

Emission Test Report

Standard: FCC Part 15 Subpart C / IC RSS-210

Document Number : FCC 19-0279-1

Model Number: WM3B2915ABG

measured with **IBM ThinkPad T40 Series**
and **IBM ThinkPad R50 Series**

FCC ID: ANO20040601CX2
IC: 349E-WM3B29AG

October 5, 2004

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Revision History

Revision	By Whom	Comment	Date
FCC 19-0279-0	Takeshi Asano	The original document for FCC certification approval	September 9, 2004,
FCC 19-0279-1	Takeshi Asano	Update of re-measurement results for Chapter 7.5 and 8.5 to add the radiated spurious emissions performed with the co-located Bluetooth transmitter (FCC ID: ANO20020100MTN).	October 5, 2004

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

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)

and

IBM ThinkPad R50 Series

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

FCC ID : ANO20040601CX2

October 5, 2004

This report concerns: (check one)

Original Grant ☒

Class I change ☐

Class II change ☐

Equipment type: Wireless LAN device

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

Measurement procedure used is ANSI C63.4-2000 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:

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(Yes) or No

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A. General Information

APPLICANT : IBM Japan, Ltd.

TEST SITE : IBM Japan, Ltd., Yamato Semi-anechoic chamber #1

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REGULATION : FCC Part 15 Subpart C
Industry Canada RSS-210 (Issue No.5)

MODEL NUMBER : WM3B2915ABG
(Advertising Name) (Intel PRO/Wireless 2915 ABG Mini-PCI Adapter)

FCC ID : ANO20040601CX2
IC Certification Number : 349E-WM3B29AG

SERIAL NUMBER : 00S0SIT004

PHYSICAL CONDITION : Preproduction

KIND OF EQUIPMENT : Personal computer with a IEEE802.11a, 11b & 11g Wireless LAN
Mini-PCI Combo Card ([Composite application](#))

TESTED DATE : August 23, 26, 30, 31, September 1, 2, 3, 6, 7, 8, October 4 and 5, 2004

A.1 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4-2000. 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 00S0SIT004)	FCC ID: ANO20040601CX2 IC: 349E-WM3B29AG	Applying modular transmitter Built_in type IEEE802.11a/b/g Wireless LAN Mini-PCI card without antenna
BMDC200 (s/n 0020E04A4982)	FCC ID: ANO20020100MTN IC: 349E-BMDC200	Co-located Built-in type Bluetooth card without antenna
ThinkPad T40 Series M/T 2373-92U (14 inch) (s/n ZZ-00129) M/T 2373-PUU (15 inch) (s/n ZZ-22134)	N/A	Host equipment IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.7GHz
ThinkPad R50 Series M/T 1829-38x (14 inch) (s/n ZZ-08189) M/T 1829-62x (15 inch) (s/n ZZ-08233)		IBM Notebook PC with built_in antenna CPU: Intel® Pentium® M Processor, 1.5GHz
P/N 02K6746	N/A	Universal AC adapter 72W, Unshielded power cord

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(dBλV) Ave.(dBλV) 0.15 - 0.5 66 - 56 56 - 46 0.5 - 5 56 46 5 - 30 60 50	Radiated (30MHz-1GHz) Radiated (1– 25GHz)	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.		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(dBλV) Ave.(dBλV) 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) Radiated (1– 25GHz)	Pass Pass

	Other requirements		Result
15.247(b)(4)(i) –	Antenna gain	Peak gain of the device : 1.84 dBi in 2.4GHz band, and 1.78 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 (The measurement plots are indicated in shading.)

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

The host PCs (IBM ThinkPad T40 Series and R50 Series) are designed with the same conceptual hardware configuration of standard size laptop PC.

- The shading columns in the previous Table C show the transmission modes performed full testing. As for the 5.8GHz band, the full test was performed with the primary power only.

- The host devices marked in shading in the Table-D below were used for EUT which have comparatively higher antenna gains and worse measurement results in each host PC series (T40 or R50). Then, the worst case data were selected for this test report among the two systems.

The actual highest emissions taken in this report in the Chapter 6 through 8 were found at 11Mbps DSSS and 6Mbps OFDM in 2.4GHz band on the main antenna of ThinkPad T40 Series (14 inch LCD model), and 6Mbps OFDM in 5.8GHz band on the main antenna of ThinkPad R50 Series (15 inch LCD model). Refer to the Chapter 8.5 concerning the evaluation of the worst emission case.

Table-D Peak Antenna Gains of EUT

			14 inch LCD	15 inch LCD
2.4GHz band	ThinkPad T40 Series	Main Antenna gain	0.99 dBi (peak)	1.24 dBi (peak)
		Auxiliary Antenna gain	-0.48 dBi (peak)	0.38 dBi (peak)
	ThinkPad R50 Series	Main Antenna gain	1.52 dBi (peak)	1.18 dBi (peak)
		Auxiliary Antenna gain	1.84 dBi (peak)	1.71 dBi (peak)
5.8GHz band	ThinkPad T40 Series	Main Antenna gain	-0.23 dBi (peak)	1.01 dBi (peak)
		Auxiliary Antenna gain	-0.37 dBi (peak)	-0.23 dBi (peak)
	ThinkPad R50 Series	Main Antenna gain	0.02 dBi (peak)	1.78 dBi (peak)
		Auxiliary Antenna gain	0.19 dBi (peak)	1.51 dBi (peak)

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)	MITEQ AM-3A	898433	04/23/04	1 year
- for 30-200MHz		898432	04/23/04	1 year
- for 200-1000MHz	HP 8449B	3008A00582	06/01/04	1 year
Amplifier (1GHz - 18GHz)	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	08/21/04	1 year
Harmonic Mixer	Agilent 11970A	011269-001	08/04/04	1 year
Receiver (9kHz-30MHz)	R&S ESH3	891806/012	10/17/03	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

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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 2719A17228	N/A N/A	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:				
- Lisen-L <=> SW/Con.unit (SW100)	4 m	- EMIC-L	04/23/04	1 year
- Lisen-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. Bandwidth at 6 dB below

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

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

1.2 Test Instruments and Measurement Setup

Table 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

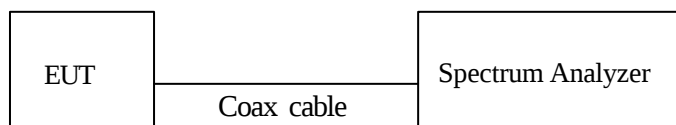


Figure 1: Measurement setup for 6dB bandwidth test

1.3 Measurement Results

Test Date: August 30, 2004

1.3.1 2.4GHz band DSSS mode

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

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
2412 (ch. 1)	omitted	2407.46	2416.60	9.14	> 0.5
2437 (ch. 6)	omitted	2432.46	2441.60	9.14	
2462 (ch. 11)	omitted	2457.46	2467.08	9.62	

Table 1-2-2. 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)
2412 (ch. 1)	omitted	2407.46	2416.60	9.14	> 0.5
2437 (ch. 6)	Plot 1-1	2432.46	2441.60	9.14	
2462 (ch. 11)	omitted	2457.46	2466.60	9.14	

1.3.2 2.4GHz band OFDM mode

Table 1-2-3. 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)
2412 (ch. 1)	omitted	2403.79	2420.27	16.48	> 0.5
2437 (ch. 6)	omitted	2428.79	2445.27	16.48	
2462 (ch. 11)	Plot 1-2	2454.39	2469.67	15.28	

Table 1-2-4. 6dB bandwidth, 2.4GHz band OFDM mode, TX mode 54Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
2412 (ch. 1)	omitted	2403.73	2420.27	16.54	> 0.5
2437 (ch. 6)	omitted	2428.73	2445.33	16.60	
2462 (ch. 11)	omitted	2454.39	2469.67	15.28	

1.3.3 5.8GHz band OFDM mode

Table 1-2-5. 6dB bandwidth, 5.8GHz band OFDM mode, TX mode 6Mbps

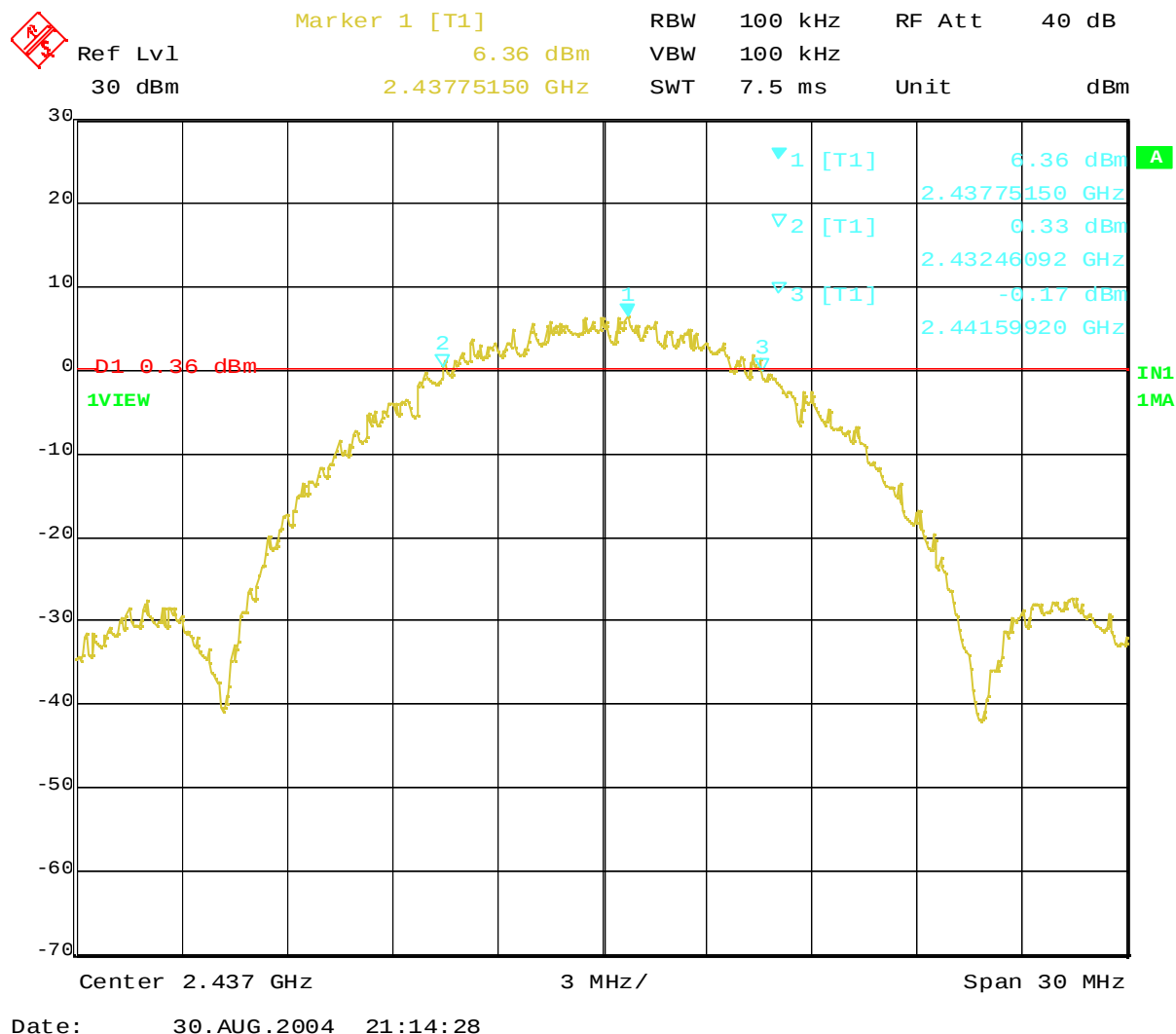
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
5745 (ch. 149)	omitted	5736.79	5753.21	16.42	> 0.5
5785 (ch. 157)	Plot 1-3	5776.79	5792.97	16.18	
5825 (ch. 165)	omitted	5816.79	5832.97	16.18	

Table 1-2-6. 6dB bandwidth, 5.8GHz band OFDM mode, TX mode 54Mbps

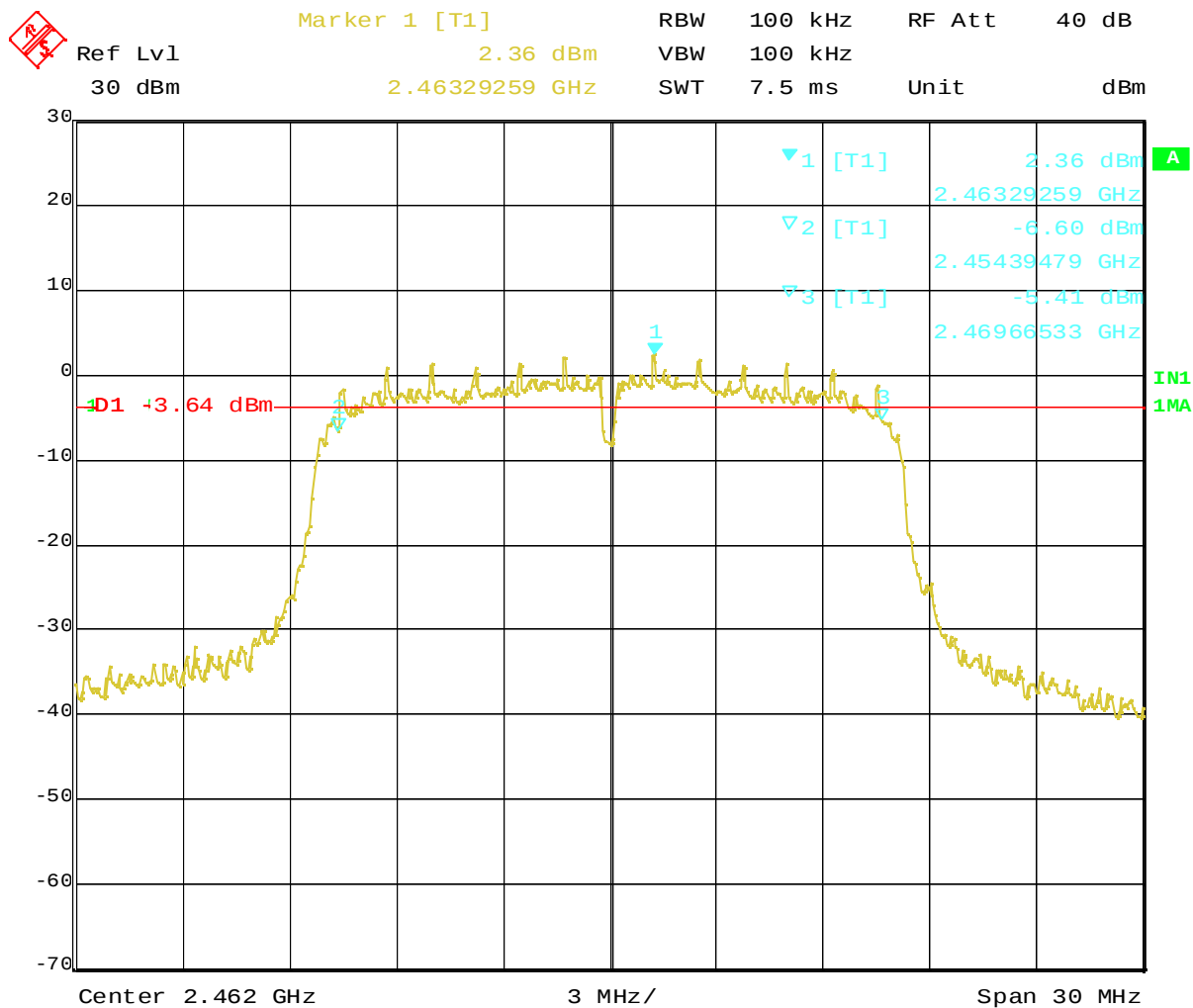
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 6 dB below (MHz)	Limit (MHz)
5745 (ch. 149)	omitted	5736.73	5753.27	16.54	> 0.5
5785 (ch. 157)	omitted	5776.73	5793.27	16.54	
5825 (ch. 165)	omitted	5816.73	5833.27	16.54	

1.4 Trace Data of 6dB bandwidth

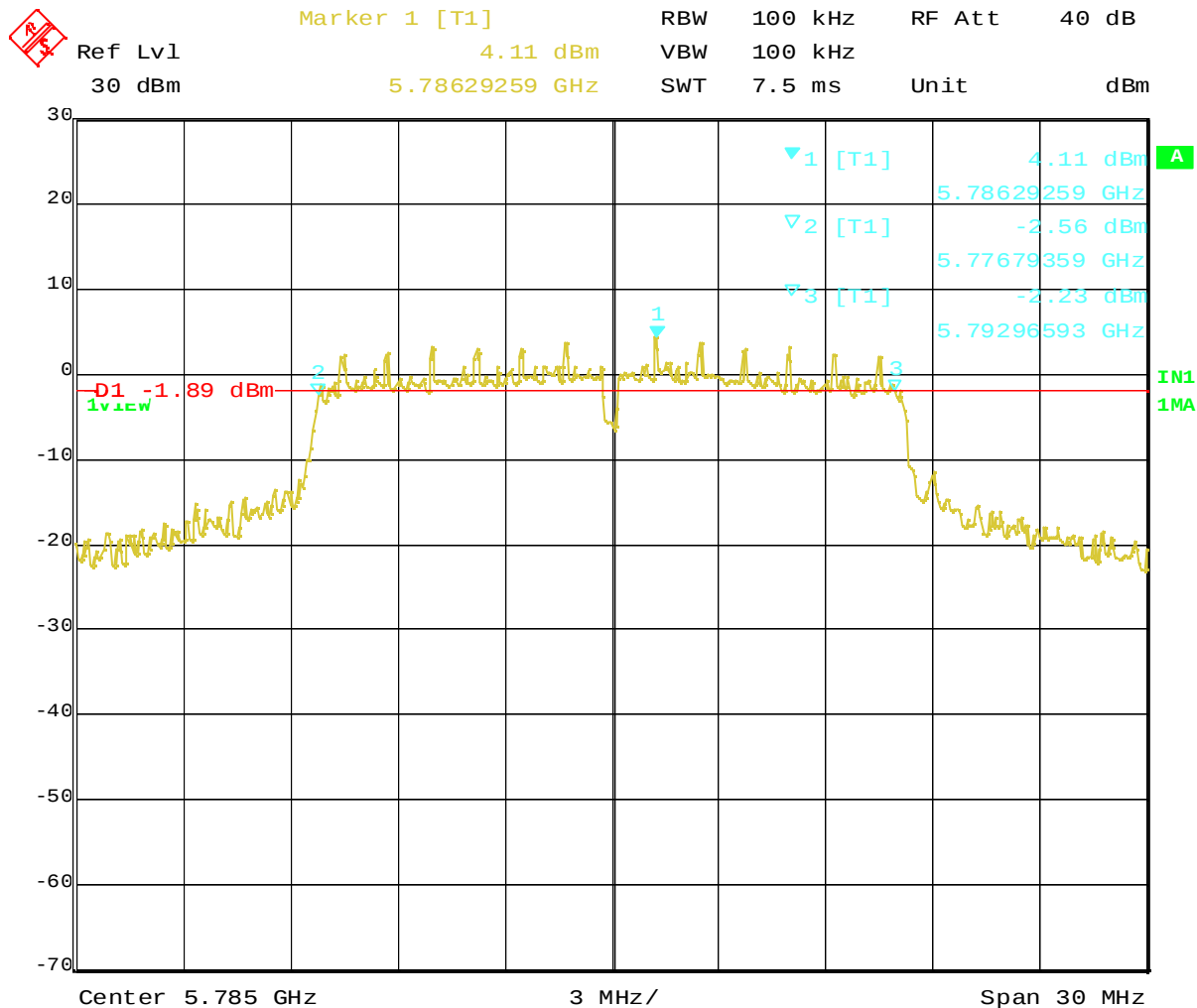
The plots are comparatively worse measurement cases of each transmission mode in the previous Table 1-2-1 through Table 1-2-8.



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



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



Date: 30.AUG.2004 21:46:27

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

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

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

2.2 Test Instruments and Measurement Setup

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

2.3 Measurement Results

Test Date: August 30, 2004

: the closest frequencies to the bandedge in each transmission mode

2.3.1 2.4GHz band DSSS mode

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

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
2412 (ch. 1)	omitted	2403.78	2420.17	16.39
2437 (ch. 6)	omitted	2428.83	2445.22	16.39
2462 (ch. 11)	omitted	2453.83	2470.17	16.34

Table 2-2. 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 2-1	2403.38	2420.67	17.29
2437 (ch. 6)	omitted	2428.53	2445.22	16.69
2462 (ch. 11)	Plot 2-2	2453.33	2470.67	17.34

2.3.2 2.4GHz band OFDM mode

Table 2-3. 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 2-3	2403.13	2421.07	17.94
2437 (ch. 6)	omitted	2428.13	2446.02	17.89
2462 (ch. 11)	Plot 2-4	2453.53	2470.47	16.94

Table 2-4. Occupied bandwidth, 2.4GHz band OFDM mode, TX 54Mbps

Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
2412 (ch. 1)	omitted	2403.13	2420.87	17.74
2437 (ch. 6)	omitted	2428.13	2445.82	17.69
2462 (ch. 11)	omitted	2453.53	2470.47	16.94

2.3.3 5.8GHz band OFDM mode

Table 2-5. Occupied bandwidth, 5.8GHz band OFDM mode, TX 6Mbps

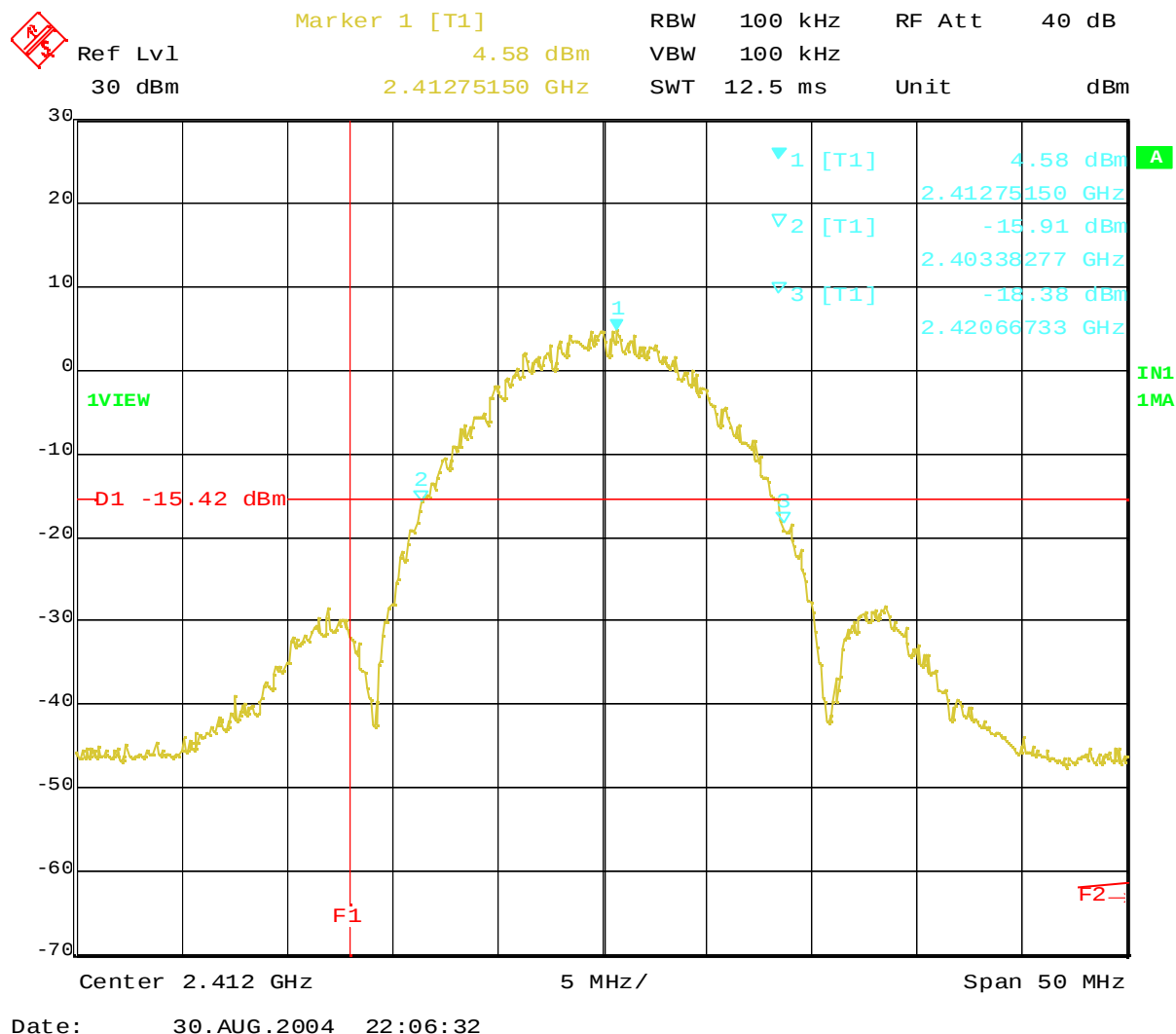
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
5745 (ch. 149)	Plot 2-5	5733.23	5757.07	23.84
5785 (ch. 157)	omitted	5773.23	5795.77	22.54
5825 (ch. 165)	Plot 2-6	5813.23	5835.47	22.24

Table 2-6. Occupied bandwidth, 5.8GHz band OFDM mode, TX 54Mbps

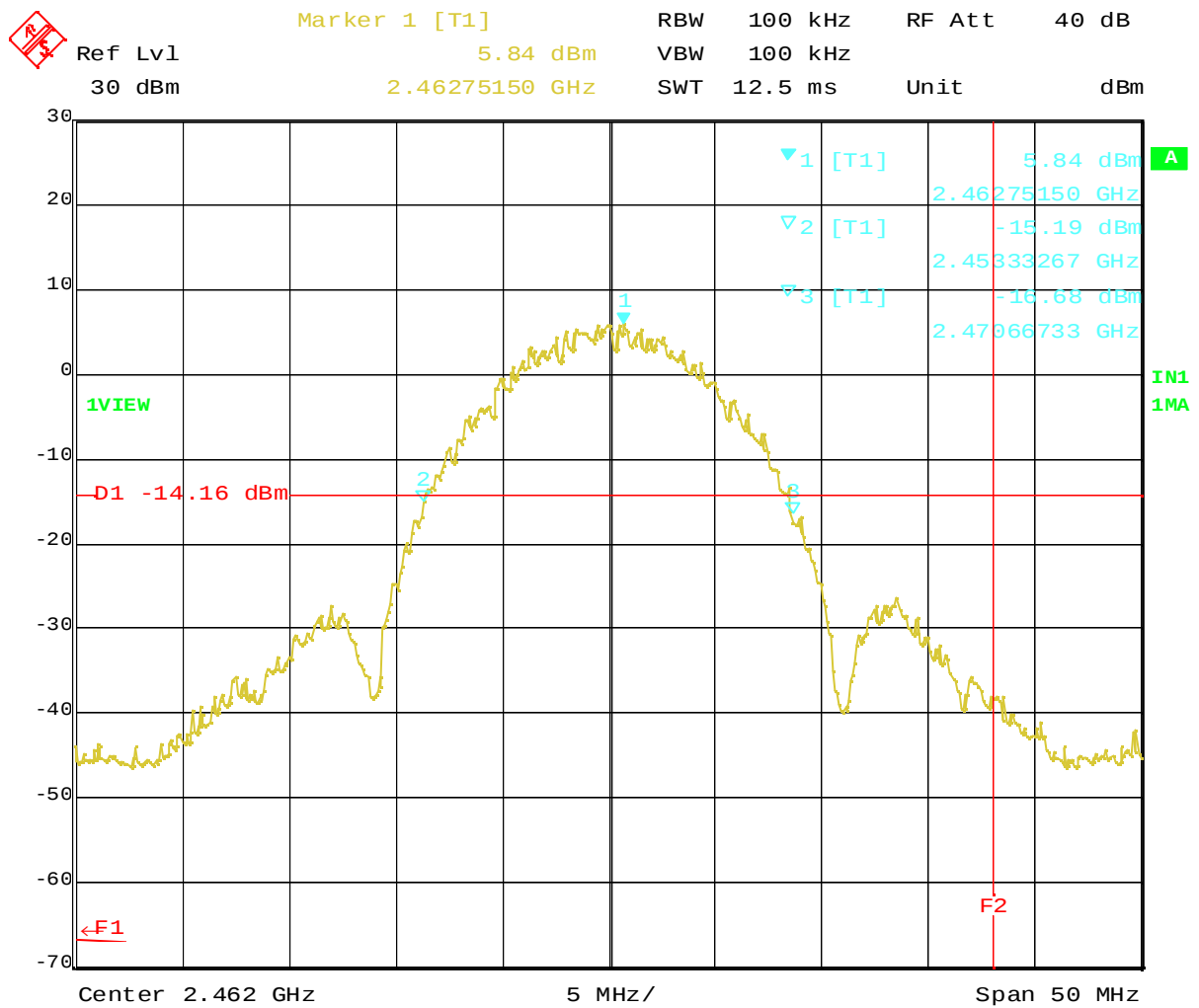
Center Frequency (MHz)	Trace number	Lower frequency (MHz)	Upper frequency (MHz)	Bandwidth at 20 dB below (MHz)
5745 (ch. 149)	omitted	5735.73	5753.87	18.14
5785 (ch. 157)	omitted	5775.93	5793.87	17.94
5825 (ch. 165)	omitted	5816.03	5833.87	17.84

2.4 Trace Data of Occupied Bandwidth

The plots are comparatively worse measurement cases of each transmission mode at the bandedge channels (i.e. ch.1 or ch.11) in the previous [Table 2-1](#) through [Table 2-8](#).

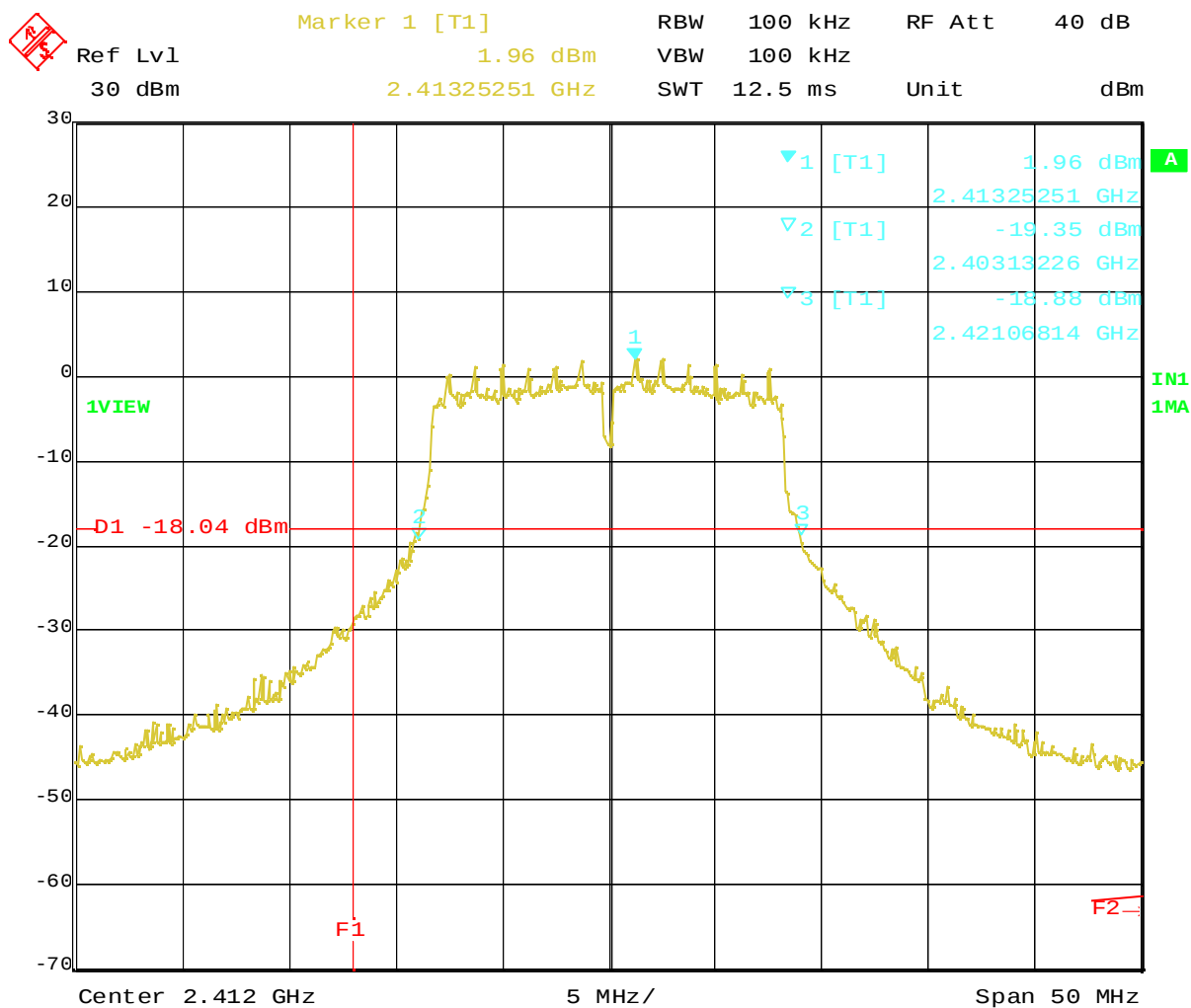


Plot 2-1. 20dB BW at 2412MHz (DSSS, 11Mbps)



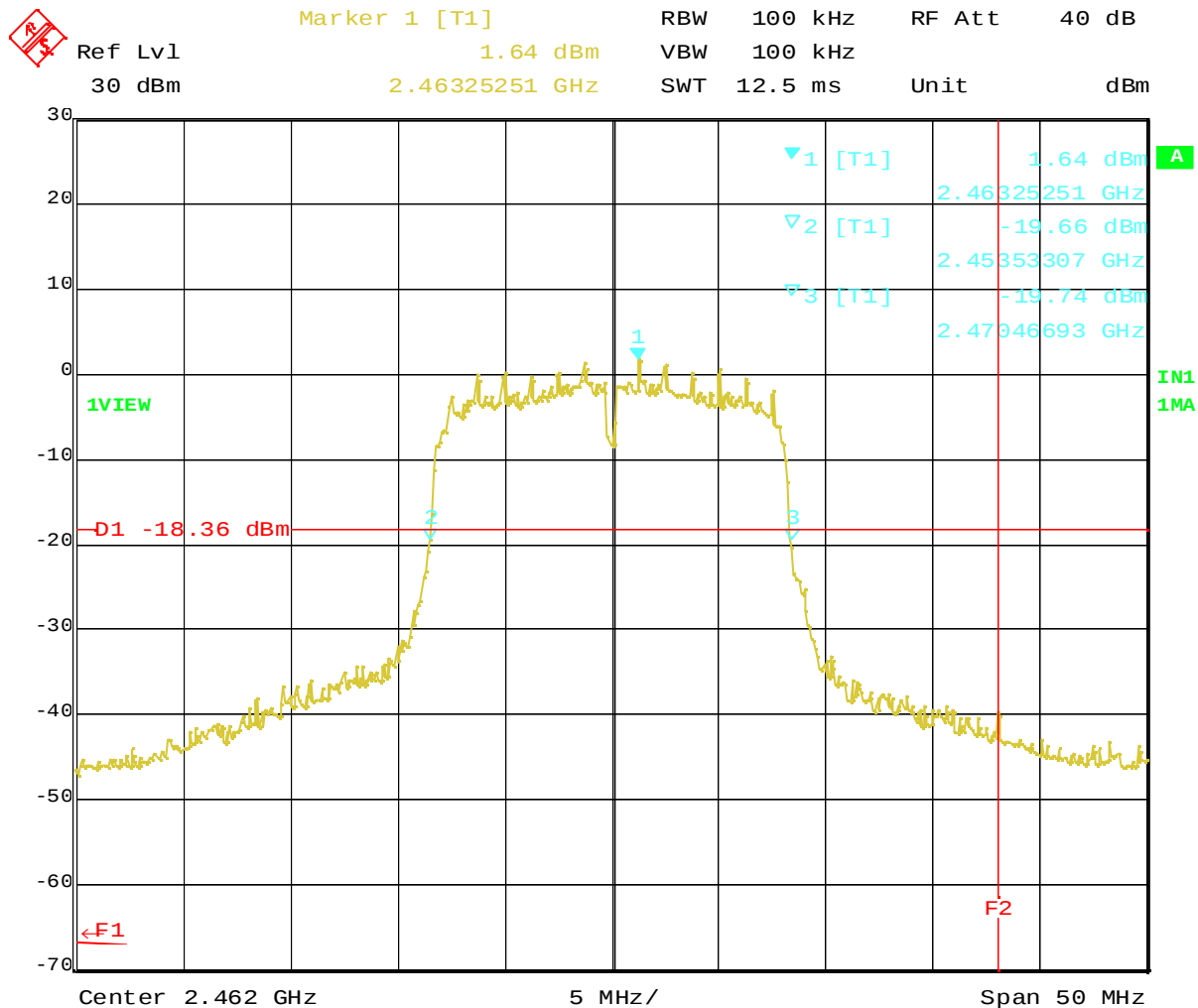
Date: 30.AUG.2004 22:14:03

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



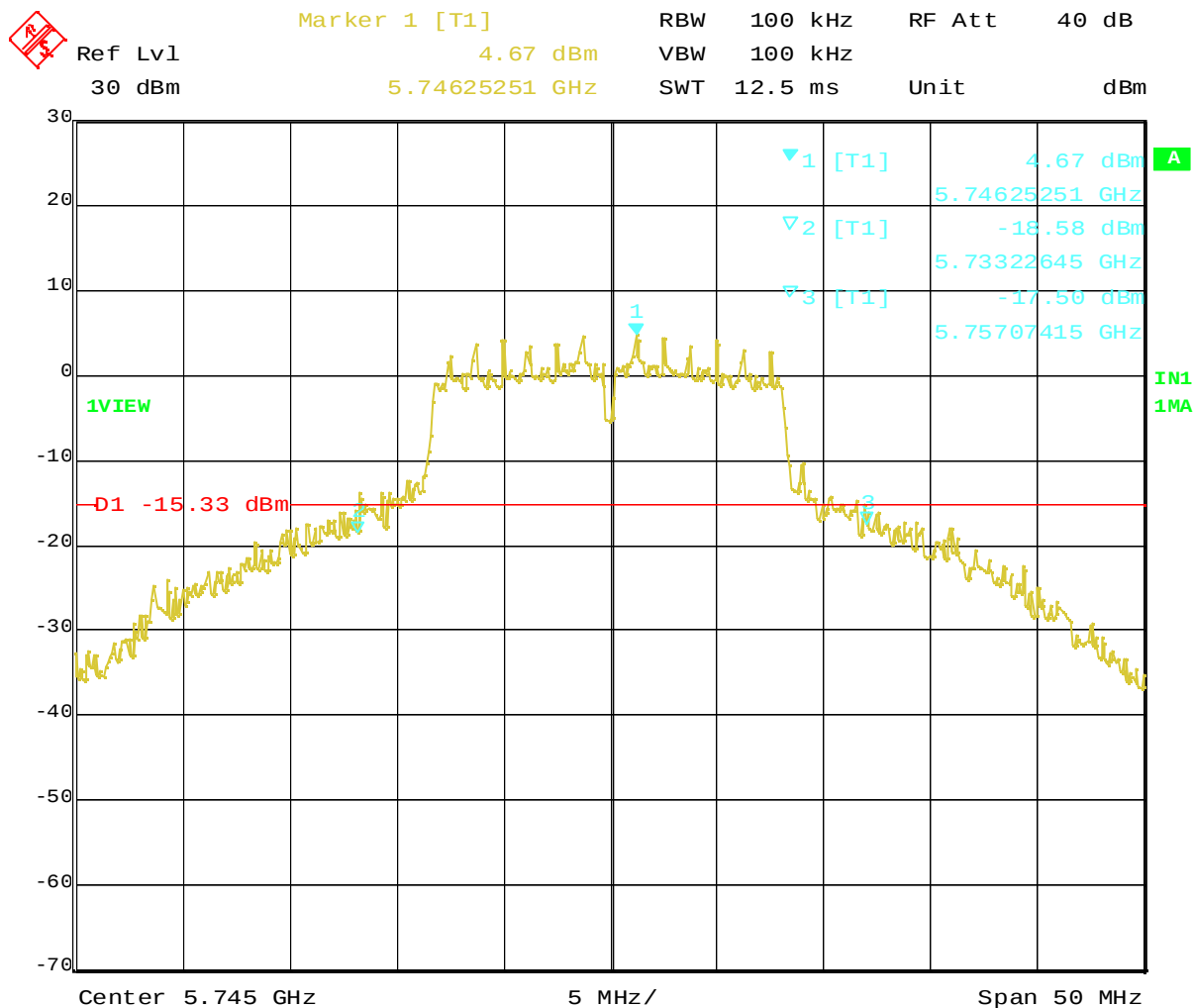
Date: 30.AUG.2004 22:23:53

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

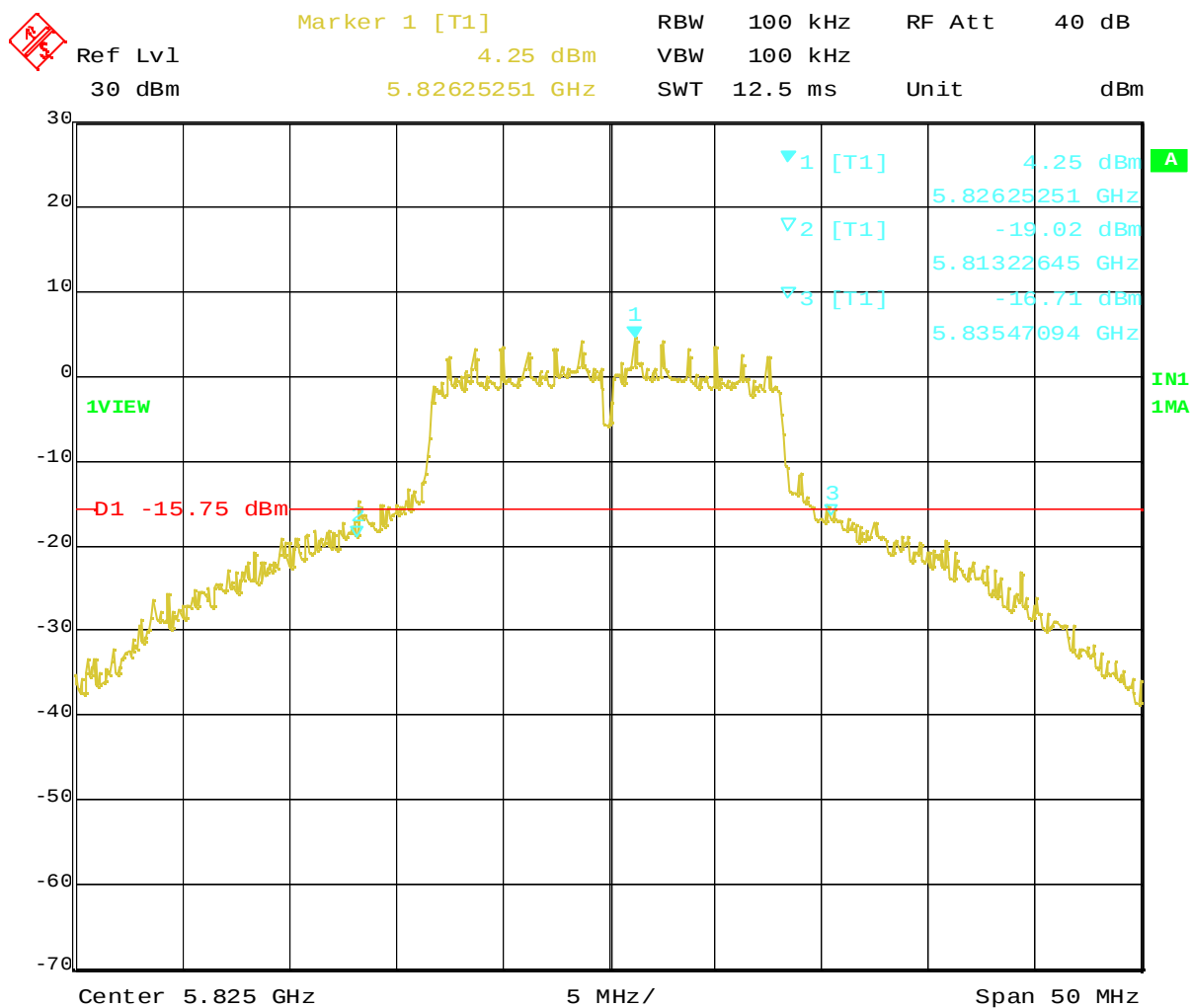


Date: 30.AUG.2004 22:29:58

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



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



Date: 30.AUG.2004 22:53:11

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

3. Conducted Peak Transmit Output Power

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

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.

3.2 Test Instruments and Measurement Setup

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

3.3 Measurement Results

Test Date: August 23 and 26, 2004

Table 3-1. Conducted peak output power measurement results in 2.4GHz band

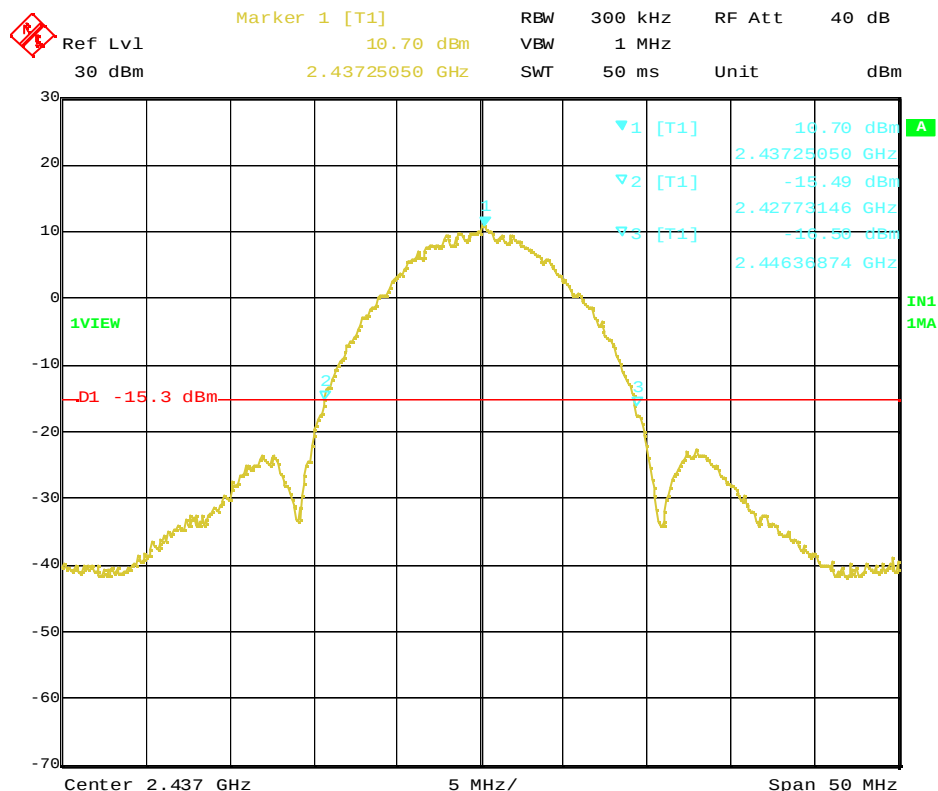
Measured Frequency (MHz)	Tx mode (Mb/s)	Analyzer reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBm)
						FCC (dBm)	IC (dBm)	
2412 (DSSS)	1	17.11	omitted	1.3	18.41 (69.3 mW)	30	30	11.59
	5.5	18.16	omitted		19.46 (88.3 mW)			10.54
	11	19.20	omitted		20.50 (112.2 mW)			9.50
2437 (DSSS)	1	17.77	omitted	1.3	19.07 (80.7 mW)			10.93
	5.5	19.79	omitted		21.09 (128.5 mW)			8.91
	11	20.78	Plot 3-1b		22.08 (161.4 mW)			7.92
2462 (DSSS)	1	17.50	omitted	1.3	18.80 (75.9 mW)			11.20
	5.5	19.35	omitted		20.65 (116.1 mW)			9.35
	11	20.54	omitted		21.84 (152.8 mW)			8.16
2412 (OFDM)	6	20.01	Plot 3-2b	1.3	21.31 (135.2 mW)			8.69
	18	19.87	omitted		21.17 (130.9 mW)			8.83
	54	19.96	omitted		21.26 (133.7 mW)			8.74
2437 (OFDM)	6	19.40	omitted	1.3	20.70 (117.5 mW)			9.30
	18	19.28	omitted		20.58 (114.3 mW)			9.42
	54	19.33	omitted		20.63 (115.6 mW)			9.37
2462 (OFDM)	6	19.87	omitted	1.3	21.17 (130.9 mW)			8.83
	18	19.69	omitted		20.99 (125.6 mW)			9.01
	54	19.78	omitted		21.08 (128.2 mW)			8.92

Table 3-2. Conducted peak output power measurement results in 5.8GHz band
with both primary and secondary powers

Measured Frequency (MHz)	Tx mode (Mb/s)	Power setting	Analyzer r reading (dBm)	Trace number	Cable Loss (dB)	Results (dBm)	Limit		Margin to limit (dBm)
							FCC (dBm)	IC (dBm)	
5745 (OFDM)	6	primary	21.92	Plot 3-3b omitted	2.3	24.22 (264.2 mW)	30	30	5.78
		secondary	19.40			21.70 (147.9 mW)			8.30
	18	primary	21.70	omitted		24.00 (251.2 mW)			6.00
		secondary	19.24			21.54 (142.6 mW)			8.46
	54	primary	20.47	omitted		22.77 (189.2 mW)			7.23
		secondary	16.59			18.89 (77.4 mW)			11.11
5785 (OFDM)	6	primary	21.51	omitted	2.3	23.81 (240.4 mW)			6.19
		secondary	18.94			21.24 (133.0 mW)			8.76
	18	primary	21.33	omitted		23.63 (230.7 mW)			6.37
		secondary	18.78			21.08 (128.2 mW)			8.92
	54	primary	19.93	omitted		22.23 (167.1 mW)			7.77
		secondary	16.26			18.56 (71.8 mW)			11.44
5825 (OFDM)	6	primary	21.66	omitted	2.3	23.96 (248.9 mW)			6.04
		secondary	19.00			21.30 (134.9 mW)			8.70
	18	primary	21.38	omitted		23.68 (233.3 mW)			6.32
		secondary	18.82			21.12 (129.4 mW)			8.88
	54	primary	19.99	omitted		22.29 (169.4 mW)			7.71
		secondary	16.30			18.60 (72.4 mW)			11.40

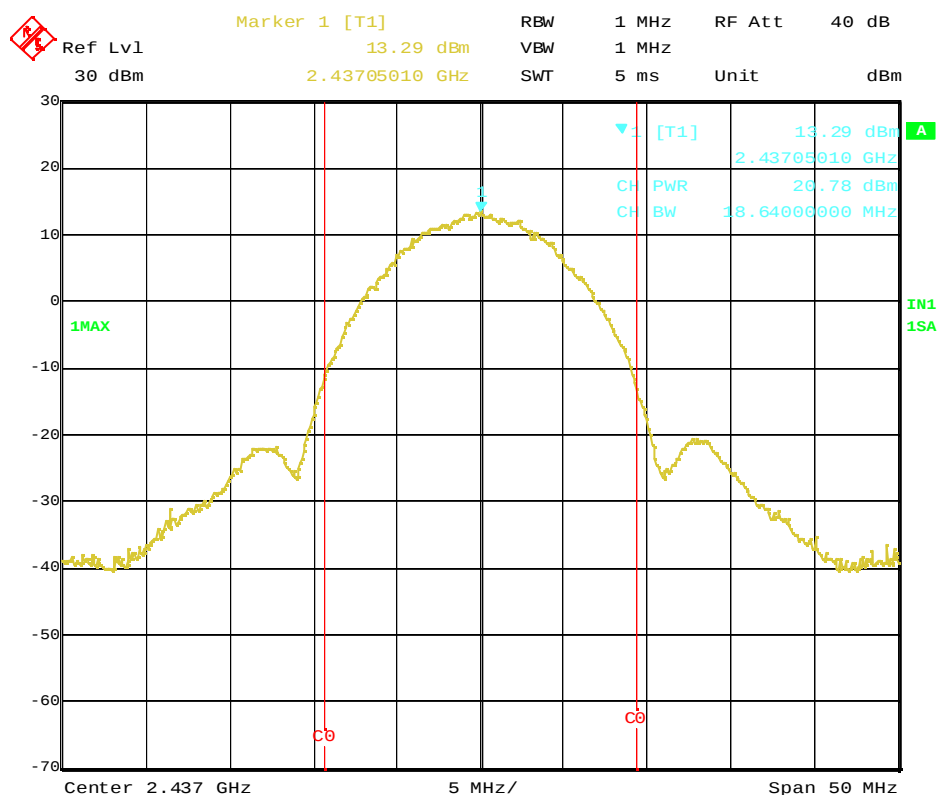
3.4 Trace Data of Conducted Peak Output Power

The plots are comparatively worse measurement cases of each transmission mode in the previous [Table 3-1](#) and [Table 3-2](#).



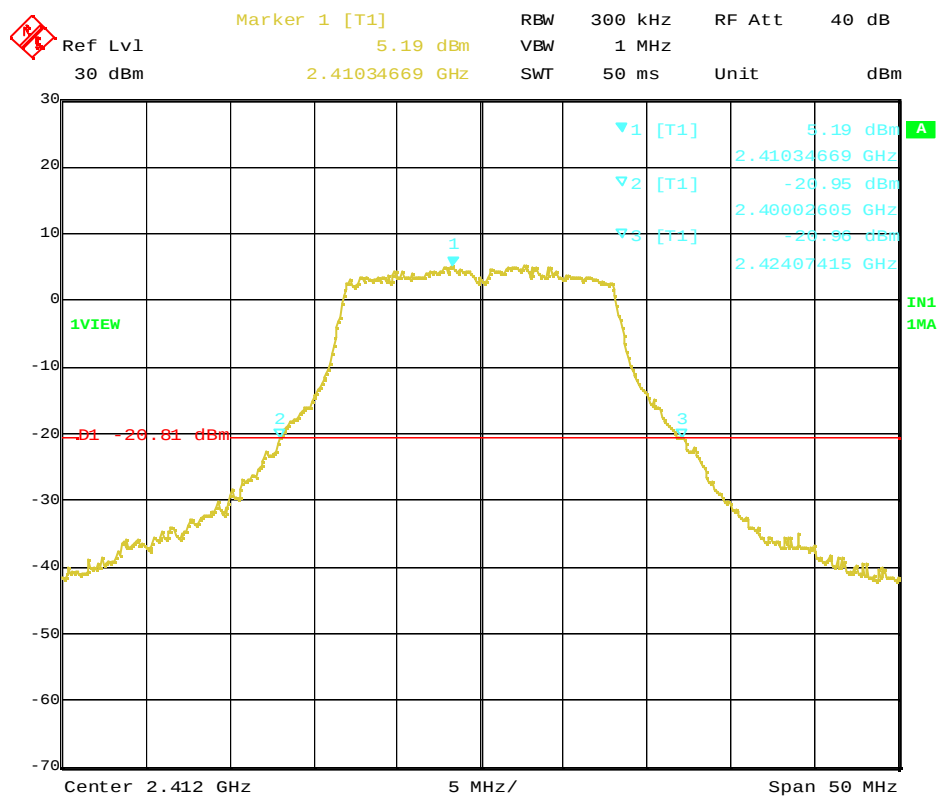
Date: 26.AUG.2004 17:35:33

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

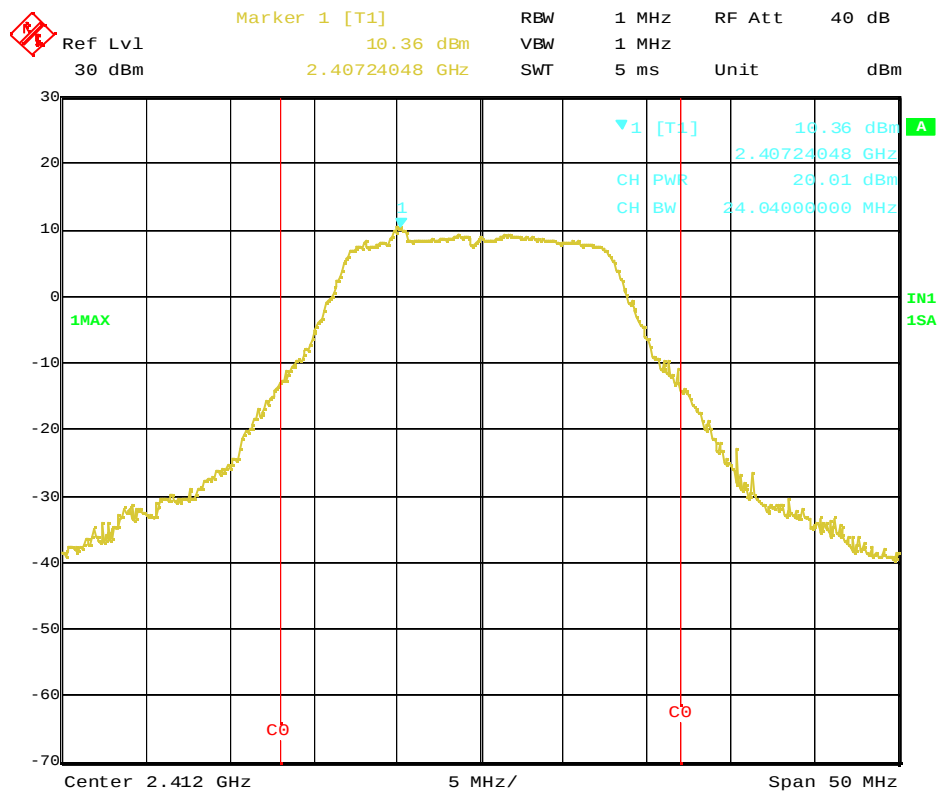


Date: 26.AUG.2004 18:11:35

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

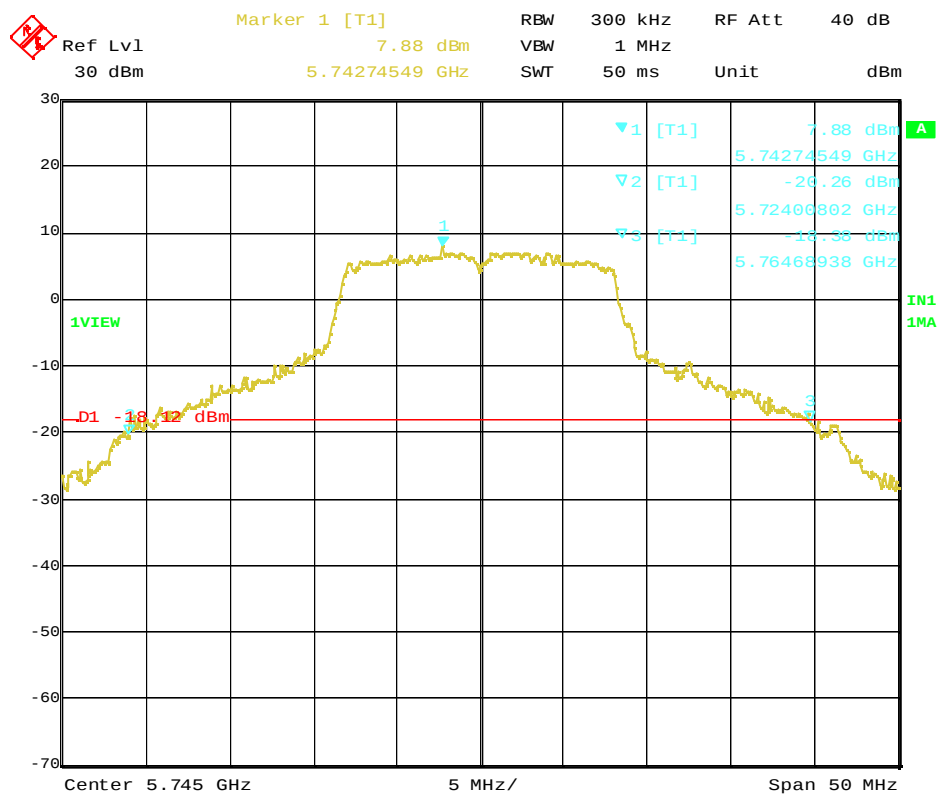


Date: 23.AUG.2004 18:15:16

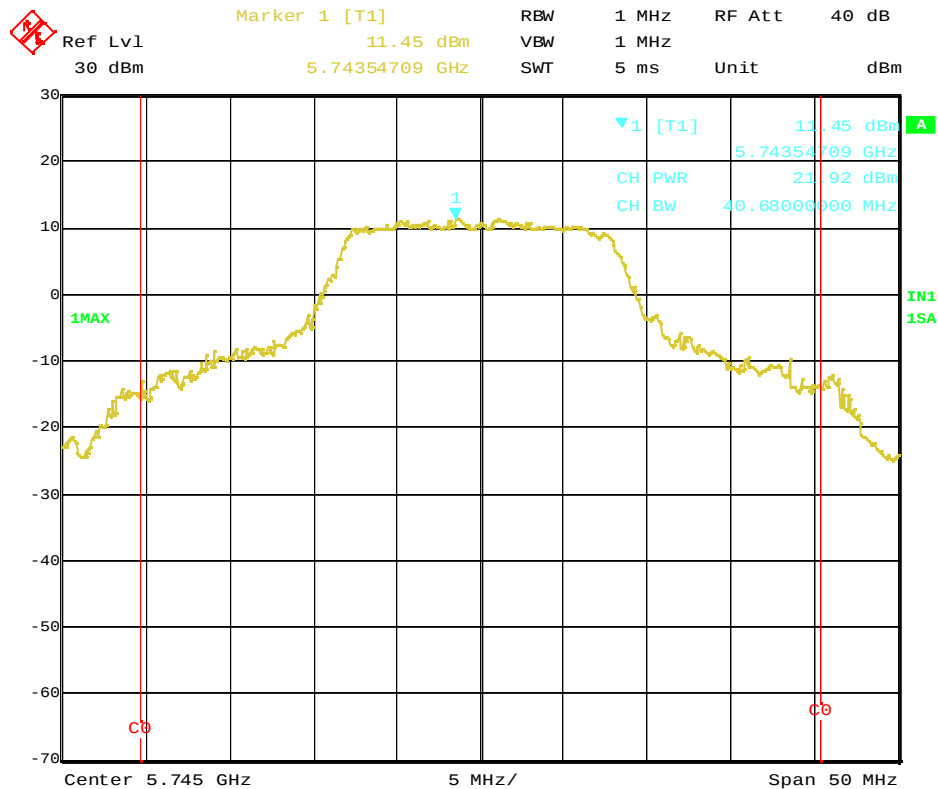
Plot 3-2a. 26dB Bandwidth of 2412MHz (OFDM, 6Mbps)

Date: 23.AUG.2004 21:40:52

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



Date: 26.AUG.2004 20:49:06

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

Date: 26.AUG.2004 22:11:08

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

4. Out of Band Emissions (Conducted Spurious) [FCC 15.247(c), RSS-210 6.2.2(o)(e1)]

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

4.2 Test Instruments and Measurement Setup

4.2.1 Below 26.5GHz

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

4.2.2 Above 26.5GHz

Table 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)	Length: 1m Cable loss: 2.9dB (at 40GHz)	- SF102-21108
- Mixer <=> Spectrum Analyzer (26.5-40GHz)	1m 2.9dB (at 40GHz)	- SF102-21105

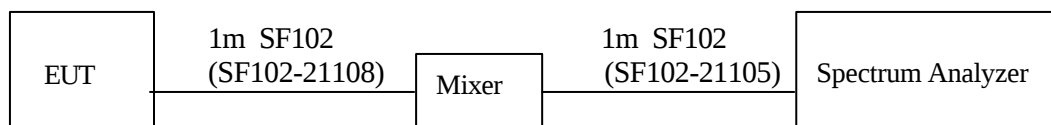


Figure 4: Measurement setup for Conducted Spurious test

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.

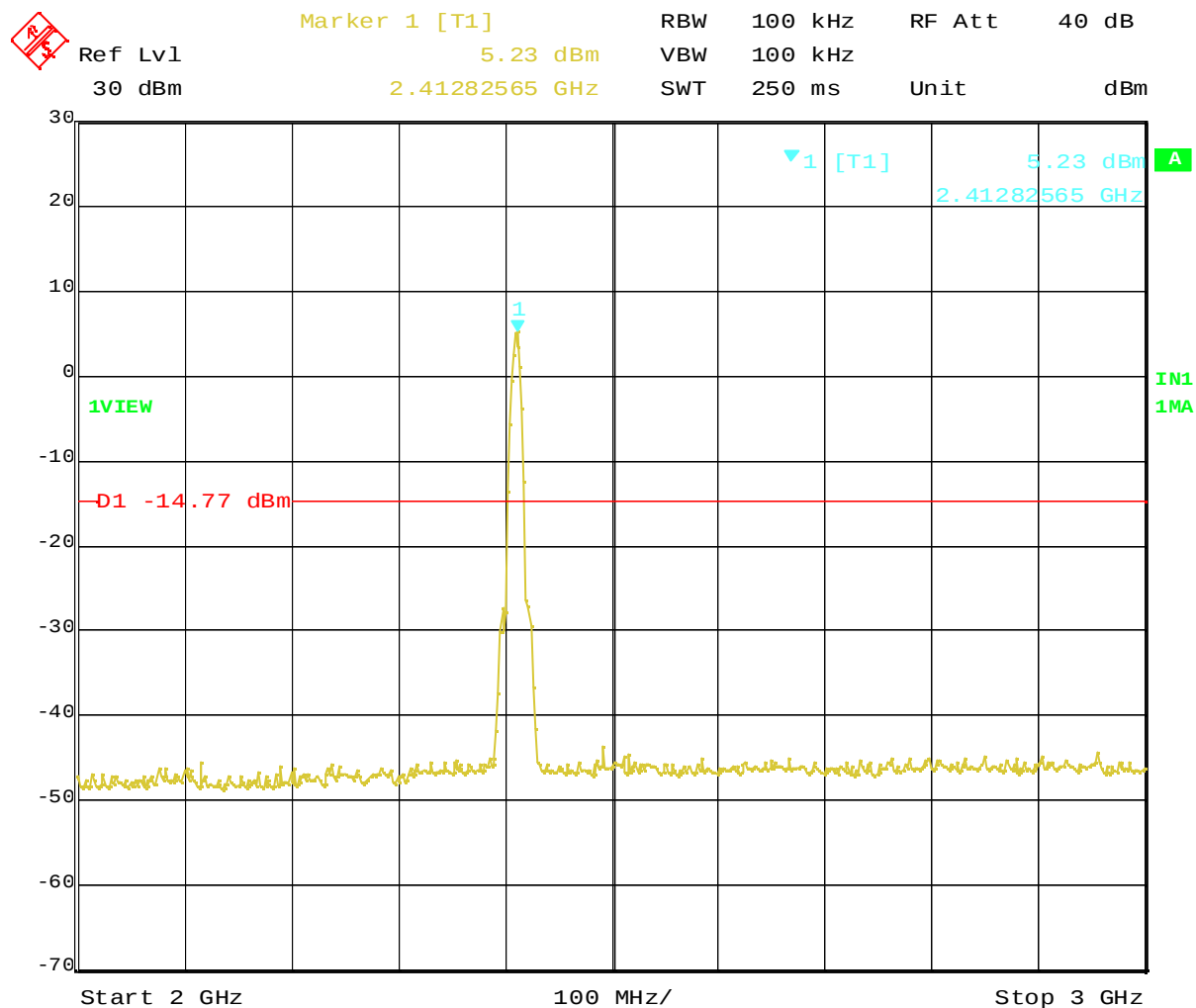
The measurement was performed with the worse cases of each transmission mode, that tend to have higher conducted peak power, based on the results of previous Chapter 3, “Conducted Peak Output Power” measurement.

Test Date: August 31, 2004 : See the following plots.

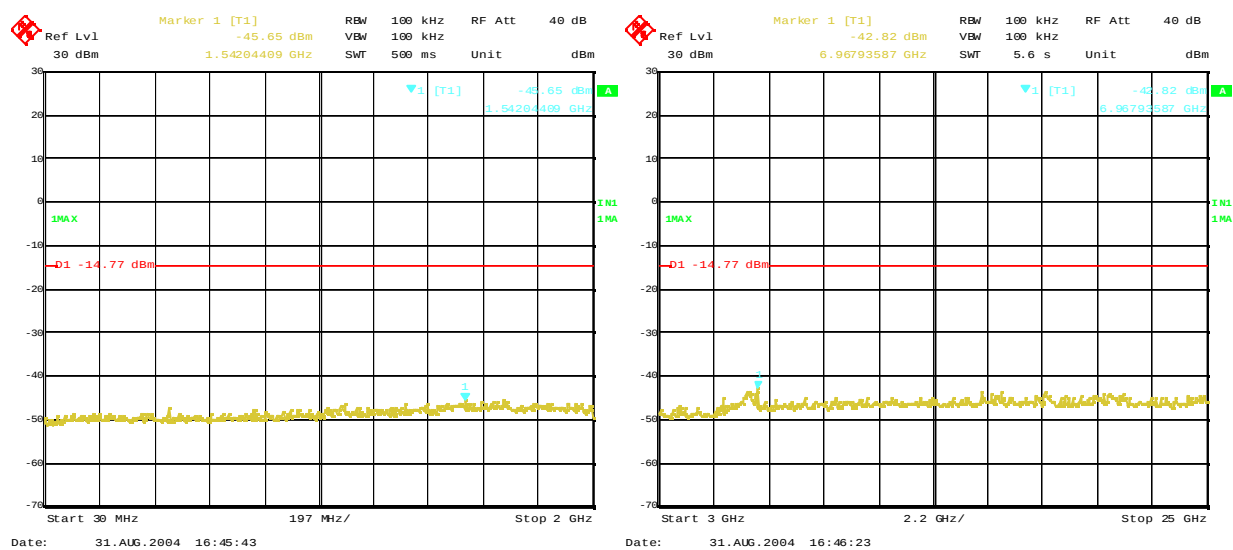
Center Frequency (MHz)		Tx Rate (worst case)	Trace number *1
2412 (ch. 1)	DSSS	11Mbps	Plot 4-1
2437 (ch. 6)		11Mbps	Plot 4-2
2462 (ch. 11)		11Mbps	Plot 4-3
2412 (ch. 1)	OFDM	6Mbps	Plot 4-4
2437 (ch. 6)		6Mbps	Plot 4-5
2462 (ch. 11)		6Mbps	Plot 4-6
5745 (ch. 149)	OFDM	6Mbps	Plot 4-7
5785 (ch. 157)		6Mbps	Plot 4-8
5825 (ch. 165)		6Mbps	Plot 4-9

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

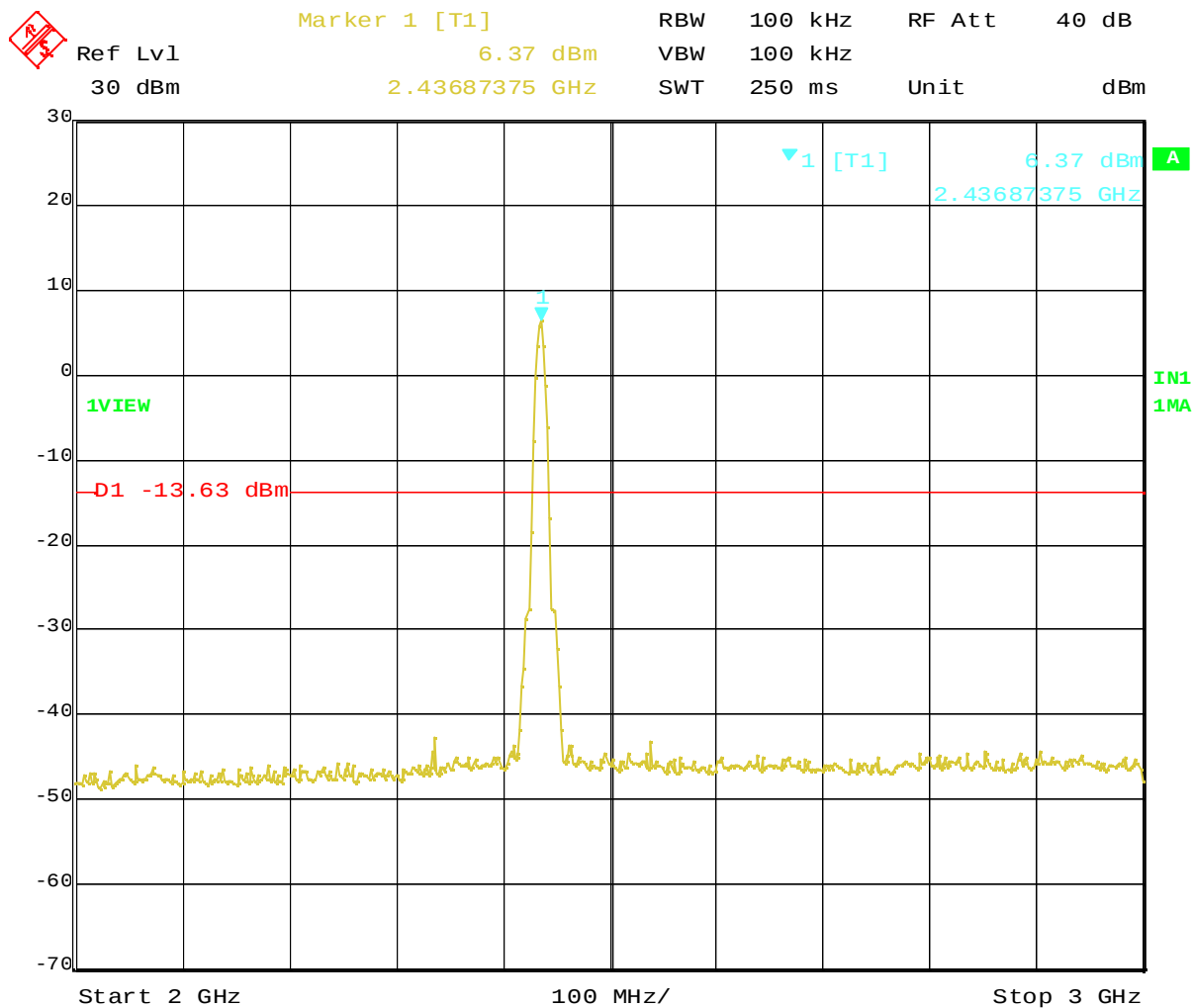
4.4 Trace Data of Out of Band Emissions



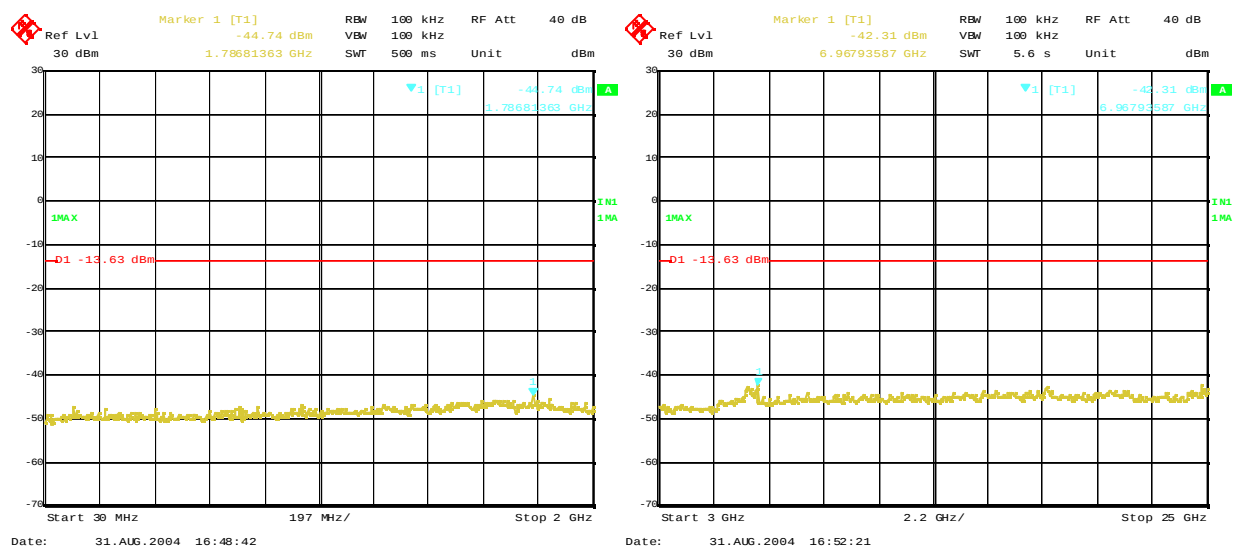
Date: 31.AUG.2004 16:44:46

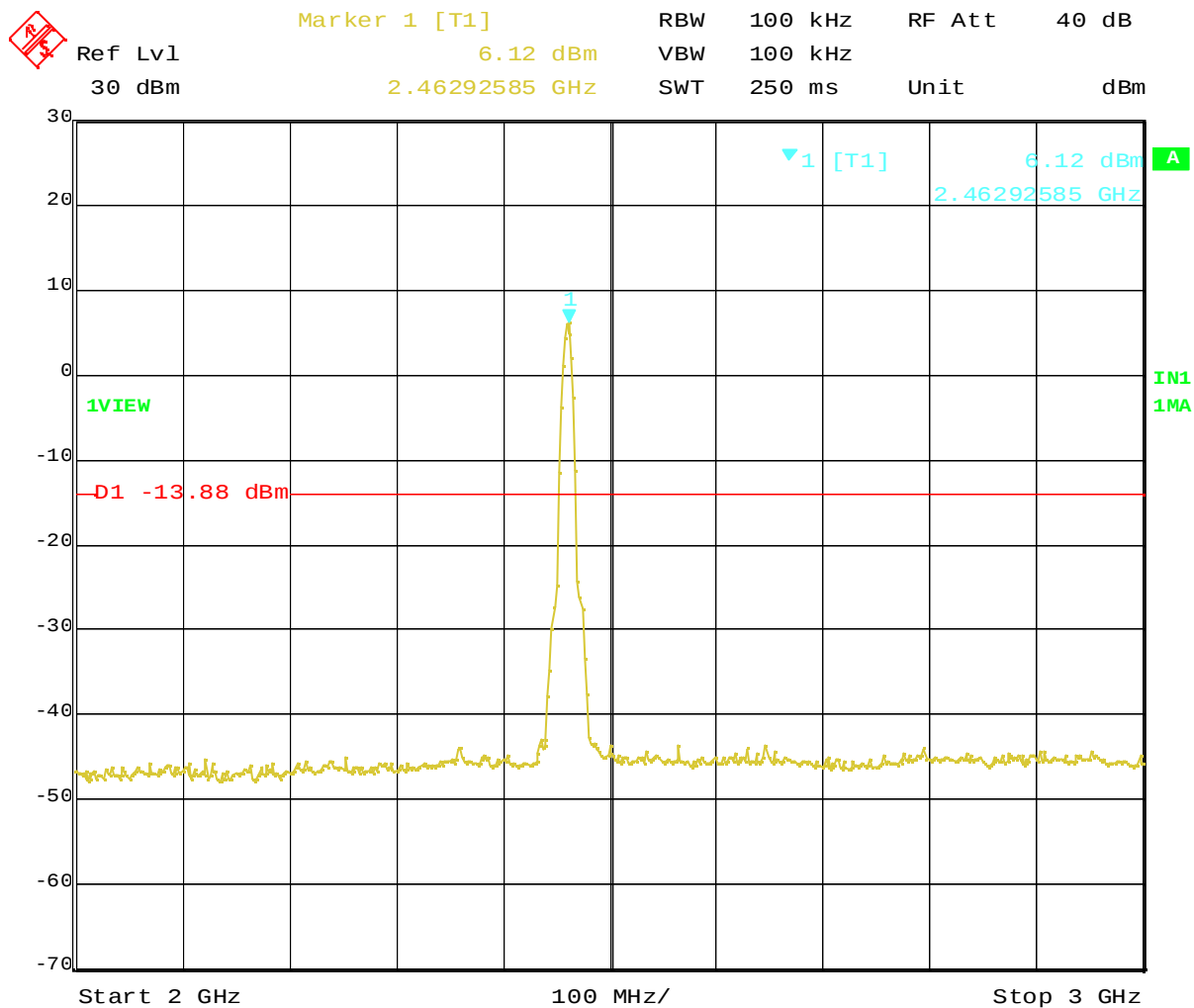


Plot 4-1. Out of band emissions around 2412MHz (DSSS, 11Mbps)

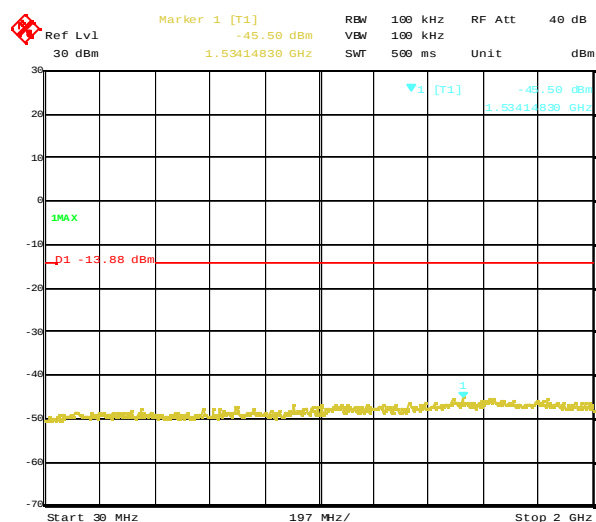


Date: 31.AUG.2004 16:47:44

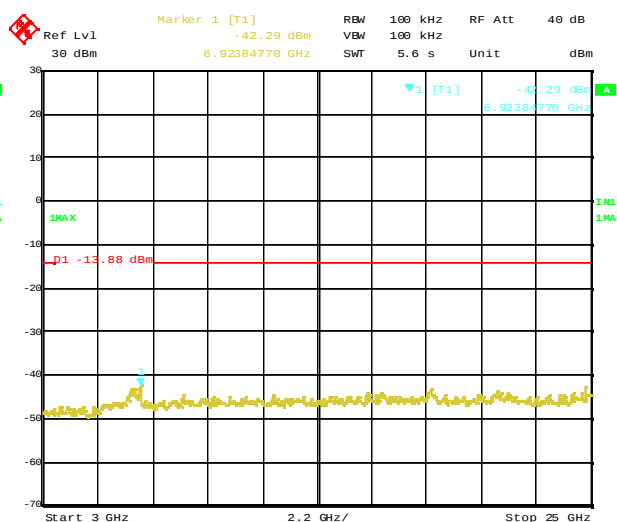
Plot 4-2. Out of band emissions around 2437MHz (DSSS, 11Mbps)



Date: 31.AUG.2004 16:55:52

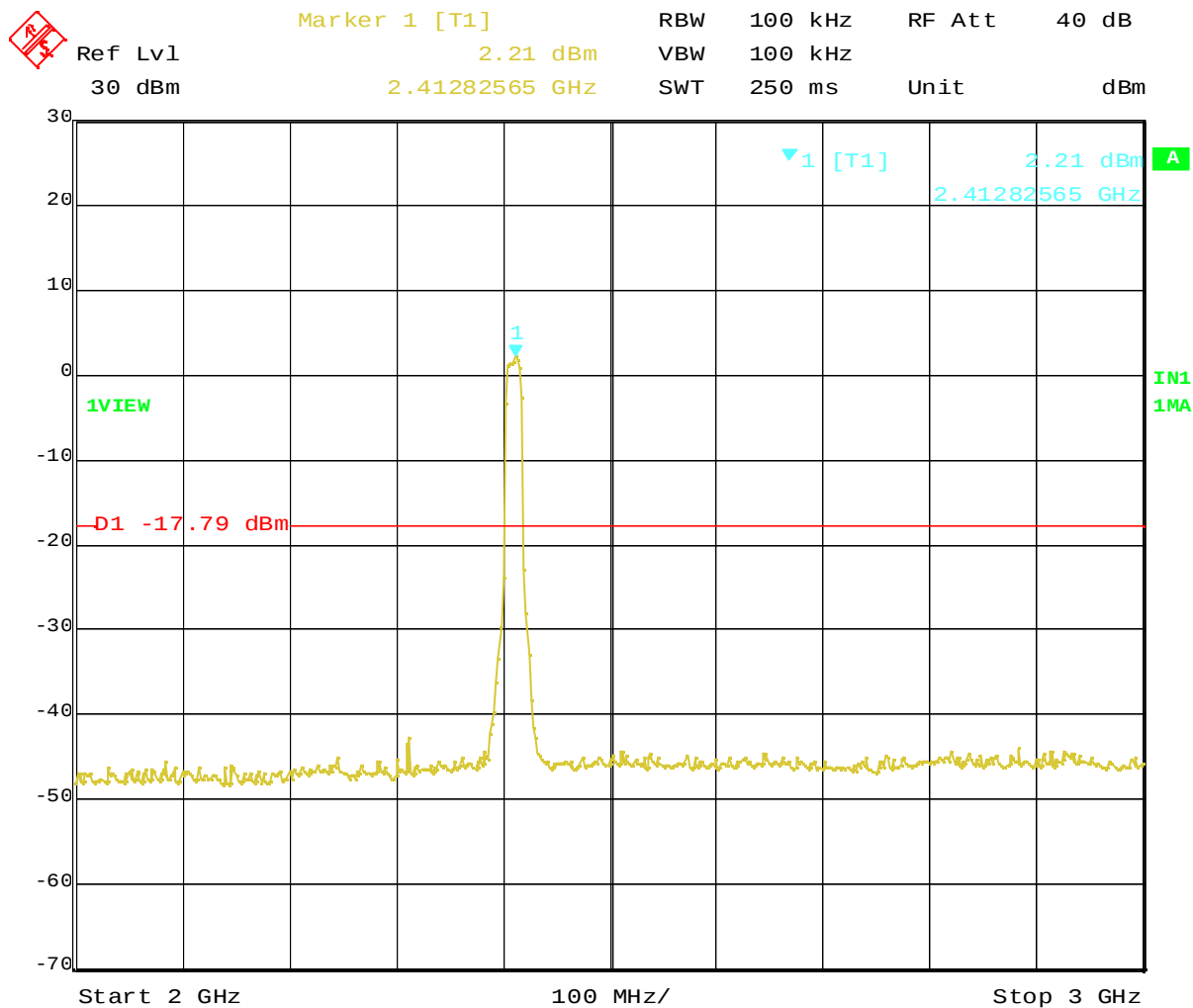


Date: 31.AUG.2004 16:56:49

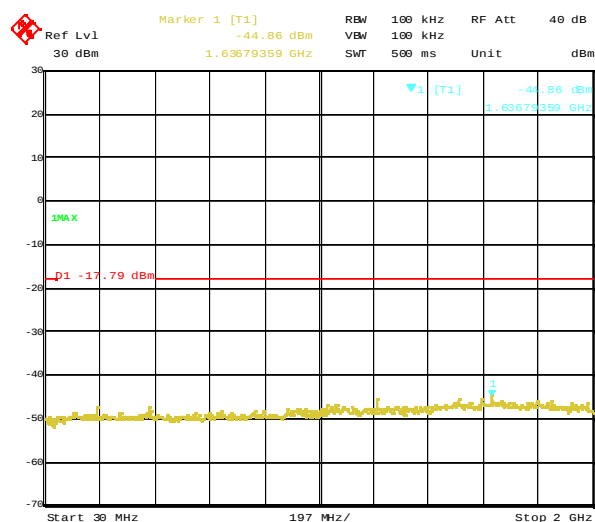


Date: 31.AUG.2004 16:57:44

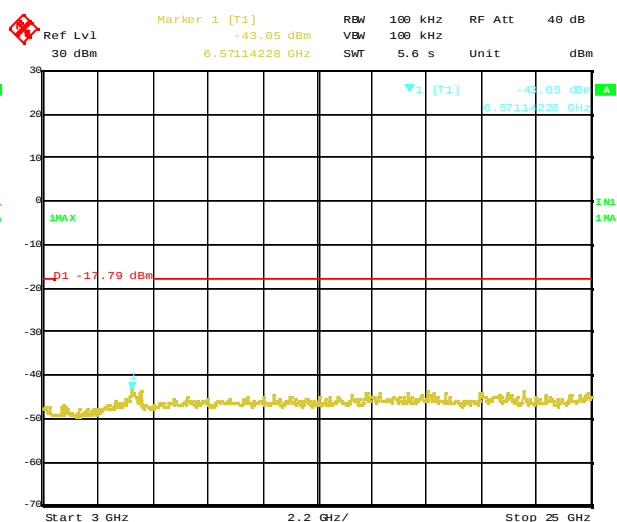
Plot 4-3. Out of band emissions around 2462MHz (DSSS, 11Mbps)



Date: 31.AUG.2004 17:00:32

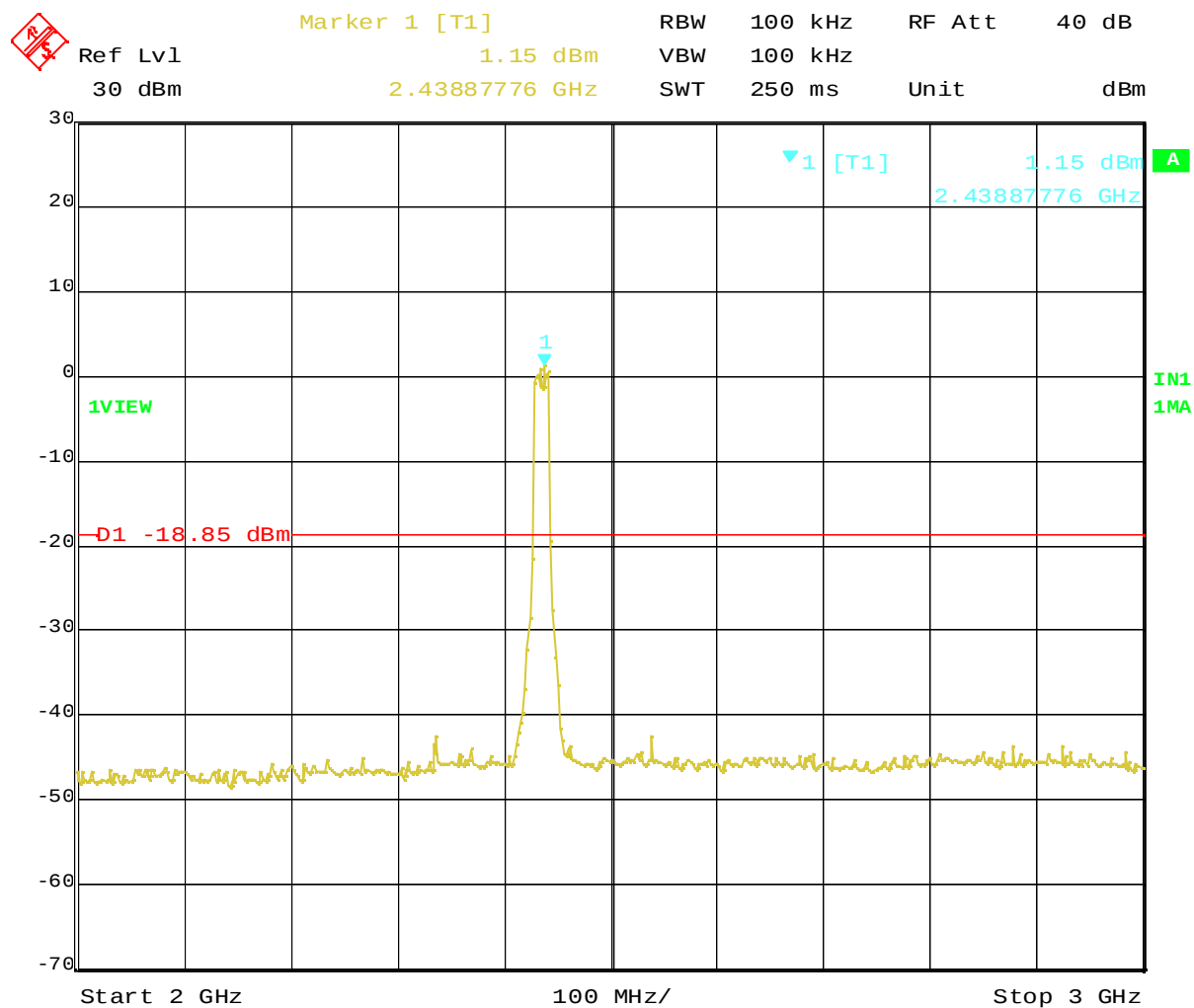


Date: 31.AUG.2004 17:01:33

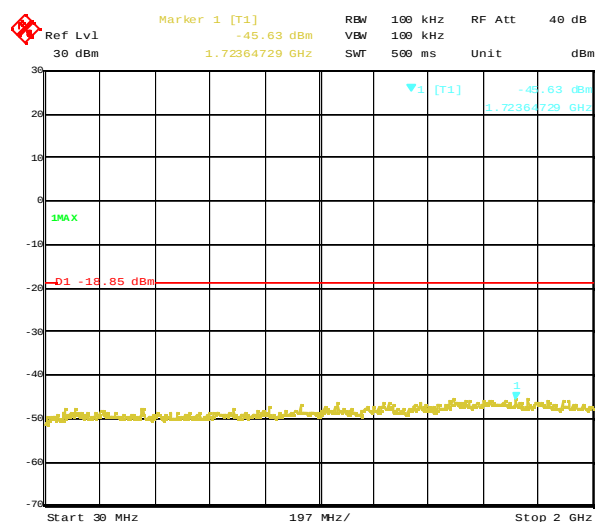


Date: 31.AUG.2004 17:02:18

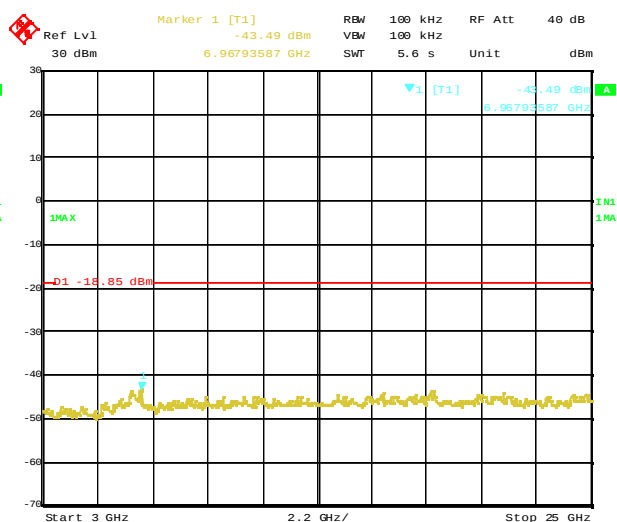
Plot 4-4. Out of band emissions around 2412MHz (OFDM, 6Mbps)



Date: 31.AUG.2004 17:04:15

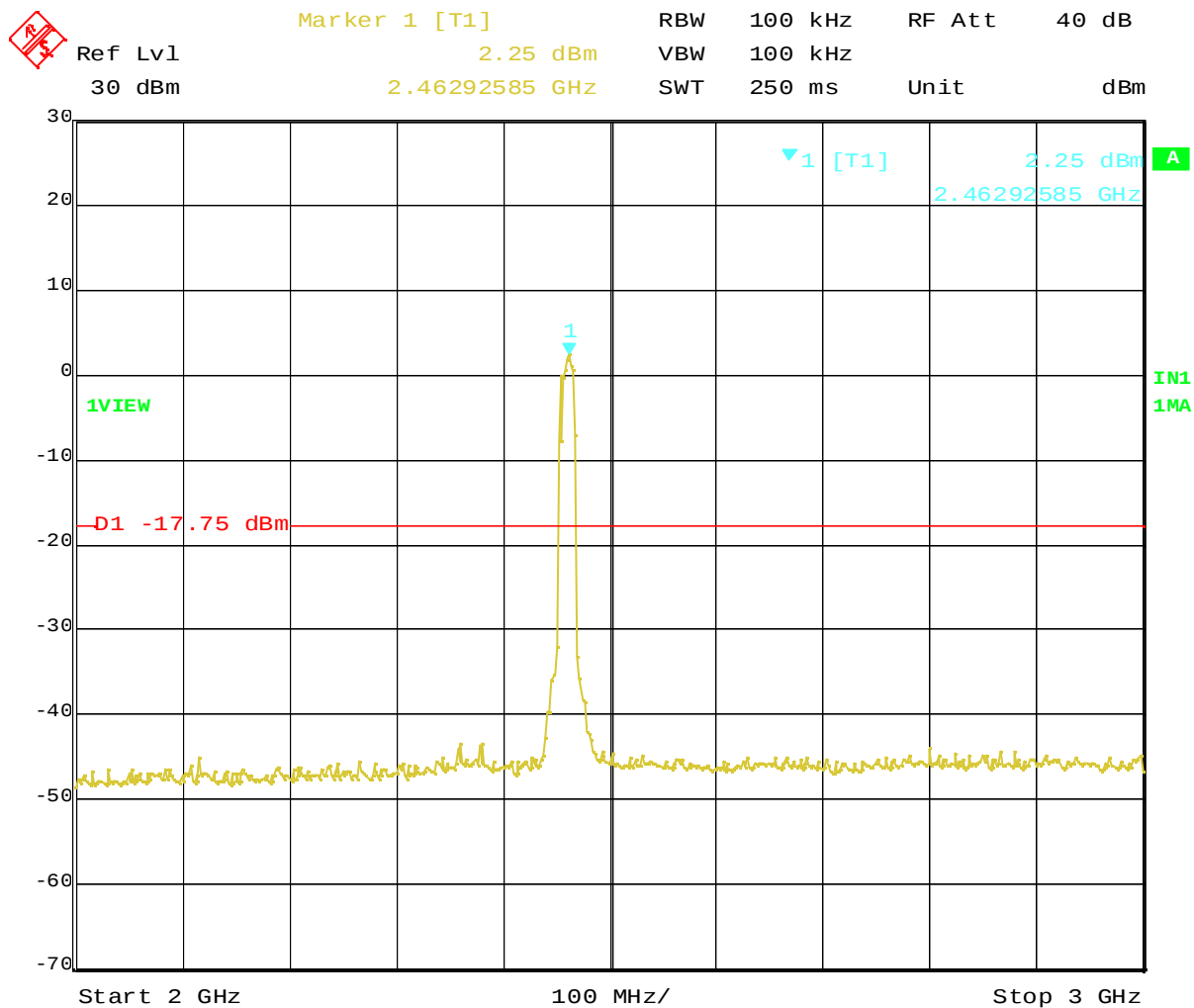


Date: 31.AUG.2004 17:04:58

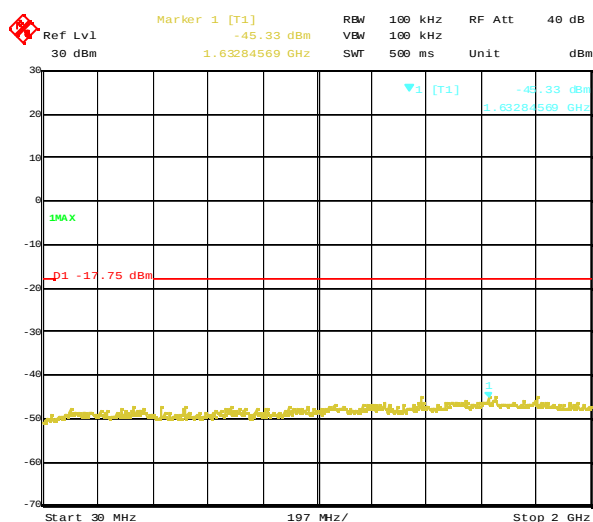


Date: 31.AUG.2004 17:05:48

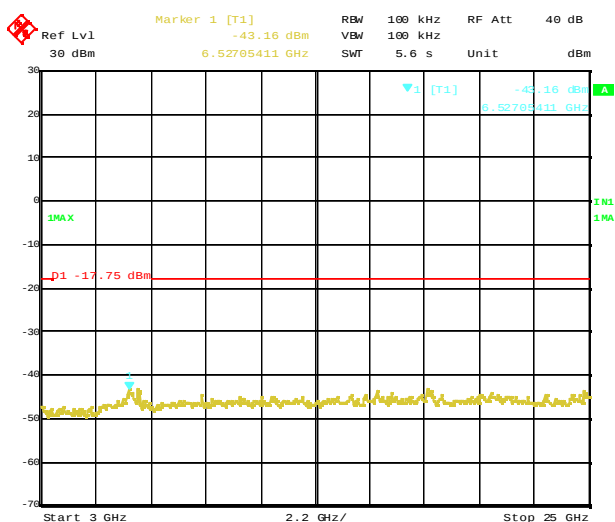
Plot 4-5. Out of band emissions around 2437MHz (OFDM, 6Mbps)



Date: 31.AUG.2004 17:11:02

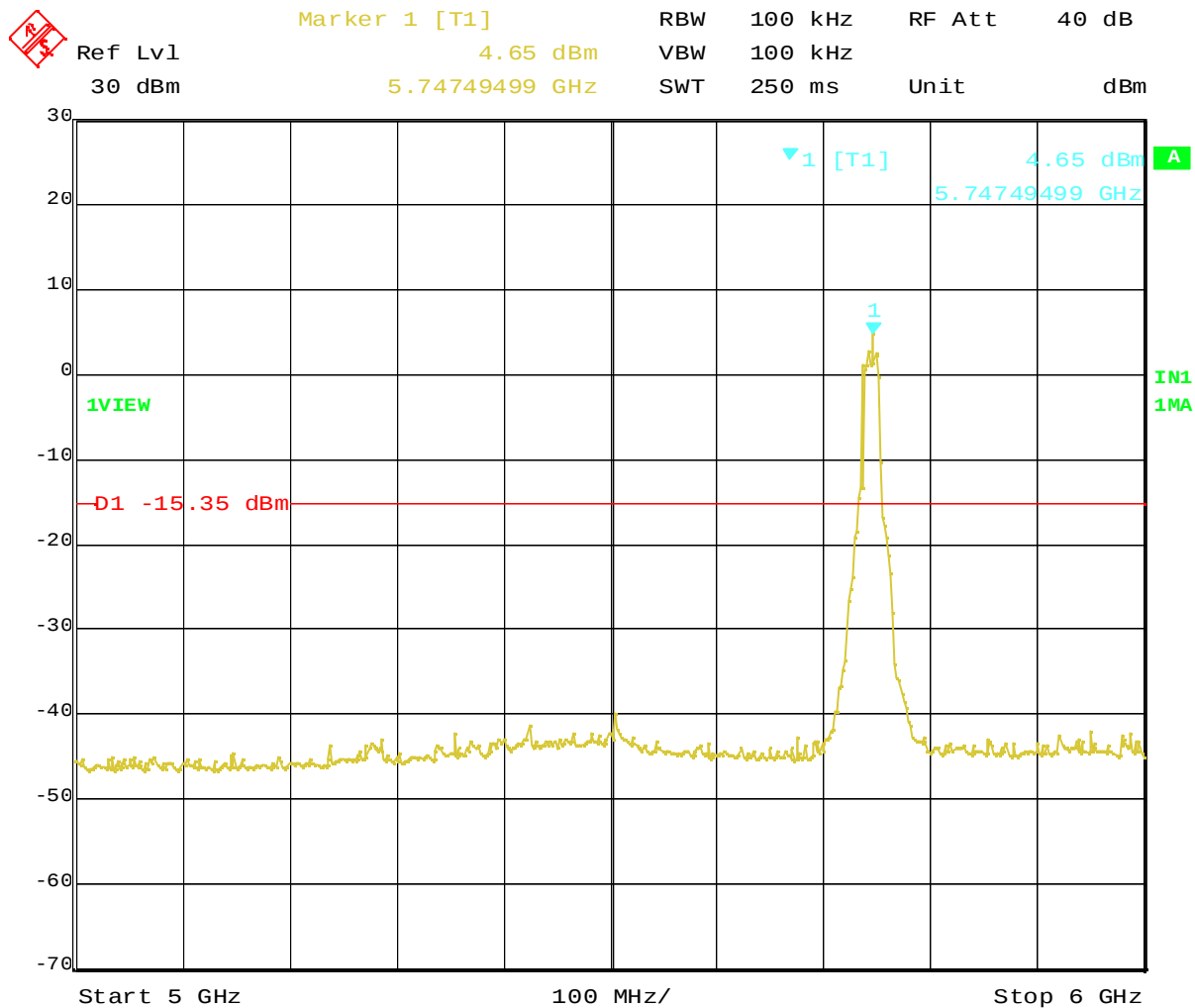


Date: 31.AUG.2004 17:12:16

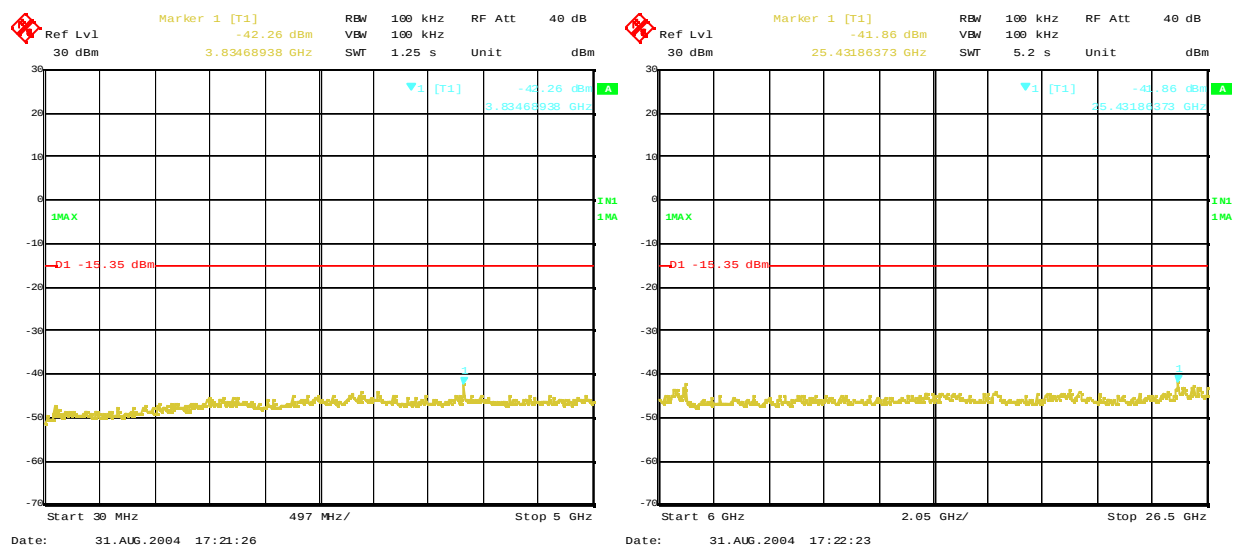


Date: 31.AUG.2004 17:13:13

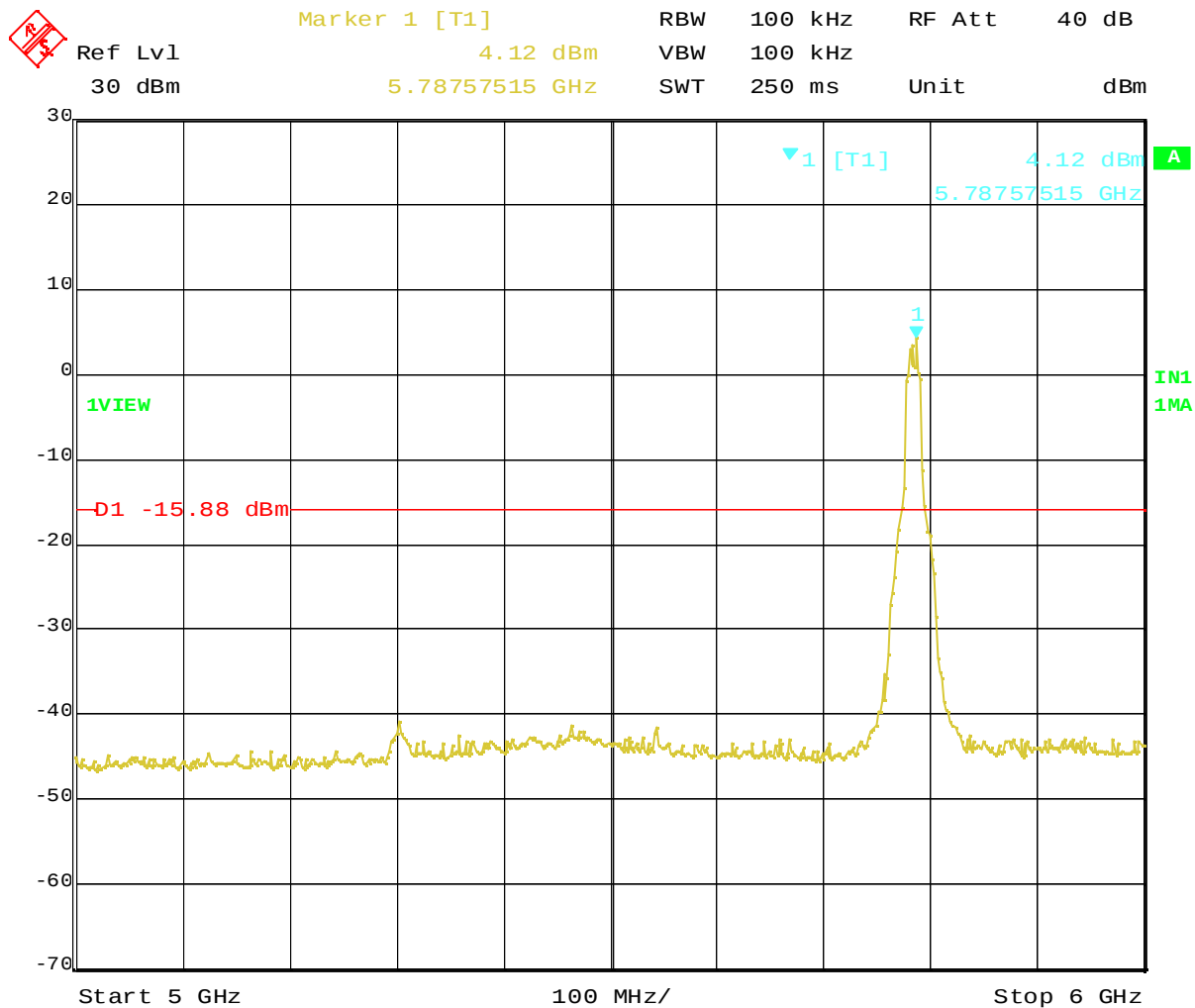
Plot 4-6. Out of band emissions around 2462MHz (OFDM, 6Mbps)



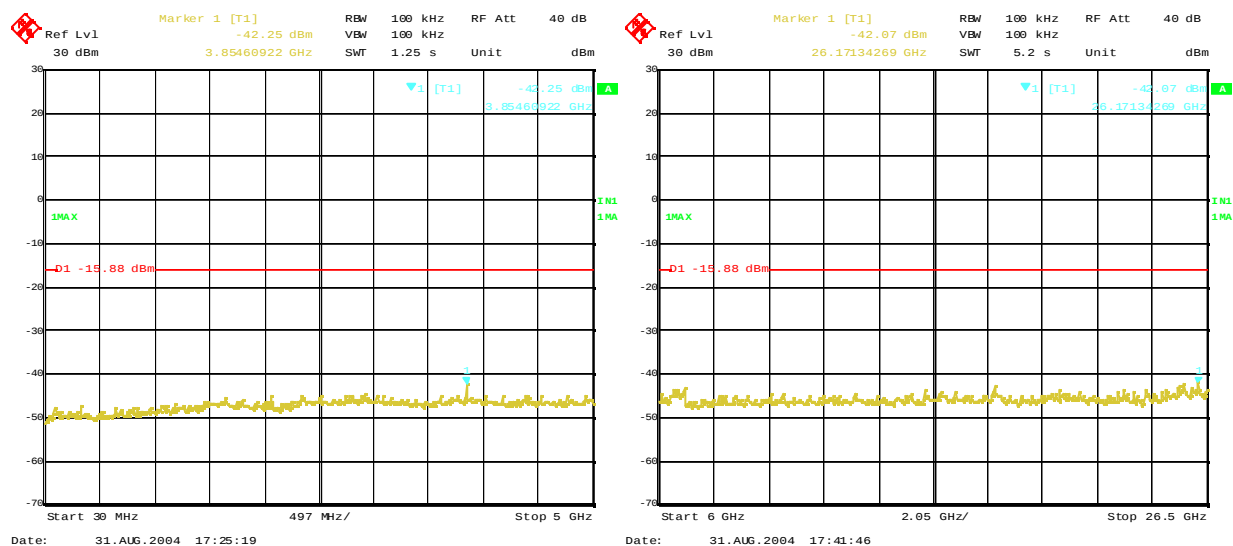
Date: 31.AUG.2004 17:19:30



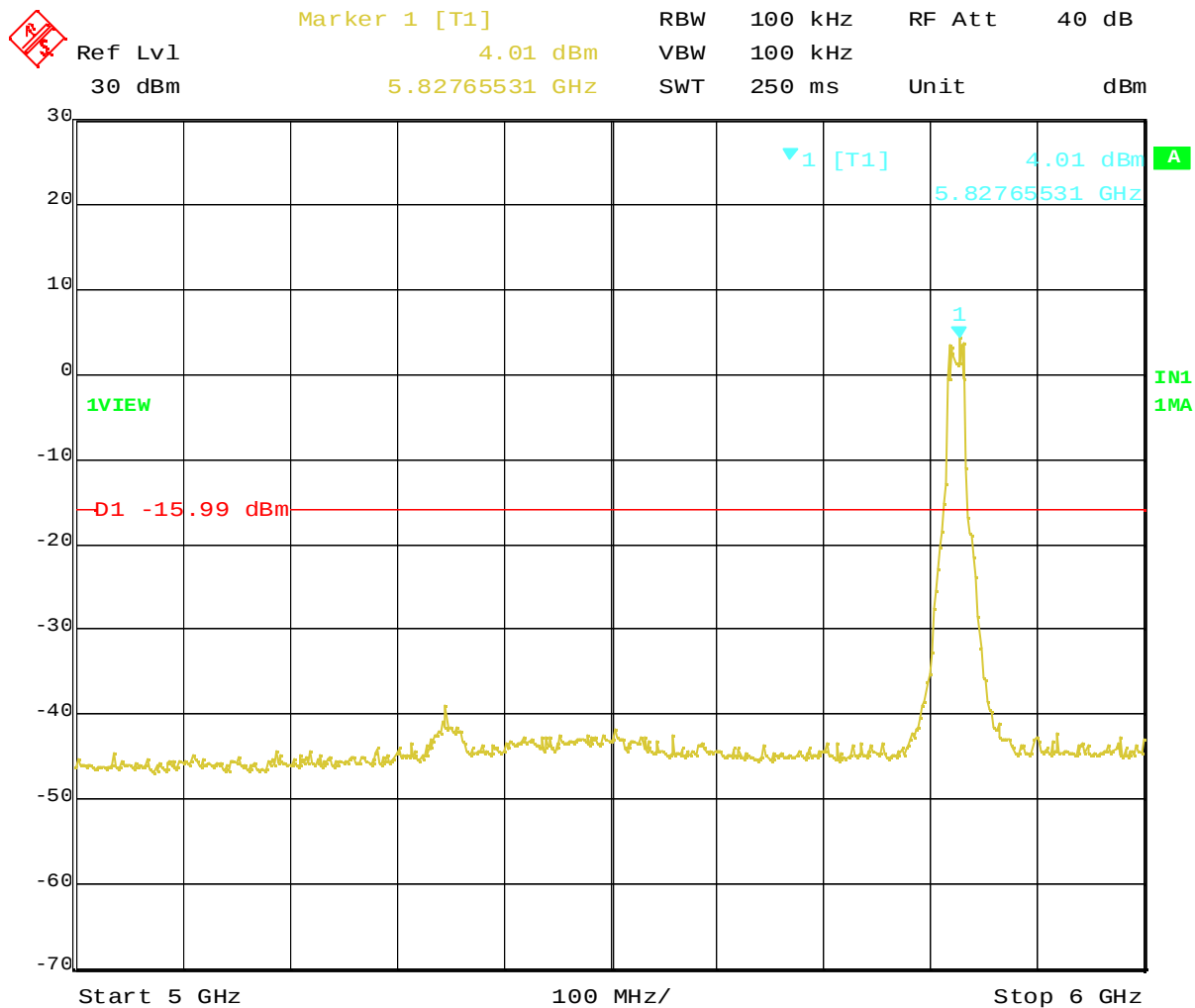
Plot 4-7. Out of band emissions around 5745MHz (OFDM, 6Mbps)



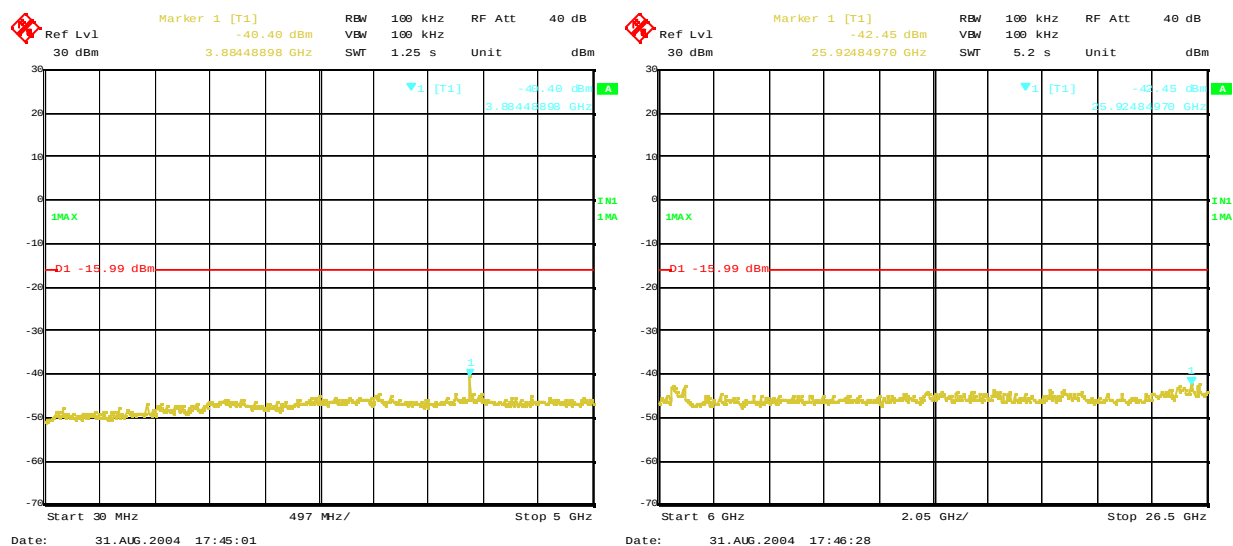
Date: 31.AUG.2004 17:24:29



Plot 4-8. Out of band emissions around 5785MHz (OFDM, 6Mbps)



Date: 31.AUG.2004 17:44:10



Plot 4-9. Out of band emissions around 5825MHz (OFDM, 6Mbps)

5. Peak Power Spectral Density

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

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

5.2 Test Instruments and Measurement Setup

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

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 3, “Conducted Peak Output Power” measurement.

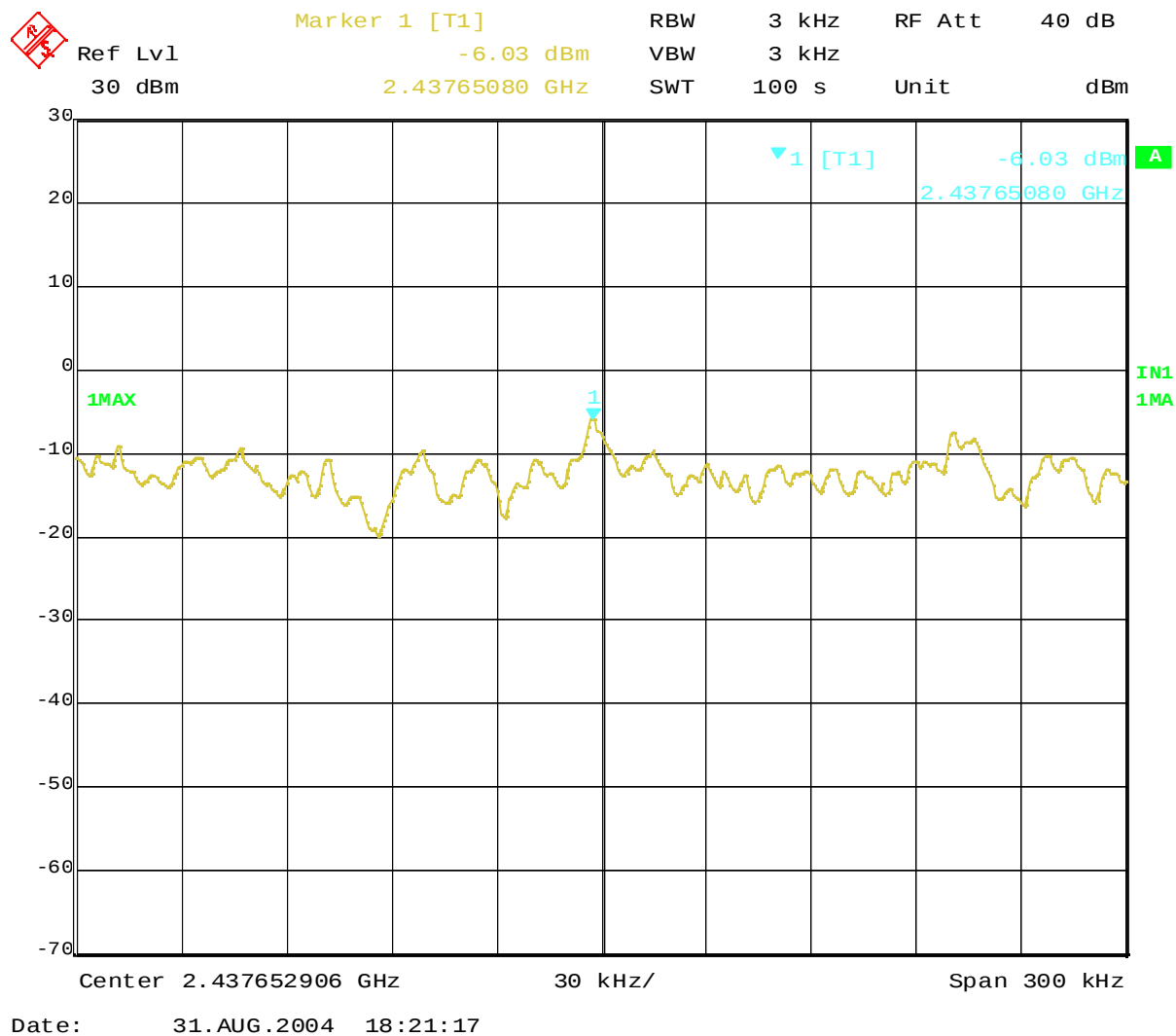
Test Date: August 31, 2004

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

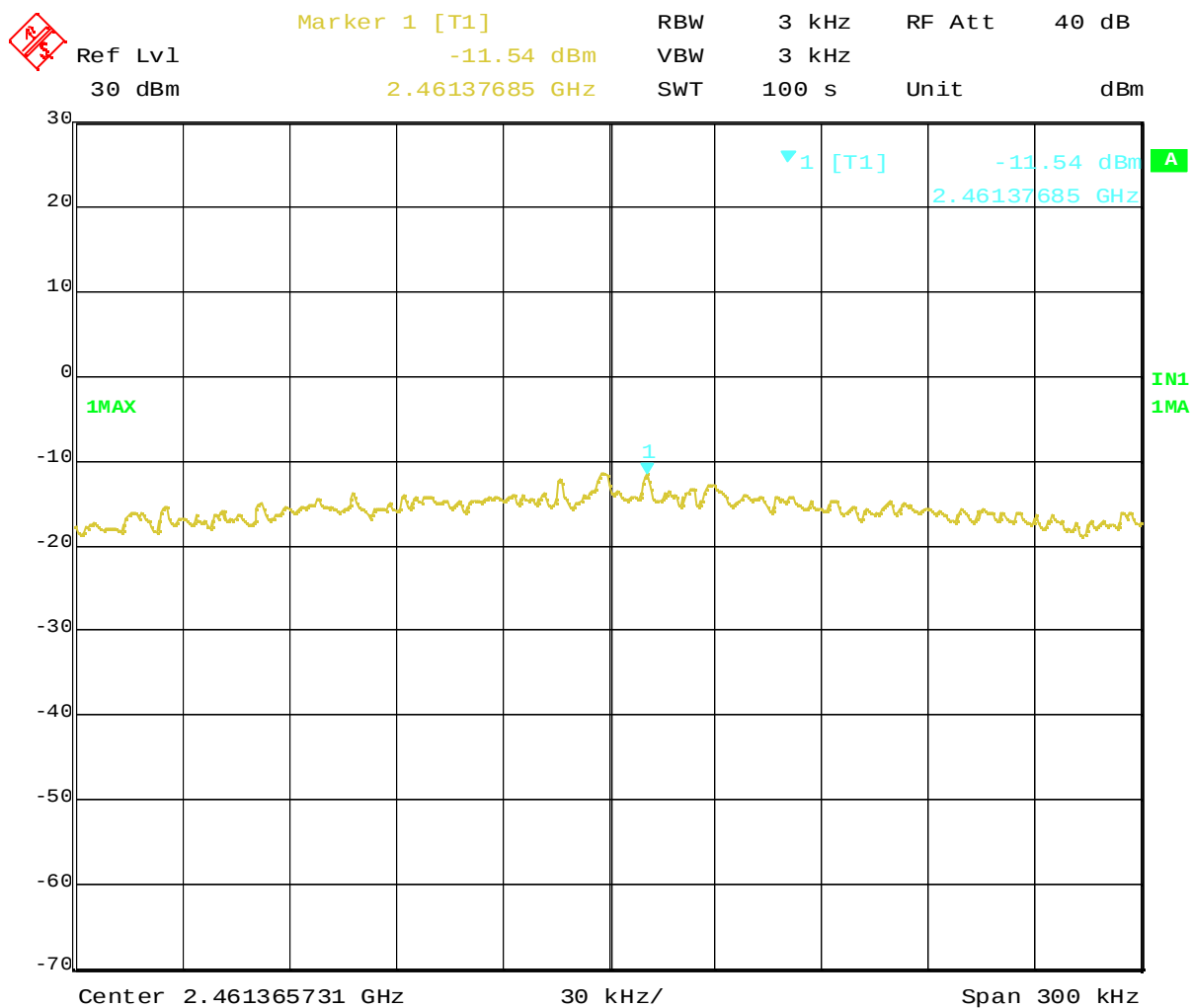
Ch No.			Frequency (MHz)	Analyzer Reading (dBm)	Trace number	Cable loss (dB)	Result (dBm)	Limit (dBm)	Margin (dB)
DSSS	2.4GHz 11Mbps	1	2412.65	-6.74	omitted	1.3	- 5.4	8.0	13.4
		6	2437.65	-6.03	Plot 5-1	1.3	- 4.7	8.0	12.7
		11	2462.65	-6.36	omitted	1.3	- 5.1	8.0	13.1
OFDM	2.4GHz 6Mbps	1	2410.72	-11.74	omitted	1.3	-10.4	8.0	18.4
		6	2436.37	-12.91	omitted	1.3	-11.6	8.0	19.6
		11	2461.38	-11.54	Plot 5-2	1.3	-10.2	8.0	18.2
	5.8GHz 6Mbps	149	5745.29	-10.84	omitted	2.3	- 8.5	8.0	16.5
		157	5783.73	-10.02	Plot 5-3	2.3	- 7.7	8.0	15.7
		165	5824.35	-10.70	omitted	2.3	- 8.4	8.0	16.4

5.4 Trace Data of Peak Power Spectral Density

The plots are comparatively worse measurement cases of each transmission mode in the previous [Table 5-1](#).

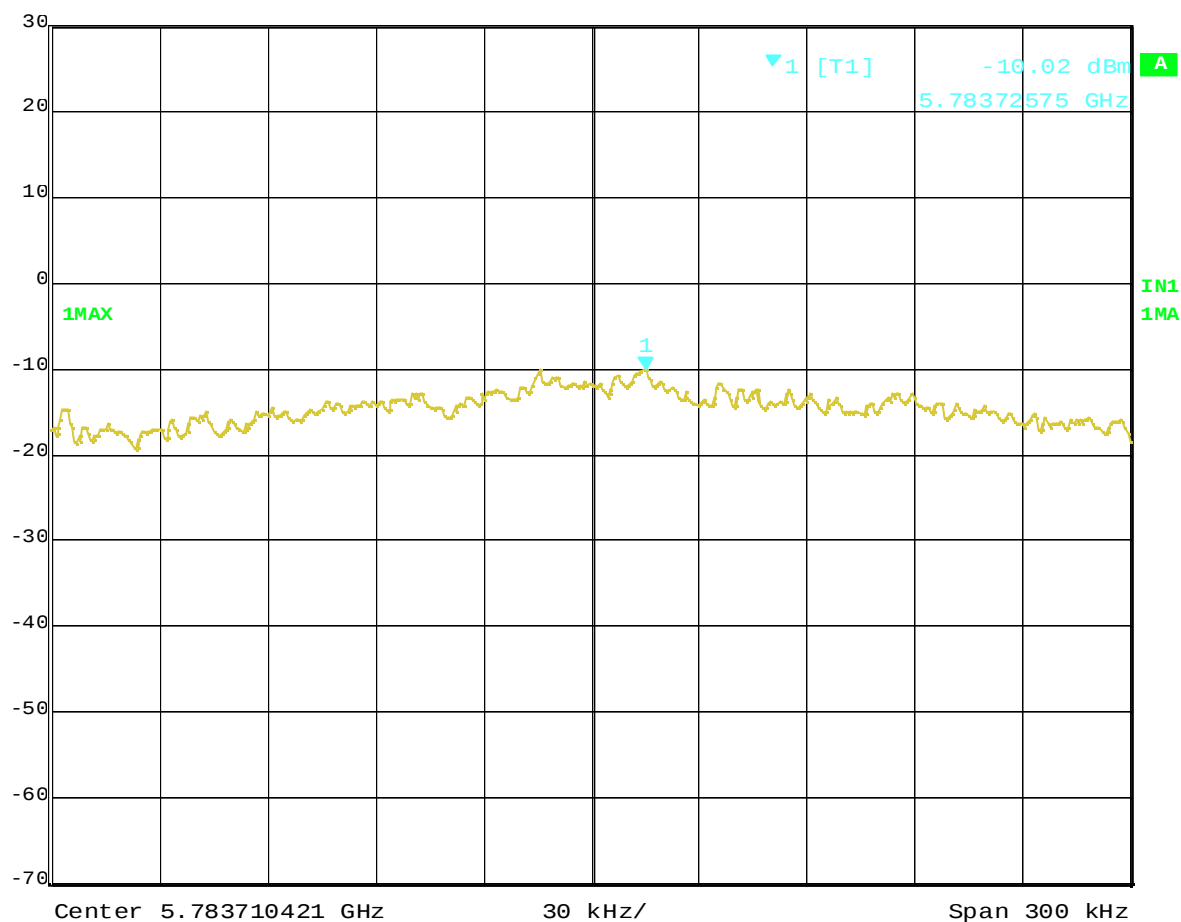


Plot 5-1. Peak Power Spectral Density of 2437MHz (DSSS, 11Mbps)



Date: 31.AUG.2004 19:08:44

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

Ref Lvl
30 dBmMarker 1 [T1]
-10.02 dBm
5.78372575 GHzRBW 3 kHz RF Att 40 dB
VBW 3 kHz
SWT 100 s Unit dBm

Date: 31.AUG.2004 19:21:42

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

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

[FCC 15.207, RSS-210 6.6 / 7.4]

6.1 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.

6.2 Test Instruments and Measurement Setup

Table 6-1. 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

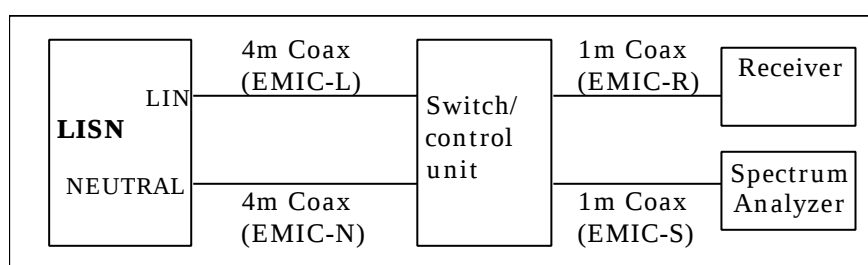


Figure 6. Cables for Conducted Emission Test

6.3 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.

$$PV = R + \text{CORR}$$

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:

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

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

6.4 Measurement Results

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 11.3dB. The 6 highest emissions relative to the limits are reported.

Test Date: September 7 and 8, 2004

6.3.1 EUT in 2.4GHz DSSS transmission mode (ThinkPad T40 Series, LCD 14" model)

Table 6-2-1. Ch.1 (2412MHz) **TX** mode 11Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2066	49.0	0.5	49.5	37.6	0.5	38.1	63.3	53.3	Neutral
0.2758	40.4	0.6	41.0	32.8	0.6	33.4	60.9	50.9	Line
0.3445	37.5	0.6	38.1	32.8	0.6	33.4	59.1	49.1	Line
0.4135	38.1	0.6	38.7	33.9	0.6	34.5	57.6	47.6	Line
0.4788	33.7	0.6	34.3	28.0	0.6	28.6	56.4	46.4	Line
0.6164	29.1	0.6	29.7	24.6	0.6	25.2	56.0	46.0	Line

Table 6-2-2. Ch.6 (2437MHz) **TX** mode 11Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2044	48.7	0.5	49.2	37.6	0.5	38.1	63.4	53.4	Neutral
0.2758	39.9	0.6	40.5	32.6	0.6	33.2	60.9	50.9	Line
0.3445	37.0	0.6	37.6	32.9	0.6	33.5	59.1	49.1	Line
0.4147	36.1	0.6	36.7	32.6	0.6	33.2	57.6	47.6	Line
0.4795	32.3	0.6	32.9	25.9	0.6	26.5	56.3	46.3	Neutral
0.5470	29.9	0.6	30.5	24.7	0.6	25.3	56.0	46.0	Line

Table 6-2-3. Ch.11 (2462MHz) **TX** mode 11Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2040	48.2	0.5	48.7	37.4	0.5	37.9	63.4	53.4	Neutral
0.2759	39.7	0.6	40.3	32.7	0.6	33.3	60.9	50.9	Line
0.3439	37.5	0.6	38.1	33.3	0.6	33.9	59.1	49.1	Line
0.4142	36.7	0.6	37.3	33.7	0.6	34.3	57.6	47.6	Line
0.4782	32.6	0.6	33.2	25.6	0.6	26.2	56.4	46.4	Line
0.5485	30.4	0.6	31.0	25.2	0.6	25.8	56.0	46.0	Line

Table 6-2-4. Ch. 6 (2437MHz) **RX** mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2070	47.5	0.5	48.0	36.4	0.5	36.9	63.3	53.3	Neutral
0.2772	38.2	0.6	38.8	31.1	0.6	31.7	60.9	50.9	Line
0.3439	37.5	0.6	38.1	33.5	0.6	34.1	59.1	49.1	Line
0.4147	37.2	0.6	37.8	32.5	0.6	33.1	57.6	47.6	Line
0.4784	32.8	0.6	33.4	28.1	0.6	28.7	56.4	46.4	Neutral
0.5485	30.1	0.6	30.7	26.1	0.6	26.7	56.0	46.0	Line

6.3.2 EUT in 2.4GHz OFDM transmission mode (ThinkPad T40 Series, LCD 14" model)Table 6-2-5. Ch.1 (2412MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2077	47.3	0.5	47.8	36.3	0.5	36.8	63.3	53.3	Neutral
0.2752	39.9	0.6	40.5	32.8	0.6	33.4	61.0	51.0	Line
0.3411	37.1	0.6	37.7	33.2	0.6	33.8	59.2	49.2	Line
0.4140	38.0	0.6	38.6	34.5	0.6	35.1	57.6	47.6	Line
0.4793	32.9	0.6	33.5	26.5	0.6	27.1	56.4	46.4	Line
0.5498	30.0	0.6	30.6	25.1	0.6	25.7	56.0	46.0	Line

Table 6-2-6. Ch.6 (2437MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2073	47.5	0.5	48.0	36.7	0.5	37.2	63.3	53.3	Neutral
0.2765	39.0	0.6	39.6	32.2	0.6	32.8	60.9	50.9	Line
0.3451	37.0	0.6	37.6	33.2	0.6	33.8	59.1	49.1	Neutral
0.4118	39.1	0.6	39.7	35.7	0.6	36.3	57.6	47.6	Line
0.4807	33.2	0.6	33.8	26.6	0.6	27.2	56.3	46.3	Line
0.6202	28.3	0.6	28.9	25.8	0.6	26.4	56.0	46.0	Line

Table 6-2-7. Ch.11 (2462MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2056	48.1	0.5	48.6	37.1	0.5	37.6	63.4	53.4	Neutral
0.2757	39.2	0.6	39.8	32.5	0.6	33.1	60.9	50.9	Line
0.3458	36.5	0.6	37.1	32.5	0.6	33.1	59.1	49.1	Neutral
0.4134	38.9	0.6	39.5	35.4	0.6	36.0	57.6	47.6	Line
0.4803	32.3	0.6	32.9	25.8	0.6	26.4	56.3	46.3	Line
0.5474	29.1	0.6	29.7	24.2	0.6	24.8	56.0	46.0	Line

Table 6-2-8. Ch.6 (2437MHz) **RX** mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2081	46.8	0.5	47.3	35.9	0.5	36.4	63.3	53.3	Neutral
0.2762	40.1	0.6	40.7	32.2	0.6	32.8	60.9	50.9	Neutral
0.3409	36.8	0.6	37.4	33.0	0.6	33.6	59.2	49.2	Line
0.4147	37.7	0.6	38.3	33.2	0.6	33.8	57.6	47.6	Line
0.4818	33.8	0.6	34.4	28.7	0.6	29.3	56.3	46.3	Line
0.5517	29.7	0.6	30.3	25.6	0.6	26.2	56.0	46.0	Line

6.3.3 EUT in 5.8GHz OFDM transmission mode (ThinkPad R50 Series, LCD 15" model)Table 6-2-9. Ch.1 (5745MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2056	48.8	0.5	49.3	37.7	0.5	38.2	63.4	53.4	Neutral
0.2781	38.6	0.6	39.2	30.0	0.6	30.6	60.9	50.9	Neutral
0.3447	37.0	0.6	37.6	32.7	0.6	33.3	59.1	49.1	Line
0.4114	37.3	0.6	37.9	34.6	0.6	35.2	57.6	47.6	Line
0.4800	30.6	0.6	31.2	27.2	0.6	27.8	56.3	46.3	Neutral
0.5477	29.9	0.6	30.5	25.0	0.6	25.6	56.0	46.0	Line

Table 6-2-10. Ch.6 (5785MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2068	47.9	0.5	48.4	37.1	0.5	37.6	63.3	53.3	Neutral
0.2781	37.5	0.6	38.1	30.1	0.6	30.7	60.9	50.9	Line
0.3415	37.1	0.6	37.7	33.1	0.6	33.7	59.2	49.2	Neutral
0.4125	37.5	0.6	38.1	34.6	0.6	35.2	57.6	47.6	Line
0.4803	30.5	0.6	31.1	25.1	0.6	25.7	56.3	46.3	Neutral
0.5480	30.4	0.6	31.0	25.2	0.6	25.8	56.0	46.0	Line

Table 6-2-11. Ch.11 (5825MHz) **TX** mode 6Mbps

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2080	47.2	0.5	47.7	36.4	0.5	36.9	63.3	53.3	Neutral
0.2779	37.7	0.6	38.3	30.5	0.6	31.1	60.9	50.9	Line
0.3449	36.8	0.6	37.4	33.2	0.6	33.8	59.1	49.1	Line
0.4128	37.7	0.6	38.3	35.0	0.6	35.6	57.6	47.6	Line
0.4811	29.5	0.6	30.1	26.0	0.6	26.6	56.3	46.3	Neutral
0.5484	29.8	0.6	30.4	24.8	0.6	25.4	56.0	46.0	Line

Table 6-2-12. Ch.6 (5875MHz) **RX** mode

Frequency (MHz)	QP			AV			CISPR22 QP Limit (dBμV)	CISPR22 AV Limit (dBμV)	Phase
	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)	Measured Reading (dBμV)	Corr. Factor (dB)	Powerline Voltage (dBμV)			
0.2101	43.3	0.5	43.8	32.7	0.5	33.2	63.2	53.2	Neutral
0.2761	39.4	0.6	40.0	32.4	0.6	33.0	60.9	50.9	Line
0.3411	36.9	0.6	37.5	33.0	0.6	33.6	59.2	49.2	Line
0.4133	36.4	0.6	37.0	33.3	0.6	33.9	57.6	47.6	Line
0.4789	33.6	0.6	34.2	28.4	0.6	29.0	56.4	46.4	Line
0.5465	28.9	0.6	29.5	25.2	0.6	25.8	56.0	46.0	Line

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

[FCC 15.205 / 209, RSS-210 6.3 / 7.3]

7.1 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.

7.2 Test Instruments and Measurement Setup

Table 7-1 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

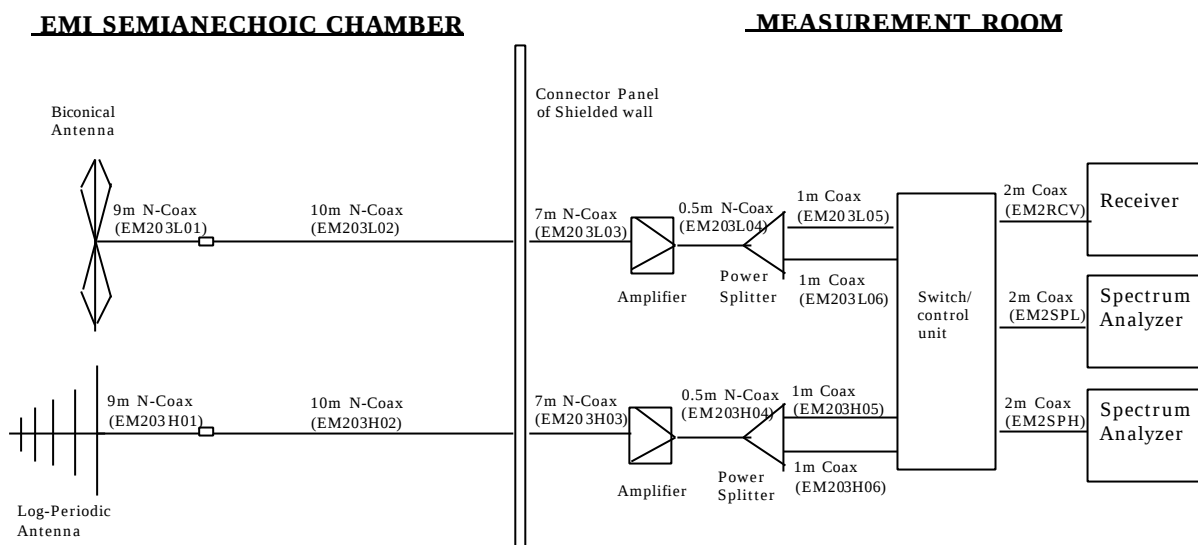


Figure 7 Cables for Radiated Emission Test

7.3 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 λ 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:

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

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

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

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

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

7.4 Measurement Results of the applying device

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 2.4dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: September 7 and 8, 2004

7.4.1 EUT in 2.4GHz DSSS transmission mode (ThinkPad T40 Series, LCD 14" model)

Table 7-2-1. Ch.1 (2412MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
195.800	H	39.1	13.6	-26.6	26.1	43.5	20.2	150
255.940	H	42.5	11.9	-24.0	30.4	46.0	33.1	200
400.504	V	49.5	15.3	-22.4	42.4	46.0	131.8	200
599.524	H	33.8	18.7	-19.8	32.7	46.0	43.2	200
756.008	V	31.5	21.0	-18.6	33.9	46.0	49.5	200
801.008	V	37.8	21.2	-18.5	40.5	46.0	105.9	200

Table 7-2-2. Ch.6 (2437MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	44.9	13.6	-26.7	31.8	43.5	38.9	150
255.941	H	42.5	11.9	-24.0	30.4	46.0	33.1	200
400.504	V	49.1	15.3	-22.4	42.0	46.0	125.9	200
599.529	V	31.6	18.7	-19.8	30.5	46.0	33.5	200
756.008	V	31.3	21.0	-18.6	33.7	46.0	48.4	200
801.008	V	37.5	21.2	-18.5	40.2	46.0	102.3	200

Table 7-2-3. Ch.11 (2462MHz) **TX** mode 11Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
38.549	V	42.0	12.1	-29.1	25.0	40.0	17.8	100
196.605	H	44.8	13.6	-26.7	31.7	43.5	38.5	150
400.505	V	49.7	15.3	-22.4	42.6	46.0	134.9	200
599.529	H	34.1	18.7	-19.8	33.0	46.0	44.7	200
756.007	V	31.5	21.0	-18.6	33.9	46.0	49.5	200
801.008	V	37.5	21.2	-18.5	40.2	46.0	102.3	200

Table 7-2-4. Ch.6 (2437MHz) **RX** mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.604	H	45.1	13.6	-26.7	32.0	43.5	39.8	150
257.066	V	45.1	12.0	-24.1	33.0	46.0	44.7	200
400.505	H	46.5	15.3	-22.4	39.4	46.0	93.3	200
600.756	V	38.0	18.7	-19.8	36.9	46.0	70.0	200
756.007	V	31.6	21.0	-18.6	34.0	46.0	50.1	200
801.009	V	37.1	21.2	-18.5	39.8	46.0	97.7	200

7.4.2 EUT in 2.4GHz OFDM transmission mode (ThinkPad T40 Series, LCD 14" model)Table 7-2-5. Ch.1 (2412MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	44.3	13.6	-26.7	31.2	43.5	36.3	150
255.940	V	42.1	11.9	-24.0	30.0	46.0	31.6	200
400.505	H	46.3	15.3	-22.4	39.2	46.0	91.2	200
600.757	V	37.9	18.7	-19.8	36.8	46.0	69.2	200
756.009	V	31.5	21.0	-18.6	33.9	46.0	49.5	200
801.008	V	37.2	21.2	-18.5	39.9	46.0	98.9	200

Table 7-2-6. Ch.6 (2437MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	43.9	13.6	-26.7	30.8	43.5	34.7	150
257.066	H	44.4	12.0	-24.1	32.3	46.0	41.2	200
400.504	H	46.3	15.3	-22.4	39.2	46.0	91.2	200
600.756	V	37.8	18.7	-19.8	36.7	46.0	68.4	200
756.008	V	31.6	21.0	-18.6	34.0	46.0	50.1	200
801.009	V	37.2	21.2	-18.5	39.9	46.0	98.9	200

Table 7-2-7. Ch.11 (2462MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	43.4	13.6	-26.7	30.3	43.5	32.7	150
213.190	H	41.5	10.8	-24.6	27.7	43.5	24.3	150
400.504	V	49.7	15.3	-22.4	42.6	46.0	134.9	200
599.529	H	34.0	18.7	-19.8	32.9	46.0	44.2	200
756.009	V	31.6	21.0	-18.6	34.0	46.0	50.1	200
801.008	V	36.9	21.2	-18.5	39.6	46.0	95.5	200

Table 7-2-8. Ch.6 (2437MHz) **RX** mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
196.605	H	43.6	13.6	-26.7	30.5	43.5	33.5	150
257.065	H	44.4	12.0	-24.1	32.3	46.0	41.2	200
400.505	H	46.5	15.3	-22.4	39.4	46.0	93.3	200
599.525	H	33.8	18.7	-19.8	32.7	46.0	43.2	200
756.008	V	31.7	21.0	-18.6	34.1	46.0	50.7	200
801.009	V	37.3	21.2	-18.5	40.0	46.0	100.0	200

7.4.3 EUT in 5.8GHz OFDM transmission mode (ThinkPad R50 Series, LCD 15" model)Table 7-2-9. Ch.1 (5745MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
57.811	V	45.9	9.5	-28.8	26.6	40.0	21.4	100
156.345	V	43.7	12.4	-27.1	29.0	43.5	28.2	150
195.801	H	44.4	13.6	-26.6	31.4	43.5	37.2	150
364.507	H	43.4	14.4	-22.3	35.5	46.0	59.6	200
729.014	H	36.2	21.1	-19.0	38.3	46.0	82.2	200
911.267	V	29.4	22.8	-17.2	35.0	46.0	56.2	200

Table 7-2-10. Ch.6 (5785MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
155.680	H	47.0	12.4	-27.1	32.3	43.5	41.2	150
195.800	H	46.0	13.6	-26.6	33.0	43.5	44.7	150
364.507	H	47.2	14.4	-22.3	39.3	46.0	92.3	200
431.408	V	35.8	15.8	-21.5	30.1	46.0	32.0	200
729.014	H	41.5	21.1	-19.0	43.6	46.0	151.4	200
911.268	V	30.4	22.8	-17.2	36.0	46.0	63.1	200

Table 7-2-11. Ch.11 (5825MHz) **TX** mode 6Mbps

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
195.801	H	48.3	13.6	-26.6	35.3	43.5	58.2	150
333.596	H	40.3	14.2	-23.1	31.4	46.0	37.2	200
364.507	V	46.8	14.4	-22.3	38.9	46.0	88.1	200
400.315	H	44.3	15.3	-22.4	37.2	46.0	72.4	200
729.014	V	36.4	21.1	-19.0	38.5	46.0	84.1	200
911.267	V	32.7	22.8	-17.2	38.3	46.0	82.2	200

Table 7-2-12. Ch.6 (5875MHz) **RX** mode

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Field Strength (μV/m)	Limit (μV/m)
195.801	H	46.3	13.6	-26.6	33.3	43.5	46.2	150
364.507	V	47.0	14.4	-22.3	39.1	46.0	90.2	200
386.587	V	42.4	14.9	-22.5	34.8	46.0	55.0	200
400.316	H	43.5	15.3	-22.4	36.4	46.0	66.1	200
729.014	V	36.6	21.1	-19.0	38.7	46.0	86.1	200
911.268	V	32.0	22.8	-17.2	37.6	46.0	75.9	200

7.5 Measurement Results with co-located Bluetooth device

The test was performed with the representative worse cases in the previous Table 7-2-1 through Table 7-2-12 while both the applying WLAN transmitter and the co-located Bluetooth transmitter (FCC ID: ANO20020100 MTN) were active and emitted radio frequencies simultaneously.

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 3.4dB at 30MHz - 1000MHz band.

The 6 highest emissions relative to the limits are reported.

Test Date: October 4, 2004

Table 7-2-13. Ch.11 (2462MHz) DSSS mode 11Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad T40 Series, LCD 14" model

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)
199.158	V	43.8	13.7	-26.6	30.9	43.5	12.6	35.1	150
257.065	H	44.5	12.0	-24.1	32.4	46.0	13.6	41.7	200
400.507	V	49.2	15.3	-22.4	42.1	46.0	3.9	127.4	200
511.694	V	31.6	18.7	-20.5	29.8	46.0	16.2	30.9	200
701.580	V	29.3	21.0	-19.0	31.3	46.0	14.7	36.7	200
801.009	V	33.4	21.2	-18.5	36.1	46.0	9.9	63.8	200

Table 7-2-14. Ch.11 (2462MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad T40 Series, LCD 14" model

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)
200.451	H	45.2	11.4	-25.1	31.5	43.5	12.0	37.6	150
257.065	V	42.3	12.0	-24.1	30.2	46.0	15.8	32.4	200
400.507	V	48.6	15.3	-22.4	41.5	46.0	4.5	118.9	200
428.442	V	33.2	15.8	-21.4	27.6	46.0	18.4	24.0	200
695.191	V	25.8	21.0	-19.1	27.7	46.0	18.3	24.3	200
801.008	V	34.5	21.2	-18.5	37.2	46.0	8.8	72.4	200

Table 7-2-15. Ch.6 (5785MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad R50 Series, LCD 15" model

Frequency (MHz)	Polarity (H/V)	Measured (dBμV)	Antenna Factor (dB/m)	Corr. Factor (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin to limit (dB)	Field Strength (μV/m)	Limit (μV/m)
143.180	V	45.2	12.2	-27.3	30.1	43.5	13.4	32.0	150
203.453	H	49.1	11.3	-24.8	35.6	43.5	7.9	60.3	150
364.507	V	42.5	14.4	-22.3	34.6	46.0	11.4	53.7	200
386.587	V	42.7	14.9	-22.5	35.1	46.0	10.9	56.9	200
729.014	H	40.5	21.1	-19.0	42.6	46.0	3.4	134.9	200
911.268	V	26.5	22.8	-17.2	32.1	46.0	13.9	40.3	200

8. Restricted Bands Radiatio (1GHz – 40GHz)

[FCC 15.205 / 209, RSS-210 6.3 / 7.3]

8.1 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.

8.2 Test Instruments and Measurement Setup

Table 8 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:	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

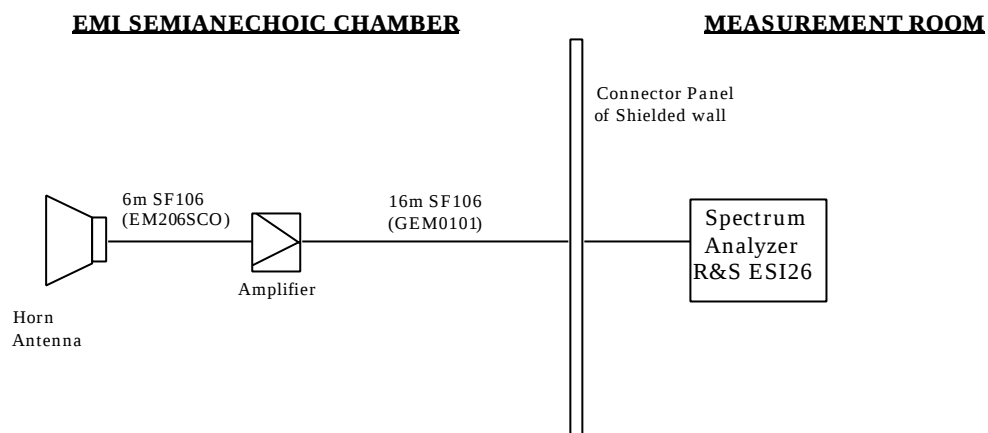


Figure 8-1. Cables for Radiated Emission Test (1 – 12.4 GHz)

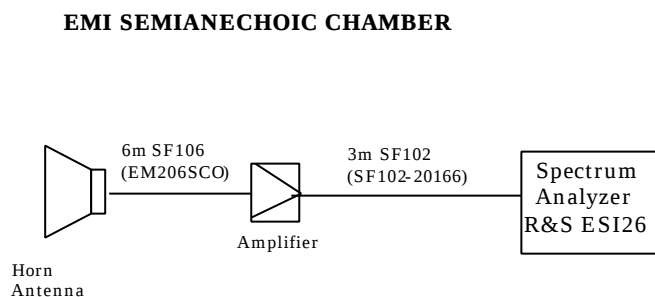


Figure 8-2. Cables for Radiated Emission Test (12.4 - 18GHz)

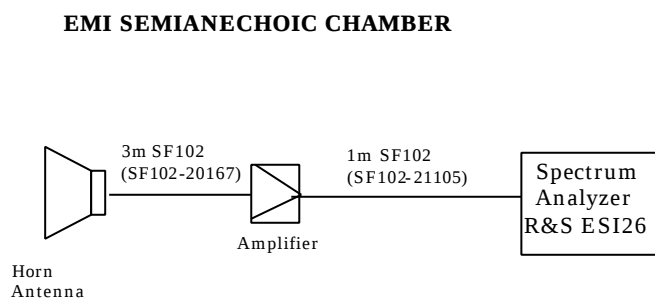


Figure 8-3. Cables for Radiated Emission Test (18 – 26.5GHz)

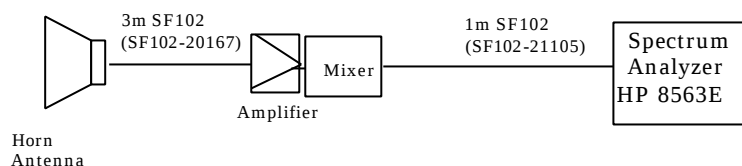
EMI SEMIANECHOIC CHAMBER

Figure 8-4. Cables for Radiated Emission Test (26.5 - 40GHz)

8.3 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 :

$$\begin{aligned}
 \text{Level(dB}\mu\text{V/m)} &= 20 \% \text{ Log (Level(}\mu\text{V/m))} \\
 40 \text{ dB}\mu\text{V/m} &= 100 \mu\text{V/m} \\
 48 \text{ dB}\mu\text{V/m} &= 250 \mu\text{V/m}
 \end{aligned}$$

8.4 Measurement Results of the applying device

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 1.9 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: September 1, 2, 3 and 6, 2004

8.4.1 EUT in 2.4GHz DSSS transmission mode (ThinkPad T40 Series, LCD 14" model)

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

Table 8-2-1. Ch.1 (2412MHz) **TX** mode 11Mbps

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
Inband 2.412	H	114.4	106.0	28.3	-29.1	0.0	113.6	OB*	105.2	OB*
Adjacent RB 2.387	H	58.0	47.6	28.2	-29.2	0.0	57.0	74.0	46.6	54.0
2.389	H	58.4	46.3	28.2	-29.2	0.0	57.4	74.0	45.3	54.0
2.390	H	57.9	45.7	28.2	-29.2	0.0	56.9	74.0	44.7	54.0
1.000	V	55.1	-	24.1	-31.9	0.0	47.3	74.0	-	54.0
1.163	V	48.5	-	24.6	-31.3	0.0	41.8	74.0	-	54.0
1.202	V	50.7	-	25.2	-31.3	0.0	44.6	74.0	-	54.0
1.325	V	53.9	-	25.6	-31.0	0.0	48.5	74.0	-	54.0
2.311	H	52.1	-	28.0	-29.3	0.0	50.8	74.0	-	54.0
2.361	H	51.3	-	28.1	-29.2	0.0	50.2	74.0	-	54.0
2.373	H	52.2	-	28.2	-29.2	0.0	51.2	74.0	-	54.0
4.834	H	38.7	-	27.0	-26.5	0.0	39.2	74.0	-	54.0

Table 8-2-2. Ch.6 (2437MHz) **TX** mode 11Mbps

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
Inband 2.437	H	114.9	106.6	28.4	-29.2	0.0	114.1	OB*	105.8	OB*
Adjacent RB 2.389	H	55.0	41.9	28.2	-29.2	0.0	54.0	74.0	40.9	54.0
2.484	H	55.1	40.7	28.4	-29.1	0.0	54.4	74.0	40.0	54.0
1.000	V	50.0	-	24.1	-31.9	0.0	42.2	74.0	-	54.0
1.166	V	55.2	-	24.6	-31.3	0.0	48.5	74.0	-	54.0
1.202	V	50.9	-	25.2	-31.3	0.0	44.8	74.0	-	54.0
1.328	V	52.9	-	25.6	-31.0	0.0	47.5	74.0	-	54.0
2.325	H	48.7	-	28.0	-29.3	0.0	47.4	74.0	-	54.0
2.336	H	53.8	-	28.1	-29.3	0.0	52.6	74.0	-	54.0
2.359	H	54.5	-	28.1	-29.2	0.0	53.4	74.0	-	54.0
2.386	H	52.0	-	28.2	-29.2	0.0	51.0	74.0	-	54.0
4.876	H	40.3	-	27.0	-26.6	0.0	40.7	74.0	-	54.0
7.314	H	39.3	-	29.8	-24.4	0.0	44.7	74.0	-	54.0

Table 8-2-3. Ch.11 (2462MHz) **TX** mode 11Mbps

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
Inband 2.462	H	113.9	105.5	28.4	-29.2	0.0	113.1	OB*	104.7	OB*
Adjacent RB 2.484	H	58.8	47.7	28.4	-29.1	0.0	58.1	74.0	47.0	54.0
2.488	H	60.3	49.6	28.4	-29.1	0.0	59.6	74.0	48.9	54.0
2.490	H	60.4	48.0	28.4	-29.1	0.0	59.7	74.0	47.3	54.0
1.000	V	50.1	-	24.1	-31.9	0.0	42.3	74.0	-	54.0
1.136	V	49.8	-	24.6	-31.4	0.0	43.0	74.0	-	54.0
1.202	V	51.2	-	25.2	-31.3	0.0	45.1	74.0	-	54.0
1.332	V	50.5	-	25.6	-31.0	0.0	45.1	74.0	-	54.0
2.344	H	50.3	-	28.1	-29.3	0.0	49.1	74.0	-	54.0
2.361	H	54.7	-	28.1	-29.2	0.0	53.6	74.0	-	54.0
2.371	H	51.3	-	28.2	-29.2	0.0	50.3	74.0	-	54.0
2.383	H	55.3	44.1	28.2	-29.2	0.0	54.3	74.0	43.1	54.0
4.926	V	46.8	-	27.0	-26.4	0.0	47.4	74.0	-	54.0
7.388	H	40.7	-	29.8	-24.5	0.0	46.0	74.0	-	54.0

Table 8-2-4. Ch.6 (2437MHz) **RX** mode

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
1.000	V	48.2	-	24.1	-31.9	0.0	40.4	74.0	-	54.0
1.136	V	50.1	-	24.6	-31.4	0.0	43.3	74.0	-	54.0
1.202	V	49.9	-	25.2	-31.3	0.0	43.8	74.0	-	54.0
1.324	V	53.9	-	25.6	-31.0	0.0	48.5	74.0	-	54.0

8.4.2 EUT in 2.4GHz OFDM transmission mode (ThinkPad T40 Series, LCD 14" model)

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

Table 8-2-5. Ch.1 (2412MHz) **TX** mode 6Mbps

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
Inband 2.407	H	113.1	102.1	28.3	-29.1	0.0	112.3	OB*	101.3	OB*
Adjacent RB 2.386	H	63.3	47.7	28.2	-29.2	0.0	62.3	74.0	46.7	54.0
2.389	H	69.6	50.8	28.2	-29.2	0.0	68.6	74.0	49.8	54.0
2.390	H	70.7	53.1	28.2	-29.2	0.0	69.7	74.0	52.1	54.0
1.000	V	48.2	-	24.1	-31.9	0.0	40.4	74.0	-	54.0
1.136	V	49.5	-	24.6	-31.4	0.0	42.7	74.0	-	54.0
1.202	V	50.3	-	25.2	-31.3	0.0	44.2	74.0	-	54.0
1.332	V	53.1	-	25.2	-30.9	0.0	47.4	74.0	-	54.0
2.313	H	52.6	-	28.0	-29.3	0.0	51.3	74.0	-	54.0
2.335	H	50.4	-	28.1	-29.3	0.0	49.2	74.0	-	54.0
2.383	H	61.0	43.3	28.2	-29.2	0.0	60.0	74.0	42.3	54.0
4.828	H	37.9	-	27.1	-26.6	0.0	38.4	74.0	-	54.0

Table 8-2-6. Ch.6 (2437MHz) **TX** mode 6Mbps

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) (<i>peak</i>)	FCC Limit (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	FCC Limit (dBμV/m) (<i>average</i>)
Inband 2.432	H	112.6	100.9	28.4	-29.2	0.0	111.8	OB*	100.1	OB*
Adjacent RB 2.390	H	54.8	-	28.2	-29.2	0.0	53.8	74.0	-	54.0
2.484	H	55.8	44.0	28.4	-29.1	0.0	55.1	74.0	43.3	54.0
2.485	H	57.6	44.1	28.4	-29.6	0.0	56.4	74.0	42.9	54.0
1.000	V	55.9	-	24.1	-31.9	0.0	48.1	74.0	-	54.0
1.136	V	51.2	-	24.6	-31.4	0.0	44.4	74.0	-	54.0
1.202	V	50.5	-	25.2	-31.3	0.0	44.4	74.0	-	54.0
1.327	V	54.4	-	25.6	-31.0	0.0	49.0	74.0	-	54.0
2.336	H	54.2	-	28.1	-29.3	0.0	53.0	74.0	-	54.0
2.364	H	52.7	-	28.1	-29.2	0.0	51.6	74.0	-	54.0
2.383	H	50.7	-	28.2	-29.2	0.0	49.7	74.0	-	54.0
2.390	H	52.7	-	28.2	-29.2	0.0	51.7	74.0	-	54.0
4.890	V	38.7	-	27.0	-26.6	0.0	39.1	74.0	-	54.0
7.314	V	37.5	-	29.8	-24.4	0.0	42.9	74.0	-	54.0

Table 8-2-7. Ch.11 (2462MHz) **TX** mode 6Mbps

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) (peak)	FCC Limit (dBμV/m) (peak)	Field Strength (dBμV/m) (average)	FCC Limit (dBμV/m) (average)
Inband 2.457	H	112.3	101.5	28.4	-29.2	0.0	111.5	OB*	100.7	OB*
Adjacent RB 2.484	H	66.5	50.1	28.4	-29.1	0.0	65.8	74.0	49.4	54.0
2.485	H	62.8	48.8	28.4	-29.1	0.0	62.1	74.0	48.1	54.0
2.487	H	62.3	48.6	28.4	-29.1	0.0	61.6	74.0	47.9	54.0
1.000	V	54.6	-	24.1	-31.9	0.0	46.8	74.0	-	54.0
1.129	V	49.1	-	24.5	-31.5	0.0	42.1	74.0	-	54.0
1.201	V	50.3	-	25.2	-31.3	0.0	44.2	74.0	-	54.0
1.327	V	53.7	-	25.6	-31.0	0.0	48.3	74.0	-	54.0
2.340	H	48.4	-	28.1	-29.3	0.0	47.2	74.0	-	54.0
2.360	H	54.2	-	28.1	-29.2	0.0	53.1	74.0	-	54.0
2.383	H	53.5	-	28.2	-29.2	0.0	52.5	74.0	-	54.0
2.386	H	53.1	-	28.2	-29.2	0.0	52.1	74.0	-	54.0
4.922	V	41.8	-	27.0	-26.4	0.0	42.4	74.0	-	54.0
7.393	H	39.5	-	29.8	-24.5	0.0	44.8	74.0	-	54.0

Table 8-2-8. Ch.6 (2437MHz) **RX** mode

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) (peak)	FCC Limit (dBμV/m) (peak)	Field Strength (dBμV/m) (average)	FCC Limit (dBμV/m) (average)
1.000	V	48.4	-	24.1	-31.9	0.0	40.6	74.0	-	54.0
1.133	V	49.1	-	24.6	-31.4	0.0	42.3	74.0	-	54.0
1.202	V	50.6	-	25.2	-31.3	0.0	44.5	74.0	-	54.0
1.324	V	50.7	-	25.6	-31.0	0.0	45.3	74.0	-	54.0

8.4.3 EUT in 5.8GHz OFDM transmission mode (ThinkPad R50 Series, LCD 15" model)

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

Table 8-2-9. Ch.149 (5745MHz) **TX** mode 6Mbps

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) (peak)	FCC Limit (dBμV/m) (peak)	Field Strength (dBμV/m) (average)	FCC Limit (dBμV/m) (average)
Inband 5.743	H	103.9	93.6	34.0	-25.6	0.0	112.3	OB*	102.0	OB*
1.000	V	48.4	-	24.1	-31.9	0.0	40.6	74.0	-	54.0
1.094	V	51.2	-	24.4	-31.5	0.0	44.1	74.0	-	54.0
1.140	V	50.8	-	24.6	-31.4	0.0	44.0	74.0	-	54.0
1.196	V	50.8	-	25.2	-31.3	0.0	44.7	74.0	-	54.0
5.395	H	50.3	38.6	33.9	-25.6	0.0	58.6	74.0	46.9	54.0
5.430	H	51.0	39.8	34.1	-25.6	0.0	59.5	74.0	48.3	54.0
7.663	H	43.9	-	30.0	-24.3	0.0	49.6	74.0	-	54.0
11.489	H	41.2	25.5	33.5	-20.2	0.0	54.5	74.0	38.8	54.0

Table 8-2-10 Ch.157 (5785MHz) **TX** mode 6Mbps

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) <i>(peak)</i>	FCC Limit (dBμV/m) <i>(peak)</i>	Field Strength (dBμV/m) <i>(average)</i>	FCC Limit (dBμV/m) <i>(average)</i>
Inband										
5.783	H	104.1	94.2	34.0	-25.5	0.0	112.6	OB*	102.7	OB*
1.000	V	48.2	-	24.1	-31.9	0.0	40.4	74.0	-	54.0
1.094	V	50.0	-	24.4	-31.5	0.0	42.9	74.0	-	54.0
1.132	V	47.4	-	24.6	-31.4	0.0	40.6	74.0	-	54.0
1.196	V	52.7	-	25.2	-31.3	0.0	46.6	74.0	-	54.0
5.416	H	51.4	39.3	34.1	-25.6	0.0	59.9	74.0	47.8	54.0
5.451	H	52.2	40.0	34.2	-25.7	0.0	60.7	74.0	48.5	54.0
7.715	H	43.4	-	30.0	-24.2	0.0	49.2	74.0	-	54.0
11.565	V	40.9	27.4	33.5	-19.7	0.0	54.7	74.0	41.2	54.0

Table 8-2-11 Ch.165 (5825MHz) **TX** mode 6Mbps

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) <i>(peak)</i>	FCC Limit (dBμV/m) <i>(peak)</i>	Field Strength (dBμV/m) <i>(average)</i>	FCC Limit (dBμV/m) <i>(average)</i>
Inband										
5.823	H	104.2	94.1	34.0	-25.6	0.0	112.6	OB*	102.5	OB*
1.000	V	49.2	-	24.1	-31.9	0.0	41.4	74.0	-	54.0
1.094	V	49.4	-	24.4	-31.5	0.0	42.3	74.0	-	54.0
1.132	V	48.8	-	24.6	-31.4	0.0	42.0	74.0	-	54.0
1.196	V	46.8	-	25.2	-31.3	0.0	40.7	74.0	-	54.0
5.353	H	53.7	40.4	33.9	-25.6	0.0	62.0	74.0	48.7	54.0
5.416	H	50.6	39.5	34.3	-25.6	0.0	59.3	74.0	48.2	54.0
5.451	H	50.4	40.0	34.2	-25.7	0.0	58.9	74.0	48.5	54.0
11.647	V	39.8	-	33.6	-20.0	0.0	53.4	74.0	-	54.0

Table 8-2-12 Ch.157 (5785MHz) **RX** mode

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) <i>(peak)</i>	FCC Limit (dBμV/m) <i>(peak)</i>	Field Strength (dBμV/m) <i>(average)</i>	FCC Limit (dBμV/m) <i>(average)</i>
1.000	V	49.3	-	24.1	-31.9	0.0	41.5	74.0	-	54.0
1.094	V	49.9	-	24.4	-31.5	0.0	42.8	74.0	-	54.0
1.300	V	47.0	-	24.6	-31.4	0.0	40.2	74.0	-	54.0
1.198	V	48.9	-	25.2	-31.3	0.0	42.8	74.0	-	54.0
7.715	V	40.8	-	30.0	-24.2	0.0	46.6	74.0	-	54.0

8.5 Measurement Results with co-located Bluetooth device

The test was performed with the representative worst cases in the previous Table 8-2-1 through Table 8-2-12 while both the applying WLAN transmitter and the co-located Bluetooth transmitter (FCC ID: ANO20020100 MTN) were active and emitted radio frequencies simultaneously.

The EUT was found to comply to the limits of FCC Part 15 Subpart C and RSS-210 with a margin of 1.3 dB.

Test Date: October 4 and 5, 2004

Table 8-2-13. Ch.1 (2412MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad T40 Series, LCD 14" model

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	102.6	28.3	-29.1	0.0	112.5	OB*	-	101.8	OB*	-
2.384	H	64.8	46.8	28.2	-29.2	0.0	63.8	74.0	10.2	45.8	54.0	8.2
2.388	H	69.1	50.9	28.2	-29.2	0.0	68.1	74.0	5.9	49.9	54.0	4.1
2.390	H	70.2	53.7	28.2	-29.2	0.0	69.2	74.0	4.8	52.7	54.0	1.3
1.066	V	49.1	-	24.6	-31.7	0.0	42.0	74.0	32.0	-	54.0	-
1.136	V	50.0	-	24.6	-31.4	0.0	43.2	74.0	30.8	-	54.0	-
1.202	V	50.8	-	25.2	-31.3	0.0	44.7	74.0	29.3	-	54.0	-
1.328	V	54.9	-	25.2	-30.9	0.0	49.2	74.0	24.8	-	54.0	-
2.313	H	52.1	-	28.0	-29.3	0.0	50.8	74.0	23.2	-	54.0	-
2.380	H	53.3	-	28.2	-29.2	0.0	52.3	74.0	21.7	-	54.0	-
2.383	H	53.8	-	28.2	-29.2	0.0	52.8	74.0	21.2	-	54.0	-
4.828	H	38.0	-	27.1	-26.6	0.0	38.5	74.0	35.5	-	54.0	-

*Note: OB means "operation band" (2400-2483.5MHz).

Table 8-2-14. Ch.165 (5825MHz) OFDM mode 6Mbps with the co-located Bluetooth transmitter
Host device: IBM ThinkPad R50 Series, LCD 15" model

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												
5.823	H	103.8	93.7	34.0	-25.6	0.0	112.2	OB*	-	102.1	OB*	-
1.092	V	48.9	-	24.4	-31.5	0.0	41.8	74.0	32.2	-	54.0	-
1.130	V	47.7	-	24.6	-31.4	0.0	40.9	74.0	33.1	-	54.0	-
1.343	V	48.6	-	25.2	-30.9	0.0	42.9	74.0	31.1	-	54.0	-
1.671	V	49.7	-	25.8	-30.1	0.0	45.4	74.0	28.6	-	54.0	-
5.355	H	54.9	42.1	33.9	-25.6	0.0	63.2	74.0	10.8	50.4	54.0	3.6
5.427	H	53.9	40.6	34.1	-25.6	0.0	62.4	74.0	11.6	49.1	54.0	4.9
5.452	H	52.0	40.3	34.2	-25.7	0.0	60.5	74.0	13.5	48.8	54.0	5.2
5.458	H	52.6	40.1	34.3	-25.7	0.0	61.2	74.0	12.8	48.7	54.0	5.3
11.657	H	39.6	-	33.6	-20.0	0.0	53.2	74.0	20.8	-	54.0	-

*Note: OB means "operation band" (5725-5850MHz).

8.6 Measurement plots of adjacent restricted band

8.6.1 List of Measurement Results

The measurement was performed with the worse cases of each transmission mode that tend to have higher peak output power based on the results of previous Chapter 3 “Conducted Peak Output Power” measurement. And each host device with the highest antenna gain was selected for each transmission mode.

Table 8-3-1. Radiated peak emission in 2.4GHz DSSS transmission mode, 11Mbps

Measured host device: IBM ThinkPad **T40** Series, 14/15 inch LCD model, main antenna
IBM ThinkPad **R50** Series, 14/15 inch LCD model, auxiliary antenna

Host device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) (peak)	Rading (dBμV) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) (peak)	Margin to Limit (dB) (peak)	Field Strength (dBμV/m) (average)	Margin to Limit (dB) (average)
T40 14"	2.387	H	58.0	47.6	28.2	-29.2	0.0	57.0	17.0	46.6	7.4
	2.488	H	60.3	49.6	28.4	-29.1	0.0	59.6	14.4	48.9	5.1
T40 15"	2.388	H	57.7	46.7	28.2	-29.2	0.0	56.7	17.3	45.7	8.3
	2.487	H	59.3	48.7	28.4	-29.1	0.0	58.6	15.4	48.0	6.0
R50 14"	2.387	H	52.1	39.7	28.2	-29.2	0.0	51.1	22.9	38.7	15.3
	2.487	H	58.5	48.4	28.4	-29.1	0.0	57.8	16.2	47.7	6.3
R50 15"	2.390	H	51.0	39.3	28.2	-29.2	0.0	50.0	24.0	38.3	15.7
	2.487	H	56.3	44.6	28.4	-29.1	0.0	55.6	18.4	43.9	10.1

Table 8-3-2. Radiated peak emission in 2.4GHz OFDM transmission mode, 6Mbps

Measured host device: IBM ThinkPad **T40** Series, 14/15 inch LCD model, main antenna
IBM ThinkPad **R50** Series, 14/15 inch LCD model, auxiliary antenna

Host device	Frequency (GHz)	Polarity (H/V)	Reading (dBμV) (peak)	Rading (dBμV) (average)	Antenna Factor (dB/m)	Corr. Factor (dB)	Falloff Factor (dB)	Field Strength (dBμV/m) (peak)	Margin to Limit (dBμV/m) (peak)	Field Strength (dBμV/m) (average)	Margin to Limit (dBμV/m) (average)
T40 14"	2.390	H	70.7	53.1	28.2	-29.2	0.0	69.7	4.3	52.1	1.9
	2.484	H	66.5	50.1	28.4	-29.1	0.0	65.8	8.2	49.4	4.6
T40 15"	2.390	H	67.0	51.4	28.2	-29.2	0.0	66.0	8.0	50.4	3.6
	2.484	H	64.1	48.4	28.4	-29.1	0.0	63.4	10.6	47.7	6.3
R50 14"	2.390	H	59.5	44.3	28.2	-29.2	0.0	58.5	15.5	43.3	10.7
	2.495	H	59.6	47.5	28.4	-29.1	0.0	58.9	15.1	46.8	7.2
R50 15"	2.390	H	56.6	41.9	28.2	-29.2	0.0	55.6	18.4	40.9	13.1
	2.486	H	56.1	43.9	28.4	-29.1	0.0	55.4	18.6	43.2	10.8

Table 8-3-3. Radiated peak emission in **2.4GHz** OFDM transmission mode, 6Mbps
with co-located Bluetooth device

Performed with the worst case in the above Table 8-3-3 using IBM ThinkPad **T40** Series, 14” model

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 (dBμV/m) (<i>peak</i>)	Field Strength (dBμV/m) (<i>average</i>)	Margin to Limit (dBμV/m) (<i>average</i>)
T40 14”	2.390	H	70.2	53.7	28.2	-29.2	0.0	69.2	4.8	52.7	1.3

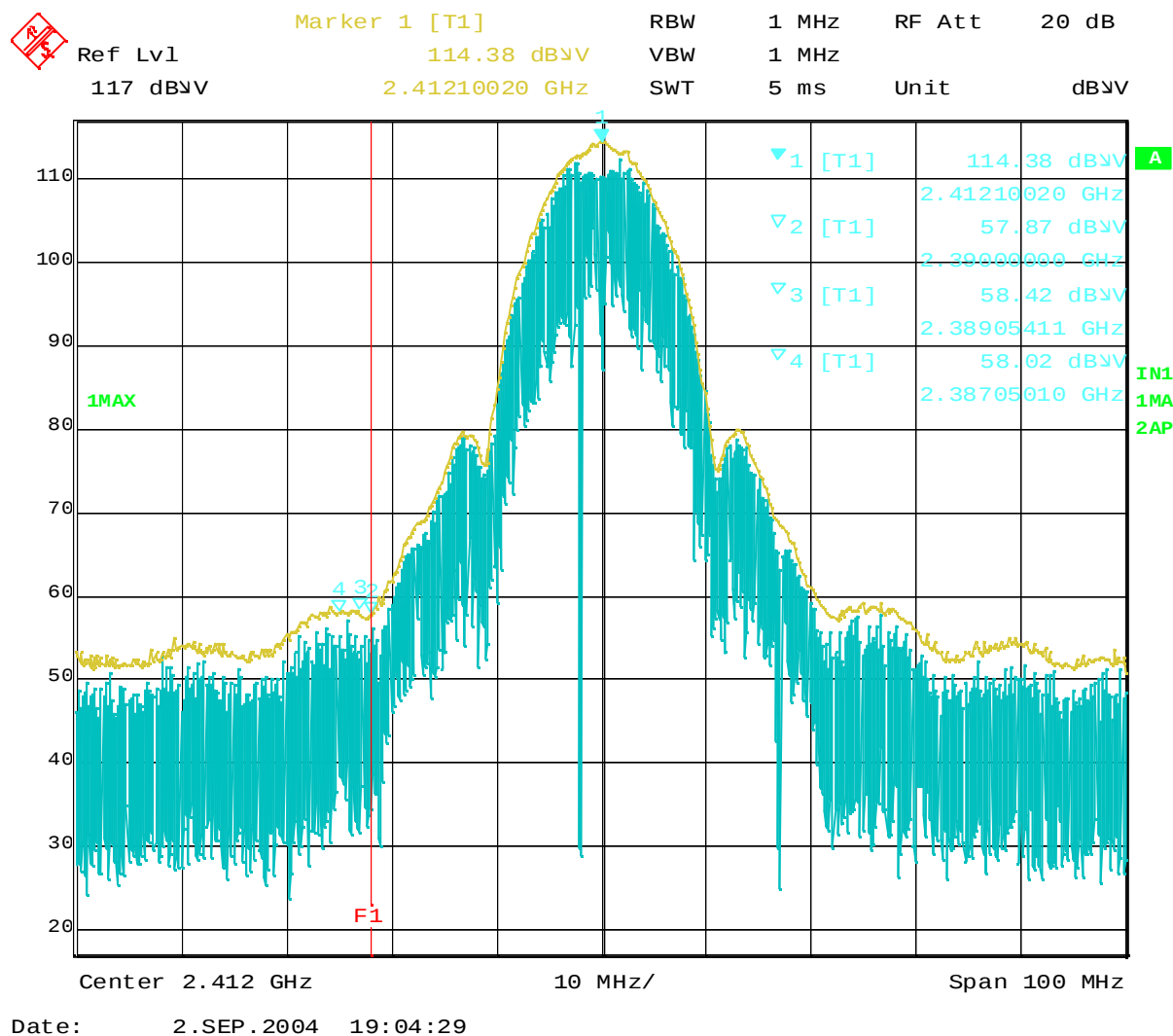
Table 8-3-4. Radiated peak emission in **5.8GHz** OFDM transmission mode, 6Mbps
(**References only** since there is no restricted band near 5.8GHz band.)

Measured host device: IBM ThinkPad **T40** Series, 14/15 inch LCD model, main antenna
IBM ThinkPad **R50** Series, 14 inch LCD model, auxiliary antenna
IBM ThinkPad **R50** Series, 15 inch LCD model, main antenna

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>)	Field Strength (dBμV/m) (<i>average</i>)
T40 14”	5.746	H	102.8	92.8	34.0	-25.6	0.0	111.2	101.2
T40 15”	5.784	H	97.9	88.1	34.0	-25.5	0.0	106.4	96.6
R50 14”	5.743	H	101.3	91.1	34.0	-25.6	0.0	109.7	99.5
R50 15”	5.783	H	104.1	94.2	34.0	-25.5	0.0	112.6	102.7

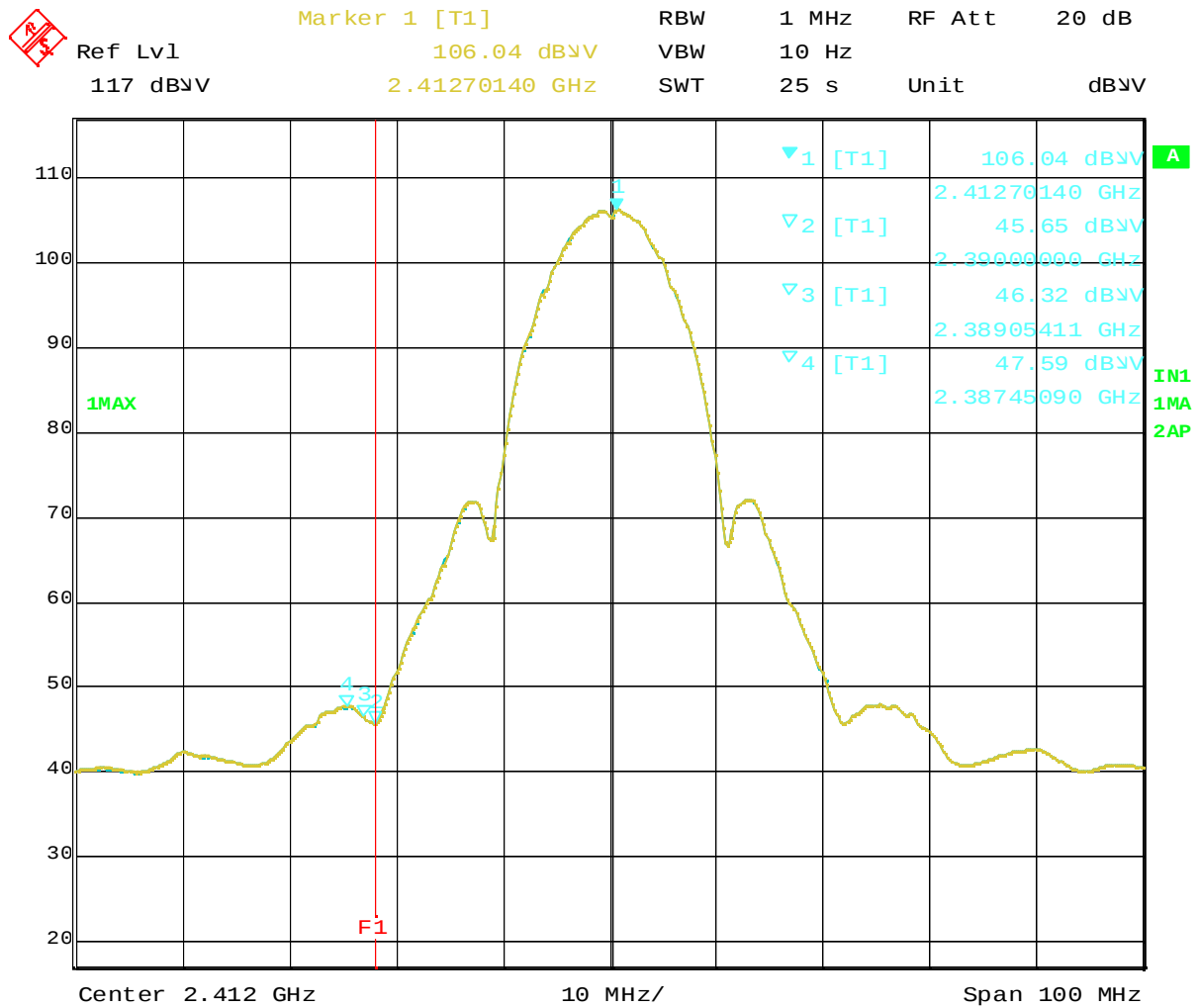
8.6.2 Bandedge Measurement Plots

The plots are comparatively worse measurement cases of each transmission mode in the Table 8-3-1 through Table 8-3-4.



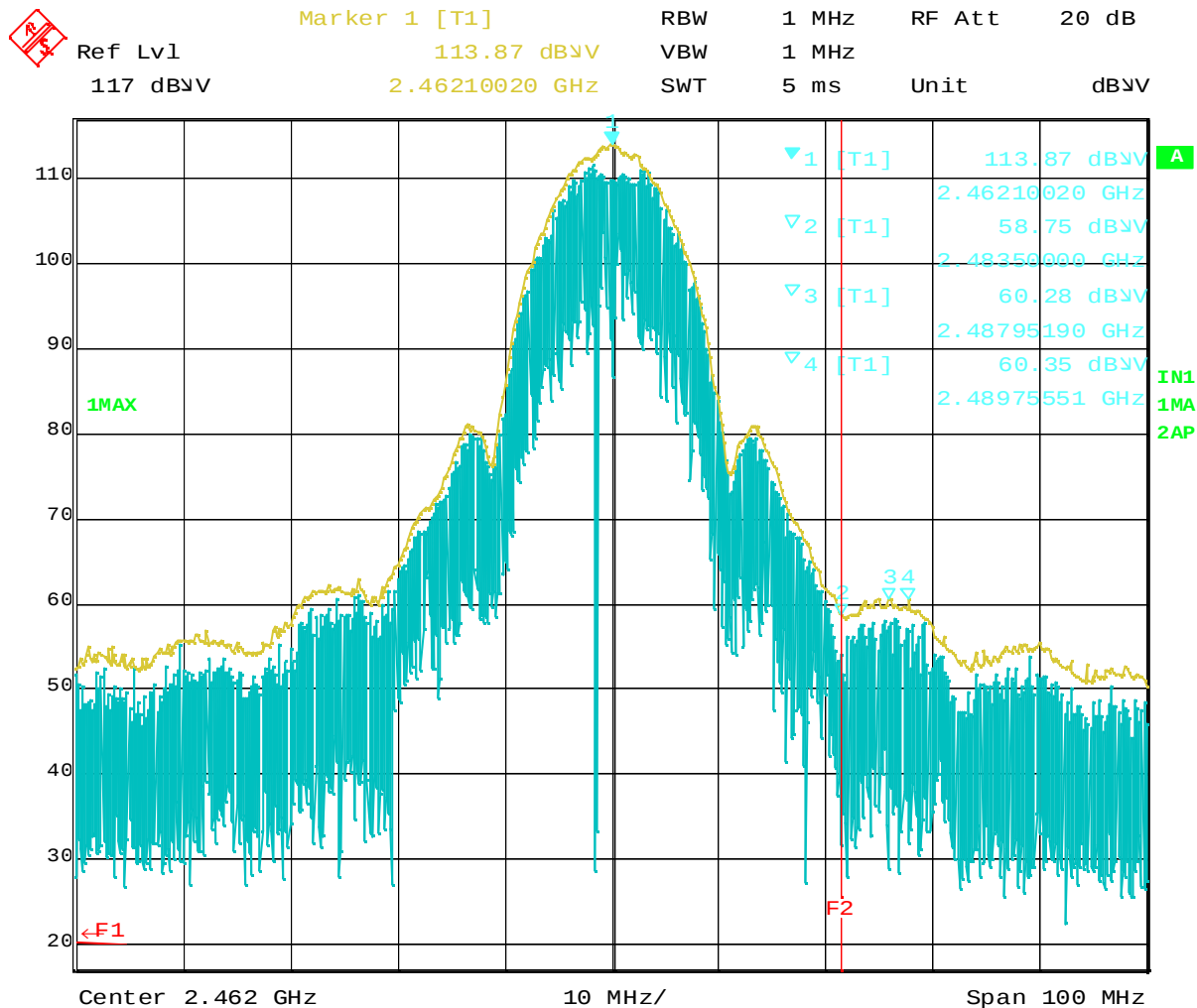
Plot 8-1 Ch.1 2412MHz TX, DSSS 11Mbps (Peak), T40 Series 14" model

(the applying transmitter only)



Date: 2.SEP.2004 19:05:57

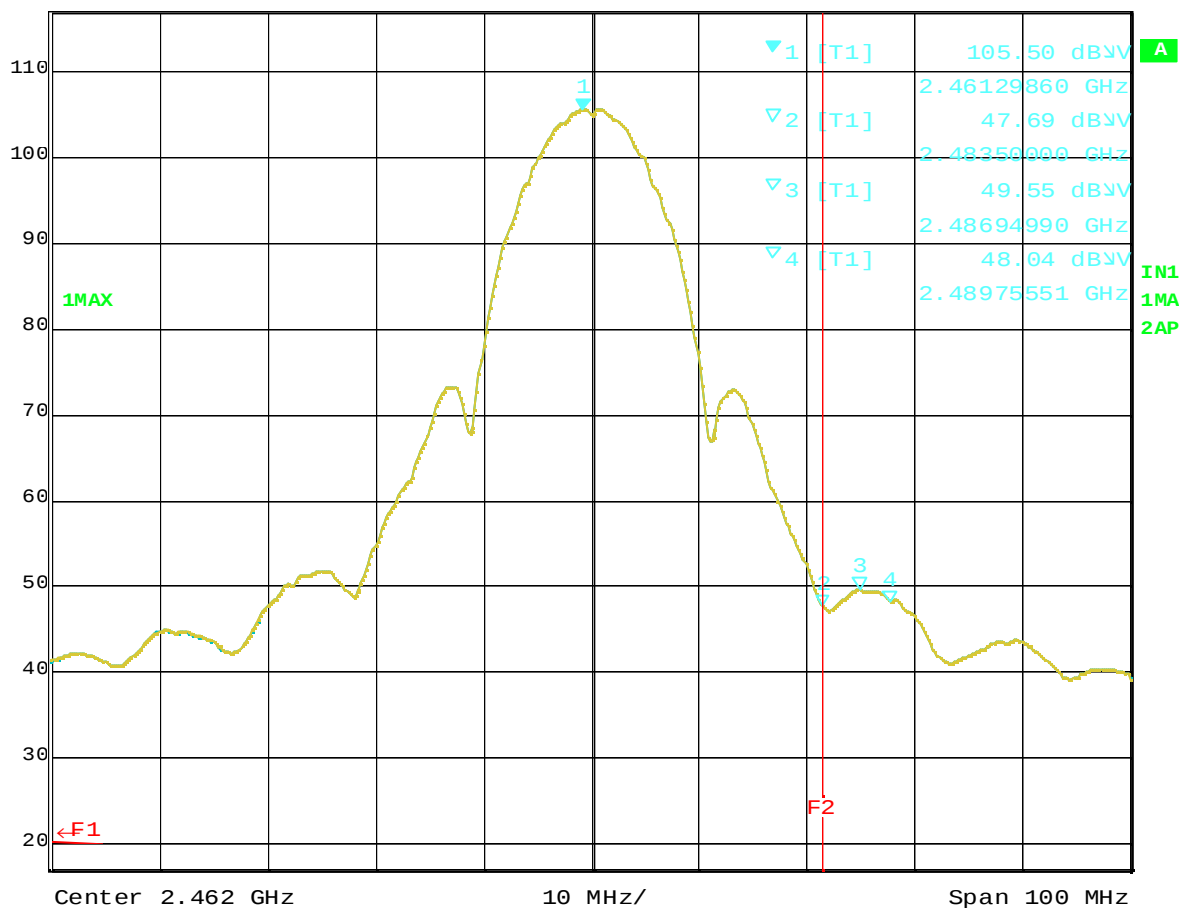
Plot 8-2 Ch.1 2412MHz TX, DSSS 11Mbps (Average). T40 Series 14" model
(the applying transmitter only)



Date: 2.SEP.2004 19:07:37

Plot 8-3 Ch.11 2462MHz TX, DSSS 11Mbps (Peak), T40 Series 14" model

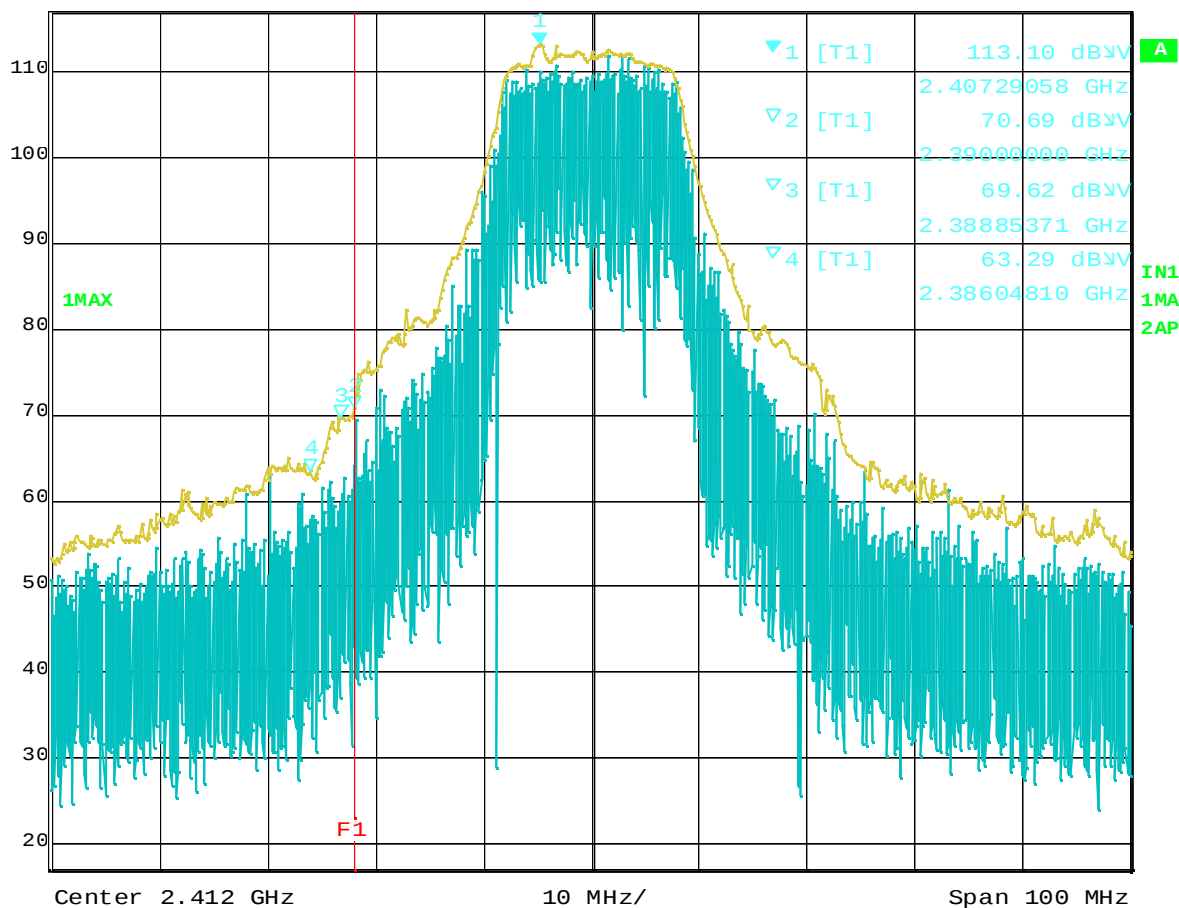
(the applying transmitter only)

Ref Lvl
117 dBμVMarker 1 [T1]
105.50 dBμV
2.46129860 GHzRBW 1 MHz RF Att 20 dB
VBW 10 Hz
SWT 25 s Unit dBμV

Date: 2.SEP.2004 19:08:39

Plot 8-4 Ch.11 2462MHz TX, DSSS 11Mbps (Average), T40 Series 14" model

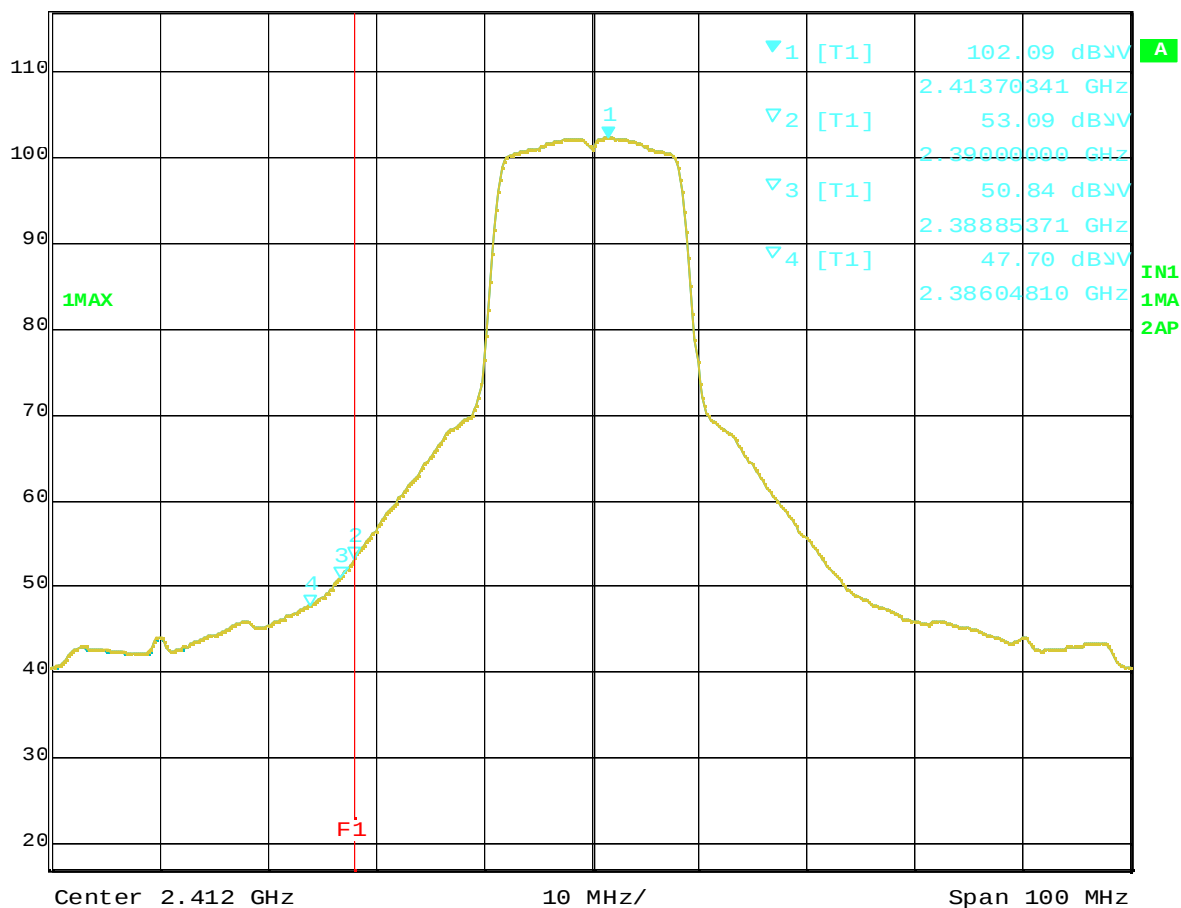
(the applying transmitter only)

Ref Lvl
117 dBμVMarker 1 [T1]
113.10 dBμV
2.40729058 GHzRBW 1 MHz RF Att 20 dB
VBW 1 MHz
SWT 5 ms Unit dBμV

Date: 2.SEP.2004 23:33:49

Plot 8-5 Ch.1 2412MHz TX, OFDM 6Mbps (Peak), T40 Series 14" model

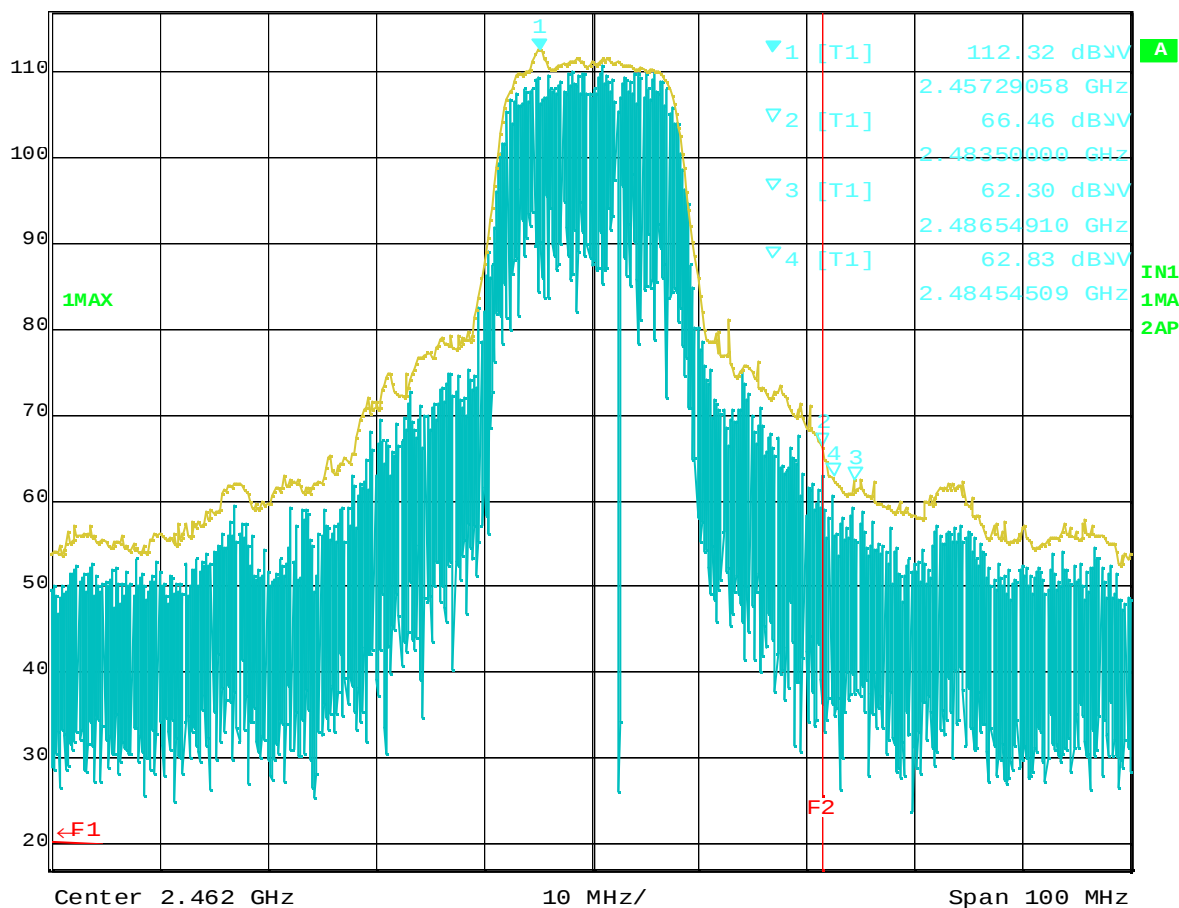
(the applying transmitter only)

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

Date: 2.SEP.2004 23:34:42

Plot 8-6 Ch.1 2412MHz TX. OFDM 6Mbps (Average). T40 Series 14" model

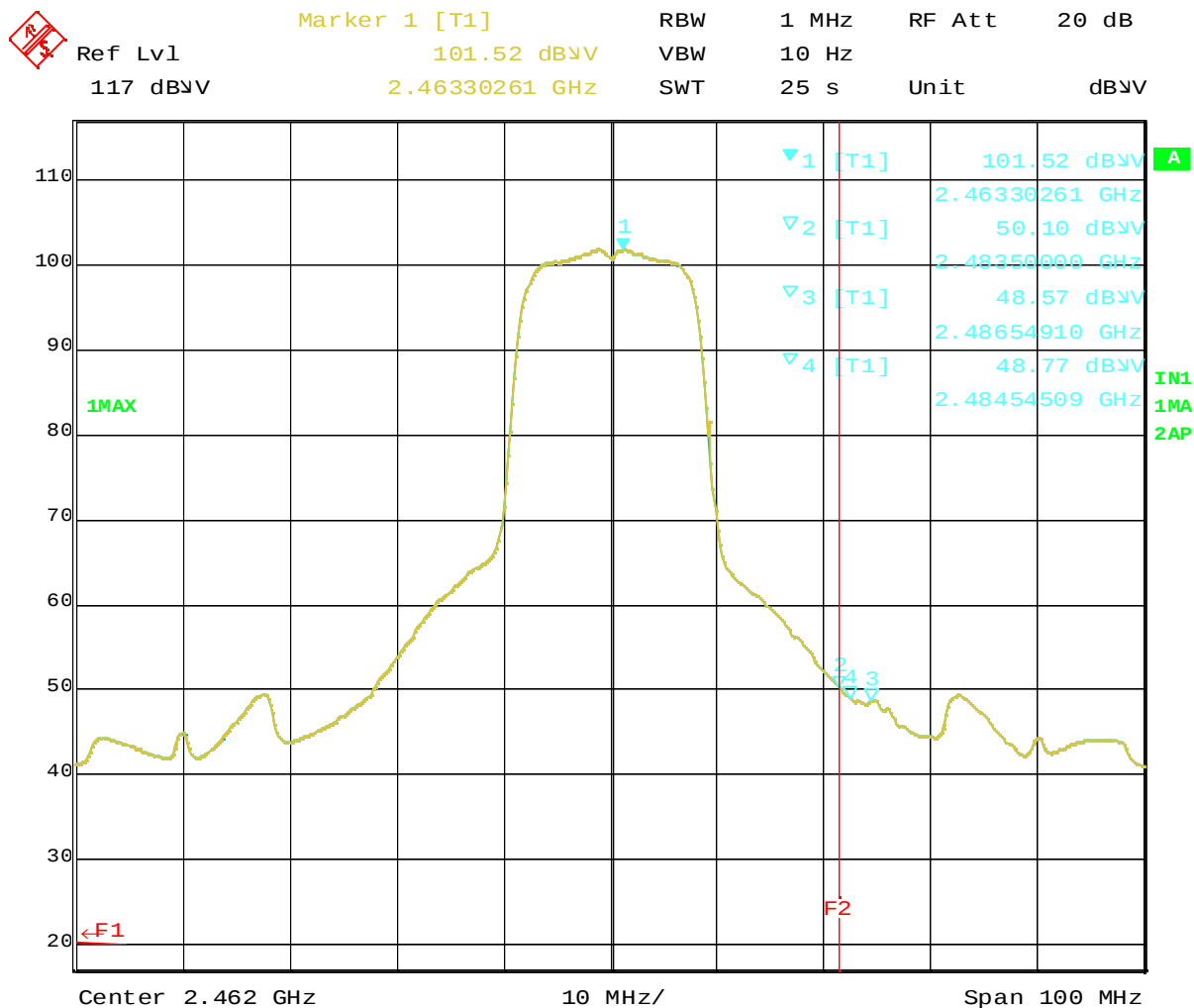
(the applying transmitter only)

Ref Lvl
117 dBμVMarker 1 [T1]
112.32 dBμV
2.45729058 GHzRBW 1 MHz RF Att 20 dB
VBW 1 MHz
SWT 5 ms Unit dBμV

Date: 2.SEP.2004 19:40:58

Plot 8-7 Ch.11 2462MHz TX. OFDM 6Mbps (Peak). T40 Series 14" model

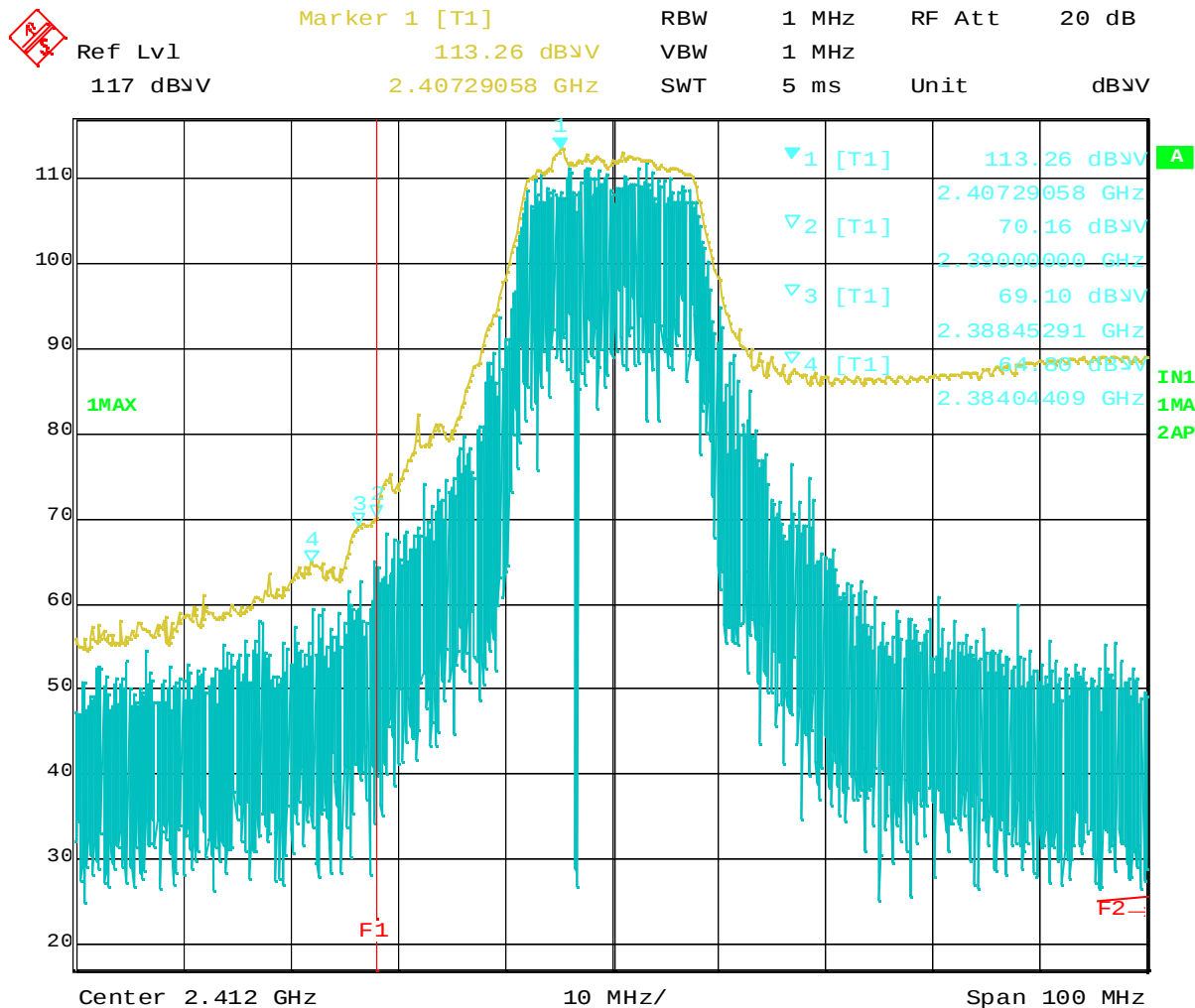
(the applying transmitter only)



Date: 2.SEP.2004 19:41:57

Plot 8-8 Ch.11 2462MHz TX, OFDM 6Mbps (Average), T40 Series 14" model

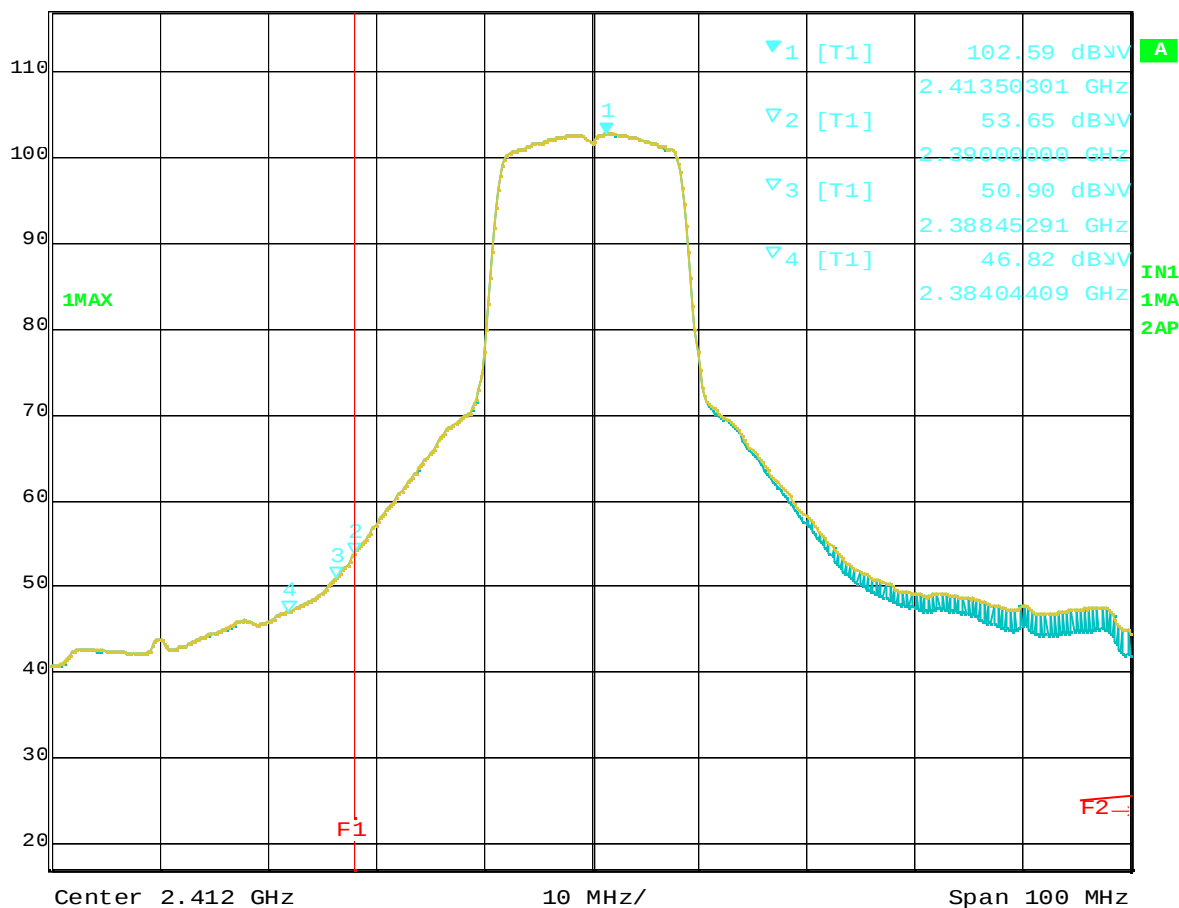
(the applying transmitter only)



Date: 4.OCT.2004 14:05:26

Plot 8-9 Ch.11 2412MHz TX. OFDM 6Mbps (Peak). T40 Series 14" model

(the applying transmitter with co-located Bluetooth device)

Ref Lvl
117 dBμVMarker 1 [T1]
102.59 dBμV
2.41350301 GHzRBW 1 MHz RF Att 20 dB
VBW 10 Hz
SWT 25 s Unit dBμV

Date: 4.OCT.2004 14:10:19

Plot 8-10 Ch.11 2412MHz TX. OFDM 6Mbps (Average). T40 Series 14" model

(the applying transmitter with co-located Bluetooth device)