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# OPERATION AND MAINTENANCE



## SWAN MARK II LINEAR AMPLIFIER

 **SWAN**  
ELECTRONICS  
Oceanside, California  
A Subsidiary of Cubic Corporation



## SPECIFICATIONS:

### Power Rating:

2000 Watts PEP Input in Single Sideband Mode.  
1000 Watts DC input on CW AM or RTTY.

### 5 Frequency Ranges:

1. 3,400 — 4,500 kc
2. 6,000 — 9,000 kc
3. 11,000 — 16,000 kc
4. 16,000 — 22,000 kc
5. 22,000 — 32,000 kc

Uses two Eimac 3-500Z  
Grounded Grid Triodes.

### Drive Requirement:

100 Watts for maximum legal input.

### Meter Selector:

Reads Plate Voltage, Plate Current, Grid Current,  
and Relative Output.

Includes Transmit-Receive Relay Control for simple  
operation with a Transceiver.

Wide range Pi Output Circuit matches 52 or 75 ohm

coax cable or variety of other load impedances.

### Dimensions:

13" wide x 7" high x 12" deep.

### Weight:

20 lbs.

### POWER SUPPLY

Matching unit may be operated next to Amplifier as  
illustrated, or with its 4-1/2 foot connecting cable,  
may be placed on the floor.

Computer grade electrolytic capacitors, 40 mfd. fil-  
tering at 2500 VDC.

Silicon Rectifiers.

AC input: 117 or 230 volts, 50-60 cycles.

Includes quiet running fan for cool operation of all  
components.

### Dimensions:

9" wide x 8" high x 14" deep.

### Weight:

35 lbs.



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**CAUTION: NEVER REMOVE THE CABINET OR BOTTOM PLATE WHEN POWER LINE VOLTAGE IS CONNECTED. HIGHLY LETHAL VOLTAGE IS USED IN THIS AMPLIFIER. ALLOW AT LEAST ONE MINUTE FOR CAPACITORS TO DISCHARGE AFTER TURNING THE AMPLIFIER OFF AND PULLING THE PLUG.**

**INSTALLATION**

- (a) Remove the amplifier cabinet, and install the tubes. They should, of course, be handled very gently, and inserted into the sockets carefully. Attach the plate leads firmly but carefully to the heat dissipators. Eimac 3-500Z tubes are normally being supplied with the Mark II amplifier.
- (b) Plug the power supply cable into the back of the amplifier, and install the High Voltage connector. Be sure that this is done before the AC power supply is plugged in.
- (c) Refer to the pictorial in Fig. 1 when making the installation. Connect a short length of coaxial cable (RG-58 or RG8) from the transceiver or exciter to the coaxial input jack on the Mark II. A PL-259 type connector is required at the amplifier end of the cable. This cable should be as short as practical and preferably not more than 5 feet long. NOTE: Swamping the exciter or driver power with an attenuator is not normally required with drivers up to 500 watt PEP input rating. After proper tuning procedures have been followed, the Mic. Gain control will be used to set the level of drive. If the driver is called on for less than its maximum power, distortion products will be less, and overall performance improved.

- (d) Connect a 2 conductor line from auxiliary switching contacts on the driver to the Relay Control jack on the Mark II. When using the Swan-Transceiver as a driver, the 2 conductors connect to "C" and "T" terminals on back of the transceiver. The phono type plug for the Mark II end of this line is furnished with the amplifier.
- (e) Connect the antenna coax, or dummy load to the output jack. If a low-pass filter is to be installed to reduce TVI, connect it between the output jack and the antenna.
- (f) Connect a ground lead to the Mark II Chassis. A water pipe connection or ground rod will be suitable.
- (g) AC power line connections. The Mark II power supply is shipped from the factory with terminals jumpered for 230 volt operation. There are three wires in the AC power cord.

The black and white wires connect to 230 volts, and the green wire connects to the neutral or ground leg. A 3 terminal AC plug will be required. This plug is not furnished because of the many different types being used. Therefore, it will be necessary to secure a plug of the type which will fit your 230 volt outlet.

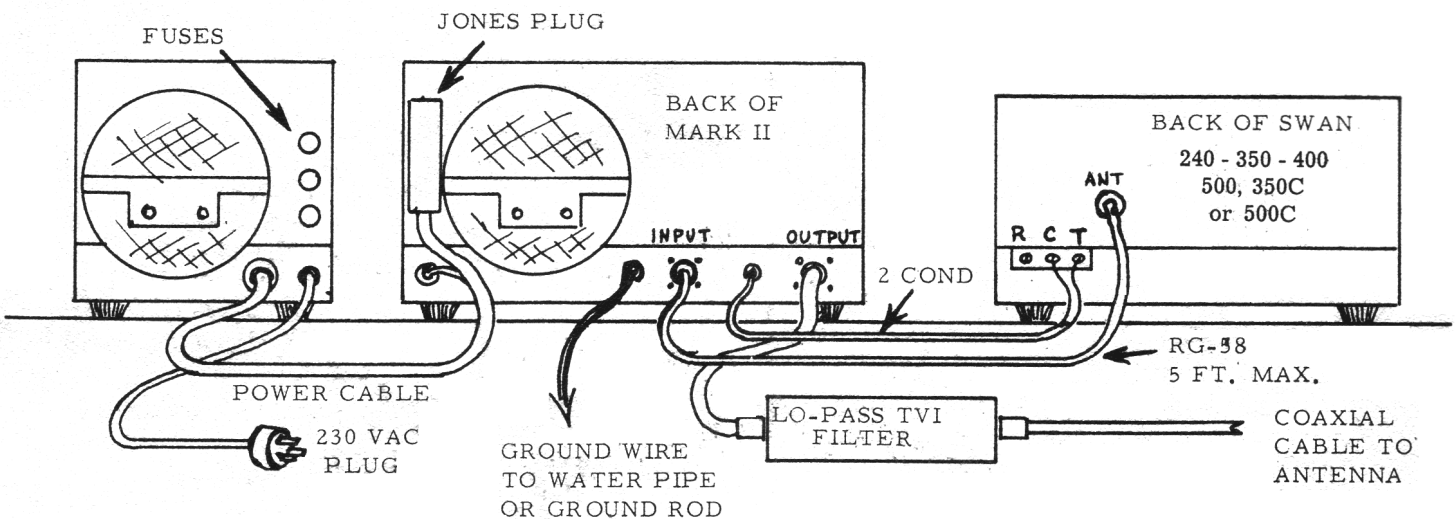


FIG. 1 INSTALLATION, REAR VIEW

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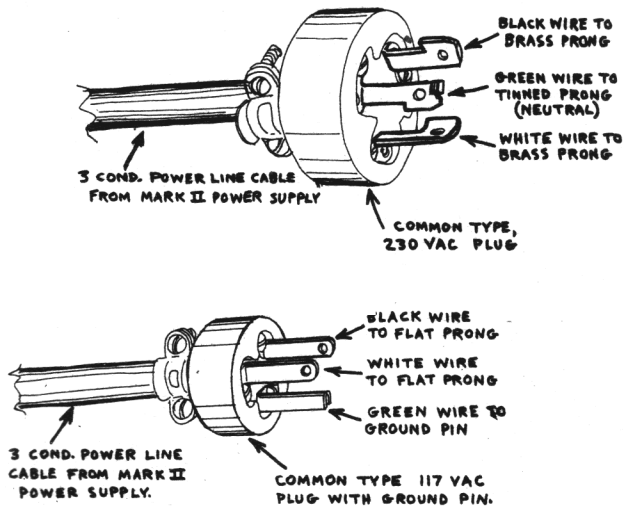


FIG. 2 AC PLUG CONNECTIONS

For 117 volt operation of the Mark II, it will be necessary to change jumpers on the terminal strip in the power supply. Remove the power supply cabinet, and refer to Fig. 3 for jumper changes. Replace the two 20 amp. line fuses with 30 amps. Connect the black and white power cord wires to 117 volts, and connect the green wire to neutral ground.

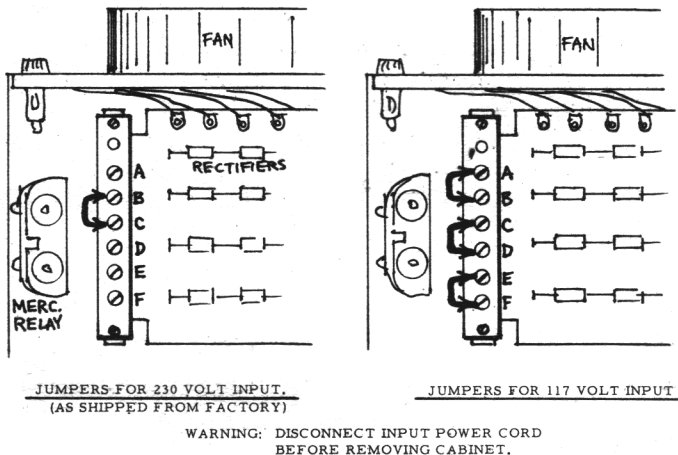
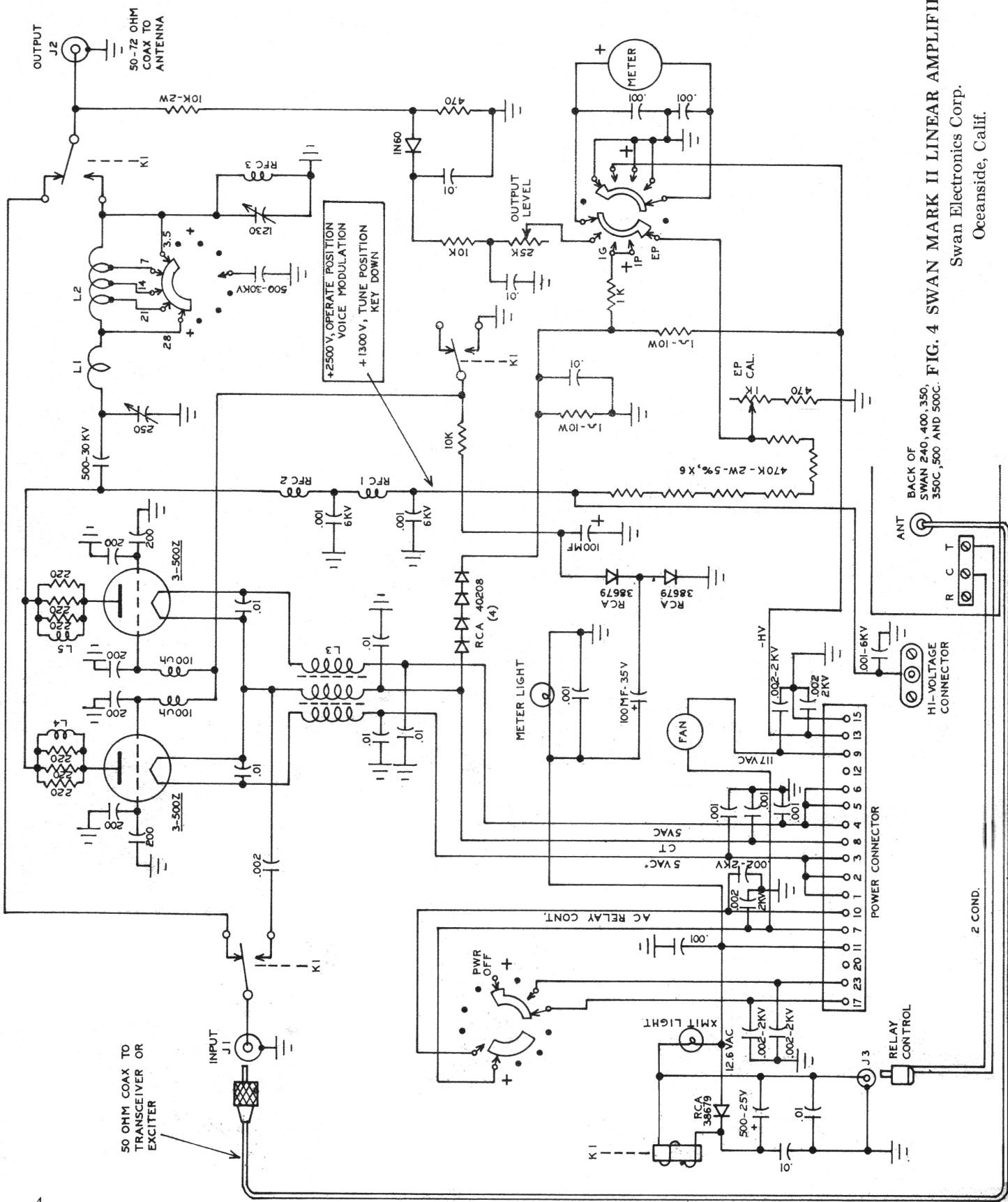


FIG. 3. POWER SUPPLY, TOP VIEW.

NOTE: When the Mark II is operated with 117 volt AC input, current drain will exceed most outlet ratings, particularly in the full power "SSB" position. It may be necessary to operate only in the "TUNE-CW" position in order to reduce power drain and thus keep the house circuit breaker from kicking out. If it is necessary to operate the Mark II on 117 volts, try to run it on a separate circuit, and if possible on the opposite side of the primary house circuit from the side used for the rest of the station. Always use 230 volts for the Mark II whenever possible.

## TUNING INSTRUCTIONS

1. Always tune the exciter or transceiver first, with the Mark II turned OFF. Exciter output will be shunted around the linear amplifier by the internal relay, and will go to whatever antenna or load is connected. The "Output" position of the Mark II meter circuit will indicate exciter output, and may be used conveniently as a tuning meter. Simply adjust the exciter controls for maximum output, using whatever tuning procedure is prescribed for the particular exciter. Then switch the exciter back to standby or receive position.
2. Turn the Mark II function switch to the "TUNE-CW" position, and allow several seconds for filament warm-up. Leave the meter switch in "Output" position. Set the bandswitch to proper band position and the P.A. Load control to 9 o'clock. Illumination of the meter indicates that power is on, and the tungsten filaments in the 3-500Z tubes will be lit. As long as the exciter is in "Standby" mode, and the Relay Control circuit is open, the 3-500Z tubes are biased to cut-off. IP and IG, (plate current and grid current, respectively), should read zero when tested. EP, (plate voltage), should read approximately 1600 volts, depending on power line voltage.
3. Turn the Mic. Gain down on the exciter (transceiver), and be sure the carrier has been balanced out. Then switch the exciter to normal Voice-Transmit position. With the Swan 350 or 500 transceiver this is done by pressing the push-to-talk button. If the relay control circuitry is properly connected and functioning, the Mark II is now in Transmit mode, and the red indicator light on its panel will be on. The 3-500Z tubes will now be drawing "idling Current," so IP will read about .15 amps. and EP will be about 1500 volts. IG should still read zero.
4. Switch the Exciter to its "TUNE" or full CW power position. Quickly adjust P.A. TUNE on the Mark II for maximum output, as indicated by the meter in Output Position. Then go back to the Exciter and adjust its P.A. TUNE for maximum output. (It may have changed slightly when switched into the amplifier cathode circuit.) Next advance the P.A. LOAD control on the Mark II for increased output, and then alternate between adjusting P.A. TUNE and P.A. LOAD until the highest possible output indication is reached. Set the Output Level Control as required to keep the meter from going off scale. The output reading is a relative indication, only, and will vary considerably with different antenna loads as well as with frequency. CAUTION: DO NOT KEEP THE EXCITER OR TRANSCEIVER IN TUNE POSITION FOR LONGER THAN 30 SECONDS AT A TIME. This cau-



**FIG. 4 SWAN MARK II LINEAR AMPLIFIER**  
 Swan Electronics Corp.  
 Oceanside, Calif.

BACK OF  
 SWAN 240, 400, 350,  
 350C, 500 AND 500C.

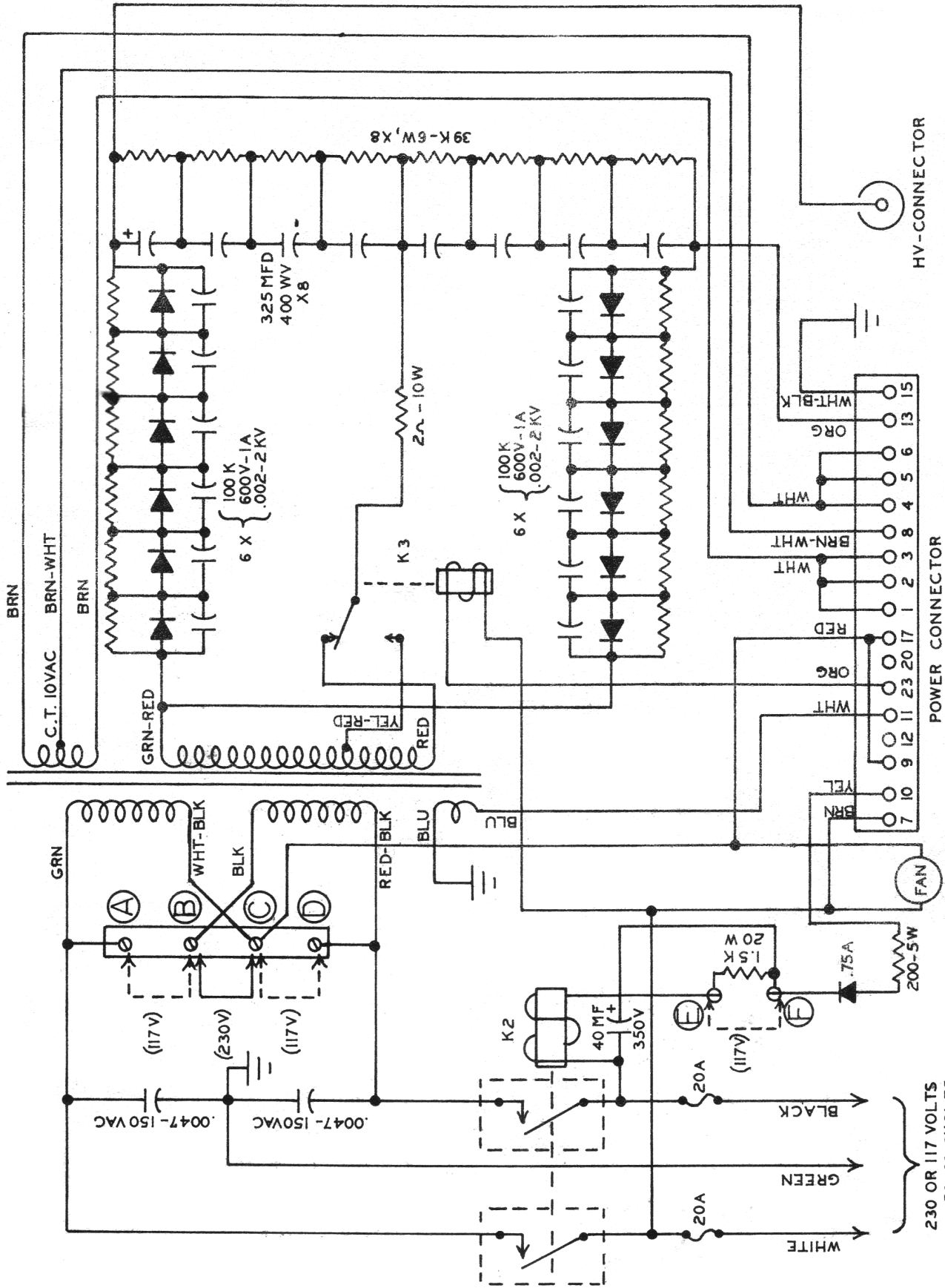


FIG. 5 SWAN MARK II POWER SUPPLY

Swan Electronics Corp.  
Oceanside, Calif.



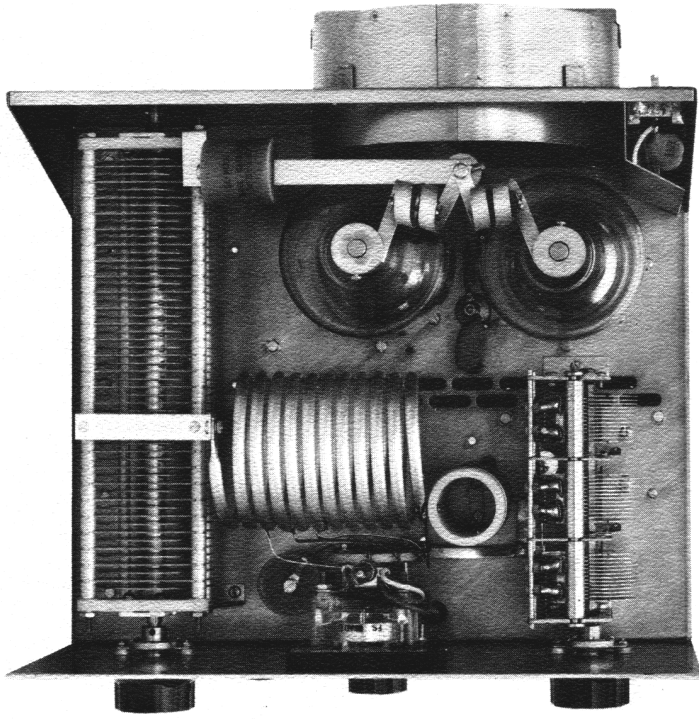


FIG. 6 MARK II AMPLIFIER, TOP VIEW

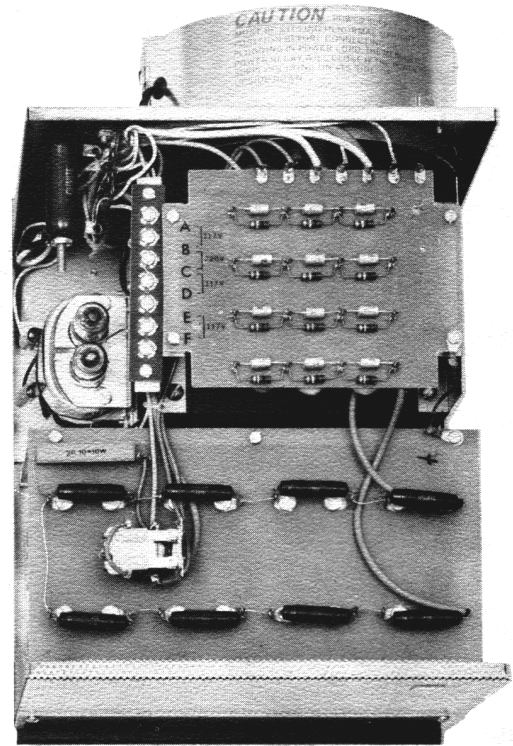


FIG. 8 MARK II POWER SUPPLY, TOP VIEW

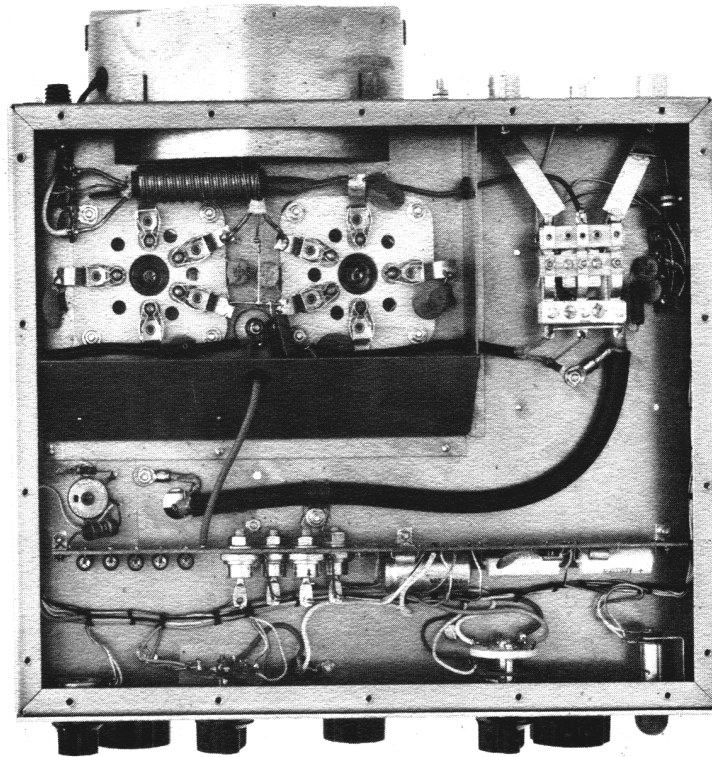


FIG. 7 MARK II AMPLIFIER, BOTTOM VIEW



tion note concerns the exciter more than the Mark II, but since the 3-500Z power amplifier tubes are operating at full input during tune, the time should always be kept short. If longer time is required, switch to standby for a minute, and then back to TUNE for 30 seconds. With experience in tuning procedures, it will be found that 30 seconds is more than enough time.

Band	Dial Setting	
	Plate	Load
80	3.5	4
40	6.5	3
20	7.5	4
15	8	4.5
10	9	5.5

Typical dial settings on Mark II when coupled to a 50 ohm non-inductive load.

- After tuning all controls for maximum output indication as described, other meter readings may be observed. IG (grid current) should indicate .2 to .3 amperes in TUNE position, depending on the amount of driving power. Swan transceivers will generally supply more driving power than others presently on the market. However; most transceivers will provide enough to drive the Mark II to full legal power. IP (plate current) should indicate at least .6 amps, and up to .9 amps, depending on driving power. The exact values of grid and plate current are not critical providing they do not exceed .6 grid amperes, and .9 plate amperes, and this only during short tuning periods.

- SSB Voice Operation. Having followed the preceding tuning procedures, now switch the Mark II to "SSB" position, and its meter switch to "IP." Apply SSB voice excitation from the transceiver or driver, and advance its Mic. Gain control for an average IP reading of .40 amperes. Only occasional voice peaks should kick up to .6 amps.

CAUTION (1). Exercise great care in setting the Mic. Gain control. It is quite easy to produce higher meter readings, but flat-topping and distortion will result, as well as the possibility of exceeding legal power limits.

CAUTION (2). Do not switch the exciter into "TUNE" position when the Mark II is in "SSB" position. Only voice modulated excitation should be applied in this position.

- Monitoring and tuning with an oscilloscope. A highly recommended piece of test equipment for the complete amateur radio station is an oscilloscope suitable for monitoring transmitter output and linearity. This instrument will permit optimum tuning of both the driver and amplifier, as well as continuous monitoring during operation.

An excellent oscilloscope for this purpose is the Heath model SB-610 sold in kit form by the Heath Company of Benton Harbor, Michigan. The instruction book supplied with this kit explains in detail how to connect and use the instrument, and how to interpret the screen patterns. Other oscilloscopes may also be used. The Radio Amateur's Handbook, published by the ARRL, and the Radio Handbook by Bill Orr, published by Editors and Engineers both contain detailed information on the use of oscilloscopes for transmitter tuning and operation. These publications are recommended references for this purpose.

- When the Mark II Function Switch is in "SSB" position for voice transmission, plate voltage is increased from the TUNE-CW value. In Standby or Receive condition, the 3-500Z tubes are biased to cut-off, so IP will be zero, and EP will indicate 2900 to 3000 volts, depending on power line voltage. In TRANSMIT position, without modulation, IP will show an idling current of .28 amperes, and EP will drop to 2650 volts. With voice modulation averaging .40 amperes, EP will drop to about 2500 volts. Occasional voice syllables may drop the plate voltage further, but with proper setting of the Mic. Gain control, dynamic regulation of the power supply is more than adequate. Use of computer grade electrolytics assures long capacitor life, with a filter capacity of 40 mfd. across the plate supply. (All voltage readings above are subject to line voltage variations).
- To operate without the Mark II Linear Amplifier, simply switch it to "Power OFF" position. The antenna circuit is then by-passed around the amplifier by the internal relay and the transceiver-driver will operate "Barefoot". When switching back to amplifier use, allow a few seconds for filament warm up.
- CW Operation. To operate CW with the Mark II always keep the Function Switch in the TUNE-CW position in order to limit input power to 1000 watts. CAUTION: Because the Mark II uses a grounded grid amplifier circuit, input power measurements must include the driver stage input. If for example, the driver is running 300 watts input, the linear amplifier input must be limited to 700 watts when in CW Mode. Thus, you must first measure driver input, in order to determine how much input you may run to the Mark II. Use the EP meter position to measure plate voltage, and then calculate how much IP (plate current) you can run and stay within the legal limit. Then use the P.A. Load control to hold IP down to this level.
- AM Operation. The Mark II Linear Amplifier may be operated in the "AM" mode at 1000 watts D.C. input and 100 percent modulation. When using a transceiver or exciter which will

also operate in the SSB mode, first tune the transceiver and Mark II for SSB transmission, just as described in previous instructions. Then insert carrier in accordance with instructions furnished with the exciter. With Swan Transceivers, this is explained in tuning instructions under "AM operation."

If the exciter operates only in the AM mode, it is recommended that an oscilloscope and an audio oscillator be used for proper adjustment. Feed an audio tone of about 1000 cycles into the Mic. Jack of the exciter and couple the vertical input of the scope loosely to the output of the Mark II. Switch the exciter to Transmit mode and adjust its modulation level to approximately 90%. Then adjust P.A. Load and P.A. Tune Controls on the Mark II for optimum output with minimum flat-topping of the modulation envelope. Next, remove modulation and check the total power input with carrier only. It should not exceed the legal 1000 watt limit. Reduce coupling from the exciter as required to control input.

**CAUTION:** It is quite possible to run well in excess of the legal power limit on CW as well as SSB with the Mark II. The design of an amplifier with excellent linear characteristics up to the legal limit results in this capability. The burden of operating within legal limits falls on the operator and Swan Electronics Corporation is not responsible for improper or illegal operation. Every well informed operator should be familiar with measurement procedures, and with mathematical calculations of power level. Whenever possible, an oscilloscope should be used to monitor peak power levels, since ordinary meters are unable to do so.

12. RTTY Operation. The Mark II is rated at a minimum of 800 watts continuous input power for RTTY service. The full legal limit of 1000 watts may be run for periods up to 1 hour or longer when ventilation is adequate. Temperature rise of the power transformer is the main limiting factor, and it is limited to a maximum of 105° C

Tuning procedures when using FSK or AFSK are essentially the same as when tuning for CW operation. Care must be observed in order to hold input power to the legal limit. For continuous operation, it is important that adequate ventilation be provided. In a confined, relatively warm environment, the equipment will naturally run hotter, and additional ventilation from an auxiliary fan may be advisable. Normally, however, this will not be required. Temperature rise is the sole criterion.

13. Alternate Tube Types. Although the Mark II is now manufactured for use with the Eimac 3-500Z tubes, it may also be operated with the type 3-400Z. Power ratings will be the same. Either tube type will operate easily at the legal power limit. The 3-500Z's are supplied with the

Mark II because of the added safety factor in the higher dissipation rating. Two changes are required to use the 3-400Z's. First, the plate caps must be changed, and since the type needed for the 3-400Z is supplied by Eimac with the tubes, this should present no problems. Second, the 4 diodes connected in series with the filament center-tap circuit must be jumpered. These diodes are the large stud mounted type located on a terminal board under the amplifier chassis. Their zener characteristic is used to supply approx. 4 volts of bias required by the 3-500Z's. Simply connect a jumper wire around them if 3-400Z's are to be used.

## MAINTENANCE

- (a) The 3-500Z tubes will show little or no color, due to the carbon plate and higher plate dissipation rating.
- (b) The Amplifier Function Switch is no longer vulnerable to damage because it no longer switches the H.V. directly, but switches the relay K3 instead.
- (c) K2 is now a highly reliable Mercury relay and burnishing is no longer necessary or possible.

There will be little maintenance required in the Mark II amplifier. The 3-500Z tubes will provide thousands of service hours when operated according to instructions. Deterioration of a tube will generally be indicated by a change in idling current or inability to draw normal plate current, or both.

However, except for occasional field problems which may occur with any electronic device, the tubes may be expected to operate month after month and year after year with no problems. NOTICE— If warranty replacement is required, the tubes must be shipped to the tube manufacturer with a complete failure report. Do not ship them to your dealer or to Swan Electronics as this will only delay warranty adjustments.

Other components are also operated conservatively, and well within nominal ratings. The electrolytic filter capacitors in the power supply are computer grade, meaning that they have a much higher degree of purity and quality control than conventional types. Life expectancy of these filters is approximately 10 years. The silicon diodes used in the supply are hermetically sealed and are not likely to ever fail or wear out. They are rated at 600 PIV, 1 ampere.

The blower motors are lifetime lubricated and likewise are not expected to require maintenance of any kind.

## CAUTION:

DUE TO THE USE OF A MERCURY RELAY (K2), THE POWER SUPPLY MUST BE SITTING IN A NORMAL UPRIGHT POSITION BEFORE CONNECTING OR PLUGGING IN POWER CORD. THE MERCURY RELAY MAY CLOSE ACCIDENTALLY IN ANY OTHER POSITION.

#### WARRANTY POLICY

SWAN ELECTRONICS CORPORATION WARRANTS THIS EQUIPMENT AGAINST DEFECTS IN MATERIAL OR WORKMANSHIP, EXCEPT FOR TUBES, TRANSISTORS, AND DIODES, UNDER NORMAL SERVICE FOR A PERIOD OF ONE YEAR FROM DATE OF ORIGINAL PURCHASE. THIS WARRANTY IS VALID ONLY IF THE ENCLOSED CARD IS PROPERLY FILLED IN AND MAILED TO THE FACTORY WITHIN TEN DAYS OF DATE OF PURCHASE. DO NOT SHIP TO THE FACTORY WITHOUT PRIOR AUTHORIZATION. THIS WARRANTY IS LIMITED TO REPAIRING OR REPLACING ONLY THE DEFECTIVE PARTS, AND IS NOT VALID IF THE EQUIPMENT HAS BEEN TAMPERED WITH, MISUSED OR DAMAGED.