3.0 SYSTEM TEST CONFIGURATION

3.1 JUSTIFICATION

The system was configured for testing a typical fashion (as a customer would normally use it). The EUT was testing in all three orthogonal planes in order to determine worst case emission. Test results are recorded in the data tables and plots.

3.2 EUT EXERCISE SOFTWARE

The EUT was enabled to continuously transmit. It was exercised by continuously metering using software provided by the manufacturer. This metering was fed from the EUT's sensor through a 100-foot cable to the secondary unit (digital device). All cabling is typical of what would be implemented by the end user.

3.3 SPECIAL ACCESSORIES

N/A

3.4 POWER OUTPUT

The power output was measured on the EUT using ERP test method.

EUT Antenna Gain is equal to 23dBi (≈200), Gn=199.5

The Electric Field was measured at 3 meter distance and is equal to 127.9 dBuV/m.\

$$ERP=E^2D^2/30Gn=9.6mW$$

See Section 8.0 for test data.

3.5 RADIATED SPURIOUS EMISSIONS

It applies to harmonics and spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.

Please, refer to section 10.0 for data test results. Note: A signal is identified if it is the left (or lower) frequency component of an image pair separated by 642MHz (twice the 321.4MHz IF).

3.6 CONFORMANCE STATEMENT

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. No modifications were made during testing to the equipment in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI C63.4 test methodology.

Signature: ______________________ Date: February 23, 1999

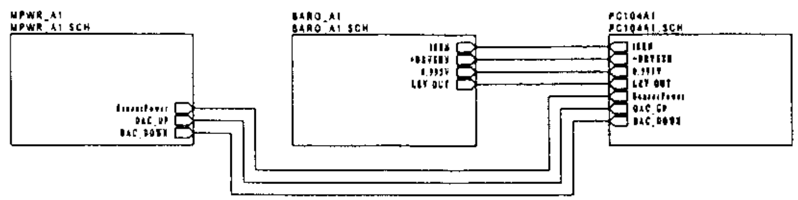
Typed/Printed Name: Bruno Clavier Position: Quality Manager (NVLAP Signatory)

NVLAP *Accredited by the National Voluntary Accreditation Program for the specific scope of accreditation under Lab Code 20061-0.*

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

4.0 BLOCK DIAGRAM OF FLO-DAR 450

Please refer to following pages for detailed schematics.



NOTES

(1) 0.1%, 50ppm/C

(2) Do not install TB3, PTC1, C5, PS2, D2, or R33 if board is configured for AC power.

REVISIONS

Size B

Number 220157200

5.0 Field Strength Calculation, and Radiated Test Methodology

5.1 Conducted measurement

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 microhenry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 400 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 400 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from (150/450) kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

5.2 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FI(dBuV/m) = SAR(dBuV) + SCF(dB/m)$$

FI = Field Intensity
SAR = Spectrum Analyzer Reading
SCF = Site Correction Factor

The Site Correction Factor (SCF) used in the above equation is determined empirically, and is expressed in the following equation:

$$SCF(dB/m) = -PG(dB) + AF(dB/m) + CL(dB)$$

SCF = Site Correction Factor
PG = Pre-amplifier Gain
AF = Antenna Factor
CL = Cable Loss

The field intensity in microvolts per meter can then be determined according to the following equation:

$$FI(uV/m) = 10^{FI(dBuV/m)/20}$$

For example, assume a signal at a frequency of 125 MHz has a received level measured as 49.3 dBuV. The total Site Correction Factor (antenna factor plus cable loss minus preamplifier gain) for 125 MHz is -11.5 dB/m. The actual radiated field strength is calculated as follows:

$$49.3\ dBuV - 11.5\ dB/m = 37.8\ dBuV/m$$

$$10^{37.8/20} = 10^{1.89} = 77.6\ uV/m$$

5.3 Radiated measurement

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one meter and three meter distances if necessary in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to 100GHz using a Hewlett Packard 8566B spectrum analyzer, a Hewlett Packard 85650A quasi-peak adapter, HP11790 mixers, and EMCO log periodic, EMCO horn antennas and Rod antenna. In order to gain sensitivity, a cougar preamplifier (from 30 to 2GHZ), and an HP preamplifier (from 1GHz to 26.5 GHz) was connected in series between the antenna and the input of the spectrum analyzer.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6 dB resolution bandwidth was set to 120 kHz for measurements below 1GHz, and 1MHz for measurements above 1GHz. The analyzer was operated in peak detection mode below 1GHz and in the peak mode with 10Hz video averaging above 1 GHz. No video filter less than 10 times the resolution bandwidth was used when measuring below 1GHz. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech quality manual, section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as daily calibration methods, technician training, and emphasis to employees on avoiding error.

6.0 CONDUCTED EMISSION DATA

The following table lists worst case conducted emission data. Specifically: Emission Frequency, Test Detector, Analyzer Reading, Site Correction Factor, corrected Emission Level, Quasi-Peak Limit and Margin, and the Average Limit and Margin.

The conducted test was performed with the EUT exercise program loaded, and the emissions were scanned between 450 kHz to 30 MHz on the NEUTRAL SIDE and HOT SIDE, herein referred to as L1 and L2, respectively.

L1

EMISSION FREQUENCY (MHz)	TEST DETECTOR	ANALYZER READING (dBuV)	SITE CORRECTION FACTOR (dB)	EMISSION LEVEL (dBuV)	FCC PART 15.207 LIMIT (dBuV)	FCC PART 15.207 MARGIN (dBuV)
0.588	Pk	44.6	0.6	45.2	48	-2.8
1.414	Qp	41.1	1	42.1	48	-5.9
2.473	Pk	43.4	1.3	44.7	48	-3.3
13.752	Pk	38.1	3	41.1	48	-6.9
22.002	Qp	42.1	3.7	45.8	48	-2.2
24.753	Qp	35.8	3.8	39.6	48	-8.4
27.502	Pk	40.2	3.8	44	48	-4

L2

EMISSION FREQUENCY (MHz)	TEST DETECTOR	ANALYZER READING (dBuV)	SITE CORRECTION FACTOR (dB)	EMISSION LEVEL (dBuV)	FCC PART 15.207 LIMIT (dBuV)	FCC PART 15.207 MARGIN (dBuV)
0.646	Qp	39.8	0.7	40.5	48	-7.5
1.412	Qp	41.5	1	42.5	48	-5.5
13.75	Pk	37.8	3.2	41	48	-7
22.002	Qp	38.6	3.9	42.5	48	-5.5
24.75	Pk	40.5	4	44.5	48	-3.5
27.501	Pk	38.5	4	42.5	48	-5.5

TEST PERSONNEL:

Signature: ____ BRUNOLLAVIER FOR Date: 2/12/99

Typed/Printed Name: Daniel W. Baltzell

8.0 RADIATED EMISSION DATA

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable and antenna corrections), the corrected reading, plus the limit. Explanation of the Correction Factor is given in paragraph 5.2.

TABLE 1 RADIATED EMISSIONS: SENSOR

(Temperature: 74°F, Humidity: 33%)

EMISSION FREQUENCY (MHz)	ANTENNA POLARITY (H/V)	ANALYZER READING (dBuV)	SITE CORRECTION FACTOR (dB/m)	EMISSION LEVEL (dBuV/m)	FCC PART 15.209 LIMIT* (dBuV/m)	FCC PART 15.209 MARGIN (dB)
15.782	V	54	-2	52	89	-37
24.754	V	52.4	-1.4	51	89	-38

3 meter distance

TABLE 2: SENSOR CARRIER

Frequency (GHz)	Polarization Rx Antenna	EUT	Emission Level (dBm)*	Cable Loss (dB)**	Antenna Factor (dB/m)	Corrected Level (dBuV/m)	FCC Part 15.245 Limit (dBuV/m)	FCC Part 15.245 Margin (dB)
24.124	H	H	-19.7	0.3	40.3	127.9	128.0	-0.1

*Calibrated level including mixer conversion loss.
**Cable loss at 321.4MHz (IF).

TEST PERSONNEL:

Signature: [signature] BRUNO CLAVIER FOR Date: 2/12/99

Typed/Printed Name: Daniel W. Baltzell

10.0 MEASUREMENT PLOTS

Figure 3: Radiated Spurious Emissions (Screen Room Data) 9kHz to 150kHz Sensor

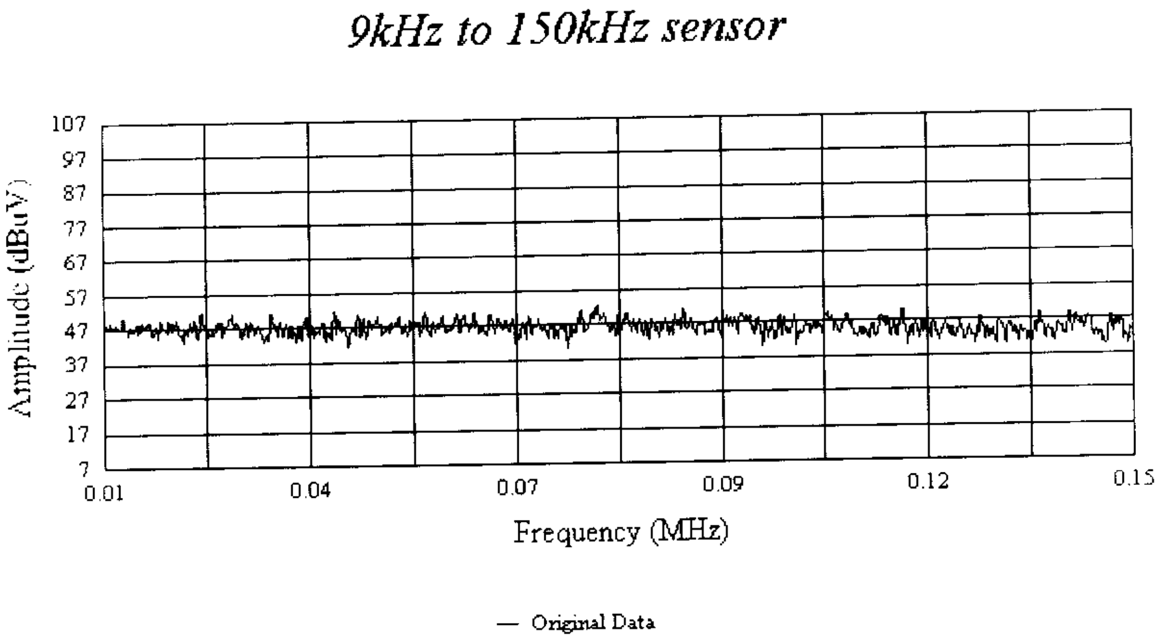


Figure 4: Radiated Spurious Emissions (Screen Room Data) 150kHz to 30MHz Sensor

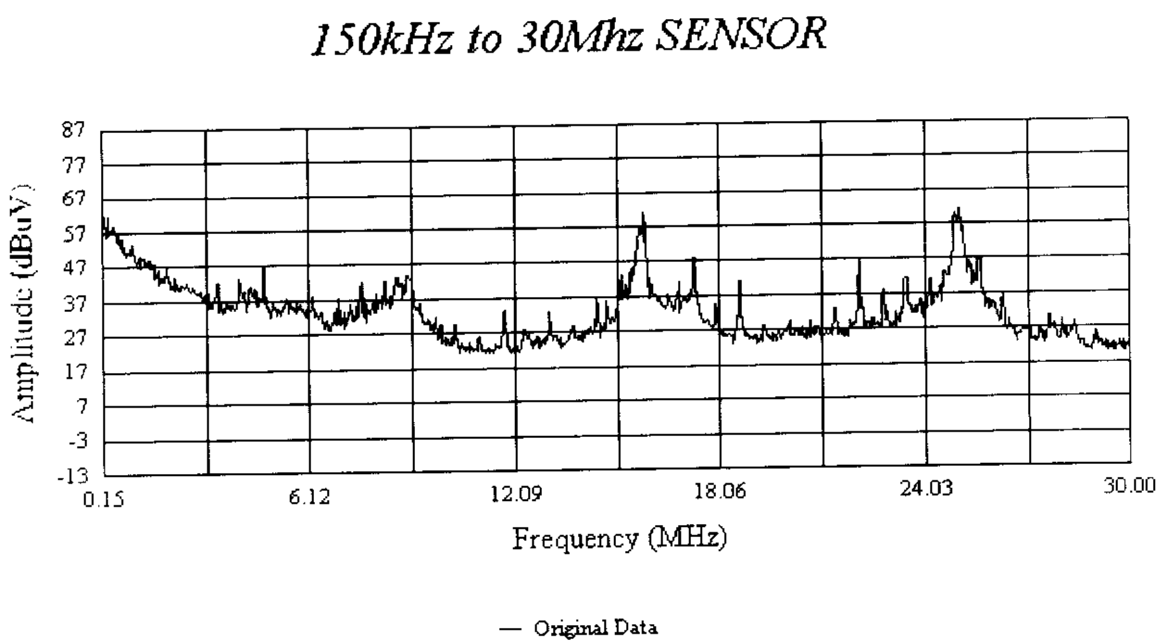


Figure 5: Radiated Spurious Emissions (Screen Room Data) 30MHz to 1GHz Sensor

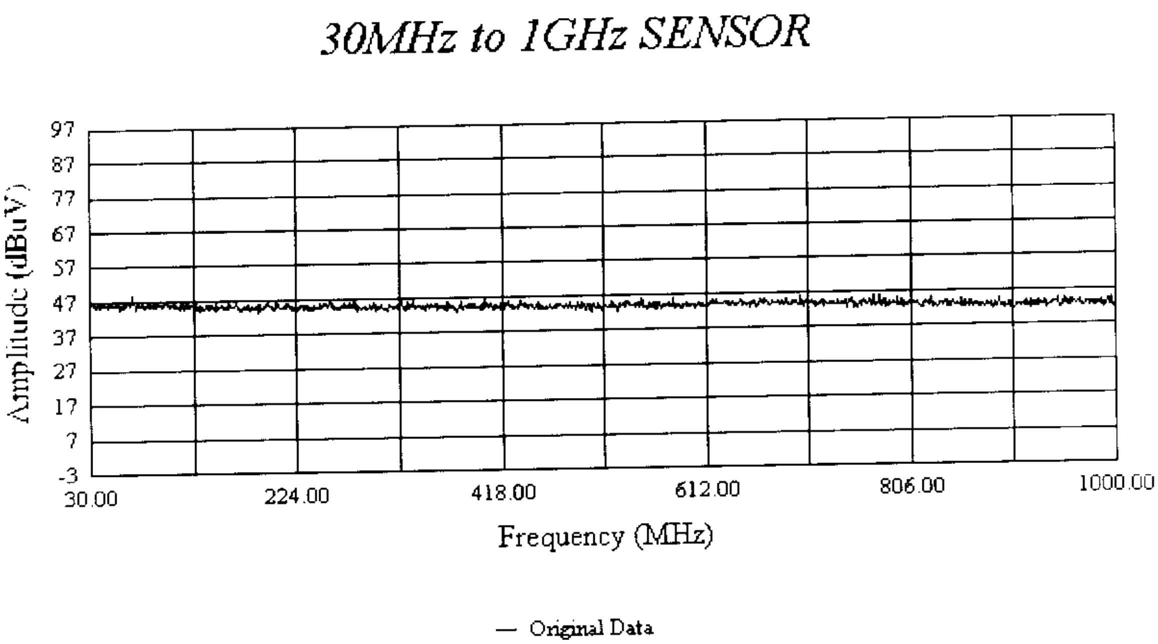


Figure 6: Radiated Spurious Emissions (Screen Room Data) 1GHz to 2GHz Sensor

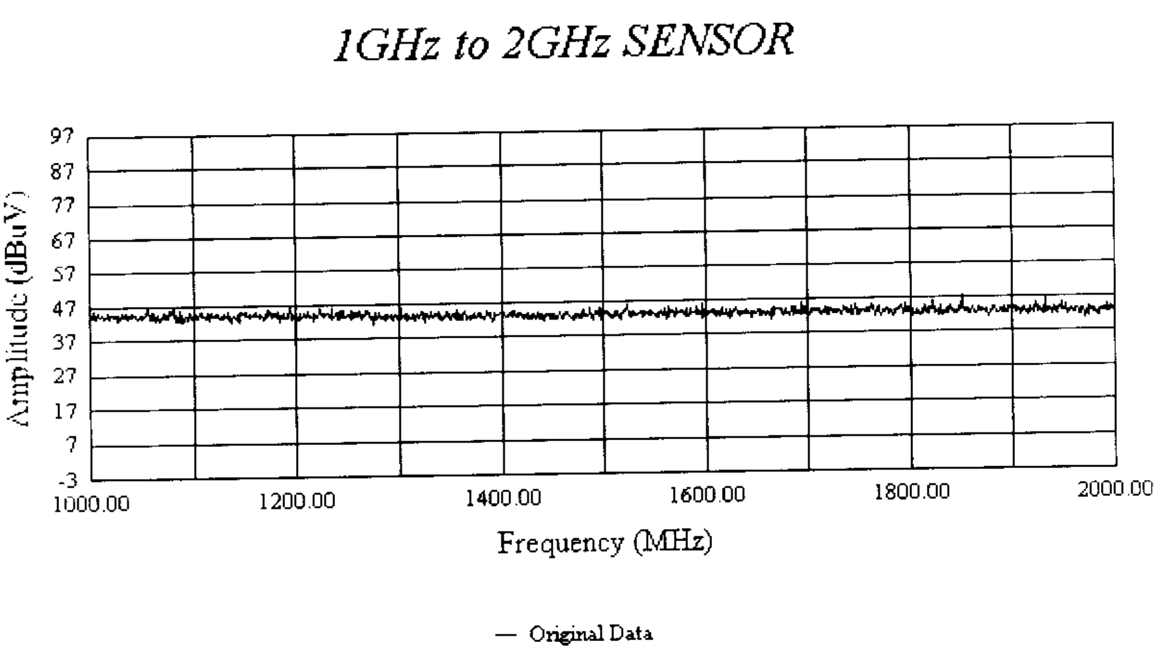


Figure 7: Radiated Spurious Emissions (Screen Room Data) 2GHz to 4GHz Sensor

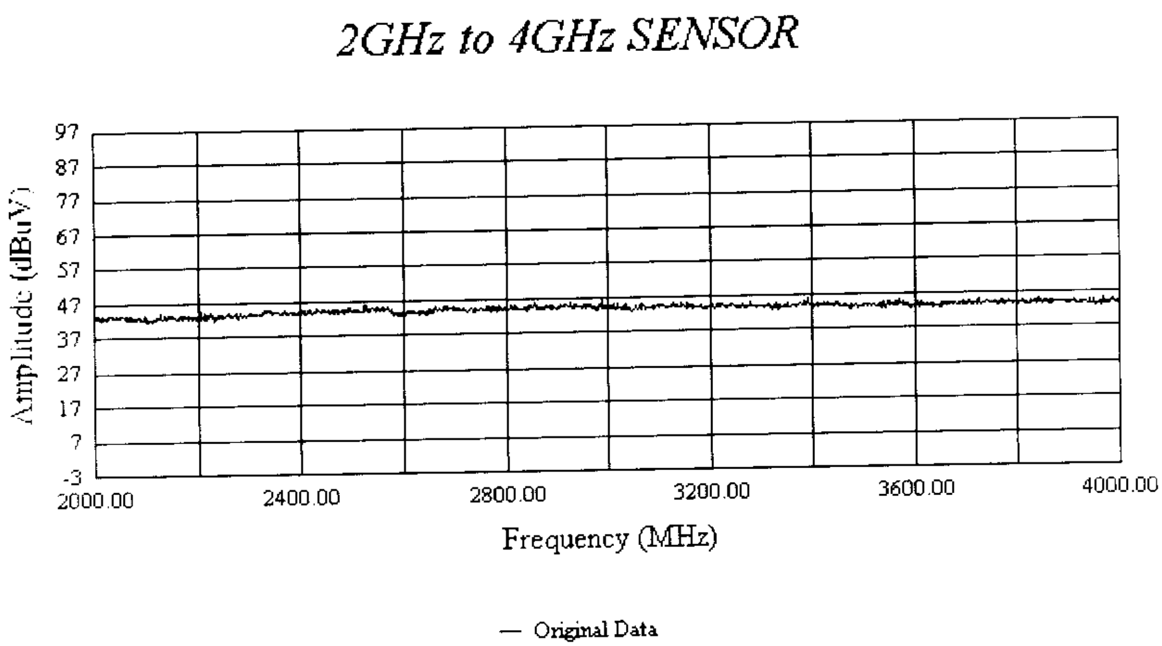


Figure 8: Radiated Spurious Emissions (Screen Room Data) 4GHz to 5GHz Sensor

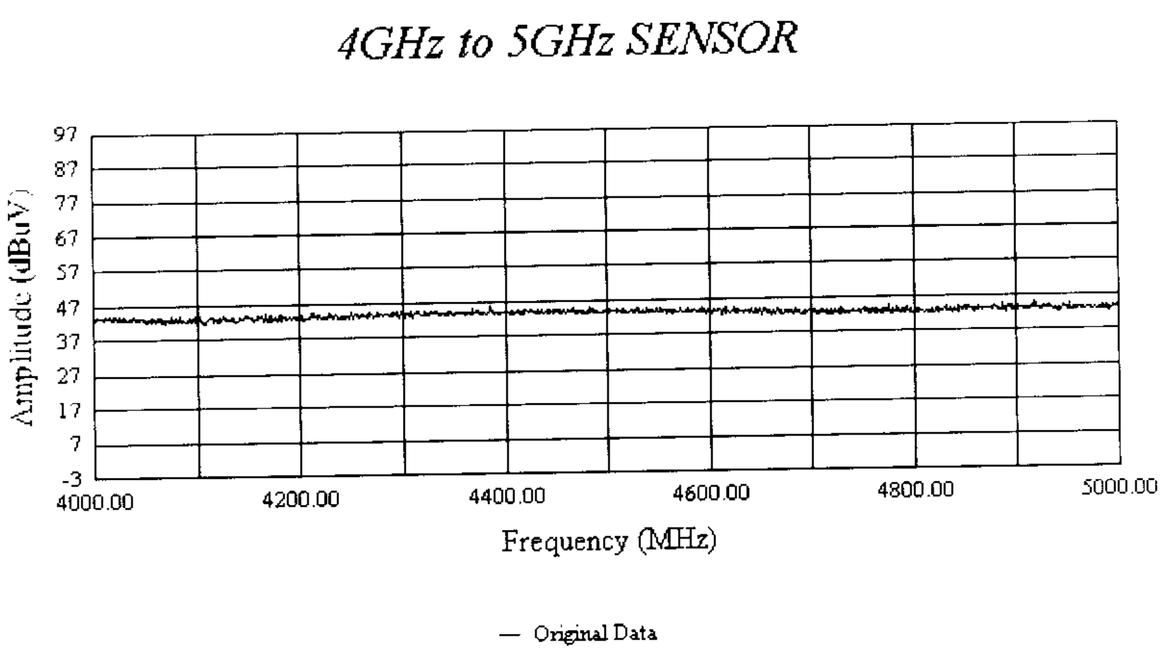


FIGURE 9: Radiated spurious emission (4 GHz – 8.2 GHz)

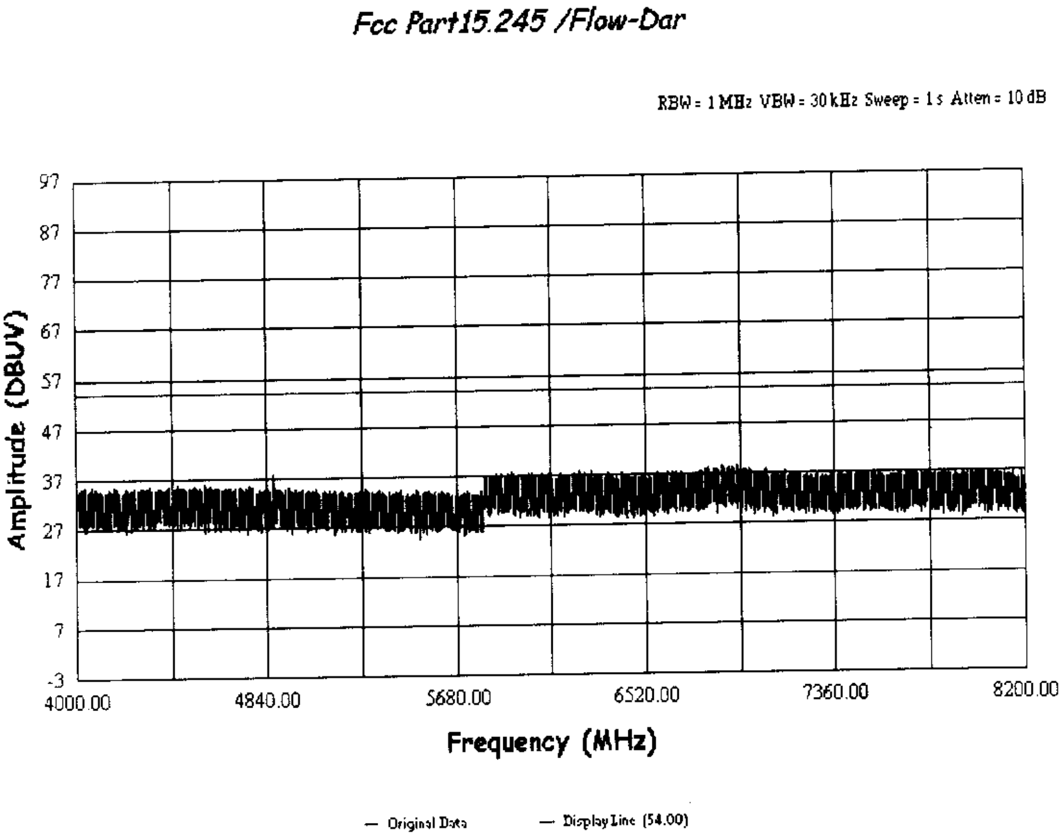


FIGURE 10: Radiated spurious emission (8.2 GHz – 12.4 GHz)

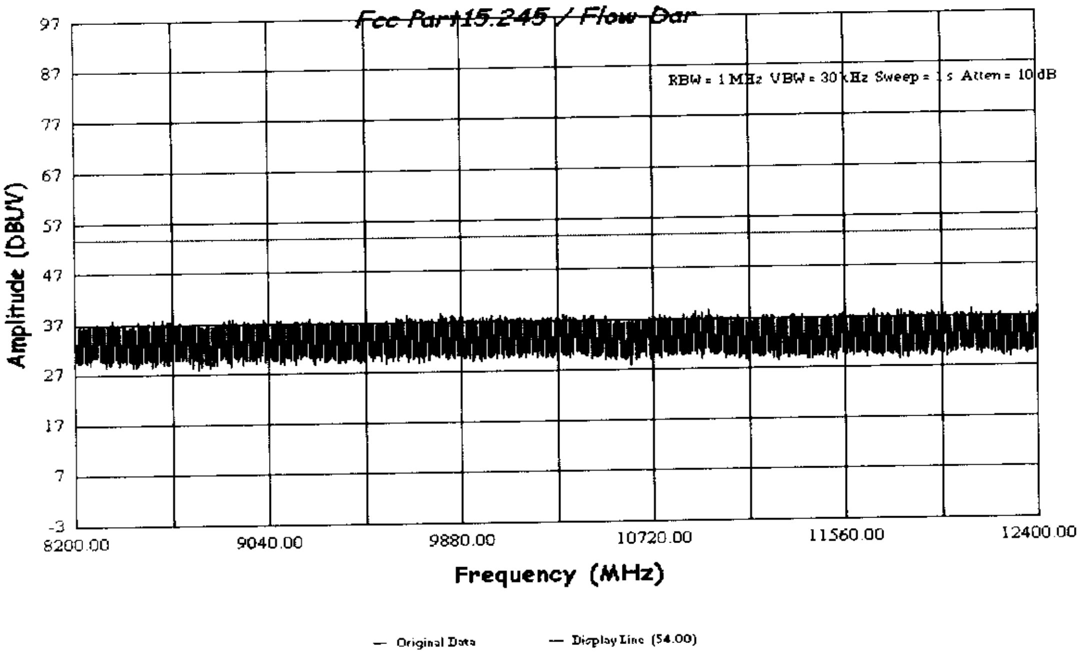


FIGURE 11: Radiated spurious emission 12.4 GHZ to 18GHz

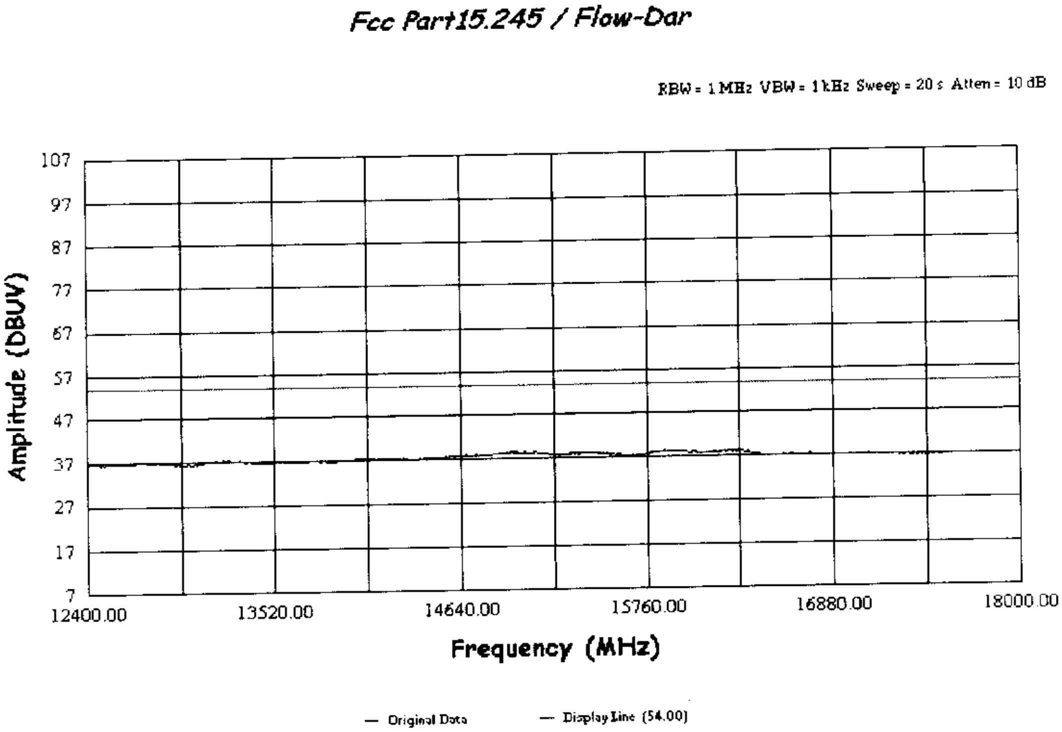


FIGURE 12: Radiated spurious emission 18 GHZ to 26.5GHz

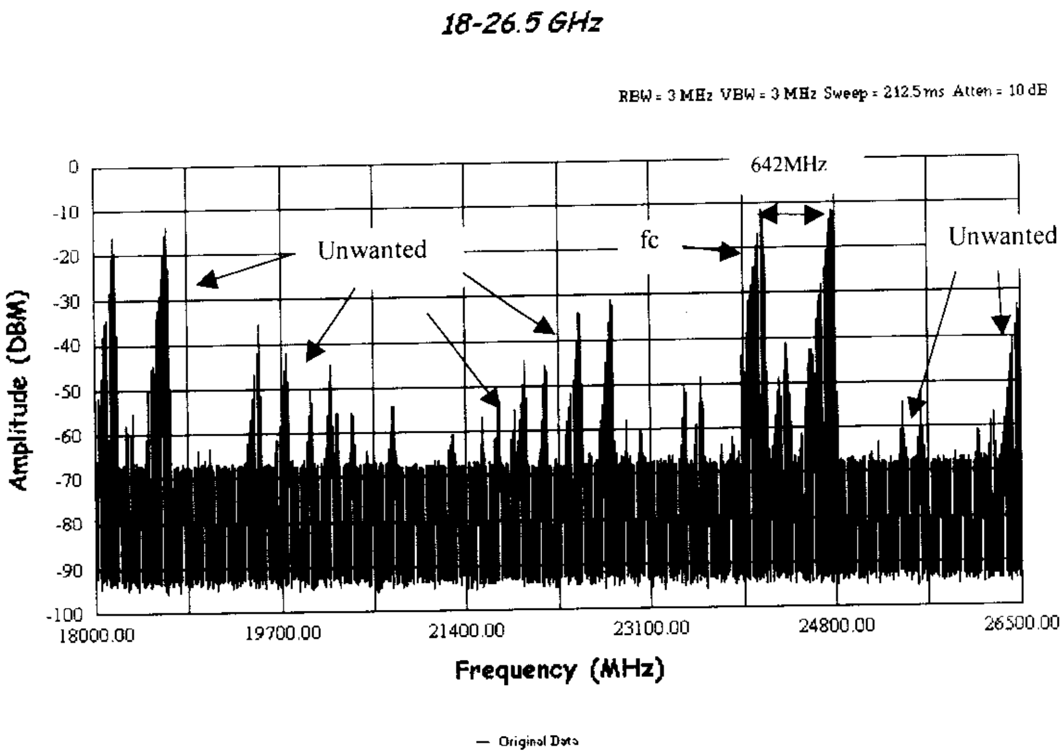


FIGURE 13: Radiated spurious emission 26.5 GHz to 40 GHz

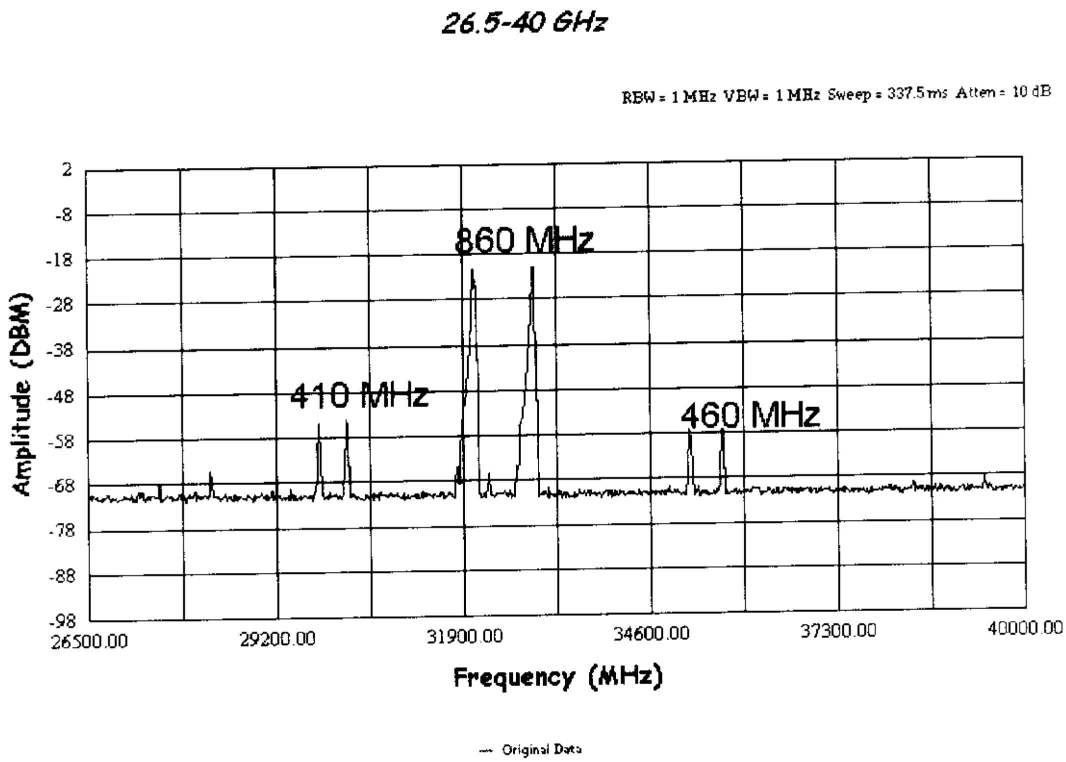


FIGURE 14: Radiated spurious emission 40 GHz to 60 GHz

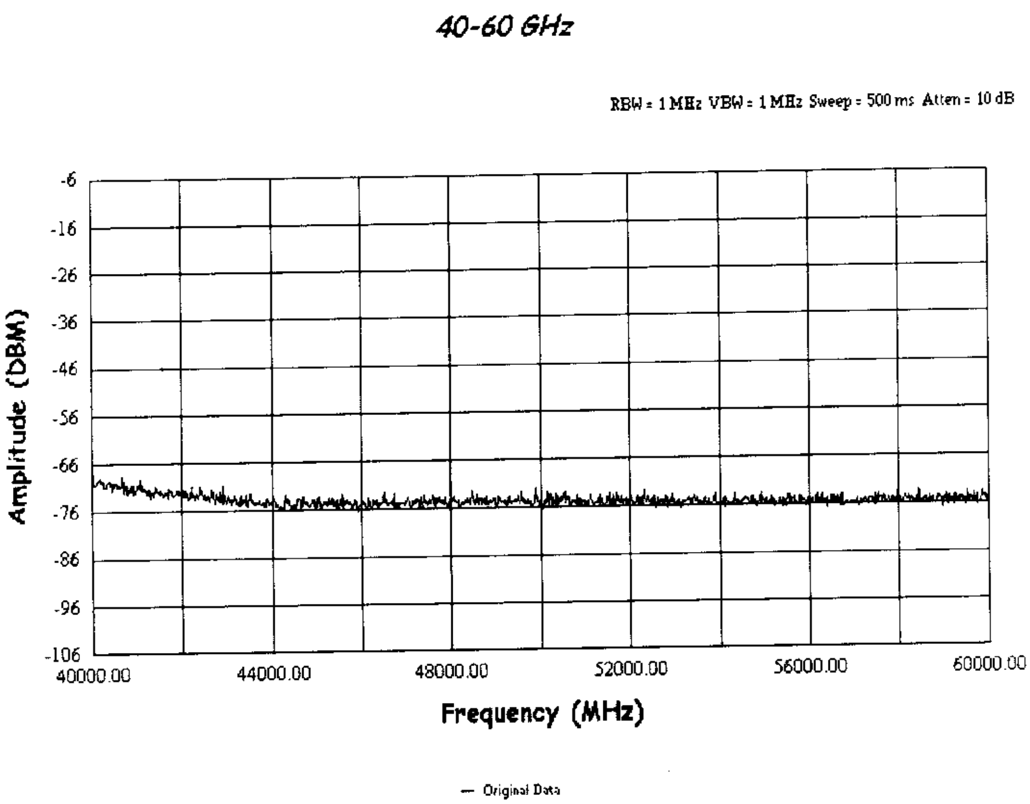


FIGURE 15: Radiated spurious emission 50 GHz to 75 GHz

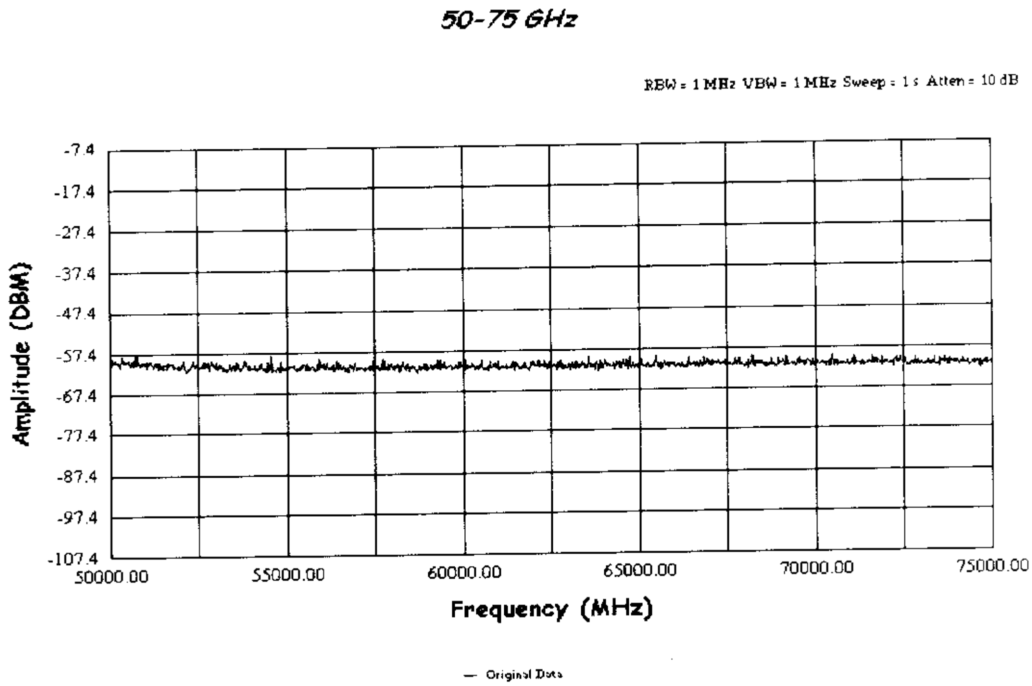
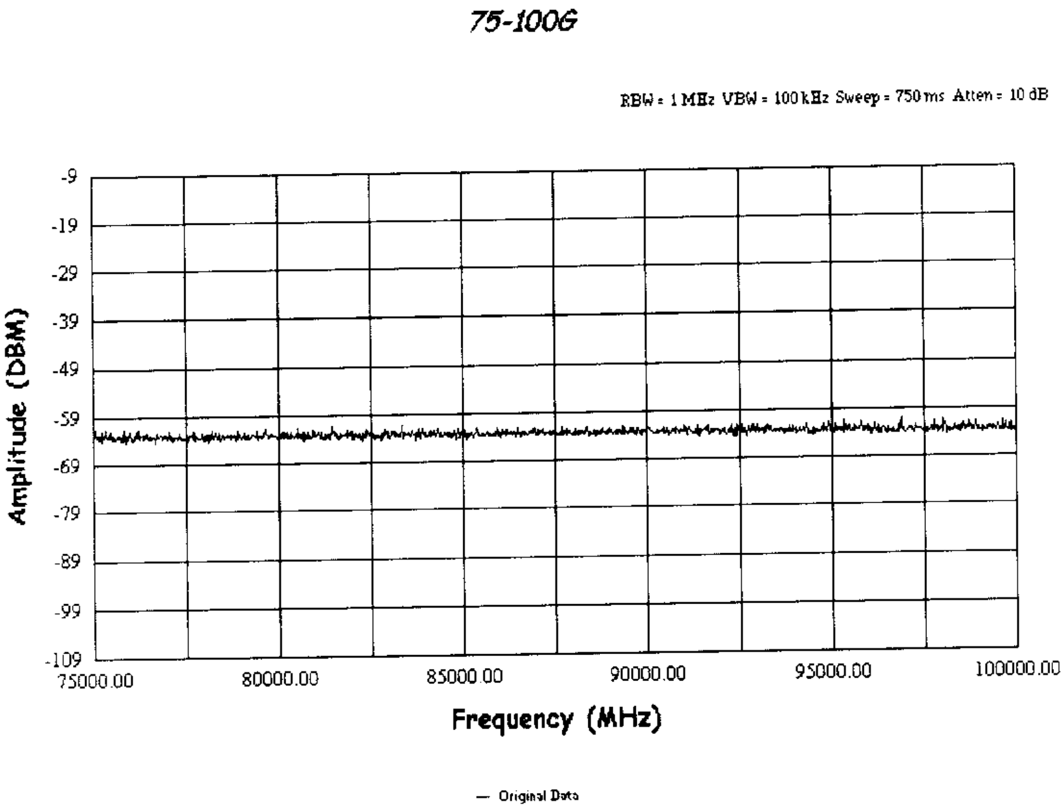


FIGURE 16: Radiated spurious emission 75 to 100 GHz



APPENDIX A: Emissions Equipment List

DESCRIPTION	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CAL. LAB
AMPLIFIER	HEWLETT PACKARD	11975A	2304A00348	TEST EQUITY
AMPLIFIER (S/A 1)	RHEIN TECH	PR-1040	00001	RTL
AMPLIFIER (S/A 2)	RHEIN TECH	RTL2	900723	RTL
AMPLIFIER (S/A 3)	RHEIN TECH	8447F	2944A03783	RTL
AMPLIFIER (S/A 4)	RHEIN TECH	8447D	2727A05397	RTL
BICONICAL/LOG ANTENNA 1	ANTENNA RESEARCH	LPB-2520	1037	LIBERTY LABS
BICONICAL/LOG ANTENNA 2	ANTENNA RESEARCH	LPB-2520	1036	LIBERTY LABS
FIELD SITE SOURCE	RTL	RSS1	1001	RTL
FILTER (ROOM 1)	SOLAR	8130	947305	RTL
FILTER (ROOM 2)	SOLAR	8130	947306	RTL
HARMONIC MIXER 1	HEWLETT PACKARD	11970K	2332A00563	TELOGY
HARMONIC MIXER 2	HEWLETT PACKARD	11970A	2332A01199	TELOGY
LISN (ROOM 1/L1)	SOLAR	7225-1	900727	ACUCAL
LISN (ROOM 1/L2)	SOLAR	7225-1	900727	ACUCAL
LISN (ROOM 2/L1)	SOLAR	7225-1	900078	ACUCAL
LISN (ROOM 2/L2)	SOLAR	7225-1	900077	ACUCAL
PRE-AMPLIFIER	HEWLETT PACKARD	8449B OPT	3008A00505	TELOGY
QUASI-PEAK ADAPTER (S/A 1)	HEWLETT PACKARD	85650A	3145A01599	ACUCAL
QUASI-PEAK ADAPTER (S/A 2)	HEWLETT PACKARD	85650A	2811A01276	ACUCAL
QUASI-PEAK ADAPTER (S/A 3)	HEWLETT PACKARD	85650A	2521A00473	ACUCAL
QUASI-PEAK ADAPTER (S/A 4)	HEWLETT PACKARD	85650A	2521A01032	ACUCAL
RF PRESELECTOR (S/A 1)	HEWLETT PACKARD	85685A	3146A01309	ACUCAL
SIGNAL GENERATOR (HP)	HEWLETT PACKARD	8660C	1947A02956	ACUCAL
SIGNAL GENERATOR (WAVETEK)	WAVETEK	3510B	4952044	ACUCAL
SPECTRUM ANALYZER 1	HEWLETT PACKARD	8566B	3138A07771	ACUCAL
SPECTRUM ANALYZER 2	HEWLETT PACKARD	8567A	2841A00614	ACUCAL
SPECTRUM ANALYZER 4	HEWLETT PACKARD	8567A	2727A00535	ACUCAL
TUNABLE DIPOLE	EMCO	3121	274	LIBERTY LABS
EMISSION SOFTWARE	RHEIN TECH	VERSION 10.2	N/A	RTL

Calibration certificates are available upon request.