	27.1	-26.4	0.0	62.0	74.0	12.0	30.7	54.0	23.3
4.944	V	61.5	31.0	27.1	-26.4	0.0	62.2	74.0	11.8	31.7	54.0	22.3
4.957	V	61.1	30.4	27.1	-26.6	0.0	61.6	74.0	12.4	30.9	54.0	23.1
5.360	H	51.8	39.7	33.9	-25.6	0.0	60.1	74.0	13.9	48.0	54.0	6.0
5.430	H	52.3	39.2	34.1	-25.6	0.0	60.8	74.0	13.2	47.7	54.0	6.3
7.251	V	42.2	-	30.0	-24.5	0.0	47.7	74.0	26.3	-	54.0	-
7.283	V	40.6	-	29.9	-24.6	0.0	45.9	74.0	28.1	-	54.0	-
7.311	V	41.2	-	29.9	-24.4	0.0	46.7	74.0	27.3	-	54.0	-
11.645	H	37.1	-	33.6	-20.0	0.0	50.7	74.0	23.3	-	54.0	-

Table 3-2-14. Ch.157 (5785MHz) 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>		
1.110	V	49.2	-	24.5	-31.5	0.0	42.2	74.0	31.8	-	54.0	-
1.134	V	51.1	-	24.6	-31.4	0.0	44.3	74.0	29.7	-	54.0	-
1.166	V	52.3	-	24.6	-31.3	0.0	45.6	74.0	28.4	-	54.0	-
1.517	V	52.2	-	25.5	-30.4	0.0	47.3	74.0	26.7	-	54.0	-

3.5 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.1 (2412MHz) with the co-located Bluetooth transmitter

D: 11Mb/s DSSS mode O: 6Mb/s OFDM mode

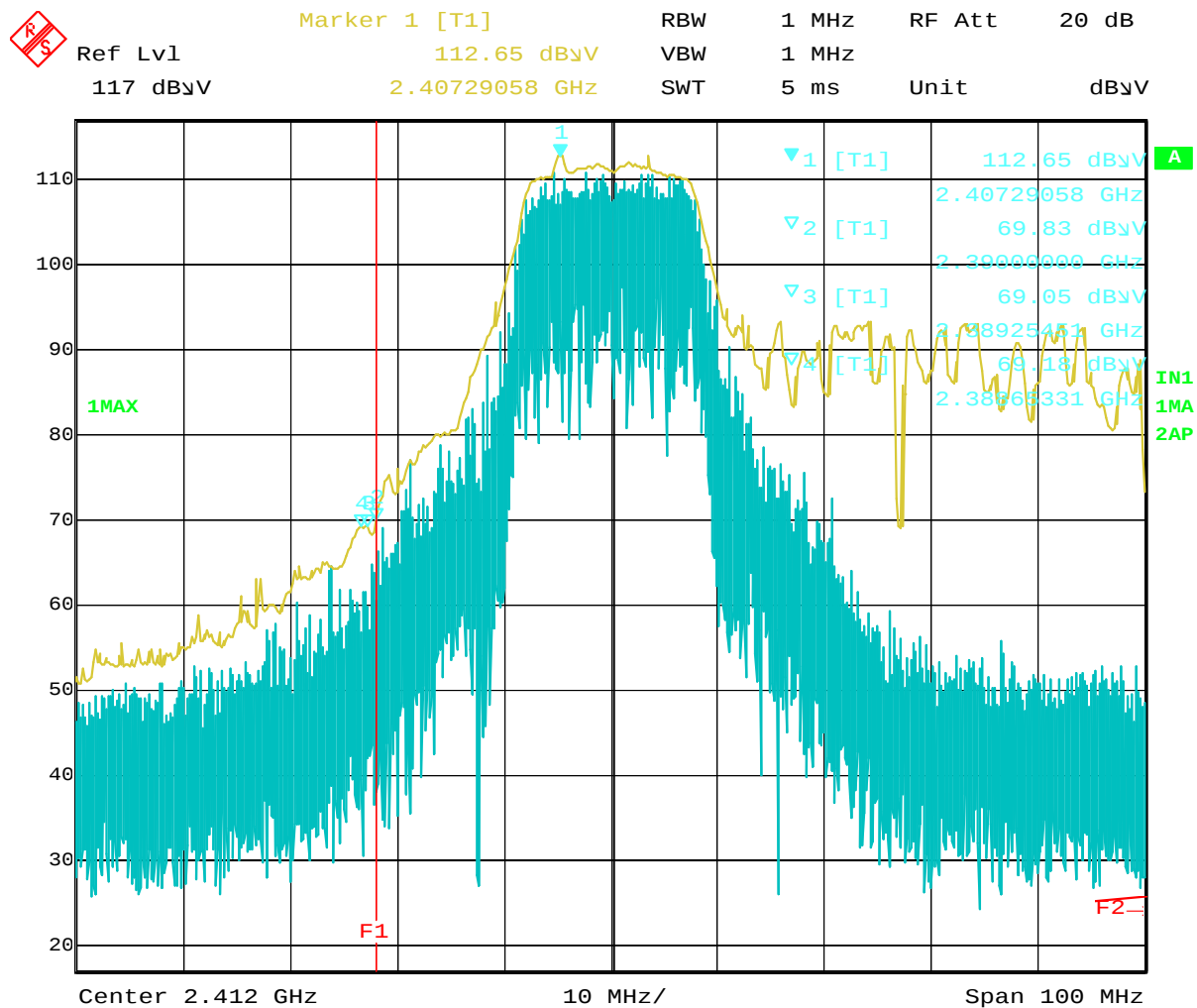
Host device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) <i>(peak)</i>	Rading (dBμV) <i>(average)</i>	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) <i>(peak)</i>	Margin to Limit (dB) <i>(peak)</i>	Field Strength (dBμV/m) <i>(average)</i>	Margin to Limit (dB) <i>(average)</i>
T40 14"	D 2.388	H	57.3	46.9	28.2	-29.2	0.0	56.3	17.7	45.9	8.1
	O 2.390	H	72.1	53.6	28.2	-29.2	0.0	71.1	2.9	52.6	1.4
X40	D 2.388	H	56.6	45.3	28.2	-29.2	0.0	55.6	18.4	44.3	9.7
	O 2.390	H	69.8	54.1	28.2	-29.2	0.0	68.8	5.2	53.1	0.9

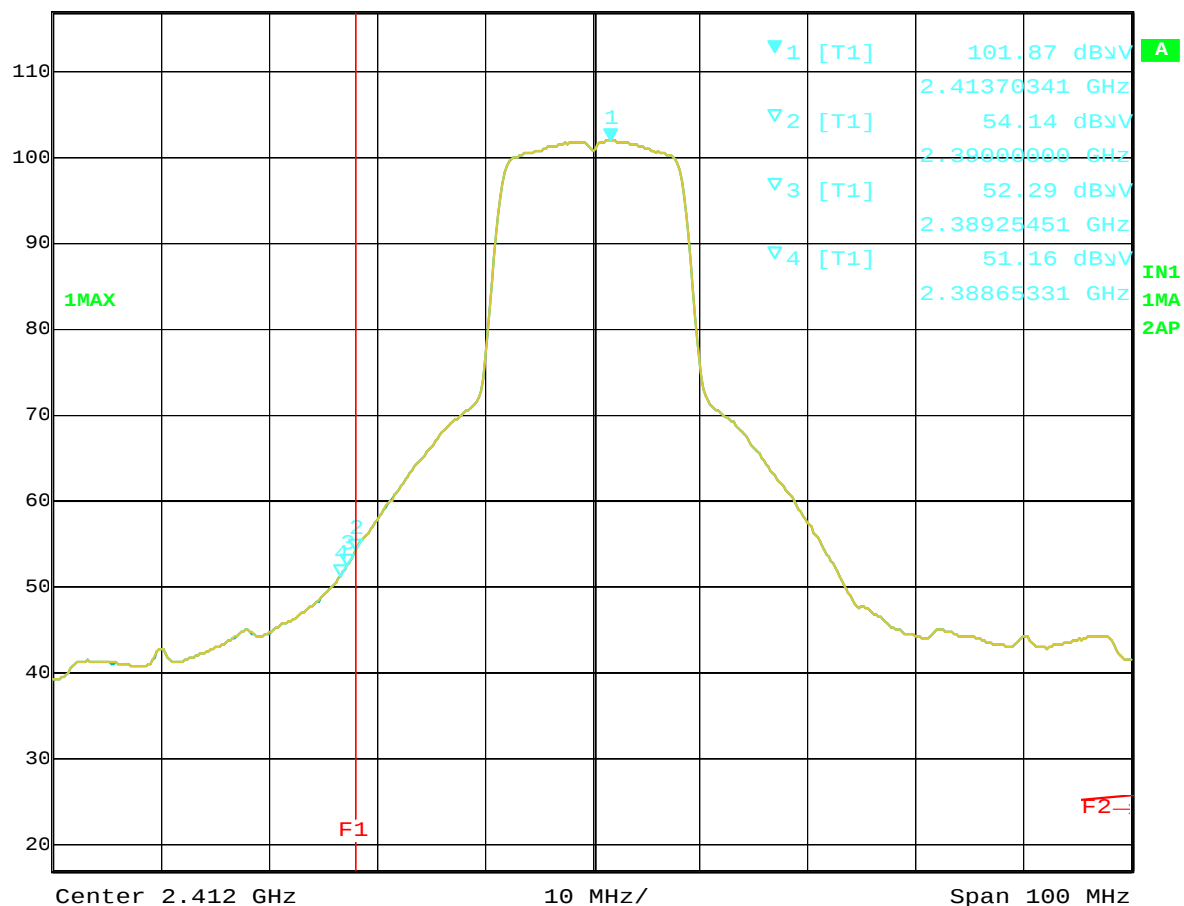
Table 3-3-2. Ch.11 (2462MHz) with the co-located Bluetooth transmitter

D: 11Mb/s DSSS mode O: 6Mb/s OFDM mode

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"	D 2.487	H	59.9	48.7	28.4	-29.1	0.0	59.2	14.8	48.0	6.0
	O 2.484	H	71.3	51.9	28.4	-29.1	0.0	70.6	3.4	51.2	2.8
X40	D 2.487	H	60.2	49.2	28.4	-29.1	0.0	59.5	14.5	48.5	5.5
	O 2.484	H	68.0	49.5	28.4	-29.1	0.0	67.3	6.7	48.8	5.2

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



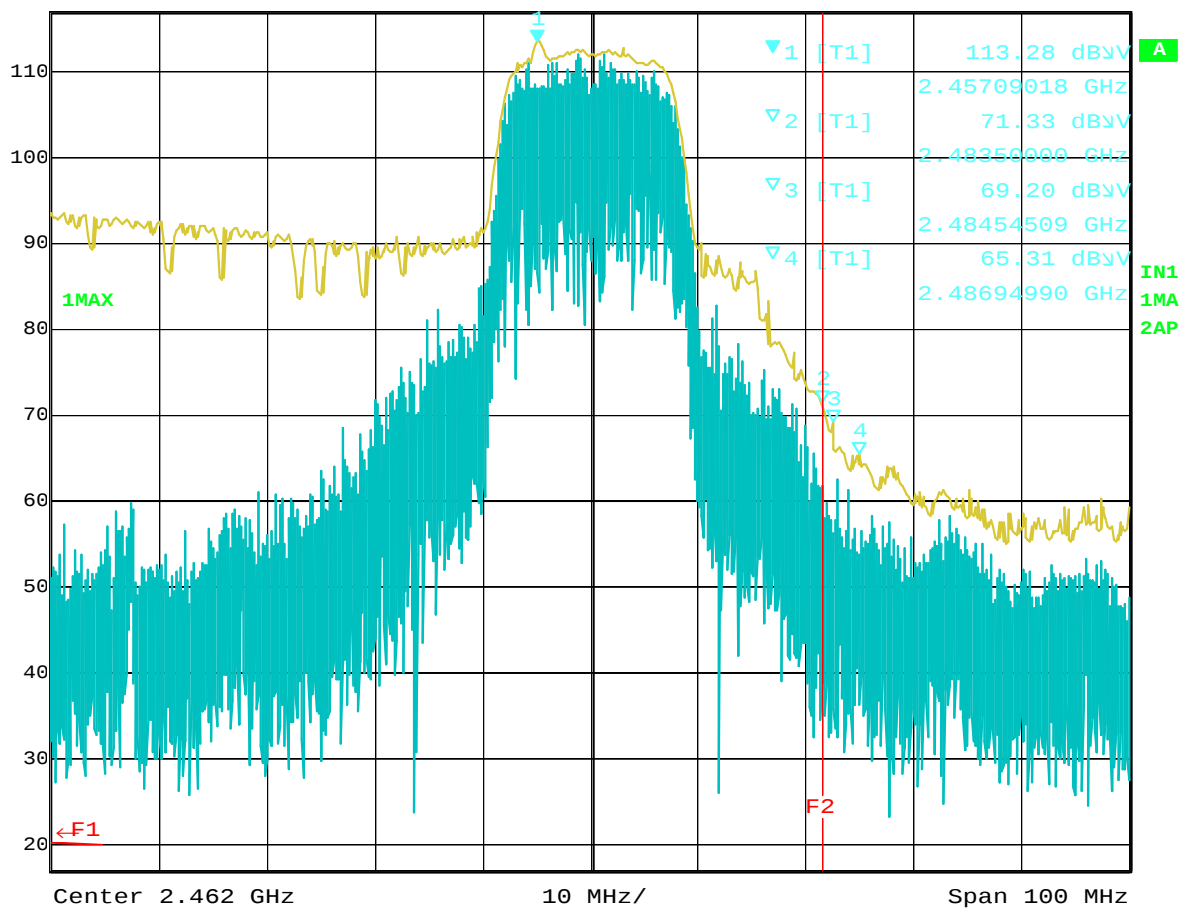
Ref Lvl
117 dBμVMarker 1 [T1]
101.87 dBμV
2.41370341 GHzRBW 1 MHz RF Att 20 dB
VBW 10 Hz
SWT 25 s Unit dBμV

Date: 15.NOV.2004 15:40:59

Plot-2 Ch.1 2412MHz TX, OFDM 6Mbps (Average), X40



Ref Lvl 117 dBμV
Marker 1 [T1] 113.28 dBμV
2.45709018 GHz
RBW 1 MHz
VBW 1 MHz
SWT 5 ms
RF Att 20 dB
Unit dBμV

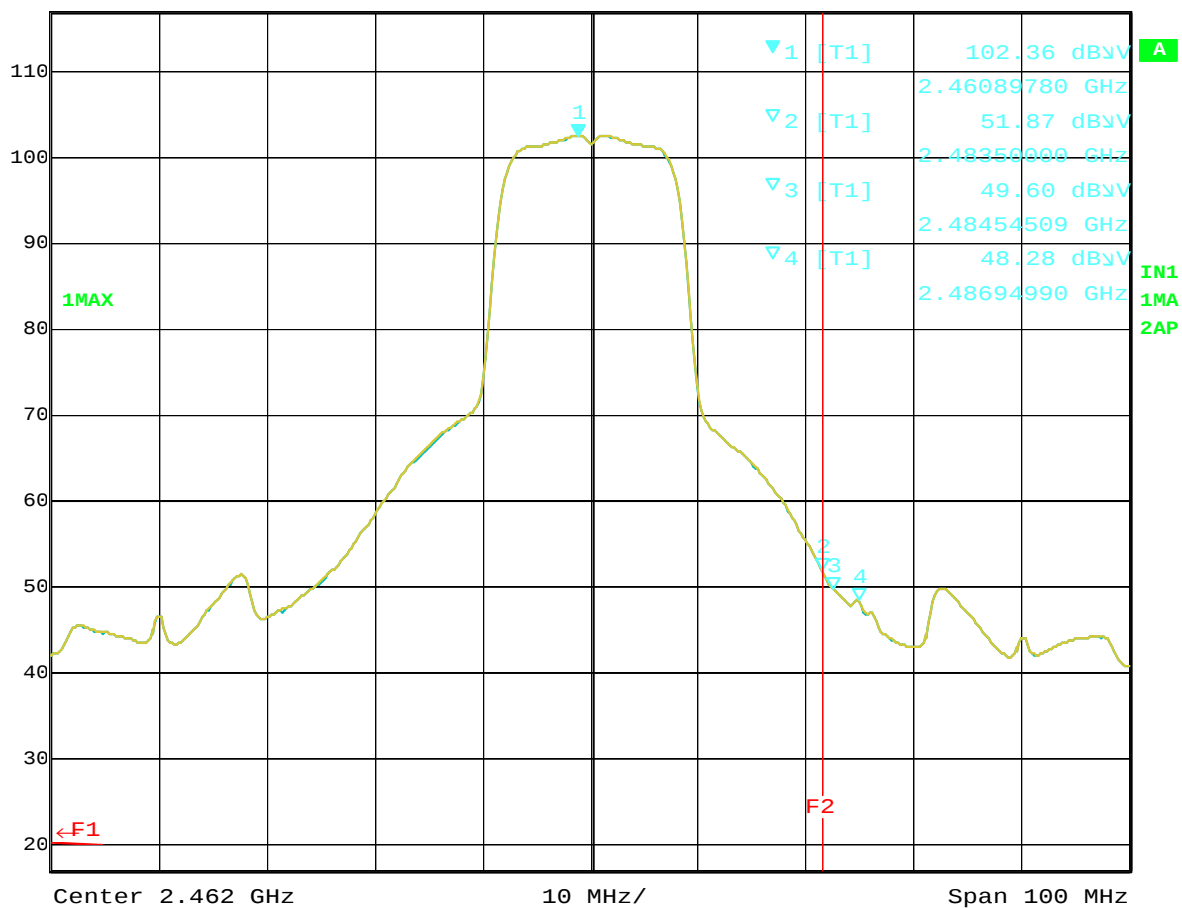


Date: 22.NOV.2004 14:14:11

Plot-3 Ch.11 2462MHz TX, OFDM 6Mbps (Peak), T40



Ref Lvl 117 dBμV
Marker 1 [T1] 102.36 dBμV
2.46089780 GHz
RBW 1 MHz
VBW 10 Hz
SWT 25 s
RF Att 20 dB
Unit dBμV



Date: 22.NOV.2004 14:15:29

Plot-4 Ch.11 2462MHz TX, OFDM 6Mbps (Average), T40

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 6 dB below

[FCC 15.247(a)(2), RSS-210 6.2.2(o)/ Issue 5: Amendment]

4.1.1 Test Procedure

The bandwidth at 6 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in transmission mode at the appropriate center frequency.

The spectrum analyzer was set to :

RBW=100kHz, VBW=100kHz^{*1}, Span=30MHz, Sweep = suitable duration based on the EUT specification

*1: To be adjusted accordingly based on the spectrum stability

4.1.2 Test Instruments and Measurement Setup

Table 4-1-1 : 6 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 : 2.4GHz 1.3 dB 5.8GHz 2.3 dB	

Notes: - R&S: Rohde & Schwarz

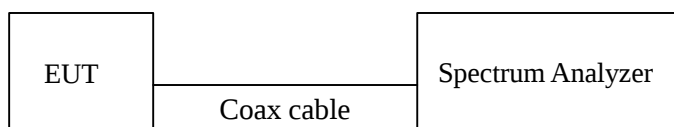


Figure 4-1: Measurement setup for 6dB bandwidth test

4.1.3 Measurement Results

Test Date: November 15, 2004

Table 4-1-2. 6dB bandwidth, 2.4GHz band DSSS mode, TX mode 11Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
2437 (ch. 6)	Plot 4-1-1	2432.46	2441.60	9.14	> 0.5
(Previous results)		2432.46	2441.60	9.14	

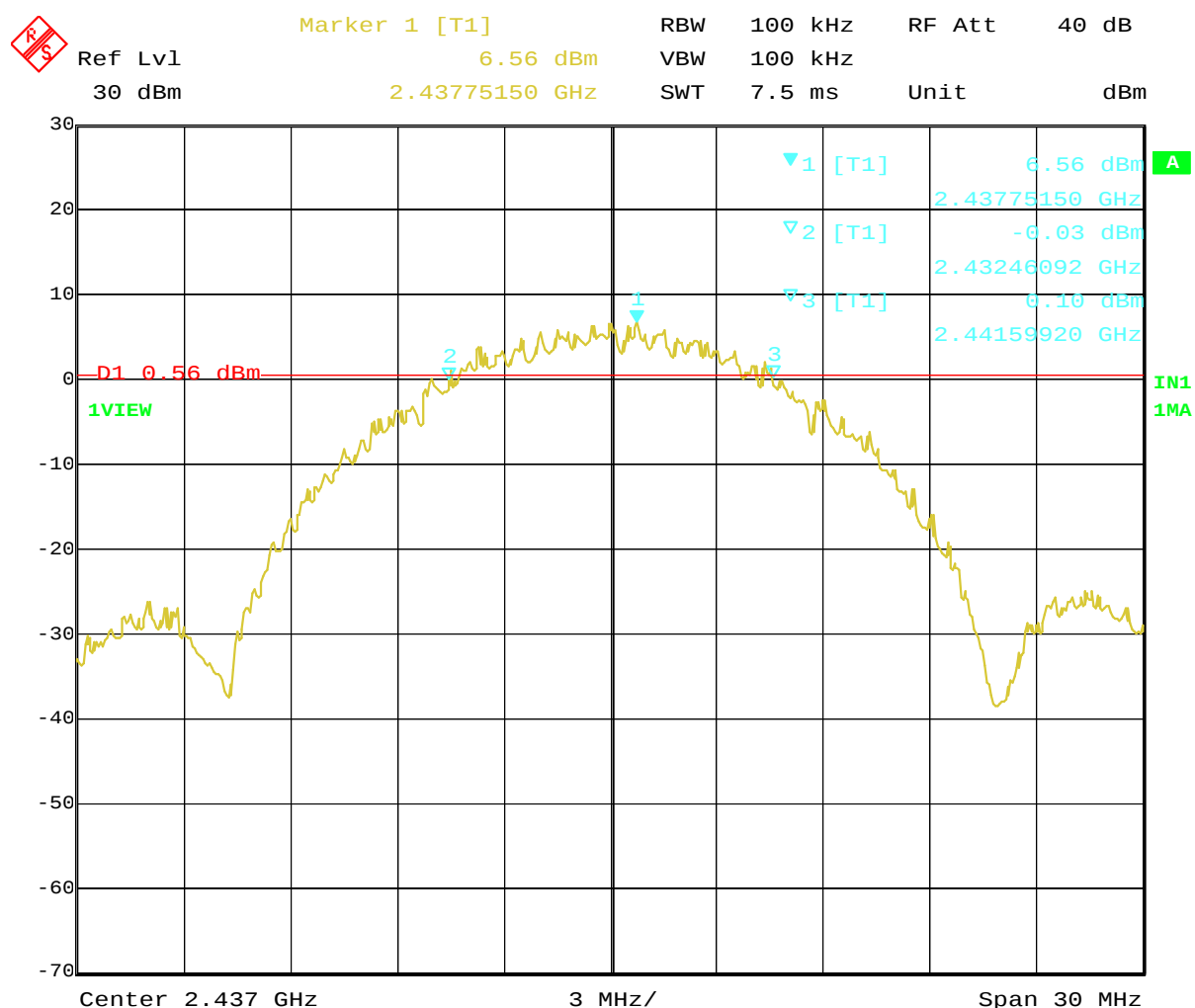
Table 4-1-3. 6dB bandwidth, 2.4GHz band OFDM mode, TX mode 6Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
2462 (ch. 11)	Plot 4-1-2	2454.39	2469.67	15.28	> 0.5
(Previous results)		2454.39	2469.67	15.28	

Table 4-1-4. 6dB bandwidth, 5.8GHz band OFDM mode, TX mode 6Mbps

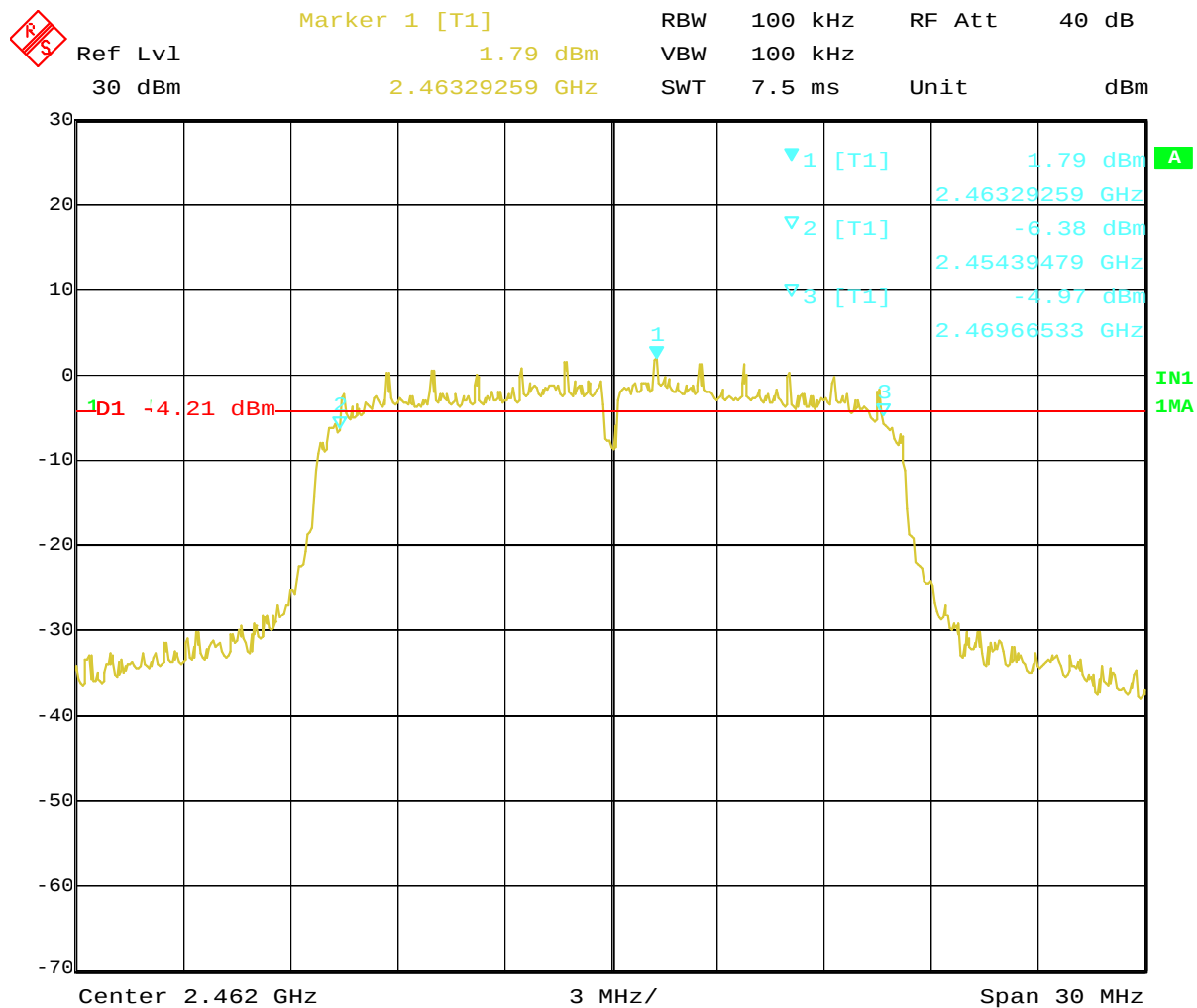
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
5785 (ch. 157)	Plot 4-1-3	5776.79	5792.97	16.18	> 0.5
(Previous results)		5776.79	5792.97	16.18	

4.1.4 Trace Data of 6dB bandwidth



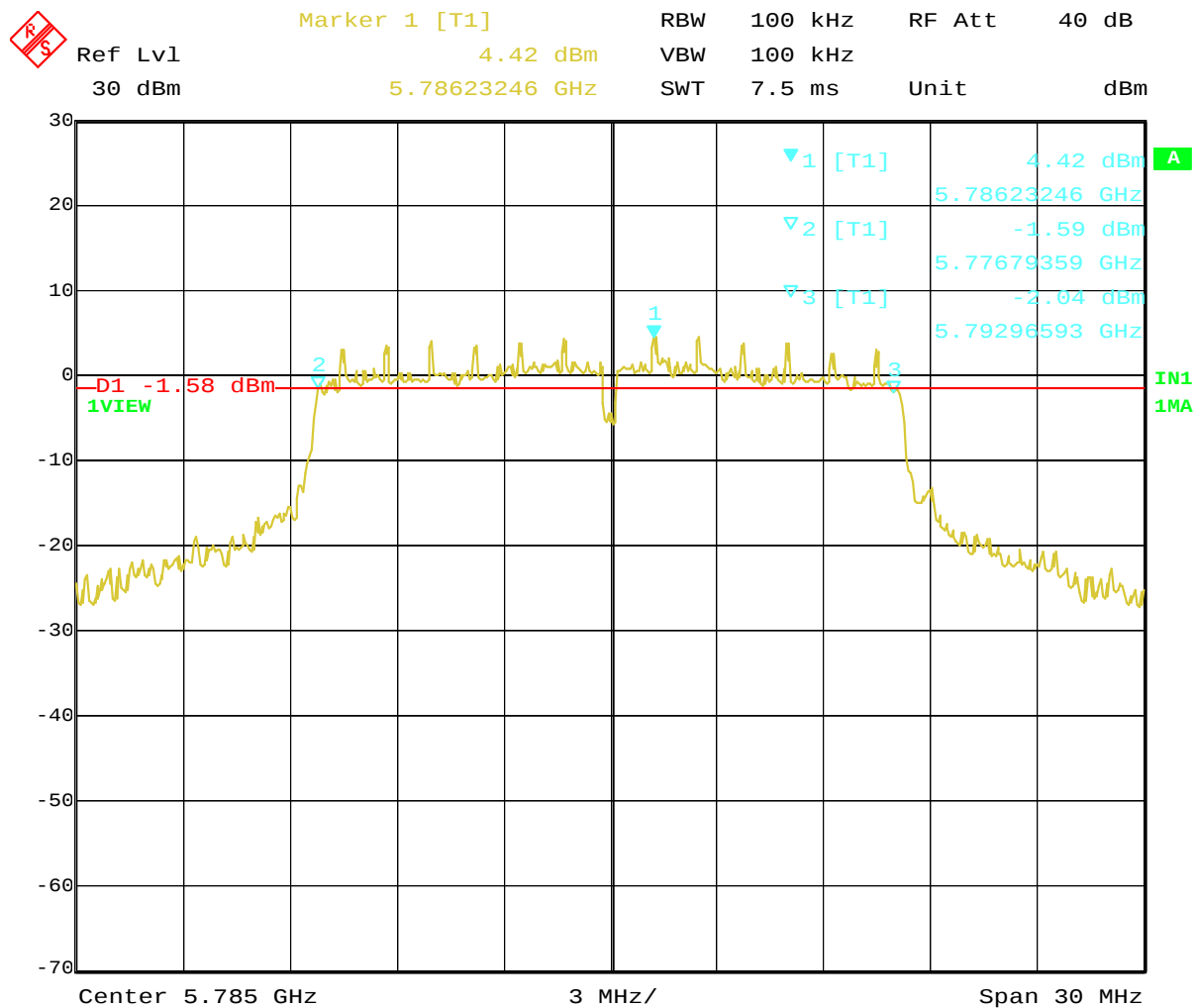
Date: 15.NOV.2004 17:51:47

Plot 4-1-1. 6dB BW at 2437MHz (DSSS, 11Mbps)



Date: 15.NOV.2004 18:00:28

Plot 4-1-2. 6dB BW at 2462MHz (OFDM, 6Mbps)



Date: 15.NOV.2004 18:06:37

Plot 4-1-3. 6dB BW at 5785MHz (OFDM, 6Mbps)

4.2 Occupied Bandwidth (20 dB Bandwidth) [FCC 15.215(c), RSS-210 5.9.1]

4.2.1 Test Procedure

The bandwidth at 20 dB down from the highest inband spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in transmission mode at the appropriate center frequency.

The spectrum analyzer was set to:

RBW=100kHz, VBW=100kHz*1, Span=50MHz, Sweep = suitable duration based on the EUT specification

*1: To be adjusted accordingly based on the spectrum stability

4.2.2 Test Instruments and Measurement Setup

Same as the Chapter 4.1 (Table 4-1-1 & Figure 4-1).

4.2.3 Measurement Results

Test Date: November 15, 2004

 : the closest frequencies to the bandedge in each transmission mode

Table 4-2-1. Occupied bandwidth, 2.4GHz band DSSS mode, TX 11Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
2412 (ch. 1)	Plot 4-2-1	2403.45	2420.69	17.24
(Previous results)		2403.38	2420.67	17.29
2462 (ch. 11)	Plot 4-2-2	2453.43	2470.69	17.26
(Previous results)		2453.33	2470.67	17.34

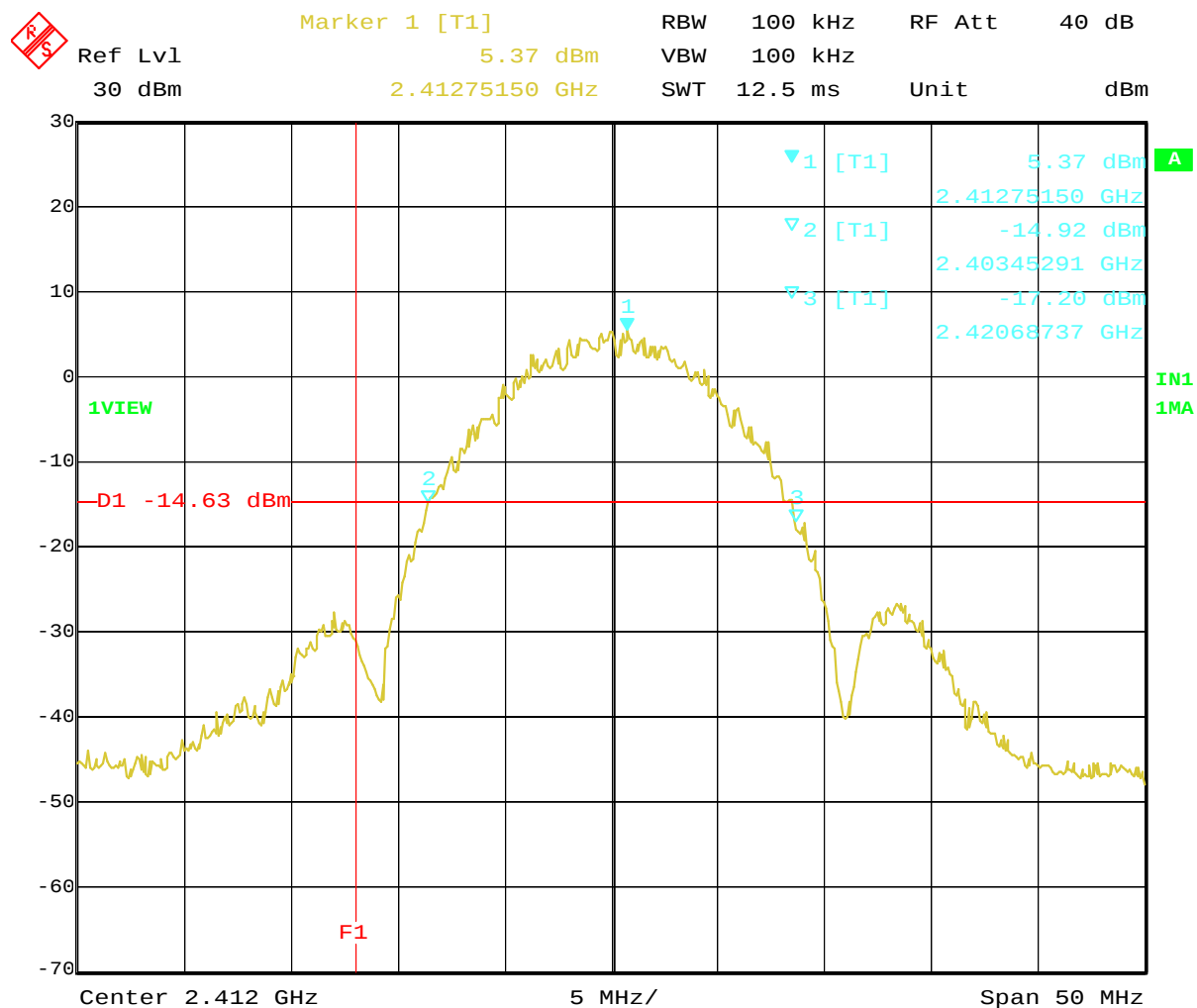
Table 4-2-2. Occupied bandwidth, 2.4GHz band OFDM mode, TX 6Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
2412 (ch. 1)	Plot 4-2-3	2402.93	2421.07	18.14
(Previous results)		2403.13	2421.07	17.94
2462 (ch. 11)	Plot 4-2-4	2453.53	2470.47	16.94
(Previous results)		2453.53	2470.47	16.94

Table 4-2-3. Occupied bandwidth, 5.8GHz band OFDM mode, TX 6Mbps

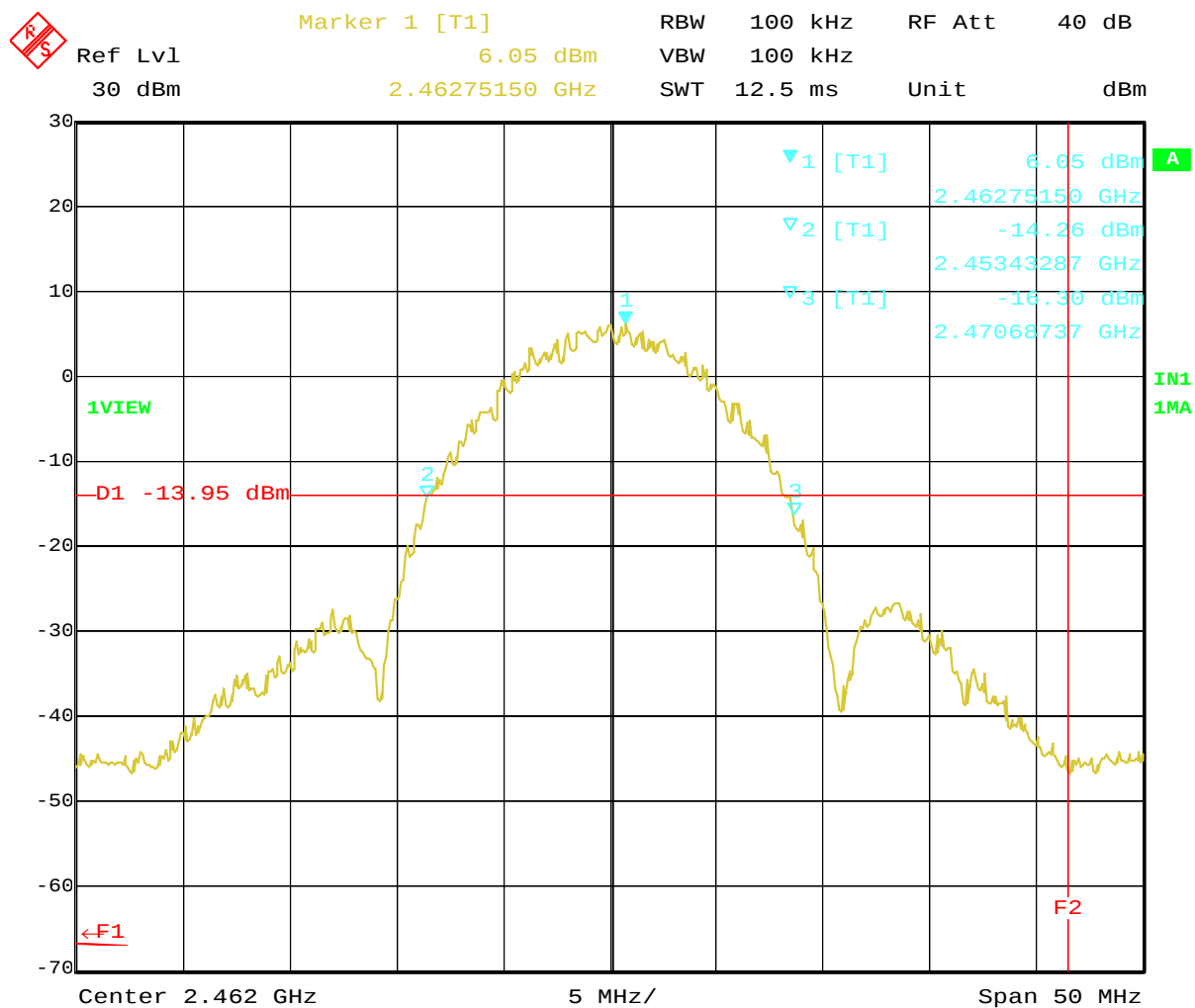
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
5745 (ch. 149)	Plot 4-2-5	5735.83	5754.27	18.44
(Previous results)		5733.23	5757.07	23.84
5825 (ch. 165)	Plot 4-2-6	5815.83	5834.27	18.44
(Previous results)		5813.23	5835.47	22.24

4.2.4 Trace Data of Occupied Bandwidth



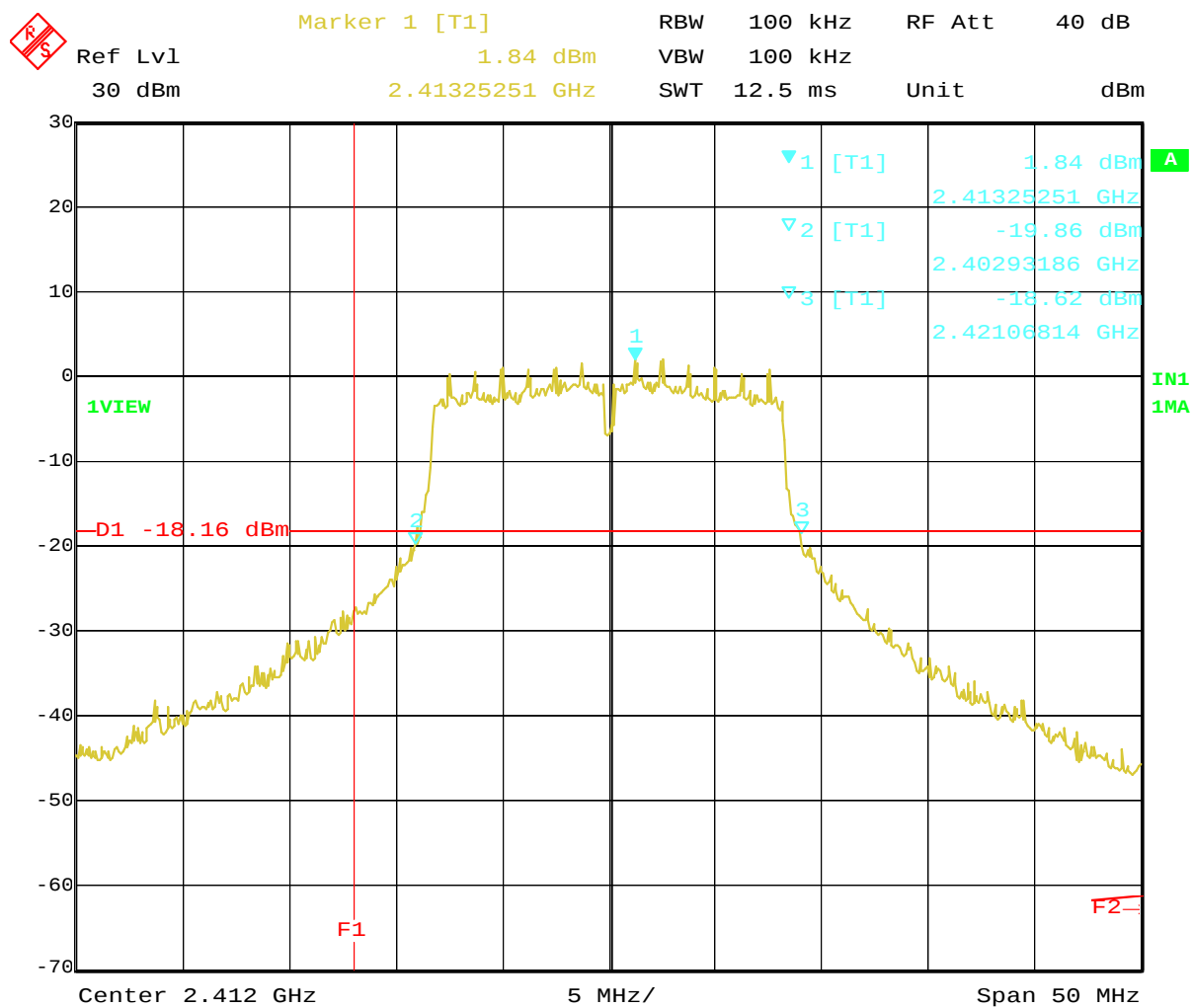
Date: 15.NOV.2004 18:15:45

Plot 4-2-1. 20dB BW at 2412MHz (DSSS, 11Mbps)

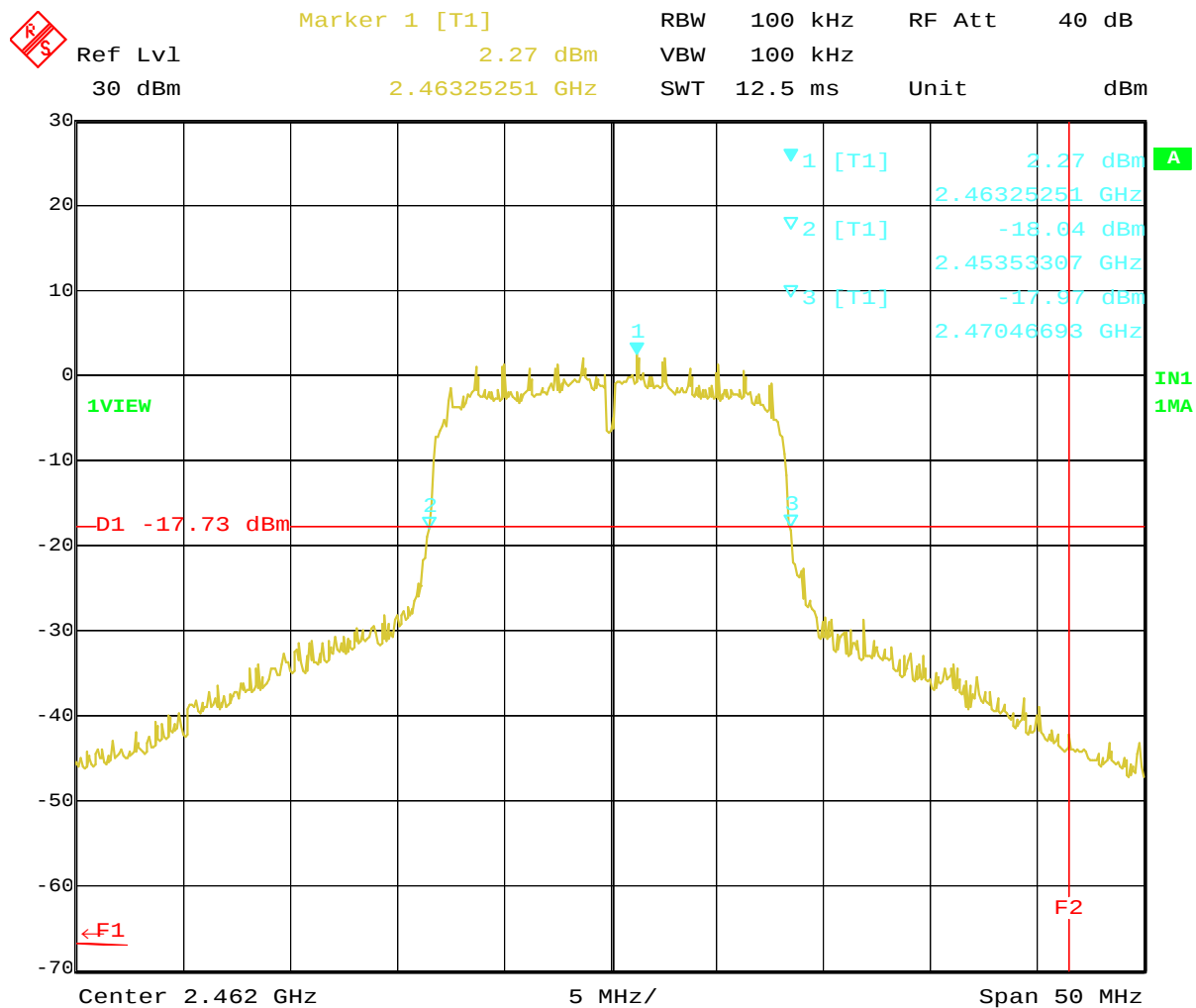


Date: 15.NOV.2004 18:20:47

Plot 4-2-2. 20dB BW at 2462MHz (DSSS, 11Mbps)

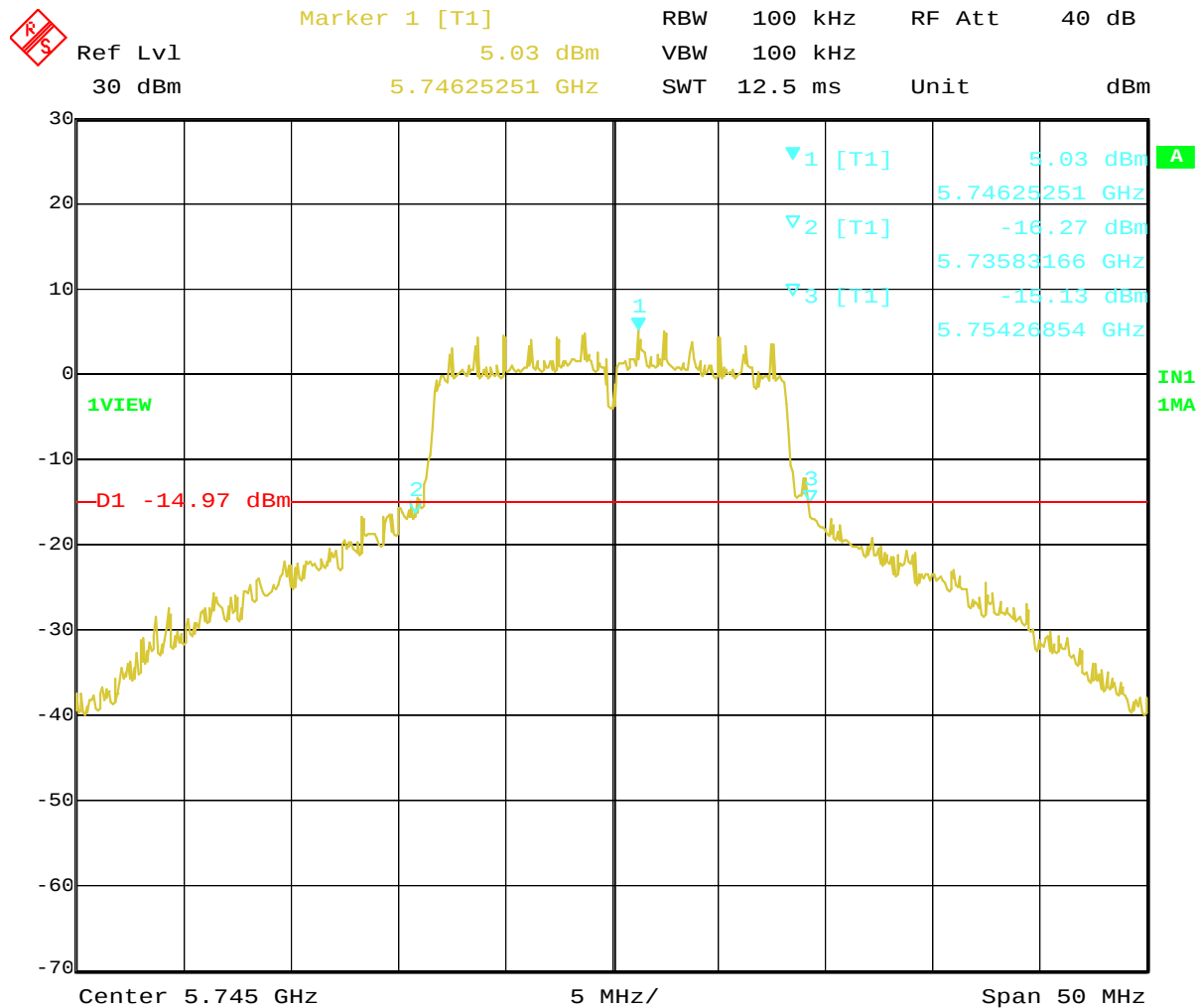


Plot 4-2-3. 20dB BW at 2412MHz (OFDM, 6Mbps)



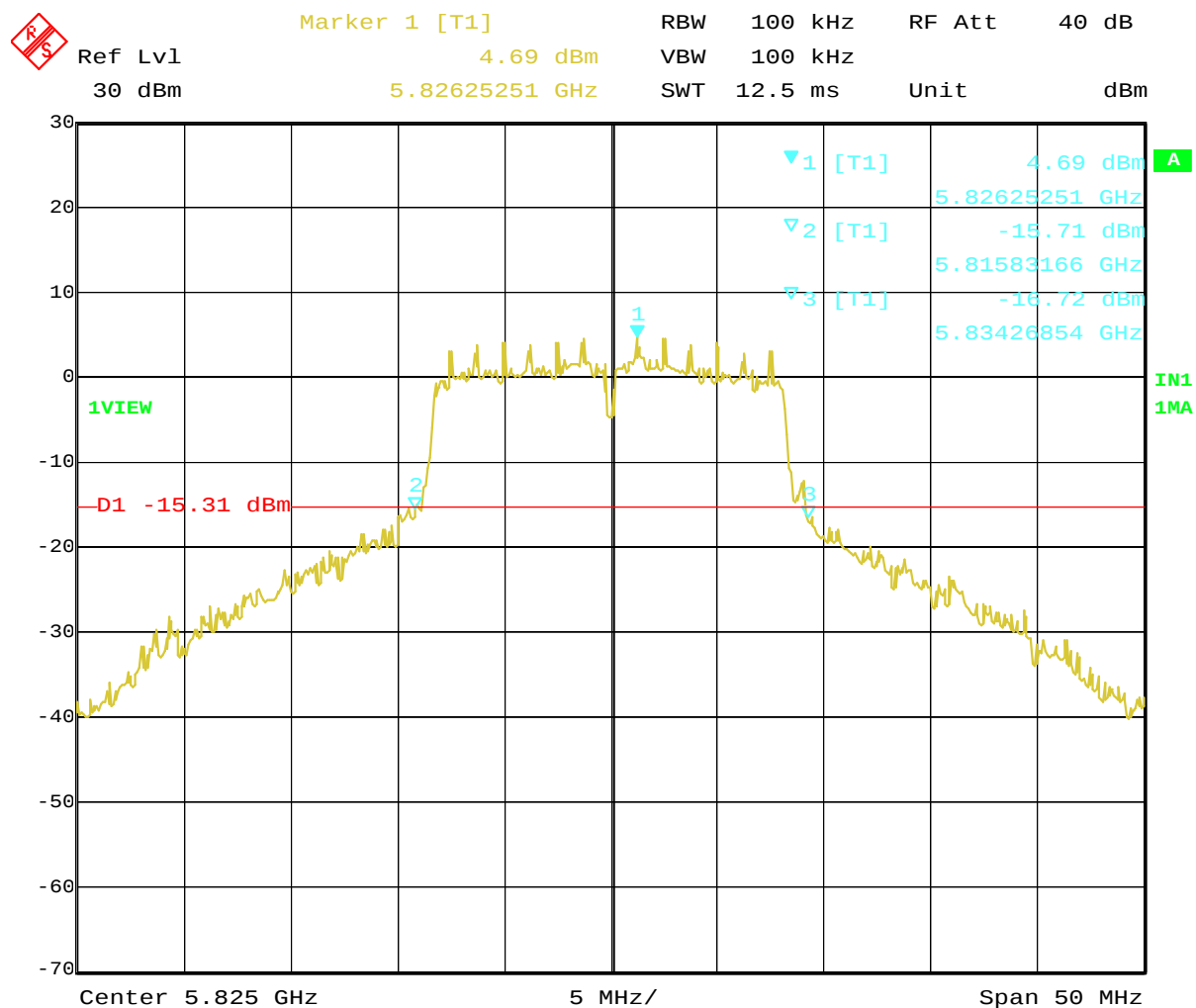
Date: 15.NOV.2004 18:28:20

Plot 4-2-4. 20dB BW at 2462MHz (OFDM, 6Mbps)



Date: 15.NOV.2004 19:09:12

Plot 4-2-5. 20dB BW at 5745MHz (OFDM, 6Mbps)



Date: 15.NOV.2004 19:14:51

Plot 4-2-6. 20dB BW at 5825MHz (OFDM, 6Mbps)

4.3 Conducted Peak Transmit Output Power

[FCC 15.247(b)(3), RSS-210 6.2.2(o)(b)]

4.3.1 Test Procedure

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

The spectrum analyzer was set to :

RBW=1MHz, VBW=RBW or more, Mode=Peak detection, Trigger=free run,
Span=50MHz encompassing the entire 26 dB emission bandwidth of the transmission signal

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

4.3.2 Test Instruments and Measurement Setup

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

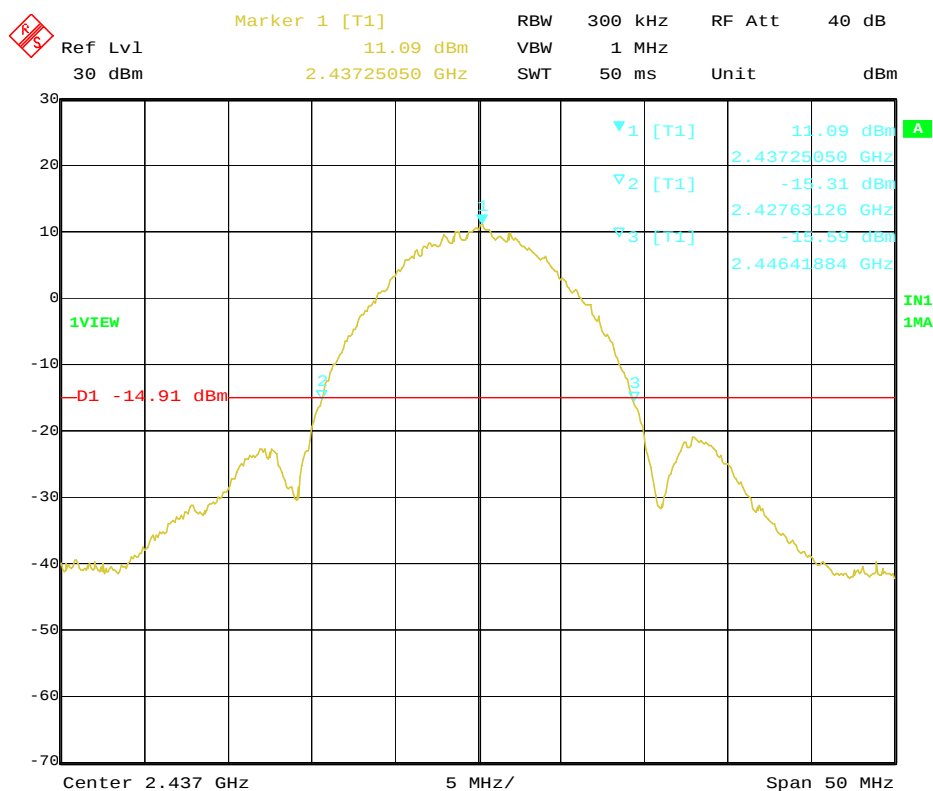
4.3.3 Measurement Results

Test Date: November 9 and 11, 2004

Table 4-3-1. Conducted peak output power measurement results

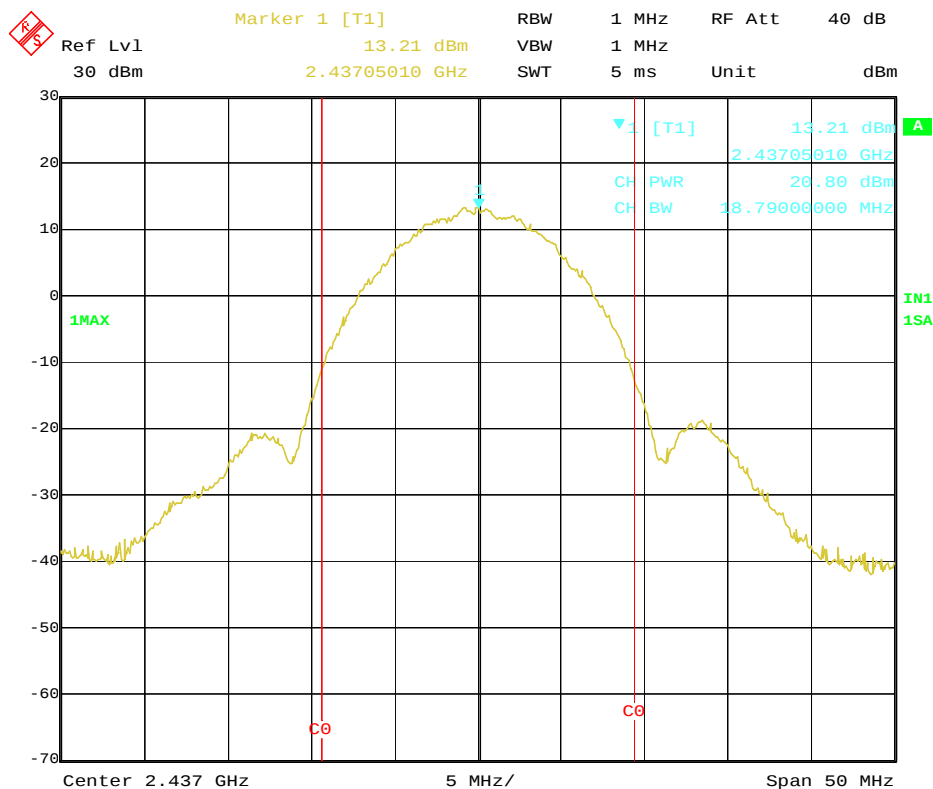
Measured Frequency (MHz)	Tx mode (Mb/s)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBm)
						FCC (dBm)	IC (dBm)	
2437 (DSSS)	11	20.80	Plot 4-3-1b	1.3	22.10 (162.2 mW)	30	30	7.90
	(Previous results)				22.08 (161.4 mW)			7.92
2412 (OFDM)	6	20.02	Plot4-3-2b	1.3	21.32 (135.5 mW)			8.68
	(Previous results)				21.31 (135.2 mW)			8.69
5745 (OFDM)	6	21.94	Plot 4-3-3b	2.3	24.24 (265.5 mW)			5.76
	(Previous results)				24.22 (264.2 mW)			5.78

4.3.4 Trace Data of Conducted Peak Output Power



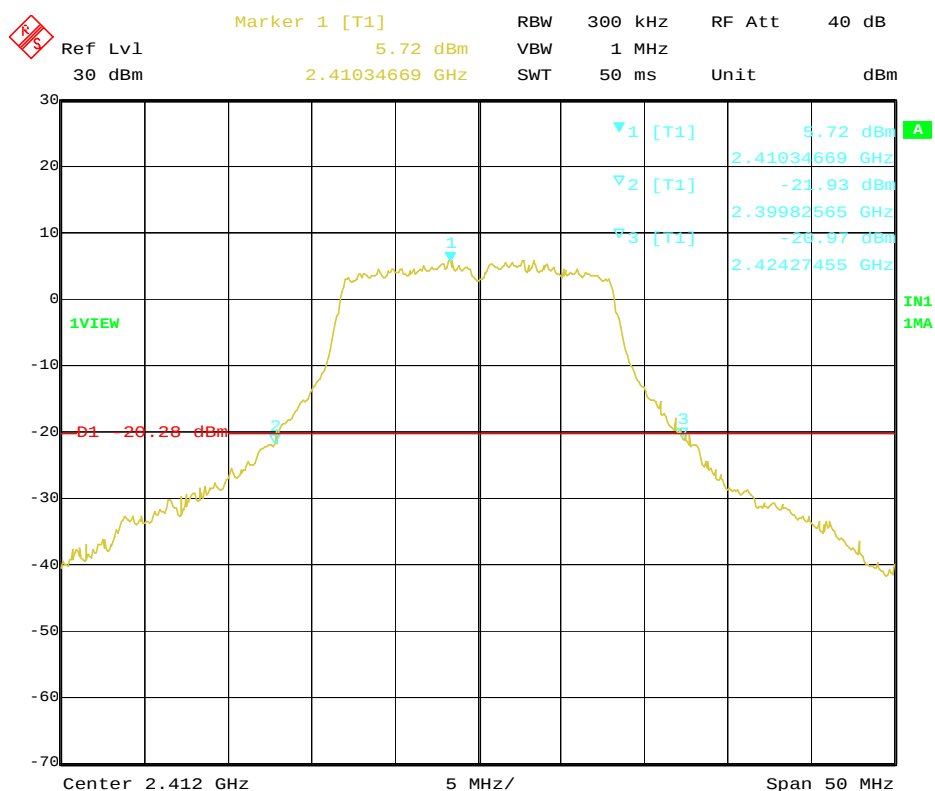
Date: 9.NOV.2004 19:18:22

Plot 4-3-1a. 26dB Bandwidth of 2437MHz (DSSS, 11Mbps)



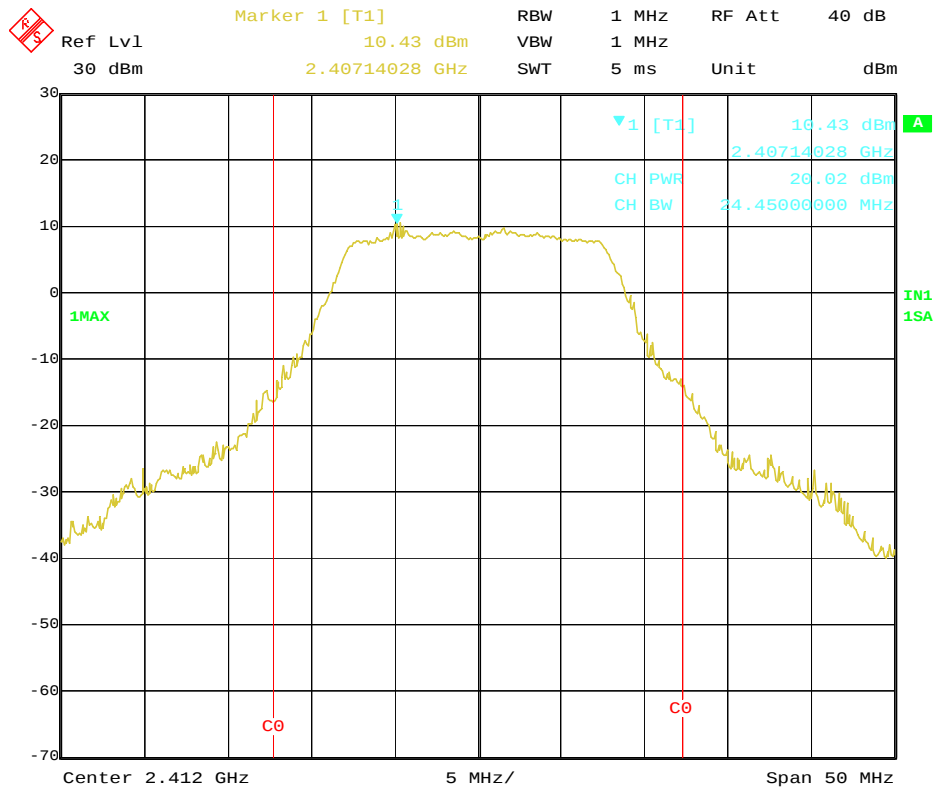
Date: 9.NOV.2004 19:43:07

Plot 4-3-1b. Conducted Peak Output Power of 2437MHz (DSSS, 11Mbps)



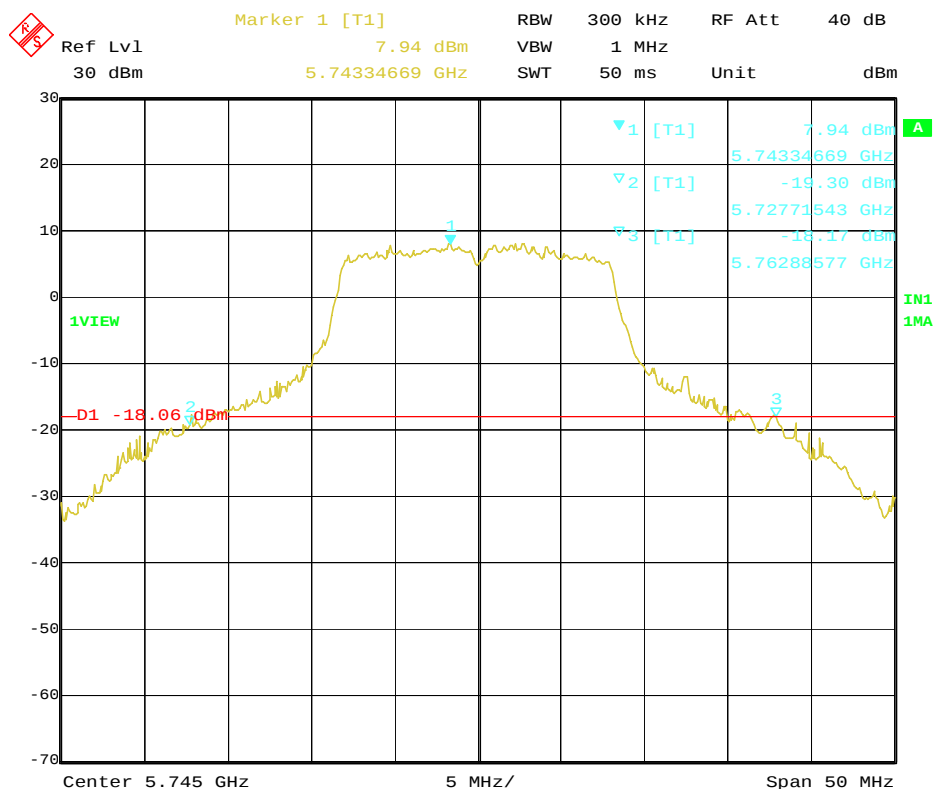
Date: 9.NOV.2004 19:23:57

Plot 4-3-2a. 26dB Bandwidth of 2412MHz (OFDM, 6Mbps)



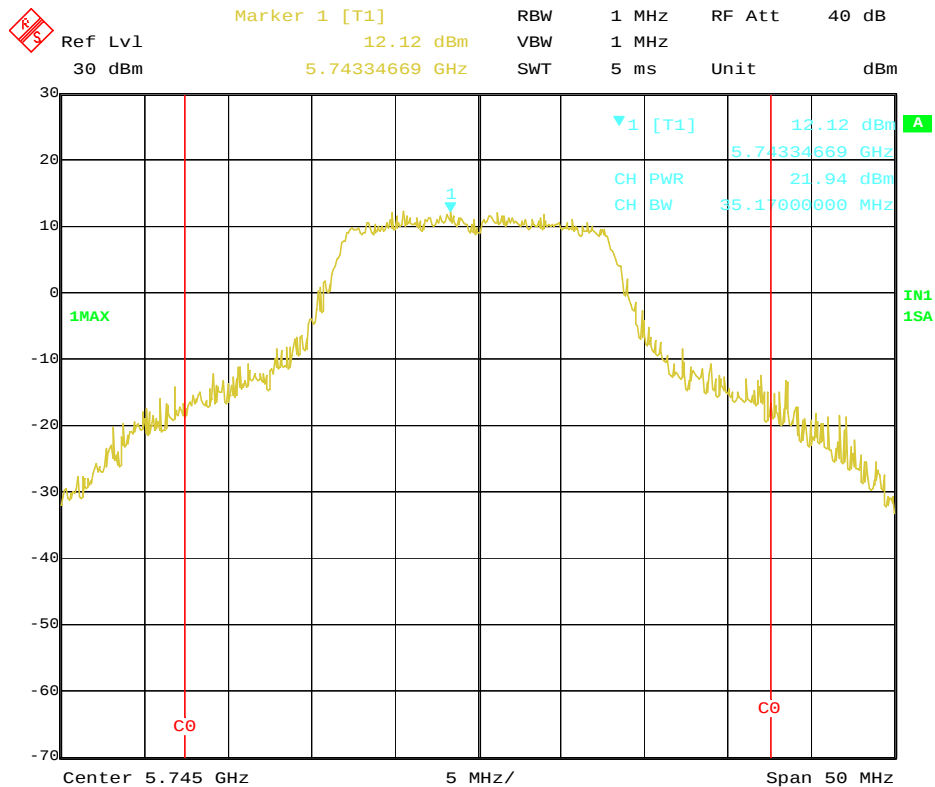
Date: 9.NOV.2004 19:54:28

Plot 4-3-2b. Conducted Peak Output Power of 2412MHz (OFDM, 6Mbps)



Date: 11.NOV.2004 20:36:55

Plot 4-3-3a. 26dB Bandwidth of 5745MHz (OFDM, 6Mbps)



Date: 11.NOV.2004 20:49:31

Plot 4-3-3b. Conducted Peak Output Power of 5745MHz (OFDM, 6Mbps)

4.4 Out of Band Emissions (Conducted Spurious)

[FCC 15.247(c), RSS-210 6.2.2(o)(e1)]

4.4.1 Test Procedure

The outband emissions in any 100kHz bandwidth was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in transmission mode at the appropriate center frequency. The spectrum analyzer was set to:

2.4GHz: RBW = 100kHz, VBW = 100kHz*1, Scanning frequency range = 30MHz~2GHz,
2GHz~3GHz, and 3GHz~25GHz, Sweep = suitable duration based on the EUT specification
5.8GHz: RBW = 100kHz, VBW = 100kHz*1, Scanning frequency range = 30MHz~5GHz,
5GHz~6GHz, 6GHz~26.5GHz and 26.5GHz~40GHz, Sweep = suitable duration based on the
EUT specification

*1: To be adjusted accordingly based on the spectrum stability

4.4.2 Test Instruments and Measurement Setup

- **Below 26.5GHz**

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

- **Above 26.5GHz**

Table 4-4-1 Conducted Spurious Test Instrumentation

Description	Model	Serial Number
Spectrum Analyzer	HP 8563E	3416A02248
Harmonic Mixer (26.5 – 40GHz)	Agilent 11970A	011269-001
Coaxial cables: - EUT <=> Mixer (26.5-40GHz) - Mixer <=> Spectrum Analyzer (26.5-40GHz)	Length: Cable loss: 1m 2.9dB (at 40GHz) 1m 2.9dB (at 40GHz)	- SF102-21108 - SF102-21105

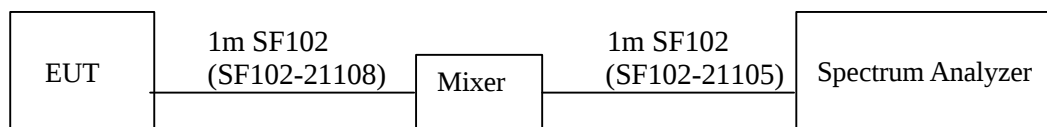


Figure 4-4: Measurement setup for Conducted Spurious test

4.4.3 Measurement Results

All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density.

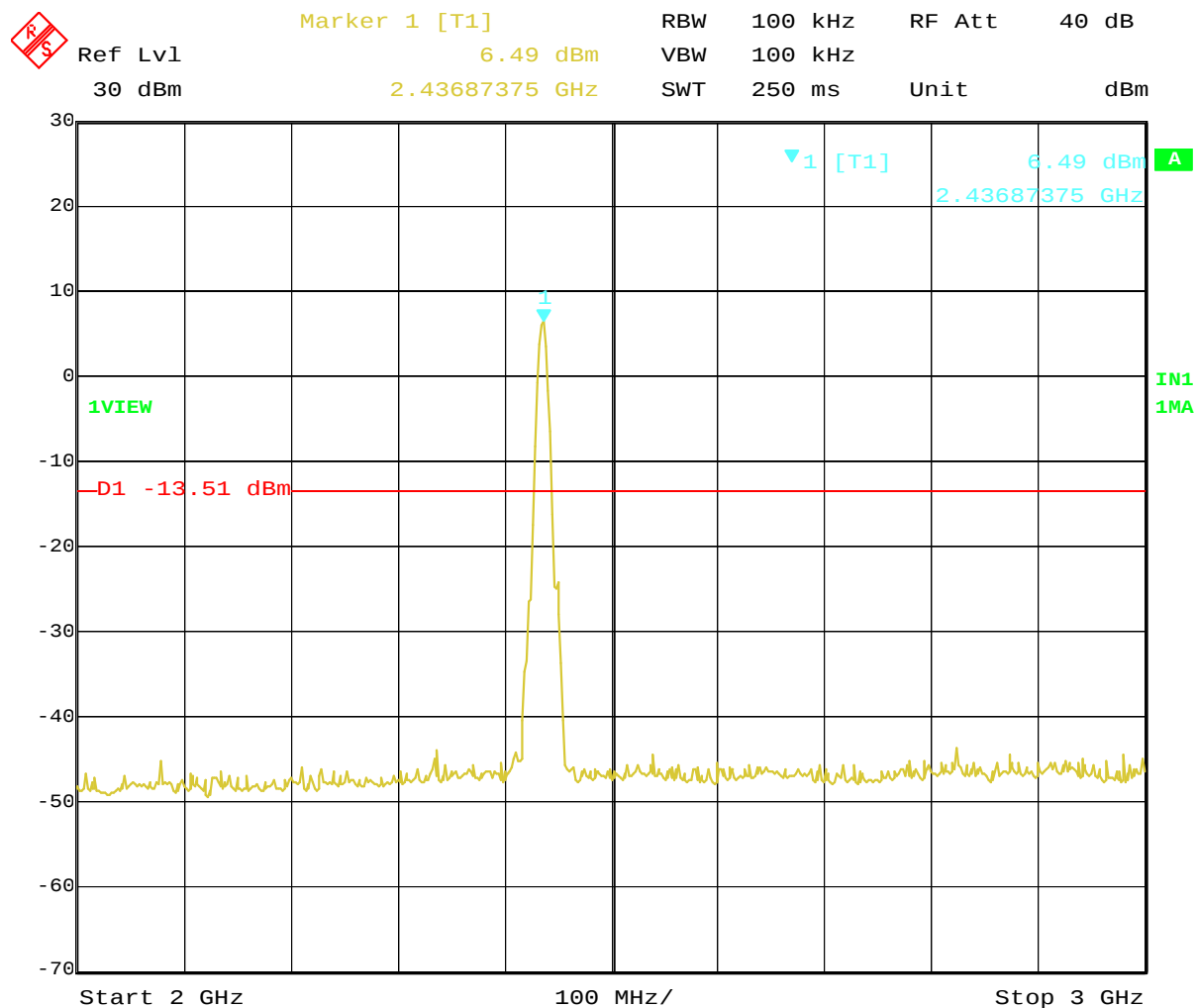
The measurement was performed with the worse cases of each transmission mode, that tend to have higher conducted peak power, based on the results of previous Chapter 4-3, “Conducted Peak Output Power” measurement.

Test Date: November 15, 2004 : See the following plots.

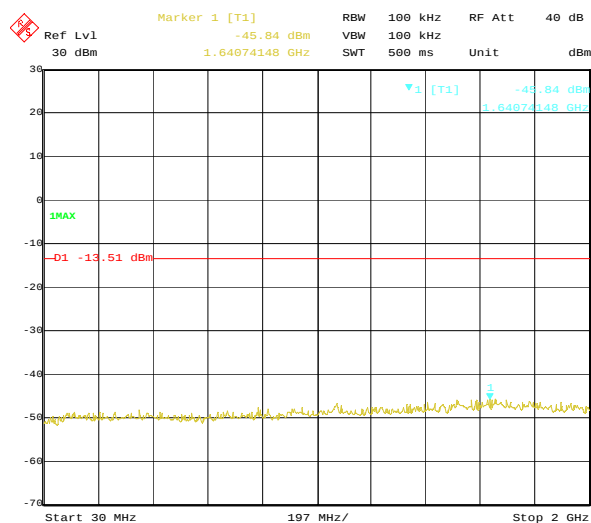
Center Frequency (MHz)		Tx Rate (worst case)	Trace number *1
2437 (ch. 6)	DSSS	11Mbps	Plot 4-4-1
2412 (ch. 1)	OFDM	6Mbps	Plot 4-4-2
5745 (ch. 149)		6Mbps	Plot 4-4-3

*1 : Each submittal plot includes the highest conducted spurious in the 10th harmonics frequency range of each worst case in measured Tx modes.

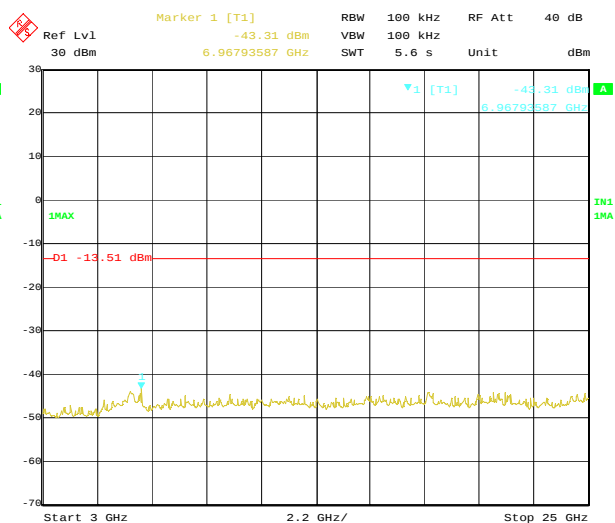
4.4.4 Trace Data of Out of Band Emissions



Date: 15.NOV.2004 19:27:22

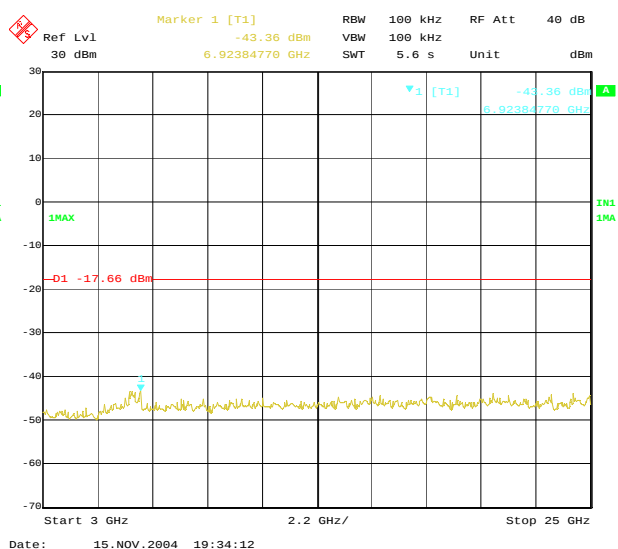
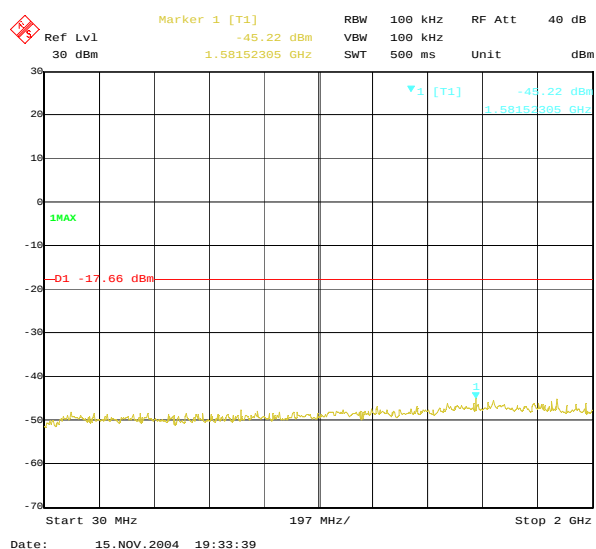
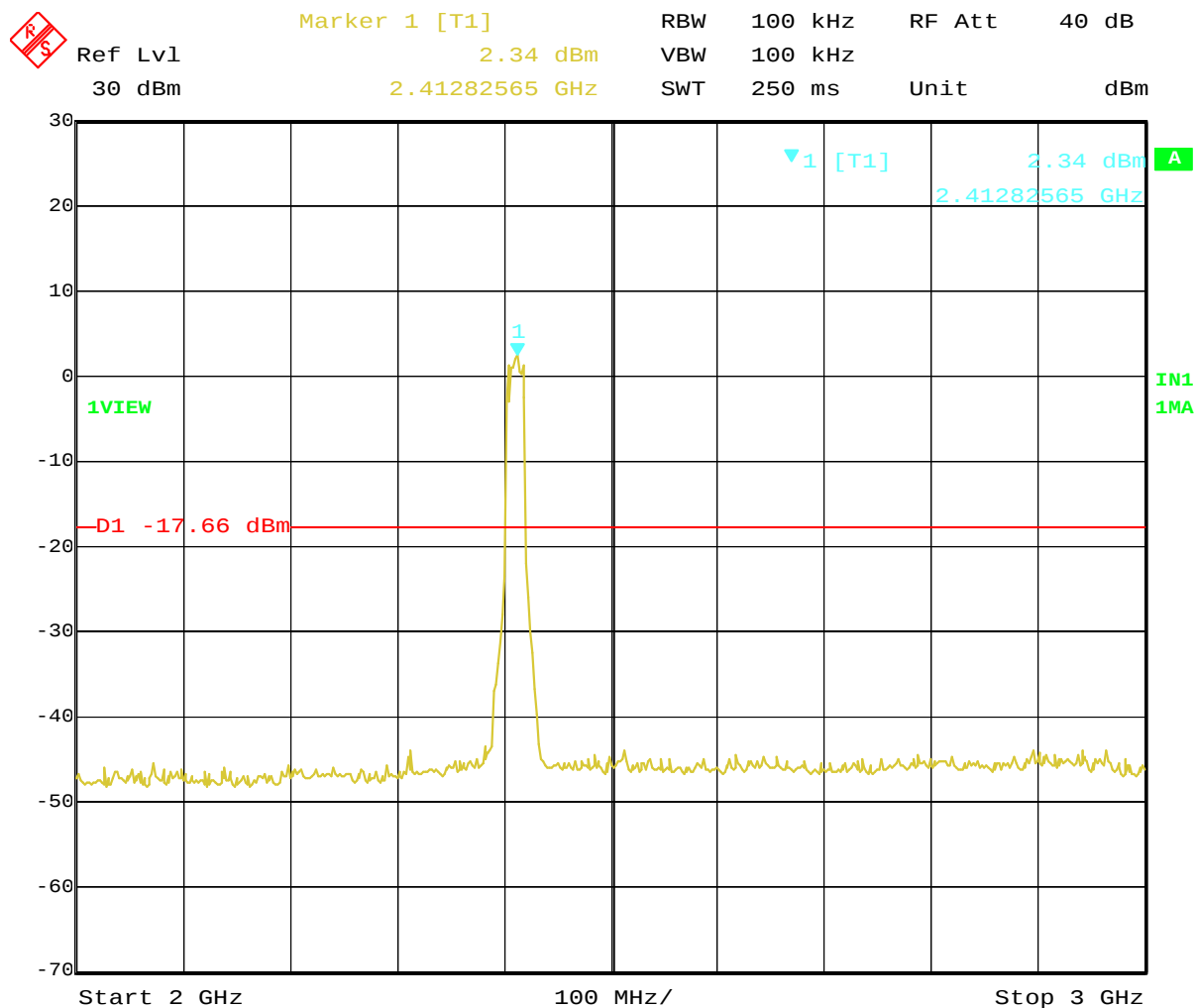


Date: 15.NOV.2004 19:27:59

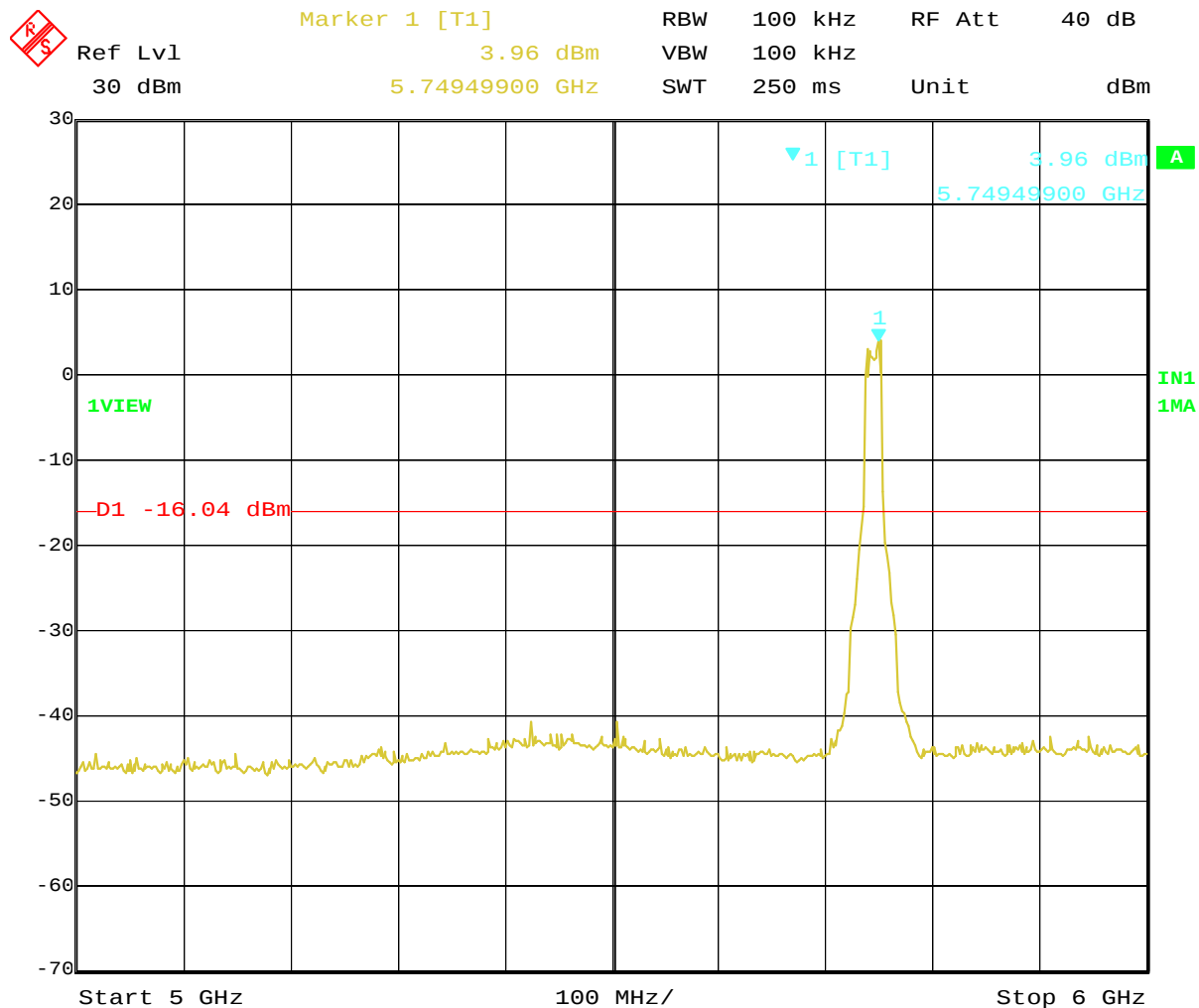


Date: 15.NOV.2004 19:28:30

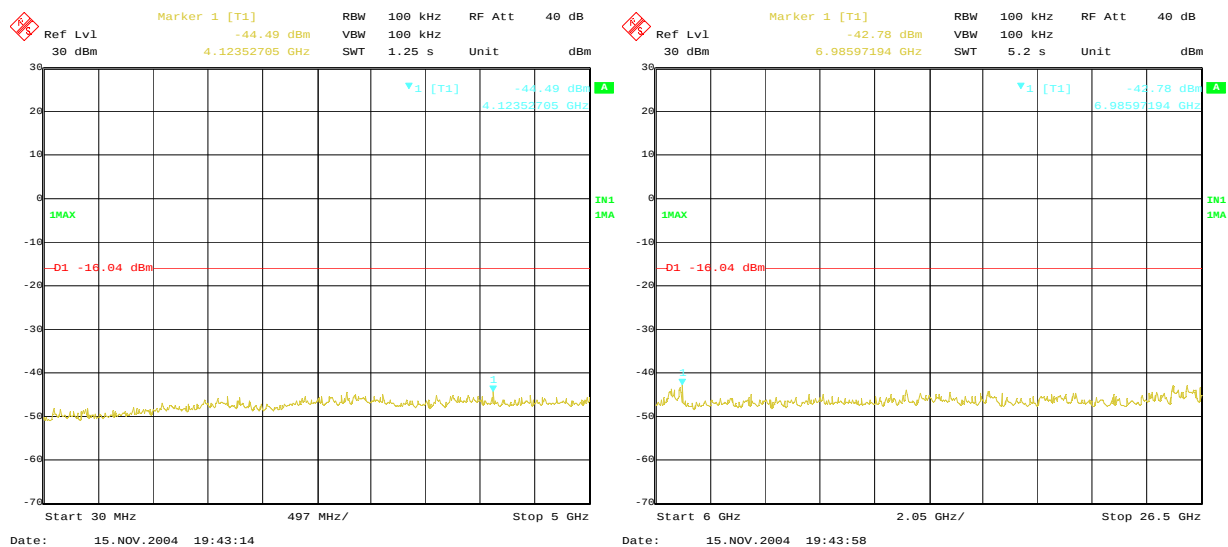
Plot 4-4-1. Out of band emissions around 2437MHz (DSSS, 11Mbps)



Plot 4-4-2. Out of band emissions around 2412MHz (OFDM, 6Mbps)



Date: 15.NOV.2004 19:42:38



Plot 4-4-3. Out of band emissions around 5745MHz (OFDM, 6Mbps)

4.5 Peak Power Spectral Density

[FCC 15.247(d), RSS-210 6.2.2(o)(b)]

4.5.1 Test Procedure

The power spectral density was measured with a spectrum analyzer connected to the antenna terminal, while EUT was operating in transmission mode at the appropriate center frequency.

The pre-scanning was performed with the spectrum analyzer to search and locate the center frequency at the peak emission of each transmission mode.

Then, the spectral analyzer was set to the emission peak found in the pre-scan and the peak power spectral density was measured with:

RBW = 3 kHz, VBW = 3 kHz, Span = 300 kHz, Sweep = 100 seconds

4.5.2 Test Instruments and Measurement Setup

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

4.5.3 Measurement Results

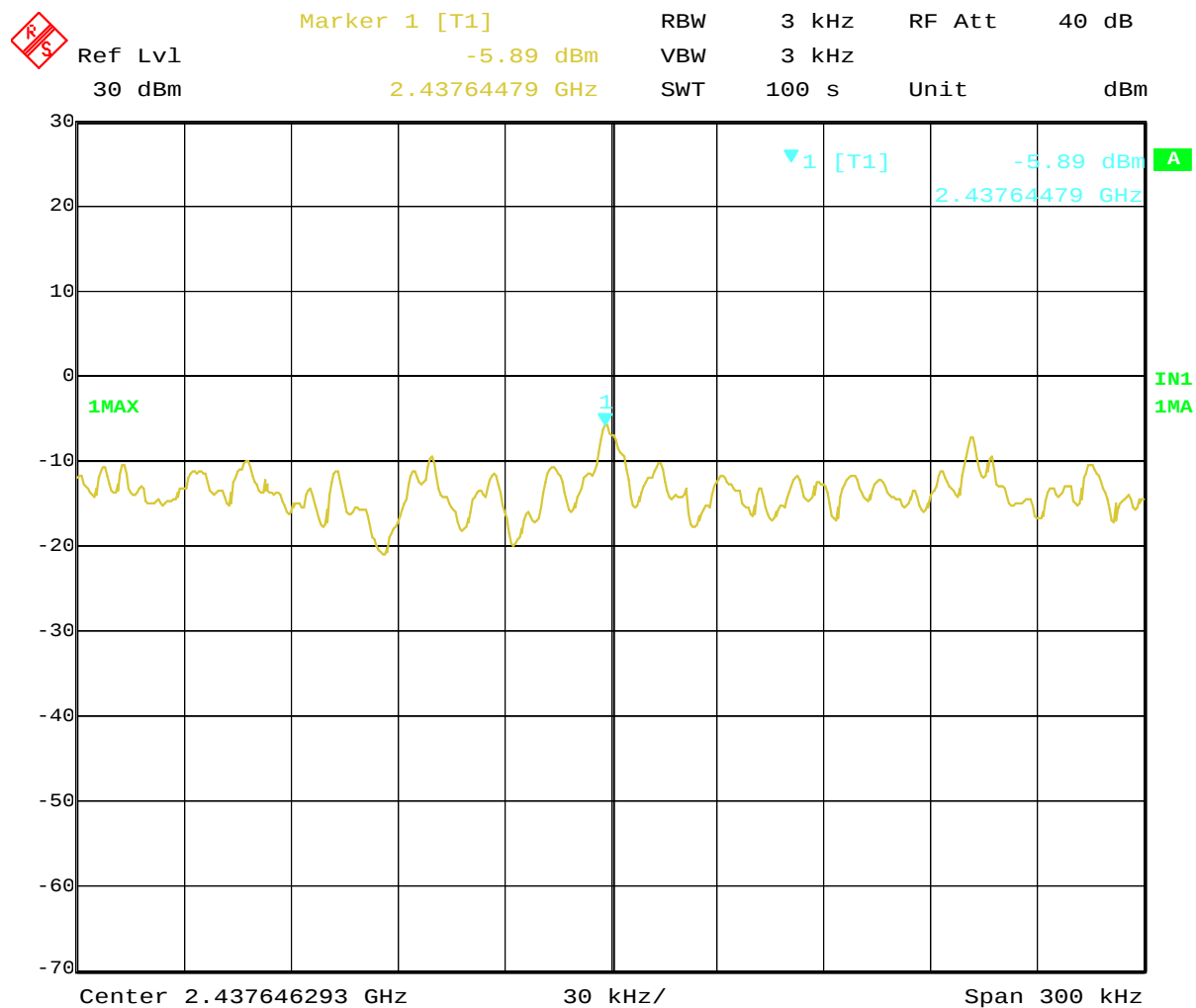
The measurement was performed with the worse cases of each transmission mode, that tend to have higher conducted peak power, based on the results of previous Chapter 4.3, “Conducted Peak Output Power” measurement.

Test Date: November 15, 2004

Table 4-5-1. Peak Power Spectrum Density, TX mode

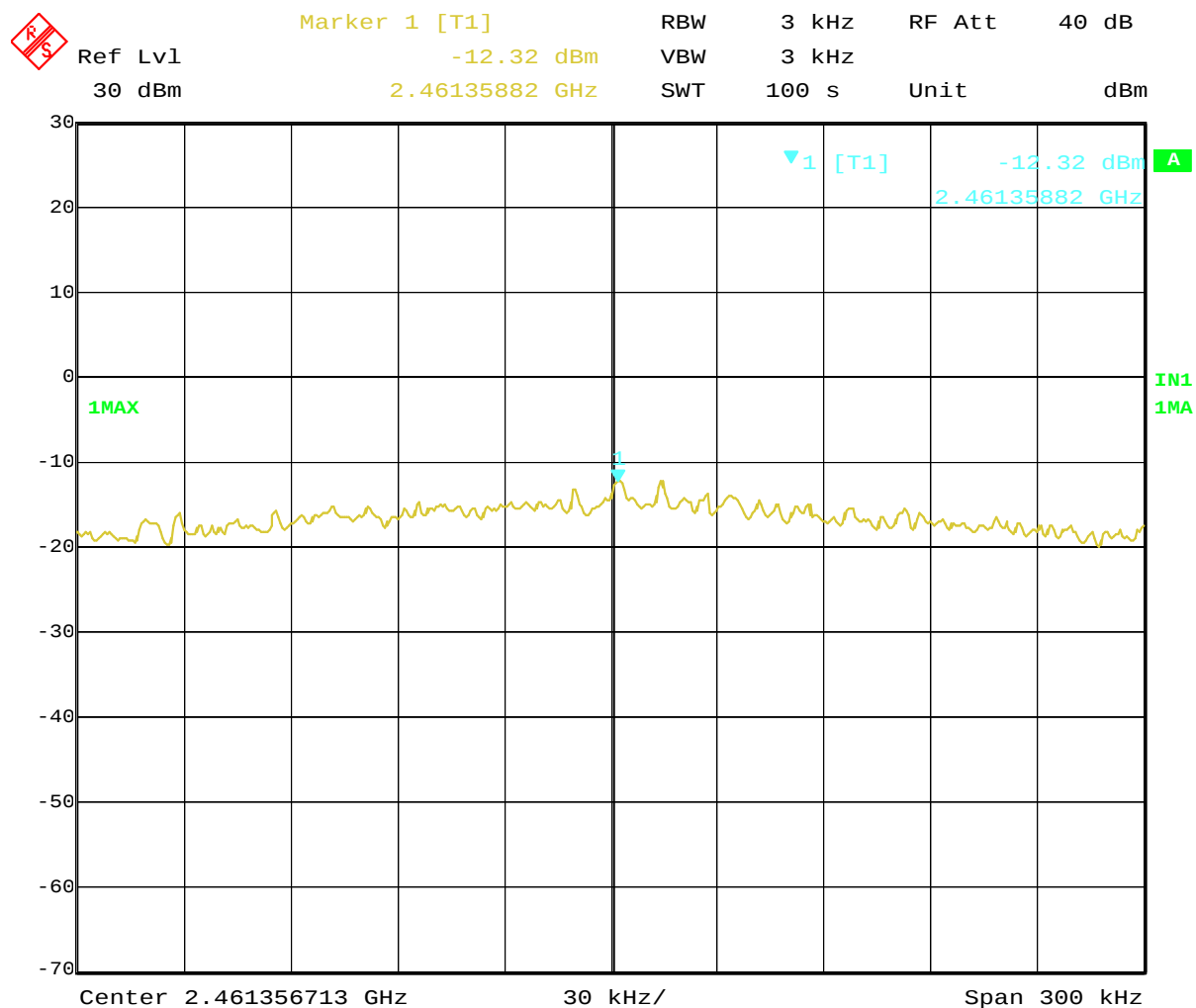
Ch No.			Frequency (MHz)	Analyzer Reading (dBm)	Cable loss (dB)	Trace number	Result (dBm)	Limit (dBm)	Margin (dB)
DSSS	2.4GHz 11Mbps	6	2437.65	-5.89	1.3	Plot 4-5-1	- 4.6	8.0	12.6
			2437.65	-6.03		Previous results	- 4.7	8.0	12.7
OFDM	2.4GHz 6Mbps	11	2461.36	-12.32	1.3	Plot 4-5-2	-11.0	8.0	19.0
			2461.38	-11.54		Previous results	-10.2	8.0	18.2
	5.8GHz 6Mbps	157	5783.68	-10.11	2.3	Plot 4-5-3	- 7.8	8.0	15.8
			5783.73	-10.02		Previous results	- 7.7	8.0	15.7

4.5.4 Trace Data of Peak Power Spectral Density



Date: 15.NOV.2004 20:00:42

Plot 4-5-1. Peak Power Spectral Density of 2437MHz (DSSS, 11Mbps)

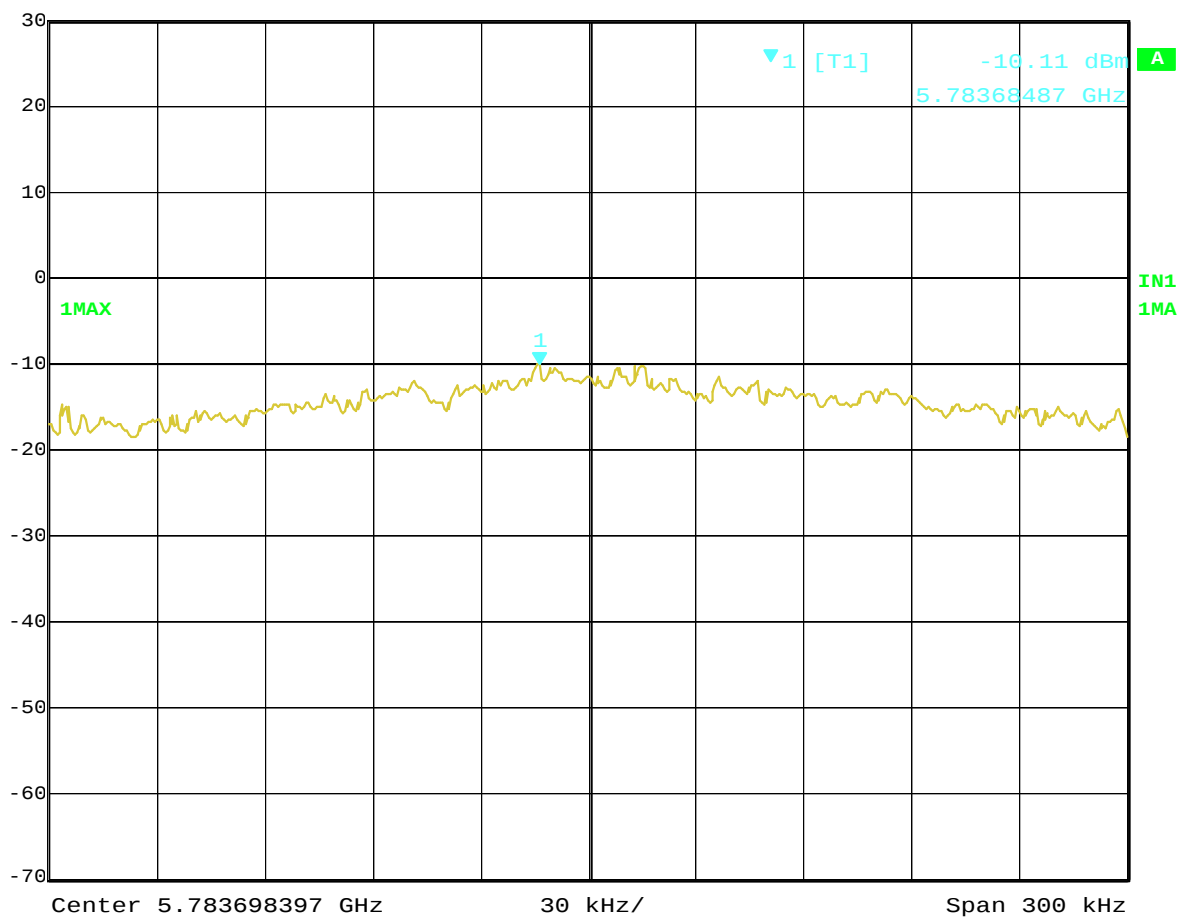


Date: 15.NOV.2004 20:13:57

Plot 4-5-2. Peak Power Spectral Density of 2462MHz (OFDM, 6Mbps)



Ref Lvl 30 dBm
Marker 1 [T1] -10.11 dBm
5.78368487 GHz
RBW 3 kHz
VBW 3 kHz
SWT 100 s
RF Att 40 dB
Unit dBm



Date: 15.NOV.2004 20:29:38

Plot 4-5-3. Peak Power Spectral Density of 5785MHz (OFDM, 6Mbps)