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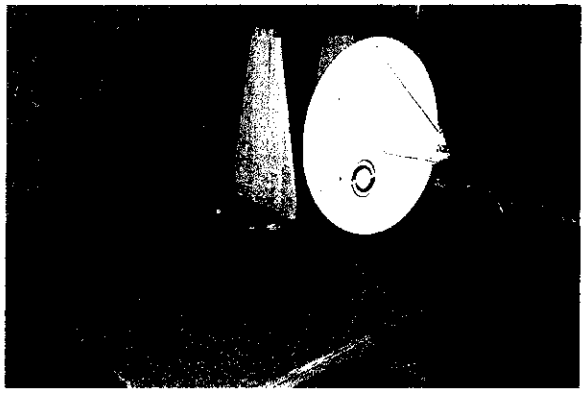
CLASS 2 PERMISSIVE CHANGE for FCC ID: LOZ102035

FCC Part 2.1043, Part 15 Subpart C(15.247)

Report #09800126F
Issued 07/30/98



LM4511 WITH ALTERNATE ANTENNA SYSTEM

Prepared for:

Mr. Dave Case
Aironet Wireless Communications, Inc.
367 Ghent Road, Suite 300
P.O. Box 5292
Fairlawn, OH 44334-0292

Test Date(s): June 9-10, 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 alternate antenna designs into the approval of the 2.4Ghz transmitter / receiver.

The antennas evaluated include:

✓ 21dBi parabolic antenna.	Evaluated by AHD EMC Lab. This Report
8.5dBi Patch.	Evaluated by Mort Flom Associates, Inc. Appendix A.
12dBi OMNI	Evaluated by Mort Flom Associates, Inc. Appendix A.
23dBi Parabolic (being phased out)	Evaluated by Mort Flom Associates, Inc. Appendix A.
13.5dBi YAGI	Evaluated by Mort Flom Associates, Inc. Appendix A.

See 6/14/99 letter

Except for the above mentioned antenna differences, 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 styles. The body of this test report shows the measurement data with the 21dBi parabolic antenna in the test system. The Appendix B shows the measurement data using the remaining antenna styles.

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.

Verbal OK
6-9-98

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)]

An antenna to be incorporated into the LM4511 system, which was tested at AHD, is:

Aironet part number:	430-3338
Type of Device:	21dBi gain, Parabolic Dish Antenna
Device working frequency:	2.45GHz ISM band (2400-2483 MHz)
Fabrication Technology:	Spun metal dish with center horn feed.
Package:	RTNC PLUG Conn., White paint.
Tolerance:	Half power beam width = 12.5deg.
Polarization:	Linearly polarized, vswr =< 1.8:1
Front to Back Ratio:	> 25dB
Mount:	Fine & coarse adjustments, 2.%" O.D. pole mount.
Diameter of Reflector:	2 ft.
Model:	Telex Communications, Inc. Model 2440AC

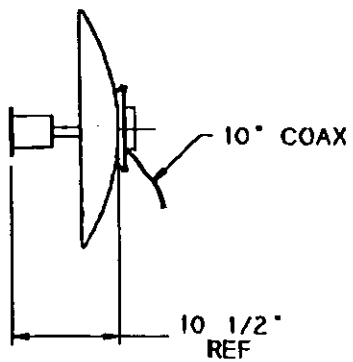
The following page is a copy of the manufacturer's specification print for the Model 2440AC antenna.

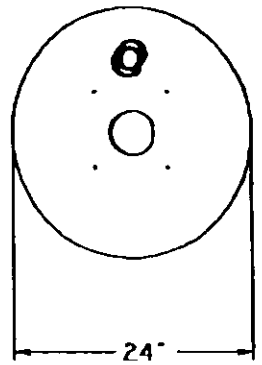
2440AC

REVISIONS				
CHG NO	LTR	DESCRIPTION	DATE	APPD
--------	A	RELEASE	25 SEP 96	

ANTENNA SPECIFICATIONS

TYPE	PARABOLIC DISH
FREQUENCY	2.400 GHz - 2.483 GHz
GAIN	20.0 dBi NOMINAL
SWR	1.8: 1 MAXIMUM
FRONT/BACK RATIO	> 25dB
HALF POWER BEAMWIDTH	12.5°
MAX SIDE LOBE LEVEL	-17dB
NOMINAL IMPEDANCE	50 OHMS
WEIGHT	9 lb.
POLARIZATION	VERTICAL
COAX	RG142
COAX TERMINATION	TNC REVERSE POLARITY PLUG
ENVIRONMENT	OUTDOOR
MOUNTING	2 1/2" DIA. MAST MOUNT WITH HARDWARE PROVIDED





PRELIMINARY DATA

QTY	DESCRIPTION	ITEM	PART NO.	SPECIFICATION

UNSPECIFIED LIMITS OF TOLERANCE
DECIMAL: .X = ±.050 IN. .XX = ±.030 IN. .XXX = ±.010 IN.
FRACTION: ±1/2
MACHINED FINISH: 64
ANGLES ±1°, BENDS ±2°
STRAIGHTNESS AND/OR FLATNESS .005 IN./1 IN.
CONCENTRICITY .010 TIR
UNMARKED ANGLES, BENDS AND INTERSECTIONS 90°
THREADS- EXT. CLASS 2A INT. CLASS 2B

DATE	25 SEP 96
DR BY	T.J.Y.
CHK BY	
APPD.	
PROD.	
MATERIAL:	------

TELEX Lincoln

TITLE
2 FT. PARABOLIC DISH

SIZE	CODE IDENT	DWG. NO.
B	57010	2440AC (2440AC DISK 131)

SCALE: NONE SHEET: 1 OF 1

NEXT ASSY.	USED ON
------	------
------	------

APPLICATIONS

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

LN

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: 21dBi Parabolic Antenna

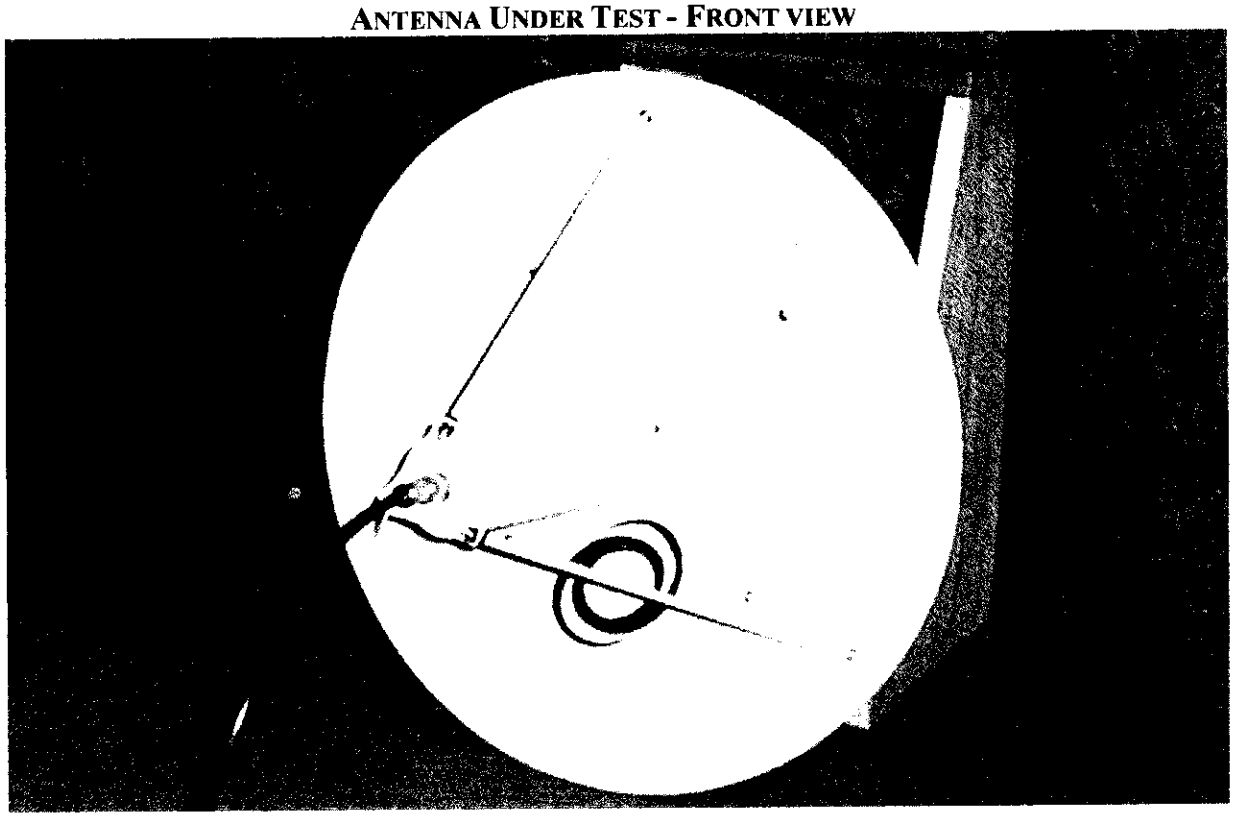
1. This test series evaluated the Equipment Under Test, LM4511 with alternate Parabolic Antenna , to FCC Part 15, SubPart C.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for Spread Spectrum, 2.4GHz, Intentional Radiators.
3. The equipment under test was received on June 9, 1998 and this test series commenced on June 9, 1998.
4. The line conducted emission level nearest the FCC limit of 250uV occurred at 2.88MHz when measuring phase to ground. The signal was measured to be 43uV, which is 15.3dB below the limit when measuring phase to ground.
5. The radiated level of spurious emissions nearest the limit, with the EUT in 'Receive Mode', occurred at 418MHz, vertically polarized. This signal was measured to be 77.9uV/m which is 8.2dB below the 200uV/m limit.
6. The radiated emission level nearest the limit, when measuring at the band edges only, occurred at 2.485GHz with the EUT in 11Mbut/Sec operation, vertically polarized. This signal was measured to be 0.7dB below the 500uV/m limit.
7. The radiated emission level nearest the limit, when measuring the transmitter harmonic emissions, occurred at 9.647Ghz. The signal was measured to be 295uV/m which is 4.6dB below the 500uV/m limit.
8. The spectral density measurement with the transmitter tuned to 2.442GHz with an 11MBit data rate was observed to be 16.7dB below the 15.247(d) limit of 8dBm.
9. The transmitter maximum power was measured at 2.412GHGz, 2.442GHz, and 2.462GHz. The highest level observed measured to be 7.4dB below the 15.247(b)(3)(i) limit of 25dBm. [This limit is derated due to the 21dBi antenna used with the transmitter].

Changes made to achieve compliance

1. NONE

EUT Picture: [2.1033(b)(7)]

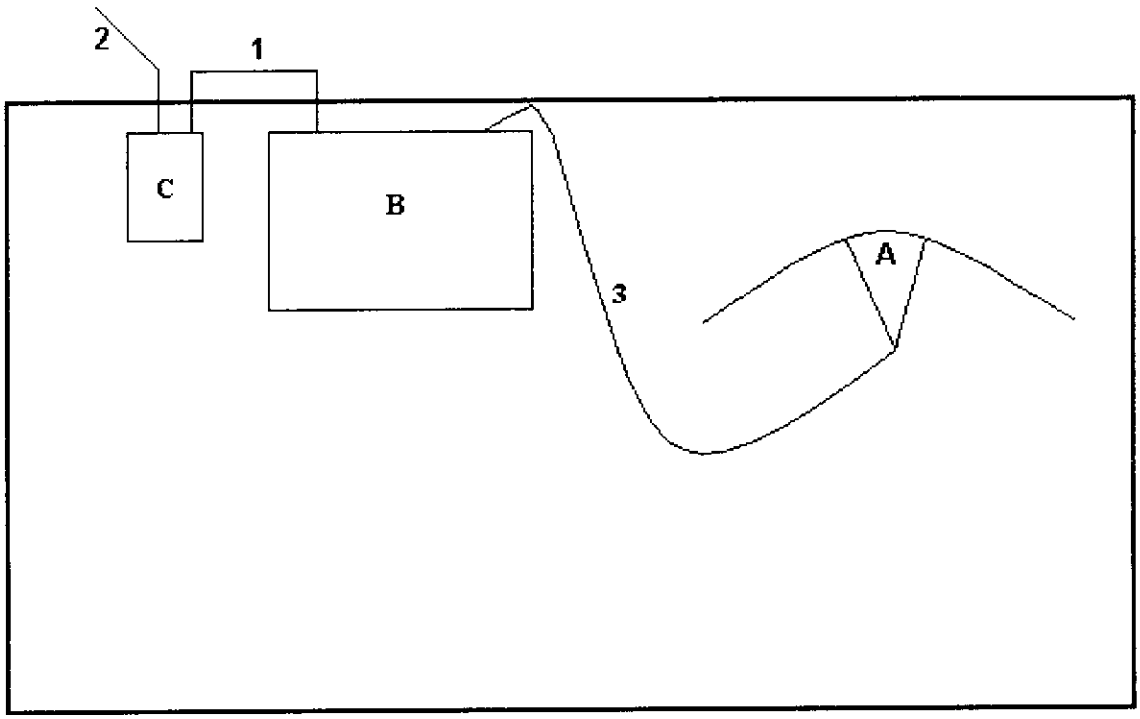
ANTENNA UNDER TEST - FRONT VIEW



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

Support Equipment & Cabling

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] Parabolic Antenna	[Telex] 2440AC	--	--
B	Host Computer 486DX2 50MHz	[Hewlett Packard] Omnibook 4000C	TW50902541	FCC ID:B944000XY1
C	Laptop Power Supply	[HP] F1072A	T5005165	1meter DC cable, Shielded.
1	DC line cord	--	--	1.5meters, Unshielded
2	Power supply AC line cord	--	--	1.5 meters, Unshielded
3	Transmit coax	--	--	1 meters

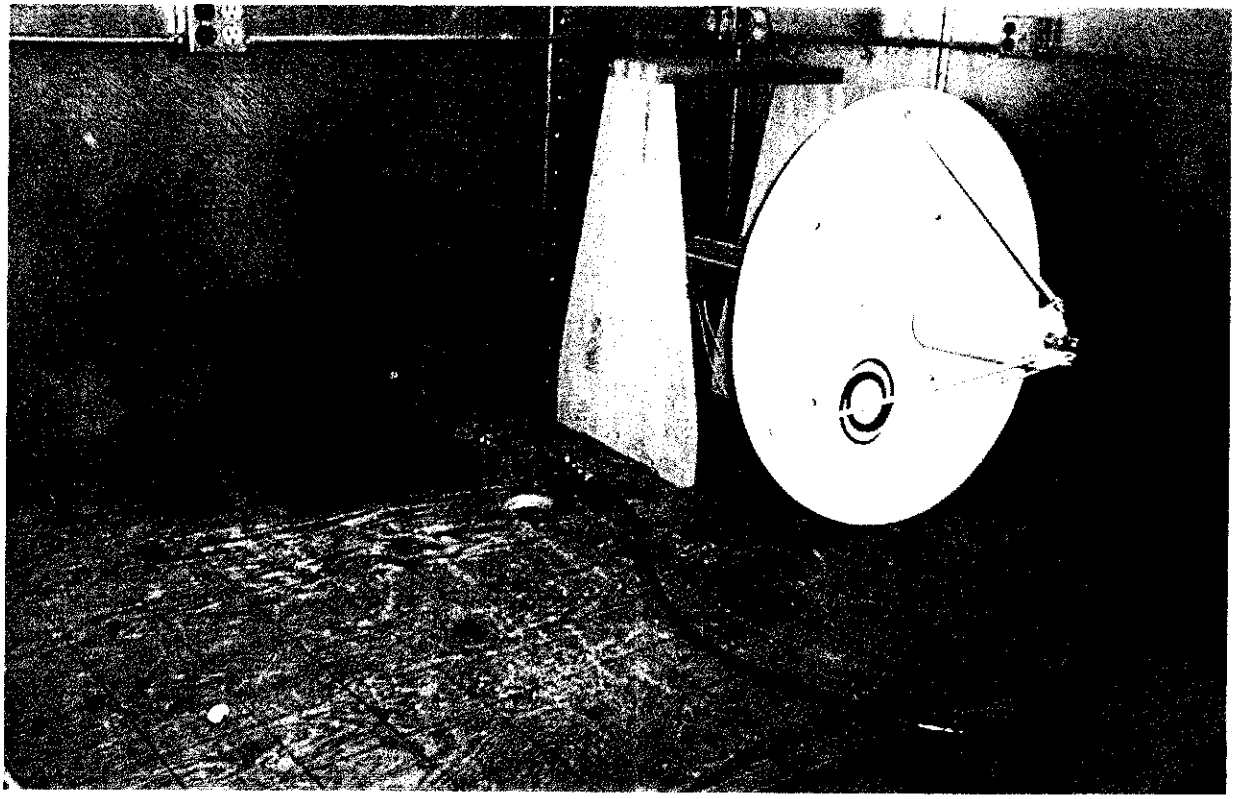


BASIC EUT SETUP
(Legend designation is above)

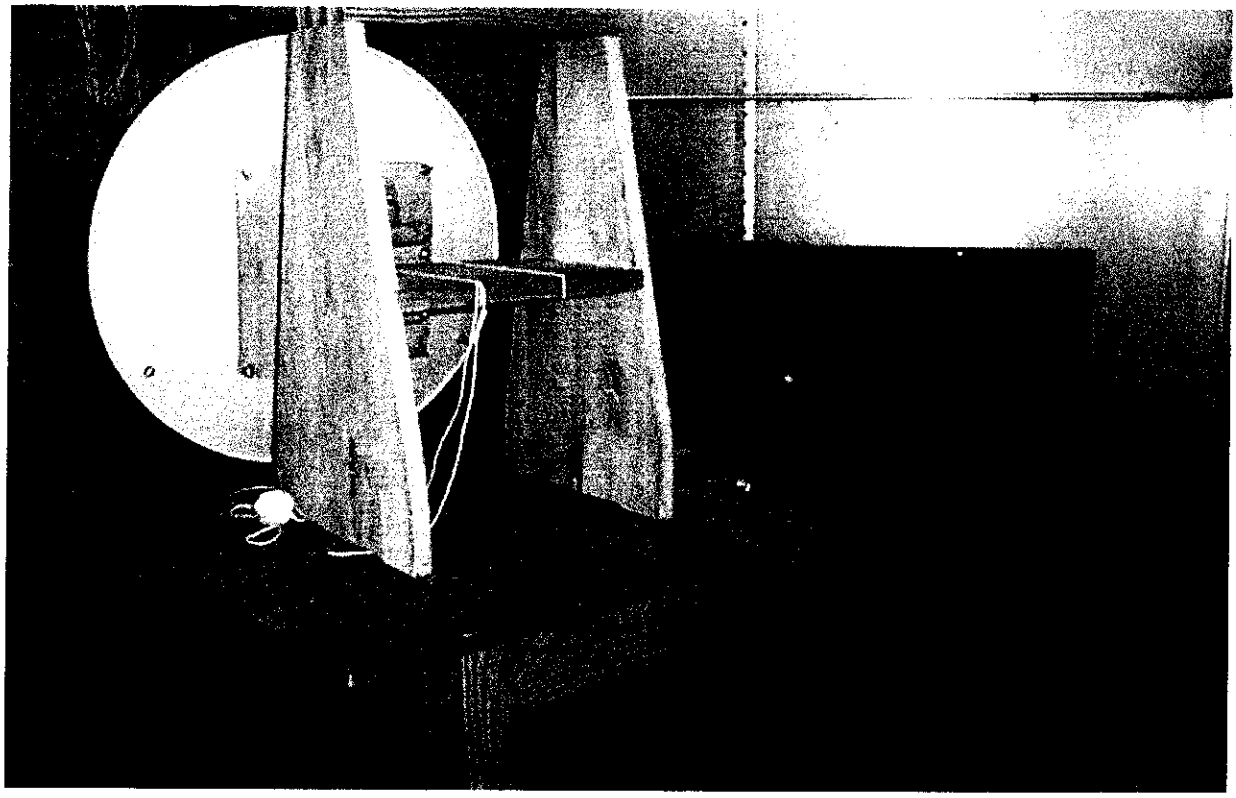
Setup Pictures

LINE CONDUCTED SETUP

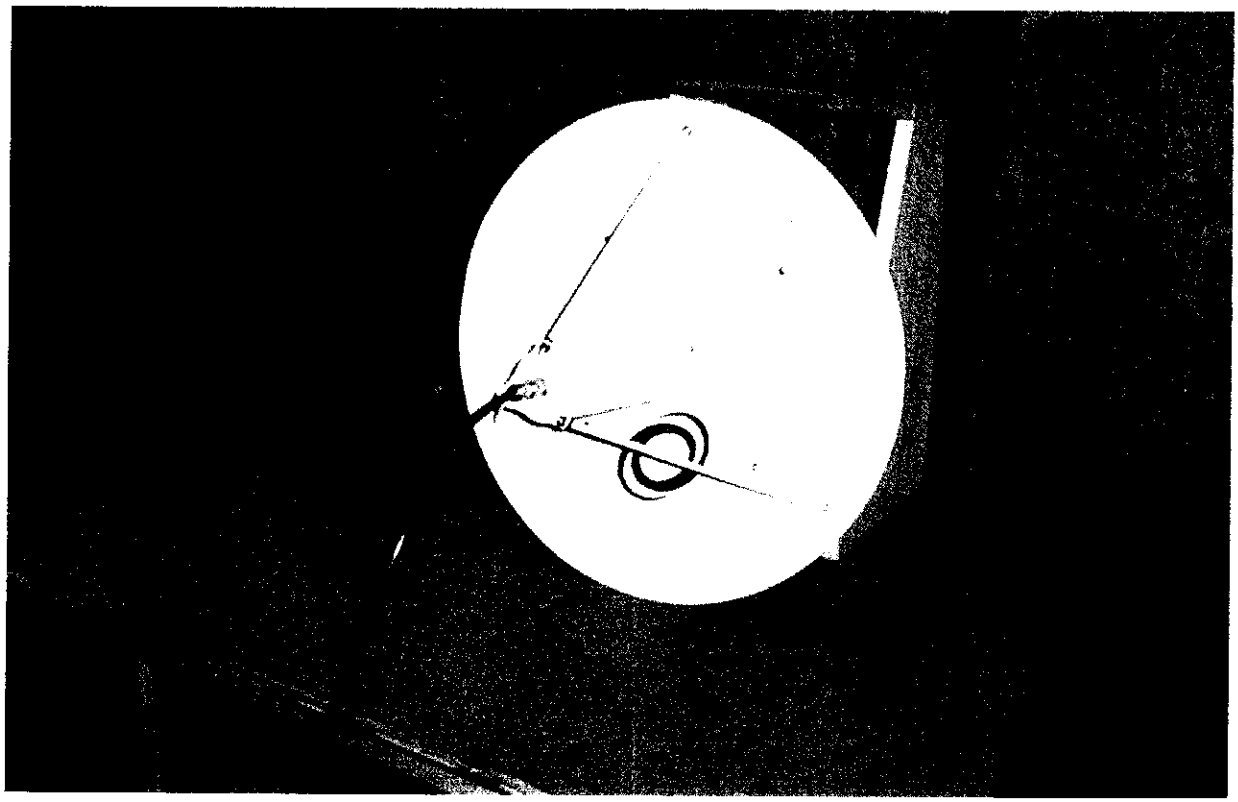
FRONT VIEW



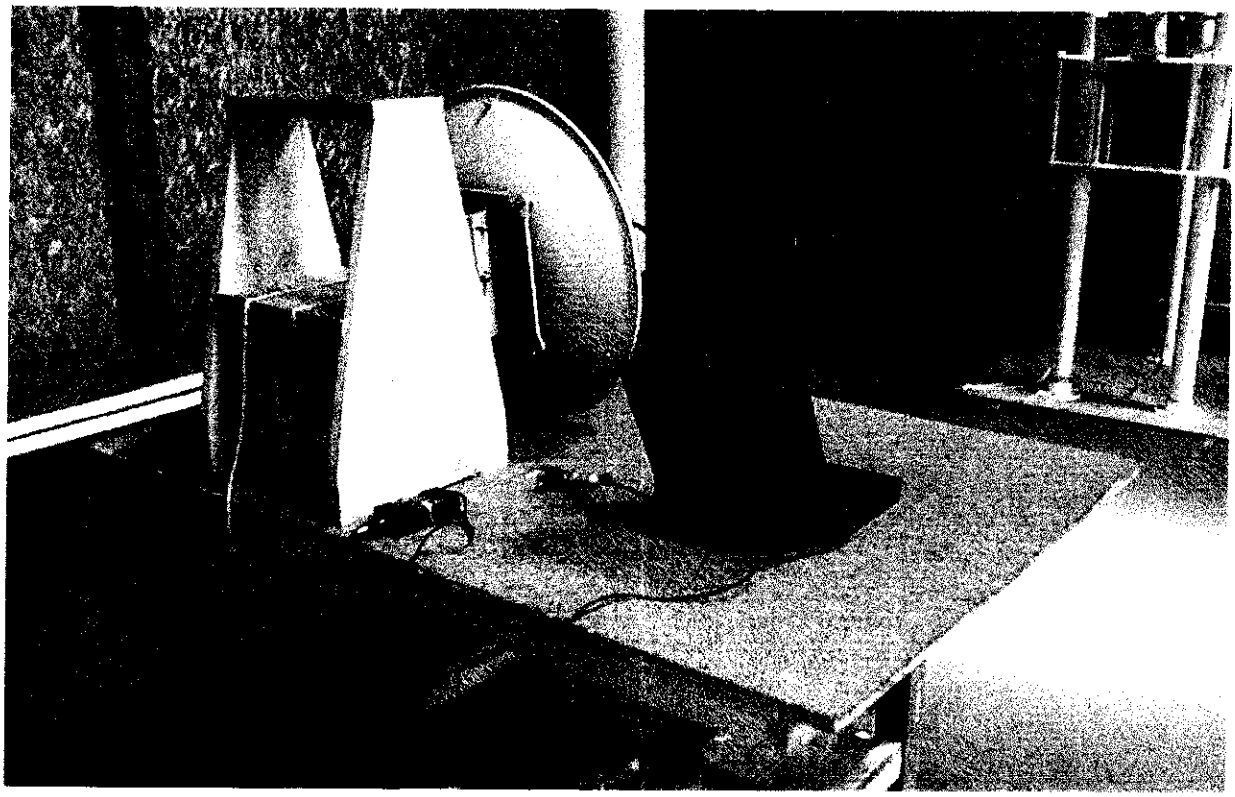
REAR VIEW



RADIATED SETUP
FRONT VIEW



REAR VIEW



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.

Line Conducted testing, performed in a shielded enclosure, and radiated testing, performed at a 3 meter open field test site, were both 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 LM1200.

Line Conducted

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm from the ground floor and 40cm from the vertical conducting plane in the prescribed setup per ANSI C63.4, Figure 9(a). This table is housed in a shielded enclosure to prevent the detection of unwanted ambients.

The mains power is nominally 115Vac, 60Hz.

The host unit was connected to the LISN being monitored by the EMI Receiver.

During the evaluation the transmitter was on continuously. Tests at different BIT rates of transfer of data were made to assure that the highest possible RF profile was being captured.

The principal settings of the EMI Receiver for line conducted testing include:

Bandwidth = 9KHz
Detector Function: scanning and signal search = Peak Detection Mode
measurements = Quasi Peak Detection

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 or 10 meters from the table center, is also remote controlled.

During the evaluation the transmitter was on continuously. Tests at different BIT rates of transfer of data were made to assure that the highest possible RF profile was being captured.

Preliminary tests were done at the 3 meter open field test site. The final tests are done at the appropriate standards distance of 3 or 10 meters. The "Biconical/Log Periodic" broadband antenna connected to an EMI Receiver, meeting CISPR 16, is used throughout the testing.

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
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 in radiated scanning 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: $FS(dBuV/m) = RF(dBuV) + AF(dB/m) + CF(dB) - PA(dB)$

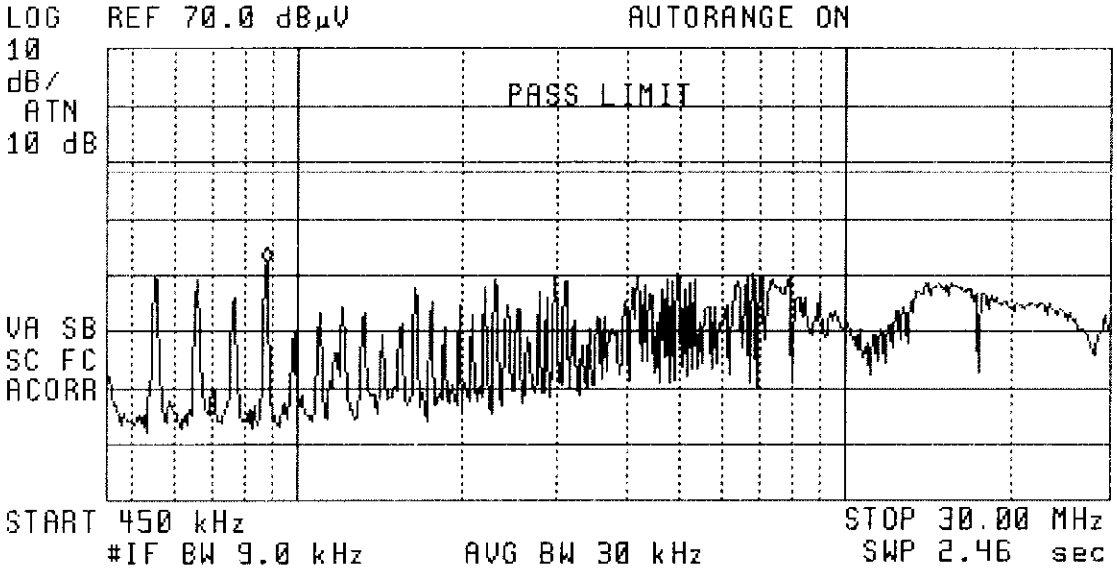
To convert the Field Strength dBuV/m term to uV/m, the dBuV/m is first divided by 20. The Base 10 AntiLog is taken of this quotient. The result is the Field Strength value in uV/m terms.

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

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

Line Conducted 15.207(a)

NEUTRAL to Ground Measurement.
Plot of Peak Values



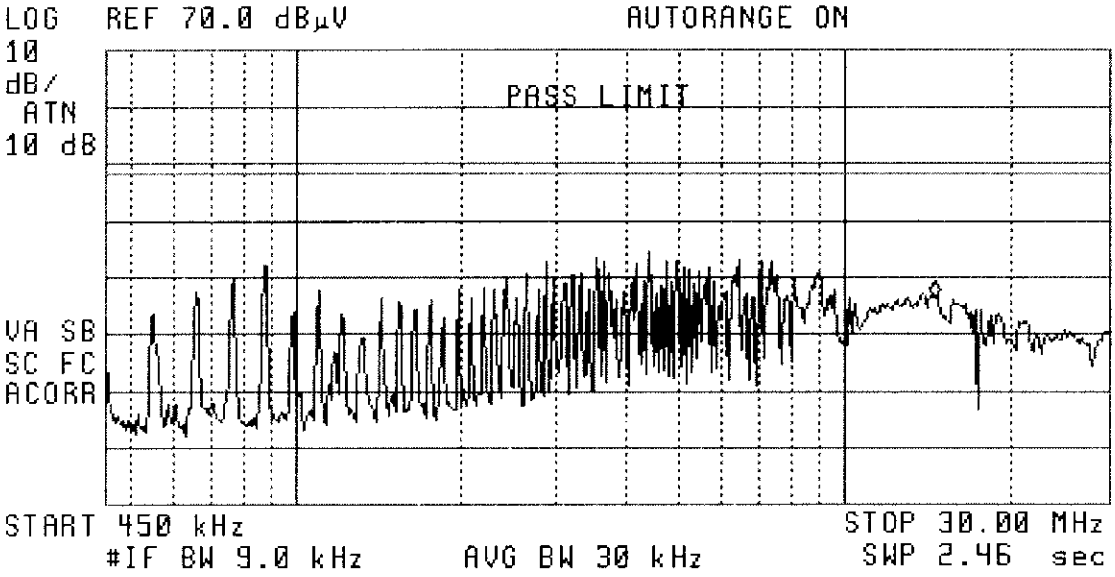
Tabulated Quasi-Peak Measurement.

Frequency MHz	QP Reading dBuV	uV	FCC Limit dBuV	FCC Limit uV	Margin dB
0.554	28.98	28.12	48.00	250	-19.02
0.665	29.09	28.48	48.00	250	-18.91
0.776	28.36	26.18	48.00	250	-19.64
0.887	31.93	39.49	48.00	250	-16.07
1.661	28.00	25.12	48.00	250	-20.00
2.326	28.75	27.38	48.00	250	-19.25
2.990	28.58	26.85	48.00	250	-19.42
4.985	29.37	29.41	48.00	250	-18.63
6.756	29.36	29.38	48.00	250	-18.64

Measurements by: Ted Chaffee

PHASE to Ground Measurement.

Class B
Plot of Peak Values



Tabulated Quasi-Peak Measurement.

Frequency MHz	QP Reading dBuV	uV	FCC Limit dBuV	FCC Limit uV	Margin dB
0.665	28.38	26.24	48.00	250	-19.62
0.776	29.25	29.01	48.00	250	-18.75
0.886	32.24	40.92	48.00	250	-15.76
1.108	27.34	23.28	48.00	250	-20.66
2.879	32.68	43.05	48.00	250	-15.32
3.544	32.48	42.07	48.00	250	-15.52
4.429	31.85	39.13	48.00	250	-16.15
6.421	31.47	37.45	48.00	250	-16.53
9.078	30.02	31.70	48.00	250	-17.98

Measurements by: Fred Chaffee

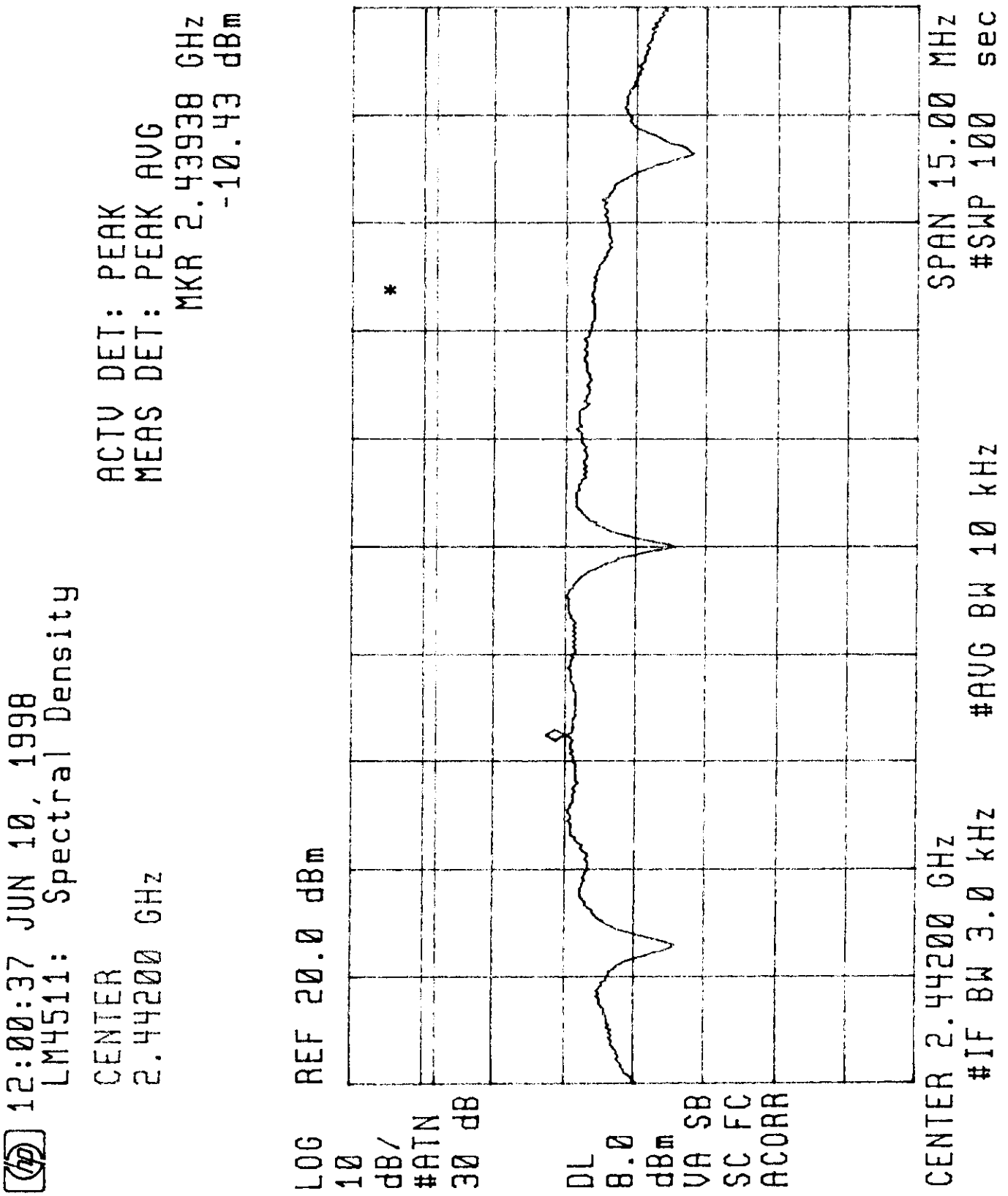
Spectral Power Density [15.247(d)]

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 = 3KHz, Avg BW = 10KHz, and span = 15MHz.
4. A representative transmission centered at 2.442GHz was set to continually transmit to observe the spectral density.
5. A span from 2434.5MHz to 2449.5MHz was observed.
5. The next page shows the chart of the observed RF profile.

Tuned Frequency MHz	Measurement dBm		Cable Factor dB	Total Level dBm	15.247(d) Limit dBm
2442	-10.4		1.18	-9.22	8

Measurements by: Ted Chee


12:00:37 JUN 10, 1998
LM4511: Spectral Density
CENTER
2.44200 GHz
ACTV DET: PEAK
MEAS DET: PEAK AVG
MKR 2.43938 GHz
-10.43 dBm
LOG REF 20.0 dBm
10 dB/
#ATN
30 dB
DL
8.0
dBm
VA SB
SC FC
ACORR
CENTER 2.44200 GHz
#IF BW 3.0 kHz
#AVG BW 10 kHz
SPAN 15.00 MHz
#SWP 100 sec

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 2440AC Parabolic Dish Antenna tested has a rated gain of 21dBi.

Thus the maximum allowable power is derated by (21dBi - 6dB)/3 = 5dB.

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

Therefore, the maximum allowable power is:

30dBm - 5dBm = 25dBm. [or antilog(25/10) = 316mW].

Tuned Frequency MHz	Measurement dBm		Cable Factor dB	Total Field Strength dBm	15.247(b)(3)(i) Limit dBm
2412	15.94		1.17	17.11	25
2442	14.98		1.18	16.16	25
2462	15.82		1.19	17.01	25

Measurements by: Ted Chmielewski

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			

Radiated Field Strength Measurements: [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.
5. 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:
   $E(uV/m) = LOG_{10}^{-1}((dBuV/m + Ant.Factor(dB) + Coax\ Loss(dB) - PreAmp(dB))/20)$
8. Note: The PreAmp was used only above 1000MHz. Its gain is 30dB.

Tabulated Measurements

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

Frequency MHz	Measurement dBuV/m	Polarity	Cable +Antenna Factor dB	Total Field Strength dBuV/m	Total Field Strength uV/m	FCC Limit uV/m
96	21.71	V	9.56	31.27	36.60	150
110	24.12	H	10.40	34.52	53.21	150
120	24.55	H	10.18	34.73	54.51	150
330	18.70	V	17.53	36.23	64.79	200
374	17.54	V	18.89	36.43	66.30	200
396	13.73	V	19.31	33.04	44.87	200
418	18.10	V	19.73	37.83	77.89	200
426	9.17	V	19.87	29.04	28.31	200
440	13.18	V	20.11	33.29	46.18	200

Frequency MHz	Measurement dBuV/m	Polarity	Cable +Antenna - PreAmp Factor dB	Total Field Strength dBuV/m	Total Field Strength uV/m	FCC Limit uV/m
1456	29 (floor noise)	V&H	-6.7	< 22.3	< 13.03	500
1702	29 (floor noise)	V&H	-6.6	< 22.4	< 13.18	500
1925	29 (floor noise)	V&H	-6.4	< 22.6	< 13.49	500
2097	29 (floor noise)	V&H	-6.3	< 22.7	< 13.64	500

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

Measurements by: Neal 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 27.]

3. The receiving spectrum analyzer was connected directly to the antenna terminals to observe the relative levels of the in band to out of band emissions prior to taking open field radiated measurements.
4. The waveforms displayed were recorded in chart format for both the high side and low side of band edges. Differing data rates from 1MBit/Sec to 11MBit/Sec have been charted and are viewable on the following pages.
5. 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 25, 26.]

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

1MBit/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	Peak	Average	uV/m
2.380	7.3	7.1	V	37.2	44.5	44.3	167.9	164.1	500
2.382	7.3	7.1	V	37.2	44.5	44.3	167.9	164.1	500
2.384	7.3	7.1	V	37.2	44.5	44.3	167.9	164.1	500
2.386	7.3	7.2	V	37.2	44.5	44.4	167.9	166.0	500
2.388	7.3	7.2	V	37.3	44.6	44.5	169.8	167.9	500
2.390	7.5	7.3	V	37.3	44.8	44.6	173.8	169.8	500
2.380	7.1	6.9	H	37.2	44.3	44.1	164.1	160.3	500
2.382	7.1	6.9	H	37.2	44.3	44.1	164.1	160.3	500
2.384	7.1	6.9	H	37.2	44.3	44.1	164.1	160.3	500
2.386	7.1	6.9	H	37.2	44.3	44.1	164.1	160.3	500
2.388	7.1	6.9	H	37.3	44.4	44.2	166.0	162.2	500
2.390	7.1	6.9	H	37.3	44.4	44.2	166.0	162.2	500

1MBit/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	Peak	Average	uV/m
2.4835	9.2	9.0	V	37.9	47.1	46.9	226.5	221.3	500
2.485	9.3	9.1	V	37.9	47.2	47.0	229.1	223.9	500
2.488	9.5	9.4	V	37.9	47.4	47.3	234.4	231.7	500
2.491	9.8	9.6	V	37.9	47.7	47.5	242.7	237.1	500
2.494	9.7	9.6	V	38	47.7	47.6	242.7	239.9	500
2.497	9.4	9.3	V	38	47.4	47.3	234.4	231.7	500
2.500	9.1	8.9	V	38	47.1	46.9	226.5	221.3	500
2.4835	7.0	6.9	H	37.9	44.9	44.8	175.8	173.8	500
2.485	7.1	6.8	H	37.9	45.0	44.7	177.8	171.8	500
2.488	7.1	6.8	H	37.9	45.0	44.7	177.8	171.8	500
2.491	7.0	6.8	H	37.9	44.9	44.7	175.8	171.8	500
2.494	7.0	6.8	H	38	45.0	44.8	177.8	173.8	500
2.497	7.0	6.8	H	38	45.0	44.8	177.8	173.8	500
2.500	7.0	6.8	H	38	45.0	44.8	177.8	173.8	500

Measurements by: Ted Chaffee

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	Peak	Average	uV/m
2.380	9.1	9.0	V	37.2	46.3	46.2	206.5	204.2	500
2.382	9.7	9.6	V	37.2	46.9	46.8	221.3	218.8	500
2.384	9.9	9.8	V	37.2	47.1	47.0	226.5	223.9	500
2.386	10.4	10.3	V	37.2	47.6	47.5	239.9	237.1	500
2.388	10.1	9.9	V	37.3	47.4	47.2	234.4	229.1	500
2.390	11.7	11.4	V	37.3	49.0	48.7	281.8	272.3	500
2.380	-3.5	-3.6	H	37.2	33.7	33.6	48.4	47.9	500
2.382	-3.4	-3.5	H	37.2	33.8	33.7	49.0	48.4	500
2.384	-3.4	-3.5	H	37.2	33.8	33.7	49.0	48.4	500
2.386	-3.5	-3.5	H	37.2	33.7	33.7	48.4	48.4	500
2.388	-3.5	-3.6	H	37.3	33.8	33.7	49.0	48.4	500
2.390	-3.5	-3.6	H	37.3	33.8	33.7	49.0	48.4	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	Peak	Average	uV/m
2.4835	15.3	15.1	V	37.9	53.2	53.2	457.1	457.1	500
2.485	15.4	15.1	V	37.9	53.3	53.0	462.4	446.7	500
2.488	14.7	14.4	V	37.9	52.6	52.3	426.6	412.1	500
2.491	14.7	14.4	V	37.9	52.6	52.3	426.6	412.1	500
2.494	14.9	14.7	V	38	52.9	52.7	441.6	431.5	500
2.497	15.1	14.9	V	38	53.1	52.9	451.9	441.6	500
2.500	15.2	14.9	V	38	53.2	52.9	457.1	441.6	500
2.4835	-2.4	-2.5	H	37.9	35.5	35.4	59.6	58.9	500
2.485	-2.4	-2.5	H	37.9	35.5	35.4	59.6	58.9	500
2.488	-2.4	-2.5	H	37.9	35.5	35.4	59.6	58.9	500
2.491	-2.3	-2.3	H	37.9	35.6	35.6	60.3	60.3	500
2.494	-2.1	-2.2	H	38	35.9	35.8	62.4	61.7	500
2.497	-1.9	-2.0	H	38	36.1	36.0	63.8	63.1	500
2.500	-1.8	-1.9	H	38	36.2	36.1	64.6	63.8	500

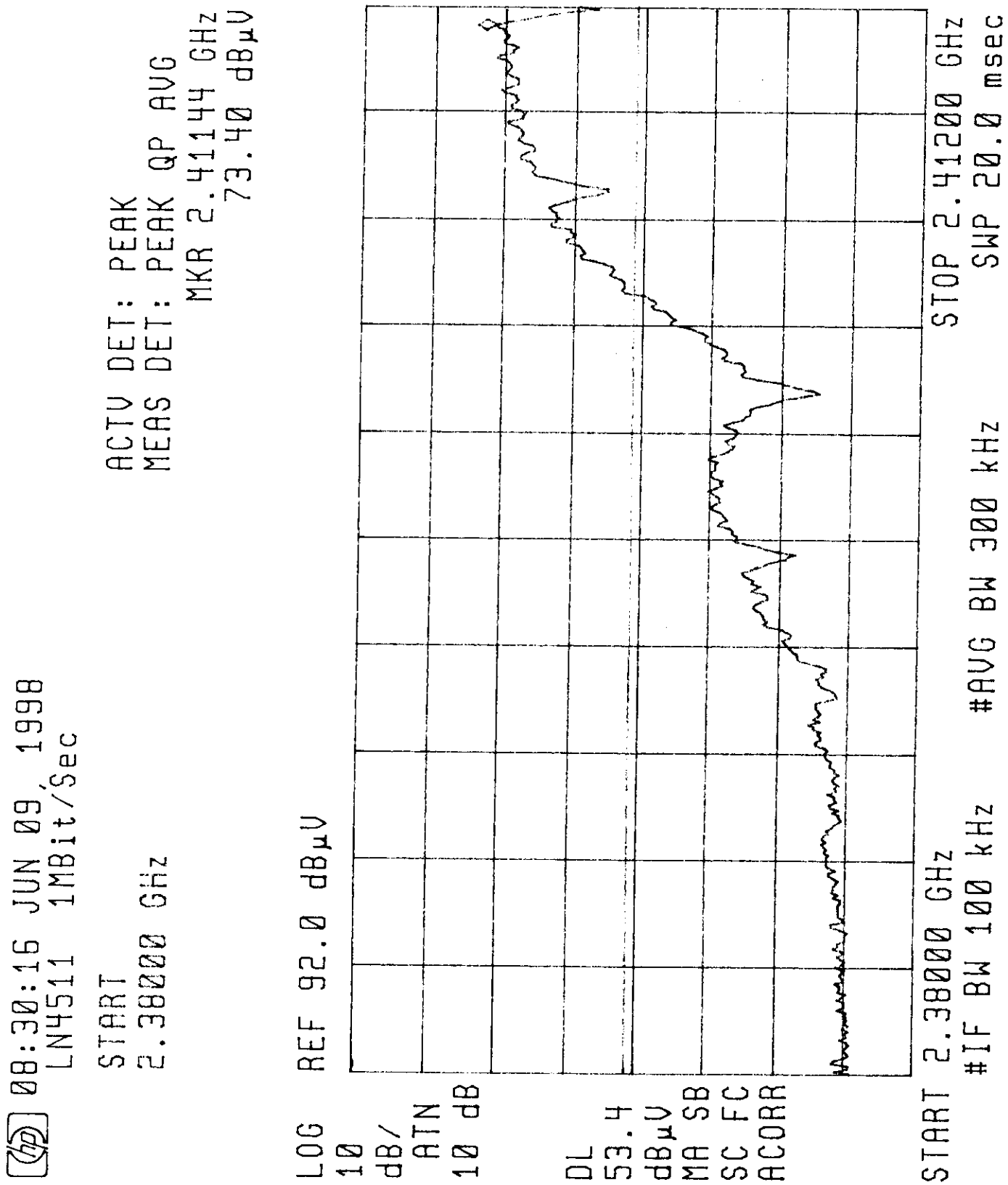
Measurements by: Fred C. Chaffee

The following pages show, in chart format, the emission profiles of the band edges with the system operating at 1MBit/Sec, 2MBit/Sec, 5.5MBit/Sec, and 11 MBit/Sec.

In any 100KHz bandwidth outside the frequency band of operation, the RF power is at least 20dB below that in the highest 100KHz bandwidth within the band of operation. The charts on the pages that follow indicate this compliance by displaying a reference line that is 20dB below the peak reading of the in band RF level.

Band Edge: IF Bandwidth = 100KHz; Video Bandwidth = 300KHz

Band Edge: IF Bandwidth = 1.0MHz; Video Bandwidth = 10Hz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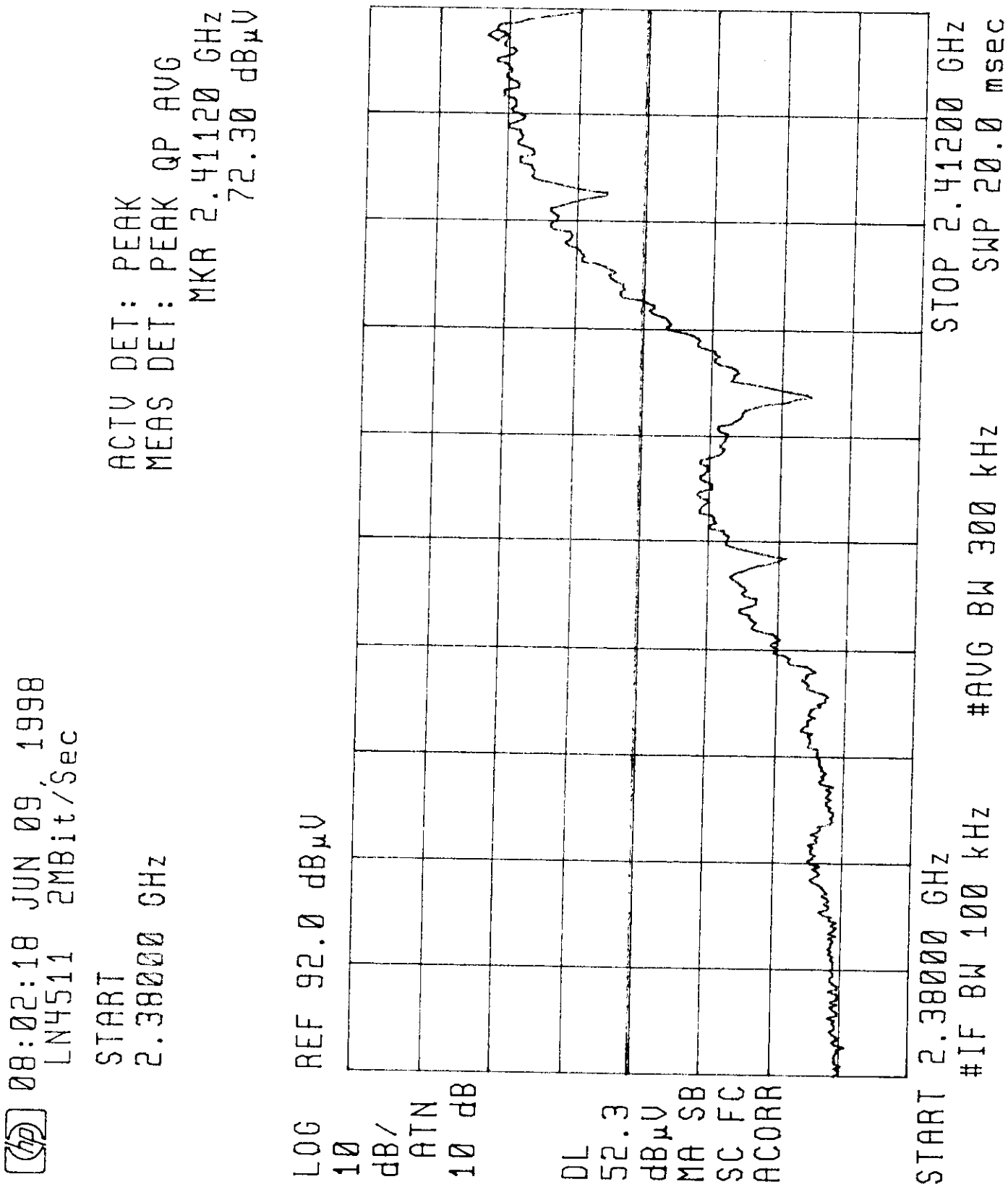
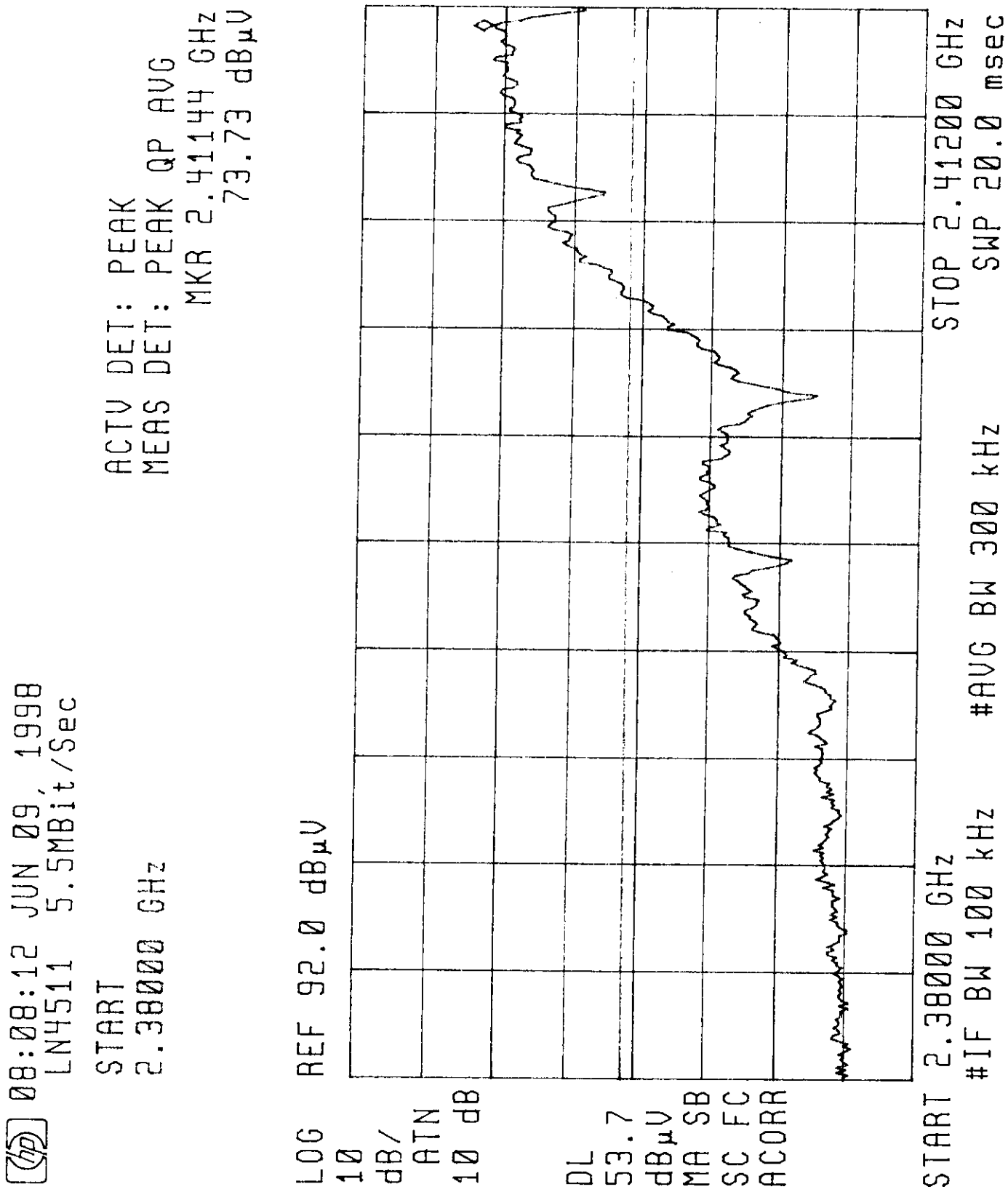
LN4511 1MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41144 GHz
73.40 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
53.4
dBµV
MA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.41200 GHz
SWP 20.0 msec


08:02:18 JUN 09, 1998
LN4511 2MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41120 GHz
72.30 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
52.3
dBµV
MA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.41200 GHz
SWP 20.0 msec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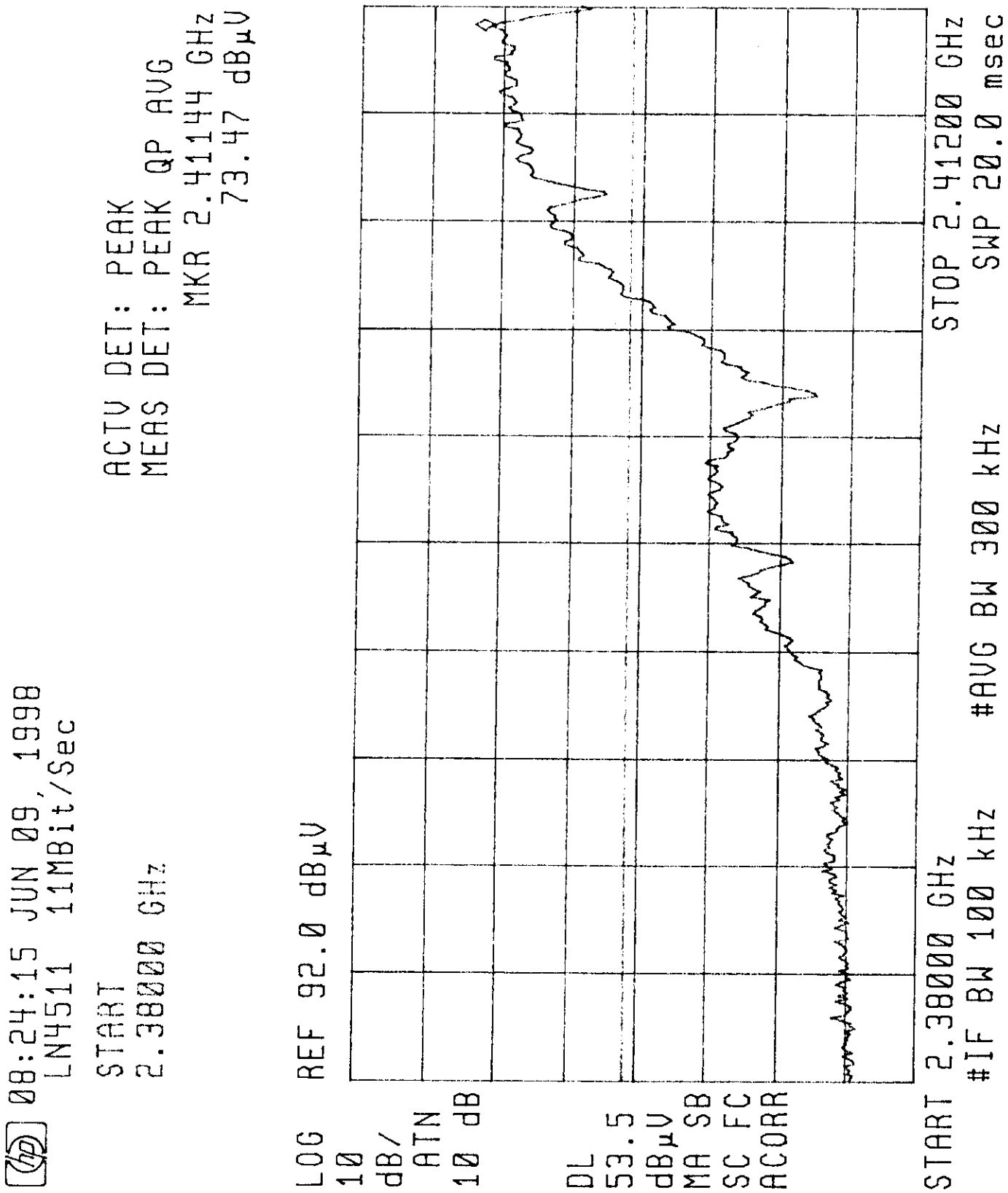
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41144 GHz
73.73 dBµV
LOG REF 92.0 dBµV
10 dB/ ATN
10 dB
DL
53.7
dBµV
MA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.41200 GHz
SWP 20.0 msec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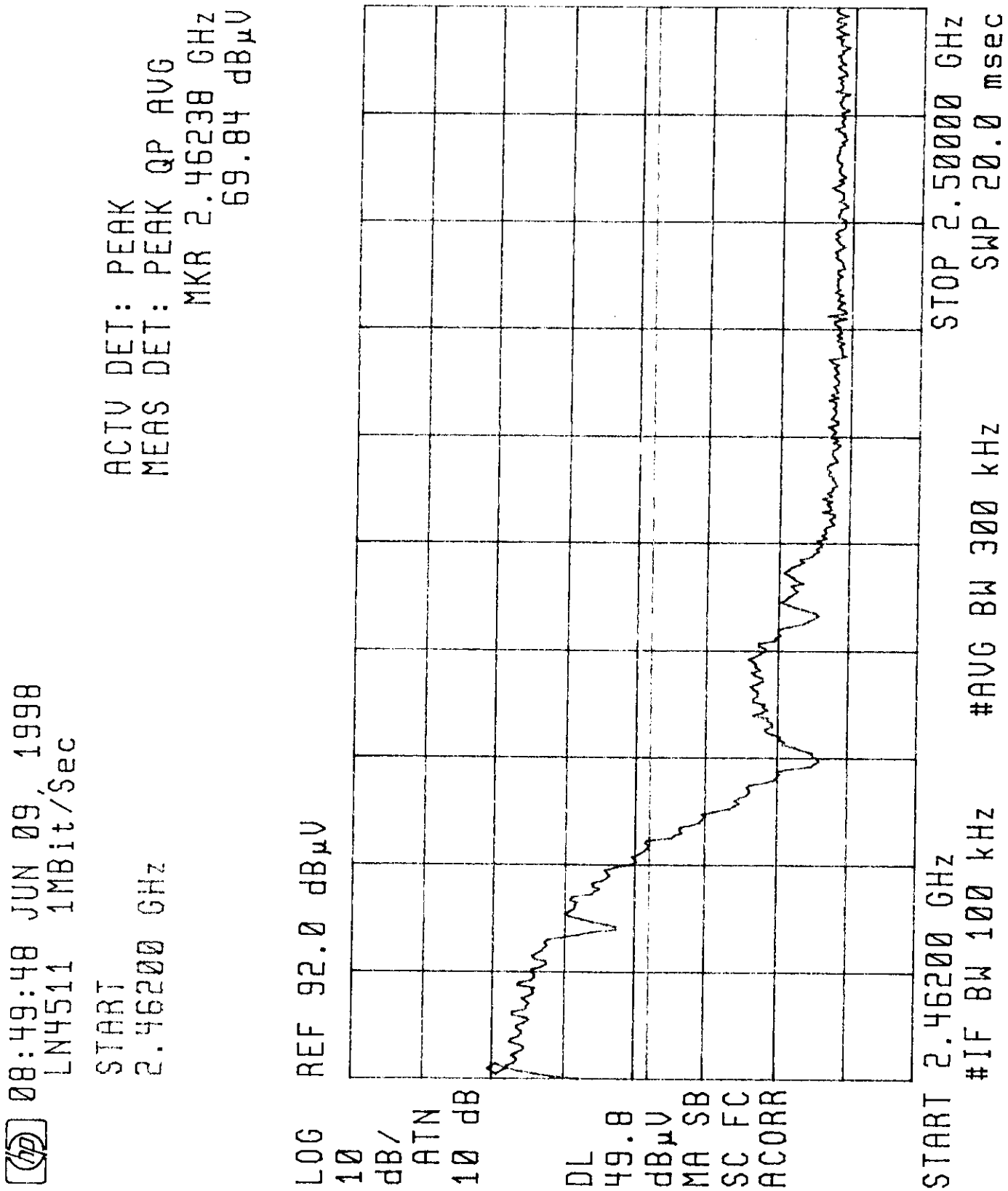
LN4511 11MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41144 GHz
73.47 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
53.5
dBµV
MA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.41200 GHz
SWP 20.0 msec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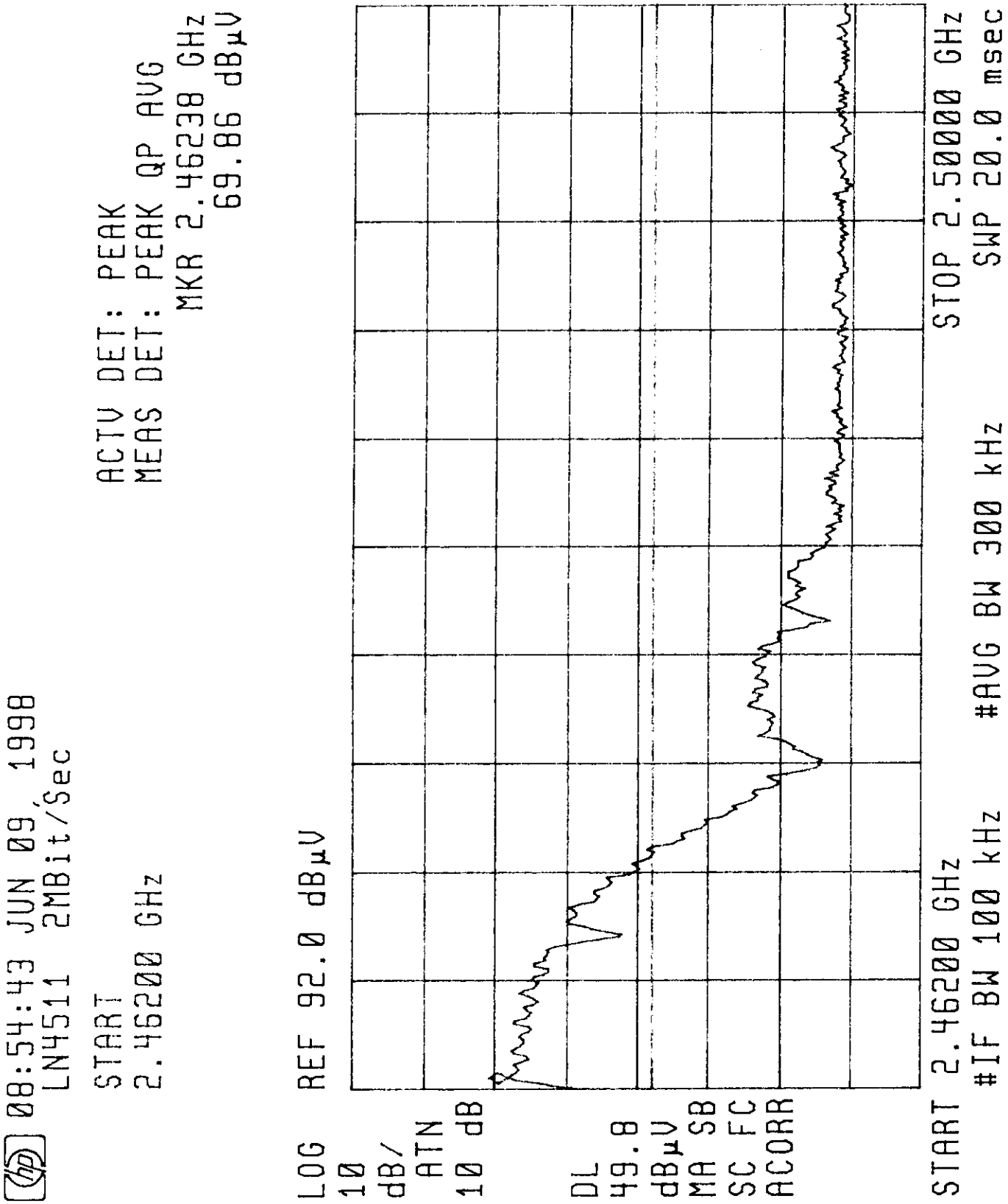
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46238 GHz
69.84 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.8
dBµV
MA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec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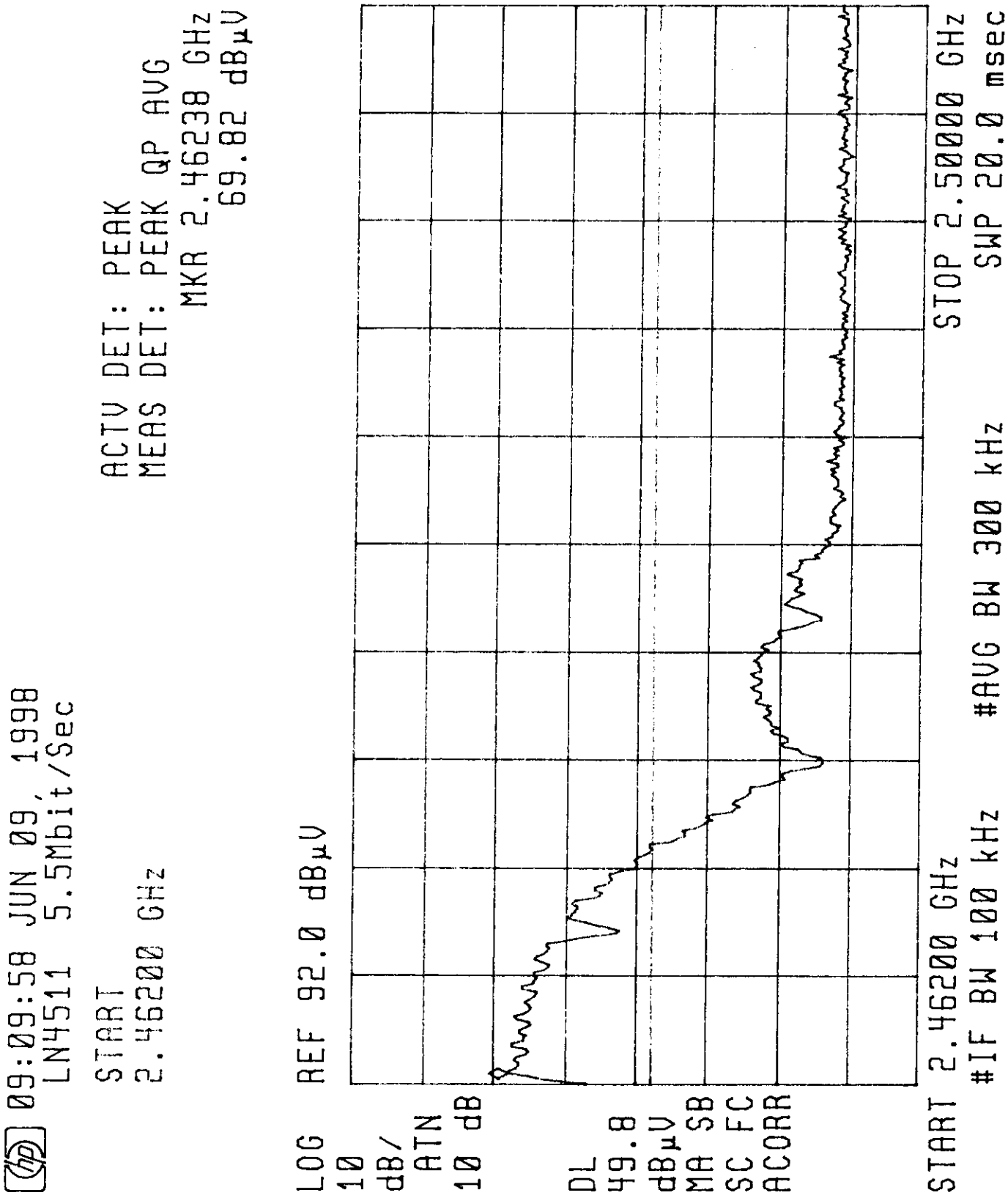
LN4511 2MBit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46238 GHz
69.86 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.8
dBµV
MA SB
SC FC
ACORR
STOP 2.50000 GHz
SWP 20.0 msec
#AVG BW 300 kHz
START 2.46200 GHz
#IF BW 100 kHz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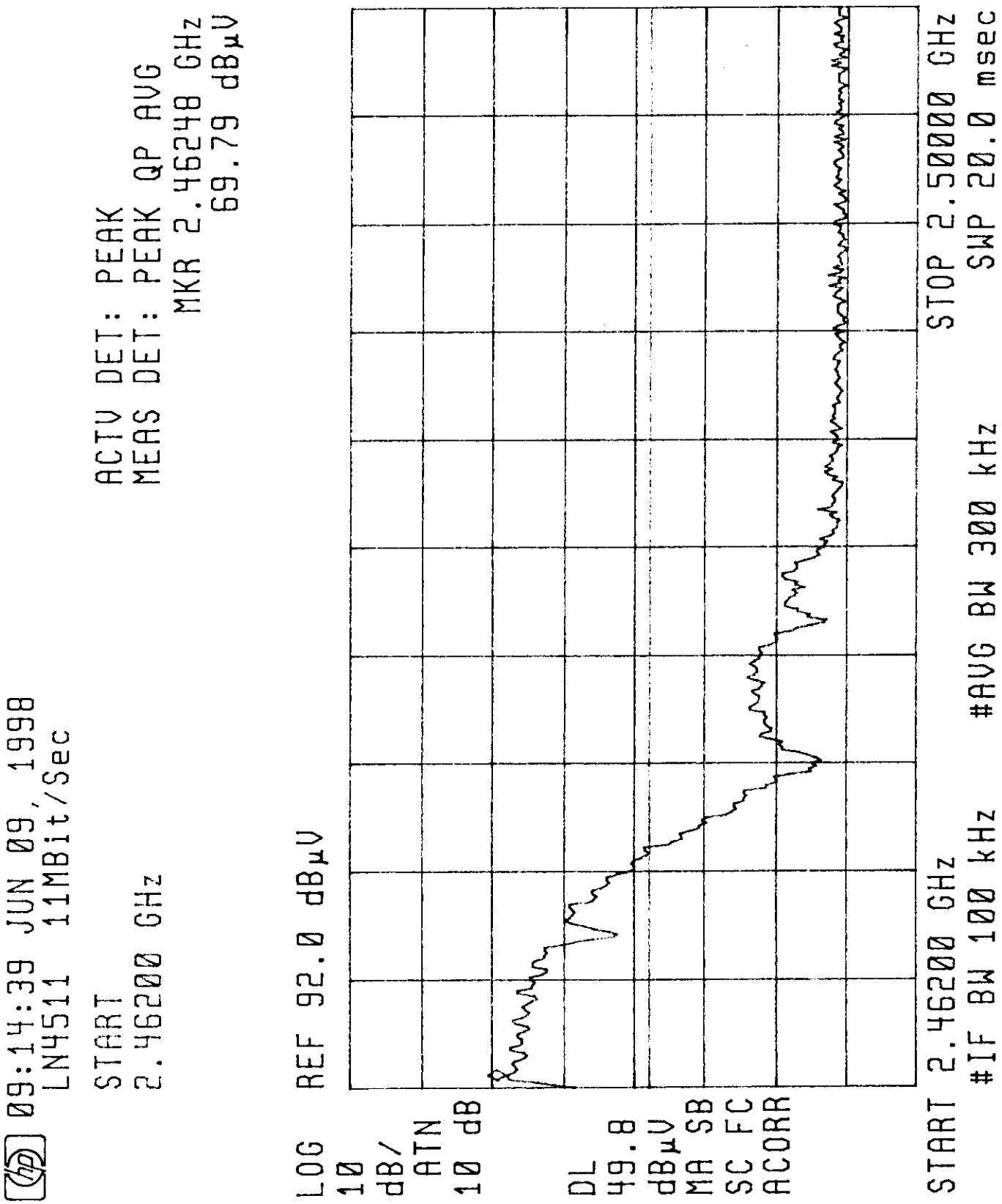
LN4511 5.5Mbit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46238 GHz
69.82 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.8
dBµV
MA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec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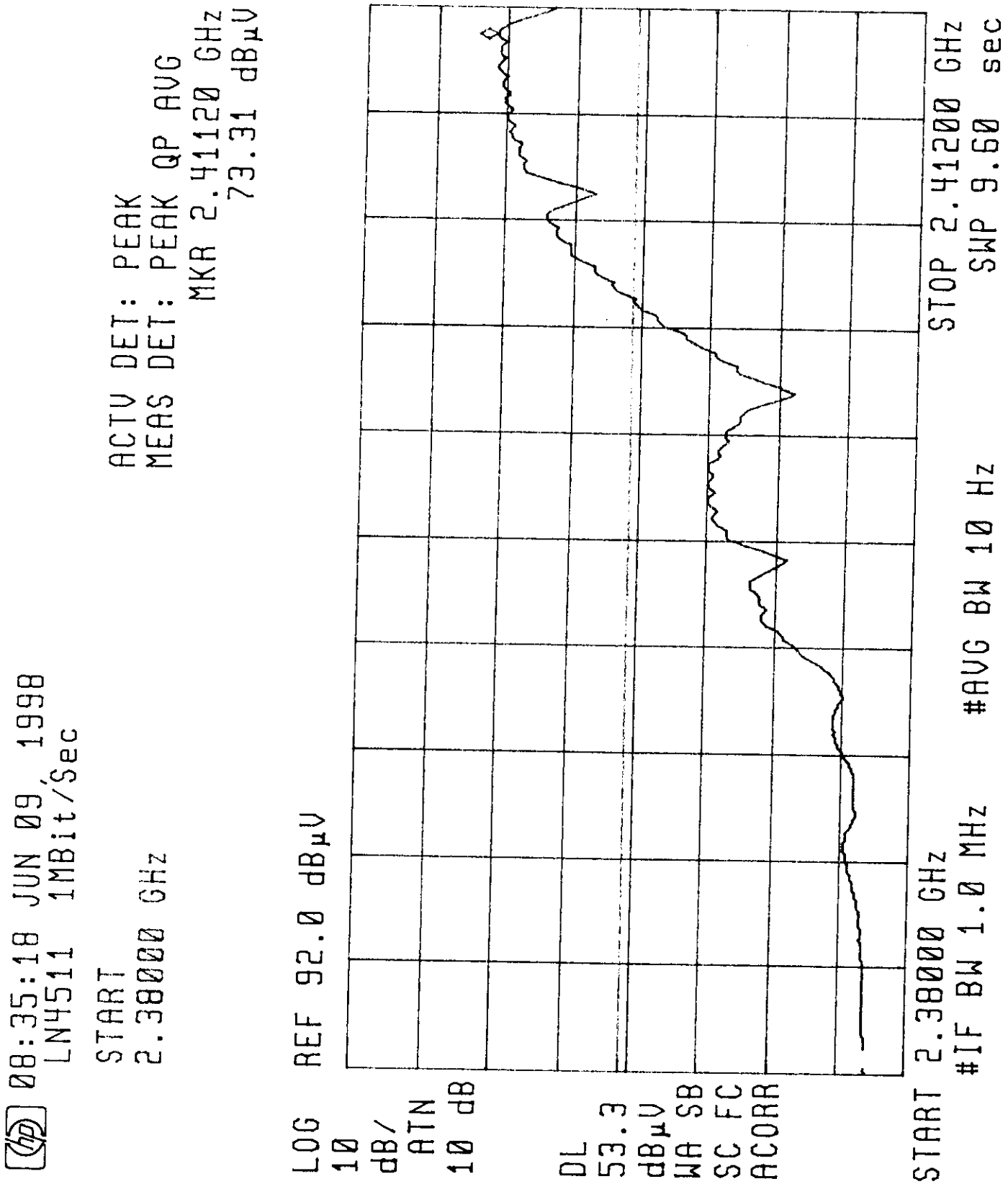
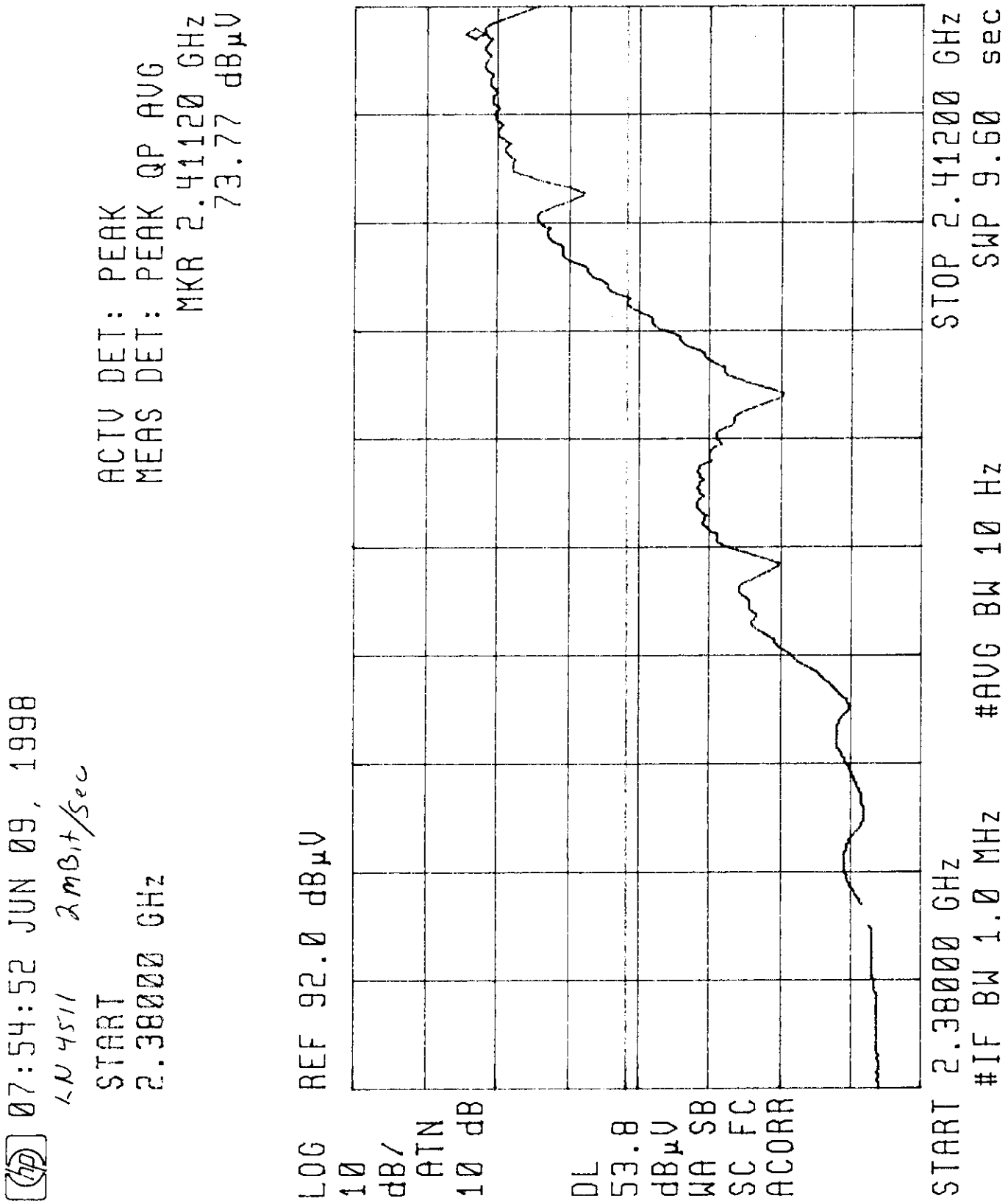
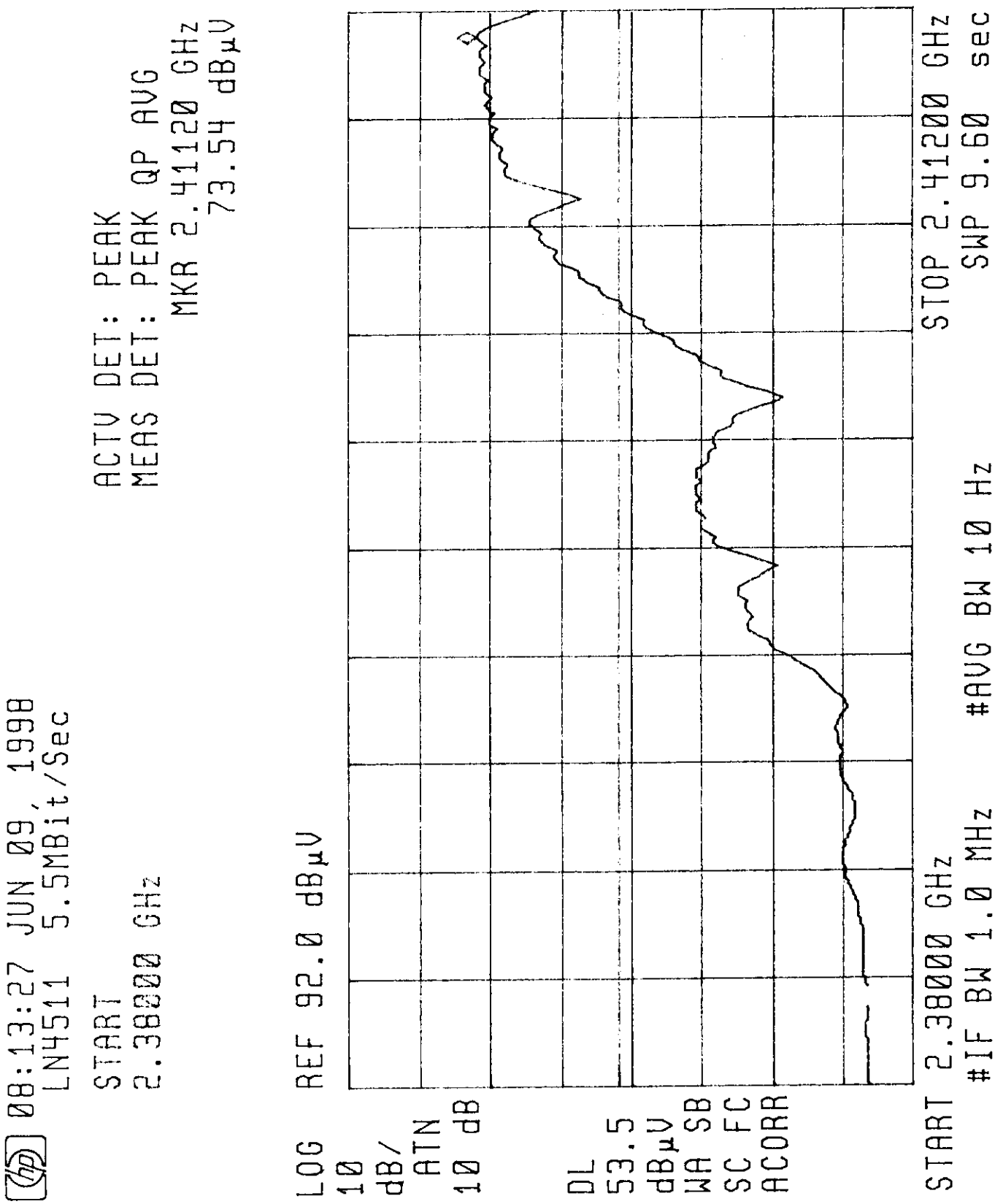
LN4511 11MBit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46248 GHz
69.79 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.8
dBµV
MA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 100 kHz
#AVG BW 300 kHz
STOP 2.50000 GHz
SWP 20.0 msec


08:35:18 JUN 09, 1998
LN4511 1MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41120 GHz
73.31 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
53.3
dBµV
WA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.41200 GHz
SWP 9.60 sec


07:54:52 JUN 09, 1998
LN 4511 2mBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41120 GHz
73.77 dBµV
LOG REF 92.0 dBµV
10 dB/ ATN
10 dB
DL
53.8
dBµV
WA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.41200 GHz
SWP 9.60 sec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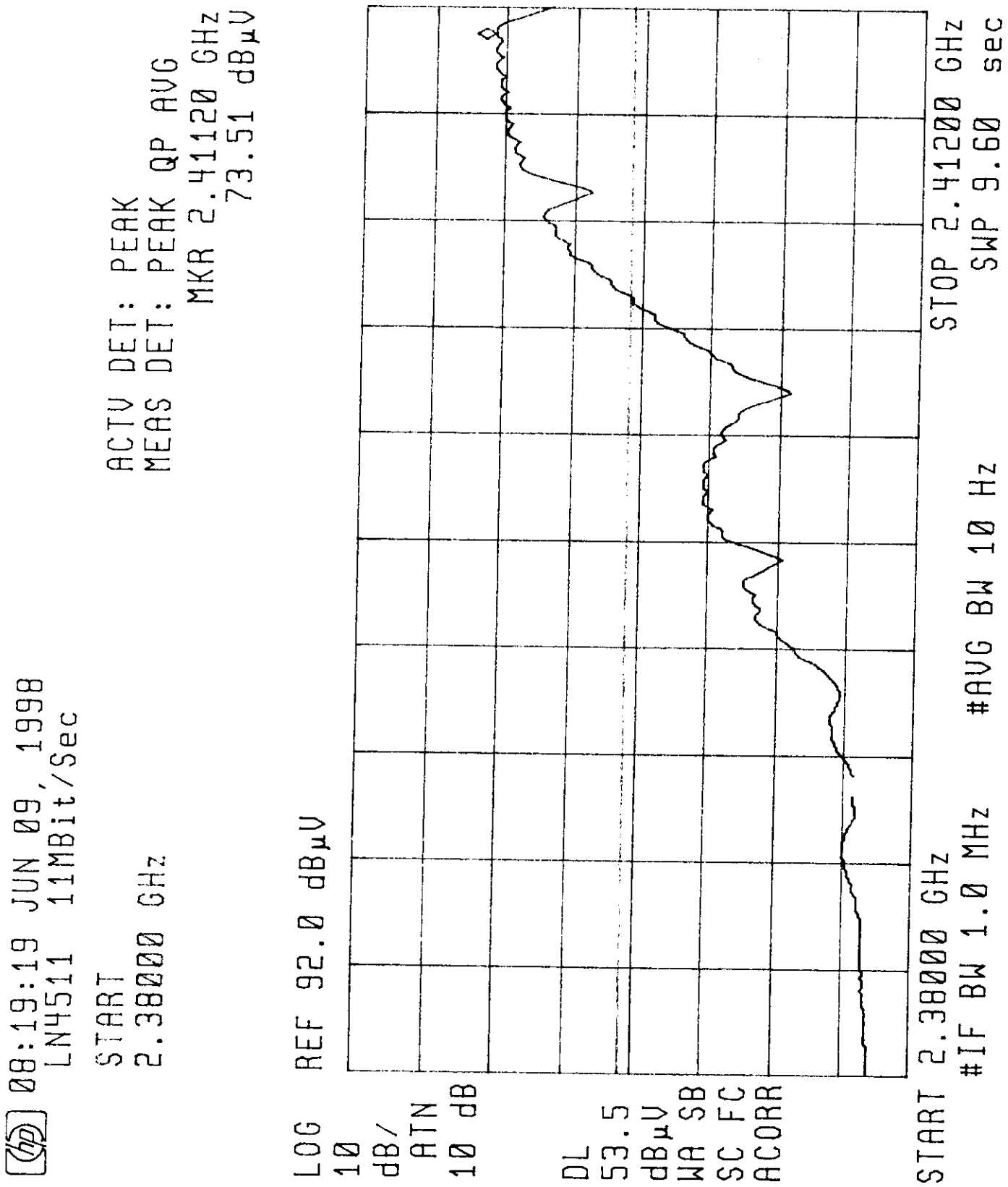
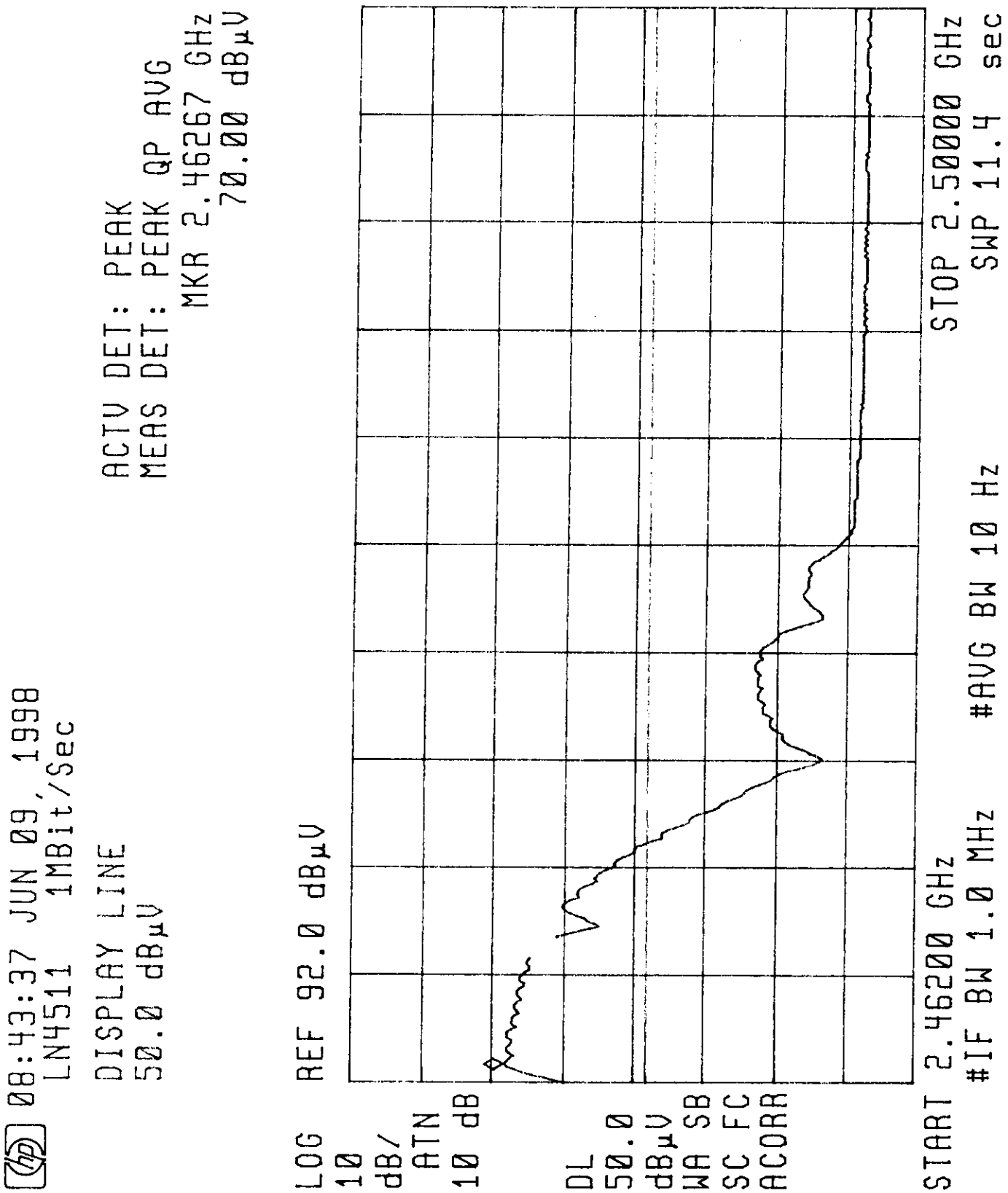
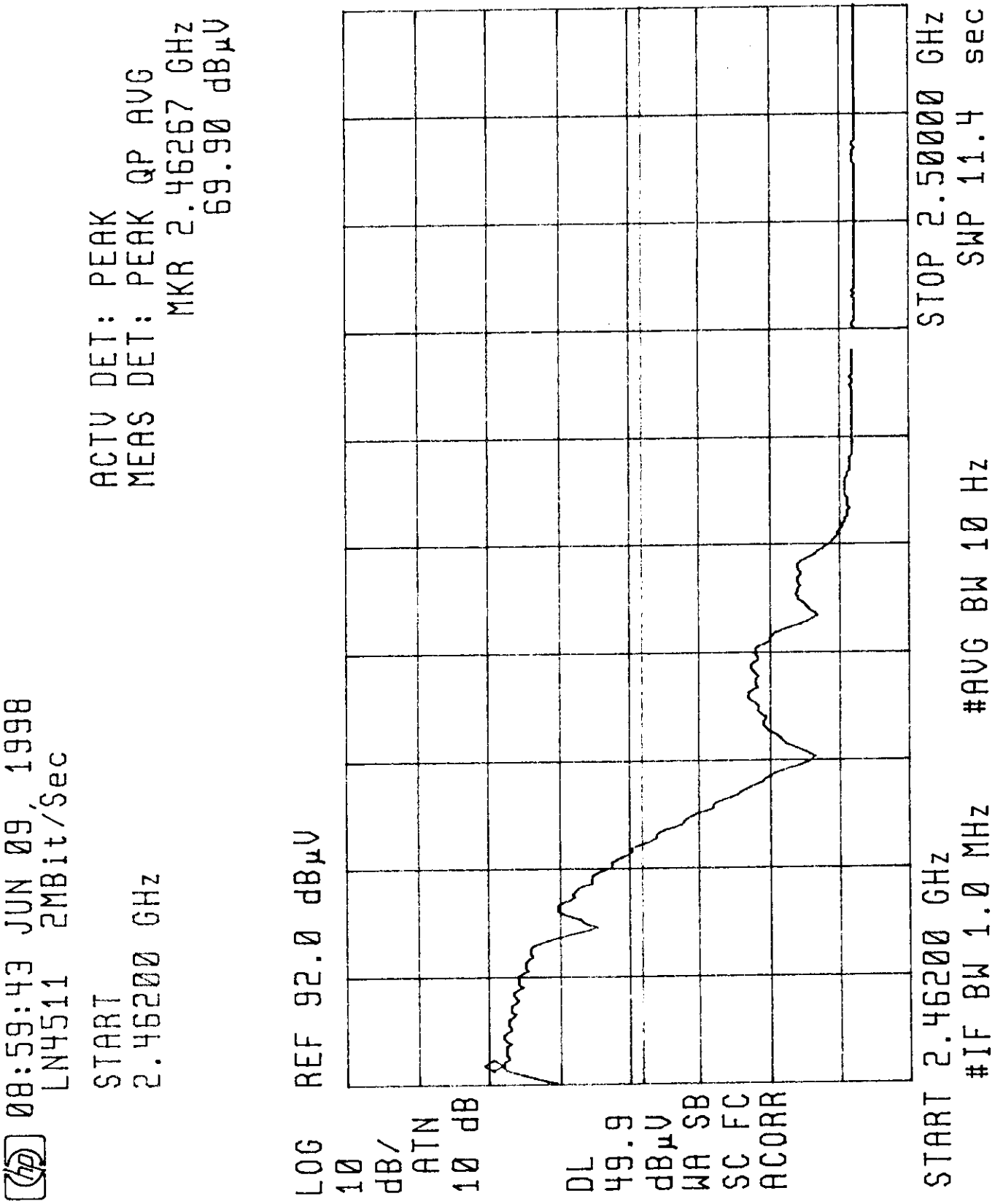
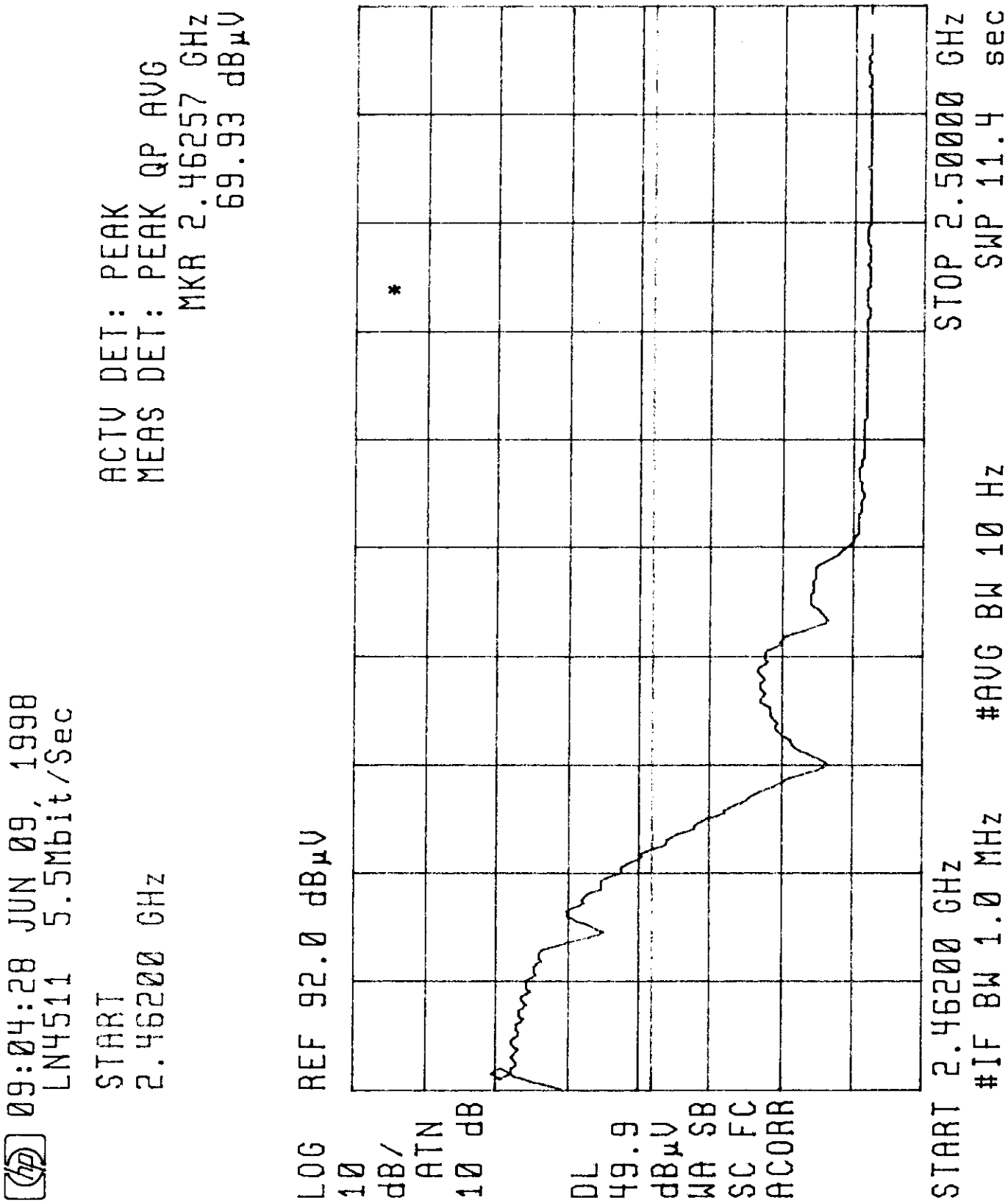
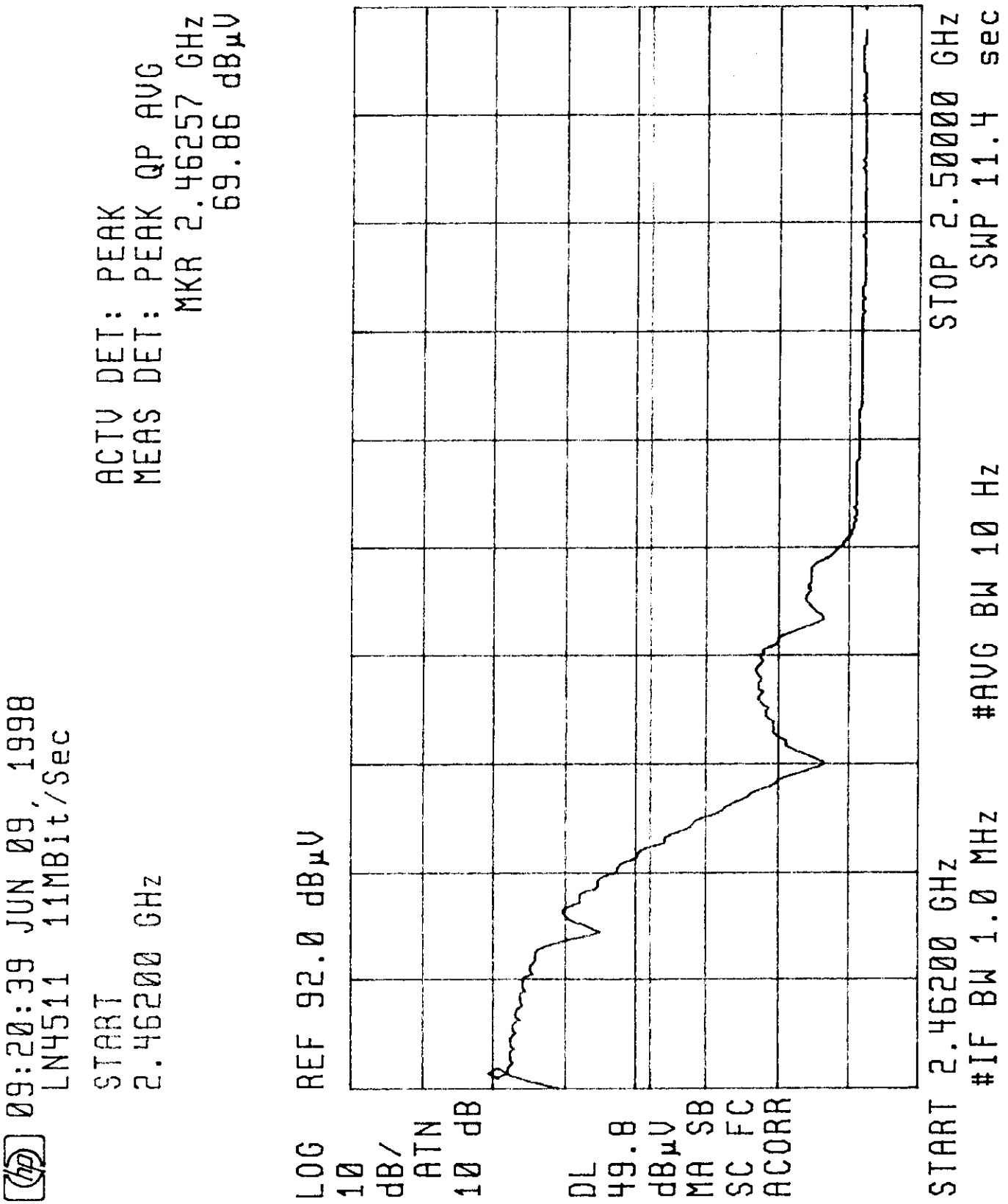
LN4511 5.5MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41120 GHz
73.54 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
53.5
dBµV
WA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.41200 GHz
SWP 9.60 sec


08:19:19 JUN 09, 1998
LN4511 11MBit/Sec
START
2.38000 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.41120 GHz
73.51 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
53.5
dBµV
WA SB
SC FC
ACORR
START 2.38000 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.41200 GHz
SWP 9.60 sec


08:43:37 JUN 09, 1998
LN4511 1MBit/Sec
DISPLAY LINE
50.0 dBµV
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46267 GHz
70.00 dBµV
LOG REF 92.0 dBµV
10 dB/ ATN 10 dB
DL 50.0 dBµV
WA SB SC FC ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.50000 GHz
SWP 11.4 sec


08:59:43 JUN 09, 1998
LN4511 2MBit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46267 GHz
69.90 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.9
dBµV
WA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.50000 GHz
SWP 11.4 sec


09:04:28 JUN 09, 1998
LN4511 5.5Mbit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46257 GHz
69.93 dBµV
LOG REF 92.0 dBµV
10 dB/ ATN 10 dB
DL 49.9 dBµV
WA SB SC FC ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.50000 GHz
SWP 11.4 sec


09:20:39 JUN 09, 1998
LN4511 11MBit/Sec
START
2.46200 GHz
ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 2.46257 GHz
69.86 dBµV
LOG REF 92.0 dBµV
10 dB/
ATN
10 dB
DL
49.8
dBµV
MA SB
SC FC
ACORR
START 2.46200 GHz
#IF BW 1.0 MHz
#AVG BW 10 Hz
STOP 2.50000 GHz
SWP 11.4 sec

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 include already the Antenna factors and a 30dB factor for the PreAmp. The total field strength has been adjusted to include the attenuation factor of the coax and the difference in true PreAmp gain from 30dB at the specific frequencies of interest.

Tuned Frequency	Measured Frequency	Pol	Indicated Level dBuV/m		Coax - PreAmp Factor not included in S.A. memory	Total Field Strength dBuV/m		Total Field Strength uV/m		FCC Limit	Antenna factor and 30dB preamp factor in S.A. memory
GHz	GHz		Peak	Avg	dB	Peak	Avg	Peak	Avg	uV/m	dB
2.412	4.8238	V	40.7	39.1	1.6	42.3	40.7	130	108	500	-1.2
	7.2364	V	44.0	43.2	1.7	45.7	44.9	193	176	500	4.2
	*9.6476	V	45.8	44.3	2.6	48.4	46.9	263	221	500	9.0
	**12.06	V	51	51	3.6	<54.6	<54.6	<537	<537	500	11.6
2.442	4.884	V	41.0	39.0	1.8	42.8	40.8	138	110	500	-1.0
	7.326	V	43.3	41.9	1.8	45.1	43.7	180	153	500	4.6
	**9.768	V	51	51	2.7	<53.7	<53.7	<484	<484	500	9.1
	**12.21	V	51	51	3.7	<54.7	<54.7	<543	<543	500	11.7
2.462	4.924	V	40.5	39.5	1.8	42.3	41.3	130	116	500	-1.0
	7.386	V	46.2	44.5	1.8	48.0	46.3	251	206	500	4.8
	**9.848	V	51	51	2.7	<53.7	<53.7	<484	<484	500	9.1
	**12.31	V	51	51	3.6	<54.6	<54.6	<537	<537	500	11.7

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

** NOTE: At frequencies above 9.7GHz 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 9.7GHz.

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	3704A00366	05-April-98	12 month
RF Receiver Section	HP-85462A	3801A00431	05-April-98	12 month
EMCO BiconiLog Antenna	3142	1077	15-Aug-97	12 months
Solar LISN	8012-50-R-24-BNC	962138	15-Aug-97	12 months
(LCI) Double shielded 50ohm Coax	RG58/U	920809	05-Dec-97	6 months
(rad) Double shielded 50ohm Coax	RG58/U	971212	09-June-98	6 months
from Aironet Wireless Communications, Inc.				
HP Spectrum Analyzer	8593EM	3536A00115	13-Sep-97	12 months
HP 1-26GHz RF PreAmplifier	8449B	3008A00911	13-Sep-97	12 months
ElectroMechanics Double Ridge Horn	3115	4363	10-Dec-97	12 months
6 ft.GORE 145 50ohm coax	145		06-July-98	12 months

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

DEPARTMENT OF COMMERCE ★ UNITED STATES OF AMERICA ★

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)

EXHIBIT 6: APPENDIX A: 4 ADDITIONAL ANTENNAS MEASUREMENTS: MORT FLOM, INC.

Mort Flom Associates, Inc. Cover Letter

Radiated Emissions: index

Restricted Bands of Operation: index

Allowed Occupied Bandwidth: index

Transmitter Conducted Measurements: index

Band Edge Charts: index

MFA M. Flom Associates, Inc.
Global Compliance Center
3356 North San Marcos Place, Suite 107
Chandler, Arizona 85224-1571
(602) 926-3100, FAX: 926-3598
www.goodnet.com/~mflom

June 30, 1998.

Federal Communications Commission,
Office of Eng'g & Technology,
7435 Oakland Mills Road,
Columbia, Maryland 21046.

Attention: Charles M. Cobbs, Chief, Applications Processing
and/or: Joe Dichoso, Electronics Engineer
Applicant: AIRONET WIRELESS COMMUNICATIONS, INC.
Equipment: FCC ID: LOZ102034
Reference: File 1387 (copy attached)
Subject: Request for re-consideration of dismissed app'n

Gentlemen:

Under Subsection 2.923 of the FCC Rules, please consider this letter as a request for re-consideration of the dismissal of the attached application. The matter was discussed with C. Cobbs and David Case, the Applicant's Engineer.

David Case was present throughout the test program conducted for this application. He confirms that the test results up to the third harmonic (3x2442=7326) are valid. Beyond the third harmonic, the observed results were that of 'floor noise' produced by the H.P. Microwave preamp.

In support of this request for re-consideration, please find FCC Form 731 signed and currently dated; additional data on Page 7.6, and amended Pages 9.3 and 9.5. (Pages 9.2, 9.4 and 9.6 have been deleted and are now intentionally left blank).

We trust the foregoing explanations and the enclosed application for re-consideration will be favourably received. As you know, the submission was 'lost' somewhere in the FCC system, resulting in 40 days delay.

Sincerely yours,

MORTON FLOM, P. Eng.

mf;mgf
encs.
~~via FEDEX A/B 07501 6777 3~~
cc: Applicant

PAGE NO. 9.1. LOZ102034
RADIATED EMISSIONS TX2
1998-FEB-12, 14:47, THR 8.5 dBi PATCH

TUNED, MHz	EMISSION, MHz	PEAK /AVE	METER, dBuV	C.F., dB	µV/m @ 3m
2412.000	2361.88	A	-1.0	35.4	52
2412.000	2364.75	P	1.6	35.4	71
2412.000	2367.63	A	0.2	35.4	60
2412.000	2370.38	P	3.6	35.4	90
2412.000	2371.25	A	1.1	35.4	67
2412.000	2374.00	P	4.6	35.4	100
2412.000	2378.88	P	7.5	35.4	141
2412.000	2379.13	A	5.3	35.4	109
2412.000	2381.00	P	5.8	35.5	116
2412.000	2381.63	P	8.1	35.5	151
2412.000	2383.63	A	4.2	35.5	97
2412.000	2384.63	P	7.6	35.5	143
2412.000	2386.88	A	11.0	35.5	212
2412.000	2387.25	P	12.3	35.5	244
2412.000	2388.13	P	7.2	35.5	136
2412.000	2390.00	P	8.6	35.5	160
2412.000	2390.00	A	9.3	35.5	173
2457.000	2483.50	A	6.4	35.9	129
2457.000	2483.50	P	7.6	35.9	149
2457.000	2485.80	A	6.6	35.9	133
2457.000	2486.50	P	10.2	35.9	200
2457.000	2493.80	A	5.9	35.9	124
2457.000	2496.80	P	9.0	35.9	176
2457.000	2501.50	P	9.8	36.0	195
2457.000	2504.50	A	5.2	36.0	114
2457.000	2513.50	A	10.8	36.0	220
2457.000	2513.50	P	10.9	36.0	221
2457.000	2525.50	P	5.8	36.1	124
2457.000	2525.50	A	7.5	36.1	151
2457.000	2537.50	A	7.7	36.1	156
2457.000	2537.80	P	8.5	36.1	170
2457.000	2549.80	A	10.5	36.2	216
2457.000	2550.00	P	11.8	36.2	252
2457.000	2555.00	P	-2.0	47.0	178
2457.000	2555.30	A	4.2	36.2	105
2412.000	4824.00	A	31.7	12.7	164
2412.000	4824.00	P	39.7	12.7	413
2442.000	4884.00	P	40.5	12.9	468
2442.000	4884.00	A	31.3	12.9	163
2457.000	4914.00	A	29.7	13.7	147
2457.000	4914.00	P	38.2	13.7	390
2412.000	7236.00	P	40.3	18.7	893
2412.000	7236.00	A	32.7	18.7	370
2442.000	7326.00	A	32.8	19.0	388

APPENDIX A

PAGE NO. 9.3. LOZ102034
RADIATED EMISSIONS TX4
1998-FEB-11, 14:13, WED 12 dBi OMNI

TUNED, MHz	EMISSION, MHz	PEAK /AVE	METER, dBuV	C.F., dB	µV/m @ 3m
2412.000	2363.25	A	1.7	35.4	71
2412.000	2364.00	P	1.9	35.4	73
2412.000	2367.13	A	2.9	35.4	82
2412.000	2368.88	P	6.7	35.4	127
2412.000	2371.25	A	4.5	35.4	100
2412.000	2374.13	A	5.2	35.4	107
2412.000	2374.13	P	8.0	35.4	148
2412.000	2378.63	A	6.5	35.4	125
2412.000	2379.13	P	9.0	35.4	166
2412.000	2383.25	A	7.5	35.5	141
2412.000	2388.13	P	21.6	35.5	711
2412.000	2388.13	A	8.9	35.5	166
2412.000	2389.13	P	9.7	35.5	182
2412.000	2389.38	P	19.7	35.5	575
2412.000	2390.00	P	9.8	35.5	183
2412.000	2390.00	A	21.0	35.5	671
2412.000	2390.00	A	9.8	35.5	184
2462.000	2483.50	A	14.2	35.9	318
2462.000	2483.50	P	15.6	35.9	374
2462.000	2484.00	A	14.4	35.9	327
2462.000	2487.50	P	16.4	35.9	412
2462.000	2488.13	A	13.3	35.9	287
2462.000	2492.88	P	15.7	35.9	380
2462.000	2493.38	A	11.9	35.9	247
2462.000	2498.50	A	11.7	35.9	240
2462.000	2500.13	P	14.5	36.0	332
2462.000	2501.50	A	11.3	36.0	231
2462.000	2503.38	P	13.5	36.0	297
2412.000	4824.00	P	36.0	12.7	271
2412.000	4824.00	A	26.8	12.7	94
2442.000	4884.00	A	27.0	12.9	99
2442.000	4884.00	P	37.0	12.9	313
2462.000	4924.00	P	36.2	13.1	290
2462.000	4924.00	A	27.7	13.1	109
2412.000	7236.00	A	27.2	18.7	196
2412.000	7236.00	P	36.7	18.7	586
2442.000	7326.00	P	36.2	19.0	570
2442.000	7326.00	A	27.3	19.0	206
2462.000	7386.00	A	28.7	19.1	245
2462.000	7386.00	P	40.8	19.1	995
2412.000	9648.00	P	35.7	22.4	797

PAGE NO. 9.4.
RADIATED EMISSIONS TX4
1998-FEB-11, 14:13, WED 12 dBi OMNI

LOZ102034

TUNED, MHz	EMISSION, MHz	PEAK /AVE	METER, dBuV	C.F., dB	µV/m @ 3m
2412.000	9648.00	A	27.0	22.4	294
2442.000	9768.00	A	28.0	22.5	336
2442.000	9768.00	P	36.2	22.5	861
2462.000	9848.00	P	39.0	22.6	1208
2462.000	9848.00	A	29.5	22.6	405
2412.000	12060.00	A	27.2	24.4	378
2412.000	12060.00	P	38.0	24.4	1317
2442.000	12210.00	P	35.2	24.3	945
2442.000	12210.00	A	27.2	24.3	376
2462.000	12310.00	A	27.3	24.3	382
2462.000	12310.00	P	35.7	24.3	998
2412.000	14472.00	P	37.0	25.9	1390
2412.000	14472.00	A	27.2	25.9	448
2442.000	14652.00	A	27.5	25.8	461
2442.000	14652.00	P	35.5	25.8	1159
2462.000	14772.00	P	36.2	25.7	1243
2462.000	14772.00	A	27.8	25.7	476
2412.000	16884.00	A	27.2	28.2	586
2412.000	16884.00	P	36.5	28.2	1716
2442.000	17094.00	P	39.0	29.4	2627
2442.000	17094.00	A	27.8	29.4	726
2462.000	17234.00	A	27.7	30.2	785
2462.000	17234.00	P	36.5	30.2	2170

APPENDIX A

APPENDIX A

PAGE NO. 9.7.
RADIATED EMISSIONS TX1 LOZ102034
1998-FEB-11, 11:20, WED 13.5 dBi YAGI

TUNED, MHz	EMISSION, MHz	PEAK /AVE	METER, dBuV	C.F., dB	µV/m @ 3m
2412.000	2364.50	A	4.4	35.4	97
2412.000	2364.75	P	6.0	35.4	117
2412.000	2368.50	P	9.0	35.4	166
2412.000	2369.00	A	6.4	35.4	123
2412.000	2374.00	A	7.5	35.4	139
2412.000	2374.13	P	10.4	35.4	196
2412.000	2378.88	A	9.3	35.4	173
2412.000	2378.88	P	12.5	35.4	250
2412.000	2382.25	P	13.4	35.5	279
2412.000	2382.25	A	10.2	35.5	192
2412.000	2386.25	A	12.1	35.5	239
2412.000	2386.25	P	14.3	35.5	308
2412.000	2390.00	P	14.5	35.5	315
2412.000	2390.00	A	12.4	35.5	248
2462.000	2483.50	A	12.2	35.5	243
2462.000	2483.50	P	13.0	35.9	276
2462.000	2484.13	A	13.1	35.9	282
2462.000	2484.25	A	13.3	35.9	287
2462.000	2484.25	P	13.1	35.9	281
2462.000	2484.38	P	15.7	35.9	380
2462.000	2489.38	P	15.9	35.9	390
2462.000	2490.13	A	15.4	35.9	368
2462.000	2494.25	P	11.3	35.9	230
2462.000	2496.38	A	14.0	35.9	314
2462.000	2500.38	P	9.2	35.9	181
2462.000	2501.25	A	11.6	36.0	237
2462.000	2507.38	P	8.1	36.0	159
2462.000	2509.25	A	10.0	36.0	198
2412.000	4824.38	A	6.8	36.0	137
2412.000	4824.38	P	-3.7	42.7	89
2442.000	4884.12	A	5.6	42.7	259
2442.000	4884.12	P	-3.6	42.9	92
2462.000	4924.38	P	7.9	42.9	346
2462.000	4924.38	A	6.7	43.1	309
2412.000	7236.00	A	-3.1	43.1	100
2412.000	7236.00	P	27.2	18.7	196
2442.000	7326.00	A	35.5	18.7	512
2442.000	7326.00	P	27.2	19.0	202
2462.000	7386.00	A	37.3	19.0	652
2462.000	7386.00	P	28.7	19.1	245
			36.0	19.1	571

PAGE NO. 9.8. LOZ102034

RADIATED EMISSIONS TX1

1998-FEB-11, 11:20, WED 13.5 dBi YAGI

TUNED, MHz	EMISSION, MHz	PEAK /AVE	METER, dBuV	C.F., dB	µV/m @ 3m
2412.000	9648.00	A	26.8	22.4	288
2412.000	9648.00	P	35.0	22.4	738
2442.000	9768.00	P	35.5	22.5	797
2442.000	9768.00	A	27.8	22.5	330
2462.000	9848.00	P	37.3	22.6	997
2462.000	9848.00	A	29.3	22.6	397
2412.000	12060.00	A	27.5	24.4	393
2412.000	12060.00	P	35.8	24.4	1026
2442.000	12210.00	A	27.3	24.3	383
2442.000	12210.00	P	36.2	24.3	1060
2462.000	12310.00	A	27.5	24.3	389
2462.000	12310.00	P	37.0	24.3	1163
2412.000	14472.00	P	33.7	25.9	947
2412.000	14472.00	A	27.5	25.9	466
2442.000	14652.00	P	36.0	25.8	1227
2442.000	14652.00	A	27.5	25.8	461
2462.000	14772.00	P	36.3	25.7	1266
2462.000	14772.00	A	28.0	25.7	485
2412.000	16884.00	A	27.7	28.2	621
2412.000	16884.00	P	36.5	28.2	1716
2442.000	17094.00	A	27.5	29.4	699
2442.000	17094.00	P	37.7	29.4	2254
2462.000	17234.00	A	28.0	30.2	816
2462.000	17234.00	P	36.0	30.2	2049

PAGE NO. 10. LOZ102034

NAME OF TEST: RESTRICTED BANDS OF OPERATION

PARAGRAPH: 47 CFR 15.205

TEST CONDITIONS: S. T. & H.

SPEC. LIMIT:

TEST EQUIPMENT: AS PER ATTACHED PAGE

MEASUREMENT PROCEDURE

The EUT was set up on a three meter open field site according to the procedures on ANSI C63.4.

Sensitivity of system was measured:

Below 2 GHz:

HP 8566B/HP85685A

CISPR Bandwidths	= 8 dBµV
1 MHz RBW, 1 MHz VBW	= 12 dBµV
1 MHz RBW, 10 Hz VBW	= 3 dBµV

Above 2 GHz:

HP 8563E

1 MHz RBW, 1 MHz VBW	33 dBµV
1 MHz RBW, 10 Hz VBW	= 22 dBµV

Sensitivity of system with preamps (HP 8449A):

Below 2 GHz:

Preamps are not used in this range.

Above 2 GHz:

HP 8563E

Peak	= 3 dBµV
Average	= -8 dBµV

Cable loss:

915 MHz	= -0.8 dB
2450 MHz	= -3 dB

Note:

dB loss vs. frequency included in programmed software.

Reference Level Offset:

set @ 1 dB, accounts for cable and connector loss.

TEST RESULTS: No harmonic or spurious emissions were detected in the restricted bands in excess of the limits of 15.205. System measurement sensitivity was -130 dBm.

PAGE NO. 11.

LOZ102034

NAME OF TEST: ALLOWED OCCUPIED BANDWIDTH

PARAGRAPH: 47 CFR 15.247(a)(2)

TEST CONDITIONS: S. T. & H.

SPEC. LIMIT: SEE *

TEST EQUIPMENT: AS PER ATTACHED PAGE

*LIMITS

RULE	TYPE	BANDS (MHz)	LIMIT (kHz)
15.247(a)(1)(i)	F.H.	902-928	20 dB BW ≤ 500
15.247(a)(1)(ii)	F.H.	2400-2483.5, 5725-5850	20 dB BW ≤ 1000
15.247(a)(2)	D.S.	ALL	6 dB BW ≥ 500

MEASUREMENT DATA

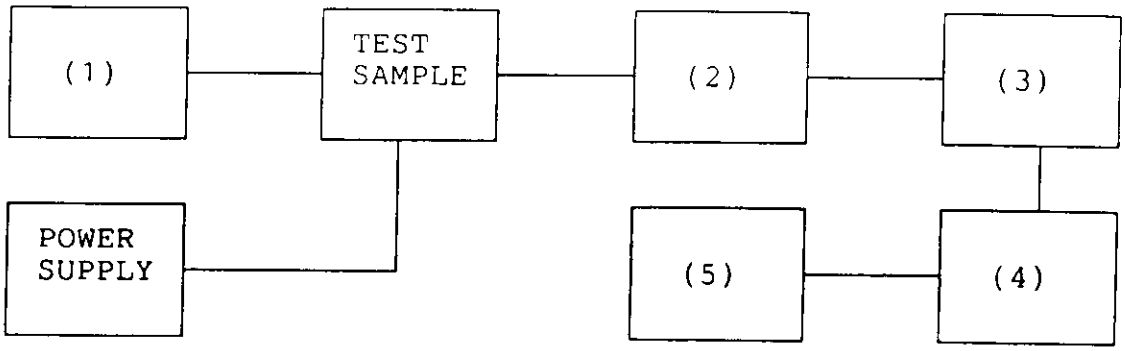
MEASURED BANDWIDTH, kHz = 10.2 MHZ

RESULTS = ATTACHED

SUPERVISED BY: MORTON FLOM, P. Eng.

PAGE NO. 12. LOZ102034

TRANSMITTER CONDUCTED MEASUREMENTS



(1) AUDIO OSCILLATOR/GENERATOR

HP 204D	___
HP 8903A	___
HP 3312A	___
_____	___

(2) COAXIAL ATTENUATOR

NARDA 766-10	___
SIERRA 661A-30	___
BIRD 8329 (30 dB)	___
_____	___

(3) FILTERS; NOTCH, HP, LP, BP

CIRQTEL FHT	___
EAGLE TNF-1	___
PHELPS DODGE PD-495-8	___
_____	___

(4) SPECTRUM ANALYZER

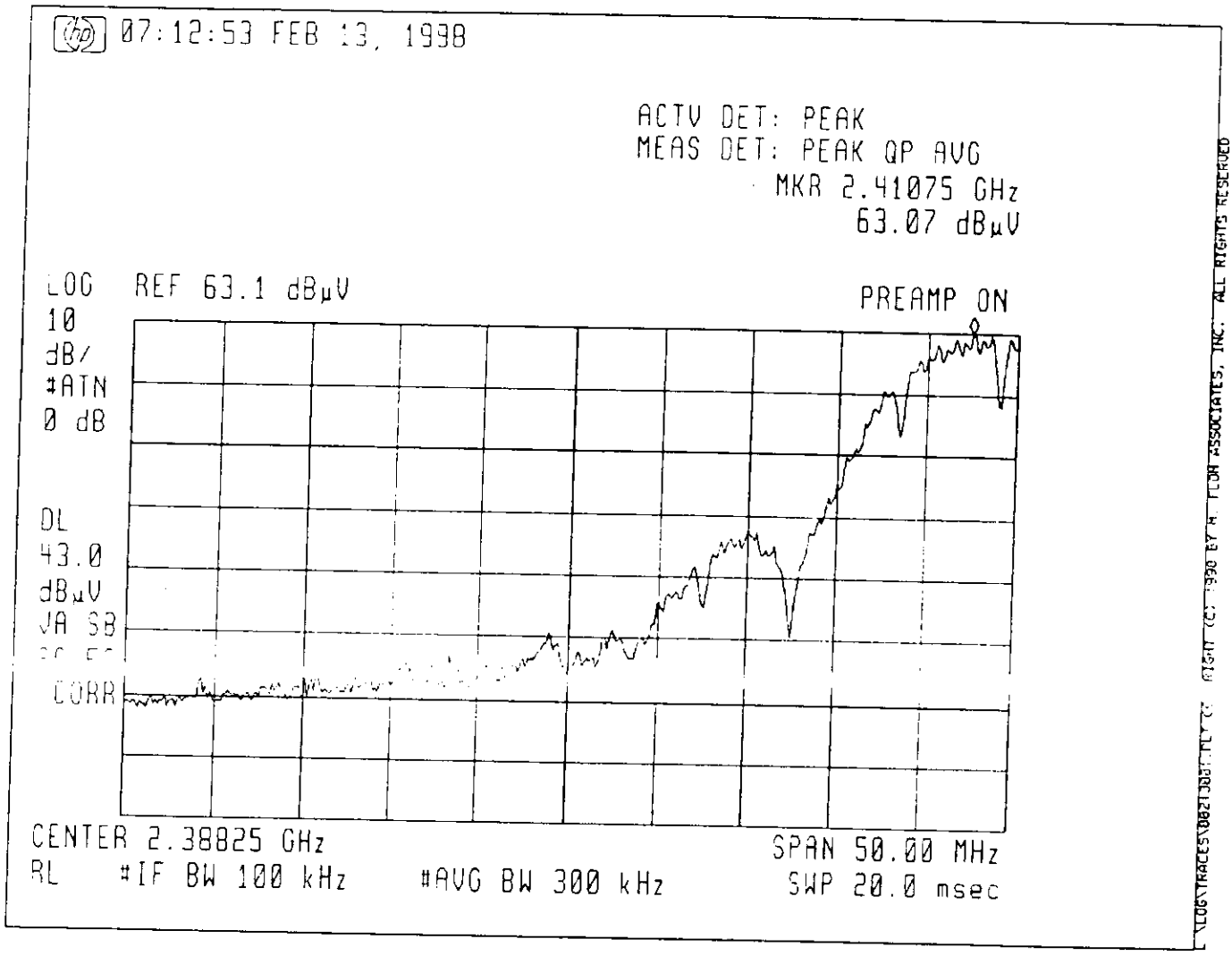
HP 8566B	x
HP 8558B	___
HP 8557A	___
_____	___

(5) SCOPE

HP 54502A	___
HP 1741A	___
HP 181T	___
TEK 935	___
_____	___

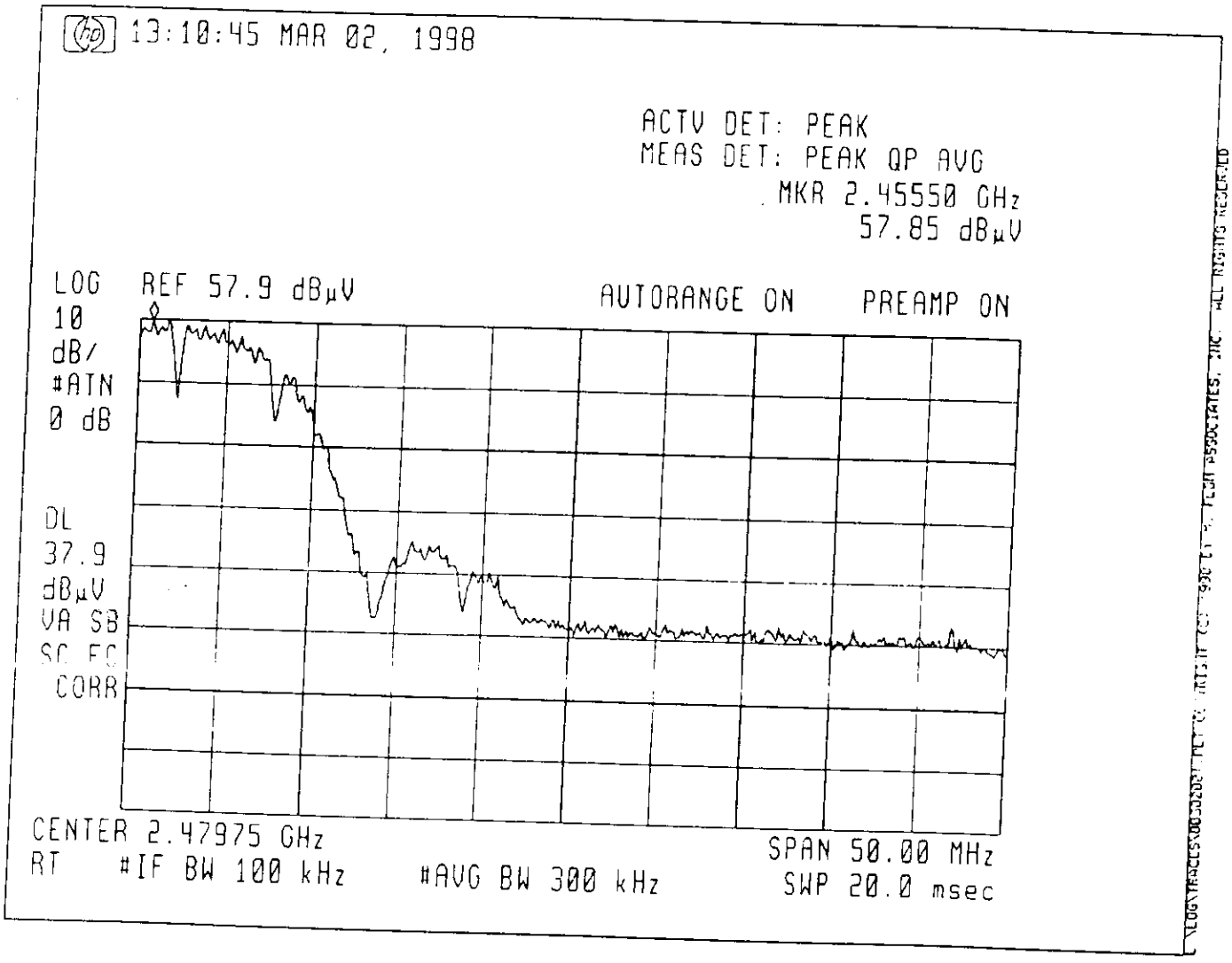
PAGE 13.1.
EMISSIONS
AIRONET, PC 4500
1998-FEB-13, 07:08, FRI

8.5 dBi PATCH



PAGE 13.2.
EMISSIONS
AIRONET, PC 4500
1998-MAR-02, 13:03, MON

8.5 dBi PATCH



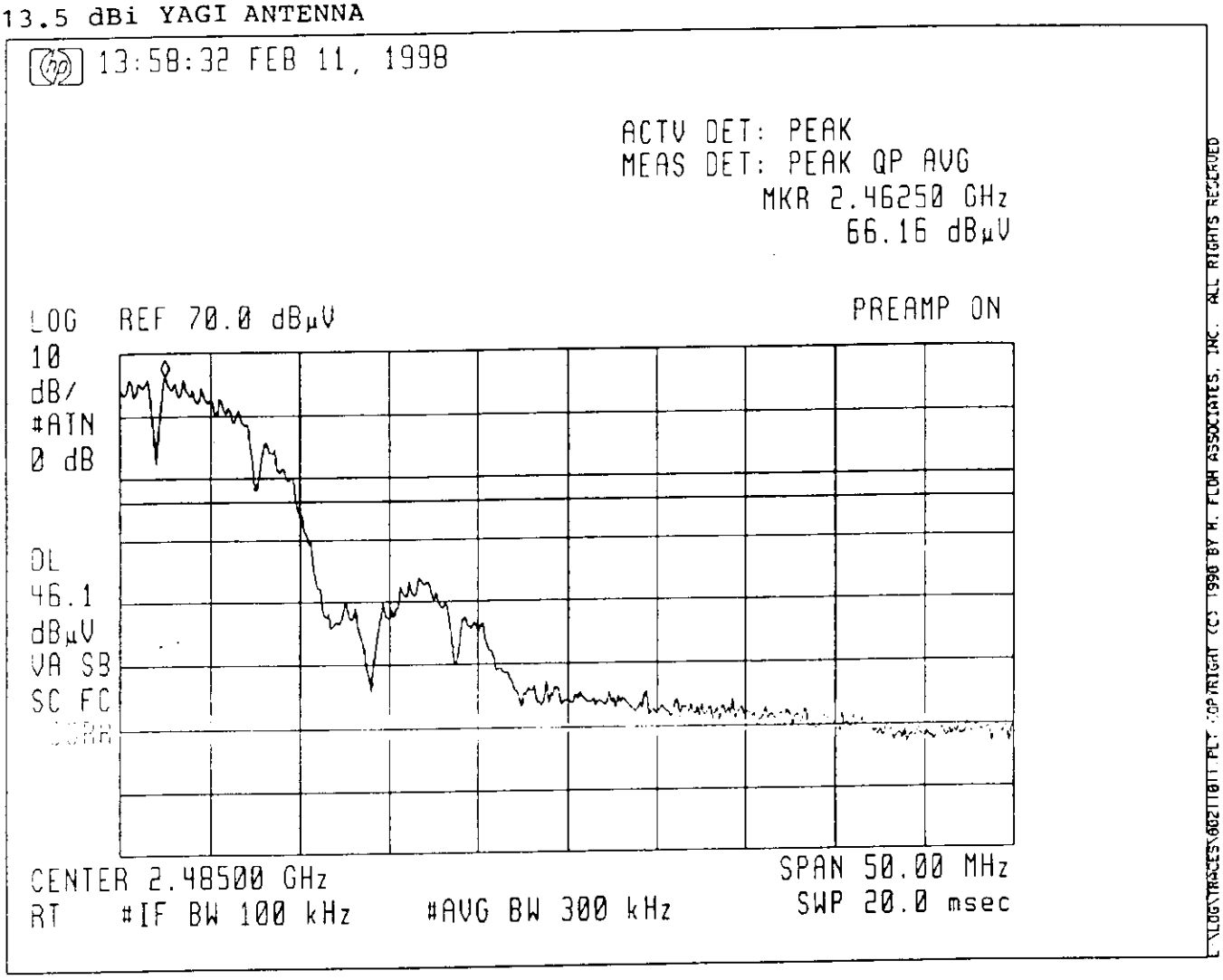
APPENDIX A

APPENDIX A

PAGE 13.5.

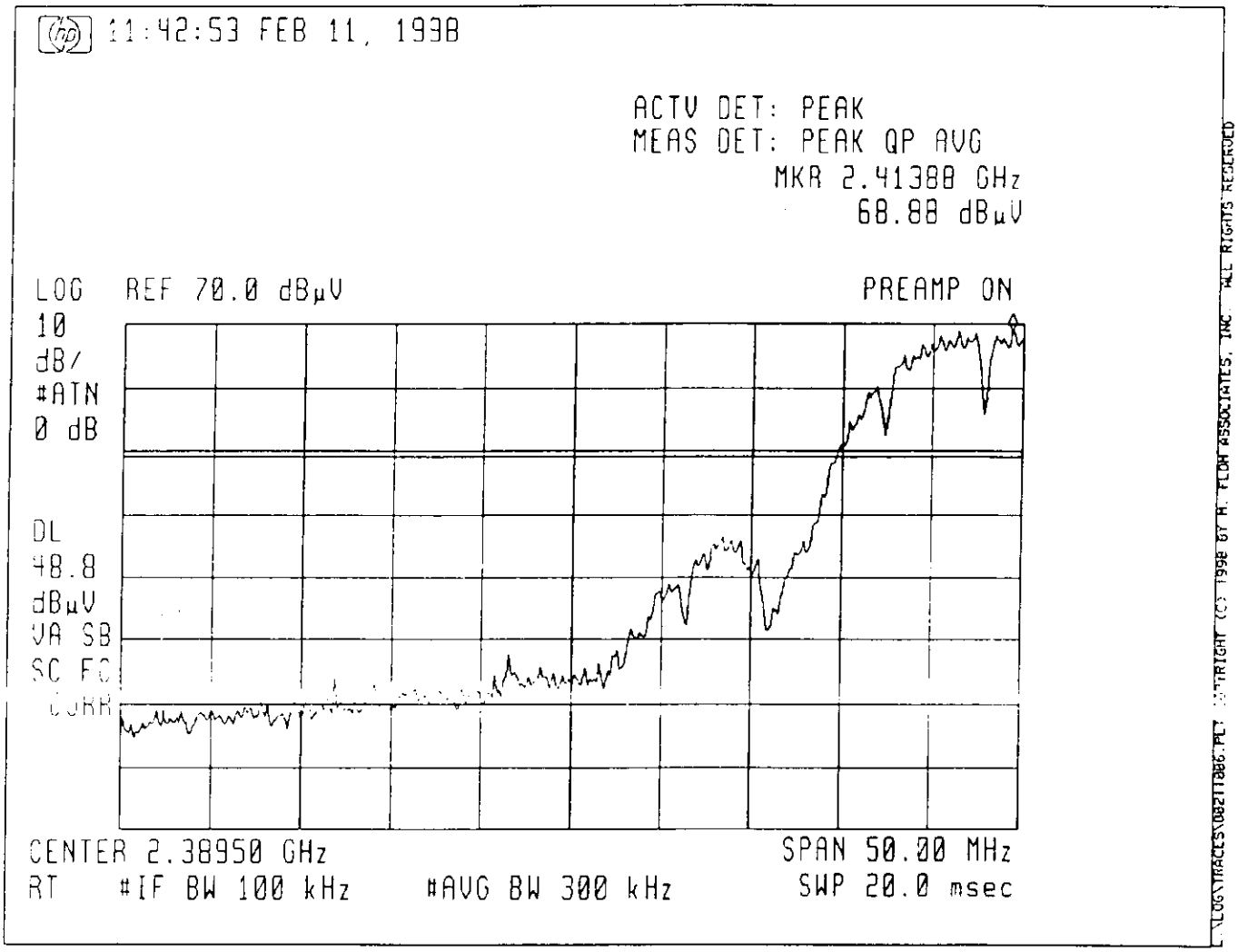
EMISSIONS
AIRONET, PC 4500
1998-FEB-11, 13:52, WED

13.5 dBi YAGI ANTENNA



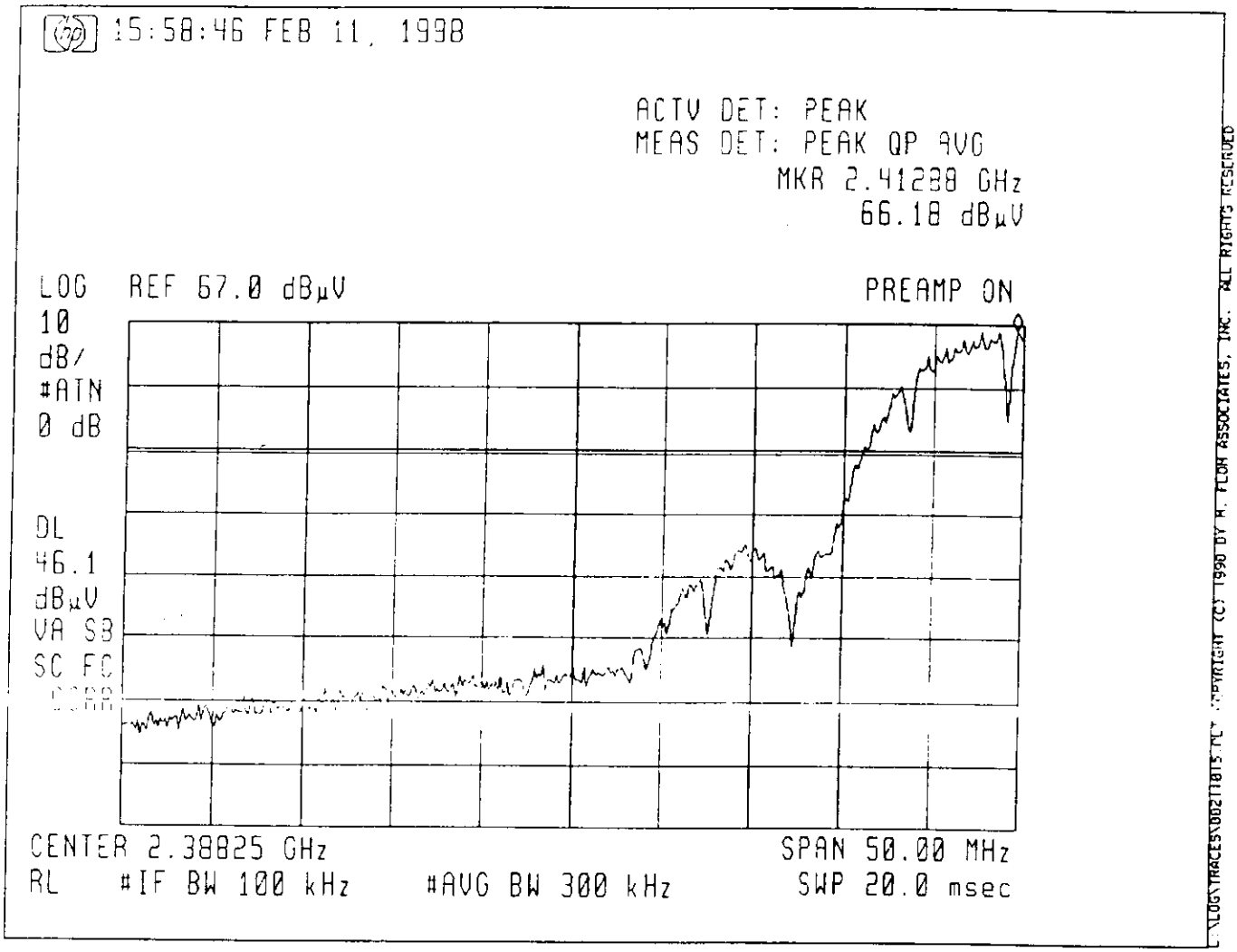
PAGE 13.6.
EMISSIONS
AIRONET, PC 4500
1998-FEB-11, 11:37, WED

13.5 dBi YAGI ANTENNA



PAGE 13.7.
EMISSIONS
AIRONET, PC 4500
1998-FEB-11, 15:53, WED

12 dBi OMNI



PAGE 13.8.
EMISSIONS
AIRONET, PC 4500
1998-MAR-02, 13:42, MON

12 dBi OMNI

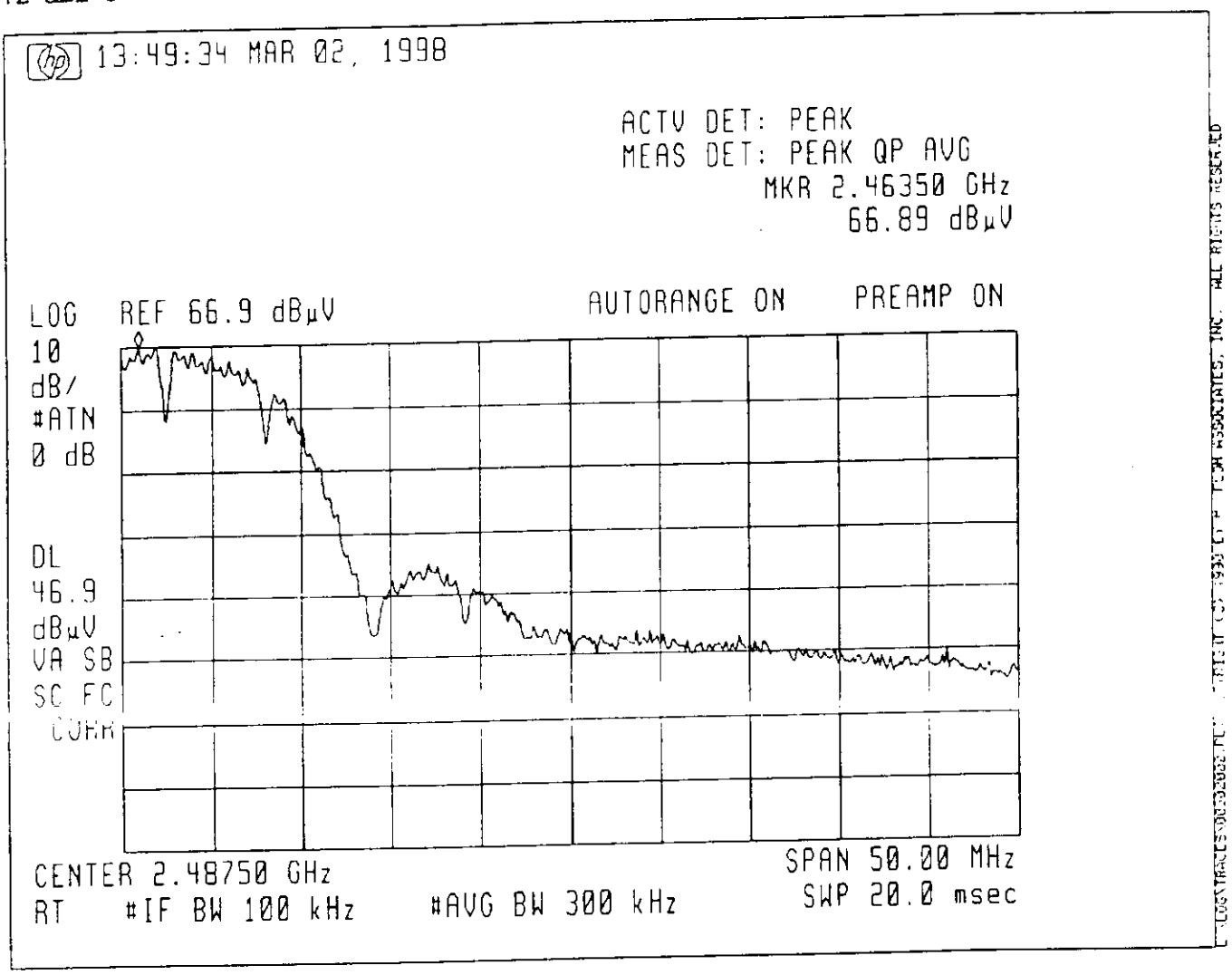


EXHIBIT 7: APPENDIX B: STATEMENT FOR RF EXPOSURE LIMITS [15.247(b)(4)]

Aironet

Engineering Analysis of

Transceiver Model LM4511

FCC ID: LOZ102035

To

Federal Communications Commission

Part 1.1310 Radio Frequency Exposure Limits

&

OET 65 Supplement C

6/24/98

David A. Case N.C.E.
Sr. EMC Engineer
Aironet Wireless Communications
367 Ghent Rd Suite 300
Fairlawn OH 44334
330-664-7396

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I Equipment Under Test

FCC ID:	LOZ102035
Model:	LM4511
Type:	PCMCIA Wireless LAN Adapter
Max Power	0.25 Watts
Duty Cycle	0.5

Max Radio Power for antenna combination

For 21dB Parabolic 0.02 Watts

II Power Density

Ref: Reference Data for Engineers 8th edition p32-7

$$P := \frac{Pt \cdot Gant}{(4 \cdot \pi \cdot R^2)}$$

P	=	Power Density in $\frac{W}{m^2}$
Pt	=	Power radiated by an isotropic radiator (watts)
Gant	=	Antenna Gain
R	=	distance in measurement from source

Assume R = 0.2 meters (~8 inches)

Justification: Antenna is designed for mast mounting above the user, it is not hand held and it is not positioned close to the human body for extended periods during normal use. (per manufacturers specifications)

For worst case duty cycle of 100% will be used.

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Case #1

Pt = Rated Power x Duty cycle x Antenna Gain
= 0.04 x 1.0 x 125.989
= 5.04 Watts
R = 0.205

Therefore at 0.205 m from the EUT P=0.952mW/cm2

$$P := \frac{Pt \cdot Gant}{\left(4 \cdot \pi \cdot R^2\right)}$$

P= 9.563W/m

P= 0.956mW/cm2

Page 3

III Maximum Permissible Exposure

Ref: FCC Rules, CFR 47 1.1310

FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	E Field Strength (V/m)	M Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	E Field Strength (V/m)	M Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

The uncontrolled environment represents the most restrictive limits.

IV. Summary

In an uncontrolled environment, the maximum permissible exposure from a radio device operating at 2.4 Ghz is 1mW/cm2 average over a 30 minute period.

Based on the calculated power density, the high gain antenna must be mounted at a minimum distance of .21meters from the user. This antenna focuses it's energy on a narrow path (about 12 degrees) and is designed to be mounted on a mast above the user. By design, this antennas placement in the field would keep it out of the near field of the user. The following warning statement will be placed in the user manuals to caution the user on correct and safe use of this antenna.

For High Gain wall mount or mast mount antennas

These antennas are designed to be professionally installed and should be located above and oriented away from the user. Please contact your professional installer, VAR, or antenna manufacturer for proper installation requirements

Since the analysis is favorable in the Uncontrolled Environment, it is unnecessary to analyze the device to the less restrictive limits of the Controlled Environment or Partial Body Exposure.