



**ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT  
INTENTIONAL RADIATOR CERTIFICATION TO  
FCC PART 15 SUBPART C REQUIREMENT**

*OF*

**2.4GHz Direct Sequence Spread Spectrum Data Transceiver for  
Notebook computer Built-in Mini PCI wireless LAN**

**MODEL NO: VERSA L320**

**BRAND NAME: NEC**

**FCC ID: EUNMPC13A**

**REPORT NO: 01E9714**

**ISSUE DATE: September 08, 2001**

*Prepared for*

**First International Computer, Inc.  
118, Nan-Lin Road, Taishan Hsiang, 243 Taipei Hsien  
Taiwan, R. O. C.**

*Prepared by*

**Compliance Engineering Services, Inc.  
No. 199, Chung Sheng Road, Hsin Tien City,  
Taipei, Taiwan, R.O.C.  
Tel: (02) 2217-0894  
Fax: (02) 2217-1254**

*d.b.a*

*Prepared by*

**Compliance Certification Services.**



**FCC, VCCI, CISPR, CE  
UL, CSA, TÜV, VDE**

**U.S.A. : P.O.BOX 612650, SAN JOSE, CA 95161-2650  
TAIPEI : P.O.BOX 17-82, HSIN TIEN, TAIWAN, R.O.C.**

<b>TABLE OF CONTENT</b>		<b>PAGE</b>
<b>1. VERIFICATION OF COMPLIANCE .....</b>		<b>1</b>
<b>2. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) .....</b>		<b>2</b>
<b>3. TEST LOCATION.....</b>		<b>2</b>
<b>4. DESCRIPTION OF TEST MODES .....</b>		<b>3</b>
<b>5. SUPPORT EQUIPMENT .....</b>		<b>3</b>
<b>6. TEST PROCEDURES AND TEST RESULTS .....</b>		<b>4</b>
RADIATED EMISSIONS (GENERAL REQUIREMENTS) .....		4
TEST REQUIREMENT: 15.205.....		4
TEST REQUIREMENT: 15.209 (15.109).....		11
TEST REQUIREMENT: 15.207.....		15
MINIMUM 6 dB BANDWIDTH FOR DSSS.....		19
TEST REQUIREMENT: 15.247(A)1(I)-(II).....		19
RF POWER OUTPUT .....		24
TEST REQUIREMENT: 15.247(B).....		24
OUT OF BAND MEASUREMENTS .....		29
TEST REQUIREMENT: 15.247(C).....		29
DSSS POWER DENSITY .....		36
TEST REQUIREMENT: 15.247(D).....		36
PROCESSING GAIN OF A DSSS.....		45
TEST REQUIREMENT: 15.247(E) .....		45
<b>APPENDIX 1</b> EUT Photographs		
<b>APPENDIX 2</b> Proposed FCC ID Label Format		
<b>APPENDIX 3</b> User Manual		
<b>APPENDIX 4</b> Theory of Operation and Block Diagram		
<b>APPENDIX 5</b> Schematic Diagram		

## 1. VERIFICATION OF COMPLIANCE

COMPANY NAME: First International Computer, Inc.  
118, Nan-Lin Road, Taishan Hsiang,  
243 Taipei Hsien, Taiwan, R. O. C.

CONTACT PERSON: Herman Chien / Manager

TELEPHONE NO: (02) 2908-0302


EUT DESCRIPTION: 2.4GHz Direct Sequence Spread Spectrum Data Transceiver for  
Notebook computer Built-in Mini PCI wireless LAN

MODEL NAME: VERSA L320

DATE TESTED: August 15, 2001 ~ August 28, 2001

<b>LIMIT APPLY TO: FCC PART 15 SECTION 15.247</b>	
<b>TECHNICAL LIMITS</b>	<b>TEST RESULT</b>
Minimum 6dB Bandwidth@ > 500kHz	Passed
RF Power Output < 1 Watt	Passed
Out of Band Measurements	Passed
DSSS Power Density < 8dBm @ 3kHz bandwidth	Passed
Processing Gain of a DSSS > 10dB	Passed
<b>LIMIT APPLY TO: FCC PART 15 SECTION 15.205/SECTION 15.209</b>	
Restricted Band of Operation	Passed
<b>LIMIT APPLY TO: FCC PART 15 SECTION 15.209 (15.109)</b>	
Radiated Emission Limits	Passed
<b>LIMIT APPLY TO: FCC PART 15 SECTION 15.207</b>	
AC Line Conducted Emission	Passed
The above equipment was tested by Compliance Engineering Services Inc. for compliance with the requirements set forth in CFR 47 PART 15 SUBPART C. This said equipment in the configuration described in this report show that maximum emission levels emanating from equipment are within the compliance requirements.	

*Approved By*

  
\_\_\_\_\_  
RICK YEO / EMC MANAGER  
COMPLIANCE ENGINEERING SERVICES

## 2. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)

Product	Notebook Computer Built-in Mini PCI Wireless LAN
Model No.	VERSA L320
Power Supply	Input: 100~240V , Ouput: 19V, 3.16A AC Adaptor
Frequency Range	2.400GHz – 2.462GHz
Local OSC. / Location	2060 ~ 2110MHz
Channel Spacing	5MHz
Transmit Power	15dBm
Modulation Technique	DSSS (CCK; DQPSK; DBPSK)
Radio Technique	Direct Sequence spread Spectrum
Number of Channels	11
Operating Mode	Point-to-Point
Air data Rate	11Mbps
Antenna	50 Ohms / omni – direction

## 3. TEST LOCATION

All emissions tests were performed at:

Compliance Engineering Services, Inc.  
No. 199, CHUNG SHENG ROAD  
HSIN TIEN CITY, TAIPEI, TAIWAN, R.O.C.

CES has site descriptions on file with the FCC for 10 and 3 meter site configurations. CES is a NVLAP accredited facility.

Radiated emissions from the digital portion of the EUT were performed on site E, one of the 10 meter sites.

#### 4. DESCRIPTION OF TEST MODES

The EUT (Notebook Computer built-in mini PCI wireless LAN) has been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel, 6 and 11 with 11Mbps highest data rate are chosen for testing.

#### 5. SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial No.	FCC ID / DoC	Description
MONITOR	SAMSUNG	SYNCMaster 980P	N/A	DOC	Shielded, 1.8m Two Ferrite core
LCD MONITOR	SAMSUNG	170MP	N/A	DOC	Un-Shielded, 1.4m Two Ferrite core
MOUSE	LOGITECH	M-BE58	LZA10752403	DOC	Un-Shielded, 1.8m
MOUSE	LOGITECH	M-S34	LZE02353706	DZL211029	Un-Shielded, 1.8m
MOUSE	LOGITECH	M-BE58	LZA10752862	DOC	Un-Shielded, 1.4m
MODEM	DATATRONICS	2496CF	N/A	DOC	Shielded, 1.4m
PRINTER	HP	2225C	2550540697	BS46XU2225C	Shielded, 1.8m
IEEE 1394 MO	FUJITSU	MDF3064EE	05002981	DOC	Shielded, 1.5m
IEEE 1394 MO	FUJITSU	MDF3064EE	05003225	DOC	Shielded, 1.5m
EAR. & MIC.	E.SENSE	MSB-206	N/A	N/A	Un-Shielded, 2.3m
TELEPHONE LINE SIMULATOR	TELTONE	TLS-4A-01	N/A	DOC	Un-Shielded, 2.0m
* Notebook	NEC	VERSA L320	N/A	EUNMPC13A	Built-in Mini PCI wireless LAN

Remark: “ \* “ means Equipment Under Test.

## 6. TEST PROCEDURES AND TEST RESULTS

### RADIATED EMISSIONS (GENERAL REQUIREMENTS)

#### TEST REQUIREMENT: 15.205

#### Measurement Equipment Used:

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
Advantest Spectrum Analyzer	R3271A	85060321	01/03/2002
HP Spectrum Analyzer	8566B	2937A06102	06/06/2002
HP Spectrum Analyzer	85662A	2848A18276	06/06/2002
HP Quasi-Peak Detector	85650A	2811A01439	06/07/2002
HP pre-amplifier	8449B	3008A00965	10/03/2001
EMCO Horn Antenna	3115	5761	02/23/2002
EMCO Horn Antenna	3116	2487	08/24/2002
Huber + Suhner low loss cable	SUCOFLEX 104	N/A	N/A
HP High Pass Filter	84300-80038	R9812	08/01/2002

#### Test Set-Up:

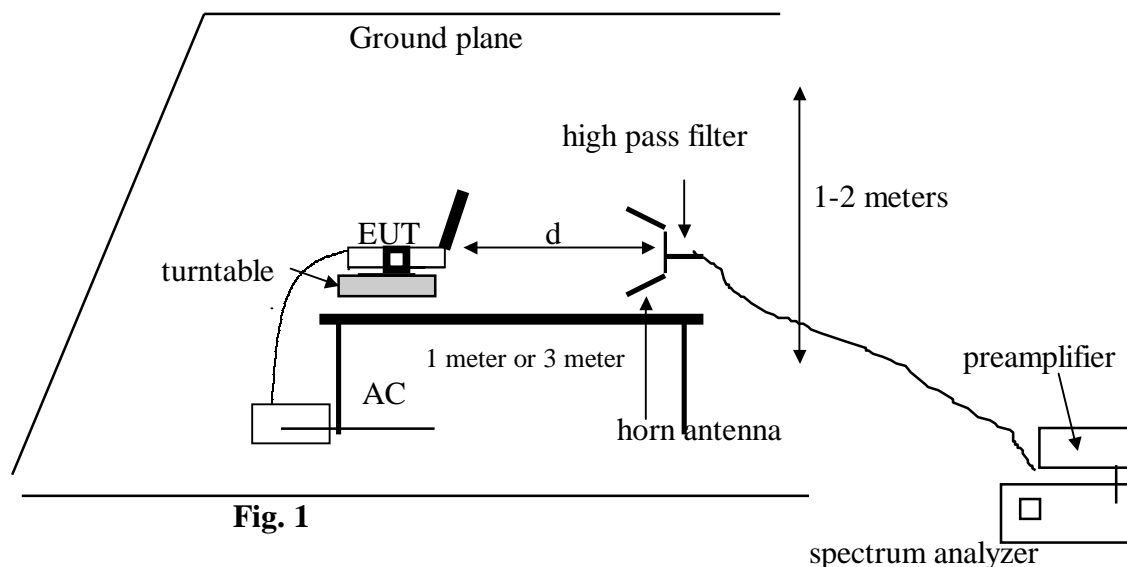


Fig. 1

#### Test Procedures

1. The EUT was placed on a wooden table on the outdoor ground plane. The search antenna was placed 3 or 1 meter from the EUT. The EUT antenna was mounted vertically as per normal installation.
2. The turntable was slowly rotated to locate the direction of maximum emission at each emission falling in the restricted bands of 15.205.
3. Once maximum direction was determined, the search antenna was raised and lowered in both vertical and horizontal polarizations. The maximum readings so obtained are recorded in the data listed below.

**Test Results:** Refer to attached tabular data sheets

### 15.205 Radiated Emissions

Operation Mode: Transmitting

Test Date : August 27, 2001

Fundamental Frequency: 2412MHz (CH 1 )

Test By: Bill Huang

Temperature : 30

Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4824.29*	57.37	33.8	7.0	35.2	1	-9.5	54.47	74.00	-19.53	P	1mV	30	1.2
4824.29*	46.85	33.8	7.0	35.2	1	-9.5	43.95	54.00	-10.05	A	1mV	30	1.2
7237.53	65.06	36.9	9.0	34.6	1	-9.5	58.86	74.00	-15.14	P	1mV	30	1.2
7237.53	44.78	36.9	9.0	34.6	1	-9.5	47.58	54.00	-6.42	A	1mV	30	1.2
9647.887	45.25	38.3	9.3	34.75	1	-9.5	49.60	74.00	-24.40	P	1mV	330	1.3
9647.887	35.69	38.3	9.3	34.75	1	-9.5	49.60	54.00	-24.40	A	1mV	330	1.3
12059.93*	---	39.2	11.6	34.4	1	-9.5	---	74.00	---	---	---	---	---
12059.93*	---	39.2	11.6	34.4	1	-9.5	---	54.00	---	---	---	---	---
14471.97*	---	41.5	12.5	33.5	1	-9.5	---	74.00	---	---	---	---	---
14471.97*	---	41.5	12.5	33.5	1	-9.5	---	54.00	---	---	---	---	---
16884.01	---	40.0	14.0	33.2	1	-9.5	---	74.00	---	---	---	---	---
16884.01	---	40.0	14.0	33.2	1	-9.5	---	54.00	---	---	---	---	---
19296.05*	---	45.2	17.0	31.3	1	-9.5	---	74.00	---	---	---	---	---
19296.05*	---	45.2	17.0	31.3	1	-9.5	---	54.00	---	---	---	---	---
21708.09	---	45.0	18.0	30.8	1	-9.5	---	74.00	---	---	---	---	---
21708.09	---	45.0	18.0	30.8	1	-9.5	---	54.00	---	---	---	---	---
24120.13	---	45.9	21.0	30.0	1	-9.5	---	74.00	---	---	---	---	---
24120.13	---	45.9	21.0	30.0	1	-9.5	---	54.00	---	---	---	---	---

Note :

1. Measurement was up to 10<sup>th</sup> harmonic, Remark “---” means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (3.5GHz) Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark “\*\*” means that Restricted band.

Operation Mode: Transmitting  
 Fundamental Frequency: 2412MHz (CH 1)  
 Temperature : 30

Test Date : August 27, 2001  
 Test By: Bill Huang  
 Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4824.29*	58.95	33.8	7.0	35.2	1	-9.5	56.05	74.00	-17.95	P	1mH	30	1.2
4824.29*	45.88	33.8	7.0	35.2	1	-9.5	42.98	54.00	-11.02	A	1mH	30	1.2
7237.53	57.44	36.9	9.0	34.6	1	-9.5	60.24	74.00	-13.76	P	1mH	30	1.3
7237.53	46.3	36.9	9.0	34.6	1	-9.5	49.10	54.00	-4.9	A	1mH	30	1.3
9647.887	44.35	38.3	9.3	34.75	1	-9.5	48.70	74.00	-25.3	P	1mH	330	1.3
9647.887	38.78	38.3	9.3	34.75	1	-9.5	43.13	54.00	-10.87	A	1mH	330	1.3
12059.93*	---	39.2	11.6	34.4	1	-9.5	---	74.00	---	---	---	---	---
12059.93*	---	39.2	11.6	34.4	1	-9.5	---	54.00	---	---	---	---	---
14471.97*	---	41.5	12.5	33.5	1	-9.5	---	74.00	---	---	---	---	---
14471.97*	---	41.5	12.5	33.5	1	-9.5	---	54.00	---	---	---	---	---
16884.01	---	40.0	14.0	33.2	1	-9.5	---	74.00	---	---	---	---	---
16884.01	---	40.0	14.0	33.2	1	-9.5	---	54.00	---	---	---	---	---
19296.05*	---	45.2	17.0	31.3	1	-9.5	---	74.00	---	---	---	---	---
19296.05*	---	45.2	17.0	31.3	1	-9.5	---	54.00	---	---	---	---	---
21708.09	---	45.0	18.0	30.8	1	-9.5	---	74.00	---	---	---	---	---
21708.09	---	45.0	18.0	30.8	1	-9.5	---	54.00	---	---	---	---	---
24120.13	---	45.9	21.0	30	1	-9.5	---	74.00	---	---	---	---	---
24120.13	---	45.9	21.0	30	1	-9.5	---	54.00	---	---	---	---	---

## Note :

1. Remark "---" means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (3.5GHz )  
Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P (Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark "\*" means that Restricted band.



Operation Mode: Transmitting

Test Date : August 27, 2001

Fundamental Frequency: 2437MHz (CH 6)

Test By: Bill Huang

Temperature : 30

Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4874.25*	48.48	33.8	7.0	35.2	1	-9.5	45.58	74.00	-28.42	P	1mV	30	1.2
4874.25*	36.09	33.8	7.0	35.2	1	-9.5	33.19	54.00	-20.81	A	1mV	30	1.2
7309.85	52.09	36.9	9.0	34.6	1	-9.5	54.89	74.00	-19.11	P	1mV	330	1.2
7309.85	40.6	36.9	9.0	34.6	1	-9.5	43.40	54.00	-10.60	A	1mV	330	1.2
9748.08	---	38.5	10.4	34.75	1	-9.5	---	74.00	---	---	---	---	---
9748.08	---	38.5	10.4	34.75	1	-9.5	---	54.00	---	---	---	---	---
12185.10*	---	39.25	11.7	34.2	1	-9.5	---	74.00	---	---	---	---	---
12185.10*	---	39.25	11.7	34.2	1	-9.5	---	54.00	---	---	---	---	---
14622.12	---	41.0	13.0	33.5	1	-9.5	---	74.00	---	---	---	---	---
14622.12	---	41.0	13.0	33.5	1	-9.5	---	54.00	---	---	---	---	---
17059.14	---	43.0	14.2	33.1	1	-9.5	---	74.00	---	---	---	---	---
17059.14	---	43.0	14.2	33.1	1	-9.5	---	54.00	---	---	---	---	---
19496.16*	---	45.2	17.0	31.3	1	-9.5	---	74.00	---	---	---	---	---
19496.16*	---	45.2	17.0	31.3	1	-9.5	---	54.00	---	---	---	---	---
21933.18	---	45.0	18.0	30.8	1	-9.5	---	74.00	---	---	---	---	---
21933.18	---	45.0	18.0	30.8	1	-9.5	---	54.00	---	---	---	---	---
24370.20	---	45.9	21.0	30.0	1	-9.5	---	74.00	---	---	---	---	---
24370.20	---	45.9	21.0	30.0	1	-9.5	---	54.00	---	---	---	---	---

## Note :

1. Remark "---" means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (3.5GHz) Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark "\*" means that Restricted band.

Operation Mode: Transmitting  
 Fundamental Frequency: 2437MHz (CH 6)  
 Temperature : 30

Test Date : August 27, 2001  
 Test By: Bill Huang  
 Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4874.25*	50.83	33.8	7.0	35.2	1	-9.5	47.93	74.00	-26.07	P	1mH	30	1.2
4874.25*	41.06	33.8	7.0	35.2	1	-9.5	38.16	54.00	-15.84	A	1mH	30	1.2
7309.85*	53.93	36.9	9.0	34.6	1	-9.5	56.73	74.00	-17.27	P	1mH	330	1.3
7309.85*	42.62	36.9	9.0	34.6	1	-9.5	45.42	54.00	-8.58	A	1mH	330	1.3
9748.08	---	38.5	10.4	34.75	1	-9.5	---	---	---	---	---	---	---
9748.08	---	38.5	10.4	34.75	1	-9.5	---	---	---	---	---	---	---
12185.10*	---	39.25	11.7	34.2	1	-9.5	---	---	---	---	---	---	---
12185.10*	---	39.25	11.7	34.2	1	-9.5	---	---	---	---	---	---	---
14622.12	---	41.0	13.0	33.5	1	-9.5	---	---	---	---	---	---	---
14622.12	---	41.0	13.0	33.5	1	-9.5	---	---	---	---	---	---	---
17059.14	---	43.0	14.2	33.1	1	-9.5	---	---	---	---	---	---	---
17059.14	---	43.0	14.2	33.1	1	-9.5	---	---	---	---	---	---	---
19496.16	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
19496.16	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
21933.18	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
21933.18	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
24370.20	---	45.9	21.0	30.0	1	-9.5	---	---	---	---	---	---	---
24370.20	---	45.9	21.0	30.0	1	-9.5	---	---	---	---	---	---	---

## Note :

1. Remark "---" means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (3.5GHz)  
 Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark "\*" means that Restricted band.

Operation Mode: Transmitting  
 Fundamental Frequency: 2462MHz (CH 11 )  
 Temperature : 30

Test Date : August 27, 2001  
 Test By: Bill Huang  
 Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4924.05*	49.75	33.8	7.1	35.2	1	-9.5	46.95	74.00	-27.05	P	1mH	30	1.2
4924.05*	35.65	33.8	7.1	35.2	1	-9.5	32.85	54	-21.15	A	1mH	30	1.2
7386.0*	48.56	36.9	9.0	34.6	1	-9.5	51.36	74	-22.64	P	1mH	330	1.3
7386.0*	39.72	36.9	9.0	34.6	1	-9.5	45.52	54	-11.48	A	1mH	330	1.3
9848.02	---	38.5	10.4	34.7	1	-9.5	---	---	---	---	---	---	---
9848.02	---	38.5	10.4	34.7	1	-9.5	---	---	---	---	---	---	---
12310.04*	---	39.25	11.7	34.0	1	-9.5	---	---	---	---	---	---	---
12310.04*	---	39.25	11.7	34.0	1	-9.5	---	---	---	---	---	---	---
14772.06	---	41.0	13.0	33.2	1	-9.5	---	---	---	---	---	---	---
14772.06	---	41.0	13.0	33.2	1	-9.5	---	---	---	---	---	---	---
17234.08	---	43.0	14.2	33.1	1	-9.5	---	---	---	---	---	---	---
17234.08	---	43.0	14.2	33.1	1	-9.5	---	---	---	---	---	---	---
19696.1*	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
19696.1*	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
22158.12*	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
22158.12*	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
24620.14	---	45.9	21.0	30.0	1	-9.5	---	---	---	---	---	---	---
24620.14	---	45.9	21.0	30.0	1	-9.5	---	---	---	---	---	---	---

## Note :

1. Remark “---” means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (1.0dB)  
Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark “\*” means that Restricted band.

Operation Mode: Transmitting  
 Fundamental Frequency: 2462MHz (CH 11 )  
 Temperature : 30

Test Date : August 27, 2001  
 Test By: Bill Huang  
 Humidity : 65 %

Freq. (MHz)	Reading (dBuV)	AF (dBuV)	Closs (dB)	Pre-amp (dB)	Filter dB	Dist dB	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Mark (P/Q/A)	Pol (H/V)	Az (Deg)	Height (Meter)
4924.05*	50.42	33.8	7.1	35.2	1	-9.5	47.62	74.00	-26.38	P	1mV	1.2	30
4924.05*	43.25	33.8	7.1	35.2	1	-9.5	39.45	54.00	-14.55	A	1mV	1.2	30
7386.0*	49.93	36.9	9.0	34.6	1	-9.5	51.73	74.00	-22.27	P	1mV	1.3	330
7386.0*	39.48	36.9	9.0	34.6	1	-9.5	41.28	54.00	-12.72	A	1mV	1.3	330
9848.02	---	38.5	10.4	34.7	1	-9.5	---	---	---	---	---	---	---
9848.02	---	38.5	10.4	34.7	1	-9.5	---	---	---	---	---	---	---
12310.04*	---	39.25	11.7	34	1	-9.5	---	---	---	---	---	---	---
12310.04*	---	39.25	11.7	34	1	-9.5	---	---	---	---	---	---	---
14772.06	---	41.0	13.0	33.2	1	-9.5	---	---	---	---	---	---	---
14772.06	---	41.0	13.0	33.2	1	-9.5	---	---	---	---	---	---	---
17234.08	---	43.0	14.2	33	1	-9.5	---	---	---	---	---	---	---
17234.08	---	43.0	14.2	33	1	-9.5	---	---	---	---	---	---	---
19696.1*	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
19696.1*	---	45.2	17.0	31.0	1	-9.5	---	---	---	---	---	---	---
22158.12*	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
22158.12*	---	45.0	18.0	30.8	1	-9.5	---	---	---	---	---	---	---
24620.14	---	45.9	21.0	30	1	-9.5	---	---	---	---	---	---	---
24620.14	---	45.9	21.0	30	1	-9.5	---	---	---	---	---	---	---

## Note :

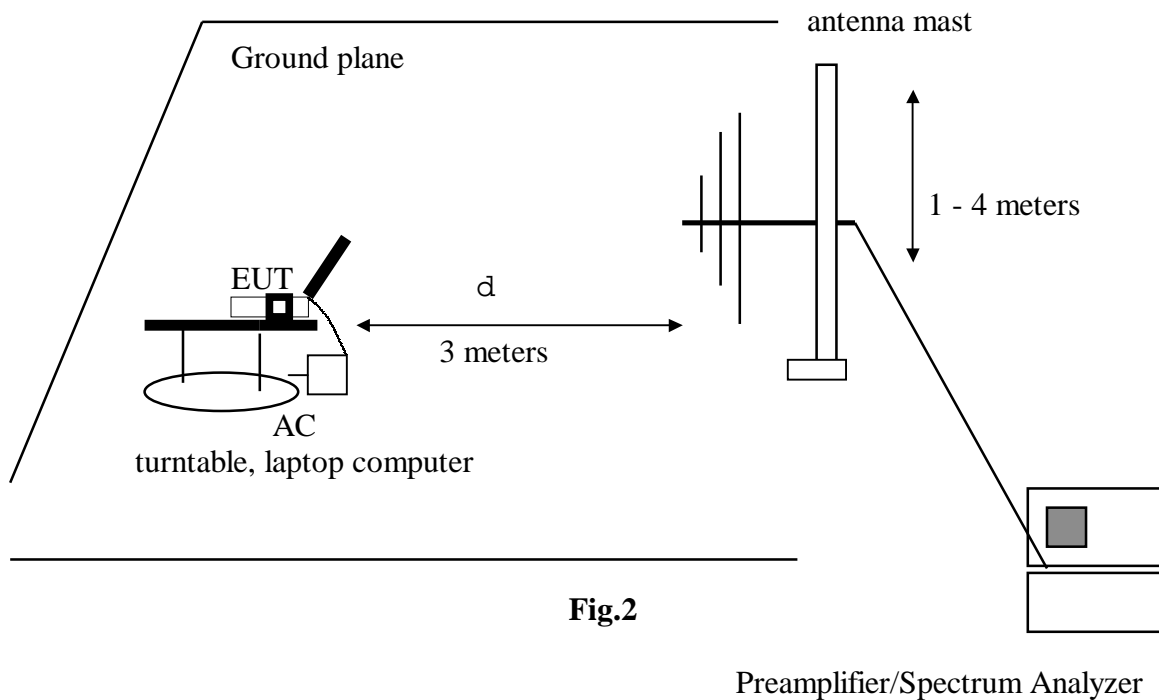
1. Remark "---" means that the emissions level is too low to be measured.
2. AF: Antenna Factor, Closs: Cable Loss, Pre-Amp: Preamp gain, Filter: High Pass Filter Insertion Loss (3.5GHz) Dist: Correction to extra plate reading to 3m specification distance 1M measurement distance: -9.5dB
3. Analyzer setting P(Peak): RBW=1MHz, VBW=1MHz, A(Average): RBW=1MHz, VBW=10Hz
4. Remark "\*" means that Restricted band.

**RADIATED EMISSIONS  
TEST REQUIREMENT: 15.209 (15.109)**

**Measurement Equipment Used:**

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
HP Spectrum Analyzer	8566B	2937A06102	06/06/2002
HP Spectrum Display	85662A	2484A18276	06/06/2002
HP Quasi-Peak Detector	85650A	2811A01439	06/07/2002
HP Preamplifier	8447D	1466A02328	05/07/2002
HP Preamplifier	8449B	8449B	3008A00965
EMCO Bilog Antenna	3142	1310	06/30/2002
EMCO Horn antenna	3115	5761	02/23/2002

**Test Set-up**



**Fig.2**

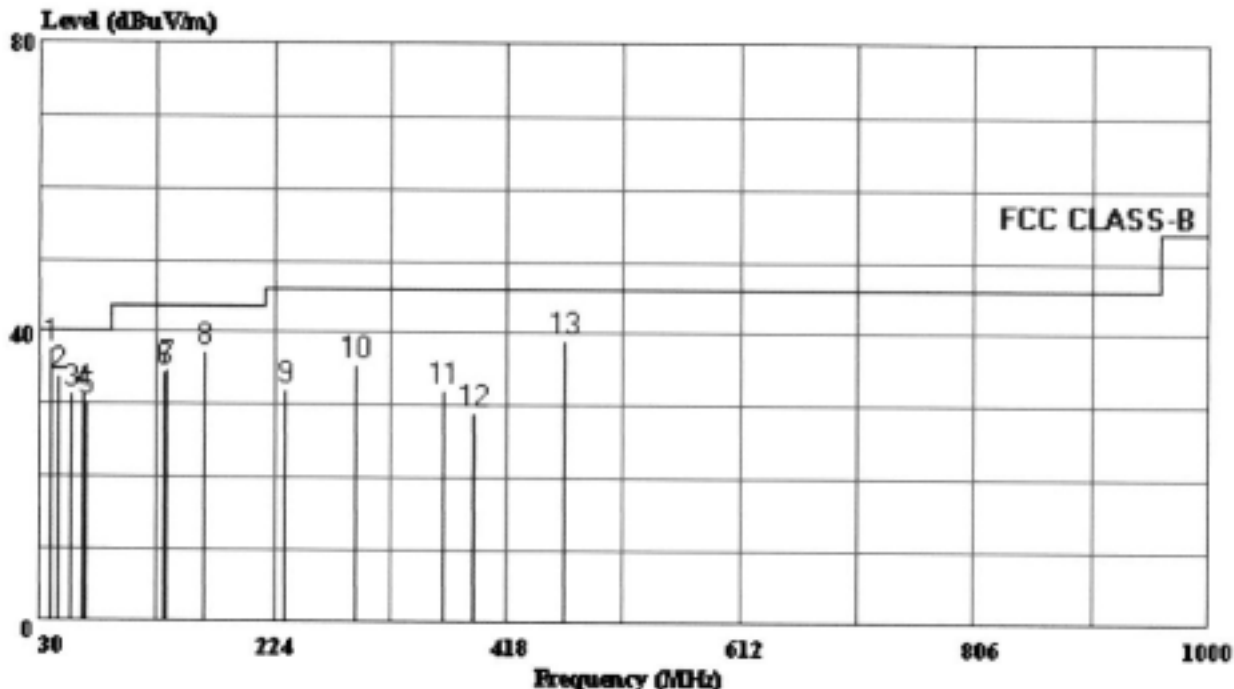
**Test Procedures:**

The EUT was placed on a turntable at a distance of 3 meters from a Bilog a Antenna or Log Periodic or double ridged horn antenna search antenna. The antenna was raised and lowered, the EUT rotated on the turntable, until the EUT azimuth, antenna elevation, and antenna polarity were found which yielded maximum received emission levels on the spectrum analyzer. Since the CPU is 1.13GHz and the unit was evaluated up to 5.65GHz.

Test Result: Refer to attached tabular data sheets.

Data#: 26 File#: 9714f.emi

Date: 2001-08-20 Time: 14:16:29



(CCS E-Site)

Trace:

Ref Trace:

Condition: VERTICAL

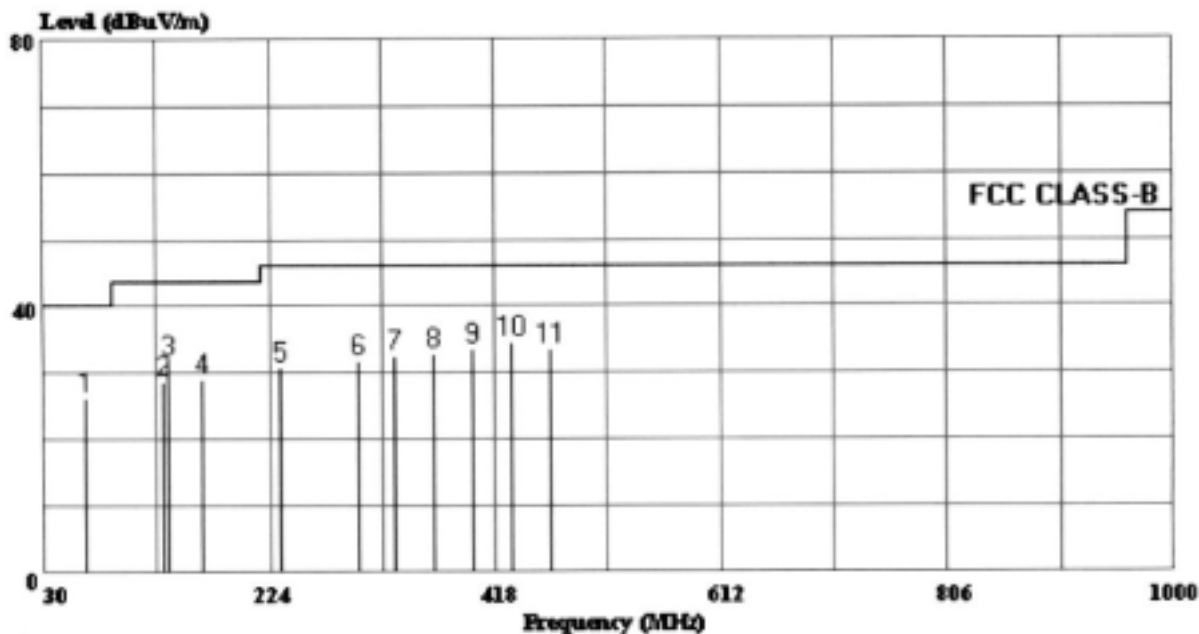
Company : FIRST INTERNATIONAL COMPUTER, INC.  
 EUT : VERSA L320  
 Test Config : EUT / ALL PERIPHERALS  
 Type of Test: FCC CLASS B  
 Mode of Op. : NORMAL MODE

Page: 1

	Freq	Read	Factor	Level	Limit	Over	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	38.775	46.85	-8.99	37.86	40.00	-2.14	QP
2	44.210	45.50	-11.58	33.92	40.00	-6.08	Peak
3	55.300	45.30	-13.64	31.66	40.00	-8.34	Peak
4	66.380	46.30	-14.96	31.34	40.00	-8.66	Peak
5	68.010	45.40	-15.04	30.36	40.00	-9.64	Peak
6	132.710	48.50	-13.87	34.63	43.50	-8.87	Peak
7	135.031	48.50	-13.47	35.03	43.50	-8.47	QP
8	165.990	48.30	-10.76	37.54	43.50	-5.96	Peak
9	233.160	41.10	-8.95	32.15	46.00	-13.85	Peak
10	292.620	42.40	-6.80	35.60	46.00	-10.40	Peak
11	365.420	37.30	-5.20	32.10	46.00	-13.90	Peak
12	390.310	33.90	-4.72	29.18	46.00	-16.82	Peak
13	465.230	42.80	-3.74	39.06	46.00	-6.94	Peak

Data#: 25 File#: 9714F.EMI

Date: 2001-08-28 Time: 09:37:25



(CCS E-Site)

Trace:

Ref Trace:

Condition: HORIZONTAL

Company : FIC  
 EUT : VERSA L320  
 Test Config : ALL DEVICE  
 Type of Test : FCC CLASS B  
 Mode of Op. : RX CHANNEL 6

Page: 1

	Read Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	66.350	41.30	-14.96	26.34	40.00	-13.66	Peak
2	133.180	42.50	-13.74	28.76	43.50	-14.74	Peak
3	136.730	44.90	-13.20	31.70	43.50	-11.80	Peak
4	166.440	40.00	-10.76	29.24	43.50	-14.26	Peak
5	233.200	39.70	-8.95	30.75	46.00	-15.25	Peak
6	299.570	38.50	-6.47	32.03	46.00	-13.97	Peak
7	331.180	38.30	-5.84	32.46	46.00	-13.54	Peak
8	365.480	38.20	-5.20	33.00	46.00	-13.00	Peak
9	399.530	38.30	-4.56	33.74	46.00	-12.26	Peak
10	431.910	38.70	-4.15	34.55	46.00	-11.45	Peak
11	465.280	37.50	-3.74	33.76	46.00	-12.24	Peak

**Radiated Emission Setup Photos (Worst Emission Position)**



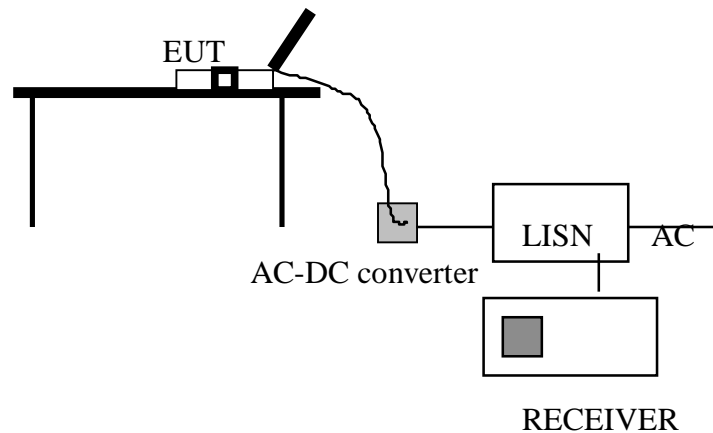


## AC LINE CONDUCTED EMISSIONS TEST REQUIREMENT: 15.207

### Measurement Equipment Used:

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
Rohde & Schwarz EMI Receiver	ESHS20	840455/006	03/15/2002
EMCO LISN	3825/2	1842	01/10/2002
SOLAR LISN	8012-50-R-24BNC	8305114	07/23/2002

### Test Set-up



**Fig. 3**

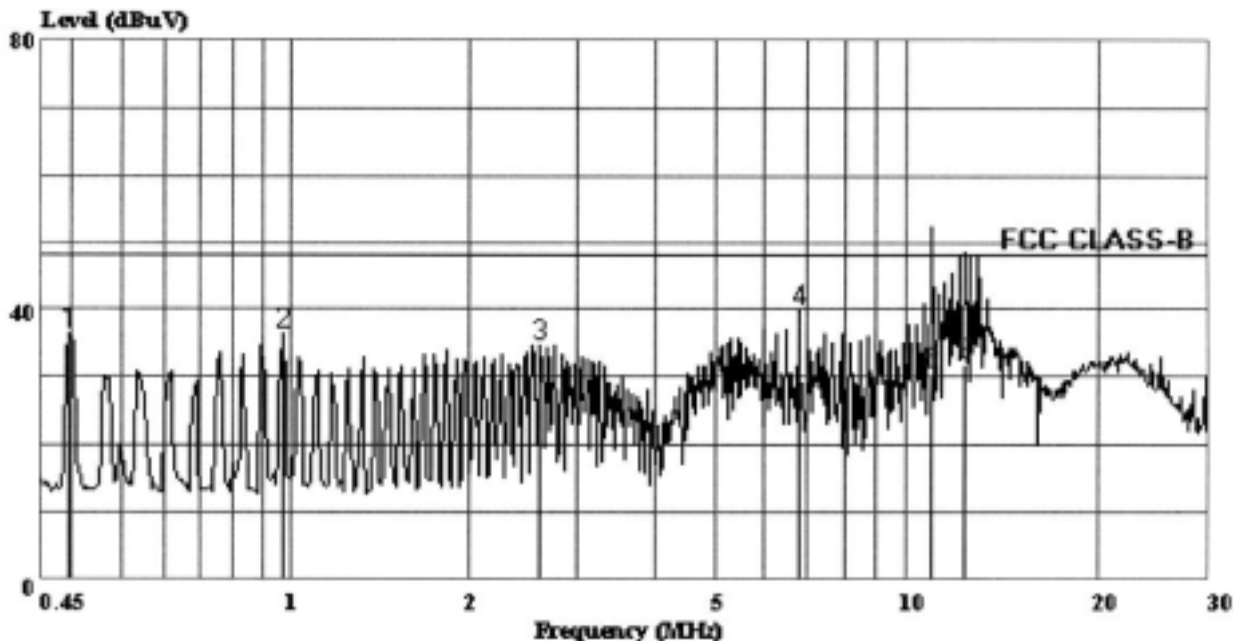
### Test Procedure:

1. The EUT was placed on a wooden table 40 cm from a vertical ground plane and approximately 80 cm above the horizontal ground plane on the floor. The EUT was set to transmit in a normal mode.
2. Line conducted data was recorded for both NEUTRAL and HOT lines.

**Test Results :** Refer to attached graph.

Data#: 65 File#: PICWIRELESS.EMI

Date: 2001-08-19 Time: 14:37:33



(CES Conducted)

Trace: 61

Ref Trace:

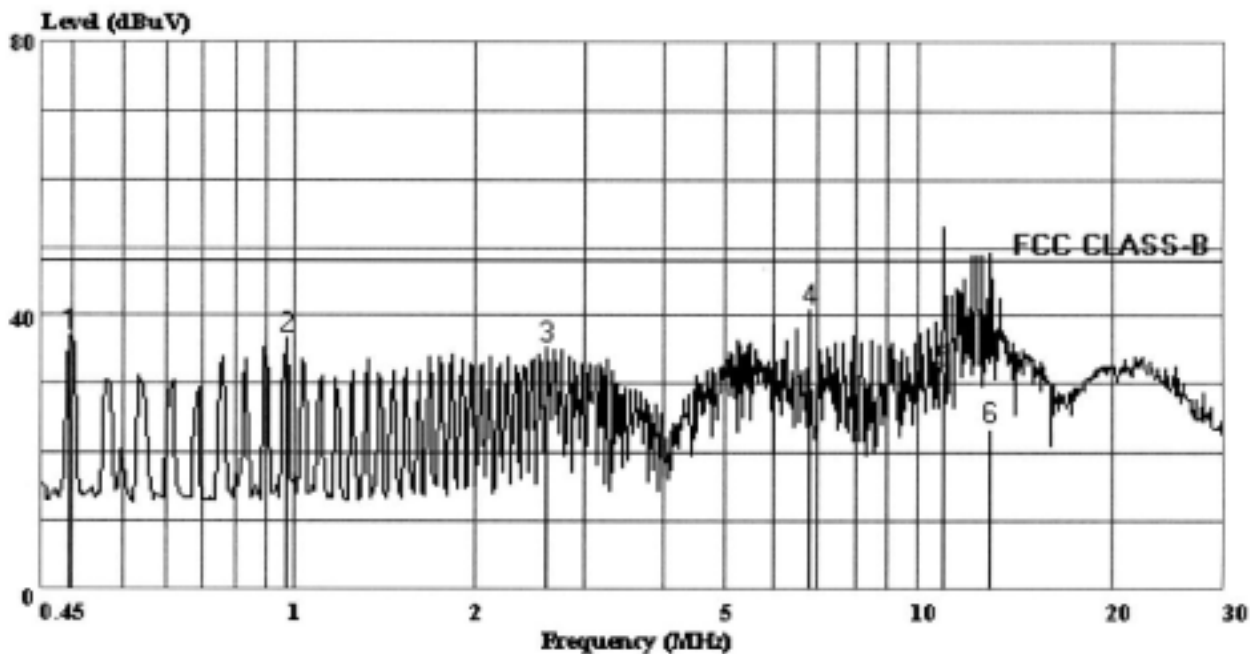
Condition: LINE  
 Report No. : 01E9714  
 Test Engr. : BILL HUANG  
 Company : FIRST INTERNATIONAL COMPUTER, INC.  
 EUT : VERSA L320  
 Test Config : EUT / ALL PERIPHERALS  
 Type of Test: FCC CLASS B  
 Mode of Op. : Blue Trace (Peak)

Page: 1

	Read		Limit	Over	
Freq	Level	Factor	Line	Limit	Remark
MHz	dBuV	dB	dBuV	dB	
1	0.499	36.42	0.05	36.47	48.00 -11.53 Peak
2	1.071	36.23	0.08	36.31	48.00 -11.69 Peak
3	2.721	34.56	0.17	34.73	48.00 -13.27 Peak
4	6.878	39.44	0.30	39.74	48.00 -8.26 Peak
5	11.080	30.11	0.35	30.47	48.00 -17.53 QP
6	12.449	31.40	0.37	31.77	48.00 -16.23 QP

Data#: 79 File#: FICWIRELESS.EMI

Date: 2001-08-19 Time: 14:50:57



**(CES Conducted)**

Trace: 73

Ref Trace:

Condition: NEUTRAL  
 Report No. : 01E9714  
 Test Engr. : BILL HUANG  
 Company : FIRST INTERNATIONAL COMPUTER, INC.  
 EUT : VERSA L320  
 Test Config : EUT / ALL PERIPHERALS  
 Type of Test : FCC CLASS B  
 Mode of Op. : Blue Trace (Peak)

Page: 1

	Read Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.499	37.10	0.05	37.15	48.00	-10.85	Peak
2	1.071	36.49	0.08	36.57	48.00	-11.43	Peak
3	2.721	35.15	0.17	35.32	48.00	-12.68	Peak
4	6.878	40.53	0.30	40.83	48.00	-7.17	Peak
5	11.080	31.65	0.35	32.01	48.00	-15.99	QP
6	12.988	23.05	0.38	23.43	48.00	-24.57	QP

**Conducted Emission Setup Photos (Worst Emission Position)**



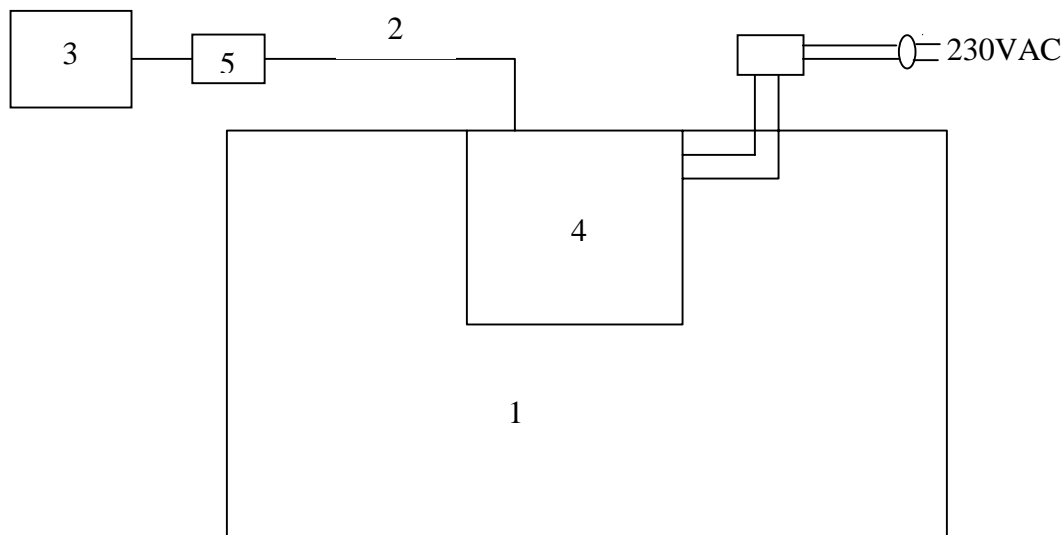
**MINIMUM 6 dB BANDWIDTH FOR DSSS  
TEST REQUIREMENT: 15.247(A)1(I)-(II)**

**Measurement Equipment Used:**

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
HP Spectrum Analyzer	8566B	2937A06102	06/06/2002
HP Preamplifier	8449B	3008A00965	10/03/2001
ADVANTEST Spectrum Analyzer	R3271A	85060321	01/03/2002
EMCO Horn antenna	3115	5761	02/23/2002
HP Plotter	7475	2325A82294	N/A
Huber + Suhner low loss cable	Sucoflex 104	N/A	N/A

**Test Set-up**

1. Wooden table
2. Test cable
3. Spectrum analyzer
4. Notebook Computer with built-in mini PCI
5. PAD



**Fig. 4 :** Measurement setup for testing on Antenna connector

**Test Procedure:**

The minimum 6dB band width was measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency.

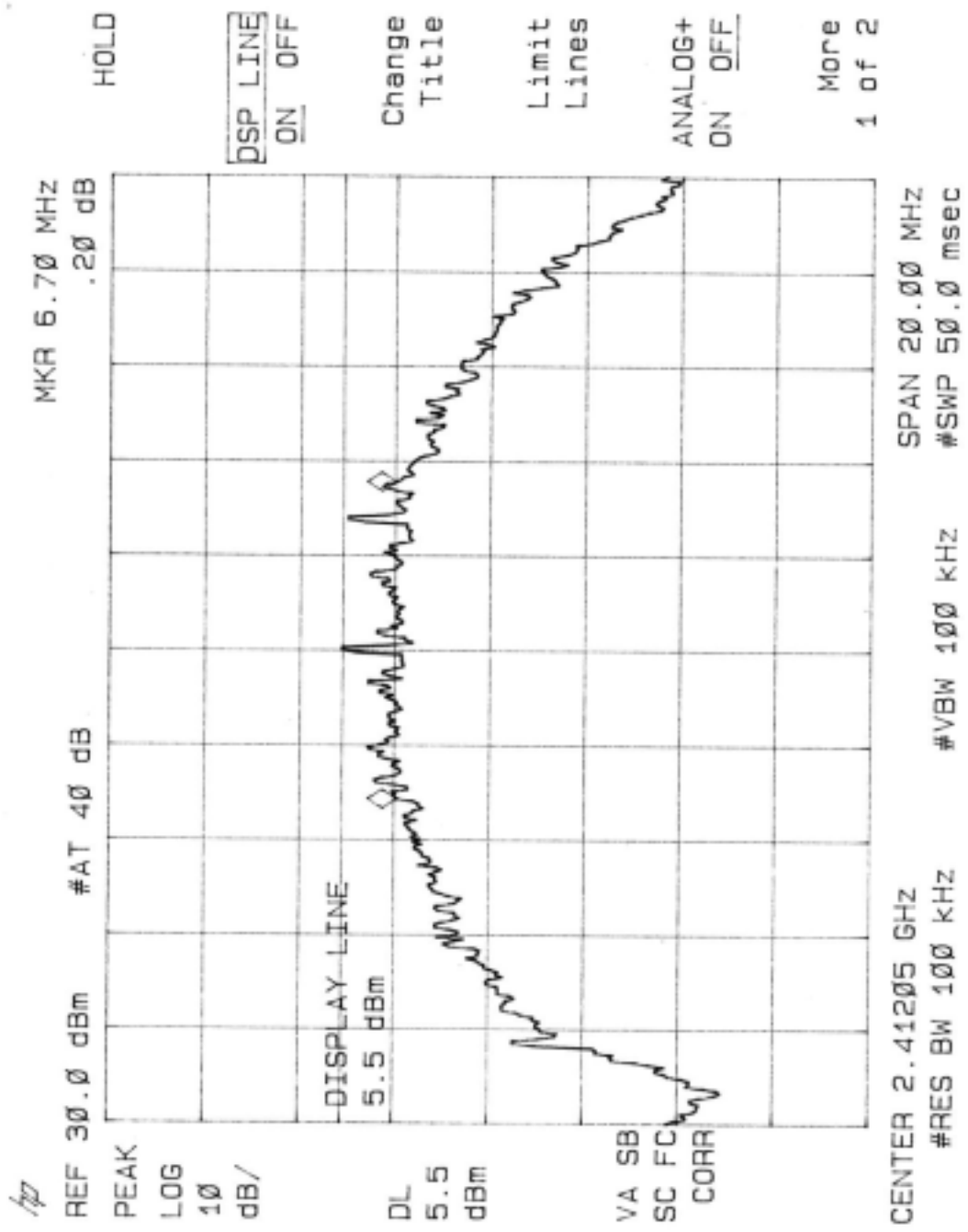
The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.

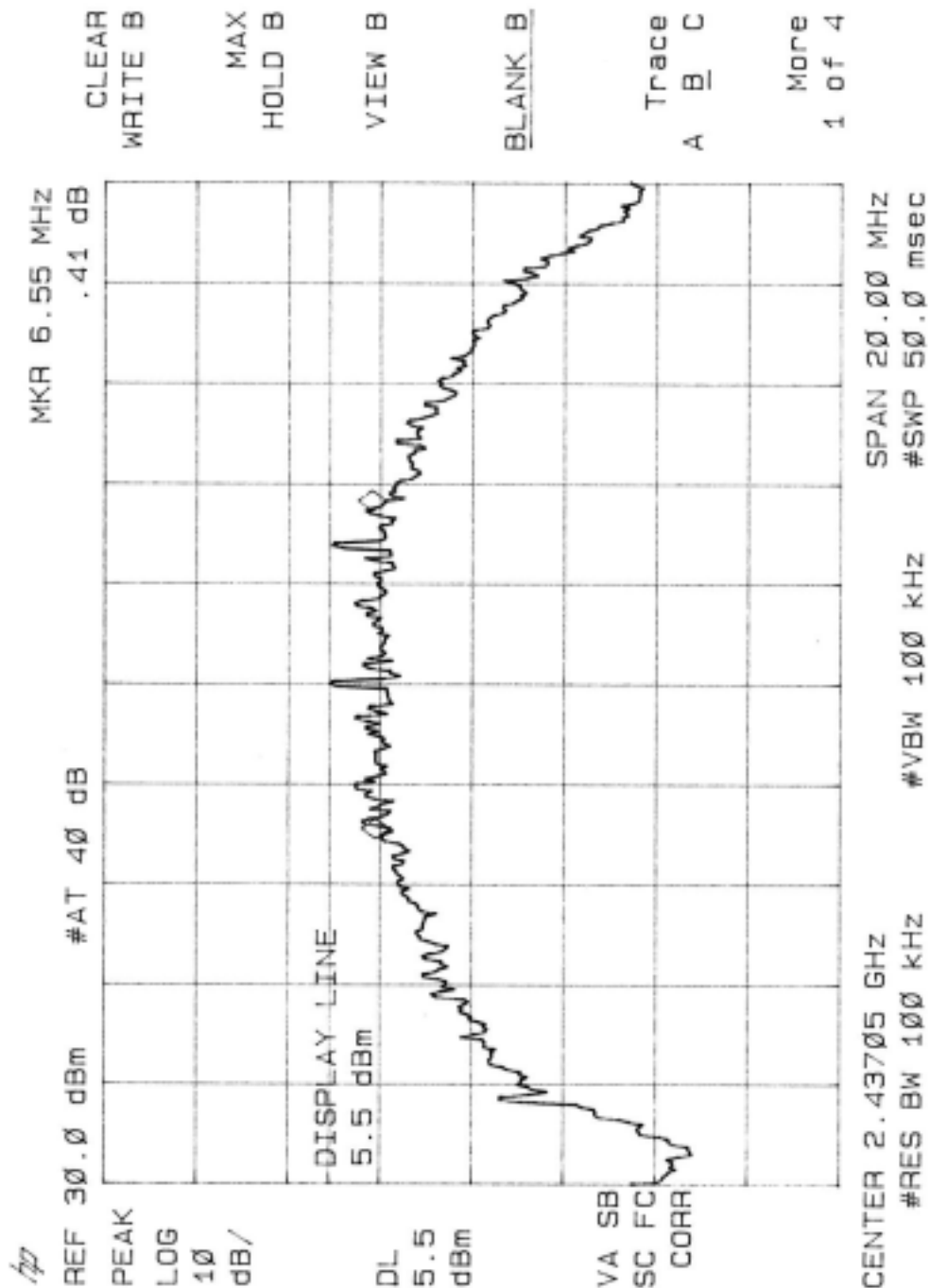
Display Line and Marker Delta functions, the 6dB band width of the emission was determined.

**Test Results:** Refer to attached spectrum analyzer data chart.

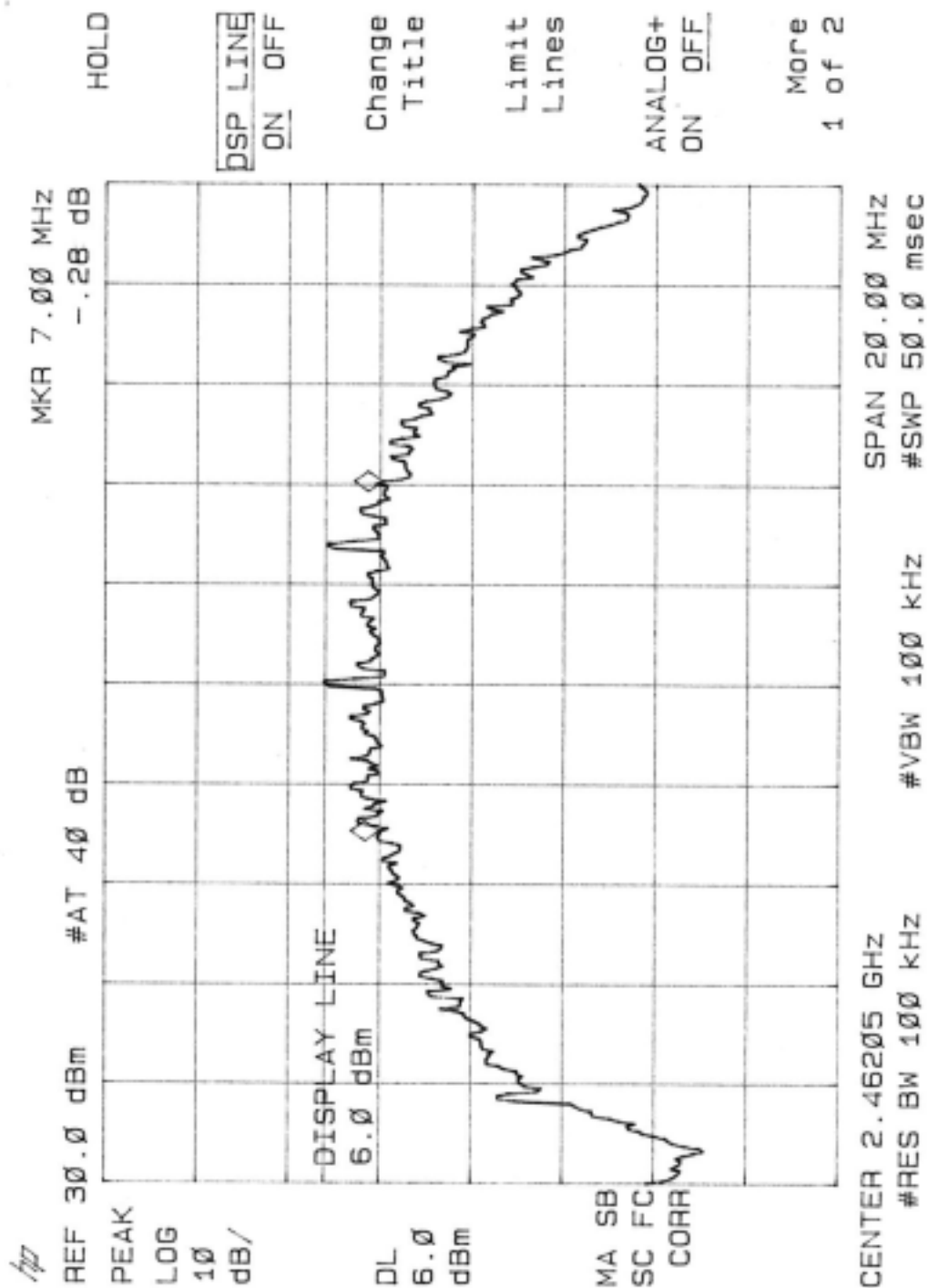
6dB band width >500KHz

- |                    |         |
|--------------------|---------|
| (1) 2412 MHz (Low) | 6.7MHz  |
| (2) 2437MHz (Mid)  | 6.55MHz |
| (3) 2462MHz (High) | 7.0MHz  |









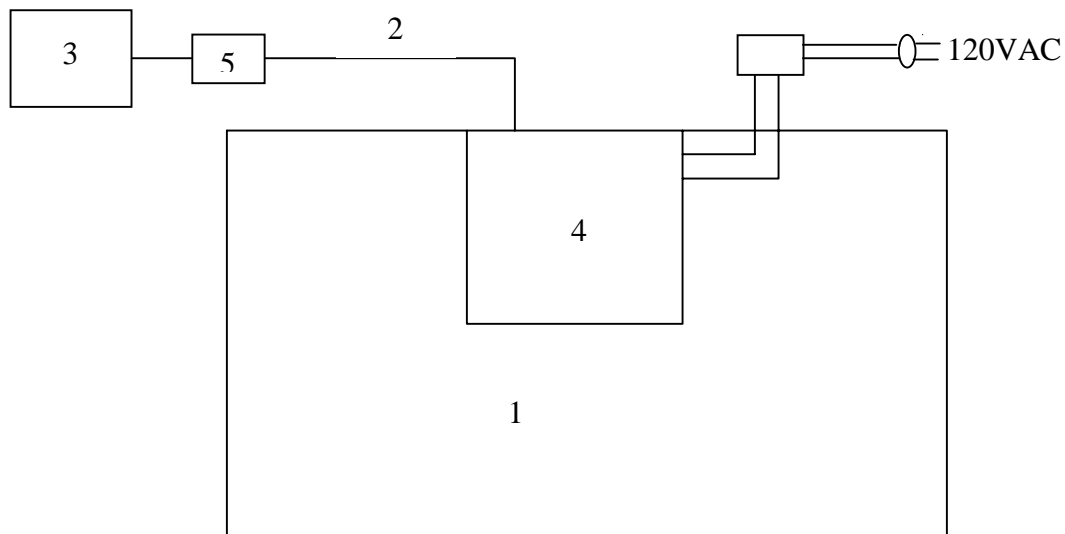
**RF POWER OUTPUT  
TEST REQUIREMENT: 15.247(b) ( CONDUCTED )**

**Measurement Equipment Used:**

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
HP Spectrum Analyzer	8566B	2937a06102	06/06/2002
ADVANTEST Spectrum Analyzer	R3271A	85060321	01/03/2002
HP Plotter	7475	2325A82294	N/A
HP Power Meter	436A	2709A29027	2/14/2002
Huber + Suhner low loss cable	Sucoflex 104	N/A	N/A

**Test Setup:**

1. Wooden table
2. Test cable
3. Power meter
4. Notebook Computer with built-in mini PCI
5. PAD



**Fig. 5**

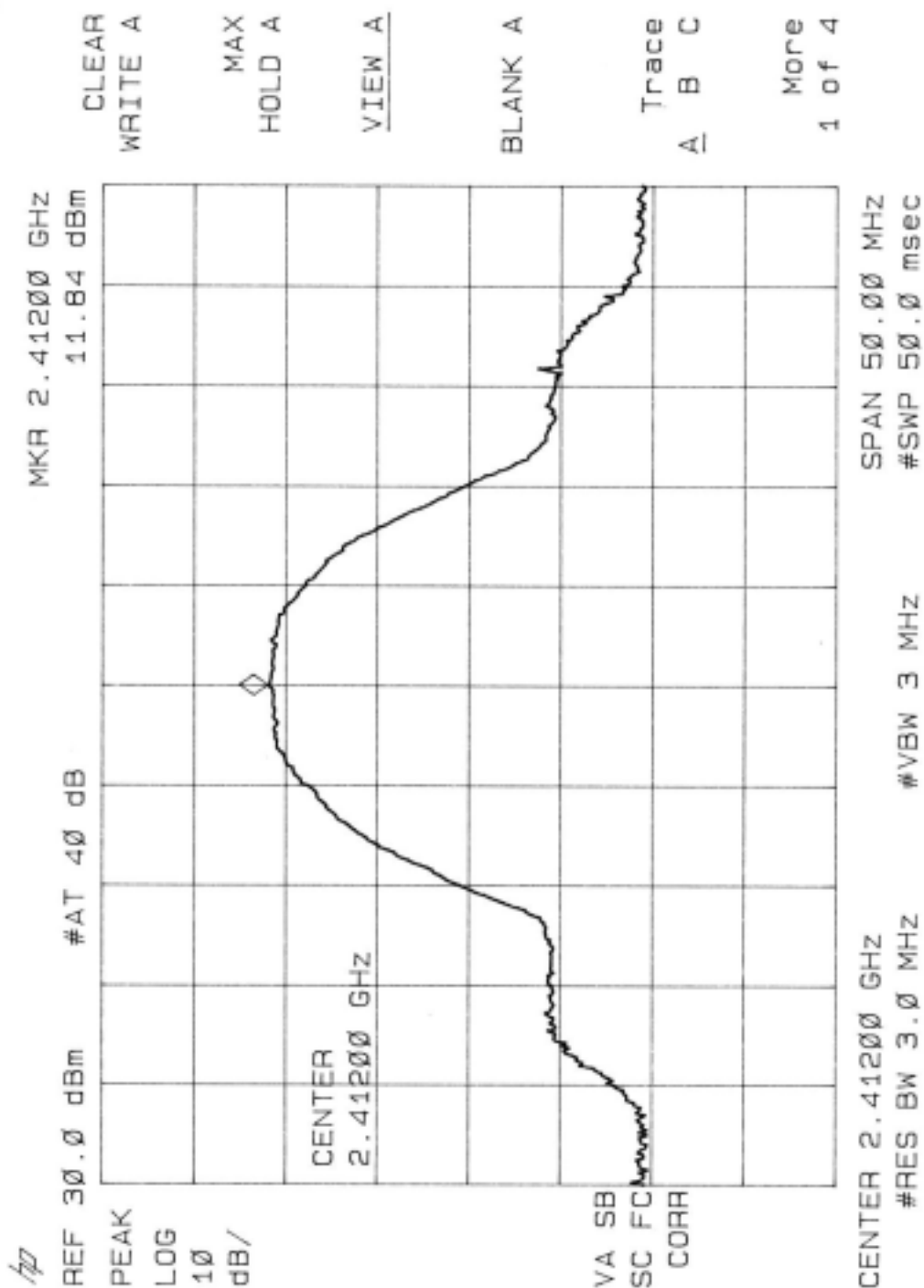
**Test Procedure**

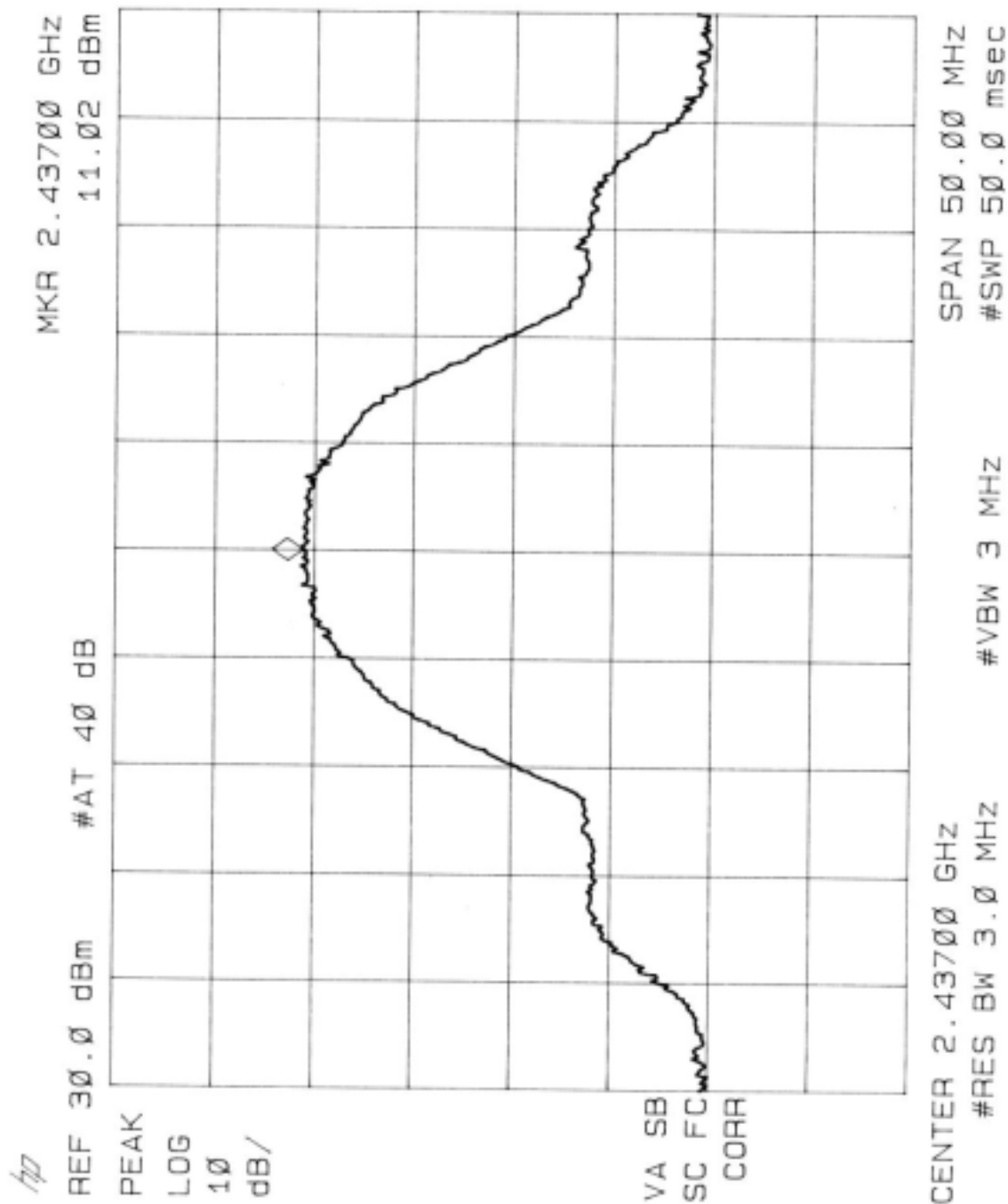
The RF power output was measured by using a HP power meter connected to the RF Antenna connector ( conducted measurement ) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the reference shape of the transmit signal see Fig. 5 for the measurement set up.

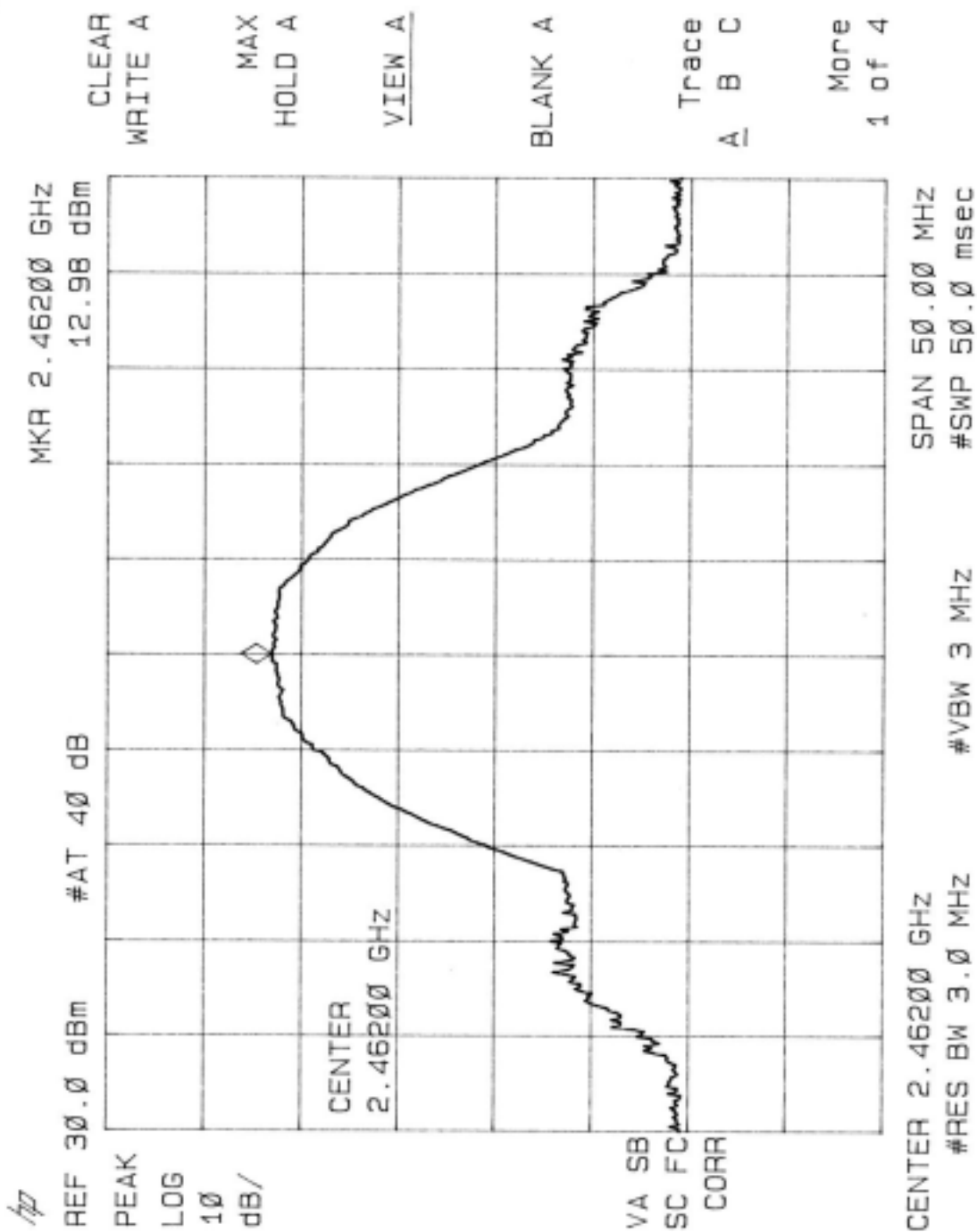
**Test Results :** Measured by using HP power meter, a reference wave shape please see the attached graph.

<b>TX Freq.(MHz)</b>	<b>Power Output (dBm)</b>	<b>Limit (dBm)</b>
2412 (Low)	12.93	30
2432 ( Mid )	12.95	30
2462 ( High )	13.02	30

Design goal for transmitter output power: 15dBm output.







## OUT OF BAND MEASUREMENTS

### TEST REQUIREMENT: 15.247(c)

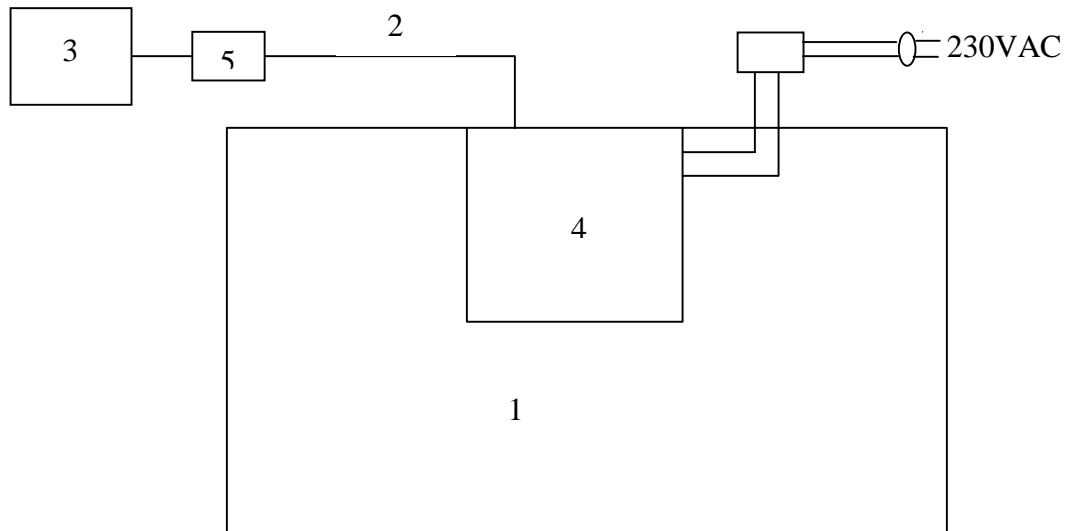
#### Measurement Equipment Used:

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
HP Spectrum Analyzer	8566B	2937A06102	06/06/2002
ADVANTEST Spectrum Analyzer	R3271A	85060321	01/03/2002
EMCO Horn antenna	3115	5761	02/23/2002
EMCO Horn antenna	3116	2487	08/24/2002
HP Plotter	7475	2325A82294	N/A
Huber + Suhner low loss cable	Sucoflex 104	N/A	N/A

#### Test Set-Up

Conducted

1. Wooden table
2. Test cable
3. Spectrum analyzer
4. Notebook Computer with built-in mini PCI
5. PAD



**Test Procedure:**

Section 15.247(c): Spurious emissions. The following tests are required:

- (1) RF antenna conducted test: Set RBW= 100kHz, Video bandwidth (VBW) > RBW, scan up through 10<sup>th</sup> harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100kHz RBW.
- (2) Radiated emission test: Applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp (and possibly a high-pass filter) is necessary for this measurement. For measurements above 1 GHz, set RBW= 1MHz, VBW= 10Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation, use the setting shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

**Test Results:**

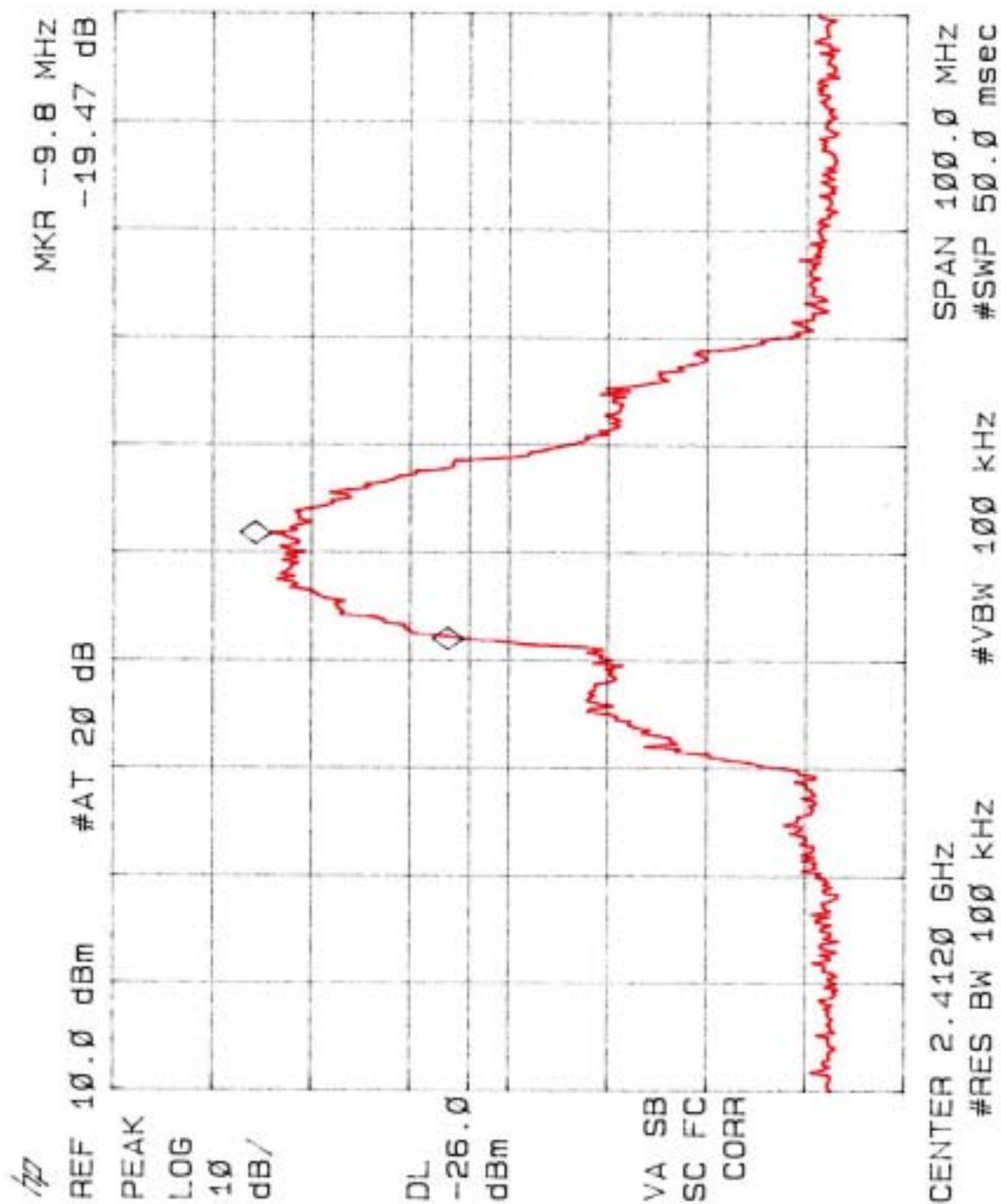
## a. Conducted

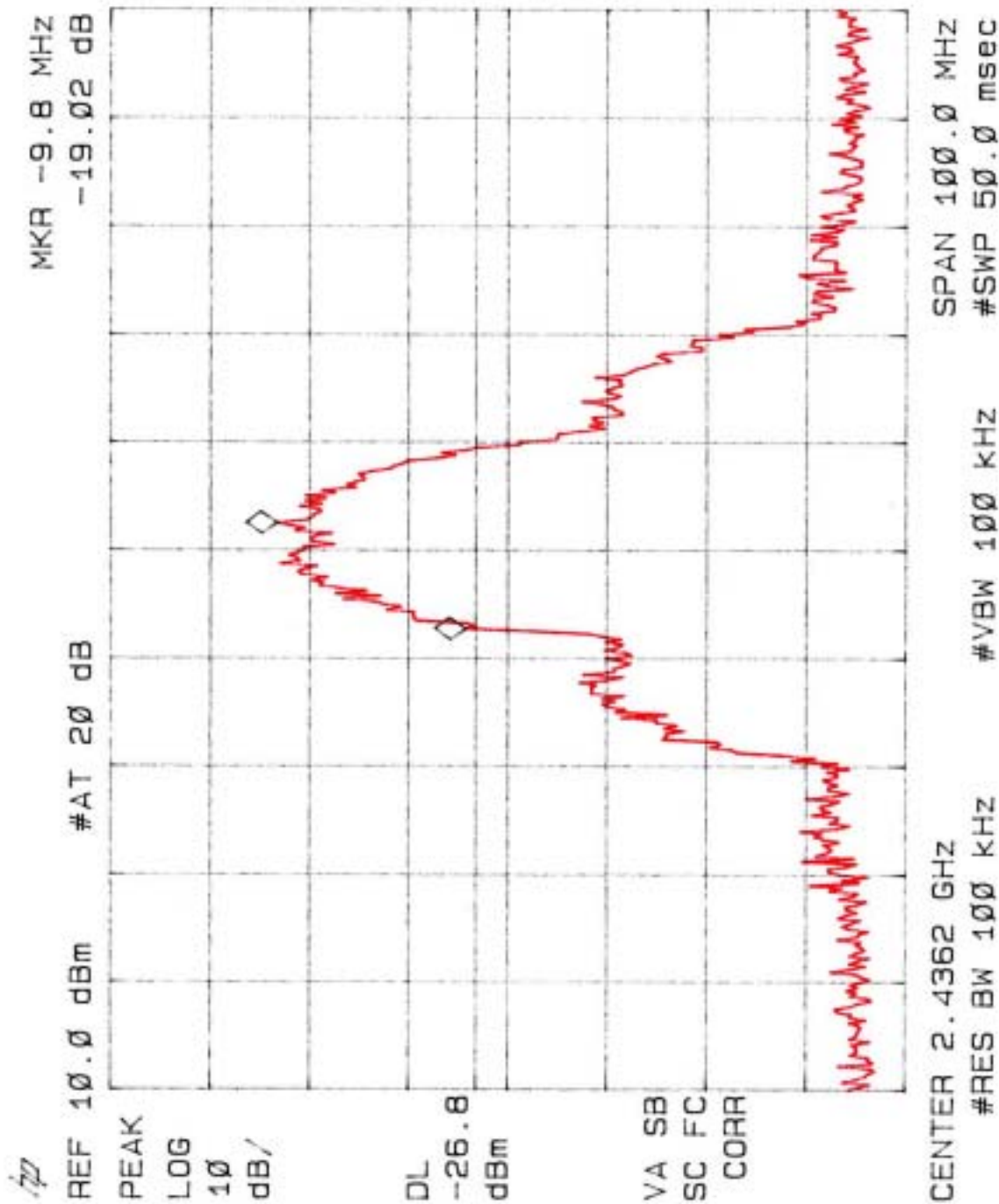
Refer to attached spectrum analyzer data chart.

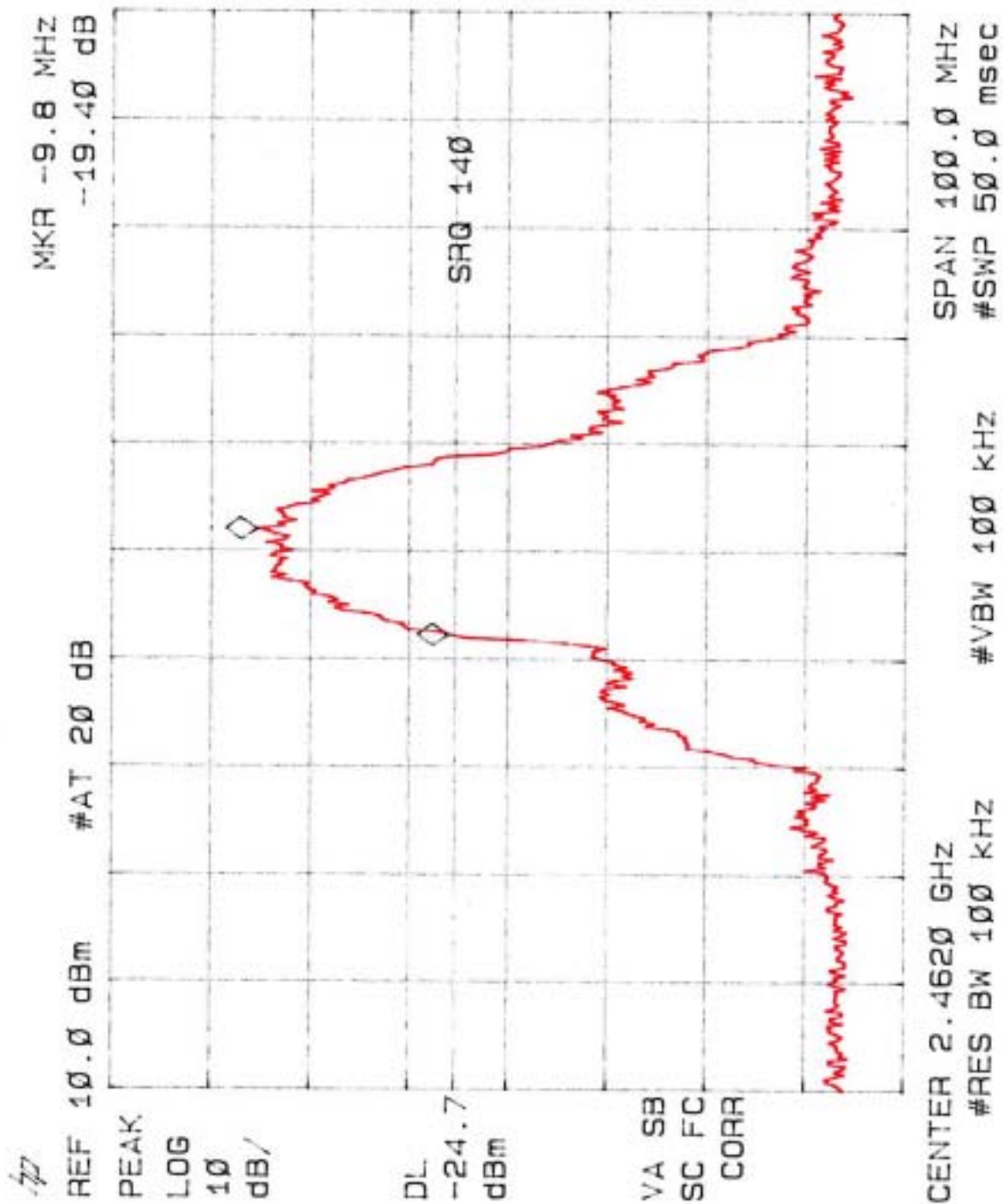
## b. Radiated

Refer to the section of “Radiated Emissions(General Requirements)”. Test requirement: 15.205, from P.5 to P. 10 of the measurements data.



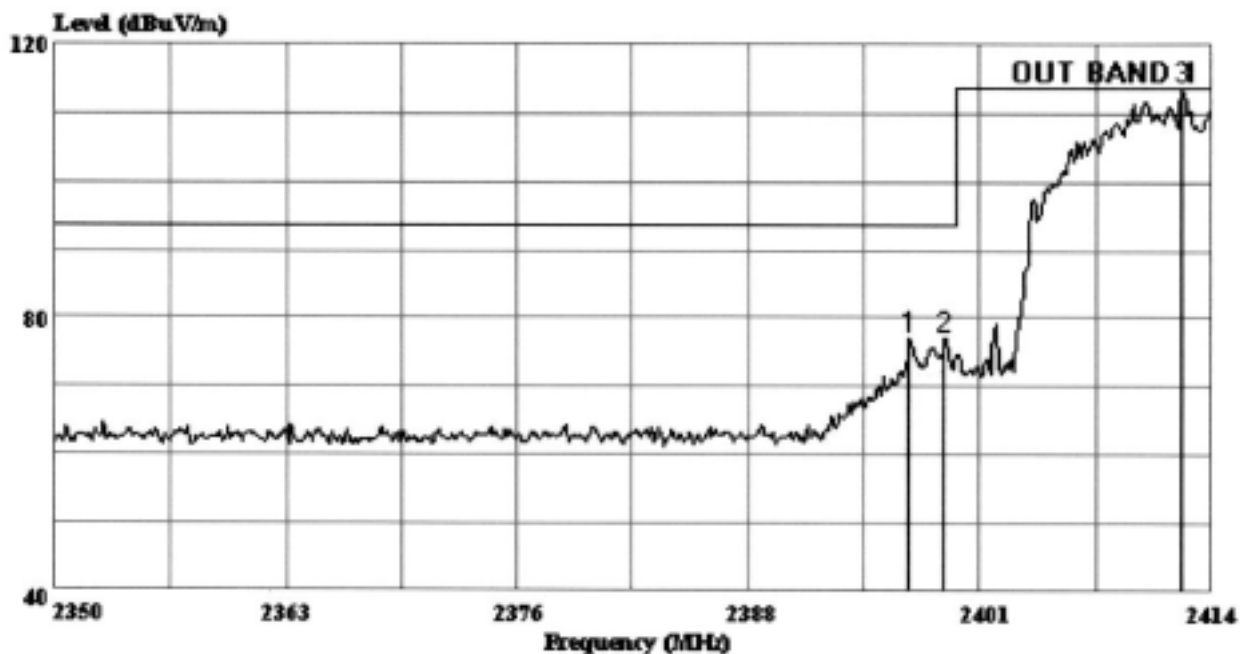






Data#: 18 File#: Fic.emi

Date: 2001-08-23 Time: 19:08:34



(CES Chamber)

Trace: 16

Ref Trace:

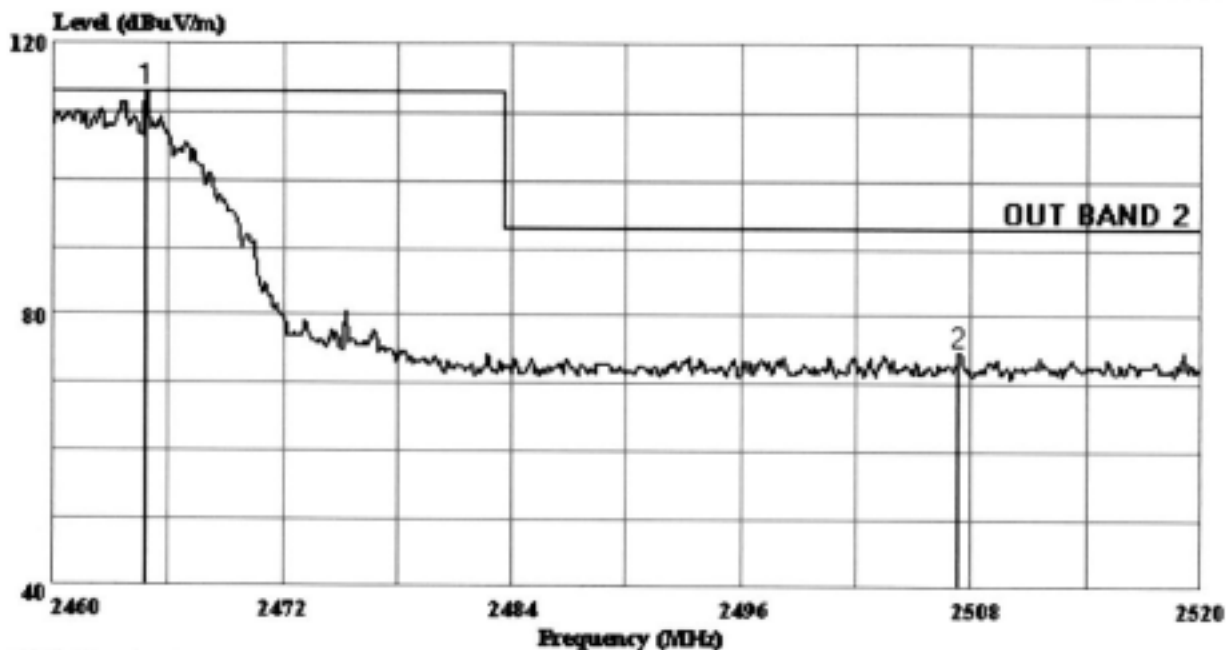
Condition:

Company : FIC  
 EUT : INTERGRATED WIRELESS LAN CARD  
 Test Config : EUT/ALL DEVICE  
 Type of Test: FCC CLASS B  
 Mode of Op. : CHANNEL 1

	Read Freq	Probe Level	Probe Factor	Cable Loss	Preamp Factor	Level
	MHz	dBuV	dB	dB	dB	dBuV/m
1	2397.296	72.20	0.00	4.87	0.00	77.07
2	2399.216	72.25	0.00	4.87	0.00	77.12
3	2412.336	108.86	0.00	4.88	0.00	113.74

Data#: 20 File#: Fic.emi

Date: 2001-08-23 Time: 19:17:32



(CES Chamber)

Trace: 19

Ref Trace:

Condition:  
 Report No. : 01E9726  
 Test Engr. : GEORGE  
 Company : FIC  
 EUT : INTERGRATED WIRELESS LAN CARD  
 Test Config : EUT/ALL DEVICE  
 Type of Test: FCC CLASS B  
 Mode of Op. : CHANNEL 11

	Read Freq	Level	Probe Factor	Cable Loss	Preamp Factor	Level
	MHz	dBuV	dB	dB	dB	dBuV/m
1	2464.740	108.08	0.00	4.96	0.00	113.04
2	2507.340	69.60	0.00	5.01	0.00	74.61

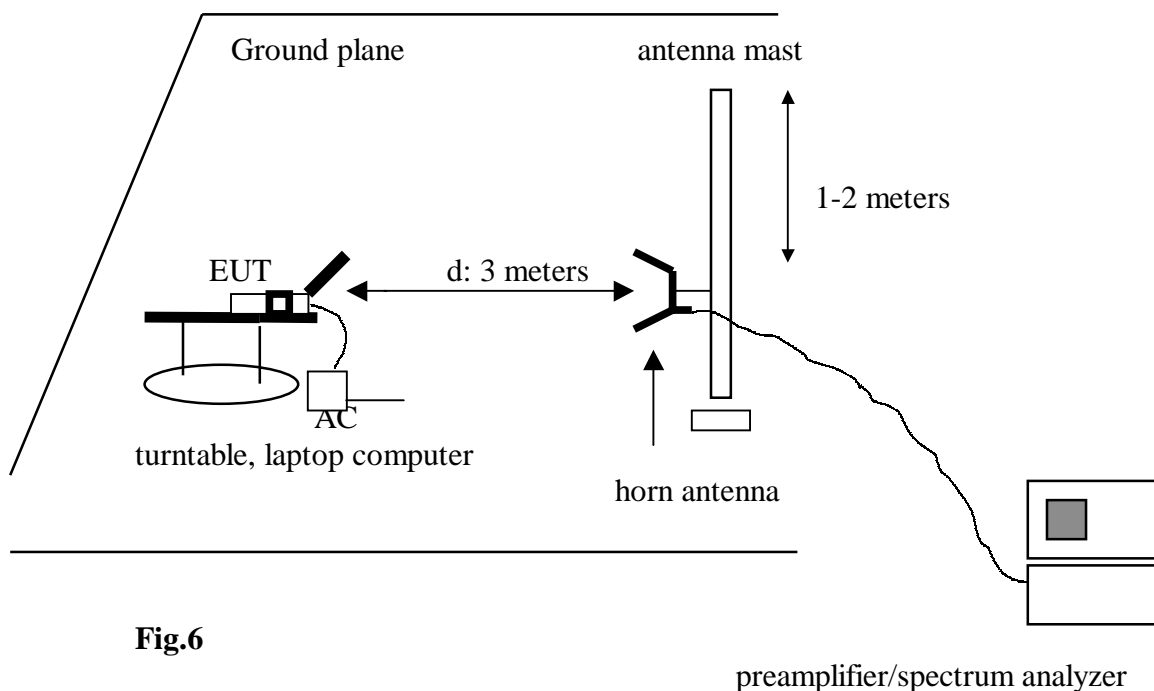
**DSSS POWER DENSITY**

**TEST REQUIREMENT: 15.247(d) ( CONDUCTED AND RADIATED )**

**Measurement Equipment Used:**

<i>Equipment</i>	<i>Model No.</i>	<i>Serial No.</i>	<i>Cal. Due.</i>
HP Spectrum Analyzer	8566B	2937A06102	06/06/2002
ADVANTEST Spectrum Analyzer	R3271A	85060321	01/03/2002
EMCO Horn antenna	3115	5761	02/23/2002
HP Plotter	7475	2325A82294	N/A
Huber + Suhner low loss cable	Sucpflex 104	N/A	N/A

**Test Set-up**



**Fig.6**

**Test Procedure**

## a. Conducted

The DSSS power Density was measured with a spectrum analyzer connected to the RF Antenna connector ( conducted measurement ) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used and then print out for recording the shape of the transmit signal, see Fig. 4 for the measurement set up.

## b. Radiated

output power levels were calculated from radiated emission levels.

The transmitter emissions so measured were compared to the 8 dBm limit in the Rules.

**Test Results**

a. Conducted Measurement

Refer to attached spectrum analyzer data chart.

b. Radiated Measurement

Refer to attached spectrum analyzer data chart and refer to Tabulated data follows:

Out of Band 15.247 (d)							Site: E Site (3 Meter)	
Company: First International Computer, Inc.								
EUT: 2.4GHz Mini PCI Wireless LAN								
F(GHz)	Reading	AF	CL	AMP	HPF	Total	Poer Density	Limit
	(dBuV)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBm)	(dBm)
2.412	50.16	28	4.8	0	0	82.96	-14.42	8
2.437	50.69	28	4.8	0	0	83.49	-13.89	8
2.462	47.42	28	4.8	0	0	80.22	-17.16	8

- AF:** Antenna Factor
- AMF:** Pre-amp gain
- CL:** Cable loss
- HPF:** High pass filter insertion loss

**Formulas used to calculate Power Density.**

Using the relationship between field strength and RF power into an isotropic transmit antenna:

$$E = (30 \times P \text{ watts})^{.5} / D$$

D: meters

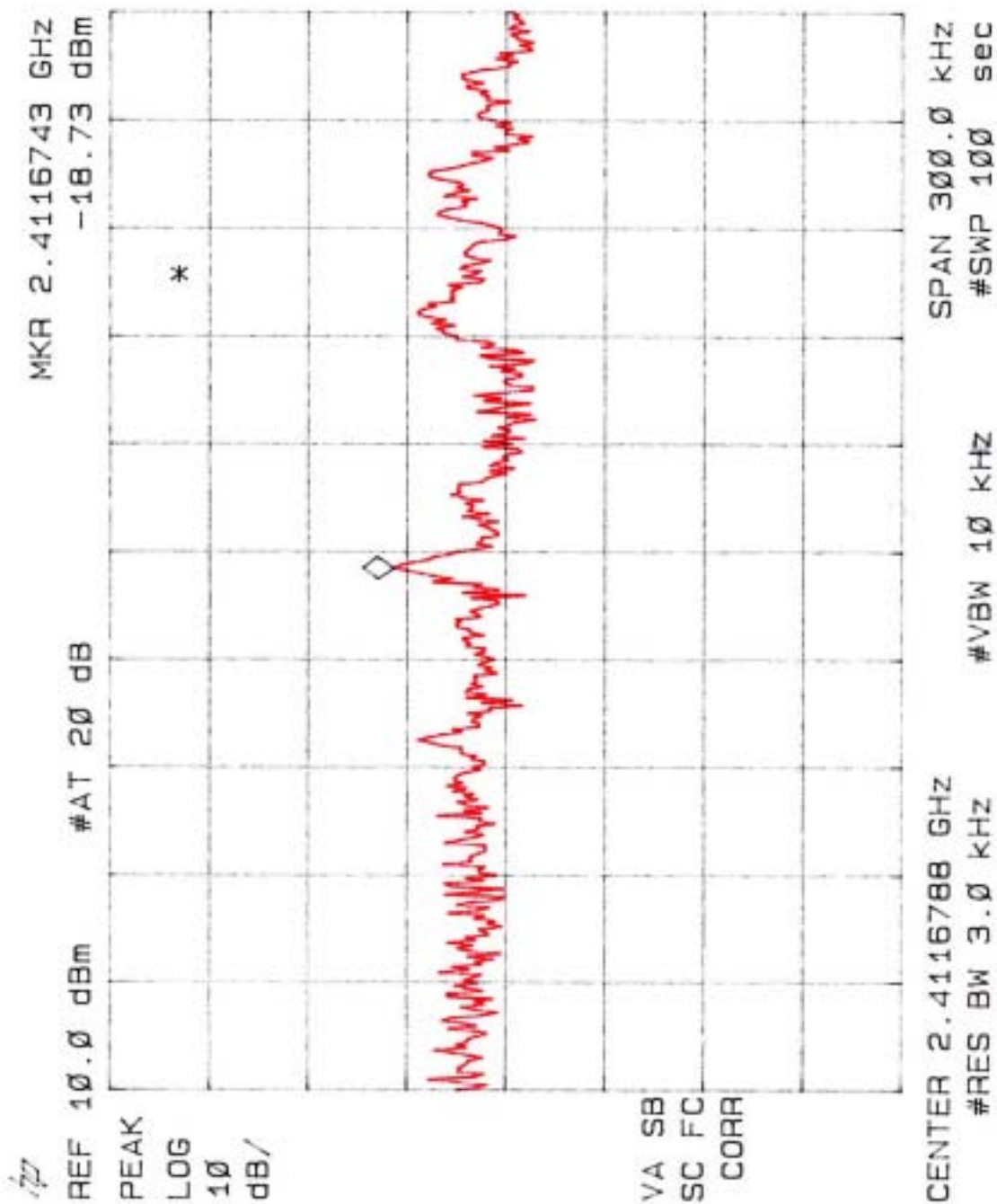
$$P(\text{Watts}) = (E(\text{V/m}) \times D(\text{meters}))^2 / 30G \qquad D = \text{Distance}$$

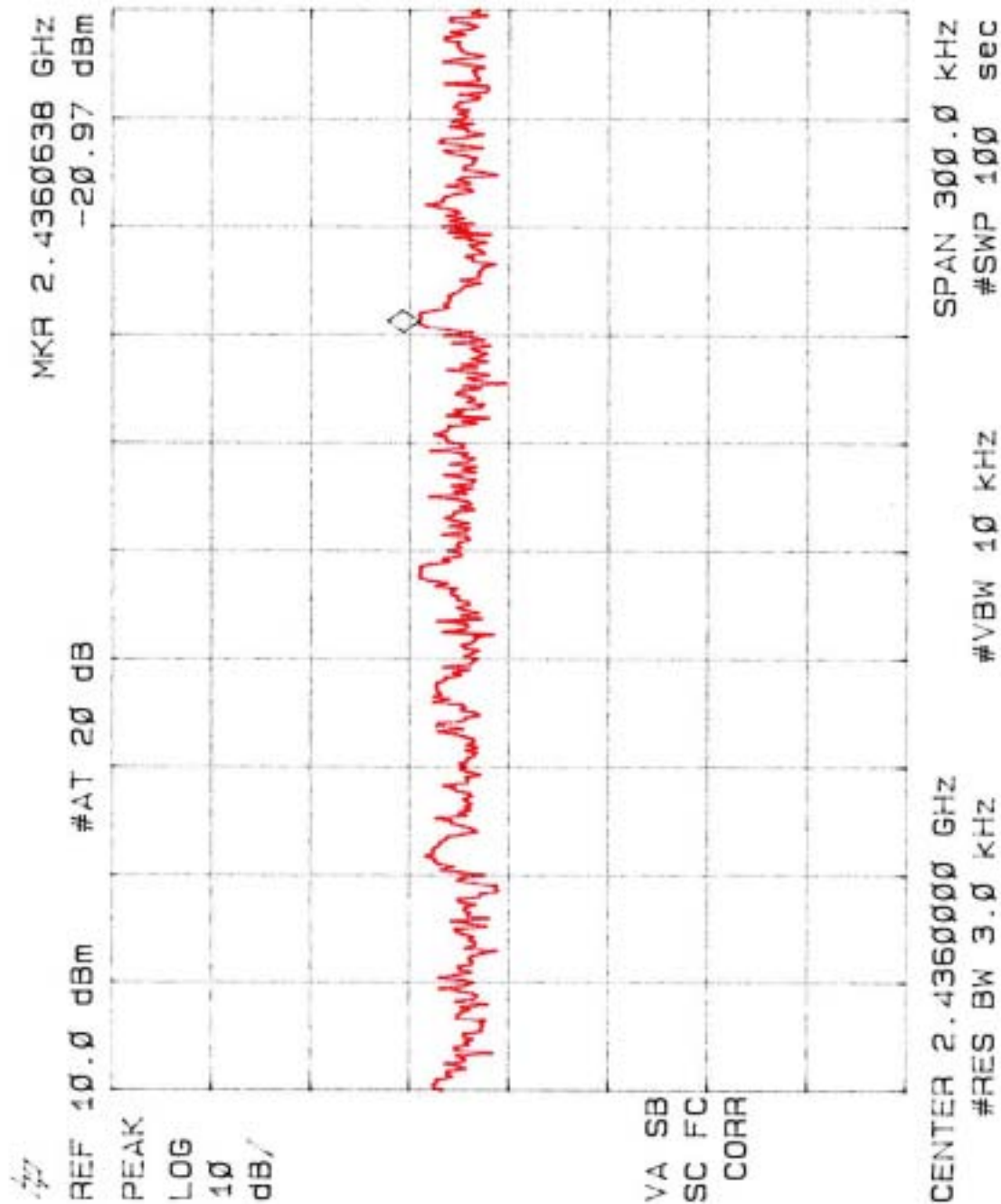
$$82.96 \text{ dBuVm} = .0140604752 \text{ V/m}$$

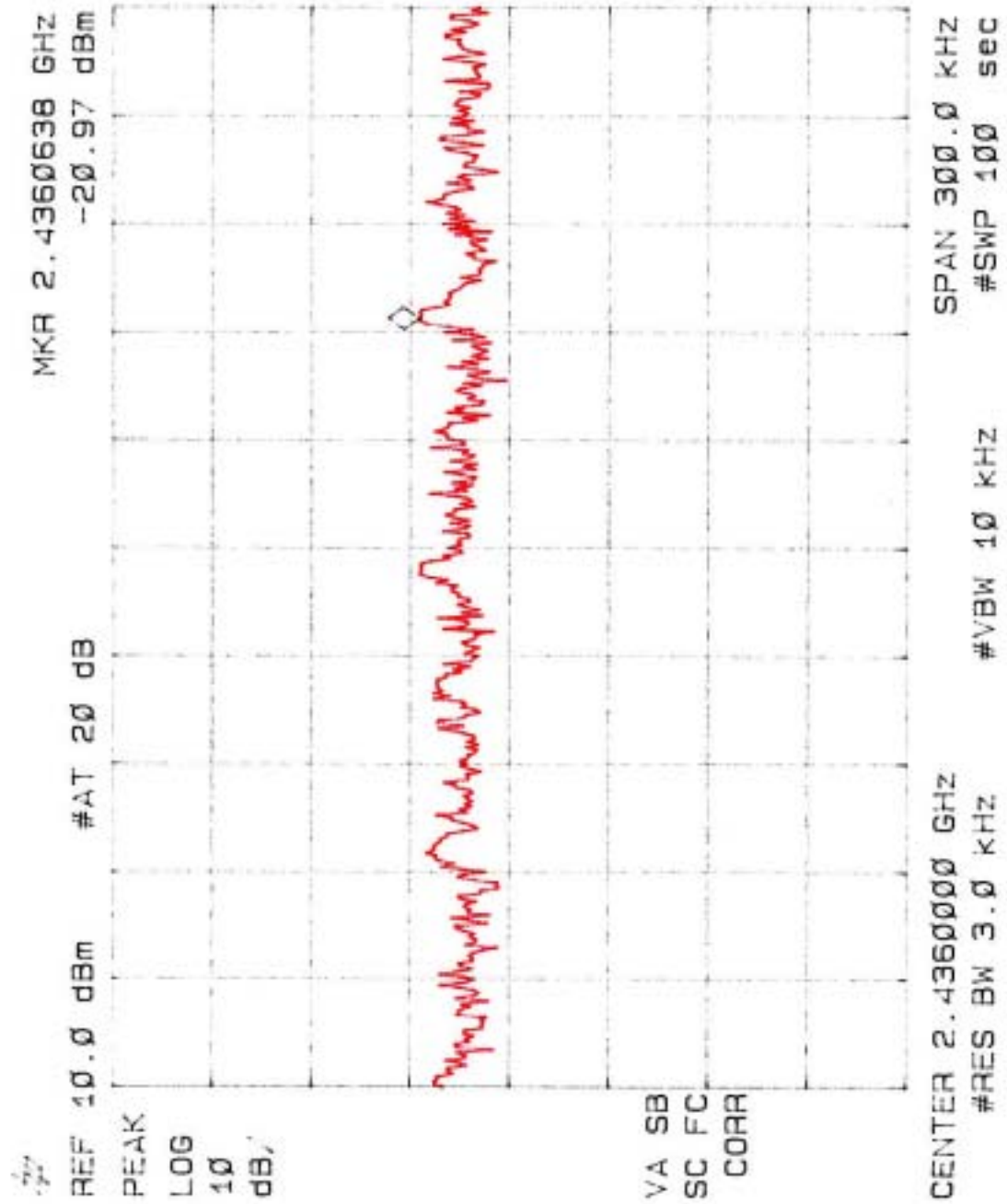
$$P(\text{Watts}) = (0.0140604752 \text{ V/m} \times 3 \text{ Meters})^2 / 49.2 = 0.000036164$$

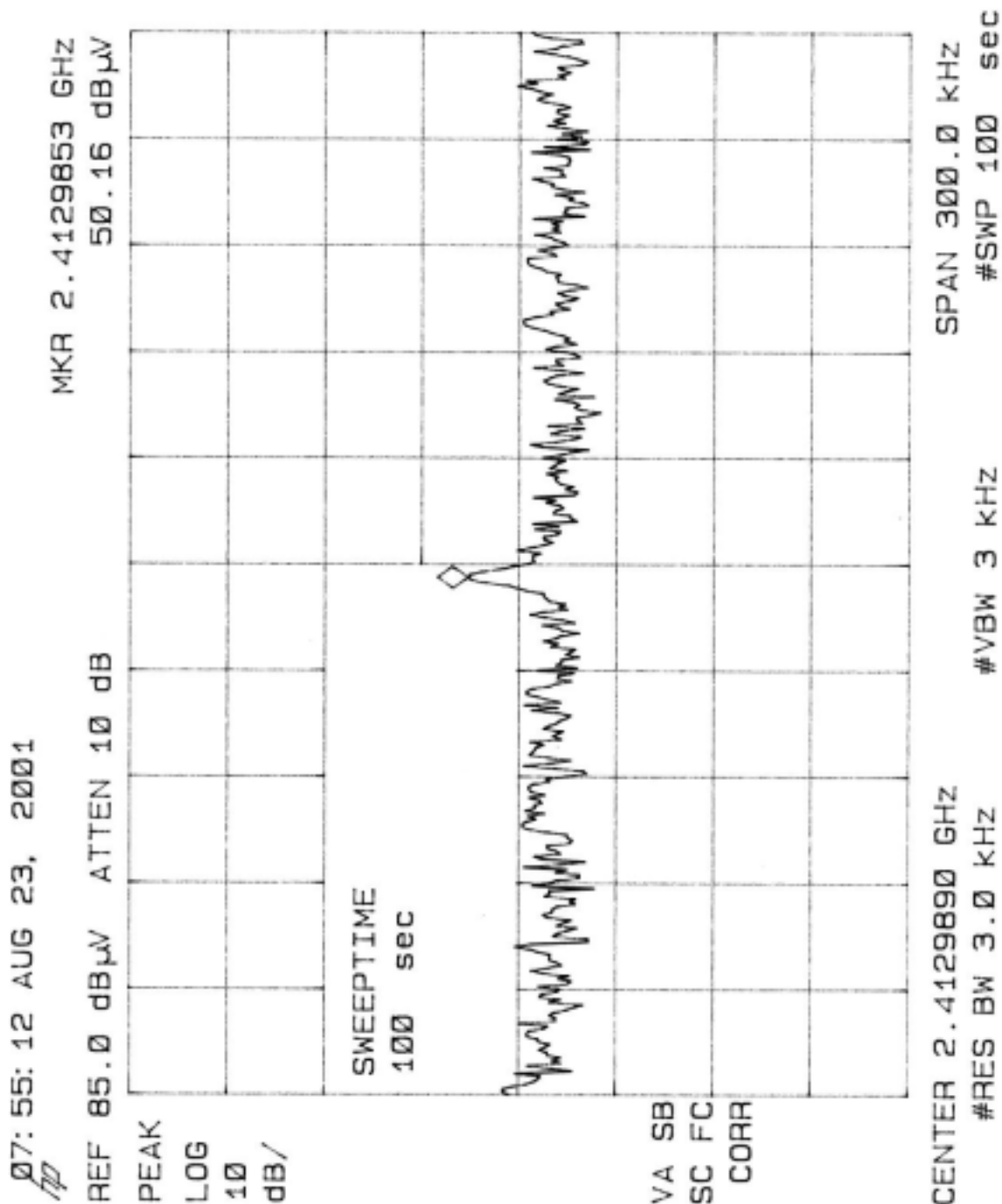
$$10 * \log(0.000036164 * 1000) = -14.42 \text{ dBm}$$

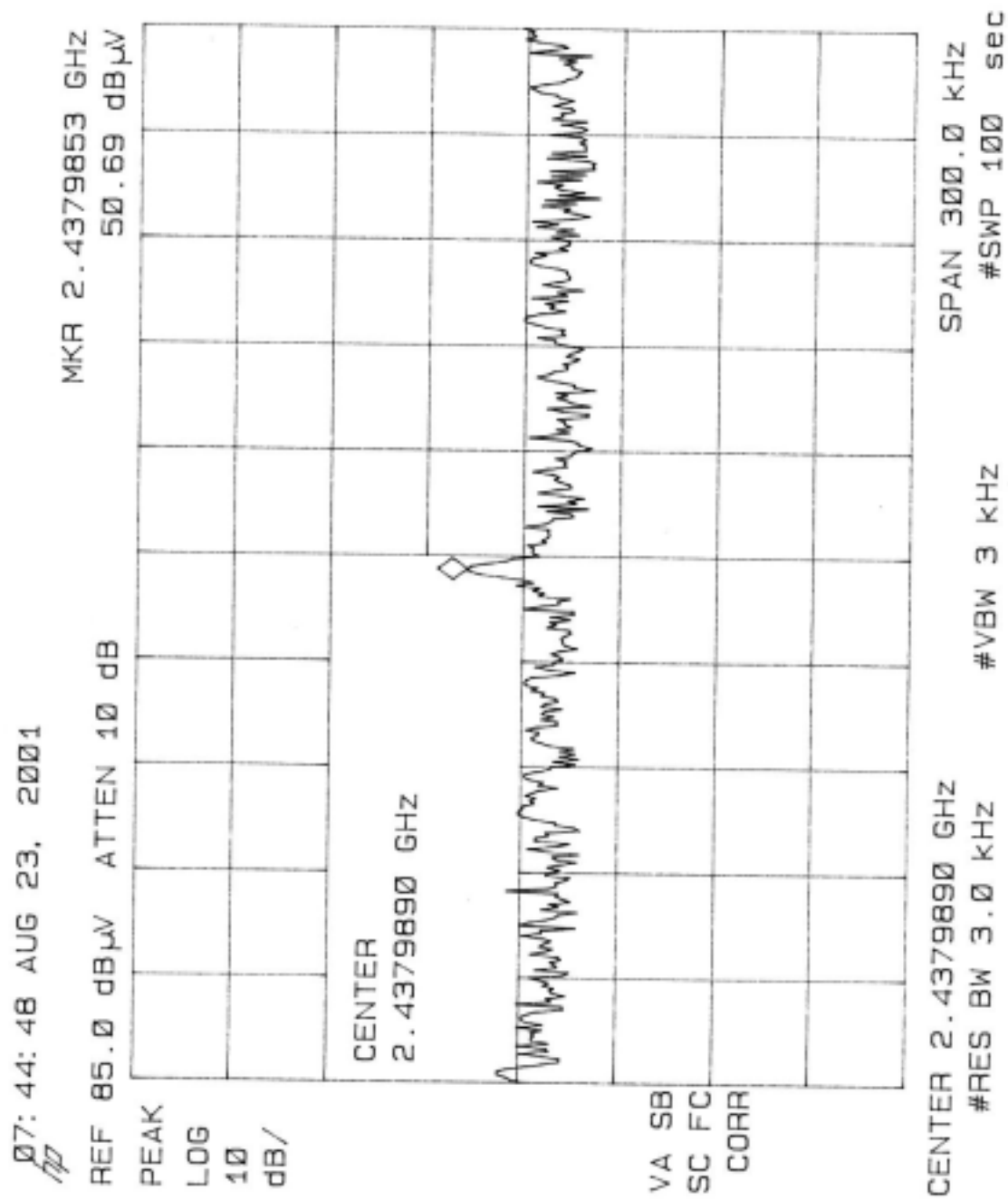


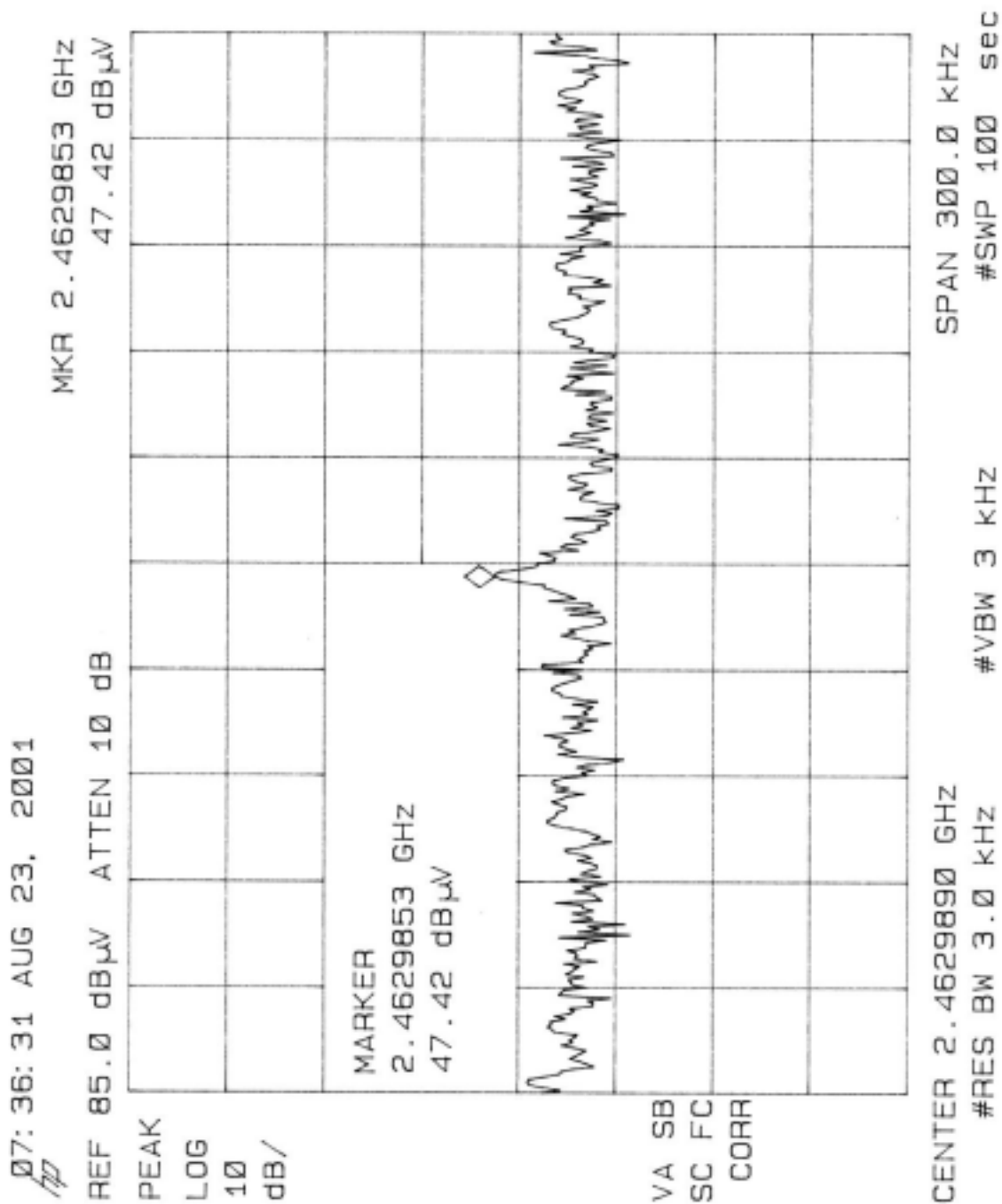












**PROCESSING GAIN OF A DSSS  
TEST REQUIREMENT: 15.247(e)**

Processing gain was performed by manufacturer. Please refer to the Test Report as following information provided by the manufacturer.

Lucent Technologies  
Bell Labs Innovators



Nederland B.V. WCND  
Report No. 015127, Rev. A

**TEST REPORT**

Subject: Processing Gain For the ORINOCO IEEE802.11b products

Ref.: FCC Rules 47 CFR Part 15, Section 5.247d

Report Prepared by:

Maarten Visee  
Name

\_\_\_\_\_  
Signature

July 28, 2000  
Date

Concurrence:

1. Director of Engineering

Bruce Tuch

Name

\_\_\_\_\_

Signature

August 10, 2000

Date

2. Team Captain

Frans Hoekstra

Name

\_\_\_\_\_

Signature

August 10, 2000

Date

Lucent WCND Confidential Information ©2000



FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

**0 Change History:**

Date	Section	Description
07/28/00, Rev. A		Initial release.

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

**1 . Summary:**

This document describes the Receiver Processing Gain verification measurements performed at the Lucent Technologies ORiNOCO IEEE802.11b products according to Ref.[2] and Ref.[5].

**2 . Conclusion:**

The Lucent Technologies ORiNOCO Mini PCI product conforms to the minimum required 10 dB processing gain, as set forth by the FCC for operation in the 2.4 GHz ISM band.

**3 . References:**

- 1- Document FCC 97-114, Appendix C, Guidance on Measurements for Direct Sequence Spread Spectrum Systems.
- 2- Hardware Functional Specification for WaveLAN-II Embedded, High Speed, Doc. No. 011735, Rev. A, Source Organization Lucent Technologies WCND Utrecht.
- 3- Viterbi, A. J., Principles of Coherent Communications, New York, McGraw-Hill 1966.
- 4- Proakis, J.G., Digital Communications, New York, McGraw-Hill 1989, page 270.
- 5- Hardware Functional Specification for the Lucent Technologies ORiNOCO Mini PCI, Doc. No. 015143, Source Organization Lucent Technologies WCND Utrecht.

**4 . Measurement description:**

**4.1 Test introduction - FCC requirements:**

Part of FCC certification for Lucent Technologies ORiNOCO IEEE802.11b High Speed compliant Network Interface Cards (NIC) is a processing gain test. This test proves that the receiver of the tested product employs a true spread spectrum device receiver structure, taking full advantage of the direct sequence spread spectrum modulation technique.

This test verifies the receiver processing gain to be 10 dB or more for a data rate of 1, 2, 5.5 and 11 Mbit/s, by monitoring the Bit Error Rate (BER) of the product under test for each data rate, while operating under strict defined received signal conditions.

Several methods of showing compliance to the rules are possible, from a stepped CW jammer to a continuous sweeping CW interferer. For this test the discrete stepped CW jammer method was chosen, as described in Ref.[1].

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

Therefore a receiver input signal is applied to the product under test, in the presence of a Continuous Wave (CW) interference source, also referred to as CW jammer.

The test takes place at the product Functional Specification (Ref.[2], Ref.[5]) specified conditions for BER rate measurements, specifying a BER equal or better than  $10^{-8}$  at a receiver input level of -55 dBm. For practical reasons these test are performed at -55 dBm or -53 dBm. This small deviation from the Functional Specification should not cause any deviation from the specified Bit Error Rate, since the received levels are well above the thermal noise.

The test criteria for meeting the minimal processing gain is such that it takes the theoretical calculated SNR for the applied modulation technique and specified BER as a reference. From this given SNR the processing gain is subtracted, yielding the CW Jammer to Signal ratio J/S. From Ref. [4], likewise as Ref.[3] consulted in Ref. [1], it is determined that for a BER of  $10^{-8}$  the SNR (S/N)<sub>o</sub> equals:

13 dB @ 1 Mbit/s,  
15 dB @ 2 Mbit/s,  
15 dB @ 5.5 Mbit/s,  
18 dB @ 11 Mbit/s.

Thus the J/S ratio for a processing gain of 10 dB that must be met is calculated as:

-13 + 10 = -3 dB @ 1 Mbit/s (DBPSK),  
-15 + 10 = -5 dB @ 2 Mbit/s (DQPSK),  
-15 + 10 = -5 dB @ 5.5 Mbit/s (CCK),  
-18 + 10 = -8 dB @ 11 Mbit/s (CCK).

Two types of measurement corrections are allowed for as described in Ref.[1]. The first taking into account 2 dB implementation losses, thus increasing the absolute J/S ratio by 2 dB.

The second correction allows for deleting the 20% worst-case frequencies in the processing gain test that causes the test at that CW interference to fail. This implies that for the considered 14 MHz wide measurement interval the worst case 57 CW jammer frequencies can be ignored, being those that result in received data errors/missing frames (20% of 14 MHz \* (1 MHz/50 KHz) + 1 = (20% \* 281) + 1 = 57).

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

Therefore a receiver input signal is applied to the product under test, in the presence of a Continuous Wave (CW) interference source, also referred to as CW jammer.

The test takes place at the product Functional Specification (Ref.[2], Ref.[5]) specified conditions for BER rate measurements, specifying a BER equal or better than  $10^{-8}$  at a receiver input level of -55 dBm. For practical reasons these test are performed at -55 dBm or -53 dBm. This small deviation from the Functional Specification should not cause any deviation from the specified Bit Error Rate, since the received levels are well above the thermal noise.

The test criteria for meeting the minimal processing gain is such that it takes the theoretical calculated SNR for the applied modulation technique and specified BER as a reference. From this given SNR the processing gain is subtracted, yielding the CW Jammer to Signal ratio J/S. From Ref. [4], likewise as Ref.[3] consulted in Ref. [1], it is determined that for a BER of  $10^{-8}$  the SNR (S/N)<sub>0</sub> equals:

13 dB @ 1 Mbit/s,  
15 dB @ 2 Mbit/s,  
15 dB @ 5.5 Mbit/s,  
18 dB @ 11 Mbit/s.

Thus the J/S ratio for a processing gain of 10 dB that must be met is calculated as:

-13 + 10 = -3 dB @ 1 Mbit/s (DBPSK),  
-15 + 10 = -5 dB @ 2 Mbit/s (DQPSK),  
-15 + 10 = -5 dB @ 5.5 Mbit/s (CCK),  
-18 + 10 = -8 dB @ 11 Mbit/s (CCK).

Two types of measurement corrections are allowed for as described in Ref.[1]. The first taking into account 2 dB implementation losses, thus increasing the absolute J/S ratio by 2 dB.

The second correction allows for deleting the 20% worst-case frequencies in the processing gain test that causes the test at that CW interference to fail. This implies that for the considered 14 MHz wide measurement interval the worst case 57 CW jammer frequencies can be ignored, being those that result in received data errors/missing frames (20% of 14 MHz \* (1 MHz/50 KHz) + 1 = (20% \* 281) + 1 = 57).

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000  
sequence is repeated until received data errors or missing  
frames are detected.

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

Now instead of a quick error scan using 1000 frames, 50000 frames (equals  $10^8$  bits) are transmitted to verify the BER. For this test the CW jammer level is lowered 1 dB, compared to the CW jammer level at which the first receive data errors and/or missing frames were detected. All the measurement results are recorded for later use.

After completion of the 50000 frames BER test, the spreading gain verification test continues by raising the CW jammer frequency by 50 KHz and re-setting the CW jammer level to the start value, taken from the controller configuration file. For this new CW frequency the measurements are repeated as described above (see Annex A).

All CW frequencies and power levels are listed in a command-file that is read by the controller at start up.

Before measurements are started, the receiver input level and CW jammer level need to be calibrated. See figure 1 for the test set-up.

The test takes place at an arbitrarily chosen channel, being channel two (2417 MHz).

#### 4.3 Receiver level calibration:

The receiver input level is calibrated using the RF power meter. For this purpose, the reference transmitter output attenuator is set to 0 dB. The CW jammer is disabled during the calibration. Using the RF power meter at the receiver input of the device under test, the received level at the receiver input is measured for a continuous active reference transmitter. The attenuator value is calculated to achieve a received level of -55 dBm. Finally the attenuator is adjusted to this value.

#### 4.4 CW level calibration:

The reference transmitter is disabled during this calibration. The CW jammer generator output level is set to 0 dBm, and the RF power meter value is read. The difference in CW output level setting and RF power meter measured at receiver input of the device under test is the attenuation of the test set-up. This is the correction factor that needs to be applied for analysis of the measurements results.

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

5 .	Equipment used:
# Item needed	Description
1	Portable PC with WaveLAN-II NIC, Zenith 2-lite, SN-3GSAZW000061, for receiver.
1	Portable PC with WaveLAN-II NIC, NCR 3150, SN 17-26106224, for transmitter.
1	Software 'Testware, V5.09', Rev. 0, <TW.EXE>, 141456 bytes, 12-13-1998. Used for the transmitter and receiver.
2	WaveLAN Turbo NIC IEEE802.11b ORINOCO Mini PCI card IEEE802.11b
1	PC + IEEE interface card, NCR PC6, SN 17-17039925 and CEC PC<->488 interface card.
1	Received error checker, wire-wrap prototype, Lucent WCND designed and built.
1	Power supply, Delta D030-1, for error checker.
1	Spectrum Analyzer, HP 9592B SN 3009U00102.
1	Power Meter, Rohde & Schwarz, Millivolt meter URV5, SN 893430/070.
1	Power Sensor, Rhode & Schwarz, type NRV-Z2 828218.02, SN 860925/005.
1	CW jammer generator, Gigatronics 7200, SN 746604.
1	Variable attenuator, 0-70 dB, Midwest Microwave, Model 1044.
2	Fixed attenuator, 10 dB, Inmet Corp., model 18AH-10.
1	RF power splitter, ARRA 3-9200-2, SN 2001.
1	Misc. IEEE cabling.
1	Misc. SMA cabling.
1	RF shielded cage.

FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

**6 . Measurement set\_up:**

The test setup is given below in Figure 1, measurement test set-up. To avoid interference that can disrupt the measurement, the whole test is performed within a RF shielded cage.

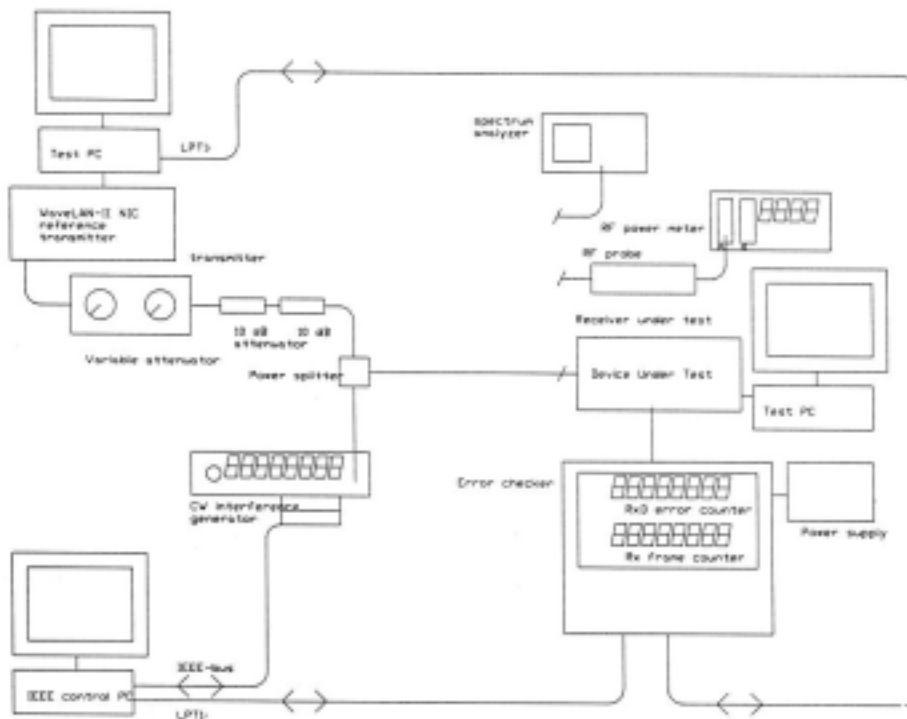


Figure 1, measurement test set-up.



FCC Processing Gain Measurements Results,  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000

## 7 Measurement results:

### 7.1 Calibrations:

Receiver calibration 1, 2, 5.5 and 11 Mbit/s: For 0 dB total attenuator setting the received level at the receiver input equals +10 dBm.

Test setting: the fixed attenuator is chosen to be 20 dB, the variable attenuator is set to 45, respectively 43 dB attenuation.

CW jammer generator calibration: For a 0 dBm output level at the generator the received level at the receiver input is -6 dBm.

### 7.2 Processing Gain Measurement Results:

For each CW jammer frequency between  $F_c \pm 7$  MHz, being the receiver bandwidth, a BER measurement is taken.

For each CW measurement frequency the jammer level is varied from -66 dBm to -58 dBm at the receiver input, yielding a J/S ratio of -11 to -3 dB, respectively -13 to -5 dB.

For some CW frequencies received data errors/missing frames are detected while performing the BER test.

Applying the allowed margin of 2 dB implementation losses for 1 Mbit/s, a 1 dB implementation loss for 5.5 and 11 Mbit/s, and no implementation loss for 2 Mbit/s, together with the rule of discarding the 20% worst-case jamming/signal points (Ref.[1]), results in meeting the specified BER for which less than 20% of the measured CW interference frequencies were found to cause received data errors and/or missing frames.

These percentage numbers are respectively 16% @ 1 Mbit/s, 3% @ 2 Mbit/s, 17% @ 5.5 Mbit/s and 18% @ 11 Mbit/s.

Therefore, a J/S ratio better or equal to -5 dB @ 1 Mbit/s, -5 dB @ 2 Mbit/s, -7 dB @ 5.5 Mbit/s and -9 dB @ 11 Mbit/s is measured.

### 7.3 Measurement Conclusion:

The tested product complies to the required Processing Gain of 10 dB for a data rate of 1, 2, 5.5 and 11 Mbit/s, as set forth in Ref. [1].

Annex A, ORiNOCO FCC Processing Gain Measurements, Controller  
Flow Chart  
Report No. 015127, Rev. A.

Lucent WCND Confidential ©2000  
Annex A: Flow-Chart IEEE control program

