



FCC CFR47 PART 90 CERTIFICATION

TEST REPORT

FOR

SINGLE CHANNEL 100W AMPLIFIER

MODEL: MRA4100C

FCC ID: O9HMRA4100C

REPORT NUMBER: 00U0336-1

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Prepared for
AMPLIFIER TECHNOLOGIES
26802 VIA LLANO
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LAB CODE:200065-0

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1. EUT PHOTOGRAPHS
2. INSTALLATION & SERVICE MANUAL
3. ADDENUM 1 SCHEMATIC & PARTS LISTS
4. PROPOSED FCC ID LABEL FORMAT

1. FCC CERTIFICATION INFORMATION

The following information is in accordance with FCC Rules, 47CFR Part2, Subpart J, Sections 2.983 – 2.999.

2.983(a)

Applicant:	AMPLIFIER TECHNOLOGIES 26802 VIA LLANO MISSION VIEJO CA 92691-2634
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Contact person: ROLAND HEILMAN

Telephone number: (949) 830-5720

2.983(b) FCC ID: O9HMRA4100C
Model: MRA4100C

2.983(c) Quantity production is planned

2.983(d) Technical Description

The MRA4100C is a linear, single channel amplifier that operates in the frequency band from 450 MHz to 470 MHz. Each amplifier is a self-contained plug-in module, up to 5 of which may be plugged into the MR6-5 5-Way Rack, and each amplifier is functionally independent of other amplifier modules. Input level to the MRA4100C is 15 watts, output level is 100 watts.

1) Type of emissions

F3E

2) Frequency Range

Power Amplifier: 450 – 470MHz

3) Maximum Power Rating

100 Watts

4) Applied voltage and currents into the final transistor elements

Refer to **Attachment: Schematics and Parts list**. Confidentiality is requested for these items.

5) Function of Each Active Device

Refer to **Attachment: Schematics and Parts list**. Confidentiality is requested for these items.

6) Complete Circuit Diagrams and Functional Diagram

Refer **Attachment: Schematics and Parts list**. Confidentiality is requested for these items.

7) Instructions/Installation Manual

Refer to **Attachment: Installation and Service manual**.

8) Tune-up/Optimizations Procedure

Refer to **Attachment: Installation and Service manual**.

9) Means for Frequency Stabilization

Not Applicable. Eut is an RF power amplifier.

10) Means for Limiting Modulation

Not Applicable. Eut is an RF power amplifier.

11) Means for Limiting Power.

Refer to Attachment: Theory of Operation. Confidentiality is requested for this item.

12) Means for Attenuating Higher Audio Frequencies

Not Applicable. Eut is an RF power amplifier

13) Description of Digital Modulation Techniques

Not Applicable.

2.983(e) Standard Test Condition

The power amplifier was tested under the following conditions.

DC Supply Voltage: 12.6Vdc

The amplifier was aligned and tuned up according to manufacturer's alignment procedure, prior to testing. All data presented represents the worst case parameter being measured.

2.983(f) Equipment Identification

A drawing of the equipment identification nameplate appears under **Attachment: PROPOSED FCC ID LABEL FORMAT.**

2.983(g) Photographs

Photographs of the equipment, internal and external views, are found in the **Attachment: Eut Photographs .**

2.983 Description of Various Base Station Configuration

Not Applicable.

2.983 Use of Various Power Supplies

Normal operation is from 12 .6 Vdc sources.

TYPE OF EQUIPMENT:	SINGLE CHANNEL 100W AMPLIFIER
MEASUREMENT DISTANCE:	3 METER
TECHNICAL LIMIT:	FCC 90.210, 90.691
FCC RULES:	PART 2, PART 15, PART 90
EQUIPMENT AUTHORIZATION PROCEDURE	CERTIFICATION
MODIFICATIONS MADE ON EUT	YES (REFER TO PAGE 9) x NO

The above equipment was tested by Compliance Certification Services for compliance with the requirements set forth in the FCC CFR 47, PARTS 2, 15 AND 90. The results of testing in this report apply to the product/system, which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Warning : This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification will constitute fraud and shall nullify the document.

Approved For Release By:

T. N. COKENIAS / ENGINEERING DIRECTOR
COMPLIANCE CERTIFICATION SERVICES

2. TEST FACILITY

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

3. ACCREDITATION AND LISTING

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code:200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT(1300F2))

4. MEASUREMENT INSTRUMENTATION

Radiated emissions were measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, BI-log, ridged waveguide, and liner horn. EMI receivers were used for line conducted readings, spectrum analyzers with pre-selectors and quasi-peak detectors were used to perform radiated measurements. Receiving equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and LISNs conform to CISPR specification for "Radio Interference Measuring Apparatus and Measurement Methods," Publication 16.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

5. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

6. UNITS OF MEASUREMENT

Measurements of radiated interference are reported in terms of dB(uV/m) at a specified distance. The indicated readings on the spectrum analyzer were converted to dB(uV/m) by

use of appropriate conversion factors. Measurements of conducted interference are reported in terms of dB(uV).

The field strength is calculated by adding the Antenna Factor and Cable Factors, then 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 52.5 dBuV is obtained. The Antenna Factor of 7.4dB/m and a Cable Factor of 1.1dB is added. The Amplifier Gain of 29 dB is subtracted, giving a field strength of 32 dBuV/m. The 32 dBuV/m value was mathematically converted to its corresponding level in uV/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dBuV/m}$$

$$\text{Level in uV/m} = \text{Common Antilogarithm} [(32 \text{ dBuV/m})/20] = 39.8 \text{ uV/m}$$

7. CLASSIFICATION OF DIGITAL DEVICE

Class A includes digital devices that are marketed for use in commercial, industrial or business environments, excluding devices which are marketed for use by the general public or are intended to be used in the home.

Class B includes digital devices that are marketed for use in residential environments, notwithstanding use in commercial, business and industrial environments.

Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as Class B device, and in fact is encouraged to do so provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

8. RADIATED EMISSION LIMITS

FCC PART 15 CLASS A

MEASURING DISTANCE OF 10 METER		
FREQUENCY RANGE (MHz)	FIELD STRENGTH (Microvolts/m)	FIELD STRENGTH (dBuV/m)
30-88	90	39.1
88-216	150	43.5
216-960	210	46.4
Above 960	300	49.5

FCC PART 15 CLASS B

MEASURING DISTANCE OF 3 METER		
FREQUENCY RANGE (MHz)	FIELD STRENGTH (Microvolts/m)	FIELD STRENGTH (dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

FCC RADIATED EMISSION ALTERNATIVE METHOD (CISPR 22/EN55022)

Limits for radiated disturbance of Class A ITE at
measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB(uV/m)
30 to 230	40
230 to 1000	47
NOTES 1. The lower limit shall apply at the transition frequency. 2. Additional provisions may be required for cases where interference occurs.	

Limits for radiated disturbance of Class B ITE at
Measuring distance of 10 m

Frequency range MHz	Quasi-peak limits dB(uV/m)
30 to 230	30
230 to 1000	37
NOTES 1. The lower limit shall apply at the transition frequency. 2. Additional provisions may be required for cases where interference occurs.	

9. RADIATED EMISSION TEST PROCEDURE

The EUT and all other support equipment are placed on a wooden table 80-cm above the ground screen. Antenna to EUT distance is 3 meters . During the test, the table is rotated 360 degrees to maximize emissions and the antenna is positioned from 1 to 4 meters above the ground screen to further maximize emissions. The antenna is polarized in both vertical and horizontal positions.

EUT test configuration is according to Section 8 of ANSI C63.4/1992.

Monitor the frequency range of interest at a fixed antenna height and EUT azimuth. Frequency span should be small enough to easily differentiate between broadcast stations and intermittent ambients. Rotate EUT 360 degrees to maximize emissions received from EUT. If emission increases by more than 1 dB, or if another emission appears that is greater by 1 dB, return to azimuth where maximum occurred and perform additional cable manipulation to further maximize received emission.

Move antenna up and down to further maximize suspected highest amplitude signal. If emission increased by 1 dB or more, or if another emission appears that is greater by 1dB or more, return to antenna height where maximum signal was observed and manipulate cables to produce highest emissions, noting frequency and amplitude.

10. CONDUCTED EMISSION LIMITS

FCC CLASS A

FREQUENCY RANGE	FIELD STRENGTH (Microvolts)	FIELD STRENGTH (dBuV)/QP
450kHz-1.705MHz	1000	60
1.705MHz - 30MHz	3000	69.54

FCC CLASS B

FREQUENCY RANGE	FIELD STRENGTH (Microvolts)	FIELD STRENGTH (dBuV)/QP
450kHz-30MHz	250	48

FCC CONDUCTED EMISSION ALTERNATIVE METHOD (CISPR 22/EN55022)

Limits for conducted disturbance at the mains ports of
Class A ITE

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	79	66
0.5 to 30	73	60
Note- The lower limit shall apply at the transition frequency.		

Limits of Conducted disturbance at the mains ports
of Class B ITE

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

11. AMBIENT CONDITIONS

The ambient conditions at the time of final tests were as follows:

Not applicable: No digital circuitry in EUT. Part 15 test not required/not performed

	Radiated Emission	Conducted Emission
Temperature	°C	°C
Humidity	%	%

12. EQUIPMENT MODIFICATIONS

NOT APPLICABLE.

13. TEST EQUIPMENT LIST

A) MEASUREMENT EQUIPMENT

Equipment	Manufacturer	Model No.	Serial No.	Cal Due
Spectrum Analyzer	H.P.	8593	3710A00205	05/01
Bilog Antenna	CHASE	CBL6112	2049	05/01
Horn Antenna	EMCO	3115	9001-3245	12/00
RF Power Meter	BIRD	44122	1828	3/01

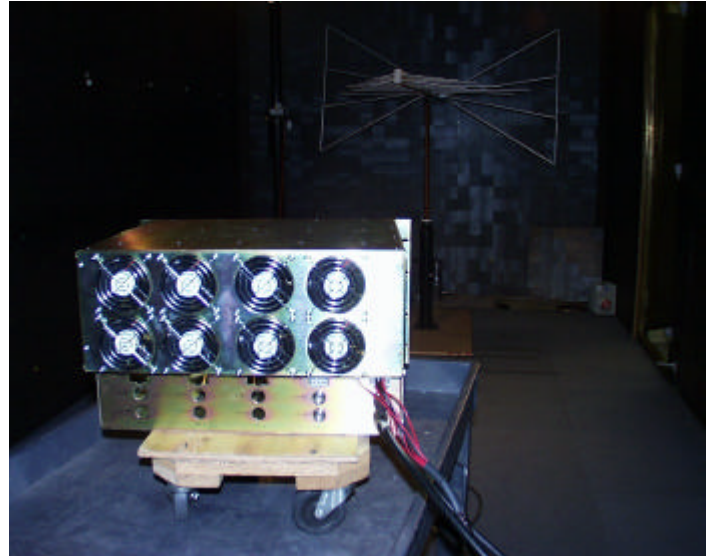
B) SUPPORT EQUIPMENT

Device Type	Manufacturer	Model Number	Serial No.	FCC ID / DoC
SIGNAL GENERATOR	HP	8648B	002557	N/A
HIGH POWER ATTENUATOR	BIRD ELECTRIC	8325	4800	N/A
30 dB ATTENUATOR	NARDA	N/A	N/A	3/01
DC POWER SUPPLY	H.P.	6269B	2436A-11867	N/A

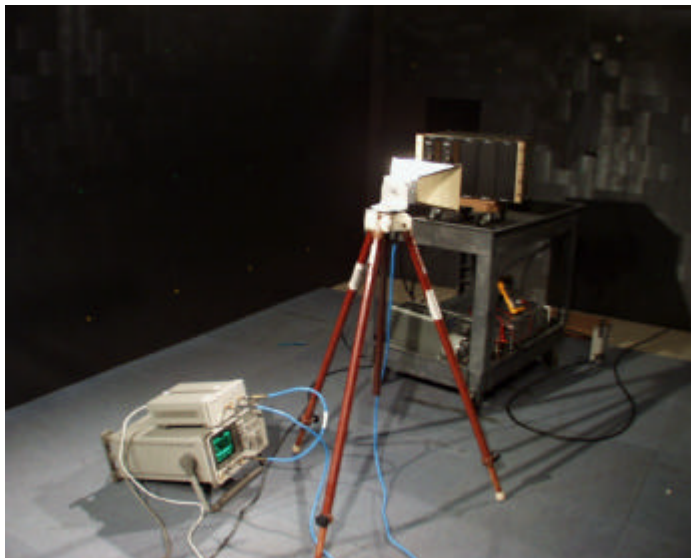
14. EUT SETUP PHOTOS



3 METER FRONT



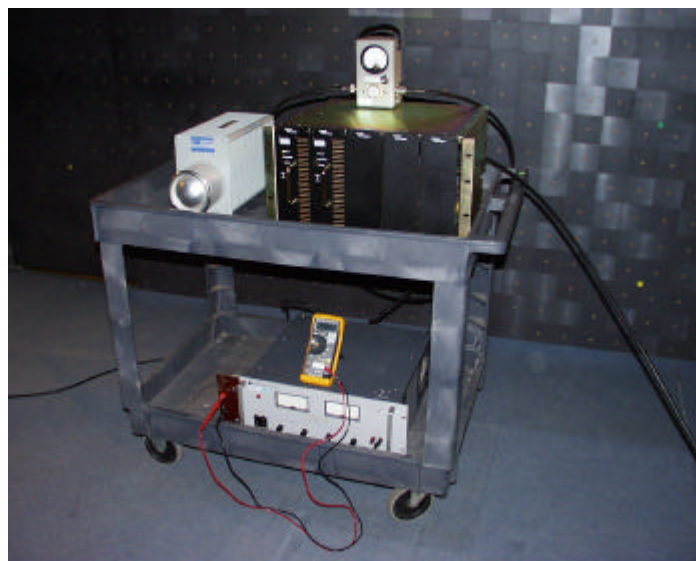
3 METER BACK



HIGH FREQUENCY MEASUREMENT



OUT-OF -BAND OCCUPIED BAND WIDTH



RF POWER OUTPUT

15. TEST RESULT SUMMARY FOR PART 15.

Not applicable - EUT has no digital circuitry. Part 15 test not required/not performed.

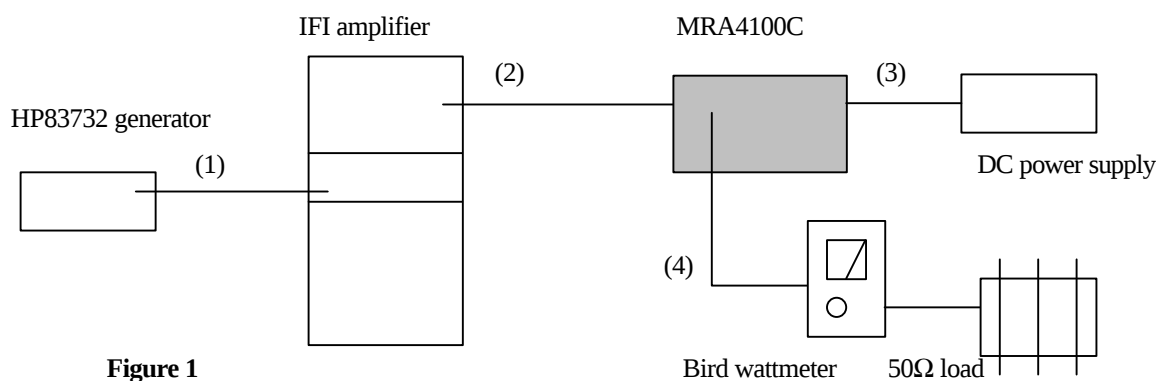
16. EXTERNAL I/O CABLE CONSTRUCTION DESCRIPTION

CABLE NO:1	
I/O Port: : RF OUTPUT TO ATTENUATOR	Number of I/O ports of this type:1
Number of Conductors: 2	Connector Type: N TYPE
Capture Type: SCREW-IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length:1.5 M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO:2	
I/O Port:: SIGNAL GENERATOR OUT	Number of I/O ports of this type:1
Number of Conductors: 2	Connector Type: N-TYPE
Capture Type: SCREW-IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length:2.5M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

CABLE NO:3	
I/O Port: EUT DC-INPUT	Number of I/O ports of this type:1
Number of Conductors: 5	Connector Type: DC POWER HARNESS
Capture Type: PUSH-IN	Type of Cable used: UN-SHIELDED
Cable Connector Type: PLASTIC	Cable Length: 2.0M
Bundled During Tests: NO	Data Traffic Generated: NO
Remark: N/A	

CABLE NO:4	
I/O Port: RF-IN TO EUT	Number of I/O ports of this type:1
Number of Conductors: 2	Connector Type: N -TYPE
Capture Type: SCREW-IN	Type of Cable used: SHIELDED
Cable Connector Type: METAL	Cable Length:1.5M
Bundled During Tests: NO	Data Traffic Generated: YES
Remark: N/A	

17. FCC PART 2 CERTIFICATION TEST RESULTS:**SECTION 2.985 RF POWER OUTPUT****Equipment used.****BIRD 44122 RF power meter****BIRD 500 watt load****TEST SETUP:****Minimum Requirement:**

Section 90.205(g); Technical regulations regarding the use of frequencies in the 450-470 MHz bands.

The effective radiated power for base stations shall no be greater than **500Watts**.

Test Result:

Power meter manufactured by Bird Electronics was used to measure the RF power output.

MRA4100C	
NO. OF AMPLIFIER	MEASURED RF POWER OUTPUT
1	100W

SECTION 2.987 MODULATION CHARACTERISTICS

Not applicable. EUT is a power amplifier.

SECTION 2.989 OCCUPIED BANDWIDTH

Equipment used.

HP Spectrum Analyzer/8593

Narda 30dB Attenuator

Bird 6 dB 500 watt attenuator

TEST SETUP:

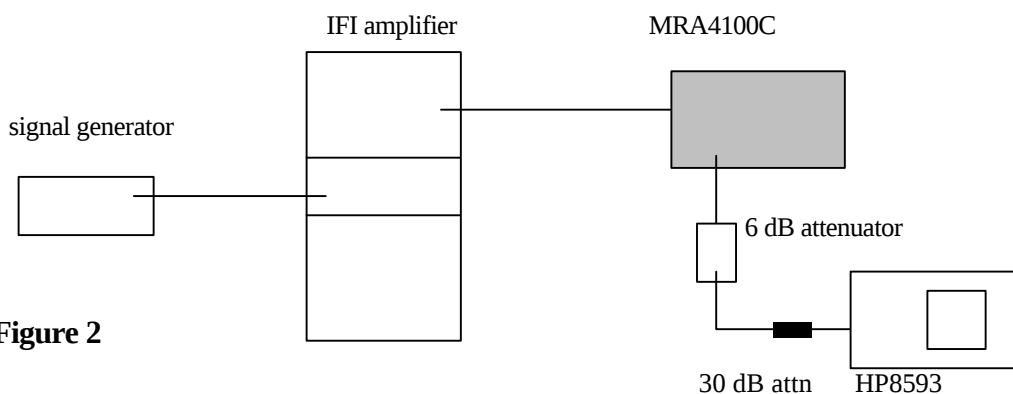


Figure 2

Minimum Requirement

Section 2.989 (I); Transmitters designed for other types of modulation –when modulated by an appropriate signal of sufficient amplitude to be representative of the type of service in which used. A description of the input signal should be supplied.

Test Result:

Test results are presented in spectrum analyzer plots. Plots were made for the output of the amplifier and another for the input from signal generator, used to generate **FM** modulation. Table shows order of plots.

<i>MRA4100C</i>	
450 MHz(LOW)	
MODULATION TYPE: FM	
	PLOT NUMBER
INPUT TO RF AMPLIFIER (15W)	1
OUTPUT FROM RF AMPLIFIER (100W)	2
460MHz(MIDDLE)	
MODULATION TYPE: FM	
	PLOT NUMBER
INPUT TO RF AMPLIFIER (15W) FM: 5 kHz Dev.	3
OUTPUT FROM RF AMPLIFIER (100W) FM: 5 kHz Dev.	4
INPUT TO RF AMPLIFIER (15W) FM: 10 kHz Dev.	5
OUTPUT FROM RF AMPLIFIER (100W) FM: 10 kHz Dev.	6
470 MHz(HIGH)	
MODULATION TYPE: FM	
	PLOT NUMBER
INPUT TO RF AMPLIFIER (15W)	7
OUTPUT FROM RF AMPLIFIER (100W)	8

SECTION 2.991 SPURIOUS EMISSION AT ANTENNA TERMINALS**Equipment used.****HP Spectrum Analyzer/8593****Narda 30dB Attenuator****Bird 6 dB 500 watt attenuator****TEST SETUP:**

Refer to Figure 2 above.

Minimum requirement:

Technical Limits applied Section 90.210(d) emission mask

The magnitude of each spurious and harmonic emissions that can be detected when the equipment is operated under conditions specified in the instruction manual and/or alignment procedure, shall not be more than $43 + \log(\text{mean output power})$ dBc below the mean power output, which is equivalent to -13 dBm.

Test Procedure:

Spurious emissions tests were performed for Single input signal to amplifier. For all modulations that applies to EUT. Spectrum was scanned from 1 MHz to 10^{TH} harmonic. of fundamental to search for spurious, harmonics, and intermodulation product emissions.

<i>FREQUENCY 470 MHz(High)</i>	
MODULATION TYPE: 5 kHz Dev, 1 kHz FM	
FREQUENCY RANGE	PLOT NUMBER
1 MHz TO 400 MHz	9
400 MHz TO 1 GHz	10
1 GHz TO 2.9 GHz	11
2.9 GHz TO 4.7 GHz	12

SECTION 2.995 FREQUENCY STABILITY

Not Applicable. Device is a power amplifier.

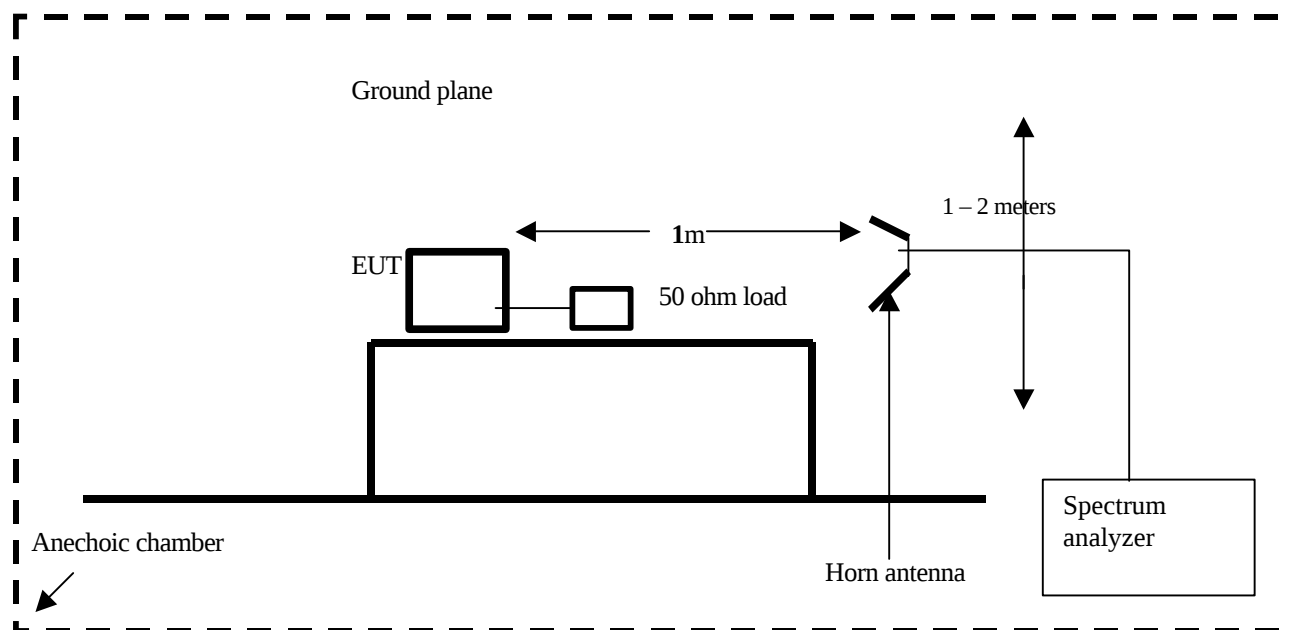
SECTION 2.993 FIELD STRENGTH OF SPURIOUS RADIATION

Emco Horn Antenna/3146

HP Spectrum Analyzer/8593EM

FLEXCO cable/20761; 19ft. coaxial cable (loss: .9dB/ft @ 26GHz)

Test setup



Technical Limits applied Section 90.210(g), 90.210(h), 90.691 emission masks

MRA4100C

All readings Vertical polarized

F₀= 460MHz

1 Amplifiers 100WATTS Output:

$$(\sqrt{30 * 100}) / 3 = 18.3 \text{ V/m} = 145.2 \text{ dBuV/m}$$

$$\text{Emission Masks} = 43 + 10 \log (100) = 63$$

$$145.2 - 63 = 82.2 \text{ dBuV/m limit at 3 meters separation}$$

Radiated emissions data of harmonics at 1 meter from second to 10fo attached.**COMPLIANCE ENGINEERING SERVICES, INC.****CASE RADIATED EMISSIONS**

21 Jul 00

Sunnyvale

Amplifier Technology 100 watt RF amplifier

Corpuz /Cokenias

Model: MRA4100C

 $f_0 = 460$ MHz

F(MHz)	READING (dBuV)	AF (dB)	CL (dB)	AMP (dB)	dist (dB)	TOTAL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)
	<u>Pk</u>					<u>Pk</u>	<u>Pk</u>	<u>Pk</u>
1380	94	25	2.34	-31.25	-13	76.95	82.2	-5.25
1840	76.3	27	3.06	-31.25	-13	62.47	82.2	-19.7
2300	67.7	29	3.4	-31.25	-13	56.21	82.2	-26
2760	68.8	30	3.57	-31.25	-13	58.48	82.2	-23.7
3680	62.2	33	4.25	-31.25	-13	55.56	82.2	-26.6

to 4600: no emissions detected within 30 dB of limit

NOTE: ALL READINGS ARE VERTICAL**AF:** Antenna Factor**AMP:** Pre-amp gain**CL:** Cable loss**DIST:** Distance correction 0.7m to 3 m

ATTACHMENTS

EUT PHOTOGRAPHS

INSTALLATIONS & SERVICE MANUAL

ADDENDUM 1 SCHEMATICS & PARTS LISTS

PROPOSED FCC ID LABEL FORMAT

Applicant: AMPLIFIER TECHNOLOGY
26802 VIA LLANO
MISSION VIEJO, CALIFORNIA 92691-2634
USA

Model: MRA4100C

FCC ID: O9HMRA4100C

