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SECTION I

GENERAL INFORMATION

1.1 GENERAL DESCRIPTION

The Model 25W1000M7 Amplifier is a self-contained broadband unit designed for laboratory applications where instantaneous band width, high gain, and moderate power output are required. Solid state technology is used exclusively to offer significant advantages in reliability and cost. A Model 25W1000M7 used with a frequency swept signal source will provide 20 watts of linear swept power output from 25 MHz to 1000 MHz. 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 Magnetic Resonance Imaging studies.

1.2 POWER SUPPLIES

The unit has a self-contained line operated power supply that can be adjusted for use on AC voltages found throughout most of the world. The power consumption is a nominal 750 watts. Primary circuit fusing is provided.

1.3 SPECIFICATIONS

Refer to the *"Amplifier Research Data Sheet"* on the following page for detailed specifications.

1.4 PERFORMANCE VERIFICATION

Refer to Amplifier Research Drawing Number 1003567 titled *"Flatness Test Model 25W1000M7"*, located after specifications.

SECTION II

OPERATING INSTRUCTIONS

2.1 GENERAL

Operation of the Model 25W1000M7 broadband amplifier is quite simple. The input signal, whether swept or fixed in frequency, is fed into 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. 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 cord is also included with the unit to provide cabinet and chassis grounding to the power mains.

CAUTION:

THE MODEL 25W1000M7 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, WITHOUT DAMAGE, RF INPUT POWER UP TO TWENTY (20) TIMES ITS RATED INPUT OF 1mW. HOWEVER, SIGNAL LEVELS HIGHER THAN 20mW OR TRANSIENTS WITH HIGH PEAK VOLTAGES CAN DAMAGE THE AMPLIFIER. ALSO, ACCIDENTAL CONNECTION OF THE 25W1000M7 OUTPUT TO THE INPUT CAUSES OSCILLATIONS WHICH WILL PERMANENTLY DAMAGE THE INPUT TRANSISTOR. INTERNAL CROWBAR PROTECTION IS DESIGNED INTO THE AMPLIFIER TO PROTECT AGAINST INPUT OVERDRIVE.

The amplifier is protected by a fast acting crowbar circuit. The crowbar may be activated by an input signal greater than required for full output power. When the input signal reaches a level that may cause damage to the amplifier power stages, the 28 volt power supply is turned off and the red overload light on the front panel is activated. Typically, the input level required to activate the crowbar is approximately +1 to +3dBm.

To reset the crowbar, reduce the input RF to 0dBm or lower, and push the reset switch (S3) located by the overload light on the front panel.

2.2 AMPLIFIER OPERATION

Figure 2.1 shows the Model 25W1000M7 Amplifier in pictorial form.

Figure 2.1 "Amplifier Operation"

TURN ON SEQUENCE:

1. Connect input signal to *"INPUT"* connector.

2. Connect load to *"OUTPUT"* connector.

3. Select either 120/240 VAC operation by means of switch located on rear of unit.

4. Activate power switch to *"ON"* position. A red indicator light mounted within the switch will light when power is applied.

CAUTION:

DO NOT CONNECT UNIT TO 240 VAC MEASURED LINE TO LINE. TO DO SO WOULD RESULT IN ONE SIDE OF THE LINE NOT BEING FUSED, CREATING A HAZARDOUS SITUATION. THE 240 VAC FEATURE IS DESIGNED PRIMARILY FOR USE IN COUNTRIES HAVING 240 VAC MEASURED LINE TO NEUTRAL.

2.3 REMOTE CONTROL

The 25W1000M7 may be operated remotely through a 25 Pin subminiature *"D"* connector (J1) located at the rear panel. It is designed to operate either with manual switches and lights, or with Amplifier Research CP2001 or CP3000 Computer Interface units. Computer Interface units are furnished with 25 feet of cable that plugs into J1 at the rear panel.

If the unit is operated manually, appropriate switches and indicators must be utilized for power *"ON/OFF"*, overload indicator and reset. Also, an interlock jumper must be installed at J1 mating connector, pins 6 to 7.

Low voltage (28 volts), low current switches may be used for remote operation and 10 milliamp LED's may be used for function indicators.

The local/remote push button switch at the rear panel of the 25W1000M7 must be in the remote (LED on) position, and the power switch on the front panel must be on for the unit to operate.

SECTION III

THEORY OF OPERATION

3.1 INTRODUCTION

Refer to Block Diagram Number 1006273, *"RF Amplifier Assembly"*.

The input signal to the amplifier is connected through a signal limiter (A1A11) to a directional coupler (A1A12) and gain equalizer (A1A13) to the low level/driver amplifier (A2). A2 consists of low level amplifier (A2A1) and driver amplifier (A2A2). The gain of A2 is 36dB minimum.

The output of A2 drives the input of final amplifier (A3), where the input signal is split by A3A5 into four (4) equal signals and drives power amplifiers A3A1, A3A2, A3A3, and A3A4. Their outputs are added together by power combiner A3A6 and drives the 25 watt RF output. The gain of final amplifier A3 is 6dB minimum.

The low level/driver amplifier A2 consists essentially of five (5) cascaded stages of broadband transistor amplifiers and a two (2) stage output which yield a total power gain greater than 36dB. Input and output matching networks are utilized to provide optimum power transfer of the signal to and from the amplifier with a 50 ohm source and load impedance. Intra-stage feedback is also used to further flatten the frequency response and bias stabilization of the individual stages is provided.

The self-contained power supply employs a full wave rectifier, two (2) integrated circuit regulators to provide stable, low ripple, regulated output voltages.

3.2 AMPLIFIER OPERATION

The Model 25W1000M7 contains a low level driver amplifier and a final amplifier. Each will be explained.

3.2.1 Low Level Driver Amplifier

Refer to Block Diagram Number 1006273, *"RF Amplifier Assembly"*, Schematic Diagram Number 1006303, *"RF Board Assembly"* and Schematic Diagram Number 1006307, *"RF Board Assembly"*. The low level driver amplifier is shown in Block Diagram Number 1006273.

The input signal to the amplifier is fed from the gain equalizer through a matching network to the base of the first transistor amplifier stage. The component values in this network are chosen to effect a compromise between obtaining the best VSWR and the lowest insertion loss.

3.2.1 Low Level Driver Amplifier (Continued)

The first stage is connected in the common emitter mode with the emitter connected to ground through three (3) resistors. This configuration allows the selection of the emitter resistors to achieve the desired stage gain. The collector voltage (+) is supplied to this stage from the transistor immediately above it (refer to Schematic Diagram Number 1006303, *"RF Board Assembly"*). This allows the RF transistor to operate at a constant DC current and provides a high degree of protection since the transistor current is independent of overdrive and/or short circuits. Temperature dependence is also avoided. The required decoupling and bypassing of the positive supply is provided by ferrite beads and capacitors.

A coupling network is used to route the output of the first stage to the base of the second stage. The first five stages are coupled in substantially the same manner with the fifth stage matched to a 50 ohm output impedance.

The output of the fifth stage is applied through an input matching network to the input of the two (2) stage output amplifier, Q2 (refer to Schematic Diagram Number 1006307). The collectors are transformer coupled to the output, which has a 50 ohm impedance. Q1 and Q3 are bias stages for Q2 and help Q2 to operate at a constant DC current.

3.2.2 Final Amplifier

Refer to Block Diagram Number 1006273, *"RF Amplifier Assembly"* and Schematic Diagram Number 1006309, *"RF Assembly"*.

The final amplifier is shown in Block Diagram Number 1006273. The input signal is split by A3A5 into four (4) equal signals and drives four (4) identical power amplifiers. Only one will be discussed.

The input signal is applied through an input matching network to the input of the two (2) stage amplifier, Q2.

The collectors are transformer coupled to the output which has a 50 ohm impedance. Q1 and Q3 are bias stages and help to operate Q2 at a constant bias.

3.3 POWER SUPPLY SECTION

Refer to Schematic Diagram Number 1004216, *"PS & Housing Assembly"*.

Input AC power is fed through RFI filter FL1 before being switched by the main power switch, S1. The AC power indicator is an integral part of S1. S2 serves to select the primary tap configuration of T1 for operation on either 120 or 240 VAC.

3.3 POWER SUPPLY SECTION (Continued)

CAUTION:

DO NOT CONNECT UNIT TO 240 VAC MEASURED LINE TO LINE. TO DO SO WOULD RESULT IN ONE SIDE OF THE LINE NOT BEING FUSED, CREATING A HAZARDOUS SITUATION. THE 240 VAC FEATURE IS DESIGNED PRIMARILY FOR USE IN COUNTRIES HAVING 240 VAC MEASURED LINE TO NEUTRAL.

The power supply utilizes a full wave rectifier on A1A2 and A1A6 assemblies. DC output from the rectifiers is filtered by C3. A1A2 supplies regulated +VDC to the low level amplifier (A2A1) and A1A6 supplies regulated +VDC to the driver amplifier (A2A2). A1A2 supplies +VDC to the protection circuit assembly, A1A4.

3.3.1 Regulators MPLV

3.3.1.1 Regulator A1A6

Refer to Schematic Diagram Number 1001098, *"Regulator Assembly"*.

The full wave rectifier consists of CR1 and CR2. The filtered DC output from the rectifiers pass through the series regulator U1, pre-regulator and current boost transistor located external to regulator assembly. U1 is a linear integrated circuit with adjustable output current and voltage. R2 adjusts the output current and R3 adjusts the output voltage. U1 also contains power limiting, thermal shutdown, and input overvoltage protection.

The overload light DS2 is located on the front panel and will light when regulated VDC approaches zero. A crowbar will cause DS2 to light and must be reset to restore proper operation. To reset the crowbar reduce the input to 0dBm and push the red switch (S3) located under the overload light on the front panel.

3.3.1.2 Regulator A1A2

Refer to Schematic Diagram Number 1001507, *"Regulator Assembly"*.

The full wave rectifier consists of CR1 and CR2. The filtered DC output from the rectifiers pass through the series regulator U1. U1 is a linear integrated circuit with adjustable output current and voltage. R2 adjusts the output current and R3 adjusts the output voltage. U1 also contains power limiting, thermal shutdown, and input over voltage protection. R1 and VR1 output voltage goes to DS2 and protection circuit.

3.3.2 Protection Circuit

Refer to Schematic Diagram Number 1001132, *"Protection Circuit"*.

The protection circuit consists of a DC amplifier U1 with its bias circuit, an SCR crowbar Q2, and optical coupler U2. The input signal at E2 originates from a peak detector which detects the RF input level and delivers an equivalent DC potential to the DC amplifier. The input signal is amplified to the desired level. R15 adjusts the threshold setting which turns on Q2. With Q2 turned on, the +28 VDC at E5 is pulled close to ground and the A1A2 regulator output is near zero thus removing the DC power to the driver amplifier (A2A1). Holding current is supplied to E9 from the A1 regulator, through R8 and CR2 and Q2 anode. Thus when Q2 turns on, it stays on until the RF amplifier is reset. To reset, reduce the input RF to 0dBm or less and push the red switch (S3) located on the front panel.

The optical coupler U2 is used to sense when any driver or final regulator output voltage has decreased below a preset value. Should this happen, the output of the optical coupler will turn Q2 on and cause the RF to the driver and final amplifiers to turn off, thus protecting the output circuits. The red overload light on the front panel will light. To reset, reduce the input to 0dBm or less and push S3 located on the front panel.

3.4 REMOTE CONTROL

3.4.1 General

Refer to Schematic Diagram Number 1004216, *"PS & Housing"* and Block Diagram Number 1006273, *"RF Amplifier Assembly"*.

Remote control of Model 25W1000M7 provides the following functions.

1. Power *"ON/OFF"*.
2. Overload Indication.
3. Overload Reset.

The Amplifier Research Computer Interface unit Model CP2001 may be utilized to provide the above functions. It can also provide the appropriate interface between the Model 25W1000M7 and any controller-computer having an IEEE-488 bus and appropriate interface.

The 25W1000M7 can also be operated remotely with Amplifier Research Model CP3000 which interfaces directly with a computer over the IEEE-488 bus.

The *"Pulse"* push button switch and built in lamp is utilized for reset and overload indicator functions at the CP2001.

3.4.2 Theory of Operation

The power switch on the front panel must be in the *"ON"* position. This energizes power supply A1A1 (24 VDC), which provides 24 volts to remote/local switch S4 and the remote control unit. The +24 VDC also energizes final amplifier interlock relay A1A5K1, which is part of the interlock circuit. Placing S4 in the on position energizes remote enable relay A1A3K1, enabling the remote control unit to turn the Model 25W1000M7 *"ON"* and *"OFF"*. When remote control is used an interlock connection must be provided between J1-6 and J1-7.

The overload indicator assembly A8 furnishes voltage to the overload lamp through R1. Under normal operating conditions Q1 is turned on by 28 volts from regulator A4, and the voltage to the overload indicator is grounded through Q1.

In the event of a fault condition, the source voltage to the base of Q1 of A1A8 is turned off allowing 28 VDC to turn on the overload indicator lamp of remote control unit. If fault condition is cleared, pressing overload reset switch on remote control unit will reset 25W1000M7 via relay A1A7K1 and return amplifier to operation.

The final amplifier interlock assembly (A1A5) completes an interlock circuit that is normally made through J4. The RF final amplifier referenced at J4 is not utilized with the Model 25W1000M7.

SECTION IV

MAINTENANCE

4.1 GENERAL MAINTENANCE INFORMATION

The Model 25W1000M7 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 changes may ruin the amplifier due to excessive dissipation or transients.

Components within 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 Corporation
160 School House Road
Souderton, PA 18964

4.2 COVERS AND CIRCUIT BOARD REMOVAL

CAUTION:

REMOVE POWER CORD FROM RECEPTACLE BEFORE SERVICING.

4.2.1 Remove top cover by removing the screws.

4.2.2. Remove circuit board and heat sink by removing the screws around the perimeter of the heat sink.

4.2.3 Remove bottom cover by removing the screws.

4.2.4 Remove circuit board and heat sink by removing the screws at each end of the heat sink.

4.3 TROUBLESHOOTING

The techniques used in troubleshooting solid state instruments are similar to those used in vacuum tube instruments. For instance, a good way to start troubleshooting is to check the supply voltage at the amplifier supply voltage terminal. If it is low or nonexistent, check the power supply components starting with the AC fuse.

The power supply output voltage should be nominally +28 volts. Incorrect voltage could result in over dissipation of the transistors or severe distortion and non-linearity of the amplifier. The power supply may be disconnected from the RF board to enable troubleshooting without danger of damaging the RF board. The amplifier board should be removed (Section 4.2) and the power supply output connected to an external load resistor to simulate the amplifier load.

The red overload light on the front panel will light if the input RF is above a preset value (approximately 0dBm) or if one of the regulators output voltage drops below a preset value. Each regulator has a red indicator on the PC board. Thus a visual check for a red light will tell which regulator or amplifier stage is at fault.

First remove the input RF signal and press the reset switch if the overload light is on then look for a regulator problem.

Finally, determine if the individual amplifier stages are operational by injecting a signal into the transistor base and looking for an indication of output.

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.