Measurement/Technical Report

Percon, Inc.

0840-0011-00 WaveLAN PC card

FCC ID: OKA1001

June 4 ,1999

This report concerns (check one):	Original Grant__*X*	*Class II Change*____
Equipment Type: Spread Spectrum Transmitter		
Deferred grant requested per 47 CFR 0.457 (d)(1)(ii)?		Yes_____ no__X__
	If yes, defer until:	______N/A______ date
Percon, Inc. agrees to notify the Commission by:		______N/A______ 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 B for unintentional radiators – new 47 CFR [10-1-92] provision.		
Report prepared by:	Northwest EMC, Inc. 120 South Elliott Road, Suite 300 Newberg, OR 97132 (503) 537-0728 fax: (503) 537-0735	

Report No. PERC0011

Table of Contents

1.0 General Information

1.1 Product Description

Manufactured By .... Percon, Inc.

Address .... 1800 Millrace Drive Eugene, OR 97403

Test Requested By: .... Brian Lindsey

Model .... 0840-0011-00 WaveLAN PC card

FCC ID OKA1001

Serial Number(s) .... N/A

Date of Test.. March 31, 1999 through June 4 ,1999

Job Number... PERC0011

The Equipment Under Test (EUT) is the Percon, Inc. 0840-0011-00 WaveLAN PC card, a long-range, high-performance, one-piece wireless LAN adapter. When used with Falcon RF units (battery operated, handheld barcode scanners), the WaveLAN's direct sequencing, spread-spectrum technology provides the following benefits:

- Seamless , full roaming mobility within a facility while staying connected to the LAN
- Low power consumption
- High throughput capacity
- High network capactiy
- A 2-Mbps data rate, for fast operation
- Configurable radio settings
- Standard NDIS (Network Driver Interface Specification) and ODI (Open Data-link Interface) drivers for DOS
- Support for Socket Services v2.0 and Card Services v2.1

The WaveLAN wireless LAN PC card allows a mobile unit (MU) to connect to the WaveLAN network through access points (APs*).*

With a WaveLAN PC card installed in a Falcon (battery operated handheld barcode scanners) the Falcon becomes a mobile unit associated with WavaeLAN APs in a given domain. The Falcon appears as a peer to other MUs on the network. The PC card offers high-level performance while making low power demands on the portable.

The WaveLAN PC card was tested for use with the following antennas:

- Huber + Suhner dipole
- Toko Internal miniature diaelectric
- Cushcraft dipole

All antennas use unique couplings that should be considered sufficient to comply with the provisions of 47CFR15.203. Please see the antenna descriptions on the following pages as well as the specification sheets in Appendix II at the end of this technical report.

1.2 Related Submittals/Grants

None

1.3 Tested System Details

EUT and Peripherals

Item	FCC ID	Description and Serial No.
EUT	N/A	Percon 0840-0011-00 (WaveLAN 802.11 RF card)
Toko Antenna *	N/A	Miniature dielectric antenna element with PCB mount and gain of 0 dBi. Mfg. P/N DAC2450CT1, Percon P/N 5501-9245-00
Huber+Suhner * Antenna	N/A	Dipole Antenna, rubber ducky, through case mount with MMCX adapter and gain of 1.8 dBi. Percon P/N 8912-0057-00
Cushcraft Antenna *	N/A	Dipole Antenna, rubber ducky, reversed TNC mount and gain of 0 dB, dipole ref. Mfg P/N RTN2400SXR.
Falcon 325	N/A	Percon S/N F299063020.
Falcon 615	N/A	Percon (Mfg. by LXE) S/N 13809909P198.
Falcon 335	N/A	Percon S/N EP-2.

*Additional antenna specifications may be referenced in Appendix II

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters. Please reference Appendix I for further detail on Test Methodology.

1.5 Test Facility

The Open Area Test Site and conducted measurement facility used to collect the radiated and conducted data is located at

Northwest EMC, Inc.
30475 NE Trails End Ln
Newberg, OR 97132
(503) 537-5566
Fax: 537-5562

The Open Area Test Site, and conducted measurement facility is located in Newberg, OR, at the address shown above. These sites have been fully described in reports filed with the FCC (Federal Communications Commission), and accepted by the FCC in letters maintained in our files.

Northwest EMC, Inc. is recognized under the United States Department of Commerce, National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 25 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of calibration or test results. NVLAP Lab Code: 200059-0.

Northwest EMC, Inc. has been assessed and accredited by NEMKO (Norwegian testing and certification body) for European emissions and immunity testing. As a result of NEMKO's laboratory assessment, they will accept test results from Northwest EMC, Inc. for product certification (Authorization No. ELA 119).

3.0 System Test Configuration

3.1 Justification

All operating modes of the EUT were investigated. The EUT was configured for low, mid, and high XMIT frequencies for all measurements at the antenna port, and for Out-of-band-harmonics. Low, mid, and high transmit frequencies were pre-scanned for spurious radiated emissions, with the worst case transmit frequency tested at the Open Area Test Site.

3.2 EUT Exercise Software

The test software consists of a repetitive ping from the device. It is set for no delay and maximum packet length which generates more transmit energy than would be experienced in actual use because no receive signals are interleaved. Additionally, the device is forced to transmit at the center frequency and at the band edges by initializing the card with an access point programmed to the desired frequency.

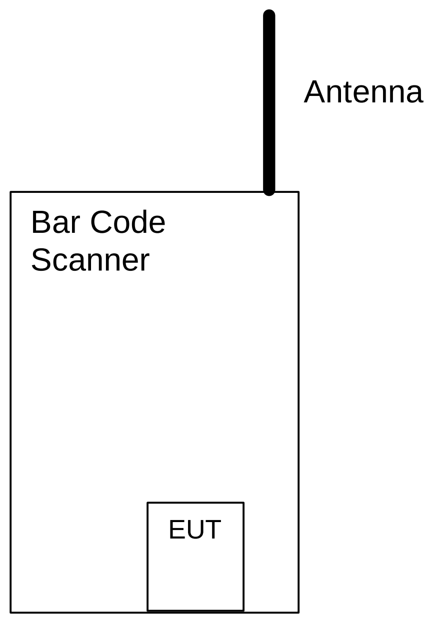
3.3 Special Accessories

None

3.4 Equipment Modifications

None.

Figure 3.1: Configuration of Tested System



4.0 Radiated Emissions Data

4.1 The following data lists the six most significant emission frequencies, total (corrected) levels, and specification margins. Correction factors, antenna height, table azimuth, etc., are contained in the data sheets immediately following. Explanation of the correction factors is given in paragraph 4.8 of this report. Complete graphs and data sheets may be referenced in the test data attachment. Minimum margins are listed below:

FCC Part 15 Specification Limits

Toko Patch Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
165.917	QP	35.4	43.5	8.1	Horizontal
199.033	QP	32.7	43.5	10.8	Vertical
132.742	QP	30.7	43.5	12.8	Horizontal
199.033	QP	30.3	43.5	13.2	Horizontal
331.762	QP	32.5	46.0	13.5	Horizontal
315.201	QP	31.3	46.0	14.7	Horizontal

Judgment: Passed, minimum margin of 8.1 dB.

Hubert & Suhner Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
265.421	QP	44.4	46.0	1.6	Horizontal
248.827	QP	42.7	46.0	3.3	Horizontal
252.395	QP	41.3	46.0	4.7	Horizontal
199.059	QP	38.7	43.5	4.8	Horizontal
278.481	QP	39.5	46.0	6.5	Horizontal
265.421	QP	34.4	46.0	11.6	Vertical

Judgment: Passed, minimum margin of 1.6 dB.

Cushcraft Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
265.429	QP	43.8	46.0	2.2	Horizontal
248.825	QP	38.6	46.0	7.4	Horizontal
278.450	QP	38.0	46.0	8.0	Horizontal
331.770	QP	37.7	46.0	8.3	Horizontal
282.010	QP	36.8	46.0	9.2	Horizontal
252.400	QP	36.2	46.0	9.8	Horizontal

Judgment: Passed, minimum margin of 22 dB.

4.2 Out of Band Harmonics Data

4.2.1 The following data lists the six most significant emission frequencies, total (corrected) levels, and specification margins. Correction factors, antenna height, table azimuth, etc., are contained in the data sheets immediately following. Explanation of the correction factors is given in paragraph 4.8 of this report. Complete graphs and data sheets may be referenced in the test data attachment. Minimum margins are listed below:

FCC Part 15 Specification Limits

Toko Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
4924.000	AV	44.4	54.0	9.6	Vertical
7296.000	AV	42.8	54.0	11.2	Horizontal
7296.000	AV	42.7	54.0	11.3	Vertical
7236.000	AV	42.6	54.0	11.4	Horizontal
4924.000	AV	42.5	54.0	11.5	Horizontal
7387.000	AV	41.9	54.0	12.1	Horizontal

Judgment: Passed, minimum margin of 9.6 dB.

Hubert & Suhner Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
7310.950	AV	51.3	54.0	2.7	Horizontal
7385.950	AV	50.7	54.0	3.3	Horizontal
7385.950	AV	49.5	54.0	4.5	Vertical
4923.950	AV	47.8	54.0	6.2	Horizontal
12059.850	AV	47.7	54.0	6.3	Vertical
12059.850	AV	47.6	54.0	6.4	Horizontal

Judgment: Passed, minimum margin of 2.7 dB.

Cushcraft Antenna

Frequency (MHz)	Detection	Total Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)*	Polarization
7387.000	AV	46.9	54.0	7.0	Horizontal
4864.000	AV	45.9	54.0	8.1	Vertical
4824.000	AV	45.7	54.0	8.3	Horizontal
7387.000	AV	45.6	54.0	8.4	Vertical
4824.000	AV	45.3	54.0	8.7	Vertical
4864.000	AV	45.2	54.0	8.8	Horizontal

Judgment: Passed, minimum margin of 7.0 dB.

Test Personnel:

Typed/Printed Name:____________________________

4.3 Occupied (6dB) Bandwidth

As per Section 15.247 (a2) , the following graphs show that the minimum 6dB bandwidth is greater 500 kHz. The bandwidth was measured with the EUT set to low, mid, and high band frequencies. The measurement was made with the spectrum analyzer's resolution bandwidth = 100 kHz. The span was set to 20 MHz.

Band	Bandwidth (MHz)
Low	9.80
Mid	9.95
High	9.95

Additional high and low band plots show the direct sequence emission is greater than 20 dB down at the band edges.

4.4 Power Output

As per Section 15.247 (b), the maximum peak output power of the EUT does not exceed 1 watt. The output power was measured with the EUT set to low, medium, and high transmit frequencies. The measurement was made using a direct connection between the antenna port of the EUT and the power meter. The data below also includes the cable loss of 2.0 dB. The low power output exempts this device from the RF safety requirements of 47CFR15.247(b)4

Frequency(GHz)	Power Output(mW)
Low	15.85
Mid	15.85
High	13.47

4.5 Antenna Conducted Emissions

As per Section 15.247 (c), the following graphs show that the maximum level of harmonics/spurs are at least 20dB down from the highest emission level within the authorized band. The conducted emissions were measured with the EUT set to low, medium, and high transmit frequencies. The measurement was made using a direct connection between the antenna port of the EUT and the spectrum analyzer. The resolution bandwidth was set to 100 kHz and the video bandwidth was set to 100 kHz. The EUT was scanned up to 25 GHz.

Results: All Harmonics or spurs are greater than 20dB below the level of the transmit frequency.

4.6 Power Spectral Density

To demonstrate compliance with 15.247(d), the power spectral density measurement was made as follows: The emission peak(s) are located and zoom in on within the passband. Set RBW = 3 kHz, VBW>RBW, sweep = (SPAN/3 kHz) e.g., for a span of 1.5 MHz, the sweep should be $1.5 \times 10^6 \div 3 \times 10^3$ = 500 seconds. The peak level measured must be no greater than +8 dBm. External attenuation is used and added to the reading. If necessary, the following FCC procedure is used for modifying the power spectral density measurements:

"If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzers will directly measure the noise power density normalized to a 1 Hz noise power bandwidth. Add 34.7 dB for correction to 3 kHz."

Data was taken using the 1 Hz noise power bandwidth on an HP8593 spectrum analyzer. The data summary shown below includes the 34.7 dB correction to 3 kHz and the cable loss and external attenuation of 2 dB.

Low	-7.21 dBm
Mid	-6.48 dBm
High	-7.79 dBm

4.7 Processing Gain

Processing gain measurements were performed in accordance with the definitions, calculations, and explanation in the test report provided by Percon, Inc., found in Appendix III.

4.8 Field Strength Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured level. The basic equation with a sample calculation is as follows:
FS = RA + AF + CF - AG

where : FS = Field Strength

RA = Measured Level

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

Assume a receiver reading of 52.5 dBuV is obtained. The Antenna Factor of 7.4 and a Cable Factor of 1.1 is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/meter.

FS = 52.5 + 7.4 + 1.1 - 29 = 32 dBuV/meter
Level in uV/m = Common Antilogarithm [(32 dBuV/m)/20] = 39.8 uV/m

4.9 Measurement Bandwidths

Peak Data

150 kHz - 30 MHz....................10 kHz
30 MHz - 1000 MHz....................100 kHz
1000 MHz - 2000 MHz....................1000 kHz

Quasi-peak Data

150 kHz - 30 MHz.................... 9 kHz
30 MHz - 1000 MHz....................120 kHz

All radiated measurements are quasi-peak unless otherwise stated. A video filter was not used.
All conducted measurements are peak unless otherwise stated. A video filter was not used.

5.0 Measurement Equipment

Instrument	Model	Serial No.	Freq Range	Last Cal	Cal Due
Log Periodic Ant	EMCO 3146	4693	200 MHz - 1 GHz	12/30/98	12/30/99
Bicon Antenna	EMCO 3104	3600	30 MHz - 200 MHz	12/31/98	12/31/99
Spectrum Analyzer	HP 8568B	2601A02125	100 Hz - 1.5 GHz	09/01/98	09/01/99
Q-peak Adapter	HP 85650A	2043A00214	10 kHz - 1000 MHz	09/01/98	09/01/99
Pre-Amplifier	AR LN1000	15224	100 kHz-1300 MHz	07/20/98	07/20/99
Spectrum Analyzer	HP 8593E	3543A02557	9 kHz – 2.9 GHz	04/13/99	04/13/00
Horn Antenna	EMCO 3115	4074	100 Hz - 1.5 GHz	10/03/98	10/03/99
Pre-Amplifier	Miteq	565125	0.5 GHz – 18 GHz	06/15/98	06/15/99
High Pass Filter	Microlab/FXR HD-40N	8402	4 GHZ – 25 GHz	NCR	NCR
Power Meter	HP 435B	2702A15817	10 MHz – 18 GHz	04/02/99	04/02/00
Power Sensor	HP 8481H	2349A07714	10 MHz – 18 GHz	04/23/99	04/23/00

Appendix I: Measurement Procedures

Each frequency was measured in both the horizontal and vertical antenna polarization’s.

The EUT position was maximized for each frequency, for both the horizontal and vertical antenna polarization’s, using a remotely controlled turntable.

The antenna height was varied from 1 - 4 meters at each frequency, for both the horizontal and vertical positions to maximize the emission level.

The cable and peripheral positions were manipulated to ensure maximum levels at each frequency for both horizontal and vertical antenna polarization’s.

Measurements are made at an antenna to EUT distance of 3 meters.

Appendix II: Antenna Specifications

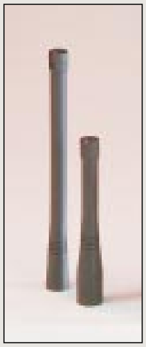
Appendix III: Processing Gain

Portable Radio Antennas

PORTABLE PHONE & RADIO ANTENNAS

- Available to fit all models
- Enhance the clarity
- Choices for every application
- Very long life

From our selector charts you may locate the proper antenna for your application whether it is for your cellular or radio application. Complete details on how to assemble a part number are in the price list. If you need additional help, please do not hesitate to contact your distributor or the factory.



How often have you seen bent or broken antennas on phones or radios? Were these instruments still working? Cushcraft has solved the problem by developing the Sigflex portable antenna. Whether you're making cellular calls from your home or trekking through the brush, our Rugged Duck can be depended upon to outlast ordinary antennas by a factor or ten, twenty, or even one hundred.

In addition to their long life, many of our products are designed to replace the original antenna and enhance the performance of your unit at the same time. Our goal is to bring you signal clarity at its best. With portables becoming the dominant type of phone and applications, including the wireless office, becoming standard, our quality guarantees you the best possible performance. More than a dozen basic models are available with connectors to fit all cellular phones. We also design products for industrial applications such as data transmission, security, etc.

Connector Styles

BN - BNC connector, fits Wilson, Regency, Tama phone, Standard, Yaesu, etc.

HT - 5/16-32 x 1/2 inch threads, fits Motorola MT, MH, most common stud connector.

MD - M7 x 1.0 metric thread, fits GE MPD.

MX - 1/4-32 x 3/16 inch thread, fits Motorola MX.

SF - SMA female thread, fits Motorola 800 MHz radios.

SFJ - Special SMA female thread, fits Johnson and most other 800 MHz radios.

SFU - (Rugged antennas only) for King Radio 800 MHz, Uniden 800 MHz. (Skirt)

TN - TNC male thread, fits ICOM and others

VHF Lowband Selector Guide
Connector
BN # A
HT # A
MX # A
TN # A

Specifiy 3" or 6"

Insert desired frequency

Highband VHF Rugged Duck Selector Guide

Conn	150-162	155-164	164-174
BN 6 inch	BN150RD	BN155RD	BN164RD
BN 3 inch	BN150RS	BN155RS	BN164RS
HT 6 inch	HT150RD	HT155RD	HT164RD
HT 3 inch	HT150RS	HT155RS	HT164RS
MX 6 inch	MX150RD	MX155RD	MX164RD
MX 3 inch	MX150RS	MX155RS	MX164RS
PE 6 inch	PE150RD	PE155RD	PE164RD
PE 3 inch	PE150RS	PE155RS	PE164RS
SFJ 6 inch	SFJ150RD	SFJ155RD	SFJ164RD
SFJ 3 inch	SFJ150RS	SFJ155RS	SFJ164RS
TN 6 inch	TN150RD	TN155RD	TN164RD
TN 3 inch	TN150RS	TN155RS	TN164RS

UHF Rugged Duck Selector Guide

Conn	406-430	450-470	470-512
BN 6 inch	BN406RB	BN450RB	BN470RB
BN 2 inch	BN406RC	BN450RC	BN470RC
HT 6 inch	HT406RB	HT450RB	HT470RB
HT 2 inch	HT406RC	HT450RC	HT470RC
MD 6 inch	MD406RB	MD450RB	MD470RB
MD 2 inch	MD406RC	MD450RC	MD470RC
MR 6 inch	MR406RB	MR450RB	MR470RB
MR 2 inch	MR406RC	MR450RC	MR470RC
MX 6 inch	MX406RB	MX450RB	MX470RB
MX 2 inch	MX406RC	MX450RC	MX470RC
PE 6 inch	PE406RB	PE450RB	PE470RB
PE 2 inch	PE406RC	PE450RC	PE470RC
SFJ 6 inch	SFJ406RB	SFJ450RB	SFJ470RB
SFJ 2 inch	SFJ406RC	SFJ450RC	SFJ470RC
SFU 6 inch	SFU406RB	SFU450RB	SFU470RB
SFU 2 inch	SFU406RC	SFU450RC	SFU470RC
TN 6 inch	TN406RB	TN450RB	TN470RB
TN 2 inch	TN406RC	TN450RC	TN470RC

800/900 Rugged Duck Selector Guide

Conn	806-866	821-896	896-960
BN Elevated	BN800RE	BN821RE	BN900RE
BN 1/4 Wave	BN800RC	BN821RC	BN900RC
MD Elevated	MD800RE	MD821RE	MD900RE
MD 1/4 Wav	MD800RC	MD821RC	MD900RC
MX Elevated	MX800RE	MX821RE	MX900RE
MX 1/4 Wave	MX800RC	MX821RC	MX900RC
SF Elevated	SF800RE	SF821RE	SF900RE
SF 1/4 Wave	SF800RC	SF821RC	SF900RC
SFJ Elevated	SFJ800RE	SFJ821RE	SFJ900RE
SFJ 1/4 Wave	SFJ800RC	SFJ821RC	SFJ900RC
SFU Elevated	SFU800RE	SFU821RE	SFU900RE
SFU 1/4 Wave	SFU800RC	SFU821RC	SFJ900RC
SM Elevated	SM800RE	SM821RE	SM900RE
SM 1/4 Wave	SM800RC	SM821RC	SM900RC
TN Elevated	TN800RE	TN821RE	TN900RE
TN 1/4 Wave	TN800RC	TN821RC	TN900RC

Rick Maulding

From: Stuart McIntosh [stuartm@cushcraft.com]
Sent: Friday, March 26, 1999 12:09 PM
To: 'Rick Maulding'
Subject: RE: Response to technical questions;

Rick the unity gain is referenced a dipole. Have a great weekend

Stuart McIntosh

-----Original Message-----
From:	Rick Maulding [SMTP:rmaulding@percon.com]
Sent:	Friday, March 26, 1999 2:17 PM
To:	'Stuart McIntosh'
Subject:	RE: Response to technical questions;

Thanks for the quick response. Is that unity referenced to an isotropic
source or referenced to a dipole. Thanks, Rick

> -----Original Message-----
> From:Stuart McIntosh [SMTP:stuartm@cushcraft.com]
> Sent:	Friday, March 26, 1999 9:04 AM
> To:	'rmaulding@percon.com'
> Subject:	Response to technical questions;
>
> Dear Sir:
> Regarding your questions for technical questions regarding the RTN2400SXR.
> This is a half wave portable antennas that does not require a ground plane
> to operate. The antenna exhibits unity gain. I hope this information is
> of some help. Thank you
>
> Stuart McIntosh
>
> Stuartm@cushcraft.com

SUHNER
DIPOLE ANTENNA 2.45 GHZ
FOR WIRELESS COMMUNICATION

Type No. 9090.16.0001

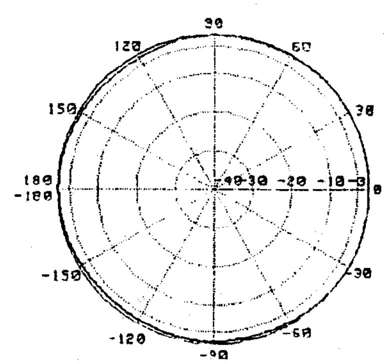
mmcx
adapter

Technical Data

Electrical properties	
Frequency range	2.4 – 2.5 GHz
Impedance	50 Ω
VSWR	≤ 2.0
Polarisation	vertical
Gain	1.8 dBi
Pattern	Omni
Permitted power on entrance	1 W (CW) at 25 °C
Standard connector	right angle MCX-male

Mechanical properties	
Length	79 mm
Connector case	ABS
Antenna case	ELVAX 550
Color	Pantone cool grey 11c
Operating temperature range	– 20 °C to + 65 °C

Radiation Pattern



horizontal

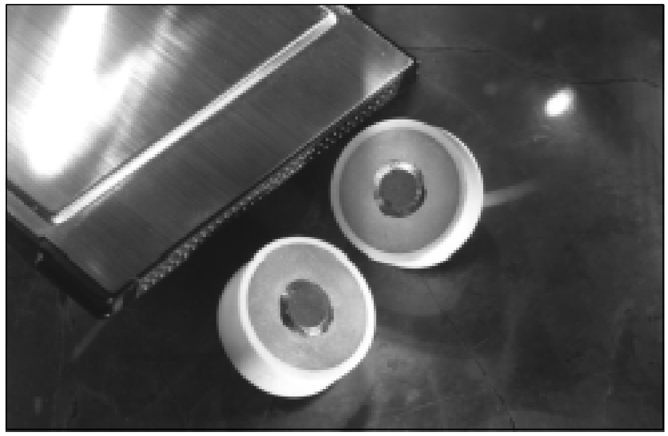
Data Sheet 02.95/Edition 1, 231GHA/st

HUBER+SUHNER AG
Radio Transmission Department
CH–9100 Herisau
☎ 071 53 41 11
FAX 071 53 45 90
Tx 88 27 29

ANTENNA ELEMENT FOR 2.4 GHz

DESCRIPTION

The DAC Series is a miniature dielectric antenna element for 2.4 GHz wireless LAN systems. This antenna has vertical polarization characteristics. TOKO's proprietary ceramic dielectric material provides excellent stability and sensitivity. It is mountable in Type II extended PCMCIA cards.



FEATURES

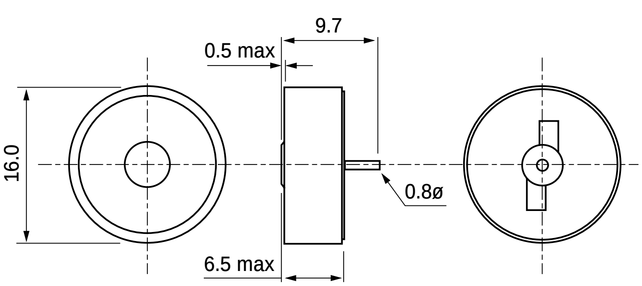
- Vertical Polarization reception
- Low profile (6.5mm max)
- Omni-directional in azimuth
- Low interference design
- Central feeding point terminal
- Wide bandwidth
- Light weight

SPECIFICATIONS

Part Number	DAC2450CT1
Center Frequency	2450 MHz
Receiving Bandwidth	±50 MHz min.
Impedance	50Ω
Peak Gain	2.15 dBi (0dBi typ.) max.
Operating Temperature	-10 ~ +60° C
Storage Temperature	-20 ~ +85° C
Weight	4g

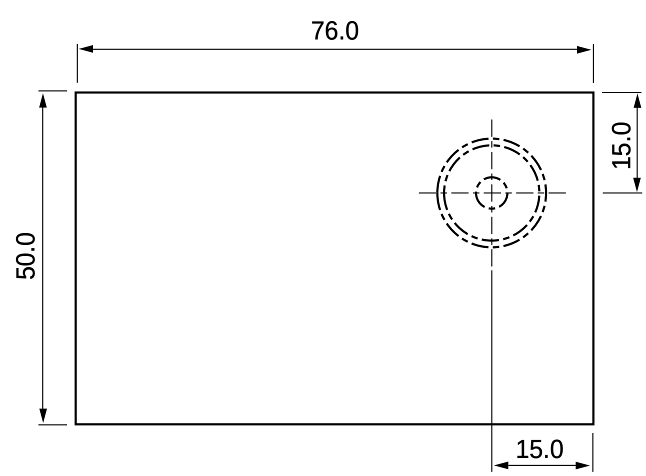
DIMENSIONS

DAC SERIES



Unit: mm

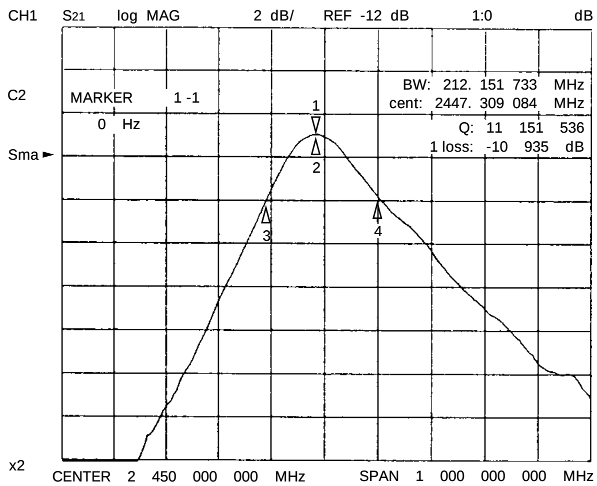
Mounted with Ground Plane



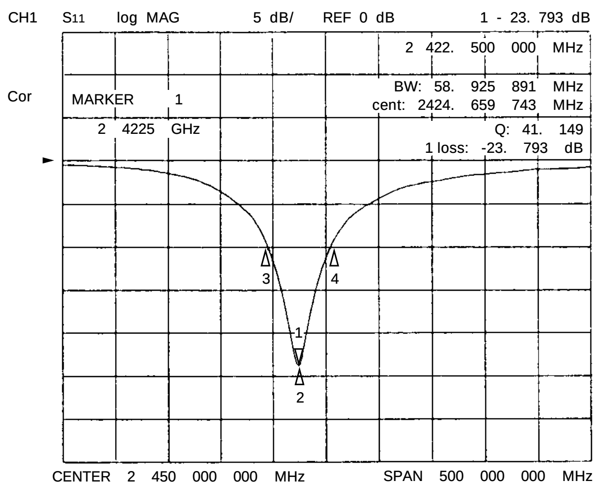
DAC Series

TYPICAL CHARACTERISTICS

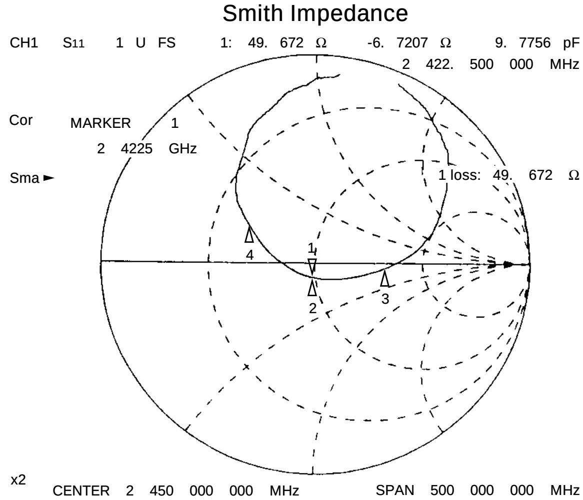
Receiving Signal Response vs Frequency



Return Loss

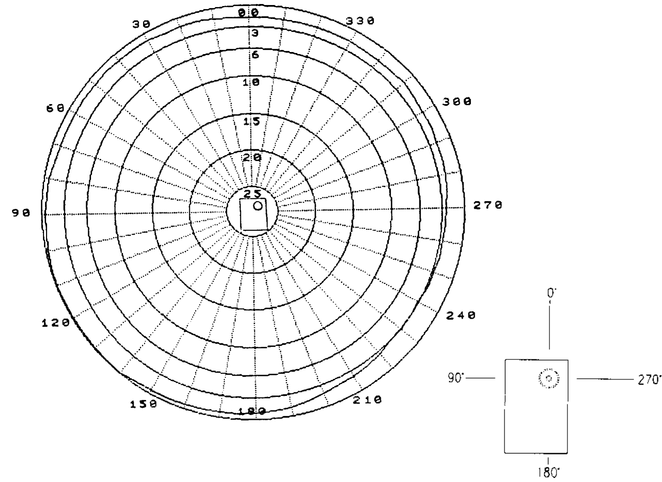


Smith Impedance

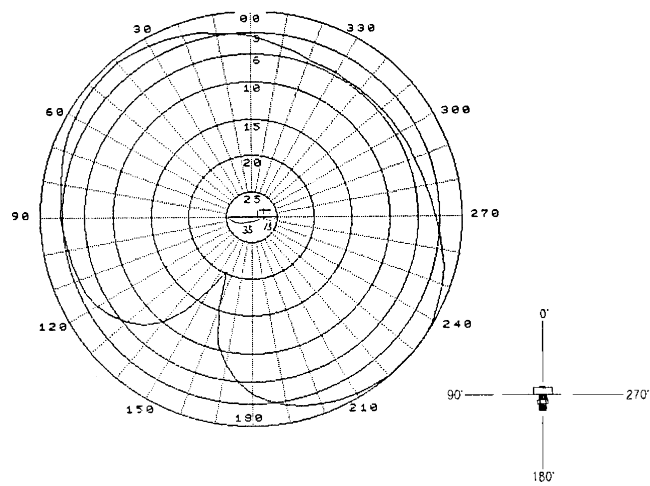


DIRECTIVITY CHART

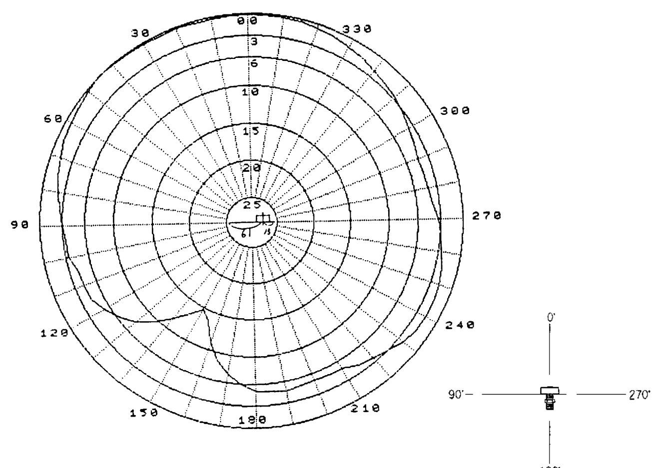
Horizontal Pattern



Vertical Pattern

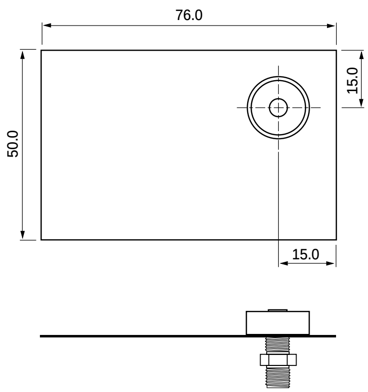


Vertical Pattern



INTERFERENCE COMPARISON OF DAC VS. PLANAR INVERTED F ANTENNA

DAC Set-up



Planar F Inverted Set-up

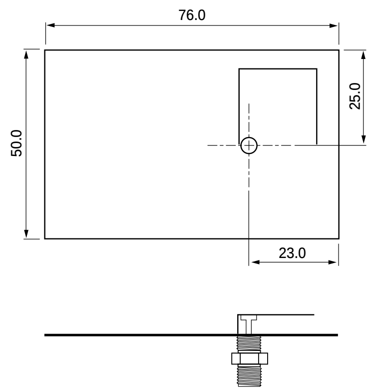
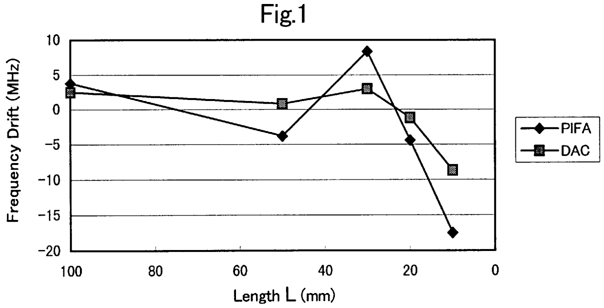


Fig.1



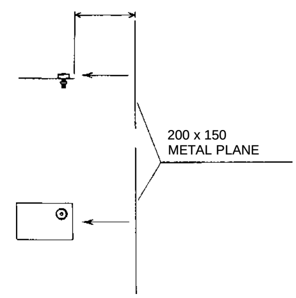
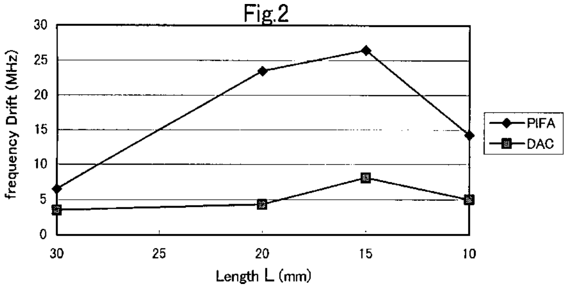


Fig.2



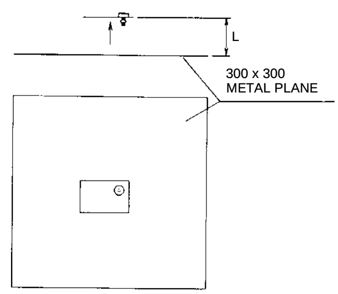
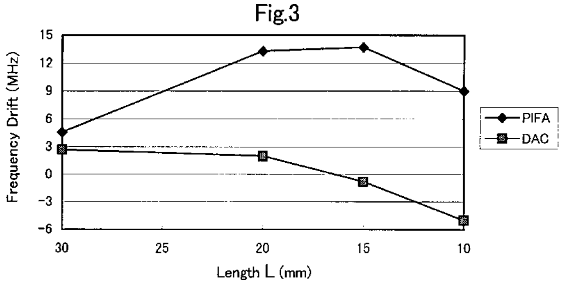


Fig.3



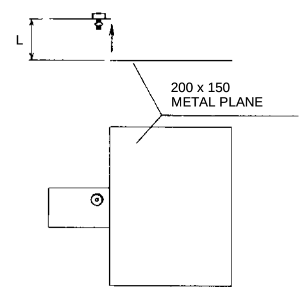
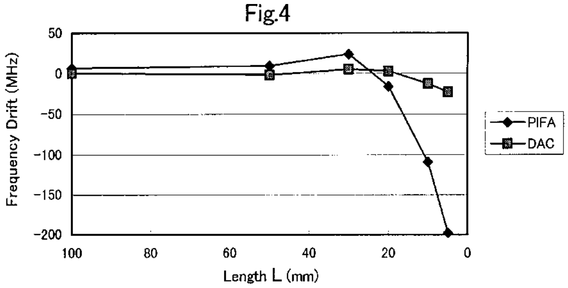
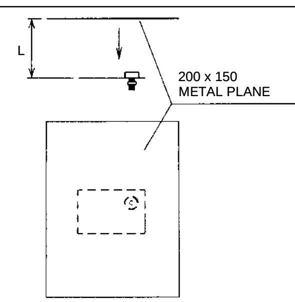


Fig.4

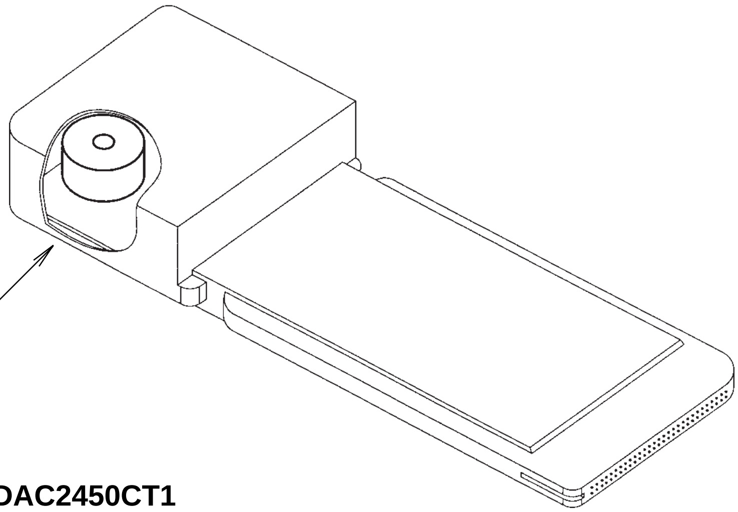




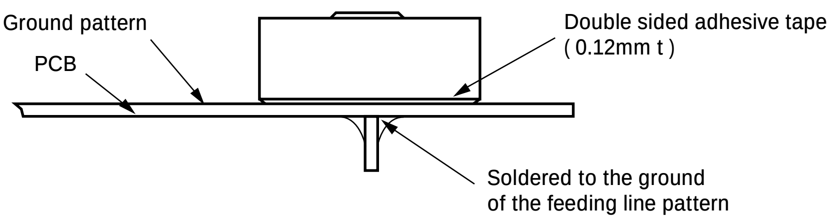
DAC Series

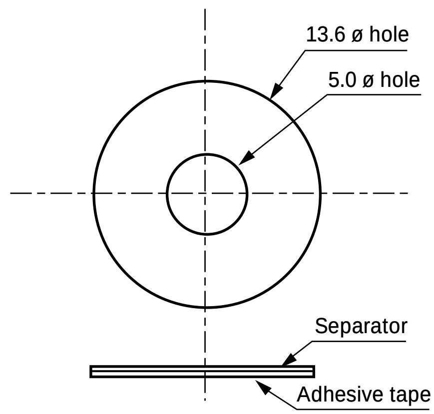
TYPICAL APPLICATION

MOUNTED IN PCMCIA TYPE II EXTENDED CARD



TYPICAL MOUNTING TO PRINTED CIRCUIT BOARD





Unit: mm
Material: Nitto N5015

Notes:

- Fix the antenna element on PCB using double sided adhesive tape of 0.12mm thickness. (Recommend No. 5015 : NITTO DENKO CORP.)
- Solder the antenna terminal pin on the bottom side of PCB to the ground of the feeding line patten.
- The terminal pin should be separated from the ground pattern.

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Tel: (847) 297-0070 Fax: (847) 699-7864 Web: http://www.tokoam.com

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Lucent Technologies
Bell Labs Innovations
WCND Utrecht B.V.

FCC ID: IMRWLPC24

TEST REPORT

Subject: Processing Gain Lucent WaveLAN IEEE

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

Report Prepared by:

Maarten Visee		December 11, 1997
Name	Signature	Date

Concurrence:

1. Director of Engineering

Bruce Tuch		December 12, 199
Name	Signature	Date

2. Team Captain

Wilbert Smorenburg		December 12, 1997
Name	Signature	Date

WaveLAN-II FCC Spreading Gain Measurements
FCCID: IMRWLPC24
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1. Summary:

This document describes the Receiver Spreading Gain as measured for WaveLAN-II, according to Ref.[1].

2. Conclusion:

The Lucent WaveLAN-II NIC product confirms 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/PC Card type 2 extended, Doc. No. HFS-25018 Rev. C, Date 97/05/27, 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.

4. Measurement description:

Part of the Lucent WaveLAN IEEE Network Interface Card (NIC) product FCC certification is a Processing Gain test. This test has to prove 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 proves the Receiver Processing Gain to be 10 dB or more, by monitoring the Bit Error Rate (BER) of the product under test while operating under strict specific received signal conditions.

This implies that a receiver input signal is applied to the product in the presence of a CW jammer. The CW jamming margin method as defined in Ref.[1] is used.

The test is such that it takes the theoretical calculated SNR for the applied modulation technique and specified BER as a reference. For coherent QPSK demodulation as applied in the WaveLAN IEEE product the theoretical required SNR for a BER of 10^-8 is 15 dB.

The test takes place at the product Functional Specification (Ref.[2]) specified conditions for BER rate measurements. It specifies a BER equal or better than 10^-8 at an receiver input level of -55 dBm. From reference [4], likewise as Ref.[3] consulted in Ref. [1], it is determined that for this BER the SNR (S/N)o equals 15 dB (QPSK, coherent detection).

To meet the minimum required processing gain of 10 dB, the receiver should meet the BER in the under a J/S ratio of:

10 - 15 = -5 dB.

Taking into account 2 dB implementation losses (Ref.[1]), a J/S ratio of -7 dB is calculated.

Thus, no received bit errors should be detected for a CW jammer level equal or less than:

-55 -7 = -62 dBm.

For received data errors detected while the CW jammer level is higher than -62 dBm, the J/S margin of -7 dB is exceeded, and are not taken into account.

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 (Ref.[1]).

The measurements are performed at a 50 KHz CW raster. For each CW jammer frequency 10^8 bits are transmitted by the transmitter and received by the product under test.

Though it would be more elegant to show BER compliance for at least say ten times 10^8 transmitted/received bits, the time involved with this grows significantly. Since the CW interferer is stepped in a 50 KHz raster, covering the receiver bandwidth of 16 MHz, it is considered that the BER requirement is sufficiently met since such a multitude of measurements are taken.

The measurement time for each CW frequency is set by the transmitter message length and the number of messages transmitted per second.

For the firmware set data field length of 96 µS, which equals 192 data bits for the WaveLAN IEEE 2 Mbit/sec. data rate (unfortunately today message length is firmware limited), the number of messages that need to be transmitted for a total of 10^8 bits can be calculated.

The number of needed messages to transmit 10^8 bits equals 10^8/192 = 520833 messages.

For a Tx rate of 1.3 KHz, the measurement time is 520833*(1/1300)= 400 seconds.

4.1. Set-up:

See figure 1 for the measurement set-up. A transmitter transmitting continuously 1300 frames per is second is used as the data source for the receiver under test. The transmitter Tx mode is under external control by means of a pulse generator. The transmitted data pattern is fixed, and known at the receiver. This enables a check of the received data against the known transmitted data at the receiver side.

In addition to this signal, a CW jammer is added to the received signal at the receiver input. At the inter-connection between the RF circuits and the Digital Signal Processor (DSP) the demodulated received RF signal is made available to an error checker. This error checker is a dedicated piece of hardware that monitors the received data, gating out any other information that is likely to be present in the received data stream (message header, message length field, CRC field, diagnostic information field etc.). In this hardware the known transmitted data sequence and the received data sequence are compared to eachother, and possible errors are signalled to an external counter.

Both CW jammer generator and counter are under control of a Personal Computer by means of an IEEE-Instrument Control Bus. Using a dedicated test software program the PC sets the CW jammer frequency and level at the CW generator. The program controls the counter, i.e. counter start, stop, reset and read-out of the error count.

The test sequence is as follows:

The PC issues a CW frequency and output level to the CW generator, taken from an input command file. Thus the CW signal together with the transmitted data signal becomes present at the receiver input. Immediately after the counter is reset by the PC, there is a 30 second test time. For any received data error detected by the error checker hardware, the error counter is incremented by one. After these 30 seconds have elapsed, the PC reads the number of errors recorded at the counter. When no errors are detected, the PC increases the CW level by +1 dB, and the test is restarted (reset counter, measure 30 seconds, read counter value).
-When no errors are detected, the jammer level is increased by +1 dB, and the test is repeated.
-If errors are detected, the CW jammer level is lowered by 1 dB. For a more accurate measurement where 10^8 bits are being received, a 400 seconds test time is used to measure the BER. After this long test, the test data (time, frequency, CW level, #errors) is written to disc in the PC.

Any measurement for that CW frequency that is not performed due to the fact that errors were detected are stored with the numbers of errors marked as `-1'.

The test continues by raising the jammer frequency by 50 KHz and setting the CW jammer level to the start value, and the measurements are repeated as described above. Annex B shows a flowchart of this process.

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

<u>4.1.1. Receiver level calibration:</u>

First, the receiver input level is calibrated using the RF power meter. For this purpose, the transmitter output attenuator is set to 0 dB, the CW jammer level is set to -90 dBm. Using the reading from the RF power meter, the attenuator is set such that the received level is -55 dBm.

4.1.2. CW level calibration:

Stop the transmitter, dial the output attenuator to 70 dB and stop the transmitter. 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 is the attenuation of the set-up. This is the correction factor that needs to be applied once the measurements results are known.

4.1.3. Test frequency:

Channel two (2417 MHz) was used for this test.

5. Equipment used:

# Item needed	Description
1	Portable PC with WaveLAN-II NIC, Panasonic CF-V21P, SN-3JKSM01028, for transmitter.
1	Software `NoHermes' is <thes.exe>, 9629 bytes, 6-30-97. Test software configuration file as given in Appendix D. Used for the transmitter.
1	Portable PC with WaveLAN-II NIC, NCR 3150, SN 1-26106224, for receiver.
1	Software `Testware V2.04' <TW.EXE>, 27826 bytes, 11-18-97, for receiver testing.
2	WaveLAN IEEE NIC.
1	PC + IEEE interface card, NCR PC6, SN 17-17039925.
1	Received error checker, wire-wrap prototype, home-built.
1	Power supply, Delta D030-1, for error checker.
1	Error counter, HP 534B, SN 2973A08980.
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 828.3218.02, SN 860925/005.
1	Pulse generator, HP 8112A, SN2343G01166.
1	CW jammer generator, Gigatronics 7200, SN 746604.
1	Variable attenuator, 0-70 dB, Midwest Microwave, Model 1044.
1	Fixed attenuator, 10 resp. 20 dB, Inmet Corp., model 18AH-20 and 18AH-10.
2	RF power splitter, ARRA 3-9200-2, SN 2001, SN 2003
1	Misc. IEEE cabling
1	Misc. SMA cabling
1	Misc. BNC cabling for error counter
1	RF shielded cage

6. Measurement set_up:

See Figure 1, measurement test set-up. To avoid signal leakage and unwanted interference that can disrupt the measurement, the whole test is performed within the shielded RF cage, with the exception of the transmitter with variable and fixed attenuators. These are placed outside the cage. The fixed 30 dB attenuator assembly is placed at the RF feed-through connector in the shielded cage wall.

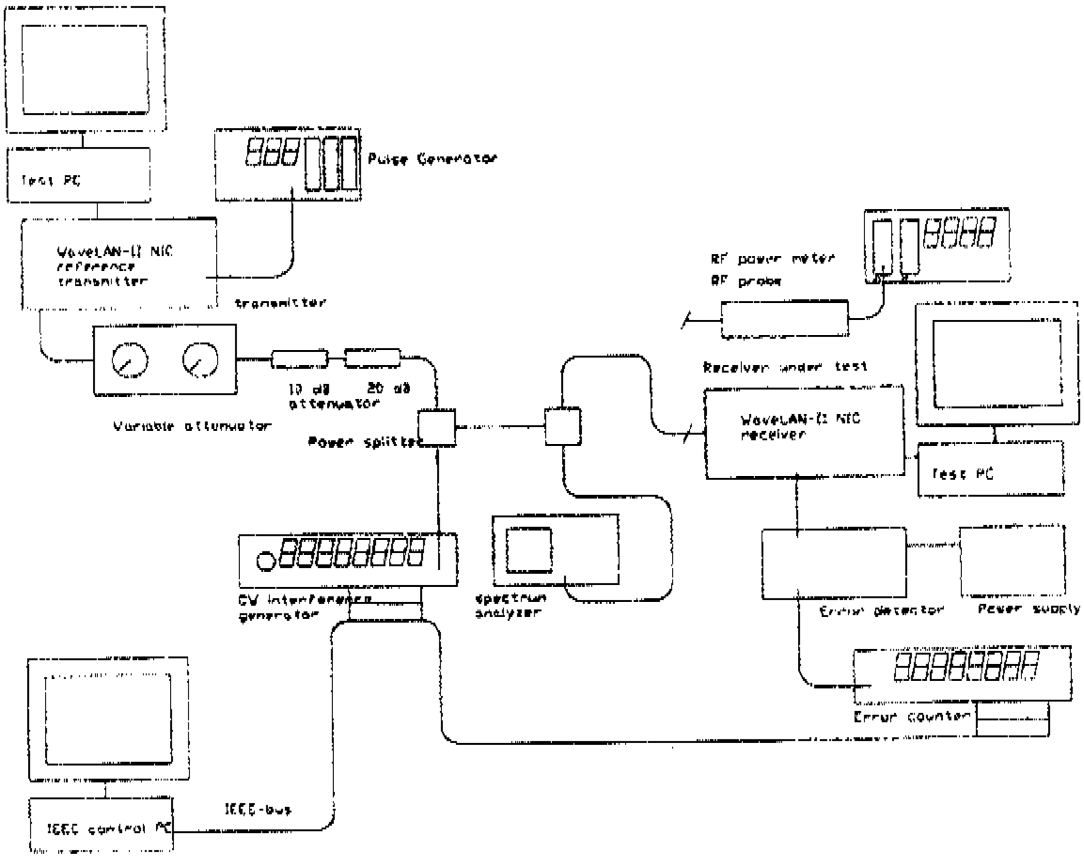

Figure 1. Measurement test set-up.

7. Measurement results:

Calibrations:

Receiver calibration: For 0 dB attenuator setting (variable and fixed = 0) the received level at the receiver input equals -3 dBm. Therefore, set the variable attenuator to 13 dB, and select the fixed attenuator for 30 dB attenuation.

CW jammer generator calibration: For a 0 dBm output level at the generator the received level at the receiver input is -8 dBm.

Spreading Gain Measurement Results:

Annex A lists the measurement results. For each frequency between Fc+/-8 MHz a BER measurement is taken.

Note that the J/S ration is given at the top of the table.

At each measurement frequency the jammer level is varied from -68 dBm to -60 dBm a the receiver input, yielding a J/S ratio of -13 to -5 dB.

As can be seen, for some measured CW jammer frequencies received data errors are detected.

Applying the rule of discarding the 20% worst-case jamming/signal points (see Ref.[1]) results in zero received errors (250 CW frequencies measured, at 45 CW frequencies a received data error was detected for a J/S ratio more than -7 dB, 45 < 20% * 250).

Therefore, a J/S ratio better or equal to -7 dB is found (CW = -62 dBm at receiver input).

Therefore the tested product complies to the required Processing Gain of 10 dB.

Annex A, FCC Spreading Gain Measurements Results, Lucent Confidential, ©1997

Annex A: Measurement results

Measurement file output name is: MEASRES.TXT
Input command file name is: INPUT.CMD
Input CW correction level: 8 dB

Number of received data errors as a function of frequency and interference level
Not measured combinations listed as "-1"

Uncorrected interference level dialed at CW generator	-60	-59	-58	-57	-56	-55	-54	-53	-52	Errors detected	Errors detected			
True CW interference level at receiver input (dBm)	-68	-67	-66	-65	-64	-63	-62	-61	-60	full test range	up to CW '=< -62 dBm			
J/S ratio (dB)	-13	-12	-11	-10	-9	-8	-7	-6	-5			start time	stop time	date
Frequency (Hz)														
2411000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:52:24	0:59:07	12/1/97
2411050000	0	0	0	0	0	0	0	1	-1	Errors	0	0:41:00	0:47:42	12/1/97
2411100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:30:07	0:36:49	12/1/97
2411150000	0	0	0	0	0	0	1	1	-1	Errors	1	0:18:43	0:25:25	12/1/97
2411200000	1	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	0:07:49	0:14:31	12/1/97
2411250000	0	0	0	0	0	1	-1	-1	-1	Errors	1	0:00:02	0:06:44	12/1/97
2411300000	0	0	0	0	0	0	0	0	1	Errors	0	23:50:10	23:56:52	11/30/97
2411350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:38:46	23:45:28	11/30/97
2411400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:27:22	23:34:04	11/30/97
2411450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:15:58	23:22:40	11/30/97
2411500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:04:34	23:11:16	11/30/97
2411550000	0	0	0	0	0	0	0	0	1	Errors	0	22:53:10	22:59:53	11/30/97
2411600000	0	0	0	0	0	0	1	-1	-1	Errors	1	22:41:45	22:48:28	11/30/97
2411650000	0	0	0	0	0	0	0	0	1	Errors	0	22:31:23	22:38:06	11/30/97
2411700000	0	0	0	0	0	0	0	0	1	Errors	0	22:19:58	22:26:41	11/30/97
2411750000	0	0	0	0	0	0	0	0	1	Errors	0	22:08:34	22:15:16	11/30/97
2411800000	0	0	0	0	0	0	0	0	1	Errors	0	21:57:10	22:03:52	11/30/97
2411850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:45:46	21:52:28	11/30/97
2411900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:34:22	21:41:04	11/30/97
2411950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:22:58	21:29:40	11/30/97
2412000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:11:33	21:18:15	11/30/97
2412050000	0	0	0	0	0	0	0	0	1	Errors	0	21:00:09	21:06:51	11/30/97
2412100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:48:44	20:55:27	11/30/97

Annex A, FCC Spreading Gain Measurements Results,
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2412150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:37:20	20:44:02	11/30/97
2412200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:25:56	20:32:38	11/30/97
2412250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:14:32	20:21:14	11/30/97
2412300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:03:08	20:09:50	11/30/97
2412350000	0	0	0	0	1	-1	-1	-1	-1	Errors	1	19:51:43	19:58:26	11/30/97
2412400000	0	0	0	0	0	2	1	-1	-1	Errors	1	19:42:23	19:49:05	11/30/97
2412450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:32:01	19:38:43	11/30/97
2412500000	1	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	19:20:37	19:27:20	11/30/97
2412550000	0	1	1	-1	-1	-1	-1	-1	-1	Errors	1	19:12:50	19:19:32	11/30/97
2412600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:04:32	19:11:14	11/30/97
2412650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:53:08	18:59:50	11/30/97
2412700000	0	0	0	0	0	0	0	0	1	Errors	0	18:41:44	18:48:26	11/30/97
2412750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:30:20	18:37:03	11/30/97
2412800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:18:56	18:25:38	11/30/97
2412850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:07:31	18:14:13	11/30/97
2412900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:56:07	18:02:49	11/30/97
2412950000	0	0	0	1	1	-1	-1	-1	-1	Errors	1	17:44:43	17:51:25	11/30/97
2413000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:23:23	12:30:05	11/29/97
2413050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:34:47	12:41:29	11/29/97
2413100000	0	0	0	0	0	0	0	0	1	Errors	0	12:46:11	12:52:53	11/29/97
2413150000	0	0	0	0	0	1	-1	-1	-1	Errors	1	12:56:02	13:02:44	11/29/97
2413200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:07:26	13:14:08	11/29/97
2413250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:18:50	13:25:32	11/29/97
2413300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:30:14	13:36:56	11/29/97
2413350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:41:38	13:48:20	11/29/97
2413400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:53:02	13:59:44	11/29/97
2413450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:04:26	14:11:08	11/29/97
2413500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:15:50	14:22:32	11/29/97
2413550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:27:14	14:33:56	11/29/97
2413600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:38:38	14:45:20	11/29/97
2413650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:50:02	14:56:44	11/29/97
2413700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:01:27	15:08:09	11/29/97
2413750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:12:51	15:19:33	11/29/97
2413800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:24:15	15:30:58	11/29/97
2413850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:35:39	15:42:21	11/29/97
2413900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:47:03	15:53:45	11/29/97
2413950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:58:27	16:05:09	11/29/97
2414000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:09:51	16:16:33	11/29/97

Annex A, FCC Spreading Gain Measurements Results,
Lucent Confidential, ©1997

2414050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:21:15	16:27:58	11/29/97
2414100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:32:39	16:39:21	11/29/97
2414150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:44:03	16:50:45	11/29/97
2414200000	0	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	16:51:50	16:58:32	11/29/97
2414250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:03:14	17:09:56	11/29/97
2414300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:14:38	17:21:20	11/29/97
2414350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:26:02	17:32:44	11/29/97
2414400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:37:26	17:44:08	11/29/97
2414450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:48:51	17:55:34	11/29/97
2414500000	0	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	17:56:38	18:03:20	11/29/97
2414550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:08:02	18:14:44	11/29/97
2414600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:19:26	18:26:09	11/29/97
2414650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:30:50	18:37:32	11/29/97
2414700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:42:14	18:48:57	11/29/97
2414750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	18:53:38	19:00:20	11/29/97
2414800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:05:02	19:11:44	11/29/97
2414850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:16:26	19:23:08	11/29/97
2414900000	0	0	0	2	-1	-1	-1	-1	-1	Errors	1	19:25:15	19:31:57	11/29/97
2414950000	0	0	0	0	0	0	0	0	1	Errors	0	19:36:39	19:43:21	11/29/97
2415000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:48:03	19:54:46	11/29/97
2415050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	19:59:27	20:06:09	11/29/97
2415100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:10:51	20:17:34	11/29/97
2415150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:22:15	20:28:57	11/29/97
2415200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:33:40	20:40:23	11/29/97
2415250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:45:05	20:51:48	11/29/97
2415300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	20:56:29	21:03:11	11/29/97
2415350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:07:53	21:14:35	11/29/97
2415400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:19:17	21:26:00	11/29/97
2415450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:30:41	21:37:23	11/29/97
2415500000	0	1	1	-1	-1	-1	-1	-1	-1	Errors	1	21:38:59	21:45:42	11/29/97
2415550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	21:50:23	21:57:05	11/29/97
2415600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	22:01:47	22:08:29	11/29/97
2415650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	22:13:11	22:19:54	11/29/97
2415700000	0	0	0	0	0	0	0	0	1	Errors	0	22:24:35	22:31:17	11/29/97
2415750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	22:35:59	22:42:41	11/29/97
2415800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	22:47:23	22:54:06	11/29/97
2415850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	22:58:47	23:05:29	11/29/97
2415900000	0	0	0	0	0	1	-1	-1	-1	Errors	1	23:08:38	23:15:21	11/29/97

Annex A, FCC Spreading Gain Measurements Results,
Lucent Confidential, ©1997

2415950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:20:03	23:26:46	11/29/97
2416000000	0	0	0	0	0	0	0	0	1	Errors	0	23:31:27	23:38:09	11/29/97
2416050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	23:42:51	23:49:34	11/29/97
2416100000	0	-1	-1	-1	-1	-1	-1	-1	-1	Errors	1	23:50:07	23:56:49	11/29/97
2416150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:01:31	0:08:13	11/30/97
2416200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:12:55	0:19:37	11/30/97
2416250000	0	0	0	0	0	0	0	0	1	Errors	0	0:24:19	0:31:01	11/30/97
2416300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:35:43	0:42:26	11/30/97
2416350000	1	-1	-1	-1	-1	-1	-1	-1	-1	Errors	1	0:42:59	0:49:42	11/30/97
2416400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	0:54:23	1:01:05	11/30/97
2416450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	1:05:47	1:12:30	11/30/97
2416500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	1:17:11	1:23:53	11/30/97
2416550000	0	0	0	0	0	0	0	0	1	Errors	0	1:28:35	1:35:17	11/30/97
2416600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	1:39:59	1:46:42	11/30/97
2416650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	1:51:23	1:58:05	11/30/97
2416700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:02:48	2:09:31	11/30/97
2416750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:14:12	2:20:55	11/30/97
2416800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:25:36	2:32:18	11/30/97
2416850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:37:01	2:43:44	11/30/97
2416900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:48:25	2:55:07	11/30/97
2416950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	2:59:49	3:06:31	11/30/97
2417000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	3:11:13	3:17:56	11/30/97
2417050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	3:22:37	3:29:19	11/30/97
2417100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	3:34:02	3:40:45	11/30/97
2417150000	0	0	1	-1	-1	-1	-1	-1	-1	Errors	1	3:42:21	3:49:03	11/30/97
2417200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	3:53:45	4:00:27	11/30/97
2417250000	0	0	0	0	0	0	0	0	1	Errors	0	4:05:09	4:11:51	11/30/97
2417300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	4:16:33	4:23:15	11/30/97
2417350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	4:27:57	4:34:39	11/30/97
2417400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	4:39:21	4:46:03	11/30/97
2417450000	0	0	1	-1	-1	-1	-1	-1	-1	Errors	1	4:47:40	4:54:22	11/30/97
2417500000	0	0	0	1	1	-1	-1	-1	-1	Errors	1	4:57:00	5:03:43	11/30/97
2417550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	5:08:24	5:15:06	11/30/97
2417600000	0	0	0	0	0	0	0	0	1	Errors	0	5:19:48	5:26:30	11/30/97
2417650000	0	0	0	0	0	0	0	0	1	Errors	0	5:31:12	5:37:54	11/30/97
2417700000	0	0	0	0	0	0	0	0	1	Errors	0	5:42:36	5:49:18	11/30/97
2417750000	0	0	0	0	0	0	0	0	1	Errors	0	5:54:00	6:00:42	11/30/97
2417800000	0	0	0	0	0	0	0	0	1	Errors	0	6:05:24	6:12:06	11/30/97

Annex A, FCC Spreading Gain Measurements Results,
Lucent Confidential, ©1997

2417850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	6:16:46	6:23:30	11/30/97
2417900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	6:28:12	6:34:55	11/30/97
2417950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	6:39:36	6:46:18	11/30/97
2418000000	0	0	0	1	-1	-1	-1	-1	-1	Errors	1	6:48:25	6:55:07	11/30/97
2418050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	6:59:49	7:06:31	11/30/97
2418100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	7:11:13	7:17:55	11/30/97
2418150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	7:22:37	7:29:19	11/30/97
2418200000	0	0	0	0	0	1	-1	-1	-1	Errors	1	7:32:30	7:39:13	11/30/97
2418250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	7:43:55	7:50:37	11/30/97
2418300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	7:55:19	8:02:01	11/30/97
2418350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	8:06:43	8:13:25	11/30/97
2418400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	8:18:07	8:24:49	11/30/97
2418450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	8:29:31	8:36:13	11/30/97
2418500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	8:40:55	8:47:37	11/30/97
2418550000	0	0	0	0	0	0	1	-1	-1	Errors	1	8:51:17	8:57:59	11/30/97
2418600000	0	0	0	0	0	0	1	-1	-1	Errors	1	9:01:39	9:08:22	11/30/97
2418650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:13:03	9:19:45	11/30/97
2418700000	0	-1	-1	-1	-1	-1	-1	-1	-1	Errors	1	9:20:19	9:27:02	11/30/97
2418750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:31:43	9:38:25	11/30/97
2418800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:43:07	9:49:49	11/30/97
2418850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:54:31	10:01:13	11/30/97
2418900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:05:55	10:12:37	11/30/97
2418950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:17:20	10:24:02	11/30/97
2419000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:28:44	10:35:27	11/30/97
2419050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:40:08	10:46:50	11/30/97
2419100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:51:33	10:58:16	11/30/97
2419150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:02:57	11:09:39	11/30/97
2419200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:14:21	11:21:03	11/30/97
2419250000	0	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	11:22:08	11:28:51	11/30/97
2419300000	0	0	1	-1	-1	-1	-1	-1	-1	Errors	1	11:30:26	11:37:08	11/30/97
2419350000	0	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	11:38:13	11:44:56	11/30/97
2419400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:49:38	11:56:21	11/30/97
2419450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:01:02	12:07:44	11/30/97
2419500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:12:27	12:19:10	11/30/97
2419550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:23:51	12:30:33	11/30/97
2419600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:35:16	12:41:57	11/30/97
2419650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:46:39	12:53:22	11/30/97
2419700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:58:04	13:04:46	11/30/97

Annex A, FCC Spreading Gain Measurements Results,
Lucent Confidential, ©1997

2419750000	0	1	1	-1	-1	-1	-1	-1	-1	Errors	1	13:06:22	13:13:04	11/30/97
2419800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:17:46	13:24:29	11/30/97
2419850000	0	0	0	0	0	0	1	1	-1	Errors	1	13:28:39	13:35:21	11/30/97
2419900000	0	0	1	-1	-1	-1	-1	-1	-1	Errors	1	13:36:57	13:43:40	11/30/97
2419950000	0	0	0	0	1	1	-1	-1	-1	Errors	1	13:46:48	13:53:30	11/30/97
2420000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:58:12	14:04:54	11/30/97
2420050000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:09:36	14:16:19	11/30/97
2420100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:21:01	14:27:43	11/30/97
2420150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:32:25	14:39:07	11/30/97
2420200000	0	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	14:40:12	14:46:55	11/30/97
2420250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:51:36	14:58:18	11/30/97
2420300000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:03:00	15:09:43	11/30/97
2420350000	0	0	0	1	-1	-1	-1	-1	-1	Errors	1	15:11:49	15:18:31	11/30/97
2420400000	0	0	0	0	0	2	1	-1	-1	Errors	1	15:22:11	15:28:53	11/30/97
2420450000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:33:36	15:40:19	11/30/97
2420500000	0	0	0	0	0	0	0	0	1	Errors	0	15:45:00	15:51:43	11/30/97
2420550000	0	0	0	0	0	0	0	0	1	Errors	0	15:56:24	16:03:06	11/30/97
2420600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:07:48	16:14:31	11/30/97
2420650000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:19:12	16:25:54	11/30/97
2420700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:30:36	16:37:18	11/30/97
2420750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:42:00	16:48:42	11/30/97
2420800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	16:53:24	17:00:06	11/30/97
2420850000	0	0	0	0	0	0	1	-1	-1	Errors	1	17:03:48	17:10:29	11/30/97
2420900000	0	0	0	1	-1	-1	-1	-1	-1	Errors	1	17:12:35	17:19:17	11/30/97
2420950000	0	0	0	0	0	0	0	0	1	Errors	0	17:23:59	17:30:41	11/30/97
2421000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	17:35:23	17:42:05	11/30/97
2421050000	0	0	0	0	0	0	0	0	1	Errors	0	8:28:04	8:34:46	12/1/97
2421100000	0	0	0	0	0	1	1	-1	-1	Errors	1	8:38:26	8:45:09	12/1/97
2421150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	8:49:50	8:56:32	12/1/97
2421200000	0	0	0	0	1	1	-1	-1	-1	Errors	1	8:59:41	9:06:23	12/1/97
2421250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:11:05	9:17:48	12/1/97
2421300000	0	0	0	0	0	0	0	0	1	Errors	0	9:22:29	9:29:11	12/1/97
2421350000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	9:33:54	9:40:36	12/1/97
2421400000	0	0	0	0	0	0	0	0	2	Errors	0	9:45:18	9:52:01	12/1/97
2421450000	0	0	0	0	0	0	0	0	1	Errors	0	9:56:42	10:03:24	12/1/97
2421500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:08:06	10:14:49	12/1/97
2421550000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:19:30	10:26:12	12/1/97
2421600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:30:54	10:37:36	12/1/97

Annex A, FCC Spreading Gain Measurements Results,
Lucent Confidential, ©1997

2421650000	0	0	1	-1	-1	-1	-1	-1	-1	Errors	1	10:39:13	10:45:56	12/1/97
2421700000	0	-1	-1	-1	-1	-1	-1	-1	-1	Errors	1	10:46:29	10:53:11	12/1/97
2421750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	10:57:54	11:04:36	12/1/97
2421800000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:09:18	11:16:01	12/1/97
2421850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:20:42	11:27:24	12/1/97
2421900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:32:06	11:38:49	12/1/97
2421950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:43:30	11:50:12	12/1/97
2422000000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	11:54:54	12:01:36	12/1/97
2422050000	0	0	0	1	1	-1	-1	-1	-1	Errors	1	12:04:15	12:10:58	12/1/97
2422100000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:15:39	12:22:21	12/1/97
2422150000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:27:03	12:33:45	12/1/97
2422200000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:38:28	12:45:11	12/1/97
2422250000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	12:49:52	12:56:34	12/1/97
2422300000	1	1174	-1	-1	-1	-1	-1	-1	-1	Errors	1	12:57:39	13:04:22	12/1/97
2422350000	0	0	0	0	0	1	-1	-1	-1	Errors	1	13:07:30	13:14:12	12/1/97
2422400000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:18:54	13:25:36	12/1/97
2422450000	0	0	0	0	0	0	0	0	1	Errors	0	13:30:18	13:37:01	12/1/97
2422500000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	13:41:43	13:48:26	12/1/97
2422550000	1	1	-1	-1	-1	-1	-1	-1	-1	Errors	1	13:49:30	13:56:13	12/1/97
2422600000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:00:55	14:07:37	12/1/97
2422650000	0	0	0	0	0	0	0	1	-1	Errors	0	14:11:48	14:18:30	12/1/97
2422700000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:23:12	14:29:55	12/1/97
2422750000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:34:36	14:41:18	12/1/97
2422800000	0	0	0	0	0	0	0	1	-1	Errors	0	14:45:29	14:52:11	12/1/97
2422850000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	14:56:53	15:03:36	12/1/97
2422900000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:08:18	15:15:01	12/1/97
2422950000	0	0	0	0	0	0	0	0	0	OK, 0 errors	0	15:19:42	15:26:25	12/1/97
2423000000	0	0	0	0	0	0	0	0	1	Errors	0	15:31:07	15:37:50	12/1/97
											45			
											18.7500%			
											< 20% so OK!			

Annex B: FCC processing gain description

APPENDIX C

FEDERAL COMMUNICATIONS COMMISSION

Equipment Authorization Division
7435 Oakland Mills Road
Columbia, MD 21046
Telephone: (301) 725-1585
Facsimile: (301) 344-2050

Guidance on Measurements for Direct Sequence Spread Spectrum Systems

Part 15 of the FCC Rules provides for operation of direct sequence spread spectrum transmitters. Examples of devices that operate under these rules include radio local area networks, cordless telephones, wireless cash registers, and wireless inventory tracking systems.

The Commission frequently receives requests for guidance as to how to perform measurements to demonstrate compliance with the technical standards for such systems. No formal measurement procedure has been established for determining compliance with the technical standards. Such tests are to be performed following the general guidance in Section 15.31 of the FCC Rules and using good engineering practice. The following provides information on the measurement techniques the Commission has accepted in the past for equipment authorization purposes. Alternative techniques may be acceptable upon consultation and approval by the Commission staff. The information is organized according to the pertinent FCC rule sections.

Section 15.31(m): This rule specifies the number of operating frequencies to be examined for tunable equipment.

Section 15.207: Power line conducted emissions. If the unit is AC powered, an AC power line conducted test is also required per this rule.

Section 15.247(a)(2): Bandwidth. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span >> RBW.

Section 15.247(b): Power output. This is an RF conducted test. Use a direct connection between the antenna port of the transmitter and the spectrum analyzer, through suitable attenuation. Set the RBW > 6 dB bandwidth of the emission or use a peak power meter.

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

(1) RF antenna conducted test: Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. All harmonics/spurs must be at least 20 dB down from the highest emission level within the authorized band *as measured with a 100 kHz 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 = 1 MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation, use the settings 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 (e).

Section 15.247(d): Power spectral density. Locate and zoom in on emission peak(s) within the passband. Set RBW = 3 kHz, VBW > RBW, sweep = (SPAN/3 kHz) e.g., for a span of 1.5 MHz, the sweep should be $1.5 \times 10^6 \div 3 \times 10^3 = 500$ seconds. The peak level measured must be no greater than +8 dBm. If external attenuation is used, don't forget to add this value to the reading. Use the following guidelines for modifying the power spectral density measurement procedure when necessary.

- For devices with spectrum line spacing greater than 3 kHz no change is required.
- For devices with spectrum line spacing equal to or less than 3 kHz, the resolution bandwidth must be reduced below 3 kHz until the individual lines in the spectrum are resolved. The measurement data must then be normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band (in linear power units) to determine compliance.
- If the spectrum line spacing cannot be resolved on the available spectrum analyzer, the noise density function on most modern conventional spectrum analyzers will directly measure the noise power density normalized to a 1 Hz noise power bandwidth. Add 34.8 dB for correction to 3 kHz.
- Should all the above fail or any controversy develop regarding accuracy of measurement, the Laboratory will use the HP 89440A Vector Signal Analyzer for final measurement unless a clear showing can be made for a further alternate.

Section 15.247(e): Processing Gain. 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 the 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 Processing Gain.

In a practical system, there are always implementation losses which degrade the performance below that of an optimal theoretical system of the same type. Losses occur due to non-optimal filtering, lack of equalization, LO phase noise, "corner cutting in digital processing", etc. Total losses in a system, including transmitter and receiver, should be assumed to be no more than 2 dB.

The signal to noise ratio for an <u>ideal</u> non-coherent receiver is calculated from:

(1) $P_e = \frac{1}{2}e^{(-\frac{1}{2}(S/N)o)}$

where : P_e = probability of error (BER)
$(S/N)o$ = the required signal to noise ratio at the receiver output for a given received signal quality

This is an example. You should use the equation (or curve) dictated by your demodulation scheme.

Ref.: Viterbi, A. J. <u>Principles of Coherent Communications</u>, (New York: McGraw-Hill 1966), Pg. 207

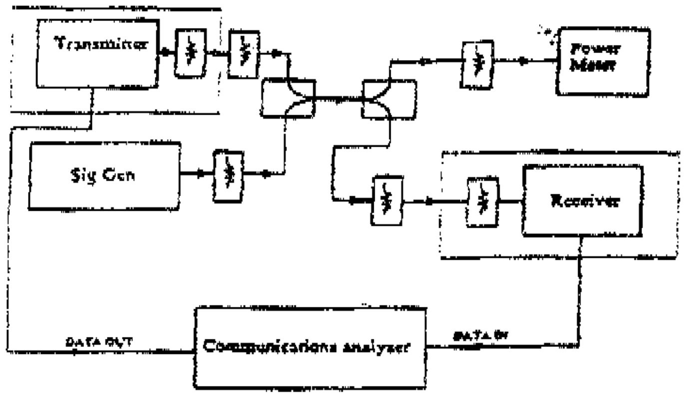
Using equation (1) shown above, calculate the signal to noise ratio required for your chosen BER. This value and the measured J/S ratio are used in the following equation to calculate the Processing Gain (Gp) of the system.

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

where: $(S/N)o$ = Signal to noise ratio

Mj = J/S ratio
$Lsys$ = System losses.

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



Jamming Test Setup
Figure 1

ALTERNATIVE TEST PROCEDURES

If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the various conducted requirements of Section 15.247 are acceptable. As stated previously, a pre-amp must be used in making the following measurements.

1) Calculate the transmitter's peak power using the following equation:

$$E = \frac{\sqrt{30\,PG}}{d}$$

Where: E is the measured maximum field strength in V/m utilizing the widest available RBW.
G is the numeric gain of the transmitting antenna over an isotropic radiator.
d is the distance in meters from which the field strength was measured.
P is the power in watts for which you are solving:

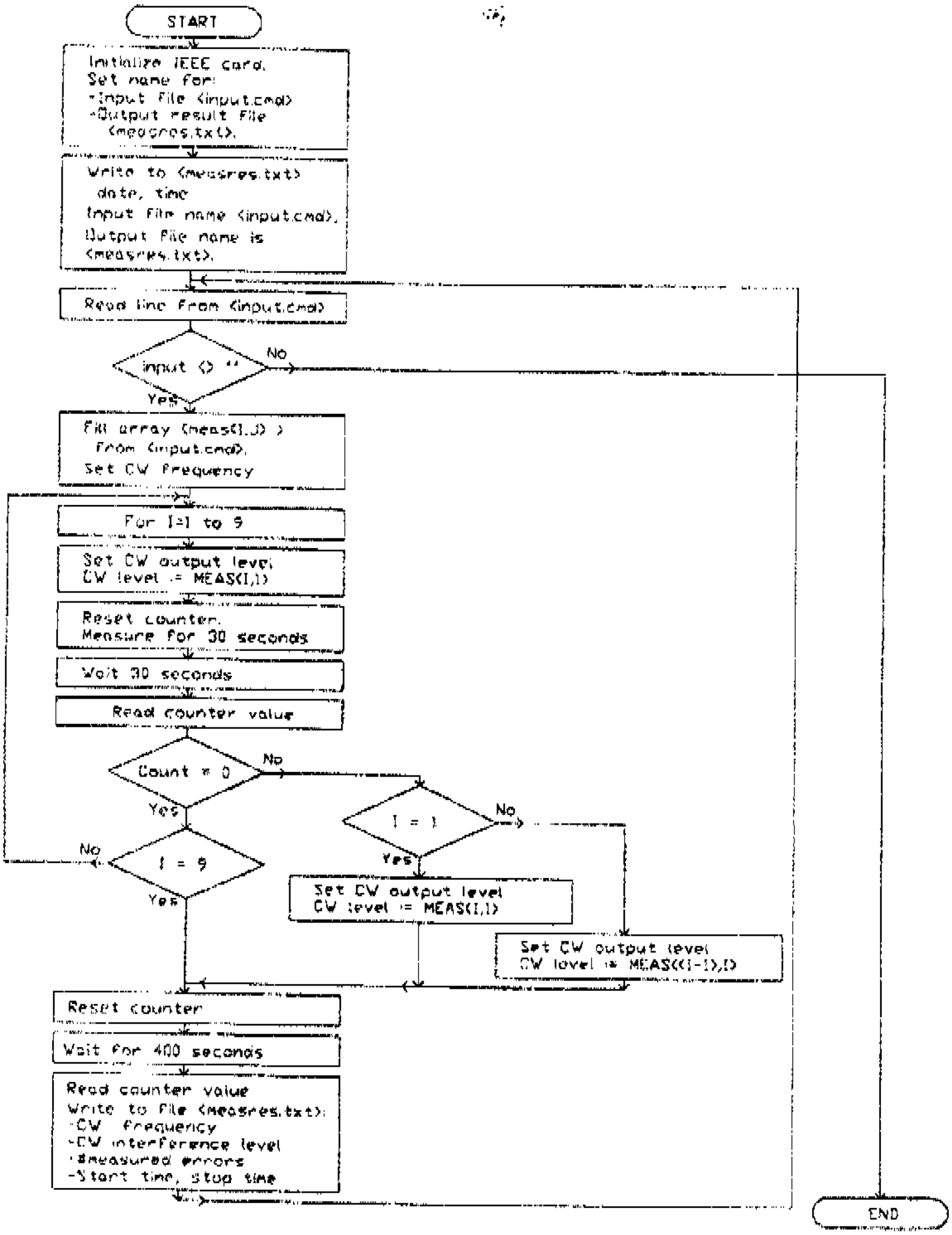
$$P = \frac{(Ed)^2}{30G}$$

2) Measure the power spectral density as follows:

A. Tune the analyzer to the highest point of the maximized fundamental emission. Reset the analyzer to a RBW = 3 kHz, VBW > RBW, span = 300 kHz, sweep = 100 sec.

B. From the peak level obtained in (A), derive the field strength, E, by applying the appropriate antenna factor, cable loss, pre-amp gain, etc. Using the equation listed in (1), calculate a power level for comparison to the +8 dBm limit.

Annex C: Flow-Chart IEEE control program



Annex D, FCC Spreading Gain Measurements Results, 'NoHermes Configuration File', Lucent Confidential, ©1997

Below is the configuration file for the test software 'NoHermes' listed for an 2 MBit/sec Tx rate.

```
;
;NOHERMES configuration file for FCC receiver spreading gain
;test, Nov 19, '97.
;Make register 42h, IDACtrim register Bh for NoHermes testboard <FCC_1>.
;Use ext. HP8112A pulse generator for Txenable generation,
;per = 770 uS, DC=97 %, HIL=1.90 V, LOL=-0.1 V.
;Receiver use A model with A-WMAC, using Testware TW software
;Monitor with Wire-Wrap board and counter the Rx
;for received error bits.
;Make sure the transmitter has the fixed data pattern!
;Use OEM Tx mode, PLCP      (address 39h) = 01h),
;and file length  PLCPLEN0 (address 3Ah, lsb, 00h),
;                 PLCPLEN1 (address 3Bh, msb, 04h),
;                 PLCPSERV (         3Ch,      00h),
;                 PLCPSIGN (         3Dh,      14h),
;                 PLCPSYNC (         3Eh,      80h),
; Default clock low to high in the middle of the data
; Default enable, active high to low at start of data,
; low to high at the end of the data.
; First out bit is the left one of the string

; Setting up the Theseus
; Always start with a 1  this indicates a Write operation.

; Default clock low to high in the middle of the data
; Default enable, active high to low at start of data,
; low to high at the end of the data.

;  Lutindx  address  00
MMI: 1000000000000000

;  Lutdata  address  01
MMI: 1000000100000000

;  Lutmax/min address  02
MMI: 1000001011110011

;  Lutfinal  address  03
MMI: 1000001110101101

;  Lutgain  address  04
MMI: 1000010001100000

;  Maxsar  address  05
MMI: 1000010100000100

;  Tblank  address  06
MMI: 1000011000001010

;  Textblank address  07
MMI: 1000011100010010

;  Trfblank  address  08
MMI: 1000100000001010

;  Tmeas  address  09
MMI: 1000100100010110

;  Textmeas  address  0A
MMI: 1000101000101100
```

Annex D, FCC Spreading Gain Measurements Results,
'NoHermes Configuration File',
Lucent Confidential, ©1997

```
; Nummeas address 0B
MMI: 1000101100000100

; Tfast address 0C
MMI: 1000110000100000

; Tslow address 0D
MMI: 1000110110000000

; Hystcomp address 0E
MMI: 1000111000000000

; PCEN address 10
MMI: 1001000000000001

; DAC step address 11
MMI: 1001000100000001

; VG DAC address 12
MMI: 1001001001100011

; Ref DAC address 13
MMI: 1001001101100100

; Comppol address 14
MMI: 1001010000000001

; Edetthr address 20
MMI: 1010000001000101

; Cdetthr address 21
MMI: 1010000101000101

; Dfrthr address 22
MMI: 1010001001000111

; Mimdlvl address 23
MMI: 1010001100000110

; Huntdlvl address 24
MMI: 1010010000000011

; Sifs address 25
MMI: 1010010100001010

; Maxrxtime address 26
MMI: 1010011001001000

; Huntmode address 27
MMI: 1010011100000000

; Sacken address 28
MMI: 1010100000000000

; Sacklen address 29
MMI: 1010100100000000

; Noantdiv address 2A
MMI: 1010101000000000

; Ignserv address 2B
MMI: 1010101100000000

; Endropdlvl address 2C
```

```
MMI: 1010110000000110

;  Txcallsign0  address  30
MMI: 1011000000000000

;  Txcallsign1  address  31
MMI: 1011000100000000

;   Txcallsign2 address  32
MMI: 1011001000000000

;   Txcallsign3 address  33
MMI: 1011001100000000

;   Txcallsign4 address  34
MMI: 1011010000000000

;   Txcallsign5 address  35
MMI: 1011010100000000

;   Txcallsign6 address  36
MMI: 1011011000000000

;   Txcallsign7 address  37
MMI: 1011011100000000

;   Rx/Tx Cen address  38
MMI: 1011100000000000

;   Plcpen address  39
MMI: 1011100100000001

;   Plcpen0 address  3A
MMI: 1011101000000000

;   Plcpen1 address  3B
MMI: 1011101100000011

;   Plcpserv address  3C
MMI: 1011110000000000

;   Plcpsign address  3D
MMI: 1011110100010100

;   Plcpsync address  3E
MMI: 1011111010000000

;    Boosten address  3F
MMI: 1011111100000000

;   Cpthr address  40
MMI: 1100000001010000

;  Cwthr address  41
MMI: 1100000100100111

;    Trim IDAC address  42
MMI: 1100001000001011

;    Trim Q DAC address  43
MMI: 1100001100000100

;    Level compadres  44
MMI: 1100010001000000
```

```
;    AD on/off address  45
MMI: 1100010100000000

;    Scr/sfd off address  70
MMI: 1111000000000000

;    IQ pat/IQ test address  71
MMI: 1111000100000000

;    AGC address  72
MMI: 1111001010111111

;    Antsel address  73
MMI: 1111001100000000

;    Anlp address  74
MMI: 1111010000000000

;    ETset/adten address  75
MMI: 1111010100000000

;    Da digen/ten address  76
MMI: 1111011000000000

;    Da test address  77
MMI: 1111011100000000

;    Theseus enable address  7F
MMI: 1111111110000000

; Programming of the 1630 on 352 MHz
; Main divider
GPSIO0: 0011101000000110100111
GPSIO0: 1011111110000000010111

;  Programming of the 1021 on 2065 MHz resulting in 2417 MHz Fo
;  For 2417-352=2065 MHz, = (811)h
GPSIO1:    000000000000000000001

;  Main divider coeff 2100
;  For 2065
;        (0  0  8   1   1)h last 4 bits is synthesizer register address
;            -...,----,...----,...,
GPSIO1:    00000100000000100010100

;reference divider  22
GPSIO1:    0000000000000101100101
```