VERIFICATION TEST REPORT

for

400 – 512 MHz HIGH POWER AMPLIFIER
MODEL NUMBER: HPA4
FCC ID: MI7-ECSHPA45TX

MEASUREMENTS PERFORMED IN ACCORDANCE WITH...

FCC TITLE 47, PART 90: Private Land Mobile Radio Services

PREPARED FOR:

ElectroCom Communications Systems
10400 Pioneer Blvd., Bldg. E2
Santa Fe Springs, California 90670

Contact: Mr. Louis Chagoya

PREPARED BY:

Aegis Labs, Inc.
22431 Antonio Parkway B160-417
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Agent(s): Mr. Steve Kuiper
Mr. Dick Chaing

Test Report #: **ELECT-990716F**
Test Date(s): July 14, 15, 20 & Oct. 21, 1999

	REPORT BODY	APPENDIX	ATTACHMENTS						TOTAL
		A	***Supplemental Test Data***	Block Diagram	Perspective Drawing	Schematics	Parts List	User's Manual	
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AEGIS LABS, INC 22431 Antonio Parkway B160-417, Rancho Santa Margarita, CA 92688

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Measurement/Technical Report Summary

Representative	Louis Chagoya
Manufacturer	ElectroCom Communication Systems
Address	10400 Pioneer Blvd., Bldg. E-2
City, State, Zip	Santa Fe Springs, CA 90670
Phone	(562) 946-9493
Fax	(562) 946-7483
Type of Authorization	Certification for 450-512MHz High Power Amplifier
Applicable FCC Rules	PART 90 – Private Land Mobile Radio Services Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-98 Edition). The following subparts are applicable to the results in this test report: Part 90, Subpart I – General Technical Standards Part 2, Subpart J – Equipment Authorization Procedures for Certification, and FCC98058 Document The test data presented in this report has been acquired using the guidelines set forth in FCC Part 2 section §2.981 through §2.1005 and Part 90. The test results presented in this document are valid only for the equipment identified herein under the test conditions described. Repeatability of these test results will only be achieved with identical measurement conditions.
Equipment Under Test	400MHz High Power Amplifier
Production Quantity	Multiple Units
Identification of EUT	Model: HPA4 FCC ID: MI7-ECSHPA45TX
Testing Date	14, 15, 20 July 1999 & 21 October 1999

Test Facility	Aegis Labs, Inc.	
Address	32231 Trabuco Creek Road	22431-B160 Antonio Parkway
City, State, Zip Code	Trabuco Canyon, CA 92678	Rancho Santa Margarita, CA 92688
Country	USA	
Phone	(949) 459-7886	
Fax	(949) 459-7869	

1. General Information

1.1 Product Description

Equipment Under Test	450-512MHz Base Station Data Radio
Model Number	HPA4
Serial Number	Prototype
Description of EUT	The EUT is an integrated linear RF Power Amplifier providing 20dB gain with 1-watt drive, intended for trunking and conventional repeater applications requiring high duty cycles. The RF input signal is divided and phase shifted into four 25-watt RF modules. Each 25-watt output is then properly phased and summed to provide 100 watts of amplification followed by low pass filters and associated control circuitry. Refer to the block diagram of the amplifier for details.
Clock Frequencies	None

Refer to the product specification data that has been included as an attachment of this report for additional details

1.2 Tested System Details

The following table lists all of the components of the tested system. FCC ID numbers are included if available for a tested system component. Refer to the table following Tested System Details for cabling information.

Tested System Details					
Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	ElectroCom	High Power Amplifier	HPA4	Prototype	MI7-ECSHPA45TX

The following table lists all of the cabling details for the tested system.

Cabling of the Tested System					
Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT	Power Supply
B	DB25 Shielded Cable	1.0	RS232	EUT	Test Fixture
C	RF Coaxial Cable	0.3	RG214 (190-57793)	EUT	DR4B
D	RF Coaxial Cable	0.3	RG214 (190-57793)	EUT	Attenuator
E	RF Coaxial Cable	0.3	RG214 (190-57793)	Directional Coupler	Attenuator
F	RF Coaxial Cable	0.3	RG214 (190-57793)	Directional Coupler	Spectrum Analyzer
G	RF Coaxial Cable	1.2	RG214 (190-57793)	Directional Coupler	50 ohm Terminator

1.3 Test Facility

The open area test site and measurement facility used to collect the test data is located at the Aegis Labs, Inc. chamber test facility in the city of Rancho Santa Margarita, CA and OATS facility in Trabuco Canyon, CA. This site has been fully described in a report submitted to the FCC and accepted in a letter dated 5, February 1997 (31040/SIT 1300F2). The test facility is also recognized and accredited from the following accreditation organizations.

A2LA (American Assoc. for Lab Accredit)	Certificate No.: FCC, CISPR, AS/NZS	1111.01	Dated: 02/11/1998
BSMI (Bureau Std. & Meth. Insp)	Accreditation Number: EMC Mark for Taiwan	0007	Dated: 03/21/1998
VCCI (Voluntary Control Council)	Registration Number: VCCI for Japan	C-574~6, R-561	Dated: 05/04/1998

2. Technical Description

Type of Emission	20K0F1D
Frequency Range	450 ~ 512 MHz
Range of Operating Power	100W
Maximum output Power Level	100W
Maximum Specified Output Power Rating	Location Dependant per Part 90 Subpart S
Final Stage Amplifier DC Voltage, Current	Voltage: 15.0 Vdc, Current: 25 Amps

2.1 Function of All Active Circuit Devices

Please refer to Attachment (Exhibits).

2.2 Circuit Diagram

Please refer to Figure in Attachment (Exhibits).

2.3 Instruction Manual(s)

Please see Attachment (Exhibits).

3. PRODUCT LABELING

3.1 FCC ID Label

FCC ID: MI7-ECSHPA45TX

3.2 Location of Label on EUT

The FCC ID was located at the right side of EUT. Please refer to the photo in section 6.5 for the location.

3.3 Information to User

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

4. System Test Configuration

4.1 Justification

The EUT was used in a system configured for testing in a typical installation, as a customer would normally use it.

4.2 EUT Exercise Software/Equipment

The EUT requires exercise software program used during testing to activate data from PC to modem and deliver to the test fixture by manually switching the EUT on or off.

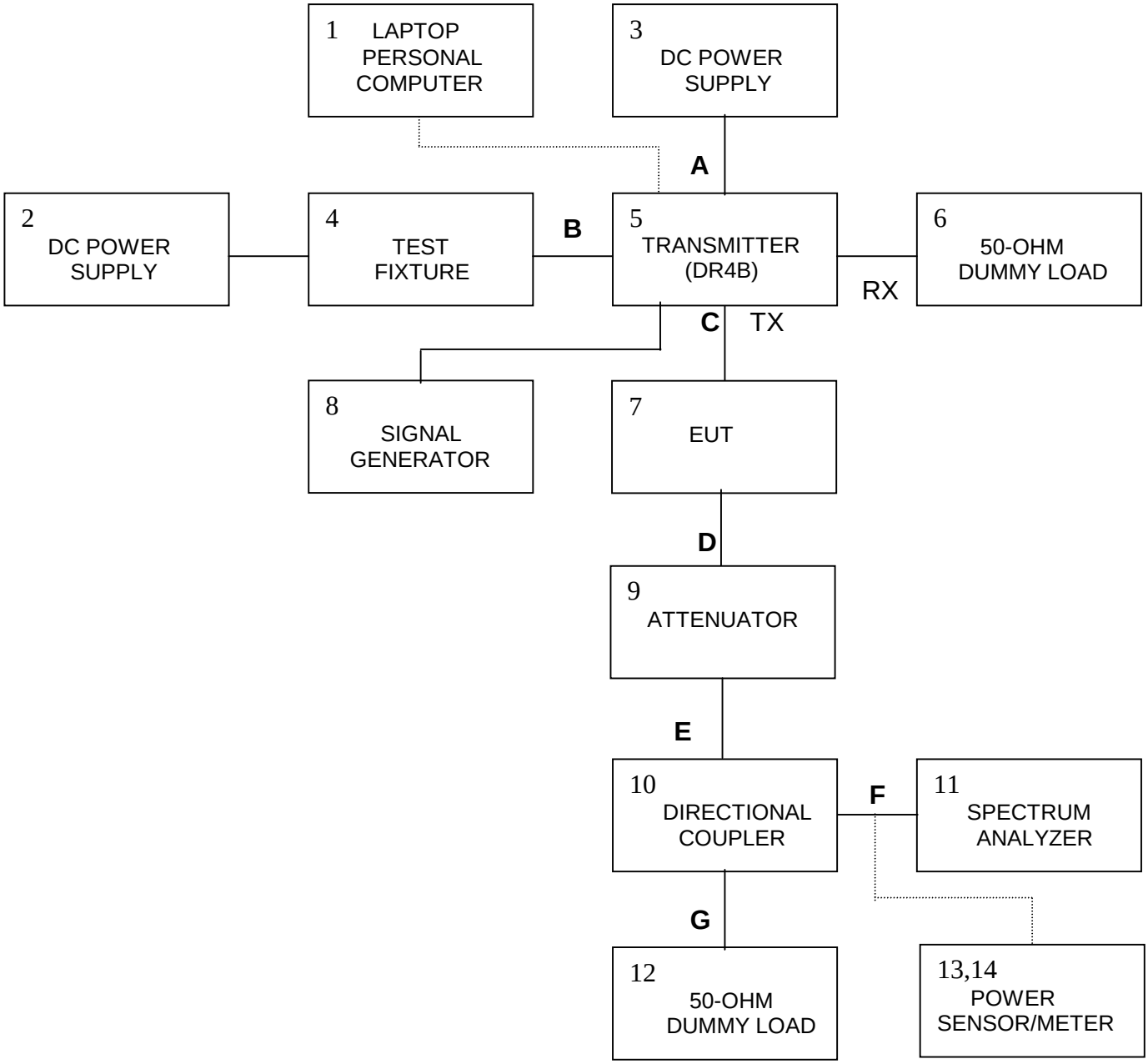
4.3 Special Accessories

The EUT requires no special accessories to comply with the FCC regulations.

4.4 Equipment Modifications

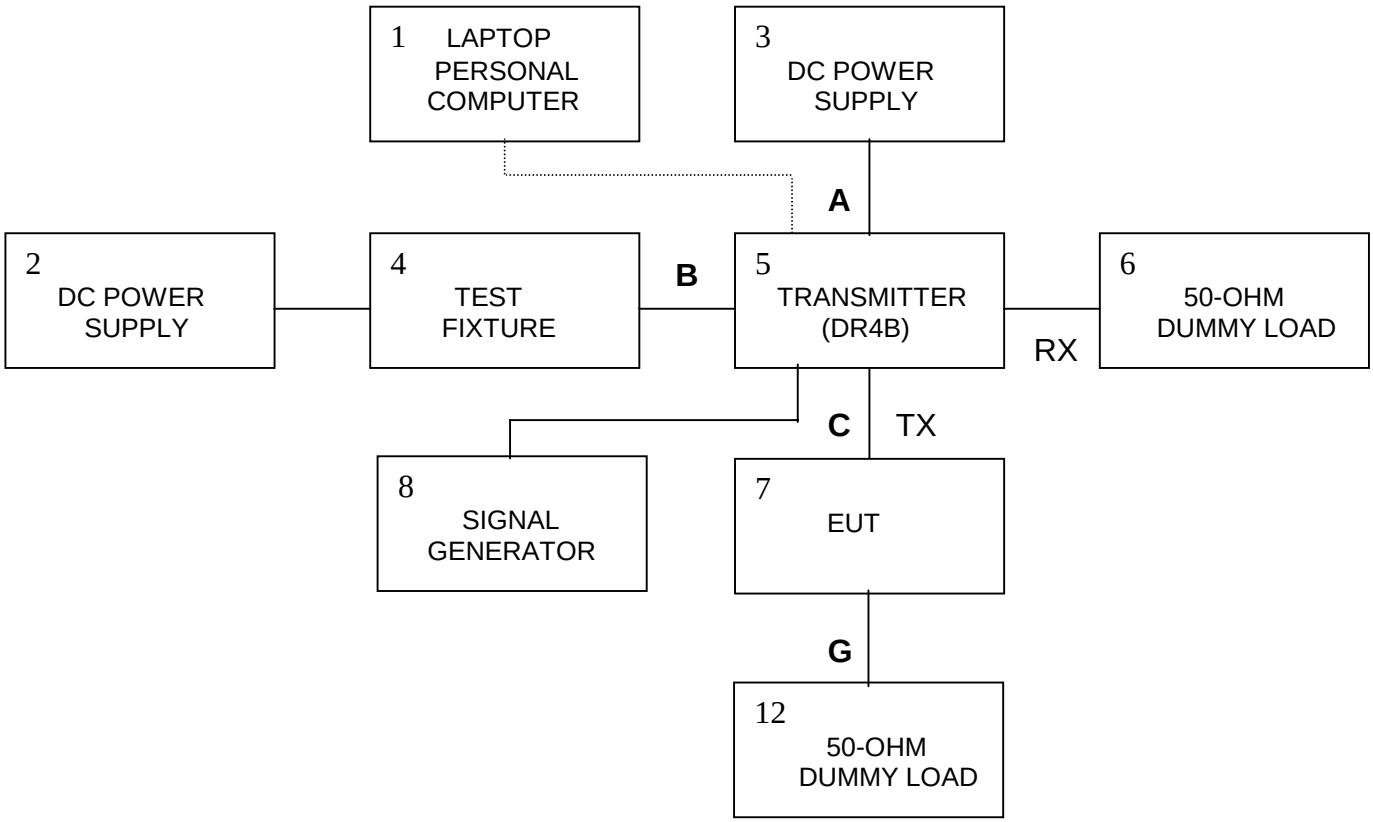
No modifications and/or adjustments were made to the EUT during compliance testing to achieve the required specification limits.

4.5 Configuration of Tested System



Test Setup Configuration 1

4.5 Configuration of Tested System (Continued)



Test Setup Configuration 2

4.5 Configuration of Tested System (Continued)

Legend:

Item	Manufacturer	Description	Model No.	Serial No.	FCC ID
1	CTX	Laptop PC	EzBook	F2A300A-8121341	FCC Class B Logo
2	Astron	DC Power Supply	RS-12M	9404046	N/A
3	Astron	DC Power Supply	RS-70M	9702007	N/A
4	ElectroCom	Test Fixture	Prototype	N/A	N/A
5	ElectroCom	Data Radio	DR4B	Prototype	MI7-ECSDR4BSTX
6	Pasterneck	50 ohm Terminator	PE6024	N/A	N/A
7	ElectroCom	EUT	HPA4	Prototype	MIL-ECSHPA45TX
8	Gigatronics	Signal Generator	6062A	9809906	N/A
9	Bird Electronics	RF Attenuator	500-WA-FFN-20	9903	N/A
10	Hewlett Packard	Directional Coupler	778D	1144A08005	N/A
10	Hewlett Packard	Directional Coupler	11691D	1212A00305	N/A
11	Hewlett Packard	Spectrum Analyzer	8566B	2532A02014	N/A
12	Bird Electronics	50 ohm Load	1000-WT-FN	9924	N/A
13	Rohde & Schwarz	RF Power Sensor	NRV-Z5	844855/012	N/A
14	Rohde & Schwarz	RF Power Meter	NRVS	826149/077	N/A

Item	Description	Length (m)	Type	Connected from	Connected to
A	Power Cords	1.2	8 gauge wires	EUT & DR4B	Power Supply
B	DB25 Shielded Cable	1.0	RS232	DR4B	Test Fixture
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5. TEST DATA

5.1 RF Power Output

Output power was measured at the Transmitter Module RF output terminal. The test setup and method as shown in Configuration 1.
The output power was measured at each frequency 455MHz, 470MHz, 512MHz and tuned with nominal voltage 15.0V. The voltage over 15.75V will trigger the protection circuitry and turn the amplifier off. The Rohde & Schwarz NRVS power meter and NRV-Z5 power sensor was used to measure RF output power.

Freq. tuned	nominal voltage (15.0V)
455.0 MHz	95.7W
470.0 MHz	91.4W
512.0 MHz	95.7W

5.2 Modulation Characteristics

The modulation characteristics were measured with the signal generator input FM signal tuned at each frequency with typical 2.4kHz frequency modulated at 5.0kHz deviation. The test results are enclosed in appendix B pages B4-6.

5.3 Occupied Bandwidth

Occupied bandwidth is the frequency bandwidth below its lower and above its upper frequency limits, the mean power radiated by a given emission. The measurements were made with the modulating signal. The authorized occupied bandwidth for emission mask C is 20KHz. The measured occupied bandwidth that was the manufacturer intended to design for sufficient data transmission. Test setup was connected to the equipment per configuration 1. The test signal was typical FM signal with 2.4kHz tone and 5.0kHz deviation. Test results were attached in appendix B pages B7-18.

Necessary bandwidth Bn = 2M + 2D = 19.6KHz
Where M = 4.8KHz
D = 5.0KHz

5.4 Spurious Emissions at Antenna Terminals

Antenna conducted spurious emissions are emissions at the antenna terminals on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information or required quality for the class of communication desired. The reduction in the level of the spurious emissions will not affect the quality of the information being transmitted. Conducted spurious emissions shall be attenuated at least; 43 + 10 log (Po) dB (where Po is 40W maximum output power) below the maximum level of the carrier frequency in accordance with the transmitter as authorized. Connect the equipment as shown in configuration 1. Adjust the spectrum analyzer to display the modulated carrier and scan the frequency spectrum from the lowest radio frequency generated in the equipment through the 10th harmonic of the carrier frequency. Test results were attached in appendix B pages B19-32.

5.5 Radiated Spurious Emission

Emissions from the equipment when connected into a non-radiating load on a frequency of frequencies, which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communication desired. The reduction in the level of these spurious emissions will not affect the quality of the information being transmitted. Connect the equipment as shown in configuration 2. All cables connected to generate maximum emissions from the EUT. The EUT was placed 80 centimeters above the ground plane on a non-conductive tabletop 1.0 meter wide by 1.5 meters long. The amplitude levels of the emissions were maximized by varying the configuration of the EUT and cables. The highest emissions were maximized by rotating the turntable 360 degrees and varying the antenna height 1 to 4 meters. The frequency range was measured up to the 10th harmonic utilizing a log-periodic and a double-ridged horn antenna. Measurements were made in vertical and horizontal polarizations. The distance between EUT and measuring antenna is 3 meters. Amplitude levels were recorded in dBµV/m. All spurious emissions were attenuated at least 63 dB below each tuned carrier field strength. Test results were attached in appendix B pages B33-35.

* Field strength = $1/D \times (Po \times RL)^{1/2}$, where D = 3 meters, Po = 100.0W, RL= 50.2 ohm

$= 1/3 \times (100 \times 50.2)^{1/2}$

= 147.5 dBµV/m

** FCC Limit = 43 + 10 log (Po) , where Po = 100W

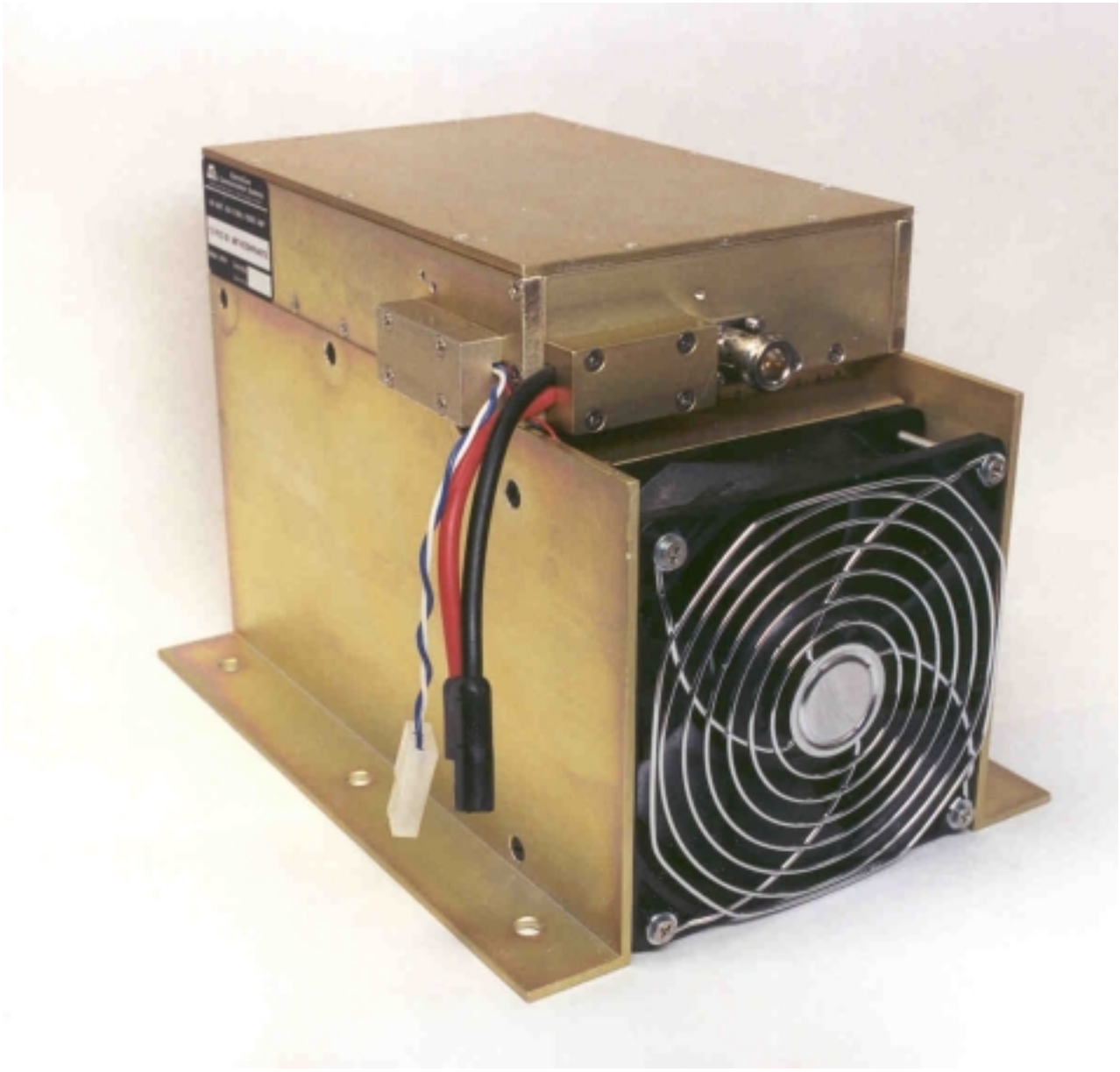
= 63dB

5.6 Frequency Stability

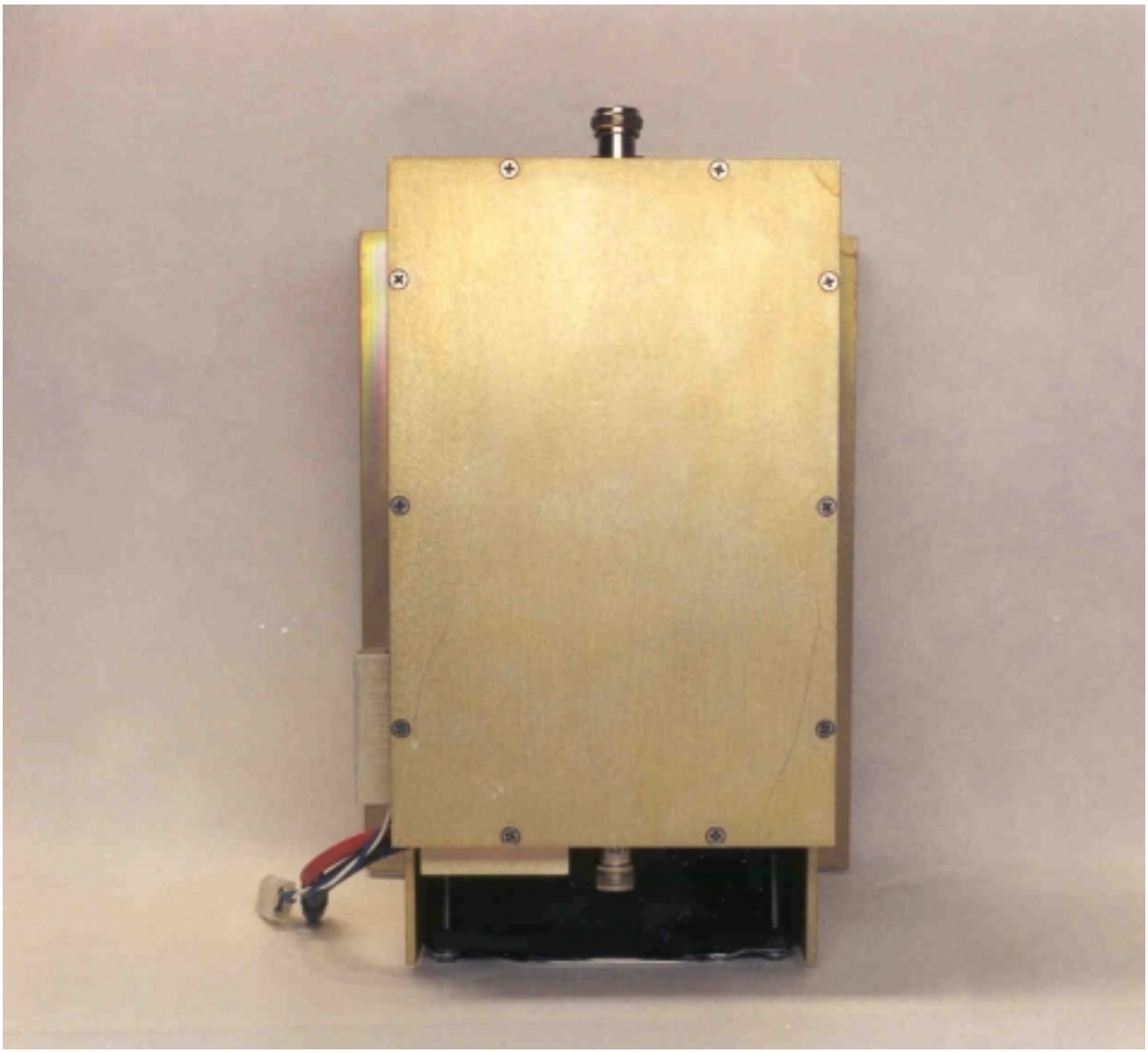
The EUT contains no frequency generation oscillator or crystal. The frequency stability measurement was non-required.

6. PHOTOGRAPHS AND/OR DRAWINGS SHOWING CONSTRUCTION TECHNIQUES

6.1 Photo: EUT 3D View

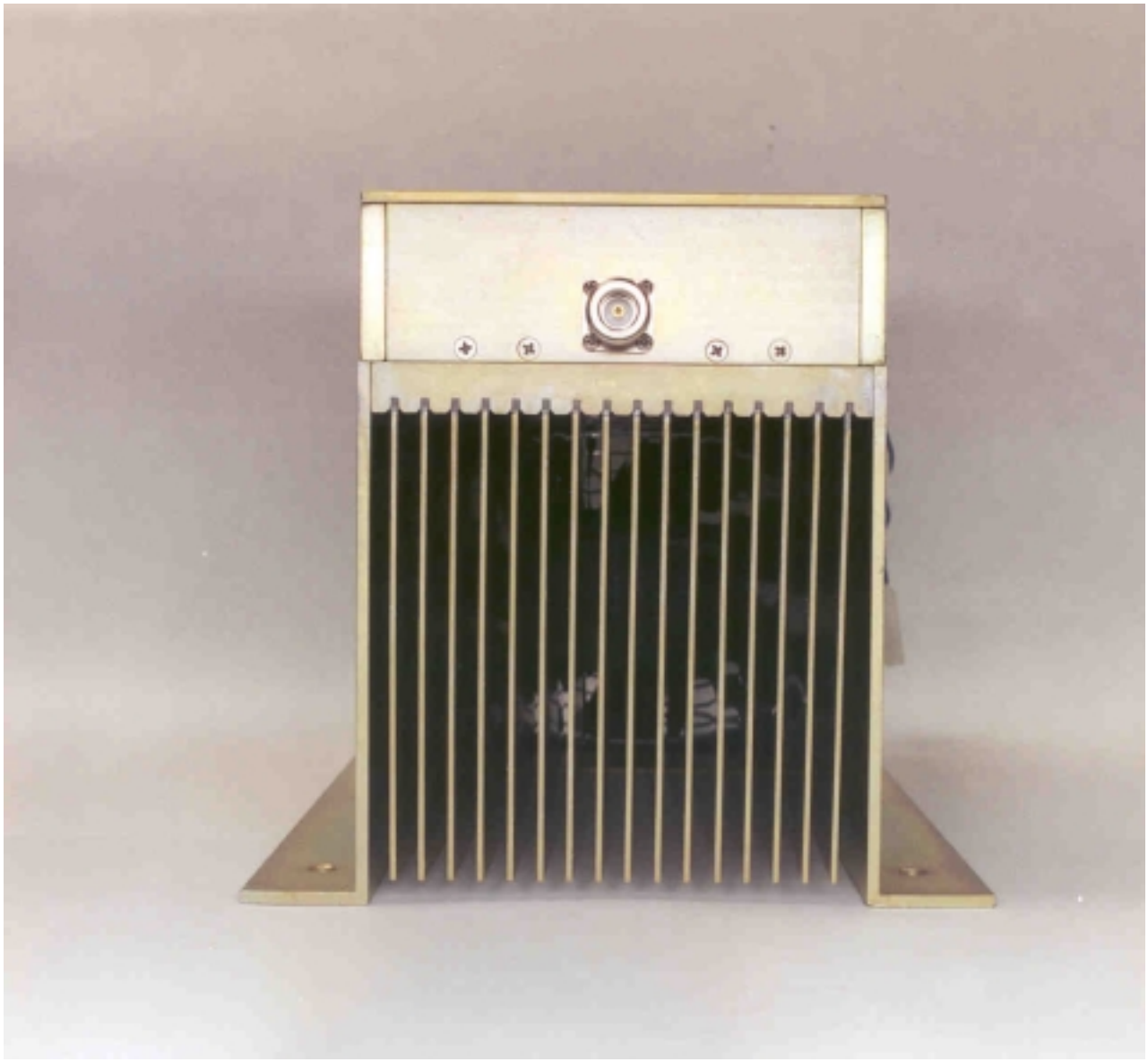


6.2 Photo: EUT Top View

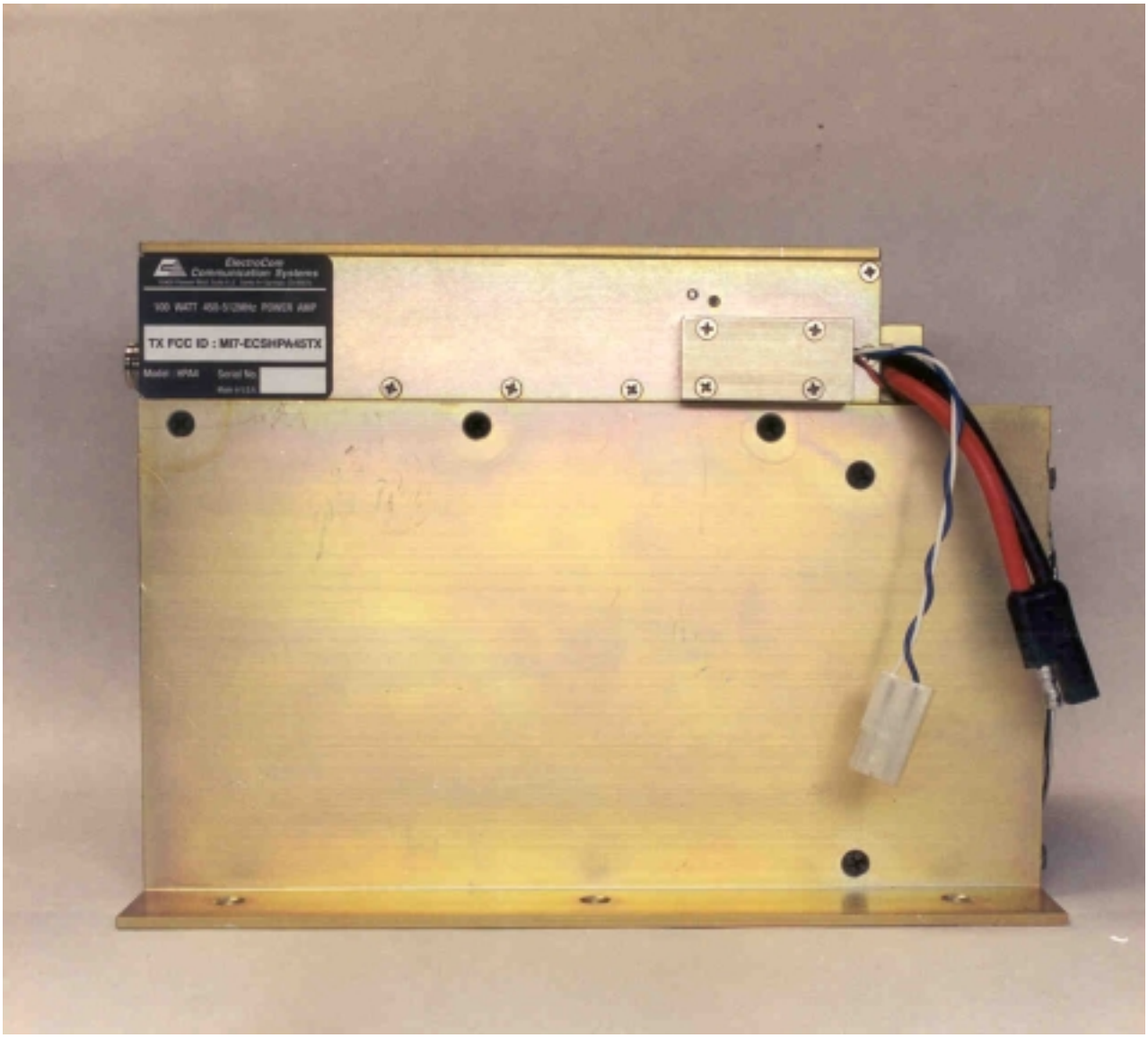


6.3 Photo: EUT Front View

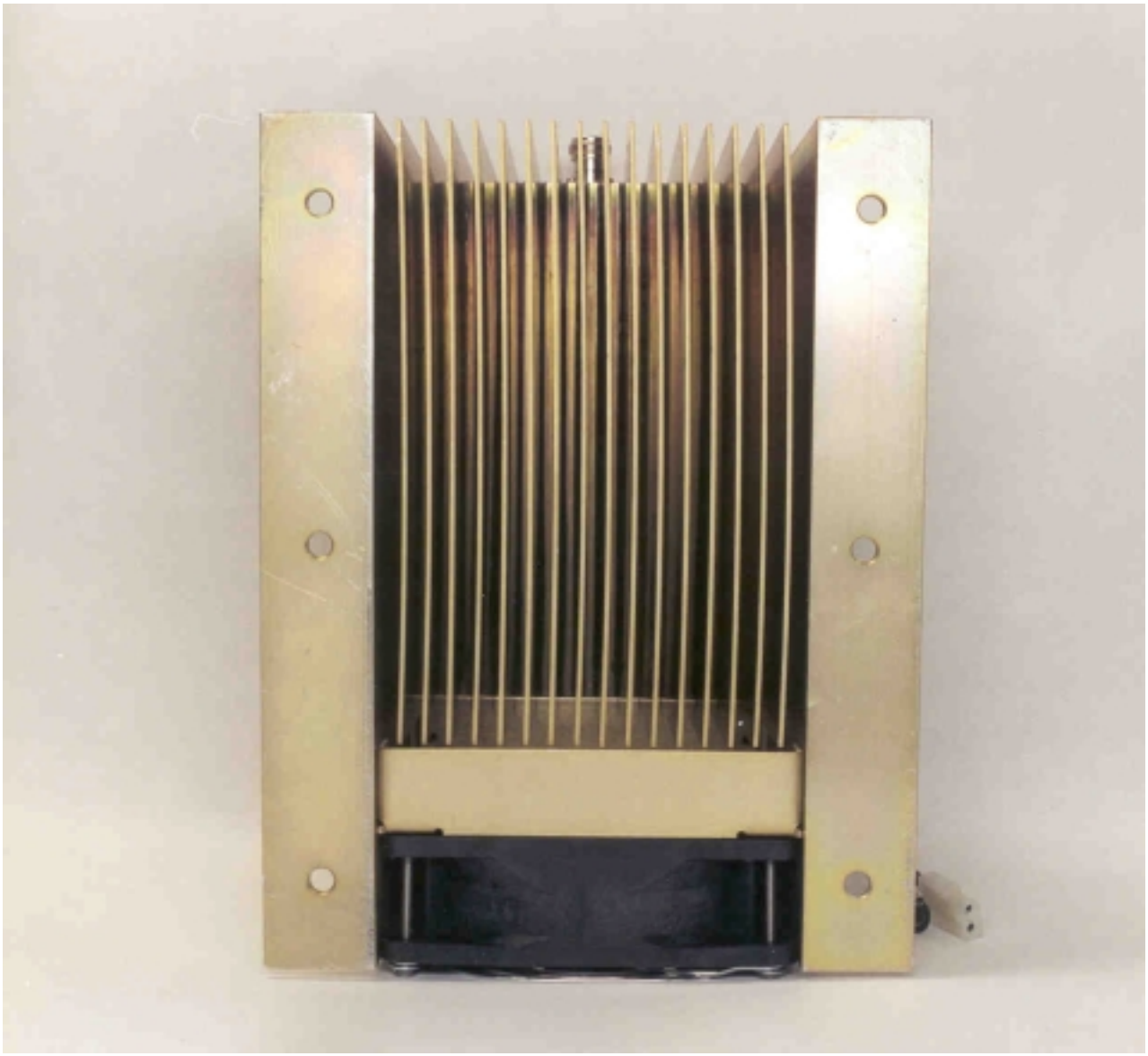
6.4 Photo: EUT Rear View



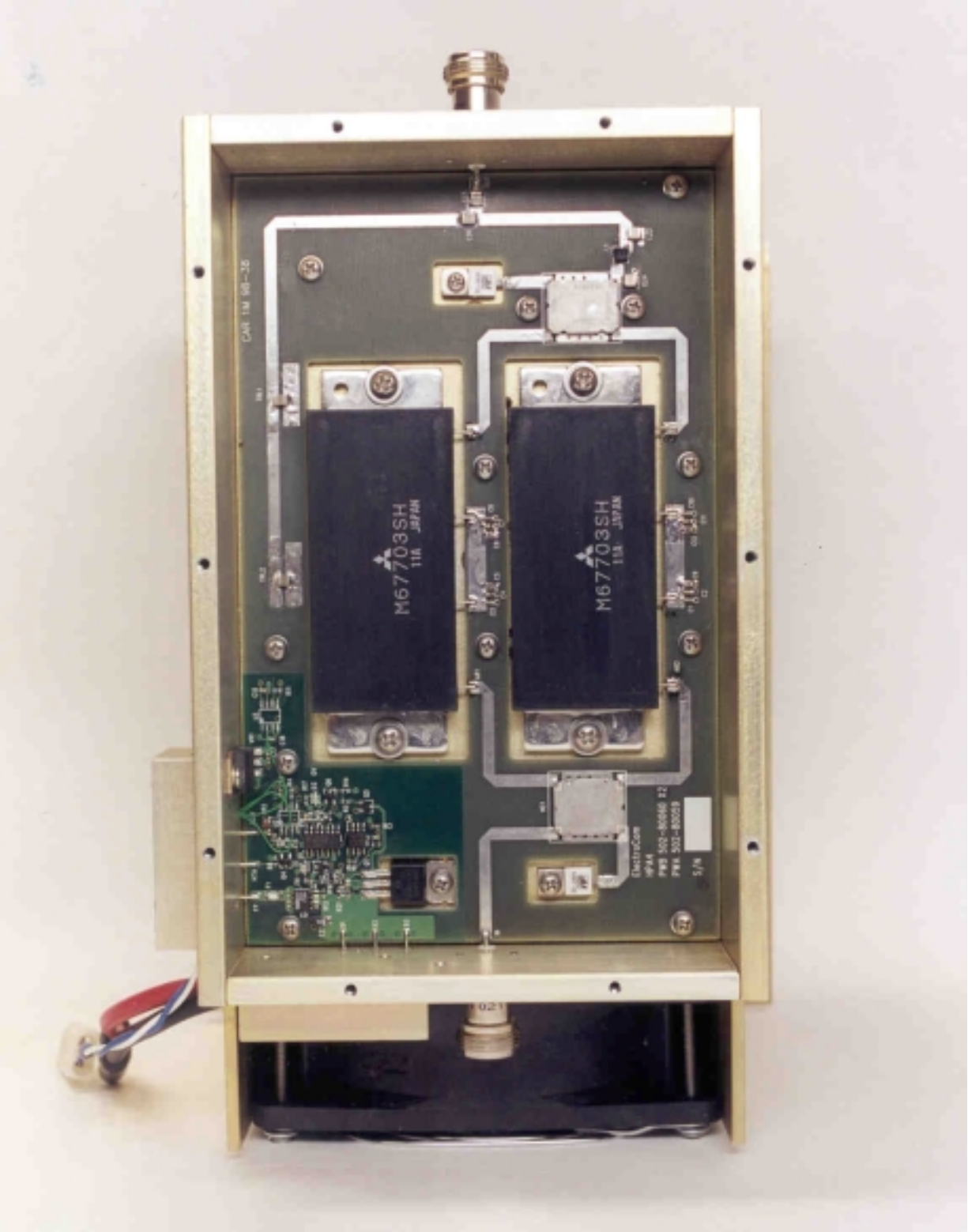
6.5 Photo: EUT Side View



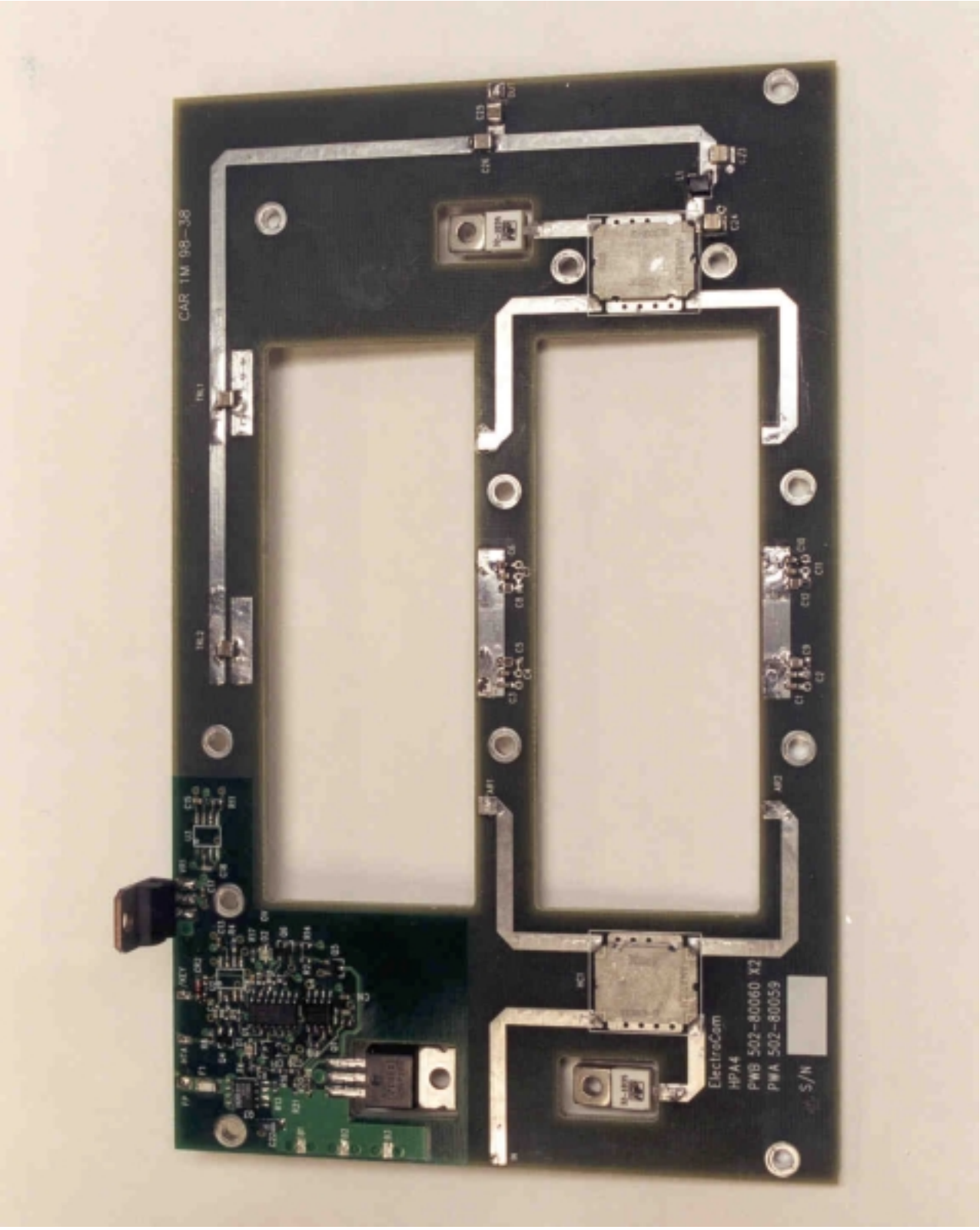
6.6 Photo: EUT Bottom View



6.7 Photo: EUT with cover removed



6.8 Photo: EUT PCB Top



6.9 Photo: EUT PCB Bottom

APPENDIX A - TEST EQUIPMENT USED

A complete list of test equipment used for each test can be found in their perspective test procedure. The equipment absolute performance calibration of the equipment requiring calibration is performed on an as needed basis in accordance with MIL-STD-45662. However, calibration periods do not exceed one (1) year. The test equipment is capable of making measurements within tolerances of at least ±2 dB amplitude and ±2% frequency deviation. Equipment certifications showing traceability to NIST (National institute of Standards and Technology) are maintained on file at Aegis Labs offices in Trabuco Canyon or Rancho Santa Margarita, CA. All equipment is checked and verified for proper operation before and after each series of tests.

A.1 Specific Equipment Used

Test Instrument	*Mfg*	*Model No.*	*Serial No.*	*Freq. or Range*	*Cal. Due Date*
EMI Spectrum Analyzer	Hewlett Packard	8566B	2532A02014	100 Hz – 22GHz	02/16/00
Communication Test Set	Hewlett Packard	8920A	4500020132-10	.4 – 1000 MHz	03/22/00
Digitizing Oscilloscope	Tektronix	TDS410A	B010112	200MHz	04/19/00
Directional Coupler	Amp. Research	DC6080	25315	80 – 1000 MHz	02/25/00
Directional Coupler	Hewlett Packard	11692D	1212A00305	2 – 18 GHz	12/03/99
Directional Coupler	Hewlett Packard	778D	1144A08005	80 – 2000 MHz	12/01/99
Power Sensor	Rohde & Schwarz	NRVS	826149/077	DC – 26.5 GHz	08/29/00
Digital Power Meter	Rohde & Schwarz	NRV-Z5	844855/012	0.1 MHz – 6GHz	08/29/00
Double Ridged Antenna	Com-Power	AH-118	10069	1 – 18 GHz	12/11/99
Log-Periodic Antenna	Com-Power	AL-100	16041	.3 – 1 GHz	12/30/99
Signal Generator	Hewlett Packard	8673B	2823A01357	2 – 26 GHz	11/25/99
Signal Generator	Gigatronics	6062A	9809906	.1 – 2 GHz	03/13/00
RF Attenuator	Pasterneck	PE7021-40	N/A	100W	CIP
RF Attenuator	Bird Electronics	500-WA-FFN-20	9903	500W	CIP
50 ohm Resistive Load	Bird Electronics	1000-WT-FN	9924	1000W	CIP
50 ohm Resistive Load	Pasterneck	PE6034	N/A	0.5W	CIP
DC Power Supply	Astron	RS-70M	N/A	0 – 18V, 0 – 70A	CIP
DC Power Supply	Astron	RS-12M	N/A	0 – 18V, 0 – 12A	CIP
DC Power Supply	Sorensen	SRL-60-17M1	0431	0 – 60V, 0 – 17A	CIP
Temperature Chamber	Environ. Equip.	RB-16-705-705	0688603	– 73 ~ + 177°C	11/04/99
Temperature Recorder	Honeywell	DR4501-1000	930589598032	– 60 ~ + 160°C	11/13/99
RF Coax Cable	United Microwave	190-57793	N/A	.1MHz – 10 GHz	10/28/99

* CIP – calibrate in place