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LIST OF EXHIBITS

MEASUREMENT/TECHNICAL REPORT

Zoom Telephonics, Inc. - Trade Name: ZOOM 230 Board
Models: 1450, 4000 and 4005
FCC ID: BDNWLANPCCARD1
September 1998

This report concerns (check one:) Original Grant__X__ Class II Change_____

Equipment Type: Wireless LAN PC Card (example: computer, printer, modem, etc.)

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes___ No_X_

If yes, defer until: _____
date

Company Name agrees to notify the Commission by: _____
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Transition Rules Request per 15.37? Yes___ No_X_

If no, assumed Part 15, Subpart C for intentional radiator - the new 47 CFR [10-1-97 Edition] provision.

Report prepared by:

Michael J. Peters
Intertek Testing Services NA Inc.
70 Codman Hill Road
Boxborough, MA 01719
Phone: 978-263-2662
FAX: 978-263-7086

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EXHIBIT 1

GENERAL DESCRIPTION

1.0 General Description

1.1 Product Description

A PCMCIA card that provides an interface between a PCMCIA-compatible computer and a wireless Ethernet network based on the IEEE 802.11 Ethernet standard. The card can operate with or without an access point to a wired network. If an access point is not used, thedevice can communicate with another wireless ethernet adapter and will function as a peer-to-peer workgroup LAN. If used with an access point, the Adapter will provide access to a wired network just like a standard wired Ethernet adapter.

Zoom Telephonics would like to certify 3 models under FCC ID: BDNWLANPCCARD1. The models are listed below and please see the attached letter from Zoom Telephonics.

1450 Wirless LAN PC Card
4000 Zoom/Wirless LAN PC Card
4005 Zoom/Wireless LAN PC Card and Adapter Card

1.2 Related Submittal(s) Grants

The Zoom 230 Board is one device that falls under two parts of the FCC rules. FCC Part 15, Subpart B Class B which Zoom will file Declaration of Conformity and FCC Part 15, Subpart C 15.247. One application, one certification, FCC identifier and application fee is required.

1.3 Test Methodology

Both AC mains line-conducted and radiated emission measurements were performed according to the procedures in ANSI C63.4 (1992). All measurements were performed in Open Area Test Sites. Preliminary scans were performed in the Open Area Test Sites only to determine worst case modes. For each scan, the procedure for maximizing emissions in Appendices D and E were followed. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

Intertek Testing Services emissions test sites at 593 Massachusetts Avenue, Boxborough Massachusetts are registered with the FCC (Refer to 31040/SIT 1300F2) and under the NAVLAP program (NAVLAP Lab Code: 100270-0).

ZOOM

Statement of Modification Filing

To Whom this May Concern:

The different model numbers are for Marketing and/or Packaging purposes only. Please note that the following model numbers are the same product:

- 1450
- 4000
- 4005

If you have any questions, please do not hesitate to contact me. I may be reached by voice on 617.753.0583, via facsimile at 617.542.8276, or via the internet at *allens@zoomtel.com* if you prefer.

Sincerely,

Allen R. Sangco
Compliance Administrator

Zoom Telephonics, Inc.
207 South Street, Boston, MA 02111
Tel 617 423-1072
Fax 617 423-3923
Web Site: www.zoomtel.com

EXHIBIT 2

SYSTEM TEST CONFIGURATION

2.0 System Test Configuration

Test Equipment List:

Some of the following measurement equipment were used during compliance testing:

EQUIPMENT LIST TABLE 1					
Abbr	Equipment	Manufacturer	Model	Serial	Cal Due
ANT1	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	1649, 1650, 1651	25Apr98
ANT2	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	1831, 1850, 1852	11Jun98
ANT3	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	668, 523, 533	15Apr98
ANT4	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	3317, 3245, 3352	03Jul98
ANT5	BROADBAND ANTENNA	COMPLIANCE DESIGN	B1000	1670, 1671, 1672	29May98
CLMP1	ABSORBING CLAMP	FISCHER CUSTOM	F-201	122	30Apr98
CLMP2	ABSORBING CLAMP	FISCHER CUSTOM	F-201	297	16Jan99
DIP1	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	402	30-Jan-99
DIP2	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	506	24Jun98
DIP3	TUNED DIPOLE SET	COMPLIANCE DESIGN	A100	3947	23Jan99
HORN1	HORN ANTENNA	EMCO	3115	4632	03Jul98
HORN2	HORN ANTENNA	EMCO	3115	4675	02Sep98
HORN3	HORN ANTENNA	EMCO	3116	2090	11Feb99
HP1	SPECTRUM ANALYZER	HEWLETT PACKARD	8591	3308A01445	12May98
HP2	SPECTRUM ANALYZER	HEWLETT PACKARD	8591	3346A02319	25Jun98
HP3	SPECTRUM ANALYZER	HEWLETT PACKARD	8593A	3009A00659	30Apr98
LISN1	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	871083	15Jan99
LISN10	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941712	24May98
LISN11	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941713	23May98
LISN12	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	941714	25Aug98
LISN13	LISN	SOLAR ELECTRONICS	9252-50-R-24-BNC	955107	15Jan99
LISN14	LISN	SOLAR ELECTRONICS	6338-5-TS-50-N	871131	27Jan99
LISN15	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	865575	1/10/98
LISN2	LISN	SOLAR ELECTRONICS	6338-5-TS-50-N	871132	27Jan99
LISN3	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	8379114	14Jan99
LISN4	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	837929	15Jan99
LISN5	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934610	05Jun98
LISN6	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934611	23May98
LISN7	LISN	SOLAR ELECTRONICS	8012-50-R-24-BNC	934612	05Jun98
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	871047	08Jul98
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	871055	08Jul98

EQUIPMENT LIST TABLE 2					
Abbr	Equipment	Manufacturer	Model	Serial	Cal Due
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	883147	08Jul98
LISN8	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	883151	08Jul98
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953947	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953948	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953949	14Jan99
LISN9	LISN	SOLAR ELECTRONICS	8028-50-TS-24-BNC	953950	14Jan99
LOG1	BICONOLOG ANTENNA	EMCO	3142	1116	1/13/99
LOG2	BICONOLOG ANTENNA	EMCO	3142	1223	12/6/98
LOOP1	LOOP ANTENNA	EMPIRE DEVICES	LG105	61	17Jan99
LOOP2	LOOP ANTENNA	EMPIRE DEVICES	LP105	905	17Jan99
LOOP3	LOOP ANTENNA	EMCO	6509	9612-1403	05Jun98
PRB1	LINE PROBE	SOLAR ELECTRONICS	8614-1	932725	24May98
PRB2	LINE PROBE	SOLAR ELECTRONICS	8614-1	932731	08Jul98
PRB3	LINE PROBE	SOLAR ELECTRONICS	9533-1	955905	24May98
PRE1	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1648	02Apr98
PRE2	PREAMPLIFIER	COMPLIANCE DESIGN	P950	5107	02Apr98
PRE3	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1828	02Apr98
PRE4	PREAMPLIFIER	COMPLIANCE DESIGN	P950	1844	02Apr98
PRE5	PREAMPLIFIER	COMPLIANCE DESIGN	P950	PROTO1	02Apr98
PRE6	PREAMPLIFIER	HEWLETT PACKARD	8447D	1937A03354	10Apr98
PRE7	PREAMPLIFIER	HEWLETT PACKARD	8447D	2944A08718	16Apr98
PRE8	PREAMPLIFIER	MITEQ	NSP4000-NF	507145	9/25/98
REC1	RECEIVER	HEWLETT PACKARD	8542	3520A00125	06Nov98
REC1	RF FILTER	HEWLETT PACKARD	85420	3427A00126	06Nov98
REC2	RECEIVER	HEWLETT PACKARD	85422	3625A00188	04Jan99
REC2	RF FILTER	HEWLETT PACKARD	8542	3427A00177	04Jan99
REC3	RECEIVER	HEWLETT PACKARD	8546A	3325A00160	09May98
REC3	RECEIVER	HEWLETT PACKARD	8546A	3330A00158	09May98
SCOPE1	OSCILLOSCOPE	TEKTRONIX	TDS380	B011379	07Oct98
SIG1	SIGNAL GENERATOR	HEWLETT PACKARD	8648B	3537A01040	10Apr99
TEK1	SPECTRUM ANALYZER	TEKTRONIX	2784	B010153	25Apr98

2.1 Justification

The transmitter was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in ANSI C63.4 (1992).

During testing, the peripheral locations were not varied with respect to the main unit.

The arrangement of the cables dangling from the rear of the table was varied to the extent possible to produce the maximum emissions.

For maximizing emissions, the system was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed. This step by step procedure for maximizing emissions led to the data.

2.2 EUT Exercising Software

The unit was configured to transmit continuously on three different frequencies; high, medium and low. Radiated emissions testing was performed with hop stopped and while hopping. During emissions testing of the unintentional radiator, the device was installed a computer peripheral within the guidelines of ANSI C63.4(1992).

2.3 Special Accessories

There are no special accessories necessary for compliance of this product.

Confirmed by:

Michael J. Peters
Staff Engineer, Emissions
Intertek Testing Services NA Inc.
Agent forZoom Telephonics, Inc.

Michael J. Peters
Signature

9-29-98
Date

2.4 Equipment Modification

Any modifications installed previous to testing by Zoom Telephonics, Inc. will be incorporated in each production model sold/leased in the United States.

No modifications were installed by Intertek Testing Services NA Inc.

Confirmed by:

Michael J. Peters
Staff Engineer, Emissions
Intertek Testing Services NA Inc.
Agent for Zoom Telephonics, Inc.

Michael J. Peters
Signature

9-29-98
Date

2.5 Support Equipment List and Description

The FCC ID's for all equipment, plus descriptions of all cables used in the tested system (included inserted cards, which have grants) are:

Mouse:	Microsoft P/N: 58267 S/N: 00865704 FCC ID: C3KSMP1
Laptop:	Toshiba Laptop M/N: PA1253U XCD S/N: 58743377A FCC ID: Not Labeled
Monitor:	NANAO M/N: MA-1760 S/N: A7585023-USM FCC ID: GCJMA-1760
Printer:	Hewlett Packard M/N: DeskJet 400 S/N: SG65A1B0KF FCC ID: B94C2642X
Modem:	US Robotics M/N: Sportster 14,400 S/N: 0002670002389841 FCC ID: CJE-0216
AC Adapter:	US Robotics M/N: AA-0950

2.5 Support Equipment List and Description (con't)

Cables:

(1) Serial, (1m, shielded, metal hood)
(1) Parallel, (1m, shielded, metal hood)
(1) Video Cable (1m, shielded, metal hood)
(2) AC Adapter (1m, unshielded)
(1) Power Cord (1.5, unshielded)

2.6 Test Configuration Block Diagram

The following diagram illustrates how the equipment under test was arranged onthe table top (1.0m x 1.5m) when tested as a digital device.

Figure 2.6 Configuration of Tested System

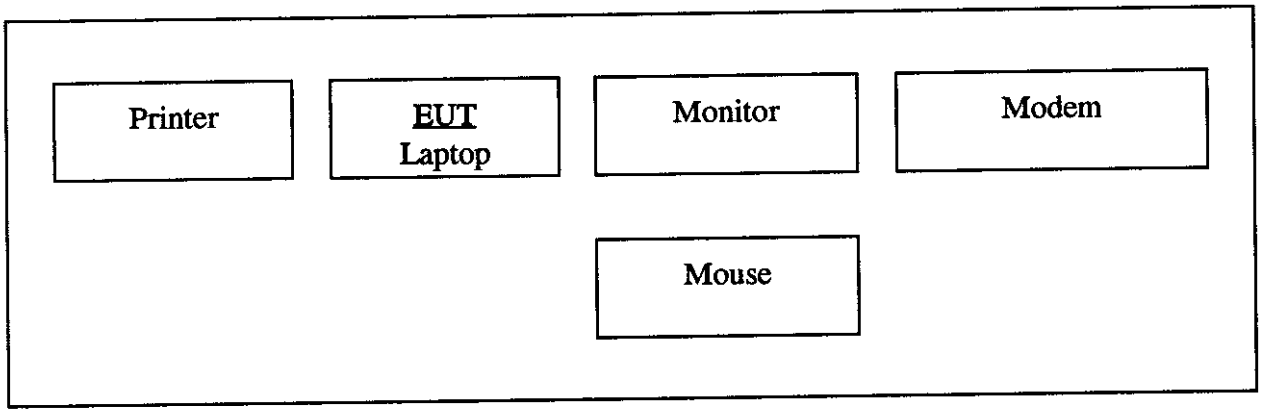


EXHIBIT 3

EMISSION RESULTS

3.0 Emission Results

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

3.1 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD - AV

where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB
PD = Pulse Desensitization in dB
AV = Average Factor in dB

In the radiated emission table which follows, the reading shown on the data table may reflect the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Assume a receiver reading of 62.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted. The pulse desensitization factor of the spectrum analyzer was 0 dB, and the resultant average factor was -10 dB. The net field strength for comparison to the appropriate emission limit is 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV/m
AF = 7.4 dB
CF = 1.6 dB
AG = 29.0 dB
PD = 0 dB
AV = -10 dB
FS = 52 + 7.4 + 1.6 - 29 + 0 - 10 = 32 dBμV/m

Level in μV/m = Common Antilogarithm [(32 dBμV/m)/20] = 39.8 μV/m

3.2 Radiated Emission Configuration Photograph

The following pages are photos of the radiated emissions testing set-up.

3.3 Radiated Emission Data

The data on the following page lists the significant emission frequencies, the limit and the margin of compliance. Numbers with a minus sign are below the limit.

Channel Frequency (MHz)	Emission Frequency (MHz)	Margin (dB)	RBW* (Khz)	Distance (MHz)	Table #
2437	227.6	-5	120	3	1
2437	1010 & 1112	-13	1000	3	2
2411	10,685	-5	1000	1	4
2437	10,785	-3	1000	1	5
2462	10,910	-8	1000	1	6

*RBW and VBW for the entire emissions scan.

*All readings are peak unless stated otherwise

TEST PERSONNEL:

Vathana F. Ven

Tester Signature

Vathana F. Ven, Compliance Engineer

Typed/Printed Name

9/29/98

Date

Intertek Testing Services

Emissions Site 3 Boxborough, MA

Table:1

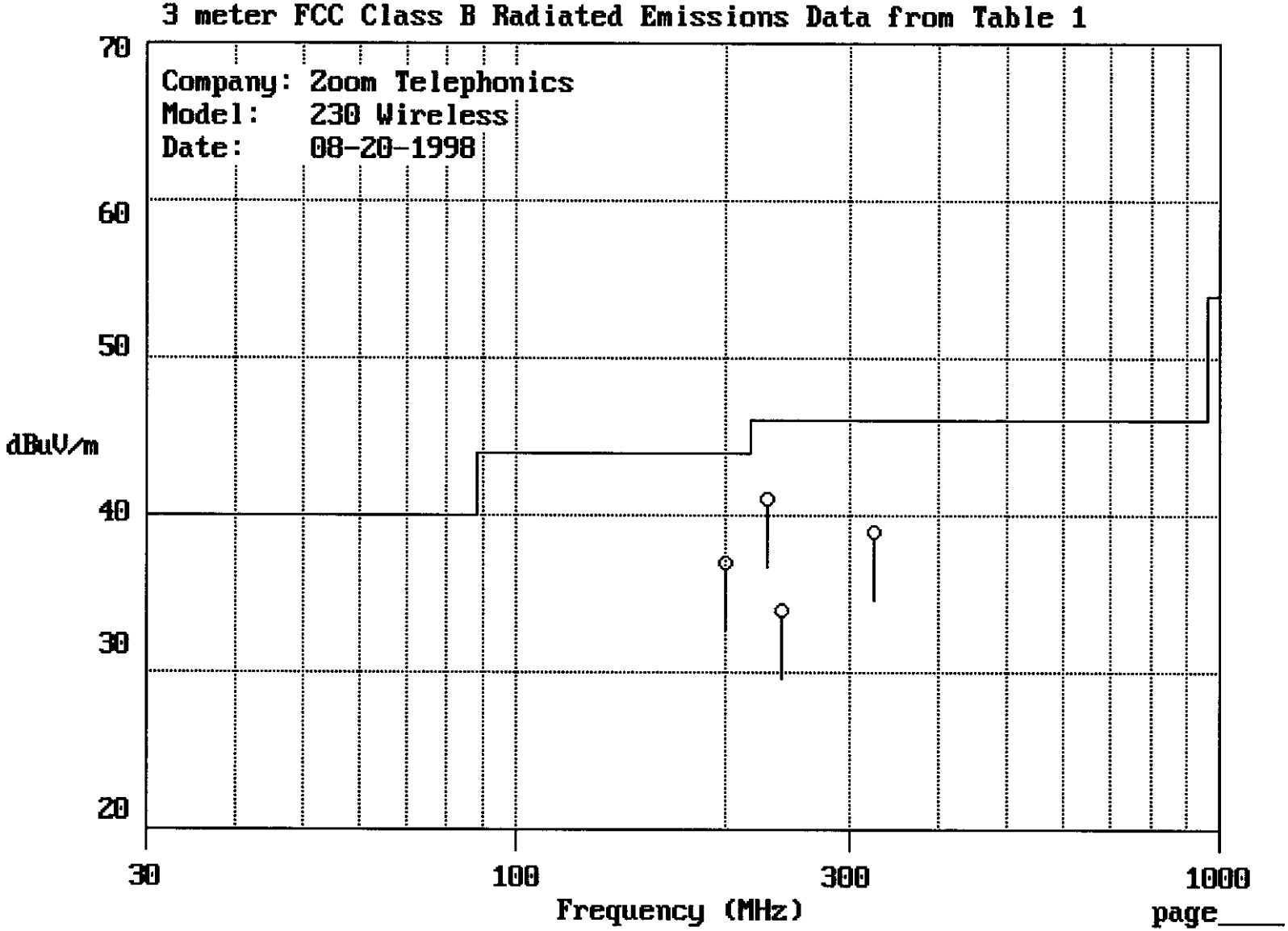
Company: Zoom Telephonics Model: 230 Wireless

Notes: Initial scan

FCC Class B Radiated Emissions

Antenna Polarity	Frequency (MHz)	Reading (dBuV)	Antenna Factor (dB)	Net at 3 meter (dBuV/m)	Class B Limit (dBuV/m)	Margin (dB)
H	200.0	20.0	17	37	44	-7
H	227.6	21.0	20	41	46	-5
H	240.0	14.0	20	34	46	-12
H	325.2	16.0	23	39	46	-7

Test Engineer: Vathana F. Ven Test Date: 08-20-1998


3 meter FCC Class B Radiated Emissions Data from Table 1
Company: Zoom Telephonics
Model: 230 Wireless
Date: 08-20-1998
70
60
50
40
30
20
dBuV/m
30
100
300
1000
Frequency (MHz)
page____

Intertek Testing Services NA, Inc.

Emissions Site 2 Boxborogh, MA

Table: 2

Company: Zoom Telephonics, Inc. Model: 230 Wireless LAN

Notes: Initial scan

FCC Class B Radiated Emissions

Antenna Polarity	Frequency (Mhz)	Reading (dBuV)	Antenna Factor (dB)	Net at 3 Meter (dBuV/m)	Class B Limit (dBuV/m)	Margin (dB)
V	1010	16	25	41	54	-13
V	1048	15	25	40	54	-14
V	1112	16	25	41	54	-13

Test Engineer: Vathana F. Ven Test Date: 08-20-1998

COMPANY: Zoom Telephonics, Inc.
MODEL: 230 Wireless LAN

TABLE: 4
Date of Test: 08-20-1998

NOTES: Spurous Radiated Emissions for the Low Channel

Radiated Emissions

Frequency (MHz)	Reading (dBuV)	Distance Factor (dB)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Averaging Factor (dB)	Pulse Desensitization (dB)	Field Strength @ 3 m (dBuV/m)	Field Strength @ 3 m (uV/m)	Limits @ 3 m (uV/m)	Margin (dB)
2137.000	63	0	28	24	0	0	67	2239	10000	-13
4274.000	39	10	33	24	0	0	38	79	500	-16
4822.000	35	10	34	24	0	0	35	56	500	-19
6411.000	41	10	34	24	0	0	41	112	10000	-39
7233.000	35	10	37	24	0	0	38	79	10000	-42
8548.000	40	10	38	23	0	0	45	178	10000	-35
9644.000	35	10	38	23	0	0	40	100	10000	-40
10685.000	40	10	40	21	0	0	49	282	500	-5
12055.000	36	10	39	21	0	0	44	158	500	-10
12822.000	40	10	39	21	0	0	48	251	10000	-32
14466.000	29	10	41	21	0	0	39	89	10000	-41
14959.000	43	10	42	21	0	0	54	501	10000	-26
16877.000	40	10	38	21	0	0	47	224	10000	-33
17096.000	47	10	42	21	0	0	58	794	10000	-22
19233.000	32	10	43	22	0	0	43	141	500	-11
19288.000	31	10	43	22	0	0	42	126	500	-12
21370.000	27	10	44	22	0	0	39	89	500	-15
21699.000	32	10	44	22	0	0	44	158	10000	-36
24110.000	32	10	44	22	0	0	44	158	10000	-36

No other harmonic or spurious emissions were detected at a test distance of 0.3 meter.

Test Engineer: Vathana F. Ven

COMPANY: Zoom Telephonics, Inc.
MODEL: 230 Wireless LAN

TABLE: 5
Date of Test: 08-20-1998

NOTES: Spurous Radiated Emissions for the Mid Channel

Radiated Emissions

Frequency (MHz)	Reading (dBuV)	Distance Factor (dB)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Averaging Factor (dB)	Pulse Desensitization (dB)	Field Strength @ 3 m (dBuV/m)	Field Strength @ 3 m (uV/m)	Limits @ 3 m (uV/m)	Margin (dB)
2157.000	64	0	28	24	0	0	68	2512	10000	-12
4314.000	43	10	33	24	0	0	42	126	500	-12
4874.000	34	10	33	24	0	0	33	45	500	-21
6471.000	43	10	35	24	0	0	44	158	10000	-36
7311.000	26	10	37	24	0	0	29	28	500	-25
8628.000	44	10	38	23	0	0	49	282	10000	-31
9748.000	25	10	38	24	0	0	29	28	10000	-51
10785.000	44	10	38	21	0	0	51	355	500	-3
12185.000	25	10	39	21	0	0	33	45	500	-21
12942.000	41	10	39	21	0	0	49	282	10000	-31
15099.000	47	10	39	21	0	0	55	562	10000	-25
17059.000	34	10	41	22	0	0	43	141	10000	-37
17256.000	53	10	39	21	0	0	61	1122	10000	-19
19413.000	50	10	47	22	0	0	65	1778	500	11
19413.000	33	10	47	22	0	0	48	251	500	-6
19496.000	28	10	43	22	0	0	39	89	500	-15
21570.000	33	10	44	22	0	0	45	178	1000	-15
21933.000	27	10	43	22	0	0	38	79	1000	-22
24370.000	28	10	44	22	0	0	40	100	1000	-20

No other harmonic or spurious emissions were detected at a test distance of 0.3 meter.

Test Engineer: Vathana F. Ven .

COMPANY: Zoom Telephonics, Inc.
MODEL: 230 Wireless LAN

TABLE: 6
Date of Test: 08-20-1998

NOTES: Spurous Radiated Emissions for the High Channel

Radiated Emissions

Frequency (MHz)	Reading (dBuV)	Distance Factor (dB)	Antenna Factor (dB)	Pre-Amp Gain (dB)	Averaging Factor (dB)	Pulse Desensitization (dB)	Field Strength @ 3 m (dBuV/m)	Field Strength @ 3 m (uV/m)	Limits @ 3 m (uV/m)	Margin (dB)
2182.000	64	0	28	24	0	0	68	2512	10000	-12
4364.000	39	10	33	24	0	0	38	79	500	-16
4924.000	40	10	33	24	0	0	39	89	500	-15
6546.000	39	10	35	24	0	0	40	100	10000	-40
7386.000	35	10	38	23	0	0	40	100	500	-14
8728.000	42	10	38	23	0	0	47	224	10000	-33
9848.000	26	10	38	21	0	0	33	45	10000	-47
10910.000	39	10	38	21	0	0	46	200	500	-8
12325.000	26	10	39	21	0	0	34	50	500	-20
13092.000	46	10	41	21	0	0	56	631	10000	-24
14772.000	31	10	42	21	0	0	42	126	10000	-38
15274.000	48	10	39	21	0	0	56	631	10000	-24
17234.000	33	10	42	22	0	0	43	141	10000	-37
17456.000	50	10	42	21	0	0	61	1122	10000	-19
19638.000	34	10	43	22	0	0	45	178	500	-9
19696.000	30	10	43	22	0	0	41	112	500	-13
21820.000	54	10	44	22	0	0	66	1995	10000	-14
22158.000	31	10	45	22	0	0	44	158	500	-10
24620.000	29	10	44	22	0	0	41	112	10000	-39

No other harmonic or spurious emissions were detected at a test distance of 0.3 meter.

Test Engineer: Vathana F. Ven

3.4 Line Conducted Configuration Photograph

The following pages are line-conducted configuration photographs.

3.5 Line Conducted Emission Configuration Data

The data on the following page lists the significant emission frequencies, the limit, and the margin of compliance. Numbers with a minus sign are below the limit.

Frequency (MHz)	Margin (dB)	RBW (Khz)	Table #
0.515	-6	9	3

TEST PERSONNEL:

Vathana F. Ven

Tester Signature

Vathana F. Ven, Compliance Engineer

Typed/Printed Name

9/29/98

Date

Intertek Testing Services

Emissions Site 2 Boxborough, MA

Table:3

Company: Zoom Telephonics Model: 230 Wireless

Notes: Initial scan

FCC Class B Conducted Emissions

Frequency (MHz)	Reading Side A (dBuV)	Reading Side B (dBuV)	Class B Limit (dBuV)	Margin (dB)
0.515	42	38	48	-6
0.650	40	35	48	-8
0.940	40	35	48	-8
3.055	39	32	48	-9
24.93	32	30	48	-16

Test Engineer: Vathana F. Ven Test Date: 08-20-1998

ITS Intertek Testing Services

December 2, 1998

Mr. Richard Fabina
Federal Communications Commission
7435 Oakland Mills Road
Columbia, MD 21046

ITS Letter Report No. J98024386
Facsimile Number: (301) 344-2050

Dear Mr. Fabina,

I have received your request for further information from the FCC in regards to the Zoom Telephonics Wireless LAN PC Card (FCC ID: BDNWLANPCCARD1, Confirmation Number EA 91949). The questions are repeated here in italics and after each question is my answer.

1. An operational description in accordance with Section 2.1033(b)(4) of the FCC Rules that includes the number of channels and their frequencies.

The number of channels and their frequencies are contained in the application under Exhibit 7 - The Instruction Manual (Page 24 of application, Page 48 of Instruction Manual). The channels are repeated here for your convenience.

Channel Table

Channel ID	Frequency (MHz)	Channel ID	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

The operation description is contained in the application under Exhibit 9 - Information Provided by Zoom Telephonics and Harris Corporation. For further clarification, view the block diagram after page 22 of the application. The requirements of 47 CFR 2.1033 a4 are contained here for your convenience.

Intertek Testing Services NA Inc.
70 Codman Hill Road, Boxborough, MA 01719
Telephone 978-263-2662 Fax 978-263-7086 Home Page www.worldlab.com

Receive Process

A single antenna is used. The received input is appled to bandpass filter (Toko - TDF2A-2450T-10) which provides image rejection. The IF frequency is 280 MHz and low side injection is used, puting the received signal 560 MHz below the tuned channel. The Transmit/Receive switch is integrated in the RF power amplifier (RFPA). Following the RF amplifier is a low noise amplifier (HFA3424 LNA) to set the receive noise figure. Following the low noise amplifier is a 5 dB attenuator.

Next the signal enters the RF/IF Converter (HFA3624). Image noise is suppressed by a LC bandpass filter (Murata - LFJ30-03B2442B084) that is generated by the low noise amplifier and the RF/IF converter.

Down coversion from 2.4 to 2.5 GHz is accomplished HFA3624 RF/IF Converter mixer section. A discrete LC matching network is used to combine the IF outputs and impedance match to 50 ohms. A trimmer capacitor is used as part of the narrow band matching network.

Next there is a IF receive filter (Toyocom - TQS-432), it is a SAW band-pass filter. The center is 280 MHz and the 3 dB bandwidth is 17 MHz.

Next is the quadrature IF modulator/demodulator (HFA3724) provides two limiting amplifiers, a quadrature baseband demodulator and two baseband low pass filters (5th order butterworth). At the output of the limiters a 200 mVp-p differential signal level is maintained under all input conditions. The signal is mixed in quadrature to baseband in the quadrature IF MOD/DEMOD. The LO is applied at twice the IF frequency (560 MHz). A divide by two circuit then provides an accurate quadrature LO for the mixers. The output of the filter is ac coupled to the baseband processor. The coupling is accomplished with series capacitors.

The baseband processor (HSP3824) accomplishes the analog to digital conversion, spreading of the signal spectrum, the spread signal is correlated and locked on to to extract the BPSK or QPSK data. The data is decoded and descrambled for preparation for processing of the media access controller (MAC - AMD - 79C930). The MAC processes the data packets and send them on through the PC card interface to the computer.

Transmit Processing.

Data from the host computer is sent to the MAC via the PC card interface. The MAC formats the data and performs network protocols. The MAC awaits a clear to send signal. The signal is sent to the baseband processor (HSP3824) which clocks it in, scambles and differentially encodes and then

applies the spread spectrum modulation (DBPSK or DQPSK). The spreading is a 11 chip Barker sequence clocked at 11 MHz and modulated with I and Q data components. The signal is then outputed to the HFA3724 as CMOS logic signals.

Processing is similar to the receive stage at the HFA3724 except there is only one amplifier. Following the HFA3724 is a transmit IF SAW band pass filter (Toyocom TQS-432). The output of the SAW is terminated in a potentiometer for gain control. The potentiometer is used to adjust the ratio of transmit output power and main-lobe to side-lobe ratio of the output PSK waveform.

Next is the up conversion to the 2.4 to 2.5 GHz band at the HFA3624. The output is bandpass filtered (Murata LFJ30-03B2442B084). The signal is further bandpass filtered (Toko TDF2A-2450T-10) to suppress leakage and undesired sideband.

Next is the T/R switch and RF power amplifier which is the same as the receiver. The same antenna is used for transmit and receive.

2. A plot of the lowest available channel that shows compliance with the bandedge requirement in Section 15.247(c) of the Rules where the fundamental emission at the bandedge of 2400 MHz is attenuated at least 20 dB below of its maximum level in any 100 kHz bandwidth within the band. I believe the lowest channel has a frequency of 2411 MHz. The bandwidth plot of the 2411 MHz provided doesn't show compliance with this requirement.

Based on our conversation on December 1, the bandwidth plot at a center frequency of 2414 MHz is misleading because the emission is not at the center of the screen. Upon further examination, there is over 30 dB of attenuation at 2400 MHz.

3. If the highest available channel (frequency) is above 2464 MHz, a plot of the upper bandedge to show compliance with Section 15.247(c) as above. The bandwidth plot of 2464 MHz shows compliance with this requirement but I don't know if its the highest channel or not!

The channel/frequency table of question 1 indicates that 2462 MHz is the highest center frequency.

4. The output power requested on the application form does not agree with the output power measured during radiated emission measurements. Based upon your radiated emission measurements, I can grant a maximum output power of 4 milliwatts on the grant of equipment authorization. To obtain a grant for 63 milliwatts as requested, you must remeasure all parameters from another transmitter that has an output power of 63 milliwatts. Please either inform me that 4 milliwatts is acceptable for the grant or provide new measurement data on another transmitter.

After our discussion of December 1, the correct power to indicate on the form 731 is 3.8 mW calculated from the field strength. The calculation is as follows:

$P = ((E \times d)^2 / (30 \times G)) \times 1{,}000 = ((10^{(101/20)}/1{,}000{,}000) \times 3) / (30 \times 1)) \times 1{,}000 = 3.8$ mW where,

P - Power in mW
E - Field Strength measured in V/m = 101 dBμV
d - distance in meters = 3 meters
G - numeric gain of the antenna over isotropic = 1

note that the antenna gain has been changed from -0.53 to 1 to compare with an isotropic radiator. There is no difference in the reported values.

The Form 731 will be changed to reflect the correct power level. Note that the original number of 18 dBm was a manufacturer specified number and not a measured value.

5. Provide a copy of the Declaration of Conformity information that must be included with the product in accordance with Section 2.1077(a)(1) through (3) of the FCC Rules. No documentation of this sort was provided.

Following this question and answer section are three DoC compliance statements that will be shipped with each product. There are three to address the the three different model numbers.

6. Describe the differences between the three model numbers (1450, 4000, and 4005) which are being approved under this FCC ID number. The basic description provided in this application indicates that the Commission may not be able to grant all three of these devices under the same FCC ID number.

The three models are the same product. The only differences are in packaging and marketing purposes (perhaps the tradenames on the DoC's will shed light on how confusing this can be). After page 1 of the application is a letter from Zoom Telephonics that confirms that the devices are identical.

7. For your information - The test report lacked some vital information on several tests. For example, the power spectral density measurements did not provide a sample calculation of the conversion from field strength to output power. There was no conversion of the measured value to field strength as for radiated emission measurements. The resolution and video bandwidth of the measuring instrument was not provided. The test distance was not mentioned. Finally, there was not test set-up description provided. Section 10 of ANSI C63.4-1992 requires these items to enable the Commission staff to determine if a device has been tested properly. I advise you to include these items in all future submittals to the Commission to avoid delays in obtaining equipment authorization for your clients.

Although a sample calculation was not provided, I did indicate that the measurement method used was in accordance with FCC 97-114 Appendix C. Based on our conversation of December 1, I am providing a sample calculation. The difference reflects the calculation based on a antenna numeric gain of 1 rather than -0.53. I would have re-sent the spectral density tables, however there is no difference in the reported values.

The following calculation is from table 7 after page 27 and taking the highest value on the table:

Frequency: 2410 MHz
RBW: 3 Khz
Field Strength: 77 dBμV at 3 meters

$P = ((E \times d)^2 / (30 \times G)) \times 1{,}000 = ((10^{(77/20)}/1{,}000{,}000) \times 3) / (30 \times 1)) \times 1{,}000 = 0.016$ mW

or -18 dBm.

- - -

If I can be of any further assistance, please feel free to contact me. I may be reached by phone at (978) 635-8507, by facsimile at (978) 263-7086 or by E-mail at MJP@ITSQS.COM.

Best Regards,

Michael J. Peters
Staff Engineer / Emissions

Enclosures: Three pages of DoC statements
Corrected Form 731 page 2

Filename: n:\dailyfax\zoo24386.98d

ZOOM

Declaration of Conformity

Standard(s) to which conformity is declared:	**47CFR, Part 15 Subpart B**
Manufacturer's Name:	***Zoom Telephonics, Inc.***
Manufacturer's Address:	***207 South Street Boston, MA 02111 USA***
Manufacturer's Telephone:	***(617) 423-1072***
Type of Equipment:	***PCMCIA Ethernet Card***
Model(s):	***1450 (Wireless LAN PC Card)***
Year of Manufacture:	***1998***

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

I, the undersigned, hereby declare that the equipment specified above conforms to Part 15 of the FCC Rules.

Place: Boston, MA

Date: 2 December, 1998

(Signature)

Frank Manning
(Full Name)

President
(Position)

Zoom Telephonics, Inc.
207 South Street, Boston, MA 02111
Tel 617 423-1072
Fax 617 423-3923
Web Site: www.zoomtel.com

ZOOM

Declaration of Conformity

Standard(s) to which conformity is declared:	**47CFR, Part 15 Subpart B**
Manufacturer's Name:	*Zoom Telephonics, Inc.*
Manufacturer's Address:	*207 South Street* *Boston, MA 02111* *USA*
Manufacturer's Telephone:	*(617) 423-1072*
Type of Equipment:	*PCMCIA Ethernet Card*
Model(s):	*4000 (Zoom/Wireless LAN PC Card)*
Year of Manufacture:	*1998*

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

I, the undersigned, hereby declare that the equipment specified above conforms to Part 15 of the FCC Rules.

Place: Boston, MA

(Signature)

Date: 2 December, 1998

Frank Manning
(Full Name)

President
(Position)

Zoom Telephonics, Inc.
207 South Street, Boston, MA 02111
Tel 617 423-1072
Fax 617 423-3923
Web Site: www.zoomtel.com

ZOOM

Declaration of Conformity

Standard(s) to which conformity is declared:	47CFR, Part 15 Subpart B
Manufacturer's Name:	*Zoom Telephonics, Inc.*
Manufacturer's Address:	*207 South Street* *Boston, MA 02111* *USA*
Manufacturer's Telephone:	*(617) 423-1072*
Type of Equipment:	*PCMCIA Ethernet Card*
Model(s):	*4005 (Zoom/Wireless LAN PC Card and Adapter Card)*
Year of Manufacture:	*1998*

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.

I, the undersigned, hereby declare that the equipment specified above conforms to Part 15 of the FCC Rules.

Place: Boston, MA

Date: 2 December, 1998

(Signature)

Frank Manning
(Full Name)

President
(Position)

Zoom Telephonics, Inc.
207 South Street, Boston, MA 02111
Tel 617 423-1072
Fax 617 423-3923
Web Site: www.zoomtel.com

EXHIBIT 8

MISCELLANEOUS INFORMATION

8.0 Miscellaneous Information

This miscellaneous information includes details of the measured bandwidth, spectral density, the test procedure and calculation of factors such as average factor and processing gain.

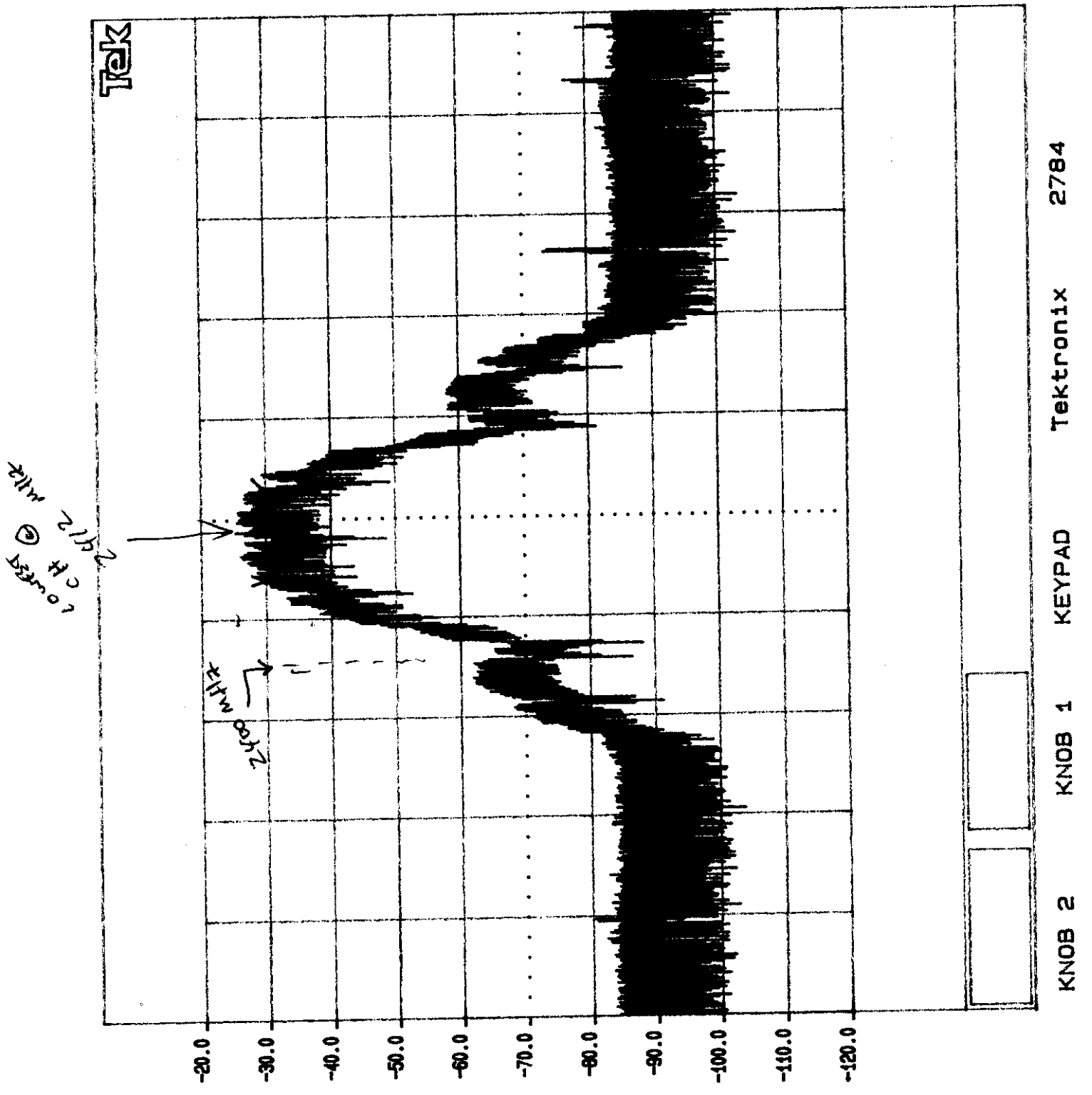
8.1 Measured Bandwidth

The plot on the following page shows the fundamental emission when modulated with a worst-case bit sequence. The unit meets the FCC bandwidth requirements.

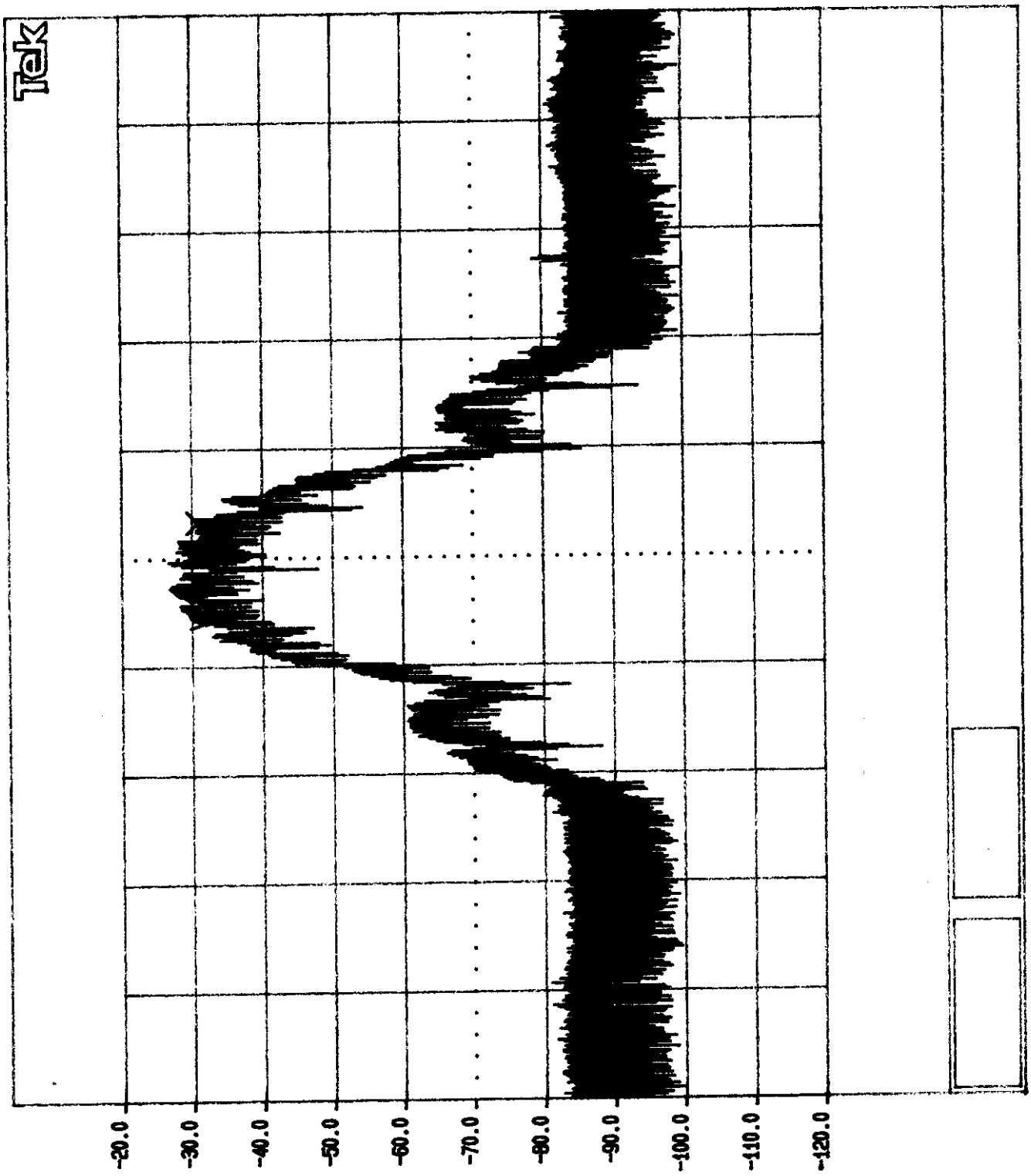
Figure 8.1 Bandwidth

Plot #	Frequency	Measured 6 dB Bandwidth	Limit (KHz)	Pass or Fail	RBW (KHz)
1	2411	9,200 KHz	greater than 500	Pass	100
2	2437	9,200 KHz	greater than 500	Pass	100
3	2462	10,000 KHz	greater than 500	Pass	100

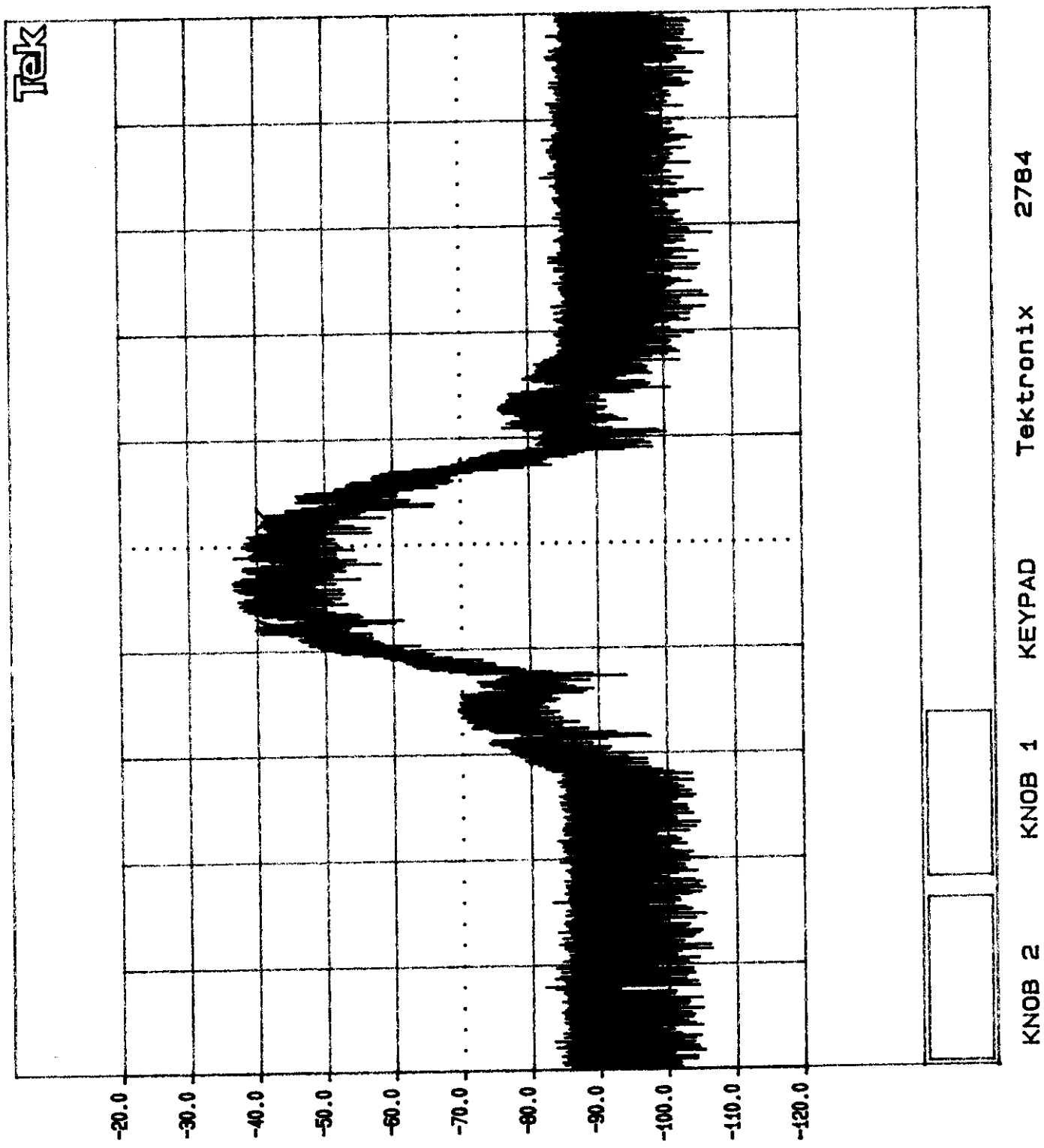
COMPANY: ZOOM TELEPHONICS
FCC ID: BDNWLANPCCARD1
PLOT #1



COMPANY: ZOOM TELEPHONICS
FCC ID: BDNWLANPCCARD1
PLOT #2



COMPANY: ZOOM TELEPHONICS
FCC ID: BDNWLANPCCARD1
PLOT #3



8.2 Spectral Density

Spectral Density measurements were performed using the test procedures of FCC Pamphlet 97-114 Appendix C.

Table #	Transmit Frequency (MHz)	Field Strength (dBμV)	Worst-Case Emission (dBm)	Limit dBM
7	2411	77	-18.21	+8
8	2437	77	-18	+8
9	2462	68	-27	+8

Spectral density was calculated using an antenna gain of -0.53 dBi and a measurement distance of three meters.

Company: Zoom Telephonics
Model: 230 Wirless LAN card

TABLE # 7

Notes: Low Frequency

SPECTRAL DENSITY MEASUREMENTS

Frequency	Reading (dBμV)	Antenna + Cable Factor (dB)	Net at 3 meters (dBμV)	Calculated Power (dBm)	Limit (dBm)	Margin (dB)
2381	-13	32	19	-76	+8	-84
2393	-7	32	25	-70	+8	-78
2397	3	32	35	-60	+8	-68
2399	10	32	42	-53	+8	-61
2402	14	32	46	-49	+8	-57
2405	31	32	63	-32	+8	-40
2407	42	32	74	-21	+8	-29
2410	45	32	77	-18	+8	-26
2413	45	32	77	-18	+8	-26
2418	39	32	71	-24	+8	-32
2420	21	32	53	-42	+8	-50
2425	6	32	38	-57	+8	-65
2429	1	32	33	-62	+8	-70

Engineer: Vathana F. Ven Date: August 20, 1998

Company: Zoom Telephonics
Model: 230 Wirless LAN card

TABLE # 8

Notes: Middle Frequency

SPECTRAL DENSITY MEASUREMENTS

Frequency	Reading (dBμV)	Antenna + Cable Factor (dB)	Net at 3 meters (dBμV)	Calculated Power (dBm)	Limit (dBm)	Margin (dB)
2402	-13	32	19	-76	+8	-84
2419	5	32	37	-58	+8	-66
2422	11	32	43	-52	+8	-60
2428	24	32	56	-39	+8	-47
2433	44	32	76	-19	+8	-27
2435	45	32	77	-18	+8	-26
2439	44	32	76	-19	+8	-27
2443	38	32	70	-25	+8	-33
2445	25	32	57	-38	+8	-46
2450	7	32	39	-56	+8	-64
2454	2	32	34	-61	+8	-69
2456	-8	32	24	-71	+8	-79
2463	-15	32	17	-78	+8	-86

Engineer: Vathana F. Ven Date: August 20, 1998

Company: Zoom Telephonics
Model: 230 Wirless LAN card

TABLE # 9

Notes: High Frequency

SPECTRAL DENSITY MEASUREMENTS

Frequency	Reading (dBμV)	Antenna + Cable Factor (dB)	Net at 3 meters (dBμV)	Calculated Power (dBm)	Limit (dBm)	Margin (dB)
2433	-16	32	16	-79	+8	-87
2445	-5	32	27	-68	+8	-76
2449	4	32	36	-59	+8	-67
2453	20	32	52	-43	+8	-51
2457	35	32	67	-28	+8	-36
2460	36	32	68	-27	+8	-35
2464	35	32	67	-28	+8	-36
2456	32	32	64	-31	+8	-39
2468	29	32	61	-34	+8	-42
2471	-8	32	24	-71	+8	-79
2475	-5	32	27	-68	+8	-76
2479	-7	32	25	-70	+8	-78
2487	-15	32	17	-78	+8	-86

Engineer: Vathana F. Ven

Date: August 20, 1998

8.3 Human Exposure to Radio Frequency Electromagnetic Fields

In accordance with OET bulletin 97-01 Supplement C, no special provisions or labeling requirements are necessary for this transmitter as it transmits at less than 0.5 watts.

8.4 Calculation of Average Factor

An average factor was not applied to peak readings.

8.5 Processing Gain

The following table is an excerpt from a test report that the measurement of processing gain was made. Following the table is the complete test report.

Note that the processing gain is greater than 10 dB which complies with the requirement.

SIG. GEN. FREQ. (MHz)	BER	(S/N)o (dB)	Lsys (dB)	Sig. Gen. Total Peak Power @ Rx (dBm)	Transmitter Total Peak Power @ Rx (dBm)	Jammer to Signal Ratio Mj (dB)	Processing Gain (dB)
Fc - 1.00	0.000020	9.6	2.0	-24.5	-27.9	3.4	15.0
Fc - 0.90	0.000013	9.8	2.0	-24.4	-27.9	3.5	15.3
Fc - 0.70	0.000010	9.9	2.0	-25.9	-27.9	2.0	13.9
Fc - 0.50	0.000015	9.8	2.0	-26.7	-27.9	1.2	13.0
Fc - 0.45	0.000018	9.7	2.0	-26.0	-27.9	1.9	13.6
Fc - 0.40	0.000015	9.8	2.0	-26.2	-27.9	1.7	13.5
Fc - 0.35	0.000012	9.9	2.0	-26.6	-27.9	1.3	13.2
Fc - 0.30	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc - 0.25	0.000018	9.7	2.0	-27.6	-27.9	0.3	12.0
Fc - 0.20	0.000011	9.9	2.0	-27.7	-27.9	0.2	12.1
Fc - 0.15	0.000016	9.8	2.0	-28.0	-27.9	-0.1	11.7
Fc - 0.10	0.000020	9.6	2.0	-28.4	-27.9	-0.5	11.1
Fc - 0.05	0.000010	9.9	2.0	-29.2	-27.9	-1.3	10.6
Fc	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.05	0.000010	9.9	2.0	-27.9	-27.9	0.0	11.9
Fc + 0.10	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.15	0.000017	9.7	2.0	-27.9	-27.9	0.0	11.7
Fc + 0.20	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc + 0.25	0.000010	9.9	2.0	-26.2	-27.9	1.7	13.6
Fc + 0.30	0.000010	9.9	2.0	-25.8	-27.9	2.1	14.0
Fc + 0.35	0.000012	9.9	2.0	-25.0	-27.9	2.9	14.8
Fc + 0.40	0.000013	9.8	2.0	-24.7	-27.9	3.2	15.0
Fc + 0.45	0.000014	9.8	2.0	-25.3	-27.9	2.6	14.4
Fc + 0.50	0.000020	9.6	2.0	-25.5	-27.9	2.4	14.0
Fc + 0.70	0.000015	9.8	2.0	-25.2	-27.9	2.7	14.5
Fc + 0.90	0.000016	9.7	2.0	-24.5	-27.9	3.4	15.1
Fc + 1.00	0.000013	9.8	2.0	-24.9	-27.9	3.0	14.8
MINIMUM PROCESSING GAIN: 10.6 dB							

- (S/N)o: Refer to attached curcves, BER versus (S/N)o for Differiential Coherent Detection of Differentially Encoded DPSK
- Processing gain Gp = (S/N)o + Lsys + Mj = (S/N)o + 2 Mj

4.6. *Processing Gain of A Direct Sequence Spread Spectrum, FCC CFR 47, Para. 15.247(e)*

PRODUCT NAME: OEM WLAN PC CARD 13316C, Model No.: GERSHWIN3

FCC REQUIREMENTS:

The processing gain of a direct sequence system shall be at least 10 dB. The processing gain shall be determined from the ratio in dB of the signal-to-noise ratio with the system spreading code turned off to the signal-to-noise ratio with the system spreading code turned on, as measured at the demodulated output of the receiver.

CLIMATE CONDITION:

Standard Temperature and Humidity: 21°C and 34%

POWER INPUT:

Using DC Power from a laptop computer.

TEST EQUIPMENT:

- Advantest Spectrum Analyzer, Model R3271, S/N: 15050203
- 3dB & 40 dB Attenuators, 50 Ohm IN/OUT
- Fluke RF Signal Generator, Model 6061A, Freq. range: 10 KHz - 1050 MHz.
- HP 8900 RF Peak Power Meter, Measuring Frequency Range: 100 MHz - 18 GHz.
- Bert Fireberd 4000 Communication Analyzer

METHOD OF MEASUREMENT:- Jamming Margin Method

The processing gain may be measured using the CW jamming margin method. Figure 1 shows the test configuration. The test consists of stepping a signal generator in 50 KHZ increments across the passband of the system. At each point, the generator level required to produce the recommended Bit Error Rate (BER) is recorded. This level is jammer level. The output power of the transmitting unit is measured at the same point. The Jammer to Signal (J/S) ratio is then calculated. Discard the worst 20% of the J/S data points. The lowest remaining J/S ratio is used when calculating the Process Gain.

The signal to noise ratio for an ideal differentially coherent detetion of a differentially encoded DPSK receiver can be derived from the Bit Error Probability (Pb) versus Signal-to-Noise ratio. See attached plot for detailed information.

For measurement of the $(S/N)_o$ we use the Pb of 1.0×10^{-5} minimum.

Ref.: Viterbi, A.J. Principles of Coherent Communications (New York: McGraw-HILL 1966), Pg. 207

Using equation (1) shown above, calculate the signal to noise ratio required for your chosen BER. This value and the measured J/S ratio are used in the following equation to calculate the Process Gain (Gp) of the system.

$$Gp = (S/N)o+Mj+Lsys$$

Where:

(S/N)o: Theoretical signal to noise ratio required to maintain the normal operation just before the BER appears. In real measurements the maximum error of 0.001 is allowed in an ideal system using their modulation scheme with all codes turned off (i.e. no spreading or processing gain).

Mj: Maximum jammer to Signal Ratio that recorded at the detected BER.

Lsys: System losses such as non-ideal synchronization, tracking circuitry, non-optimal baseband receiver filtering and etc... These losses can be in excess of 3 dB for each transmitter and receiver pair. For the purpose of this processing gain calculation we assume a Lsys at its minimum value of 3 dB. ≠2

Ref.: Dixon, R. Spread Spectrum Systems. (New York: Wiley, 1984), Chapter 1.

TEST RESULTS:

Conforms.

TEST PERSONNEL:

Tri M. Luu, P.Eng.

DATE:

Oct. 17, 1997

MEASUREMENT DATA:

Test Method Employed: Jamming Margin

SIG. GEN. FREQ. (MHz)	BER	(S/N)o (dB)	Lsys (dB)	Sig. Gen. Total Peak Power @ Rx (dBm)	Transmitter Total Peak Power @ Rx (dBm)	Jammer to Signal Ratio Mj (dB)	Processing Gain (dB)
Fc - 1.00	0.000020	9.6	2.0	-24.5	-27.9	3.4	15.0
Fc - 0.90	0.000013	9.8	2.0	-24.4	-27.9	3.5	15.3
Fc - 0.70	0.000010	9.9	2.0	-25.9	-27.9	2.0	13.9
Fc - 0.50	0.000015	9.8	2.0	-26.7	-27.9	1.2	13.0
Fc - 0.45	0.000018	9.7	2.0	-26.0	-27.9	1.9	13.6
Fc - 0.40	0.000015	9.8	2.0	-26.2	-27.9	1.7	13.5
Fc - 0.35	0.000012	9.9	2.0	-26.6	-27.9	1.3	13.2
Fc - 0.30	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc - 0.25	0.000018	9.7	2.0	-27.6	-27.9	0.3	12.0
Fc - 0.20	0.000011	9.9	2.0	-27.7	-27.9	0.2	12.1
Fc - 0.15	0.000016	9.8	2.0	-28.0	-27.9	-0.1	11.7
Fc - 0.10	0.000020	9.6	2.0	-28.4	-27.9	-0.5	11.1
Fc - 0.05	0.000010	9.9	2.0	-29.2	-27.9	-1.3	10.6
Fc	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.05	0.000010	9.9	2.0	-27.9	-27.9	0.0	11.9
Fc + 0.10	0.000020	9.6	2.0	-27.8	-27.9	0.1	11.7
Fc + 0.15	0.000017	9.7	2.0	-27.9	-27.9	0.0	11.7
Fc + 0.20	0.000015	9.8	2.0	-26.9	-27.9	1.0	12.8
Fc + 0.25	0.000010	9.9	2.0	-26.2	-27.9	1.7	13.6
Fc + 0.30	0.000010	9.9	2.0	-25.8	-27.9	2.1	14.0
Fc + 0.35	0.000012	9.9	2.0	-25.0	-27.9	2.9	14.8
Fc + 0.40	0.000013	9.8	2.0	-24.7	-27.9	3.2	15.0
Fc + 0.45	0.000014	9.8	2.0	-25.3	-27.9	2.6	14.4
Fc + 0.50	0.000020	9.6	2.0	-25.5	-27.9	2.4	14.0
Fc + 0.70	0.000015	9.8	2.0	-25.2	-27.9	2.7	14.5
Fc + 0.90	0.000016	9.7	2.0	-24.5	-27.9	3.4	15.1
Fc + 1.00	0.000013	9.8	2.0	-24.9	-27.9	3.0	14.8
MINIMUM PROCESSING GAIN: 10.6 dB							

- (S/N)o: Refer to attached curcves, BER versus (S/N)o for Differiential Coherent Detection of Differentially Encoded DPSK
- Processing gain Gp = (S/N)o + Lsys + Mj = (S/N)o + 2 Mj

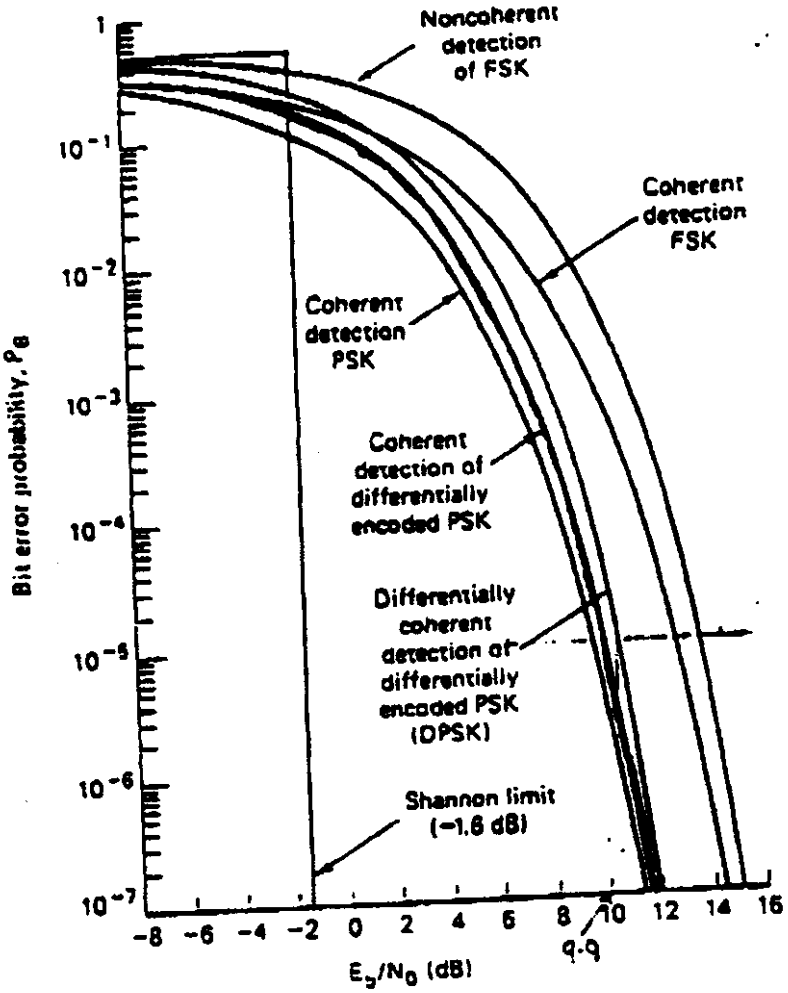


Figure 3.22 Bit error probability for several types of binary systems.

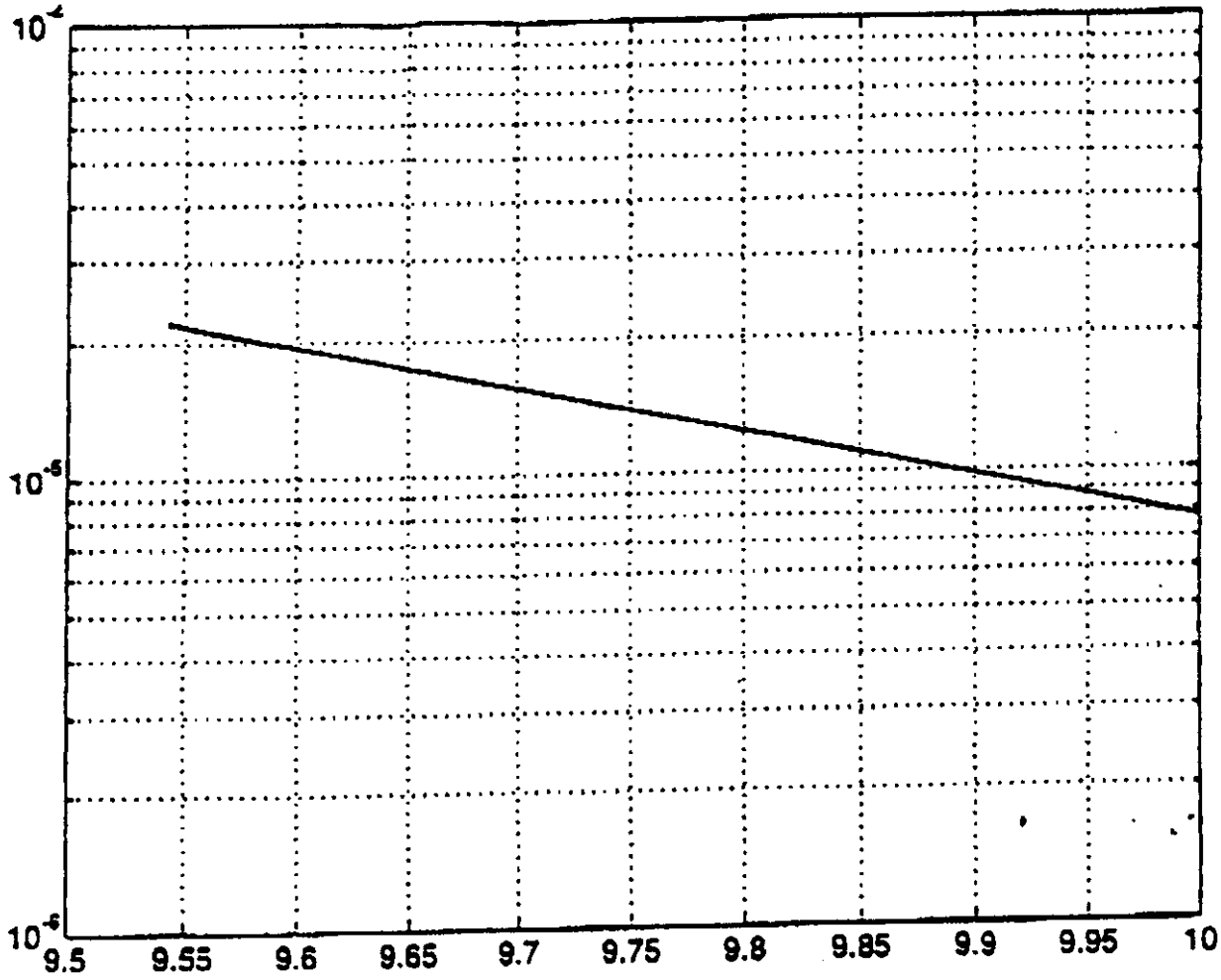
3.7.2 Probability of Bit Error for Coherently Detected Differentially Encoded PSK

Channel waveforms sometimes experience inversion; for example, when using a coherent reference generated by a phase-locked loop (see Chapter 8), one may have phase ambiguity. If the carrier phase were reversed in a DPSK modulation application, what would be the effect on the message? The only effect would be an error in the bit during which inversion occurred or the bit just after inversion, since the message information is encoded in the similarity or difference between adjacent symbols. The similarity or difference quality remains unchanged if the carrier is inverted. Sometimes, systems are *differentially encoded* and *coherently detected*, simply to avoid these phase ambiguities.

The probability of bit error for coherently detected, differentially encoded PSK is given by [7]

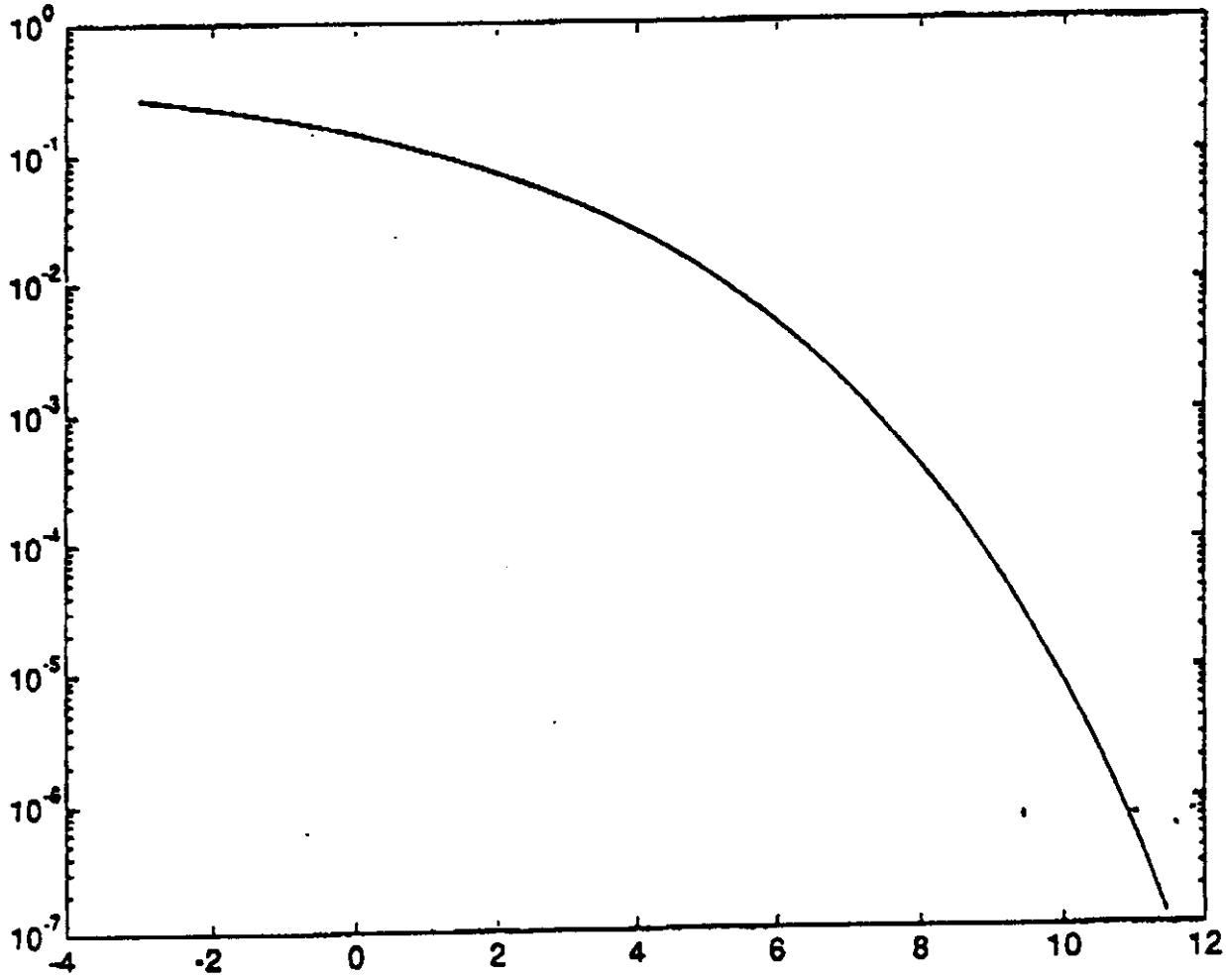
$$P_e = 2Q\left(\sqrt{\frac{2E_b}{N_0}}\right)\left[1 - Q\left(\sqrt{\frac{2E_b}{N_0}}\right)\right]$$

BER

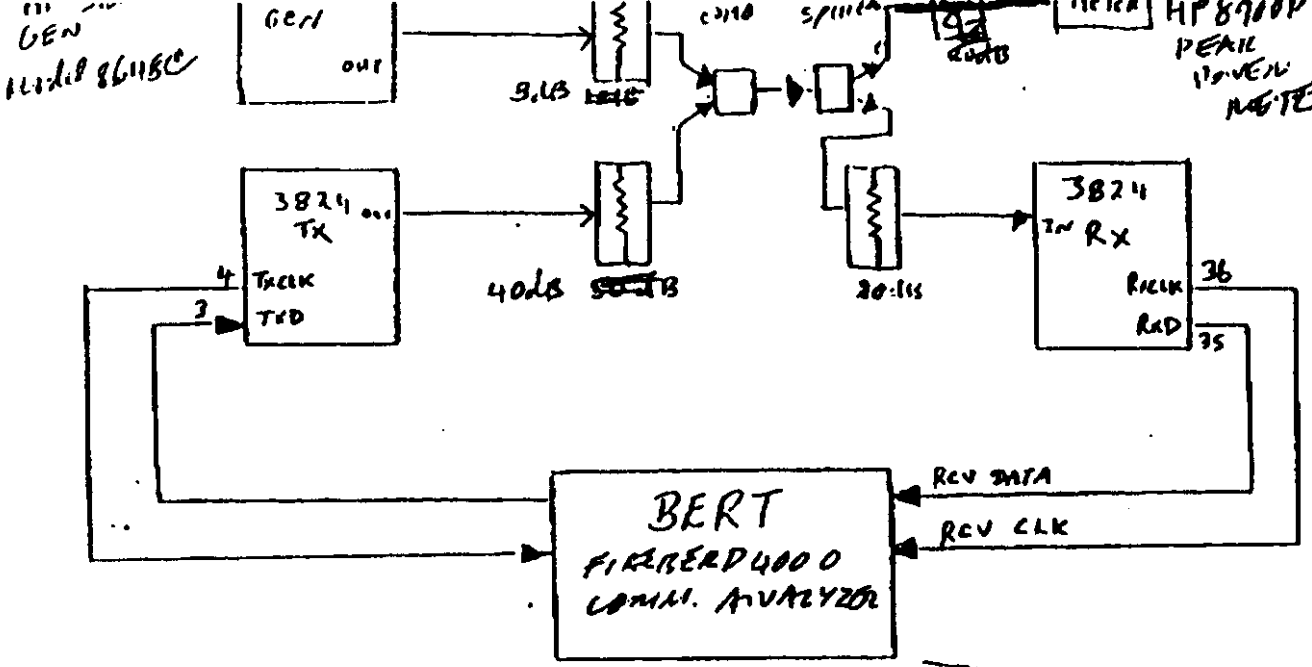


$\left(\frac{E_b}{N_0}\right)$ dB

BER



$\left(\frac{E_b}{N_o}\right)$ dB



1) Set MAC chip to continuous transmit on the transmit end.
This guarantees that TX_PE (pin 2 on 3824 TX) is always active and DATA will be clocked in from BERT.

2) Set MAC chip to continuous Receive at the Receive end.
This guarantees that RX_PE is enabled and the receiver is operational.

1) Set up BERT to work with UNIPOLAR UNBALANCED sig

2) Set Input Impedance to 8k (clock and oscilloscope to make sure too many reflections are not degrading BER)

3) CLK PHASING switch: Use Ref
(A) TX ↑
RCV ↑

4) PATTERN to use:
Pseudorandom $2^{20}-1$ {1
or $2^{23}-1$ {2

Synchronization declared when $30+n$ consecutive errors occurred $n = \begin{cases} 50 \\ 53 \end{cases}$

8.6 Output Power Measurements

Output power measurements were performed by making radiated emissions measurements and converting the field strength to power using the following formula.

$$P = \frac{(Ed)^2}{30\ G}$$

P - Power in Watts
E - Field strength in volts/meter
d - Measurement distance in meters
G - Numeric gain of transmit antenna

The following table summarizes the results:

Frequency (MHz)	Field Strength (dBμV/m)	Distance (m)	RBW (Khz)	Power (dBm)	Limit* (dBm)	Margin (dB)
2411	100	3	1000	5.3	+30	-24.7
2437	101	3	1000	6.3	+30	-23.7
2462	96	3	1000	1.3	+30	-28.7

*Limit is 1 watt which is equal to +30 dBm.

The numberic gain of the antenna is 0.885 (-0.53 dBi). Note that the antenna is integral to the transmitter and provision ot connect any other antenna is not provided.

3.7 mW @
101 dBμV/m @ 3 m

8.7 Emissions Test Procedures

The following is a description of the test procedure used by Intertek Testing Services NA Inc. in the measurements of transmitters operating under Part 15, Subpart C rules.

The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4(1992).

During the radiated emissions test, the turntable is rotated and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the testing to search for maximum signal levels. The height of the antenna is varied from one to four meters.

Detector function for radiated emissions is in peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in Exhibit 8.3.

The frequency range scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or 40 GHz, whichever is lower. For line conducted emissions, the range scanned is 450 kHz to 30 MHz.

The EUT is warmed up for 15 minutes prior to the test.

Conducted measurements were made as described in ANSI C63.4(1992). An IF bandwidth of 10 kHz is used, and peak detection is employed.

Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz, signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.