Electromagnetic Compatibility Test Report

Tests Performed on a United Service Equipment Co.

Transmitter, Model Unitron

Radiometrics Document RP-4696

ACCREDITED
Certification # 1495.01

Product Detail:
FCC ID: **P7M-UNITRON**
Equipment type: 916.5 MHz; Low-Power Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C
FCC Part 15 CFR Title 47: 2001
This report concerns: Original Grant for Certification
FCC Part 15.249

Tests Performed For:	*Test Facility:*
United Service Equipment Co. 1152 Park Ave Murfreesboro, TN 37129 Phone: 615-893-8432	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 Phone: (815) 293-0772 e-mail: info@radiomet.com

Test Date(s): (Month-Day-Year)
January 22 and 23, 2002

Document RP-4696 Revisions:

Rev.	Issue Date	Affected Pages	Revised By	Authorized Signature for Revision
0	February 25, 2002			
1	March 20, 2002	All	Joseph Strzelecki	Joseph Strzelecki
2	May 7, 2002	All	Joseph Strzelecki	Joseph Strzelecki

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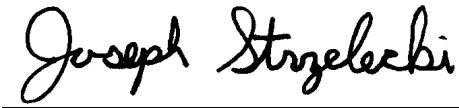
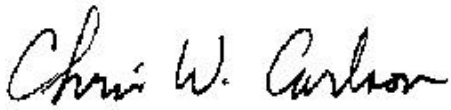
1 ADMINISTRATIVE DATA

Equipment Under Test: A United Service Equipment Co., Transmitter Model: Unitron, Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) December 11, 2001	*Test Date(s): (Month-Day-Year)* January 22 and 23, 2002
Test Report Written By: Ron Lazarowicz EMC Technician	*Test Witnessed By:* none
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Transmitter, Model Unitron, manufactured by United Service Equipment Co. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30 - 9200 MHz	FCC Part 15	Pass
Conducted Emissions, AC Mains	0.45 - 30 MHz	FCC Part 15	Pass
Occupied Bandwidth Test	916.5 MHz	FCC Part 15	Pass

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Transmitter, Model Unitron, manufactured by United Service Equipment Co. The EUT was in good working condition during the tests, with no known defects.

3.2 Related Submittals

United Service Equipment Co. is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration and Operating Mode

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. A one meter, unterminated long field wire was connected to the EUT during the tests. Since the EUT is wall mounted, it was placed in an upright configuration during the tests. The EUT communicates to an off-the-shelf PC via the phone line. The 1.4-meter length of the phone line is typical of those plugged into a wall outlet.

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Transmitter	E	United Service Equipment Co.	Unitron P/N 501C586G97	None

* Type: E = EUT, P = Peripheral, S = Support Equipment

List of System Cables

QTY	Length (m)	Cable Description	Connected to (Item #)	Shielded?
1	1	AC Cord	#1 Power input	No
1	1.4	Modem cable Terminated in 600 Ohms	#1	No

The EUT was tested as a stand-alone device. The wiring was consistent with manufacturer's recommendations. The system was configured for testing in a typical fashion (as a customer would normally use it). Power was supplied at 115 VAC, 60 Hz single-phase.

During the preliminary emissions test, the EUT was tested with communications on the phone line. No additional emissions were detected from the communication on the phone line. Because of this, the final tests were performed with the modem cable terminated into 600 Ohms.

The final tests were performed with the EUT operating in one of two modes. It was tested while transmitting continuously at 916 MHz. The EUT had a switch installed that enabled continuous RF transmission. This switch will not be installed when sold to the public. The second mode was with the EUT in receiving mode.

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

The following modifications were made prior to the start of compliance testing:
A Fair-Rite p/n 2512066017 SMT ferrite bead was added in series with pin 12 of Z11 on the modem board. The RF PCB was not modified.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Test Specifications

Document	Date	Title
FCC CFR Title 47	1999	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-1992	1992	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 5	2001	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands)
IC RSS-212 Issue 1	1998	Test Methods For Radio Equipment

The test procedures used are in accordance with the ANSI document C63.4-1992, (July 17, 1992) "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics has been accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 1999 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the "basic standards" listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la.org).

The following Sites were used to perform the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles in the located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber B: Is a shielded enclosure that measures 24' L X 12' W X 8' H. Erik A. Lindgren & Associates of Chicago, Illinois manufactured the enclosure.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

Open Area Test Site (OATS): Is located on 8625 Helmar Road in Newark, Illinois, USA and measures 56' L X 24' W X 17' H. The entire open field test site has a metal ground screen. The FCC has accepted these sites as test site number 31040/SIT 1300F2. The FCC test site Registration Number is 90897. Details of the site characteristics are on file with the Industry Canada as file number IC3124.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 TEST PROCEDURES

The test procedures used are in accordance with the Industry Canada RSS-212 and ANSI document C63.4-1992, (July 17, 1992) "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

8.1 Radiated RF Emissions Measurement Procedures

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun.

The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 450 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu Spectrum analyzer and a MITEQ AM-1431 amplifier with a 10 dB attenuator connected to the input were used. The out of band emissions and the ambient emissions were below the level of input overload (80 dBuV).

For tests from 1 to 9.2 GHz, an HP8566A spectrum analyzer was used with a Celeritek uWave amplifier. The fundamental emission, out of band emissions and the ambient emissions were below the level of input overload (72 dBuV). In addition, a high pass filter was used to reduce the fundamental emission.

Preliminary radiated emission tests were performed inside of an anechoic enclosure. The frequency range from 30 to 9200 MHz was scanned and plotted using the peak detector function. The test antennas were positioned 3 meters from the EUT. The results of the preliminary scans were only used to identify the frequencies being emitted from the EUT and were not used to determine compliance with the test specification. Radiated emission measurements are performed with linearly polarized broadband antennas.

Final radiated emissions measurements were performed in the open area test site at a test distance of 3 meters. Measurements were performed using the peak or quasi-peak detector function. The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground. The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. All other tests are performed at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 9200 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high in the preliminary emission scan. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded.

8.1.1 Field Strength Calculation

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

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Assume a receiver reading of 49.5 dBuV is obtained. The Antenna Factor of 8.1 and a Cable Factor of 1.7 is added. The Amplifier Gain of 23.3 dB is subtracted, giving a field strength of 36 dBuV/m. The 36 dBuV/m can be mathematically converted to its corresponding level in uV/m.

FS = 49.5 + 8.1 + 1.7 - 23.3 = 36.0 dBuV/m
Level in uV/m = Common Antilogarithm [(36 dBuV/m)/20] = 63.1 uV/m

8.1.2 Conducted Emission Measurement Procedures

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on semi-log graph paper generated by the computer and plotter. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

Broadband conducted emissions may exceed the following limits by no more than 13 dB. An emission is defined as broadband if the average detector amplitude is 6 dB or more under the quasi-peak detector amplitude.

FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B, QP Limit (dBuV)
0.450 - 1.705	48.0
1.705 - 30	48.0

9 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

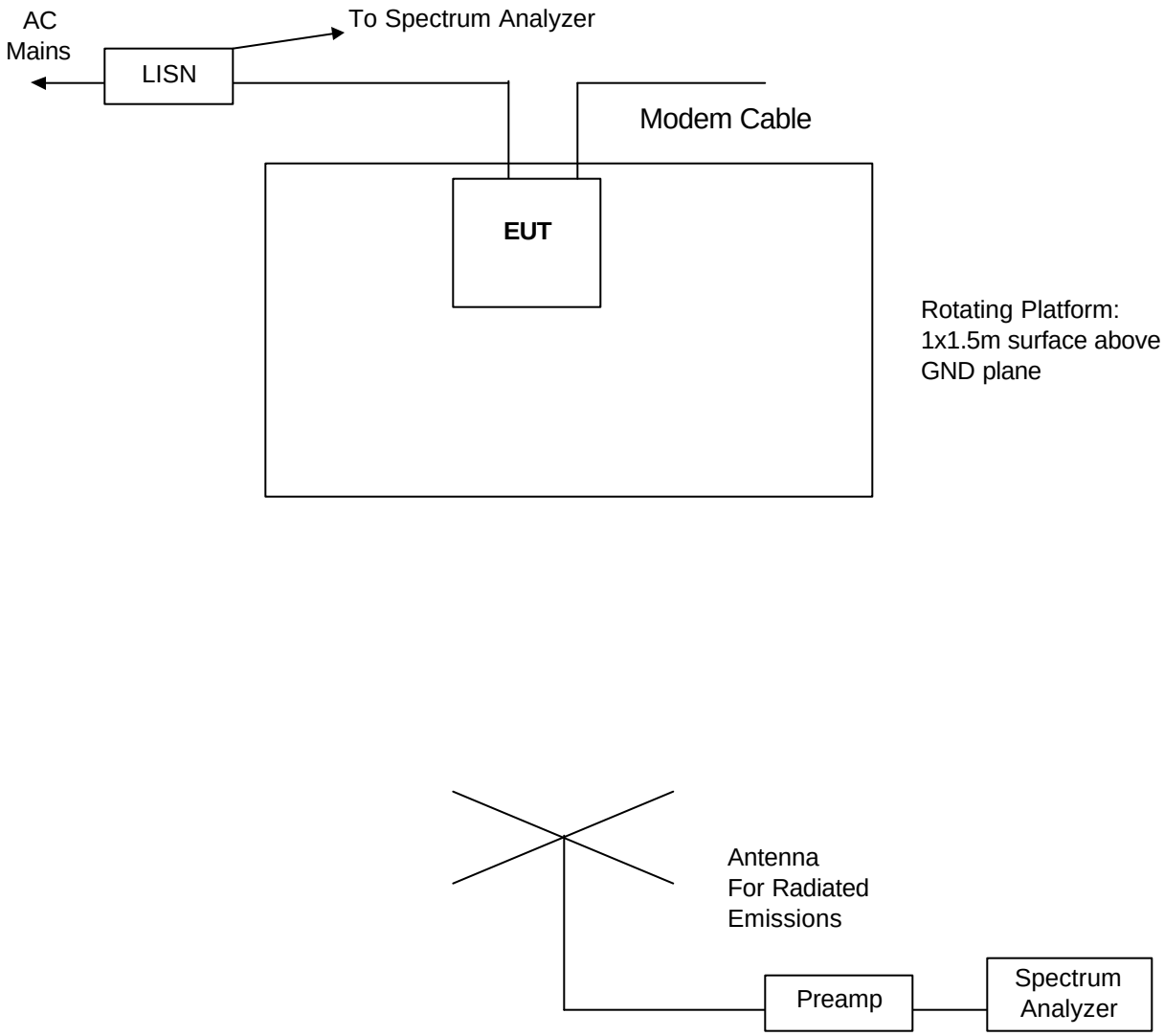
10 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	11/28/01
AMP-12	MITEQ	Pre-amplifier	AM-1431	530935	0.01-1000MHz	12 Mo.	12/28/01
AMP-16	MITEQ	Pre-amplifier	AM-1300	608852	0.01-1000MHz	12 Mo.	01/22/02
ANT-03	Tensor	Biconical Antenna	4104	2231	20-200MHz	24 Mo.	08/07/01
ANT-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 mo	08/07/01
ANT-11	RMC	Dipole Antennas	HW1010	201	25-1000MHz	12 Mo.	07/10/01
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	09/28/00
ATT-02	KDI	Attenuator	A710N	RMC1	DC-10GHz	24 Mo.	12/28/00
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	12/28/00
HPF-02	Microwave Cir.	High Pass Filter	H2G09G02	HPF-2	1.5-11 GHz	24 Mo.	05/29/01
LSN-01	Electrometrics	LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	01/04/01
LSN-02	Electrometrics	LISN	LISN 25/3	1063	0.01-30MHz	24 Mo.	03/30/01
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	06/08/01
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	10/12/01
THM-01	Extech Inst.	Temp/Humid Meter	4465CF	001106557	N/A	12 Mo.	12/26/01

Note: All calibrated equipment is subject to periodic checks.
NCR – No Calibration Required. Device monitored by calibrated equipment. N/A: Not Applicable.

11 TEST SETUP DOCUMENTATION

Figure 1. Configuration of Tested System



Radiated Emissions:
- LISN's not used
- AC outlet with low-pass filter at the base of the turntable
- No vertical conductive wall
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters

Notes:
- Not to Scale

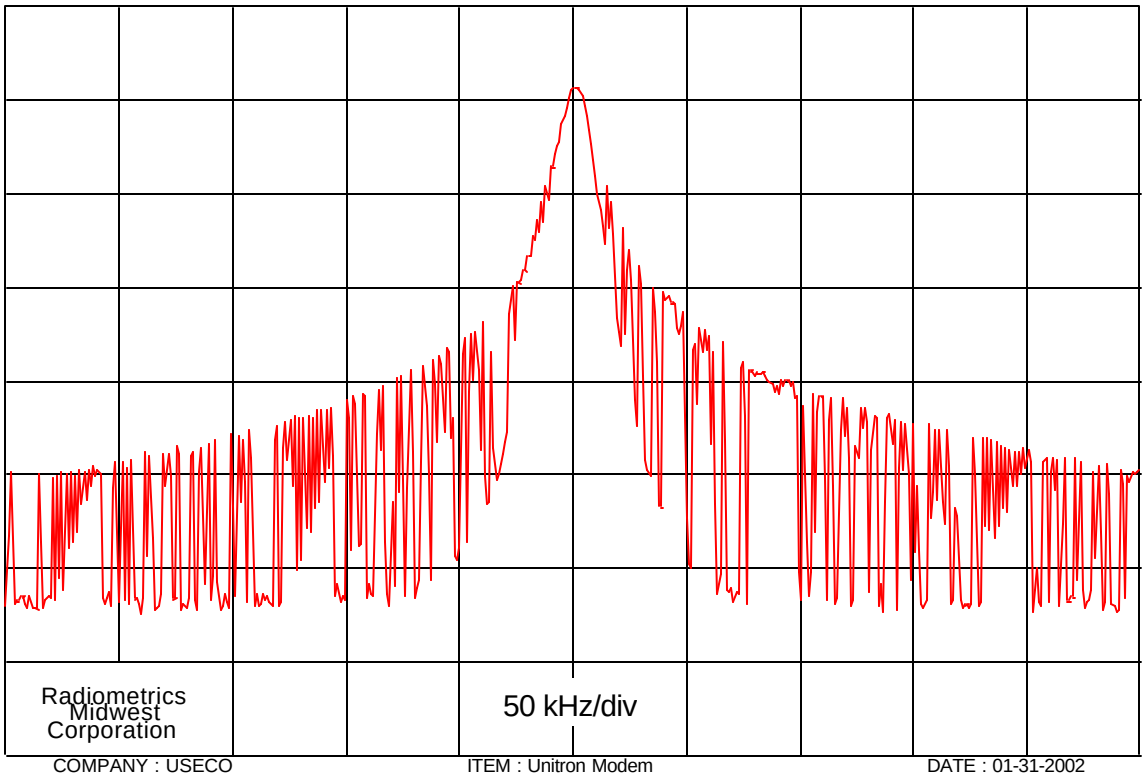
Conducted Emissions:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled
- Test platform is not rotated

12 OCCUPIED BANDWIDTH DATA

The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the "MAX HOLD" mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

Figure 2. Occupied Bandwidth Plot



13 DETAILED TEST RESULTS

13.1 Radiated Emissions Test Results

Manufacturer	United Service Equipment Co.	Specification	FCC Part 15 Subpart C & RSS-210
Model	Unitron	Test Date	1/22/2002
Serial Number	None	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP; A = Average		

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
39.3	43.9 Q	12.2	H/BC	-25.8	30.3	40.0	9.7
59.0	37.3 P	9.7	H/BC	-25.5	21.6	40.0	18.4
78.6	43.8 Q	6.1	H/BC	-24.9	25.0	40.0	15.0
118.0	43.2 P	12.2	H/BC	-24.3	31.1	43.5	12.4
137.6	37.7 P	11.9	H/BC	-24.0	25.6	43.5	17.9
177.0	33.3 P	16.4	H/BC	-23.3	26.4	43.5	17.1
216.3	35.0 P	15.6	H/BC	-22.8	27.8	46.0	18.2
39.3	43.4 Q	10.7	V/BC	-25.8	28.3	40.0	11.7
78.6	45.8 Q	7.5	V/BC	-24.9	28.4	40.0	10.6
81.0	36.9 P	8.2	V/BC	-24.8	20.3	40.0	19.7
118.0	38.7 P	13.1	V/BC	-24.3	27.5	43.5	16.0
137.5	37.7 P	12.5	V/BC	-24.0	26.2	43.5	17.3
177.0	33.6 P	17.3	V/BC	-23.3	27.6	43.5	15.9
216.3	40.2 P	16.2	V/BC	-22.8	33.5	46.0	12.5
916.6	53.1 P	23.8	H/LP	8.7	85.6	94.0	8.4
916.6	59.3 P	23.8	V/LP	8.7	91.8	94.0	2.2
1833.0	32.0 A	27.6	H/HN	-15.9	43.7	54.0	10.3
1833.0	31.5 A	27.6	V/HN	-15.9	43.2	54.0	10.8

All emissions outside of the band from 902 to 928 were below the limits of 15.209.
No preamp was used when measuring the fundamental emission at 916.5 MHz.

Judgment: Fundamental Passed by 2.2 dB
Judgment: Spurious and Harmonics Passed by 9.7 dB
No Emissions were detected from 2000 to 9200 MHz within 15 dB of the limits.

During the preliminary tests, no additional emissions were detected when the communication on the phone line was activated. The above data represents the worst case emissions two modes of operation as described in section 4.1 herein.

13.2 Conducted Emission Test Results

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from power cord, after testing all modes of operation.

Test Date : January 23, 2002

Line Tested	Freq. MHz	Strength of Signal dBuV		Margin Under Limit dB
		EUT	Limit	
AC Hot	0.478	39.2	48.0	8.8
AC Hot	0.5167	38.0	48.0	10.0
AC Hot	0.557	37.0	48.0	11.0
AC Hot	19.95	31.5	48.0	16.5
AC Neutral	0.4772	39.3	48.0	8.7
AC Neutral	0.5085	38.3	48.0	9.7
AC Neutral	0.5393	37.6	48.0	10.4
AC Neutral	19.95	31.8	48.0	16.2

* All reading are quasi-peak with a 9 kHz bandwidth and no video filter.

Judgment: Passed by 8.8 dB

During the preliminary tests, no additional emissions were detected when the communication on the phone line was activated. The above data represents the worst case emissions two modes of operation as described in section 4.1 herein.