

15.407 Certification
FCC ID: EV9N2L5-7S1-01

EMI TEST REPORT

On

N2 Link 1 x DS1 5.725 - 5.8250 GHz

Prepared for

Multipoint Networks
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Prepared by

Electronic Compliance Laboratories Inc.
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Test Report Number: A804008B
Date of Test: April 10 - 13, 1998

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1.0 TEST FACILITY

Name: Electronic Compliance Laboratories

Location: 1249 Birchwood Dr.
Sunnyvale, CA 94089

Site Filing: A site description is on file at the Federal Communications
Commission
P.O. Box 429
Columbia, MD 21045

NVLAP LAB CODE: 200089

Types of Sites: Open Field Radiated and Indoor Screen Room (Line Conducted). All sites
are constructed and calibrated to meet ANSI C63.4-1994 requirements.

2.0 TEST EQUIPMENT

Description	Manufacturer	Model	SN
EMI Receiver	HP	8546A	3325A00137
Spectrum Analyzer	HP	8563A	3137A01183
Spectrum Analyzer	HP	8564E	3741A00986
Preamplifier	HP	8447F	3113A05849
Preamplifier	HP	8449B	3008A00527
LISN	EM	ANS-25/2	2532
Biconical Antenna	EM	EM 6912	414
Log Periodic Ant	EM	EM 6950	311
Double Ridge Horn	EM	EM 6961	6231
Filter BP 1.2-45 GHz	FSY	HM 1160-1155	001
Filter BP 4-10 GHz	FSY	HM 2950-1565	001
Filter BP 10-18 GHz	FSY	HP8601-7SS	001

3.0 EUT

N2 Link 1 x DS1 5.725 - 5.825 GHz

The N2 Link is comprised of the following:

N2 1 x DS1 Interface Unit, 5.725 - 5.825 GHz Outdoor Unit (ODU)

3 ft. RG-8 Type N coaxial cable ODU to Antenna jumper

Radiowaves SP2-5.2 2 ft. Parabolic antenna

Model Number: 1 x DS1 Low Band, 5.725 - 5.825 GHz

Serial Number: Prototype

FCC ID: EV9N2L5-7S1-01

4.0 SUPPORT EQUIPMENT

HP 37701B T1 / Data Tester S/N 3630U00840

5.0 EQUIPMENT CONFIGURATION

All of the equipment and cables were placed in worst case positions to maximize emissions.

Interconnecting cables were of the type and length specified in the individual equipment requirements.

Grounding was in accordance with the manufacturer requirements and conditions for intended use.

6.0 SUMMARY OF TESTS

The N2 Link 1 x DS1 5.725 - 5.825GHz is a wireless point to point communications system with a low power radio system operating in the 5.725 -5.825 GHz band. Tests were performed a 28.5 dB gain antenna. Test firmware resident in the EUT was used to do the test.

6.1 15.407(a)(2) Peak Transmit Power

26 The N2 Link was set to transmit continuously on it's low, middle, and high frequency. The dB bandwidth was measured for each frequency. The peak transmit power limit is the lesser of either 30 dBm or 11 dBm + 10Log(26 dB BW). The peak transmit power limit was reduced by the number of dB that the antenna gain exceeded 23 dBi.

The power was measured by setting RBW to 1MHz and VBW to 30MHz. The analyzer span was set to 1Mhz, the trace set for Max Hold, and the frequency set to the center of the selected EUT frequency. The peak reading of the analyzer was recorded. The analyzer frequency was the shifted by 1 MHz and the procedure was repeated. This was done for 10 MHz on each side of the EUT frequency. Table 1 shows the results for each frequency.

Data Sheets are shown in Appendix A.

Freq. (GHz)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Limit (dBm) based on 26 dB BW	Limit - Excess Antenna Gain (dBm)	Delta
5.73	3.14	28.5	27.5	22.5	-19.36
5.77	2.33	28.5	27.3	21.8	-19.47
5.80	2.52	28.5	27.4	21.9	-19.38

Table 1. Peak Transmit Power vs. Limit

Peak Spectral Power Density

by Peak Power Spectral Density measurements were taken at the same time the output power. The peak spectral density limit is 17 dBm in any 1 MHz band. This limit is reduced the number of dB that the antenna gain exceeds 23 dBi, making the limit 12 dBm. The N2 Link meets the specification. **Data Sheets are shown in Appendix A.**

6.2 15.407(a)6

Ratio of the peak excursion of the modulation envelope to the peak transmit power shall not exceed 13 dB.

Freq. (GHz)	Peak Transmit Power (dBm)	Peak Excursion Power (dBm)	Delta	Limit (dB)
5.73	3.14	5.72	2.58	13
5.77	2.33	5.51	3.18	13
5.80	2.52	5.38	2.86	13

6.1.2 15.407(b)(3) OUT OF BAND EMISSIONS

The spectrum analyzer plots titled "" OUT OF BAND - LOWER BAND EDGE" shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled "" OUT OF BAND - UPPER BAND EDGE" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down from the band edges to 10MHz above and below the band edges.

The spectrum analyzer plots titled "" OUT OF BAND - LOWER BAND EDGE + 10MHz" shows the output spectrum of the EUT when set to it's lowest transmitting frequency. The spectrum analyzer plots titled "" OUT OF BAND - UPPER BAND EDGE + 10 MHz" shows the output spectrum of the EUT when set to it's highest transmitting frequency. The analyzer was placed in MAX HOLD mode, and several sweeps were recorded. The resultant plots show that the EUT emissions were at least 60 dB down for frequencies grater than 10MHz above and below the band edges.

The spreadsheet in Appendix B shows the EIRP of the out of band emissions, up to 20 MHz away from the band edge, is better than -27 dBm / MHz.

The spectrum analyzer plots labeled "OUT OF BAND <30 MHz - 6 GHz", " OUT OF BAND 6 - 13 GHz", "OUT OF BAND 13 - 26.5 GHz", "OUT OF BAND 26.5 - 31GHz", and "OUT OF BAND 31 - 40 GHz", show that emissions measured in ≥ 100 kHz bandwidth are more than 20 dB below the highest level of the desired power outside of the 5.725 - 5.825 GHz band. **Test Plots are shown in Appendix B.**

6.3 15.401(g) Frequency Stability

Frequency measurements were taken at 10 degree intervals between the temperatures of -30 and +50 degrees Celsius. The transmitter was allowed to stabilize for a minimum of 15 minutes at each temperature level before measurement data was collected. The frequency stability data is presented in tabular in Table 1. This test was performed at SE Labs. The temperature profile and log are in Appendix E

Frequency stability verses the input supply voltage data is shown in Table 2. For this test the AC line voltage was varied between 85% and 115% of the normal value. The EUT uses standard 120 VAC 60 Hz input to its power supply. To satisfy the frequency stability requirement the line voltage was varied between 102 VAC and 138 VAC by using a variable transformer.

Temperature	Transmitter Output Frequency
-30 °C	5.77664 GHz
-20 °C	5.77664 GHz
-10 °C	5.77664 GHz
0 °C	5.77664 GHz
10 °C	5.77664 GHz
20 °C	5.77664 GHz
30 °C	5.77664 GHz
40 °C	5.77664 GHz
50 °C	5.77664 GHz

Table 1 Transmitter Frequency vs. Temperature

Line Voltage	Transmitter Output Frequency
102 VAC	5.77664 GHz
107 VAC	5.77664 GHz
112 VAC	5.77664 GHz
117 VAC	5.77664 GHz
123 VAC	5.77664 GHz
128 VAC	5.77664 GHz
132 VAC	5.77664 GHz
138 VAC	5.77664 GHz

Table 2 Transmitter Frequency vs. Input Line Voltage

6.4 15.205 RESTRICTED BAND RADIATION LIMITS

The EUT was placed on a wooden table resting on a turntable. The wooden table was approximately 1 meter above the groundplane of the 3 meter test site. The search antenna was moved in to 1 meter when necessary to improve the noise floor, and the appropriate range factor was applied. While the EUT was transmitting uninterrupted random data on each of the low / mid / high channels and with the spectrum analyzer on MAX HOLD, the turntable was rotated, and the search antenna raised and lowered in an attempt to maximize the received radiated emission level. **Test results are attached in Appendix C** in tabular form showing that no spurious signals were detected above the 74 dBuV/m peak/54dBuV/m average limits. Peak measurements were made with a RBW and VBW = 1Mhz. Average measurements were made with a RBW = 1 MHz and a VBW = 10 Hz. The N2 harmonics were only measured up to 3rd due to measuring equipment limitations. The Out Of Band plots in Appendix B show that no harmonics are seen above the noise floor.

6.5 15.209 RADIATED EMISSIONS

was
antennas
C63.4-1994.

The attached table shows that the Class B radiated limits from 30 - 1000 MHz are not exceeded by the EUT. The EUT was set in a receive only mod during this test. The EUT placed near one edge of a wooden table resting on a turntable. The wooden table was approximately 1 meter above the groundplane of the 3 meter test site. The search antennas were located at 3 meters. Measurements were made in accordance with ANSI C63.4-1994. **Test Data is in Appendix E.**

6.6 15.207 AC LINE CONDUCTED EMISSIONS

The RF line conducted levels for emissions in the 0.45 - 30 MHz band must not exceed 250 μ V when measured with a LISN. Attached graphs and tabular data show that emissions are below the 250 μ V (48 dB μ V) maximum allowed level. **Test Data is in Appendix D.**

6.7 15.203 ANTENNA REQUIREMENT

The unit requires professional installation and is therefore exempt from the requirements of 15.203. This product has a standard N type Antenna connector to provide a coupling to the intentional radiator.

Electronic Compliance Laboratories

Chris Byleckie
Technical Director

Date

APPENDIX A

Peak Transmit Power and Peak Power Spectral Density Data Sheets

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date: 9/10/98 Freq (GHz) = 5.73568
Work Order 8090301B 26 dB BW = 11.3 MHz
File Name 573ptp.xls
Tested By Chris Byleckie

Peak Transmit Power Limit

17dBm+10Log(11.3Mhz)= 27.5 dBm

RBW = 1 MHz
VBW = 30 kHz
Span = 1 MHz

Antenna gain = 28.5 dBi

Antenna gain - 6dBi = 22.5 dBi

PTP Limit - 22.5 dB = 5.0 dBm

Freq (GHz)	Pout (dBm)	Pout (mW)
5.72568	-41.10	0.000
5.72668	-36.53	0.000
5.72768	-34.83	0.000
5.72868	-34.90	0.000
5.72968	-28.39	0.001
5.73068	-19.02	0.013
5.73168	-13.98	0.040
5.73268	-8.76	0.133
5.73368	-5.92	0.256
5.73468	-4.34	0.368
5.73568	-3.51	0.446
5.73668	-4.49	0.356
5.73768	-5.53	0.280
5.73868	-9.29	0.118
5.73968	-14.26	0.037
5.74068	-19.85	0.010
5.74168	-29.01	0.001
5.74268	-35.53	0.000
5.74368	-35.93	0.000
5.74468	-38.34	0.000
5.74568	-42.52	0.000

Ptotal (mW) = 2.06
Ptotal (dBm) = 3.14
Ant. Gain (dBi) = 28.50
EIRP (dBm) = 31.64

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date: 9/10/98 **Freq (GHz) =** 5.77664
Work Order 8090301B **26 dB BW =** 10.9 MHz
File Name 577ptp.xls
Tested By Chris Byleckie

Peak Transmit Power Limit

17dBm+10Log(10.9Mhz)= 27.3 dBm

RBW = 1 MHz
VBW = 30 kHz
Span = 1 MHz

Antenna gain = 28.5 dBi
 Antenna gain - 6dBi = 22.5 dBi

PTP Limit - 22.5 dB = 4.8 dBm

Freq (GHZ)	Pout (dBm)	Pout (mW)
5.76664	-42.10	0.000
5.76764	-37.62	0.000
5.76864	-36.10	0.000
5.76964	-36.31	0.000
5.77064	-29.28	0.001
5.77164	-20.36	0.009
5.77264	-14.87	0.033
5.77364	-10.22	0.095
5.77464	-6.55	0.221
5.77564	-5.30	0.295
5.77664	-3.99	0.399
5.77764	-5.21	0.301
5.77864	-6.62	0.218
5.77964	-10.19	0.096
5.78064	-15.09	0.031
5.78164	-20.65	0.009
5.78264	-30.02	0.001
5.78364	-37.59	0.000
5.78464	-37.57	0.000
5.78564	-39.30	0.000
5.78664	-43.45	0.000

Ptotal (mW) = 1.71
 Ptotal (dBm) = 2.33
 Ant. Gain (dBi) = 28.50
 EIRP (dBm) = 30.83

5.725 - 5.825 GHz NII
Output Power / Peak Power Spectral Density

Date: 9/10/98 Freq (GHz) = 5.80992
Work Order 8090301B 26 dB BW = 11.1 MHz
File Name 580ptp.xls
Tested By Chris Byleckie

Peak Transmit Power Limit
 $17\text{dBm} + 10\text{Log}(11.1\text{MHz}) = 27.4\text{ dBm}$

RBW = 1 MHz
VBW = 30 kHz
Span = 1 MHz

Antenna gain = 28.5 dBi
 Antenna gain - 6dBi = 22.5 dBi

PTP Limit - 22.5 dB = 4.9 dBm

Freq (GHZ)	Pout (dBm)	Pout (mW)
5.79992	-42.42	0.000
5.80092	-37.94	0.000
5.80192	-36.15	0.000
5.80292	-36.74	0.000
5.80392	-29.30	0.001
5.80492	-20.43	0.009
5.80592	-14.87	0.033
5.80692	-10.19	0.096
5.80792	-6.12	0.244
5.80892	-4.88	0.325
5.80992	-3.94	0.404
5.81092	-4.74	0.336
5.81192	-6.76	0.211
5.81292	-10.45	0.090
5.81392	-15.43	0.029
5.81492	-21.05	0.008
5.81592	-30.22	0.001
5.81692	-38.51	0.000
5.81792	-38.34	0.000
5.81892	-40.04	0.000
5.81992	-44.70	0.000

Ptotal (mW) = 1.79
 Ptotal (dBm) = 2.52
 Ant. Gain (dBi) = 28.50
 EIRP (dBm) = 31.02

APPENDIX B
Out of Band Plots

**5.725 - 5.825 GHz NII
Out of Band**

Date: 9/10/98
Work Order 8090301B
File Name 57OOB.xls
Tested By Chris Byleckie

RBW = 1 MHz
VBW = 30 kHz
Span = 1 MHz

Ant. Gain = 28.5 dBi

Freq = 5.73568 GHZ			Freq = 5.80992 GHZ		
Freq (GHz)	Pout (dBm)	Pout (mW)	Freq (GHz)	Pout (dBm)	Pout (mW)
5.725	-39.96	0.000	5.825	-57.69	0.000
5.724	-47.93	0.000	5.826	-58.66	0.000
5.723	-54.24	0.000	5.827	-58.27	0.000
5.722	-54.76	0.000	5.828	-58.27	0.000
5.721	-54.86	0.000	5.829	-58.27	0.000
5.72	-55.63	0.000	5.83	-58.27	0.000
5.719	-55.17	0.000	5.831	-58.27	0.000
5.718	-54.81	0.000	5.832	-58.27	0.000
5.717	-54.81	0.000	5.833	-58.27	0.000
5.716	-54.81	0.000	5.834	-58.27	0.000
5.715	-54.81	0.000	5.835	-58.27	0.000
5.714	-54.81	0.000	5.836	-58.27	0.000
5.713	-54.81	0.000	5.837	-58.27	0.000
5.712	-54.81	0.000	5.838	-58.27	0.000
5.711	-54.81	0.000	5.839	-58.27	0.000
5.71	-54.81	0.000	5.84	-58.27	0.000
5.709	-54.81	0.000	5.841	-58.27	0.000
5.708	-54.81	0.000	5.842	-58.27	0.000
5.707	-54.81	0.000	5.843	-58.27	0.000
5.706	-54.81	0.000	5.844	-58.27	0.000
5.705	-54.81	0.000	5.845	-58.27	0.000

Note: In order to make filing the report electronically easier the out of band plots have been sent separately

APPENDIX C
Restricted Band Data

EUT:	N2-Link	CUSTOMER NAME:				WIRELESS				
RULE PART:	15.400	WORK ORDER:				8090301B				
		FILE:				80900301BA				
ANTENNA:	HORN	ATTN dB: 0								
POLARIZATION:	VERT	DUTY dB: 0								
MODULATION TYPE:		HP IL dB: 0								
TESTED BY:	SHAWN	DIST dB: 0								
COMMENT:	2'DIA ANTENNA									
FREQ.	READING	Pk	A.F.	Cbl	FLTR	AMP	TOTAL,	LIMIT	DELTA	
MHz	dB(uV)	NF or Av	dB	dB	dB	dB	dB(uV/m)	dB(uV/m)	dB	
5735.68										
11471.36	49.20	* Pk	38.8	-13.6	-0.5	34.3	67.8	74.0	-6.2	
11471.36	29.10	* Avg	38.8	-13.6	-0.5	34.3	47.7	54.0	-6.3	
17207.04	45.50	* Pk	41.9	-16.9	-0.5	34.3	70.5	74.0	-3.5	
17207.04	26.53	* Avg	41.9	-16.9	-0.5	34.3	51.5	54.0	-2.5	
5776.64										
11553.28	46.10	* Pk	39.4	-13.6	-0.5	34.3	65.3	74.0	-8.8	
11553.28	28.60	* Avg	39.4	-13.6	-0.5	34.3	47.8	54.0	-6.3	
17329.92	44.69	* Pk	41.9	-16.9	-0.5	34.3	69.7	74.0	-4.3	
17329.92	26.01	* Avg	41.9	-16.9	-0.5	34.3	51.0	54.0	-3.0	
5809.92										
11620.00	47.60	* Pk	39.4	-13.6	-0.5	34.3	66.8	74.0	-7.3	
11619.84	29.30	* Avg	39.4	-13.6	-0.5	34.3	48.5	54.0	-5.6	
17429.76	48.20	* Pk	41.9	-16.9	-0.5	34.3	73.2	74.0	-0.8	
17429.76	26.53	* Avg	41.9	-16.9	-0.5	34.3	51.5	54.0	-2.5	

APPENDIX D
15.207 Conducted Emissions

Electronic Compliance Laboratories, Inc.
1249 Birchwood Ave.
Sunnyvale, CA

Conducted Emissions
Frequency range: 450KHz-30MHz

Government Agency and Limit: FCC Class A

QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists

PK = Peak

Customer: Wireless Operator: Chris
Date: 04-13-1998 Time: 12:50:03
Temperature Range: 60 Deg F Percent Humidity: 60
E.U.T.: N2 Link 5.75GHz
Serial Number: prototype
Support Devices: HP T1 / Data Tester
Serial Number:
FCC ID:
Exercise Program: N/A
Modifications: N/A
Report File Name: F:\TESTDATA\8041002b.F

TEST FREQ	TEST dBuV	CLASS A LIMIT	VERSUS A LIMIT	CONDUCTOR	TYPE
=====	=====	=====	=====	=====	=====
0.450	42.2	60.0	-17.8	LINE	PK
15.000	61.5	69.5	-8.0	LINE	PK
18.700	55.0	69.5	-14.5	LINE	PK
23.130	46.8	69.5	-22.8	LINE	PK
0.450	40.8	60.0	-19.2	NEUTRAL	PK
14.490	61.1	69.5	-8.4	NEUTRAL	PK
18.700	54.3	69.5	-15.2	NEUTRAL	PK
23.200	46.0	69.5	-23.5	NEUTRAL	PK

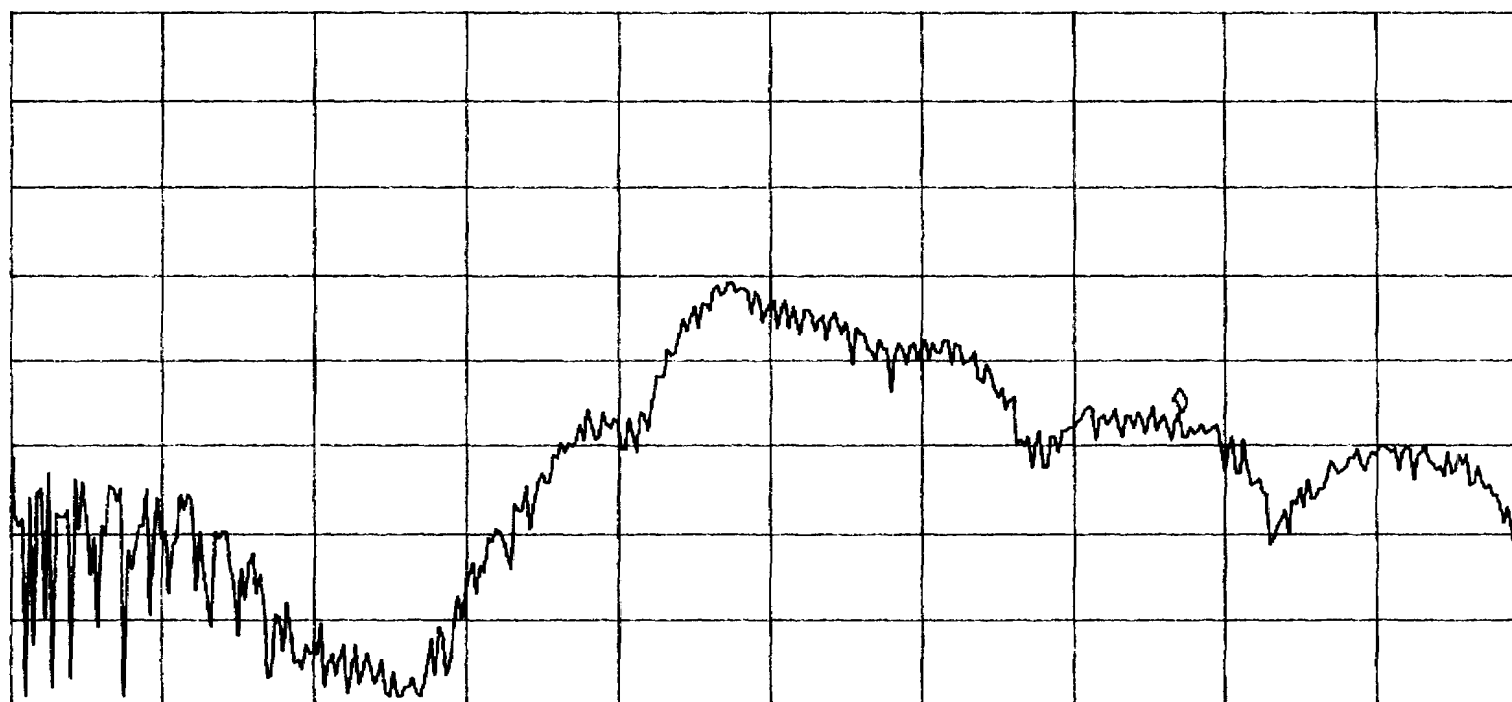
12:54:03 APR 13, 1998
80410028 NEUTRAL

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 23.20 MHz
45.96 dB μ V

LOG REF 92.0 dB μ V

10
dB/
ATN
10 dB

VA SB
SC FC
ACDRA



START 450 kHz

IF BW 9.0 kHz

AVG BW 30 kHz

STOP 30.00 MHz

SWP 2.46 sec

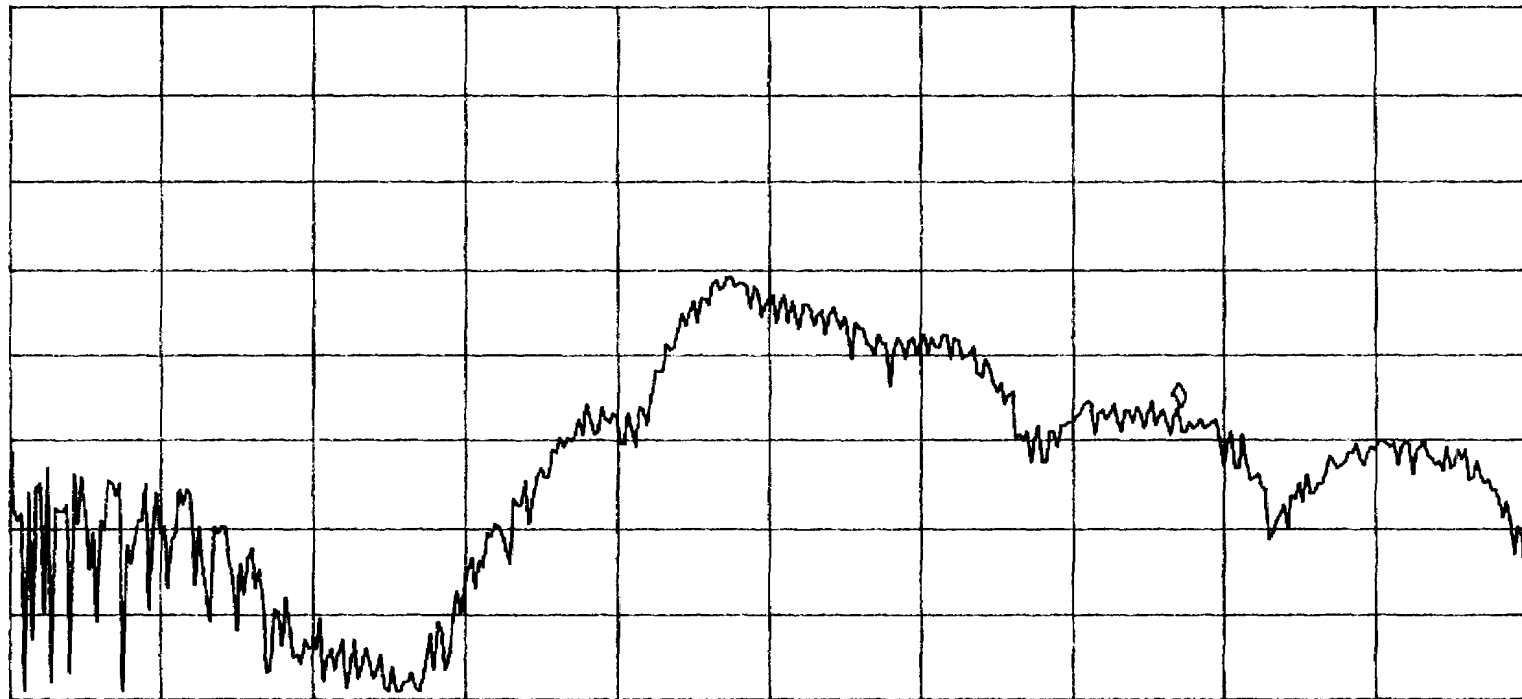
(7) 12:54:03 APR 13, 1998
80410028 NEUTRAL

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 23.20 MHz
45.96 dB μ V

LOG REF 92.0 dB μ V

10
dB/
ATN
10 dB

VA SB
SC FC
ACDRA



START 450 kHz

IF BW 9.0 kHz

AVG BW 30 kHz

STOP 30.00 MHz

SWP 2.46 sec

APPENDIX E
15.209 Radiated Emissions

Electronic Compliance Laboratories, Inc.
1249 Birchwood Ave.
Sunnyvale, CA

Radiated Emissions
Frequency range: 30MHz-1000MHz

10 Meter Open Site
Site Calibrated: June 1997

Government Agency and Limit: FCC Class A

QP = Quasi-Peak Note: Ignore peak readings when Quasi-Peak reading exists
PK = Peak

Customer: Wireless Operator: Chris
Date: 04-13-1998 Time: 11:04:00
Temperature Range: 55 Deg F Percent Humidity: 70
E.U.T.: N2 Link 5.7GHz
Serial Number: prototype
Support Devices: HP T / Data Tester
Serial Number: 3630U00840
FCC ID:
Exercise Program: N/A
Modifications: N/A
Report File Name: F:\TESTDATA\8041002b.RF

Antenna Type: BICONICAL

TEST FREQ	TEST dBuV	ACTUAL dBuV/m	CLASS A LIMIT	VERSUS A LIMIT	TABLE DEGREES	ANTENNA HEIGHT	POLAR- IZATION	DETECTOR Type
=====	=====	=====	=====	=====	=====	=====	=====	=====
32.419	39.4	31.7	39.0	-7.3	0	1.0	V	PK
33.960	46.0	37.1	39.0	-1.9	0	1.0	V	PK
33.960	44.2	35.3	39.0	-3.7	0	1.0	V	QP

NOTE: above 2 readings are from broadband noise, EUT related.

38.590	48.1	37.1	39.0	-1.9	270	1.0	V	PK
38.590	45.2	34.2	39.0	-4.8	270	1.0	V	QP

NOTE: previous readings also broadband

43.157	42.6	30.1	39.0	-8.9	270	1.0	V	PK
38.740	37.5	26.5	39.0	-12.5	0	1.0	H	PK

CHANGED ANTENNA TO LOG PERIODIC

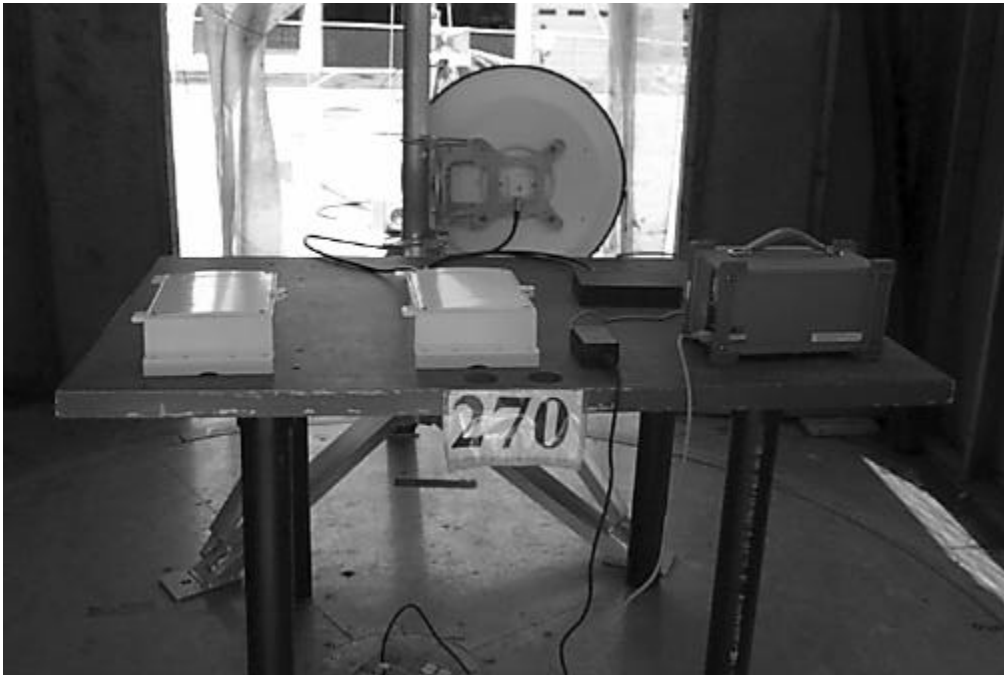
NOTE: no emissions seen above noise floor to 1 GHz

-----+
CHANGED ANTENNA TO 1-18Gig HORN

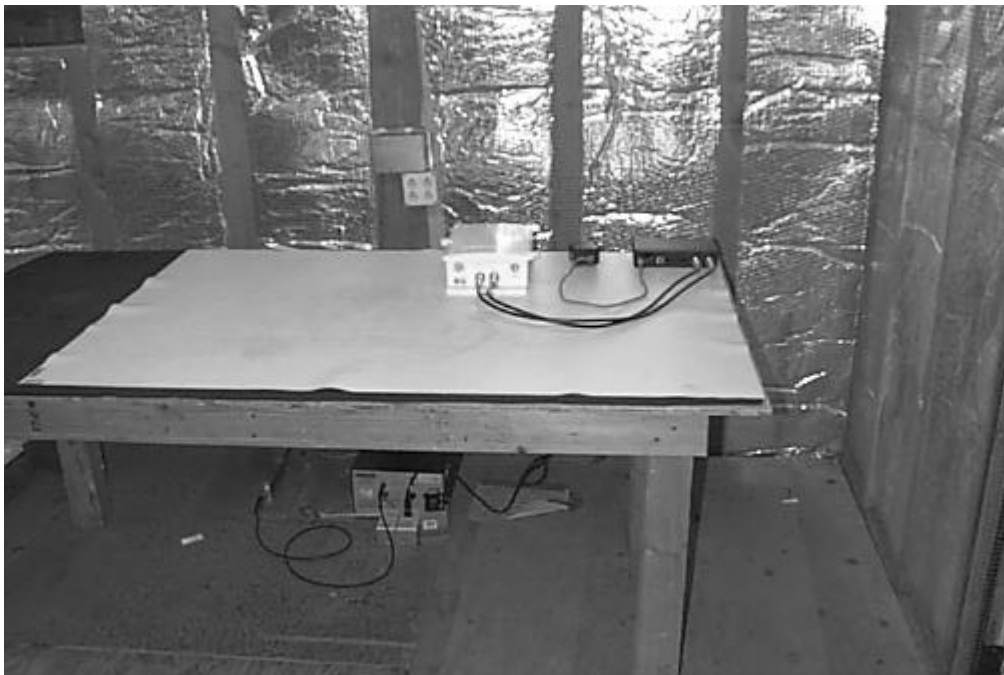
NOTE: no emissions seen above noise floor from 1 to 5 GHz

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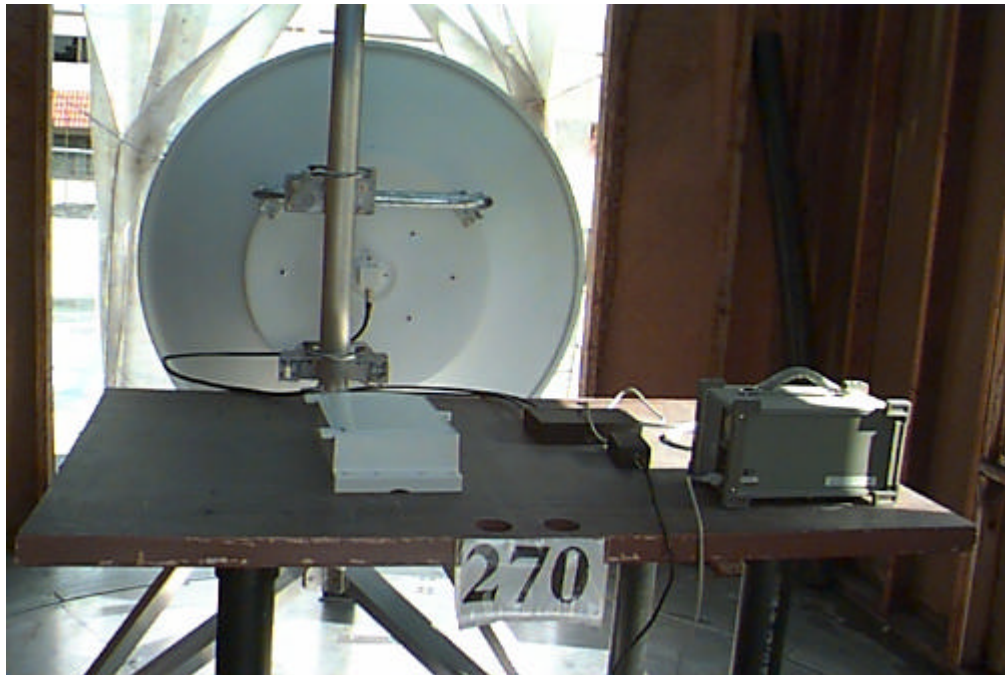
APPENDIX F
Set-up Photographs



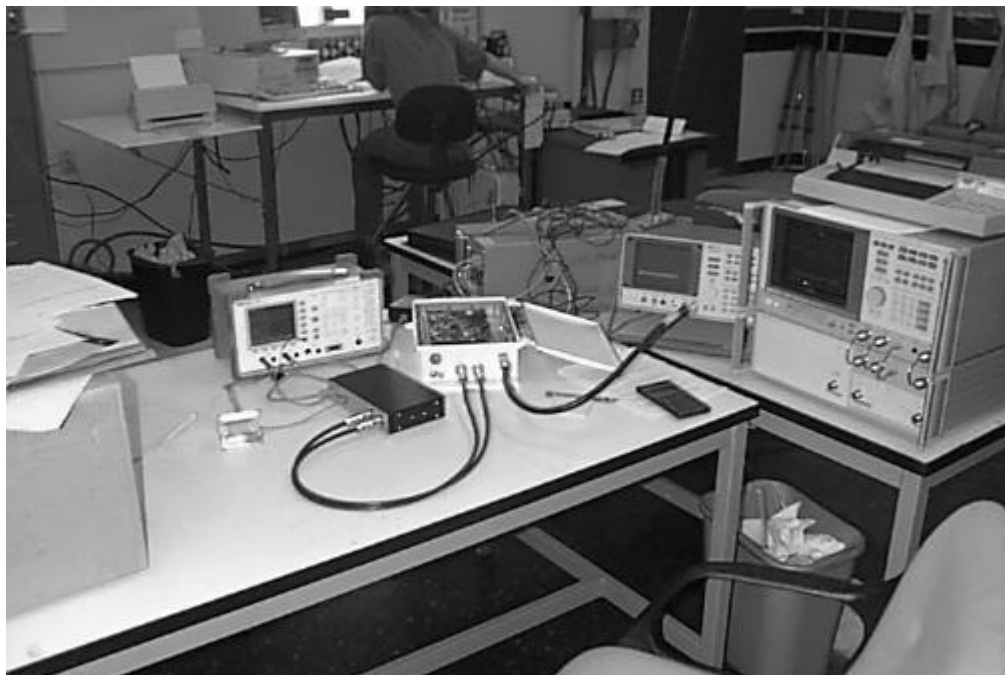
**FCC 15.209 Class B
Radiated Emissions**



**FCC 15.207 Class B
Conducted Emissions**



**FCC 15.205 Restricted Band
SP2-5.2 Antenna**



FCC 15.407 Conducted RF