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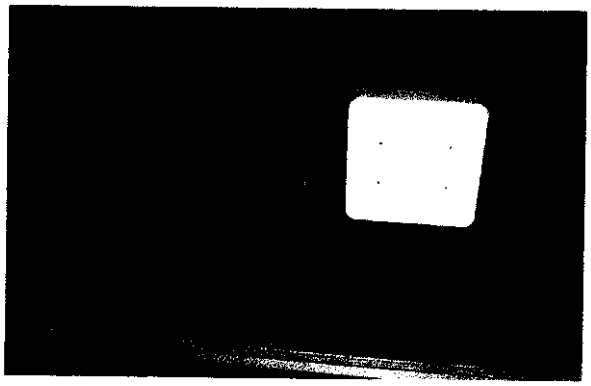
CLASS 2 PERMISSIVE CHANGE for FCC ID: LOZ102035

FCC Part 2.1043, Part 15 Subpart C(15.247)

Report #09800164F1
Issued 12/10/98



LM4511 WITH ALTERNATE ANTENNA SYSTEM

Prepared for:

Mr. Dave Case
Aironet Wireless Communications, Inc.
3875 Embassy Parkway
Akron, OH 44333

Test Date(s): November 11, 1998

On the basis of the measurements made, the equipment tested is capable of operation in compliance with the requirements of Part 15 of the FCC Rules under normal use and maintenance.

tested by

Ted Chaffee, NCE
Lab Manager/Test Engineer, AHD

witnessed by

Dave Case, NCE
EMC Engineer

Table of Contents

EXHIBIT 1: JUSTIFICATION OF PERMISSIVE CHANGE [2.1043(b)(2)(3)]

This submittal concerns the Class 2 Permissive Change, pursuant to Part 2.1043, of the 2.4GHz Direct Sequence transmitter / receiver, FCC ID: LOZ102035.

The permissive change addressed in this application is to include an alternate antenna design into the approval of the 2.4Ghz transmitter / receiver.

The antenna evaluated is a 16dBi patch antenna.

Except for the antenna difference, the system is identical to that already granted for FCC ID: LOZ102035 on March 17, 1998.

This application contains the necessary additions to the original application that reflect the testing of the system with the alternate antenna style.

All other information in the original submittal granted March 17, 1998 apply.

Grantee / FCC Correspondence

The following three pages are copies of correspondence between the Grantee and the FCC supporting the test plan used and justifying the permissive change requested.

Aironet

5/28/98

To: Greg Czumak
cc: Charlie Cobb
From: David Case N.C.E.

3 pages

Greg,

I ask before posting this on the FCC bulleting board, that do to some of the confidential information (part numbers) that if possible can you remove the part numbers before posting.

This is an inquiry into a test method for approving additional antennas for the LM4511 series (11MB product) FCC ID :LOZ102035 which you are familiar with. We are now ready to proceed to the next phase and add additional antennas to the product. However before I run through the entire range of our antennas, I would like to propose a modified test program. This modified test program would using only one or two of the highest gain antennas (23dB Parabolic Dish and 13.5dB Yagi) to show compliance to FCC Part 15.247 and have the other lower gain antennas listed in the file based on the results from the testing with LOZ102034.

I am basing this on the following.

1) The LOZ102035 is electrically and physically identical to the LM4500 radio FCC ID LOZ102034 including the circuit board.
2) Both are approved for maximum power of 250mW, though standard configuration is currently 100mW output.
3) The difference between the LOZ102035 and the LOZ10234 is the Harris PHY chip. The 2MB version LOZ102034 uses the HFA3824 and for the 11 MB version HFA3860 chip (a direct drop in replacement).
4) Based on the above information, the RF profiles are the same and that no significant difference would be observed when using the lower gain antennas and data rates.
5) Memo issued by Ed Gibbons on 7/11/96 in which I asked a similar question (see attached memo #1) and his suggestion was to test with worse case antenna to fulfill requirements.

Aironet

06/11/98

Subject: Class 2 Change for FCC file LOZ102035.

The following data is being submitted to update the Aironet 11 MB radio approval file FCC ID: LOZ102035. Based on conversations with both Greg Czumak and Rich Fabina and a technical opinion by Ed Gibbons in 1996, we tested only the worst case antenna combination and our supplying additional data from a previous model that is electrically and physically identical to the LM4511.

As stated in an earlier fax (see attached), the Aironet 11 MB Direct Sequence radio (FCC ID: LOZ102035) is both physically and electrically to the 2MB Direct Sequence radio (FCC ID:LOZ102034) identical except for the Harris PHY chip.

The worst combination testing was done with highest gain antenna, the 21dB parabolic dish (the 23dB parabolic dish is being phased out). The additional data supplies on the dipoles, Omni's, and Patch antennas was performed at M. Flom Associates on the LM4500 (LOZ102034).

I have attached a list of the Aironet model numbers for inclusion into this file.

Part number	Antenna
420-3549	1.0dBi Snap On (approved with LOZ102035)
430-1499	2.2dBi dipole
430-3449	1.9dBi dipole
430-3213	5.2dB Diversity Omni pillar mount
430-3214	8.5dBi Patch
430-1729	6.0dB Patch
430-3677	12dB Omni
430-3677	5.2dB Omni
430-1949	13.5dB Yagi

For testing purposes the highest gain version of each type antenna was tested with the LOZ102034.

TO: DAVE CASE

David A. Case N.C.E.
Aironet Wireless Comm
367 Ghent Rd
Suite 300
Akron OH, 44333
216-665-7396
330

Date : 7/1/96

copy { Jim F. & file
Jim N.
Here is FCC (Ed Gibbons) response to Dave Case's questions on the 4 Mbit radio Don

Ed Gibbons
FCC Engineer

Mr. Gibbons,

We have several questions that we would like clarified before we proceed with additional testing of one of our products.

Our 2.4 Ghz Direct Sequence Spread Spectrum Radio FCC ID LOZ025-2 was certified with a 23dBi Dish antenna with the radio power being reduced to meet the FCC Part 15 C requirements.

The radio FCC ID LOZ025-2 is a modified version of our radio LOZ025-1A except for a change in firmware and a filter to allow it to be a 4 Mbit version only instead of a 2 Mbit.

1) Since both radios are +20dBm and with the circuitry being similar do we need to retest all the antennas approved with the LOZ025-1A for the LOZ025-2 if everything else remains constant? – No, test w/ only the worst case antenna.

2) The current version of the LOZ025-2 is being reengineered and will possibly have an increase in power by about +3.5dBm. Besides retesting the antennas with this version of the radio (it will be set by firmware at the factory for power setting) will we need to change the FCC ID number to something like LOZ025-2A or can this be covered by a Class II Change? – New ID unless the changes are minor

3) We currently have a 23dBi dish antenna approved, we are now also planning to offer a +19dBm Patch array antenna as a replacement for the dish. Please confirm that we need to retest the unit with the radios instead of falling under a family type approval. – Patch ant. must be tested

We also understand that Cylinx has had their waiver for antennas granted for another couple of years, is there a public notice or ruling on this or what information on what the waiver covers? – Check w/ John Reed. 202/418-2455

Hope you're feeling better soon,

Ed 7/11

Grant of Equipment Authorization FCC ID: LOZ102035

FEDERAL COMMUNICATIONS COMMISSION

WASHINGTON, D.C. 20554

GRANT OF EQUIPMENT AUTHORIZATION

Certification

Aironet Wireless Communications Inc
367 Ghent Road, Suite 301
Fairlawn, Ohio 44334

Date of Grant: March 17, 1998

File No.: 31010/EQU 4-3-2

Application dated: February 12, 1998

Attention: Donald I. Sloan

NOT TRANSFERABLE

EQUIPMENT AUTHORIZATION is hereby issued to the named GRANTEE, and is VALID ONLY for the equipment identified hereon for use under the Commission's Rules and Regulations listed below.

FCC IDENTIFIER LOZ102035

Name of Grantee Aironet Wireless Communications, Inc.

FCC Rule Part(s): 15

Frequency (MHz) : 2412-2465

Equipment Class : Spread Spectrum Transmitter

PCMCIA WLAN
Maximum OUtput Power: 0.250 watts

This device has shown compliance with new rules adopted under Docket 87-389 and is not affected by Section 15.37, transition rule.

Mail to:
Morton Flom
M. Flom Associates, Inc.
3356 N. San Marcos Place, Suite 107
Chandler, AZ 85224-1571

EXHIBIT 2: DESCRIPTION OF PRODUCT CHANGE [2.1033(b)(4)]

The 16dBi antenna tested with the LM4511 system is:

Type of Device:	16dBi gain patch antenna
Manufacturer:	Conifer II, Wireless Telecommunication Technology
Model:	Model QD-2402
Device working frequency:	2.4 - 2.5GHz
Fabrication Technology:	Stamped Aluminum housed in ABS plastic.
VSWR:	1.5:1
Tolerance:	3dB beam width = 27deg.
Front to Back Ratio:	> 40dB

The following pages is a copy of the manufacturer's specification print for the Model QD2402 antenna.

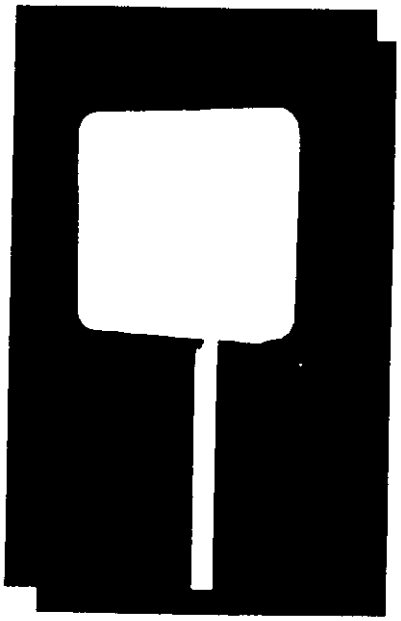
For World-Wide Applications

WLAN/ISM

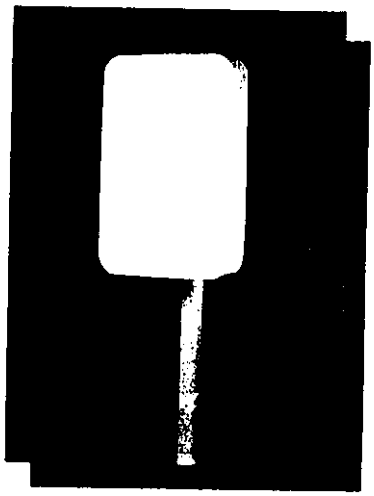
2.4 - 2.5 GHz*

New Microceptor® Series

Model QD-24XX
16dBi Typical Gain



Model DL-24XX
13dBi Typical Gain



MODELS

DL-2400
- 13dBi Typical Gain
- Standard Mast Mount

DL-2402
- 13dBi Typical Gain
- Elevation Mast Mount

QD-2400
- 16dBi Typical Gain
- Standard Mast Mount

QD-2402
- 16dBi Typical Gain
- Elevation Mast Mount

DL-2410
- 11dBi Typical Gain
- Standard Mast Mount
- 75° 3 db Beam Width

DL-2420
- 11dBi Typical Gain
- Elevation Mast Mount
- 75° 3 dB Beam Width

FEATURES

- Excellent Cross Pole Patterns
- Quick Mount "U" Bracket
- Tilt Mast Mount Option
- Broad Beam Width Option
- Light Weight But Durable
- Low Wind Loading
- Five Year Warranty

BENEFITS

- Superior Performance
- Easy To Install
- Optimize Signal Level
- Wide Area Coverage
- Saves On Shipping Costs
- Minimal Hardware Per Installation
- Guaranteed Reliability

Optional **Micro-Mount™**
Model UM-1000

The universal Micro-Mount makes antenna installation a snap! Mount it to a wall, a vent, roof, and even most rain gutters. Also available is the EX-1000 extension tube that adds another 10" of pipe to the end of the Microceptor Mount.

CONIFER II℠
WIRELESS TELECOMMUNICATION TECHNOLOGY

URS ISO 9001

1400 N Roosevelt, Burlington, IA 52601
Phone 800-843-5419 (U.S.), 319-752-3607 (Int'l)
Fax 319-753-6508, e-mail: conifer@conifer.com

*Contact Conifer's Sales Department for other frequencies such as PCS, ENG, WLL, WCS

MICROCEPTOR®* ANTENNAS
MODELS QD AND DL

SPECIFICATIONS**	DL-2400 or DL-2402	QD-2400 or QD-2402	DL-2420 or DL-2410
Input Frequency***	2400 - 2500 GHz	2400 - 2500 GHz	2400 - 2500 GHz
Gain (Typical)	13 dBi	16 dBi	11 dBi
3 dB Beam Width E Plane	27°	27°	27°
H Plane	45°	27°	75°
Front to Back Ratio (Typical)	>40 dB	>40 dB	>25 dB
Cross Pole	>25 dB	>30 dB	>25 dB
VSWR	1.4:1	1.5:1	1.4:1
Impedance	50 OHMS	50 OHMS	50 OHMS
Wind Loading			
@100 MPH	25.0 lbs.	25.0 lbs.	25.0 lbs.
@140 MPH	49.4 lbs.	49.4 lbs.	49.4 lbs.
Polarity	Dual	Dual	Dual
Input Power	50 Watts	50 Watts	50 Watts
Connector "N" Type	Female	Female	Female
Right Angle Male Adaptor	Option	Option	Option
Size			
Inches	7.5 x 11	10.75 x 11	7.5 x 11
Millimeters	.30 x .43	.42 x .43	.30 x .43
Weight			
Pound	1.4	2.0	1.4
Kilograms	.64	.91	.64
Reflector Material	Stamped Aluminum	Stamped Aluminum	Stamped Aluminum
Backplate Bracket Material	Zinc-plated Steel	Zinc-plated Steel	Zinc-plated Steel
Housing Material	High Impact ABS Plastic	High Impact ABS Plastic	High Impact ABS Plastic
Radome	Standard	Standard	Standard
Standard Mount			
DL-2400, QD-2400, DL-2410 Elevation Mast Mount	1 - 2 inch O.D. Pipe	1 - 2 inch O.D. Pipe	1 - 2 inch O.D. Pipe
DL-2402, QD-2402, DL-2420	1 - 2 inch O.D. Pipe 60° in 10° increments or less	1 - 2 inch O.D. Pipe 60° in 10° increments or less	1 - 2 inch O.D. Pipe 60° in 10° increments or less
Micro-Mount *(Optional Mounting)* Material	Stainless Steel/Aluminum	Stainless Steel/Aluminum	Stainless Steel/Aluminum
EX-1000 Extension Tube			
Size	12 Inches	12 Inches	12 Inches
Material	Aluminum	Aluminum	Aluminum

*One or more Patents may apply: 5,229,782 • 5,523,768 • 5,402,138 • 5,394,115 • Patents Pending
**Specifications subject to change without notice.
***Consult factory for other frequencies including ENG and PCS.

MANUFACTURED IN BURLINGTON, IOWA

EXHIBIT 3: REPORT OF MEASUREMENTS [2.1033(b)(6)]

Statements concerning this report

Test Traceability:
The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

Limitations on results:
The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

Limitations on copying:
This report shall not be reproduced, except in full, without the written approval of AHD.

Limitations of the report:
This report shall not be used to claim product endorsement by NVLAP, FCC, or any agency of the US Government.

Statement of Test Results Uncertainty: Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: ± 2.1 dB

Summary of Results: 16dBi Patch Antenna

1. This test series evaluated the Equipment Under Test, LM4511 with alternate 16dBi Antenna , to FCC Part 15, SubPart C.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for Spread Spectrum, 2.4GHz, Intentional Radiators.
3. The equipment under test was received on November 10, 1998 and this test series commenced on November 10, 1998.
4. The radiated level of spurious emissions nearest the limit, with the EUT in 'Receive Mode', occurred at 122.9MHz, vertically polarized. This signal was measured to be 54uV/m which is 8.8dB below the 150uV/m limit.
5. The radiated emission level nearest the limit, when measuring at the band edges only, occurred at 2.4835GHz and 2.485GHz with the EUT in 11Mbut/Sec operation, horizontally polarized. This signal was measured to be 0.3dB below the 500uV/m limit.
6. The radiated emission level nearest the limit, when measuring the transmitter harmonic emissions, occurred at 9.848Ghz. The signal was measured to be 495.4uV/m which is 0.1dB below the 500uV/m limit.
7. The transmitter maximum power was measured at 2.412GHGz, 2.442GHz, and 2.462GHz. The highest level observed, 2.412GHz, measured to be 5.8dB below the 15.247(b)(3)(i) limit of 27dBm. [This limit is derated due to the 16dBi antenna used with the transmitter].

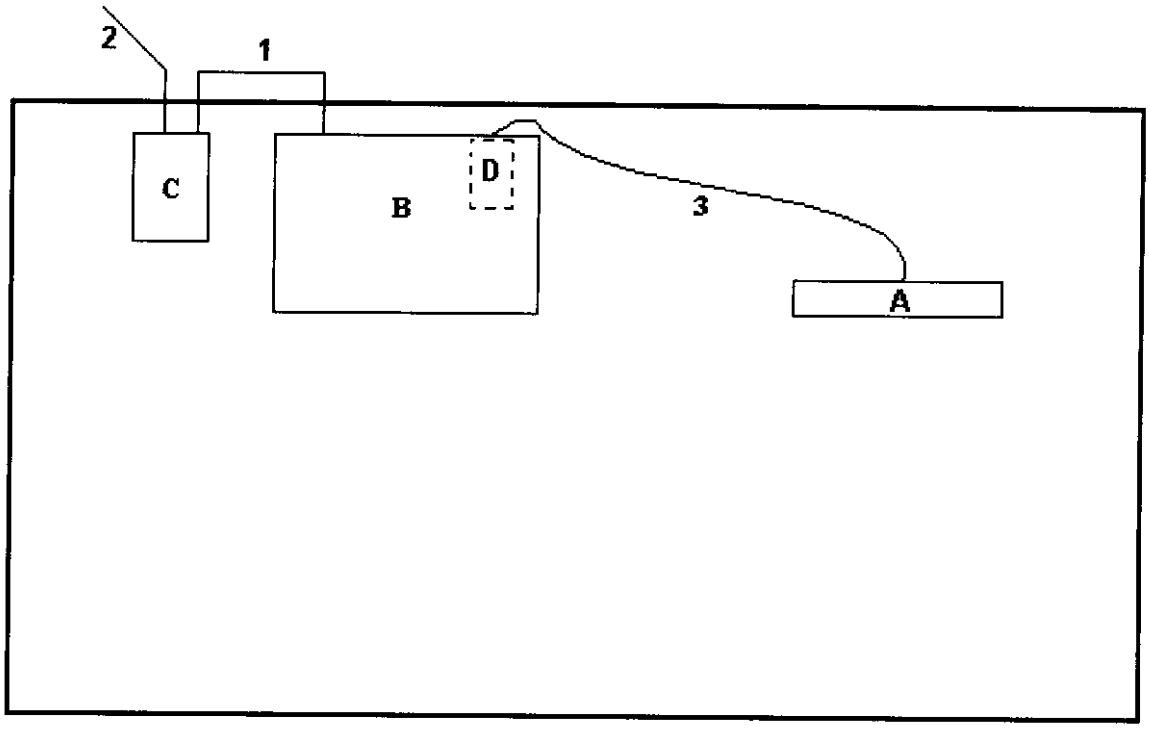
Changes made to achieve compliance

1. NONE

Configuration Tested: [2.1033(b)(8)]

Support Equipment & Cabling

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] 16dBi antenna	[Conifer] QD2402	--	--
B	Host Computer 486DX4 100MHz	[Hewlett Packard] Omnibook 4000C	TW50902541	FCC ID:B944000XY1
C	Laptop Power Supply	[HP] F1072A	T5005165	1meter DC cable, Shielded.
D	RF source	[Aironet] LM4511		FCC ID: LOZ102035
1	DC line cord	--	--	1.5meters, Unshielded
2	Power supply AC line cord	--	--	1.5 meters, Unshielded
3	Transmit coax	--	--	1 meters



setup_1h

BASIC EUT SETUP
(Legend designation is above)

Setup Pictures

Standards Applied to Test: [2.1033(b)(6)]

ANSI C63.4 - 1992, Appendix I
CFR47 FCC Part 2, Part 15, SubPart C, 15.247

Test Methodology: [2.947(a), 2.1033(b)(6)]

For the testing, the placement of the EUT and the support equipment was selected to represent a configuration which would operate the equipment within the setup constraints of ANSI C63.4.

Radiated testing, performed at a 3 meter open field test site, was completed according to the procedures outlined in the standards.

The cables of the EUT were manipulated to produced the highest signal level relative to the limit.

The pictures, in the preceding pages, show the position of the equipment and cabling that produced the maximum signal level.

A laptop computer hosted the transmitter LM4511.

Line Conducted

The line conducted tests were not repeated during this test series. The line conducted emission profile of the host system has been evaluated in previous tests and the data is on file with the FCC.

Variance in Test Procedure

The plotted charts of the band edge emissions (pp. 23-31) inadvertently used an averaging bandwidth of 1MHz. Thus, the charts depict a profile higher than measured. The measured data (p.22), however, used the correct averaging detector of the HP8546A Receiver and are accurate.

Radiated

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm from the open field site ground plane in the prescribed setup per ANSI C63.4, Figure 9(c).

The table sits upon a remote controlled turntable. The receiving antenna, located at the appropriate standards distance of 3 meters from the table center, is also remote controlled.

During the evaluation the transmitter was on continuously. Tests were performed with the system operating at the maximum BIT rate of 11MegaBits/Sec of data transfer. The determination of this as worst case was made in previous tests using the LM4511 2.4GHz Spread Spectrum Transmitter.

Preliminary and final tests were done at the 3 meter open field test site.

The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions. Both Vertical and Horizontal RF profiles were evaluated.

The principal settings of the EMI Receiver for radiated testing include:

Bandwidth:	120KHz for frequencies less than 1GHz.
	1MHz for frequencies greater than 1GHz.
Detector Function:	scanning and signal search = Peak Mode
	measurements = Quasi Peak Mode for frequencies less than 1Ghz.
	Average mode for frequencies greater than 1GHz.

The cable loss of the coax used is charted in this report.

The resultant Field Strength (FS) is a summation in decibels (dB) of the Indicated Receiver Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF). If a PreAmplifier (PA) is used, its gain (dB) is subtracted from the above sum.

Formula 1: $FS(dBuV/m) = RF(dBuV) + AF(dB/m) + CF(dB) - PA(dB)$

To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

Formula 2: $FS(uV/m) = AntiLog[(FS(dBuV/m))/20]$

EXHIBIT 4: TEST DATA [2.1033(b)(6)

Transmitter Maximum Peak Output Power: 15.247(b)(1), (b)(3)(i)

MEASUREMENT PROCEDURE:

1. The EUT was setup to operate in for an 11MBit data rate which represents worst case interference potential.
2. The EMC Receiver was connected directly to the transmitter output.
3. The EMC Receiver was setup using IF BW = 1MHz, Avg BW = 300Hz.

Calculation justification:

The maximum allowable power of 1 Watt is derated by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

The Model QD2402 Patch Antenna has a rated gain of 16dBi.

Thus the maximum allowable power is derated by (16dBi - 6dB)/3 = 3dB.

Given that 1Watt = 1000mWatts: 1000mW is 10*LOG(1000) = 30dBm

Therefore, the maximum allowable power is:

30dBm - 3dBm = 27dBm. [or antilog(27/10) = 501mW].

Tuned Frequency MHz	Measurement dBm		Cable Factor dB	Total Field Strength dBm	15.247(b)(3)(i) Limit dBm
2412	20.0		1.17	21.17	27
2442	19.5		1.18	20.68	27
2462	19.3		1.19	20.49	27

Measurements by: Ted Chaffee

Out of Band Emissions: [15.205(a),(b),(c), 15.209(a), 15.247(c)]

Restricted Bands: [15.205]

The following frequency bands are restricted. Only spurious emissions are permitted at levels limited by 15.209:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.25
0.490-0.510	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

LIMIT @ 3meter: [15.209(a)]

30-88MHz	100uV/m	40dBuV/m
88-216MHz	150uV/m	43.5dBuV/m
216-960MHz	200uV/m	46dBuV/m
above 960MHz	500uV/m	54dBuV/m

Receive Mode - Radiated Field Strength: [15.33(b), 15.109(a), 15.209(a)]

MEASUREMENT PROCEDURE:

1. The EUT was setup to operate as the receiver.
2. The receiving spectrum analyzer was connected directly to the antenna terminals to locate the spurious emissions prior to taking open field radiated measurements.
3. The EUT system was set upon the wooden turntable 80cm above the ground plane at a distance of 3 meters from the receiving antenna.
4. At each suspect frequency, the EUT system was rotated and the search antenna raised and lowered to obtain the maximum signal level. Also, a scan of 30MHz through 5GHz was made.
6. Both Horizontal and Vertical polarization modes were evaluated.
7. The Field Strength E(uV/m) is calculated using the formula:

$$E(uV/m) = LOG_{10}^{-1}((dBuV/m + Ant.Factor(dB) + Coax\ Loss(dB) - PreAmp(dB))/20)$$

Tabulated Measurements

Quasi-Peak for frequencies less than 1GHz. Average for frequencies greater than 1 GHz.

Frequency MHz	Measurement Quasi-Peak dBuV/m	Polarity	Cable +Antenna Factor dB	Total Field Strength dBuV/m	Total Field Strength uV/m	FCC Limit uV/m
43.05	11.40	V	15.42	26.82	21.9	100
50.38	13.02	H	12.7	25.72	19.3	100
96.00	16.14	V	9.68	25.82	19.5	150
120.76	21.54	H	10.28	31.82	39.0	150
122.89	24.41	V	10.24	34.65	54.0	150
168.01	20.94	H	11.59	32.53	42.3	150
192.00	16.47	V	12.85	29.32	29.2	150
374.00	8.41	V	19.05	27.46	23.6	200
375.94	17.11	H	19.09	36.2	64.6	200
396.82	7.69	V	19.51	27.2	22.9	200
400.97	12.58	H	19.58	32.16	40.6	200

Frequency MHz	Measurement Average dBuV/m	Polarity	Cable +Antenna Factor dB	Total Field Strength dBuV/m	Total Field Strength uV/m	FCC Limit uV/m
1456	-12.3 (floor noise)	V&H	34.17	< 21.9	< 12.4	500
1702	-12.2 (floor noise)	V&H	37.14	< 24.9	< 17.6	500
1925	-12.3 (floor noise)	V&H	37.92	< 25.6	< 19.0	500
2097	-11.5 (floor noise)	V&H	41.20	< 29.7	< 30.5	500

All other emissions in the range 30MHz - 5GHz were greater than 20dB below the limits.

Measurements by: Ted Chaffee

Transmitter Radiated Measurements

Emissions at Band Edges [15.205(a), 15.209, 15.247(c)]

MEASUREMENT PROCEDURE:

1. The EUT was adjusted to operate at 2412MHz to evaluate the lower band edge
2. The EUT was adjusted to operate at 2462MHz to evaluate the upper band edge

Charted Waveforms at Band Edges. [Waveform charts begin at page 23.]

3. The waveforms displayed were recorded in chart format for both the high side and low side of band edges.
4. The EMI Receiver settings for charting the waveform display are:
   a) IF Bandwidth = 100KHz, Avg Bandwidth = 300KHz, and
   b) IF Bandwidth = 1MHz, Avg Bandwidth = 10Hz.

Measurement of Radiated Emissions. [Tabulated data is on pages 22.]

5. The EUT system was set upon the wooden turntable 80cm above the ground plane at a distance of 3 meters from the receiving antenna.
6. The transmit frequency emission level was maximized by rotating the turntable and raising and lowering the search antenna.
7. Data was recorded with the LM4511 at 11MBit/Sec (highest data rate). Unless noted, the EMI Receiver settings at IF Bandwidth=1MHz, Avg Bandwidth=10Hz.
8. Both Horizontal and Vertical polarization modes were evaluated.
9. The Field Strength E(uV/m) is calculated using the formula:
   $E(uV/m) = LOG_{10}^{-1}((dBuV/m + Ant.Factor(dB) + Coax\ Loss(dB)$.

11MBit/Sec operation.
Tabulated Measurements for the lower band edge.

Frequency	Measurement dBuV/m		Polarity	Cable + Antenna Factor	Total Field Strength dBuV/m		Total Field Strength uV/m	FCC Limit
GHz	Peak	Average		dB	Peak	Average	Average	uV/m
2.380	6.4	-5.6	V	34.6	41.0	29.0	28.2	500
2.382	5.8	-7.8	V	34.6	40.4	26.8	21.9	500
2.384	3.4	-9.4	V	34.6	38.0	25.2	18.2	500
2.386	11.3	0.9	V	34.7	46.0	35.6	60.2	500
2.388	8.4	-4.0	V	34.7	43.1	30.7	34.3	500
2.390	10.7	0.9	V	34.7	45.4	35.6	60.2	500
2.380	29.7	18.4	H	34.6	64.3	53.0	446.7	500
2.382	29.1	16.1	H	34.6	63.7	50.7	342.8	500
2.384	22.9	16.0	H	34.6	57.5	50.6	338.8	500
2.386	29.6	17.8	H	34.7	64.3	52.5	421.7	500
2.388	29.3	17.4	H	34.7	64.0	52.1	402.7	500
2.390	30.9	18.9	H	34.7	65.6	53.6	478.6	500

11MBit/Sec operation.
Tabulated Measurements for the upper band edge.

Frequency	Measurement dBuV/m		Polarity	Cable + Antenna Factor	Total Field Strength dBuV/m		Total Field Strength uV/m	FCC Limit
GHz	Peak	Average		dB	Peak	Average	Average	uV/m
2.4835	3.9	-7.5	V	35.2	39.1	27.7	24.3	500
2.485	5.4	-7.5	V	35.2	40.6	27.7	24.3	500
2.488	5.7	-6.4	V	35.3	41.0	28.9	27.9	500
2.491	5.3	-7.6	V	35.3	40.6	27.7	24.3	500
2.494	4.2	-8.3	V	35.3	39.5	27.0	22.4	500
2.497	3.9	-8.7	V	35.3	39.2	26.6	21.4	500
2.500	3.2	-9.3	V	35.3	38.5	26.0	20.0	500
2.4835	31.9	18.5	H	35.2	67.1	53.7	484.2	500
2.485	32.0	18.5	H	35.2	67.2	53.7	484.2	500
2.488	31.2	17.7	H	35.3	66.5	53.0	446.7	500
2.491	31.0	17.7	H	35.3	62.2	53.0	446.7	500
2.494	31.4	18.0	H	35.3	66.7	53.3	462.4	500
2.497	28.1	15.3	H	35.3	63.4	50.6	338.8	500
2.500	28.6	14.7	H	35.3	63.9	50.0	316.2	500

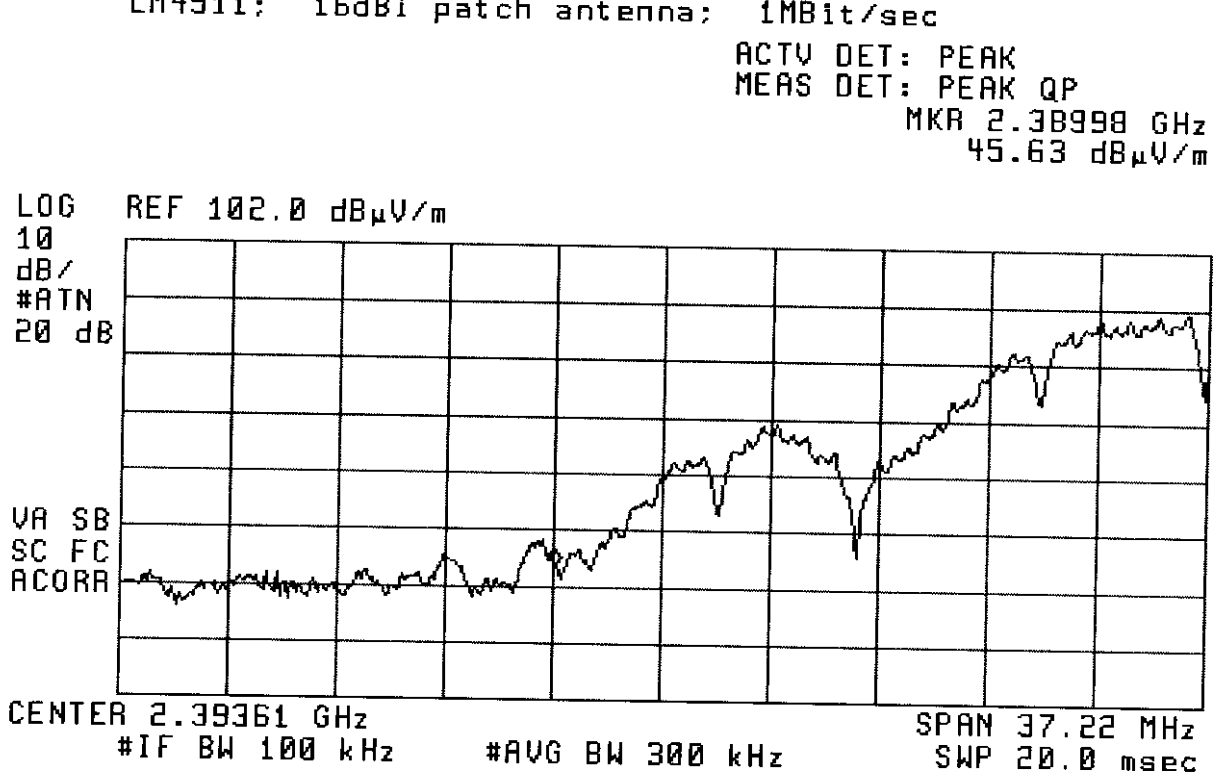
Measurements by: Ted Chaffee

The following pages show, in chart format, the emission profiles of the band edges with the system operating at 11 MBit/Sec.

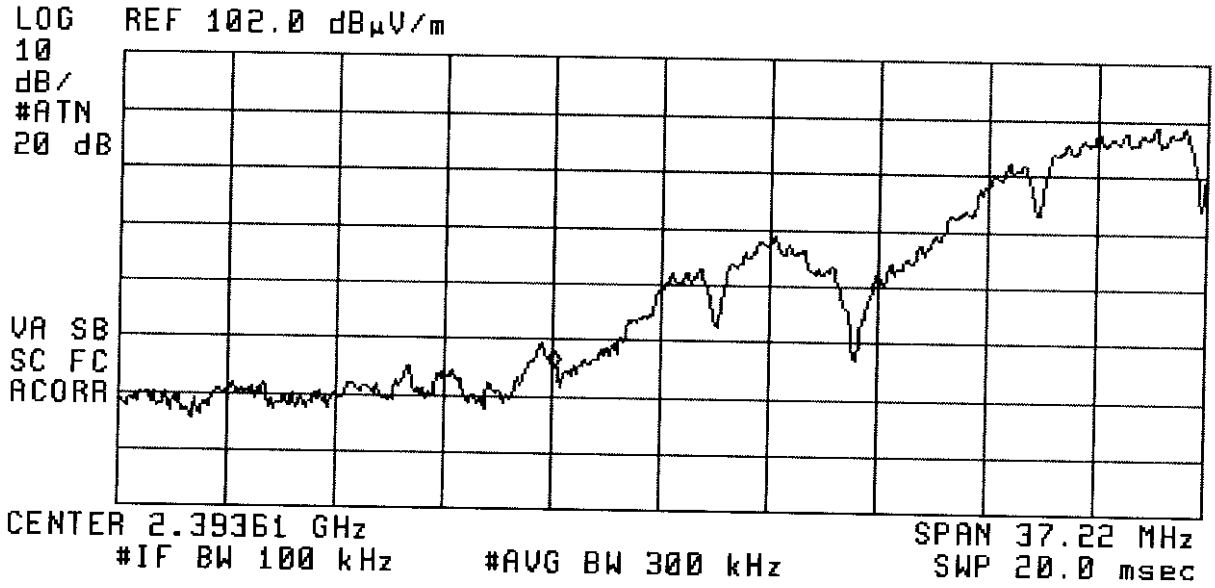
Band Edge:

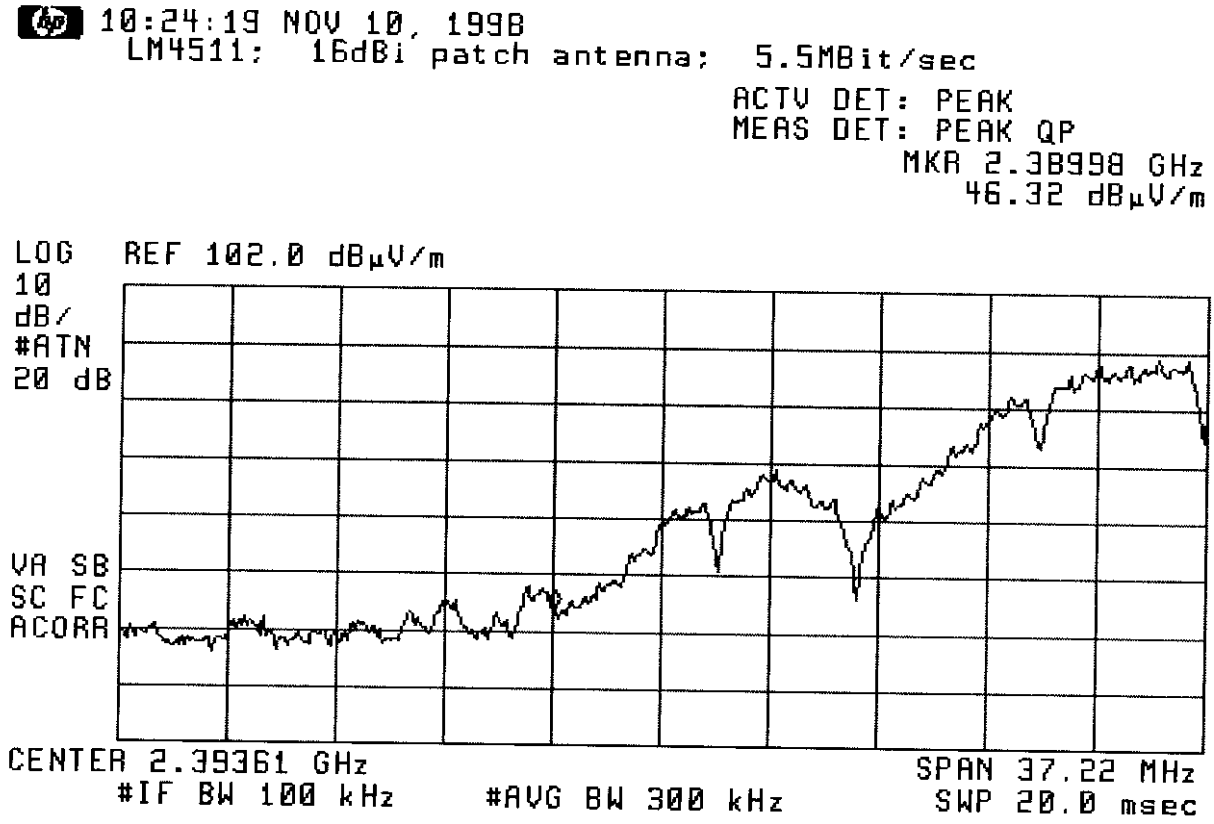
Band Edge:

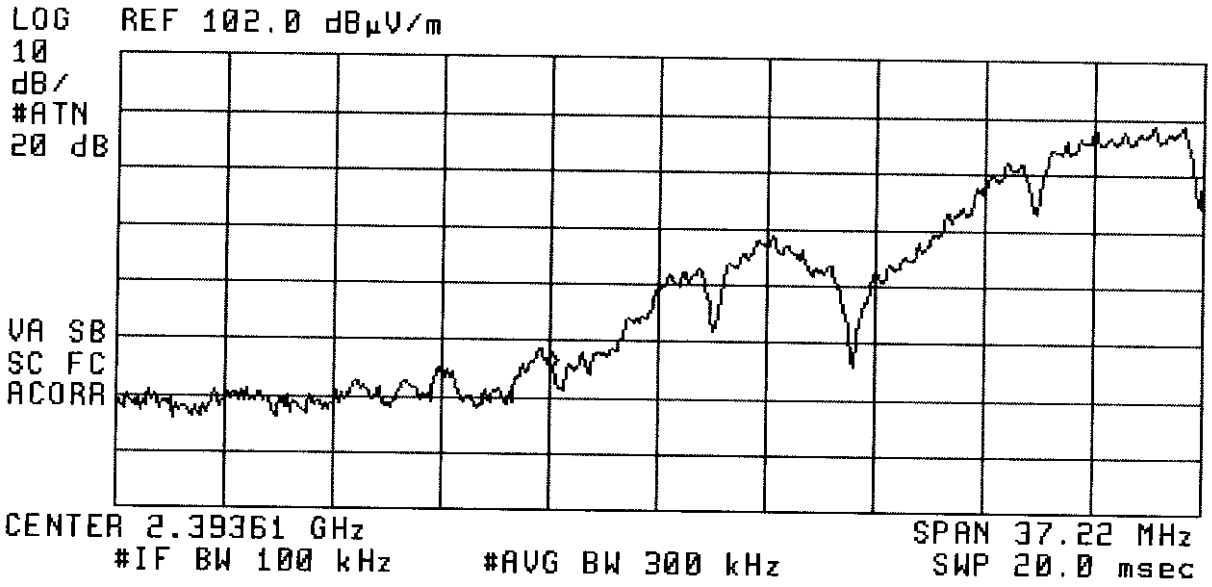
10:08:03 NOV 10, 1998
LM4511: 16dBi patch antenna: 1MBit/sec

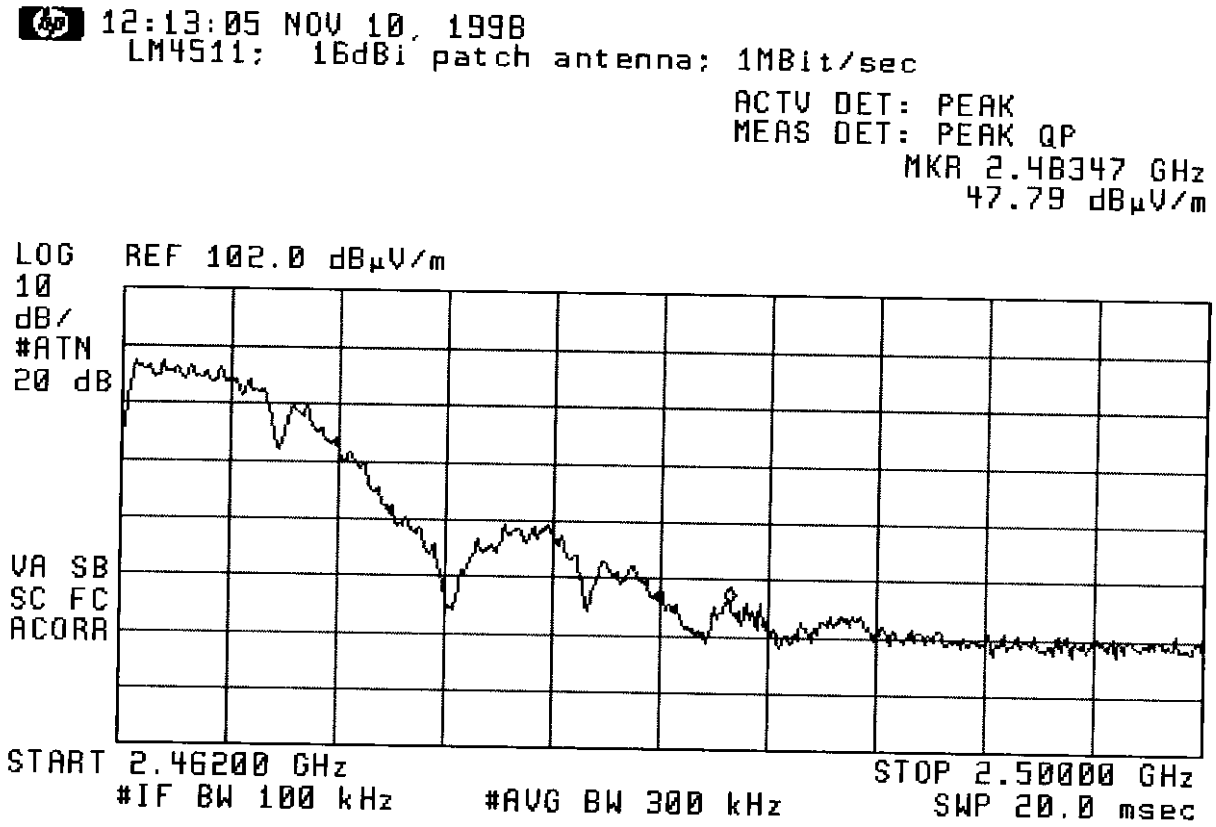


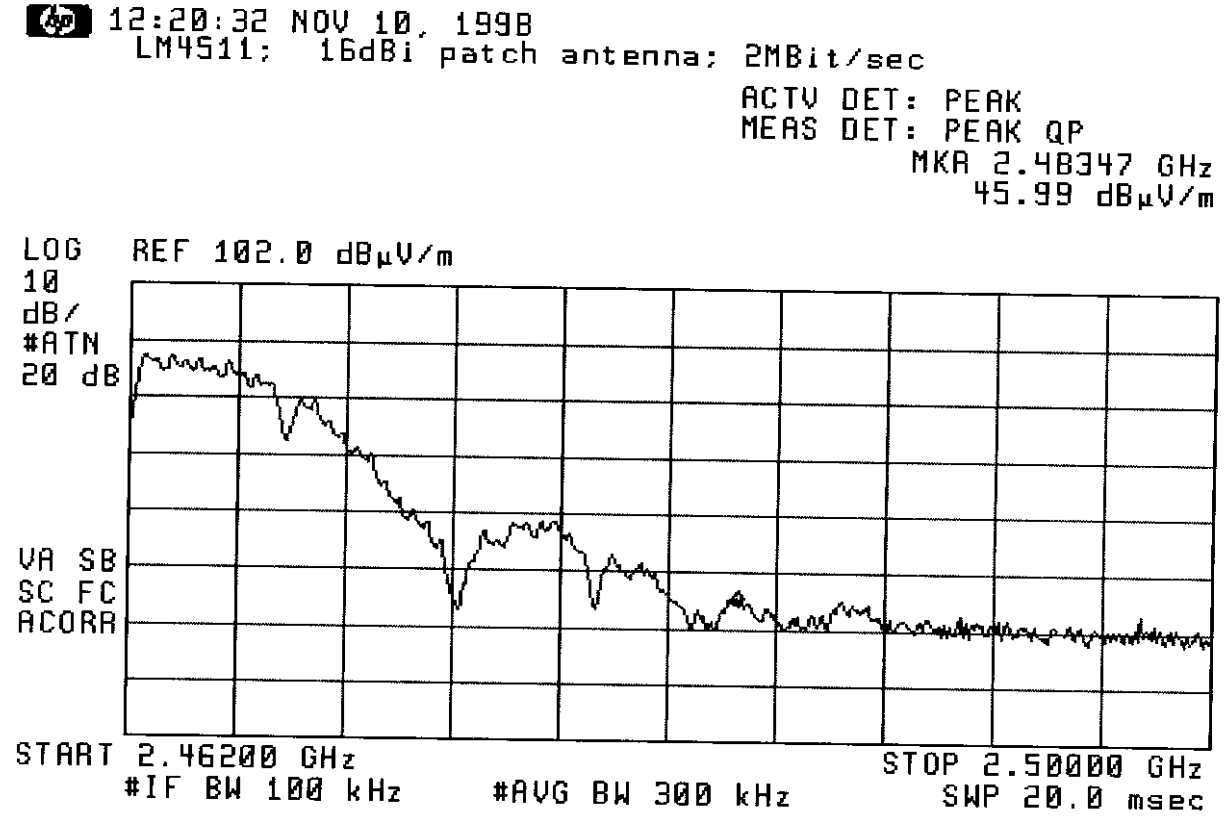
10:16:35 NOV 10, 1998
LM4511: 16dBi patch antenna: 2MBit/sec

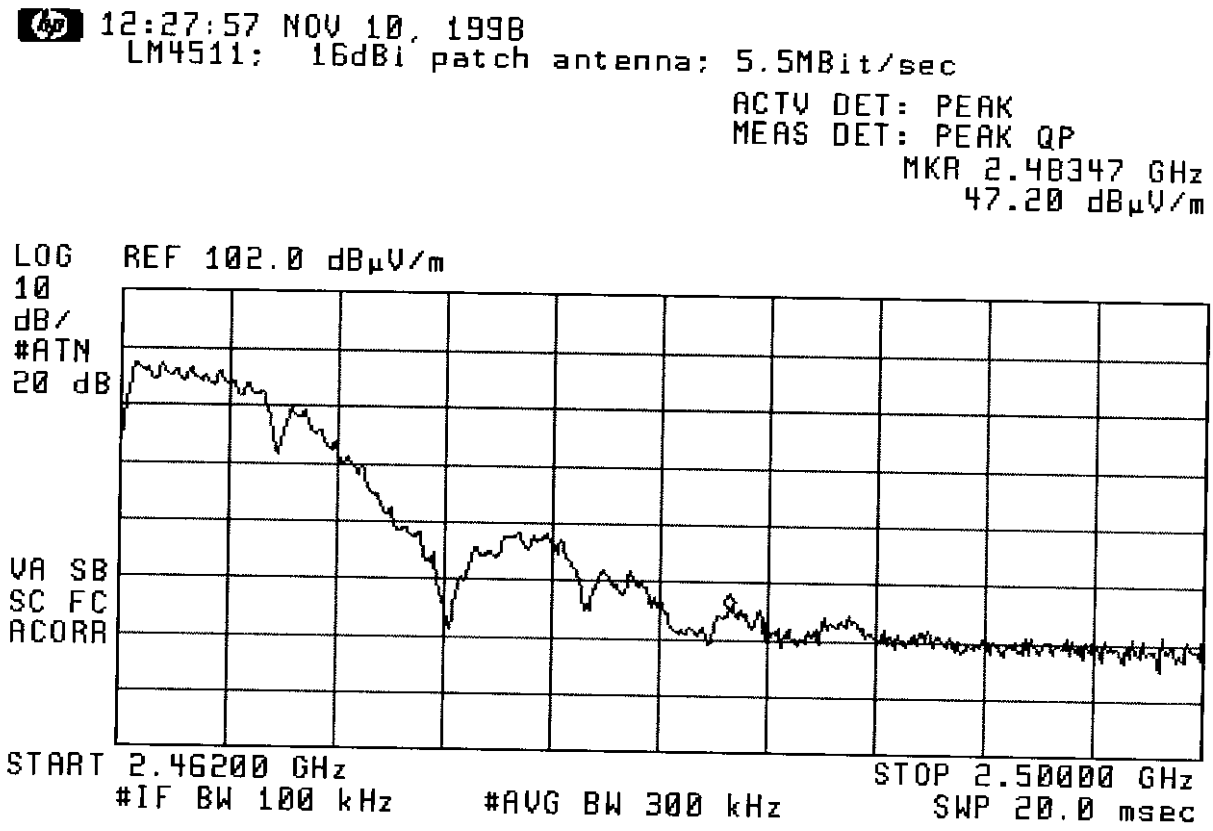


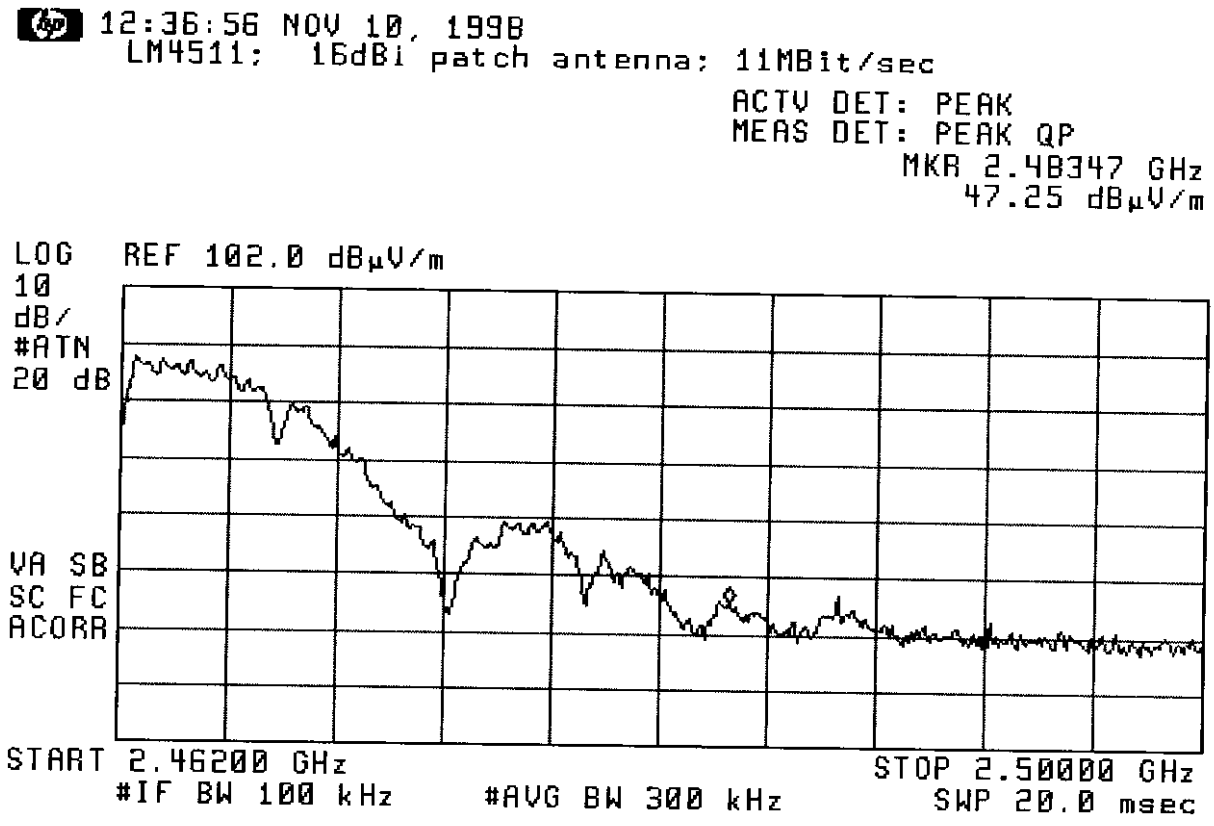

10:24:19 NOV 10, 1998
LM4511: 16dBi patch antenna: 5.5MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.38998 GHz
46.32 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
CENTER 2.39361 GHz
SPAN 37.22 MHz
#IF BW 100 kHz
#AVG BW 300 kHz
SWP 20.0 msec


10:32:07 NOV 10, 1998
LM4511: 16dBi patch antenna: 11MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.38998 GHz
47.04 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
CENTER 2.39361 GHz
SPAN 37.22 MHz
#IF BW 100 kHz
#AVG BW 300 kHz
SWP 20.0 msec


12:13:05 NOV 10, 1998
LM4511; 16dBi patch antenna; 1MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
47.79 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec

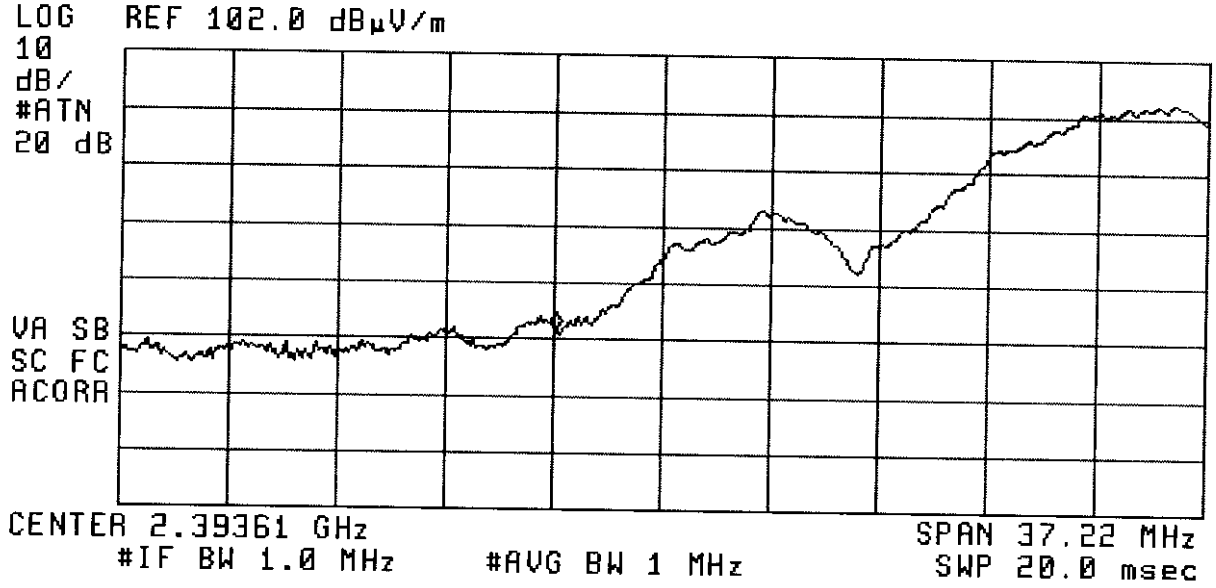

12:20:32 NOV 10, 1998
LM4511; 16dBi patch antenna; 2MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
45.99 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec


12:27:57 NOV 10, 1998
LM4511: 16dBi patch antenna; 5.5MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
47.20 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec


12:36:56 NOV 10, 1998
LM4511: 16dBi patch antenna; 11MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
47.25 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec

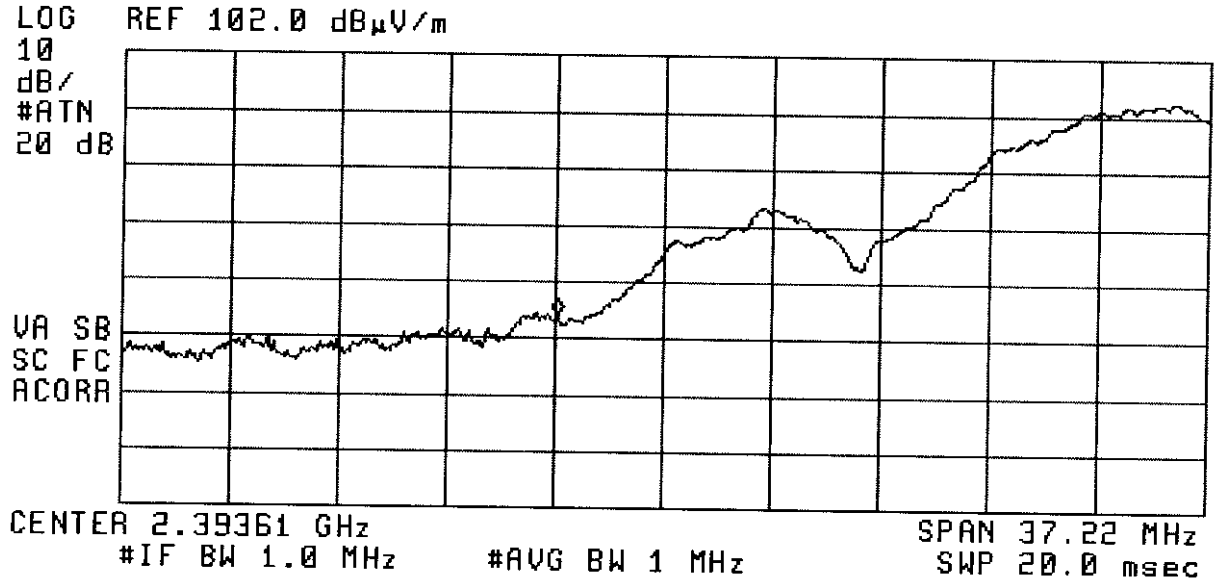
09:30:40 NOV 10, 1998
LM4511: 16dBi patch 1MBit/sec

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.38998 GHz
53.79 dBµV/m

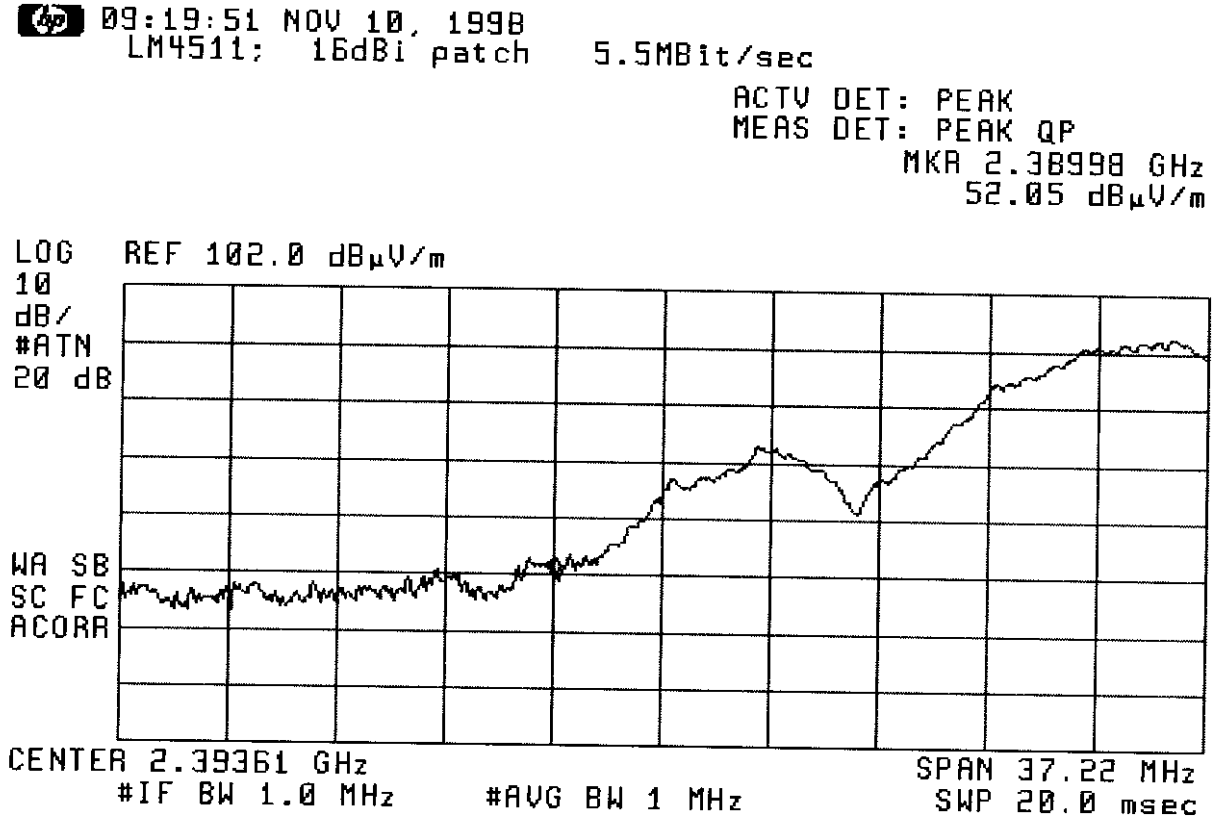


09:25:11 NOV 10, 1998
LM4511: 16dBi patch 2MBit/sec

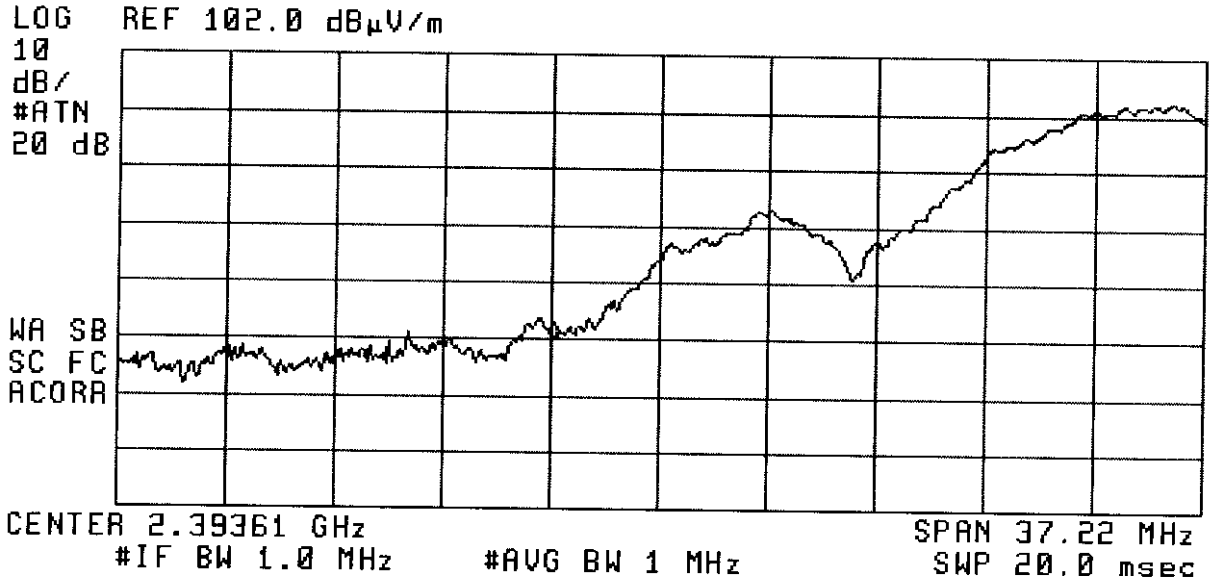
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.38998 GHz
55.87 dBµV/m

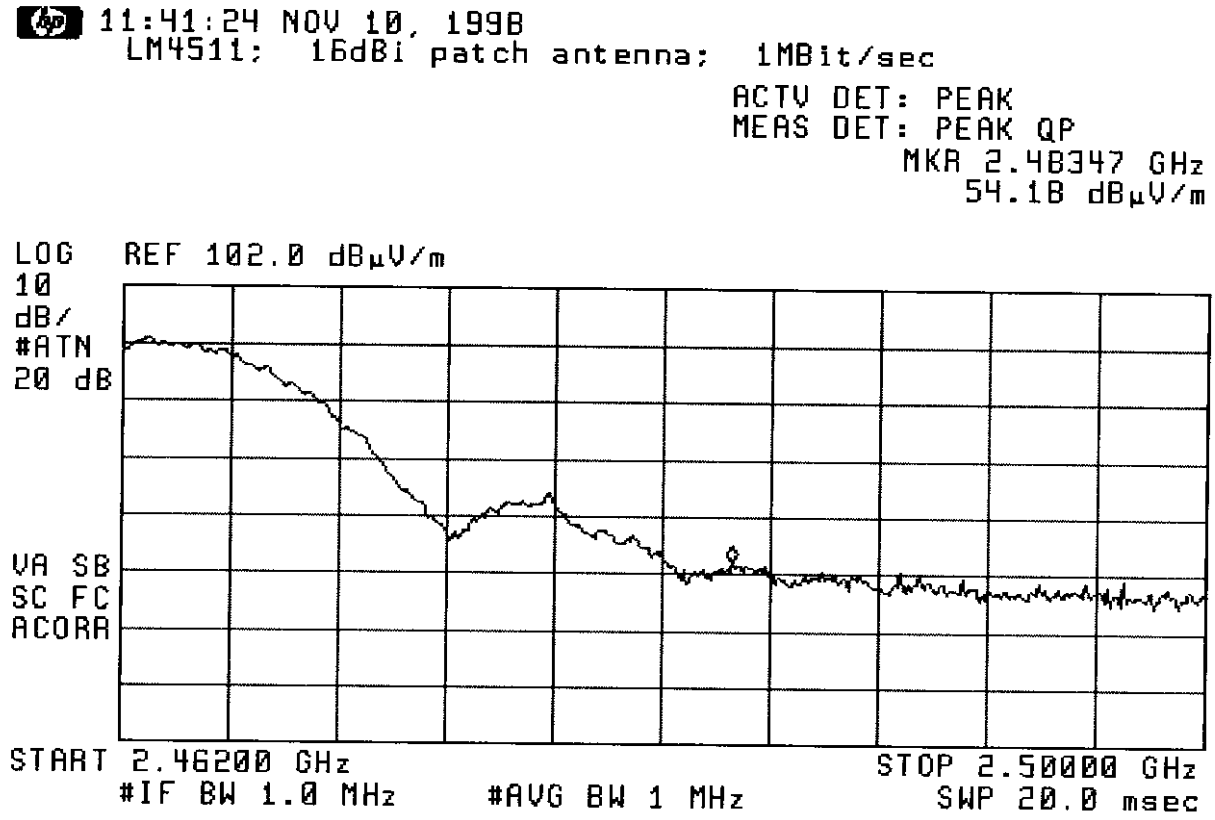


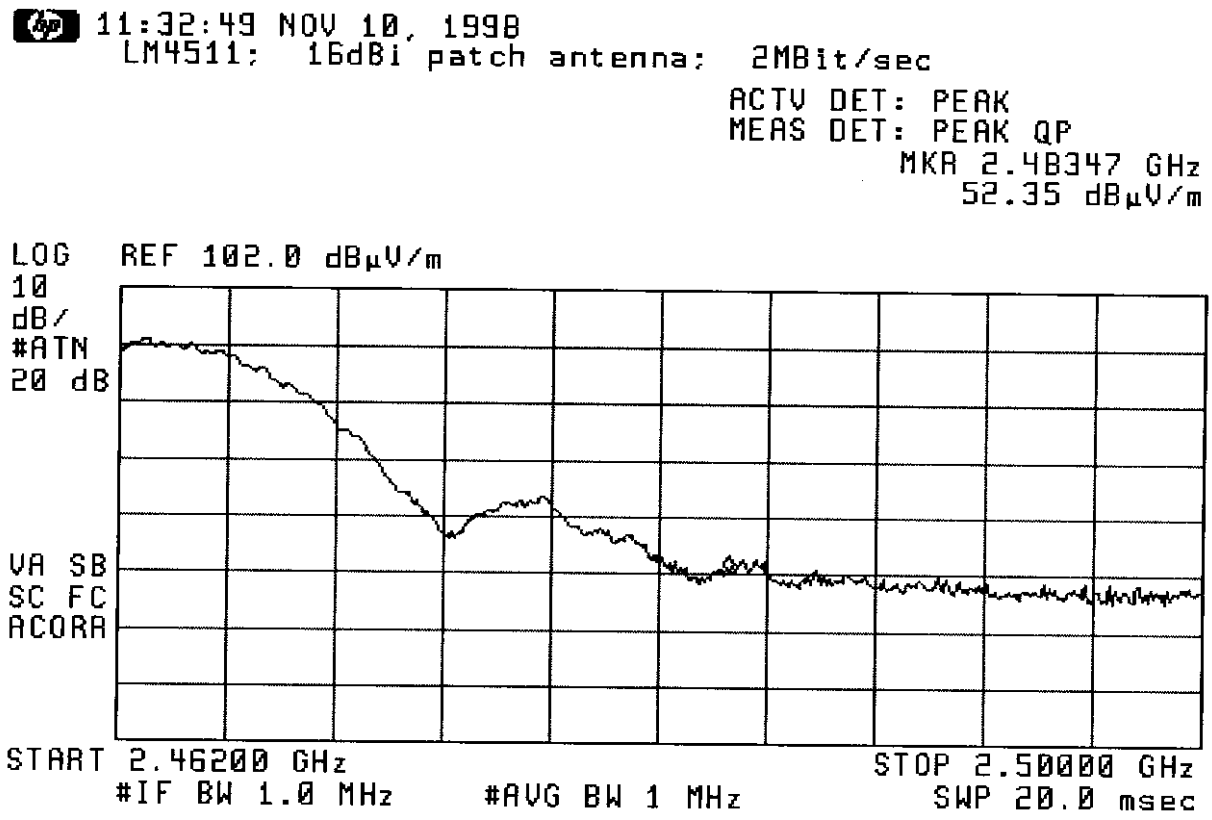
09:19:51 NOV 10, 1998
LM4511; 16dBi patch 5.5MBit/sec

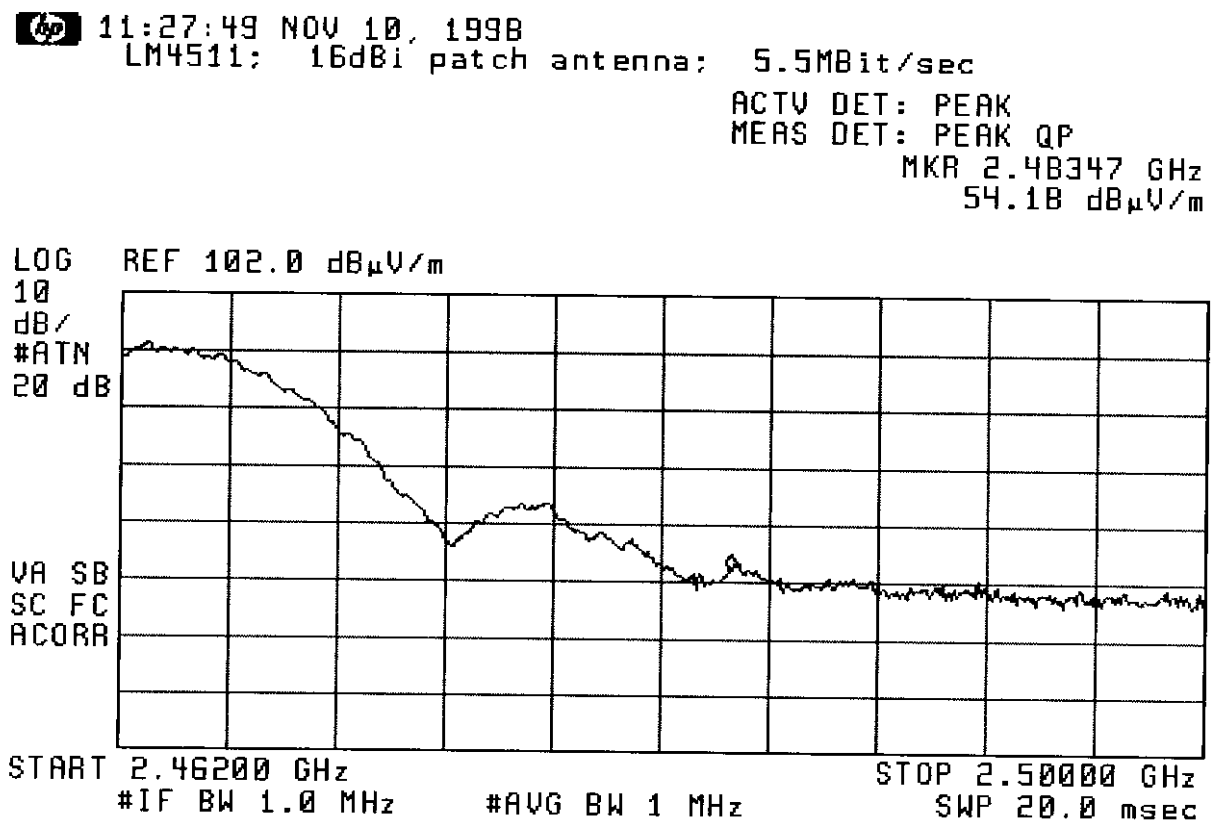


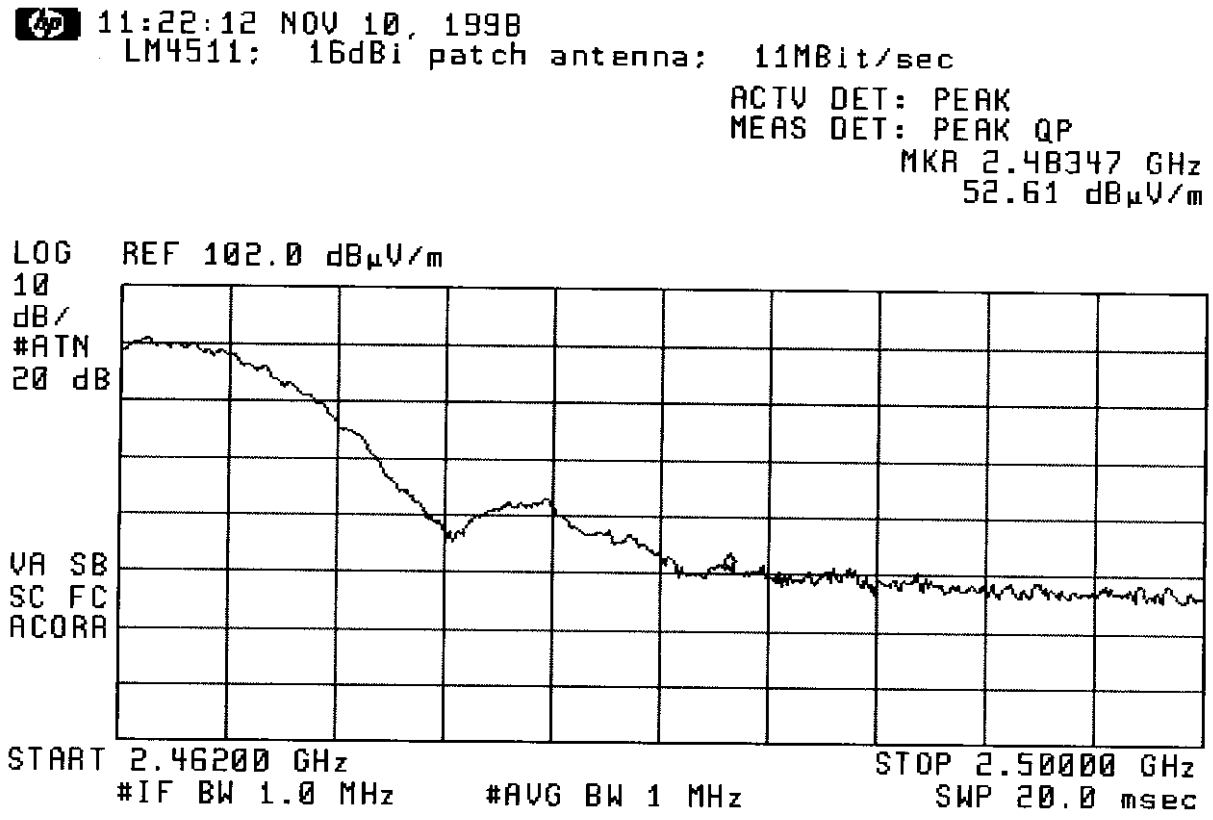
09:11:38 NOV 10, 1998
11MBit/sec LM4511; 16dBi patch




11:41:24 NOV 10, 1998
LM4511: 16dBi patch antenna: 1MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
54.18 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 1 MHz
STOP 2.50000 GHz
SWP 20.0 msec


11:32:49 NOV 10, 1998
LM4511: 16dBi patch antenna: 2MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
52.35 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 1 MHz
STOP 2.50000 GHz
SWP 20.0 msec


11:27:49 NOV 10, 1998
LM4511: 16dBi patch antenna: 5.5MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
54.18 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 1 MHz
STOP 2.50000 GHz
SWP 20.0 msec


11:22:12 NOV 10, 1998
LM4511: 16dBi patch antenna: 11MBit/sec
ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 2.48347 GHz
52.61 dBµV/m
LOG REF 102.0 dBµV/m
10
dB/
#ATN
20 dB
VA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 1 MHz
STOP 2.50000 GHz
SWP 20.0 msec

Transmitter Harmonic Emissions [15.205(a), 15.209(a),(f)]

MEASUREMENT PROCEDURE:

1. The EUT was adjusted to operate at its low, mid, and high range. These frequencies are, respectively, 2412MHz, 2442MHz, and 2462MHz.
2. The EUT system was set upon the wooden turntable 80cm above the ground plane at a distance of 3 meters from the receiving antenna.
3. The EUT was setup to operate in for an 11MBit data rate which represents worst case interference potential.
4. The EMC Receiver was setup using IF BW = 1MHz, Avg BW = 10Hz.
5. The transmit harmonic emission level was maximized by rotating the turntable and raising and lowering the search antenna.
6. Both Horizontal and Vertical polarization modes were evaluated. Vertical is worst case.
7. The Field Strength E(uV/m) is calculated using the formula:
   $E(uV/m) = LOG_{10}^{-1}(dBuV/m)/20)$
8. The indicated levels of the HP8593EM Spectrum Analyzer a 30dB factor for the PreAmp. The total field strength has been adjusted to include the attenuation factor of the coax, the correction factor of the horn antenna, and the difference in true PreAmp gain from 30dB at the specific frequencies of interest.

Tuned Freq	Measured Frequency	Pol	Indicated Level dBuV/m		Horn+Coax - PreAmp Factors not included in S.A. memory	Total Field Strength dBuV/m		Total Field Strength	FCC Limit
GHz	GHz		Peak	Avg	dB	Peak	Avg	uV/m Avg	uV/m
2.412	4.8238	H	22.7	12.2	31.16	53.9	43.4	147.9	500
	7.2364	H	19.7	12.2	35.92	55.6	48.1	254.1	500
	*9.6476	H	24.2	11.4	41.61	65.8	53.0	446.7	500
	**12.06	H	19.9	11.1	45.16	<65.1	<56.3	<653	500
2.442	4.884	H	20.5	12.2	31.44	51.9	43.6	151.4	500
	7.326	H	24.2	13.2	36.34	60.5	49.5	298.5	500
	*9.768	H	21.9	11.5	41.87	63.8	53.4	467.7	500
	**12.21	H	24.7	16	45.29	<70.0	<56.8	<692	500
2.462	4.924	H	21.7	12.3	31.49	53.2	43.8	154.9	500
	7.386	H	22.1	11.9	36.55	58.6	48.4	263	500
	*9.848	H	22.5	12.0	41.86	64.4	53.9	495.4	500
	**12.31	H	25.6	17	45.31	<70.9	<62.3	<1303.2	500

* NOTE: This signal is at the system floor noise level.

** NOTE: At frequencies above 10GHz no EUT emissions were observed. All emissions at these frequencies are less than the floor noise of the measurement system. Only the floor noise of the measurement system was observed and recorded at the frequencies above 10GHz.

Measurements by: _____

EXHIBIT 5: MEASUREMENT FACILITIES & EQUIPMENT

Test Site: [2.948]

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 M-152, Dowagiac, Michigan 49047. This test facility has been fully described in a report filed with the FCC, dated November 5, 1996, and accepted by the FCC in a letter dated January 15, 1997, (31040/SIT 1300F2).

Environment

The test was performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 22deg.C., the relative humidity 60%. The power supplying the system under test was a nominal 120VAC at 60Hz.

Measurement Equipment Used: [2.948]

Equipment	Model	S/N	Last Cal Date	Calibration Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	19-Jun-98	12 month
RF Receiver Section	HP-85462A	3625A00342	19-Jun-98	12 month
EMCO BiconiLog Antenna	3142	1077	26-Aug-98	12 months
Solar LISN	8012-50-R-24-BNC	962138	25-Aug-98	12 months
(LCI) Double shielded 50ohm Coax	RG58/U	920809	05-Dec-97	12 months
(3-M) Double shielded 50ohm Coax	RG58/U	9807-12	30-Jul-98	6 months
(10-M) Double shielded 50ohm Coax	RG58/U	960720	04-Aug-98	6 months
from Aironet Wireless Communications, Inc.				
HP Spectrum Analyzer	8593EM	3536A00115	13-Sep-97	
HP 1-26GHz RF PreAmplifier	8449B	3008A00911	13-Sep-97	
ElectroMechanics Double Ridge Horn	3115	4363	10-Dec-97	
6 ft.GORE 145 50ohm coax	145		06-July-98	

AHD Site Approval

FEDERAL COMMUNICATIONS COMMISSION

7435 Oakland Mills Road
Columbia, MD 21046
Telephone: 301-725-1585 (ext-218)
Facsimile: 301-344-2050

January 15, 1997

IN REPLY REFER TO
31040/SIT
1300F2

AHD EMC Laboratory
92723 M-152
Dowagiac, MI 49047

Attention: Ted Chaffee

Re: Measurement facility located at Sister Lakes
(3 and 10 meter site)

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for certification or notification under Parts 15 or 18 of the Commission's Rules. Our list will also indicate that the facility complies with the radiated and AC line conducted test site criteria in ANSI C63.4-1992. Please note that this filing must be updated for any changes made to the facility, and at least every three years the data on file must be certified as current.

Per your request, the above mentioned facility has been also added to our list of those who perform these measurement services for the public on a fee basis. This list is published periodically and is also available on the Laboratory's Public Access Link as described in the enclosed Public Notice.

Sincerely,

Thomas W. Phillips
Electronics Engineer
Customer Service Branch

Enclosure:
PAL PN

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Certificate of Accreditation

AHD
DOWAGIAC, MI

is recognized under the National Voluntary Laboratory Accreditation Program 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. Accreditation is awarded for specific services, listed on the Scope of Accreditation for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS
FCC

June 30, 1999

Effective through

For the National Institute of Standards and Technology

NVLAP Lab Code: 200129-0

NVLAP-01C (11-95)