í í

APPLICATION FOR PART 90 CERTIFICATION
TRANSMITTER 2450-2483 MHz BAND

Backgrounds Unlimited, Incorporated.
Old Town Hall, Rt. 11 South
P.O. Box 327
Mt. Sidney, VA 24467

MODEL: TXBD-11A
FCC ID: NH5FWVTXBD11A

December 4, 1998

This report concerns (check one): **Original Grant:** X **Class II Change:**
Equipment Type: **Transmitter**

Deferred grant requested per 47 CFR 0.457 (d) (1) (ii)? **Yes:** **No**: X
If yes, defer until: ____________________
Date

Company name agrees to notify the Commission by: ________________________**(date) of the intended date of announcement of the product so that the grant can be issued on that date.**

REPORT PREPARED BY:

EMI Technician: Daniel W. Baltzell
Administrative Writer: Dixie L. Shetter
Rhein Tech Laboratories, Inc.

Document Number: 980564

No part of this report may be reproduced without the full written approval of Rhein Tech Laboratories, Inc.

TABLE OF CONTENTS

1.0 GENERAL INFORMATION 1

1.1 PRODUCT DESCRIPTION 1
1.2 RELATED SUBMITTAL(S)/GRANT(S) 2
1.3 TEST SYSTEM DETAILS 2
1.4 CONFIGURATION OF TESTED SYSTEM 3

2.0 PRODUCT LABELING 6

3.0 SYSTEM TEST CONFIGURATION 7

3.1 JUSTIFICATION 7
3.2 EUT EXERCISE SOFTWARE 7
3.3 CONFORMANCE STATEMENT 8

4.0 STANDARD REQUIREMENTS 9

4.1 FCC PART 90.211(C) AND PART 2.987: MODULATION REQUIREMENTS AND CHARACTERISTICS 9
4.1.1 FCC Part 2.987(a): Audio Frequency Response 9
4.1.1.1 Method of Measurement 9
4.1.1.2 Test Results 9
4.2 FCC PART 2.987(A): AUDIO LOW PASS FILTER RESPONSE 10
4.2.1 Method of Measurement 10
4.2.2 Test Results 10
4.3 FCC PART 90.205(L) AND PART 2.985 15
4.3.1 RF Power Output (ERP): 15
4.3.2 Method of Measurement 15
4.4 FCC PART 90.207: TYPE OF EMISSIONS - EMISSION DESIGNATOR 16
4.5 FCC PART 2.997(A)(1): FREQUENCY SPECTRUM TO BE INVESTIGATED 16
4.6 FCC PART 90.210(B) AND PART 2.991: EMISSION MASKS AND SPURIOUS EMISSIONS AT ANTENNA TERMINAL 16
4.6.1 Method of Measurement 16
4.7 FCC PART 90.210 (B)(1)(2)(3) 17
4.8 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION 17
4.8.1 Method of Measurement 17
4.9 FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE 17
4.9.1 Method of Measurement 17
4.9.2 Minimum Frequency stability (ppm) 17

5.0 MEASUREMENT PLOTS 18

5.1 MEASUREMENT PLOTS FCC PART 90.210 (B) / PART 2.993 18
5.2 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION 37
5.3 RADIATED MEASUREMENT PHOTOS 38
5.4 FREQUENCY STABILITY FUNCTION OF TEMPERATURE 39
5.5 FCC PART 90.214: TRANSIENT FREQUENCY BEHAVIOR 40

6.0 BLOCK DIAGRAM 42

7.0 FIELD STRENGTH CALCULATION, AND RADIATED TEST METHODOLOGY 43

7.1 FIELD STRENGTH CALCULATION 43
7.2 RADIATED MEASUREMENT 44

8.0 PHOTOS OF TESTED EUT 45

~~**1.0 GENERAL INFORMATION ..... 1**~~

~~1.1 PRODUCT DESCRIPTION ..... 1~~
~~1.2 RELATED SUBMITTAL(S)/GRANT(S) ..... 2~~
~~1.3 TEST SYSTEM DETAILS ..... 2~~

1.4 CONFIGURATION OF TESTED SYSTEM 3
1.5 TEST METHODOLOGY 4
1.6 TEST FACILITY 4

2.0 PRODUCT LABELING 5

3.0 SYSTEM TEST CONFIGURATION 6

3.1 JUSTIFICATION 6
3.2 EUT EXERCISE SOFTWARE 6
3.3 CONFORMANCE STATEMENT 7

4.0 STANDARD REQUIREMENTS 8

4.1 FCC PART 90.211(C) AND PART 2.987: MODULATION REQUIREMENTS AND CHARACTERISTICS 8
4.1.1 FCC Part 2.987(a): Audio Frequency Response 8
4.1.1.1 Method of Measurement 8
4.1.1.2 Test Results 8
4.2 FCC PART 2.987(A): AUDIO LOW PASS FILTER RESPONSE 9
4.2.1 Method of Measurement 9
4.2.2 Test Results 9
4.3 FCC PART 90.205(L) AND PART 2.985 10
4.3.1 RF Power Output (ERP): 10
4.3.2 Method of Measurement 10
4.4 FCC PART 90.207: TYPE OF EMISSIONS - EMISSION DESIGNATOR 11
4.5 FCC PART 2.997(A)(1): FREQUENCY SPECTRUM TO BE INVESTIGATED 11
4.6 FCC PART 90.210(B) AND PART 2.991: EMISSION MASKS AND SPURIOUS EMISSIONS AT ANTENNA TERMINAL 11
4.6.1 Method of Measurement 11
4.7 FCC PART 90.210 (B)(1)(2)(3) 12
4.8 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION 12
4.8.1 Method of Measurement 12
4.9 FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE 12
4.9.1 Method of Measurement 12
4.9.2 Minimum Frequency stability (ppm) 12

5.0 MEASUREMENT PLOTS 13

5.1 MEASUREMENT PLOTS FCC PART 90.210 (B)(1)(2)(3) 15
5.2 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION 25
5.3 RADIATED MEASUREMENT PHOTOS 26
5.4 FREQUENCY STABILITY FUNCTION OF TEMPERATURE 27
5.5 FCC PART 90.214: TRANSIENT FREQUENCY BEHAVIOR 28

6.0 BLOCK DIAGRAM 30

7.0 FIELD STRENGTH CALCULATION, AND RADIATED TEST METHODOLOGY 31

7.1 FIELD STRENGTH CALCULATION 31
7.2 RADIATED MEASUREMENT 32

8.0 PHOTOS OF TESTED EUT 33

APPENDIX LISTING

APPENDIX A: EMISSIONS EQUIPMENT LIST 52
APPENDIX B: USER'S MANUAL 53
APPENDIX A: EMISSIONS EQUIPMENT LIST 38
APPENDIX B: USER'S MANUAL 39

FIGURE INDEX

FIGURE 1: FCC ID LABEL ..... 6~~5~~
FIGURE 2: LOCATION OF LABEL ON EUT ..... 6~~5~~
FIGURE 25: BANDWIDTH DETERMINATION 2.473 GHZ ..... 9~~8~~
FIGURE 25: BANDWIDTH DETERMINATION 2.473 GHZ ..... 10~~9~~
FIGURE 4: BANDWIDTH DETERMINATION 2.453 GHZ ..... 11~~10~~
FIGURE 5: BANDWIDTH DETERMINATION 2.453 GHZ ..... 12~~11~~
FIGURE 6: BANDWIDTH DETERMINATION 2.453 GHZ ..... 12~~11~~
FIGURE 23: BANDWIDTH DETERMINATION 2.473 GHZ ..... 13~~12~~
FIGURE 24: BANDWIDTH DETERMINATIO 2.473 GHZ ..... 13~~12~~
FIGURE 25: BANDWIDTH DETERMINATION 2.473 GHZ ..... 14~~13~~
FIGURE 3: FCC PART 90.210 (B) MASK ..... 18~~17~~
FIGURE 7 10 KHZ TO 1 GHZ ..... 18~~17~~
FIGURE 8: 1 TO 5 GHZ ..... 19~~18~~
FIGURE 9: 5 TO 10 GHZ ..... 20~~19~~
FIGURE 10: 10 TO 15 GHZ ..... 20~~19~~
FIGURE 11: 15 TO 23 GHZ ..... 21~~20~~
FIGURE 17: 4.905 GHZ FIRST HARMONIC ..... 21~~20~~
FIGURE 18: 7.358 GHZ SECOND HARMONIC ..... 22~~21~~
FIGURE 19: 9.811 GHZ THIRD HARMONIC ..... 22~~21~~
FIGURE 20: 12.263 GHZ FOURTH HARMONIC ..... 23~~22~~
FIGURE 21: 14.716 GHZ FIFTH HARMONIC ..... 23~~22~~
FIGURE 22: FCC PART 90.210 (B) MASK ..... 30~~29~~
FIGURE 26: 9 KHZ TO 12.473 GHZ ..... 32~~31~~
FIGURE 27: 1 TO 5 GHZ ..... 32~~31~~
FIGURE 28: 5 TO 10 GHZ ..... 33~~32~~
FIGURE 29: 10 TO 15 GHZ ..... 33~~32~~
FIGURE 30: 15 TO 23 GHZ ..... 34~~33~~
FIGURE 17: 4.905 GHZ FIRST HARMONIC ..... 34~~33~~
FIGURE 18: 7.358 GHZ SECOND HARMONIC ..... 35~~34~~
FIGURE 19: 9.811 GHZ THIRD HARMONIC ..... 35~~34~~
FIGURE 20: 12.263 GHZ FOURTH HARMONIC ..... 36~~35~~
FIGURE 21: 14.716 GHZ FIFTH HARMONIC ..... 36~~35~~
FIGURE 29: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR ..... 40~~39~~
FIGURE 30: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR ..... 41~~40~~
FIGURE 29: 10 TO 15 GHZ ..... 45~~44~~
FIGURE 29: 10 TO 15 GHZ ..... 45~~44~~
FIGURE 29: 10 TO 15 GHZ ..... 46~~45~~
FIGURE 29: 10 TO 15 GHZ ..... 46~~45~~
~~FIGURE 1: FCC ID LABEL ..... 5~~
~~FIGURE 2: LOCATION OF LABEL ON EUT ..... 5~~
~~FIGURE 3: FCC PART 90.210 (C)(1)(2)(3) ..... 13~~
~~FIGURE 4: ..... 13~~
~~FIGURE 5: ..... 14~~
~~FIGURE 6 ..... 14~~
~~FIGURE 7 10 KHZ TO 1 GHZ ..... 15~~
~~FIGURE 8: 1 TO 5 GHZ ..... 15~~
~~FIGURE 9: 5 TO 10 DB ..... 16~~
~~FIGURE 10: 10 TO 15 GHZ ..... 16~~
~~FIGURE 11: 15 TO 23 GHZ ..... 17~~
~~FIGURE 12 ..... 17~~
~~FIGURE 13: ..... 18~~
~~FIGURE 14: ..... ERROR! BOOKMARK NOT DEFINED.~~
~~FIGURE 15: ..... ERROR! BOOKMARK NOT DEFINED.~~

~~FIGURE 16: ..... ERROR! BOOKMARK NOT DEFINED.~~
~~FIGURE 17: 4.905 GHZ ..... 18~~
~~FIGURE 18: 7.358 GHZ ..... 19~~
~~FIGURE 19: 9.811 GHZ ..... 19~~
~~FIGURE 20: 12.263 GHZ ..... 20~~
~~FIGURE 21: 14.716 GHZ ..... 20~~
~~FIGURE 22: ..... 21~~
~~FIGURE 23: ..... 21~~
~~FIGURE 24: ..... 22~~
~~FIGURE 25: ..... 22~~
~~FIGURE 26: 9 KHZ TO 12.473 GHZ ..... 23~~
~~FIGURE 27: 1 TO 5 GHZ ..... 23~~
~~FIGURE 28: 5 TO 10 GHZ ..... 24~~
~~FIGURE 29: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR ..... 28~~
~~FIGURE 30: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR ..... 29~~

TABLE INDEX

TABLE 1: TEST SYSTEM DETAILS 2
TABLE 2: RADIATED EMISSIONS: FCC PART 2.993 37
TABLE 3: FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY FUNCTION OF TEMPERATURE 39
~~TABLE 1: TEST SYSTEM DETAILS ..... 2~~
~~TABLE 2: RADIATED EMISSIONS: FCC PART 2.993 ..... 25~~
~~TABLE 3: FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY FUNCTION OF TEMPERATURE ..... 27~~

1.0 GENERAL INFORMATION

The following application for Certification of a Part 90 FCC Transmitter 2450-2483 MHz Band is prepared on behalf of Backgrounds Unlimited, Incorporated.. in accordance with Part 2, and Part 90, of the Federal Communications Commissions rules and regulations. The Equipment Under Test (EUT) was M/N: TXBD11ATXBD11A, FCC ID: NH5FWVTXBD11A. The test results reported in this document relate only to the item that was tested.

All measurements contained in this application were conducted in accordance with CFR 47, Part 90, ANSI C63.4 Methods of Measurement of Radio Noise Emissions, 1992. The instrumentation utilized for the measurements conforms to the ANSI C63.4 standard for EMI and Field Strength Instrumentation. Some accessories are used to increase sensitivity and prevent overloading of the measuring instruments. These are explained in the appendix of this report. Calibration checks are performed regularly on the instruments, and all accessories including the high pass filter, preamplifier and cables.

All radiated and conducted emissions measurement were performed manually at Rhein Tech, Incorporated. The radiated emissions measurements required by the rules were performed on the three meter, open field, test range maintained by Rhein Tech Laboratories, Inc., 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. Complete description and site attenuation measurement data have been placed on file with the Federal Communications Commission. The power line conducted emission measurements were performed in a shielded enclosure also located at the Herndon, Virginia facility. Rhein Tech Laboratories, Inc. is on the FCC accepted lab list as a facility available to do measurement work for others on a contract basis.

1.1 PRODUCT DESCRIPTION

The EUT was developed from the commercially available transmitter printed circuit board manufactured by RF Link. The identical power supply voltages and filtering components were maintained. Only the size was reduced and other features such as channel selection were not necessary.

Twelve volt (12V) power from an AC adapter or Battery Pack is brought to the PCB via solder pads. A 470 MFD electrolytic capacitor and a 0.1 MFD capacitor provide power supply filtering at the PCB. The inputted 12V then regulated to 8 volts by LM7808 voltage regulator. The 8.0 volt power is filtered via a 2200 MFD electrolytic capacitor and a 0.1 capacitor and feeds pin 9 of the transmitter module. The transmitter module contains a 10 pin header which is soldered to the PCB. Although there are only 10 header pins exiting on the transmitter module they are aligned for a 12 pin footprint. Pin 12 is attached to the ground plane, NTSC video from the CCD camera is hardwired to pin 9, and if audio is utilized it is hard wired to pin 11. The transmitter module's antenna pad is left intact and utilized in the applications.

Note: All PCB trace runs were reduced and a tight ground plane maintained.

1.2 RELATED SUBMITTAL(S)/GRANT(S)

The EUT was developed from a commercially available transmitter, FCC ID: MFEMODTX24-10

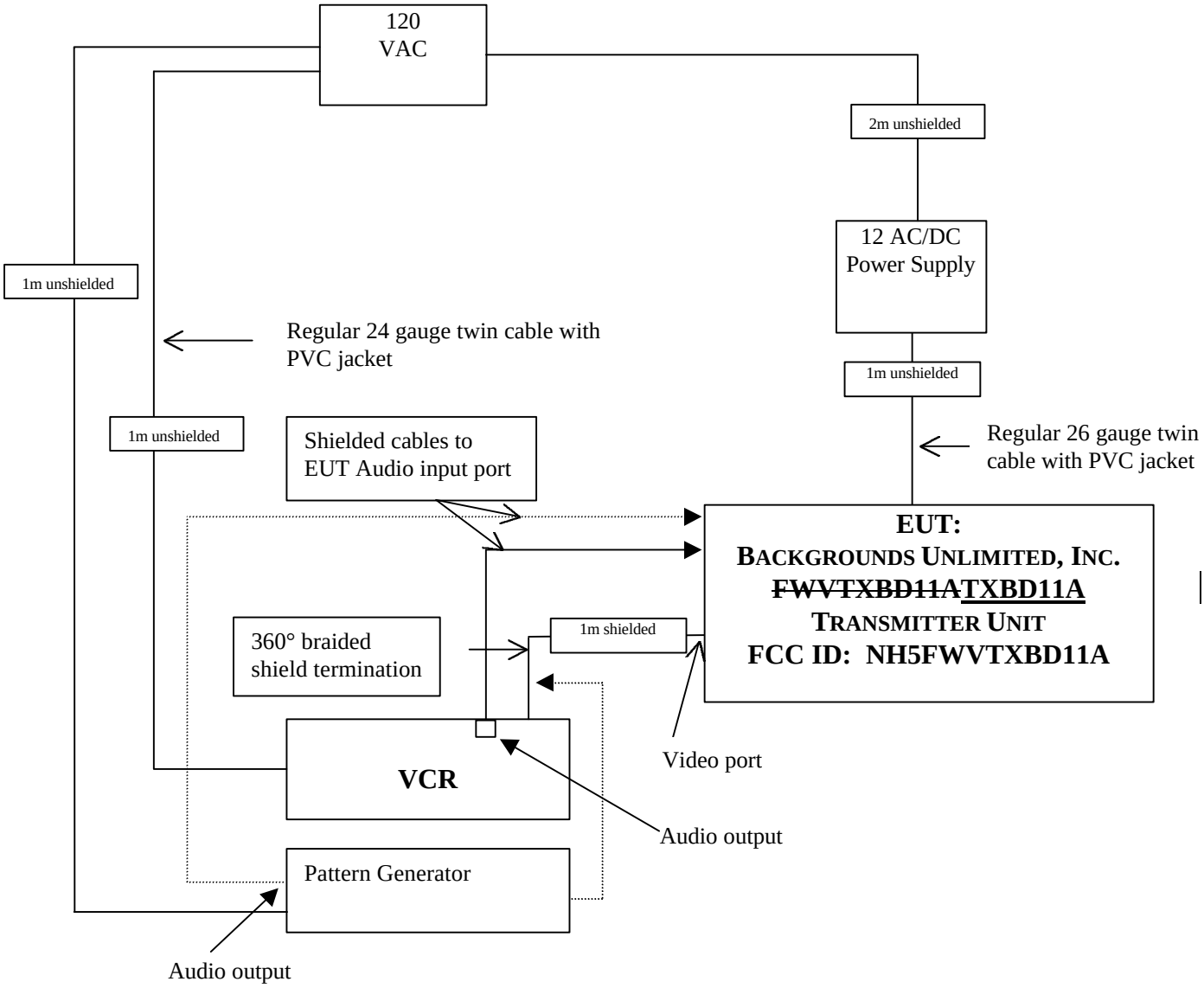
1.3 TEST SYSTEM DETAILS

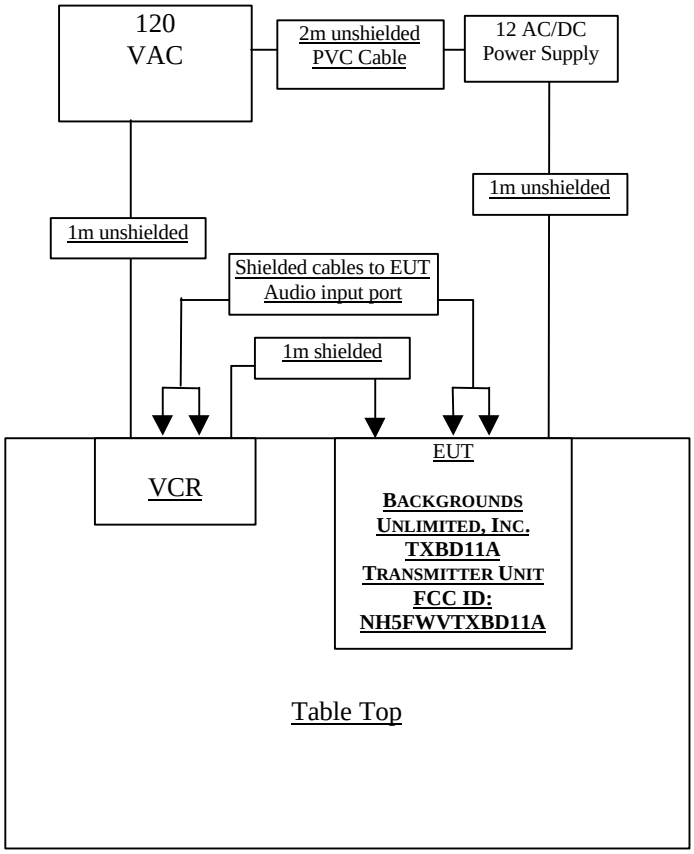
The FCC Identifiers for all equipment, plus descriptions of all cables used in the tested system (including inserted cards, which have grants) are:

TABLE 1: TEST SYSTEM DETAILS

DESCRIPTION	MANUFACTURER	MODEL	SERIAL NO.	FCC ID	CABLE DESCRIPTIONS	RTL BAR CODE
Transmitter Module (EUT)	**Backgrounds Unlimited, Incorporated., Inc.**	**TXBD11A**		**NH5FWVTXBD11A**	**Unshielded Power**	
Television	Sony Corp.	PVM-1354Q	2019597	N/A	Shielded I/O, Unshielded Power	900470
Receiver	RF-Link Technology, Inc.	Wavecom FR101J	7B052J	N/A	Shielded I/O, Unshielded Power, Shielded Coaxial Cable	7140
Receiving Antenna (Camera)	Backgrounds Unlimited, Incorporated.	FWV-01A	12A6	NH5FWVTXBD01A	N/A	7138
VCR	JVC	HR-S5100U	15920318	ASIP5D024	Shielded I/O, Unshielded Power	900161
Pattern Generator	Phillips	PM5418TDSI	NC: 9452 054 18763 NO: LO 662559	N/A	Shielded I/O	900369

1.4 CONFIGURATION OF TESTED SYSTEM




120
VAC
2m unshielded
PVC Cable
12 AC/DC
Power Supply
1m unshielded
1m unshielded
Shielded cables to EUT
Audio input port
1m shielded
VCR
EUT
BACKGROUNDS
UNLIMITED, INC.
TXBD11A
TRANSMITTER UNIT
FCC ID:
NH5FWVTXBD11A
Table Top

~~1.5 TEST METHODOLOGY~~

~~All tests were performed according to the procedures contained in ANSI 63.4 1992, TIA/EIA-603 February 1993 measurement procedures and FCC Rules and Regulations per CFR 47, part 90, October 1, 1997 and Part 2, October 1, 1997. Spectrum efficiency standard, RF power output, spurious emissions at antenna terminal, occupied bandwidth, frequency stability versus temperature and voltage, transient frequency behavior were measured per the aforementioned documents. Field strength of spurious radiation testing was performed at an antenna to EUT distance of 3 meters.~~

~~.~~

~~1.6 TEST FACILITY~~

~~The open area test site and conducted measurement facility used to collect the radiated data is located on the rear lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report dated March 3, 1996, submitted to and approved by the Federal Communication Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 1992).~~

~~Remove this page~~

2.0 PRODUCT LABELING

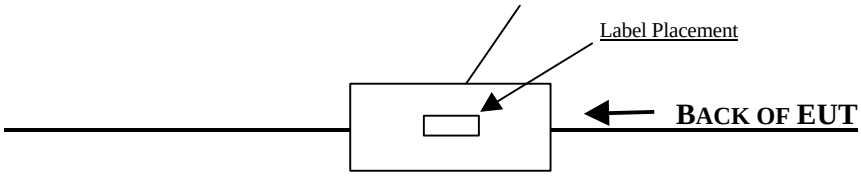
FIGURE 1: FCC ID LABEL

Backgrounds Unlimited, Incorporated.

This device complies with the FCC, part 15 rules.
Operation is subject to the following two conditions:
1) This device may not cause harmful interference.
2) This device must accept any interference received, including interference that may cause undesired operation.

FCC ID: NH5FWVTXBD11A

FIGURE 2: LOCATION OF LABEL ON EUT



3.0 SYSTEM TEST CONFIGURATION

3.1 JUSTIFICATION

To complete the test configuration required by the FCC, the transmitter was connected to the external video/audio base band output of a VCR. With the EUT's antenna installed and an off the shelf AC/DC power supply connected, a receiver attached to an external monitor ~~aws~~was used to monitor the EUT's data. The EUT was tested in all three orthogonal planes in order to determine worst case emissions. The EUT was investigated and tested from 9KHz to 22.5GHz. The following IF, local oscillators, and crystal oscillators namely …… and their harmonics were investigated and tested.

3.2 EUT EXERCISE SOFTWARE

The EUT was enabled to continuously transmit data with base band video and audio from the VCR directly connected to the transmitters video and audio inputs in order to modulate the RF carrier. The carrier was also checked to verify that the information was being transmitted on an external monitor connected to an RF receiver. Worst case emissions are recorded in the data tables.

3.3 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 to the equipment during testing in order to achieve compliance with these standards.

Furthermore, there was no deviation from, additions to or exclusions from the FCC Part 90 Certification 2450-2483MHz Band test methodology.

Signature: _____ Date: December 4, 1998

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

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 STANDARD REQUIREMENTS

TYPE ACCEPTANCE FCC PART 90: PRIVATE LAND MOBILE RADIO SERVICES SUBPART I : GENERAL TECHNICAL STANDARDS AND FCC PART 2 SUBPART J: EQUIPMENT AUTHORIZATION PROCEDURES

4.1 FCC PART 90.211(C) AND PART 2.987: MODULATION REQUIREMENTS AND CHARACTERISTICS

4.1.1 FCC Part 2.987(a): Audio Frequency Response

4.1.1.1 Method of Measurement:
The method used is referenced in the following publication ANSI/TIA/EIA-603: 1992 Land Mobile for PM Communications Equipment Measurement and Procedure Standard (Section 2.2.6 and 5.2.6)

4.1.1.2 Test Results:

~~INSERT PLOTS~~

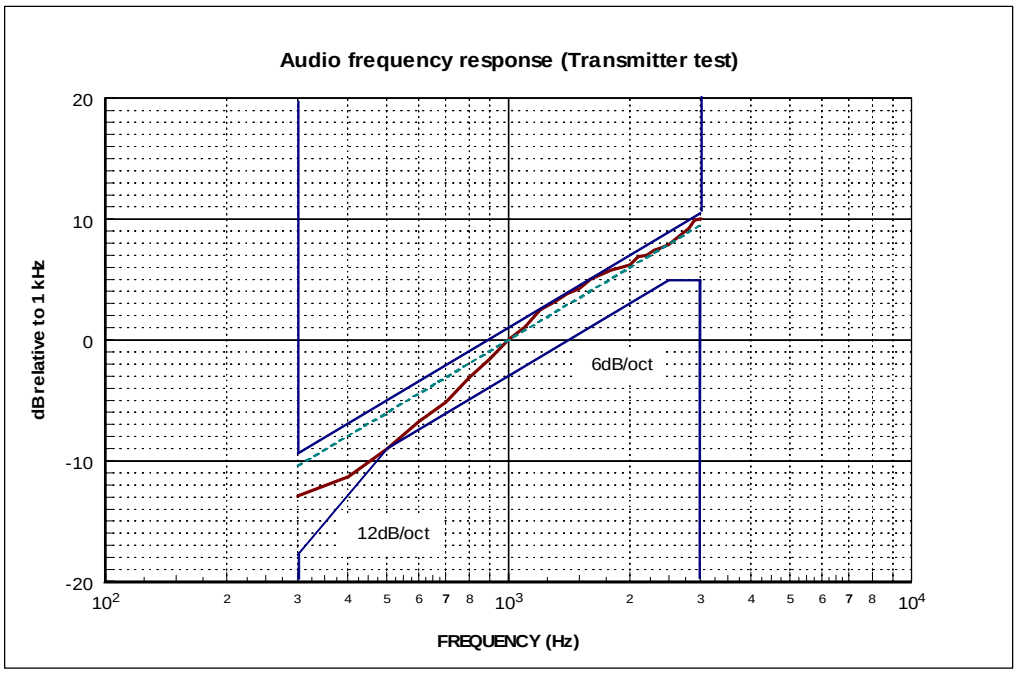


FIGURE 3: AUDIO FREQUENCY RESPONSE

4.2 FCC PART 2.987(a): AUDIO LOW PASS FILTER RESPONSE

4.2.1 Method of Measurement:

The method used is referenced in the following publication: ANSI/TIA/EIA-603: 1992 Land Mobile for PM Communications Equipment Measurement and Procedure Standards (Section 2.2.15 and 5.2.15).

4.2.2 Test Results:

~~INSERT PLOTS~~

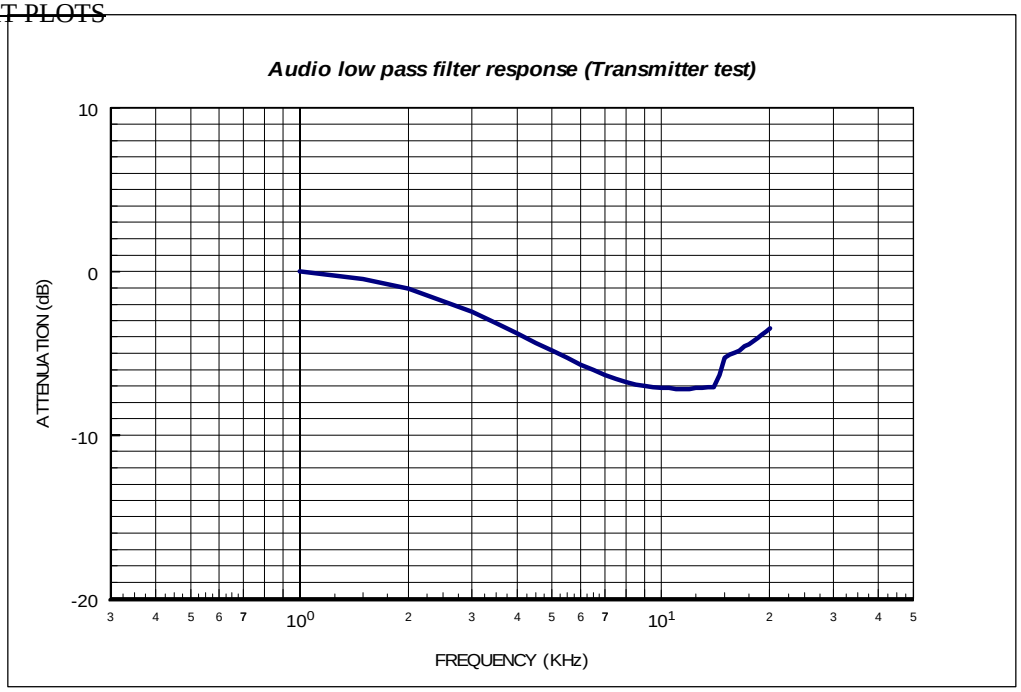
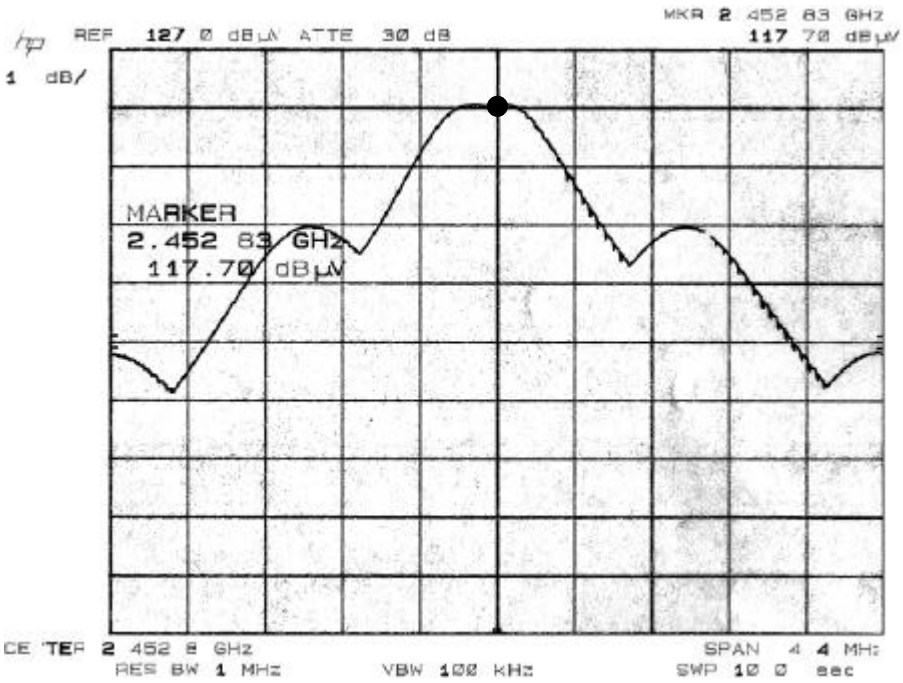


FIGURE 4: AUDIO LOW PASS FILTER RESPONSE

4.3 FCC Part 2.989(b) OCCUPIED BANBWIDTH per ANSIC63.4 section 13.1.7.

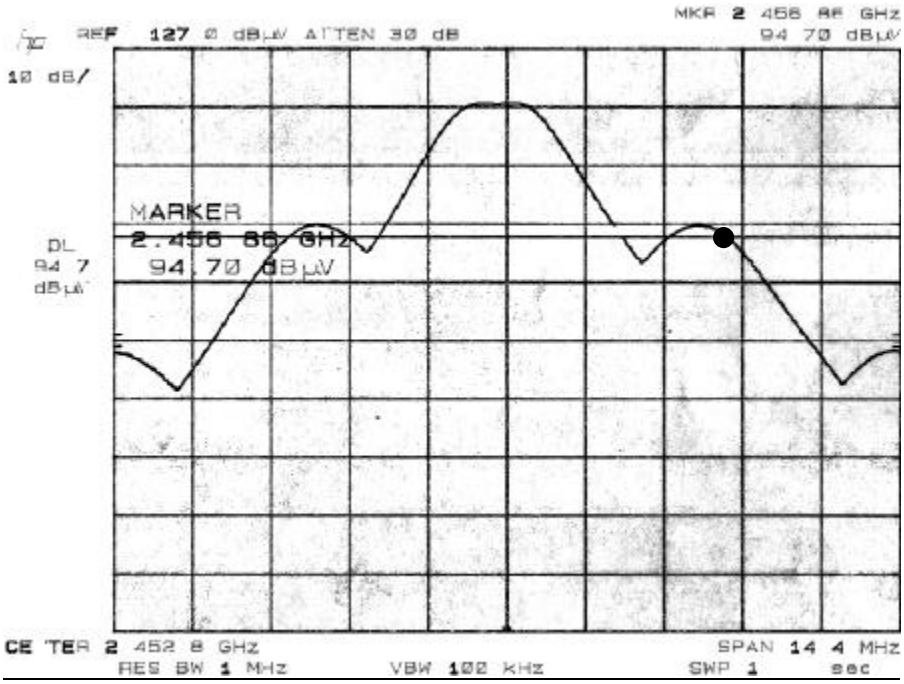
The occupied bandwidth that is the frequency bandwidth such that, below its lower and above its upper frequency limit the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission shall be measured under the following condition as applicable. An NTSC pattern generator with sound capability was used as the input source to the audio and video input of the transmitter (EUT) in order to provide modulation. A color bar pattern wsa selected on the generator enabling a constant maximum modulation. The occupied bandwidth was measured per ANSI 63.4 section 13.1.7 to be 7.66 MHz see Occupied bandwidth plots.

~~ISERT OCCUPIED BANDWIDTH PLOTS~~



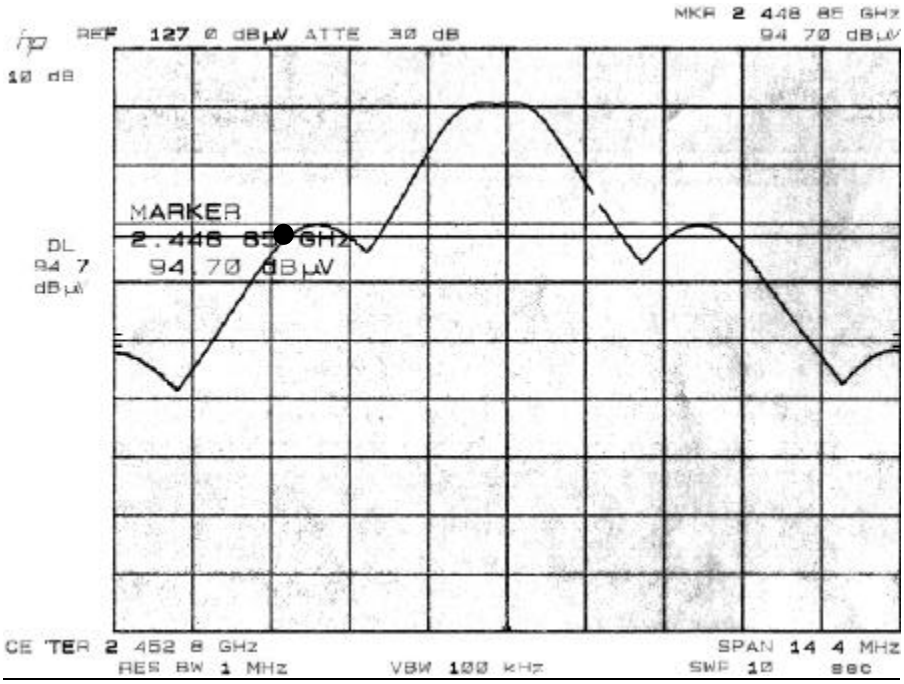
f_o=2.453 GHz
Modulated Carrier

FIGURE 5: BANDWIDTH DETERMINATION 2.453 GHZ



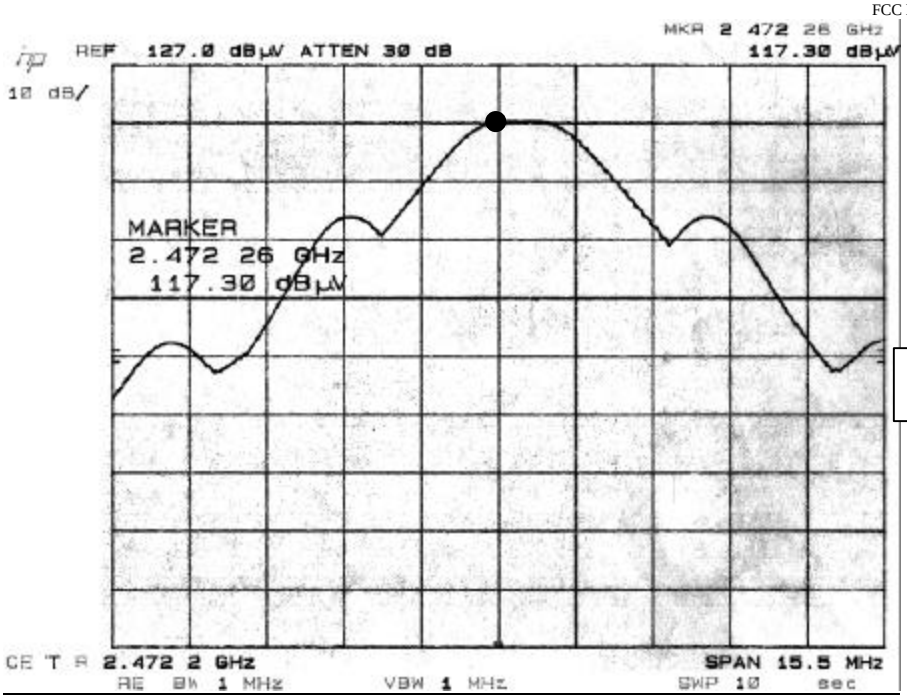
f_o=2.453 GHz
Modulated Carrier

FIGURE 6: BANDWIDTH DETERMINATION 2.453 GHZ



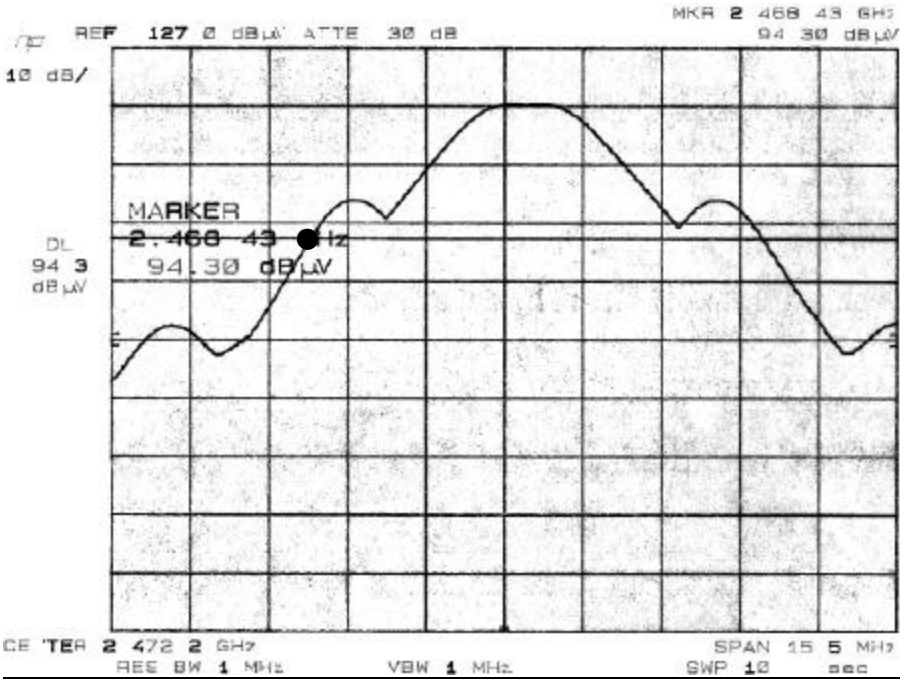
f_o=2.453 GHz
Modulated Carrier

FIGURE 7: BANDWIDTH DETERMINATION 2.453 GHZ



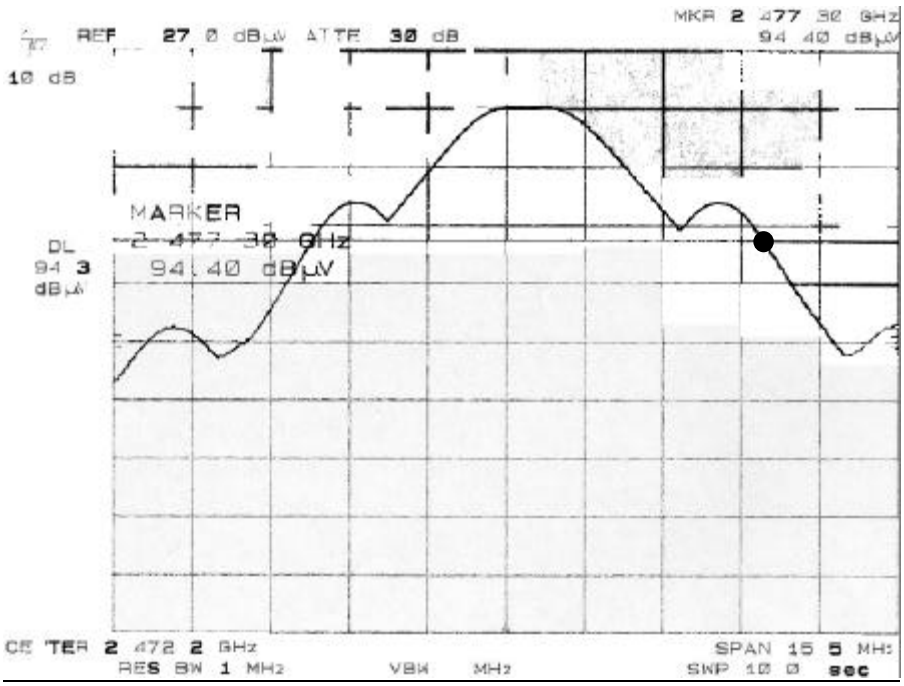
f_o=2.473 GHz
Modulated Carrier

FIGURE 8: BANDWIDTH DETERMINATION 2.473 GHz



f_o=2.473 GHz
Modulated Carrier

FIGURE 9: BANDWIDTH DETERMINATIO 2.473 GHz



f_o=2.473 GHz
Modulated Carrier

FIGURE 10: BANDWIDTH DETERMINATION 2.473 GHZ

4.3 FCC PART 90.205(L) AND PART 2.985:

4.3.1 RF POWER OUTPUT (ERP):

The RF power output is 11.75mW and therefore it complies with the 5 Watt limit.

4.3.2 METHOD OF MEASUREMENT:

DIRECT Conducted measurement: Transmitter antenna directly port connected to EMI receiver

Termination	Level (dBuV)	Output Power (mW)
50 ohm	117.7	11.75

4.4 FCC PART 90.207: TYPE OF EMISSIONS - EMISSION DESIGNATOR

The first symbol indicates the type of modulation on the transmitter carrier. The second symbol indicates the type of signal modulating the transmitter carrier. The third symbol indicates the type of transmitted information.

Designator for the Transmitter (EUT)M/N:TXBD11A, FCCID: NH5FWVTXBD11A , is : F3F

4.5 FCC PART 2.997(A)(1): FREQUENCY SPECTRUM TO BE INVESTIGATED

(a) In all of the measurement set forth in 2.991 and 2.993, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10GHz: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

4.6 FCC PART 90.210(B) AND PART 2.991: EMISSION MASKS AND SPURIOUS EMISSIONS AT ANTENNA TERMINAL

4.6.1 Method of Measurement:

The transmitter was properly loaded with a 50 Ohm termination and operated under normal conditions in its intended use. That is the maximum rated conditions under which the equipment will be operated.

For measuring emissions up to and including 50kHz from the edge of the authorized bandwidth was adjusted to 100Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps was measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must be no less than the instrument resolution bandwidth. For frequencies more than 50kHz removed from the edge of the authorized bandwidth a resolution of at least 10kHz was used for frequencies below 1000 MHz. Above 1000 MHz, the resolution bandwidth of the instrumentation was at least 1 MHz.

Applicable emission mask for equipment designed to operate with a 25kHz channel bandwidth:

Frequency (MHz)	Mask for equipment with audio low pass filter
2.473 and 2.453	B

4.7 FCC Part 90.210 (B)(1)(2)(3):

The power of any emission must be attenuated below the unmodulated carrier power P as follows:

Frequency Range (kHz) Displacement Frequency	Reference unmodulated output level (dBuV/mW)	Attenuation (dB) from reference level
Fo+50% of ABW*<Fd<Fo+100% of ABW Fo-100% of ABW*<Fd<Fo-50% of ABW	117.7/11.75	25
Fo+100% of ABW*<Fd<Fo+250% of ABW Fo-250% of ABW*<Fd<Fo-100% of ABW	117.7/11.75	35
Fo+250% of ABW*<Fd<22.473GHz 9KHz<Fd<Fo-250% of ABW	117.7/11.75	43+10Log(P)=45.1

Measurements of emission power are expressed with the same parameters used to specify the unmodulated transmitter carrier power.
*: ABW is the Authorized Bandwidth (Note that no value is provided in this part.)
Fo: Carrier fundamental frequency (MHz)
Fd: Displacement frequency
P: Output power in watt

Figures 3 through 35, Section 5.0 demonstrate compliance with the emission mask B.

4.8 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION

4.8.1 Method of Measurement

A 50 Ohm dummy load is used to terminate the transmitter antenna output port. A second antenna is placed adjacent to the device under test and is connected to a signal generator providing a reference power level. The requirement assumes that all emissions are radiated from half-wave dipole antennas. See section 1.5 and Section 8 for additional information concerning the radiated emission test methodology.

Data test results are provided in Table 2, Section 5.2.

4.9 FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE

4.9.1 Method of Measurement

The transmitter is set in operation with the maximum rated output power specified by the manufacturer. A Thermotron temperature chamber is used to perform the test. The transmitter is exercised with a transmission mode providing a continuous stream of data. The ambient temperature is varied from -30° to +60°C. The device under test is operated for 15 minutes prior to testing. A sufficient period of time (about 30 minutes) before any measurements was observed to stabilize all transmitter components for each temperature level.

4.9.2 Minimum Frequency stability (ppm)

See Table 3, Section 5.4 for data test results.

5.0 MEASUREMENT PLOTS

5.1 MEASUREMENT PLOTS FCC PART 90.210 (B) / PART 2.993

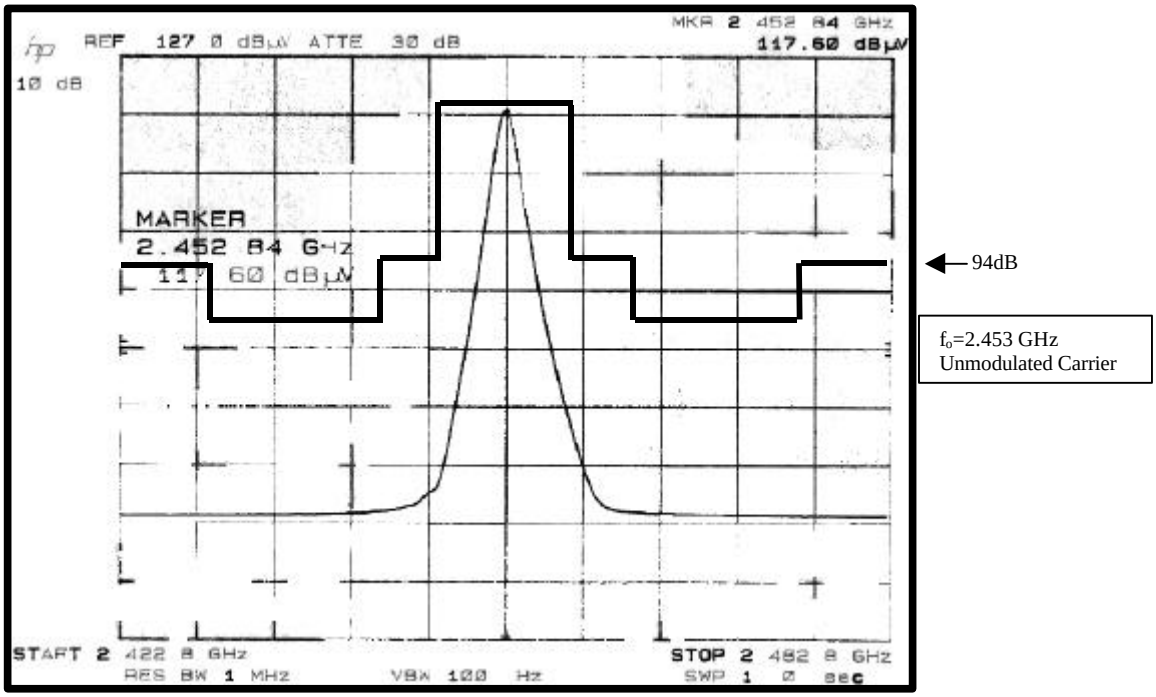


FIGURE ~~3~~11: -FCC PART 90.210 (B) MASK

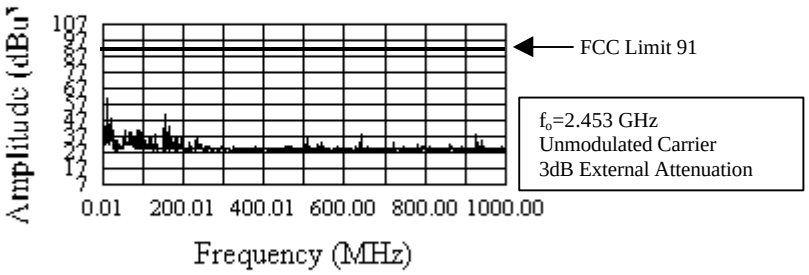


FIGURE 12: 9 KHZ TO 1 GHZ

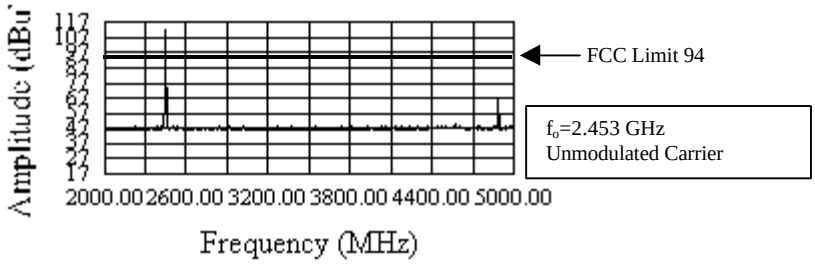


FIGURE 13: 1 to 5 GHz

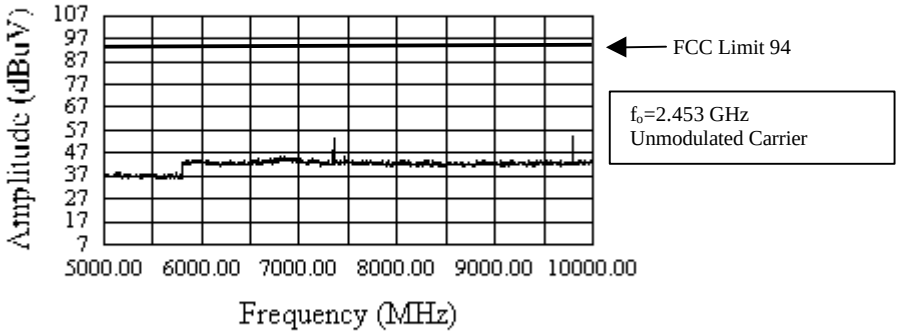


FIGURE 14: 5 TO 10 GHZ

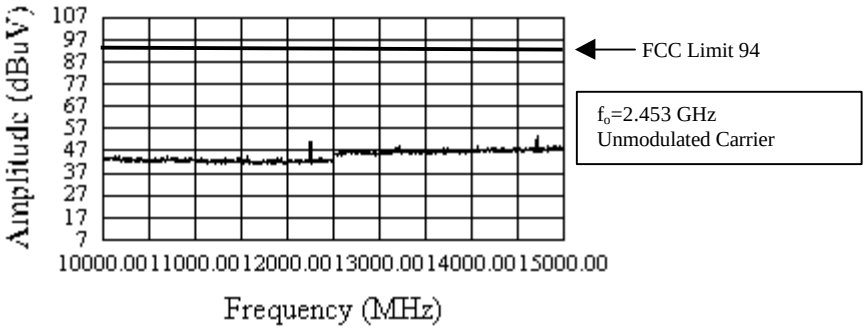


FIGURE 15: 10 TO 15 GHZ

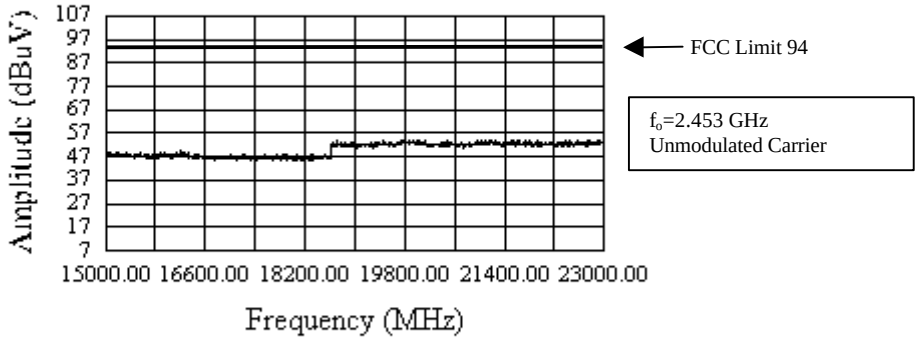


FIGURE 16: 15 TO 23 GHZ

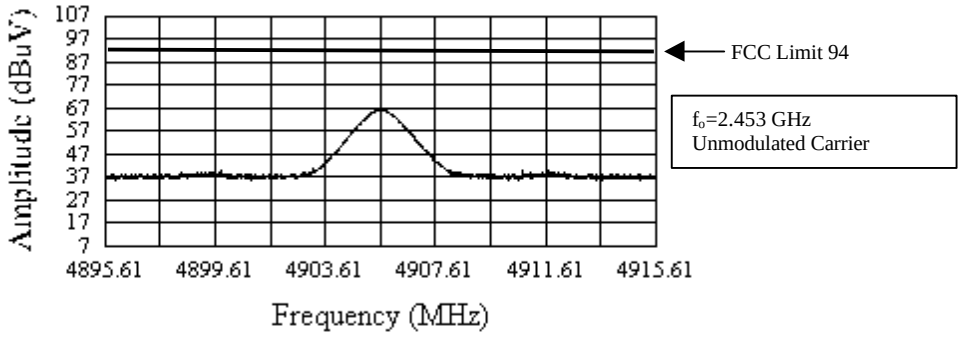


FIGURE 17: 4.905 GHZ FIRST HARMONIC

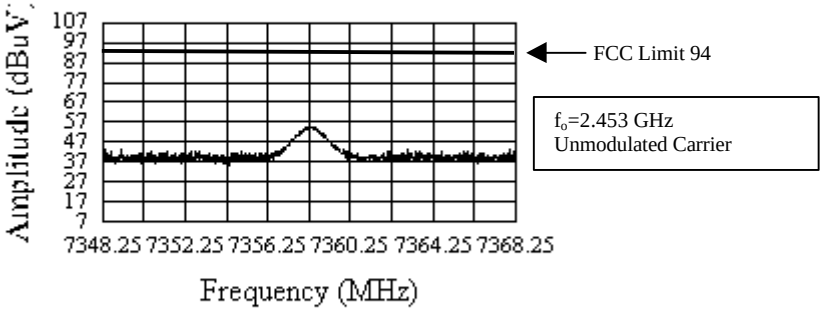


FIGURE 18: 7.358 GHZ SECOND HARMONIC

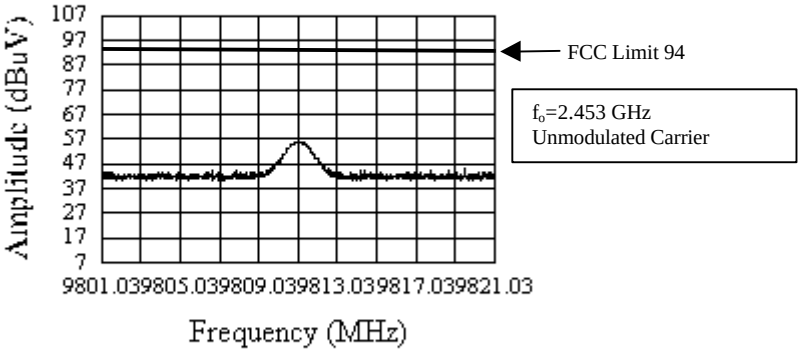


FIGURE 19: 9.811 GHZ THIRD HARMONIC

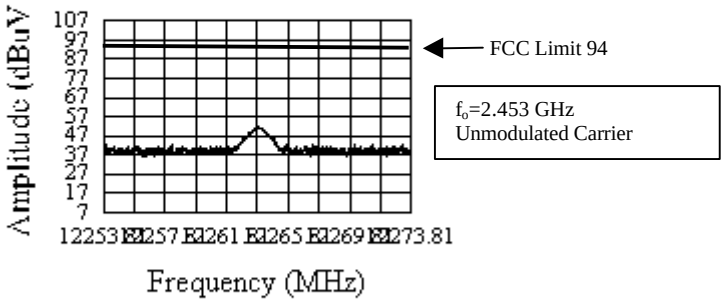


FIGURE 20: 12.263 GHz FOURTH HARMONIC

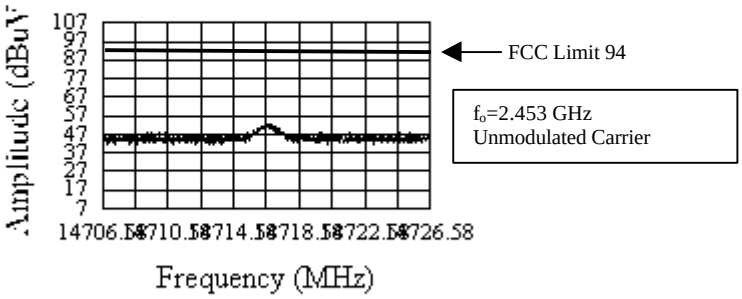
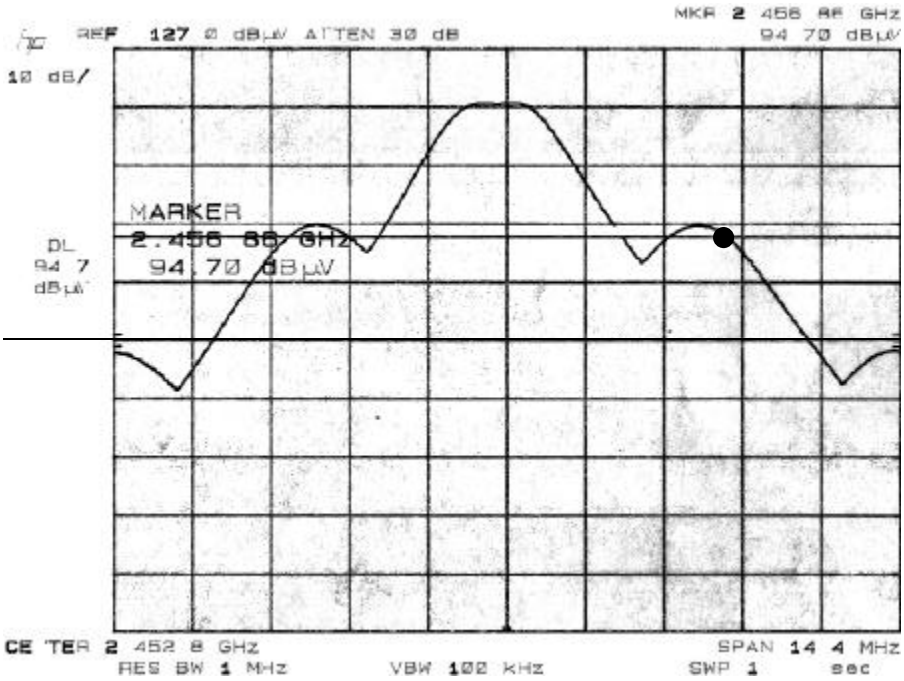


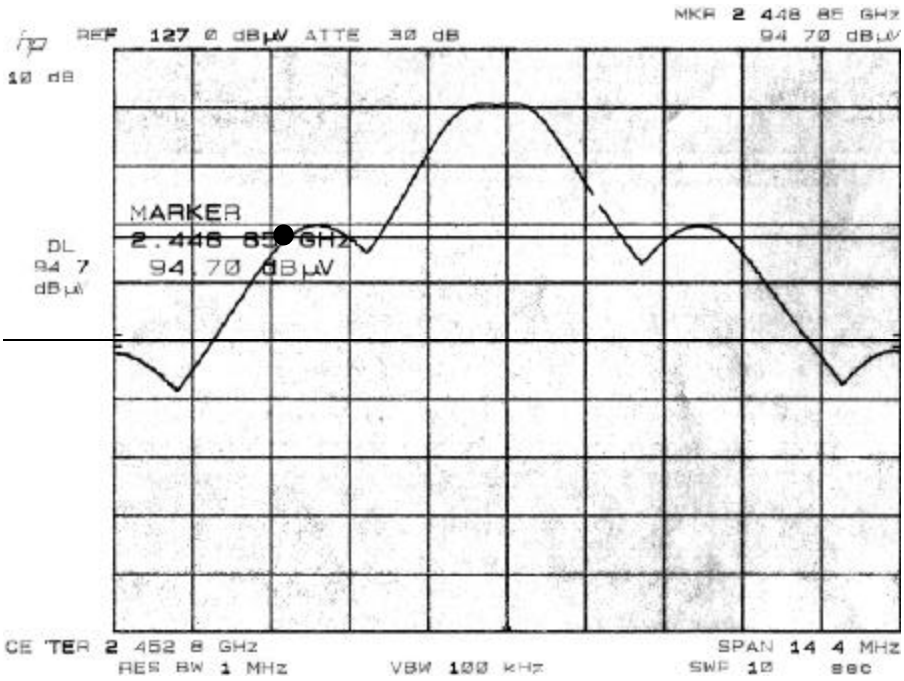
FIGURE 21: 14.716 GHz FIFTH HARMONIC

~~FIGURE 4: BANDWIDTH DETERMINATION 2.453 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~



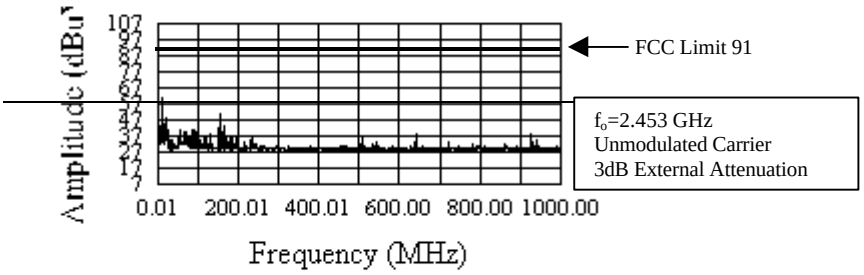
f_o=2.453 GHz
Modulated Carrier

~~FIGURE 5: BANDWIDTH DETERMINATION 2.453 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~

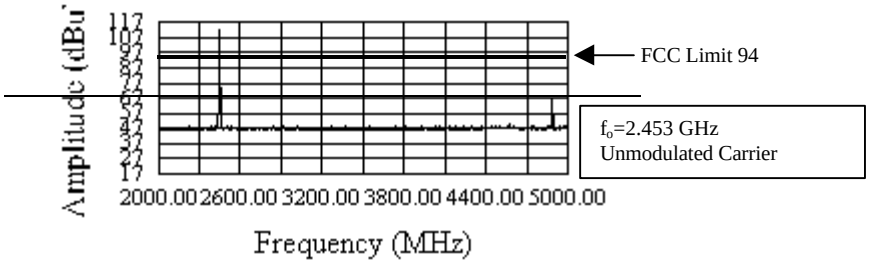


f_o=2.453 GHz
Modulated Carrier

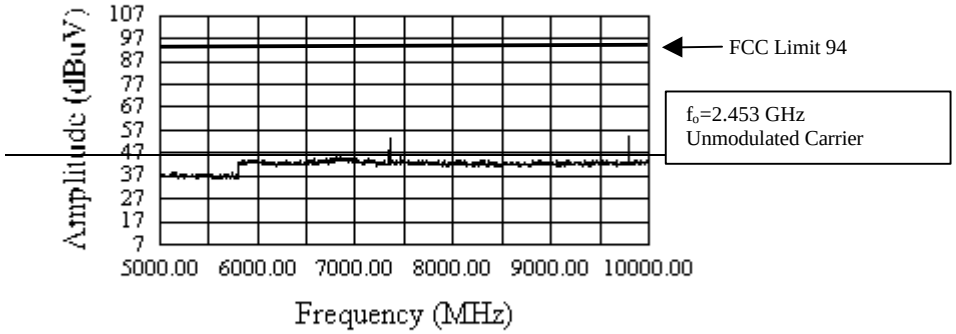
~~FIGURE 6: BANDWIDTH DETERMINATION 2.453 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~



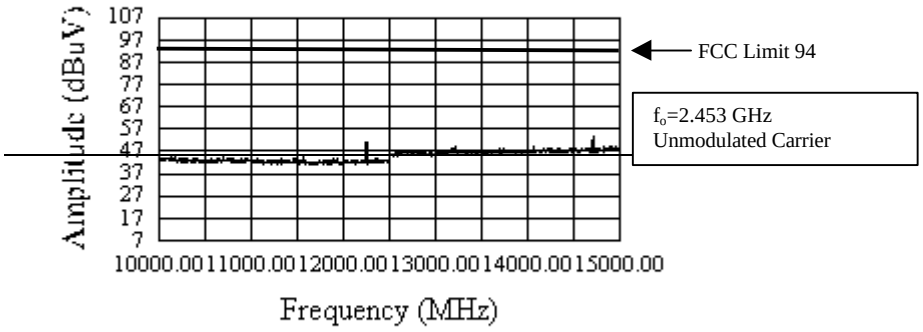
~~FIGURE 7 9 KHZ TO 1 GHZ~~



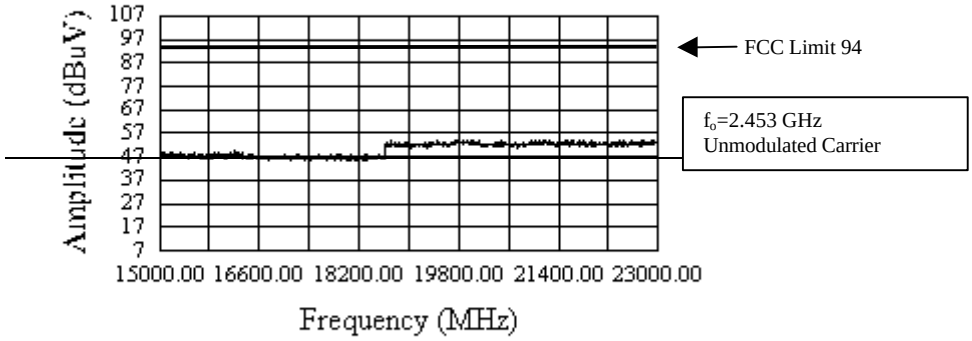
~~FIGURE 8: 1 to 5 GHz~~



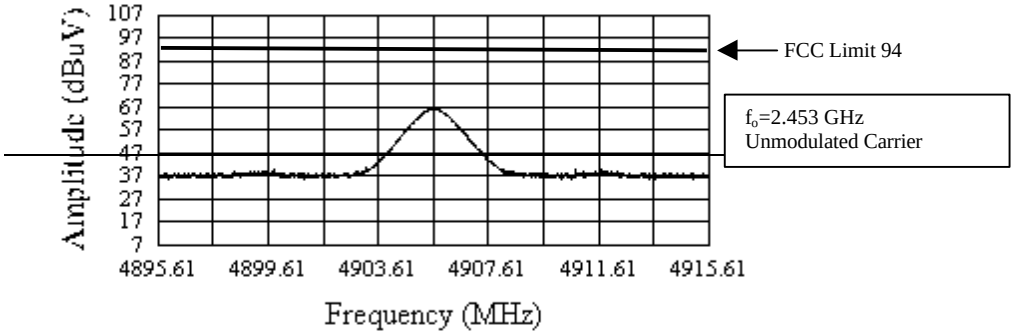
~~FIGURE 9: 5 TO 10 GHZ~~



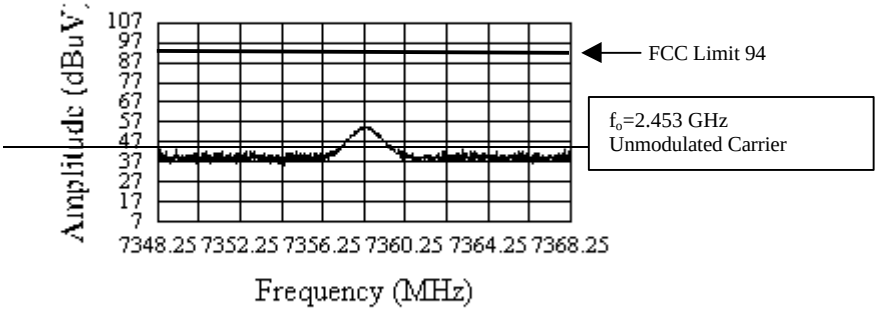
~~FIGURE 10: 10 TO 15 GHZ~~



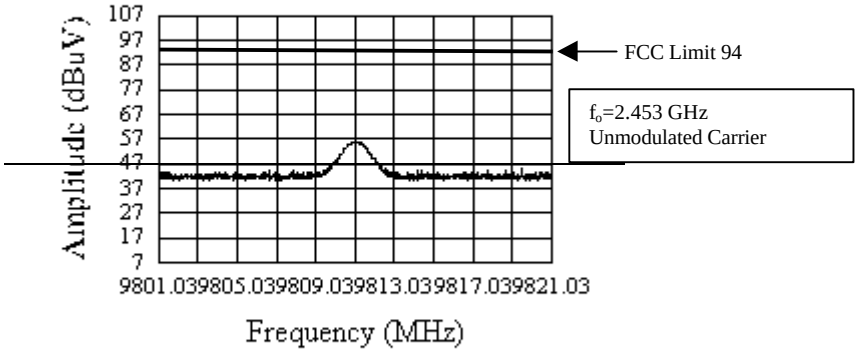
~~FIGURE 11: 15 TO 23 GHZ~~



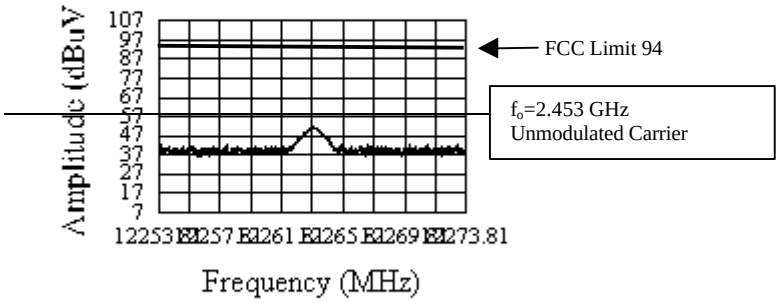
~~FIGURE 17: 4.905 GHZ FIRST HARMONIC~~



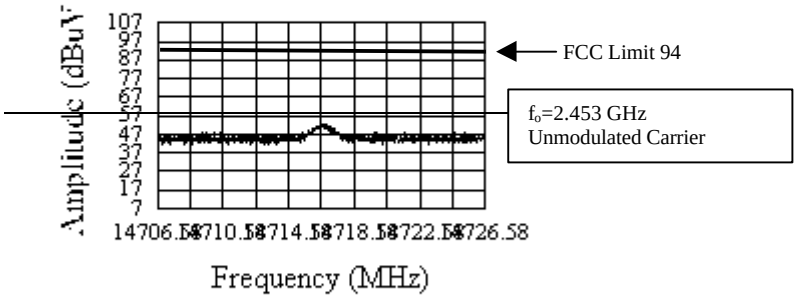
~~FIGURE 18: 7.358 GHZ SECOND HARMONIC~~



~~FIGURE 19: 9.811 GHZ THIRD HARMONIC~~



~~FIGURE 20: 12.263 GHZ FOURTH HARMONIC~~



~~FIGURE 21: 14.716 GHZ FIFTH HARMONIC~~

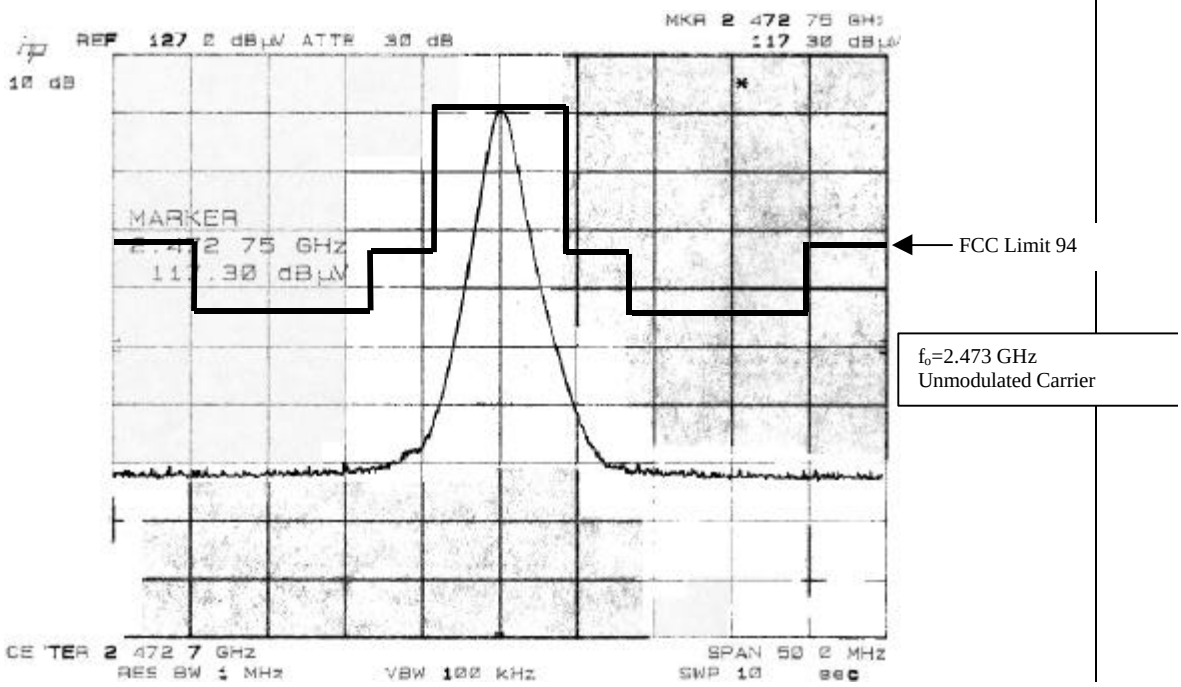
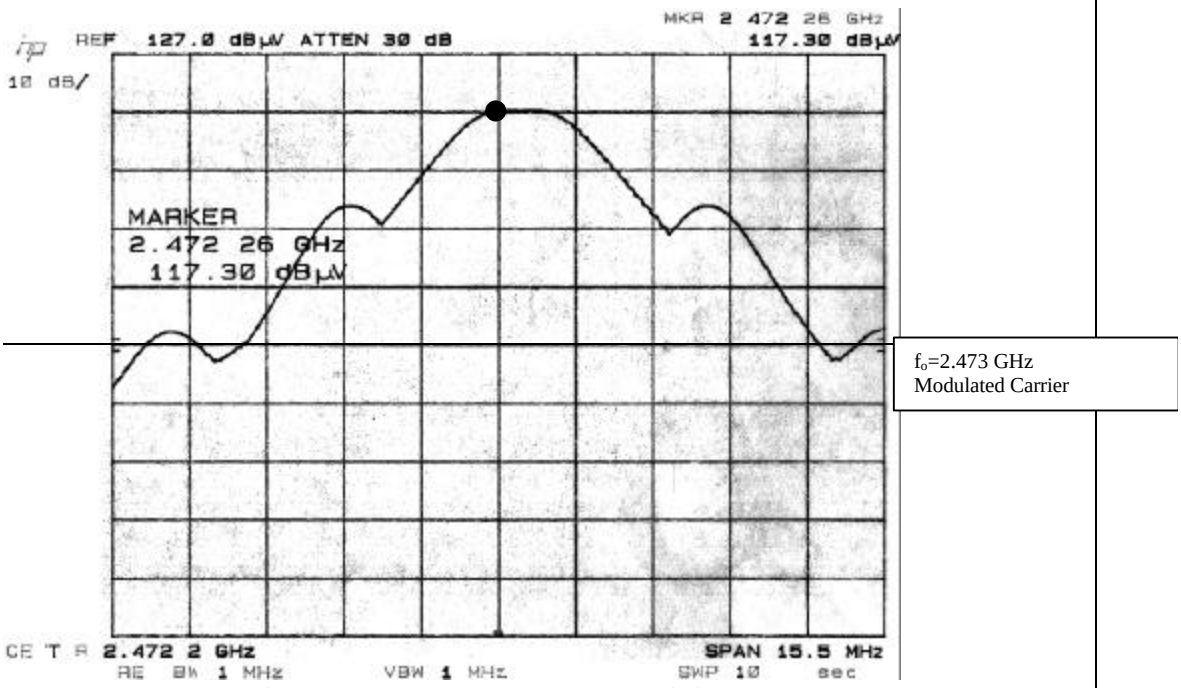
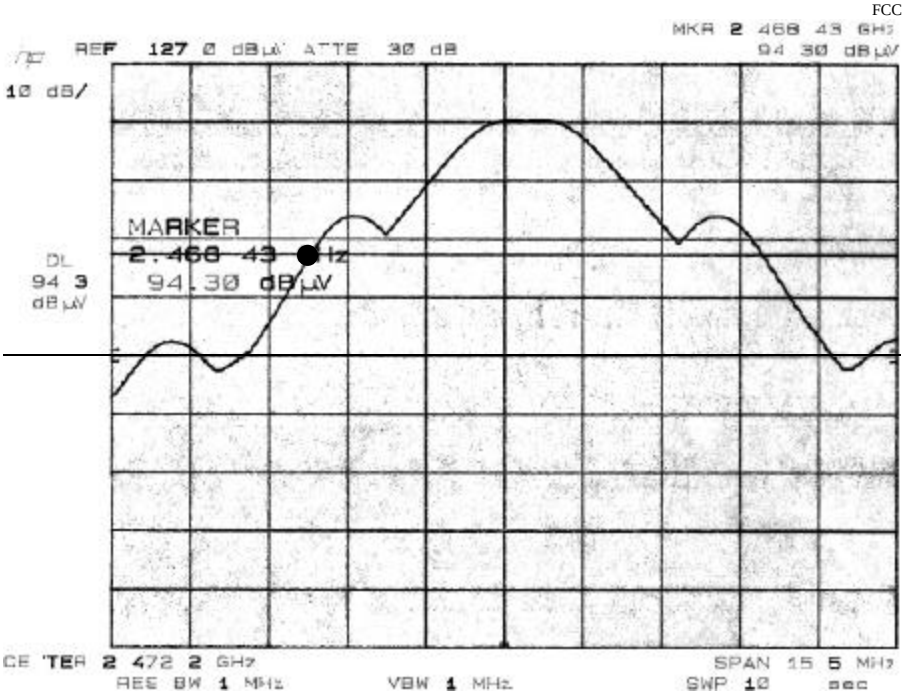


FIGURE 22: FCC PART 90.210 (B) MASK

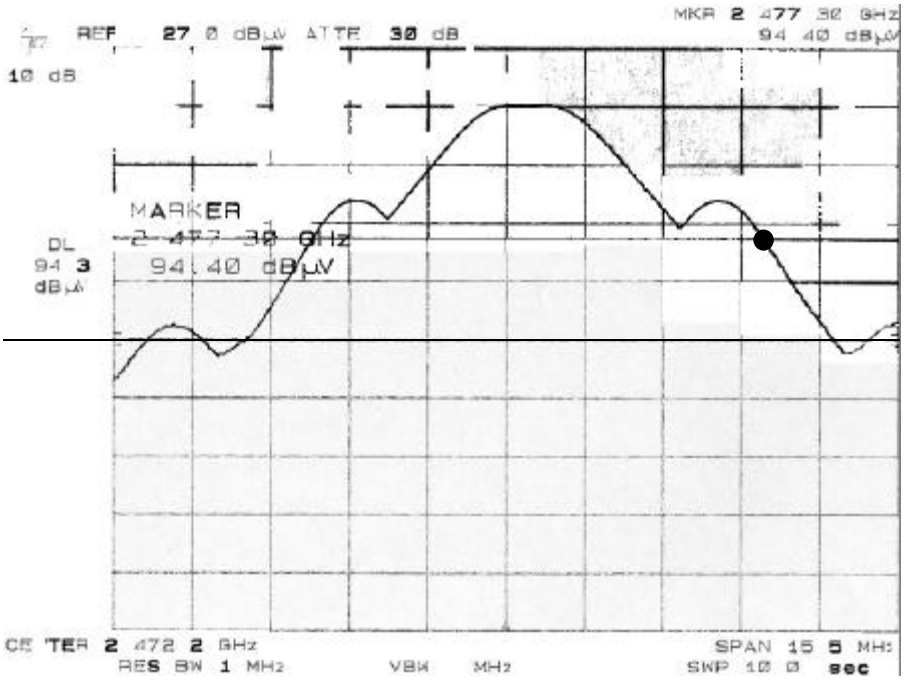


~~FIGURE 23: BANDWIDTH DETERMINATION 2.473 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~



f_o=2.473 GHz
Modulated Carrier

~~FIGURE 24: BANDWIDTH DETERMINATIO 2.473 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~



f_o=2.473 GHz
Modulated Carrier

~~FIGURE 25: BANDWIDTH DETERMINATION 2.473 GHz~~
~~FCC PART 2.989/ANSI C63.4:1992, SECTION 13.1.7~~

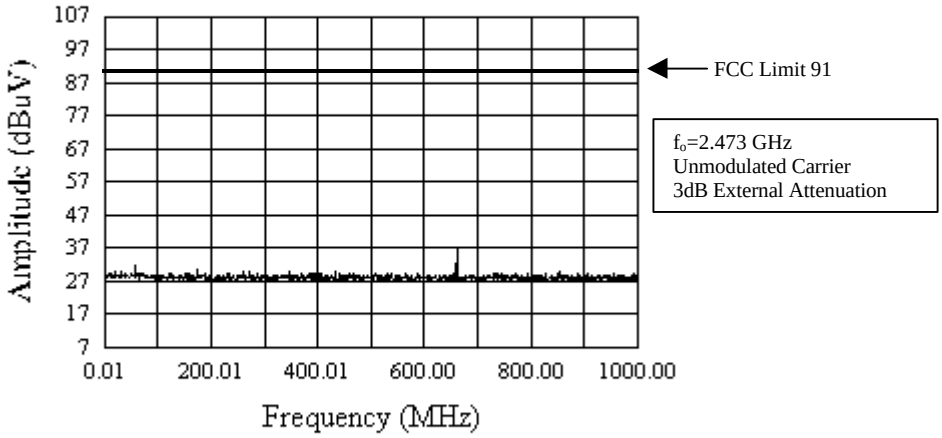


FIGURE ~~26~~23: 9 kHz to 1 GHz FCC

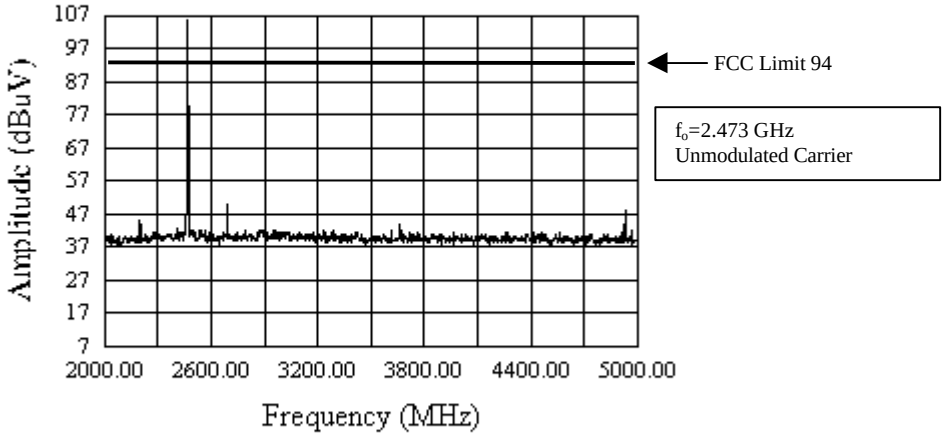


FIGURE ~~27~~24: 1 TO 5 GHZ

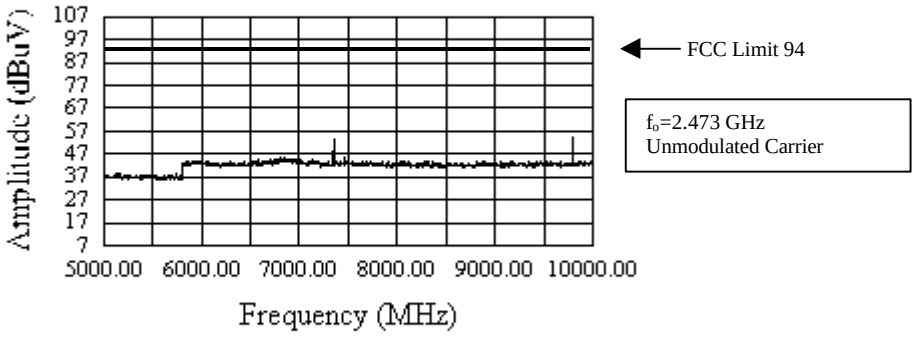


FIGURE ~~28~~25: 5 to 10 GHz

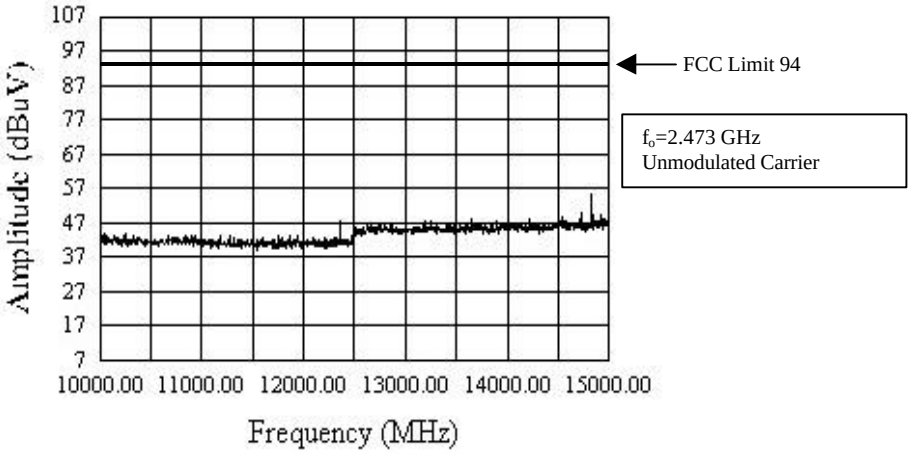


FIGURE ~~29~~26: 10 TO 15 GHZ

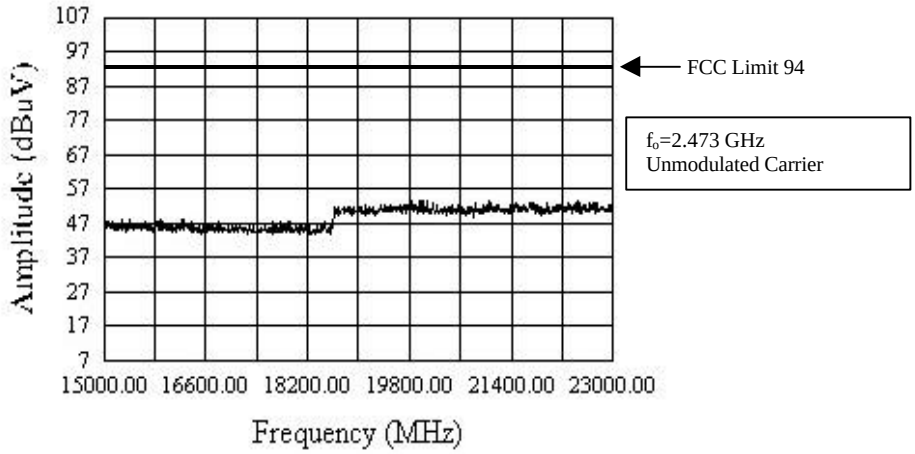


FIGURE ~~30~~27: 15 TO 23 GHZ

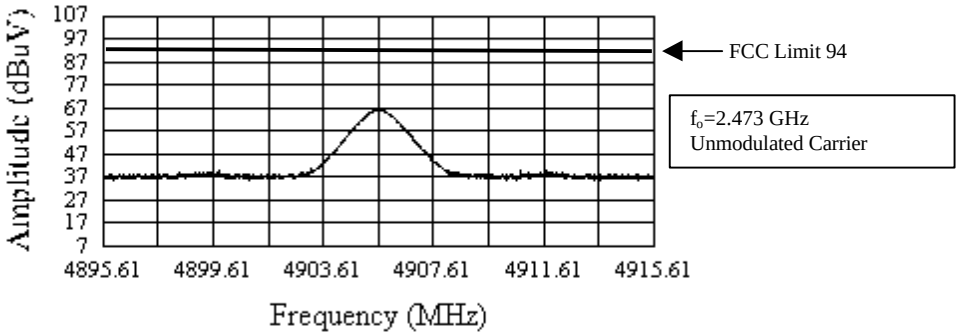


FIGURE ~~31~~28: 4.945 GHZ FIRST HARMONIC

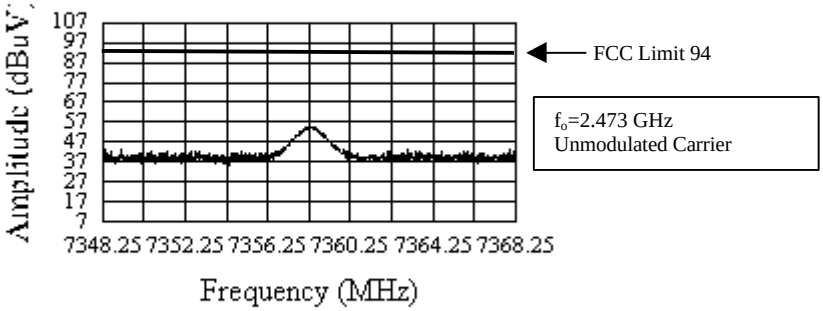


FIGURE ~~32~~29: 7.418 GHZ SECOND HARMONIC

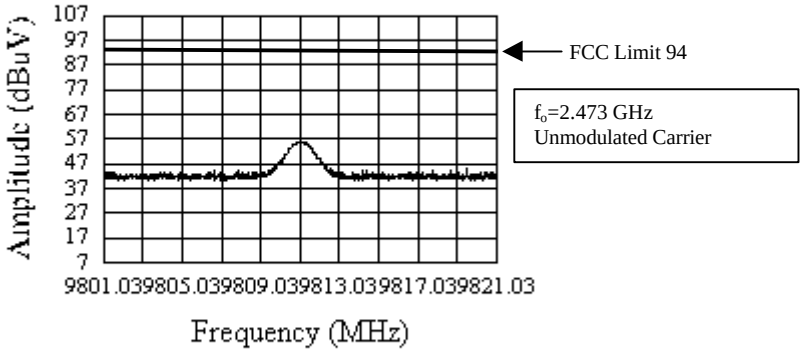


FIGURE ~~33~~30: 9.891 GHZ THIRD HARMONIC

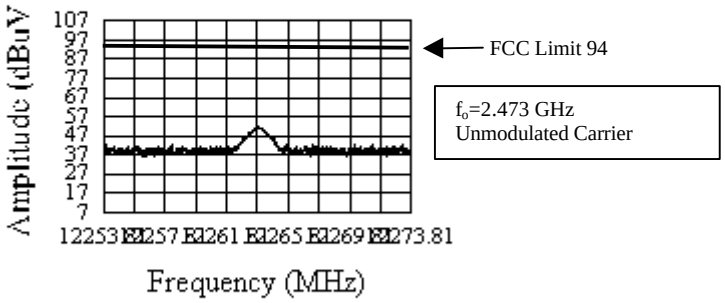


FIGURE ~~34~~31: 12.363 GHZ FOURTH HARMONIC

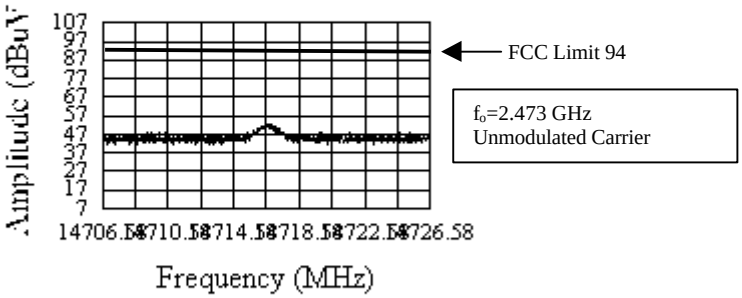


FIGURE ~~35~~32: 14.836 GHZ FIFTH HARMONIC

5.2 FCC PART 2.993: FIELD STRENGTH OF SPURIOUS RADIATION

The following data lists the significant emission frequencies, measured levels, correction factor (includes cable and antenna corrections), the corrected reading, plus the limit.

TABLE 2: RADIATED EMISSIONS: FCC PART 2.993

Transmitter Section
Distance: 3 Meters
Output Power Measured 117.7 dBuV = 11.7 mW
43+10Log P = 23.7 dB down from P thus 117.7-23.7=94dBuV=-13dBm
Oscillators: 2.411GHz/2.434GHz/2.453GHz/2.473GHz

Freq. MHz	Polar.	CL Ref. dB	S/G level dBm	TX Gain dBi	Gain Diff.* dB	Ref. Rdg. dBm	DUT Rdg. dBm	Margin dB	TX Antenna #
2453.0	H	N/A	N/A	N/A	N/A	-19.4	N/A	N/A	2
4905.0	H	30.2	16.29	1.24	-0.91	-38.6	-53.3	-14.7	2
7.358	H	41.5	27.88	1.53	-0.62	-48.0	-59.6	-11.6	2
2473.0	H	N/A	N/A	N/A	N/A	-19.4	N/A	N/A	2
4945.0	H	30.7	16.77	1.22	-0.93	-40.3	-51.0	-10.7	2
7418.0	H	42.1	28.38	1.43	-0.72	-42.5	-60.6	-18.1	2

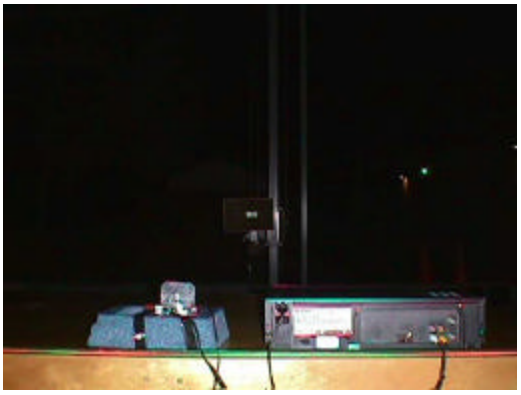
Antenna:
1.) Half Wave dipole S/N 274
2.) Spiral S/N 2620
*Difference in gain between half-wave dipole and antenna used for the reference power level.

TEST PERSONNEL:

Signature: _____ Date: 10/23/98

Typed/Printed Name: Daniel W. Baltzell

5.3 RADIATED MEASUREMENT PHOTOS



5.4 FREQUENCY STABILITY FUNCTION OF TEMPERATURE

TABLE 3: FCC PART 90.213 AND PART 2.995(A): FREQUENCY STABILITY FUNCTION OF TEMPERATURE

Frequency stability function of temperature		
Temperature (°C)	MCF(MHz)	PPM error $[(MCF/ACF)-1]10^6$
-30	451.3496	1.994
-20	451.3496	1.994
-10	451.3496	1.994
0	451.3496	1.994
10	451.34973	1.706
20	451.3501	0.886
30	451.35023	0.598
40	451.35035	0.332
50	451.3506	0.222

where MCF is the Measured Carrier Frequency in MHz, ACF is the Assigned Carrier Frequency in MHz. and ACF(MHz)=451.3505

5.5 FCC PART 90.214: TRANSIENT FREQUENCY BEHAVIOR

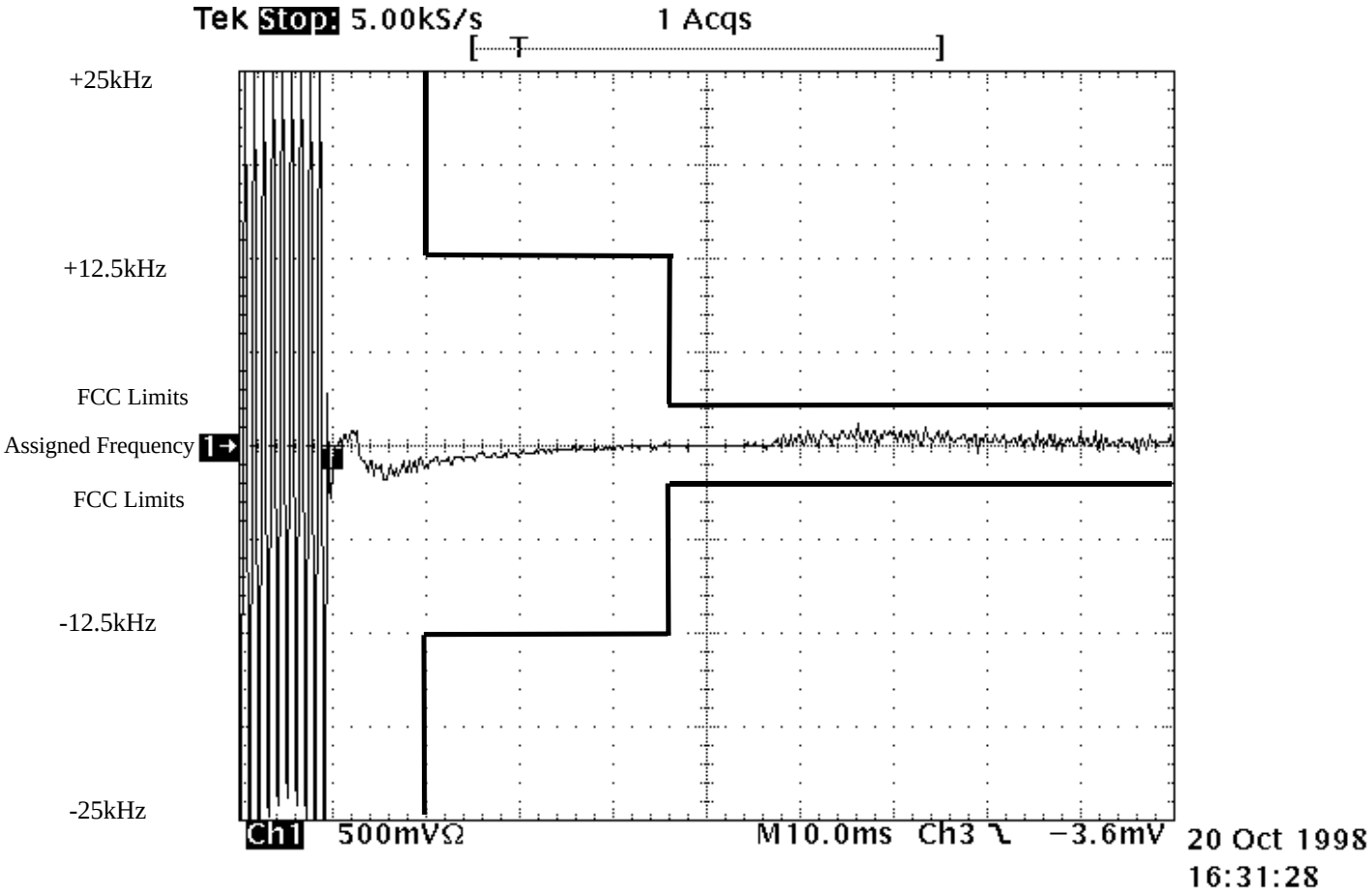


FIGURE ~~29~~33: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR

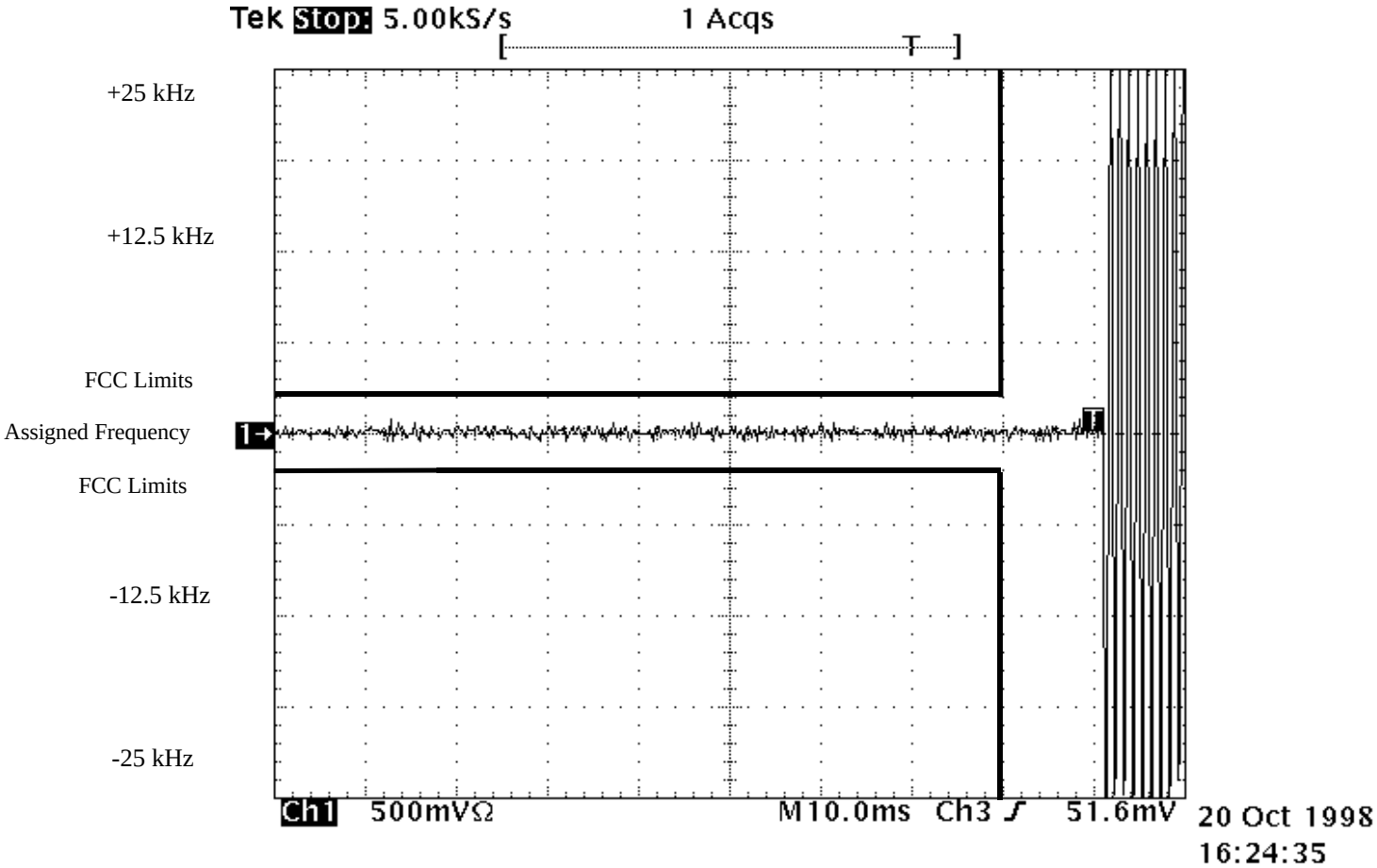


FIGURE ~~30~~34: PART 90.214, TRANSIENT FREQUENCY BEHAVIOR

6.0 BLOCK DIAGRAM

Please see following pages.

7.0 Field Strength Calculation, and Radiated Test Methodology

7.1 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

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

7.2 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 30 MHz to 1000 MHz using a Hewlett Packard 8566B spectrum analyzer, a Hewlett Packard 85650A quasi-peak adapter, and an Antenna Research bilog antenna. In order to gain sensitivity, an RTL PR-1040 preamplifier 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.

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 well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

8.0 PHOTOS OF TESTED EUT

FIGURE 35: 10 TO 15 GHZ

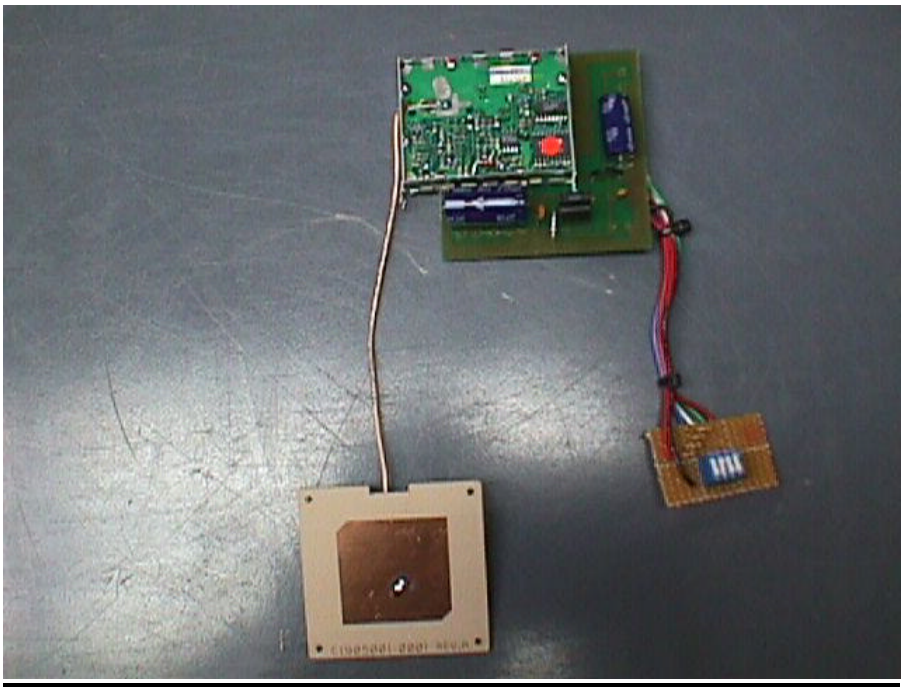


FIGURE 36: 10 TO 15 GHZ

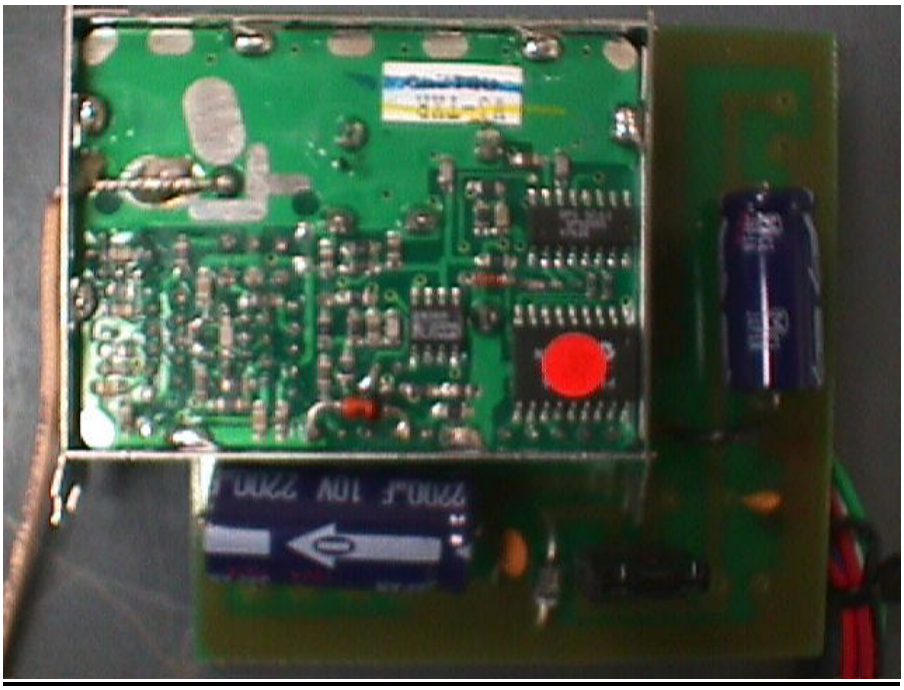


FIGURE 37: 10 TO 15 GHZ

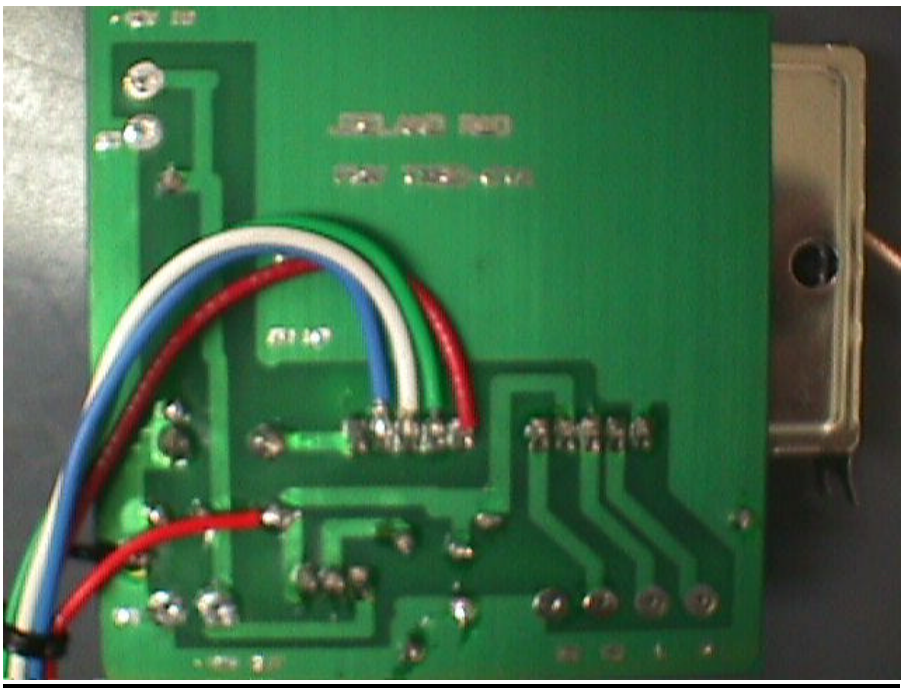


FIGURE 38: 10 TO 15 GHZ

~~FIGURE 31:~~

~~FIGURE 32:~~

~~FIGURE 33:~~

~~FIGURE 34:~~

~~FIGURE 35:~~

~~FIGURE 36:~~

~~FIGURE 37:~~

~~FIGURE 38:~~

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	EMCO	4610	9604-1313	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
Horn Antenna 1	EMCO	3160-10	9606-1033	EMCO
Horn Antenna 2	EMCO	3160-9	9605-1051	EMCO
Horn Antenna 3	EMCO	3160-7	9605-1054	EMCO
Horn Antenna 4	EMCO	3160-8	9605-1044	EMCO
Horn Antenna 5	EMCO	3160-03	9508-1024	EMCO
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

APPENDIX B:

USER'S MANUAL