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AMPLIFIER RESEARCH

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# *EC Declaration of Conformity*

We; Amplifier Research
160 School House Road
Souderton, Pa. 18964

declare that as of 1997, our product(s);

the Model 75A250 series amplifiers

to which this declaration relates is in compliance with the requirements of the EEC EMC Directive (89/336/EEC) and Low Voltage Directive (73/23/EEC) in accordance with the relative standards listed below:

**EMC:**

EN 50082-2 : 1995
Electromagnetic compatibility - Generic immunity standard
Part 2: Industrial environment

EN 55011 : 1991
Electromagnetic emissions requirements for Industrial, Scientific and Medical (ISM) Equipment
Group 1, Class A

**Safety:**

IEC 1010-1 : 1990 + A1, A2

The CE marking is affixed on the device according to the EC Directives.

Donald R. Shepherd
President

# INSTRUCTIONS FOR SAFE OPERATION

**BEFORE APPLYING POWER**

Review this manual and become familiar with all safety markings and instructions.

Verify that the equipment line voltage selection is compatible with the main power source.

Protection provided by the equipment may be impaired if used in a manner not specified by Amplifier Research.

**INTENDED PURPOSES**

This equipment is intended for general laboratory use in a wide variety of industrial and scientific applications. It is designed to be used in the process of generating, controlling and measuring high levels of electromagnetic Radio Frequency (RF) energy. Therefore the output of the amplifier must be connected to an appropriate load such as an antenna or field generating device. It is the responsibility of the user to assure that the device is operated in a location which will control the radiated energy such that it will not cause injury and will not violate regulatory levels of electromagnetic interference.

**HAZARDOUS RF VOLTAGES**

The RF voltages on the center pin of the RF output connector can be hazardous. The RF output connector should be connected to a load before AC power is applied to the amplifier. Do not come into contact with the center pin of the RF output connector or accessories connected to it. Place the equipment in a non-operating condition before disconnecting or connecting the load to the RF output connector.

**SAFETY GROUND**

This equipment is provided with a protective earth terminal. The main power source to the equipment must supply an uninterrupted safety ground of sufficient size to the input wiring terminals, power cord, or supplied power cord set. The equipment **MUST NOT BE USED** if this protection is impaired.

**PHYSICAL DAMAGE**

The RF amplifier should not be operated if there is physical damage, missing hardware or missing panels.

**MAINTENANCE CAUTION**

Adjustment, maintenance, or repair of the equipment must be performed only by qualified personnel. Hazardous energy may be present while protective covers are removed from the equipment even if disconnected from the power source. Contact may result in personal injury. Replacement fuses are required to be of specific type and current rating.

# INSTRUCTIONS FOR SAFE OPERATION (continued)

## SAFETY SYMBOLS

This symbol is marked on the equipment when it is necessary for the user to refer to the manual for important safety information. This symbol is indicated in the Table of Contents to assist in locating pertinent information.

Dangerous voltages are present. Use extreme care.

**CAUTION**: The caution symbol denotes a potential hazard. Attention must be given to the statement to prevent damage, destruction or harm.

Indicates protective earth terminal.

## RANGE OF ENVIRONMENTAL CONDITIONS

This equipment is designed to be safe under the following environmental conditions:

Indoor use

Altitude up to 2000M

Temperature of 5°C to 40°C

Maximum relative humidity 80% for temperatures up to 31°C. Decreasing linearity to 50% at 40°C.

Mains supply voltage fluctuations not to exceed ± 10% of the nominal voltage or minimum and maximum autoranging values.

Pollution degree 2: Normally non-conductive with occasional condensation

While the equipment will not cause hazardous condition over this environmental range, performance may vary.

## COOLING AIR

Care should be exercised not to block the cooling air inlets or outlets. Cooling air blockage can result in damage to the RF amplifier or intermittent shut downs.

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# SECTION I

# GENERAL INFORMATION

## 1.1 GENERAL INFORMATION

The Model 75A250 Amplifier is a self-contained broadband unit designed for laboratory applications where instantaneous bandwidth, high gain and moderate power output are required. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A valuable feature is the continually variable attenuator which enables the operator to adjust the amplifier gain over a 18 dB range to meet specific output power requirements by means of a simple front panel control.

Typical applications include antenna and component testing, wattmeter calibration, EMI susceptibility testing, use as a driver for frequency multipliers and high power amplifiers and as an RF source for nuclear magnetic resonance imaging studies.

## 1.2 POWER SUPPLIES

The 75A250 has a self-contained switching power supply. The input voltage range to this supply is 90-132 VAC or 180-264 VAC, 50/60 Hz, universal or selected automatically. The operator does not have to switch or change anything when changing the input line voltage.

The power consumption is a maximum of 400 watts. Primary circuit fusing is provided.

## 1.3 SPECIFICATIONS

Refer to Amplifier Research Data Sheet on the next page for detailed specifications.



# SECTION II

## OPERATING INSTRUCTIONS

### 2.1 GENERAL

Operation of the Model 75A250 broadband amplifier is quite simple. The input signal, whether swept or fixed in frequency, is applied to the jack marked "INPUT" and the amplifier output signal is taken from the jack labeled "OUTPUT". The unit is turned on by activating the power switch marked "1" / "0". In the event of a unit malfunction, protection is provided by fusing located at the rear of the unit. A polarized, three (3) wire AC power cord is also included with the unit to provide cabinet and chassis grounding to the power mains.

**CAUTION:**

**THE MODEL 75A250 AMPLIFIER IS NOT CRITICAL IN REGARDS TO SOURCE AND LOAD VSWR AND WILL REMAIN UNCONDITIONALLY STABLE WITH ANY MAGNITUDE AND PHASE OF SOURCE AND LOAD VSWR. IT ALSO HAS BEEN DESIGNED TO WITHSTAND RF INPUT POWER UP TO TWENTY (2) TIMES ITS RATED INPUT OF 1mW. HOWEVER, SIGNAL LEVELS HIGHER THAN 20 mW OR TRANSIENTS WITH HIGH PEAK VOLTAGES CAN DAMAGE THE AMPLIFIER. ALSO, ACCIDENTAL CONNECTION OF THE OUTPUT TO ITS INPUT CAUSES OSCILLATIONS WHICH MAY PERMANENTLY DAMAGE THE UNIT.**

**WHILE THE MODEL 75A250 WILL OPERATE AT ITS RATED OUTPUT POWER INTO ANY LOAD IMPEDANCE, THE AMPLIFIER MAY BE DAMAGED IF IT IS SIMULTANEOUSLY OVERDRIVEN WITH AN OPEN OR SHORT CIRCUITED LOAD. TO PREVENT DAMAGE TO THE AMPLIFIER, THE FOLLOWING PRACTICES ARE RECOMMENDED:**

1) **DO NOT INTENTIONALLY OVERDRIVE THE AMPLIFIER AT ANY TIME. WHEN OPERATING INTO A MISMATCHED LOAD, TAKE SPECIAL PRECAUTIONS SO THAT THE INPUT CABLE CANNOT BE INADVERTENTLY OVERDRIVEN.**

2) **WHEN CONNECTING AND DISCONNECTING CABLES, TURN THE POWER SWITCH OFF. 75 WATTS OF RF POWER IS SUFFICIENT TO CAUSE SERIOUS ELECTRICAL SHOCK AND/OR BURNS.**

3) **CARE MUST BE TAKEN TO PREVENT RESTRICTIONS OF THE COOLING FAN AIR INLET OPENING ON THE BOTTOM OF THE UNIT. RESTRICTION OF THE OPENING FOR EXTENDED PERIODS WILL CAUSE OVERHEATING OF THE UNIT AND POSSIBLE PREMATURE FAILURE.**



### 2.2 AMPLIFIER OPERATION

Figure 2.1 shows the Model 75A250 Amplifier in pictorial form.

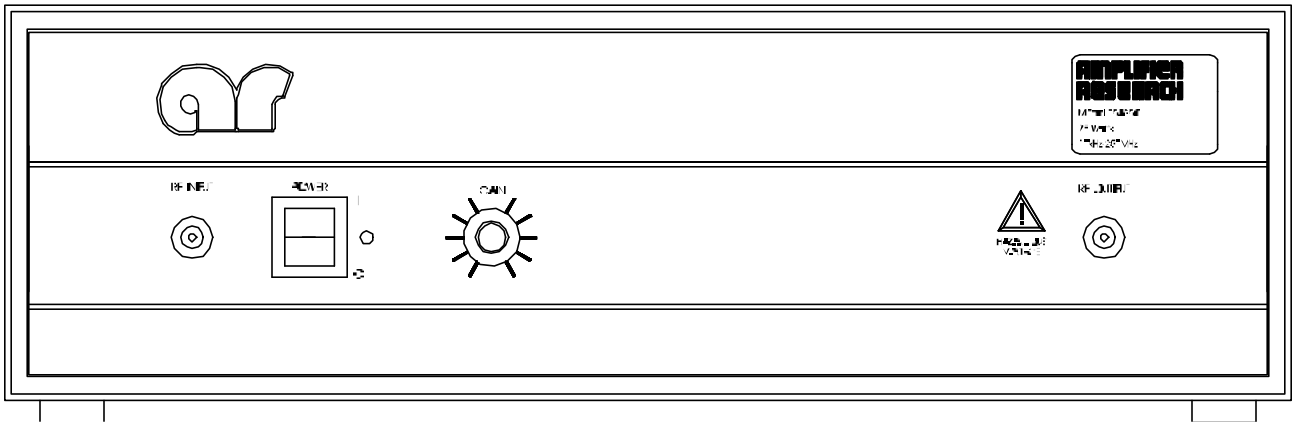


FIGURE 2.1
AMPLIFIER OPERATION

1. Connect the AC power to the unit.
2. Connect input signal to INPUT connector.
3. Connect load to OUTPUT connector.
4. Set gain control fully counter clockwise.
5. Activate power switch to on (1) position. A GREEN indicator light mounted on the front panel will light when power is applied.
6. Adjust gain control as required.



**SECTION III**

**THEORY OF OPERATION**

## 3.1 INTRODUCTION

The Model 75A250 amplifier consists of two (2) modules. The first module (A2) consists of three (3) cascaded mosfet amplifier stages that provide approximately 33dB of gain. This module drives the second module (A4) which consists of a dual mosfet amplifier operated as a push-pull stage that provides approximately 16dB of gain. Input and output networks are utilized to provide optimum power transfer of the RF signal when the amplifier is connected to a source and load impedance of 50 ohms. Interstage coupling is accomplished by means of capacitors between the three (3) cascaded stages and transformer coupling between these stages and the push-pull output stage. This provides an overall flat frequency response that is further enhanced by utilizing negative feedback around each transistor stage..

The self-contained power supply consists of a switching power supply, which features universal input voltage capability, followed by a current limiter circuit which provides over dissipation protection for the amplifier. Gate bias stability is provided by a three (3) terminal regulator set for 15 VDC.

## 3.2 AMPLIFIER SECTION

Refer to Schematic Diagram No. 1007868 and 1007872.

The input signal to the amplifier is fed through the front panel attenuator to the gate of Q1, which is input level limited by diodes CR1 and CR2. Biasing for Q1 is accomplished by R10, R14 and R16 which drives the gate of Q1. Bias voltage for Q2 is adjusted via R6 through R11 and R17. Output of Q2 is coupled through C4 to the gate of Q3. The output of Q3 is coupled to transformer T1 and T2 of the A4 module which is utilized to drive push-pull stage Q1A and Q1B. Resistor R12 sets bias voltages for Q1A and Q1B, in conjunction with R10 which is used to equalize the bias voltage on gates of Q1A and Q1B.

The output of Q1A and Q1B are coupled through matching transformers T3 and T4 to the coaxial connector on front panel of the unit.

Power gain of each of the three (3) cascaded stages is approximately +11 dB and +16 dB for push-pull stage, giving an overall gain of better than +49 dB for the amplifier.

U1 and U4 with their associated circuitry provide over-dissipation protection for the FETs in the final amplifier. This is done by sensing the DC input current. When the DC input current exceeds a preset level, the bias voltage on the output transistor is reduced, limiting the current.



## 3.3 POWER SUPPLY

Refer to Schematic Diagrams No. 1007756 and 1007690.

The self-contained power supply employs a switching power supply with universal input line voltage capability. Input AC power is fed through RFI filter FL1 before being switched by the main power switch S1. FL1 also contains the line fuses that protect the unit against excessive line current. Power switch S1 supplies power to the switching power supply PS1. The approximately 29 VDC output of PS1 is fed to a current limiter circuit A3. A3 allows the voltage to the amplifier to be adjusted to 28 VDC and also allows the current limit to be set to approximately ten (10) amps.



## SECTION IV

## MAINTENANCE

### 4.1 GENERAL MAINTENANCE INFORMATION

The Model 75A250 should require very little maintenance since it is a relatively simple instrument. It is built with etched circuit wiring and solid state devices which should ensure long, trouble-free life. However, should trouble occur special care must be taken in servicing to avoid damage to the devices or the etched circuit board.

Since the components are soldered in place, substitution of components should not be resorted to unless there is some indication that they are faulty. In addition, take care when troubleshooting not to short voltages across the amplifier. Small bias changed may ruin the amplifier due to excessive dissipation or transients.

Components with Amplifier Research instruments are conservatively operated to provide maximum instrument reliability. In spite of this, parts within an instrument may fail. Usually, the instrument must be immediately repaired with a minimum of "down time". A systematic approach can greatly simplify and thereby speed up the repair.

However, due to the importance of the amplifier's alignment, it is recommended that when failure is caused by breakdown of any of the components in the signal circuits, the amplifier be returned to the factory for part replacement and amplifier realignment. Shipping instructions are as follows:

Ship **PREPAID** via United Parcel Service to: AMPLIFIER RESEARCH
160 SCHOOL HOUSE ROAD
SOUDERTON, PA 18964

See warranty statement at rear of manual.

## 4.2 COVER AND CIRCUIT BOARD REMOVAL

**CAUTION:**

**REMOVE POWER CORD FROM RECEPTACLE BEFORE SERVICING.**

4.2.1 The amplifier can be removed from the housing by removing 4 screws from the front panel and 4 screws from the back panel. The amplifier can then be slid from the housing.

4.2.2 The top cover can be removed to gain access to the RF assembly. The bottom cover can be removed to gain access to the power supply assembly..



## 4.3 TROUBLESHOOTING

**EXTREME CAUTION SHOULD BE EXERCISED WHEN TROUBLESHOOTING THIS UNIT. HAZARDOUS VOLTAGES EXIST IN THE UNIT WHICH COULD CAUSE SERIOUS INJURY TO ANY PERSONNEL PERFORMING INTERNAL MEASUREMENTS.**

A good way to start troubleshooting is to check the supply voltage at the amplifier supply voltage terminal. If it is low or non-existent, check the power supply components starting with the AC line.

The power supply output voltage should be nominally +29.5 VDC. The output voltage of the current regulator assembly should be 28.0 VDC.

Assuming these voltages are correct, the problem may lie in the RF amplification chain. A re-alignment of the RF board should reveal the problem. Contact Amplifier Research for the appropriate alignment / test procedure.

**CAUTION:**

**BEWARE OF VOLTAGES APPLIED TO THE GATE OF A MOSFET TRANSISTOR IN EXCESS OF ±20 V. THIS WILL RESULT IN TRANSISTOR GATE FAILURE.**

## 4.4 SERVICING ETCHED CIRCUIT BOARDS

When soldering leads, use a hot forty (40) watt or smaller iron. Apply heat sparingly to the leads, not to the printed wiring on the board. Before installing new parts, clean holes to receive new part without forcing. Have new leads tinned to receive solder quickly with a minimum of heat and without residue.

**75A250**
**PRODUCTION TEST PROCEDURE**

## Saturated Power

The signal generator is set to a level of 0dBm, and output power is measured by the power meter across the frequency range and recorded on the graph. Power must be above the 75 watt limit.

## Linear Power

An automated procedure searches for the power at which a 10dB decrease in input results is a 9dB decrease in output. When this point is found, the output power is measured by the power meter and recorded on the graph. This procedure is repeated across the frequency range. Power must be above the 50 watt limit.

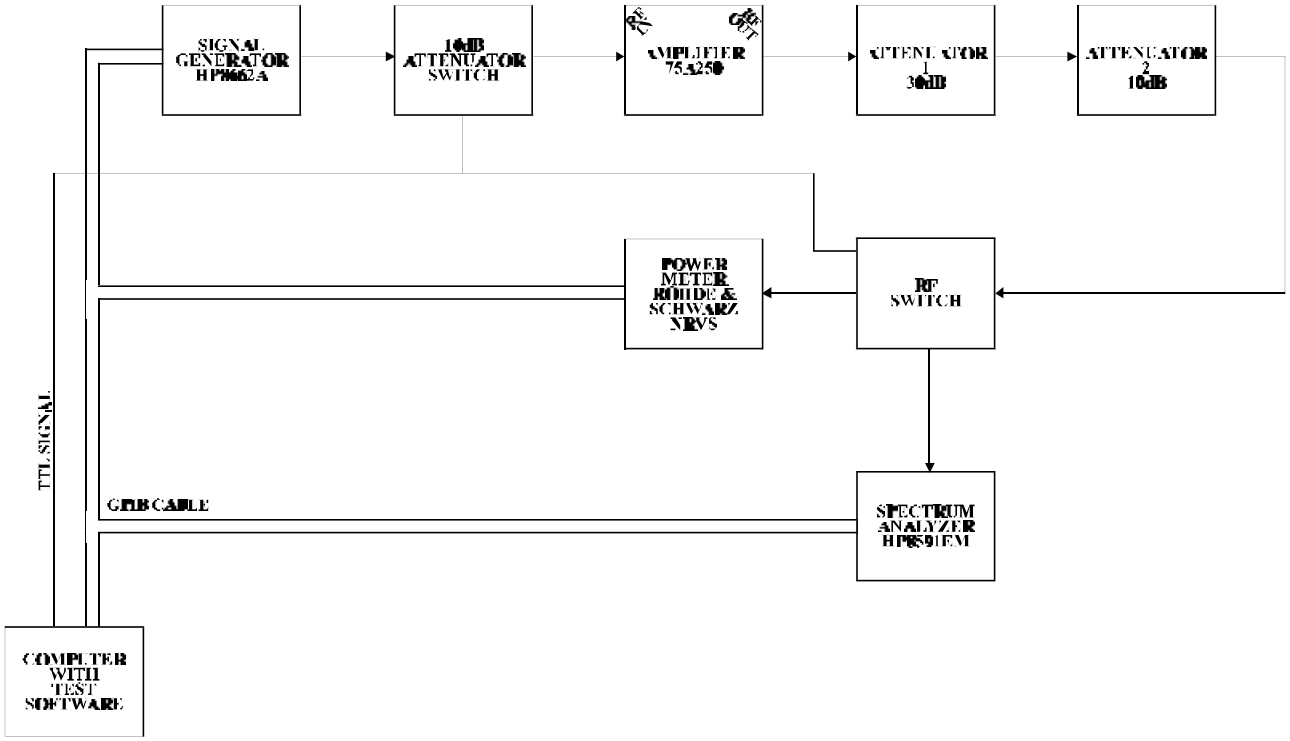
## Gain Flatness

The 1dB compression point is found at 100MHz, then the signal generator is set to a power 10dB below this compression point. Output power is then read across the frequency range at this input power and gain is calculated and recorded on the graph. The gain plot must not cross the limit lines which represent the specification of ± 1dB.

## Harmonics Test

Output power is set to the linear power specification (50 watts) using a power meter. Then the amplitude of this carrier frequency is measured by the spectrum analyzer in dBm. The second and third harmonics are then measured and subtracted from the fundamental. These measurements are represented as negative numbers on the graph to show that they are below the fundamental. Both the second and third harmonic must be at least 20dB below the carrier.

**DIAGRAM OF TEST SETUP**




**NOTE:**

All cable lengths are kept as short as possible to minimize power loss.